

FCC Test Report

(PART 90S)

Report No.: RF170616D05-3

FCC ID: 2AMTS-LEC-2580P

Test Model: LEC-2580P

Series Model: LEC-2580xxxxxx(where x can be 0-9, A-Z, a-z, any alphanumeric character or blank)

Received Date: Dec. 28, 2016

Test Date: Jan. 10, 2017 ~ Feb. 14, 2017

Issued Date: Jul. 26, 2017

Applicant: LEI Technology Canada Ltd.

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

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Release Control Record

Issue No.	Description	Date Issued
RF170616D05-3	Original Release	Jul. 26, 2017

1 Certificate of Conformity

Product: Fanless Embedded System

Brand: Lanner

Test Model: LEC-2580P

Series Model: LEC-2580xxxxxxx(where x can be 0-9, A-Z, a-z, any alphanumeric character or blank)

Sample Status: Production Unit

Applicant: LEI Technology Canada Ltd.

Test Date: Jan. 10, 2017 ~ Feb. 14, 2017

Standards: FCC Part 90, Subpart S

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 : Evonne Liu , **Date:** Jul. 26, 2017
Evonne Liu / Specialist

Approved by : David Huang , **Date:** Jul. 26, 2017
David Huang / Project Engineer

2 Summary of Test Results

Applied Standard: FCC Part 90 & Part 2			
FCC Clause	Test Item	Result	Remarks
2.1046 90.635 (b)	Effective Radiated Power	Pass	Meet the requirement of limit.
2.1055 90.213	Frequency Stability	Pass	Meet the requirement of limit.
2.1049 90.209	Occupied Bandwidth (*)	Pass	Meet the requirement of limit.
2.1051 90.209	Emission Masks	Pass	Meet the requirement of limit.
2.1051 90.691	Conducted Spurious Emissions	Pass	Meet the requirement of limit.
2.1053 90.691	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -36.47 dB at 42.61 MHz.

2.1 Measurement Uncertainty

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

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.44 dB
Radiated Emissions up to 1 GHz	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

2.2 Test Site and Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	ESCS 30	100027	Jun. 06, 2016	Jun. 05, 2017
Spectrum Analyzer Agilent	N9010A	MY52220314	Dec. 16, 2016	Dec. 15, 2017
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Dec. 13, 2016	Dec. 12, 2017
BILOG Antenna SCHWARZBECK	VULB9168	9168-472	Dec. 26, 2016	Dec. 27, 2017
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-969	Dec. 12, 2016	Dec. 11, 2017
Double Ridge Guide Horn Antenna EMCO	3115	5619	Dec. 27, 2016	Dec. 26, 2017
BILOG Antenna SCHWARZBECK	VULB 9168	9168-153	Dec. 13, 2016	Dec. 12, 2017
Agilent Communications Tester-Wireless	8960 Series 10	MY53201073	Jul. 03, 2015	Jul. 02, 2017
Preamplifier EMCI	EMC 012645	980115	Oct. 21, 2016	Oct. 20, 2017
Preamplifier EMCI	EMC 184045	980116	Oct. 21, 2016	Oct. 20, 2017
Preamplifier EMCI	EMC 330H	980112	Oct. 21, 2016	Oct. 20, 2017
Power Meter Anritsu	ML2495A	1232002	Sep. 08, 2016	Sep. 07, 2017
Power Sensor Anritsu	MA2411B	1207325	Sep. 08, 2016	Sep. 07, 2017
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	309219/4 2950114	Oct. 21, 2016	Oct. 20, 2017
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	250130/4	Oct. 21, 2016	Oct. 20, 2017
RF Coaxial Cable Worken	8D-FB	Cable-Ch10-01	Oct. 21, 2016	Oct. 20, 2017
Software BV ADT	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower & Turn Table Controller MF	MF-7802	NA	NA	NA
Radio Communication Analyzer	MT8820C	6201300640	Aug. 10, 2015	Aug. 09, 2017
Temperature & Humidity Chamber	GTH-120-40-CP-A R	MAA1306-019	Sep. 02, 2016	Sep. 01, 2017
DC Power Supply Topward	33010D	807748	Oct. 25, 2016	Oct. 24, 2018
Digital Multimeter Fluke	87-III	70360742	Jul. 01, 2016	Jun. 30, 2017
Signal Generator Agilent	N5182B	MY53050430	Oct. 19, 2016	Oct. 18, 2017

- Note:
1. The calibration interval of the above test instruments is 12 / 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
 2. The test was performed in HwaYa Chamber 10.
 3. The horn antenna and preamplifier (model: EMC 184045) are used only for the measurement of emission frequency above 1 GHz if tested.
 4. The IC Site Registration No. is IC7450F-10.

3 General Information

3.1 General Description of EUT

Product	Fanless Embedded System	
Brand	Lanner	
Test Model	LEC-2580P	
Series Model	LEC-2580xxxxxx(where x can be 0-9, A-Z, a-z, any alphanumeric character or blank)	
Status of EUT	Production Unit	
Power Supply Rating	24.0 Vdc (adapter)	
Modulation Type	CDMA	QPSK, OQPSK, HPSK
Frequency Range	CDMA BC10	817.9 ~ 823.1 MHz
Emission Designator	CDMA BC10	1M27F9W
Max. ERP Power	CDMA BC10	84.92 mW
Antenna Type	Fixed Internal Antenna	
Accessory Device	Refer to Note as below	
Data Cable Supplied	Refer to Note as below	

