

FCC Test Report

Report No.: RF190529C27-1

FCC ID: S6J2128P

Test Model: 2128P (refer to item 3.1 for more details)

Received Date: May 29, 2019

Test Date: Jun. 10 ~ Aug. 15, 2019

Issued Date: Aug. 22, 2019

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FCC Registration / 788550 / TW0003
Designation Number:



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Table of Contents

Release Control Record	4
1 Certificate of Conformity	5
2 Summary of Test Results	6
2.1 Measurement Uncertainty	6
2.2 Modification Record	6
3 General Information	7
3.1 General Description of EUT	7
3.2 Description of Test Modes	9
3.2.1 Test Mode Applicability and Tested Channel Detail	10
3.3 Description of Support Units	11
3.3.1 Configuration of System under Test	12
3.4 General Description of Applied Standards	12
4 Test Types and Results	13
4.1 Radiated Emission and Bandedge Measurement	13
4.1.1 Limits of Radiated Emission and Bandedge Measurement	13
4.1.2 Test Instruments	14
4.1.3 Test Procedures	15
4.1.4 Deviation from Test Standard	15
4.1.5 Test Setup	16
4.1.6 EUT Operating Conditions	17
4.1.7 Test Results	18
4.2 Conducted Emission Measurement	32
4.2.1 Limits of Conducted Emission Measurement	32
4.2.2 Test Instruments	32
4.2.3 Test Procedures	33
4.2.4 Deviation from Test Standard	33
4.2.5 Test Setup	33
4.2.6 EUT Operating Conditions	33
4.2.7 Test Results	34
4.3 Number of Hopping Frequency Used	38
4.3.1 Limits of Hopping Frequency Used Measurement	38
4.3.2 Test Setup	38
4.3.3 Test Instruments	38
4.3.4 Test Procedure	38
4.3.5 Deviation from Test Standard	38
4.3.6 Test Results	39
4.4 Dwell Time on Each Channel	40
4.4.1 Limits of Dwell Time on Each Channel Measurement	40
4.4.2 Test Setup	40
4.4.3 Test Instruments	40
4.4.4 Test Procedures	40
4.4.5 Deviation from Test Standard	40
4.4.6 Test Results	41
4.5 Channel Bandwidth	43
4.5.1 Limits of Channel Bandwidth Measurement	43
4.5.2 Test Setup	43
4.5.3 Test Instruments	43
4.5.4 Test Procedure	43
4.5.5 Deviation from Test Standard	43
4.5.6 EUT Operating Condition	43
4.5.7 Test Results	44
4.6 Hopping Channel Separation	45
4.6.1 Limits of Hopping Channel Separation Measurement	45

4.6.2	Test Setup	45
4.6.3	Test Instruments	45
4.6.4	Test Procedure	45
4.6.5	Deviation from Test Standard	45
4.6.6	Test Results	46
4.7	Maximum Output Power.....	47
4.7.1	Limits of Maximum Output Power Measurement	47
4.7.2	Test Setup.....	47
4.7.3	Test Instruments	47
4.7.4	Test Procedure	47
4.7.5	Deviation fromTest Standard	47
4.7.6	EUT Operating Condition	47
4.7.7	Test Results	47
4.8	Conducted Out of Band Emission Measurement.....	48
4.8.1	Limits Of Conducted Out Of Band Emission Measurement	48
4.8.2	Test Instruments	48
4.8.3	Test Procedure	48
4.8.4	Deviation from Test Standard	48
4.8.5	EUT Operating Condition	48
4.8.6	Test Results	48
5	Pictures of Test Arrangements.....	51
	Appendix – Information on the Testing Laboratories	52

Release Control Record

Issue No.	Description	Date Issued
RF190529C27-1	Original release	Aug. 22, 2019

1 Certificate of Conformity

Product: 2128P Bluetooth Handheld UHF RFID Reader

Brand: Technology Solutions (UK) Ltd

Test Model: 2128P (refer to item 3.1 for more details)

Sample Status: Engineering sample

Applicant: Technology Solutions (UK) Ltd

Test Date: Jun. 10 ~ Aug. 15, 2019

Standards: 47 CFR FCC Part 15, Subpart C (Section 15.247)
ANSI C63.10:2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

Prepared by : Celine Chou , **Date:** Aug. 22, 2019
Celine Chou / Senior Specialist

Approved by : Bruce Chen , **Date:** Aug. 22, 2019
Bruce Chen / Senior Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit. Minimum passing margin is -10.73dB at 0.16564MHz.
15.247(a)(1)(iii)	Number of Hopping Frequency Used	Pass	Meet the requirement of limit.
15.247(a)(1)(iii)	Dwell Time on Each Channel	Pass	Meet the requirement of limit.
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	Pass	Meet the requirement of limit.
15.247(a)(1)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
15.205 & 209 & 15.247(d)	Radiated Emissions & Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -5.9dB at 2483.50MHz.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

Note:

1. If The Frequency Hopping System operating in 2400-2483.5MHz band and the output power less than 125mW. The hopping channel carrier frequencies separated by a minimum of 25kHz or two-thirds of the 20dB bandwidth of hopping channel whichever is greater.
2. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 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	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.94 dB
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.04 dB
	30MHz ~ 200MHz	3.86 dB
	200MHz ~ 1000MHz	3.87 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	2128P Bluetooth Handheld UHF RFID Reader
Brand	Technology Solutions (UK) Ltd
Test Model	2128P
Sample Status	Engineering sample
Power Supply Rating	3.6Vdc or 3.7Vdc (Handle's battery) 5.2Vdc (Charging Cradle's adapter)
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8DPSK
Modulation Technology	FHSS
Transfer Rate	1/2/3Mbps
Operating Frequency	2402~2480MHz
Number of Channel	79
Output Power	14.555mW
Antenna Type	Ceramic Chip Antenna with 1dBi gain
Antenna Connector	NA
Accessory Device	Refer to note
Cable Supplied	NA

Note:

1. All models are listed as below. Part Number: 2128P-AS1 was chosen for final test.

Model	Part Number	Variant Description	Remark
2128P	2128P-AX1	FCC/North America - No Imager	RFID Frequency Band is 902-928 MHz
	2128P-AS1	FCC/North America - with 2D Imager	RFID Frequency Band is 902-928 MHz, SE4750 Barcode Imager.

2. The EUT tests with following devices and cables.

Item	Brand	Model		Specification	Remark
Dummy Battery (for EUT use)	Technology Solutions (UK) Ltd	MD-2102-001		-	Accessory (Optional)
CT50	Honeywell	CT50		-	Support Unit
Smart Phone	Motorola	Moto E5		-	Support Unit
Handles	Technology Solutions (UK) Ltd	2102	P/N: 2102-PH-Y	Accessory (Optional)	Accessory
			P/N: 2102-PH-R	Accessory (Optional)	Accessory
		2128-TRG	P/N: 2128-TRG	Accessory	Accessory
			P/N: IH21-TRG	Accessory	Accessory
Battery (for Handle 2102)	Fey	PA-UL-LNB46E		Fey PA-UL-LNB46E (integrated into Power Handle) Rating: 3.6Vdc	Integrated into 2102
Battery (for Handle 2128-TRG)	VARTA Storage GmbH	EZPack XL, 1ICP5/35/60-2		Varta EZPack XL (fitted to 2128P Main Body) Rating: 3.7Vdc	Accessory
Charging Cradle	Technology Solutions (UK) Ltd	2128-CRD		S-Mark File Number: CUBA 5.2Vdc, 4.0A Input (PSU:T6607YY)	Support Unit
Adapter (for Cradle use)	STONTRONICS	T6607YY		Input: 100-240Vac, 50/60Hz Output: 5.2Vdc, 4.0A Cable: 1.45m power cable without core attached on adapter	Support Unit
Micro USB cable (for Cradle use)	N/A	N/A		0.95m shielded with 4 cores	Support Unit
Micro SD Card	Kingston	8GB		-	Support Unit

3.2 Description of Test Modes

79 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to				Description
	RE $\geq$ 1G	RE<1G	PLC	APCM	
A	√	√	-	√	EUT + Handle (2102)
B	-	√	-	-	EUT + Handle (2128-TRG)
C	-	√	√	-	EUT + Handle (2102) + Charging Cradle (2128-CRD)
D	-	√	√	-	EUT + Handle (2128-TRG) + Charging Cradle (2128-CRD)

Where RE $\geq$ 1G: Radiated Emission above 1GHz & Bandedge Measurement

RE<1G: Radiated Emission below 1GHz

PLC: Power Line Conducted Emission

APCM: Antenna Port Conducted Measurement

Note:

1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Y-plane for test mode A and B & Z-plane for test mode C and D.**
2. Radiated emission test (below 1GHz) and power line conducted emission test items chosen the worst maximum power.

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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Pakcet Type
A	0 to 78	0, 39, 78	FHSS	GFSK	DH5
A	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Pakcet Type
A, B, C, D	0 to 78	0	FHSS	8DPSK	3DH5

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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Pakcet Type
C, D	0 to 78	0	FHSS	8DPSK	3DH5

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.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Pakcet Type
A	0 to 78	0, 39, 78	FHSS	GFSK	DH5
A	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

Test Condition:

Applicable to	Environmental Conditions	Input Power	Tested by
RE $\geq$ 1G	23 deg. C, 67% RH	3.7Vdc	Adair Peng
RE $<$ 1G	25 deg. C, 68% RH	3.6Vdc 3.7Vdc 120Vac, 60Hz	Willy Cheng
PLC	23 deg. C, 66% RH	120Vac, 60Hz	Willy Cheng
APCM	25 deg. C, 60% RH	3.7Vdc	Alan Wu

3.3 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.

