FCC TEST REPORT

REPORT NO.: RF140612E04

MODEL NO.: KT-6160

FCC ID: 2ACEXKT6160

RECEIVED: June 12, 2014

TESTED: June 26 to July 04, 2014

ISSUED: Sep. 29, 2014

APPLICANT: Keystone Microtech Corporation

ADDRESS: 9F., No.255 Dong Sec. 1, Guangming 6th Rd., Jhubei City, Hsinchu County 302

ISSUED BY: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory

LAB ADDRESS: No. 81-1, Lu Liao Keng, 9th Ling,Wu Lung Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan, R.O.C.

TEST LOCATION (1): No. 81-1, Lu Liao Keng, 9th Ling,Wu Lung Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan, Taiwan, R.O.C.

TEST LOCATION (2): No.49, Ln. 206, Wende Rd., Shangshan Tsuen, Chiung Lin Hsiang, Hsin Chu Hsien 307, Taiwan, Taiwan, R.O.C.

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
RF140612E04	Original release	Sep. 29, 2014

1 CERTIFICATION

PRODUCT :	EZ-Extender
BRAND NAME :	Keystone Microtech Corporation
MODEL NO. :	KT-6160
TEST SAMPLE :	MASS-PRODUCTION
APPLICANT :	Keystone Microtech Corporation
TESTED DATE :	June 26 to July 04, 2014
STANDARDS :	**FCC Part 15, Subpart C (Section 15.247)** ANSI C63.10-2009

The above equipment (Model: KT-6160) 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:** Sep. 29, 2014
(Elsie Hsu, Specialist)

APPROVED BY : _____ , **DATE:** Sep. 29, 2014
(May Chen, Manager)

2 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARD: FCC Part 15, Subpart C			
STANDARD SECTION	**TEST TYPE AND LIMIT**	**RESULT**	**REMARK**
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit. Minimum passing margin is -20.41dB at 14.80256MHz.
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.
15.247(d)	Transmitter Radiated Emissions	PASS	Meet the requirement of limit. Minimum passing margin is -5.1dB at 172.59MHz.
15.247(d)	Band Edge Measurement	PASS	Meet the requirement of limit.
15.203	Antenna Requirement	PASS	Antenna connector is SMA. (The device is professionally installed)

NOTE: Frequency Hopping System operating in 2407-2477MHz 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 ME ASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

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

Measurement	**Value**
Conducted emissions	2.86 dB
Radiated emissions (30MHz-1GHz)	5.37 dB
Radiated emissions (1GHz -6GHz)	3.65 dB
Radiated emissions (6GHz -18GHz)	3.88 dB
Radiated emissions (18GHz -40GHz)	4.11 dB

3 GENERAL INFORMATION

3.1 GENERAL DESCRIPTION OF EUT

PRODUCT	EZ-Extender
MODEL NO.	KT-6160
POWER SUPPLY	DC 12-24V from host equipment
MODULATION TYPE	GFSK
MODULATION TECHNOLOGY	FHSS
DATE RATE	Up to 1Mbps
FREQUENCY RANGE	2407MHz ~ 2477MHz
NUMBER OF CHANNEL	71
MAX. OUTPUT POWER	12.050 mW
ANTENNA TYPE	Please see NOTE
DATA CABLE	NA
I/O PORTS	Refer to user's manual
ASSOCIATED DEVICES	DC Connector x 1

NOTE:

1. The antenna provided to the EUT, please refer to the following table:

Manufacture	Model name	Antenna Gain(dBi) Including cable loss	Antenna Type	Connecter Type	Frequency range (MHz to MHz)
Keystone	F1B_003404-MMP	2	Dipole	SMA	2400~2500

1. The EUT was pre-tested for radiated test under following test modes:

Pre-test Mode	Power
A	DC 12V from DC power supply
B	**DC 24V from DC power supply**

From the above modes, the worst radiated test was found in **Mode B**. Therefore only the test data of the modes were recorded in this report.

2. The above EUT information was declared by the manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

3.2 DESCRIPTION OF TEST MODES

71 channels are provided for EUT.

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

3.3 TEST MODE APPLICABLITY AND TESTED CHANNEL DETAIL:

EUT CONFIGURE MODE	APPLICABLE TO					DESCRIPTION
	PLC	RE < 1G	RE ≥ 1G	APCM	OB	
1	√	√	√	√	√	DC 24V from DC power supply
2	√	-	-	-	-	DC 12V from DC power supply

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

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

OB: Conducted Out-Band Emission Measurement

NOTE: 1. The EUT had been pre-tested on the positioned of each 2 axis. The worst case was found when positioned on **X-plane.**

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.

Available Channel	Tested Channel	Modulation Technology	Modulation Type
1 to 71	1	FHSS	GFSK

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.

Available Channel	Tested Channel	Modulation Technology	Modulation Type
1 to 71	1	FHSS	GFSK

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.

Available Channel	Tested Channel	Modulation Technology	Modulation Type
1 to 71	1, 36, 71	FHSS	GFSK

ANTENNA PORT CONDUCTED MEASUREMENT:

☒ 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.

Available Channel	Tested Channel	Modulation Technology	Modulation Type
1 to 71	1, 36, 71	FHSS	GFSK

CONDUCTED OUT-BAND EMISSION MEASUREMENT:

☒ 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.

Available Channel	Tested Channel	Modulation Technology	Modulation Type
1 to 71	1, 71	FHSS	GFSK

TEST CONDITION:

APPLICABLE TO	ENVIRONMENTAL CONDITIONS	INPUT POWER (SYSTEM)	TESTED BY
PLC	25deg. C, 70%RH	120Vac, 60 Hz	Jyunchun Lin
RE<1G	25deg. C, 67%RH	120Vac, 60 Hz	Robert Cheng
RE≥1G	23deg. C, 66%RH	120Vac, 60 Hz	Nelson Teng
APCM	25deg. C, 60%RH	120Vac, 60 Hz	Robert Cheng
OB	25deg. C, 60%RH	120Vac, 60 Hz	Robert Cheng

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:

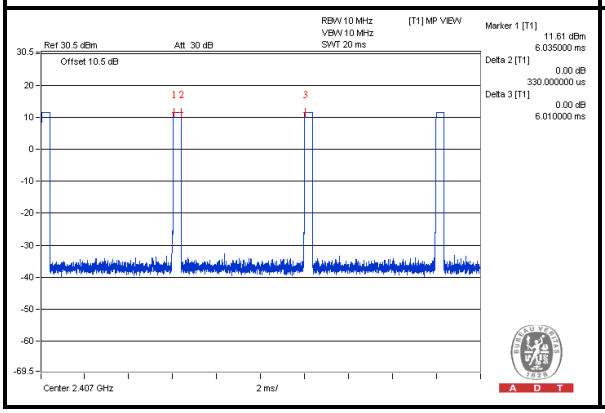
FCC Part 15, Subpart C (15.247)
ANSI C63.10-2009

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

Note: The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC). The test report has been issued separately.

