

TEST REPORT



Applicant	Hangzhou Tuya Information Technology Co., Ltd.
Address	Room701, Building3, More Center, No.87 GuDun Road, Hangzhou, Zhejiang, China

Manufacturer or Supplier	Hangzhou Tuya Information Technology Co., Ltd.
Address	Room701, Building3, More Center, No.87 GuDun Road, Hangzhou, Zhejiang, China
Product	Tuya Zigbee Smart Hub Plus
Brand Name	N/A
Model	THP12-Z
Additional Model & Model Difference	N/A
Date of tests	Jul. 16, 2020 ~ Oct. 21, 2020

the tests have been carried out according to the requirements of the following standard:

☒ **FCC Part 15, Subpart C, Section 15.247**

CONCLUSION: The submitted sample was found to COMPLY with the test requirement

Tested by Lucas Chen Project Engineer / EMC Department	Approved by Glyn He Assistant Manager / EMC Department
	 Date: Dec. 30, 2020

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TABLE OF CONTENTS

RELEASE CONTROL RECORD	4
1 SUMMARY OF TEST RESULTS.....	5
2 MEASUREMENT UNCERTAINTY	5
3 GENERAL INFORMATION	6
3.1 GENERAL DESCRIPTION OF EUT	6
3.2 DESCRIPTION OF TEST MODES	7
3.2.1. CONFIGURATION OF SYSTEM UNDER TEST	7
3.2.2. TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL.....	7
3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS	10
3.4 DESCRIPTION OF SUPPORT UNITS	10
4 TEST TYPES AND RESULTS.....	11
4.1 CONDUCTED EMISSION MEASUREMENT	11
4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT	11
4.1.2 TEST INSTRUMENTS.....	11
4.1.3 TEST PROCEDURES	12
4.1.4 DEVIATION FROM TEST STANDARD	12
4.1.5 TEST SETUP	13
4.1.6 EUT OPERATING CONDITIONS	13
4.1.7 TEST RESULTS	14
4.2 RADIATED EMISSION MEASUREMENT	16
4.2.1 LIMITS OF RADIATED EMISSION MEASUREMENT	16
4.2.2 TEST INSTRUMENTS.....	17
4.2.3 TEST PROCEDURES	18
4.2.4 DEVIATION FROM TEST STANDARD	19
4.2.5 TEST SETUP	19
4.2.6 EUT OPERATING CONDITIONS	20
4.2.7 TEST RESULTS	21
4.3 6DB BANDWIDTH MEASUREMENT	26
4.3.1 LIMITS OF 6DB BANDWIDTH MEASUREMENT	26
4.3.2 TEST INSTRUMENTS.....	26
4.3.3 TEST PROCEDURE.....	27
4.3.4 DEVIATION FROM TEST STANDARD	27
4.3.5 TEST SETUP	27

4.3.6	EUT OPERATING CONDITIONS	27
4.3.7	TEST RESULTS	28
4.4	CONDUCTED OUTPUT POWER.....	30
4.4.1	LIMITS OF CONDUCTED OUTPUT POWER MEASUREMENT	30
4.4.2	TEST SETUP	30
4.4.3	TEST INSTRUMENTS.....	30
4.4.4	TEST PROCEDURES	30
4.4.5	DEVIATION FROM TEST STANDARD	30
4.4.6	EUT OPERATING CONDITIONS	30
4.4.7	TEST RESULTS	31
4.4.7.1	MAXIMUM PEAK OUTPUT POWER	31
4.4.7.2	AVERAGE OUTPUT POWER (FOR REFERENCE)	31
4.5	POWER SPECTRAL DENSITY MEASUREMENT	32
4.5.1	LIMITS OF POWER SPECTRAL DENSITY MEASUREMENT	32
4.5.2	TEST SETUP	32
4.5.3	TEST INSTRUMENTS.....	32
4.5.4	TEST PROCEDURE.....	32
4.5.5	DEVIATION FROM TEST STANDARD	32
4.5.6	EUT OPERATING CONDITION	32
4.5.7	TEST RESULTS	33
4.6	OUT OF BAND EMISSION MEASUREMENT	35
4.6.1	LIMITS OF OUT OF BAND EMISSION MEASUREMENT	35
4.6.2	TEST SETUP	35
4.6.3	TEST INSTRUMENTS.....	35
4.6.4	TEST PROCEDURE.....	35
4.6.5	DEVIATION FROM TEST STANDARD	36
4.6.6	EUT OPERATING CONDITION	36
4.6.7	TEST RESULTS	37
5	PHOTOGRAPHS OF THE TEST CONFIGURATION	39
6	APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB	40



Test Report No.: RF200716N016-2

RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF200716N016-2	Original release	Dec. 30, 2020

1 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC PART 15, SUBPART C (SECTION 15.247)			
STANDARD SECTION	TEST TYPE AND LIMIT	RESULT	REMARK
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit.
15.205 15.209	Radiated Emission	PASS	Meet the requirement of limit.
15.247(d)	Out of band Emission Measurement	PASS	Meet the requirement of limit.
15.247(a)(2)	6dB bandwidth	PASS	Meet the requirement of limit.
15.247(b)	Conducted Output power	PASS	Meet the requirement of limit.
15.247(e)	Power Spectral Density	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	Antenna connector is i-pex not a standard connector.

2 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
Conducted emissions	0.15MHz ~ 30MHz	2.70dB
Radiated emissions	9KHz ~ 30MHz	2.16dB
	30MHz ~ 1GMHz	3.60dB
	1GHz ~ 18GHz	4.82dB
	18GHz ~ 40GHz	5.00dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k = 2$.

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

PRODUCT	Tuya Zigbee Smart Hub Plus
MODEL NO.	THP12-Z
ADDITIONAL MODEL	N/A
FCC ID	2ANDL-THP12-Z
NOMINAL VOLTAGE	DC 5V from Adapter
MODULATION TECHNOLOGY	DSSS(IEEE 802.15.4)
MODULATION TYPE	OQPSK
OPERATING FREQUENCY	2405-2480MHz
PEAK OUTPUT POWER	15.241mW (Max. Measured)
ANTENNA TYPE	FPCB Antenna, 3dBi Gain
I/O PORTS	Refer to user's manual
CABLE SUPPLIED	Refer to user's manual

NOTE:

- For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.
- For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.
- Please refer to the EUT photo document (Reference No.: 200716N016) for detailed product photo.
- The EUT was powered by the following adapter:

Adapter1	
BRAND:	N/A
MODEL:	KA06E-0501000US
INPUT:	AC 100-240V, 50/60Hz 0.25A MAX
OUTPUT:	DC 5V 1A 5W
USB LINE:	Unshielded, Detachable 50cm

- The EUT provides completed transmitter and receiver.

MODULATION MODE	TX FUNCTION
DSSS(IEEE 802.15.4)	1TX/1RX

3.2 DESCRIPTION OF TEST MODES

16 channels are provided:

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
11	2405 MHz	19	2445 MHz
12	2410 MHz	20	2450 MHz
13	2415 MHz	21	2455 MHz
14	2420 MHz	22	2460 MHz
15	2425 MHz	23	2465 MHz
16	2430 MHz	24	2470 MHz
17	2435 MHz	25	2475 MHz
18	2440 MHz	26	2480 MHz

3.2.1. CONFIGURATION OF SYSTEM UNDER TEST

Please see section 5 photographs of the test configuration for reference.

