PSM3000, PSM4000, and PSM5000 Series RF and Microwave Power Sensors/Meters Specifications and Performance Verification

Technical Reference

077-0603-00

Tektronix

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Technical Reference

www.tektronix.com

077-0603-00

Tektronix

Contacting Tektronix

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For product information, sales, service, and technical support:

- In North America, call 1-800-833-9200.
- Worldwide, visit www.tektronix.com to find contacts in your area.

Warranty

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of three (3) years from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product. Parts, modules and replacement products used by Tektronix for warranty work may be new or reconditioned to like new performance. All replaced parts, modules and products become the property of Tektronix.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

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[W4 – 15AUG04]

Table of Contents

List of Tables

General Safety Summary

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it.

To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

While using this product, you may need to access other parts of a larger system. Read the safety sections of the other component manuals for warnings and cautions related to operating the system.

To Avoid Fire or Personal Injury

Observe all terminal ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

The inputs are not rated for connection to mains or Category II, III, or IV circuits.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Do not operate without covers. Do not operate this product with covers or panels removed.

Do not operate with suspected failures. If you suspect that there is damage to this product, have it inspected by qualified service personnel.

Avoid exposed circuitry. Do not touch exposed connections and components when power is present.

Do not operate in wet/damp conditions.

Do not operate in an explosive atmosphere.

Keep product surfaces clean and dry.

Terms in This Manual

These terms may appear in this manual:

⚠ ***WARNING.*** *Warning statements identify conditions or practices that could result in injury or loss of life.*

⚠ ***CAUTION.*** *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Symbols and Terms on the Product

These terms may appear on the product:

- DANGER indicates an injury hazard immediately accessible as you read the marking.
- WARNING indicates an injury hazard not immediately accessible as you read the marking.
- CAUTION indicates a hazard to property including the product.

The following symbol(s) may appear on the product:

Preface

This document contains the Specifications and the Field Calibration procedure for the PSM3000, PSM4000, and PSM5000 USB Power Sensors. It contains procedures suitable for determining that the power sensor functions and is calibrated properly.

Related Manuals

The following documents relate to the operation or service of the power sensor:

Table i: Related manuals

Title	Description	Part number
PSM3000/4000/5000 Series Safety & Installation Manual	Describes safety practices to follow while operating a power sensor and how to install power sensor.	071-2958-XX
PSM3000/4000/5000 Series English User Manual	Explains how to use PSM3000/4000/5000 Series USB Power Sensors with the Power Meter Application software.	077-0592-XX
PSM3000/4000/5000 Series French User Manual	French translation of the User Manual.	077-0593-XX
PSM3000/4000/5000 Series Italian User Manual	Italian translation of the User Manual.	077-0594-XX
PSM3000/4000/5000 Series German User Manual	German translation of the User Manual.	077-0595-XX
PSM3000/4000/5000 Series Spanish User Manual	Spanish translation of the User Manual.	077-0596-XX
PSM3000/4000/5000 Series Portuguese User Manual	Portuguese translation of the User Manual.	077-0597-XX
PSM3000/4000/5000 Series Simplified Chinese User Manual	Simplified Chinese translation of the User Manual.	077-0598-XX
PSM3000/4000/5000 Series Traditional Chinese User Manual	Traditional Chinese translation of the User Manual.	077-0599-XX
PSM3000/4000/5000 Series Korean User Manual	Korean translation of the User Manual.	077-0600-XX
PSM3000/4000/5000 Series Russian User Manual	Russian translation of the User Manual.	077-0601-XX
PSM3000/4000/5000 Series Japanese User Manual	Japanese translation of the User Manual.	077-0602-XX
PSM3000/4000/5000 Series Specifications and Field Verification Technical Reference	Lists the Power Sensor specifications and explains how to perform a field calibration.	077-0603-XX
PSM3000/4000/5000 Series Declassification and Security Instructions	Addresses customer data security concerns with information on how to sanitize or remove memory devices from the power sensor.	
PSM3000/4000/5000 Series Online Help	Online help in the Power Meter Application software explains how to use the Power Meter Application software with the power sensor.	

Specifications

This section lists the PSM3000, PSM4000, and PSM5000 Series specifications. Items listed in the Performance Requirement column are generally quantitative, and are either tested by the Performance Verification procedure or are guaranteed by design. Items listed in the Reference Information column are useful operating parameters that have typical values; information in this column is not guaranteed.

NOTE. *This section lists the PSM3000, PSM4000, and PSM5000 Series specifications. Items listed in the Performance Requirement column are generally quantitative, and are either tested by the Performance Verification procedure or are guaranteed by design. Items listed in the Reference Information column are useful operating parameters that have typical values; information in this column is not guaranteed.*

Performance Conditions

The performance limits in these specifications are valid with these conditions:

- The power sensor must have been calibrated and adjusted at an ambient temperature between +20 °C and +30 °C.
- The power sensor must be in an environment with temperature, altitude, humidity, and vibration within the operating limits described in these specifications.
- The power sensor must have had a warm-up period of at least 20 minutes.

Table 1: Hardware specifications

Characteristic	Description
Frequency range	
PSM3110, PSM3120	10 MHz – 8 GHz
PSM3310, PSM3320	10 MHz – 18 GHz
PSM3510	10 MHz – 26.5 GHz
PSM4110, PSM4120	10 MHz – 8 GHz
PSM4320, PSM4410	50 MHz – 18.6 GHz (Type N) 50 MHz – 20 GHz (SMA)
PSM5110, PSM5120	100 MHz – 8 GHz
PSM5320, PSM5410	50 MHz – 18.6 GHz (Type N) 50 MHz – 20 GHz (SMA)
Frequency (Typical)	
PSM4110, PSM4120	10 MHz – 10 GHz
PSM4320	50 MHz – 20 GHz (Type N)
PSM5110, PSM5120	100 MHz – 10 GHz
PSM5320	50 MHz – 20 GHz (Type N)

Table 1: Hardware specifications (cont.)

Characteristic	Description
Dynamic Range	
PSM3110, PSM3120, PSM3310. PSM3320, PSM3510	-55 dBm to +20 dBm
PSM4110, PSM4120	-60 dBm to +20 dBm (10 MHz – 6 GHz) -50 dBm to +20 dBm (6 GHz – 8 GHz)
PSM5110, PSM5120	-60 dBm to +20 dBm (100 MHz – 6 GHz) -50 dBm to +20 dBm (6 GHz – 8 GHz)
PSM4320, PSM4410, PSM5320. PSM5410	-40 dBm to +20 dBm
Maximum Average Power	+20 dBm
Maximum Average Power: Damage Level	+23 dBm
Maximum Pulse Power	+20 dBm
Maximum Pulse Power: Damage Level	+23 dBm
Maximum Peak Voltage	+25 VDC
✓ Maximum Peak-to-Average Ratio	
PSM4110, PSM4120	10 MHz – 6 GHz: 80 dB 6 GHz – 8 GHz: 70 dB
PSM5110, PSM5120	100 MHz – 6 GHz: 80 dB 6 GHz – 8 GHz: 70 dB
PSM4320, PSM4410, PSM5320, PSM5410	50 MHz – 20 GHz: 55 dB
Video Bandwidth, typical	
PSM3110, PSM3120, PSM3310, PSM3320, PSM3510	Standard: 100 Hz
PSM4110, PSM4120, PSM4320, PSM4410, PSM5110, PSM5120, PSM5320, PSM5410	Standard: 10 MHz
PSM5110, PSM5120, PSM5320, PSM5410	Additional Digital Filters: 100 kHz, 200 kHz, 300 kHz, 500 kHz, 1 MHz, 2 MHz, 3 MHz, 5 MHz, 10 MHz
✓ **Video Transition Time**	
PSM5110, PSM5120	10% to 90% Rise Time: 54 ns (-70 to -20 dBm pulse at 4 GHz) 10% to 90% Fall Time: 44 ns (-70 to -20 dBm pulse at 4 GHz
PSM5320, PSM5410	10% to 90% Rise Time: 54 ns (-40 to -20 dBm pulse at 4 GHz) 10% to 90% Fall Time: 44 ns (-40 to -20 dBm pulse at 4 GHz)
Minimum Pulse Width, typical	Average Power measurements: 500 ns Peak Power measurements: 200 ns

Table 1: Hardware specifications (cont.)

