

Calibration

<u>CALIBRATION PROCEDURE</u>	<u>PAGE</u>
Self Test	2
Calibration Test Setup.....	3
Miscellaneous	5
RF Amplitude Levels	7
Modulation	9

A. Calibration Schedule

The Calibration Procedures should be performed as a result of one or more of the following conditions:

- Failure to Meet Specifications

If, during the course of normal operation, the Test Set or any major function thereof fails to meet the performance specifications, the Calibration Procedures should be performed.

If any failure occurs during performance of the Verification Procedures, the user is instructed as to the pertinent Calibration Procedure or hardware failure associated with the failure.

- Module/Assembly Replacement

If one or more of the Test Set assemblies are replaced, the Calibration Procedures should be performed.

- Annual Calibration

Aeroflex recommends an annual Calibration on the Test Set to maintain proper testing standards.

Calibration of the TCXO is required annually even if the timebase is within specification. This helps insure the cumulative effects of aging on the TCXO and ensures the Test Set stays within specification before the next calibration cycle.

B. Precautions

The Calibration Procedures are performed with the Test Set Covers in place. No internal adjustments or probing points are required.

C. Requirements

(1) Performance

It is strongly recommended that personnel thoroughly read and understand all steps of the procedures prior to performing each procedure. Knowledge of external test equipment connections and operation is also recommended.

(2) Test Equipment

Appendix A contains a list of test equipment suitable for performing the Calibration Procedures. Other equipment meeting specifications listed in Appendix A may be substituted in place of the recommended models.

(3) Disassembly

No disassembly is required to perform the Calibration Procedures.

(4) Environment

For best results, environmental conditions should be identical to the conditions at the normal operating location.



D. Calibration Procedures

(1) Self Test

TEST EQUIPMENT: None

STEP	PROCEDURE
1.	Connect Test Set to an appropriate AC power source with the External DC Power Supply. Press POWER Key ON.
2.	Press the SETUP Key to display the Setup Menu.
3.	Press the H/W TOOLS Soft Key to display the Hardware Tools Screen.
4.	Press the DIAGS Soft Key to display the Diagnostics Screen.
5.	Press the SELFTEST Soft Key to display the Self Test Screen.
6.	Press the RUN Soft Key to initiate the Self Test.
	NOTE: The Self Test cannot be performed until the Test Set has finished the warm-up cycle. If the user attempts to initiate the Self Test before the Test Set is ready, the following message is displayed: Instrument warming up Please wait xx secs The message counts down to zero (0) then the Self Test can be initiated.
7.	Verify all tests pass.

(2) Test Setup

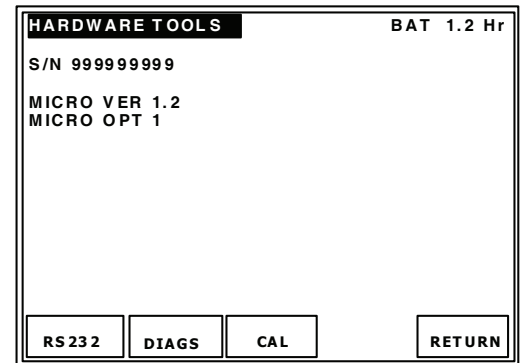
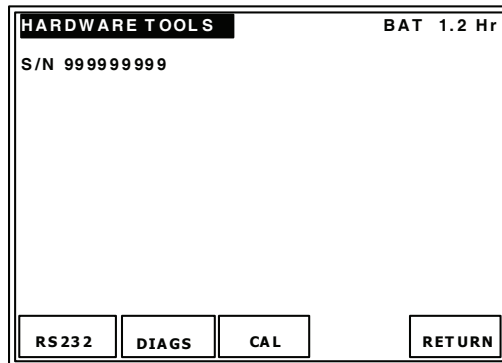
- PREREQUISITES:** Self Test (para D[1])
- TEST EQUIPMENT:** Measuring Receiver
Signal Generator
Audio Analyzer
Power Meter
TNC Precision Short (Male)
RF Amplifier (100 W)
20 dB Directional Coupler (N-Type Connector)
20 dB N-Connector Attenuator
15 MHz Low-Pass Filter (N-Type Connector)
250 MHz Low-Pass Filter (N-Type Connector)
450 MHz Low-Pass Filter (N-Type Connector)
10 dB BNC Connector Attenuator
3 dB, 100 W N-Type Connector Attenuator

