FCC Test Report

Report No.:	RF180720C20
FCC ID:	A8J-922PSLBU
Test Model:	DuraFon PSL-BU
Series Model:	SP-922PRO SL-BU
Received Date:	Jul. 20, 2018
Test Date:	Jul. 30 ~ Aug. 08, 2018
Issued Date:	Aug. 13, 2018
Applicant:	EnGenius Technologies, Inc.
Address:	1580 Scenic Avenue, Costa Mesa, CA92626
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:	No. 19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, TAIWAN (R.O.C.)
FCC Registration / Designation Number:	788550 / TW0003

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Release Control Record

Issue No.	Description	Date Issued
RF180720C20	Original release	Aug. 13, 2018

1 Certificate of Conformity

Product:	Digital Long Range Cordless Phone System
Brand:	EnGenius
Test Model:	DuraFon PSL-BU
Series Model:	SP-922PRO SL-BU
Sample Status:	Engineering sample
Applicant:	EnGenius Technologies, Inc.
Test Date:	Jul. 30 ~ Aug. 08, 2018
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) ANSI C63.10: 2013

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

Prepared by : _____ , **Date:** Aug. 13, 2018

Suntee Liu / Specialist

Approved by : _____ , **Date:** Aug. 13, 2018

Bruce Chen / Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit. Minimum passing margin is -18.83dB at 0.42577MHz.
15.247(a)(1)(i)	Number of Hopping Frequency Used	Pass	Meet the requirement of limit.
15.247(a)(1)(i)	Dwell Time on Each Channel	Pass	Meet the requirement of limit.
15.247(a)(1) (i)	Spectrum Bandwidth of a Frequency Hopping Sequence Spread Spectrum System	Pass	Meet the requirement of limit.
15.247(b)(2)	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 -2.2dB at 5414.3040MHz.
15.247(d)	Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -27.1dB at 902.00MHz.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	Antenna connector is Reverse TNC not a standard connector.

NOTE: If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

2.1 Measurement Uncertainty

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

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.94 dB
Radiated Emissions up to 1 GHz	30MHz ~ 200MHz	3.86 dB
	200MHz ~1000MHz	3.87 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Digital Long Range Cordless Phone System
Brand	EnGenius
Test Model	DuraFon PSL-BU
Series Model	SP-922PRO SL-BU
Model Difference	Refer to Note
Status of EUT	Engineering sample
Power Supply Rating	12Vdc (adapter)
Modulation Type	MSK
Operating Frequency	902.3840~927.4656MHz
Number of Channel	50
Output Power	818.465mW
Antenna Type	Dipole antenna with 2dBi gain
Antenna Connector	Reverse TNC
Accessory Device	Adapter
Cable Supplied	1.8m non-shielded RJ11 cable without core 1.85m shielded audio cable without core

Note:

1. All models are listed as below. Model DuraFon PSL-BU is the representative for final test.

Brand	Model	Difference
EnGenius	DuraFon PSL-BU	Marketing purpose
	SP-922PRO SL-BU	

2. The EUT uses following adapter.

Brand	DVE
Model	DSA-12PFT-12 FUS 120100
Input Power	100-240Vac, 50/60Hz, 0.5A
Output Power	+12Vdc, 1A
Power Line	1.45m cable without core attached on adapter

3.2 Description of Test Modes

50 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
1	902.3840	21	912.4975	41	923.0157
2	902.7885	22	912.9021	42	923.8247
3	903.1930	23	913.3066	43	924.2293
4	903.5976	24	914.1157	44	924.6338
5	904.4067	25	914.9248	45	925.0384
6	904.8112	26	915.3293	46	925.4429
7	905.2158	27	915.7339	47	926.2520
8	905.6203	28	916.5430	48	926.6566
9	906.0248	29	917.3521	49	927.0611
10	906.8339	30	917.7566	50	927.4656
11	907.6430	31	918.1611		
12	908.0476	32	918.9702		
13	908.4521	33	919.3748		
14	909.2612	34	919.7793		
15	909.6657	35	920.1839		
16	910.0703	36	920.5884		
17	910.4748	37	921.3975		
18	910.8797	38	921.8020		
19	911.6885	39	922.2066		
20	912.0930	40	922.6111		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to				Description
	RE≥1G	RE<1G	PLC	APCM	
-	√	√	√	√	-

Where RE≥1G: Radiated Emission above 1GHz & Bandedge Measurement
RE<1G: Radiated Emission below 1GHz
PLC: Power Line Conducted Emission
APCM: Antenna Port Conducted Measurement

Note:

1. The EUT had been pre-tested on the positioned of X-plane and Z-plane. The worst case was found when positioned on X-plane.

