

FCC - TEST REPORT

Report Number : 68.950.20.0653.01 Date of Issue: June 25, 2021

Model : TG-SD-D

Product Type : Wireless Receiver

Applicant : Heyday (HongKong) International Trade Limited

Address : Room 061 1/F Amoycan Ind Ctr 7 Ngau Tau Kok Road Kowloon
: Bay KI Hong Kong.

Factory : Shenzhen Lingxian Electronics Co. LTD.

Address : Room 201, 2nd Floor, 137 Songyu Road, Songgang,
: Shenzhen, Guangdong, CHINA

Test Result : **n Positive** **o Negative**

Total pages including
Appendices : 39

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2 Details about the Test Laboratory

Details about the Test Laboratory

Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shenzhen Branch
Building 12 & 13, Zhiheng Wisdomland Business Park, Nantou Checkpoint
Road 2, Nanshan District
Shenzhen 518052
P.R. China

Telephone: 86 755 8828 6998

Fax: 86 755 8288 5299

FCC Registration No.: 514049

3 Description of the Equipment Under Test

Product:	Wireless Receiver
Model no.:	TG-SD-D
FCC ID:	2AYAETG02
Options and accessories:	N/A
Rating:	5VDC (Supplied by USB Dongle)
RF Transmission Frequency:	2405MHz-2470MHz
No. of Operated Channel:	16
Modulation:	GFSK
Antenna Type:	PCB antenna
Antenna Gain:	0dBi
Description of the EUT:	The Equipment Under Test (EUT) is a Wireless Receiver operated at 2.4GHz



4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2019 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators

All the test methods were according to Public Notice DA 00-705 -Frequency Hopper Spread Spectrum Test Procedure, KDB558074 D01 v05r02 and ANSI C63.10-2013.

5 Summary of Test Results

Technical Requirements				
FCC Part 15 Subpart C				
Test Condition		Pages	Test Result	Test Site
§15.207	Conducted emission AC power port	10	Pass	Site 1
§15.247(b)(1)	Conducted peak output power	13	Pass	Site 1
§15.247(e)	Power spectral density	--	N/A	--
§15.247(a)(2)	6dB bandwidth	--	N/A	--
§15.247(a)(1)	20dB bandwidth and 99% Occupied Bandwidth	16	Pass	Site 1
§15.247(a)(1)	Carrier frequency separation	20	Pass	Site 1
§15.247(a)(1)(iii)	Number of hopping frequencies	22	Pass	Site 1
§15.247(a)(1)(iii)	Dwell Time	24	Pass	Site 1
§15.247(d)	Spurious RF conducted emissions	27	Pass	Site 1
§15.247(d)	Band edge	31	Pass	Site 1
§15.247(d) & §15.209 & §15.205	Spurious radiated emissions for transmitter and receiver	34	Pass	Site 1
§15.203	Antenna requirement	See note 2	Pass	--

Note 1: N/A=Not Applicable.

Note 2: The EUT uses a PCB antenna, which gain is 0dBi. In accordance to §15.203, it is considered sufficiently to comply with the provisions of this section.



6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2AYAETG02 complies with Section 15.205, 15.209, 15.247 of the FCC Part 15, Subpart C.

SUMMARY:

All tests according to the regulations cited on page 5 were

n - Performed

o - **Not** Performed

The Equipment Under Test

n - **Fulfills** the general approval requirements.

o - **Does not** fulfill the general approval requirements.

Sample Received Date: April 28, 2020

Testing Start Date: April 28, 2020

Testing End Date: July 30, 2020

Reviewed by:

Prepared by:

Tested by:

John Zhi
EMC Project Manager

Mark Chen
EMC Project Engineer

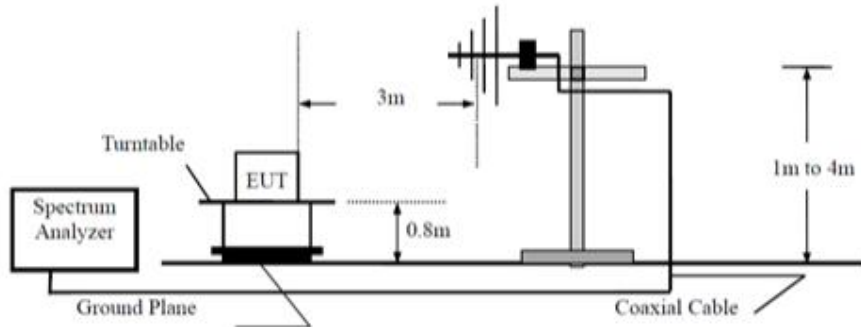


Carry Cai
EMC Test Engineer

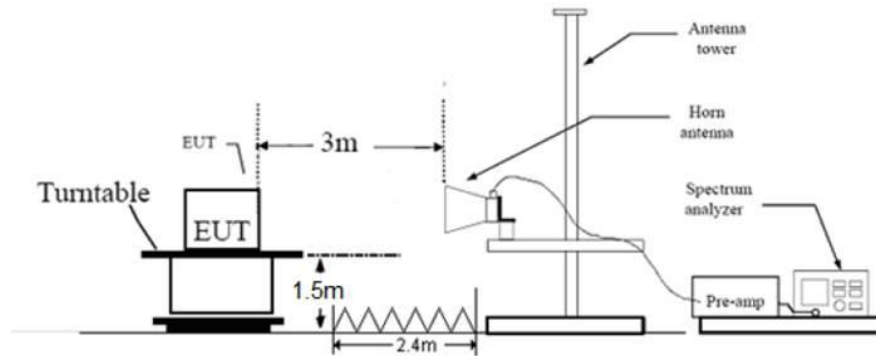
7 Test Setups

7.1 Radiated test setups

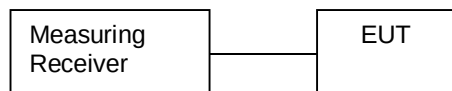
Below 1GHz



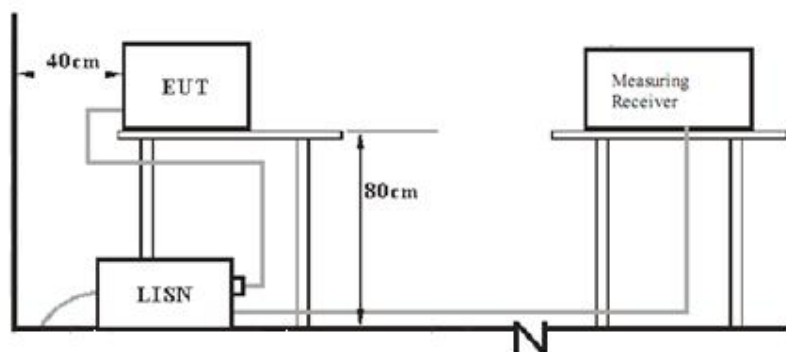
Above 1GHz



7.2 Conducted RF test setups



7.3 AC Power Line Conducted Emission test setups



8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.	S/N
Notebook	Lenovo	X220	---

The system was configured to hopping mode and non-hopping mode.

Hopping mode: typical working mode (normal hopping status)

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

9 Technical Requirement

9.1 Conducted Emission

Test Method

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

Limit

Frequency MHz	QP Limit dB μ V	AV Limit dB μ V
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

*Decreasing linearly with logarithm of the frequency.

