

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT OF

Product Name: Industrial radio remote control systems

Brand Name: ARC

Model No.: FLEX ECO 8S/8X

Model Different: N/A

FCC ID: R4UARCFLEXECO

Report No.: ER/2015/40149

Issue Date: Jul. 20, 2015

Rule Part: §15.231

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VERIFICATION OF COMPLIANCE

Applicant: Advanced Radiotech Corporation
1F. 288-1, Hsin Ya Road, Chien Chen Dist., Kaohsiung City, Taiwan.

Product Name: Industrial radio remote control systems

Brand Name: ARC

FCC ID: R4UARCFLEXECO

Model No.: FLEX ECO 8S/8X

Model Different: N/A

File Number: ER/2015/40149

Date of test: Apr. 13, 2015 ~ Jul. 06, 2015

Date of EUT Received: Apr. 13, 2015

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 2009 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.231.

The test results of this report relate only to the tested sample identified in this report.

Test By:

Marcus Tseng

Date:

Jul. 20, 2015

Marcus Tseng / Engineer**Prepared By:**

Allen Tsai

Date:

Jul. 20, 2015

Allen Tsai / Engineer**Approved By:**

Jim Chang

Date:

Jul. 20, 2015

Jim Chang / Asst. Manager

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Version

Report Number	Revision	Description	Issue Date
ER/2015/40149	Rev.00	Initial creation of document	May. 22, 2015
ER/2015/40149	Rev.01	Correct Page 9 Radiated Emission from 1.5M table height to 0.8M.	May. 27, 2015
ER/2015/40149	Rev.02	1. Correct Duty cycle test result and update Average factor to Radiated emission test. 2. Add extra equipment calibration tables.	Jun. 30, 2015
ER/2015/40149	Rev.03	Correct Typos on page 20~35 and page 40.	Jul. 01, 2015
ER/2015/40149	Rev.04	Update Duty Cycle and average factor.	Jul. 15, 2015
ER/2015/400149	Rev.05	Revise Transmit power to ≤ 88.18 dBuV/m Max.	Jul. 20, 2015

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1. GENERAL INFORMATION

1.1 Product Description

Product Name:	Industrial radio remote control systems
Brand Name:	ARC
Model No.	FLEX ECO 8S/8X
Model Different:	N/A
Hardware Version:	N/A
Software Version:	N/A
Power Supply:	3Vdc from AA batteries*2

433 MHz:

Operating Frequency	433.050MHz ~434.575MHz
Transmit Power	≤ 88.18 dBuV/m Max.
Modulation Technique	GFSK
Number of Channels	62 Channel
Channel Spacing	25 kHz
Antenna Type	PCB Antenna

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1.2 Related Submittal(s) / Grant (s)

The equipment under Test (Hereafter Called: EUT) is Industrial radio remote control systems supporting, 433MHz features, and below is details of information.

Product Feature	
Product Name:	Industrial radio remote control systems
Brand Name:	ARC
Type No.:	FLEX ECO 8S/8X
Model Difference:	N/A
FCC ID	R4UARCFLEXECO
433MHz	GFSK

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

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1.3 Test Methodology

FCC Part 15, Subpart C § 15.231

ANSI C63.10:2009

Note:

1. All test items have been performed and record as per the above standards.
2. The composite system is compliance with FCC Subpart B is authorized under the certification procedure.

1.4 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan. (TAF code 0513)

FCC Registration Numbers are: 990257 (Wugu)

Canada Registration Number: 4620A-5

1.5 Special Accessories

There are no special accessories used while test was conducted.

1.6 Equipment Modifications

There was no modification incorporated into the EUT.

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2. SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. the Tx frequency was fixed which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions (Not apply in the report)

The EUT is a placed on as turn table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz,. The CISPR Quasi-Peak and Average detector mode is employed according to §15.107. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Radiated Emissions

The EUT is a placed on as turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 0.8 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.

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2.4 Results Explanation Example

For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

Note:

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Following shows an offset computation example with cable loss 0.5 dB and 10 dB attenuator.

Offset = RF cable loss (dB)+ attenuation factor(dB) =0.5+10=10.5(dB)

2.5 Limitation

(1) Conducted Emission

According to section 15.207(a) Conducted Emission Limits is as following.

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 – 0.5	66 - 56	56 - 46
0.5 – 5	56	46
5 - 30	60	50

(2) Radiated Emission

According to 15.231(b), the field strength of emissions from Intentional Radiators operated under this section shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental		Field Strength of Spurious	
	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)
40.66 - 40.70	67.04	2,250	47	225
70 - 130	61.94	1,250	41.9	125
130 - 174	* 61.94 - 71.48	* 1,250 -3,750	* 41.9 – 51.48	* 125 to 375
174 - 260	71.48	3,750	51.48	375
260 - 470	* 71.48 - 81.94	* 3,750 - 12,500	* 51.48 - 54	* 375 to 1250
above 470	81.94	12,500	74	1250

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- Remark:
1. Emission level in dBuV/m = $20 \log (\mu\text{V/m})$
 2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
 3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of § 15.205
 4. Emission spurious frequency which appearing within the Restricted Bands specified in provision of §15.205, then the general radiated emission limits in § 15.209 apply.
 5. For the band 130-174MHz, $\mu\text{V/m}$ at 3meters = $56.81818(F) - 6136.3636$;
For the band 260-470MHz $\mu\text{V/m}$ at 3meters = $41.6667(F) - 7083.3333$;
Where F is the frequency in MHz.
 6. 433.05 MHz limit = $41.6667 * 433.05 - 7083.3333 = 10965.431435 \mu\text{V/m}$
= 80.80 dBuV/m
433.825 MHz limit = $41.6667 * 433.825 - 7083.3333 = 10992.7228275 \mu\text{V/m}$
= 80.82 dBuV/m
434.575 MHz limit = $41.6667 * 434.575 - 7083.3333 = 11023.972853 \mu\text{V/m}$
= 80.85 dBuV/m

2.5 Configuration of Tested System

Fig. 2-1 Configuration of Tested System

EUT(TX)

Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1.	N/A					

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3. SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§ 15.207	Conducted Emission	N/A
§ 15.231	Radiated Emission	Compliant
§ 15.231(c)	20dB Bandwidth	Compliant
§ 15.35 (c)	Duty Cycle Test (Pulse Modulation)	Compliant
§ 15.231(a)(1)	Release Time Measurement	Compliant

4. DESCRIPTION OF TEST MODES

4.1 Operated in 433.05 ~ 434.57 MHz Band

62 channels are provided.

CH	FREQUENCY	CH	FREQUENCY	CH	FREQUENCY	CH	FREQUENCY
01	433.050MHZ	18	433.475MHZ	35	433.900MHZ	52	434.325MHZ
02	433.075MHZ	19	433.500MHZ	36	433.925MHZ	53	434.350MHZ
03	433.100MHZ	20	433.525MHZ	37	433.950MHZ	54	434.375MHZ
04	433.125MHZ	21	433.550MHZ	38	433.975MHZ	55	434.400MHZ
05	433.150MHZ	22	433.575MHZ	39	434.000MHZ	56	434.425MHZ
06	433.175MHZ	23	433.600MHZ	40	434.025MHZ	57	434.450MHZ
07	433.200MHZ	24	433.625MHZ	41	434.050MHZ	58	434.475MHZ
08	433.225MHZ	25	433.650MHZ	42	434.075MHZ	59	434.500MHZ
09	433.250MHZ	26	433.675MHZ	43	434.100MHZ	60	434.525MHZ
10	433.275MHZ	27	433.700MHZ	44	434.125MHZ	61	434.550MHZ
11	433.300MHZ	28	433.725MHZ	45	434.150MHZ	62	434.575MHZ
12	433.325MHZ	29	433.750MHZ	46	434.175MHZ		
13	433.350MHZ	30	433.775MHZ	47	434.200MHZ		
14	433.375MHZ	31	433.800MHZ	48	434.225MHZ		
15	433.400MHZ	32	433.825MHZ	49	434.250MHZ		
16	433.425MHZ	33	433.850MHZ	50	434.275MHZ		
17	433.450MHZ	34	433.875MHZ	51	434.300MHZ		

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4.2 The Worst Test Modes and Channel Details

RADIATED EMISSION TEST:

RADIATED EMISSION TEST (BELOW 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
433 MHz	1 to 62	1,32,62	GFSK	1	MAIN
RADIATED EMISSION TEST (ABOVE 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
433 MHz	1 to 62	1,32,62	GFSK	1	MAIN

Note:

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for 433MHz Transmitter for channel Low, Mid and High, the worst case H position was reported.

ANTENNA PORT CONDUCTED MEASUREMENT:

CONDUCTED TEST					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
433 MHz	1 to 62	1,32,62	GFSK	1	MAIN

Note:

Per 15.31 (e) - For battery operated equipment, the equipment tests shall be performed using a new battery. All test items for this report are performed with a new battery.

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5. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 1.55 dB
20dB Bandwidth	+/- 123.36 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Frequency Separation	+/- 123.36 Hz
Number of hopping frequency	+/- 123.36 Hz
Time of Occupancy	+/- 123.36 Hz
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : Vertical)	9kHz~30MHz: +2.3dB
	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

Measurement uncertainty (Polarization : Horizontal)	9kHz~30MHz: +2.3dB
	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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6. CONDUCTED EMISSIONS TEST (NOT APPLY IN THE REPORT)

6.1 Standard Applicable

According to §15.207 and frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

6.2 Measurement Equipment Used:

SGS Conducted Emission Test Site No.A					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
EMI Test Receiver	R&S	ESCI7	100760	05/26/2014	05/25/2015
LISN	TESEQ	NNB 51	36076	02/16/2015	02/15/2016
LISN	FCC	FCC-LISN-50/250-25 -2-01	04034	03/13/2015	03/12/2016
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2014	11/25/2015

Remark: Please note that the duration to conduct the test took place in the mean time when the calibration for several equipments is due, and therefore an extra table of equipment calibration is constructed to indicate the calibration work is still maintained.

SGS SAC Chamber No.C (FCC)					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
EMI Test Receiver	R&S	ESCI7	100760	05/04/2015	05/03/2016

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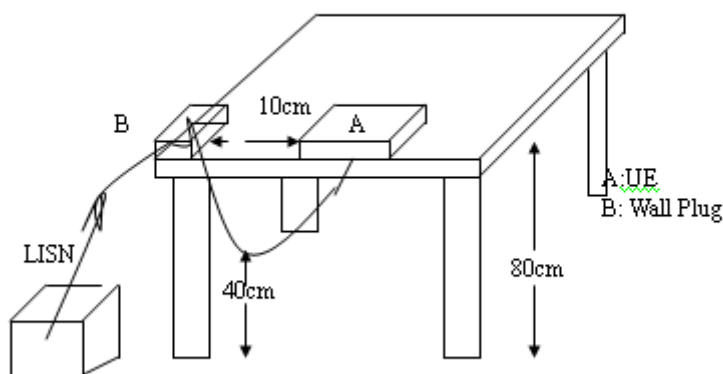
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6.3 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2009.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

6.4 Test SET-UP (Block Diagram of Configuration)



6.5 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

6.6 Measurement Result

N/A; Powered from AA battery.