3.5 DUTY CYCLE OF TEST SIGNAL

Duty cycle of test signal is < 98 %, duty factor shall be considered.
GFSK: Duty cycle = 0.33 ms/6.01 ms = 0.055, Duty factor = 10 * log(1/0.055) = 12.6

GFSK	
	

3.6 DESCRIPTION OF SUPPORT UNITS

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

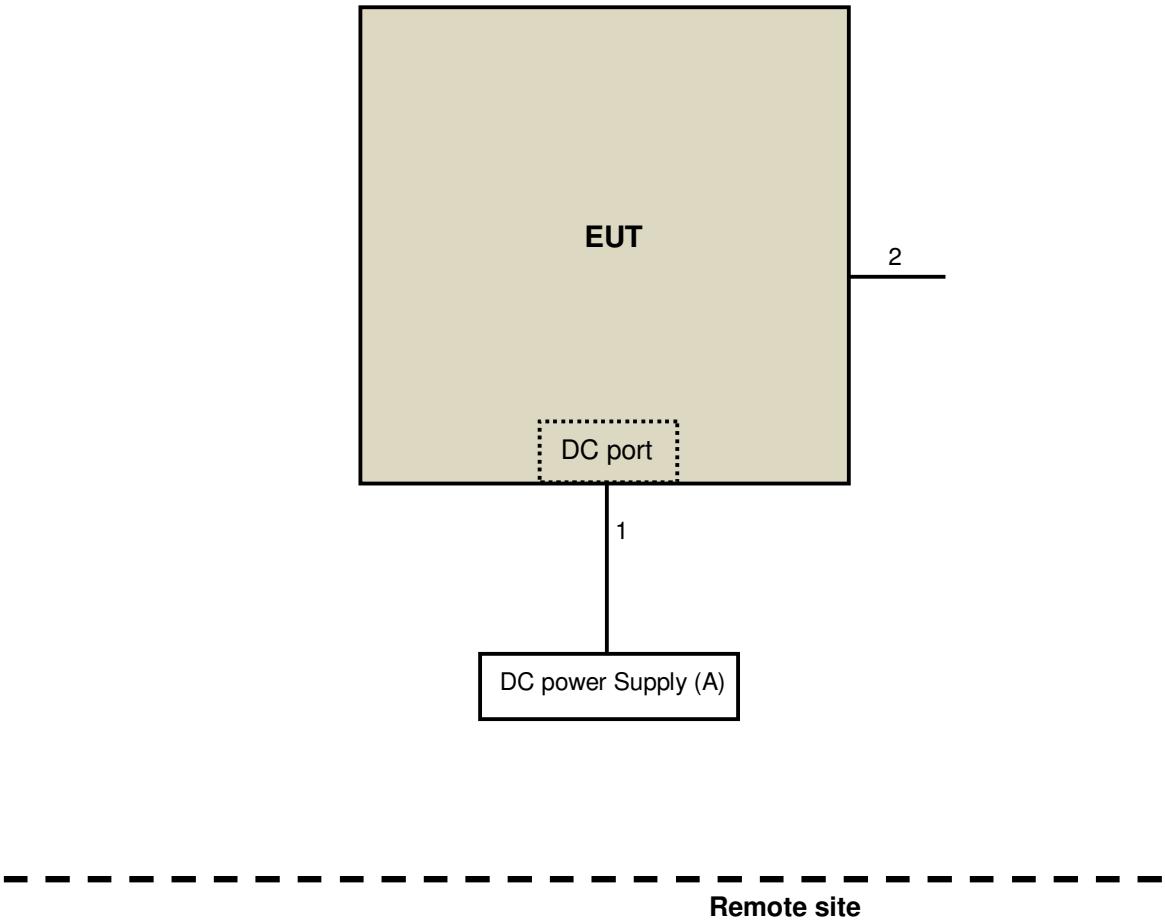
No.	Product	Brand	Model No.	Serial No.	FCC ID	Remark
A.	DC POWER SUPPLY	Topward	6603D	795558	NA	Provided by Lab

NOTE:

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

No.	Cable	Qty.	Length (m)	Shielded (Yes/ No)	Cores (Number)	Remark
1.	DC	1	1.8	N	0	Provided by Lab
2.	RS-232	1	1.8	Y	0	Provided by Lab

3.7 CONFIGURATION OF SYSTEM UNDER TEST



4 TEST PROCEDURES AND RESULTS

4.1 CONDUCTED EMISSION MEASUREMENT

4.1.1 LIMITS OF CONDUCTED EMISSION MEASUREMENT

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBμV)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

NOTE: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

4.1.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver ROHDE & SCHWARZ	ESCS 30	100375	Apr. 29, 2014	Apr. 28, 2015
Line-Impedance Stabilization Network (for EUT) SCHWARZBECK	NSLK8127	8127-522	Sep. 12, 2013	Sep. 11, 2014
Line-Impedance Stabilization Network (for Peripheral)	ENV216	100071	Nov. 13, 2013	Nov. 12, 2014
RF Cable (JYEBAO)	5DFB	COCCAB-001	Mar. 10 , 2014	Mar. 09, 2015
50 ohms Terminator	N/A	EMC-03	Sep. 24, 2013	Sep. 23, 2014
50 ohms Terminator	N/A	EMC-02	Oct. 01, 2013	Sep. 30, 2014
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 Shielded Room No. C.
3 The VCCI Con C Registration No. is C-3611.
4 Tested Date: July 04, 2014

4.1.3 TEST PROCEDURE

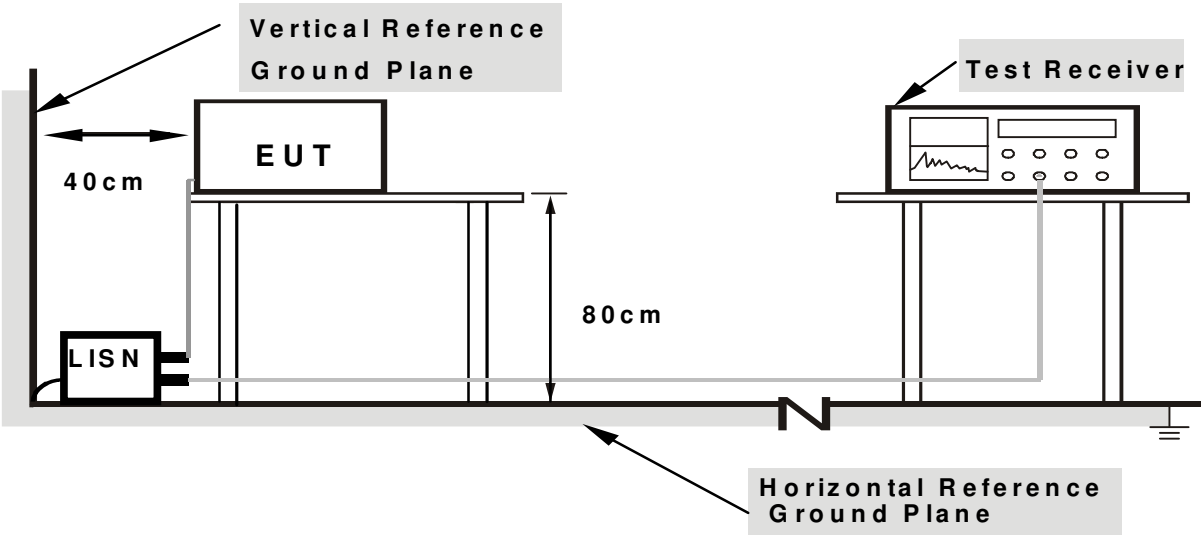
a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN.
b. The two LISNs provide 50 ohm/ 50uH of coupling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

NOTE: The resolution bandwidth of test receiver is 9kHz for Quasi-peak detection (QP) & Average detection (AV).

