Certificate Number: 5055.02

TEST REPORT FOR SAR TESTING

Report No.: SRTC2020-9004(F)-20082801(H)

Product Name: Fi Smart Collar 2

Product Model: FC2

Applicant: Barking Labs

Manufacturer: Barking Labs

Specification: Part 2.1093

IEEE Std 1528

KDB Procedures

FCC ID: 2ARXN-FC2

The State Radio_monitoring_center Testing Center (SRTC)

15th Building, No.30 Shixing Street, Shijingshan District, Beijing, P.R. China

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Contents

1. GENERAL INFORMATION

1.1 Notes of the test report

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The test results relate only to individual items of the samples which have been tested.
The certification and accreditation identifiers used in this report shall not be applicable to the tested or calibrated samples thereof. The manufacturer shall not mark the tested samples or items (or a separate part of the item) with the identifiers of certification and accreditation to mislead relevant parties about the tested samples or items.

1.2 Information about the testing laboratory

Company:	The State Radio_monitoring_center Testing Center (SRTC)
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1.3 Applicant's details

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City:	Brooklyn, NY
Country or Region:	USA
Contacted person:	Bob Blake
Tel:	+1-914-249-9347
Email:	bob@tryfi.com
Company:	Barking Labs Corp.

1.4 Manufacturer's details

Company:	Barking Labs
Address:	215 Plymouth St., Fl. 1
City:	Brooklyn, NY
Country or Region:	USA
Contacted person:	Bob Blake
Tel:	+1-914-249-9347
Email:	bob@tryfi.com
Company:	Barking Labs Corp.

1.5 Test Environment

Date of Receipt of test sample at SRTC:	2020.08.28
Testing Start Date:	2020.08.28
Testing End Date:	2020.09.04

Environmental Data:	Temperature (°C)	Humidity (%)
Ambient	25	40

Normal Supply Voltage (Vdc.):	3.85

2. DESCRIPTION OF THE DEVICE UNDER TEST

2.1 Final Equipment Build Status

Wireless Technology and Frequency Bands	☐GSM Band: GSM850/GSM1900 ☐WCDMA Band: FDD II/IV/V ☒LTE CAT-M: 2/4/12 ☒Wi-Fi Band: 2.4GHz ☒BT
Mode	GSM ☐GPRS (GMSK) ☐EGPRS (GMSK/8PSK) WCDMA ☐UMTS Rel. 99 ☐HSDPA (Rel. 5) ☐HSUPA (Rel. 6) ☐HSPA+ (Rel.7) ☐DC-HSDPA (Rel.8) LTE CAT-M1 ☒QPSK ☒16QAM ☐64QAM Wi-Fi 2.4GHz ☒802.11b ☒802.11g ☒802.11n HT20 ☐802.11n HT40 Bluetooth ☐BR(GFSK) ☐EDR (π/4 DQPSK , 8-DPSK) ☒BLE(GFSK)
Note	For licensed cellular network duty cycle is inherent. For unlicensed network WLAN Duty cycle is depends on the data traffic, and the traffic allocation in operating mode could be the most conservative condition which with 100% duty cycle. SAR measurement also use non signalling mode, so the duty factor shall be taken into consideration.

2.2 Support Equipment

The following support equipment was used to exercise the DUT during testing:

State of sample	Normal
H/W Version S/W Version	Rev.A 1.0
SN	ON12089MBJ0007(CAT-M) ON12089MBJ0026(WIFI) ON12089MBJ002E(BLE)
Notes	As the information described above, we use test sample offered by the customer. The relevant tests have been performed in order to verify in which combination case the EUT would have the worst features.

3. REFERENCE SPECIFICATION

Specification	Version	Title
Part 2.1093	2019	Radiofrequency radiation exposure evaluation: portable devices.
IEEE Std 1528	2013	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
KDB 447498 D01	v06	General RF Exposure Guidance
KDB 648474 D04	v01r03	Handset SAR
KDB 865664 D01	v01r04	SAR Measurement from 100 MHz to 6 GHz
KDB 865664 D02	v01r02	RF Exposure Reporting
KDB 941225 D05	v02r05	SAR for LTE Devices

4. TEST CONDITIONS

4.1 Picture to demonstrate the required liquid depth

The liquid depth is large than 15cm in the used SAM phantoms in flat section, and the depth of the tissue simulant was 15.0 ± 0.5 cm measured from the ear reference point during system checking and device measurements.

Liquid depth for SAR Measurement

4.2 Test Signal, Frequencies and Output Power

The device was put into operation by using a call tester. Communication between the device and the call tester was established by air link.
The device output power was set to maximum power level for all tests; a fully charged battery was used for every test sequence.
In all operating bands the measurements were performed on middle channel, and few of them were also performed on lowest and highest channels.

4.3 SAR Measurement Set-up

The system is based on a high precision robot (working range greater than 0.9m), which positions the probes with a positional repeatability of better than ± 0.02mm. Special E-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines (length =300mm) to the data acquisition unit. A cell controller system contains the power supply, robot controller, teaches pendant (Joystick), and remote control, is used to drive the

robot motors.
The PC consists of the Micron Pentium IV computer with Win7 system and SAR Measurement Software DASY5 Professional, A/D interface card, monitor, mouse, and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot.
A data acquisition electronic (DAE) circuit performs the signal amplification; signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card. The DAE consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines.
The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection
The robot uses its own controller with a built in VME-bus computer.

4.4 Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin headed "SAM Phantom", manufactured by SPEAG. The phantom conforms to the requirements of IEEE 1528.
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.
The SPEAG device holder was used to position the device in all tests whilst a tripod was used to position the validation dipoles against the flat section of phantom.

4.5 Tissue Simulants

Recommended values for the dielectric parameters of the tissue simulants are given in IEEE 1528. All tests were carried out using simulants whose dielectric parameters were within ± 10% below 3GHz and ± 5% above 3GHz of the recommended values when use DASY system according to KDB865664D01. All tests were carried out within 24 hours of measuring the dielectric parameters.

Tissue Stimulant Recipes	
Name	Broadband tissue-equivalent liquid
Type	HBBL600-6000V6 Simulating Liquid
Note: The stimulant could be the same for head and body.	

4.6 DESCRIPTION OF THE TEST PROCEDURE

4.6.1 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the Dasy system.

Device holder supplied by SPEAG

4.6.2 Test Exposure Conditions

4.6.2.1 Head Configuration

Measurements were made in “cheek” and “tilt” positions on both the left hand and right-hand sides of the phantom.

The positions used in the measurements were according to IEEE 1528 "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques".

4.6.2.2 Body Worn Configuration

The device was placed in the SPEAG holder below the flat section of the phantom. The distance between the device and the phantom was kept at the separation distance using a separate flat spacer that was removed before the start of the measurements. And the distance is normally determined according to the actual scene which might be the worst use condition for general exposure. The device’s front and rear were oriented facing the phantom since these orientations give higher results for most regular portable devices.

4.6.2.3 Hotspot Configuration

Hotspot mode SAR is measured for all edges and surfaces of the device with a transmitting antenna located within 25 mm from that surface or edge; for the data modes, wireless technologies and frequency bands supporting hotspot mode.

4.6.3 Scan Procedure

First, area scans were used for determination of the field distribution and the approximate location of the local peak SAR values. The SAR distribution is scanned along the inside surface, at least for an area larger than the projection of the handset and antenna. The angle between the probe axis and the surface normal line is recommended but not required to be less than 30°. The SAR distribution is first measured on a 2-D coarse grid. The scan region should cover all areas that are exposed and encompassed by the projection of the handset. There are 15 mm × 15 mm (equal or less than 2GHz), 12 mm × 12 mm (from 2GHz~4GHz) and 10mm x 10mm (from 4GHz~6GHz) measurement grid used when two staggered one-dimensional cubic splines are used to estimate the maximum SAR location.

When the reported 1g-SAR estimated by area scan is less than 1.40 w/kg.

Zoom scan was performed by using the configuration mentioned below or more conservative scan area and step to determine the averaged SAR value. Drift was determined by measuring the same point at the start of the area scan and again at the end of the zoom scan.

Below 3GHz：32mmX32mmX30mm scan area with 8 mm X8 mm X5 mm steps

2GHz-3GHz：32mmX32mmX30mm scan area with 8 mm X8 mm X5 mm steps

3GHz-4GHz：28mmX28mmX28mm scan area with 7 mm X7 mm X4 mm steps

4GHz-5GHz： 25mmX25mmX24mm scan area with 5 mm X5 mm X3 mm steps

5GHz-6GHz： 25mmX25mmX22mm scan area with 5 mm X5 mm X2 mm steps

4.6.4 SAR Averaging Methods

The maximum SAR value was averaged over a cube of tissue using interpolation and extrapolation.

