Certificate Number: 2861.01

TEST REPORT

Report No.:	**E20190305644901-6-G1**	**Application No.:**	**E20190305644901**
Applicant:	GL Technologies (HongKong) Limited		
Address:	Unit 210D, 2/F, Enterprise Place Hong Kong SciencePark, ShaTin, N.T. Hong Kong, China		
Sample Description:	Bluetooth & ZigBee Module		
Model:	GL-EFR32S		
Adding Model:	GL-EFR32H		
FCC ID:	2AFIW-SH32BZ		
Test Specification:	FCC 47 CFR Part 15 Subpart C		
Test Date:	2019-03-27 to 2019-04-10		
Issue Date:	2019-05-08		
Test Result:	**PASS**		

Prepared By:	**Reviewed By:**	**Approved By:**
Darry Wu / Test Engineer	Eve Wang /Technical Manager	Tony Han / Manager
Date:2019-05-08	Date:2019-05-08	Date:2019-05-08

Other Aspects:
/

Abbreviations: *ok / P = passed; fail / F = failed; n.a. / N = not applicable*

The test result in this test report refers exclusively to the presented test sample. This report shall not be reproduced except in full, without the written approval of GRGT.

DIRECTIONS OF TEST

1. This company carries out test task according to the national regulation of verifications which can be traced to National Primary Standards and BIPM.

2. The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

3. If there is any objection concerning the test, the client should inform the laboratory within 15 days from the date of receiving the test report.

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1. TEST RESULT SUMMARY

Section B of FCC Part 15.247:2012			
Standard	**Item**	**Limit / Severity**	**Result**
FCC Part 15,Subpart C (15.247)	Antenna Requirement	§15.203	PASS
	Conducted Emissions	§15.207 (a)	PASS
	Radiated Spurious Emission	§15.247(d)	PASS
	6 dB Bandwidth	§15.247 (a)(2)	PASS
	Maximum Peak Output Power	§15.247(b)(3)	PASS
	Power Spectral Density	§15.247(e)	PASS
	Conducted band edges and Spurious Emission	§15.247(d)	PASS
	Restricted bands of operation	§15.205	PASS

2. GENERAL DESCRIPTION OF EUT

2.1. APPLICANT

Name:	GL Technologies (HongKong) Limited
Address:	Unit 210D, 2/F, Enterprise Place Hong Kong SciencePark, ShaTin, N.T. Hong Kong, China

2.2. MANUFACTURER

Name:	GL Technologies (HongKong) Limited
Address:	Unit 210D, 2/F, Enterprise Place Hong Kong SciencePark, ShaTin, N.T. Hong Kong, China

2.3. FACTORY

Name:	Shenzhen Guanglianzhitong Technology co. LTD
Address:	Room 305, 306, Skyworth digital building, Songbai Road,Shiyan Street, Baoan District, Shenzhen,China

2.4. BASIC DESCRIPTION OF EQUIPMENT UNDER TEST

Equipment:	Bluetooth & ZigBee Module
Model No.:	GL-EFR32S
Adding Model:	GL-EFR32H
Model Discrepancy:	The models are identical to each other except for ports and components position front and back.
Trade Name:	GL.iNET
Power supply:	DC 3.3V power supplied by notebook
Frequency Range:	2405~ 2480 MHz
Transmit Power:	14.53 dBm
Modulation type:	QPSK
Channel space:	2MHz
Antenna Specification:	PCB Antenna with -0.042dBi gain (Max)
Temperature Range:	0~75℃
Hardware Version:	V1.0
Software Version:	V1.0
Note:	/

2.5. TEST OPERATION MODE

Test Item	Mode No.	Description of the modes
Conducted Emission	1	BLE(GL-EFR32S)
	2	BLE(GL-EFR32H)
	3	Zigbee(GL-EFR32S)
	4	Zigbee(GL-EFR32H)
Radiated Emission	1	Continuously Transmitting

2.6. LOCAL SUPPORTIVE

Name of Equipment	Manufacturer	Model	Serial Number	Note
Notebook	ACER	MS2392	NXMPGCN01550311F8C6600	/
Adapter(Notebook)	/	A13-45N2A	F258341423005687	/
AC1300 Home Gateway PCB Mainboard	GL Technologies (HongKong) Limited	GL-S1300	/	/
Cable				
AC Cable	/	/	/	Unshielded,1.50m
DC Cable	/	/	/	Shielded,1.80m
USB Cable	/	/	/	Unshielded,0.80m
AC Cable	/	/	/	Unshielded,0.50m

Test software:

Software version	Test level
Tera Term	40

3. LABORATORY AND ACCREDITATIONS

3.1. LABORATORY

The tests and measurements refer to this report were performed by EMC Laboratory of GRG METROLOGY & TEST (SHENZHEN) CO., LTD

Add. : No.1301 Guanguang Road Xinlan Community, Guanlan Street, Longhua District Shenzhen, 518110, People's Republic of China

Telephone : +86-755-61180008

Fax : /

3.2. ACCREDITATIONS

A2LA	Certificate Number 2861.01

3.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement		Frequency	Uncertainty
Radiated Emission	Horizontal	30MHz～1000MHz	4.8dB
		1GHz～26.5GHz	5.8dB
	Vertical	30MHz～1000MHz	4.8dB
		1GHz～26.5GHz	5.9dB
Conducted Emission		9kHz～30MHz	3.5dB

This uncertainty represents an expanded uncertainty factor of *k*=2.

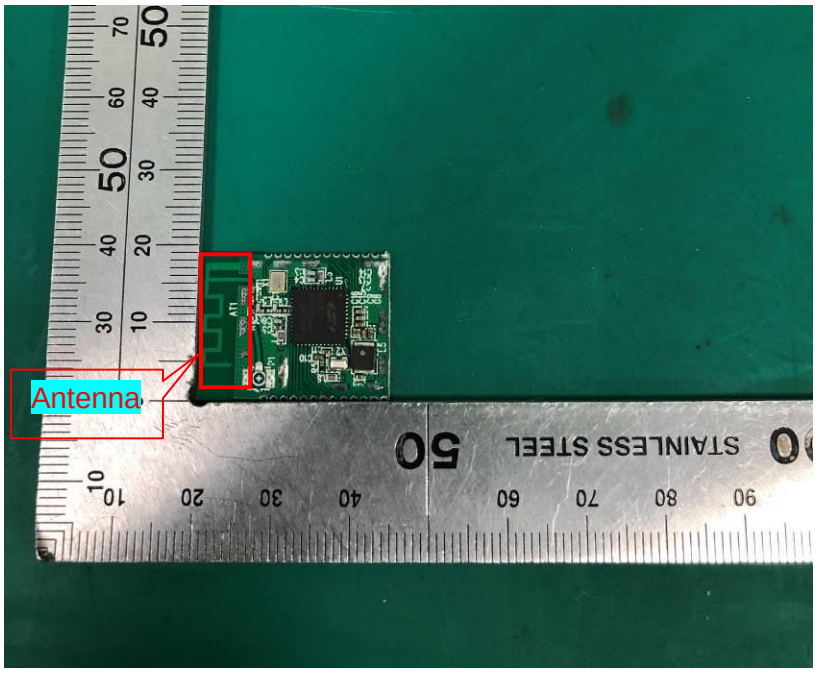
4. LIST OF USED TEST EQUIPMENT AT GRGT

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due
Conducted Emissions				
EMI TEST Receiver	ROHDE&SCHWARZ	ESCI	100783	2020-01-10
LISN(EUT)	ROHDE&SCHWARZ	ENV216	101543	2020-01-10
Hygrothermograph	VICTOR	HTC-1	N/A	2019-12-25
Test S/W	FARAD	EZ-EMC/ CCS-3A1-CE		
Radiated Spurious Emission& Restricted bands of operation				
ESPI Test Receiver	ROHDE&SCHWARZ	ESPI	101026	2020-01-09
EXA signal analyzer	Agilent	N9010A	MY52221469	2020-01-10
Bilog Antenna	Schwarzbeck	VULB 9160	9160-3401	2019-12-21
Horn Antenna	Schwarzbeck	BBHA9120	D286	2019-12-21
Board-Band Horn Antenna	Schwarzbeck	BBHA9170	9170-497	2020-01-15
Active Loop Antenna	COM-POWER	AL-130	121044	2019-12-27
Amplifier	EM Electronics Corporation	EM330	060661	2019-12-21
High Noise Amplifier	Agilent	8449B	3008A02060	2019-12-21
Hygrothermograph	VICTOR	HTC-1	NA	2019-12-24
Test SW	FARAD	EZ-EMC/ CCS-3A1-CE		
6 dB Bandwidth				
EXA signal analyzer	Agilent	N9010A	MY52221469	2020-01-10
Maximum Peak Output Power				
EXA signal analyzer	Agilent	N9010A	MY52221469	2020-01-10
Conducted band edges and Spurious Emission				
EXA signal analyzer	Agilent	N9010A	MY52221469	2020-01-10
Power Spectral Density				
EXA signal analyzer	Agilent	N9010A	MY52221469	2020-01-10

5. ANTENNA REQUIREMENT

The EUT has one antenna. The antenna is PCB antenna.
The max gain of antenna is -0.042dBi .which accordance 15.203.is considered sufficient to comply with the provisions of this section

GL-EFR32S



6. CONDUCTED EMISSION MEASUREMENT

6.1. LIMITS

Frequency range	Limits (dBμV)	
	Quasi-peak	Average
150kHz ～ 0.5MHz	66～56	56～46
0.5 MHz ～ 5 MHz	56	46
5 MHz ～ 30 MHz	60	50

NOTE: (1) The lower limit shall apply at the transition frequencies.
(2) The limit decreases in line with the logarithm of the frequency in the range of 150 kHz to 0.5MHz.

6.2. TEST PROCEDURES

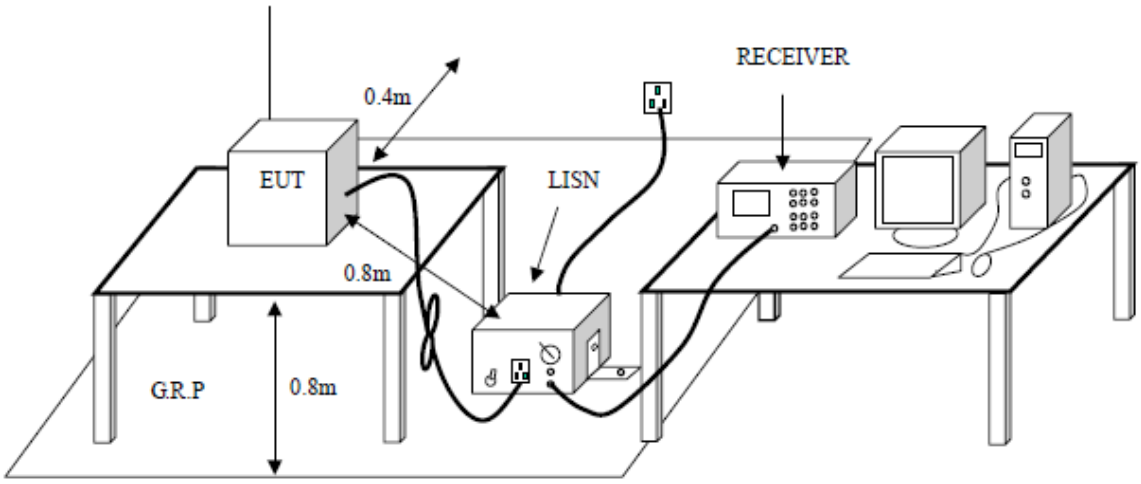
Procedure of Preliminary Test

Test procedures follow ANSI C63.4:2014.
For measurement of the disturbance voltage the equipment under test (EUT) is connected to the power supply mains and any other extended network via one or more artificial network(s). An EUT, whether intended to be grounded or not, and which is to be used on a table is configured as follows:
– Either the bottom or the rear of the EUT shall be at a controlled distance of 40 cm from a reference ground plane. This ground plane is normally the wall or floor of a shielded room. It may also be a grounded metal plane of at least 2 m by 2 m. This is physically accomplished as follows:
1) place the EUT on a table of non-conducting material which is at least 80 cm high. Place the EUT so that it is 40 cm from the wall of the shielded room, or
2) place the EUT on a table of non-conducting material which is 40 cm high so that the bottom of the EUT is 40 cm above the ground plane;
– All other conductive surfaces of the EUT shall be at least 80 cm from the reference ground plane;
– The EUT are placed on the floor that one side of the housings is 40 cm from the vertical reference ground plane and other metallic parts;
– Interconnecting cables that hang closer than 40 cm to the ground plane shall be folded back and forth forming a bundle 30 cm to 40 cm long, hanging approximately in the middle between the ground plane and the table.
– I/O cables that are connected to a peripheral shall be bundled in the centre. The end of the cable may be terminated if required using correct terminating impedance. The total length shall not exceed 1 m.
The test mode(s) described in Item 2.4 were scanned during the preliminary test. After the preliminary scan, we found the test mode described in Item 2.4 producing the highest emission level. The EUT configuration and cable configuration of the above highest emission levels were recorded for reference of the final test.

Procedure of Final Test

EUT and support equipment were set up on the test bench as per the configuration with highest emission level in the preliminary test. A scan was taken on both power lines, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit. The test data of the worst-case condition(s) was recorded.

6.3. TEST SETUP



6.4. DATA SAMPLE

Frequency (MHz)	QuasiPeak Reading (dBuV)	Average Reading (dBuV)	Correction Factor (dB)	QuasiPeak Result (dBuV)	Average Result (dBuV)	QuasiPeak Limit (dBuV)	Average Limit (dBuV)	QuasiPeak Margin (dB)	Average Margin (dB)	Remark (Pass/Fail)
X.XXXX	32.69	25.65	11.52	44.21	37.17	65.78	55.79	-21.57	-18.62	Pass

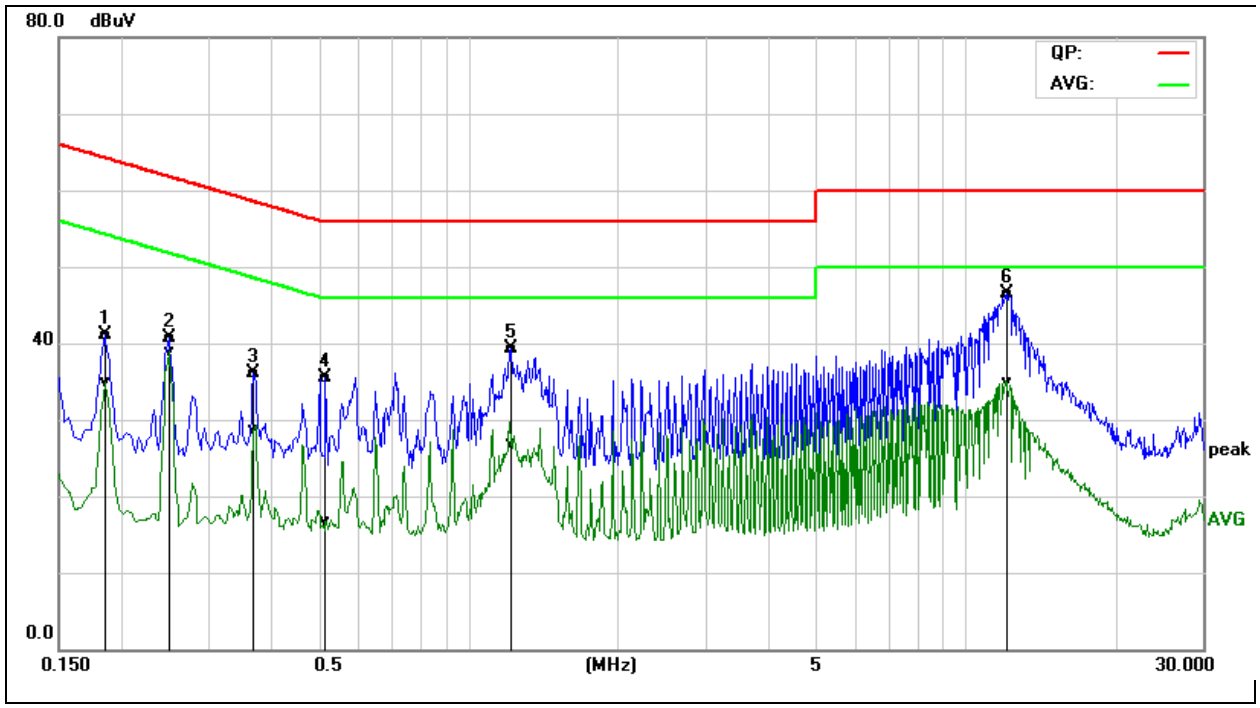
Factor = Insertion loss of LISN + Cable Loss
Result = Quasi-peak Reading/ Average Reading + Factor
Limit = Limit stated in standard
Margin = Result (dBuV) – Limit (dBuV)

6.5. TEST RESULTS

Pre-test Mode 1 to Mode 4, found that Mode 3 are the worst case.