3.2.2. TEST MODE APPLICABILITY AND TESTED CHANNEL DETAIL

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis, power supply voltage range and antenna ports. The worst case was found when positioned on X axis for radiated emission. Following test modes were selected for the final test, and the final worst case is marked in boldface and recorded in the report:

EUT CONFIGURE MODE	APPLICABLE TO				DESCRIPTION
	RE<1G	RE≥1G	PLC	APCM	
A	√	√	√	√	DC 5V from Adapter

Where **RE<1G**: Radiated Emission below 1GHz
PLC: Power Line Conducted Emission

RE≥1G: Radiated Emission above 1GHz
APCM: Antenna Port Conducted Measurement

POWER LINE CONDUCTED EMISSION TEST:

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

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
11 to 26	26	DSSS	OQPSK	250kbps

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, XYZ axis and antenna ports (if EUT with antenna diversity architecture).
- ☒ Following channels were selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
ZIGBEE	11 to 26	26	DSSS	OQPSK	250kbps

For the test results, only the worst case was shown in test report.

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, XYZ axis and antenna ports (if EUT with antenna diversity architecture).

- ☒ Following channels were selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
ZIGBEE	11 to 26	11,19, 26	DSSS	OQPSK	250kbps



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 channels were selected for the final test as listed below.

MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
ZIGBEE	11 to 26	11,19, 26	DSSS	OQPSK	250kbps

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	TEST VOLTAGE	TESTED BY
RE<1G	25deg. C, 55%RH	AC 120V 60Hz	Vincent
RE≥1G	25deg. C, 55%RH	AC 120V 60Hz	Vincent
PLC	25deg. C, 49%RH	AC 120V 60Hz	Ming Bai
APCM	25deg. C, 60%RH	AC 120V 60Hz	Daniel

3.3 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C, Section 15.247

558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10-2013

Note: All test items have been performed and recorded as per the above standards.

3.4 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	Wireless Router	TP-LINK	TL-WDR3310	1.24E+09	N/A

NO.	SIGNAL CABLE DESCRIPTION OF THE ABOVE SUPPORT UNITS
1	DC Line: Unshielded, Detachable 1.2m; Network Line: Unshielded, Detachable 4/10m

4 TEST TYPES AND RESULTS

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBμV)	
	Quasi-peak	Average
0.15 ~ 0.5	66 to 56	56 to 46
0.5 ~ 5	56	46
5 ~ 30	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 0.15 to 0.50MHz.

3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.1.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESR7	101494	Mar. 11,21
Artificial Mains Network	Rohde&Schwarz	ENV216	101173	Mar. 11,21
Artificial Mains Network	Rohde&Schwarz	ESH3-Z5	100317	Mar. 11,21
Voltage probe	SCHWARZBECK	TK 9421	TK 9421-176	Sep. 23,21
Test software	ADT	ADT_Conc_V7.3.7	N/A	N/A

NOTES:

1. The test was performed in shielded room 553.

2. The calibration interval of the above test instruments is 12 months. And the calibrations are traceable to CEPREI/CHINA, GRGT/CHINA and NIM/CHINA.

4.1.3 TEST PROCEDURES

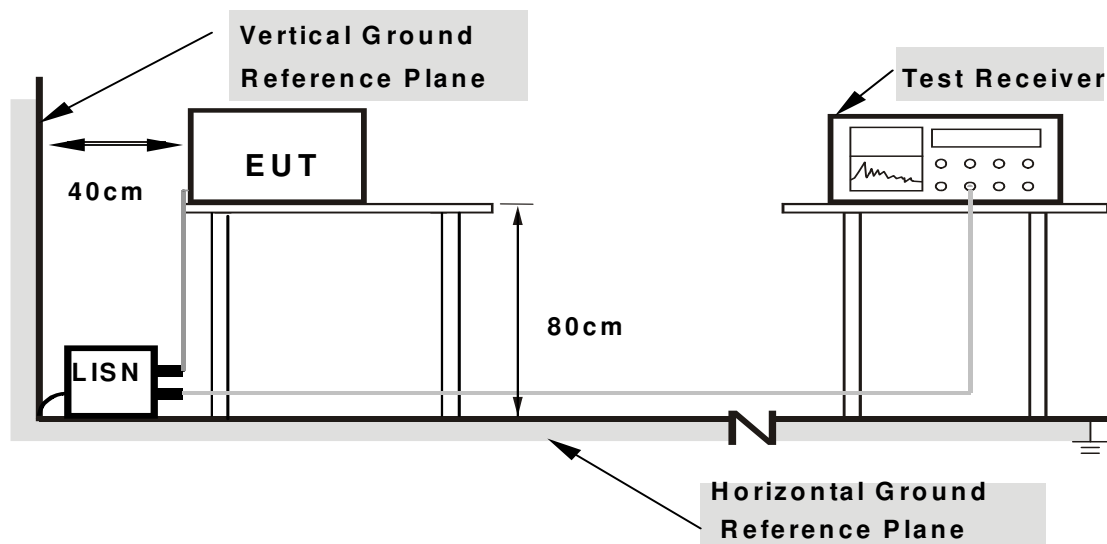
- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling 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: All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 DEVIATION FROM TEST STANDARD

No deviation.

4.1.5 TEST SETUP



- Note:**
1. Support units were connected to second LISN.
 2. Both of LISNs (AMN) are 80 cm from EUT and at least 80 cm from other units and other metal planes

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

4.1.6 EUT OPERATING CONDITIONS

- a. Turned on the power and connected of all equipment.
- b. EUT was operated according to the type used was description in manufacturer's specifications or the User's Manual.

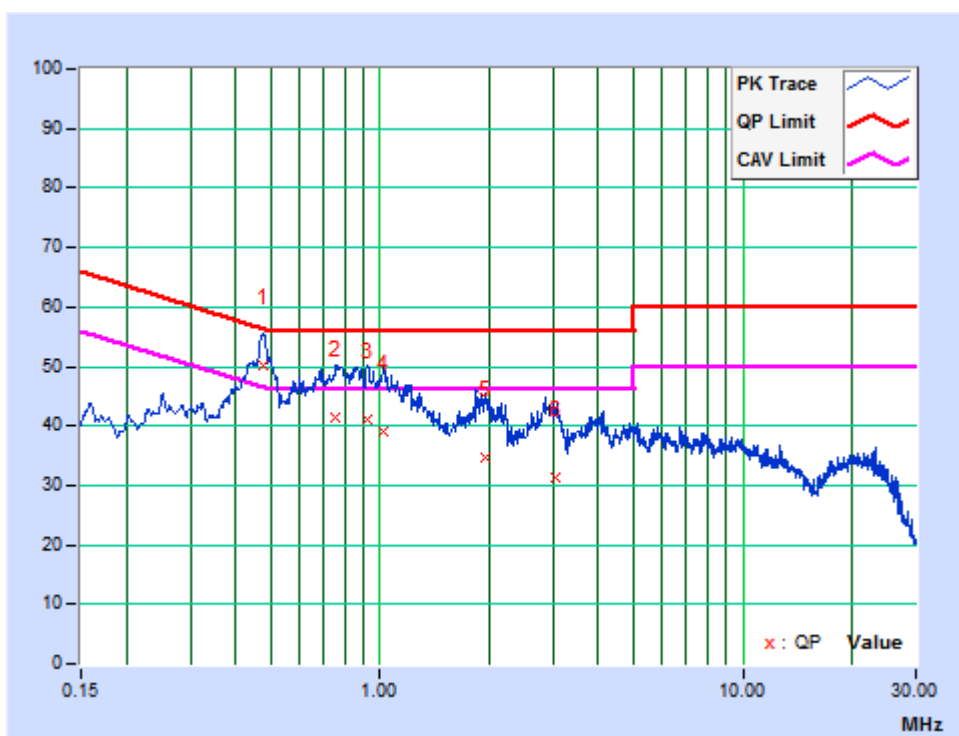
4.1.7 TEST RESULTS

CONDUCTED WORST-CASE DATA:

PHASE	Line	6dB BANDWIDTH	9kHz
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No.	Freq. [MHz]	Corr. Factor (dB)	Reading Value		Emission Level		Limit		Margin	
			[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.47635	10.22	39.91	28.31	50.13	38.53	56.40	46.40	-6.27	-7.87
2	0.75525	10.24	31.14	20.85	41.38	31.09	56.00	46.00	-14.62	-14.91
3	0.91928	10.24	30.88	18.51	41.12	28.75	56.00	46.00	-14.88	-17.25
4	1.02075	10.24	28.93	17.98	39.17	28.22	56.00	46.00	-16.83	-17.78
5	1.96130	10.22	24.59	13.56	34.81	23.78	56.00	46.00	-21.19	-22.22
6	3.02775	10.22	21.03	11.64	31.25	21.86	56.00	46.00	-24.75	-24.14

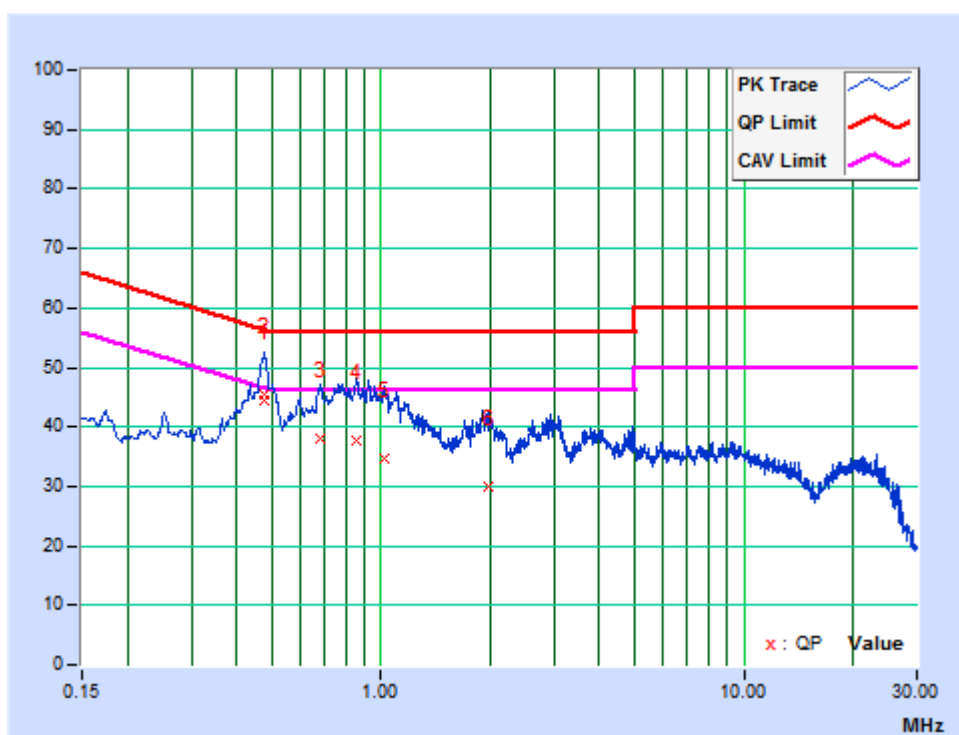
REMARKS: The emission levels of other frequencies were very low against the limit.



PHASE	Neutral	6dB BANDWIDTH	9kHz
-------	---------	---------------	------

No.	Freq. [MHz]	Corr. Factor (dB)	Reading Value		Emission Level		Limit		Margin	
			[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.47635	10.02	34.50	23.91	44.52	33.93	56.40	46.40	-11.88	-12.47
2	0.47635	10.02	35.32	23.85	45.34	33.87	56.40	46.40	-11.06	-12.53
3	0.68214	10.03	27.87	16.17	37.90	26.20	56.00	46.00	-18.10	-19.80
4	0.85829	10.03	27.76	16.92	37.79	26.95	56.00	46.00	-18.21	-19.05
5	1.02438	10.03	24.77	14.63	34.80	24.66	56.00	46.00	-21.20	-21.34
6	1.96649	10.01	19.84	9.50	29.85	19.51	56.00	46.00	-26.15	-26.49

REMARKS: The emission levels of other frequencies were very low against the limit.





4.2 RADIATED EMISSION MEASUREMENT

4.2.1 LIMITS OF RADIATED EMISSION MEASUREMENT

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a).

FREQUENCIES (MHz)	FIELD STRENGTH (microvolts/meter)	MEASUREMENT 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

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20dB under any condition of modulation.

4.2.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESU40	100449	Mar. 17,21
Signal and Spectrum Analyzer	Rohde&Schwarz	FSV7	102331	May 13, 21
Active Loop Antenna (9KHz -30MHz)	SCHWARZBECK	FMZB 1519B	1519B-045	May 27,21
Amplifier (9KHz -1GHz)	Burgeon	BPA-530	100210	Mar. 14,21
Bilog Antenna (20MHz -2GHz)	Teseq	CBL 6111D	30643	May 29,21
Horn Antenna (1GHz -18GHz)	ETS -Lindgren	3117	00062558	May 29,21
Horn Antenna (18GHz -40GHz)	SCHWARZBECK	BBHA 9170	BBHA9170147	May 09, 21
3m Semi-anechoic Chamber	ETS-LINDGREN	9m*6m*6m	NSEMC003	May 22,21
Test Software	ADT	ADT_Radiated_V 7.6.15.9.2	N/A	N/A
Broadband Preamplifier (1GHz~18GHz)	SCHWARZBECK	BBV9718	305	May 08,21
Pre-Amplifier (18GHz-40GHz)	EMCI	EMC 184045	980102	Mar. 03,21
Test Software	ADT	ADT_Radiated_V 7.6.15.9.2	N/A	N/A
BLUETOOTH TESTER	Rohde&Schwarz	CBT32	100811	May 19,21

NOTES:

1. The test was performed in 966 Chamber.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GREGT/CHINA and NIM/CHINA.
3. The horn antenna is used only for the measurement of emission frequency above 1GHz if tested.
4. The FCC Site Registration No. is 749762.

4.2.3 TEST PROCEDURES

- a. The EUT was placed on the top of a rotating table 1.5 meters (above 1GHz) and 0.8 meters (below 1GHz) above the ground at a 3 meters semi-anechoic chamber. 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 antenna is a broadband antenna, and its height 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 Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- f. For below 30MHz, a loop antenna with its vertical plane is place 3m from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. And the centre of the loop shall be 1m above the ground.
- g. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, For battery operated equipment, the equipment tests shall be perform using fresh batteries. The turntable was rotated to maximize the emission level.

NOTE:

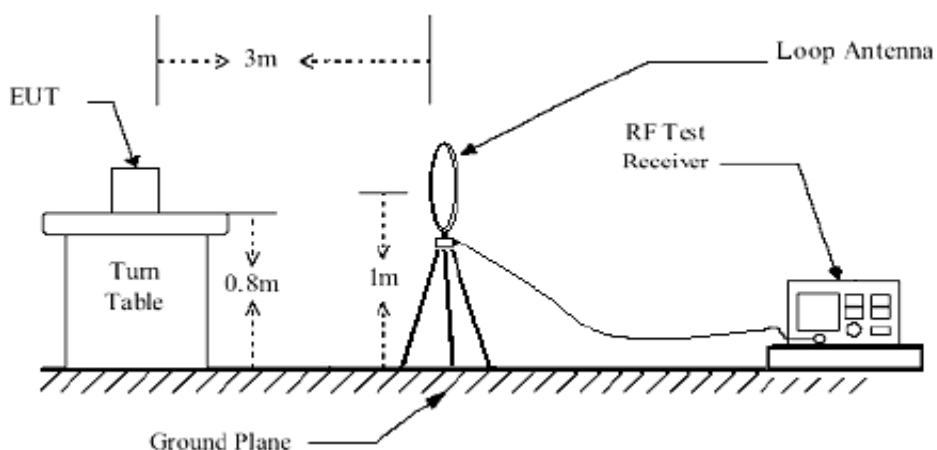
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz(Duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported.
5. The testing of the EUT was performed on all 3 orthogonal axes; the worst-case test configuration was reported on the file test setup photo.

