

## FCC Test Report

**Report No.:** RF170421C58-2

**FCC ID:** UZ7TC200J

**Test Model:** TC200J

**Received Date:** Apr. 21, 2017

**Test Date:** Apr. 26 ~ Jun. 30, 2017

**Issued Date:** Jul. 04, 2017

**Applicant:** Zebra Technologies Corporation

**Address:** 1 Zebra Plaza Holtsville New York United States 11742

**Manufacturer:** Zebra Technologies Corporation

**Address:** 1 Zebra Plaza Holtsville New York United States 11742

**Issued By:** Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

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**Test Location:** No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan, R.O.C.



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### Release Control Record

Issue No.	Description	Date Issued
RF170421C58-2	Original release.	Jul. 04, 2017

## 1 Certificate of Conformity

**Product:** Touch Computer

**Brand:** ZEBRA

**Test Model:** TC200J

**Sample Status:** Engineering sample

**Applicant:** Zebra Technologies Corporation

**Test Date:** Apr. 26 ~ Jun. 30, 2017

**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 EMC characteristics under the conditions specified in this report.

**Prepared by :**  , **Date:** Jul. 04, 2017  
Pettie Chen / Senior Specialist

**Approved by :**  , **Date:** Jul. 04, 2017  
Ken Liu / Senior Manager

## 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 -15.62dB at 0.41252MHz.
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(b)	Maximum Peak Output Power	Pass	Meet the requirement of limit.
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -3.9dB at 30.00MHz.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used.

**Note:** 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.

### 2.1 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) ( $\pm$ )
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.94 dB
Radiated Emissions up to 1 GHz	30MHz ~ 200MHz	3.63 dB
	200MHz ~ 1000MHz	3.64 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	Touch Computer
Brand	ZEBRA
Test Model	TC200J
Status of EUT	Engineering sample
MFD	28MAR17
HW Version	EV
SW Version	90-04-03-N-00-E1
Power Supply Rating	5Vdc from adapter or host equipment 3.85Vdc from battery
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	2.377 mW
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	Adapter, Gun Handle, Headset (1.25m non-shielded cable without core), Arm Mount, Holster (Refer to note 4 for more details)
Data Cable Supplied	1.5m shielded USB Type C to Type A cable without core (Refer to note 4 for more details)

Note:

1. The EUT has three types for sale.

Brand	Model	Difference
ZEBRA	TC200J	Scanner SE4710 with camera, with 2pin
		Scanner SE4710 with camera, with 8pin (option)
		Scanner SE2100 without camera, blank

2. The EUT consumes power from the following adapter and battery.

Adapter	
Brand	ZEBRA
Model	SAWA-65-20005A
Input Power	100-240Vac, 0.5A, 50-60Hz
Output Power	5Vdc, 2.5A

Battery	
Brand	ZEBRA
Model	BT-000334
Rate capacity(mAh)	3000mAh
Min capacity(mAh)	2800mAh
Rate Voltage	3.85Vdc

3. The following antennas were provided to the EUT.

Type	Connector	Gain (dBi)	
		2.4GHz	5GHz
PIFA	NA	2.25	4.22

4. Accessory devices of EUT are list as below:

Specification of Accessory		
AC Adapter	Brand Name	ZEBRA
	Model Name	SAWA-65-20005A
USB Type C cable	Brand Name	ZEBRA
	P/N Number	CBL-MPM-USB1-01
Ear Headset	Brand Name	ZEBRA
	Model Name	HDST-25MM-PTVP-01
Headset Adapter Cable	Brand Name	ZEBRA
	Model Name	CBL-TC51-HDST35-01
Gun Handle	Brand Name	ZEBRA
	P/N Number	TRG-TC2X-SNP1-01
Arm Mount	Brand Name	ZEBRA
	P/N Number	SG-TC2X-ARMNT-01
Holster	Brand Name	ZEBRA
	P/N Number	SG-TC2X-HLSTR1-01

5. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.



### 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	√	√	√	√	Scanner SE4710 (2pin), EUT with Headset
B	-	√	√	-	Scanner SE4710 (2pin), EUT with Gun Handle
C	-	√	√	-	Scanner SE4710 (8pin), EUT with Headset
D	-	√	√	-	Scanner SE2100 (2pin), EUT with Headset

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 **X-plane**.
2. "-": Means no effect.

#### 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	PACKET TYPE
A	0 to 78	0, 39, 78	FHSS	GFSK	DH5
A	0 to 78	0, 39, 78	FHSS	8DPSK	DH5

#### 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	PACKET TYPE
A, B, C, D	0 to 78	39	FHSS	GFSK	DH5

#### 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	PACKET TYPE
A, B, C, D	0 to 78	39	FHSS	GFSK	DH5

**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	PACKET TYPE
A	0 to 78	0, 39, 78	FHSS	GFSK	DH5
A	0 to 78	0, 39, 78	FHSS	8DPSK	DH5

**Test Condition:**

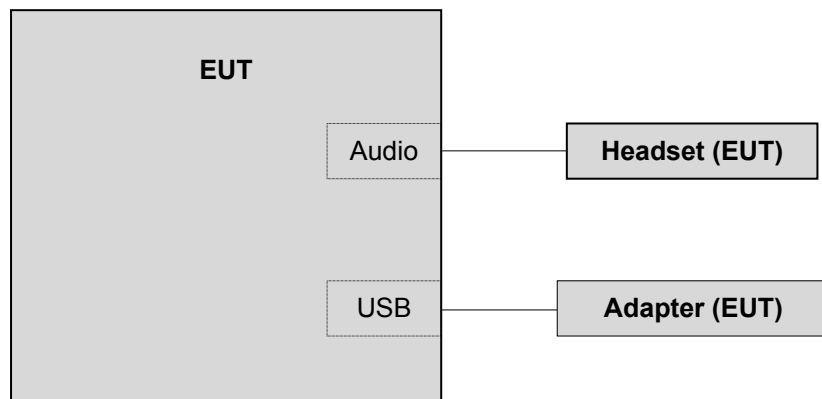
APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER (SYSTEM)	TESTED BY
RE $\geq$ 1G	20deg. C, 69%RH	120Vac, 60Hz	Chris Lin
RE<1G	20deg. C, 69%RH	120Vac, 60Hz	Bayu Chen
PLC	25deg. C, 75%RH	120Vac, 60Hz	Chris Lin
APCM	25deg. C, 60%RH	120Vac, 60Hz	Ted Chang

### 3.3 Description of Support Units

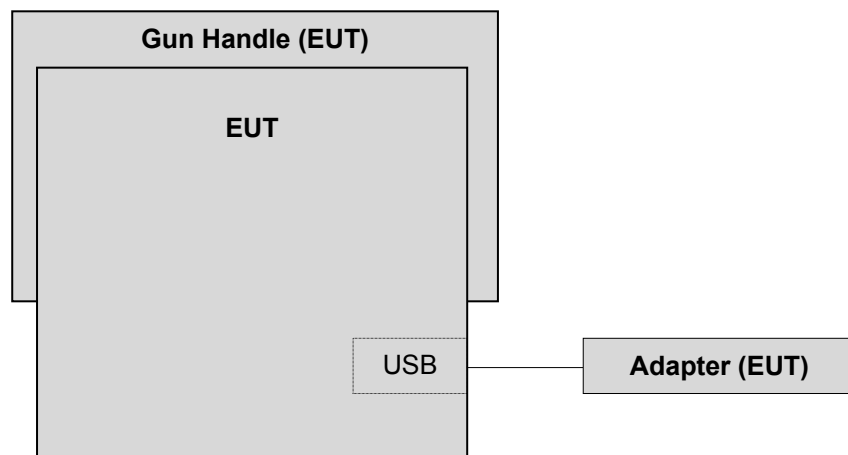
The EUT has been tested as an independent unit together with other necessary accessories or support units.

#### 3.3.1 Configuration of System under Test

Test Mode A, C, D



Test Mode B



### 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)

ANSI C63.10-2013

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

**NOTE:** The EUT is also considered as a kind of computer peripheral, because the connection to computer is necessary for typical use. It has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC). The test report has been issued separately.

## 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	ESCI	100424	Oct. 24, 2016	Oct. 23, 2017
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100040	Aug. 16, 2016	Aug. 15, 2017
BILOG Antenna SCHWARZBECK	VULB9168	9168-155	Dec. 28, 2016	Dec. 27, 2017
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-1170	Dec. 15, 2016	Dec. 14, 2017
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Dec. 14, 2016	Dec. 13, 2017
Loop Antenna	EM-6879	269	Aug. 11, 2016	Aug. 10, 2017
Preamplifier Agilent	8449B	3008A01960	Aug. 09, 2016	Aug. 08, 2017
Preamplifier Agilent	8447D	2944A10631	Aug. 09, 2016	Aug. 08, 2017
RF signal cable HUBER+SUHNER	SUCOFLEX 104	MY 13380+295012/04	Aug. 09, 2016	Aug. 08, 2017
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-CH4-03 (250724)	Aug. 09, 2016	Aug. 08, 2017
Software BV ADT	ADT_Radiated_ V7.6.15.9.4	NA	NA	NA
Antenna Tower inn-co GmbH	MA 4000	010303	NA	NA
Antenna Tower Controller BV ADT	AT100	AT93021703	NA	NA
Turn Table BV ADT	TT100	TT93021703	NA	NA
Turn Table Controller BV ADT	SC100	SC93021703	NA	NA
High Speed Peak Power Meter	ML2495A	0824012	Aug. 11, 2016	Aug. 10, 2017
Power Sensor	MA2411B	0738171	Aug. 11, 2016	Aug. 10, 2017

- 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 4.
  3. The horn antenna and preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
  4. The FCC Site Registration No. is 460141.
  5. The IC Site Registration No. is IC7450F-4.

