STATION ALIGNMENT

1. GENERAL

This section describes the alignment procedure for *PURC 5000* stations with Advanced Control. Before aligning a station, the configuration procedure described in Station Configuration section 68P81085E81 must be reviewed in its entirety. All operating parameters are software controlled and are programmable from the front mounted control panel. Control panel operation, menu selection, and data entry procedures are described in Description and Operation section 68P81085E78. The Description and Operation section also contains a full description of each of the station's parameters and functions. The *PURC 5000* is factory aligned for proper operation. The following procedure should be followed to verify or change station alignment.

NOTE

When any of the functions under the ALGN (Station Alignment), or the SERV (Service Mode) main menus (except User Audio) are invoked, the station is access disabled and the control panel disable LED will light. Whenever the station is keyed from the control panel in any of the alignment modes under the ALGN or SERV main menus, the station will remain keyed for 5 minutes. The station may be de-keyed at any time by depressing the **Exit** key.

2. TEST EQUIPMENT

- Audio Generator
- Modulation Analyzer - Deviation meter, monitor
- Oscilloscope
- Frequency Counter
- RF Signal Generator
- Volt-Ohm Meter
- Tuning Tool (Motorola kit No. TRN9282A)
- Audio Cable for Control Panel Jacks (Motorola Part No. 3083902P01).

3. ALIGNMENT PROCEDURE

The following paragraphs describe the alignment of a given function or group of functions. For convenience, each section is preceded by a list of all menu entries/functions which are addressed by, and described in the section's description. Each item in the list contains a full pathname to the lowest level entry. For example, main menu\sub menu 1\sub–menu 2\entry. In the alignment description, entries are only referred to by their lowest level name, as the full pathname appears in the list preceding the description.

3.1 PRELIMINARY CHECKS

CAUTION

The *PURC 5000* station contains CMOS devices. Good troubleshooting/installation techniques require proper grounding of personnel prior to handling equipment. Refer to the Safe Handling of CMOS Integrated Circuits Devices instruction section of this manual.

Before attempting alignment, check to be sure that all the station equipment is functioning properly. The following steps provide a quick method of verification.

Step 1. Verify all boards are seated securely in the control tray, and that all backplane connections are correct.

Step 2. Verify the +5V and A+ LEDs on the Power Supply/Line Interface Board are lit.

Step 3. Reset the station by pressing the **Rst** key on the station control panel. All LEDs should light, and a software version number will be momentarily displayed on the control panel display. When all internal diagnostics are complete and successful, a momentary 'READY' message will appear on the control panel display. Only the **Tx Lck** LED and the **Alm** (Alarm) LED should be lit. The **Alm** LED will light to indicate a RESET occurred.

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The alarm may be cleared under the Station Alarms submenu of the ALM (Alarms) main menu. Refer to Description and Operation section 68P81085E78 for more details on clearing alarms.

NOTE

If the transmit frequencies were changed by several megahertz during configuration, the **Tx Lck** LED may not be lit. In this case, the VCO may need to be realigned as described in the following VCO alignment section.

Step 4. Make sure the station's RF output is properly loaded in a 50 ohm load capable of absorbing the maximum station output power.

If the station does not pass any of the preliminary checks, refer to the appropriate troubleshooting guides in the station service manual. See Table 2 in Description and Operation section 68P81085E78 for a list of *PURC 5000* service manuals.

3.2 VCO FREQUENCY ALIGNMENT

NOTE

The VHF and 280 MHz transmit VCOs are not field adjustable, and are designed to lock over the entire band of operation. This section may be skipped when aligning VHF and 280 MHz stations.

Normally, the transmit VCO will require only slight adjustment over time. However, if after programming new transmit frequencies, the control panel **Tx Lck** LED is not lit, the VCO will require alignment.

Step 1. Turn the locking cams on the RF tray cover to the transit position.

Step 2. In multiple frequency radios, set the station to the highest frequency channel by setting the proper channel in the Current Channel field of the STN - Station main menu.

Step 3. Plug a Radio Metering Panel (RMP) into Tx J413 found on the RF tray front panel.

Step 4. Using the tool kit allen wrench, adjust the VCO tuning screw for a reading of 38 μA + 1.5/–0.5 on meter 5. Turn the allen wrench counter–clockwise to reduce the meter reading, and turn the wrench clockwise to increase the meter reading.

Step 5. Turn the locking cams on the RF tray cover to the operate position.

