

# FCC Test Report

APPLICANT : Bullitt Group  
EQUIPMENT : Rugged Smart Phone  
BRAND NAME : CAT  
MODEL NAME : S48c  
FCC ID : ZL5S48C  
STANDARD : FCC CFR Title 47 Part 15 Subpart B  
CLASSIFICATION : Certification

The product was received on Jun. 06, 2018 and testing was completed on Jun. 19, 2018. We, Sporton International (Shenzhen) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures given in ANSI C63.4-2014 and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Shenzhen) Inc., the test report shall not be reproduced except in full.



Approved by: Eric Shih / Manager



**Sporton International (Shenzhen) Inc.**

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Guangdong Province 518055 China**



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## REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FC850804-02	Rev. 01	Initial issue of report	Jul. 06, 2018



## SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
3.1	15.107	AC Conducted Emission	< 15.107 limits	PASS	Under limit 15.36 dB at 0.21 MHz
3.2	15.109	Radiated Emission	< 15.109 limits	PASS	Under limit 4.63 dB at 30.00 MHz



## 1. General Description

### 1.1. Applicant

**Bullitt Group**

One Valpy, Valpy Street, Reading, Berkshire, England RG1 1AR

### 1.2. Product Feature of Equipment Under Test

Product Feature	
<b>Equipment</b>	Rugged Smart Phone
<b>Brand Name</b>	CAT
<b>Model Name</b>	S48c
<b>FCC ID</b>	ZL5S48C
<b>EUT supports Radios application</b>	CDMA/EV-DO/GSM/GPRS/EGPRS/WCDMA/HSPA/ DC-HSDPA/HSPA+/LTE/NFC/ WLAN 2.4GHz 802.11b/g/n HT20/HT40/ WLAN 5GHz 802.11a/n HT20/HT40/ WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE
<b>IMEI Code</b>	Conduction: 358016090005806 Radiation: 358016090012505
<b>EUT Stage</b>	Identical Prototype

**Remark:** The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

### 1.3. Product Specification of Equipment Under Test

Standards-related Product Specification	
<b>Tx Frequency</b>	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band IV : 1712.4 MHz ~ 1752.6 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz LTE Band 2 : 1850.7 MHz ~ 1909.3 MHz LTE Band 4 : 1710.7 MHz ~ 1754.3 MHz LTE Band 5 : 824.7 MHz ~ 848.3 MHz LTE Band 7 : 2502.5 MHz ~ 2567.5 MHz LTE Band 12: 699.7 MHz ~ 715.3 MHz LTE Band 13: 779.5 MHz ~ 784.5 MHz LTE Band 14 : 790.5 MHz ~ 795.5 MHz LTE Band 25 : 1850.7 MHz ~ 1914.3 MHz LTE Band 26 : 814.7 MHz ~ 848.3 MHz LTE Band 41 : 2498.5 MHz ~ 2687.5 MHz LTE Band 66 : 1710.7 MHz ~ 1779.3 MHz CDMA2000 BC0 : 824.70 MHz ~ 848.31 MHz CDMA2000 BC1 : 1851.25 MHz ~ 1908.75 MHz CDMA2000 BC10 : 817.9 MHz ~ 823.1 MHz 802.11b/g/n/ac: 2412 MHz ~ 2462 MHz 802.11a/n/ac: 5180 MHz ~ 5240 MHz; 5260 MHz ~ 5320 MHz; 5500MHz ~ 5720 MHz ; 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz NFC : 13.56 MHz
<b>Rx Frequency</b>	GSM850: 869.2 MHz ~ 893.8 MHz GSM1900: 1930.2 MHz ~ 1989.8 MHz WCDMA Band V: 871.4 MHz ~ 891.6 MHz WCDMA Band IV : 2112.4 MHz ~ 2152.6 MHz WCDMA Band II: 1932.4 MHz ~ 1987.6 MHz LTE Band 2 : 1930.7 MHz ~ 1989.3 MHz LTE Band 4 : 2110.7 MHz ~ 2154.3 MHz LTE Band 5 : 869.7 MHz ~ 893.3 MHz LTE Band 7 : 2622.5 MHz ~ 2687.5 MHz LTE Band 12 : 729.7 MHz ~ 745.3 MHz LTE Band 13: 748.5 MHz ~ 753.5 MHz LTE Band 14 : 760.5 MHz ~ 765.5 MHz LTE Band 25 : 1930.7 MHz ~ 1994.3 MHz LTE Band 26 : 859.7 MHz ~ 893.3 MHz LTE Band 41 : 2498.5 MHz ~ 2687.5 MHz LTE Band 66 : 2110.7 MHz~ 2199.3 MHz CDMA2000 BC0 : 869.70 MHz ~ 893.31 MHz CDMA2000 BC1 : 1931.25 MHz ~ 1988.75 MHz CDMA2000 BC10 : 862.9 MHz ~ 868.1 MHz 802.11b/g/n/ac: 2412 MHz ~ 2462 MHz 802.11a/n/ac: 5180 MHz ~ 5240 MHz; 5260 MHz ~ 5320 MHz; 5500MHz ~ 5720 MHz ; 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz GNSS: 1559 MHz to 1610 MHz FM : 88 MHz ~ 108 MHz NFC : 13.56 MHz