4.2.4 DEVIATION FROM TEST STANDARD

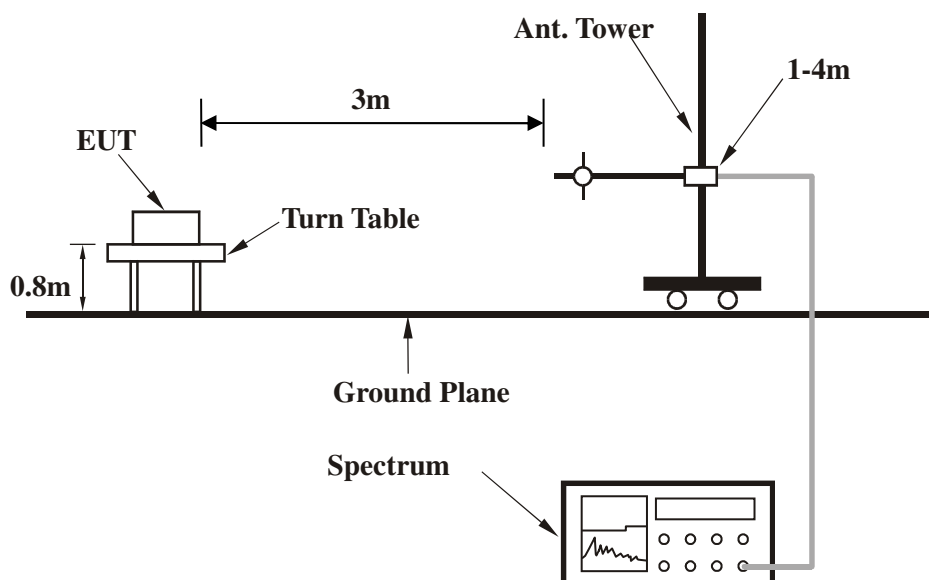
No deviation.

4.2.5 TEST SETUP

Below 30MHz test setup

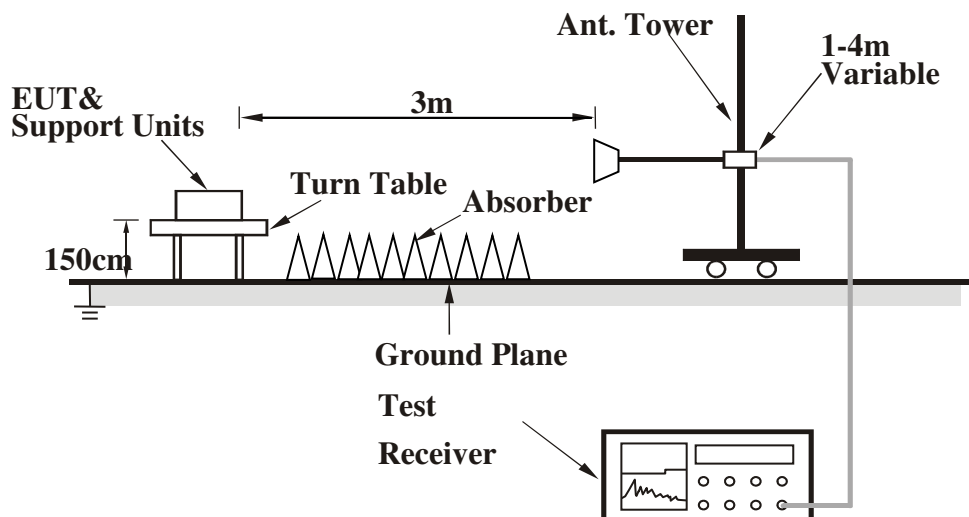


Below 1GHz test setup



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

Above 1GHz test setup



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

4.2.6 EUT OPERATING CONDITIONS

- Set the EUT under full load condition and placed them on a testing table.
- Set the transmitter part of EUT under transmission condition continuously at specific channel frequency.
- The necessary accessories enable the EUT in full functions.

4.2.7 TEST RESULTS

BELOW 1GHz WORST-CASE DATA:

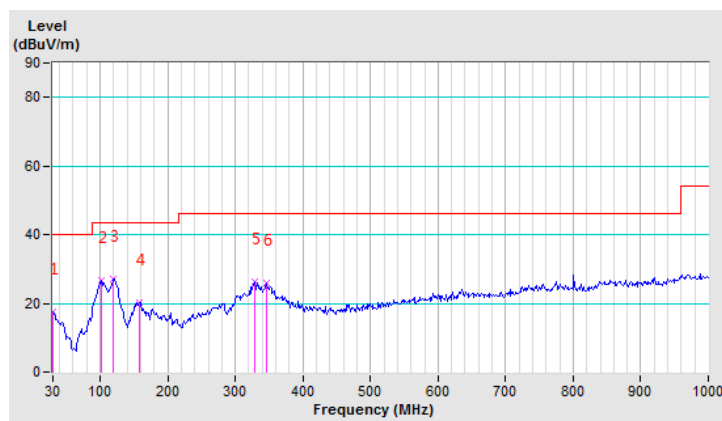
ZIGBEE (OQPSK)

CHANNEL	TX Channel 26	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	30.00	17.48 QP	40.00	-22.52	1.00 H	215	29.62	-12.14
2	101.51	26.55 QP	43.50	-16.95	1.00 H	157	46.84	-20.29
3	120.16	27.03 QP	43.50	-16.47	1.00 H	36	46.84	-19.81
4	157.47	20.11 QP	43.50	-23.39	1.00 H	206	37.31	-17.20
5	328.46	26.43 QP	46.00	-19.57	1.00 H	87	39.91	-13.48
6	345.56	25.93 QP	46.00	-20.07	1.00 H	45	38.91	-12.98

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.
5. Margin value = Emission level – Limit value

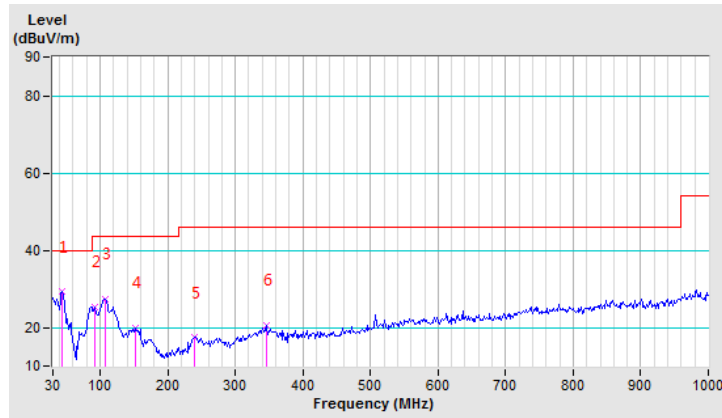


CHANNEL	TX Channel 26	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9KHz ~ 1GHz		

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	43.99	29.21 QP	40.00	-10.79	1.00 V	69	47.22	-18.01
2	92.18	25.41 QP	43.50	-18.09	1.00 V	45	46.15	-20.74
3	107.72	27.39 QP	43.50	-16.11	1.00 V	128	47.51	-20.12
4	151.25	19.83 QP	43.50	-23.67	1.00 V	324	37.48	-17.65
5	239.86	17.36 QP	46.00	-28.64	1.00 V	88	34.85	-17.49
6	345.56	20.66 QP	46.00	-25.34	1.00 V	241	33.64	-12.98

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were greater than 20dB margin.
4. 9KHz~30MHz have been test and test data more than 20dB margin.
5. Margin value = Emission level – Limit value



