

TEST REPORT

Report No.: SHE20090001-02FE

Date: 2020-11-27

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Applicant : Leica Geosystems AG
Address of Applicant : Heinrich-Wild-Strasse, CH-9435 Heerbrugg

Product Name : Rugged Windows Field Controller
Model No. : CS30 LTE
Sample No. : SHE20090001-02FE #01
SHE20090001-02FE #02
FCC ID : RFD-CS30
ISED Number : 3177A-CS30

Standards : FCC CFR47 Part 15, Subpart C
RSS-Gen (Issue 5, March 2019)
RSS-247 (Issue 2, February 2017)

Date of Receipt : 2020-09-03
Date of Test : 2020-09-22 ~ 2020-11-26
Date of Issue : 2020-11-27

Remark:

This report details the results of the testing carried out on one sample, the results contained in this report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

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Revision Record

Version	Date	Revisions	Revised By
1.0	2019-10-31	Original	--

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1 General Information

1.1 Testing Laboratory

Company Name	ICAS Testing Technology Service (Shanghai) Co., Ltd.
Address	No.1298 Pingan Rd, Minhang District, Shanghai, China
Telephone	0086 21-51682999
Fax	0086 21-54711112
Homepage	www.icasiso.com

1.2 Details of Application

Company Name	Leica Geosystems AG
Address	Heinrich-Wild-Strasse, CH-9435 Heerbrugg
Contact Person	Tero Huhtala
Telephone	+41 71 727 3422
Email	tero.huhtala@leica-geosystems.com

1.3 Details of EUT

Product Name	Rugged Windows Field Controller
Brand Name	Leica
Model No.	CS30 LTE
FCC ID	RFD-CS30
ISED Number	3177A-CS30
Mode of Operation	Bluetooth BLE
Frequency Range	2400MHz ~ 2483.5MHz
Number of Channels	40 (at intervals of 2 MHz)
Modulation Type	GFSK
Antenna Type	Internal Antenna
Antenna Gain	1.97 dBi
Extreme Temperature Range	-20°C ~ +60°C
Test Voltage	DC 11.1V
Hardware version	PCB V0.4
Software version	R.ED.00.02.03
Test SW Version	BL410_R
RF power setting in TEST SW	DRTU

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1.4 Test Methodology

47 CFR Part 15, Subpart C (10-1-16 Edition)	Miscellaneous Wireless Communications Services
KDB Publication 558074 D01 v05r02	DTS Meas Guidance.
RSS-Gen (Issue 5, March 2019)	General Requirements for Compliance of Radio Apparatus
RSS-247 (Issue 2, February 2017)	Digital Transmission Systems (DTSSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

Note(s):

All test items were verified and recorded according to the standards and without any addition/deviation/exclusion during the test.

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2 Test Condition

2.1 Environmental conditions

Temperature (°C)	18-25
Humidity (%RH)	40-65
Barometric Pressure (mbar)	960-1060

2.2 Equipment List

Name of Equipment	Manufacturer	Model	Serial No.	Cal. Due Date
Spectrum Analyzer	Keysight	N9020B	MY59260184	2021-08-18
Spectrum Analyzer	Rohde & Schwarz	FSV40N	101450	2021-06-08
EMI Test Receiver	Rohde & Schwarz	ESPI3	100173	2021-06-08
EMI Test Receiver	Rohde & Schwarz	ESR 7	101911	2021-06-08
V-network	SCHWARZBECK	NSLK 8127	8127-902	2021-02-20
Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	100687	2021-08-18
Broadband Antenna	SCHWARZBECK	VULB9163	9163-1037	2021-06-08
Horn Antenna-18G	SCHWARZBECK	BBHA9120D	9120D-1775	2021-06-08
Loop Antenna	SCHWARZBECK	FMZB 1513	N/A	2021-03-19
Horn Antenna-40G	YINGLIAN	LB-180400-KF	N/A	2021-07-26
EMC chamber 9*6*6 (L*W*H)	CHANGNING	966	N/A	2021-06-08
Shielded Enclosure 8*5*4 (L*W*H)	CHANGNING	854	N/A	2021-06-08
Test Software	BL	BL410_E	N/A	N/A

2.3 Measurement Uncertainty

Parameter	Frequency	Uncertainty
Antenna Port Conducted Emission	< 1GHz	± 1.5 dB
	> 1GHz	± 1.5 dB
Radiated Emission	30 MHz – 1 GHz	± 3 dB
	> 1GHz	± 3 dB

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3 Test Set-up and Operation Modes

3.1 Details of Test Mode

Using test software was control EUT work in continuous transmitter and receiver mode. Select test channel as below:

Channel	Frequency
The lowest channel(CH0)	2402MHz
The middle channel(CH19)	2440MHz
The Highest channel(CH39)	2480MHz

The basic operation modes are:

- A. On
 - 1. BLE mode
 - a. Transmitting
 - i. Low Channel
 - ii. Middle Channel
 - iii. High Channel
 - b. Receiving
 - 2. Normal working with Bluetooth on
- B. Standby
- C. Off