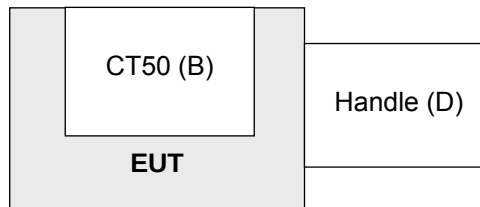
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Adapter	STONTRONICS	T6607YY	NA	NA	Provided by client For test mode C and D
B.	CT50	Honeywell	CT50	NA	NA	Provided by client For test mode A and B
C.	Charging Cradle	Technology Solutions (UK) Ltd	2128-CRD	NA	NA	Provided by client For test mode C and D
D.	Handle	Technology Solutions (UK) Ltd	2102	NA	NA	Accessory of EUT For test mode A and C
		Technology Solutions (UK) Ltd	2128-TRG	NA	NA	Accessory of EUT For test mode B and D

Note: All power cords of the above support units are non-shielded (1.8m).

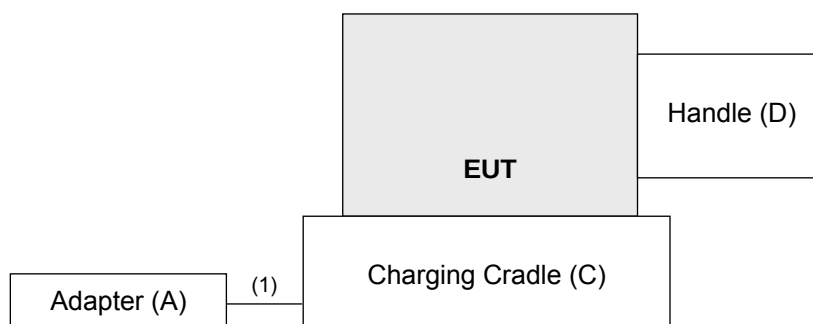
ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Power cable	1	1.45	N	0	Provided by client Attached on adapter

3.3.1 Configuration of System under Test

Test Mode A and B



Test Mode C and D



3.4 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 (15.247)

KDB 558074 D01 15.247 Meas Guidance v05r02

ANSI C63.10:2013

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

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

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. 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.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESIB7	100187	May 30, 2019	May 29, 2020
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100269	Jun. 10, 2019	Jun. 09, 2020
BILOG Antenna SCHWARZBECK	VULB9168	9168-171	Nov. 22, 2018	Nov. 21, 2019
HORN Antenna SCHWARZBECK	9120D	209	Nov. 25, 2018	Nov. 24, 2019
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Nov. 25, 2018	Nov. 24, 2019
Loop Antenna EMCI	EM-6879	269	Sep. 07, 2018	Sep. 06, 2019
Preamplifier Agilent (Below 1GHz)	8447D	2944A10738	Aug. 21, 2018	Aug. 20, 2019
Preamplifier Agilent (Above 1GHz)	8449B	3008A02465	Mar. 27, 2019	Mar. 26, 2020
RF Coaxial Cable WORKEN With 5dB PAD	8D-FB	Cable-CH3-01	Aug. 21, 2018	Aug. 20, 2019
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-CH3-03 (223653/4)	Aug. 21, 2018	Aug. 20, 2019
RF signal cable HUBER+SUHNER& EMCI	SUCOFLEX 104&EMC104-SM-S M-8000	Cable-CH3-03 (309224+170907)	Aug. 21, 2018	Aug. 20, 2019
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower inn-co GmbH	MA 4000	013303	NA	NA
Antenna Tower Controller BV ADT	AT100	AT93021702	NA	NA
Turn Table BV ADT	TT100	TT93021702	NA	NA
Turn Table Controller BV ADT	SC100	SC93021702	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Pre-amplifier (18GHz-40GHz) EMC	EMC184045B	980175	Nov. 14, 2018	Nov. 13, 2019
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY5519 0004/MY55190007/MY 55210005	Jul. 17, 2018	Jul. 16, 2019
			Jul. 15, 2019	Jul. 14, 2020

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 3.

4.1.3 Test Procedures

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. Parallel, perpendicular, and ground-parallel orientations 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.

Note:

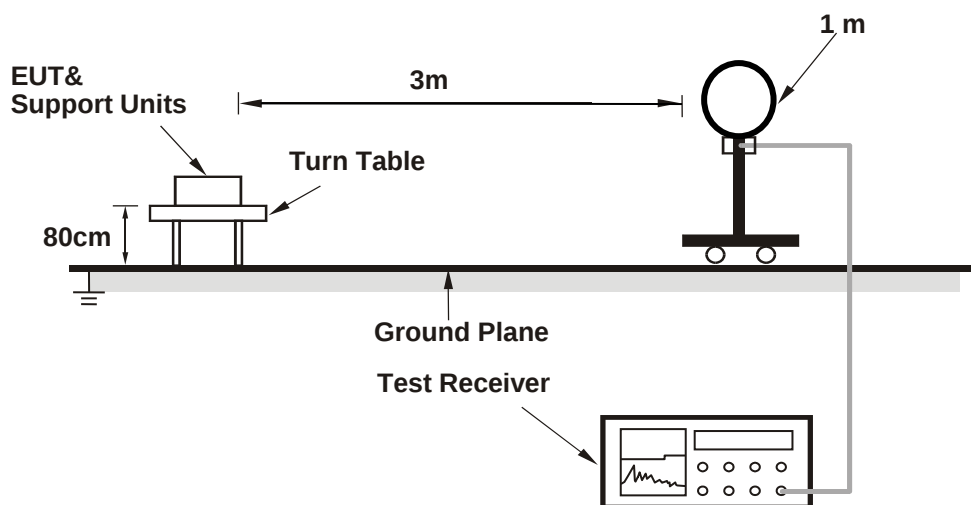
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz. (RBW = 1MHz, VBW = 1kHz)
4. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

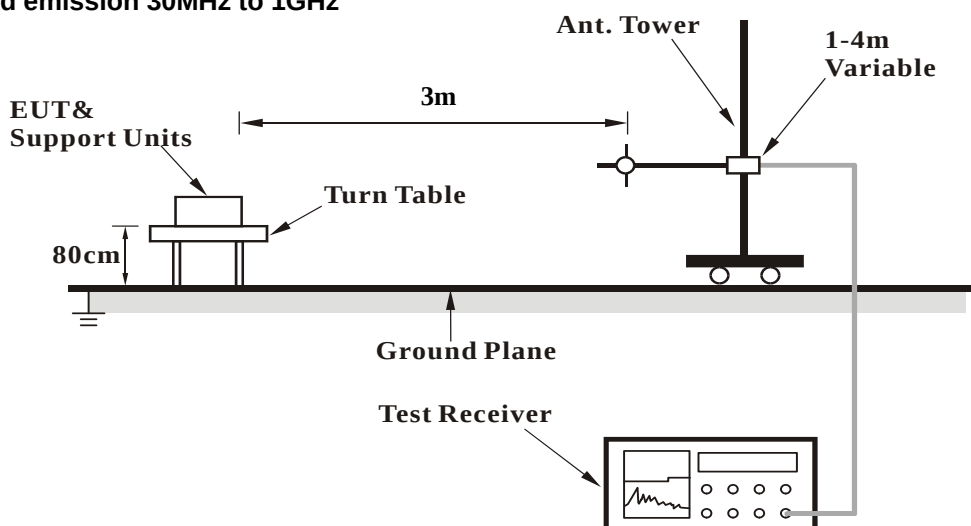
No deviation.

4.1.5 Test Setup

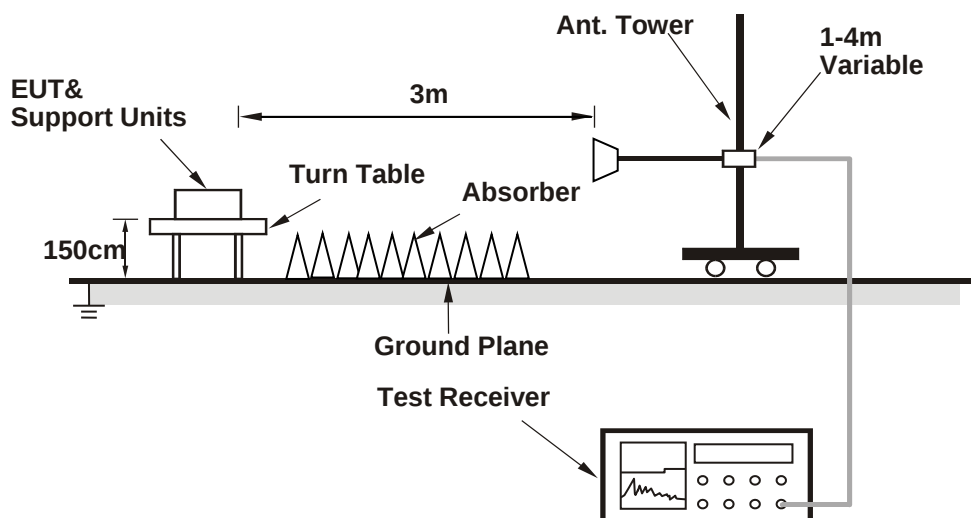
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



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

4.1.6 EUT Operating Conditions

- a. Set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1GHz data:

GFSK

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

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	59.5 PK	74.0	-14.5	3.59 H	110	26.6	32.9
2	2390.00	47.4 AV	54.0	-6.6	3.59 H	110	14.5	32.9
3	*2402.00	97.7 PK			3.64 H	103	64.8	32.9
4	*2402.00	96.9 AV			3.64 H	103	64.0	32.9
5	4804.00	48.9 PK	74.0	-25.1	1.69 H	10	45.3	3.6
6	4804.00	40.6 AV	54.0	-13.4	1.69 H	10	37.0	3.6
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	59.1 PK	74.0	-14.9	1.63 V	244	26.2	32.9
2	2390.00	47.7 AV	54.0	-6.3	1.63 V	244	14.8	32.9
3	*2402.00	102.5 PK			1.59 V	235	69.6	32.9
4	*2402.00	101.5 AV			1.59 V	235	68.6	32.9
5	4804.00	48.4 PK	74.0	-25.6	1.88 V	162	44.8	3.6
6	4804.00	39.6 AV	54.0	-14.4	1.88 V	162	36.0	3.6

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) – Pre-Amplifier Factor(dB).
3. Margin value = Emission Level – Limit value.
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

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	*2441.00	99.2 PK			3.70 H	109	66.3	32.9
2	*2441.00	97.8 AV			3.70 H	109	64.9	32.9
3	4882.00	49.8 PK	74.0	-24.2	1.77 H	13	45.9	3.9
4	4882.00	40.7 AV	54.0	-13.3	1.77 H	13	36.8	3.9
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	*2441.00	103.7 PK			1.69 V	249	70.8	32.9
2	*2441.00	102.4 AV			1.69 V	249	69.5	32.9
3	4882.00	49.2 PK	74.0	-24.8	1.93 V	181	45.3	3.9
4	4882.00	40.4 AV	54.0	-13.6	1.93 V	181	36.5	3.9

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) – Pre-Amplifier Factor(dB).
3. Margin value = Emission Level – Limit value.
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 78	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

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	98.1 PK			3.61 H	111	65.1	33.0
2	*2480.00	96.7 AV			3.61 H	111	63.7	33.0
3	2483.50	59.7 PK	74.0	-14.3	3.57 H	101	26.7	33.0
4	2483.50	48.0 AV	54.0	-6.0	3.57 H	101	15.0	33.0
5	4960.00	50.2 PK	74.0	-23.8	1.73 H	13	45.7	4.5
6	4960.00	41.1 AV	54.0	-12.9	1.73 H	13	36.6	4.5
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	102.7 PK			1.51 V	220	69.7	33.0
2	*2480.00	101.3 AV			1.51 V	220	68.3	33.0
3	2483.50	59.8 PK	74.0	-14.2	1.55 V	213	26.8	33.0
4	2483.50	48.1 AV	54.0	-5.9	1.55 V	213	15.1	33.0
5	4960.00	49.6 PK	74.0	-24.4	1.99 V	185	45.1	4.5
6	4960.00	40.8 AV	54.0	-13.2	1.99 V	185	36.3	4.5

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) – Pre-Amplifier Factor(dB).
3. Margin value = Emission Level – Limit value.
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

8DPSK

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

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	59.4 PK	74.0	-14.6	3.55 H	114	26.5	32.9
2	2390.00	47.2 AV	54.0	-6.8	3.55 H	114	14.3	32.9
3	*2402.00	98.4 PK			3.61 H	107	65.5	32.9
4	*2402.00	93.6 AV			3.61 H	107	60.7	32.9
5	4804.00	46.9 PK	74.0	-27.1	1.81 H	15	43.3	3.6
6	4804.00	37.9 AV	54.0	-16.1	1.81 H	15	34.3	3.6
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	59.3 PK	74.0	-14.7	1.77 V	229	26.4	32.9
2	2390.00	47.4 AV	54.0	-6.6	1.77 V	229	14.5	32.9
3	*2402.00	103.1 PK			1.81 V	219	70.2	32.9
4	*2402.00	98.0 AV			1.81 V	219	65.1	32.9
5	4804.00	45.9 PK	74.0	-28.1	1.94 V	170	42.3	3.6
6	4804.00	37.5 AV	54.0	-16.5	1.94 V	170	33.9	3.6

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) – Pre-Amplifier Factor(dB).
3. Margin value = Emission Level – Limit value.
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 39	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

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	*2441.00	98.5 PK			3.63 H	113	65.6	32.9
2	*2441.00	93.9 AV			3.63 H	113	61.0	32.9
3	4882.00	47.8 PK	74.0	-26.2	1.69 H	17	43.9	3.9
4	4882.00	38.9 AV	54.0	-15.1	1.69 H	17	35.0	3.9
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	*2441.00	103.2 PK			1.77 V	220	70.3	32.9
2	*2441.00	98.2 AV			1.77 V	220	65.3	32.9
3	4882.00	47.0 PK	74.0	-27.0	2.01 V	175	43.1	3.9
4	4882.00	38.1 AV	54.0	-15.9	2.01 V	175	34.2	3.9

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) – Pre-Amplifier Factor(dB).
3. Margin value = Emission Level – Limit value.
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 78	DETECTOR FUNCTION	Peak (PK) Average (AV)
FREQUENCY RANGE	1GHz ~ 25GHz		

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	98.4 PK			3.79 H	113	65.4	33.0
2	*2480.00	93.2 AV			3.79 H	113	60.2	33.0
3	2483.50	59.8 PK	74.0	-14.2	3.67 H	105	26.8	33.0
4	2483.50	47.8 AV	54.0	-6.2	3.67 H	105	14.8	33.0
5	4960.00	47.8 PK	74.0	-26.2	1.76 H	10	43.3	4.5
6	4960.00	38.4 AV	54.0	-15.6	1.76 H	10	33.9	4.5
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	102.9 PK			1.80 V	226	69.9	33.0
2	*2480.00	97.8 AV			1.80 V	226	64.8	33.0
3	2483.50	59.9 PK	74.0	-14.1	1.75 V	213	26.9	33.0
4	2483.50	48.0 AV	54.0	-6.0	1.75 V	213	15.0	33.0
5	4960.00	47.2 PK	74.0	-26.8	1.89 V	175	42.7	4.5
6	4960.00	37.8 AV	54.0	-16.2	1.89 V	175	33.3	4.5

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) – Pre-Amplifier Factor(dB).
3. Margin value = Emission Level – Limit value.
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

Below 1GHz worst-case data:

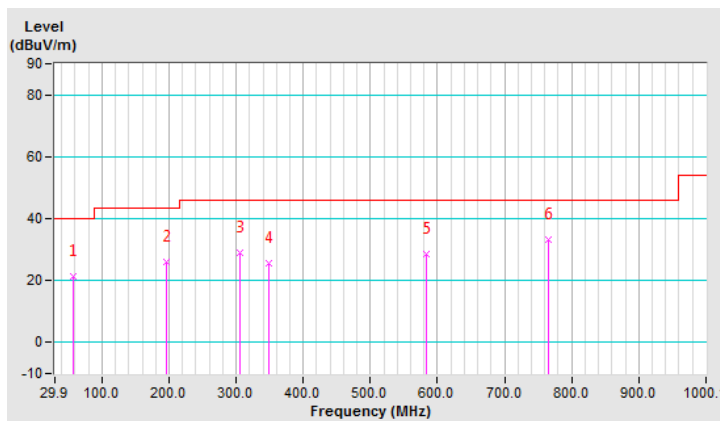
8DPSK

CHANNEL	TX Channel 0	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		
TEST MODE	A		

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	57.12	21.2 QP	40.0	-18.8	1.51 H	24	31.3	-10.1
2	197.11	26.0 QP	43.5	-17.5	1.99 H	239	37.2	-11.2
3	305.99	29.1 QP	46.0	-16.9	1.00 H	250	36.3	-7.2
4	348.76	25.7 QP	46.0	-20.3	1.00 H	79	32.4	-6.7
5	584.02	28.5 QP	46.0	-17.5	1.00 H	318	30.1	-1.6
6	764.84	33.1 QP	46.0	-12.9	1.00 H	12	31.0	2.1

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) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report

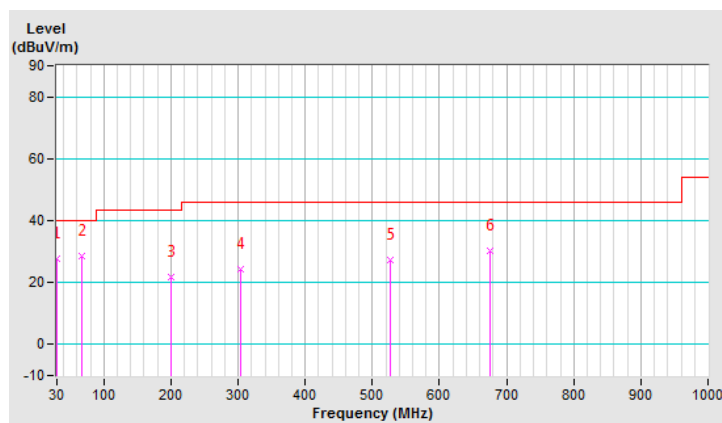


CHANNEL	TX Channel 0	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		
TEST MODE	A		