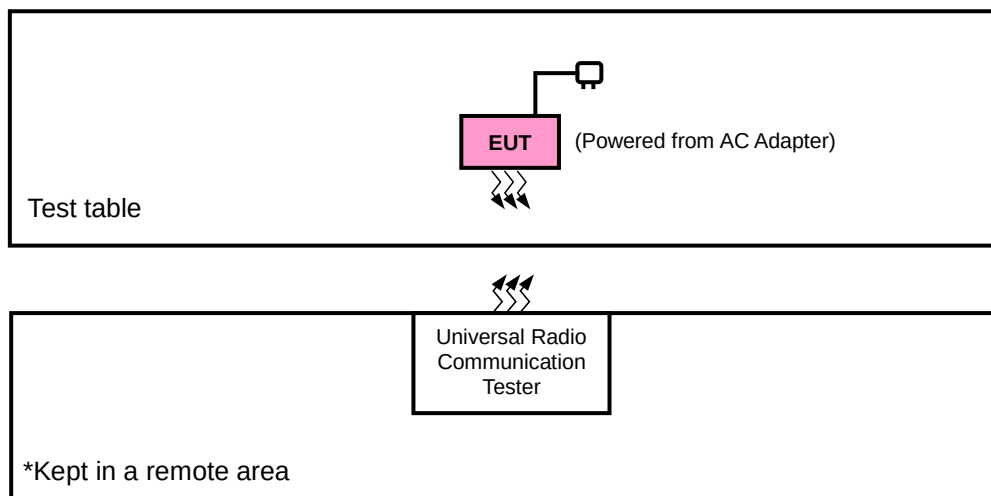
Note:

1. The EUT contains following accessory devices.

Product	Brand	Model	Description
Adapter	FSP GROUP INC.	FSP120-AAAN2	I/P: 100-240 Vac, 50-60 Hz, 1.8 A O/P: 24 Vdc, 5 A
Battery	Panasonic	CR2032L-JP-W-1A	3 Vdc, 230 mAh
Main Board	Lanner	LEB-2580-V1.0	--
CPU	Intel	i7-6600U	2.6G
Memory	Transcend	TS512MSK64W3N(Samsung)	4G DDR3L 1333MHz
HDD	Intel	SSDSC2BX480G401940783	480G
WWAN Module	Sierra	MC7354	--

2. 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 Configuration of System under Test



3.2.1 Description of Support Units

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

No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Universal Radio Communication Tester	R&S	CMU200	123295	N/A

No.	Signal Cable Description Of The Above Support Units
1.	N/A

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Items 1 acted as communication partners to transfer data.

3.3 Test Mode Applicability and Tested Channel Detail

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis, and antenna ports

The worst case was found when positioned as the table below. Following channel(s) was (were) selected for the final test as listed below:

Band	ERP	Radiated Emission
CDMA	X-plane	X-axis

CDMA

EUT Configure Mode	Test Item	Available Channel	Tested Channel	Mode
-	ERP	476 to 684	476, 580, 684	1xRTT
-	Frequency Stability	476 to 684	476, 684	1xRTT
-	Occupied Bandwidth	476 to 684	476, 580, 684	1xRTT
-	Emission Mask	476 to 684	476, 684	1xRTT
-	Conducted Emission	476 to 684	476, 580, 684	1xRTT
-	Radiated Emission	476 to 684	476, 580, 684	1xRTT

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
ERP	25 deg. C, 65 % RH	3 Vdc	Toby Tian
Frequency Stability	25 deg. C, 65 % RH	3 Vdc	Taylor Liu
Occupied Bandwidth	25 deg. C, 65 % RH	3 Vdc	Taylor Liu
Band Edge	25 deg. C, 65 % RH	3 Vdc	Taylor Liu
Peak to Average Ratio	25 deg. C, 65 % RH	3 Vdc	Taylor Liu
Condcudeted Emission	25 deg. C, 65 % RH	3 Vdc	Taylor Liu
Radiated Emission	25 deg. C, 65 % RH	120 Vac, 60 Hz	Toby Tian

3.4 EUT Operating Conditions

The EUT makes a call to the communication simulator. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency

3.5 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 47 CFR Part 2

FCC 47 CFR Part 90

ANSI/TIA/EIA-603-D 2010

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

4 Test Types and Results

4.1 Output Power Measurement

4.1.1 Limits of Output Power Measurement

Mobile / Portable station are limited to 100 watts e.r.p.

4.1.2 Test Procedures

EIRP / ERP Measurement:

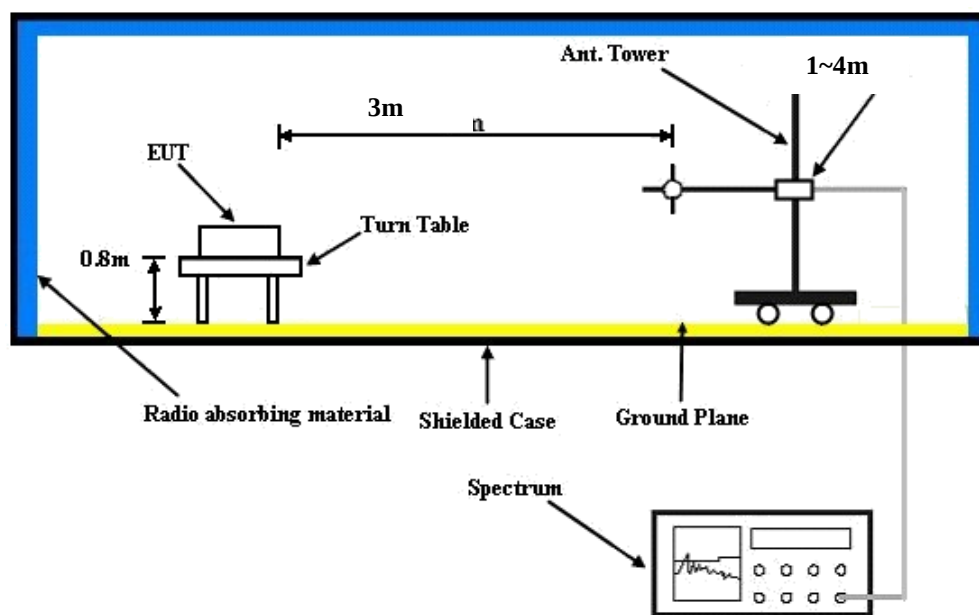
- a. All measurements were done at low, middle and high operational frequency range. RBW and VBW is 5 MHz for CDMA and 10 MHz for LTE mode.
- b. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1 m to 4 m to find the maximum polar radiated power. The "Read Value" is the spectrum reading the maximum power value.
- c. The substitution horn antenna is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a tx cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to "Read Value" of step b. Record the power level of S.G.
- d. $EIRP = \text{Output power level of S.G} - \text{TX cable loss} + \text{Antenna gain of substitution horn}$. E.R.P power can be calculated from E.I.R.P power by subtracting the gain of dipole, $E.R.P \text{ power} = E.I.P.R \text{ power} - 2.15 \text{ dBi}$.