3.2 Special Accessories and Auxiliary Equipment

Description	Manufacturer	Model No.	Serial No.
Laptop	Lenovo	TP00083A	N/A

3.3 Support Software

Description	Manufacturer	Software Name
Software	Intel	DRTU

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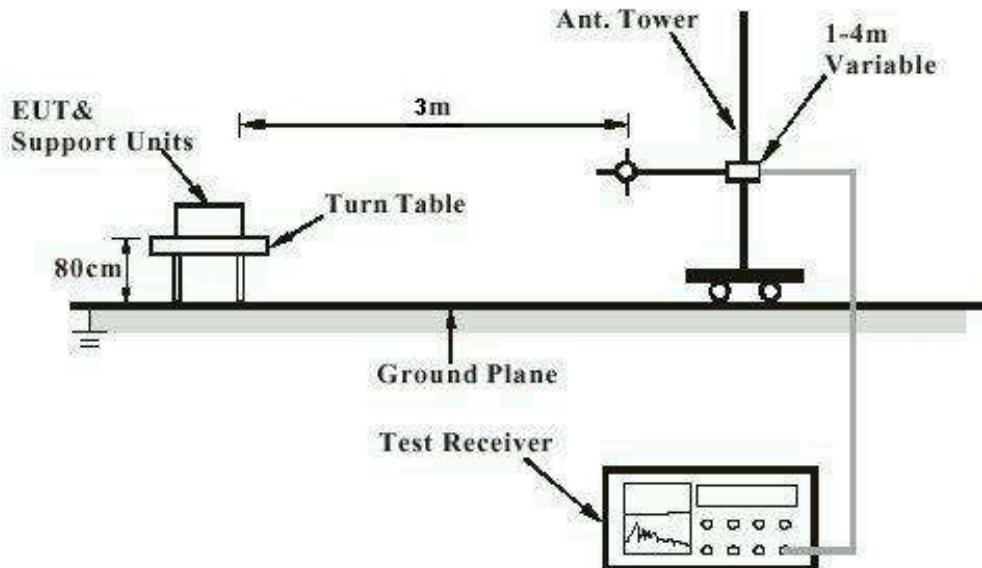
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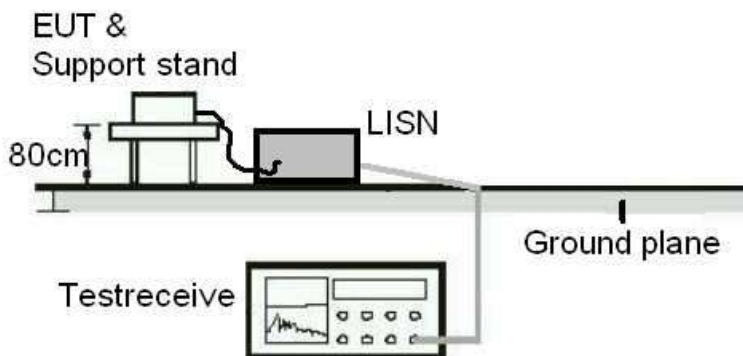
3.4 Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



Note: Measurements above 1GHz are done with a table height of 1.5m. In addition, there is RF absorbing material on the floor of the test site for above 1GHz measurement.

Diagram of Measurement Equipment Configuration for Conduction Measurement



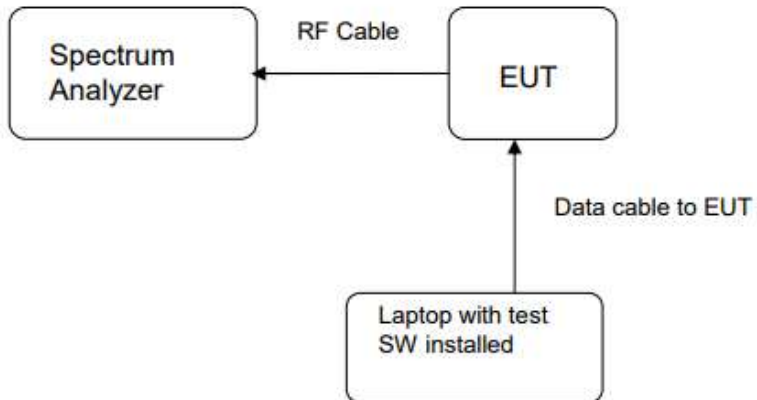
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Diagram of Measurement Equipment Configuration for Transmitter Measurement



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4 Test Results

4.1 Transmitter Requirement & Test Suites

4.1.1 Antenna Requirement

RESULT:

PASS

Test standard : FCC Part 15.247(b)(4), Part 15.203
RSS-247 5.4(6)

Requirement : The use of approved antennas only with directional gains that do not exceed 6dBi

According to the manufacturer declaration, the EUT has an antenna with a directional gain of 1.97 dBi. The antenna is an internal antenna with no possibility of replacement with a non-approved antenna by the end-user.

Therefore, the EUT is considered to comply with this provision.

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4.1.2 Peak Output Power and E.I.R.P

RESULT:

PASS

Test standard : FCC Part 15.247(b)(3)
RSS-247 5.4(4)
Requirement : ANSI C63.10-2013, KDB 558074
Kind of test site : Shielded room

Test setup

Test Channel : Low/Middle/High
Operation Mode : A.1.a
Ambient temperature : 23°C
Relative humidity : 52%

Table 1: Peak Output Power

Test Mode	Test Channel (MHz)	Measured Peak Power		Limit (W)
		(dBm)	(mW)	
BLE	2402	1.66	1.47	< 1
	2440	2.60	1.82	
	2480	2.41	1.74	

Table 2: E.I.R.P

Test Mode	Test Channel (MHz)	E.I.R.P		Limit (W)
		(dBm)	(mW)	
BLE	2402	3.63	2.31	< 4
	2440	4.57	2.86	
	2480	4.38	2.74	

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Figure 3: Peak Output Power, 2480MHz



