

IC-215

TRANSCEIVER
PORTABLE
2 METER FM

INSTRUCTION
MANUAL

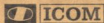


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FM Portable Transceiver

Small and light. Handy for use any time, whether outdoors, in a car or at home. With 3W output and a sensitive receiver, it can work as well as large transceivers when used in good locations or with high-performance antenna.

Aluminum Die-cast Frame

The IC-215 chassis and frame are integrated into an aluminum die-casting. It's light but resistant to vibration or shock when carried. High mechanical performance is ensured.

15 Channels

The unit incorporates 15 channels to select from; 12 by channel selector and 3 by Function switch. Each channel (TX and RX) uses the standard 20 series ICOM crystal configuration.

Dual Power Level

Transmitter output can be switched easily in 2 steps; 3W output HI for long distances, and 0.5W LOW for short distances. Battery consumption is minimized in the Low Power Mode.

Dial Illumination

The dial can be illuminated to facilitate night operation. This is controlled by a selector switch.

**Power Pilot Lamp**

If the power source voltage drops under the required value, the pilot lamp goes out as an indication the batteries are almost exhausted or external power is inadequate.

External Power and Antenna Terminals

For fixed stations or car mounted use, terminals for both external power and antenna are provided.

IC-20L and IC-3PS

Our ten-watt linear amplifier IC-20L and AC power IC-3PS can be used in combination as a completed fixed station.

SECTION II SPECIFICATIONS

GENERAL

Semiconductor	Transistor	36
	FET	3
	IC	2
	Diode	51
Frequency Range	146 - 148 MHz	
Power source voltage	13.8V $\pm$ 15%	
Impedence	50 ohm unbalanced	
Required current	Transmission HI:	approx. 750mA
	LOW:	approx. 350mA
	Reception with max. output:	270mA
	Squelched reception:	55mA
	Dial illumination:	approx. 40mA
Exterior dimensions	183mm(high) x 61mm(wide) x 162mm(deep)	
Weight	1.9 kg (including batteries)	

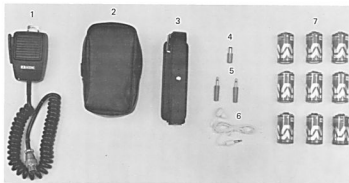
TRANSMISSION:

Transmitting frequency	15 channels in 146 MHz band
Emission	F3
Transmission power	HI : 3W
	LOW : 0.5W
Max. frequency deviation	5 KHz
Modulation system	Variable reactance phase modulation
Multiplication Factor	8 Times
Spurious radiation	-60dB below carrier
Microphone	500ohm dynamic microphone with push-to-talk switch

RECEPTION:

Receiving frequency	15 channels in the 146-148MHz
Modulation acceptance	16 F3
Reception system	Double super heterodyne
Intermediate frequency	First IF 10.7 MHz
	Second IF 455 MHz
20dB quieting sensitivity	Under -4dB
1ohm input S+N/N	Over 30dB S & N/N
Spurious attenuation	-60dB or less
Selectivity	$\pm$ 7.5KHz or less At the -6dB point
	$\pm$ 15KHz or less At the -6dB point
Squelch sensitivity	-8dB or less referenced to 1 microvolt
Audio output	1W or more (with 8 ohm load and 10% distortion)

SECTION III ACCESSORIES



- | | | | |
|-----------------------|---|--------------------------------|---|
| 1. Dynamic Microphone | 1 | 5. Ext. Speaker Plug, Key Plug | 2 |
| 2. Microphone Case | 1 | 6. Earphone | 1 |
| 3. Shoulder Strap | 1 | 7. Dry Cells Type "C" | 9 |
| 4. Power Supply Plug | | | |

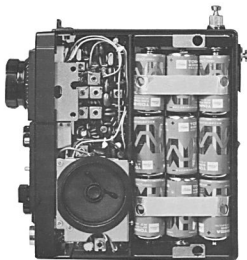
SECTION IV PRE-OPERATION

BATTERY INSTALLATION

Batteries are not installed in the unit. When you receive the unit, install the batteries (C size x 9) in the following manner. (Be sure to keep the power switch OFF). First pull the head of the snaps on the right side cover of the body to disengage the snaps and remove the cover from the body.

Insert top and bottom batteries to touch with contacts of the body. Be careful to maintain correct polarity. Next, by pushing the batteries toward the springs, insert more batteries in between. The cloth ribbon should be put under one battery to facilitate easy removal for replacement.

After inserting batteries, place the cover over the body without depressing the snaps, then push in the head of the snaps to lock the cover. To replace batteries, remove the cover and withdraw old batteries by pulling the battery ribbon. After replacement, attach the cover again.



