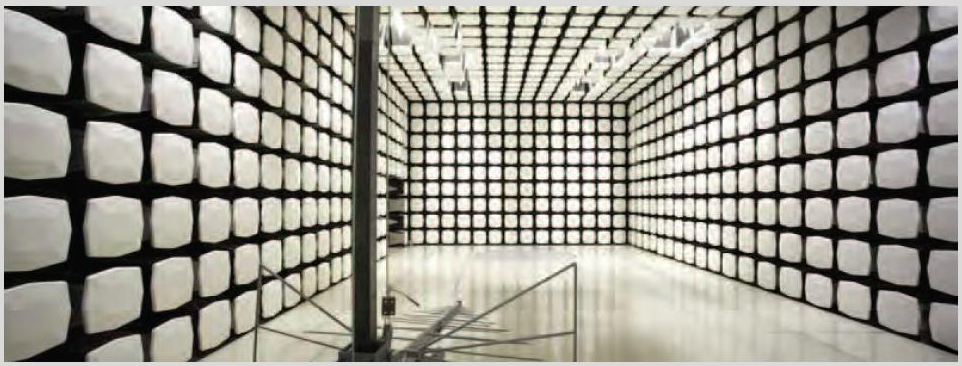
Element Materials Technology

Smart Connected Hub

SAR Evaluation Report # ELEM0093.3

Evaluated to the following SAR specification:

FCC 2.1093:2020



NVLAP Lab Code: 200881-0

CERTIFICATE OF TEST

Last Date of Test: January 25, 2020
Element Materials Technology
EUT: Smart Connected Hub

Applicable Standard

Test Description	Specification	Test Method	Pass/Fail
SAR Evaluation	FCC 15.247:2020 FCC 2.1093:2020	FCC KDB 865664 D01 v01r04 FCC KDB 865664 D02 v01r02 FCC KDB 248227 D01 V02r02 FCC KDB 447498 D01 v06 FCC KDB 941225 D05 v02r05 FCC KDB 941225 D01 v03r01 IEEE Std 1528:2013	Pass

Highest SAR Values:

Radio	Frequency Band	Body (W/kg) 1g	Limit (W/kg) 1g	Exposure Environment
Cellular	850 (GSM)	0.98	1.6	General Population
Cellular	1900 (PCS)	0.29	1.6	
Cellular	LTE Band 2	0.06	1.6	
Cellular	LTE Band 4	0.21	1.6	
Cellular	LTE Band 5	0.12	1.6	
Cellular	LTE Band 12	0.12	1.6	
802.11bgn	2.4 GHz ISM	0.02	1.6	

Highest Simultaneous Transmission Values:

Radios	Combined Body (W/kg) 1g	Limit (W/kg) 1g	Exposure Environment
Cellular, Bluetooth, NFC	1.04	1.6	General Population
Cellular, Bluetooth Low Energy, NFC	1.04	1.6	
Cellular, 802.11bgn, NFC	1.00	1.6	

Deviations From Test Standards

None

Approved By:

Don Facteau, Systems Architect

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		

ACCREDITATIONS AND AUTHORIZATIONS

United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

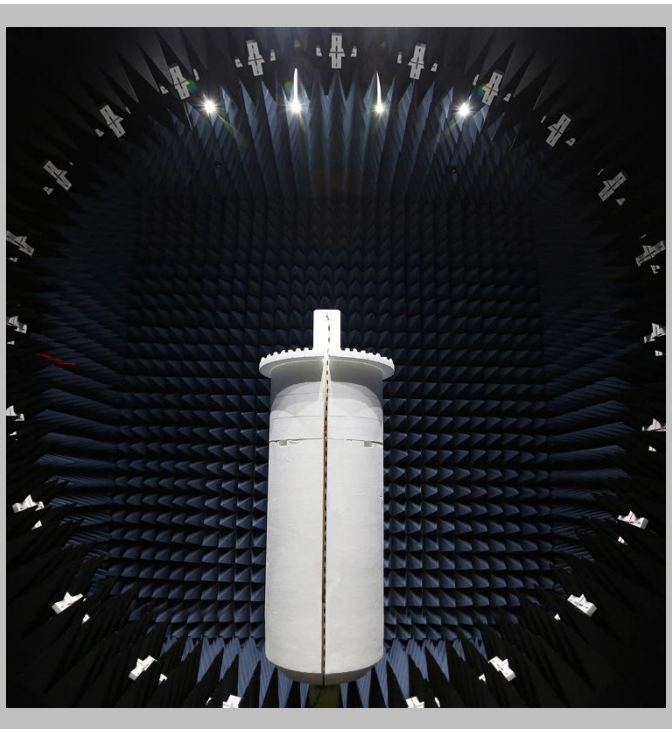
MIC – Recognized by MIC as a CAB for the acceptance of test data.

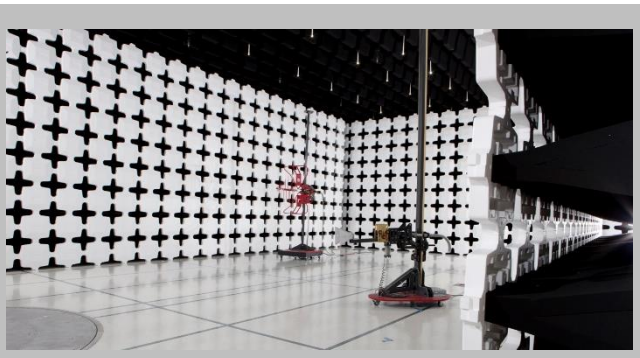
SCOPE

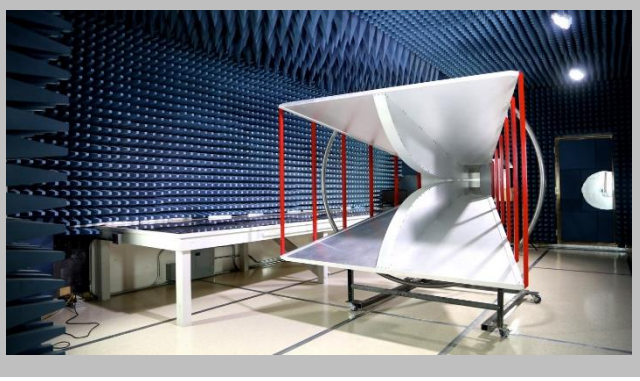
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

FACILITIES

California	Minnesota	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP				
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157







PRODUCT DESCRIPTION

2014-12-10

Client and Equipment Under Test (EUT) Information

Company Name:	Wearable Technologies Ltd
Address:	Unit 12 Warren Park Way
City, State, Zip:	Enderby, Leicester, LE19 4SA
Test Requested By:	Alex Toohie of Element Materials Technology, Hull
Model:	Smart Connected Hub
First Date of Test:	September 27, 2019
Last Date of Test:	January 25, 2020
Receipt Date of Samples:	August 11, 2019
Equipment Design Stage:	Production
Equipment Condition:	No Damage
Purchase Authorization:	P038958

Information Provided by the Party Requesting the Test

Functional Description of the EUT:

The Eleksen™ Smart Connected Hub, acts as both transmitter and receiver for several technologies, that transmits data at a configurable interval period over a work shift, working in correlation with the Eleksen™ Connected Worker Platform real-time module. This ensures that both the worker and the control center are alerted to any imminent danger. If at any point the Hub loses cellular connection, it will continue to gather data and deliver alerts to the "worker", and it will upload the missed data to the control center once it comes back into range or alternatively when the HUB is plugged into the Hub Station.
The stored data will be transmitted via WiFi to the dashboard."

The device contains the following radios:
4G LTE: Cat M1/NB-IoT
EGPRS Quad-Band
Wi-Fi 802.11 bgn
Bluetooth v4 with BLE (Bluetooth low energy)
GNSS: GPS / A-GPS / GLONASS / BeiDou / Galileo – Receive only
NFC
ISM – Receive only

The device transmits Wi-Fi 802.11bgn and Bluetooth from the same combination radio module. The device transmits 4G LTE and EGPRS from the same combination radio module.

FCC IDs: 2AU6IWTLM028, 8595A-UBX18ZO01, 2AC7Z-ESPWROOM32

Frequency Ranges:

a) Bluetooth: 2402-2480 MHz
b) 802.11bgn: 2412-2462 MHz (SISO, 20 MHz and 40 MHz channel bandwidth)
c) NFC: 13.56 MHz
d) Cellular LTE Band 2 for Cat M1 and NB-IoT: 1850-1910 MHz
e) Cellular LTE Band 4 for Cat M1 and NB-IoT: 1710-1755 MHz
f) Cellular LTE Band 5 for Cat M1 and NB-IoT: 824-849 MHz
g) Cellular LTE Band 12 for Cat M1 and NB-IoT: 699-716 MHz
h) Cellular GSM-850 for GPRS and EDGE: 824.2-848.8 MHz
i) Cellular PCS-1900 for GPRS and EDGE: 1850.2-1909.8

PRODUCT DESCRIPTION

2014-12-10

Location of transmit antenna(s):

Testing Locations:

Testing was performed on the front, back, and both sides of the EUT. For clarity, the sides of the EUT are referred to as the connector side and the SIM card side. When near the human body for non-transient amounts of time, the EUT will either be in a belt holster or in the pocket on a reflective vest. Neither of these accessories contains metal nor conductive material. Of these two options, the pocket on the reflective vest will always result in the EUT being closer to the human body. Testing was done with the EUT in the reflective vest pocket.

Testing Objective:

To demonstrate compliance of the 802.11bgn radio and the cellular radio with the SAR requirements of FCC 2.1093:2020.

The RF exposure compliance of the Bluetooth radio is documented in a separate report, Element Report # ELEM0093.

Scaling:

Maximum Power:

Per FCC KDB 447498, the measured SAR values were scaled to the maximum tune-up tolerance limit. The results are referred to as the “Reported SAR” values. The following formula was used to calculate the linear SAR scaling factor:

SAR scaling factor = 10^((Maximum Rated Power (dBm) - Measured Power (dBm)) / 10)

SAR Scaling Factors

Radio	Maximum Rated Power (dBm)	Measured Power (dBm)	SAR scaling factor
802.11bgn	5.0	5.0	1
Cellular LTE Category M1 Band 2	17.0	17.0	1
Cellular LTE Category M1 Band 4	16.6	16.6	1
Cellular LTE Category M1 Band 5	10.2	10.2	1
Cellular LTE Category M1 Band 12	10.1	10.1	1
Cellular LTE NB-IoT Band 2	18.4	18.4	1
Cellular LTE NB-IoT Band 4	17.8	17.8	1
Cellular LTE NB-IoT Band 5	13.7	13.7	1
Cellular LTE NB-IoT Band 12	11.3	11.1	1.05
Cellular GSM-850*	12.5	12.5	1
Cellular PCS-1900*	20.8	20.8	1
*Per KDB 941225 the maximum average values across all time slot combinations are considered the maximum power.			

802.11bgn Test Reduction

Per KDB 248227 D01 section 5.2.2, when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, test exclusion applies.

(DSSS Value) * (OFDM specified maximum output power)/(DSSS specified maximum output power) ≤ 1.2 W/kg

0.02 W/kg * 2.40 mW / 3.13 mW = 0.02 W/kg

0.02 W/kg ≤ 1.2 W/kg is true, therefore OFDM test exclusion applies.

Duty Cycle

The operational duty cycle can be up to 100% for Wi-Fi.
Per the customer, the operational duty cycle can be up to 30% for LTE Category M1.
Per the customer, the operational duty cycle can be up to 80% for LTE NB-IoT.
All SAR measurements were performed with the maximum possible duty cycle.

Simultaneous Transmission:

There are three different operational modes that support simultaneous transmission:

(1) Cellular, Bluetooth, and 13.56 MHz NFC
(2) Cellular, Bluetooth Low Energy, and 13.56 MHz NFC
(3) Cellular, 802.11bgn, and 13.56 MHz NFC

The 13.56 MHz NFC radio is exempt from RF exposure evaluation. The applicable estimated standalone SAR values and the measured standalone SAR values are added together and compared against the limit to determine compliance. For each of the 3 scenarios, this is done below:

Cellular + Bluetooth + NFC = 0.98 + 0.06 + 0 (exempt) = 1.04
Cellular + Bluetooth Low Energy + NFC = 0.98 + 0.06 + 0 (exempt) = 1.04
Cellular + 802.11bgn + NFC = 0.98 + 0.02 + 0 (exempt) = 1.00

Where all values given have the units W/kg averaged over 1g.

PRODUCT DESCRIPTION

2014-12-10

The limit for all of these cases is the head/torso general population exposure limit of 1.60 W/kg. All cases comply with this limit.

CONFIGURATIONS

Configuration ELEM0093- 1

Software/Firmware Running during test	
Description	**Version**
m-center	V02.01.00

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Eleksen Smart Connected Hub	Wearable Technology	M.28.R1.B1	SAR C3

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Test Computer	Rohde & Schwarz	1201.0002K50	167070

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Eleksen Connector	No	0.3 m	No	Eleksen Smart Connected Hub	Unterminated
DC Leads	No	0.2 m	No	Eleksen Smart Connected Hub	TQL
USB Cable	Yes	>3.0 m	No	Eleksen Smart Connected Hub	Test Computer

Configuration ELEM0093- 2

Software/Firmware Running during test	
Description	**Version**
m-center	V02.01.00

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Eleksen Smart Connected Hub	Wearable Technology	M.28.R1.B1	SAR C1

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Test Computer	Rohde & Schwarz	1201.0002K50	167070

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Eleksen Connector	No	0.3 m	No	Eleksen Smart Connected Hub	Unterminated
DC Leads	No	0.2 m	No	Eleksen Smart Connected Hub	TQL
USB Cable	Yes	>3.0 m	No	Eleksen Smart Connected Hub	Test Computer

CONFIGURATIONS

Configuration ELEM0093- 3

Software/Firmware Running during test	
Description	**Version**
m-center	V02.01.00

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Eleksen Smart Connected Hub	Wearable Technology	M.28.R1.B1	Conducted Cellular 1

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Test Computer	Rohde & Schwarz	1201.0002K50	167070

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
Eleksen Connector	No	0.3 m	No	Eleksen Smart Connected Hub	Unterminated
DC Leads	No	0.2 m	No	Eleksen Smart Connected Hub	TQL
USB Cable	Yes	>3.0 m	No	Eleksen Smart Connected Hub	Test Computer

Configuration ELEM0093- 4

Software/Firmware Running during test	
Description	**Version**
ESP RF Test Tool	V1.1.0

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Eleksen Smart Connected Hub	Wearable Technology	M.28.R1.B1	Conducted Wi-Fi 1

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Test Computer	Rohde & Schwarz	1201.0002K50	167070

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
DC Leads	No	0.2 m	No	Eleksen Smart Connected Hub	TQL
Eleksen Connector	No	0.3 m	No	Eleksen Smart Connected Hub	USB Cable
USB Cable	Yes	>3.0 m	No	Eleksen Connector	Test Computer

CONFIGURATIONS

Configuration ELEM0093- 5

Software/Firmware Running during test	
Description	**Version**
ESP RF Test Tool	V1.1.0

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Eleksen Smart Connected Hub	Wearable Technology	M.28.R1.B1	SAR C4

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Test Computer	Rohde & Schwarz	1201.0002K50	167070

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
DC Leads	No	0.2 m	No	Eleksen Smart Connected Hub	TQL
Eleksen Connector	No	0.3 m	No	Eleksen Smart Connected Hub	USB Cable
USB Cable	Yes	>3.0 m	No	Eleksen Connector	Test Computer

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2019-09-27	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2020-01-16	SAR Evaluation	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2020-01-20	SAR Evaluation	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

TISSUE – EQUIVALENT LIQUID DESCRIPTION

Characterization of tissue-equivalent liquid dielectric properties

Per IEEE 1528: 2003, Section 5.2.2, the permittivity and conductivity of the tissue material should be measured at least within 24 hours of any full-compliance test. The measured values must be within +/- 5% of the target values or +/- 10% as long as SAR error compensation algorithms documented in IEEE Std 1528-2013 are implemented for upward correction purposes only. The temperature variation in the liquid during SAR measurements must be within +/- 2 degrees C of that recorded when the dielectric properties were measured.

The dielectric parameters of the tissue-equivalent liquids were measured within 24 hours of the start of testing using the SPEAG DAKS:200 dielectric assessment kit. The dielectric measurements were made across the frequency range of the liquid. The attached data sheets show that the dielectric parameters of the liquid were within the required 10% tolerances.

Target values of dielectric parameters

Per KDB 865664 D01 v01r04, Appendix A:

"The head tissue dielectric parameters recommended by IEEE Std 1528-2013 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in IEEE Std 1528 are derived from tissue dielectric parameters computed from the 4-Cole-Cole equations described above and extrapolated according to the head parameters specified in IEEE Std 1528."

Target Frequency	Head		Body	
(MHz)	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

TISSUE – EQUIVALENT LIQUID DESCRIPTION

Composition of Ingredients for Liquid Tissue Phantoms

Element uses broadband tissue equivalent liquids prepared by SPEAG and confirmed by Element to be within +/- 10% of target values. If the liquids prepared are between +/- 5% and +/- 10% of their target values, SAR error compensation algorithms documented in IEEE Std 1528-2013 are implemented for upward correction purposes only. Their recipes are based upon the following formulations as found in IEEE 1528:2013 Annex C (head) and IEC 62209-2:2010 Annex E (body):

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation:

HEAD

Table C.1—Suggested recipes for achieving target dielectric parameters: 300 MHz to 900 MHz

Frequency (MHz)	300	450	450	450	835	835	900	900	900	900
Reference	[B118]	[B118]	[B172]	[B74]	[B118]	[B74]	[B118]	[B196]	[B172]	[B74]
Ingredients (% by weight)										
1,2-Propanediol	—	—	—	—	—	—	—	64.81	—	—
Bactericide	0.19	0.19	0.50	—	0.10	—	0.10	—	0.50	—
Diacetin	—	—	48.90	—	—	—	—	—	49.20	—
DGBE	—	—	—	—	—	—	—	—	—	—
HEC	0.98	0.98	—	—	1.00	—	1.00	—	—	—
NaCl	5.95	3.95	1.70	1.96	1.45	1.25	1.48	0.79	1.10	1.35
Sucrose	55.32	56.32	—	—	57.00	—	56.50	—	—	—
Triton X-100	—	—	—	—	—	—	—	—	—	—
Tween 20	—	—	—	49.51	—	48.39	—	—	—	48.34
Water	37.56	38.56	48.90	48.53	40.45	50.36	40.92	34.40	49.20	50.31

Table C.2—Suggested recipes for achieving target dielectric parameters: 1450 MHz to 2000 MHz

Frequency (MHz)	1450	1800	1800	1800	1800	1800	1900	1900	1950	2000
Reference	[B118]	[B118]	[B196]	[B196]	[B172]	[B74]	[B118]	[B196]	[B74]	[B118]
Ingredients (% by weight)										
1,2-Propanediol	—	—	—	—		—	—	—	—	—
Bactericide	—	—	—	—	0.50	—	—	—	—	—
Diacetin	—	—	—	—	49.43	—	—	—	—	—
DGBE	45.51	47.00	13.84	44.92	—	—	44.92	13.84	45.00	50.00
HEC	—	—	—	—	—	—	—	—	—	—
NaCl	0.67	0.36	0.35	0.18	0.64	0.50	0.18	0.35	—	—
Sucrose	—	—	—	—	—	—	—	—	—	—
Triton X-100	—	—	30.45	—	—	—	—	30.45	—	—
Tween 20	—	—	—	—	—	45.27	—	—	—	—
Water	53.82	52.64	55.36	54.90	49.43	54.23	54.90	55.36	55.00	50.00

TISSUE – EQUIVALENT LIQUID DESCRIPTION

element VERSION

Table C.3—Suggested recipes for achieving target dielectric parameters: 2100 MHz to 5800 MHz

Frequency (MHz)	2100	2100	2450	2450	3000	5200	5800
Reference	[B118]	[B196]	[B196]	[B172]	[B196]		
Ingredients (% by weight)							
1,2-Propanediol	—	—	—		—	—	—
Bactericide	—	—	—	0.50	—	—	—
Diacetin	—	—	—	49.75	—	—	—
DGBE	50.00	7.99	7.99	—	7.99	—	—
HEC	—	—	—	—	—	—	—
NaCl	—	0.16	0.16	—	0.16	—	—
Sucrose	—	—	—	—	—	—	—
Triton X-100	—	19.97	19.97	—	19.97	17.24	17.24
Diethylenglycol monohexylether	—	—	—	—	—	17.24	17.24
Water	50.00	71.88	71.88	49.75	71.88	65.52	65.52

BODY

Frequency (MHz)	30	50		144		450		835	900	
Recipe source number	3	3	2	2	3	2	4	2	2	4
Ingredients (% by weight)										
Deionised water	48,30	48,30	53,53	55,12	48,30	48,53	56	50,36	50,31	56
Tween			44,70	43,31		49,51		48,39	48,34	
Oxidised mineral oil							44			44
Diethylenglycol monohexylether										
Triton X-100										
Diacetin	50,00	50,00			50,00					
DGBE										
NaCl	1,60	1,60	1,77	1,57	1,60	1,96		1,25	1,35	
Additives and salt	0,10	0,10			0,10					

Frequency (MHz)	1 800		2 450	4 000	5 000	5 200	5 800	6 000
Recipe source number	2	4	4	4	4	1	1	4
Ingredients (% by weight)								
Deionised water	54,23	56	56	56	56	65,53	65,53	56
Tween	45,27							
Oxidised mineral oil		44	44	44	44			44
Diethylenglycol monohexylether						17,24	17,24	
Triton X-100						17,24	17,24	
Diacetin								
DGBE								
NaCl	0,50							
Additives and salt								

TISSUE – EQUIVALENT LIQUID

element
WSTE.2016.12.19

Date:	2020-01-14	Temperature:	22.7°C
Tissue:	MBBL600-6000V6	Liquid Temperature:	21.3°C
Tested By:	Kyle McMullan	Relative Humidity:	24.6%
Job Site:	MN11	Bar. Pressure:	1015.4 mb

