

# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

## INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

**Applicant:** Opticon Sensors Europe B.V.  
Opaallaan 35, 2132 XV Hoofddorp, The Netherlands

**Product Name:** ESL Electronic Shelf Label

**Brand Name:** OPTICON

**Model No.:** PE-152

**Model Difference:** N/A

**Report Number:** E2/2018/90041

**FCC ID** Q2QPE152

**FCC Rule Part** Part 15.225

**Issue Date:** Dec. 05, 2018

**Date of Test:** Sep. 12, 2018 ~ Oct. 02, 2018

**Date of EUT Received:** Sep. 12, 2018 ~ Oct. 02, 2018

### We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. 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 of FCC Rules Part 15.225.

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

**Tested By:**

Aken Huang

**Aken Huang / Engineer**

**Approved By:**

CHUN-CHIEH CHEN

**Chun Chieh Chen /  
Asst. Supervisor**



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## Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
E2/2018/90041	Rev.00	Initial creation of document	All	Oct. 26, 2018	Yuri Tsai
E2/2018/90041	Rev.01	Modification of model no.	1,4	Dec. 05, 2018	Yuri Tsai

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# 1 GENERAL INFORMATION

## 1.1 Product Description

General:

Product Name:	ESL Electronic Shelf Label
Brand Name:	OPTICON
Model No.:	PE-152
Model Difference:	N/A
Hardware Version:	DVT
Software Version:	N/A
Power Supply:	5Vdc from power supply

NFC:

Operating Frequency	13.56MHz
Transmit Power	< 124dBuV/m at 3m.
Number of Channels	1
Antenna Type	Loop Antenna
Modulation Type	ASK

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## 1.2 Test Methodology

FCC Part 15, Subpart C §15.225

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards..

## 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 Number and Designation number are: 735305 / TW0002

## 1.4 Special Accessories

There is no special accessory used while test was conducted.

## 1.5 Equipment Modifications

There was no modification incorporated into the EUT.

## 1.6 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m\*9m\*6m semi-anechoic chamber,  
the measurements correspond to those obtained at an open-field test site.

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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 0.8m 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 1.5 m above the reference 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 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

- The field strength of any emission within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- The field strength of any emissions appearing outside of the 13.110-14.010 MHz shall not exceed the general radiated emission limits in section 15.209 as below.

Frequency (MHz)	Field strength $\mu\text{V/m}$	Distance (m)	Field strength at 3m $\text{dB}\mu\text{V/m}$
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

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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. Distance extrapolation factor =  $40 \log (\text{required distance/ test distance})$  (dB);  
4. The measurement was undertaken in closer distance at 3m, where extrapolation factor is offset to convert the limit of the measurement.  
Ex.  $20 \log(30) + 40 \log(30/3) = 69.54 \text{ dBuV/m}$   
5. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of §15.205.  
6. The general radiated emission limits in §15.209 apply for the spurious emission generate from UE, except for the fundamental emission where the respective section specifies otherwise.

### (3) Frequency Tolerance

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

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## 2.5 Configuration of Tested System

Fig. 2-1 Emission test set up configuration

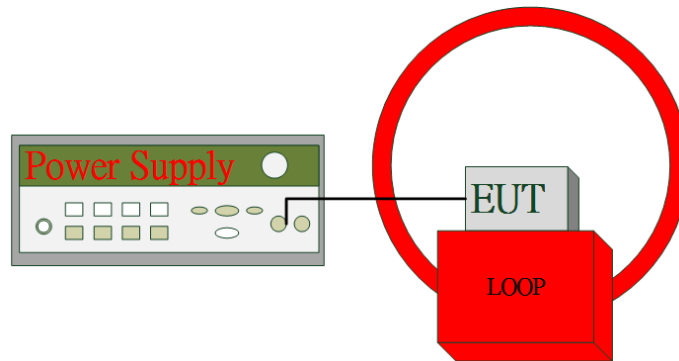


Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1.	NFC Test software	Tera Term	N/A	N/A	N/A	N/A
2.	DC Power Supply	Agilent	E3640A	MY53140006	N/A	Unshielded

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### 3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207	AC Power Line Conducted Emission	N/A
§15.225 (a)-(d)	Radiated Emission	Compliant
§15.209	Radiated Emission Limits, general requirement	Compliant
§15.225 (e)	Frequency Stability	Compliant
§2.1049 §15.215 (c)	99% & 20 dB OCCUPIED BANDWIDTH	Compliant
§15.203	Antenna Requirement	Compliant

### 4 DESCRIPTION OF TEST MODES

The EUT stay in continuous transmitting mode. The frequency 13.56MHz is the default channel to test, where it is the only manipulative channel as this application supports.

The field strength of spurious radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode), the worst case H position was reported.

The data rate as the lowest supported is selected while tests are conducted.

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## 5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Frequency Stability	+/- 123.36 Hz
20 dB OCCUPIED BANDWIDTH	+/- 123.36 Hz
Temperature	+/- 0.8 °C
Humidity	+/- 4.7 %
DC / AC Power Source	DC= +/- 1%, AC= +/- 0.2%

Radiated Spurious Emission:

Measurement uncertainty	9kHz - 30MHz: +/- 2.3dB
-------------------------	-------------------------

Measurement uncertainty (Polarization : <b>Vertical</b> )	30MHz - 180MHz: +/- 3.37dB
	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB

Measurement uncertainty (Polarization : <b>Horizontal</b> )	30MHz - 167MHz: +/- 4.22dB
	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB

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

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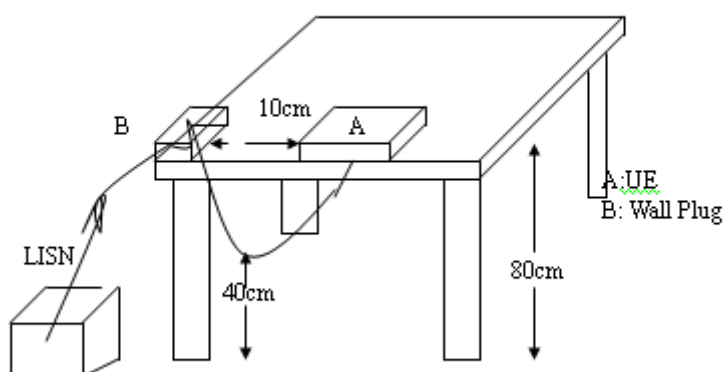
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## 6 CONDUCTED EMISSIONS TEST

### 6.1 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. Sweep frequency starting from 150 kHz to 30 MHz for phase L1.
4. Repeating the measurement as lists above for phase neutral.