<b>Antenna Type</b>	WWAN : Fixed Internal Antenna WLAN : IFA Antenna Bluetooth : IFA Antenna GNSS: IFA Antenna NFC : Loop Antenna FM: External Handset Antenna
<b>Type of Modulation</b>	GSM: GMSK GPRS: GMSK EDGE(MCS 0-4): GMSK / (MCS 5-9): 8PSK WCDMA : BPSK (Uplink) HSDPA/DC-HSDPA : QPSK (Uplink) HSUPA : QPSK (Uplink) HSPA+ : 16QAM (Uplink) DC-HSDPA : 64QAM LTE: QPSK / 16QAM / 64QAM 802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11a/g/n/ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM) Bluetooth LE : GFSK Bluetooth (1Mbps) : GFSK Bluetooth (2Mbps) : $\pi/4$ -DQPSK Bluetooth (3Mbps) : 8-DPSK GNSS : BPSK NFC: ASK FM

Note: GNSS=GPS RX +GLONASS RX + BDS RX

#### 1.4. Modification of EUT

No modifications are made to the EUT during all test items.

## 1.5. Test Location

Sporton International (Shenzhen) Inc. is accredited to ISO 17025 by National Voluntary Laboratory Accreditation Program (NVLAP code: 600156-0) and the FCC designation No. are CN5018 and CN5019.

<b>Test Site</b>	Sporton International (Shenzhen) Inc.	
<b>Test Site Location</b>	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan Shenzhen City Guangdong Province 518055 China TEL: +86-755-8637-9589 FAX: +86-755-8637-9595	
<b>Test Site No.</b>	<b>Sporton Site No.</b>	<b>FCC Test Firm Registration No.</b>
	CO01-SZ	251365

<b>Test Site</b>	Sporton International (Shenzhen) Inc.	
<b>Test Site Location</b>	No. 3 Bldg the third floor of south, Shahe River west, Fengzeyuan Warehouse, Nanshan District Shenzhen City Guangdong Province 518055 China TEL: +86-755-3320-2398	
<b>Test Site No.</b>	<b>Sporton Site No.</b>	<b>FCC Test Firm Registration No.</b>
	03CH03-SZ	577730

**Note:** The test site complies with ANSI C63.4 2014 requirement.

## 1.6. Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- ♦ FCC CFR Title 47 Part 15 Subpart B
- ♦ ANSI C63.4-2014

**Remark:** All test items were verified and recorded according to the standards and without any deviation during the test.



## 2. Test Configuration of Equipment Under Test

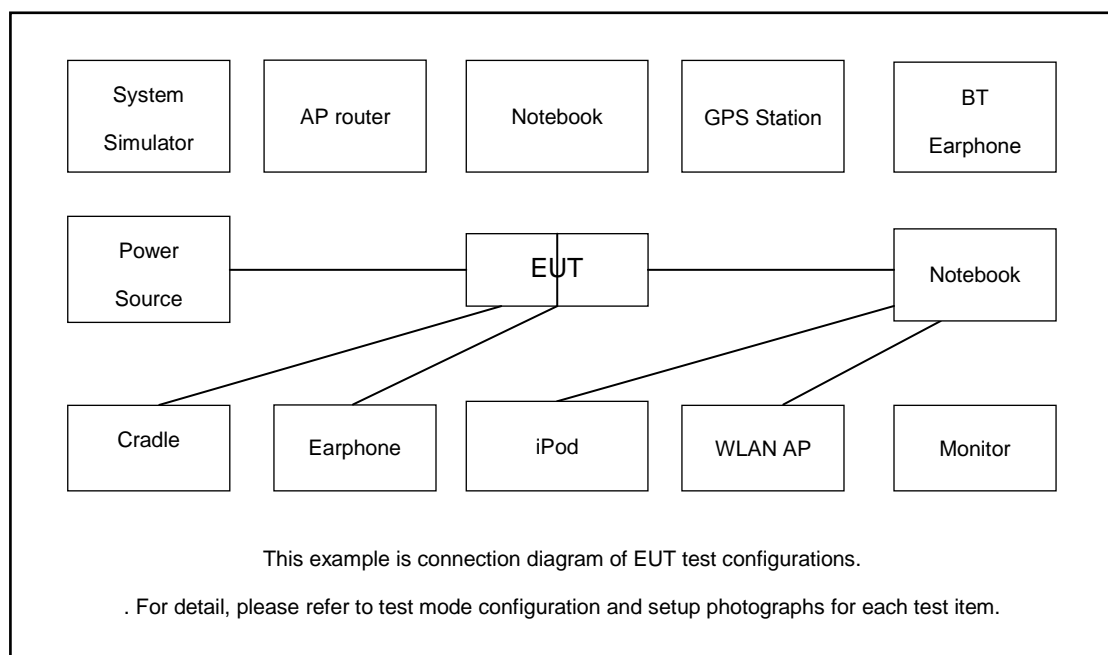
### 2.1. Test Mode

The EUT has been associated with peripherals pursuant to ANSI C63.4-2014 and configuration operated in a manner tended to maximize its emission characteristics in a typical application.

Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (30MHz to the 5th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

Test Items	Function Type
AC Conducted Emission	Mode 1: GSM 850 Idle + Bluetooth Idle + WLAN(2.4G) Idle + USB Cable (Charging from Adapter) + Earphone + Camera(Rear) + SIM 1
	Mode 2: GSM 1900 Idle + Bluetooth Idle + WLAN(5G) Idle + USB Cable (Charging from Adapter) + Earphone + Camera(Front) + SIM 2
	Mode 3: WCDMA Band V Idle + Bluetooth Idle + WLAN(2.4G) Idle + USB Cable (Charging from Adapter ) + Earphone + Color bar + SIM 1
	Mode 4: LTE Band 2 Idle + Bluetooth Idle + WLAN(5G) Idle + USB Cable (Charging from Adapter) + Earphone + NFC On + SIM 2
	Mode 5: LTE Band 4 Idle + Bluetooth Idle + WLAN(2.4G) Idle + USB Cable (Charging from Adapter) + Earphone + GNSS RX + SIM 1
	Mode 6: Bluetooth Idle + WLAN(5G) Idle + USB Cable (Data Link with Notebook) + Earphone + SIM 2
Radiated Emissions	Mode 1: GSM 850 Idle + Bluetooth Idle + WLAN(2.4G) Idle + USB Cable (Charging from Adapter) + Earphone + Camera(Rear) + SIM 1
	Mode 2: GSM 1900 Idle + Bluetooth Idle + WLAN(5G) Idle + USB Cable (Charging from Adapter) + Earphone + Camera(Front) + SIM 1
	Mode 3: WCDMA Band V Idle + Bluetooth Idle + WLAN(2.4G) Idle + USB Cable (Charging from Adapter ) + Earphone + Color bar + SIM 1
	Mode 4: LTE Band 2 Idle + Bluetooth Idle + WLAN(5G) Idle + USB Cable (Charging from Adapter) + Earphone + NFC On + SIM 1
	Mode 5: LTE Band 4 Idle + Bluetooth Idle + WLAN(2.4G) Idle + USB Cable (Charging from Adapter) + Earphone + GNSS RX + SIM 1
	Mode 6: Bluetooth Idle + WLAN(5G) Idle + USB Cable (Data Link with Notebook) + Earphone + SIM 1
<b>Remark:</b> <ol style="list-style-type: none"> <li>1. The worst case of AC is mode 1; only the test data of this mode is reported.</li> <li>2. The worst case of RE is mode 2; only the test data of this mode is reported.</li> <li>3. Data Link with Notebook means data application transferred mode between EUT and Notebook.</li> </ol>	

## 2.2.Connection Diagram of Test System



## 2.3. Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	System Simulator	Anritsu	MT8820C	N/A	N/A	Unshielded, 1.8 m
2.	FM Station	R&S	SMB100A	N/A	N/A	Unshielded, 1.8m
3.	LABSAT GPS Simulator	RACELOGIC	RLLS03-2P	Fcc DoC	N/A	Unshielded, 1.8m
4.	WLAN AP	ASUSTek	RT-AC66U	MSQ-RTAC66U	N/A	Unshielded, 2.7 m
5.	WLAN AP	D-Link	DIR-820L	KA2IR820LA1	N/A	Unshielded, 1.8m
6.	Bluetooth Earphone	Samsung	EO-MG900	CCAH14LP1680T5	N/A	N/A
7.	Bluetooth Earphone	Samsung	EO-MG900	PYAHS-107W	N/A	N/A
8.	NOTE BOOK	Lenovo	E540	FCC DoC	N/A	AC I/P: Unshielded, 1.2 m DC O/P: Shielded, 1.8 m
9.	Labsat	RACELOGIC	18645	N/A	N/A	Unshielded, 1.8m
10.	iPod	Apple	MC525 ZP/A	DoC	Shielded, 1.0m	iPod
11.	SD Card	Kingston	3300-10000-078	FCC DoC	N/A	SD Card
12.	SD Card	N/A	MicroSD HC	FCC DoC	N/A	N/A
13.	GNSS Station	RACELOGIC	18645	N/A	N/A	Unshielded, 1.8m
14.	Earphone	Apple	MC690ZP/A	N/A	Shielded, 1.0m	N/A
15.	Earphone	Apple	DCAY1V-A9007ZJ W3-000	N/A	N/A	Unshielded, 1.8m



## **2.4. EUT Operation Test Setup**

The EUT was in GSM or WCDMA or LTE idle mode during the testing. The EUT was synchronized to the BCCH, and is in continuous receiving mode by setting system simulator's paging reorganization.

At the same time, the EUT was attached to the Bluetooth earphone or WLAN AP, and the following programs installed in the EUT were programmed during the test.