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2020 FCC 2.1093:2020	FCC KDB 865664 D01 v01r04 FCC KDB 865664 D02 v01r02 IEEE Std 1528:2013

RESULTS

	Actual Values		Target Values		Deviation (%)	
Frequency (MHz)	Relative Permittivity	Conductivity	Relative Permittivity	Conductivity	Relative Permittivity	Conductivity
750	52.5	0.97	55.5	0.96	-5.41	1.04
835	52.2	1.00	55.2	0.97	-5.43	3.09
1750	50.5	1.49	53.4	1.37	-5.43	8.76
1900	50.3	1.59	53.3	1.52	-5.63	4.61
2450	49.4	2.03	52.7	1.95	-6.26	4.10

Freq (MHz)	Relative Perm.	Cond. (S/m)
600	52.91	0.92
650	52.78	0.94
700	52.62	0.95
750	52.48	0.97
800	52.33	0.99
850	52.20	1.01
900	52.05	1.03
950	52.00	1.05
1000	51.85	1.08
1050	51.73	1.10
1100	51.61	1.12
1150	51.51	1.15
1200	51.40	1.17
1250	51.25	1.20
1300	51.21	1.22
1350	51.16	1.25
1400	51.08	1.28
1450	51.00	1.31
1500	50.90	1.33
1550	50.81	1.36
1600	50.67	1.39
1650	50.61	1.42
1700	50.53	1.46
1750	50.50	1.49
1800	50.44	1.52
1850	50.36	1.56
1900	50.29	1.59
1950	50.17	1.62
2000	50.08	1.66
2050	49.96	1.70
2100	49.92	1.74
2150	49.84	1.78
2200	49.82	1.82
2250	49.74	1.86
2300	49.68	1.90
2350	49.60	1.94
2400	49.50	1.98

Freq (MHz)	Relative Perm.	Cond. (S/m)
2450	49.42	2.03
2500	49.32	2.08
2550	49.25	2.12
2600	49.13	2.17
2650	49.02	2.22
2700	49.01	2.27
2750	48.88	2.31
2800	48.80	2.36
2850	48.68	2.41
2900	48.63	2.46
2950	48.54	2.51
3000	48.41	2.55
3050	48.29	2.61
3100	48.20	2.67
3150	48.08	2.72
3200	47.97	2.77
3250	47.96	2.81
3300	47.88	2.86
3350	47.76	2.91
3400	47.66	2.97
3450	47.58	3.02
3500	47.44	3.07
3550	47.39	3.13
3600	47.35	3.17
3650	47.24	3.23
3700	47.18	3.29
3750	47.08	3.35
3800	47.02	3.41
3850	46.94	3.46
3900	46.89	3.52
3950	46.78	3.58
4000	46.69	3.64
4050	46.63	3.71
4100	46.57	3.75
4150	46.47	3.81
4200	46.35	3.88
4250	46.27	3.94

Freq (MHz)	Relative Perm.	Cond. (S/m)
4300	46.17	4.03
4350	46.10	4.10
4400	46.06	4.17
4450	45.90	4.22
4500	45.84	4.28
4550	45.74	4.34
4600	45.62	4.41
4650	45.50	4.49
4700	45.41	4.55
4750	45.26	4.62
4800	45.19	4.69
4850	45.05	4.65
4900	44.80	4.75
4950	44.76	4.71
5000	44.41	4.88
5050	44.69	4.98
5100	44.48	5.07
5150	44.48	5.09
5200	44.05	5.19
5250	43.88	5.35
5300	43.46	5.30
5350	43.93	5.55
5400	43.82	5.56
5450	43.83	5.58
5500	43.80	5.62
5550	43.74	5.67
5600	43.42	5.70
5650	43.12	5.75
5700	42.95	6.01
5750	43.16	6.01
5800	42.70	6.06
5850	42.82	5.95
5900	42.68	6.05
5950	42.54	6.13
6000	42.39	6.20

SAR SYSTEM VERIFICATION DESCRIPTION

element
WSSV.2017.1.31

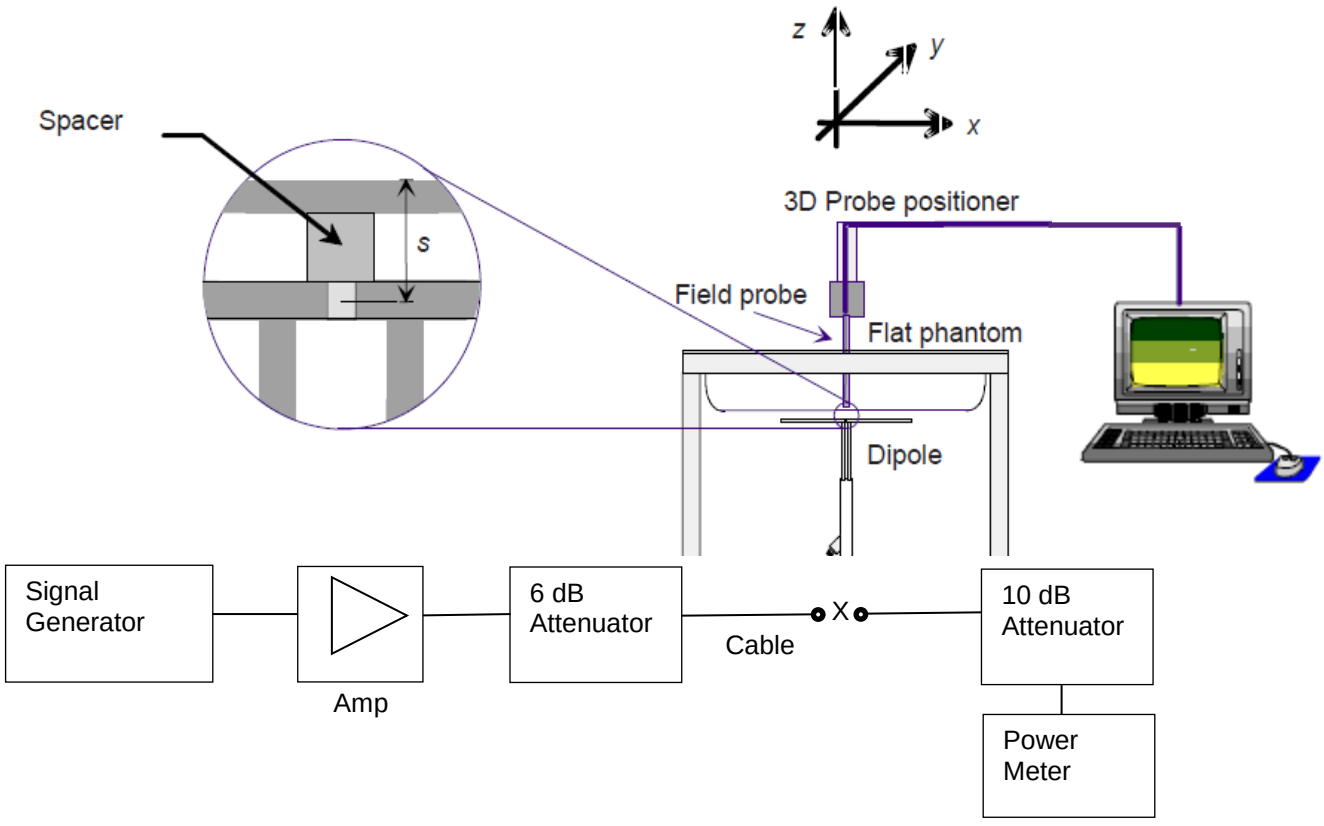
REQUIREMENT
Per IEEE 1528, Section 8.2.1, “System checks are performed prior to compliance tests and the results must always be within ± 10% of the target value corresponding to the test frequency, liquid, and the source used. The target values are 1 g or 10 g averaged SAR values measured on systems having current system validation and calibration status, and using the system check setup as shown in Figure 14. These target values should be determined using a standard source.”

TEST DESCRIPTION
Element used the system validation kit (calibrated reference dipole) to test whether the system was operating within its specifications. The validation was performed in the indicated bands by making SAR measurements of the reference dipole with the phantom filled with the tissue-equivalent liquid. First, a signal generator and power amplifier were used to produce a 100mW level as measured with a power meter at the antenna terminals of the dipole (X). Then, the reference dipole was positioned below the bottom of the phantom and centered with its axis parallel to the longest side of the phantom. A low loss and low relative permittivity spacer was used to establish the correct distance between the center axis of the reference dipole and the liquid.

For the reference dipoles, the spacing distance s is given by:

s = 15mm, +/- 0.2mm for 300MHz ≤ f ≥ 1000 MHz:
s = 10mm, +/- 0.2mm for 1000MHz ≤ f ≥ 6000MHz

The measured 1 g and 10 g spatial average SAR values were normalized to a 1W dipole input power for comparison to the calibration data. The results are summarized in the attached table. The deviation is less than 10% in all cases, indicating that the system performance check was within tolerance.



SAR SYSTEM VERIFICATION

element
WSSV.2016.12.19

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2020 FCC 2.1093:2020	FCC KDB 865664 D01 v01r04 FCC KDB 865664 D02 v01r02 IEEE Std 1528:2013

RESULTS

Date	Liquid part number and frequency	Conducted Power into the Dipole (dBm)	Correction Factor	Measured		Normalized to 1W		Target (Normalized to 1W) Get from Dipole Calibration Certificate		% Difference	
				1g	10g	1g	10g	1g	10g	1g	10g
2020-01-14	MBBL600-6000V6 (750 MHz)	20.00	10.00	0.86	0.57	8.62	5.73	8.55	5.64	0.70	1.60
2020-01-14	MBBL600-6000V6 (835 MHz)	20.00	10.00	1.00	0.66	9.99	6.59	9.73	6.40	4.28	5.44
2020-01-14	MBBL600-6000V6 (1750 MHz)	20.00	10.00	3.72	1.98	37.20	19.80	37.8	20.0	-0.53	0.00
2020-01-14	MBBL600-6000V6 (1900 MHz)	20.00	10.00	4.19	2.18	41.90	21.80	40.4	21.2	3.46	2.83
2020-01-25	MBBL600-6000V6 (2450 MHz)	20.00	10.00	4.65	2.15	46.50	21.50	50.80	23.80	-8.46	-9.66

SAR SYSTEM VERIFICATION

element
WSSV.2016.12.19

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.1°C
Date:	2020-01-14	Liquid Temperature (°C):	21.3°C
		Humidity (%RH):	24.3%
		Bar. Pressure (mb):	998 mb

MBBL600-6000V6 System Check
DUT: Dipole 750 MHz D750V3; Type: D750V3; Serial: D750V3 - SN: 1094
Communication System: UID 0, CW (0); Communication System Band: D750 (750.0 MHz); Frequency: 750 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 750 MHz; σ = 0.972 S/m; ε_r = 52.477; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(9.3, 9.3, 9.3) @ 750 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 5mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 1.0, 101.0, 31.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

System Check/System Check/Area Scan (51x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.857 W/kg

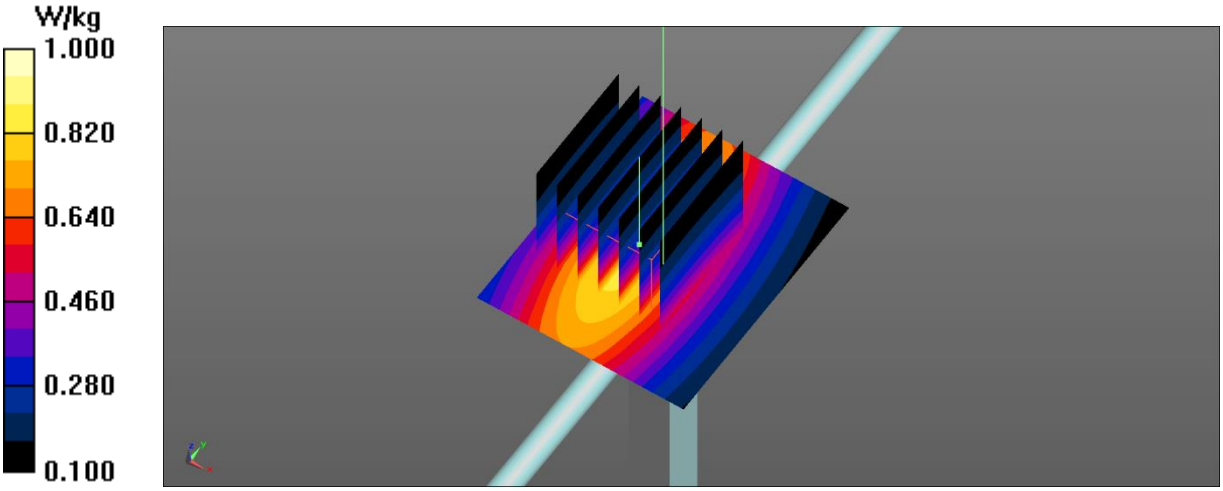
System Check/System Check/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of Total (measured) = 35.59 V/m

System Check/System Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 28.91 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 1.27 W/kg
SAR(1 g) = 0.862 W/kg; SAR(10 g) = 0.573 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.861 W/kg

System Check/System Check/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 1.23 W/kg

Approved By

MSL750 System Check



SAR SYSTEM VERIFICATION

element
WSSV.2016.12.19

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.1°C
Date:	2020-01-14	Liquid Temperature (°C):	21.3°C
		Humidity (%RH):	24.3%
		Bar. Pressure (mb):	998 mb

MBBL600-6000V6 System Check
DUT: Dipole 835 MHz D835V2; Type: D835V2 Serial: 4d108
Communication System: UID 10000, CW; Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used (interpolated): f = 835 MHz; σ = 1.005 S/m; ε_r = 52.237; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(9.06, 9.06, 9.06) @ 835 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 0mm (Fix Surface), Sensor-Surface: 5mm (Mechanical Surface Detection), z = 101.0, 31.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

System Check/System Check/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of Total (measured) = 37.69 V/m

System Check/System Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 31.10 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 1.48 W/kg
SAR(1 g) = 0.999 W/kg; SAR(10 g) = 0.659 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.999 W/kg

System Check/System Check/Area Scan (71x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

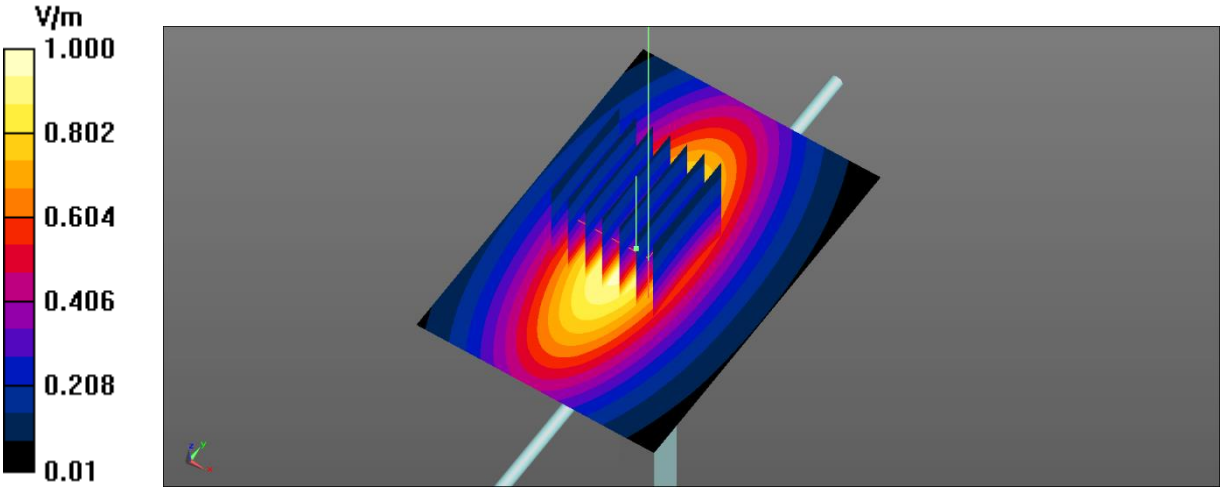
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.995 W/kg

System Check/System Check/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.43 W/kg

Approved By

MSL835 System CheckMHz



SAR SYSTEM VERIFICATION

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.1°C
Date:	2020-01-14	Liquid Temperature (°C):	21.3°C
		Humidity (%RH):	24.3%
		Bar. Pressure (mb):	998 mb

MBBL600-6000V6 System Check
DUT: Dipole 1750 MHz D1750V2; Type: D1750V2; Serial: D1750V2 - SN: 1040
Communication System: UID 0, CW (0); Communication System Band: D1750 (1750.0 MHz); Frequency: 1750 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1750 MHz; σ = 1.49 S/m; ε_r = 50.504; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(7.67, 7.67, 7.67) @ 1750 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 0mm (Fix Surface), Sensor-Surface: 5mm (Mechanical Surface Detection), z = 101.0, 31.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

System Check/System Check/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of Total (measured) = 61.42 V/m

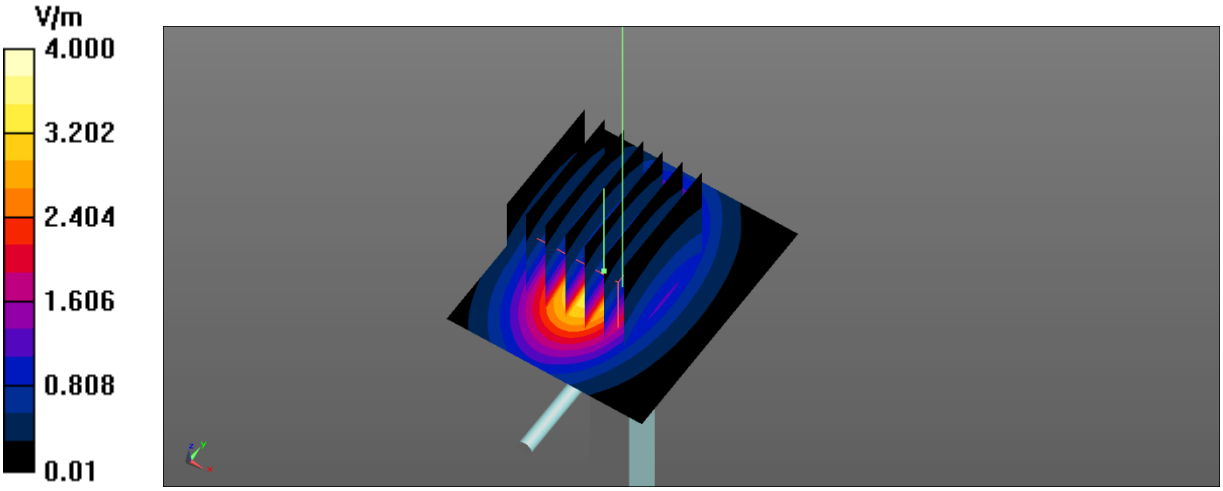
System Check/System Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 48.96 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 6.71 W/kg
SAR(1 g) = 3.72 W/kg; SAR(10 g) = 1.98 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 3.74 W/kg

System Check/System Check/Area Scan (51x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 3.78 W/kg

System Check/System Check/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 5.62 W/kg

Approved By

MSL1750 System Check



SAR SYSTEM VERIFICATION

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.1°C
Date:	2020-01-14	Liquid Temperature (°C):	21.3°C
		Humidity (%RH):	24.3%
		Bar. Pressure (mb):	998 mb

MBBL600-6000V6 System Check
DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN: 5d131
Communication System: UID 10000, CW; Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 1900 MHz; σ = 1.589 S/m; ε_r = 50.292; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(7.44, 7.44, 7.44) @ 1900 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 5mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 1.0, 31.0, 101.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

System Check/System Check/Area Scan (51x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 4.37 W/kg

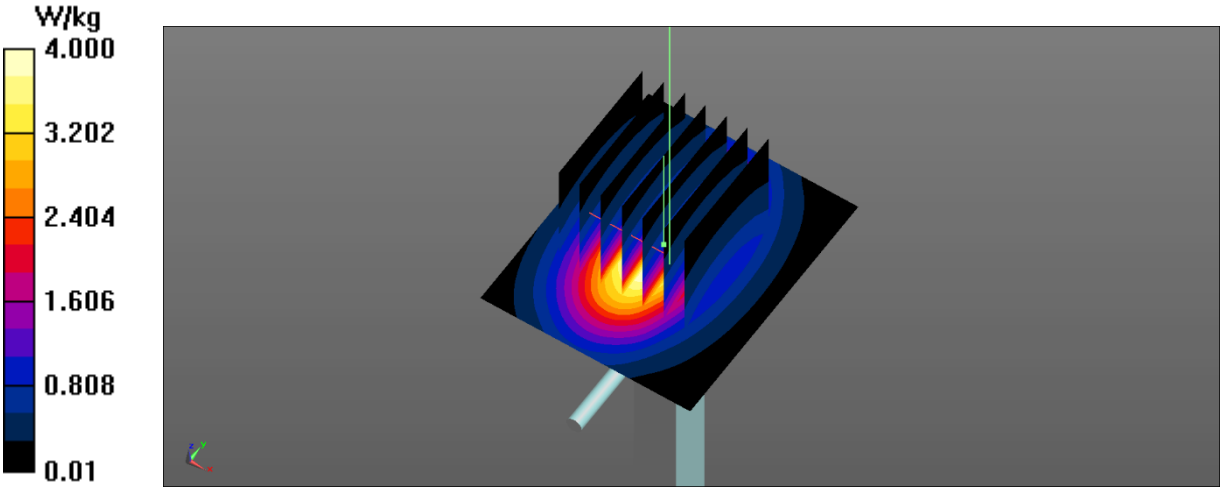
System Check/System Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 51.60 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 7.78 W/kg
SAR(1 g) = 4.19 W/kg; SAR(10 g) = 2.18 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 4.20 W/kg

System Check/System Check/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of Total (measured) = 65.80 V/m

System Check/System Check/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 6.88 W/kg

Approved By

MSL1900 System Check



SAR SYSTEM VERIFICATION

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.1°C
Date:	2020-01-25	Liquid Temperature (°C):	21.3°C
		Humidity (%RH):	24.3%
		Bar. Pressure (mb):	998 mb