ABOVE 1GHz TEST DATA:

ZIGBEE (OQPSK)

CHANNEL	TX Channel 11	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	50.11 PK	74.00	-23.89	1.00 H	245	46.58	3.53
2	2390.00	40.20 AV	54.00	-13.80	1.00 H	245	36.67	3.53
3	*2405.00	101.56 PK			1.00 H	245	97.94	3.62
4	*2405.00	97.83 AV			1.00 H	245	94.21	3.62
5	4810.00	51.20 PK	74.00	-22.80	1.00 H	249	43.20	8.00
6	4810.00	39.34 AV	54.00	-14.66	1.00 H	249	31.34	8.00
7	#7215.00	55.67 PK	74.00	-18.33	1.00 H	291	42.17	13.50
8	#7215.00	42.50 AV	54.00	-11.50	1.00 H	291	29.00	13.50
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2390.00	50.30 PK	74.00	-23.70	1.00 V	330	46.77	3.53
2	2390.00	35.50 AV	54.00	-18.50	1.00 V	330	31.97	3.53
3	*2405.00	98.23 PK			1.00 V	330	94.61	3.62
4	*2405.00	97.20 AV			1.00 V	330	93.58	3.62
5	4810.00	50.63 PK	74.00	-23.37	1.00 V	230	42.63	8.00
6	4810.00	38.30 AV	54.00	-15.70	1.00 V	230	30.30	8.00
7	#7215.00	56.24 PK	74.00	-17.76	1.00 V	274	42.74	13.50
8	#7215.00	43.10 AV	54.00	-10.90	1.00 V	274	29.60	13.50

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.
6. " # ": The radiated frequency is out of the restricted band.

CHANNEL	TX Channel 19	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2440.00	100.88 PK			1.00 H	194	97.10	3.78
2	*2440.00	97.24 AV			1.00 H	194	93.46	3.78
3	4880.00	52.34 PK	74.00	-21.66	1.00 H	210	44.09	8.25
4	4880.00	40.20 AV	54.00	-13.80	1.00 H	210	31.95	8.25
5	7320.00	56.63 PK	74.00	-17.37	1.00 H	98	42.80	13.83
6	7320.00	42.40 AV	54.00	-11.60	1.00 H	98	28.57	13.83
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2440.00	98.24 PK			1.00 V	105	94.46	3.78
2	*2440.00	96.06 AV			1.00 V	105	92.28	3.78
3	4880.00	50.37 PK	74.00	-23.63	1.00 V	265	42.12	8.25
4	4880.00	39.00 AV	54.00	-15.00	1.00 V	265	30.75	8.25
5	7320.00	57.14 PK	74.00	-16.86	1.00 V	194	43.31	13.83
6	7320.00	44.20 AV	54.00	-9.80	1.00 V	194	30.37	13.83

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 26	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	98.67 PK			1.00 H	146	94.69	3.98
2	*2480.00	95.70 AV			1.00 H	146	91.72	3.98
3	2483.50	56.34 PK	74.00	-17.66	1.00 H	146	52.34	4.00
4	2483.50	53.23 AV	54.00	-0.77	1.00 H	146	49.23	4.00
5	4960.00	51.26 PK	74.00	-22.74	1.00 H	268	42.73	8.53
6	4960.00	39.20 AV	54.00	-14.80	1.00 H	268	30.67	8.53
7	7440.00	55.67 PK	74.00	-18.33	1.00 H	26	41.46	14.21
8	7440.00	42.50 AV	54.00	-11.50	1.00 H	26	28.29	14.21
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	95.69 PK			1.00 V	261	91.71	3.98
2	*2480.00	93.60 AV			1.00 V	261	89.62	3.98
3	2483.50	55.14 PK	74.00	-18.86	1.00 V	261	51.14	4.00
4	2483.50	51.30 AV	54.00	-2.70	1.00 V	261	47.30	4.00
5	4960.00	50.28 PK	74.00	-23.72	1.00 V	248	41.75	8.53
6	4960.00	39.60 AV	54.00	-14.40	1.00 V	248	31.07	8.53
7	7440.00	56.28 PK	74.00	-17.72	1.00 V	185	42.07	14.21
8	7440.00	43.50 AV	54.00	-10.50	1.00 V	185	29.29	14.21

REMARKS:

1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB/m).
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB).
3. The emission levels of other frequencies were greater than 20dB margin.
4. Margin value = Emission level – Limit value.
5. " * ": Fundamental frequency.

4.3 6dB BANDWIDTH MEASUREMENT

4.3.1 LIMITS OF 6dB BANDWIDTH MEASUREMENT

The minimum of 6dB Bandwidth Measurement is 0.5 MHz.

4.3.2 TEST INSTRUMENTS

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
Power Sensor	Keysight	U2021XA	MY55060016	May 21,21
Power Sensor	Keysight	U2021XA	MY55060018	May 21,21
Power Meter	Anritsu	ML2495A	1139001	Mar. 11,21
Power Sensor	Anritsu	MA2411B	1531155	Mar. 11,21
Digital Multimeter	FLUKE	15B	A1220010DG	Oct.16, 21
Humid & Temp Programmable Tester	Haida	HD-2257	110807201	Nov. 14,20
Oscilloscope	Agilent	DSO9254A	MY51260160	Sep. 17,21
Signal and Spectrum Analyzer	Rohde&Schwarz	FSV40	101094	Mar. 12,21
Signal Generator	Agilent	N5183A	MY50140980	Sep. 18,21
MXG-B RF Vector Signal Generator	Keysight	N5182B	MY56200288	Sep. 11,21
BLUETOOTH TESTER	Rohde&Schwarz	CBT32	100811	May 19,21
Attenuator	MINI	BW-S10W2+	S130129FGE2	N/A
DC Source	Keysight	E3642A	MY56146098	N/A

NOTES:

1. The test was performed in RF Oven room.
2. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA, GREGT/CHINA and NIM/CHINA.

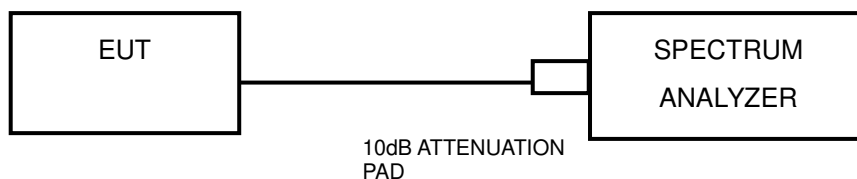
4.3.3 TEST PROCEDURE

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. 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.

4.3.4 DEVIATION FROM TEST STANDARD

No deviation.

4.3.5 TEST SETUP



4.3.6 EUT OPERATING CONDITIONS

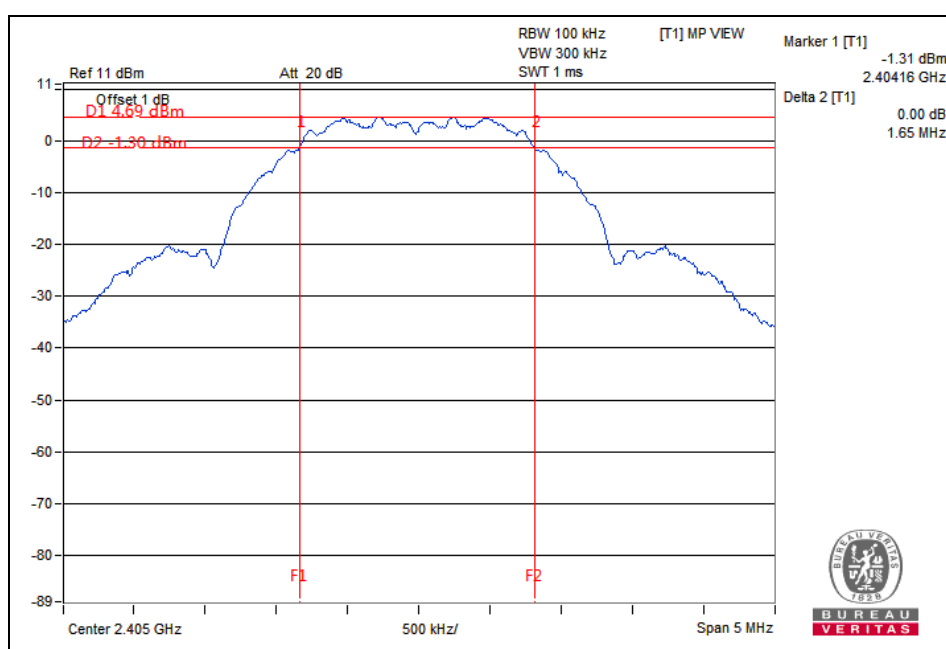
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.3.7 TEST RESULTS

