SECTION V
ADJUSTMENTS

5-1. INTRODUCTION.

5-2. This section contains the procedures required to adjust the HP 3325B to meet its specifications. These adjustments should be used following repairs or if performance tests indicate a deficiency.

NOTE

Table 8-3 lists the adjustment procedures that must be performed after repair of certain circuits.

5-3. EQUIPMENT REQUIRED.

5-4. Each adjustment procedure lists the test equipment required to perform that adjustment. All test equipment required for adjustments is itemized in Table 5-1. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model.

Table 5-1. Test Equipment Required for Adjustments

Equipment	Critical Specifications	Recommended Model
AC/DC Digital Voltmeter	AC Function: 1 V Range Accuracy: ±.5% Resolution: 4 digits DC Function: Ranges: 0.1V, 1V, 10V, 100V Accuracy: ±0.05% Resolution: 4 1/2 digits	HP 3455A/3478A
Low Frequency Spectrum Analyzer	Frequency Range: 1 kHz – 50 kHz Amplitude Accuracy: ±0.5 dB Spurious Responses: 80 dB below ref.	HP 3580A/3585A
Resistor	1 kΩ	HP Part No. 0683-1025
Electronic Counter	Frequency measurement: to 20 MHz Accuracy: ±2 counts Resolution: 8 digits	HP 5328A with Opt. 010, 040, and 041/5328B with Opt. 010
Analog Oscilloscope	Vertical: 2 channel Bandwidth: dc to 100 MHz Deflection: 5 mV to 5 V/div div Horizontal: Main and Delayed Sweeps Main: 50 ns to 0.5 s/div Delayed: 50 ns to 20 ms/div	HP 1740A/TEK 2245
Frequency Standard (for Option 001 only)	Frequency: 5 MHz Accuracy: 1×10^{-9}	HP 105B
10:1 Oscilloscope Probe	Impedance: 1 MΩ, 12 pF	HP 10041A/10040A
50-ohm Load	Accuracy: ± 0.2% Power Rating: 1W	HP 11048C
Adapter	BNC-to-dual banana plug	HP 1251-2277
High Frequency Spectrum Analyzer	Frequency Range: 1 kHz - 80 MHz Amplitude Accuracy: ±.5 dB	HP 141T/8552B/8553B/ 8566A/8568A
Thermal Converter	Input Impedance: 50Ω, Input Voltage: 1Vrms, Frequency: 1kHz to 20MHz, Frequency Response: ±0.05dB	HP 11050A/Ballantine Model 1395A-1 with cable 12577A Opt 10 PO Box 97 Booton, NJ 07005
Resistor	200Ω 1% 1/8W	HP 0757-0407
Resistor	50Ω 1% 0.5W	HP 0698-5965
Resistor	~~13Ω~~ 1% 1/8W 63.4Ω	~~HP 0757-0380~~ 0698-4388
Resistor	25Ω 5% 1/4W	HP 0683-2505
Resistor	150Ω 1% 1/8W	HP 0757-0284

5-5. ADJUSTMENT PROCEDURES.

5-6. The Power Supply and the D/A Converter Gain and Offset adjustment must be performed before any of the others are made. It is recommended that all adjustments be performed in the order given. Location of all adjustments is shown on Figure 5-3 at the end on this section. Remove the top and bottom covers to gain access to all adjustments.

NOTE

The metal stiffener channel on the deck between the printed circuit boards may be used as circuit ground for all measurements.

5-7 Power Supply. A22

Equipment Required: dc digital voltmeter

WARNING

AC power line voltage is exposed at the rear panel and on the power supply assembly.

a. Connect a dc digital voltmeter between the –15V test point on the Power Supply assembly, A22, and ground.

b. Adjust the –15V ADJ (A22R352) for a voltmeter reading of –14.970 to –15.030 V.

c. Measure the voltages at the +15V test point and +5V test point on A22. The reading should be +14.970V to +15.030V and +5.010V to +5.070V respectively. If not, readjust the –15V ADJ control to bring all three voltages within tolerance. These voltages may be adjusted out of tolerance by Paragraph 5-8 Step f, but it is not a cause for concern.