MBBL600-6000V6 System Check
DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN: 855
Communication System: UID 10000, CW; Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz;Communication System PAR: 0 dB; PMF: 1
Medium parameters used: f = 2450 MHz; σ = 2.028 S/m; ε_r = 49.416; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(7.33, 7.33, 7.33) @ 2450 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 5mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 1.0, 101.0, 31.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

System Check/System Check/Area Scan (51x61x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 5.05 W/kg

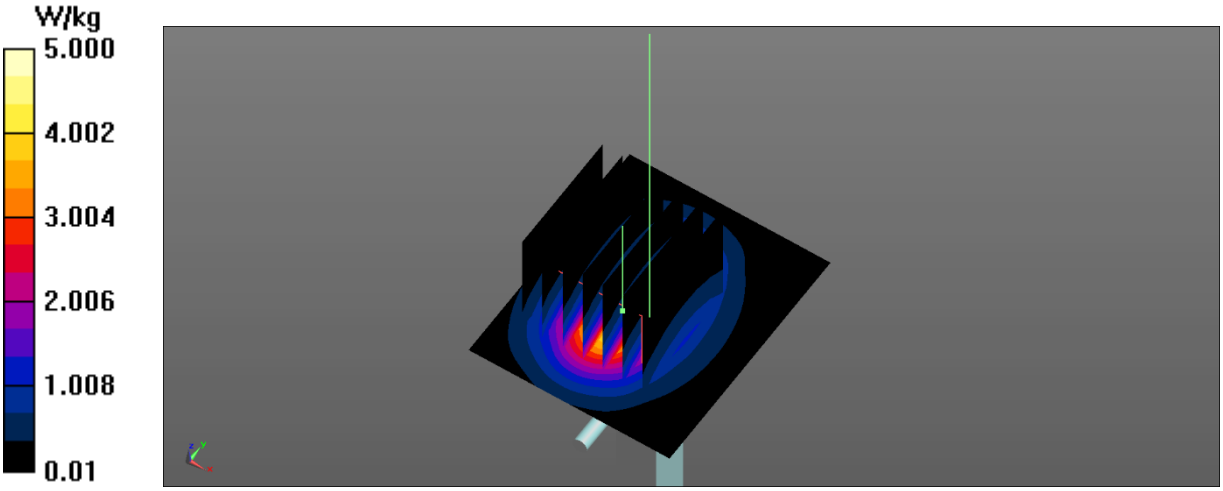
System Check/System Check/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of Total (measured) = 60.73 V/m

System Check/System Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 46.33 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 9.50 W/kg
SAR(1 g) = 4.65 W/kg; SAR(10 g) = 2.15 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 4.62 W/kg

System Check/System Check/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 7.48 W/kg

Approved By

MSL2450 System Check 1-25-20



OUTPUT POWER

element
WTD.2017.11.22.1

EUT:	Smart Connected Hub	Work Order:	ELEM0093
Serial Number:	Conducted Cellular 1 and Conducted WiFi 1	Date:	2019-12-05
Customer:	Element Materials Technology	Temperature:	23 °C
Attendees:	None	Relative Humidity:	34.5% RH
Customer Project:	None	Bar. Pressure:	1018 mbar
Tested By:	Kyle McMullan	Job Site:	MN11
Power:	4.1VDC	Configuration:	ELEM0093-3 ELEM0093-4

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2019 FCC 2.1093:2019	FCC KDB 248227 D01 V02r02 FCC KDB 447498 D01 V06 FCC KDB 865664 D01 v01r04 FCC KDB 865664 D02 v01r02 FCC KDB 941225 D01 v03r01 FCC KDB 941225 D05 v02r05 IEEE Std 1528:2013

COMMENTS

See the data tables below for the transmitter power setting used for each channel/data rate/band.

The EUT is not capable of voice calling and therefore GSM is not tested.

After testing all combinations of LTE Category M1, it was determined that the worst-case mode is maximum bandwidth and minimal resource blocks. This worst-case mode was used for the rest of LTE Category M1 and NB-IoT testing.

Serial number Conducted Cellular 1 and configuration ELEM0093-3 used for conducted cellular testing. Serial number Conducted WiFi 1 and configuration ELEM0093-4 used for Wi-Fi testing.

DEVIATIONS FROM TEST STANDARD

None

OUTPUT POWER

element
WTD.2017.11.22.1

802.11bgn Results

20 MHz Bandwidth

Channel	Frequency (MHz)	Radio Mode	Data Rate (Mbps)	Modulation	Software Atten. Setting dBm	Meter Reading dBm	mW
1	2412	802.11b	1	BPSK	0	4.96	**3.13**
			11	CCK	0	4.92	3.10
		802.11g	6	OFDM	0	3.81	**2.40**
			54	OFDM	0	-0.63	0.86
		802.11n	MCS0	OFDM	0	3.81	2.40
			MCS7	OFDM	0	-1.54	0.70
6	2437	802.11b	1	BPSK	0	4.45	2.79
			11	CCK	0	4.34	2.72
		802.11g	6	OFDM	0	3.24	2.11
			54	OFDM	0	-1.12	0.77
		802.11n	MCS0	OFDM	0	3.14	2.06
			MCS7	OFDM	0	-2.33	0.58
11	2462	802.11b	1	BPSK	0	1.77	1.50
			11	CCK	0	1.63	1.46
		802.11g	6	OFDM	0	0.78	1.20
			54	OFDM	0	-3.51	0.45
		802.11n	MCS0	OFDM	0	0.69	1.17
			MCS7	OFDM	0	-4.53	0.35

40 MHz Bandwidth

Channel	Frequency (MHz)	Radio Mode	Data Rate (Mbps)	Modulation	Software Power Setting	Meter Reading dBm	mW
3F	2422	802.11n	MCS0	BPSK	0	3.86	2.43
			MCS7	64-QAM	0	-2.00	0.63
7F	2442	802.11n	MCS0	OFDM	0	3.23	2.10
			MCS7	OFDM	0	-2.33	0.58
11F	2462	802.11n	MCS0	OFDM	0	1.11	1.29
			MCS7	OFDM	0	-4.25	0.38

OUTPUT POWER

element
WTD.2017.11.22.1

GPRS and EDGE Results

GSM/GPRS/EDGE Maximum Output Power (in dBm)											
Band	Ch	Freq (MHz)	Voice 1 UL	Data 1 UL		Data 2 UL		Data 3 UL		Data 4 UL	
			GSM GSMK	GPRS/ EDGE GMSK	EDGE 8-PSK	GPRS/ EDGE GMSK	EDGE 8-PSK	GPRS/ EDGE GMSK	EDGE 8-PSK	GPRS/ EDGE GMSK	EDGE 8-PSK
GSM-850	**128**	824.2	N/A	19.4	14.6	17.8	13.2	16.4	11.5	15.5	10.6
	190	836.6	N/A	20.1	14.6	18.3	13.0	16.7	12.0	15.5	10.6
	251	848.8	N/A	**20.8**	15.0	18.4	13.5	17.2	12.0	15.7	11.0
PCS-1900	**512**	1850.2	N/A	**24.7**	21.1	**24.7**	20.7	24.5	20.4	24.2	20.3
	661	1880	N/A	**24.7**	20.8	24.4	20.5	24.2	20.3	24.0	20.0
	810	1909.8	N/A	24.6	20.3	24.3	20.4	24.1	20.1	23.8	19.9

GPRS/EDGE Data Average Output Power (in dBm)											
Band	Ch	Freq (MHz)	Voice 1 UL	Data 1 UL		Data 2 UL		Data 3 UL		Data 4 UL	
			GSM GSMK	GPRS/ EDGE GMSK	EDGE 8-PSK	GPRS/ EDGE GMSK	EDGE 8-PSK	GPRS/ EDGE GMSK	EDGE 8-PSK	GPRS/ EDGE GMSK	EDGE 8-PSK
GSM-850	**128**	824.2	N/A	10.2	5.4	11.4	6.8	11.7	6.8	12.1	7.2
	190	836.6	N/A	10.9	5.4	11.9	6.6	12.0	7.3	12.1	7.2
	251	848.8	N/A	11.6	5.8	12.0	7.1	**12.5**	7.3	12.3	7.6
PCS-1900	**512**	1850.2	N/A	15.5	11.9	18.3	14.3	19.8	15.7	**20.8**	16.9
	661	1880	N/A	15.5	11.6	18.0	14.1	19.5	15.6	20.6	16.6
	810	1909.8	N/A	15.4	11.1	17.9	14.0	19.4	15.4	20.4	16.5

OUTPUT POWER

element
WTD.2017.11.22.1

LTE Category M1 Results Band 2

Bandwidth (MHz)	Channel	Channel Frequency (MHz)	Modulation	RB Allocation	NB Value and RB start	Power (dBm)	Modulation	RB Allocation	NB Value and RB start	Power (dBm)
20	18700	1860.0	QPSK	1	0,0	16.35	16-QAM	1	0,0	16.06
				1	8,0	**16.99**		1	8,0	16.08
				1	15,5	16.59		1	15,5	16.51
				3	0,0	16.48		3	0,0	16.37
				3	8,0	16.57		3	8,0	16.20
				3	15,5	16.29		3	15,5	16.15
				6	0,0	16.41		6	0,0	16.24
				6	8,0	16.54		6	8,0	16.28
				6	15,5	16.54		6	15,5	16.26
	18900	1880.0	QPSK	1	0,0	16.39	16-QAM	1	0,0	16.16
				1	8,0	16.66		1	8,0	16.35
				1	15,5	16.88		1	15,5	16.61
				3	0,0	16.50		3	0,0	16.22
				3	8,0	16.57		3	8,0	16.63
				3	15,5	16.56		3	15,5	16.51
				6	0,0	16.63		6	0,0	16.13
				6	8,0	16.78		6	8,0	16.72
				6	15,5	16.63		6	15,5	16.60
	19100	1900.0	QPSK	1	0,0	16.72	16-QAM	1	0,0	16.39
				1	8,0	16.60		1	8,0	16.55
				1	15,5	16.68		1	15,5	16.61
				3	0,0	16.59		3	0,0	16.48
				3	8,0	16.54		3	8,0	16.16
				3	15,5	16.31		3	15,5	16.34
				6	0,0	16.76		6	0,0	16.72
				6	8,0	16.70		6	8,0	16.59
				6	15,5	16.57		6	15,5	16.44
15	18675	1857.5	QPSK	1	0,0	16.73	16-QAM	1	0,0	16.60
				1	6,0	16.53		1	6,0	15.70
				1	11,5	16.44		1	11,5	16.61
				3	0,0	16.76		3	0,0	16.78
				3	6,0	16.78		3	6,0	16.66
				3	11,5	16.55		3	11,5	16.45
				6	0,0	16.61		6	0,0	16.79
				6	6,0	16.72		6	6,0	16.64
				6	11,5	16.81		6	11,5	17.03
	18900	1880.0	QPSK	1	0,0	16.39	16-QAM	1	0,0	16.35
				1	6,0	16.41		1	6,0	16.38
				1	11,5	16.27		1	11,5	16.33
				3	0,0	16.37		3	0,0	16.44
				3	6,0	16.79		3	6,0	16.63
				3	11,5	16.60		3	11,5	16.59

OUTPUT POWER

element
WTD.2017.11.22.1

				6	0,0	16.55		6	0,0	16.51
				6	6,0	16.83		6	6,0	16.73
				6	11,5	16.65		6	11,5	16.56
	19125	1902.5	QPSK	1	0,0	16.83	16-QAM	1	0,0	16.76
				1	6,0	16.61		1	6,0	16.59
				1	11,5	16.87		1	11,5	16.76
				3	0,0	16.64		3	0,0	16.24
				3	6,0	16.48		3	6,0	16.20
				3	11,5	16.42		3	11,5	16.50
				6	0,0	16.71		6	0,0	16.73
				6	6,0	16.76		6	6,0	16.63
				6	11,5	16.77		6	11,5	16.60
10	18650	1855.0	QPSK	1	0,0	15.66	16-QAM	1	0,0	14.58
				1	4,0	16.49		1	4,0	16.48
				1	9,5	16.43		1	9,5	16.41
				3	0,0	16.64		3	0,0	16.55
				3	4,0	16.66		3	4,0	16.64
				3	9,5	16.78		3	9,5	16.66
				6	0,0	15.59		6	0,0	14.99
				6	4,0	15.76		6	4,0	14.55
				6	9,5	15.77		6	9,5	14.58
	18900	1880.0	QPSK	1	0,0	16.33	16-QAM	1	0,0	16.26
				1	4,0	16.64		1	4,0	16.63
				1	9,5	16.46		1	9,5	15.64
				3	0,0	16.61		3	0,0	16.62
				3	4,0	16.77		3	4,0	16.12
				3	9,5	16.80		3	9,5	16.66
				6	0,0	15.65		6	0,0	14.50
				6	4,0	15.79		6	4,0	15.70
				6	9,5	15.72		6	9,5	15.66
	19150	1905.0	QPSK	1	0,0	16.39	16-QAM	1	0,0	15.62
				1	4,0	16.34		1	4,0	15.47
				1	9,5	16.55		1	9,5	16.60
				3	0,0	16.74		3	0,0	16.46
				3	4,0	16.71		3	4,0	16.52
				3	9,5	16.64		3	9,5	16.63
				6	0,0	15.51		6	0,0	14.43
				6	4,0	15.72		6	4,0	15.07
				6	9,5	15.84		6	9,5	15.11
5	18625	1852.5	QPSK	1	0,0	16.46	16-QAM	0,0	low/0	15.48
				1	2,0	16.65		2,0	2/0	15.88
				1	4,5	16.36		4,5	high/5	15.57
				3	0,0	15.81		0,0	low/0	15.43
				3	2,0	15.94		2,0	2/0	15.58
				3	4,5	15.66		4,5	high/3	15.65
				6	0,0	15.47		0,0	low/0	14.49

OUTPUT POWER

element
WTD.2017.11.22.1

				6	2,0	15.80		2,0	2/0	14.84
				6	4,5	15.79		4,5	high/0	15.77
	18900	1880.0	QPSK	1	0,0	16.59	16-QAM	0,0	low/0	16.33
				1	2,0	16.65		2,0	2/0	16.32
				1	4,5	16.27		4,5	high/5	16.30
				3	0,0	15.75		0,0	low/0	15.31
				3	2,0	15.91		2,0	2/0	15.45
				3	4,5	16.69		4,5	high/3	15.45
				6	0,0	15.64		0,0	low/0	14.60
				6	2,0	15.77		2,0	2/0	15.74
				6	4,5	15.71		4,5	high/0	14.59
	19175	1907.5	QPSK	1	0,0	16.46	16-QAM	0,0	low/0	16.16
				1	2,0	16.51		2,0	2/0	16.43
				1	4,5	16.40		4,5	high/5	16.16
				3	0,0	15.49		0,0	low/0	15.42
				3	2,0	15.51		2,0	2/0	15.26
				3	4,5	15.48		4,5	high/3	15.41
				6	0,0	15.57		0,0	low/0	14.39
				6	2,0	15.73		2,0	2/0	15.69
				6	4,5	15.67		4,5	high/0	14.57
3	18615	1851.5	QPSK	1	0,0	14.84	16-QAM	1	0,0	14.66
				1	1,0	16.66		1	1,0	16.16
				1	1,5	16.66		1	1,5	15.26
				3	0,0	15.73		3	0,0	14.40
				3	1,0	15.75		3	1,0	14.36
				3	1,5	15.77		3	1,5	14.23
				6	0,0	14.35		6	0,0	14.58
				6	N/A	N/A		6	N/A	N/A
				6	1,5	14.78		6	1,5	14.90
	18900	1880.0	QPSK	1	0,0	16.67	16-QAM	1	0,0	15.99
				1	1,0	16.70		1	1,0	15.37
				1	1,5	16.74		1	1,5	15.36
				3	0,0	15.73		3	0,0	14.21
				3	1,0	15.75		3	1,0	14.19
				3	1,5	15.80		3	1,5	14.20
				6	0,0	14.55		6	0,0	14.48
				6	N/A	N/A		6	N/A	N/A
				6	1,5	15.16		6	1,5	14.76
	19185	1908.5	QPSK	1	0,0	16.42	16-QAM	1	0,0	15.19
				1	1,0	16.57		1	1,0	15.06
				1	1,5	16.52		1	1,5	15.13
				3	0,0	15.77		3	0,0	14.27
				3	1,0	15.90		3	1,0	14.28
				3	1,5	15.73		3	1,5	14.23
				6	0,0	14.54		6	0,0	14.27
				6	N/A	N/A		6	N/A	N/A

				6	1,5	14.64		6	1,5	15.02
1.4	18607	1850.7	QPSK	1	0,0	16.70	16-QAM	1	0,0	15.29
				1	0,3	16.84		1	0,3	15.35
				1	0,5	16.66		1	0,5	15.32
				3	0,0	15.67		3	0,0	14.38
				3	0,3	15.84		3	0,3	14.35
				3	0,5	15.88		3	0,5	14.38
				6	N/A	N/A		6	N/A	N/A
				6	0,6	14.77		6	0,6	14.66
				6	N/A	N/A		6	N/A	N/A
	18900	1880.0	QPSK	1	0,0	16.58	16-QAM	1	0,0	15.30
				1	0,3	16.71		1	0,3	15.33
				1	0,5	16.64		1	0,5	15.38
				3	0,0	15.73		3	0,0	14.28
				3	0,3	15.98		3	0,3	14.55
				3	0,5	16.88		3	0,5	15.23
				6	N/A	N/A		6	N/A	N/A
				6	0,6	14.59		6	0,6	14.90
				6	N/A	N/A		6	N/A	N/A
	19193	1909.3	QPSK	1	0,0	16.34	16-QAM	1	0,0	15.06
				1	0,3	16.80		1	0,3	16.72
				1	0,5	16.29		1	0,5	14.75
				3	0,0	15.73		3	0,0	14.38
				3	0,3	15.60		3	0,3	14.31
				3	0,5	15.58		3	0,5	14.40
				6	N/A	N/A		6	N/A	N/A
				6	0,6	14.75		6	0,6	14.80
				6	N/A	N/A		6	N/A	N/A

OUTPUT POWER

element
WTD.2017.11.22.1

LTE Category M1 Results Band 4, 5, 12

Band	Bandwidth (MHz)	Channel	Channel Frequency (MHz)	Modulation	RB Allocation	NB Value and RB start	Power (dBm)	Modulation	RB Allocation	NB Value and RB start	Power (dBm)
4	20	20050	1720.0	QPSK	1	0,0	16.06	16-QAM	1	0,0	15.16
					1	8,0	16.3		1	8,0	15.28
					1	15,5	16.16		1	15,5	15.36
		20175	1732.5	QPSK	1	0,0	16.11	16-QAM	1	0,0	15.58
					1	8,0	16.37		1	8,0	15.44
					1	15,5	16.48		1	15,5	15.52
		20300	1745.0	QPSK	1	0,0	16.15	16-QAM	1	0,0	16.4
					1	8,0	16.56		1	8,0	16.62
					1	15,5	**16.57**		1	15,5	**16.68**
5	10	20450	829.0	QPSK	1	0,0	10.05	16-QAM	1	0,0	9.21
					1	6,0	**10.23**		1	6,0	9.22
					1	11,5	10.12		1	11,5	9.36
		20525	836.5	QPSK	1	0,0	10.13	16-QAM	1	0,0	9.24
					1	6,0	9.82		1	6,0	9.15
					1	11,5	9.87		1	11,5	9.01
		20600	844.0	QPSK	1	0,0	9.91	16-QAM	1	0,0	9.03
					1	6,0	9.73		1	6,0	8.88
					1	11,5	9.92		1	11,5	8.99
12	10	23060	704.0	QPSK	1	0,0	9.23	16-QAM	1	0,0	9.03
					1	6,0	9.33		1	6,0	9.05
					1	11,5	9.60		1	11,5	9.29
		23095	707.5	QPSK	1	0,0	9.47	16-QAM	1	0,0	8.43
					1	6,0	9.86		1	6,0	8.75
					1	11,5	**10.07**		1	11,5	8.88
		23130	711.0	QPSK	1	0,0	9.53	16-QAM	1	0,0	9.44
					1	6,0	9.55		1	6,0	9.58
					1	11,5	9.75		1	11,5	9.73

OUTPUT POWER

element
WTD.2017.11.22.1

LTE NB-IoT Results Bands 2, 4, 5, 12

Band	Channel	Channel Frequency	UL SCS	RB Allocation	RB start	Power (dBm)	UL SCS	RB Allocation	RB start	Power (dBm)
2	18600	1850.0	15	1	0	18.16	3.75	1	0	17.87
				1	5	**18.41**		1	23	18.08
				1	11	18.11		1	47	17.73
	18900	1880.0	15	1	0	17.90	3.75	1	0	17.64
				1	5	18.09		1	23	17.93
				1	11	17.91		1	47	17.71
	19199	1910.0	15	1	0	17.66	3.75	1	0	17.58
				1	5	17.78		1	23	17.81
				1	11	17.54		1	47	17.75
4	19950	1710.0	15	1	0	17.23	3.75	1	0	17.28
				1	5	17.50		1	23	17.97
				1	11	17.17		1	47	17.13
	20175	1732.5	15	1	0	17.24	3.75	1	0	17.19
				1	5	17.53		1	23	18.15
				1	11	17.26		1	47	17.24
	20399	1755.0	15	1	0	17.22	3.75	1	0	17.23
				1	5	17.76		1	23	**18.16**
				1	11	17.51		1	47	17.44
5	20400	824.0	15	1	0	13.31	3.75	1	0	13.04
				1	5	**13.65**		1	23	13.44
				1	11	13.35		1	47	13.24
	20525	836.5	15	1	0	12.54	3.75	1	0	12.20
				1	5	12.72		1	23	12.50
				1	11	12.42		1	47	12.33
	20649	849.0	15	1	0	11.70	3.75	1	0	11.47
				1	5	11.81		1	23	11.63
				1	11	11.79		1	47	11.50
12	23010	699.0	15	1	0	10.71	3.75	1	0	11.10
				1	5	11.14		1	23	**11.25**
				1	11	10.64		1	47	9.99
	23095	707.5	15	1	0	9.59	3.75	1	0	9.40
				1	5	9.61		1	23	10.10
				1	11	9.58		1	47	9.56
	23179	716.0	15	1	0	9.45	3.75	1	0	9.62
				1	5	9.66		1	23	9.99
				1	11	9.04		1	47	8.78

SAR TEST DATA – 2G GPRS AND EDGE

element
WSTD.2016.12.19

EUT:	Smart Connected Hub	Work Order:	ELEM0093
Customer:	Element Materials Technology	Job Site:	MN11
Attendees:	None	Customer Project:	None

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2020 FCC 2.1093:2020	FCC KDB 865664 D01 v01r04 FCC KDB 865664 D02 v01r02 FCC KDB 447498 D01 v06 FCC KDB 941225 D01 v03r01 IEEE Std 1528:2013

COMMENTS

All tests run with the reflective vest body-worn accessory. Per the manufacturer, this represents the worst-case scenario for EUT proximity to the human body.

