FCC Test Report (BT-EDR)

Report No.:	RF170908C01A-2
FCC ID:	HD5-CT60L0N
Test Model:	CT60L0N
Received Date:	Oct. 30, 2017
Test Date:	Nov. 01 to 06, 2017
Issued Date:	Nov. 15, 2017
Applicant:	Honeywell International Inc.
Address:	9680 Old Bailes Road, Fort Mill, SC 29707 USA
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
Lab Address:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.
Test Location :	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan R.O.C.

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Release Control Record

Issue No.	Description	Date Issued
RF170908C01A-2	Original release.	Nov. 15, 2017

1 Certificate of Conformity

Product:	Dolphin CT60
Brand:	Honeywell
Test Model:	CT60L0N
Sample Status:	ENGINEERING SAMPLE
Applicant:	Honeywell International Inc.
Test Date:	Nov. 01 to 06, 2017
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) ANSI C63.10: 2013

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

Prepared by : _____ , **Date:** Nov. 15, 2017

Claire Kuan / Specialist

Approved by : _____ , **Date:** Nov. 15, 2017

May Chen / Manager

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (SECTION 15.247)			
FCC Clause	Test Item	Result	Remarks
15.247(b)	Maximum Peak Output Power	PASS	Meet the requirement of limit.
15.205 & 209 & 15.247(d)	Radiated Emissions & Band Edge Measurement	PASS	Meet the requirement of limit. Minimum passing margin is -10.1dB at 2390.00MHz.

Note: This report is supplementary report.

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) (±)
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.30 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	5.16 dB
	6GHz ~ 18GHz	4.91 dB
	18GHz ~ 40GHz	5.30 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT (BT-EDR)

Product	Dolphin CT60
Brand	Honeywell
Test Model	CT60L0N
Status of EUT	ENGINEERING SAMPLE
HW Version	V1.0
SW Version	249D
HW P/N	DVT2.2
Power Supply Rating	3.6Vdc from battery 5Vdc from USB interface
Modulation Type	GFSK, π/4-DQPSK, 8DPSK
Modulation Technology	FHSS
Transfer Rate	Up to 3Mbps
Operating Frequency	2402MHz ~ 2480MHz
Number of Channel	79
Output Power	5.058mW
Antenna Type	Refer to Note
Antenna Connector	Refer to Note
Accessory Device	Battery x 1
Data Cable Supplied	USB snap-on adapter x 1 (1.25m, Shielded with two cores)

Note:

1. This report is prepared for FCC Class II change. The difference compared with the Report No.: RF170908C01-2 design is as the following:
   - ◆ The change list as below table:

No.	Change Item	BOM Change	Layout Change
1	1.U2101 SIM_SWIO_1 connect to SIM1 J1301 2.U2101 SIM_SWIO_2 connect to SIM1 J1303 3. SIM powers path change	Yes	Yes
2	Add a pull-up 100K resistor to VREG_L11A_1P8 at J1202 pin-34 and connect J1202 pin-35 to GPIO_56	Yes	Yes
3	1. Pull-down WIPWR_CHG_OK. 2. There is divided voltage 1.8V from VDC_IN by 180K and 100K resistors to QI_PMA_ON	Yes	Yes
4	Add more vias to mic pads to make the pads hold.	No	Yes
5	They need to be shifted base on MD's drawing.	No	Yes
6	Add more vias to the solder pads to make them hold better. (SW1401~SW1406)	No	Yes
7	Circuit change between J2003 and U2001	Yes	Yes
8	Remove U1901 circuit, just keep J1901,L1906(DNI),R1910(0R), E1911(DNI),EMI1901 from original for RF.	Yes	Yes
9	1.Remove U1801 circuit,just keep EMI1801,EMI1802,R1813,R1812,L1806,J1801,R1809,R1810,R1811 for RF.	Yes	Yes
10	AIN1 pin needs to be pulled down	No	Yes