Characteristic	Description
Time Base Accuracy, typical	±50 ppm
Effective Sample Rate, nominal	48 MS/second Reference Info: Sensors use a repetitive under-sampling technique to reconstruct the input signal. This requires a signal with a constant duty-cycle.
Measurement speed, nominal	2000 measurements per second (100 settled measurements per second typical) Reference Info: Sample rate is 500 kHz (ADC clock rate). 1/500kHz = 2 µs per reading. 1 measurement = 125 readings. 125 readings/measurement * 2 µs/reading = 250 µs/measurement. 250 µs are added to account for data transfer from the sensor to the PC and CPU interrupts (typical CPU and transfer time is <100 µs). 250 µs/measurement + 250 µs (transfer time and interrupts) = 500 µs/measurement. 1/500 µs = 2000 measurements/sec.
Recommended calibration cycle, nominal	1 year
Pulse Profiling Power Measurements, nominal	
PSM5110, PSM5120, PSM5320, PSM5410	Time gating to analyze pulse parameters Pulse Power, Peak Power, Average Power, Droop, Rise Time, Fall Time, Overshoot, Pulse Width, Pulse Repetition Frequency, Duty Cycle, Crest Factor (Peak-to-Average Ratio) Reference Info: Pulse profiling measurement results are computed from averaged-detected trace data.
Pulse (Modulation) Power Measurements	
PSM4110, PSM4120, PSM4320, PSM4410, PSM5110, PSM5120, PSM5320, PSM5410	Duty Cycle, Measured Pulse Power, Peak Power, Crest Factor (Peak- to-Average Ratio) Reference Info: When using the Power Meter Application, measurement results are computed from power sensor sample data. When using the Pulse Profiling Application, PSM5xxx measurement results are computed from averaged-detected trace data.
Average Power Measurements	Average Power, Duty Cycle-Computed Pulse Power, Data Logging
Statistical Measurements	
PSM5110, PSM5120, PSM5320, PSM5410	Cumulative Distribution Function (CDF), Complementary Cumulative Distribution Function (CCDF), Probability Distribution Function (PDF) Reference Info: Statistical measurement results are computed from averaged-detected trace data.
Display & Data Processing Capability	Multiple sensors, displays, and traces. Scaling: Linear, dB Memory: Unlimited
PSM5110, PSM5120, PSM5320, PSM5410:	Markers: 5 pairs Gating: 5 pairs Trace: Averaging, offset, scaling, statistics
Absolute Accuracy	

Table 1: Hardware specifications (cont.)

Characteristic	Description
Uncertainty Shape Factors	Mismatch Error: √2 Calibration Error: 2 Linearity Error: 2 Noise Error: 2 Temperature Error: √2 Zero Offset Error: √2 Reference Info: Total error is 2 times the RSS of the individual error uncertainties with each error divided by its shape factor before computing the RSS. Mismatch error is computed using peak match specifications.
Calibration Factor	**PSM3110, PSM3120**: Type N: 10 MHz – 1 GHz: 1.8% 1 GHz – 8 GHz: 1.7% SMA: 10 MHz – 1 GHz: 2.5% 1 GHz – 8 GHz: 2.4%
	PSM3310, PSM3320: Type N: 10 MHz – 1 GHz: 1.8% 1 GHz – 10 GHz: 1.7% 10 GHz – 18 GHz: 1.9% SMA: 10 MHz – 1 GHz: 2.5% 1 GHz – 10 GHz: 2.4% 10 GHz – 18 GHz: 2.7%
	PSM3510: 10 MHz – 1 GHz: 2.5% 1 GHz – 10 GHz: 2.4% 10 GHz – 18 GHz: 2.7% 18 GHz – 26.5 GHz: 2.7%
	PSM4110, PSM4120: Type N: 10 MHz – 100 MHz: 7.0% 100 MHz – 500 MHz: 4.0% 500 MHz – 8 GHz: 1.7% SMA: 10 MHz – 100 MHz: 7.0% 100 MHz – 500 MHz: 4.0% 500 MHz – 8 GHz: 2.5%
	PSM4320, PSM4410: Type N: 50 MHz – 500 MHz: 4.0% 500 MHz – 10 GHz: 1.7% 10 GHz – 18.6 GHz: 1.9% SMA: 50 MHz – 500 MHz: 4.0% 500 MHz – 12.5 GHz: 2.6% 12.5 GHz – 18 GHz: 3.2% 18 GHz – 20 GHz: 3.5%

Table 1: Hardware specifications (cont.)

Characteristic	Description

	PSM5110, PSM5120:
	Type N:
	    100 MHz – 500 MHz: 4.0%
	    500 MHz – 8 GHz: 1.7%
	SMA:
	    100 MHz – 500 MHz: 4.0%
	    500 MHz – 8 GHz: 2.5%

	PSM5320, PSM5410:
	Type N:
	    50 MHz – 500 MHz: 4.0%
	    500 MHz – 10 GHz: 1.7%
	    10 GHz – 18.6 GHz: 1.9%
	SMA:
	    50 MHz – 500 MHz: 4.0%
	    500 MHz – 12.5 GHz: 2.6%
	    12.5 GHz – 18.6 GHz: 3.2%
	    18 GHz – 20 GHz: 3.5%

✓ **Linearity**	
	PSM3110, PSM3120, PSM3310, PSM3320, PSM3510: +15 to +20 dBm: 3.0% -15 to +15 dBm: 2.5% -55 to -15 dBm: 2.0%

	PSM4110, PSM4120:
	10 MHz – 100 MHz:
	    +15 to +20 dBm: 7.0%
	    +10 to +15 dBm: 5.0%
	    -60 to +10 dBm: 4.0%
	100 MHz – 2 GHz:
	    +15 to +20 dBm: 7.0%
	    +10 to +15 dBm: 5.0%
	    -60 to +10 dBm: 3.0%
	2 GHz – 8 GHz:
	    +15 to +20 dBm: 5.0%
	    +10 to +15 dBm: 3.0%
	    -60 to +10 dBm: 2.0%

	PSM4320, PSM4410:
	50 MHz – 100 MHz:
	    +15 to +20 dBm: 7.0%
	    -40 to +15 dBm: 5.0%
	100 MHz – 2 GHz:
	    +15 to +20 dBm: 7.0%
	    +5 to +15 dBm: 5.0%
	    -40 to +5 dBm: 3.0%
	2 GHz – 20 GHz:
	    +15 to +20 dBm: 6.0%
	    +5 to +15 dBm: 4.0%
	    -40 to +5 dBm: 2.0%

Table 1: Hardware specifications (cont.)

