

FCC TEST REPORT

For
IROOTECH TECHNOLOGY CO.,LTD
T-Box

Model No.: HI1503-DC-H

Prepared For : IROOTECH TECHNOLOGY CO.,LTD
Address : Room 606, Floor 6, Building 5, Eastern Yard 10, Xibeiwang East Road,
Haidian District, Beijing, China
Prepared By : Shenzhen Anbotech Compliance Laboratory Limited
Address : 1/F, Building D, Sogood Science and Technology Park, Sanwei
community, Hangcheng Street, Bao'an District, Shenzhen, Guangdong,
China.518102
Tel: (86) 755-26066440 Fax: (86) 755-26014772
Report Number : SZAWW180302005-02
Date of Test : Mar. 12~ 28, 2018
Date of Report : Apr. 09 , 2018

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TEST REPORT

Applicant : IROOTECH TECHNOLOGY CO.,LTD
Manufacturer : IROOTECH TECHNOLOGY CO.,LTD
Product Name : T-Box
Model No. : HI1503-DC-H
Trade Mark : N.A.
Rating(s) : Input: DC 9~36V, MAX: 0.5A (Built-in battery 3V, 5.8mAh)

Test Standard(s) : FCC PART 2, FCC Part 22(H), FCC Part 24(E),FCC Part 27:2018

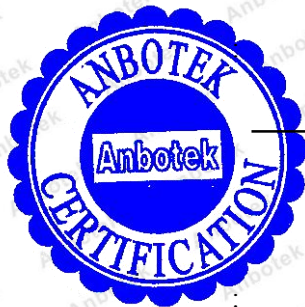
Test Method(s) : ANSI/TIAC603 D: 2010

The device described above is tested by Shenzhen Anbotech Compliance Laboratory Limited to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and Shenzhen Anbotech Compliance Laboratory Limited is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the FCC Part 22/24/27 requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of Shenzhen Anbotech Compliance Laboratory Limited.

Date of Test : Mar. 12~ 28, 2018

Prepared by :



(Tested Engineer / Winkey Wang)

Reviewer :

(Project Manager / Calvin Liu)

Approved & Authorized Signer :

(Manager / Tom Chen)

1. General Information

1.1. Client Information

Applicant	:	IROOTECH TECHNOLOGY CO.,LTD
Address	:	Room 606, Floor 6, Building 5, Eastern Yard 10, Xibeiwang East Road, Haidian District, Beijing, China
Manufacturer	:	IROOTECH TECHNOLOGY CO.,LTD
Address	:	Room 606, Floor 6, Building 5, Eastern Yard 10, Xibeiwang East Road, Haidian District, Beijing, China

1.2. Description of Device (EUT)

Product Name	:	T-Box
Model No.	:	HI1503-DC-H
Trade Mark	:	N.A.
Test Power Supply	:	DC 12V From External lead-acid battery
Product Description	Operation Frequency:	UMTS-FDD Band 5 TX: 826.4 ~ 846.6 MHz; RX: 871.4 ~ 891.6 MHz UMTS-FDD Band 2 TX:1852.4~1907.6 MHz; RX: 1932.4~1987.6 MHz UMTS-FDD Band 4 TX :1712.4~1752.6 MHz; RX: 2112.4~2152.6 MHz
	Modulation Type:	UMTS-FDD: QPSK
	Antenna Type:	External disk antenna
	Antenna Gain(Peak):	UMTS-FDD Band 2 :0.55 dBi UMTS-FDD Band 4 :1.55 dBi UMTS-FDD Band 5 :-0.21 dBi
	Equipment Category:	PCB

Remark: 1) For a more detailed features description, please refer to the manufacturer's specifications or the User's Manual.
2)This report is for WCDMA.

1.3. Auxiliary Equipment Used During Test

N/A	:	N/A
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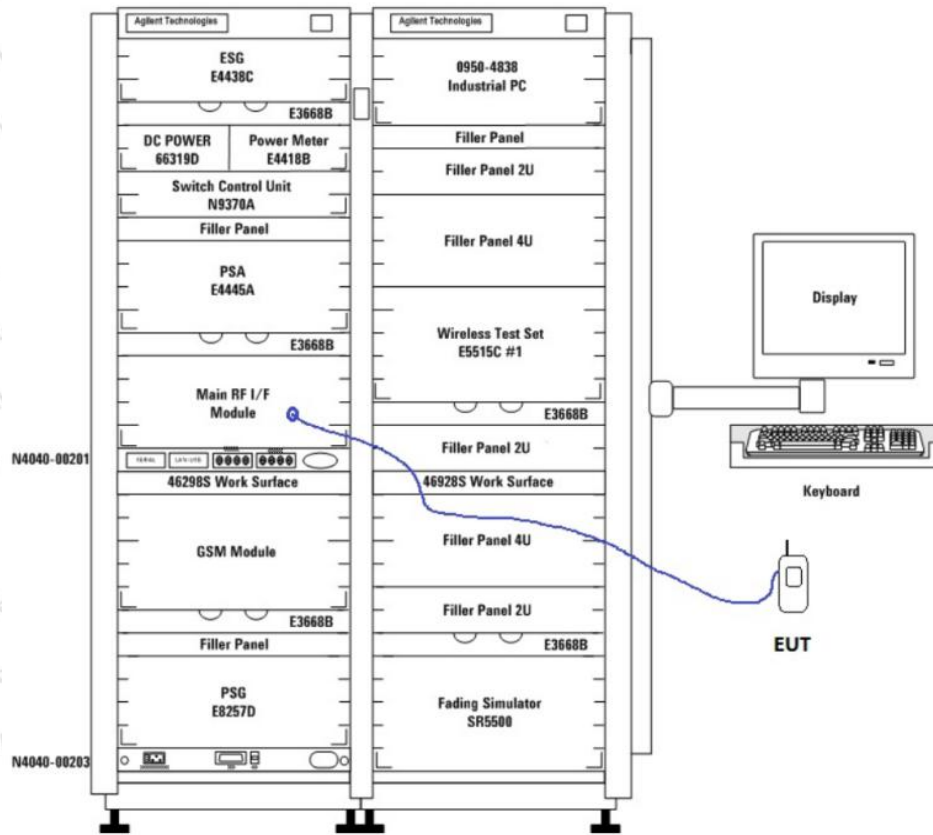
1.4. Description of Test Modes

The following is the description of how the EUT is exercised during testing.

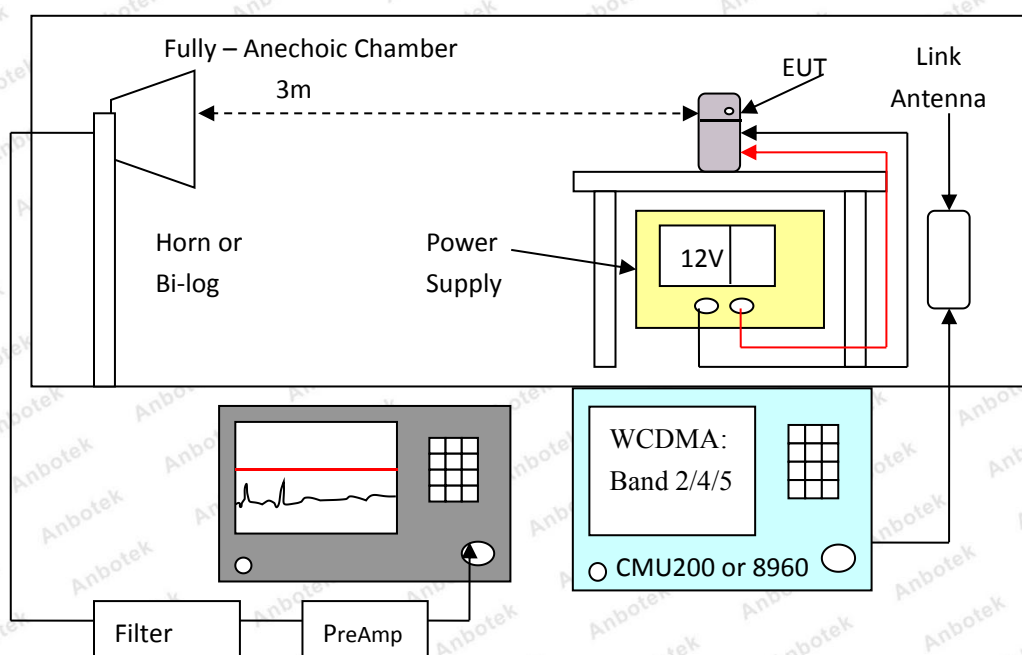
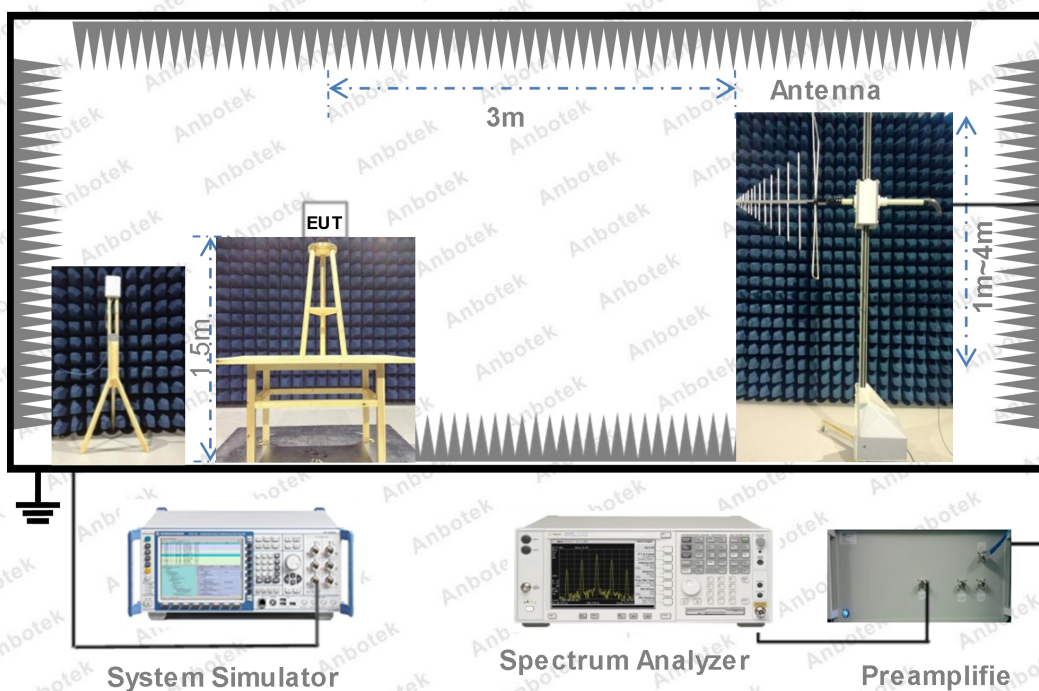
Test	Description Of Operation
Emissions Testing	The EUT was communicating with base station and set to work at maximum output power.
Others Testing	The EUT was communicating with base station and set to work at maximum output power.

