650-049020
RT/P2000 V/U Power Amp/800 Filter Board Alignment Procedure
REV. A

Purpose: To align the P2000 VHF or UHF 10 watt amplifier boards or the 800 MHz low pass filter board for power flatness and maximum harmonic rejection.

Procedure: The Alignment procedure is broken up into 3 main stages as follows. The first stage is the **Initial Setup and DC Voltage Tests** and applies to all versions of the P2000; VHF, UHF and 800 MHz. The second stage is the **Swept RF power Measurements** and applies to the VHF and UHF 10 watt amplifier boards only as there is no swept power tests required for the 800 MHz board**.** The final part is **HI power, Harmonic, DC current and Hi/Low power Tx indicator measurements**. The 800 MHz CW test requires driving with an 800 MHz driver amplifier, the WEI800, while VHF and UHF use the Mini Circuits driver amp. The VHF and UHF Harmonic test require that a High pass filter be installed between the coupler output and the analyzer input and that the PA test cover be in place to achieve accurate harmonic readings without overloading the analyzer. During some of the steps there are sections in the test data sheet that are to be filled out along with the power amp boards serial number, frequency range and the initials of the technician who is performing the measurements. This document covers the VHF, UHF and 800 MHz amp and passive filter boards as well as does the accompanying data sheet. Note: Make sure that the test box fan is running during all tests and when using the WEI800 driver module that its supply voltage is set to 8.5 volts.

Test Equipment Required:

QTY	Description
1.	RT/P2000 power amplifier test set.
1.	HP RF power meter
1.	HP8657B or equivalent RF generator. Freq range of 130 to 870 MHz capable of +17 dBm output
1.	HP70000 or equivalent spectrum analyzer with tracking generator. Range, 1MHz to 2.5 GHz. +30 dBm RF input handling level.
1.	Mini Circuits ZHL-1042J/ 15 volt supply, Amp for VHF and UHF test
1.	WEI800 Mhz ~2.5 watt with 8.5 Volt supply, P2000 driver module for 800MHz board tests
1.	30 dB >=50 watt RF power Attenuator.
1.	40 dB high power RF directional coupler.
1.	VHF Band analyzer High Pass Filter **VHPF**
1.	UHF Band Analyzer High Pass Filter **UHPF**
1.	28 volt/3 amp minimum DC power supply.
1.	Digital Voltmeter, DVM.
1.	Powdered iron/ brass tuning wand.
1.	P2000 calibration cable assy. Output 50 ohm cable is a BNC male to TNC male connected to a TNC female jack that is soldered to a MMCX male socket and the input 50 ohm coax is a MMCX female on one end and a BNC male connector on the other end (used to cal out system losses, these input/output cables match the length of the 2 cables used below)
1.	50 ohm coax with a BNC male on one end and a TNC male on other end. Length matches that of P2000 calibration assy. above. Used for output connection.
1.	50 ohm coax with BNC male on one end and MMCX female on other end, length matches that of the P2000 calibration cable assy. above within .2” Used for input connection.
1.	Insulated probe/alignment tool
1.	Variable 8 volt to 15 volt @ >= 2 amp DC supply for the WEI800 and Mini circuits driver amps.
A/R	50 ohm jumper cables for RF generator to driver amps less than or equal to 18 inches long
1	RT/P2000 PA board test cover with cutout hole for +5 volt press in lead

P2000 Power amplifier Module level Alignment
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Initial Setup and DC Voltage Tests

1.0 Initial setup and low pass filter alignment: The Power amplifiers low pass filters are initially aligned in Section 1 with the aid of the P2000 power amp test fixture, this requires the use of the spectrum analyzer with tracking generator to simulate the RF drive.

Initial adjustments:
Set the equipment up as shown in figure 1.1. Prior to applying power to the test fixture turn control R42 fully counter clockwise (typically several turns will be sufficient). Screw the power amp/filter board down to the test fixture at all points. Attach the test box cable being careful to observe the 27.5 volt polarity.