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4.1.3 6dB Bandwidth and 99% Bandwidth

RESULT:

PASS

Test standard : FCC Part 15.247(a)(2)
RSS-247 5.2(1)
RSS-Gen 6.6
Requirement : ANSI C63.10-2013, KDB 558074
Kind of test site : Shielded room

Test setup

Test Channel : Low/Middle/High
Operation Mode : A.1.a
Ambient temperature : 23°C
Relative humidity : 52%

Table 3: 6dB Bandwidth and 99% Bandwidth

Test Mode	Test Channel (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	6dB Bandwidth Limit
BLE	2402	0.640	1.036	0.5 MHz
	2440	0.665	1.035	
	2480	0.635	1.034	

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Figure 4: 6dB Bandwidth and 99% Bandwidth, 2402MHz



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Figure 5: 6dB Bandwidth and 99% Bandwidth, 2440MHz



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Figure 6: 6dB Bandwidth and 99% Bandwidth, 2480MHz



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4.1.4 Power Spectral Density

RESULT:

PASS

Test standard : FCC Part 15.247(e)
RSS-247 5.2(2)
Requirement : ANSI C63.10-2013, KDB 558074
Kind of test site : Shielded room

Test setup

Test Channel : Low/Middle/High
Operation Mode : A.1.a
Ambient temperature : 23°C
Relative humidity : 52%

Table 4: Power Spectral Density

Test Mode	Test Channel (MHz)	Measured Result (dBm/3kHz)	Limit (dBm/3kHz)
BLE	2402	-13.94	8
	2440	-12.97	
	2480	-13.10	

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Figure 7: Power Spectral Density, 2402MHz



Figure 8: Power Spectral Density, 2440MHz



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Figure 9: Power Spectral Density, 2480MHz



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4.1.5 Conducted Spurious Emission & Authorized-band band-edge

RESULT:

PASS

Test standard : FCC Part 15.247(d)
RSS-247 5.5
Requirement : ANSI C63.10-2013, KDB 558074
Kind of test site : Shielded room

Test setup

Test Channel : Low/Middle/High for spurious, Low/High for Band
Edge
Operation Mode : A.1.a
Ambient temperature : 23°C
Relative humidity : 52%

For details refer to following test plot.