### 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. Both X and Y axes of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

#### NOTE:

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

#### For Radiated emission above 30MHz

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

#### Note:

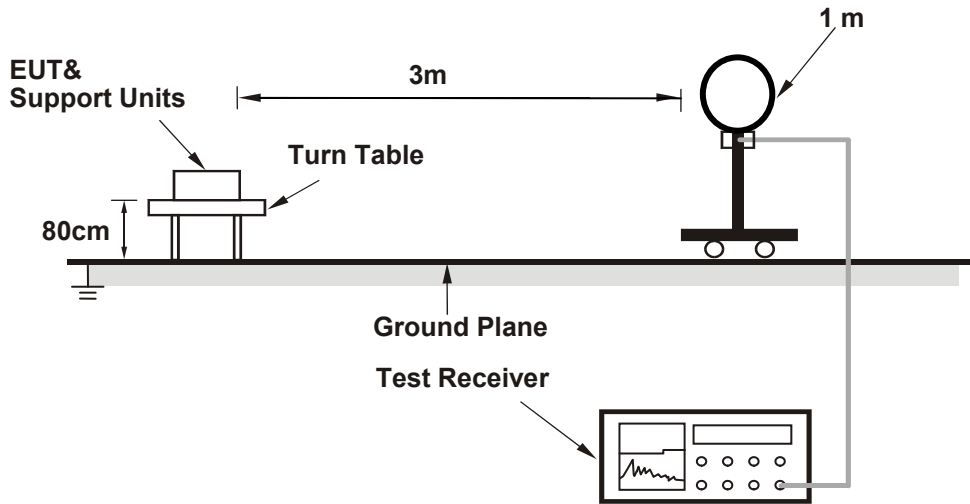
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
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.
4. All modes of operation were investigated and the worst-case emissions are reported.

### 4.1.4 Deviation from Test Standard

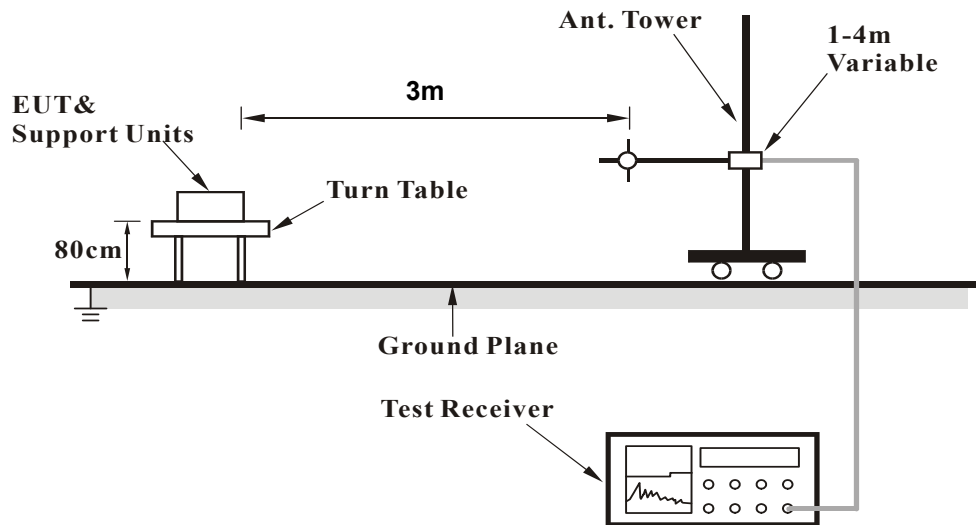
No deviation.

#### 4.1.5 Test Set Up

For Radiated emission below 30MHz

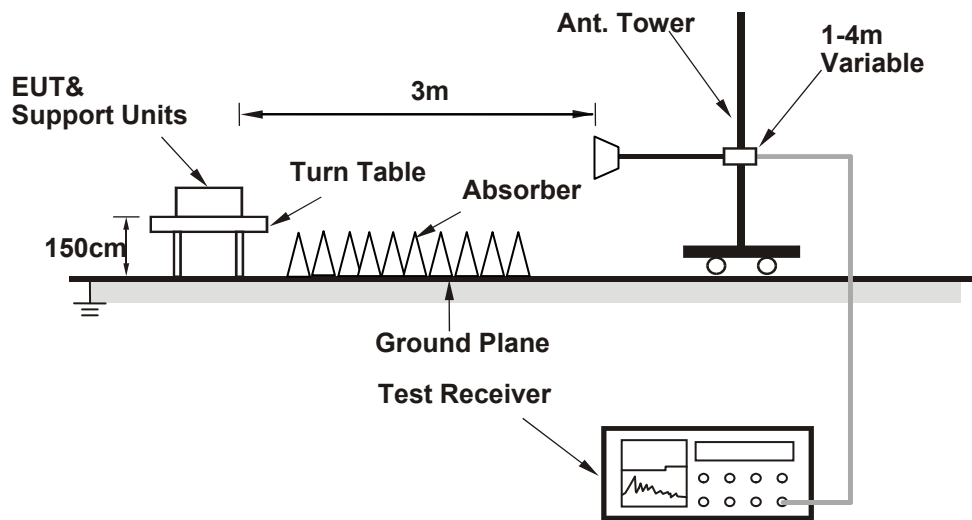


For Radiated emission 30MHz to 1GHz





### For Radiated emission above 1GHz



#### 4.1.6 EUT Operating Conditions

The EUT has been tested as an independent unit together with other necessary accessories or support units.

#### 4.1.7 Test Results

##### Above 1GHz Data:

##### GFSK

<b>CHANNEL</b>	TX Channel 0	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	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	52.1 PK	74.0	-21.9	3.06 H	180	53.6	-1.5
2	2390.00	39.8 AV	54.0	-14.2	3.06 H	180	41.3	-1.5
3	#2400.00	54.4 PK	74.0	-19.6	3.06 H	180	55.9	-1.5
4	#2400.00	24.3 AV	54.0	-29.7	3.06 H	180	25.8	-1.5
5	*2402.00	99.4 PK			3.06 H	180	66.5	32.9
6	*2402.00	69.3 AV			3.06 H	180	36.4	32.9
7	4804.00	49.3 PK	74.0	-24.7	1.32 H	89	42.6	6.7
8	4804.00	19.2 AV	54.0	-34.8	1.32 H	89	12.5	6.7

##### 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	51.1 PK	74.0	-22.9	2.78 V	198	52.6	-1.5
2	2390.00	39.1 AV	54.0	-14.9	2.78 V	198	40.6	-1.5
3	#2400.00	49.8 PK	74.0	-24.2	2.78 V	198	51.3	-1.5
4	#2400.00	19.7 AV	54.0	-34.3	2.78 V	198	21.2	-1.5
5	*2402.00	94.8 PK			2.78 V	198	61.9	32.9
6	*2402.00	64.7 AV			2.78 V	198	31.8	32.9
7	4804.00	48.2 PK	74.0	-25.8	1.28 V	38	41.5	6.7
8	4804.00	18.1 AV	54.0	-35.9	1.28 V	38	11.4	6.7

#### REMARKS:

- Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
- Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB)
- The other emission levels were very low against the limit.
- Margin value = Emission Level – Limit value
- " \* ": Fundamental frequency.
- The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 \* 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to:  $20\log(3.125 / 100) = -30.1$  dB
- Average value = peak reading + 20log(duty cycle).

<b>CHANNEL</b>	TX Channel 39	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	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	*2441.00	98.4 PK			2.54 H	188	65.3	33.1
2	*2441.00	68.3 AV			2.54 H	188	35.2	33.1
3	4882.00	49.4 PK	74.0	-24.6	1.62 H	87	42.6	6.8
4	4882.00	19.3 AV	54.0	-34.7	1.62 H	87	12.5	6.8

**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	95.0 PK			1.00 V	191	61.9	33.1
2	*2441.00	64.9 AV			1.00 V	191	31.8	33.1
3	4882.00	48.4 PK	74.0	-25.6	1.08 V	54	41.6	6.8
4	4882.00	18.3 AV	54.0	-35.7	1.08 V	54	11.5	6.8

**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)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 \* 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to:  $20\log(3.125 / 100) = -30.1$  dB
7. Average value = peak reading +  $20\log(\text{duty cycle})$ .

<b>CHANNEL</b>	TX Channel 78	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	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	99.6 PK			1.38 H	136	66.3	33.3
2	*2480.00	69.5 AV			1.38 H	136	36.2	33.3
3	2483.50	54.6 PK	74.0	-19.4	1.38 H	136	55.7	-1.1
4	2483.50	24.5 AV	54.0	-29.5	1.38 H	136	25.6	-1.1
5	4960.00	47.5 PK	74.0	-26.5	1.32 H	69	40.5	7.0
6	4960.00	17.4 AV	54.0	-36.6	1.32 H	69	10.4	7.0

**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	95.2 PK			1.51 V	93	61.9	33.3
2	*2480.00	65.1 AV			1.51 V	93	31.8	33.3
3	2483.50	50.2 PK	74.0	-23.8	1.51 V	93	51.3	-1.1
4	2483.50	20.1 AV	54.0	-33.9	1.51 V	93	21.2	-1.1
5	4960.00	48.2 PK	74.0	-25.8	1.23 V	64	41.2	7.0
6	4960.00	18.1 AV	54.0	-35.9	1.23 V	64	11.1	7.0

**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 other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 \* 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to:  $20\log(3.125 / 100) = -30.1$  dB
7. Average value = peak reading +  $20\log(\text{duty cycle})$ .

