B

Power Sensors

B.1 Introduction

This appendix contains the selection, specifications and calibration data for the Giga-tronics power sensors used with the Series 8540C Universal Power Meters. This appendix is divided into:

Power Sensor Selection

- Modulation Power Sensors
- Modulation Sensor Specifications
- Peak Power Sensors
- Directional Bridges

Power Sensor Calibration

- Local Calibration
- Remote Calibration

All Giga-tronics power sensors contain balanced zero-biased Schottky diodes for power sensing.

CAUTION

Input power in excess of +23 dBm (200 mW, which is the 100% average for standard and pulse sensors) can degrade or destroy these diodes. Diodes degraded or destroyed in this manner will not be replaced under warranty. Destructive signal levels are higher for high power, true rms, and low VSWR sensors. When connecting power sensors to other devices, do not turn the body of the sensor in order to tighten the RF connection. This can damage the connector mating surfaces.

B.2 Power Sensor Selection

Standard 80300A Series Sensor measure CW signals from -70 to +20 dBm; the 80400 Series Sensors measure modulated or CW signals from -67 to +20 dBm; the 80601A Series Sensors measure modulated or CW signals from -67 to +20 dBm. The 8540C Series Universal Power Meters also use Peak Power Sensors for measuring radar and digital modulation signals.

Giga-tronics True RMS sensors are recommended for applications such as measuring quadrature modulated signals, multi-tone receiver intermodulation distortion power, noise power, or the compression power of an amplifier. These sensors include a pad to attenuate the signal to the RMS region of the diode's response. This corresponds to the -70 dBm to -20 dBm linear operating region of Standard CW Sensors. The pad improves the input VSWR to ≤1.15 at 18 GHz.

High Power (1, 5, 25, and 50 Watt) and Low VSWR sensors are also available for use with the 8540C Power Meters. Table B-1 lists the Giga-tronics power sensors used with the 8540C. Refer to applicable notes on page B-4. See Figures B-1 or B-2 for modulation-induced measurement uncertainty.

B.2.1 Modulation Power Sensors

Table B-1: Power Sensor Selection Guide

Model	Freq. Range/ Power Range	Max. Power	Power Linearity[4] (Freq >8 GHz)	RF Conn	Length	Dia.	Wgt	VSWR
Modulation Sensors								
80601A[9]	10 MHz to 18 GHz -67 to +20 dBm, CW -60 to +20 dBm, Modulation	+23 dBm (200 mW)	-67 to -20 dBm ±0.00 dB -20 to +20 dBm ±0.05 dB/ 10 dB	Type N(m) 50Ω	114.5 mm (5.39 in)	32 mm (1.62 in)	0.23 kg (0.4 lb)	1.12:0.01 - 2 GHz 1.22:2 - 12.4 GHz 1:29:12.4 - 18 GHz
80401A	10 MHz to 18 GHz -67 to +20 dBm, CW -60 to +20, dBm, Modulation	+23 dBm (200 mW)	-67 to -20 dBm ±0.00 dB -20 to +20 dBm: ±0.05 dB/ 10 dB	Type N(m) 50Ω	114.5mm (4.5 in)	32 mm (1.25 in)	0.18 kg (0.4 lb)	1.12:0.01 - 2 GHz 1.22:2 - 12.4 GHz 1.29:12.4 - 18 GHz
80402A	10 MHz to 18 GHz -67 to +20 dBm, CW -60 to +20,dBm, Modulation	+23 dBm (200 mW)	-67 to -20 dBm ±0.00 dB -20 to +20 dBm ±0.05 dB/ 10 dB	APC-7 50Ω				
80410A	10 MHz to 18 GHz -64 to +26 dBm, CW -57 to +26, dBm, Modulation	+29 dBm (800 mW)	-60 to -14 dBm ±0.00 dB -14 to + 26 dBm ±0.05 dB/ 10 dB	Type K(m)[1] 50Ω	127 mm (5.0 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)	1.13:0.01 - 2 GHz 1.16:2 - 12 GHz 1.23:12 - 18 GHz
80420A	10 MHz to 18 GHz -60 to +30 dBm, CW -53 to +30 dBm, Modulation	+30 dBm (1 W)	-60 to -10 dBm ±0.00 dB -10 to +30 dBm ±0.05 dB/ 10 dB					1.11:0.01 - 2 GHz 1.12:2 - 12 GHz 1.18:12 - 18 GHz
80421A	10 MHz to 18 GHz -50 to +37 dBm, CW -43 to +37 dBm, Modulation	+37 dBm (5 W)	-47 to +0 dBm ±0.00 dB 0 to +37 dBm ±0.05 dB/ 10 dB	Type N(m) 50Ω	150 mm (5.9 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)	1.20:0.011 - 6 GHz 1.25:6 - 12.4 GHz 1.35:12.4 - 18 GHz
80422A	10 MHz to 18 GHz -40 to +44 dBm, CW -33 to +44 dBm, Modulation	+44 dBm (25 W)	-37 to +10 dBm ±0.00 dB +10 to +44 dBm ±0.05 dB/ 10 dB		230 mm (9.0 in)	104 mm (4.1 in)	0.3 kg (0.6 lb)	1.20:0.01 - 6 GHz 1.30:6 - 12.4 GHz 1.40:12.4 - 18 GHz
80425A	10 MHz to 18 GHz -40 to +47 dBm, CW -33 to +47 dBm, Modulation	+47 dBm (50 W)	-34 to +10 dBm ±0.00 dB +10 to +47 dBm ±0.05 dB/ 10 dB					1.25:0.01 - 6 GHz 1.35:6 - 12.4 GHz 1.45:12.4 - 18 GHz
Standard CW Sensors								
80301A	10 MHz to 18 GHz -70 to +20 dBm	+23 dBm (200 mW)	-70 to -20 dBm ±0.00 dB -20 to +20 dBm ±0.05 dB/ 10 dB	Type N(m) 50Ω	114.5 mm (4.5 in)	32 mm (1.25 in)	0.18 kg (0.4 lb)	1.12:0.01 - 2 GHz 1.22:2 - 12.4 GHz 1.29:12.4 - 18 GHz
80302A	10 MHz to 18 GHz -70 to +20 dBm	+23 dBm (200 mW)		APC-7 50Ω				
80303A	10 MHz to 26.5 GHz -70 to +20 dBm	+23 dBm (200 mW)	-70 to +20 dBm ±0.00 dB -20 to +20 dBm ±0.1 dB/ 10dB	Type K(m)[1] 50Ω				1.12:0.01 - 2 GHz 1.22:2 - 12.4 GHz 1.38:12.4 - 18 GHz 1.43:18 - 26.5 GHz 1.92:26.5 - 40 GHz
80304A	10 MHz to 40 GHz -70 to 0 dBm	+23 dBm (200 mW)	-70 to -20 dBm ±0.00 dB -20 to 0 dBm ±0.2 dB/ 10 dB					
Low VSWR CW Sensors								
80310A	10 MHz to 18 GHz -64 to +26 dBm	+29 dBm (800 mW)	-64 to -14 dBm ±0.00 dB -14 to + 26 dBm ±0.05 dB/ 10 dB	Type K(m)[1] 50Ω	127mm (5.0 in)	32 mm (1.25 in)	0.23 kg (0.5lb)	1.13:0.01 - 2 GHz 1.15:2 - 12 GHz 1.23:12 - 18 GHz 1.29:18 - 26.5 GHz 1.50:26.5 - 40 GHz
80313A	10 MHz to 26.5 GHz -64 to +26 dBm		-64 to -14 dBm ±0.00 dB -14 to + 26 dBm ±0.1 dB/ 10 dB					
80314A	10 MHz to 40 GHz -64 to +6 dBm		-64 to -14 dBm ±0.00 dB -14 to + 6 dBm ±0.2 dB/ 10 dB					