Conducted Power Measurement:

- a. The EUT was set up for the maximum power with LTE link data modulation and link up with simulator.
- b. Set the EUT to transmit under low, middle and high channel and record the power level shown on simulator.

4.1.3 Test Setup

EIRP / ERP Measurement:



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

Conducted Power Measurement:



4.1.4 Test Results

Conducted Output Power (dBm)

Band	CDMA		
Channel	476	580	684
Frequency (MHz)	817.9	820.5	823.1
RC1+SO55	22.66	22.67	22.63
RC3+SO55	22.59	22.61	22.55
RC3+SO32(+ F-SCH)	22.48	22.53	22.44
RC3+SO32(+SCH)	22.42	22.51	22.41
RTAP 153.6	22.39	22.48	22.38
RETAP 4096	22.31	22.44	22.33

ERP Power (dBm)

CDMA							
Plane	Channel	Frequency (MHz)	LVL (dBm)	Correction Factor (dB)	ERP (dBm)	ERP (mW)	Polarization (H/V)
X	476	817.9	-11.36	32.62	19.11	81.47	H
	580	820.5	-11.08	32.52	19.29	84.92	
	684	823.1	-11.60	32.65	18.90	77.62	
	476	817.9	-14.11	32.76	16.50	44.67	V
	580	820.5	-13.56	32.39	16.68	46.56	
	684	823.1	-13.94	32.54	16.45	44.16	

4.2 Frequency Stability Measurement

4.2.1 Limits of Frequency Stability Measurement

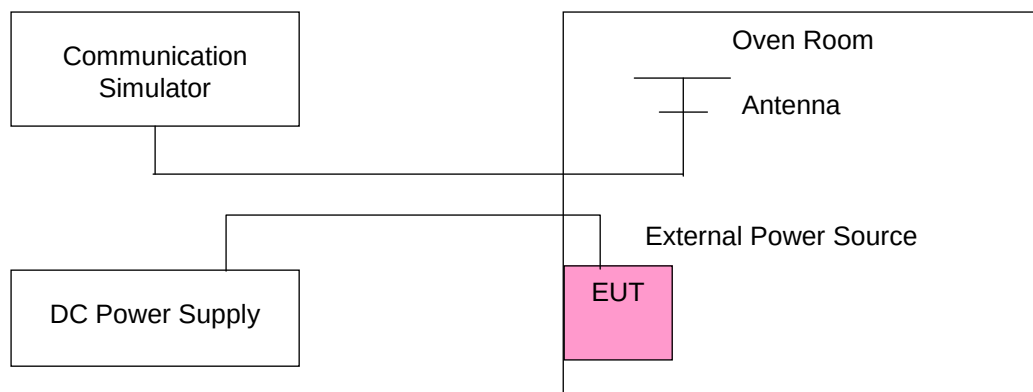
1.5 ppm is for base and fixed station. 2.5 ppm is for mobile station.

4.2.2 Test Procedure

- Device is placed at the oven room. The oven room could control the temperatures and humidity. Power warm up is at least 15 min and power applied should perform before recording frequency error.
- EUT is connected the external power supply to control the DC input power. The test voltage range is from minimum to maximum working voltage. Each step shall be record the frequency error rate.
- The temperature range step is 10 degrees in this test items. All temperature levels shall be hold the ± 0.5 °C during the measurement testing. The each temperature step shall be at least 0.5 hours, consider the EUT could be test under the stability condition.

NOTE: The frequency error was recorded frequency error from the communication simulator.

4.2.3 Test Setup



4.2.4 Test Results

Frequency Error vs. Voltage

Voltage (Volts)	CDMA				Limit (ppm)
	Low Channel		High Channel		
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)	
24	817.900001	0.001	822.750004	0.005	2.5
20.4	817.900003	0.003	822.750002	0.003	2.5
27.6	817.900002	0.002	822.750002	0.002	2.5

Note: The applicant defined the normal working voltage of the battery is from 20.4 Vdc to 27.6 Vdc.

Frequency Error vs. Temperature

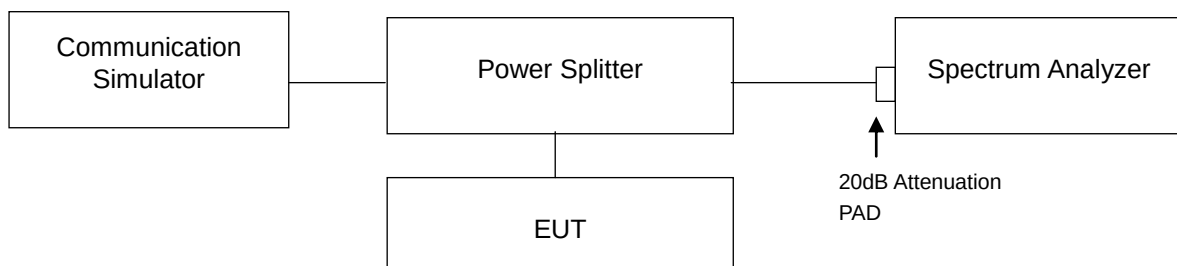
Temp. (°C)	CDMA				Limit (ppm)
	Low Channel		High Channel		
	Frequency (MHz)	Frequency Error (ppm)	Frequency (MHz)	Frequency Error (ppm)	
-30	817.900002	0.002	822.749998	-0.003	2.5
-20	817.900002	0.002	822.749996	-0.004	2.5
-10	817.900003	0.004	822.749997	-0.004	2.5
0	817.899998	-0.002	822.749998	-0.003	2.5
10	817.899999	-0.001	822.750003	0.004	2.5
20	817.899997	-0.004	822.750002	0.003	2.5
30	817.899996	-0.004	822.750004	0.005	2.5
40	817.899998	-0.003	822.750001	0.001	2.5
50	817.900003	0.004	822.750002	0.003	2.5