Model No.	GL-EFR32S	**RBW,VBW**	9 kHz
Environmental Conditions	23.4°C, 50%RH	**Test Mode**	Mode 3
Tested By	Sam Zeng	**Line**	L
Tested Date	2019-03-27	**Test Voltage**	AC120V/60Hz

(The chart below shows the highest readings taken from the final data.)

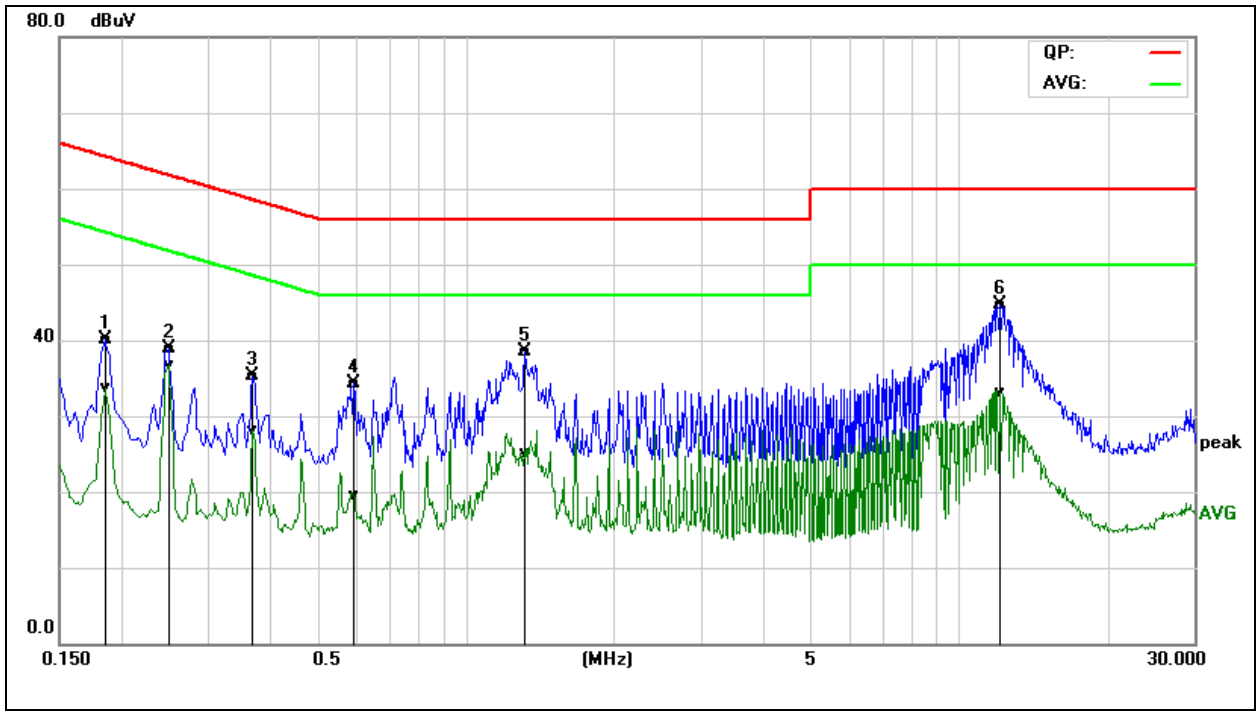


Frequency (MHz)	QuasiPeak Reading (dBuV)	Average Reading (dBuV)	Correction Factor (dB)	QuasiPeak Result (dBuV)	Average Result (dBuV)	QuasiPeak Limit (dBuV)	Average Limit (dBuV)	QuasiPeak Margin (dB)	Average Margin (dB)	Remark (Pass/Fail)
0.1860	21.57	15.27	19.63	41.20	34.90	64.21	54.21	-23.01	-19.31	Pass
0.2500	21.04	19.26	19.62	40.66	38.88	61.75	51.76	-21.09	-12.88	Pass
0.3700	16.52	9.21	19.57	36.09	28.78	58.50	48.50	-22.41	-19.72	Pass
0.5180	15.87	-2.90	19.54	35.41	16.64	56.00	46.00	-20.59	-29.36	Pass
1.2180	19.75	7.34	19.59	39.34	26.93	56.00	46.00	-16.66	-19.07	Pass
12.0940	26.36	14.78	20.09	46.45	34.87	60.00	50.00	-13.55	-15.13	Pass

REMARKS: *L = Live Line*

Model No.	GL-EFR32S	**RBW,VBW**	9 kHz
Environmental Conditions	23.4°C, 50%RH	**Test Mode**	Mode 3
Tested By	Sam Zeng	**Line**	N
Tested Date	2019-03-27	**Test Voltage**	AC120V/60Hz

(The chart below shows the highest readings taken from the final data.)



Frequency (MHz)	QuasiPeak Reading (dBuV)	Average Reading (dBuV)	Correction Factor (dB)	QuasiPeak Result (dBuV)	Average Result (dBuV)	QuasiPeak Limit (dBuV)	Average Limit (dBuV)	QuasiPeak Margin (dB)	Average Margin (dB)	Remark (Pass/Fail)
0.1860	20.40	14.01	19.63	40.03	33.64	64.21	54.21	-24.18	-20.57	Pass
0.2500	19.23	17.06	19.62	38.85	36.68	61.75	51.76	-22.90	-15.08	Pass
0.3700	15.72	8.50	19.57	35.29	28.07	58.50	48.50	-23.21	-20.43	Pass
0.5940	14.77	0.01	19.57	34.34	19.58	56.00	46.00	-21.66	-26.42	Pass
1.3220	18.97	5.57	19.60	38.57	25.17	56.00	46.00	-17.43	-20.83	Pass
12.1660	24.64	13.07	20.09	44.73	33.16	60.00	50.00	-15.27	-16.84	Pass

REMARKS: *N = Neutral Line.*

7. RADIATED SPURIOUS EMISSIONS

7.1. LIMITS

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required.

Frequency (MHz)	Quasi-peak(μV/m)	Measurement distance(m)	Quasi-peak(dBμV/m)@distance 3m
0.009-0.490	2400/F(kHz)	300	53.8~88.5
0.490-1.705	24000/F(kHz)	30	43~53.8
1.705-30.0	30	30	49.5
30 ~ 88	100	3	40
88~216	150	3	43.5
216 ~ 960	200	3	46
Above 960	500	3	54

NOTE: (1) The lower limit shall apply at the transition frequencies.

7.2. TEST PROCEDURES (please refer to measurement standard)

1) Sequence of testing 9 kHz to 30 MHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions.

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Pre measurement:

--- The turntable rotates from 0 °to 315 °using 45 °steps.

--- The antenna height is 0.8 meter.

--- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

--- Identified emissions during the pre measurement the software maximizes by rotating the turntable position (0 °to 360 °) and by rotating the elevation axes (0 °to 360 °).

--- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.

--- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Pre measurement:

--- The turntable rotates from 0 °to 315 °using 45 °steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height changes from 1 to 3 meter.

--- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (±45°) and antenna movement between 1 and 4 meter.

--- The final measurement will be done with QP detector with an EMI receiver.

--- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 3 meter.

--- The EUT was set into operation.

Pre measurement:

--- The turntable rotates from 0° to 315° using 45° steps.

--- The antenna is polarized vertical and horizontal.

--- The antenna height scan range is 1 meter to 2.5 meter.

--- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

--- The final measurement will be performed with minimum the six highest peaks.

--- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position (±45°) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.

--- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
--- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the pre measurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz
Setup:

--- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.

--- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.

--- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.

--- Auxiliary equipment and cables were positioned to simulate normal operation conditions

--- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

--- The measurement distance is 1 meter.

--- The EUT was set into operation.

Pre measurement:

--- The antenna is moved spherical over the EUT in different polarisations of the antenna.

Final measurement:

--- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.
--- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

NOTE: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average (Duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor (10 log(1/duty cycle)).

7.3. TEST SETUP

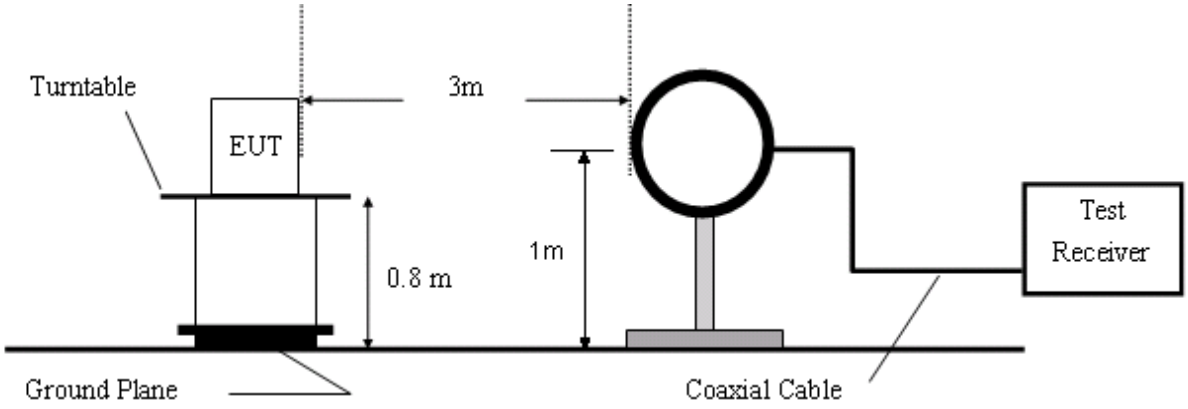


Figure 1. 9KHz to 30MHz radiated emissions test configuration

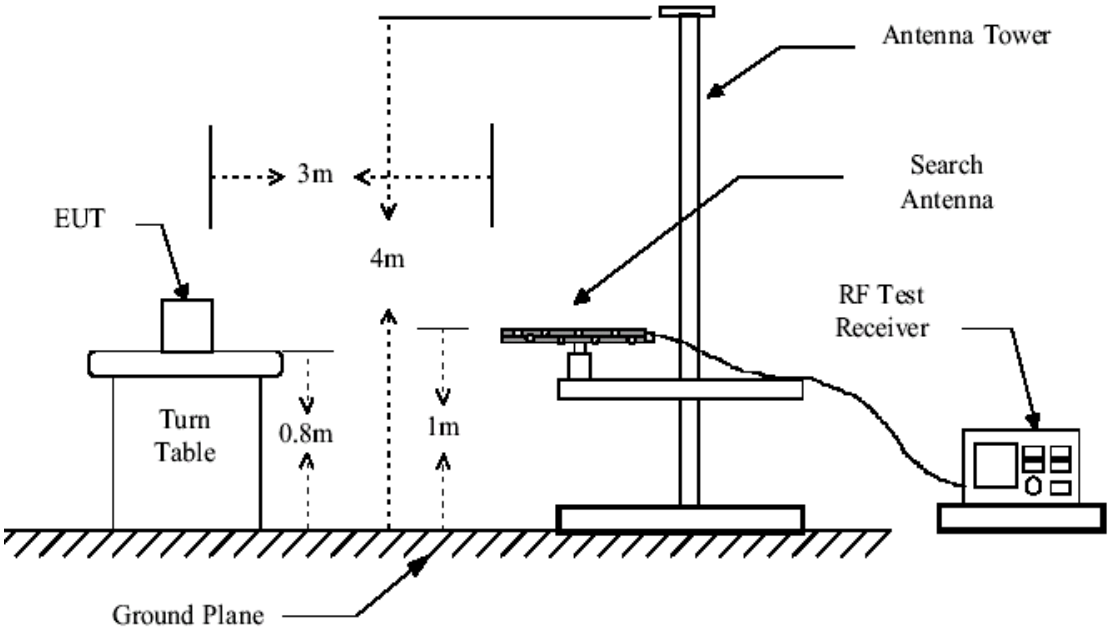


Figure 2. 30MHz to 1GHz radiated emissions test configuration

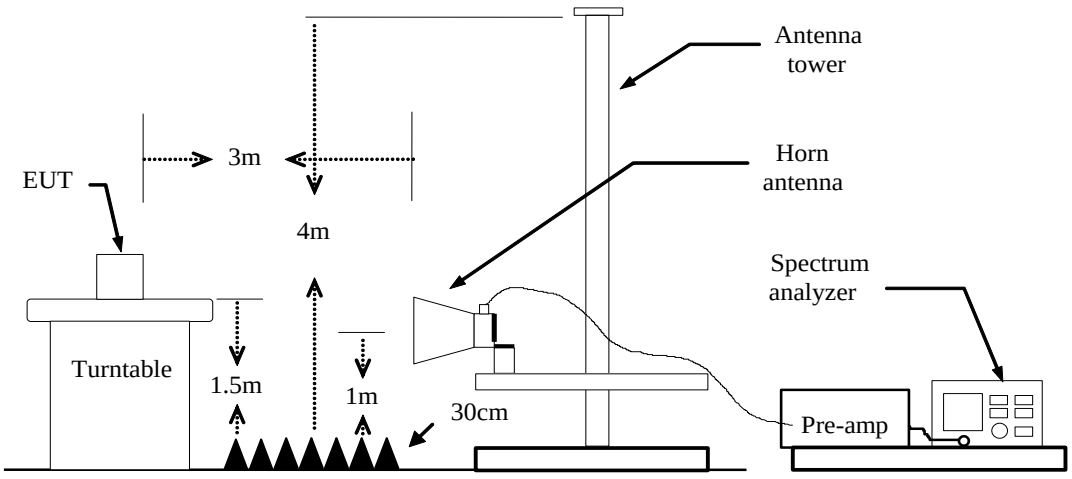


Figure 3. Above 1GHz radiated emissions test configuration

7.4. DATA SAMPLE

30MHz to 1GHz

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
xxx	xxx	37.06	-15.48	21.58	40.00	-18.42	QP	Vertical

Above 1 GHz

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
xxx	xxx	65.45	-11.12	54.33	74.00	-19.67	peak	Vertical
xxx	xxx	63.00	-11.12	51.88	54.00	-2.12	AVG	Vertical

Frequency (MHz) = Emission frequency in MHz

Ant.Pol. (H/V) = Antenna polarization

Reading (dBuV) = Uncorrected Analyzer / Receiver reading

Correction Factor (dB/m) = Antenna factor + Cable loss – Amplifier gain

Result (dBuV/m) = Reading (dBuV) + Correction Factor (dB/m)

Limit (dBuV/m) = Limit stated in standard

Margin (dB) = Remark Result (dBuV/m) – Limit (dBuV/m)