Table B-1: Power Sensor Selection Guide (Continued)

Model	Freq. Range/ Power Range	Max. Power	Power Linearity[4] (Freq >8 GHz)	RF Conn	Length	Dia.	Wgt	VSWR
1W CW Sensors								
80320A	10 MHz to 18 GHz -60 to +30 dBm		-60 to -10 dBm ±0.00 dB -10 to +30 dBm ±0.05 dB/ 10 dB					
80323A	10 MHz to 26.5 GHz -60 to +30 dBm	+30 dBm (1 W)	-60 to -10 dBm ±0.00 dB -10 to +30 dBm ±0.1 dB/ 10 dB	Type K(m)[1] 50Ω	127 mm (5.0 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)	1.11:0.01 - 2 GHz 1.12:2 - 12 GHz 1.18:12 - 18 GHz 1.22:18 - 26.5 GHz 1.36:26.5 - 40 GHz
80324A	10 MHz to 40 GHz -60 to +10 dBm		-60 to -10 dBm ±0.00 dB -10 to +10 dBm ±0.2 dB/ 10 dB					
5W CW Sensor[2]								
80321A	10 MHz to 18 GHz -50 to +37 dBm	+37 dBm (5 W)	-50 to +0 dBm ±0.00 dB 0 to +37 dBm ±0.05 dB/ 10 dB	Type N(m) 50Ω	150 mm (5.9 in)	32 mm (1.25 in)	0.23 kg (0.5 lb)	1.20:0.01 - 2 GHz 1.25:6 - 12.4 GHz 1.35:12.4 - 18 GHz
25W CW Sensor[3]								
80322A	10 MHz to 18 GHz -40 to +44 dBm	+44 dBm (25 W)	-40 to +10 dBm ±0.00 dB +10 to +44 dBm ±0.05 dB/ 10 dB	Type N(m) 50Ω	230 mm (9.0 in)	104 mm (4.1 in)	0.3 kg (0.6 lb)	1.20:0.01 - 2 GHz 1.30:6 - 12.4 GHz 1.40:12.4 - 18 GHz
50W CW Sensor[3]								
80325A	10 MHz to 18 GHz -40 to +47 dBm	+47 dBm (50 W)	-40 to +10 dBm ±0.00 dB +10 to +47 dBm ±0.05 dB/ 10 dB	Type N(m) 50Ω	230mm (9.0 in)	104 mm (4.1 in)	0.3 kg (0.6 lb)	1.25:0.01 - 2 GHz 1.35:6 - 12.4 GHz 1.45:12.4 - 18 GHz
True RMS Sensors (-30 to +20 dBm)								
80330A 80333A 80334A	10 MHz to 18 GHz 10 MHZ to 26.5 GHz 10 MHz to 40 GHz	+33 dBm (2 W)	-30 to +20 dBm ±0.00 dB	Type K(m)[1] 50Ω	152.5 mm (6.0 in)	32 mm 1.25 in)	0.27 kg (0.6 lb)	1.12:0.01 - 12 GHz 1.15:12 - 18 GHz 1.18:18 - 26.5 GHz 1.29:26.5 - 40 GHz
80340 Series Peak Power Sensors (-30 to +20 dBm)								
80340A	50 MHz to 18 GHz	+23 dBm (200 mW)	-30 to -20 dBm ±0.13 dB 0 to +20 dBm	Type N(m)[1] 50Ω	146 mm (5.75 in)	37 mm (1.44 in)	0.3 kg (0.6lb)	1.12:0.01 - 2 GHz 1.22:2 - 12.4 GHz 1.37:12.4 - 18 GHz
80343A 80344A	50MHz to 26.5 50 MHz to 40 GHz		0 to +20 dBm ±0.13 dB ±0.01 dB/dB	Type K(m)[1] 50Ω				1.50:18 - 26.5 GHz 1.92:26.5 - 40 GHz