No.	Change Item	BOM Change	Layout Change
11	CT50 pad size is 2.0x3.0mm but MD team suggests pad size is 1.5x3.0mm because receiver spec suggested having 0.5mm gape requirement.	No	Yes
12	Moving camera's test points x 7 pcs to left	No	Yes
13	Moving U1107 circuit to right for 0.5mm	No	Yes
14	Add additional vias on the battery connector pads	No	Yes
15	RF team needs to have NFC circuit changes and matching components value changes.	Yes	Yes
16	Open a ground pad to contact receiver's back side metal	No	Yes
17	R401 needs to be changed to 33 Ohm	Yes	No
18	Put R1219 and R1220	Yes	No
19	Change Tool1716 to PTH.	No	Yes
20	Add 0.5pF to USIM2_DATA_CONN, USIM1_DATA_CONN between system GND,instead to SIM GND	Yes	Yes
21	Add Ferried Bead and capacitor on Vibrator driving line.	Yes	Yes
22	Remove R505,C512,C513	Yes	Yes

2. According to above conditions, only radiated emissions (Above 1GHz test: only GFSK modulation test) and maximum peak output power test item needs to be performed. And all data was verified to meet the requirements.
3. There are WLAN, Bluetooth and NFC technology used for the EUT.
4. Simultaneously transmission condition.

Condition	Technology	
1	WLAN 2.4GHz	NFC
2	WLAN 5GHz	NFC
3	Bluetooth	NFC
Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.		

5. The EUT needs to be supplied from battery, the information is as below table:

Brand	Model No.	Spec.
Inventus	CT50-BTSC	3.6Vdc, 4040mAh, 14.6Wh

6. The antennas provided to the EUT, please refer to the following table:

WLAN / Bluetooth Antenna Spec.				
Antenna No.	Antenna Gain include path loss (dBi)	Frequency rang (GHz)	Antenna type	Connector type
1	0.62	2.4~2.4835	PIFA	UFL
	1.14	5.15~5.25		
	1.14	5.25~5.35		
	1.14	5.47~5.725		
	1.14	5.725~5.85		

NFC Antenna Spec.			
Antenna No.	Frequency rang (MHz)	Antenna type	Connector type
1	13~14	Loop	NA
Note: 1. The antenna has path loss. 2.4GHz: 1dB; 5GHz: 1.7dB			

7. In the original test report, for the radiated emissions, the EUT was pre-tested under the following modes:

Test Mode	Description
Mode A	**Power from laptop**
Mode B	Power from adapter

From the above modes, the worst case was found in **Mode A**. Therefore only the test data of the mode was recorded in this report.

8. 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 for BT-EDR mode:

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	APCM	
-	√	√	√	Power from Laptop

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

APCM: Antenna Port Conducted Measurement

NOTE: In the oritinal test repot, the EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Z-plane (below 1GHz) & X-plane (Above 1GHz).**

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.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
0 to 78	0, 39, 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.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
0 to 78	0	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.

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	PACKET TYPE
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 (System)	TESTED BY
RE≥1G	24deg. C, 67%RH	120Vac, 60Hz	Rey Chen
RE<1G	22deg. C, 63%RH	120Vac, 60Hz	Rey Chen
APCM	25deg. C, 60%RH	120Vac, 60Hz	Anderson Chen

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.	Laptop	HP	Pavilion 14-ab023TU	5CD5340WXZ	FCC DoC	Provided by Lab
B.	Micro SD Card	Transcend	16GB	NA	NA	Provided by Lab

