

FCC Test Report

(Spot Check: Part 24 – GSM, WCDMA Band 2)

Report No.: RF200514C16B-8

FCC ID: T8GSAN9001

Original FCC ID: T8GSAN9000

Test Model: SA-N9001 CUS D1

Received Date: May 14, 2020

Test Date: Nov. 29 ~ Dec. 24, 2020

Issued Date: Dec. 30, 2020

Applicant: Harman Connected Car Division

Address: Parking 3, 85748 Garching Germany

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

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FCC Registration / 788550 / TW0003

Designation Number:



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Release Control Record

Issue No.	Description	Date Issued
RF200514C16B-8	Original release	Dec. 30, 2020

1 Certificate of Conformity

Product: Module

Brand: Harman

Test Model: SA-N9001 CUS D1

Sample Status: Standard Sample

Applicant: Harman Connected Car Division

Test Date: Nov. 29 ~ Dec. 24, 2020

Standards: FCC Part 24, Subpart E

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 : Celine Chou , **Date:** Dec. 30, 2020
Celine Chou / Senior Specialist

Approved by : Bruce Chen , **Date:** Dec. 30, 2020
Bruce Chen / Senior Project Engineer

2 Summary of Test Results

Applied Standard: FCC Part 24 & Part 2			
FCC Clause	Test Item	Result	Remarks
2.1046 24.232	Effective radiated power	Pass	Meet the requirement of limit.
2.1053 24.238	Radiated Spurious Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -37.80dB at 3760.00MHz.

Note: 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) ($\pm$)
Radiated Emissions up to 1 GHz	9kHz ~ 30MHz	3.04 dB
	30MHz ~ 200MHz	3.59 dB
	200MHz ~ 1000MHz	3.60 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB

2.2 Test Site and Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver KEYSIGHT	N9038A	MY55420137	Apr. 16, 2020	Apr. 15, 2021
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100039	Jun. 12, 2020	Jun. 11, 2021
BILOG Antenna SCHWARZBECK	VULB9168	9168-160	Nov. 06, 2020	Nov. 05, 2021
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-1169	Nov. 22, 2020	Nov. 21, 2021
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Nov. 22, 2020	Nov. 21, 2021
Loop Antenna TESEQ	HLA 6121	45745	Jul. 06, 2020	Jul. 05, 2021
Preamplifier Agilent (Below 1GHz)	8447D	2944A10638	Jun. 08, 2020	Jun. 07, 2021
Preamplifier Agilent (Above 1GHz)	8449B	3008A02367	Feb. 18, 2020	Feb. 17, 2021
RF signal cable HUBER+SUHNER&EMCI	SUCOFLEX 104 & EMC104-SM-SM8 000	CABLE-CH9-02 (248780+171006)	Jan. 18, 2020	Jan. 17, 2021
RF signal cable HUBER+SUHNER	SUCOFLEX 104	CABLE-CH9-(250795/4)	Jan. 18, 2020	Jan. 17, 2021
RF signal cable Woken	8D-FB	Cable-CH9-01	Jun. 08, 2020	Jun. 07, 2021
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower EMCO	2070/2080	512.835.4684	NA	NA
Turn Table EMCO	2087-2.03	NA	NA	NA
Antenna Tower & Turn BV ADT	AT100	AT93021705	NA	NA
Turn Table BV ADT	TT100	TT93021705	NA	NA
Turn Table Controller BV ADT	SC100	SC93021705	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
Pre-amplifier (18GHz-40GHz) EMC	EMC184045B	980175	Sep. 04, 2020	Sep. 03, 2021
UXM 5G Wireless Test Platform Keysight	E7515B	MY58300759	Apr. 18, 2020	Apr. 17, 2021
Standard Temperature And Humidity Chamber TERCHY	MHU-225AU	920842	May 27, 2020	May 31, 2021
JFW 20dB attenuation	50HF-020-SMA	NA	NA	NA
True RMS Clamp Meter Fluke	325	31130711WS	Jun. 06, 2020	Jun. 05, 2021
DC power supply	U8002A	MY56330015	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 9.

