FCC Test Report

Report No.:	RF200508C01
FCC ID:	DMOCX400TW1L
Test Model:	CX400TW1 L
Received Date:	May 08, 2020
Test Date:	May 13 ~ Jun. 30, 2020
Issued Date:	Jul. 03, 2020
Applicant:	Sennheiser electronic GmbH & Co. KG
Address:	Am Labor 1, D-30900 Wedemark, Germany
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Lin Kou Laboratories
Lab Address:	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan
Test Location:	No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan
FCC Registration / Designation Number:	788550 / TW0003

Testing Laboratory
2021

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Release Control Record

Issue No.	Description	Date Issued
RF200508C01	Original Release	Jul. 03, 2020

1 Certificate of Conformity

Product:	CX True Wireless (CX400TW1)
Brand:	SENNHEISER
Test Model:	CX400TW1 L
Sample Status:	Engineering Sample
Applicant:	Sennheiser electronic GmbH & Co. KG
Test Date:	May 13 ~ Jun. 30, 2020
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 : _____ , **Date:** Jul. 03, 2020

Gina Liu / Specialist

Approved by : _____ , **Date:** Jul. 03, 2020

Dylan Chiou / 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 -13.54 dB at 0.16600 MHz.
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.
---	Occupied Bandwidth Measurement	Pass	Reference only
15.205 & 209	Radiated Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -10.16 dB at 934.04 MHz.
15.247(d)	Band Edge Measurement	Pass	Meet the requirement of limit.
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 2400-2483.5 MHz band and the output power less than 125 mW. The hopping channel carrier frequencies separated by a minimum of 25 kHz or two-thirds of the 20 dB 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	150 kHz ~ 30 MHz	2.79 dB
Radiated Emissions up to 1 GHz	9 kHz ~ 30 MHz	3.04 dB
	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	CX True Wireless (CX400TW1)
Brand	SENNHEISER
Test Model	CX400TW1 L
Status of EUT	Engineering Sample
Power Supply Rating	5Vdc from USB interface 3.7Vdc from battery (a) Earbuds: 54-60mAh (b) Charging Case: 400-420mAh
Modulation Type	GFSK, π/4-DQPSK, 8DPSK
Transfer Rate	1Mbps (BDR) & 2Mbps/3Mbps (EDR)
Operating Frequency	2402 ~ 2480 MHz
Number of Channel	79
Output Power	14.322 mW
Antenna Type	MONOPOLE antenna with -2.42 dBi gain
Antenna Connector	N/A
Accessory Device	Refer to Note as below
Data Cable Supplied	0.2m shielded USB cable without core

Note:

1. The EUT system CX True Wireless (CX400TW1), contain the following devices:

Item	Brand	Device Model
Right Earbud	SENNHEISER	CX400TW1 R
Left Earbud	SENNHEISER	CX400TW1 L
Charging Case	SENNHEISER	CX400TW1 C

   * CX400TW1 R and CX400TW1 L with BT & BT LE TX/RX function
   * Charging case is solely used for charging CX400TW1 R and CX400TW1 L only

2. The above EUT information is declared by manufacturer and for more detailed features description, please refers 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≥1G	RE<1G	PLC	APCM	
A	√	√	-	√	EUT (Left Earbud (main battery cell))
B	-	√	-	-	EUT (Left Earbud (alternative battery cell))
C	-	√	√	-	EUT (Left Earbud + Right Earbud + Charging case (main battery))
D	-	√	√	-	EUT (Left Earbud + Right Earbud + Charging case (alternative battery))

Where **RE≥1G:** Radiated Emission above 1 GHz **RE<1G:** Radiated Emission below 1 GHz

PLC: Power Line Conducted Emission **APCM:** Antenna Port Conducted Measurement

Note:

1. For Radiated emission test, pre-tested GFSK, π/4-DQPSK, 8DPSK modulation type and found GFSK was the worse, therefore chosen for the final test and presented in the test report.
2. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Z-plane**.
3. "-" means no effect.

Radiated Emission Test (Above 1 GHz):

☒ 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
	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

Radiated Emission Test (Below 1 GHz):

☒ 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
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
	0 to 78	0, 39, 78	FHSS	8DPSK	3DH5

Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested by
RE≥1G	25 deg. C, 65 % RH	3.7 Vdc	Jisyong Wang, Tim Chen
RE<1G	25 deg. C, 65 % RH	3.7 Vdc, 120 Vac, 60Hz	Tim Chen
PLC	25 deg. C, 65 % RH	120 Vac, 60 Hz	Jisyong Wang
APCM	25 deg. C, 65 % RH	3.7 Vdc	Wayne Lin

3.3 Description of Support Units

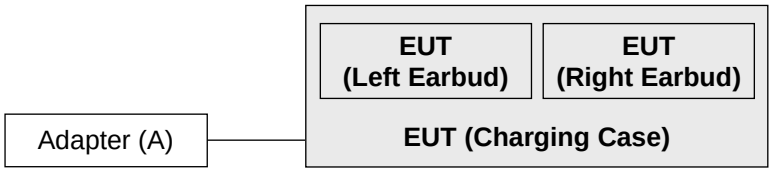
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Adapter	ASUS	AD827M	NA	NA	-

3.3.1 Configuration of System under Test

Test Mode A, B

Test Mode C, D



3.4 General Description of Applied Standards and References

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

Test Standard:

FCC Part 15, Subpart C (15.247)
ANSI C63.10-2013

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

References Test Guidance:

KDB 558074 D01 15.247 Meas Guidance v05r02

All test items have been performed as a reference to the above KDB test guidance.

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 20 dB 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:

a. The lower limit shall apply at the transition frequencies.

b. Emission level (dBuV/m) = 20 log Emission level (uV/m).

c. For frequencies above 1000 MHz, 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 20 dB under any condition of modulation.

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	N9038A	MY51210203	Mar. 18, 2020	Mar. 17, 2021
Spectrum Analyzer Agilent	N9010A	MY52220314	Dec. 12, 2019	Dec. 11, 2020
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Apr. 16, 2020	Apr. 15, 2021
Broadband Horn Antenna SCHWARZBECK	BBHA 9170	148	Nov. 24, 2019	Nov. 23, 2020
HORN Antenna SCHWARZBECK	BBHA 9120D	9120D-969	Nov. 24, 2019	Nov. 23, 2020
BILOG Antenna SCHWARZBECK	VULB 9168	9168-472	Nov. 08, 2019	Nov. 07, 2020
MXG Vector signal generator Agilent	N5182B	MY53050430	Oct. 25, 2019	Oct. 24, 2020
Loop Antenna	EM-6879	269	Sep. 16, 2019	Sep. 15, 2020
Preamplifier EMCI	EMC001340	980201	Oct. 14, 2019	Oct. 13, 2020
Bluetooth Tester	CBT	100946	Aug. 09, 2018	Aug. 08, 2020
Preamplifier EMCI	EMC 012645	980115	Oct. 08, 2019	Oct. 07, 2020
Preamplifier EMCI	EMC 184045	980116	Oct. 08, 2019	Oct. 07, 2020
Preamplifier EMCI	EMC 330H	980112	Oct. 08, 2019	Oct. 07, 2020
Power Meter Anritsu	ML2495A	1012010	Sep. 04, 2019	Sep. 03, 2020
Power Sensor Anritsu	MA2411B	1315050	Sep. 04, 2019	Sep. 03, 2020
RF Coaxial Cable HUBER+SUHNNER	EMC104-SM-SM-8000&3000	140811+170717	Oct. 08, 2019	Oct. 07, 2020
RF Coaxial Cable HUBER+SUHNNER	SUCOFLEX 104	EMC104-SM-SM-1000(140807)	Oct. 08, 2019	Oct. 07, 2020
RF Coaxial Cable WOKEN	8D-FB	Cable-Ch10-01	Oct. 08, 2019	Oct. 07, 2020
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Software BV ADT	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower &Turn Table Controller MF	MF-7802	NA	NA	NA

Note: 1. The calibration interval of the above test instruments is 12 / 24 months and the calibrations are traceable to NML/ROC and NIST/USA.

2. The test was performed in HwaYa Chamber 10.

4.1.3 Test Procedures

For Radiated Emission below 30 MHz

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 9 kHz at frequency below 30 MHz.

For Radiated Emission above 30 MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30 MHz ~ 1 GHz) / 1.5 meters (for above 1 GHz) 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 detected 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:

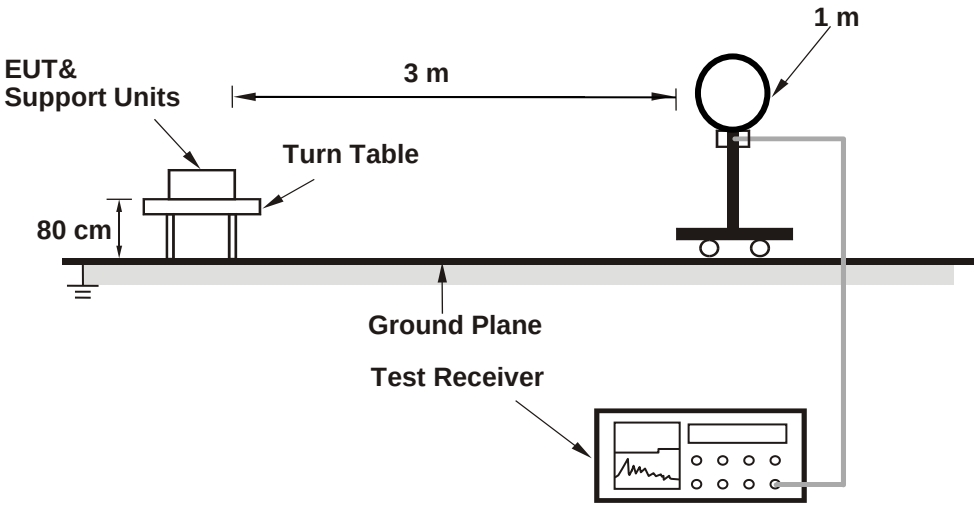
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) or Peak detection (PK) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK)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

4.1.4 Deviation from Test Standard

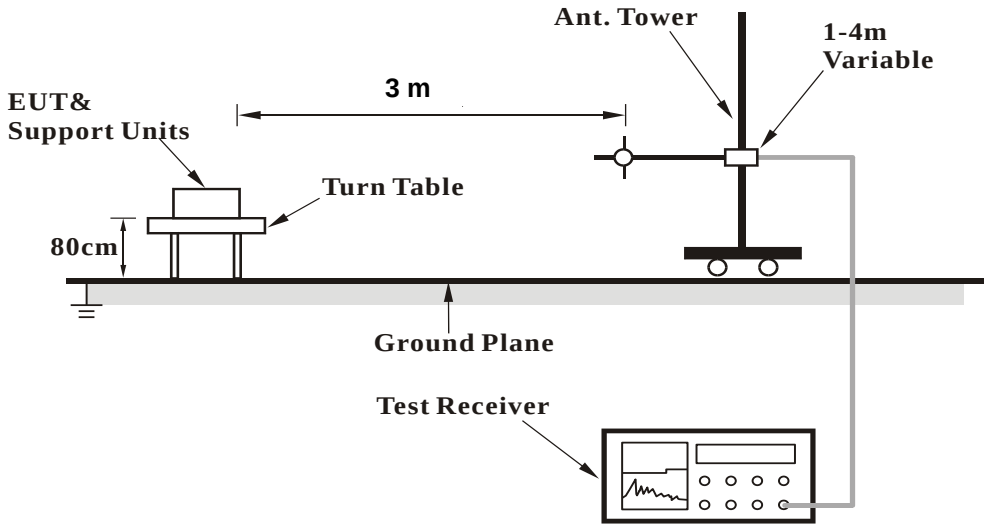
No deviation.