Notes:

1. The K connector is electrically and mechanically compatible with the APC-3.5 and SMA connectors.
2. Power coefficient equals <0.01 dB/Watt.
3. Power coefficient equals <0.015 dB/Watt.
4. For frequencies above 8 GHz, add power linearity to system linearity.
5. Peak operating range above CW maximum range is limited to <10% duty cycle.
6. Includes uncertainty of reference standard and transfer uncertainty. Directly traceable to NIST.
7. Square root of sum of the individual uncertainties squared (RSS).
8. Cal Factor numbers allow for 3% repeatability when connecting attenuator to sensor, and 3% for attenuator measurement uncertainty and mismatch of sensor/pad combination. Attentuator frequency response is added to the Sensor Cal Factors which are stored in he sensor's EEPROM.
9. The Model 80601 is compatible with the 8541C and 8542C, and later configurations.

Table B-2: Power Sensor Cal Factor Uncertainties

Freq. (GHz)		Sum of Uncertainties (%)[6]						Probable Uncertainties (%)[7]					
Lower	Upper	80301A 80302A 80340 80401A 80402A 80601A[9]	80303A 80304A 80343 80344	80310A 80313A 80314A	80320A 80323A 80324A	80321A[8] 80322A[8] 80325A[8]	80330A 80333A 80334A	80301A 80302A 80340 80401A 80402A 80601A[9]	80303A 80304A 80343 80344	80310A 80313A 80314A	80320A 80323A 80324A	80321A[8] 80322A[8] 80325A[8]	80330A 80333A 80334A
0.1	1	1.61	3.06	2.98	2.96	7.61	2.95	1.04	1.64	1.58	1.58	4.54	1.58
1	2	1.95	3.51	3.58	3.57	7.95	3.55	1.20	1.73	1.73	1.73	4.67	1.73
2	4	2.44	4.42	4.33	4.29	8.44	4.27	1.33	1.93	1.91	1.91	4.89	1.90
4	6	2.67	4.74	4.67	4.63	8.67	4.60	1.41	2.03	2.02	2.02	5.01	2.01
6	8	2.86	4.94	4.87	4.82	8.86	4.80	1.52	2.08	2.07	2.07	5.12	2.06
8	12.4	3.59	6.04	5.95	5.90	9.59	5.87	1.92	2.55	2.54	2.53	5.56	2.53
12.4	18	4.09	6.86	6.76	6.69	10.09	6.64	2.11	2.83	2.80	2.79	5.89	2.78
18	26.5	—	9.27	9.43	9.28	—	9.21	—	3.63	3.68	3.62	—	3.59
26.5	40	—	15.19	14.20	13.86	—	13.66	—	6.05	5.54	5.39	—	5.30

Notes:

1. The K connector is electrically and mechanically compatible with the APC-3.5 and SMA connectors.
2. Power coefficient equals <0.01 dB/Watt.
3. Power coefficient equals <0.015 dB/Watt.
4. For frequencies above 8 GHz, add power linearity to system linearity.
5. Peak operating range above CW maximum range is limited to <10% duty cycle.
6. Includes uncertainty of reference standard and transfer uncertainty. Directly traceable to NIST.
7. Square root of sum of the individual uncertainties squared (RSS).
8. Cal Factor numbers allow for 3% repeatability when connecting attenuator to sensor, and 3% for attenuator measurement uncertainty and mismatch of sensor/pad combination. Attentuator frequency response is added to the Sensor Cal Factors which are stored in he sensor's EEPROM.
9. The Model 80601 is compatible with the 8541C and 8542C and later configurations.

B.2.2 Modulation Sensor Specifications

Table B-3: 804XXA Modulation Sensor Specifications

Sensor Measurement Capabilities		
Signal Type	**Test Conditions**	**Typical Error[1]**
CW	-67 to +20 dBm	none
Single Carrier with AM	Power level -60 to +20 dBm, $f_m \leq 40$ kHz, Power level -60 to -20 dBm, $f_m \geq 40$ kHz, Power level -20 to +20 dBm, $f_m > 40$ kHz	none none see note[2]
Two-Tone	Power level -60 to +20 dBm, max carrier separation <40 kHz Power level -60 to -20 dBm, max carrier separation >40 kHz Power level -20 to +20 dBm, max carrier separation >40 kHz	none none see note[2]
Multi-Carrier	Power level -60 to +20 dBm, max carrier separation <40 kHz, ten carriers Power level -60 to -20 dBm, max carrier separation >40 kHz, ten carriers Power level -30 to +10 dBm, max carrier separation >40 kHz, ten carriers	none none see note[2]
Pulse Modulation	MAP or PAP mode, power level -60 to +20 dBm, pulse width >200 µs MAP or PAP mode, power level -60 to -20 dBm, pulse width <200 µs BAP mode, power level -40 to +20 dBm, pulse width >200 µs BAP mode, power level -40 to -20 dBm, pulse width <200 µs	none see note[2] none see note[2,3]
Burst with Modulation	MAP or PAP mode, power level -60 to +20 dBm, pulse width >200 µs, $f_m \leq 40$ kHz MAP or PAP mode, power level -60 to +20 dBm, pulse width <200 µs, $f_m \geq 40$ kHz MAP or PAP mode, power level -60 to -20 dBm, pulse width <200 µs BAP mode, power level -40 to +20 dBm, pulse width >200 µs, $f_m \leq 40$ kHz BAP mode, power level -40 to +20 dBm, pulse width <200 µs, $f_m \geq 40$ kHz BAP mode, power level -40 to -20 dBm, pulse width <200 µs, $f_m \leq 40$ kHz	none see note[2] see note[2] none see note[2,3] see note[2,3]