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7. RADIATED EMISSION TEST

7.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all frequency of the interest measured were complete.

Auxiliary Procedure (Setting on Spectrum to capture the reading of emission level):

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Test was measured starting from 9kHz to 10th harmonic of the fundamental frequency, and data containing the worst result over 30MHz are shown on the test report.

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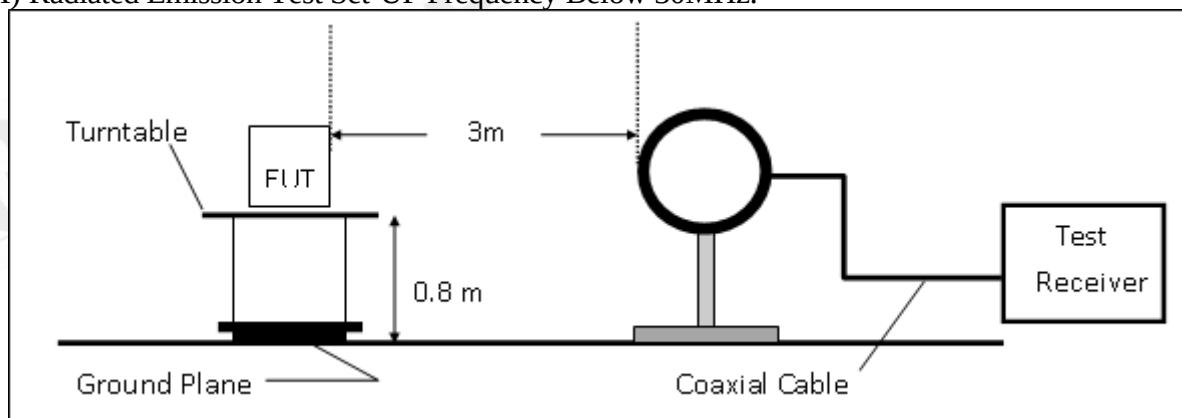
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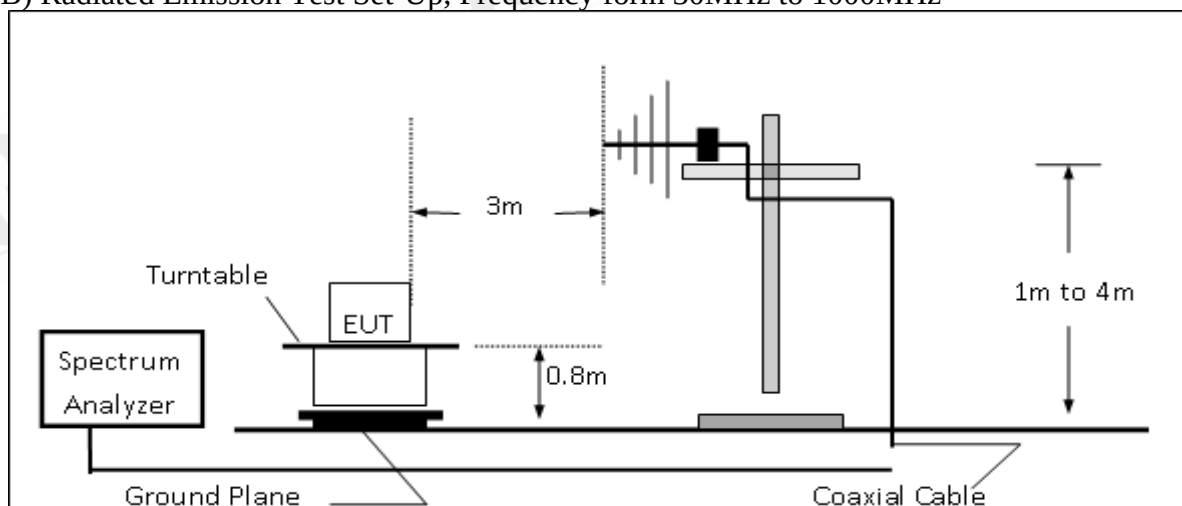
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7.2 Test SET-UP (Block Diagram of Configuration).

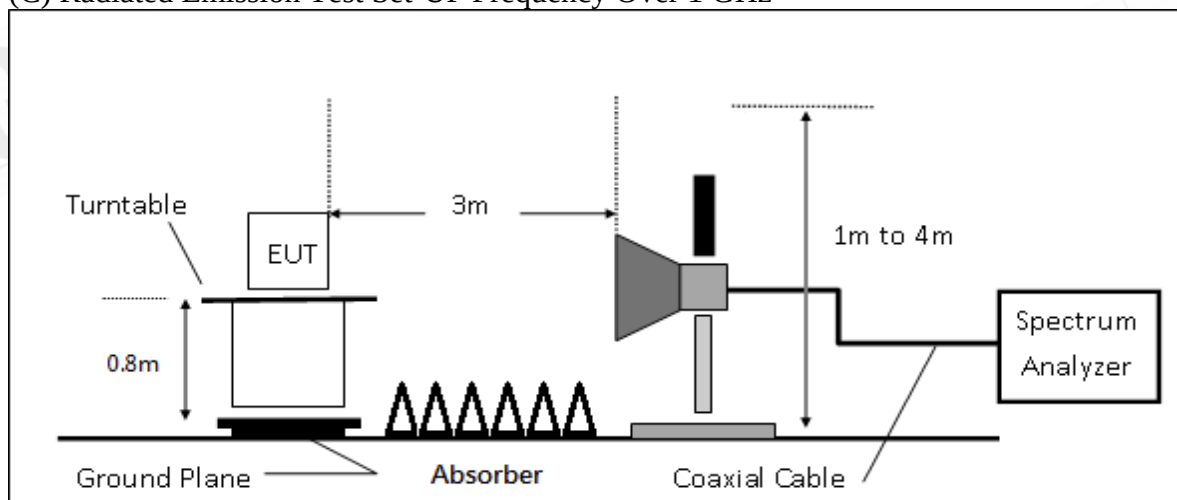
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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7.3 Measurement Equipment Used:

SGS SAC Chamber No.C (FCC)					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
EMI Test Receiver	R&S	ESCI7	100760	05/26/2014	05/25/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	12/22/2014	12/21/2015
Spectrum Analyzer	R&S	FSV-30	101398	10/07/2014	10/06/2015
Loop Antenna	ETS.LINDGREN	6502	00148045	07/03/2014	07/02/2015
Bilog Antenna	SCHWAZBECK	VULB9168	378	12/23/2014	12/22/2015
Horn antenna	ETS.LINDGREN	3117	123995	05/19/2014	05/18/2015
Horn Antenna	Schwarzbeck	BBHA9170	184	12/25/2014	12/24/2015
Pre-Amplifier	Agilent	8447D	2944A07676	01/02/2015	01/01/2016
Pre-Amplifier	Agilent	8449B	3008A00578	01/02/2015	01/01/2016
Pre-Amplifier	EMC Instruments Corp.	EMC184045	980135	01/02/2015	01/01/2016
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M2	01/02/2015	01/01/2016
Attenuator	Mini-Circuit	BW-S10W2+	004	01/02/2015	01/01/2016
Turn Table	HD	DT420	N/A	N.C.R	N.C.R
Antenna Tower	HD	MA240-N	240/657	N.C.R	N.C.R
Controller	HD	HD100	N/A	N.C.R	N.C.R
Low Loss Cable	Huber Suhner	966_Rx	9	01/02/2015	01/01/2016
3m Site NSA	SGS	966 chamber	N/A	07/15/2014	07/14/2015

Remark: Please note that the duration to conduct the test took place in the mean time when the calibration for several equipments is due, and therefore an extra table of equipment calibration is constructed to indicate the calibration work is still maintained.

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SGS SAC Chamber No.C (FCC)					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
EMI Test Receiver	R&S	ESCI7	100760	04/05/2015	05/03/2016
Spectrum Analyzer	Agilent	E4446A	MY51100003	01/29/2015	01/28/2016
Loop Antenna	ETS.LINDGREN	6502	00143303	12/9/2014	12/08/2015
Horn antenna	ETS.LINDGREN	3117	123995	05/05/2015	05/04/2016
3m Site NSA	SGS	966 chamber	N/A	07/01/2015	06/30/2016

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7.4 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

Remark:

The limit of the emission level is expressed in dBuV/m, which converts $20 \times \log(uV/m)$

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note :

“F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

7.5 Test Results of Radiated Spurious Emissions form 9 KHz to 30 MHz

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit per 15.31(o) was not reported.

7.6 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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7.7. Measurement Result

Operation Band	: Main Low	Test Date	:2015-07-14
Fundamental Frequency	:433.05 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX MAIN	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
433.05	F	Peak	93.78	-5.82	87.96	100.80	-12.84
433.05	F	Average	---	-8.24	79.72	80.80	-1.08

Operation Band	: Main Low	Test Date	:2015-07-14
Fundamental Frequency	:433.05 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX MAIN	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
433.05	F	Peak	76.43	-5.82	70.48	100.80	-30.32
433.05	F	Average	---	-8.24	62.24	80.80	-18.56

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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Operation Band	: Main Mid	Test Date	:2015-07-14
Fundamental Frequency	:433.825 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX MAIN	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
433.83	F	Peak	94.01	-5.83	88.18	100.82	-12.64
433.83	F	Average	---	-8.24	79.94	80.82	-0.88

Operation Band	: Main Mid	Test Date	:2015-07-14
Fundamental Frequency	:433.825 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX MAIN	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
433.83	F	Peak	76.88	-5.83	71.05	100.82	-29.77
433.83	F	Average	---	-8.24	62.81	80.82	-18.01

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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Operation Band	: Main High	Test Date	:2015-07-14
Fundamental Frequency	:434.575 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX MAIN	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:VERTICAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
434.57	F	Peak	93.87	-5.84	88.03	100.85	-12.82
434.57	F	Average	---	-8.24	79.79	80.85	-1.06

Operation Band	: Main High	Test Date	:2015-07-14
Fundamental Frequency	:434.575 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX MAIN	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:HORIZONTAL

Freq.	Note	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
434.57	F	Peak	76.57	-5.84	70.73	100.85	-30.12
434.57	F	Average	---	-8.24	62.49	80.85	-18.36