4.3 Occupied Bandwidth Measurement

4.3.1 Test Procedure

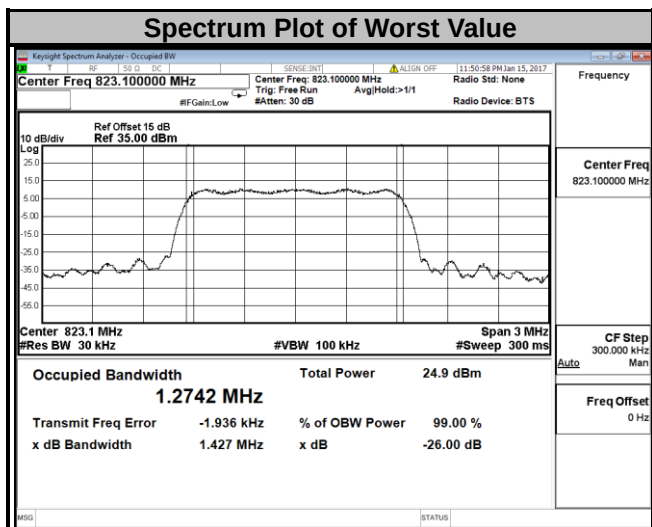
The EUT makes a call to the communication simulator. All measurements were done at low, middle and high operational frequency range. The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency. Use OBW measurement function of Spectrum analyzer to measure 99 % occupied bandwidth.

4.3.2 Test Setup



4.3.3 Test Result

CDMA		
Channel	Frequency (MHz)	99 % Occupied Bandwidth (MHz)
476	817.9	1.2722
580	820.5	1.2724
684	823.1	1.2742

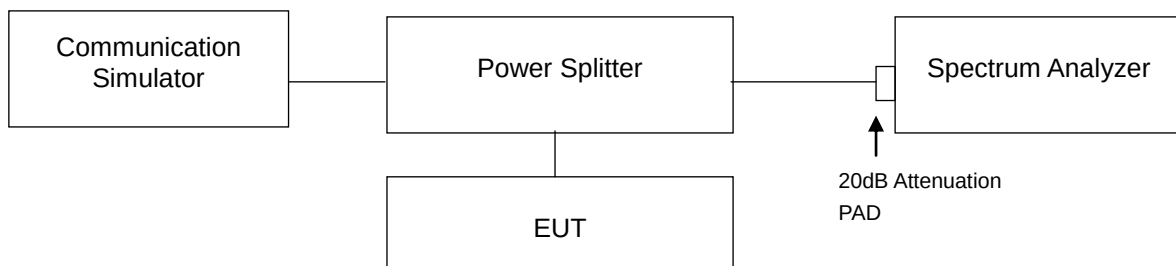


4.4 Emission Mask Measurement

4.4.1 Limits of Band Edge Measurement

According to FCC part 90.691 shall be tested the emission mask. For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

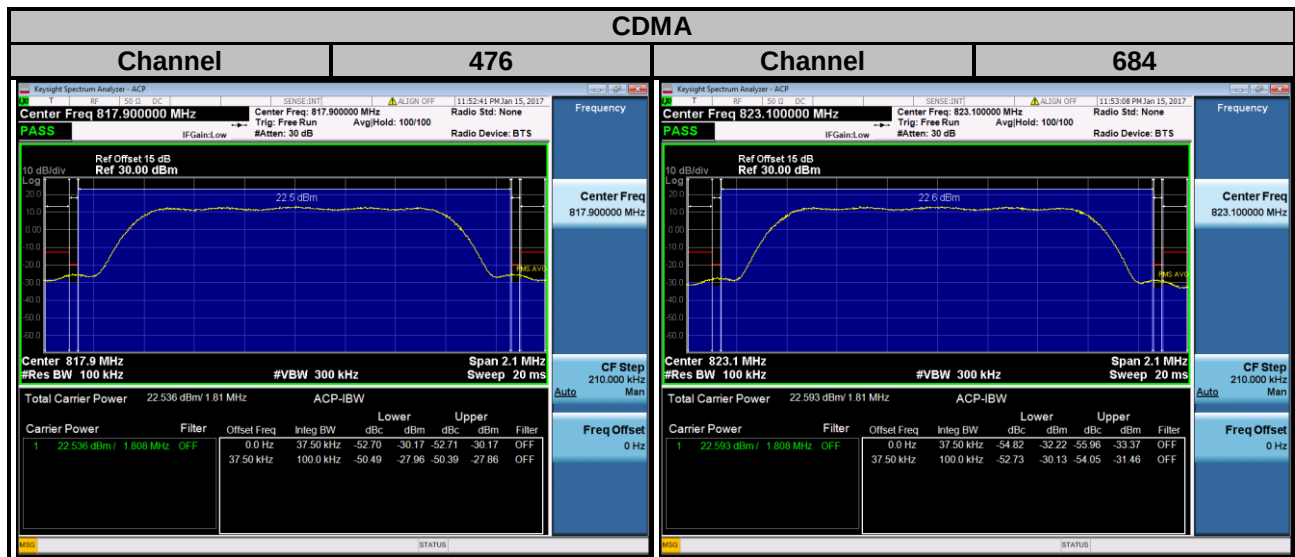
4.4.2 Test Setup



4.4.3 Test Procedures

- The measurement used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.
- Record the test plot.