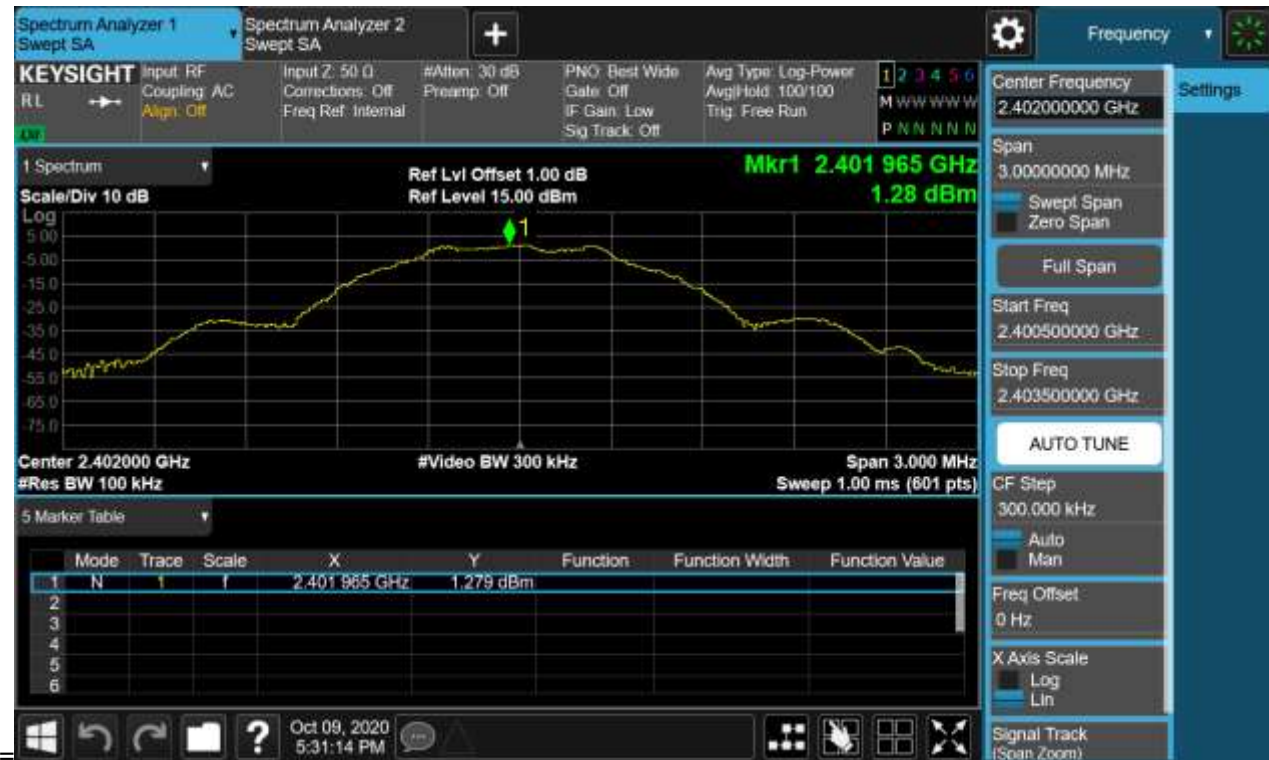
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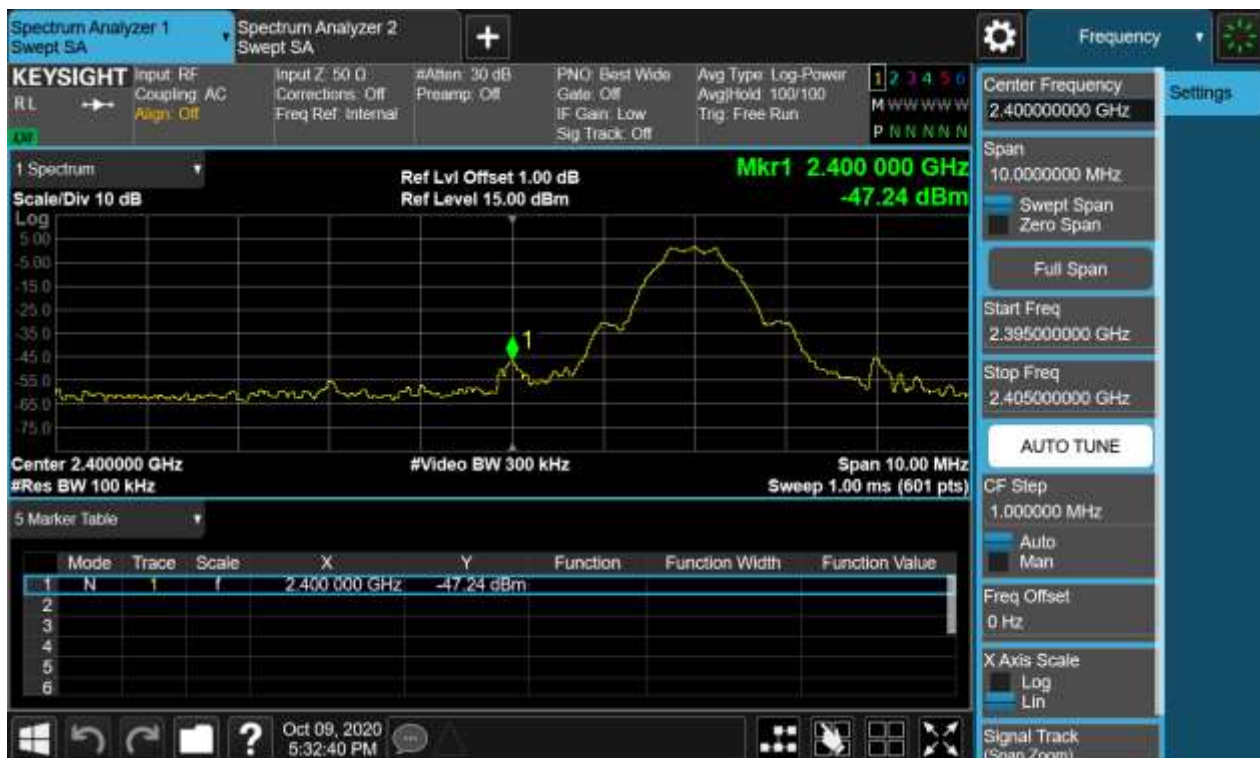
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Figure 10: Conducted Spurious Emission & Authorized-band band-edge, 2402MHz, BLE Carrier Level



Band Edge



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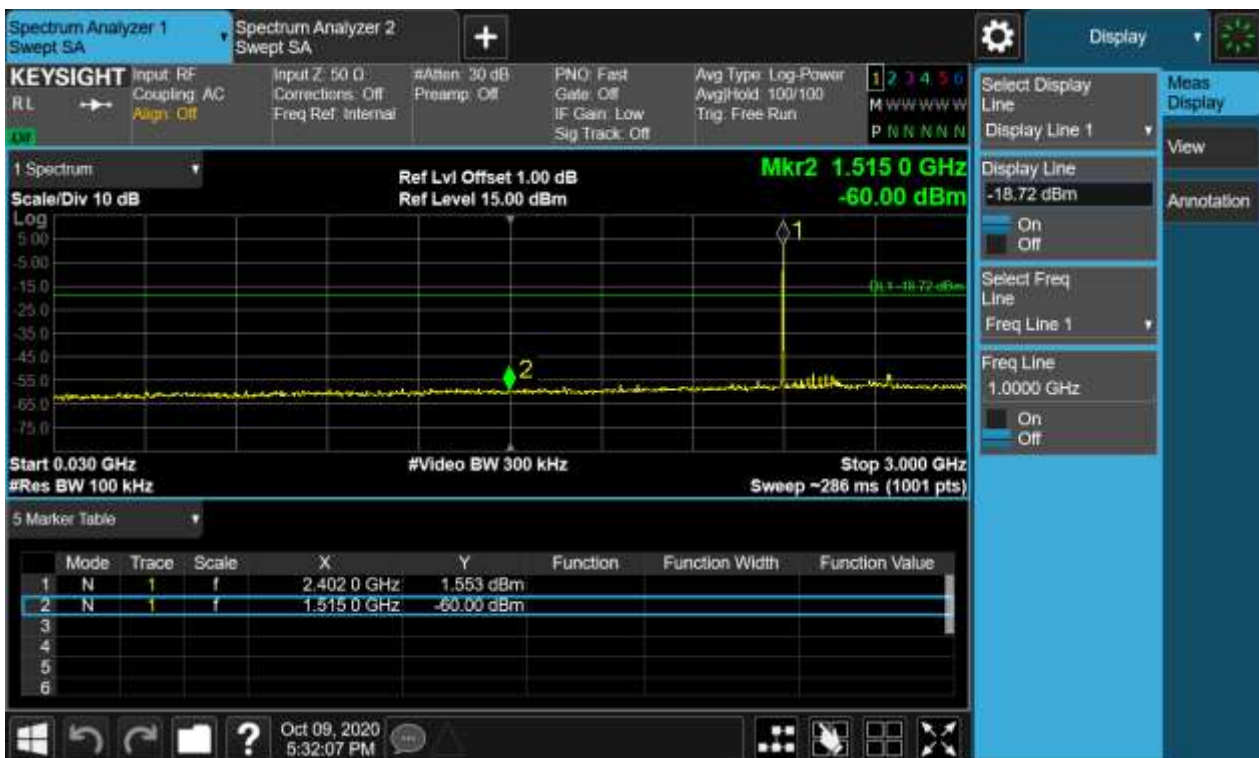
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Conducted spurious emissions 30MHz-25GHz