### 8DPSK

<b>CHANNEL</b>	TX Channel 0	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	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	52.1 PK	74.0	-21.9	2.81 H	141	53.6	-1.5
2	2390.00	39.8 AV	54.0	-14.2	2.81 H	141	41.3	-1.5
3	#2400.00	50.1 PK	74.0	-23.9	2.81 H	141	51.6	-1.5
4	#2400.00	20.0 AV	54.0	-34.0	2.81 H	141	21.5	-1.5
5	*2402.00	95.1 PK			2.81 H	141	62.2	32.9
6	*2402.00	65.0 AV			2.81 H	141	32.1	32.9
7	4804.00	48.0 PK	74.0	-26.0	1.05 H	28	41.3	6.7
8	4804.00	17.9 AV	54.0	-36.1	1.05 H	28	11.2	6.7

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	50.4 PK	74.0	-23.6	1.04 V	192	51.9	-1.5
2	2390.00	38.1 AV	54.0	-15.9	1.04 V	192	39.6	-1.5
3	#2400.00	49.2 PK	74.0	-24.8	1.04 V	192	50.7	-1.5
4	#2400.00	19.1 AV	54.0	-34.9	1.04 V	192	20.6	-1.5
5	*2402.00	94.2 PK			1.04 V	192	61.3	32.9
6	*2402.00	64.1 AV			1.04 V	192	31.2	32.9
7	4804.00	47.0 PK	74.0	-27.0	1.05 V	87	40.3	6.7
8	4804.00	16.9 AV	54.0	-37.1	1.05 V	87	10.2	6.7

#### 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)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 \* 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to:  $20\log(3.125 / 100) = -30.1$  dB
7. Average value = peak reading +  $20\log(\text{duty cycle})$ .

<b>CHANNEL</b>	TX Channel 39	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	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	*2441.00	95.8 PK			2.60 H	182	62.7	33.1
2	*2441.00	65.8 AV			2.60 H	182	32.7	33.1
3	4882.00	49.1 PK	74.0	-24.9	1.30 H	54	42.3	6.8
4	4882.00	19.0 AV	54.0	-35.0	1.30 H	54	12.2	6.8

**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	94.9 PK			1.21 V	186	61.8	33.1
2	*2441.00	64.8 AV			1.21 V	186	31.7	33.1
3	4882.00	48.0 PK	74.0	-26.0	1.36 V	20	41.2	6.8
4	4882.00	17.9 AV	54.0	-36.1	1.36 V	20	11.1	6.8

**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)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 \* 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to:  $20\log(3.125 / 100) = -30.1$  dB
7. Average value = peak reading +  $20\log(\text{duty cycle})$ .

<b>CHANNEL</b>	TX Channel 78	<b>DETECTOR FUNCTION</b>	Peak (PK)
<b>FREQUENCY RANGE</b>	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	96.3 PK			2.82 H	182	63.0	33.3
2	*2480.00	66.2 AV			2.82 H	182	32.9	33.3
3	2483.50	51.3 PK	74.0	-22.7	2.82 H	182	52.4	-1.1
4	2483.50	21.2 AV	54.0	-32.8	2.82 H	182	22.3	-1.1
5	4960.00	49.3 PK	74.0	-24.7	1.08 H	54	42.3	7.0
6	4960.00	19.2 AV	54.0	-34.8	1.08 H	54	12.2	7.0

**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	95.1 PK			1.51 V	91	61.8	33.3
2	*2480.00	65.0 AV			1.51 V	91	31.7	33.3
3	2483.50	50.1 PK	74.0	-23.9	1.51 V	91	51.2	-1.1
4	2483.50	20.0 AV	54.0	-34.0	1.51 V	91	21.1	-1.1
5	4960.00	48.2 PK	74.0	-25.8	1.47 V	87	41.2	7.0
6	4960.00	18.1 AV	54.0	-35.9	1.47 V	87	11.1	7.0

**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 other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " \* ": Fundamental frequency.
6. The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 \* 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to:  $20\log(3.125 / 100) = -30.1$  dB
7. Average value = peak reading +  $20\log(\text{duty cycle})$ .

Below 1GHz worst-case data:

GFSK

<b>CHANNEL</b>	TX Channel 39	<b>DETECTOR FUNCTION</b>	Quasi-Peak (QP)
<b>FREQUENCY RANGE</b>	30MHz ~ 1GHz	<b>TEST MODE</b>	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	49.40	28.7 QP	40.0	-11.3	1.99 H	310	42.7	-14.0
2	70.74	29.9 QP	40.0	-10.1	1.00 H	286	45.6	-15.7
3	111.48	29.2 QP	43.5	-14.3	1.49 H	313	45.9	-16.7
4	286.08	26.8 QP	46.0	-19.2	1.49 H	313	38.3	-11.5
5	582.90	31.0 QP	46.0	-15.0	1.99 H	178	35.4	-4.4
6	786.60	38.8 QP	46.0	-7.2	1.00 H	221	38.5	0.3

**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	36.1 QP	40.0	-3.9	2.00 V	356	52.1	-16.0
2	47.46	33.9 QP	40.0	-6.1	1.01 V	10	48.0	-14.1
3	105.66	27.7 QP	43.5	-15.8	1.01 V	286	45.2	-17.5
4	295.78	32.9 QP	46.0	-13.1	1.51 V	313	44.1	-11.2
5	582.90	31.5 QP	46.0	-14.5	1.01 V	325	35.9	-4.4
6	794.36	41.3 QP	46.0	-4.7	1.26 V	22	41.0	0.3

**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.



<b>CHANNEL</b>	TX Channel 39	<b>DETECTOR FUNCTION</b>	Quasi-Peak (QP)
<b>FREQUENCY RANGE</b>	30MHz ~ 1GHz	<b>TEST MODE</b>	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	31.94	27.0 QP	40.0	-13.0	1.49 H	14	43.0	-16.0
2	59.10	27.6 QP	40.0	-12.4	1.00 H	64	41.8	-14.2
3	84.32	23.5 QP	40.0	-16.5	1.24 H	22	42.3	-18.8
4	158.04	20.1 QP	43.5	-23.4	1.24 H	131	33.1	-13.0
5	596.48	28.4 QP	46.0	-17.6	1.49 H	93	32.3	-3.9
6	926.28	35.5 QP	46.0	-10.5	1.49 H	84	32.0	3.5

**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	30.00	32.2 QP	40.0	-7.8	1.26 V	220	48.2	-16.0
2	59.10	31.9 QP	40.0	-8.1	1.01 V	52	46.1	-14.2
3	84.32	27.3 QP	40.0	-12.7	1.50 V	220	46.1	-18.8
4	606.18	28.1 QP	46.0	-17.9	1.26 V	10	31.5	-3.4
5	683.78	29.2 QP	46.0	-16.8	1.26 V	35	31.3	-2.1
6	932.10	34.9 QP	46.0	-11.1	1.50 V	103	31.3	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. 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.

<b>CHANNEL</b>	TX Channel 39	<b>DETECTOR FUNCTION</b>	Quasi-Peak (QP)
<b>FREQUENCY RANGE</b>	30MHz ~ 1GHz	<b>TEST MODE</b>	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	33.88	27.7 QP	40.0	-12.3	1.24 H	85	43.2	-15.5
2	53.28	26.7 QP	40.0	-13.3	1.49 H	252	40.6	-13.9
3	128.94	23.8 QP	43.5	-19.7	1.24 H	278	39.0	-15.2
4	189.08	18.4 QP	43.5	-25.1	1.99 H	116	33.7	-15.3
5	454.86	25.3 QP	46.0	-20.7	1.01 H	16	32.7	-7.4
6	903.00	32.4 QP	46.0	-13.6	1.01 H	16	29.6	2.8

**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	33.88	32.7 QP	40.0	-7.3	1.00 V	346	48.2	-15.5
2	53.28	31.8 QP	40.0	-8.2	1.00 V	9	45.7	-13.9
3	68.80	28.0 QP	40.0	-12.0	1.50 V	207	43.5	-15.5
4	88.20	26.0 QP	43.5	-17.5	1.00 V	220	45.4	-19.4
5	480.08	27.3 QP	46.0	-18.7	1.25 V	201	34.2	-6.9
6	939.86	36.4 QP	46.0	-9.6	1.99 V	54	32.7	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.

<b>CHANNEL</b>	TX Channel 39	<b>DETECTOR FUNCTION</b>	Quasi-Peak (QP)
<b>FREQUENCY RANGE</b>	30MHz ~ 1GHz	<b>TEST MODE</b>	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	30.00	26.2 QP	40.0	-13.8	1.49 H	17	42.2	-16.0
2	53.28	27.5 QP	40.0	-12.5	1.24 H	202	41.4	-13.9
3	123.12	22.2 QP	43.5	-21.3	1.49 H	126	37.7	-15.5
4	150.28	21.6 QP	43.5	-21.9	1.49 H	217	35.0	-13.4
5	588.72	27.8 QP	46.0	-18.2	1.49 H	5	32.0	-4.2
6	819.58	33.6 QP	46.0	-12.4	1.49 H	234	32.6	1.0

**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	31.1 QP	40.0	-8.9	1.26 V	29	47.1	-16.0
2	53.28	32.5 QP	40.0	-7.5	1.26 V	64	46.4	-13.9
3	86.26	21.9 QP	40.0	-18.1	1.01 V	202	41.0	-19.1
4	497.54	26.0 QP	46.0	-20.0	1.50 V	144	32.4	-6.4
5	619.76	28.8 QP	46.0	-17.2	1.01 V	234	32.0	-3.2
6	961.20	36.9 QP	54.0	-17.1	1.26 V	269	32.6	4.3

**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.

## 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.	Date Of Calibration	Due Date Of Calibration
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Nov. 21, 2016	Nov. 20, 2017
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond1-01	Dec. 22, 2016	Dec. 21, 2017
LISN ROHDE & SCHWARZ (EUT)	ESH3-Z5	835239/001	Mar. 10, 2017	Mar. 09, 2018
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Jul. 28, 2016	Jul. 27, 2017
Software ADT	BV ADT_Cond_ V7.3.7.3	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-2040.