The interpolation, extrapolation and maximum search routines within DASY5 are all based on the modified Quadratic Shepard's method (Robert J. Renka, Multivariate Interpolation of Large Sets of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988, pp. 139-148).

The interpolation scheme combines a least-square fitted function method with a weighted average method. A triradiate 3-D / bivariate 2-D quadratic function is computed for each measurement point and fitted to neighboring points by a least-square method. For the zoom scan, inverse distance weighting is incorporated to fit distant points more accurately. The interpolating function is finally calculated as a weighted average of the quadratics.

In the zoom scan, the interpolation function is used to extrapolate the Peak SAR from the deepest measurement points to the inner surface of the phantom.

5 RESULT SUMMAR

The maximum reported SAR values for Limbs configuration are given as follows. The device conforms to the requirements of the standard(s) when the maximum reported SAR value is less than or equal to the limit.

Standalone Transmission Summary(10g- SAR)

Exposure Position	Frequency Band	SAR Result(W/kg)	Highest SAR Result(W/kg)	Limit(W/kg)	Result
Limbs(0mm)	LTE CAT-M 2	1.02	1.02	4.0	Pass
	LTE CAT-M 4	0.50			
	LTE Band 12	0.45			
	BT/BLE	0.02			
	WLAN 2.4GHz	0.28			

Simultaneous Transmission Summary(10g- SAR)

Exposure Position	Frequency Band	Highest SAR Result(W/kg)	Limit(W/kg)	Result
Limbs(0mm)	LTE CAT-M1 + Wi-Fi	1.19	4.0	Pass

This Test Report Is Approved by: Mr. Peng Zhen	Review by: Mr. Li Bin
Tested and issued by: Mr. Chang Tianyu	Approved date: 2020/09/14

6 TEST RESULT

6.1 Manufacturing Tolerance

Cat M

Note: RB allocation mentioned below is for all Bandwidths, and the Frequency Range are divided to 3 ranges (Low, Mid, High)

Band 2

BW	Modulation	RB allocation with different offset	Frequency range	Tolerance (dBm)
All Bandwidth	QPSK	1	Low	18.5~22.5
			Mid	
			High	
		50%	Low	18.0~22.0
			Mid	
			High	
		100%	Low	18.0~22.0
			Mid	
			High	
	16QAM	1	Low	18.0~22.0
			Mid	
			High	
		50%	Low	18.0~22.0
			Mid	
			High	

Band 4

BW	Modulation	RB allocation with different offset	Frequency range	Tolerance (dBm)
All Bandwidth	QPSK	1	Low	18.0~22.0
			Mid	
			High	
		50%	Low	18.0~22.0
			Mid	
			High	
		100%	Low	18.0~22.0
			Mid	
			High	
	16QAM	1	Low	18.5~22.5
			Mid	
			High	
		50%	Low	18.5~22.5
			Mid	
			High	

Band 12

BW	Modulation	RB allocation with different offset	Frequency range	Tolerance (dBm)
All Bandwidth	QPSK	1	Low	19.5~23.5
			Mid	
			High	
		50%	Low	19.0~23.0
			Mid	
			High	
		100%	Low	18.5~22.5
			Mid	
			High	
	16QAM	1	Low	19.5~23.5
			Mid	
			High	
		50%(or partial RB)	Low	19.0~23.0
			Mid	
			High	
			Mid	
			High	

Bluetooth (BLE)

Modulation type	Average Power Output (dBm)		
	2402MHz (Ch0)	2440MHz (Ch19)	2480MHz (Ch39)
GFSK (LE 1Mbps)	-4.5~-0.5		

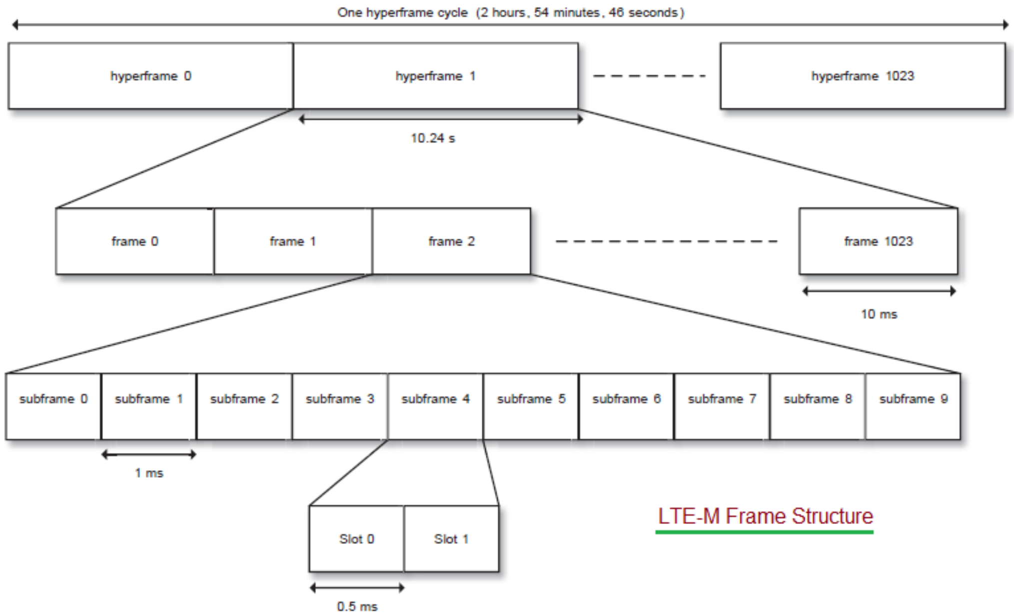
WLAN 2.4GHz

Modulation type	Tolerance (dBm)		
	2412MHz	2437MHz	2462MHz
11b	12.0~16.0		
11g	11.5~15.5		
11n HT20	11.5~15.5		

6.2 Measurement power

UE category M1 and M2 is designed to operate in the E-UTRA operating bands in both half duplex FDD mode and full-duplex FDD mode, as well as TDD mode. LTE-M follows 3GPP specifications similar to LTE technology. LTE-M Cat-0, Cat-M1 and Cat-M2 follow 3GPP TS 36 series of rel.12, rel.13 and rel.14 respectively.

The figure depicts LTE-M frame structure similar to LTE technology. One subframe duration is about 1ms. And the duty cycle is inherent as100%



LTE CAT-M Band 2

Modulation	Carrier frequency (MHz)	UL Channel	BW	RB Size	RB Offset	Conducted Power (dBm)
QPSK	1850.7	18607	1.4	1	0	21.45
				3	0	21.02
				6	0	19.44
	1880	18900		1	0	21.35
				3	0	20.67
				6	0	19.70
	1909.3	19193		1	0	21.99
				3	0	21.05
				6	0	19.80
16QAM	1850.7	18607	1.4	1	0	20.04
				1	5	20.14
				5	0	19.48
				5	1	19.85
	1880	18900		1	0	20.24
				1	5	20.38
				5	0	20.02
				5	1	20.06
	1909.3	19193		1	0	20.42
				1	5	20.51
				5	0	20.43
				5	1	20.29
QPSK	1851.7	18615	3	1	0	21.37
				3	0	20.39
				6	0	19.41
	1880	18900		1	0	21.19
				3	0	20.44
				6	0	19.68
	1908.5	19185		1	0	21.84
				3	0	20.81
				6	0	19.77
16QAM	1851.7	18615	3	1	0	20.01
				1	5	20.12
				5	0	19.39
				5	1	19.76
	1880	18900		1	0	20.18
				1	5	20.32
				5	0	20.00
				5	1	20.03
	1908.5	19185		1	0	20.37
				1	5	20.48
				5	0	20.32
				5	1	20.17

Modulation	Carrier frequency (MHz)	UL Channel	BW	RB Size	RB Offset	Conducted Power (dBm)
QPSK	1852.5	18625	5	1	0	21.78
				3	0	21.07
				6	0	20.36
	1880	18900		1	0	21.89
				3	0	21.36
				6	0	20.82
	1907.5	19175		1	0	21.93
				3	0	21.34
				6	0	20.75
16QAM	1852.5	18625	5	1	0	21.18
				1	5	21.19
				5	0	20.87
				5	1	20.79
	1880	18900		1	0	21.18
				1	5	21.47
				5	0	21.13
				5	1	21.02
	1907.5	19175		1	0	21.16
				1	5	21.48
				5	0	21.12
				5	1	21.21
QPSK	1855	18650	10	1	0	21.84
				3	0	21.16
				6	0	20.48
	1880	18900		1	0	21.94
				3	0	21.34
				6	0	20.74
	1905	19150		1	0	22.11
				3	0	21.43
				6	0	20.74
16QAM	1855	18650	10	1	0	21.20
				1	5	21.23
				5	0	20.98
				5	1	20.88
	1880	18900		1	0	21.19
				1	5	21.49
				5	0	21.21
				5	1	21.06
	1905	19150		1	0	21.25
				1	5	21.53
				5	0	21.18
				5	1	21.24