WHEN TO REPLACE BATTERIES

When the power pilot lamp does not light up with the power switch on, or when it lights up during reception and goes out during transmission, the batteries are exhausted. Use batteries of the same type, for mixed types might cause leakage. Replace worn batteries with a complete new set of nine. If used with old batteries, the life of new ones might be shortened. Battery life is shortened more by transmitting than by receiving, since several times more current is drawn in transmit. To prolong battery life, therefore, practice as follows:

- * Try to minimize the transmit period.
- * Keep the transmission output **LOW** as much as possible.
- * Reduce volume during reception
- * Be sure to cut off power source when not used.

More working hours are available if high-performance batteries such as Alkaline type are employed.

EXTERNAL POWER PLUG CONNECTION

External Power Source

For use at home or in the car, please use the external power source which assures you of stable communication without concern about battery consumption.

1. Use either a regulated supply or car battery of 13.8V DC and of over 1A current capability. (Though this transceiver may work at 11 to 15 VDC, use it preferably at the rated voltage.)
2. Correctly connect the external supply plug, as shown in the figure. If polarity is reversed, source power is cut off by the protection circuit and the unit will not work.

3. When the transceiver is kept out of use for a prolonged period, when the unit is long operated by external power only, when the batteries are exhausted etc., remove the batteries to protect the unit from possible damage by battery leakage.
4. The outside electrode of the power plug is + (Positive). Be careful not to short the plug to the chassis frame, etc. When used in the car, don't short the plug to the car body or to the transceiver body itself, but connect it to the car battery through its special fuse (1A-2A).

FOR OUTDOOR USE

1. Insert the supplied batteries. (Refer to "How to insert batteries.")
2. Attach the supplied shoulder strap through the fixture of the body (as shown in the drawings).
3. Fully extend the whip antenna for operation, or install the rubber fley antenna. Keep the collapsable antenna depressed when the set is not in use so that it will not be damaged.

FOR USE IN THE CAR

1. Don't place the unit near the outlet of heaters, air-conditioners, etc.
2. Install the unit in a convenient place to avoid disrupting safe driving.
3. For the best power source, connect to the car battery through the special fuse (1A-2A).
4. Firmly ground to the car body if a mobile antenna (e.g. whip antenna) that requires grounding is used.

FOR FIXED USE

1. Don't install the unit in places exposed to rain, water splash, direct sunshine, dust, vibration, or heat.
2. Use a high performance external antenna as recommended. When doing this, be sure to depress the whip antenna into the body.
3. For fixed use, an external power source is more economical than batteries.
4. Use of the linear amplifier IC-20L and AC power source IC-3PS give excellent performance for fixed use.

HOW TO USE EXTERNAL ANTENNA

1. Select a high performance antenna (a multi-element beam or gain antenna) and set it up in the highest possible position. Tightly connect the antenna so that performance will not be affected by weather or vibration. The matching impedance is designed to be 50Ω.

SECTION V DESCRIPTION OF CONTROLS AND CONNECTIONS



1. Whip Antenna

A fully collapsible antenna for transmission and reception is built-in. For outdoor operation, fully extend this antenna. A flexible helical antenna can also be installed.

2. Power Pilot Lamp

Lights up when power source is on. Brightness varies according to source voltage to indicate battery condition.

3. Meter

Indicates received signal strength during reception, and output level during transmission.

4. Channel Indicator

Indicates operating channels by numbers 1 - 12.

5. Channel Selector

Selects frequencies for transmission and reception.

6. **Squelch**
Adjusts squelch operating point. Turning clockwise tightens squelch. With squelch set at point just beyond where no noise is heard when no signal is present, the transceiver is at the most sensitive squelch point.
7. **Light Switch**
With this switch turned on, the channel indicator and meter are illuminated for use at night.
8. **Power Change-over Switch**
HI makes transmission output 3W and LOW makes it 0.5W.
9. **Volume (VOL) Knob**
Regulates receiving volume. Turning it clockwise increases volume.
10. **External Speaker Jack (EXT SP)**
External speaker (8 ohm), earphone, etc. may be connected to this jack. This connection disables the internal speaker.
11. **Function Switch**
Turning it OFF cuts off the power. Turning it to DIAL enables operation at the frequency indicated by channel indicator. Turning to A B or C enables operation on your favorite frequencies not indicated by channel indicator.
12. **Microphone Plug Socket (MIC)**
Connect attached microphone to this socket. A "PUSH TO TALK" switch is provided on the microphone.
13. **Discriminator Meter Jack**
Remove rubber bushing and connect a zero center meter to this jack. Use a meter having about 1K internal resistance and $\pm 50 \mu\text{A}$ sensitivity.
14. **External Power Jack**
Polarity is positive on outside of plug. Inserting plug into this jack enables a change-over to recommended external power even with batteries installed.
15. **External Antenna Socket**
Connect on external antenna here. Impedance is 50 ohm. When external antenna is used, be sure to fully depress the built-in whip antenna.
16. **Cover Snaps**
To remove the covers, pull out on the snap heads and withdraw cover from body. To replace cover, place it over body with the snap heads out, then lock the cover by pushing in the heads.
17. **Shoulder Belt Fixture**
Attach the supplied shoulder belt to transceiver through this fixture.
18. **Microphone Hook**
The hand-held microphone may be placed here during reception or when the microphone is not used.