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 Type	Remark
-	1 to 50	1, 25, 50	MSK	-

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 Type	Remark
-	1 to 50	50	MSK	-

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 Type	Remark
-	1 to 50	50	MSK	-

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 Type	Remark
-	1 to 50	1, 25, 50	MSK	-

Test Condition:

Applicable to	Environmental Conditions	Input Power	Tested by
RE≥1G	26 deg. C, 65% RH	120Vac, 60Hz	Willy Cheng
RE<1G	26 deg. C, 65% RH	120Vac, 60Hz	Willy Cheng
PLC	22 deg. C, 66% RH	120Vac, 60Hz	Adair Peng
APCM	25 deg. C, 60% RH	120Vac, 60Hz	Chris Lin

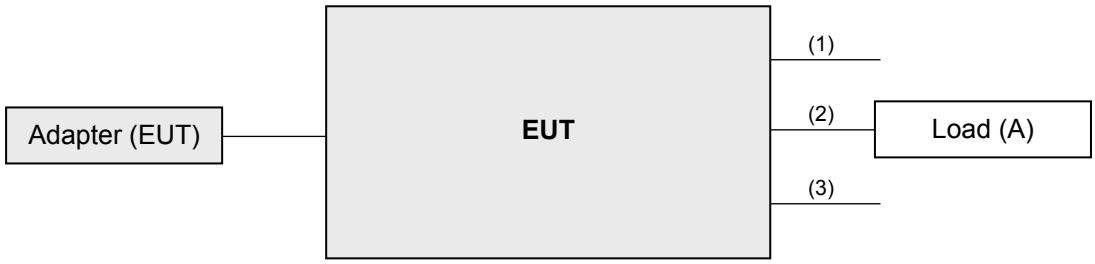
3.3 Description of Support Units

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

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Load	NA	NA	NA	NA	-

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Audio cable	1	1.85	Y	0	Accessory
2.	RJ11 cable	1	1.8	N	0	Accessory
3.	RJ11 cable	1	1.8	N	0	-

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.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

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

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

NOTE:

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

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESIB7	100187	May 29, 2018	May 28, 2019
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100041	Dec. 12, 2017	Dec. 11, 2018
BILOG Antenna SCHWARZBECK	VULB9168	9168-171	Dec. 11, 2017	Dec. 10, 2018
HORN Antenna SCHWARZBECK	9120D	209	Dec. 13, 2017	Dec. 12, 2018
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Dec. 01, 2017	Nov. 30, 2018
Loop Antenna EMCI	EM-6879	269	Aug. 11, 2017	Aug. 10, 2018
Preamplifier Agilent (Below 1GHz)	8447D	2944A10738	Aug. 21, 2017	Aug. 20, 2018
Preamplifier Agilent (Above 1GHz)	8449B	3008A02465	Apr. 03, 2018	Apr. 02, 2019
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-CH3-03 (223653/4)	Aug. 21, 2017	Aug. 20, 2018
RF signal cable HUBER+SUHNER& EMCI	SUCOFLEX 104&EMC104-SM-SM -8000	Cable-CH3-03 (309224+170907)	Sep.11, 2017	Sep. 10, 2018
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower inn-co GmbH	MA 4000	013303	NA	NA
Antenna Tower Controller BV ADT	AT100	AT93021702	NA	NA
Turn Table BV ADT	TT100	TT93021702	NA	NA
Turn Table Controller BV ADT	SC100	SC93021702	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Turn Table Controller BV ADT	SC100	SC93021705	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	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 Chamber 3.
3. The horn antenna and preamplifier (model: 8449B) are used only for the measurement of emission frequency above 1GHz if tested.
4. The FCC Designation Number is TW0003. The number will be varied with the Lab location and scope as attached.
5. The IC Site Registration No. is IC 7450F-3.

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. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.

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

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

Note:

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

For Radiated emission above 30MHz

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

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

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

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

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

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

Note:

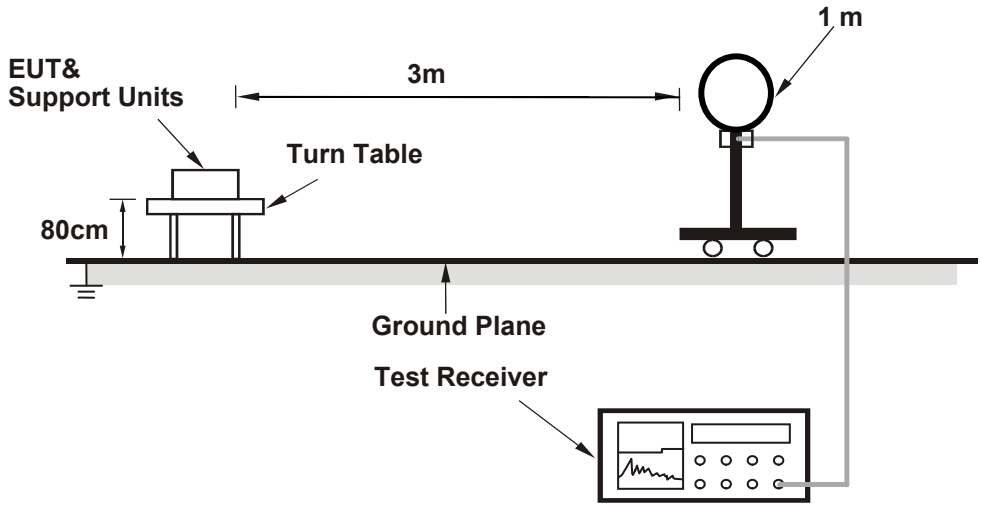
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is ≥ 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.