Characteristic	Description
	PSM5110, PSM5120: 100 MHz – 2 GHz: +15 to +20 dBm: 7.0% +5 to +15 dBm: 5.0% -60 to +5 dBm: 3.0% 2 GHz – 8 GHz: +15 to +20 dBm: 5.0% +5 to +15 dBm: 3.0% -60 to +5 dBm: 2.0%
	PSM5320, PSM5410: 50 MHz – 100 MHz: +15 to +20 dBm: 7.0% -40 to +15 dBm: 5.0% 100 MHz – 2 GHz: +15 to +20 dBm: 7.0% +5 to +15 dBm: 5.0% -40 to +5 dBm: 3.0% 2 GHz – 20 GHz: +15 to +20 dBm: 6.0% +5 to +15 dBm: 4.0% -40 to +5 dBm: 2.0%
Noise	
	PSM3110, PSM3120, PSM3310, PSM3320, PSM3510 5 second integration. +10 to +20 dBm: 0.10% -15 to +10 dBm: 0.25% -30 to -15 dBm: 0.10% -40 to -30 dBm: 0.25% -50 to -40 dBm: 1.50% -55 to -50 dBm: 4.50%
	PSM4110, PSM4120: 1 second integration +10 to +20 dBm: 10 MHz – 100 MHz: 0.22% 100 MHz – 8 GHz: 0.15% -30 to +10 dBm: 10 MHz – 100 MHz: 0.22% 100 MHz – 8 GHz: 0.04% -50 to -30 dBm: 10 MHz – 100 MHz: 0.22% 100 MHz – 6 GHz: 0.04% 6 GHz to 8 GHz: 0.15% -60 to -50 dBm: 10 MHz – 100 MHz: 0.44% 100 MHz – 6 GHz: 0.15%

Table 1: Hardware specifications (cont.)

Characteristic	Description
	PSM4320, PSM4410: 5 second integration. +10 to +20 dBm: 1.5% (50 MHz – 20 GHz) -20 to +10 dBm: 1.0% (50 MHz – 20 GHz) -30 to -20 dBm: 1.5% (50 MHz – 20 GHz) -40 to -30 dBm: 7% (50 MHz – 18.6 GHz)
	PSM5110, PSM5210: 1 second integration +10 to +20 dBm: 100 MHz – 8 GHz: 0.15% -30 to +10 dBm: 100 MHz – 8 GHz: 0.04% -50 to -30 dBm: 100 MHz – 6 GHz: 0.04% 6 GHz – 8 GHz: 0.15% -60 to -50 dBm: 100 MHz – 6 GHz: 0.15%
	PSM5320, PSM5410: 5 second integration: +10 to +20 dBm: 50 MHz – 20 GHz: 1.5% -20 to +10 dBm: 50 MHz – 20 GHz: 1.0% -30 to -20 dBm: 50 MHz – 20 GHz: 1.5% -40 to -30 dBm: 50 MHz – 18.6 GHz: 7%
Zero Offset	
	PSM3110, PSM3120, PSM3310, PSM3320, PSM3510: $[(3.0nW@25°C) + \|\Delta T\| \times (0.15\,nW/°C)] \pm 0.01\,nW/month$
	PSM4110, PSM4120, PSM5110, PSM5120: $[(35nW@25°C) + \|\Delta T\| \times (0.025\,nW/°C)] \pm 0.005\,nW/month$
	PSM4320, PSM4410, PSM5320, PSM5410: 50 MHz – 500 MHz: $[(200\,nW@25°C) + \|\Delta T\| \times (10\,nW/°C)] \pm 10\,nW/month$ 500 MHz – 20 GHz: $[(100\,nW@25°C) + \|\Delta T\| \times (5\,nW/°C)] \pm 5\,nW/month$
Match	
PSM3110 and PSM3120	< 1.2 (10 MHz to 8 GHz)
PSM3310 and PSM3320	< 1.2 (10 MHz to 10 GHz) < 1.29 (10 MHz to 18 GHz)
PSM3510	< 1.2 (10 MHz to 10 GHz) < 1.29 (10 GHz to 26.5 GHz)
PSM4110	< 1.09 (10 MHz to 8 GHz)

Table 1: Hardware specifications (cont.)

Characteristic	Description
PSM4120	< 1.15 (10 MHz to 8 GHz)
PSM4320	< 1.2 (50 MHz to 10 GHz) < 1.29 (10 GHz to 18.6 GHz)
PSM4410	< 1.2 (50 MHz to 10 GHz) < 1.29 (10 GHz to 20 GHz)
PSM5110	< 1.18 (100 MHz to 250 MHz) < 1.09 (250 MHz to 8 GHz)
PSM5120	< 1.18 (100 MHz to 250 MHz) < 1.15 (250 MHz to 8 GHz)
PSM5320	< 1.2 (50 MHz to 10 GHz) < 1.29 (10 GHz to 18.6 GHz)
PSM5410	< 1.2 (50 MHz to 10 GHz) < 1.29 (10 GHz to 20 GHz)
Temperature (°C)	
PSM3110, PSM3120, PSM3310, PSM3320, PSM3510	40-50 ˚C: 2.00% 30-40 ˚C: 0.75% 20-30 ˚C: 0.00% 10-20 ˚C: 0.75% 0-10 ˚C: 2.00%
PSM4110, PSM4120, PSM5110, PSM5120	40-50 ˚C: 1.00% (+1%, 0 dBm to 10 dBm; +3%, 10 dBm to 20 dBm) 30-40 ˚C: 0.75% (+1%, 0 dBm to 10 dBm; +3%, 10 dBm to 20 dBm) 20-30 ˚C: 0.00% 10-20 ˚C: 0.75% (+1%, 0 dBm to 10 dBm; +3%, 10 dBm to 20 dBm) 0-10 ˚C: 1.00% (+1%, 0 dBm to 10 dBm; +3%, 10 dBm to 20 dBm)
PSM4320, PSM4410, PSM5320, PSM5410	40-50 ˚C: 6.00% 30-40 ˚C: 3.00% 20-30 ˚C: 0.00% 10-20 ˚C: 3.00% 0-10 ˚C: 6.00%

Table 2: Trigger specifications

Characteristic	Description
Resolution, typical	2 µs **PSM5110, PSM5120, PSM5320, PSM5410:** 20.8 ns
Delay, typical	**PSM5110, PSM5120, PSM5320, PSM5410:** 10 ms
Modes (GUI)	Single, Continuous
Source	External **PSM5110, PSM5120, PSM5320, PSM5410:** Internal, External

Table 2: Trigger specifications (cont.)

