

FCC Test Report

(Part 90)

Report No.: RFBBGM-WTW-P21116011-3

FCC ID: WIYLE910C1NF

Test Model: LE910C1-NF

Received Date: Dec. 01, 2021

Test Date: Dec. 02 ~ Dec. 07, 2021

Issued Date: Jan. 04, 2022

Applicant: CASTLES TECHNOLOGY CO., LTD.

Address: 6F, NO. 207-5, SEC. 3, BEIXIN RD., XINDIAN DISTRICT, NEW TAIPEI CITY 23143, TAIWAN (R. O. C.)

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

Lab Address: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

Test Location (1): No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan

FCC Registration /

Designation Number(1): 788550 / TW0003

Test Location(2): No. 70, Wenming Rd., Guishan Dist., Taoyuan City 333, Taiwan

FCC Registration /

Designation Number(2): 281270 / TW0032



This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification.

Table of Contents

Release Control Record	3
1 Certificate of Conformity.....	4
2 Summary of Test Results	5
2.1 Measurement Uncertainty	5
2.2 Test Site and Instruments.....	6
3 General Information.....	7
3.1 General Description of EUT	7
3.2 Configuration of System under Test.....	8
3.2.1 Description of Support Units.....	8
3.3 Test Mode Applicability and Tested Channel Detail	9
3.4 EUT Operating Conditions	9
3.5 General Description of Applied Standards	9
4 Test Types and Results	10
4.1 Output Power Measurement	10
4.1.1 Limits of Output Power Measurement.....	10
4.1.2 Test Procedures.....	10
4.1.3 Test Setup.....	10
4.1.4 Test Results	11
4.2 Radiated Emission Measurement	13
4.2.1 Limits of Radiated Emission Measuremen	13
4.2.2 Test Procedure	13
4.2.3 Deviation from Test Standard	13
4.2.4 Test Setup.....	14
4.2.5 Test Results	15
5 Pictures of Test Arrangements.....	18
Appendix – Information of the Testing Laboratories	19

Release Control Record

Issue No.	Description	Date Issued
RFBBGM-WTW-P21116011-3	Original release	Jan. 04, 2022

1 Certificate of Conformity

Product: WCDMA and LTE cellular wireless module

Brand:  **CASTLES
TECHNOLOGY**

Test Model: LE910C1-NF

Sample Status: Identical Prototype

Applicant: CASTLES TECHNOLOGY CO., LTD.

Test Date: Dec. 02 ~ Dec. 07, 2021

Standards: FCC Part 90, Subpart R

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 :

Pettie Chan

Date:

Jan. 04, 2022

Pettie Chen / Senior Specialist

Approved by :

Jeremy Lin

Date:

Jan. 04, 2022

Jeremy Lin / Project Engineer

2 Summary of Test Results

Applied Standard: FCC Part 90 & Part 2			
FCC Clause	Test Item	Result	Remarks
2.1046 90.542(a)(7)	Maximum Peak Output Power Limit: max. 3 watts e.r.p peak power	Pass	Meet the requirement of limit.
2.1055 90.539	Frequency Stability	N/A	Refer to Note
2.1049	Occupied Bandwidth	N/A	Refer to Note
90.210(n)	Emission Mask	N/A	Refer to Note
90.543(e)	Band Edge Measurements	N/A	Refer to Note
---	Peak To Average Ratio	N/A	Refer to Note
2.1051 90.543(e)	Conducted Spurious Emissions	N/A	Refer to Note
2.1051 90.543(e)(2)	Emission in the 769–775 MHz and 799–805 MHz band	N/A	Refer to Note
2.1053 90.543 (c) & (f)	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is - 2.39dB at 1586.00MHz.
2.1053 90.543(f)	Emissions in the band 1559–1610 MHz	N/A	Refer to Note

Note:

1. This report is a partial report. Therefore, only test item of Equivalent Isotropic Radiated Power and Radiated Spurious Emissions tests were performed for this report. Other testing data please refer to DEKRA report no.: 1980255R-HPUSP17V00-B & 1980255R-HPUSP17V00-C (LTE Module, Brand: Telit, Model: LE910C4-NF, FCC ID: RI7LE910CXNF).
2. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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	9kHz ~ 30MHz	3.00 dB
	30MHz ~ 200MHz	2.91 dB
	200MHz ~ 1000MHz	2.93 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	1.76 dB
	18GHz ~ 40GHz	1.77 dB