4.4.4 Test Results

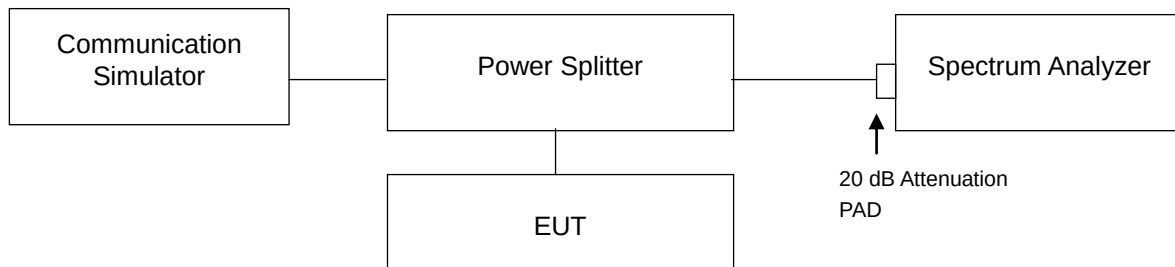


4.5 Conducted Spurious Emissions

4.5.1 Limits of Conducted Spurious Emissions Measurement

The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10}(P)$ dB. The limit of emission is equal to -13 dBm.

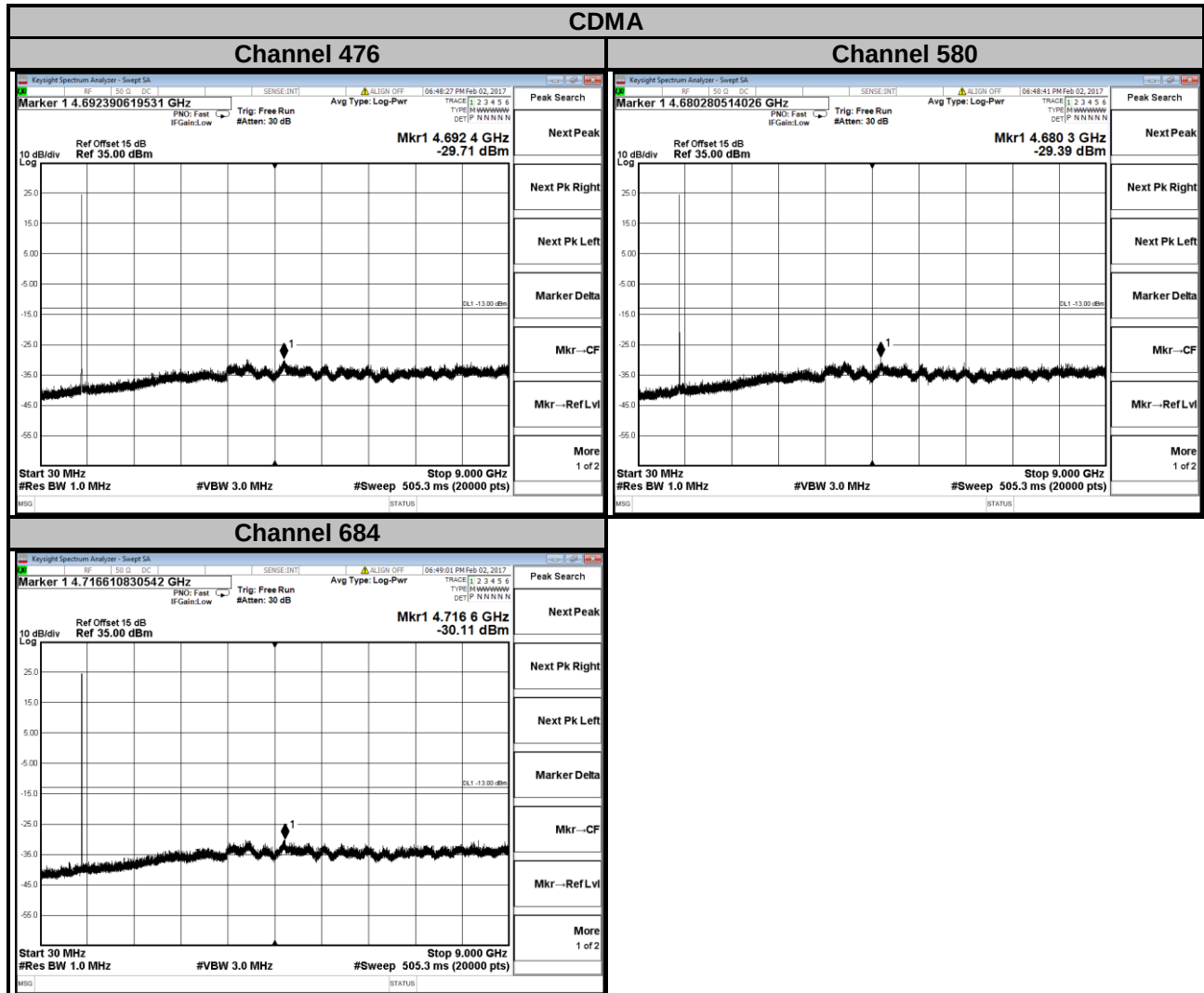
4.5.2 Test Setup



4.5.3 Test Procedure

- The EUT makes a phone call to the communication simulator. All measurements were done at low, middle and high operational frequency range.
- Measuring frequency range is from 30 MHz to 9 GHz. 10 dB attenuation pad is connected with spectrum. RBW=1 MHz and VBW=3 MHz are used for conducted emission measurement.