4.1.5 Test Set Up

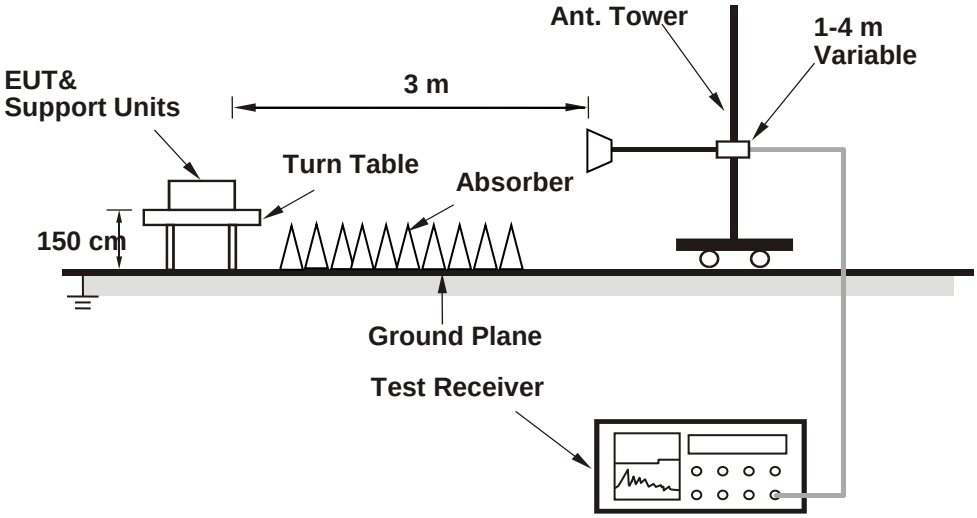
<Radiated Emission below 30 MHz>



<Radiated Emission 30 MHz to 1 GHz>



<Radiated Emission above 1 GHz>



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

4.1.6 EUT Operating Conditions

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

4.1.7 Test Results

Above 1 GHz Data:

GFSK

EUT Test Condition		Measurement Detail	
Channel	Channel 0	**Frequency Range**	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2390	36.22	42.14	-5.92	54	-17.78	167	38	Average
2390	46.15	52.07	-5.92	74	-27.85	167	38	Peak
2402	96.7	102.64	-5.94	------	------	167	38	Average
2402	97.17	103.11	-5.94	------	------	167	38	Peak
4804	35.9	51.54	-15.64	54	-18.1	103	156	Average
4804	45.01	60.65	-15.64	74	-28.99	103	156	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2390	36.02	41.94	-5.92	54	-17.98	100	99	Average
2390	45.37	51.29	-5.92	74	-28.63	100	99	Peak
2402	91.39	97.33	-5.94	------	------	100	99	Average
2402	91.87	97.81	-5.94	------	------	100	99	Peak
4804	36.73	52.37	-15.64	54	-17.27	132	166	Average
4804	43.81	59.45	-15.64	74	-30.19	132	166	Peak

Remarks:

1. Emission Level = Read Level + Factor
   Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
   Margin value = Emission level – Limit value
2. 2402 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 39	**Frequency Range**	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2390	36.27	42.19	-5.92	54	-17.73	168	55	Average
2390	45.84	51.76	-5.92	74	-28.16	168	55	Peak
2441	96.19	102	-5.81	------	------	168	55	Average
2441	96.63	102.44	-5.81	------	------	168	55	Peak
2483.5	36.32	42.02	-5.7	54	-17.68	168	55	Average
2483.5	45.91	51.61	-5.7	74	-28.09	168	55	Peak
4882	35.67	51.23	-15.56	54	-18.33	103	167	Average
4882	43.93	59.49	-15.56	74	-30.07	103	167	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2390	36.34	42.26	-5.92	54	-17.66	105	103	Average
2390	46.37	52.29	-5.92	74	-27.63	105	103	Peak
2441	90.02	95.83	-5.81	------	------	105	103	Average
2441	90.48	96.29	-5.81	------	------	105	103	Peak
2483.5	36.38	42.08	-5.7	54	-17.62	105	103	Average
2483.5	45.64	51.34	-5.7	74	-28.36	105	103	Peak
4882	34.8	50.36	-15.56	54	-19.2	106	37	Average
4882	44.4	59.96	-15.56	74	-29.6	106	37	Peak

Remarks:

1. Emission Level = Read Level + Factor
   Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
   Margin value = Emission level – Limit value
2. 2441 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 78	**Frequency Range**	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Tim Chen

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2480	94.82	100.52	-5.7	------	------	100	360	Average
2480	95.29	100.99	-5.7	------	------	100	360	Peak
2483.5	36.97	42.67	-5.7	54	-17.03	100	360	Average
2483.5	46.5	52.2	-5.7	74	-27.5	100	360	Peak
4960	34.19	49.64	-15.45	54	-19.81	155	104	Average
4960	42.01	57.46	-15.45	74	-31.99	155	104	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2480	91.05	96.75	-5.7	------	------	102	74	Average
2480	91.55	97.25	-5.7	------	------	102	74	Peak
2483.5	36.46	42.16	-5.7	54	-17.54	102	74	Average
2483.5	46.2	51.9	-5.7	74	-27.8	102	74	Peak
4960	34.69	50.14	-15.45	54	-19.31	121	163	Average
4960	42.21	57.66	-15.45	74	-31.79	121	163	Peak

Remarks:

1. Emission Level = Read Level + Factor
   Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
   Margin value = Emission level – Limit value
2. 2480 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

8DPSK

EUT Test Condition		Measurement Detail	
Channel	Channel 0	**Frequency Range**	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Jisyong Wang

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2390	35.85	41.77	-5.92	54	-18.15	125	201	Average
2390	46.02	51.94	-5.92	74	-27.98	125	201	Peak
2402	95.25	101.19	-5.94	------	------	125	201	Average
2402	96.03	101.97	-5.94	------	------	125	201	Peak
4804	35.45	51.09	-15.64	54	-18.55	110	132	Average
4804	44.89	60.53	-15.64	74	-29.11	110	132	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2390	35.92	41.84	-5.92	54	-18.08	100	249	Average
2390	45.11	51.03	-5.92	74	-28.89	100	249	Peak
2402	90.21	96.15	-5.94	------	------	100	249	Average
2402	90.53	96.47	-5.94	------	------	100	249	Peak
4804	36.42	52.06	-15.64	54	-17.58	131	158	Average
4804	43.25	58.89	-15.64	74	-30.75	131	158	Peak

Remarks:

1. Emission Level = Read Level + Factor
   Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
   Margin value = Emission level – Limit value
2. 2402 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 39	**Frequency Range**	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Jisyong Wang

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2390	36.11	42.03	-5.92	54	-17.89	104	212	Average
2390	45.25	51.17	-5.92	74	-28.75	104	212	Peak
2441	95.16	100.97	-5.81	------	------	104	212	Average
2441	95.42	101.23	-5.81	------	------	104	212	Peak
2483.5	36.16	41.86	-5.7	54	-17.84	104	212	Average
2483.5	45.73	51.43	-5.7	74	-28.27	104	212	Peak
4882	35.11	50.67	-15.56	54	-18.89	111	162	Average
4882	43.52	59.08	-15.56	74	-30.48	111	162	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2390	36.01	41.93	-5.92	54	-17.99	106	239	Average
2390	45.85	51.77	-5.92	74	-28.15	106	239	Peak
2441	87.85	93.66	-5.81	------	------	106	239	Average
2441	88.11	93.92	-5.81	------	------	106	239	Peak
2483.5	36.25	41.95	-5.7	54	-17.75	105	103	Average
2483.5	45.25	50.95	-5.7	74	-28.75	106	239	Peak
4882	34.25	49.81	-15.56	54	-19.75	132	111	Average
4882	44.03	59.59	-15.56	74	-29.97	132	111	Peak

Remarks:

1. Emission Level = Read Level + Factor
   Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
   Margin value = Emission level – Limit value
2. 2441 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

EUT Test Condition		Measurement Detail	
Channel	Channel 78	**Frequency Range**	1 GHz ~ 25 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Jisyong Wang

Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2480	93.75	99.45	-5.7	------	------	121	213	Average
2480	94.02	99.72	-5.7	------	------	121	213	Peak
2483.5	36.85	42.55	-5.7	54	-17.15	121	213	Average
2483.5	46.02	51.72	-5.7	74	-27.98	121	213	Peak
4960	34.02	49.47	-15.45	54	-19.98	151	111	Average
4960	41.98	57.43	-15.45	74	-32.02	151	111	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
2480	90.01	95.71	-5.7	------	------	105	241	Average
2480	90.44	96.14	-5.7	------	------	105	241	Peak
2483.5	36.11	41.81	-5.7	54	-17.89	105	241	Average
2483.5	45.98	51.68	-5.7	74	-28.02	105	241	Peak
4960	34.25	49.7	-15.45	54	-19.75	165	111	Average
4960	42.01	57.46	-15.45	74	-31.99	165	111	Peak

Remarks:

1. Emission Level = Read Level + Factor
   Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
   Margin value = Emission level – Limit value
2. 2480 MHz: Fundamental frequency.
3. The emission levels of other frequencies were very low against the limit.

9 kHz ~ 30 MHz Data:

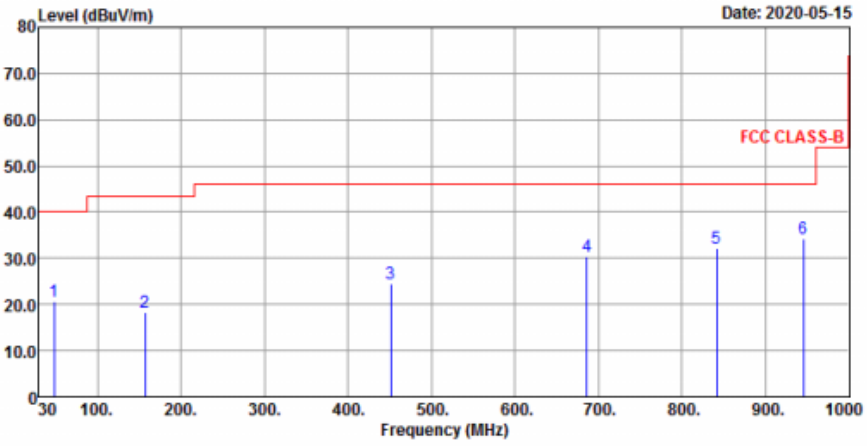
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

30 MHz ~ 1 GHz Worst-Case Data:

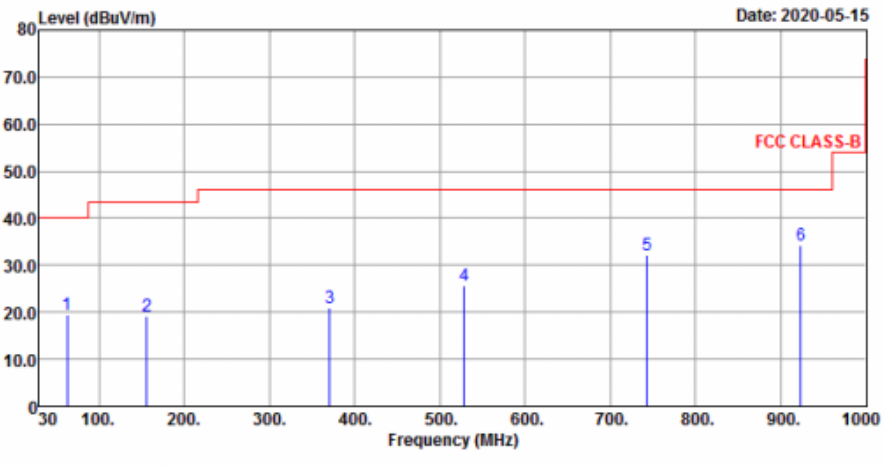
Mode A

EUT Test Condition		Measurement Detail	
Channel	Channel 39	**Frequency Range**	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Tim Chen

