GNC400 COMM TRANSCEIVER
ALIGNMENT PROCEDURE

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005-00051-55 Rev. T

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Revisions

Rev.	Date	Description of Change	Apprvd.
G	10/26/98	Change tuning order of IF transformers, change RF AGC setting.	9901
H	10/30/98	Increase TX MOSFET bias to 100mA	9929
J	11/20/98	Add 25 KHz noise squelch adjustment, change SI program reference to test page display.	10058
K	8/11/99	Add instructions for tuning –03 board TCXO.	11584
L	5/5/00	Change voltage range on VCO alignment. Add troubleshooting note to TX MOSFET bias setting	13278
M	5/23/00	Add Q-Dope to L302	13396
N	6/7/00	Q504 Fix	13512
P	5/10/01	Eliminate TCXO and RX IF Alignment	15734
Q	08/15/01	Add Digital adjustments for PA and Driver bias, and MIC gain	16341
R	08/20/01	Change AF IN LO from 600 TO HI to GND	16379
S	09/25/01	Change TX MOD adjustment on-05 comm to 80%	16582
T	11/14/01	Update procedures for 16Watt TX	16894

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1. GENERAL

The alignment procedures are intended to be performed after board assembly . The alignment procedures are also used after replacing a component or module causing misalignment. The alignment procedures should be followed in the sequence presented. Certain sections of the radio must be aligned using subsections of the alignment procedure before the whole board can be aligned.

This alignment procedure is written for a complete realignment. If only a subsection is required, use only the initial settings required as outlined in the procedure for the subsection.
The comm board must be placed into a main chassis before alignment. Unless otherwise specified, alignment should be performed with the input power supply set to 27.5 ± 0.2 VDC.

2. REFERENCE DOCUMENTS

004-00044-03 Min Prfm Spec, GNC 400 Comm
016-00214-XX Assy Dwg, GNC400 Comm PCB
016-00611-XX Assy Dwg, GNC400 Comm, 16 Watt
320-00099-06 Ca Assy, (B), GNC400 COMM

2.1 Test Equipment

The test equipment needed to perform an alignment of a GNC 400 COMM XCVR assembly is as listed below.

DESCRIPTION	VENDOR/PART NO.	QTY
0-30VDC/0-6A VARIABLE POWER SUPPLY	TOPWARD MODEL 2306 OR EQUIV	1
486DX PC W / SERIAL PORT	486DX PC W / SERIAL PORT	1
Software - GNC400 Automated Alignment Program		1
MANUAL TEST PANEL	GARMIN GPS/GNC MANUAL TEST PANEL T10-00035-00	1
RADIO TEST SET	HP 8920A WITH OPTIONS 003/019/050/102 OR HP8920B WITH OPTIONS 001/102	1
DIGITAL MULTIMETER	FLUKE 87 W/TEST PROBE LEADS	1

2.2 Setup Procedure

1. Preset variable power supply to +27.5 VDC and set the current limit to 4.0 A.

2. Connect power supply positive output to red 'DC IN +' banana jack on rear panel of Manual Test panel. Connect power supply negative output to black 'DC IN -' banana jack on rear panel of Manual Test panel.

3. Make the following connections for the Manual Test Panel as shown in Figure 1 and described here. Connect an approved 6 ft RG-223 cable between the comm transceiver antenna connector and the HP8920A/B RF IN/OUT connector. Connect the 320-00099-06 Ca Assy, (B), GNC400 COMM to the 26-pin high-density connector on the back of the comm (J2) and to the surface mount connector J26 on the top side of the comm. Connect the other end of the cable to the (B) connector on the manual test panel. Connect COMM AUDIO HI on Manual Test panel to HP8920A/B AUDIO IN HI. Connect Audio Out on HP8920A/B to Manual Test Panel connector marked COMM MIC AUDIO. Connect serial port cable from PC to serial port input connector on manual test panel.

4. Connect positive and negative digital multimeter inputs to COMM IF AGC and GND outputs, respectively, on Manual Test panel. Set up DVM to measure DC voltage in autoscale.