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	30.00	27.9 QP	40.0	-12.1	1.00 V	111	39.4	-11.5
2	66.93	28.6 QP	40.0	-11.4	1.00 V	235	39.7	-11.1
3	201.06	21.7 QP	43.5	-21.8	1.00 V	44	32.8	-11.1
4	304.09	24.2 QP	46.0	-21.8	1.50 V	13	31.5	-7.3
5	527.64	27.3 QP	46.0	-18.7	1.50 V	6	30.5	-3.2
6	675.37	30.3 QP	46.0	-15.7	1.00 V	6	30.5	-0.2

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) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report

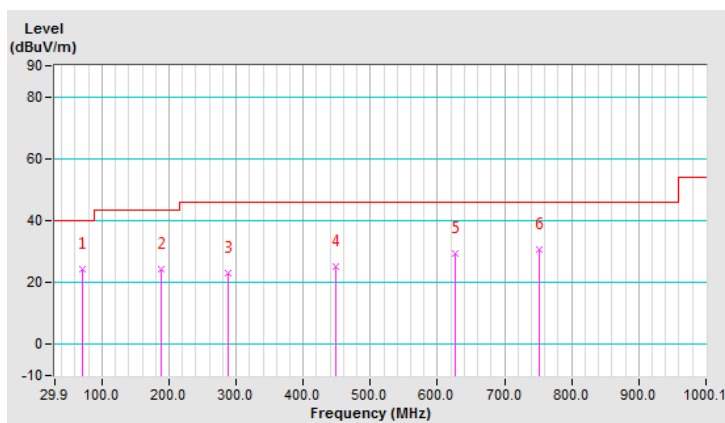


CHANNEL	TX Channel 0	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		
TEST MODE	B		

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	70.73	24.5 QP	40.0	-15.5	1.99 H	105	36.5	-12.0
2	187.39	24.3 QP	43.5	-19.2	1.50 H	243	35.2	-10.9
3	288.49	23.1 QP	46.0	-22.9	1.00 H	240	30.7	-7.6
4	447.92	25.2 QP	46.0	-20.8	1.50 H	291	29.6	-4.4
5	626.80	29.3 QP	46.0	-16.7	1.99 H	3	30.0	-0.7
6	751.23	30.7 QP	46.0	-15.3	1.00 H	250	28.9	1.8

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) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report

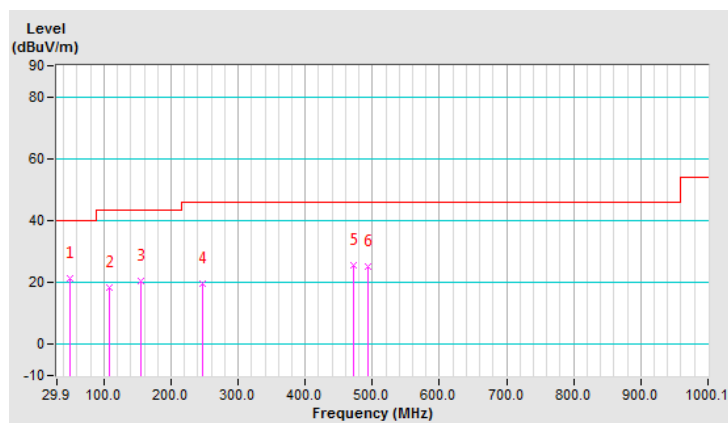


CHANNEL	TX Channel 0	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		
TEST MODE	B		

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	49.34	21.5 QP	40.0	-18.5	1.00 V	18	31.2	-9.7
2	107.67	18.5 QP	43.5	-25.0	1.00 V	339	31.1	-12.6
3	154.33	20.5 QP	43.5	-23.0	1.00 V	193	29.5	-9.0
4	247.66	19.8 QP	46.0	-26.2	1.00 V	16	29.0	-9.2
5	471.25	25.7 QP	46.0	-20.3	1.00 V	20	29.8	-4.1
6	492.64	25.2 QP	46.0	-20.8	1.00 V	310	29.0	-3.8

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) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report

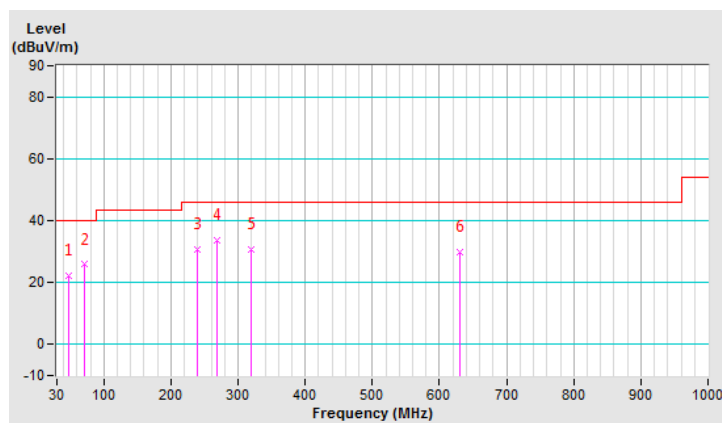


CHANNEL	TX Channel 0	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		
TEST MODE	C		

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	47.49	22.4 QP	40.0	-17.6	1.99 H	102	32.1	-9.7
2	70.82	25.8 QP	40.0	-14.2	1.99 H	144	37.8	-12.0
3	239.94	30.6 QP	46.0	-15.4	1.50 H	89	40.2	-9.6
4	269.10	33.6 QP	46.0	-12.4	1.50 H	237	41.9	-8.3
5	319.64	30.5 QP	46.0	-15.5	1.50 H	241	37.4	-6.9
6	630.66	30.0 QP	46.0	-16.0	1.50 H	6	30.6	-0.6

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) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report

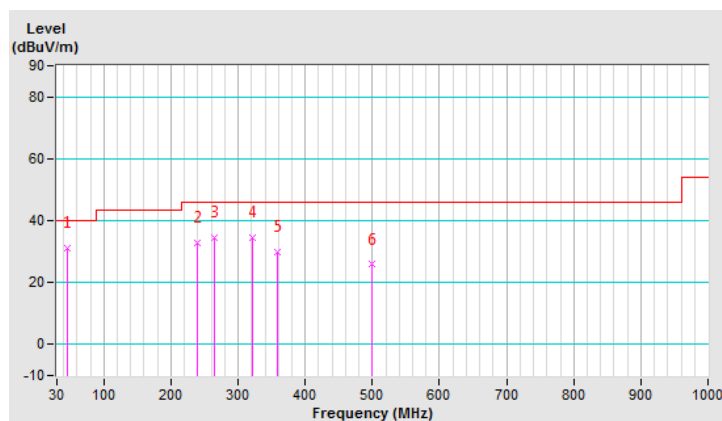


CHANNEL	TX Channel 0	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		
TEST MODE	C		

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	45.55	31.2 QP	40.0	-8.8	1.01 V	114	41.0	-9.8
2	239.94	32.7 QP	46.0	-13.3	1.01 V	158	42.3	-9.6
3	265.21	34.5 QP	46.0	-11.5	1.50 V	182	43.0	-8.5
4	321.58	34.6 QP	46.0	-11.4	1.50 V	155	41.5	-6.9
5	358.52	29.9 QP	46.0	-16.1	1.50 V	58	36.3	-6.4
6	498.48	25.8 QP	46.0	-20.2	1.50 V	115	29.5	-3.7

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) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report

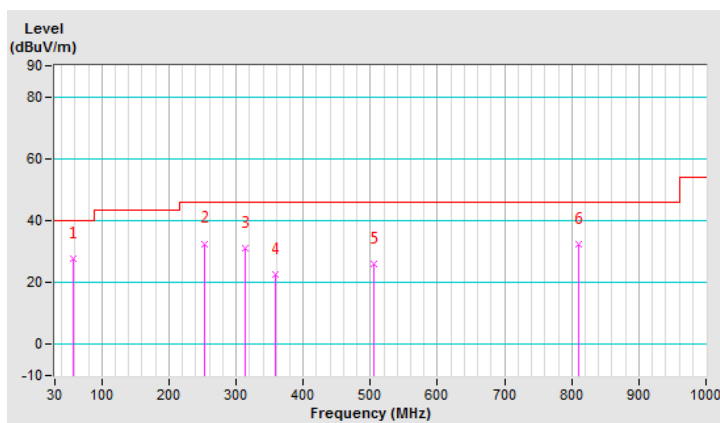


CHANNEL	TX Channel 0	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		
TEST MODE	D		

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	57.21	27.7 QP	40.0	-12.3	1.99 H	332	37.8	-10.1
2	253.55	32.6 QP	46.0	-13.4	1.00 H	113	41.7	-9.1
3	313.81	31.2 QP	46.0	-14.8	1.00 H	231	38.3	-7.1
4	358.52	22.5 QP	46.0	-23.5	1.50 H	13	28.9	-6.4
5	504.31	26.0 QP	46.0	-20.0	1.00 H	237	29.6	-3.6
6	809.50	32.2 QP	46.0	-13.8	1.99 H	3	29.6	2.6

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) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report

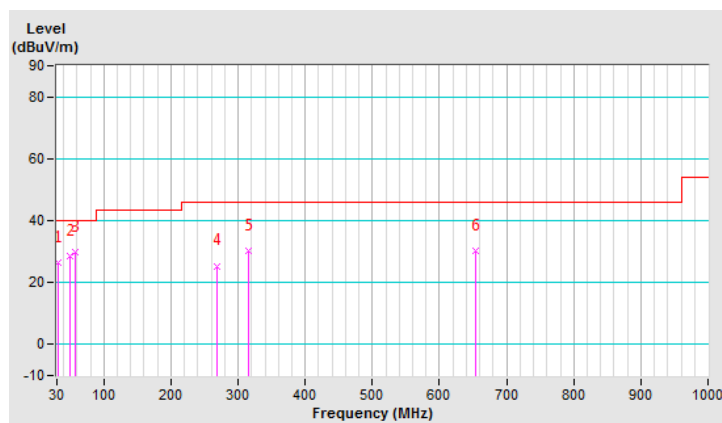


CHANNEL	TX Channel 0	DETECTOR FUNCTION	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 1GHz		
TEST MODE	D		

