Stanley Black & Decker, Inc.

RF TEST REPORT

Report Type:
FCC Part 15.249 & ISED RSS-210 RF report

Model:
MHL600
REPORT NUMBER:
180501586SHA-001

ISSUE DATE:
Aug 30, 2018

DOCUMENT CONTROL NUMBER:
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Intertek Testing Services Shanghai
Building No.86, 1198 Qinzhou Road (North)
Caohejing Development Zone
Shanghai 200233, China

Telephone: 86 21 6127 8200
www.intertek.com

Total Quality. Assured.

TEST REPORT

Report no.: 180501586SHA-001

Applicant:	**Stanley Black & Decker, Inc.**
	400 Executive Blvd S, Southington, CT 06489 USA
Manufacturer:	**Stanley Black & Decker, Inc.**
	400 Executive Blvd S, Southington, CT 06489 USA
Manufacturing site:	**AEC Lighting Solutions Co., Ltd.**
	No.2548, Baoan Road, Jiading District, Shanghai, 201801, China
FCC ID:	**2ANWF-MHL600LAMP**
IC:	**23237-MHL600LAMP**

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:

47CFR Part 15 (2017): Radio Frequency Devices (Subpart C)

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

RSS-210 Issue 9 (August 2016): Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

RSS-Gen Issue 5 (April 2018): General Requirements for Compliance of Radio Apparatus

PREPARED BY:	**REVIEWED BY:**
Teddy Yin	Daniel Zhao
Project Engineer	Reviewer
Teddy Yin	Daniel Zhao

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Revision History

Report No.	Version	Description	Issued Date
180501586SHA-001	Rev. 01	Initial issue of report	Aug 30, 2018

Measurement result summary

TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
Radiated emission	15.249 & 15.209	RSS-210 Issue 9 Clause B.10	Pass
Power line conducted emission	15.207	RSS-Gen Issue 5 Clause 8.8	NA
Assigned bandwidth (20dB bandwidth)	15.215(c)	RSS-Gen Issue 5 Clause 6.7	Pass
Antenna requirement	15.203	-	Pass

Notes: 1: NA =Not Applicable

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Inspection LED Light
Type/Model:	MHL600
Description of EUT:	The EUT is a wireless device with 915MHz. We tested the channels: 913.75MHz and 915.50MHz and listed the worst data in this report.
Rating:	4.2VDC; 2A
Category of EUT:	Class B
EUT type:	☒ Table top ☐ Floor standing
Software Version:	/
Hardware Version:	/
Sample received date:	May 18, 2018
Date of test:	May 18~Jul 27, 2018

1.2 Technical Specification

Frequency Range:	913.75MHz ~ 915.50MHz
Support Standards:	/
Type of Modulation:	FSK
Channel Number:	8
Data Rate:	/
Channel Separation:	0.25 MHz

Antenna Information:	PCB antenna, 1.9dBi Peak gain

1.3 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address:	Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China
Telephone:	86 21 61278200
Telefax:	86 21 54262353

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L0139
	FCC Accredited Lab Designation Number: CN1175
	IC Registration Lab Registration code No.: 2042B-1
	VCCI Registration Lab Registration No.: R-4243, G-845, C-4723, T-2252
	NVLAP Accreditation Lab NVLAP LAB CODE: 200849-0
	A2LA Accreditation Lab Certificate Number: 3309.02

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2017)
ANSI C63.10 (2013)
RSS-210 Issue 9 (August 2016)
RSS-Gen Issue 5 (April 2018)

2.2 Mode of operation during the test

The lowest and highest channel were tested as representatives.

Frequency Band (MHz)				913.75 ~ 915.50			
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	913.75						
1	914.00						
2	914.25						
3	914.50						
4	914.75						
5	915.00						
6	915.25						
7	915.50						

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

1) Radiated test mode: EUT transmitted signal with antenna;
2) The EUT is a handheld unlicensed wireless device, so three axes (X, Y, Z) were observed while the test receiver worked as “max hold” continuously and the highest reading (X axis)among the whole test procedure was recorded.