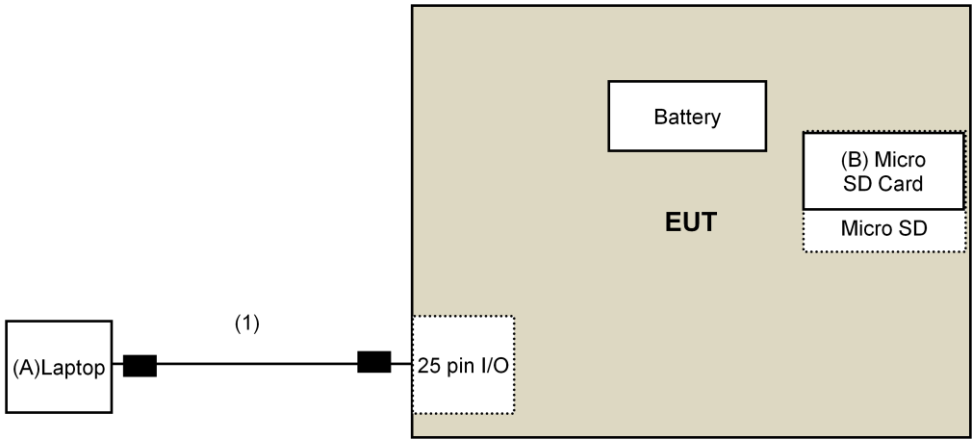
Note:

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

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	USB Charging Cable	1	1.25	Yes	2	Supplied by client(for RF Setup)

Note: The core(s) is(are) originally attached to the cable(s).

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)
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.

4.1.2 Test Instruments

DESCRIPTION & MANUFACTURER	MODEL NO.	SERIAL NO.	CALIBRATED DATE	CALIBRATED UNTIL
Test Receiver Keysight	N9038A	MY54450088	July 08, 2017	July 07, 2018
Pre-Amplifier(*) EMCI	EMC001340	980142	Jan. 20, 2016	Jan. 19, 2018
Loop Antenna(*) Electro-Metrics	EM-6879	264	Dec. 16, 2016	Dec. 15, 2018
RF Cable	NA	LOOPCAB-001 LOOPCAB-002	Jan. 17, 2017	Jan. 16, 2018
Pre-Amplifier Mini-Circuits	ZFL-1000VH2B	AMP-ZFL-01	Nov. 10, 2016	Nov. 09, 2017
Trilog Broadband Antenna SCHWARZBECK	VULB 9168	9168-406	Dec. 13, 2016	Dec. 12, 2017
RF Cable	8D	966-4-1 966-4-2 966-4-3	Apr. 01, 2017	Mar. 31, 2018
Fixed attenuator Mini-Circuits	UNAT-5+	PAD-3m-4-01	Oct. 03, 2017	Oct. 02, 2018
Horn_Antenna SCHWARZBECK	BBHA 9120D	9120D-783	Dec. 27, 2016	Dec. 26, 2017
Pre-Amplifier EMCI	EMC12630SE	980385	Feb. 02, 2017	Feb. 01, 2018
RF Cable	EMC104-SM-SM-1200 EMC104-SM-SM-2000 EMC104-SM-SM-5000	160923 150318 150321	Feb. 02, 2017 Mar. 29, 2017 Mar. 29, 2017	Feb. 01, 2018 Mar. 28, 2018 Mar. 28, 2018
Pre-Amplifier EMCI	EMC184045SE	980387	Feb. 02, 2017	Feb. 01, 2018
Horn_Antenna SCHWARZBECK	BBHA 9170	BBHA9170608	Dec. 15, 2016	Dec. 14, 2017
RF Cable	SUCOFLEX 102	36432/2 36433/2	Jan. 15, 2017	Jan. 14, 2018
Software	ADT_Radiated_V8.7.08	NA	NA	NA
Antenna Tower & Turn Table Max-Full	MF-7802	MF780208410	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP02	NA	NA
Spectrum Analyzer Agilent	E4446A	MY48250253	Dec. 21, 2016	Dec. 20, 2017
Power meter Anritsu	ML2495A	1014008	May 11, 2017	May 10, 2018
Power sensor Anritsu	MA2411B	0917122	May 11, 2017	May 10, 2018

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 calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
3. The test was performed in 966 Chamber No. 4.
4. The FCC Designation Number is TW2022.
5. The CANADA Site Registration No. is 20331-2
6. Tested Date: Nov. 01 to 03, 2017