Conducted Emission Test 0.15MHz – 30MHz

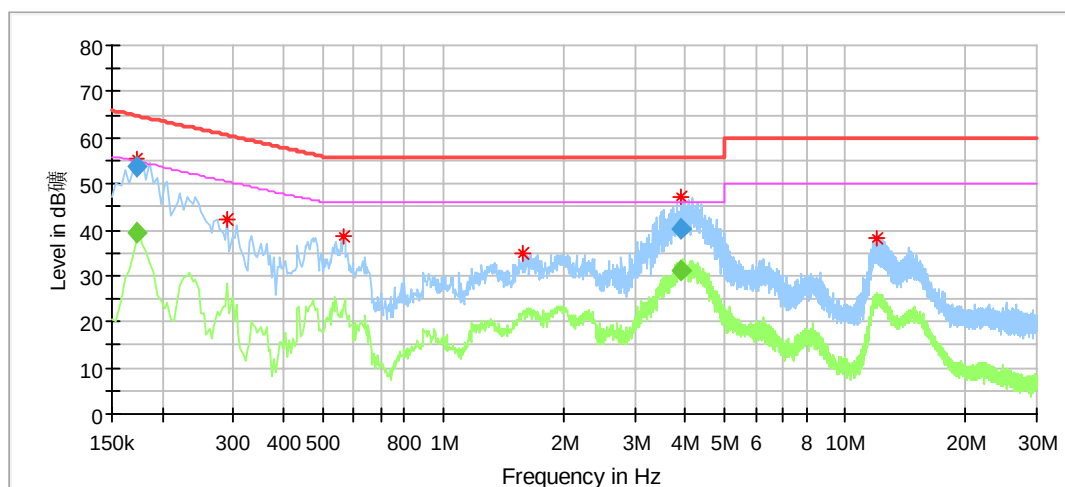
EUT: Wireless Receiver

M/N: TG-SD-D

Operating Condition: TX

Test Specification: Power Line, Live

Comment: AC120V/60Hz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB/m)
0.173500	55.35	---	64.58	9.23	L1	9.5
0.290000	42.31	---	60.52	18.21	L1	9.5
0.566000	38.38	---	56.00	17.62	L1	9.6
1.582000	35.01	---	56.00	20.99	L1	9.6
3.889500	47.18	---	56.00	8.82	L1	9.6
11.974000	38.27	---	60.00	21.73	L1	9.7

Final_Result

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB/m)
0.173500	---	39.23	54.79	15.56	L1	9.5
0.173500	53.67	---	64.79	11.12	L1	9.5
3.889500	---	31.13	46.00	14.87	L1	9.6
3.889500	40.14	---	56.00	15.86	L1	9.6

Remark:

Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

(The Reading Level is recorded by software which is not shown in the sheet)

Conducted Emission Test 0.15MHz – 30MHz

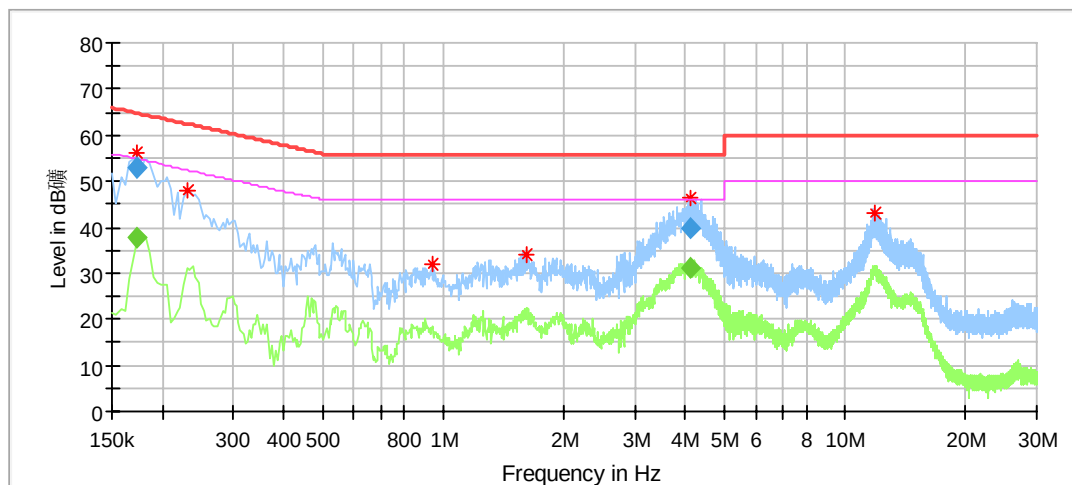
EUT: Wireless Receiver

M/N: TG-SD-D

Operating Condition: TX

Test Specification: Power Line, Neutral

Comment: AC120V/60Hz



Critical_Freqs

Frequency (MHz)	MaxPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB/m)
0.173500	56.00	---	64.77	8.76	N	9.5
0.230000	48.11	---	62.45	14.34	N	9.5
0.938000	31.99	---	56.00	24.01	N	9.6
1.618000	33.95	---	56.00	22.05	N	9.6
4.101500	46.28	---	56.00	9.72	N	9.6
11.902000	42.87	---	60.00	17.13	N	9.7

Final_Result

Frequency (MHz)	QuasiPeak (dBμV)	Average (dBμV)	Limit (dBμV)	Margin (dB)	Line	Corr. (dB/m)
0.173500	---	37.91	54.79	16.88	N	9.5
0.173500	52.83	---	64.79	11.96	N	9.5
4.101500	---	31.13	46.00	14.87	N	9.6
4.101500	39.88	---	56.00	16.12	N	9.6

Remark:

Level=Reading Level + Correction Factor

Correction Factor=Cable Loss + LISN Factor

(The Reading Level is recorded by software which is not shown in the sheet)

9.2 Conducted peak output power

Test Method

1. Use the following spectrum analyzer settings:
Span = approximately 5 times the 20dB bandwidth, centered on a hopping channel
RBW > the 20dB bandwidth of the emission being measured, VBW $\geq$ RBW,
Sweep = auto, Detector function = peak, Trace = max hold
2. Add a correction factor to the display.
3. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power

Limits

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤ 1	≤ 30

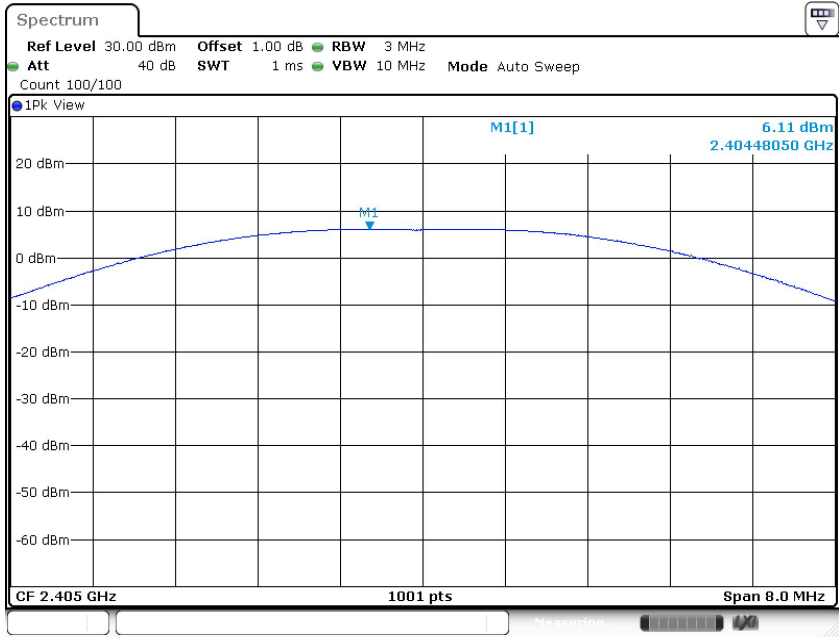


Conducted peak output power

GFSK modulation Test Result

Frequency MHz	Conducted Peak Output Power dBm	Result
Low channel 2405MHz	6.11	Pass
Middle channel 2435MHz	6	Pass
High channel 2470MHz	6.29	Pass