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	ESxS-K1	R&S	V2.1.0
Radiated emission	ES-K1	R&S	V1.71

2.4 Test peripherals list

Item No.	Name	Band and Model	Description
1	/	/	/
/	/	/	/
/	/	/	/

2.5 Test environment condition:

Test items	Temperature	Humidity
Radiated emission	24°C	51% RH
Assigned bandwidth (20dB bandwidth)	24°C	52% RH
Power line conducted emission	/	/

2.6 Instrument list

Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Test Receiver	R&S	ESIB 26	EC 3045	2018-09-12
☑	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2019-05-30
☑	Horn antenna	R&S	HF 906	EC 3049	2018-09-23
☑	Pre-amplifier	R&S	Pre-amp 18	EC5881	2019-06-19
☑	Semi-anechoic chamber	Albatross project	-	EC 3048	2018-09-15
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2019-03-05
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 2323	2019-06-14
☑	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3325	2019-03-28

2.7 Measurement uncertainty

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

Test item	Measurement uncertainty
Maximum peak output power	± 0.74dB
Radiated Emissions in restricted frequency bands below 1GHz	± 4.90dB
Radiated Emissions in restricted frequency bands above 1GHz	± 5.02dB
Emission outside the frequency band	± 2.89dB
Power line conducted emission	± 3.19dB

3 Radiated emission

Test result: **Pass**

3.1 Limit

Fundamental Frequency (MHz)	Fundamental limit (dBuV/m)	Harmonic limit (dBuV/m)
☒ 902 - 928	94	54
☐ 2400 - 2483.5	94	54
☐ 5725 - 5875	94	54
☐ 24000 - 24250	108	68

The radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) showed as below:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 ~ 0.490	2400/F(kHz)	300
0.490 ~ 1.705	24000/F(kHz)	30
1.705 ~ 30.0	30	30
30 ~ 88	100	3
88 ~ 216	150	3
216 ~ 960	200	3
Above 960	500	3

3.2 Measurement Procedure

For Radiated emission below 30MHz:

a) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.
b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c) Both X and Y axes of the antenna are set to make the measurement.
d) For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e) The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

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For Radiated emission above 30MHz:

a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c) The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d) For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e) The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

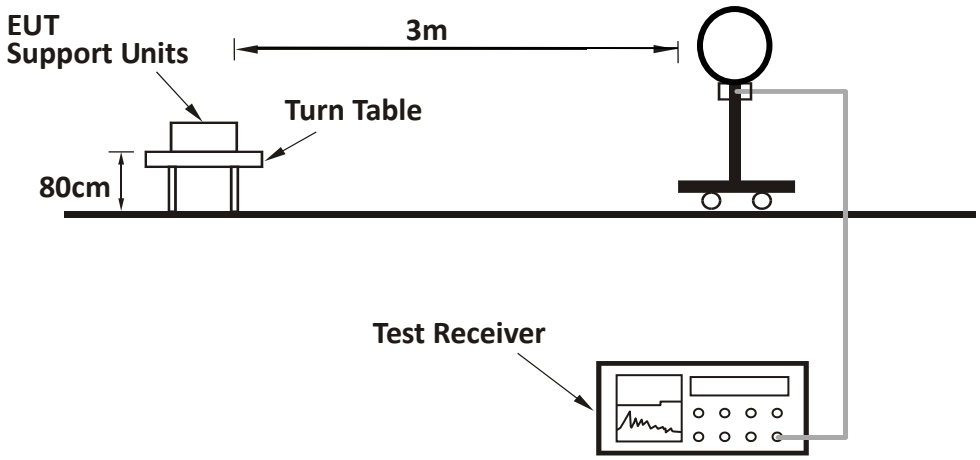
f) The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