### 4.2.3 Test Procedures

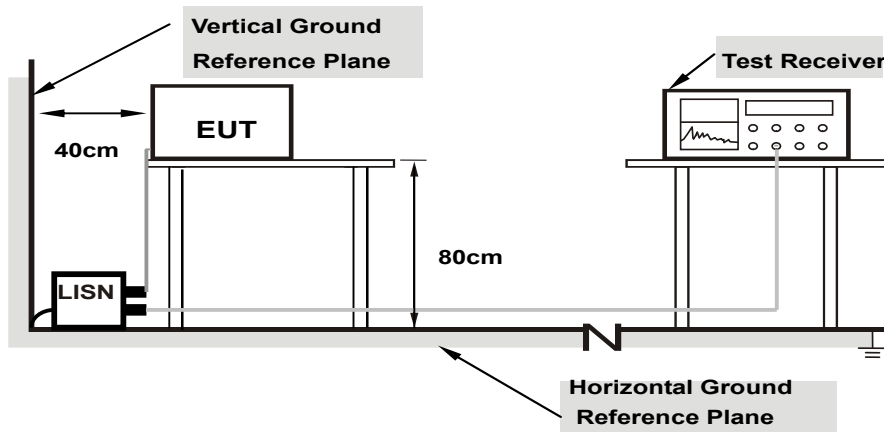
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

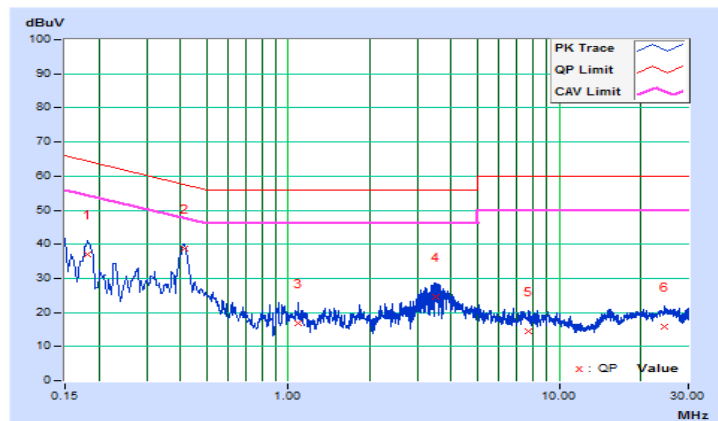
##### GFSK

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 39	Test Mode	A

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	0.18180	10.36	26.75	16.43	37.11	26.79	64.40
2	0.41252	10.40	28.43	21.39	38.83	31.79	57.60	47.60	-18.77	-15.81
3	1.08600	10.41	6.45	0.72	16.86	11.13	56.00	46.00	-39.14	-34.87
4	3.48600	10.54	13.88	5.87	24.42	16.41	56.00	46.00	-31.58	-29.59
5	7.69800	10.73	3.58	-1.62	14.31	9.11	60.00	50.00	-45.69	-40.89
6	24.45400	11.49	4.49	0.20	15.98	11.69	60.00	50.00	-44.02	-38.31

#### 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.

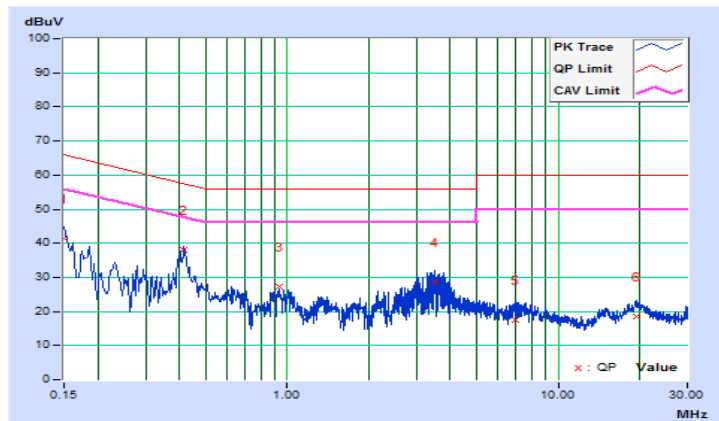


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 39	Test Mode	A

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	10.10	31.37	20.58	41.47	30.68	66.00
2	0.41400	10.16	27.73	20.17	37.89	30.33	57.57	47.57	-19.68	-17.24
3	0.93800	10.17	17.11	4.78	27.28	14.95	56.00	46.00	-28.72	-31.05
4	3.51800	10.31	18.28	8.53	28.59	18.84	56.00	46.00	-27.41	-27.16
5	6.93000	10.44	7.17	-0.25	17.61	10.19	60.00	50.00	-42.39	-39.81
6	19.55800	10.95	7.59	3.54	18.54	14.49	60.00	50.00	-41.46	-35.51

**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.

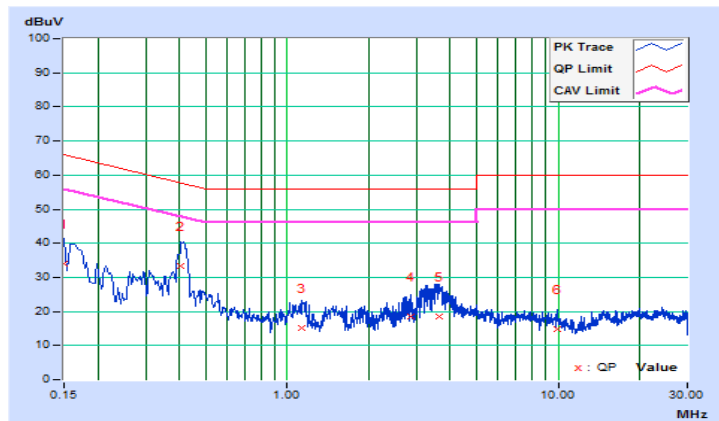


Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 39	Test Mode	B

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	10.34	23.82	12.59	34.16	22.93	66.00
2	0.40605	10.40	22.80	9.25	33.20	19.65	57.73	47.73	-24.53	-28.08
3	1.13800	10.41	4.88	-2.41	15.29	8.00	56.00	46.00	-40.71	-38.00
4	2.87400	10.51	8.01	-1.39	18.52	9.12	56.00	46.00	-37.48	-36.88
5	3.63400	10.55	8.03	-1.74	18.58	8.81	56.00	46.00	-37.42	-37.19
6	9.96600	10.83	3.85	-2.93	14.68	7.90	60.00	50.00	-45.32	-42.10

**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.



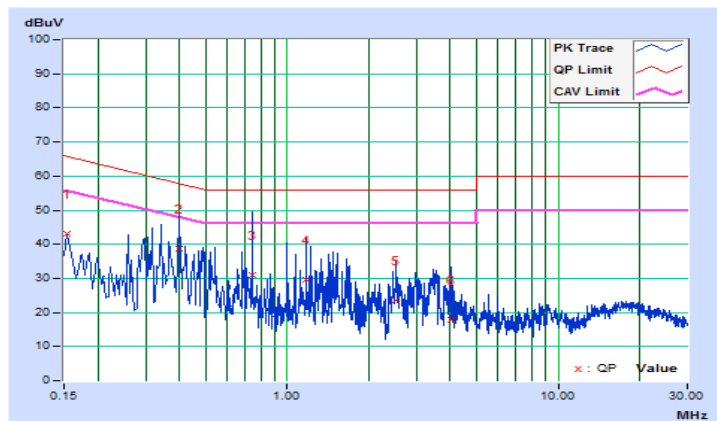


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 39	Test Mode	B

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	0.15400	10.11	33.00	19.64	43.11	29.75	65.78
2	0.39800	10.16	28.60	17.15	38.76	27.31	57.90	47.90	-19.14	-20.59
3	0.74200	10.17	20.72	0.02	30.89	10.19	56.00	46.00	-25.11	-35.81
4	1.17400	10.18	19.29	2.55	29.47	12.73	56.00	46.00	-26.53	-33.27
5	2.53390	10.26	13.38	1.66	23.64	11.92	56.00	46.00	-32.36	-34.08
6	4.05400	10.34	7.37	-2.10	17.71	8.24	56.00	46.00	-38.29	-37.76

**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.

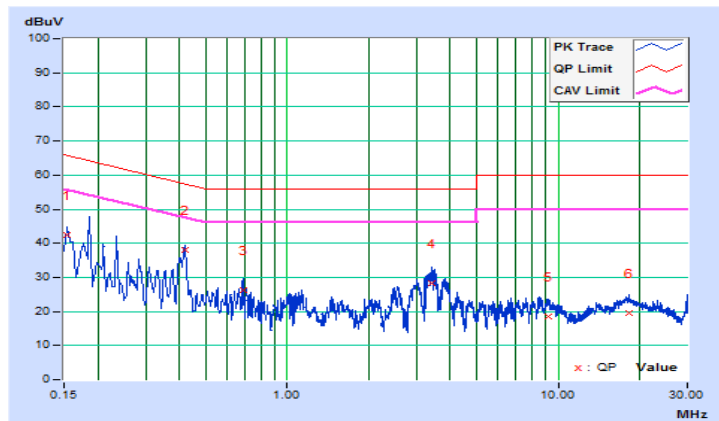


Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 39	Test Mode	C

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	0.15400	10.35	31.91	19.14	42.26	29.49	65.78
2	0.41799	10.40	27.70	17.52	38.10	27.92	57.49	47.49	-19.39	-19.57
3	0.68592	10.40	15.88	5.11	26.28	15.51	56.00	46.00	-29.72	-30.49
4	3.41800	10.54	17.69	3.99	28.23	14.53	56.00	46.00	-27.77	-31.47
5	9.19800	10.80	7.73	0.04	18.53	10.84	60.00	50.00	-41.47	-39.16
6	18.36600	11.27	8.23	0.07	19.50	11.34	60.00	50.00	-40.50	-38.66