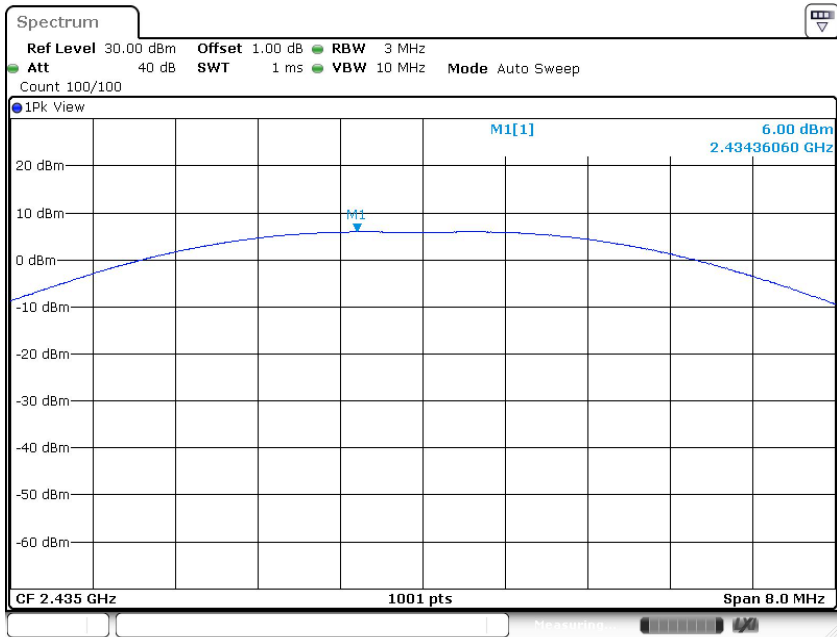
Low channel 2405MHz



Date: 4 JUN. 2020 13:29:24

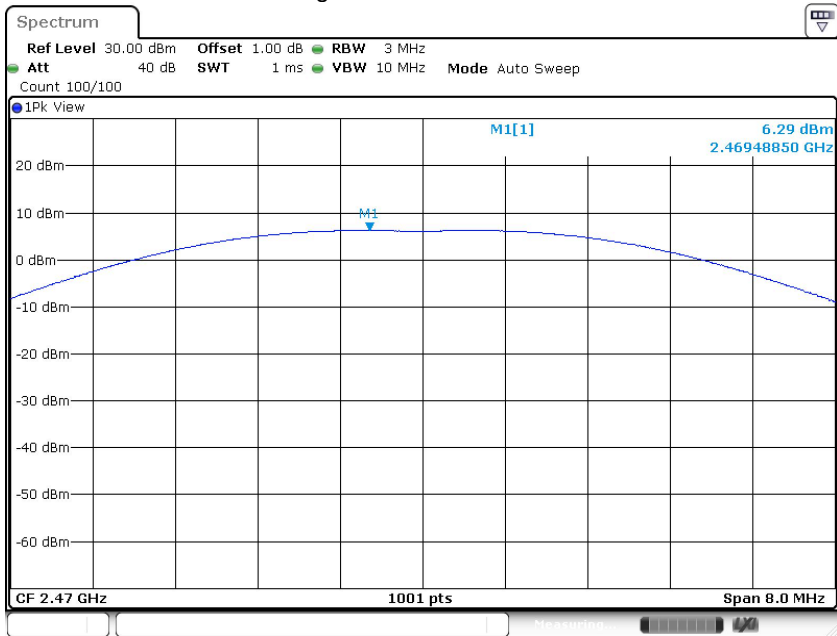


Middle channel 2435MHz



Date: 4.JUN.2020 13:31:29

High channel 2470MHz



Date: 4.JUN.2020 13:33:16

9.3 20 dB bandwidth and 99% Occupied Bandwidth

Test Method

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit [kHz]

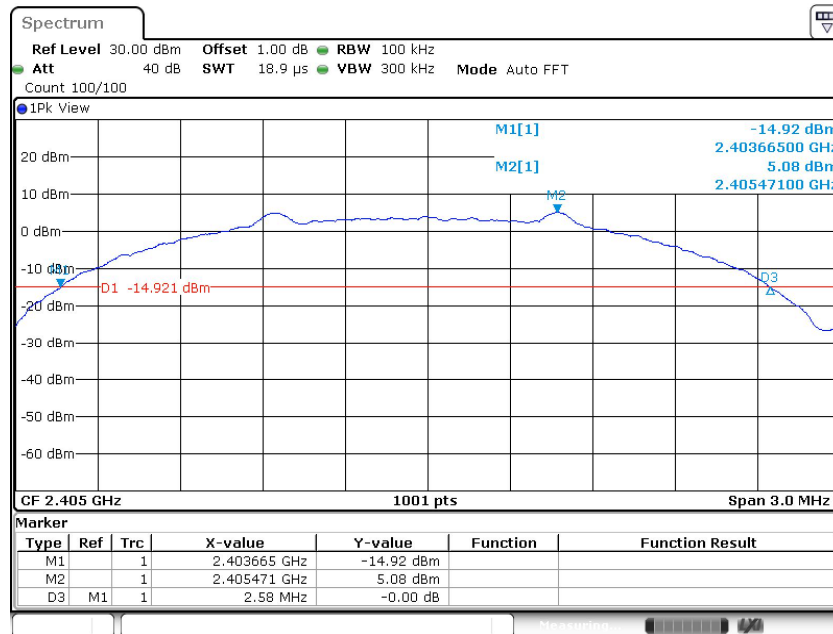
N/A

20 dB bandwidth and 99% Occupied Bandwidth

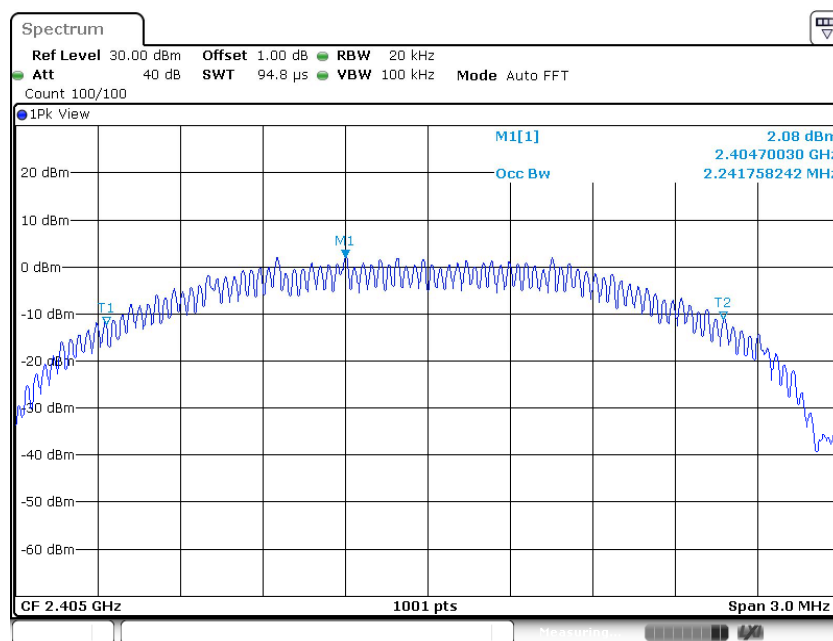
GFSK Modulation test result

Frequency MHz	20 dB Bandwidth kHz	99% Bandwidth kHz	Limit kHz	Result
2405	2580	2242	--	Pass
2435	2592	2242	--	Pass
2470	2604	2251	--	Pass