Modulation	Carrier frequency (MHz)	UL Channel	BW	RB Size	RB Offset	Conducted Power (dBm)
QPSK	1857.5	18675	15	1	0	21.48
				3	0	21.41
				6	0	21.34
	1880	18900		1	0	21.71
				3	0	21.56
				6	0	21.40
	1902.5	19125		1	0	21.80
				3	0	21.65
				6	0	21.50
16QAM	1857.5	18675	15	1	0	21.39
				1	5	21.32
				5	0	22.05
				5	1	21.91
	1880	18900		1	0	21.52
				1	5	21.54
				5	0	21.97
				5	1	21.53
	1902.5	19125		1	0	21.68
				1	5	21.64
				5	0	22.17
				5	1	22.16
QPSK	1860	18700	20	1	0	22.03
				3	0	21.62
				6	0	21.21
	1880	18900		1	0	21.59
				3	0	21.53
				6	0	21.47
	1900	19100		1	0	21.77
				3	0	21.80
				6	0	21.82
16QAM	1860	18700	20	1	0	21.11
				1	5	21.79
				5	0	21.93
				5	1	21.88
	1880	18900		1	0	21.55
				1	5	21.59
				5	0	22.06
				5	1	21.93
	1900	19100		1	0	22.11
				1	5	21.52
				5	0	22.17
				5	1	22.15

LTE CAT-M Band 4

Modulation	Carrier frequency (MHz)	UL Channel	BW	RB Size	RB Offset	Conducted Power (dBm)
QPSK	1710.5	19957	1.4	1	0	21.82
				3	0	20.75
				6	0	19.67
	1732.5	20175		1	0	21.61
				3	0	20.54
				6	0	19.47
	1754.3	20393		1	0	21.35
				3	0	20.30
				6	0	19.25
16QAM	1710.5	19957	1.4	1	0	20.23
				1	5	20.31
				5	0	20.01
				5	1	19.96
	1732.5	20175		1	0	20.07
				1	5	20.14
				5	0	19.86
				5	1	19.78
	1754.3	20393		1	0	19.86
				1	5	19.98
				5	0	19.67
				5	1	19.59
QPSK	1711.5	19965	3	1	0	21.79
				3	0	20.64
				6	0	19.48
	1732.5	20175		1	0	21.57
				3	0	20.47
				6	0	19.36
	1753.5	20385		1	0	21.31
				3	0	20.26
				6	0	19.21
16QAM	1711.5	19965	3	1	0	20.18
				1	5	20.23
				5	0	20.09
				5	1	20.03
	1732.5	20175		1	0	20.14
				1	5	20.26
				5	0	20.11
				5	1	20.08
	1753.5	20385		1	0	19.79
				1	5	19.88
				5	0	19.73
				5	1	19.64

Modulation	Carrier frequency (MHz)	UL Channel	BW	RB Size	RB Offset	Conducted Power (dBm)
QPSK	1712.5	19975	5	1	0	21.80
				3	0	21.69
				6	0	21.57
	1732.5	20175		1	0	21.68
				3	0	21.63
				6	0	21.58
	1752.5	20375		1	0	21.39
				3	0	21.32
				6	0	21.25
16QAM	1712.5	19975	5	1	0	21.46
				1	5	21.63
				5	0	21.70
				5	1	22.03
	1732.5	20175		1	0	21.84
				1	5	22.33
				5	0	22.08
				5	1	22.11
	1752.5	20375		1	0	21.14
				1	5	21.12
				5	0	21.54
				5	1	21.15
QPSK	1715	20000	10	1	0	21.77
				3	0	21.64
				6	0	21.51
	1732.5	20175		1	0	21.75
				3	0	21.70
				6	0	21.64
	1750	20350		1	0	21.42
				3	0	21.30
				6	0	21.17
16QAM	1715	20000	10	1	0	21.40
				1	5	21.64
				5	0	21.67
				5	1	22.07
	1732.5	20175		1	0	21.92
				1	5	22.30
				5	0	22.02
				5	1	22.12
	1750	20350		1	0	21.11
				1	5	21.06
				5	0	21.57
				5	1	21.09

Modulation	Carrier frequency (MHz)	UL Channel	BW	RB Size	RB Offset	Conducted Power (dBm)
QPSK	1717.5	20025	15	1	0	21.74
				3	0	21.61
				6	0	21.48
	1732.5	20175		1	0	21.69
				3	0	21.64
				6	0	21.58
	1747.5	20325		1	0	21.37
				3	0	21.28
				6	0	21.19
16QAM	1717.5	20025	15	1	0	21.52
				1	5	21.71
				5	0	21.73
				5	1	21.09
	1732.5	20175		1	0	21.97
				1	5	22.25
				5	0	22.07
				5	1	22.17
	1747.5	20325		1	0	21.16
				1	5	21.13
				5	0	21.46
				5	1	21.11
QPSK	1720	20050	20	1	0	21.86
				3	0	21.73
				6	0	21.59
	1732.5	20175		1	0	21.77
				3	0	21.72
				6	0	21.66
	1745	20300		1	0	21.43
				3	0	21.35
				6	0	21.26
16QAM	1720	20050	20	1	0	21.47
				1	5	21.71
				5	0	21.76
				5	1	22.10
	1732.5	20175		1	0	21.93
				1	5	22.37
				5	0	22.09
				5	1	22.13
	1745	20300		1	0	21.17
				1	5	21.14
				5	0	21.59
				5	1	21.16

LTE CAT-M Band 12

Modulation	Carrier frequency (MHz)	UL Channel	BW	RB Size	RB Offset	Conducted Power (dBm)
QPSK	699.7	23017	1.4	1	0	23.39
				3	0	22.33
				6	0	21.27
	707.5	23095		1	0	22.97
				3	0	22.16
				6	0	21.34
	715.3	23173		1	0	23.26
				3	0	22.27
				6	0	21.27
16QAM	699.7	23017	1.4	1	0	21.78
				1	5	21.89
				5	0	21.46
				5	1	21.62
	707.5	23095		1	0	21.83
				1	5	21.91
				5	0	21.53
				5	1	21.64
	715.3	23173		1	0	21.78
				1	5	21.88
				5	0	21.48
				5	1	21.60
QPSK	700.5	23025	3	1	0	23.36
				3	0	22.30
				6	0	21.23
	707.5	23095		1	0	22.96
				3	0	22.11
				6	0	21.25
	714.5	23165		1	0	23.21
				3	0	22.23
				6	0	21.24
16QAM	700.5	23025	3	1	0	21.77
				1	5	21.85
				5	0	21.44
				5	1	21.57
	707.5	23095		1	0	21.76
				1	5	21.85
				5	0	21.50
				5	1	21.59
	714.5	23165		1	0	21.72
				1	5	21.86
				5	0	21.41
				5	1	21.59

Modulation	Carrier frequency (MHz)	UL Channel	BW	RB Size	RB Offset	Conducted Power (dBm)
QPSK	701.5	23035	5	1	0	23.12
				3	0	22.69
				6	0	22.25
	707.5	23095		1	0	23.20
				3	0	22.72
				6	0	22.23
	713.5	23155		1	0	23.19
				3	0	22.74
				6	0	22.28
16QAM	701.5	23035	5	1	0	22.85
				1	5	23.12
				5	0	22.61
				5	1	22.85
	707.5	23095		1	0	22.98
				1	5	23.16
				5	0	22.62
				5	1	22.22
	713.5	23155		1	0	22.91
				1	5	23.03
				5	0	22.78
				5	1	22.14
QPSK	704	23060	10	1	0	23.21
				3	0	22.76
				6	0	22.30
	707.5	23095		1	0	23.22
				3	0	22.75
				6	0	22.28
	711	23130		1	0	23.27
				3	0	22.82
				6	0	22.37
16QAM	704	23060	10	1	0	22.90
				1	5	23.15
				5	0	22.70
				5	1	22.88
	707.5	23095		1	0	22.99
				1	5	23.17
				5	0	22.64
				5	1	22.27
	711	23130		1	0	22.98
				1	5	23.11
				5	0	22.79
				5	1	22.20

BLE

Modulation type	Average Power Output (dBm)		
	2402MHz (Ch0)	2440MHz (Ch19)	2480MHz (Ch39)
GFSK (LE 1Mbps)	-0.99	-1.23	-1.54
GFSK (LE 2Mbps)	-1.01	-1.24	-1.55

WIFI2.4GHz

Modulation type	Average power output (dBm)		
	2412MHz	2437MHz	2462MHz
11b	15.66	15.35	15.08
11g	15.12	14.86	14.62
11n HT20	15.01	14.72	14.46

6.3 Standalone SAR Test Exclusion Considerations

Standalone 1-g/10-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm

Mothod1:
According to the KDB447498 4.3.1 (1)

For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f (GHz)] ≤ 3.0 for 1-g SAR, where

·f(GHz) is the RF channel transmit frequency in GHz
·Power and distance are rounded to the nearest mW and mm before calculation
·The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

This is equivalent to [(max. power of channel, including tune-up tolerance, mW)/(60/√f(GHz) mW)] ·[20 mm/(min.test separation distance, mm)] ≤ 1.0 for 1-g SAR; also see Appendix A for approximate exclusion threshold values at selected frequencies and distances.