4.1.3 Test Procedures

For Radiated emission below 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. Both X and Y axes of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

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

For Radiated emission above 30MHz

a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

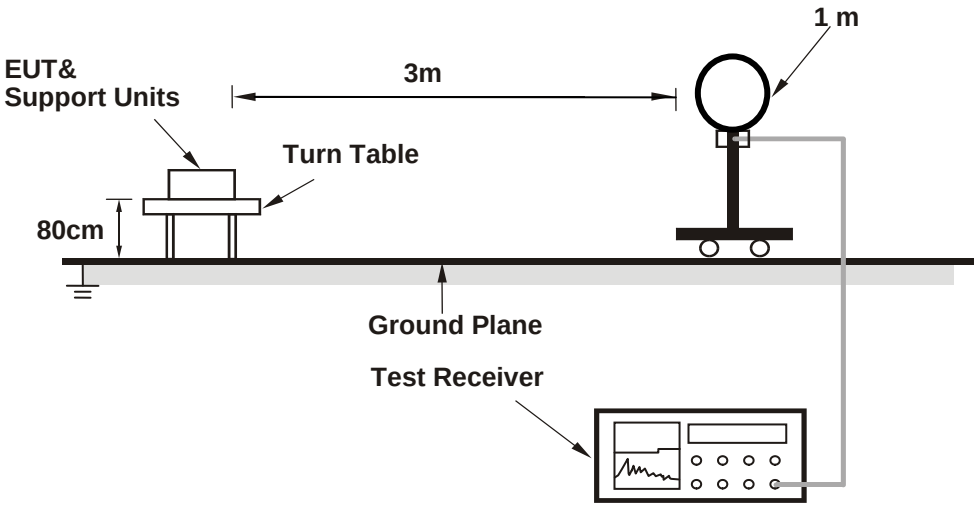
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

4.1.4 Deviation from Test Standard

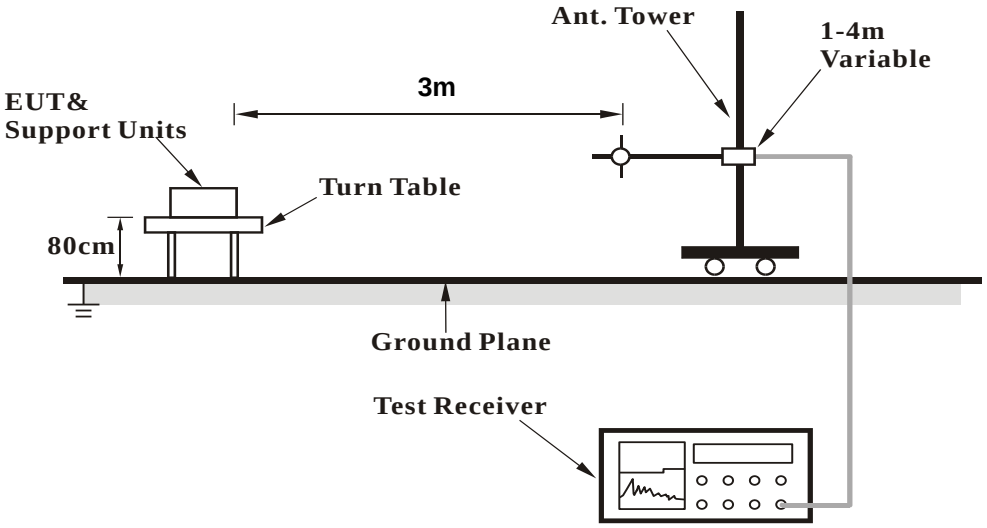
No deviation.