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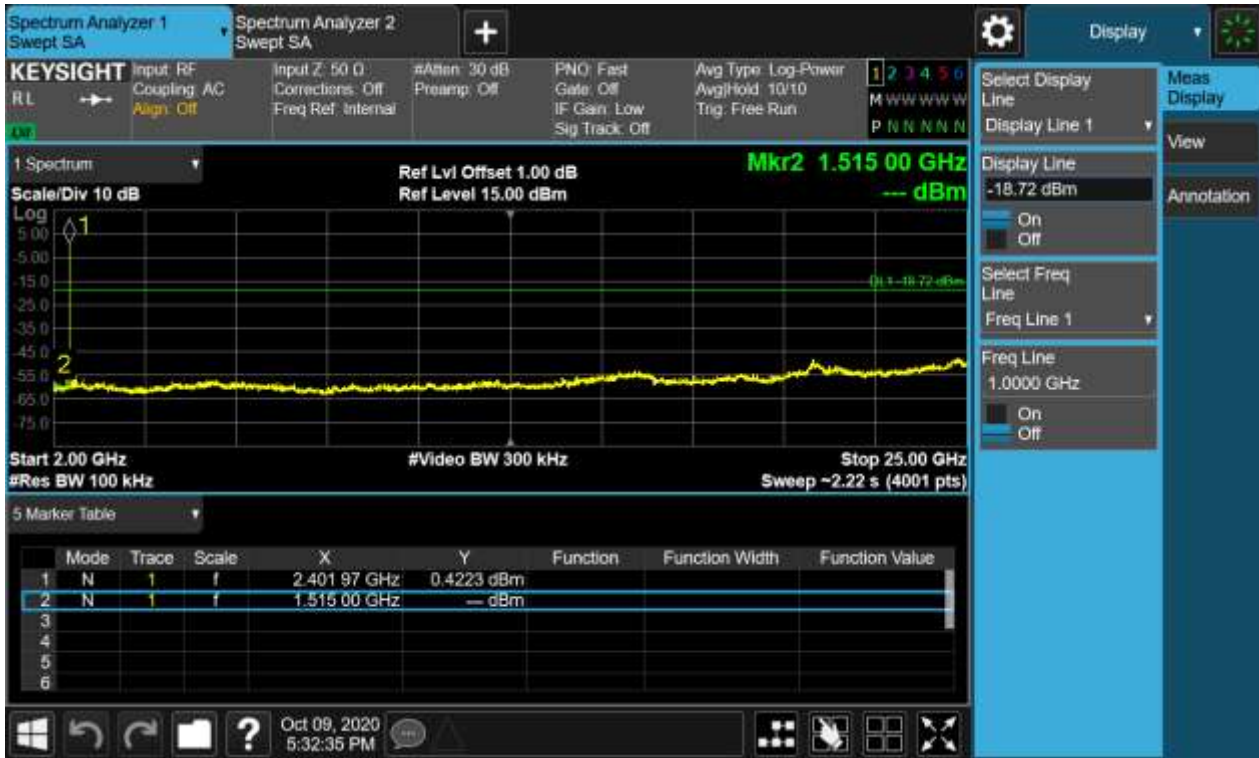


Figure 11: Conducted Spurious Emission & Authorized-band band-edge, 2440MHz, BLE Carrier Level