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

6. Insure that PANEL POWER push-button switch and UNIT POWER push-button switch are not depressed and are not lighted (OFF). Turn on external power supply. Push PANEL POWER switch to turn on. Verify that lighted push-button lights up. Push UNIT POWER switch to turn on. Verify that lighted push-button lights up. Monitor 28V voltage with DVM. Set voltage of external power supply at +27.5 VDC. Push UNIT POWER switch to turn off.

7. Test Fixture is now ready for GNC400 COMM XCVR assembly alignment.

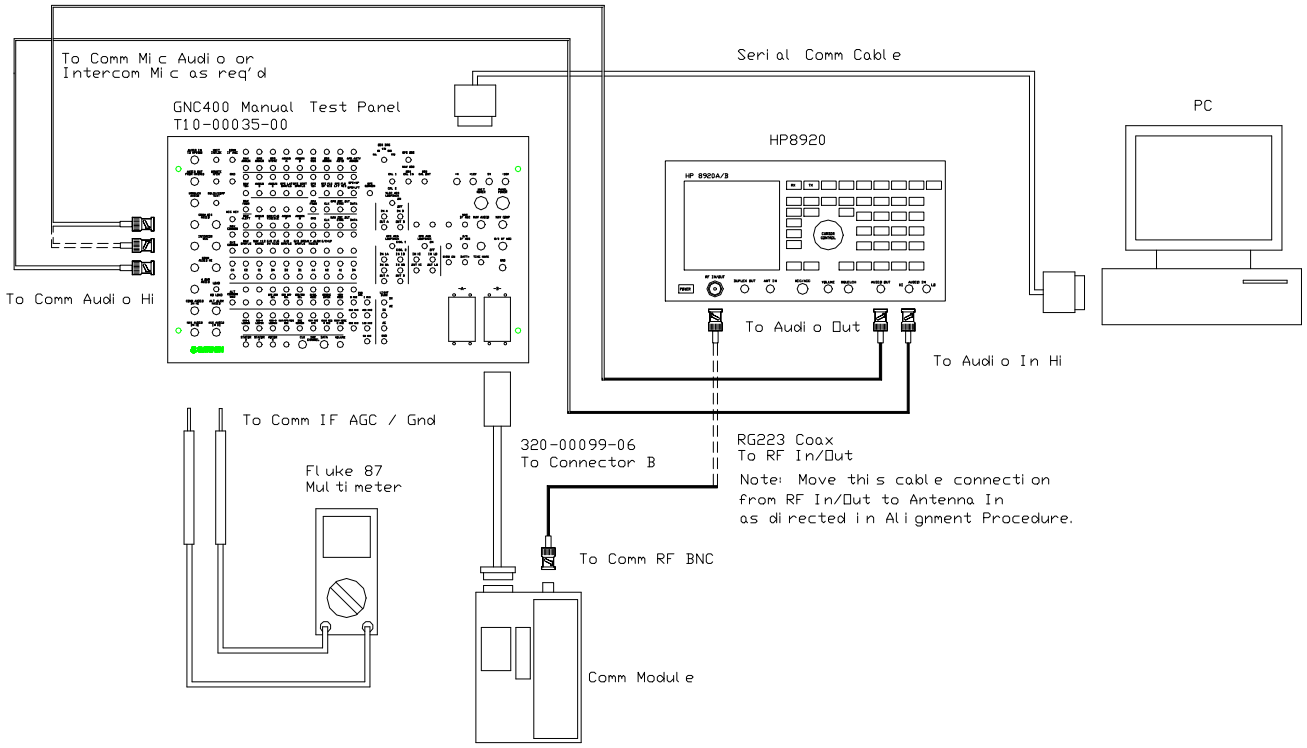

Figure 1

3. COMM TRANSCEIVER ASSEMBLY ALIGNMENT

This section describes the step-by-step procedure used to perform a GNC400 COMM transceiver assembly alignment. Refer to the GNC 400 COMM XCVR MINIMUM PERFORMANCE SPECIFICATION (MPS) Garmin P/N 004-00044-03 for specifications.