4.1.4 DEVIATION FROM TEST STANDARD

No deviation

4.1.5 TEST SETUP



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

For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

4.1.6 EUT OPERATING CONDITIONS

1. Controlling software (Button function) has been activated to set the EUT on specific status.

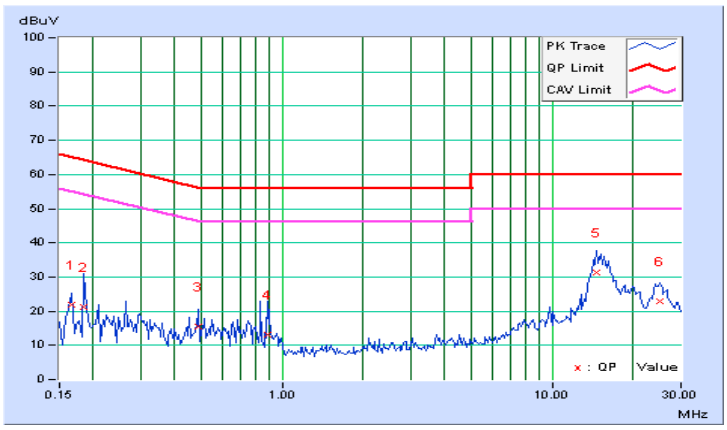
4.1.7 TEST RESULTS (MODE 1)

PHASE	Line (L)	DETECTOR FUNCTION	Quasi-Peak (QP) / Average (AV)

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)] Q.P.	Reading Value [dB (uV)] AV.	Emission Level [dB (uV)] Q.P.	Emission Level [dB (uV)] AV.	Limit [dB (uV)] Q.P.	Limit [dB (uV)] AV.	Margin (dB) Q.P.	Margin (dB) AV.
1	0.16562	0.07	21.87	15.01	21.94	15.08	65.18	55.18	-43.24	-40.10
2	0.18516	0.07	21.15	10.84	21.22	10.91	64.25	54.25	-43.03	-43.34
3	0.48984	0.10	15.31	14.46	15.41	14.56	56.17	46.17	-40.76	-31.61
4	0.88828	0.12	13.11	12.92	13.23	13.04	56.00	46.00	-42.77	-32.96
5	14.50781	0.57	30.86	25.00	31.43	25.57	60.00	50.00	-28.57	-24.43
6	24.99609	0.80	21.93	16.95	22.73	17.75	60.00	50.00	-37.27	-32.25

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

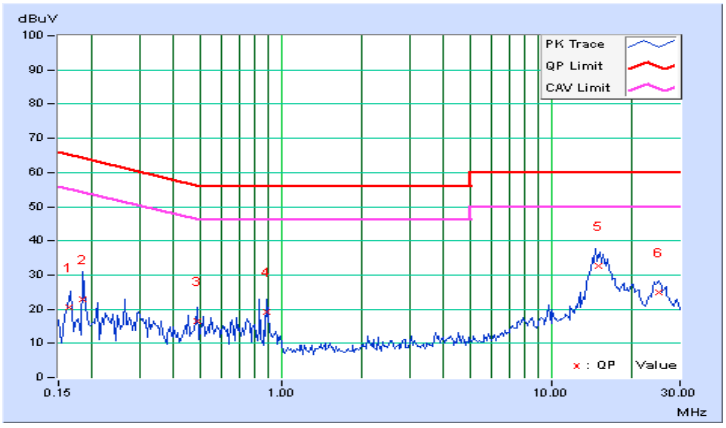


PHASE	Neutral (N)	DETECTOR FUNCTION	Quasi-Peak (QP) / Average (AV)

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)] Q.P.	Reading Value [dB (uV)] AV.	Emission Level [dB (uV)] Q.P.	Emission Level [dB (uV)] AV.	Limit [dB (uV)] Q.P.	Limit [dB (uV)] AV.	Margin (dB) Q.P.	Margin (dB) AV.
1	0.16410	0.06	20.38	18.45	20.44	18.51	65.25	55.25	-44.81	-36.74
2	0.18528	0.06	22.78	19.51	22.84	19.57	64.25	54.25	-41.40	-34.67
3	0.48999	0.10	16.23	14.78	16.33	14.88	56.17	46.17	-39.84	-31.29
4	0.88828	0.12	18.95	15.69	19.07	15.81	56.00	46.00	-36.93	-30.19
5	14.98625	0.61	32.18	26.44	32.79	27.05	60.00	50.00	-27.21	-22.95
6	25.01235	0.85	23.93	20.78	24.78	21.63	60.00	50.00	-35.22	-28.37

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



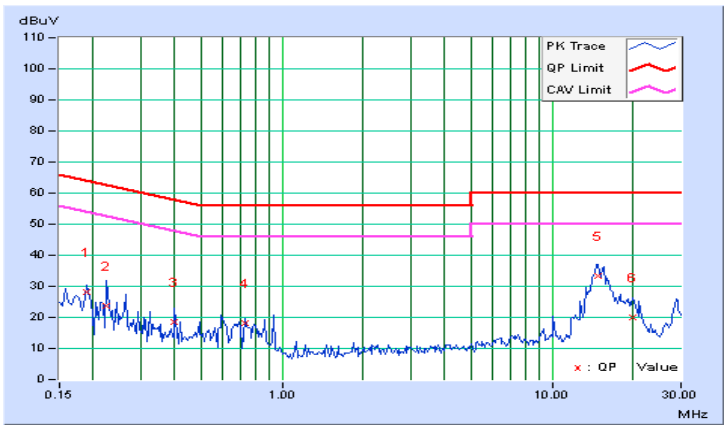
4.1.8 TEST RESULTS (MODE 2)

PHASE	Line (L)	DETECTOR FUNCTION	Quasi-Peak (QP) / Average (AV)

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)] Q.P.	Reading Value [dB (uV)] AV.	Emission Level [dB (uV)] Q.P.	Emission Level [dB (uV)] AV.	Limit [dB (uV)] Q.P.	Limit [dB (uV)] AV.	Margin (dB) Q.P.	Margin (dB) AV.
1	0.18906	0.07	27.93	20.15	28.00	20.22	64.08	54.08	-36.08	-33.86
2	0.22422	0.07	23.78	22.41	23.85	22.48	62.66	52.66	-38.81	-30.18
3	0.40000	0.09	18.36	17.24	18.45	17.33	57.85	47.85	-39.40	-30.52
4	0.72813	0.11	18.12	17.11	18.23	17.22	56.00	46.00	-37.77	-28.78
5	14.70313	0.58	32.68	27.26	33.26	27.84	60.00	50.00	-26.74	-22.16
6	19.98828	0.70	19.38	10.60	20.08	11.30	60.00	50.00	-39.92	-38.70

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

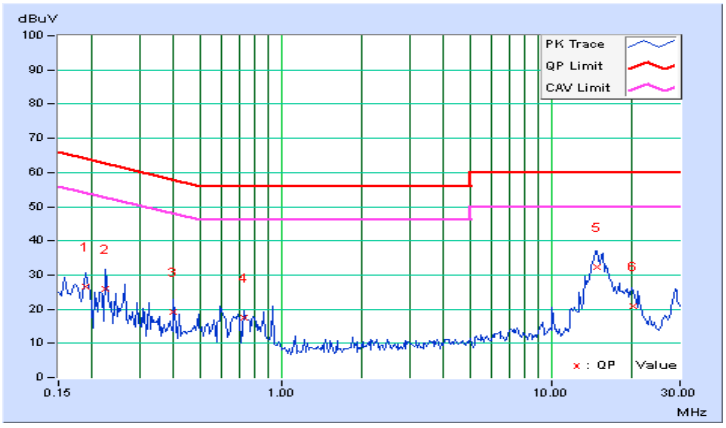


PHASE	Neutral (N)	DETECTOR FUNCTION	Quasi-Peak (QP) / Average (AV)

