



# FCC PART 15C ANT+ TEST REPORT No. 2013TAR662

for

**Sony Mobile Communications AB**

**GSM/WCDMA/LTE mobile phone**

**Type: PM-0590-BV**

**FCC ID: PY7PM-0590**

with

**Hardware Version: AP1**

**Software Version: 14.1.F.0.111**

**Issued Date: 2013-10-16**



**DAR accreditation (DIN EN ISO/IEC 17025): No. D-PL-12123-01-01**

**FCC 2.948 Listed: No.733176**

**Note:** The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of TMC Beijing.

**Test Laboratory:**

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## **CONTENTS**

<b>CONTENTS .....</b>	<b>2</b>
<b>1. TEST LABORATORY .....</b>	<b>3</b>
1.1. TESTING LOCATION .....	3
1.2. TESTING ENVIRONMENT.....	3
1.3. PROJECT DATA .....	3
1.4. SIGNATURE .....	3
<b>2. CLIENT INFORMATION .....</b>	<b>4</b>
2.1. APPLICANT INFORMATION .....	4
2.2. MANUFACTURER INFORMATION .....	4
<b>3. EQUIPMENT UNDER TEST (EUT) AND ANCILLARY EQUIPMENT (AE) .....</b>	<b>5</b>
3.1. ABOUT EUT .....	5
3.2. INTERNAL IDENTIFICATION OF EUT USED DURING THE TEST .....	5
3.3. INTERNAL IDENTIFICATION OF AE USED DURING THE TEST .....	5
3.4. NORMAL ACCESSORY SETTING .....	6
3.5. GENERAL DESCRIPTION.....	6
<b>4. REFERENCE DOCUMENTS.....</b>	<b>7</b>
4.1. DOCUMENTS SUPPLIED BY APPLICANT .....	7
4.2. REFERENCE DOCUMENTS FOR TESTING.....	7
<b>5. LABORATORY ENVIRONMENT.....</b>	<b>8</b>
<b>6. SUMMARY OF TEST RESULTS .....</b>	<b>9</b>
6.1. SUMMARY OF TEST RESULTS.....	9
6.2. STATEMENTS.....	10
6.3. TEST CONDITIONS .....	10
<b>7. TEST EQUIPMENTS UTILIZED .....</b>	<b>11</b>
<b>ANNEX A: MEASUREMENT RESULTS.....</b>	<b>12</b>
A.1. MEASUREMENT METHOD .....	12
A.2. OCCUPIED BANDWIDTH.....	13
A.3. DUTY CYCLE CALCULATION.....	14
A.4. FUNDAMENTAL FIELD STRENGTH LEVEL .....	16
A.5. RADIATED EMISSION.....	17
A.6. AC POWERLINE CONDUCTED EMISSION .....	26
<b>ANNEX B: PHOTOGRAPHS OF THE TEST SET-UP .....</b>	<b>29</b>
<b>ANNEX C: PHOTOGRAPHS OF THE EUT .....</b>	<b>30</b>

## 1. Test Laboratory

### 1.1. Testing Location

Company Name: TMC Beijing, Telecommunication Metrology Center of MIIT  
Address: No.18A, Kangding Street, Beijing Economical Development Area,  
Beijing, China  
Postal Code: 100176  
Telephone: 00861067857376  
Fax: 00861067857376

### 1.2. Testing Environment

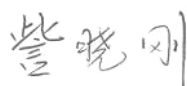
Normal Temperature: 15-35℃  
Extreme Temperature: -20/+55℃  
Relative Humidity: 30-60%  
Air Pressure 990hPa-1040hPa

Note: The climatic requirements above are general exclude the special requirements for dedicated test environments listed in section 5 and some specific test cases in other parts of this report.

### 1.3. Project data

Project Leader: Zi Xiaogang  
Testing Start Date: 2013-08-15  
Testing End Date: 2013-09-11

### 1.4. Signature



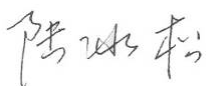
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**Zi Xiaogang**  
**(Prepared this test report)**



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**Sun Xiangqian**  
**(Reviewed this test report)**



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**Lu Bingsong**  
**Deputy Director of the laboratory**  
**(Approved this test report)**

## **2. Client Information**

### **2.1. Applicant Information**

Company Name: Sony Mobile Communications AB  
Address /Post: Sony Mobile R&D Center, No. 16, Guangshun South Street,  
Chaoyang District  
City: Beijing  
Postal Code: 100102  
Country: China  
Contact Person: Ma, Gang  
Telephone: +86-10-58656312  
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### **2.2. Manufacturer Information**

Company Name: Sony Mobile Communications AB  
Address /Post: Sony Mobile R&D Center, No. 16, Guangshun South Street,  
Chaoyang District  
City: Beijing  
Postal Code: 100102  
Country: China  
Contact Person: Ma, Gang  
Telephone: +86-10-58656312  
Fax: +86-10-58659049

### 3. Equipment Under Test (EUT) and Ancillary Equipment (AE)

#### 3.1. About EUT

Description	GSM/WCDMA/LTE mobile phone
Type	PM-0590-BV
FCC ID	PY7PM-0590
Frequency Range	ISM 2400MHz~2483.5MHz
Number of Channels	79
Cellular Frequency Band	GSM 850/900/1800/1900 UMTS Band 1/2/4/5/8 LTE Band 4/17
Support Functions	MP3, camera, USB memory, Mobile High-Definition Link (MHL), FM radio, GPS receiver, NFC, Bluetooth (EDR and Low Energy), ANT+, WLAN (802.11 a/ac/b/g/n) and Wi-Fi hotspot functions
Antenna	Integrated Antenna
Power Supply	3.8VDC by Battery

Note: Photographs of EUT are shown in ANNEX C of this test report.

#### 3.2. Internal Identification of EUT used during the test

EUT ID*	S/N	IMEI	HW Version	SW Version
N59	CB5A1U1CCK	004402451409415	AP1	14.1.F.0.111
N56	CB5A1U337R	004402451403483	AP1	14.1.F.0.111

\*EUT ID: is used to identify the test sample in the lab internally.

#### 3.3. Internal Identification of AE used during the test

AE ID*	Description	SN	Revision
#22972	Travel Charger	8512W19 100198	1C
#23815	USB Cable	123107D30009FA0	1
#23691	MHL dongle	/	1
AE7	HDMI cable	/	A

#22972

Commercial name	EP880
Type	AC-0400-EU
Manufacturer	SALCOMP
Length of cable	98.5 cm (length of USB cable)

## #23815

Commercial name	EC801
Type	AI-0401
Manufacturer	Sony Mobile
Length of cable	98.5 cm

## #23691

Type	AI-0200
Manufacturer	Sony Mobile
Length of cable	12.5 cm

## AE7

Type	3871
Manufacturer	Monoprice
Length of cable	93 cm

\*AE ID: is used to identify the test sample in the lab internally.

### 3.4. Normal Accessory setting

Fully charged battery was used during the test

### 3.5. General Description

The Equipment Under Test (EUT) is a model of GSM/WCDMA/LTE mobile phone with integrated antenna and inbuilt battery.

The EUT supports GSM 850/900/1800/1900MHz bands, WCDMA FDD band 1/2/4/5/8 and LTE FDD bands 4/17. It supports GPRS service with multi-slots class 12 and EGPRS service with multi-slots class 12. The HSDPA and HSUPA features are also supported.

