THEORY OF OPERATION

EVR-100(EA362USL)

Oct 11, 2007

1. Frequency Configuration

The receiver utilizes double conversion. The first IF is 21.4MHz and the second IF is 450KHz. The first local oscillator signal is supplied from the PLL circuit.

The PLL circuit in the transmitter generates the necessary frequencies.

2. Receiver System

1) RF AMP

The RF signal coming from the antenna passes through harmonic filter (LPF) consisting of C1, L1, C4, C11, L2, C5, C16 to filter out the unwanted signals, the antenna switching circuit (D1, D2, D5), passes through a SAW filter F4, and is amplified by RF Low-Noise-Amplifier Q5. The resulting signal passes through another SAW filter F5 and goes to the mixer.

2) First Mixer

The signal from the front end is mixed with the first local oscillator signal generated in the PLL circuit by Q18 to produce a first IF frequency of 21.4 MHz. The resulting signals passes through a pair of crystal filter F1 and F2 to cut the adjacent spurious and provide the optimum characteristics, such as adjacent frequency selectivity.

3) IF amplifier

The filtered first IF signal is amplified by Q1 and then applied to the IF system U3 (BA4116) The IF system U3 (BA4116) integrates the second local OSC, second mixer, second IF limiting amplifier, quadrature detector, noise amplifier, noise detector and RSSI (Received Signal Strength Indicator). The second mixer mixes the first IF signal with the 20.95MHz of the second local oscillator (provided from buffer output of U4 Pin9) and produces the second IF signal of 450KHz. The second IF signal is passed through the ceramic filter F3 to remove the adjacent channel signal. The filtered second IF signal is amplified by the limiting amplifier and demodulated by detector with the ceramic discriminator X3. The demodulated signal is routed to the audio circuit

4) AF amplifier

The AF signal from the IF IC (U3) passes through the de-emphasis circuit of R106 and C123 to restore the audio frequency characteristics. Then passes the active BPF filter consisting of U8A to remove sub-audio signal out of 300~3000 Hz, then passes through AF Volume VR21 and enters the audio power amplifier U2 (LA4425A) to drive the speaker.

5) Squelch

Part of the AF signal from the U3 enters the IF IC again, and the noise component is amplified and rectified by a filter consisting of R114, C164, C165 and an amplifier to produce a DC voltage corresponding to the noise level.

The DC signal from FM IC U3 goes to the analog port of microprocessor U5. U5 determines whether to output sounds from the speaker by checking whether the input voltage is higher or lower than the preset value.

To output sounds from the speaker, U5 sends controlling level to the AF MUTE and AF SW lines to turns U2 on through Q12 and Q10.

3. PLL Frequency Synthesizer

Both receive and transmitter shares the same PLL (Phase Lock Loop) circuit to generate the first local oscillator signal for reception and the RF carrier signal for transmission.

The receiver has a VCO (Voltage Controlled Oscillator) (Q16), and the transmitter has another VCO (Q17).

The generated signal passes through the Q3 buffer and enters the U4 PLL IC. U4 incorporates the reference oscillation divider and phase comparator functions. The input signal is divided into a 6.25KHz signal according to divide ratio data from the microprocessor U5. This signal and the 6.25KHz signal divided from the reference signal enter the phase comparator to produce a differential signal. The frequency control signal is output from the charge pump. This signal passes through the passive LPF of R13, C182, R82, C188, R117, C189 and goes to varicap to control the VCO frequency.

The reference oscillator circuit in the PLL IC produces the 20.95 MHz PLL reference frequency, To stabilize the frequency, the 20.95MHz crystal oscillator X1 is temperature-compensated by RT1, C137 ,C172, C176 and R60.

4. Transmitter System

1) Transmit audio

The audio is picked up from the internal MIC, the signal is then amplified by Audio Amplifier, U7D LM324 (4/4), U7A (1/4) and filtered by a low pass filter U7B (2/4). The audio is adjusted with VR3 to obtain a suitable audio frequency response

2) VCO and RF amplifier

The modulation signal is modulated to VCO by D8. The modulated signal output from the VCO is pre-amplified by Q3, Q4 and Q2. Then it is amplified by RF power amplifier Q20 Q19 which maximum power could be more than 7W.

3) ANT switch and LPF

The amplified signal then passes through a low -pass filter network which consists of L3, C78, C98, C19, L6, C91 filters out spurious emission, and the antenna switching circuit D1, D2, D5. The signal is filtered by harmonic filter (LPF) which is consists of C21, L2, C5, C16, L1, C4, C11, C1. These filters are necessary to suppress the second and third harmonics. The signal is then applied to the antenna terminal.