Mothod2:
According to the KDB447498 appendix A

Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table.

MHz	5	10	15	20	25	mm
150	39	77	116	155	194	*SAR Test Exclusion Threshold* (mW)
300	27	55	82	110	137	
450	22	45	67	89	112	
835	16	33	49	66	82	
900	16	32	47	63	79	
1500	12	24	37	49	61	
1900	11	22	33	44	54	
2450	10	19	29	38	48	
3600	8	16	24	32	40	
5200	7	13	20	26	33	
5400	6	13	19	26	32	
5800	6	12	19	25	31	

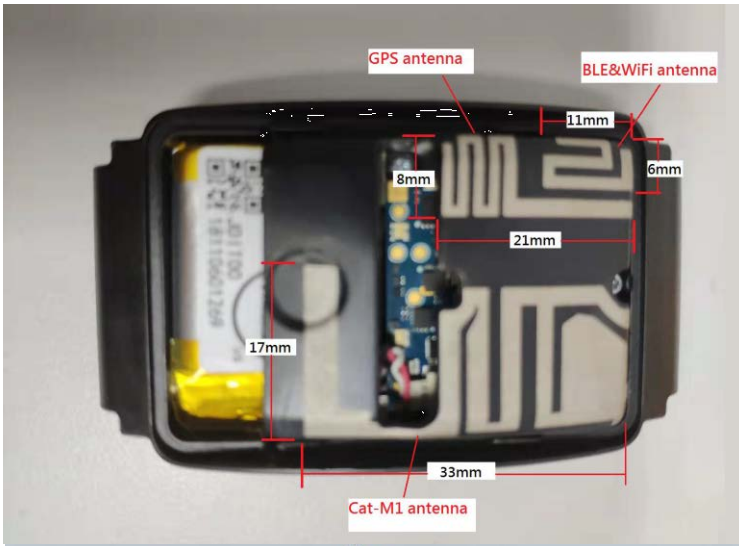
Note: **10-g Extremity SAR Test Exclusion Power Thresholds are 2.5 times higher than the 1-g SAR Test Exclusion Thresholds indicated above.** These thresholds do not apply, by extrapolation or other means, to occupational exposure limits.

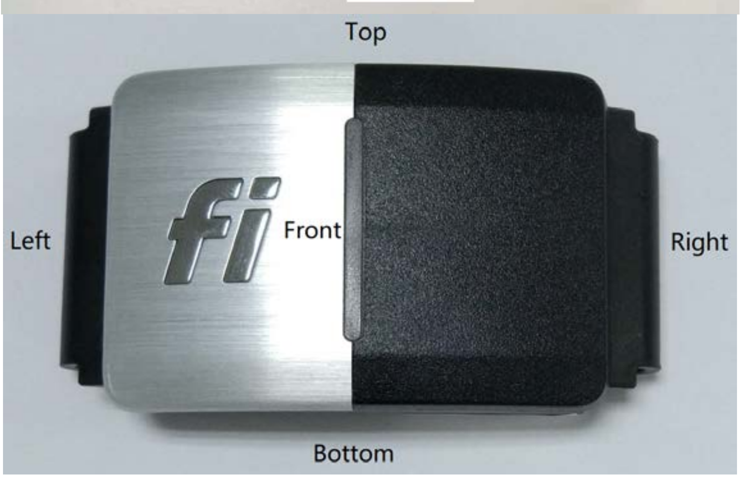
Summary of Transmitters

Band/Mode	Max conducted power adjusted for tune-up tolerance(mW)	Exposure condition	SAR test exclusion threshold (mW)	Standalone SAR Required
2.4GHz BT/BLE	0.89	Limbs	25	No
2.4GHz Wi-Fi	39.81	Limbs	25	Yes

6.4 RF exposure conditions

6.4.1 Antenna information





Band	Peak Gain
Cat- M1 B2	0.60dBi
Cat-M1 B4	-0.70dBi
Cat-M1 B12	-2.30dBi
GPS	2.08dBi
BLE/WiFi	2.35dBi

6.4.2 Limb Exposure conditions

For WWAN/LPWAN

Test Configurations	SAR Required	Note
Back	yes	/
Front	yes	/
Top	yes	/
Bottom	yes	/
Left	yes	/
Right	yes	/

For WLAN

Test Configurations	SAR Required	Note
Back	yes	/
Front	yes	/
Top	yes	/
Bottom	yes	/
Left	yes	/
Right	yes	/

For BT/BLE

Test Configurations	Estimated SAR	Note
Back	Yes	Excluded from SAR test
Front	Yes	
Top	yes	
Bottom	yes	
Left	yes	
Right	yes	

6.5 System Checking

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulants were measured every day using the dielectric probe kit and the network analyser.

For the measurement of the following parameters the SPEAG DAKS-3.5 dielectric parameter probe is used, representing the open-ended coaxial probe measurement procedure.

Date Tested	Freq. (MHz)	Liquid parameters	measured	Target	Delta (%)	Tolerance (%)
2020.08.28	750	εr	41.352	41.9	-1.31	±10
		σ[S/m]	0.923	0.89	3.71	±10
2020.08.31	1800	εr	40.688	40.0	1.72	±10
		σ[S/m]	1.418	1.40	1.29	±10
2020.09.02	2000	εr	39.844	40.0	-0.39	±10
		σ[S/m]	1.427	1.40	1.93	±10
2020.09.04	2450	εr	38.343	39.2	-2.19	±10
		σ[S/m]	1.866	1.80	3.67	±10

Note: For DASY system, the conservative tolerance 5% could expand to 10% when the frequency under 3GHz

A system check measurement was made following once the determination of the dielectric parameters of the simulant, using the dipole validation kit. The system checking results (dielectric parameters and SAR values) are given in the table below.

Date Tested	System dipole	SAR measured (normalized to 1W)		Target (Ref. Value)	Delta (%)	Tolerance (%)
2020.08.28	D750V3	10g	5.8	5.39	7.61	±10
2020.08.31	D1800V2	10g	19.88	20.4	-2.55	±10
2020.09.02	D2000V2	10g	19.84	20.5	-3.22	±10
2020.09.04	D2450V2	10g	24.56	24.4	0.66	±10

6.6 SAR TEST RESULT

In order to determine the largest value of the peak spatial-average SAR of a handset, all device positions, configurations, and operational modes should be tested for each frequency band according to Steps 1 to 3 below.
Step 1: The tests should be performed at the channel that is closest to the center of the transmit frequency band.
a) All device positions (cheek and tilt, for both left and right sides of the SAM phantom),
b) All configurations for each device position in a), e.g., antenna extended and retracted, and
c) All operational modes for each device position in item a) and configuration in item b) in each frequency band, e.g., analog and digital, If more than three frequencies need to be tested (i.e., Nc > 3), then all frequencies, configurations and modes shall be tested for all of the above test conditions.
Step 2: For the condition providing the highest peak spatial-average SAR determined in Step 1 for each frequency, perform all tests at all other test frequency channels, e.g., lowest and highest frequencies. In addition, for all other conditions (device position, configuration, and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies should be tested as well.
Step 3: Examine all data to determine the largest value of the peak.
Note:
1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
Scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
Duty Factor = 1 / Duty Cycle(%)
For cellular network:
Reported SAR (W/kg) = Measured SAR (W/kg) * Scaling Factor
For WLAN
Reported SAR (W/kg) = Measured SAR (W/kg) * Scaling Factor*Duty factor .
2. The distance between the EUT and the phantom bottom is 0mm.

