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SAFETY TRAINING INFORMATION



Your FM radio generates RF electromagnetic energy during transmit mode. This radio is designed for and classified as “Occupational Use Only”, meaning it must be used only during the course of employment by individuals aware of the hazards, and the ways to minimize such hazards.

This radio is **NOT** intended for use by the “General Population” in an uncontrolled environment.

This radio has been tested and complies with the FCC RF exposure limits for “Occupational Use Only.” In addition, your FM radio complies with the following Standards and Guidelines with regard to RF energy and electromagnetic energy levels and evaluation of such levels for exposure to humans:

- FCC OET Bulletin 65 Edition 97-01 Supplement C, Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
- American National Standards Institute (C95.1 – 1992), IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
- American National Standards Institute (C95.3 – 1992), IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.



**Restricted to occupational use to satisfy
FCC RF energy exposure limits.
See user manual for awareness and
control info.**

- **DO NOT** operate the radio without a proper antenna attached, as this may damage the radio and may also cause you to exceed FCC RF exposure limits. A proper antenna is the antenna supplied with,

this radio by the manufacturer or an antenna specifically authorized by the manufacturer for use with this radio.

- **DO NOT** transmit for more than 50% of total radio use time (“50% duty cycle”). Transmitting more than 50% of the time can cause FCC RF exposure compliance requirements to be exceeded. The radio is transmitting when the “TX indicator” lights red. You can cause the radio to transmit by pressing the “PTT” switch.
- **ALWAYS use** Icom authorized accessories (antennas, batteries, belt clips, speaker/mics, etc). Use of unauthorized accessories can cause the FCC RF exposure compliance requirements to be exceeded.
- **ALWAYS keep** the antenna at least 2.5cm (1 inch) away from the body when transmitting and only use the belt-clips which supplied when attaching the radio to your belt, etc., to ensure FCC RF exposure compliance requirements are not exceeded. To provide the recipients of your transmission the best sound quality, hold the antenna at least 5 cm (2 inches) from mouth, and slightly off to one side.

The information listed above provides the user with the information needed to make him or her aware of RF exposure, and what to do to assure that this radio operates within the FCC RF exposure limits of this radio.

Electromagnetic Interference/Compatibility

During transmissions, your Icom radio generates RF energy that can possibly cause interference with other devices or systems. To avoid such interference, turn off the radio in areas where signs are posted to do so. **DO NOT** operate the transmitter in areas that are sensitive to electromagnetic radiation such as hospitals, aircraft, and blasting sites.

1. Introduction

IP 400 has a compact size with a various features in the range of 405~490MHz. IP 400

Has a various features shown as below.

IP 400 constructed with a microprocessor controlled, temperature compensated Phase Locked Loop(PLL) frequency synthesizer. The radio features a double conversion receiver and a direct FM transmitter modulator. A special integrated circuit provides support to sub-audible signaling(CTCSS & DCS) and most of the receiving parts are switched off periodically in the power save mode to reduce battery current drain during standby.

2. Description of Unit

	Items	Model
Supplied Package	Radio	IP 400
	Antenna	IA-444
	1700mAh Li-Ion battery pack	BL 1700
	Desktop rapid charger	IC-170
	Adaptor	
	User manual	

	Items	Model
Accessories	External / Speaker Microphone	ES-1
	Earpiece Microphone	EP-1
	Earpiece VOX Microphone	EV-1
	VOX & PTT Headset	VP-1

3. Technical Specifications

3-1 General

- 1) Frequency range : 405~490 MHz
- 2) Channels : 255 Channels
- 3) Channel spacing : 12.5 kHz/25 kHz
- 4) Communication method : Simplex
- 5) Antenna Impedance : 50 ohm
- 6) Antenna : Whip Antenna
- 7) Power supply voltage : LI-1700mAh Li-Ion battery pack(Voltage: 7.5V DC)
- 8) Current Drain :