5-8. D/A Converter Gain and Offset. A14, A22

Equipment Required:

digital voltmeter (HP 3478A)
50 ohm load (HP 11048C)

a. Connect the 50 ohm load directly to the 3325 Main Signal output connector on the front panel. Connect the digital voltmeter to the 50 ohm load.

b. Place the 3325 in Special Test Mode 51 by pressing the following keys:

Shift Deg mVrms Self Test 5 1

c. Press the 0 key to set the 3325 to 0 Vdc.

d. Adjust DAC OFFSET ADJ (A14R40) for a voltmeter reading of less than 5 mVdc. Press the 0 key again to verify. Readjust A14R40 if necessary.

e. Press the . (decimal) key to set the 3325 to +5 Vdc.

f. Adjust –15V ADJ (A22R352) for a voltmeter reading of +4.985 Vdc to +5.015 Vdc. Press the . (decimal) key again to verify. Readjust –15V ADJ if necessary. ADJUST R352 TO HI END OF SPEC (+5.015) FOR BEST PERFORMANCE

g. Press the – (minus) key to set the 3325 to –5 Vdc. Verify that the voltmeter reading is between –5.015 Vdc and –4.985 Vdc.

h. Repeat Steps c through g until all readings are within the tolerances.

i. Press the Local key to exit Special Test Mode 51. Two numbers are displayed for a moment. Both numbers should be within the +20 to –20 range. If they are not, DC Offset Accuracy may not meet all specifications.

5-9. Voltage Controlled Oscillator (VCO Frequency). A21

Equipment Required: dc digital voltmeter

a. Connect a dc digital voltmeter to test point A21TP11.

b. Set the 3325 frequency to 60 MHz.

c. With a non-conductive tool, adjust VCO ADJ (A21L162) through the hole in the metal cover for a voltmeter reading of –2.990V to –3.010V.

d. Set the frequency to 1 kHz. Voltmeter reading should be between +9.4V and +11.0V.

5-10. Analog Phase Interpolation (API). A21

Equipment Required:

low frequency spectrum analyzer
resistor 1 kΩ

a. Set 3325 as follows:

Function ..... Sine
Frequency ..... 5.003 MHz

b. Connect the low frequency spectrum analyzer input through a 1kΩ series resistor to A21TP11.

c. Set spectrum analyzer controls as follows:

Start Frequency ..... Ø kHz
Bandwidth ..... 30 Hz
Frequency Span ..... 1 kHz/div
Display Smoothing ..... Max
Sweep Time/Div ..... 200 sec
Input Sensitivity ..... 10 mV
Amplitude Reference ..... Normal
Amplitude Mode ..... 10 dB/div
Sweep Mode ..... Manual

d. Adjust the spectrum analyzer manual vernier control to place the display marker at the peak of the API spur which appears at 3 kHz (3 display divisions).

e. Adjust the API 1 ADJ (A21R76) to reduce the spur to a minimum.

f. Change the 3325 frequency to 5 000 300 Hz.

g. Adjust API 2 ADJ (A21R74) to reduce the spur to a minimum.

h. Change the 3325 frequency to 5 000 003 Hz.

i. Adjust API 4 ADJ (A21R88) to reduce the spur to a minimum.

j. Set the 3325 to 5.003 MHz and readjust API 1 ADJ (A21R76) to its minimum value. Also check the harmonic distortion performance test.

5-11. 30 MHz Reference Oscillator. A3

Equipment Required: electronic counter

NOTE

The instrument must have been ON for at least 20 minutes before performing this adjustment.

a. If the instrument has the Option 001 High Stability Frequency Reference installed, the rear panel connection from "10 MHz Oven Output" to "Ext Ref In" must be disconnected.

b. Connect an electronic counter to the 3325 signal output, using 50-ohm input termination.

c. Set the 3325 as follows:

Function ..... Sine
Frequency ..... 20 MHz
Amplitude ..... 10 Vp-p

d. Adjust the counter to measure frequency (20 MHz).

e. Adjust REF ADJ (A3R30) for a counter display of 20.000 000 MHz.

5-12. Option 001 High Stability Frequency Reference.

Equipment Required:

oscilloscope, 2 channel
quartz frequency standard, 5 MHz

NOTE

The rear panel "10 MHz Oven Output" must be connected to "Ext Ref In".

a. This procedure is for instruments with the Option 001 High Stability Frequency Reference. The instrument must have been connected to ac power in either STANDBY (⏻) or ON (I) for at least 30 minutes before attempting this adjustment. To minimize subsequent drift, the instrument should be connected to ac power for at least 12 hours before attempting this adjustment.

b. Connect the frequency standard 5 MHz output to one vertical channel of the oscilloscope and trigger the sweep from this channel.

c. Set the 3325 as follows:

Function ..... Sine
Frequency ..... 5 MHz
Amplitude ..... 10 Vp-p

d. Connect the 3325 signal output to the second channel of the oscilloscope.

e. Adjust FINE ADJ (A9R7) to stop the 3325 signal on the oscilloscope display. (The frequency standard signal must be stationary and the 3325 signal as near stationary as possible.)

f. If FINE ADJ does not have enough range, proceed with Step g.

g. Adjust FINE ADJ to mechanical center.

h. Remove the screw from the Coarse Frequency adjustment in the end of the temperature controlled oven assembly (A9E1).

i. Using a non-conductive tool, adjust COARSE ADJ to stop the 3325 signal on the oscillope (as near stationary as possible).

j. Replace the screw in the Oven assembly and repeat Step e.

