Programming and Configuring Fixed Radio

Once the appropriate equipment for performing the factory test is gathered, perform the following steps to program and configure an F32700N-25 Fixed Radio:

Step 1 Enter the following information on the ***Test Data Sheet (see Appendix A)***:
- Radio Serial number
- Date test being performed
- Tester's Name

Step2 Connect the power cable with a voltage source of 13.8vDC able to deliver 5 amps continuous and apply power to the mobile radio.

Step 3 Program the radio to the current Firmware revision using the AVR programming utility.

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Step 4 Connect a PC to the radio and launch the *IP*Message program. In the *IP*Message window, and verify the IP Message connection using the "?" command.

Step 5 The radio will need to be unlocked using the command "**Unlock=Password"** using the appropriate password and placed into testmode using the command **"testmode=1"** for all tests unless specified otherwise.

Step 6 Type **'pll type=Analog Devices".**

Step 7 Enter the appropriate values for the radio's frequency band. The following values were used for the fixed 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, 799.000000 769.000000 814.000000
[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 = HIGH SIDE, 45 MHz
[From: 172.16.64.1] TX Power = 150
[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 = 32000
```

```
[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 = AUTO
[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] 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 frequency:

Step 1 Connect the RF output/input of HP8920 to the TX/RX antenna port of the radio and HP RF probe to the antenna port of the service monitor.

Step 2 Enter the test frequency using the command (For example **“frequency=0,799,769”)**. Set the reference calibration using the command “**reference calibration=128**”. Measure the refmod voltage input to the tcxo (at JMP1). It should be close to 1.50 volts.

Step 3 Select the monitor on TX measurement mode tune the measurement frequency to the injection frequency. (for example 814 MHz)

Step 4 While monitoring the receiver injection frequency at RXINJ1, Select the reference calibration number by using **“reference calibration = x”.** Change the value of X (between 0-255) to obtain the minimum frequency error of< +/- 50 Hz. Record this value of x and the injection frequency on the ***Test Data Sheet***.

Step 5 While monitoring the 44.545 MHz 2nd injection frequency at U13 pin 4, adjust trimmer capacitor CV10 to midway between the points where the oscillation stops, then slightly turn to get the amplitude between -3 to 0 dBm. Measure

the frequency and make sure that is between 44.500 and 44.590 Record this value on the ***Test Data Sheet***.

Receiver Adjustment

Perform the following steps to adjust receiver:

Step1 Set the monitor in spectrum analyzer mode;

- **a.** In the main menu select; Antenna, frequency 45 MHz, Reference level -20dBm, and span=100 kHz.
- **b.** In the RF Gen. menu select; Track, Offset frequency to; (receive frequency- 45 MHz) (For example 724MHz), Level -50 dBm, and Port/sweep RF out/invert.

Step2 While monitoring C80 pin1, adjust the capacitors CV7, CV8, CV9, and CV11 to measure; flat, wide, and the maximum level of the signal.

Step3 Set the monitor at RX mode; select the frequency: 769 MHz, Amplitude: -80, Atten: Hold Off, AFGen1 Freq: 1.00 kHz, AFGen1to: FM 5 kHz, AFGen2Freq: 1.00 kHz, AFGen2 to; Off, Filter1: 300 Hz HPF, Filter2: 3 kHz LPF, Ext Load R: 600 Ohm, Output Port: RF Out.

Step 4 Connect audio probe to the HI audio port on service monitor.

Step 5 While monitoring the recovered audio signal from pin 7 Of U9, Inject carrier signal with amplitude of -80 dBm, modulated with a 1 kHz test tone at +/- 5.0 kHz deviation into receiver's antenna port of the radio.

Step 6 Adjust discriminator CV12 to achieve the minimum distortion (less than 1.5%). Note that the amplitude of the audio signal should be at the maximum level at the point of minimum distortion

Step 7 Using IP Message, set the mobile to receiver1 using the command **"receiver=1".**

Step 8 Clip the audio probe to TP1 of the digital board. While monitoring the amplitude of the recovered audio signal, adjust potentiometer RV3 for reading of 350 mV RMS.

Step 9 While monitoring the DC level of the recovered audio, adjust potentiometer RV4 for a reading of 2.500 VDC +/- 10 mV DC.

