

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name: SmartSense Staff Tag
Brand Name: SmartSense Staff Tag
Model No.: STG-821(919), STG-821(925)
Model Difference: Different in frequency (919.8MHz & 925MHz)
FCC ID: VPE-STG-821
Report No.: E2/2016/90061
Issue Date: Nov. 15, 2016
FCC Rule Part: §15.209
Prepared for
Prepared by
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408694, Singapore
SGS Taiwan Ltd.
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Taoyuan City, Taiwan 333



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VERIFICATION OF COMPLIANCE

Applicant: CADI SCIENTIC PTE LTD
31, Ubi Road 1, Aztech Building, #07-01A, 408694, Singapore

Product Description: SmartSense Staff Tag

Brand Name: SmartSense Staff Tag

FCC ID: VPE-STG-821

Model No.: STG-821(919), STG-821(925)

Model Difference: Different in frequency (919.8MHz & 925MHz)

File Number: E2/2016/90061

Date of test: Sep. 23, 2016 ~ Nov. 9, 2016

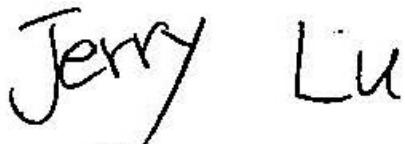
Date of EUT Received: Sep. 23, 2016

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:

Nov. 15, 2016

Jerry Lu / Asst. Supervisor

Prepared By:

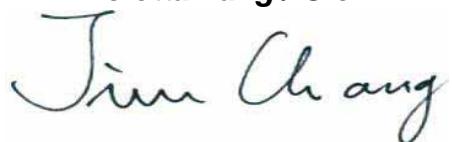


Date:

Nov. 15, 2016

Violetta Tang / Clerk

Approved By



Date:

Nov. 15, 2016

Jim Chang / Asst. Manager

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Revision History

Report Number	Revision	Description	Issue Date
E2/2016/90061	Rev.00	Initial creation of document	Nov. 15, 2016

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1. GENERAL INFORMATION

1.1. Product Description

Product Name:	SmartSense Staff Tag	
Brand Name:	SmartSense Staff Tag	
Model No.:	STG-821(919), STG-821(925)	
Model Difference:	Different in frequency (919.8MHz & 925MHz)	
Hardware Version:	V3.1	
Software Version	V6	
Power Supply:	3.7Vdc from Rechargeable Lithium Ion Polymer Battery or 5Vdc from USB Port	
	Battery:	Model No.: N/A; Supplier: N/A

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: 735305

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 placed on a 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 placed on a 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.

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2.4. Limitation

(1) Conducted Emission

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

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
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,

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

If the frequency between 490kHz – 1.705MHz

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

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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 (a)	AC Power Line Conducted Emission	Compliant
§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.

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)	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

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 7	100950	12/12/2015	12/11/2016
Coaxial Cables	N/A	N30N30-1042-150cm	N/A	02/07/2016	02/06/2017
LISN	Schwarzbeck	NSLK 8127	8127-648	03/11/2016	03/10/2017
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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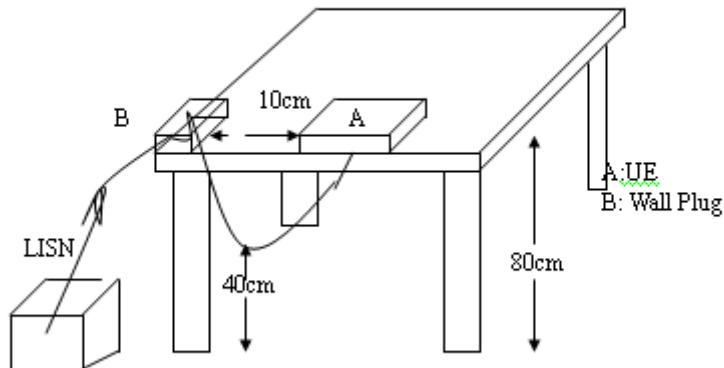
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6.4. Test SET-UP (Block Diagram of Configuration)



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:

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit.