The unit should be connected as outlined in section 2.2**.**

3.1 Initial Control Settings

3.1.1 Discrete Adjustment

L104	Pre-selector Pole 1 coil	Mid - range as Factory preset
L106	Pre-selector Pole 2 coil	Mid - range as Factory preset
L109	Pre-selector Pole 3 coil	Mid - range as Factory preset
L111	Pre-selector Pole 4 coil	Mid - range as Factory preset
L200	8.33 kHz Xtal filter Input	Mid - range as Factory preset
L201	25 kHz Xtal filter Input	Mid - range as Factory preset
L202	8.33 kHz Xtal filter Output	Mid - range as Factory preset
L203	25 kHz Xtal filter Output	Mid - range as Factory preset
T200	IF AMP Input Match	Mid - range as Factory preset
T201	IF AMP Output Match	Mid - range as Factory preset
C300	Synthesizer Ref. Osc.	Mid - range as Factory preset

(C300 only on –02 and lower 10 Watt comm boards)

Y301	TCXO Trimmer	Factory preset

(Y301 only on –03 and higher 10 Watt comm boards, and 16 Watt comm boards)

L302	VCO Coil	Mid - range as Factory preset
R558	MIC GAIN	Fully CW
R530	TX Driver Bias	Fully CCW
R563	TX PA-A	Fully CCW
R532	TX PA-B	Fully CCW

(R558, R530, R563, and R532 only on –04 and lower 10 Watt comm boards)

3.1.2 Digital Pots

PRESELECTOR POLE 1	Software Default
PRESELECTOR POLE 2	Software Default
PRESELECTOR POLE 3	Software Default
PRESELECTOR POLE 4	Software Default
RF AGC THRESHOLD	Software Default

(RF AGC THRESHOLD only on –00 10 Watt comm board)

NOISE SQUELCH	Software Default

(NOISE SQUELCH only on –01 and higher 10 Watt comm boards, and 16 Watt comm boards)

SQUELCH 25 kHz	Software Default
SQUELCH 8.33 kHz	Software Default
TRANSMITTER POWER	Software Default
MODULATION DEPTH	Software Default
SIDETONE ADJ	Software Default
PA BIAS CURRENT	Software Default
DRIVER BIAS CURRENT	Software Default
MIC GAIN	Software Default

(PA and DRIVER BIAS CURRENT and MIC GAIN only on –05 and higher 10 Watt comm boards, and 16 Watt comm boards)

3.1.3 Covers

Remove the covers from the synthesizer and RF sections.

3.2 Synthesizer Alignment

NOTE: All synthesizer adjustments should be completed within 60 seconds of a cold start.

3.2.1 VCO Alignment

a. Power up the comm unit in test mode.
b. Change the display to the comm alignment test page
c. Set the Channel Spacing switch for 25 kHz channel spacing.
d. Set the frequency to 136.975 MHz.
e. Monitor TP303 voltage with a DMM.
f. Adjust VCO coil L302 until the voltage reads 11.0 ± 0.1V. If the tuning voltage cannot be set to 11V, adjust for the maximum voltage achievable. The voltage must be greater than 9.50 VDC.
g. Apply Q-Dope (GPN 291-00024-00) to L302.

3.2.2 TCXO Alignment

For –03 and higher 10 Watt comm boards, and 16 Watt comm boards, the integrated circuit TCXO Y301 is pre-aligned by the manufacturer and no adjustment is required.

AT NO TIME DURING THE TCXO ADJUSTMENT PROCEDURE SHOULD THE TRANSMITTER BE KEYED. DOING SO COULD DAMAGE THE 8920!

a. Connect comm transceiver module BNC connector to HP8920A/B ANT IN.
b. Recall saved State 1 on HP8920A/B.
c. State 1 on Radio Test Set:
   - TX mode
   - Manual Tuning
   - Tune Frequency of 158.375 MHz
   - Input Port - Ant
d. Monitor the TX frequency error on the 8920. For –00 and –02 comm boards, adjust C300 until the frequency error is less than ±50 Hz.
e. Install the synthesizer cover on the unit.
f. Remove the BNC cable from the ANT IN port on the 8920 and re-connect it to the RF IN/OUT port. It is now OK to transmit without damaging the 8920.