STEP	PROCEDURE
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1. Allow 15 minute warm-up for Test Set.
2. Connect the Measuring Receiver to the Signal Generator and calibrate the Measuring Receiver in Tuned RF Level Mode at the following frequencies (storing the calibration in the storage location indicated):

1	113.000 MHz	5	400.000 MHz
2	75.000 MHz	6	175.000 MHz
3	225.000 MHz	7	10.000 MHz
4	332.000 MHz	8	25.000 MHz

3. Connect the Measuring Receiver (Modulation Output/Audio Input) to the Audio Analyzer (High Input). Set the Audio Analyzer to Distortion (DISTN).
4. Press the SETUP Key to display the Setup Menu.
5. Press the H/W TOOLS Soft Key to display the Hardware Tools Screen.



6. If "MICRO VER 1.2 and MICRO OPT 1" are displayed on the Hardware Tools Screen, perform Steps 7, 8 and 10; otherwise, perform Steps 7, 8 and 9.
7. Press the CAL Soft Key to display the Calibration Screen.

STEP PROCEDURE

8. Enter password (3524) to display the Calibration Screen.
9. Characterize and record the loss of the Power Meter Calibration Setup (Figure 1):
 - Measure the loss (at 200 MHz) between the Signal Generator and the 20 dB attenuator on the coupled port of the directional coupler. Record as A.
 - Measure the loss (at 200 MHz) between the Signal Generator and the end of the coaxial cable going to the RF I/O Connector. Record as B.
 - Subtract Loss (B) from Loss (A) and record.

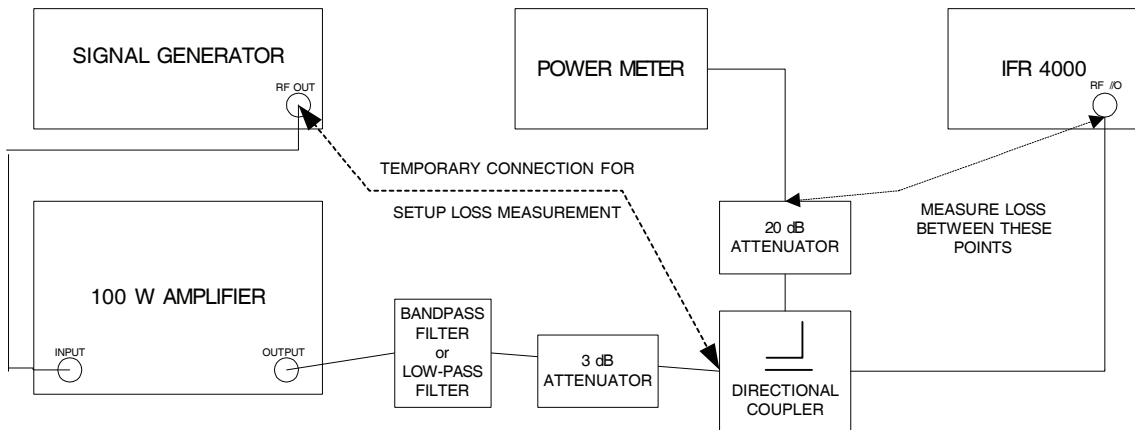
Characterize Test Setup:

FREQ	A	B	OFFSET
200 MHz	-----	-----	-----

10. Characterize and record the loss of the Power Meter Calibration Setup (2-2-3, Figure 5):
 - Measure the loss (at 10, 200 and 400 MHz) between the Signal Generator and the 20 dB attenuator on the coupled port of the directional coupler. Record as A.
 - Measure the loss (at 10, 200 and 400 MHz) between the Signal Generator and the end of the coaxial cable going to the RF I/O Connector. Record as B.
 - Subtract Loss (B) from Loss (A) and record.