DEVIATIONS FROM TEST STANDARD

None

RESULTS

Test Config.	Transmit Band	Transmit Freq. (MHz)	Transmit Channel	Transmit Mod.	Time Slots	EUT Position	SAR Drift During Test (dB)	Measured 1g SAR Level (mW/g)	Measured 10g SAR Level (mW/g)	SAR Scaling Factor	Scaled 1g SAR Level (mW/g)	Scaled 10g SAR Level (mW/g)	Test#
Body	**GSM-850**	**848.6**	**251**	**GMSK**	**3**	**Front**	**-0.18**	**0.98**	**0.64**	**1**	**0.98**	**0.64**	**GPRS 3A**
Body	GSM-850	848.6	251	GMSK	3	Connector side	-0.26	0.24	0.16	1	0.24	0.16	GPRS 3B
Body	GSM-850	848.6	251	GMSK	3	SIM card side	0.07	0.03	0.03	1	0.03	0.03	GPRS 3C
Body	GSM-850	848.6	251	GMSK	3	Back	-0.00	0.22	0.15	1	0.22	0.15	GPRS 3D
Body	**PCS-1900**	**1850.2**	**512**	**GMSK**	**4**	**Front**	**0.00**	**0.29**	**0.16**	**1**	**0.29**	**0.16**	**GPRS 4A**
Body	PCS-1900	1850.2	512	GMSK	4	Connector side	0.02	0.13	0.07	1	0.13	0.07	GPRS 4B
Body	PCS-1900	1850.2	512	GMSK	4	SIM card side	-0.04	0.03	0.02	1	0.03	0.02	GPRS 4C
Body	PCS-1900	1850.2	512	GMSK	4	Back	0.00	0.29	0.16	1	0.29	0.16	GPRS 4D

SAR TEST DATA – 2G GPRS AND EDGE

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.7°C
Date:	2020-01-20	Liquid Temperature (°C):	21.3°C
Serial Number:	C3	Humidity (%RH):	24.6%
Configuration:	ELEM0093-1	Bar. Pressure (mb):	1015.4 mb
Comments:	None		

GPRS 3A
DUT: Eleksen Smart Connected Hub; Type: M.28.R1.B1; Serial: SAR C3
Communication System: UID 0, Generic GSM (0); Communication System Band: GSM 850 (824.0 - 849.0 MHz); Frequency: 848.6 MHz;Communication System PAR: 9.191 dB; PMF: 2.88104
Medium parameters used (interpolated): f = 848.6 MHz; σ = 1.011 S/m; ε_r = 52.201; ρ = 1000 kg/m^3 , Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(9.06, 9.06, 9.06) @ 848.6 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 3mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 31.0, 106.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Body/Body/Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.38 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 1.52 W/kg
SAR(1 g) = 0.977 W/kg; SAR(10 g) = 0.643 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.11 W/kg

Body/Body/Area scan (41x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.25 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of Total (measured) = 24.20 V/m

Body/Body/Reference scan (41x51x1): Interpolated grid: dx=3.000 mm, dy=3.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.13 W/kg

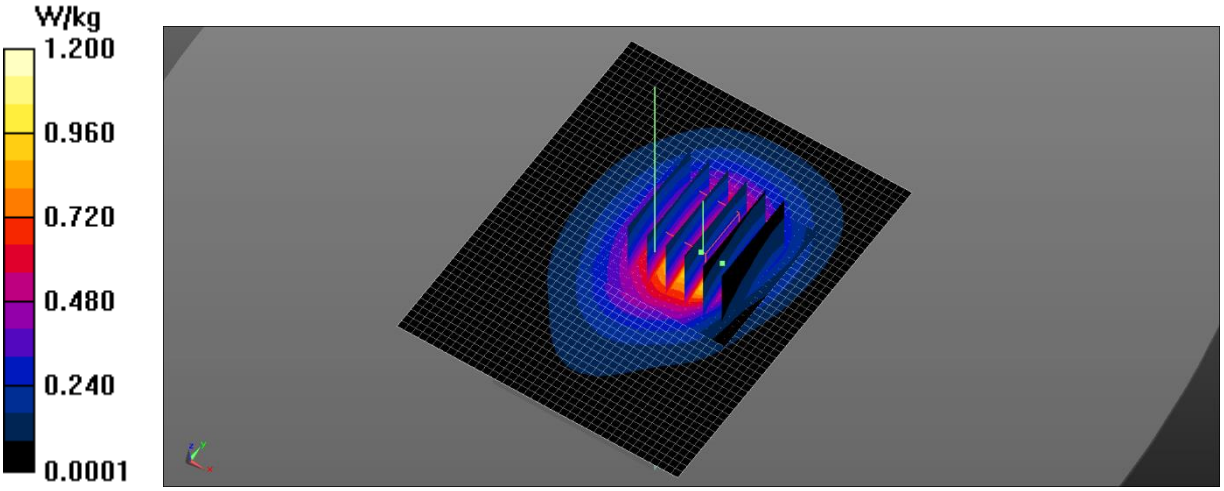
Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.592 W/kg

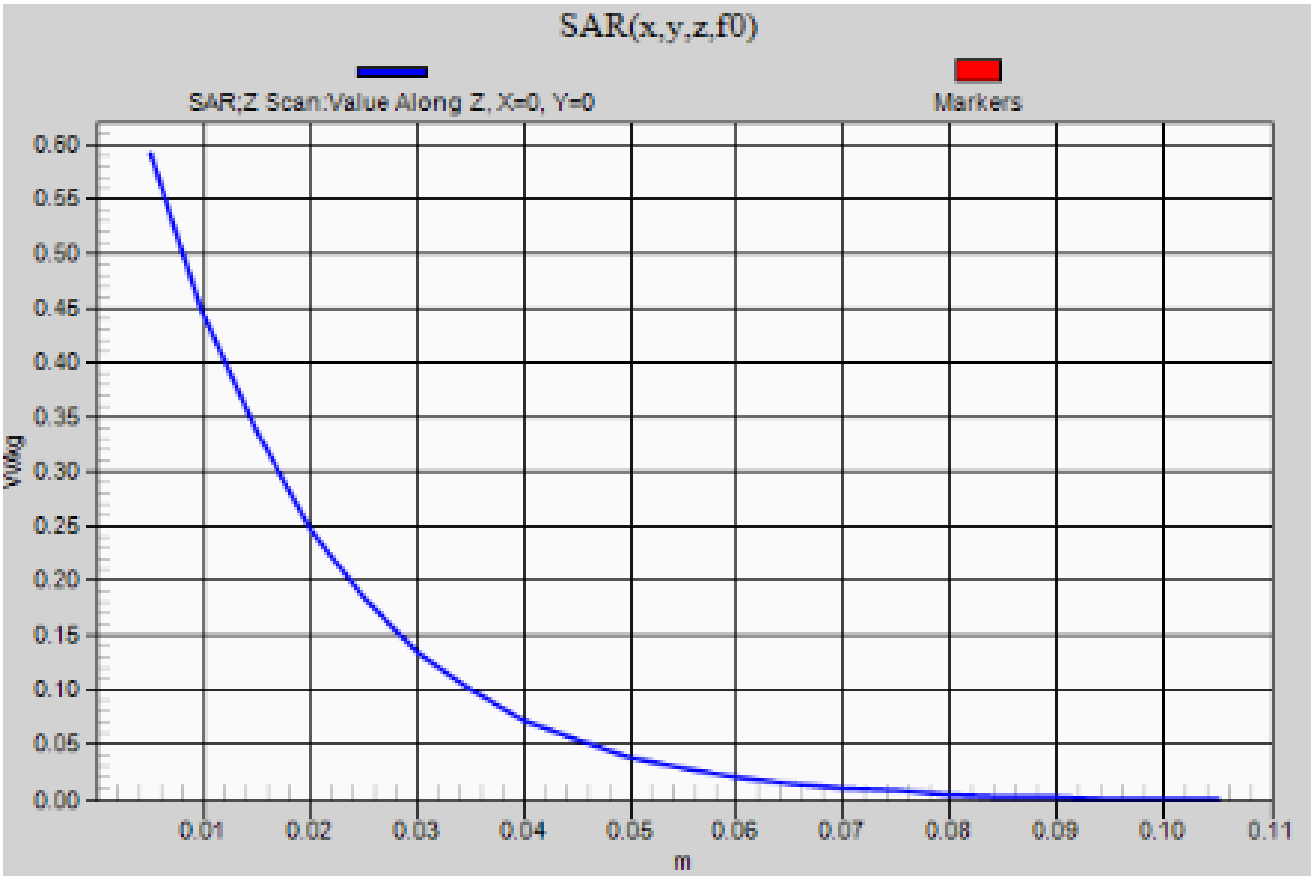
Approved By

SAR TEST DATA – 2G GPRS AND EDGE

GPRS 3A



SAR TEST DATA – 2G GPRS AND EDGE



SAR TEST DATA – 2G GPRS AND EDGE

element
WSTD.2016.12.19

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.7°C
Date:	2020-01-20	Liquid Temperature (°C):	21.3°C
Serial Number:	C3	Humidity (%RH):	24.6%
Configuration:	ELEM0093-1	Bar. Pressure (mb):	1015.4 mb
Comments:	None		

GPRS 4A
DUT: Eleksen Smart Connected Hub; Type: M.28.R1.B1; Serial: SAR C3
Communication System: UID 0, GPRS and Edge (0); Communication System Band: PCS 1900; Frequency: 1850.2 MHz;Communication System PAR: 9.2 dB; PMF: 2.88403
Medium parameters used (interpolated): f = 1850.2 MHz; σ = 1.555 S/m; ε_r = 50.356; ρ = 1000 kg/m^3 , Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(7.44, 7.44, 7.44) @ 1850.2 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 3mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 31.0, 106.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Body/Body/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.08 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.484 W/kg
SAR(1 g) = 0.289 W/kg; SAR(10 g) = 0.156 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.357 W/kg

Body/Body/Area scan (41x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.350 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of Total (measured) = 12.15 V/m

Body/Body/Reference scan (41x51x1): Interpolated grid: dx=3.000 mm, dy=3.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.332 W/kg

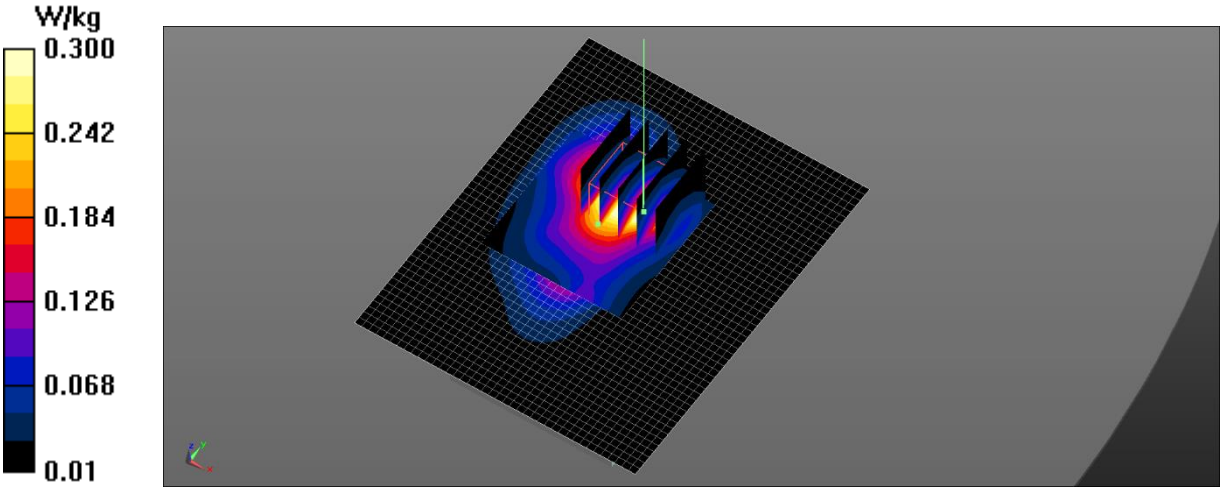
Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.229 W/kg

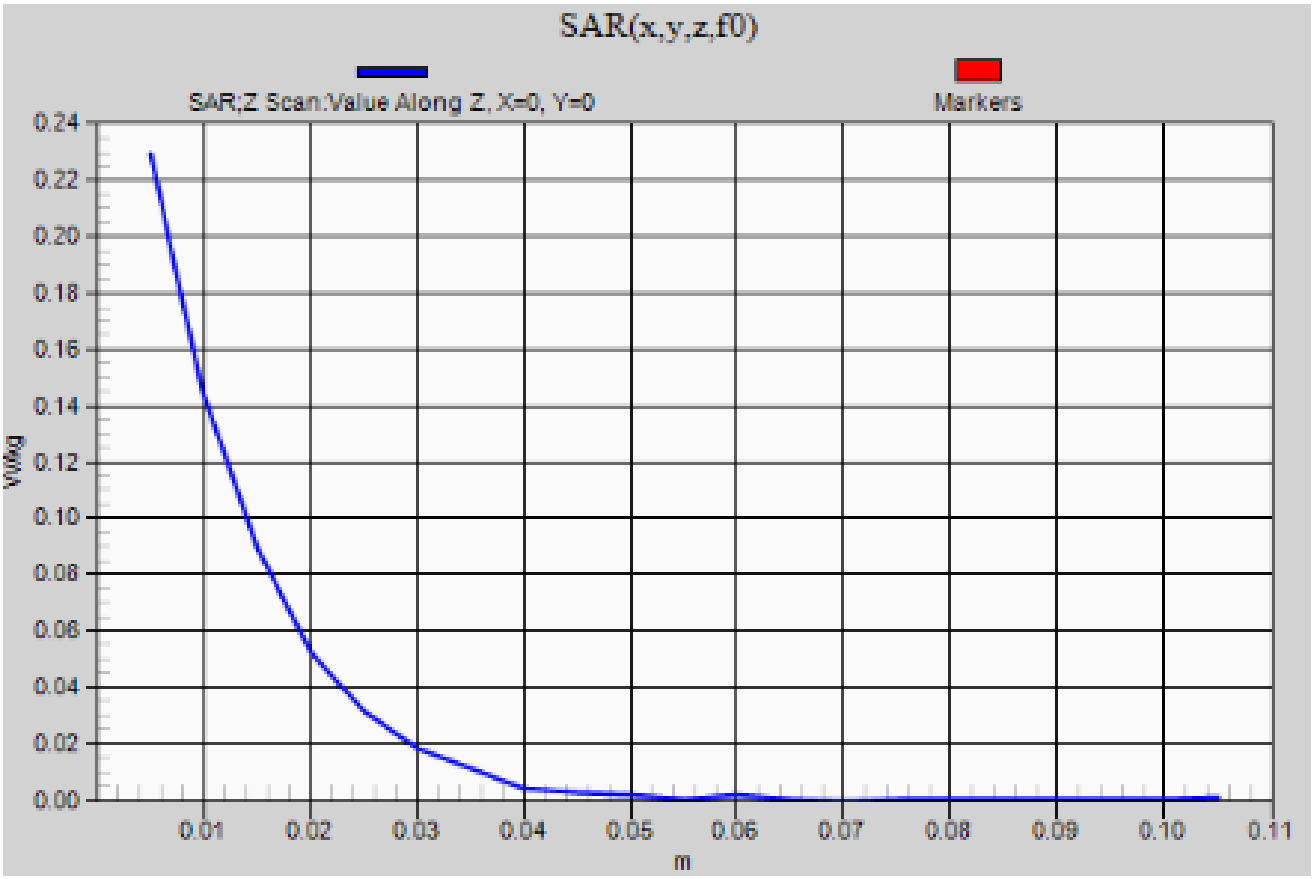
Approved By

SAR TEST DATA – 2G GPRS AND EDGE

GPRS 4A



SAR TEST DATA – 2G GPRS AND EDGE



SAR TEST DATA – LTE CATEGORY M1

element
WSTD.2016.12.19

EUT:	Smart Connected Hub	Work Order:	ELEM0093
Customer:	Element Materials Technology	Job Site:	MN11
Attendees:	None	Customer Project:	None

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2020 FCC 2.1093:2020	FCC KDB 865664 D01 v01r04 FCC KDB 865664 D02 v01r02 FCC KDB 941225 D05 v02r05 FCC KDB 447498 D01 v06 IEEE Std 1528:2013

COMMENTS

All tests run with the reflective vest body-worn accessory. Per the manufacturer, this represents the worst-case scenario for EUT proximity to the human body.

N/A on a SAR drift measurement indicates the signal seen by the probe was at noise floor levels, therefore a SAR drift measurement was not possible.

DEVIATIONS FROM TEST STANDARD

None

RESULTS

Test Config.	Freq. Band	Transmit Freq. (MHz)	Transmit Channel	Transmit Mod.	Bandwidth, NB Index, and Start RB	RBs	EUT Position	SAR Drift During Test (dB)	Measured 1g SAR Level (mW/g)	Measured 10g SAR Level (mW/g)	SAR Scaling Factor	Scaled 1g SAR Level (mW/g)	Scaled 10g SAR Level (mW/g)	Test#
Body	LTE Band 2	1860	18700	QPSK	20 MHz, NB 0, RB 0	1	Front	0.34	0.04	0.02	1	0.04	0.02	Cat M1 1A
Body	**LTE Band 2**	**1860**	**18700**	**QPSK**	**20 MHz, NB 0, RB 0**	**1**	**Connector Side**	**0.04**	**0.06**	**0.03**	**1**	**0.06**	**0.03**	**Cat M1 1B**
Body	LTE Band 2	1860	18700	QPSK	20 MHz, NB 0, RB 0	1	SIM Card Side	0.24	0.01	<0.01	1	0.01	<0.01	Cat M1 1C
Body	LTE Band 2	1860	18700	QPSK	20 MHz, NB 0, RB 0	1	Back	0.17	0.03	0.02	1	0.03	0.02	Cat M1 1D
Body	**LTE Band 4**	**1745**	**20300**	**QPSK**	**20 MHz, NB 15, RB 0**	**1**	**Front**	**0.14**	**0.08**	**0.05**	**1**	**0.08**	**0.05**	**Cat M1 3A**
Body	LTE Band 4	1745	20300	QPSK	20 MHz, NB 15, RB 0	1	Connector Side	0.03	0.07	0.04	1	0.07	0.04	Cat M1 3B
Body	LTE Band 4	1745	20300	QPSK	20 MHz, NB 15, RB 0	1	SIM Card Side	<0.01	<0.01	-0.35	1	<0.01	-0.35	Cat M1 3C
Body	LTE Band 4	1745	20300	QPSK	20 MHz, NB 15, RB 0	1	Back	0.14	0.08	0.5	1	0.08	0.5	Cat M1 3D
Body	**LTE Band 5**	**829**	**20450**	**QPSK**	**10 MHz, NB 4, RB 0**	**1**	**Front**	**0.13**	**0.12**	**0.08**	**1**	**0.12**	**0.08**	**Cat M1 4A**
Body	LTE Band 5	829	20450	QPSK	10 MHz, NB 4, RB 0	1	Connector Side	0.05	0.09	0.05	1	0.09	0.05	Cat M1 4B
Body	LTE Band 5	829	20450	QPSK	10 MHz, NB 4, RB 0	1	SIM Card Side	-0.14	<0.01	<0.01	1	<0.01	<0.01	Cat M1 4C
Body	LTE Band 5	829	20450	QPSK	10 MHz, NB 4, RB 0	1	Back	0.11	0.07	0.05	1	0.07	0.05	Cat M1 4D
Body	**LTE Band 12**	**707.5**	**23095**	**QPSK**	**10 MHz, NB 7, RB 5**	**1**	**Front**	**-0.08**	**0.12**	**0.08**	**1**	**0.12**	**0.08**	**Cat M1 6A**
Body	LTE Band 12	707.5	23095	QPSK	10 MHz, NB 7, RB 5	1	Connector Side	-0.08	0.08	0.04	1	0.08	0.04	Cat M1 6B
Body	LTE Band 12	707.5	23095	QPSK	10 MHz, NB 7, RB 5	1	SIM Card Side	0.11	<0.01	<0.01	1	<0.01	<0.01	Cat M1 6C
Body	LTE Band 12	707.5	23095	QPSK	10 MHz, NB 7, RB 5	1	Back	0.23	0.02	0.01	1	0.02	0.01	Cat M1 6D

SAR TEST DATA – LTE CATEGORY M1

element
WSTD.2016.12.19

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.7°C
Date:	2020-01-16	Liquid Temperature (°C):	21.3°C
Serial Number:	C3	Humidity (%RH):	24.6%
Configuration:	ELEM0093-1	Bar. Pressure (mb):	1015.4 mb
Comments:	None		

Cat M1 1B
DUT: Eleksen Smart Connected Hub; Type: M.28.R1.B1; Serial: SAR C3
Communication System: UID 0, LTE-FDD (0); Communication System Band: Band 2; Frequency: 1860 MHz;Communication System PAR: 0 dB; PMF: 1.12202e-005
Medium parameters used (interpolated): f = 1860 MHz; σ = 1.562 S/m; ε_r = 50.344; ρ = 1000 kg/m^3 , Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(7.44, 7.44, 7.44) @ 1860 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 3mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 31.0, 106.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Body/Body/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.968 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.0980 W/kg
SAR(1 g) = 0.059 W/kg; SAR(10 g) = 0.032 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0713 W/kg