4.1.5 Test Setup

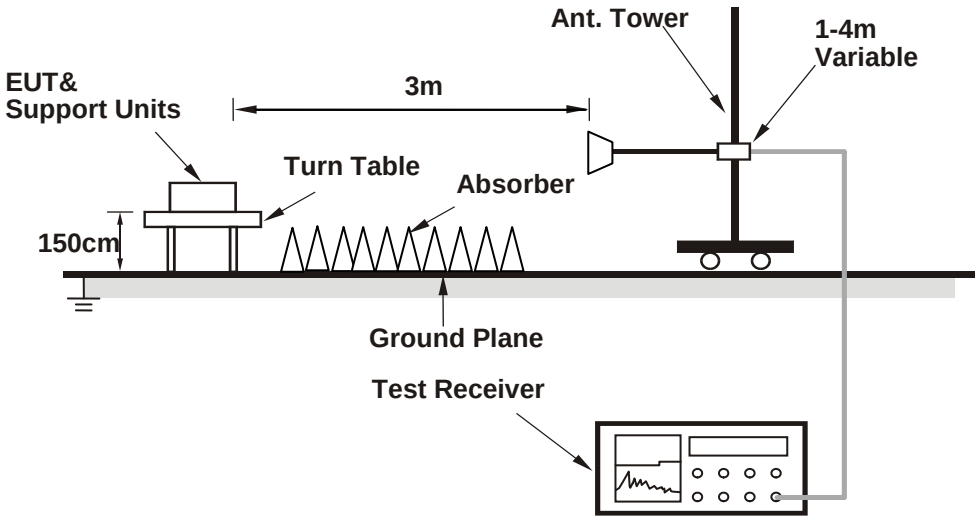
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



For Radiated emission above 1GHz



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

4.1.6 EUT Operating Conditions

a. Connected the EUT with the Laptop.

b. Controlling software (QRCT_Version3.0.268.0) has been activated to set the EUT on specific status.

4.1.7 Test Results

Above 1GHz Data:

BT_GFSK

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

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	**FREQ. (MHz)**	**EMISSION LEVEL (dBuV/m)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA HEIGHT (m)**	**TABLE ANGLE (Degree)**	**RAW VALUE (dBuV)**	**CORRECTION FACTOR (dB/m)**
1	2390.00	56.8 PK	74.0	-17.2	1.09 H	171	58.1	-1.3
2	**2390.00**	**43.9 AV**	**54.0**	**-10.1**	**1.09 H**	**171**	**45.2**	**-1.3**
3	*2402.00	107.1 PK			1.09 H	171	108.2	-1.1
4	*2402.00	77.0 AV			1.09 H	171	78.1	-1.1
5	4804.00	39.1 PK	74.0	-34.9	1.26 H	233	35.9	3.2
6	4804.00	9.0 AV	54.0	-45.0	1.26 H	233	5.8	3.2
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	**FREQ. (MHz)**	**EMISSION LEVEL (dBuV/m)**	**LIMIT (dBuV/m)**	**MARGIN (dB)**	**ANTENNA HEIGHT (m)**	**TABLE ANGLE (Degree)**	**RAW VALUE (dBuV)**	**CORRECTION FACTOR (dB/m)**
1	2390.00	54.6 PK	74.0	-19.4	1.53 V	259	55.9	-1.3
2	2390.00	41.7 AV	54.0	-12.3	1.53 V	259	43.0	-1.3
3	*2402.00	103.7 PK			1.53 V	259	104.8	-1.1
4	*2402.00	73.6 AV			1.53 V	259	74.7	-1.1
5	4804.00	40.3 PK	74.0	-33.7	1.17 V	55	37.1	3.2
6	4804.00	10.2 AV	54.0	-43.8	1.17 V	55	7.0	3.2

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.
6. The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 * 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to: 20log(3.125 / 100)= -30.1 dB
7. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle)