Step 10 While monitoring the recovered audio signal at TP1, verify that radio performs 12 dB SINAD or higher at -118 dBm input. Reduce the signal level to the input of the receiver until the SINAD= 12 dB.

Step 11 Record the signal level for 12 dB SINAD, distortion, AC Voltage and DC voltage on the ***Test Data Sheet***.

Receiver Calibration

Equipment set up

Step1 Connect cable from RF in/out port on service monitor to TX/RX1 input of mobile.

Step2 Connect audio probe from HI audio in port on service monitor to Tp1 on digital board.

Step3 Select the "RX" function, Set "RF Gen Freq" to the receive frequency of the mobile under test. (For example 769 MHz)

Step4 Set other values as: Amplitude: *Varies,* Atten Hold: Off, AFGen1 Freq: 1.000 kHz, AFGen1 to: FM 5 KHz AFGen2 Freq: 1.000 kHz, AFGen2 to: Off Filter 1: 300 Hz HPF, Filter 2: 3 kHz LPF, Output Port: RF Out, Ext Load R: 600 ohm

Calibration

Step1 In IP Message, type the command "**receiver = 1**".

Step2 Set the Service Monitor to measure SINAD.

Step3 Reduce signal amplitude on the Service Monitor until 12dB SINAD is reached.

Step4 **I**n IP Message, type the command "**12DB SINAD =X0**" where X0 is the amplitude in dBm.

Step5 Set the Service Monitor to measure SNR.

Step6 Increase signal amplitude until reaching a level of 30dB SNR.

Step7 In IP Message, type the command "**30DB S/N =X1** "where X1 is the amplitude in dBm.

Step8 Increase signal amplitude until reaching 40dB SNR. Record the amplitude.

Step9 In IP Message, type the command "**40DB S/N = X2**" where X2 is the amplitude in dBm.

Step10 Set the signal amplitude to -50dBm.

Step11 In IP Message, type the command "**-50DBM = -50**".

Step12 Set the signal amplitude to -40dBm.

Step13 In IP Message, type the command "**-40DBM = -40**".

Receiver Calibration Test

Step1 Inject a signal with amplitude of -95dBm into the TX/RX1 antenna port.

Step2 Set the mobile to receiver1 using the command "**receiver=1**"

Step3 In IP Message, type the command "**noise"**, the equipment must measure -95 dBm +/- 2.

Transmitter Alignments

Perform the following steps to adjust transmit data:

Step1 Set the service monitor to TX.

Step2 Set the "tune freq" of the service monitor to the mobile transmit frequency (For example 799 MHz).

Step3 Set the transmit parameters as follows: Tune Mode: Manual, Input port = RFIN,
IF filter: 15 kHz, Filter 1: 50 Hz HPF, Filter 2: 15 kHz LPF.

Step 4 Connect the RFIN/OUT of the monitor to TX/RX1 port of the radio.

When connecting the TX/RX1 port to any equipment than antenna and HP service monitor make sure to use a power attenuator.

Step 5 Use *IP*Message to set power to 150 by using the command **"txpower=150".**

Step 6 Turn the carrier on by using the command **"txkey=1"**.

Step 7 Check the transmit frequency with monitor and record the offset frequency.

Step 8 Turn the carrier off using the command **"txkey=0"**.

Step 9 Turn potentiometer RV5 fully counterclockwise.

Step 10 Turn on the modulated transmit signal using transmit command **"x = 1400, 19"**

Step 11 Adjust RV6 for deviation of 4.9 kHz.

Step 12 Select the right combination of polarity for transmit and receive signals TX+/- RX+/- out of four possible choices.

Step13 Using calibrated base station at the paired frequency, and monitoring the uplink received data quality on the base station's Hyperterminal screen. With the correct selection in step 12 the base station will receive data and the carrier detect (green light) turns on. Slowly turn RV5 clockwise until consistent data quality readings of 220 - 248 are achieved using 1400 character test messages. Data quality reading should not be less than 220 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 14 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 Using the **" txkey=1"** command of *IP*Message, and while monitoring the transmit power level on the HP communications test set, send the **txpower= x** command to adjust the power level settings to slightly less than 5 Watts of output power is obtained. Record this value on the ***Test Data Sheet***.

Step 2 Adjust "**maximum txpower = x"**to the value that output power does not exceed 5.0 Watts. Record this value on the ***Test Data Sheet***.