### 6.2 Test SET-UP (Block Diagram of Configuration)



### 6.3 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
LISN	TESEQ	NNB 51	36076	2018/02/14	2019/02/13
EMI Test Receiver	R&S	ESCI	101300	2017/11/02	2018/11/01

### 6.4 Measurement Result:

N/A, this device is supplied 5Vdc from power supply.

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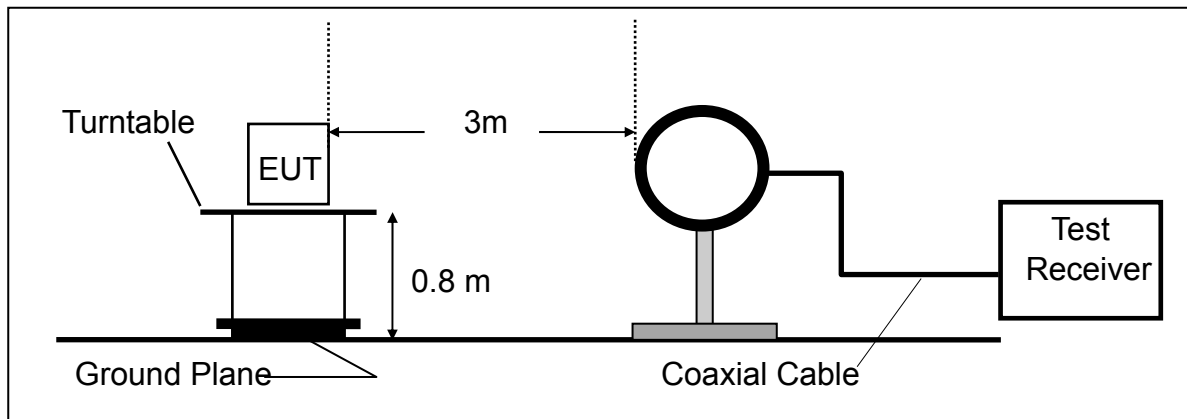
## 7 RADIATED EMISSION TEST

### 7.1 Measurement Procedure

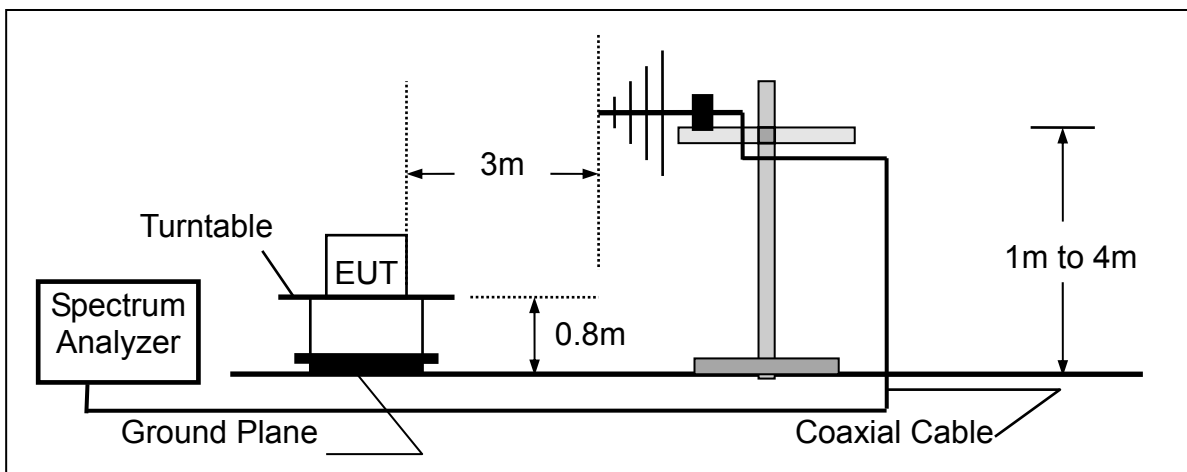
1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.

### 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:

SGS 966 Chamber No.C					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Broadband Antenna	SCHWAZBEC K	VULB 9168	9168-617	2017/10/27	2018/10/26
Loop Antenna	ETS.LINDGR EN	6502	148045	2017/09/26	2018/09/25
Loop Antenna	ETS.LINDGR EN	6502	148045	2018/09/26	2019/09/25
3m Site NSA	SGS	966 chamber D	N/A	2018/07/06	2019/07/05
EMI Test Receiver	R&S	ESU 40	100363	2018/04/11	2019/04/10
Pre-Amplifier	EMC Instruments	EMC9135	980234	2017/12/26	2018/12/25
Coaxial Cable	Huber Suhner	RG 214/U	W22.03	2017/12/26	2018/12/25
DC Power Supply	DHA	DPS-3003	9411005787	2018/08/19	2019/08/18

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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	

## 7.5 Field Strength of Fundamental Emission

### 7.5.1 Limit

Field strength of fundamental emissions limit:

The field strength of fundamental emissions shall not exceed 15848 micorvolts/meter at 30 meters. The Limit is converted to 123.90dBuV/m by offsetting the distance extrapolation factor as measurement distance is taken place at 3 meters.

$$\text{Distance extrapolation} = 40 * \log (30/3) = 40 \text{ dB}$$

$$\text{Limit is re-adjusted in terms of limit taken in 3m} = 20 * \log (15848 \text{ uV/m}) + 40 = 124.00\text{dBuV/m}$$

Note:

Actual FS(dBuV/m) = Spectrum. Reading level(dBuV) + Factor(dB)

Factor(dB) = Antenna Factor(dBuV/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.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we’ve employed is peak detector.

