Programming and Configuring Mobile Radio

Once the appropriate equipment for performing the factory test are gathered, perform the following steps to program and configure an IPM8 Mobile Radio:

Step 1 Enter the following information on the ***Test Data Sheet (see Appendix B)***:

- Radio Serial number
- Date test being performed
- Tester's Name

Step 2 Program the radio to the current Firmware revision using the AVR programming utility.

Step 3 Connect a PC to the radio and launch the IPMessage program. In the IPMessage window, type **`factory default`**, press **[ENTER]**, and the radio displays the radio's default values.

Step 4 Enter the appropriate values for the radio's frequency band. The following values were used for an 806 to 821 MHz radio:

```
[From: 172.16.64.1] Host serial = 115200,N,8,1, timeout=200
[From: 172.16.64.1] Channel = 0
[From: 172.16.64.1]          Channel      Tx freq      Rx freq      Inj freq
[From: 172.16.64.1] Frequency= 0, 807.000000, 852.000000, 807.000000
[From: 172.16.64.1] IP Address = 172.16.64.1 (VIU = 0.0.0.0, PC = 192.168.3.5)
[From: 172.16.64.1] IPNC = 172.16.112.200
[From: 172.16.64.1] netmask = 255.255.255.0
[From: 172.16.64.1] Radio Mac Address = 00:08:ce:00:00:00
[From: 172.16.64.1] Hosting framing = SLIP no status messages
[From: 172.16.64.1] channel spacing = 25000
[From: 172.16.64.1] Injection = LOW SIDE, 45 MHz
[From: 172.16.64.1] TX Power = 0
[From: 172.16.64.1] Car to car TX power = 0
[From: 172.16.64.1] serial number: undefined
[From: 172.16.64.1] TX quiet time = 5
[From: 172.16.64.1] TX sync time = 2- milliseconds
[From: 172.16.64.1] TX tail time = 5
[From: 172.16.64.1] TX delay = 0 slots
[From: 172.16.64.1] Radio data rate = 19200
[From: 172.16.64.1] Max data tx time = 60 seconds
[From: 172.16.64.1] PLL load to txkey delay = 2 milliseconds
[From: 172.16.64.1] Carrier detect delay time = 6 milliseconds
[From: 172.16.64.1] roam status times = 900 seconds
[From: 172.16.64.1] roam lost time = 60 seconds
[From: 172.16.64.1] Polarity = TX-, RX+
[From: 172.16.64.1] RSSI step = 12 (=234mV)
[From: 172.16.64.1] noise = -126dBm, -126dBm
[From: 172.16.64.1] num timeslots = 16
[From: 172.16.64.1] timeslot period = 992ms
[From: 172.16.64.1] timeslots per voice packet = 4
[From: 172.16.64.1] 06Feb2036 22:28:34 (PST), calibration=43
[From: 172.16.64.1] diversity speed = 5
[From: 172.16.64.1] receiver = 2
[From: 172.16.64.1] Receiver Hysteresis = 2
[From: 172.16.64.1] Internal GPS Port Address = 5000
[From: 172.16.64.1] Internal GPS Input Protocol = TSIP
[From: 172.16.64.1] Internal GPS Output Protocol = TSIP
[From: 172.16.64.1] 12dB SINAD = -120dBm (54 on RX0)
[From: 172.16.64.1] 12dB SINAD = -120dBm (54 on RX1)
[From: 172.16.64.1] 30dB S/N = -106dBm (72 on RX0)
[From: 172.16.64.1] 30dB S/N = -106dBm (72 on RX1)
[From: 172.16.64.1] 40dB S/N = -90dBm (114 on RX0)
[From: 172.16.64.1] 40dB S/N = -90dBm (114 on RX1)
[From: 172.16.64.1] –40dBm = (214) on RX0)
[From: 172.16.64.1] –40dBm = (214) on RX1)
[From: 172.16.64.1] PLL counter: 510.000000 MHz, N = 22200, R = 800 (400x2)
[From: 172.16.64.1] Suspend Tx = 0 seconds
[From: 172.16.64.1] DHCP Client disabled
[From: 172.16.64.1] DHCP Server disabled
[From: 172.16.64.1] diag message level = 0
[From: 172.16.64.1] TFTP options = 512 (block size), 0 (interval)
```

[From: 172.16.64.1] Internal GPS not found
[From: 172.16.64.1] Modem FEC = on

Adjustment / Alignment Procedures

Receiver Injection

Perform the following steps to adjust the receiver injection and injection frequency:

Step 1 While monitoring the receiver injection frequency at **C206** pin 1, adjust potentiometer **R186** for minimum frequency error of +/- 100Hz. Record this value on the ***Test Data Sheet***.

