

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name: Wireless remote controller
Brand Name: Thermalution
Model No.: SPE-005, SPE-005-* ("*" is 0~9, A~Z or blank)
Model Difference: Different models for different exterior color
FCC ID: 2AD8XSPE-005
Report No.: E2/2015/30071
Issue Date: Apr. 20, 2015
FCC Rule Part: §15.209
Prepared for
Prepared by

**Petatech International Co., Ltd.
(Thermalution)**
**6F, No.101, Zhouzi Street, Neihu District, 114,
Taipei, Taiwan, R.O.C.**

**SGS Taiwan Ltd.
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VERIFICATION OF COMPLIANCE

Applicant:Petatech International Co., Ltd. (Thermalution)
6F, No.101, Zhouzi Street, Neihu District, 114, Taipei, Taiwan, R.O.C.**Product Description:**

Wireless remote controller

Brand Name:

Thermalution

FCC ID:

2AD8XSPE-005

Model No.:

SPE-005, SPE-005-* ("*" is 0~9, A~Z or blank)

Model Difference:

Different models for different exterior color

File Number:

E2/2015/30071

Date of test:

Mar. 23, 2015 ~ Apr. 13, 2015

Date of EUT Received:

Mar. 23, 2015

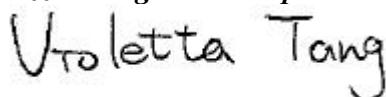
We hereby certify that:

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 2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

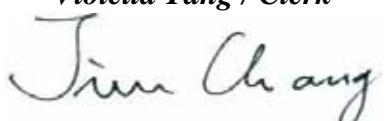
The test results of this report relate only to the tested sample identified in this report.

Test By:**Date:**

Apr. 20, 2015

*Jazz Huang / Asst. Supervisor***Prepared By:****Date:**

Apr. 20, 2015

*Violetta Tang / Clerk***Approved By****Date:**

Apr. 20, 2015

Jim Chang / Asst. Manager

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Revision History

Report Number	Revision	Description	Issue Date
E2/2015/30071	Rev.00	Initial creation of document	Apr. 20, 2015

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1. GENERAL INFORMATION

1.1. Product Description

Product Name:	Wireless remote controller
Brand Name:	Thermalution
Model No.:	SPE-005, SPE-005-* ("*" is 0~9, A~Z or blank)
Model Difference:	Different models for different exterior color
Hardware Version:	6
Software Version	N/A
Power Supply:	3.6Vdc from Battery

Transmitter:

Operating Frequency	125kHz
Transmit Power	< 105dBuV/m at 3m.
Number of Channels	1
Operating Mode	Point-to-Point

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1.2. Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.225

ANSI C63.10:2013

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.
3. The EUT was placed 1.5m height for frequency above 1GHz in accordance with ANSI C63.10:2013.

1.3. Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333. (TAF code 0513)

FCC Registration Numbers are: 628985

Canada Registration Number: 4620A-5

1.4. Special Accessories

There are no special accessories used while test was conducted.

1.5. 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

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

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 which is 0.8 m above ground plane. 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.

2.4. Limitation

(1) Conducted Emission

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

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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.

(2) Radiated Emission

- Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:
- In the emission table above, the tighter limit applies at the band edges.
- The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other Sections within this Part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

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Frequency (MHz)	Field strength μ V/m	Distance (m)	Field strength at 3m $\text{dB}\mu$ V/m
0.009-0.490	2400/F(KHz)	300	
0.490-1.705	24000/F(KHz)	30	
1.705-30	30	30	69.54
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
Above 960	500	3	54

Limit Table:

Frequency kHz	Distance m	Limit at 300m $\text{dB}\mu$ V/m	Limit at 30m $\text{dB}\mu$ V/m	Distance Factor dB	Limit $\text{dB}\mu$ V/m at 3m
125	300	25.67	---	80	105.67
250	300	19.65	---	80	99.65
375	300	16.12	---	80	96.12
500	30	---	33.62	40	73.62
625	30	---	31.69	40	71.69
750	30	---	30.10	40	70.10
875	30	---	28.76	40	68.76
1000	30	---	27.60	40	67.60
1125	30	---	26.58	40	66.58
1250	30	---	25.67	40	65.67

Limit Calculation and transfer to 1m test distance:

If the frequency between 9 – 490kHz,

Limit = $20\log(2400/f(\text{kHz})) + 40\log(300/1)$

If the frequency between 490kHz – 1.705MHz

Limit = $20\log(24000/f(\text{kHz})) + 40\log(30/1)$

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2.5. Configuration of Tested System

Fig. 2-1 Configuration of Tested System

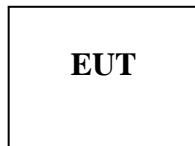


Table 2-1 Equipment Used in Tested System

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

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3. Summary of Test Results

FCC Rules	Description of Test	Result
§15.207	Conducted Emission	N/A
§15.209	Radiated Emission	Compliant

4. Description of test modes

The EUT has been tested under continuous operating condition. The Frequency 125kHz was chosen for testing.