4.5.4 Test Results



4.6 Radiated Emission Measurement

4.6.1 Limits of Radiated Emission Measurement

The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10}(P)$ dB. The limit of emission is equal to -13 dBm.

4.6.2 Test Procedure

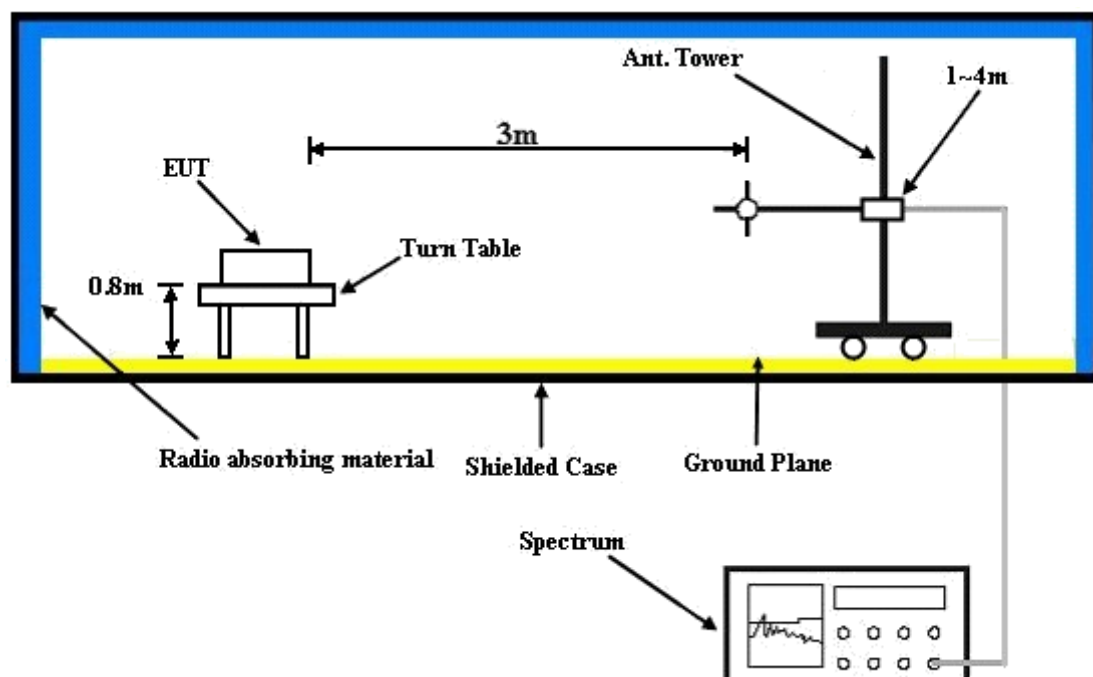
- Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1 m to 4 m to find the maximum polar radiated power. The "Read Value" is the spectrum reading the maximum power value.
- The substitution horn antenna is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a TX cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to "Read Value" of step a. Record the power level of S.G.
- $EIRP = \text{Output power level of S.G} - \text{TX cable loss} + \text{Antenna gain of substitution horn}.$
- E.R.P power can be calculated form E.I.R.P power by subtracting the gain of dipole, $E.R.P \text{ power} = E.I.P.R \text{ power} - 2.15 \text{ dBi}.$

Note: The resolution bandwidth of spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz.

4.6.3 Deviation from Test Standard

No deviation.

4.6.4 Test Setup



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

4.6.5 Test Results

CDMA:

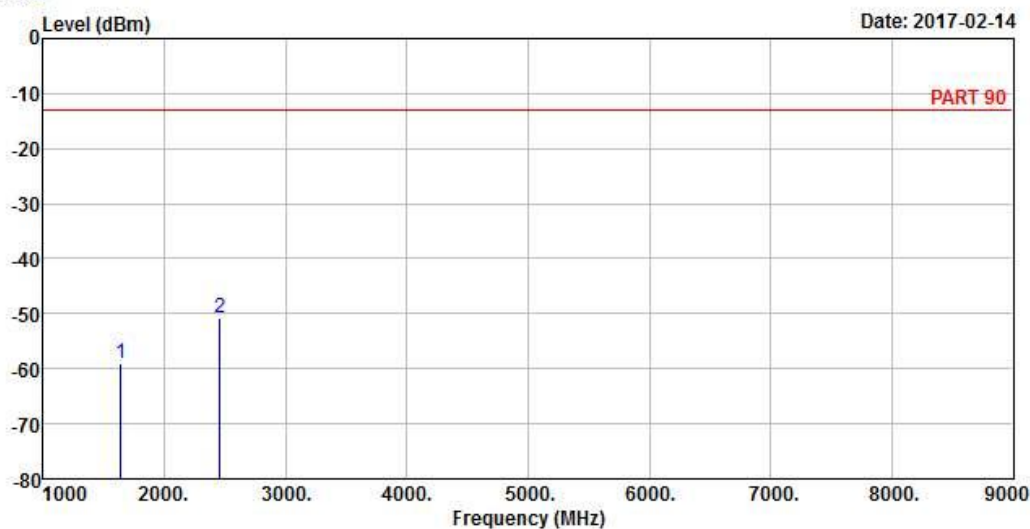
Low Channel



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 5



Site : 966 Chamber 5
Condition: PART 90 HORIZONTAL
Remak : CDMA BC10_L-CH Link
Tested by: Gavin Wu