Notes:

1. Error is in addition to sensor linearity and zero set accuracy.
2. See Figure B-1 or B-2 for modulation-related uncertainty.
3. The BAP mode does not function at input levels below -40 dBm.
4. The power levels quoted in the table are for Model 80401A. For other modulation sensors, add the values listed below to all power levels shown Table B-3:

   For Model 80410A, add 6 dB.
   For Model 80420A, add 10 dB.
   For Model 80421A, add 20 dB.
   For Model 80422A, add 30 dB.
   For Model 80425A, add 33 dB.

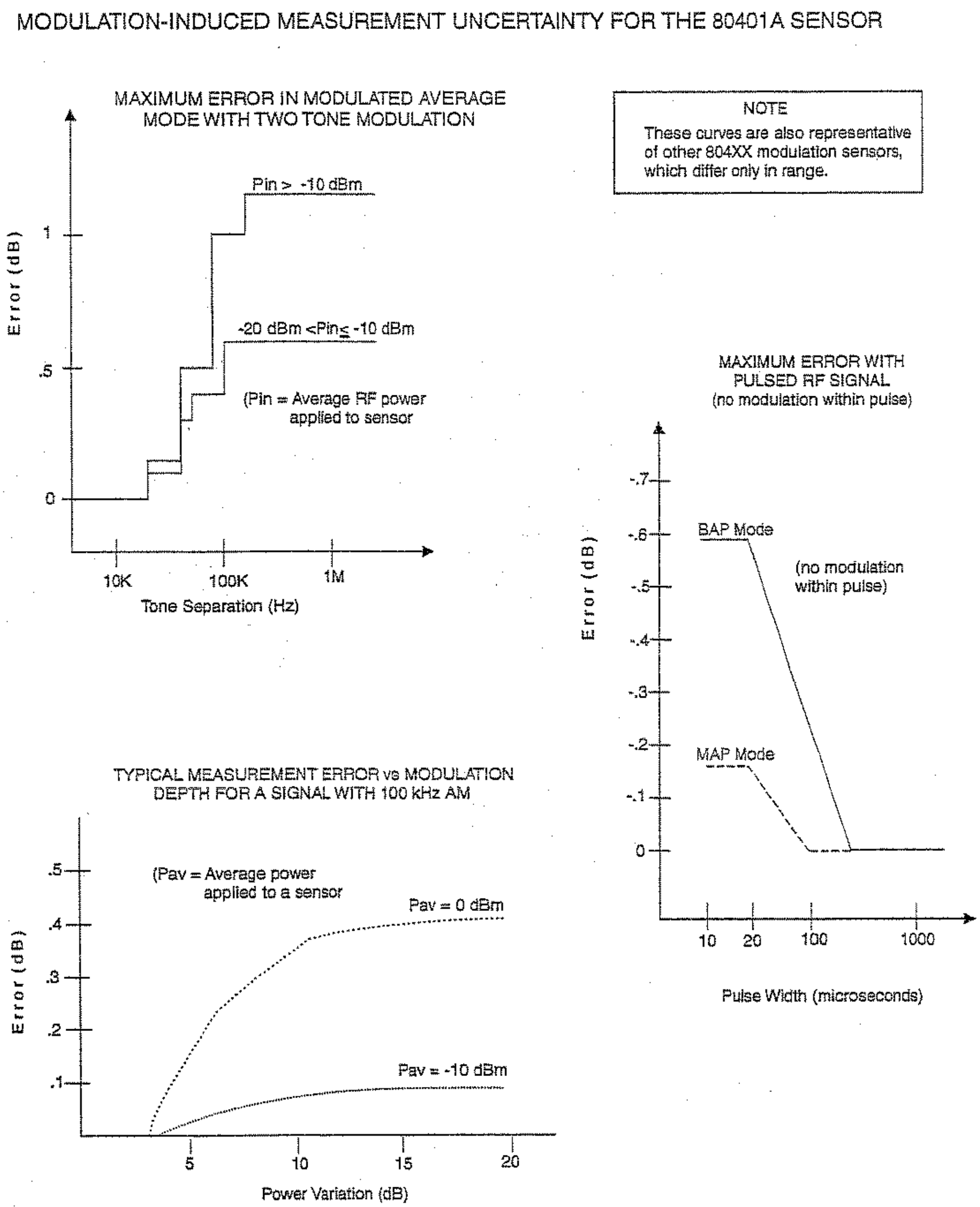


Figure B-1: 80401A Modulation-Related Uncertainty

BAP Mode Limitations

The minimum input level is -40 dBm (average); the minimum pulse repetition frequency is 20 Hz. If the input signal does not meet these minima, BURST AVG LED will flash to indicate that the input is not suitable for BAP measurement. The 8540C will continue to read the input but the BAP measurement algorithms will not be able to synchronize to the modulation of the input; the input will be measured as if the 8540C were in MAP mode. In addition, some measurement inaccuracy will result if the instantaneous power within the pulse falls below -43 dBm; however, this condition will not cause LED to flash.

