

THEORY OF OPERATION

PJ-318 US Version

7 September, 2000

This FRS transceiver provides accurate and stable operation.

The basic functions consist of 10 main sections:

- Power
- Receiver Stage
- Squelch Control
- Transmit Stage
- VCO and PLL
- Micro-controller
- CTCSS(QUIET)
- CALL
- VOX
- INTERCOM

Power

The unit is powered with 4.5V (3×AAA type) Alkaline battery. The power is spread into four sections.

1. The power for the low battery detect circuitry. This circuit is used to detect the battery capacity and turn on the Lo battery icon accordingly.
2. The power for the RF-power amplifier.
3. The power for the Audio amplifier section.
4. 4.5 V battery voltage is regulated to 2.8V by IC8 RN5RZ28A for the VCO & PLL power, CPU power, TX and RX power control circuitry. Q15 FMA5A compose as a power switch for VCO and TX. They are controlled by VCO and TX CTL from CPU. Q1 compose as a power switch for Rx and VOX. They are controlled by Rx and VOX CTL from CPU. For power saving purpose, Q15 and Q1 are turned on and off in a ratio of 1:3, that is 250 msec on and 750 msec off.

Receive Stage

RF signal is received through the antenna and is passed onto a low pass filter network and amplified by Q5. This allows only the required band signal to pass through to the band pass filter (BPF). The mixer Q6 converts the incoming signal down to 21.7MHz. This signal again passes to a 21.7MHz XTAL band pass filter F1. This gives a better channel selectivity. The selected 21.7MHz signal is amplified by IF amplifier Q4 before it is passed to the second converter IC2 MC3361. IC2 MC3361 is the second converter with a 21.25MHz local oscillator. This converts the 21.7MHz signal down to 450KHz. This 450KHz signal is sent to discriminator. The detected audio signal passes through Audio Amplifier, Audio Filter and volume control which are included in IC 6 CMX808, and then to the speaker.

Squelch Control

Squelch control circuitry consists of IC2 MC3361 and its related circuit. The squelch signal output from IC2 pin 9 pass

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through filter amplifier circuit composed by pin 10 and pin 11. The signal is amplified and detected by IC2 and generate a control voltage at pin 13 of IC2 for CPU to detect. VR1 is used to control the threshold of the squelch (squelch sensitivity). Pin 13 of IC2 is output a Hi to MCU IC5 pin 50 to indicate an incoming signal is detected.

Transmit Stage

When the PTT switch goes down, the transceiver is switched into transmit mode through the TX/RX exchange control. TX/2.8V of Q15 is turned on for the power to the transmitter. The voice is picked up by the condenser MIC and is amplified by IC4:4 NJM3403 MIC amplifier circuit. The signal modulates with the carrier in the form of FM modulation. The modulated signal from the VCO goes into the power amplifier unit which consists of a buffer amplifier Q7/B, a driver amplifier Q7/A and the RF power amplifier Q2. The signal then is finally radiated out through antenna.

VCO and PLL

PLL circuitry is composed of IC3 M64082 the high frequency PLL and VCO. The channel information from the CPU is sent to the shift register in IC3 from pin 2. A control voltage is generated through the low pass filter to the VCO from pin 8 and is used to control RF frequency from Q3. Q10 is the RX/TX exchange switch. RF signal from the VCO passes through the buffer amplifier Q9 and then is fed into PLL IC3. In receive mode, the signal is fed to the receiver first mixer Q6 to convert the received signal to 21.7MHz. In transmit mode, this signal modulations with the audio signal and is passed through to the transmit power amplifier unit for transmission.

Microcontroller

The Microcontroller UPD789405 is the main control of the whole transceiver unit. It is also used to drive the LCD to show the status of the unit. On the LCD, there is current working channel display, transmit indication, receive indication, CTCSS indication, and low battery indication. The MCU scans the keypad to detect key pressed and released, then execute the function accordingly.

CTCSS(QUIET)

The CTCSS consists of transmit and receive section, in CTCSS transmit, a CTCSS signal generated by IC6 CMX808 pin 18 is added to the audio and modulated for transmission. The receive section consists of a CTCSS decoder circuit which is used to separate the audio signal and a CTCSS signal for the existence of a CTCSS signal. The CTCSS signal is filtered and detected by IC6 CMX808. Then the CPU UPD789405 will determine whether the CTCSS signal is received.

CALL

When the CALL button is pressed, the transceiver is switched into transmit mode through the CPU control. IC5 UPD789405 generates a ringer audio signal. This 800/1200Hz signal is modulated for transmission.