Horizontal



Vertical



Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
48.43	20.81	32.52	-11.71	40	-19.19	193	12	Peak
157.07	18.41	30.01	-11.6	43.5	-25.09	169	112	Peak
450.98	24.48	30.9	-6.42	46	-21.52	179	21	Peak
685.72	30.39	31.32	-0.93	46	-15.61	165	278	Peak
840.92	32.22	29.83	2.39	46	-13.78	156	144	Peak
945.68	34.11	30.46	3.65	46	-11.89	212	326	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
62.98	19.62	32.47	-12.85	40	-20.38	176	92	Peak
156.1	19.24	30.96	-11.72	43.5	-24.26	138	242	Peak
370.47	21.08	30.08	-9	46	-24.92	153	211	Peak
528.58	25.57	30.55	-4.98	46	-20.43	115	199	Peak
742.95	32.07	31.16	0.91	46	-13.93	103	188	Peak
923.37	34.36	31.03	3.33	46	-11.64	197	311	Peak

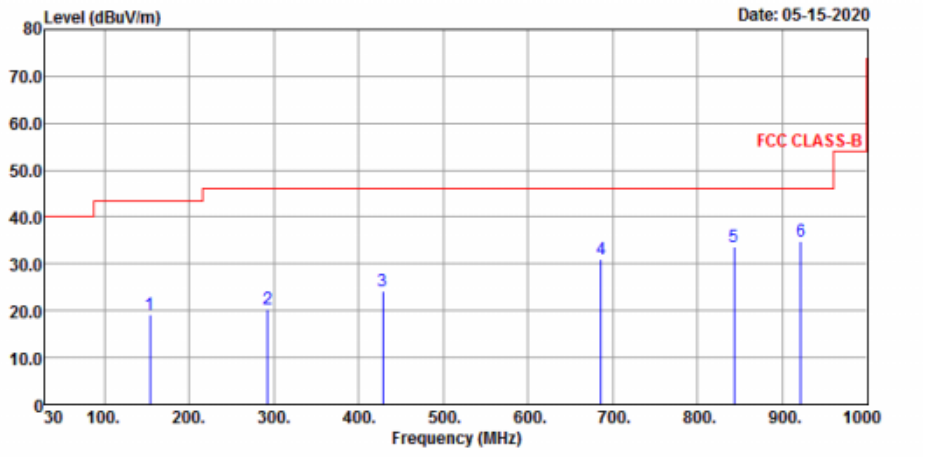
Remarks:

1. Emission Level = Read Level + Factor
   Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
   Margin value = Emission level – Limit value
2. The emission levels of other frequencies were very low against the limit.

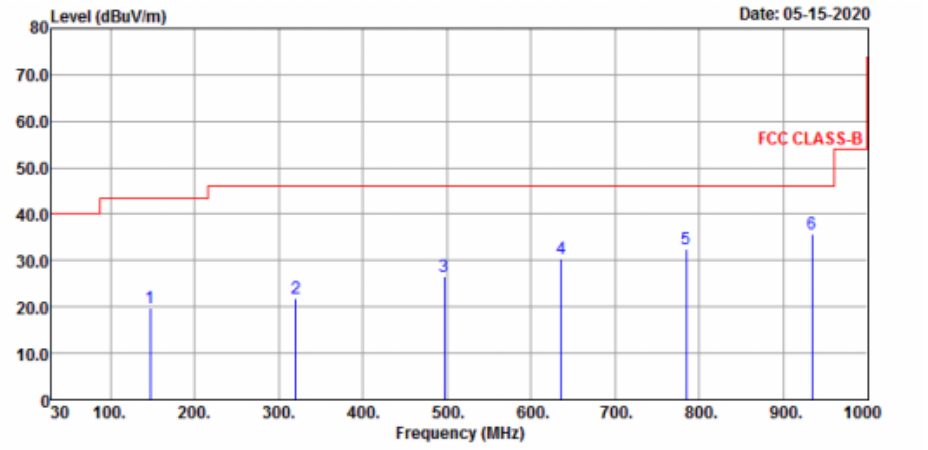
Mode B

EUT Test Condition		Measurement Detail	
Channel	Channel 39	**Frequency Range**	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Tim Chen

Horizontal



Vertical



Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
154.16	19.2	30.76	-11.56	43.5	-24.3	132	132	Peak
292.87	20.34	31.72	-11.38	46	-25.66	111	145	Peak
428.67	24.08	31.23	-7.15	46	-21.92	102	265	Peak
685.72	30.94	31.87	-0.93	46	-15.06	185	245	Peak
842.86	33.66	31.26	2.4	46	-12.34	165	231	Peak
921.43	34.75	31.45	3.3	46	-11.25	147	152	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
147.37	19.78	31.51	-11.73	43.5	-23.72	125	145	Peak
320.03	21.77	32.24	-10.47	46	-24.23	132	251	Peak
496.57	26.62	32.14	-5.52	46	-19.38	111	165	Peak
635.28	30.42	32.15	-1.73	46	-15.58	102	285	Peak
784.66	32.48	30.93	1.55	46	-13.52	147	152	Peak
934.04	**35.84**	**32.41**	**3.43**	**46**	**-10.16**	**132**	**265**	**Peak**

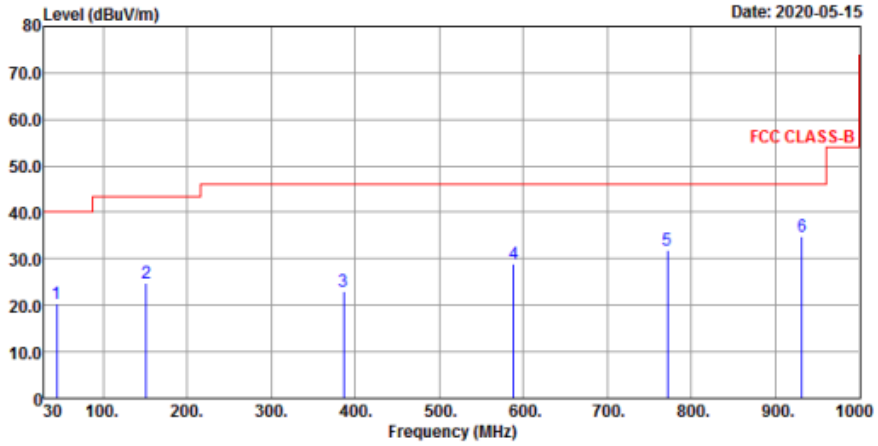
Remarks:

1. Emission Level = Read Level + Factor
   Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
   Margin value = Emission level – Limit value
2. The emission levels of other frequencies were very low against the limit.

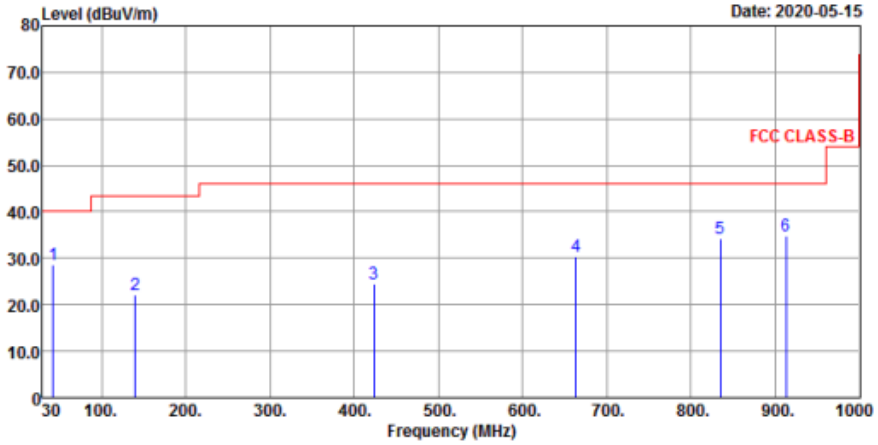
Mode C

EUT Test Condition		Measurement Detail	
Channel	Channel 39	**Frequency Range**	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Tim Chen

Horizontal



Vertical



Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
44.55	20.33	32.2	-11.87	40	-19.67	154	122	Peak
151.25	24.81	36.52	-11.71	43.5	-18.69	132	155	Peak
385.99	23.03	31.66	-8.63	46	-22.97	166	36	Peak
588.72	28.82	31.9	-3.08	46	-17.18	112	352	Peak
771.08	31.88	30.61	1.27	46	-14.12	147	87	Peak
931.13	34.83	31.4	3.43	46	-11.17	111	121	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
42.61	28.78	40.76	-11.98	40	-11.22	171	74	Peak
139.61	22.14	34.29	-12.15	43.5	-21.36	146	166	Peak
423.82	24.55	31.9	-7.35	46	-21.45	188	163	Peak
663.41	30.54	31.96	-1.42	46	-15.46	142	144	Peak
835.1	34.18	31.9	2.28	46	-11.82	181	156	Peak
912.7	34.8	31.59	3.21	46	-11.2	177	192	Peak

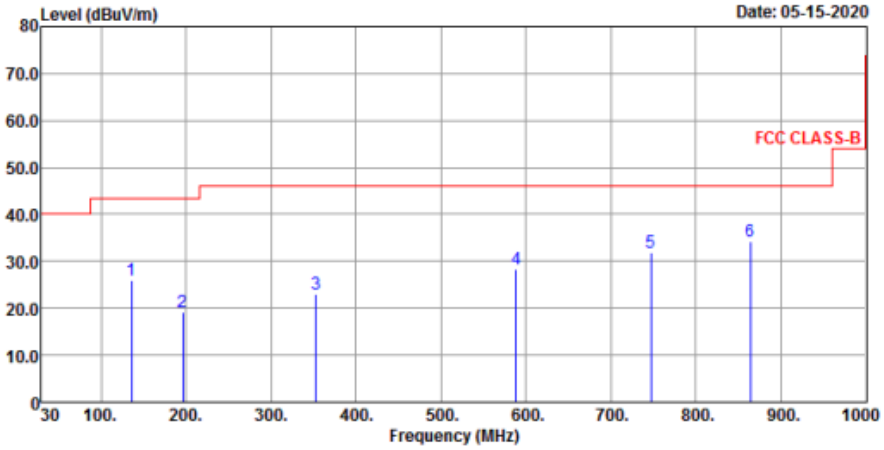
Remarks:

1. Emission Level = Read Level + Factor
   Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
   Margin value = Emission level – Limit value
2. The emission levels of other frequencies were very low against the limit.