1. Data application is transferred between Notebook and EUT via USB cable.
2. Execute "GPS Test" to make the EUT receive continuous signals from GNSS station.
3. Turn on camera to capture images.
4. Turn on NFC function.

### 3. Test Result

#### 3.1. Test of AC Conducted Emission Measurement

##### 3.1.1 Limits of AC Conducted Emission

For equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table.

<Class B Limit>

Frequency of emission (MHz)	Conducted limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

\*Decreases with the logarithm of the frequency.

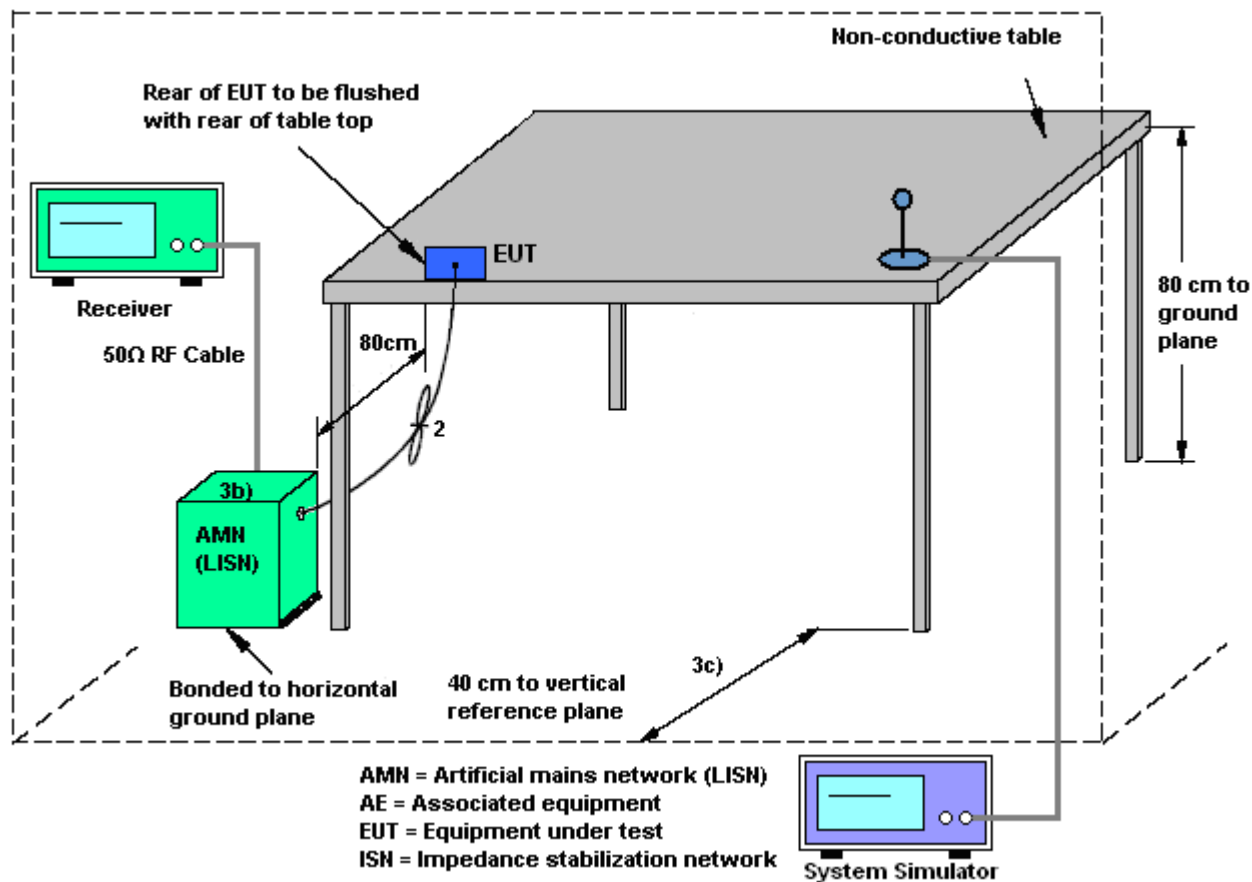
##### 3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

