

# THEORY OF OPERATION

## 21-1850

This FRS transceiver provides accurate and stable operation.

The basic functions consist of 8 main sections:

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

### Power

The power supply unit is a external cigarette lighter adapter. It can be plugged into the car cigarette plug.

It regulates 12V~13.8V input to 8V with IC501 LM7808. The 8V power is spread into three sections.

1. The power for the RF-power amplifier.
2. The power for the Audio amplifier section.
3. 8V voltage is regulated to 3.5V by IC103 TK11335 for the VCO & PLL power, and also regulated to 3.5V by IC309 TK11335 for CPU power, TX and RX power control circuitry. Q304 and Q306 compose as a power switch for RX and TX. They are controlled by RX and TX CTL from CPU.

### Receive Stage

RF signal is received through the antenna and is passed onto a low pass filter network and amplified by Q101. This allows only the required band signal to pass through to the band pass filter (BPF). The mixer Q103 converts the incoming signal down to 21.3MHz. This signal again passes to a 21.3MHz XTAL band pass filter F101. This gives a better channel selectivity. The selected 21.3MHz signal is amplified by IF amplifier Q104 before it is passed to the second converter IC101 TA31180FN. IC101 TA31180FN is the second converter with a 21.25MHz local oscillator. This converts the 21.3MHz signal down to 50KHz. This 50KHz signal is sent to discriminator. The detected audio signal passes through Audio Amplifier unit IC304 NJM3403, the 300Hz high pass filter and volume control, and then to the speaker.

### Squelch Control

Squelch control circuitry consists of IC101 TA31180FN and its related circuit. The squelch signal output from IC101 pin 15 pass through filter amplifier circuit composed by pin 16 and pin 17. The signal is amplified and detected by IC101 and generate a control voltage at pin 19 of IC101 for CPU to detect. VR101 is used to control the threshold of the squelch (squelch sensitivity). Pin 19 of IC101 is output a Lo to MCU IC307 pin 15 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. Q306 is turned on for the power to the transmitter. The voice is picked up by the condenser MIC and passes through the 300Hz high pass filter IC302 NJM3403 and is amplified by IC303 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 Q108A, a driver amplifier Q108B and the RF power amplifier Q106. The signal then is finally radiated out through antenna.

### **VCO and PLL**

PLL circuitry is composed of IC102 M64082 the high frequency PLL and VCO. The channel information from the CPU is sent to the shift register in IC102 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 Q113. Q114 is the RX/TX exchange switch. RF signal from the VCO passes through the buffer amplifier Q112 and then is fed into PLL IC102. In receive mode, the signal is fed to the receiver first mixer Q103 to convert the received signal to 21.3MHz. 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 MPD789405 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, QUIET 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 is added to the audio and modulated for transmission. CPU pin OUT1, OUT2, OUT3 and OUT4 output a 16 stage of digital values. These digital values then are passed through a digital to analog converter R385 to R392. The output is a step waveform, and then is filtered by a low pass filter and mixed with the audio. The receive section consists of a CTCSS decoder circuit which is used to separate the audio signal and a CTCSS signal for the existing of a CTCSS signal. The CTCSS signal is filtered and amplified by IC101 TA31180FN and reshaped as a square wave by IC305 NJM3403. The signal then is input to the CPU and is determined the CTCSS signal value for the valid CTCSS received.

### **CALL**

When the CALL button is pressed, the transceiver is switched into transmit mode through the CPU control. IC306 MC14001 generates a ringer audio signal which is controlled by CPU. This 1.6KHz signal is amplified in the MIC amplifier unit and modulated for transmission.

## ADJUSTMENT PROCEDURE

STEP	ITEM	ADJUSTMENT	PROCEDURE
1	TX Frequency	VC101	Adjust VC101 to obtain demanded TX frequency.
2	TX	L117 L118 L119	Adjust L117, L118, L119 to obtain demanded TX power.
3	TX. Dev.	VR301	<ol style="list-style-type: none"> <li>1. Inject an audio frequency (AF) -20dBm.</li> <li>2. Adjust VR301 to obtain maximum TX deviation <math>\leq 2.5\text{KHz}</math>.</li> <li>3. Check MIC modulation sensitivity, and it should be 2.5~10mV.</li> </ol>
4	CTCSS Dev.		Check CTCSS deviation if it is normal.
5	RX		Check RX sensitivity if it is normal.
6	RX	L103 L104	Adjust L103 and L104 to obtain Max. Sensitivity.
7	RX	VR101	Adjust VR101 to obtain demanded squelch sensitivity.

## 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**

The following equipment is required for the alignment.

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.