4.1.4 Deviation from Test Standard

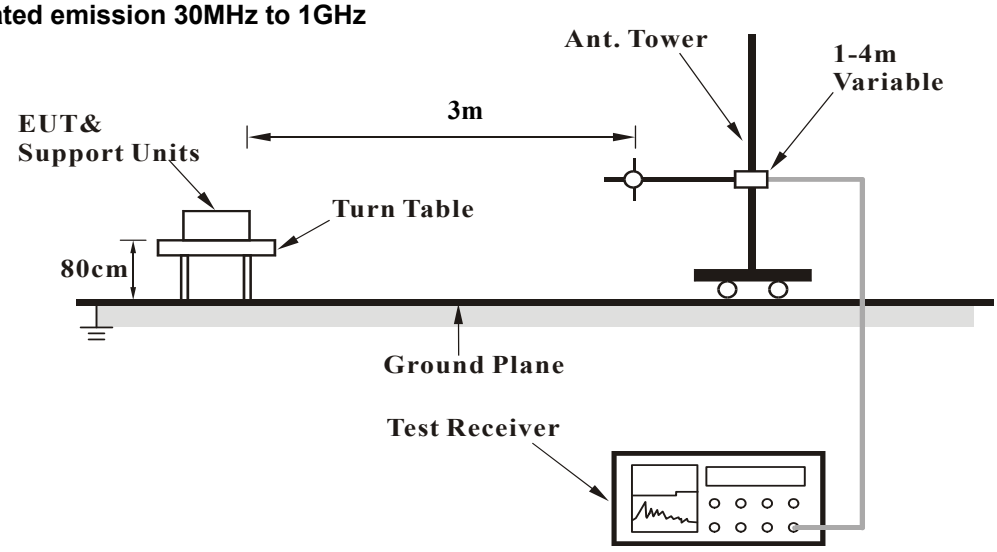
No deviation.

4.1.5 Test Setup

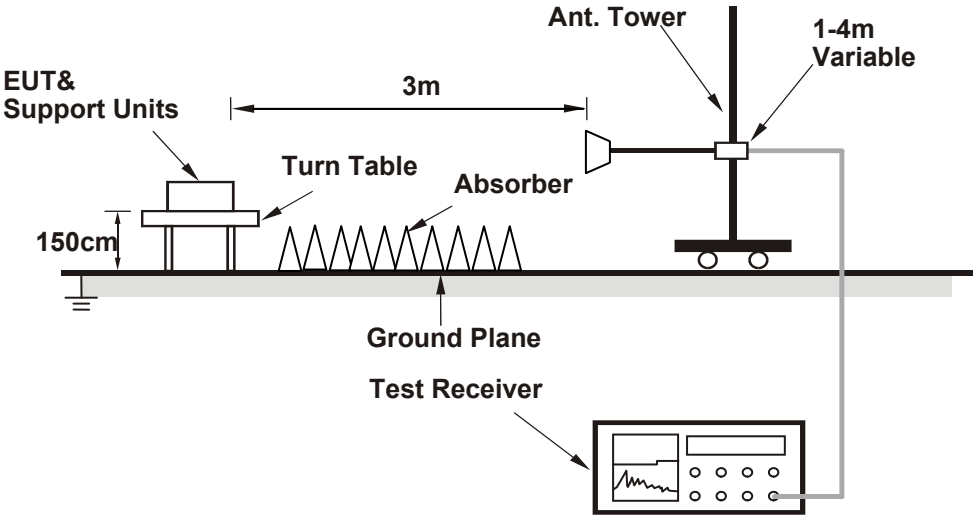
For Radiated emission below 30MHz



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

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

4.1.7 Test Results

worst-case data:

CHANNEL	TX Channel 1	DETECTOR FUNCTION	Quasi-Peak (QP) 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	#902.0000	68.2 QP	95.5	-27.3	1.00 H	34	34.5	33.7
2	*902.3840	115.5 QP			1.00 H	34	81.7	33.8
3	#1804.7680	39.0 PK	74.0	-35.0	1.51 H	277	45.1	-6.1
4	#1804.7680	31.4 AV	54.0	-22.6	1.51 H	277	37.5	-6.1
5	2707.1520	42.9 PK	74.0	-31.1	1.47 H	329	45.0	-2.1
6	2707.1520	33.3 AV	54.0	-20.7	1.47 H	329	35.4	-2.1
7	5414.3040	51.4 PK	74.0	-22.6	3.08 H	248	47.2	4.2
8	5414.3040	45.7 AV	54.0	-8.3	3.08 H	248	41.5	4.2
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	#902.0000	80.3 QP	107.4	-27.1	1.00 V	105	46.6	33.7
2	*902.3840	127.4 QP			1.00 V	105	93.6	33.8
3	#1804.7680	47.1 PK	74.0	-26.9	1.50 V	356	53.2	-6.1
4	#1804.7680	44.4 AV	54.0	-9.6	1.50 V	356	50.5	-6.1
5	2707.1520	45.8 PK	74.0	-28.2	2.16 V	103	47.9	-2.1
6	2707.1520	40.4 AV	54.0	-13.6	2.16 V	103	42.5	-2.1
7	5414.3040	57.9 PK	74.0	-16.1	2.19 V	355	53.7	4.2
8	**5414.3040**	**51.8 AV**	**54.0**	**-2.2**	**2.19 V**	**355**	**47.6**	**4.2**

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 radiated frequency is out of the restricted band.