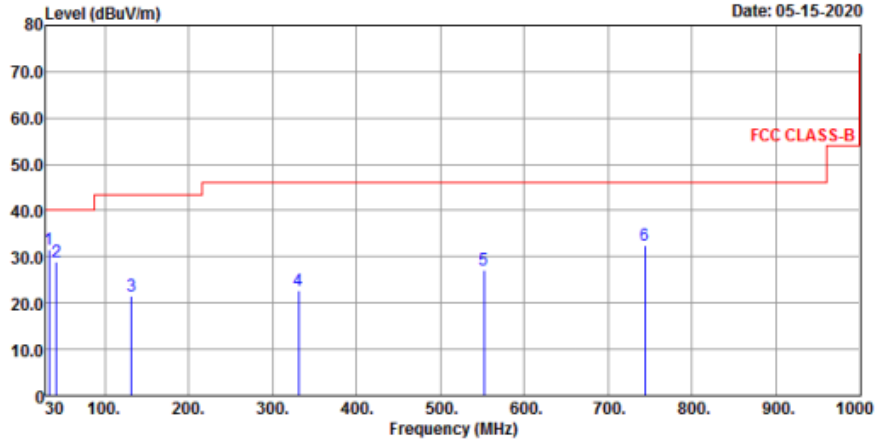
Mode D

EUT Test Condition		Measurement Detail	
Channel	Channel 39	**Frequency Range**	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	**Detector Function**	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	**Tested By**	Tim Chen

Horizontal



Vertical



Antenna Polarity & Test Distance: Horizontal at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
135.73	25.93	38.29	-12.36	43.5	-17.57	145	152	Peak
195.87	19.15	34.14	-14.99	43.5	-24.35	102	231	Peak
353.01	22.9	32.57	-9.67	46	-23.1	165	295	Peak
588.72	28.44	31.52	-3.08	46	-17.56	147	152	Peak
746.83	31.94	30.99	0.95	46	-14.06	111	132	Peak
864.2	34.26	31.65	2.61	46	-11.74	158	256	Peak
Antenna Polarity & Test Distance: Vertical at 3 m								
Frequency (MHz)	**Emission Level (dBuV/m)**	**Read Level (dBuV)**	**Factor (dB/m)**	**Limit (dBuV/m)**	**Margin (dB)**	**Antenna Height (cm)**	**Table Angle (Degree)**	**Remark**
33.88	31.63	44.5	-12.87	40	-8.37	145	125	Peak
42.61	28.98	40.96	-11.98	40	-11.02	145	285	Peak
131.85	21.49	34.31	-12.82	43.5	-22.01	132	265	Peak
330.7	22.79	32.79	-10	46	-23.21	111	142	Peak
551.86	27.14	31.55	-4.41	46	-18.86	185	147	Peak
743.92	32.49	31.56	0.93	46	-13.51	102	231	Peak

Remarks:

1. Emission Level = Read Level + Factor
   Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB).
   Margin value = Emission level – Limit value
2. The emission levels of other frequencies were very low against the limit.

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 0.50 MHz.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Dec. 11, 2019	Dec. 10, 2020
RF signal cable Woken	5D-FB	Cable-cond1-01	Sep. 05, 2019	Sep. 04, 2020
LISN/AMN ROHDE & SCHWARZ (EUT)	ENV216	101826	Feb. 20, 2020	Feb. 19, 2021
LISN/AMN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Aug. 22, 2019	Aug. 21, 2020
Software ADT	BV ADT_Cond_ 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

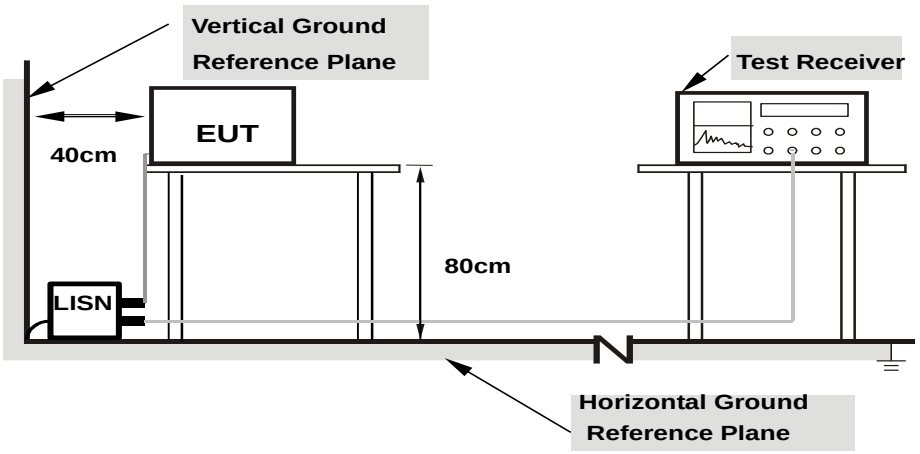
a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50 uH of coupling impedance for the measuring instrument.
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit – 20 dB) was not recorded.

Note: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz - 30 MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



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

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

4.2.6 EUT Operating Condition

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

4.2.7 Test Results

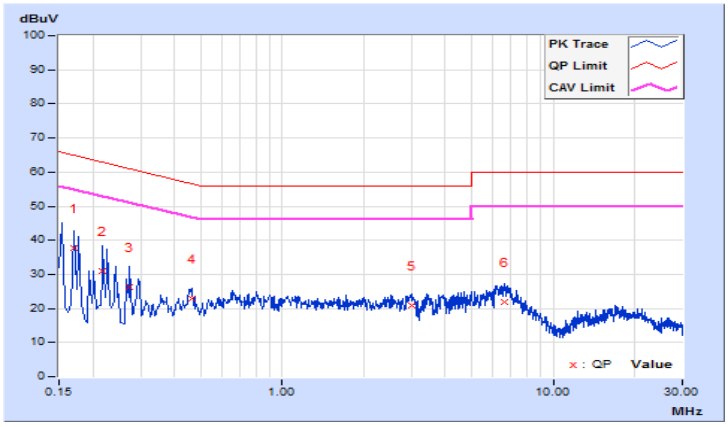
CONDUCTED WORST-CASE DATA：GFSK

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25℃, 65%RH
Tested by	Jisyong Wang	Test Date	2020/5/13
Test Mode	Mode C		

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.17000	9.63	28.21	21.26	37.84	30.89	64.96	54.96	-27.12	-24.07
2	0.21800	9.62	21.52	15.08	31.14	24.70	62.89	52.89	-31.75	-28.19
3	0.27400	9.63	16.61	13.15	26.24	22.78	61.00	51.00	-34.76	-28.22
4	0.46200	9.65	13.22	10.59	22.87	20.24	56.66	46.66	-33.79	-26.42
5	3.00200	9.76	11.10	8.91	20.86	18.67	56.00	46.00	-35.14	-27.33
6	6.57800	9.82	12.16	8.40	21.98	18.22	60.00	50.00	-38.02	-31.78

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

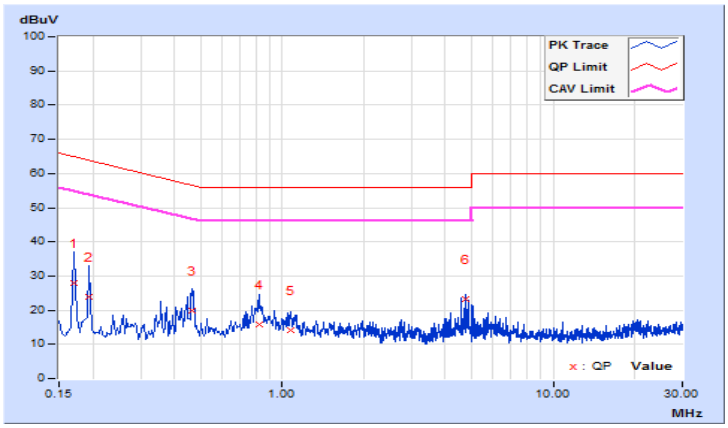


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25℃, 65%RH
Tested by	Jisyong Wang	Test Date	2020/5/13
Test Mode	Mode C		

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.17000	9.65	18.13	13.76	27.78	23.41	64.96	54.96	-37.18	-31.55
2	0.19400	9.64	14.43	12.43	24.07	22.07	63.86	53.86	-39.79	-31.79
3	0.46200	9.67	10.25	8.24	19.92	17.91	56.66	46.66	-36.74	-28.75
4	0.81800	9.69	6.10	3.50	15.79	13.19	56.00	46.00	-40.21	-32.81
5	1.07400	9.70	4.41	2.06	14.11	11.76	56.00	46.00	-41.89	-34.24
6	4.77400	9.83	13.27	11.01	23.10	20.84	56.00	46.00	-32.90	-25.16

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

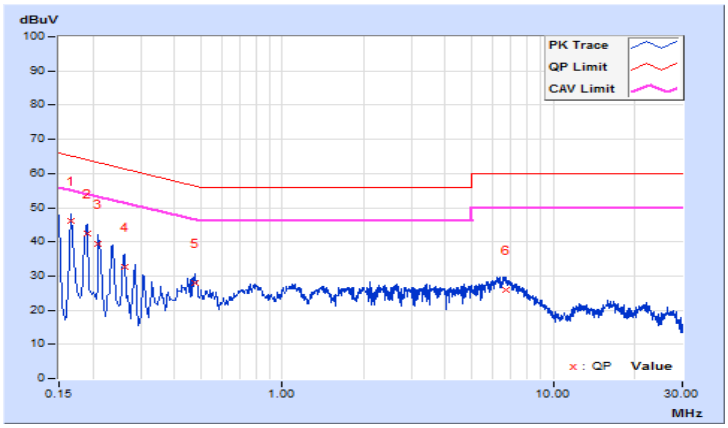


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25℃, 65%RH
Tested by	Jisyong Wang	Test Date	2020/5/13
Test Mode	Mode D		

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	**0.16600**	**9.63**	**36.63**	**31.99**	**46.26**	**41.62**	**65.16**	**55.16**	**-18.90**	**-13.54**
2	0.19000	9.62	32.84	30.76	42.46	40.38	64.04	54.04	-21.58	-13.66
3	0.21000	9.62	29.72	24.83	39.34	34.45	63.21	53.21	-23.87	-18.76
4	0.26152	9.63	23.18	20.09	32.81	29.72	61.38	51.38	-28.57	-21.66
5	0.47400	9.65	18.27	16.83	27.92	26.48	56.44	46.44	-28.52	-19.96
6	6.68600	9.83	16.01	10.01	25.84	19.84	60.00	50.00	-34.16	-30.16

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

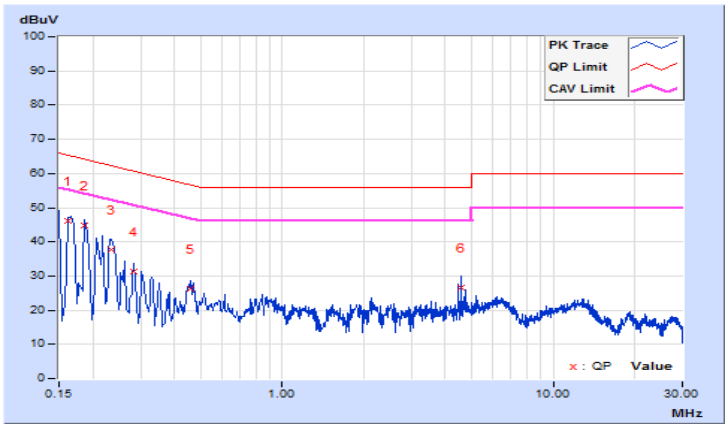


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25℃, 65%RH
Tested by	Jisyong Wang	Test Date	2020/5/13
Test Mode	Mode D		

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16276	9.65	36.41	31.41	46.06	41.06	65.32	55.32	-19.26	-14.26
2	0.18600	9.65	35.07	30.46	44.72	40.11	64.21	54.21	-19.49	-14.10
3	0.23289	9.64	28.14	21.91	37.78	31.55	62.35	52.35	-24.57	-20.80
4	0.28200	9.65	21.74	18.63	31.39	28.28	60.76	50.76	-29.37	-22.48
5	0.45800	9.67	16.57	13.11	26.24	22.78	56.73	46.73	-30.49	-23.95
6	4.57000	9.83	16.75	13.13	26.58	22.96	56.00	46.00	-29.42	-23.04

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

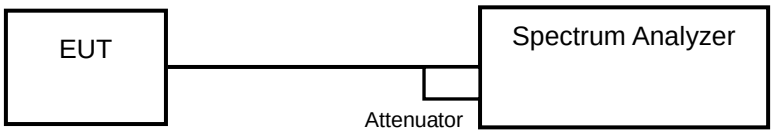


4.3 Number of Hopping Frequency Used

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.