Characteristic	Description
External Trigger Rate, typical	**PSM5110, PSM5120, PSM5320, PSM5410:** 1 Hz – 750 kHz
External Trigger Off Time, typical	**PSM5110, PSM5120, PSM5320, PSM5410:** 1 µs minimum
Internal Trigger	Applies to **PSM5110**, **PSM5120**, **PSM5320**, and **PSM5410** only
Level Mode	Manual – User sets trigger manually Auto – Trigger is automatically set between the maximum and minimum values of the incoming signal
Internal Trigger Range	**PSM5110, PSM5120:** 100 MHz – 6 GHz: -45 dBm to +20 dBm 6 GHz – 8 GHz: -40 dBm to +20 dBm **PSM5320**, **PSM5410**: 50 MHz – 20 GHz: -20 dBm to +20 dBm
Signal Level Trigger Accuracy	±1 dB
Input	
Reference info: TTL compatible, rising or falling edge	
V_{IH}, minimum high-level input, nominal	2.0 V at ±10 µA
V_{IL}, maximum low-level input, nominal	0.8 V at ±10 µA
Connector type	SMB male
Absolute maximum	5.5 V maximum, -0.5 V minimum
Output	
V_{OH}, minimum high-level output, nominal	4.6 V at 1 mA
V_{OL}, minimum high-level output, nominal	0.8 V at -1 mA
Connector type	SMB male
Absolute maximum levels	5.5 V maximum, -0.5 V minimum

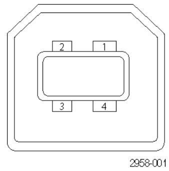


Table 3: USB interface connector pin definitions

Contact number	Signal name	Typical wiring assignment
1	VBUS	Red
2	D-	White
3	D+	Green
4	GND	Black
Shell	Shield	Drain wire

Table 4: Mechanical characteristics

Characteristic	Description
Weight (including boots and connectors)	**PSM3110, PSM3310, PSM3510**: 5.78 oz. (164 g.) **PSM3120, PSM3320**: 7.16 oz. (203 g.) **PSM4110, PSM5110**: 3.88 oz. (110 g.) **PSM4120, PSM5120**: 5.26 oz. (149 g.) **PSM4320, PSM5320**: 5.75 oz. (163 g.) **PSM4410, PSM5410**: 4.37 oz. (124 g.)
Size	**PSM3110, PSM3120, PSM3310, PSM3320, PSM3510, PSM4110, PSM4120, PSM4320, PSM4410:** 1.6 in. (40 mm) diameter by 2.25 in. (57 mm) long plus connector length
	PSM5110, PSM5120, PSM5320, PSM5410: 1.6 in. (40 mm) diameter by 2.25 in. (57 mm) long plus connector length

Performance Verification

This documents the calibration process for the Tektronix, Inc. PSM3000, PSM4000, and PSM5000 line of products. This is a manual procedure intended to satisfy the needs of annual recalibration. In addition, this procedure is useful for validating performance of sensors whose connectors have been replaced with connectors of an identical type (for example, N-Type male with N-Type male).

Any sensors failing this procedure must be returned to Tektronix for adjustment and/or repair.

Products Covered

This procedure covers the following products:

- PSM3110
- PSM3120
- PSM3310
- PSM3320
- PSM3510
- PSM4110
- PSM4120
- PSM4410
- PSM4320
- PSM5110
- PSM5120
- PSM5410
- PSM5320

Overview

The procedure applies to sensors that are in good working order, fully functional, and without mechanical defect or damage. If there is any question about the serviceability or functionality of the sensor, consult the User's Manual to ascertain the state of the sensor or contact Tektronix for advice. This procedure consists of six steps:

1. Select the Test Record
2. Physical and functional check of DUT
3. Warm up
4. Match Test

5. Absolute Level Accuracy Test
6. Linearity Test

As with any procedure, it is impractical to verify all conditions and states. So, the procedure tests a selected set of measurement points. These points are sufficient to ensure a high level of confidence in the sensor's continued performance. As with all calibration procedures, there is great reliance on the experience, knowledge, sound judgment and skill of those doing the work.

Finally, if, during the calibration procedure, the sensor fails at any point, follow local procedures for recording and resolving the problem before proceeding.

Required Equipment

This section lists the equipment required for the calibration procedure. This procedure refers to equipment by "NAME" rather than model number. So, rather than refer to an "Agilent N5183A" (see Table 1) the calibration procedure refers to "SOURCE". This term, "SOURCE", comes from the Required Equipment List below.

Like most calibration procedures, this procedure assumes access to common hardware such as precision adapters and high quality cables. This hardware is not called out in the equipment list. Nor is it depicted in the setup diagrams. Nonetheless, it is required.

This procedure applies to several sensors with both 3.5 mm male and N-type male input connectors. The required equipment varies depending on input connector. Other equipment varies by DUT model number. Pay special attention to the type of DUT you are calibrating when selecting your equipment.

If you choose to substitute equipment, consult the equipment list for information. Be aware of the test range for each sensor. The test ranges for each sensor are shown below:

- PSM3110: 10 MHz – 8 GHz
- PSM3120: 10 MHz – 8 GHz
- PSM3310: 10 MHz – 18 GHz
- PSM3320: 10 MHz – 18 GHz
- PSM3510: 10 MHz – 26.5 GHz
- PSM4110: 10 MHz – 8 GHz
- PSM4120: 10 MHz – 8 GHz
- PSM4320: 50 MHz – 18 GHz
- PSM4410: 50 MHz – 20 GHz
- PSM5110: 100 MHz – 8 GHz
- PSM5120: 100 MHz – 8 GHz

- PSM5320: 50 MHz – 18 GHz
- PSM5410: 50 MHz – 20 GHz

When selecting your equipment be sure to check the equipment for damage or excessive wear. SWR or match is the single biggest contributor to error and uncertainty in power measurements. Using worn or damaged connectors during calibration can induce “false failures”.

The same advice applies when selecting cables. Use high quality cables during calibration and ensure they are in good working order. When building the setups, keep cables as short as possible. Keep any strain on the cables at a minimum.

If you choose to substitute any of the passive devices (adapters, attenuators, or splitters) pay close attention to the specified SWR or match. Selecting components with marginal performance will degrade the quality of the measurements. Note that the limits on the Test Records take into account the published uncertainties in the reference sensor, cal sensor, DUT, port tracking error in the splitter, and mismatch errors.

Table 5: Required equipment

	DUT connector			
Item	**Plug/socket**	**Type**	**Description**	**Comments**
DUT	Plug	All	Device Under Test	The sensor to be calibrated
TR	– –	– –	Test record	The appropriate Test Record is selected in step 1
PC	– –	– –	Personal computer running Windows XP with Service Pack 3	
PM_APP	– –	– –	Power meter application. Software available from download from: www.tektronix.com	Power meter application is part of the standard application installation
Source	Plug	All	Agilent N5183A or equivalent	Suitable substitutes with equal or better: ■ Harmonics ■ Output power level (-100 dBm to +20 dBm) ■ Frequency range
VNA	Plug	All	Vector Network Analyzer capable of measuring match or S11 over the required frequency range	Use cal kits and cables as recommended by the manufacturer
Splitter	Plug	N-type	Agilent 1167A, 2 resistor splitter, 18 GHz or equivalent	Select splitter based on DUT connector type
	Plug	3.5 mm	Agilent 1167A, 2 resistor splitter, 26.5 GHz or equivalent	

Table 5: Required equipment (cont.)