When Transmitting(4W)	-	< 2A
When Receiving(0.5W)	-	< 300mA
Transmit standby	-	< 60mA
Receiver standby(PSC MODE)	-	< 50mA
- 9) Microphone : Internal Condenser Microphone(External Speaker Micro phone is available)
- 10) Operating temperature range: -30 +60
- 11) Size : 56(W)x100(H)x34(D)
- 12) Weight : 285g

3-2 Transmitter

- 1) Power Output : HIGH – 4 W, LOW - 1W
- 2) Modulation : 8K5F3E/16K0F3E
- 3) Oscillator method : PLL
- 4) Frequency Stability : less than $\pm 0.00025\%$ (± 2.5 PPM)
- 5) Maximum frequency deviation: ± 2.5 kHz(Narrow)/ ± 5 kHz(Wide)
- 6) Audio Distortion : less than 5% (1 kHz 60%)
- 7) SPURIOUS Emission : -36 [dBm]
- 8) FM Hum & Noise : -40 [dB] (HP8920A 300Hz 3kHz BPF)
- 9) BAND SPREAD : 85 [MHz]

3-3 Receiver

- | | | |
|----------------------------------|---|---------------------------------|
| 1) Receiver Type | : | Double Super Hetero type |
| 2) Sensitivity | : | -0.25 μ V (12dB SINAD) |
| 3) Frequency Stability | : | \pm 0.00025%(\pm 2.5PPM) |
| 4) SPURIOUS Rejection | : | -70 dB |
| 5) Adjacent Channel Selectivity: | | -60 dB (Narrow) , -70 dB (Wide) |
| 6) Distortion | : | 5% (1 kHz 60%) |
| 7) Hum & Noise | : | -40 dB(HP8920A 300Hz 3kHz BPF) |
| 8) Audio output | : | 1000 mW |
| 9) BAND SPREAD | : | 85MHz |
| 10) Speaker size | : | 45 pi |

4. Theory of Operation

EXTERNAL VIEW



4-1 Features & Operation

1. Monitor

Press the Monitor key momentarily to disable the Tone squelch.

2. Radio Call

By using Various 5Tone, individual / Group call is available.

16 Receiving codes are available as well as open call.

3. Missed calls list

16 Missed calls can be listed. If a call remains unanswered, the call will be stored by the radio.

4. contact list

During a call, the contact list may be used to give access to up to 16 preprogrammed numbers accessed via the menu.

5. status list

A status is a code for transmitting prearranged messages, e.g. status "05" may indicate "launch". Status list contains up to 30 entries.

6. Channel : 255 channel

7. Scan ON/off

8. Power level : Power level is adjustable in each channel respectively.

9. Talkaround on/off

10. Emergency :

11. Lone Worker

12. Tx Tone select : In the menu, tx dcs /ctcss tone is adjustable.

13. Rx Tone select : In the menu, rx dcs /ctcss tone is adjustable.

14. Group : Defines group tone. You can select tone code for group, and it is used as a default value . 0~9 and a, b, c, d available. And "A" is used as a basic value..

15. BEEP ON/OFF : BEEP sound ON/OFF.

16. KEY LOCK : LOCK/UNLOCK Button KEY.

17. SQUELCH : Squelch level is adjustable

18. AUTO SQUELCH : Squelch level is adjustable automatically by surroundings.

19. DTMF ON/OFF : DTMF function is available.

20. VOX : VOX LEVEL is adjustable by pushing up and down button.

21. AUTO VOX : VOX level is adjustable automatically by surroundings.

22. P - SCAN : Priority Scan

23. POWER SAVE : Power save mode is available.

24. PASS WORD : This function is useful for security reason.

25. LOCATION INDICATE : Indicate where the radio is located by blinking green light every 7 seconds.

26. SCRMABLE : Internal Voice Scrambler is available.

27. STUN / UNSTUN : For added security and to avoid abuse of the radio system in which you operate a feature known as Stun/Unstun is included in your radio.

