

SAR System validation

Reference : KDB865664 D01 SAR measurement 100MHz to 6 GHz v01

3.3. SAR system validation

1. Equipment List

Model name	Spec.
N9020A	Signal Analyzer(20Hz~13.6GHz), Agilent
N5182A	Vector Signal Generator(250KHz~6GHz), Agilent
E4419B	EPM Series Power Meter, Agilent
BBS3Q7ELU	Power RF AMP(800MHz~4200MHz)
8481A	Power Sensor
16072	Dual Directional Coupler

No	Item	S/N	Customer
1	EX3DV4	3863	HCT
2	D850	441	HCT
3	D2450	743	HCT

2. SAR System Validation Procedure

KDB864664 D01 SAR measurement 100MHz to 6 GHz v01

3.3.1. Basic System Validation requirement

When : SAR Probe ,system component or s/w changed or recalibrated

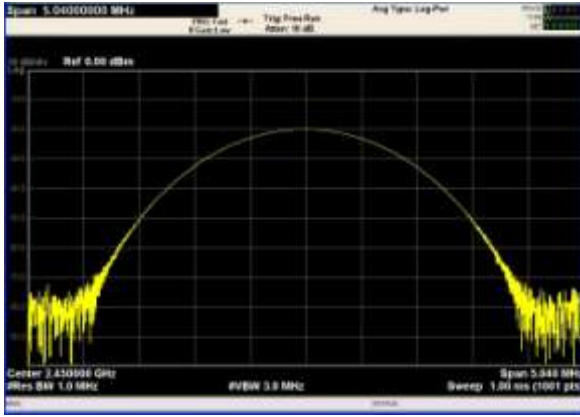
Refer to below Table

Probe	probe Type	Probe Calibration Point		Dipole	Date	Dielectric Parameters		CW Validation			Modulation Validation		
						Measured Permittivity	Measured conductivity	Sensitivity	Probe Linearity	Probe Isortopy	MOD. Type	Duty Factor	PAR
3863	EX3DV4	Head	835	441	Dec.20,2012	40.4	0.92	PASS	PASS	PASS	GMSK	PASS	NA
3863	EX3DV4	Head	2450	743	Dec.20,2012	38.1	1.83	PASS	PASS	PASS	OFDM	N/A	PASS

3.3.2. System validation for CW probe calibrations

1) SAR probe sensitivity

CW signal (for each frequency) should be fed to a reference dipole and the measured 1-g SAR should correspond to approximately 4.0 W/kg.



The measured SAR that normalized with 1.0 W net power is within 10% of the calibrated dipole SAR target. (refer to below table)

1) sensitivity

(Dipole Antenna: 743, Head Target value(1g): 52.7 W/kg)

	configuration	Measured Power(dBm)	Measured Power (W)	SAR(1g) W/Kg	1W normalized SAR W/kg	Deviation (%)
CW	2450MHz	10	0.01	0.559	55.9	6.07
		17	0.05	2.67	53.4	1.33
		18.7	0.07	3.92	56	6.26
		20	0.1	5.35	53.5	1.52
		22.1	0.16	8.61	53.81	2.11
		23	0.2	10.6	53	0.57
		26.19	0.42	22	52.38	-0.61

2) SAR Probe linearity

Single point SAR should be measured at the peak SAR location determined in step 1), with the probe tip positioned at 1/2 the probe tip diameter from the phantom surface.

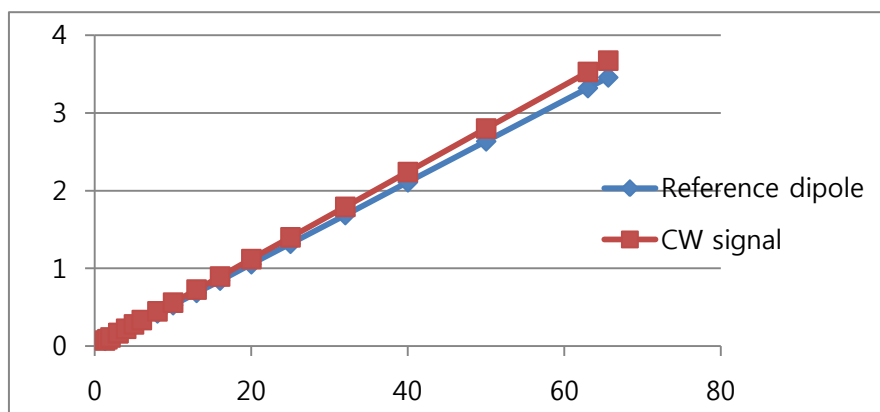
Probe linear straight line is established between the origin (0) and this single point SAR

The maximum deviation of each single point is within 10% of the linear straight line.