3.3 TRANSMIT POWER OUTPUT (PO) ADJUSTMENT

- SERV\Key Analog Pass Audio
- SERV\Key and Read Power

This section describes Power out (**Po**) adjustment as well as the overdrive cutback adjustment. Note that only high power stations equipped with a driver power amplifier deck use the overdrive cutback circuitry. Omit steps 1–5 when aligning low power stations that do not contain a driver power amplifier deck.

NOTE

To ensure full power operation on all station channels, the power out and overdrive trip point should be set on the channel which produces the lowest power output. This is typically the lowest frequency channel.

Step 1. Terminate the station in a 50 ohm load and adjust the **Po Power Set** potentiometer, accessible from the RF tray's front panel, fully counter–clockwise (min power).

Step 2. Preset R453 on the Uniboard fully clockwise.

Step 3. Key the station via the Key Analog Pass Audio function.

Step 4. Adjust the power out to the level indicated in the overdrive column of Table 1, depending on frequency band and RF peripherals.

Step 5. Adjust R453 on the Uniboard until the station's power out drops by approximately 3dB.

Step 6. Rotate the **Po Power Set** potentiometer fully counter–clockwise.

Step 7. Key the station via the Key Analog Pass Audio function and adjust **Power Set Po** for desired power output. Table 1 contains the maximum rated output power by frequency band and RF peripherals.

If the station is equipped with the optional wattmeter, power output may be set using the internal wattmeter. Keying the station with the Key and Read Power function will cause the display to cycle through the current forward power, reflected power and VSWR. The display may be frozen at any of these three settings by pressing the **Tog** (toggle) key. Depressing the **Tog** key again will resume cycling.

NOTE

Prior to setting power with the optional internal wattmeter, the wattmeter must be calibrated as in the following paragraph. Factory installed wattmeters are fully calibrated but field installations must be calibrated before accurate measurements can be made.

Table 1. Power Settings for PURC 5000 Stations

900 MHz						
	No Circulator		Single Circulator		Triple Circulator	
Station (W)	Power Set (W)	Overdrive (W)	Power Set (W)	Overdrive (W)	Power Set (W)	Overdrive (W)
150	N/A	N/A	160	220	135	180
VHF						
125	130	N/A	115	N/A	Not Available	
350	355	425	310	392	Not Available	
280 MHz						
125	131	N/A	105	N/A	Not Available	
UHF						
225	N/A	N/A	235	285	N/A	N/A
110	N/A	N/A	115	N/A	80	N/A
75	N/A	N/A	80	N/A	55	N/A
40	N/A	N/A	45	N/A	35	N/A
15	N/A	N/A	17	N/A	13	N/A
6	N/A	N/A	6.3	N/A	4.3	N/A

3.4 WATTMETER CALIBRATION

- ALGN\Calibrate Wattmeter
- SERV\Key and Read Power

The wattmeter is factory calibrated and does not require re-calibration under normal circumstances. However, when replacing a wattmeter element or Advanced Control board, the wattmeter calibration procedure must be followed.

NOTE

The wattmeter should be calibrated only after the station has been keyed continuously for ten minutes.

Step 1. Key the station via the Calibrate Wattmeter function.

Step 2. Measure the output power using an external accurate wattmeter and enter the value into the control panel display. Depress the **Ent** key; this will enter the value and de-key the station.

Step 3. Invoke the Key, and Read Power function to verify the control panel display reading matches the external wattmeter reading.

3.5 INPUT AUDIO LEVEL AND DEVIATION ADJUSTMENTS

3.5.1 Link Receiver Audio Adjust

- RX\RX DPL/PL Enable/Disable
- ALGN\Measure De-Emphasized RX Level

If the station is equipped with C659-C663 or C850 link receiver options, adjust the receiver audio output as follows. When adjusting wireline controlled stations, skip this section.

NOTE

The following steps outline only the audio level adjustment and do not cover the RF alignment of the Link Receiver. For a full description of Link Receiver RF tuning, see the appropriate section of 68P81064E10 *PURC 5000* Link Receiver manual. The Measure De-emphasized RX Level function gates de-emphasized link receiver output to the front panel **Usr Aud** jack for alignment and 20 dBQ measurements. The following procedure replaces the Receive Audio Level Adjustment section of the System Information section of the Link Receiver manual. The RF sections of the Link Receiver must be properly aligned before proceeding with the audio adjustment procedure.

Step 1. Set the receiver front panel squelch control fully counter-clockwise (unsquelched). The coded squelch function in *Digital Private-Line* equipped receivers should be disabled by toggling the RX DPL/PL Enable/Disable field.