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)] Q.P.	Reading Value [dB (uV)] AV.	Emission Level [dB (uV)] Q.P.	Emission Level [dB (uV)] AV.	Limit [dB (uV)] Q.P.	Limit [dB (uV)] AV.	Margin (dB) Q.P.	Margin (dB) AV.
1	0.18906	0.06	26.65	18.63	26.71	18.69	64.08	54.08	-37.37	-35.39
2	0.22418	0.06	25.87	23.14	25.93	23.20	62.66	52.66	-36.73	-29.46
3	0.40000	0.09	19.23	18.02	19.32	18.11	57.85	47.85	-38.53	-29.74
4	0.72825	0.11	17.26	16.55	17.37	16.66	56.00	46.00	-38.63	-29.34
5	**14.80256**	**0.60**	**31.58**	**28.99**	**32.18**	**29.59**	**60.00**	**50.00**	**-27.82**	**-20.41**
6	20.12547	0.74	20.21	15.62	20.95	16.36	60.00	50.00	-39.05	-33.64

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



4.2 RADIATED EMISSION AND BANDEDGE MEASUREMENT

4.2.1 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.

4.2.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
MXE EMI Receiver Agilent	N9038A	MY51210105	Jan. 21, 2014	Jan. 20, 2015
Pre-Amplifier Mini-Circuits	ZFL-1000VH2 B	AMP-ZFL-03	Nov. 13, 2013	Nov. 12, 2014
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-360	Feb. 26, 2014	Feb. 25, 2015
RF Cable	NA	CHGCAB_001	Oct. 05, 2013	Oct. 04, 2014
Spectrum Analyzer R&S	FSV40	100964	July 15, 2013	July 14, 2014
Horn_Antenna AISI	AIH.8018	0000320091110	Nov. 18, 2013	Nov. 17, 2014
Pre-Amplifier Agilent	8449B	3008A02578	June 24, 2014	June 23, 2015
RF Cable	NA	RF104-201 RF104-203 RF104-204	Dec. 12, 2013	Dec. 11, 2014
Spectrum Analyzer Agilent	E4446A	MY48250253	Aug. 28, 2013	Aug. 27, 2014
Pre-Amplifier SPACEK LABS	SLKKa-48-6	9K16	Nov. 13, 2013	Nov. 12, 2014
Horn_Antenna SCHWARZBECK	BBHA 9170	9170-424	Oct. 08, 2013	Oct. 07, 2014
Software	ADT_Radiated _V8.7.07	NA	NA	NA
Antenna Tower & Turn Table CT	NA	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 horn antenna, preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
3. The test was performed in 966 Chamber No. G.
4. The FCC Site Registration No. is 966073.
5. The VCCI Site Registration No. is G-137.
6. The CANADA Site Registration No. is IC 7450H-2.
7. Tested Date: June 26 to 30, 2014

4.2.3 TEST PROCEDURES

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meters 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. 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 detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz.

NOTE:

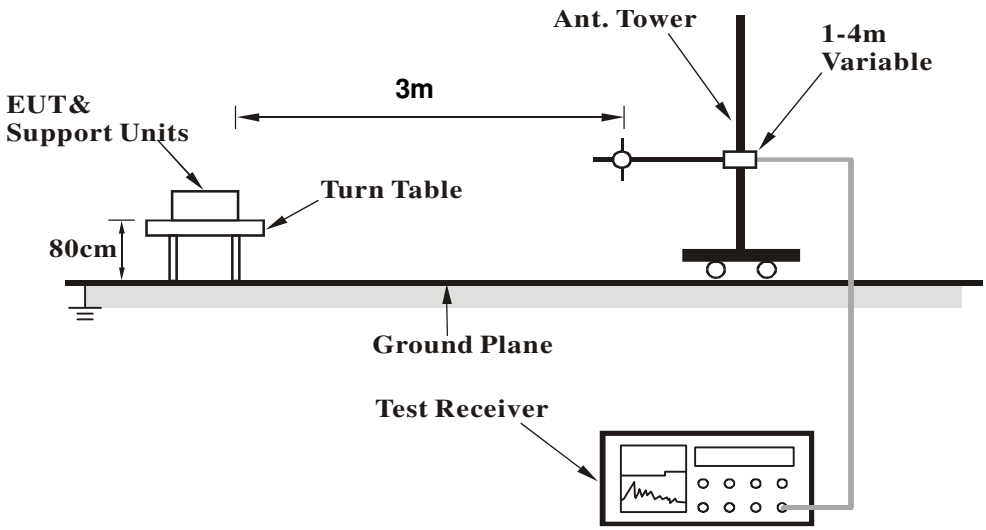
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3MHz for Peak detection (PK) at frequency above 1GHz.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

4.2.4 DEVIATION FROM TEST STANDARD

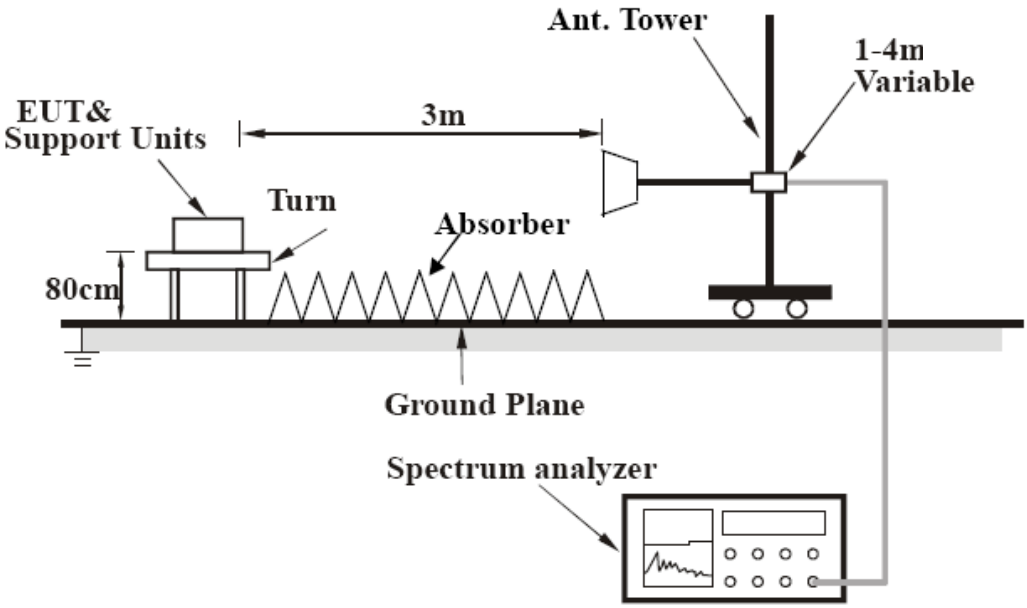
No deviation

4.2.5 TEST SETUP

<Frequency Range below 1GHz>



<Frequency Range above 1GHz>



For the actual test configuration, please refer to the related item – Photographs of the Test Configuration.

