SAR Measurements with cSAR3D

APPLICATION NOTE

POWERSOURCE1 for System Validation

speag

POWERSOURCE1 for System Validation

1 Introduction

POWERSOURCE1 is a portable and very stable RF source providing a continuous wave (CW) signal at frequencies between 600 MHz and 5800 MHz. It is designed for conducting SAR system checks and SAR system validation of DASY and cSAR3D and is compatible with IEC 62209-1, IEC 62209-2, IEEE 1528 and draft IEC 62209-3 standards. Calibration of the POWERSOURCE1 is available from SPEAG's ISO/IEC 17025-accredited calibration center.

POWERSOURCE1 is powered via USB. It includes a bi-directional coupler and a micro-controller that precisely control the output power over a range from -5 dBm to +17 dBm. The output is continuously controlled based on a calibrated forward and reflected power measurement. The frequency and power can be controlled manually via the buttons on the housing or remotely via the USB interface (e.g., using cSAR3D or DASY6 software).

This application note provides information on the specifications, standards compatibility and procedure for performing system check or system validation measurements.

2 Specifications

The specifications of POWERSOURCE1 are given in Table 1.1. Please consult the POWERSOURCE1 Handbook for detailed information on the installation, handling and operation of this device.

The specifications in Table 1.1 apply under the following conditions:

- ambient temperature within the range 10°C to 30°C
- humidity within the range 30% to 90%, non-condensing
- atmospheric pressure within the range 860 hPa to 1060 hPa
- 5 minutes warm-up time at ambient temperature
- unit has a valid calibration

3 SAR Standards Compatibility

POWERSOURCE1 can be used for system check or system validation measurements of SAR measurement systems in accordance with international standards, wherever the power level, modulation and frequency requirements are within the specifications in Section 2. These standards include IEC 62209-1, IEC 62209-2, IEEE 1528 and draft IEC 62209-3 standards. They also include national regulations, such as FCC KDB 865664 (USA), RSS-102 (Canada), AS/NZS 2772-2:2011 (Australia, New Zealand), and ARIB STD T-56 3.1 (Japan).

System check and system validation are procedures to verify the accuracy of a SAR measurement system. Both procedures make use of a stable signal generator and a reference antenna to expose the phantom to a known SAR distribution. System check is a fast method that can be routinely applied to ensure that the SAR measurement system performance has not drifted and is being operated properly. System validation is a more extensive process to ensure that the system performs according to its specifications. It is a means to validate the reported measurement uncertainty.

Operating Frequencies	600, 750, 835, 850, 900, 1300, 1450, 1500, 1640, 1750, 1800, 1900, 1950, 2000, 2100, 2300, 2450, 2550, 2600, 3000, 3300, 3500, 3700, 5200, 5250, 5300, 5500, 5600, 5750, 5800 MHz
Signal Type	Continuous Wave
Output Power	-5.0 dBm to +17.0 dBm
Power Stability After Warm Up	± 0.1 dB equivalent for Normal dist. with k = 1 (± 0.2 dB rectangular)
Frequency Accuracy After Warm Up	± 1 MHz
Harmonics	-20 dBc
RF Connectivity	1 male SMA port
Power Supply	5 V DC, via USB type B mini jack
Power Consumption	<3 W
Dimensions	$93 \times 46.5 \times 19\,\text{mm}^3$
Weight	0.11 kg
Accessories	USB-Cable
Calibration	Annual calibration is recommended for optimal performance. Calibration is performed to SPEAG's high-quality standards.

Table 1.1: Specifications of POWERSOURCE1, which is compatible with IEC 62209-1, IEC 62209-2, IEEE 1528 and draft IEC 62209-3 standards.

Figure 1.1 shows the recommended power measurement setup in accordance with international standards. When using POWERSOURCE1, the setup can be simplified, as shown in Figure 1.2. The POWERSOURCE1 can be directly connected to the antenna as all separate components (signal generator, amplifier, coupler and power meter) are built into the unit. The signal purity is also warrantied by design, i.e., the low-pass filter is not needed. If the POWERSOURCE1 is calibrated, no additional equipment is needed and the unit can directly be connected to the SMA connector of the dipole without a cable. Otherwise, the output power needs to be measured with a calibrated power meter.