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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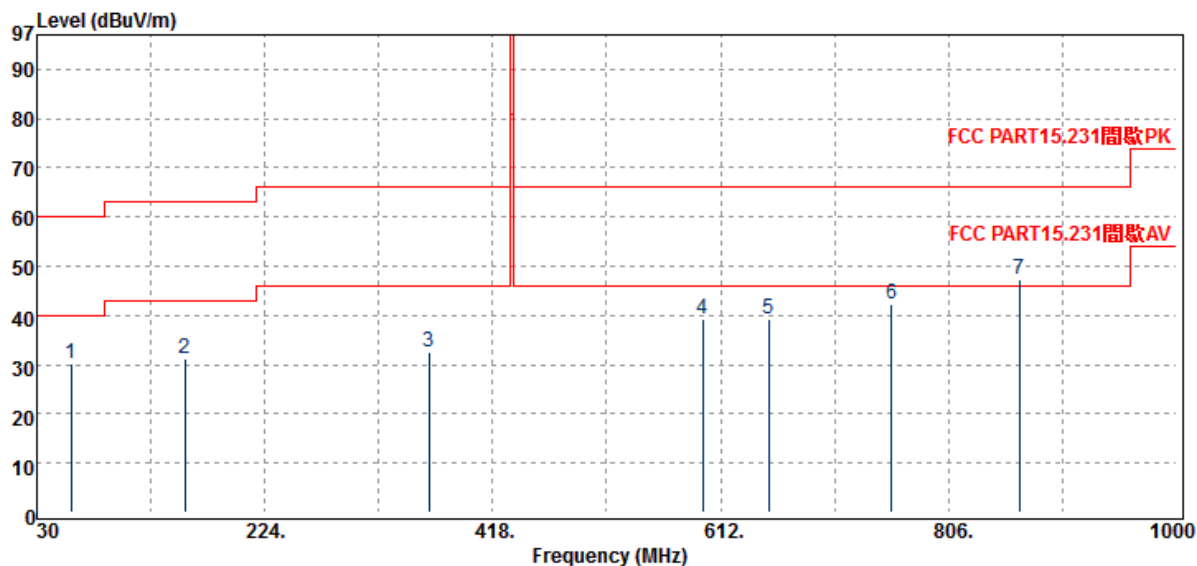
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Operation Band	:433 MHz	Test Date	:2015-07-14
Fundamental Frequency	:433.05 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
59.10	S	Peak	40.18	-10.10	30.08	60.00	-29.92
156.10	S	Peak	40.23	-8.98	31.25	63.00	-31.75
363.68	S	Peak	39.68	-6.99	32.69	66.00	-33.31
596.48	S	Peak	41.00	-1.73	39.27	66.00	-26.73
652.74	S	Peak	40.56	-1.26	39.30	66.00	-26.70
757.50	S	Peak	41.35	0.97	42.32	66.00	-23.68
866.14	H	Average	---	-8.24	38.96	46.00	-7.04
866.14	H	Peak	44.74	2.46	47.20	66.00	-18.80

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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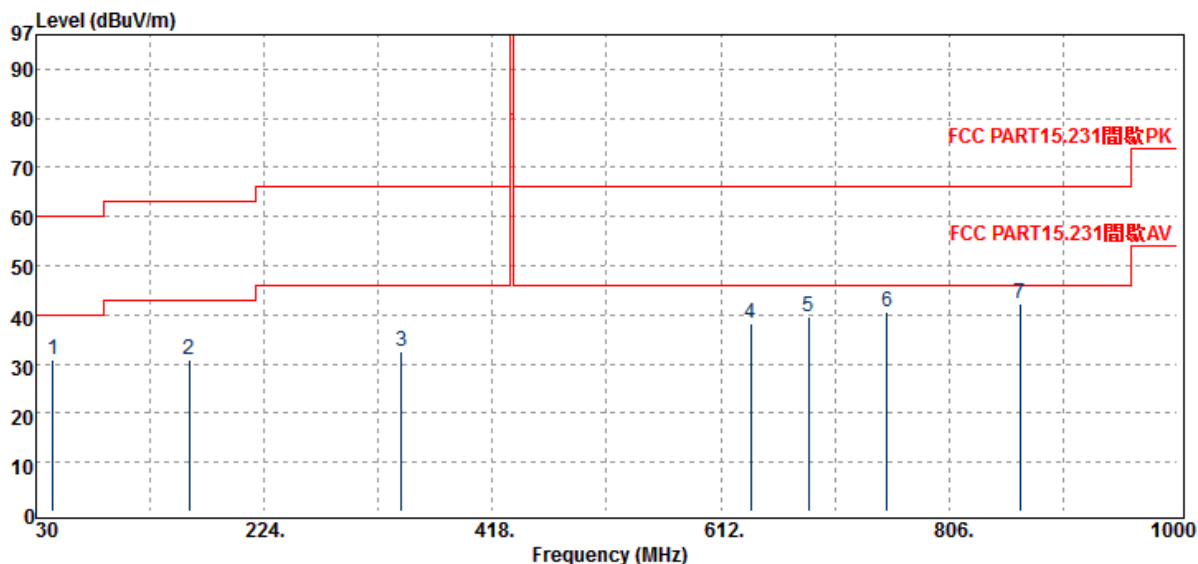
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Operation Band	:433 MHz	Test Date	:2015-07-14
Fundamental Frequency	:433.05 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	dB
		PK/QP/AV	dBuV		dBuV / m	dBuV / m	
44.55	S	Peak	40.33	-9.38	30.95	60.00	-29.05
159.98	S	Peak	39.80	-8.81	30.99	63.00	-32.01
340.40	S	Peak	40.21	-7.49	32.72	66.00	-33.28
637.22	S	Peak	40.29	-2.11	38.18	66.00	-27.82
686.69	S	Peak	40.53	-0.89	39.64	66.00	-26.36
753.62	S	Peak	39.98	0.64	40.62	66.00	-25.38
866.14	H	Average	---	-8.24	34.05	46.00	-11.95
866.14	H	Peak	39.83	2.46	42.29	66.00	-23.71

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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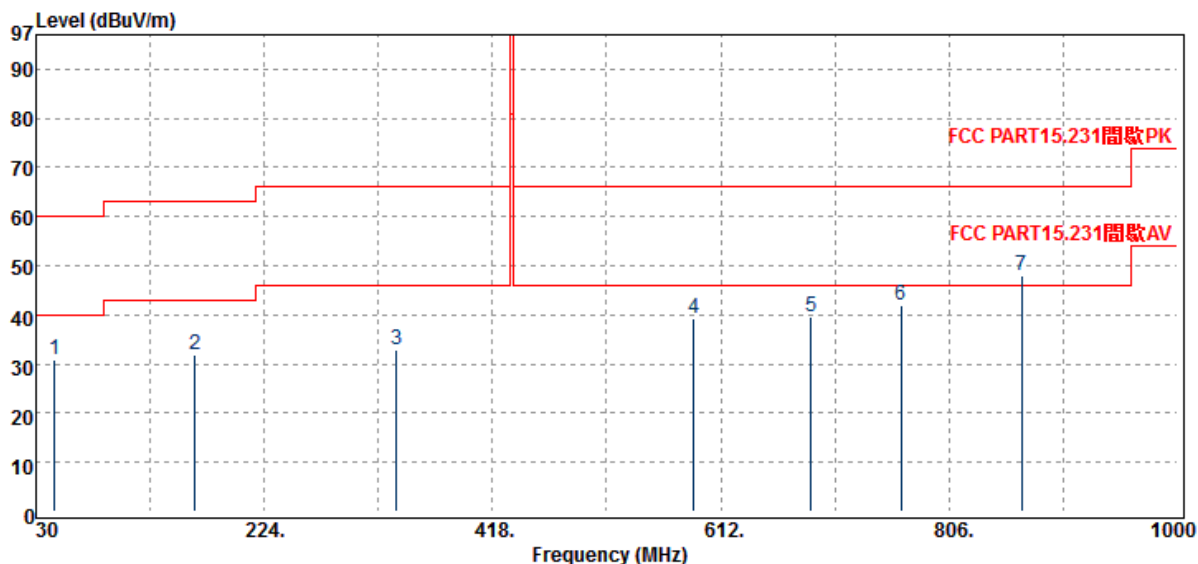
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Operation Band	:433 MHz	Test Date	:2015-07-14
Fundamental Frequency	:433.825 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
		PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
45.52	S	Peak	40.07	-9.34	30.73	60.00	-29.27
164.83	S	Peak	40.70	-8.96	31.74	63.00	-31.26
336.52	S	Peak	40.48	-7.59	32.89	66.00	-33.11
588.72	S	Peak	40.86	-1.55	39.31	66.00	-26.69
688.63	S	Peak	40.47	-0.84	39.63	66.00	-26.37
765.26	S	Peak	40.96	1.11	42.07	66.00	-23.93
867.66	H	Average	---	-8.24	39.79	46.00	-6.21
867.66	H	Peak	45.53	2.50	48.03	66.00	-17.97

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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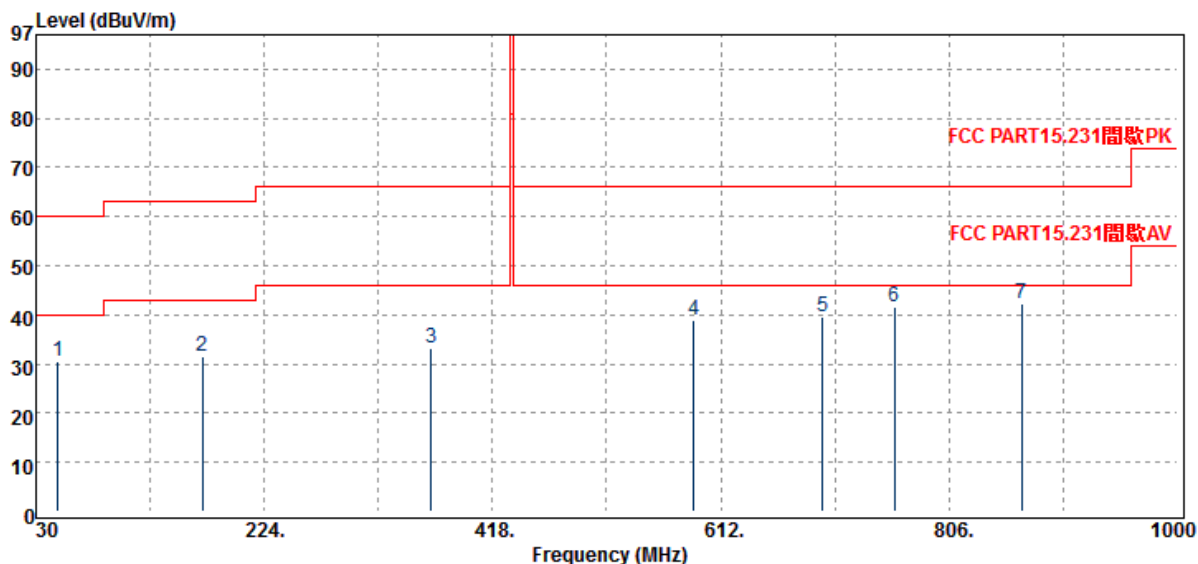
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Operation Band	:433 MHz	Test Date	:2015-07-14
Fundamental Frequency	:433.825 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	dB
		PK/QP/AV	dBuV		dBuV / m	dBuV / m	
48.43	S	Peak	39.99	-9.35	30.64	60.00	-29.36
171.62	S	Peak	41.04	-9.42	31.62	63.00	-31.38
365.62	S	Peak	40.02	-6.95	33.07	66.00	-32.93
588.72	S	Peak	40.56	-1.55	39.01	66.00	-26.99
698.33	S	Peak	40.74	-1.00	39.74	66.00	-26.26
759.44	S	Peak	40.40	1.07	41.47	66.00	-24.53
867.66	H	Average	---	-8.24	34.22	46.00	-11.78
867.66	H	Peak	39.96	2.50	42.46	66.00	-23.54