28. BACKLIGHT : Lamp is lighting when you check LCD status.

4-2 LCD Display and Icons



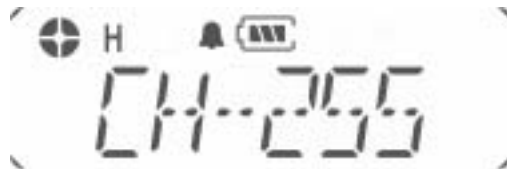
1. ANT GAZE ; Shows the received signal strength.
2. TX POWER HIGH: Indicate power level
3. KEY LOCK: Appears during key lock function is ON.
4. ALART(BEEP) ON/OFF: Appears when beep sound is turned ON.
5. Battery level indicator: Indicates reaming battery power.
6. VOX ON/OFF: Appears when VOX function is turned On.
7. SCAN: Appears when Scan function is activated.
8. SCRAMBLE: Appears while the voice scrambler function is activated.
9. TALK AROUND Indicator.

4-3 Features

1. Channel


This radio offers up to 255 channels

- 1). By using   button, you can select the desired channel.







2. Missed calls list

Up to 16 calls can be stored. If the same radio calls more than once, only the most recent call is stored. When fifteen calls have been stored by the radio, depending on the radio programming the sixteenth call received may overwrite the first or not be stored by the radio.









- 1).  to enter Menu Mode.

2) Display shows










- 3)  to select
- 4)  or  to scroll list
- 5)  to exit

3. Contact list









- 1)  to enter Menu Mode.
- 2)  or  to until 
- 3)  to select
- 4)  or  to scroll list
- 5)  to exit

4. Status call list








4-1. Making STATUS call

- 1)  to enter Menu Mode.
- 2)  or  to until 
- 3)  to select
- 4)  or  to scroll list
- 5) Push PTT KEY for sending message on the LCD.









4-2 Make STATUS Message

- 1)  to enter Menu Mode.
- 2)  or  to until 
- 3)  to select
- 4)  or  to scroll list
- 5)  to SELECT

5. Lone work




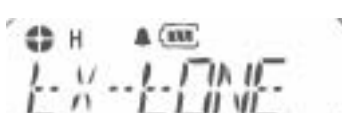




- 1)  to enter Menu Mode.
- 2)  or  to until 
- 3)  to select
- 4)  or  to select ON/OFF

6. Tx power

- 1)  to enter Menu Mode.
- 2)  or  to until 
- 3)  to select
- 4)  or  to select HIGH / LOW POWER
- 5)  to select









7. Tx Tone

Selecting Transmitting TONE(CTCSS/DCS).

- 1)  to enter Menu Mode.
 - 2)  or  to until 
 - 3)  to select
 - 4)  or  to Select TONE either CTCSS or DCS.
- 0= NON TONE
 1-38 CTCSS
 101 – 183 DCS TONE
- 5)  to select exit









8. Rx Tone

Changing Receiving TONE(CTCSS/DCS).









- 1)  to enter Menu Mode.
- 2)  or  to until .
- 3)  to select
- 4)  or  to select TONE either CTCSS or DCS.
 0= NON TONE
 1-38 CTCSS
 101 – 183 DCS TONE.
- 5)  to select exit

9. Group




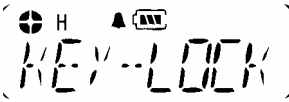




Changing GROUP Tone.

