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Test Procedure for the 4G TTFSS

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1 Introduction

This test procedure describes the test of the fourth generation table-top frequency stabilization servo (4G TTFSS), D1700075.

2 Test Equipment

- 2 RF synthesizers (e.g. Tektronix AFG3102)
- Oscilloscope
- Network analyzer SR785 and HP4395A
- Active probe & high voltage probe
- Bipolar high voltage supply: ±200V / 50 mA
- 4G TTFFS Tester, D1700362
- Prepare a 10-wire flat ribbon cable that is terminated with IDC header on one end, and employs a BNC/Breakout connector between pins 3 & 4 on the other end.
  - Alternatively a 10 wire flat ribbon cable with IDC on one end, and a DB9 on the other with a DB9 breakout board and clip to pin 2 and pin 7 will work too.

3 Result

Serial #:

Engineer:

Variant: PFD / Mixer

Date: Pass / Fail

4 Preparation

Provide a ±18V power supply. For most of the testing, a ±24V power supply will replaced the high voltage supply. After power up, the two green LEDs in the front panel should be on.

LED +15V: On / Off

LED −15V: On / Off

Hook up the TTFSS tester using a DB37 cable and power it with ±18V.

Put all switches on the left into their default up state, with the exception of the Controls, EOM and Excitation switch, which are down.

The servo switch should be in its middle off position.

Set all offset potentiometers to their central value of 500, set the gain potentiometers to 250.

5 Voltage Rails and Current Draw

All voltage rails should be within 5% of their nominal value. On the power board, check the following test points

+15V: Measured: ……………………. Pass: …………

−15V: Measured: ……………………. Pass: …………

+5V: Measured: ……………………. Pass: …………

−5V: Measured: ……………………. Pass: …………

Write down the current draw. The nominal is 575mA +/- 75mA.

+18V: Current: ………………………. Pass: …………

−18V: Current: ………………………. Pass: …………

6 RF Power Monitors

Test the power monitors by applying a 30 MHz, 10 dBm RF signal, use an attenuator if necessary to achieve 10dBm, to “RF In” and “LO”. Measure the output voltages “RF Mon” and “LO Mon” on the tester. The RF power detected will be 23dB less than applied to the “RF In” and 20 dB less than applied to the “LO”. The voltage at the tester monitors is given by 0.06 × (dBm + 95).

RF In (dBm)	Nom. Output (Volts)		Measured Output (Volts)	
	RF Mon	LO Mon	RF Mon	Lo Mon
10	4.92	5.10		
3	4.50	4.68		
0	4.32	4.50		
-10	3.72	3.90		
-20	3.12	3.30		
-30	2.52	2.70		

Apply a 30 MHz, 10 dBm signal to “RF In” and check that the “RF Mon” shows the same signal 23dB down.

Confirm ……………………..

7 RF demodulation stage

The RF demodulation stage is either a phase-frequency discriminator (PFD), D1002471, or a FET mixer, D0902745, implementing the ultra-fast option described in E1100044. Typically, locking two lasers requires a PFD, whereas locking a laser to a reference cavity requires a mixer.

7.1 PFD Option

1) Test the RF sensitivity by applying a 30 MHz, -47 dBm signal to “RF In” on the TTFSS and look at pin 1 or 2 on U1A with an X10 probe. You should see a full ECL logic swing.

Confirm ……………………..

2) Test the phase detector by applying two 30 MHz, 10 dBm signals to "RF In" and "LO". Measure the output voltage on "I-Mon" as a function of the phase difference of the two input signals. The Tektronix AFG 3102 will generate both signals with an adjustable phase difference. Remember to align the two phases and monitor them on a scope. Suggest 45° steps for a general check. The offset is the output voltage when the phase difference is zero and the phase sensitivity is best measured for phase differences near zero not more than plus or minus 135°. The corrected output voltage is the output voltage with the offset removed.