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5. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty (Polarization : Vertical)	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)	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

6.1. Standard Applicable:

Frequency range within 150kHz 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:

Conducted Emission Test Site					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
EMI Test Receiver	R&S	ESCI 3	101311	06/20/2014	06/19/2015
Coaxial Cables	N/A	N30N30-1042-150cm	N/A	01/06/2015	01/07/2016
LISN	Schwarzbeck	NSLK 8127	8127-648	06/10/2014	06/09/2015
LISN	Rolf-Heine	NNB-2/16Z	99012	03/04/2015	03/03/2016
Test Software	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R.	N.C.R.

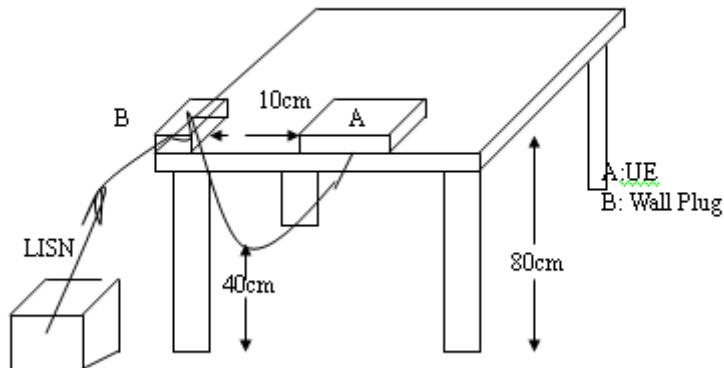
6.3. EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
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.

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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 phases of power being supplied by given UE are completed.

6.6. Measurement Result:

N/A, the devise is powered by 3.6Vdc battery.

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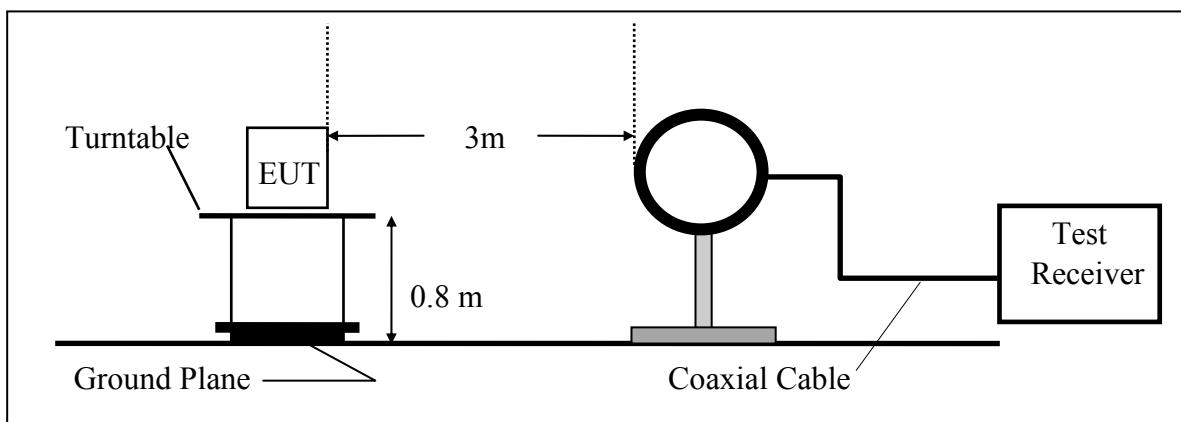
7. Radiated Emission Test