Low channel 2405MHz



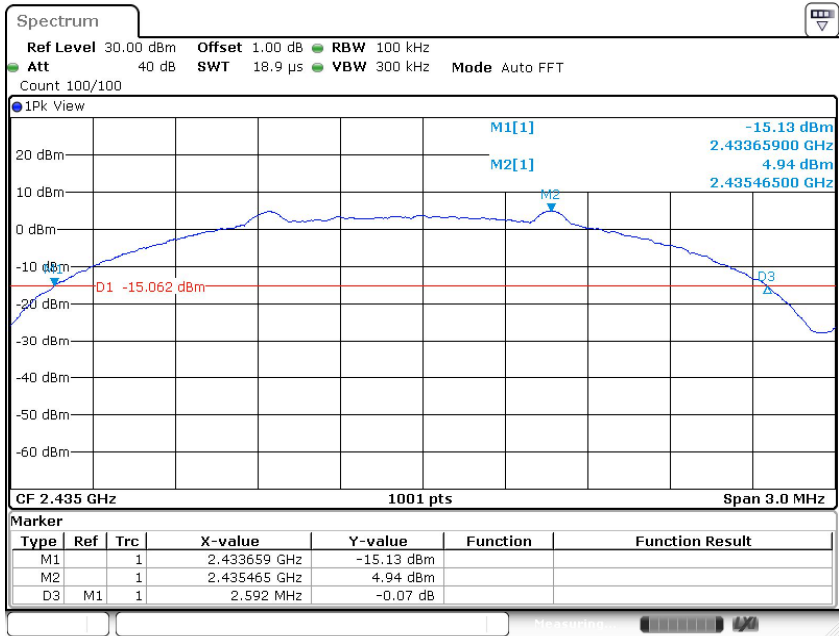
Date: 4 JUN 2020 13:28:38



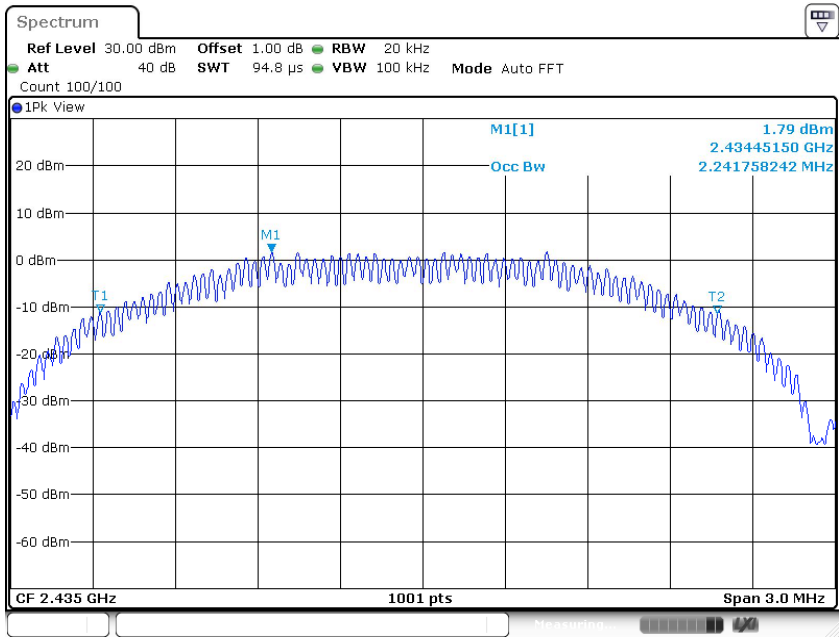
Date: 4 JUN 2020 13:28:49



Middle channel 2435MHz



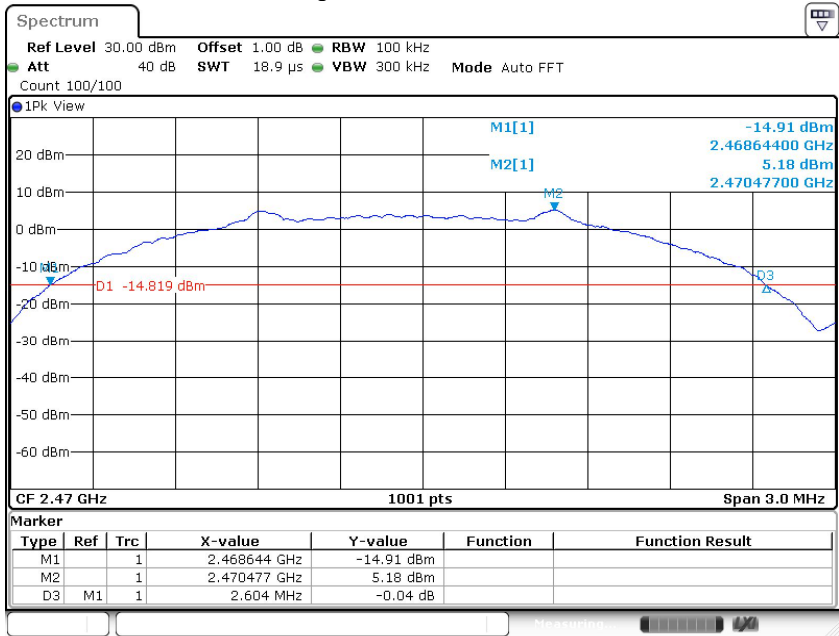
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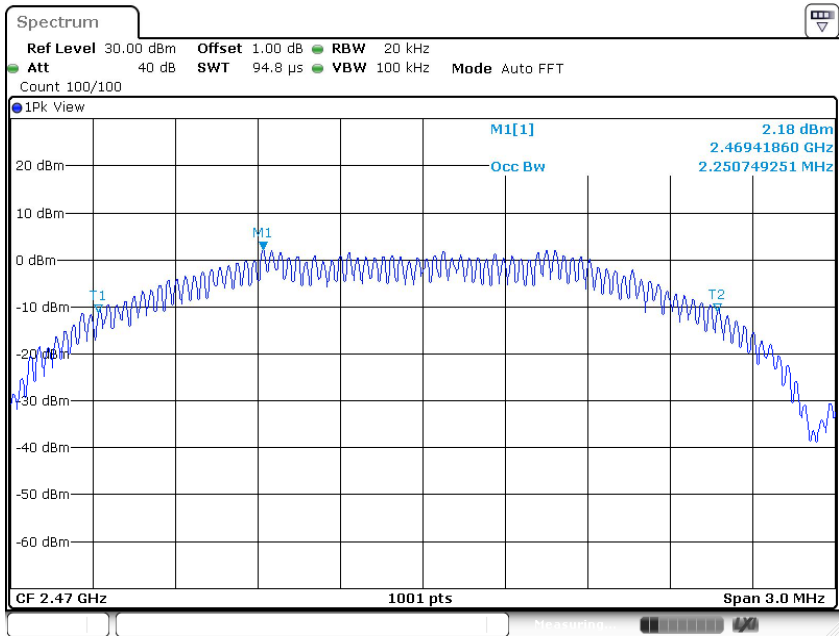
Date: 4.JUN.2020 13:31:03



High channel 2470MHz



Date: 4 JUN 2020 13:32:29



Date: 4 JUN 2020 13:32:40

9.4 Carrier Frequency Separation

Test Method

1. Use the following spectrum analyzer settings:
Span = wide enough to capture the peaks of two adjacent channels, RBW $\geq$ 1% of the span, VBW $\geq$ RBW, Sweep = auto, Detector function = peak
2. By using the Max-Hold function record the separation of two adjacent channels.
3. Measure the frequency difference of these two adjacent channels by spectrum analyzer marker function.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit kHz	
$\geq 25\text{KHz}$ or $2/3$ of the 20 dB bandwidth which is greater	
Test Mode	2/3 of 20 dB Bandwidth kHz
GFSK	1728

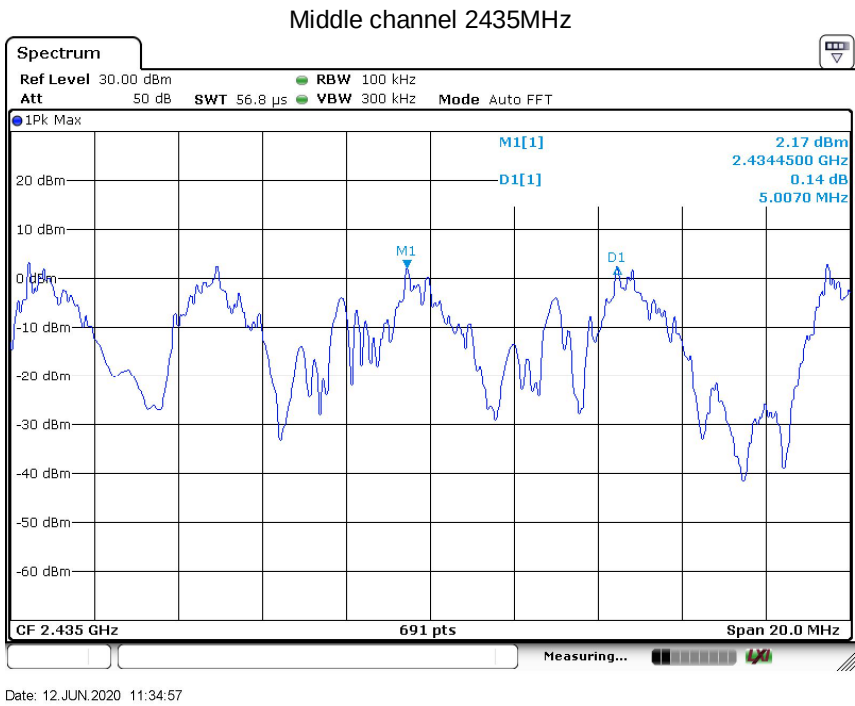


Carrier Frequency Separation

Test result: The measurement was performed with the typical configuration (normal hopping status), here GFSK modulation mode was used to show compliance.