4) APC

The APC circuit always monitors the current flowing through the RF power amplifier and keeps a constant current. The voltage drop at R158, R160 and R161 is caused by the current flowing through the RF power amplifier and this voltage is applied to the differential amplifier U1B, then U1A compares the output voltage of U1B with reference voltage, the output of U1A controls the VG of the RF power amplifier, drive amplifier and pre-drive amplifier to make both voltages the same. The change of power high/low is carried out by the change of the reference voltage adjusted by VR2 and VR1

5. Power Supply

There are several power supplies for the circuit:

VCC_13.8V is battery voltage for power amplifier;

CPU_5V is common 5V for MCU and peripheral circuits;

TX_5V is 5V for transmission circuit;

RX_5V is 3.3V for reception circuit.

6. Control Circuit

The control circuit consists of a microprocessor (U5) and its peripheral circuits. It controls the TX-RX unit. U5 mainly performs the following:

(1) Switching between transmission and reception by the PTT signal input

(2) Reading system, group, frequency, and program data from the memory circuit.

(3) Sending frequency program data to the PLL IC

(4) Controlling squelch ON/OFF by the DC voltage from the squelch circuit

(5) Reading keys and channel selector

(6) Drive the LCD display

1) Memory Circuit

Memory circuit consists of the microprocessor (U5) and an EEPROM (U10). An EEPROM has a capacity of 16K bits that contains the transceiver control program for the CPU and data such as transceiver channels and operating features.

2) Low Battery Warning

The battery voltage is checked using by the microprocessor. The battery voltage, divided by R20,R21,R22 is input to U5 Pin 41 for voltage monitoring

Note:

The transceiver immediately stops transmission or into Low power level when the battery voltage falls below the threshold value. A message logo will appears in LCD

3) Keys and channel selector circuit.

The signal from keys and channel selector input to microprocessor U5 directly

4) LCD circuit

The microprocessor U5 directly drive the LCD display

7. ATIS (Option function just for Germany Version)

ATIS signal of reception pass through a band pass filter consisting of U8 (B,C) LM324, and is reshaped by U8D LM324, then is detected by MCU U5.

ATIS transmitting signal from MCU U5 passes through a low pass CR filter C8, R27, C152, mixes with the audio signal, and goes to the VCO modulation input..

ALIGNMENT AND ADJUSTMENT

This transceiver is completely aligned at the factory and does not require any adjustments for installation. However it is considered as good practice to verify that none of the adjustments have changed.

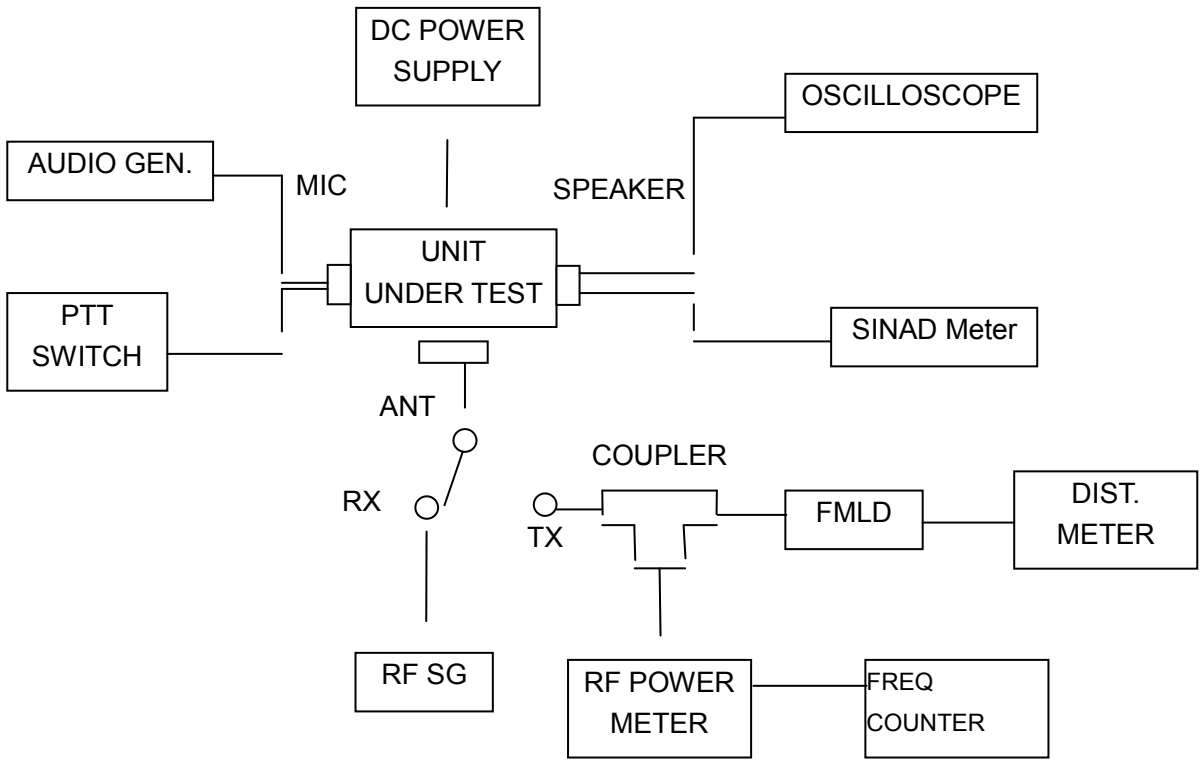
The test equipment listed below are used for the test setup shown in Fig. 3.1.

