GIA6X COMM TRANSCEIVER
ALIGNMENT PROCEDURE

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005-00148-08 Rev. H

Approvals   **Date**

Drawn: MDD	05/19/03
Checked: NJH	05/19/03
Approved: SDT	05/21/03
Project Mgr.: CBP	05/19/03

Revisions

Rev.	Date	Description of Change	Apprvd.
01	05/19/03	Experimental Release	-------
A	12/08/03	Production Release	23549
B	02/02/04	Remove auto align for TX. Add 25 KHz RX IF alignment. Change TX power alignment to 20W. Adjust TX mod depth to just below 90%	24276
C	7/26/05	Change equipment list	32380
D	04/07/06	Resolve discrepancies between align proc and Align 400	37192
E	04/26/06	Change MIC alignment target to 91% - 95%	37544
F	07/31/06	Correct references, add Q-Dope compensation	39340
G	07/24/09	Update to include 012-01400-XX	64102
H	08/13/09	Update T201 tuning procedure to reference Test Select. Corrected VCO coil voltage reference for Q-Dope comp.	64630

TABLE OF CONTENTS

I. 012-00585-XX AND 012-01400-XX

1. SCOPE OF DOCUMENT

This alignment procedure is provided to calibrate the GIA COMM transceiver sub-assembly, 012-00585-XX and 012-01400-XX at unit level. Verify the board number, 105-00585-XX and 105-01400-XX located on the COMM Board to ensure the proper procedure is being used.

2. REFERENCE DOCUMENT
004-00145-03 MPS,GIA6X Comm Assy

3. EQUIPMENT

DESCRIPTION	VENDOR/PART NO.	QTY
0-30VDC/0-6A VARIABLE POWER SUPPLY	HP 6267B OR EQUIV	1
350Mhz PC or higher W / SERIAL PORT and GPIB card	**Dell** PII W / SERIAL PORT And GPIB card	1
Software – GNC400 Serial Interface and Automated Comm Alignment Program	T06-A0029-00 T06-A0062-00	1 1
MANUAL TEST PANEL	GARMIN GPS/GNC MANUAL TEST PANEL T11-00040-00	1
RADIO TEST SET	HP 8920A WITH OPTIONS 003/019/050/102 OR HP8920B WITH OPTIONS 001/102	1
Ca, Banana Pl-Spade (Red)	310-00011-00	1
Ca, Banana Pl-Spade (Blk)	310-00011-01	1
Banana Plug Test Cable (BLK)	Probe Master 3435-60-0 or equivalence	2
Banana Plug Test Cable (RED)	Probe Master 3435-60-2or equivalence	1
430 Main to GIA Main adapter cable	GT0432	1
430 Comm to GIA Comm adapter cable	GT0430	1
Conn, Male/Female BNC	330-00053-01	1
3 ft RG-223 RF cable	320-00121-03	3
1 meter IEEE488 cable	Nat'l Inst. P/N 763061-01or equivalence	2
Conn, Male/Female, DB9	320-00045-00 or equivalence	1
DIGITAL MULTIMETER	HP-34401A	1
.9mm Tuning Tool	C.K. OR EQUIV	1
1.8mm Tuning Tool	C.K. OR EQUIV	1
Cable Assy 'A'	320-00099-03	1
Cable Assy 'B'	320-00099-04	1
RTC Switch Test Box	GT0384	1

4. SETUP PROCEDURE

Figure 1

4.1 Interconnections

4.1.1   Install 330-00053-01 BNC adapter to the end of an approved 320-00121-03 3ft RG-223 cable and connect between the comm transceiver antenna connector and the HP 8920A/B RF IN /OUT connector.

4.1.2   Connect the connector cable (A) 320-00099-03 Ca Assy, to the Manual test panel connector (A).

4.1.3   Connect the connector cable (B) 320-00099-04 Ca Assy, to the Manual test panel connector(B).

4.1.4   Unplug the banana connector COMM current test lead on the (B) Ca Assy.

4.1.5   Plug the male connector into the RTC (Rear terminal connect) switch in the "C" position.

4.1.6   Plug the female connector into the 1st black banana plug test cable, and plug the other end of the cable to the RTC switch in the "D" position.