CHANNEL	TX Channel 25	DETECTOR FUNCTION	Quasi-Peak (QP) 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	*914.9248	120.9 QP			1.52 H	26	86.7	34.2
2	#1829.8496	39.4 PK	74.0	-34.6	2.18 H	291	45.3	-5.9
3	#1829.8496	31.1 AV	54.0	-22.9	2.18 H	291	37.0	-5.9
4	#5489.5488	52.4 PK	74.0	-21.6	2.48 H	276	47.9	4.5
5	#5489.5488	44.8 AV	54.0	-9.2	2.48 H	276	40.3	4.5
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	*914.9248	130.5 QP			1.00 V	105	96.3	34.2
2	#1829.8496	44.1 PK	74.0	-29.9	1.45 V	331	50.0	-5.9
3	#1829.8496	40.8 AV	54.0	-13.2	1.45 V	331	46.7	-5.9
4	#5489.5488	56.7 PK	74.0	-17.3	1.53 V	353	52.2	4.5
5	#5489.5488	48.8 AV	54.0	-5.2	1.45 V	344	44.3	4.5

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 radiated frequency is out of the restricted band.

CHANNEL	TX Channel 50	DETECTOR FUNCTION	Quasi-Peak (QP) 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	*927.4656	122.7 QP			1.54 H	25	88.1	34.6
2	#928.00	62.6 QP	102.7	-40.1	1.51 H	25	28.1	34.5
3	#1854.9312	38.1 PK	74.0	-35.9	3.72 H	294	43.8	-5.7
4	#1854.9312	27.6 AV	54.0	-26.4	3.72 H	294	33.3	-5.7
5	#5564.7936	50.0 PK	74.0	-24.0	3.60 H	139	45.6	4.4
6	#5564.7936	43.0 AV	54.0	-11.0	3.60 H	139	38.6	4.4
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	*927.4656	130.8 QP			1.00 V	358	96.2	34.6
2	#928.00	70.5 QP	110.8	-40.3	1.00 V	354	36.0	34.5
3	#1854.9312	40.9 PK	74.0	-33.1	1.79 V	125	46.6	-5.7
4	#1854.9312	31.5 AV	54.0	-22.5	1.79 V	125	37.2	-5.7
5	#5564.7936	53.7 PK	74.0	-20.3	1.48 V	346	49.3	4.4
6	#5564.7936	49.3 AV	54.0	-4.7	1.48 V	346	44.9	4.4

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 radiated frequency is out of the restricted band.

Below 1GHz worst-case data:

CHANNEL	TX Channel 50	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	57.12	22.5 QP	40.0	-17.5	2.00 H	192	32.0	-9.5
2	237.94	28.9 QP	46.0	-17.1	1.01 H	228	38.7	-9.8
3	253.49	28.7 QP	46.0	-17.3	1.01 H	231	37.6	-8.9
4	311.82	28.7 QP	46.0	-17.3	1.01 H	226	35.5	-6.8
5	430.42	32.3 QP	46.0	-13.7	1.01 H	190	36.5	-4.2
6	496.53	30.8 QP	46.0	-15.2	1.51 H	6	33.8	-3.0
ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M								
NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	51.29	31.5 QP	40.0	-8.5	1.00 V	19	40.8	-9.3
2	237.94	26.5 QP	46.0	-19.5	1.00 V	180	36.3	-9.8
3	253.49	26.6 QP	46.0	-19.4	2.00 V	133	35.5	-8.9
4	302.10	27.8 QP	46.0	-18.2	2.00 V	212	34.9	-7.1
5	430.42	34.5 QP	46.0	-11.5	1.00 V	259	38.7	-4.2
6	496.53	31.9 QP	46.0	-14.1	1.00 V	317	34.9	-3.0

REMARKS:

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

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Nov. 23, 2017	Nov. 22, 2018
RF signal cable Woken	5D-FB	Cable-cond1-01	Sep. 05, 2017	Sep. 04, 2018
LISN ROHDE & SCHWARZ (EUT)	ENV216	101826	Feb. 26, 2018	Feb. 25, 2019
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Aug. 15, 2017	Aug. 14, 2018
Software ADT	BV ADT_Cond_ V7.3.7.4	NA	NA	NA

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

4.2.3 Test Procedures

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

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

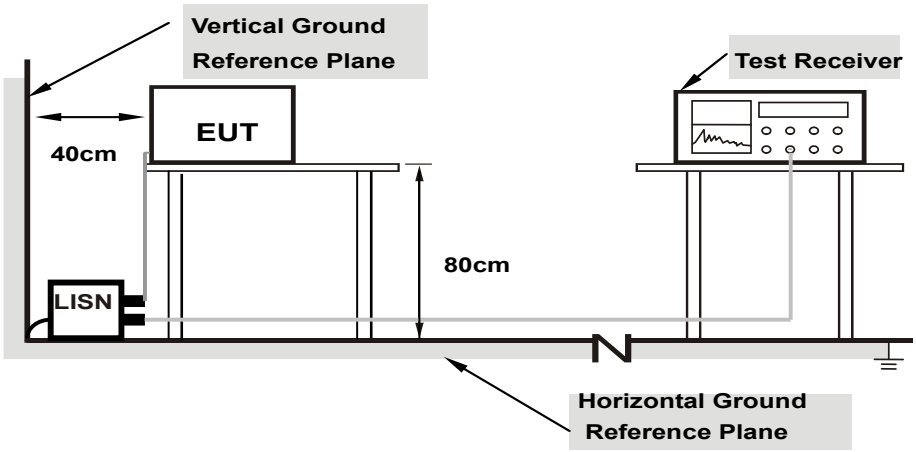
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

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

4.2.4 Deviation From Test Standard

No deviation.