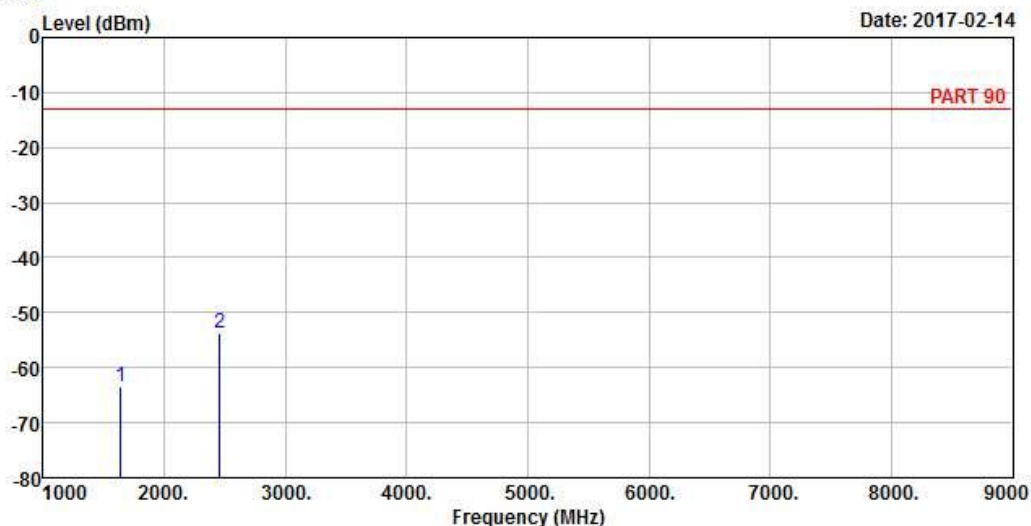
	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1	1635.80	-59.13	-44.34	-13.00	-46.13	-14.79	Peak
2 pp	2453.70	-50.87	-40.43	-13.00	-37.87	-10.44	Peak



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 6



Site : 966 Chamber 5
Condition: PART 90 VERTICAL
Remak : CDMA BC10_L-CH Link
Tested by: Gavin Wu

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1	1635.80	-63.39	-48.60	-13.00	-50.39	-14.79	Peak
2 pp	2453.70	-53.80	-43.36	-13.00	-40.80	-10.44	Peak

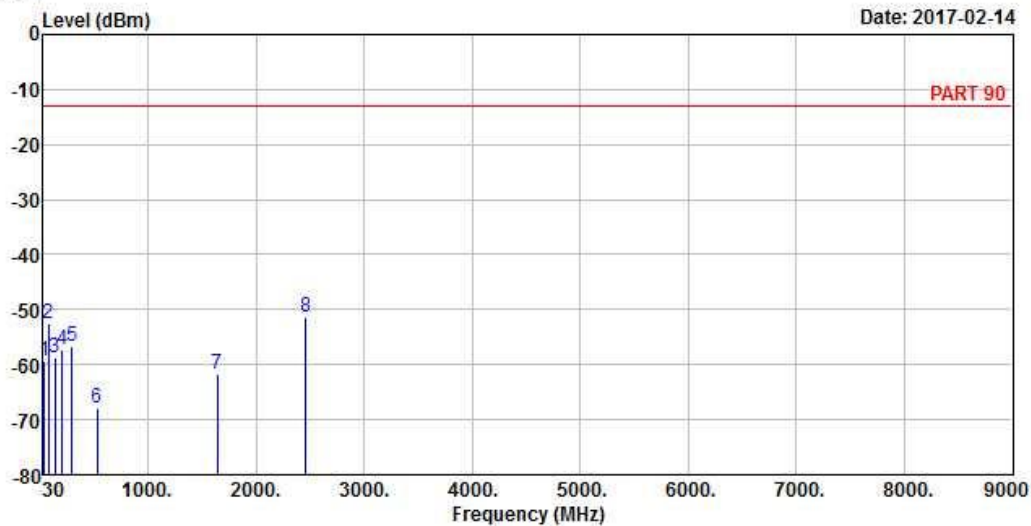
Middle Channel



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 7



Site : 966 Chamber 5
 Condition: PART 90 HORIZONTAL
 Remak : CDMA BC10_M-CH Link
 Tested by: Gavin Wu

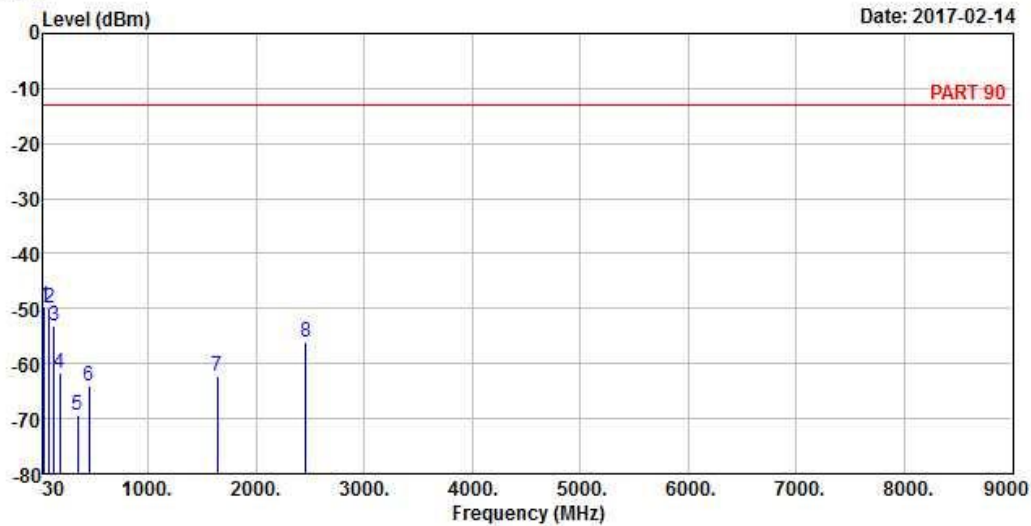
	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1	37.76	-59.20	-58.76	-13.00	-46.20	-0.44	Peak
2	78.50	-52.50	-42.07	-13.00	-39.50	-10.43	Peak
3	139.61	-58.67	-50.02	-13.00	-45.67	-8.65	Peak
4	208.48	-57.40	-49.73	-13.00	-44.40	-7.67	Peak
5	297.72	-56.78	-49.81	-13.00	-43.78	-6.97	Peak
6	526.64	-67.97	-64.29	-13.00	-54.97	-3.68	Peak
7	1641.00	-61.74	-47.01	-13.00	-48.74	-14.73	Peak
8 pp	2461.50	-51.42	-40.98	-13.00	-38.42	-10.44	Peak