Peak = Peak Reading

QP = Quasi-peak Reading

AVG = Average Reading

7.5. TEST RESULTS

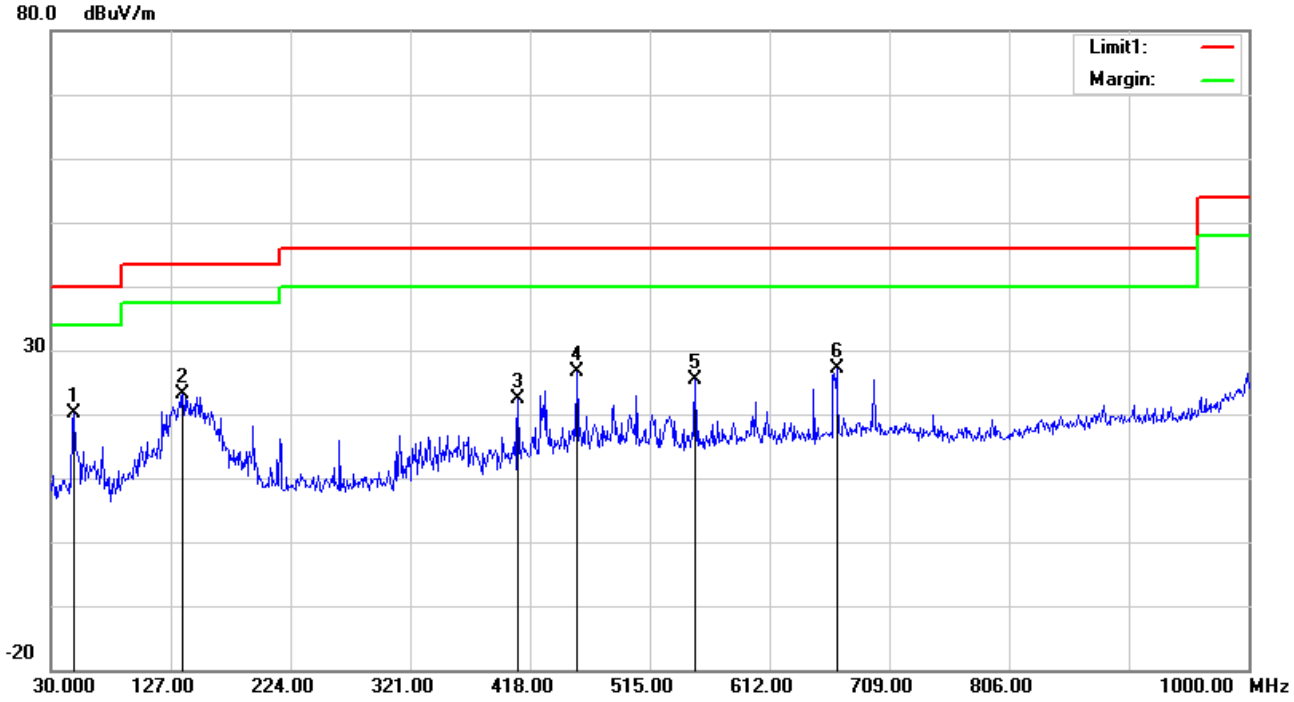
30MHz to 1GHz:

Pre-scan all modes and recorded the worst case results in this report (ZigBee (Low Channel)

GL-EFR32S

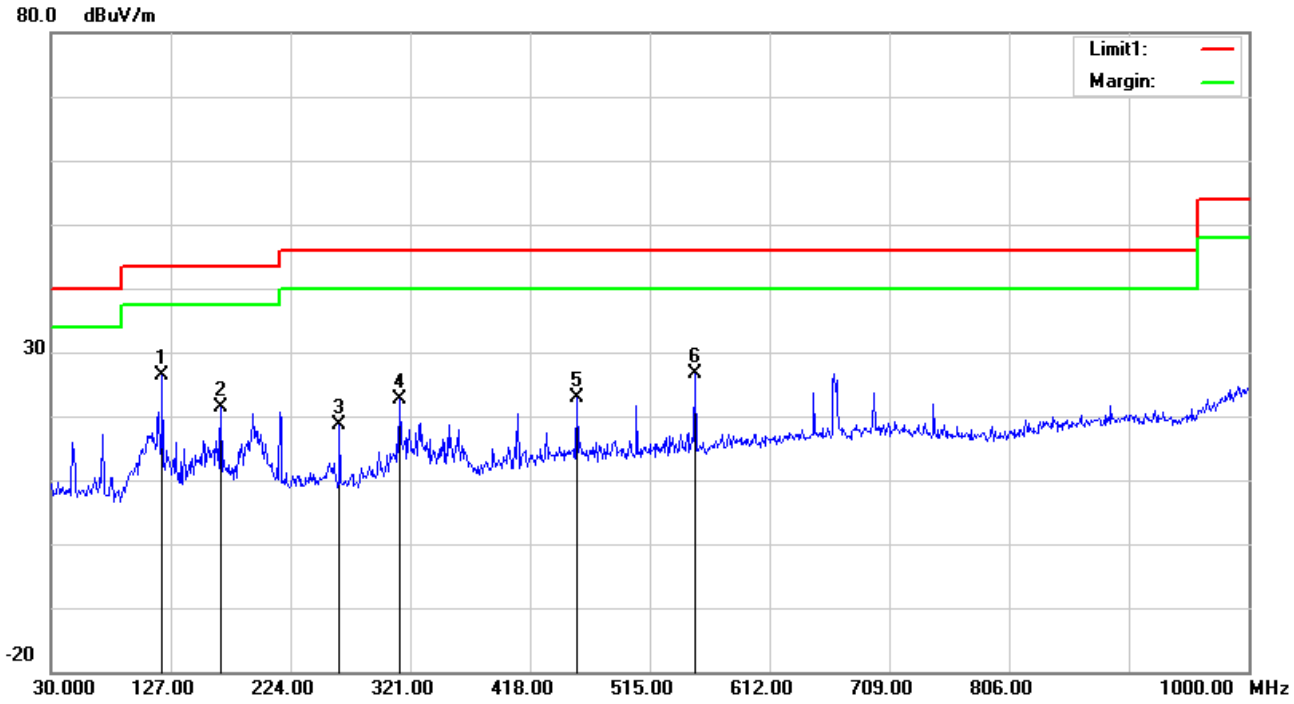
Mode: TX

Lowest channel (2404MHz) Date: 2019-03-27



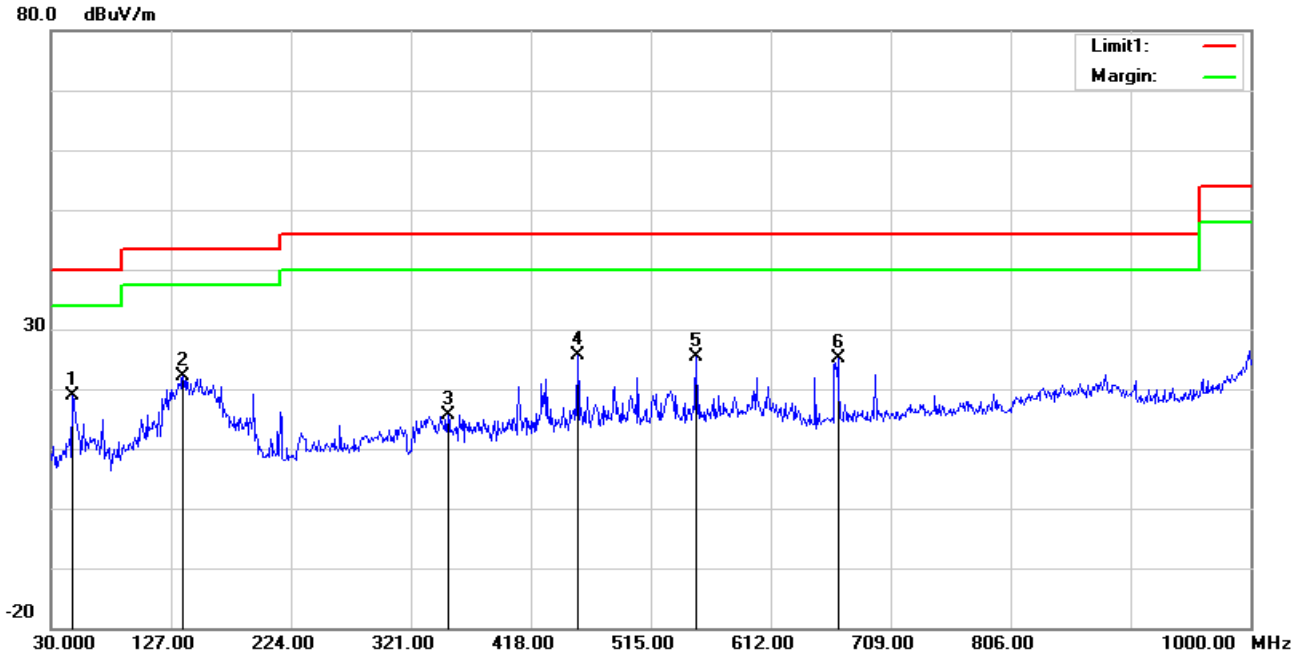
No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
1	48.4300	38.22	-18.08	20.14	40.00	-19.86	QP	Vertical
2	136.7000	39.16	-16.04	23.12	43.50	-20.38	QP	Vertical
3	408.3000	35.24	-12.96	22.28	46.00	-23.72	QP	Vertical
4	455.8300	37.82	-11.14	26.68	46.00	-19.32	QP	Vertical
5	551.8600	35.42	-9.95	25.47	46.00	-20.53	QP	Vertical
6	666.3200	34.19	-7.18	27.01	46.00	-18.99	QP	Vertical

Mode: TX
Lowest channel (2404MHz) Date: 2019-03-27



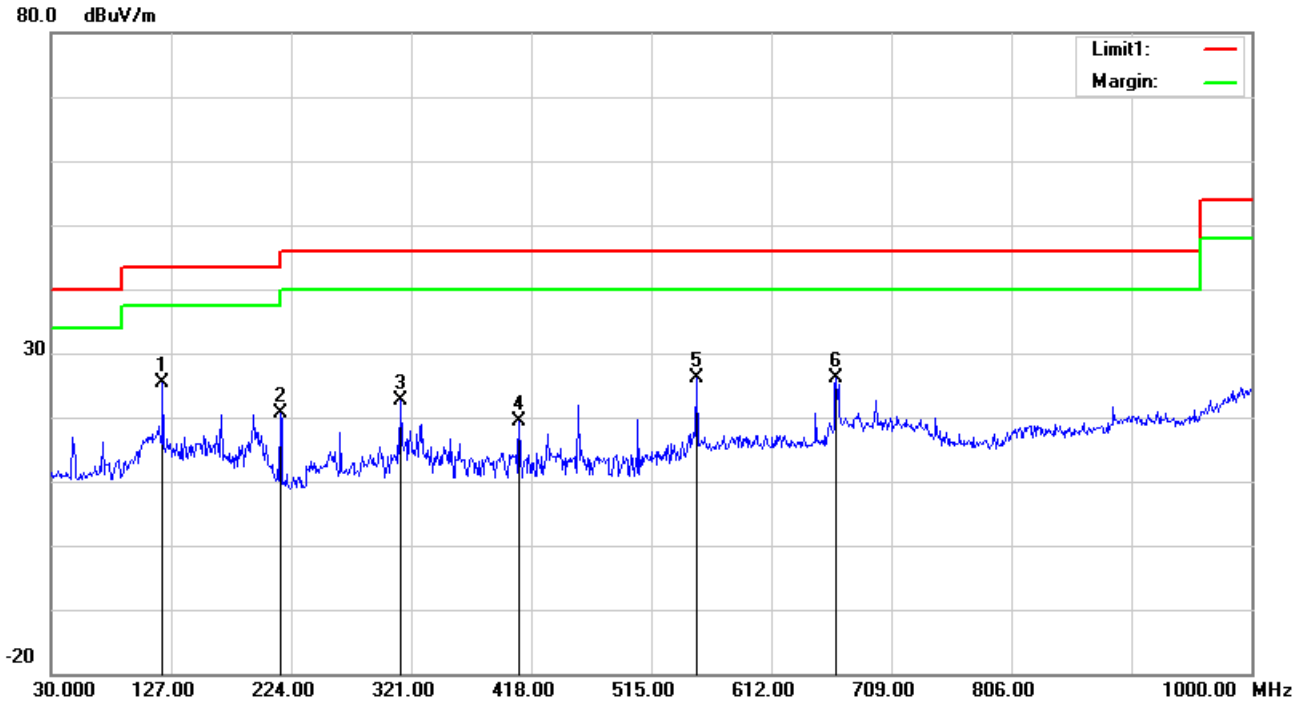
No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
1	120.2100	43.70	-17.38	26.32	43.50	-17.18	QP	Horizontal
2	167.7400	36.87	-15.39	21.48	43.50	-22.02	QP	Horizontal
3	263.7700	35.21	-16.67	18.54	46.00	-27.46	QP	Horizontal
4	312.2700	38.34	-15.63	22.71	46.00	-23.29	QP	Horizontal
5	455.8300	33.96	-11.14	22.82	46.00	-23.18	QP	Horizontal
6	551.8600	36.52	-9.95	26.57	46.00	-19.43	QP	Horizontal

GL-EFR32H
Mode: TX
Lowest channel (2404MHz) Date: 2019-03-27



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
1	47.4600	36.82	-18.01	18.81	40.00	-21.19	QP	Vertical
2	136.7000	38.16	-16.04	22.12	43.50	-21.38	QP	Vertical
3	351.0700	30.25	-14.54	15.71	46.00	-30.29	QP	Vertical
4	455.8300	36.82	-11.14	25.68	46.00	-20.32	QP	Vertical
5	551.8600	35.42	-9.95	25.47	46.00	-20.53	QP	Vertical
6	666.3200	32.19	-7.18	25.01	46.00	-20.99	QP	Vertical

Mode: TX
Lowest channel (2404MHz) Date: 2019-03-27



No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
1	120.2100	42.70	-17.38	25.32	43.50	-18.18	QP	Horizontal
2	215.2700	38.41	-17.67	20.74	43.50	-22.76	QP	Horizontal
3	312.2700	38.34	-15.63	22.71	46.00	-23.29	QP	Horizontal
4	408.3000	32.45	-12.96	19.49	46.00	-26.51	QP	Horizontal
5	551.8600	36.02	-9.95	26.07	46.00	-19.93	QP	Horizontal
6	664.3800	33.47	-7.23	26.24	46.00	-19.76	QP	Horizontal

Remark:

1 No emission found between lowest internal used/generated frequency to 30MHz.
2 Radiated emissions measured in frequency range from 9 kHz to 1GHz were made with an instrument using Quasi-peak detector mode.
3 Data of measurement within this frequency range shown "---" in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
4 The IF bandwidth of Receiver between 30MHz to 1GHz was 120 kHz.

Above 1GHz:

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Mode: TX

Lowest channel (2404MHz) Date: 2019-03-28

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
1	1891.000	46.73	-3.00	43.73	74.00	-30.27	peak	Vertical
2	2638.000	45.14	-0.65	44.49	74.00	-29.51	peak	Vertical
3	4069.000	41.67	1.72	43.39	74.00	-30.61	peak	Vertical
4	4807.000	47.57	2.35	49.92	74.00	-24.08	peak	Vertical
5	5941.000	40.51	5.07	45.58	74.00	-28.42	peak	Vertical
6	6805.000	40.98	6.65	47.63	74.00	-26.37	peak	Vertical
7	1288.000	52.03	-5.90	46.13	74.00	-27.87	peak	Horizontal
8	1909.000	46.64	-2.90	43.74	74.00	-30.26	peak	Horizontal
9	3061.000	43.09	0.92	44.01	74.00	-29.99	peak	Horizontal
10	3646.000	41.84	1.12	42.96	74.00	-31.04	peak	Horizontal
11	4807.000	47.70	2.35	50.05	74.00	-23.95	peak	Horizontal
12	5995.000	39.68	5.24	44.92	74.00	-29.08	peak	Horizontal

Mode: TX

Middle channel (2440 MHz) Date: 2019-03-28

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
1	1900.000	48.56	-2.95	45.61	74.00	-28.39	peak	Vertical
2	2521.000	44.99	-1.15	43.84	74.00	-30.16	peak	Vertical
3	3250.000	42.56	0.92	43.48	74.00	-30.52	peak	Vertical
4	3871.000	42.34	1.42	43.76	74.00	-30.24	peak	Vertical
5	4888.000	51.55	2.30	53.85	74.00	-20.15	peak	Vertical
6	4888.000	47.82	2.30	50.12	54.00	-3.88	AVG	Vertical
7	6337.000	40.15	5.77	45.92	74.00	-28.08	peak	Vertical
8	1603.000	53.88	-4.72	49.16	74.00	-24.84	peak	Horizontal
9	2503.000	44.98	-1.22	43.76	74.00	-30.24	peak	Horizontal
10	3214.000	42.79	0.92	43.71	74.00	-30.29	peak	Horizontal
11	4402.000	41.40	2.36	43.76	74.00	-30.24	peak	Horizontal
12	4888.000	50.72	2.30	53.02	74.00	-20.98	peak	Horizontal
13	4888.000	47.85	2.30	50.15	54.00	-3.85	AVG	Horizontal
14	6283.000	40.35	5.68	46.03	74.00	-27.97	peak	Horizontal