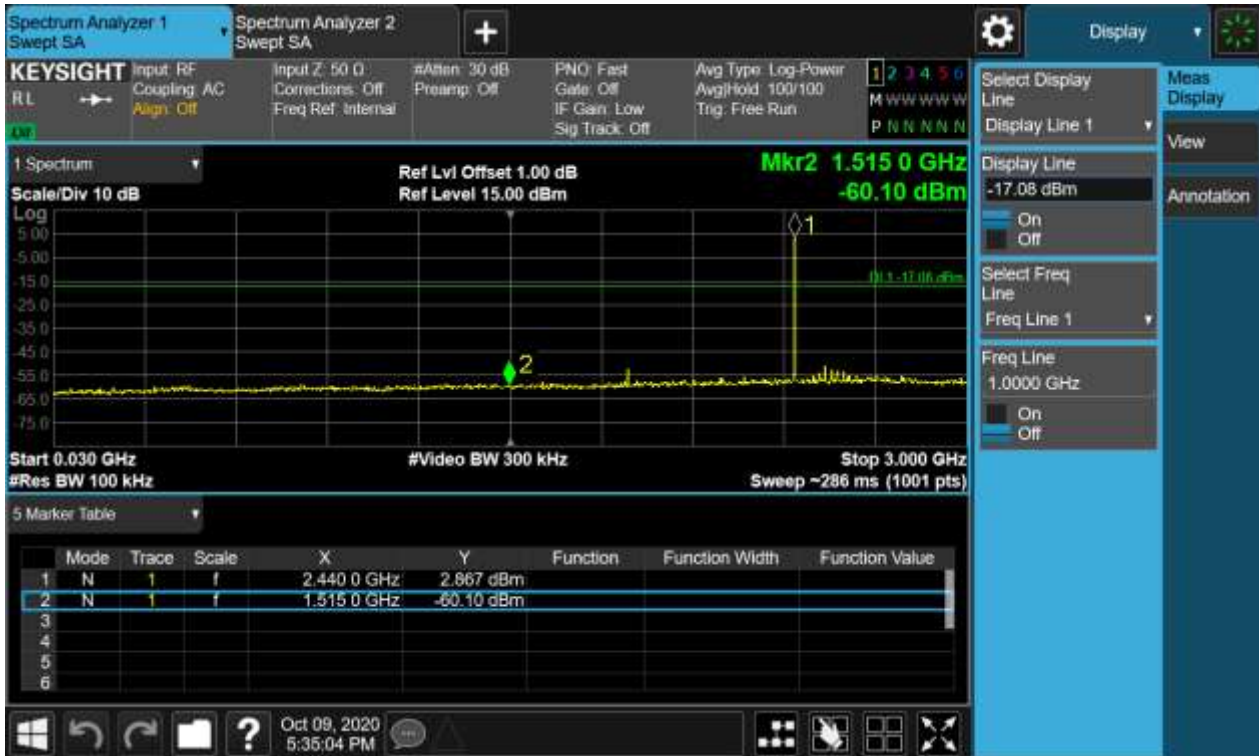
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Conducted spurious emissions 30MHz-25GHz



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Figure 12: Conducted Spurious Emission & Authorized-band band-edge, 2480MHz, BLE Carrier Level



Band Edge



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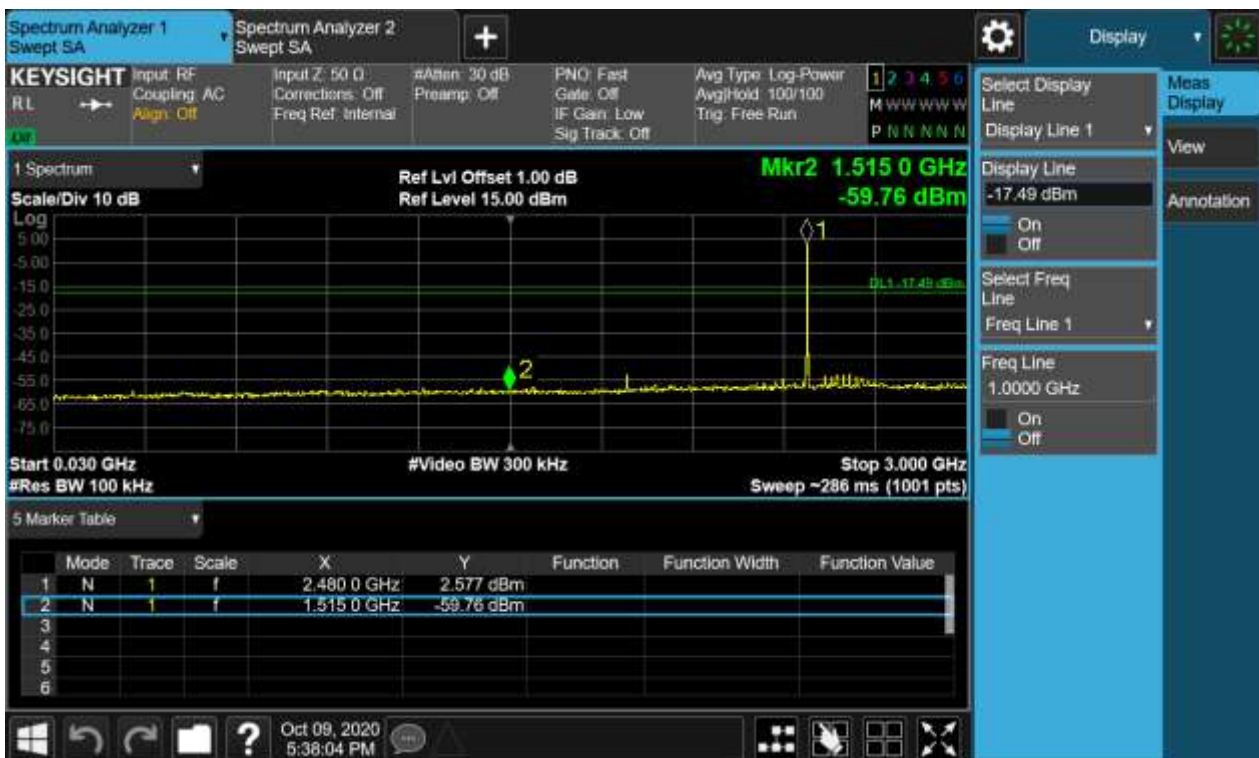
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Conducted spurious emissions 30MHz-25GHz



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4.1.6 Spurious Emission

RESULT:

PASS

Test standard : FCC Part 15.247(d), 15.205, 15.209
RSS-247 5.5
Requirement : ANSI C63.10-2013, KDB 558074
Kind of test site : 3m Semi-Anechoic Chamber

Test setup

Test Channel : Low/Middle/High
Operation Mode : A
Ambient temperature : 23°C
Relative humidity : 52%

Notes

Test plots please refer to the annex document "BLE-TX EXHIBIT A of SHE20090001-02FE".