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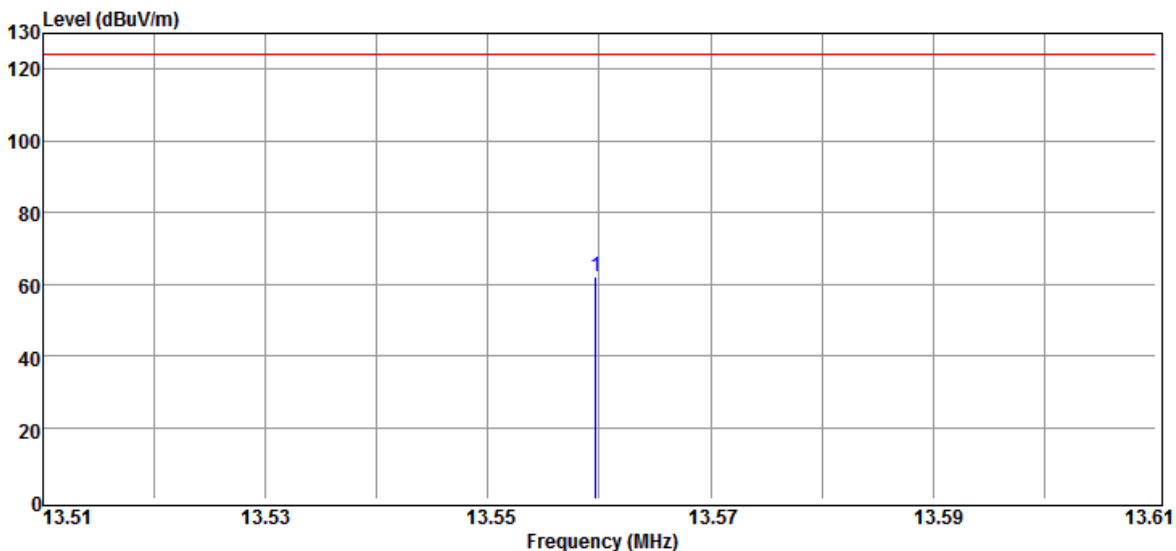
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Operation Mode	:NFC	Test Date	:2018-09-29
Test Mode	:Main CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
13.56	Peak	50.45	11.56	62.01	124.00	-61.99

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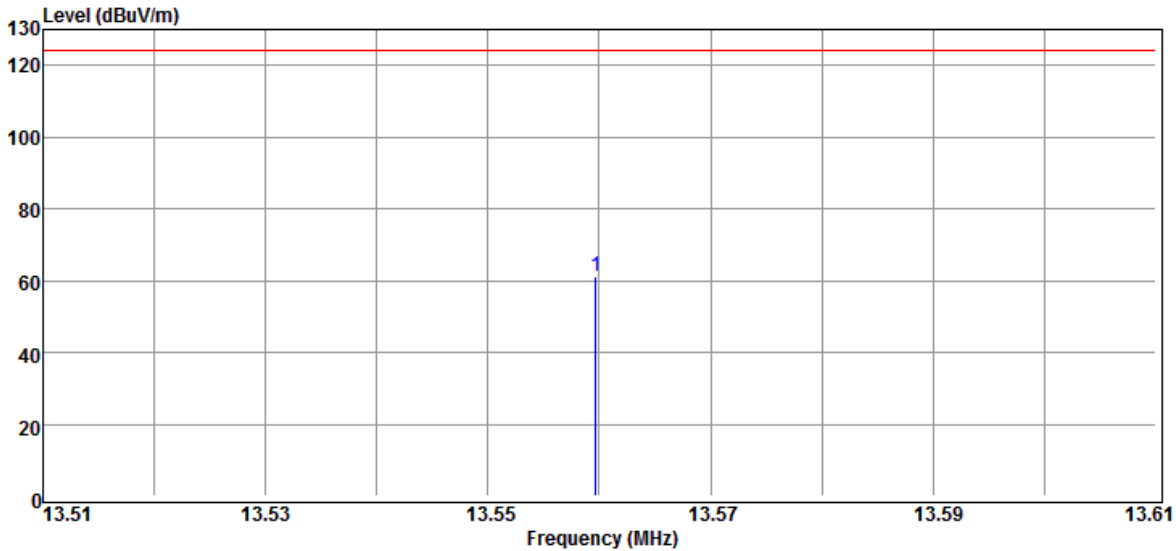
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Operation Mode	:NFC	Test Date	:2018-09-29
Test Mode	:Main CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
13.56	Peak	49.54	11.56	61.10	124.00	-62.90

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### 7.5.2 Radiated Mask

- (a) 15.848 millivolts/m (84 dB $\mu$ V/m) at 30 m, within the band 13.553-13.567 MHz.
- (b) 334 microvolts/m (50.5 dB $\mu$ V/m) at 30 m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz.
- (c) 106 microvolts/m (40.5 dB $\mu$ V/m) at 30 m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz.

Distance extrapolation =  $40 \cdot \log(30/3) = 40$  dB

Limit is re-adjusted in terms of limit taken in 3m for the following frequency segment of the interest:

- a)  $20 \cdot \log(15848 \mu\text{V/m}) + 40\text{dB} = 124.00\text{dB}\mu\text{V/m}$
- b)  $20 \cdot \log(334 \mu\text{V/m}) + 40\text{dB} = 90.47\text{dB}\mu\text{V/m}$
- c)  $20 \cdot \log(106 \mu\text{V/m}) + 40\text{dB} = 80.50\text{dB}\mu\text{V/m}$

