Registration
No.788871

TEST REPORT FOR BLUETOOTH TESTING

Report No: SRTC2018-9004(F)-18051502(E)

Product Name: Mobile Phone

Product Model: H1T1000

Applicant: RED Technologies LLC

Manufacturer: RED Technologies LLC

Specification: FCC Part 15, Subpart C (2018)

FCC ID: 2AOYWH1T1000

The State Radio_monitoring_center Testing Center (SRTC)

15th Building, No.30, Shixing Street, Shijingshan District,

Beijing, P.R.China

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1. GENERAL INFORMATION

1.1 Notes of the test report

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written permission of The State Radio_monitoring_center Testing Center (SRTC).
The test results relate only to individual items of the samples which have been tested.

1.2 Information about the testing laboratory

Company:	The State Radio_monitoring_center Testing Center (SRTC)
Address:	15th Building, No.30 Shixing Street, Shijingshan District, P.R.China
City:	Beijing
Country or Region:	P.R.China
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1.3 Applicant's details

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1.4 Manufacturer's details

Company:	RED Technologies LLC
Address:	34 Parker, Irvine, California, United States
City:	Irvine
Country or Region:	United States
Contacted person:	Doug Kwon
Tel:	9492067900 ext 7794
Fax:	---
Email:	Doug.kwon@Red.com

1.5 Test Environment

Date of Receipt of test sample at SRTC:	2018-03-06
Testing Start Date:	2018-04-11
Testing End Date:	2018-08-10

Environmental Data:	Temperature (°C)	Humidity (%)
Ambient	25	30

Normal Supply Voltage (V d.c.):	3.85

2 DESCRIPTION OF THE DEVICE UNDER TEST

2.1 Final Equipment Build Status

Frequency Range	2.402GHz~2.480GHz
Number of Channel	40
Modulation Type	GFSK
Equipment Class	DTS
Transmission specification	Bluetooth V5.0 BLE
Channel Spacing	2MHz
Data Rate	1Mbps,2 Mbps
Power Supply	Battery/AC adapter
Rated Power Supply Voltage	3.85V
HW Version	DVT
SW Version	H1T1000.005ho.01.00.01d.403
IMEI	355929090014854
Antenna type	Refer to Note
Antenna connector	Refer to Note

Note:

The antenna provide to the EUT, please refer to the following table:

Brand	Model	Antenna gain	Frequency range(GHz)	Antenna type	Connecter Type
N/A	N/A	-1.5dBi	2.402GHz~2.480GHz	PIFA Antenna	N/A
Manufacturers ensure that their designs will not be modified by the user or third parties arbitrary antenna parameters and performance.					

Note: The product model changes from H1A1000 to H1T1000. Software version changes from H1A1000.005ho.01.00.01d.403 to H1T1000.005ho.01.00.01d.403. HW version changes from EVT2.1 to DVT. The test results of variant product derive from original product Report No.: SRTC2018-9004(F)-18030601(E).

Schematics and layout are not change. Only material of battery cover changed, so conducted data refer to H1A1000 (FCC ID: 2AOYWH1A1000). Radiation test and SAR are verified.

2.2 Description of Test Modes

40 channels are provided to this EUT:

CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)	CHANNEL	FREQ. (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

2.2.1 Test Mode Applicability and Tested Channel Detail

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE ≥ 1G	RE<1G	PLC	APCM	-
GFSK	√	√	√	√	-

Where RE 1G: Radiated Emission above 1GHz RE<1G: Radiated Emission below 1GHz
PLC: Power Line Conducted Emission APCM: Antenna Port Conducted Measurement

Radiated Emission Test (Above 1GHz):

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	19	GFSK	1/2

Radiated Emission Test (Below 1GHz):

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	19	GFSK	1 /2

Power Line Conducted Emission Test:

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	19	GFSK	1 /2

Antenna Port Conducted Measurement:
This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
Following channel(s) was (were) selected for the final test as listed below.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TYPE	DATA RATE (Mbps)
0 to 39	0, 19, 39	GFSK	1 /2

2.3 Duty Cycle of Test Signal

Duty cycle of test signal is < 98 %, duty factor shall be considered.
Duty cycle = 59.5%
Correction factor = 10* log (1/duty cycle) =10 * log (1/0.595) = 2.25 dB

2.4 EUT Operating conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

2.5 Support Equipment

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

Equipment	Charger
Manufacturer	TEN PAO INDUSTRIAL CO., LTD
Model Number	S018CDU1200150
Serial Number	---

Equipment	Battery
Manufacturer	DONGGUAN DRN NEW ENERGY CO.,LTD
Model Number	RED-A2H-4500
Serial Number	---

Equipment	Notebook
Manufacturer	LENOVO
Model Number	ThinkPad E420
Serial Number	---

3 REFERENCE SPECIFICATION

Specification	Version	Title
15.35	2018	Measurement detector functions and bandwidths.
15.209	2018	Radiated emission limits; general requirements.
15.247	2018	Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
15.203	2018	Antenna requirement
ANSI C63.10	2013	Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
KDB 558074	April 5, 2017	GUIDANCE FOR PERFORMING COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEMS (DTS) OPERATING UNDER SECTION 15.247

4 KEY TO NOTES AND RESULT CODES

Code	Meaning
PASS	Test result shows that the requirements of the relevant specification have been met.
FAIL	Test result shows that the requirements of the relevant specification have not been met.
N/T	Test case is not tested.
NTC	Nominal voltage, Normal Temperature
HV	High voltage, Normal Temperature
LV	Low voltage, Normal Temperature
HTHV	high voltage, High Temperature
LTHV	High voltage, Low Temperature
HTLV	Low voltage, High Temperature
LTLV	Low voltage, Low Temperature

5 RESULT SUMMARY

No.	Test case	Reference	Verdict
1	Occupied Bandwidth	15.247(a)(2)	Pass
2	Peak Power Output	15.247(b)(3))	Pass
3	Transmitter Power Spectral Density	15.247(e))	Pass
4	Conducted Out of band emission measurement	15.247(d)	Pass
5	Band-edge	15.247(d)	Pass
6	Spurious Radiated Emissions	15.247(d)/15.35(b)/15.209	Pass
7	AC Power line Conducted Emission	15.207	Pass
8	Antenna requirement	15.203	Pass（refer to section 2.1）

This Test Report Is Issued by: Mr. Peng Zhen	Checked by: Mr. Li Bin
Tested by: Mr. He Dengshun	Issued date: 20180820

6 TEST RESULT

6.1 Occupied Bandwidth

6.1.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.1.2 Test Description

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer and Bluetooth test set via a power splitter with a known loss.Which connected to the transmitter antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies. All modes of operation were investigated and the worst case configuration results are reported in this section.

6.1.3 Test limit

Part15.247 (a)(2)
The minimum permissible 6dB bandwidth is 500 kHz

6.1.4 Test Procedure Used

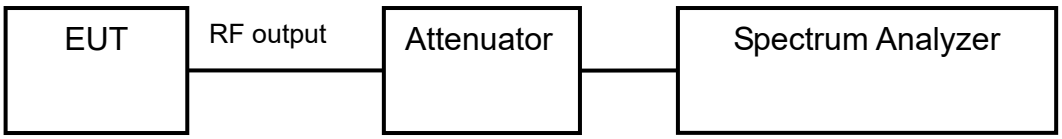
KDB 558074 D01 DTS Meas Guidance v04 – Section 8.1 Option 1

6.1.5 Test Settings

a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 x RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

6.1.6 Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



6.1.7 Test result

The test results are shown in Appendix A .

6.2 Peak Power Output

6.2.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.2.2 Test Description

The transmitter antenna terminal of the EUT is connected to the spectrum analyzer and Bluetooth test set via a power splitter with a known loss. Measurements are made while the EUT is operating at maximum power and at the appropriate frequencies.

6.2.3 Test limit

Part15.247(b)(3)
The maximum permissible conducted output power is 1 Watt.
Used conversion factor: Limit (dBm) = 10 log (Limit (W)/1mW)
==> Maximum Output Power: 30.0 dBm

6.2.4 Test Procedure Used

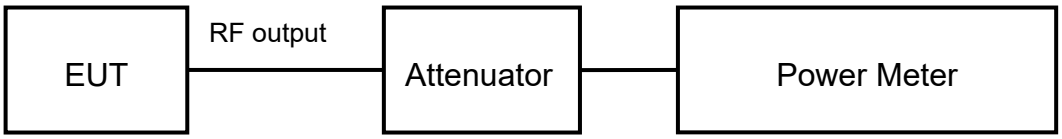
KDB 558074 D01 DTS Meas Guidance v04 – Section 9.1.3

6.2.5 Test Settings

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

6.2.6 Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



6.2.7 Test result

The test results are shown in Appendix A .

6.3 Transmitter Power Spectral Density

6.3.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.3.2 Test Description

The peak power density is measured with a spectrum analyzer and Bluetooth test set via a power splitter with a known loss connected to the antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies.

6.3.3 Test limit

Part15.247(e)
The maximum permissible power spectral density is 8.0 dBm in any 3 kHz band.

6.3.4 Test Procedure Used

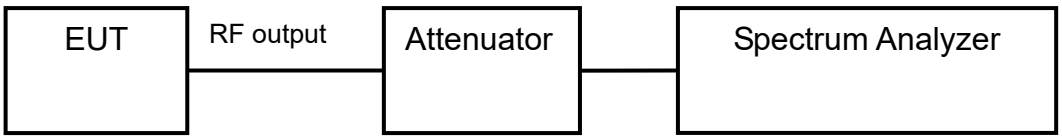
KDB 558074 D01 DTS Meas Guidance v04 Section 10.2.

6.3.5 Test Settings

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ≥ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

6.3.6 Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



6.3.7 Test result

The test results are shown in Appendix A.

6.4 Conducted Out of band emission measurement

6.4.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.4.2 Test Description

For the following out of band conducted spurious emissions plots, the EUT was set to transmit at maximum power with the largest packet size available. The worst case spurious emissions were found in this configuration.

6.4.3 Test limit

Part 15.247(d) The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth.

6.4.4 Test Procedure Used

KDB 558074 D01 DTS Meas Guidance v04 Section 11.3,11.2

6.4.5 Reference level measurement Settings

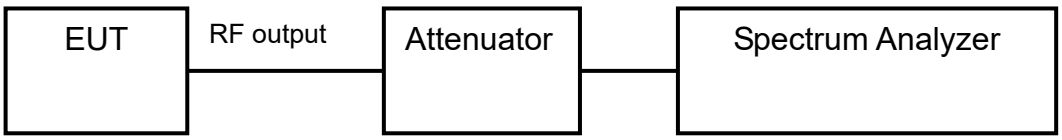
Establish a reference level by using the following procedure:
a) Set instrument center frequency to DTS channel center frequency.
b) Set the span to ≥ 1.5 MHz
c) Set the RBW = 100 kHz.
d) Set the VBW ≥ 300kHz.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum PSD level.

6.4.6 Test Settings

a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100kHz.
c) Set the VBW ≥ 300kHz.
d) Detector = peak.
e) Set span to encompass the spectrum to be examined
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level.

6.4.8 Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



6.4.9 Test result

The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.
The test results are shown in Appendix A .

6.5 Band-edge measurement

6.5.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.5.2 Test Description

For the following out of band conducted spurious emissions plots, the EUT was set to transmit at maximum power with the largest packet size available. The worst case spurious emissions were found in this configuration.

6.5.3 Test limit

Part 15.247(d)
The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth.

6.5.4 Test Procedure Used

KDB 558074 D01 DTS Meas Guidance v04 Section 11.2

6.5.5 Reference level measurement Settings

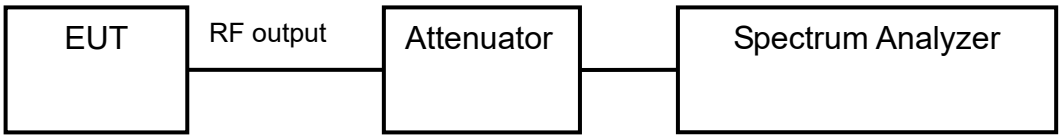
Establish a reference level by using the following procedure:
a) Set instrument center frequency to DTS channel center frequency.
b) Set the span to ≥ 1.5 MHz
c) Set the RBW = 100 kHz.
d) Set the VBW ≥ 300kHz.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum PSD level.

