

IC-490A/E

430MHz ALL MODE TRANSCEIVER

INSTRUCTION MANUAL

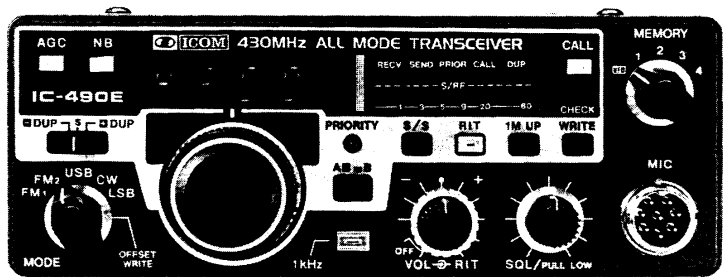


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SECTION I SPECIFICATIONS

GENERAL

Numbers of semiconductors	:	Transistor	67
		FET	10
		IC	37 (IC-490E : 38)
		Diode	139 (IC-490E : 140)
Frequency coverage	:	430.000 ~ 439.9999MHz	
Frequency resolution	:	SSB 100Hz steps FM 5KHz steps/25KHz steps 1KHz steps with 1KHz STEPS button depressed	
Frequency control	:	Microcomputer based 100Hz step Digital PLL synthesizer Independent Dual VFO Capability	
Frequency readout	:	5 digit LED 100Hz readout	
Frequency stability	:	Within ± 2.5 KHz	
Memory channels	:	5 channels with any inband frequency programmable	
Usable conditions	:	Temperature: $-10^{\circ}\text{C} \sim 60^{\circ}\text{C}$ ($14^{\circ}\text{F} \sim 140^{\circ}\text{F}$) Operational time: Continuous	
Antenna impedance	:	50 ohms unbalanced	
Power supply requirement	:	13.8V DC $\pm 15\%$ (negative ground) 3.6A Max.	
Current drain (at 13.8V DC)	:	Transmitting	
		SSB (PEP 10W)	Approx. 3.2A
		FM (10W)	Approx. 3.3A
		FM (1W)	Approx. 1.5A
		CW (10W)	Approx. 3.6A
		Receiving	
		At max audio output	Approx. 0.9A
		Squelched	Approx. 0.6A
Dimensions	:	64mm(H) x 170mm(W) x 218mm(D)	
Weight	:	Approx. 2.6Kg	

TRANSMITTER

Output power	:	SSB	High 10W (PEP) Low 1W (PEP)
		CW	High 10W Low 1W
		FM	High 10W Low 1W
Emission mode	:	SSB	(A3J, USB/LSB), CW (A1), FM (F3)
Modulation system	:	SSB	Balanced modulation
		FM	Variable reactance frequency modulation
Max. frequency deviation	:	± 5 KHz	
Spurious emission	:	More than 60dB below peak power output	
Carrier Suppression	:	More than 40dB below peak power output	
Unwanted Sideband	:	More than 40dB down at 1000Hz AF input	
Microphone	:	1.3K ohm dynamic microphone with built-in preamplifier, push-to-talk switch and tone call switch	
Operating mode	:	Simplex, Duplex (Any 100KHz steps inband frequency separation programmable)	
Tone Burst	:	1750Hz ± 0.1 Hz (IC-490A : Not installed)	

RECEIVER

Receiving system	: SSB, CW	Double conversion superheterodyne
	FM	Triple conversion superheterodyne
Receiving mode	: SSB	(A3J, USB/LSB), CW (A1), FM (F3)
Intermediate frequency	: SSB, CW	39.38MHz, 10.75MHz
	FM	39.38MHz, 10.75MHz, 455KHz
Sensitivity	: SSB, CW	Less than 0.5 microvolts for 10dB S+N/N
	FM	More than 30dB S+N+D/N+D at 1 microvolt Less than 0.6 microvolts for 20dB Noise quieting
Squelch sensitivity	: Less than 0.4 microvolts	
Spurious response rejection ratio	: More than 60dB	
Selectivity	: SSB, CW	More than ± 1.2 KHz at -6 dB point Less than ± 2.4 KHz at -60 dB point
	FM	More than ± 7.5 KHz at -6 dB point Less than ± 15 KHz at -60 dB point
Audio output power	: More than 2W	
Audio output impedance	: 4 ~ 8 ohms	



SECTION II DESCRIPTION

430MHz ALL-MODE TRANSCEIVER INCORPORATING A MICROCOMPUTER

CPU control with ICOM's original programs provide various operating capabilities. No-backlash dial controlled by ICOM's unique rotary encoder circuit. The band-edge detector and Endless System provides out-of-band protection. There are no variable capacitors or dial gear, ensuring problem-free use. The IC-490A/E can accommodate FM, USB, LSB, CW coverage in the 430 ~ 440 MHz frequency range, and thus the IC-490A/E can be used for mobile, DX, local calls, and satellite work.

MULTI-PURPOSE SCANNING

The Memory Scan allows you to monitor five different memory channels and two VFO frequencies, and the Program Scan provides scanning between two programmed frequencies. The scanning speed is adjustable, and the auto-stop terminates scanning when a signal is received or a channel is empty, for all modes.

DUAL VFO'S

Two separate VFO's can be used independently either for simplex operation or for duplex operation, and any 100KHz steps frequency can be offset in duplex operation.

CONTINUOUS TUNING SYSTEM

ICOM's new continuous tuning system features an LED display that follows the tuning knob movement and provides an extremely accurate readout. Frequencies are displayed in 5 LED digits representing 100Hz digits.

Automatic recycling restarts tuning at the top of the band, i.e., at 439.999.9MHz when the dial goes below 430.000.0MHz. Recycling changes 439.999.9MHz to 430.000.0MHz as well. Quick tuning in 1KHz steps is available, and fine tuning in 100Hz steps in the SSB and CW modes, and 5KHz steps and 1KHz steps in the FM mode, is also provided for trouble free QSO.

OUTSTANDING PERFORMANCE

The RF amplifier and first mixer circuits using MOS FETs, and other circuits provide excellent Cross Modulation and Two-Signal Selectivity characteristics. The IC-490A/E has excellent sensitivity demanded especially for mobile operation, high stability, and with Crystal Filters having high shape factors, exceptional selectivity as well.

The transmitter uses balanced mixers in a double conversion system, a band-pass filter and a high-performance low-pass filter. This system provides distortion-free signals with a minimum spurious radiation level.

ADDITIONAL CIRCUITS

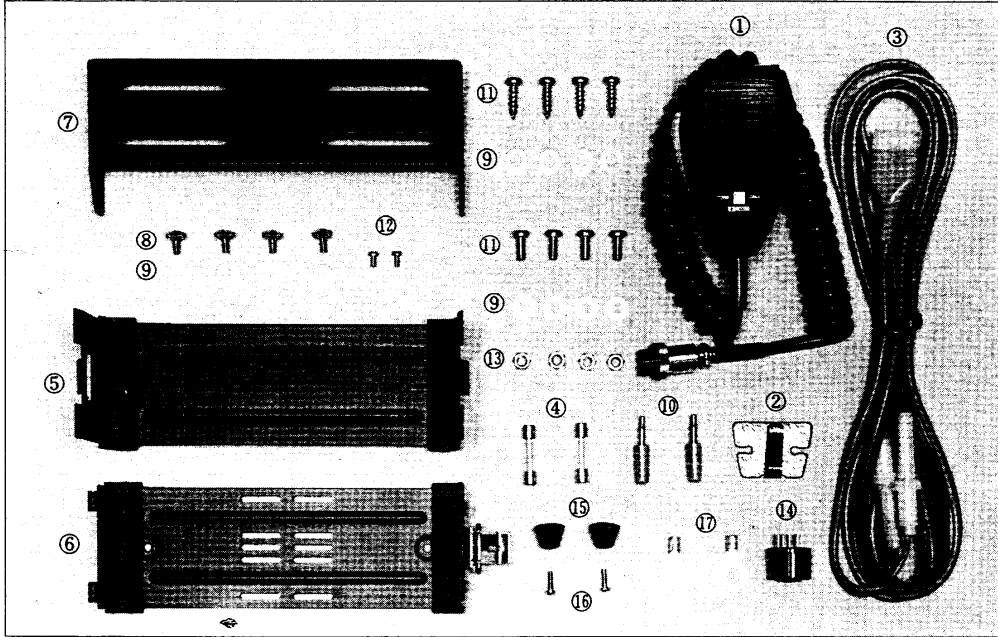
The IC-490A/E has a built-in Noise Blanker, CW Break-in, CW Monitor, APC, and many other circuit features for your convenience.

The IC-490A/E has everything you need to truly enjoy UHF operation, in an extremely compact, rugged transceiver, designed to ensure high quality, long term use.

SECTION III INSTALLATION

UNPACKING

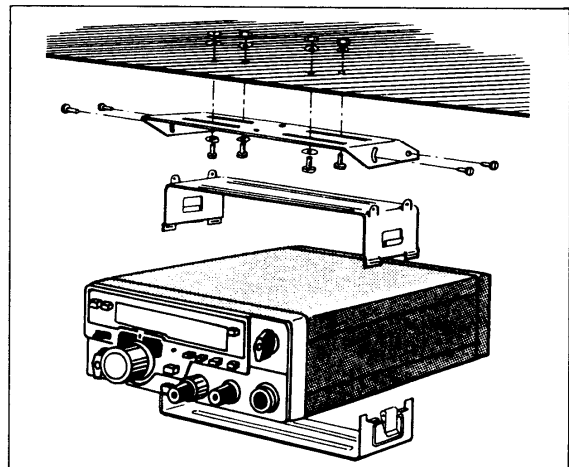
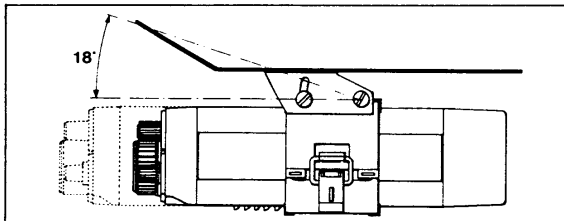
Carefully remove your transceiver from the packing carton and examine it for signs of shipping damage. Should there be any damage, notify the delivering carrier or dealer immediately, stating the full extent of the damage. It is recommended you keep the shipping cartons. In the event storage, moving,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



- | | | | |
|--|----|--|---|
| 1. Microphone (dynamic type) | 1 | 10. Plugs for speaker and key | 2 |
| 2. Microphone hook | 1 | 11. Mounting screws | 8 |
| 3. Power cord. | 1 | 12. Screws for additional bracket. | 2 |
| 4. Spare fuses (5A) | 2 | 13. Mounting screw nuts | 4 |
| 5. Installing holder A. | 1 | 14. 9-Pin MT plug. | 1 |
| 6. Installing holder B. | 1 | 15. Rubber feet | 2 |
| 7. Installing angle joint. | 1 | 16. Fixing screws | 2 |
| 8. Gimp screws. | 4 | 17. Battery Terminal Lugs | 2 |
| 9. Flat washers. | 12 | | |

LOCATION

The placement of the transceiver in your automobile is not critical and should be determined by convenience and accessibility. Since the unit is so compact, various mobile possibilities present themselves. In general,



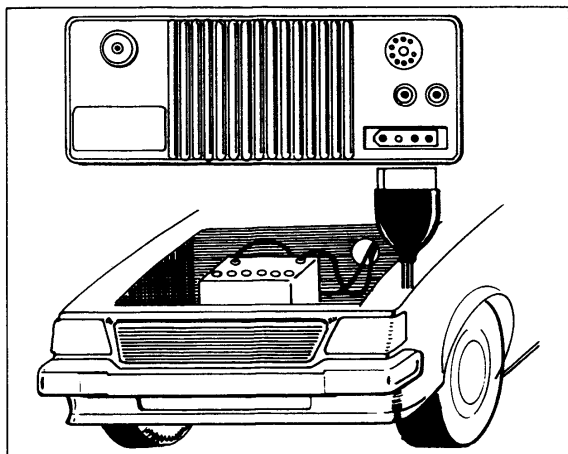
the mobile mounting bracket will provide you with some guidance as to placement. Any place where it can be mounted with metal screws, bolts, or pop-rivets will work. For fixed station use, a power supply should be designed to produce 3.6 amps for the transceiver.

POWER REQUIREMENTS

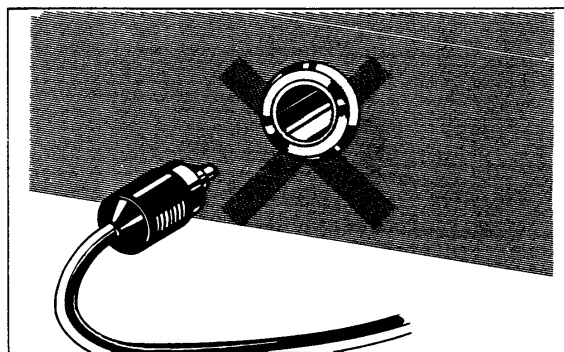
The transceiver is supplied ready to operate from any regulated 13.8V DC, 3.6 ampere negative ground source. An automobile 12 volt, negative ground system is usually more than adequate for operation. Some note must be taken, however, of the condition of the vehicle's electrical system. Items such as a low battery, worn generator/alternator, poor voltage regulator, etc., will impair operation of your transceiver as well as the vehicle. High noise generation or low voltage delivery can be traced back to these deficiencies. If an AC power supply is used with your transceiver, make certain it is adequately regulated for both voltage and current. Low voltage while under load will not produce satisfactory results from your transceiver. Receiver gain and transmitter output will be greatly impaired. Caution against catastrophic failure of the power supply should be observed, and steps should be taken to ensure continual maintenance of the power supply.

CAUTION: Excessive Voltage (above 15V DC) will cause damage to your transceiver. Be sure to check source voltage before plugging in the power cord.

Included with your transceiver is a DC power cable with plug attached. The Red Wire is positive (+), the Black, negative (-). If your mobile installation permits, it is best to connect these directly to the battery terminals. This arrangement eliminates random noise and transient spikes sometimes found springing from automotive accessory wiring. If such an arrangement is not possible, then any convenient B+ lead in the interior of the vehicle and the negative frame can be utilized. Remember, the unit operates on a negative ground system only; it cannot be used in a positive ground automobile. After making your connections, simply insert the plug into your transceiver.



Do not use a cigarette lighter socket.



ANTENNA

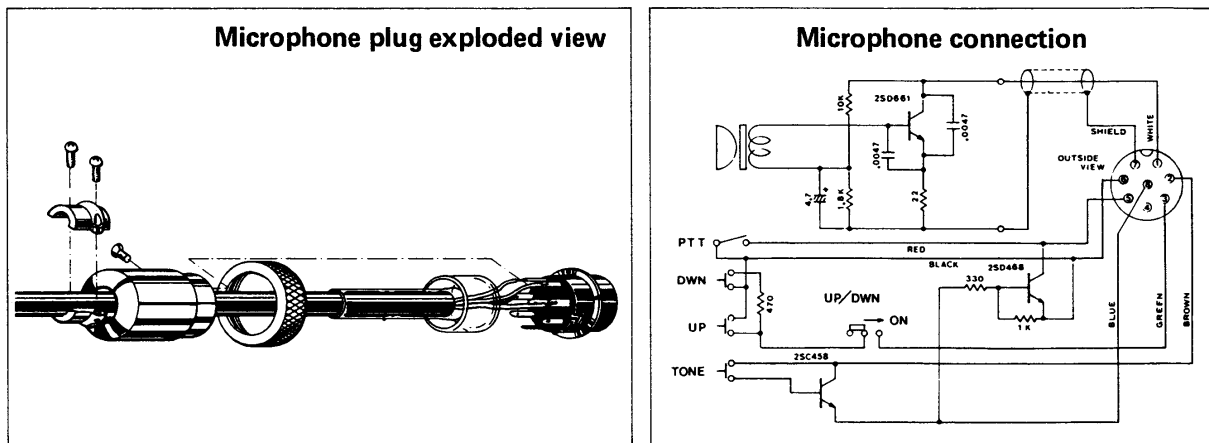
The single most important item that will influence the performance of any communication system is the antenna. For that reason, a good, high-quality, gain antenna of 50 ohms impedance is recommended, fixed or mobile. In UHF as well as the low bands, every watt of ERP makes some difference. Therefore, 10 watts average output plus 3dB of gain antenna equals 20 watts ERP, presuming low VSWR of course. The few extra 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 however 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 UHF applications. Such readings will invariably have an error of 40% or more. Instead, use an in line watt meter similar to the Bird Model 43 or Sierra Model 164B with UHF cartridge. Further, when adjusting a mobile antenna, do so with the engine 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 N (UG-21/U) connector.