- 1)  to enter Menu Mode.
- 2)  or  to until .
- 3)  to select
- 4)  or  to select scroll list
- 5)  to select exit

10. Beep on/off









- 1)  to enter Menu Mode.
- 2)  or  to until .
- 3)  to select
- 4)  or  to select on off .
- 5)  to select

11. Key lock









- 1)  to enter Menu Mode.
- 2)  or  to until 
- 3)  to select
- 4)  or  to select key lock /unlock.
- 5)  to select

12. Squelch level






16 level is available. 0 = terminate sq function

- 1)  to enter Menu Mode.
- 2)  or  to until 
- 3)  to select
- 4)  or  to the scroll list
- 5)  to select exit

13. Auto Squelch


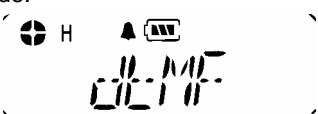


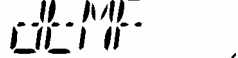




- 1)  to enter Menu Mode.
- 2)  or  to until 
- 3)  to select
- 4)  or  to select on /off .
- 5)  to select

14. Scan





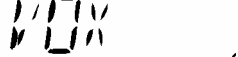




- 1)  to enter Menu Mode.
- 2)  or  to until 
- 3)  to scan.

4) Push PTT for exit

15. DTMF





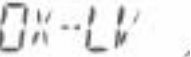




- 1).  to enter Menu Mode. 
- 2).  or  to until 
- 3).  to select
- 4).  or  to select ON /OFF.
- 5).  to select

16. Vox on/off









- 1).  to enter Menu Mode. 
- 2).  or  to until 
- 3).  to select
- 4).  or  to select ON /OFF.
- 5).  to select

17. Vox Level









16 level is available..

- 1).  to enter Menu Mode. 
- 2).  or  to until 
- 3).  to select
- 4).  or  to scroll list
- 5).  to select for exit









18. Auto Vox

- 1).  to enter Menu Mode.
- 2).  or  to until .
- 3).  to select
- 4).  or  to select ON /OFF.
- 5).  to select


19. Priority Scan




- 1).  to enter Menu Mode.
- 2).  or  to until .
- 3).  to select
- 4).  or  to select ON /OFF.
- 5).  to select

20. Priority scan CH



- 1).  to enter Menu Mode.
- 2).  or  to until .
- 3).  to select
- 4).  or  to scroll list
- 5).  to select for exit

21. Power save

1).  to enter Menu Mode.

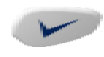
2).  or  to until 

3).  to select

4).  or  to select ON /OFF.



5).  to select

22. Talkaround

1).  to enter Menu Mode.

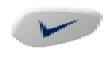
2).  or  to until 

3).  to select

4).  or  to select ON /OFF.



5).  to select

23. Password

1).  to enter Menu Mode.









2).  or  to until 

3).  to select

4).  or  to select ON /OFF.









5).  to select

24. Password CH









- 1).  to enter Menu Mode.
- 2).  or  to until 
- 3).  to select
- 4) ---- will display on the LCD(enter old password)
 or  by pushing up and down KEY to change password.
 by pushing enter KEY to change digit of password.
- 5) Enter new password by 4 digit.

25. Location


Indicate where the radio is located by blinking green light every 7 seconds.



- 1).  to enter Menu Mode.
- 2).  or  to until 
- 3).  to select
- 4).  or  to select ON /OFF.
- 5).  to select

26. Scramble

- 1).  to enter Menu Mode.
- 2).  or  to until 
- 3).  to select
- 4).  or  to select ON /OFF.
- 5).  to select

27. Status call Send

1).  to enter Menu Mode.

2).  or  to until



3).  to select

4).  or  to select ON /OFF.

5).  to select

5. Circuit Description.

5-1 Transmitter

1) MIC AMP Circuit

Voice signal from the microphone are applied to microphone amplifier U303. U303 contains a low-pass filter that has a 6dB/oct response between 300Hz and 3kHz and eliminate above 3kHz. The pre-emphasized audio signal is applied to VR302 to adjust maximum frequency deviation.

2) VCO circuit

The transmit frequency is directly generated by the Colpitts oscillation circuit contains Q402,Q403.

3) POWER AMP

Signals from Q202, Q206 is supplied through antenna switch Q203,Q204 to a low-pass filter made up and then applied to Antenna Jack.