1.1 **DC Voltage Check**. Apply 27.5 volts DC power to the test box and for the VHF/UHF board connect a jumper from test box +5 volts to TP1 on the power amp board. This jumper is not required when testing an 800 MHz board. Turn test box power on and set the test box switches according to the measurement conditions in the data sheet under section 1.1. Using the digital voltmeter (DVM) record the DC voltages listed in Table 1.0 under initial DC voltages .

1.1.1 Record the initial 27.5 volt power supply current reading on the test sheet under **INITIAL CURRENT**.

1.1.2 Slowly adjust R42 so that the power supply current reading increases by 450 milli Amps(+-50mA)above the initial reading. Record '**INITIAL+ Q19 BIAS'** current on the test sheet.

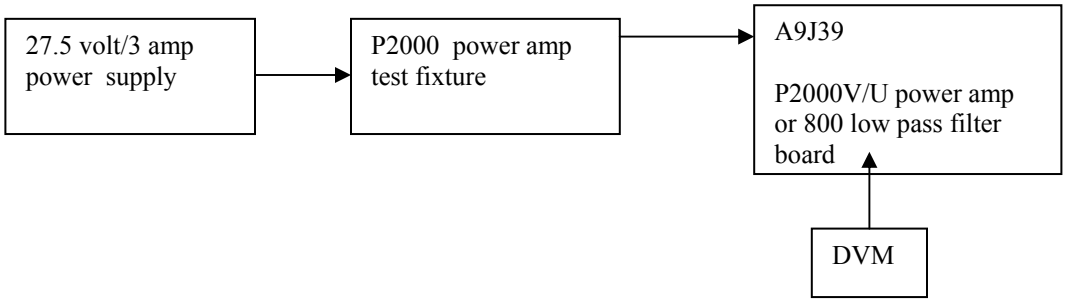

Figure 1.1 initial setup for DC measurements

Swept RF power Measurements

1.2 **Cable calibration alignment**. Connect the spectrum analyzer RF out to the Mini circuit amplifiers input, connect the amps output to the couplers RF input using the P2000 calibration cable Assy. Connect the couplers forward port to the analyzers RF input and the RF output to the 30 dB attenuator/pad as shown in figure 1.2 below. Set the tracking generator for -5 dBm output power for both the VHF or the UHF boards. Adjust the span to track from 130 to 2000 MHz, set the analyzer as follows resolution bandwidth for 10 kHz, the attenuation to 0 dB, the reference level to 0 dBm and perform a through loss zero cal of this setup by following the proper procedure in the spectrum analyzers manual. **Note:** There is no 800 Board sweep test required, only a CW test in section 1.8

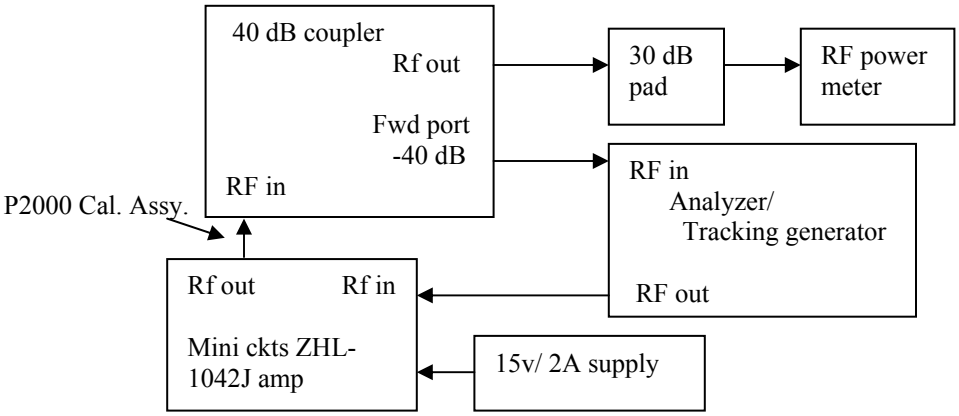

Figure 1.2 System zero loss calibration connection

1.3 Once calibrated connect either the Mini circuits amp RF out to the P2000 board under tests at A9J40 Using the 50 ohm BNC to MMCX cable. Connect the P2000 boards RF output at A9J34 to the input of the directional coupler with the TNC to BNC cable and connect the test box ribbon cable to the DUTs A9J39 connector as shown in figure 1.3 below.