2.2 Test Site and Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver Rohde & Schwarz	ESR3	102782	Dec. 21, 2020	Dec. 20, 2021
Spectrum Analyzer Rohde & Schwarz	FSW43	101582	Apr. 01, 2021	Mar. 31, 2022
BILOG Antenna SCHWARZBECK	VULB9168	9168-1213	Oct. 27, 2021	Oct. 26, 2022
HORN Antenna RF SPIN	DRH18-E	210103A18E	Nov. 14, 2021	Nov. 13, 2022
HORN Antenna SCHWARZBECK	BBHA 9170	9170-1048	Nov. 14, 2021	Nov. 13, 2022
Preamplifier EMCI	EMC330N	980782	Jan. 19, 2021	Jan. 18, 2022
Preamplifier EMCI	EMC118A45SE	980808	Jan. 03, 2021	Jan. 02, 2022
Preamplifier EMCI	EMC184045SE	980788	Jan. 18, 2021	Jan. 17, 2022
RF signal cable EMCI	EMC104-SM-SM- (9000+2000+1000)	201243+ 201231+ 210102	Jan. 18, 2021	Jan. 17, 2022
RF signal cable EMCI	EMCCFD400-NM- NM- (9000+300+500)	201236+ 201235+ 201233	Jan. 18, 2021	Jan. 17, 2022
RF signal cable EMCI	EMC101G-KM-KM- (5000+3000+2000)	201260+201257+201254	Jan. 18, 2021	Jan. 17, 2022
Software BV ADT	ADT_Radiated_V7. 6.15.9.5	NA	NA	NA
Antenna Tower Max-Full	MFT-151SS-0.5T	NA	NA	NA
Turn Table Max-Full	MF-7802BS	NA	NA	NA
Turn Table Controller Max-Full	MF-7802BS	MF780208674	NA	NA
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY5519000 4/MY55190007/MY55210 005	Jul. 12, 2021	Jul. 11, 2022

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 WM Chamber 8.

3 General Information

3.1 General Description of EUT

Product	WCDMA and LTE cellular wireless module		
Brand			
Test Model	LE910C1-NF		
Sample Status	Identical Prototype		
Power Supply Rating	5.0 Vdc (host equipment) 3.8 Vdc		
Modulation Type	QPSK, 16QAM		
Operating Frequency	LTE Band 14	Channel Bandwidth 5MHz	790.5MHz ~ 795.5MHz
		Channel Bandwidth 10MHz	793MHz
Max. ERP Power	LTE Band 14		QPSK 16QAM
		Channel Bandwidth 5MHz	177.419mW (22.49dBm) 140.281mW (21.47dBm)
		Channel Bandwidth 10MHz	175.388mW (22.44dBm) 144.212mW (21.59dBm)
Antenna Type	Refer to Note		
Accessory Device	NA		
Cable Supplied	NA		

Note:

1. The EUT was installed in POS Terminal (Brand:  , Model: UPT1000F).
2. The antenna information of POS Terminal is listed as below.

Antenna Type	Dipole	Brand	Aristotle
Antenna Connector	SMA R/A PLUG	Model	RFA-US-T1000G-2M-A5
Antenna Gain (dBi)	LTE Band 14		2

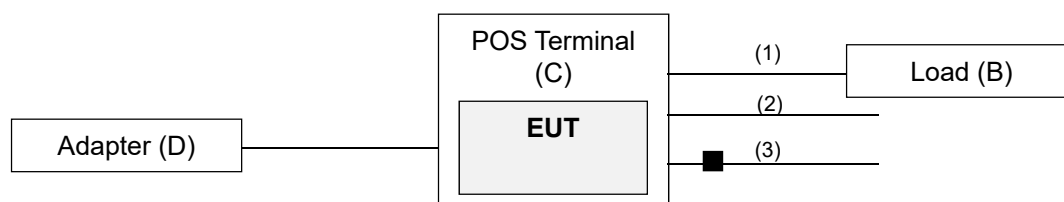
*The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.