##### 3.1.3 Test Procedure

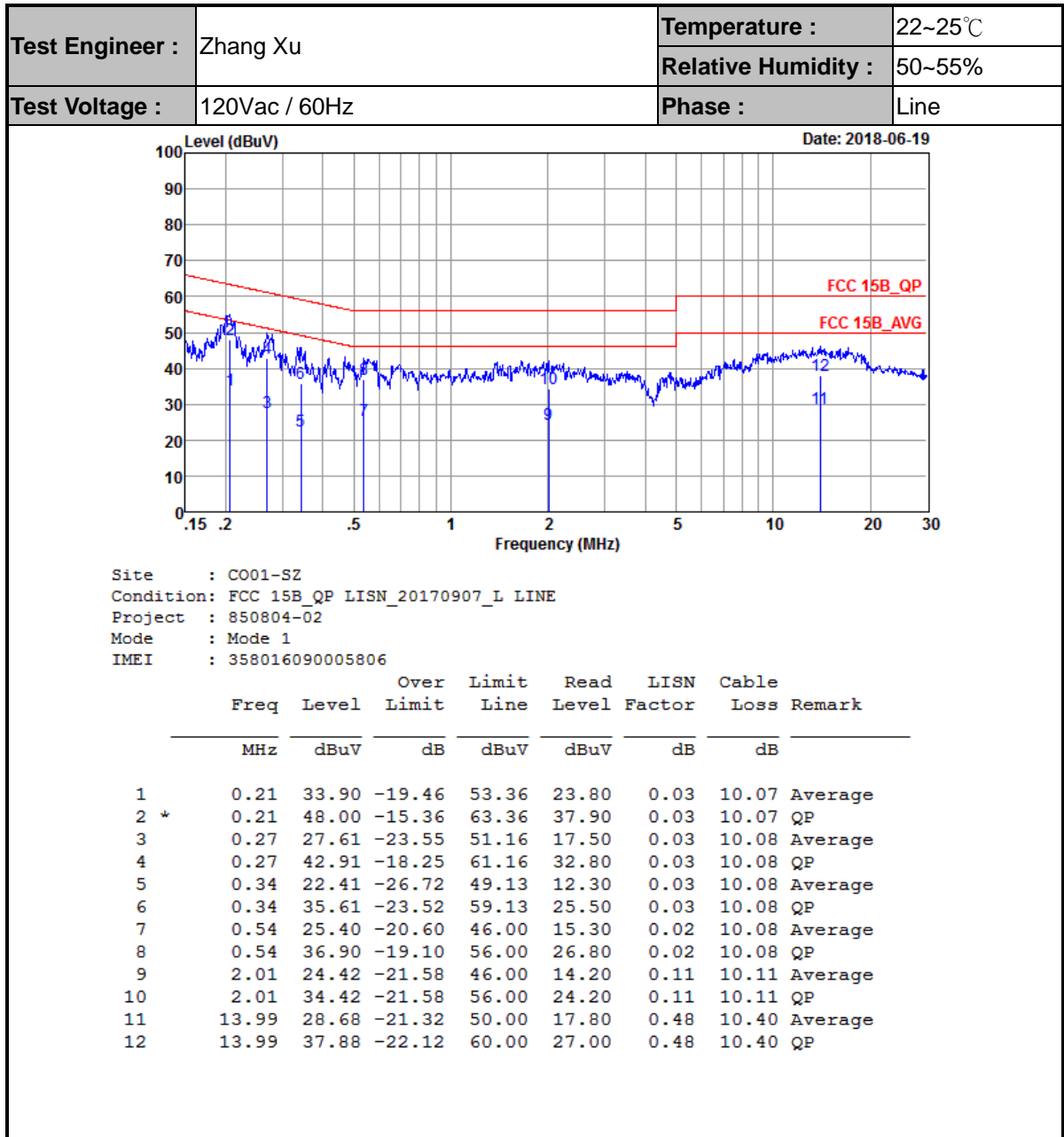
1. The EUT was placed 0.4 meter from the conducting wall of the shielding room was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF Bandwidth = 9kHz) with Maximum Hold Mode. Then measurement is also conducted by Average Detector and Quasi-Peak Detector Function respectively.

### 3.1.4 Test Setup



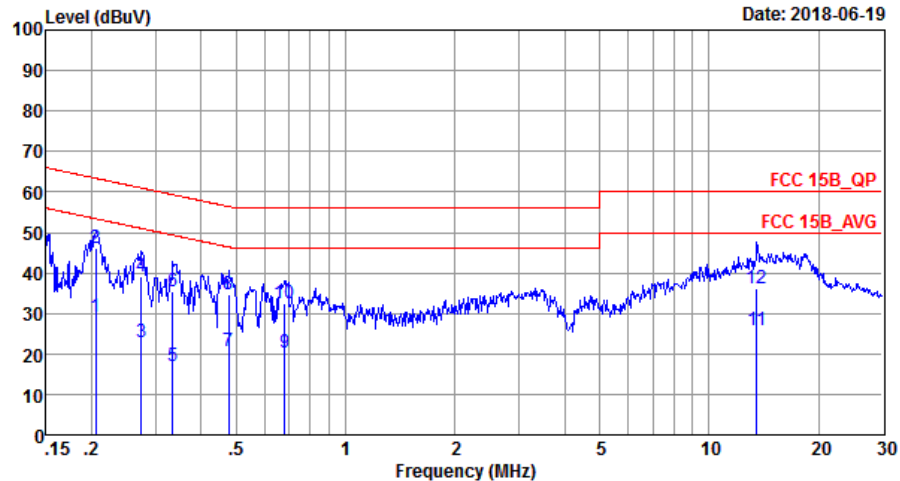


## 3.1.5 Test Result of AC Conducted Emission





<b>Test Engineer :</b>	Zhang Xu	<b>Temperature :</b>	22~25℃
		<b>Relative Humidity :</b>	50~55%
<b>Test Voltage :</b>	120Vac / 60Hz	<b>Phase :</b>	Neutral