1.5. Description Of Test Setup

1.5.1 Conducted Test Setup



1.5.2 Radiated Test Setup



1.6. Test Equipment List

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	Spectrum Analysis	Agilent	E4407B	US39390582	Nov. 17, 2017	1 Year
2.	Preamplifier	SKET Electronic	BK1G18G30 D	KD17503	Nov. 17, 2017	1 Year
3.	EMI Test Receiver	Rohde & Schwarz	ESPI	101604	Nov. 17, 2017	1 Year
4.	Double Ridged Horn Antenna	Instruments corporation	GTH-0118	351600	Nov. 20, 2017	1 Year
5.	Bilog Broadband Antenna	Schwarzbeck	VULB9163	VULB 9163-289	Nov. 20, 2017	1 Year
6.	Pre-amplifier	SONOMA	310N	186860	Nov. 17, 2017	1 Year
7.	EMI Test Software EZ-EMC	SHURPLE	N/A	N/A	N/A	N/A
8.	MXA Spectrum Analysis	Agilent	N9020A	MY51170037	Nov. 18, 2017	1 Year
9.	MXG RF Vector Signal Generator	Agilent	N5182A	MY48180656	Nov. 18, 2017	1 Year
10.	DC Power Supply	LW	TPR-6410D	349315	Nov. 01, 2017	1 Year
11.	Constant Temperature Humidity Chamber	Sertep	ZJ-HWHS8 0B	ZJ-17042804	Nov. 01, 2017	1 Year
12.	Universal Radio Communication Tester	Rohde & Schwarz	CMU 200	117888	Nov. 17, 2017	1 Year
13.	Wideband Radio Communication Tester	Rohde & Schwarz	CMW 500	1201.0002K50-1 04209-JC	Nov. 18, 2017	1 Year
14.	High-Pass Filter	CDKMV	ZHPF-BM1 100 -4000-0730	B2015094550	Nov. 18, 2017	1 Year
15.	High-Pass Filter	CDKMV	ZHPF-M3.5 -18G-3834	1307006523	Nov. 17, 2017	1 Year
16.	4 Ch. Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	TW54063507	Nov. 17, 2017	1 Year
17.	4 Ch. Simultaneous Sampling 14 Bits 2 MS/s	Agilent	U2531A	TW54063513	Nov. 17, 2017	1 Year

1.7. Measurement Uncertainty

Maximum measurement uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	$\pm 5 \%$
RF output power, conducted	$\pm 1,5 \text{ dB}$
Power Spectral Density, conducted	$\pm 3 \text{ dB}$
Unwanted Emissions, conducted	$\pm 3 \text{ dB}$
All emissions, radiated	$\pm 6 \text{ dB}$
Temperature	$\pm 1 \text{ }^{\circ}\text{C}$
Humidity	$\pm 5 \%$
DC and low frequency voltages	$\pm 3 \%$
Time	$\pm 5 \%$
Duty Cycle	$\pm 5 \%$

1.8. Description of Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

FCC-Registration No.: 184111

Shenzhen Anbotech Compliance Laboratory Limited, EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No. 184111, July 31, 2017.

ISED-Registration No.: 8058A-1

Shenzhen Anbotech Compliance Laboratory Limited, EMC Laboratory has been registered and fully described in a report filed with the (ISED) Innovation, Science and Economic Development Canada. The acceptance letter from the ISED is maintained in our files. Registration 8058A-1, June 13, 2016.

Test Location

All Emissions tests were performed at
Shenzhen Anbotech Compliance Laboratory Limited,
1/F, Building D, Sogood Science and Technology Park, Sanwei community, Hangcheng Street, Bao'an District,
Shenzhen, Guangdong, China.518102

2. Summary of Test

2.1. Summary of test result

FCC Rules	Description of Test	Result
§2.1046; § 22.913(a); § 24.232(c); § 27.50(c.10); § 27.50(d.4)	RF Output Power	Compliance
§ 24.232 (d); § 27.50(d)	Peak-Average Ratio	Compliance
§ 2.1047	Modulation Characteristics	Compliance
§ 2.1049; § 22.905; § 22.917; § 24.238; § 27.53(a.5)	99% & -26 dB Occupied Bandwidth	Compliance
§ 2.1051; § 22.917(a); § 24.238(a); § 27.53(h)	Spurious Emissions at Antenna Terminal	Compliance
§ 2.1053; § 22.917(a); § 24.238(a); § 27.53(h)	Field Strength of Spurious Radiation	Compliance
§ 22.917(a); § 24.238(a); § 27.53(h)	Out of band emission, Band Edge	Compliance
§ 2.1055; § 22.355; § 24.235; § 27.5(h); § 27.54	Frequency stability vs. temperature Frequency stability vs. voltage	Compliance

Note: Testing was performed by configuring EUT to maximum output power status, the declared output power class for different

2.2. Test mode

During all testing, EUT is in link mode with base station emulator at maximum power level in each test mode and channel as below:

Temperature range	21-25℃
Humidity range	40-75%
Pressure range	86-106kPa

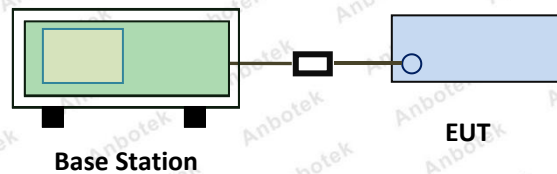
Mode	Channel	Frequency(MHz)
UMTS BAND V	4132	826.4
	4182	836.4
	4233	846.6
UMTS BAND II	9262	1852.4
	9400	1880.0
	9538	1907.6
UMTS BAND IV	1313	1712.4
	1413	1732.6
	1512	1752.6

3. RF Output Power Test

3.1. Test Standard and Limit

Spec	Item	Requirement
§22.913 (a)	a)	ERP:38.5dBm
§24.232 (c)	b)	EIRP:33dBm
§ 27.50 (c)	c)	EIRP:30dBm

3.2. Test Setup



3.3. Test Procedure

For Conducted Power:

The transmitter output port was connected to base station.

Set EUT at maximum power through base station.

Select lowest, middle, and highest channels for each band and different test mode.

For ERP/EIRP:

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Spurious emissions in dB = 10 log (TX power in Watts/0.001) – the absolute level

Spurious attenuation limit in dB = 43 + 10 Log10 (power out in Watts).