3.3 Transmitter Power MOSFET Bias Setting

3.3.1 Bias Settings for –04 and Lower 10 Watt Comm Boards

a. Turn off the 28V power supply.
b. Place a DMM configured to read current in line with the 28V supply to the comm. Use the 10A current input and not the 400mA input on the DMM.
c. Turn on the 28V power supply.
d. Zero out the current reading on the display using the REL Δ function on the DMM.
e. Make sure the potentiometers R530, R563, and R562 have been turned fully CCW as outlined in section 3.1.1.
f. On the unit display, set the TX CAL field to CALIBRT. If the current reading on the DMM increases more than 50mA, send the unit to troubleshoot.
g. ***SLOWLY*** Adjust R530 until 28V current is 15 mA ± 5 mA.
h. Zero out the current reading on the display using the REL Δ function on the DMM.
i. ***SLOWLY*** Adjust R532 until 28V current is 100 mA ± 10 mA.
j. Zero out the current reading on the display using the REL Δ function on the DMM.
k. ***SLOWLY*** Adjust R563 until 28V current is 100 mA ± 10 mA.
l. Place the TX CAL field on the display back to normal mode.
m. Turn off the 28V power supply.
n. Remove the DMM from in-line with the 28V supply and reconnect the 28V supply.
o. Turn on the 28V power supply.

3.3.2 Bias Settings for –05 and Higher 10 Watt, and 16 Watt Comm Boards

a. Turn off the 28V power supply.
b. Place a DMM configured to read current in line with the 28V supply to the comm. Use the 10A current input and not the 400mA input on the DMM.
c. Turn on the 28V power supply.
d. Tune the comm to 118.000 MHz.
e. Zero out the current reading on the display using the REL Δ function on the DMM.

f. On the unit display, set the TX CAL field to CALIBRT. If the current reading on the DMM increases more than 50mA, send the unit to troubleshoot.
g. ***SLOWLY*** Adjust the PA digital pot value until 28V current is between 200 and 300mA.
h. Make note of the PA digital pot value and turn it back to 00.
i. ***SLOWLY*** Adjust the DRVR until 28V current is between 50 and 75mA.
j. Make note of the DRVR digital pot value and turn it back to 00.
k. Place the TX CAL field on the display back to normal mode.
l. Adjust the DRVR and PA settings to the values obtained in h and j.
m. Scroll the display to the Store Calibration? field and press ENT on the CDI.
n. Tune the comm to 127.000 MHz.
o. Adjust the DRVR and PA settings to the values obtained in h and j.
p. Scroll the display to the Store Calibration? field and press ENT on the CDI.
q. Tune the comm to 136.975 MHz.
r. Adjust the DRVR and PA settings to the values obtained in h and j.
s. Scroll the display to the Store Calibration? field and press ENT on the CDI.

3.4 Receiver IF Alignment

For –03 and higher comm boards, the receiver IF alignment of section 3.4 is not required.

3.4.1 IF Alignment – 8.33 KHz Mode

a. Recall saved State 2 on the HP8920A/B.

State 2 on Radio Test Set:

- 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
- ohm/emf = emf on config page
- RF Level Offset ON - configuration page
- RF In/Out = -0.3 dB - configuration page

b. Set the COMM frequency to 118.005 MHz, 8.33 KHz mode.
c. While monitoring the IF AGC voltage on the test panel with a DMM, adjust the HP8920A/B RF GEN amplitude until the DMM reads 5.0 ± 0.1 VDC.
d. Adjust T200 until maximum IF AGC voltage is achieved.
e. Adjust T201 until maximum IF AGC voltage is achieved.
f. Adjust L200 until maximum IF AGC voltage is achieved.
g. Adjust L202 until maximum IF AGC voltage is achieved.