PREPARATIONS

Before turning on the power source, confirm as follows:

1. Make sure batteries are properly inserted.
When external power source is employed, make sure it is properly connected.
2. Make sure antenna is properly set.
When external antenna is employed, make sure whip antenna is depressed into the body and external antenna is firmly connected.
3. Make sure microphone is properly and tightly connected.

Set controls as follows:

- *Function switchOFF
- *Volume (VOL) knobFull counterclockwise
- *SquelchFull counterclockwise
- *Light switchOFF
- *Power change-over switchLOW

Set the channel selector to any channel which has crystals installed.

RECEPTION

Turn the function switch clockwise to ON; the power source pilot lamp then lights up to show the power is on. If the light switch is set to LIGHT, the channel indicator and meter are illuminated to facilitate night operation.

VOLUME

If the volume (VOL) knob is slowly turned clockwise, noise or sound can be heard. Set where adequate volume is obtained. The meter shows deflection according to the strength of the signal.

SQUELCH

Turn the squelch (SQL) slowly clockwise. Noise becomes inaudible just past the threshold point. If the control is set at this point, audio can be heard only when signals are present. In cases when squelch is unstable (mobile operation, weak signal etc), rotate the squelch knob clockwise for more stable operation.

TRANSMISSION

The MIC controls transmission with the PTT switch. You may select high or low power to suit your needs and observe that the meter deflection gives a relative indication of output.

ADDING MORE CHANNELS AND FREQUENCY ADJUSTMENT

To add channel frequencies, refer to the crystal placement guide instructions below.

1. The crystal oscillator is HC-25/U type which oscillates in the fundamental mode.

$$\text{Receiving crystal oscillator frequency} = \frac{\text{receiving frequency} - 10.7}{9} (\text{MHz})$$

$$\text{Transmitting crystal oscillator frequency} = \frac{\text{transmitting frequency}}{8} (\text{MHz})$$

2. To adjust by a frequency counter (capable of measuring 130 to 150 MHz), do as follows:
 - a) Receiving frequency adjustment:
Connect the frequency counter to J8 and adjust the RX trimmer so that the frequency reading is 10.7 MHz.
 - b) Transmitting frequency adjustment:
Short the frequency counter lead wire at the end and bring it close to the antenna connector to pick up the RF output. Adjust the TX trimmer to the desired frequency.

COMBINED USE OF LINEAR AMPLIFIER IC-20L AND AC POWER IC-3PS

IC-20L is a linear amplifier which amplifies the IC-215 output of 3W to up 10W. IC-3PS is an AC power source which serves also as a stand with IC-20L mounted inside and is designed to fully attain functions as a fixed transceiver when used in combination with the IC-215.



SECTION VI CIRCUIT DESCRIPTION

GENERAL

The IC-215 employs a dual conversion Superhetrodyne receiver. MOS, FET devices are used for RF amplification and First Mixer. The first IF is 10.7MHz with a monolithic crystal filter. The second IF is 455KHz with two cascaded ceramic filters. This system results in a very selective and sensitive receiver.

The transmitter section employs a quality audio amplifier using IDC (Instantaneous Deviation Control) technique and well-shaped pre-emphasis. The transmit frequency is derived from an 18MHz range crystal oscillator and phase modulation multiplied 8 times. Multiplier and amplifier circuits are designed and tuned for extremely low spurious and harmonic content.

RECEIVER

Antenna input or self contained antenna signals pass through switching diode D-40, located in the PA section to the RF amplifier Q2 from which the amplified signal is injected into gate 1 of the first mixer Q3. Out of band signals are attenuated by the band pass filters. The multiplied LO frequency is also applied to Q3 where a resultant 10.7MHz IF signal is derived. This signal is passed through a filter which greatly attenuates other in-band signals. The 10.7MHz signal is again mixed with second LO, Q8 operation at 11.155 MHz at mixer 2, Q4. The resulting mixer output is 455KHz. Two ceramic filters and Q5 and Q7 amplifiers drive IC-1 limiter, and thence the signal is detected by the ceramic discriminator.