Characterize Test Setup:

FREQ	A	B	OFFSET
10 MHz	-----	-----	-----
200 MHz	-----	-----	-----
400 MHz	-----	-----	-----



Power Meter Calibration Setup
Figure 1

(3) Miscellaneous

PREREQUISITES:	Test Setup (para D[2])
TEST EQUIPMENT:	Measuring Receiver Signal Generator Audio Analyzer Power Meter TNC Precision Short (Male) RF Amplifier (100 W) 20 dB Directional Coupler (N-Type Connector) 20 dB N-Connector Attenuator 250 MHz Low-Pass Filter (N-Type Connector) 10 dB BNC Connector Attenuator 3 dB, 100 W N-Type Connector Attenuator

STEP	PROCEDURE
1.	From the Calibration Screen, press the MISC CALS Soft Key to enter the MISC CALS Screen.
	TXCO
2.	Press the TCXO Soft Key to display the TCXO CAL Sequence Screen.
3.	Connect the Signal Generator to the AUX I/O Connector. Set the Signal Generator for 10.000 MHz, +6 dBm output and no modulation. (The Signal Generator should have a frequency error of <0.1 PPM.)
4.	Press the START Soft Key to begin the TCXO CAL Sequence.
5.	When the TCXO CAL Sequence is complete, press the SAVE & RETURN Soft Key to return to the MISC CALS Screen.
6.	Disconnect the Signal Generator.
	SWR
7.	Press the SWR Soft Key to display the SWR CAL Sequence Screen.
8.	Connect TNC Short to the SWR Connector.
9.	Press the NEXT Soft Key to begin the SWR CAL Sequence and follow the on-screen prompts.
10.	When the SWR CAL Sequence is complete, press the SAVE & RETURN Soft Key to return to the MISC CALS Screen.
	POWER METER
11.	Press the POWER METER Soft Key to display the POWER METER CAL Sequence Screen.
12.	Connect Test Equipment to Test Set as shown in Figure 1. Using the loss figure recorded in para D(2) Step 8, input that number as an offset in the Power Meter and set the Power Meter to read Watts.

STEP	PROCEDURE
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13. Follow the on-screen prompts, adjusting the Signal Generator output level to achieve the Power Meter readings indicated on the Test Set.

CAUTION: USE CAUTION WHEN PERFORMING THE >10 W CALS AS THE TEST SET IS NOT RATED FOR CONTINUOUS INPUT AT THESE LEVELS. COMPLETE THESE STEPS AS QUICKLY AS POSSIBLE, AND REDUCE THE INPUT POWER AS SOON AS POSSIBLE. DO NOT ALLOW THE TEMPERATURE INDICATED ON THE TEST SET CAL SCREEN TO EXCEED 35 °C. (INPUT POWER MAY NEED TO BE REDUCED BETWEEN HIGHER LEVEL SETTINGS TO ALLOW THE POWER TERMINATION TO COOL.)

14. When the POWER METER CAL Sequence is complete, press the SAVE & RETURN Soft Key to return to the MISC CAL Screen.

FM

15. Press the FM CAL Soft Key to display the FM CAL Screen.
16. Press the FM DEV Soft Key to display the FM DEV CAL Sequence Screen.
17. Connect the Signal Generator to the ANT Connector. Set the Signal Generator for 156.000 MHz at -20 dBm with FM Modulation enabled.
18. Follow the on-screen prompts and set the FM deviation on the Signal Generator as indicated. When changing deviation levels, wait several seconds before pressing the NEXT Soft Key to allow the 4000 to average the modulation.
19. When the FM DEV CAL Sequence is complete, press the SAVE & RETURN Soft Key to return to the MISC CAL Screen.
20. Press the FM GEN Soft Key to display the FM GEN CAL Sequence Screen.
21. Follow the on-screen prompts to calibrate FM Low.
22. When the FM GEN CAL Sequence is complete, press the SAVE & RETURN Soft Key to return to the FM CAL Screen.
23. Press the RETURN Soft Key to return to the Calibration Screen.

(4) RF Amplitude Levels

PREREQUISITES: Test Setup (para D[2])
Miscellaneous (para D[3])

TEST EQUIPMENT: Measuring Receiver w/ Sensor Head

NOTE: Before connecting the Measuring Receiver to the 4000, the following frequencies should be calibrated and the Tuned RF levels should be saved in the Measuring Receiver: 10, 25, 75, 113, 225, 332 and 400 MHz.