GFSK Modulation test result

Test Mode	Carrier Frequency Separation	Result
GFSK	5007 kHz	Pass



9.5 Number of hopping frequencies

Test Method

1. Use the following spectrum analyzer settings:
Span = wide enough to capture the peaks of two adjacent channels, $RBW \geq 1\%$ of the span, $VBW \geq RBW$, Sweep = auto, Detector function = peak
2. Set the spectrum analyzer on Max-Hold Mode, and then keep the EUT in hopping mode.
3. Record all the signals from each channel until each one has been recorded.
4. Repeat above procedures until all frequencies measured were complete.

Limit

Limit
number

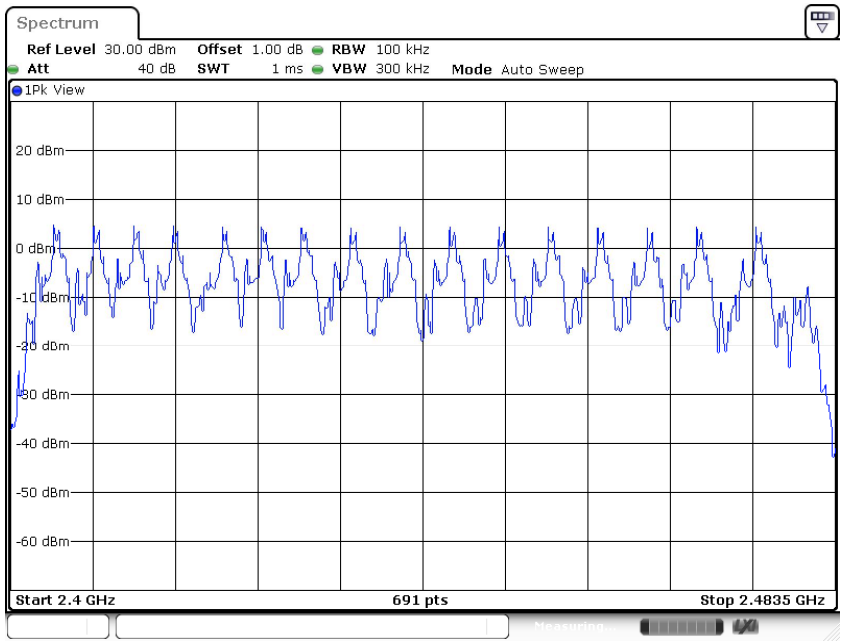
≥ 15



Number of hopping frequencies

Test result: The measurement was performed with the typical configuration (normal hopping status), and the total hopping channels is constant for the all modulation mode according with the Bluetooth Core Specification. Here GFSK modulation mode was used to show compliance.

Number of hopping frequencies	Result
16	Pass



Date: 12 JUN 2020 10:08:28

9.6 Dwell Time

Test Method

1. Connect EUT antenna terminal to the spectrum analyzer with a low loss cable.
Equipment mode: Spectrum analyzer
2. RBW: 1MHz; VBW: 1MHz; SPAN: Zero Span
3. Adjust the center frequency of spectrum analyzer on any frequency be measured.
4. Measure the Dwell Time by spectrum analyzer Marker function.
5. Repeat above procedures until all frequencies measured were complete.

Limit

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.



Dwell Time

Dwell time

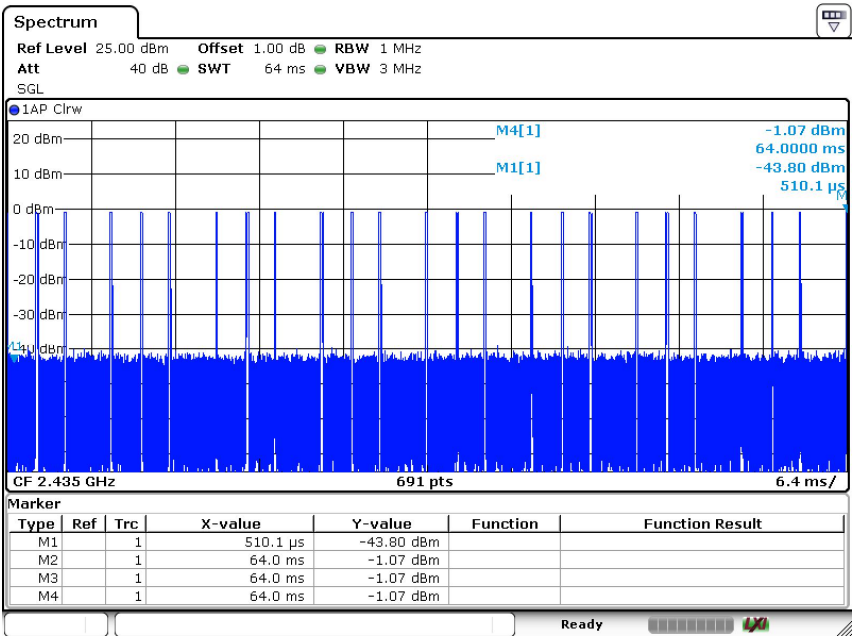
The maximum dwell time shall be 0.4 s.

The Dwell Time = Burst Width * Total Hops.

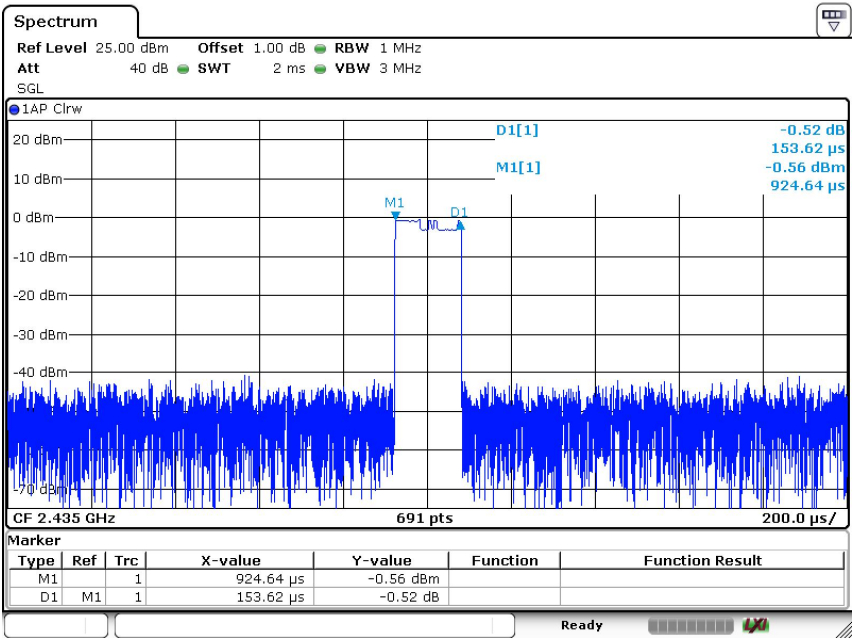
Test Result

Modulation	Mode	Reading Burst Width (us)	Total Hops	Test Result (ms)	Limit (ms)	Result
GFSK	TX	153.62	2300	353.326	< 400	Pass

GFSK Modulation



Date: 19.AUG.2021 15:37:25



Date: 19.AUG.2021 15:39:07

9.7 Spurious RF conducted emissions

Test Method

1. Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
3. The level displayed must comply with the limit specified in this Section. Submit these plots.
4. Repeat above procedures until all frequencies measured were complete.