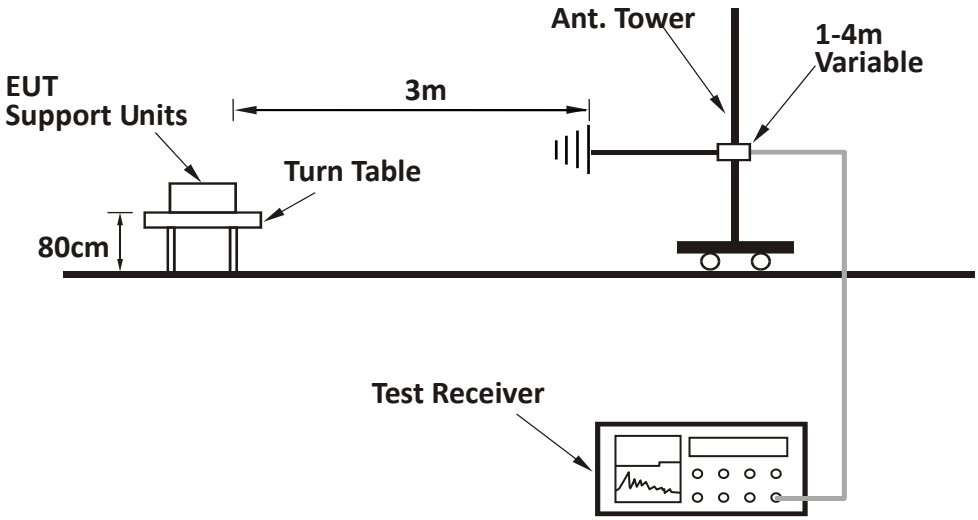
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98%) or 3 x RBW (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
4. All modes of operation were investigated and the worst-case emissions are reported

3.3 Test Configuration

For Radiated emission below 30MHz:



For Radiated emission 30MHz to 1GHz:



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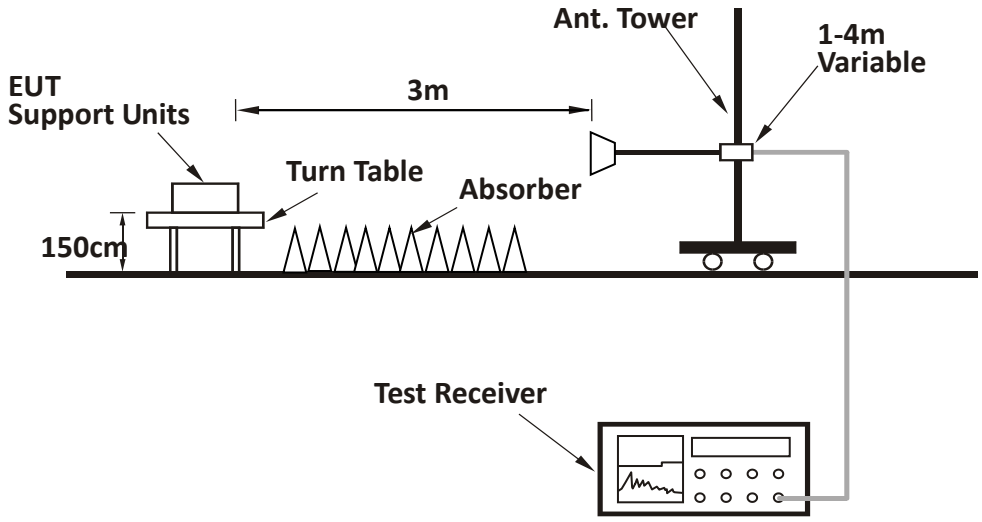
For Radiated emission above 1GHz:

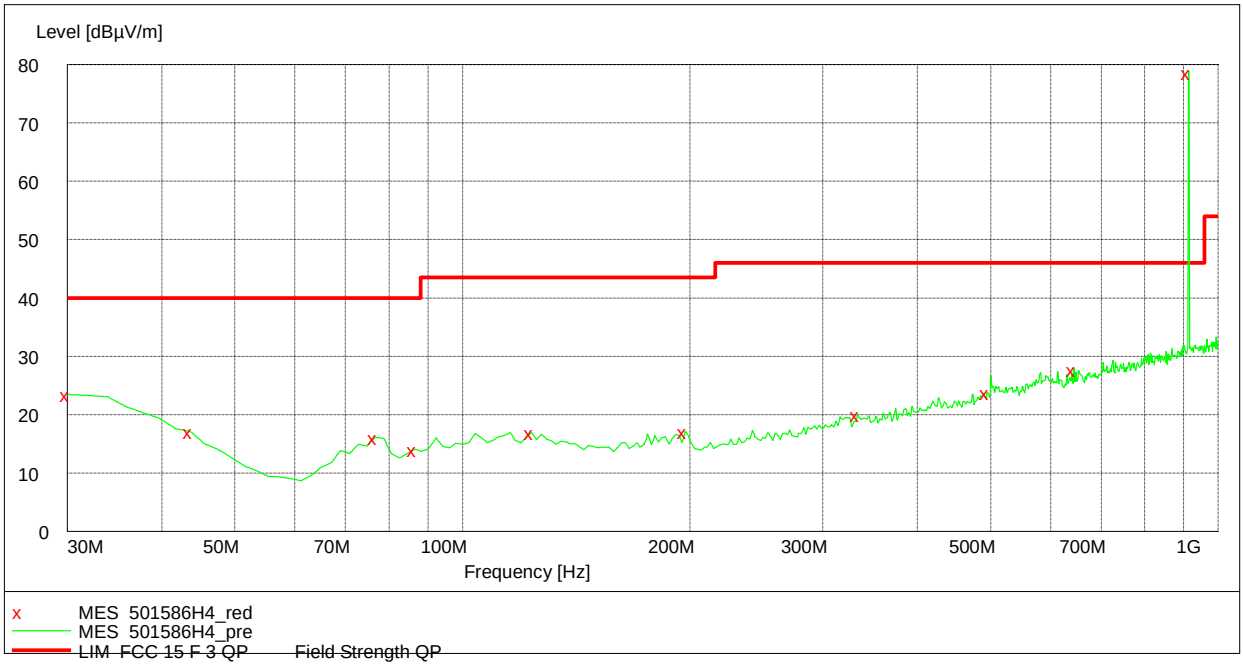


3.4 Test Results of Radiated Emissions

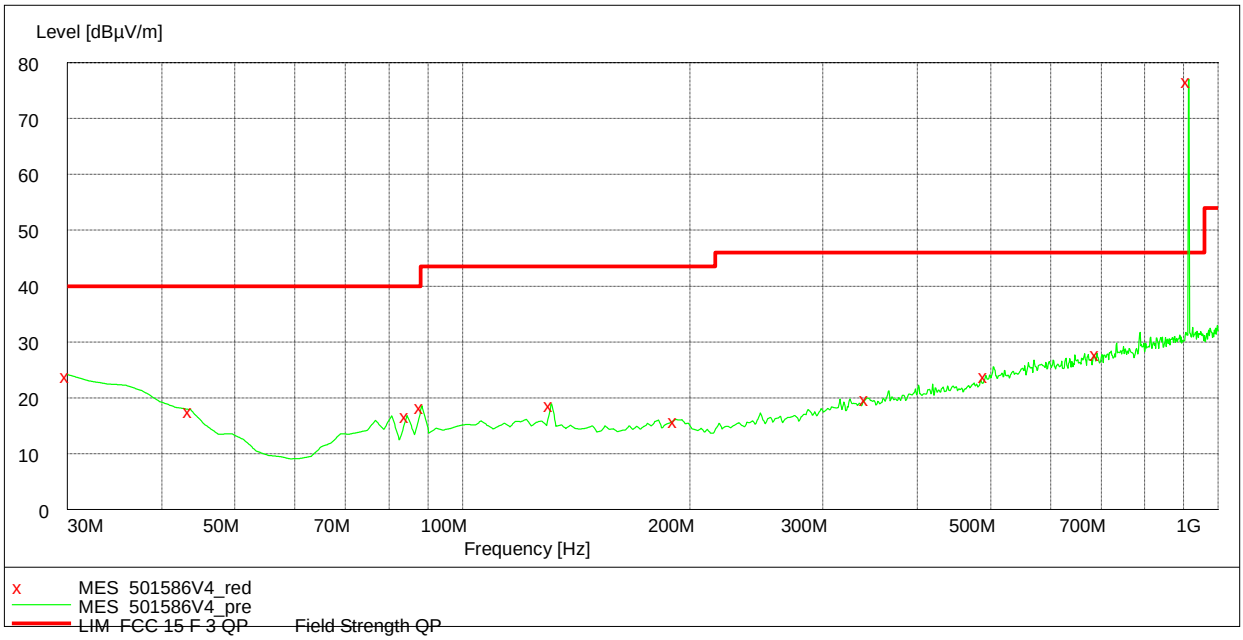
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

The worst waveform from 30MHz to 1000MHz is listed as below:

Horizontal



Vertical



Test data below 1GHz

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	30.00	23.50	21.10	40.00	16.50	PK
H	43.60	17.10	13.70	40.00	22.90	PK
H	76.65	16.10	9.50	40.00	23.90	PK
H	123.30	16.90	11.60	43.50	26.60	PK
H	644.26	27.70	21.40	46.00	18.30	PK
H	902.00	32.20	24.40	46.00	13.80	PK
H	913.75 (lowest channel)	78.70	25.10	94.00	15.30	QP
H	915.50 (highest channel)	81.60	25.20	94.00	12.40	QP
H	928.00	32.80	27.10	46.00	13.20	PK
V	30.00	24.20	21.10	40.00	15.80	PK
V	43.60	17.90	13.70	40.00	22.10	PK
V	84.42	16.80	9.80	40.00	23.20	PK
V	492.64	24.00	19.20	46.00	22.00	PK
V	690.92	28.00	21.90	46.00	18.00	PK
V	902.00	31.80	24.40	46.00	14.20	PK
V	913.75 (lowest channel)	76.90	25.10	94.00	17.10	QP
V	915.50 (highest channel)	76.70	25.20	94.00	17.30	QP
V	928.00	32.40	27.10	46.00	13.60	PK

Test result above 1GHz:

CH	Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	1827.50	39.90	-10.10	74.00	34.10	PK
	V	1827.50	48.20	-10.10	74.00	25.80	PK
	H	4568.75	46.90	1.2	74.00	27.10	PK
	V	4568.75	48.80	1.2	74.00	25.20	PK
	H	7310.00	59.00	8.50	74.00	15.00	PK

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	H	7310.00	48.20	8.50	54.00	5.80	AV
	V	7310.00	58.00	8.50	74.00	16.00	PK
	V	7310.00	46.70	8.50	54.00	7.30	AV
	H	8223.75	52.10	10.70	74.00	21.90	PK
	V	8223.75	53.30	10.70	74.00	20.70	PK
H	H	1831.00	38.60	-10.10	74.00	35.40	PK
	V	1831.00	47.90	-10.10	74.00	26.10	PK
	H	4577.50	45.90	1.2	74.00	28.10	PK
	V	4577.50	47.90	1.2	74.00	26.10	PK
	H	7324.00	52.00	8.70	74.00	22.00	PK
	V	7324.00	58.40	8.70	74.00	15.60	PK
	V	7324.00	47.10	8.70	54.00	6.90	AV
	H	8239.50	51.00	10.70	74.00	23.00	PK
	V	8239.50	53.00	10.70	74.00	21.00	PK

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.
2. Corrected Reading = Original Receiver Reading + Correct Factor
3. Margin = Limit - Corrected Reading
4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
Limit = 40.00dBuV/m.
Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
Margin = 40.00dBuV/m - 10.20dBuV/m = 29.80dB.

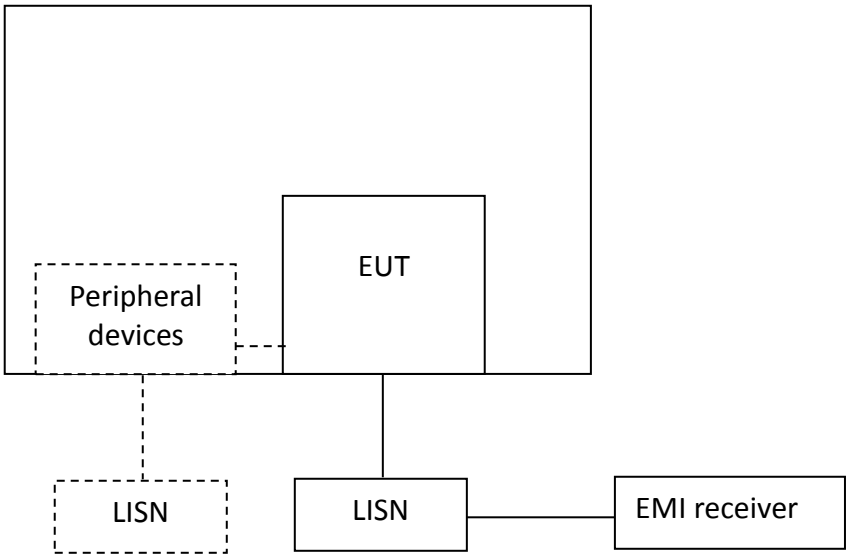
4 Power line conducted emission

Test result: **NA**

4.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

4.2 Test Configuration



4.3 Measurement Procedure

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

4.4 Test Results of Power line conducted emission

Test Curve:

L Line

Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.16	NA	65.3	NA	NA	55.3	NA
0.25	NA	61.9	NA	NA	51.9	NA
0.60	NA	56.0	NA	NA	46.0	NA
4.29	NA	56.0	NA	NA	46.0	NA
10.45	NA	60.0	NA	NA	50.0	NA
19.40	NA	60.0	NA	NA	50.0	NA

Note: *means margin is more than 10dB

Test Curve:

N Line

Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.16	NA	65.3	NA	NA	55.3	NA
0.25	NA	61.9	NA	NA	51.9	NA
0.60	NA	56.0	NA	NA	46.0	NA
4.29	NA	56.0	NA	NA	46.0	NA
10.45	NA	60.0	NA	NA	50.0	NA
19.40	NA	60.0	NA	NA	50.0	NA

Note: *means margin is more than 10dB.

Remark: 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.

2. Corrected Reading = Original Receiver Reading + Correct Factor

3. Margin = Limit - Corrected Reading

4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

5 Assigned bandwidth (20dB bandwidth)

Test result: **Pass**

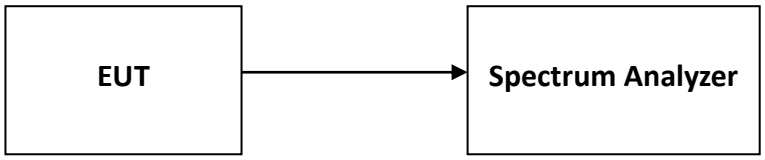
5.1 Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the allocated frequency band.

5.2 Measurement Procedure

The 20dB Bandwidth is measured using the Spectrum Analyzer.
Set Span = 2 to 3 times the 20 dB bandwidth, RBW = approximately 1% of the 20 dB bandwidth, VBW>RBW, Sweep = auto, Detector = peak, Trace = max hold.
The test was performed at 2 channels (lowest and highest channel).