1. For 9 kHz ~ 30 MHz, the amplitude of spurious emissions that are attenuated by more than 20dB below the permissible. The value has no need to be reported.
2. The spurious above 18GHz is noise only and 20dB below the limit. The value has no need to be reported.
3. The EUT is working in the Normal link mode below 1 GHz.

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4.1.7 Band Edge (Restricted-band band-edge)

RESULT:

PASS

Test standard : FCC Part 15.247(d), 15.205, 15.209
RSS-247 5.5
Requirement : ANSI C63.10-2013, KDB 558074
Kind of test site : 3m Semi-Anechoic Chamber

Test setup

Test Channel : Low/Middle/High
Operation Mode : A.1
Ambient temperature : 23°C
Relative humidity : 52%

Notes

Test plots please refer to the annex document "BLE-TX EXHIBIT A of SHE20090001-02FE".

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4.2 Mains Emissions

4.2.1 Conducted Emission on AC Mains

RESULT:

PASS

Test standard : FCC Part 15.207(a)
RSS-Gen 8.8
Requirement : ANSI C63.10-2013
Kind of test site : Shielded room

Test setup

Input Voltage : AC 120V, 60Hz; AC 240V, 50Hz
Operation Mode : A.2
Earthing : Not Connected
Ambient temperature : 23°C
Relative humidity : 52%

For details refer to following test plot.

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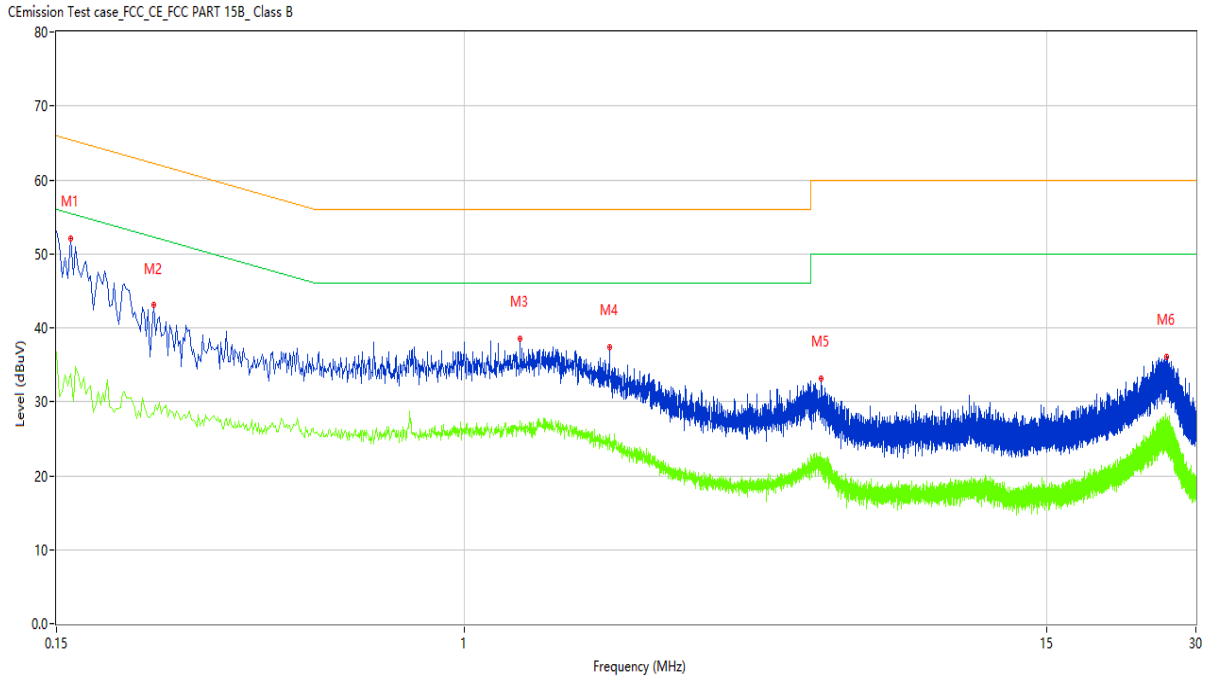
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Note: The all configurations were tested respectively, but only the worst configuration shown here.

Figure 13: Conducted Emission on AC Mains, L Phase



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Over Limit (dB)	Detector	Line	Verdict
1	0.160	53.50	10.15	65.46	-11.96	Peak	L	Pass
1*	0.160	44.90	10.15	65.46	-20.56	QP	L	Pass
1**	0.160	33.81	10.15	55.46	-21.65	AV	L	Pass
2	0.236	44.67	10.14	62.24	-17.57	Peak	L	Pass
2*	0.236	34.73	10.14	62.24	-27.51	QP	L	Pass
2**	0.236	28.20	10.14	52.24	-24.04	AV	L	Pass
3	1.294	33.20	10.16	56.00	-22.80	Peak	L	Pass
3*	1.294	24.06	10.16	56.00	-31.94	QP	L	Pass
3**	1.294	27.41	10.16	46.00	-18.59	AV	L	Pass
4	1.962	32.94	10.17	56.00	-23.06	Peak	L	Pass
4*	1.962	23.99	10.17	56.00	-32.01	QP	L	Pass
4**	1.962	24.60	10.17	46.00	-21.40	AV	L	Pass
5	5.262	32.63	10.26	60.00	-27.37	Peak	L	Pass
5*	5.262	25.90	10.26	60.00	-34.10	QP	L	Pass
5**	5.262	21.79	10.26	50.00	-28.21	AV	L	Pass
6	26.186	35.79	10.51	60.00	-24.21	Peak	L	Pass
6*	26.186	30.84	10.51	60.00	-29.16	QP	L	Pass
6**	26.186	27.46	10.51	50.00	-22.54	AV	L	Pass