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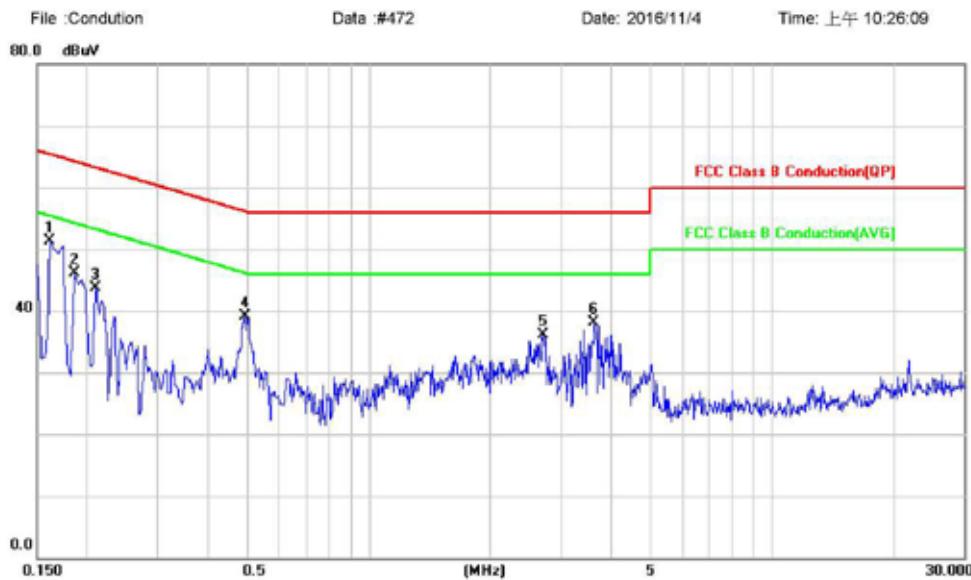
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Operation Mode:	Operation Mode			Test Date:	Nov. 04, 2016
Temperature:	23	Humidity:	60 %	Test By:	Jerry
Probe:	L1 / N				

Site : Conduction Room Phase: **L1** Temperature: 23 °C
 Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 60 %
 Mode: CADI
 Note:

Conducted Emission



No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Comment
			Level	Factor	ment			
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1 *		0.1620	31.64	19.72	51.36	65.36	-14.00	peak
2		0.1860	26.36	19.71	46.07	64.21	-18.14	peak
3		0.2100	24.03	19.72	43.75	63.21	-19.46	peak
4		0.4940	19.27	19.90	39.17	56.10	-16.93	peak
5		2.7180	16.24	19.94	36.18	56.00	-19.82	peak
6		3.6380	18.20	19.95	38.15	56.00	-17.85	peak

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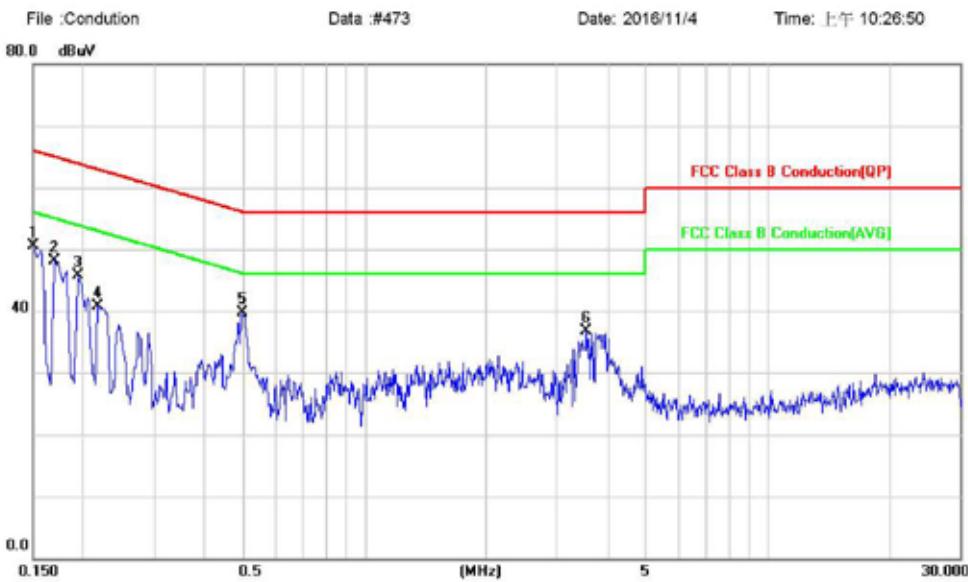
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Site : Conduction Room Phase: **N** Temperature: 23 °C
 Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 60 %
 Mode: CADI
 Note:

Conducted Emission



No.	Mk.	Freq.	Reading	Correct	Measure-	Limit	Over	Detector	Comment
			Level	Factor	ment				
		MHz	dBuV	dB	dBuV	dBuV	dB		
1 *		0.1500	30.83	19.73	50.56	66.00	-15.44	peak	
2		0.1700	28.47	19.73	48.20	64.96	-16.76	peak	
3		0.1940	26.05	19.72	45.77	63.86	-18.09	peak	
4		0.2180	20.95	19.73	40.68	62.89	-22.21	peak	
5		0.4980	19.82	19.91	39.73	56.03	-16.30	peak	
6		3.5620	16.71	19.96	36.67	56.00	-19.33	peak	

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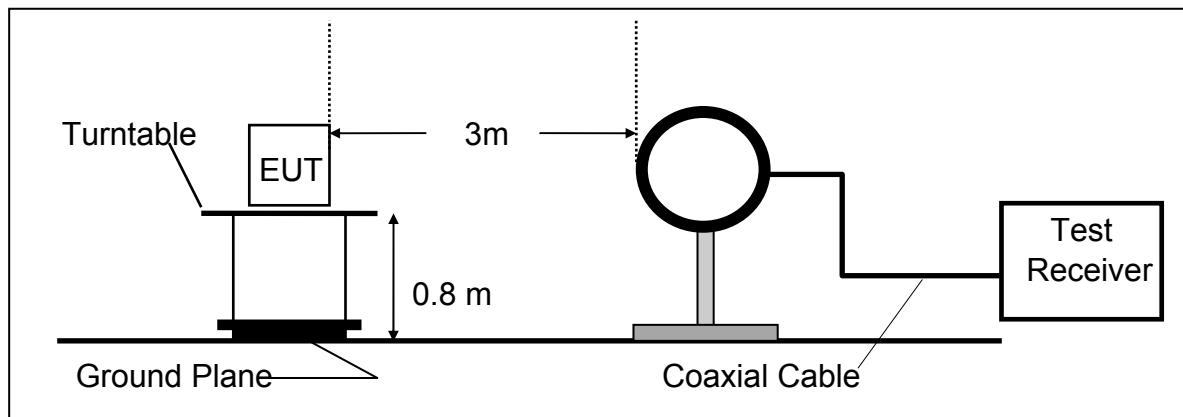
7. Radiated Emission Test