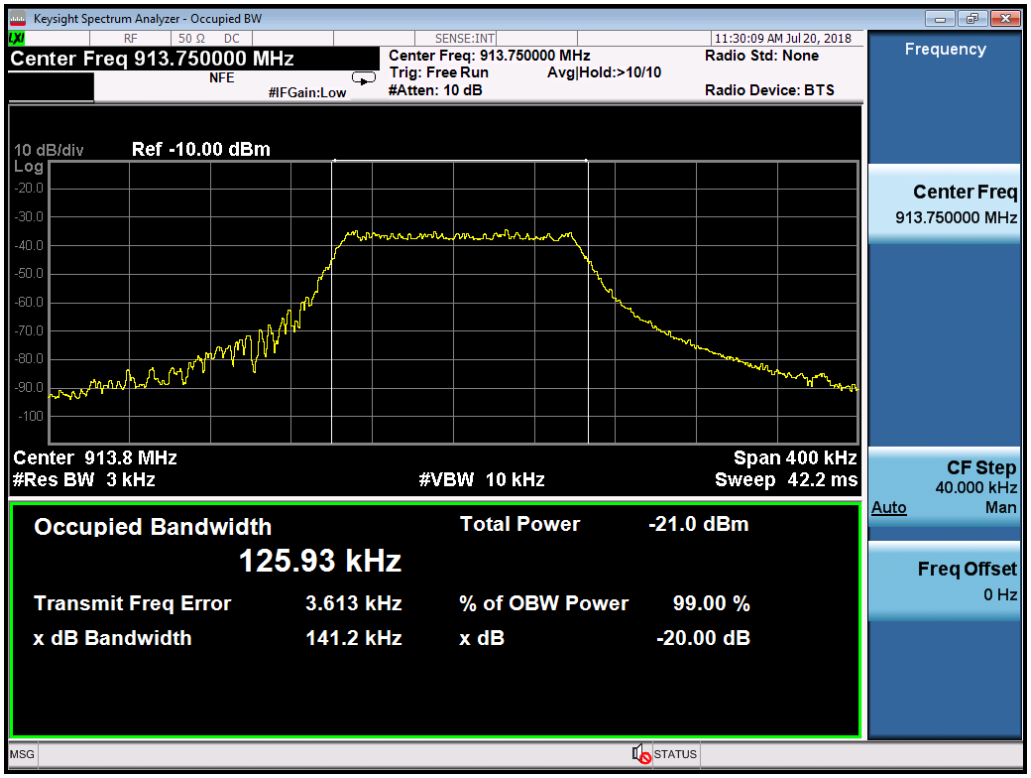
5.3 Test Configuration



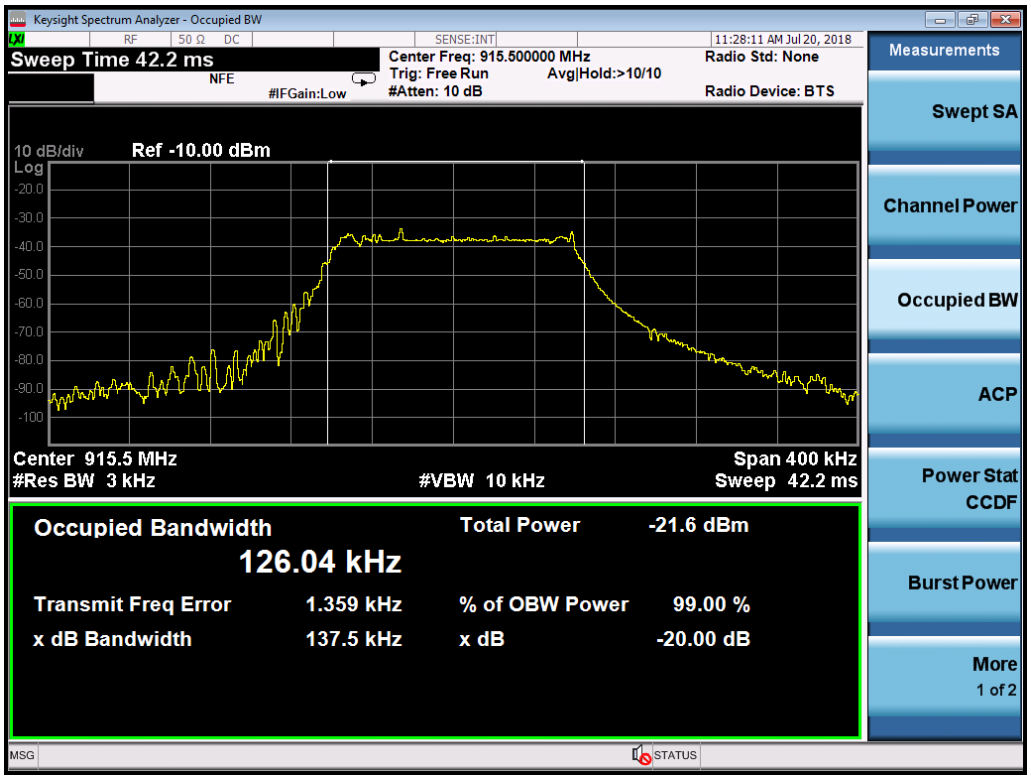
5.4 The results

Test Mode	Frequency (MHz)	20dB Bandwidth (kHz)	99% Bandwidth (kHz)	F_L at 20dB BW (MHz)	F_H at 20dB BW (MHz)
transmit	913.75	141.20	125.93	>902	/
	915.50	137.50	126.04	/	<928
Limit		N/A	N/A	F_L >902	F_H <928
Result		**Complied**			

Channel L



Channel H


Keysight Spectrum Analyzer - Occupied BW
RF
50 Ω DC
SENSE:INT
11:28:11 AM Jul 20, 2018
Sweep Time 42.2 ms
NFE
#IFGain:Low
Center Freq: 915.500000 MHz
Trig: Free Run
Avg|Hold:>10/10
#Atten: 10 dB
Radio Std: None
Radio Device: BTS
Measurements
Swept SA
Channel Power
Occupied BW
ACP
Power Stat CCDF
Burst Power
More 1 of 2
10 dB/div
Log
Ref -10.00 dBm
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100
Center 915.5 MHz
#Res BW 3 kHz
#VBW 10 kHz
Span 400 kHz
Sweep 42.2 ms
Occupied Bandwidth
126.04 kHz
Total Power
-21.6 dBm
Transmit Freq Error
1.359 kHz
% of OBW Power
99.00 %
x dB Bandwidth
137.5 kHz
x dB
-20.00 dB
MSG
STATUS

6 Antenna requirement

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.

Result:
EUT uses PCB antenna to the intentional radiator, so it can comply with the provisions of this section.

********** END **********