6.5.6 Test Settings

a) Set the center frequency and span to encompass frequency range to be measured.
b) Set the RBW = 100kHz.
c) Set the VBW ≥ 300kHz.
d) Detector = peak.
e) Set span to encompass the spectrum to be examined
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level.

6.5.8 Test Setup

The EUT and measurement equipment were set up as shown in the diagram below.



6.5.9 Test result

The spectrum plots are attached on the following pages. D1 line indicates the highest level, and D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.
The test results are shown in Appendix A .

6.6 Spurious Radiated Emissions

6.6.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.6.2 Test Description

All out of band radiated spurious emissions are measured with a spectrum analyzer connected to a receive antenna while the EUT is operating at maximum power and at the appropriate frequencies. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section. The measurements shall be repeated with orthogonal polarization of the test antenna. The results shall be showed the worst case of the three orthogonal axes of EUT.

6.6.3 Test limit

Part15.205, 15.209, 15.247(d)

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in below Table per Section 15.209.

Frequency [MHz]	Field strength [μV/m]	Measured Distance [meters]
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30～88	100	3
88～216	150	3
216～960	200	3
Above 960	500	3

Radiated Limits

Part15.35(b):

there is also a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit

Used conversion factor: Limit (dBμV/m) = 20 log (Limit (μV/m)/1μV/m)

Frequency [MHz]	Detector	Unit (dBμV/m)
30～88	Quasi-peak	40.0
88～216	Quasi-peak	43.5
216～960	Quasi-peak	46.0
960～1000	Quasi-peak	54.0
1000～5th harmonic of the highest frequency or 40GHz, whichever is lower	Average	54.0
	Peak	74.0

Conversion Radiated limits

6.6.4 Test Procedure Used

KDB 558074 D01 DTS Meas Guidance v04 – Section 12.2.7

For Radiated emission below 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. Both X and Y axes of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz
a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

For the radiated emission test above 1GHz:
Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement

antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Average detection (AV) at frequency above 1GHz. If duty cycle of test signal is < 98%, the duty factor need added to measured value.
4. All modes of operation were investigated and the worst-case emissions are reported.

6.6.5 Test Settings

Average Field Strength Measurements per Section 12.2.7 of KDB 558074 (Part 15.35)
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz > 1/T
4. Averaging type was set to RMS to ensure that video filtering was applied in the power domain
5. Detector = peak
6. Sweep time = auto
7. Trace mode = max hold
8. Trace was allowed to run for at least 50 times (1/duty cycle) traces

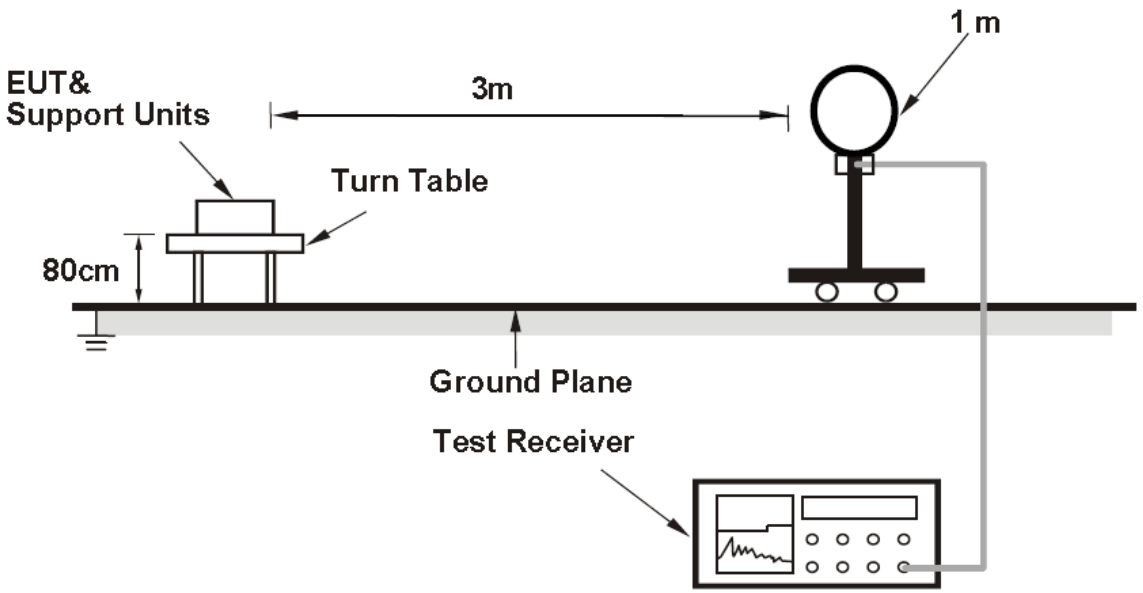
Peak Field Strength Measurements per Section 12.2.7of KDB 558074 (Part 15.35)
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW is set depending on measurement frequency, as specified in following table

Frequency	RBW
9-150kHz	200-300Hz
0.15-30MHz	9-10kHz
30-1000MHz	100-120kHz
>1000MHz	1MHz

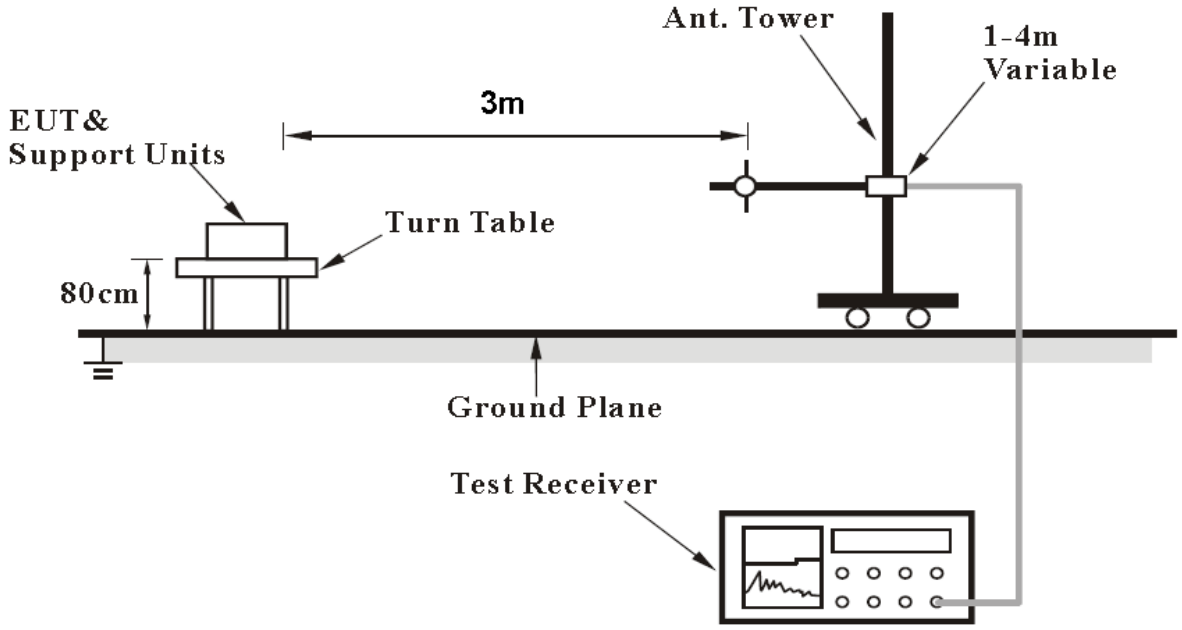
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

6.6.6 Test Setup

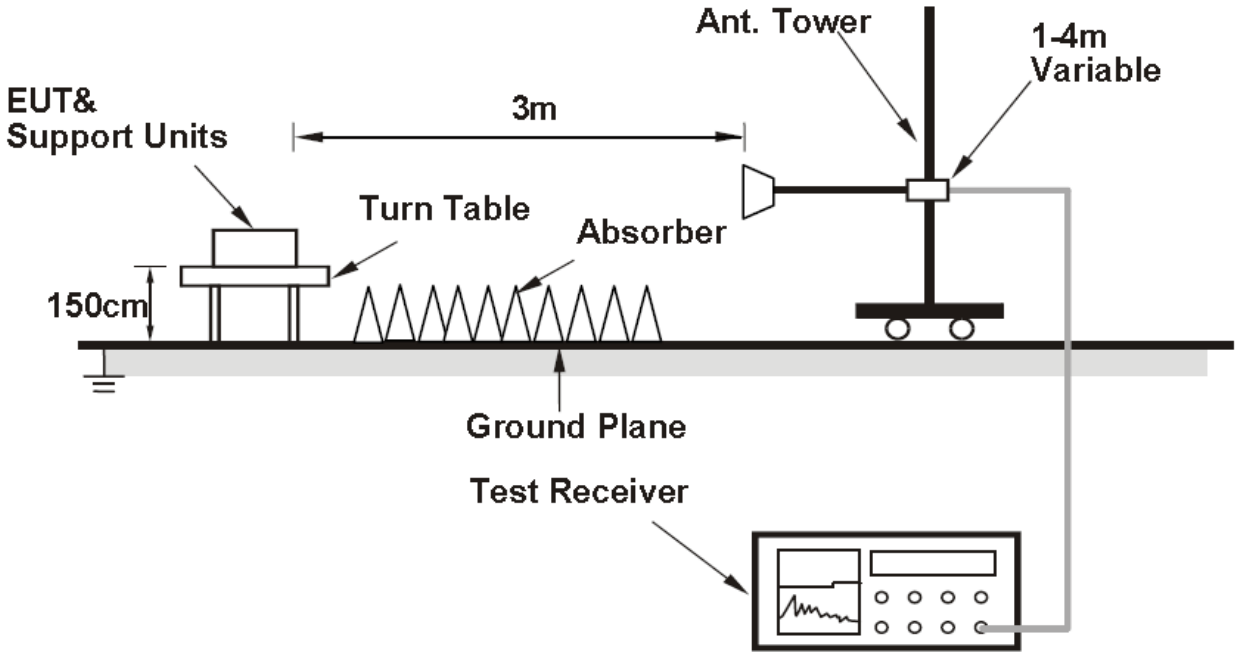
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



6.6.7 Test result

The test results are shown in Appendix B.

6.7 AC Power line Conducted Emission

6.7.1 Ambient condition

Temperature	Relative humidity	Pressure
22°C	40%	101.5kPa

6.7.2 Test limit

FCC Part15.207

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

The measurement is made according to ANSI C63.10-2013

6.7.3 Test Procedures

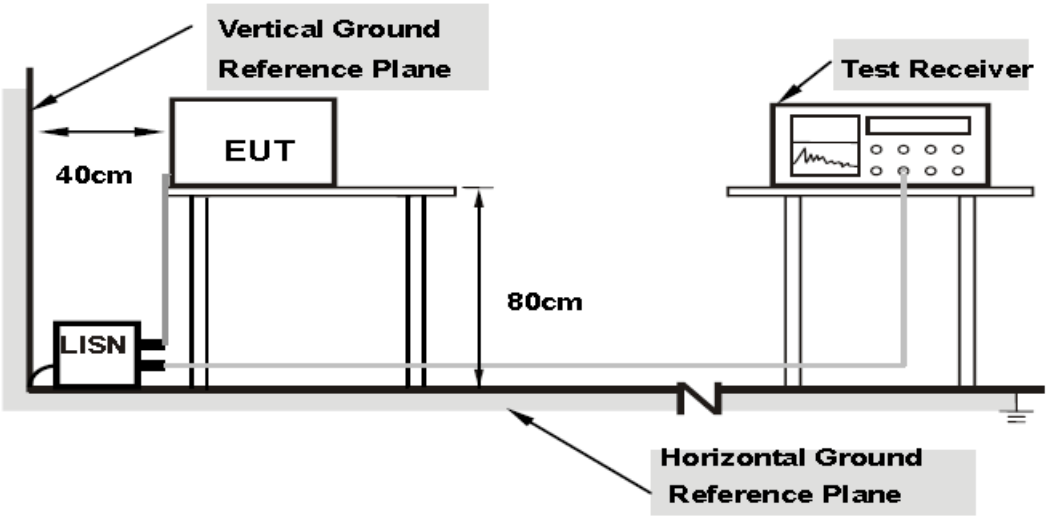
a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit -20dB) was not recorded.