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	31.94	26.3 QP	40.0	-13.7	1.00 V	238	37.8	-11.5
2	49.44	28.5 QP	40.0	-11.5	1.00 V	114	38.2	-9.7
3	57.21	30.0 QP	40.0	-10.0	1.00 V	217	40.1	-10.1
4	269.10	25.4 QP	46.0	-20.6	1.49 V	171	33.7	-8.3
5	315.75	30.3 QP	46.0	-15.7	1.49 V	163	37.3	-7.0
6	653.99	30.1 QP	46.0	-15.9	1.49 V	13	30.6	-0.5

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) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit of frequency range 30MHz ~ 1000MHz
4. Margin value = Emission Level – Limit value
5. The emission levels were very low against the limit of frequency range 9kHz ~ 30MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report



4.2 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	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.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Dec. 10, 2018	Dec. 09, 2019
RF signal cable Woken	5D-FB	Cable-cond1-01	Sep. 05, 2018	Sep. 04, 2019
LISN ROHDE & SCHWARZ (EUT)	ENV216	101826	Feb. 21, 2019	Feb. 20, 2020
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Aug. 19, 2018	Aug. 18, 2019
Software ADT	BV ADT_Conc_ V7.3.7.4	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

2. The test was performed in HwaYa Shielded Room 1.

3. The VCCI Site Registration No. is C-12040.

4.2.3 Test Procedures

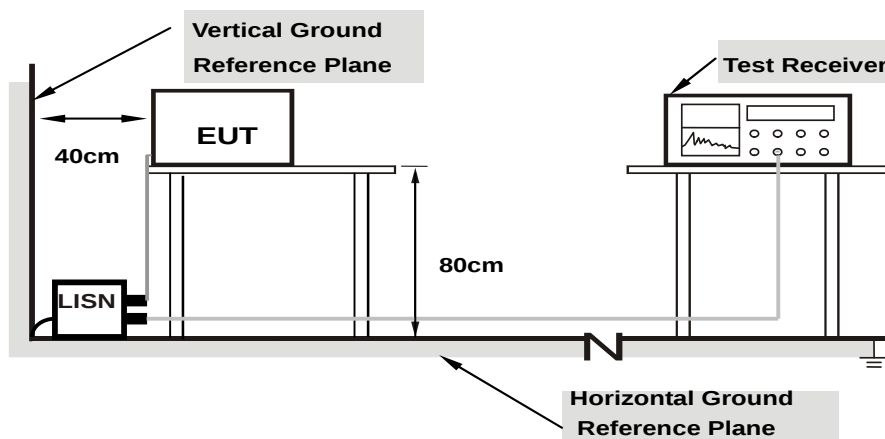
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



Note: 1.Support units were connected to second LISN.

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

4.2.6 EUT Operating Conditions

Same as 4.1.6.

4.2.7 Test Results

Worst-case data:

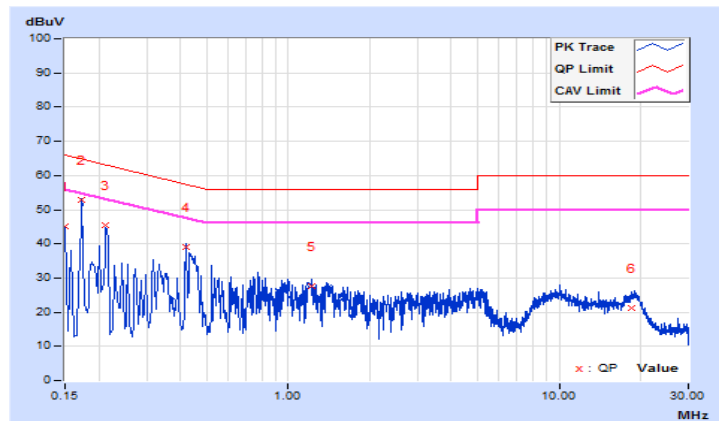
8DPSK

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Test Mode	C		

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	9.84	35.28	13.88	45.12	23.72	66.00	56.00	-20.88	-32.28
2	0.17346	9.84	42.97	29.60	52.81	39.44	64.79	54.79	-11.98	-15.35
3	0.21226	9.85	35.69	20.61	45.54	30.46	63.12	53.12	-17.58	-22.66
4	0.41890	9.88	29.14	18.45	39.02	28.33	57.47	47.47	-18.45	-19.14
5	1.21352	9.93	17.54	8.45	27.47	18.38	56.00	46.00	-28.53	-27.62
6	18.58956	10.24	11.01	5.90	21.25	16.14	60.00	50.00	-38.75	-33.86

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

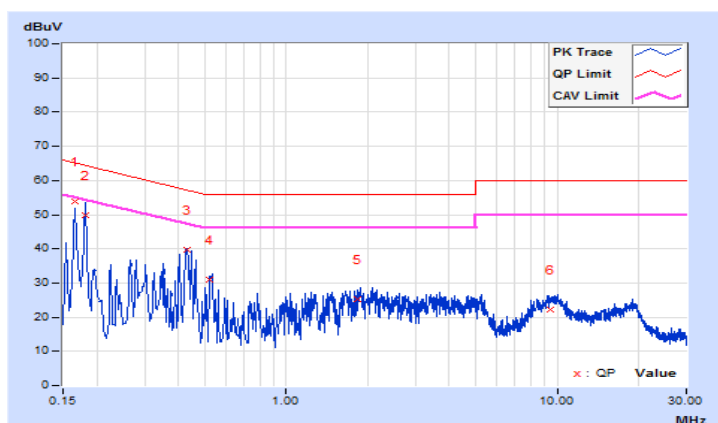


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Test Mode	C		

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16526	9.83	43.90	26.94	53.73	36.77	65.20	55.20	-11.47	-18.43
2	0.18128	9.83	40.14	21.07	49.97	30.90	64.43	54.43	-14.46	-23.53
3	0.43122	9.87	29.90	21.91	39.77	31.78	57.23	47.23	-17.46	-15.45
4	0.52130	9.87	20.94	8.56	30.81	18.43	56.00	46.00	-25.19	-27.57
5	1.83684	9.92	15.39	6.95	25.31	16.87	56.00	46.00	-30.69	-29.13
6	9.46753	10.15	11.99	6.50	22.14	16.65	60.00	50.00	-37.86	-33.35

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

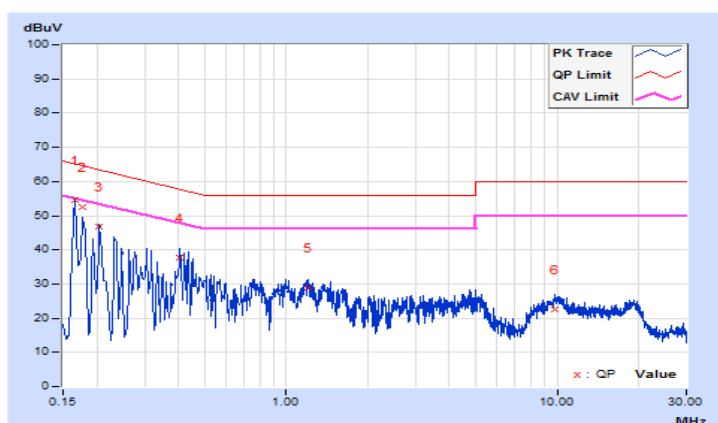


Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Test Mode	D		

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16564	9.84	44.61	29.14	54.45	38.98	65.18	55.18	-10.73	-16.20
2	0.17744	9.85	42.52	26.06	52.37	35.91	64.60	54.60	-12.23	-18.69
3	0.20474	9.85	37.02	23.64	46.87	33.49	63.42	53.42	-16.55	-19.93
4	0.40415	9.88	27.97	17.06	37.85	26.94	57.77	47.77	-19.92	-20.83
5	1.20181	9.93	18.98	9.36	28.91	19.29	56.00	46.00	-27.09	-26.71
6	9.84289	10.16	12.45	6.45	22.61	16.61	60.00	50.00	-37.39	-33.39

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

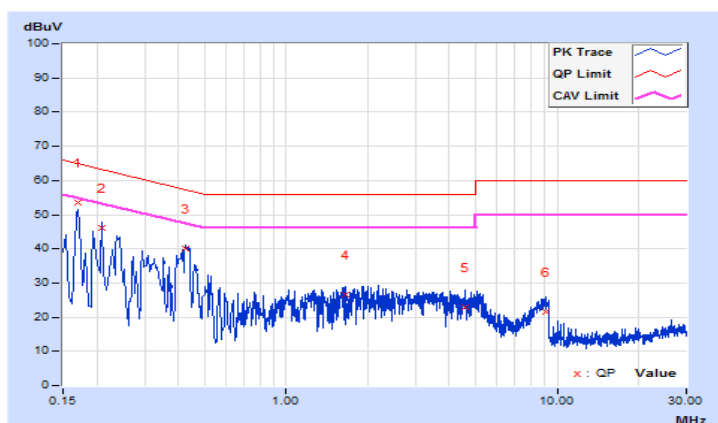


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Test Mode	D		

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16955	9.83	43.86	30.36	53.69	40.19	64.98	54.98	-11.29	-14.79
2	0.20865	9.84	36.37	21.07	46.21	30.91	63.26	53.26	-17.05	-22.35
3	0.42445	9.87	30.09	20.73	39.96	30.60	57.36	47.36	-17.40	-16.76
4	1.64753	9.91	16.73	8.86	26.64	18.77	56.00	46.00	-29.36	-27.23
5	4.55266	10.01	12.86	4.79	22.87	14.80	56.00	46.00	-33.13	-31.20
6	9.10390	10.14	11.44	5.52	21.58	15.66	60.00	50.00	-38.42	-34.34

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

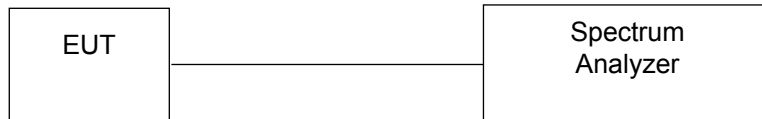


4.3 Number of Hopping Frequency Used

4.3.1 Limits of Hopping Frequency Used Measurement

At least 15 channels frequencies, and should be equally spaced.