VOX

The VOX function is enabled by pressing MONI+VOX, when the VOX works. The audio signal is amplified and filtered by IC4 NJM3403. The amplified signal is detected through a peak detector and is transferred to DC level that can be detected by MCU, when the DC level matches with the setting level. The MCU then switches the unit into TX mode. MCU will continually monitor the VOX input when the DC level from peak detector is under the setting level the MCU will terminate the TX mode and return to RX mode in a delay of 2sec. The VOX sensitivity can be adjusted by selecting one of 1(low), 2(middle), 3(high) for environment condition.

INTERCOM

The audio signal from microphone is amplified by Q19 when intercom works, then is amplified once by IC1 NJM2070 to the speaker.

ALIGNMENT PROCEDURES

Important: The FCC requires that any frequency adjustment on a radiophone must be done by authorized person, who is the holder of a current first or second class radiotelephone license.

This unit has been fully aligned at the factory before shipment and does not normally require further adjustment. When necessary, however, the unit may be aligned as indicated below.

Do not adjust any circuit in this radiotelephone unless you understand the circuit operation and have experience in adjusting radiotelephone. Tampering with the radiotelephone may upset the alignment and lower its performance.

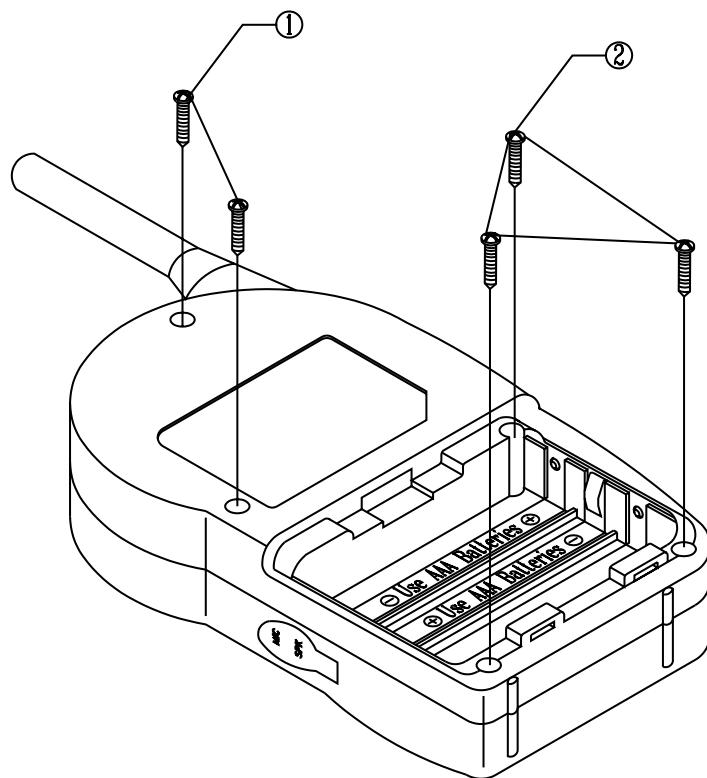
Test Equipment Required

- Regulated DC power supply, 0~12V,1A or higher; or 4.5V, 1A
- Audio signal generator,10Hz~3KHz
- Digital multimeter
- Deviation meter
- Frequency counter,0~500MHz high impedance
- Oscilloscope
- RF power meter, 0.5W
- High frequency standard generator,>500MHz
- Tracking generator,>500MHz
- Distortion analyzer
- Audio level meter
- T-coupler
- Alignment drivers, etc.

DISASSEMBLY INSTRUCTIONS

To remove the front and rear panels from the main chassis:

1. Remove the two screws from the bottom of the unit.
2. Remove the three screws from the battery compartment.



ADJUSTMENT PROCEDURE

Step	Item	Adjustment	Procedure
1	TX Frequency	VC1	Adjust VC1 to obtain demanded TX frequency.
2	TX	L3, L11, L12, L16	Adjust L3, L11, L12, L16 to obtain demanded TX power.
3	TX. Dev.	VR2	<ol style="list-style-type: none">1. Inject an audio frequency (AF) -20dBm.2. Adjust VR2 to obtain maximum TX deviation $\leq 2.5\text{kHz}$.3. Check MIC modulation sensitivity, and it should be $2.5\text{~}10\text{mV}$.
4	CTCSS Dev.		Check CTCSS deviation if it is normal.
5	RX		Check RX sensitivity if it is normal.
6	RX	L9,L10	Adjust L9 and L10 to obtain Max. Sensitivity.
7	RX	VR1	Adjust VR1 to obtain demanded squelch sensitivity.