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## FCC Test Report

**Report No.:** RF160104C14-2

**FCC ID:** GKR-TP00078ASB

**Test Model:** TP00078A

**Received Date:** Jul. 22, 2015

**Test Date:** Jul. 28, 2015 ~ Aug. 18, 2015

**Issued Date:** Feb. 18, 2016

**Applicant:** Compal Electronics Inc

**Address:** No.581, Ruiguang Rd., Neihu District, Taipei City, Taiwan 11492, R.O.C.

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

**Lab Address:** No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan ( R.O.C )

**Test Location (1):** No. 19, Hwa Ya 2nd Rd, Wen Hwa Tsuen, Kwei Shan Hsiang, Taoyuan Hsien 333, Taiwan, R.O.C.

**Test Location (2):** No.215, Sec. 3, Beixin Rd., Xindian Dist., New Taipei City 231, Taiwan, R.O.C



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### Release Control Record

Issue No.	Description	Date Issued
RF160104C14-2	Original Release	Feb. 18, 2016



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## 1 Certificate of Conformity

**Product:** Tablet Computer

**Brand:** Lenovo

**Test Model:** TP00078A

**Sample Status:** Production Unit

**Applicant:** Compal Electronics Inc

**Test Date:** Jul. 28, 2015 ~ Aug. 18, 2015

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

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

**Prepared by :** Gina Liu, **Date:** Feb. 18, 2016  
Gina Liu / Specialist

**Approved by :** Stanley Wu, **Date:** Feb. 18, 2016  
Stanley Wu / Assistant Manager



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## 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 -16.68dB at 0.15391MHz.
15.247(a)(1)(iii)	Number of Hopping Frequency Used	N/A	Refer to Note
15.247(a)(1)(iii)	Dwell Time on Each Channel	N/A	Refer to Note
15.247(a)(1)	1. Hopping Channel Separation 2. Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	N/A	Refer to Note
15.247(b)	Maximum Peak Output Power	PASS	Meet the requirement of limit.
15.205 & 209	Radiated Emissions	PASS	Meet the requirement of limit. Minimum passing margin is -3.16dB at 533.1MHz.
15.247(d)	Band Edge Measurement	N/A	Refer to Note
15.247(d)	Antenna Port Emission	N/A	Refer to Note
15.203	Antenna Requirement	PASS	No antenna connector is used.

Note: Only test item of AC power Conducted Emission and Radiated Emissions were performed for this report. Other testing data please refer to SPORTON International Inc. report no.: FR473142AC for module (Brand: Broadcom, Model: BCM94356Z, FCC ID: QDS-BRCM1085).

### 2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Frequency	Expended Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.44 dB
Radiated Emissions up to 1 GHz	30MHz ~ 200MHz	2.0153 dB
	200MHz ~ 1000MHz	2.0224 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	1.0121 dB
	18GHz ~ 40GHz	1.1508 dB

### 2.2 Modification Record

There were no modifications required for compliance.

### 3 General Information

#### 3.1 General Description of EUT

Product	Tablet Computer
Brand	Lenovo
Test Model	TP00078A
Status of EUT	Production Unit
Power Supply Rating	20Vdc (Adapter) 15.2Vdc (Li-ion battery)
Modulation Type	GFSK, $\pi/4$ -DQPSK, 8DPSK
Transfer Rate	1/2/3 Mbps
Operating Frequency	2402 ~ 2480 MHz
Number of Channel	79
Antenna Type	Refer to Note as below
Antenna Connector	N/A
Accessory Device	Refer to Note as below
Data Cable Supplied	Refer to Note as below

Note:

1. This EUT contains two samples listed as below.

Sample	Difference
EUT 1	Tablet computer with Antenna (Ethertronics Inc.)
EUT 2	Tablet computer with Antenna (HIGH-TEK)

2. The antenna information is listed as below.

Antenna Type	Brand Name	Parts Number	Antenna Gain	
			2.4GHz	5GHz
PIFA	Ethertronics Inc.	WLAN Main Antenna: 5002022 WLAN Aux. Antenna: 5002030	Main: 0.85 Aux.: -0.71	Main: 0.46 Aux.: 0.36
	HIGH-TEK	WLAN Main Antenna: DC33001RQ00 WLAN Aux. Antenna: DC33001RQ10	Main: -0.17 Aux.: -0.30	Main: 1.84 Aux.: 1.56

3. The EUT contains following accessory devices.

Product	Brand	Model	Description
Adapter 1	Lenovo	ADLX45NCC2A	I/P: 100-240Vac, 50~60Hz, 1.3A O/P: 20Vdc, 2.25A
Adapter 2	Lenovo	ADLX45NDC2A	I/P: 100-240Vac, 50~60Hz, 1.3A O/P: 20Vdc, 2.25A
Battery	Lenovo	SB10F46465	15.2Vdc, 2.895Ah
WLAN Module	Broadcom	BCM94356Z	--
WWAN Moudle	Sierra	EM7455	--

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

### 3.2 Description of Test Modes

79 channels are provided to this EUT:

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

### 3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To				Description
	RE $\geq$ 1G	RE<1G	PLC	APCM	
A	√	√	√	√	EUT 1 (Ant. Ethertronic)
B	√	√	√	√	EUT 2 (Ant. HIGH-TEK)

Where **RE $\geq$ 1G:** Radiated Emission above 1GHz

**RE<1G:** Radiated Emission below 1GHz

**PLC:** Power Line Conducted Emission

**APCM:** Antenna Port Conducted Measurement

#### NOTE:

1. For Radiated emission test, pre-tested GFSK,  $\pi/4$ -DQPSK, 8DPSK modulation type and found GFSK was the worse, therefore chosen for the final test and presented in the test report.