Mode: TX

Highest channel (2480MHz) Date: 2019-03-28

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
1	1594.000	52.01	-4.77	47.24	74.00	-26.76	peak	Vertical
2	2476.000	45.10	-1.30	43.80	74.00	-30.20	peak	Vertical
3	3331.000	42.93	0.92	43.85	74.00	-30.15	peak	Vertical
4	4348.000	41.63	2.26	43.89	74.00	-30.11	peak	Vertical
5	4960.000	50.23	2.26	52.49	74.00	-21.51	peak	Vertical
6	4960.000	47.97	2.26	50.23	54.00	-3.77	AVG	Vertical
7	6625.000	40.67	6.28	46.95	74.00	-27.05	peak	Vertical
8	1324.000	54.18	-5.80	48.38	74.00	-25.62	peak	Horizontal
9	1891.000	47.81	-3.00	44.81	74.00	-29.19	peak	Horizontal
10	3205.000	43.55	0.91	44.46	74.00	-29.54	peak	Horizontal
11	4222.000	41.41	2.02	43.43	74.00	-30.57	peak	Horizontal
12	4960.000	50.43	2.26	52.69	74.00	-21.31	peak	Horizontal
13	4960.000	47.88	2.26	50.14	54.00	-3.86	AVG	Horizontal
14	6229.000	40.00	5.60	45.60	74.00	-28.40	peak	Horizontal

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Mode: TX

Lowest channel (2405MHz) Date: 2019-03-28

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
1	1081.000	51.75	-6.45	45.30	74.00	-28.70	peak	Vertical
2	1594.000	48.54	-4.77	43.77	74.00	-30.23	peak	Vertical
3	2638.000	44.14	-0.65	43.49	74.00	-30.51	peak	Vertical
4	3205.000	42.24	0.91	43.15	74.00	-30.85	peak	Vertical
5	3799.000	42.38	1.32	43.70	74.00	-30.30	peak	Vertical
6	4807.000	46.57	2.35	48.92	74.00	-25.08	peak	Vertical
7	1063.000	52.50	-6.49	46.01	74.00	-27.99	peak	Horizontal
8	1351.000	51.07	-5.73	45.34	74.00	-28.66	peak	Horizontal
9	1909.000	46.64	-2.90	43.74	74.00	-30.26	peak	Horizontal
10	2521.000	45.16	-1.15	44.01	74.00	-29.99	peak	Horizontal
11	3151.000	43.28	0.91	44.19	74.00	-29.81	peak	Horizontal
12	4807.000	46.70	2.35	49.05	74.00	-24.95	peak	Horizontal

Mode: TX

Middle channel (2440 MHz) Date: 2019-03-28

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
1	1594.000	49.49	-4.77	44.72	74.00	-29.28	peak	Vertical
2	1900.000	48.06	-2.95	45.11	74.00	-28.89	peak	Vertical
3	2827.000	43.07	0.16	43.23	74.00	-30.77	peak	Vertical
4	3070.000	42.56	0.91	43.47	74.00	-30.53	peak	Vertical
5	4888.000	50.05	2.30	52.35	74.00	-21.65	peak	Vertical
6	4888.000	46.28	2.30	48.58	54.00	-5.42	AVG	Vertical
7	7075.000	39.99	7.24	47.23	74.00	-26.77	peak	Vertical
8	1063.000	52.35	-6.49	45.86	74.00	-28.14	peak	Horizontal
9	1603.000	52.88	-4.72	48.16	74.00	-25.84	peak	Horizontal
10	1891.000	46.67	-3.00	43.67	74.00	-30.33	peak	Horizontal
11	2836.000	42.66	0.21	42.87	74.00	-31.13	peak	Horizontal
12	3214.000	42.29	0.92	43.21	74.00	-30.79	peak	Horizontal
13	4888.000	49.22	2.30	51.52	74.00	-22.48	peak	Horizontal
14	4888.000	46.15	2.30	48.45	54.00	-5.55	AVG	Horizontal

Mode: TX

Highest channel (2480MHz) Date: 2019-03-28

No.	Frequency (MHz)	Reading (dBuV/m)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Pole
1	1594.000	51.01	-4.77	46.24	74.00	-27.76	peak	Vertical
2	2476.000	44.60	-1.30	43.30	74.00	-30.70	peak	Vertical
3	3331.000	42.93	0.92	43.85	74.00	-30.15	peak	Vertical
4	4375.000	41.87	2.30	44.17	74.00	-29.83	peak	Vertical
5	4960.000	48.73	2.26	50.99	74.00	-23.01	peak	Vertical
6	6130.000	40.18	5.46	45.64	74.00	-28.36	peak	Vertical
7	1054.000	52.90	-6.52	46.38	74.00	-27.62	peak	Horizontal
8	1324.000	53.18	-5.80	47.38	74.00	-26.62	peak	Horizontal
9	1891.000	46.81	-3.00	43.81	74.00	-30.19	peak	Horizontal
10	3205.000	43.55	0.91	44.46	74.00	-29.54	peak	Horizontal
11	4042.000	41.48	1.67	43.15	74.00	-30.85	peak	Horizontal
12	4960.000	49.43	2.26	51.69	74.00	-22.31	AVG	Horizontal
13	4960.000	45.86	2.26	48.12	54.00	-5.88	peak	Horizontal

Remark:

1 Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.

2 Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.

3 Average test would be performed if the peak result were greater than the average limit or as required by the applicant.

4 Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

5 Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.

8. 6DB BANDWIDTH

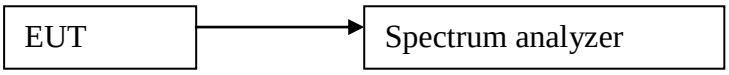
8.1. LIMITS

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.2. TEST PROCEDURES

1) Remove the antenna from the EUT, and then connect a low loss RF cable from antenna port to the spectrum analyzer**.**
2) Set resolution bandwidth (RBW) = 100kHz.Set the video bandwidth (VBW) ≥ 3 x RBW. Detector = Peak. Trace mode = max hold. Sweep = auto couple. Allow the trace to stabilize, record 6dB bandwidth value.
3) Repeat above procedures until all frequencies measured were complete.

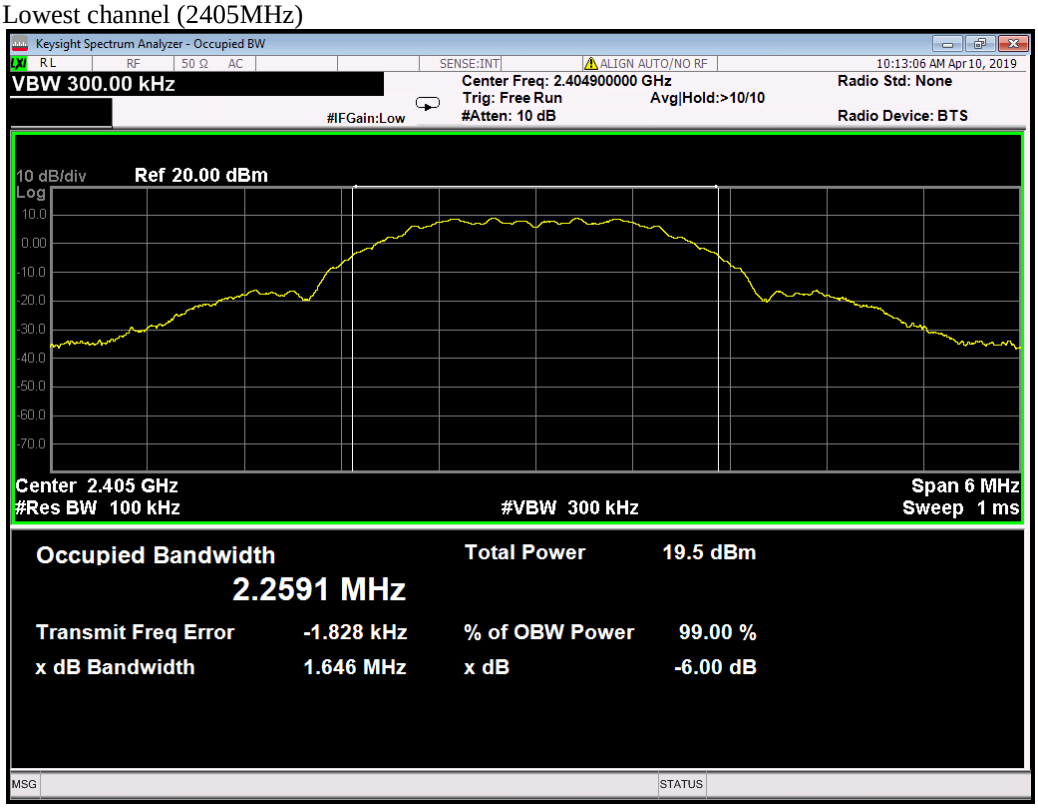
8.3. TEST SETUP



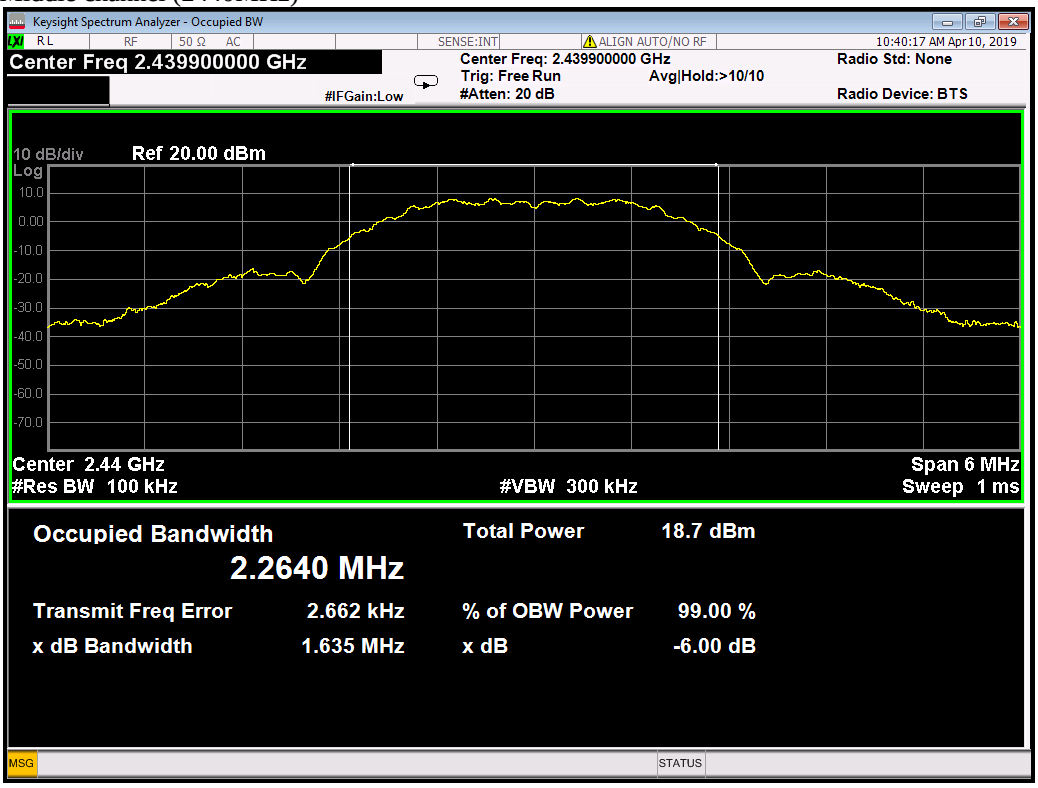
8.4. TEST RESULTS

Channel	Frequency (MHz)	Bandwidth (kHz)	Limit (kHz)	Test Result
Lowest	2405	1646	>500	PASS
Middle	2440	1635		PASS
Highest	2480	1647		PASS

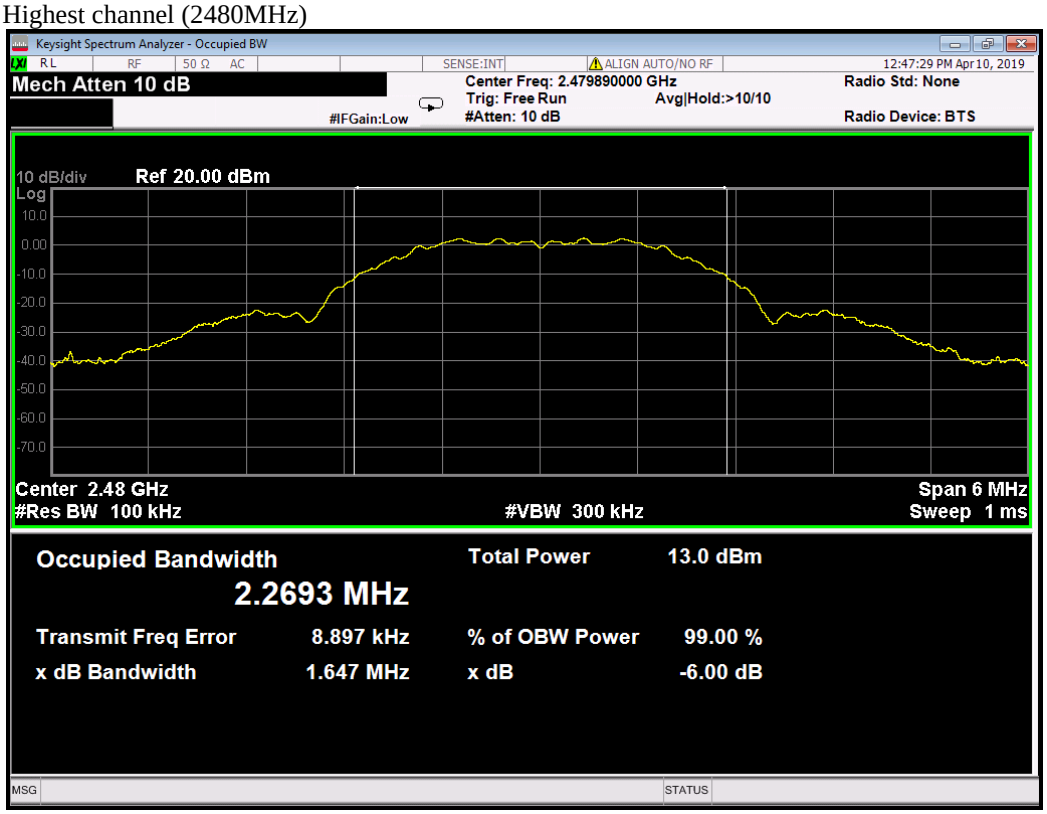
Lowest channel (2405MHz)



Middle channel (2440MHz)



Highest channel (2480MHz)



9. MAXIMUM PEAK OUTPUT POWER

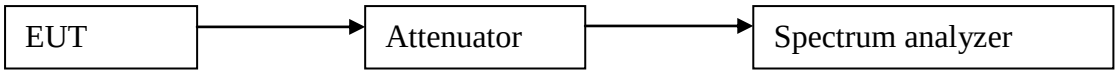
9.1. LIMITS

The maximum Peak output power measurement is 1W

9.2. TEST PROCEDURES

1) Place the EUT on a bench and set it in transmitting mode.
2) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to an EMI Test Receiver.
3) The spectrum analyzer resolution bandwidth that is ≤EBW. So we test the Maximum Conducted Output Power ——Integrated band power method.
4) Set the analyzer span≥ 1.5 x DTS bandwidth. Set the RBW = 1 MHz. Set the VBW ≥ 3 MHz. Sweep time = auto couple. Detector = peak. Allow trace to fully stabilize.

9.3. TEST SETUP



9.4. TEST RESULTS

Channel	Frequency (MHz)	Measured Channel Power (dBm)	Limit	Peak/ Average	Result
Lowest	2405	14.53	1W (30dBm)	Peak	Pass
Middle	2440	13.51			Pass
Highest	2480	8.47			Pass
Lowest	2405	11.59		Average	Pass
Middle	2440	10.55			Pass
Highest	2480	5.50			Pass

10. POWER SPECTRAL DENSITY

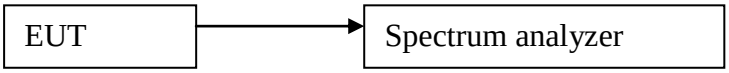
10.1. LIMITS

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

10.2. TEST PROCEDURES

1) Remove the antenna from the EUT, and then connect a low loss RF cable from antenna port to the spectrum analyzer.
2) Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3) Set the analyzer span to 1.5 times the DTS bandwidth. Set the RBW = 3 kHz. Set the VBW ≥3 RBW. Detector = peak. Ensure that the number of measurement points in the sweep ≥ 2 x span/RBW (use of a greater number of measurement points than this minimum requirement is recommended).
4) Repeat above procedures until all frequencies measured were complete.