7.1. Measurement Procedure

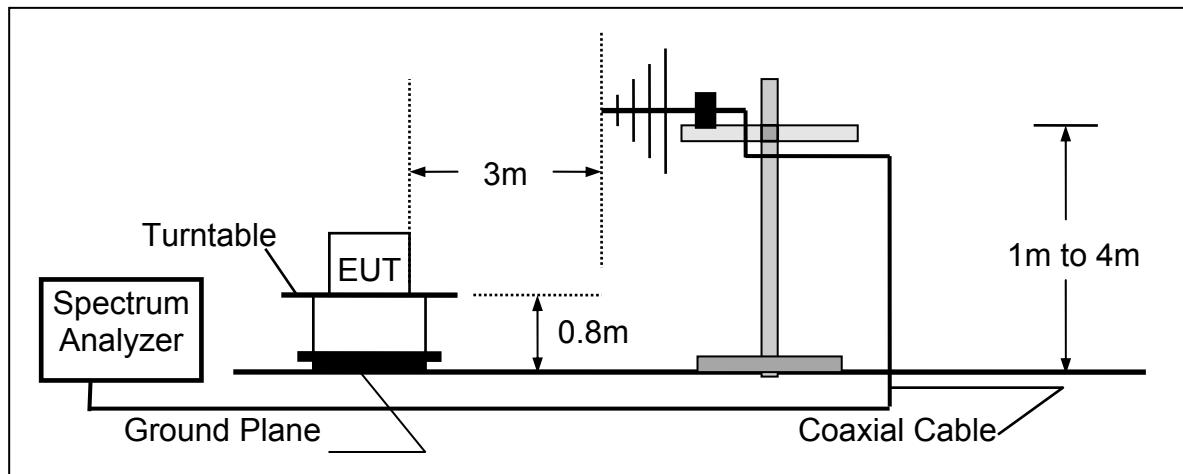
1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above 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	04/12/2016	04/11/2017
Loop Antenna	ETS-Lindgren	6502	00143303	12/23/2015	12/22/2016
Broadband Antenna	TESEQ	CBL 6112D	35240	10/28/2015	10/27/2016
Horn Antenna	ETS-Lindgren	3117	00143272	12/16/2015	12/15/2016
Horn Antenna	Schwarzbeck	BBHA9170	185	07/18/2016	07/17/2017
Pre Amplifier	EMC Instruments	EMC330	980096	12/12/2015	12/11/2016
Pre Amplifier	EMC Instruments	EMC0011830	980199	12/12/2015	12/11/2016
Pre Amplifier	R&S	SCU-18	10204	12/12/2015	12/11/2016
Pre Amplifier	R&S	SCU-26	100780	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	RG 214/U	966Rx 9K-30M	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	RG 214/U	966Rx SUCAFLEX 104	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	SUCAFLEX 104	966Rx 1G-18G	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	mini 141-12	966Rx SUCAFLEX 104	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	SUCAFLEX 104	966Tx 30M-18G	12/12/2015	12/11/2016
Coaxial Cable	Huber+Suhner	SUCAFLEX 102	966Tx 18G-40G	12/12/2015	12/11/2016
Attenuator	WOKEN	218FS-10	RF27	12/12/2015	12/11/2016
Site NSA	SGS	966 Chamber C	SAC-C	03/04/2016	03/03/2017
Site VSWR	SGS	966 Chamber C	SAC-C	03/04/2016	03/03/2017
DC Power Supply	HOLA	DP-3003	D7070035	05/04/2016	05/03/2017
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.

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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	

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.

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7.5. Measurement Result

Operation Mode :	125kHz	Test Date :	2016/10/14
Fundamental Frequency :	125kHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Main CH Mid	Test Engineer :	Ashton
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	FS	FS	@3m	
		PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
0.12	F	Peak	55.67	11.61	67.28	105.7086	-38.43

Operation Mode :	125kHz	Test Date :	2016/10/14
Fundamental Frequency :	125kHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Main CH Mid	Test Engineer :	Ashton
EUT Pol. :	E2	Measurement Antenna Pol. :	Horizontal

Freq.	Note	Detector	Spectrum	Factor	Actual	Limit	Margin
MHz	F/H/E/S	Mode	Reading Level	FS	FS	@3m	
		PK/QP/AV	dB μ V	dB	dB μ V/m	dB μ V/m	dB
0.13	F	Peak	55.20	11.61	66.82	105.6573	-38.84