Site : CO01-SZ  
Condition: FCC 15B\_QP LISN\_20170907\_N NEUTRAL  
Project : 850804-02  
Mode : Mode 1  
IMEI : 358016090005806

	Freq	Level	Over Limit	Limit Line	Read Level	LISN Factor	Cable Loss	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.21	29.30	-24.10	53.40	19.20	0.03	10.07	Average
2 *	0.21	46.20	-17.20	63.40	36.10	0.03	10.07	QP
3	0.27	22.81	-28.17	50.98	12.70	0.03	10.08	Average
4	0.27	39.11	-21.87	60.98	29.00	0.03	10.08	QP
5	0.33	17.01	-32.34	49.35	6.90	0.03	10.08	Average
6	0.33	35.41	-23.94	59.35	25.30	0.03	10.08	QP
7	0.48	20.50	-25.91	46.41	10.40	0.02	10.08	Average
8	0.48	34.70	-21.71	56.41	24.60	0.02	10.08	QP
9	0.68	20.30	-25.70	46.00	10.20	0.02	10.08	Average
10	0.68	32.40	-23.60	56.00	22.30	0.02	10.08	QP
11	13.55	25.78	-24.22	50.00	15.10	0.29	10.39	Average
12	13.55	36.08	-23.92	60.00	25.40	0.29	10.39	QP



## 3.2. Test of Radiated Emission Measurement

### 3.2.1. Limit of Radiated Emission

The emissions from an unintentional radiator shall not exceed the field strength levels specified in the following table:

**<Class B Limit>**

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

### 3.2.2. Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

### 3.2.3. Test Procedures

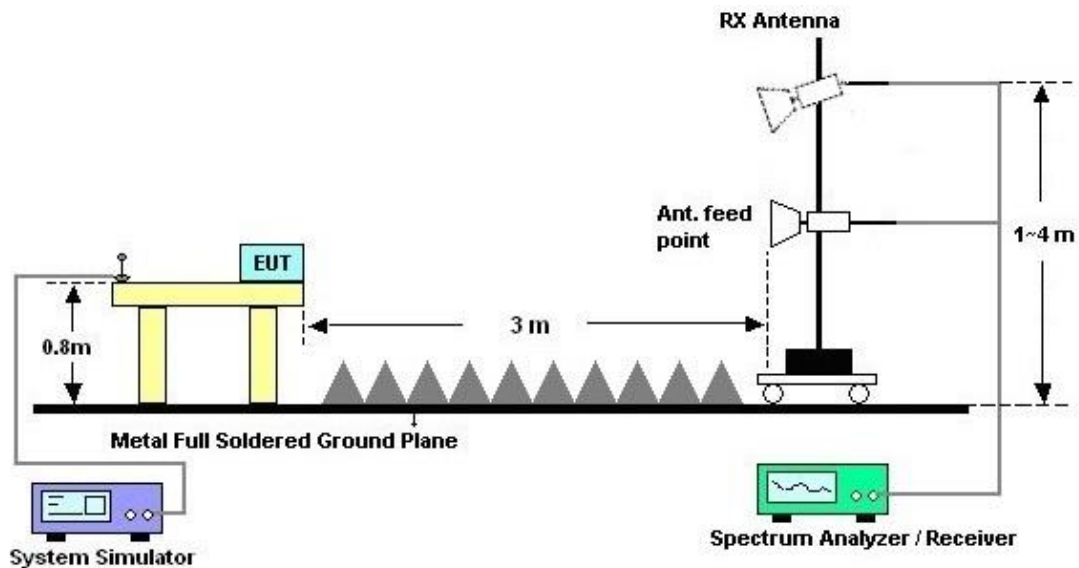
1. The EUT was placed on a turntable with 0.8 meter above ground.
2. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
3. The table was rotated 360 degrees to determine the position of the highest radiation.
4. The antenna is a Bi-Log antenna and its height is adjusted between one to four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. Set the test-receiver system to Peak Detect Function and specified bandwidth with Maximum Hold Mode (RBW=120kHz/VBW=300kHz for frequency below 1GHz; RBW=1MHz VBW=3MHz (Peak), RBW=1MHz/VBW=10Hz (Average) for frequency above 1GHz).
7. If the emission level of the EUT in peak mode was 3 dB lower than the limit specified, peak values of EUT will be reported. Otherwise, the emission will be repeated by using the quasi-peak method and reported.
8. Emission level (dBμV/m) = 20 log Emission level (μV/m)
9. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