Body/Body/Area scan (41x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.0666 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of Total (measured) = 5.474 V/m

Body/Body/Reference scan (51x31x1): Interpolated grid: dx=3.000 mm, dy=3.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.0600 W/kg

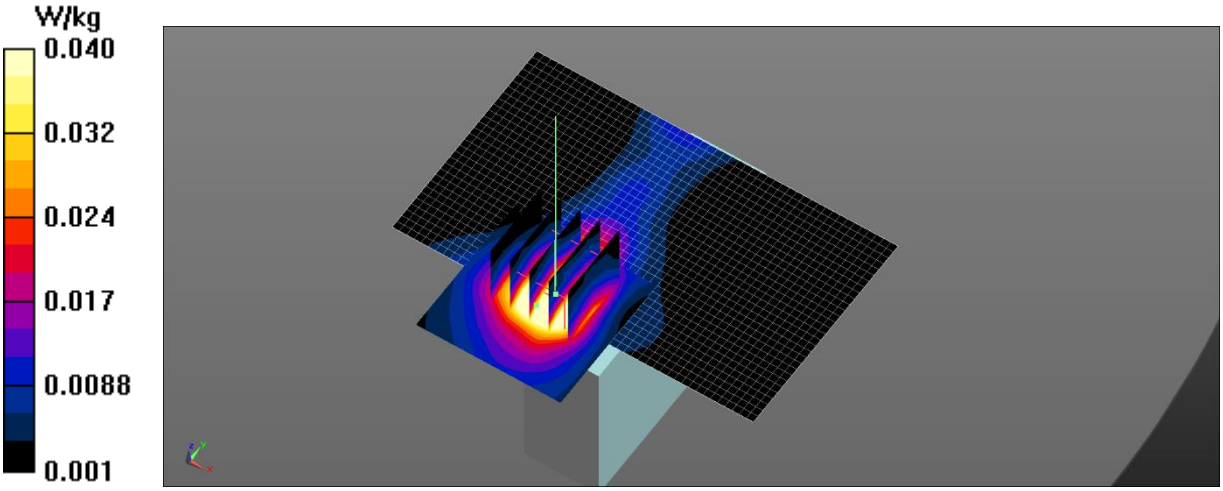
Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0468 W/kg

Approved By

SAR TEST DATA – LTE CATEGORY M1

Cat M1 1B



SAR TEST DATA – LTE CATEGORY M1

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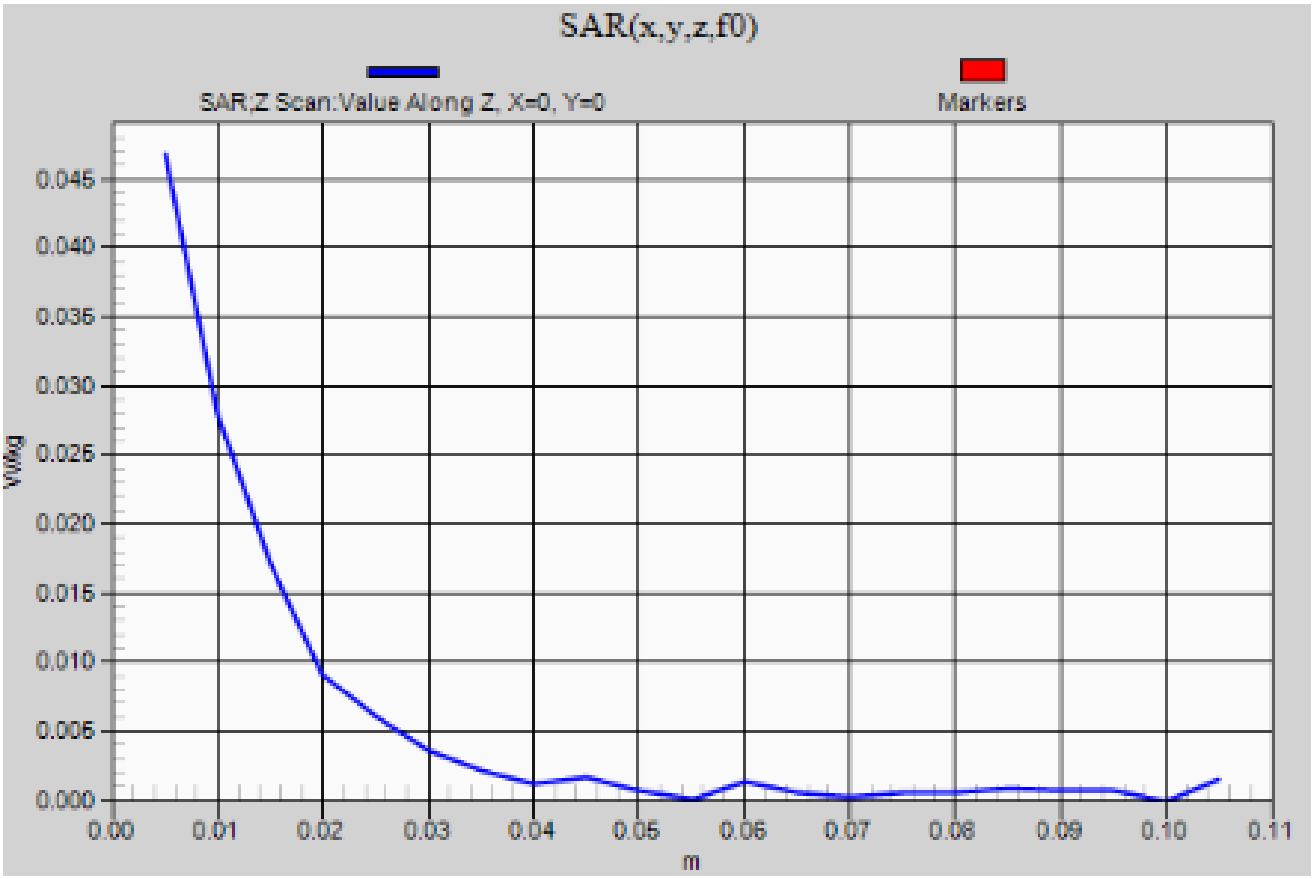


SAR TEST DATA – LTE CATEGORY M1

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.7°C
Date:	2020-01-16	Liquid Temperature (°C):	21.3°C
Serial Number:	C3	Humidity (%RH):	24.6%
Configuration:	ELEM0093-1	Bar. Pressure (mb):	1015.4 mb
Comments:	None		

Cat M1 3A
DUT: Eleksen Smart Connected Hub; Type: M.28.R1.B1; Serial: SAR C3
Communication System: UID 0, LTE-FDD (0); Communication System Band: Band 4; Frequency: 1745 MHz;Communication System PAR: 0 dB; PMF: 1.12202e-005
Medium parameters used (interpolated): f = 1745 MHz; σ = 1.487 S/m; ε_r = 50.506; ρ = 1000 kg/m^3 , Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(7.67, 7.67, 7.67) @ 1745 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 3mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 31.0, 106.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Body/Body/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 7.901 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.128 W/kg
SAR(1 g) = 0.080 W/kg; SAR(10 g) = 0.046 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0923 W/kg

Body/Body/Area scan (41x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.106 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of Total (measured) = 6.377 V/m

Body/Body/Reference scan (41x51x1): Interpolated grid: dx=3.000 mm, dy=3.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.0772 W/kg

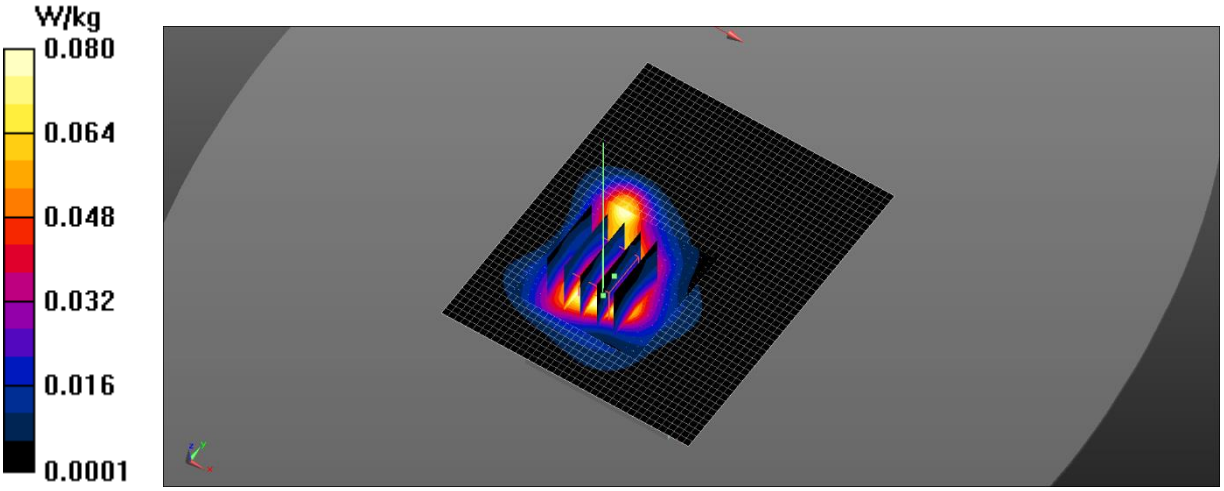
Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0604 W/kg

Approved By

SAR TEST DATA – LTE CATEGORY M1

Cat M1 3A



SAR TEST DATA – LTE CATEGORY M1

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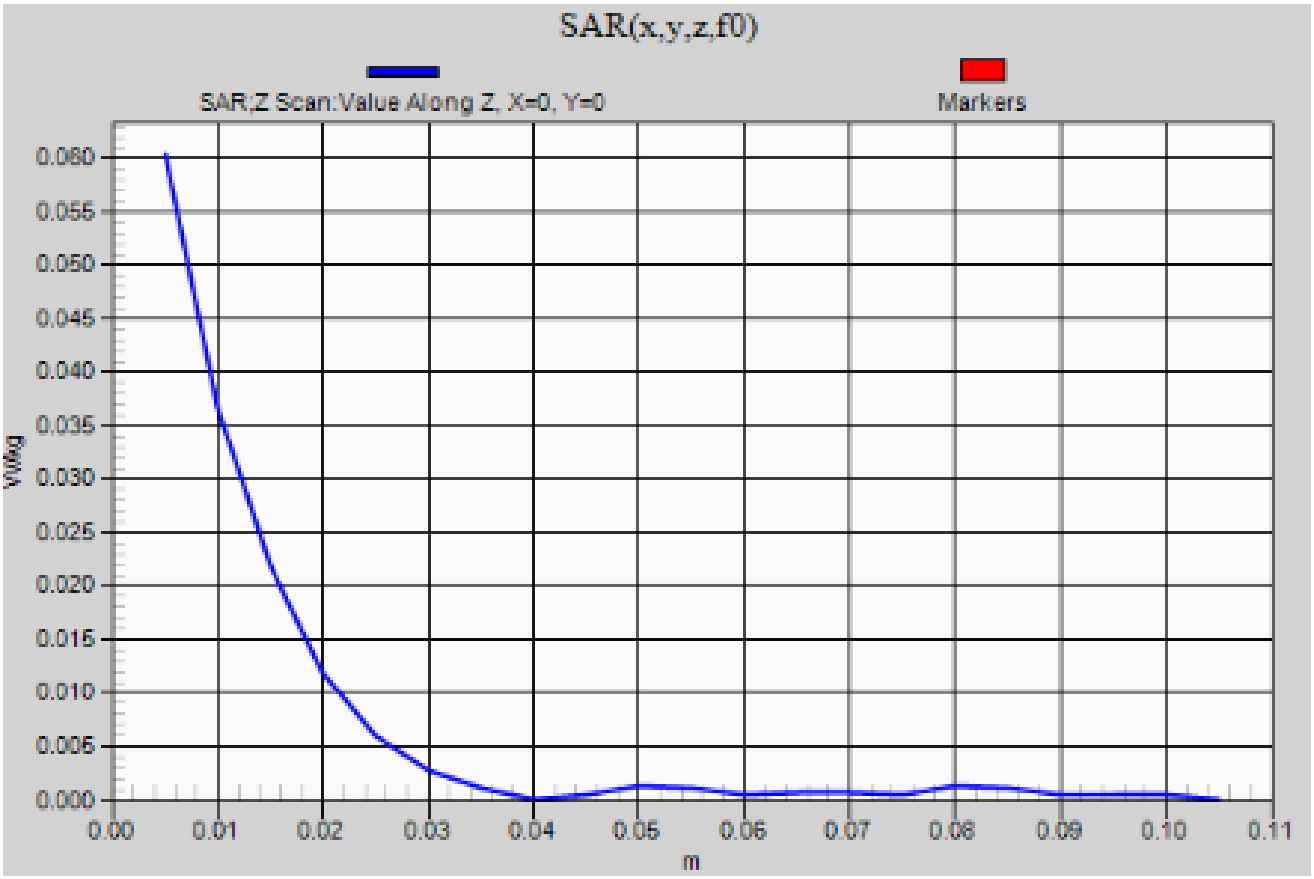


SAR TEST DATA – LTE CATEGORY M1

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.7°C
Date:	2020-01-16	Liquid Temperature (°C):	21.3°C
Serial Number:	C3	Humidity (%RH):	24.6%
Configuration:	ELEM0093-1	Bar. Pressure (mb):	1015.4 mb
Comments:	None		

Cat M1 4A
DUT: Eleksen Smart Connected Hub; Type: M.28.R1.B1; Serial: SAR C3
Communication System: UID 0, LTE-FDD (0); Communication System Band: Band 5; Frequency: 829 MHz;Communication System PAR: 0 dB; PMF: 1.12202e-005
Medium parameters used (interpolated): f = 829 MHz; σ = 1.002 S/m; ε_r = 52.253; ρ = 1000 kg/m^3 , Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(9.06, 9.06, 9.06) @ 829 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 3mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 31.0, 106.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Body/Body/Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.77 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 0.174 W/kg
SAR(1 g) = 0.123 W/kg; SAR(10 g) = 0.084 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.138 W/kg

Body/Body/Area scan (41x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.151 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of Total (measured) = 9.890 V/m

Body/Body/Reference scan (41x51x1): Interpolated grid: dx=3.000 mm, dy=3.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.136 W/kg

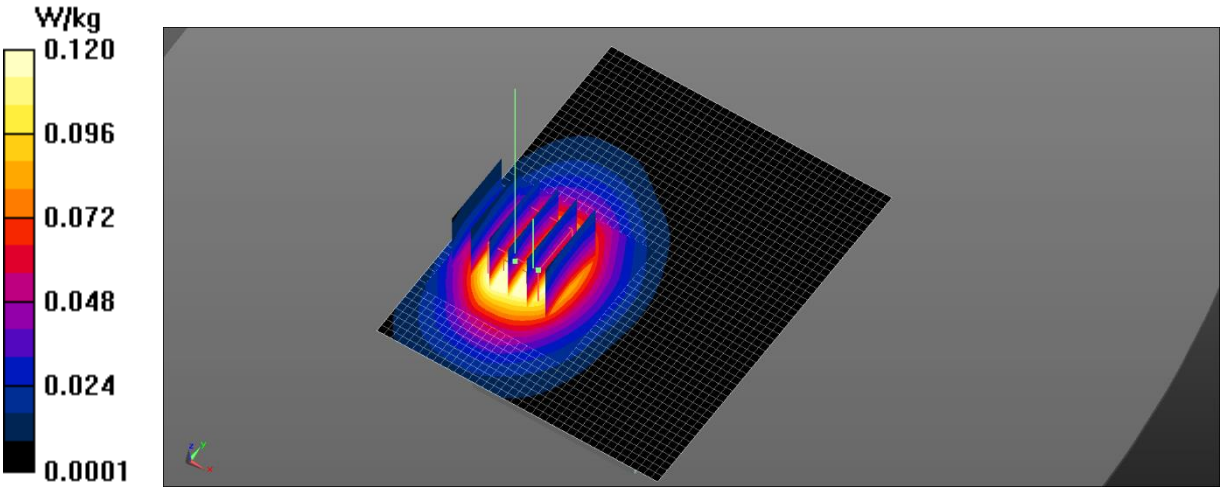
Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0980 W/kg

Approved By

SAR TEST DATA – LTE CATEGORY M1

Cat M1 4A



SAR TEST DATA – LTE CATEGORY M1

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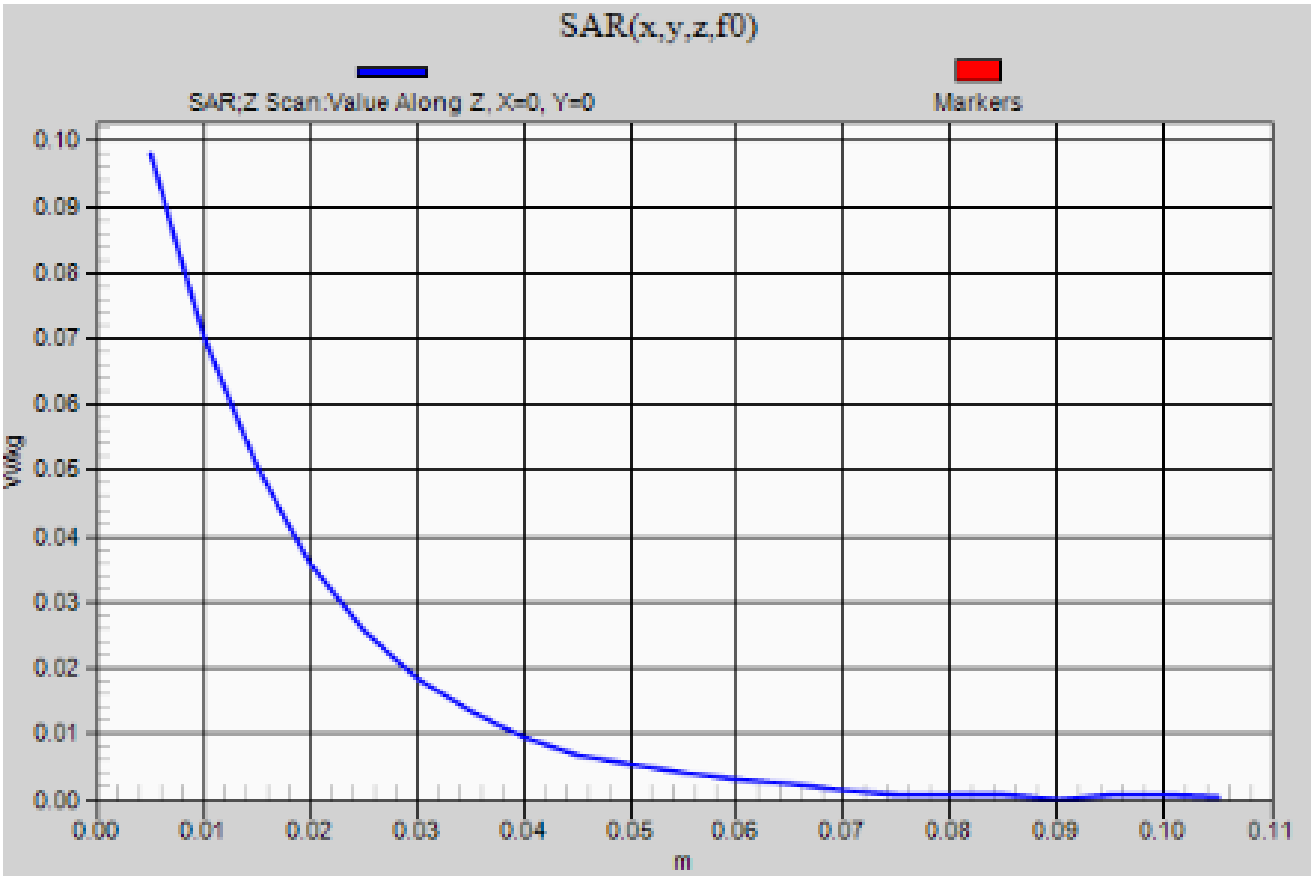


SAR TEST DATA – LTE CATEGORY M1

element
WSTD.2016.12.19

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.7°C
Date:	2020-01-16	Liquid Temperature (°C):	21.3°C
Serial Number:	C3	Humidity (%RH):	24.6%
Configuration:	ELEM0093-1	Bar. Pressure (mb):	1015.4 mb
Comments:	None		

Cat M1 6A
DUT: Eleksen Smart Connected Hub; Type: M.28.R1.B1; Serial: SAR C3
Communication System: UID 0, LTE-FDD (0); Communication System Band: Band 12; Frequency: 707.5 MHz;Communication System PAR: 0 dB; PMF: 1.12202e-005
Medium parameters used (interpolated): f = 707.5 MHz; σ = 0.956 S/m; ε_r = 52.6; ρ = 1000 kg/m^3 , Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(9.3, 9.3, 9.3) @ 707.5 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 3mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 31.0, 106.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Body/Body/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.42 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.199 W/kg
SAR(1 g) = 0.116 W/kg; SAR(10 g) = 0.073 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.142 W/kg

Body/Body/Area scan (41x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.143 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of Total (measured) = 9.540 V/m

Body/Body/Reference scan (41x51x1): Interpolated grid: dx=3.000 mm, dy=3.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.168 W/kg