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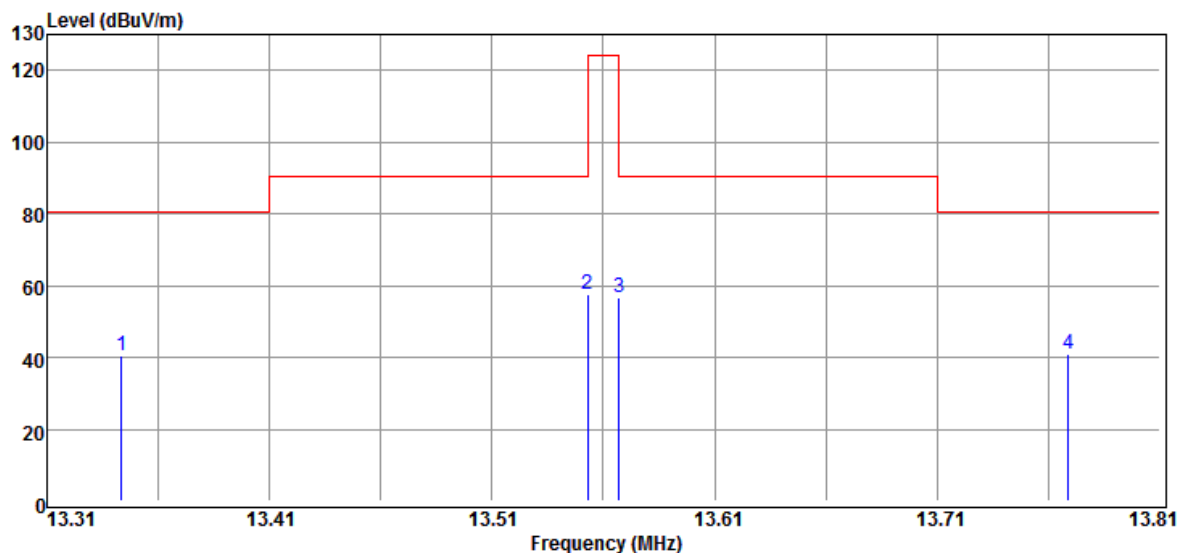
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Test Mode	:Mask CH Mid	Temp./Humi.	:25/60
EUT Pol	:HPlan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
13.34	Peak	28.89	11.57	40.46	80.54	-40.08
13.55	Peak	45.88	11.56	57.44	90.47	-33.03
13.57	Peak	45.14	11.56	56.70	90.47	-33.77
13.77	Peak	29.21	11.55	40.76	80.50	-39.74

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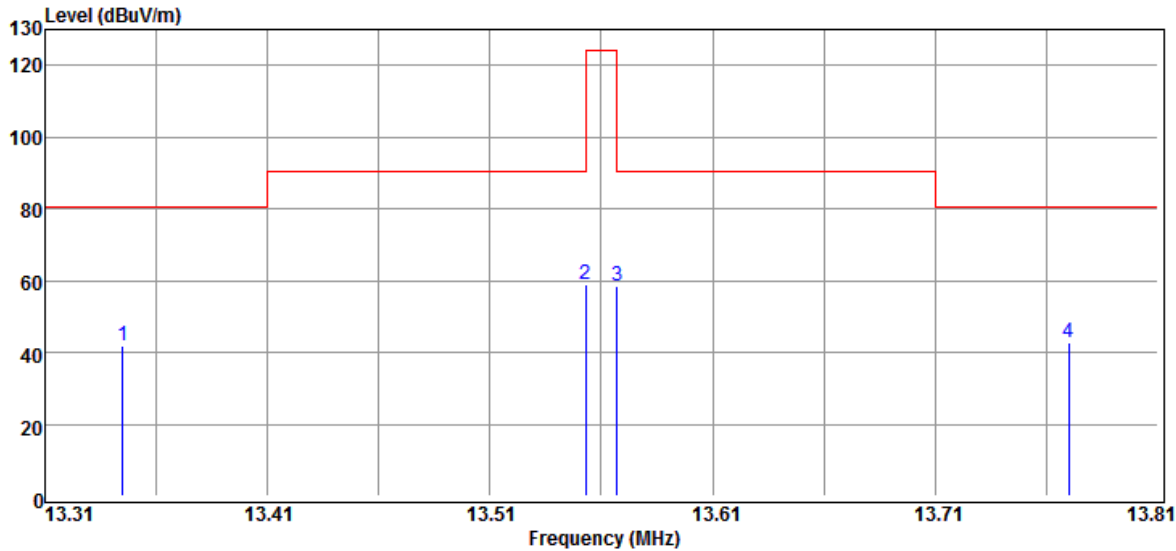
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Test Mode	:Mask CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
13.35	Peak	30.44	11.57	42.01	80.54	-38.53
13.55	Peak	47.45	11.56	59.01	90.47	-31.46
13.57	Peak	46.71	11.56	58.27	90.47	-32.20
13.77	Peak	31.05	11.55	42.60	80.50	-37.90

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### 7.5.3 Radiated Emission –

Limit:

§15.225

(d) 30 microvolts/m (29.4 dBμV/m) at 30 m, outside the band 13.110-14.010 MHz.

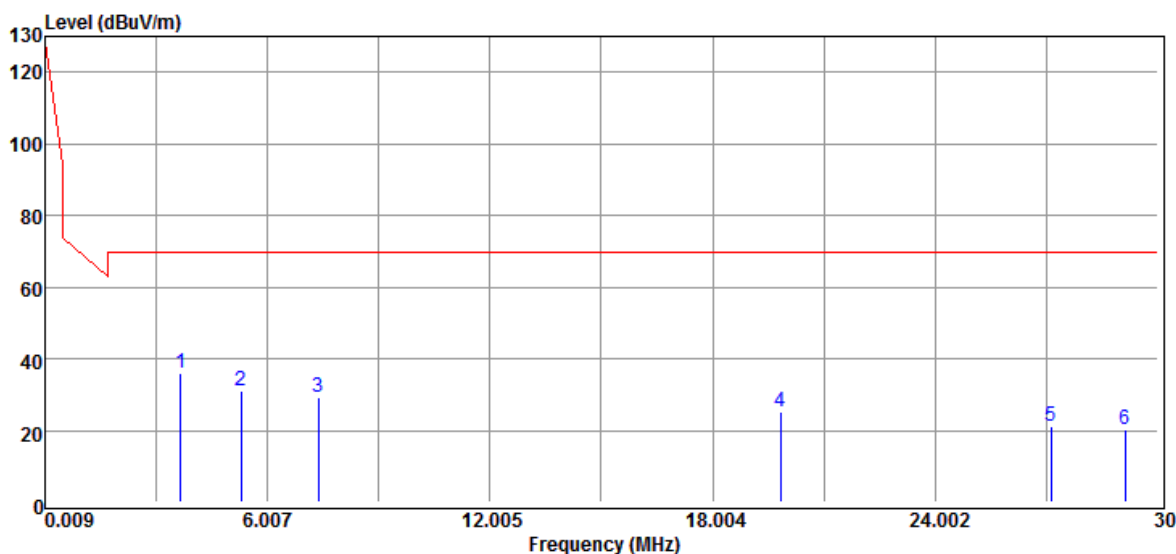
Limit is converted by adding the distance extrapolation factor as the measurement distance was taken place at 3m.