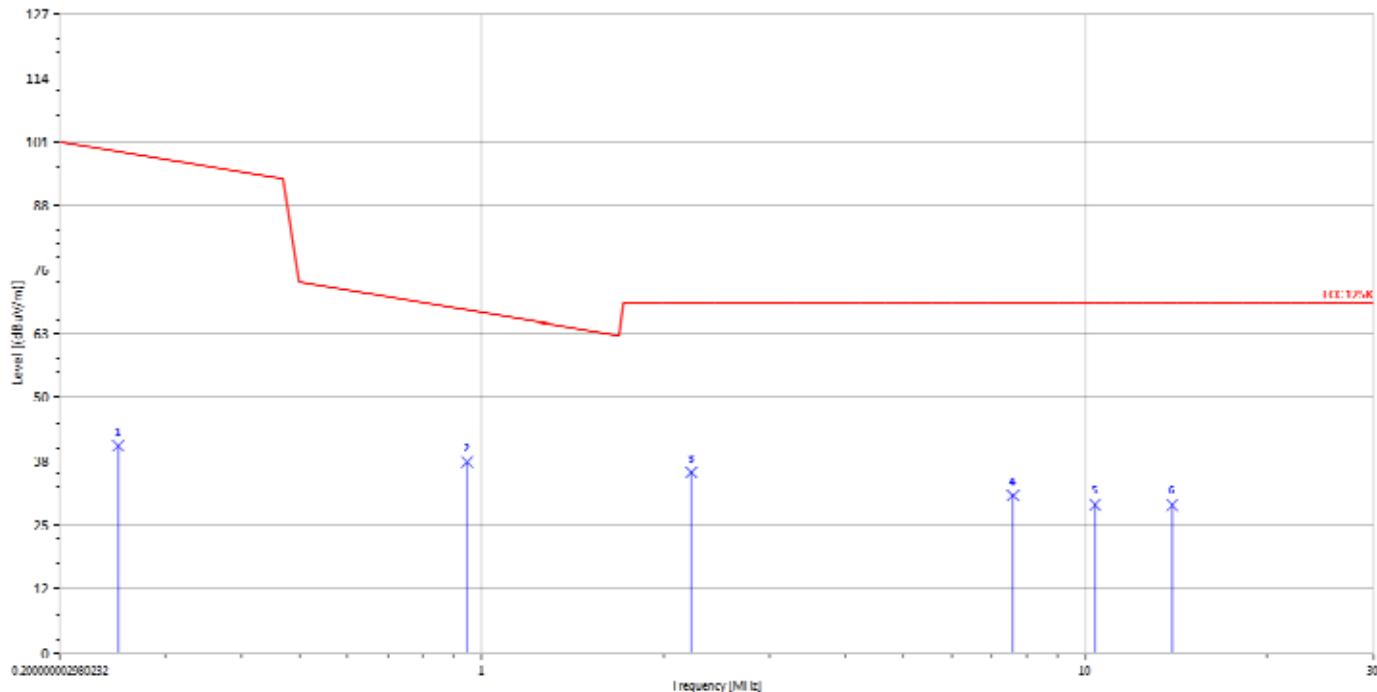
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(10MHz~30MHz)

Operation Mode : 125kHz Test Date : 2016/10/14
Fundamental Frequency : 125kHz Temp. / Humi. : 22.7deg_C/57RH
Operation Band : Tx CH Mid Test Engineer : Ashton
EUT Pol. : E2 Measurement Antenna Pol. : Vertical