4.1.7   Plug the red banana plug test cable, into the RTC switch in the "E" position and plug the other end into the rear connection of the 34401A configured to read current (LO).

4.1.8   Plug the 2nd black banana plug test cable, into the RTC switch in the "F" position and plug the other end into the 34401A rear connection (I).

4.1.9   Connect an RF cable 320-00121-03 from COMM AUDIO HI on the Manual Test panel to HP8920A/B AUDIO IN HI.

4.1.10   Connect an RF cable 320-00121-03 from the Audio out on HP8920A/B to Manual Test panel connector marked COM MIC AUDIO.

4.1.11   Connect the serial cable from PC port 1 to serial port 2 on the manual test panel.

4.1.12   Connect IEEE 488 cable from PC to HP34401A.

4.1.13   Connect IEEE 488 cable from HP34401A to HP8920A/B.

4.1.14   Connect positive and negative test leads from front of digital Multimeter HP34401A inputs to COMM IF AGC and GND outputs, respectively, on Manual Test panel.

4.1.15   Connect the power supply in remote sensing configuration to the banana jacks in the back of the manual test panel. Consult the operation manual corresponding to the power supply being used for the appropriate connection from the supply.

4.1.16   Plug AC power cord into rear of test panel. Plug AC power cord into 120VAC outlet.

4.2 External Power Supply Settings

4.2.1   On the manual test panel insure that PANEL POWER push-button switch and UNIT POWER push-button switch are not depressed and are not lighted (OFF).

4.2.2   Insure the unit is turned off.

4.2.3   **Important!** Set the RTC switch to the position B, bypassing the 34401A rear terminals to prevent damage to the equipment.

4.2.4   Connect the Ca Assy (A) P1001 (78-pin Male) to the GNC400/500-GIA Main adapter cable (GT0432).

4.2.5   Connect the Ca Assy (B) P1002 (25-pin Female) to the
         GNC400/500-GIA Comm adapter cable (GT0430).

4.2.6   Connect the GIA Main and GIA Comm adapter cables into the
         back of the UUA.

4.2.7   Turn on the external power supply.

4.2.8   On the manual test panel push the PANEL POWER and the the
         UNIT POWER swich to turn on.

4.2.9   On the external power supply verify the unit is drawing less than
         1 Amp of current.

4.2.10   Set the 34401A to front terminals and monitor the DC Voltage at
         the 28V test jack on the manual test panel. Set voltage on the
         external power supply to +27.5 VDC $\pm$.2VDC for 28 V alignment
         and +13.75 VDC $\pm$ 0.2 VDC for 14 V alignment.
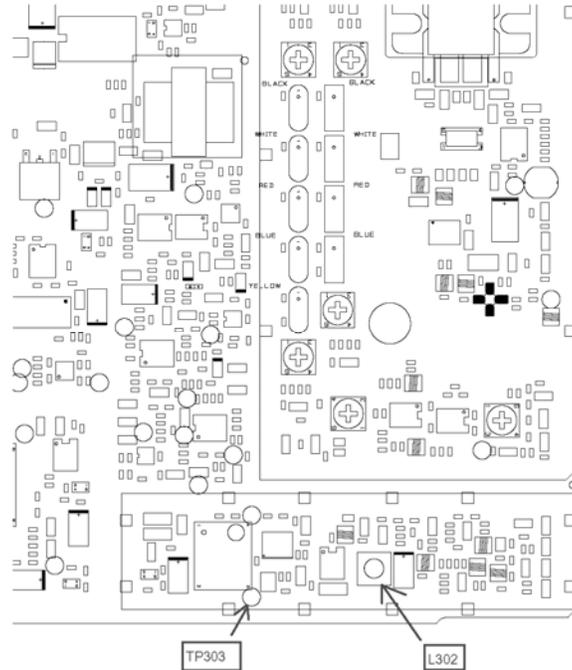
5. ALIGNMENT

5.1 VCO Alignment

Figure. 2

5.1.1   On the manual test panel toggle the switch labeled 'Test Mode' up and power the unit on in test mode.

5.1.2   Open the "GNC400 Serial Interface (SI) Program, T06-A0029-00)" program on the computer. Select the Product Request button, select the Com button.