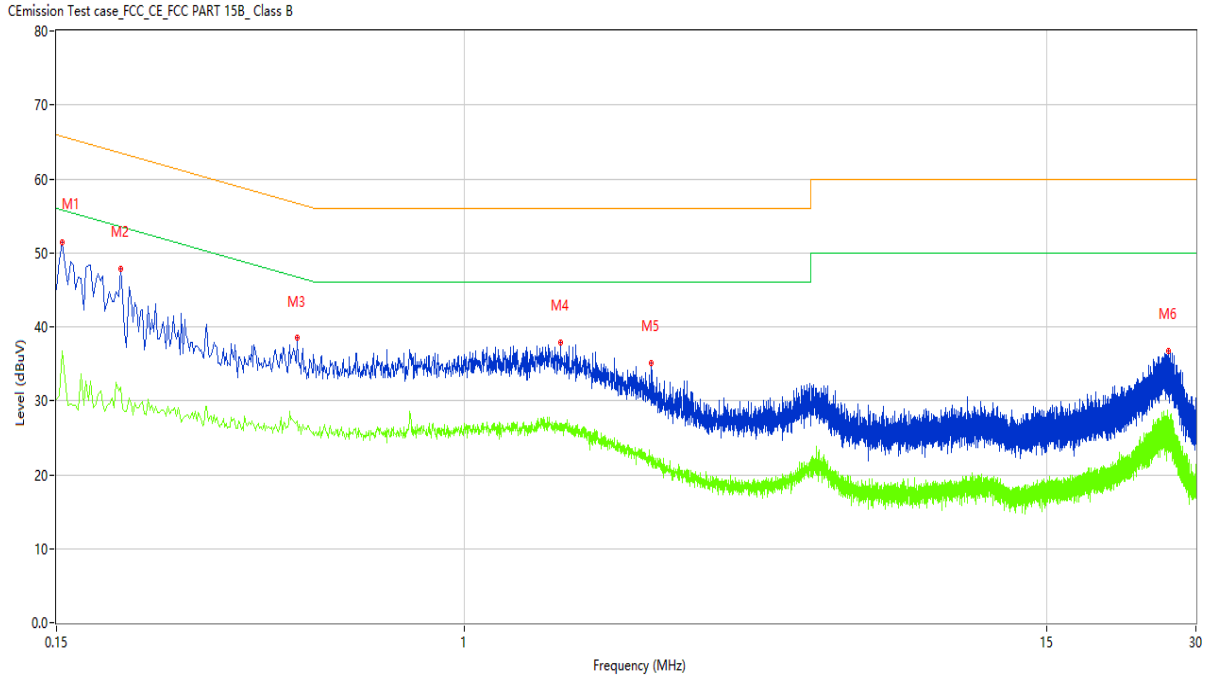
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Figure 14: Conducted Emission on AC Mains, N Phase



No.	Frequency (MHz)	Results (dBUV)	Factor (dB)	Limit (dBUV)	Over Limit (dB)	Detector	Line	Verdict
1	0.150	55.19	10.15	66.00	-10.81	Peak	N	Pass
1*	0.150	48.06	10.15	66.00	-17.94	QP	N	Pass
1**	0.150	30.12	10.15	56.00	-25.88	AV	N	Pass
2	0.202	48.28	10.15	63.53	-15.25	Peak	N	Pass
2*	0.202	40.73	10.15	63.53	-22.80	QP	N	Pass
2**	0.202	31.82	10.15	53.53	-21.71	AV	N	Pass
3	0.460	36.65	10.15	56.69	-20.04	Peak	N	Pass
3*	0.460	29.45	10.15	56.69	-27.24	QP	N	Pass
3**	0.460	27.31	10.15	46.69	-19.38	AV	N	Pass
4	1.564	34.11	10.17	56.00	-21.89	Peak	N	Pass
4*	1.564	24.08	10.17	56.00	-31.92	QP	N	Pass
4**	1.564	26.99	10.17	46.00	-19.01	AV	N	Pass
5	2.380	30.64	10.19	56.00	-25.36	Peak	N	Pass
5*	2.380	23.40	10.19	56.00	-32.60	QP	N	Pass
5**	2.380	22.34	10.19	46.00	-23.66	AV	N	Pass
6	26.446	36.51	10.52	60.00	-23.49	Peak	N	Pass
6*	26.446	31.11	10.52	60.00	-28.89	QP	N	Pass
6**	26.446	27.64	10.52	50.00	-22.36	AV	N	Pass

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5 Appendixes

5.1 Photographs of the Sample



Front of the sample



Rear of the sample

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5.2 Set-up for Conducted Emissions



5.3 Set-up for Conducted RF test at Antenna Port



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5.4 Set-up for Spurious Emissions below 1GHz



Below 1 GHz

5.5 Set-up for Spurious Emissions above 1GHz



Above 1GHz

End of the report