3. The adapter information of POS Terminal is listed as below.

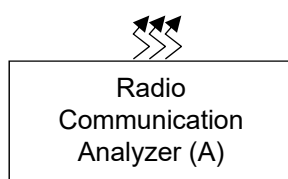
Adapter (Support unit)	
Brand	
Model	FSP040-DRAN2
Input Power	100-240 Vac, 50-60 Hz, 1.4 A
Output Power	9.0 Vdc, 4.44 A MAX
Power Line:	1.45 m cable w/o core

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 Configuration of System under Test



Remote site



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.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Radio Communication Analyzer	Anritsu	MT8821C	6261806803	NA	-
B.	Load	NA	NA	NA	NA	-
C.	POS Terminal	 CASTLES TECHNOLOGY	UPT1000F	NA	NA	-
D.	Adapter	 CASTLES TECHNOLOGY	FSP040-DRAN2	NA	NA	-

Note:

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

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	LAN cable	1	1.5	N	0	RJ45
2.	Audio cable	1	1.5	Y	0	Provided by client
3.	USB cable	1	1.5	Y	1	Provided by lab

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 on Z-plane. Following channel(s) was (were) selected for the final test as listed below:

EUT Configure Mode	Test item	Available channel	Tested channel	Channel Bandwidth	Modulation	Mode
-	ERP	23305 to 23355	23305(790.5MHz), 23330(793.0MHz), 23355(795.5MHz)	5MHz	QPSK / 16QAM	1 RB / 0 RB Offset 1 RB / 12 RB Offset 1 RB / 24 RB Offset 12 RB / 0 RB Offset 12 RB / 6 RB Offset 12 RB / 13 RB Offset 25 RB / 0 RB Offset
		23330	23330(793.0MHz)	10MHz	QPSK / 16QAM	1 RB / 0 RB Offset 1 RB / 24 RB Offset 1 RB / 49 RB Offset 25 RB / 0 RB Offset 25 RB / 12 RB Offset 25 RB / 25 RB Offset 50 RB / 0 RB Offset
-	Radiated Emission below 1GHz	23330	23330(793.0MHz)	10MHz	QPSK	1 RB / 49 RB Offset
-	Radiated Emission above 1GHz	23330	23330(793.0MHz)	10MHz	QPSK	1 RB / 49 RB Offset

Test Condition:

Test Item	Environmental Conditions	Input Power	Tested By
ERP	23deg. C, 70%RH	120Vac, 60Hz	Rui Chan
Radiated Emission	23deg. C, 68%RH	120Vac, 60Hz	Edison Lee

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

KDB 971168 D01 Power Meas License Digital Systems v03r01

ANSI/TIA/EIA-603-E 2016

ANSI 63.26-2015

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

Portable stations (hand-held devices) transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 3 watts ERP.

4.1.2 Test Procedures

Conducted Power Measurement:

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

EIRP / ERP Measurement:

The relevant equation for determining the maximum ERP or EIRP from the measured RF output power is

given in Equation as follows:

$$\text{EIRP} = P_{\text{Meas}} + G_T$$

$$\text{ERP} = P_{\text{Meas}} + G_T - 2.15$$

where

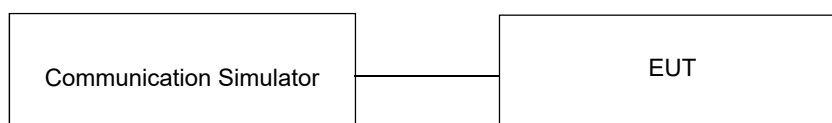
ERP or EIRP effective radiated power or equivalent isotropically radiated power, respectively
(expressed in the same units as P_{Meas} , e.g., dBm or dBW)

P_{Meas} measured transmitter output power or PSD, in dBm or dBW

G_T gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP)

4.1.3 Test Setup

Conducted Power Measurement:



4.1.4 Test Results

Conducted Output Power (dBm)

LTE Band 14				
BW	MCS Index	RB Size	RB Offset	Mid
		Channel		23330
		Frequency (MHz)		793
10M	QPSK	1	0	22.58
		1	24	22.59
		1	49	22.12
		25	0	21.36
		25	12	21.19
		25	25	21.20
		50	0	21.32
10M	16QAM	1	0	21.25
		1	24	21.74
		1	49	21.30
		25	0	20.49
		25	12	20.11
		25	25	19.89
		50	0	20.55