5.1.3   On the SI program set the Channel Spacing switch for 25 kHz.

5.1.4   On the SI Program set the Comm frequency to 136.975MHz.

5.1.5   Set the 34401A to the front terminals and set the fuction to DCV.

5.1.6   Monitor TP303 and Adjust VCO coil L302 to 4.35±0.1VDC. If the tuning voltage cannot be set to 4.35±0.1VDC, adjust for the maximum voltage achievable. The voltage must be greater than 4.0 VDC.

5.1.7   Apply Q-Dope (GPN 291-00024-00) to L302.

5.1.8   If the VCO coil voltage was adjusted to 4.35 ± 0.1VDC in step 5.1.6, verify that the voltage is 4.5 ± 0.1VDC after step 5.1.7. If necessary, adjust L302 again and reapply Q-Dope.

5.2 Receiver IF Alignment

5.2.1   Recall saved **State 2** on the HP8920A/B.

- RX Mode
- RF GEN Freq = 118.000 MHz
- RF GEN amplitude = 25μV
- AF GEN1 to FM
- FM DEVIATION = 7.0 KHz
- AF GEN1 FREQ = 1 KHz
- RFGenVolts ohm/emf = emf on config page
- RF Level Offset ON - configuration page
- RF In/Out = -0.3 dB - configuration page

5.2.2   On the SI program set the channel spacing to 8.33KHz.

5.2.3   On the SI program set the COMM frequency to 118.005 MHz.

5.2.4   Set the 34401A Multimeter to read front terminals and the function to read DCV.

5.2.5   While monitoring the COMM IF AGC voltage on the manual test panel with a DMM, adjust the HP8920A/B RF GEN amplitude until the DMM reads 5.0 ± 0.1 VDC.

NOTE: If the RF GEN amplitude must be adjusted above 300 μV, click "Load Com Cal From File" again and select the next value file. Wait for the values to be loaded, then repeat steps 5.2.1 through 5.2.5.
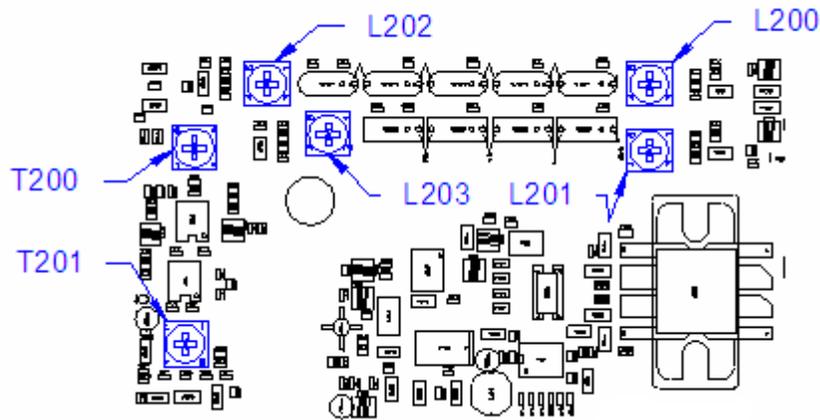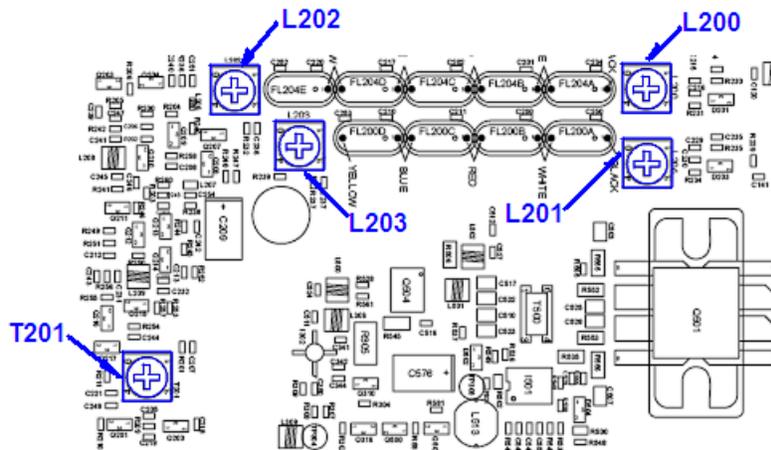
Figure 3. 012-00585-XX board layout