4.2.6 EUT OPERATING CONDITIONS

Same as 4.1.6

4.2.7 TEST RESULTS

BELOW 1GHz WORST-CASE DATA

CHANNEL	TX Channel 1	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	Below 1GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	**FREQ. (MHz)**	**EMISSION LEVEL (dBuV/m)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA HEIGHT (m)**	**TABLE ANGLE (Degree)**	**RAW VALUE (dBuV)**	**CORRECTION FACTOR (dB/m)**
1	116.62	30.2 QP	43.5	-13.3	1.50 H	76	45.76	-15.56
2	163.81	34.7 QP	43.5	-8.8	2.00 H	84	47.98	-13.32
3	173.61	34.8 QP	43.5	-8.7	1.50 H	92	48.84	-14.07
4	246.02	32.7 QP	46.0	-13.3	1.00 H	57	47.20	-14.46
5	296.17	30.7 QP	46.0	-15.3	1.00 H	270	43.17	-12.50
6	326.82	37.7 QP	46.0	-8.3	1.00 H	296	49.18	-11.52
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	38.97	31.3 QP	40.0	-8.7	1.00 V	125	45.14	-13.84
2	134.13	31.8 QP	43.5	-11.7	1.00 V	303	45.78	-13.99
3	**172.59**	**38.4 QP**	**43.5**	**-5.1**	**1.00 V**	**293**	**52.45**	**-14.02**
4	249.12	30.1 QP	46.0	-15.9	1.50 V	360	44.42	-14.34
5	322.46	34.1 QP	46.0	-11.9	1.50 V	3	45.73	-11.67
6	355.14	33.6 QP	46.0	-12.4	1.00 V	349	44.61	-10.99

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.
4. Margin value = Emission Level – Limit value

ABOVE 1GHz DATA

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

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	2376.52	37.3 PK	74.0	-36.7	1.01 H	340	39.84	-2.54
2	2376.52	25.4 AV	54.0	-28.6	1.01 H	340	27.94	-2.54
3	*2407.00	96.6 PK			1.01 H	340	98.98	-2.38
4	*2407.00	95.8 AV			1.01 H	340	98.18	-2.38
5	4814.00	47.8 PK	74.0	-26.2	1.43 H	121	42.13	5.67
6	4814.00	36.9 AV	54.0	-17.1	1.43 H	121	31.23	5.67
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	2376.52	37.3 PK	74.0	-36.7	1.01 V	340	39.84	-2.54
2	2376.52	25.4 AV	54.0	-28.6	1.01 V	340	27.94	-2.54
3	*2407.00	96.6 PK			1.01 V	340	98.98	-2.38
4	*2407.00	95.8 AV			1.01 V	340	98.18	-2.38
5	4814.00	47.3 PK	74.0	-26.7	1.02 V	51	41.63	5.67
6	4814.00	38.6 AV	54.0	-15.4	1.02 V	51	32.93	5.67

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.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 36	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2442.00	96.7 PK			1.00 H	326	98.93	-2.23
2	*2442.00	96.1 AV			1.00 H	326	98.33	-2.23
3	4884.00	48.4 PK	74.0	-25.6	1.45 H	107	42.45	5.95
4	4884.00	37.3 AV	54.0	-16.7	1.45 H	107	31.35	5.95
5	7326.00	50.5 PK	74.0	-23.5	1.27 H	322	37.33	13.17
6	7326.00	40.8 AV	54.0	-13.2	1.27 H	322	27.63	13.17
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	*2442.00	108.5 PK			1.19 V	40	110.73	-2.23
2	*2442.00	108.3 AV			1.19 V	40	110.53	-2.23
3	4884.00	47.0 PK	74.0	-27.0	1.06 V	47	41.05	5.95
4	4884.00	38.1 AV	54.0	-15.9	1.06 V	47	32.15	5.95
5	7326.00	50.3 PK	74.0	-23.7	1.28 V	220	37.13	13.17
6	7326.00	40.7 AV	54.0	-13.3	1.28 V	220	27.53	13.17

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.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

CHANNEL	TX Channel 71	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 25GHz		

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2477.00	96.5 PK			1.00 H	315	98.56	-2.06
2	*2477.00	95.8 AV			1.00 H	315	97.86	-2.06
3	2500.00	40.2 PK	74.0	-33.8	1.00 H	330	42.16	-1.96
4	2500.00	28.4 AV	54.0	-25.6	1.00 H	330	30.36	-1.96
5	4954.00	48.6 PK	74.0	-25.4	1.40 H	106	42.37	6.23
6	4954.00	37.6 AV	54.0	-16.4	1.40 H	106	31.37	6.23
7	7431.00	50.8 PK	74.0	-23.2	1.31 H	329	37.66	13.14
8	7431.00	40.8 AV	54.0	-13.2	1.31 H	329	27.66	13.14
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	*2477.00	108.2 PK			1.19 V	36	110.26	-2.06
2	*2477.00	107.8 AV			1.19 V	36	109.86	-2.06
3	2500.00	62.4 PK	74.0	-11.6	1.19 V	36	64.36	-1.96
4	2500.00	46.8 AV	54.0	-7.2	1.19 V	36	48.76	-1.96
5	4954.00	46.9 PK	74.0	-27.1	1.11 V	55	40.67	6.23
6	4954.00	38.0 AV	54.0	-16.0	1.11 V	55	31.77	6.23
7	7431.00	50.2 PK	74.0	-23.8	1.27 V	226	37.06	13.14
8	7431.00	40.6 AV	54.0	-13.4	1.27 V	226	27.46	13.14

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.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.

4.3 NUMBER OF HOPPING FREQUENCY USED

4.3.1 LIMIT OF HOPPING FREQUENCY USED

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

4.3.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSV 40	100964	July 15, 2013	July 14, 2014

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. Tested date : July 01, 2014

4.3.3 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. 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.

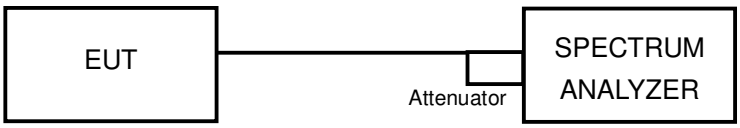
d. Set the SA on View mode and then plot the result on SA screen.

e. Repeat above procedures until all frequencies measured were complete.