Receiver 1

Perform the following steps to adjust receiver 1:

Step1 Inject an on-frequency carrier signal with an amplitude of -80 dBm, modulated with a 1 kHz test tone at +/- 5.0 kHz deviation into receiver 1's antenna port.

Step 2 While monitoring the voltage at RSSI1 Test Point with a DMM, adjust trimmer capacitor CV1 to midway between the points where the oscillation stops.

Step 3 While monitoring the DC level of the recovered modulation, adjust potentiometer R82 for a reading of 2.500 VDC +/- 1 mV DC.

Step 4 While monitoring the amplitude of the recovered audio signal, adjust potentiometer R81 and R82 for a reading of 350 mV RMS and 2.500 VDC.

Step 5 Steps 3 and 4 are interactive adjustments, therefore repeat steps 3 and 4 until further adjustment is no longer required (i.e. when 350 mV RMS and 2.500 VDC are realized).

Step 6 While monitoring the recovered audio signal at TP1, verify the distortion is less than 3.5%, adjust CV1 if necessary to achieve less than 3.5% distortion. Record this value on the ***Test Data Sheet***.

If CV1 is adjusted to minimize 3.5% distortion, then repeat steps 3 to 5 to readjust AC-DC levels.

Step 7 While monitoring the recovered audio signal at TP1, verify the SINAD is -117 dBm or better. Record this value on the ***Test Data Sheet***.

Receiver 2

Perform the following steps to adjust receiver 2:

Step 1 Inject an on-frequency carrier signal with an amplitude of -80 dBm, modulated with a 1 kHz test tone at +/- 5.0 kHz deviation into Receiver 2's antenna port.

Step 2 While monitoring the voltage at RSSI2 Test Point with a DMM, adjust trimmer capacitor C159 to midway between the points where the oscillation stops.

Step 3 While monitoring the DC level of the recovered modulation, adjust potentiometer R93 for a reading of 250 mV (+/-10 mV) RMS.

Step 4 While monitoring the amplitude of the recovered audio signal, adjust potentiometer R99 for a reading of 350 mV (+/-10 mV) RMS.

Step 5 Steps 3 and 4 are interactive adjustments, therefore repeat steps 3 and 4 until further adjustment is no longer required (i.e. when 350 mV RMS and 2.500 VDC are realized).

Step 6 While monitoring the recovered audio signal at TP1, verify the distortion is less than 3.5%, adjust C159 if necessary to achieve less than 3.5% distortion. Record this value on the ***Test Data Sheet***.

If C159 is adjusted to minimize 3.5% distortion, then repeat steps 3 to 5 to readjust AC-DC levels.

Step 7 While monitoring the recovered audio signal at TP1, verify the SINAD is -117 dBm or better. Record this value on the ***Test Data Sheet***.

Transmit Data

Perform the following steps to adjust transmit data:

Step 1 Use IPMessage to set the transmit power to 0.

Step 2 Using the **x=2000,19** command of IPMessage to generate transmit data messages while observing the transmitted signal on the HP RF communications test set, adjust pot R186 for minimum frequency error while transmitting data messages.

Step 3 Turn potentiometer RV2 fully counterclockwise.

Step 4 Adjust RV1 for deviation of 4.9 kHz.

Step 5 Using calibrated base station, and monitoring the uplink received data quality on the base station's Hyperterminal screen, slowly turn RV2 clockwise until consistent data quality readings of 240 - 248 are achieved using 1400 character test messages. Data quality reading should not be less than 240 for 1400 character messages.

If unable to reach the data quality readings then ask for Technical Support. Poor data quality readings are indicative of poor group delay performance, or other defect.

Step 6 Verify transmit deviation, frequency error, and transmitting data messages quality and record this data on the ***Test Data Sheet***.