Phase Difference	Output Voltage	Corrected Output Voltage	Phase Sensitivity Phase / Voltage
180			
135			
90			
45			
0			
-45			
-90			
-135			
-180			

Phase sensitivity ……………………….. °/Volt (41 degree/Volt)

Offset …………………………………… Volt

3) Test the frequency discriminator by applying two 30 MHz, 10 dBm signals to "RF In" and "LO". Set the frequency of the signal applied to the "RF In" a few Hz higher than the signal applied to the "LO", then a few Hz lower, looking at the difference frequency on the output "I-Mon". The output level should shift positive or negative depending on whether "RF In" is a higher or lower frequency than "LO" and will pulse to ground at a frequency related to the difference between the two input frequencies. The sign of the output "I-Mon" inverts, when the "Sign" input is grounded. Verify proper operation including the sign.

Frequency Discriminator working: ……………………………

Sign working: …………………………

4) Measure the bandwidth of the discriminator output circuit. Using an HP4395A network analyzer with the RF drive applied to either U2 pin 7 or U2 pin 14 through a 1k resistor using a 1X probe. The analyzer RF out should be split with one output going to the analyzer R in and the other applied to U2 as described above. The I-MON output is applied to either the A or B analyzer input. The RF drive level is 3dBm, the BW is 1 kHz, the start frequency is 100 kHz and the stop frequency is 10 MHz. The 3 dB point is at about 7.7 MHz with a phase close to −180°. At 1 MHz there should be no appreciable amplitude loss and a phase around −50°. The purpose of this measurement is to confirm that the correct components have been loaded. The display should be attached to this report for future reference.

3dB Point: ………………………… Hz Phase: ……………….. °

1MHz Magnitude: ………………… dB Phase: ……………….. °

100kHz Magnitude: ………………… dB Phase: ……………….. °

5) Measure the phase-frequency discriminator noise. Apply the same 10 dBm signal to both the "RF In" and "LO", and measure the noise on output "I-Mon" and "Com MON" outputs with an SR785 using the rms power spectrum. A Wenzel crystal oscillator with 13 dBm output can be split to provide both 10 dBm signals. Try to match the cable length as closely as possible to achieve an output offset as small as possible (~0° phase).

I-Mon: …………………………… nV/√Hz (less than 100 nV/√Hz at 140 Hz)

Com MON: ……………………… nV/√Hz (less than 100 nV/√Hz at 140 Hz)

7.2 Mixer Option

See also E1100114.

1) Record that the front panel LED are working.

Confirm ……………………..

2) Insertion Loss: Using a calibrated and normalized RF network analyzer, measure the insertion loss from each front panel SMA RF input to its respective RF monitor.

Parameter	Typical Value	Allowable Range	Measured Values		
			9 MHz	45 MHz	100 MHz
Chan.1 RF In to RF Monitor Gain	-23.4dB	±0.5dB			

3) RF Level Monitors: Apply a signal of the indicated magnitude to the RF or LO input on the front chassis SMA and TNC connectors as specified in Table 5. Using a multimeter, record the DC voltage as measured at the RF monitor outputs on the rear D-sub connector of the mixer board.

RF Freq/Level	LO Freq/Level	Typical Value		Allowable Range	Measured Value
45 MHz (-20dBm)	45 MHz (-20dBm)	**LO**	4.0V	±0.05V	
		RF	3.15V	±0.05V	
45 MHz (-10dBm)	45 MHz (-10dBm)	**LO**	4.6V	±0.05V	
		RF	3.75V	±0.05V	
45 MHz (0dBm)	45 MHz (0dBm)	**LO**	5.2V	±0.05V	
		RF	4.35V	±0.05V	
45 MHz (10dBm)	45 MHz (10dBm)	**LO**	5.8V	±0.05V	
		RF	4.95V	±0.05V	

4) Beat note: Using a pair of RF signal generators, apply the indicated amplitude and frequency signals to the chassis under test as detailed in the table below.