It has MP3, camera, USB memory, Mobile High-Definition Link (MHL), FM radio, GPS receiver, NFC, Bluetooth (EDR and Low Energy), ANT+, WLAN (802.11 a/ac/b/g/n) and Wi-Fi hotspot functions. For WLAN 802.11n, it supports 20MHz bandwidth on 2.4GHz band and 20MHz/40MHz bandwidths on 5GHz/5.8GHz band. For WLAN 802.11 ac, it supports 20MHz/40MHz/80MHz bandwidths.

It includes normal options: travel charger, USB cable, MHL dongle and HDMI cable.

Manual and specifications of the EUT were provided to fulfill the test.

## **4. Reference Documents**

### **4.1. Documents supplied by applicant**

EUT feature information is supplied by the applicant or manufacturer, which is the basis of testing.

### **4.2. Reference Documents for testing**

The following documents listed in this section are referred for testing.

FCC Part15	FCC CFR 47, Part 15, Subpart C: 15.205 Restricted bands of operation; 15.209 Radiated emission limits, general requirements; 15.247 Operation within the bands 902–928MHz, 2400–2483.5 MHz, and 5725–5850 MHz.	10–1–12 Edition
FCC Part 2	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations	10–1–12 Edition
ANSI C63.4	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	2003

## 5. LABORATORY ENVIRONMENT

**Semi-anechoic chamber** (23 meters×17meters×10meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 °C, Max. = 30 °C
Relative humidity	Min. = 30 %, Max. = 60 %
Shielding effectiveness	> 110 dB
Electrical insulation	> 2 MΩ
Ground system resistance	< 0.5 Ω
Normalised site attenuation (NSA)	< ±3.2 dB, 10 m distance, from 30 to 1000 MHz
Uniformity of field strength	Between 0 and 6 dB, from 80 to 2000 MHz

**Control room/ conducted chamber** did not exceed following limits along the EMC testing:

Temperature	Min. = 15 °C, Max. = 35 °C
Relative humidity	Min. =20 %, Max. = 80 %
Shielding effectiveness	> 110 dB
Electrical insulation	> 2 MΩ
Ground system resistance	< 0.5 Ω

**Fully-anechoic chamber1** (6.8 meters×3.08 meters×3.53 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 °C, Max. = 30 °C
Relative humidity	Min. = 35 %, Max. = 60 %
Shielding effectiveness	> 110 dB
Electrical insulation	> 2 MΩ
Ground system resistance	< 0.5 Ω
Uniformity of field strength	Between 0 and 6 dB, from 80 to 3000 MHz

**Fully-anechoic chamber2** (8.6 meters×6.1 meters×3.85 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 °C, Max. = 30 °C
Relative humidity	Min. = 35 %, Max. = 60 %
Shielding effectiveness	> 110 dB
Electrical insulation	> 2 MΩ
Ground system resistance	< 1 Ω
Uniformity of field strength	Between 0 and 6 dB, from 80 to 4000 MHz

**Fully-anechoic chamber3** (10 meters×6.7 meters×6.15 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 °C, Max. = 30 °C
Relative humidity	Min. = 35 %, Max. = 60 %
Shielding effectiveness	> 100 dB
Electrical insulation	> 2 MΩ
Ground system resistance	< 0.5 Ω
Site voltage standing-wave ratio ( $S_{VSWR}$ )	Between 0 and 6 dB, from 1GHz to 18GHz

**Additional Humidity Requirements for Electrostatic Discharge Test:** Min. = 30%, Max. = 60%.



## 6. SUMMARY OF TEST RESULTS

### 6.1. Summary of Test Results

Abbreviations used in this clause:

**P** Pass, The EUT complies with the essential requirements in the standard.

**F** Fail, The EUT does not comply with the essential requirements in the standard

**NA** Not Applicable, The test was not applicable

**NP** Not Performed, The test was not performed by TMC

<b>SUMMARY OF MEASUREMENT RESULTS</b>	<b>Sub-clause</b>	<b>Verdict</b>
Occupied Bandwidth	2.1049	<b>P</b>
Duty Cycle Calculation	15.35	<b>P</b>
Fundamental Field Strength Level	15.249	<b>P</b>
Radiated Emission	15.205, 15.209, 15.249	<b>P</b>
AC Powerline Conducted Emission	15.207	<b>P</b>

Please refer to **ANNEX A** for detail.

## 6.2. Statements

TMC has evaluated the test cases requested by the applicant /manufacturer as listed in section 6.1 of this report for the EUT specified in section 3 according to the standards or reference documents listed in section 4.2

The EUT met all requirements of the standards or reference documents.

This report only deals with the ANT+ functions among the features described in section 3.

## 6.3. Test Conditions

T nom	Normal Temperature
T min	Low Temperature
T max	High Temperature
V nom	Normal Voltage
V min	Low Voltage
V max	High Voltage
H nom	Norm Humidity
A nom	Norm Air Pressure

For this report, all the test case listed above are tested under Normal Temperature and Normal Voltage, and also under norm humidity, the specific conditions as following:

Temperature	T nom	26℃
Voltage	V nom	3.8V (By battery)
Humidity	H nom	43%
Air Pressure	A nom	1010hPa

## 7. Test Equipments Utilized

### Conducted test system

No.	Equipment	Model	Serial Number	Manufacturer	Calibration Due date
1	Vector Signal Analyzer	FSU26	200030	Rohde & Schwarz	2014-06-12

### Radiated emission test system

No.	Equipment	Model	Serial Number	Manufacturer	Calibration Due date
1	Test Receiver	ESU26	100376	Rohde & Schwarz	2013-11-07
2	EMI Antenna	VULB 9163	9163482	Schwarzbeck	2014-02-17
3	EMI Antenna	3117	00119024	EMCO	2014-02-03
4	Dual-Ridge Waveguide Horn Antenna	3116	2663	ETS-Lindgren	2014-06-30
5	Dual-Ridge Waveguide Horn Antenna	3116	2661	ETS-Lindgren	2014-06-30
6	LISN	ESH2-Z5	829991/012	Rohde & Schwarz	2014-03-17
7	Pre-amplifier(18GHz)	SCU18	1005277	Rohde & Schwarz	/
8	Pre-amplifier(26.5GHz)	SCU26	1006788	Rohde & Schwarz	/

### Anechoic chamber

Fully anechoic chamber by Frankonia German.

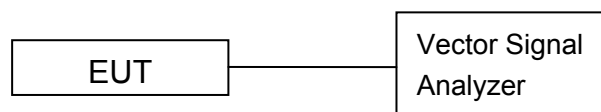
Note : The pre amplifiers is calibrated with routes calibration every time before test, therefore no need for the calibration date.