MODULATION-INDUCED MEASUREMENT UNCERTAINTY FOR THE 80601A SENSOR

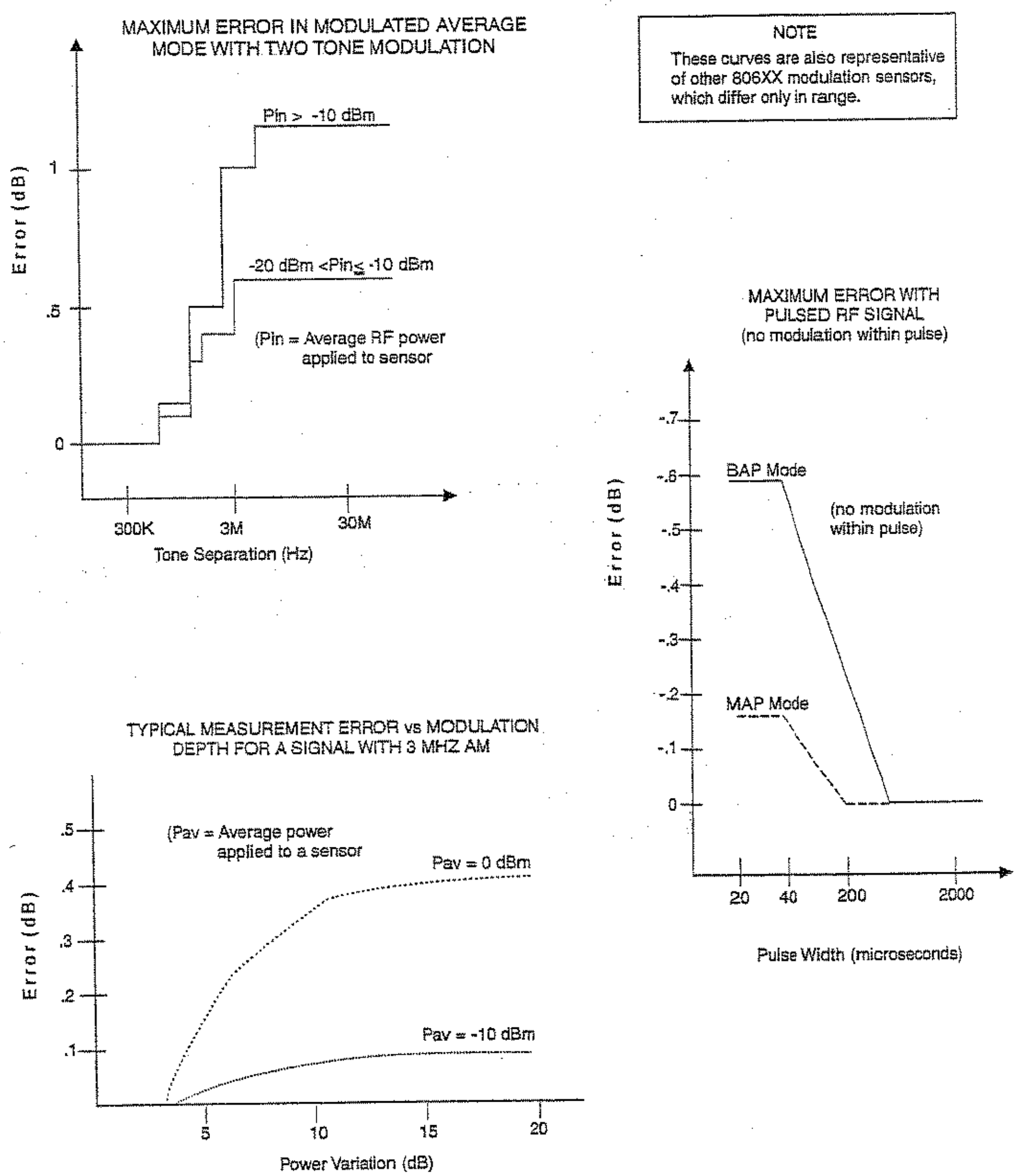


Figure B-2: 80601A Modulation-Related Uncertainty

BAP Mode Limitations

The minimum input level is -35 dBm (average); the minimum pulse repetition frequency is 20 Hz. If the input signal does not meet these minima, BURST AVG LED will flash to indicate that the input is not suitable for BAP measurement. The 8540C will continue to read the input but the BAP measurement algorithms will not be able to synchronize to the modulation of the input; the input will be measured as if the 8540C were in MAP mode. In addition, some measurement inaccuracy will result if the instantaneous power within the pulse falls below -38 dBm; however, this condition will not cause the LED to flash. See Section 2.6.2 for modulation bandwidth limitations below 200 MHz. When the modulation bandwidth is below 200 MHz, the 806XX sensors' performance is equal to that of the 804XX sensors.