The measured and reported limb SAR values for the test device are tabulated below:
Mode: Cat.M Band 2

L:1860MHz M:1880 MHz H:1900MHz

SAR Values Limit of SAR (W/kg): 4.0W/kg (10g Average)

Test case			Meas power(dBm)	Tune-up(dBm)	Scaling factor	Meas SAR(w/kg)		Report SAR(w/kg)	
Mode	Position	Channel				First	Second	First	Second
QPSK 1RB	Back	L	22.03	22.50	1.11	---	---	---	---
		M	21.59	22.50	1.23	0.252	---	0.310	---
		H	21.77	22.50	1.18	---	---	---	---
	Front	L	22.03	22.50	1.11	---	---	---	---
		M	21.59	22.50	1.23	0.481	---	0.592	---
		H	21.77	22.50	1.18	---	---	---	---
	Top	L	22.03	22.50	1.11	---	---	---	---
		M	21.59	22.50	1.23	0.166	---	0.204	---
		H	21.77	22.50	1.18	---	---	---	---
	Bottom	L	22.03	22.50	1.11	0.918	---	1.019	---
		M	21.59	22.50	1.23	0.826	---	1.016	---
		H	21.77	22.50	1.18	0.823	---	0.971	---
	Left	L	22.03	22.50	1.11	---	---	---	---
		M	21.59	22.50	1.23	0.025	---	0.031	---
		H	21.77	22.50	1.18	---	---	---	---
	Right	L	22.03	22.50	1.11	---	---	---	---
		M	21.59	22.50	1.23	0.075	---	0.092	---
		H	21.77	22.50	1.18	---	---	---	---
QPSK 50%RB	Back	L	21.62	22.00	1.09	---	---	---	---
		M	21.53	22.00	1.11	0.226	---	0.251	---
		H	21.80	22.00	1.05	---	---	---	---
	Front	L	21.62	22.00	1.09	---	---	---	---
		M	21.53	22.00	1.11	0.456	---	0.506	---
		H	21.80	22.00	1.05	---	---	---	---
	Top	L	21.62	22.00	1.09	---	---	---	---
		M	21.53	22.00	1.11	0.134	---	0.149	---
		H	21.80	22.00	1.05	---	---	---	---
	Bottom	L	21.62	22.00	1.09	---	---	---	---
		M	21.53	22.00	1.11	0.852	---	0.946	---
		H	21.80	22.00	1.05	---	---	---	---
	Left	L	21.62	22.00	1.09	---	---	---	---
		M	21.53	22.00	1.11	0.012	---	0.013	---
		H	21.80	22.00	1.05	---	---	---	---
	Right	L	21.62	22.00	1.09	---	---	---	---
		M	21.53	22.00	1.11	0.049	---	0.055	---
		H	21.80	22.00	1.05	---	---	---	---

Mode: Cat.M Band 4

L:1720MHz M:1732.5 MHz H:1745MHz

SAR Values Limit of SAR (W/kg): 4.0W/kg (10g Average)

Test case			Meas power(dBm)	Tune-up(dBm)	Scaling factor	Meas SAR(w/kg)		Report SAR(w/kg)	
Mode	Position	Channel				First	Second	First	Second
QPSK 1RB	Back	L	21.86	22.00	1.03	---	---	---	---
		M	21.77	22.00	1.05	0.288		0.302	---
		H	21.43	22.00	1.14	---	---	---	---
	Front	L	21.86	22.00	1.03	---	---	---	---
		M	21.77	22.00	1.05	0.446		0.468	---
		H	21.43	22.00	1.14	---	---	---	---
	Top	L	21.86	22.00	1.03	---	---	---	---
		M	21.77	22.00	1.05	0.112		0.118	---
		H	21.43	22.00	1.14	---	---	---	---
	Bottom	L	21.86	22.00	1.03	---	---	---	---
		M	21.77	22.00	1.05	0.178		0.187	---
		H	21.43	22.00	1.14	---	---	---	---
	Left	L	21.86	22.00	1.03	---	---	---	---
		M	21.77	22.00	1.05	0.058		0.061	---
		H	21.43	22.00	1.14	---	---	---	---
	Right	L	21.86	22.00	1.03	---	---	---	---
		M	21.77	22.00	1.05	0.257		0.270	---
		H	21.43	22.00	1.14	---	---	---	---
QPSK 50%RB	Back	L	21.73	22.00	1.06	---	---	---	---
		M	21.72	22.00	1.07	0.272		0.291	---
		H	21.35	22.00	1.16	---	---	---	---
	Front	L	21.73	22.00	1.06	---	---	---	---
		M	21.72	22.00	1.07	0.429		0.459	---
		H	21.35	22.00	1.16	---	---	---	---
	Top	L	21.73	22.00	1.06	---	---	---	---
		M	21.72	22.00	1.07	0.091		0.097	---
		H	21.35	22.00	1.16	---	---	---	---
	Bottom	L	21.73	22.00	1.06	---	---	---	---
		M	21.72	22.00	1.07	0.163		0.174	---
		H	21.35	22.00	1.16	---	---	---	---
	Left	L	21.73	22.00	1.06	---	---	---	---
		M	21.72	22.00	1.07	0.052		0.056	---
		H	21.35	22.00	1.16	---	---	---	---
	Right	L	21.73	22.00	1.06	---	---	---	---
		M	21.72	22.00	1.07	0.233		0.249	---
		H	21.35	22.00	1.16	---	---	---	---
16QAM 1RB	Back	L	21.71	22.50	1.20	---	---	---	---
		M	22.37	22.50	1.03	0.302	---	0.311	---
		H	21.17	22.50	1.36	---	---	---	---

	Front	L	21.71	22.50	1.20	---	---	---	---
		M	22.37	22.50	1.03	0.488	---	0.503	---
		H	21.17	22.50	1.36	---	---	---	---
	Top	L	21.71	22.50	1.20	---	---	---	---
		M	22.37	22.50	1.03	0.152	---	0.157	---
		H	21.17	22.50	1.36	---	---	---	---
	Bottom	L	21.71	22.50	1.20	---	---	---	---
		M	22.37	22.50	1.03	0.203	---	0.209	---
		H	21.17	22.50	1.36	---	---	---	---
	Left	L	21.71	22.50	1.20	---	---	---	---
		M	22.37	22.50	1.03	0.082	---	0.084	---
		H	21.17	22.50	1.36	---	---	---	---
	Right	L	21.71	22.50	1.20	---	---	---	---
		M	22.37	22.50	1.03	0.287	---	0.296	---
		H	21.17	22.50	1.36	---	---	---	---

Note: power (16QAM) minus power(QPSK) is higher than 0.5db, so 16QAM need to be considered.

Mode: Cat.M Band 12

L:704MHz M:707.5 MHz H:711MHz

SAR Values Limit of SAR (W/kg): 4.0W/kg (10g Average)

Test case			Meas power(dBm)	Tune-up(dBm)	Scaling factor	Meas SAR(w/kg)		Report SAR(w/kg)	
Mode	Position	Channel				First	Second	First	Second
QPSK 1RB	Back	L	23.21	23.50	1.07	---	---	---	---
		M	23.22	23.50	1.07	0.422	---	0.452	---
		H	23.27	23.50	1.05	---	---	---	---
	Front	L	23.21	23.50	1.07	---	---	---	---
		M	23.22	23.50	1.07	0.107	---	0.114	---
		H	23.27	23.50	1.05	---	---	---	---
	Top	L	23.21	23.50	1.07	---	---	---	---
		M	23.22	23.50	1.07	0.203	---	0.217	---
		H	23.27	23.50	1.05	---	---	---	---
	Bottom	L	23.21	23.50	1.07	---	---	---	---
		M	23.22	23.50	1.07	0.212	---	0.227	---
		H	23.27	23.50	1.05	---	---	---	---
	Left	L	23.21	23.50	1.07	---	---	---	---
		M	23.22	23.50	1.07	0.021	---	0.022	---
		H	23.27	23.50	1.05	---	---	---	---
	Right	L	23.21	23.50	1.07	---	---	---	---
		M	23.22	23.50	1.07	0.199	---	0.213	---
		H	23.27	23.50	1.05	---	---	---	---
QPSK 50%RB	Back	L	22.76	23.00	1.06	---	---	---	---
		M	22.75	23.00	1.06	0.401	---	0.425	---
		H	22.82	23.00	1.04	---	---	---	---
	Front	L	22.76	23.00	1.06	---	---	---	---
		M	22.75	23.00	1.06	0.085	---	0.090	---
		H	22.82	23.00	1.04	---	---	---	---
	Top	L	22.76	23.00	1.06	---	---	---	---
		M	22.75	23.00	1.06	0.177	---	---	---
		H	22.82	23.00	1.04	---	---	---	---
	Bottom	L	22.76	23.00	1.06	---	---	---	---
		M	22.75	23.00	1.06	0.192	---	0.204	---
		H	22.82	23.00	1.04	---	---	---	---
	Left	L	22.76	23.00	1.06	---	---	---	---
		M	22.75	23.00	1.06	0.016	---	0.017	---
		H	22.82	23.00	1.04	---	---	---	---
	Right	L	22.76	23.00	1.06	---	---	---	---
		M	22.75	23.00	1.06	0.162	---	0.172	---
		H	22.82	23.00	1.04	---	---	---	---

Mode: BT

SAR Values Limit of SAR (W/kg): 4.0W/kg (10g Average)

MAX power(dBm)	Limbs SAR(w/kg)
-0.5	0.015

- *(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)*]·[$\sqrt{f_{(GHz)}}/x$] W/kg for *test separation distances* ≤ 50 mm;
  where $x = 7.5$ for 1-g SAR, and $x = 18.75$ for 10-g SAR.