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.
The EUT shall test under the power AC120V/60Hz.

6.7.4 Test Setup



For the actual test configuration, please refer to the attached file (Test Setup Photo).

6.7.5 Test result

The test results are shown in AppendixB .

7 MEASUREMENT UNCERTAINTIES

Items	Uncertainty	
Occupied Bandwidth	3kHz	
Peak power output	0.67dB	
Band edge compliance	1.20dB	
Spurious emissions	30MHz～1GHz	2.83dB
	1GHz～12.75GHz	2.50dB
	12.75GHz～25GHz	2.75dB

8 TEST EQUIPMENTS

No.	Name/ Model	Manufacturer	S/N	Cal date	Cal Due date
1.	Spectrum Analyzer FSV	ROHDE&SCHWARZ	101065	2017.08.20	2018.08.19
2.	Power Meter E4416A	Agilent	MY52370013	2018.03.01	2019.02.28
3.	Power Sensor E9327A	Agilent	MY52420006	2018.03.01	2019.02.28
4.	23.18m×16.88m×9.60m Semi-Anechoic Chamber	FRANKONIA	---	-----	-----
5.	12.65m×8.03m×7.50m Fully-Anechoic Chamber	FRANKONIA	-----	-----	-----
6.	Turn table Diameter:5m	HD	-----	-----	-----
7.	Turn table Diameter:1m	HD	-----	-----	-----
8.	Antenna master FAC(MA4.0)	MATURO	-----	-----	-----
9.	Antenna master SAC(MA4.0)	MATURO	-----	-----	-----
10.	9.080m×5.255m×3.525m Shielding room	FRANKONIA	-----	-----	-----
11.	HF 906 Double-Ridged Waveguide Horn Antenna	R&S	100029	2017.08.20	2018.08.19
12.	HF 906 Double-Ridged Waveguide Horn Antenna	R&S	100030	2017.08.20	2018.08.19
13.	HL562 Ultra log antenna	R&S	100016	2017.08.20	2018.08.19
14.	3160-09 Receive antenna	SCHWARZ-BECK	002058-002	2017.08.20	2018.08.19
15.	ESI 40 EMI test receiver	R&S	100015	2017.08.20	2018.08.19
16.	ESCS30 EMI test receiver	R&S	100029	2017.08.20	2018.08.19
17.	ESH3-Z5 LISN	R&S	100020	2017.08.20	2018.08.19
18.	HFH2-Z2	R&S	100340	2017.08.20	2018.08.19

APPENDIX A – TEST DATA OF CONDUCTED EMISSION

Please refer to the attachment.

APPENDIX B – TEST DATA OF RADIATED EMISSION

Please refer to the attachment.

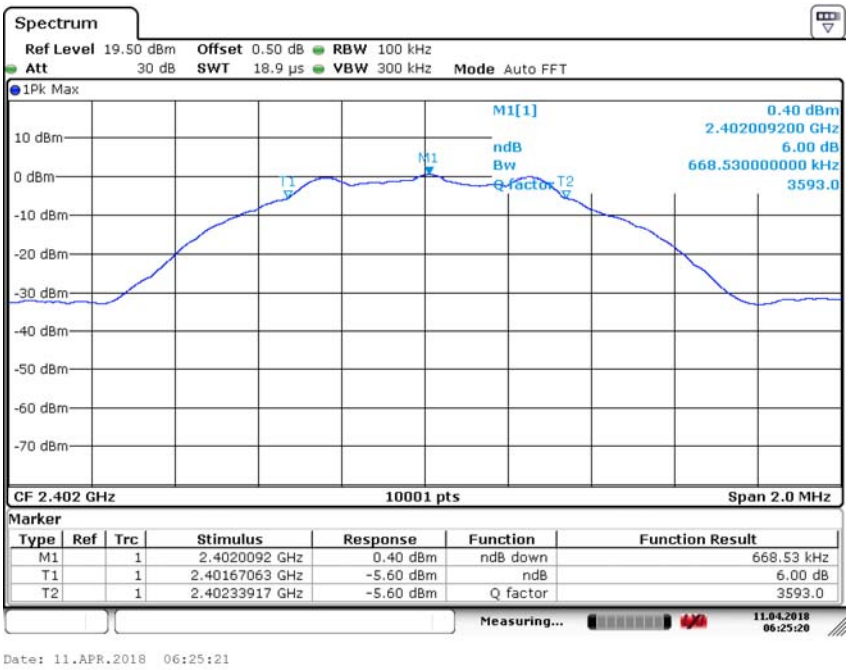
APPENDIX A – TEST DATA OF CONDUCTED EMISSION

Occupied Bandwidth

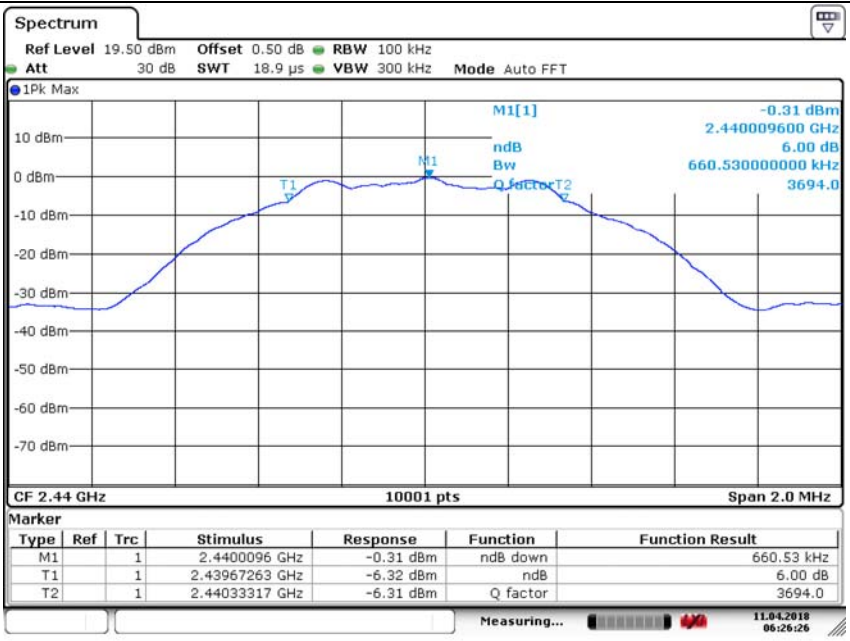
Offset 0.5dB = Temporary antenna connector loss 0.2dB+ Cable loss 0.3dB

Modulation type: GFSK (LE 1Mbps)

Carrier frequency (MHz)	Channel No.	6 dB bandwidth(kHz)
2402	0	668.53
2440	19	660.53
2480	39	661.93

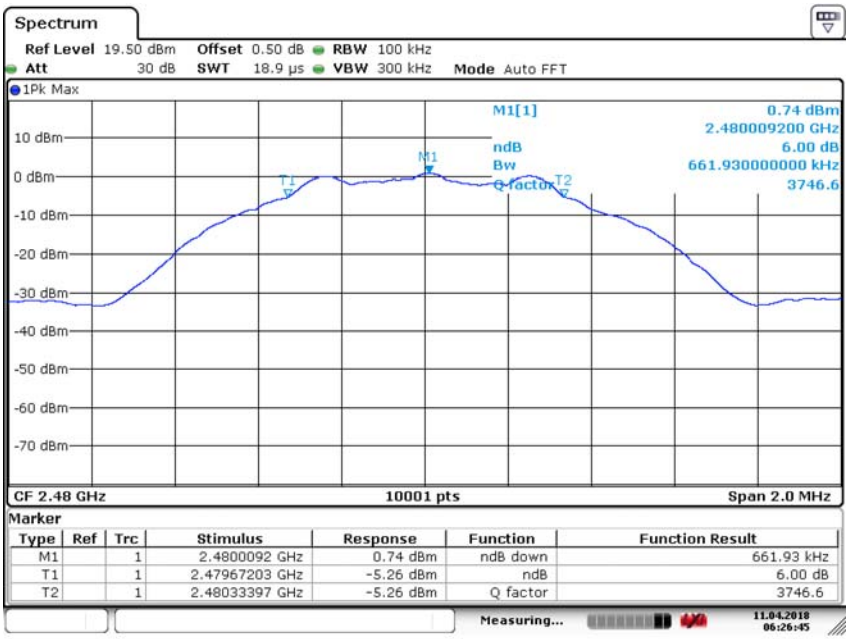


Carrier frequency (MHz): 2402
Channel No.:0
Modulation type: GFSK (LE 1Mbps)



Date: 11.APR.2018 06:26:27

Carrier frequency (MHz): 2440
Channel No.:19
Modulation type: GFSK (LE 1Mbps)

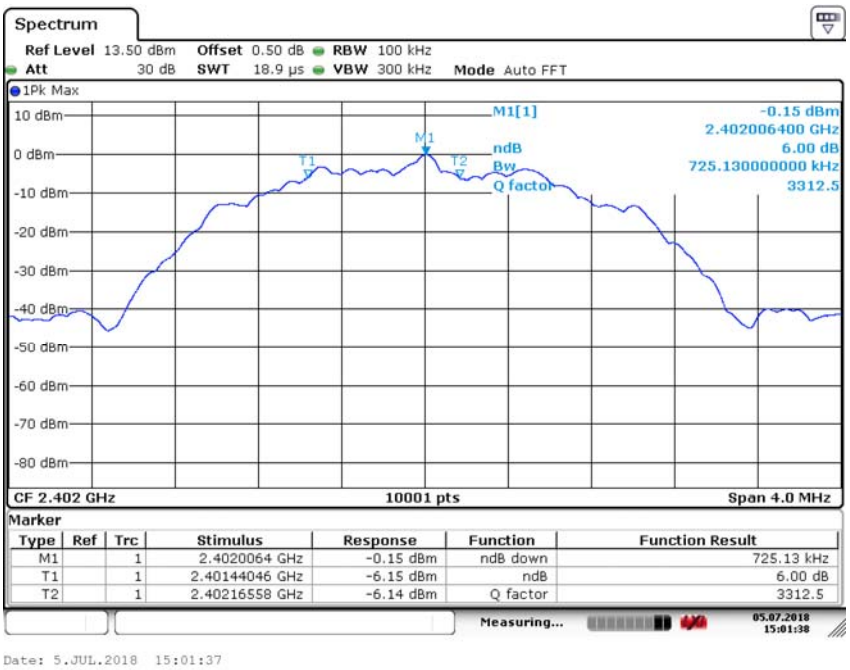


Date: 11.APR.2018 06:26:45

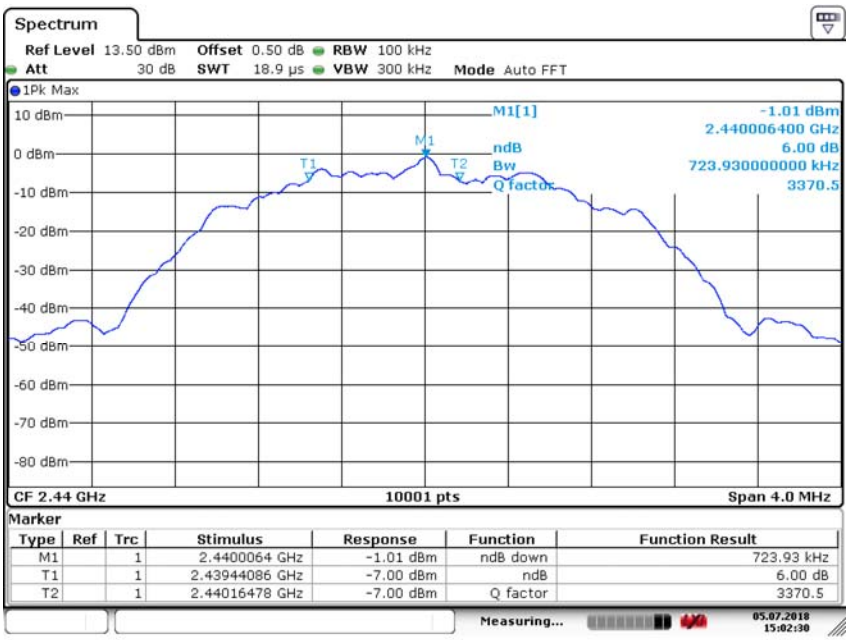
Carrier frequency (MHz): 2480
Channel No.:39
Modulation type: GFSK (LE 1Mbps)