MICROPHONE

A high quality dynamic microphone with built-in preamplifier 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 has a proper preamplifier. Particular care should be exercised in wiring also, as the internal electric switching system is dependent upon it. See the schematic for the proper hookup.

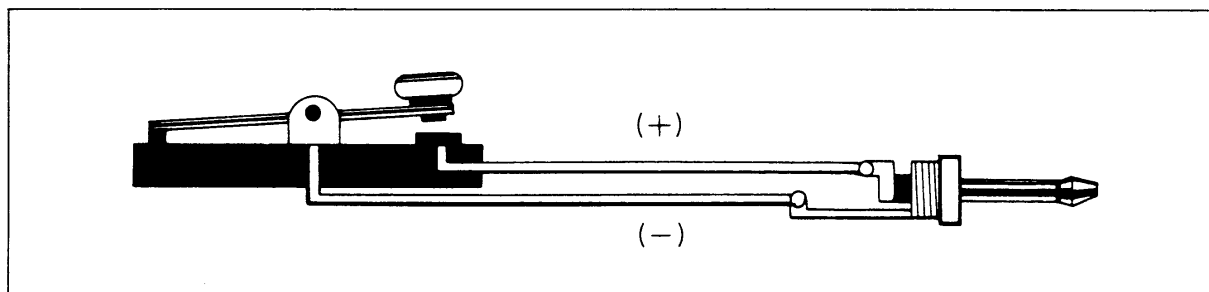


EXTERNAL SPEAKER

An external speaker jack and plug is supplied with your unit in the event another speaker is desirable. The external speaker impedance should be 4 ~ 8 ohms, and when used, will disable the internal speaker. A 4 ~ 16 ohm headset can be utilized as well.

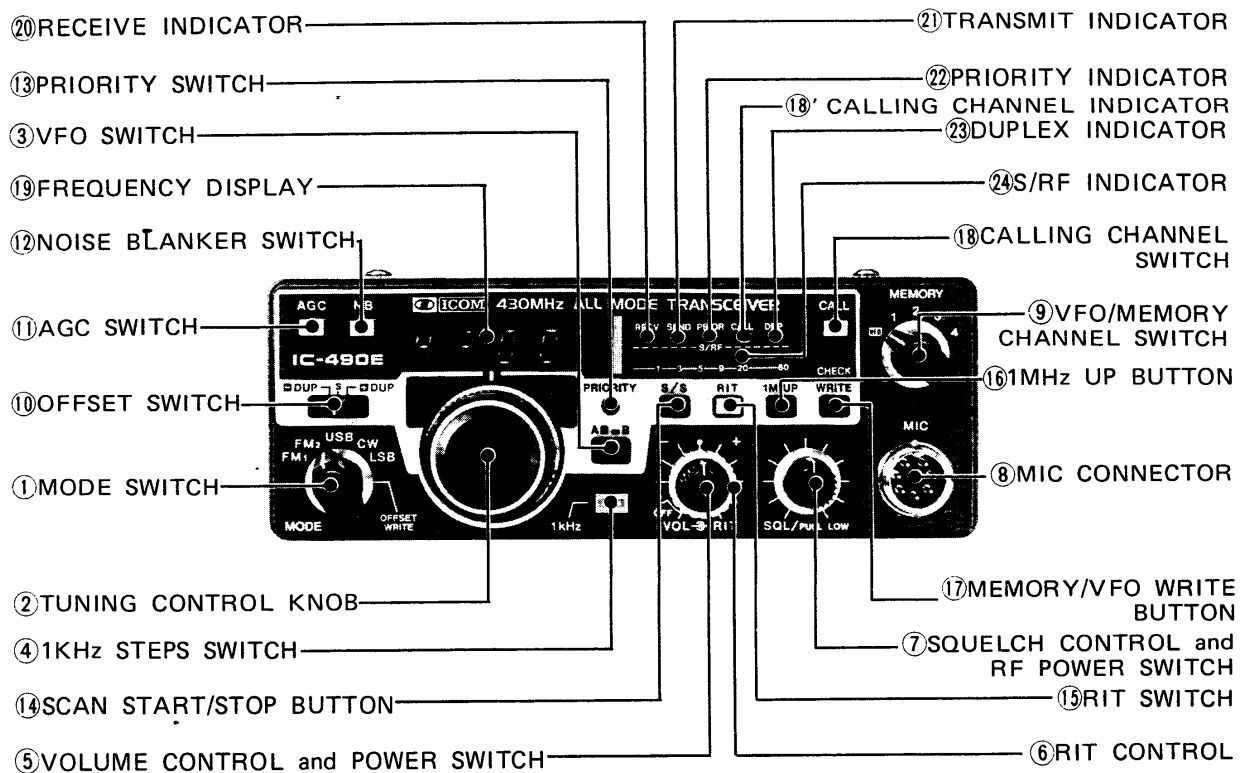
CW KEY

When operating CW, connect a Key to the Key Jack with the plug supplied as shown in the figure. 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!



SECTION IV CONTROL FUNCTIONS

FRONT PANEL



1. MODE SWITCH

Selects either side band, USB or LSB, for SSB operation. For FM (FM1: 25KHz steps, FM2: 5KHz steps) or CW operation, set the switch in the desired mode.

In the "OW" position, any 100KHz steps OFFSET frequency can be programmed into the CPU.

2. TUNING CONTROL KNOB

Rotating the TUNING CONTROL KNOB clockwise increases the frequency, while rotating it counterclockwise decreases the frequency. The frequency is changed in 100Hz steps in the SSB and CW modes and in 5KHz steps in the FM mode (25KHz steps in the FM1 position) which correspond to the click-stops. The smaller vernier marks on the knob each indicate a click-stop and the larger marks represent ten click-stops.

When tuning up past 439.999.9MHz, (439.999MHz When 1KHz STEPS Switch is pushed.) the frequency will automatically revert to 430.000MHz. Likewise, when tuning down past 430.000MHz, the frequency will automatically revert to 439.9999MHz (439.999MHz).

3. VFO SWITCH

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

4. 1KHz STEPS SWITCH

Pushing the 1KHz STEPS Switch IN, and rotating the tuning knob will result in changing the frequency in 1KHz steps in any mode. This button will allow you to quickly QSY over a great frequency range in SSB and CW, and to tune in FM signals which are off from 5KHz-step frequencies.

5. VOLUME CONTROL and POWER SWITCH

When the control is turned completely counterclockwise, the power is OFF. By turning the control clockwise beyond the "click", the unit is turned ON and the audio level increases by further rotating it clockwise.

6. RIT CONTROL

Shifts the receive frequency $\pm 800\text{Hz}$ either side of the transmit frequency. Rotating the control to the (+) side raises the receive frequency, and rotating to the (-) side lowers the receive frequency. The frequency shift by turning the RIT Control is not indicated on the frequency display.

This function can be turned ON and OFF by the ⑮ RIT SWITCH.

7. SQUELCH CONTROL and RF POWER SWITCH

Turning this control clockwise sets the squelch threshold higher. To turn OFF the squelch function, turn this control completely counterclockwise.

By pulling the Squelch control knob, the RF output power is reduced to 1 watt. By depressing the knob to the normal position, the RF output power returns to 10 watts.

These functions activate in any mode.

8. MIC CONNECTOR

Connect the supplied microphone to this jack. If you wish to use a different microphone, refer to the drawing on page 6.

9. VFO/MEMORY CHANNEL SWITCH

Selects a VFO or a memory channel, one of the channels 1 ~ 4.

10. OFFSET SWITCH

Selects the SIMPLEX operation (in the "S" position) or the DUPLEX operation (in the "+DUP" or "-DUP" position).

In the "+DUP" position, the transmitting frequency is set 5MHz (IC-490E: 1.6MHz) (This can be changed to any 100KHz steps frequency.) above the receiving frequency.

In the "-DUP" position, the transmitting frequency is set 5MHz (IC-490E: 1.6MHz) below the receiving frequency. Also the offset frequency can be changed to any 100KHz steps frequency.

These operations may be utilized with the VFO or any memory channels.

11. AGC (AUTOMATIC GAIN CONTROL) SWITCH

With this switch you can select the time constant of the AGC circuit. With the switch in the AGC (out) position, the AGC voltage is released slowly, and thus is suitable for SSB reception. With the switch in the FAST (locked in) 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. (The AGC circuit does not activate in the FM mode.)

12. NB (NOISE BLANKER) SWITCH

When pulse type noise such as automobile ignition noise is audible, set this switch to the ON (locked in) position. The noise will be reduced to provide comfortable reception. (The Noise Blanker does not activate in the FM mode.)

13. PRIORITY SWITCH

Turns the priority function ON and OFF.

During a QSO or receiving with VFO, if you would like to watch your favorite channel or a calling channel, that is busy or empty, set the memory channel switch to the favorite or calling channel which is memorized in a memory channel, and push the priority switch, and the receiving frequency will go to the channel a moment at every five seconds.

14. SCAN START/STOP BUTTON

Starts and stops any of the scan functions. When depressing it again to restart the scan, it will start from the stopped memory channel or frequency.

15. RIT SWITCH

Switches the RIT circuit ON and OFF.

16. 1MHz UP BUTTON

Each push increases the frequency in 1MHz steps. The lower digits will maintain the previous ones.

17. MEMORY/VFO WRITE BUTTON

By pushing this button, VFO A's frequency is written into a memory channel, or one VFO's frequency is transferred to the other VFO. When the ⑩ OFFSET SWITCH is set in the +DUP or -DUP position, by pushing this button, the receiving frequency goes the OFFSET frequency respectively.

18. CALLING CHANNEL SWITCH

Selects the calling channel which can be programmed any frequency, the same as the memory channels, and this is prior to other VFO's and memory channels.

When this switch is pushed, the ⑪ CALLING CHANNEL INDICATOR is lit.

19. FREQUENCY DISPLAY

The five large 7 segment LED's represent the digits between 1MHz and 100Hz of the operating frequency. The frequency indicated is the carrier frequency of each mode. If you turn the RIT control ON to change the receive frequency and rotate the RIT control knob, the frequency display will not change.

20. RECEIVE INDICATOR

Illuminates when the squelch is opened in the receive mode.

21. TRANSMIT INDICATOR

Illuminates in the transmit mode.

22. PRIORITY INDICATOR

Illuminates when the priority function is turned ON.

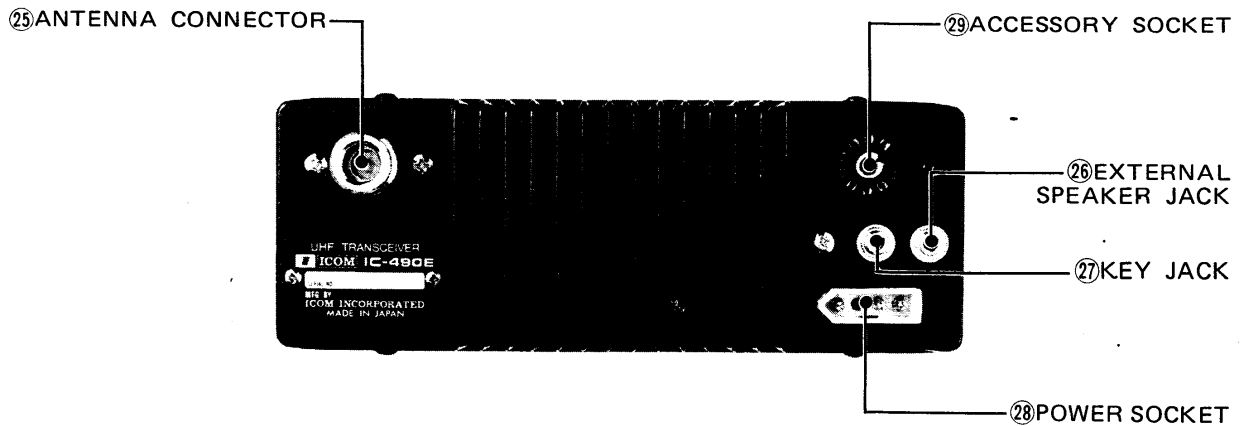
23. DUPLEX INDICATOR

Illuminates when the set is in the duplex mode (the OFFSET Switch is in the "+DUP" or "-DUP" position).

24. S/RF INDICATOR

Indicates S-unit and RF output level with seven LED's in line. The numbers on the S-meter represent S1 through S9 and 20 and 60dB over S9. The RF output level meter functions only as a relative output meter and does not indicate the wattage. These functions are switched automatically when T/R switching is made.

REAR PANEL



25. ANTENNA CONNECTOR

This is used to connect an antenna to the set. Its impedance is 50 ohms and connects with an N (UG-21/U) connector.

26. EXTERNAL SPEAKER JACK

When an external speaker is used, connect it to this jack. Use a speaker with an impedance of 4 ~ 8 ohms. When the external speaker is connected the built-in speaker does not function.

27. KEY JACK

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

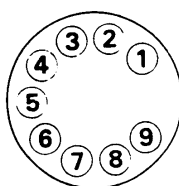
28. POWER SOCKET

Connect the supplied power cord to this socket.

29. ACCESSORY SOCKET

The table below shows terminal connections of this connector.

ACC SOCKET CONNECTIONS

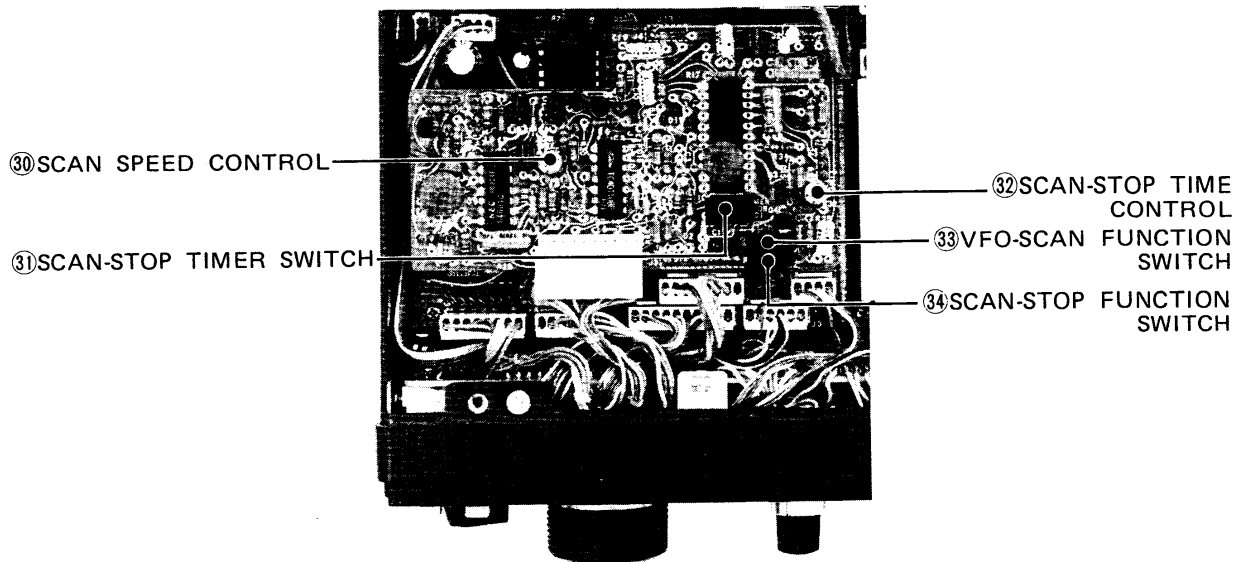


Outside view

PIN No.	FUNCTION
1.	Output of the applied voltage to the meter circuit.
2.	Connected to Push-to-talk, T/R change-over switch. When grounded, the set operates in the transmit mode.
3.	13.8 Volts DC in conjunction with the power switch operation. (0.3A Max.)
4.	Ground.
5. ~ 6.	NC (no connection).

PIN No.	FUNCTION
7.	8 Volts DC available (20mA Max.).
8.	Input of the tone-call unit power supply. When 8 Volts DC is applied to this terminal, a tone-burst is generated.
9.	When this terminal is connected to Pin 3, +13.8 Volts DC is superimposed on the antenna feed line for a preamplifier's power source. (80mA Max.)

UNDER THE TOP COVER



30. SCAN SPEED CONTROL

Controls the scanning speed in any scan mode. Adjust the control to desired scanning speed.

31. SCAN-STOP TIMER SWITCH

Switches the scan-stop interval function ON and OFF.

32. SCAN-STOP TIME CONTROL

Controls the interval of the scan auto-stopping time. Adjust the control to desired interval. It can be adjusted from 5 to 20 seconds.

33. VFO-SCAN FUNCTION SWITCH

Switches the VFO-scan function to either the programmed scan or the full range scan.

34. SCAN-STOP FUNCTION SWITCH

Switches the scan-stop function to either stop on a busy channel or stop on an empty channel.