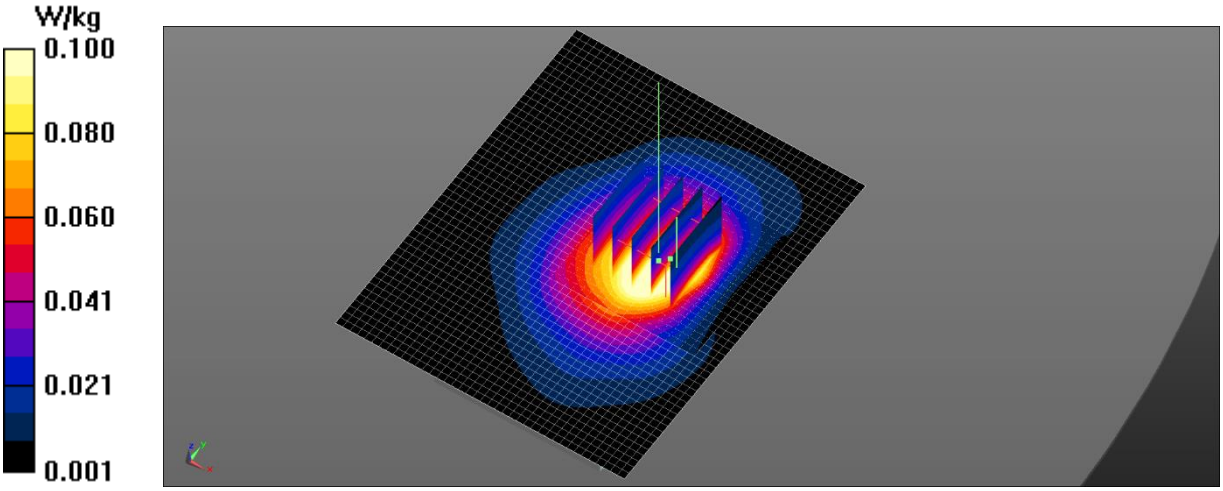
Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0870 W/kg

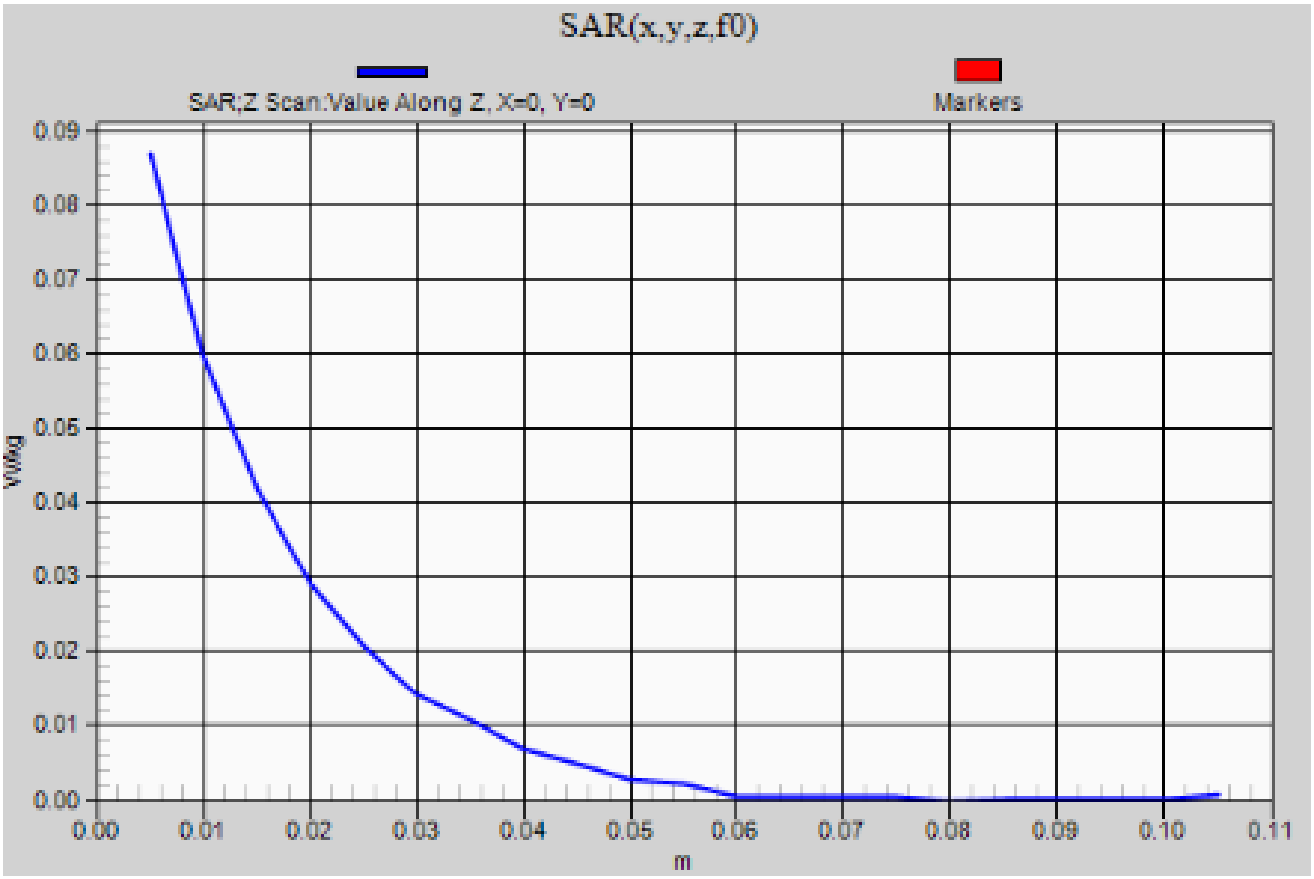
Approved By

SAR TEST DATA – LTE CATEGORY M1

Cat M1 6A



SAR TEST DATA – LTE CATEGORY M1



SAR TEST DATA – NB-IOT

element
WSTD.2016.12.19

EUT:	Smart Connected Hub	Work Order:	ELEM0093
Customer:	Element Materials Technology	Job Site:	MN11
Attendees:	None	Customer Project:	None

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2020 FCC 2.1093:2020	FCC KDB 865664 D01 v01r04 FCC KDB 865664 D02 v01r02 FCC KDB 941225 D05 v02r05 FCC KDB 447498 D01 v06 IEEE Std 1528:2013

COMMENTS

All tests run with the reflective vest body-worn accessory. Per the manufacturer, this represents the worst-case scenario for EUT proximity to the human body.

N/A on a SAR drift measurement indicates the signal seen by the probe was at noise floor levels, therefore a SAR drift measurement was not possible.

DEVIATIONS FROM TEST STANDARD

None

RESULTS

Test Config.	Freq. Band	Transmit Freq. (MHz)	Transmit Channel	Transmit Mod.	Subcarrier Spacing and RBs	EUT Position	SAR Drift During Test (dB)	Measured 1g SAR Level (mW/g)	Measured 10g SAR Level (mW/g)	SAR Scaling Factor	Scaled 1g SAR Level (mW/g)	Scaled 10g SAR Level (mW/g)	Test#
Body	**LTE Band 2**	**1850**	**18600**	**QPSK**	**15 kHz, 1 RB**	**Front**	**-0.12**	**0.06**	**0.04**	**1**	**0.06**	**0.04**	**NBIoT 1A**
Body	LTE Band 2	1850	18600	QPSK	15 kHz, 1 RB	Connector Side	0.20	0.05	0.03	1	0.05	0.03	NBIoT 1B
Body	LTE Band 2	1850	18600	QPSK	15 kHz, 1 RB	SIM Card Side	0.38	<0.01	<0.01	1	<0.01	<0.01	NBIoT 1C
Body	LTE Band 2	1850	18600	QPSK	15 kHz, 1 RB	Back	-0.10	<0.01	<0.01	1	<0.01	<0.01	NBIoT 1D
Body	LTE Band 4	1755	20399	QPSK	15 kHz, 1 RB	Front	0.03	0.20	0.11	1	0.20	0.11	NBIoT 3A
Body	LTE Band 4	1755	20399	QPSK	15 kHz, 1 RB	Connector Side	0.07	0.07	0.04	1	0.07	0.04	NBIoT 3B
Body	LTE Band 4	1755	20399	QPSK	15 kHz, 1 RB	SIM Card Side	0.50	0.01	0.01	1	0.01	0.01	NBIoT 3C
Body	**LTE Band 4**	**1755**	**20399**	**QPSK**	**15 kHz, 1 RB**	**Back**	**-0.12**	**0.21**	**0.12**	**1**	**0.21**	**0.12**	**NBIoT 3D**
Body	**LTE Band 5**	**824**	**20400**	**QPSK**	**15 kHz, 1 RB**	**Front**	**-0.04**	**0.03**	**0.02**	**1**	**0.03**	**0.02**	**NBIoT 4A**
Body	LTE Band 5	824	20400	QPSK	15 kHz, 1 RB	Connector Side	-0.30	0.01	<0.01	1	0.01	<0.01	NBIoT 4B
Body	LTE Band 5	824	20400	QPSK	15 kHz, 1 RB	SIM Card Side	N/A*	<0.01	<0.01	1	<0.01	<0.01	NBIoT 4C
Body	LTE Band 5	824	20400	QPSK	15 kHz, 1 RB	Back	0.35	0.01	0.01	1	0.01	0.01	NBIoT 4D
Body	LTE Band 12	699	23010	QPSK	15 kHz, 1 RB	Front	-0.41	0.01	0.01	1.05	0.01	0.01	NBIoT 6A
Body	LTE Band 12	699	23010	QPSK	15 kHz, 1 RB	Connector Side	0.41	<0.01	<0.01	1.05	0.01	0.01	NBIoT 6B
Body	LTE Band 12	699	23010	QPSK	15 kHz, 1 RB	SIM Card Side	N/A*	<0.01	<0.01	1.05	0.01	0.01	NBIoT 6C
Body	**LTE Band 12**	**699**	**23010**	**QPSK**	**15 kHz, 1 RB**	**Back**	**0.19**	**0.02**	**0.02**	**1.05**	**0.02**	**0.02**	**NBIoT 6D**

SAR TEST DATA – NB-IOT

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.7°C
Date:	2020-01-16	Liquid Temperature (°C):	21.3°C
Serial Number:	C1	Humidity (%RH):	24.6%
Configuration:	ELEM0093-2	Bar. Pressure (mb):	1015.4 mb
Comments:	None		

NBIoT 1A
DUT: Eleksen Smart Connected Hub; Type: M.28.R1.B1; Serial: SAR C1
Communication System: UID 0, LTE-FDD (0); Communication System Band: Band 2; Frequency: 1850 MHz;Communication System PAR: 0 dB; PMF: 1.12202e-005
Medium parameters used: f = 1850 MHz; σ = 1.555 S/m; ε_r = 50.356; ρ = 1000 kg/m^3 , Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(7.44, 7.44, 7.44) @ 1850 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 3mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 31.0, 106.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Body/Body/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.972 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 0.119 W/kg
SAR(1 g) = 0.062 W/kg; SAR(10 g) = 0.037 W/kg (SAR corrected for target medium)
Maximum value of SAR (measured) = 0.0758 W/kg

Body/Body/Area scan (41x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.0750 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of Total (measured) = 5.514 V/m

Body/Body/Reference scan (41x51x1): Interpolated grid: dx=3.000 mm, dy=3.000 mm
Maximum value of SAR (interpolated) = 0.0777 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm
Maximum value of SAR (measured) = 0.0473 W/kg

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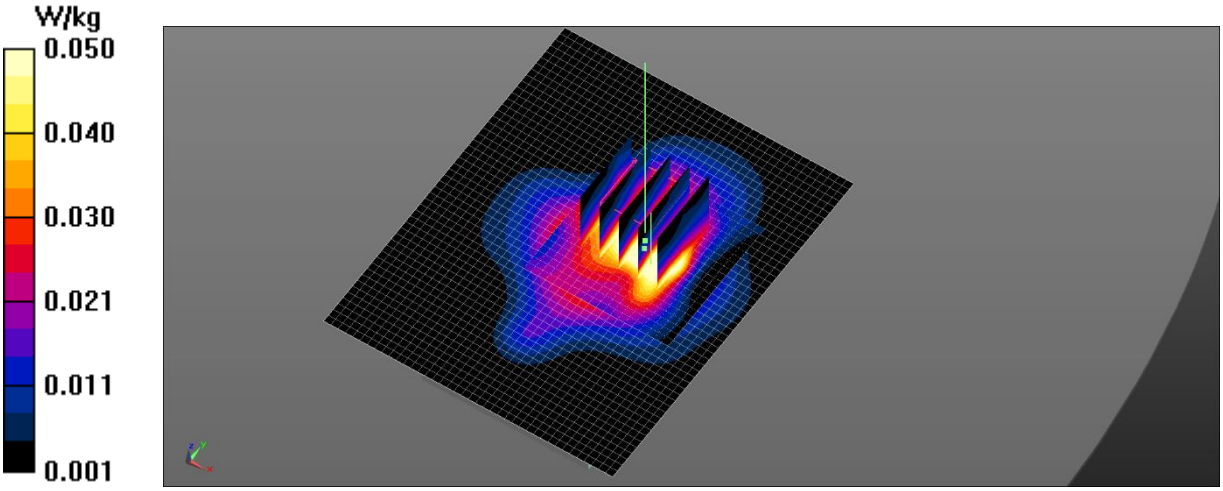
SAR TEST DATA – NB-IOT

NBIoT 1A



SAR TEST DATA – NB-IOT

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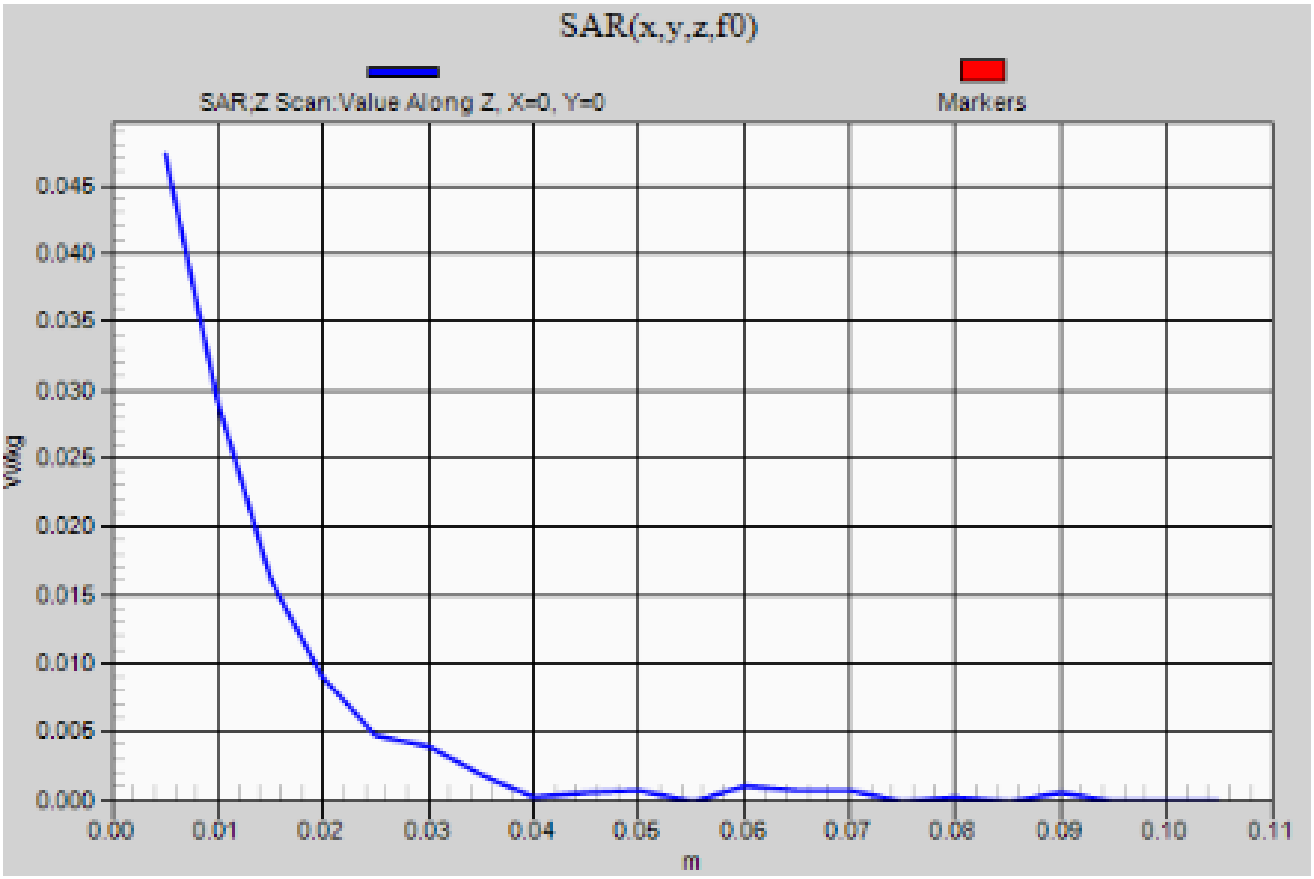

SAR TEST DATA – NB-IOT

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.7°C
Date:	2020-01-16	Liquid Temperature (°C):	21.3°C
Serial Number:	C1	Humidity (%RH):	24.6%
Configuration:	ELEM0093-2	Bar. Pressure (mb):	1015.4 mb
Comments:	None		

NBIoT 3D
DUT: Eleksen Smart Connected Hub; Type: M.28.R1.B1; Serial: SAR C1
Communication System: UID 0, LTE-FDD (0); Communication System Band: Band 4; Frequency: 1754.9 MHz;Communication System PAR: 0 dB; PMF: 1.12202e-005
Medium parameters used (interpolated): f = 1754.9 MHz; σ = 1.493 S/m; ε_r = 50.497; ρ = 1000 kg/m^3 , Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(7.67, 7.67, 7.67) @ 1754.9 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 3mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 31.0, 106.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Body/Body/Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.32 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 0.339 W/kg
SAR(1 g) = 0.214 W/kg; SAR(10 g) = 0.119 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.243 W/kg

Body/Body/Area scan (41x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.275 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of Total (measured) = 10.33 V/m

Body/Body/Reference scan (41x51x1): Interpolated grid: dx=3.000 mm, dy=3.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.200 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.159 W/kg

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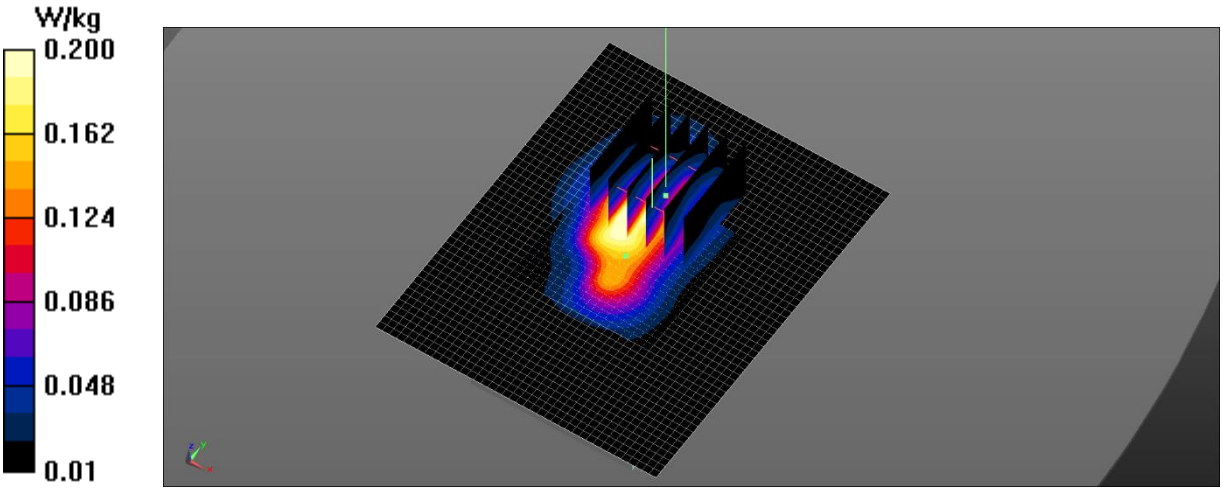
SAR TEST DATA – NB-IOT

NBIoT 3D



SAR TEST DATA – NB-IOT

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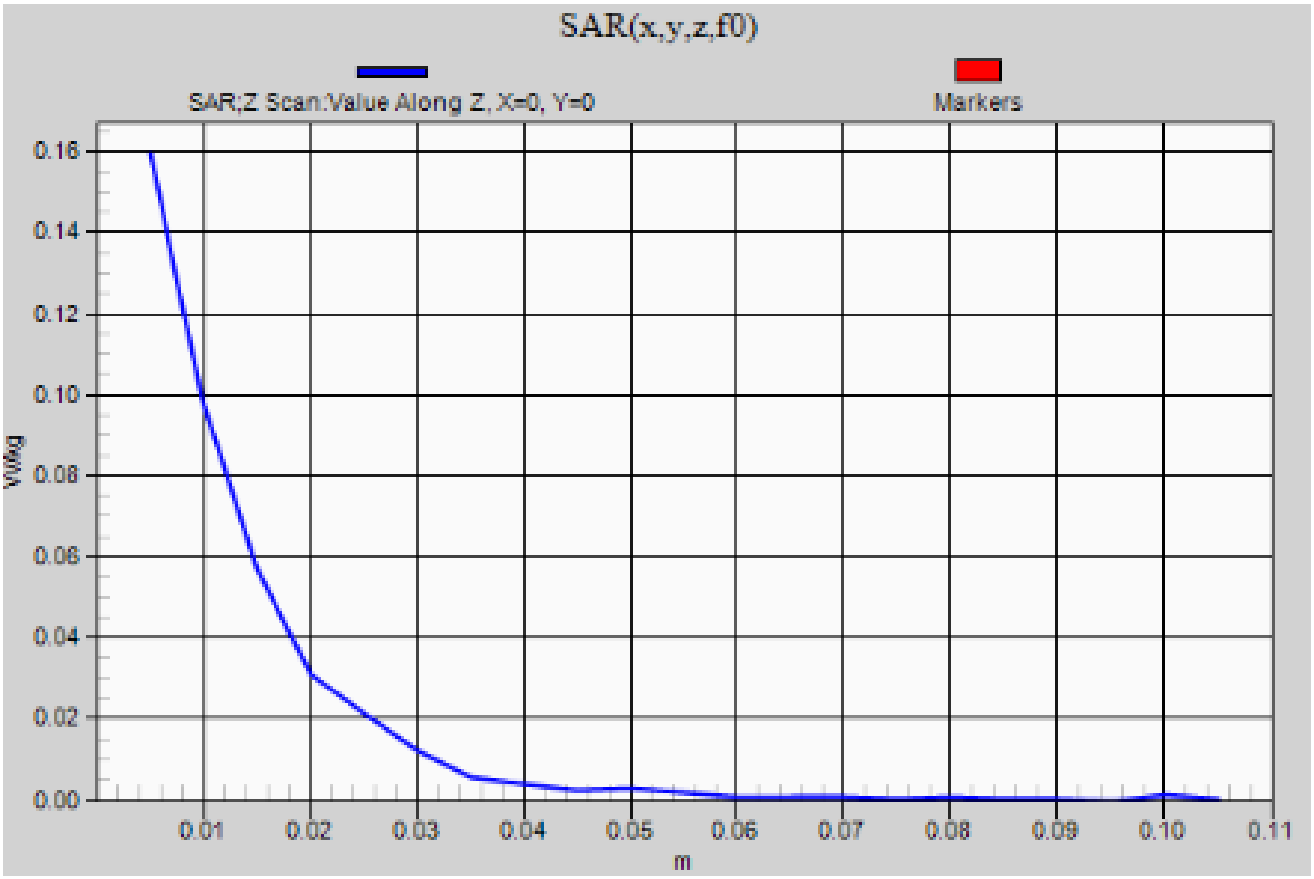