#### Radiated Emission Test (Above 1GHz):

- ☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates 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
B	0 to 78	78	FHSS	GFSK	DH5

#### Radiated Emission Test (Below 1GHz):

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

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
A, B	0 to 78	78	FHSS	GFSK	DH5

#### Power Line Conducted Emission Test:

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

EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
A, B	0 to 78	78	FHSS	GFSK	DH5





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**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.

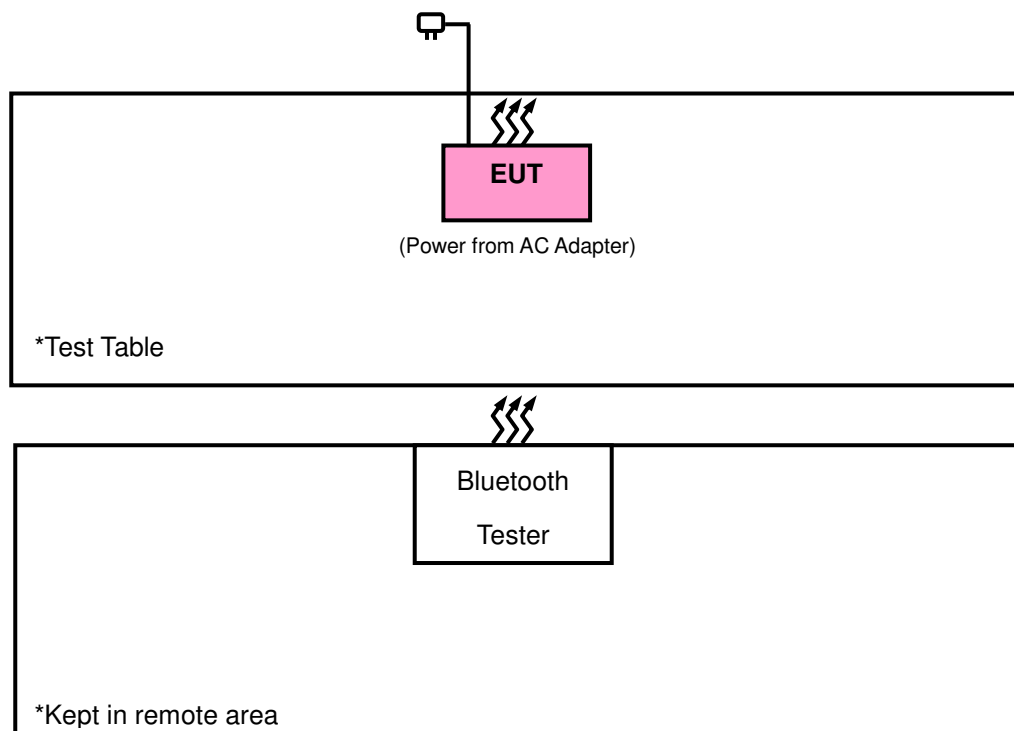
EUT Configure Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Packet Type
A, B	0 to 78	0, 39, 78	FHSS	GFSK	DH5
A, B	0 to 78	0, 39, 78	FHSS	$\pi/4$ -DQPSK	DH5
A, B	0 to 78	0, 39, 78	FHSS	8DPSK	DH5

**Test Condition:**

Applicable To	Environmental Conditions	Input Power	Tested by
RE $\geq$ 1G	25deg. C, 65%RH	120Vac, 60Hz	Karl Lee
RE<1G	25deg. C, 65%RH	120Vac, 60Hz	Karl Lee
PLC	25deg. C, 68%RH	120Vac, 60Hz	Toby Tian
APCM	25deg. C, 65%RH	120Vac, 60Hz	Howard Kao

### 3.3 Description of Support Units

#### 3.3.1 Configuration of System under Test



#### 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)**

**FCC Public Notice DA 00-705**

ANSI C63.10-2013

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.

## 4 Test Types and Results

### 4.1 Radiated Emission and Bandedge Measurement

#### 4.1.1 Limits of Radiated Emission and Bandedge Measurement

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

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

#### NOTE:

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



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## 4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Spectrum Analyzer Agilent Technologies	N9038A	MY52260177	May 19, 2015	May 18, 2016
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Dec. 10, 2014	Dec. 09, 2015
BILOG Antenna SCHWARZBECK	VULB9168	9168-472	Feb. 04, 2015	Feb. 04, 2016
HORN Antenna ETS-Lindgren	3117	00143293	Aug. 28, 2014	Aug. 27, 2015
Bluetooth Tester	CBT	100980	Apr. 27, 2015	Apr. 26, 2016
Preamplifier Agilent	310N	187226	Jun. 29, 2015	Jun. 28, 2016
Preamplifier Agilent	83017A	980116	Jan. 09, 2015	Jan. 08, 2016
Power Meter Anritsu	ML2495A	1232002	Sep. 17, 2014	Sep. 16, 2015
Power Sensor Anritsu	MA2411B	1207325	Sep. 17, 2014	Sep. 16, 2015
RF signal cable ETS-LINDGREN	5D-FB	Cable-CH1-01(R FC-SMS-100-SM S-120+RFC-SMS -100-SMS-400)	Jun. 27, 2015	Jun. 26, 2016
RF signal cable ETS-LINDGREN	8D-FB	Cable-CH1-02(R FC-SMS-100-SM S-24)	Jun. 27, 2015	Jun. 26, 2016
Software BV ADT	E3 8.130425b	NA	NA	NA
Antenna Tower MF	NA	NA	NA	NA
Turn Table MF	NA	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 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HsinTien Chamber 1.
3. The horn antenna and HP preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
4. The FCC Site Registration No. is 149147.
5. The IC Site Registration No. is IC7450I-1.