Modulation type: GFSK (LE 2Mbps)

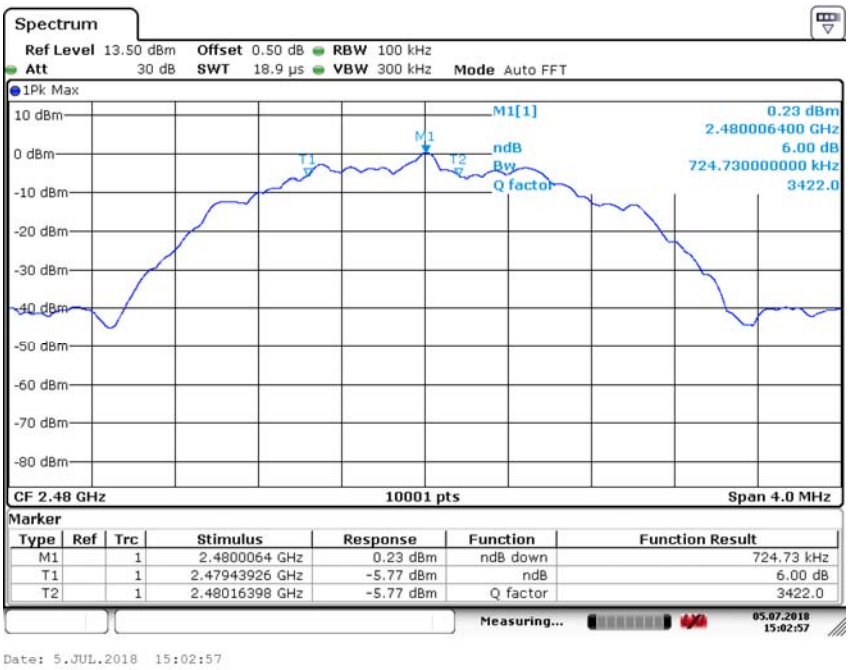
Carrier frequency (MHz)	Channel No.	6 dB bandwidth(kHz)
2402	0	725.13
2440	19	723.93
2480	39	724.73



Carrier frequency (MHz): 2402
Channel No.:0
Modulation type: GFSK (LE 2Mbps)



Carrier frequency (MHz): 2440
Channel No.:19
Modulation type: GFSK (LE 2Mbps)



Carrier frequency (MHz): 2480
Channel No.:39
Modulation type: GFSK (LE 2Mbps)

Peak Power Output

Offset 0.5dB = Temporary antenna connector loss 0.2dB+ Cable loss 0.3dB

Modulation type	Peak Power Output (dBm)		
	2402MHz (Ch0)	2440MHz (Ch19)	2480MHz (Ch39)
GFSK (LE 1Mbps)	0.81	0.36	1.14
GFSK (LE 2Mbps)	0.58	0.02	0.96

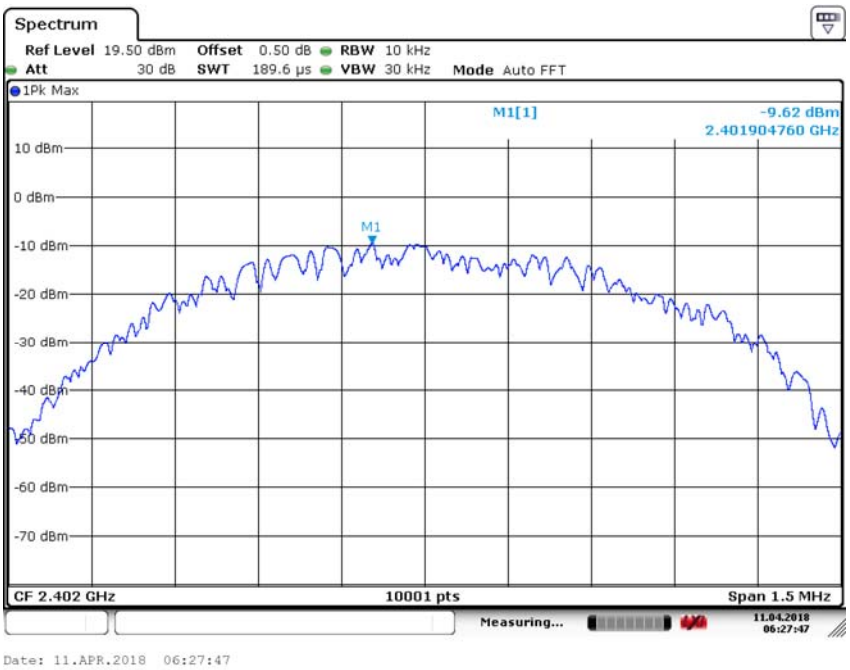
Modulation type	Average Power Output (dBm)		
	2402MHz (Ch0)	2440MHz (Ch19)	2480MHz (Ch39)
GFSK (LE 1Mbps)	-1.39	-1.95	-1.07
GFSK (LE 2Mbps)	-4.64	-5.30	-4.25

Transmitter Power Spectral Density

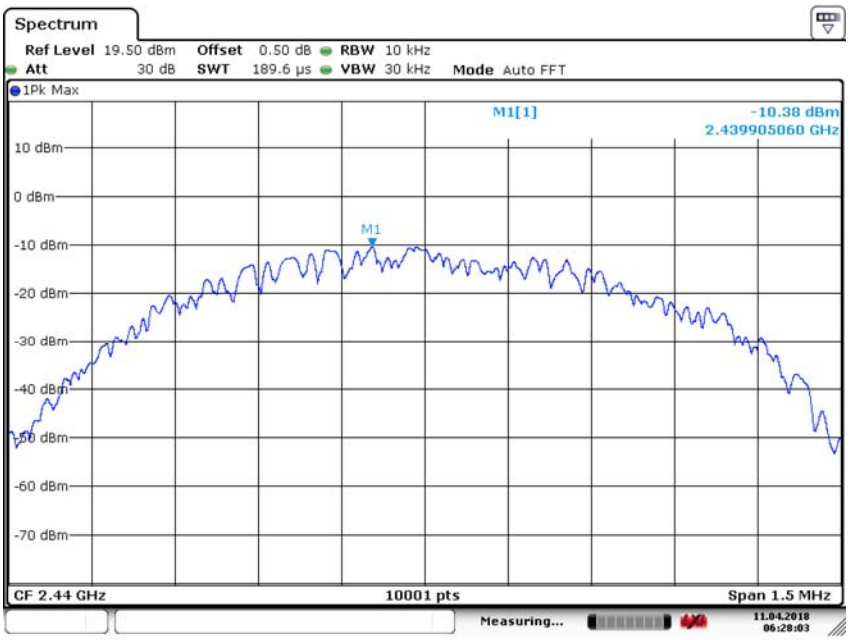
Offset 0.5dB = Temporary antenna connector loss 0.2dB+ Cable loss 0.3dB

Modulation type: GFSK (LE 1Mbps)

Carrier frequency (MHz)	Channel No	Power Density(dBm/10kHz)
2402	0	-9.62
2440	19	-10.38
2480	39	-9.33

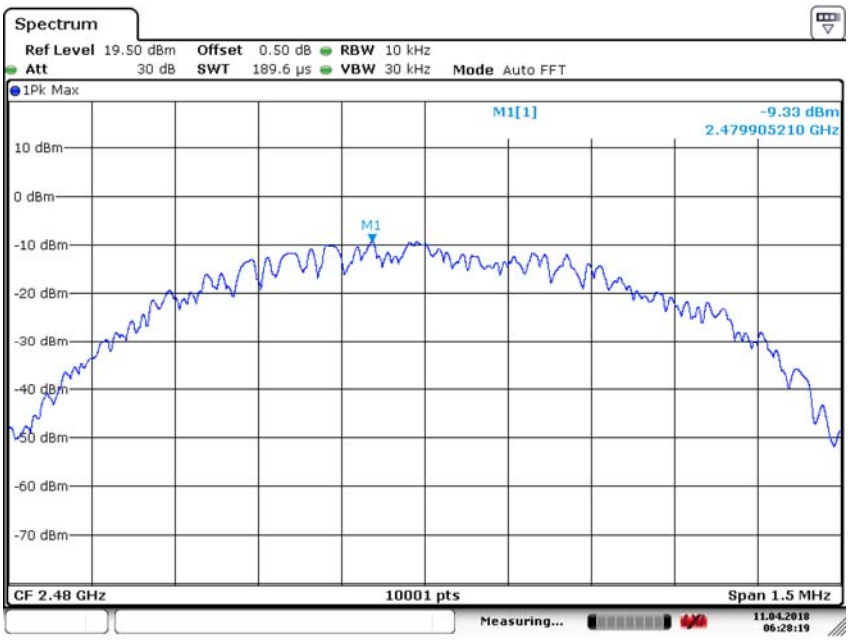


Carrier frequency (MHz): 2402
Channel No.:0
Modulation type: GFSK (LE 1Mbps)



Date: 11.APR.2018 06:28:03

Carrier frequency (MHz): 2440
Channel No.:19
Modulation type: GFSK (LE 1Mbps)

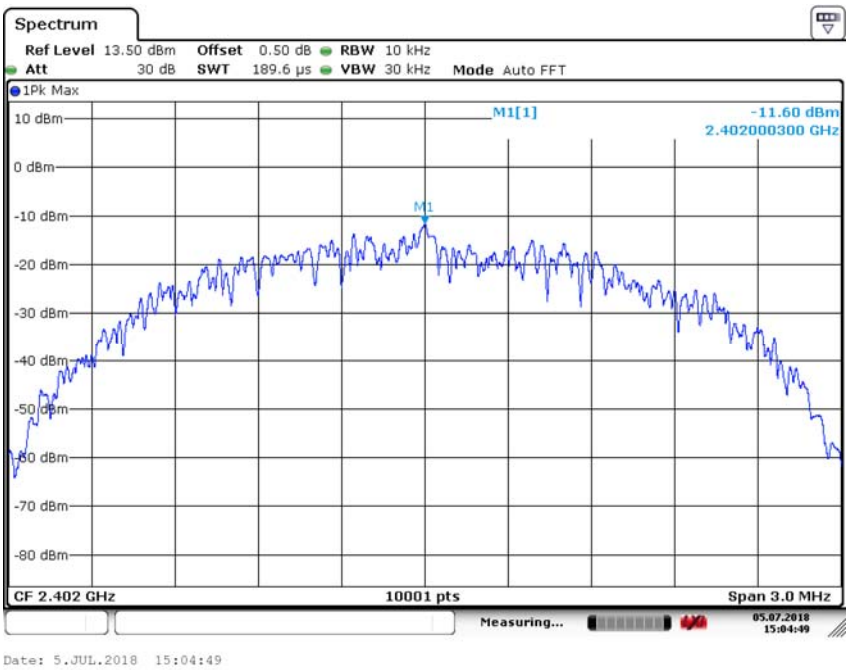


Date: 11.APR.2018 06:28:19

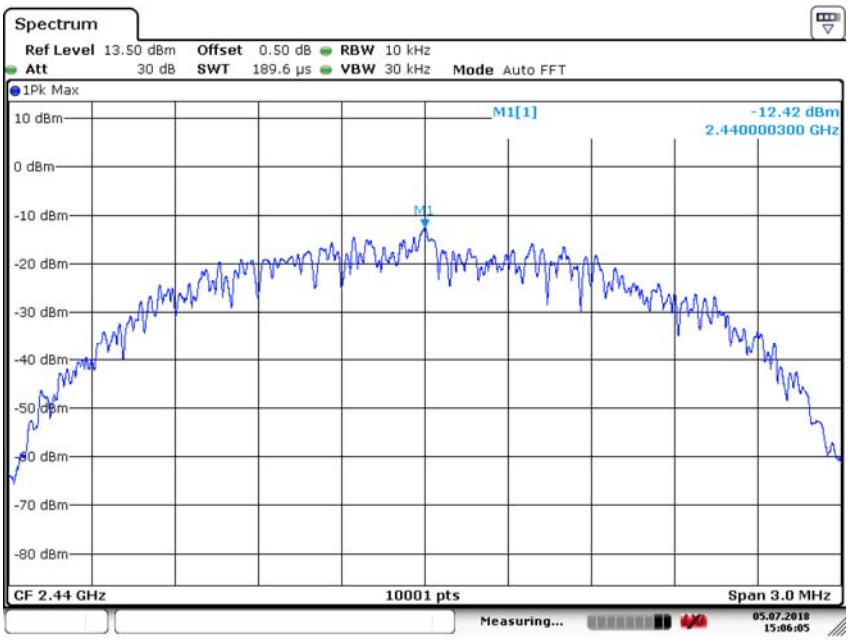
Carrier frequency (MHz): 2480
Channel No.:39
Modulation type: GFSK (LE 1Mbps)