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

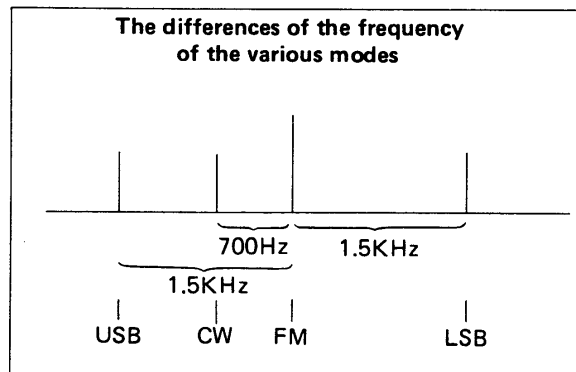
When the POWER Switch is turned ON, the frequency display will be 1.000, representing 431.000 MHz, when the MODE Switch is in the FM position. The frequencies of the VFO's and the Memory Channels are preset so that they start from the frequencies shown above whenever the IC-490A/E is turned ON.

FREQUENCY DISPLAY ON EACH MODE

Turn the MODE Select Switch to either "FM", to "USB", to "CW", or to "LSB". The displayed frequency will be changed as follows.

At the "FM" position	1.000
At the "USB" position	0.998.5
At the "CW" position	0.999.3
At the "LSB" position	1.001.5

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



When the MODE Switch is set in the "FM" position from any other mode, the last digit of the operating frequency is cleared, and the 100Hz digit of the frequency display are turned OFF. (When switch back to SSB or CW mode, the 100Hz digit will be recalled.)

TUNING CONTROL

Rotating the Tuning Knob clockwise increases the frequency; turning it counterclockwise decreases the frequency in 100Hz steps in the SSB or CW modes, 5KHz steps in the FM2 mode or 25KHz steps in the FM1 mode (1KHz steps when the 1KHz Steps Switch is pushed IN in any mode).

The click stops of the knob change in 100Hz Steps in the SSB or CW modes, or 5KHz or 25KHz Steps in the FM mode (1KHz when the 1KHz Steps Switch is pushed IN). The smaller vernier marks on the knob represent a click stop and the larger marks represent ten click stops. One complete rotation of the tuning knob results frequency increases or decreases of a 5KHz (1.25MHz in FM1 mode, 250KHz in FM2 mode and 50KHz when the 1KHz Steps Switch is pushed IN).

When you reach 439.999.9MHz in the SSB or CW modes, or 439.995MHz in FM mode (439.999 MHz when the 1KHz Steps Switch is pushed IN) turning the Tuning Control Knob clockwise will bring the operating frequency to 430.000MHz, 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 430.000MHz, and will prevent you from inadvertently operating out of the amateur radio band.

1KHz STEPS SWITCH

By pushing the 1KHz STEPS Switch IN, the frequency is increased or decreased in 1KHz steps in any mode.

VFO/MEMORY CHANNEL SWITCH and VFO SWITCH

The CPU in the IC-490A/E 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 Switch, when the VFO/MEMORY CHANNEL Switch is the VFO position. This dual VFO system gives the IC-490A/E 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 for practice!

1. "A" VFO is for both transmitting and receiving and is selected by placing the VFO Switch in the "A" (out) 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 Switch in the "B" (in) position. The transmit and receive frequency will be controlled by "B" VFO, displayed on the frequency display, and stored in "B" memory.

NOTE: The memory channel positions are described in the "MEMORY CHANNEL OPERATION" on page 16.

- When the IC-490A/E is first turned ON, 431.000MHz is preset into the "A" VFO and "B" VFO when the MODE is in FM.

FOR EXAMPLE:

When the VFO Switch is set in the "A" position and the set is turned ON, "1.000." will be displayed on the readout representing 431.000MHz. This will occur whether the VFO switch is in either the "A" or "B" positions. Rotating the tuning control knob clockwise will increase the frequency, and rotating the tuning knob counterclockwise will decrease the frequency in 5KHz (or 25KHz) steps. (100Hz steps in the SSB and CW modes.)

- 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 432.125.0MHz is set with "A" VFO, and the VFO switch is set to "B" VFO, the frequency readout will show "B" VFO's frequency, but 432.125.0MHz is still stored in "A" VFO's memory. Returning the VFO Switch to "A" VFO position, and "432.125.0" 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!

TRANSFERRING VFO FREQUENCY

When the OFFSET Switch is "S" position, the MEMORY/VFO WRITE button allows either VFO's to be brought to the exact frequency of the other VFO without turning the tuning control knob.

FOR EXAMPLE:

When "A" VFO is 432.255.5MHz and "B" VFO is 432.355.0MHz, 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 (432.255.5MHz). 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 (432.255.5MHz), switch back to the other VFO. To reverse this (A the same as B), select "A" VFO first, then push the MEMORY/VFO WRITE button.

RIT (RECEIVER INCREMENTAL TUNING)

By pushing the RIT Switch, you can shift the receive frequency ± 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.

When the RIT knob is in the center (12 o'clock) 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, push the RIT switch again and release it. When the RIT circuit is OFF, the transmit and receive frequencies are the same.

Other things to remember are: The frequency shifted by turning the RIT control is not indicated on the frequency display.

OFFSET SWITCH (DUPLEX OPERATION)

This switch allows DUPLEX (repeater) operation. The offset frequency is preset for the standard separation; 5MHz (IC-490E: 1.6MHz), but this frequency can be reset for any 100KHz steps in-band frequency. So you can access to any repeater.

1. When the OFFSET Switch is in the "S" position, the set is in SIMPLEX mode; the receive frequency and transmit frequency are controlled a frequency which is by placing the VFO/MEMORY CHANNEL Switch and VFO Switch in any position of "A", "B" or Memory Channel 1 ~ 4, or Calling Channel.

2. When the OFFSET Switch is in the "+DUP" position, the set is in DUPLEX mode, and the transmit frequency is set 5MHz (or 1.6MHz, or reset offset frequency) above the receive frequency. At the same time, the DUPLEX INDICATOR is lit.
 3. When the OFFSET Switch is in the "-DUP" position, the set is in DUPLEX mode, and the transmit frequency is set 5MHz (or 1.6MHz, or reset offset frequency) below the receive frequency, and the DUPLEX INDICATOR is lit.
 4. When the OFFSET Switch is in the "-DUP" or "+DUP" position, while the MEMORY/VFO WRITE button is pushed, the receive frequency becomes the expecting transmit frequency, so you can receive the repeater's input frequency.
- "+DUP" or "-DUP" position will allow you to access a repeater that has a 1.6MHz input/output frequency separation.

FOR EXAMPLE:

Set "A" VFO to 434.725MHz. Then set the OFFSET Switch to the "-DUP" position. **4.725.** will be shown on the readout during receive and **3.125.** during transmit. You are now receiving on 434.725MHz and transmitting on 433.125MHz, so you can access 433.125/434.725 repeater.

If you push the MEMORY/VFO WRITE button, **3.125.** will be shown on the readout and you can receive on 433.125MHz, i.e., repeater input frequency, while the button is pushed.

If you change the receiving ("A" VFO) frequency from 434.725MHz to 434.675MHz, the transmitting frequency will change from 433.125MHz to 433.075MHz, so now you can access a 433.075/434.675 repeater.

Setting the OFFSET Switch to "+DUP" position changes the transmitting frequency to 1.6MHz above the receiving frequency.

If you set "A" VFO to 433.250MHz, the transmitting frequency will be 434.850MHz.

These functions will be available also in "B" and Memory 1 ~ 4 positions of the VFO/MEMORY CHANNEL Switch, and the CALLING CHANNEL.

RESETTING THE OFFSET FREQUENCY

The offset frequency can be reset to any in-band frequency other than 5MHz (or 1.6MHz).

Set the MODE Switch in the "OW" position, and the FREQUENCY DISPLAY shows 1MHz digit and 100KHz digit of the offset frequency. If no offset frequency has been reset since turning the power of the set ON, "5.0" (or "1.6") will be shown on the display.

Rotating the Tuning control knob clockwise increases the frequency; turning it counterclockwise decreases the frequency in 100KHz steps. Turn the tuning control knob to obtain the desired offset frequency, then push the MEMORY/VFO WRITE button, and the desired offset frequency is written into the CPU and maintained as long as the power of the set is not turned OFF or a new offset frequency is reset.

- When to do if you want to operate repeaters that have a frequency difference other than $\pm 5\text{MHz}$ (or $\pm 1.6\text{MHz}$), (for example : 4.6MHz).

FOR EXAMPLE:

Set the MODE Switch in the "OW" position, and the FREQUENCY DISPLAY shows "5.0" (IC-490E : "1.6"). Turn the tuning control knob to be shown "4.6" on the display, then push the MEMORY/VFO WRITE button.

Set the MODE Switch to the "FM" position, and set "A" VFO to 437.725MHz . Then set the OFFSET Switch to the "-DUP" position. 7.725 . will be shown on the display during receive and 3.125 . during transmit.

You are now receiving on 437.725MHz and transmitting on 433.125MHz , so you can access a $433.125/437.725$ repeater.

If you change the receiving frequency from 437.725MHz to 437.675MHz , the transmitting frequency will change from 433.125MHz to 433.075MHz , so now you can access a $433.075/437.675$ repeater.

MEMORY CHANNEL OPERATION

MEMORY-WRITE (PROGRAMMING THE MEMORY CHANNELS)

NOTE: 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 $434.700.0\text{MHz}$, the display shows "4.700.0" in SSB or CW mode, or "4.700". in FM mode.
2. Set the VFO/MEMORY CHANNEL Switch to the channel to be programmed (1 ~ 4 or push the CALLING CHANNEL Switch). As an example, set it at Memory Channel 1. If no frequency has been programmed since turning the power of the unit ON, "1.000." will be shown on the display when the mode is in FM, and the unit will receive on 431.000MHz .
3. One push of the MEMORY/VFO WRITE Button erases the previous programmed frequency ($431.000.0$) and programs the new frequency ($434.700.0$) into Memory Channel 1.
4. Program any desired frequencies in Memory Channels 2 ~ 4 and Calling Channel in the same manner. Memory Channels 1 and 2 are used also for the Programmed Scan. For Programmed Scan operation, refer to SCANNING OPERATION on page 17.

MEMORY READING

Set the VFO/MEMORY CHANNEL Switch to the desired memory channel 1, 2, 3, 4 or push the CALLING CHANNEL Switch. At that frequency the "A" or "B" VFO was set, that previously programmed frequency is then recalled. When the VFO/MEMORY CHANNEL Switch is set back to VFO, the previous operating frequency of that VFO will again be shown on the display.

The programmed frequencies in the five Memory Channels are maintained as long as the power, including MEMORY BACKUP power, of the IC-490A/E is not turned OFF or new frequencies reprogrammed. When the power cord is connected to a continuous operating power source, 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-490A/E provides various scanning operations. Please read the following instructions carefully to fully enjoy the IC-490A/E's many capabilities.

MEMORY SCAN

This is to scan the five Memory Channels and two VFO's frequencies continuously.

1. Program five desired frequencies in Memory Channels 1 ~ 4 and Calling Channel.
2. Set the VFO/MEMORY CHANNEL Switch to one of the memory positions.
3. Depress the S/S (Scan Start/Stop) button, and the frequency starts scanning the programmed frequencies in the Memory Channels 1, 2, 3, 4, CALL, then "A" VFO and "B" VFO, 1, 2, 3, 4, CALL, "A" VFO, "B" VFO
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 S/S Button. Depress it again to restart the scanning.

This function can be changed to stop when the squelch is closed, i.e., an empty channel, by the SCAN-STOP FUNCTION Switch located under the top cover.

PROGRAMMED SCAN

This is used to scan between two desired frequencies, which are programmed in Memory Channels 1 and 2, by setting the VFO-SCAN FUNCTION Switch located inside cover to "PROG SCAN" position.

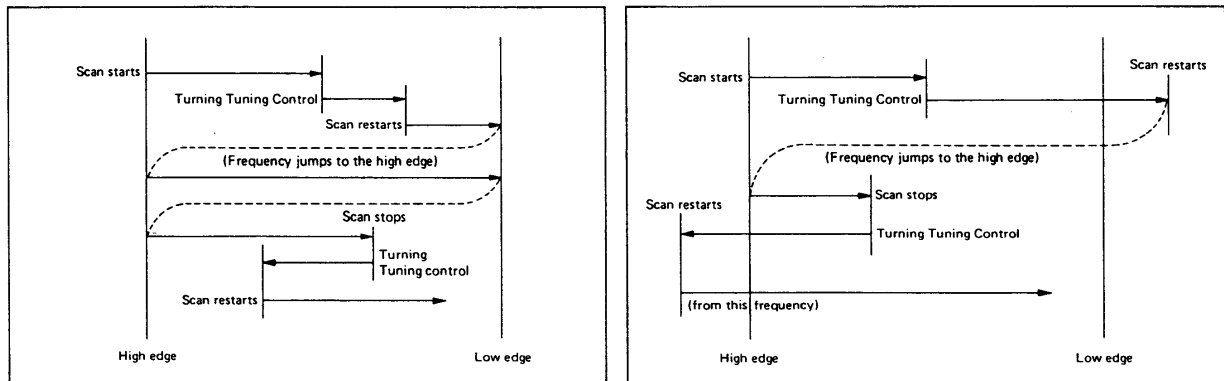
1. Program the frequencies of the high edge of the desired scanning range in Memory Channel 2, and the low edge in Memory Channel 1.

For example, program 434.200MHz in Memory Channel 1 and 434.800MHz in Memory Channel 2.

2. Set the VFO/MEMORY CHANNEL Switch to VFO position. Depressing the S/S Button starts the scan from the high edge (434.800MHz) to the low edge. The scanning frequency increments depend on the MODE Switch setting and the 1KHz STEPS Switch setting.
3. When the scanning frequency reaches the lowest edge (434.200MHz), it automatically returns to the high edge (434.800MHz) and continues scanning down to provide endless scanning operation.
4. While the SQUELCH is engaged, the squelch opening as a signal is received will stop the scanning automatically to lock onto the frequency. If the RECEIVE indicator LED is lit because the SQUELCH is not engaged, the scan does not stop at any signal.
5. To stop the scan operation, depress the S/S Button. Depressing the S/S Button again restarts the scan from the frequency at which it stopped.
6. If this frequency is changed with turning the Tuning Control knob while the scan is stopped, the scanning will restart from the VFO frequency.

In this case, if the VFO frequency is below the low edge frequency, the frequency jumps to the high edge frequency (434.800MHz) and restarts from the high edge.

If the changed frequency is higher than the high edge frequency and the S/S Button is pushed, scanning will begin at the VFO frequency, scan down to the low edge but will return to the preprogrammed high edge frequency.



VFO FULL RANGE SCAN

This is to scan the entire band between 430.000MHz and 439.999MHz.

1. Set the VFO/MEMORY CHANNEL Switch to VFO position, and the VFO-SCAN FUNCTION Switch located under the top cover to "FULL SCAN" position. Depressing the S/S button starts the scan from the VFO frequency to the low edge. The scanning frequency increments depend on the MODE Switch setting and the 1KHz STEPS Switch setting.
2. When the scanning frequency reaches the low edge, it automatically returns to the high edge and continues scanning down to provide endless scanning operation.
3. Other operations are the same as the PROGRAMMED SCAN and MEMORY SCAN.

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

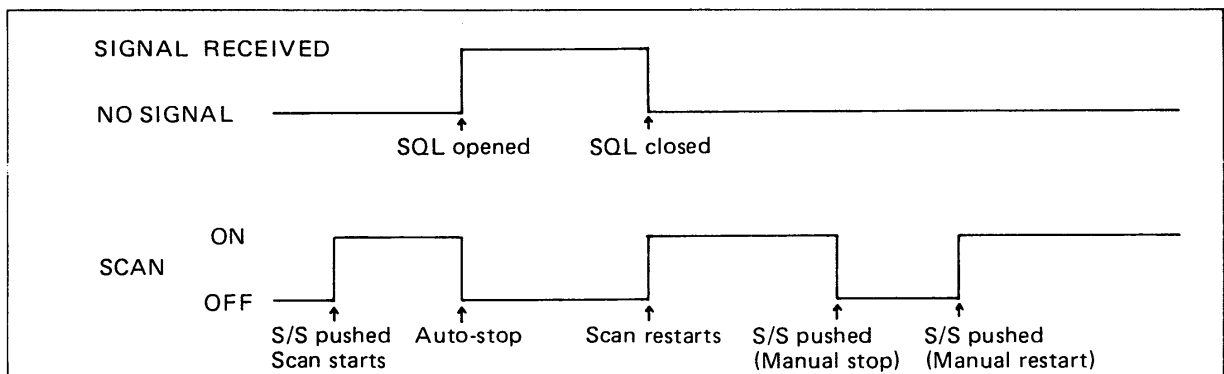
While the SCAN is operating even if the SCAN stops on a frequency, the decimal points of the frequency display will blink according to the scanning speed.