4.2.5 Test Setup



Note: 1.Support units were connected to second LISN.
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 item 4.1.6.

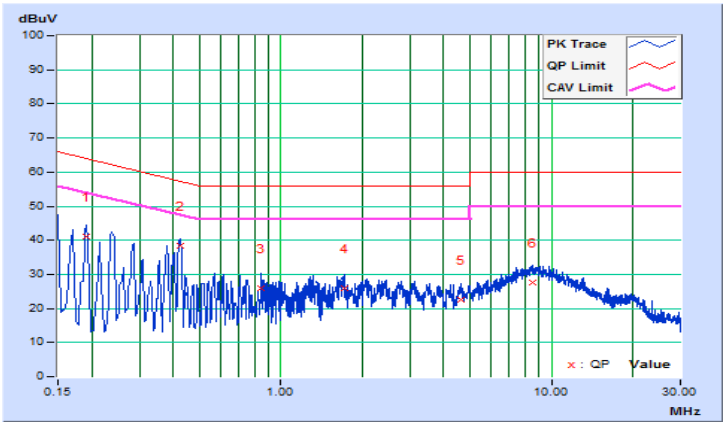
4.2.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	TX Channel 50		

No	Freq.	Corr. Factor	Reading Value		Emission Level		Limit		Margin	
			[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.19013	10.10	31.05	12.82	41.15	22.92	64.03	54.03	-22.88	-31.11
2	**0.42577**	**10.12**	**28.17**	**18.38**	**38.29**	**28.50**	**57.33**	**47.33**	**-19.04**	**-18.83**
3	0.84462	10.14	15.79	6.08	25.93	16.22	56.00	46.00	-30.07	-29.78
4	1.71000	10.17	15.72	7.63	25.89	17.80	56.00	46.00	-30.11	-28.20
5	4.64600	10.32	12.33	6.10	22.65	16.42	56.00	46.00	-33.35	-29.58
6	8.56600	10.54	17.18	11.84	27.72	22.38	60.00	50.00	-32.28	-27.62

REMARKS:

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

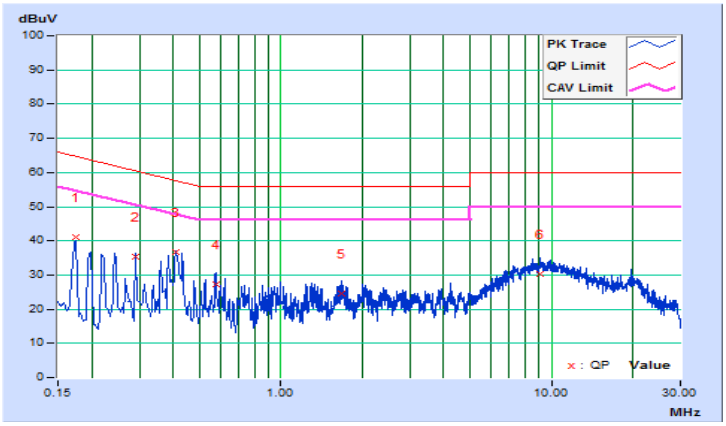


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Channel	TX Channel 50		

No	Freq.	Corr. Factor	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
	[MHz]	(dB)	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.17384	10.10	30.85	12.61	40.95	22.71	64.77	54.77	-23.82	-32.06
2	0.29000	10.11	25.26	9.21	35.37	19.32	60.52	50.52	-25.15	-31.20
3	0.41000	10.12	26.71	17.19	36.83	27.31	57.65	47.65	-20.82	-20.34
4	0.57400	10.12	17.04	7.40	27.16	17.52	56.00	46.00	-28.84	-28.48
5	1.67800	10.16	14.33	7.49	24.49	17.65	56.00	46.00	-31.51	-28.35
6	9.07800	10.48	19.89	14.03	30.37	24.51	60.00	50.00	-29.63	-25.49

REMARKS:

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

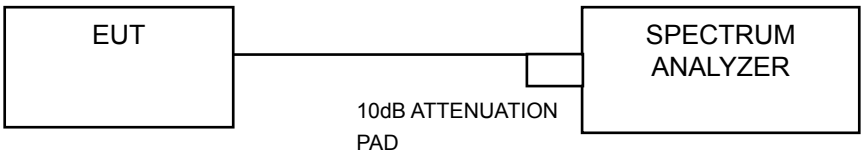


4.3 Number of Hopping Frequency Used

4.3.1 Limits of Hopping Frequency Used Measurement

At least 50 channels frequencies, and should be equally spaced.

4.3.2 Test Setup



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedure

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

b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.

c. Set the SA on MaxHold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.