B.2.3 Peak Power Sensors

Table B-4: Peak Power Sensor Selection Guide

Peak Power Sensors								
Model	Freq. Range/ Power Range	Max. Power	Power Linearity[4]	RF Conn	Dimensions Length	Dimensions Dia.	Wgt	VSWR
Standard Peak Power Sensors								
80350A	45 MHz to 18 GHz -20 to +20 dBm, Peak -30 to +20 dBm, CW	+23 dBm (200 mW) CW or Peak	-30 to -20 dBm ±0.00 dB -20 to +20 dBm ±0.05 dB/ 10 dB	Type N(m) 50Ω	165 mm (6.5 in)	37 mm 1.25 in)	0.3 kg (0.7 lb)	1.12:0.045 - 2 GHz 1.22:2 - 12.4 GHz 1.37:12.4 -18 GHz
80353A	45 MHz to 26.5 GHz -20 to +20 dBm, Peak -30 to +20 dBm, CW		-30 to -20 dBm ±0.00 dB -20 to +20 dBm ±0.1 dB/ 10 dB	Type K(m)[1] 50Ω				1.12:0.045 - 2 GHz 1.22:2 - 12.4 GHz 1.37:12.4 -18 GHz 1.50:18 - 26.5 GHz
80354A	45 MHz to 40 GHz -20 to +0.0 dBm, Peak -30 to +0.0 dBm, CW		-30 to -20 dBm ±0.00 dB -20 to 0.0 dBm ±0.2 dB/ 10dB					1.12:0.045 - 2 GHz 1.22:2 - 12.4 GHz 1.37:12.4 -18 GHz 1.50:18 - 26.5 GHz 1.92:26.5 - 40 GHz
5W Peak Power Sensor[2,5]								
80351A	45 MHz to 18 GHz 0.0 to +40 dBm, Peak -10 to +37 dBm, CW	CW: +37 dBm (5 W Avg.) Peak: +43 dBm	-10 to +0 dBm ±0.00 dB +0 to +40 dBm ±0.05 dB/ 10 dB	Type N(m) 50Ω	200 mm (7.9 in)	37 mm (1.25 in)	0.3 kg (0.7 lb)	1.15:0.045 - 4 GHz 1.25:4 - 12.4 GHz 1.35:12.4 -18 GHz
25W Peak Power Sensor[3,5]								
80352A	45 MHz to 18 GHz +10 to +50 dBm, Peak 0.0 to +44 dBm, CW	CW: +44 dBm (25 W Avg.) Peak: +53 dBm	0.0 to +10 dBm ±0.00 dB +10 to +50 dBm ±0.05 dB/ 10 dB	Type N(m) 50Ω	280 mm (11.0 in)	104 mm (4.1 in)	0.3 kg (0.7 lb)	1.20:0.045 - 6 GHz 1.30:6 - 12.4 GHz 1.40:12.4 -18 GHz
50W Peak Power Sensor[3,5]								
80355A	45 MHz to 18 GHz +10 to +50 dBm, Peak 0.0 to +47 dBm, CW	CW: +47 dBm (50 W Avg.) Peak: +53 dBm	0.0 to +10 dBm ±0.00 dB +10 to +50 dBm ±0.05 dB/ 10 dB	Type N(m) 50Ω	280 mm (11.0 in)	104 mm (4.1 in)	0.3 kg (0.7 lb)	1.25:0.045 - 6 GHz 1.35:6 - 12.4 GHz 1.45:12.4 -18 GHz

Notes:

1. The K connector is electrically and mechanically compatible with the APC-3.5 and SMA connectors.
2. Power coefficient equals <0.01 dB/Watt (AVG).
3. Power coefficient equals <0.015 dB/Watt (AVG).
4. For frequencies above 8 GHz, add power linearity to system linearity.
5. Peak operating range above CW maximum range is limited to <10% duty cycle.

Table B-5: Peak Power Sensor Cal Factor Uncertainties

Freq. (GHz)		Sum of Uncertainties (%)[1]					Probable Uncertainties (%)[2]		
Lower	Upper	80350A	80353A 80354A	80351A[3]	80352A[3]	80355A[3]	80350A	80353A 80354A	80351A[3] 80352A[3] 80355A[3]
0.1	1	1.61	3.06	9.09	9.51	10.16	1.04	1.64	4.92
1	2	1.95	3.51	9.43	9.85	10.50	1.20	1.73	5.04
2	4	2.44	4.42	13.10	13.57	14.52	1.33	1.93	7.09
4	6	2.67	4.74	13.33	13.80	14.75	1.41	2.03	7.17
6	8	2.86	4.94	13.52	13.99	14.94	1.52	2.08	7.25
8	12.4	3.59	6.04	14.25	14.72	15.67	1.92	2.55	7.56
12.4	18	4.09	6.86	19.52	20.97	21.94	2.11	2.83	12.37
18	26.5	—	9.27	—	—	—	—	3.63	—
26.5	40	—	15.19	—	—	—	—	6.05	—

Notes:

1. Includes uncertainty of reference standard and transfer uncertainty. Directly traceable to NIST.
2. Square root of sum of the individual uncertainties squared (RSS).
3. Cal Factor numbers allow for 3% repeatability when connecting attenuator to sensor, and 3% for attenuator measurement uncertainty and mismatch of sensor/pad combination. Attenuator frequency response is added to the Sensor Cal Factors which are stored in the sensor's EEPROM.
4. For additional specifications, see the Series 80350A manual and data sheet.

B.2.4 Directional Bridges

The 80500 CW Directional Bridges are designed specifically for use with Giga-tronics power meters to measure the Return Loss/SWR of a test device. Each bridge includes an EEPROM which has been programmed with Identification Data for that bridge.