Lower frequency audio components are amplified by Q10 and passed Q11 active filter. These (desired) audio signals are adjusted to level by the volume control and amplified up to 1 watt power by IC-2.

At point J-5, discriminator noise is taken at a selected level by R-1 Squelch Control back via J-4 and amplified by Q4 and Q5, rectified by D32 and D33 and applied to Q9 base. Under no signal conditions, when noise is high and this rectified voltage is high, Q9 turns off Q10. The reverse is true when a signal is of sufficient strength to reduce noise; the squelch opens permitting the audio signal path to operate normally.

During transmit, positive voltage is fed to the Q9 base, silencing the audio system.

After switching back to receive, a delay in Q9 base voltage change provided by C-56 allows a silent transition. The receiver first LO, Q1, operating near 15MHz is tripled by Q2 and again tripled by Q3 for first mixer injection.

Crystals are switched by diodes which, operating with DC bias, have no effect on the oscillator frequency when control wires are moved.

TRANSMITTER

An 18MHz crystal oscillator Q15 is buffered by Q16. A sample of the Q16 collector and emitter AC voltages (180° out of phase) are fed to the bridge of L5 and D37. Amplified audio from the microphone is applied to D37 also, resulting in a slight change which doubles Q17, Q18 and Q19. Each of these stages is double tuned to prevent spurious signals. Amplifiers Q20 and Q21 provide the last amplification to the 3 watt level. The microphone signal, divided by R72, is amplified by Q6 and Q7. The IDC circuit, Q8, Q9 and Q10 differentiate the level variations and via Q11 active filter limits higher frequency energy from coming through. R87 controls this deviation level. Q12 amplifier arrangement provides a Miller integrator by which the proper pre-emphasis is achieved. R96 sets maximum frequency deviation. Q13 is the output level control driver which is fed information from Q14 where a change in base voltage (via R109 for 3W and R110 for low power) provides Q13 control of driver Q20 and final Q21 collector voltage.

METER CIRCUIT

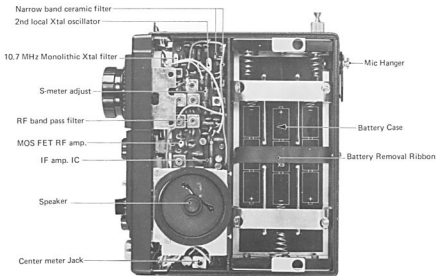
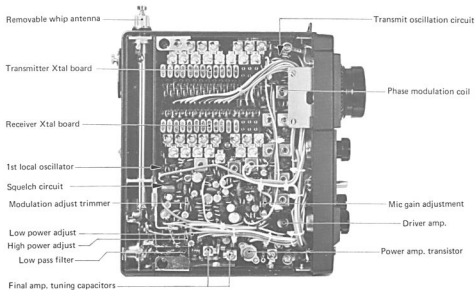
The S meter is provided a voltage by the sampling of the second IF Q7 collector which is rectified by D4. Calibration is effected by adjusting the gain of Q5 via R19. In the transmit mode, D39 is lightly coupled to L15 where a rectifier RF voltage is fed to the meter for a relative power indication. Adjustment is made via the degree of coupling of D39 with the L15.

T/R SWITCHING

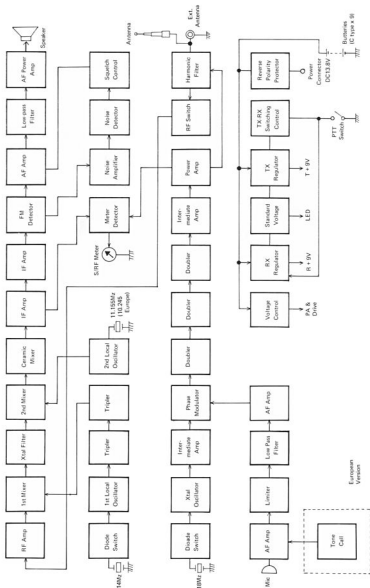
In the receive mode, source voltage is applied to R155, D44, D41 (Zener) and LED indicator D1. A reference voltage of approximately 9.4 volts appears at the cathode of D41. This reference is fed to Q24 base where a regulated voltage of 9 volts is available at its emitter.

During transmission, Q24 base is grounded through D43 by the PTT (MIC) switch which reduces receiver section voltage to zero. From the transmit regulator, current is passed through Q23, R146 and D42 to D41 and D1. The reference voltage at D41 cathode is applied to Q22 base. Then, a regulated 9 volts is available at Q22 emitter.

SECTION VII INSIDE VIEW



SECTION VIII BLOCK DIAGRAM





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