## ANNEX A: MEASUREMENT RESULTS

### A.1. Measurement Method

#### A.1.1. Conducted Measurements

- 1). Connect the EUT to the test system correctly.
- 2). Set the EUT to the required work mode (Transmitter, receiver or transmitter & receiver).
- 3). Set the EUT to the required channel.
- 4). Set the EUT hopping mode (hopping or hopping off).
- 5). Set the spectrum analyzer to start measurement.
- 6). Record the values. Vector Signal Analyzer



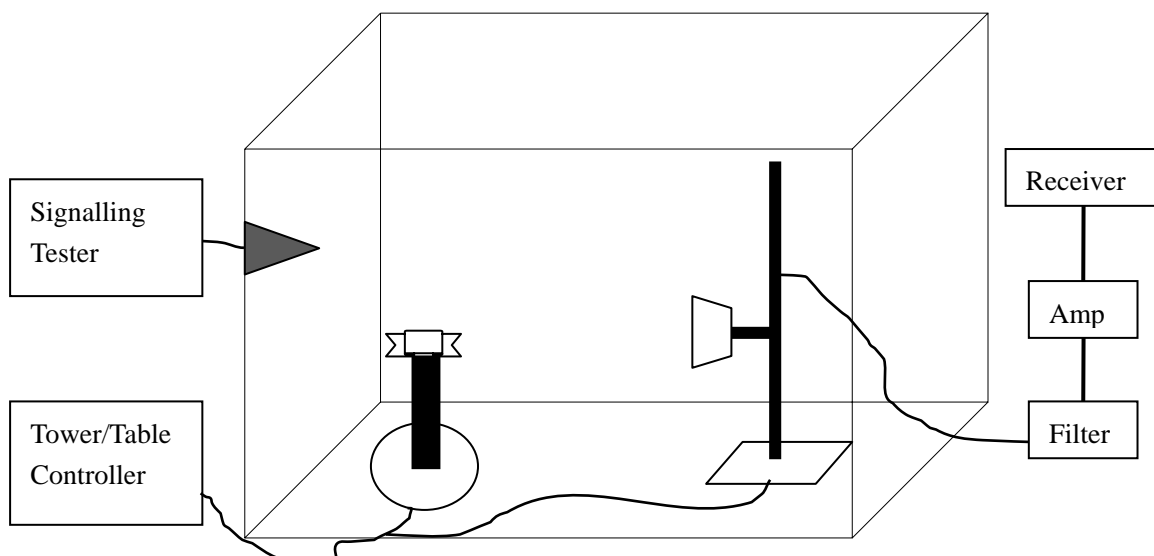
#### A.1.2. Radiated Emission Measurements

The radiated emission test is performed in semi-anechoic chamber. The distance from the EUT to the reference point of measurement antenna is 3m. The test is carried out on both vertical and horizontal polarization and only maximization result of both polarizations is kept. During the test, the turntable is rotated 360° and the measurement antenna is moved from 1m to 4m to get the maximization result.

In the case of radiated emission, the used settings are as follows,

Sweep frequency from 30 MHz to 1GHz, RBW = 100 kHz, VBW = 300 kHz;

Sweep frequency from 1 GHz to 26GHz, RBW = 1MHz, VBW = 1MHz;



## A.2. Occupied Bandwidth

### Measurement Limit:

Standard	Limit
FCC 47 CFR Part 2.1049	N/A

### Measurement Condition:

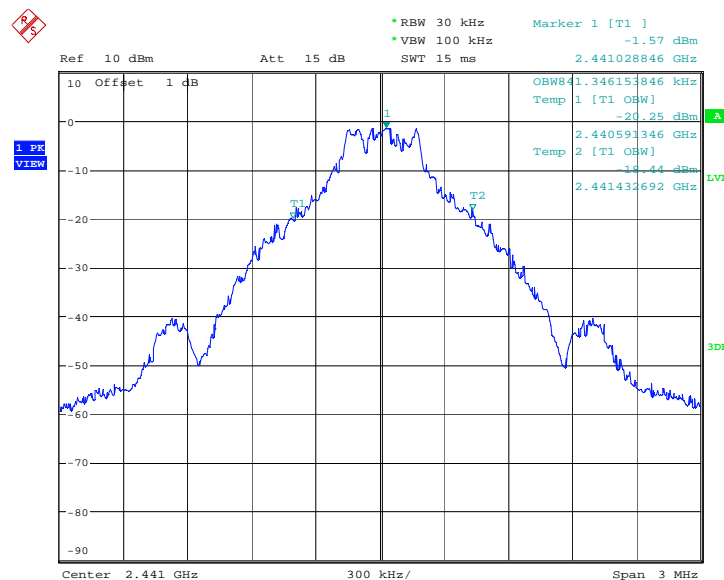
RBW=30KHz; VBW=100KHz; SPAN=3MHz; Detector: peak

### Measurement Result:

Channel	Occupied Bandwidth(KHz)	Conclusion
39	Fig.1	P

**Conclusion: PASS**

Test graphs as below



Date: 9.SEP.2013 09:38:37

Fig.1. Occupied Bandwidth: Channel39

### A.3. Duty Cycle Calculation

#### Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.35	N/A

An average radiated field strength can be determined by applying a duty cycle correction factor to a measured peak radiated field strength level. The duty cycle correction factor is determined based on the worst case operation over a 100ms time period on any given channel.

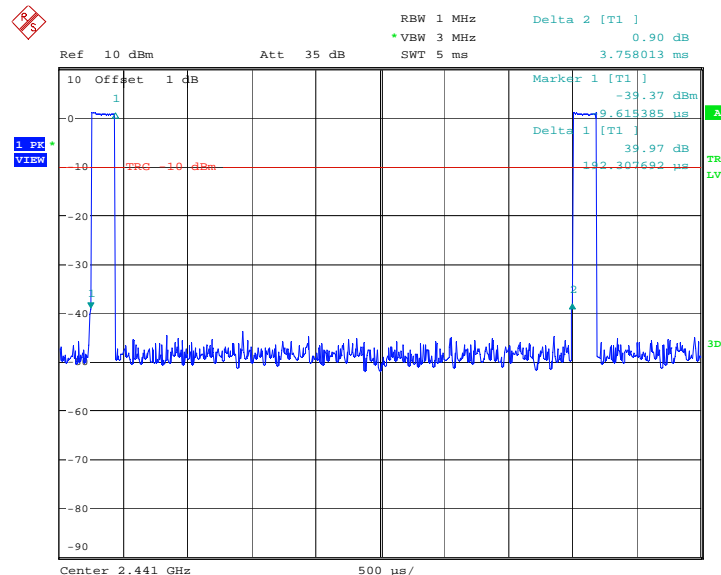
#### Measurement Results:

Channel	pulse width(μs)		Conclusion
39	Fig.2	192.31	P

Channel	operation time over a 100ms time period		Conclusion
39	Fig.3	27	P

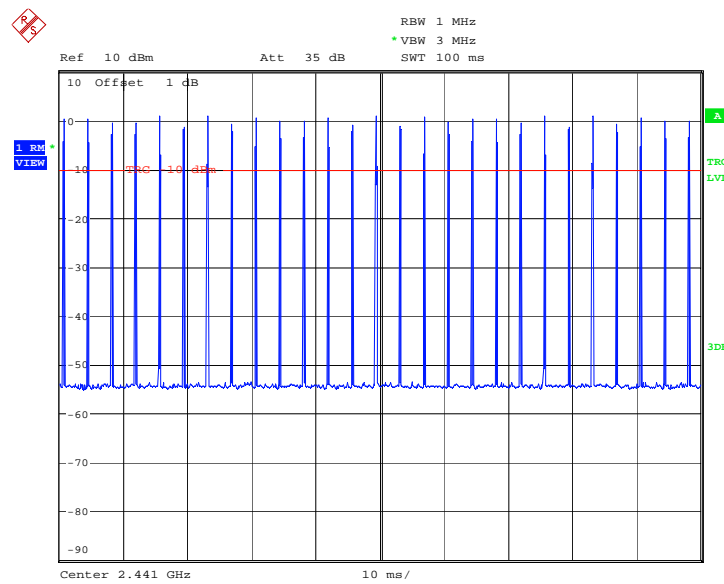
$$\begin{aligned} \text{DCCF} &= 20\lg(\text{number of hits} \times (\text{worst case 100ms operation} / 100\text{ms})) \\ &= 20\lg(27 \times (0.19231\text{ms} / 100\text{ms})) = -25.69\text{dB} \end{aligned}$$

#### Test graphs as below



Date: 9.SEP.2013 10:07:47

Fig.2. pulse width: Channel 39



Date: 11.SEP.2013 15:06:22

Fig.3. Worst Case 100ms Operation: Channel 39

#### A.4. Fundamental Field Strength Level

##### Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.249	Average field strength< 50mV/m (94.0dBμV/m) Peak field strength< 500mV/m (114.0dBμV/m)

Measurement is made while the EUT is operating in non-hopping transmission mode. The field strengths shown below are measured using a spectrum analyzer. Peak field strength measurements are performed in the analyzer's swept spectrum mode using a peak detector with RBW=3MHz and VBW $\geq$ RBW. Average field strength data is determined by applying the duty cycle correction factor(DCCF).