Modulation type: GFSK (LE 2Mbps)

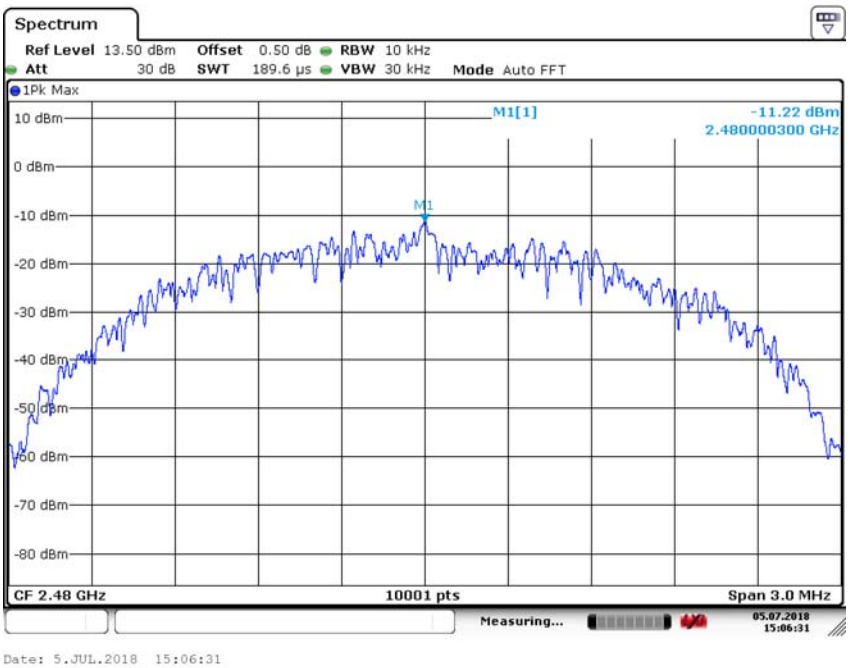
Carrier frequency (MHz)	Channel No	Power Density(dBm/10kHz)
2402	0	-11.60
2440	19	-12.42
2480	39	-11.22



Carrier frequency (MHz): 2402
Channel No.:0
Modulation type: GFSK (LE 2Mbps)



Carrier frequency (MHz): 2440
Channel No.:19
Modulation type: GFSK (LE 2Mbps)



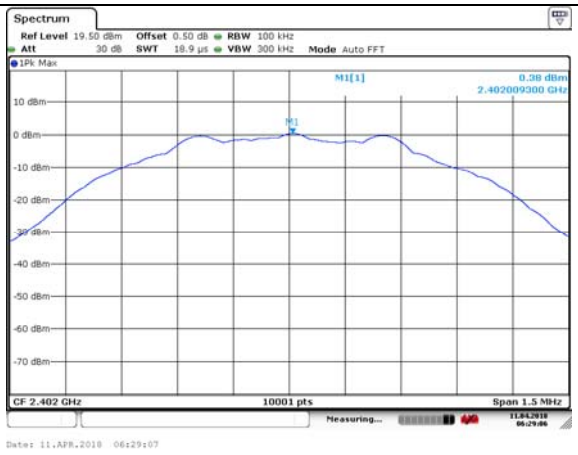
Carrier frequency (MHz): 2480
Channel No.:39
Modulation type: GFSK (LE 2Mbps)

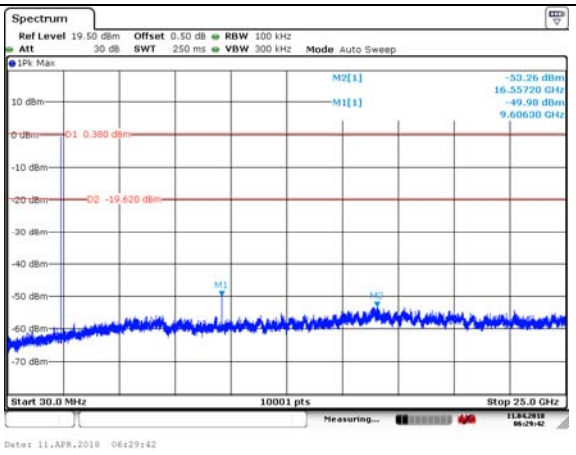
Conducted Out of band emission measurement

Offset 0.5dB = Temporary antenna connector loss 0.2dB+ Cable loss 0.3dB

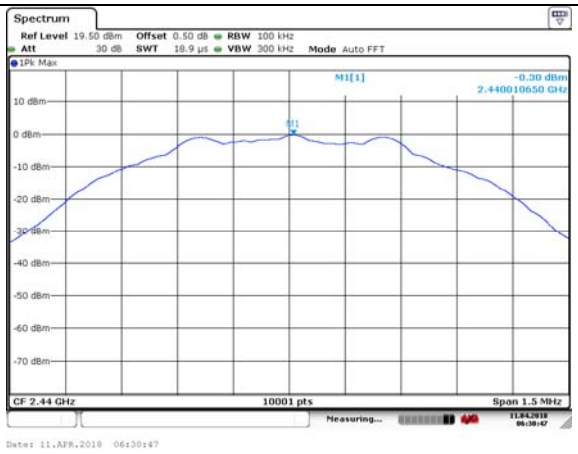
Modulation type: GFSK (LE 1Mbps)

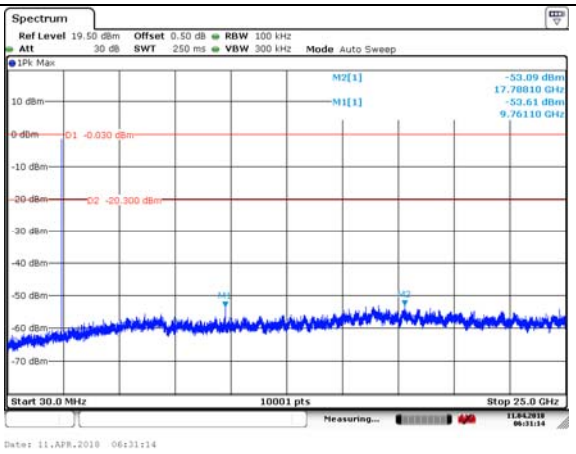
CH0



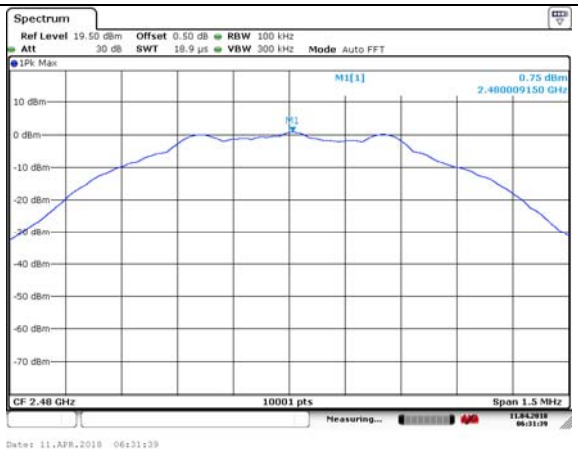


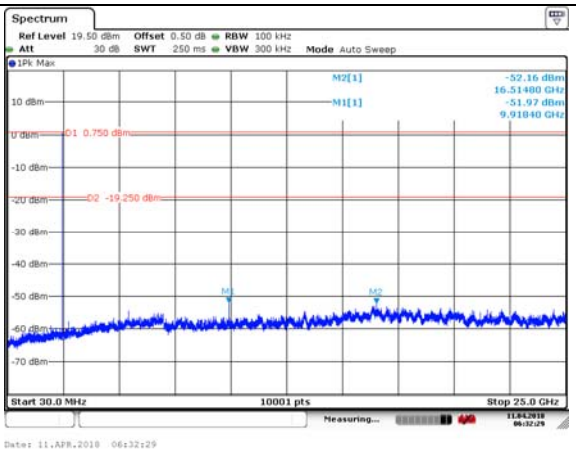
CH19





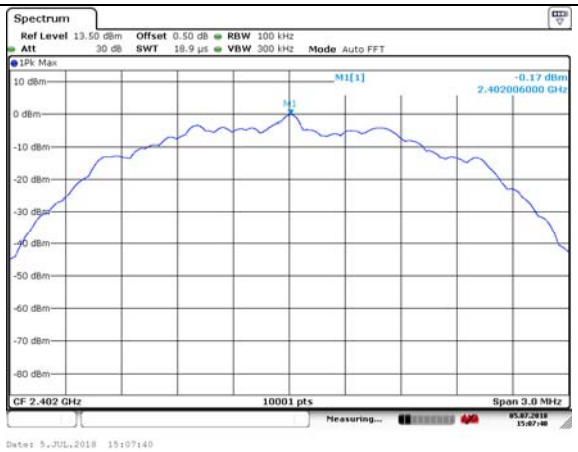
CH39

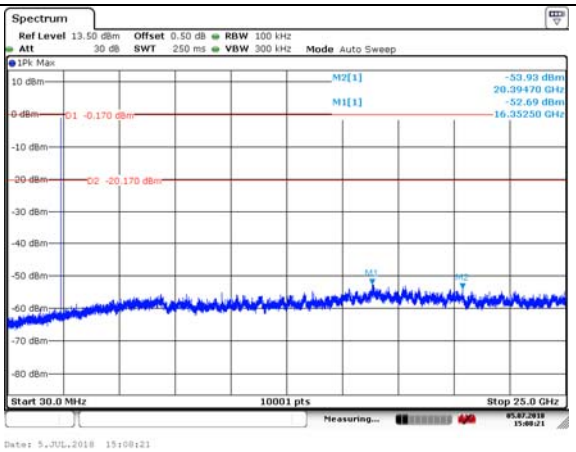




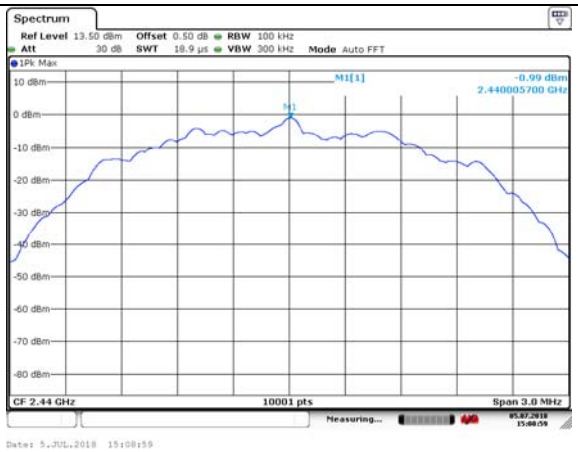
Modulation type: GFSK (LE 2Mbps)