#### 4.1.3 Test Procedures

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

**Note:**

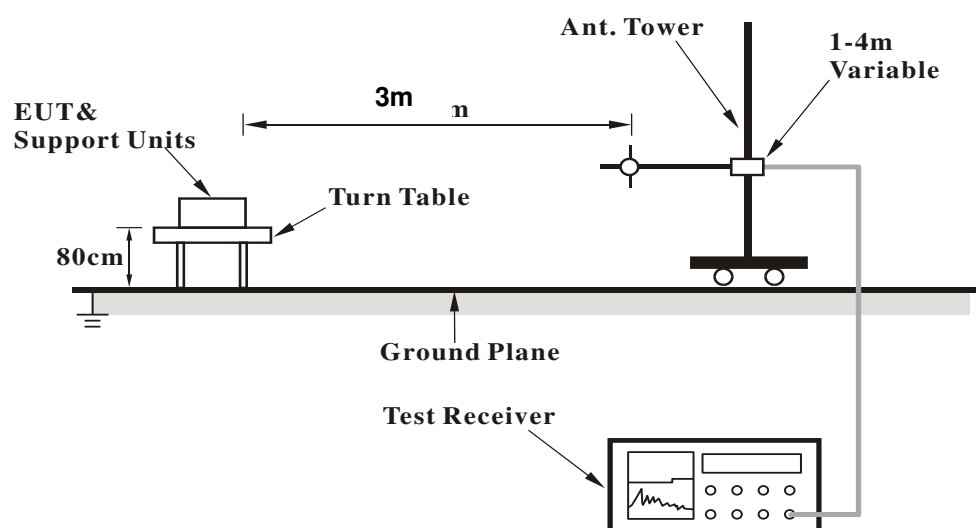
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average (Duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor ( $10 \log(1/\text{duty cycle})$ ).
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (Duty cycle  $\geq 98\%$ ) for Average detection (AV) at frequency above 1GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.1.4 Deviation from Test Standard

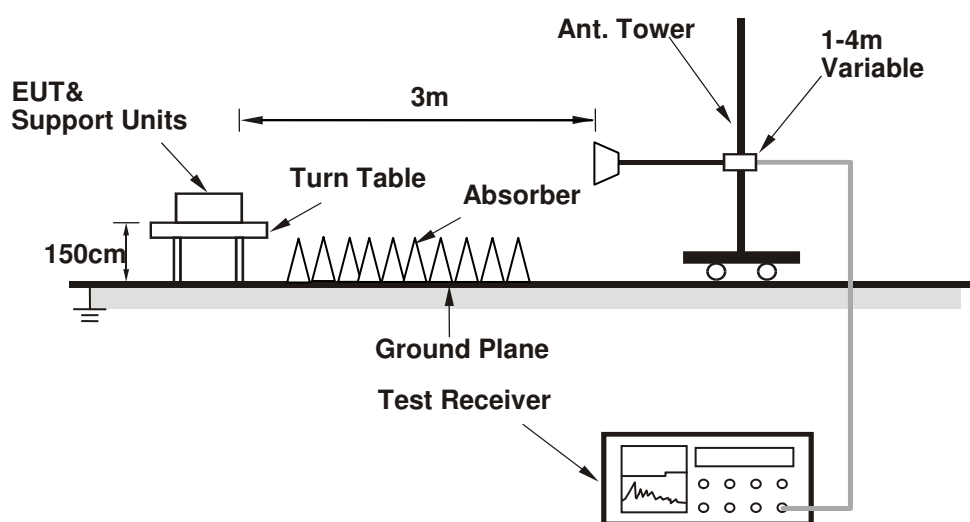
No deviation.

#### 4.1.5 Test Set Up

##### <Frequency Range below 1GHz>



##### <Frequency Range above 1GHz>



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.



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## 4.1.7 Test Results

## ABOVE 1GHz DATA :

## Mode A

## GFSK

EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 0	FREQUENCY RANGE	1GHz ~ 25GHz
INPUT POWER	120Vac, 60 Hz	DETECTOR FUNCTION	Peak (PK) Average (AV)
ENVIRONMENTAL CONDITIONS	25deg. C, 65%RH	TESTED BY	Karl Lee

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2328	42.66	41.15	54	-11.34	31.73	5.3	35.52	100	64	Average
2328	62.07	60.56	74	-11.93	31.73	5.3	35.52	100	64	Peak
2402	93.95	92.22			31.8	5.4	35.47	100	64	Average
2402	95.12	93.39			31.8	5.4	35.47	100	64	Peak
2488	42.72	40.71	54	-11.28	31.9	5.53	35.42	100	64	Average
2488	62.54	60.53	74	-11.46	31.9	5.53	35.42	100	64	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2374	42.06	40.4	54	-11.94	31.78	5.37	35.49	103	267	Average
2374	55.35	53.69	74	-18.65	31.78	5.37	35.49	103	267	Peak
2402	92.99	91.26			31.8	5.4	35.47	103	267	Average
2402	93.46	91.73			31.8	5.4	35.47	103	267	Peak
2498	42.62	40.6	54	-11.38	31.9	5.53	35.41	103	267	Average
2498	55.23	53.21	74	-18.77	31.9	5.53	35.41	103	267	Peak