3.4. Test Data

Please to see the following pages

Conducted Power:

Band	Channel	Power(dBm)	Limit(dBm)	Verdict
Band II	9262	23.46	33	PASS
Band II	9400	23.68	33	PASS
Band II	9538	23.79	33	PASS
Band IV	1312	23.48	30	PASS
Band IV	1413	23.37	30	PASS
Band IV	1513	23.31	30	PASS
Band V	4132	23.06	38.5	PASS
Band V	4182	22.88	38.5	PASS
Band V	4233	23.00	38.5	PASS

Band	Channel	SubTest	Power(dBm)	Limit(dBm)	Verdict
Band II	9262	HSDPA_Sub0	22.50	33	PASS
Band II	9262	HSDPA_Sub1	21.85	33	PASS
Band II	9262	HSDPA_Sub2	22.01	33	PASS
Band II	9262	HSDPA_Sub3	21.74	33	PASS
Band II	9400	HSDPA_Sub0	22.56	33	PASS
Band II	9400	HSDPA_Sub1	21.92	33	PASS
Band II	9400	HSDPA_Sub2	21.89	33	PASS
Band II	9400	HSDPA_Sub3	21.84	33	PASS
Band II	9538	HSDPA_Sub0	22.58	33	PASS
Band II	9538	HSDPA_Sub1	21.84	33	PASS
Band II	9538	HSDPA_Sub2	21.84	33	PASS
Band II	9538	HSDPA_Sub3	21.82	33	PASS
Band IV	1312	HSDPA_Sub0	23.41	30	PASS
Band IV	1312	HSDPA_Sub1	22.69	30	PASS
Band IV	1312	HSDPA_Sub2	22.69	30	PASS
Band IV	1312	HSDPA_Sub3	22.76	30	PASS
Band IV	1413	HSDPA_Sub0	23.33	30	PASS
Band IV	1413	HSDPA_Sub1	22.58	30	PASS
Band IV	1413	HSDPA_Sub2	22.67	30	PASS
Band IV	1413	HSDPA_Sub3	22.51	30	PASS
Band IV	1513	HSDPA_Sub0	23.14	30	PASS
Band IV	1513	HSDPA_Sub1	22.48	30	PASS
Band IV	1513	HSDPA_Sub2	22.46	30	PASS
Band IV	1513	HSDPA_Sub3	22.37	30	PASS
Band V	4132	HSDPA_Sub0	23.03	38.5	PASS

Band V	4132	HSDPA_Sub1	22.98	38.5	PASS
Band V	4132	HSDPA_Sub2	23.01	38.5	PASS
Band V	4132	HSDPA_Sub3	22.91	38.5	PASS
Band V	4182	HSDPA_Sub0	22.78	38.5	PASS
Band V	4182	HSDPA_Sub1	22.81	38.5	PASS
Band V	4182	HSDPA_Sub2	22.89	38.5	PASS
Band V	4182	HSDPA_Sub3	22.86	38.5	PASS
Band V	4233	HSDPA_Sub0	23.01	38.5	PASS
Band V	4233	HSDPA_Sub1	22.97	38.5	PASS
Band V	4233	HSDPA_Sub2	22.84	38.5	PASS
Band V	4233	HSDPA_Sub3	23.02	38.5	PASS

Band	Channel	SubTest	Power(dBm)	Limit(dBm)	Verdict
Band II	9262	HSUPA_Sub1	19.04	33	PASS
Band II	9262	HSUPA_Sub2	19.38	33	PASS
Band II	9262	HSUPA_Sub3	20.04	33	PASS
Band II	9262	HSUPA_Sub4	18.74	33	PASS
Band II	9262	HSUPA_Sub5	18.37	33	PASS
Band II	9400	HSUPA_Sub1	19.23	33	PASS
Band II	9400	HSUPA_Sub2	19.53	33	PASS
Band II	9400	HSUPA_Sub3	20.25	33	PASS
Band II	9400	HSUPA_Sub4	18.98	33	PASS
Band II	9400	HSUPA_Sub5	18.57	33	PASS
Band II	9538	HSUPA_Sub1	19.38	33	PASS
Band II	9538	HSUPA_Sub2	19.77	33	PASS
Band II	9538	HSUPA_Sub3	20.46	33	PASS
Band II	9538	HSUPA_Sub4	19.27	33	PASS
Band II	9538	HSUPA_Sub5	18.67	33	PASS
Band IV	1312	HSUPA_Sub1	21.25	30	PASS
Band IV	1312	HSUPA_Sub2	21.44	30	PASS
Band IV	1312	HSUPA_Sub3	22.26	30	PASS
Band IV	1312	HSUPA_Sub4	20.88	30	PASS
Band IV	1312	HSUPA_Sub5	20.37	30	PASS
Band IV	1413	HSUPA_Sub1	21.08	30	PASS
Band IV	1413	HSUPA_Sub2	21.21	30	PASS
Band IV	1413	HSUPA_Sub3	22.09	30	PASS
Band IV	1413	HSUPA_Sub4	20.76	30	PASS

Band IV	1413	HSUPA_Sub5	20.24	30	PASS
Band IV	1513	HSUPA_Sub1	20.87	30	PASS
Band IV	1513	HSUPA_Sub2	21.05	30	PASS
Band IV	1513	HSUPA_Sub3	21.88	30	PASS
Band IV	1513	HSUPA_Sub4	20.34	30	PASS
Band IV	1513	HSUPA_Sub5	20.08	30	PASS
Band V	4132	HSUPA_Sub1	22.07	38.5	PASS
Band V	4132	HSUPA_Sub2	22.03	38.5	PASS
Band V	4132	HSUPA_Sub3	22.12	38.5	PASS
Band V	4132	HSUPA_Sub4	21.47	38.5	PASS
Band V	4132	HSUPA_Sub5	20.95	38.5	PASS
Band V	4182	HSUPA_Sub1	21.96	38.5	PASS
Band V	4182	HSUPA_Sub2	21.95	38.5	PASS
Band V	4182	HSUPA_Sub3	21.97	38.5	PASS
Band V	4182	HSUPA_Sub4	21.39	38.5	PASS
Band V	4182	HSUPA_Sub5	21.14	38.5	PASS
Band V	4233	HSUPA_Sub1	22.09	38.5	PASS
Band V	4233	HSUPA_Sub2	22.08	38.5	PASS
Band V	4233	HSUPA_Sub3	22.14	38.5	PASS
Band V	4233	HSUPA_Sub4	21.47	38.5	PASS
Band V	4233	HSUPA_Sub5	21.20	38.5	PASS

Radiated Output power

EIRP for UMTS-FDD Band II (Part 24E)

Frequency (MHz)	Substituted level (dBm)	Antenna Polarization	Antenna Gain correction (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)
1852.4	10.61	V	7.88	0.85	17.64	33
1852.4	11.36	H	7.88	0.85	18.39	33
1880	11.99	V	7.88	0.85	19.02	33
1880	11.56	H	7.88	0.85	18.59	33
1907.6	10.85	V	7.86	0.85	17.86	33
1907.6	10.94	H	7.86	0.85	17.95	33

ERP & EIRP

ERP for UMTS-FDD Band V (Part 22H)

Frequency (MHz)	Substituted level (dBm)	Antenna Polarization	Antenna Gain correction (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)
826.4	11.78	V	6.8	0.53	18.05	38.45
826.4	11.50	H	6.8	0.53	17.77	38.45
836.6	11.05	V	6.8	0.53	17.32	38.45
836.6	11.85	H	6.8	0.53	18.12	38.45
846.6	10.89	V	6.9	0.53	17.26	38.45
846.6	10.85	H	6.9	0.53	17.22	38.45

EIRP for UMTS-FDD Band IV (Part 27)

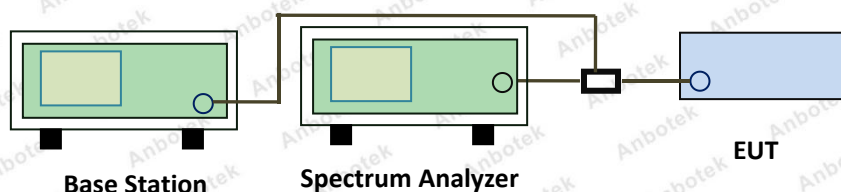
Frequency (MHz)	Substituted level (dBm)	Antenna Polarization	Antenna Gain correction (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)
1712.4	10.03	V	7.76	0.82	16.97	30
1712.4	11.57	H	7.76	0.82	18.51	30
1740	10.39	V	7.76	0.82	17.33	30
1740	11.47	H	7.76	0.82	18.41	30
1752.6	10.77	V	7.74	0.82	17.69	30
1752.6	10.61	H	7.74	0.82	17.55	30

4. Peak-Average Ratio

4.1. Test Standard and Limit

In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

4.2. Test Setup



4.3. Test Procedure

According with KDB 971168

1. The signal analyzer's CCDF measurement profile is enabled
2. Frequency = carrier center frequency
3. Measurement BW > Emission bandwidth of signal
4. The signal analyzer was set to collect one million samples to generate the CCDF curve
5. The measurement interval was set depending on the type of signal analyzed. For continuous signals (>98% duty cycle), the measurement interval was set to 1ms. For burst transmissions, the spectrum analyzer is set to use an internal "RF Burst" trigger that is synced with an incoming pulse and the measurement interval is set to less than the duration of the "on time" of one burst to ensure that energy is only captured during a time in which the transmitter is operating at maximum power

4.4. Test Data

Band	Channel	Peak-to-Average Ratio(dB)	Limit(dBm)	Verdict
Band II	9262	2.71	13	PASS
Band II	9400	2.54	13	PASS
Band II	9538	2.83	13	PASS
Band IV	1312	2.89	13	PASS
Band IV	1413	2.75	13	PASS
Band IV	1513	2.94	13	PASS
Band V	4132	2.48	13	PASS
Band V	4182	2.38	13	PASS
Band V	4233	2.72	13	PASS