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedure

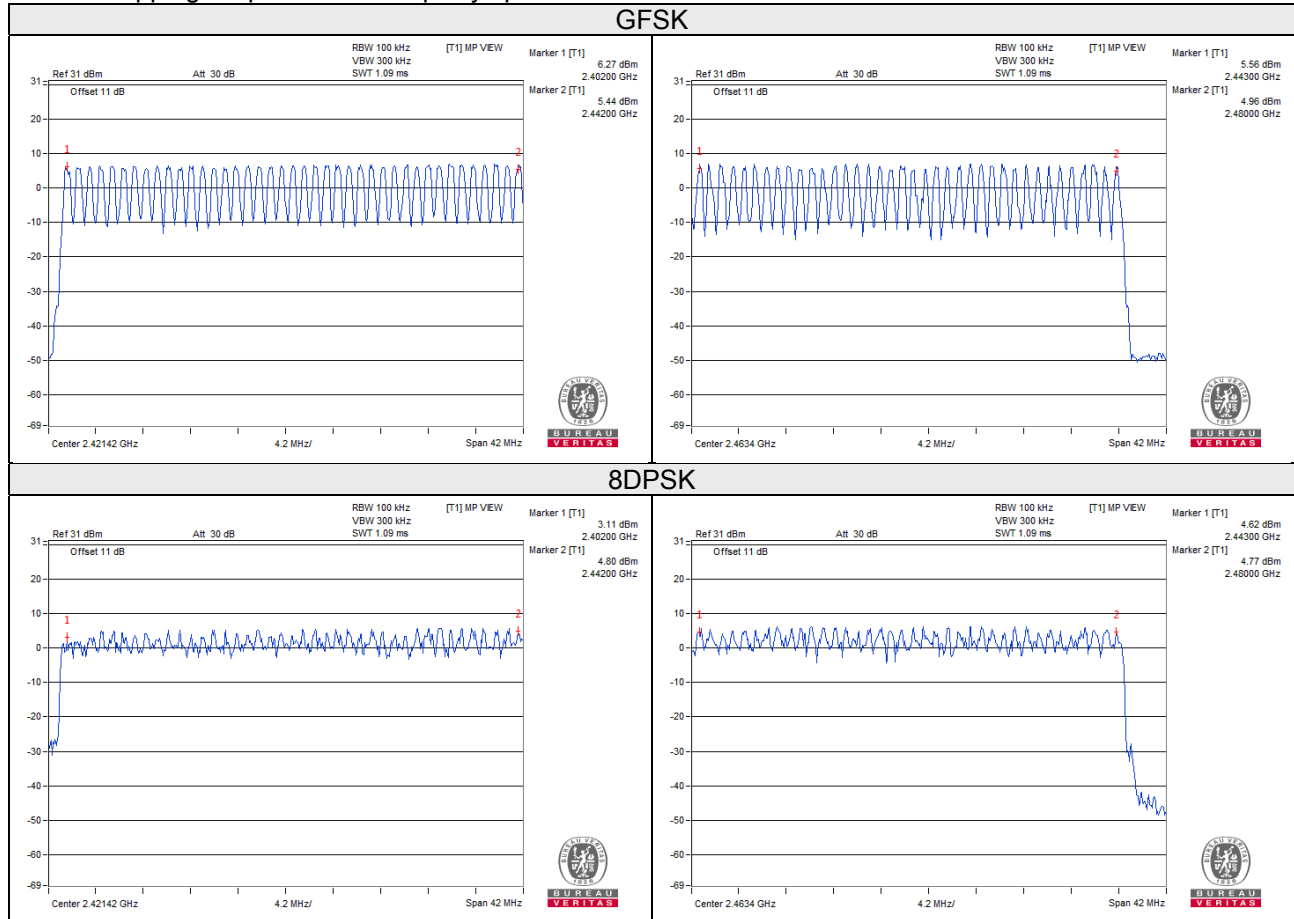
- Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
- Set the SA on View mode and then plot the result on SA screen.
- Repeat above procedures until all frequencies measured were complete.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 Test Results

There are 79 hopping frequencies in the hopping mode. Please refer to the test result. On the plots, it shows that the hopping frequencies are equally spaced.



4.4 Dwell Time on Each Channel

4.4.1 Limits of Dwell Time on Each Channel Measurement

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

4.4.2 Test Setup



4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedures

- Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
- Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
- Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- Repeat above procedures until all different time-slot modes have been completed.

4.4.5 Deviation from Test Standard

No deviation.

4.4.6 Test Results

GFSK

Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
DH1	51 (times / 5 sec) * 6.32 = 322.32 times	0.440	141.82	400
DH3	27 (times / 5 sec) * 6.32 = 170.64 times	1.710	291.79	400
DH5	16 (times / 5 sec) * 6.32 = 101.12 times	2.950	298.30	400

Note: Test plots of the transmitting time slot are shown as below.



8DPSK

Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
3DH1	51 (times / 5 sec) * 6.32 = 322.32 times	0.490	157.94	400
3DH3	26 (times / 5 sec) * 6.32 = 164.32 times	1.690	277.70	400
3DH5	18 (times / 5 sec) * 6.32 = 113.76 times	2.980	339.00	400

Note: Test plots of the transmitting time slot are shown as below.



4.5 Channel Bandwidth

4.5.1 Limits of Channel Bandwidth Measurement

For frequency hopping system operating in the 2400-2483.5MHz, If the 20dB bandwidth of hopping channel is greater than 25kHz, two-thirds 20dB bandwidth of hopping channel shall be a minimum limit for the hopping channel separation.

4.5.2 Test Setup



4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.5.4 Test Procedure

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 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.
- Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
- Repeat above procedures until all frequencies measured were complete.

4.5.5 Deviation from Test Standard

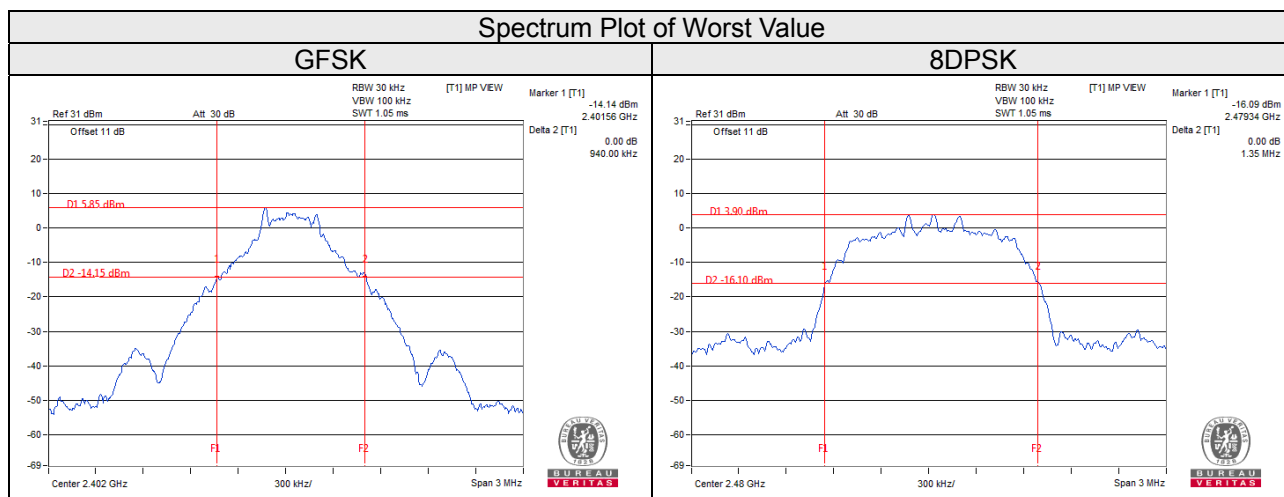
No deviation.

4.5.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.5.7 Test Results

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	
		GFSK	8DPSK
0	2402	0.94	1.31
39	2441	0.91	1.35
78	2480	0.92	1.35

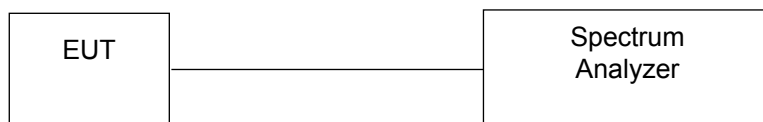


4.6 Hopping Channel Separation

4.6.1 Limits of Hopping Channel Separation Measurement

At least 25kHz or two-third of 20dB hopping channel bandwidth (whichever is greater).