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

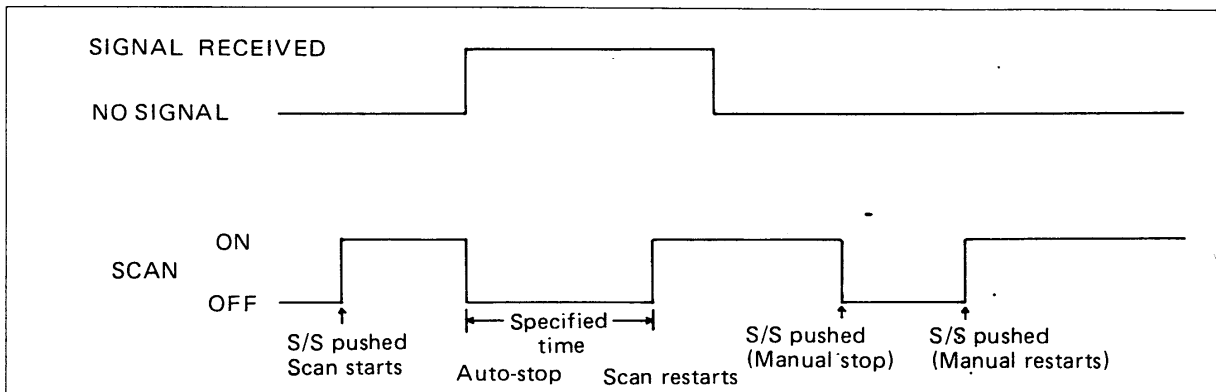
RESUMING SCAN

All scan modes are provided with the resume scan function. When the scan has been stopped by the auto-stop function, the scan will restart after the cause goes away, or after passed specified time.

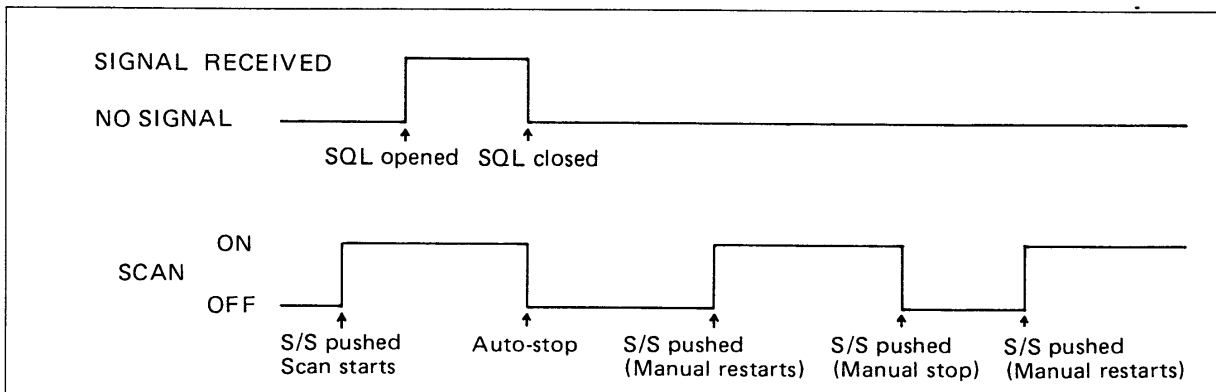
1. By setting the SCAN-STOP TIMER Switch in OFF position and the SCAN-STOP FUNCTION Switch in BUSY position (both switches located under the top cover), the scan will stop on a signal (by opening the squelch), then the scan will restart with disappearing the signal.



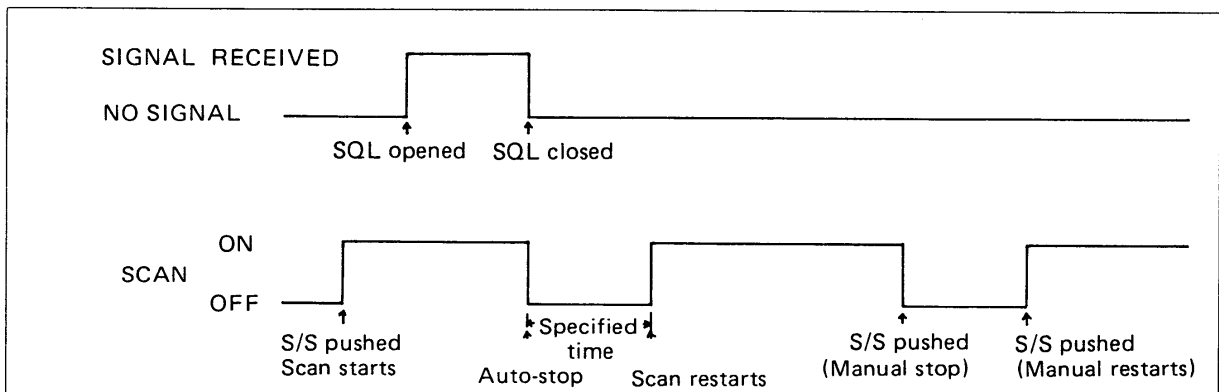
- By setting the SCAN-STOP TIMER Switch in ON position and the SCAN-STOP FUNCTION Switch in BUSY position, the scan will stop on a signal, and will restart after specified time is passed, whether a signal has been received or not. This scan stopping time is adjustable between 5 seconds and 20 seconds with the SCAN-STOP TIME CONTROL located under the top cover.



- By setting the SCAN-STOP FUNCTION Switch in EMPTY position and the SCAN-STOP TIMER Switch in OFF position, the scan will stop on an empty channel (by closing the squelch), then the scan will restart with the appearance of a signal.



- By setting the SCAN-STOP FUNCTION Switch in EMPTY position and the SCAN-STOP TIMER Switch in ON position, the scan will stop on an empty channel, then will restart after specified time is passed, whether a signal has been received or not.



Set the SCAN-STOP TIMER Switch, SCAN-STOP TIME Control, VFO-SCAN FUNCTION Switch and SCAN-STOP FUNCTION Switch at the most convenient position for you before the set is installed.

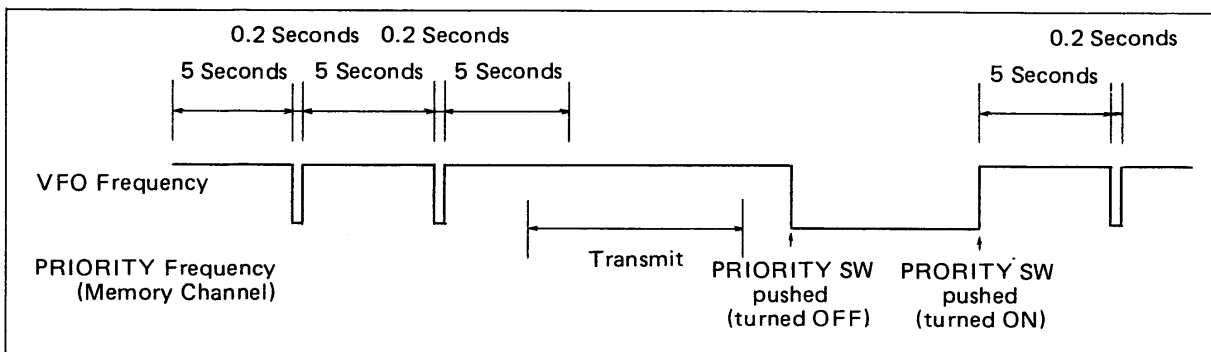
NOTE: The auto-stop circuit functions with SSB or CW signals, but the scan does not always stop at the exact carrier frequencies. While the scan stop is operating on one of these signals, tune in to the signals for better reception by rotating the Tuning Control and by setting the MODE Switch to the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

PRIORITY FUNCTION

This function is provided to check your favorite channel, such as a local repeater or a calling channel, written into a memory channel while operating on a VFO frequency, whether a signal has appeared on the selected favorite channel, or disappeared from the channel.

The following steps are taken to utilize the PRIORITY FUNCTION. -

1. Write your favorite frequency into a memory channel.
2. Set the VFO/MEMORY CHANNEL Switch in the position written with your favorite frequency, and the set then receives on the memory channel.
3. By pushing the PRIORITY Switch, the PRIORITY INDICATOR is lit and the set receives on a VFO frequency, a period of 5 seconds and on the priority channel (written with your favorite frequency) 0.2 seconds, and then repeats this function until the PRIORITY Switch is pushed again.
4. If the set is turned to transmit mode, during the priority function, the transmit frequency will be the VFO frequency in SIMPLEX mode, or its OFFSET frequency in DUPLEX mode. When returned to receive mode, the priority function will be continued.
5. If you wish to stop the priority function, push the PRIORITY Switch again, and the PRIORITY indicator is turned OFF and the operating frequency goes to the priority channel's frequency.
6. If you wish to continue the operation on the VFO frequency, set the VFO/MEMORY CHANNEL Switch to the VFO position.



SSB OPERATION

1. RECEIVING

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

MODE SWITCH	USB
OFFSET SWITCH	"S" (Simplex)
VFO/MEMORY CHANNEL SWITCH	VFO
VFO SWITCH	"A" (out)
1KHz STEPS SWITCH	OFF (out)
RIT CONTROL	Center (12 o'clock) position (or RIT SWITCH OFF)
NOISE BLANKER SWITCH	OFF (out)
AGC SWITCH	Normal (out)
VOLUME CONTROL and POWER SWITCH	Completely counterclockwise (OFF position)
SQUELCH CONTROL and RF POWER SWITCH	Completely counterclockwise (Pull switch is normal position.)

The other switches 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 band, while LSB is usually used on the downlink of the satellite communications. Select the mode according to your use.

Now turn ON the POWER SWITCH. The RECEIVE indicator will be illuminated and "0.998.5" will be shown on the FREQUENCY DISPLAY. Slowly turn the VOLUME Control clockwise to a comfortable level. Rotate the tuning knob until a signal is received. The S/RF indicator will light according to the signal strength, so tune for the highest possible indicator 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 VFO's in the IC-490A/E 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-490A/E, 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.

For tuning, Memory Channel operation and Scanning operation, please refer to "HOW TO TUNE" on page 12, "MEMORY CHANNEL OPERATION" on page 16 and "SCANNING OPERATION" on page 17.

2. NB (NOISE BLANKER)

Set the noise blanker ON (pushed IN) 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-490A/E 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.

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

4. 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.

Knobs and switches are left in the same positions as for receiving. When the PTT (push-to-talk) switch on the microphone is depressed, the transmit indicator is illuminated. By speaking into the microphone, the S/RF indicator will light 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 with a built-in preamplifier and provides good pickup for all levels of voice. 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 to 1 watt, pull the SQUELCH control and RF POWER Switch to the LOW (out) position.

To receive again, release the PTT button. This will also switch OFF the transmit indicator.

CW OPERATION

1. RECEIVING

For CW reception, set the MODE 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 headphones. Set the noise blanker switch and/or the AGC switch for clear reception, 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.

The IC-490A/E 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. When you key the keyer, the transmit indicator is lit and the S/RF indicator lights and your CW signal is transmitted.

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 on the main unit inside cover. Rotating the CW MONI Control clockwise makes the tone louder.

FM OPERATION

1. RECEIVING

For FM reception, set the MODE Switch to the FM1 or FM2 position. Other switches and knobs are set the same as for SSB reception.

Turn the Volume Control clockwise to a comfortable audio level.

If no signal can be heard but only noise, turn the Squelch Control clockwise until the noise from the speaker stops and set it just below this threshold. (When adjusting the Squelch control setting, if some communication signals can be heard, turn the tuning control in either direction and set it where only noise can be heard.) 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 signals or mobile stations, adjust the squelch control further until the proper threshold is obtained.

The S/Rf indicator indicates the signal strength of the incoming signals and is calibrated in S units and dB over S9.

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

Turn the tuning control to the desired frequency, or set the VFO/Memory Channel Switch to the desired channel.

For tuning, Memory Channel operation and Scanning operation refer to "HOW TO TUNE" on page 12, "MEMORY CHANNEL OPERATION" on page 16, and "SCANNING OPERATION" on page 17.

2. TRANSMITTING

For simplex operation, set the OFFSET Switch in the "S" (simplex) position.

For duplex (repeater) operation, set the OFFSET Switch in the "-DUP" or "+DUP" position according to repeater's input frequency.

When the IC-490A/E is first turned ON, the OFFSET frequency will be preset 5MHz (IC-490E: 1.6MHz) OFFSET frequency is normal repeater input/output frequency separation.

If you desire to operate repeaters that have a frequency difference other than ± 5 MHz or 1.6 MHz, set the MODE Switch to "OW" position to reset desired OFFSET frequency. Refer to "RESETTING THE OFFSET FREQUENCY" on page 15.

If the lower output power (1 watt) is sufficient, set the Squelch Control and RF Power Switch to the LOW (out) position.

Depress the PTT (push-to-talk) Switch on the microphone and the transceiver will transmit. At the same time the TRANSMIT indicator will be illuminated red and the S/Rf indicator will provide an indication of relative power output of the transmitter.

If you need a tone-burst for initial access for the repeater, depress the Tone Call Switch on the microphone for the required period. (Tone-burst period varies individually from 100 milliseconds to 2 seconds.) (IC-490A : The Tone Call unit is not installed.)

SATELLITE COMMUNICATION

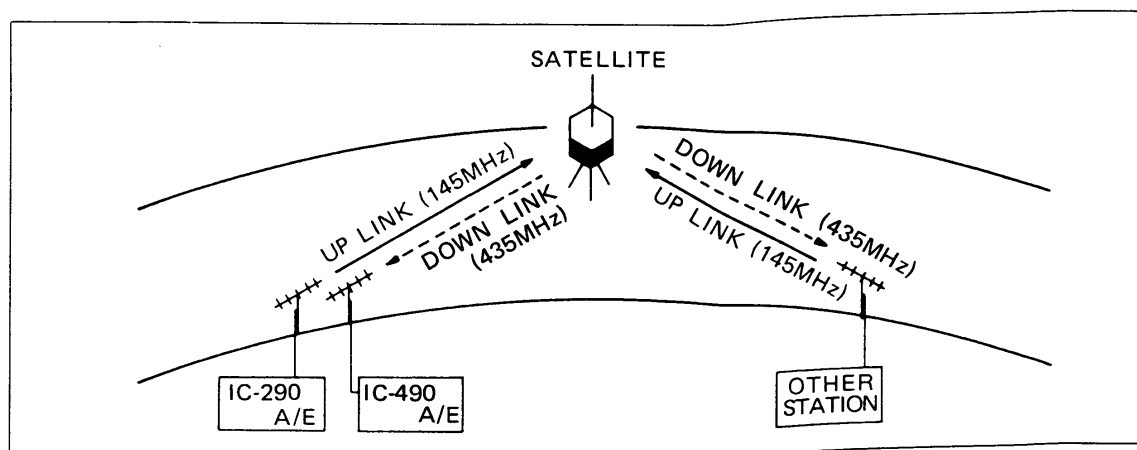
At present there is an active satellite for amateur radio use, AMSAT OSCAR 8 was launched in March, 1978. Satellite communications can be made by using an IC-490A/E for receiving and IC-290A/E or IC-251A/E (144MHz SSB/CW transceiver) for transmitting in Mode J, and an IC-290A/E or IC-251A/E for transmitting and IC-720A or IC-730 (HF SSB/CW transceiver) for receiving in Mode A.

NOTE: FM mode is prohibited for these satellite communications.

For frequency information refer to the chart below. Further information on communicating through satellites can be found in various amateur radio books and periodicals.