Test slot

Band II_9262



Band IV_1312



Band II_9400



Band IV_1413



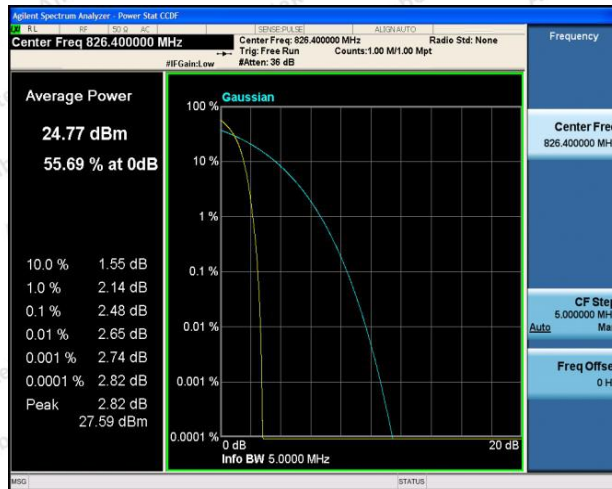
Band II_9538



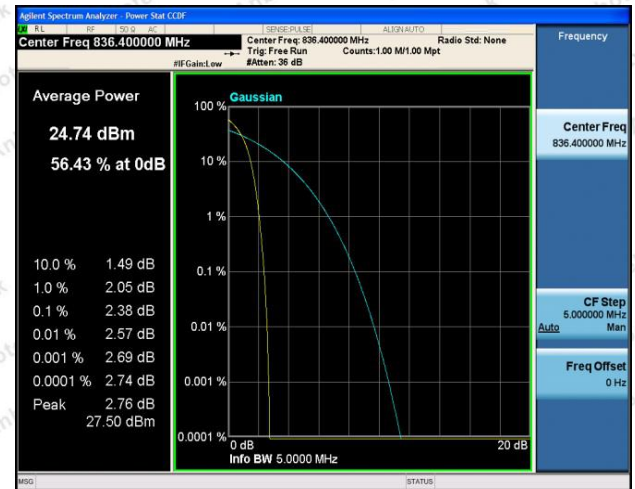
Band IV_1513



Band V_4132



Band V_4182



Band V_4233



5. Modulation Characteristic

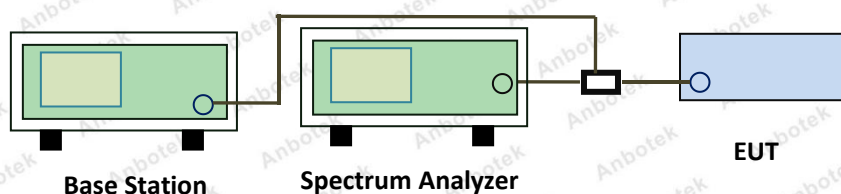
According to FCC § 2.1047(d), Part 22H, 24E& Part 27 there is no specific requirement for digital modulation, therefore modulation characteristic is not presented.

6. Occupied Bandwidth

6.1. Test Standard and Limit

Spec	Item	Requirement
§2.1049, §22.917, §22.905 §24.238 §27.53(a)	a)	99% Occupied Bandwidth(kHz)
	b)	26 dB Bandwidth(kHz)

6.2. Test Setup



6.3. Test Procedure

The EUT was connected to Spectrum Analyzer and Base Station via power divider.

The 99% and 26 dB occupied bandwidth (BW) of the middle channel for the highest RF powers.

6.4. Test Data

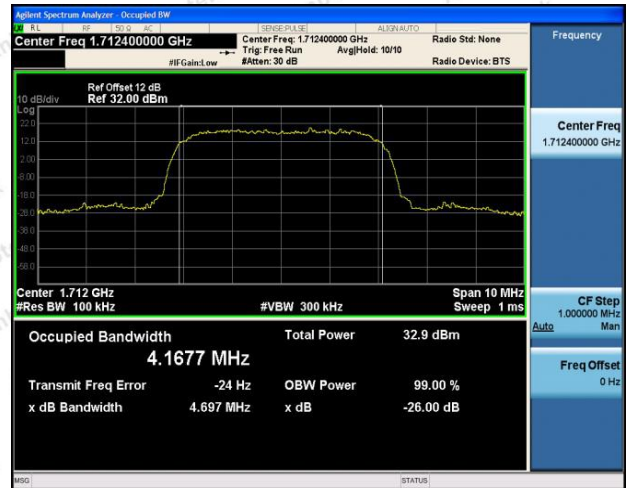
Band	Channel	Occupied Bandwidth (kHz)	26dB Bandwidth (kHz)	Limit(kHz)	Verdict
Band II	9262	4158.2	4730	---	PASS
Band II	9400	4179.5	4738	---	PASS
Band II	9538	4157.7	4710	---	PASS
Band IV	1312	4167.7	4697	---	PASS
Band IV	1413	4170.0	4699	---	PASS
Band IV	1513	4159.8	4712	---	PASS
Band V	4132	4177.8	4746	---	PASS
Band V	4182	4190.9	4746	---	PASS
Band V	4233	4175.3	4720	---	PASS

Test slot

Band II_9262



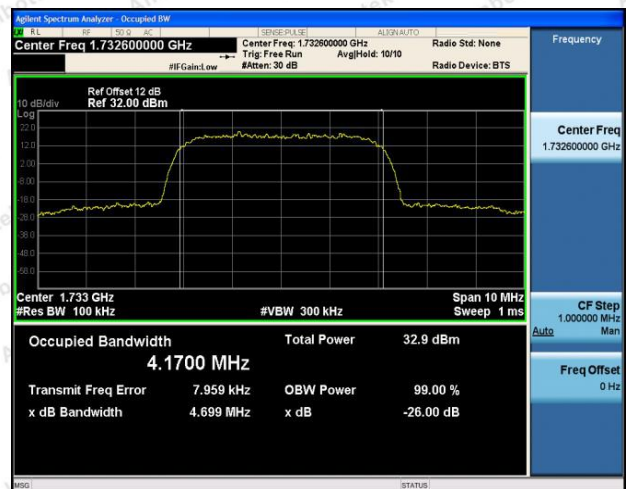
Band IV_1312



Band II_9400



Band IV_1413



Band II_9538



Band IV_1513



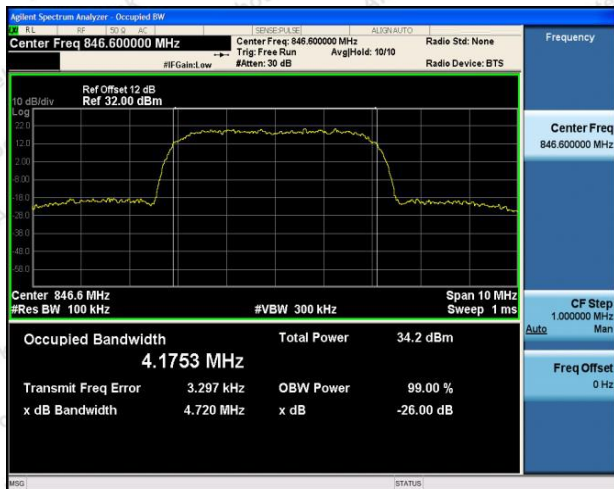
Band V_4132



Band V_4182



Band V_4233

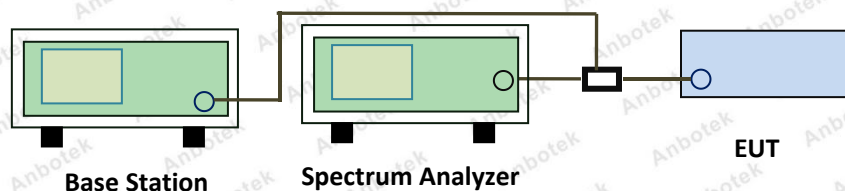


7. Spurious Emissions at Antenna Terminals

7.1. Test Standard and Limit

The mean power of emissions must be attenuated below the mean power of the unmodulated carrier (P) on any frequency outside the frequency band by at least $(43 + 10 \log P)$ dB, in this case, -13dBm.

7.2. Test Setup



7.3. Test Procedure

The EUT was connected to Spectrum Analyzer and Base Station via power divider.

The Band Edges of low and high channels for the highest RF powers were measured.

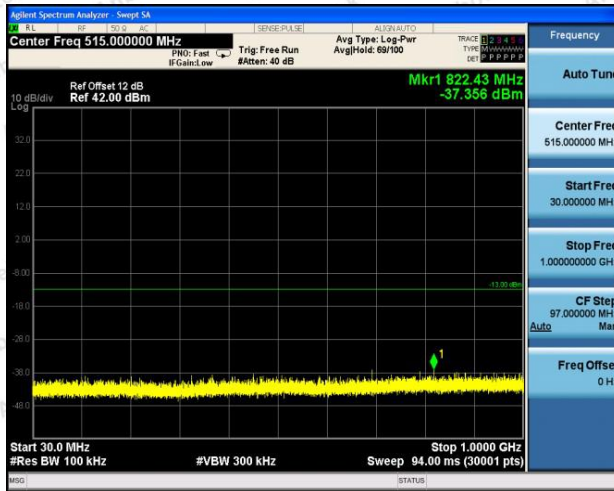
Setting RBW as roughly BW/100.