Mode: Wi-Fi 2.4GHz

fL (MHz)=2412MHz fM (MHz)=2437MHz fH (MHz)= 2462MHz

SAR Values Limit of SAR (W/kg): 4.0W/kg (10g Average)

Test case			Meas power(dBm)	Tune-up (dBm)	Scaling factor	Duty factor	Meas SAR(w/kg)		Report SAR(w/kg)	
Mode	Position	Channel					First	Second	First	Second
802.11b	Back	L	15.66	16.00	1.08	1.03	---	---	---	---
		M	15.35	16.00	1.16	1.03	0.168	---	0.200	---
		H	15.08	16.00	1.24	1.03	---	---	---	---
	Front	L	15.66	16.00	1.08	1.03	---	---	---	---
		M	15.35	16.00	1.16	1.03	0.231	---	0.275	---
		H	15.08	16.00	1.24	1.03	---	---	---	---
	Top	L	15.66	16.00	1.08	1.03	---	---	---	---
		M	15.35	16.00	1.16	1.03	0.212	---	0.253	---
		H	15.08	16.00	1.24	1.03	---	---	---	---
	Bottom	L	15.66	16.00	1.08	1.03	---	---	---	---
		M	15.35	16.00	1.16	1.03	0.140	---	0.167	---
		H	15.08	16.00	1.24	1.03	---	---	---	---
	Left	L	15.66	16.00	1.08	1.03	---	---	---	---
		M	15.35	16.00	1.16	1.03	0.026	---	0.031	---
		H	15.08	16.00	1.24	1.03	---	---	---	---
	Right	L	15.66	16.00	1.08	1.03	---	---	---	---
		M	15.35	16.00	1.16	1.03	0.120	---	0.143	---
		H	15.08	16.00	1.24	1.03	---	---	---	---

Note: The duty cycle of 802.11b is 97.33%, so the duty factor is approximate 1.03.

6.7 SAR Measurement Variability

SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.

The Highest Reported/Estimated SAR configuration in Each Frequency Band

Frequency band	Air interface	Limbs(w/kg)
750 MHz	Cat M BAND12	<4.0
1800/1900 MHz	Cat M BAND2 Cat M BAND4	<4.0
2450MHz	WIFI2.4GHz BLE	<4.0

6.8 Simultaneous Transmission SAR Analysis

Antenna numbers of Simultaneous Transmission	Antennas of Simultaneous Transmission	Simultaneous Transmission Modes
2	MAIN ANT+ WLAN/BT ANT	LTE CAT M+ WIFI 2.4GHz LTE CAT M +BT

Limbs exposure

Position of worst case	Licensed band	Unlicensed band	Simultaneous SAR(w/kg)
Bottom	LTE CAT-M1 Band2	WIFI 2.4GHz	1.19

According to the above tables, all the exposure condition of SAR values＜4.0W/kg.

7 MEASUREMENT UNCERTAINTY

(0.3 - 3 GHz range)

Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.0 %	N	1	1	1	±6.0 %	±6.0 %	∞
Axial Isotropy	±4.7 %	R	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	∞
Boundary Effects	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Linearity	±4.7 %	R	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
System Detection Limits	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Modulation Response^m	±2.4 %	R	$\sqrt{3}$	1	1	±1.4 %	±1.4 %	∞
Readout Electronics	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
Response Time	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	$\sqrt{3}$	1	1	±1.5 %	±1.5 %	∞
RF Ambient Noise	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
RF Ambient Reflections	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.4 %	R	$\sqrt{3}$	1	1	±0.2 %	±0.2 %	∞
Probe Positioning	±2.9 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Max. SAR Eval.	±2.0 %	R	$\sqrt{3}$	1	1	±1.2 %	±1.2 %	∞
Test Sample Related								
Device Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Power Drift	±5.0 %	R	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Power Scaling^p	±0 %	R	$\sqrt{3}$	1	1	±0.0 %	±0.0 %	∞
Phantom and Setup								
Phantom Uncertainty	±6.1 %	R	$\sqrt{3}$	1	1	±3.5 %	±3.5 %	∞
SAR correction	±1.9 %	R	$\sqrt{3}$	1	0.84	±1.1 %	±0.9 %	∞
Liquid Conductivity (mea.)^{DAK}	±2.5 %	R	$\sqrt{3}$	0.78	0.71	±1.1 %	±1.0 %	∞
Liquid Permittivity (mea.) ^{DAK}	±2.5 %	R	$\sqrt{3}$	0.26	0.26	±0.3 %	±0.4 %	∞
Temp. unc. - Conductivity ^{BB}	±3.4 %	R	$\sqrt{3}$	0.78	0.71	±1.5 %	±1.4 %	∞
Temp. unc. - Permittivity ^{BB}	±0.4 %	R	$\sqrt{3}$	0.23	0.26	±0.1 %	±0.1 %	∞
Combined Std. Uncertainty						±11.2 %	±11.1 %	361
Expanded STD Uncertainty						**±22.3 %**	**±22.2 %**	

(3 - 6 GHz range)

Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.55 %	N	1	1	1	±6.55 %	±6.55 %	∞
Axial Isotropy	±4.7 %	R	$\sqrt{3}$	0.7	0.7	±1.9 %	±1.9 %	∞
Hemispherical Isotropy	±9.6 %	R	$\sqrt{3}$	0.7	0.7	±3.9 %	±3.9 %	∞
Boundary Effects	±2.0 %	R	$\sqrt{3}$	1	1	±1.2 %	±1.2 %	∞
Linearity	±4.7 %	R	$\sqrt{3}$	1	1	±2.7 %	±2.7 %	∞
System Detection Limits	±1.0 %	R	$\sqrt{3}$	1	1	±0.6 %	±0.6 %	∞
Modulation Response^m	±2.4 %	R	$\sqrt{3}$	1	1	±1.4 %	±1.4 %	∞
Readout Electronics	±0.3 %	N	1	1	1	±0.3 %	±0.3 %	∞
Response Time	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Integration Time	±2.6 %	R	$\sqrt{3}$	1	1	±1.5 %	±1.5 %	∞
RF Ambient Noise	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
RF Ambient Reflections	±3.0 %	R	$\sqrt{3}$	1	1	±1.7 %	±1.7 %	∞
Probe Positioner	±0.8 %	R	$\sqrt{3}$	1	1	±0.5 %	±0.5 %	∞
Probe Positioning	±6.7 %	R	$\sqrt{3}$	1	1	±3.9 %	±3.9 %	∞
Max. SAR Eval.	±4.0 %	R	$\sqrt{3}$	1	1	±2.3 %	±2.3 %	∞
Test Sample Related								
Device Positioning	±2.9 %	N	1	1	1	±2.9 %	±2.9 %	145
Device Holder	±3.6 %	N	1	1	1	±3.6 %	±3.6 %	5
Power Drift	±5.0 %	R	$\sqrt{3}$	1	1	±2.9 %	±2.9 %	∞
Power Scaling^p	±0 %	R	$\sqrt{3}$	1	1	±0.0 %	±0.0 %	∞
Phantom and Setup								
Phantom Uncertainty	±6.6 %	R	$\sqrt{3}$	1	1	±3.8 %	±3.8 %	∞
SAR correction	±1.9 %	R	$\sqrt{3}$	1	0.84	±1.1 %	±0.9 %	∞
Liquid Conductivity (mea.)^{DAK}	±2.5 %	R	$\sqrt{3}$	0.78	0.71	±1.1 %	±1.0 %	∞
Liquid Permittivity (mea.) ^{DAK}	±2.5 %	R	$\sqrt{3}$	0.26	0.26	±0.3 %	±0.4 %	∞
Temp. unc. - Conductivity ^{BB}	±3.4 %	R	$\sqrt{3}$	0.78	0.71	±1.5 %	±1.4 %	∞
Temp. unc. - Permittivity ^{BB}	±0.4 %	R	$\sqrt{3}$	0.23	0.26	±0.1 %	±0.1 %	∞
Combined Std. Uncertainty						±12.3 %	±12.2 %	748
Expanded STD Uncertainty						**±24.6 %**	**±24.5 %**	

8 TEST EQUIPMENTS

The measurements were performed using an automated near-field scanning system, DASY5, manufactured by Schmid & Partner Engineering AG (SPEAG) in Switzerland. The SAR extrapolation algorithm used in all measurements was the 'advanced extrapolation' algorithm.