### 3.2.4. Test Setup of Radiated Emission

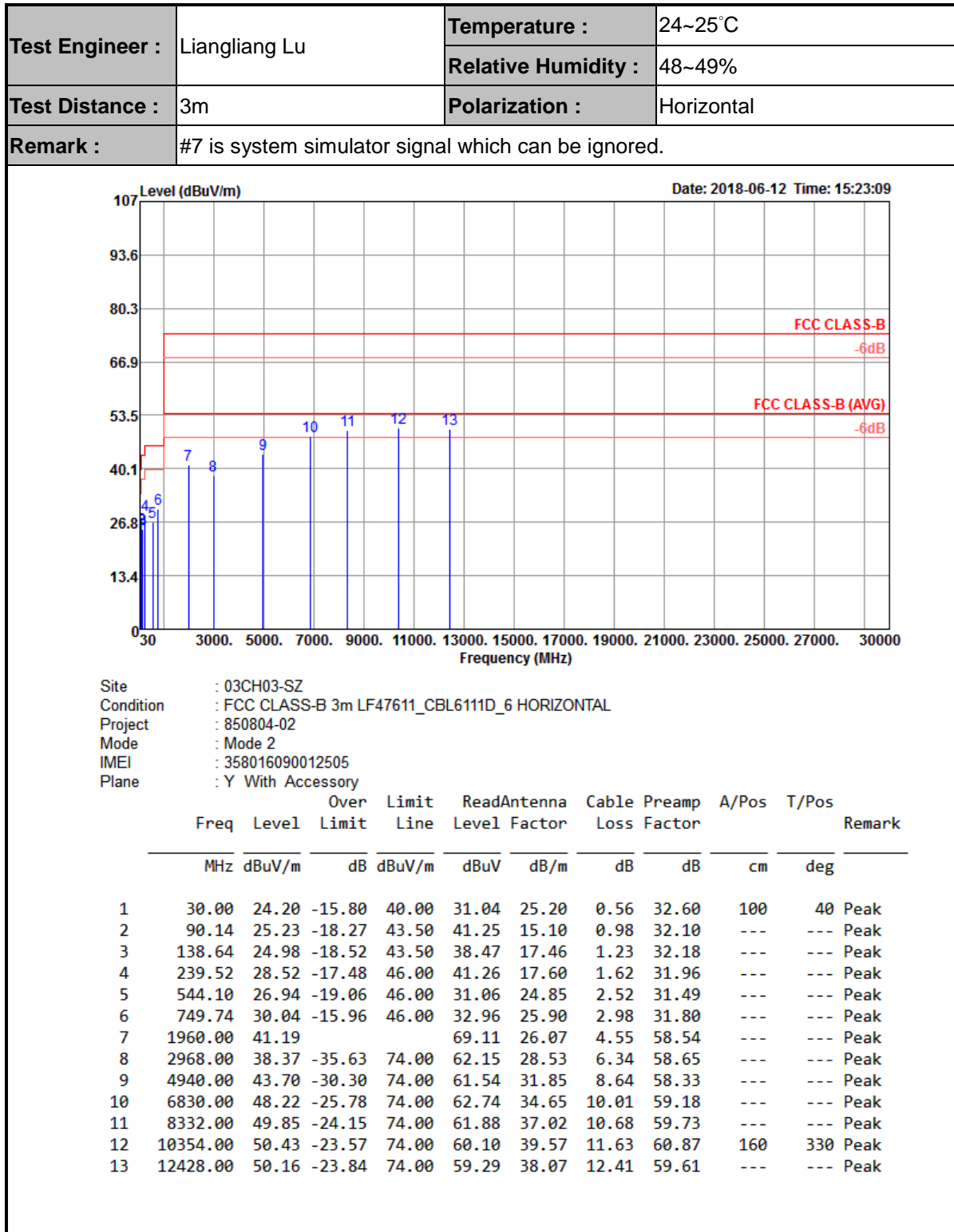
For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz

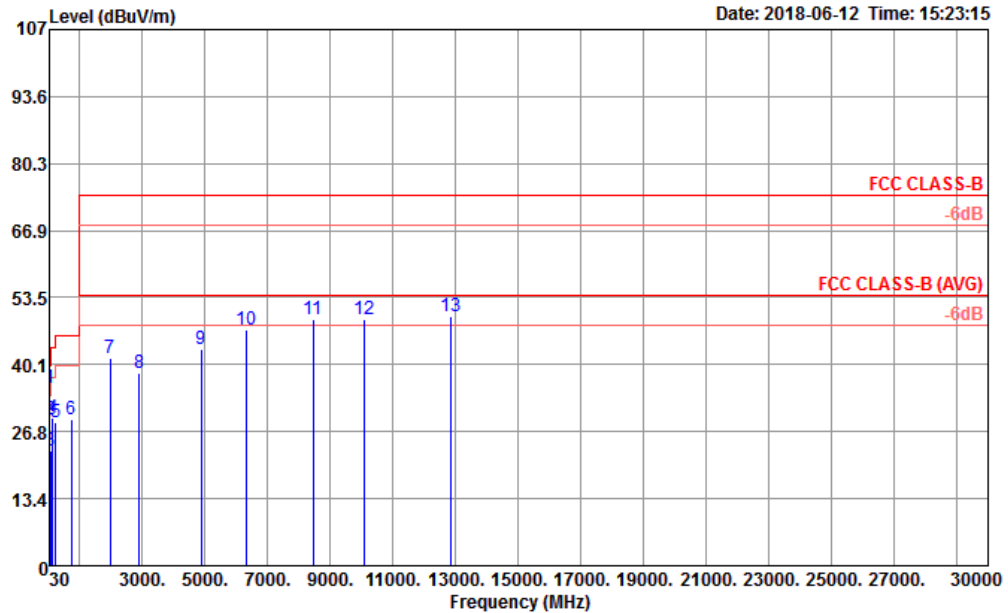


### 3.2.5. Test Result of Radiated Emission





Test Engineer :	Liangliang Lu	Temperature :	24~25°C
		Relative Humidity :	48~49%
Test Distance :	3m	Polarization :	Vertical
Remark :	#7 is system simulator signal which can be ignored.		