7.4. Test Data

Band	Channel	Frequency Rang(Mhz)	Value(dBm)	Limit(dBm)	Verdict
Band II	9262	30~1000	-37.36	-13	PASS
Band II	9262	1000~20000	-18.04	-13	PASS
Band II	9400	30~1000	-37.62	-13	PASS
Band II	9400	1000~20000	-19.49	-13	PASS
Band II	9538	30~1000	-37.52	-13	PASS
Band II	9538	1000~20000	-19.13	-13	PASS
Band IV	1312	30~1000	-37.91	-13	PASS
Band IV	1312	1000~20000	-19.60	-13	PASS
Band IV	1413	30~1000	-38.29	-13	PASS
Band IV	1413	1000~20000	-18.79	-13	PASS
Band IV	1513	30~1000	-38.20	-13	PASS
Band IV	1513	1000~20000	-19.13	-13	PASS
Band V	4132	30~1000	-37.87	-13	PASS
Band V	4132	1000~20000	-19.41	-13	PASS
Band V	4182	30~1000	-37.83	-13	PASS
Band V	4182	1000~20000	-18.94	-13	PASS
Band V	4233	30~1000	-37.04	-13	PASS
Band V	4233	1000~20000	-19.43	-13	PASS

Test slot

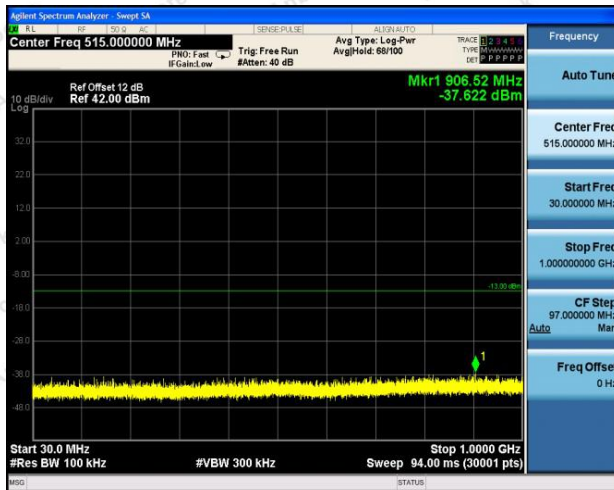
Band II_9262-30M~1000M



Band II_9262-1000M~20000M



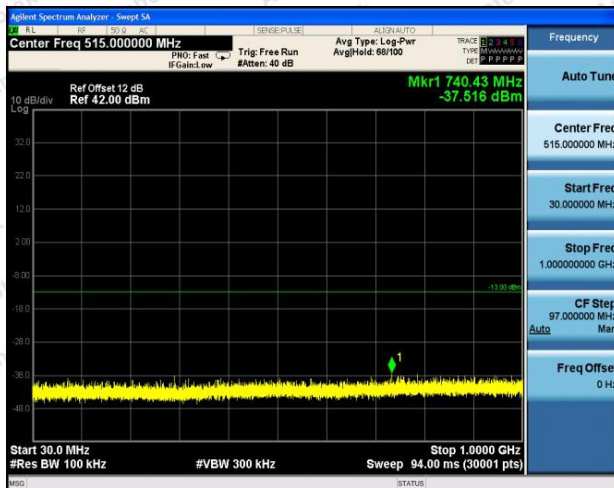
Band II_9400-30M~1000M



Band II_9400-1000M~20000M



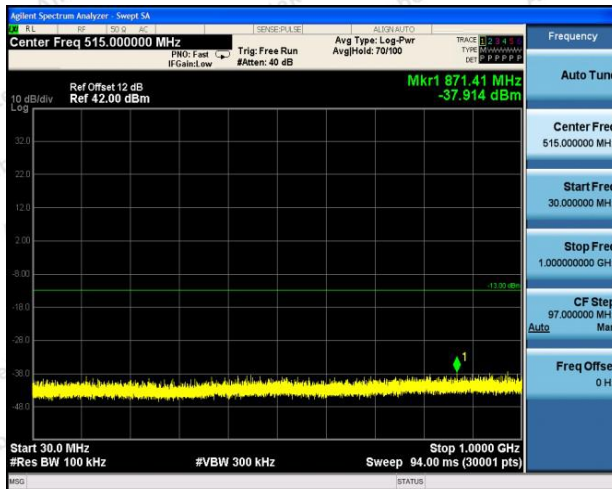
Band II_9538-30M~1000M



Band II_9538-1000M~20000M



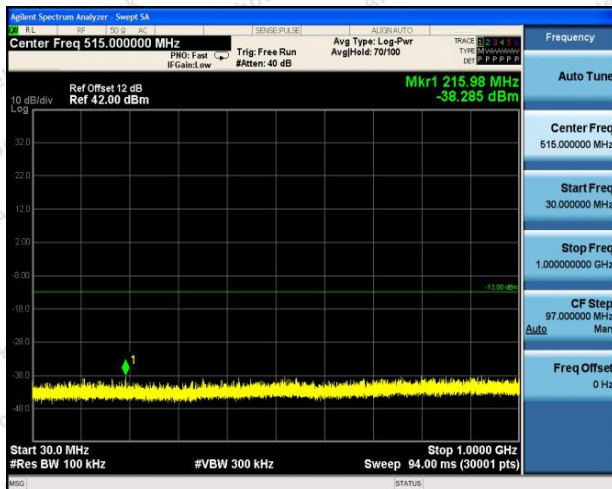
Band IV_1312-30M~1000M



Band IV_1312-1000M~20000M



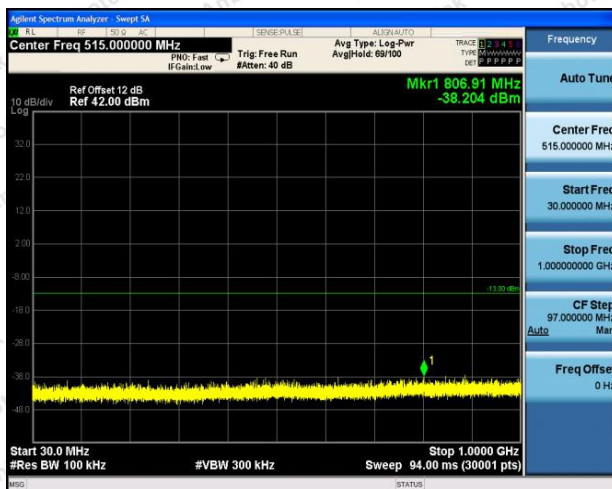
Band IV_1413-30M~1000M



Band IV_1413-1000M~20000M



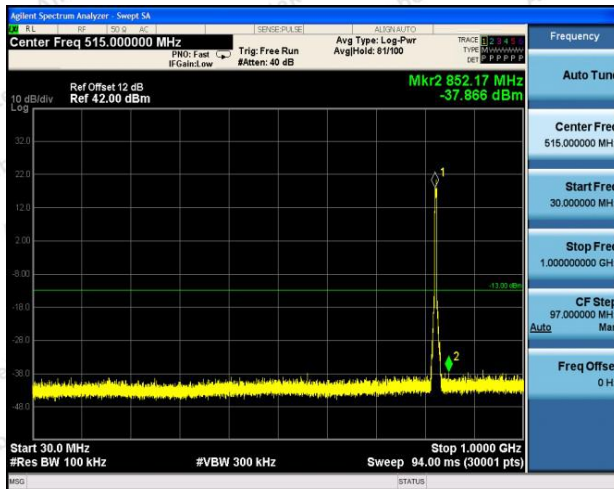
Band IV_1513-30M~1000M



Band IV_1513-1000M~20000M



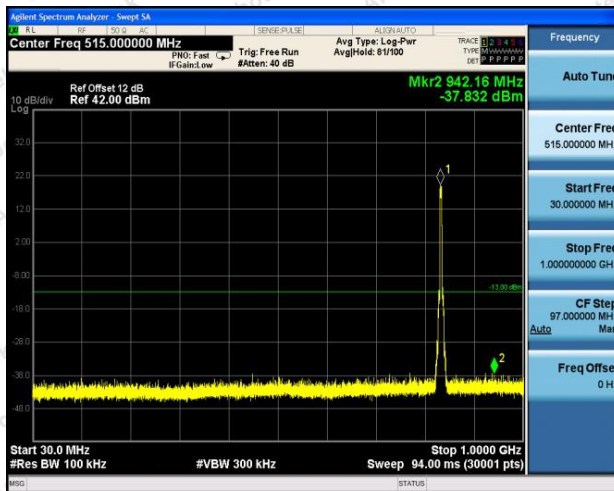
Band V_4132-30M~1000M



Band V_4132-1000M~20000M



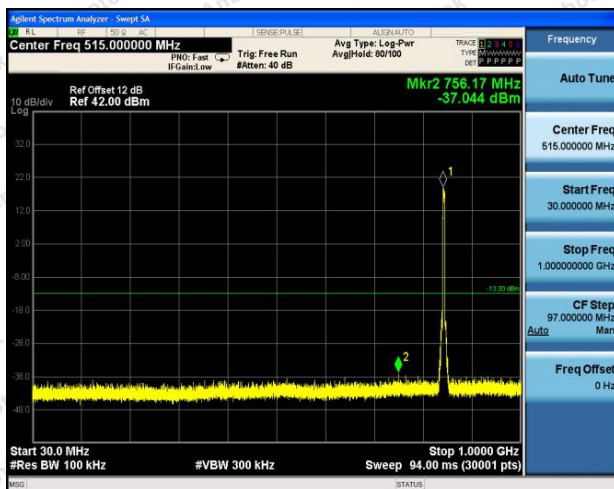
Band V_4182-30M~1000M



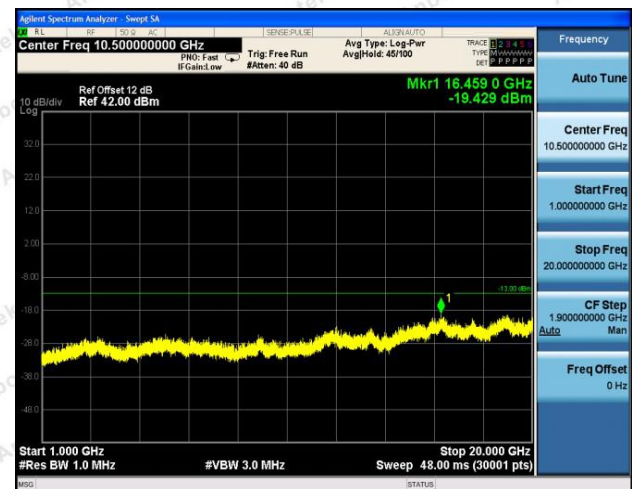
Band V_4182-1000M~20000M



Band V_4233-30M~1000M



Band V_4233-1000M~20000M

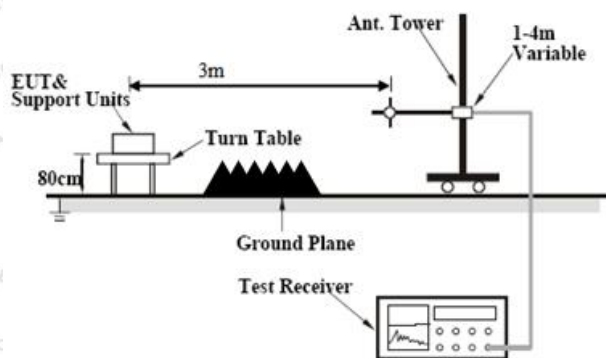


8. Spurious Radiated Emissions

8.1. Test Standard and Limit

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB. The spectrum is scanned from 30 MHz up to a frequency including its 10th harmonic.

8.2. Test Setup



8.3. Test Procedure

1. The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load which was also placed on the turntable.
2. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.
3. Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

Sample Calculation:

EUT Field Strength = Raw Amplitude (dB μ V/m) – Amplifier Gain (dB) + Antenna Factor (dB) + Cable Loss (dB) + Filter Attenuation (dB, if used)

8.4. Test Data

UMTS-FDD Band V (Part 22H)

Low channel

Frequency (MHz)	Substituted level (dBm)	Polarity (H/V)	Antenna Gain Correction (dB)	Cable Loss (dB)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)
1652.8	-46.75	V	7.95	0.78	-39.58	-13	-26.58
1652.8	-46.17	H	7.95	0.78	-39	-13	-26
268.5	-54.78	V	5.40	0.24	-49.62	-13	-36.62
689.2	-51.48	H	7.00	0.39	-44.87	-13	-31.87

Middle channel

Frequency (MHz)	Substituted level (dBm)	Polarity (H/V)	Antenna Gain Correction (dB)	Cable Loss (dB)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)
1670	-48.72	V	7.95	0.78	-41.55	-13	-28.55
1670	-47.26	H	7.95	0.78	-40.09	-13	-27.09
269.4	-54.57	V	5.40	0.24	-49.41	-13	-36.41
