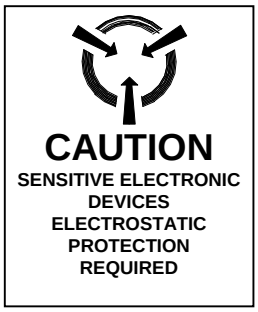
APPLICATION		
DASH NO.	**NEXT**	**USED ON**
0002	PL120589-0002	ILS 420

REVISIONS			
REV	**DESCRIPTION**	**DATE**	**APPROVED**
A	FINAL RELEASE PER ECN 02575	2/14/06	M.McNally
B	Add test to verify TP1 and TP2 Per ECN 03687.	10/15/08	M.McNally



REVISION	**B**
SHEET NO.	**1-29**

CONT. NO.		THALES AIR TRAFFIC MANAGEMENT	**THALES ATM, INC.** SHAWNEE, KANSAS		
First release signatures below. Subsequent versions signatures per ECN		**TEST PROCEDURE:**			
DRAWING/CHECKED Y M.MCNALLY	2/14/06	**ILS 420 GS MOD PA**			
E.E. APPROVAL N/A					
M.E. APPROVAL N/A					
T.E. APPROVAL M.MCNALLY	2/14/06	**SIZE**	**FSCM NO.**	**DWG NO.**	**REV**
Q.A. APPROVAL L.STROH	2/14/06	**A**	**65597**	**TP120589-0002**	**B**
CONF. MGMT. M.GRAY	2/14/06	**SCALE NONE**	**FSC**	**SHEET 1 OF 29**	

1. Scope

This Test Procedure verifies the electrical performance of the ILS 420 Glideslope Modulator Power Amplifier assembly, Thales P/N 120589-0002.

2. Notes

***** CAUTION *****

The UUT and its components are ESD sensitive. ESD precautions should be taken when handling the UUT and its components.

***** CAUTION *****

Except as required during testing, the RF outputs of the UUT, J 2 and J 3, must always be terminated with 50 Ohm loads capable of handling the full power output of the UUT. Extended Operation of the UUT into an open circuit can result in instability, this may potentially damage the RF output transistors.

3. Applicable Documents

PL120589-0002a
EL120589-0002a
AD120589-0002a
EL1291-60148-1a

4. Required Equipment

Equivalent equipment may be substituted for the items listed below. Substitute equipment is acceptable provided it meets either the accuracy, and resolution specifications of the original item, or minimally meets the tolerances and accuracy where defined in the body of this test procedure.

FIG 1 Item	FIG 2 Item	FIG 3 Item	Description
	A,E		+24V PWR Supply >9Amps with current display 6038A
	B,C		±15V PWR Supply E3631A
	D		Audio Oscillator 209A
	F	F	LOC/GS PA Test Fixture
	I		Digital Multimeter 34401A
	J	S	Oscilloscope 400MHz 2465B
L		A,L,F	>20dB Coupler
		B,G	30dB 100W Attn.
		C,H	10 dB 1W Attn.
		D,I	20dB 1W Attn.
		E,J	Thermal PWR Meter 437B
K		K	RF Freq. Synthesizer 8656B
N		N	Vector Volt meter 8405A
		P,Q	Power Divider
		R	Spectrum Analyzer 8568B
X		X	50Ω load 25W
		Y	Fan - may be used to cool UUT during extended operation
			Tuning Tool - Johanson Mfg. Type 4192

Note: A Johanson Mfg. Type 4192 adjustment tool is required to tune the high Q, high stability variable capacitors in the UUT.

5. Test Procedure

Refer to Drawing EL120589-0002, “Schematic Diagram, GS MOD/PA”, and locate the jumper configuration table on Sheet 1 of the drawing.

Verify that all jumpers on the UUT are installed as indicated for the “Factory” configurations indicated in the two tables on Sheet 1.

5.1 Test Equipment Setups.

As directed by this procedure, configure the test equipment as indicated in Figures 1 through 4. These diagrams are all located in section 7 for convenience.

The setup for initial adjustment of the GSPA SBO and CSB directional coupler output matching is indicated in Figure 1.

Figure 2 shows the connections between the test fixture, the UUT, and the RF test equipment group.

Figure 3 shows the connections within the RF test equipment group for Test of the CSB section of the UUT.

Figure 4 shows the connections within the RF test equipment group for Test of the SBO section of the UUT.

5.1.1 RF Test Group Calibration.

This procedure shall be performed or verified as required to ensure the offset entered into the thermal power meters is correct. It must be performed after removal, re-connection, or substitution of the associated attenuators, power meters, or couplers in the RF Test Group, other than as required for testing in this procedure.

Use a network analyzer to determine the total RF attenuation via the RF path from the cable at J2 to the connection point of the power sensor for the CSB Power Meter, Box 1 in Figure 2. Measure this attenuation to an accuracy of ± 0.1 dB at the test frequency of 333 MHz.

Use a network analyzer to determine the VSWR that the amplifier will see. Connect Port 1 of the network analyzer to the cable that will hook to J2 on the amplifier going to the coupler Item F in Figure 2. Verify that the VSWR is less than 1.15.

Perform a power meter calibration for the CSB power meter. Ensure that the offset is turned off.

Enter the attenuation “offset” into the power meter offset memory. Enable “offset” on the power meter.

Use a network analyzer to determine the total RF attenuation via the RF path from the cable at J3 to the connection point of the power sensor for the SBO Power Meter, Box 2 in Figure 2. Measure this attenuation to an accuracy of ± 0.1 dB at the test frequency of 333 MHz.

Use a network analyzer to determine the VSWR that the amplifier will see. Connect Port 1 of the network analyzer to the cable that will hook to J3 on the amplifier going to the coupler Item A in Figure 2. Verify that the VSWR is less than 1.15.

Perform a power meter calibration for the SBO power meter. Ensure that the offset is turned off.

Enter the attenuation "offset" into the power meter offset memory. Enable "offset" on the power meter.

5.2 Initial Adjustments.

The first step prior to application of power is to tune the CSB and SBO output coupler-matching network controls, C17 and C93, for minimum reflected power. Failure to do this will result in false VSWR shutdown during performance of this procedure. The Vector Voltmeter or Network Analyzer may be used to perform this the adjustment.

If using a Vector voltmeter, configure the RF test equipment as indicated in Figure 1. Set up the Vector Voltmeter (VVM) for measurement of VSWR. Calibrate the VVM using a 50-Ohm (i.e. RG 316) test cable having a two pin header connector at one end and a SMA connector at the other for attachment to the directional coupler. Use a shorted header to calibrate the VVM.

If using the network analyzer, calibrate it to read VSWR using the cable described above. In this instance the Short, Open, and 50 Ohm standards required for calibration consist of 2 or 4 pin headers which are shorted, open, and terminated in a 51 Ohm chip resistor.