Step 2. Invoke the Measure De-emphasized RX Level function.

Step 3. Connect an RF signal generator to the receiver antenna connection. Adjust the generator output for an RF level of 1000 μV rms, modulated with a 1000 Hz test tone at system deviation.

Step 4. Adjust R203 on the Link Receiver Audio and Squelch board until a reading of 0.61V ±0.05V is displayed on the control panel display.

NOTE

0.61V on the control panel display corresponds to a -5 dBm receiver output level.

Step 5. Leave the test equipment connected, but exit the Measure De-Emphasized RX Level function and return to the ALGN main menu.

3.5.2 Advanced Control Board Input Gain Adjust

- ALGN\Input Audio Level

Step 1. Apply a 1 kHz test tone at the system level (see note) to Line 1 on the station junction box. If the station is equipped with options C659–663 or C850 link receiver, modulate an on-channel RF signal with a 1 kHz test tone at system level deviation.

NOTE

The system level is defined as the nominal audio input level required to achieve nominal transmit deviation. Stations are factory aligned with a default system level of -5 dBm. During installation, the station must be realigned using the actual system level. Ideally, the test tone should be generated by the paging terminal and distributed to each paging transmitter by the normal control path. Make certain that all control path level adjustments have been completed before proceeding.

Step 2. Invoke the Input Audio Level function.

The Advanced Control board will automatically adjust the audio gain stages for the optimal board level and display 'Adj Gain' on the control panel display. In this mode the station continually monitors the input level and adjusts the gain accordingly to achieve an optimal board level. One of three messages is displayed after each measurement pass. If 'Too Low' is displayed, check the test tone level and external audio connections. If 'Too High' is displayed, check the test tone level for proper adjustment. When 'Complete' is displayed, exit the function.

3.5.3 Transmit Deviation Programming

- TX\TX Deviation Setup\Maximum Deviation
- TX\TX Deviation Setup\Nominal Deviation

The Advanced Control board is factory configured for a nominal audio transmit deviation of ±3 kHz. The maximum audio deviation is factory configured for ±5 kHz. The station may be re-configured for desired operation by editing the Maximum Deviation and Nominal Deviation parameters.

NOTE

The VCO calibration procedure described in the following section is required to account for modulation sensitivity differences in station hardware.

3.5.4 VCO Modulation Sensitivity Calibration

- STN\Current Channel
- ALGN\Calibrate VCO

This section describes the calibration steps required to account for modulation sensitivity variations in the modulation hardware. The station has been factory calibrated and need not be re-calibrated unless a new Advanced Control board, Uniboard, or VCO is installed.

IMPORTANT

In multi-frequency stations, the VCO should be calibrated on the channel which produces the highest transmit deviation. This frequency may be the highest or lowest radio frequency depending on the frequency band of operation. The channel can be changed from the front panel by editing the Current Channel field.

Step 1. Invoke the Calibrate VCO function. The display will read VCO 1 followed by the current correction table entry. Depress the **Ent** key.

Step 2. The station will automatically key and modulate the transmitter with a software generated 1012.5 Hz tone at a level which would produce 1 kHz deviation with nominal modulation circuitry. The display will flash the current correction table entry.

Step 3. Enter the actual recovered deviation as read on an external frequency deviation meter. Depress the **Ent** key.

Step 4. Step Down to VCO 2. The display will then show VCO 2 followed by the current correction table entry. Depress the **Ent** key.

Step 5. Enter the actual recovered deviation as read on an external frequency deviation meter. Depress the **Ent** key.

Step 6. Repeat steps 4 and 5 for VCO 3, VCO 4, VCO 5, VCO 6, and VCO 7 corresponding to 3, 4, 5, 6 and 7 kHz deviation.

3.5.5 Nominal Deviation Verification

- ALGN\Nominal Deviation

The nominal deviation is set as described in paragraph 3.5.3 and may be verified or modified by following this procedure.

Step 1. Apply a 1 kHz test tone at the system level (see note) to Line 1 on the station junction box. If the station is equipped with options C659–663 or C850 link receiver, modulate an on–channel RF signal with a 1 kHz test tone at system deviation.

NOTE

The system level is defined as the nominal audio input level required to achieve the nominal transmit deviation. Stations are factory aligned with a default system level of –5 dBm. During installation, the station must be realigned using the actual system level. Ideally, the test tone should be generated by the paging terminal and distributed to each paging transmitter by the normal control path. Make certain that all control path level adjustments have been completed before proceeding.

Step 2. Invoke the Nominal Deviation function.