The IF beat note is measured differentially at the front panel TNC outputs for each channel under test using an SR785. Be sure to set the window function of the dynamic signal analyzer FFT to “flat top” during this amplitude measurement in order to measure the peak-to-peak voltage at each beat note frequency accurately.

RF Freq/Level	LO Freq/Level	IF Beat Note Typical Value	Allowable Range	Measured Value (p-p)	
				I	Q
45 MHz 0dBm±0.2dB	45.0001 MHz 10dBm±0.2dB	100Hz @ 1Vp-p	±0.1Vp-p		
45 MHz 0dBm±0.2dB	45.001 MHz 10dBm±0.2dB	1kHz @ 1Vp-p	±0.1Vp-p		
45 MHz 0dBm±0.2dB	45.01 MHz 10dBm±0.2dB	10kHz @ 1Vp-p	±0.1Vp-p		
45 MHz 0dBm±0.2dB	45.1 MHz 10dBm±0.2dB	100kHz @ 1Vp-p	±0.1Vp-p		

5) IQ imbalance: When measuring the IF beat note, the I and Q IF outputs should ideally be exactly equal in magnitude, and 90 degrees out of phase. These settings are available in T1100087. Set the curser to the beat note frequency.

Apply an LO and RF signal at the indicated frequencies shown in the table below. The LO signal level should be 10dBm±0.2dB, and the RF signal level should be 0dBm±0.2dB. Measure the I & Q channels available at the front panel BNCs and record the data in the table below.

Channel 1 RF Input and LO Frequency	Typical Amplitude Balance	Allowable Range	Typical Phase Balance	Allowable Range	Measured Amplitude Balance	Measured Phase Balance
9MHz & 9.01MHz	0dB	±0.5dB	90°	±5°		
36MHz & 36.01MHz	0dB	±0.5dB	90°	±5°		
45MHz & 45.01MHz	0dB	±0.5dB	90°	±5°		
99MHz & 99.01MHz	0dB	±0.5dB	90°	±5°		

6) Noise: With 45 MHz, 10 dBm applied to the LO; terminate the RF input with 50 ohms. Measure the IF output referred noise differentially at the rear panel D-sub output.

IF Measurement Frequency	Typical Amplitude dBVrms/√Hz	Allowable Range	Measured Amplitude dBVrms/√Hz	
			I	Q
100Hz	-140dB	±2dB		
1kHz	-138dB	±2dB		

7) IF Bandwidth: Apply a fixed 45MHz RF generator at 0dBm ±0.2dB as the front panel RF input, and a variable frequency LO starting at a frequency of 45.001MHz and a fixed level of 10dBm ±0.2dB applied to the LO input on the rear of the chassis under test. Use a dual channel oscilloscope with a pair of probes to view the IF beat note differentially on the rear panel D-sub for the channel under test. Increment the LO frequency until a 3dB decrease in the IF beat note is observed. Record the frequency corresponding to the -3dB frequency in the table below.

Typical -3dB Bandwidth	Allowable Range	Measured -3dB IF Bandwidth	
		I	Q
6 MHz	>5 MHz		

8 Analog Section

Preparation:

1) Both:

Make sure the DIP switches are set to their default position: On/Off/On/Off/Off/Off/Off/On.

Disconnect P1 on the servo board and connect the prepared flat ribbon cable. Terminate the BNC/Breakout with 50 Ohms.

Connect the TTFSS tester and set the switch to their default position:

- Controls: Local (down)
- Common Sign: + (up)
- Anti: Disable (up)
- Common Exc: Disable (down)
- Fast Exc: Disable (down)
- Fast Sign: + (up)
- EOM: Enable (down)
- AO: Disabled (up)
- Ramp: Disabled (up)
- Boost 1: Disabled (up)
- Boost 2: Disabled (up)
- SP1 (Opt 1 & 2): Disabled (up)
- SP2 (Opt 4): Disabled (up)

8.1 Sign

Apply a 1 kHz 2 Vpp sine wave to the BNC/Breakout/Breakout and use the oscilloscope to look at the COM MON output. Check the function of the Sign switch of the tester by turning it on and off. Mixer Option: The nominal signal at COM is 2 Vpp in phase (Sign +) and out of phase (Sign −). PFD Option: 2 Vpp in phase (both signs).