**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.

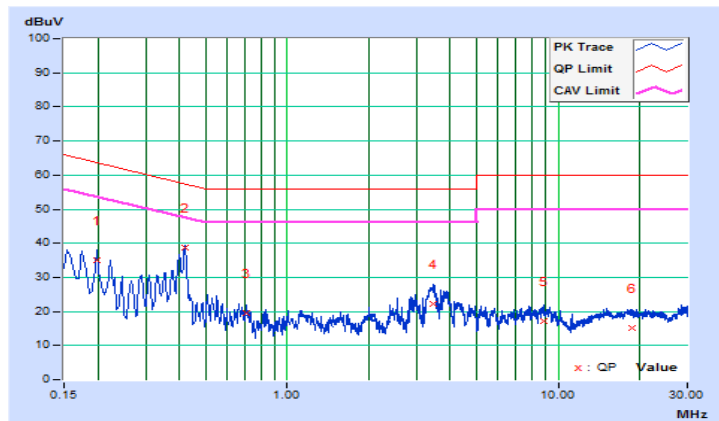


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 39	Test Mode	C

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	0.19800	10.14	24.92	12.75	35.06	22.89	63.69
2	0.41799	10.16	28.42	19.04	38.58	29.20	57.49	47.49	-18.91	-18.29
3	0.70609	10.17	9.25	1.19	19.42	11.36	56.00	46.00	-36.58	-34.64
4	3.47400	10.31	11.93	0.45	22.24	10.76	56.00	46.00	-33.76	-35.24
5	8.82600	10.51	6.69	-2.15	17.20	8.36	60.00	50.00	-42.80	-41.64
6	18.68200	10.91	4.29	-2.47	15.20	8.44	60.00	50.00	-44.80	-41.56

**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.

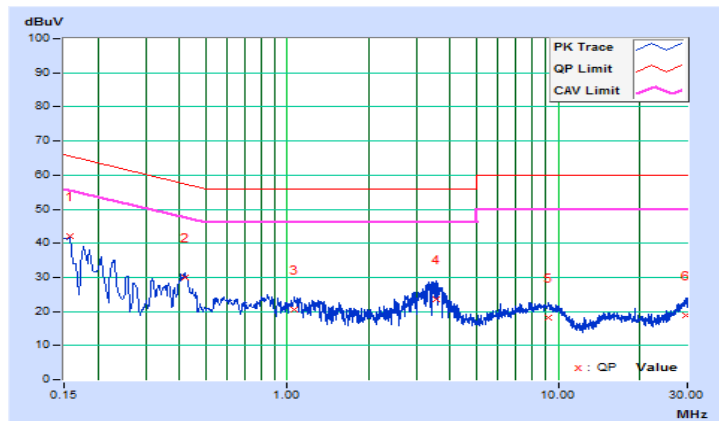


Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 39	Test Mode	D

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	0.15728	10.35	31.63	18.21	41.98	28.56	65.61
2	0.41799	10.40	19.44	13.66	29.84	24.06	57.49	47.49	-27.65	-23.43
3	1.06220	10.40	10.11	2.89	20.51	13.29	56.00	46.00	-35.49	-32.71
4	3.55800	10.55	13.02	3.14	23.57	13.69	56.00	46.00	-32.43	-32.31
5	9.25400	10.80	7.23	2.60	18.03	13.40	60.00	50.00	-41.97	-36.60
6	29.78200	11.67	7.32	1.60	18.99	13.27	60.00	50.00	-41.01	-36.73

**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.

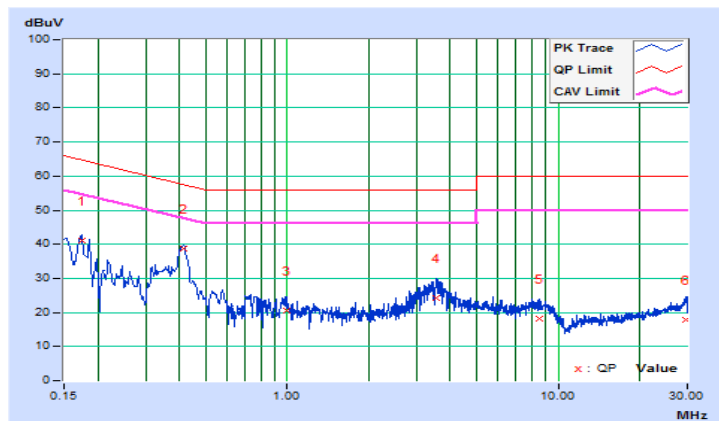


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	Channel 39	Test Mode	D

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	0.17384	10.12	30.89	19.82	41.01	29.94	64.77
<b>2</b>	<b>0.41252</b>	<b>10.16</b>	<b>28.71</b>	<b>21.82</b>	<b>38.87</b>	<b>31.98</b>	<b>57.60</b>	<b>47.60</b>	<b>-18.73</b>	<b>-15.62</b>
3	0.99000	10.17	10.43	1.54	20.60	11.71	56.00	46.00	-35.40	-34.29
4	3.55800	10.32	14.09	4.88	24.41	15.20	56.00	46.00	-31.59	-30.80
5	8.54200	10.50	7.76	1.60	18.26	12.10	60.00	50.00	-41.74	-37.90
6	29.43400	11.18	6.72	1.48	17.90	12.66	60.00	50.00	-42.10	-37.34

**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

- a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- b. 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.
- c. 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.
- d. Set the SA on View mode and then plot the result on SA screen.
- e. Repeat above procedures until all frequencies measured were complete.

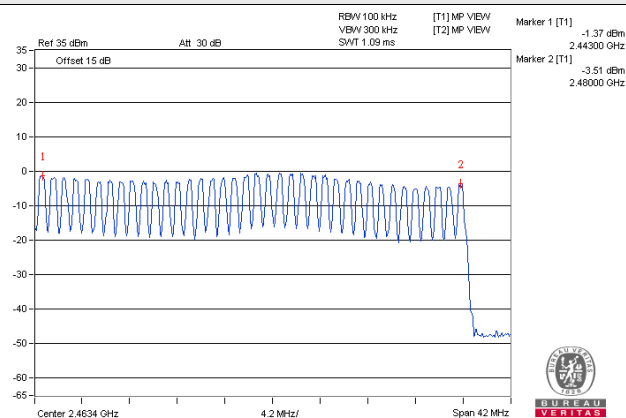
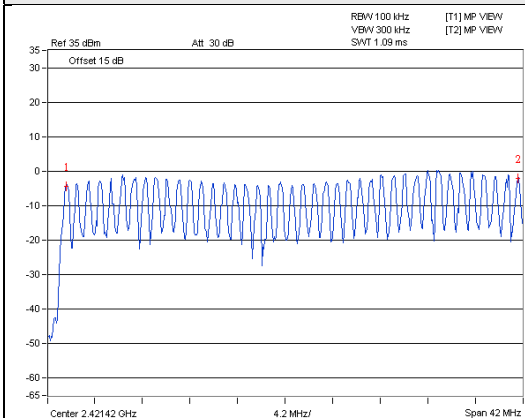
#### 4.3.5 Deviation from Test Standard

No deviation.

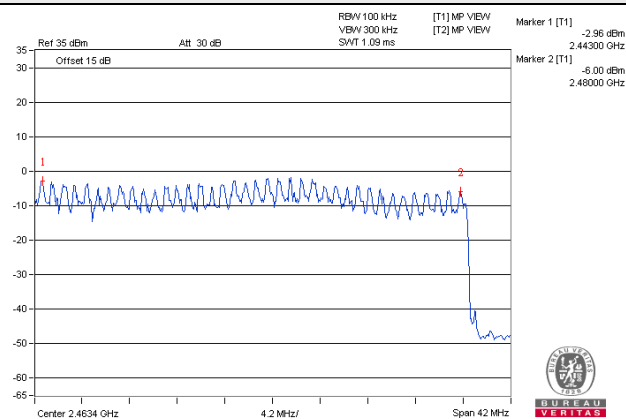
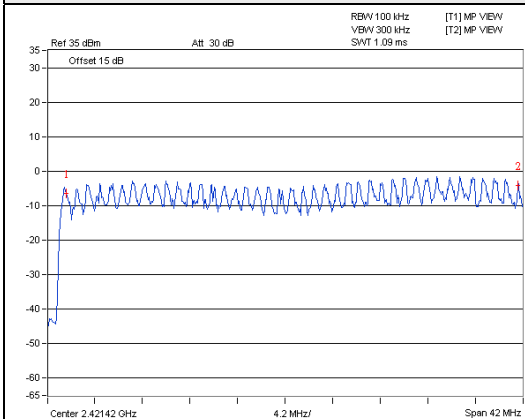
#### 4.3.6 Test Results

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

### GFSK



### 8DPSK



#### 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

- a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- b. 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.
- c. 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.
- d. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
- e. Repeat above procedures until all different time-slot modes have been completed.

##### 4.4.5 Deviation from Test Standard

No deviation.