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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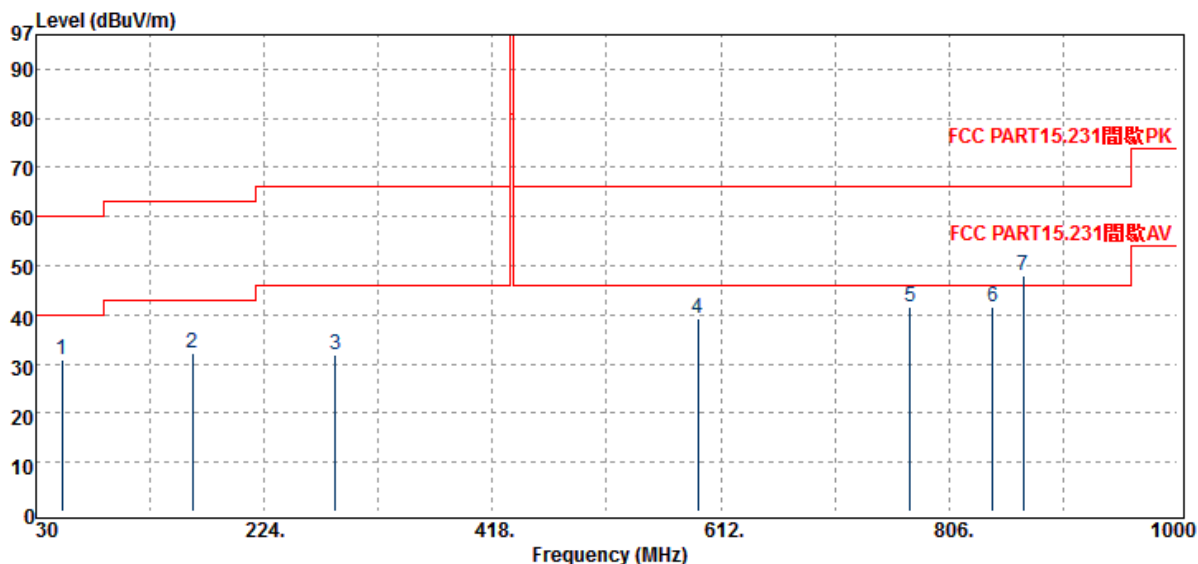
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Operation Band	:433 MHz	Test Date	:2015-07-14
Fundamental Frequency	:434.575 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX High	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	dB
		PK/QP/AV	dBuV		dBuV / m	dBuV / m	
52.31	S	Peak	40.34	-9.57	30.77	60.00	-29.23
162.89	S	Peak	41.00	-8.88	32.12	63.00	-30.88
284.14	S	Peak	40.22	-8.30	31.92	66.00	-34.08
592.60	S	Peak	40.80	-1.55	39.25	66.00	-26.75
773.02	S	Peak	40.71	0.82	41.53	66.00	-24.47
842.86	S	Peak	40.76	0.79	41.55	66.00	-24.45
869.14	H	Average	---	-8.24	39.70	46.00	-6.30
869.14	H	Peak	45.41	2.53	47.94	66.00	-18.06

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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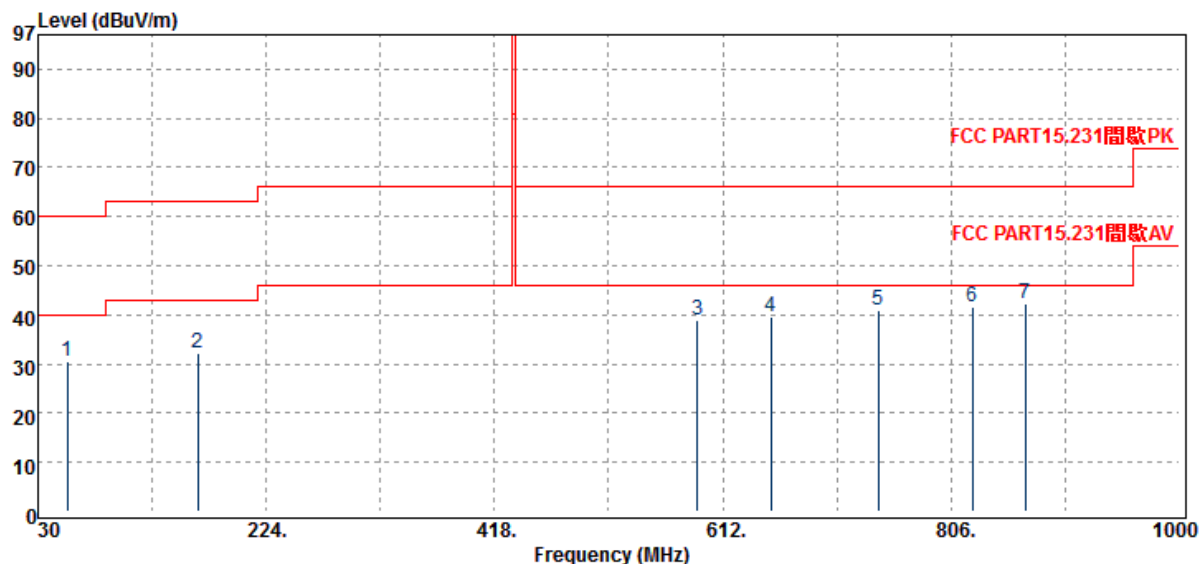
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Operation Band	:433 MHz	Test Date	:2015-07-14
Fundamental Frequency	:434.575 MHz	Temp./Humi.	:24.5 deg_C / 57RH
Operation Mode	:TX High	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level		FS	@3m	
		PK/QP/AV	dBμV	dB	dBμV / m	dBμV / m	dB
55.22	S	Peak	40.38	-9.80	30.58	60.00	-29.42
165.80	S	Peak	41.16	-8.99	32.17	63.00	-30.83
590.66	S	Peak	40.59	-1.53	39.06	66.00	-26.94
652.74	S	Peak	40.75	-1.26	39.49	66.00	-26.51
743.92	S	Peak	41.10	-0.17	40.93	66.00	-25.07
824.43	S	Peak	40.71	0.89	41.60	66.00	-24.40
869.14	H	Average	---	-8.24	34.02	46.00	-11.98
869.14	H	Peak	39.73	2.53	42.26	66.00	-23.74

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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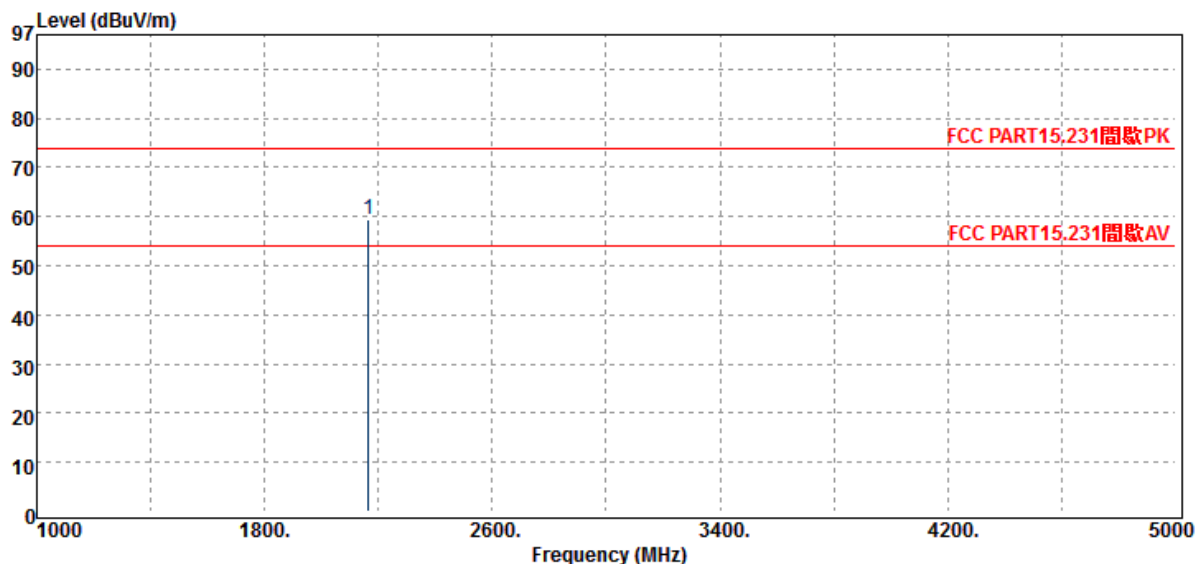
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Operation Band	:433 MHz	Test Date	:2015-05-22
Fundamental Frequency	:433.05 MHz	Temp./Humi.	:25.5 deg_C / 62RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	dB
		PK/QP/AV	dBμV		dBμV / m	dBμV / m	
2165.25	H	Average	---	-8.24	51.02	54.00	-2.98
2165.25	H	Peak	54.69	4.57	59.26	74.00	-14.74

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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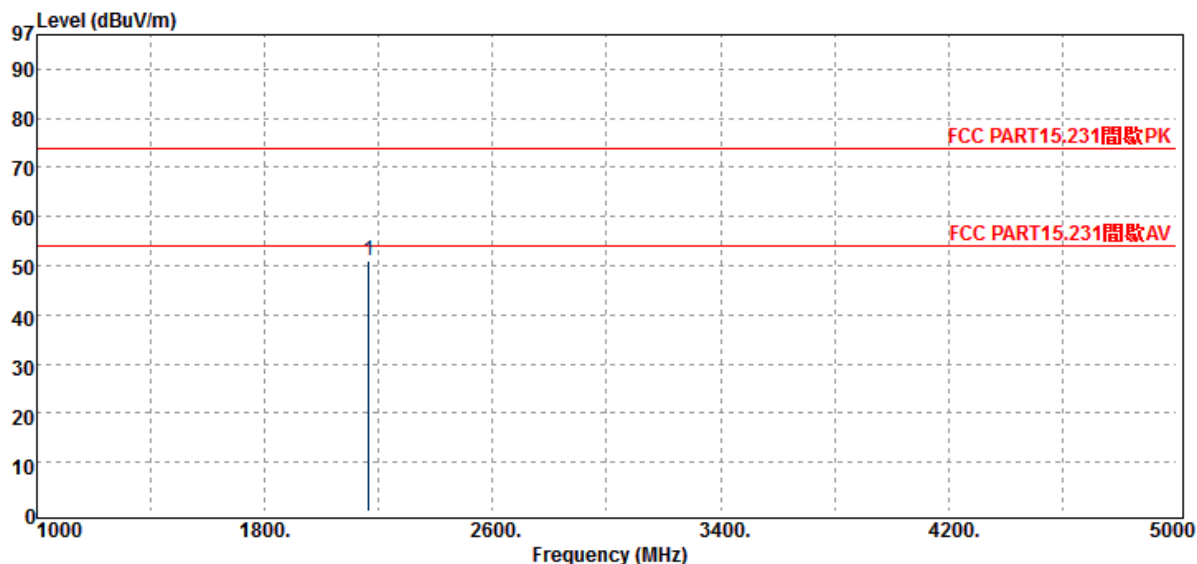
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Operation Band	:433 MHz	Test Date	:2015-05-22
Fundamental Frequency	:433.05 MHz	Temp./Humi.	:25.5 deg_C / 62RH
Operation Mode	:TX LOW	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	dB
		PK/QP/AV	dBuV		dBuV / m	dBuV / m	
2165.25	H	Average	---	-8.24	42.73	54.00	-11.27
2165.25	H	Peak	46.40	4.57	50.97	74.00	-23.03