Item	DUT connector Plug/socket	DUT connector Type	Description	Comments
20 dB Attenuator	Plug	N-type	Agilent 8491B Option 020, 20 dB, N-type, 18 GHz or equivalent	Select splitter based on DUT connector type
	Plug	3.5 mm	Agilent 8493C Option 020, 20 dB, 3.5 mm, 26.5 GHz or equivalent	
10 dB Attenuator	Plug	N-type	Agilent 8491B Option 020, 10 dB, N-type, 18 GHz or equivalent	Select splitter based on DUT connector type
	Plug	3.5 mm	Agilent 8493C Option 020, 10 dB, 3.5 mm, 26.5 GHz or equivalent	
Reference sensor	Plug	N-type	PSM3320	
	Plug	3.5 mm	PSM3510	
Calibration sensor	Plug	N-type	PSM3320	Factory calibrated sensors
	Plug	3.5 mm	PSM3510	Factory calibrated sensors

Select the Test Record

1. Select the Test Record (TR).

   Determine the DUT model number and select the TR from that applies to the DUT. Copy or print the Test Record. Record the following on the TR:

   a. Record the date and time on the TR.

   b. Record the DUT model number on the TR.

   c. Record the DUT serial number (on the rear of the DUT, below the USB connection) on the TR.

Physical and Functional Check of DUT

1. Inspect the DUT for signs of physical and/or mechanical damage. If there is any question that the DUT has experienced undue damage beyond normal handling scratches, mark this as “FAIL”. Enter the result on the TR.
2. Inspect the DUT connector for signs of wear or damage. Specifically inspect the center conductor on the RF connector for breakage, deformation, or scoring. If damage of the sort is found, mark this as “FAIL”. Enter the result on the TR.
3. Connect the DUT to the PC via USB cable.
4. Turn on and preset the SOURCE.
5. Turn SOURCE RF output off.
6. Connect SOURCE to DUT RF input connector (use adapters as required but no cables).
7. Start the Power Meter Application (PM_APP).

8. After the PM_APP starts, click the PM_APP Reset button. Switch the PM_APP to CW mode.
9. Vary the input power to prove the DUT is functioning properly. Use the procedure below.
   a. Turn the SOURCE RF output off.
   b. Set the SOURCE frequency to 1 GHz.
   c. Set the SOURCE power to 0 dBm.
   d. Turn the SOURCE RF output on.
   e. Read the DUT power.
   f. Set the SOURCE power to -20 dBm.
   g. With a high quality SOURCE and adapters, the SOURCE and DUT power readings should agree within ±1 dB. You may see larger disagreement with some sources.
   h. The functional check is *PASS* if the DUT is within ±1 dB of the SOURCE power.
10. Record result of the Functional Test on the TR.

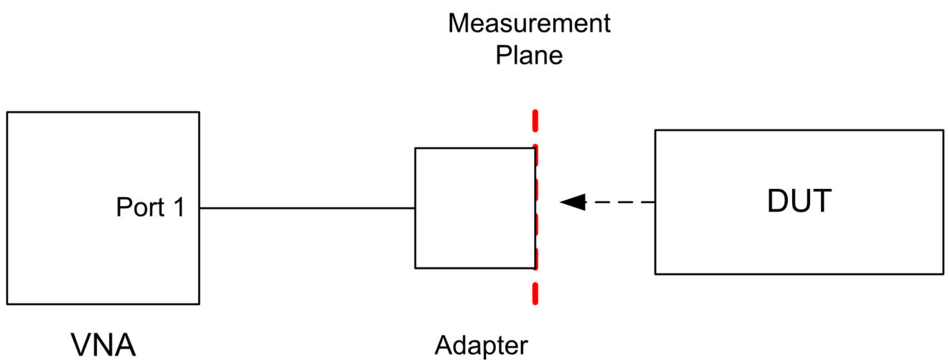
Warm Up

1. For 24 hours prior to and during execution of this test procedure the DUT must be stored in a stable laboratory environment. In addition, the sensor should be powered for at least 1 hour before starting the test. Stable environmental conditions are defined as:
   - Temperature: 20 °C to 30 °C (68 °F to 86 °F).
   - Humidity: 15% to 95% noncondensing.
   - Altitude: Sea Level to 3,000 meters (9,850 feet).
2. All equipment requiring power should be connected to mains and warmed up according to the manufacturer's recommendations.
3. Record temperature on TR. (top of the TR)
4. Record humidity on TR. (top of the TR)

Match

1. Setup and calibrate the VNA per manufacturer's directions over the range specified on the TR. During calibration use the appropriate adapters to ensure the measurement port is calibrated at the adapter output plane for the DUT connector type and sex.
2. After calibration is complete, check to ensure the DUT can connect directly to a calibrated test port without adding or removing any adapters or cables.
3. Connect the DUT to the PC via USB cable.

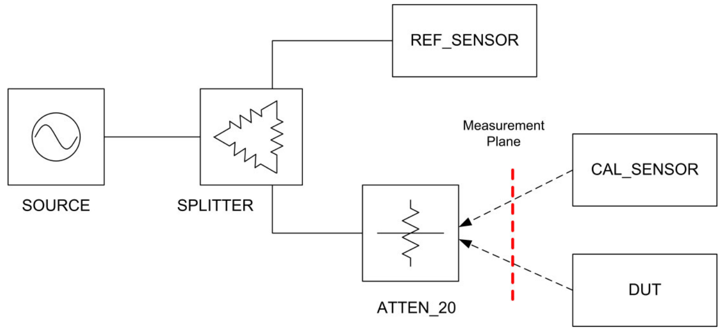
4. Connect the DUT to the calibrated test port. The DUT must be powered during this test.
5. Use the VNA to measure input match over the frequency range shown on TR.
6. Note worst case return loss within the frequency range(s) indicated on the TR.
7. Record the worst case return loss on the TR.



Absolute Level Accuracy

Use the Level Accuracy Worksheet (See Table 6.) to record data and calculate test results:

1. Set the SOURCE mode to CW.
2. Set the SOURCE RF output to OFF.
3. Set the SOURCE power level to -120 dBm or lowest power.
4. Connect the REF_SENSOR, CAL_SENSOR and DUT to PC via USB cables.
5. Start an instance of the PM_APP for REF_SENSOR, CAL_SENSOR, and DUT.
6. Preset each PM_APP.
7. Setup the equipment as depicted in the following diagram. Do not connect CAL_SENSOR or DUT to ATTEN_20 at this time. The open end of ATTEN_20 is the measurement plane. Do not connect any additional adapters or cables to the measurement plane.



Absolute level accuracy setup

8. Ensure the CAL_SENSOR and DUT have the same connector type and sex.

9. Ensure the open end of ATTEN_20 can mate directly with the CAL_SENSOR and DUT.

10. Set the CAL_SENSOR and DUT PM_APPs as shown below:
    - Mode = CW.
    - Averages = 500.
    - Freq = Same as SOURCE frequency.
    - Units = dBm.

11. Set the REF_SENSOR PM_APP as shown below:
    - Mode = CW.
    - Averages = 500.
    - Freq = Same as SOURCE frequency.
    - Units = dB (relative dB).