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

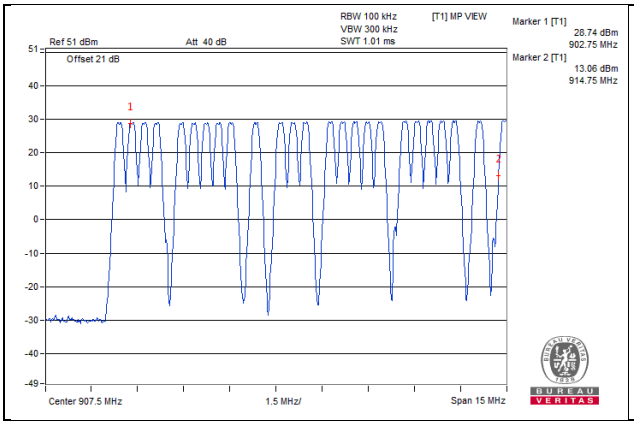
e. Repeat above procedures until all frequencies measured were complete.

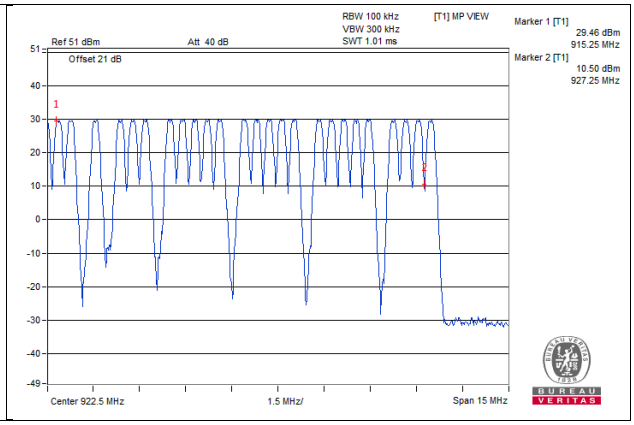
4.3.5 Deviation from Test Standard

No deviation.

4.3.6 Test Results

There are 50 hopping frequencies in the hopping mode. On the plots, it shows that the hopping frequencies are equally spaced.





4.4 Dwell Time on Each Channel

4.4.1 Limits of Dwell Time on Each Channel Measurement

The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

4.4.2 Test Setup

4.4.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.4.4 Test Procedures

a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect its antenna terminal to measurement via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
c. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
d. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
e. Repeat above procedures until all different time-slot modes have been completed.

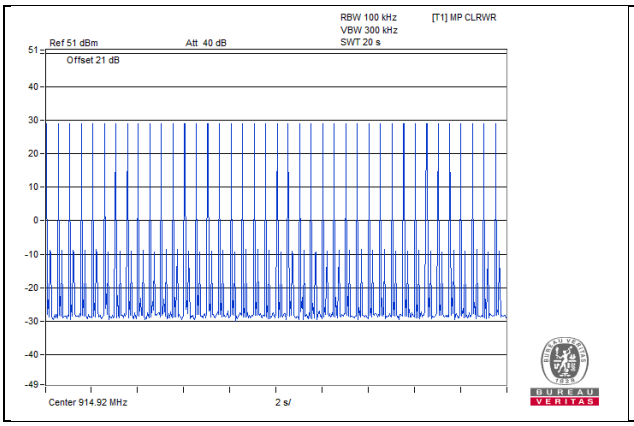
4.4.5 Deviation from Test Standard

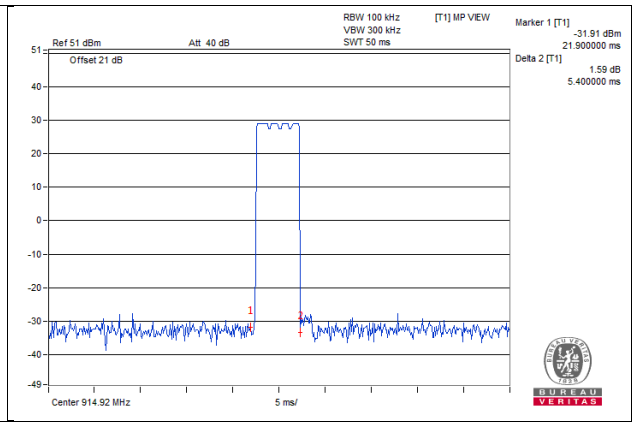
No deviation.

4.4.6 Test Results

Number of transmission in a 20 (50Hopping*0.4)	Length of transmission time (msec)	Result (msec)	Limit (msec)
39 (times / 20 sec) * 1 = 39 times	5.4	210.6	400

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





4.5 Channel Bandwidth

4.5.1 Limits of Channel Bandwidth Measurement

The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

4.5.2 Test Setup

4.5.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.5.4 Test Procedure

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
c. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
d. Repeat above procedures until all frequencies measured were complete.

4.5.5 Deviation from Test Standard

No deviation.