5-2 Receiver

1) LOWPASS FILTER and Antenna switching circuit.

Signals from antenna connector fed to the antenna switching circuit through the low pass filter consisting of L212~214. In receiving mode, D204, D202 is turned off, isolates the antenna from the transmitter circuit and matching circuitry, so that the incoming signals are fed to the RF amplifier through L211.

2) RF AMP Circuit

The signals from the switching circuit are fed to the RF amplifier Q101 through a band pass filter made up of molded coil, vvc diode and capacitor.

3) MIXER Circuit

The amplified signals are fed to Gate 1 of the first mixer Q102. First local oscillator signal is supplied to Gate 2 of Q102 from the PLL circuit to convert the RF signals into 21.4MHz first IF signal.

4) IF Circuit

The first signals from Q102 are fed to the matched pair crystal filter FL101, then IF signals are amplified in Q103. And those signals are fed to U101 which is composed of the second local oscillator, second local oscillator, second mixer, limiter amplifier, quadrature detector and active filter circuit. The second local oscillator at 20.945MHz with X 101 and is fed to the second mixer with the first IF signals to convert into 455kHz second IF signals.

5) Audio and squelch Circuit

The detected audio signals are put through a 6dB/oct de-emphasis circuit made up of Q602.

The signal is then applied to audio power amplifier U603 to obtain enough power to driver the speaker.

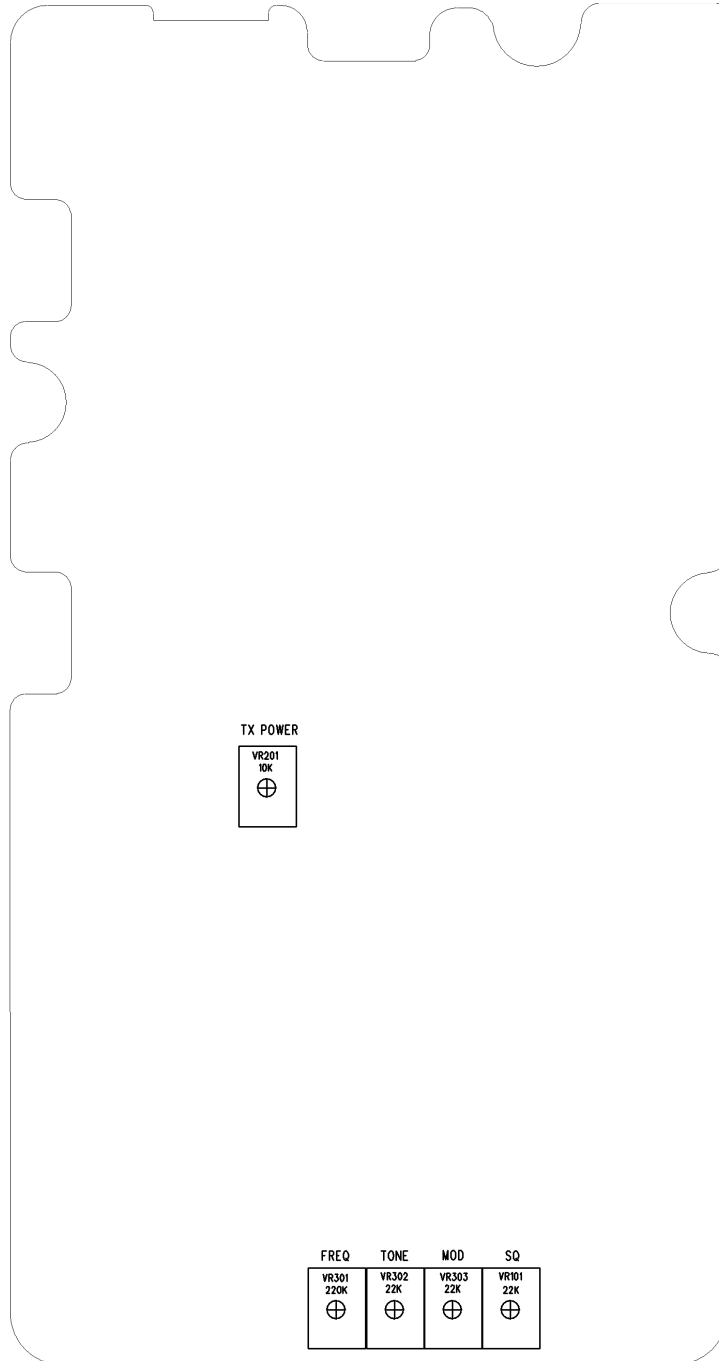
Part of the recovered noise signal is fed to the integrated operational amplifier inside U101 which makes up an low pass filter. The sensitivity of squelch is adjusted by VR 101.