(refer to below data)

Data is used measured 1g SAR that 1.0 W normalized net Power

Max deviation - between measured SAR value and reference SAR value is 6.26%



Vertical is SAR value in W/kg

Horizontal is Power in mW

3) SAR probe isotropy

The probe is rotated around its z-axis at the peak SAR location of the reference dipole, and SAR is measured at 15° intervals, with probe tip positioned at 1/2 the probe tip diameter from the phantom surface. And SAR level should be 1.6 W/kg like step1), 2).

The maximum deviation for the measured value is within $\leq \pm 0.25\text{dB}$

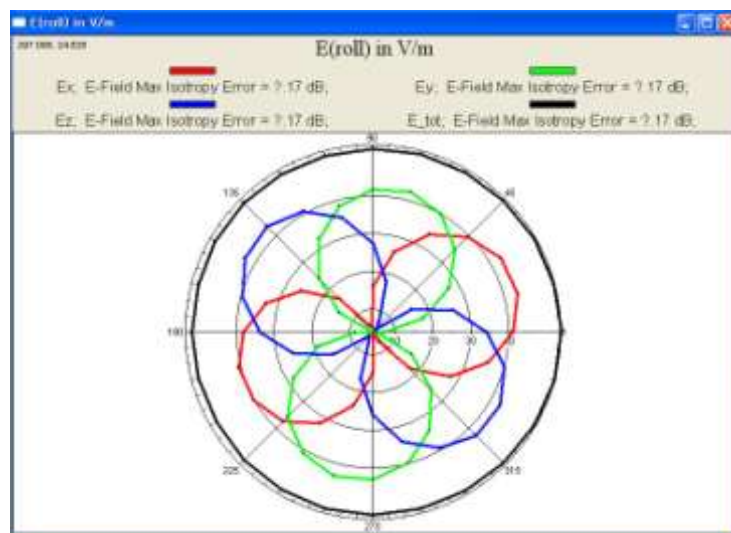
(refer to below data)

System Validation 2450 3863 isotropy

DASY4 Configuration:

- Probe: EX3DV4 - SN3863; ConvF (7.19, 7.19, 7.19); Calibrated: 2012-07-13
- Electronics: DAE3 Sn466; Calibrated: 2013-02-21
- Measurement SW: DASY4, V4.7 Build 71; Post processing SW: SEMCAD, V1.8 Build 184

Validation 2450MHz /Rotation (1D): 25 rotation steps; E-Field Max Isotropy Error = \pm 0.17 dB;



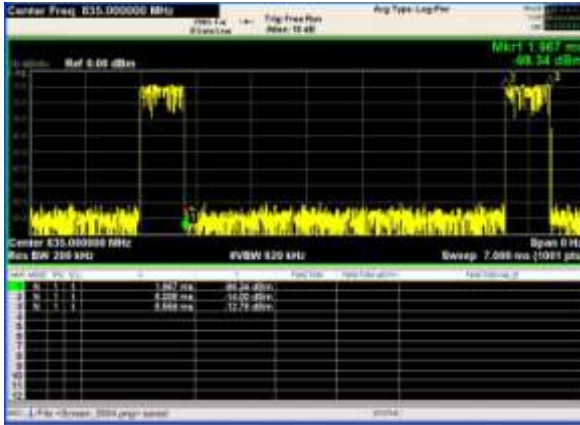
3.3.3. Additional system validation for using CW probe calibration with other signal types

1) For signals such as GMSK in GSM

Modulated CW signal at lowest duty factor should be fed to a reference dipole and the measured 1-g SAR should correspond to approximately 1.6 W/kg.