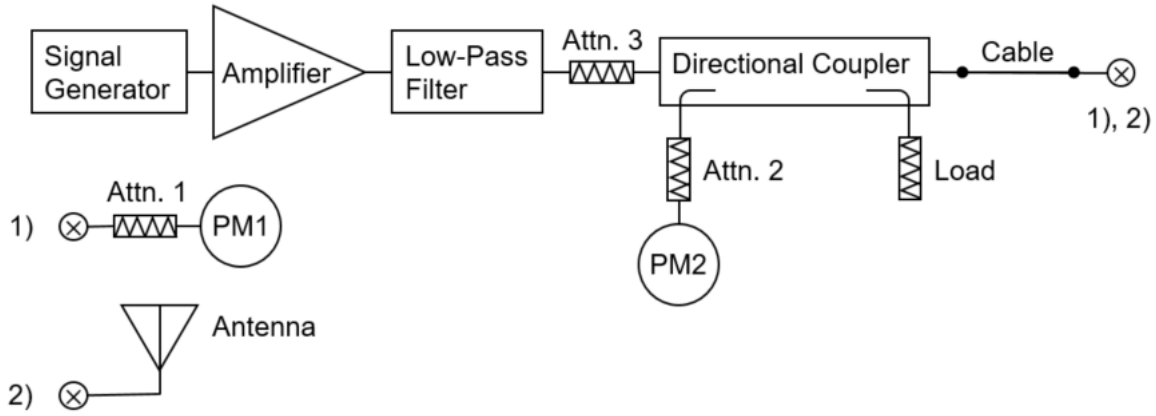

Figure 1.1: Equipment setup for system check and system validation according to IEC 62209-1 and other standards.

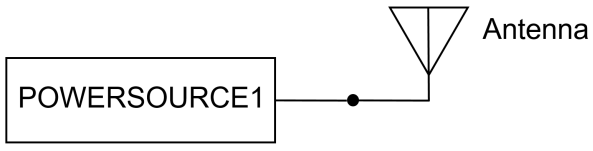

Figure 1.2: Equipment setup for system check and system validation using POWERSOURCE1. The amplifier, filter and directional coupler are not required when using the POWERSOURCE1.

4 System Check or System Validation Procedure

To use POWERSOURCE1 for system check or system validation, apply the following steps.

NOTE: for the first SAR measurement after switching it on, connect the POWERSOURCE1 to a load or antenna, set the power to highest level, turn on the power and wait for 5 minutes (warm-up period).

1. Connect the POWERSOURCE1 to the end of the relevant antenna for system check or system validation (see Figure 1.2).
2. Using either remote commands via the USB interface or the buttons on the device, set the frequency and power level.
3. Place the antenna on the phantom (e.g., see Figure 1.3), as specified in the relevant standard.
4. Wait for the auto-leveling period, which is typically 5 seconds and ends when the power level indicator has stopped flashing.
5. Measure the peak 1-gram SAR and 10-gram SAR.
6. Normalize the SAR values to the forward power.
7. Compare the normalized SAR values with the normalized target SAR values.
8. Apply the pass / fail criteria specified in the relevant standard.

NOTE: If traceability is required for submission and the unit is not ISO/IEC 17025 calibrated, measure the output power before and after the SAR measurement using a calibrated power meter in order to achieve the required traceability.

5 Output Power Uncertainty

The output power of the POWERSOURCE1 has an uncertainty of 0.34 dB for a 95% confidence interval. The components contributing to the uncertainty are described in the following Table.

uncertainty item	**tolerance (dB)**	**PDF**	**divisor**	**weight**	**uncertainty (dB)**
Forward power accuracy matched load	0.2	rect.	1.73	1	0.12
Forward power accuracy, reflection correction	0.06	rect.	1.73	1	0.03
SNR	0.086	rect.	1.73	1	0.05
VSWR	0.086	U	1.41	1	0.06
Temporal Stability	0.1	rect.	1.73	1	0.06
Thermal Stability	0.1	rect.	1.73	1	0.06
Coupler directivity	0.004	U	1.41	1	0.00
Calibration Power Meter Absolute Uncertainty	0.043	norm.	1.00	1	0.04
Total Standard Uncertainty, k = 1					0.17
Total Expanded Uncertainty, k = 2					0.34

ISO/IEC 17025 accredited calibration of POWERSOURCE1 is pending (expected in Q1 2018).

Table 1.2: Total uncertainty of POWERSOURCE1.

6 Conclusion

POWERSOURCE1 is a portable and very stable RF source providing a continuous wave (CW) signal at frequencies between 600 MHz and 5800 MHz. It is designed for conducting SAR system checks and SAR system validation of DASY and cSAR3D in accordance with IEC 62209-1, IEC 62209-2, IEEE 1528 and draft IEC 62209-3 standards.