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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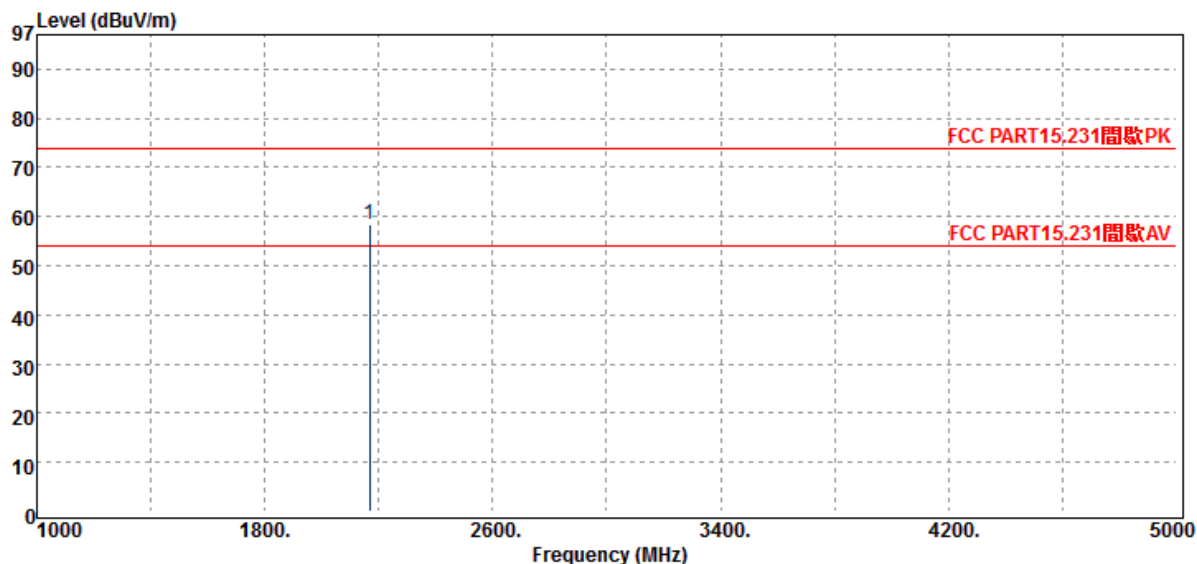
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Operation Band	:433 MHz	Test Date	:2015-05-22
Fundamental Frequency	:433.825 MHz	Temp./Humi.	:25.5 deg_C / 62RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	dB
		PK/QP/AV	dBuV		dBuV / m	dBuV / m	
2169.15	H	Average	---	-8.24	50.13	54.00	-3.87
2169.15	H	Peak	53.78	4.59	58.37	74.00	-15.63

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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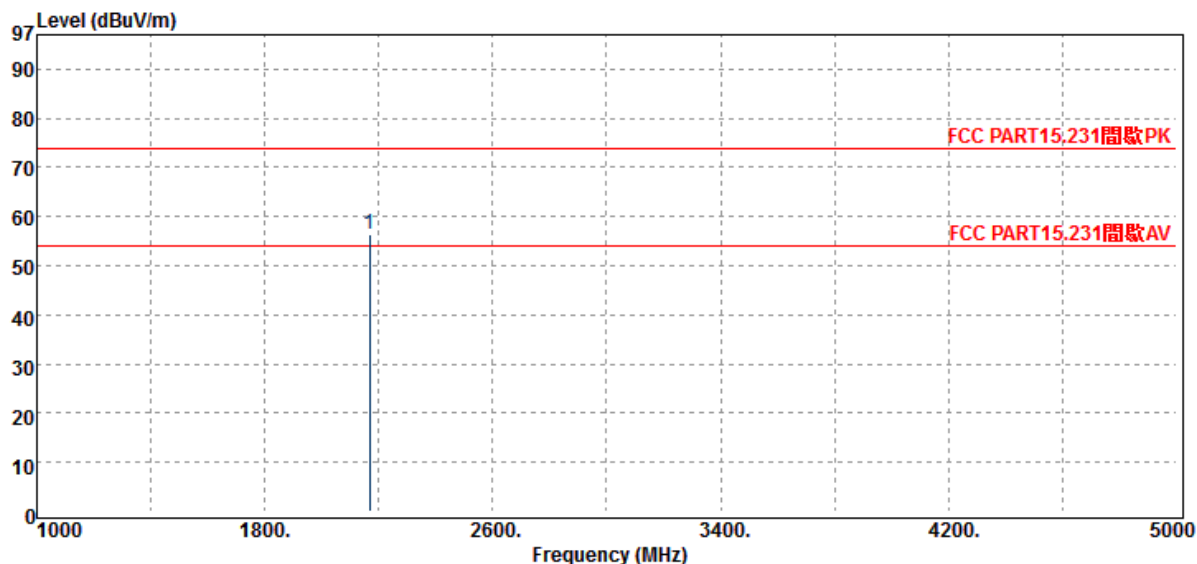
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Operation Band	:433 MHz	Test Date	:2015-05-22
Fundamental Frequency	:433.825 MHz	Temp./Humi.	:25.5 deg_C / 62RH
Operation Mode	:TX MID	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	dB
		PK/QP/AV	dB μ V		dB μ V / m	dB μ V / m	
2169.15	H	Average	---	-8.24	48.12	54.00	-5.88
2169.15	H	Peak	51.77	4.59	56.36	74.00	-17.64

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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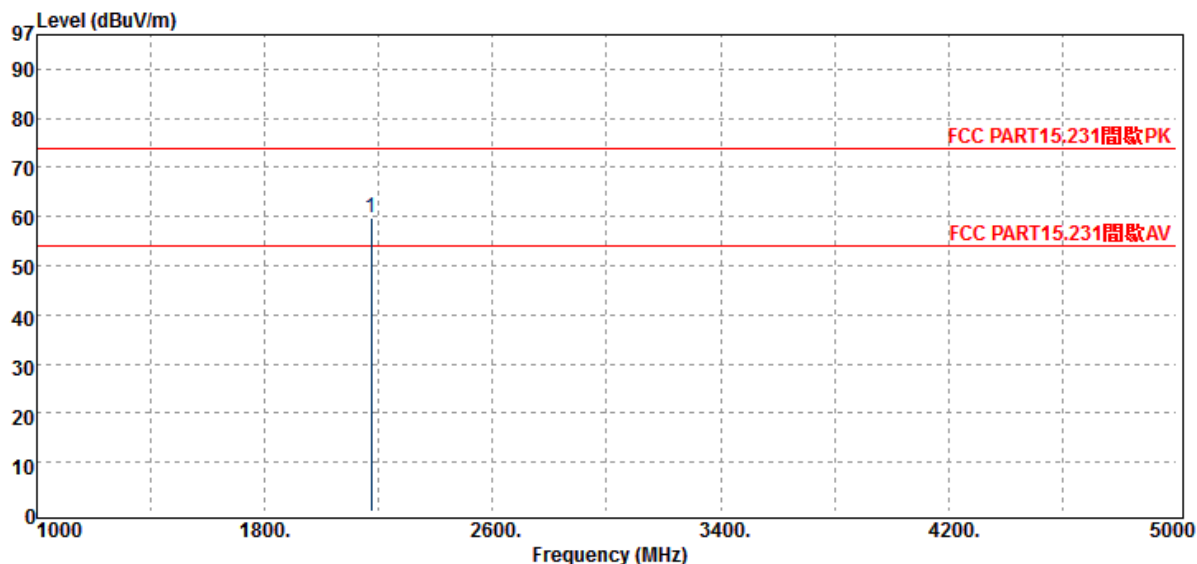
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Operation Band	:433 MHz	Test Date	:2015-05-22
Fundamental Frequency	:434.575 MHz	Temp./Humi.	:25.5 deg_C / 62RH
Operation Mode	:TX High	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:VERTICAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	dB
		PK/QP/AV	dBuV		dBuV / m	dBuV / m	
2172.85	H	Average	---	-8.24	51.53	54.00	-2.47
2172.85	H	Peak	55.16	4.61	59.77	74.00	-14.23

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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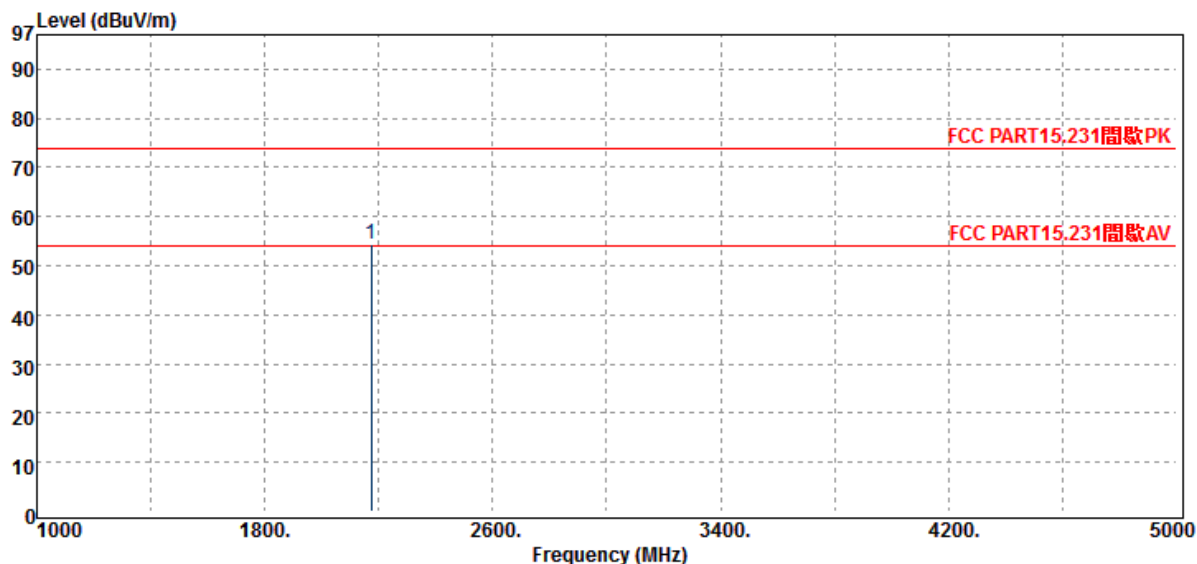
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Operation Band	:433 MHz	Test Date	:2015-05-22
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Operation Mode	:TX High	Engineer	:Curry
EUT Pol.	:H PLAN	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	dB	FS	@3m	dB
		PK/QP/AV	dBμV		dBμV / m	dBμV / m	
2172.85	H	Average	---	-8.24	46.19	54.00	-7.81
2172.85	H	Peak	49.82	4.61	54.43	74.00	-19.57

Note: Average Actual = Peak Actual + Average Factor (-8.24)

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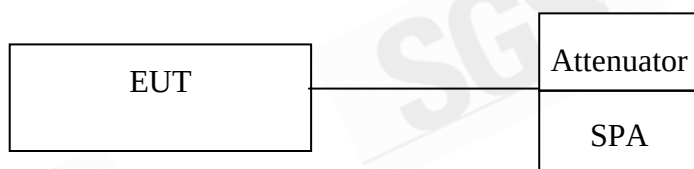
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8. 20DB OCCUPIED BANDWIDTH

8.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 10KHz, Span =100KHz.
4. Set SPA -20dB Occupied bandwidth.