LTE Band 14						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		23305	23330	23355
		Frequency (MHz)		790.5	793	795.5
5M	QPSK	1	0	22.48	22.48	22.36
		1	12	22.32	22.64	22.40
		1	24	22.31	22.31	22.38
		12	0	21.37	21.33	21.27
		12	6	21.41	21.26	21.31
		12	13	21.25	21.22	21.21
		25	0	21.33	21.35	21.32
5M	16QAM	1	0	21.56	21.41	21.24
		1	12	21.57	21.62	21.51
		1	24	21.21	21.38	21.27
		12	0	20.47	20.06	20.38
		12	6	20.28	20.50	20.45
		12	13	20.49	20.13	20.29
		25	0	20.47	20.21	20.25

ERP Power (dBm)

LTE Band 14				
BW	MCS Index	RB Size	RB Offset	Mid
		Channel		23330
		Frequency (MHz)		793
10M	QPSK	1	0	22.43
		1	24	22.44
		1	49	21.97
		25	0	21.21
		25	12	21.04
		25	25	21.05
		50	0	21.17
10M	16QAM	1	0	21.10
		1	24	21.59
		1	49	21.15
		25	0	20.34
		25	12	19.96
		25	25	19.74
		50	0	20.40

LTE Band 14						
BW	MCS Index	RB Size	RB Offset	Low	Mid	High
		Channel		23305	23330	23355
		Frequency (MHz)		790.5	793	795.5
5M	QPSK	1	0	22.33	22.33	22.21
		1	12	22.17	22.49	22.25
		1	24	22.16	22.16	22.23
		12	0	21.22	21.18	21.12
		12	6	21.26	21.11	21.16
		12	13	21.10	21.07	21.06
		25	0	21.18	21.20	21.17
5M	16QAM	1	0	21.41	21.26	21.09
		1	12	21.42	21.47	21.36
		1	24	21.06	21.23	21.12
		12	0	20.32	19.91	20.23
		12	6	20.13	20.35	20.30
		12	13	20.34	19.98	20.14
		25	0	20.32	20.06	20.10

4.2 Radiated Emission Measurement

4.2.1 Limits of Radiated Emission Measurement

For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth.

Note: Emissions in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals.

{The limits is adjusted to -40dBm (-70dBW)}

4.2.2 Test Procedure

- a. In the semi-anechoic chamber, EUT placed on the 0.8m(below or equal 1GHz) and/or 1.5m(above 1GHz) 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 1m to 4m to find the maximum polar radiated power. The "Read Value" is the spectrum reading the maximum power value.
- b. 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.
- c. Perform a field strength measurement and record the worse read value, is the field strength value via a spectrum reading obtained corrected for antenna factor, cable loss and pre-amplifier factor and then mathematically convert the measured field strength level to EIRP/ERP level.
- d. Following C63.26 section 5.5

$EIRP (dBm) = E (dB\mu V/m) + 20\log(D) - 104.8$; where D is the measurement distance (in the far field region) in m.

$ERP (dBm) = E (dB\mu V/m) + 20\log(D) - 104.8 - 2.15$; where D is the measurement distance (in the far field region) in m.

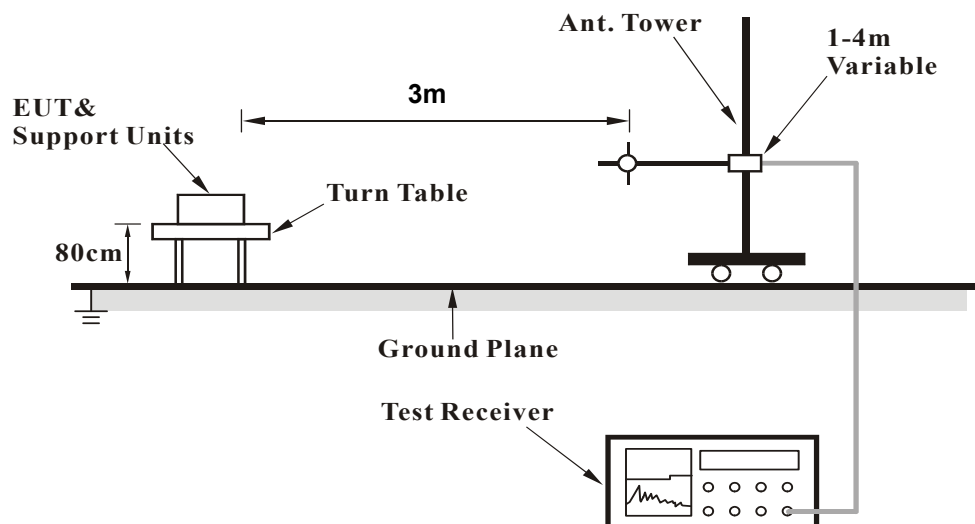
NOTE: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.