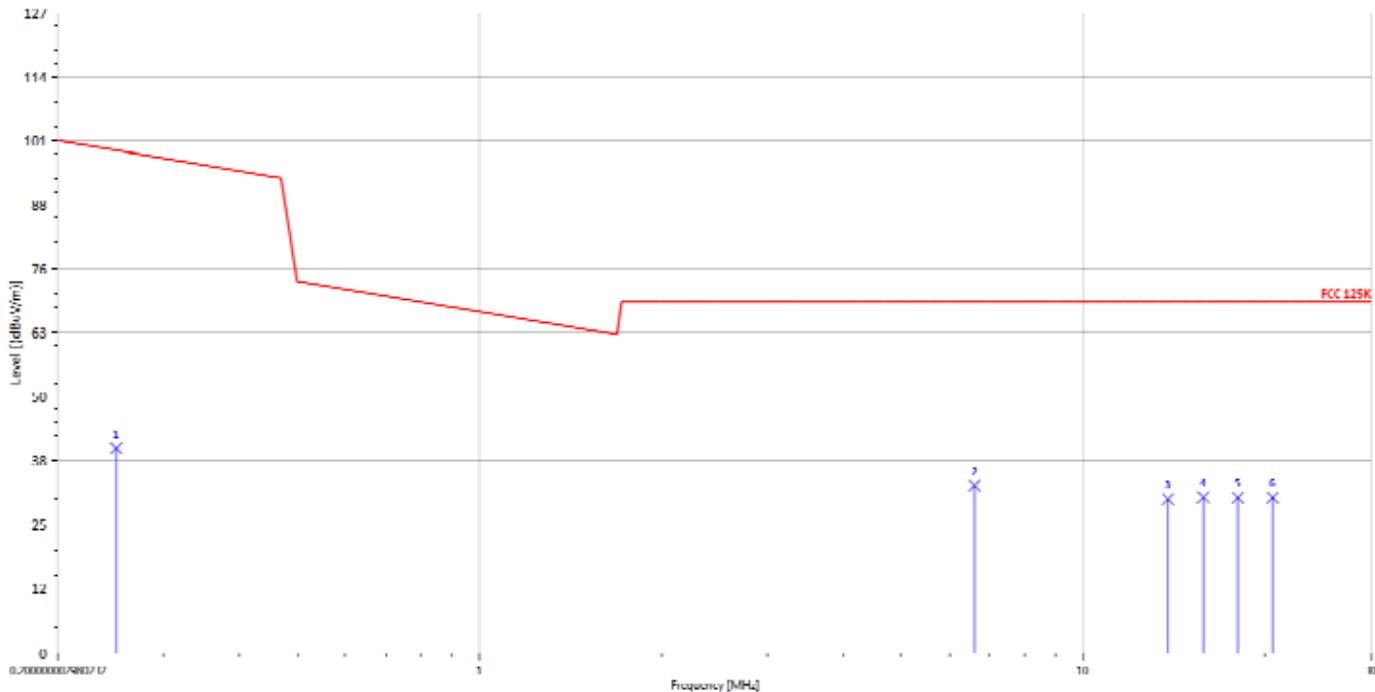
Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level		Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
			Reading	Level dB μ V				
0.25	H	Peak	29.58	29.58	11.55	41.14	99.65	-58.51
0.95	S	Peak	26.30	26.30	11.64	37.93	68.096	-30.16
2.23	S	Peak	24.43	24.43	11.39	35.82	69.54	-33.72
7.59	S	Peak	19.52	19.52	11.67	31.19	69.54	-38.35
10.39	S	Peak	17.73	17.73	11.69	29.42	69.54	-40.12
13.94	S	Peak	17.78	17.78	11.58	29.36	69.54	-40.18

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Operation Mode : 125kHz Test Date : 2016/10/14
 Fundamental Frequency : 125kHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH Mid Test Engineer : Ashton
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



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	29.02	11.55	40.58	99.65	-59.07
6.61	S	Peak	21.47	11.66	33.13	69.54	-36.41
13.82	S	Peak	18.83	11.58	30.41	69.54	-39.13
15.79	S	Peak	19.29	11.52	30.80	69.54	-38.74
18.02	S	Peak	19.24	11.45	30.70	69.54	-38.84
20.61	S	Peak	19.46	11.24	30.70	69.54	-38.84