§RSS-210 A2.6

(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

$$a) 20 \cdot \log(30 \mu\text{V/m}) + 40 \text{ dB} = 69.54 \text{ dB}\mu\text{V/m}$$

Operation Mode	:NFC	Test Date	:2018-09-29
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
3.67	Peak	24.91	11.11	36.02	69.54	-33.52
5.29	Peak	19.64	11.19	30.83	69.54	-38.71
7.39	Peak	17.91	11.51	29.42	69.54	-40.12
19.83	Peak	13.97	11.28	25.25	69.54	-44.29
27.12	Peak	11.55	9.67	21.22	69.54	-48.32
29.13	Peak	10.93	9.29	20.22	69.54	-49.32

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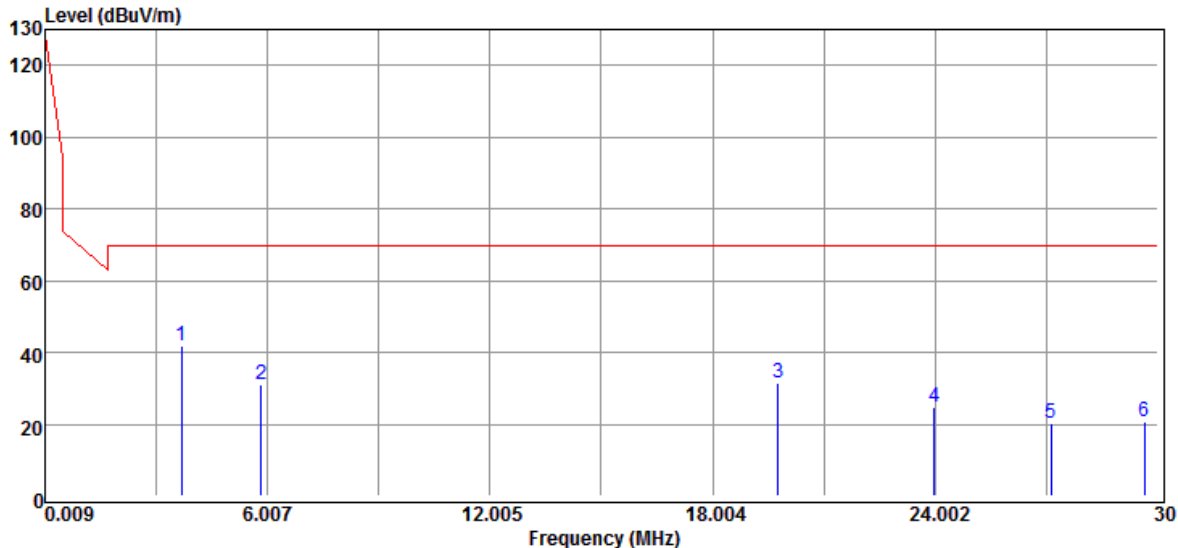
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Operation Mode	:NFC	Test Date	:2018-09-29
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
3.70	Peak	30.78	11.10	41.88	69.54	-27.66
5.83	Peak	19.73	11.29	31.02	69.54	-38.52
19.77	Peak	20.14	11.28	31.42	69.54	-38.12
23.97	Peak	14.20	10.32	24.52	69.54	-45.02
27.12	Peak	10.37	9.67	20.04	69.54	-49.50
29.64	Peak	11.53	9.21	20.74	69.54	-48.80

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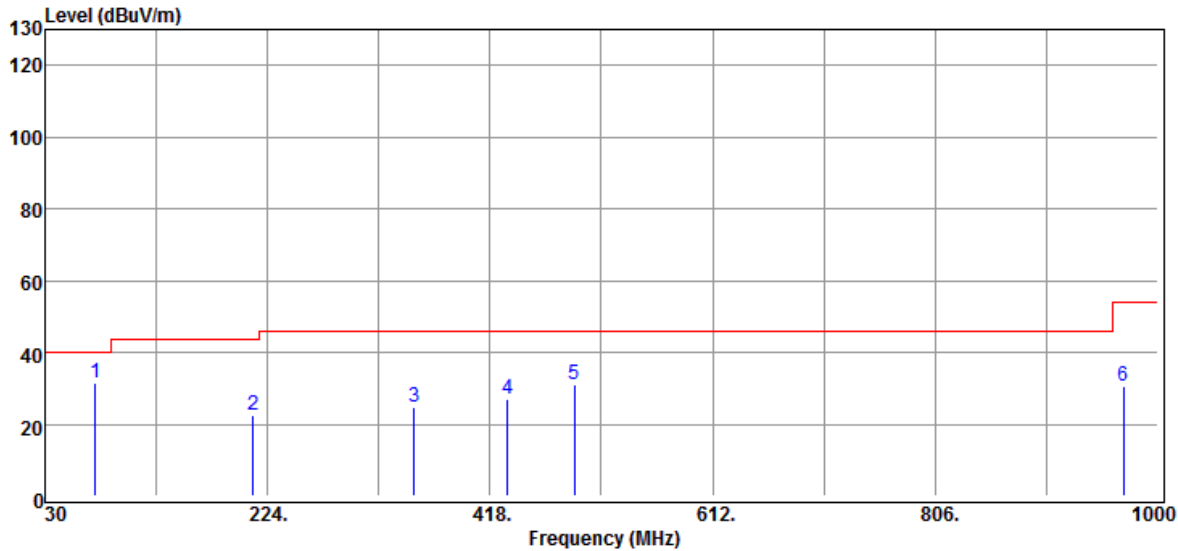
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Operation Mode	:NFC	Test Date	:2018-09-29
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:VERTICAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
73.65	Peak	51.52	-20.23	31.29	40.00	-8.71
211.39	Peak	41.18	-18.69	22.49	43.50	-21.01
352.04	Peak	38.69	-13.91	24.78	46.00	-21.22
433.52	Peak	38.72	-11.91	26.81	46.00	-19.19
491.72	Peak	42.23	-11.10	31.13	46.00	-14.87
969.93	Peak	33.84	-3.30	30.54	54.00	-23.46