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A D T

Data: 8



Site : 966 Chamber 5
Condition: PART 90 VERTICAL
Remak : CDMA BC10_M-CH Link
Tested by: Gavin Wu

	Freq	Level	Read Level	Limit Line	Over Limit	Factor	Remark
	MHz	dBm	dBm	dBm	dB	dB	
1 pp	42.61	-49.47	-48.53	-13.00	-36.47	-0.94	Peak
2	83.35	-49.90	-38.95	-13.00	-36.90	-10.95	Peak
3	128.94	-53.21	-44.40	-13.00	-40.21	-8.81	Peak
4	180.35	-61.80	-54.40	-13.00	-48.80	-7.40	Peak
5	347.19	-69.41	-63.13	-13.00	-56.41	-6.28	Peak
6	456.80	-63.99	-58.57	-13.00	-50.99	-5.42	Peak
7	1641.00	-62.30	-47.57	-13.00	-49.30	-14.73	Peak
8	2461.50	-56.15	-45.71	-13.00	-43.15	-10.44	Peak

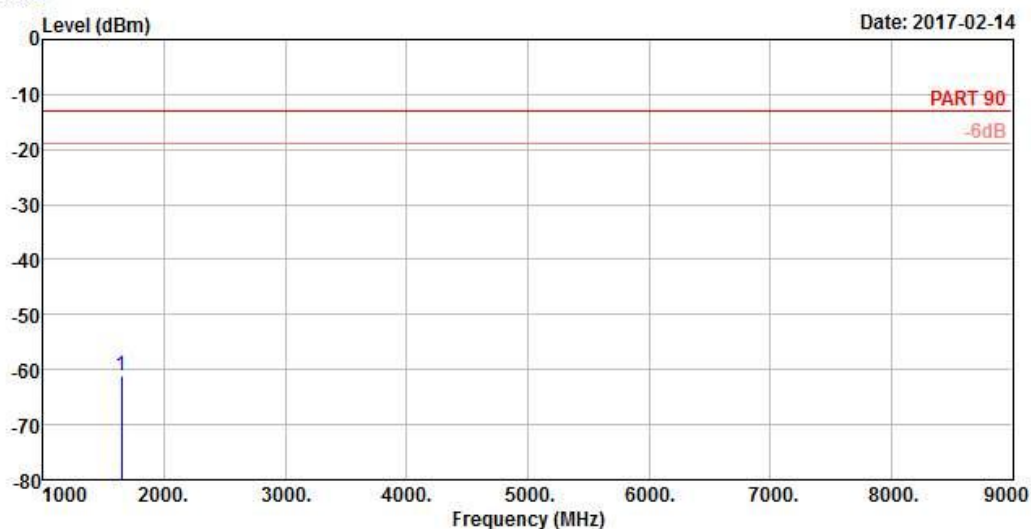
High Channel



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A D T

Data: 5



Site : 966 Chamber 5
Condition: PART 90 HORIZONTAL
Remak : CDMA BC10_H-CH Link
Tested by: Gavin Wu

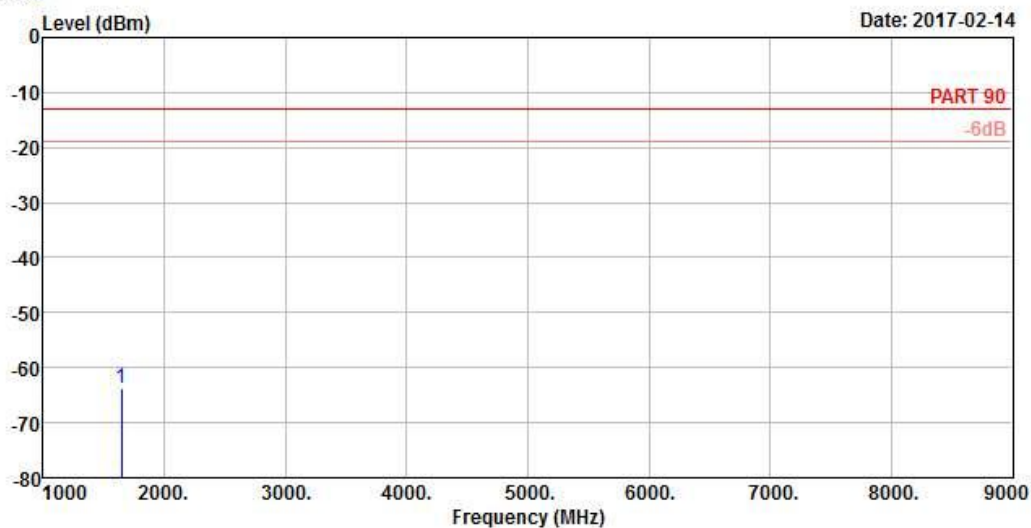
		Read	Limit	Over		
Freq	Level	Level	Line	Limit	Factor	Remark
MHz	dBm	dBm	dBm	dB	dB	
1 pp 1646.20	-61.08	-46.35	-13.00	-48.08	-14.73	Peak



Bureau Veritas Consumer Products Services Ltd., Taoyuan Branch

A D T

Data: 6



Site : 966 Chamber 5
 Condition: PART 90 VERTICAL
 Remak : CDMA BC10_H-CH Link
 Tested by: Gavin Wu

		Read	Limit	Over		
Freq	Level	Level	Line	Limit	Factor	Remark
MHz	dBm	dBm	dBm	dB	dB	
1 pp 1646.20	-63.80	-49.07	-13.00	-50.80	-14.73	Peak

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

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