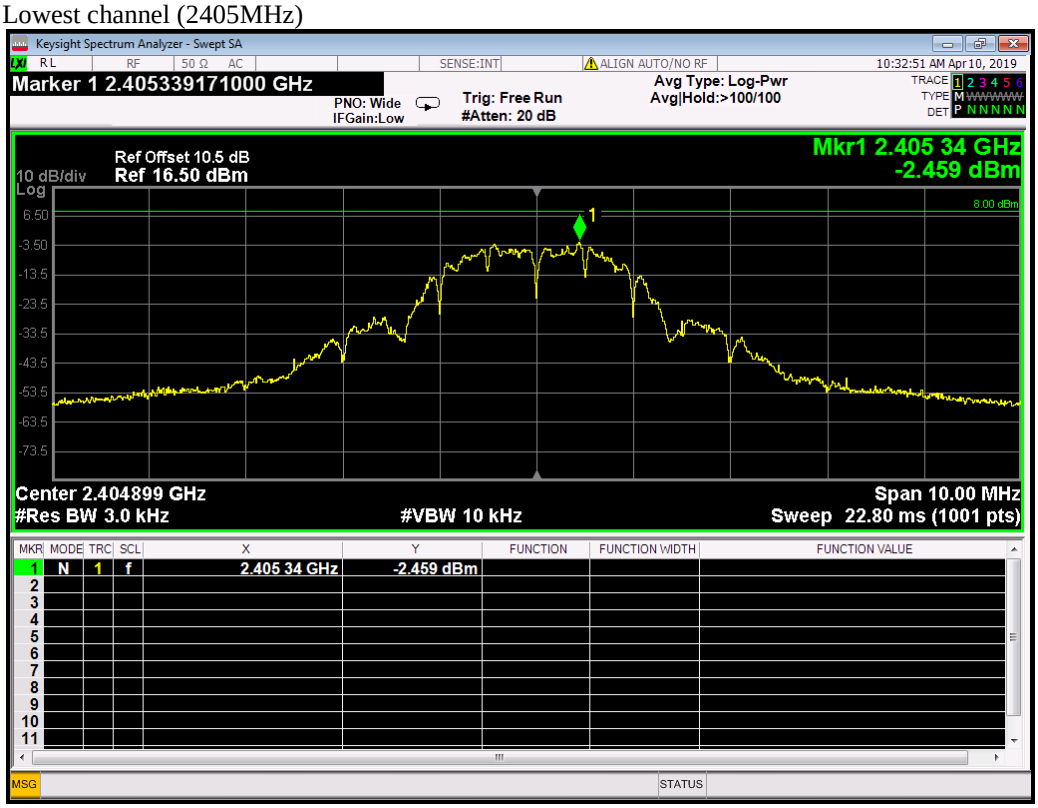
10.3. TEST SETUP



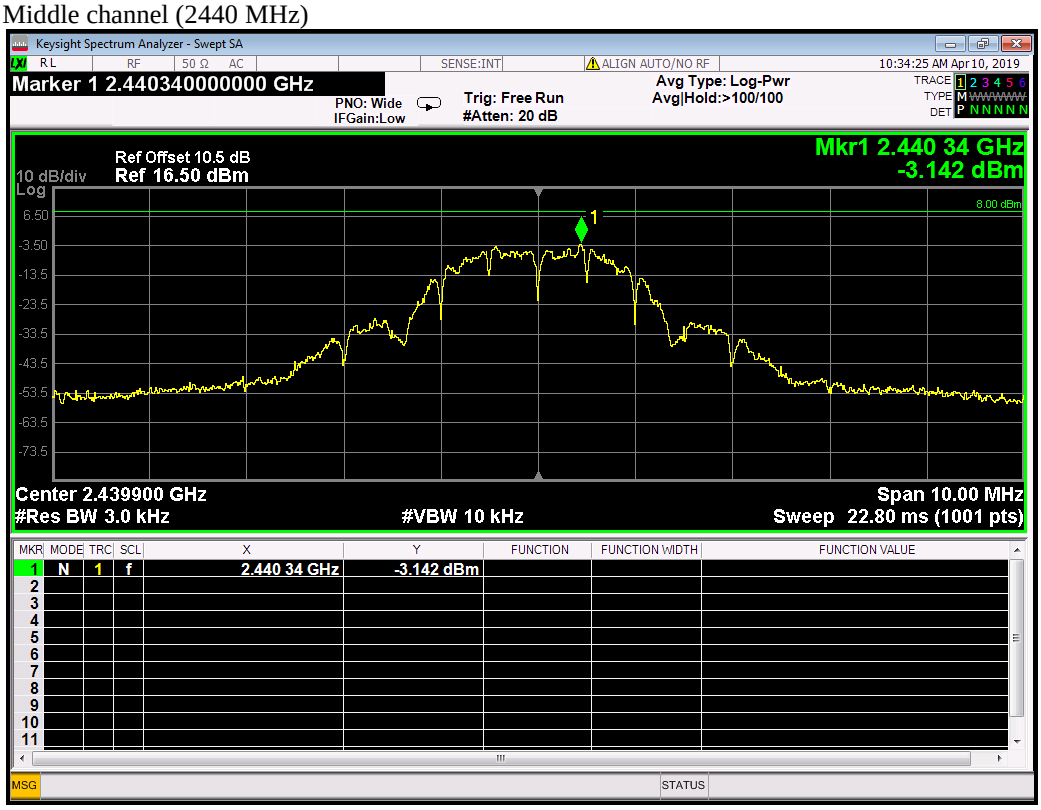
10.4. TEST RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Test Result
Lowest	2405	-2.459	8	PASS
Middle	2440	-3.142		PASS
Highest	2480	-8.916		PASS

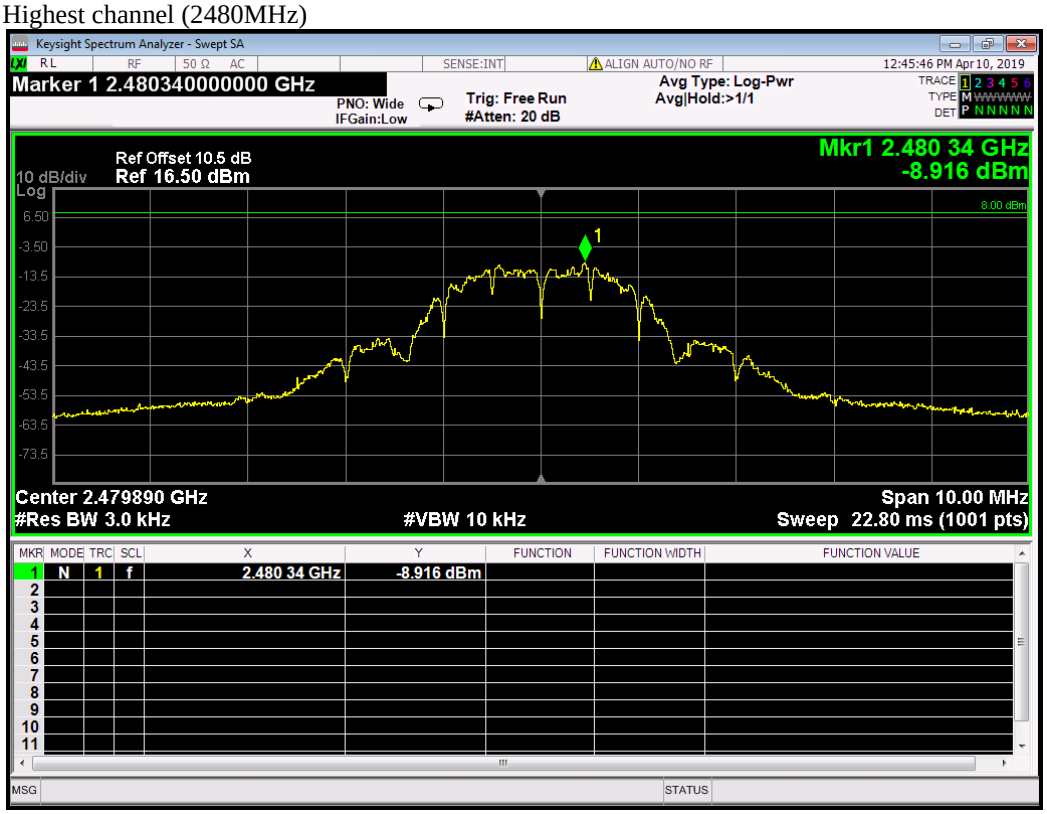
Lowest channel (2405MHz)



Middle channel (2440 MHz)



Highest channel (2480MHz)



11. CONDUCTED BAND EDGES AND SPURIOUS EMISSIONS

11.1. LIMITS

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

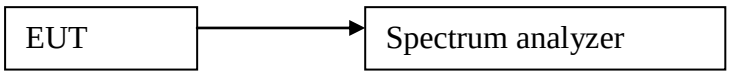
11.2. TEST PROCEDURES

Test procedures follow KDB 558074 D01 DTS Measurement Guidance v03r01.

Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum.

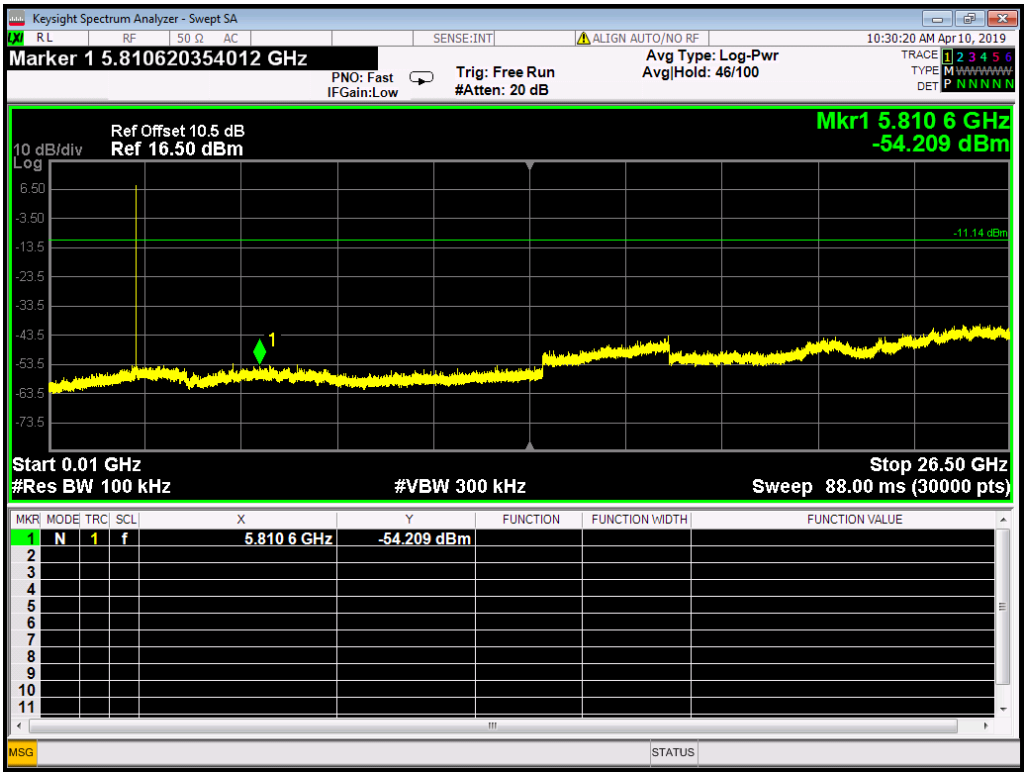
1) Remove the antenna from the EUT and then connect a low attenuation cable from the antenna port to the spectrum.
2) Set the spectrum analyzer: RBW =100KHz; VBW =300KHz, Span = 10MHz to 26GHz; Sweep = auto; Detector Function = Peak. Trace = Max, hold.
3) Measure and record the results in the test report.
4) The RF fundamental frequency should be excluded against the limit line in the operating frequency band.

11.3. TEST SETUP

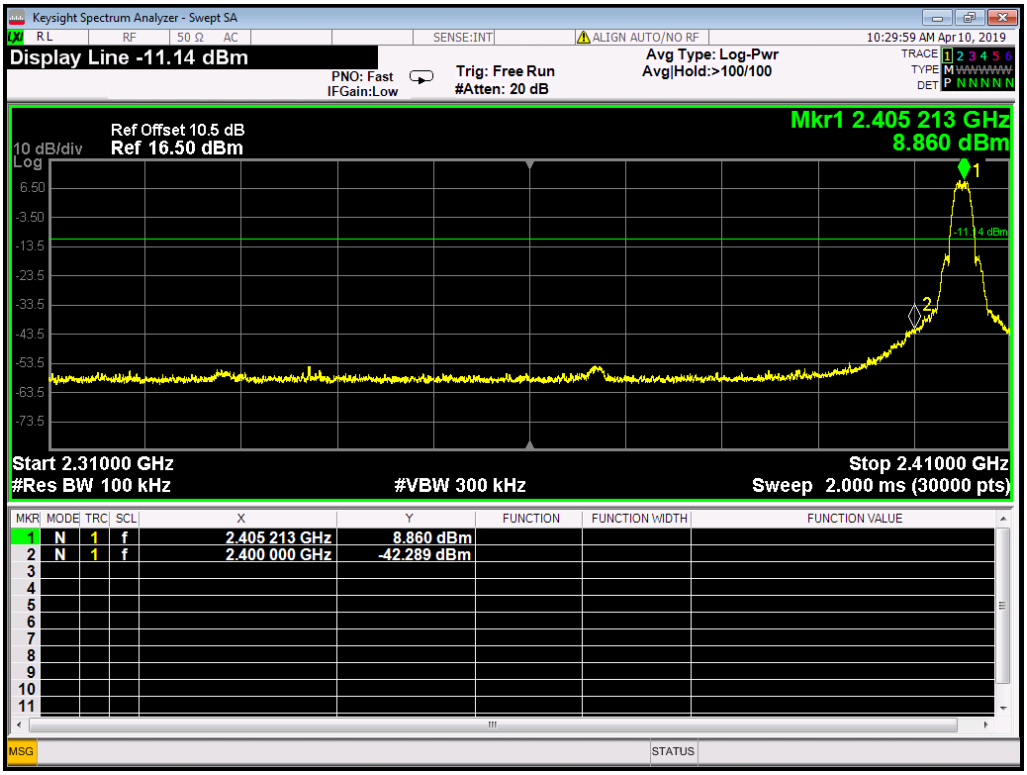


11.4. TEST RESULTS

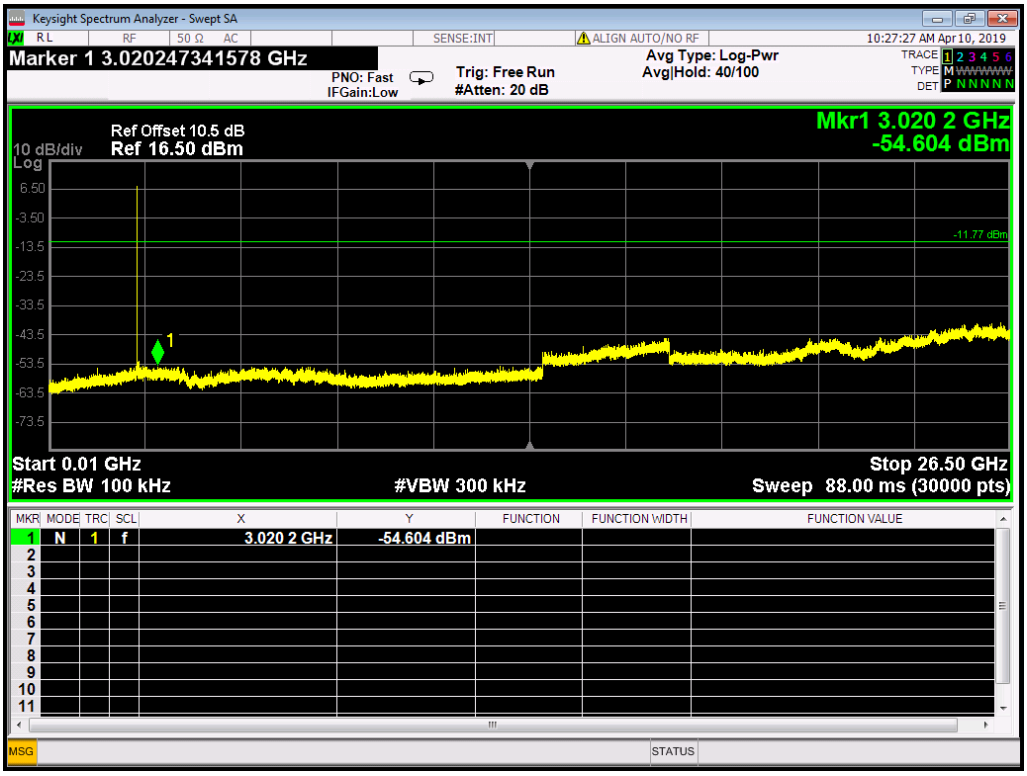
Lowest channel (2405MHz)
0.01GHz-26.5GHz