Sign switch working: …………………………

8.2 Common Offset Adjustment

Use a voltmeter to measure the level at the COM MON output and the Mixer MON on the tester, while turning the Common Offset potentiometer knob of the tester. The range should be 100±5 mVpp, whereas the intrinsic offset error should be smaller than ±10mV.

Potentiometer	COM output	Nominal	Mixer Monitor	Nominal
Full CW (-10V)		+10V		+50mV
Mid (0V)		0		0
Full CCW (+10V)		−10V		−50mV

Leave the potentiometer at the position that zeroes the COM output.

Common Offset working: …………………………

8.3 Additive Offset

1) Apply a 1 kHz 20 Vpp sine wave to the AO input and use the oscilloscope to look at the COM output. Check the function of the AO switch by turning it on and off. The nominal signal at COM with the switch on the ON position is 200mVpp.

AO switch working: …………………………

2) Check the fast ramp switch by looking at Common OUT2, while toggling the Ramp switch on the tester. With the ramp enabled, the signal should be off.

Ramp switch working: …………………………

3) Turn on the AO switch & measure the transfer function from the AO input to the COM output, the Common OUT1 and the DAQ readback on pins1/6, as well as the Mixer Mon on the tester. Write down the magnitude at 1 kHz, and the phase at 100 kHz.

Input frequency	COM Output	OUT1	DAQ	Mixer Mon
1 kHz (Magnitude)				
1 kHz (Phase)				
100 kHz (Phase)				

Additive Offset working: …………………………

8.4 Anti-Boost

Measure the transfer function of the anti-boost stage. Its nominal transfer function is a 750 Hz / 75 kHz zero/pole combination. The transfer function with the Anti-boost off should be flat at 0 dB. Set the source strength of the SR785 to 100 mV and measure from the BNC/Breakout/Breakout to the COM output. The measured transfer functions should be within ±1dB and ±10° of nominal. Record the transfer function and attach to the test report.

Input frequency	**Nominal**		**Measured**	
	Magnitude (dB)	Phase (°)	Magnitude (dB)	Phase (°)
100 Hz	−39.9	8		
1 kHz	−35.4	53		
10 kHz	−17.2	78		
100 kHz	−1.8	35		

Anti-boost working: …………………………

8.5 Common Excitation

1) Apply a 1 kHz 20 Vpp sine wave to the Common EXC input and use the oscilloscope to look at the Common OUT2 output. Check the function of the Common Exc switch by turning it on and off. The nominal signal at OUT2 with the switch on the ON position is 2 Vpp.

Common Exc switch working: …………………………

2) Measure the transfer function from the Common EXC input to the Common OUT2. It should be flat at −20.0±0.5dB. Write down the magnitude at 1 kHz, and the phase at 100 kHz.

Input frequency	**COM Output**			
1 kHz (Magnitude)				
1 kHz (Phase)				
100 kHz (Phase)				

Common Excitation working: …………………………

8.6 Common Gain

Measure the transfer function from the BNC/Breakout/Breakout input to the TP8. Set the excitation to 100 mVpp. Set the gain by turning the Common Gain potentiometer of the tester and watching the voltage at the Common Gain monitor output. It should be flat and within 1 dB of the nominal gain.

Potentiometer	**Nominal**		**Measured**	
+10V	3.16 V	30 dB -6dB		
+5V	1 V	20 dB -6dB		
0V	316 mV	10 dB -6dB		
−5V	100 mV	0 dB -6dB		
−10V	32 mV	−10dB -6dB		

Leave the potentiometer at the position at −5V and 0 dB of gain.