Figure 4. 012-01400-XX board layout

5.2.6 Adjust T200 until maximum IF AGC voltage is achieved (only for 012-00585-XX).

5.2.7 Adjust T201 until maximum IF AGC voltage is achieved. For 012-01400-XX, if the maximum IF AGC voltage is achived at the end of T201's tuning range, then apply Test Select C205 and repeat this step. A peak in IF AGC voltage must be found within T201's tuning range to pass.

5.2.8 Adjust L200 until maximum IF AGC voltage is achieved.

5.2.9 Adjust L202 until maximum IF AGC voltage is achieved.

5.2.10 On the SI program set the channel spacing to 25 KHz and verify the channel frequency is 118.000 MHz.

5.2.11   Set the FM deviation to 20 KHz on the HP8920A/B.

5.2.12   While monitoring the COMM IF AGC voltage on the manual test panel with a DMM, adjust the HP8920A/B RF GEN amplitude until the DMM reads 5.0 ± 0.1 VDC.

5.2.13   Adjust L201 until maximum IF AGC voltage is achieved.

5.2.14   Adjust L203 until maximum IF AGC voltage is achieved.

5.2.15   Repeat section 5.2 one time.

5.2.16   Close SI Program.

5.2.17   Install covers, GPN 115-00207-01, 115-00452-00 and 115-00451-00. Install RF fingers 253-00114-16. See Garmin Assy drawing 015-00782-XX.

5.3   Automated Alignment

5.3.1   Open the Automated Comm Alignment Program, T06-A0062-00 on the computer.

5.3.2   Select Product request and select COMM.

5.3.3   Push the "Auto Align All" button on the screen.

5.3.4   The alignment program will begin to run. Follow all instructions that appear in the 'Setup Instructions' box.

5.3.5   Close AlignCom Program.

6. DIGITAL ADJUSTMENTS

Digital adjustments can be made by using the SI Program. The following are instructions to manually align the digital pots. This procedure can be used in place of the auto alignment in section 5. 3.

6.1 Receiver Preselector Alignment

6.1.1   Recall saved **State 3** on the HP8920A/B.

- RX mode

- RF GEN FREQ = 118.000 MHz
- RF GEN amplitude = 2.0 μV
- AF GEN1 to AM
- AM DEPTH = 30%
- AF GEN1 FREQ = 1 KHz
- AF IN LO to GND
- Audio analyzer set to SINAD
- Analyzer averaging function ON
- Averaging sample size = 10
- RFGenVolts ohm/emf = emf on config page
- RF Level Offset ON - configuration page
- RF In/Out = -0.3dB - configuration page

6.1.2   Tune the COMM frequency to 118.000 MHz.

6.1.3   Set the channel spacing to 25 KHz.

6.1.4   Disable compressor and squelch by setting the "SQLCH/COMP TEST" switch to the up position.

6.1.5   Adjust the volume on the UUT until rated audio is achieved (7.07 Vrms).

6.1.6   Adjust the POLE 1 up and/or down until the maximum SINAD reading is achieved. Allow approximately 2 seconds between adjustment steps for the SINAD meter to settle.