The following table lists calibration dates of SPEAG components:

Test Equipment	Model	Serial Number	Calibration date	Calibration Due data
DAE	DAE4	720	2019.10.02	2020.10.01
Dosimetric E-field Probe	ES3DV3	3708	2019.09.26	2020.09.25
Dipole Validation Kit	D750V3	4d023	2017.09.13	2020.09.12
Dipole Validation Kit	D1800V2	2d084	2017.09.15	2020.09.14
Dipole Validation Kit	D2000V2	1009	2018.02.01	2021.01.31
Dipole Validation Kit	D2450V2	738	2017.09.18	2020.09.17

Additional test equipment used in testing:

Test Equipment	Model	Serial Number	Calibration date	Calibration Due data
Signal Generator	E4428C	MY45280865	2020.08.20	2021.08.19
Signal Generator	SML 03	103514	2020.08.20	2021.08.19
Power meter	E4417A	MY45101182	2020.08.20	2021.08.19
Power Sensor	E4412A	MY41502214	2020.08.20	2021.08.19
Power Sensor	E4412A	MY41502130	2020.08.20	2021.08.19
Power meter	E4417A	MY45101004	2020.08.20	2021.08.19
Power Sensor	E9300B	MY41496001	2020.08.20	2021.08.19
Power Sensor	E9300B	MY41496003	2020.08.20	2021.08.19
Communication Tester	E5515C	MY48367401	2020.08.20	2021.08.19
Communication Tester	CMW500	114666	2020.08.20	2021.08.19
Vector Network Analyzer	VNA R140	0011213	2019.09.18	2020.09.17
Dielectric Parameter Probe	DAKS-3.5	1042	2019.09.17	2020.09.16

Software	Version
DASY	52.10.2.1495
SEMCAD X	14.6.12
DAK	2.4.1.114

Detailed information of Isotropic E-field Probe Type ES3DV3

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Calibration certificate in Appendix C
Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)
Optical Surface Detection	± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm
Dynamic Range	5 µW/g to > 100 W/kg; Linearity: ± 0.2 dB
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones

Detailed information of Isotropic E-field Probe Type EX3DV4

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Calibration certificate in Appendix C
Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Optical Surface Detection	± 0.3 mm repeatability in air and clear liquids over diffuse reflecting surfaces
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Dynamic Range	10 µW/g to > 100 W/kg Linearity: ± 0.2 dB (noise: typically < 1 µW/g)
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

According to KDB 865664 D01 section 3.2.2, instead of the typical annual calibration recommended by measurement standards, longer calibration intervals of up to three years may be considered when it is demonstrated that the **SAR target**, **impedance** and **return loss** of a dipole have remain stable according to the following requirements.
1) The test laboratory must ensure that the required supporting information and documentation are included in the SAR report to qualify for the three-year extended calibration interval; otherwise, the IEEE Std 1528-2013 recommended annual calibration applies.
2) Immediate re-calibration is required for the following conditions.
a) After a dipole is damaged and properly repaired to meet required specifications.
b) When the measured SAR deviates from the calibrated SAR value by more than 10% due to changes in physical, mechanical, electrical or other relevant dipole conditions; i.e., the error is not introduced by incorrect measurement procedures or other issues relating to the SAR measurement system.
c) When the most recent return-loss result, measured at least annually, deviates by more than 20% from the previous measurement (i.e. value in dB×0.2) or not meeting the required 20 dB minimum return-loss requirement.
d) When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than 5 Ω from the previous measurement.

Dipole 750

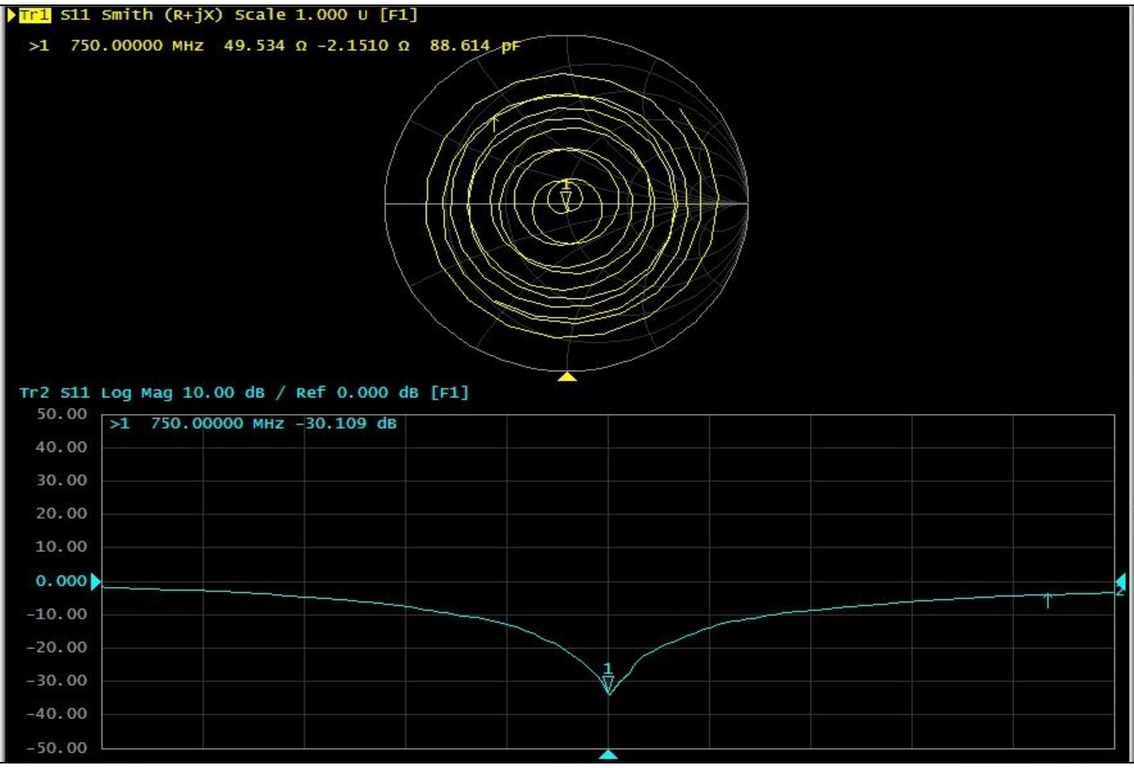
SAR target

Refers to system check, measured SAR (1g and 10g) deviates from the Target SAR value of calibration report within 10%.

Impedance and Return loss measured by Network analyzer

The most recent measurement of the real or imaginary parts of the impedance, deviates within 5 Ω from the previous measurement. (Data from the last calibration report)
The most recent return-loss result deviates within 20% from the previous measurement. (Data from the last calibration report)

Head TSL Parameters			
Parameters	Target (Ref. Value)	Measured data	Deviation
Impedance	53.9Ω+0.24jΩ	49.5Ω-2.15jΩ	<5Ω
Return loss	-28.4dB	-29.8dB	<20%



Head TSL Parameters

Dipole1800

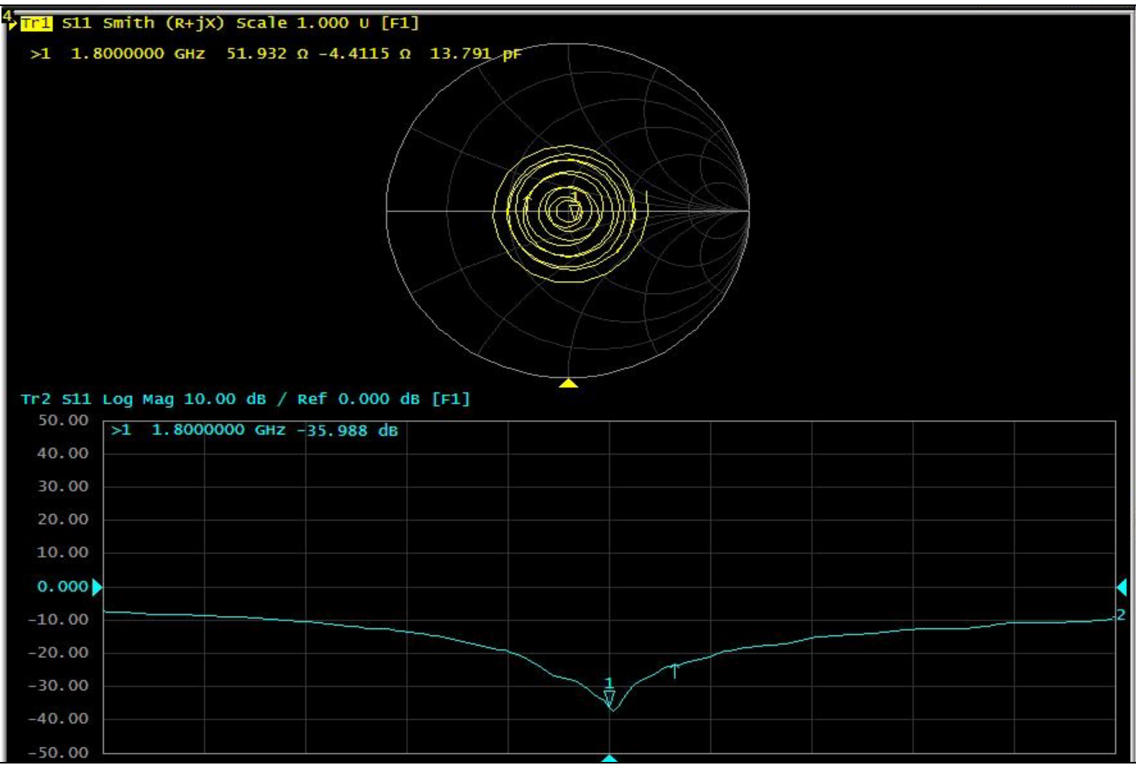
SAR target

Refers to system check, measured SAR (1g and 10g) deviates from the Target SAR value of calibration report within 10%.