## REMARKS:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2402MHz: Fundamental frequency.



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EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 39	FREQUENCY RANGE	1GHz ~ 25GHz
INPUT POWER	120Vac, 60 Hz	DETECTOR FUNCTION	Peak (PK) Average (AV)
ENVIRONMENTAL CONDITIONS	25deg. C, 65%RH	TESTED BY	Karl Lee

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2350	41.94	40.37	54	-12.06	31.74	5.33	35.5	100	64	Average
2350	55.82	54.25	74	-18.18	31.74	5.33	35.5	100	64	Peak
2441	94.75	92.88			31.85	5.46	35.44	100	64	Average
2441	95.49	93.62			31.85	5.46	35.44	100	64	Peak
2492	42.93	40.91	54	-11.07	31.9	5.53	35.41	100	64	Average
2492	55.94	53.92	74	-18.06	31.9	5.53	35.41	100	64	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2384	42.12	40.43	54	-11.88	31.78	5.4	35.49	103	267	Average
2384	55.72	54.03	74	-18.28	31.78	5.4	35.49	103	267	Peak
2441	92.85	90.98			31.85	5.46	35.44	103	267	Average
2441	93.91	92.04			31.85	5.46	35.44	103	267	Peak
2494	42.58	40.56	54	-11.42	31.9	5.53	35.41	103	267	Average
2494	55.72	53.7	74	-18.28	31.9	5.53	35.41	103	267	Peak

**REMARKS:**

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2441MHz: Fundamental frequency.





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EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 78	FREQUENCY RANGE	1GHz ~ 25GHz
INPUT POWER	120Vac, 60 Hz	DETECTOR FUNCTION	Peak (PK) Average (AV)
ENVIRONMENTAL CONDITIONS	25deg. C, 65%RH	TESTED BY	Karl Lee

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2384	42.42	40.73	54	-11.58	31.78	5.4	35.49	102	126	Average
2384	56.12	54.43	74	-17.88	31.78	5.4	35.49	102	126	Peak
2480	94.53	92.57			31.88	5.5	35.42	102	126	Average
2480	95.77	93.81			31.88	5.5	35.42	102	126	Peak
2498	42.83	40.81	54	-11.17	31.9	5.53	35.41	102	126	Average
2498	56.86	54.84	74	-17.14	31.9	5.53	35.41	102	126	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2390	42.26	40.53	54	-11.74	31.8	5.4	35.47	100	267	Average
2390	56.03	54.3	74	-17.97	31.8	5.4	35.47	100	267	Peak
2480	92.72	90.76			31.88	5.5	35.42	100	267	Average
2480	93.86	91.9			31.88	5.5	35.42	100	267	Peak
2484	43.11	41.15	54	-10.89	31.88	5.5	35.42	100	267	Average
2484	56.33	54.37	74	-17.67	31.88	5.5	35.42	100	267	Peak

**REMARKS:**

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2480MHz: Fundamental frequency.



A D F

**Mode B**

EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 78	FREQUENCY RANGE	1GHz ~ 25GHz
INPUT POWER	120Vac, 60 Hz	DETECTOR FUNCTION	Peak (PK) Average (AV)
ENVIRONMENTAL CONDITIONS	25deg. C, 65%RH	TESTED BY	Karl Lee

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2352	39.1	37.51	54	-14.9	31.76	5.33	35.5	101	127	Average
2352	54.54	52.95	74	-19.46	31.76	5.33	35.5	101	127	Peak
2480	94.98	93.02			31.88	5.5	35.42	101	127	Average
2480	95.65	93.69			31.88	5.5	35.42	101	127	Peak
2494	40.13	38.11	54	-13.87	31.9	5.53	35.41	101	127	Average
2494	55.17	53.15	74	-18.83	31.9	5.53	35.41	101	127	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
2356	39.13	37.5	54	-14.87	31.76	5.37	35.5	102	31	Average
2356	54.6	52.97	74	-19.4	31.76	5.37	35.5	102	31	Peak
2480	92.02	90.06			31.88	5.5	35.42	102	31	Average
2480	93.06	91.1			31.88	5.5	35.42	102	31	Peak
2486	40.11	38.12	54	-13.89	31.88	5.53	35.42	102	31	Average
2486	55.54	53.55	74	-18.46	31.88	5.53	35.42	102	31	Peak

**REMARKS:**

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor  
Margin value = Emission level – Limit value
- 2480MHz: Fundamental frequency.