STEP	PROCEDURE
1.	From the Calibration Screen, press the AMPLVL CALS Soft Key to enter the AMPL LEVEL CAL Screen.
	MAIN
2.	Press the MAIN Soft Key to display the MAIN AMPL LEVEL Sequence Screen.
3.	Connect Measuring Receiver Sensor Head to the ANT Connector.
4.	Switch between TUNED RF LEVEL and AM on the Measuring Receiver as necessary. (For AM measurements, use the Peak $\pm/2$ detector, and the 3 kHz Low-Pass Filter. Use no High Pass filtering.) (For distortion measurements, use the 80 kHz Low-Pass Filter on the Audio Analyzer. Use no High Pass filtering.)
5.	Follow the on-screen prompts and recall stored calibration levels on the Measuring Receiver (para D[2], Step 2). For the MAIN AMPL LEVEL Sequence, the AM modulation setting error must be <0.5% and the amplitude setting error must be <0.1 dB.
6.	Reference the following:
	<ul style="list-style-type: none"> ● <u>Step 1 of MAIN AMPL LEVEL Sequence</u>
	Turn modulation OFF to set and check RF level. Toggling the UUT Modulation field between OFF and ON and the Measuring Receiver between AM and TUNED RF LEVEL several times may be required to meet the requirements of this step.
	<ul style="list-style-type: none"> ● <u>Step 2 of MAIN AMPL LEVEL Sequence</u>
	Once the VALUE: field has been set for minimum distortion, use the PREV Soft Key to return to Step 1. Steps 1 and 2 are interactive; toggling between the two is required to meet the requirements of the steps.
	<ul style="list-style-type: none"> ● <u>Steps 3 to 8 of MAIN AMPL LEVEL Sequence</u>
	Follow the on-screen prompts and recall the necessary calibrations on the Measuring Receiver.
	<ul style="list-style-type: none"> ● <u>Steps 9 to 29 of MAIN AMPL LEVEL Sequence</u>
	Connect the Measuring Receiver Sensor Head to the RF I/O Connector.
	<ul style="list-style-type: none"> ● <u>Steps 30 to 37 of MAIN AMPL LEVEL Sequence</u>
	Follow the on-screen prompts and recall the necessary calibrations on the Measuring Receiver. If the frequency prompted on the screen is not already saved in the Measuring Receiver, press the Measuring Receiver Calibrate button and allow the cal routine to complete before setting the UUT VALUE: field.
7.	When the MAIN AMPL LEVEL Sequence is complete, press the SAVE & RETURN Soft Key to return to the AMPL LEVEL CAL Screen.

STEP	PROCEDURE
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LOC

8. Press the LOC Soft Key to display the LOC AMPL LEVEL Sequence Screen.
9. Connect Measuring Receiver Sensor Head to the ANT Connector.
10. Follow the on-screen prompts and recall stored calibration levels on the Measuring Receiver (para D[2] Step 2). For the LOC AMPL LEVEL Sequence, the AM modulation setting error must be <0.5% and the amplitude setting error must be <0.1 dB.
11. Reference the following:
 - Step 1 of LOC AMPL LEVEL Sequence
Turn modulation OFF to set and check RF level. Toggling the UUT Modulation field between OFF and ON and the Measuring Receiver between AM and TUNED RF LEVEL several times may be required to meet the requirements of this step.
 - Step 2 of LOC AMPL LEVEL Sequence
Once the VALUE: field has been set for minimum distortion, use the PREV Soft Key to return to Step 1. Steps 1 and 2 are interactive; toggling between the two is required to meet the requirements of the steps.
12. When the LOC AMPL LEVEL Sequence is complete, press the SAVE & RETURN Soft Key to return to the AMPL LEVEL Cal Screen.

MKR

13. Press the MKR Soft Key to display the MKR AMPL LEVEL Sequence Screen.
14. Connect 10 dB Attenuator between Measuring Receiver Sensor Head and ANT Connector.
15. Follow the on-screen prompts and recall stored calibration levels on the Measuring Receiver (para D[2] Step 2). For the LOC AMPL LEVEL Sequence, the AM modulation setting error must be <1% and the amplitude setting error must be <0.1 dB (taking into account the 10 dB Attenuator).
16. Reference the following:
 - Step 1 to 2 of MKR AMPL LEVEL Sequence
Turn modulation OFF to set and check RF level. Toggling the UUT Modulation field between OFF and ON and the Measuring Receiver between AM and TUNED RF LEVEL several times may be required to meet the requirements of this step.
 - Step 3 of MKR AMPL LEVEL Sequence
Select 15 kHz Low-Pass Filter on the Measuring Receiver.
17. When the MKR AMPL LEVEL Sequence is complete, press the SAVE & RETURN Soft Key to return to the AMPL LEVEL Cal Screen.
18. Press the RETURN Soft Key to return to the Calibration Screen.