4.5.6 EUT Operating Condition

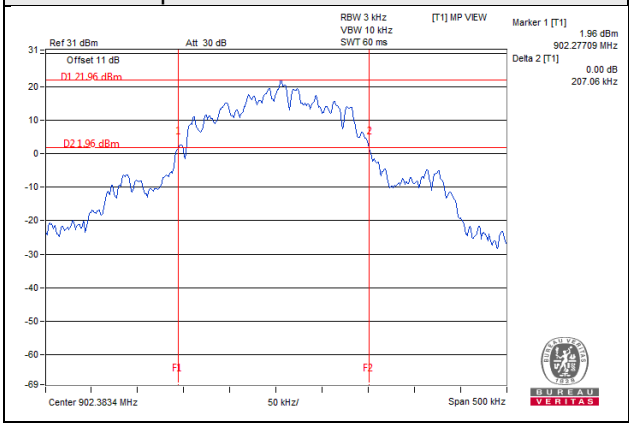
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.5.7 Test Results

Channel	Frequency (MHz)	20dB Bandwidth (MHz)	Limit (MHz)
1	902.3840	0.20706	0.5
25	914.9248	0.20706	0.5
50	927.4656	0.20673	0.5

Note: 20 dB bandwidth of the hopping channel is less than 500 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

Spectrum Plot of Worst Value

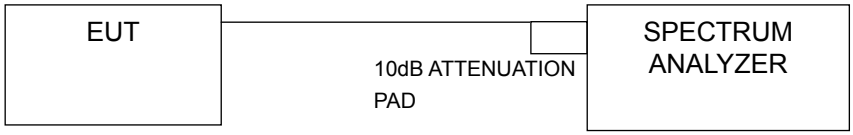


4.6 Hopping Channel Separation

4.6.1 Limits of Hopping Channel Separation Measurement

At least of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

4.6.2 Test Setup



4.6.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.6.4 Test Procedure

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.

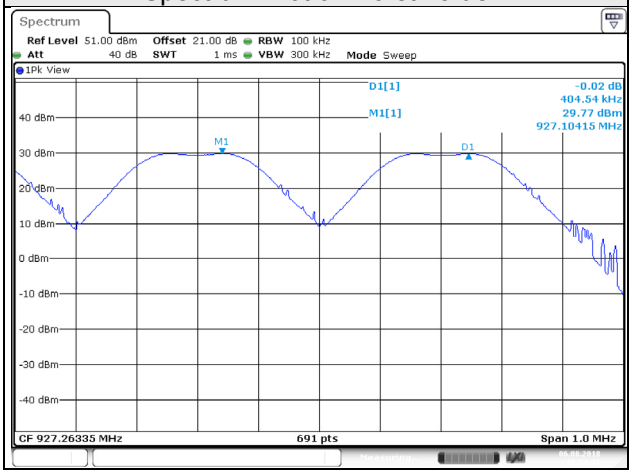
4.6.5 Deviation from Test Standard

No deviation.

4.6.6 Test Results

Channel	Frequency (MHz)	Adjacent Channel Separation (MHz)	Minimum Limit (MHz)	Pass / Fail
1	902.3840	0.40	0.20706	PASS
25	914.9248	0.40	0.20706	PASS
50	927.4656	0.40	0.20673	PASS

Spectrum Plot of Worst Value

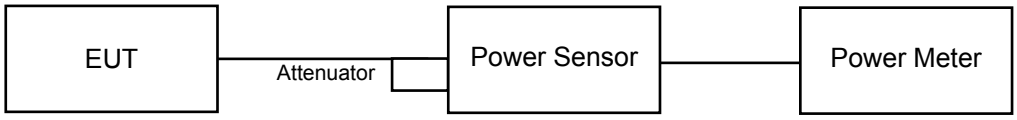


4.7 Maximum Output Power

4.7.1 Limits of Maximum Output Power Measurement

For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels.

4.7.2 Test Setup



4.7.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.7.4 Test Procedure

A peak power sensor was used on the output port of the EUT. A power meter was used to read the response of the average power sensor. Record the power level.

4.7.5 Deviation from Test Standard

No deviation.

4.7.6 EUT Operating Condition

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

4.7.7 Test Results

Channel	Frequency (MHz)	Output Power (mW)	Output Power (dBm)	Power Limit (dBm)	Pass / Fail
1	902.3840	693.426	28.41	30	PASS
25	914.9248	812.831	29.10	30	PASS
50	927.4656	**818.465**	29.13	30	PASS

4.8 Conducted Out of Band Emission Measurement

4.8.1 Limits Of Conducted Out of Band Emission Measurement

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

4.8.2 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.8.3 Test Procedure

The transmitter output was connected to the spectrum analyzer via a low lose cable. Set both RBW and VBW of spectrum analyzer to 100 kHz and 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.