12. Repeat the following steps for each frequency listed in the Absolute Level Accuracy section of the TR.
    a. Carefully connect CAL_SENSOR to the Measurement Plane.
    b. Set SOURCE frequency to first or next frequency on the TR.
    c. Set all three PM_APP frequencies to match SOURCE frequency.
    d. Turn SOURCE RF output ON.
    e. Set SOURCE power level so the CAL_SENSOR PM_APP reads within 0.100 dB of IDEAL_CAL_LEVEL indicated on the TR.
    f. Record the CAL_SENSOR PM_APP reading on Level Accuracy Worksheet.
    g. Click the **Set Ref** button on REF_SENSOR PM_APP.

h. Carefully disconnect CAL_SENSOR from measurement plane.

i. Carefully connect DUT to measurement plane.

j. Record DUT PM_APP reading on Level Accuracy Worksheet.

k. Record REF_SENSOR PM_APP reading on Level Accuracy Worksheet (be certain to record the sign of this measurement).

l. Set SOURCE RF output to OFF.

m. Carefully disconnect the DUT from measurement plane.

n. Calculate the LVL_ERROR using the following equation and the results from substeps f, j, and k. Be careful not to drop the sign of the REF_SENSOR measurement. The calculated LVL_ERROR is the test measurement result.

LVL_ERROR = DUT – CAL_SENSOR – REF_SENSOR.

o. *Record the Measurement Result on the TR.*

p. Select a Pass if the Measurement Result is within the upper and lower limits for the measurement, otherwise select a Fail.

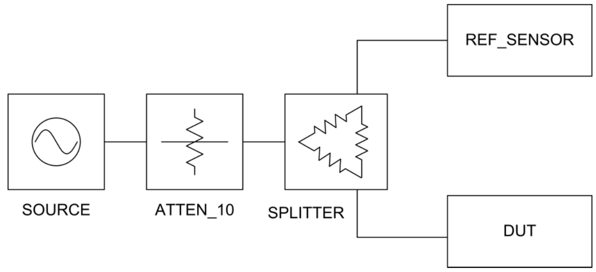
q. *Record the Pass/Fail result in the TR.*

13. After all frequencies are measured, set the SOURCE power to -120 dBm or the lowest power.
14. Press the Preset button on SOURCE.
15. Close all PM_APPs.
16. Tear down the Absolute Level Accuracy setup.

Linearity

Use the Linearity Worksheet (See Table 7.) to record data and calculate test results:

1. Set the SOURCE mode to CW.
2. Set the SOURCE RF output to OFF.
3. Set the SOURCE power level to -120 dBm or lowest power.
4. Connect the REF_SENSOR and DUT to PC via USB cables.
5. Start an instance of the PM_APP for REF_SENSOR and DUT.
6. Preset each PM_APP.
7. Setup the equipment as depicted in the “Linearity Setup” diagram below.



Linearity setup

8. Set the REF_SENSOR and DUT PM_APPs as shown below:

- Mode = CW.
- Averages = 500.
- Units = dBm.

9. Set SOURCE frequency to IDEAL_SOURCE_FREQ indicated on the TR.

10. Set SOURCE RF Output ON

11. Set REF_SENSOR and DUT PM_APP frequency to SOURCE frequency.

12. Set SOURCE level so that REF_SENSOR PM_APP indicates IDEAL_LIN_LEVEL specified in TR ±0.100 dB.

13. Check DUT PM_APP reading. DUT PM_APP should indicate within 3.00 dB of REF_SENSOR PM_APP reading.

14. Change REF_SENSOR PM_APP measurement units to “dB Relative”.

15. Click **Set Ref** button in REF_SENSOR PM_APP.

16. Change DUT PM_APP measurement units to “dB Relative”.

17. Click **Set Ref** button in DUT PM_APP.

18. Both PM_APPS should read 0.000 dB ±0.050 dB and should be very stable.

19. For the remainder of the test, record the values indicated on the PM_APPs as a result of changing the SOURCE power level. Do not change any other settings on the PM_APPs or SOURCE. Take great care not to physically disturb the setup.

20. Repeat the following steps for each power level listed in the “Measurement Range or Point” column of the “Linearity” section of the TR.

   a. Set SOURCE power level so the REF_SENSOR PM_APP indicates the first or next level in the “Measurement Range or Point” column of the “Linearity” section of the TR.

   b. Record REF_SENSOR reading on the Linearity Worksheet.

   c. Record DUT reading on the Linearity Worksheet.

d. Calculate the DUT_ERROR using the following equation and the values from substep b and c. Be careful not to drop the sign of either reading. The calculated LIN_ERROR is the measurement result.

LIN_ERROR = REF_SENSOR - DUT

e. Record the measurement result on the TR.

f. Select a Pass if the measurement result is within the upper and lower limits of the measurement, otherwise select a Fail.

g. Record the Pass/Fail results in the TR.

21. Set the SOURCE RF output to OFF.

22. Set the SOURCE power level to -120 dBm or lowest power.

23. Close all PM_APPs.

24. Tear down the Linearity setup.

Test Records

Print out the appropriate test record from the pages that follow and use them to record the performance test results for your sensor.

PSM3110 & PSM3120 test record

Model Number: Serial Number

Temperature: Humidity (%):

Date and Time: Technician:

Step	Measurement or action		Measure range or point	Lower limit	Upperlimit	Measured value	Result	
2.a	DUT physical check		Inspection				Pass	Fail
2.b	DUT connector		Inspection				Pass	Fail
2.j	Functional test						Pass	Fail
4.c	Calibrate Vector Network Analyzer (VNA)		10 MHz – 8 GHz				□ Done	
4.h	Worst Case Return Loss		10 MHz – 8 GHz		21 dB		Pass	Fail
5.l.xv	Absolute Level Accuracy		10 MHz	-0.31 dB	+0.29 dB		Pass	Fail
	IDEAL_CAL_LEVEL	-20 dBm	100 MHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			1 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			2 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			3 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			4 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			5 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			6 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			7 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			8 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
6.v.v	Linearity	+5dB		-0.18 dB	+0.17 dB	dB	Pass	Fail
	IDEAL_SOURCE_FREQ: 1 GHz	+10dB		-0.18 dB	+0.17 dB	dB	Pass	Fail
	IDEAL_LIN_LEVEL: –25 dBm	+15dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
		+20dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
		+23dB		-0.22 dB	+0.21 dB	dB	Pass	Fail

PSM3310 & PSM3320 test record

Model Number:
Serial Number
Temperature:
Humidity (%):
Date and Time:
Technician:

Step	Measurement or action		Measure range or point	Lower limit	Upper limit	Measured value	Result	
2.a	DUT physical check		Inspection				Pass	Fail
2.b	DUT connector		Inspection				Pass	Fail
2.j	Functional test						Pass	Fail
4.c	Calibrate Vector Network Analyzer (VNA)		10 MHz – 18 GHz				□ Done	
4.g	Worst Case Return Loss		10 MHz – 10 GHz		21 dB		Pass	Fail
			10 GHz – 18 GHz		18 dB		Pass	Fail
5.l.xv	Absolute Level Accuracy		10 MHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
	IDEAL_CAL_LEVEL	-20 dBm	100 MHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			1 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			2 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			3 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			4 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			5 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			6 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			7 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			8 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			9 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			10 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			11 GHz	-0.37 dB	+0.34 dB	dB	Pass	Fail
			12 GHz	-0.37 dB	+0.34 dB	dB	Pass	Fail
			13 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			14 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			15 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			16 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			17 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			18 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
6.v.v	Linearity	+5 dB		-0.18 dB	+0.17 dB	dB	Pass	Fail
	IDEAL_SOURCE_FREQ: 1 GHz	+10 dB		-0.18 dB	+0.17 dB	dB	Pass	Fail
	IDEAL_LIN_LEVEL: –25 dBm	+15 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
		+20 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
		+23 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail

PSM3510 test record

Model Number: Serial Number

Temperature: Humidity (%):

Date and Time: Technician:

Step	Measurement or action		Measure range or point	Lower limit	Upper limit	Measured value	Result	
2.a	DUT physical check		Inspection				Pass	Fail
2.b	DUT connector		Inspection				Pass	Fail
2.j	Functional test						Pass	Fail
4.c	Calibrate Vector Network Analyzer (VNA)		10 MHz – 26.5 GHz				□ Done	
4.g	Worst Case Return Loss		10 MHz – 10 GHz		21 dB		Pass	Fail
			10 GHz – 26.5 GHz		18 dB		Pass	Fail
5.l.xv	Absolute Level Accuracy		10 MHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
	IDEAL_CAL_LEVEL:	-20 dBm	100 MHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			1 GHz	-0.29 dB	+0.28 dB	dB	Pass	Fail
			2 GHz	-0.29 dB	+0.27 dB	dB	Pass	Fail
			3 GHz	-0.29 dB	+0.27 dB	dB	Pass	Fail
			4 GHz	-0.29 dB	+0.27 dB	dB	Pass	Fail
			5 GHz	-0.29 dB	+0.27 dB	dB	Pass	Fail
			6 GHz	-0.29 dB	+0.27 dB	dB	Pass	Fail
			7 GHz	-0.29 dB	+0.27 dB	dB	Pass	Fail
			8 GHz	-0.29 dB	+0.27 dB	dB	Pass	Fail
			9 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			10 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			11 GHz	-0.34 dB	+0.32 dB	dB	Pass	Fail
			12 GHz	-0.34 dB	+0.32 dB	dB	Pass	Fail
			13 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			14 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			15 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			16 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			17 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			18 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			19 GHz	-0.46 dB	+0.42 dB	dB	Pass	Fail
			20 GHz	-0.46 dB	+0.42 dB	dB	Pass	Fail
			21 GHz	-0.46 dB	+0.42 dB	dB	Pass	Fail
			22 GHz	-0.46 dB	+0.42 dB	dB	Pass	Fail
			23 GHz	-0.46 dB	+0.42 dB	dB	Pass	Fail
			24 GHz	-0.46 dB	+0.42 dB	dB	Pass	Fail
			25 GHz	-0.46 dB	+0.42 dB	dB	Pass	Fail
			26 GHz	-0.46 dB	+0.42 dB	dB	Pass	Fail

PSM3510 test record (cont.)

Step	Measurement or action		Measure range or point	Lower limit	Upper limit	Measured value	Result	
6.v.v	Linearity	+5 dB		-0.18 dB	+0.17 dB	dB	Pass	Fail
	IDEAL_SOURCE_FREQ: 1 GHz	+10 dB		-0.18 dB	+0.17 dB	dB	Pass	Fail
	IDEAL_LIN_LEVEL: –25 dBm	+15 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
		+20 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
		+23 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail

PSM4110 test record

Model Number: Serial Number

Temperature: Humidity (%):

Date and Time: Technician:

Step	Measurement or action		Measure range or point	Lower limit	Upper limit	Measured value	Result	
2.a	DUT physical check		Inspection				Pass	Fail
2.b	DUT connector		Inspection				Pass	Fail
2.j	Functional test						Pass	Fail
4.a	Calibrate Vector Network Analyzer (VNA)		10 MHz – 8 GHz				□ Done	
4.g	Worst Case Return Loss		10 MHz – 8 GHz		27 dB		Pass	Fail
5.l.xv	Absolute Level Accuracy		10 MHz	-0.51 dB	+0.46 dB		Pass	Fail
	IDEAL_CAL_LEVEL	-20 dBm	100 MHz	-0.39 dB	+0.36 dB	dB	Pass	Fail
			1 GHz	-0.34 dB	+0.31 dB	dB	Pass	Fail
			2 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			3 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			4 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			5 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			6 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			7 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			8 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
6.v.v	Linearity	+5 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
	IDEAL_SOURCE_FREQ: 1 GHz	+10 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
	IDEAL_LIN_LEVEL: –25 dBm	+15 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
		+20 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
		+23 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail

PSM4120 test record

Model Number:	Serial Number
Temperature:	Humidity (%):
Date and Time:	Technician:

Step	Measurement or action		Measure range or point	Lower limit	Upper limit	Measured value	Result	
2.a	DUT physical check		Inspection				Pass	Fail
2.b	DUT connector		Inspection				Pass	Fail
2.j	Functional test						Pass	Fail
4.a	Calibrate Vector Network Analyzer (VNA)		10 MHz – 8 GHz				□ Done	
4.g	Worst Case Return Loss		10 MHz – 8 GHz		23 dB		Pass	Fail
5.l.xv	Absolute Level Accuracy		10 MHz	-0.51 dB	+0.46 dB		Pass	Fail
	IDEAL_CAL_LEVEL	-20 dBm	100 MHz	-0.39 dB	+0.36 dB	dB	Pass	Fail
			1 GHz	-0.34 dB	+0.31 dB	dB	Pass	Fail
			2 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			3 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			4 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			5 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			6 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			7 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			8 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
6.v.v	Linearity	+5 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
	IDEAL_SOURCE_FREQ: 1 GHz	+10 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
	IDEAL_LIN_LEVEL: –25 dBm	+15 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
		+20 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
		+23 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail

PSM4320 & PSM5320 test record

Model Number: Serial Number
Temperature: Humidity (%):
Date and Time: Technician:

Step	Measurement or action		Measure range or point	Lower limit	Upper limit	Measured value	Result	
2.a	DUT physical check		Inspection				Pass	Fail
2.b	DUT connector		Inspection				Pass	Fail
2.j	Functional test						Pass	Fail
4.c	Calibrate Vector Network Analyzer (VNA)		50 MHz – 18.6 GHz				□ Done	
4.g	Worst Case Return Loss		50 MHz – 10 GHz		21 dB		Pass	Fail
			10 GHz – 18.6 GHz		18 dB		Pass	Fail
5.l.xv	Absolute Level Accuracy		50 MHz	-0.50 dB	+0.45 dB	dB	Pass	Fail
	IDEAL_CAL_LEVEL	-20 dBm	100 MHz	-0.44 dB	+0.40 dB	dB	Pass	Fail
			1 GHz	-0.38 dB	+0.35 dB	dB	Pass	Fail
			2 GHz	-0.35 dB	+0.32 dB	dB	Pass	Fail
			3 GHz	-0.35 dB	+0.32 dB	dB	Pass	Fail
			4 GHz	-0.36 dB	+0.33 dB	dB	Pass	Fail
			5 GHz	-0.36 dB	+0.33 dB	dB	Pass	Fail
			6 GHz	-0.36 dB	+0.33 dB	dB	Pass	Fail
			7 GHz	-0.36 dB	+0.33 dB	dB	Pass	Fail
			8 GHz	-0.36 dB	+0.33 dB	dB	Pass	Fail
			9 GHz	-0.36 dB	+0.33 dB	dB	Pass	Fail
			10 GHz	-0.36 dB	+0.33 dB	dB	Pass	Fail
			11 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			12 GHz	-0.40 dB	+0.37 dB	dB	Pass	Fail
			13 GHz	-0.44 dB	+0.40 dB	dB	Pass	Fail
			14 GHz	-0.44 dB	+0.40 dB	dB	Pass	Fail
			15 GHz	-0.44 dB	+0.40 dB	dB	Pass	Fail
			16 GHz	-0.44 dB	+0.40 dB	dB	Pass	Fail
			17 GHz	-0.44 dB	+0.40 dB	dB	Pass	Fail
			18 GHz	-0.44 dB	+0.40 dB	dB	Pass	Fail
			18.6 GHz	-0.44 dB	+0.40 dB	dB	Pass	Fail
6.v.v	Linearity	+5 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
	IDEAL_SOURCE_FREQ: 1 GHz	+10 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
	IDEAL_LIN_LEVEL: –25 dBm	+15 dB		-0.23 dB	+0.22 dB	dB	Pass	Fail
		+20 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
		+23 dB		-0.38 dB	+0.35 dB	dB	Pass	Fail