Table B-6: Directional Bridge Selection Guide

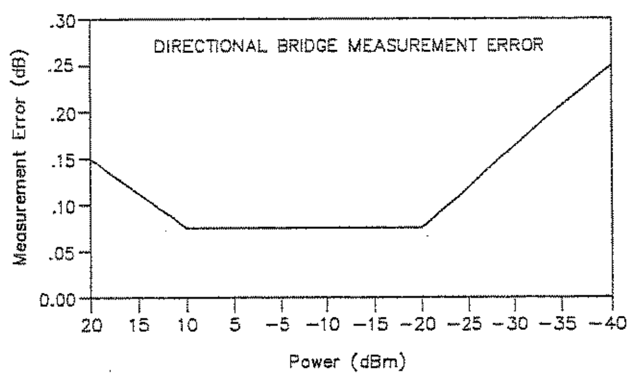
Bridge Selection Guide								
Model	**Freq. Range/ Power Range**	**Max. Power**	**Power Linearity[4]**	**Input**	**Test Port**	**Direct-tivity**	**Wgt**	**VSWR**
Precision CW Return Loss Bridges								
80501	10 MHz to 18 GHz -35 to +20 dBm	+27 dBm (0.5W)	-35 to +10 dBm ±0.1 dB +10 to +20 dBm ±0.1 dB ±0.005 dB/dB	Type N(f) 50 Ω	Type N(f) 50 Ω	38 dB	0.340 kg	<1.17:0.01 - 8 GHz <1.27:8 - 18 GHz
80502					APC-7(f) 50 W	40 dB		<1.13:0.01 - 8 GHz <1.22:8 - 18 GHz
80503	10 MHz to 26.5 GHz -35 to +20 dBm			SMA(f) 50 Ω	SMA(f) 50 W	35 dB		<1.22:0.01 - 18 GHz <1.27:8 - 26.5 GHz
80504	10 MHz to 40 GHz -35 to +20 dBm			Type K(f) 50 Ω	Type K(f) 50 W	30 dB	0.198 kg	<1.35:0.01 - 26.5 GHz <1.44:26.5 - 40 GHz

The Selection Guide in Table B-6 shows primary specifications. Additional specifications are:

Bridge Frequency Response: Return loss measurements using the 8541/2 power meter can be frequency compensated using the standard *Open/Short* supplied with the bridge.

Insertion Loss: 6.5 dB, nominal, from input port to test port

Directional Bridge Linearity Plus Zero Set & Noise vs. Input Power (50 MHz, 25 °C ±5 °C): +27 dBm (0.5 W)



Dimensions:
80501: 76 x 50 x 28 mm (3 x 2 x 1 1/8 in)
80502: 76 x 50 x 28 mm (3 x 2 x 1 1/8 in)
80503: 19 x 38 x 29 mm (3/4 x 1 1/2 x 2 1/8 in)
80504: 19 x 38 x 29 mm (3/4 x 1 1/2 x 2 1/8 in)

Weight:
80501: 340 g (12 oz)
80502: 340 g(12 oz)
80503: 198 g (7 oz)
80504: 198 g (7 oz)

Directional Bridge Accessories: An Open/Short is included for establishing the 0 dB return loss reference during path calibration.

B.3 Power Sensor Calibration

Power Sensors used with the Series 8540C Universal Power Meters have EEPROMs that manage the calibration data. You can change existing date or program special calibration data for user-specific frequencies.

The calibration process generates a correction factor expressed in dB for each frequency, and compares the measured power with a power standard. The Series 8540C uses cal factors expressed in dB but many calibration labs generate cal factors in percentage.

B.3.1 Local Calibration

Local calibration uses the front panel menu of the Series 8540C for programming power sensor EEPROMs.

Equipment Required

Series 8540C Universal Power Meter
Power Sensor

User Menus

To select a menu, press [MENU] and cursor up or down until the desired menu is showing. Press [ENTER] to move to the next menu level. To change the value in a menu, move the cursor to the digit to be changed and select its new value with the up/down cursor keys. Each digit must be individually selected and changed.

Some Series 8540C software versions will not contain all of the menus listed in this Applications Note. If any menu is missing, disregard the procedural step and proceed to the next menu.

Procedure

Connect the power sensor to Channel A or B on the Series 8540C front panel.

Press [MENU] and cursor to **SERVICE MENU**. Press [ENTER]. Cursor to **SENSOR ROM** and press [ENTER]

Display	Description
S_EE Model#: 80401	Model number of the in-use sensor. **This number should not be altered.** If the model number in the menu does not match the number printed on the sensor, contact Giga-tronics for assistance.
S_EE SNumb: 1234567	Serial number of the in-use sensor. **This number should not be altered.** If the serial number in the menu does not match the number printed on the sensor, contact Giga-tronics for assistance.
S_EE CalLoc:nn	A 2-digit user-specified number to identify the location of the last calibration (e.g., Cal Lab 01). It should be changed to the location where you are now calibrating the unit.