##### Measurement Results:

Frequency (MHz)	Field Strength (dBμV/m)	Cable loss(dB)	AF (dB)	Pmea (dBμV/m)	Pol [H/V]	Detector	Duty Cycle(dB)	Corrected Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2401.942	96.8	-27.0	30.7	93.103	H	Peak	0.00	96.8	114.0	17.2
2401.942	96.8	-27.0	30.7	93.103	H	Peak	-25.69	71.1	94.0	22.9
2440.992	98.0	-27.2	30.6	94.642	H	Peak	0.00	98.0	114.0	16.0
2440.992	98.0	-27.2	30.6	94.642	H	Peak	-25.69	72.3	94.0	21.7
2479.970	97.4	-27.4	31.1	93.672	H	Peak	0.00	97.4	114.0	16.6
2479.970	97.4	-27.4	31.1	93.672	H	Peak	-25.69	71.7	94.0	22.3

**Conclusion: PASS**



## A.5. Radiated Emission

### Measurement Limit:

Standard	Limit
FCC 47 CFR Part 15.205, 15.209,15.249	Listed as follows

Frequency (MHz) Field strength	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88–216	150	3
216–960	200	3
Above 960	500	3

In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

### Limit in restricted band:

Frequency of emission (MHz)	Field strength(uV/m)	Field strength(dBuV/m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

### Test Condition

The EUT was placed on a non-conductive table. The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and the EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. This maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

Frequency of emission (MHz)	RBW/VBW	Sweep Time(s)
0.009-30	100KHz/300KHz	5
30-1000	100KHz/300KHz	5
1000-4000	1MHz/1MHz	15
4000-18000	1MHz/1MHz	40
18000-26500	1MHz/1MHz	20

### Measurement Results:

A “reference path loss” is established and the  $A_{Rpl}$  is the attenuation of “reference path loss”, and including the gain of receive antenna, the gain of the preamplifier, the cable los.

The measurement results are obtained as described below:

$$\text{Result} = P_{\text{Mea}} + A_{\text{Rpl}}$$

Frequency	Frequency Range	Test Results	Conclusion
2402MHz	30 MHz ~ 1 GHz	Fig.4	P
	1 GHz ~ 3 GHz	Fig.5	P
	3 GHz ~ 18 GHz	Fig.6	P
	18 GHz ~ 26 GHz	Fig.7	P
2440 MHz	30 MHz ~ 1 GHz	Fig.8	P
	1 GHz ~ 3 GHz	Fig.9	P
	3 GHz ~ 18 GHz	Fig.10	P
	18 GHz ~ 26 GHz	Fig.11	P
2480 MHz	30 MHz ~ 1 GHz	Fig.12	P
	1 GHz ~ 3 GHz	Fig.13	P
	3 GHz ~ 18 GHz	Fig.14	P
	18 GHz ~ 26 GHz	Fig.15	P
Power	2.38GHz~2.4GHz---L	Fig.16	P
Power	2.45GHz~2.5GHz---H	Fig.17	P

Note: Only worst case result is given.