689.6	-51.67	H	7.00	0.39	-45.06	-13	-32.06

Frequency (MHz)	Substituted level (dBm)	Polarity (H/V)	Antenna Gain Correction (dB)	Cable Loss (dB)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)
1693.2	-48.73	V	7.95	0.78	-41.56	-13	-28.56
1693.2	-47.38	H	7.95	0.78	-40.21	-13	-27.21
267.2	-54.83	V	5.40	0.24	-49.67	-13	-36.67
684.4	-51.72	H	7.00	0.39	-45.11	-13	-32.11

UMTS-FDD Band II (Part 24E)

Low channel

Frequency (MHz)	Substituted level (dBm)	Polarity (H/V)	Antenna Gain Correction (dB)	Cable Loss (dB)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)
3704.8	-48.55	V	10.25	2.73	-41.03	-13	-28.03
3704.8	-50.02	H	10.25	2.73	-42.5	-13	-29.50
269.5	-54.19	V	5.40	0.24	-49.03	-13	-36.03
690.2	-51.62	H	7.00	0.39	-45.01	-13	-32.01

Middle channel

Frequency (MHz)	Substituted level (dBm)	Polarity (H/V)	Antenna Gain Correction (dB)	Cable Loss (dB)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)
3760	-48.66	V	10.25	2.73	-41.14	-13	-28.14
3760	-50.31	H	10.25	2.73	-42.79	-13	-29.79
270.6	-55.06	V	5.40	0.24	-49.9	-13	-36.90
690.3	-51.27	H	7.00	0.39	-44.66	-13	-31.66

High channel

Frequency (MHz)	Substituted level (dBm)	Polarity (H/V)	Antenna Gain Correction (dB)	Cable Loss (dB)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)
3815.2	-48.42	V	10.36	2.73	-40.79	-13	-27.79
3815.2	-49.72	H	10.36	2.73	-42.09	-13	-29.09
270.7	-55.64	V	5.40	0.24	-50.48	-13	-37.48
689.1	-49.21	H	7.00	0.39	-42.60	-13	-29.60

UMTS-FDD Band IV (Part 27)

Frequency (MHz)	Substituted level (dBm)	Polarity (H/V)	Antenna Gain Correction (dB)	Cable Loss (dB)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)
3424.8	-45.26	V	10.07	2.52	-37.71	-13	-24.71
3424.8	-44.81	H	10.07	2.52	-37.26	-13	-24.26
291.3	-54.28	V	6.00	0.25	-48.53	-13	-35.53
652.3	-51.46	H	6.70	0.39	-45.15	-13	-32.15

Middle channel

Frequency (MHz)	Substituted level (dBm)	Polarity (H/V)	Antenna Gain Correction (dB)	Cable Loss (dB)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)
3480	-48.59	V	10.09	2.52	-41.02	-13	-28.02
3480	-48.61	H	10.09	2.52	-41.04	-13	-28.04
292.6	-53.69	V	6.00	0.25	-47.94	-13	-34.94
653.4	-52.49	H	6.70	0.39	-46.18	-13	-33.18

High channel

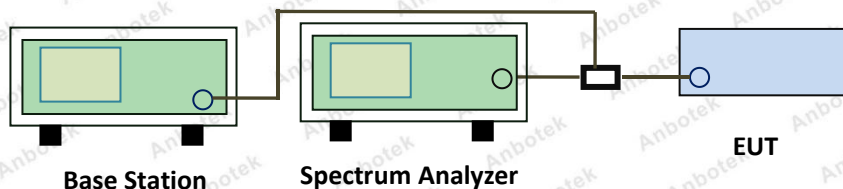
Frequency (MHz)	Substituted level (dBm)	Polarity (H/V)	Antenna Gain Correction (dB)	Cable Loss (dB)	Corrected Reading (dBm)	Limit (dBm)	Margin (dB)
3505.2	-45.17	V	10.09	2.52	-37.6	-13	-24.6
3505.2	-46.82	H	10.09	2.52	-39.25	-13	-26.25
295.1	-53.67	V	6.00	0.25	-47.92	-13	-34.92
654.7	-51.73	H	6.70	0.39	-45.42	-13	-32.42

9. Band Edge Compliance

9.1. Test Standard and Limit

The power of any emission outside of the authorized operating frequency ranges must be lower than the transmitter power (P) by a factor of at least $43 + 10 \log (P)$ dB.

9.2. Test Setup



9.3. Test Procedure

1. The EUT was connected to Spectrum Analyzer and Base Station via power divider.
2. The band edges of low and high channels for the highest RF powers were measured.