3 General Information

3.1 General Description of EUT

Product	Module	
Brand	Harman	
Test Model	SA-N9001 CUS D1	
Sample Status	Standard Sample	
Power Supply rating	4.2Vdc	
Modulation Type	GSM/GPRS	GMSK
	EDGE	GMSK, 8PSK
	WCDMA	QPSK
Operating Frequency	GSM/GPRS/EDGE	1850.2 ~ 1909.8MHz
	WCDMA	1852.4 ~ 1907.6MHz
Max. EIRP Power	GSM/GPRS	1896.706mW (32.78dBm)
	EDGE	1592.209mW (32.02dBm)
	WCDMA	479.733mW (26.81dBm)
Emission Designator	GSM/GPRS	260KGXW
	EDGE	260KG7W
	WCDMA	4M18F9W
Antenna Type	Refer to note	
Antenna Connector	Refer to note	
Accessory Device	NA	
Cable Supplied	NA	

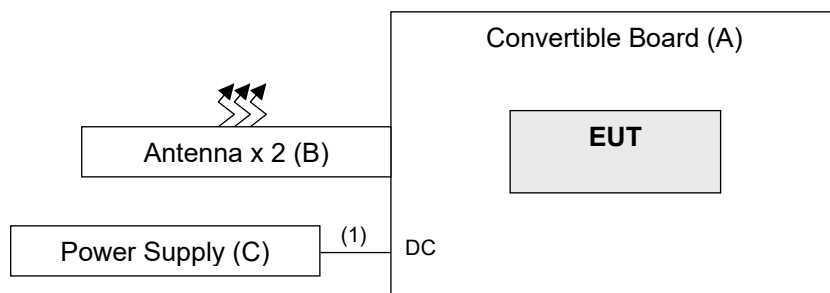
Note:

1. This report is a supplementary report to the original BV CPS report no.: RF200616C19-1. Exhibit prepared for FCC Spot Check Verification report, the format, test items and amount of spot-check test data are decided by applicant's engineering judgment, for more details please refer to declaration letter exhibit. Radiated emission and output power verification worst test refer to original report.
2. The antenna information is listed as below.

Operating frequency band	Antenna	Gain (dBi)	Connector Type
GSM/ WCDMA Band 2	5G/4G Terminal Mount Monopole Antenna	2.92	SMA
WCDMA Band 4		3.44	
GSM/ WCDMA Band 5		1.01	

* 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.

3.2 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.

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Convertible Board	NA	NA	NA	NA	Provided by client
B.	Antenna x 2	TAOGLAS	TG.55.8113	NA	NA	Provided by client
C.	DC Power supply	TECPEL	GPS-3030DD	GEO855739	NA	-

Note: 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.	DC cable	1	1	N	0	-

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

GSM

EUT Configure Mode	Test item	Available channel	Tested channel	Mode
-	EIRP	512 to 810	512 (1850.2MHz), 661 (1880.0MHz), 810 (1909.8MHz)	GSM, GPRS, EDGE
-	Radiated Emission Below 1GHz	512 to 810	512 (1850.2MHz)	GSM
-	Radiated Emission Above 1GHz	512 to 810	512 (1850.2MHz)	GSM

WCDMA

EUT Configure Mode	Test item	Available channel	Tested channel	Mode
-	EIRP	9262 to 9538	9262 (1852.4MHz), 9400 (1880.0MHz), 9538 (1907.6MHz)	WCDMA, HSDPA, HSUPA
-	Radiated Emission Below 1GHz	9262 to 9538	9538 (1907.6MHz)	WCDMA
-	Radiated Emission Above 1GHz	9262 to 9538	9538 (1907.6MHz)	WCDMA

Test Condition:

Test Item	Environmental Conditions	Input Power (System)	Tested By
EIRP	25deg. C, 70%RH	4.2Vdc	James Yang
Radiated Emission	22deg. C, 66%RH	120Vac, 60Hz	Han Wu

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 and References

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards and References:

Test Standard:

FCC 47 CFR Part 2

FCC 47 CFR Part 24

ANSI/TIA/EIA-603-E 2016

ANSI 63.26-2015

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

References Test Guidance:

KDB 971168 D01 Power Meas License Digital Systems v03r01

All test items have been performed as a reference to the above KDB test guidance.

4 Test Types and Results

4.1 Output Power Measurement

4.1.1 Limits of Output Power Measurement

Mobile / Portable station are limited to 2 watts e.i.r.p.

4.1.2 Test Procedures

Conducted Power Measurement:

The EUT was set up for the maximum power with GSM, GPRS, EDGE, WCDMA 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.