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

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2441.00	107.9 PK			1.10 H	141	109.1	-1.2
2	*2441.00	77.8 AV			1.10 H	141	79.0	-1.2
3	4882.00	39.2 PK	74.0	-34.8	1.08 H	236	35.8	3.4
4	4882.00	9.1 AV	54.0	-44.9	1.08 H	236	5.7	3.4
5	7323.00	44.0 PK	74.0	-30.0	3.09 H	229	34.2	9.8
6	7323.00	13.9 AV	54.0	-40.1	3.09 H	229	4.1	9.8
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2441.00	103.1 PK			1.59 V	241	104.3	-1.2
2	*2441.00	73.0 AV			1.59 V	241	74.2	-1.2
3	4882.00	40.3 PK	74.0	-33.7	1.15 V	65	36.9	3.4
4	4882.00	10.2 AV	54.0	-43.8	1.15 V	65	6.8	3.4
5	7323.00	44.0 PK	74.0	-30.0	2.14 V	294	34.2	9.8
6	7323.00	13.9 AV	54.0	-40.1	2.14 V	294	4.1	9.8

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.
6. The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 * 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to: 20log(3.125 / 100)= -30.1 dB
7. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle)

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

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	107.8 PK			1.48 H	354	108.8	-1.0
2	*2480.00	77.7 AV			1.48 H	354	78.7	-1.0
3	2483.50	56.8 PK	74.0	-17.2	1.48 H	354	57.8	-1.0
4	2483.50	26.7 AV	54.0	-27.3	1.48 H	354	27.7	-1.0
5	4960.00	40.0 PK	74.0	-34.0	1.00 H	260	36.4	3.6
6	4960.00	9.9 AV	54.0	-44.1	1.00 H	260	6.3	3.6
7	7440.00	43.8 PK	74.0	-30.2	3.16 H	233	33.7	10.1
8	7440.00	13.7 AV	54.0	-40.3	3.16 H	233	3.6	10.1
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*2480.00	103.1 PK			1.20 V	197	104.1	-1.0
2	*2480.00	73.0 AV			1.20 V	197	74.0	-1.0
3	2483.50	53.9 PK	74.0	-20.1	1.20 V	197	54.9	-1.0
4	2483.50	23.8 AV	54.0	-30.2	1.20 V	197	24.8	-1.0
5	4960.00	40.4 PK	74.0	-33.6	1.13 V	56	36.8	3.6
6	4960.00	10.3 AV	54.0	-43.7	1.13 V	56	6.7	3.6
7	7440.00	43.8 PK	74.0	-30.2	2.16 V	316	33.7	10.1
8	7440.00	13.7 AV	54.0	-40.3	2.16 V	316	3.6	10.1

REMARKS:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value
5. " * ": Fundamental frequency.
6. The DH5 packet was the worse case duty cycle for a transmit dwell time on a channel, based upon bluetooth theory the transmitter is on 0.625 * 5 per 296.25 ms per channel. Therefore, the duty cycle correlation factor be equal to: 20log(3.125 / 100)= -30.1 dB
7. The average value of fundamental and harmonic frequency is: Average = Peak value + 20 log(Duty cycle)

Below 1GHz Data:

BT_GFSK

CHANNEL	TX Channel 0	**DETECTOR FUNCTION**	Quasi-Peak (QP)
FREQUENCY RANGE	9kHz ~ 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	62.59	19.0 QP	40.0	-21.0	2.00 H	360	27.9	-8.9
2	161.22	23.8 QP	43.5	-19.7	1.00 H	295	31.7	-7.9
3	238.50	28.2 QP	46.0	-17.8	1.50 H	295	38.2	-10.0
4	295.39	26.6 QP	46.0	-19.4	1.50 H	201	34.4	-7.8
5	348.33	23.7 QP	46.0	-22.3	1.00 H	111	30.3	-6.6
6	718.34	33.8 QP	46.0	-12.2	1.00 H	308	32.7	1.1
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	35.92	24.9 QP	40.0	-15.1	1.50 V	19	34.3	-9.4
2	76.68	23.2 QP	40.0	-16.8	1.00 V	0	35.0	-11.8
3	128.43	22.0 QP	43.5	-21.5	1.00 V	281	31.3	-9.3
4	215.15	21.2 QP	43.5	-22.3	1.50 V	156	32.7	-11.5
5	371.44	22.5 QP	46.0	-23.5	1.00 V	249	28.3	-5.8
6	718.65	30.6 QP	46.0	-15.4	2.00 V	166	29.5	1.1