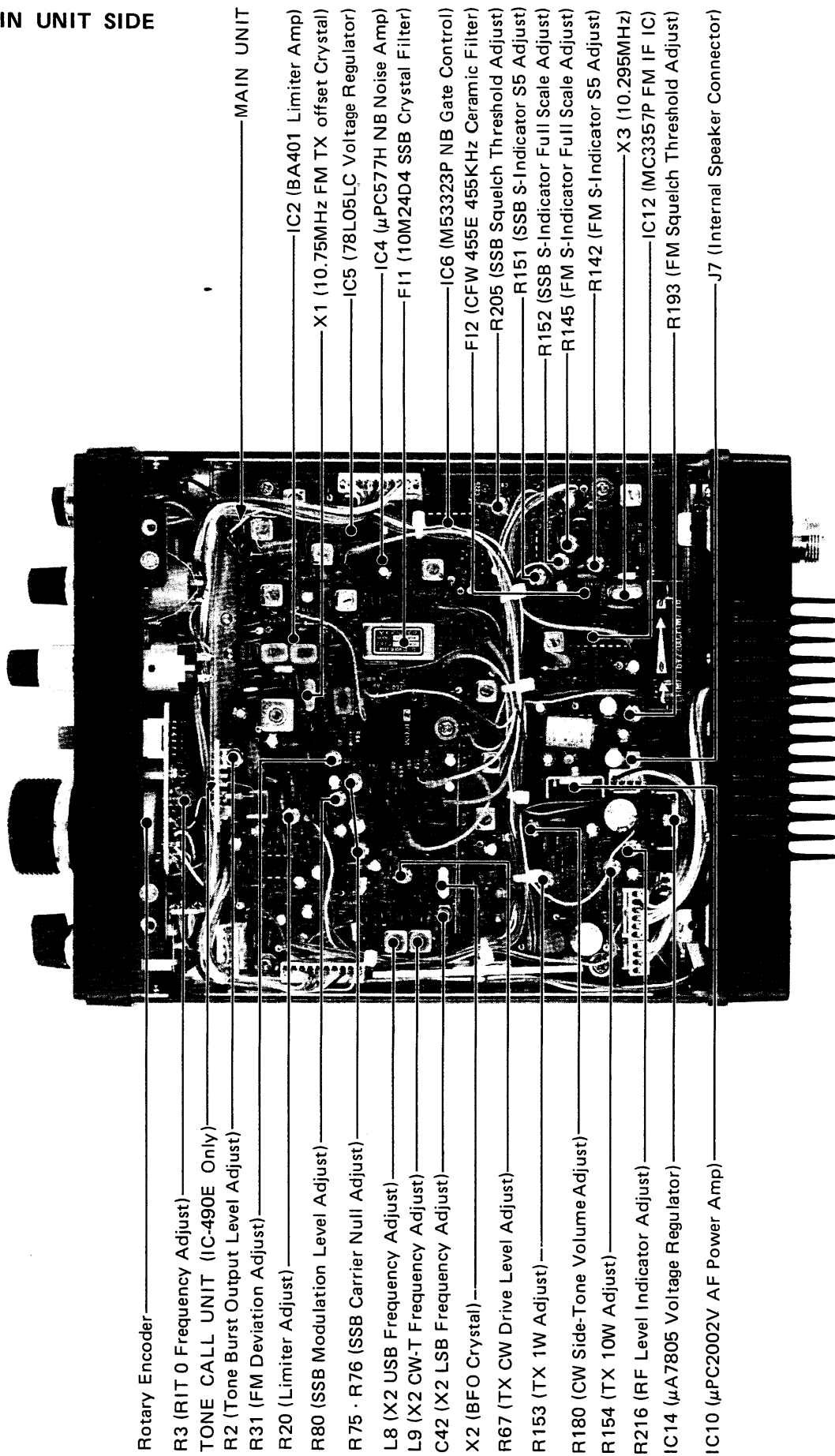
FREQUENCY CHART

SATELLITE	MODE	UPLINK (Transmitting) FREQUENCY	DOWNLINK (Receiving) FREQUENCY	BEACON
AMSAT OSCAR 8 (AO-8)	A	145.85MHz ~ 145.95MHz (USB/CW)	29.4MHz ~ 29.5MHz (USB/CW)	29.402MHz
	J	145.90MHz ~ 146.00MHz (USB/CW)	435.2MHz ~ 435.1MHz (LSB/CW)	435.097MHz



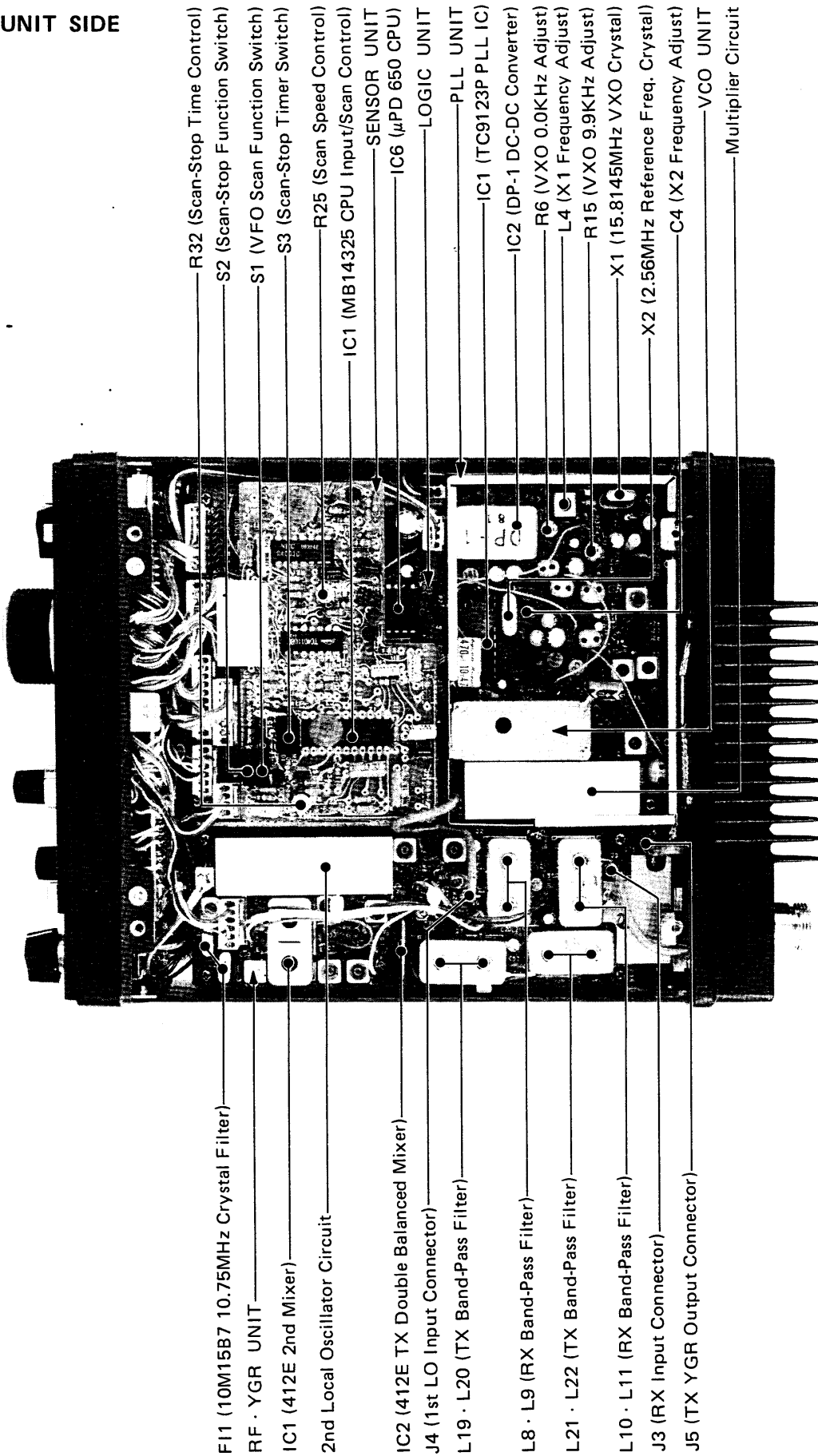
SECTION VI INSIDE VIEW

MAIN UNIT SIDE



- Rotary Encoder
- R3 (RIT 0 Frequency Adjust)
- TONE CALL UNIT (IC-490E Only)
- R2 (Tone Burst Output Level Adjust)
- R31 (FM Deviation Adjust)
- R20 (Limiter Adjust)
- R80 (SSB Modulation Level Adjust)
- R75 · R76 (SSB Carrier Null Adjust)
- L8 (X2 USB Frequency Adjust)
- L9 (X2 CW-T Frequency Adjust)
- C42 (X2 LSB Frequency Adjust)
- X2 (BFO Crystal)
- R67 (TX CW Drive Level Adjust)
- R153 (TX 1W Adjust)
- R180 (CW Side-Tone Volume Adjust)
- R154 (TX 10W Adjust)
- R216 (RF Level Indicator Adjust)
- IC14 (μ A7805 Voltage Regulator)
- IC10 (μ PC2002V AF Power Amp)
- Rotary Encoder
- R3 (RIT 0 Frequency Adjust)
- TONE CALL UNIT (IC-490E Only)
- R2 (Tone Burst Output Level Adjust)
- R31 (FM Deviation Adjust)
- R20 (Limiter Adjust)
- R80 (SSB Modulation Level Adjust)
- R75 · R76 (SSB Carrier Null Adjust)
- L8 (X2 USB Frequency Adjust)
- L9 (X2 CW-T Frequency Adjust)
- C42 (X2 LSB Frequency Adjust)
- X2 (BFO Crystal)
- R67 (TX CW Drive Level Adjust)
- R153 (TX 1W Adjust)
- R180 (CW Side-Tone Volume Adjust)
- R154 (TX 10W Adjust)
- R216 (RF Level Indicator Adjust)
- IC14 (μ A7805 Voltage Regulator)
- IC10 (μ PC2002V AF Power Amp)
- IC2 (BA401 Limiter Amp)
- X1 (10.75MHz FM TX offset Crystal)
- IC5 (78L05LC Voltage Regulator)
- IC4 (μ PC577H NB Noise Amp)
- F11 (10M24D4 SSB Crystal Filter)
- IC6 (M53323P NB Gate Control)
- F12 (CFW 455E 455KHz Ceramic Filter)
- R205 (SSB Squelch Threshold Adjust)
- R151 (SSB S-Indicator S5 Adjust)
- R152 (SSB S-Indicator Full Scale Adjust)
- R145 (FM S-Indicator Full Scale Adjust)
- R142 (FM S-Indicator S5 Adjust)
- X3 (10.295MHz)
- IC12 (MC3357P FM IF IC)
- R193 (FM Squelch Threshold Adjust)
- J7 (Internal Speaker Connector)

PLL UNIT SIDE



SECTION VII CIRCUIT DESCRIPTION

OUTLINE

The IC-490A/E 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 39.38MHz below the receive frequency, thereby spurious is kept to a minimum.

The operating frequency is controlled by pulse signals, generated by the rotary encoder located at the tuning knob, being added to or subtracted from the preset frequencies in the microcomputer.

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 dual-conversion type with 39.38MHz and 10.75MHz IF in the SSB and CW modes, and as a triple-conversion type with an additional 455KHz IF in the FM mode.

In the USB and LSB modes, the transmitter uses a carrier of 10.7485MHz for USB and 10.7515 MHz 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 10.75MHz is obtained.

In the CW mode, the set uses the carrier for USB which is shifted about +800Hz. This carrier is fed to the transmit mixer.

In the FM mode, the set uses another crystal oscillator to produce the 10.75MHz signals which are direct-frequency modulated.

The SSB, CW or FM signal is mixed with 28.63MHz 2nd local oscillator output and 390MHz range 1st local oscillator output from the PLL circuit, which are 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 L10 and L11 in the RF · YGR unit through low-pass filters in the PA unit. The switching diodes D1 and D2 in the PA unit, are turned OFF in the receive mode, and isolate the PA module from the receiver circuit.

RF CIRCUIT

Filtered signals from the double-helical cavity filter, which reduces interference and intermodulation from other radio signals or nearby signals, are amplified by the low-noise MOS FET Q3 and then sent to the 1st gate of the first mixer Q2 through the two stage band-pass filter L8 and L9. To the 2nd gate of the MOS FET mixer Q2, a 390MHz signal is supplied from the PLL unit through J4. The 39.38MHz 1st IF signal taken from the drain of Q2, is fed to the source of Q1, 1st IF amplifier which is a common gate amplifier.

2ND MIXER CIRCUIT

Amplified 1st IF signal is fed to the 2nd mixer, IC1, diode double balanced mixer through the T/R switching diode D1.

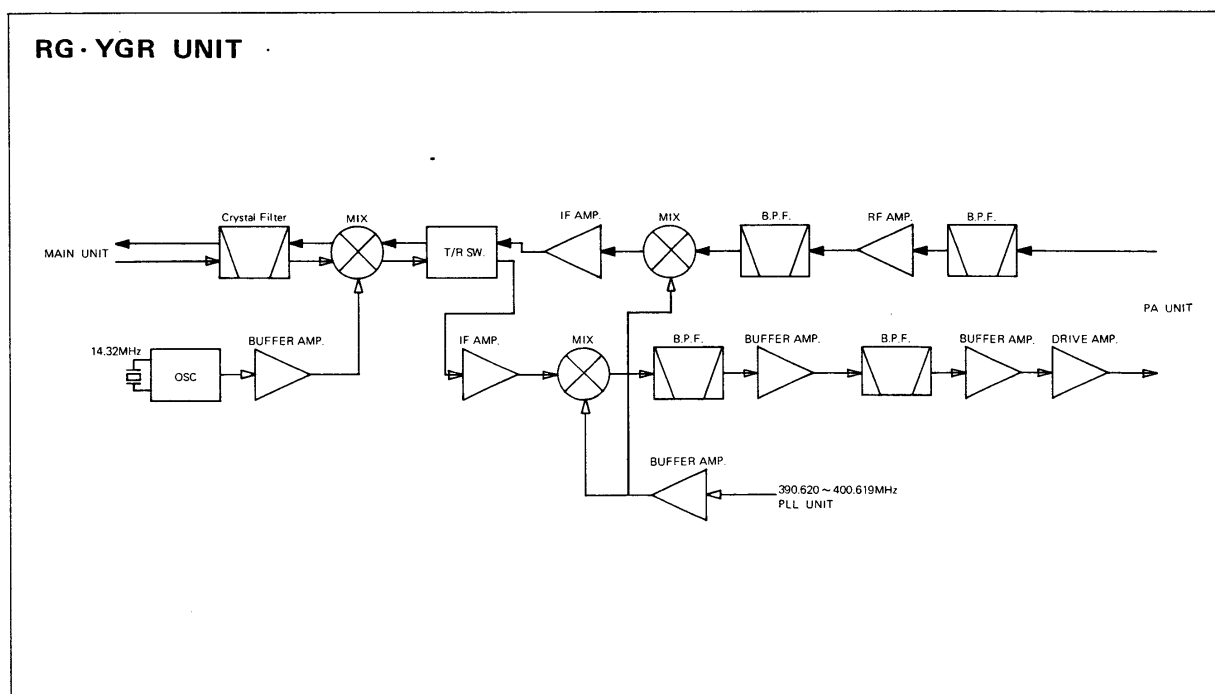
A 28.63MHz signal from the 2nd local oscillator circuit is fed to another input port of IC1, and the 1st IF signal is converted to a 10.75MHz 2nd IF signal.

The 10.75MHz 2nd IF signal put out from the output port of IC1 is fed to the IF circuit in the MAIN unit through the monolithic crystal filter F11.

2ND LOCAL OSCILLATOR CIRCUIT

This circuit consists of a crystal oscillator Q4, a multiplier Q5 and a buffer amplifier Q6.

Q4 oscillates 14.315MHz with X1 and Q5 multiplies it to 28.63MHz. This signal is amplified by Q6 and then fed to the 2nd mixer IC1.



2ND IF CIRCUIT

10.75MHz 2nd IF signals from the RF · YGR unit are fed to the 1st gate of the dual gate MOS FET Q12, through T/R Switching diode D31. AGC voltage is supplied to the 2nd gate of Q12 to improve the receiving characteristics.

Signals amplified by Q12 are fed to the FM circuit in the FM mode, and to the high-selectivity 4-stage monolithic crystal filter F11 through L10 and D26 in the SSB and CW modes.

In the FM mode, the 2nd IF signals are fed to IC12. IC12 is composed of 3rd local oscillator, 3rd mixer, limiter amplifier, quadrature detector and active filter circuits. The 3rd local oscillator oscillates 10.295MHz, and is fed to the 3rd mixer with the 2nd IF signals to convert 455KHz 3rd IF signals. The 3rd IF signals are put out from Pin 3, and fed to external ceramic filter CFW-455E

which has excellent selectivity, then fed to IC12 again to amplify and detect. The detected AF signals are put out from Pin 9 and fed to an AF amplifier Q28.

In the SSB and CW modes, D23 is turned ON and signals are amplified by a two-stage amplifier consisting of dual-gate MOS FET's Q18 and Q17. These amplifiers provide high gain and high stability, and the IF coils, L16 and L15 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.

SSB, CW DETECTOR CIRCUIT

Signals from the IF amplifiers are fed to Pin 5 of the balanced modulator, IC3. BFO signals are supplied to Pin 7 and the audio output signals appear at Pin 3. This audio signals are fed to an AF amplifier Q28.