**Conclusion: PASS**

**Test graphs as below:**

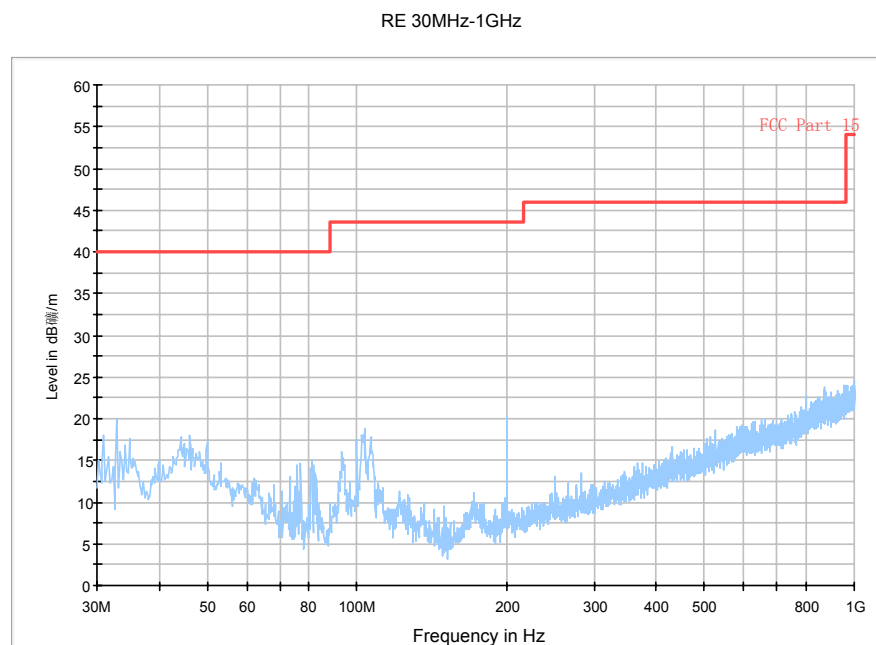


Fig.4. Radiated emission: Channel 0, 30 MHz - 1 GHz

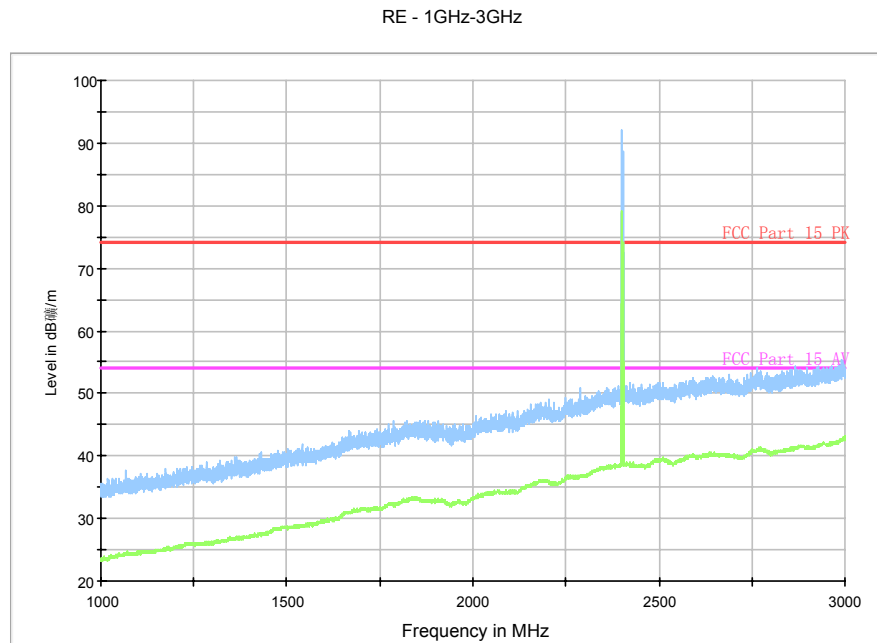


Fig.5. Radiated emission: Channel 0, 1 GHz - 3 GHz

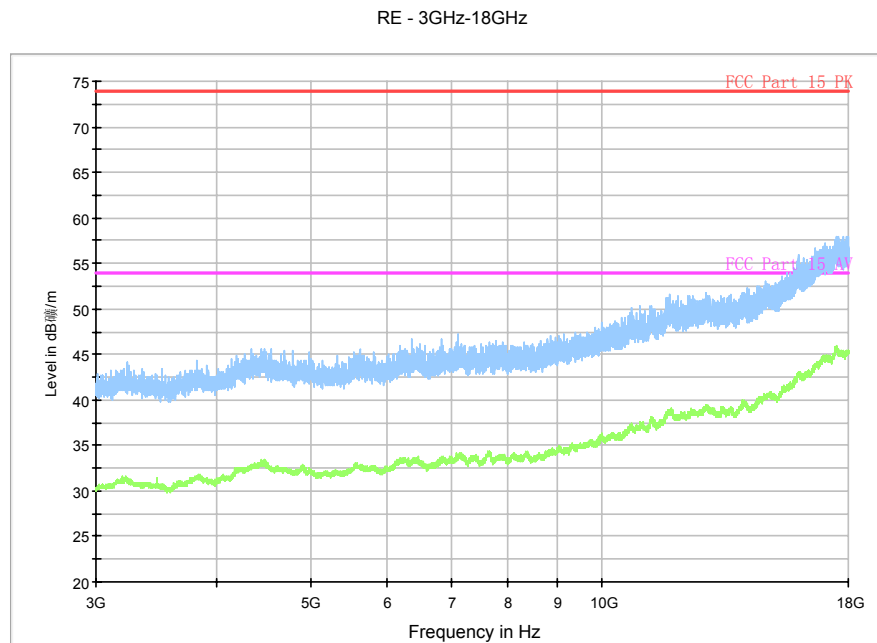


Fig.6. Radiated emission: Channel 0, 3 GHz - 18 GHz

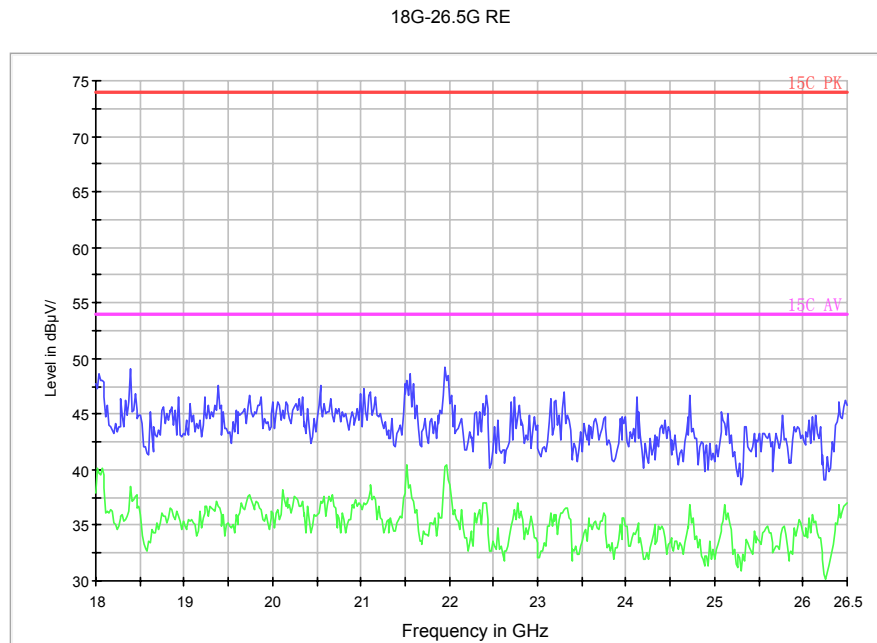


Fig.7. Radiated emission: Channel 0, 18 GHz ~ 26 GHz

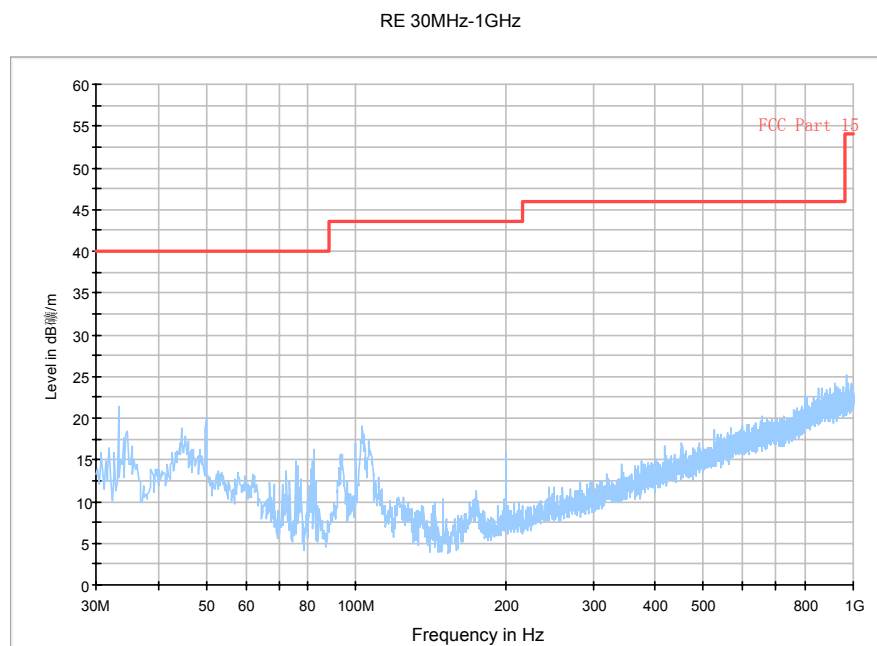


Fig.8. Radiated emission: Channel 39, 30 MHz - 1 GHz

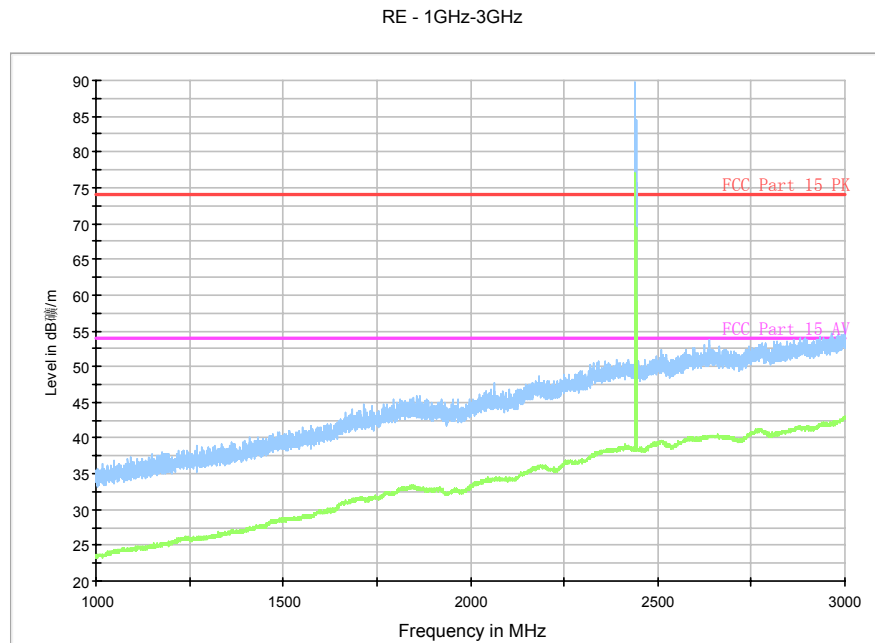


Fig.9. Radiated emission: Channel 39, 1 GHz - 3 GHz

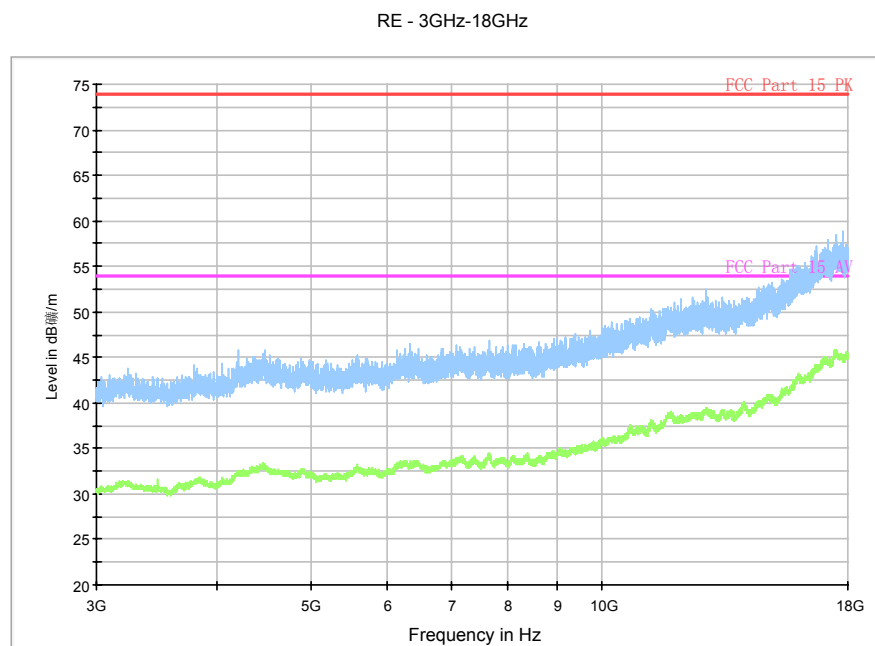


Fig.10. Radiated emission: Channel 39, 3 GHz - 18 GHz

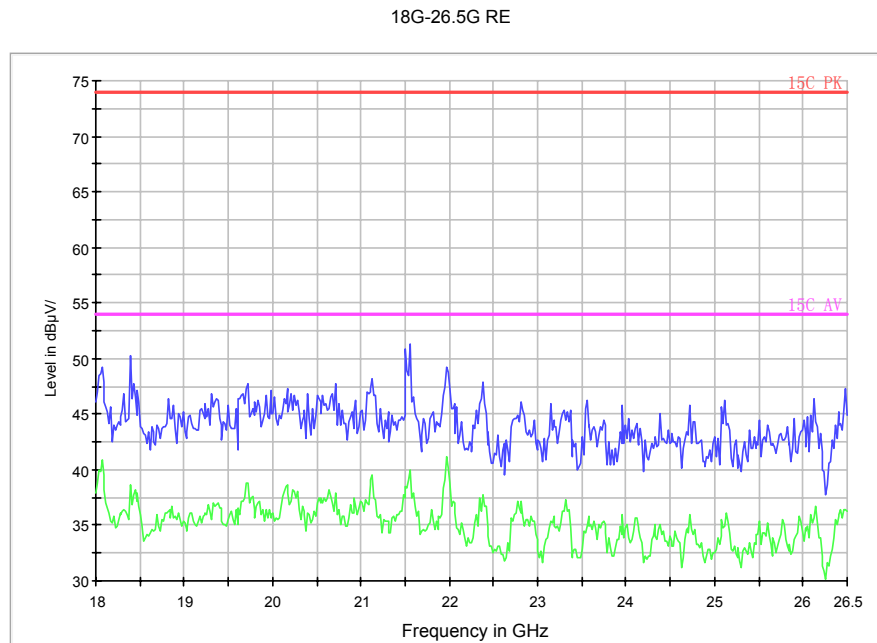


Fig.11. Radiated emission: Channel 39, 18 GHz ~ 26 GHz

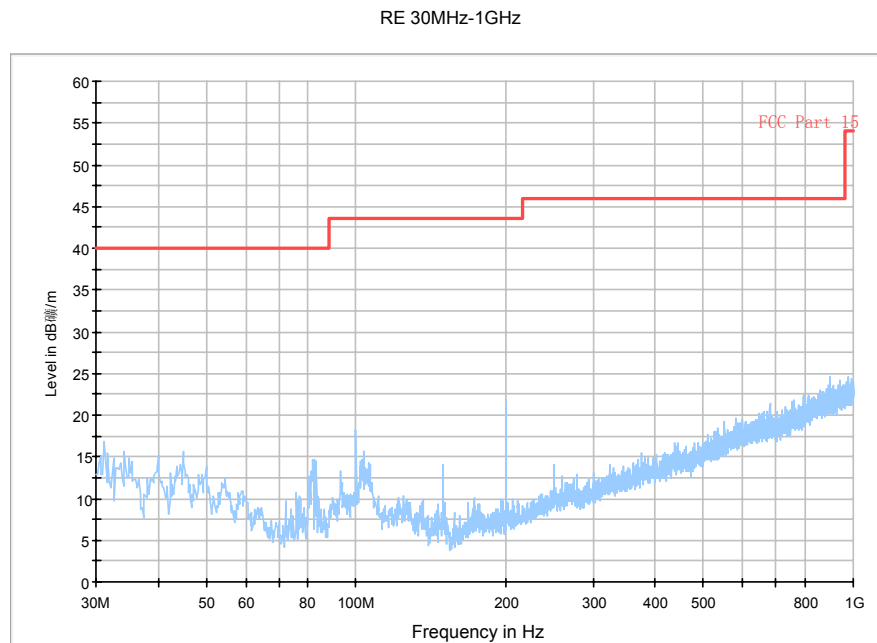


Fig.12. Radiated emission: Channel 78, 30 MHz - 1 GHz