Remove the jumper at JP2 1-2 and connect the test cable to JP2 2-4. Ensure that the shield on the coax connects to Pin 4, i.e. ground, on JP2.

Connect a 50-Ohm termination (VSWR << 1.1 to 1) at the CSB RF output, J2.

Locate C17, and adjust C17 to minimize the VSWR. A VSWR of less than 1.1 to 1 should be obtainable.

Replace the jumper at JP2, making sure the jumper connects between pin 1 and pin 2. **An improperly connected jumper may damage the RF Output stage.**

In the same way, locate Jumper JP4 on the SBO side of power amplifier and remove it. Connect the cable from the Vector Voltmeter or Network Analyzer to JP4. Ensure the ground side of the test cable is connected to Pin 4.

Connect a 50-Ohm termination (VSWR << 1.1 to 1) at the SBO RF output, J3.

Locate C93, and adjust C93 to minimize the VSWR indicated on the VVM. A VSWR of less than 1.1 to 1 should be obtainable.

Replace the jumper at JP4, making sure the jumper connects between pin 1 and pin 2. **An improperly connected jumper may damage the RF Output stage.**

This completes the preliminary adjustment of the CSB and SBO directional coupler matching networks. The

adjustment will be refined later in this procedure.

Set the Test Fixture controls as follows:

SW1	CSB Audio	Off
SW2	SBO Audio	Off
SW4	I Phase	Off
SW5	Q Phase	Off
SW6	I-Q AC/DC Coupling	AC
R2	CSB % Modulation	CCW
R3	CSB Power	CCW
R4	SBO Audio Modulation Level	CCW
R5	SBO Power	CCW

Locate Jumper JP10. Move the shorting jumper to JP10 1-3. This will enable bias to be applied to the SBO output stage, Q3.

Prior to application of power, locate R66, R67, and R140. Set each of the variable resistors fully counter clockwise to remove the bias from the RF power transistor's.

Additionally, locate and set R111, R122, and R42 fully CCW.

Next, locate R85, and R187. Apply only +15 and -15 volts to the UUT. **Do not apply +24 volts**.

Connect one probe of the multi-meter to the side of R196 that connects to the wiper of R85 and the other to ground. Adjust R85 for 0 ± 0.005 Volts DC.

Check the verification box on the data sheet.

Connect one probe of the multi-meter to the side of R197 that connects to the wiper of R185 and the other to ground. Adjust R185 for 0 ± 0.005 Volts DC. This ensures that no initial DC offset is applied to the SBO Input amplifiers.

Check the verification box on the data sheet.

5.2.1 Initial Adjustments:

Specification: R85 Verified R85 Verified _____

Specification: R187 Verified R187 Verified _____

5.2.2 Set RF Stage DC Bias.

The DC Bias for the RF stages is set by individual adjustment of the bias for each stage while observing the +24 Volt current into each stage as a voltage drop across dedicated precision shunt resistors. The shunt resistors R156, R157, and R213 are 0.1 Ohm 1% resistors. For this value 100 mA. produces a voltage drop of 10

millivolts, 350 mA. produces a drop of 35 millivolts, and 1.0 Amp produces a drop of 100 millivolts.

Set the Test Fixture controls as follows:

SW1	CSB Audio	Off
SW2	SBO Audio	Off
SW4	I Phase	Off
SW5	Q Phase	Off
SW6	I-Q AC/DC Coupling	AC
R2	CSB % Modulation	CCW
R3	CSB Power	CCW
R4	SBO Audio Modulation Level	CCW
R5	SBO Power	CCW

Apply power to the UUT.

In each of the following adjustments, increase the bias applied to the FET being adjusted until a current of 1.0 Ampere is indicated by a 100 millivolt drop across the shunt resistor. Then decrease the bias to obtain a current of 350 mA. A 35-millivolt drop across the shunt resistor indicates the correct current.

NOTE

During adjustment, the current may rise and then fall off before 1 Ampere is obtained. This is due to an oscillation, which may occur at very low bias currents. Ignore this indication and continue to increase the bias voltage until 1 Ampere is obtained, then reduce the current to 350 mA. Perform the bias adjustments in the order indicated.

5.2.2.1 BIAS Q9.
Set the bias current for Q9 to 0.35 Amperes. Connect the multimeter to TP6 and TP7. Adjust R66 clockwise while observing the voltage from TP6 - TP7. Set the current drawn by Q9 to obtain a DC voltage of 35 +/-1 millivolts at TP6 - TP7, as described above.

Record the test point voltage, and the total DC current, on the data sheet for this step.

5.2.2.2 BIAS Q10.
Set the bias current for Q10 to 0.35 Amperes. Connect the multimeter to TP4 and TP5. Adjust R67 clockwise while observing the DC Voltage at TP4 - TP5. Set the current drawn by Q10 to obtain a DC voltage of 35 millivolts at TP4 - TP5.

Record the test point voltage, and the total current, on the data sheet for this step.

5.2.2.3 BIAS Q3.

Set the bias current for Q3 to 0.35 Amperes. Connect the multimeter to TP8 and TP9. Adjust R140 clockwise while observing the DC Voltage at TP8 - TP9. Set the current drawn by Q3 to obtain a DC voltage of 35 millivolts at TP8 - TP9.

Record the test point voltage and the total current on the data sheet for this step.

5.2.2.4 RF Stage Bias Results

TEST PARAGRAPH	**SPECIFICATION** Test Point Voltage milliVolts	**MEASURED** Test Point Voltage milliVolts	**TOTAL CURRENT** (After Each Adjustment)
5.2.2.1 BIAS Q9	**TP6 - TP7 35 +/- 1**	**TP6 - TP7**	**Amperes**
5.2.2.2 BIAS Q10	**TP4 - TP5 35 +/- 1**	**TP4 - TP5**	**Amperes**
5.2.2.3 BIAS Q3	**TP8 - TP9 35 +/- 1**	**TP8 - TP9**	**Amperes**

5.3 Set the CSB Modulation Sensitivity.

As part of this adjustment a preliminary setup of the CSB forward and reverse detector match is made at 1 Watt output. This is required to prevent a false VSWR shutdown, and to overcome some interaction between adjustments.

Locate the CSB modulation Sensitivity control, R42, on the UUT. Set this control fully counter clockwise.

Set the Test Fixture controls as follows:

SW1	CSB Audio	Off
SW2	SBO Audio	Off
SW4	I Phase	Off
SW5	Q Phase	Off
SW6	I-Q AC/DC Coupling	AC
R2	CSB % Modulation	CCW
R3	CSB Power	CCW
R4	SBO Audio Modulation Level	CCW
R5	SBO Power	CCW

Connect the multimeter to CSB IN, TP6, on the test fixture. Adjust the CSB Power control, R3, on the test fixture to obtain 5.0 ± 0.02 Volts DC at TP6, CSB IN.