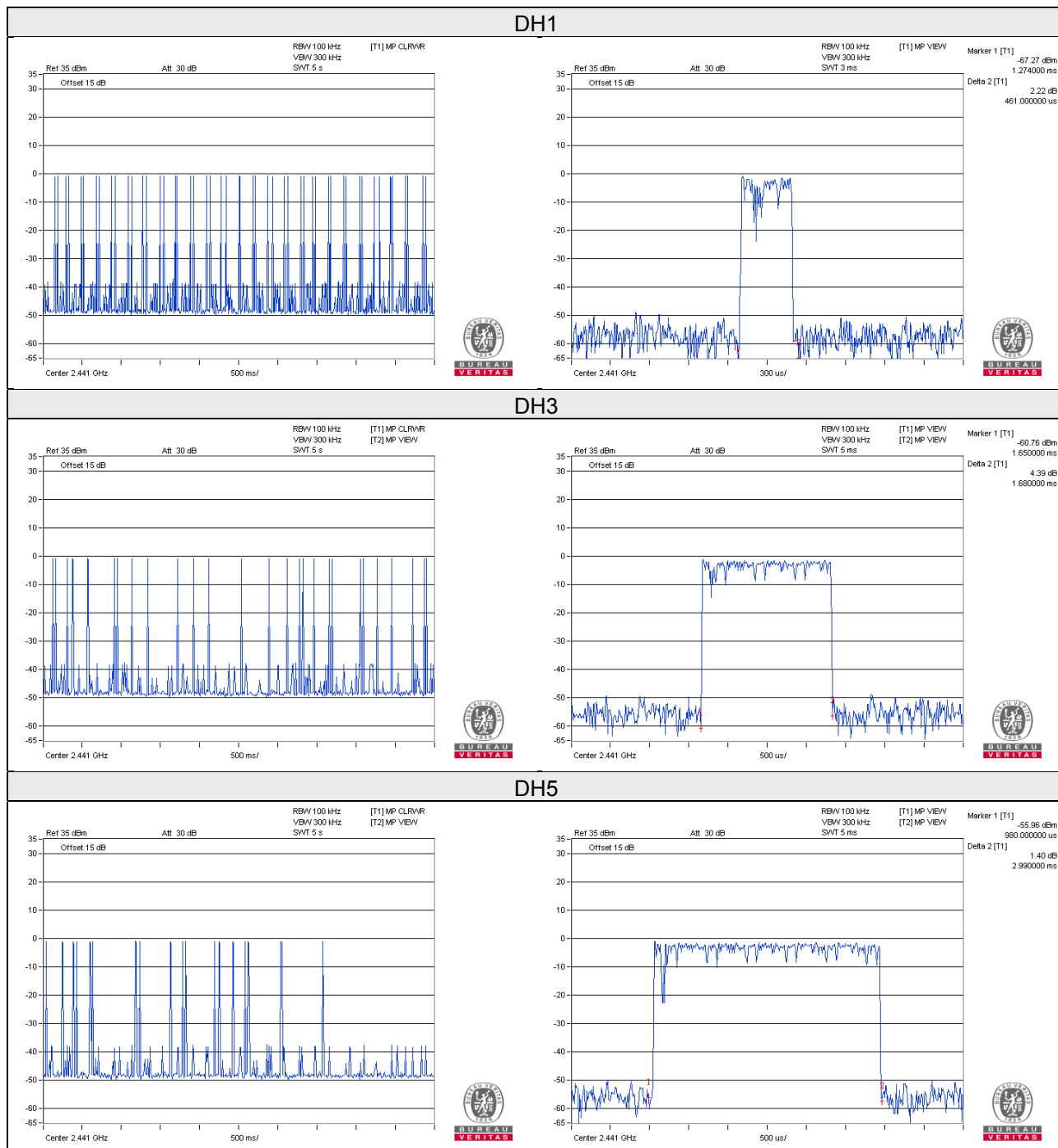


### 4.4.6 Test Results

#### GFSK

Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
DH1	50 (times / 5 sec) * 6.32 = 316.00 times	0.461	145.68	400
DH3	27 (times / 5 sec) * 6.32 = 170.64 times	1.680	286.68	400
DH5	18 (times / 5 sec) * 6.32 = 113.76 times	2.990	340.14	400

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

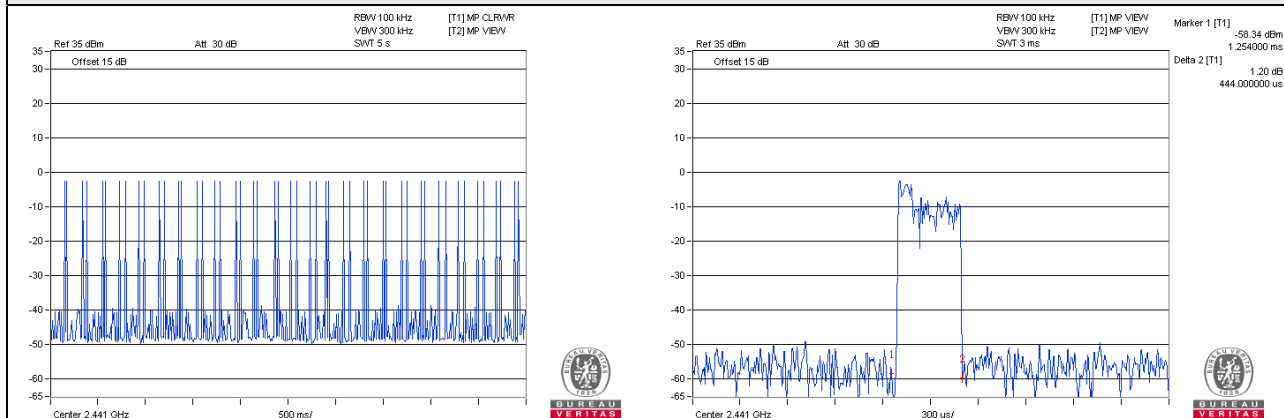


### 8DPSK

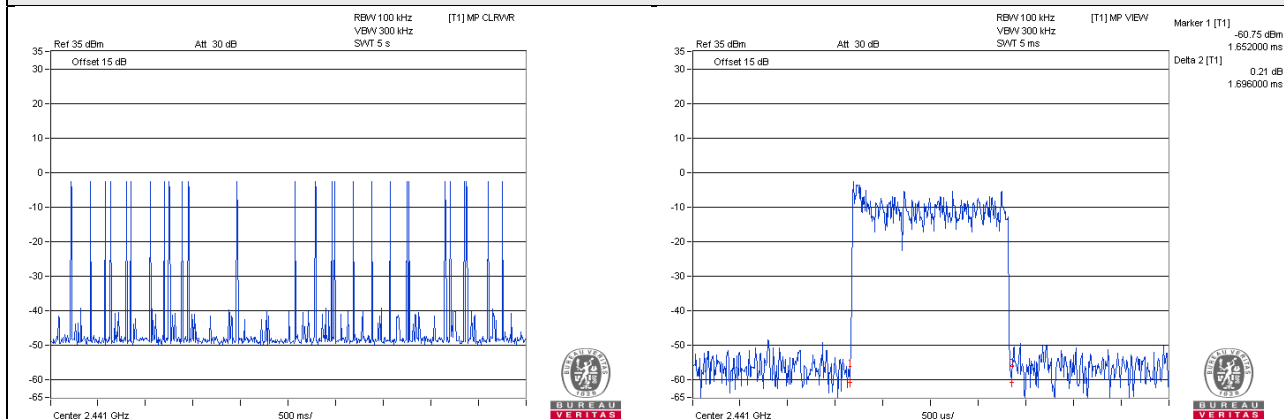
Mode	Number of transmission in a 31.6 (79Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
DH1	50 (times / 5 sec) * 6.32 = 316.00 times	0.444	140.30	400
DH3	27 (times / 5 sec) * 6.32 = 170.64 times	1.696	289.41	400
DH5	18 (times / 5 sec) * 6.32 = 113.76 times	3.020	343.56	400

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

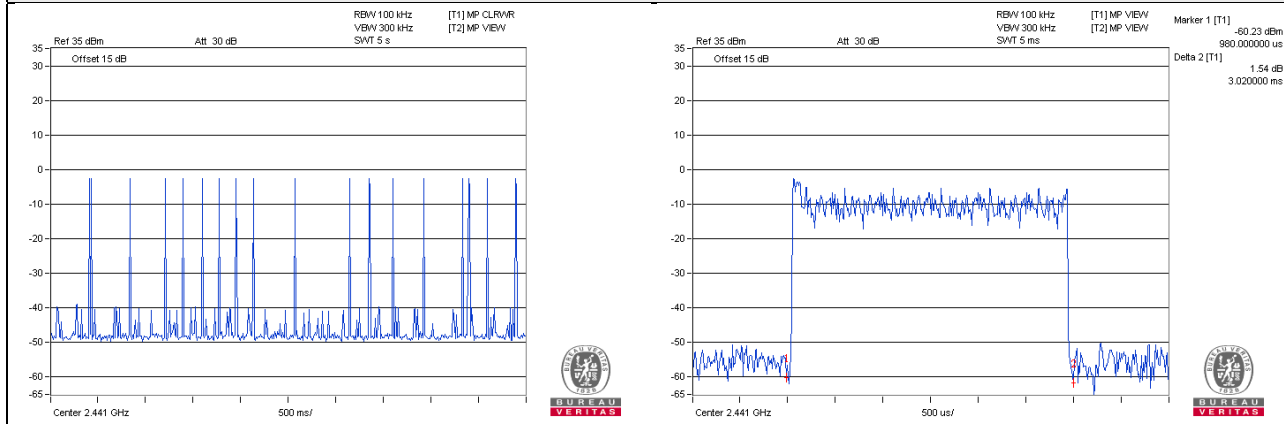
#### DH1



#### DH3



#### DH5

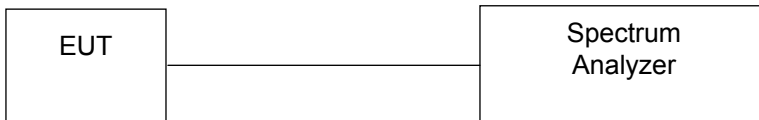


## 4.5 Channel Bandwidth

### 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

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

### 4.5.5 Deviation from Test Standard

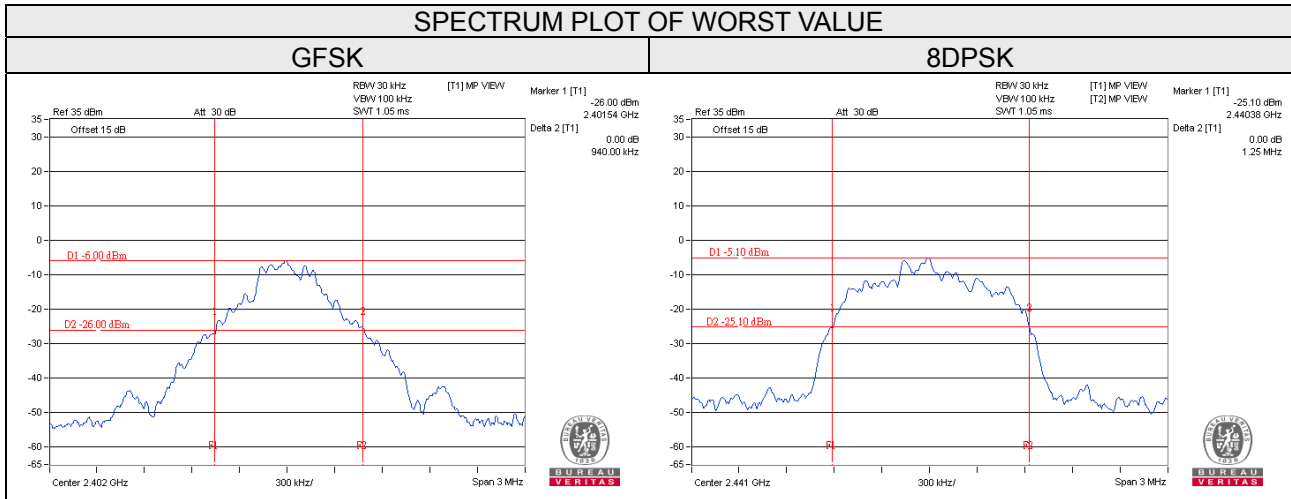
No deviation.