7.1. Measurement Procedure

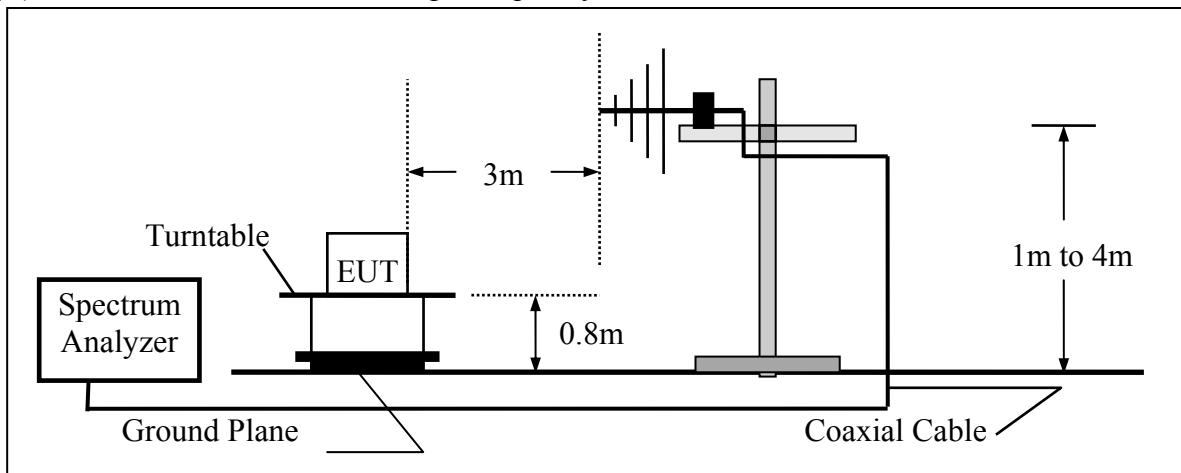
1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measured were complete.

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 Below 1000MHz



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7.3. Measurement Equipment Used:

966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESU 40	100363	04/09/2015	04/08/2016
Loop Antenna	ETS-Lindgren	6502	00143303	12/09/2014	12/08/2015
Broadband Antenna	TESEQ	CBL 6112D	35240	12/05/2014	12/04/2015
Pre Amplifier	EMC Instruments	EMC330	980096	12/19/2014	12/18/2015
Coaxial Cable	Huber+Suhner	RG 214/U	966Rx 9K-30M	12/19/2014	12/18/2015
Coaxial Cable	Huber+Suhner	RG 214/U SUCOFLEX 104	966Rx 30M-3G	12/19/2014	12/18/2015
Site NSA	SGS	966 Chamber C	SAC-C	03/04/2015	03/03/2016
Site VSWR	SGS	966 Chamber C	SAC-C	03/04/2015	03/03/2016
DC Power Supply	HOLA	DP-3003	D7070035	05/31/2014	05/30/2015
Controller	MF	MF-7802	N/A	N.C.R.	N.C.R.
Antenna Master	MF	N/A	N/A	N.C.R.	N.C.R.
Turn Table	MF	N/A	N/A	N.C.R.	N.C.R.
Test Software	World-Pallas	Dr. E	V 3.0 Lite	N.C.R.	N.C.R.

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	

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7.5. Measurement Result

Operation Band	:125kHz	Test Date	:2015-04-14
ARFCN	:	Temp./Humi.	:22.7 deg_C / 57 RH
Fundamental Frequency	:125kHz	Engineer	:Ashton
Operation Mode	:MAIN		
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

Actual FS(dB μ A/m) = SPA. Reading level(dB μ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB μ A/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.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
MHz	F/H/E/S	PK/QP/AV	Mode	Reading Level	FS	@3m	Margin

0.125 F Peak 72.90 11.20 84.10 105.67 -21.57

Operation Band	:125kHz	Test Date	:2015-04-14
ARFCN	:	Temp./Humi.	:22.7 deg_C / 57 RH
Fundamental Frequency	:125kHz	Engineer	:Ashton
Operation Mode	:MAIN		
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL

Actual FS(dB μ A/m) = SPA. Reading level(dB μ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB μ A/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.

“---” : denotes Noise Floor.