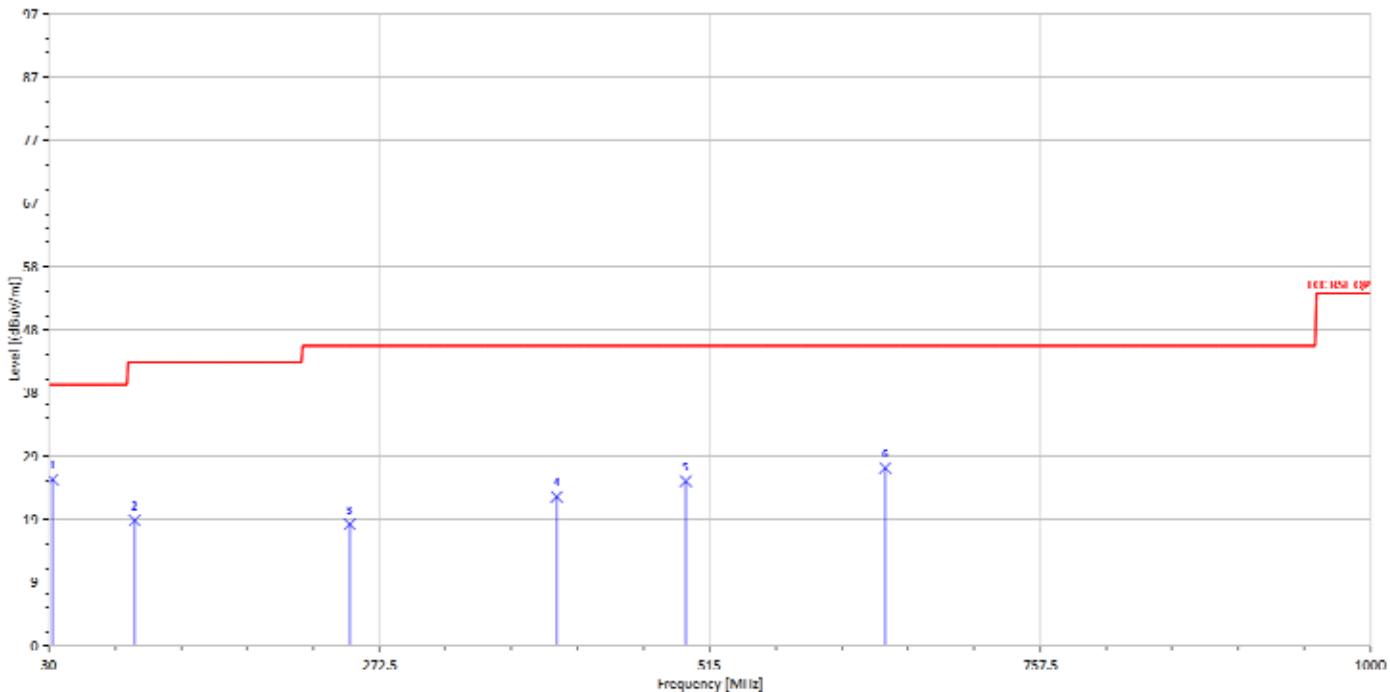
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(30MHz~1GHz)

Operation Mode : 125kHz Test Date : 2016/10/14
 Fundamental Frequency : 125kHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH Mid Test Engineer : Ashton
 EUT Pol. : E2 Measurement Antenna Pol. : Vertical