Do not to exceed 5 Watts of output power, as this may reduce the life of PA.

Final Test

Perform the following steps to verify transmit and receive data performances:

Step 1 With the same base station at the same setting, using IPlink to measure the data quality and Message success rate (MSR). IN IPlink open PLOT menu, then select new. New plot table appears, select the following parameters; IP address=172.16.23.xxx, wherte (xxx) is the address of the base station, delay time= 1000 ms, uplink size=41, downlink size= 41, timeout= 120 sec, select HI-Res, then select OK.

Step 2 Observe the data quality readings on the *IP*Message window of the PC connected to the radio using the **V** (for Verbose) command in the *IP*Message program. With the fixed radio's antenna connected to receiver, verify the received data quality readings are consistently higher than 220. Data quality readings should also be verified at the base station using the **V** command on the Hyper-terminal window. Record this data on the ***Test Data Sheet***.

Step3 Read the value of message success rate on the active plot table and record it. This value should be greater than 95% for both uplink and down link.

Appendix A

Program and Configure Radio

Date _____
Serial Number _____
Firmware Revision _____
Tester _____

Adjustment / Alignment Procedures

Receiver Injection

Parameter	Spec	Measured
Injection Frequency Error at RXINJ1(within +/- 100 Hz of exact injection frequency)	**+/- 100 Hz**	
U13 pin 4 power level	**-3 to -5 dBm**	

Receiver

Parameter	Spec	Receiver Measured
Audio DC Amplitude (1 kHz Test tone @ 5.0 kHz Deviation)	**2.5 VDC +/- 1mV**	
Audio AC Amplitude (1 kHz Test tone @ 5.0 kHz Deviation)	**350 mVRMS +/- 10mV**	
Distortion (1 kHz Test tone @ 5.0 kHz Deviation)	**2%<**	
SINAD 12 dB (1 kHz Test tone @ 5.0 kHz Deviation)	**-118dBm >**	

Transmit Section

Parameter	Spec	Measured
Transmit Modulation Deviation (4.9 kHz while transmitting 1400 character test message)	**4.9 kHz**	
Transmit Data Quality (While transmitting 1400 character test messages to the base station)	**220 >**	

Transmit Power Control
Caution: Donot to exceed 5-Watts RF output power during this test.

Transmit Power Setting	Expected RF Out	RF Out Watts
0		
25		
50		
75		
100		
125		
150		
175		
200		
225		
250		

Do not to exceed 5 Watts of output power.

Parameter	Digital Code	Measure
Maximum power output setting without exceeding 5.0Watts		

Data Quality

Parameter	**Spec**	**Measured**
Receiver Data Quality (While receiving 500 character "pings" from base station, 100 pings min, no errors allowed, CRC errors enabled)	**220>**	

Final Tests

Uplink Final

Parameter	**Spec**	**Measured**
Transmit Frequency Error	**+/- 100 Hz** (Transmitting 19, 2000 character test message)	
Transmit Modulation Deviation	**4.9 kHz** (while transmitting 19,2000 character test message)	
Uplink Hardware Timing Verified		
Transmit Carrier ramp up time	**2mS < X < 6mS**	
Symbol Sync time (Stable Amplitude to within 100mV during the period)	**12ms +/- 1ms**	
Recovered modulation signal	**1 V PtoP ~**	
	2.5 VDC ~	
Verify Sync Start (RSSI to CS first going low)	**10mS +/- 0.5**	
Verify Fram Sync (From end of Sync to CS second time going low)	**4 +/- 0.1 mS**	
Transmit Data Quality (While transmitting 19, 1400 character test messages to the base station)	**220 >**	

Downlink Final

Parameter	**Spec**	**Measured**
Downlink Hardware Timing Verification		
Sync start (RSSI to CS first going low)	**3.0 +/- 0.5ms**	
Recovered Modulation Levels	**800 mV~ 2.5VDC~**	
Frame Sync (From end of Sync to CS second time going low)	**3.2 +/- 0.5 mS**	
Receiver Data Quality (While receiving 500 character "pings" from base station, 100 pings min, no errors allowed, CRC errors enabled)	**220>**	
Message Success Rate	**95%>**	
LED Receiver	**Lit**	
Attach copy of all firmware settings	**Completed**	
Visual inspection	**Completed**	