4.6.2 Test Setup



4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.6.4 Test Procedure

Measurement Procedure REF

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range.
- By using the MaxHold function record the separation of two adjacent channels.
- Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
- Repeat above procedures until all frequencies measured were complete.

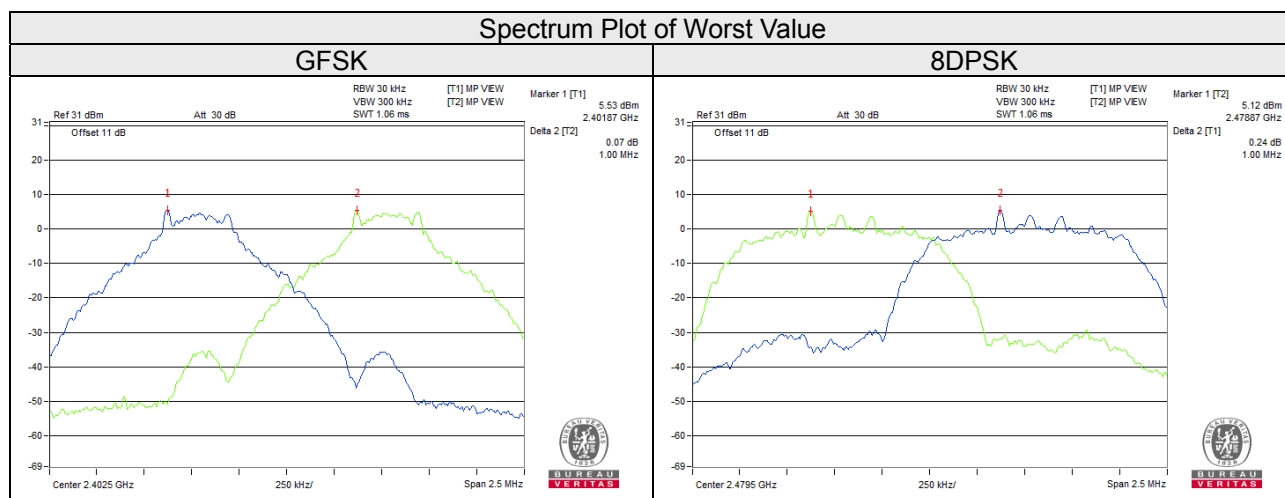
4.6.5 Deviation from Test Standard

No deviation.

4.6.6 Test Results

Channel	Frequency (MHz)	Adjacent Channel Separation (MHz)		20dB Bandwidth (MHz)		Minimum Limit (MHz)		Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK	GFSK	8DPSK	
0	2402	1.00	1.00	0.94	1.31	0.63	0.88	Pass
39	2441	1.00	1.00	0.91	1.35	0.61	0.90	Pass
78	2480	1.00	1.00	0.92	1.35	0.62	0.90	Pass

Note: The minimum limit is two-third 20dB bandwidth.

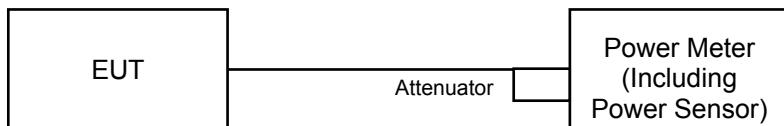


4.7 Maximum Output Power

4.7.1 Limits of Maximum Output Power Measurement

Refer to Regulation 15.247 (a) (1), the Maximum Output Power Measurement is 125mW.

4.7.2 Test Setup



4.7.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.7.4 Test Procedure

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. Record the power level.

4.7.5 Deviation from Test Standard

No deviation.

4.7.6 EUT Operating Condition

The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.7.7 Test Results

Channel	Frequency (MHz)	Output Power (mW)		Output Power (dBm)		Power Limit (mW)	Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK		
0	2402	6.209	14.555	7.93	11.63	125.00	Pass
39	2441	6.902	11.588	8.39	10.64	125.00	Pass
78	2480	6.761	9.268	8.30	9.67	125.00	Pass

4.8 Conducted Out of Band Emission Measurement

4.8.1 Limits Of Conducted Out Of Band Emission Measurement

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

4.8.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.8.3 Test Procedure

The transmitter output was connected to the spectrum analyzer via a low lose cable. Set both RBW and VBW of spectrum analyzer to 100 kHz and 300 kHz with suitable frequency span including 100 MHz bandwidth from band edge. The band edges was measured and recorded.

4.8.4 Deviation from Test Standard

No deviation.

4.8.5 EUT Operating Condition

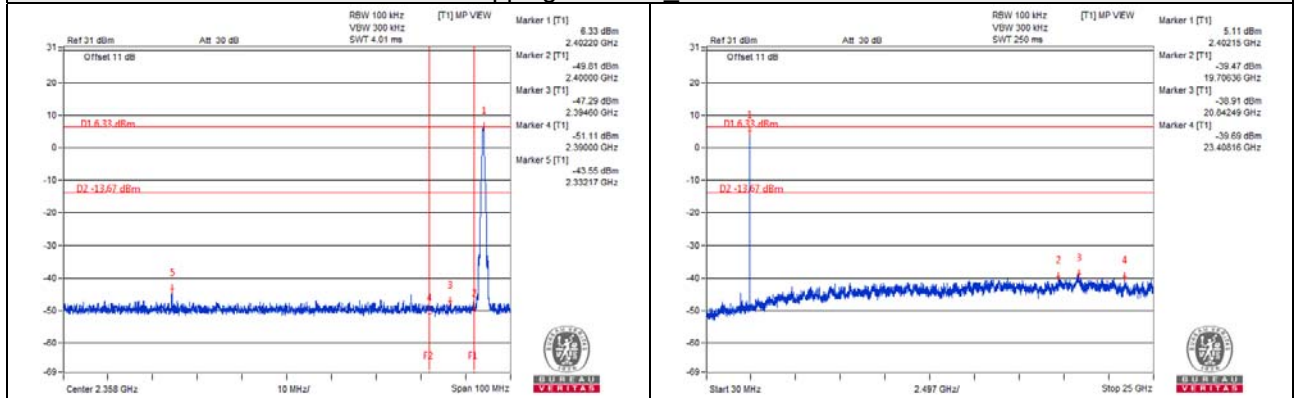
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.8.6 Test Results

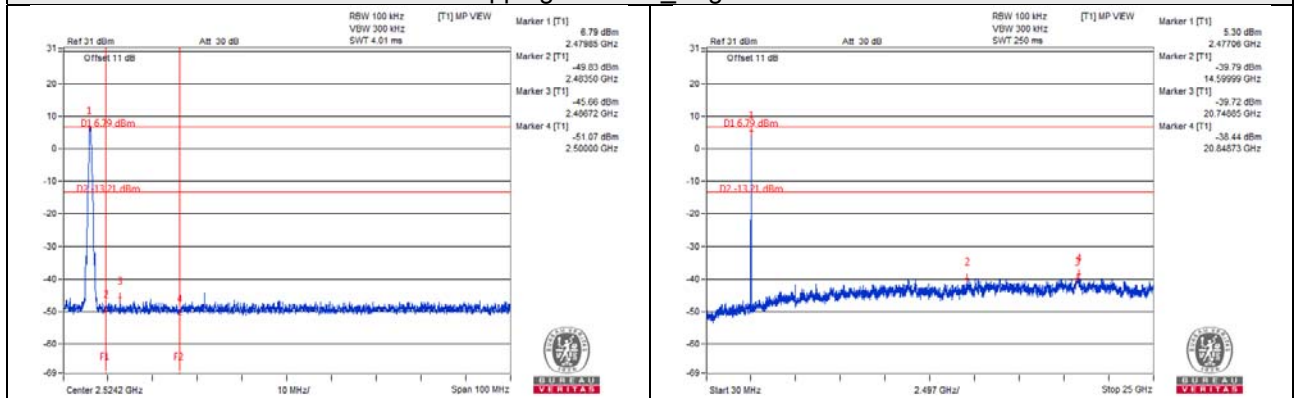
The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