Maximum EIRP / ERP

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:



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

4.1.4 Test Results

Conducted Output Power (dBm)

Band	GSM1900		
Channel	512	661	810
Frequency	1850.2	1880	1909.8
GSM	29.69	29.86	29.81
GPRS (GMSK,1Tx-solot)	29.55	29.83	29.64
GPRS (GMSK,2Tx-solot)	29.69	29.73	29.63
GPRS (GMSK,3Tx-solot)	29.61	29.79	29.72
GPRS (GMSK,4Tx-solot)	29.80	29.70	29.67
DTM (GMSK,2Tx-solot)	29.06	29.44	29.04
DTM (GMSK,3Tx-solot)	29.03	29.17	28.89
EDGE (8PSK,1Tx-solot)	28.74	29.10	28.53
EDGE (8PSK,2Tx-solot)	29.07	29.05	28.79
EDGE (8PSK,3Tx-solot)	28.94	28.99	28.86
EDGE (8PSK,4Tx-solot)	28.81	29.00	28.66
DTM (8PSK,2Tx-solot)	28.44	28.56	28.39
DTM (8PSK,3Tx-solot)	28.24	28.52	28.40

Band	WCDMA II		
Channel	9262	9400	9538
Frequency	1852.4	1880	1907.6
RMC 12.2K	23.79	23.80	23.89
HSDPA Subtest-1	23.56	23.78	23.65
HSDPA Subtest-2	23.67	23.65	23.78
HSDPA Subtest-3	23.11	23.40	23.39
HSDPA Subtest-4	23.13	23.14	23.25
HSUPA Subtest-1	23.49	23.42	23.56
HSUPA Subtest-2	22.73	22.98	23.24
HSUPA Subtest-3	22.52	22.76	22.86
HSUPA Subtest-4	22.08	22.27	22.39
HSUPA Subtest-5	22.22	22.37	22.80

EIRP Power (dBm)

Band	GSM1900		
Channel	512	661	810
Frequency	1850.2	1880	1909.8
GSM	32.61	32.78	32.73
GPRS (GMSK,1Tx-solot)	32.47	32.75	32.56
GPRS (GMSK,2Tx-solot)	32.61	32.65	32.55
GPRS (GMSK,3Tx-solot)	32.53	32.71	32.64
GPRS (GMSK,4Tx-solot)	32.72	32.62	32.59
DTM (GMSK,2Tx-solot)	31.98	32.36	31.96
DTM (GMSK,3Tx-solot)	31.95	32.09	31.81
EDGE (8PSK,1Tx-solot)	31.66	32.02	31.45
EDGE (8PSK,2Tx-solot)	31.99	31.97	31.71
EDGE (8PSK,3Tx-solot)	31.86	31.91	31.78
EDGE (8PSK,4Tx-solot)	31.73	31.92	31.58
DTM (8PSK,2Tx-solot)	31.36	31.48	31.31
DTM (8PSK,3Tx-solot)	31.16	31.44	31.32

*EIRP = Conducted + antenna gain

Band	WCDMA II		
Channel	9262	9400	9538
Frequency	1852.4	1880	1907.6
RMC 12.2K	26.71	26.72	26.81
HSDPA Subtest-1	26.48	26.70	26.57
HSDPA Subtest-2	26.59	26.57	26.70
HSDPA Subtest-3	26.03	26.32	26.31
HSDPA Subtest-4	26.05	26.06	26.17
HSUPA Subtest-1	26.41	26.34	26.48
HSUPA Subtest-2	25.65	25.90	26.16
HSUPA Subtest-3	25.44	25.68	25.78
HSUPA Subtest-4	25.00	25.19	25.31
HSUPA Subtest-5	25.14	25.29	25.72

*EIRP = Conducted + antenna gain

4.2 Radiated Emission Measurement

4.2.1 Limits of Radiated Emission Measurement

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB. The emission limit equal to -13dBm .

4.2.2 Test Procedure

- a. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8m (below or equal 1 GHz) and/or 1.5 m (above 1 GHz) 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. $\text{EIRP} = \text{Output power level of S.G} - \text{TX cable loss} + \text{Antenna gain of substitution horn}$. Correction Factor (includes EIRP and ERP unit conversion factor) = Antenna gain of substitution horn. – Tx cable loss. Measurement method refers to ANSI C63.26 section 5.5.3.2.
- c. E.R.P power can be calculated form E.I.R.P power by subtracting the gain of dipole, $\text{E.R.P power} = \text{E.I.R.P power} - 2.15\text{dBi}$.