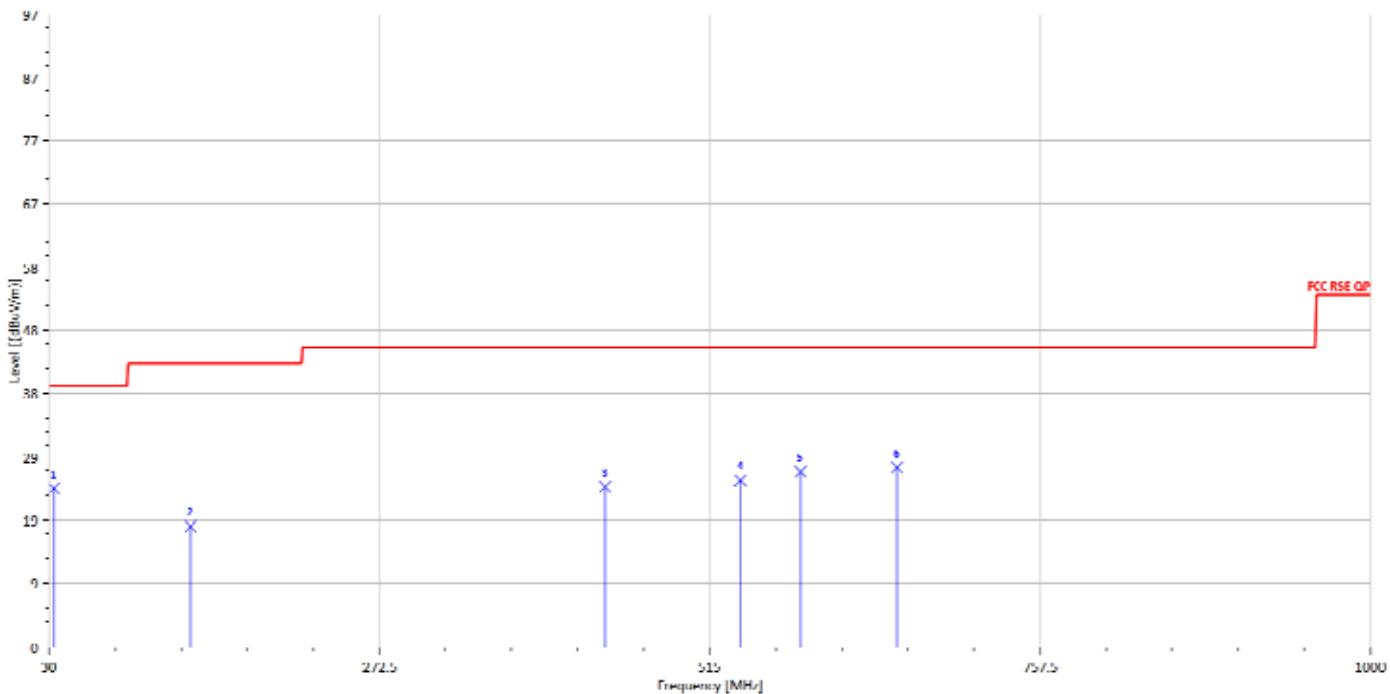
Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
32.91	S	Peak	34.17	-8.75	25.42	40	-14.58
93.05	S	Peak	38.15	-18.95	19.20	43.5	-24.30
251.16	S	Peak	33.10	-14.49	18.61	46	-27.39
402.48	S	Peak	32.47	-9.74	22.74	46	-23.26
497.54	S	Peak	32.88	-7.72	25.16	46	-20.84
644.01	S	Peak	32.31	-5.10	27.21	46	-18.79

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Operation Mode : 125kHz Test Date : 2016/10/14
 Fundamental Frequency : 125kHz Temp. / Humi. : 22.7deg_C/57RH
 Operation Band : Tx CH Mid Test Engineer : Ashton
 EUT Pol. : E2 Measurement Antenna Pol. : Horizontal



Freq. MHz	Note F/H/E/S	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
33.88	S	Peak	33.55	-9.27	24.28	40	-15.72
133.79	S	Peak	34.31	-15.82	18.49	43.5	-25.01
438.37	S	Peak	33.79	-9.27	24.51	46	-21.49
537.31	S	Peak	32.76	-7.24	25.52	46	-20.48
581.93	S	Peak	33.04	-6.17	26.87	46	-19.13
652.74	S	Peak	32.78	-5.24	27.54	46	-18.46

- End of Report -

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