The measured SAR is normalized to 1.0 W net power, this value is within 10% of the calibrated dipole SAR target. Additionally, Duty factor gets from the Modulated CW signal and compensated by system. (refer to below data)

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Crest factor = 1/duty cycle

duty cycle

T3	6.56
T2	6.01
T1	1.97

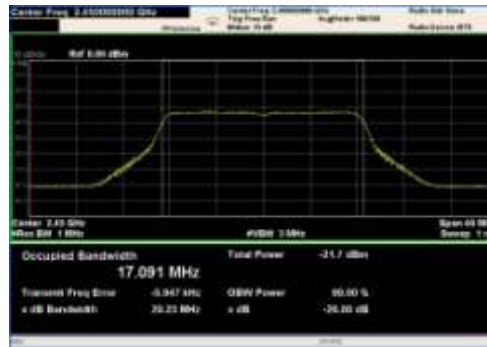
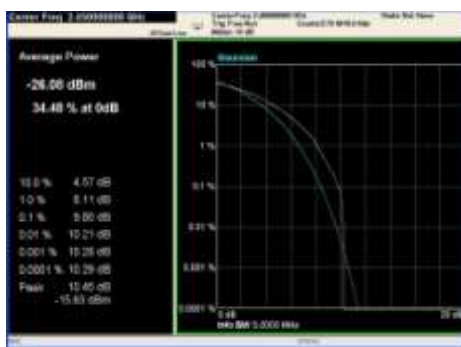
T3-T1	4.59
T3-T2	0.55
Crest factor	8.30

Modulation	Probe	Dipole S/N	Target 1g SAR(W/Kg)	Configuration
GMSK	3863	441	9.45	835MHz /Head cf=8.3
Measured SAR	Power(dBm)	Power (W)	1W Normalized SAR	Measured SAR / Target deviation (%)
1.6	22.7	0.18	8.89	-5.94

2) For Signals such as OFDM.

The procedures in steps 1) and 2) of section 3.3.2 should be repeated using modulated signal.

This signal has high peak to average power ratio (> 5 dB, refer to below CCDF)



PAR = 10.46

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Repeat 3.3.2 1) .

refer to below Table

(Dipole Antenna: 743, Head Target value(1g): 52.7 W/kg)

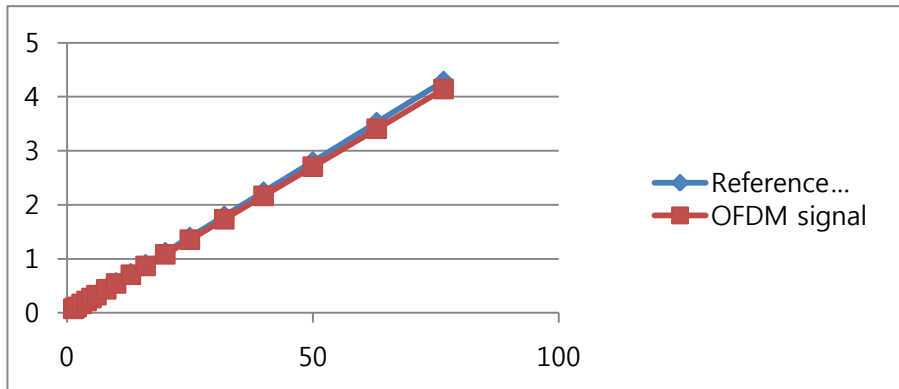
	Frequency	Measured Power(dBm)	Measured Power (W)	SAR(1g) W/Kg	1W normalized SAR W/kg	Deviation (%)
OFDM	2450MHz	10	0.01	0.534	53.4	1.33
		18.84	0.0766	4.14	54.05	2.56
		20	0.1	5.53	55.3	4.93
		22.13	0.16	9.13	57.06	8.28
		23	0.2	11.3	56.50	7.21
		26.3	0.43	24.7	57.44	9.00

Repeat 3.3.2.2)

Below chart presents the linearity error.

Data is used measured 1g SAR that 1.0 W normalized net Power

Max deviation - between measured SAR value and reference SAR value is 2.56%



Vertical is SAR value in W/kg

Horizontal is Power in mW