Limit

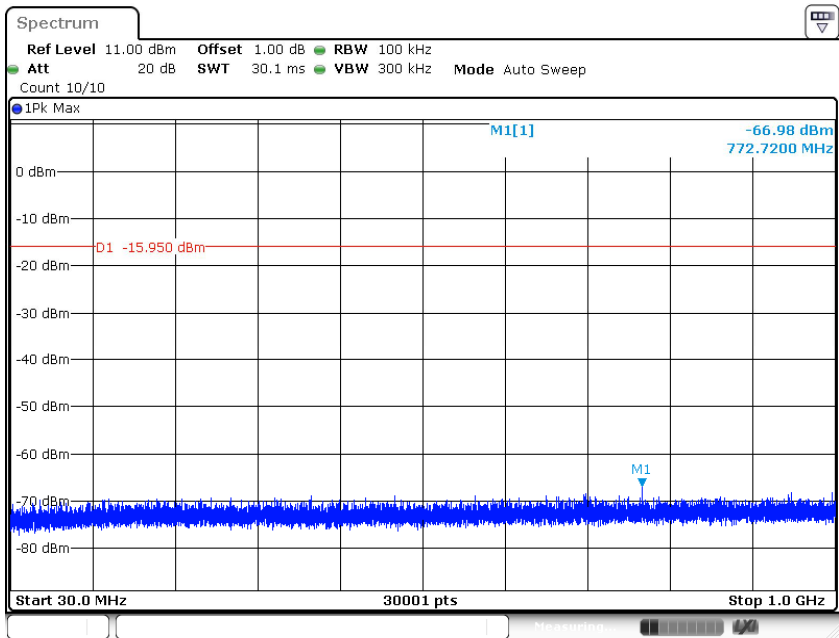
Frequency Range MHz	Limit (dBc)
30-25000	-20



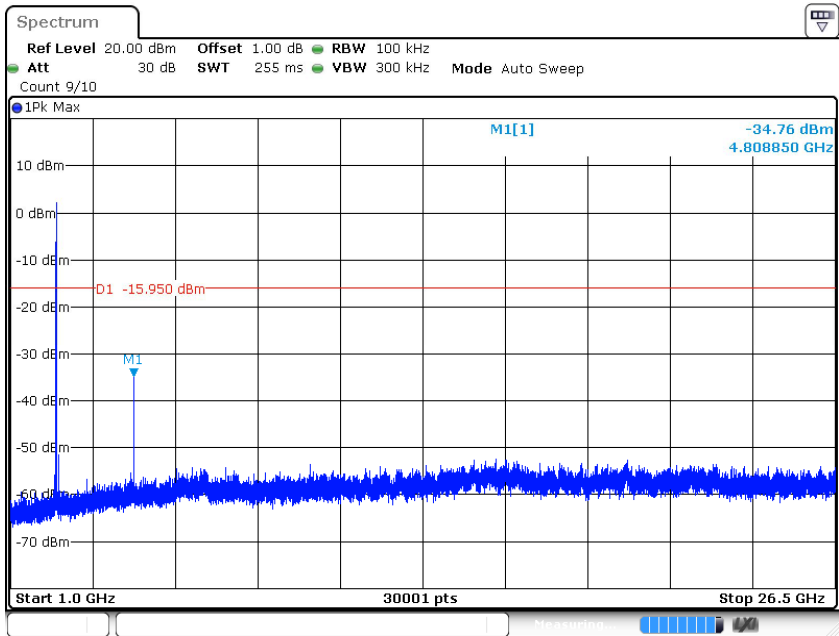
Spurious RF conducted emissions

Only the worse case (GFSK mode) test result is listed in the report.
GFSK Modulation:

Low channel 2405MHz

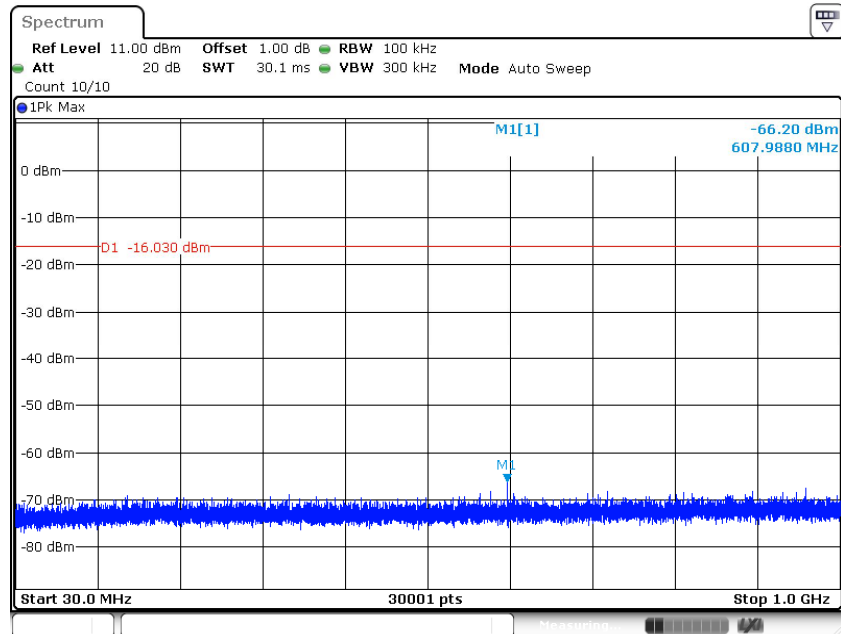


Date: 4.JUN.2020 13:29:10

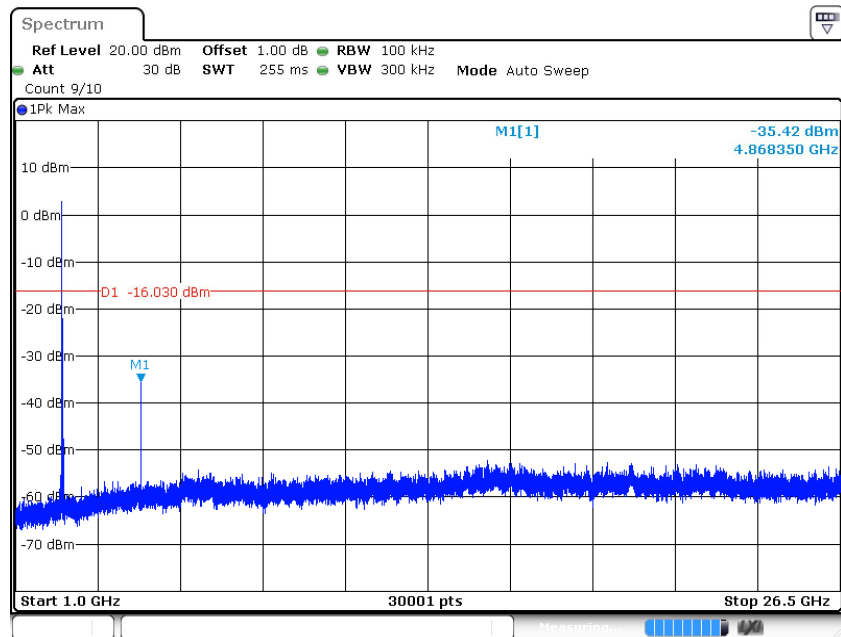


Date: 4.JUN.2020 13:29:18

Middle channel 2435MHz



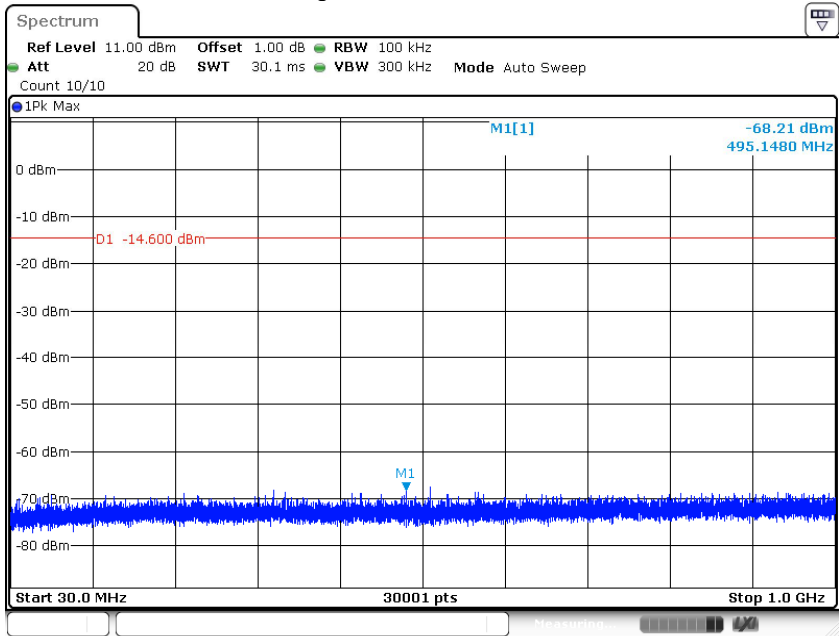
Date: 4.JUN.2020 13:31:15



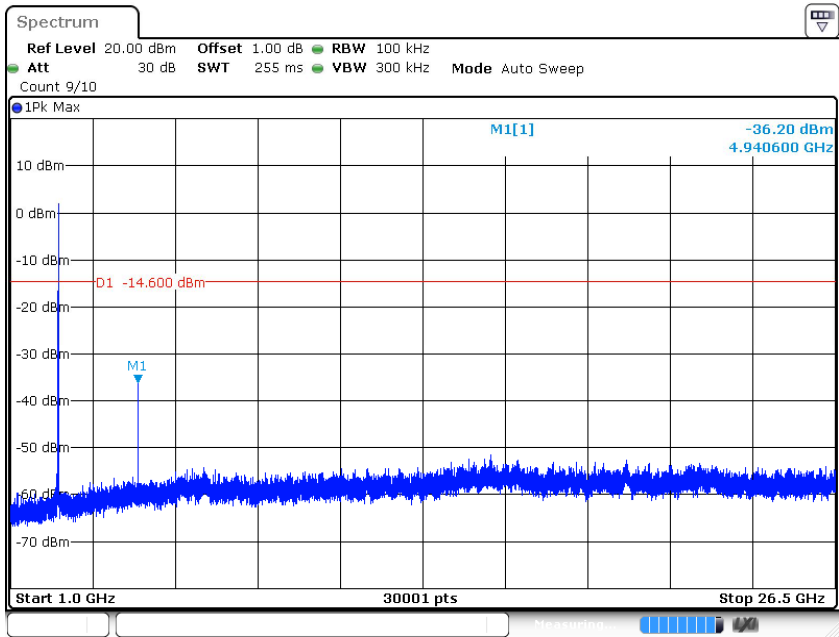
Date: 4.JUN.2020 13:31:23



High channel 2470MHz



Date: 4.JUN.2020 13:33:01



Date: 4.JUN.2020 13:33:09

9.8 Band edge testing

Test Method

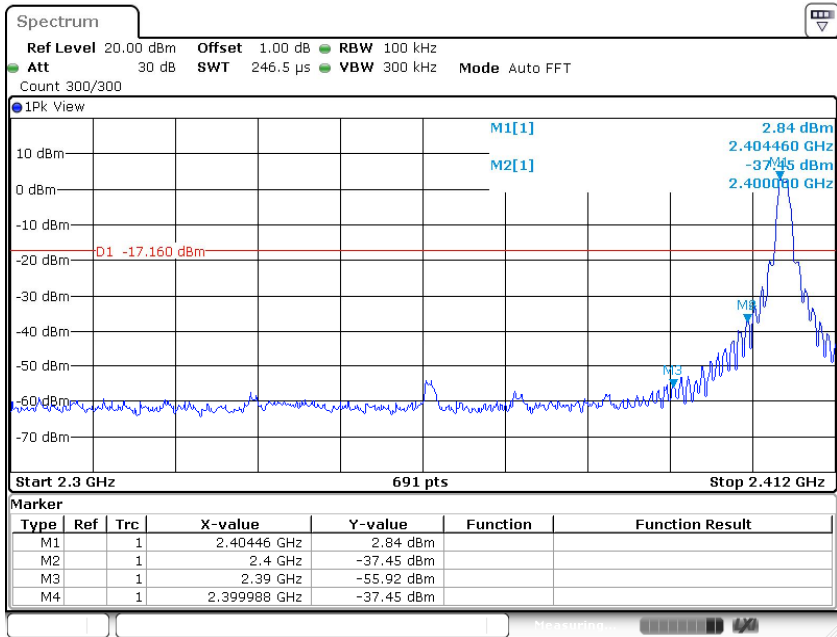
- 1 Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW $\geq$ RBW, Sweep = auto, Detector function = peak, Trace = max hold
- 2 Allow the trace to stabilize, use the peak and delta measurement to record the result.
- 3 The level displayed must comply with the limit specified in this Section. .
- 4 Repeat the test at the hopping off and hopping on mode, submit all the plots.

Limit:

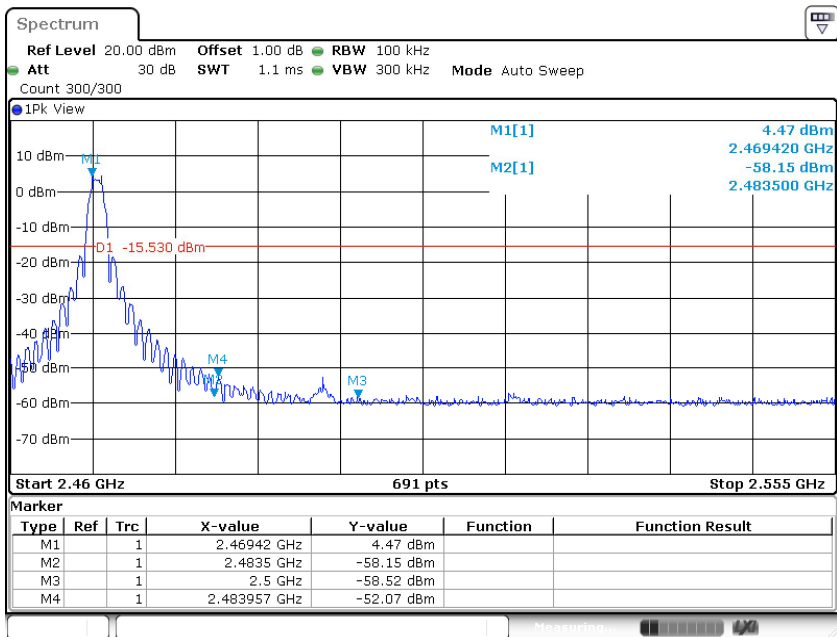
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.