4.2.3 Deviation from Test Standard

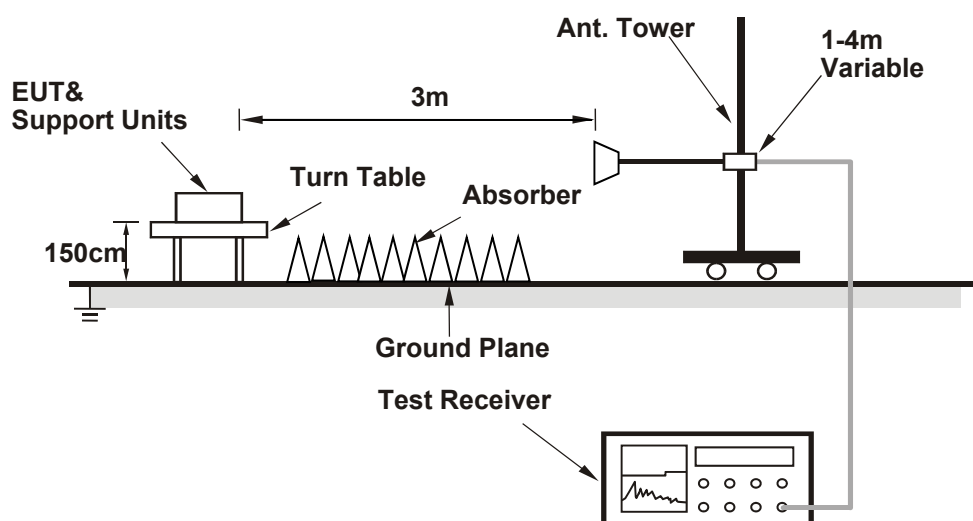
No deviation.

4.2.4 Test Setup

For Radiated Emission below or equal 1GHz



For Radiated Emission above 1GHz



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

4.2.5 Test Results

Below 1GHz

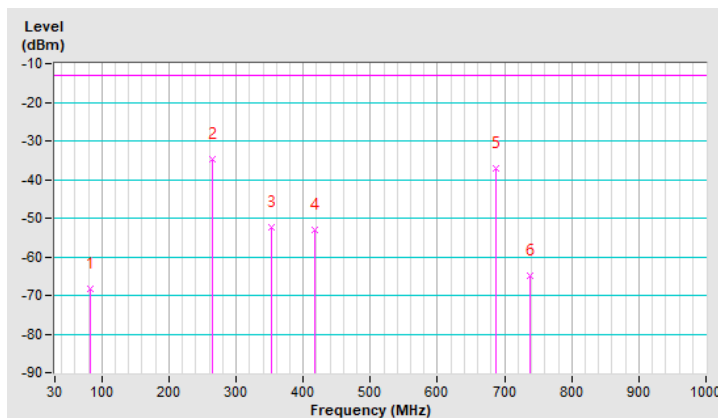
Channel Bandwidth: 10MHz

Mode	TX channel 23330(793.0MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	23deg. C, 68%RH	Input Power	120Vac, 60Hz
Tested By	Edison Lee		

Antenna Polarity & Test Distance: Horizontal at 3 M								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	82.01	-68.15	-13.00	-55.15	1.50 H	227	53.21	-121.36
2	264.77	-34.88	-13.00	-21.88	1.00 H	139	81.37	-116.25
3	353.33	-52.40	-13.00	-39.40	1.50 H	202	61.47	-113.87
4	418.00	-53.07	-13.00	-40.07	1.00 H	74	59.09	-112.16
5	686.51	-37.05	-13.00	-24.05	2.00 H	139	69.78	-106.83
6	738.52	-64.76	-13.00	-51.76	1.00 H	102	41.06	-105.82

Remarks:

1. $ERP(dBm) = Raw\ Value(dBuV/m) + Correction\ Factor(dB/m)$
2. $Correction\ Factor(dB/m) = Antenna\ Factor(dB/m) + Cable\ Factor(dB) - Pre-Amplifier\ Factor(dB) + 20\log(D) - 104.8 - 2.15$
3. $Margin\ value = ERP - Limit\ value$
4. The other ERP levels were very low against the limit.