REMARKS:

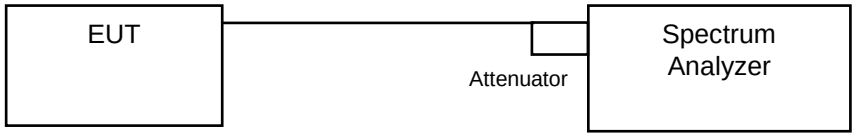
1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission Level – Limit value

4.2 Maximum Output Power

4.2.1 Limits of Maximum Output Power Measurement

The Maximum Output Power Measurement is 125mW.

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.4 Test Procedure

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

c. The center frequency of the spectrum analyzer is set to the fundamental frequency and using 3MHz RBW and 10 MHz VBW.

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

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

4.2.5 Deviation from Test Standard

No deviation.

4.2.6 EUT Operating Condition

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

4.2.7 Test Results

FOR PEAK POWER

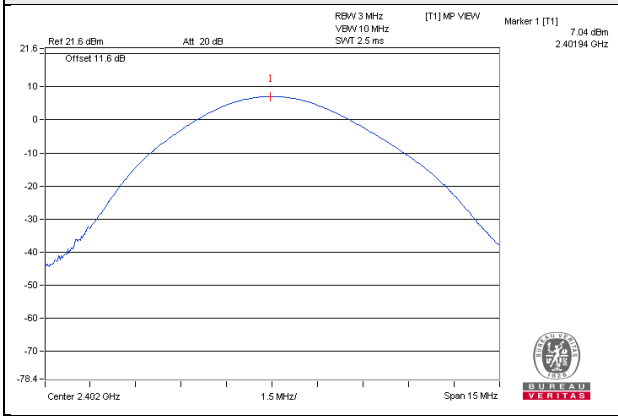
Channel	Frequency (MHZ)	Output Power (mW)		Output Power (dBm)		Power Limit (mW)	Pass / Fail
		GFSK	8DPSK	GFSK	8DPSK		
0	2402	5.058	2.958	7.04	4.71	125	Pass
39	2441	4.406	2.793	6.44	4.46	125	Pass
78	2480	4.898	2.864	6.90	4.57	125	Pass

FOR AVERAGE POWER - reference only

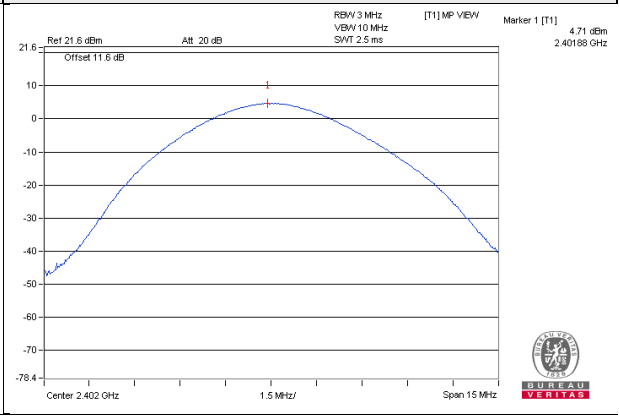
Channel	Frequency (MHZ)	Output Power (mW)		Output Power (dBm)	
		GFSK	8DPSK	GFSK	8DPSK
0	2402	4.56	2.08	6.59	3.18
39	2441	3.954	2	5.97	3.01
78	2480	4.217	2.014	6.25	3.04

Spectrum Plot of Worst Value

GFSK / CH0



8DPSK / CH0



5 Pictures of Test Arrangements

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

Appendix – Information on the Testing Laboratories

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

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

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

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