BFO CIRCUIT

The BFO circuit consists of an oscillator Q6, a buffer Q7 and crystal X2. To shift the oscillating frequency according to the operating mode, the total inductance of L8 and L9 is changed by supplying a voltage to an anode of the switching diodes D14 ~ D17, depending on the operating mode.

AF CIRCUIT

Demodulated signals from IC3 or IC12 are amplified by Q28 and fed to Pin 1 of the AF attenuator IC11, controlled by the VOLUME control on the front panel and then fed to Pin 1 of the AF power amplifier IC10 to obtain enough power to drive the speaker.

AGC CIRCUIT

IF signals amplified by Q18 and Q17 are fed to the buffer amplifier Q16, and rectified by the double voltage rectifier D33 and D34. This DC voltage is fed to the DC amplifier Q15, then supplied as the AGC voltage. $\pm 8V$ is supplied to Q15 to increase the AGC range.

NOISE BLANKER CIRCUIT

Signals amplified by the IF amplifier Q12 are coupled by C184. Noise signals are amplified by IC4 and rectified by D28 and D29. A portion of the rectified signals are amplified by Q20 and integrated by C82, and supplied to IC4 as its AGC voltage. The other part of the rectified signals are fed to the DC amplifier Q19.

When a pulse noise is received, the pulse turns Q19 ON, and triggers the monostable multivibrator IC6. Pin 4 of IC6 goes to the ground level at a time determined by R134 and C111, and it turns Q11 and D24 ON, and turns D26 and D27 OFF. Thus the IF signals including pulse noise are not fed to the crystal filter during the pulse noise and provides comfortable reception.

SQUELCH CIRCUIT

This circuit is provided in order to silence the set until a signal is received.

In the FM mode, noise components put out from Pin 9 of IC12 are fed to the AF attenuator, a half of IC11, which controls the squelch threshold level. The output of IC11 is fed to IC12 again, filtered about 70KHz signal (noise), and put out from Pin 11. This signal (noise) is rectified by D46 and D47, integrated by R197, R198 and C169, and turns Q30 ON. The collector of Q30 is

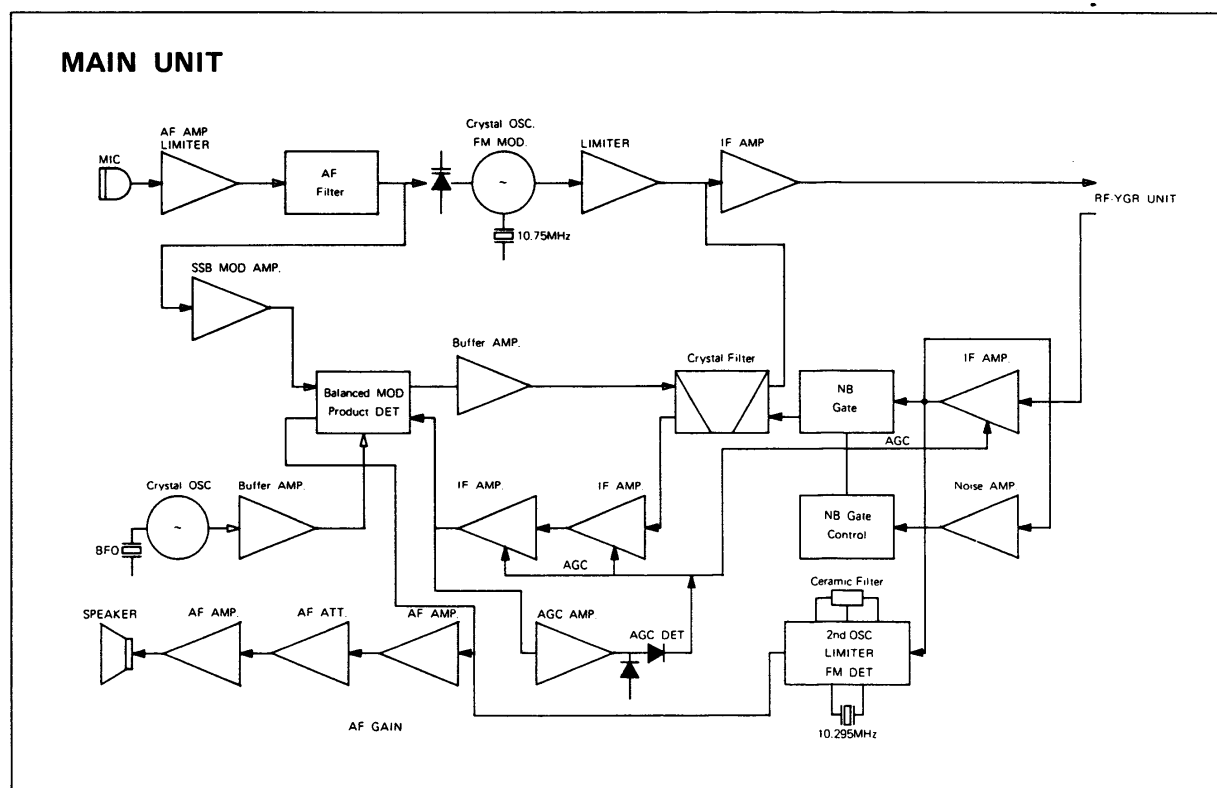
connected to Pin 13 of IC11 through D45, and it makes maximum attenuation for receiver audio signals and silences the set. When a signal is received, the noise component is suppressed by the signal, the base voltage of Q30 is lowered, and Q30 is turned OFF. Thus the receiver audio attenuator, IC11, functions with normal condition, and the received signal can be heard from the speaker.

In the SSB or CW mode, the S-meter signal from Pin 7 of IC8, is fed to Pin 2 of IC8 which is the minus input terminal of the comparator, and the squelch threshold signal set by the squelch control, is fed to Pin 3 of IC8 which is the plus input terminal.

When the squelch is closed (when the S-meter signal voltage is less than the squelch threshold signal voltage), Pin 1 of IC8 puts out 8V and Q30 is turned ON, thus no audio can be heard from the speaker. When a signal is received and the S-meter signal voltage exceeds the squelch threshold voltage, Pin 1 of IC8 is lowered to ground level, Q30 is turned OFF, and the received signal can be heard from the speaker. In the FM mode, 8V is applied to Pin 2 of IC8, the output is lowered to ground level, and IC8 is isolated from the Q30.

POWER SUPPLY CIRCUIT

This circuit employs a multipurpose voltage regulator, IC13. It puts out a constantly activated 8V, R8V which is operative during receive, and T8V which is operative during transmit. R8V is put out from Pin 6, and T8V is put out from Pin 8 of IC13. By grounding Pin 5, R8V goes 0V and T8V is actuated, thus the set will be turned to transmit mode.



TRANSMITTER CIRCUITS

ANTENNA SWITCHING CIRCUIT

In the transmit mode, D1 and D2 are turned ON. D1 feeds the transmitting signals to antenna through the low-pass filter, and D2 grounds the input terminal of the receiver, thus the transmitting signals are prevented from flowing into the receiver circuits.

MICROPHONE AMPLIFIER AND LIMITER CIRCUIT

Audio signals from the microphone are fed to Pin 2 of the audio amplifier IC1. Amplified signals appear at Pin 1 and are sent through a differential circuit R14 and C6 to Pin 5 of IC1, which is a limiter amplifier and has 6dB/Octave response between 300Hz and 3KHz. This output is fed to either low-pass filter Q1, and then the FM modulator D3 in FM mode, or a buffer amplifier Q9 through an integral circuit R81 and C75.

FM MODULATOR CIRCUIT

Audio signals from Q1 are fed to varactor diode D3 through R31 level adjust trimmer. Q3 oscillates at 10.75MHz, and D3 modulates its frequency with the audio signals. The modulated signals are fed to the limiter amplifier IC2 and the buffer amplifier Q4, then the transmit mixer in the RF · YGR unit.

BALANCED MODULATOR CIRCUIT

In the SSB mode, the amplified audio signals from Q9 are fed to Pin 5 of the balanced modulator IC3 (same as the receiver detector), through R80 level adjust trimmer. The BFO signal is fed to Pin 7, resulting in a 10.75MHz suppressed carrier double side band signal brought out from Pin 2.

In the CW mode, a voltage is applied to Pin 5 of IC3 through D20 and R78, to unbalance the IC3 and put out a carrier signal. The carrier level can be adjustable with R67.

TRANSMIT IF AMPLIFIER CIRCUIT

DSB signals which appear at Pin 2 of IC3, are fed to the base of Q10, and amplified by Q10, and then fed to F11 through the switching diode D22. DSB signals are converted to SSB signals by the filter and sent to the buffer amplifier Q4 through D25 and D5, then the 2nd mixer in the RF · YGR unit.

In the CW mode, during key up, a voltage is applied to the source of Q4, through D6, to cut off Q4, and therefore no RF output. During key down, the applied voltage is shunted to ground through D42, thus the source voltage of Q4 becomes normal and puts out RF signals.

TRANSMIT MIXER CIRCUIT

The 10.75MHz transmitting signal from the MAIN unit passes through the crystal filter F11, and is fed to the 2nd mixer IC1 to convert into 39.38MHz signal (reverse flow of the receive mode).

This output signal is fed to a buffer amplifier Q8, then transmit mixer IC2 (DBM). The local oscillator signals are supplied to an input port of IC2 through the buffer amplifier, Q7, from the PLL circuit and mixed with the FM, SSB or CW signals fed from Q8. 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 filters L19 and L20.

BUFFER AMPLIFIER CIRCUIT

The filtered 430MHz signals, supplied to the first gate of the dual-gate FET Q9, are amplified to approximately 10mW PEP. The output of this buffer amplifier is sent through the transmit band-pass filter L21 and L22 to the other buffer amplifier Q10, whose output level is approximately 200mW PEP, then sent to the PA unit.

POWER AMPLIFIER CIRCUIT

The signals from Q10 in the RF YGR unit are amplified by IC1 in the PA unit to obtain 10W PEP. The heat from IC1 is transmitted to the diecast heat sink which radiates the heat very efficiently. IC1 is a hybrid IC consisting of a three-stage RF power amplifier. The output signals of IC1 are fed to the antenna terminal through the T/R switching diode D1 and three-stage low-pass filter and a high-pass filter, which suppress harmonics by more than 60dB.

APC CIRCUIT

This circuit stabilizes the output power, even when the power voltage or the antenna load is fluctuating, and switches the output power 1 watt and 10 watts. The variation in the current of IC1 is detected at R4 in the PA unit and amplified by differential amplifier IC9 in the MAIN unit. The output voltage from Pin 7 of IC9 is fed to the first gate of Q4. This lowers input excitation level to the power amplifier module and reduces input power to the final stage, thus preventing damage to the module due to high current. The output power can be adjusted by R154 in normal power (10W), and by R153 in low power (1W) conditions.

CW BREAK-IN CIRCUIT

This circuit provides semi-break-in function in the CW mode. When the key is down, the base of Q25 goes ground level through D43, and Q25 is turned OFF, and Q24 is turned ON. The collector of Q24 is connected to the T/R switch control line and grounds it to switch in the transmit mode. When the key is up, after the time constant of C138 and R169, the base voltage of Q25 rises to turn Q25 ON, Q24 OFF, and the set is turned in the receive mode.

CW MONITOR CIRCUIT

Phase oscillator Q27 oscillates at approximately 800Hz. The positive line of the key jack is connected to the base of Q26 through R173. When the key is up, Q26 is ON and grounds the phase shift network to stop oscillation. When the positive line is grounded by keying, the base of Q26 is grounded and turned OFF, and the phase shift network works normally and Q27 oscillates CW side-tone. The oscillator signals are fed to Pin 1 of AF power amplifier IC10 through the level adjust resistor R180, C146 and R181.

METERING CIRCUIT

In the receive mode, the S/RF indicator functions as an S-meter. The source voltage of Q17 drops according to the AGC voltage applied to the second gate of each IF amplifier. The voltage is fed to a differential amplifier IC8 through R152, then fed to the indicator driver IC. R152 adjusts indicator's full scale.

In the FM mode, a part of the 2nd IF signals is fed to the IF amplifier IC7, rectified by D39 and D40, then fed to the indicator driver IC through the level adjust resistor R145.

In the transmit mode, the S/RF indicator functions as a relative RF power meter. A part of the RF power output is fed to D3 in the PA unit and rectified, then fed to the indicator driver IC through the level adjust resistor R216.

PLL (PHASE LOCKED LOOP) UNIT

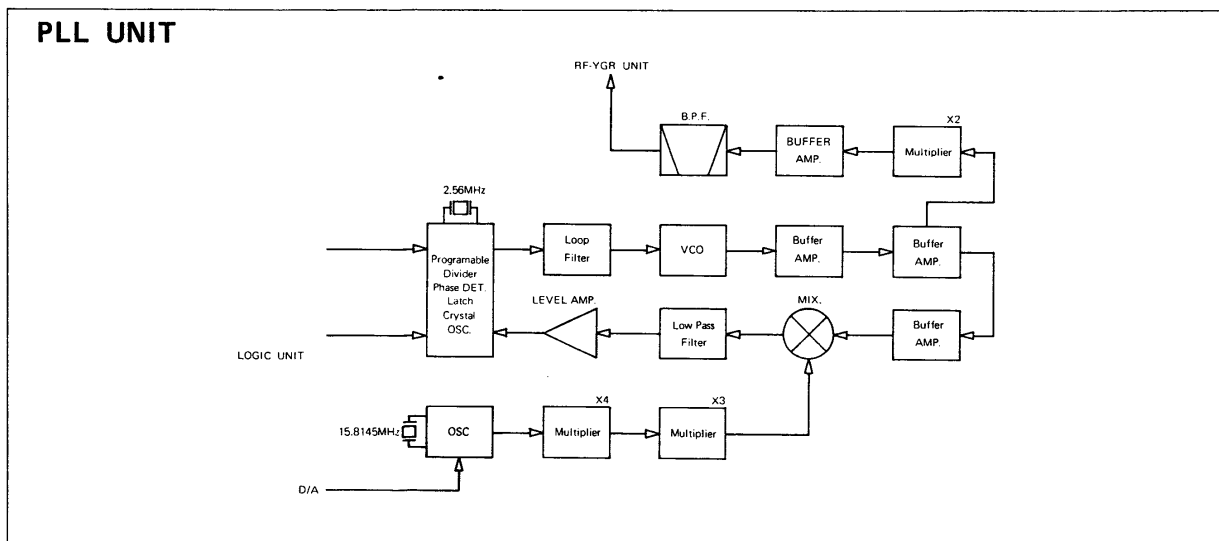
LOCAL OSCILLATOR CIRCUIT

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 Q2 oscillator, Q3 quadrupler and Q4 frequency tripler.

The crystal unit X1, a special VXO (Variable Xtal Oscillator) crystal, is connected to Q2's base and oscillates at about 15.8145MHz. The oscillating frequency is altered in 100Hz steps by the voltage supplied to the cathode of D7 from the D/A (Digital to Analog) converter. The 15MHz signal is quadrupled at Q3 and tripled at Q4, thus the local oscillator output between 189.775MHz and 189.77995MHz is obtained. The anode of D7 is connected to the RIT switch control Q1 and Q2 in the FSW board through the bias network R9 ~ R11.

When the set is in the transmit mode or the RIT is turned OFF, both Q1 and Q2 are turned ON and R11 is connected to ground through Q2. Thus a fixed voltage divided by R5, R6 and R7 is applied to D7.

When the set is in the receive mode and the RIT is turned ON, both Q1 and Q2 are turned OFF, and R11 is connected to the RIT control. A DC voltage from the RIT control is applied to D7, and the oscillating frequency will be shifted approximately $\pm 900\text{Hz}$.



MIXER, LOW-PASS FILTER, AND AMPLIFIER CIRCUIT

The output signals from the local oscillator circuit and the VCO signals are mixed by the MOS FET mixer Q6. 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 of IC1 by Q5. Then the signals are fed to Pin 12 of IC1 through C47.

PROGRAMMABLE DIVIDER CIRCUIT

The input signals at Pin 12 of the PLL IC, IC1, consists of programmable divider, reference frequency generator and phase detector, are divided by the BCD input signals at Pins 6 ~ 9 and its digit signals at Pins 2 ~ 5.