### 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	1.24
39	2441	0.94	1.25
78	2480	0.94	1.24

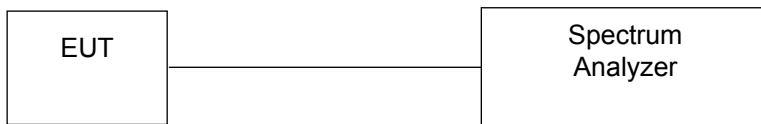


## 4.6 Hopping Channel Separation

### 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.

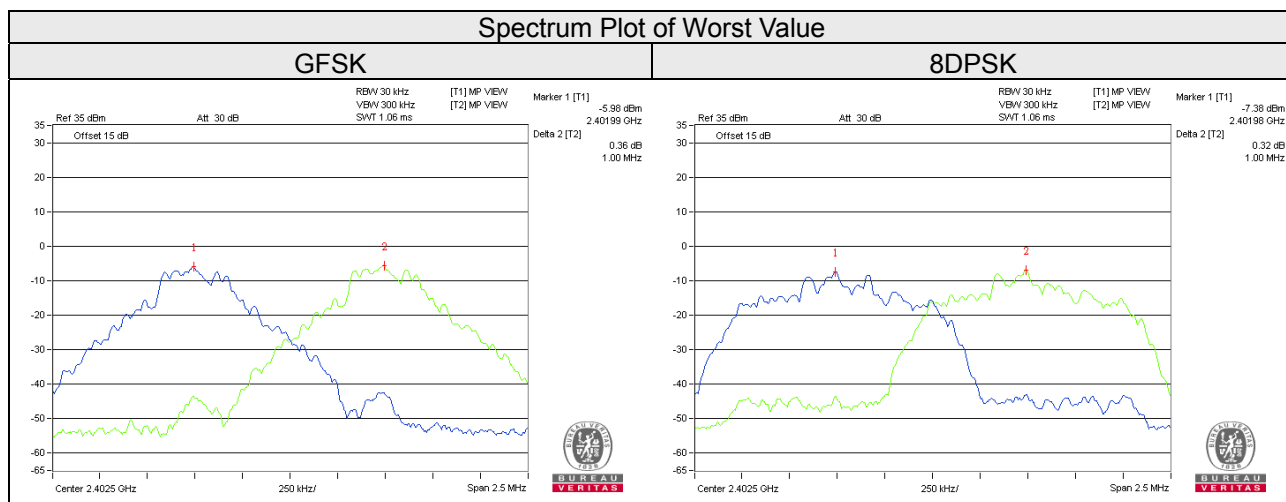
### 4.6.5 Deviation from Test Standard

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	1.24	0.63	0.83	Pass
39	2441	1.00	1.00	0.94	1.25	0.63	0.84	Pass
78	2480	1.00	1.00	0.94	1.24	0.63	0.83	Pass

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



## 4.7 Maximum Output Power

### 4.7.1 Limits of Maximum Output Power Measurement

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. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- b. 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.
- c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 3MHz RBW and 10 MHz VBW.
- d. Measure the captured power within the band and recording the plot.
- e. Repeat above procedures until all frequencies required were complete.

### 4.7.5 Deviation from Test Standard

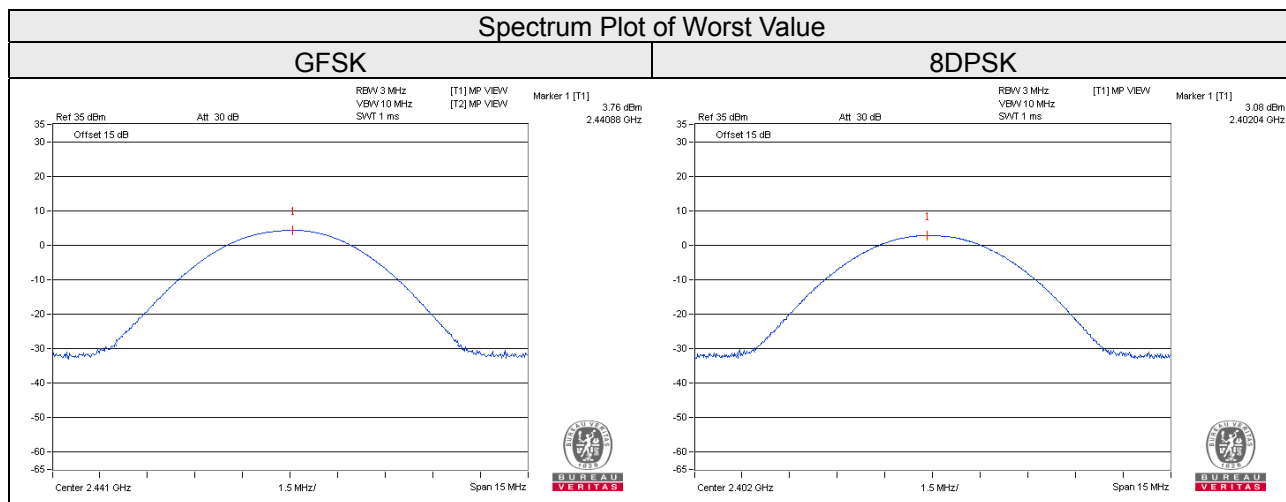
No deviation.

### 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)	Peak Power (mW)		Peak Power (dBm)		Power Limit (mW)	Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK		
0	2402	1.897	2.032	2.78	3.08	125	Pass
39	2441	<b>2.377</b>	1.820	3.76	2.60	125	Pass
78	2480	1.652	1.734	2.18	2.39	125	Pass



Channel	Frequency (MHz)	Average Power (mW)		Average Power (dBm)	
		GFSK	8DPSK	GFSK	8DPSK
0	2402	1.435	0.998	1.57	-0.01
39	2441	2.089	1.459	3.20	1.64
78	2480	1.230	0.873	0.90	-0.59



## **4.8 Conducted Out of Band Emission Measurement**

### **4.8.1 Limits Of Conducted Out Of Band Emission Measurement**

Below  $-20\text{dB}$  of the highest emission level of operating band (in  $100\text{kHz}$  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  $100\text{ kHz}$  and  $300\text{ kHz}$  with suitable frequency span including  $100\text{ MHz}$  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**

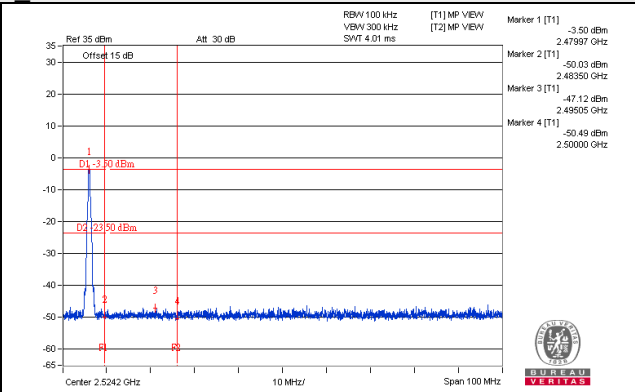
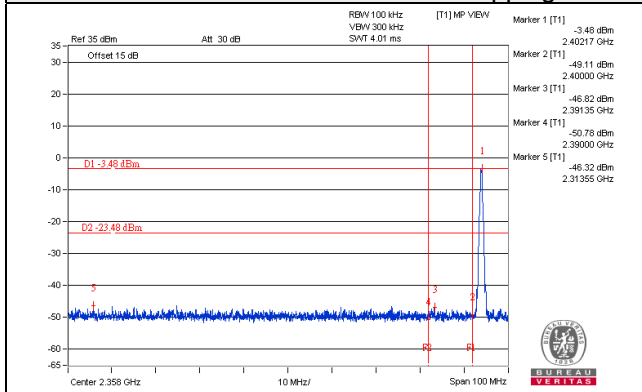
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

### **4.8.6 Test Results**

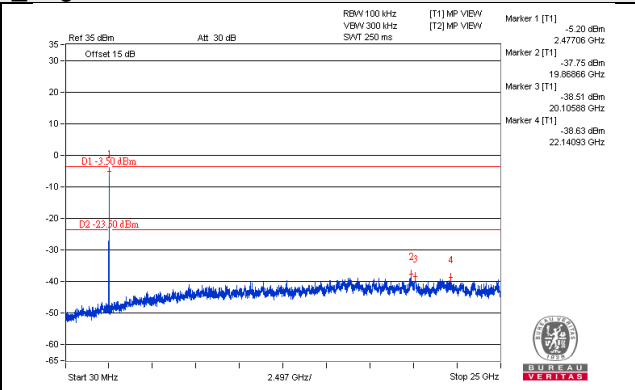
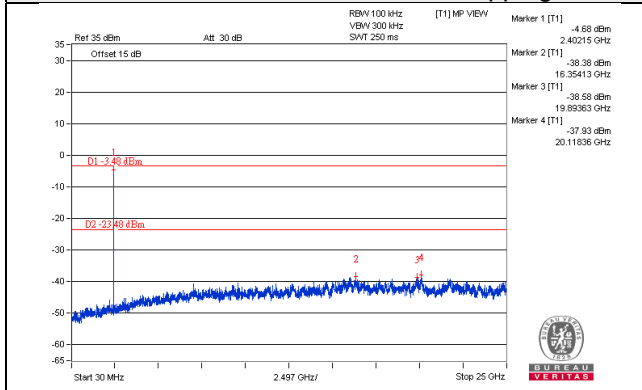
The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the  $20\text{dB}$  offset below D1. It shows compliance with the requirement.