Step 3. The station will key and modulate the carrier with the test tone at the nominal deviation level. The display will flash the current nominal deviation.

Step 4. Monitor the recovered deviation.

Step 5. The nominal deviation may be changed by keying in the new desired deviation and pressing the **Ent** key. Press the **Exit** key and the station will de–key.

3.6 LINE 2 OUTPUT LEVEL ADJUST

This section pertains to stations requiring adjustment for wireline MDC tones, verification tones, or monitor receiver audio. The source of the Line 2 output audio may be either internal or external. An internal source refers to tones generated by the Advanced Control board. An external source refers to a monitor receiver with output audio routed to the Advanced Control board. The appropriate subsection should be followed depending on the source of Line 2 audio.

3.6.1 LINE 2 ADJUST/EXTERNAL SOURCE

- ALGN\Measure De–Emphasized RX Level
- ALGN\Output Audio/Ext Source

Skip this section for stations with no C664 monitor receiver option, or equivalent field upgrade.

NOTE

The following steps outline only the audio level adjustment and do not cover the RF alignment of the Monitor Receiver. For a full description of Monitor Receiver tuning, see the appropriate section of the option manual. When tuning the receiver, the Measure De–emphasized RX Level function is used to route the monitor receiver output audio to the **Usr Aud** jack on the front panel.

Step 1. Invoke the Measure De–emphasized RX Level function.

Step 2. Connect an RF signal generator to the receiver antenna connection. Adjust the generator output for an RF level of 1000 μV rms, modulated with a 1000 Hz test tone at system deviation.

Step 3. Adjust R203 on the Monitor Receiver Audio and Squelch board until a reading of 0.61V ± 0.05V is displayed on the control panel display.

NOTE

0.61V on the control panel display corresponds to a –5dBm RX output level.

Step 4. Exit the Measure De–Emphasized RX Level function.

Step 5. Step down to the Output Audio/Ext Source function. The display will show the wiper position of the Line 2 level adjustment potentiometer. The gain range, from lowest to highest, is 0–99.

Step 6. Adjust the wiper position by depressing **Ent**, key in the new number, and press **Ent** again to reach the desired level at Line 2 on the station junction box.

3.6.2 LINE 2 ADJUST/INTERNAL SOURCE

- ALGN\Output Audio/Int Source

Skip this section if not using MDC or verification tone generation.

Step 1. Invoke the Output Audio/Int Source function. The display will show the wiper position of the Line 2 level adjustment potentiometer. The gain range, from lowest to highest, is 0–99. The station will generate a test *MDC–1200* message and route it to Line 2.

Step 2. Adjust the wiper position by depressing **Ent**, key in the new number, and press **Ent** again to reach the desired level at Line 2 on the station junction box.

3.7 BINARY DEVIATION ADJUSTMENTS

This section describes the procedure for aligning the paging synthesizer frequency and binary deviation poten-

tiometers. Prior to setting the binary deviation pots, the paging synthesizer must be properly aligned as follows. Normally, the paging synthesizer will require only slight adjustment over time. However, proper alignment should be verified before adjusting binary deviation. Refer to the Paging Synthesizer Circuit Board detail in the service manual for test point locations.

3.7.1 Paging Synthesizer Reference Oscillator Adjustment

Step 1. Adjust U1 warp coil for 1.5 ±0.1 VDC at test point 1 on the paging synthesizer board. A high resistance (11 Megohm) voltmeter must be used at this test point.

Step 2. Adjust CE1 warp capacitor for 4.7 ±0.3 VDC at test point 2 on the paging synthesizer board. Again a high resistance voltmeter is required.

3.7.2 Binary Deviation Programming

- TX\Nominal Binary Deviation

The Advanced Control board is factory configured for a nominal binary transmit deviation of ±4 kHz. The station may be re-programmed for desired operation by editing the Nominal Binary Deviation parameter.

3.7.3 Paging Synthesizer Binary Deviation Adjustment

- TX\Remote Frequency Adjust
- STN\Current Channel
- ALGN\Carrier HSO
- ALGN\Binary + Reference
- ALGN\Binary - Reference
- ALGN\Carrier VCXO
- ALGN\Binary + Dig
- ALGN\Binary - Dig
- ALGN\Binary - Inst

After the paging synthesizer is properly aligned the binary deviations may be setup. The positive and negative binary deviation is usually ±4 kHz. However, this can be offset by up to 1 kHz for simulcast systems, for example +5 kHz and -3 kHz. Using these offsets allows for station-to-station carrier offsets in the binary mode while maintaining analog mode carriers within 1 Hz of each other.