3.4.2 IF Alignment - 25 KHz Mode

a. Recall saved state 2 on the HP 8920A/B as in section 3.4.1. Change the FM deviation to 20.0 KHz
b. Set the channel spacing to 25 KHz.
c. Set the COMM frequency to 118.000 MHz, and the HP8920A/B RF GEN Freq to 118.000 MHz.
d. While monitoring the IF AGC voltage on the test panel with a DMM, adjust the HP8920A/B RF GEN amplitude until the DMM reads 5.0 ± 0.1 VDC.
e. Adjust L201 until maximum IF AGC voltage is achieved.
f. Adjust L203 until maximum IF AGC voltage is achieved.
g. Install the cover on the RF section.

3.5 Receiver / Transmitter Digital Pot Adjustments

If the comm automated alignment software is to be used, follow the steps in section 3.5.1. If the digital pots are to adjusted manually, skip to section 3.5.2.

3.5.1 Comm Automated Alignment Instructions

To perform an automated alignment on the comm board:

a. Click on the icon labeled Align 400.
b. Push the 'Set Comm Defaults' button on the screen. Wait while the Freq MHz box cycles through frequencies and returns to 118.000.
c. The manual squelch indicator on the screen must be off. If not, push comm volume knob on the front of the unit to toggle the squelch.
d. Push the 'Auto Align All' button on the screen.
e. The alignment program will begin to run. Follow all instructions that appear in the 'Setup Instructions' box.
f. When the alignment is finished, the 'Auto Align All' indicator must be green. If not, repeat the procedure beginning at step 2.
g. Stop Here. The comm alignment is complete.

3.5.2 Receiver Preselector Alignment

a. Recall saved State 3 on the HP8920A/B.
b. State 3 on Radio Test Set:
   - RX mode
   - RF GEN FREQ = 118.000 MHz
   - RF GEN amplitude = 10 μV
   - AF GEN1 OFF
   - ohm/emf = emf on config page
   - RF Level Offset ON - configuration page
   - RF In/Out = -0.3 dB - configuration page
c. Set the COMM frequency to 118.000 MHz.
d. Set the channel spacing to 25 KHz
e. While monitoring the IF AGC voltage on the test panel with a DMM, adjust the HP8920A/B RF GEN amplitude until the DMM reads 5.0 ± 0.1 VDC.
f. Adjust POLE 1 on the display until maximum IF AGC voltage is achieved.
g. While monitoring the IF AGC voltage on the test panel with a DMM, re-adjust the HP8920A/B RF GEN amplitude until the DMM reads 5.0 ± 0.1 VDC.
h. Adjust POLE 2 on the display until maximum IF AGC voltage is achieved.
i. While monitoring the IF AGC voltage on the test panel with a DMM, re-adjust the HP8920A/B RF GEN amplitude until the DMM reads 5.0 ± 0.1 VDC.
j. Adjust POLE 3 on the display until maximum IF AGC voltage is achieved.
k. While monitoring the IF AGC voltage on the test panel with a DMM, re-adjust the HP8920A/B RF GEN amplitude until the DMM reads 5.0 ± 0.1 VDC.
l. Adjust POLE 4 on the display until maximum IF AGC voltage is achieved.
m. Repeat steps e, g, i, and k to fine tune the preselector poles - it is not necessary to re-adjust the RF input level each time.

3.5.3 Receiver Noise Squelch Calibration - 25 KHz Mode

a. Recall saved State 4 on the HP8920A/B.

b. State 4 on Radio Test Set:
   - 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
   - ohm/emf = emf on config page
   - RF Level Offset ON - configuration page
   - RF In/Out = -0.3 dB - configuration page
c. Enable compressor and squelch.
d. Increase NS SQ on the display until the squelch just opens (audio turns on).