4.3.4 DEVIATION FROM TEST STANDARD

No deviation

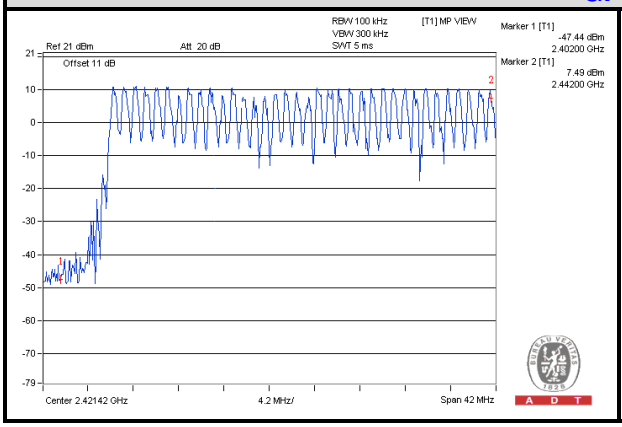
4.3.5 TEST SETUP

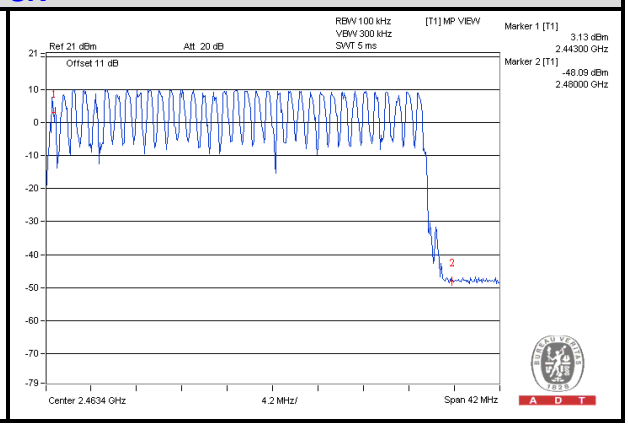


4.3.6 TEST RESULTS

There are 71 hopping frequencies in the hopping mode. Please refer the test result. On the plots, it shows that the hopping frequencies are equally spaced.

GFSK





4.4 DWELL TIME ON EACH CHANNEL

4.4.1 LIMIT OF DWELL TIME USED

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 INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSV 40	100964	July 15, 2013	July 14, 2014

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. Tested date : July 01, 2014

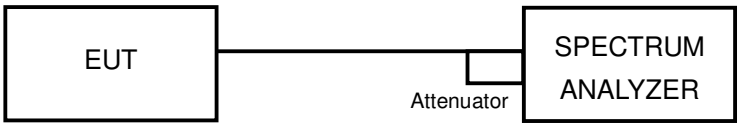
4.4.3 TEST PROCEDURES

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. Then plot the result and recorded.

4.4.4 DEVIATION FROM TEST STANDARD

No deviation

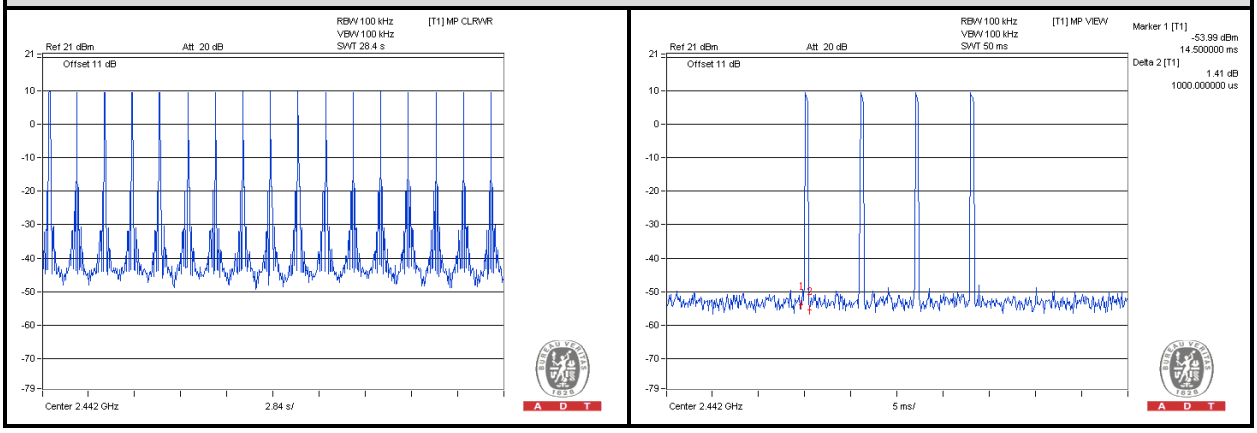
4.4.5 TEST SETUP



4.4.6 TEST RESULTS

Mode	Number of transmission in a 28.4 (71Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
FH	17 (times / 28.4 sec) *4=68 times	1	68	400

DH5



4.5 CHANNEL BANDWIDTH

4.5.1 LIMITS OF CHANNEL BANDWIDTH

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

4.5.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSV 40	100964	July 15, 2013	July 14, 2014

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. Tested date : July 01, 2014

4.5.3 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.

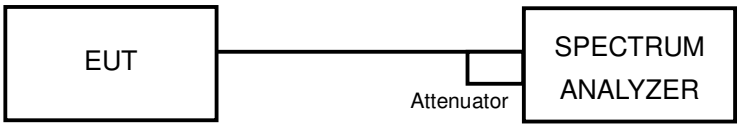
c. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.

d. Repeat above procedures until all frequencies measured were complete.

4.5.4 DEVIATION FROM TEST STANDARD

No deviation

4.5.5 TEST SETUP



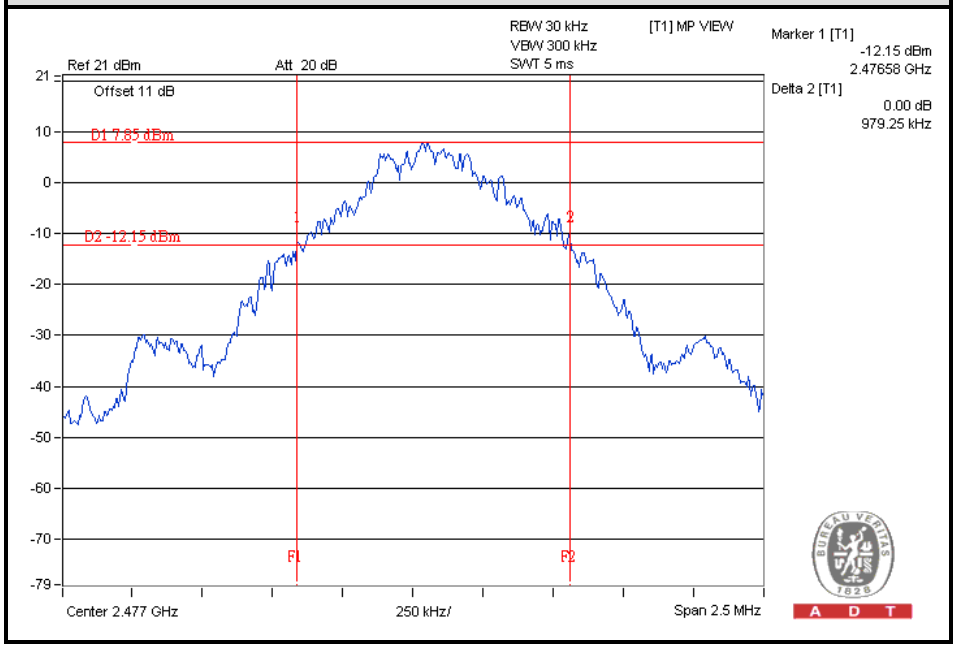
4.5.6 EUT OPERATING CONDITION

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)
1	2404	0.97
36	2442	0.96
71	2477	0.97

SPECTRUM PLOT OF WORST VALUE
GFSK



4.6 HOPPING CHANNEL SEPARATION

4.6.1 LIMIT OF HOPPING CHANNEL SEPARATION

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

4.6.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSV 40	100964	July 15, 2013	July 14, 2014

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. Tested date : July 01, 2014

4.6.3 TEST PROCEDURES

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.