Note:

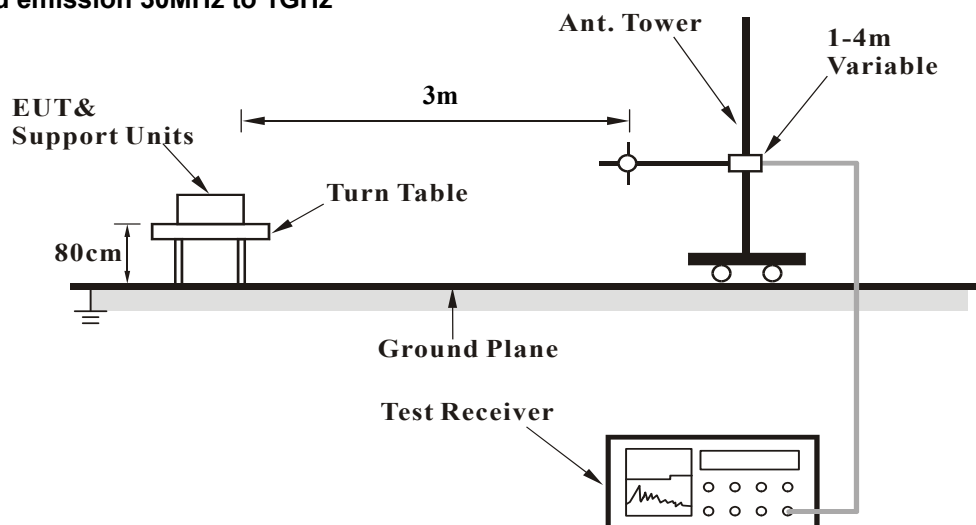
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1MHz/3MHz.
2. The emission levels were against the limit of frequency range 9 kHz ~ 30 MHz: The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report

4.2.3 Deviation from Test Standard

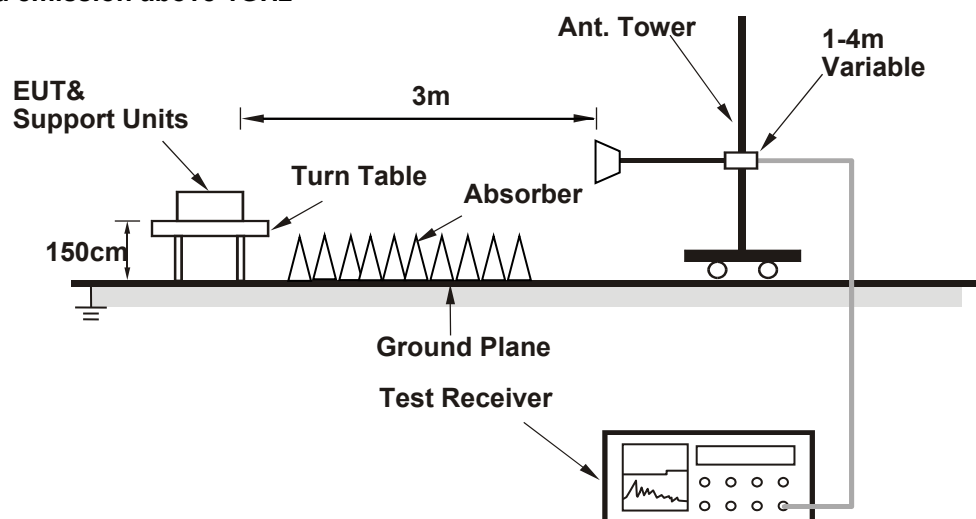
No deviation.

4.2.4 Test Setup

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).