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Safe
MHz	F/H/E/S	PK/QP/AV	Mode	Reading Level	FS	@3m	Margin

0.125 F Peak 72.39 11.20 83.59 105.67 -22.08

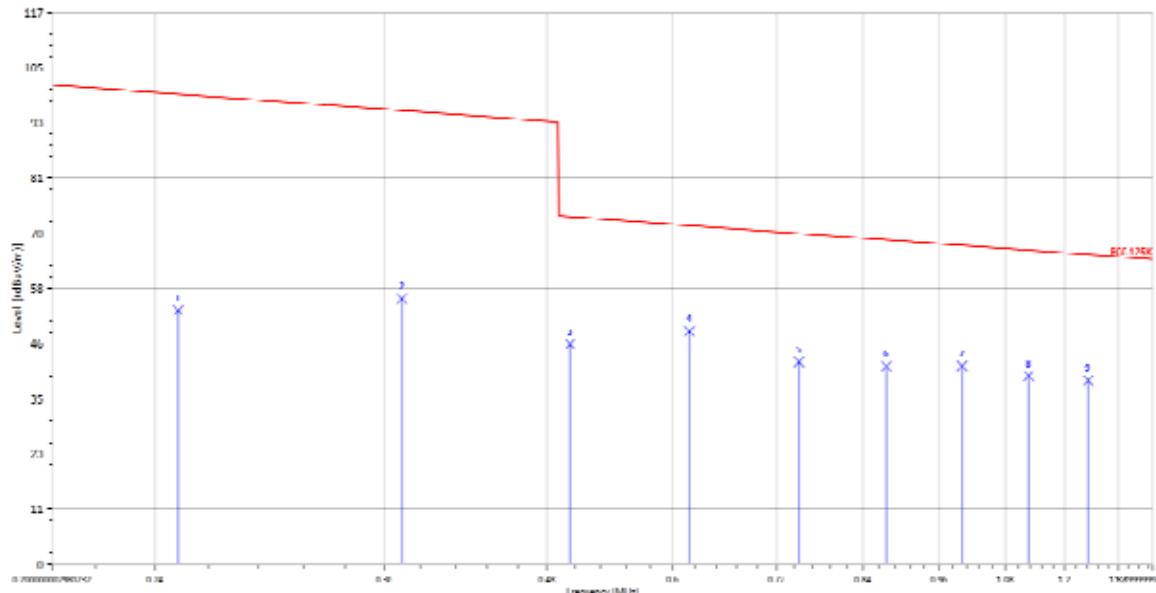
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(10MHz~30MHz)

Operation Band	:125kHz	Test Date	:2015-04-14
Fundamental Frequency	:125kHz	Temp./Humi.	:22.7deg_C/57RH
Operation Mode	:TX 125kHz	Engineer	:Ashton
EUT Pol.	:E2 PLAN	Measurement Antenna Pol.	:VERTICAL



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

Factor(dB) = Antenna Factor(dB μ V/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.

"---" : denotes Noise Floor.

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
0.25	H	Peak	42.67	11.15	53.81	99.65	-45.84
0.37	H	Peak	45.12	11.12	56.24	96.20	-39.96
0.50	H	Peak	35.52	11.13	46.65	73.62	-26.97
0.63	H	Peak	38.18	11.20	49.38	71.79	-22.41
0.75	H	Peak	31.60	11.29	42.89	70.10	-27.21
0.88	H	Peak	30.56	11.38	41.94	68.76	-26.82
1.00	H	Peak	30.56	11.45	42.01	67.60	-25.59
1.13	H	Peak	28.48	11.42	39.90	66.58	-26.68
1.25	H	Peak	27.56	11.40	38.96	65.67	-26.71