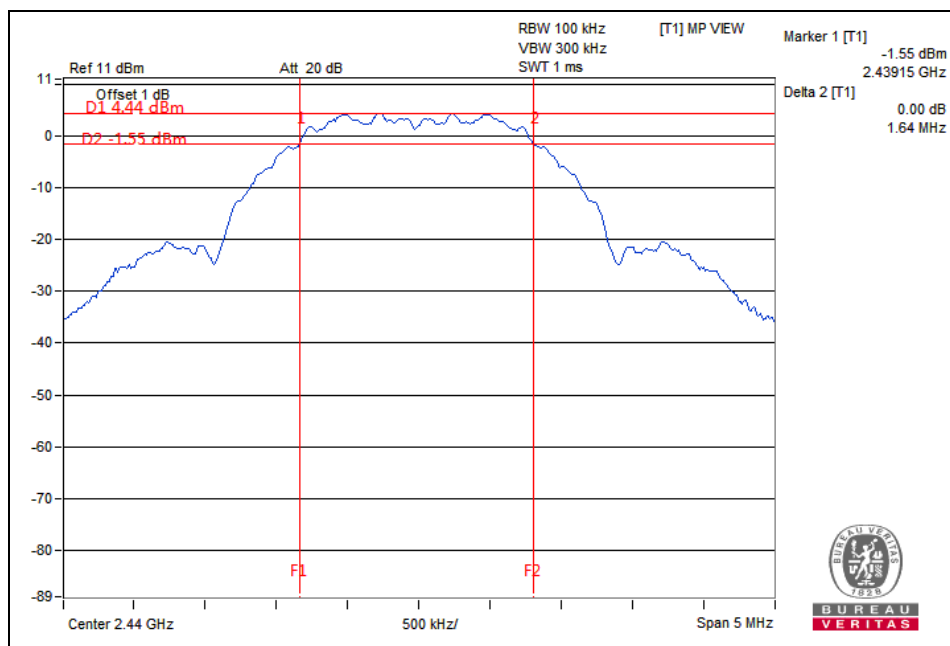
ZIGBEE (OQPSK)

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
11	2405	1.65	0.5	PASS
19	2440	1.64	0.5	PASS
26	2480	1.65	0.5	PASS

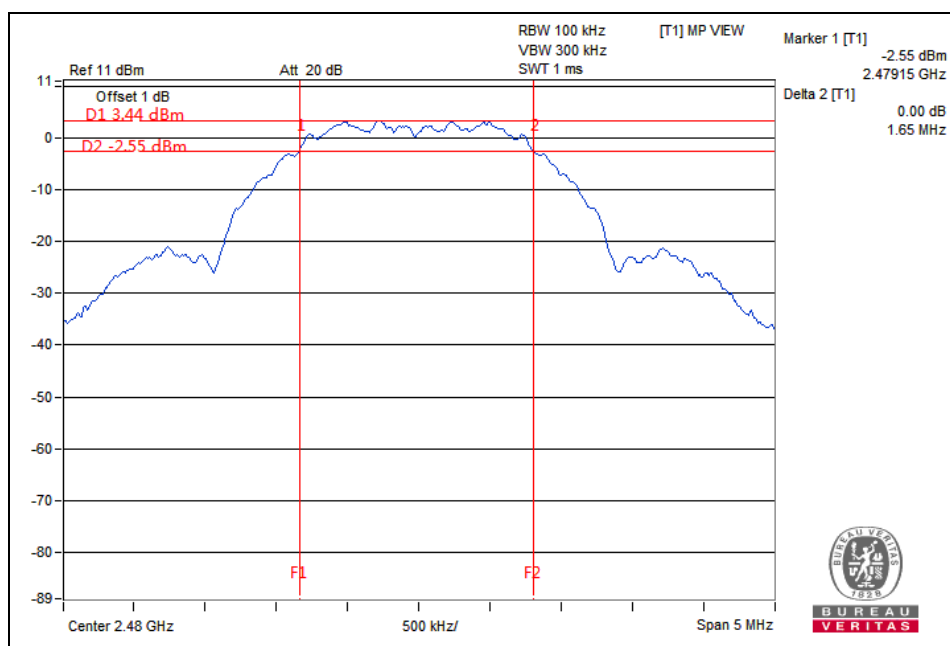
CH11



CH19



CH26

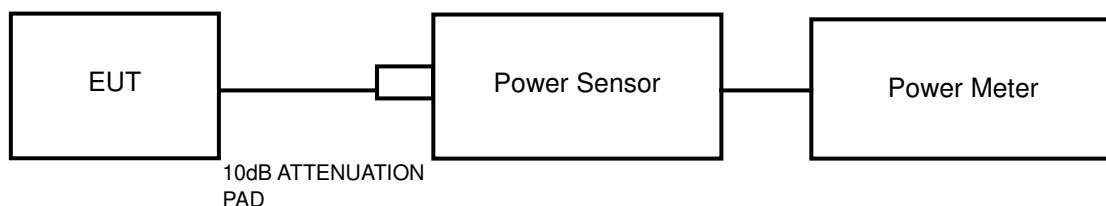


4.4 CONDUCTED OUTPUT POWER

4.4.1 LIMITS OF CONDUCTED OUTPUT POWER MEASUREMENT

For systems using digital modulation in the 2400–2483.5 MHz band: 1 Watt (30dBm)

4.4.2 TEST SETUP



4.4.3 TEST INSTRUMENTS

Refer to section 4.3.2 to get information of above instrument.

4.4.4 TEST PROCEDURES

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the peak power sensor and set the detector to PEAK. Record the power level.

An average power sensor was used on the output port of the EUT. A power meter was used to read the response of the average power sensor and set the detector to AVERAGE. Record the power level.

4.4.5 DEVIATION FROM TEST STANDARD

No deviation.

4.4.6 EUT OPERATING CONDITIONS

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

4.4.7 TEST RESULTS

4.4.7.1 MAXIMUM PEAK OUTPUT POWER

ZIGBEE (OQPSK)

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER (dBm)	PEAK POWER (mW)	PEAK POWER LIMIT (W)	PASS/FAIL
0	2405	11.83	15.241	1	PASS
19	2440	11.65	14.622	1	PASS
26	2480	10.59	11.455	1	PASS

4.4.7.2 AVERAGE OUTPUT POWER (FOR REFERENCE)

The average power sensor was used on the output port of the EUT. A power meter was used to read the response of the power sensor. Record the power level.