4.2.5 Test Results

Below 1GHz

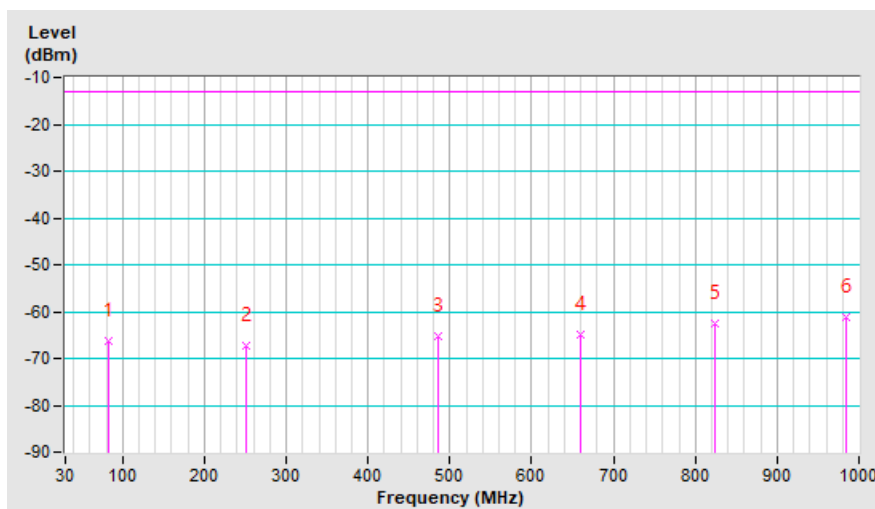
GSM

Mode	TX channel 512 (1850.2MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	82.38	-60.80	-66.60	0.40	-66.20	-13.00	-53.20
2	251.16	-61.20	-66.00	-1.40	-67.40	-13.00	-54.40
3	485.90	-65.20	-69.10	3.70	-65.40	-13.00	-52.40
4	660.50	-67.40	-68.70	3.70	-65.00	-13.00	-52.00
5	823.46	-69.30	-66.50	3.90	-62.60	-13.00	-49.60
6	984.48	-70.00	-64.80	3.50	-61.30	-13.00	-48.30

Remarks:

1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) - Cable Loss (dB).

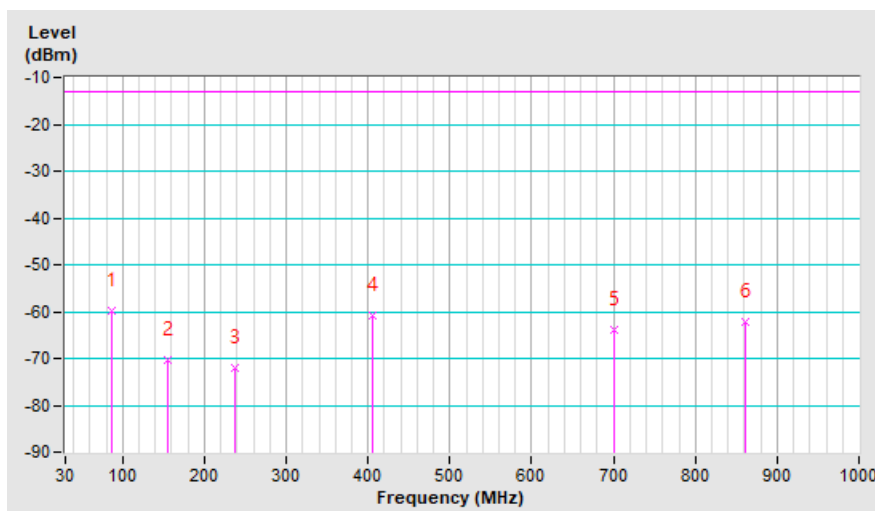


Mode	TX channel 512 (1850.2MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	87.26	-53.60	-59.70	-0.10	-59.80	-13.00	-46.80
2	156.10	-67.60	-67.50	-2.90	-70.40	-13.00	-57.40
3	237.58	-70.00	-70.60	-1.40	-72.00	-13.00	-59.00
4	406.36	-60.20	-64.10	3.30	-60.80	-13.00	-47.80
5	701.24	-69.80	-67.30	3.40	-63.90	-13.00	-50.90
6	860.32	-69.10	-65.30	3.20	-62.10	-13.00	-49.10

Remarks:

1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) - Cable Loss (dB).