(5) Modulation

PREREQUISITES:	Test Setup (para D[2]) Miscellaneous (para D[3]) RF Amplitude Levels (para D[4])
TEST EQUIPMENT:	Measuring Receiver w/ Sensor Head Digital Multimeter (DMM)

STEP	PROCEDURE
1.	From the Calibration Screen, press the MOD CALS Soft Key to enter the MODULATION CAL Screen.
	VOR
2.	Press the VOR Soft Key to display the VOR CAL Sequence Screen.
3.	Connect Measuring Receiver Sensor Head to the ANT Connector.
4.	Select AM on the Measuring Receiver as necessary. (For AM measurements, use the Peak $\pm/2$ detector, and the 3 kHz Low-Pass Filter. Use no High Pass filtering.)
5.	Follow the on-screen prompts and recall stored calibration levels on the Measuring Receiver as needed. For the VOR CAL Sequence, the AM modulation setting error must be <0.5% and the amplitude setting error must be <0.1 dB.
6.	Reference the following: <ul style="list-style-type: none"> ● <u>Step 1 of VOR CAL Sequence</u> Select 3 kHz Low-Pass Filter on the Measuring Receiver. ● <u>Step 2 of VOR CAL Sequence</u> Select 15 kHz Low-Pass Filter on the Measuring Receiver. ● <u>Step 3 of VOR CAL Sequence</u> Select 3 kHz Low-Pass Filter on the Measuring Receiver.
7.	When the VOR CAL Sequence is complete, press the SAVE & RETURN Soft Key to return to the MODULATION Cal Screen.
	MAIN LOC
8.	Press the MAIN LOC Soft Key to display the MAIN PATH LOC Sequence Screen.
9.	Connect Digital Multimeter to the AUX I/O Connector. Set DMM to read AC Volts.
10.	Follow the on-screen prompts.
11.	When the MAIN PATH LOC Sequence is complete, press the SAVE & RETURN Soft Key to return to the MODULATION Cal Screen.
	MAIN G/S
12.	Press the MAIN G/S Soft Key to display the MAIN PATH G/S Sequence Screen.
13.	Connect Measuring Receiver Sensor Head to the ANT Connector.
14.	Set Measuring Receiver input frequency to 332.000 MHz. (For AM measurements, use the 3 kHz Low-Pass Filter. Use no High Pass filtering.)
15.	Follow the on-screen prompts.
16.	When the MAIN PATH G/S Sequence is complete, press the SAVE & RETURN Soft Key to return to the MODULATION Cal Screen.



LOC LOC

17. Press the LOC LOC Soft Key to display the LOC PATH LOC Sequence Screen.
18. Connect Measuring Receiver Sensor Head to the ANT Connector.
19. Set Measuring Receiver input frequency to 110.05 MHz. (For AM measurements, use the 3 kHz Low-Pass Filter. Use no High Pass filtering.)
20. Follow the on-screen prompts.
21. When the LOC PATH LOC Sequence is complete, press the SAVE & RETURN Soft Key to return to the MODULATION Cal Screen.
22. Press the RETURN Soft Key until the Setup Menu is displayed.
23. Disconnect test equipment from Test Set.

APPENDIX A - TEST EQUIPMENT REQUIREMENTS

This Appendix contains a list of test equipment suitable for performing the Calibration Procedures. Other equipment meeting the specifications of the equipment listed in this Appendix may be substituted in place of the recommended models.

TYPE	MODEL
Adapter, TNC (M) to N-Type (F)	N/A
Attenuator, 3 dB, 100 W (N-Type)	N/A
Attenuator, 10 dB (BNC)	N/A
Attenuator, N-Connector 20 dB	N/A
Audio Analyzer	HP-8903A or Equivalent
Digital Multimeter	Agilent 34401A or Equivalent
Directional Coupler, 20 dB (N-Type)	N/A
Low-Pass Filter, 15 MHz (N-Type)	N/A
Low-Pass Filter, 250 MHz (N-Type)	N/A
Low-Pass Filter, 450 MHz (N-Type)	N/A
Measuring Receiver	HP-8902A or Equivalent
Measuring Receiver Sensor Module	HP-11722A or Equivalent
Power Meter	HP-E4418B or Equivalent
Power Sensor	HP-E4412A or Equivalent
Precision Short, TNC (M)	N/A
RF Amplifier (100 W)	N/A
Signal Generator	Aeroflex 2023B or Equivalent



CALIBRATION
IFR 4000

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