Adjust R42 on the UUT clockwise until the CSB power meter, F, in Figure 3 indicates a power output of 1.0 ± 0.1 Watts.

Set channel 1 of the oscilloscope for DC coupling and 1 Volt per division, and set the ground reference at the bottom of the screen. Set the triggering of the oscilloscope to automatic. Connect the oscilloscope probe to CSB REV, TP4, on the test fixture.

Alternatively adjust C12 and C17 to minimize the voltage indicated on the oscilloscope. This adjustment maximizes the directivity of the directional coupler, so that a full power adjustment can be made.

Next, adjust R42 on the UUT clockwise until the CSB power meter, F, in Figure 3 indicates a power output of 5.0 ±0.05 Watts.

Record the voltage at CSB IN, TP6, and the RF power output on the data sheet.

5.4 Readjust the CSB directional coupler output matching network.

This adjustment matches the output impedance of the CSB directional coupler to 50 Ohms. The reflected power output voltage, measured at CSB REV, TP4, indicates when the correct adjustment is achieved. This adjustment is sensitive to the gross setting of the CSB feedback phase shift adjustment, C27, so a preliminary setting of

C27 is made first.

Set channel 1 of the oscilloscope for DC coupling and 1 Volt per division, and set the ground reference at the bottom of the screen. Set the triggering of the oscilloscope to automatic. Connect the oscilloscope probe to PHASE CNTL, TP3, on the test fixture. Also connect the multimeter to PHASE CNTL, TP3. Set the multimeter to indicate DC voltage.

With the UUT operating as in section 5.4, adjust C27 to obtain a DC voltage of 5.5 ± 0.1 volts.
This puts the impedance presented by the phase shift network to the coupler at near the final value.

Next, set channel 1 of the oscilloscope for DC coupling and 1 Volt per division, and set the ground reference at the bottom of the screen. Set the triggering of the oscilloscope to automatic. Connect the oscilloscope probe to TP4 on the test fixture. Also connect the multimeter to CSB REV, TP4. Set the multimeter to indicate DC voltage

With the UUT still operating as in section 5.4, alternately adjust C12 and C17 to reduce the amplitude indicated on the oscilloscope as low as possible.

After the adjustment is complete, record the DC voltage as indicated by the multimeter on the data sheet. The voltage shall be less than 0.5 Volts.

Record this voltage on the data sheet.

5.4.1 Readjust the CSB directional coupler output matching network.

Specification: CSB REV, TP4 < 0.5 VDC. TP4 Voltage: _____

5.5 Calibration of CSB Reflected Power Detector Output Voltage.

With the UUT operating as above, temporarily remove the 24-Volt power. Connect a 2:1 load on the output of the CSB channel, J2. Nothing else should be connected, not even the coupler.

Locate R17 on the UUT. Adjust R17 while observing CSB REV, TP4, on the multimeter to obtain a DC voltage reading of 5.0 ± 0.02 Volts DC.

5.5.1 Calibration of CSB Reflected Power Detector Output Voltage.

Specification: TP4, CSB REV, = 5.0 ± 0.02 Volts DC. TP4 Voltage: _____

Remove the 24-Volt power. Restore the test setup connections.

5.6 Calibration of the CSB Forward Power Detector Output Voltage.

Connect the multimeter to CSB FWD, TP5, to the CSB Forward Power Detector Output test point.

Restore the 24-Volt power, and verify that the power output indicated on the CSB power meter, J, of Figure 2 is still 5 Watts ± 0.05 Watts.

If not, verify that the CSB modulation input voltage at CSB IN, TP6, is 5.0 ± 0.02 Volts and then adjust R42 slightly, if required, to obtain the specified power output.

Locate R34. With the multimeter connected to CSB FWD, TP5, adjust R34 to obtain a DC voltage indication of 5.0 ± 0.02 Volts.

Record the following data on the data sheet.

5.6.1 CSB Forward Power Detector Calibration:

Power Specification: 5 ± 0.05 Watts Power Output: _____

Detector Output Specification: 5.0 ± 0.02 Volts Detector Output: _____

5.7 Adjustment of the CSB Phase Lock Loop.

The CSB amplifier contains a Phase Lock Loop to maintain the output carrier phase in a constant relationship with a phase reference derived from the Frequency Synthesizer input at J1. The objective of this adjustment is to optimize the control range of this PLL.

Connect the oscilloscope probe and the DC multimeter to PHASE CNTL, TP3. Set the vector voltmeter, item N in Figure 2, to indicate phase A to B.

Locate the PLL phase reference adjustment capacitor, C27.

With the UUT operating as above, adjust C27 to determine the minimum and maximum phase control voltage obtainable throughout the range of adjustment. Proceed as follows.

Set C27 to obtain the minimum control voltage. Record this voltage on the data sheet.

Observe the vector voltmeter indication, item N in Figure 2, and set the phase reference to 0.

Set C27 to the maximum control voltage. Record this voltage and phase reading indicated by the vector voltmeter on the data sheet.

Determine the midpoint of the available range of phase adjustment. Adjust C27 to set the phase indicated by the vector voltmeter to the midpoint of the range. On the data sheet record the midpoint phase, and control voltage indicated when C27 is adjusted to the midpoint.

Verify that the power output indicated on the CSB power meter, J, of Figure 2 is still 5 Watts ± 0.05 Watts.

If not, verify that the CSB modulation input voltage at CSB IN, TP6, is 5.0 ± 0.02 Volts and then adjust R42 slightly, if required, to obtain the specified power output.

Verify that the CSB REV, TP4 is still < 0.5 VDC.

If not then alternately adjust C12 and C17 until the voltage is <0.5 VDC.

5.7.1 Adjustment of the CSB Phase Lock Loop.

Acceptance Criteria:

Minimum Control Voltage:	3.7	to	5.0	Volts	Measured: _____
Maximum Control Voltage:	6.0	to	8.0	Volts	Measured: _____
Phase Control Range:	85	to	115	Degrees	Measured: _____

Setup Data:

Calculated Midpoint of Phase Control Range: _____Degrees

Phase Control Voltage at Midpoint of Control Range: _____Volts

CSB REV < 0.5 VDC _____Verified

5.8 CSB Static Peak Envelope Power

The objective of this test is to verify the DC to RF conversion efficiency of the CSB RF amplifier.

Set the Test Fixture controls as follows:

SW1	CSB Audio	Off
SW2	SBO Audio	Off
SW4	I Phase	Off
SW5	Q Phase	Off
SW6	I-Q AC/DC Coupling	AC
R2	CSB % Modulation	CCW
R3	CSB Power	For 5 ± 0.05 Watts CW
R4	SBO Audio Modulation Level	CCW
R5	SBO Power	CCW

Observe the CSB RF power meter, Item J, in Figure 3. Adjust the CSB Power control, R3, on the test fixture to obtain an indicated power output of 17 Watts.