5-13. Amplitude Modulator. A3

Equipment Required:

oscilloscope
10:1 oscilloscope probe

a. On the rear panel, connect the MOD SOURCE output to the AMPTD MOD input.

b. Using a 10:1 probe, connect the oscilloscope to A3TP4. Set the oscilloscope input to ac coupled and the sweep to 5 ms/div.

c. Place the 3325 in Special Test Mode 52 by pressing the following keys:

Shift Deg mVrms Self Test 5 2

d. Adjust Y-OFFSET ADJ (A3R60) to null out the square wave signal on the display. Change the oscilloscope vertical gain as necessary to observe the signal.

e. Ground the oscilloscope input and zero the trace on the center line. Set the input to dc coupled.

f. Adjust OFFSET OUT ADJ (A3R68) to return the oscilloscope trace to the center line (0 Vdc). Readjust OFFSET OUT ADJ, if necessary, to maintain the null.

g. Press the Local key to exit Special Test Mode 52. The message ARB CLEARED is displayed to indicate that the Modulation Source Arb memory has been set to the default value by this special test.

5-14. Sine Wave Gain-Offset. A3

Equipment Required: none

a. Place the 3325 in Special Test Mode 53 by pressing the following keys:

Shift Deg mVrms Self Test 5 3

b. Repeatedly adjust SINE GAIN-OFFSET ADJ (A3R33) and press the Amptd Cal key until the number on the left side of the display reads between –10 and + 10.

c. The number on the right side of the display should read between 0.8200 and 1.000. If it is not within this range, troubleshoot the sine wave amplitude control and amplifier gains.

d. Press the Local key to exit this special test. Two numbers are displayed for a moment. Both numbers should be in the + 60 to –60 range. If they are not, the DC Offset accuracy with the sine wave function enabled may not meet all specifications.

5-15. Square Wave Gain-Offset. A14

Equipment Required: none

a. Place the 3325 in Special Test Mode 54 by pressing the following keys:

Shift Deg mVrms Self Test 5 4

b. Repeatedly adjust SQUARE GAIN-OFFSET ADJ (A14R130) and press the Amptd Cal key until the number on the left side of the display reads between –10 and + 10.

c. The number on the right side of the display should read between 0.8200 and 1.000. If it is not within this range, troubleshoot the square wave amplitude control and amplifier gains.

d. Press the Local key to exit this special test. Two numbers are displayed for a moment. Both numbers should be in the + 60 to –60 range. If they are not, the DC Offset accuracy with the square wave function enabled may not meet all specifications.

5-16. X Drive A14

Equipment Required: dc digital voltmeter

a. Connect a dc digital voltmeter to 3325 rear panel X Drive output.

b. Set the 3325 as follows:

Function ..... Sine
Amplitude ..... 10 Vp-p
Sweep Start Freq ..... 1 MHz
Sweep Stop Freq ..... 10 MHz
Sweep Marker Freq ..... 5 MHz
Sweep Time ..... 0.999 sec

c. Press RESET/START key to reset sweep to start conditions.

d. Digital voltmeter reading should be less than 20 mV.

e. Adjust X DRIVE ADJ (A14R6) to mechanical center.

f. Press the RESET/START key once to initiate a single sweep. At the end of the sweep the digital voltmeter reading should be + 10.450V to + 10.550V.

g. If the reading is less than + 10.450V, adjust X DRIVE ADJ (A14R6) slightly clockwise; and if reading is greater than + 10.550V, adjust it slightly counter-clockwise.

NOTE

The voltmeter reading will not respond to adjustment of X DRIVE ADJ (A14R6). The effect of this adjustment can be observed only after another single sweep. Following the end of a sweep, the X Drive output voltage will drift downward at ≤ 1 mV per second.

h. Press RESET/START twice to initiate another sweep. If necessary, readjust X DRIVE ADJ (A14R6) by turning clockwise to increase voltage and counter-clockwise to decrease voltage.

i. Repeat Steps g and h until proper voltage (+ 10.450 to + 10.550 V) is measured immediately following the end of a sweep.

