Performance Testing and Calibration of a Power Meter's 50 MHz Reference

NOTE: This example is based on the Agilent E4418B/E4419B Power Meter. All procedures are modified from Agilent Technologies Part # E4418-90059 Revision G, April 23 2010.

Test: Power Reference Level

Equipment:

- TEGAM 1830A RF Power Meter
- TEGAM M1130A
- DUT Power Meter with 50 MHz, 1 mW Reference Port

Procedure:

The following procedure should be used for verifying the 50 MHz reference level:

1. Power ON all equipment and allow proper warm up time for each. If using a temperature compensated thermistor mount allow for proper temperature stabilization.[1]
2. Connect thermistor mount to 1830A
    a. TEGAM CA-7-48 (Sensor Cable)
    b. TEGAM CA-10-48 (Heater Cable)
3. Manually configure the 1830A for selected thermistor mount.[2]
4. Make sure the 50 MHz reference is turned off prior to connecting the thermistor mount.[3]
5. Connect thermistor mount to 50 MHz reference output connection.
6. Enter the M1130A 50 MHz calibration factor into the 1830A.
7. Zero the 1803A.
8. Turn on the 50 MHz reference.
9. Record the measured power.
10. For this particular example the E4418B/E4419B passes if the reference in 1.000 mW +/- .009 mW.

[1] Verify on 1830A front panel that heating is complete and unit has a stable zero.
[2] Please refer to 1830A User Manual for configuring a Temperature Compensated Thermistor Mount vs. an Agilent 478A Thermistor Mount.
[3] Please refer to the DUT Power Meter Manual for operating instructions.

Test: Output SWR

NOTE: During this procedure, the M1130A impedance changes from 200 Ω to 100 Ω. It is important to change the impedance back to 200 Ω upon completion to maintain proper thermistor mount operation.

Equipment:

- TEGAM 1830A RF Power Meter
- TEGAM M1130A
- DUT Power Meter with 50 MHz, 1 mW Reference Port

Procedure:

The following procedure should be used for solving Output SWR:

1. Power ON all equipment and allow proper warm up time for each. If using a temperature compensated thermistor mount allow for proper temperature stabilization.[4]
2. Connect thermistor mount to 1830A.
    a. TEGAM CA-7-48 (Sensor Cable)
    b. TEGAM CA-10-48 (Heater Cable)
3. Manually configure the 1830A for selected thermistor mount.[5]
4. Make sure the 50 MHz reference is turned off prior to connecting the thermistor mount.[6]
5. Connect thermistor mount to 50 MHz reference output connection.
6. Record RHO_{200} the S22 magnitude of the thermistor mount at 50 MHz at 200 Ω[7].
    a. For an M1130A this value is available on the calibration report.
7. Record RHO_{100} the S22 magnitude of the thermistor mount at 50 MHz at 100 Ω.
    a. For an M1130A use the value of .33 as an estimated value
8. Verify the 1830A reference resistor is configured for 200 Ω.
9. Zero the 1830A.
10. Turn on the 50 MHz 1mW reference on the DUT power meter.
11. Record the power level from the front panel of the 1830A.
12. Turn off the 50 MHz 1mW reference on the DUT power meter.
13. Configure the 1830A reference resistor to 100 Ω.
14. Repeat steps 10-12.
15. Calculate M using the following equation.

$$M = \frac{P_{200}(1-|RHO_{100}|^2)}{P_{100}(1-|RHO_{200}|^2)}$$

[4] Verify on 1830A front panel that heating is complete and unit has a stable zero.
[5] Please refer to 1830A User Manual for configuring a Temperature Compensated Thermistor Mount vs. an Agilent 478A Thermistor Mount.
[6] Please refer to the DUT Power Meter Manual for operating instructions.
[7] Gamma of the load is a complex value; however, we can give a sufficiently accurate answer provided the phase angles are within a reasonable range. For this reason all calculations in this application note will only use RHO portion of Gamma.

16. Using the Value for M calculate the output voltage coefficient using the following equation.

$$|\Gamma_s| = \frac{(2|RHO_{200}|M-2|RHO_{100}|)\pm\sqrt{(2|RHO_{100}|-2|RHO_{200}|M)^2-4(|RHO_{200}|^2M-|RHO_{200}|^2)(M-1)}}{2(|RHO_{200}|^2M-|RHO_{100}|^2)}$$

17. Calculate the output SWR using the following equation.

$$SWR = \frac{(1+|\Gamma_s|)}{(1-|\Gamma_s|)}$$

Worked Example of Output SWR

For this example the DUT was an Agilent E4418B Power Meter. Output SWR is required to be maximum 1.06. A TEGAM 1830A with a M1130A were also used for this example. The output SWR is 1.059.

Recorded Values	**Value**
Power(mW) (200 ohms Ref Resistor)	0.9936
Power(mW) (100 ohms Ref Resistor)	0.8939
Fixed Values (from thermistor mount calibration data)	
RHO (200 ohms Ref Resistor)	0.0014
RHO (100 ohms Ref Resistor)	0.33
Calculations	
Calculate Factor M	0.990485764
Calculate Output voltage reflective coefficient(+)	0.02902246
Calculate Output voltage reflective coefficient(-)	12.04147077
Output SWR(+)	1.05977988
Output SWR(-)	-1.18113529

Calibration Procedure: Power Reference Level

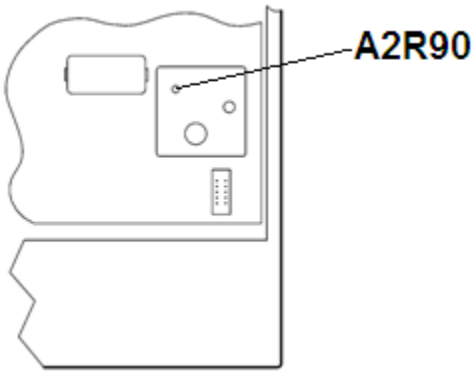
Equipment:

- TEGAM 1830A RF Power Meter
- TEGAM M1130A
- DUT Power Meter with 50 MHz, 1 mW Reference Port

Procedure:

The following procedure should be used for calibration of 50 MHz reference level:

1. Power ON all equipment and allow proper warm up time for each. If using a temperature compensated thermistor mount allow for proper temperature stabilization.[8]
2. Connect thermistor mount to 1830A
    a. TEGAM CA-7-48 (Sensor Cable)
    b. TEGAM CA-10-48 (Heater Cable)
3. Manually configure the 1830A for selected thermistor mount.[9]
4. Make sure the 50 MHz reference is turned off prior to connecting the thermistor mount.[10]
5. Connect thermistor mount to 50 MHz reference output connection.
6. Enter the M1130A 50 MHz calibration factor into the 1830A.
7. Zero the 1803A.
8. Turn on the 50 MHz reference.
9. Record the measured power.
10. For this particular example the E4418B/E4419B passes if the reference in 1.000 mW +/- .009 mW.
11. Remove the power meter's cover to adjust A2R90[11].
12. Monitor the 1830A while adjusting A2R90 until the power falls into desired range[12].



[8] Verify on 1830A front panel that heating is complete and unit has a stable zero.
[9] Please refer to 1830A User Manual for configuring a Temperature Compensated Thermistor Mount vs. an Agilent 478A Thermistor Mount.
[10] Please refer to the DUT power meter manual for operating instructions.
[11] A2R90 is only reference only for the E4418B/E4419B power meter adjustment. Please refer to actual service manual for adjustment procedures.
[12] Avoid fast adjustment; the 1830A updates once per second so adjust slowly to monitor actual change.