5-3 VCO Circuit

The transmit / receive frequency is directly generated by the Colpitts oscillation circuit contains Q402, Q405.

6. Alignment

6-1 Alignment point



6-2 Voltage Check

- 1) Set up the radio frequency to (405.025[Mhz]) then measure whether R/Tx voltage is over 0.8[V].
- 2) Set up the radio frequency (489.975[Mhz]) then measure whether R/Tx voltage is under 5[V].
- 3) When Un-Lock is display on LCD means defective goods.

6-3 Transmitter

- 1) At the frequency range of (446.025[MHz]), set up Tx mode then adjust frequency by using VR 301 at the level of ± 150 [Hz]. High power should be 3~4.6[W]. In case of out of this range, you can check whether current is under 2A then adjust at the level of 3.8W by using VR501.
Low power should be 1[W] ± 0.2 [W]. In case of out of range, you can adjust it by using VR502.
FM DEVIATION should be adjusted at the level of 2.1[khz] ± 0.1 [khz] by using VR303.
Low frequency input is 1[kHz],50[mV].
- 2) After you set up MOD at the frequency range of (446.025[MHz]), adjust TONE DEVIATION by using VR 302 at the level of 0.45[kHz] ± 0.05 [zH] .

6-4 Receiver,

Set up Receiving Mode at (SSG -60d[Bm]). At the frequency range of 446.025[MHz], FM 1.5[kHz], adjust Volume at (0.5[W]). Sensitivity at the level of 12[dB] SINAD, check whether it is under -119[dBm]., and SQ(LEVEL8) is between -117[dBm] ~ -123[dBm] by using VR101. In case of out of range, adjust it at 120[dBm].

6-5 Wideband specification check

At the frequency range of (446.025[MHz]), you have to check whether FM DEVIATION should be (3.6 ~ 4.8[kHz]), in case of 1G-4(446.025[MHz]), TONE DEVIATION should be (0.5~1.2[KHz]). Also, you have to check whether in case of 1G-2(446.025[MHz]), sensitivity should be (12[dB] SINAD, -119[dBm]). SQ sensitivity is between -116[dBm] and -124[dBm]

6-6 FINAL(QC) Inspect specification

- 1) 456.025[MHz] Narrow
 - a. Frequency : ± 300 [Hz]
 - b. Output power(L/H) : 0.7 ~ 1.2[W] / 3 ~ 4.6[W]
 - c. FM DEVIATION(Narrow) : 1.8 ~ 2.5[kHz](1[kHz], 50[mV])
 - d. TONE DEVIATION : 0.3 ~ 0.6[kHz]
 - e. Sensitivity : < -117[dBm]
 - f. SQ Sensitivity : -116[dBm] ~ -124[dBm](
- 2) 456.025[MHz] Wide band
 - a. FM DEVIATION(Wide band) : 3.8 ~ 5.0[kHz](1[kHz], 50[mV])
 - b. TONE DEVIATION : 0.5 ~ 1.2[kHz]
 - c. Sensitivity : < -117[dBm]
 - d. SQ Sensitivity : -116[dBm] ~ -124[dBm]