5-17. Amplifier Bias .

Equipment Required: high frequency spectrum analyzer

a. With the 3325 in its turn-on condition, set the frequency to 10 MHz, function to square wave, and amplitude to .999 Vp-p.

b. Adjust the spectrum analyzer as follows:

Center Frequency.....50 MHz
Bandwidth.....300 kHz
Scan Width.....0-100 MHz
Input Attenuation.....40 dB
Video Filter.....10 kHz
Scan Time.....10 msec/div
Log Reference Level...+10dBm,10dBLOG
Vernier.....−5 dBm
Scan Mode.....INT
Scan Trigger.....AUTO

c. Connect the 3325 signal output to the spectrum analyzer input. Do not use a 50 Ω feed through termination.

d. The spectrum analyzer should display the high level odd harmonics and low level even harmonics of the 10 MHz square wave.

e. Adjust BIAS ADJ (A14R275) to minimize the 20 MHz second harmonic. It should dip sharply to >34 dB below the fundamental.

5-18. Ramp Stability.

Equipment Required: oscilloscope, with delayed sweep

a. Connect the 3325 Main Signal output connector to the oscilloscope vertical input. (Do NOT use a 10:1 probe.) If the oscilloscope is an HP 1740A, set the input switch to the 50-ohm position. If your oscilloscope does not have a 50-ohm input, use a 50-ohm load at the input.

b. Set the 3325 as follows:

Function.....Positive Slope Ramp
Frequency.....100 Hz
Amplitude.....10 Vp-p

c. Set the oscilloscope as follows:

Vertical.....2V/div
Main Sweep.....2ms/div
Delayed Sweep.....20μS/div
Trigger.....Negative
Delay.....Mid Screen
Display.....A or B
(Do not use ALT or CHOP)

d. Set the oscilloscope to delayed sweep. Adjust the delay to see the ramp reset jitter and read the positive ramp jitter in microseconds.

e. Press the Negative Ramp function on the 3325.

f. Change the trigger on the oscilloscope to positive and note the negative ramp jitter in microseconds.

g. Bump the 3325 frequency to 99.999999Hz and read the ramp jitter in microseconds.

h. If any of the above readings exceed 60μs, adjust RAMP ADJ (A14C110) to reduce the jitter.

i. Repeat the ramp jitter measurements of Steps d and f, adjusting RAMP ADJ as necessary to reduce the jitter to 60μs or for the best compromise between the two.

NOTE

If ramp jitter cannot be adjusted satisfactorily, troubleshoot the ramp generating circuitry (Service Group J).

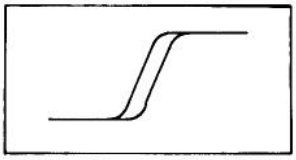

Figure 5-1. Ramp Reset Waveform.

5-19. Amplitude Flatness.

Equipment Required:

1 Vrms 50Ω thermal converter
digital voltmeter
resistors 200Ω 1% 1/8W 50Ω 1% 1/2W
13Ω 1% 1/8W 25Ω 5% 1/4W
150Ω 1% 1/4W

a. Set the 3325 as follows:

Function.....Sine
Amplitude.....10Vp-p
Frequency.....1kHz

b. Connect the 3325 signal output (through the 10Vp-p pad and thermal converter) to the digital voltmeter (see Figure 5-2a).

CAUTION

Insure that the input voltage to the thermal converter does not exceed 1Vrms. Also for best results, allow the thermal converter time to settle and adjust to surrounding temperatures.

c. Note and record the dc voltage reading on the voltmeter. This is the flatness reference voltage.

d. Set the 3325 frequency to 20 MHz. Using a nonconductive tool, adjust 20 MHz FLT ADJ (A14C217) to obtain the same reading as recorded in Step c.

e. Set the 3325 to 10 MHz. Adjust 10 MHz FLT ADJ (A14R142) to obtain the same reading as recorded in Step c. Repeat Step d, adjusting as necessary.

f. Set the 3325 to 16MHz. The voltmeter reading should be within ±0.15mV of the reference recorded in step c. If not, decrease padding capacitor A14C101 using the capacitors shown in Table 5-2. Repeat steps d and e.

g. Set the 3325 to 20MHz. Bump the frequency down to 1MHz in 1MHz steps. Note the dc voltage at each frequency and insure that it is within ±0.15mV of the reference recorded in step c.

h. If the dc voltage measured in the 19-21MHz range is out of tolerance, increase or decrease the value of A14C103 as necessary, using the values shown in Table 5-2. If A14C103 is changed, repeat steps d and g.

i. Set the 3325 amplitude to 3.0Vp-p.

j. Replace the 10Vp-p pad with the 3.0Vp-p pad (Figure 5-2b). Repeat steps d and g. If a voltage measured in step g is out of tolerance, repeat the amplitude flatness adjustment with the 3325 at both 10Vp-p and 3Vp-p until all voltages are within tolerance.