ZIGBEE (OQPSK)

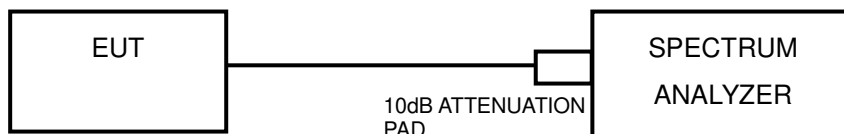
CHANNEL	CHANNEL FREQUENCY (MHz)	AVERAGE POWER (dBm)
0	2405	8.87
19	2440	8.64
26	2480	7.65

4.5 POWER SPECTRAL DENSITY MEASUREMENT

4.5.1 LIMITS OF POWER SPECTRAL DENSITY MEASUREMENT

The Maximum of Power Spectral Density Measurement is 8dBm/3KHz.

4.5.2 TEST SETUP



4.5.3 TEST INSTRUMENTS

Refer to section 4.3.2 to get information of above instrument.

4.5.4 TEST PROCEDURE

1. Set the span to 1.5 times the DSSS bandwidth
2. Set the RBW = 3 kHz, VBW $\geq 3 \times$ RBW, Detector = peak.
3. Sweep time = auto couple, Trace mode = max hold, allow trace to fully stabilize.
4. Use the peak marker function to determine the maximum amplitude level.

4.5.5 DEVIATION FROM TEST STANDARD

No deviation.

4.5.6 EUT OPERATING CONDITION

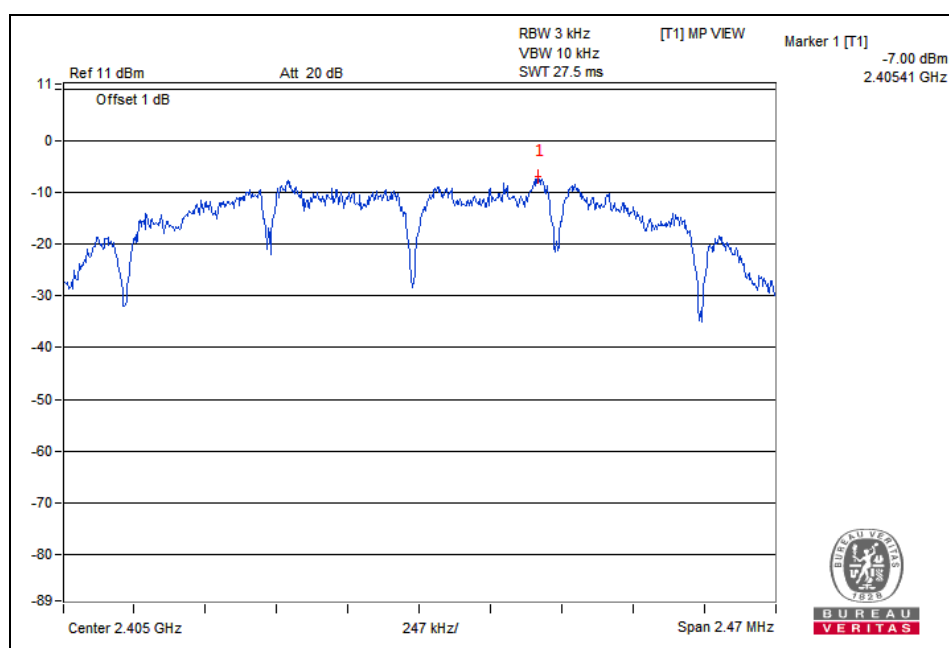
The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.5.7 TEST RESULTS

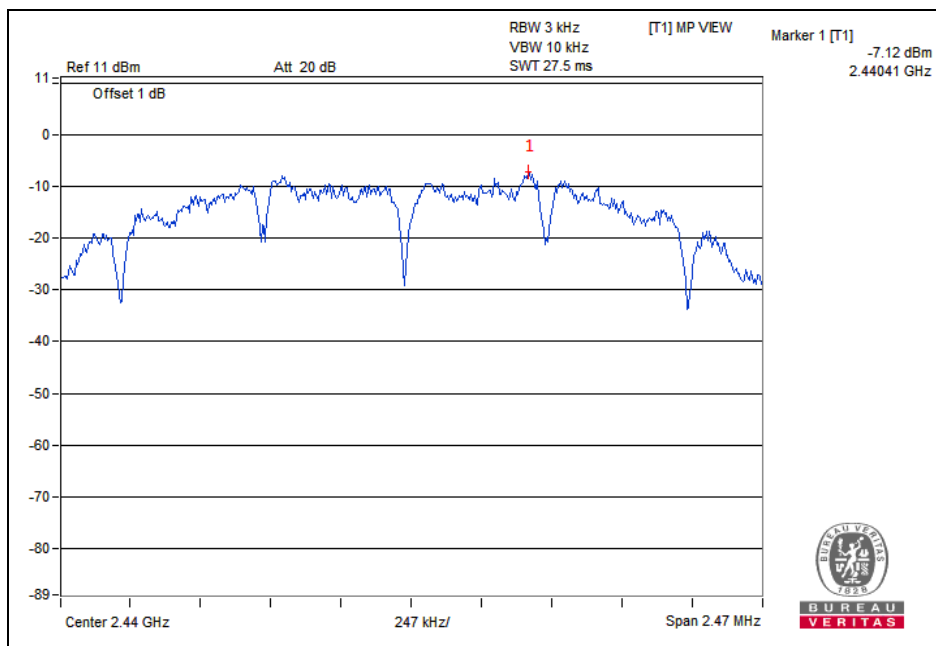
ZIGBEE (OQPSK)

Channel	FREQ. (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	PASS /FAIL
11	2405	-7.00	8	PASS
19	2440	-7.12	8	PASS
26	2480	-8.17	8	PASS

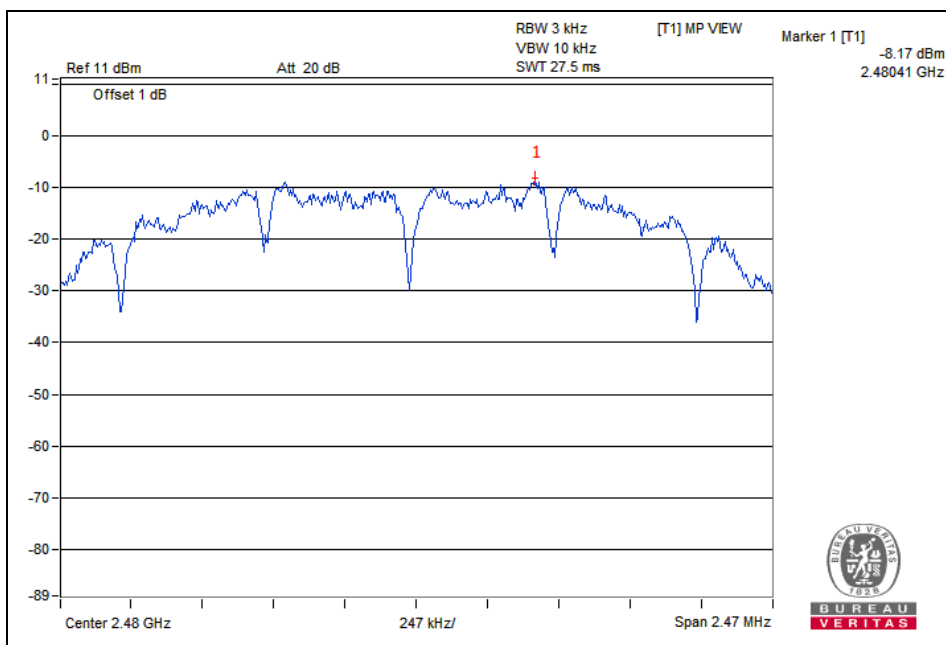
CH11



CH19



CH26

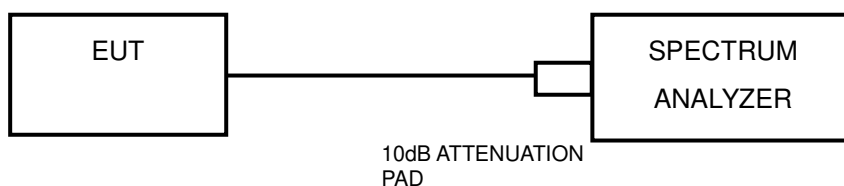


4.6 OUT OF BAND EMISSION MEASUREMENT

4.6.1 LIMITS OF OUT OF BAND EMISSION MEASUREMENT

Below -20dB of the highest emission level of operating band (in 100kHz Resolution Bandwidth).