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:

DISPLAY FREQUENCY	CPU OUTPUT	DIVIDE NUMBER (N)
430.000MHz	1000	1107
430.010MHz	1001	1108
}	}	}
431.000MHz	1100	1207
}	}	}
432.000MHz	1200	1307
}	}	}
438.000MHz	1800	1907
}	}	}
439.000MHz	1900	2007
}	}	}
439.990MHz	1999	2106

REFERENCE FREQUENCY GENERATOR CIRCUIT

Reference frequency generator consists of a crystal oscillator and a highspeed divider. X2 oscillates at 2.56MHz, which is divided by 512. The 5KHz reference frequency is fed to phase detector. This 5KHz reference frequency decides the variation step of the PLL output frequency and the divide number N decides the PLL output frequency.

$$\text{PLL unit output freq.} = [\text{local oscillator freq. (MHz)} + 0.005\text{MHz (the reference freq.)} \times \text{N (divide number of programmable divider)}] \times 2$$

When the last two digits of the display frequency are changed from 0 to 9.9KHz, the local oscillator frequency is changed from 189.775 to 189.77995MHz. When the display frequency reaches 10.0 KHz, the local oscillator frequency is set back to 189.775 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 detects the phase difference of the pulse signals of the 5KHz reference frequency, and the output signal of the programmable divider, and proportionately puts out positive/negative pulse signals at Pin 16. Pin 18 is for detecting the lock failures and changes to ground level according to the phase difference of the two pulse signals.

The loop filter, consisting of R2, R43 and C86, and R1, C5, C6 and C16 in the VCO unit, converts the pulse signal from Pin 16 into a DC voltage and decides the response time of the whole loop. The output signals are fed to tuning diode D1 of the VCO unit as the control voltage for the VCO frequency set.

VCO UNIT

The VCO (Voltage-Controlled Oscillator) is a Clapp circuit, using Q1, and oscillates in the 190MHz 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, inserted in series with the oscillation coil.

The oscillator output is taken from the source of Q1, and fed to buffer amplifier Q2.

BUFFER AMPLIFIER CIRCUIT

The VCO output signals are fed to buffer amplifiers Q8. They are then fed to the second gate of the mixer Q6 through isolation buffer amplifier Q7 to get a DC-voltage to control the frequency of the VCO.

FREQUENCY MULTIPLIER CIRCUIT

The VCO output signals are a half of the first local oscillator frequency, thus the frequency multiplier Q9 multiplies it two times to obtain 400MHz first local oscillator frequency. They are fed to buffer amplifier Q10, and to the transmit and receiver mixers in the RF-YGR unit through high-pass filter consisting of L18, L19 and C70 ~ C74.

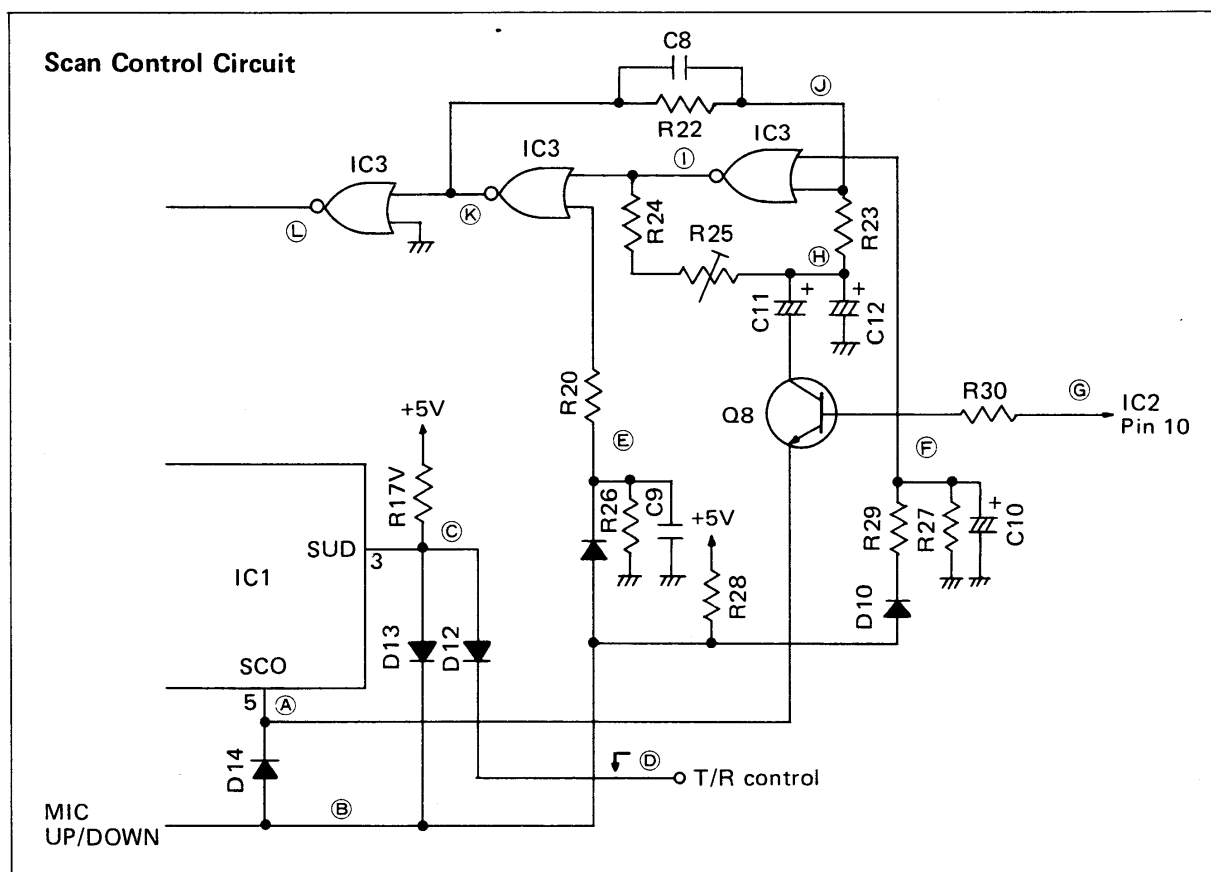
SENSOR UNIT

CLOCK PULSE GENERATE CIRCUIT

The input data for the microcomputer, is controlled by a custom-made LS type TTL IC, IC1.

The clock pulses are generated by a mechanical rotary-encoder which is connected directly to the shaft of the tuning control knob. The rotary-encoder puts out two signals which are 90 degree out of phase signals. These signals are fed to Pins 1 and 2 of IC1 through inverters.

SCAN and MIC UP/DOWN CONTROL CIRCUIT



The scan function is provided by pushing the scan Start/Stop (S/S) button. When pushed the S/S button, Pin 5 of IC1 is lowered to ground level, the voltage at ⑤ and ⑥ are also lowered, and the multivibrator, consisting of IC3, starts oscillation for scanning, and the decimal points of the frequency display will blink. When Pin 5 of IC1 is lowered, Pin 3 (UP/DOWN control terminal) is also lowered, but its voltage is still 1V ~ 2V, so the downward scanning is selected.

The oscillation frequency (scan speed) can be adjusted by R25. When a VFO is selected (in the programmed scan or full range scan function), the voltage at ⑦ is ground level, and Q8 is turned OFF. So the oscillation frequency is decided by C12 only and the frequency is higher and the scan speed is fast. When a memory channel is selected (in the memory scan function), a voltage is applied to ⑧, Q8 is turned ON and C11 is paralleled to C12. Thus the oscillation frequency is lowered and the scan speed is slow.

In the MIC UP/DOWN function (when using an UP/DOWN microphone IC-HM11), as the UP button on the microphone is depressed, the ⑨ point is grounded and the multivibrator starts oscillation. In this case, Pin 3 is grounded through D13 only and near ground level. Thus the upward scanning is selected. When the DOWN button is depressed the ⑨ point is grounded through a 470 ohms resistor installed inside the microphone. So the voltage divided by R17 and the 470 ohms resistor, is applied to Pin 3 and the downward scanning is selected.

LOGIC UNIT

CPU CONTROL CIRCUIT

The CPU in the unit is a 4-bit CPU and the input terminals are A0 ~ A3 and B0 ~ B3.

Since the CPU cannot make many functions with the small number of A and B input signals, to increase the functions of the CPU, scanning E output signals and decoded O0 ~ O7 signals by IC4, and are fed to A and B input terminals through the matrix circuit. The CPU reads the relationship of E output, and A and B input signals to decide the function as follows:

① **O0 → A0 (Clock)**

This flow occurs when the frequency is moved up or down with each pulse input by turning the tuning control knob or scanning.

② **O0 → A1 (Up/Down)**

This flow occurs when the frequency is moved up. When the frequency is moved down, the O0 signal is not fed to A1.

③ **O1 → A0 (LSB)**

This flow occurs when the MODE Switch is set at "LSB". When this happens, the display frequency is shifted +1.5KHz from the FM's one.

④ **O1 → A1 (USB)**

This flow occurs when the MODE Switch is set at "USB". When this happens, the display frequency is shifted -1.5KHz from the FM's one.

⑤ **O1 → A2 (CW)**

This flow occurs when the MODE Switch is set at "CW". When this happens, the display frequency is shifted -0.7KHz from the FM's one.

- ⑥ **O1 → A3 (FM)**
This flow occurs when the MODE Switch is set at "FM". The display shows the carrier frequency.
- ⑦ **O2 → A0 (Memory Channel 1)**
This flow occurs when the VFO/Memory Channel Switch is set at "1".
- ⑧ **O2 → A1 (Memory Channel 2)**
This flow occurs when the VFO/Memory Channel Switch is set at "2".
- ⑨ **O2 → A2 (Memory Channel 3)**
This flow occurs when the VFO/Memory Channel Switch is set at "3".
- ⑩ **O2 → A3 (Memory Channel 4)**
This flow occurs when the VFO/Memory Channel Switch is set at "4".
- ⑪ **O2 → A0, A1 (Memory Channel 5)**
This flow occurs when the CALLING CHANNEL Switch is pushed.
- ⑫ **O3 → A0 (VFO Select)**
This flow occurs when the VFO Switch is set in "B", and the unit operates at the frequency set by "B" VFO. When the VFO Switch is set in "A", the O3 signal is not fed to A0, and the unit operates at the frequency set by "A" VFO.
- ⑬ **O3 → A1 (Memory Read)**
This flow occurs when the VFO/MEMORY CHANNEL Switch is set in any memory position, and the unit operates at a memory channel set by the VFO/Memory Channel Switch. This function is prior to the function of ⑫.
- ⑭ **O4 → A1 (100Hz Steps)**
This flow occurs when the MODE Switch is set at "USB", "LSB" or "CW", and the operating frequency is moved up or down with 100Hz steps by turning the tuning control knob or scanning.
- ⑮ **O4 → A2 (5KHz Steps)**
This flow occurs when the MODE Switch is set at "FM2", and the operating frequency is moved up or down with 5KHz steps.
- ⑯ **O4 → A3 (10KHz Steps)**
When this flow occurs, the operating frequency is moved up or down with 10KHz steps. (This mode is not used for IC-490A/E.)
- ⑰ **O4 → A1, A2 (20KHz Steps)**
When this flow occurs, the operating frequency is moved up or down with 20KHz steps. (This mode is not used for IC-490A/E.)
- ⑱ **O4 → A0, A3 (25KHz Steps)**
This flow occurs when the MODE Switch is set at "FM1", and the operating frequency is moved up or down with 25KHz steps.

①9 (1KHz Steps)

When the 1KHz Steps Switch is pushed in, these flows (①4 ~ ①8) do not occur, and the operating frequency is moved up or down with 1KHz steps in any mode by turning the tuning control knob or scanning.

②0 O5 → A0 (+Duplex)

This flow occurs when the OFFSET Switch is set at "+DUP", and the transmit frequency becomes a frequency which is added the specified offset frequency to the receive frequency.

②1 O5 → A1 (-Duplex)

This flow occurs when the OFFSET Switch is set at "-DUP", and the transmit frequency becomes a frequency which is subtracted the specified offset frequency from the receive frequency.

②2 O5 → A3 (Duplex Check)

This flow occurs when the OFFSET Switch is set at "+DUP" or "-DUP" and during the MEMORY/VFO WRITE button is pushed, the receive frequency becomes a frequency which is added to the specified offset frequency or subtracted it from the original receive frequency.

NOTE: If the "+DUP" or "-DUP" frequency becomes out of the band, this frequency will remain at the original receive frequency.

②3 O6 → A0 (Offset Write)

This flow occurs when the MODE Switch is set at "OW" position, and the offset frequency can be reset by turning the tuning control knob.

②4 O6 → A1 (1MHz Up)

When this flow occurs, the 1MHz digit of operating frequency is moved up with 1MHz steps.

②5 O7 → A0 (Programmed Scan)

When this flow occurs, and the S/S button is depressed, the operating frequency scans between frequencies written into the Memory Channels 1 and 2. (Memory Channel 2 should be written higher frequency than Memory Channel 1, if not the scan function does not actuate.) When this flow does not occur and the S/S button is depressed, the operating frequency scans the entire band.

②6 O7 → A1 (Memory Scan)

When this flow occurs, the operating frequency scans on the memory channels and the VFO's A and B.

②7 O7 → A3 (Memory Write)

When a memory channel is selected and this flow occurs, a frequency of the VFO A is written into the selected memory channel.

When a VFO is selected and this flow occurs, a frequency of the other VFO is written into the selected VFO.

②8 O8 → A0 (Power ON)

This flow occurs when the POWER Switch is turned ON. When this flow does not occur, the CPU is in stand by condition.

NOTE: The port B is used to initialize the CPU when the power is turned ON.

②⑨ **O0 → B0, B1**

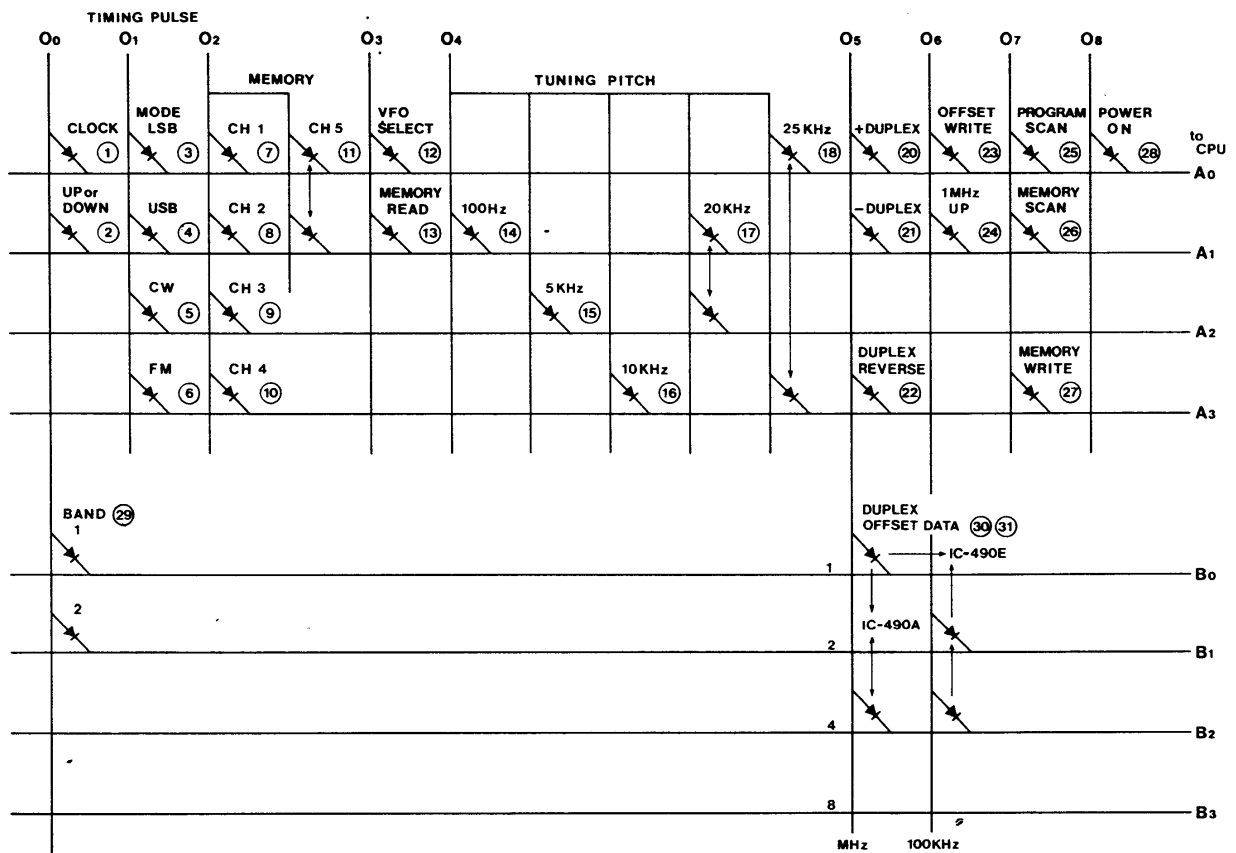
When this flow occurs, the operating frequency range is selected between 430.0000MHz and 433.9999MHz.