*****Caution*****

To avoid over heating do not operate the amplifier under these test conditions for more than 5 minutes. Do not leave the amplifier un-attended when operating under these test conditions.

Record the 24-Volt Current indicated by the ammeter, Item E, in Figure 1. The current shall be less than 2.5 Amperes.

Record the current and power on the data sheet.

5.8.1 CSB Static Peak Envelope Power.

Acceptance Criteria:

Power Output:	17 ± 0.1 Watts	
24 Volt Current	< 2.5 Amperes.	Measured Current: _____ Amps

5.9 CSB AM Modulation Performance.

Set the Test Fixture controls as follows:

SW1	CSB Audio	Off initially
SW2	SBO Audio	Off
SW4	I Phase	Off
SW5	Q Phase	Off
SW6	I-Q AC/DC Coupling	AC
R2	CSB % Modulation	CCW initially
R3	CSB Power	For 5 ± 0.05 Watts CW
R4	SBO Audio Modulation Level	CCW
R5	SBO Power	CCW

Adjust the oscilloscope, item S, in Figure 3, to display the RF envelope on channel 2. Set the gain of the oscilloscope such that the RF envelope produces a vertical deflection of approximately four divisions.

Adjust the CSB Power Control, R3, on the Test Fixture until a CSB power output of 17 Watts is indicated.

Set the cursor on the oscilloscope at the tips of the RF envelope to calibrate the oscilloscope cursors to indicate 17 Watts Peak Envelope Power, PEP.

Reset the CSB Power control to obtain 5 ± 0.05 Watts CSB output.

Connect the scope probe on channel one of the oscilloscope to the Audio oscillator Input to the Test Fixture at AUDIO GEN INP, TP20. Adjust the output of the Audio oscillator to supply a 150 Hz sine wave at an amplitude 5 ± 0.2 Volts peak to peak.

Set the CSB Audio switch, SW1, on the Test Fixture to On.

Next, adjust the CSB percent modulation control on the test fixture clockwise until the peak RF amplitude indicated on the oscilloscope is set to the cursor lines corresponding to 17 Watts Peak Envelope Power.

Adjust the spectrum analyzer to a Center Frequency of 333 MHz and a Span of 2 kHz. Observe the modulated RF spectrum.

Using the Marker facility of the spectrum analyzer record amplitude of the of the highest modulation harmonic sideband (i.e. 300 Hz, 450 Hz, etc) relative to the 150 Hz sidebands.

The amplitude of the highest harmonic sideband shall be less than 26 dB below 150 Hz sidebands. Record the offset Frequency and the amplitude of the highest harmonics sideband on the data sheet.

Connect the oscilloscope probe on channel one of the oscilloscope to PHASE CNTL, TP3, on the Test Fixture. Set the gain to the oscilloscope to 2 volts per division and ground reference at the bottom line of the oscilloscope screen.

Verify that the AC modulation present on the phase control voltage is not clipped and that the amplitude does not exceed 1-Volt peak to peak. Set the oscilloscope input coupling to AC and increase the gain if required to measure the peak to peak voltage.

Record these items on the data sheet.

5.9.1 CSB AM Modulation Performance.

CSB Modulation Harmonic Amplitude:

Requirement: < -26 dB relative to 150 Hz sideband.

Measured: ___ dB relative to 150 Hz sideband. Offset Frequency: _____ Hz

Phase Control Voltage:

Control Voltage is not Clipped. Verified: _____

AC on Control Voltage < 1 Volt Peak to Peak. AC Voltage: _____ Vpp

Connect the Scope to TP1. Verify a 150Hz sine wave is present. TP1 Verified _____

When this test is completed set the CSB Modulation to OFF, and Set the CSB Power Control Fully CCW to minimum power output.

5.10 SBO Modulator Initial Setup and I-Q Feedback Phase Adjustment.

Reconnect the RF Test Equipment Group as indicated in Figure 4.

Set the Test Fixture controls as follows:

SW1	CSB Audio	Off
SW2	SBO Audio	Off
SW4	I Phase	0 Deg
SW5	Q Phase	Off
SW6	I-Q AC/DC Coupling	DC
R2	CSB % Modulation	CCW
R3	CSB Power	CCW
R4	SBO Audio Modulation Level	CCW
R5	SBO Power	CCW

Connect the DC multimeter to test point, TP22, I INPUT. Adjust the SBO RF Power control on the Test Fixture to obtain 5 volts DC ± 0.1 Volts at TP22.

Locate R111, the SBO I modulation adjustment on the UUT. Adjust this control clockwise until the SBO RF power meter indicates 1 Watt ± 0.05 Watts.

Locate C91 and C93, the SBO directional coupler matching capacitors. Connect the oscilloscope probe to TP1, SBO REV PWR, and set for DC coupling with the ground reference at the bottom of the scope display.

Adjust C91 and C93 to minimize the DC voltage indicated.

Readjust R111, if required, to obtain an output of 1 Watt ± 0.05 Watts.

Observe the RF envelope on the oscilloscope and set the voltage cursors to mark the peak points of the RF envelope. This establishes a calibration point on the oscilloscope at 1 W Peak Envelope Power.

Set the I- Q AC DC coupling switch, SW6, to AC. Verify that the input from the Audio oscillator at AUDIO GEN INP, TP20, is set to 5 volts peak to peak and 150 Hz.

Turn SBO AUDIO On, SW2.

Rotate the SBO audio level control on the Test Fixture, R4, clockwise until the RF envelope peaks on the oscilloscope are at the preset voltage cursor lines. This sets the SBO power output to 1 W peak envelope power.

Next the IQ Feedback phase will be adjusted to minimize the output from the Q modulator.

Connect the oscilloscope probe to the Q MODULATOR, TP14, on the Test Fixture. Set the oscilloscope for AC coupling and adjust the vertical gain as required (~ 0.5 V/division) to display Q modulator output.

Locate the IQ modulator phase reference adjustment, C193, in the SBO section of the UUT.

Adjust, C193, to minimize the amplitude of the Q modulator waveform displayed on the oscilloscope.

This adjustment interacts to some extent with the adjustment of C91 and to a lesser extent with C93. Compensate for this as follows.

After adjustment of C193, move the scope probe to SBO REV PWR, TP1. Adjust C91 and C93 slightly to minimize the peak to peak amplitude of the SBO reverse power voltage.

Return the probe to Q MODULATOR, TP14, and make a final adjustment of C193 to minimize the Q modulator amplitude.

This amplitude must be less than 0.2 Volts peak to peak.

Record this amplitude on the data sheet.