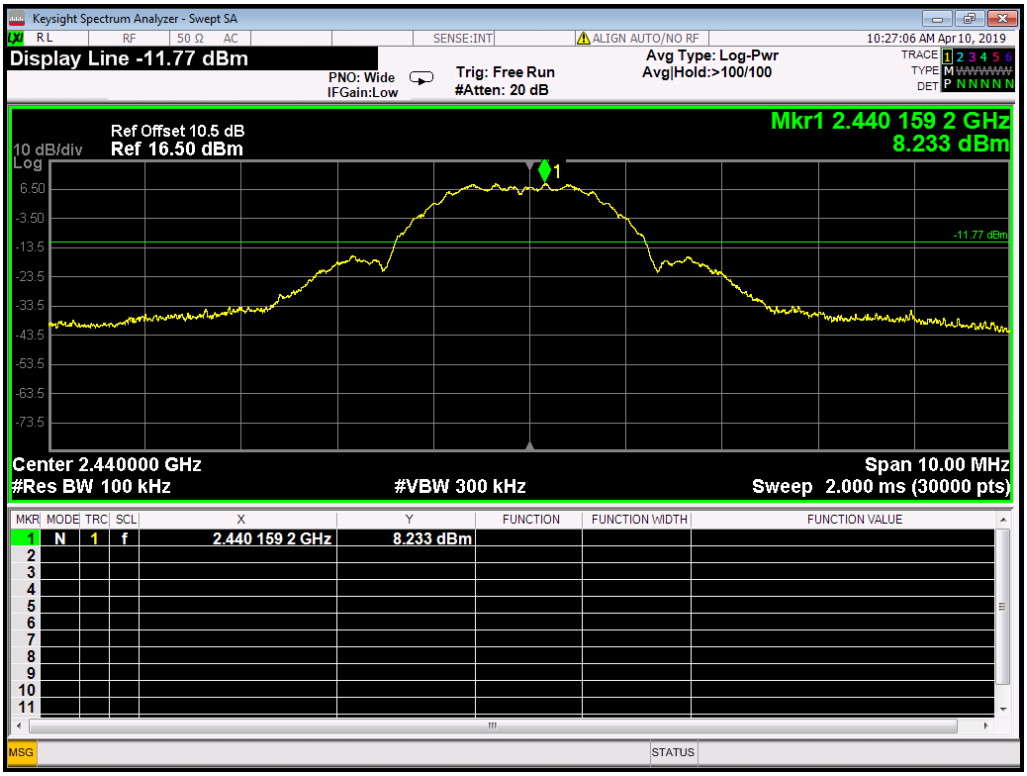


2.31GHz-2.41GHz

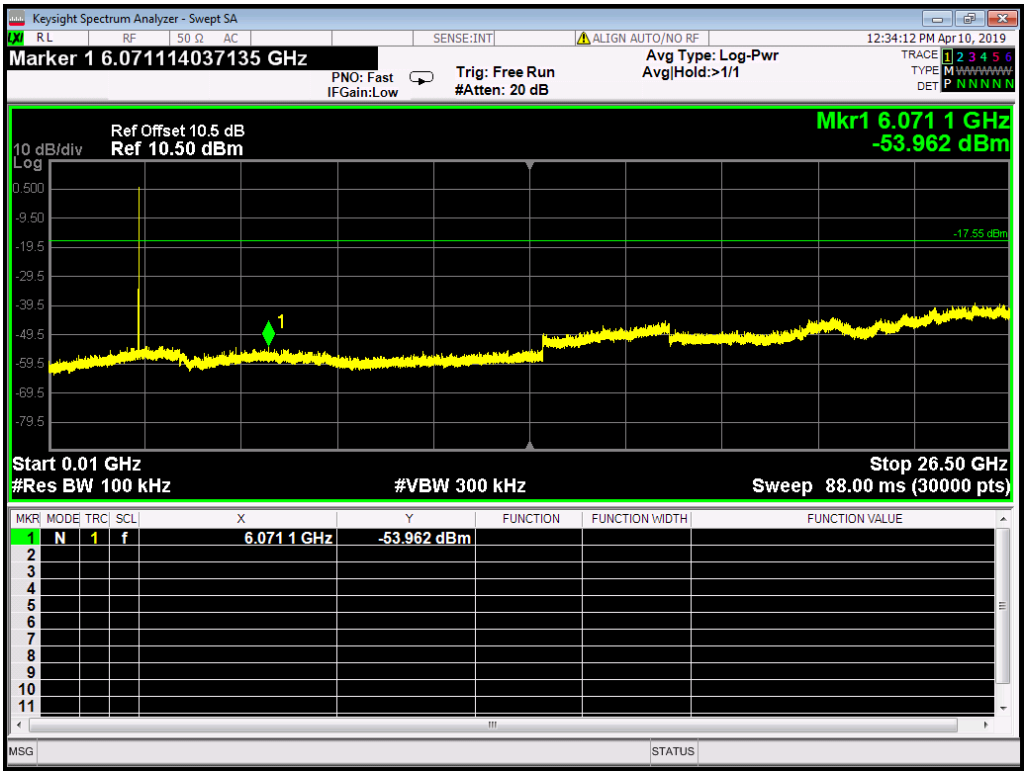


Middle channel (2440 MHz)
0.01GHz-26.5GHz

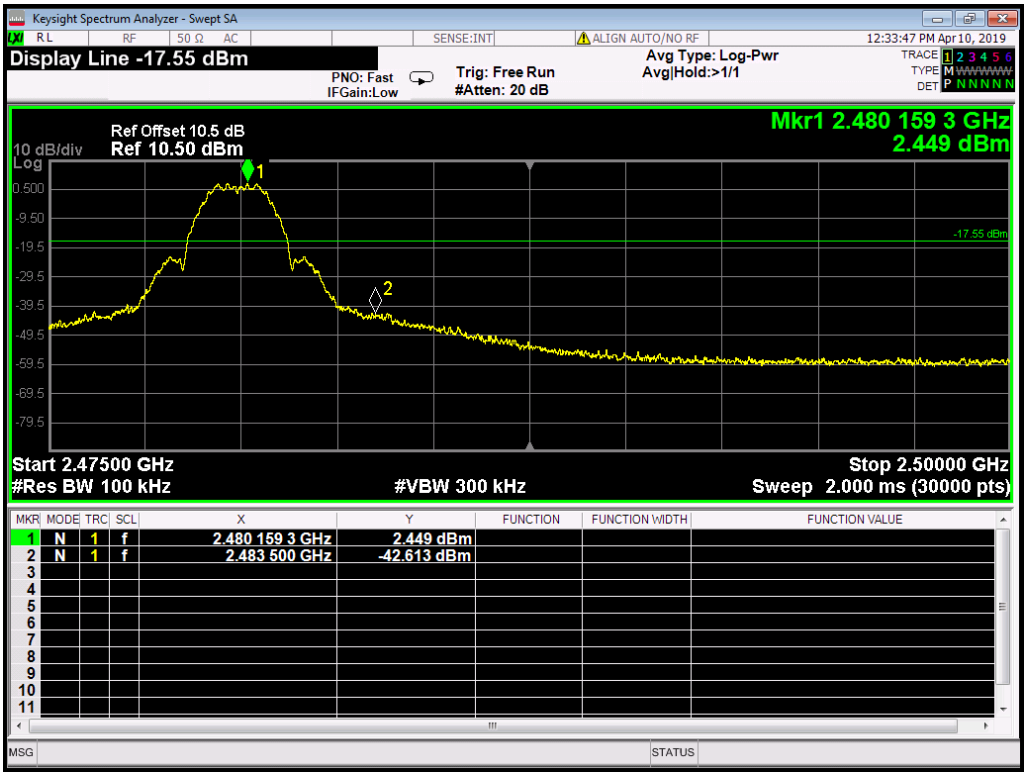




Highest channel (2480MHz)
0.01GHz-26.5GHz



2.475GHz-2.5GHz



12. RESTRICTED BANDS OF OPERATION

12.1. LIMITS

Section 15.247(d) In addition, Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

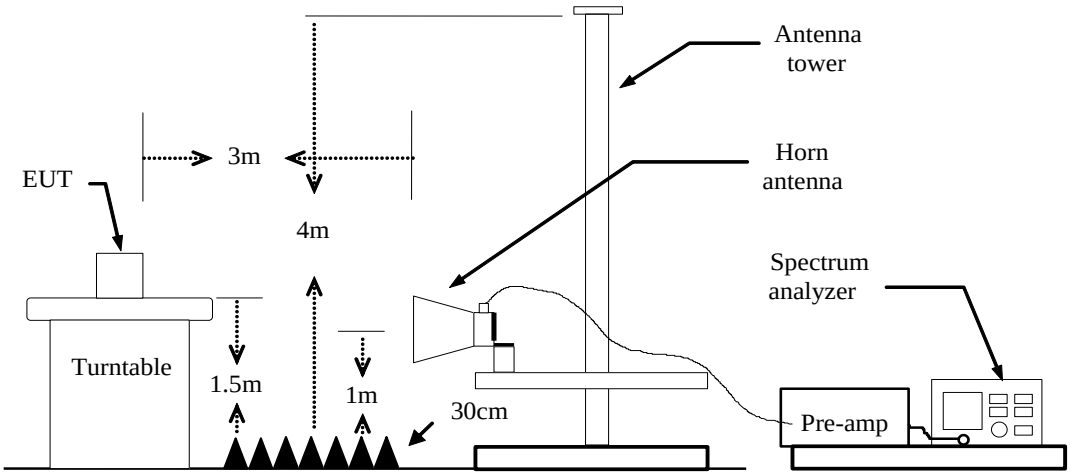
MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 -	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.69525	960 - 1240	7.25 - 7.75
4.125 - 4.128	16.80425 -	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	16.80475	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	25.5 - 25.67	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	37.5 - 38.25	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	73 - 74.6	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	74.8 - 75.2	2200 - 2300	14.47 - 14.5
8.291 - 8.294	108 - 121.94	2310 - 2390	15.35 - 16.2
8.362 - 8.366	123 - 138	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	149.9 - 150.05	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.52475 -	3260 - 3267	23.6 - 24.0
12.29 - 12.293	156.52525	3332 - 3339	31.2 - 31.8
12.51975 -	156.7 - 156.9	3345.8 - 3358	36.43 - 36.5
12.52025	162.0125 - 167.17	3600 - 4400	
12.57675 -	167.72 - 173.2		
12.57725	240 - 285		
13.36 - 13.41	322 - 335.4		

12.2. TEST PROCEDURES

Test procedures follow KDB 558074 D01 DTS Meas Guidance v03r01.

1) The EUT is placed on a turntable, which is 1.5m above the ground plane.
2) The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3) EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emission.
4) Set the spectrum analyzer in the following setting in order to capture the lower and upper band-edges of the emission:
   a) PEAK: RBW=1MHz / VBW=1MHz / Sweep=AUTO
   b) AVERAGE: RBW=1MHz / VBW=1/T / Sweep=AUTO
5) Repeat the procedures until all the PEAK and AVERAGE versus POLARIZATION are measured.

12.3. TEST SETUP

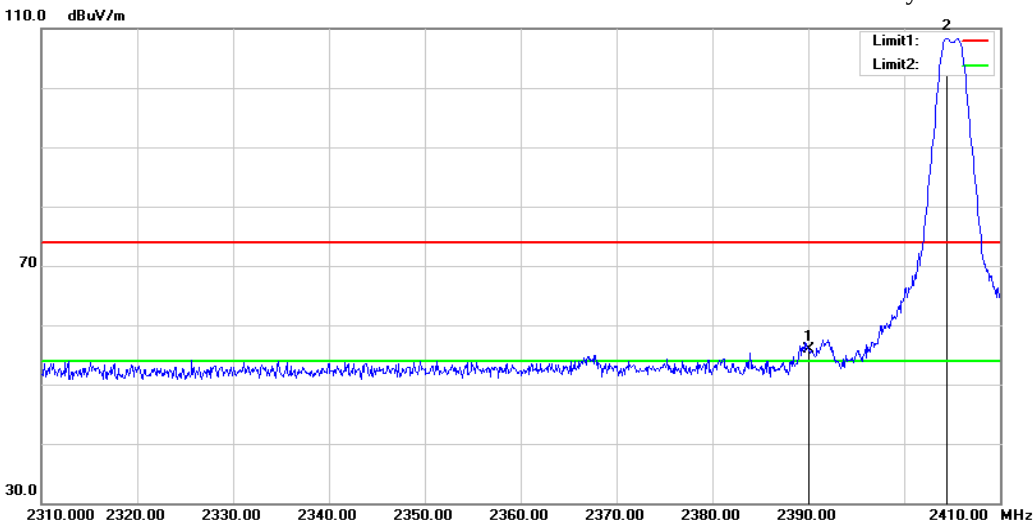


12.4. TEST RESULTS

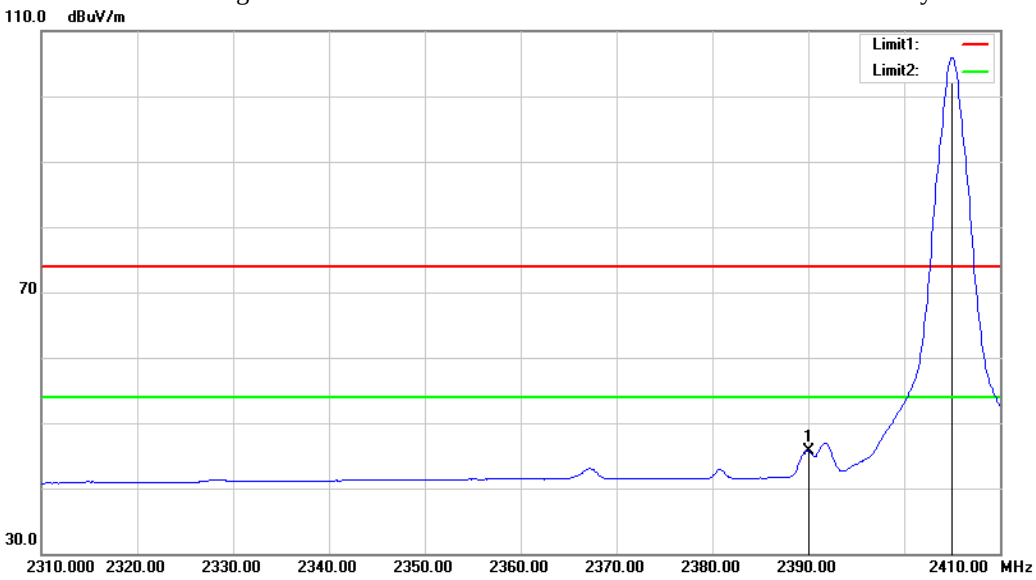
GL-EFR32S

Lowest Channel

Detector mode: Peak Polarity: Vertical



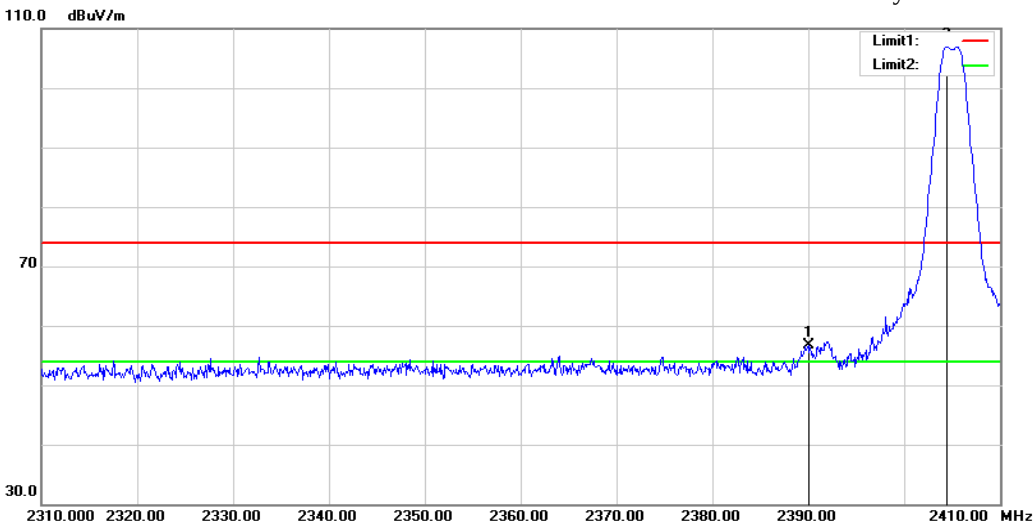
Detector mode: Average Polarity: Vertical