Site : 03CH03-SZ  
 Condition : FCC CLASS-B 3m LF47611\_CBL6111D\_6 VERTICAL  
 Project : 850804-02  
 Mode : Mode 2  
 IMEI : 358016090012505  
 Plane : Y With Accessory

	Freq	Level	Over	Limit	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark
	MHz	dBuV/m	Limit	Line	Level	Factor	Loss	Factor	cm	deg
1 !	30.00	35.37	-4.63	40.00	42.21	25.20	0.56	32.60	155	70 Peak
2	45.52	29.29	-10.71	40.00	45.17	16.13	0.69	32.70	---	---
3	71.71	23.07	-16.93	40.00	42.05	12.65	0.87	32.50	---	---
4	140.58	29.51	-13.99	43.50	43.14	17.32	1.23	32.18	---	---
5	234.67	28.67	-17.33	46.00	41.93	17.00	1.60	31.86	---	---
6	741.98	29.28	-16.72	46.00	32.30	25.79	2.96	31.77	---	---
7	1960.00	41.37			69.29	26.07	4.55	58.54	---	---
8	2908.00	38.52	-35.48	74.00	62.65	28.38	6.13	58.64	---	---
9	4886.00	43.15	-30.85	74.00	61.06	31.80	8.62	58.33	---	---
10	6314.00	47.05	-26.95	74.00	62.92	33.25	9.69	58.81	---	---
11	8462.00	49.27	-24.73	74.00	60.93	37.24	10.77	59.67	---	---
12	10084.00	49.31	-24.69	74.00	59.88	38.98	11.53	61.08	---	---
13	12868.00	49.79	-24.21	74.00	58.94	37.75	12.59	59.49	151	210 Peak



## 4. List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
EMI Test Receiver&SA	KEYSIGHT	N9038A	MY54450083	20Hz~8.4GHz	Apr. 19, 2018	Jun. 12, 2018	Apr. 18, 2019	Radiation (03CH03-SZ)
EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY55150246	10Hz~44GHz;	Apr. 19, 2018	Jun. 12, 2018	Apr. 18, 2019	Radiation (03CH03-SZ)
Bilog Antenna	TeseQ	CBL6112D	35408	30MHz~2GHz	Apr. 19, 2018	Jun. 12, 2018	Apr. 18, 2019	Radiation (03CH03-SZ)
Double Ridge Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-1355	1GHz~18GHz	Mar. 29 2018	Jun. 12, 2018	Mar. 28, 2019	Radiation (03CH03-SZ)
LF Amplifier	Burgeon	BPA-530	102210	0.01Hz~3000MHz	Oct. 19, 2017	Jun. 12, 2018	Oct. 18, 2018	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	AMF-7D-00101 800-30-10P-R	1943528	1GHz~18GHz	Oct. 19, 2017	Jun. 12, 2018	Oct. 18, 2018	Radiation (03CH03-SZ)
AC Power Source	Chroma	61601	616010001985	N/A	NCR	Jun. 12, 2018	NCR	Radiation (03CH03-SZ)
Turn Table	EM	EM1000	N/A	0~360 degree	NCR	Jun. 12, 2018	NCR	Radiation (03CH03-SZ)
Antenna Mast	EM	EM1000	N/A	1 m~4 m	NCR	Jun. 12, 2018	NCR	Radiation (03CH03-SZ)
EMI Receiver	R&S	ESR7	101630	9kHz~7GHz;	Dec. 26, 2017	Jun. 19, 2018	Dec. 25, 2018	Conduction (CO01-SZ)
AC LISN	EMCO	3816/2SH	00103912	9kHz~30MHz	Dec. 26, 2017	Jun. 19, 2018	Dec. 25, 2018	Conduction (CO01-SZ)
AC LISN (for auxiliary equipment)	MessTec	3816/2SH	00103892	9kHz~30MHz	Nov. 01, 2017	Jun. 19, 2018	Oct. 31, 2018	Conduction (CO01-SZ)
AC Power Source	Chroma	61602	616020000891	100Vac~250Vac	Jul. 19, 2017	Jun. 19, 2018	Jul. 18, 2018	Conduction (CO01-SZ)

NCR: No Calibration Required

## 5. Uncertainty of Evaluation

### Uncertainty of Conducted Emission Measurement (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	2.6 dB
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### Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	5.0 dB
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### Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ( $U = 2Uc(y)$ )	4.8 dB
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