5.10.1 SBO Modulator Initial Setup and I-Q Feedback Phase Adjustment.

Requirement:	Q modulator AC voltage < 0.2 Vpp.	Measured:	_____ Vpp
Connect the Scope to TP2. Verify a 150Hz sine wave is present.		TP2 Verified	_____

5.11 I-Q Modulator Power Calibration

Set the Test Fixture controls as follows:

SW1	CSB Audio	Off
SW2	SBO Audio	Off
SW4	I Phase	0 Deg
SW5	Q Phase	Off
SW6	I-Q AC/DC Coupling	DC
R2	CSB % Modulation	CCW
R3	CSB Power	CCW
R4	SBO Audio Modulation Level	CCW
R5	SBO Power	Unchanged from 5.11

Verify that the DC voltage on I INPUT, TP22, is 5.0 ± 0.02 Volts DC.
Adjust the SBO Power Control on the Test Fixture if required.

Adjust R111, the I modulator gain control to obtain a power output of 1.0 ± 0.05 Watts as indicated on the thermal power meter, Item E, in figure 3. Record these values on the data sheet.

Set the I Phase Switch, SW4, to OFF, and set the Q Phase Switch to 180 degrees.

Verify that the DC voltage on the Q INPUT, TP 19, is -5.0 ± 0.02 Volts DC.

Adjust R122, the Q modulator gain control to obtain a power output of 1.0 ± 0.05 Watts. Record these values on the data sheet.

5.11.1 I-Q Modulator Power Calibration

Requirement:	I input:	5.0 ± 0.02	VDC	I Output:	1.0 ± 0.05	Watts
Measured:	I input:	_____	VDC	I Output:	_____	Watts
Requirement:	Q input:	-5.0 ± 0.02	VDC	Q Output:	1.0 ± 0.05	Watts
Measured:	Q input:	_____	VDC	Q Output:	_____	Watts

5.12 I-Q Modulator Carrier Suppression

Set the Test Fixture controls as follows:

SW1	CSB Audio	Off
SW2	SBO Audio	On
SW4	I Phase	0 Deg
SW5	Q Phase	Off
SW6	I-Q AC/DC Coupling	AC
R2	CSB % Modulation	CCW
R3	CSB Power	CCW
R4	SBO Audio Modulation Level	CCW
R5	SBO Power	As Set in 5.12

Set the spectrum analyzer, Item R, in figure 3 for a span of 10 KHz, and adjust the controls to display the SBO suppressed carrier.

Change the Frequency of the Audio oscillator to 1500 Hz, and verify that the output voltage is 5 volts peak to peak.

Increase the SBO Audio modulation level control, R4, on the Test Fixture until the peaks of the RF envelope displayed on the oscilloscope matched the preset cursor lines corresponding to a peak envelope power of 1 Watt.

In the center section of the UUT, locate the I-Q modulator DC offset controls, R85, and R187.

Adjust R85, I channel offset, to obtain the maximum carrier suppression on the spectrum analyzer display.

On the Test Fixture, Set the I phase switch to OFF, and set the Q phase switch to 0 degrees.

Verify that the peak envelope power displayed on the oscilloscope corresponds to the 1 W cursor lines.

Adjust, R187, the Q channel offset, to obtain the maximum carrier suppression on the spectrum analyzer display.

On the Test Fixture Set the I phase switch to 0 degrees and do not change the setting of the Q phase switch.

The power output indicated on the oscilloscope will increase. Readjust the SBO Audio Modulation Level on the Test Fixture to reset the power output to 1 W peak envelope power as indicated by the cursor lines on the oscilloscope.

Observe the carrier suppression indicated on spectrum analyzer. The Carrier shall be suppressed by >30 dB relative to either modulation sideband.

Record the measured carrier suppression on the data sheet.

On the Test Fixture, Set the Q modulation phase switch to 180 degrees. Observe the carrier suppression indicated on spectrum analyzer. The Carrier shall be suppressed by >30 dB relative to either modulation sideband.

Record the measured carrier suppression on the data sheet.

5.12.1 I-Q Modulator Carrier Suppression

Requirement:	I-Q phase:	0 degrees	Carrier suppression >	30	dB at 1 Watt.
	I-Q phase	180 degrees	Carrier suppression >	30	dB at 1 Watt.
Measured:	I-Q phase:	0 degrees	Carrier suppression:	_____	dB at 1 Watt.
	I-Q phase	180 degrees	Carrier suppression:	_____	dB at 1 Watt.

5.13 I-Q Modulator Amplitude and Phase Performance.

This test verifies the operation of the SBO IQ modulator at eight different phase settings.

Set the Test Fixture controls as follows:

SW1	CSB Audio	Off
SW2	SBO Audio	Off
SW4	I Phase	0 Deg
SW5	Q Phase	Off
SW6	I-Q AC/DC Coupling	DC
R2	CSB % Modulation	CCW
R3	CSB Power	CCW
R4	SBO Audio Modulation Level	CCW
R5	SBO Power	CCW

Adjust the CSB Power Control, R3, on the test fixture to obtain a CSB power output of 5 ± 0.1 Watts.

Adjust the SBO Power control, R5, on the test fixture to obtain a SBO power output of 1 Watt ± 0.05 Watts. Set as close to 1 Watt as possible.

Refer to Figure 4 and set the vector voltmeter, Item N, to measure the CSB to SBO phase.

Set the vector voltmeter phase reference to zero.

Sequentially set the test fixture controls as indicated below and record the SBO power and phase (relative to the CSB phase).

5.13.1 I-Q Modulator Amplitude and Phase Performance.

SW4 I Phase	SW5 Q Phase	SBO Power	SBO/CSB Phase	Phase Requirement
0 Deg	Off	_____	_____	0 ± 6 Degrees
180 Deg	Off	_____	_____	180 ± 6 Degrees
Off	0 Deg	_____	_____	-90 ± 6 Degrees
Off	180 Deg	_____	_____	90 ± 6 Degrees

Next set SW4 and SW5 on the test fixture to 0 Degrees. The SBO power output will increase. Adjust the SBO Power Control on the test fixture to reset the power output to 1.0 ± 0.05 Watts.

Sequentially set the test fixture controls as indicated below and record the SBO power and phase (relative to the CSB phase).

SW4 I Phase	SW5 Q Phase	SBO Power	SBO/CSB Phase	Phase Requirement
0 Deg.	180 Deg.	_____	_____	+45 ± 6 Degrees
0 Deg.	0 Deg.	_____	_____	-45 ± 6 Degrees
180 Deg.	0 Deg.	_____	_____	-135 ± 6 Degrees
180 Deg.	180 Deg.	_____	_____	+135 ± 6 Degrees

5.14 SBO Forward and Reverse Power Detector Calibration.

Set the Test Fixture controls as follows:

SW1	CSB Audio	Off
SW2	SBO Audio	Off
SW4	I Phase	0 Deg
SW5	Q Phase	Off
SW6	I-Q AC/DC Coupling	DC
R2	CSB % Modulation	CCW
R3	CSB Power	CCW
R4	SBO Audio Modulation Level	CCW
R5	SBO Power	CCW

On the Test Fixture adjust the SBO Power control to obtain a power output of 1.0 ± 0.05 Watts.