CAUTION

Insure that the input voltage to the thermal converter does not exceed 1Vrms.

5-20. Mixer Spurious Signal.

Equipment Required: high frequency spectrum analyzer

a. Set the 3325 as follows:

Function ..... Sine
Amplitude 0.999Vp-p
Frequency 20MHz

b. Set the spectrum analyzer as follows:

Center Frequency 10MHz
Bandwidth 30kHz
Scan Width 2MHz/div
Input Attenuator 10dB
Scan Time 20ms/div
Log Ref Level 0dB
Vernier ..... −10dB
Scale ..... 10dB log
Video Filter 10kHz
Scan Mode ..... Int
Scan Trigger ..... Auto

c. Connect the 3325 signal output to the spectrum analyzer's 50Ω input.

d. The 2:1 mixer spur should occur at 10 MHz. Using a non-conductive tool, adjust MXR ADJ (A3R115) until the 2:1 spur is at a minimum. Check the VCO/2 spur at 5 MHz.

e. Using the modify keys, bump the frequency from 20MHz to 11MHz in 1MHz steps. Observe the spectrum analyzer for spurious responses. At 18MHz, check for the 3:2 spur at 6MHz. Note that in all cases, all spurious responses should be > 70dB below the desired signal.

Table 5-2. Padding Values.

A14C101	A14C103
68pf -hp- p/n 0140-0192 75pf -hp- p/n 0160-2202 82pf*-hp- p/n 0160-0145	130pf -hp- p/n 0140-0195 140pf*-hp- p/n 0140-0217 150pf -hp- p/n 0140-0196
*Loaded Value	

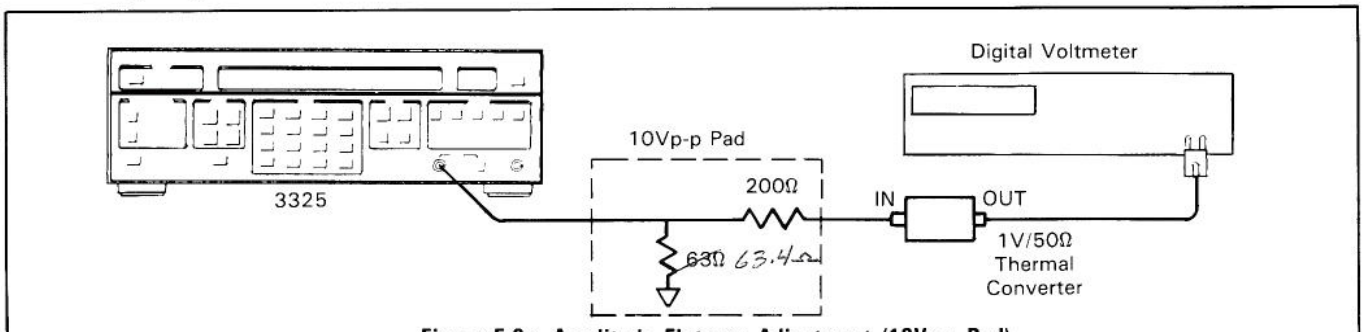

Figure 5-2a. Amplitude Flatness Adjustment (10Vp-p Pad).