1.4 With tracking generator RF off, turn the test fixture power on. For VHF or UHF boards connect a jumper from the test boxes +5 volt terminal to TP1. Place the TX/RX switch in the TX position, place the Hi/Lo switch to HI. Change the analyzers **Reference** level to +20 dBm and **Attenuation** to 0 dB.

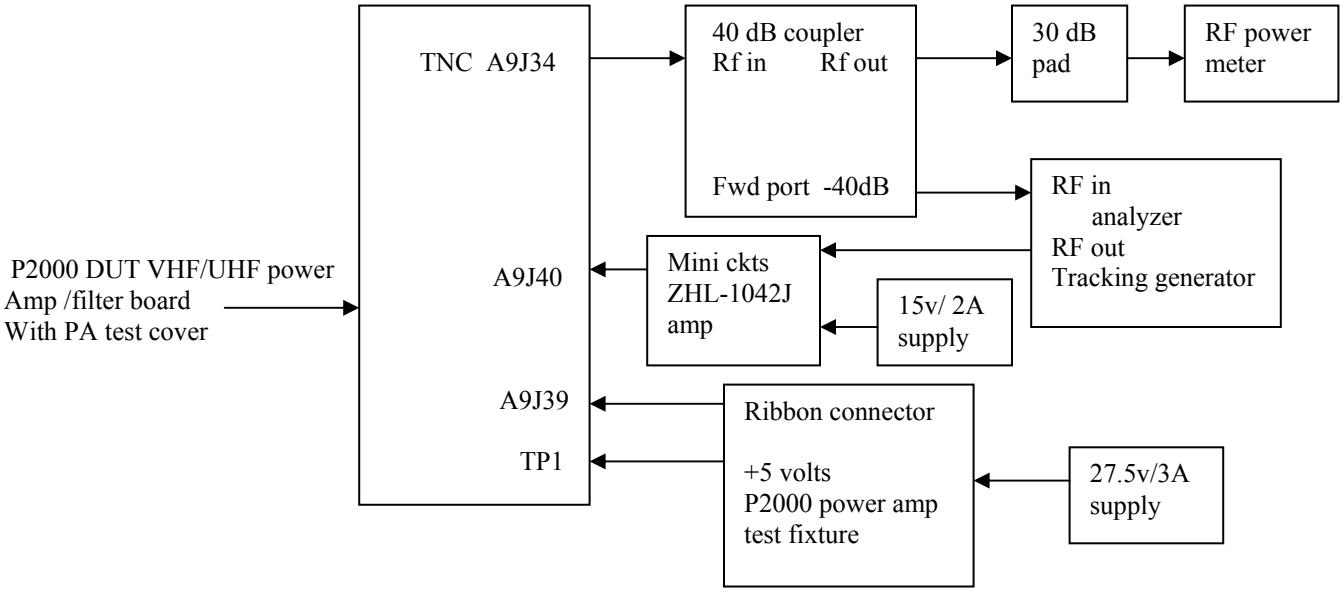

Figure 1.3 RF swept power alignment setup

1.5 Adjust the spectrum analyzers start and stop frequency depending on the board being tested as follows: For the VHF board adjust the start to 130 MHz and the stop frequency for 875 MHz, for UHF adjust the start from 400 MHz and the stop frequency to 1500Mhz. Keep the analyzers sweep and attenuation adjustments as in step 1.2

1.6 For the VHF and UHF filters use the tuning wand and break the plastic form to adjust inductors L19, L20, L21, L25 and L500 so that the difference between the Max and Min (ripple) point in the pass band is less than 2.0 dB while maintaining the minimum attenuation in the stop band as listed in the data sheet for section 1.6. In the data section record the Max and Min levels for the pass band and calculate the Max-Min value and record on the data sheet. Also record the minimum stop band attenuation value in dBc from the worse case frequency above and also the frequency of the worse case attenuation.