Connect a DC multimeter to SBO FWD PWR, TP2, on the Test Fixture.

Adjust R108 on the UUT to obtain a DC voltage of 5.0 ± 0.02 Volts at the test point.

Record the power output and the DC voltage at the test point on the test data sheet.

Remove the 24-Volt power from the UUT. Connect a 2:1 load on the output of the SBO channel, J3. Nothing else should be connected, not even the coupler.

Restore the 24-Volt power to the UUT.

Connect the DC multimeter to SBO REV PWR, TP1, on the test fixture.
Adjust R92 on the UUT to obtain a reading of 5.0 ± 0.02 Volts at the test point. Record the UUT voltage at TP1 on the data sheet.

Remove the 24-Volt power. Restore the test setup connections.

Restore the 24-Volt Power.

5.14.1 SBO Forward and Reverse Power Detector Calibration.

Forward Power Detector Output:

Requirement:	5.0 ± 0.02	Volts at	1 ± 0.05	Watts
Measured:	_____	Volts at	_____	Watts

Reverse Power Detector:

Requirement:	5.0 ± 0.02	Volts at

Measured: _____ Volts at

6. Post Test Procedures

6.1 Install the covers onto the CSB and SBO amplifier sections.

6.2 Locate JP10. Remove the Jumper from 1-3 and install it at 2-4. This sets the SBO output stage to "disabled" which is the default condition.

Check off the verification box on the data sheet.