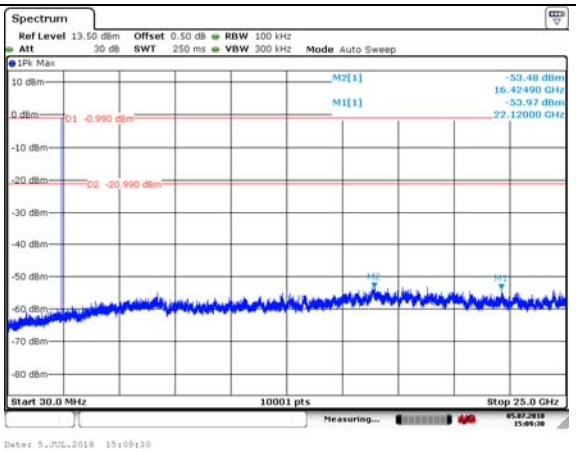
CH0



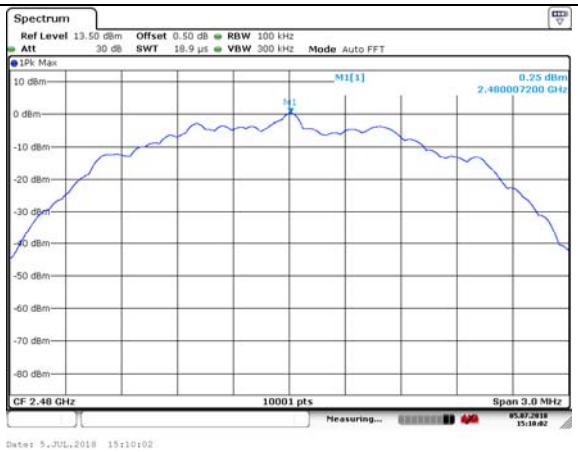


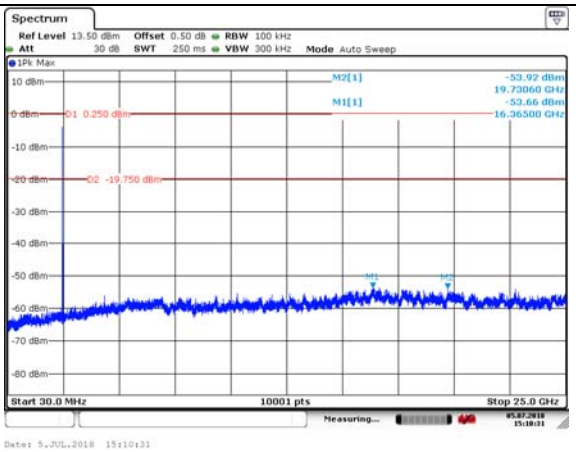
CH19





CH39

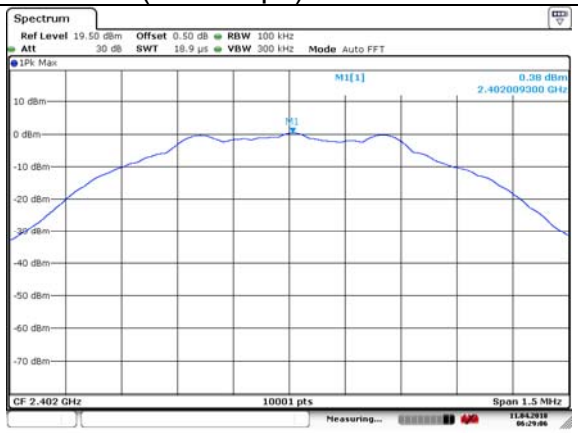


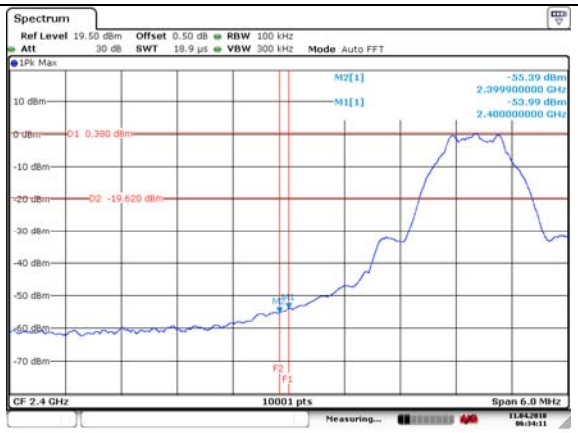


Band edge measurement (RF Conducted measurement)

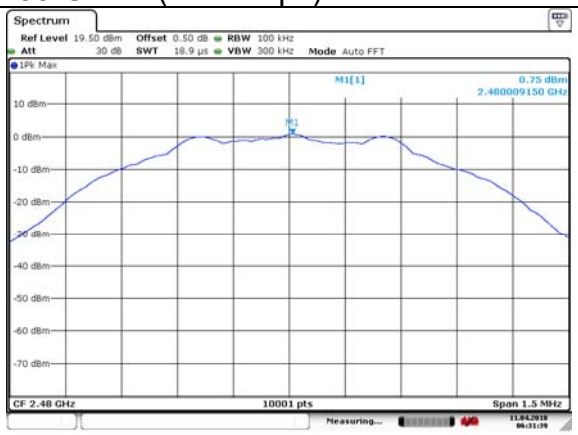
Offset 0.5dB = Temporary antenna connector loss 0.2dB+ Cable loss 0.3dB

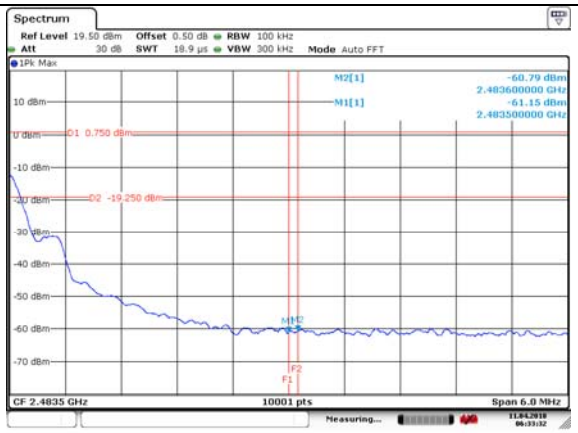
CH0 GFSK (LE 1Mbps)





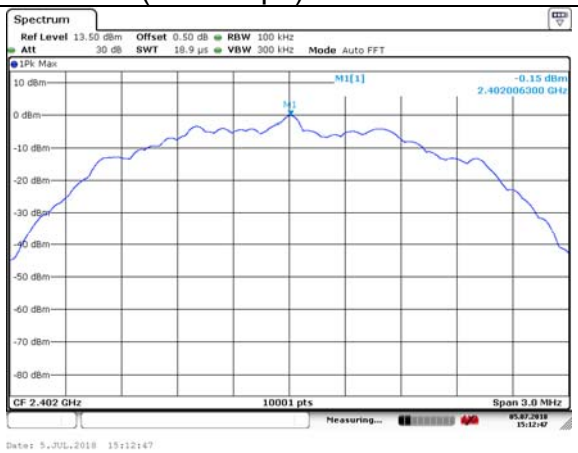
CH39 GFSK (LE 1Mbps)

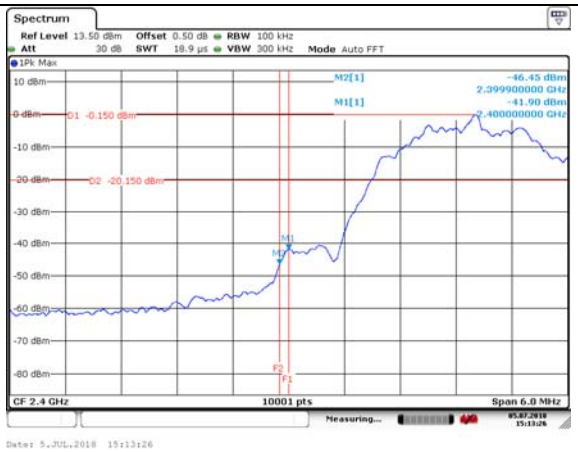




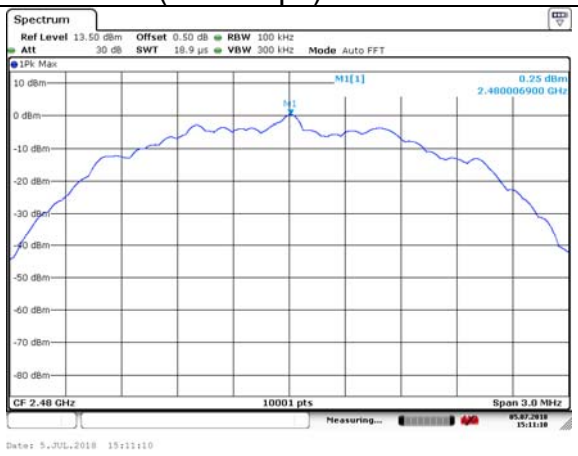
Offset 0.5dB = Temporary antenna connector loss 0.2dB+ Cable loss 0.3dB

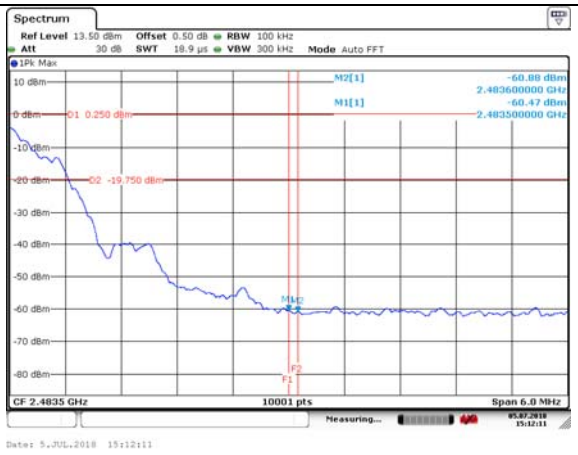
CH0 GFSK (LE 2Mbps)





CH39 GFSK (LE 2Mbps)





APPENDIX B – TEST DATA OF RADIATED EMISSION

Spurious Radiated Emissions

LE (1Mbps)
The worst case attitude: The mobile lay down.
Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	103.51	69.51	N/A	N/A	8.90	25.10
2	2390	49.87	15.87	-24.13	74.00	8.90	25.10

Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	96.07	62.07	N/A	N/A	8.90	25.10
2	2390	46.32	12.32	-27.68	74.00	8.90	25.10

Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	88.14	54.14	N/A	N/A	8.90	25.10
2	2390	36.88	2.88	-17.12	54.00	8.90	25.10

Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	84.06	50.06	N/A	N/A	8.90	25.10
2	2390	35.22	1.22	-18.78	54.00	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	103.39	69.39	N/A	N/A	8.90	25.10
2	2483.5	48.01	14.01	-25.99	74.00	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	95.46	61.46	N/A	N/A	8.90	25.10
2	2483.5	45.15	11.15	-28.85	74.00	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	86.43	52.43	N/A	N/A	8.90	25.10
2	2483.5	35.87	1.87	-18.13	54.00	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	84.67	50.67	N/A	N/A	8.90	25.10
2	2483.5	36.20	2.20	-17.80	54.00	8.90	25.10

Sample Calculations

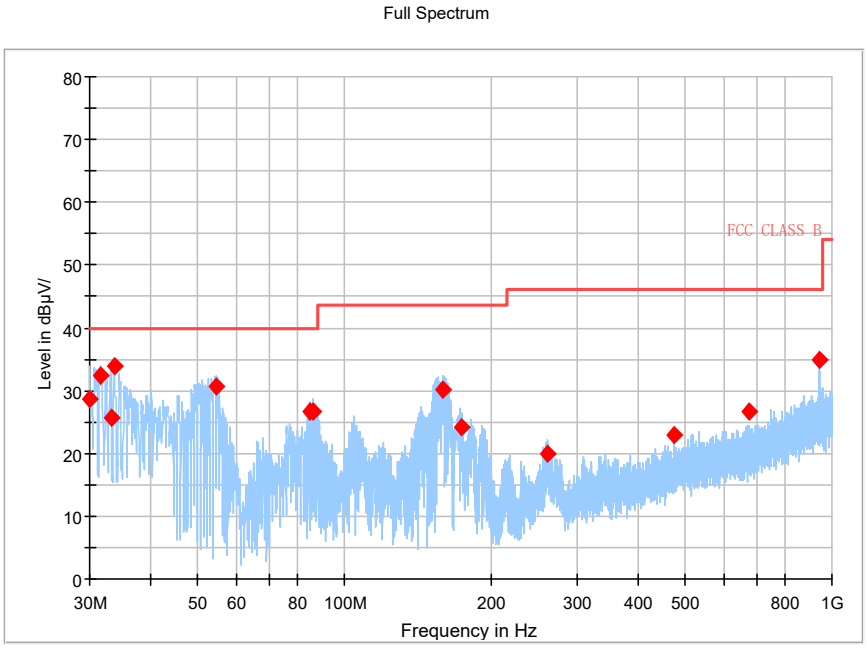
Determining Spurious Emissions Levels

A “reference path loss” is established and the A_{Rpl} is the attenuation of “reference path loss”, and including the gain of receive antenna, the gain of the preamplifier, the cable loss.
The measurement results are obtained as described below:
Result= $P_{mea} + A_{Rpl}$