8.2 Test SET-UP (Block Diagram of Configuration)



8.3 Measurement Equipment Used:

SGS Conducted Emission Test Site No.A					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Power Meter	Anritsu	ML2495A	1005007	12/20/2014	12/19/2015
Power Sensor	Anritsu	MA2411B	917032	12/20/2014	12/19/2015
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/19/2014	05/18/2015
Low Loss Cable	HUBER+SUHNER	SUCOFLEX 104PEA	N/A	01/02/2015	01/01/2016
Spectrum Analyzer	Agilent	E4440A	MY45304525	03/12/2015	03/11/2016
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2015	01/01/2016
Attenuator	Mini-Circuit	BW-S10W2+	002	01/02/2015	01/01/2016

Remark: Please note that the duration to conduct the test took place in the mean time when the calibration for several equipments is due, and therefore an extra table of equipment calibration is constructed to indicate the calibration work is still maintained.

SGS SAC Chamber No.C (FCC)					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY51100003	01/29/2015	01/28/2016

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8.4 Measurement Results

Refer to attached data chart.

The center frequency f_c is **433.825MHz**, according to the Rules, section 15.231(C), the Bandwidth of Center Frequency at-20dB should be calculated as following:

$$433.825 \times 0.0025 = 1.0846 \text{ (MHz)}$$

Measurement Result:

CH Low = 38.56 kHz

CH Mid = 39.50 kHz

CH High= 37.32 kHz

-20dB bandwidth = 38.56kHz, 39.50kHz and 37.32kHz which within allowed limit.

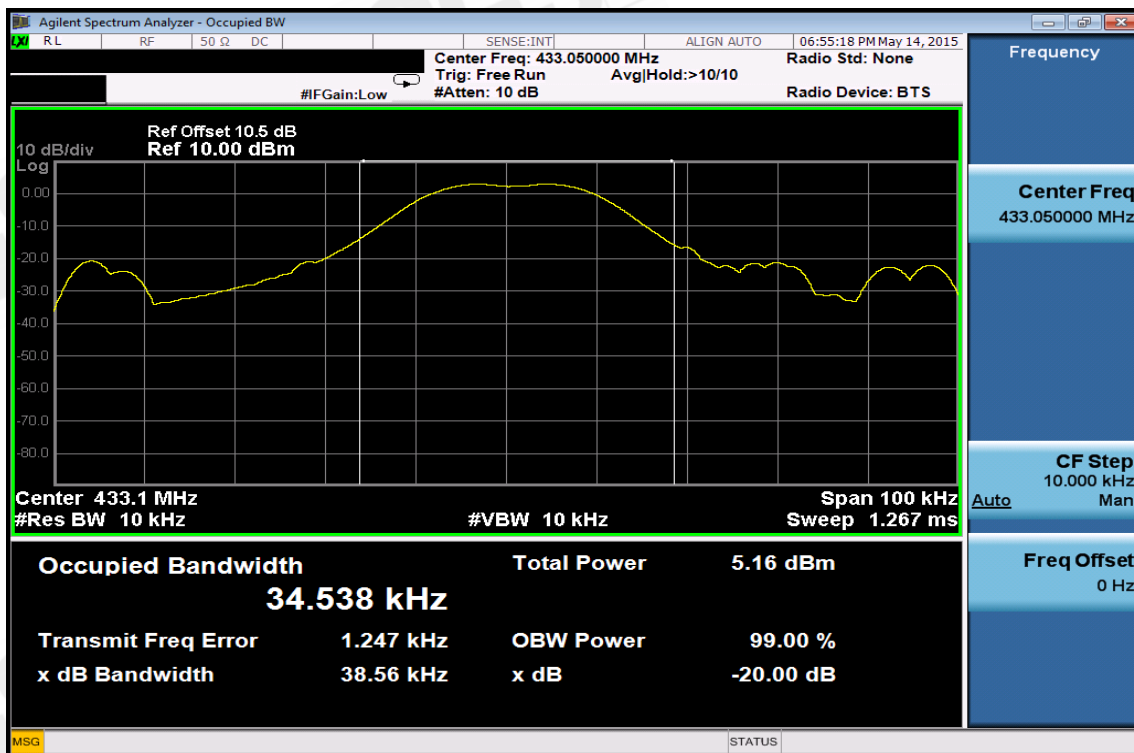
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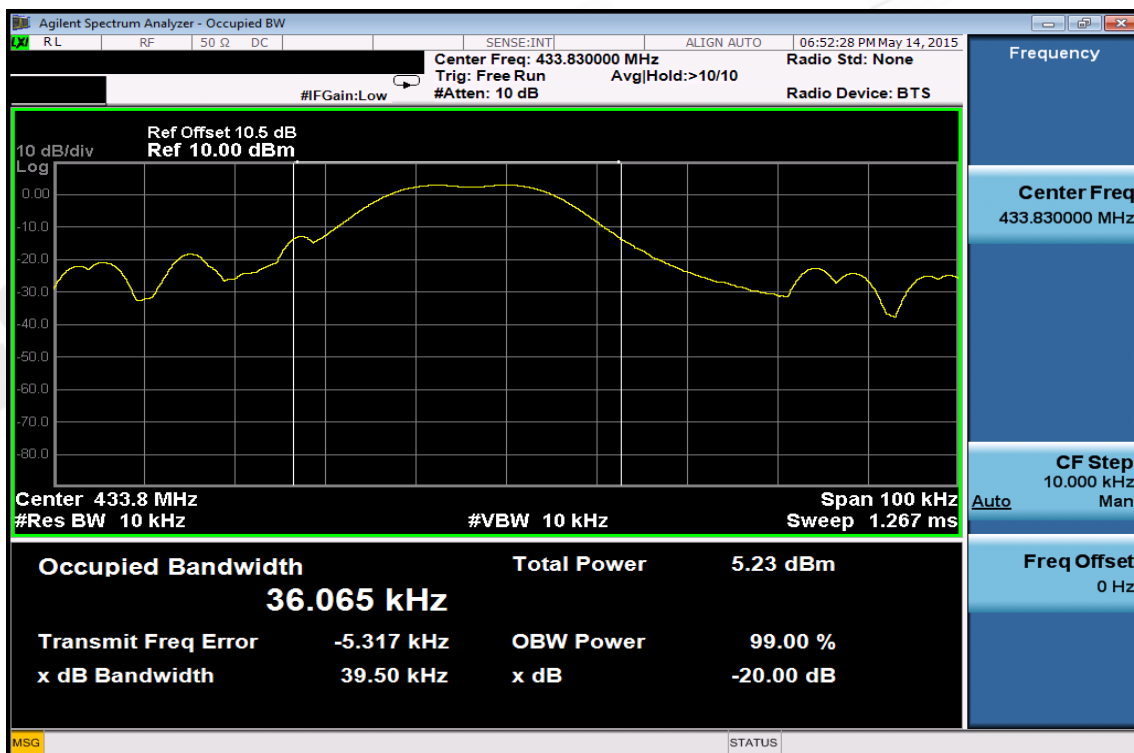
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20dB Band Width Test Data (CH Low)



20dB Band Width Test Data (CH Mid)



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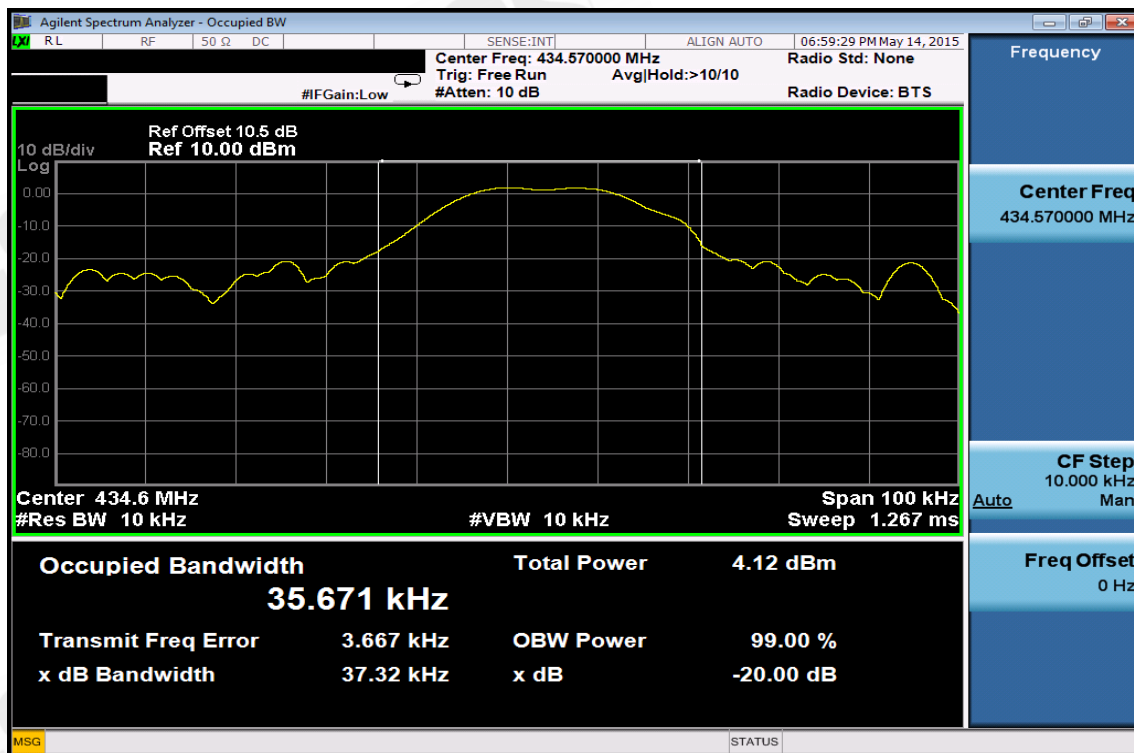
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20dB Band Width Test Data (CH High)



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9. DUTY CYCLE MEASUREMENT

9.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set ETU normal operating mode.
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 100kHz, Span =0 Hz. Adjacent sweep.
4. Set SPA View. Mark delta.