Common Gain working: …………………………

8.7 Boost 1

Measure the transfer function of the common boost stage (Boost 1). Its nominal transfer function is a 0 Hz / 100 Hz pole/zero combination. The transfer function with the boost off should be flat at 0 dB. Set the source strength of the SR785 to 10 mV and measure from the BNC/Breakout to the TP20. You may need to apply the signal to the BNC/Breakout, and measure between TP8 and TP20.. The measured transfer functions should be within ±1dB and ±10° of nominal. Due to the integrator at 0 Hz, it is important to make sure that the output is not rail. Use the Common Offset for fine-tuning. Record the transfer function and attach to the test report.

Input frequency	**Nominal**		**Measured**	
	Magnitude (dB)	Phase (°)	Magnitude (dB)	Phase (°)
1 Hz	43.7	−90		
10 Hz	23.7	−86		
100 Hz	5.2	−57		
1 kHz	0.1	−9		

Common boost working: …………………………

8.8 EOM Path

1) Measure the transfer function of the EOM path. Its nominal transfer function is AC coupled with a boost below 100 kHz. Set the source strength of the SR785 to 10 mV and measure from the BNC/Breakout to the EOM monitor. Make sure the EOM monitor switch is in the low voltage (LV) position. The measured transfer functions should be within ±1dB and ±10° of nominal. Record the transfer function and attach to the test report.

Input frequency	**Nominal**		**Measured**	
	Magnitude (dB)	Phase (°)	Magnitude (dB)	Phase (°)
30 Hz	−41.0	84		
100 Hz	−9.6	70		
1 kHz	41.3	−79		
10 kHz	28.8	66		
100 kHz	−1.7	90		

EOM path working: …………………………

2) Measure the RMS detector in the EOM path. Apply a 85 kHz sine wave to the BNC/Breakout and vary its amplitude while measuring at the EOM monitor of the tester. The EOM monitor at the tester should display a static voltage, whereas the EOM monitor at the TTFSS should show a sine wave.

Amplitude	**EOM (TTFSS)**	**Nominal**	**EOM (Tester)**	**Nominal**
10 mVp		10 mVp		
100 mVp		100 mVp		
1 Vp		1 Vp		
10 Vp		10 Vp		

EOM RMS Monitor working: …………………………

3) Tune the notch filter to the EOM resonance, or a nominal 2 MHz, if unknown. Use a HP4395A network analyzer and a 1 kHz series resistor on the EOM monitor to measure the notch transfer function. Use C147 to trim the frequency. Write down the notch depth and the 3 dB width.

Notch frequency: …………….. Depth: …………...… 3 dB with: …………………

4) Use a signal source with an AM modulation capability. Apply a fixed frequency signal at 100 kHz 1 Vpp to the BNC/Breakout input. Measure the transfer function to the DAQ readback 3/8 by using an SR785 injecting into the AM modulation input.

EOM DAQ readback working: …………………………

8.9 Fast Gain

Measure the transfer function from TP20 input to TP22, make sure that EOM switch is in the ON position.. Set the excitation to 100 mVpp. Set the gain by turning the Fast Gain potentiometer of the tester and watching the voltage at the Fast Gain monitor output. It should be flat and within 1 dB of the nominal gain.

Potentiometer	**Nominal**		**Measured**	
+10V	3.16 V	30 dB -6dB		
+5V	1 V	20 dB -6dB		
0V	316 mV	10 dB -6dB		
−5V	100 mV	0 dB -6dB		
−10V	32 mV	−10dB -6dB		

Leave the potentiometer at the position at −5V and 0 dB of gain.

Fast Gain working: …………………………

8.10 Fast Offset Adjustment

Use a voltmeter to measure the level at the TP21, while turning the Fast Offset potentiometer knob of the tester. The range should be 250±50 mVpp, whereas the intrinsic offset error should be smaller than ±100mV.

Potentiometer	**TP21**	**Nominal**		
Full CW (+10V)		+250mV		
Mid (0V)		0		
Full CCW (−10V)		−250mV		

Leave the potentiometer at the position that zeroes the TP21.