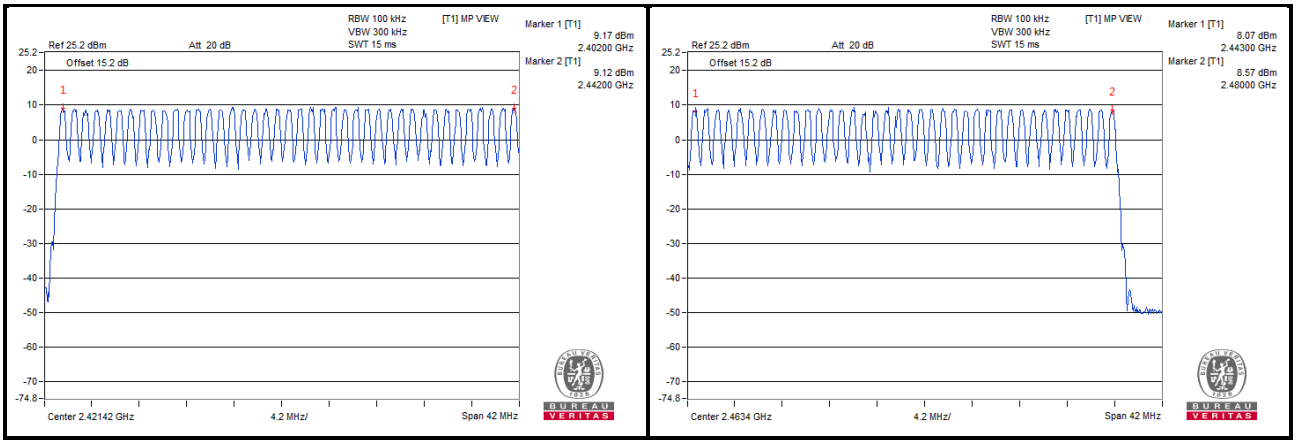
4.3.5 Deviation from Test Standard

No deviation.

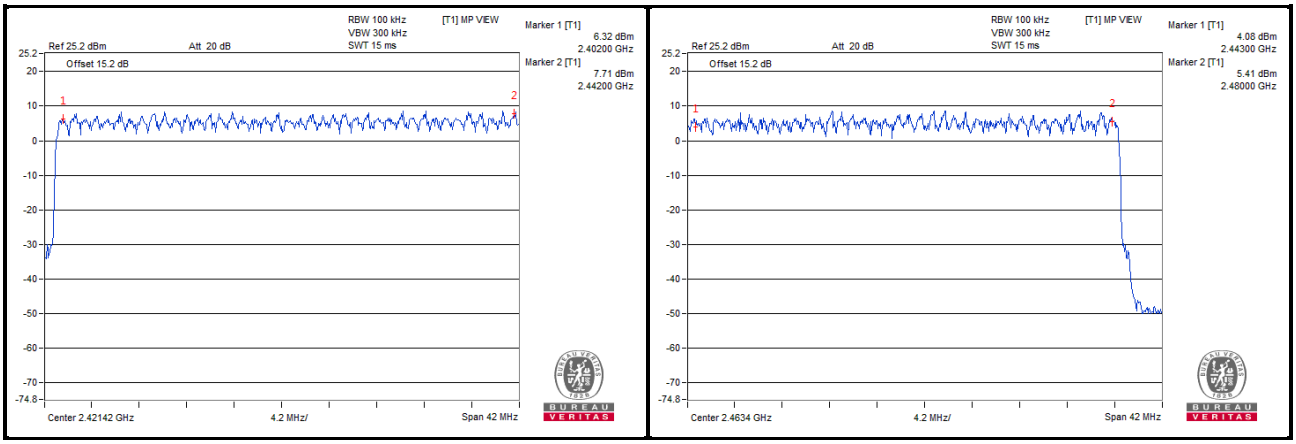
4.3.6 Test Results

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>

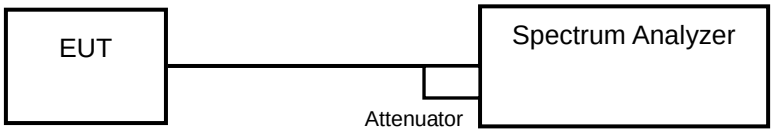


4.4 Dwell Time on Each Channel

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.

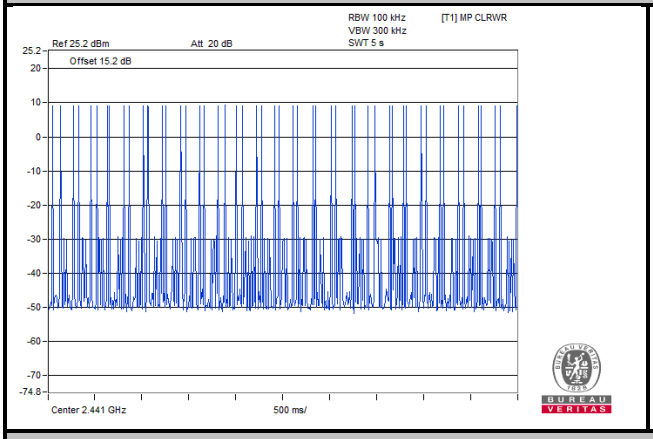
4.4.6 Test Results

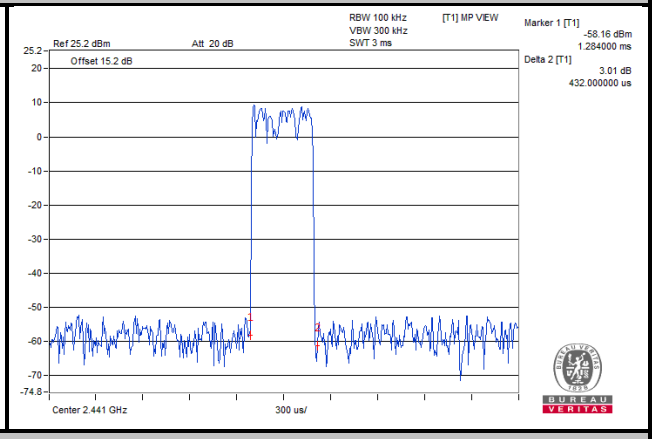
GFSK

Mode	Number of Transmission in a 31.6 (79 Hopping*0.4)	Length of Transmission Time (msec)	Result (msec)	Limit (msec)
DH1	50 (times / 5 sec) * 6.32 = 316 times	0.432	136.51	400
DH3	27 (times / 5 sec) * 6.32 = 171 times	1.74	297.54	400
DH5	18 (times / 5 sec) * 6.32 = 114 times	3.008	342.91	400

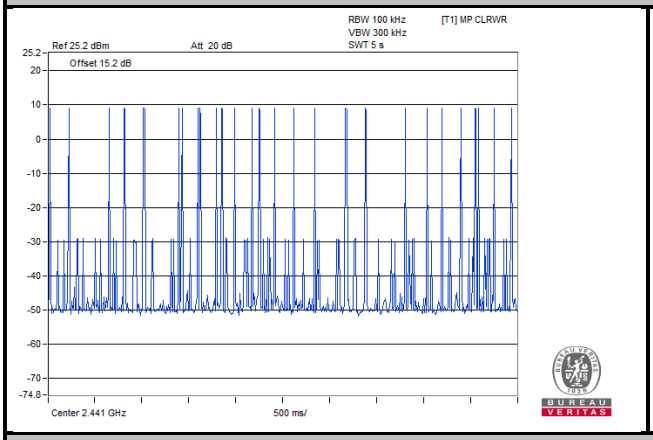
Note: Test plots of the transmitting time slot are shown as below.

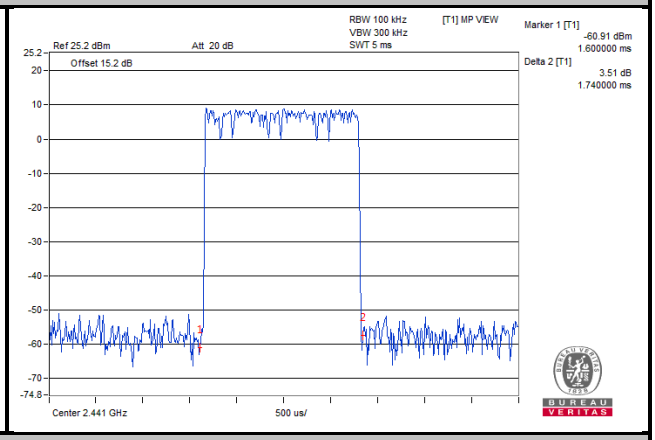
DH1



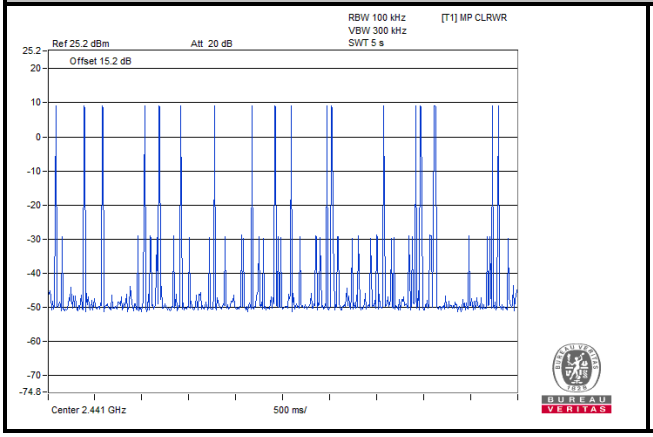


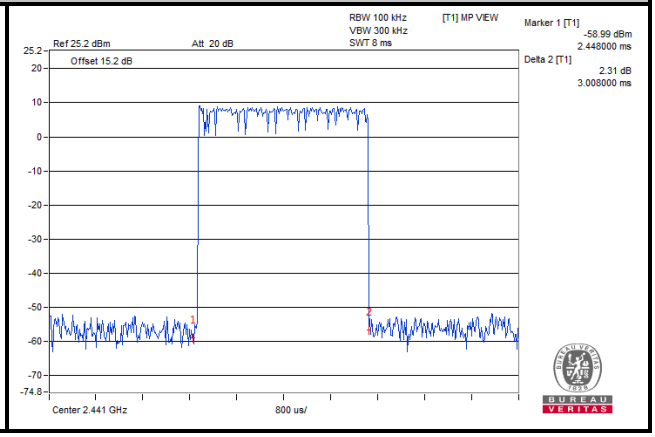
DH3





DH5



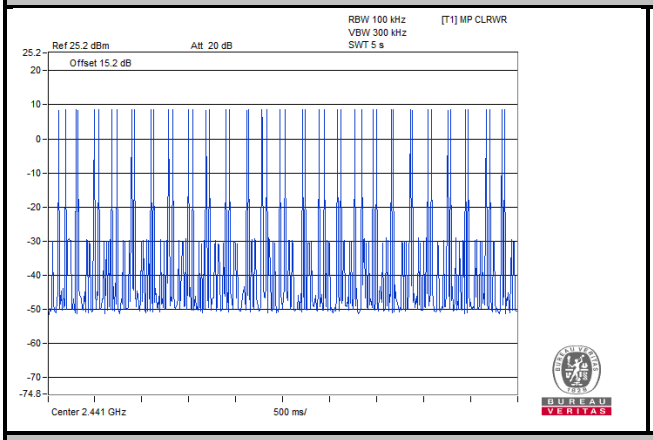


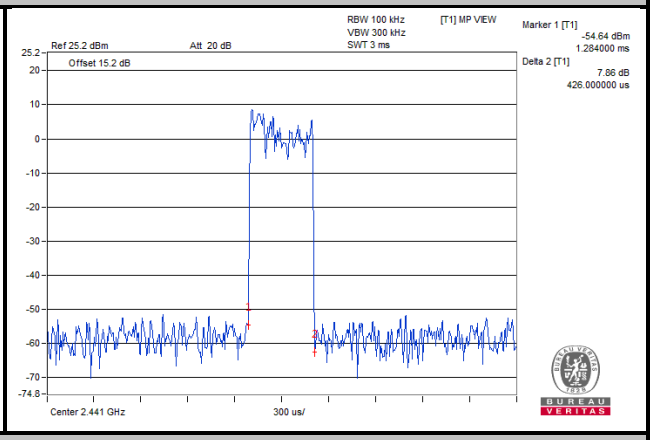
8DPSK

Mode	Number of Transmission in a 31.6 (79 Hopping*0.4)	Length of Transmission Time (msec)	Result (msec)	Limit (msec)
3DH1	50 (times / 5 sec) * 6.32 = 316 times	0.426	134.62	400
3DH3	27 (times / 5 sec) * 6.32 = 171 times	1.73	295.83	400
3DH5	18 (times / 5 sec) * 6.32 = 114 times	3.072	350.21	400