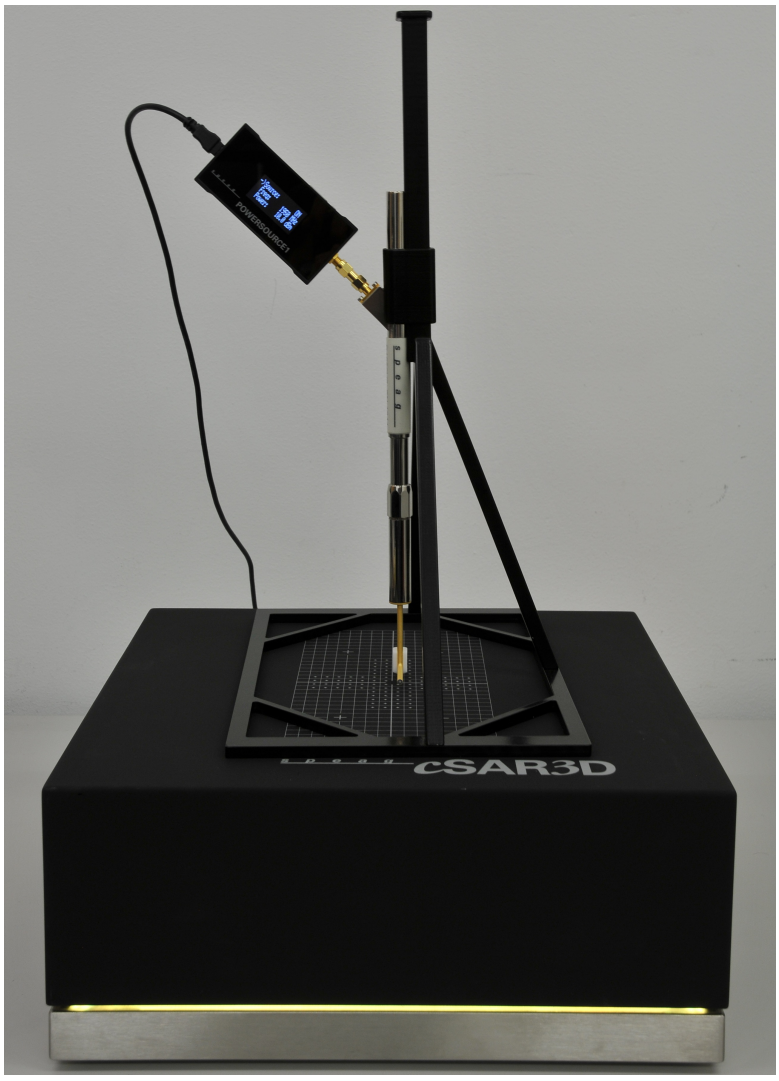

Figure 1.3: POWERSOURCE1 connected to validation dipole antenna for cSAR3D measurement.

Declaration of CE Conformity

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Certificate of test and configuration

Item	**POWERSOURCE1**
Type No	SE UMS 160 A
Series No	1000 and up
Manufacturer / Origin	Schmid & Partner Engineering AG, Zürich, Switzerland

Description of the item

POWERSOURCE1 is a CW signal source for the frequency range 600 – 6000 MHz with levels up to +17 dBm. It is powered by 5V DC via a USB cable from a separate USB supply or computer. Operating frequency and power level can be selected with buttons and monitored on the OLED display. The output signal is available from a 50 Ohm SMA connector for connection to a matched load.

The POWERSOURCE1 can be controlled remotely via a serial communication over the USB interface. To use a preferred frequency list without Python™ or a terminal, eight preset frequencies are programmed to the POWERSOURCE1.

Description	**Value**	**Unit**
Operating frequencies	600, 750, 835, 850, 900, 1300, 1450, 1500, 1640, 1750, 1800, 1900, 1950, 2000, 2100, 2300, 2450, 2550, 2600, 3000, 3300, 3500, 3700, 5200, 5800	MHz
Preset frequencies	835, 900, 1750, 1950, 2450, 3700, 5200, 5800	MHz

Functional and performance data

The data given in this section is characteristic for all units, within tight limits.

Functional test

Parameter	**Condition**	**Data**	**Unit**
Operating Voltage	4.5 V – 5.5 V	tested	
Current Consumption	Split USB cable +5 V DC	< 600	mA
Display	POWERSOURCE1 ready	tested	
Buttons	POWERSOURCE1 ready	tested	

RF Performance test

Parameter	**Condition**	**Data**	**Unit**
Frequency Deviation	Source ON → Operating frequencies	< 1	MHz
Harmonics Distortion	Source ON at 16 dBm → Operating frequencies	< -20	dBc
Output adjustment	Source ON, -5 – 17 dBm (1 dB steps)	< 5	Seconds
Output levels	Source ON, -5 – 17 dBm (1 dB steps)	< ±0.2	dB
Mismatch protection	Source ON, No Load	tested	

Typical results for Harmonics Distortion at 16 dBm output power are < -25 dBc

If the reflected power level is >-10 dB from the set power level, the power level will not be adjusted. In this case the power level flashes continuously on the display.

Handling of the item

The POWERSOURCE1 is a radio-frequency transmitter. Ensure that you comply with your local radiated emission regulations. It is recommended to only use the POWERSOURCE1 inside a screened room environment when a radiator is connected. The POWERSOURCE1 is calibrated and tested including the SMA male-male connector saver. Never remove the connector saver from the POWERSOURCE1. If removed factory calibration will be void.

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