Tuning procedure: The amplifier/filter DUT adjustments must me made while maintaining the minimum attenuation as listed in the test data sheet for the respective board under test.

This spec is to be measured between the Highest pass band value and the worse case stop band value. The average swept power output for the VHF radio should show approximately a~15 spectrum analyzer level for VHF and ~11.5 dBm spectrum analyzer level for UHF in the pass band regions respectively according to the limits in the data sheet for section 1.6. If the level in dBm is above or below the specified value by a considerable amount, then R42 may be adjusted up to a ¼ turn in either direction to center the output power in the pass band region.

For the 800 MHz filter adjustments which only apply to section 1.8, spread or compress the turns on L19 to lower the harmonic reading. **For accurate harmonic readings the PA test cover must be in place on the module under test.**

HI power, Harmonic, DC current and TX indicator measurements

RF Power, Harmonics, DC current and TX Hi indicator Measurements

1.7 Connect the setup in figure 1.4 below and set up the analyzer as follows: **resolution bandwidth** for **10 kHz**, the **attenuation to 10 dB**, the **reference level to 20 dBm**, *Do not connect the **High Pass** filter up at this point For VHF and UHF boards set the generators RF output power to +3 dBm and for 800 boards set to +17dBm when driving with the WEI800 amp module with the 8.5 volt power supply. Use the same start/stop frequencies from step 1.5. *The **HPF** filter is not used in 800 tests.

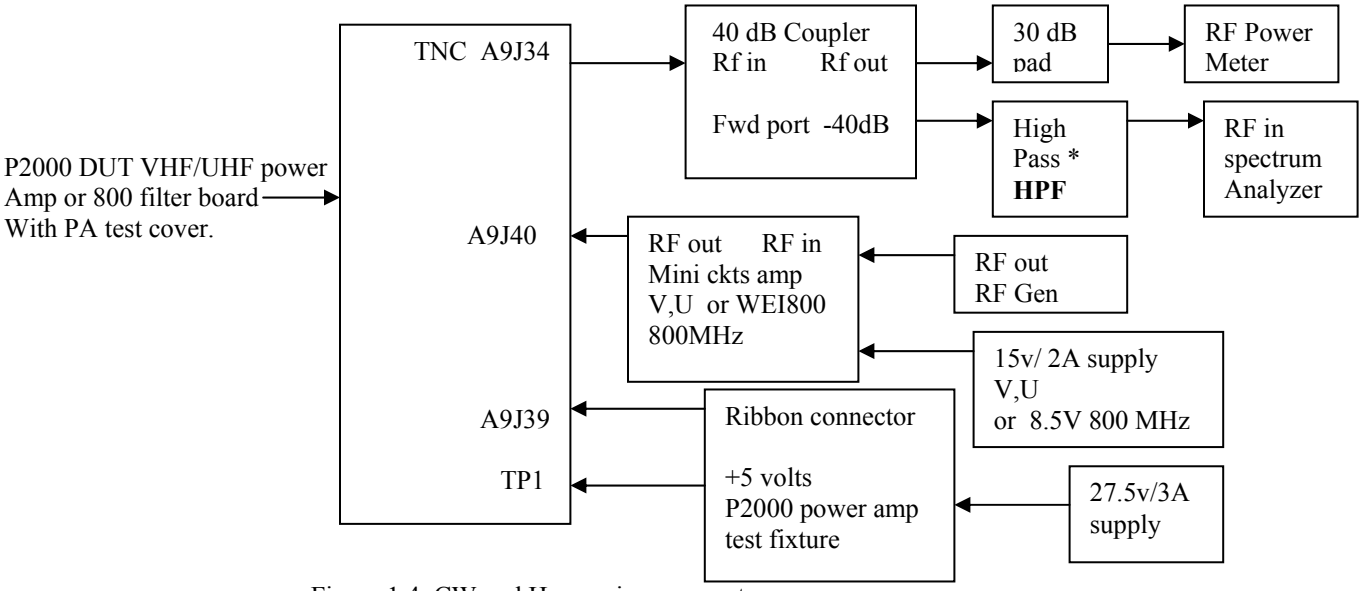

Figure 1.4 CW and Harmonic power setup

1.8 In section 1.8 of the data sheet, record at each frequency the power output, the worse case stop band attenuation frequency and the dBc value using the measurement procedure below for the respective board type VHF, UHF or 800 under test. Also record the max DC current on the 27.5 volt DC supply for the VHF and UHF boards only. Place a Check mark if the TX light comes on. NOTE: If no harmonics are visible record greater than 75 dBc.