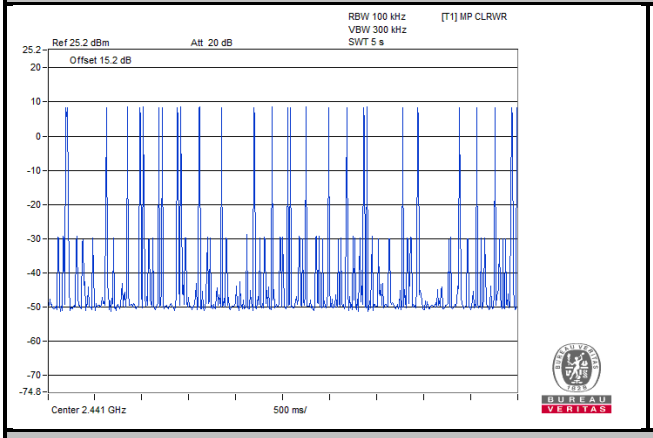
Note: Test plots of the transmitting time slot are shown as below.

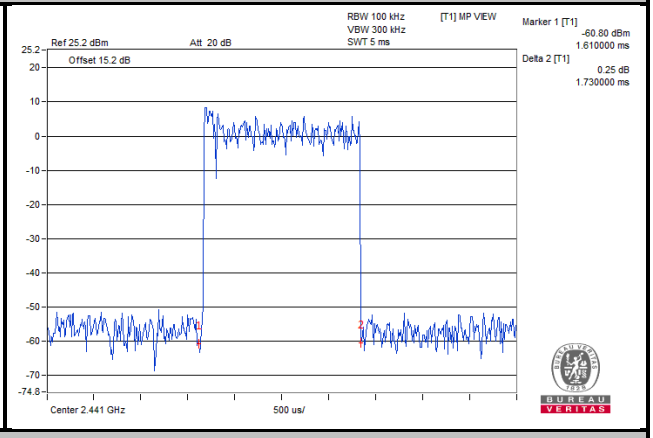
3DH1



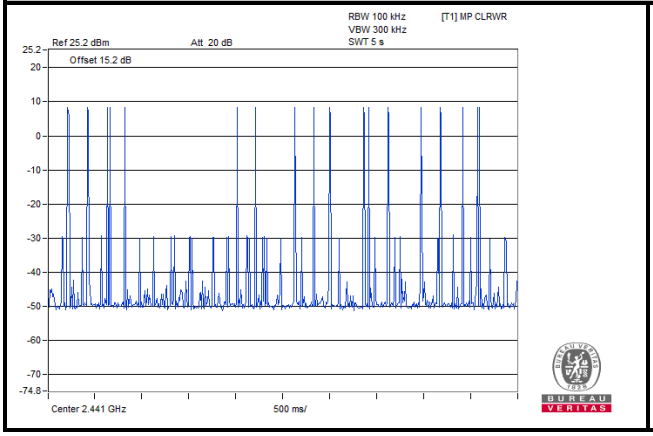


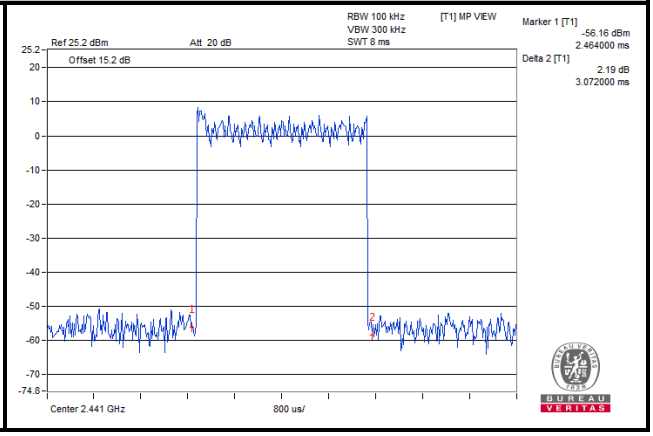
3DH3





3DH5



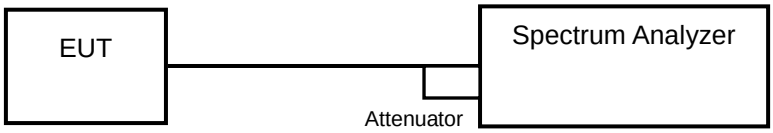


4.5 Channel Bandwidth

4.5.1 Limits of Channel Bandwidth Measurement

For frequency hopping system operating in the 2400-2483.5 MHz, if the 20 dB bandwidth of hopping channel is greater than 25 kHz, two-thirds 20 dB bandwidth of hopping channel shell 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 20 dB 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

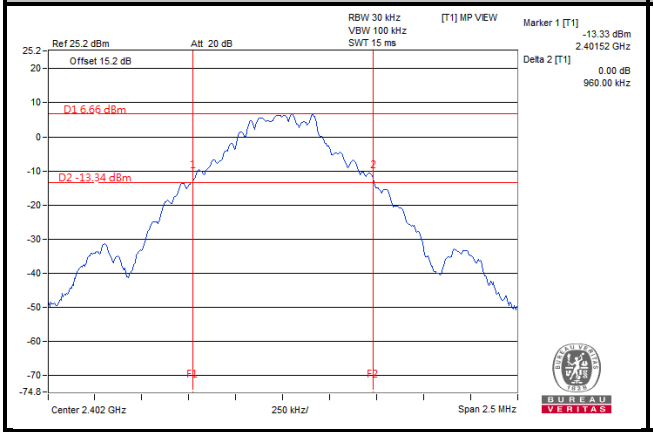
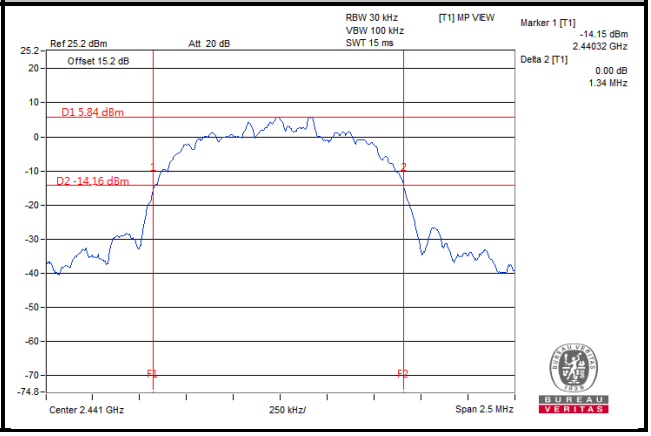
No deviation.

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.

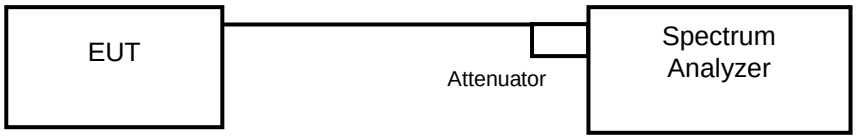
4.5.7 Test Results

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)	
		GFSK	8DPSK
0	2402	0.96	1.33
39	2441	0.96	1.34
78	2480	0.96	1.34

Spectrum Plot of Worst Value	
GFSK	8DPSK
	

4.6 Occupied Bandwidth Measurement

4.6.1 Test Setup



4.6.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument

4.6.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1 % to 5 % of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to sampling. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 % of the total mean power of a given emission.

4.6.4 Deviation from Test Standard

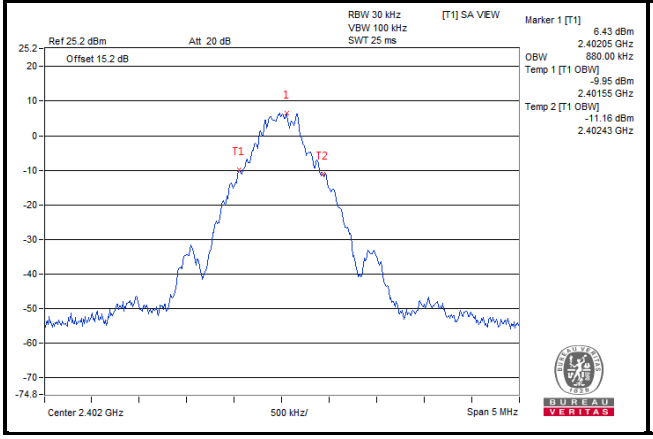
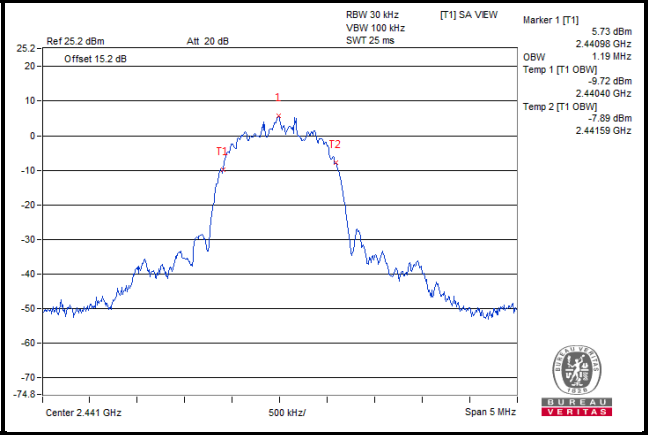
No deviation.

4.6.5 EUT Operating Conditions

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

4.6.6 Test Results

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	
		GFSK	8DPSK
0	2402	0.88	1.18
39	2441	0.88	1.19
78	2480	0.88	1.19

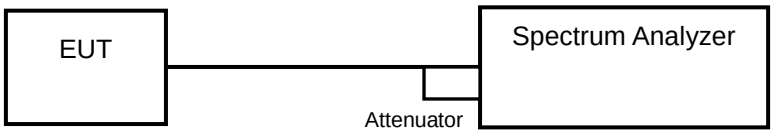
Spectrum Plot of Worst Value	
GFSK	8DPSK
	

4.7 Hopping Channel Separation

4.7.1 Limits of Hopping Channel Separation Measurement

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

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

Measurement Procedure REF

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.
c. By using the MaxHold function record the separation of two adjacent channels.
d. Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.
e. Repeat above procedures until all frequencies measured were complete.