9.2 Test SET-UP (Block Diagram of Configuration)

Same as 8.3 Radiated Emission Measurement.

9.3 Measurement Equipment Used:

Same as 8.3 Radiated Emission Measurement.

9.4 Measurement Results:

$T_{on} = 38.7 \text{ (ms)}$

$T_{on} + T_{off} = 100 \text{ ms}$

$Avg \text{ correct} = 20\log(T_{on}/TP)$
 $= 20\log(38.7/ 100)$
 $= -8.24\text{dB}$

Note: In comparison with EUT 8 buttons as examined in the section of duty cycle which has same operating mode of each button, the worst case is chosen for reported. Please refer to next page for plots.

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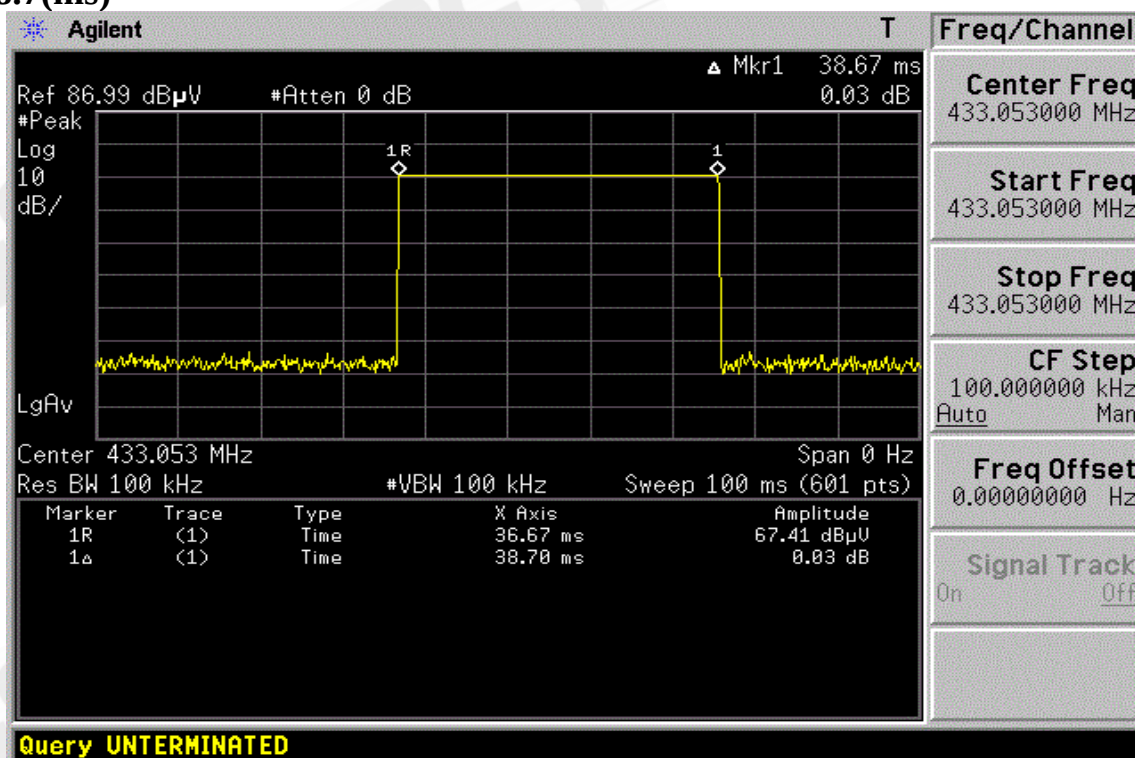
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Ton =38.7(ms)



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10. RELEASE TIME MEASUREMENT:

15.231 (a) (1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

10.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set SPA Center Frequency = fundamental frequency, RBW=100KHz, VBW= 100KHz, Span =0Hz. Sweep Time= 5s.
3. Set EUT as normal operation and press Transmitter bottom for 2 s approximately,
4. Set SPA Max hold. Delta Mark.

10.2 Test SET-UP (Block Diagram of Configuration)

Same as 8.3 Radiated Emission Measurement.

10.3 Measurement Equipment Used:

Same as 8.3 Radiated Emission Measurement.

10.4 Measurement Results

The release time is less than 5 s.

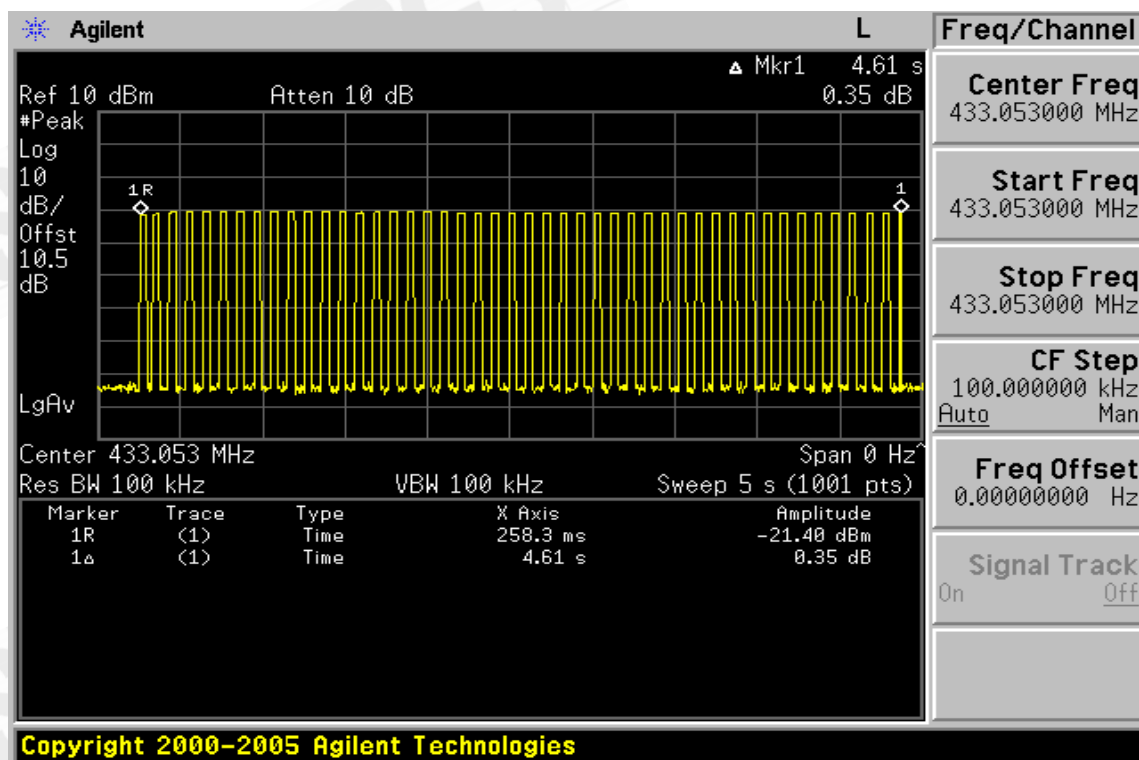
Refer to attached data chart.

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Note: X = release time

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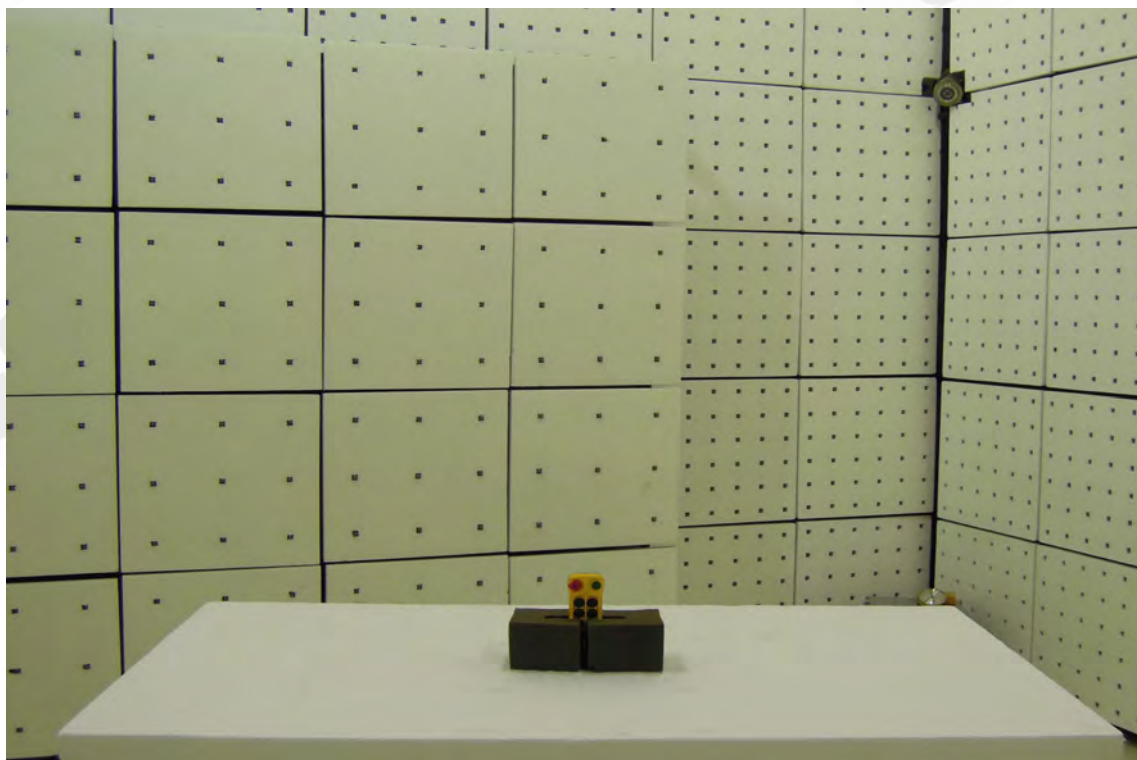
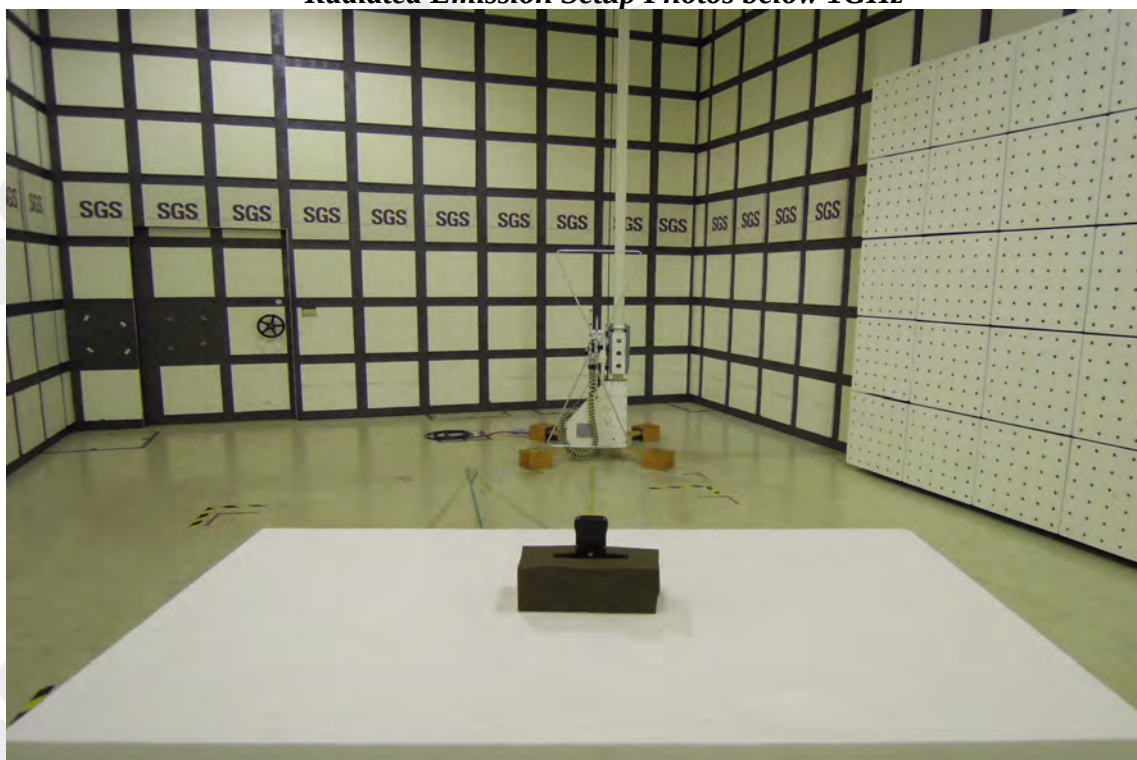
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PHOTOGRAPHS OF SET UP