***High Pass Filter Harmonic measurement procedure:** To accurately measure harmonics at VHF and UHF frequencies, a VHF or UHF High Pass Filter, **VHPF or UHPF respectively**, must be installed between the coupler output and the analyzers input when making harmonic measurements. Prior to installing the HPF in the circuit, first place a marker at the fundamental frequency, either 136, 155 & 174 MHz for VHF or 403, 430, 450, 470, 490 & 520 MHz for the UHF board and perform a marker **Peak &** marker **Delta**. Next place the proper **HPF** in the circuit and perform a marker **NEXT** measurement on each visible harmonic or spurious frequency. This procedure of placing the **HPF** in and out of the circuit is to be performed at each fundamental frequency being measured. If the filter needs any adjustment refer to the Tuning Procedure in section 1.6. A **HPF** (high pass filter) is not required for this test on 800 MHz boards. **Make sure that the PA test cover is on during all harmonic measurements.**

1.9 TX indicator, low power output. Keep the Hi/Lo RF power switch to Hi and adjust the RF generator level for 1.00 watts (+-.1 watts) output at each test frequency for each of the boards and check that the TX indicator comes on during low power. Record in section 1.9 of the data sheet.

1.10 Calculate the max current at high power for each frequency of the VHF or UHF boards as follows: subtract the CURRENT from section 1.1.2, the INITIAL + Q19 reading, from the readings from section 1.8 for each frequency. IE Current from section 1.8 - current from section 1.1.2.= section 1.10 current reading.

Date:_____
Tech:_____
PA S/N:_____
VHF, UHF or 800 PWB part number_____

Table 1.0 P2000 Power amplifier/Filter Data sheet

Section 1.1 Initial DC voltage measurements

Place the TX/RX switch to TX, HI/LO to LO At junction of CR2 and CR1---------- _____Volts DC (limits -4.0 to -6.0 V) disregard for 800 MHz At junction of CR21 and CR20---------- _____Volts DC (limits -2 to -3 V) disregard for 800 MHz At Q19 pin5 ----------_____ Volts DC (limits +27 to +28 V) disregard for 800 MHz At U1 pin 5 or pin 6----------_____Volts DC (limits 0 V +-.5V) disregard for 800 MHz

Place the TX/RX switch to TX Hi/Lo switch to HI At junction of CR2 and CR1---------- _____Volts DC (limits +4 to +5 V) disregard for 800 MHz At junction of CR21 and CR20-------- _____Volts DC (limits+2.5 to +3.5 V) disregard for 800 MHz At U1 pin 5 or pin 6---------- _____Volts DC (limits +4 to +5.5 V) disregard for 800 MHz

Place the TX/RX switch to RX and remove the + 5 volt jumper going to TP1 A9J39 pin 1 or 2 ----------_____Volts DC (limits +27 to +28 V) disregard for 800 MHz A9J39 pin 3----------_____Volts DC (limits +7.8 to +8.2 V) disregard for 800 MHz A9J39 pin 4 ----------_____ Volts DC (limits –14.0 to –16.0 V) disregard for 800Mhz A9J39 pin 9 ----------_____ Volts DC (limits +4.9 to +5.1V) measure for all boards U1 Pin10----------_____ Volts DC (limits 0 V +_.5V) disregard for 800 MHz Junction of CR2 and CR1------_____Volts DC (limits –4.0V to –6.0V) disregard for 800 MHz