3.5.4 Receiver Carrier Squelch Calibration - 25 KHz Mode

a. Recall saved State 5 on the HP8920A/B.
b. State 5 on Radio Test Set:
   - 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
   - ohm/emf = emf on config page
   - RF Level Offset ON - configuration page
   - RF In/Out = -0.3 dB - configuration page
c. Enable compressor and squelch.
d. Decrease SQ 250 on the display until the squelch just opens (audio turns on).
e. Increase SQ 250 one level.

3.5.5 Receiver Carrier Squelch Calibration - 8.33 kHz Mode

a. Recall saved State 5 on the HP8920A/B as in section 3.5.4.
b. Change RF GEN amplitude to 3.0 uV.
c. Set the channel spacing field on the display for 8.33 kHz.
d. Decrease SQ 833 on the display until the squelch just opens (audio turns on).
e. Increase the SQ 833 one level

3.5.6 Transmitter Output Power Calibration

a. Recall saved state 6 on HP8920A/B.
b. State 6 on Radio Test Set:
   - 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
c. Key the transmitter.
d. Monitor the TX Power on the HP8920A/B.
e. For 10 Watt transmitters: 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.
f. For 16 Watt transmitters: Increase the XMIT PWR setting on the display until the TX carrier power reaches the first level greater than or equal to19.0 Watts on the 8920A/B. The power should not exceed 21.0 Watts
g. Unkey the transmitter.

3.5.7 Transmitter Modulator Adjust

3.5.7.1 Modulator Adjustment for 10 Watt comm boards

a. Recall saved State 7 on the HP8920A/B.
b. State 7 on Radio Test Set:
   - TX Mode
   - Automatic Tuning
   - AF ANL IN to AM DEMOD
   - DE-EMPHASIS to OFF
   - DETECTOR to RMS*SQRT2
   - AFGEN1 FREQ = 1 KHz
   - AFGEN1 LEVEL = 275 mV
   - Input Port - RF In
   - Audio analyzer set to read Distn.

c. For –04 and lower boards: Key the transmitter and adjust R558 for 90% - 95% modulation depth. ***NOTE: Only perform this adjustment once at 118.000 MHz. Do not repeat it at 127.000 and 136.975 MHz.***

d. For –05 and higher boards: Key the transmitter and adjust the MIC setting on the display for 90% - 95% modulation depth.***.***

e. Unkey the transmitter.
f. Key the transmitter and increase the MOD DEP setting on the display until the 8920A/B modulation depth reading just falls below 80%. Decrease the MOD DEP setting one step to put the modulation reading at, or above 80%. The modulation depth should not exceed 85%
g. Unkey the transmitter.

3.5.7.2 Modulator Adjustment for 16 Watt comm boards

a. Recall saved State 7 on the HP8920A/B.
b. State 7 on Radio Test Set:
   - TX Mode
   - Automatic Tuning
   - AF ANL IN to AM DEMOD
   - DE-EMPHASIS to OFF
   - DETECTOR to RMS*SQRT2
   - AFGEN1 FREQ = 1 KHz
   - AFGEN1 LEVEL = 275 mV
   - Input Port - RF In
   - Audio analyzer set to read Distn.

c. Key the transmitter and adjust the MIC setting on the display for 90% - 95% modulation depth.
d. Unkey the transmitter.
e. Key the transmitter and increase the MOD DEP setting on the display until the 8920A/B modulation depth reading just falls below 85%. Decrease the MOD DEP setting one step to put the modulation reading at, or above 85%. The modulation depth should not exceed 90%
f. Unkey the transmitter.

3.5.8 Transmitter Sidetone Adjust

a. Recall saved State 8 on the HP8920A/B.
b. State 8 on Radio Test Set:
   - TX Mode
   - Automatic 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.

c. 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.
d. Unkey the transmitter.

Scroll the display to the Store Calibration? field and press the ENT button on the CDI.

Repeat section 3.5 in its entirety at 127.000 and 136.975 MHz. Be sure to set the frequency on the HP8920A/B and the unit to the proper channel as required.