S_EE CDate:09/01/00	Date of the last calibration. You should change it to the date of the current calibration. The format is mm/dd/yy.
S_EE CTime:13:55:00	Time of the last calibration. You should change it to the time of the current calibration. The 24-hour format is hh:mm:ss.
S_EE LwFrq:f.f f f	Lower frequency range (in GHz) of the power sensor under test. **The value should not be altered.**
S_EE HiFrq:f f.f f f	High frequency range (in GHz) of the power sensor under test. **The value should not be altered.**
S_EE Video+:n.nnn	Video impedance of the *positive* detector in the power sensor. It **should not be altered.** If the diode is changed, enter the impedance value furnished with the new diode.
S_EE Video-:n.nnn	Video impedance of the *negative* detector in the power sensor. It **should not be altered** unless you have changed the detector diode. If the diode is changed, enter the impedance value furnished with the new diode.
S_EE FStart:2.000	The first frequency (in GHz) in the list of equally spaced frequencies at which the sensor was last calibrated. These frequencies can be changed to meet user-specific applications, but it is recommended that you leave these unaltered and instead set up user-specific calibration frequencies from the FSPLITEMS menu. The factory default is 2.000.
S_EE FStep:1.000	This frequency (in GHz) is the step size or spacing of frequencies at which the sensor was last calibrated. If you alter the spacing, you will also alter the factory calibration frequencies. If you alter the step value without changing either FStart or FItems (or both), the value will not be accepted. The factory default is 1.000.
S_EE FItems: nn	This is the number of equally-spaced steps from **FSTART** to **HIFRQ.** You will need to calculate this value based on the FStart frequency and the frequency range of the sensor. If you alter this number, you may also need to alter the frequency in **FSTART.** If you alter the number of steps without altering the start frequency, you may cut off the upper frequencies and prevent calibration. Values in excess of the allowable range will not be accepted.

For example, if the start frequency is 2 GHz, the sensor maximum range is 20 GHz, and you select 2 GHz steps, the maximum number of allowable steps is 10. If you enter 20 steps in this example, the value will not be accepted.

Thus, the allowable number of steps is the maximum frequency less the start frequency divided by the step value plus 1 (because the first step is the start frequency).

S_EE
FSplItems:n

The number of user-specified calibration frequencies to be set up. Change the number as desired. The factory default is 1. Refer to SFRQ for setting up the frequencies. The 26.56 GHz sensors have two special frequencies.

RLStart

Reserved for factory use.

RLStep

Reserved for factory use.

RLItems

Reserved for factory use.

RLSplItems

Reserved for factory use.

S_EE
ACoef thru **HCoef**

These are coefficients which describe the sensor's behavior above 8 GHz. If the sensor response after calibration deviates greater than ± 0.02 dBm, contact the factory for assistance. **These values should be changed only when a new diode module is installed.**

S_EE Frq: (1)
f.fff(-*n.nn*)

First (1) in the list of calibration frequencies followed by the frequency (*f.fff*) in GHz and the correction factor (-*n.nn*) in dB. A first calibration frequency of 2 GHz is the factory default. Each step number, shown in parenthesis on the first line, will increase the frequency by the value in the FSTEP menu. **The correction factor (-*nn.n*) should not be altered unless new calibration data has been taken.**

S_EE SFrq: (1)
f.fff(-n.nn)

First (1) in the list of special (user-specified) calibration frequencies followed by the frequency (f.fff) in GHz and the correction factor (-*n.nn*) in dB. The first special calibration frequency of 0.5 MHz is a factory default. The number of steps (shown in parenthesis on the first line) will depend on the sensor's frequency range and the value in the **FSTEP** menu. Each progressive step will increase the frequency by the number in the **FSPLITEMS** menu. **The correction factor (-*n.nn*) should not be altered unless new calibration data has been taken.**

Program
EEPROM?
Exit or Write

Move the cursor to select either Exit to leave the calibration function without saving changes, or Write to write the changes to EEPROMs. The Write selection will open the Password menu.

B.3.2 Remote Calibration

Power sensors used with the Series 8540C Universal Power Meters have built-in EEPROM data that manage the cal factors by a set of frequencies entered during calibration of the sensor at the factory. You can program additional cal factors with special data for user-specific frequencies.

A cal factor expressed in dB is programmed for each factory-calibrated frequency. The calibration process compares the measurement to the frequency standard and applies the cal factor to offset frequency deviations.

Some 8540C software versions will not contain all of the menus listed here. If any menu is missing, disregard the procedural step and proceed to the next menu.

This procedure is for calibrating a power sensor by remote control with a Series 8540C Universal Power Meter via the IEEE 488 interface bus. This procedure writes the cal factors to the sensor EEPROM.

Equipment Required

Series 8540C Universal Power Meter
Power Sensor

Procedure

Connect the power sensor to Channel A or B on the Series 8540C front panel, and perform the following steps. In this procedure, bold letters are commands; the query form of a command has a question mark (?) at the end of the command. This form returns the data in the EEPROM.

1. TEST EEPROM A (or B) READ

   Read sensor A (or B) EEPROM data into the 8540C editor buffer.

2. (Optional) TEST EEPROM A (or B) CALFR?

   a. Query sensor A (or B) standard cal factor start frequency, number of standard frequencies, and number of special frequencies.

   b. Read the standard cal from the input buffer and extract the start frequency and number of standard frequencies.

   c. Calculate and set the frequencies of the cal factor table.

3. TEST EEPROM A (or B) CALFST?

   a. Query sensor A (or B) standard cal factor table.

   b. Read the standard cal from the input buffer and extract the standard cal factor; e.g., INPUT (GPIB address).

   c. Set the sensor standard cal factor table.

   d. Make changes from the table and put them back into the table.

   e. After all changes are made, put the table back into the input buffer.

4. TEST EEPROM A (or B) WRITE

   a. Write sensor A (or B) EEPROM data into the 8540C buffer.

   b. Restore the input buffer from step 3.e to the EEPROM buffer (e.g., OUTPUT [GPIB] address, input buffer).

   c. Write sensor A (or B) editor buffer data into the EEPROM with the password number; e.g., OUTPUT (GPIB address, TEST EEPROM A [or B] WRITE 0)

   d. Editing the EEPROM routine is complete.