7. Test Setups

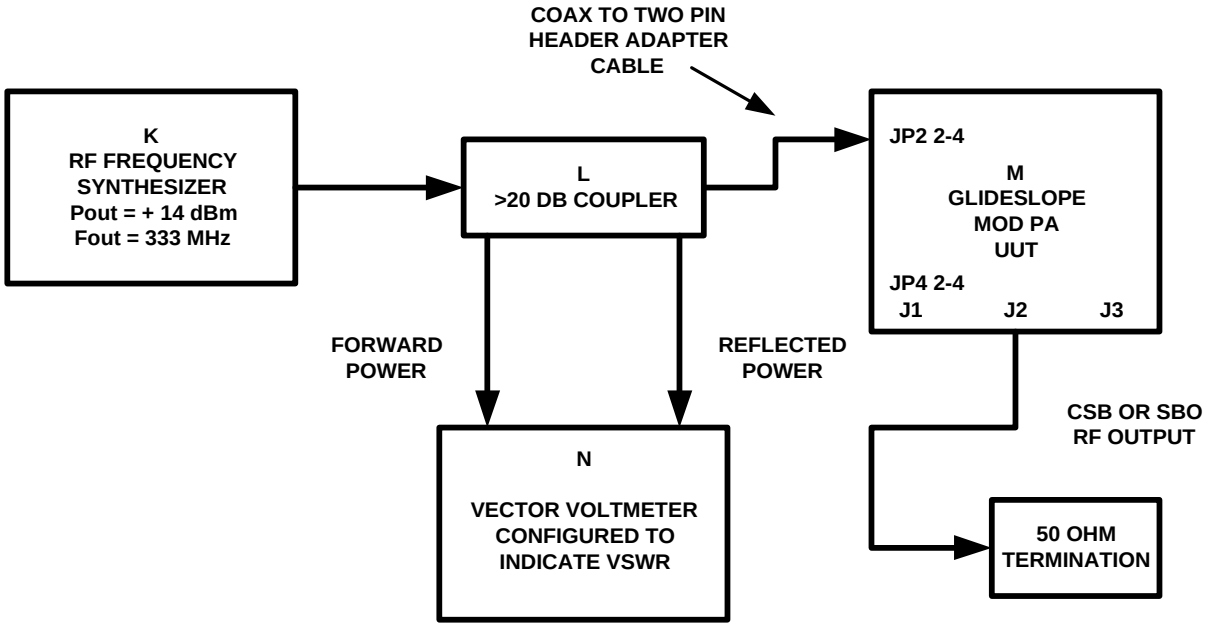


FIGURE 1 - TEST SETUP FOR C17 / C93 ADJUSTMENT OF OUTPUT DIRECTIONAL COUPLER MATCHING

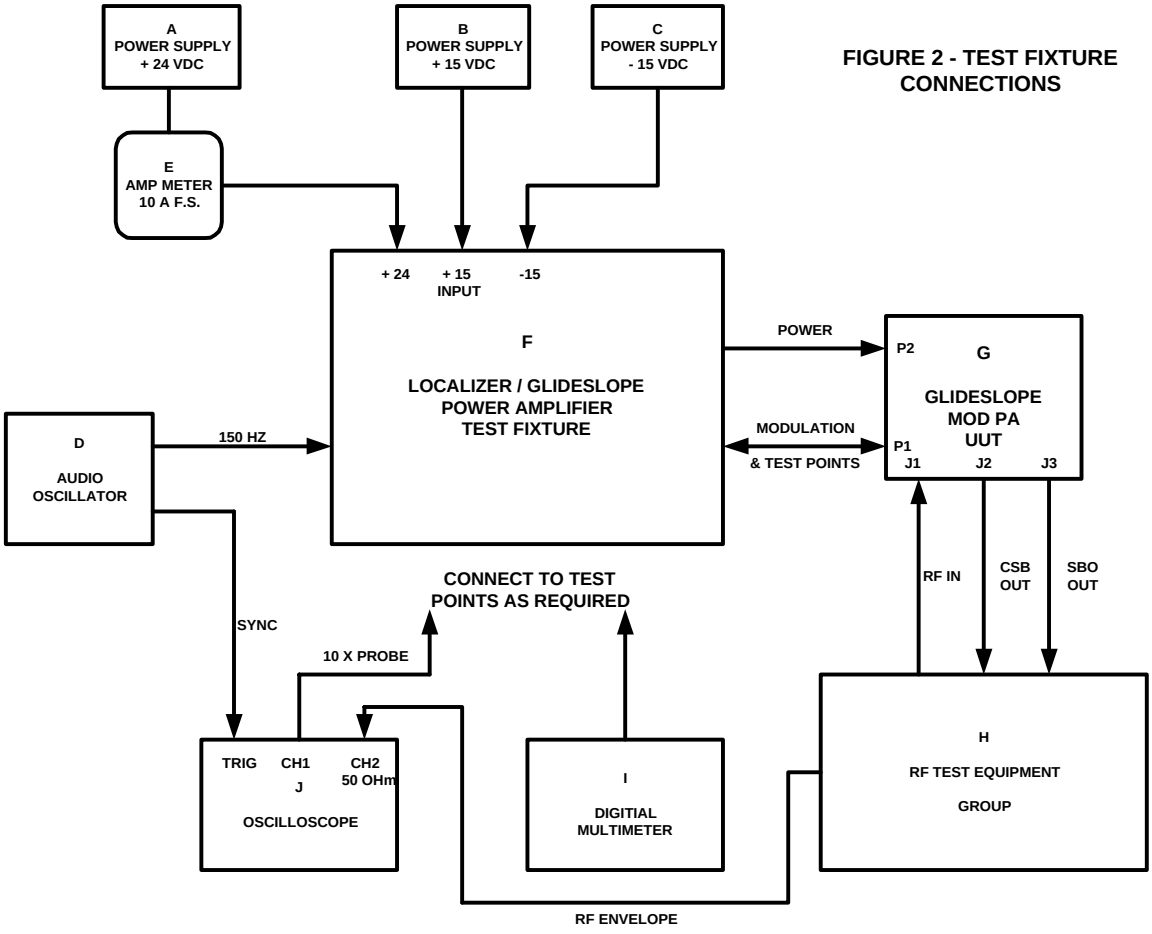


FIGURE 2 - TEST FIXTURE CONNECTIONS

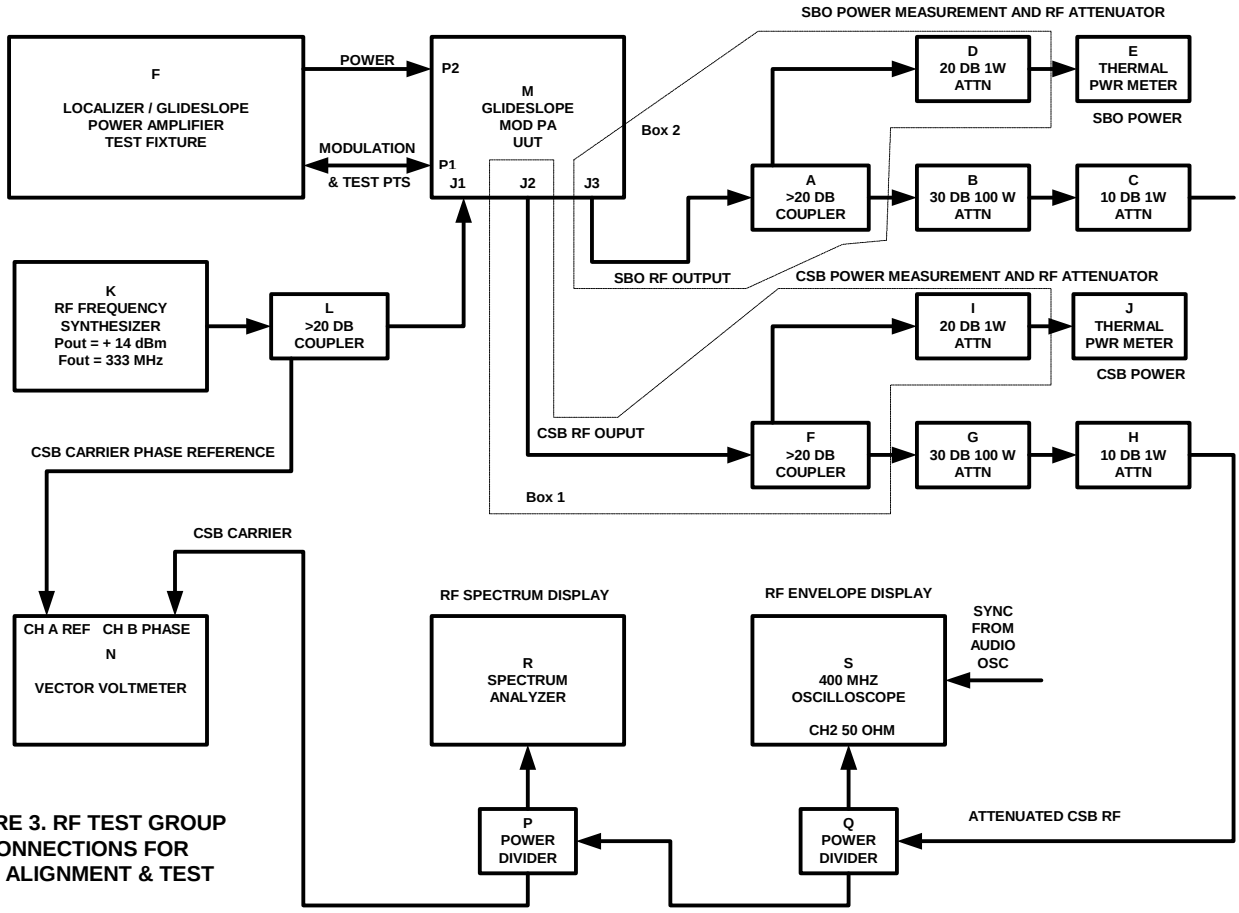


FIGURE 3. RF TEST GROUP CONNECTIONS FOR CSB ALIGNMENT & TEST

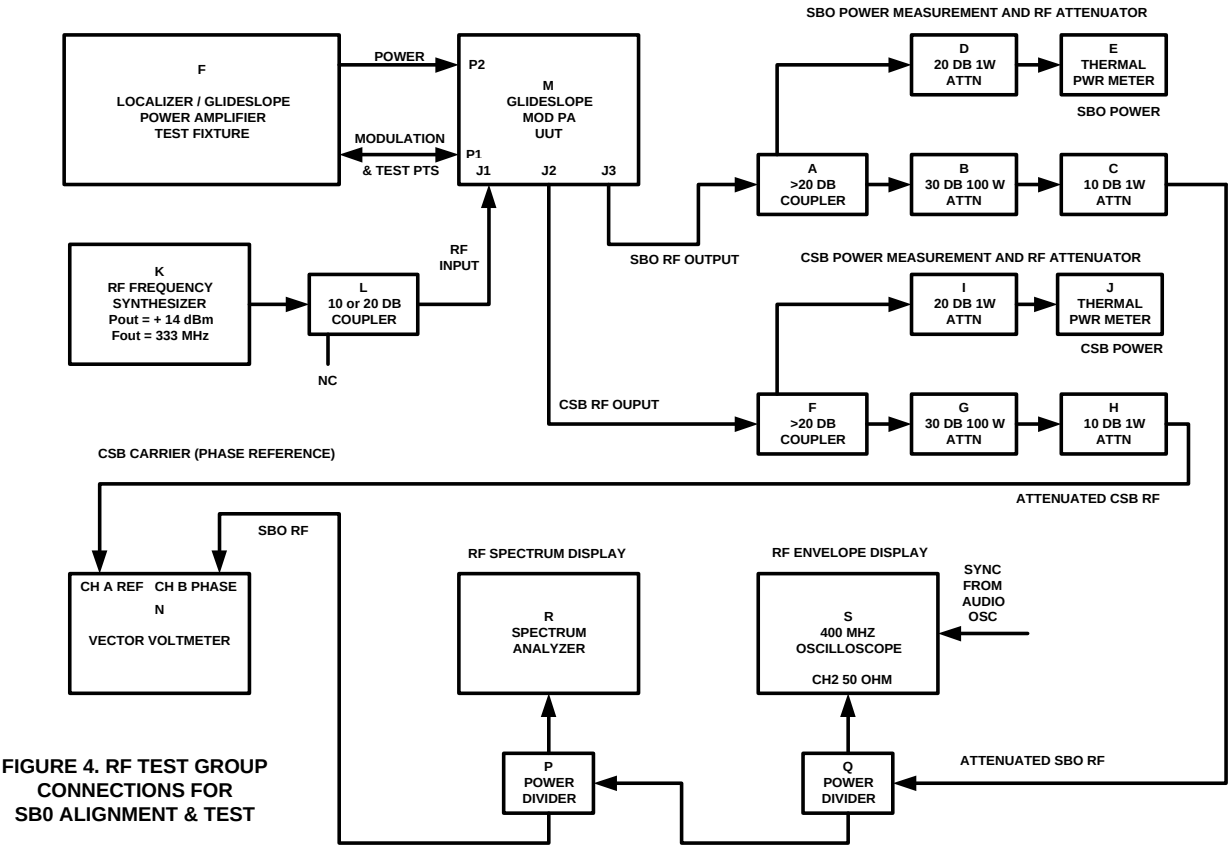


FIGURE 4. RF TEST GROUP CONNECTIONS FOR SB0 ALIGNMENT & TEST

8. Data Sheet

Name: _____ Date: _____

Part Number: 120589-0002 REV:_____

Serial Number: _____

5.2.1 Initial Adjustments:
Specification: R85 Verified R85 verified _____
Specification: R187 Verified R187 verified _____

5.2.2.4 RF Stage DC Bias results:

TEST PARAGRAPH	SPECIFICATION Test Point Voltage milliVolts	MEASURED Test Point Voltage milliVolts	TOTAL CURRENT (After Each Adjustment)
5.2.2.1 BIAS Q9	**TP6 - TP7 35 +/- 1**	**TP6 - TP7**	**Amperes**
5.2.2.2 BIAS Q10	**TP4 - TP5 35 +/- 1**	**TP4 - TP5**	**Amperes**
5.2.2.3 BIAS Q3	**TP8 - TP9 35 +/- 1**	**TP8 - TP9**	**Amperes**

5.3.1 CSB Modulation Sensitivity
Specification: TP6, CSB IN 5 ±0.02V. TP6 Voltage: _____ VDC
Specification: Total PWR Out: 5 ±0.25Watts. Total PWR: _____ Watts

5.4.1 Readjust the CSB directional coupler output matching network.

Specification: TP4, CSB REV < 0.5 VDC. TP4 Voltage: _____

5.5.1 CSB VSWR Calibration:
Specification: TP4, CSB REV, = 5.0 ± 0.02 Volts DC. TP4 Voltage: _____

5.6.1 CSB Forward Power Detector Calibration:
Power Specification: 5 ± 0.05 Watts Power Output: _____
Detector Output Specification: 5.0 ± 0.02 Volts Detector Output: _____

5.7.1 Adjustment of the CSB Phase Lock Loop.

Acceptance Criteria:

Minimum Control Voltage:	3.7	to	5.0	Volts	Measured: _____
Maximum Control Voltage:	6.0	to	8.0	Volts	Measured: _____
Phase Control Range:	80	to	115	Degrees	Measured: _____

Setup Data:
Calculated Midpoint of Phase Control Range: _____Degrees
Phase Control Voltage at Midpoint of Control Range: _____Volts
CSB REV < 0.5 _____Verified

5.8.1 CSB Static Peak Envelope Power.
Acceptance Criteria:
Power Output: 17 ± 0.1 Watts

Current < 2.5 Amperes. Measured Current: _____ Amps