9.4. Test Data

UMTS-FDD Band V (Part 22H)

Frequency (MHz)	Emission (dBm)	Limit (dBm)
824	-15.503	-13
849	-13.247	-13

UMTS-FDD Band II (Part 24E)

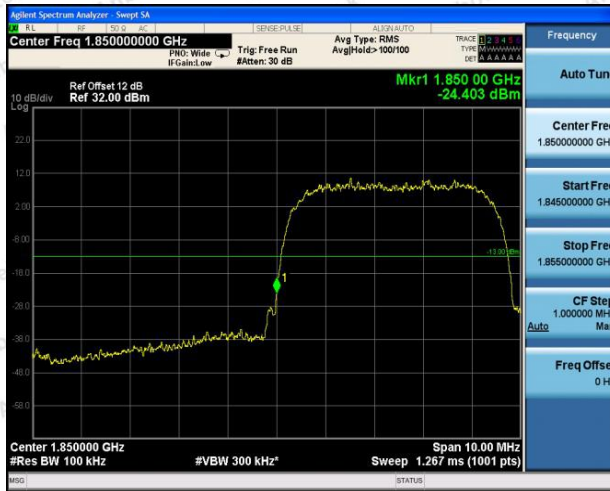
Frequency (MHz)	Emission (dBm)	Limit (dBm)
1850	-24.403	-13
1910	-16.604	-13

UMTS-FDD Band IV (Part 27)

Frequency (MHz)	Emission (dBm)	Limit (dBm)
1710	-15.873	-13
1755	-14.674	-13

Test slot

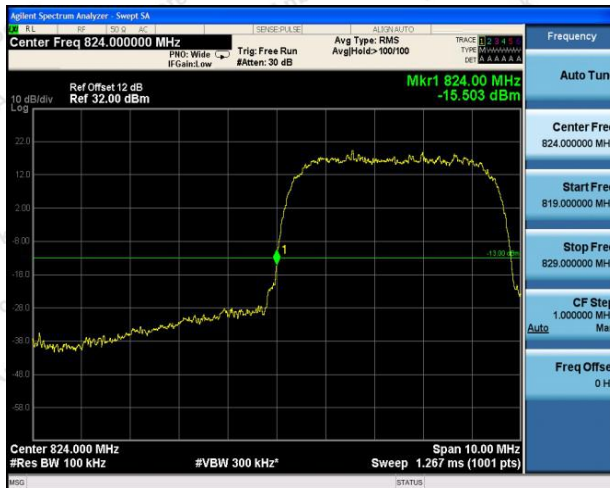
Band II_9262



Band II_9538



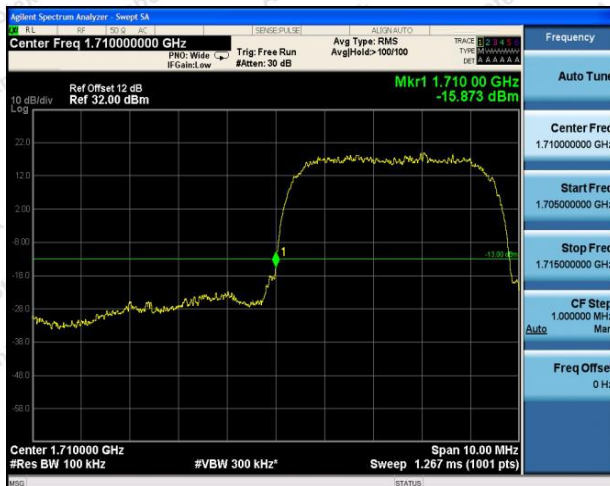
Band V_4132



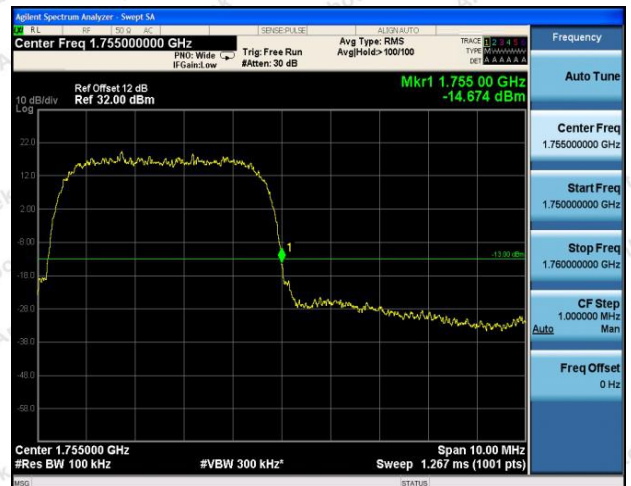
Band V_4233



Band IV_1312



Band IV_1513



10. Frequency Stability

10.1. Test Standard and Limit

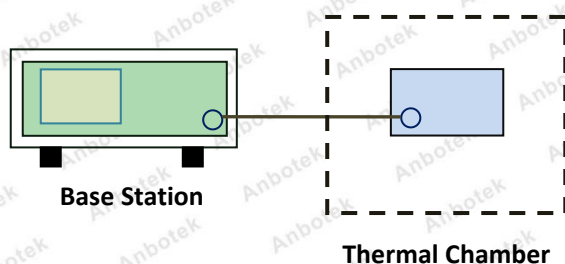
According to §22.355, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table below:

Frequency Tolerance for Transmitters in the Public Mobile Services

Frequency Range (MHz)	Base, fixed (ppm)	Mobile ≤ 3 watts (ppm)	Mobile ≤ 3 watts (ppm)
25 to 50	20.0	20.0	50.0
50 to 450	5.0	5.0	50.0
450 to 512	2.5	5.0	5.0
821 to 896	1.5	2.5	2.5
928 to 929.	5.0	N/A	N/A
929 to 960.	1.5	N/A	N/A
2110 to 2220	10.0	N/A	N/A

According to §24.235, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized frequency block.

10.2. Test Setup



10.3. Test Procedure

A communication link was established between EUT and base station. The frequency error was monitored and measured by base station under variation of ambient temperature and variation of primary supply voltage.

Limit: The frequency stability of the transmitter shall be maintained within $\pm 0.00025\%$ (± 2.5 ppm) of the center frequency.

10.4. Test Data

Voltage							
Band	Channel	Voltage (Vdc)	Temperature (°C)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Verdict
Band II	9262	VL	NT	4.55	0.002455	2.5	PASS
Band II	9262	VN	NT	0.14	0.000074	2.5	PASS
Band II	9262	VH	NT	1.88	0.001013	2.5	PASS
Band II	9400	VL	NT	4.24	0.002256	2.5	PASS
Band II	9400	VN	NT	-1.31	-0.000698	2.5	PASS
Band II	9400	VH	NT	2.72	0.001445	2.5	PASS
Band II	9538	VL	NT	1.92	0.001008	2.5	PASS
Band II	9538	VN	NT	0.79	0.000416	2.5	PASS
Band II	9538	VH	NT	3.14	0.001648	2.5	PASS
Band IV	1312	VL	NT	1.91	0.001114	2.5	PASS
Band IV	1312	VN	NT	4.15	0.002424	2.5	PASS
Band IV	1312	VH	NT	-1.24	-0.000722	2.5	PASS
Band IV	1413	VL	NT	4.09	0.002360	2.5	PASS
Band IV	1413	VN	NT	-0.06	-0.000035	2.5	PASS
Band IV	1413	VH	NT	-0.17	-0.000097	2.5	PASS
Band IV	1513	VL	NT	7.60	0.004336	2.5	PASS
Band IV	1513	VN	NT	2.76	0.001576	2.5	PASS
Band IV	1513	VH	NT	4.62	0.002638	2.5	PASS
Band V	4132	VL	NT	-4.62	-0.005595	2.5	PASS
Band V	4132	VN	NT	-3.60	-0.004358	2.5	PASS
Band V	4132	VH	NT	-4.99	-0.006038	2.5	PASS
Band V	4182	VL	NT	-2.79	-0.003339	2.5	PASS
Band V	4182	VN	NT	-3.42	-0.004087	2.5	PASS
Band V	4182	VH	NT	-5.66	-0.006768	2.5	PASS
Band V	4233	VL	NT	-3.54	-0.004181	2.5	PASS
Band V	4233	VN	NT	-3.57	-0.004218	2.5	PASS
Band V	4233	VH	NT	-5.36	-0.006326	2.5	PASS

Temperature							
Band	Channel	Voltage (Vdc)	Temperature (°C)	Deviation (Hz)	Deviation (ppm)	Limit (ppm)	Verdict
Band II	9262	NV	-30	2.58	0.001392	2.5	PASS
Band II	9262	NV	-20	-0.64	-0.000346	2.5	PASS
Band II	9262	NV	-10	8.18	0.004415	2.5	PASS
Band II	9262	NV	0	4.99	0.002694	2.5	PASS
Band II	9262	NV	10	0.64	0.000346	2.5	PASS
Band II	9262	NV	20	7.92	0.004275	2.5	PASS
Band II	9262	NV	30	0.96	0.000519	2.5	PASS
Band II	9262	NV	40	4.90	0.002644	2.5	PASS
Band II	9262	NV	50	0.70	0.000379	2.5	PASS

Band II	9400	NV	-30	2.98	0.001583	2.5	PASS
Band II	9400	NV	-20	-0.96	-0.000511	2.5	PASS
Band II	9400	NV	-10	1.66	0.000885	2.5	PASS
Band II	9400	NV	0	2.15	0.001144	2.5	PASS
Band II	9400	NV	10	0.26	0.000138	2.5	PASS
Band II	9400	NV	20	1.19	0.000633	2.5	PASS
Band II	9400	NV	30	3.81	0.002029	2.5	PASS
Band II	9400	NV	40	3.34	0.001777	2.5	PASS
Band II	9400	NV	50	-0.56	-0.000300	2.5	PASS
Band II	9538	NV	-30	-6.74	-0.003536	2.5	PASS
Band II	9538	NV	-20	1.08	0.000568	2.5	PASS
Band II	9538	NV	-10	2.66	0.001392	2.5	PASS
Band II	9538	NV	0	-4.84	-0.002536	2.5	PASS
Band II	9538	NV	10	-0.55	-0.000288	2.5	PASS
Band II	9538	NV	20	1.97	0.001032	2.5	PASS
Band II	9538	NV	30	-1.88	-0.000984	2.5	PASS
Band II	9538	NV	40	0.55	0.000288	2.5	PASS
Band II	9538	NV	50	0.46	0.000240	2.5	PASS
Band IV	1312	NV	-30	0.43	0.000250	2.5	PASS
Band IV	1312	NV	-20	6.64	0.003876	2.5	PASS
Band IV	1312	NV	-10	2.43	0.001417	2.5	PASS
Band IV	1312	NV	0	0.85	0.000499	2.5	PASS
Band IV	1312	NV	10	1.21	0.000704	2.5	PASS
Band IV	1312	NV	20	4.96	0.002896	2.5	PASS
Band IV	1312	NV	30	0.60	0.000348	2.5	PASS
Band IV	1312	NV	40	5.58	0.003261	2.5	PASS
Band IV	1312	NV	50	3.20	0.001871	2.5	PASS