Impedance and Return loss measured by Network analyzer

The most recent measurement of the real or imaginary parts of the impedance, deviates within 5 Ω from the previous measurement. (Data from the last calibration report)
The most recent return-loss result deviates within 20% from the previous measurement. (Data from the last calibration report)

TSL Parameters			
Parameters	Target (Ref. Value)	Measured data	Deviation
Impedance	49.3Ω-1.55jΩ	51.9Ω-4.41jΩ	<5Ω
Return loss	-35.4 dB	-36.0dB	<20%



TSL Parameters

Dipole2000

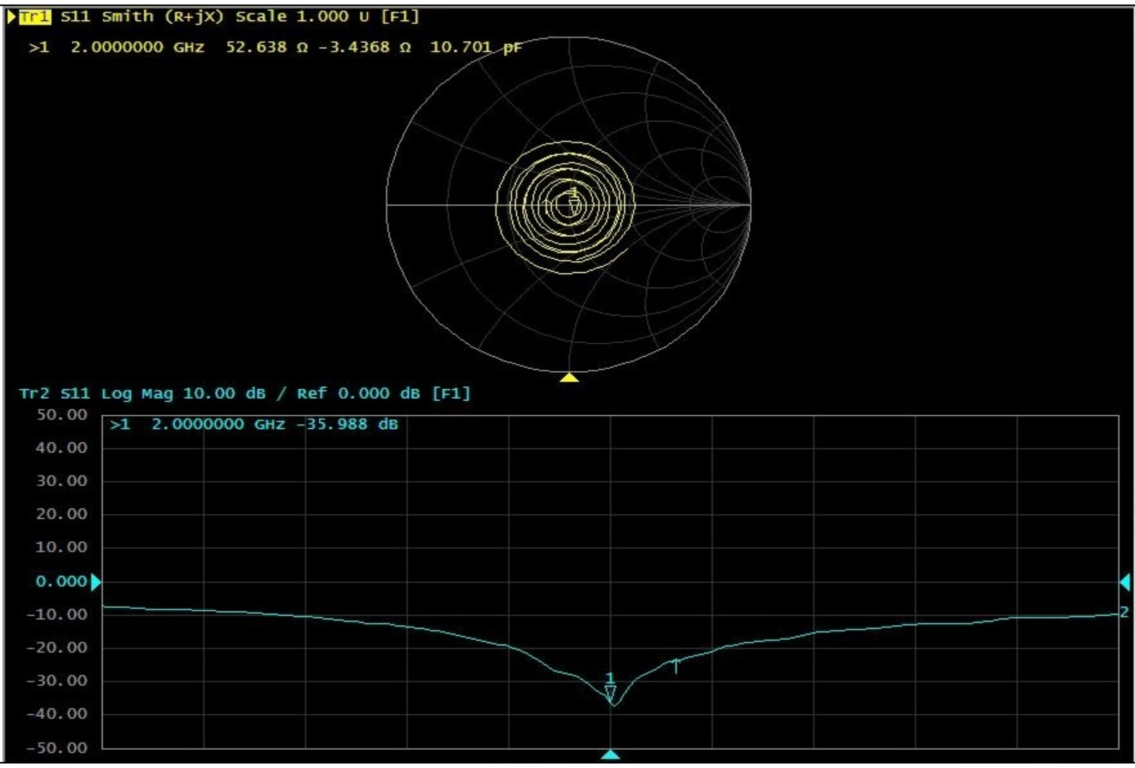
SAR target

Refers to system check, measured SAR (1g and 10g) deviates from the Target SAR value of calibration report within 10%.

Impedance and Return loss measured by Network analyzer

The most recent measurement of the real or imaginary parts of the impedance, deviates within 5 Ω from the previous measurement. (Data from the last calibration report)
The most recent return-loss result deviates within 20% from the previous measurement. (Data from the last calibration report)

TSL Parameters			
Parameters	Target (Ref. Value)	Measured data	Deviation
Impedance	49.8Ω-2.08jΩ	52.6Ω-3.44jΩ	<5Ω
Return loss	-33.6dB	-36.0dB	<20%



TSL Parameters

Dipole2450

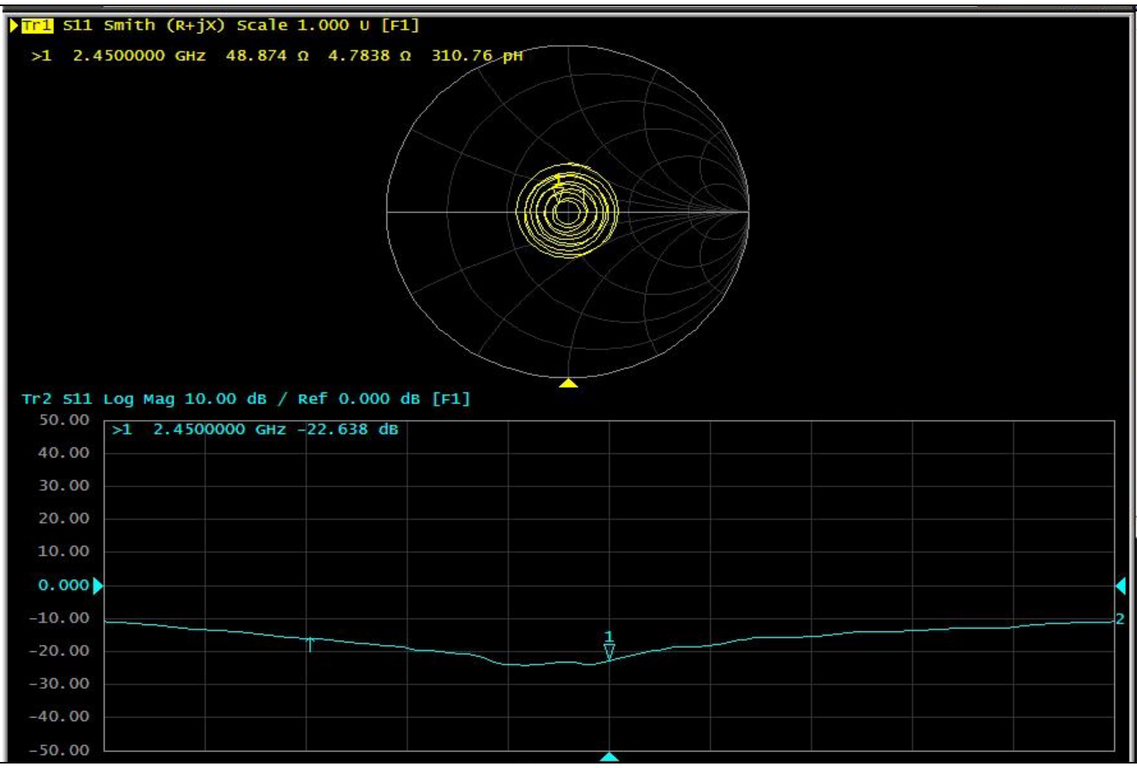
SAR target

Refers to system check, measured SAR (1g and 10g) deviates from the Target SAR value of calibration report within 10%.

Impedance and Return loss measured by Network analyzer

The most recent measurement of the real or imaginary parts of the impedance deviates within 5 Ω from the previous measurement. (Data from the last calibration report)
The most recent return-loss result deviates within 20% from the previous measurement. (Data from the last calibration report)

TSL Parameters			
Parameters	Target (Ref. Value)	Measured data	Deviation
Impedance	51.3Ω+5.92jΩ	48.9Ω+4.78jΩ	<5Ω
Return loss	-24.5 dB	-22.6dB	<20%



TSL Parameters

ANNEX A – TEST PLOTS

Please refer to the attachment.

ANNEX B – RELEVANT PAGES FROM CALIBRATION REPORTS

Please refer to the attachment.