IMPORTANT

In multi-frequency radios the binary deviation should be set on the highest frequency channel. The channel may be changed from the control panel by editing Current Channel entry.

Step 1. Invoke the Carrier HSO function. The station will key with a silent carrier.

Step 2. Measure the station output frequency. Only change the UHSO/HSO frequency when netting a simulcast system.

IMPORTANT

Make certain the paging synthesizer has been properly aligned, as described in paragraph 3.7.1, before warping the UHSO/HSO. Before adjusting the UHSO/HSO frequency, the oscillator should be allowed at least a 24 hour warm-up period. The UHSO/HSO will reach its specified aging rate after approximately a five day warm-up.

IMPORTANT

Before warping the UHSO/HSO make certain that the Remote Frequency Adjust (steps) field is zero if the feature is enabled.

Step 3. If necessary, remove the cover screw on the paging synthesizer front panel and CAREFULLY warp the UHSO/HSO so that the station frequency is within 1 Hz of the exact carrier frequency.

WARNING

The UHSO/HSO must be adjusted with tuning tool 66P84974L01, part of tuning tool kit TRN9282A. Use of excessive force or any other tuning tool may cause damage to delicate internal parts.

WARNING

When measuring the carrier frequency of a simulcast station, the frequency counter used must have a stability at least ten times more stable than the station's UHSO/HSO. If a meter with the required stability is not available, do not attempt to adjust the UHSO/HSO frequency.

Step 4. Replace the UHSO/HSO cover screw, note the exact carrier frequency, and exit the Carrier HSO function.

Step 5. Step down to the Binary + Reference function and depress **Ent**. The station will key.

Step 6. Adjust the + Reference potentiometer on the paging synthesizer front panel for the required positive recovered frequency deviation from the frequency noted in step 4.

Step 7. Exit the Binary + Reference function, step down to the Binary - Deviation function and depress **Ent**. The station will key.

Step 8. Adjust the - Reference potentiometer on the paging synthesizer front panel for the required negative recovered frequency deviation from the frequency noted in step 4.

Step 9. Exit the Binary - Reference function, step down to the Carrier VCXO function and depress **Ent**. The station will key.

Step 10. Through the top cover of the paging synthesizer, adjust the channel element 'CE 1', for on-frequency operation within ± 500 Hz. Note the frequency.

Step 11. Exit the Carrier VCXO function, step down to the Binary + Dig function and depress **Ent**. The station will key.

Step 12. Adjust the + Digital potentiometer, on the paging synthesizer front panel, to the required positive recovered frequency deviation from the frequency noted in step 10.

Step 13. Exit the Binary + Dig function, step down to the Binary - Dig function and depress **Ent**. The station will key.

Step 14. Adjust the - Digital pot on the paging synthesizer front panel to the required negative recovered frequency deviation from the frequency noted in step 10.

Step 15. Exit the Binary - Dig function, step down to the Binary/Inst function and depress **Ent**. The station will key.

Step 16. The Advanced Control board keys and modulates the transmitter with a 1200 Baud comma at the nominal binary deviation displayed on the front panel.

Step 17. The instantaneous binary deviation may now be adjusted to the desired level by entering a new value via the numeric keys on the control panel followed by pressing the **Ent** key.

Step 18. Exit the Binary/Inst function by pressing the **Exit** key.

3.8 ALIGNMENT COMPLETION

- RX\Delay (value)
- RX\Delay Enable/Disable
- TX\Special TX Setup\Audio Phase Inversion
- TX\Special TX Setup\Binary TX Data Inversion

Before returning to normal operation, the **Exit** key must be depressed until 'READY' is displayed. The station is now fully aligned and ready for normal operation.

IMPORTANT

When a Link Receiver Option is installed in a *PURC 5000* station, be sure its SQUELCH control is NOT left in an unsquelched position after installation, alignment or maintenance. This will assure proper station operation.

Prior to installation completion, the desired amount of station delay may be programmed in the Delay (value) field.

NOTE

In simulcast systems, whenever zero delay is desired, the delay line should be enabled and programmed with a value of zero.

Furthermore, a 180 degree audio phase inversion, and a binary transmit data inversion may be enabled as required.

Alignment may be completed by depressing the **Rst** key. After a reset, the Alarm LED will light to indicate a RESET has occurred. The alarm may be cleared under the Station Alarms sub-menu of the ALM (Alarms) main menu. Refer to Description and Operation section 68P81085E78 for more details on clearing alarms.