A D T

**BELOW 1GHz WORST-CASE DATA:****Mode A**

EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 78	FREQUENCY RANGE	30MHz ~ 1GHz
INPUT POWER	120Vac, 60 Hz	DETECTOR FUNCTION	Peak (PK) Quasi-peak (QP)
ENVIRONMENTAL CONDITIONS	25deg. C, 65%RH	TESTED BY	Karl Lee

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
163.65	28.78	49.01	43.5	-14.72	10.51	1.52	32.26	146	321	Peak
206.31	35.65	55.1	43.5	-7.85	11.17	1.65	32.27	100	240	QP
271.38	28.14	44.69	46	-17.86	13.62	1.94	32.11	127	38	Peak
531.7	39.37	48.26	46	-6.63	20.57	2.7	32.16	153	114	Peak
711.6	34.28	40.04	46	-11.72	23.23	3.11	32.1	177	177	Peak
879.6	32.17	35.45	46	-13.83	24.84	3.49	31.61	131	165	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
37.02	34.65	53.12	40	-5.35	13.02	0.74	32.23	102	137	Peak
146.1	32.41	53.51	43.5	-11.09	9.79	1.38	32.27	146	1	Peak
208.74	37.15	56.5	43.5	-6.35	11.26	1.65	32.26	100	209	QP
<b>533.1</b>	<b>42.84</b>	<b>51.74</b>	<b>46</b>	<b>-3.16</b>	<b>20.57</b>	<b>2.7</b>	<b>32.17</b>	<b>154</b>	<b>215</b>	<b>Peak</b>
710.9	35.63	41.39	46	-10.37	23.23	3.11	32.1	147	142	Peak
883.1	35.09	38.31	46	-10.91	24.88	3.49	31.59	111	125	Peak

**REMARKS:** Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor

Margin value = Emission level – Limit value



A D F

**Mode B**

EUT TEST CONDITION		MEASUREMENT DETAIL	
CHANNEL	Channel 78	FREQUENCY RANGE	30MHz ~ 1GHz
INPUT POWER	120Vac, 60 Hz	DETECTOR FUNCTION	Peak (PK)
ENVIRONMENTAL CONDITIONS	25deg. C, 65%RH	TESTED BY	Karl Lee

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
126.66	27.57	49.4	43.5	-15.93	9.03	1.38	32.24	166	275	Peak
189.3	35.22	55.46	43.5	-8.28	10.4	1.61	32.25	189	33	Peak
265.17	36.4	53.12	46	-9.6	13.45	1.94	32.11	194	221	Peak
533.1	39.37	48.27	46	-6.63	20.57	2.7	32.17	120	268	Peak
760.6	36.09	41.7	46	-9.91	23.3	3.22	32.13	130	141	Peak
798.4	38.9	43.22	46	-7.1	24.42	3.32	32.06	198	84	Peak
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M										
FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	READ LEVEL (dBuV)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA FACTOR (dB/m)	CABLE LOSS (dB)	PREAMP FACTOR (dB)	ANTENNA HEIGHT (cm)	TABLE ANGLE (Degree)	REMARK
125.04	31.43	53.32	43.5	-12.07	8.97	1.38	32.24	125	4	Peak
193.35	34.13	54.22	43.5	-9.37	10.57	1.61	32.27	126	85	Peak
266.25	33.1	49.78	46	-12.9	13.49	1.94	32.11	176	250	Peak
531.7	38.66	47.55	46	-7.34	20.57	2.7	32.16	153	17	Peak
700.4	34.15	40.03	46	-11.85	23.1	3.11	32.09	131	14	Peak
797.7	37.09	41.41	46	-8.91	24.42	3.32	32.06	179	77	Peak

**REMARKS:** Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor

Margin value = Emission level – Limit value

## 4.2 Conducted Emission Measurement

### 4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

- Note: 1. The lower limit shall apply at the transition frequencies.  
 2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.  
 3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

### 4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date Of Calibration	Due Date Of Calibration
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Nov. 11, 2014	Nov. 10, 2015
RF signal cable Woken	5D-FB	Cable-HYC01-01	Dec. 26, 2014	Dec. 25, 2015
LISN ROHDE & SCHWARZ (EUT)	ESH3-Z5	835239/001	Mar. 02, 2015	Mar. 01, 2016
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Jul. 24, 2015	Jul. 23, 2016
Software ADT	BV ADT_Cond_ V7.3.7.3	NA	NA	NA

- Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.  
 2. The test was performed in HwaYa Shielded Room 1.  
 3. The VCCI Site Registration No. is C-2040.

#### 4.2.3 Test Procedures

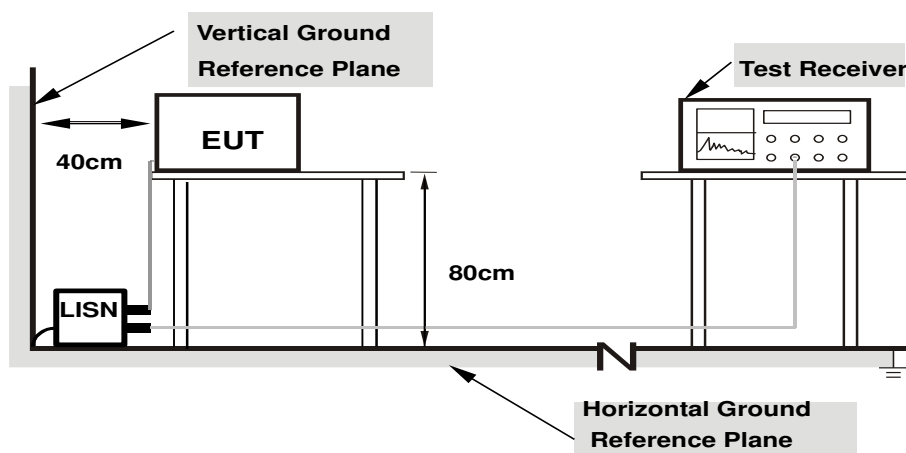
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

**NOTE:** 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



**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

Same as 4.1.6.