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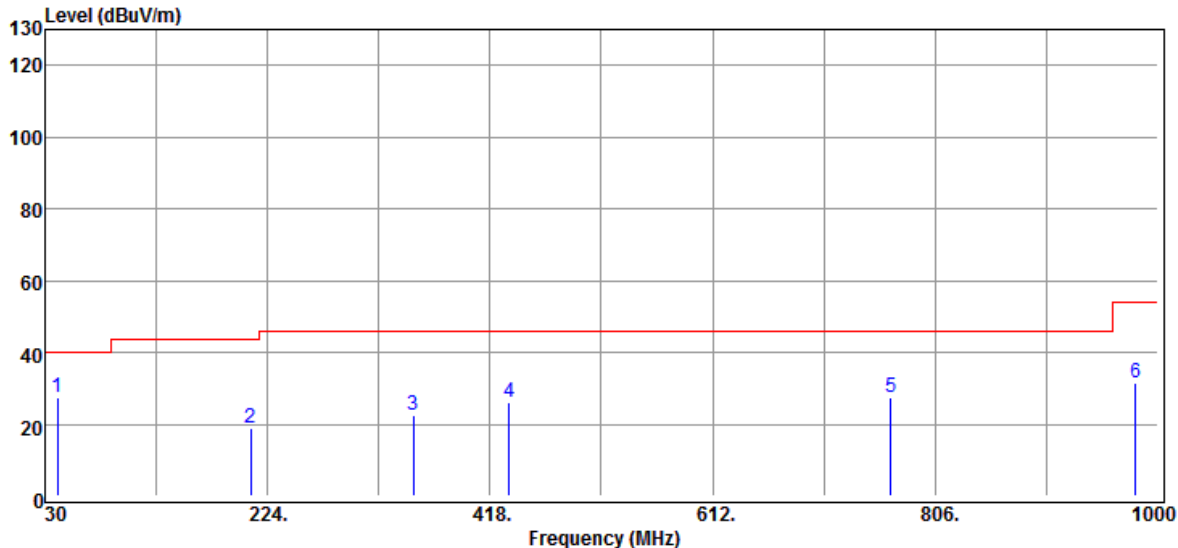
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Operation Mode	:NFC	Test Date	:2018-09-29
Test Mode	:Tx CH Mid	Temp./Humi.	:25/60
EUT Pol	:H Plan	Antenna Pol.	:HORIZONTAL
Test Channel	:13.56 MHz	Engineer	:Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
40.67	Peak	45.80	-18.50	27.30	40.00	-12.70
209.45	Peak	37.57	-18.69	18.88	43.50	-24.62
351.07	Peak	36.40	-13.93	22.47	46.00	-23.53
434.49	Peak	37.78	-11.88	25.90	46.00	-20.10
767.20	Peak	34.36	-6.85	27.51	46.00	-18.49
980.60	Peak	34.78	-3.50	31.28	54.00	-22.72

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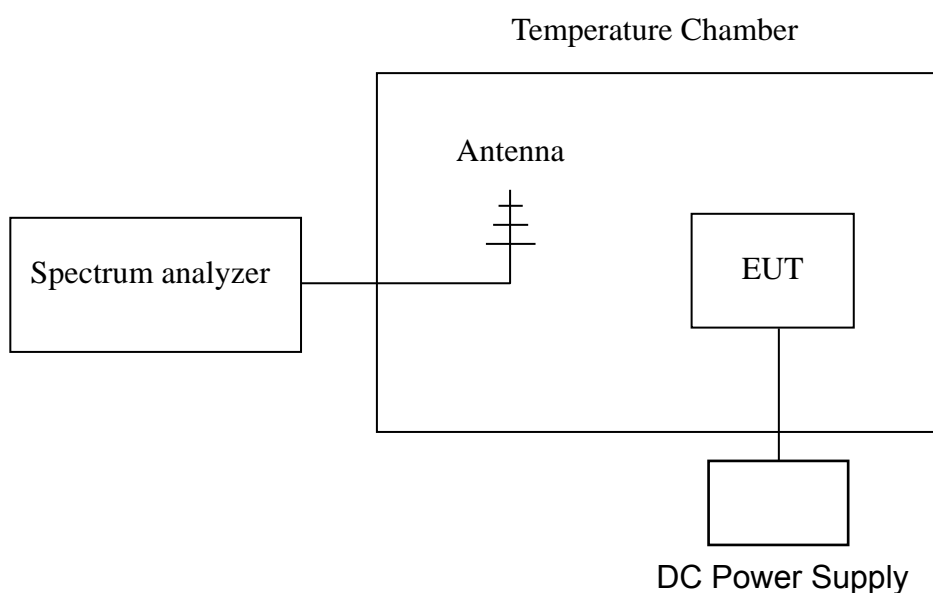
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## 8 FREQUENCY TOLERANCE

### 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 Max hold. Mark peak.

### 8.2 Test SET-UP (Block Diagram of Configuration)



### 8.3 Measurement Equipment Used:

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Loop Antenna	ETS.LINDGREN	6502	148045	2017/09/26	2018/09/25
Spectrum Analyzer	Agilent	N9010A	MY51440113	2018/06/20	2019/06/19
DC Block	PASTERNAK	PE8210	RF29	2017/12/26	2018/12/25
Coaxial Cables	Woken	00100A1F 1A185C	RF220	2017/12/26	2018/12/25
DC Power Supply	Agilent	E3640A	MY53140006	2018/05/30	2019/05/29