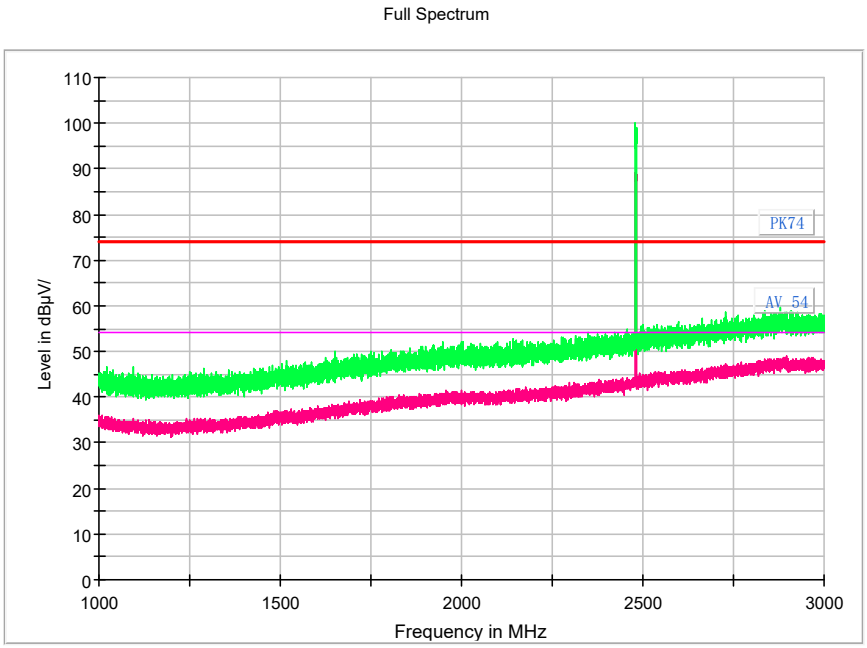
The worst case attitude: The mobile lay down.

For GFSK (LE)
Channel No.:19

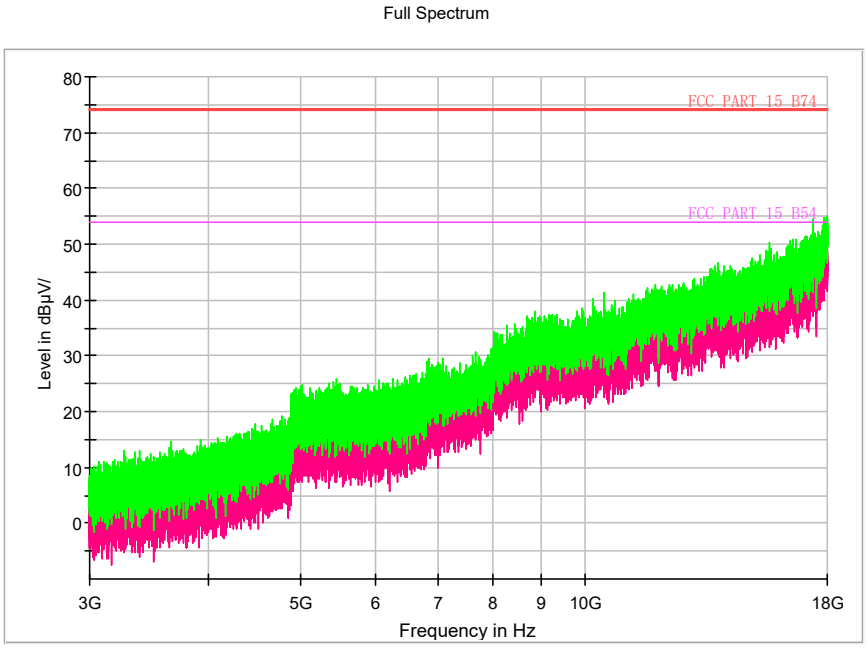
Frequency (MHz)	Result (dBuV/m)	ARpl (dB)	Pmea (dBuV/m)	Polarity	Limit (dBuV/m)
30	28.56	19.8	8.76	Vertical	40.00
31.657083	32.32	19.1	13.22	Vertical	40.00
33.192917	25.62	18.4	7.22	Horizontal	40.00
33.677917	33.9	18.2	15.70	Vertical	40.00
54.37125	30.76	8.2	22.56	Vertical	40.00
85.0475	26.71	10.2	16.51	Horizontal	40.00
85.977083	26.55	10.3	16.25	Vertical	40.00
159.495	30.07	10.2	19.87	Vertical	43.50
173.762083	24.25	10.8	13.45	Horizontal	43.50
260.213333	19.82	13.8	6.02	Horizontal	46.00
475.83625	22.85	20.3	2.55	Vertical	46.00
678.647083	26.61	23.9	2.71	Vertical	46.00
942.0425	34.82	27.8	7.02	Vertical	46.00



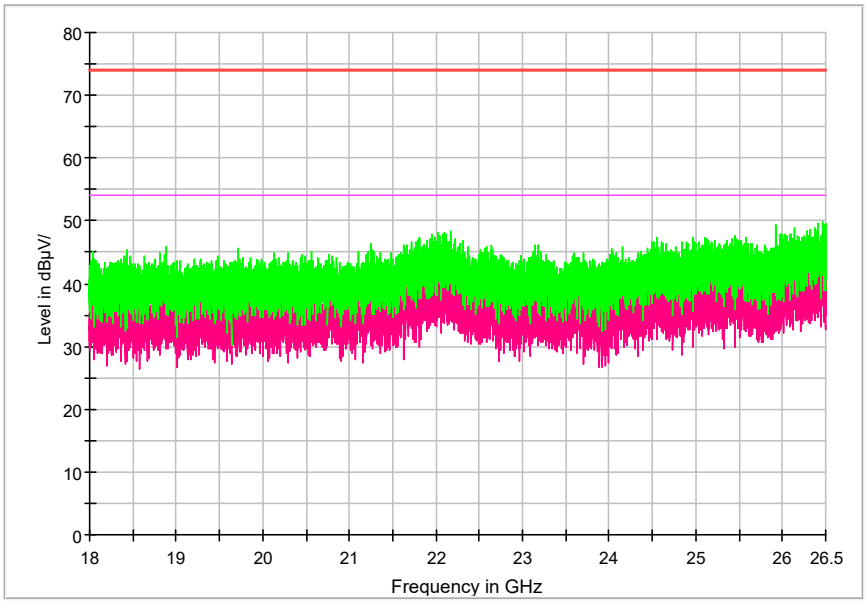
Frequency Range: 30MHz-1000 MHz
Detector: QP mode
Modulation type: GFSK (LE)



Frequency Range: 1GHz-3GHz
Detector: Av mode and PK mode
Modulation type: GFSK (LE)



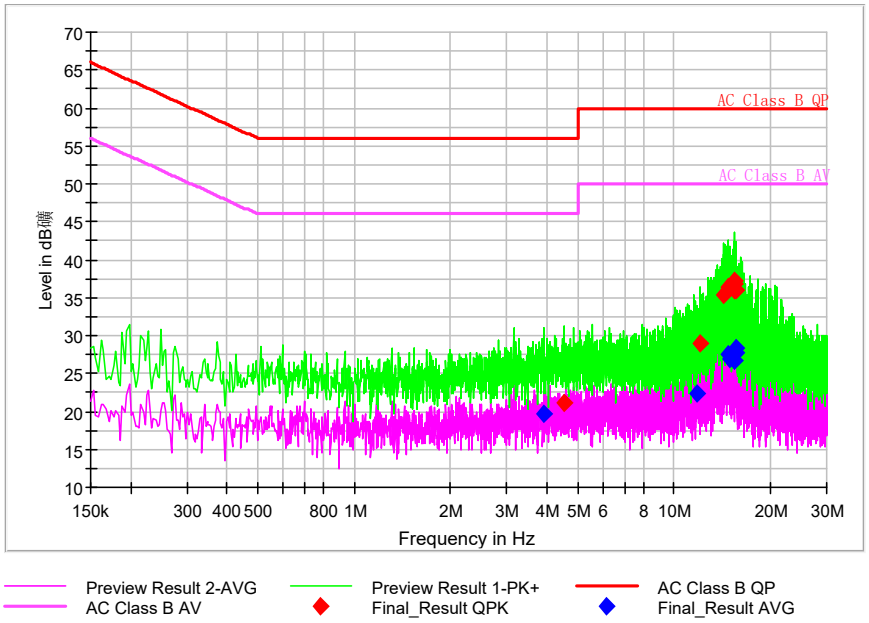
Frequency Range: 3GHz-18GHz
Detector: Av mode and PK mode
Modulation type: GFSK (LE)



Frequency Range: 18GHz-26.5GHz
Detector: Av mode and PK mode
Modulation type: GFSK (LE)

AC Power line Conducted Emission

Full Spectrum



L+N Line

MEASUREMENT RESULT:

Frequency (MHz)	MaxPeak (dBuV)	Average (dBuV)	Limit (dBuV)	Margin (dB)	Line	Corr. (dB)
3.931010	---	19.59	46.00	3.931010	L1	29.8
4.531890	21.08	---	56.00	4.531890	L1	29.8
11.812425	---	22.39	50.00	11.812425	N	29.9
12.112895	28.94	---	60.00	12.112895	N	29.9
14.234245	35.36	---	60.00	14.234245	L1	29.9
14.809245	---	27.46	50.00	14.809245	L1	29.9
14.820410	36.37	---	60.00	14.820410	L1	29.9
14.934495	---	26.92	50.00	14.934495	L1	29.9
15.451795	35.89	---	60.00	15.451795	N	29.9
15.458245	37.31	---	60.00	15.458245	L1	29.9
15.460095	---	27.79	50.00	15.460095	L1	29.9
15.493945	36.74	---	60.00	15.493945	L1	29.9
15.509945	---	26.78	50.00	15.509945	L1	29.9
15.539795	---	28.30	50.00	15.539795	L1	29.9
15.581045	36.03	---	60.00	15.581045	L1	29.9
15.613045	---	27.66	50.00	15.613045	L1	29.9

LE (2Mbps)

Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	101.21	67.21	N/A	N/A	8.90	25.10
2	2390	48.09	14.09	-25.91	74.00	8.90	25.10

Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	96.44	62.44	N/A	N/A	8.90	25.10
2	2390	45.40	11.40	-28.60	74.00	8.90	25.10

Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	88.78	54.78	N/A	N/A	8.90	25.10
2	2390	35.98	1.98	-18.02	54.00	8.90	25.10

Carrier frequency (MHz): 2402
Channel No.:0
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2402	83.65	49.65	N/A	N/A	8.90	25.10
2	2390	34.86	0.86	-19.14	54.00	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	100.76	66.76	N/A	N/A	8.90	25.10
2	2483.5	50.27	16.27	-23.73	74.00	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Peak

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	94.92	60.92	N/A	N/A	8.90	25.10
2	2483.5	43.46	9.46	-30.54	74.00	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Vertical
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	87.53	53.53	N/A	N/A	8.90	25.10
2	2483.5	37.25	3.25	-16.75	54.00	8.90	25.10

Carrier frequency (MHz): 2480
Channel No.:39
Test Mode: GFSK (LE)
Polarity: Horizontal
Detector: Average