6.1.7   Continue the adjustment with POLE's 2, 3, and 4.

6.1.8   Repeat steps 6.1.6 and 6.1.7 to fine tune the preselector.

6.1.9   After the completion of the second round of adjustments, the SINAD reading should be at least 9 dB.

6.1.10   Using 400SI, store the calibration.

6.1.11   Repeat at channels 127.000 and 136.975 MHz.

6.2   Receiver Noise Squelch Calibration - 25 KHz Mode

6.2.1   Recall saved **State 4** on the HP8920A/B.

- RX Mode
- RF GEN Freq = 118.000 MHz

- RF GEN amplitude = 2.0 uV
- AF GEN1 to AM
- AM DEPTH = 30%
- AF GEN1 FREQ = 1 KHz
- AF IN LO to GND
- RFGenVolts ohm/emf = emf on config page
- RF Level Offset ON - configuration page
- RF In/Out = -0.3 dB - configuration page

6.2.2   Enable compressor and squelch by setting the "SQLCH/COMP TEST" switch to the down position. Set the channel spacing field on the display for 25 kHz.

6.2.3   Tune the Comm frequency to 118.000MHz.

6.2.4   Increase NS SQ (for SI program versions above 5.05, choose 25 kHz NS SQ) on the display until the squelch just opens (audio turns on).

6.2.5   Using 400SI, store the calibration.

6.2.6   Repeat at Channels 127.000 and 136.975 MHz.

6.3   Receiver Noise Squelch Calibration – 8.33 KHz Mode (012-01400-XX only)

6.3.1   Recall saved **State 4** on the HP8920A/B.

- RX Mode
- RF GEN Freq = 118.000 MHz
- RF GEN amplitude = 2.0 uV
- AF GEN1 to AM
- AM DEPTH = 30%
- AF GEN1 FREQ = 1 KHz
- AF IN LO to GND
- RFGenVolts ohm/emf = emf on config page
- RF Level Offset ON - configuration page
- RF In/Out = -0.3 dB - configuration page

6.3.2   Enable compressor and squelch by setting the "SQLCH/COMP TEST" switch to the down position. Set the channel spacing field on the display for 8.33 kHz.

6.3.3   Tune the Comm frequency to 118.000MHz.

6.3.4 Increase NS SQ (for SI program versions above 5.05, choose 8.33 kHz NS SQ) on the display until the squelch just opens (audio turns on).

6.3.5 Using 400SI, store the calibration.

6.3.6 Repeat at Channels 127.000 and 136.975 MHz.

6.4 Receiver Carrier Squelch Calibration - 25 KHz Mode

6.4.1 Recall saved **State 5** on the HP8920A/B.

- RX Mode
- RF GEN Freq = 118.000 MHz
- RF GEN amplitude = 12.5 uV
- AF GEN1 to AM
- AM DEPTH = 85%
- AF GEN1 FREQ = 8 KHz
- AF IN LO to GND
- RFGenVolts ohm/emf = emf on config page
- RF Level Offset ON - configuration page
- RF In/Out = -0.3 dB - configuration page