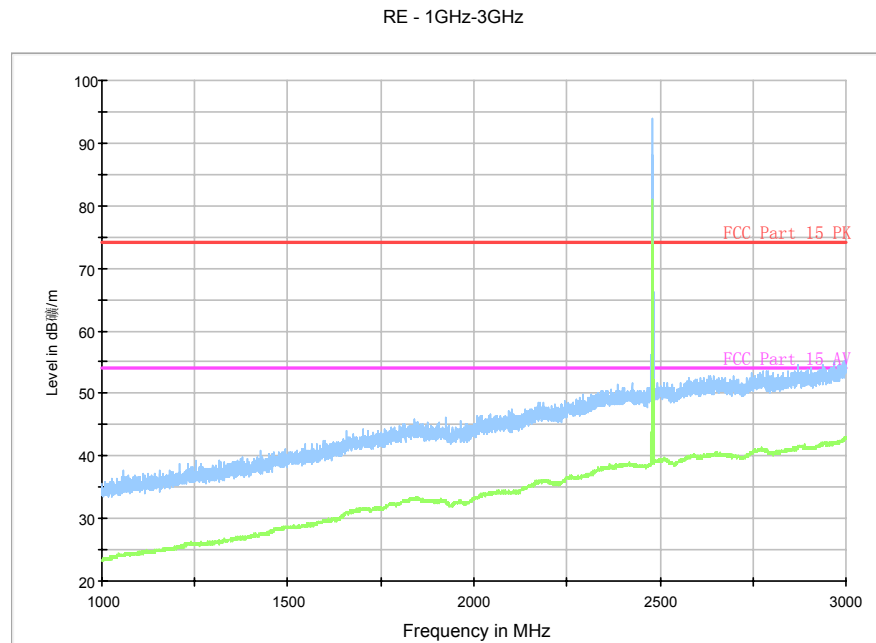


Fig.13. Radiated emission: Channel 78, 1 GHz - 3 GHz

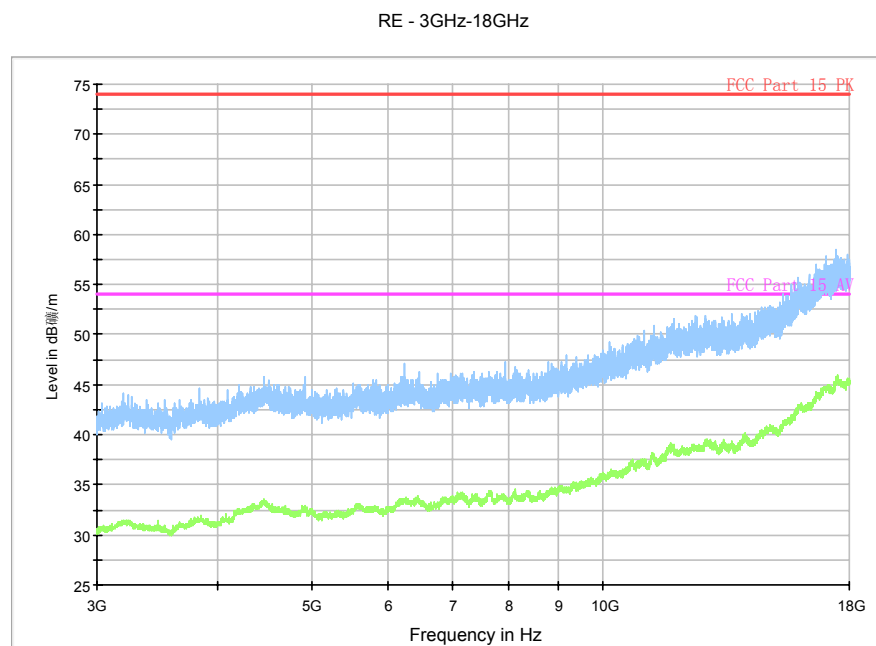


Fig.14. Radiated emission: Channel 78, 3 GHz - 18 GHz

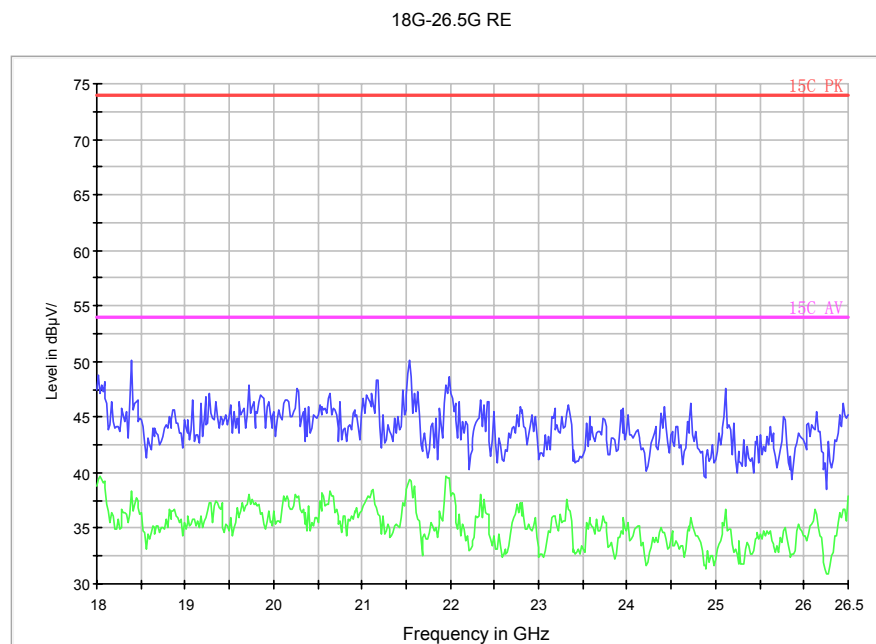


Fig.15. Radiated emission: Channel 78, 18 GHz ~ 26 GHz

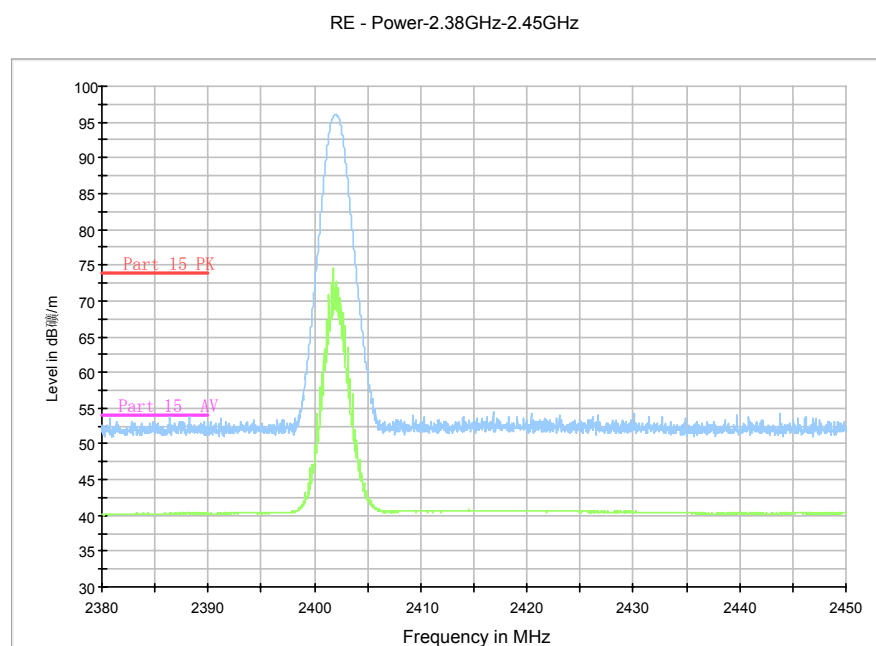


Fig.16. Radiated emission (Power): Low Channel



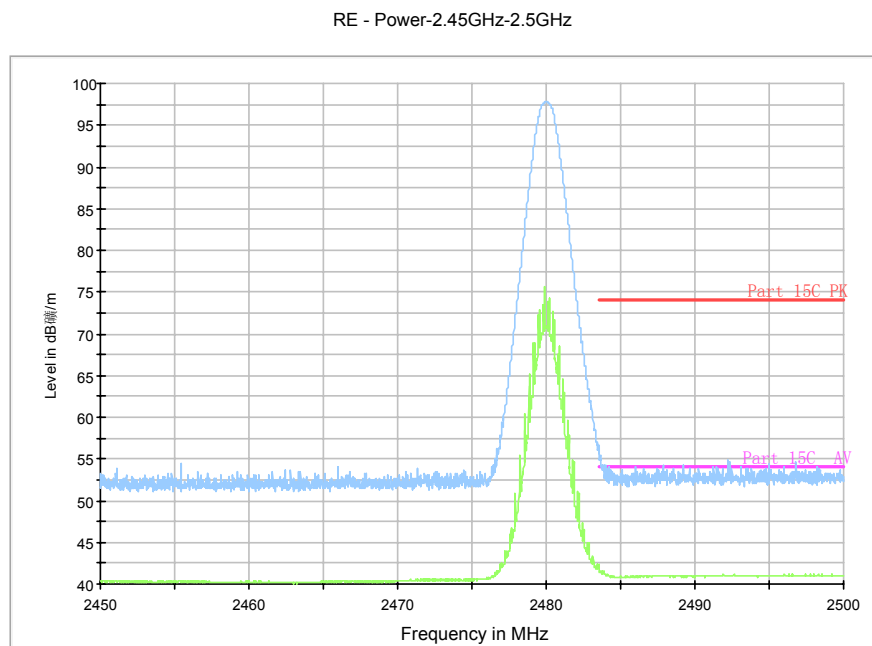


Fig.17. Radiated emission (Power): High Channel

## A.6. AC Powerline Conducted Emission

Standard	Limit
FCC 47 CFR Part 15.207	See below

### Test Condition

Voltage (V)	Frequency (Hz)
120	60

### Measurement Result and limit:

Quasi-peak:

Frequency range (MHz)	Quasi-peak Limit (dBμV)	Result (dBμV)		Conclusion
		With Charger		
0.15 to 0.5	66 o 56	Fig.18. (TX Mode)	Fig.19. (Idle Mode)	P
0.5 to 5	56			
5 to 30	60			

NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

Average:

Frequency range (MHz)	Average Limit (dBμV)	Result (dBμV)		Conclusion
		With Charger		
0.15 to 0.5	56 to 46	Fig.18. (TX Mode)	Fig.19. (Idle Mode)	P
0.5 to 5	46			
5 to 30	50			

NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz.

Note: the graphic result above is the maximum of the measurements for both phase line and neutral line.

**Conclusion: PASS**

Test graphs as below:

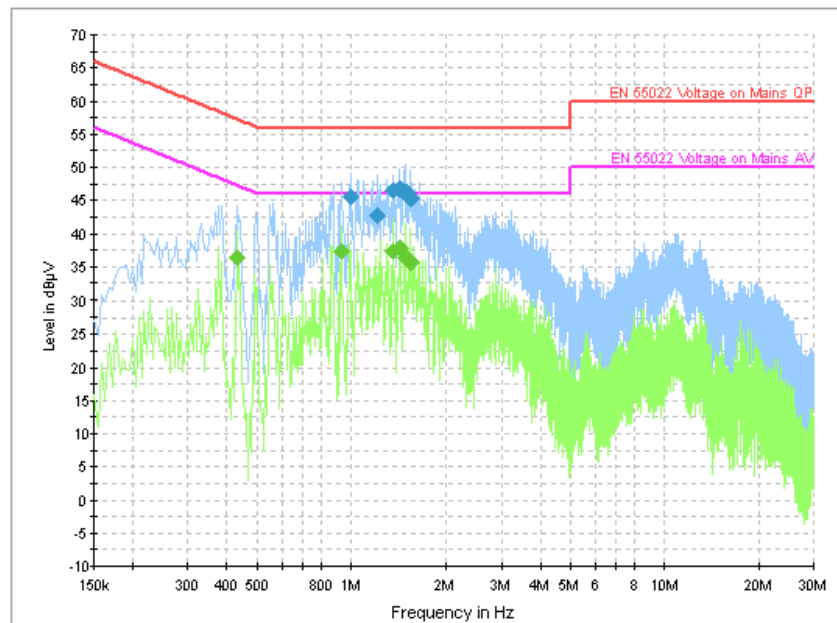


Fig.18 AC Powerline Conducted Emission with charger-TX Mode

### Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.996001	45.4	GND	L1	9.9	10.6	56.0
1.212001	42.7	GND	L1	9.9	13.3	56.0
1.365001	46.4	GND	L1	9.9	9.6	56.0
1.423501	46.7	GND	L1	9.9	9.3	56.0
1.491001	46.3	GND	L1	9.9	9.7	56.0
1.540501	45.2	GND	L1	9.9	10.8	56.0

### Final Result 2

Frequency (MHz)	CAverage (dBμV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.433501	36.2	GND	L1	9.9	10.9	47.2