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## 8.4 Measurement Results

### Startup

#### A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
5	-20	13.5596	0.60000	+/- 1.356
5	-10	13.5596	0.60000	+/- 1.356
5	0	13.5597	0.50000	+/- 1.356
5	10	13.56	0.20000	+/- 1.356
5	20	13.5602	0.00000	+/- 1.356
5	30	13.5602	0.00000	+/- 1.356
5	40	13.5603	-0.10000	+/- 1.356
5	50	13.5604	-0.20000	+/- 1.356

#### B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
16	20	13.5603	-0.10000	+/- 1.356
5	20	13.5602	0.00000	+/- 1.356
4.5	20	13.5597	0.50000	+/- 1.356

### 2 minutes

#### A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
5	-20	13.5595	0.60000	+/- 1.356
5	-10	13.5596	0.50000	+/- 1.356
5	0	13.5597	0.40000	+/- 1.356
5	10	13.5598	0.30000	+/- 1.356
5	20	13.5601	0.00000	+/- 1.356
5	30	13.5602	-0.10000	+/- 1.356
5	40	13.5602	-0.10000	+/- 1.356
5	50	13.5605	-0.40000	+/- 1.356

#### B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
16	20	13.5603	-0.20000	+/- 1.356
5	20	13.5601	0.00000	+/- 1.356
4.5	20	13.5598	0.30000	+/- 1.356

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## 5 minutes

### A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
5	-20	13.5596	0.50000	+/- 1.356
5	-10	13.5597	0.40000	+/- 1.356
5	0	13.5597	0.40000	+/- 1.356
5	10	13.5599	0.20000	+/- 1.356
5	20	13.5601	0.00000	+/- 1.356
5	30	13.5603	-0.20000	+/- 1.356
5	40	13.5606	-0.50000	+/- 1.356
5	50	13.5607	-0.60000	+/- 1.356

### B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
16	20	13.5604	-0.30000	+/- 1.356
5	20	13.5601	0.00000	+/- 1.356
4.5	20	13.5598	0.30000	+/- 1.356

## 10 minutes

### A. Temperature Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
5	-20	13.5595	0.50000	+/- 1.356
5	-10	13.5596	0.40000	+/- 1.356
5	0	13.5596	0.40000	+/- 1.356
5	10	13.5599	0.10000	+/- 1.356
5	20	13.56	0.00000	+/- 1.356
5	30	13.5602	-0.20000	+/- 1.356
5	40	13.5605	-0.50000	+/- 1.356
5	50	13.5606	-0.60000	+/- 1.356

### B. Supply Voltage Variation

Power Supply	Environment	Frequency	Delta (KHz)	Limit (KHz)
Vdc	Temperature (°C)	(MHz)		
16	20	13.5603	-0.30000	+/- 1.356
5	20	13.56	0.00000	+/- 1.356
4.5	20	13.5596	0.40000	+/- 1.356

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## 9 20 dB OCCUPIED BANDWIDTH MEASUREMENT

### 9.1 Standard Applicable:

§2.1049 & §15.215 (c)

### 9.2 Limit:

None

### 9.3 Test Set-up

Refer to section 6.2 in this report

### 9.4 Measurement Procedure

20dB bandwidth

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak mode.
2. 20dB Bandwidth the resolution bandwidth of 1 kHz and the video bandwidth of 3 kHz were used.
3. Measured the spectrum width with power higher than 20dB below carrier.

### 9.5 Measurement Equipment Used:

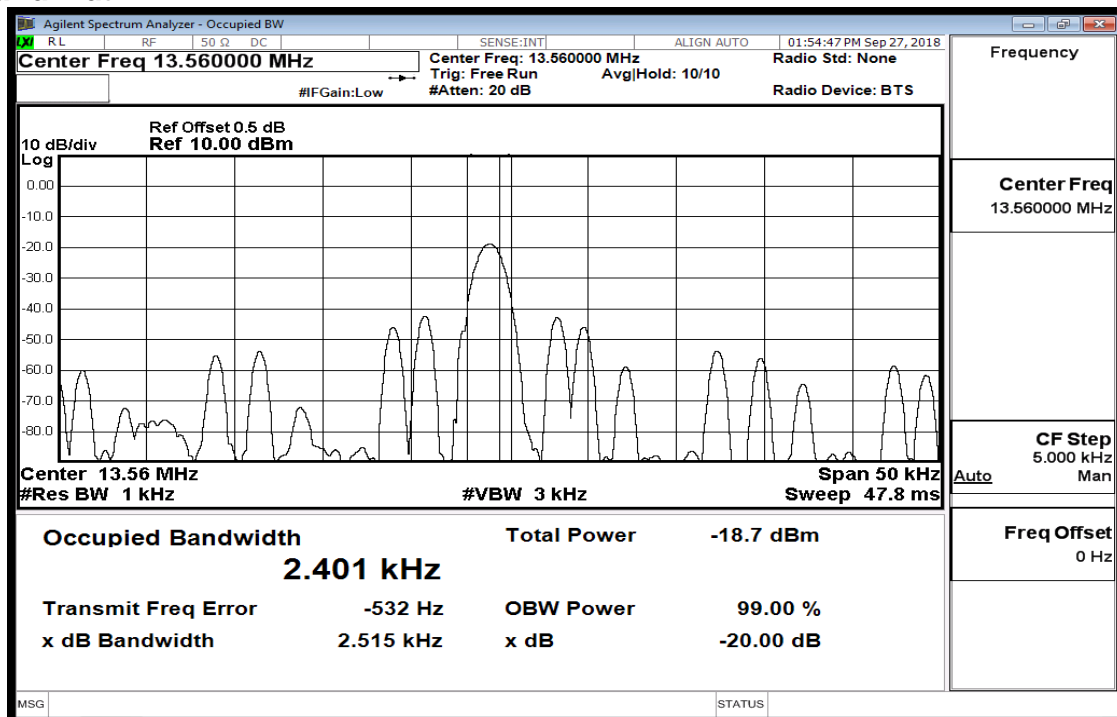
Refer to section 8.3 in this report

### 9.6 Measurement Result

20dB BW (kHz)
2.515

Operation range	Frequency (MHz)	Limit (MHz)
Low	13.55820	>13.11
High	13.56065	<14.01