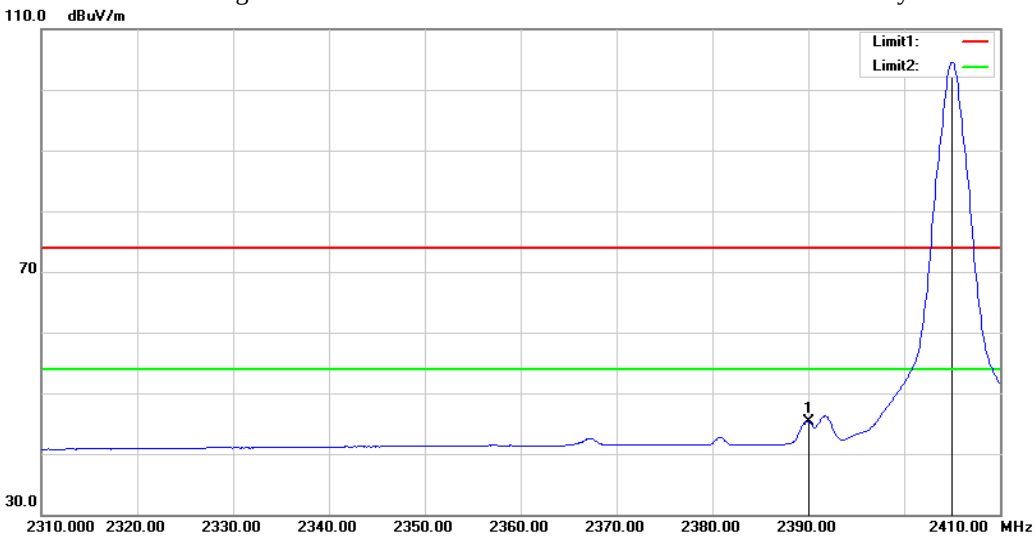
No.	Frequency MHz	Reading dBuV	Factor dB	Result dBuV/m	Limit dBuV/m	Margin dB	Remark	Pole
1	2390.000	57.42	-1.48	55.94	74.00	-18.06	Peak	Vertical
2	2404.500	109.74	-1.45	---	74.00	---	Peak	Vertical
1	2390.000	47.21	-1.48	45.73	54.00	-8.27	Average	Vertical
2	2405.000	107.31	-1.45	---	54.00	---	Average	Vertical

Lowest Channel

Detector mode: Peak Polarity: Horizontal



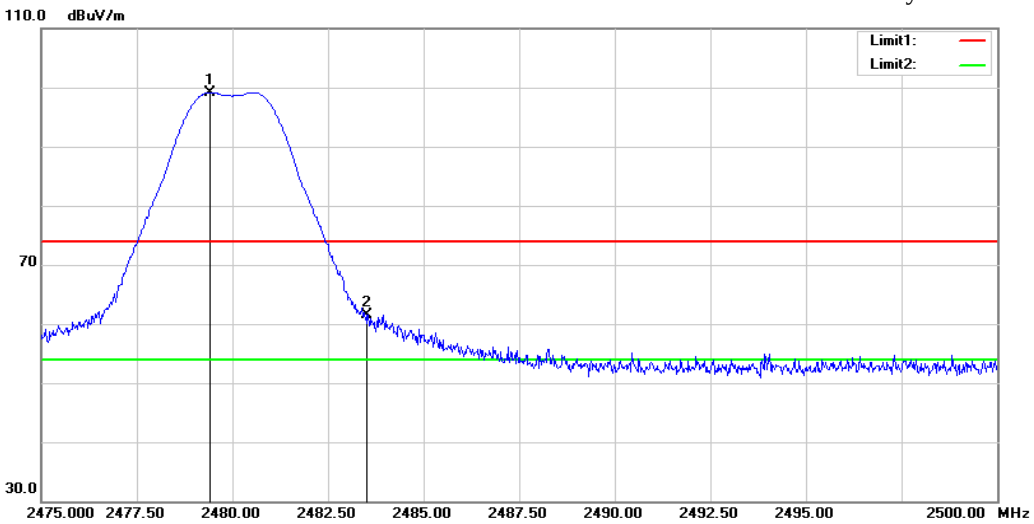
Detector mode: Average Polarity: Horizontal



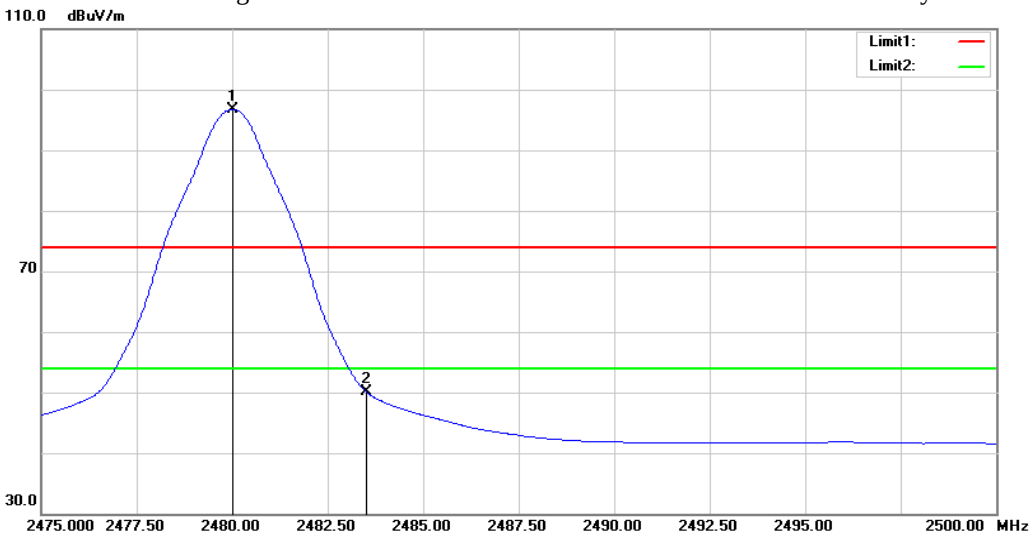
No.	Frequency MHz	Reading dBuV	Factor dB	Result dBuV/m	Limit dBuV/m	Margin dB	Remark	Pole
1	2390.000	58.23	-1.48	56.75	74.00	-17.25	Peak	Horizontal
2	2404.400	108.38	-1.45	---	74.00	---	Peak	Horizontal
1	2390.000	46.74	-1.48	45.26	54.00	-8.74	Average	Horizontal
2	2405.000	105.94	-1.45	---	54.00	---	Average	Horizontal

Highest Channel

Detector mode: Peak Polarity: Vertical



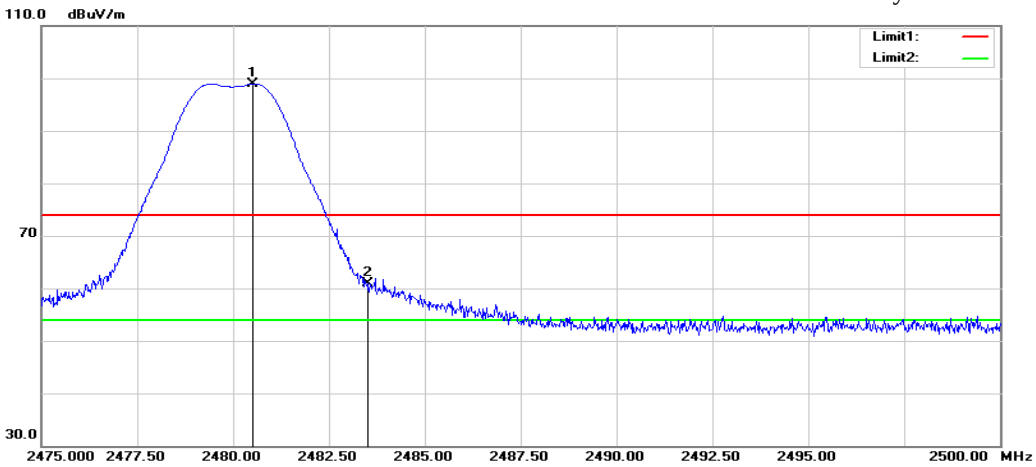
Detector mode: Average Polarity: Vertical



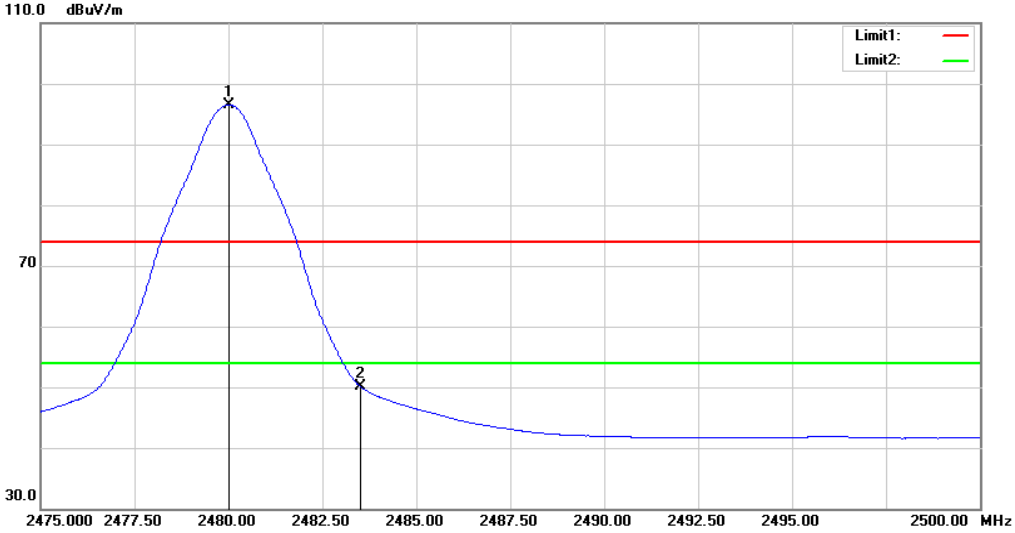
No.	Frequency MHz	Reading dBuV	Factor dB	Result dBuV/m	Limit dBuV/m	Margin dB	Remark	Pole
1	2479.400	100.47	-1.28	---	74.00	---	Peak	Vertical
2	2483.500	62.80	-1.27	61.53	74.00	-12.47	Peak	Vertical
1	2480.000	98.04	-1.28	---	54.00	---	Average	Vertical
2	2483.500	51.44	-1.27	50.17	54.00	-3.83	Average	Vertical

Highest Channel

Detector mode: Peak Polarity: Horizontal



Detector mode: Average Polarity: Horizontal

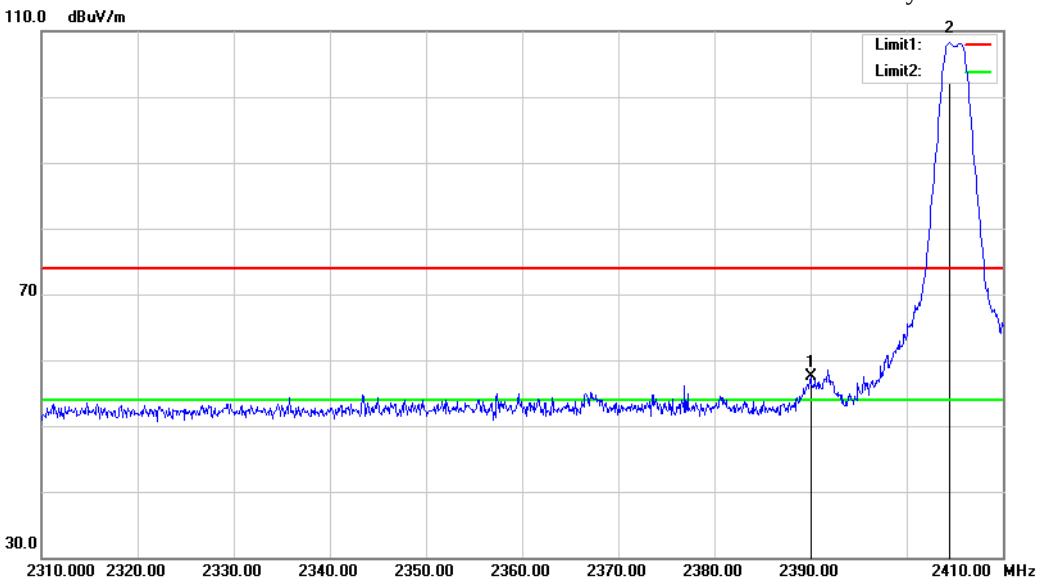


No.	Frequency MHz	Reading dBuV	Factor dB	Result dBuV/m	Limit dBuV/m	Margin dB	Remark	Pole
1	2480.525	100.25	-1.28	---	74.00	---	Peak	Horizontal
2	2483.500	62.19	-1.27	60.92	74.00	-13.08	Peak	Horizontal
1	2480.000	97.80	-1.28	---	54.00	---	Average	Horizontal
2	2483.500	51.42	-1.27	50.15	54.00	-3.85	Average	Horizontal

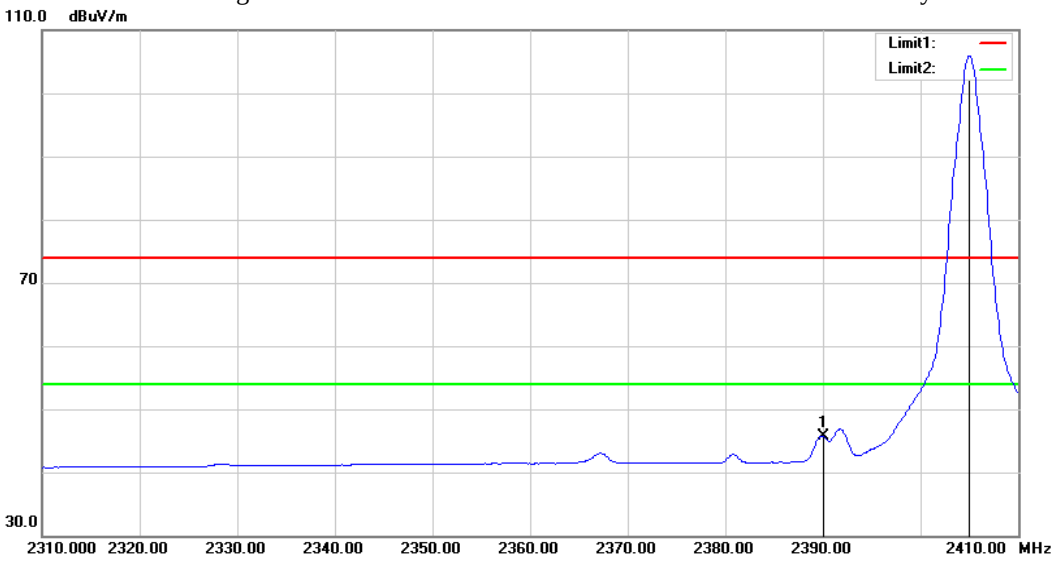
GL-EFR32H

Lowest Channel

Detector mode: Peak Polarity: Vertical



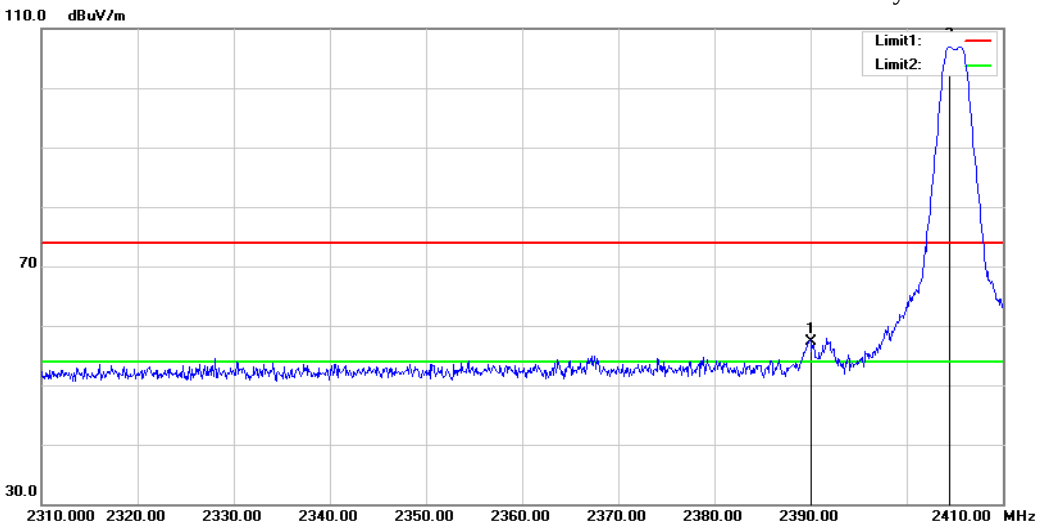
Detector mode: Average Polarity: Vertical