GFSK mode: Hopping off



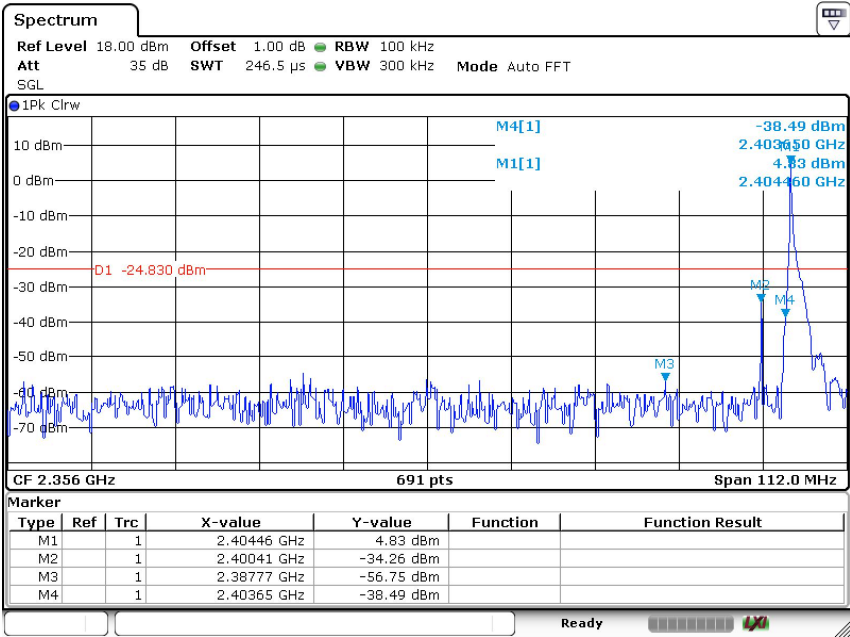
Date: 4 JUN.2020 13:28:58



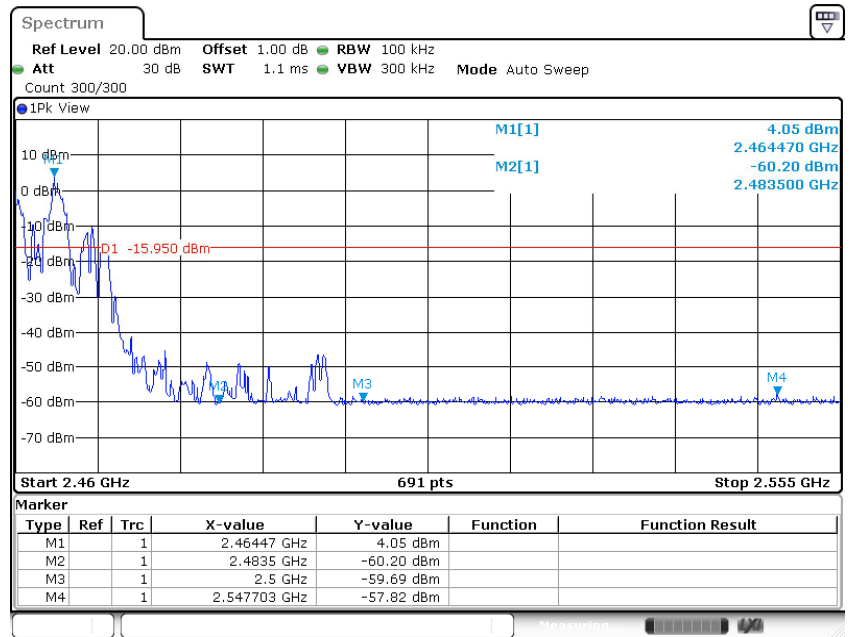
Date: 4 JUN.2020 13:32:49



GFSK mode: Hopping on



Date: 19.AUG.2021 15:32:59



Date: 12.JUN.2020 10:11:26

9.9 Spurious radiated emissions for transmitter

Test Method

- 1: The EUT was placed on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.
- 3: 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.
- 4: 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.
- 5: Use the following spectrum analyzer settings According to C63.10:

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 KHz to 120KHz, VBW $\geq$ RBW for peak measurement, Sweep = auto,
Detector function = peak, Trace = max hold.

For Peak unwanted emissions Above 1GHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW $\geq$ RBW for peak measurement, Sweep = auto,
Detector function = peak, Trace = max hold.

Procedures for average unwanted emissions measurements above 1000 MHz:

Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 1MHz, VBW=10Hz, Sweep = auto, Detector function = peak, Trace = max hold.

If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a “duty cycle correction factor”, derived from $20\log(\text{dwell time}/100 \text{ ms})$, in an effort to demonstrate compliance with the 15.209 limit.

If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation.

The setting method can refer to DA00-705.

Limit

The radio emission outside the operating frequency band 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. Radiated emissions which fall in the restricted bands, as defined in section 15.205, must comply with the radiated emission limits specified in section 15.209.

Frequency MHz	Field Strength uV/m	Field Strength dBµV/m	Detector
30-88	100	40	QP
88-216	150	43.5	QP
216-960	200	46	QP
960-1000	500	54	QP
Above 1000	500	54	AV
Above 1000	5000	74	PK

Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Transmitting spurious emission test result as below:

Low channel 2405MHz Test Result

Frequency Band	Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Correct factor (dB)	Result
30-1000MHz	945.63	39.80	H	46	QP	6.20	25.8	Pass
	442.81	38.28	V	40	QP	7.72	18.1	Pass
1000-25000MHz	7213.5	50.48	H	74	QP	23.52	6.1	Pass
	--	--	H	54	AV	--	--	Pass
	4810	49.50	H	74	PK	24.5	2.6	Pass
	--	--	V	54	AV	--	--	Pass

Middle channel 2435MHz Test Result

Frequency Band	Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Correct factor (dB)	Result
30-1000MHz	--	--	H	43.5	QP	--	--	Pass
	--	--	H	46	QP	--	--	Pass
1000-25000MHz	7306	48.73	H	74	QP	25.27	6.4	Pass
	--	--	H	54	AV	--	--	Pass
	4871	49.90	H	74	PK	24.10	2.3	Pass
	--	--	V	54	AV	--	--	Pass

High channel 2470MHz Test Result

Frequency Band	Frequency MHz	Emission Level dBuV/m	Polarization	Limit dBuV/m	Detector	Margin dBuV/m	Correct factor (dB)	Result
30-1000MHz	--	--	H	43.5	QP	--	--	Pass
	--	--	H	46	QP	--	--	Pass
1000-25000MHz	49.39.5	49.94	H	74	PK	24.06	16.8	Pass
	--	--	H	54	AV	--	--	Pass
	6512	50.96	V	74	PK	23.04	6.5	Pass
	--	--	V	54	AV	--	--	Pass

Remark:

(1) Level=Reading Level + Correction Factor

Above 1GHz: Corrector factor = Antenna Factor + Cable Loss- Amplifier Gain

Below 1GHz: Corrector factor = Antenna Factor + Cable Loss

(The Reading Level is recorded by software which is not shown in the sheet)

10 Test Equipment List

List of Test Instruments

Radiated Emission Test

Description	Manufacturer	Model no.	Equipment ID	Serial no.	cal interval (year)	cal. due date
EMI Test Receiver	Rohde & Schwarz	ESR 26	68-4-74-14-002	101269	1	2021-6-29
Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9162	68-4-80-19-003	284	1	2021-2-24
Wave Guide Antenna	ETS	3117	68-4-80-19-001	00218954	1	2021-6-15
Pre-amplifier	Rohde & Schwarz	SCU 18F	68-4-29-19-001	100745	1	2020-12-14
Pre-amplifier	Rohde & Schwarz	SCU 08F2	68-4-29-19-004	08400018	1	2020-12-14
Sideband Horn Antenna	Q-PAR	QWH-SL-18-40-K-SG	68-4-80-14-008	12827	1	2021-8-5
Pre-amplifier	Rohde & Schwarz	SCU 40A	68-4-29-14-002	100432	1	2021-7-30
3m Semi-anechoic chamber	TDK	9X6X6	68-4-90-19-006	----	3	2022-12-29
Test software	Rohde & Schwarz	EMC32	68-4-90-19-006-A01	Version10.35.0 2	N/A	N/A

Conducted Emission Test

Description	Manufacturer	Model no.	Equipment ID	Serial no.	cal interval (year)	cal. due date
EMI Test Receiver	Rohde & Schwarz	ESR 3	68-4-74-19-002	102590	1	2021-6-29
LISN	Rohde & Schwarz	ENV216	68-4-87-19-001	102472	1	2021-6-12
ISN	Rohde & Schwarz	ENY81	68-4-87-14-003	100177	1	2021-6-12
ISN	Rohde & Schwarz	ENY81-CA6	68-4-87-14-004	101664	1	2021-6-12
High Voltage Probe	Schwarzbeck	TK9420(VT9420)	68-4-27-14-001	9420-584	1	2021-6-23
RF Current Probe	Rohde & Schwarz	EZ-17	68-4-27-14-002	100816	1	2021-6-28
Attenuator	Shanghai Huaxiang	TS2-26-3	68-4-81-16-003	080928189	1	2021-6-21
Test software	Rohde & Schwarz	EMC32	68-4-90-19-005-A01	Version10.35.0 2	N/A	N/A
Shielding Room	TDK	CSR #2	68-4-90-19-005	----	1	2022-11-07

RF Conducted Test

Description	Manufacturer	Model no.	Equipment ID	Serial no.	cal interval (year)	cal. due date
Signal Analyzer	Rohde & Schwarz	FSV40	68-4-74-14-004	101030	1	2021-6-21

11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

System Measurement Uncertainty	
Test Items	Extended Uncertainty
Uncertainty for Conducted Emission in shielding room 150kHz-30MHz	3.21dB
Radiated Spurious Emission 25MHz-3000MHz	Horizontal: 4.35dB; Vertical: 4.44dB
Radiated Spurious Emission 3000MHz-18000MHz	Horizontal: 4.30dB; Vertical: 4.29dB
Radiated Spurious Emission 18000MHz-40000MHz	Horizontal: 4.51dB; Vertical: 4.50dB
Conducted RF test with TS 8997	RF Power Conducted: 1.31dB Frequency test involved: 0.6×10^{-7} or 1%