### -20dB Bandwidth



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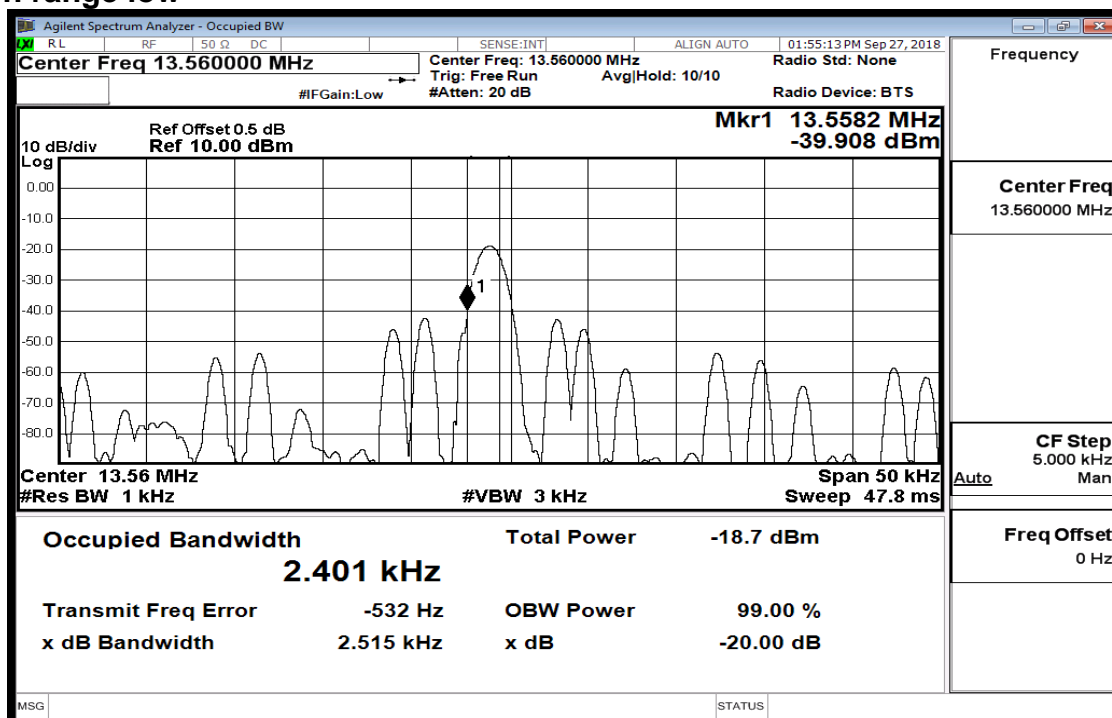
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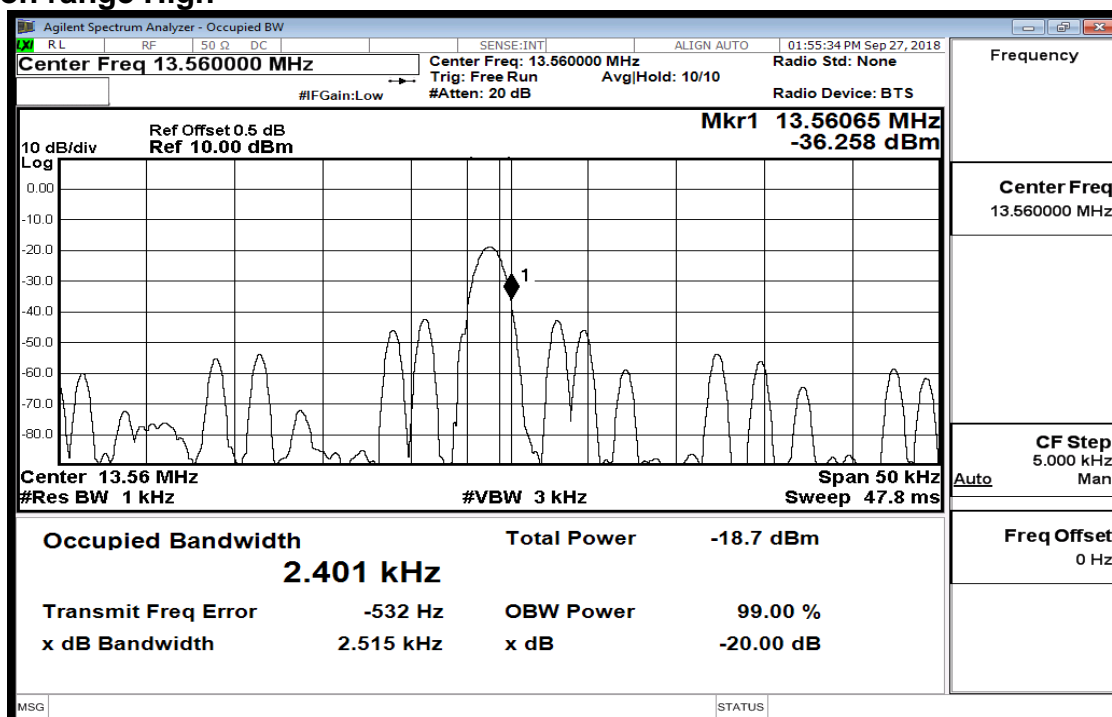
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### Operation range low



## Operation range High



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## 10 ANTENNA REQUIREMENT

### 10.1 Standard Applicable:

According to §15.203, Antenna requirement.

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

### 10.2 Antenna Connected Construction:

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo and antenna spec. for details.

*~ End of Report ~*

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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