6.4.2 Enable compressor and squelch by setting the "SQLCH/COMP TEST" switch to the down position.

6.4.3 Tune the Comm frequency to 118.000MHz.

6.4.4 Decrease SQ 250 on the display until the squelch just opens (audio turns on).

6.4.5 Increase SQ 250 one level.

6.4.6 Using 400SI, store the calibration.

6.4.7 Repeat at channels 127.000 and 136.975 MHz.

6.5 Receiver Carrier Squelch Calibration 8.33 KHz Mode

6.5.1 Recall saved **State 5** on the HP8920A/B as outlined in section 6.3.

6.5.2 Change RF GEN amplitude to 3.0 uV (for 012-00585-XX) or keep at 12.5 uV (for 012-01400-XX) on the 8920 test set.

6.5.3 Keep AF GEN1 FREQ at 8 kHz (for 012-00585-XX) or change to 3 kHz (for 012-01400-XX) on the 8920 test set.

6.5.4 Set the channel spacing field on the display for 8.33 kHz.

6.5.5 Tune the Comm frequency to 118.000MHz

6.5.6 Decrease SQ 833 on the display until the squelch just opens (audio turns on).

6.5.7 Increase the SQ 833 one level.

6.5.8 Using 400SI, store the calibration.

6.5.9 Repeat at channels 127.000 and 136.975 MHz.

6.6 Transmitter Driver and Amplifier Adjust

Important! Transmitter driver and amplifier bias current have to be adjusted at power supply voltage at 28V.

6.6.1 Set power supply voltage at +27.5 VDC ± 0.2 VDC.

6.6.2 On the 34401A Multimeter set the terminals to read the rear connection and set the function to read DCI .

6.6.3 Set the RTC switch to the "A" position.

6.6.4 On the SI program set the Comm frequency to 118.000.

6.6.5 Press the Null button on the 34401A and select the XmitCal on the SI Program turning on the transmit calibration. The unit current should not increase more than 75mA. Press Null twice to zero the current reading.

6.6.6 On the Comm test set up page, set the frequency to 118.000Mhz. Set the DRVR and PA pot to 0. Set the TX CAL to Calibrt and adjust the PA pot to the first step above 200mA. The current should not exceed 400mA. Make note of the value.

6.6.7 On the display, set the PA and DRVR pot to 0 and adjust the DRVR pot to the first step above 50mA. The current should not exceed 100mA. Make note of the value.

6.6.8 Set the TX CAL back to normal.

6.6.9　Store calibration values at 118.000, 127.000, and 136.975 MHz.

6.7　28 V Transmitter Output Power Calibration

6.7.1　Set power supply voltage at +27.5 VDC ± 0.2 VDC.

6.7.2　Recall saved **State 6** on HP8920A/B.

- Automatic Tuning
- TX mode
- AF GEN 1 OFF
- RF Level Offset ON - configuration page
- RF In/Out = -0.3 dB - configuration page
- Input Port - RF in

  Important! The rear terminals of the 34401A multi meter must not be connected to the 'B' cable while transmitting. To prevent damage to the equipment disconnect or set the RTC switch to the 'B' position to bypass the meter.

6.7.2　Tune the Comm to frequency 118.000MHz.

6.7.3　Key the transmitter by pressing the MIC KEY on the manual test panel.

6.7.4　Monitor the TX Power on the HP8920A/B.

6.7.5　Increase the XMIT PWR setting on the display until the TX carrier power reaches the first level greater than or equal to 19.0 Watts on the 8920A/B. The power should not exceed 21.0 Watts.

6.7.6　Unkey the transmitter.

6.7.7　Using 400SI, store the calibration.

6.7.8　Repeat at channels 127.000 and 136.975 MHz.

6.8　28 V Transmitter Modulator Adjust

6.8.1　Recall saved **State 7** on the HP8920A/B.

- TX Mode

- Manual Tuning
- Frequency to 118.0 MHz
- AF ANL IN to AM DEMOD
- DE-EMPHASIS to OFF
- DETECTOR to RMS*SQRT2
- AFGEN1 FREQ = 1 KHz
- AFGEN1 LEVEL = 275mV
- Input Port - RF In
- Audio analyzer set to read Distn.

6.8.2   Tune the Comm frequency to 118.000MHz.

6.8.3   Key the transmitter and adjust the MIC setting on the display for 91% - 95% modulation depth.

6.8.4   Unkey the transmitter.

6.8.5   Key the transmitter and increase the MOD DEP setting on the display until the 8920A/B modulation depth reading just falls below 90%. The modulation depth should not exceed 90%.