Power amp initial and final Idq 450 mA Bias current measurements

1.1.1 INITIAL CURRENT------- _____amps **1.1.2 INITIAL + Q19 BIAS** ---- _____amps (limits (reading 1.8.1)+.4Amp to (reading 1.8.1)+.5 Amps)

Section 1.6 Low pass filter pass band and stop band Swept attenuation values

VHF

Maximum pass band analyzer level----------_____dBm (limits 15 dBm +- 1.0 dB) Frequency of Maximum level---------- _____MHz (limits 136 to 174 MHz) Minimum Pass band analyzer level---------- _____dBm (limits 15 dBm +- 1.0dB) Frequency of minimum level----------_____MHz (limits 136 to 174 MHz) Max level-Min level (Ripple)----------_____dB Delta (limits <= 2.0 dB) Worse case stop band level ----------_____ dBc (> 65 dB down from Max level) Frequency of worst stop band level----------_____ MHz (272 to 875 MHz)

UHF

Maximum pass band analyzer level ----------_____dBm (limits 11.5 dBm +- 1.0 dB) Frequency of Maximum level---------- _____MHz (limits 403 to 520MHz) Minimum Pass band analyzer level---------- _____dBm (limits 11.5 dBm +- 1.0) Frequency of minimum level----------_____MHz (limits 403 to 520 MHz) Max level-Min level (Ripple)----------_____dB Delta (limits <= 2.0 dB) Worse case stop band level ----------_____ dBc (>=58 dB down from Max level) Frequency of worst stop band level----------_____ MHz (806 to 1500 MHz)

Date:_____
Tech:_____
PA S/N:_____
VHF, UHF or 800 PWB part number_____

Table 1.0 P2000 Power amp/Filter Data Sheet (Cont.)

Section 1.8 PA CW power out, DC supply current and harmonic measurements, TX Hi indicator
VHF BOARDS NOTE: Harmonics measured using VHPF to analyzer with PA test cover on DUT

RF power at 136 MHz----------	_____Watts (limit 8-12 watts)
Highest harmonic of 136 MHz using HPF to analyzer---	_____dBc (limit >=70 dBc) at_____(MHz)
MAX current at 136 MHz----------	_____DC amps
TX light Hi Power……	_____check mark if on
RF power at 155 MHz----------	_____Watts (limit 8-12 watts)
Highest harmonic of 155 MHz using HPF to analyzer ---	_____dBc (limit >=70 dBc) at_____(MHz)
MAX current at 155 MHz----------	_____DC amps
TX light Hi Power……	_____check mark if on
RF power at 174 MHz ----------	_____Watts (limit 8-12 watts)
Highest harmonic of 174 MHz using HPF to analyzer ---	_____dBc (limit >=70 dBc) at_____(Mhz)
MAX current at 174 MHz----------	_____DC amps
TX light Hi Power……	_____check mark if on

UHF BOARDS NOTE: Harmonics measured using UHPF to analyzer with PA test cover on DUT

RF power 403 MHz ------ ----------	_____Watts (limit 4-7 watts)
Highest harmonic of 403 MHz using HPF to analyzer -----	_____dBc (limit >=68 dBc) at_____(MHz)
MAX current at 403 MHz----------	_____DC amps
TX light Hi Power……	_____check mark if on
RF power at 430 MHz----------	_____Watts (limit 4-7 watts)
Highest harmonic of 430 MHz using HPF to analyzer ---	_____dBc (limit >=68 dBc) at_____(MHz)
MAX current at 430 MHz----------	_____DC amps
TX light Hi Power……	_____check mark if on
RF power at 450 MHz----------	_____Watts (limit 4-7 watts)
Highest harmonic of 450 MHz using HPF to analyzer ---	_____dBc (limit >=68 dBc) at_____(Mhz)
MAX current at 450 MHz----------	_____DC amps
TX light Hi Power……	_____check mark if on
RF power 470 MHz- ----------	_____Watts (limit 4-7 watts)
Highest harmonic of 470 MHz using HPF to analyzer -----	_____dBc (limit >=68 dBc) at_____(MHz)
MAX current at 470 MHz----------	_____DC amps
TX light Hi Power……	_____check mark if on
RF power at 490 MHz----------	_____Watts (limit 4-7 watts)
Highest harmonic of 490 MHz using HPF to analyzer ---	_____dBc (limit >=68 dBc) at_____(MHz)
MAX current at 490 MHz----------	_____DC amps
TX light Hi Power……	_____check mark if on
RF power at 520 MHz----------	_____Watts (limit 4-7 watts)
Highest harmonic of 520 MHz using HPF to analyzer ---	_____dBc (limit >=68 dBc) at_____(Mhz)
MAX current at 520 MHz----------	_____DC amps
TX light Hi Power……	_____check mark if on