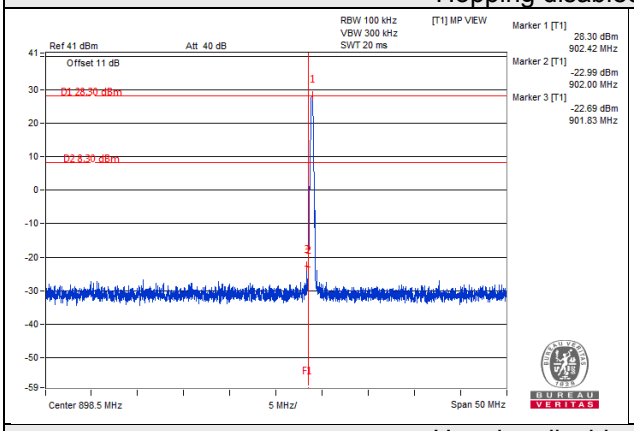
4.8.5 EUT Operating Condition

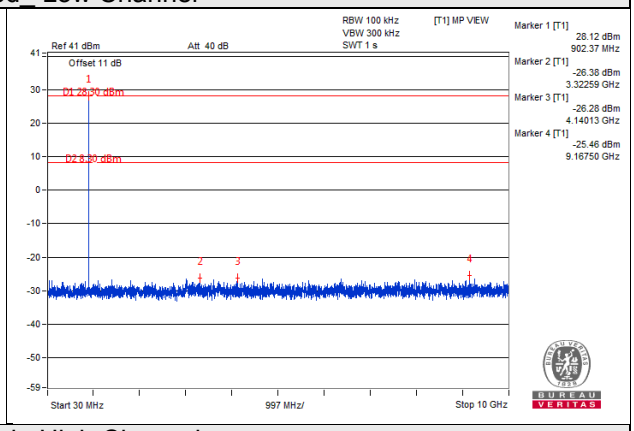
The software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel frequencies individually.

4.8.6 Test Results

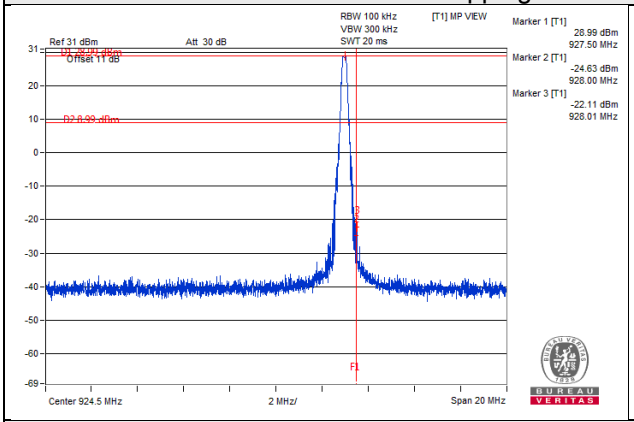
The spectrum plots are attached on the following images. D1 line indicates the highest level, D2 line indicates the 20dB offset below D1. It shows compliance with the requirement.

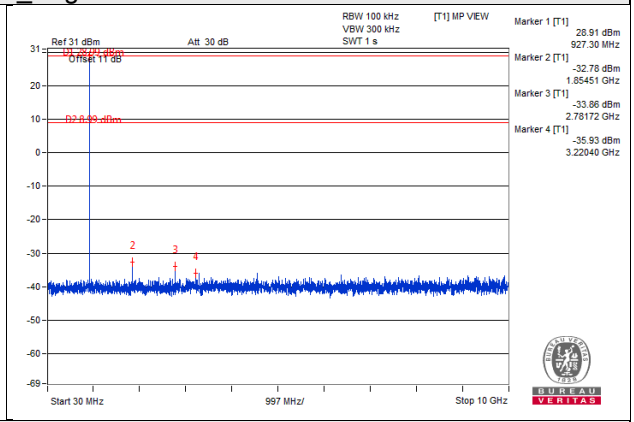
Hopping disabled_ Low Channel



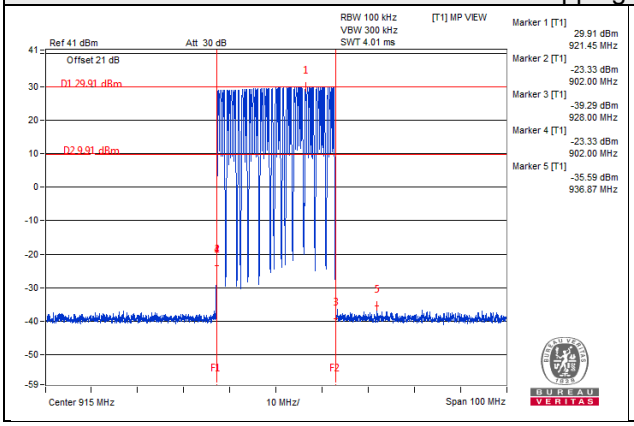


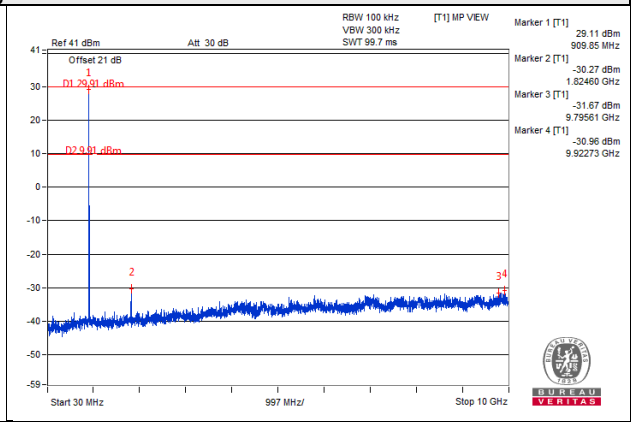
Hopping disabled_ High Channel





Hopping enabled





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 and approved according to ISO/IEC 17025.

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

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Hsin Chu EMC/RF/Telecom Lab
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