Radiated Emission Setup Photos below 1GHz

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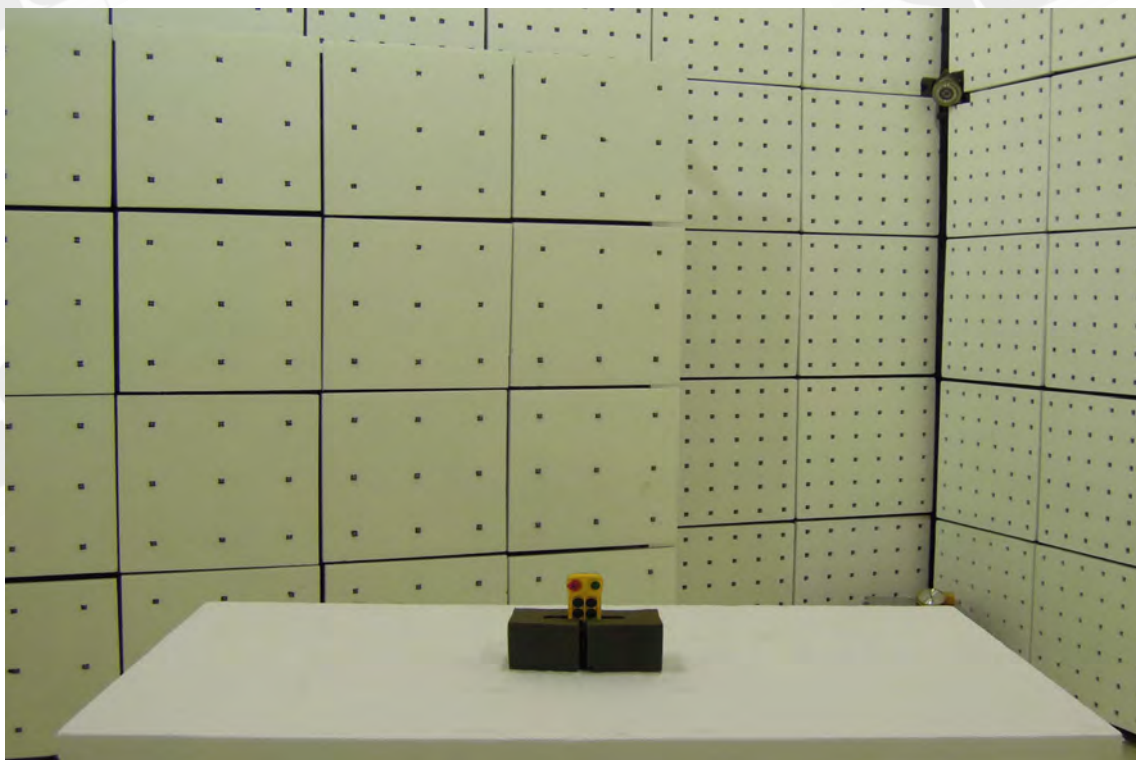
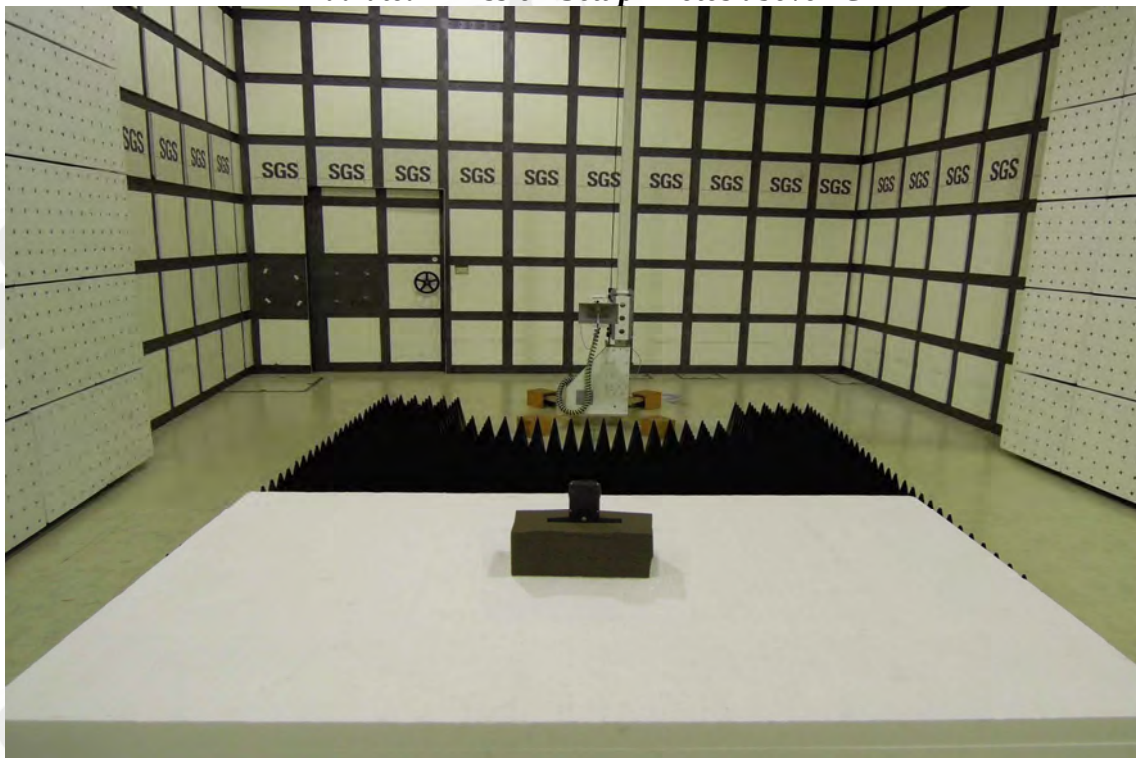
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Radiated Emission Setup Photos above 1GHz

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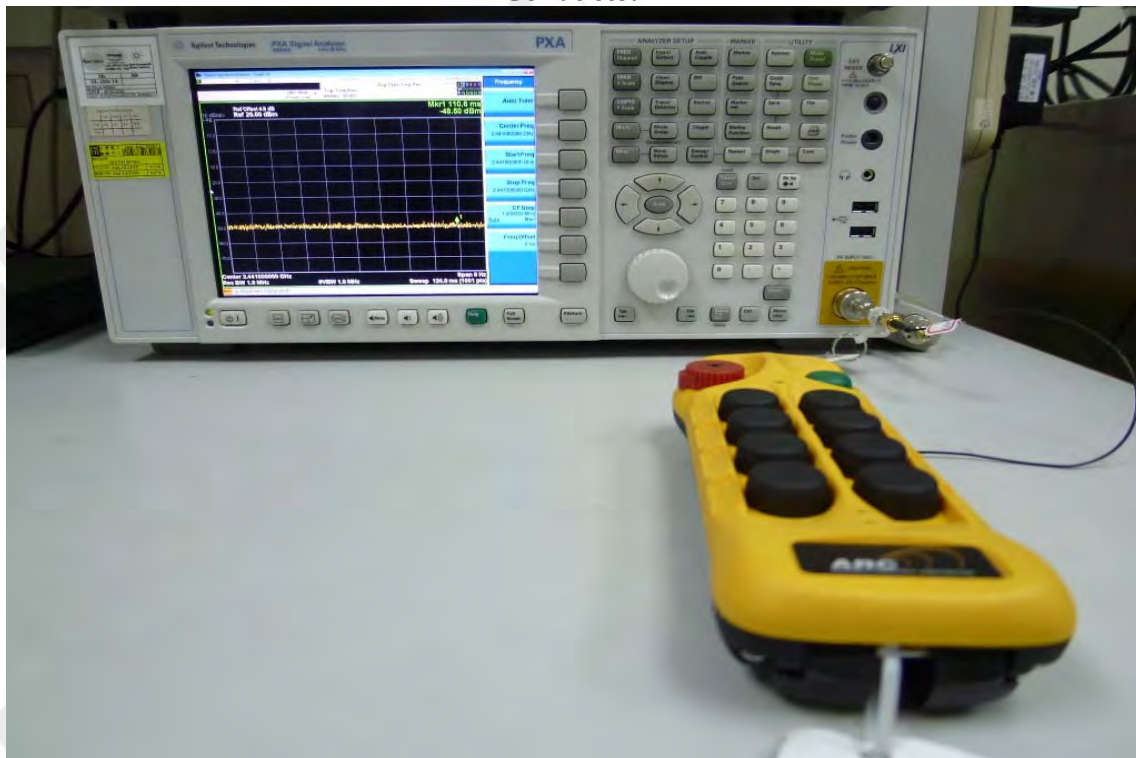
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Conducted**PHOTOGRAPHS OF EUT**

Please refer to the attached file (EUT Photo)

~ End of Report ~

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