Date:_____
Tech:_____
PA S/N:_____
VHF, UHF or 800 PWB part number_____

Table 1.0 P2000 Power amplifier/Filter Data sheet (Cont.)

1.8 (continued) CW Power output, harmonic measurements, TX indicator

800 MHz BOARDS use WEI800 driver set at 8.5 volts in place of mini circuits amp

RF power 806 MHz ---------- --- _____Watts (limit >=2.0 watts) Highest harmonic of 806 MHz---------- _____dBc (limit >=58 dBc) at_____(MHz) TX light Hi Power……_____check mark if on
RF power at 814 MHz---------- _____Watts (limit >= 2.0 watts) Highest harmonic of 814 MHz---------- _____dBc (limit >=58 dBc) at_____(MHz) TX light HI Power.……_____check mark if on
RF power at 825 MHz---------- _____Watts (limit >= 2.0 watts) Highest harmonic of 825 MHz---------- _____dBc (limit >=58 dBc) at_____(Mhz) TX light Hi Power…..……_____check mark if on
RF power 851 MHz- ---------- _____Watts (limit >= 2.0 watts) Highest harmonic of 851 MHz---------- _____dBc (limit >=58 dBc) at_____(MHz) TX light Hi Power……_____check mark if on
RF power at 859 MHz---------- _____Watts (limit >= 2.0 watts) Highest harmonic of 859 MHz ---------- _____dBc (limit >=58 dBc) at_____(MHz) TX light Hi Power……_____check mark if on
RF power at 870 MHz---------- _____Watts (limit >= 2.0 watts) Highest harmonic of 870 MHz---------- _____dBc (limit >=58 dBc) at_____(Mhz) TX light Hi Power……_____check mark if on

1.9 TX light, low power output.

VHF board

136 MHz……..……____(place check mark if indicator on)
174MHz……____(place check mark if indicator on)

UHF board

403 MHz……____(place check mark if indicator on)
4704MHz……____(place check mark if indicator on)
520 MHz……____(place check mark if indicator on)

800 board

806 MHz……____(place check mark if indicator on)
851 MHz……____(place check mark if indicator on)
870 MHz……____(place check mark if indicator on)

Date:_____
Tech:_____
PA S/N:_____
VHF, UHF or 800 PWB part number_____

Table 1.0 P2000 Power amplifier/Filter Data sheet (Cont.)

1.10 Maximum DC current at HI power on final Q19 (VHF/UHF boards only)

VHF BOARDS

136 MHz Section 1.8 MAX current reading – section 1.1.2 current =____ amps(max 1.3)
155 MHz Section 1.8 MAX current reading – section 1.1.2 current=____ amps(max 1.3)
174 MHz Section 1.8 MAX current reading – section 1.1.2 current=____ amps(max 1.3)

UHF BOARDS

403 MHz Section 1.8 MAX current reading – section 1.1.2 current=____ amps(max 1.55)
430 MHz Section 1.8 MAX current reading – section 1.1.2 current=____ amps(max 1.55)
450 MHz Section 1.8 MAX current reading – section 1.1.2 current=____ amps(max 1.55)
470 MHz Section 1.8 MAX current reading – section 1.1.2 current=____ amps(max 1.55)
490 MHz Section 1.8 MAX current reading – section 1.1.2 current=____ amps(max 1.55)
520 MHz Section 1.8 MAX current reading – section 1.1.2 current=____ amps(max 1.55)