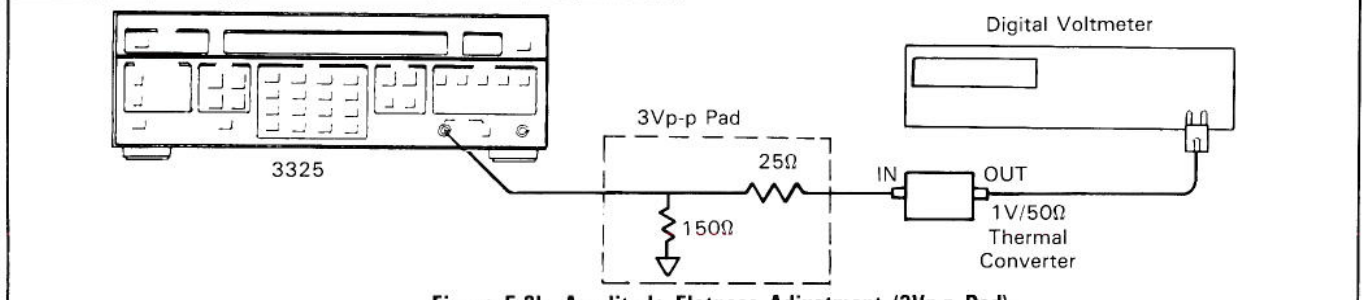

Figure 5-2b. Amplitude Flatness Adjustment (3Vp-p Pad).

Note if W/N adjust in spec: Then change A14C44 & C45 & U17 Per change.

NOTE

Table 8-4 lists the adjustment procedures that must be performed after repair of certain circuits.

5-3. EQUIPMENT REQUIRED.

5-4. Each adjustment procedure lists the test equipment required to perform that adjustment. All test equipment required for adjustments is itemized in Table 5-1. Any equipment that satisfies the critical specifications given in the table may be substituted for the recommended model.

5-5. ADJUSTMENT PROCEDURES.

5-6. The Power Supply and D/A Converter Offset adjustments must be performed before any of the others are made. It is recommended that all adjustments be performed in the order given. Location of all adjustments is shown on a foldout page, Figure 5-3, at the end of this section. Remove the top and bottom covers to gain access to all adjustments.

NOTE

The metal stiffener channel on the deck between the printed circuit boards may be used as circuit ground for all measurements.

NOTE

The following procedures apply to all board revisions (e.g. A2 Rev A - Rev F, A21(1) Rev A ..., A14(4) Rev A ..., etc.,) unless otherwise noted.

5-7. Power Supply.

Equipment Required: dc digital voltmeter (-hp- Model 3466A)

WARNING

AC power line voltage is exposed at the rear panel and on the power supply assembly.

a. Connect a dc digital voltmeter between the -15 V test point on the power supply assembly, A2, and ground.

b. Adjust the −15 V Adj (A2R22) for a voltmeter reading of −14.970 to −15.030 V.

c. Measure the voltages at the +15V test point and +5V test point on A2. The readings should be +14.970V to +15.030V and +5.010V to +5.070V respectively. If not, readjust the -15V Adj control to bring all three voltages within tolerance. These voltages may be adjusted out of tolerance by paragraph 5-8, step h. This is not a cause for concern.

5-8. D/A Converter Offset.

Equipment Required: dc digital voltmeter (-hp- Model 3466A)

a. Adjust DAC Offset Adj (A14R40) to mechanical center.

b. Press the function select key for whichever function is presently active. This sets the output to DC Offset only. Enter Ø V DC Offset.

c. Press AMPTD CAL key.

d. Connect a dc digital voltmeter to Amp Out test point on A14.

e. Adjust DAC Offset Adj (A14R40) for a voltmeter reading of less than 5mV. Disconnect voltmeter from Amp Out test point.

f. Enter 5 V DC Offset. Press AMPTD CAL key.

g. Connect digital voltmeter to 3325A Signal Output. Do [redacted] use a 50-ohm [redacted] Feed Thru Term.

h. Adjust −15 V adj (A2R22) for voltmeter reading of [redacted] V. +5.000V ref adj A2R22 maybe adjusted so that any error is < ± 0.02V & ± 5V.

i. Enter -5 V DC Offset. Voltmeter reading should be [redacted] V.

4.98 To 5.02V

5-9. Voltage Controlled Oscillator (VCO Frequency).

Equipment Required: dc digital voltmeter (-hp- Model 3466A)

a. Connect a dc digital voltmeter to test point A21TP11.

b. Set the 3325A frequency to 60 MHz.

c. Adjust VCO Adj (A21L162) through hole in metal cover with a non-conductive tool for a voltmeter reading of -2.990V to -3.010V.

d. Set the frequency to 1kHz. Voltmeter reading should be between +9.5V and +10.5V.

5-10. Analog Phase Interpolation (API).

Equipment Required:

Low frequency spectrum analyzer (-hp- Model 3580A/3585A)

Resistor, 1 kΩ (-hp- Part No. 0683-1025)

a. Set 3325A as follows:

Function ..... Sine
Frequency ..... 5.003 MHz

b. Connect the low frequency spectrum analyzer input through a 1kΩ series resistor to A21TP11.