Fast Offset working: …………………………

8.11 Fast Compensation

Measure the transfer function of the fast compensation path. Its nominal transfer function is low frequency boost with a high pass cut-off. Set the source strength of the SR785 to 10 mV and measure from TP22 to the TP23. The measured transfer functions should be within ±1dB and ±10° of nominal. Record the transfer function and attach to the test report.

Input frequency	Nominal		Measured	
	Magnitude (dB)	Phase (°)	Magnitude (dB)	Phase (°)
10 Hz	38.9	0		
100 Hz	38.9	−2		
1 kHz	38.2	−21		
10 kHz	26.8	−58		
100 kHz	17.2	−49		

Fast compensation working: …………………………

8.12 Boost 2

Measure the transfer function of the fast boost stage (Boost 2). Its nominal transfer function is a 0 Hz / 100 Hz pole/zero combination. The transfer function with the boost off should be flat at 0 dB. Set the source strength of the SR785 to 0.2 mV and measure from the TP23 to Fast OUT1. The measured transfer functions should be within ±1dB and ±10° of nominal. Due to the integrator at 0 Hz, it is important to make sure that the output is not rail. Use the Common Offset for fine-tuning. Record the transfer function and attach to the test report.

Input frequency	Nominal		Measured	
	Magnitude (dB)	Phase (°)	Magnitude (dB)	Phase (°)
1 Hz	43.7	−90		
10 Hz	23.7	−86		
100 Hz	5.2	−57		
1 kHz	0.1	−9		

Common boost working: …………………………

8.13 Fast without EOM (Fast only)

Turn the EOM switch to disable.

1) Tune the offset in the fast only path by monitoring TP18 and adjusting R51. Make sure the Option 1 (SP1) is on during this procedure.

Fast only offset working: …………………………

2) Measure the transfer function of the fast only path. Its nominal transfer function is low frequency boost. Set the source strength of the SR785 to 10 mV and measure from TP20 to TP23. Make sure the Option 1 (SP1) is on. The measured transfer functions should be within ±1dB and ±10° of nominal. Record the transfer function and attach to the test report.

Input frequency	**Nominal**		**Measured**	
	Magnitude (dB)	Phase (°)	Magnitude (dB)	Phase (°)
1 Hz	29.1	−2		
10 Hz	28.7	−16		
100 Hz	18.9	−55		
1 kHz	9.5	−15		
10 kHz	9.1	−2		
100 kHz	9.1	0		

Fast only path working: …………………………

3) Check that the signal reaches the Fast monitor (switch at low voltage).

Fast only path working: …………………………

4) Check the Option 3 (SP 2) switch. If turned on, the signal at the Fast monitor should be zero.

SP 2 working: …………………………

8.14 Fast Excitation

1) Apply a 1 kHz 20 Vpp sine wave to the Fast EXC input and use the oscilloscope to look at the Fast OUT2 output. Check the function of the Fast Exc switch by turning it on and off. The nominal signal at OUT2 with the switch on the ON position is 2 Vpp.

Fast Exc switch working: …………………………

2) Measure the transfer function from the Fast EXC input to the Fast OUT2. It should be flat at −20.0±0.5dB. Write down the magnitude at 1 kHz, and the phase at 100 kHz.

Input frequency	**COM Output**			
1 kHz (Magnitude)				
100 kHz (Phase)				

Fast Excitation working: …………………………

3) Check that the ramp switch works by watching the fast monitor: Enable the ramp and make sure no signal appears on the fast monitor. Toggle the LV switch, which should have no effect.

Ramp switch working: …………………………

8.15 Fast Notches

There are three notches in the fast path to compensate for resonances in the laser PZT. They should be tuned to the PZT of the laser. If unknown, tune them to 130 kHz, 210 kHz and 280 kHz. Use a HP4395A network analyzer and a 1 kHz series resistor on the Fast monitor to measure the notch transfer function. Inject into the Fast Excitation input. Use C130, C131 and C132 to trim the respective frequencies. Write down the notch depth and the 3 dB width.