0.933001	37.3	GND	L1	9.9	8.7	46.0
1.365001	37.3	GND	L1	9.9	8.7	46.0
1.423501	37.8	GND	L1	9.9	8.2	46.0
1.491001	36.3	GND	L1	9.9	9.7	46.0
1.540501	35.7	GND	L1	9.9	10.3	46.0

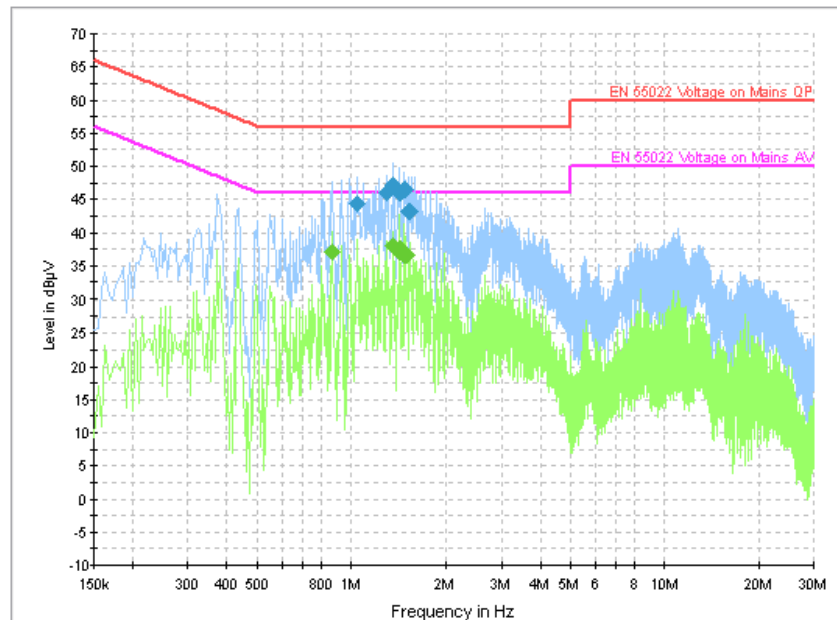


Fig.19 AC Powerline Conducted Emission with charger-Idle Mode

### Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
1.050001	44.3	GND	L1	9.9	11.7	56.0
1.302001	45.9	GND	L1	9.9	10.1	56.0
1.365001	47.2	GND	L1	9.9	8.8	56.0
1.428001	45.9	GND	L1	9.9	10.1	56.0
1.477501	46.5	GND	L1	9.9	9.5	56.0
1.527001	43.1	GND	L1	9.9	12.9	56.0

### Final Result 2

Frequency (MHz)	CAverage (dBμV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.870001	37.0	GND	L1	9.9	9.0	46.0
1.365001	38.0	GND	L1	9.9	8.0	46.0
1.419001	37.1	GND	L1	9.9	8.9	46.0
1.428001	37.6	GND	L1	9.9	8.4	46.0
1.477501	36.5	GND	L1	9.9	9.5	46.0
1.486501	36.5	GND	L1	9.9	9.5	46.0