GFSK

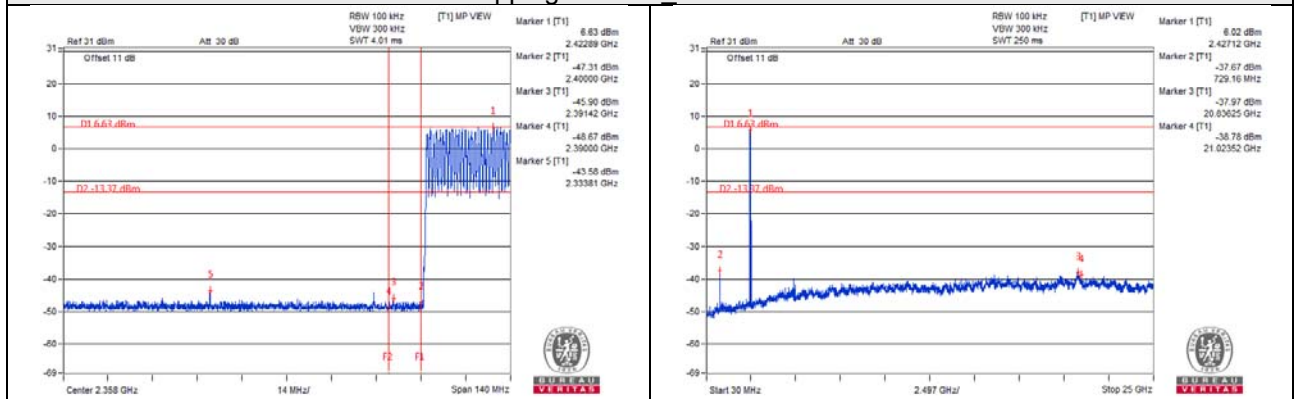
Hopping disabled Low Channel



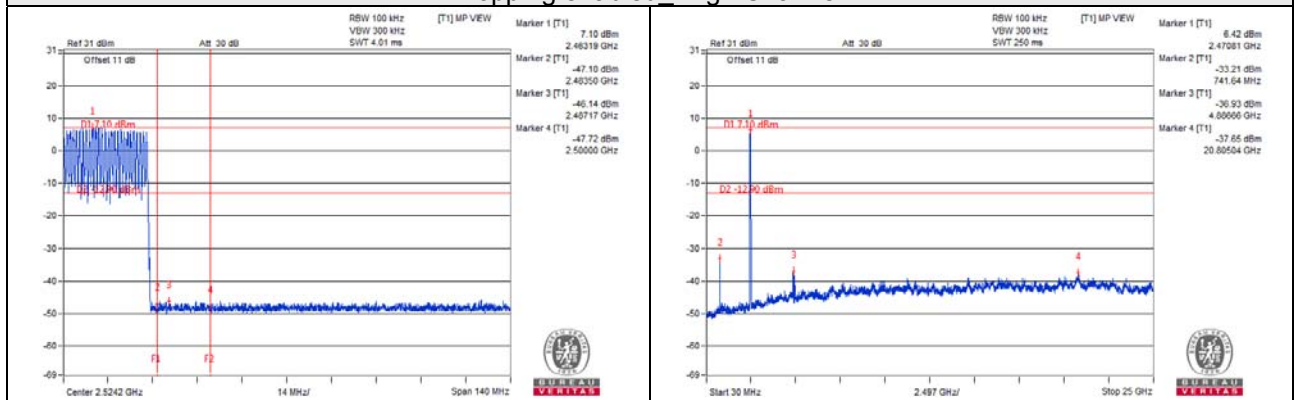
Hopping disabled High Channel



Hopping enabled Low Channel

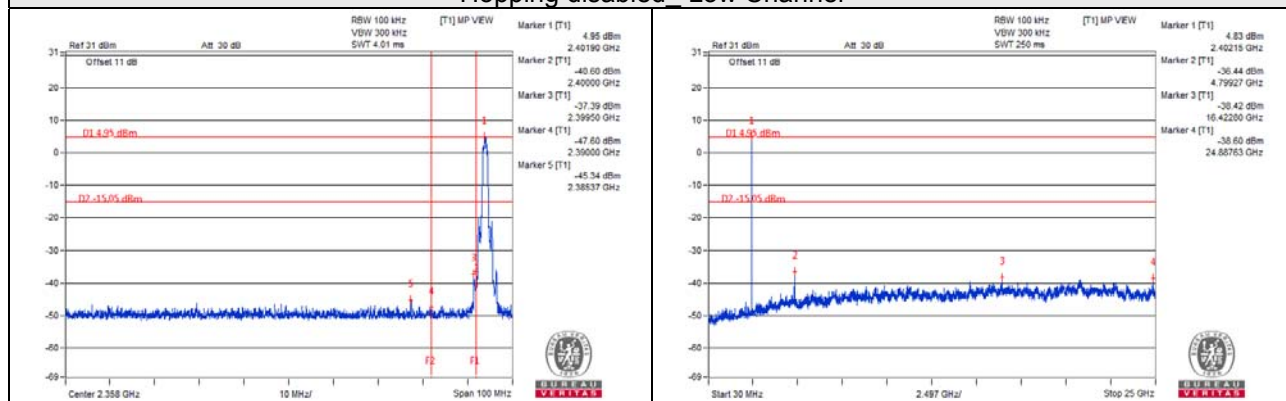


Hopping enabled High Channel

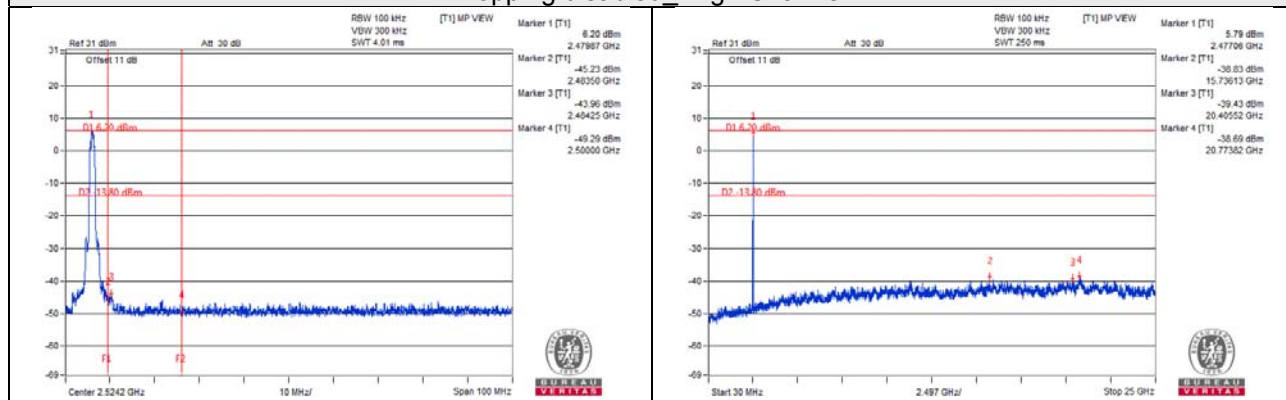


8DPSK

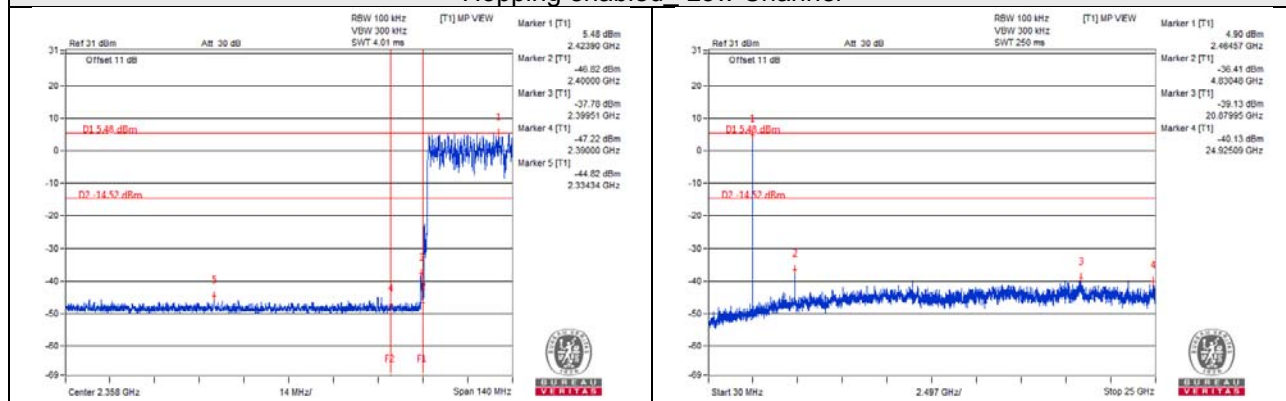
Hopping disabled Low Channel



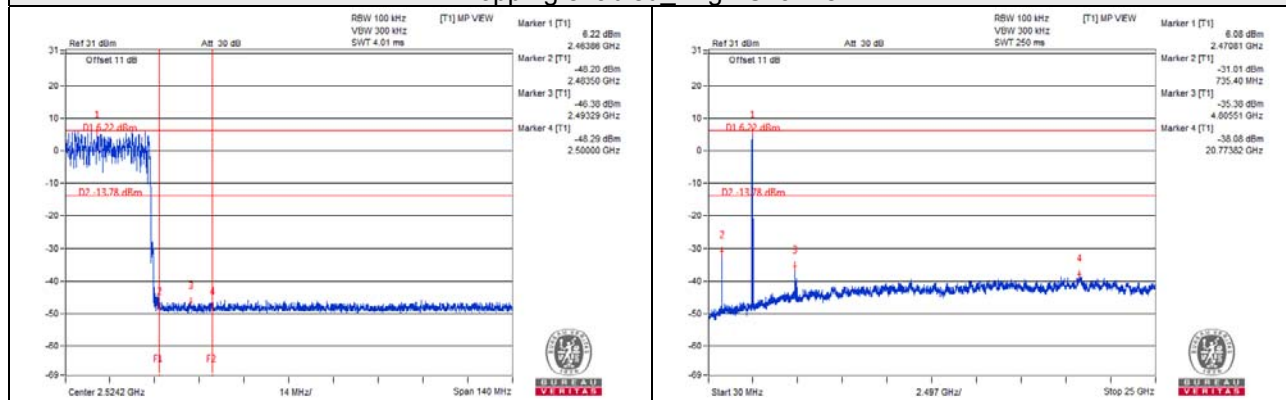
Hopping disabled High Channel



Hopping enabled Low Channel



Hopping enabled High Channel



5 Pictures of Test Arrangements

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

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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The address and road map of all our labs can be found in our web site also.

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