Notch 1 frequency: …………….. Depth: …………...… 3 dB with: …………………

Notch 2 frequency: …………….. Depth: …………...… 3 dB with: …………………

Notch 3 frequency: …………….. Depth: …………...… 3 dB with: …………………

8.16 Fast DAQ Readback

Measure the transfer function of the fast DAQ readback 2/7. Its nominal whitening function is two stages of 10 Hz / 100 Hz zero/pole combinations. Set the source strength of the SR785 to 0.2 mV and measure from the Fast monitor (LV) to the Fast DAQ. The measured transfer functions should be within ±1dB and ±10° of nominal. Record the transfer function and attach to the test report.

Input frequency	Nominal		Measured	
	Magnitude (dB)	Phase (°)	Magnitude (dB)	Phase (°)
1 Hz	0	−2		
10 Hz		−16		
100 Hz	18.9	−55		
1 kHz	9.5	−15		
10 kHz	9.1	−2		
100 kHz	9.1	0		

Fast DAQ readback working: …………………………

8.17 Slow Path

Measure the transfer function of the slow path by switching the tester into Remote. The nominal transfer function is a 40 Hz pole with a gain of 0.2. Set the source strength of the SR785 to 1V and measure from the Slow Control on the tester to the Slow Output and the DAQ readback 4/9. The measured transfer functions should be within ±1dB and ±10° of nominal.

Input frequency	Nominal		Slow		DAQ	
	Mag (dB)	Phase (°)	Mag (dB)	Phase (°)	Mag (dB)	Phase (°)
1 Hz	−14.0	−1				
10 Hz	−14.3	−14				
100 Hz	−22.6	−68				
1 kHz	−42.0	−88				

Slow path working: …………………………

9 High Voltage Section

Caution: Do not remove the Plexiglas high voltage protection over the rear board, when a high voltage is applied.

A bipolar ±200V high voltage supply with at least 50 mA current is required to finish this section.

9.1 Electrical Equipment Inspection Program

Check that the enclosure sports a red EEIP high voltage sticker (see T1000360, T1000583 and E1100330).

Red sticker is attached: …………………………

9.2 EOM Path (low voltage)

Use a ±24V supply to power the high voltage section.

Use an active probe to measure the transfer function and noise above 100 kHz. Use a scope to make sure output voltage does not damage the active probe!

1) Measure the transfer function of the full EOM path. Use an SHV-to-BNC adapter to connect to the EOM output. The nominal transfer function is AC coupled with a boost below 100 kHz. The HV section adds an additional high pass filter below 240 Hz and a pole at 33 kHz. Set the source strength of the SR785/HP4395A to 10 mV and connect to the BNC/Breakout. Measure from TP35 on the servo board to the EOM output. Make sure the EOM monitor switch is in the high voltage (HV/25) position. The measured transfer functions should be within ±1dB and ±10° of nominal. Record the transfer function and attach to the test report.

Input frequency	**Nominal**		**Measured**	
	Magnitude (dB)	Phase (°)	Magnitude (dB)	Phase (°)
30 Hz	12.3	83		
100 Hz	22.1	67		
1 kHz	30.2	12		
10 kHz	30.0	−16		
100 kHz	20.1	−73		
1 MHz	0.5	−96		
3 MHz	−8.6	ignore		
10 MHz	−19.3	ignore		

Full EOM path working: …………………………

2) Measure the noise level of the full EOM path. Terminate the input at the BNC/Breakout and measure at the EOM output. The measured noise should be below the listed maximum level. Record the noise amplitude spectrum in nV/√Hz and attach to the test report.

Input frequency	**Nominal**	**Maximum**	**Measured**
	Level (nV/√Hz)	Level (nV/√Hz)	Level (nV/√Hz)
100 Hz			
1 kHz			
10 kHz			
100 kHz			
1 MHz			
10 MHz			

Full EOM path noise OK: …………………………

9.3 PZT Path (low voltage)

Use a ±24V supply to power the high voltage section.