GFSK

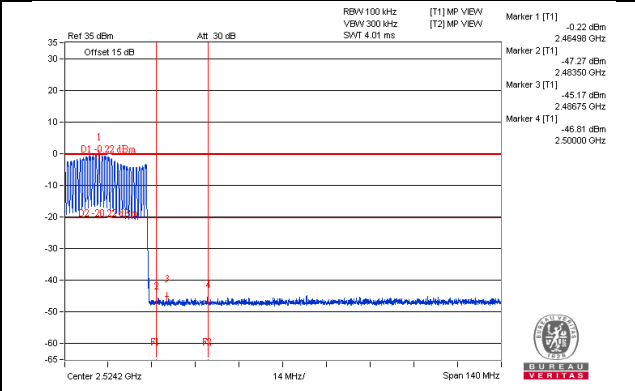
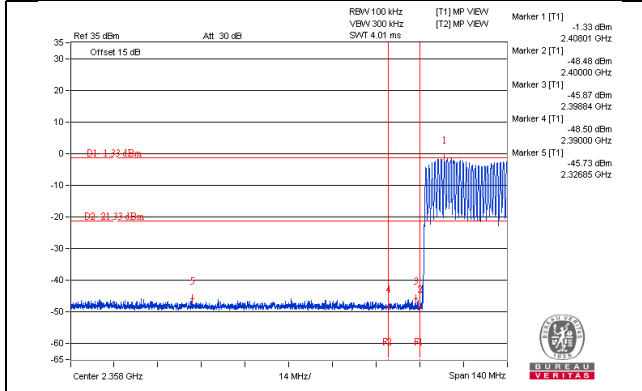
Hopping disabled Low Channel



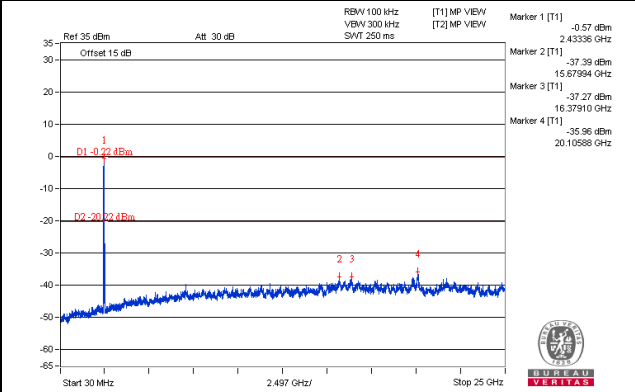
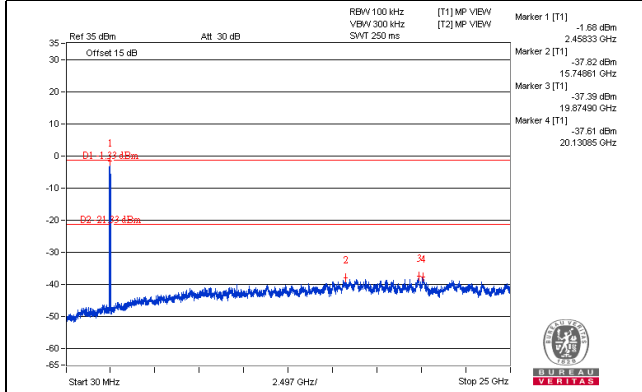
Hopping disabled High Channel



Hopping enabled Low Channel

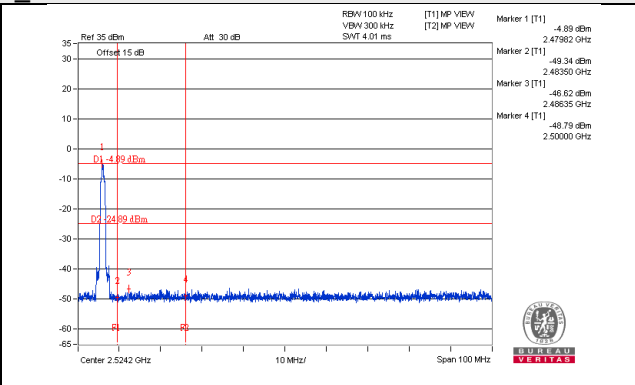
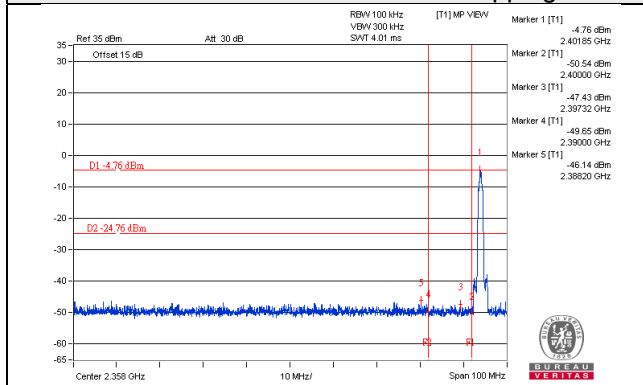


Hopping enabled High Channel

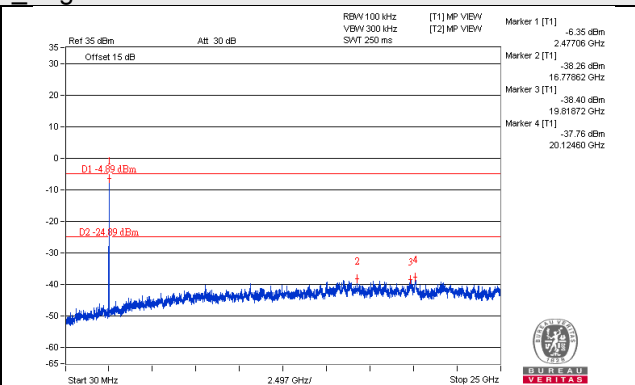
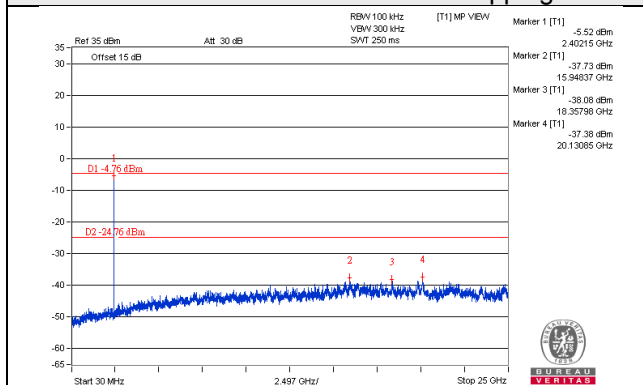


# 8DPSK

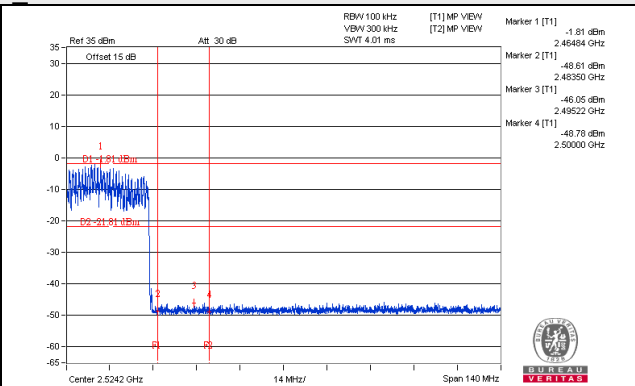
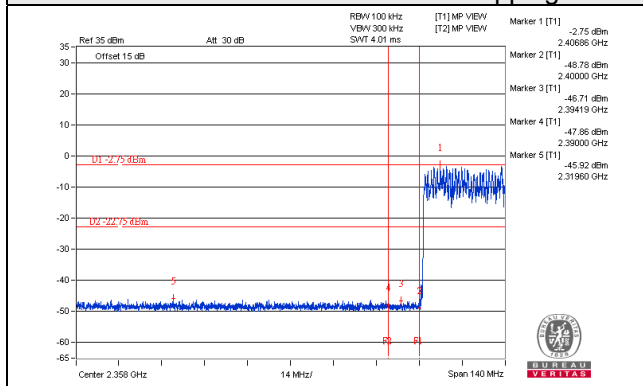
## Hopping disabled Low Channel



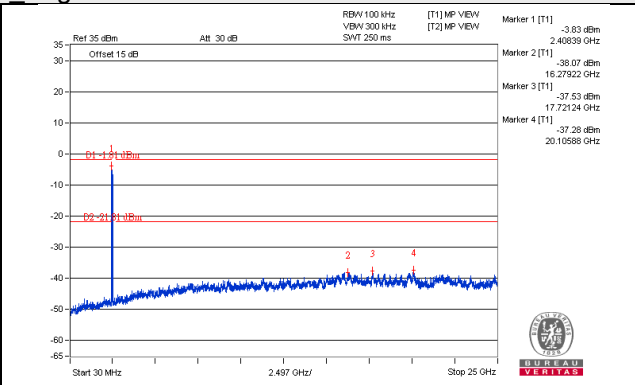
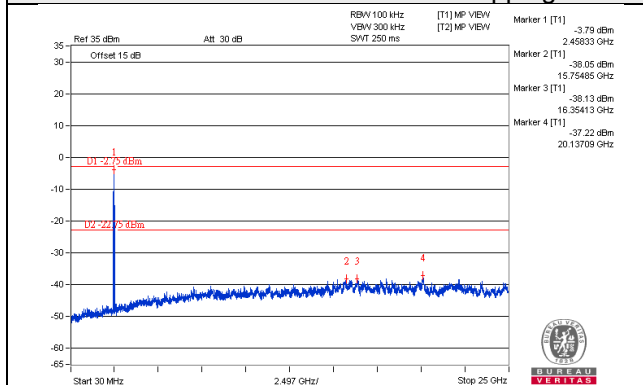
## Hopping disabled High Channel



## Hopping enabled Low Channel



## Hopping enabled High Channel



## 5 Pictures of Test Arrangements

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

## Appendix – Information on 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 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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