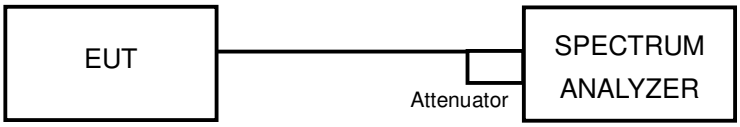
d. Measure the frequency difference of these two adjacent channels by SA MARK function. And then plot the result on SA screen.

e. Repeat above procedures until all frequencies measured were complete.

4.6.4 DEVIATION FROM TEST STANDARD

No deviation

4.6.5 TEST SETUP



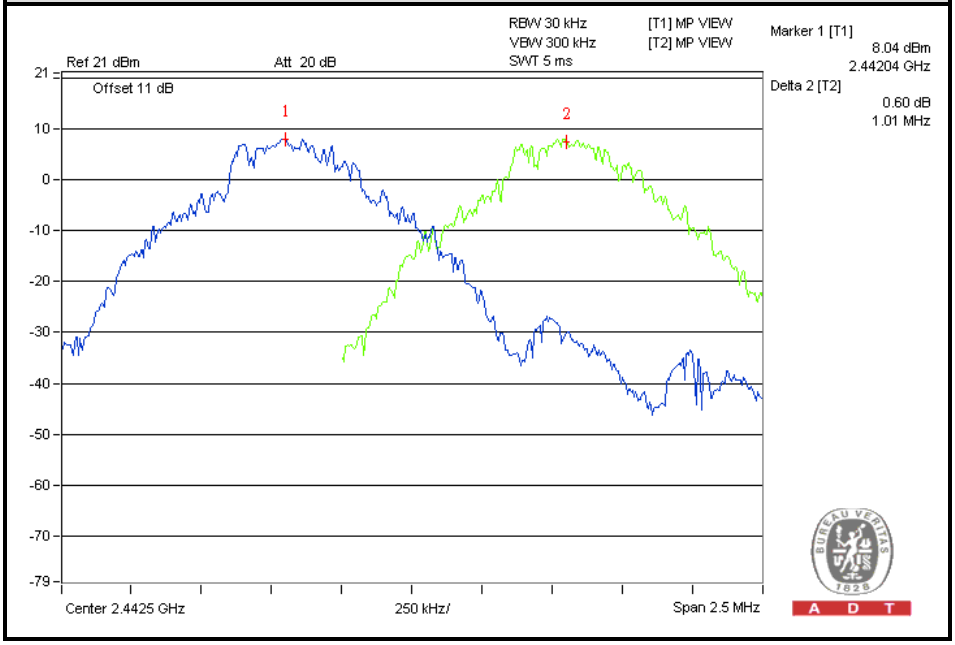
4.6.6 TEST RESULTS

CHANNEL	FREQUENCY (MHz)	ADJACENT CHANNEL SEPARATION (MHz)	20dB BANDWIDTH (MHz)	MINIMUM LIMIT (MHz)	PASS / FAIL
1	2404	1.01	0.97	0.65	PASS
36	2442	1.01	0.96	0.64	PASS
71	2477	1.01	0.97	0.65	PASS

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

SPECTRUM PLOT OF WORST VALUE

GFSK



4.7 MAXIMUM PEAK OUTPUT POWER

4.7.1 LIMITS OF MAXIMUM PEAK OUTPUT POWER MEASUREMENT

The Maximum Peak Output Power Limit is 125mW.

4.7.2 INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSV 40	100964	July 15, 2013	July 14, 2014

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. Tested date : July 01, 2014

4.7.3 TEST PROCEDURES

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.

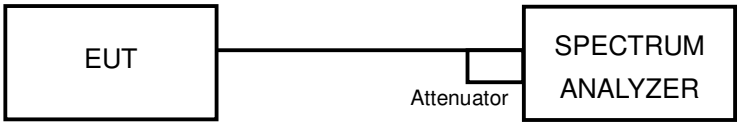
d. Measure the captured power within the band and recording the plot.

e. Repeat above procedures until all frequencies required were complete.

4.7.4 DEVIATION FROM TEST STANDARD

No deviation

4.7.5 TEST SETUP



For the actual test configuration, please refer to the related Item – Photographs of the Test Configuration.

4.7.6 EUT OPERATING CONDITION

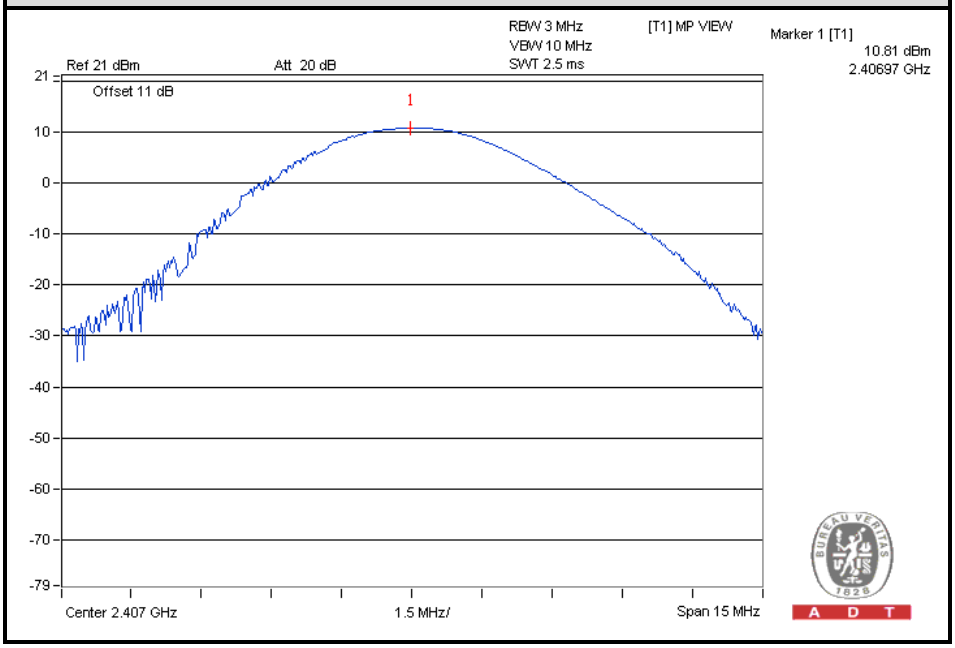
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.7.7 TEST RESULTS

CHANNEL	FREQUENCY (MHz)	OUTPUT POWER (mW)	OUTPUT POWER (dBm)	POWER LIMIT (mW)	PASS / FAIL
1	2404	12.050	10.81	125	PASS
36	2442	9.817	9.92	125	PASS
71	2477	8.072	9.07	125	PASS

SPECTRUM PLOT OF WORST VALUE

GFSK



4.8 CONDUCTED OUT-BAND EMISSION MEASUREMENT

4.8.1 LIMITS OF CONDUCTED OUT-BAND EMISSION MEASUREMENT

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

4.8.2 TEST INSTRUMENTS

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
SPECTRUM ANALYZER R&S	FSV 40	100964	July 15, 2013	July 14, 2014

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. Tested date : July 01, 2014