6.8.6   Unkey the transmitter.

6.8.7   Using 400SI, store the calibration.

6.8.8   Repeat steps 6.8.5, 6.8.6 and 6.8.7 at channels 127.000 and 136.975MHz.

6.9   28 V Transmitter Sidetone Adjust

6.9.1   Recall saved **State 8** on the HP8920A/B.

- TX Mode
- Manual Tuning
- DE-EMPHASIS to OFF
- AF GEN 1 FREQ to 1 KHz
- AF GEN 1 Level to 275 mV
- AF ANL IN to AUDIO IN
- DETECTOR to RMS
- AF IN LO to GND
- Input Port - RF In
- Audio analyzer set to read Distn.

6.9.2   Tune the Comm frequency to 118.000MHz.

6.9.3   Key the transmitter and increase the SIDETN setting on the display until the audio level on the 8920A/B reads 1.4 Vrms +/-0.2 V.

6.9.4   Unkey the transmitter.

6.9.5   Using 400SI, store the calibration.

6.9.6   Repeat at channels 127.000 and 136.975 MHz.

6.10 14 V Transmitter Output Power Calibration (for 012-01400-XX only)

6.10.1   Set power supply voltage at 13.75 VDC ± 0.2 VDC.

6.10.2   Recall saved **State 6** on HP8920A/B.

- Automatic Tuning
- TX mode
- AF GEN 1 OFF
- RF Level Offset ON - configuration page
- RF In/Out = -0.3 dB - configuration page
- Input Port - RF in

6.10.3   Tune the Comm to frequency 118.000MHz.

6.10.4   Key the transmitter by pressing the MIC KEY on the manual test panel.

6.10.5   Monitor the TX Power on the HP8920A/B.

6.10.6   Increase the XMIT PWR setting on the display until the TX carrier power reaches the first level greater than or equal to 12.0 Watts on the 8920A/B. The power should not exceed 13.0 Watts.

6.10.7   Unkey the transmitter.

6.10.8   Using 400SI, store the calibration.

6.10.9   Repeat at channels 127.000 and 136.975 MHz.

6.11 14 V Transmitter Modulator Adjust (for 012-01400-XX only)

6.11.1   Recall saved **State 7** on the HP8920A/B.

- TX Mode
- Manual Tuning
- Frequency to 118.0 MHz
- AF ANL IN to AM DEMOD
- DE-EMPHASIS to OFF
- DETECTOR to RMS*SQRT2
- AFGEN1 FREQ = 1 KHz
- AFGEN1 LEVEL = 275mV
- Input Port - RF In
- Audio analyzer set to read Distn.

6.11.2   Tune the Comm frequency to 118.000MHz.

6.11.3   Key the transmitter and adjust the MIC setting on the display for 91% - 95% modulation depth.

6.11.4   Unkey the transmitter.

6.11.5   Key the transmitter and increase the MOD DEP setting on the display until the 8920A/B modulation depth reading just falls below 90%. The modulation depth should not exceed 90%.

6.11.6   Unkey the transmitter.

6.11.7   Using 400SI, store the calibration.

6.11.8   Repeat steps 6.11.5 and 6.11.6 at channels 127.000 and 136.975MHz.

6.12 14 V Transmitter Sidetone Adjust (for 012-01400-XX only)

6.12.1   Recall saved **State 8** on the HP8920A/B.
- TX Mode
- Manual Tuning
- DE-EMPHASIS to OFF
- AF GEN 1 FREQ to 1 KHz
- AF GEN 1 Level to 275 mV
- AF ANL IN to AUDIO IN
- DETECTOR to RMS
- AF IN LO to GND

- Input Port - RF In
- Audio analyzer set to read Distn.

6.12.2   Tune the Comm frequency to 118.000MHz.

6.12.3   Key the transmitter and increase the SIDETN setting on the display until the audio level on the 8920A/B reads 1.4 Vrms +/-0.2 V.

6.12.4   Unkey the transmitter.

6.12.5   Using 400SI, store the calibration.

6.12.6   Repeat at channels 127.000 and 136.975 MHz.