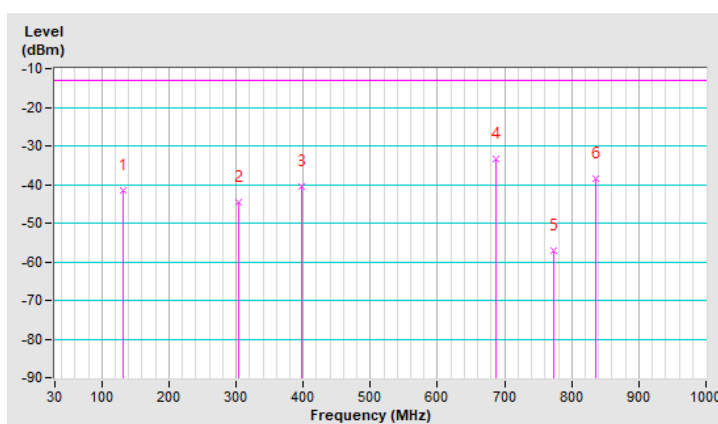


Mode	TX channel 23355 (795.5MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	23deg. C, 68%RH	Input Power	120Vac, 60Hz
Tested By	Edison Lee		

Antenna Polarity & Test Distance: Vertical at 3 M								
No	Frequency (MHz)	ERP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	132.62	-41.43	-13.00	-28.43	1.50 V	33	75.20	-116.63
2	304.13	-44.52	-13.00	-31.52	1.50 V	131	70.37	-114.89
3	396.91	-40.40	-13.00	-27.40	1.00 V	328	72.25	-112.65
4	686.51	-33.44	-13.00	-20.44	1.00 V	326	73.39	-106.83
5	773.67	-57.24	-13.00	-44.24	2.00 V	205	47.98	-105.22
6	835.52	-38.61	-13.00	-25.61	1.00 V	328	65.84	-104.45

Remarks:

1. $ERP(dBm) = Raw\ Value(dBuV/m) + Correction\ Factor(dB/m)$
2. $Correction\ Factor(dB/m) = Antenna\ Factor(dB/m) + Cable\ Factor(dB) - Pre-Amplifier\ Factor(dB) + 20\log(D) - 104.8 - 2.15$
3. Margin value = ERP – Limit value
4. The other ERP levels were very low against the limit.



Above 1GHz

Channel Bandwidth: 10MHz

Mode	TX channel 23330 (793.0MHz)	Frequency Range	1 ~ 18GHz
Environmental Conditions	23deg. C, 68%RH	Input Power	120Vac, 60Hz
Tested By	Edison Lee		

Antenna Polarity & Test Distance: Horizontal at 3 M								
No.	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1586.00	-42.39	-40.00	-2.39	3.10 H	212	59.80	-102.19
Antenna Polarity & Test Distance: Vertical at 3 M								
No.	Frequency (MHz)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	1586.00	-42.79	-40.00	-2.79	1.71 V	94	59.40	-102.19

Remarks:

1. $EIRP(dBm) = Raw\ Value(dBuV/m) + Correction\ Factor(dB/m)$
2. $Correction\ Factor(dB/m) = Antenna\ Factor(dB/m) + Cable\ Factor(dB) - Pre-Amplifier\ Factor(dB) + 20\log(D) - 104.8$
3. $Margin\ value = EIRP - Limit\ value$
4. The other EIRP levels were very low against the limit.

5 Pictures of Test Arrangements

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

Appendix – Information of 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:

Lin Kou EMC/RF Lab

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF/Telecom Lab

Tel: 886-3-6668565

Fax: 886-3-6668323

Hwa Ya EMC/RF/Safety Lab

Tel: 886-3-3183232

Fax: 886-3-3270892

Email: service.adt@tw.bureauveritas.com

Web Site: www.bureauveritas-adt.com

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

--- END ---