Power Setting

Perform the following steps to adjust the transmit power control:

Step 1 Attach a power attenuator to the transmit port of the radio.

Step 2 Using the **x=2000,19** command of IPMessage, and while monitoring the transmit power level on the HP communications test set, check the level of the transmit power. Using IPMessage set the power setting to **txpower=0**. The radio should have an output power level of approximately 1 mW. Record this value on the ***Test Data Sheet***.

Step 3 Using *IP*Message send the **txpower=** command to increase the power level settings until 20 Watts of output power is obtained. Record this value on the ***Test Data Sheet***. Note that values on the table are to plot the codes vs. power output. The 20-Watt setting can be a code not on the table. Adjust **txpower** until the code is found that does not exceed 20.0 Watts. Record this value on the ***Test Data Sheet***.

Do not to exceed 20 Watts of output power, as this may reduce the life of the amplifier.

Receive Data

Perform the following steps to verify the receive data performance:

Step 1 Using the DOS **ping** command on the PC connected to the radio, ping the network controller to generate uplink and downlink data messages. The following command will generate one Hundred 500 character messages:

```
>;Ping 192.168.3.3 -n 100 -l 500
```

Step 2 Observe the data quality readings on the IPMessage window of the PC connected to the radio using the **V** (for Verbose) command in the IPMessage program. With the mobile radio's antenna connected to receiver 1, verify the received data quality readings are consistently 248s. Data quality readings should also be verified at the base station using the **V** command on the Hyperterminal window.

Step 3 Verify receiver 2 data quality readings are also consistently 240 to 248s by changing the antenna from receiver 1 port to receiver 2 port. In this manner both uplink and downlink data quality can be verified. Record this data on the ***Test Data Sheet***.

Final Test

A final test **must** be performed prior to shipping the IPM8 mobile radio to the customer. This final test will verify that the timing characteristics are correct and that both transmit and receive data quality readings are consistently high.

Perform the following steps for the final test:

Step 1 Attach the 40dB 100-Watt power attenuator to the transmit port of the radio.

Step 2 Program the radio for full power operation. The **tx power** level setting can be found in the radio's ***Test Data Sheet***.

The setting must not to exceed 20 Watts.

Step 3 Attach a digital scope to the base station as described in the next section, ***Uplink Hardware Timing Verification***. Using the **x=2000,19** command (which will cause the radio to transmit 19 2000 character messages), verify the following:

Transmit frequency of radio is adjusted for minimum frequency error of +/- 100 Hz.

The **x=2000,19** command will generate different messages with differing DC components. Each message will slightly slew the frequency off from the center frequency). Be careful to closely monitor the variation in transmit frequency due to these different messages and ensure that on average the transit frequency error has been minimized to within +/-100 Hz. This indicates that some of these test messages will be slightly high in frequency, some messages will be slightly low in frequency, and some messages will be right on frequency.

Step 4 Verify the transmit deviation is 4.9 kHz

Step 5 Verify the timing characteristics are identical to the plots in the next section, ***Uplink Hardware Timing Verification***.

Step 6 At the base station monitor PC, verify that all the data quality readings are 240 and higher.

Step 7 Move the scope probes to monitor the timing at the mobile radio as described in ***Downlink Hardware Timing Verification***. Generate test messages by pinging the IPNC from the PC attached to the radio. The following command will cause 100 pings, 500 bytes in length to be transmitted from the mobile radio and echoed by the IPNC through the base station:

```
.>;Ping 192.168.3.3 -n 100 -l 500 -w 2000
```

Step 8 Set **CRC =1 Enable** on the radio

Step 9 Verify the timing characteristics are identical to those in ***Downlink Hardware Timing Verification***.

Step 10 Verify that both receivers on the mobile radio report data quality readings of 240 or higher (248 is typical). This can be accomplished by installing the antenna on the TX/RX1 port and verifying RX1 is selected by observing the RX1 LED on the mobile radio and installing the antenna on the RX2 port and verifying RX2 is selected by observing the RX2 LED on the mobile radio.

Step 11 Reset **CRC = 0 Disable** on the radio

Step 12 In IPMessage, type the **?** command to radio. Copy the radio settings and paste them into the ***Test Data File***.

Step 13 Perform a close visual inspection of the radio closely inspecting manufacturing related problems (loose screws, solder particles, etc.).