4.7.5 Deviation from Test Standard

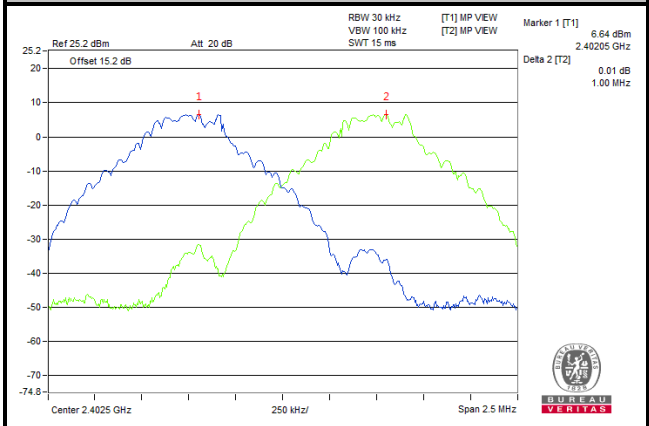
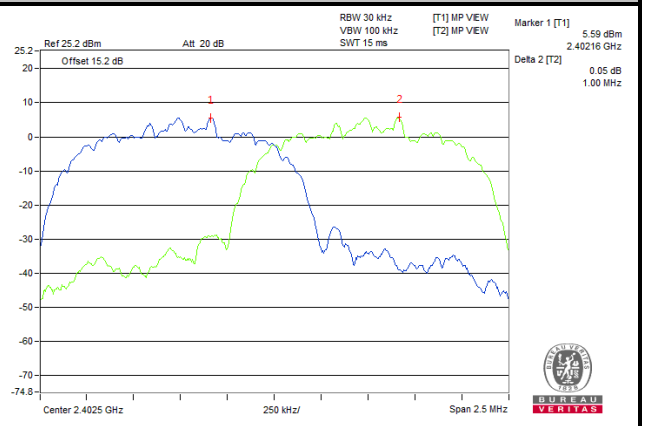
No deviation.

4.7.6 Test Results

Channel	Freq. (MHz)	Adjacent Channel Separation (MHz)		20 dB Bandwidth (MHz)		Minimum Limit (MHz)		Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK	GFSK	8DPSK	
0	2402	1.00	1.00	0.96	1.33	0.64	0.89	Pass
39	2441	1.00	1.00	0.96	1.34	0.64	0.90	Pass
78	2480	1.00	1.00	0.96	1.34	0.64	0.90	Pass

Note:

1. The minimum limit is two-third 20 dB bandwidth.

Spectrum Plot of Worst Value	
GFSK	8DPSK
	

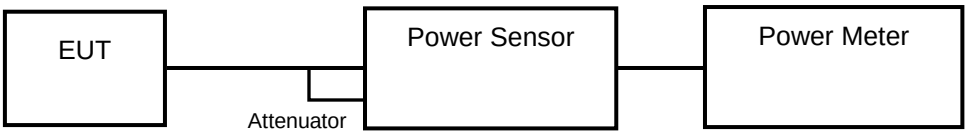
4.8 Maximum Output Power

4.8.1 Limits of Maximum Output Power Measurement

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1 watt.

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

4.8.2 Test Setup



4.8.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.8.4 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.

Average power sensor was used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

4.8.5 Deviation from Test Standard

No deviation.

4.8.6 EUT Operating Condition

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

4.8.7 Test Results

<GFSK>

Channel	Freq. (MHz)	Peak Power		Average Power		Power Limit (mW)	Pass / Fail
		(mW)	(dBm)	(mW)	(dBm)		
0	2402	8.63	9.36	8.318	9.20	125 / 1000 Note	Pass
39	2441	8.81	9.45	8.511	9.30	125 / 1000 Note	Pass
78	2480	8.81	9.45	8.511	9.30	125 / 1000 Note	Pass

Note: RF Output Power limit depends on the operating channel numbers, please refer to section 4.3 of the results.

<8DPSK>

Channel	Freq. (MHz)	Peak Power		Average Power		Power Limit (mW)	Pass / Fail
		(mW)	(dBm)	(mW)	(dBm)		
0	2402	14.223	11.53	6.607	8.20	125 / 1000 Note	Pass
39	2441	14.322	11.56	6.761	8.30	125 / 1000 Note	Pass
78	2480	14.191	11.52	6.761	8.30	125 / 1000 Note	Pass

Note: RF Output Power limit depends on the operating channel numbers, please refer to section 4.3 of the results.

4.9 Conducted Out of Band Emission Measurement

4.9.1 Limits Of Conducted Out of Band Emission Measurement

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

4.9.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.9.3 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.

4.9.4 Deviation from Test Standard

No deviation.

4.9.5 EUT Operating Condition

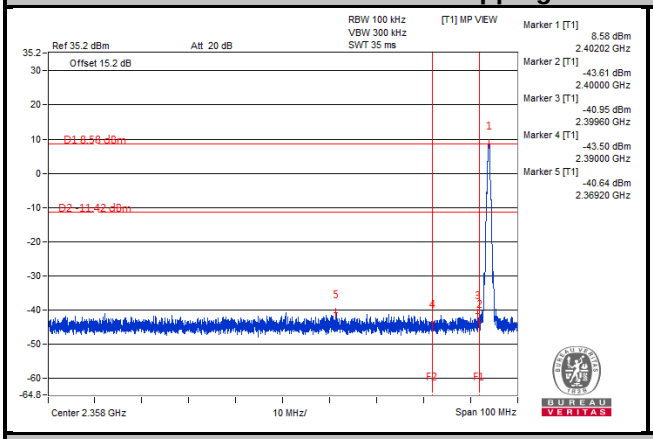
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