## 4.2.7 Test Results

### Mode A

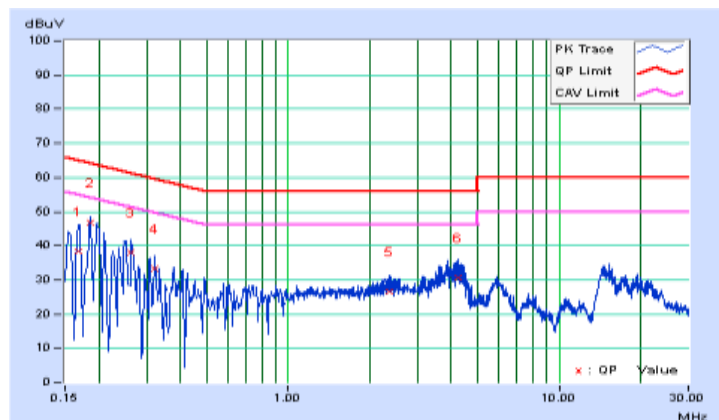
#### CONDUCTED WORST-CASE DATA : GFSK

PHASE	Line 1	6dB BANDWIDTH	9kHz
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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	0.16922	0.05	38.42	14.31	38.47	14.36	65.00	55.00	-26.52	-40.63
2	0.18519	0.06	46.71	30.30	46.77	30.36	64.25	54.25	-17.48	-23.89
3	0.26339	0.06	37.98	21.29	38.04	21.35	61.32	51.32	-23.28	-29.97
4	0.32204	0.06	33.26	16.10	33.32	16.16	59.65	49.65	-26.33	-33.49
5	2.36306	0.13	26.49	15.25	26.62	15.38	56.00	46.00	-29.38	-30.62
6	4.24377	0.20	30.28	19.70	30.48	19.90	56.00	46.00	-25.52	-26.10

#### REMARKS:

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

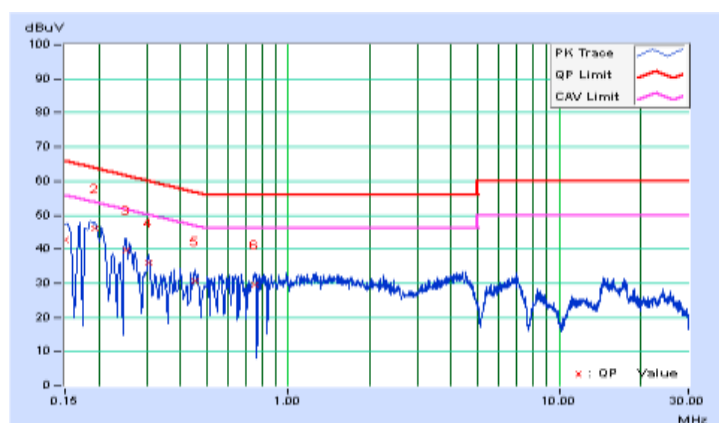


PHASE	Line 2	6dB BANDWIDTH	9kHz
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No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.15000	0.05	42.63	24.39	42.68	24.44	66.00	56.00	-23.32	-31.56
2	0.19255	0.05	46.19	31.26	46.24	31.31	63.93	53.93	-17.69	-22.62
3	0.25125	0.05	39.84	24.22	39.89	24.27	61.72	51.72	-21.82	-27.44
4	0.30615	0.06	36.13	19.70	36.19	19.76	60.07	50.07	-23.89	-30.32
5	0.45107	0.06	30.51	15.70	30.57	15.76	56.86	46.86	-26.28	-31.09
6	0.75214	0.07	29.49	14.88	29.56	14.95	56.00	46.00	-26.44	-31.05

### 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.





## Mode B

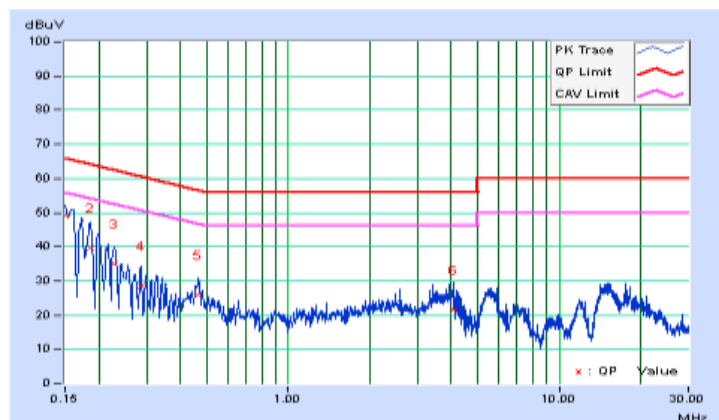
### CONDUCTED WORST-CASE DATA : GFSK

PHASE	Line 1	6dB BANDWIDTH	9kHz
-------	--------	---------------	------

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	0.15000	0.05	49.18	34.66	49.23	34.71	66.00	56.00	-16.77	-21.29
2	0.18508	0.06	39.54	20.22	39.60	20.28	64.25	54.25	-24.66	-33.98
3	0.22791	0.06	34.94	20.88	35.00	20.94	62.53	52.53	-27.53	-31.59
4	0.28685	0.06	28.55	14.46	28.61	14.52	60.62	50.62	-32.01	-36.10
5	0.46301	0.06	25.73	16.56	25.79	16.62	56.64	46.64	-30.85	-30.02
6	4.06000	0.19	21.22	12.43	21.41	12.62	56.00	46.00	-34.59	-33.38