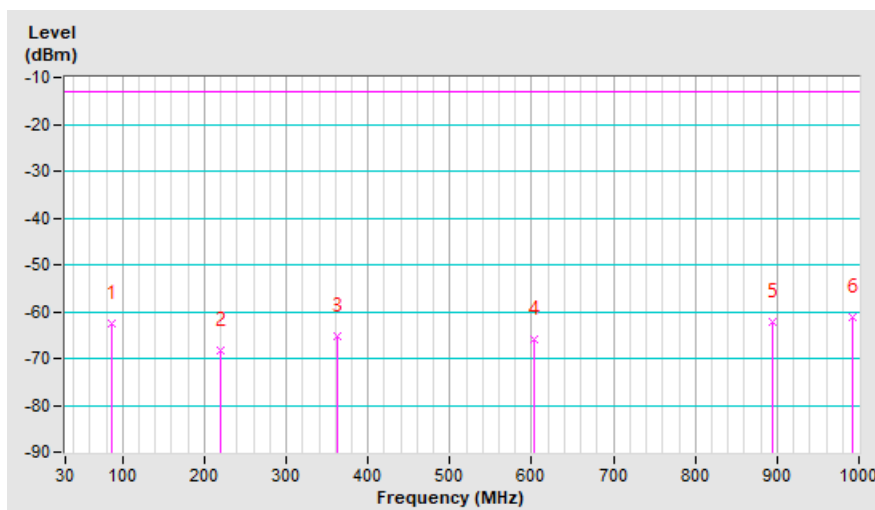
WCDMA

Mode	TX channel 9538 (1907.6MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	86.26	-55.60	-62.50	0.10	-62.40	-13.00	-49.40
2	220.12	-60.10	-66.30	-1.90	-68.20	-13.00	-55.20
3	361.74	-62.50	-68.90	3.80	-65.10	-13.00	-52.10
4	602.30	-67.40	-69.50	3.70	-65.80	-13.00	-52.80
5	895.24	-69.70	-65.80	3.50	-62.30	-13.00	-49.30
6	992.24	-70.00	-64.50	3.40	-61.10	-13.00	-48.10

Remarks:

1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) - Cable Loss (dB).

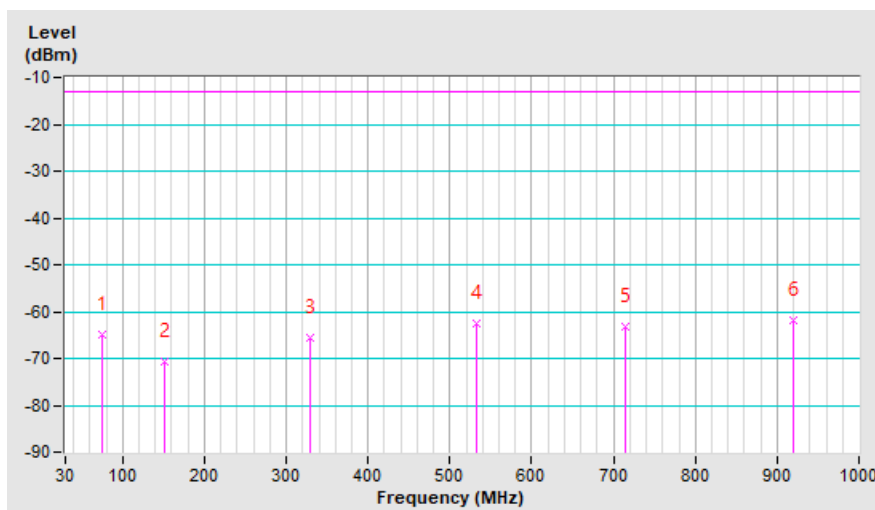


Mode	TX channel 9538 (1907.6MHz)	Frequency Range	Below 1000 MHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	74.62	-59.30	-65.00	0.10	-64.90	-13.00	-51.90
2	152.22	-68.70	-67.80	-2.80	-70.60	-13.00	-57.60
3	328.76	-65.40	-69.80	4.10	-65.70	-13.00	-52.70
4	532.46	-63.60	-66.40	3.90	-62.50	-13.00	-49.50
5	714.82	-69.20	-66.70	3.50	-63.20	-13.00	-50.20
6	920.46	-70.40	-65.60	3.60	-62.00	-13.00	-49.00

Remarks:

1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) - Cable Loss (dB).



Above 1GHz
GSM

Mode	TX channel 512 (1850.2MHz)	Frequency Range	1GHz ~ 20GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	3760.00	-63.30	-54.80	1.30	-53.50	-13.00	-40.50
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	3760.00	-60.40	-52.10	1.30	-50.80	-13.00	-37.80

Remarks:

1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) - Cable Loss (dB).

WCDMA

Mode	TX channel 9538 (1907.6MHz)	Frequency Range	1GHz ~ 20GHz
Environmental Conditions	22deg. C, 66%RH	Input Power	120Vac, 60Hz
Tested By	Han Wu		

Antenna Polarity & Test Distance: Horizontal at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	3815.20	-65.10	-56.80	1.40	-55.40	-13.00	-42.40
Antenna Polarity & Test Distance: Vertical at 3 M							
No.	Freq. (MHz)	Reading (dBm)	S.G Power Value (dBm)	Correction Factor (dB)	EIRP (dBm)	Limit (dBm)	Margin (dB)
1	3815.20	-65.70	-57.50	1.40	-56.10	-13.00	-43.10

Remarks:

1. EIRP (dBm) = S.G Value (dBm) + Correction Factor (dB).
2. Correction Factor (dB) = Substitution Antenna Gain (dB) - Cable Loss (dB).

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:

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Web Site: www.bureauveritas-adt.com

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

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