SAR TEST DATA – NB-IOT

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.7°C
Date:	2020-01-16	Liquid Temperature (°C):	21.3°C
Serial Number:	C1	Humidity (%RH):	24.6%
Configuration:	ELEM0093-2	Bar. Pressure (mb):	1015.4 mb
Comments:	None		

NBIoT 4A
DUT: Eleksen Smart Connected Hub; Type: M.28.R1.B1; Serial: SAR C1
Communication System: UID 0, LTE-FDD (0); Communication System Band: Band 5; Frequency: 824 MHz;Communication System PAR: 0 dB; PMF: 1.12202e-005
Medium parameters used (interpolated): f = 824 MHz; σ = 1 S/m; ε_r = 52.267; ρ = 1000 kg/m^3 , Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(9.06, 9.06, 9.06) @ 824 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 3mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 31.0, 106.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Body/Body/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.222 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.0480 W/kg
SAR(1 g) = 0.030 W/kg; SAR(10 g) = 0.020 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0357 W/kg

Body/Body/Area scan (41x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.0402 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of Total (measured) = 4.832 V/m

Body/Body/Reference scan (41x51x1): Interpolated grid: dx=3.000 mm, dy=3.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.0346 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0233 W/kg

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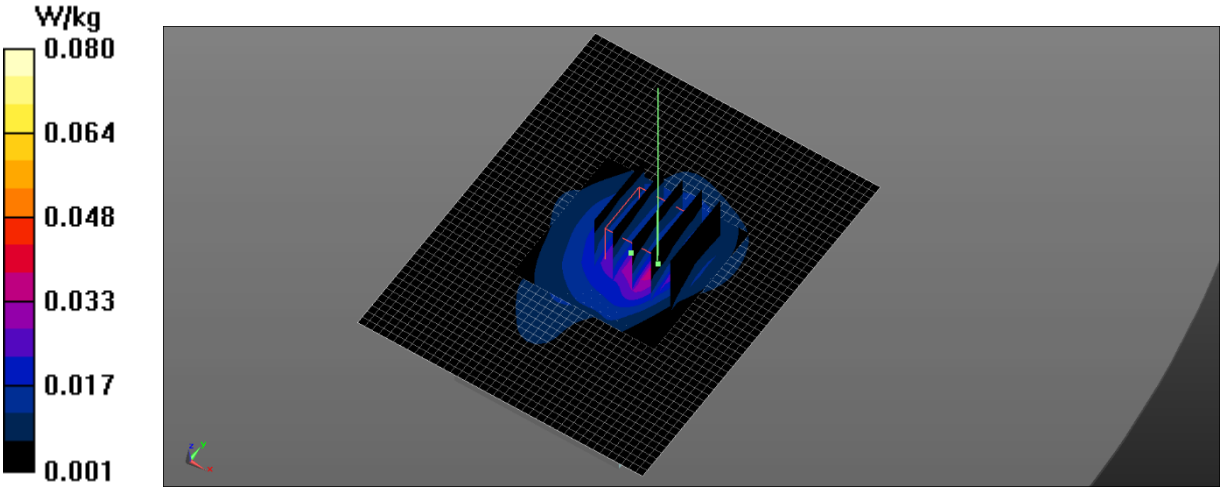
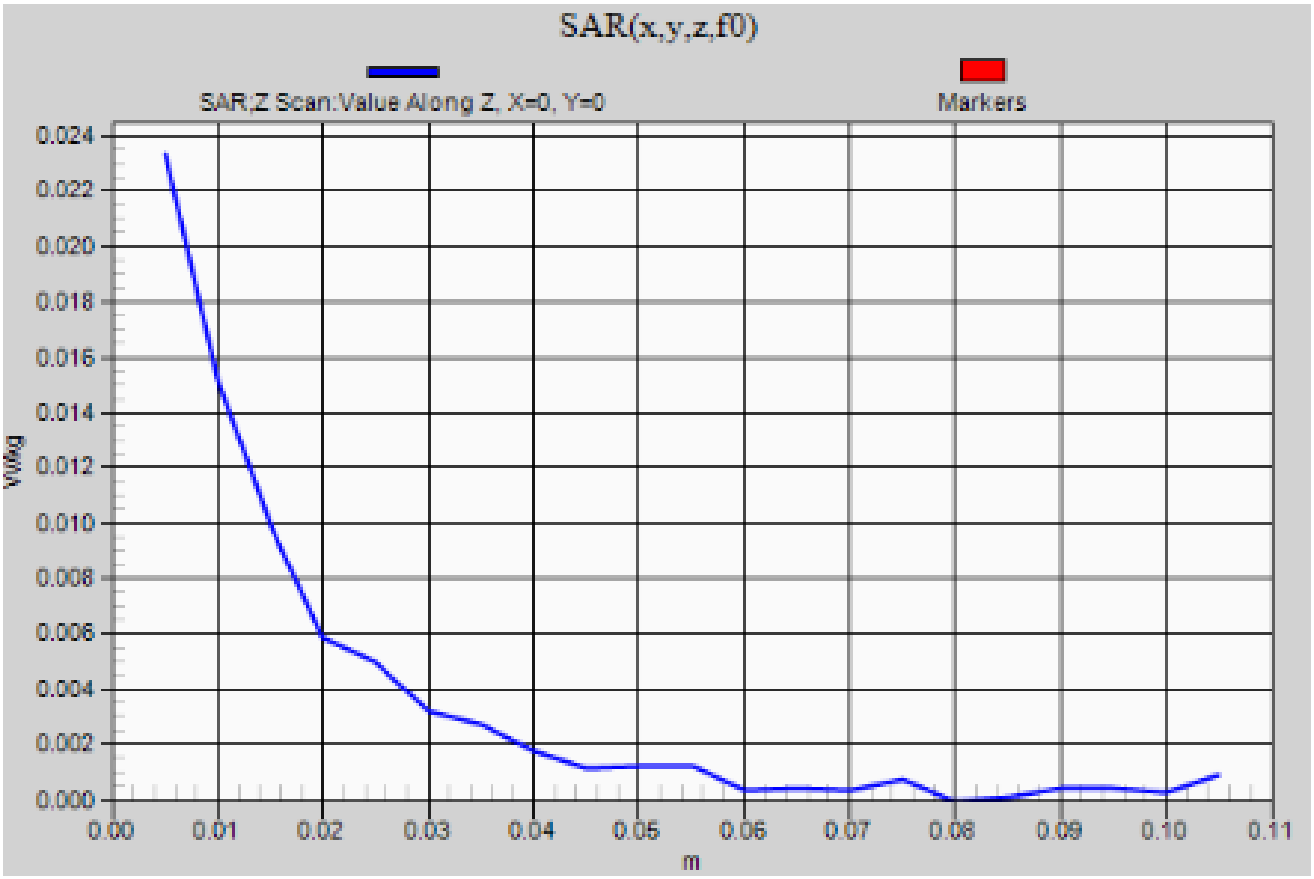
SAR TEST DATA – NB-IOT

NBIoT 4A



SAR TEST DATA – NB-IOT



SAR TEST DATA – NB-IOT

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.7°C
Date:	2020-01-16	Liquid Temperature (°C):	21.3°C
Serial Number:	C1	Humidity (%RH):	24.6%
Configuration:	ELEM0093-2	Bar. Pressure (mb):	1015.4 mb
Comments:	None		

NBIoT 6D
DUT: Eleksen Smart Connected Hub; Type: M.28.R1.B1; Serial: SAR C1
Communication System: UID 0, LTE-FDD (0); Communication System Band: Band 12; Frequency: 699 MHz;Communication System PAR: 0 dB; PMF: 1.12202e-005
Medium parameters used (interpolated): f = 699 MHz; σ = 0.953 S/m; ε_r = 52.625; ρ = 1000 kg/m^3 , Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(9.3, 9.3, 9.3) @ 699 MHz; Calibrated: 11/19/2019
  - Modulation Compensation:
- Sensor-Surface: 3mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 31.0, 106.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Body/Body/Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 5.374 V/m; Power Drift = 0.19 dB
Peak SAR (extrapolated) = 0.0340 W/kg
SAR(1 g) = 0.024 W/kg; SAR(10 g) = 0.016 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0281 W/kg

Body/Body/Area scan (41x41x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.0285 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of Total (measured) = 4.638 V/m

Body/Body/Reference scan (41x51x1): Interpolated grid: dx=3.000 mm, dy=3.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.0291 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0205 W/kg

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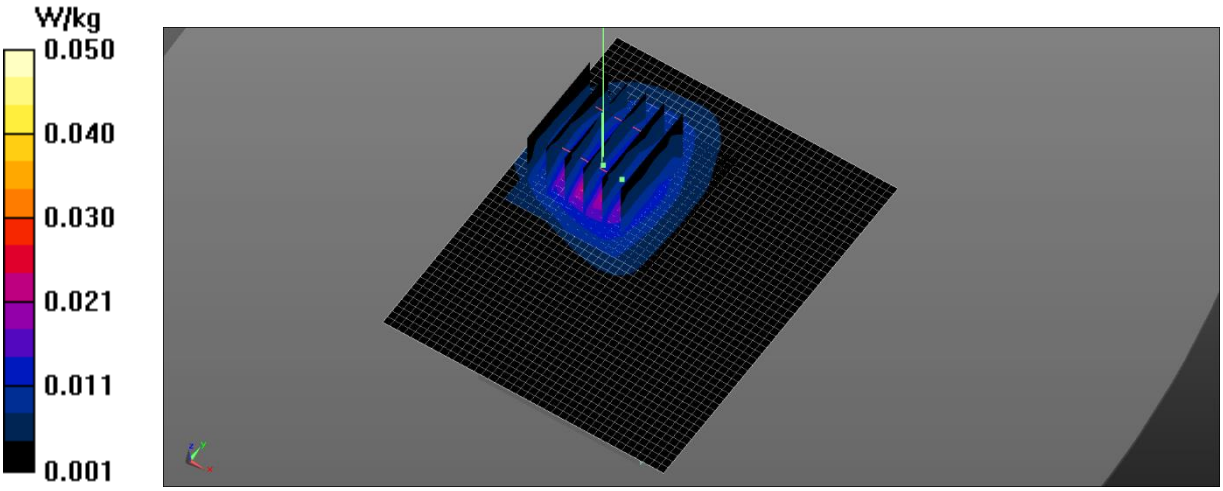
SAR TEST DATA – NB-IOT

NBIoT 6D



SAR TEST DATA – NB-IOT

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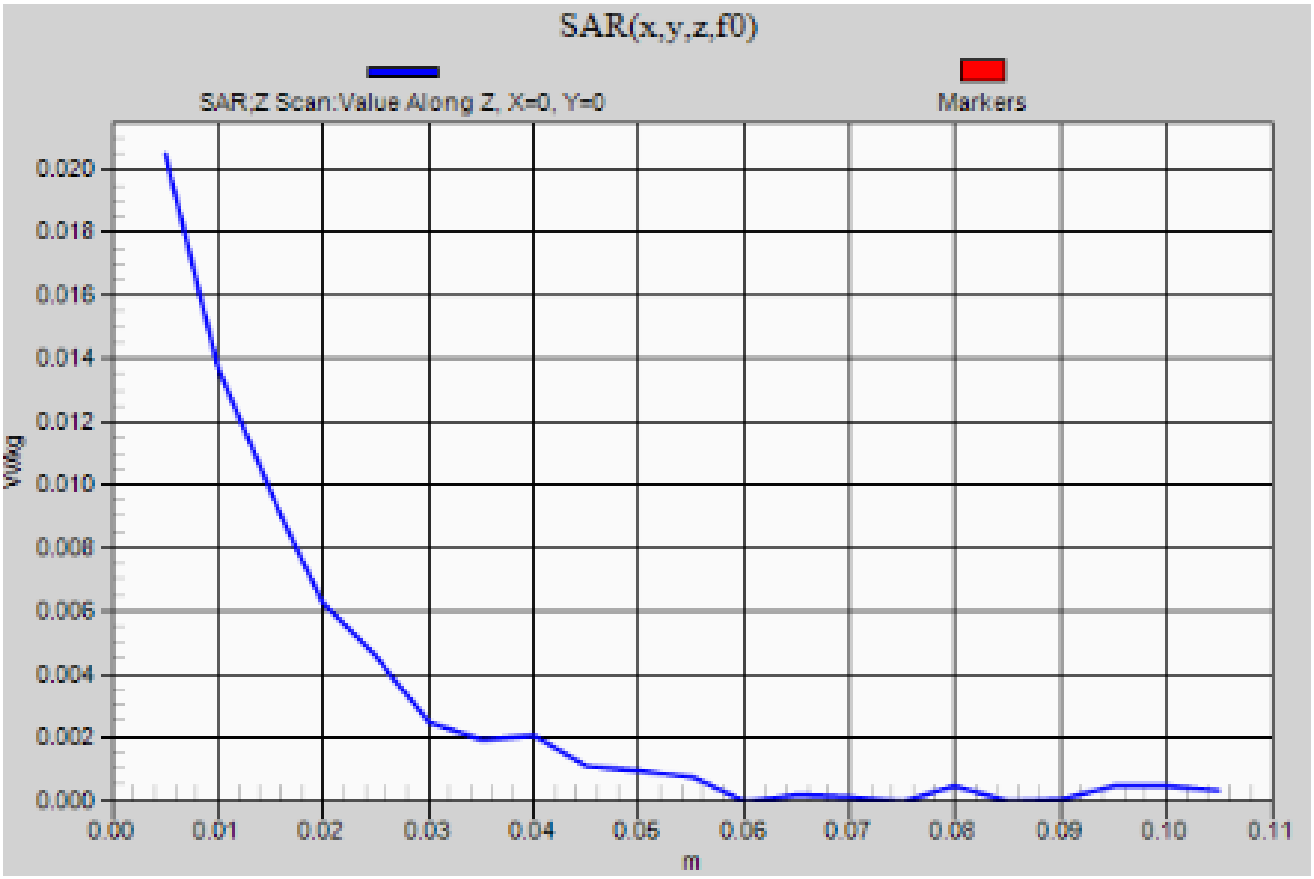

SAR TEST DATA – Wi-Fi 802.11bgn

EUT:	Smart Connected Hub	Work Order:	ELEM0093
Customer:	Element Materials Technology	Job Site:	MN011
Attendees:	None	Customer Project:	None

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.247:2020 FCC 2.1093:2020	FCC KDB 865664 D01 v01r04 FCC KDB 865664 D02 v01r02 FCC KDB 248227 D01 v02r02 FCC KDB 447498 D01 v06 IEEE Std 1528:2013

COMMENTS

All tests run with the reflective vest body-worn accessory. Per the manufacturer, this represents the worst-case scenario for EUT proximity to the human body.

DEVIATIONS FROM TEST STANDARD

None

RESULTS

Test Config.	Frequency Band	Transmit Frequency (MHz)	Transmit Channel	Data Rate (Mbps)	Transmit Mode	EUT Position	SAR Drift During Test (dB)	Measured 1g SAR Level (mW/g)	Measured 10g SAR Level (mW/g)	SAR Scaling Factor	Scaled 1g SAR Level (mW/g)	Scaled 10g SAR Level (mW/g)	Test#
Body	**2.4GHz**	**2412**	**1**	**1**	**DSSS**	**Sim Card Side**	**0.48**	**0.02**	**0.01**	**1**	**0.02**	**0.01**	**WiFi 802.11b 1a**
Body	2.4GHz	2412	1	1	DSSS	Front	-0.23	0.01	<0.01	1	0.01	<0.01	WiFi 802.11b 1b
Body	2.4GHz	2412	1	1	DSSS	Back	-0.40	<0.01	<0.01	1	<0.01	<0.01	WiFi 802.11b 1c
Body	2.4GHz	2412	1	1	DSSS	Connector Side	0.29	<0.01	<0.01	1	<0.01	<0.01	WiFi 802.11b 1d

SAR TEST DATA – Wi-Fi 802.11bgn

Tested By:	Marcelo Aguayo, Kyle McMullan	Room Temperature (°C):	22.7°C
Date:	2020-01-25	Liquid Temperature (°C):	21.3°C
Serial Number:	C4	Humidity (%RH):	24.6%
Configuration:	ELEM0093-5	Bar. Pressure (mb):	1015.4 mb
Comments:	None		

WiFi 802.11b 1a
DUT: Eleksen Smart Connected Hub; Type: M.28.R1.B1; Serial: SAR C4
Communication System: UID 0, IEEE 802.11b DSSS 1 Mbps (0); Communication System Band: 2400 MHz ;
Frequency: 2412 MHz;Communication System PAR: 1.872 dB; PMF: 1
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.993 S/m; ε_r = 49.48; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)
DASY Configuration:

- Probe: EX3DV4 - SN3746; ConvF(7.33, 7.33, 7.33) @ 2412 MHz; Calibrated: 11/19/2019
- Sensor-Surface: 3mm (Mechanical Surface Detection), Sensor-Surface: 0mm (Fix Surface), z = 31.0, 106.0
- Electronics: DAE4 Sn909; Calibrated: 12/6/2019
- Phantom: ELI V6.0 (SAC); Type: QD OVA 003 AA; Serial: 2044
- DASY52 52.10.2(1504); SEMCAD X 14.6.12(7470)

Body/Body/Zoom Scan (11x13x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.619 V/m; Power Drift = 0.48 dB
Peak SAR (extrapolated) = 0.0390 W/kg
SAR(1 g) = 0.022 W/kg; SAR(10 g) = 0.012 W/kg (SAR corrected for target medium)

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0273 W/kg

Body/Body/Area scan (51x51x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.0338 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of Total (measured) = 2.609 V/m

Body/Body/Reference scan (41x51x1): Interpolated grid: dx=3.000 mm, dy=3.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.0231 W/kg

Body/Body/Z Scan (1x1x21): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0136 W/kg

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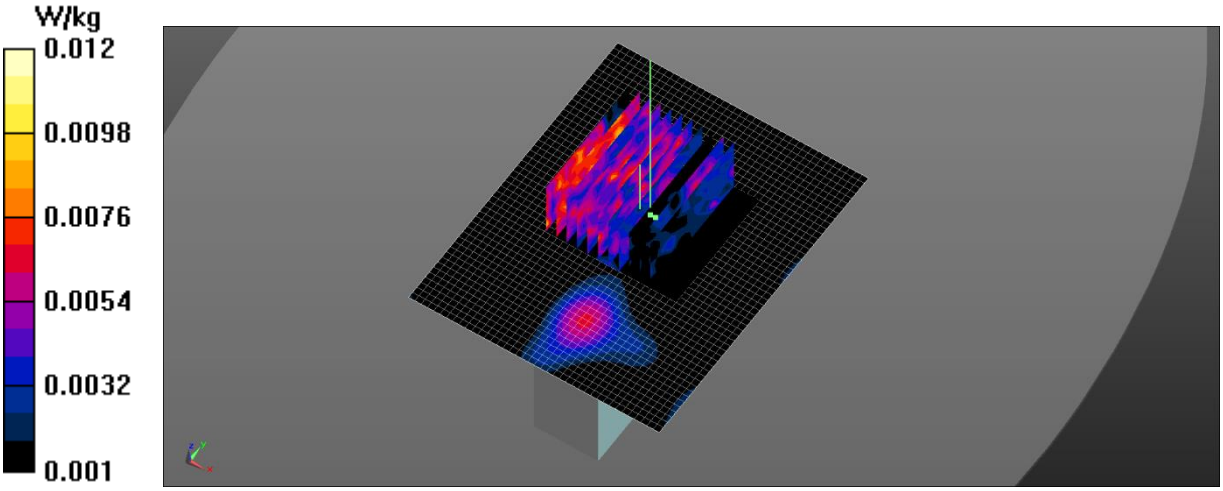
SAR TEST DATA – Wi-Fi 802.11bgn

WiFi 802.11b 1a



SAR TEST DATA – Wi-Fi 802.11bgn

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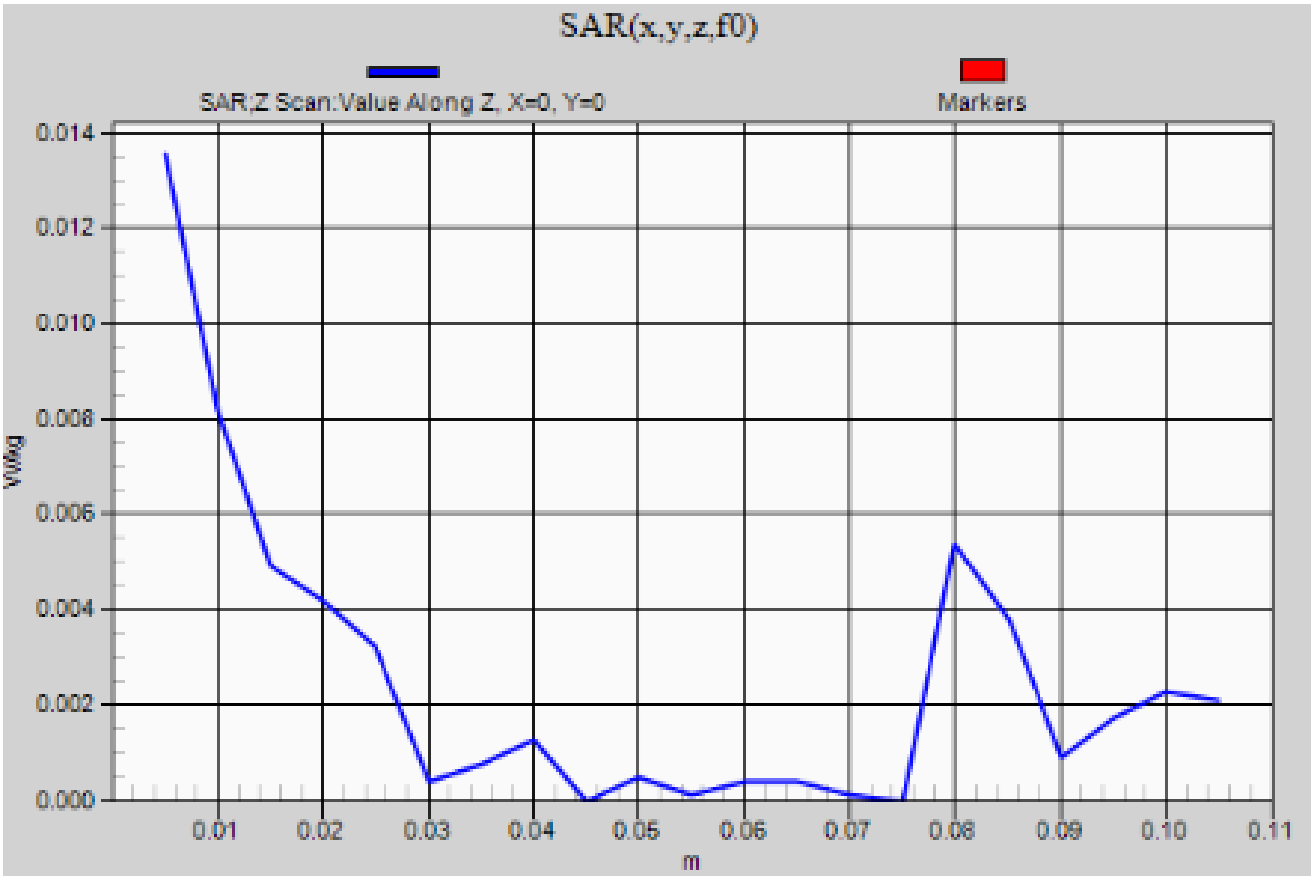


SIMULTANEOUS TRANSMISSION TEST EXCLUSION

element
EXRPT.2019.04.10

EQUIPMENT OPERATIONAL DETAILS

The 802.11bgn, Bluetooth or Bluetooth Low Energy, cellular and 13.56 MHz NFC radios are located a minimum distance of 15 mm from the user. The 802.11bgn and Bluetooth/Bluetooth Low Energy radios share an antenna, and are incapable of simultaneous transmission.