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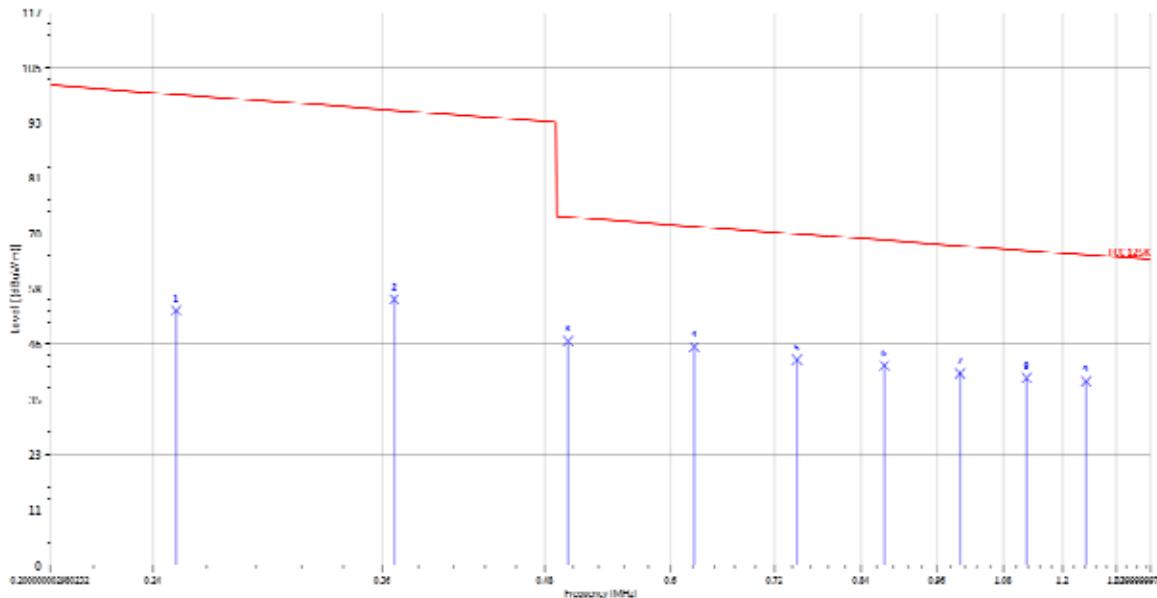
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Operation Band :125kHz
 Fundamental Frequency :125kHz
 Operation Mode :TX 125kHz
 EUT Pol. :E2 PLAN

Test Date :2015-04-14
 Temp./Humi. :22.7deg_C/57RH
 Engineer :Ashton
 Measurement Antenna Pol. :HORIZONTAL



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.

“---” : denotes Noise Floor.

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit		Margin dB
						Limit @3m dBµV/m	Margin dB	
0.25	H	Peak	42.75	11.15	53.89	99.65	-45.76	
0.37	H	Peak	45.16	11.12	56.28	96.29	-40.01	
0.50	H	Peak	36.28	11.13	47.41	73.62	-26.21	
0.63	H	Peak	35.00	11.20	46.20	71.69	-25.49	
0.75	H	Peak	32.16	11.29	43.45	70.10	-26.65	
0.88	H	Peak	30.86	11.38	42.24	68.76	-26.52	
1.00	H	Peak	29.07	11.45	40.52	67.60	-27.08	
1.13	H	Peak	28.18	11.42	39.59	66.58	-26.99	
1.25	H	Peak	27.51	11.40	38.91	65.67	-26.76	

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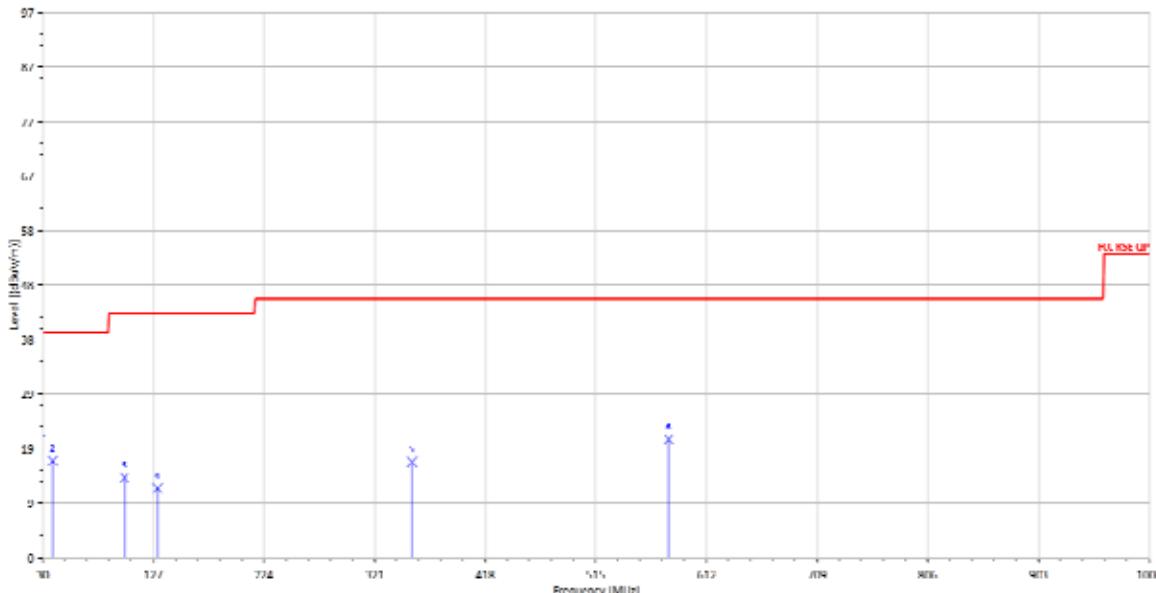
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(30MHz~1GHz)

Operation Band	:125kHz	Test Date	:2015-04-14
Fundamental Frequency	:125kHz	Temp./Humi.	:22.7deg_C/57RH
Operation Mode	:TX 125kHz	Engineer	:Ashton
EUT Pol.	:E2 PLAN	Measurement Antenna Pol.	:VERTICAL



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

Factor(dB) = Antenna Factor(dB μ V/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.