5.9.1 CSB AM Modulation Performance.

CSB Modulation Harmonic Amplitude:

Requirement: < -26 dB relative to 150 Hz sideband.
Measured: ___ dB relative to 150 Hz sideband. Offset Frequency: _____ Hz

Phase Control Voltage:

Control Voltage is not Clipped. Verified: _____
AC on Control Voltage < 1 Volt Peak to Peak. AC Voltage: _____ Vpp
Connect the Scope to TP1. Verify a 150Hz sine wave is present. TP1 Verified _____

5.10.1 SBO Modulator Initial Setup and I-Q Feedback Phase Adjustment.
Requirement: Q modulator AC voltage < 0.2 Vpp. Measured: _____ Vpp
Connect the Scope to TP2. Verify a 150Hz sine wave is present. TP2 Verified _____

5.11.1 I-Q Modulator Power Calibration

Requirement:	I input:	5.0 ± 0.02	VDC	I Output:	1.0 ± 0.05	Watts
Measured:	I input:	_____	VDC	I Output:	_____	Watts
Requirement:	Q input:	-5.0 ± 0.02	VDC	Q Output:	1.0 ± 0.05	Watts
Measured:	Q input:	_____	VDC	Q Output:	_____	Watts

5.12.1 I-Q Modulator Carrier Suppression

Requirement:	I-Q phase:	0 degrees	Carrier suppression >	30	dB at 1 Watt.
	I-Q phase	180 degrees	Carrier suppression >	30	dB at 1 Watt.
Measured:	I-Q phase:	0 degrees	Carrier suppression:	_____	dB at 1 Watt.
	I-Q phase	180 degrees	Carrier suppression:	_____	dB at 1 Watt.

5.13.1 I-Q Modulator Amplitude and Phase Performance.

SW4 I Phase	SW5 Q Phase	SBO Power	SBO/CSB Phase	Phase Requirement
0 Deg	Off	_____	_____	0 ± 6 Degrees
180 Deg	Off	_____	_____	180 ± 6 Degrees
Off	0 Deg	_____	_____	-90 ± 6 Degrees
Off	180 Deg	_____	_____	90 ± 6 Degrees

SW4 I Phase	SW5 Q Phase	SBO Power	SBO/CSB Phase	Phase Requirement
0 Deg.	180 Deg.	_____	_____	+45 ± 6 Degrees
0 Deg.	0 Deg.	_____	_____	-45 ± 6 Degrees
180 Deg.	0 Deg.	_____	_____	-135 ± 6 Degrees
180 Deg.	180 Deg.	_____	_____	+135 ± 6 Degrees

5.14.1 SBO Forward and Reverse Power Detector Calibration.

Forward Power Detector Output:

Requirement:	5.0 ± 0.02	Volts at	1 ± 0.05	Watts
Measured:	_____	Volts at	_____	Watts

Reverse Power Detector:

Requirement:	5.0 ± 0.02	Volts at
Measured:	_____	Volts at

6.2.1 Verify the SBO Disable Jumper in installed at JP10 2-4: JP10 Set to 2-4 _____