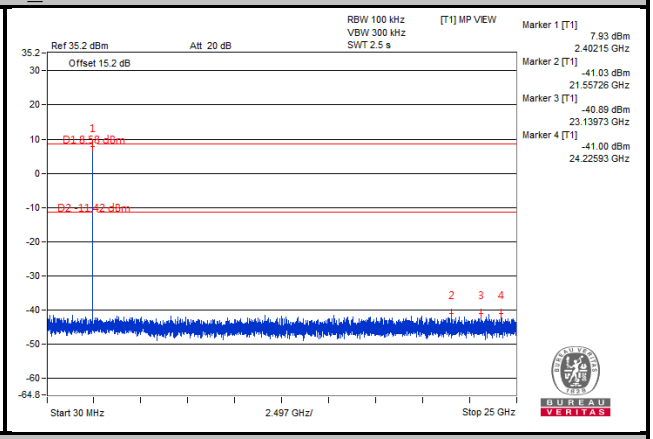
4.9.6 Test Results

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

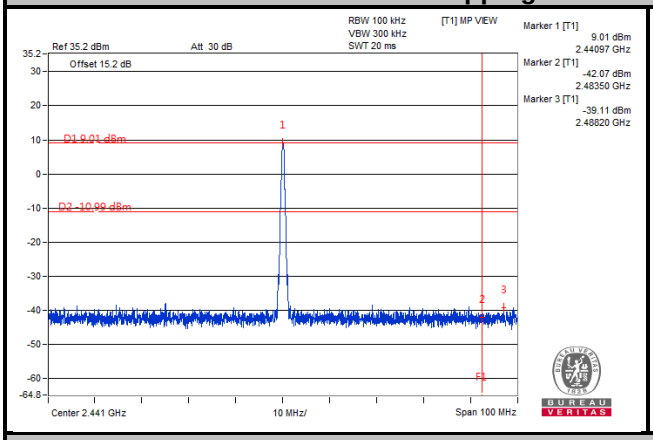
GFSK

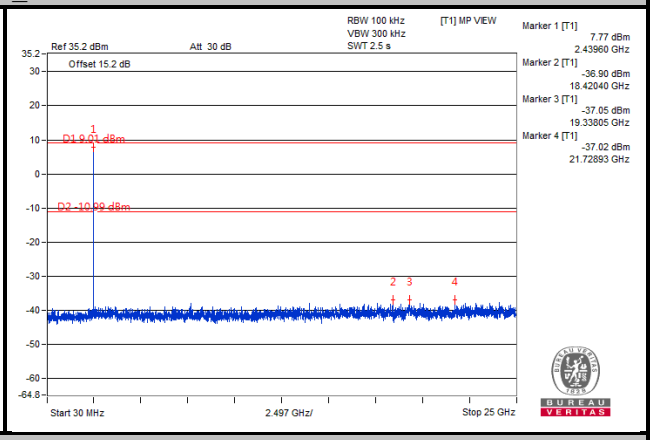
Hopping Disabled_Low Channel



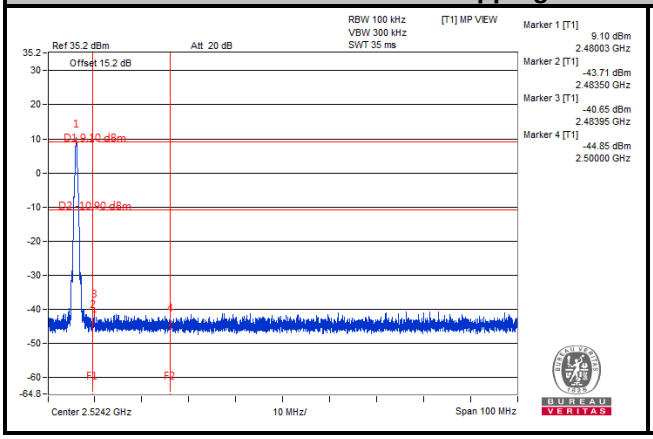


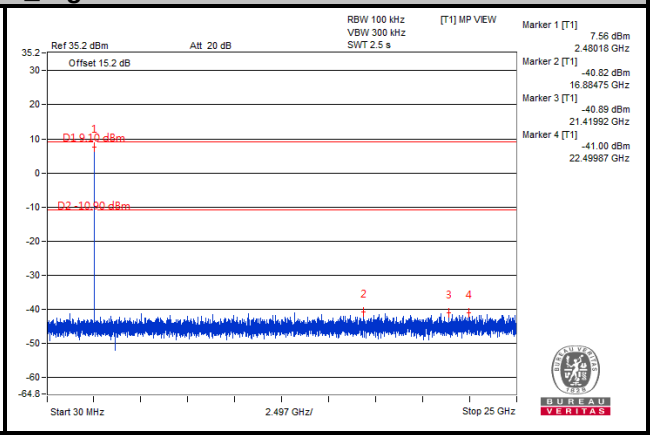
Hopping Disabled_Middle Channel



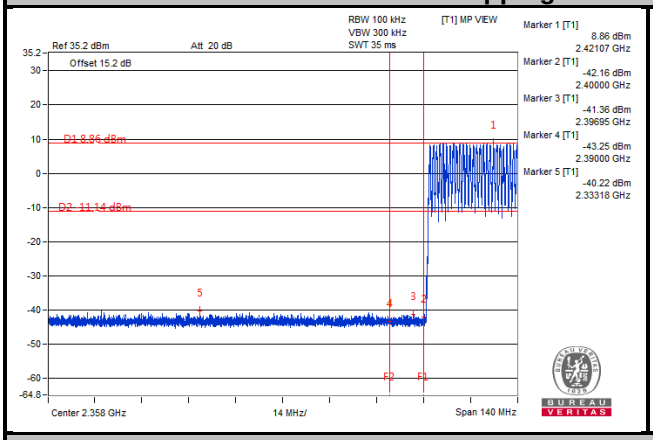


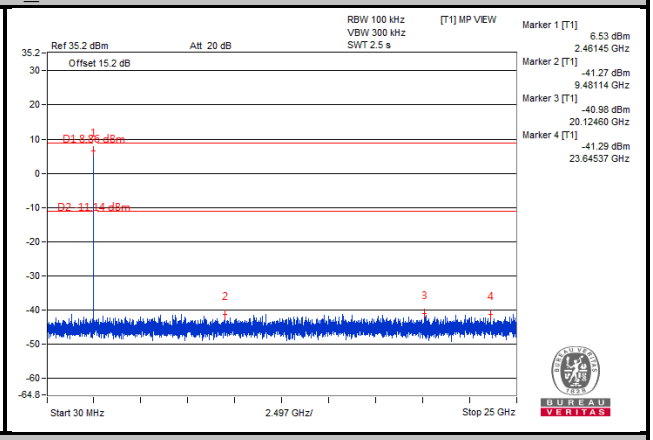
Hopping Disabled_High Channel





Hopping Enabled_Low Channel





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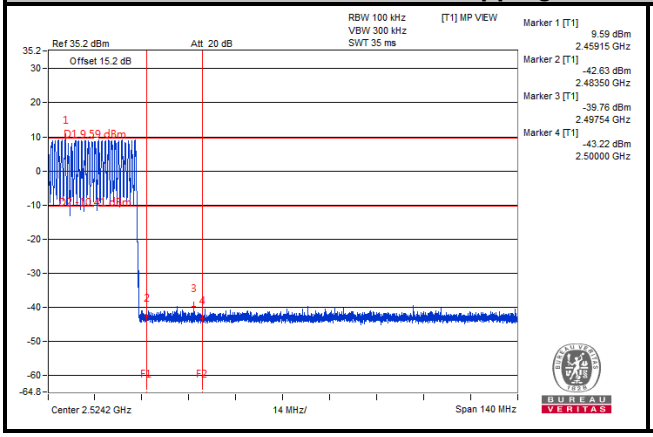
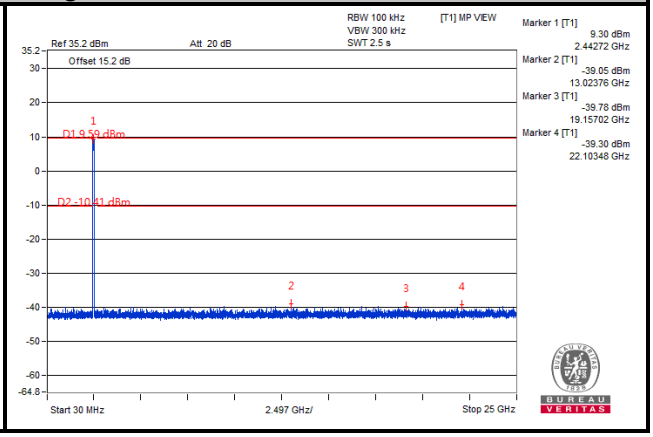
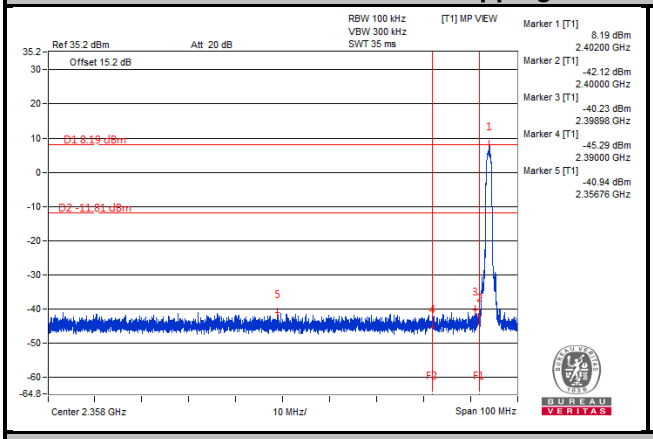
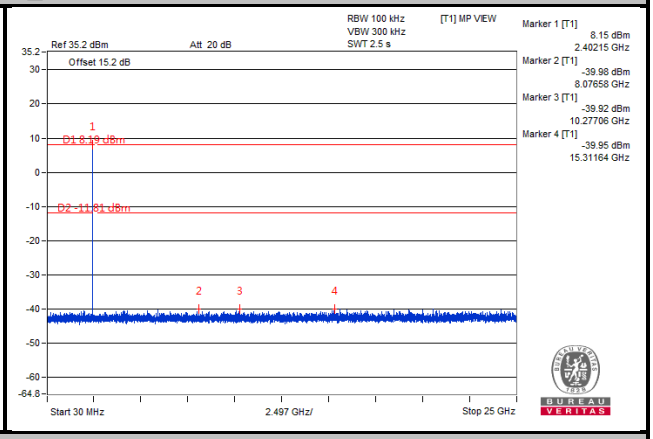




8DPSK

Hopping Disabled_Low Channel





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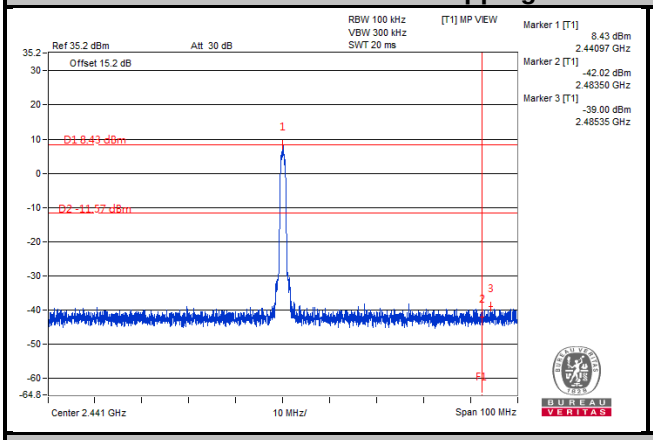

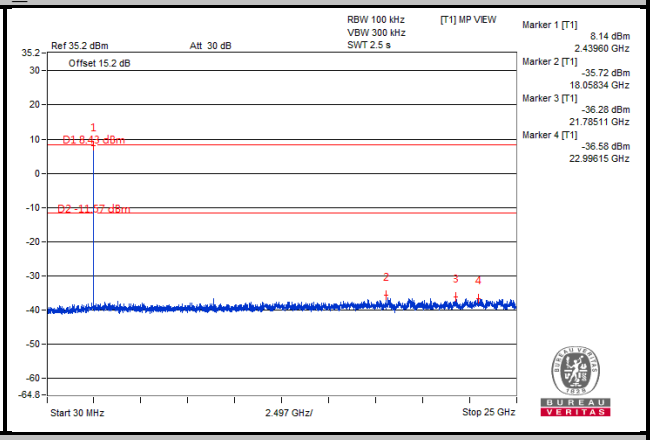

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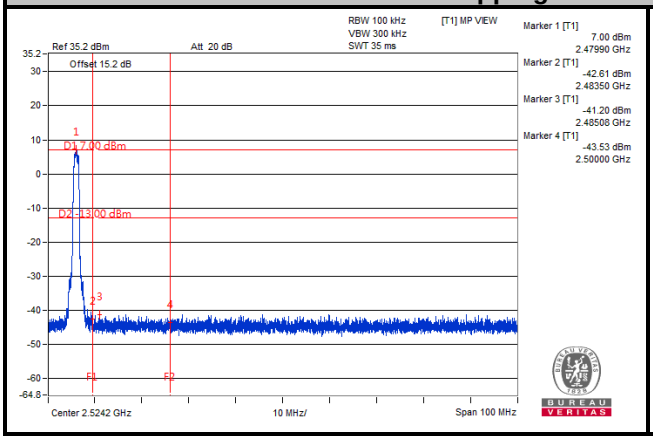
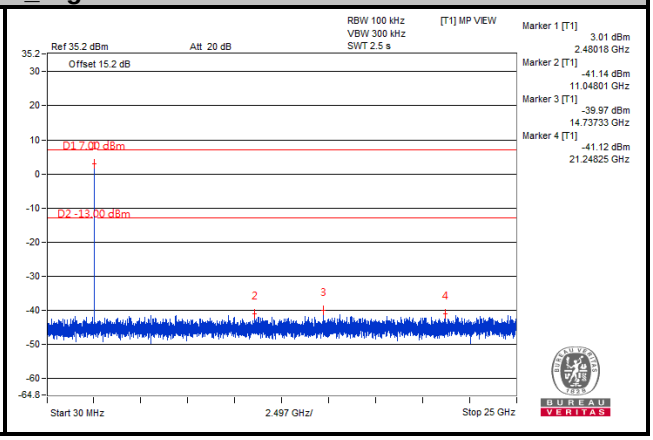
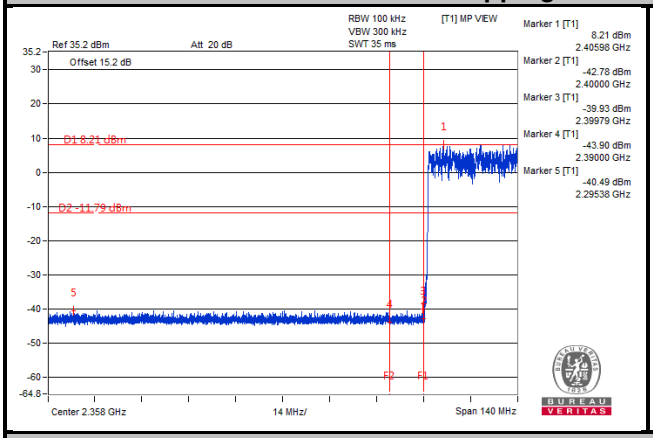
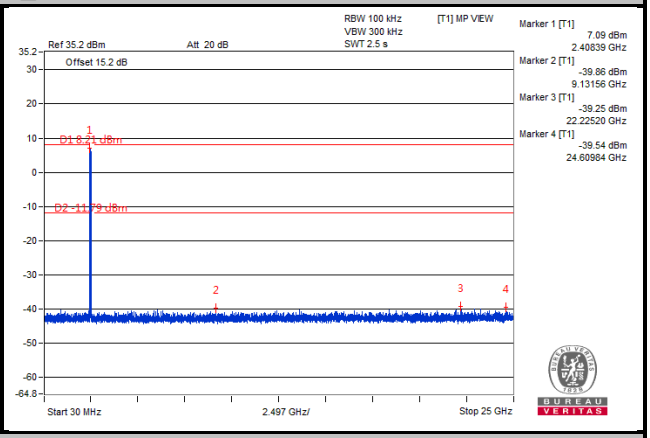




Hopping Enabled_Low Channel





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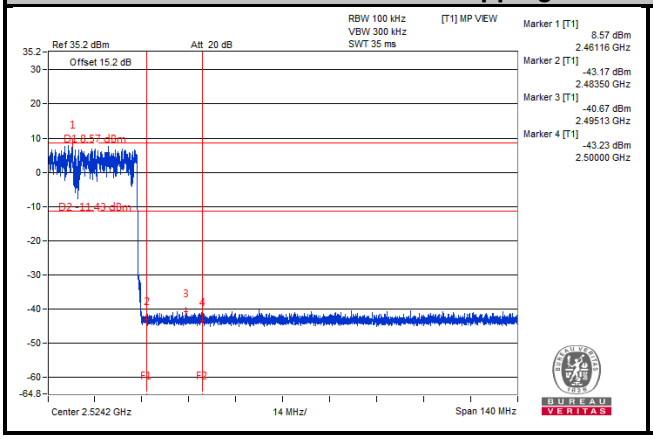

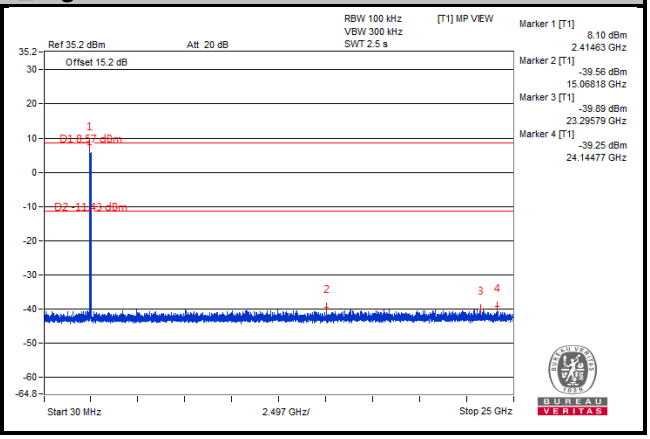

5 Photographs of the Test Configuration

Please refer to the attached file (Reference no.: RF200508C01 (TSup photo_left earbud)).

6 Construction Photos of EUT

Please refer to the attached file (200508C01 (EUT 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 according to ISO/IEC 17025.

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Email: service.adt@tw.bureauveritas.com
Web Site: www.bureauveritas-adt.com

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

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