There are three different operational modes that support simultaneous transmission:

(1) Cellular, Bluetooth, and 13.56 MHz NFC
(2) Cellular, Bluetooth Low Energy, and 13.56 MHz NFC
(3) Cellular, 802.11bgn, and 13.56 MHz NFC

The 13.56 MHz NFC radio is exempt from RF exposure evaluation.

ESTIMATED STANDALONE VALUES FOR SAR TEST EXCLUDED RADIOS

KDB 447498 D01 General RF Exposure Guidance v06, Section 4.3.2(b)

"When an antenna qualifies for the standalone SAR test exclusion of 4.3.1 and also transmits simultaneously with other antennas, the standalone SAR value must be estimated according to the following to determine the simultaneous transmission SAR test exclusion criteria:

1) [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [$\sqrt{f(GHz)}/x$], for test separation distances ≤ 50mm;

where x = 7.5 for 1-g SAR and x = 18.75 for 10-g SAR.

2) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distance is > 50 mm.

This SAR estimation formula has been considered in conjunction with the SAR Test Exclusion Thresholds to result in substantially conservative SAR values of ≤ 0.4 W/kg. When SAR is estimated, the peak SAR location is assumed to be at the feed-point or geometric center of the antenna, whichever provides a smaller antenna separation distance, and this location must be clearly identified in test reports. The estimated SAR is used only to determine simultaneous transmission SAR test exclusion; it should not be reported as the standalone SAR. When SAR is estimated, it must be applied to determine the sum of 1-g SAR test exclusion. When SAR to peak location separation ratio test exclusion is applied, the highest reported SAR for simultaneous transmission can be an estimated standalone SAR if the estimated SAR is the highest among the simultaneously transmitting antennas (see also KDB Publication 690783 D01). For situations where the estimated SAR is overly conservative for certain conditions, the test lab may choose to perform standalone SAR measurements, then use the measured SAR to determine simultaneous transmission SAR test exclusion. Estimated SAR values at selected frequencies, distances, and power levels are illustrated in Appendix D.

In the table below, the estimated stand-alone SAR for both the Bluetooth and Bluetooth Low Energy radios (FCC ID: 2AC7Z-ESPWROOM32) has been calculated, and the values are below the head/torso limit of 1.6 W/kg. The standalone SAR test exclusion calculation for the Bluetooth and Bluetooth Low Energy radios is documented in Element report# ELEM0093.

Radio	Transmit Frequency (GHz)	Test Separation (mm)	Output Power (mW)	Duty Cycle	Estimated Standalone SAR (W/kg)
Bluetooth	2.44	15	4.4	1	0.061
Bluetooth Low Energy	2.44	15	4.0	1	0.056

SIMULTANEOUS TRANSMISSION TEST EXCLUSION

element
EXRPT.2019.04.10

The information in the table above is from: From FCC ID: 2AC7Z-ESPWROOM32 Bay Area Compliance Laboratories Corp. Report No.'s RKS161017001-00A and RKS161017001-00B.

MEASURED STANDALONE VALUES

Radio	Highest Reported 1-g SAR (W/kg)	Position
Cellular	0.98	Any
802.11bgn	0.02	Any

SIMULTANEOUS TRANSMIT VALUES

Simultaneous transmission is evaluated according to KDB 447498 D01 4.3.2 and is initially evaluated as follows:

"Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneously transmitting antenna. When the sum of 1-g or 10-g SAR of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration… When the sum of SAR considered in this manner does not qualify for test exclusion, the individual test positions of each exposure condition should be considered separately for the sum of 1-g or 10-g SAR test exclusion"

If the sum of the 1g or 10g SAR of all simultaneously transmitting antennas exceeds the SAR limit, then the SAR to peak location separation ratio detailed in KDB 447498 D01 4.3.2 is used to evaluate compliance:

"The ratio is determined by $((SAR_1 + SAR_2)^{1.5})/R_i$, rounded to two decimal digits, and must be ≤ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion. When 10-g SAR applies, the ratio must be ≤ 0.10. SAR_1 and SAR_2 are the highest reported or estimated SAR values for each antenna in the pair, and R_i is the separation distance in mm between the peak SAR locations for the antenna pair."

There are three different operational modes that support simultaneous transmission:

(1) Cellular, Bluetooth, and 13.56 MHz NFC
(2) Cellular, Bluetooth Low Energy, and 13.56 MHz NFC
(3) Cellular, 802.11bgn, and 13.56 MHz NFC

The 13.56 MHz NFC radio is exempt from RF exposure evaluation. The applicable estimated standalone SAR values and the measured standalone SAR values are added together and compared against the limit to determine compliance. For each of the 3 scenarios, this is done below:

Cellular + Bluetooth + NFC = 0.98 + 0.06 + 0 (exempt) = 1.04
Cellular + Bluetooth Low Energy + NFC = 0.98 + 0.06 + 0 (exempt) = 1.04
Cellular + 802.11bgn + NFC = 0.98 + 0.02 + 0 (exempt) = 1.00

Where all values given have the units W/kg averaged over 1g.

The limit for all of these cases is the head/torso general population exposure limit of 1.60 W/kg. All cases comply with this limit.

SYSTEM AND TEST SITE DESCRIPTION

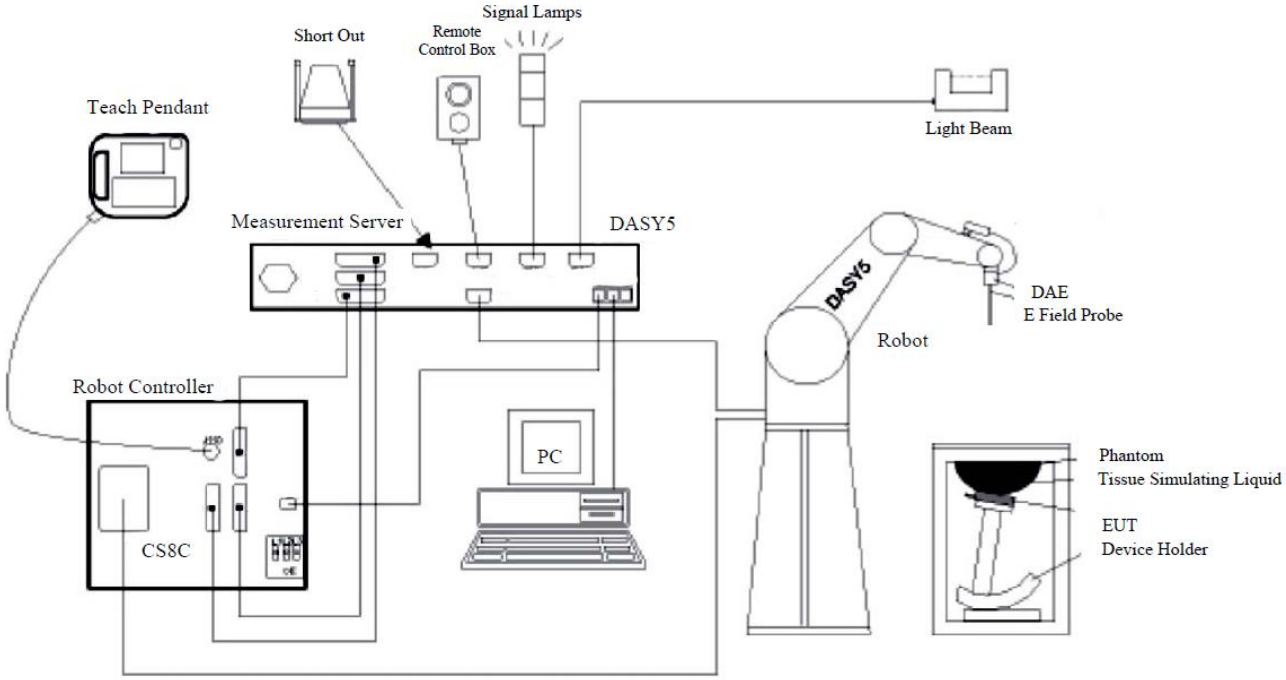
element
WSTD.2017.1.31

SAR MEASUREMENT SYSTEM

Schmid & Partner Engineering AG, DASY52

Element selected the leader in SAR evaluation systems to provide the measurement tools for this evaluation. SPEAG's DASY52 is the fastest and most accurate scanner on the market. It is fully compatible with all world-wide standards for transmitters operating at the ear or within 20cm of the body. It provides full compatibility with IEC 62209-1, IEC 62209-2, IEEE 1528 as well as national adaptations such as FCC OET-65c and Korean Std. MIC #2000-93

The DASY52 system for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot (Staubli TX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom, oval flat phantom, device holder, tissue simulating liquids, and validation dipole kits.

SYSTEM AND TEST SITE DESCRIPTION

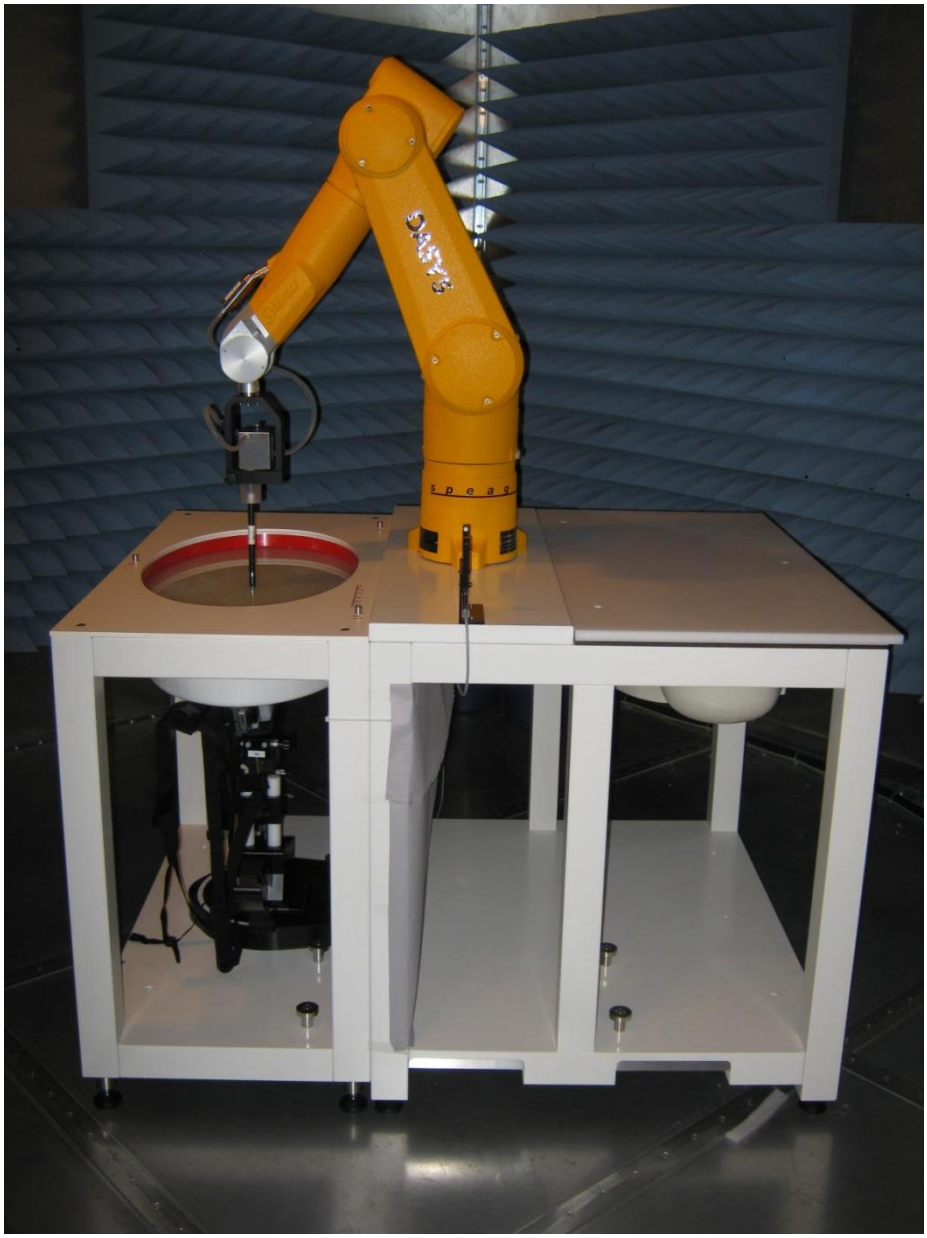
element
WSTD.2017.1.31

TEST SITE

Element

The SAR measurement system is located in a semi-anechoic chamber. This provides an ambient free environment that also eliminates reflections.

The chamber is 12 ft wide by 16 ft long x 8 ft high. A dedicated HVAC unit provides +/- 1 degree C temperature control.



TEST EQUIPMENT

element
WSEQ.2016.12.19

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Amplifier	Mini Circuits	ZHL-5W-2G-S+	TRZ	NCR [1]	0 mo
Amplifier	Mini Circuits	ZVE-3W-83+	TTA	NCR [1]	0 mo
Antenna - Dipole	SPEAG	D835V2	ADK	11/11/2019	12 mo
Antenna - Dipole	SPEAG	D1750v2	ADN	11/13/2019	12 mo
Antenna - Dipole	SPEAG	D1900v2	ADO	11/13/2019	12 mo
Antenna - Dipole	SPEAG	D2450V2	ADL	11/12/2019	12 mo
Antenna - Dipole	SPEAG	D750V3	ADQ	11/11/2019	12 mo
Antenna - Double Ridge	ETS Lindgren	3115	AJA	8/28/2019	24 mo
Cellular Base Station Simulator	Agilent	E5515C	BSV	NCR	0 mo
Cellular Base Station Simulator	Rohde & Schwarz	1201.0002K50	AFR	9/13/2019	12 mo
Device Holder	SPEAG	N/A	SAW	NCR	0 mo
Dielectric Assessment Kit	SPEAG	DAKS:200	IPR	4/25/2019	36 mo
Generator - Signal	Agilent	V2920A	TIH	NCR	0 mo
Meter - Power	Agilent	N1913A	SQR	10/8/2019	12 mo
Power Sensor	Agilent	E9300H	SQO	10/8/2019	12 mo
Power Supply	Kikusui	PWR401ML	TQL	NCR	0 mo
Probe - Dielectric	SPEAG	DAKS-3.5	IPRA	11/12/2019	36 mo
Probe - SAR	SPEAG	EX3DV4	SAG	11/19/2019	12 mo
SAR - Tissue Test Solution	SPEAG	MBBL600-6000V6		At start of testing	
SAR Test System	Staeubli	DAYS5	SAK	NCR	0 mo
SAR Test System	SPEAG	QD OVA 001 BB	SAC	NCR	0 mo
Thermometer	Omega Engineering, Inc.	HH311	DUI	2/15/2018	36 mo
DAE	SPEAG	SD 000 D04 BK	R219	12/06/2019	12 mo

Note 1: The output of the signal generator / amplifier is verified with the calibrated power meter listed above.

MEASUREMENT UNCERTAINTY

MEASUREMENT UNCERTAINTY BUDGETS PER IEEE 1528:2013

300-3000 MHz Range

Uncertainty Component	Tolerance (+/- %)	Probability Distribution	Divisor	c_i (1g)	c_i (10g)	u_i (1g) (+/-%)	u_i (10g) (+/-%)	v_i
Measurement System								
Probe calibration (k=1)	5.5	normal	1	1	1	5.5	5.5	∞
Axial isotropy	4.7	rectangular	1.732	0.707	0.707	1.9	1.9	∞
Hemispherical isotropy	9.6	rectangular	1.732	0.707	0.707	3.9	3.9	∞
Boundary effect	1.0	rectangular	1.732	1	1	0.6	0.6	∞
Linearity	4.7	rectangular	1.732	1	1	2.7	2.7	∞
System detection limits	1.0	rectangular	1.732	1	1	0.6	0.6	∞
Readout electronics	0.3	normal	1	1	1	0.3	0.3	∞
Response time	0.8	rectangular	1.732	1	1	0.5	0.5	∞
Integration time	2.6	rectangular	1.732	1	1	1.5	1.5	∞
RF ambient conditions - noise	1.7	rectangular	1.732	1	1	1.0	1.0	∞
RF Ambient Reflections	0.0	rectangular	1.732	1	1	0.0	0.0	∞
Probe positioner mechanical tolerance	0.4	rectangular	1.732	1	1	0.2	0.2	∞
Probe positioner with respect to phantom shell	2.9	rectangular	1.732	1	1	1.7	1.7	∞
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	1.0	rectangular	1.732	1	1	0.6	0.6	∞
Test Sample Related								
Device Positioning	2.9	normal	1	1	1	2.9	2.9	145
Device Holder	3.6	normal	1	1	1	3.6	3.6	5
Power Drift	5.0	rectangular	1.732	1	1	2.9	2.9	∞
Phantom and tissue parameters								
Phantom Uncertainty - shell thickness tolerances	4.0	rectangular	1.732	1	1	2.3	2.3	∞
Liquid conductivity - deviation from target values	5.0	rectangular	1.732	0.64	0.43	1.8	1.2	∞
Liquid conductivity - measurement uncertainty	6.5	normal	1	0.64	0.43	4.2	2.8	∞
Liquid permittivity - deviation from target values	5.0	rectangular	1.732	0.6	0.49	1.7	1.4	∞
Liquid permittivity - measurement uncertainty	3.2	normal	1	0.6	0.49	1.9	1.6	∞
Combined Standard Uncertainty		RSS				11.2	10.6	387
Expanded Measurement Uncertainty (95% Confidence/		normal (k=2)				22.5	21.2	

ADK

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Accreditation No.: SCS 0108

Client **Element**

Certificate No: D835V2-4d108_Nov19

CALIBRATION CERTIFICATE

Object: D835V2 - SN:4d108

Calibration procedure(s): QA CAL-05.v11
Calibration Procedure for SAR Validation Sources between 0.7-3 GHz

Calibration date: November 11, 2019

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	03-Apr-19 (No. 217-02892/02893)	Apr-20
Power sensor NRP-Z91	SN: 103244	03-Apr-19 (No. 217-02892)	Apr-20
Power sensor NRP-Z91	SN: 103245	03-Apr-19 (No. 217-02893)	Apr-20
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-19 (No. 217-02894)	Apr-20
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-19 (No. 217-02895)	Apr-20
Reference Probe EX3DV4	SN: 7349	29-May-19 (No. EX3-7349_May19)	May-20
DAE4	SN: 601	30-Apr-19 (No. DAE4-601_Apr19)	Apr-20

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB39512475	30-Oct-14 (in house check Feb-19)	In house check: Oct-20
Power sensor HP 8481A	SN: US37292783	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
Power sensor HP 8481A	SN: MY41092317	07-Oct-15 (in house check Oct-18)	In house check: Oct-20
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-18)	In house check: Oct-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-19)	In house check: Oct-20

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 12, 2019

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Accreditation No.: SCS 0108

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.