"---" : denotes Noise Floor.

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
30.00	S	Peak	32.94	-13.11	19.83	40.00	-20.17
38.73	S	Peak	35.37	-18.19	17.18	40.00	-22.82
101.78	S	Peak	37.75	-23.54	14.21	43.50	-29.29
130.88	S	Peak	33.64	-21.37	12.27	43.50	-31.23
353.98	S	Peak	34.28	-17.30	16.98	46.00	-29.02
579.02	S	Peak	33.53	-12.52	21.02	46.00	-24.98

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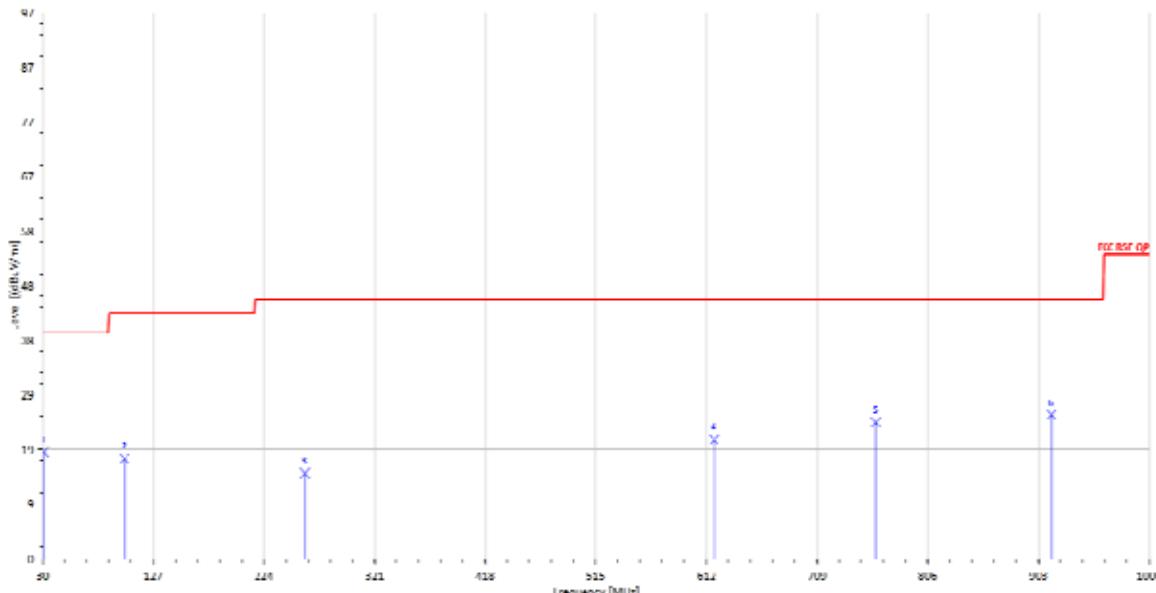
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Operation Band :125kHz
 Fundamental Frequency :125kHz
 Operation Mode :TX 125kHz
 EUT Pol. :E2 PLAN

Test Date :2015-04-14
 Temp./Humi. :22.7deg_C/57RH
 Engineer :Ashton
 Measurement Antenna Pol. :HORIZONTAL



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

Factor(dB) = Antenna Factor(dB μ V/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.

“---” : denotes Noise Floor.

Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
30.97	S	Peak	32.52	-13.64	18.89	40.00	-21.11
101.78	S	Peak	41.27	-23.54	17.72	43.50	-25.78
259.89	S	Peak	34.42	-19.33	15.09	46.00	-30.91
618.79	S	Peak	33.44	-12.33	21.11	46.00	-24.89
760.41	S	Peak	34.13	-9.96	24.17	46.00	-21.83
914.64	S	Peak	33.24	-7.74	25.50	46.00	-20.50

- End of Report -

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