### REMARKS:

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

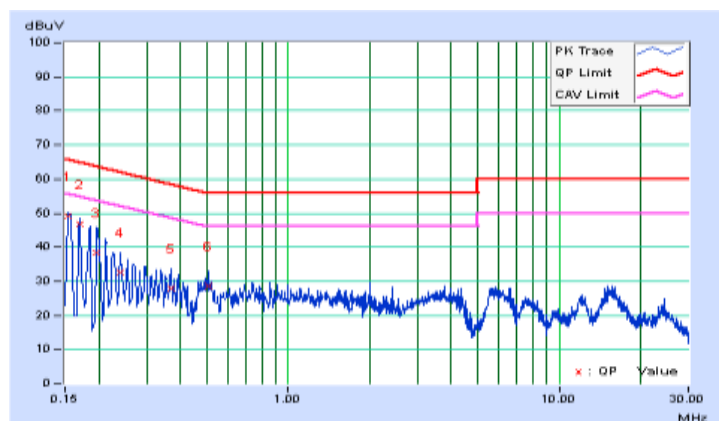


PHASE	Line 2	6dB BANDWIDTH	9kHz
-------	--------	---------------	------

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	0.15391	0.05	49.06	33.83	49.11	33.88	65.79	55.79	-16.68	-21.91
2	0.16967	0.05	46.63	30.71	46.68	30.76	64.98	54.98	-18.30	-24.22
3	0.19692	0.05	38.33	19.08	38.38	19.13	63.74	53.74	-25.36	-34.61
4	0.23993	0.05	32.57	16.53	32.62	16.58	62.10	52.10	-29.48	-35.52
5	0.36896	0.06	27.92	17.66	27.98	17.72	58.52	48.52	-30.55	-30.81
6	0.50581	0.06	28.42	20.26	28.48	20.32	56.00	46.00	-27.52	-25.68

#### 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.

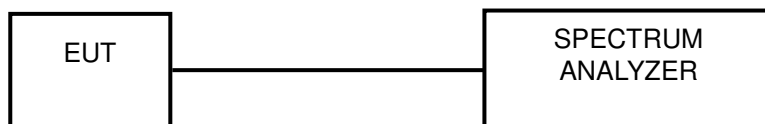


### 4.3 Maximum Output Power

#### 4.3.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125mW.

#### 4.3.2 Test Setup



#### 4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

#### 4.3.4 Test Procedure

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
- The center frequency of the spectrum analyzer is set to the fundamental frequency and using 3MHz RBW and 10 MHz VBW.
- Measure the captured power within the band and recording the plot.
- Repeat above procedures until all frequencies required were complete.

#### 4.3.5 Deviation from Test Standard

No deviation.