4.6.2 TEST SETUP



4.6.3 TEST INSTRUMENTS

Refer to section 4.3.2 to get information of above instrument.

4.6.4 TEST PROCEDURE

MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW \geq 300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

MEASUREMENT PROCEDURE OOBE

1. Set RBW = 100 kHz.
2. Set VBW \geq 300 kHz.
3. Set span to encompass the spectrum to be examined
4. Detector = peak.
5. Trace Mode = max hold.
6. Sweep = auto couple.

4.6.5 DEVIATION FROM TEST STANDARD

No deviation.

4.6.6 EUT OPERATING CONDITION

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



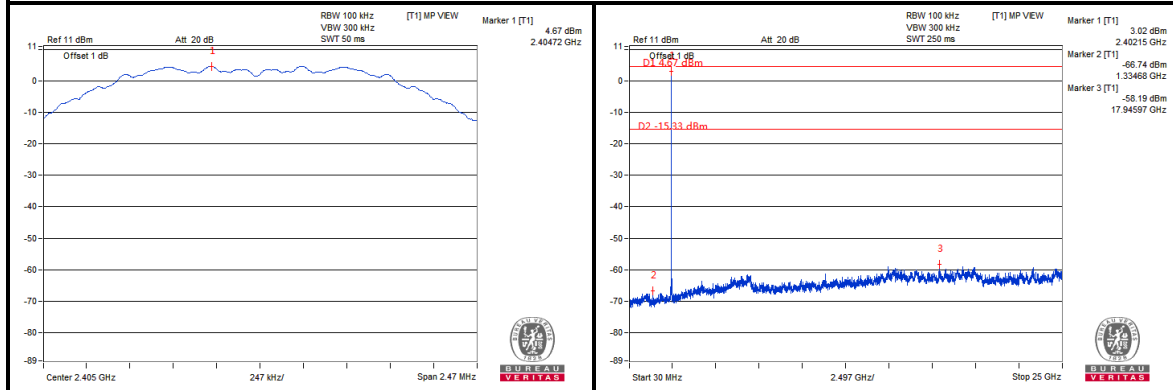
BUREAU
VERITAS

Test Report No.: RF200716N016-2

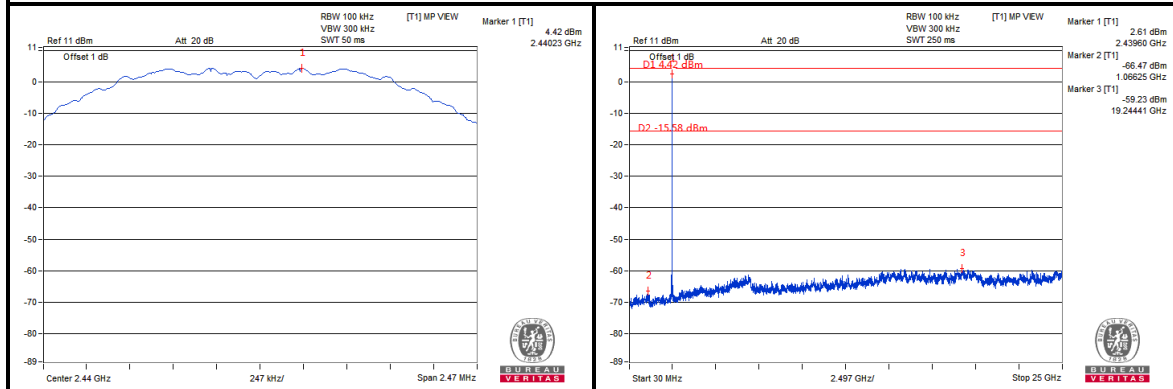
4.6.7 TEST RESULTS

ZIGBEE (OQPSK)

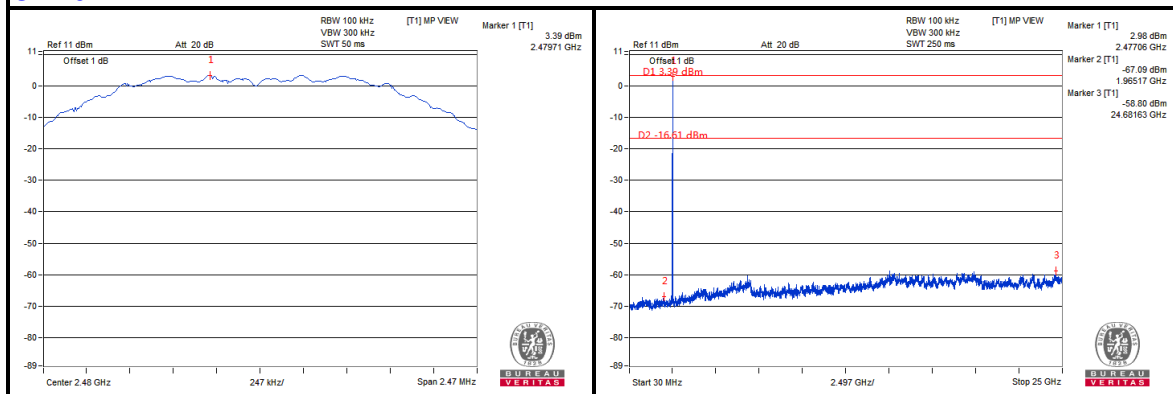
CH 11



CH 19



CH 26

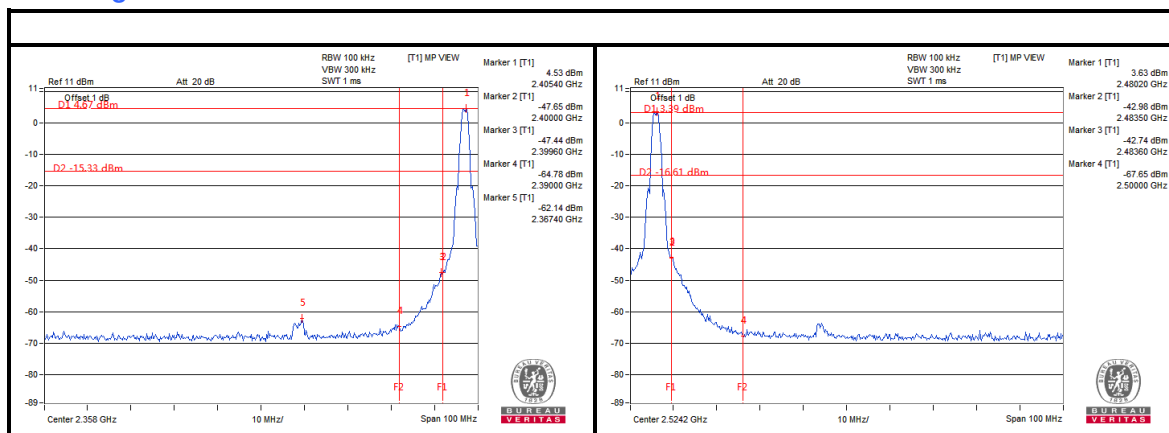


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Band Edge:





Test Report No.: RF200716N016-2

5 PHOTOGRAPHS OF THE TEST CONFIGURATION

Please refer to the attached file (Test Setup Photo).

6 APPENDIX A - MODIFICATIONS RECORDERS FOR ENGINEERING CHANGES TO THE EUT BY THE LAB

No any modifications are made to the EUT by the lab during the test.

---END---