No	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	cable loss (dB)	antenna factor (dB)
1	2480	86.55	52.55	N/A	N/A	8.90	25.10
2	2483.5	35.64	1.64	-18.36	54.00	8.90	25.10

Sample Calculations

Determining Spurious Emissions Levels

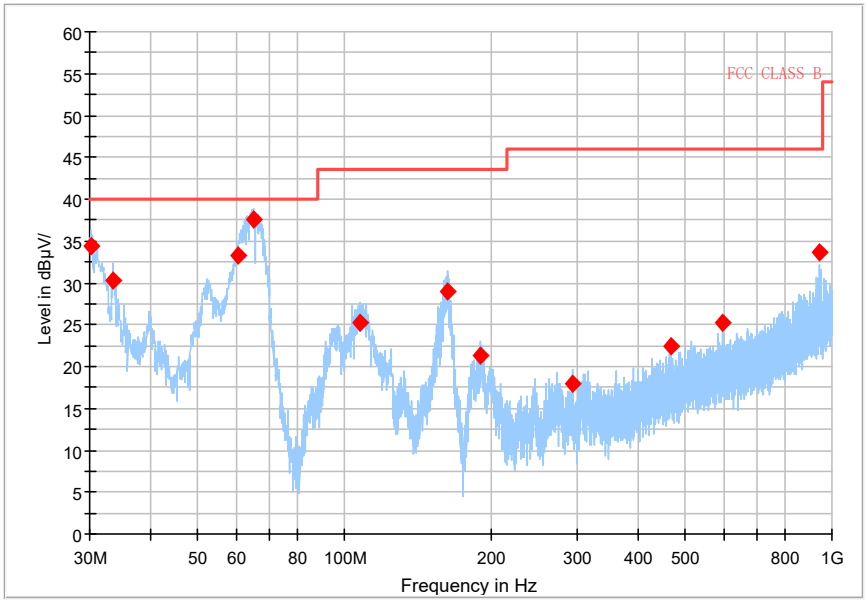
A "reference path loss" is established and the A_{Rpl} is the attenuation of "reference path loss", and including the gain of receive antenna, the gain of the preamplifier, the cable loss.
The measurement results are obtained as described below:
Result= $P_{mea} + A_{Rpl}$

The worst case attitude: The mobile lay down.

For GFSK (LE)
Channel No.:19

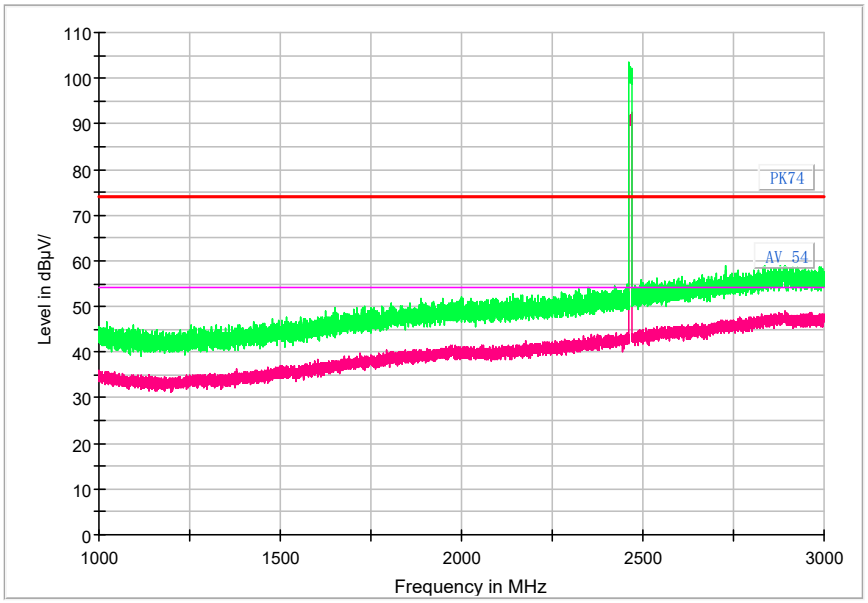
Frequency (MHz)	Result (dBuV/m)	ARpl (dB)	Pmea (dBuV/m)	Polarity	Limit (dBuV/m)
30.242500	34.47	19.7	14.77	Vertical	40.00
33.556667	30.24	18.2	12.04	Vertical	40.00
60.474167	33.33	6.9	26.43	Horizontal	40.00
64.920000	37.52	7.9	29.62	Vertical	40.00
107.195833	25.17	11.9	13.27	Vertical	40.00
162.324167	29.05	10.3	18.75	Vertical	40.00
190.211667	21.24	11	10.24	Vertical	43.50
293.314583	17.94	14.9	3.04	Vertical	43.50
468.197500	22.46	20.1	2.36	Vertical	46.00
595.671667	25.19	22.5	2.69	Horizontal	46.00
942.082917	33.59	27.8	5.79	Vertical	46.00
30.242500	34.47	19.7	14.77	Vertical	40.00

Full Spectrum

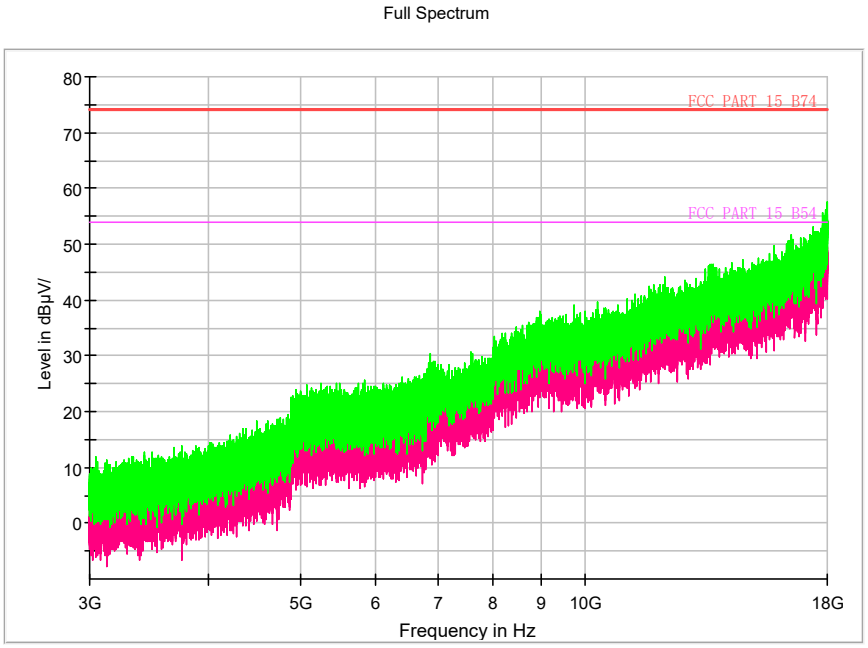


Frequency Range: 30MHz-1000 MHz
Detector: QP mode
Modulation type: GFSK (LE)

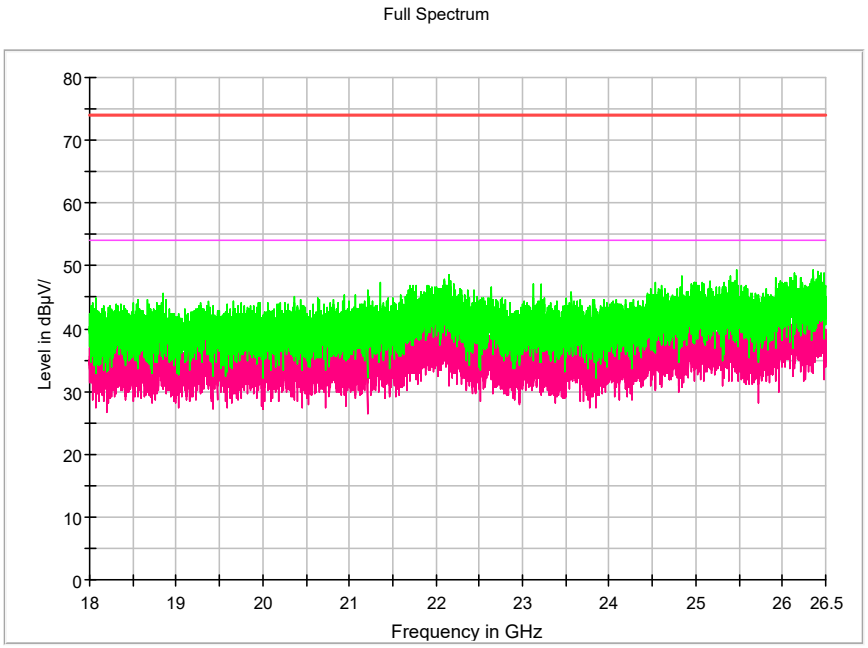
Full Spectrum



Frequency Range: 1GHz-3GHz
Detector: Av mode and PK mode
Modulation type: GFSK (LE)



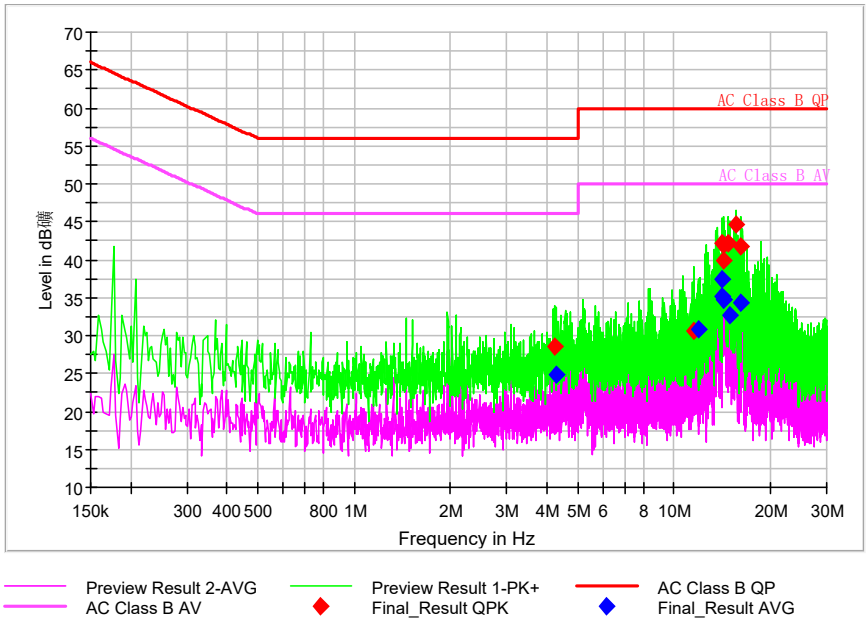
Frequency Range: 3GHz-18GHz
Detector: Av mode and PK mode
Modulation type: GFSK (LE)



Frequency Range: 18GHz-26.5GHz
Detector: Av mode and PK mode
Modulation type: GFSK (LE)

AC Power line Conducted Emission

Full Spectrum



L+N Line

MEASUREMENT RESULT:

Frequency (MHz)	MaxPeak (dBuV)	Average (dBuV)	Limit (dBuV)	Margin (dB)	Line	Corr. (dB)
4.235480	28.60	---	56.00	27.40	L1	29.8
4.287180	---	24.77	46.00	21.23	L1	29.8
11.526880	30.54	---	60.00	29.46	N	29.9
11.955645	---	30.77	50.00	19.23	N	29.9
14.045145	---	35.09	50.00	14.91	L1	29.9
14.151530	---	37.48	50.00	12.52	L1	29.9
14.155530	42.07	---	60.00	17.93	L1	29.9
14.259230	41.89	---	60.00	18.11	L1	29.9
14.260245	---	34.81	50.00	15.19	N	29.9
14.278930	39.88	---	60.00	20.12	L1	29.9
14.314930	---	34.83	50.00	15.17	L1	29.9
14.843395	42.12	---	60.00	17.88	L1	29.9
14.954375	---	32.74	50.00	17.26	L1	29.9
15.600510	44.58	---	60.00	15.42	N	29.9
16.185330	41.77	---	60.00	18.23	L1	29.9
16.235060	---	34.23	50.00	15.77	L1	29.9

---End of Test Report---