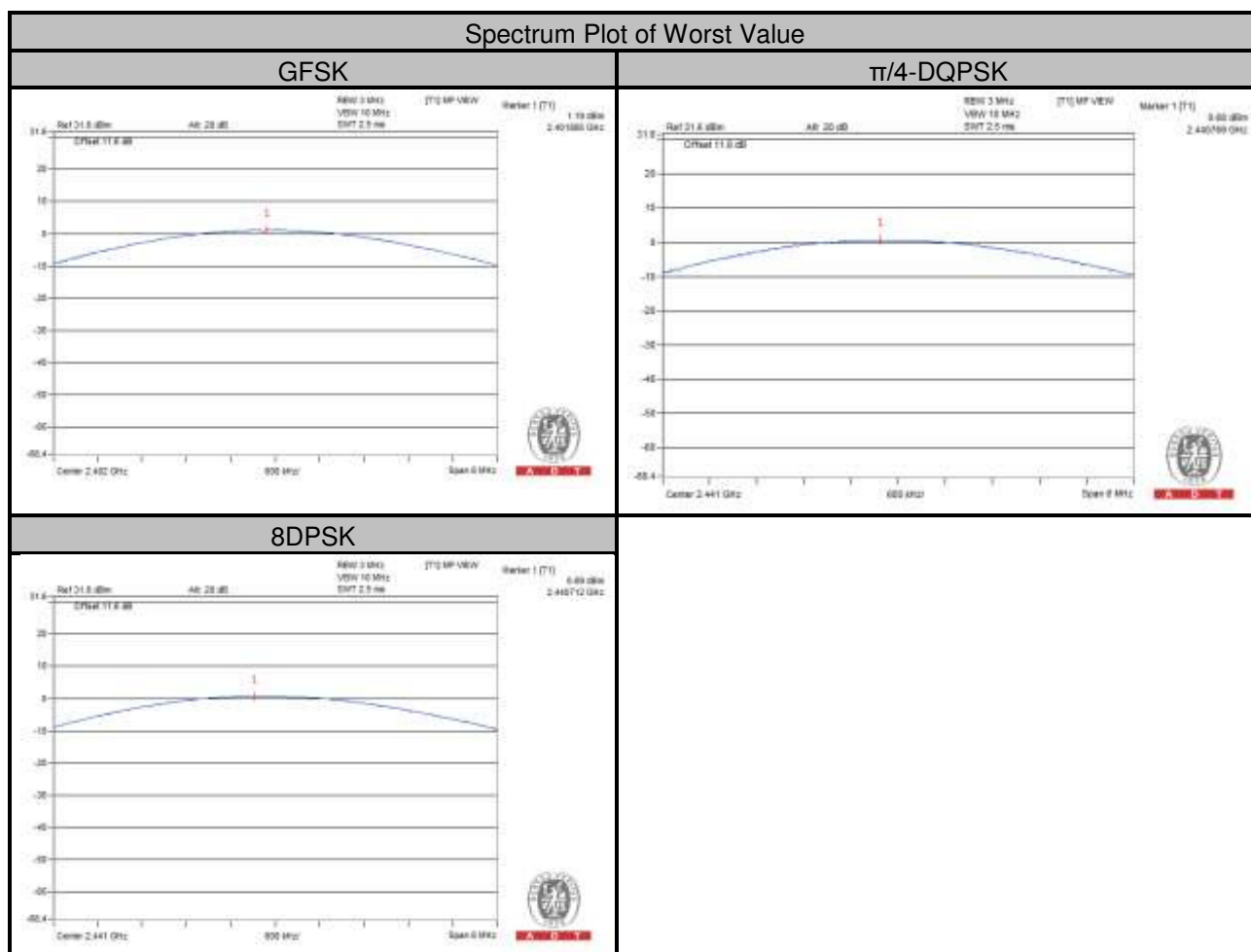
#### 4.3.6 EUT Operating Condition

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

### 4.3.7 Test Results

#### Mode A

Channel	Frequency (MHz)	Output Power (mW)			Output Power (dBm)			Power Limit (mW)	Pass / Fail
		GFSK	$\pi/4$ -DQPSK	8DPSK	GFSK	$\pi/4$ -DQPSK	8DPSK		
0	2402	1.315	1.117	1.119	1.19	0.48	0.49	125	PASS
39	2441	1.291	1.169	1.172	1.11	0.68	0.69	125	PASS
78	2480	1.199	1.104	1.102	0.79	0.43	0.42	125	PASS

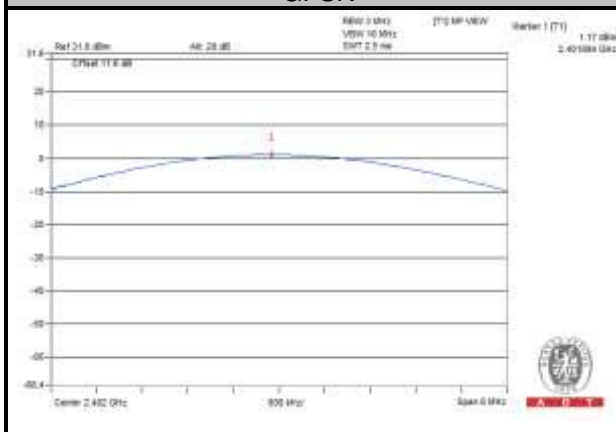


## Mode B

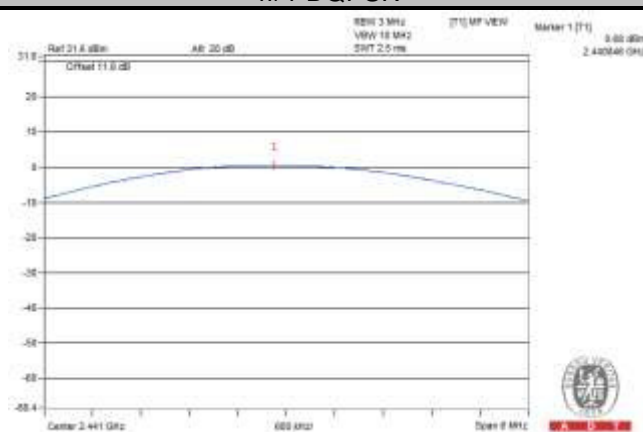
Channel	Frequency (MHz)	Output Power (mW)			Output Power (dBm)			Power Limit (mW)	Pass / Fail
		GFSK	$\pi/4$ -DQPSK	8DPSK	GFSK	$\pi/4$ -DQPSK	8DPSK		
0	2402	1.309	1.117	1.117	1.17	0.48	0.48	125	PASS
39	2441	1.291	1.169	1.178	1.11	0.68	0.71	125	PASS
78	2480	1.197	1.099	1.107	0.78	0.41	0.44	125	PASS

## Spectrum Plot of Worst Value

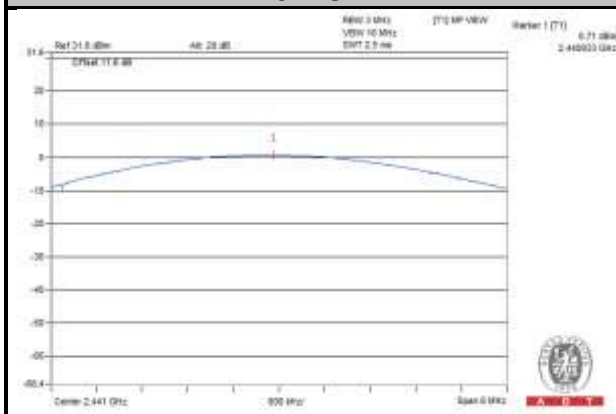
### GFSK



### $\pi/4$ -DQPSK



### 8DPSK





## 5 Pictures of Test Arrangements

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



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## Appendix – Information on the Testing Laboratories

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

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

**Linko EMC/RF Lab**

Tel: 886-2-26052180

Fax: 886-2-26051924

**Hsin Chu EMC/RF Lab/Telecom Lab**

Tel: 886-3-5935343

Fax: 886-3-5935342

**Hwa Ya EMC/RF/Safety**

Tel: 886-3-3183232

Fax: 886-3-3270892

**Email:** [service.adt@tw.bureauveritas.com](mailto:service.adt@tw.bureauveritas.com)

**Web Site:** [www.bureauveritas-adt.com](http://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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