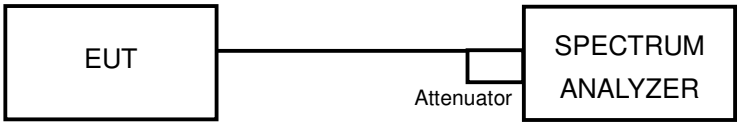
4.8.3 TEST PROCEDURE

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

4.8.4 DEVIATION FROM TEST STANDARD

No deviation

4.8.5 TEST SETUP



4.8.6 EUT OPERATING CONDITION

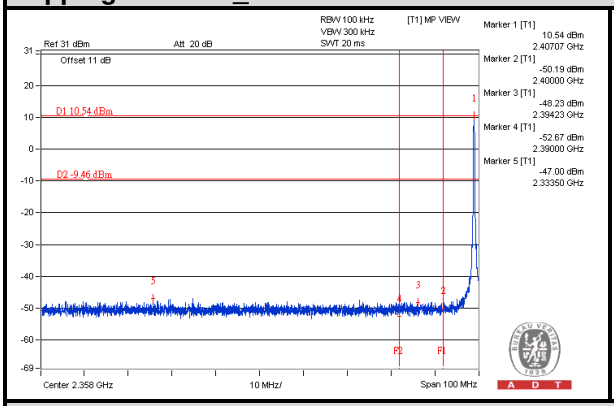
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

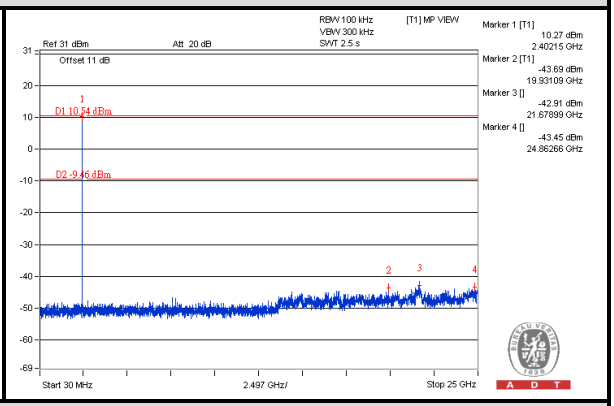
4.8.7 TEST RESULTS

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

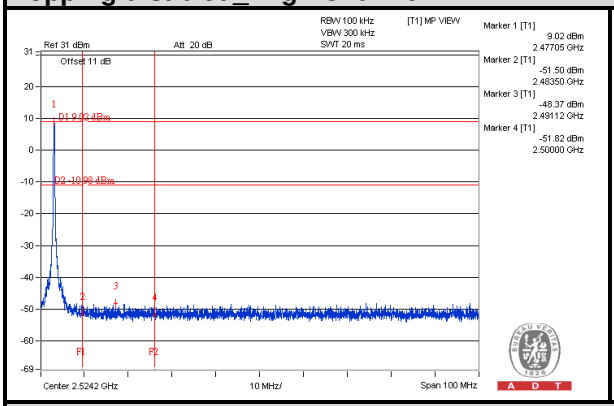
GFSK

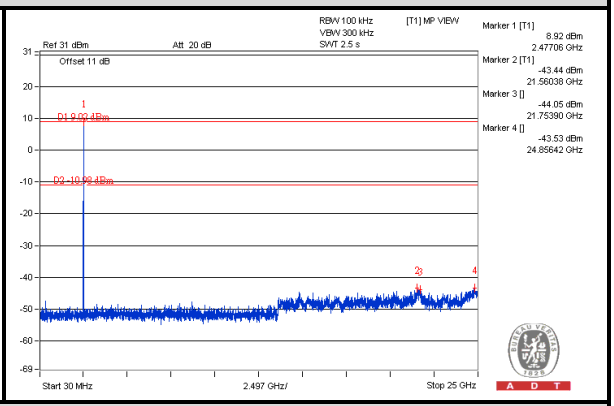
Hopping disabled_ Low Channel



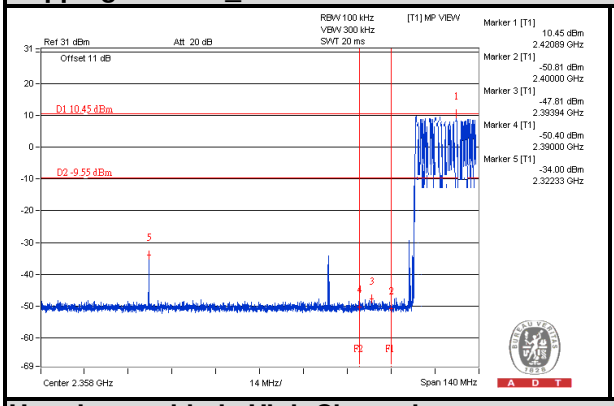


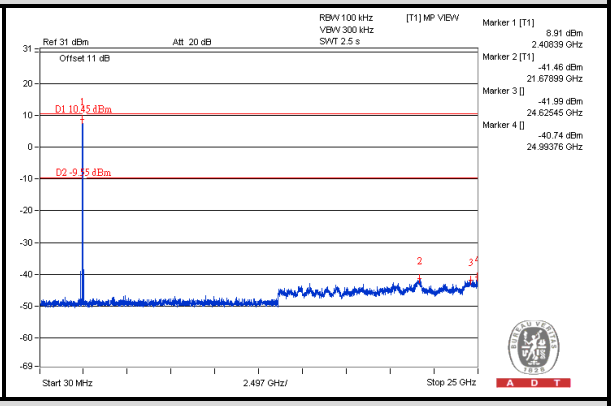
Hopping disabled_ High Channel



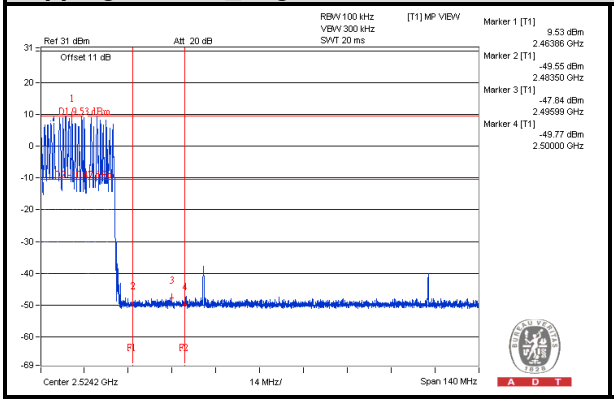


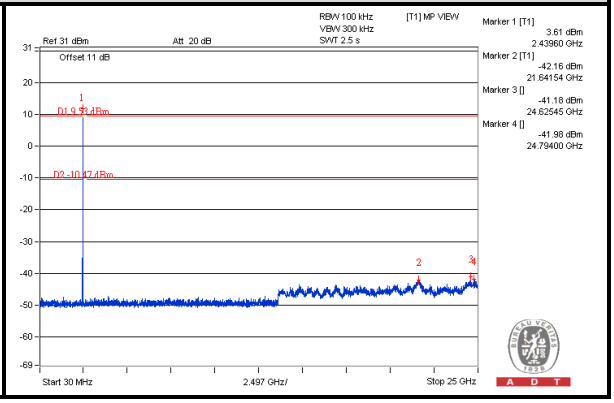
Hopping enabled_ Low Channel





Hopping enabled_ High Channel





5 PHOTOGRAPHS OF THE TEST CONFIGURATION

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

6 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:

Linko EMC/RF Lab:
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Fax: 886-2-26052943

Hsin Chu EMC/RF Lab:
Tel: 886-3-5935343
Fax: 886-3-5935342

Hwa Ya EMC/RF/Safety/Telecom Lab:
Tel: 886-3-3183232
Fax: 886-3-3270892

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.

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

No modifications were made to the EUT by the lab during the test.

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