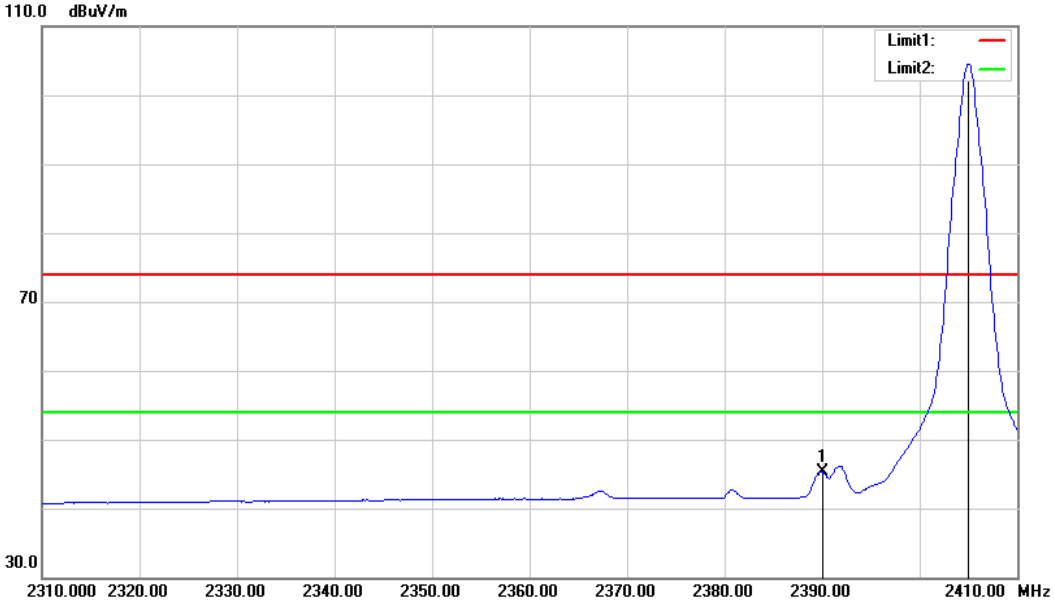
No.	Frequency MHz	Reading dBuV	Factor dB	Result dBuV/m	Limit dBuV/m	Margin dB	Remark	Pole
1	2390.000	59.00	-1.48	57.52	74.00	-16.48	Peak	Vertical
2	2404.500	109.67	-1.45	---	74.00	---	Peak	Vertical
1	2390.000	47.21	-1.48	45.73	54.00	-8.27	Average	Vertical
2	2405.000	107.29	-1.45	---	54.00	---	Average	Vertical

Lowest Channel

Detector mode: Peak Polarity: Horizontal



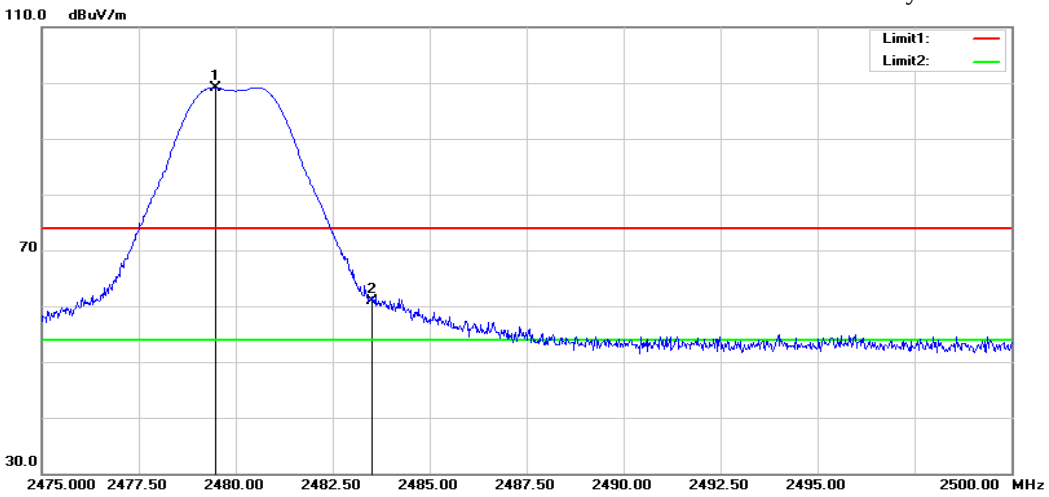
Detector mode: Average Polarity: Horizontal



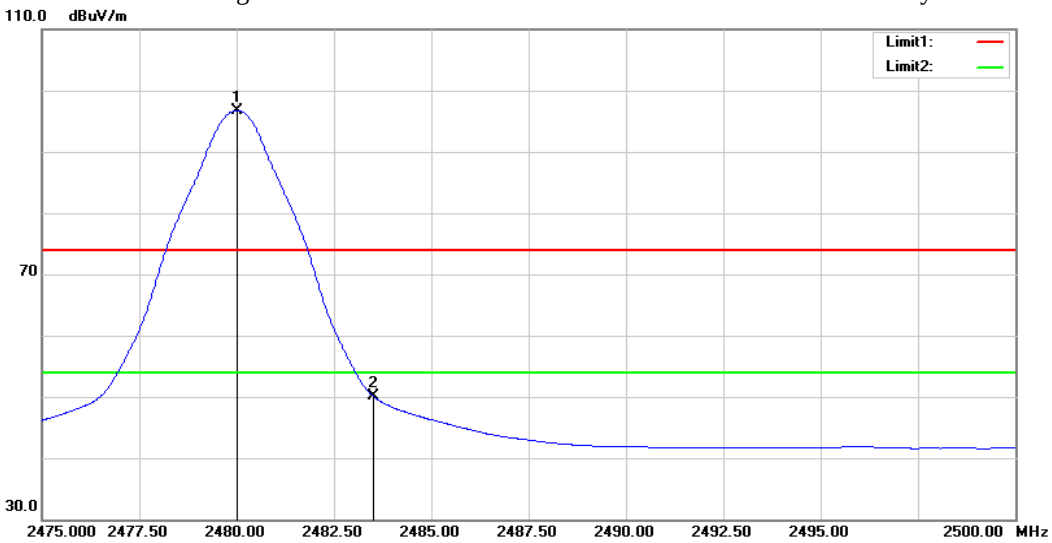
No.	Frequency MHz	Reading dBuV	Factor dB	Result dBuV/m	Limit dBuV/m	Margin dB	Remark	Pole
1	2390.000	58.74	-1.48	57.26	74.00	-16.74	Peak	Horizontal
2	2404.400	108.43	-1.45	---	74.00	---	Peak	Horizontal
1	2390.000	46.75	-1.48	45.27	54.00	-8.73	Average	Horizontal
2	2405.000	105.97	-1.45	--	54.00	---	Average	Horizontal

Highest Channel

Detector mode: Peak Polarity: Vertical



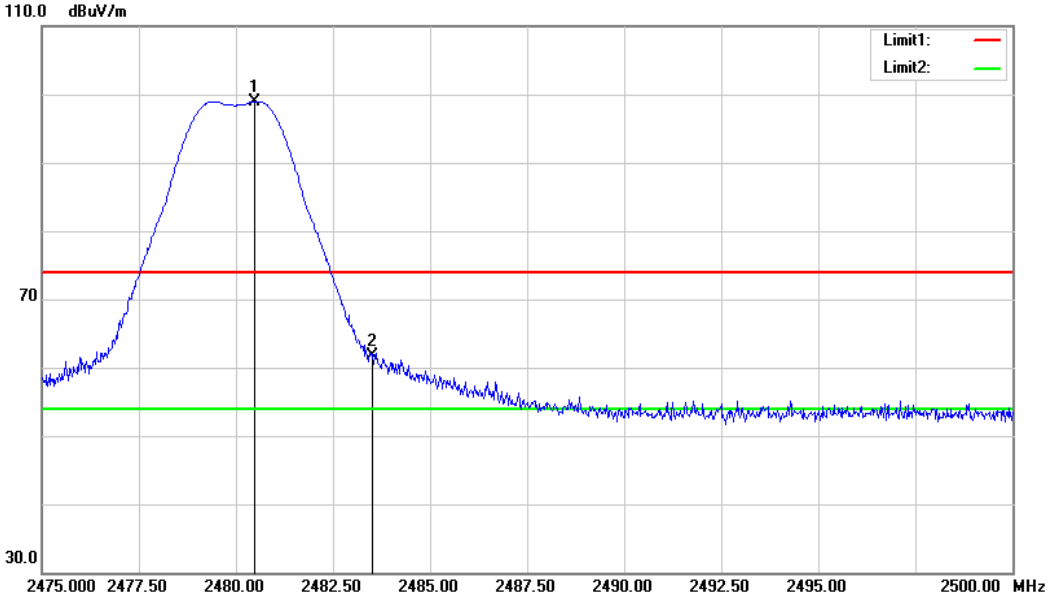
Detector mode: Average Polarity: Vertical



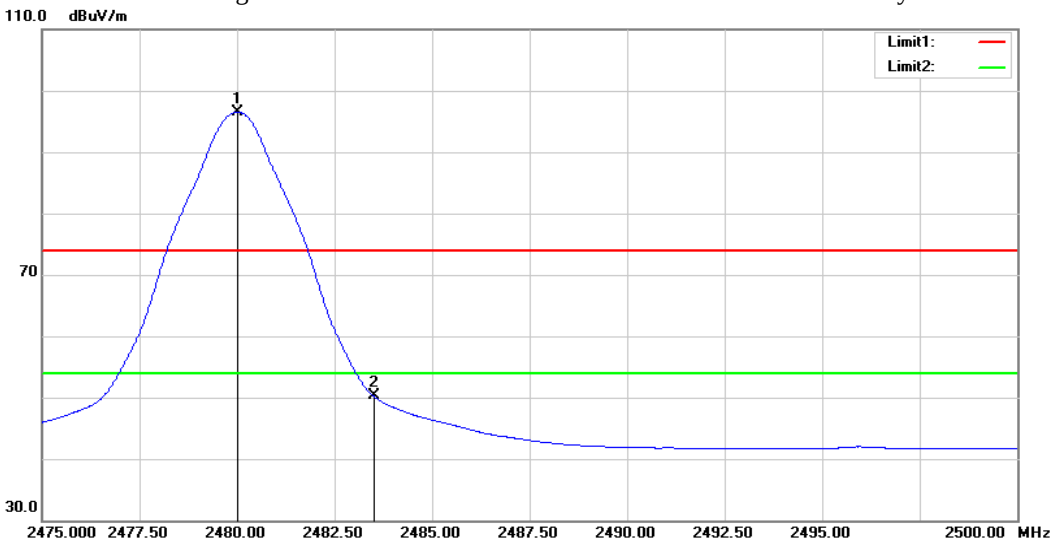
No.	Frequency MHz	Reading dBuV	Factor dB	Result dBuV/m	Limit dBuV/m	Margin dB	Remark	Pole
1	2479.475	100.47	-1.28	---	74.00	---	Peak	Vertical
2	2483.500	62.17	-1.27	60.90	74.00	-13.10	Peak	Vertical
1	2480.000	98.04	-1.28	---	54.00	---	Average	Vertical
2	2483.500	51.42	-1.27	50.15	54.00	-3.85	Average	Vertical

Highest Channel

Detector mode: Peak Polarity: Horizontal



Detector mode: Average Polarity: Horizontal



No.	Frequency MHz	Reading dBuV	Factor dB	Result dBuV/m	Limit dBuV/m	Margin dB	Remark	Pole
1	2480.475	100.27	-1.28	---	74.00	---	Peak	Horizontal
2	2483.500	62.98	-1.27	61.71	74.00	-12.29	Peak	Horizontal
1	2480.000	97.82	-1.28	---	54.00	---	Average	Horizontal
2	2483.500	51.47	-1.27	50.20	54.00	-3.80	Average	Horizontal

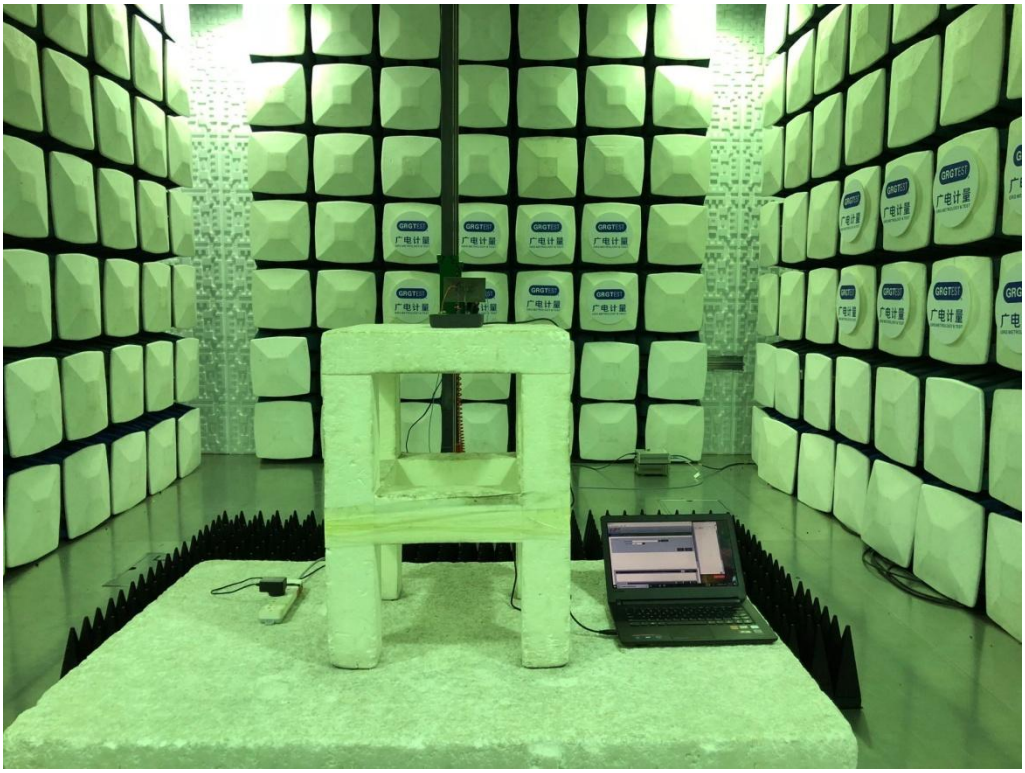
Remark: Max field strength in 3m distance. No any other emission which falls in restricted bands can be detected and be reported.

APPENDIX A: PHOTOGRAPH OF THE TEST ARRANGEMENT

CE

RSE（Below 1GHz）

RSE（Above 1GHz）



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