This test setup used either partially or totally during the following adjustments.

A.TEST EQUIPMENT

1)	DC Power Supply (13.8V DC)	0 - 30V 3A max.
2)	RF Power Meter	10 W 50 Ohm 100-200 MHz
3)	RF Signal Generator	100-200 MHz, 50 ohm
4)	FM Linear Detector (FMLD)	100-200 MHz
5)	Frequency Counter	1-500 MHz
6)	Oscilloscope	20 MHz
7)	Distortion Meter	
8)	SINAD Meter	
9)	Audio Generator	
10)	Toggle Switch (for use as PTT switch).	
11)	DMM (Digital Multi-Meter)	

Fig. 3.1



ADJUSTMENT PROCEDURE

Step	Adjustment	Test Point	Procedure
1	Receiving PD Voltage	TP1 PD	1. Connect digital voltmeter to TP1 PD on RF PCB. 2. Set CH16. 3. Check TP1 voltage 0.8~1.3 V DC.
2	Transmitting PD Voltage	TP1 PD	1. Connect a digital voltmeter to TP1 PD on RF PCB. 2. Set CH16, Press PTT 3. Check TP1 voltage 0.8~1.3 V DC.
3	VC1 Frequency		1. Connect the antenna coupler output to a frequency counter. 2. Set channel to CH16 (156.800 MHz). Press PTT 3. Adjust VC1 to obtain a frequency reading 156.800 MHz ± 200 Hz.
4	VR3 Modulation		1. Connect the antenna coupler output to an FM linear detector. 2. Connect Audio Generator to microphone Jack. 3. Set unit to transmit mode. 4. Set audio output to -23dBm @1 kHz. 5. Adjust VR3 to obtain ±4.5 kHz deviation.
5	VR5, VR1 RF Power output		1. Connect a RF power meter to antenna connector through antenna coupler. 2. Set unit to transmit mode. 3. Adjust VR5 to obtain: High power 2.5~3.5W. 4. Adjust VR1 to obtain: Low power 0.6~1.0W

TROUBLESHOOTING

Item	Description	Possible Cause
1	Unit does not turn on.	● Defective power switch (within potentiometer VR6). ● Check the battery voltage. ● Defective regulator U6
2	Speaker no sound with AF signal applied to volume control	● Defective volume control. ● Defective speaker. ● Defective U2 and/or associated components.
3	Squelch circuit inoperative	● Check squelch sensitivity set-up in Menu ● Defective U3 and/or associated circuitry between pin 7, 8 and 9.
4	No receive (RX)	● Defective regulator U6 ● Check PD voltage 0.5 – 2.8V. ● Check second OSC 20.95MHz, pin1 of U1. ● Defective Q18 ● Check U3 audio output voltage at pin 9. ● Defective audio signal buffer U8A. ● Defective X3.
5	Low receiver sensitivity	● Check antenna and connector for possible corrosion or bad connection. ● Failure of the output from Q5, Q18, Q1 ● Check the output level of local OSC.
6	No transmit (TX)	● Defective PTT switch. ● Defective regulator U6 ● Check TP1 voltage 0.5 – 2.8V; ● Check power transmits circuit Q19, Q20, switching diode D2 and D1; ● Defective VCO of Q17,D7 ● Check power control circuit U6, Q8,Q13,Q23.
7	Low RF power output	● Check RF power output from Q19, If it checks good, then check and antenna switching diode D2, D1.If not good then check the voltage level outputs of the drive amplifiers Q20 and Q2 as well as the associated circuitry.
8	Poor or no modulation	● Defective microphone. ● Defective U7 and/or its associated components.
9	Deviation of transmit frequency	● Check crystal X1 and VC1.