PSM4410 & PSM5410 test record

Model Number: Serial Number
Temperature: Humidity (%):
Date and Time: Technician:

Step	Measurement or action		Measure range or point	Lower limit	Upper limit	Measured value	Result	
2.a	DUT physical check		Inspection				Pass	Fail
2.b	DUT connector		Inspection				Pass	Fail
2.j	Functional test						Pass	Fail
4.c	Calibrate Vector Network Analyzer (VNA)		50 MHz – 20 GHz				□ Done	
4.g	Worst Case Return Loss		50 MHz – 10 GHz		21 dB		Pass	Fail
			10 GHz – 20 GHz		18 dB		Pass	Fail
5.l.xv	Absolute Level Accuracy		50 MHz	-0.49 dB	+0.44 dB	dB	Pass	Fail
	IDEAL_CAL_LEVEL	-20 dBm	100 MHz	-0.43 dB	+0.40 dB	dB	Pass	Fail
			1 GHz	-0.35 dB	+0.32 dB	dB	Pass	Fail
			2 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			3 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			4 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			5 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			6 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			7 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			8 GHz	-0.32 dB	+0.30 dB	dB	Pass	Fail
			9 GHz	-0.33 dB	+0.31 dB	dB	Pass	Fail
			10 GHz	-0.33 dB	+0.31 dB	dB	Pass	Fail
			11 GHz	-0.36 dB	+0.33 dB	dB	Pass	Fail
			12 GHz	-0.36 dB	+0.33 dB	dB	Pass	Fail
			13 GHz	-0.43 dB	+0.39 dB	dB	Pass	Fail
			14 GHz	-0.43 dB	+0.39 dB	dB	Pass	Fail
			15 GHz	-0.43 dB	+0.39 dB	dB	Pass	Fail
			16 GHz	-0.43 dB	+0.39 dB	dB	Pass	Fail
			17 GHz	-0.43 dB	+0.39 dB	dB	Pass	Fail
			18 GHz	-0.43 dB	+0.39 dB	dB	Pass	Fail
			19 GHz	-0.47 dB	+0.43 dB	dB	Pass	Fail
			20 GHz	-0.47 dB	+0.43 dB	dB	Pass	Fail
6.v.v	Linearity	+5 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
	IDEAL_SOURCE_FREQ: 1 GHz	+10 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
	IDEAL_LIN_LEVEL: –25 dBm	+15 dB		-0.23 dB	+0.22 dB	dB	Pass	Fail
		+20 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
		+23 dB		-0.38 dB	+0.35 dB	dB	Pass	Fail

PSM5110 test record

Model Number:	Serial Number
Temperature:	Humidity (%):
Date and Time:	Technician:

Step	Measurement or action		Measure range or point	Lower limit	Upper limit	Measured value	Result	
2.a	DUT physical check		Inspection				Pass	Fail
2.b	DUT connector		Inspection				Pass	Fail
2.j	Functional test						Pass	Fail
4.a	Calibrate Vector Network Analyzer (VNA)		10 MHz – 8 GHz				□ Done	
4.g	Worst Case Return Loss		100 MHz – 250 MHz		21.7 dB		Pass	Fail
			250 MHz – 8 GHz		27 dB		Pass	Fail
5.l.xv	Absolute Level Accuracy		100 MHz	-0.39 dB	+0.36 dB	dB	Pass	Fail
	IDEAL_CAL_LEVEL	-20 dBm	1 GHz	-0.34 dB	+0.31 dB	dB	Pass	Fail
			2 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			3 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			4 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			5 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			6 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			7 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			8 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
6.v.v	Linearity	+5 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
	IDEAL_SOURCE_FREQ: 1 GHz	+10 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
	IDEAL_LIN_LEVEL: –25 dBm	+15 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
		+20 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
		+23 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail

PSM5120 test record

Model Number: Serial Number

Temperature: Humidity (%):

Date and Time: Technician:

Step	Measurement or action		Measure range or point	Lower limit	Upper limit	Measured value	Result	
2.a	DUT physical check		Inspection				Pass	Fail
2.b	DUT connector		Inspection				Pass	Fail
2.j	Functional test						Pass	Fail
4.a	Calibrate Vector Network Analyzer (VNA)		10 MHz – 8 GHz				☐ Done	
4.g	Worst Case Return Loss		100 MHz – 250 MHz		21.7 dB		Pass	Fail
			250 MHz – 8 GHz		23 dB		Pass	Fail
5.l.xv	Absolute Level Accuracy		100 MHz	-0.39 dB	+0.36 dB	dB	Pass	Fail
	IDEAL_CAL_LEVEL	-20 dBm	1 GHz	-0.34 dB	+0.31 dB	dB	Pass	Fail
			2 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			3 GHz	-0.30 dB	+0.28 dB	dB	Pass	Fail
			4 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			5 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			6 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			7 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
			8 GHz	-0.31 dB	+0.29 dB	dB	Pass	Fail
6.v.v	Linearity	+5 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
	IDEAL_SOURCE_FREQ: 1 GHz	+10 dB		-0.22 dB	+0.21 dB	dB	Pass	Fail
	IDEAL_LIN_LEVEL: -25 dBm	+15 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
		+20 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail
		+23 dB		-0.25 dB	+0.23 dB	dB	Pass	Fail

Table 6: Level accuracy worksheet

Model:

Frequency	CAL_SENSOR PM_APP reading (dBm)	DUT PM_APP reading (dBm)	REF_SENSOR PM_APP reading (dB)	LVL_ERROR (DUT – CAL_SENSOR – REF_SENSOR) Record this result on the Test Record (dB)

Table 6: Level accuracy worksheet (cont.)

Model:

Frequency	CAL_SENSOR PM_APP reading (dBm)	DUT PM_APP reading (dBm)	REF_SENSOR PM_APP reading (dB)	LVL_ERROR (DUT – CAL_SENSOR – REF_SENSOR) Record this result on the Test Record (dB)

Table 7: Linearity worksheet

Model:

Source Power	DUT PM_APP reading (dBm)	REF_SENSOR PM_APP reading (dB)	LIN_ERROR (REF__SENSOR – DUT) Record this result on the Test Record (dB)