③⑩ **O5 → (B0, B1, B2, B3)**

When this flow occurs, the 1MHz digit of the offset frequency is preset. The digit is decided by a BCD code consisting of B0 ~ B3 (B0 = 1, B1 = 2, B2 = 4, B3 = 8).

③① **O6 → (B0, B1, B2, B3)**

When this flow occurs, the 100KHz digit of the offset frequency is preset. The digit is decided by a BCD code consisting of B0 ~ B3.



FREQUENCY CONTROL, DISPLAY AND I/O CIRCUIT

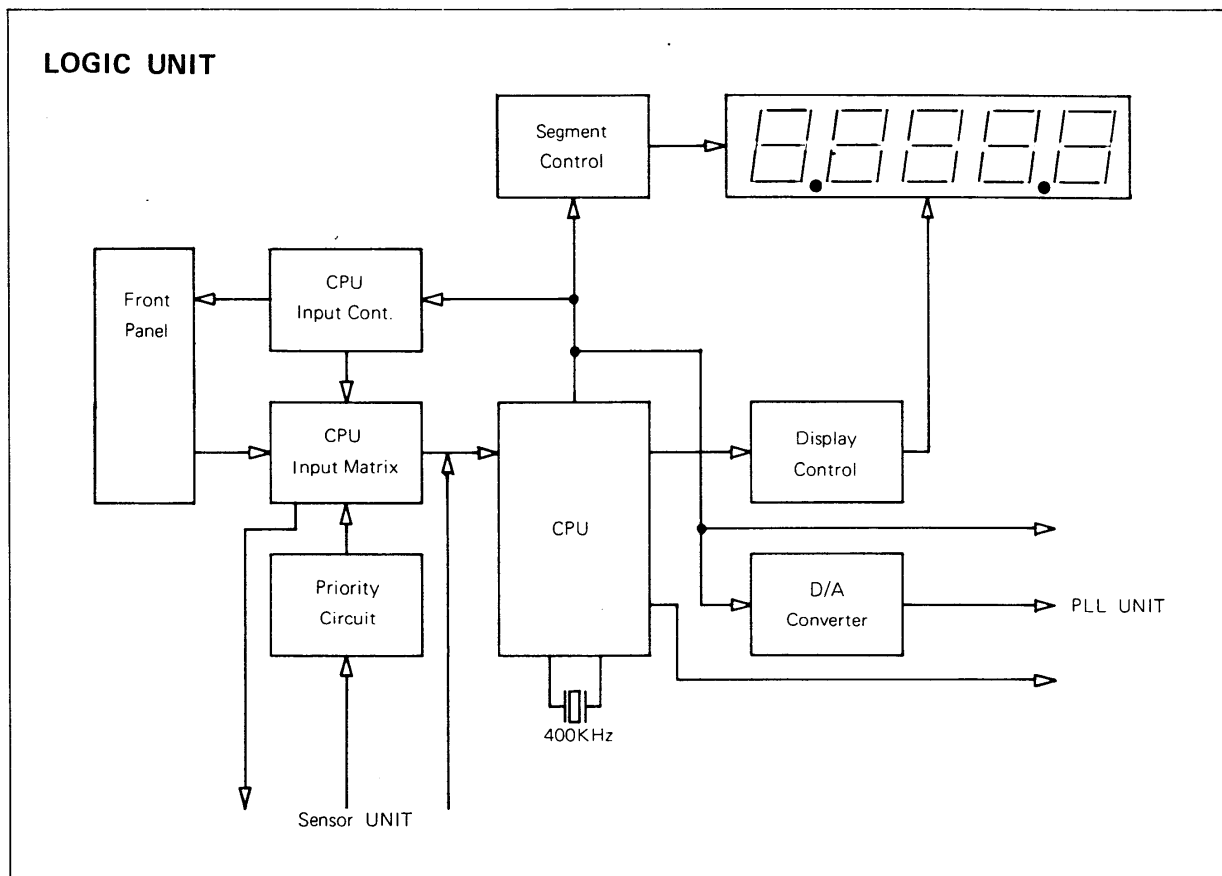
The dynamic lighting display functions with the 7-segment data output which are decoded by IC5 from BCD output at the E0 ~ E3 terminals of the CPU and the digit designation output signals at the F0 ~ F3 terminals. The two decimal points are illuminated with the current through scan blinking transistor Q10 in the sensor unit, only when the digit designation signals for the 1MHz and 1KHz order are put out. The E0 ~ E3 terminals are timeshared for the other data output. The E0 ~ E3 terminals also put out the divide number (N) for the PLL divider, and supplied to the CPU control circuit through IC4.

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 ~ 5, and the divide number (N) are programmed in each RAM area for the initial presetting.

Then, at the CPU output terminals E0 ~ E3, 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 D0 ~ D3 and the signals from G3 are latched as the strobe pulse in the Input/Output port IC8, of which the terminals A01 ~ B04 provide the VXO control data.

D/A (DIGITAL TO ANALOG) CONVERTER CIRCUIT

The signals from A01 ~ B04 of IC8 are supplied to R43 ~ R51 for D/A conversion. This D/A converted voltage is fed to the PLL unit and changes in steps to give 100Hz step variation to the VXO frequency.



SECTION VIII TROUBLE-SHOOTING

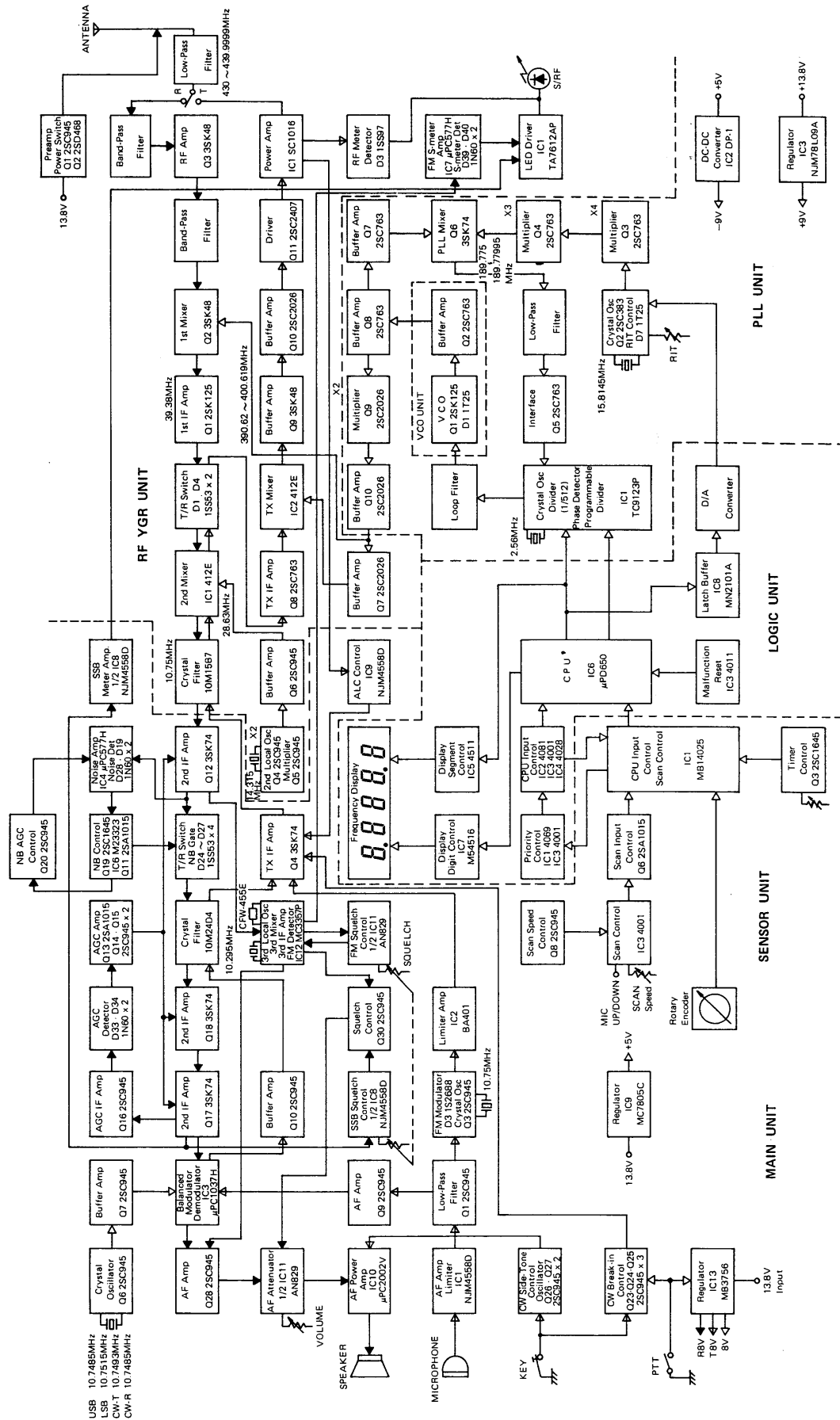
Your IC-490A/E has been tested very carefully at the factory before shipping. The chart below has been designed to help you correct any problems which are not equipment malfunctions. If you are not able to locate the problem and/or solve it through use of this chart, please contact your dealer or ICOM distributor for assistance.

Problem	Possible Cause	Solution
1. Power does not come ON when the switch is turned.	Power cord is improperly connected. Power cord is connected with the polarity reversed. Blown fuse.	Carefully reconnect power cord. Disconnect the power cord, replace the blown fuse, then reconnect the power cord observing proper polarity. Check for the cause, then replace the fuse with a new one.
2. No sound comes from the speaker.	VOLUME Control knob is completely counterclockwise, but not "clicked OFF". The unit is in the transmit mode, by the PTT Switch on the microphone. SQUELCH setting is turned too far clockwise. External speaker is in use. The internal speaker cable is not connected.	Turn the knob clockwise to a suitable level. Put the unit in the receive mode. Turn the SQUELCH control counterclockwise until noise can be heard and reset it just below the threshold. Check if the external speaker plug is inserted properly or if the external speaker cable is cut. Connect the speaker connection.
3. Sensitivity is low and only strong signals are audible.	The antenna feed line is cut or shorted.	Check the feed line and correct any improper condition.
4. Only incomprehensible voices are heard during SSB reception.	Receiving the wrong sideband. Receiving FM signals.	Set the MODE Switch to the sideband other than the one you are using, either USB or LSB. Set the MODE Switch to the FM position.

Problem	Possible Cause	Solution
5. No or low RF output.	<p>RF Power Switch is set at the Low position.</p> <p>PTT Switch is not functioning due to bad connection of the MIC connector.</p> <p>The antenna feeder is cut or shorted.</p> <p>When SSB or FM is desired, but the MODE Switch is in the CW position.</p>	<p>Set the RF Power Switch to the High (normal) position.</p> <p>Check the connection of the MIC connector and correct any problems.</p> <p>Check the antenna feeder and correct any problems.</p> <p>Set the MODE Switch to the USB, LSB or FM position.</p>
6. No modulation. (No RF output in SSB mode.)	<p>Bad connection of the MIC connector.</p> <p>The MIC cable is cut.</p>	<p>Check the connection of the MIC connector and correct any problems.</p> <p>Repair the disconnected or cut wire.</p>
7. The receive mode functions properly and your signals are transmitted, but you are unable to make contact with another station. (When desiring SIMPLEX mode.) (When desiring DUPLEX mode.)	<p>The OFFSET Switch is in the -DUP or +DUP position.</p> <p>The receive frequency is offset from the transmit frequency by the RIT control.</p> <p>The OFFSET Switch is in the "S" (Simplex) position.</p> <p>Improper frequency split or input/output frequency of the repeater.</p>	<p>Set the OFFSET Switch to "S" (Simplex) position.</p> <p>Turn OFF the RIT, or set the RIT control knob to the center (12 o'clock) position.</p> <p>Set the OFFSET Switch to the -DUP or +DUP position.</p> <p>Set the proper frequency split and turn the OFFSET Switch to the -DUP or +DUP position according to repeater input/output frequency.</p>
8. The memorized frequencies are lost and the display shows 1.000. when the power switch is turned ON.	<p>The main switch of the power source was turned OFF or the power plug was unplugged.</p> <p>The power failed (when using the AC power source).</p>	<p>Use the continuous operating power source or optional memory power source.</p>

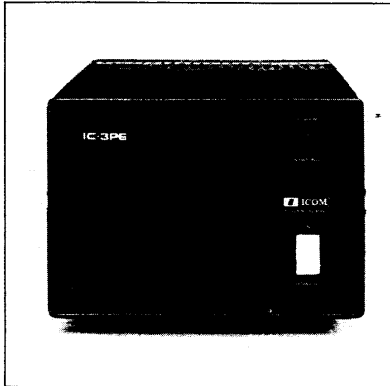
Problem	Possible Cause	Solution
<p>9. The memory scan operation does not function when the S/S Switch is pushed.</p>	<p>No frequency is programmed in the memory channels or the same frequency is programmed in all the memory channels.</p> <p>The VFO/MEMORY CHANNEL Switch is not in the Memory Channel position.</p>	<p>Program the required frequencies in the memory channels following the instructions for "MEMORY CHANNEL OPERATION" on page 16.</p> <p>Set the VFO/MEMORY CHANNEL Switch in the Memory Channel position.</p>
<p>10. The programmed scan operation does not function when the S/S Switch is pushed.</p>	<p>The same frequency is programmed in the memory channel 1 and 2, or the programmed frequency in the memory channel 1 is higher than the one in the channel 2.</p> <p>The VFO/MEMORY CHANNEL Switch is not in the VFO position.</p>	<p>Program the low edge frequency into the memory channel 1, and the high edge frequency into the memory channel 2.</p> <p>Set the VFO/MEMORY CHANNEL Switch in the VFO position.</p>
<p>11. The scan does not stop even if a signal is received.</p>	<p>The squelch has opened when the scan started.</p>	<p>Engage the squelch on a no-signal frequency, then start the scan by pushing the S/S Switch.</p>
<p>12. Unable to key when using an electronic keyer.</p>	<p>The Switching circuit of the electronic keyer does not close completely.</p> <p>Polarity of the connection wires from the keyer is reversed.</p> <p>The MODE Switch is not in the CW position.</p>	<p>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.</p> <p>Connect the keyer wires observing proper polarity.</p> <p>Place the MODE Switch in the CW position.</p>

SECTION IX BLOCK DIAGRAM

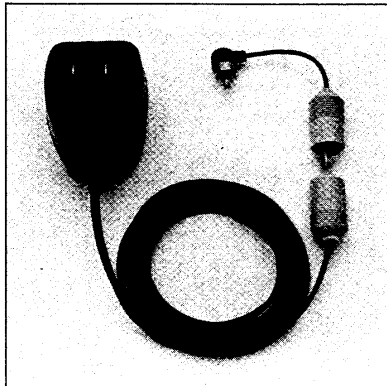


SECTION X OPTIONS

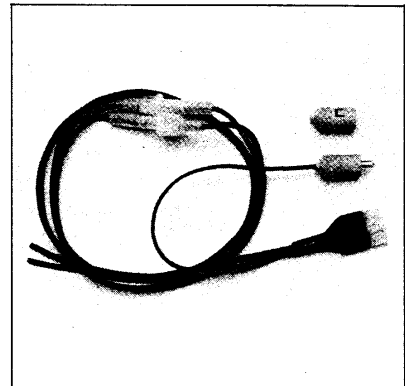
We have prepared a variety of options for the transceiver IC-490A/E in order to enlarge its use.



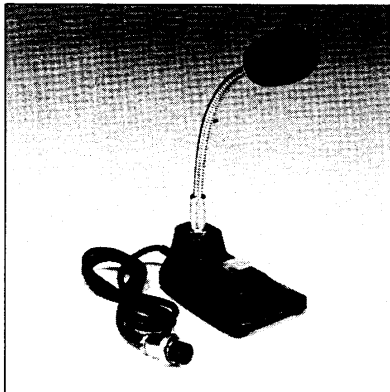
IC-3PE
AC POWER SUPPLY
13.8V 3A



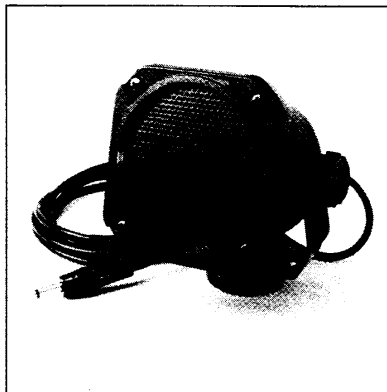
BC-10A
MEMORY BACKUP
AC POWER SUPPLY



IC-CK1
MEMORY BACKUP
DC POWER CORD



IC-SM5
ELECTRET CONDENSER TYPE
DESK MICROPHONE



IC-SP4
MOBILE SPEAKER



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