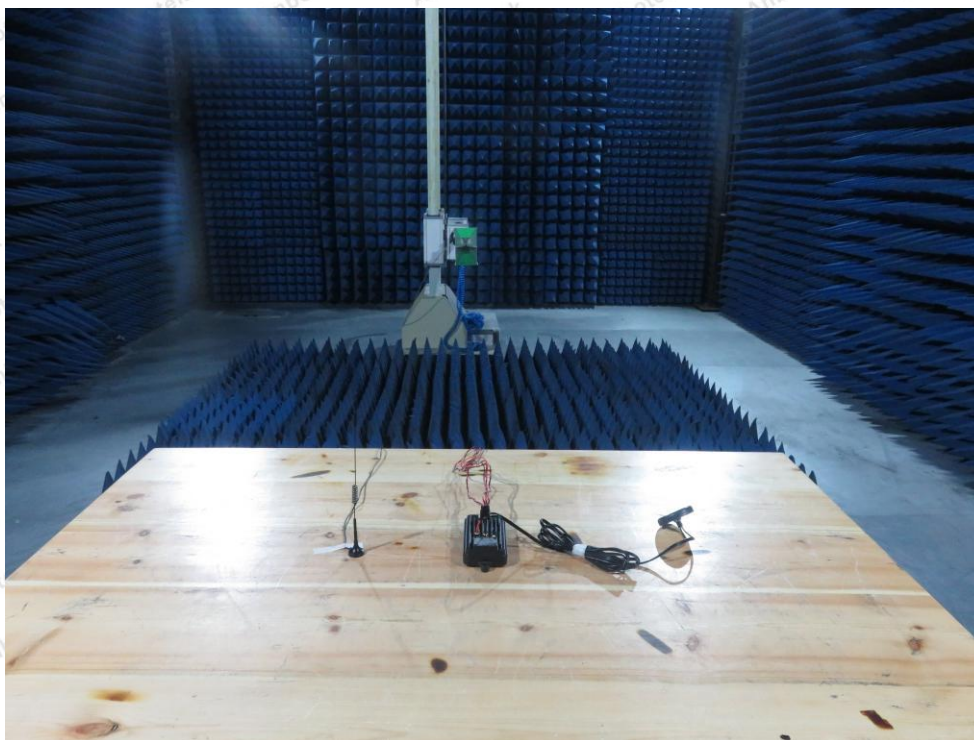
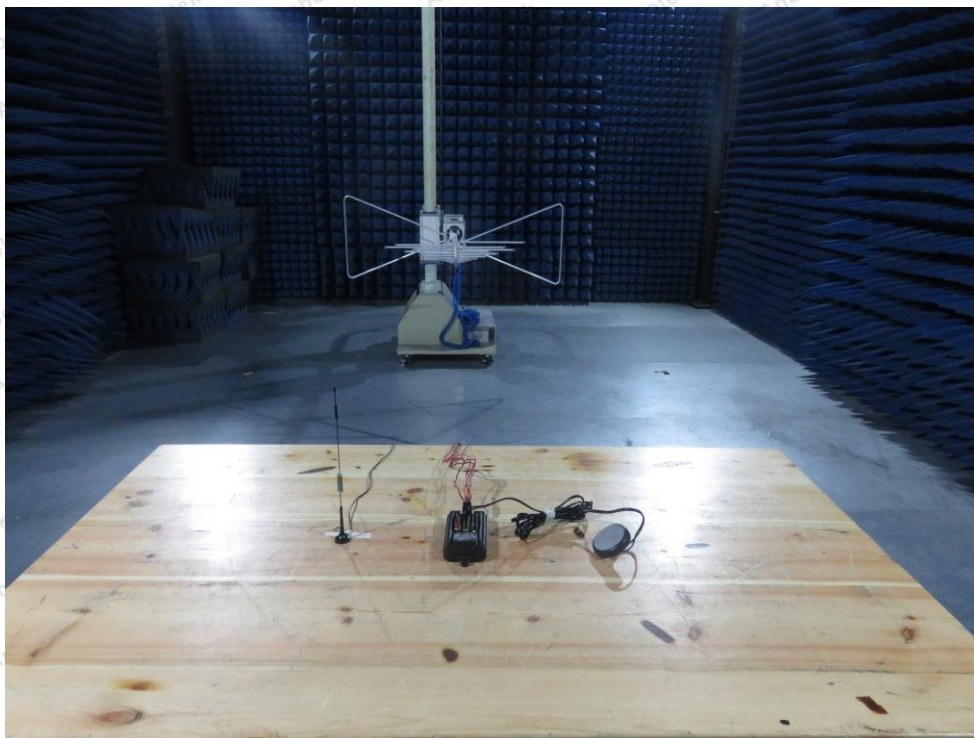
Band IV	1413	NV	-30	-0.82	-0.000476	2.5	PASS
Band IV	1413	NV	-20	-0.66	-0.000379	2.5	PASS
Band IV	1413	NV	-10	1.14	0.000661	2.5	PASS
Band IV	1413	NV	0	1.53	0.000881	2.5	PASS
Band IV	1413	NV	10	-2.96	-0.001709	2.5	PASS
Band IV	1413	NV	20	1.57	0.000907	2.5	PASS
Band IV	1413	NV	30	-0.82	-0.000476	2.5	PASS
Band IV	1413	NV	40	0.27	0.000159	2.5	PASS
Band IV	1413	NV	50	-2.29	-0.001321	2.5	PASS
Band IV	1513	NV	-30	2.98	0.001698	2.5	PASS
Band IV	1513	NV	-20	0.60	0.000340	2.5	PASS
Band IV	1513	NV	-10	5.16	0.002943	2.5	PASS
Band IV	1513	NV	0	7.84	0.004475	2.5	PASS
Band IV	1513	NV	10	4.71	0.002690	2.5	PASS
Band IV	1513	NV	20	7.69	0.004388	2.5	PASS
Band IV	1513	NV	30	4.09	0.002333	2.5	PASS
Band IV	1513	NV	40	4.21	0.002403	2.5	PASS
Band IV	1513	NV	50	6.48	0.003700	2.5	PASS
Band V	4132	NV	-30	-4.12	-0.004985	2.5	PASS
Band V	4132	NV	-20	-3.94	-0.004764	2.5	PASS
Band V	4132	NV	-10	-3.65	-0.004413	2.5	PASS
Band V	4132	NV	0	-3.83	-0.004635	2.5	PASS
Band V	4132	NV	10	-3.28	-0.003970	2.5	PASS

Band V	4132	NV	20	-2.43	-0.002936	2.5	PASS
Band V	4132	NV	30	-4.36	-0.005281	2.5	PASS
Band V	4132	NV	40	-3.59	-0.004339	2.5	PASS
Band V	4132	NV	50	-5.63	-0.006813	2.5	PASS
Band V	4182	NV	-30	-7.63	-0.009122	2.5	PASS
Band V	4182	NV	-20	-6.15	-0.007352	2.5	PASS
Band V	4182	NV	-10	-4.47	-0.005345	2.5	PASS
Band V	4182	NV	0	-3.56	-0.004251	2.5	PASS
Band V	4182	NV	10	-4.17	-0.004980	2.5	PASS
Band V	4182	NV	20	-2.85	-0.003412	2.5	PASS
Band V	4182	NV	30	-8.07	-0.009651	2.5	PASS
Band V	4182	NV	40	-4.39	-0.005254	2.5	PASS
Band V	4182	NV	50	-1.51	-0.001806	2.5	PASS
Band V	4233	NV	-30	-6.41	-0.007570	2.5	PASS
Band V	4233	NV	-20	-7.92	-0.009354	2.5	PASS
Band V	4233	NV	-10	-5.65	-0.006669	2.5	PASS

Band V	4233	NV	0	-7.16	-0.008453	2.5	PASS
Band V	4233	NV	10	-3.25	-0.003839	2.5	PASS
Band V	4233	NV	20	-4.30	-0.005083	2.5	PASS
Band V	4233	NV	30	-1.89	-0.002235	2.5	PASS
Band V	4233	NV	40	-2.61	-0.003082	2.5	PASS
Band V	4233	NV	50	-2.38	-0.002812	2.5	PASS

APPENDIX I-- TEST SETUP PHOTOGRAPH

Photo of Radiation Emission Test



APPENDIX II -- PHOTOGRAPH

Reference to the test report SZAWW180302005-01