1) Attach the scope to TP12 on the HV board and check that the fast sign switch is working by applying a 10mV/1 kHz sine wave at the BNC/breakout.

Fast sign working: …………………………

2) Attach the scope to TP14 on the HV board and check that a negative offset of −5V is present with the BNC/breakout terminated.

Fast output offset present: …………………………

3) Measure the noise level of the full PZT path. Use a battery to add a fixed offset to the input at the BNC/Breakout. Adjust the common and fast gains, so the PZT output voltage reads close to zero. Now, measure at the PZT output noise using an SR785. The measured noise should be below the listed maximum level. Record the noise amplitude spectrum in nV/√Hz and attach to the test report.

Input frequency	**Nominal**	**Maximum**	**Measured**
	Level (nV/√Hz)	Level (nV/√Hz)	Level (nV/√Hz)
10 Hz			
100 Hz			
1 kHz			
10 kHz			
100 kHz			

Full PZT path noise OK: …………………………

9.4 Power Monitor

Use a ±200V supply to power the high voltage section.

Check that the green LED on the tester that reads Power OK is on. Now reduce the each voltage rail of the HV supply independently and make sure the LED turns off between 160V and 180V absolute. Go back to 200V and reduce each voltage rail of the LV supply independently. Make sure the LED turns off between 15.5V and 16.5V absolute.

Power OK working: …………………………

9.5 EOM Path (high voltage)

Use a ±200V supply to power the high voltage section.

Use a high voltage probe to measure the check the signal at the EOM output.

1) Check that the EOM output can drive at least ±180V. Use a signal source in the frequency range 1 kHz and 10 kHz and watch the EOM output using a high voltage probe.

EOM high voltage OK: …………………………

2) Measure the transfer function of the EOM HV/25 path. Set the source strength of the HP4395A to 10 mV and measure from the BNC/Breakout to the EOM monitor. Make sure the EOM monitor switch is in the high voltage (HV/25) position, and the common gain is set to −5V. The measured transfer functions should be within ±1dB and ±10° of nominal. Record the transfer function and attach to the test report.

Input frequency	**Nominal**		**Measured**	
	Magnitude (dB)	Phase (°)	Magnitude (dB)	Phase (°)
100 Hz	−71.9	ignore		
300 Hz	−38.0	69		
1 kHz	−13.0	−67		
10 kHz	−25.6	50		
100 kHz	−65.6	17		
1 MHz	−94.6	60		

EOM HV/25 path working: …………………………

9.6 PZT Path (high voltage)

Use a ±200V supply to power the high voltage section.

Use a high voltage probe to measure the check the signal at the PZT output.

1) Check the voltage swing of the fast output using a high voltage probe. It should include 100V, but not higher than 120V and extend to −10V, but not lower than −15V. Use a 1 V/1 Hz sine wave at the BNC/breakout while varying the fast gain.

Fast voltage swing OK: …………………………

2) Measure the transfer function of the full PZT path using the fast HV monitor. Make sure the EOM path is enabled and the common and fast gains are set to −5V. The nominal transfer function has poles at 10 Hz, 2.3 kHz and 130 kHz with a zero at 23 kHz. Set the source strength of the SR785 to 10 mV and connect to the BNC/Breakout. Measure from TP32 on the servo board to the PZT output. Make sure the PZT monitor switch is in the high voltage (HV/25) position. The measured transfer functions should be within ±1dB and ±10° of nominal. Record the transfer function and attach to the test report.

Input frequency	**Nominal**		**Measured**	
	Magnitude (dB)	Phase (°)	Magnitude (dB)	Phase (°)
3 Hz	18.6	−17		
10 Hz	16.0	−45		
100 Hz	−1.0	−86		
1 kHz	−21.6	−110		
10 kHz	−53.1	−148		
100 kHz	−82.6	−139		

Full PZT path working: …………………………