TELE RADIO AB

C2PC RF TEST REPORT

Report Type:
FCC Part 15.247 & ISED RSS-247 RF report

Model:
CL-TR600-1, D00005-15, D5-15

REPORT NUMBER
180402198SHA-001

ISSUE DATE
September 26, 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

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TEST REPORT

Report no.: 180402198SHA-001

Applicant:	TELE RADIO AB Datavägen 21, SE-436 32 Askim, Sweden
Manufacturer:	TELE RADIO AB Datavägen 21, SE-436 32 Askim, Sweden
FCC ID:	ONFC1602A
IC:	4807A-C1602A

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-247 Issue 2 (February 2017): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

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

PREPARED BY:	**REVIEWED BY:**
Project Engineer Nemo Li	Reviewer Daniel Zhao

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Revision History

Report No.	Version	Description	Issued Date
180402198SHA-001	Rev. 01	Initial issue of report	September 26, 2018

Measurement result summary

TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
Minimum 6dB Bandwidth	15.247(a)(2)	RSS-247 Issue 2 Clause 5.2	NP
Maximum conducted output power and e.i.r.p.	15.247(b)(3)	RSS-247 Issue 2 Clause 5.4	NP
Power spectrum density	15.247(e)	RSS-247 Issue 2 Clause 5.2	NP
Emission outside the frequency band	15.247(d)	RSS-247 Issue 2 Clause 5.5	NP
Radiated Emissions in restricted frequency bands	15.247(d), 15.205&15.209	RSS-Gen Issue 5 Clause 8.9&8.10	Pass
Power line conducted emission	15.207(a)	RSS-Gen Issue 5 Clause 8.8	Pass
Occupied bandwidth	-	RSS-Gen Issue 5 Clause 6.6	NP
Antenna requirement	15.203	-	NP

Notes: 1: NA = Not Applicable

2. NP = Not Performed, among this C2PC report, these test items are not influenced and no repeated test is necessary.

3. Determination of the test conclusion is based on IEC Guide 115 in consideration of measurement uncertainty.

TEST REPORT

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Transceiver radio modular
Type/Model:	CL-TR600-1, D00005-15, D5-15
Description of EUT:	EUT is a radio modular. It has three models, they are electrically identical except the model name.
Rating:	Battery DC 3.7V, 1600mAh
EUT type:	☒ Table top ☐ Floor standing
Software Version:	/
Hardware Version:	/
Sample received date:	September 14, 2018
Date of test:	September 14, 2018 ~ September 26, 2018

1.2 Technical Specification

Frequency Range:	2400MHz ~ 2483.5MHz
Operating Frequency:	2405MHz to 2480MHz
Type of Modulation:	O-QPSK
Channel Number:	16 (11 - 26)
Channel Separation:	5 MHz
Antenna:	Antenna 1 & 3: Chip antenna, 4.0dBi max; Antenna 2: Chip antenna, 1.6dBi max
Host product name:	Transceiver
Host model name:	T27, T26, T26-01, T26-06, T26-07, T26-81, T26-82

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)
KDB 558074 (v05)
RSS-247 Issue 2 (February 2017)
RSS-Gen Issue 5 (April 2018)

2.2 Mode of operation during the test

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied. The EUT was tested together with the host device.

The L, M and H channels were tested as representatives (2405MHz, 2440MHz and 2480MHz).

The EUT contains 3 antennas. Antenna 1 and 2 share the same Antenna port. Therefore, for RF conducted test, antenna 1 and 3 are tested as representative. For radiated emission test, Each antenna is assessed individually.

The EUT doesn't support simultaneously transmission. No combination emission is assessed.

Test peripheral: Laptop X201i manufactured by Lenovo

The EUT is powered by the host.

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	Laptop computer	DELL 5480	-

2.5 Test environment condition:

Test items	Temperature	Humidity
20 dB Bandwidth	-	-
Output power		
Carrier Frequency Separation		
Number of Hopping Frequencies		
Dwell time		
Occupied bandwidth		
Conducted Spurious Emissions & Band Edge		
Radiated Emissions	24°C	56% RH
Power line conducted emission	-	-

2.6 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☐	Test Receiver	R&S	ESCS 30	EC 2107	2018-10-18
☐	A.M.N.	R&S	ESH2-Z5	EC 3119	2018-12-01
☐	Shielded room	Zhongyu	-	EC 2838	2019-01-08
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Test Receiver	R&S	ESIB 26	EC 3045	2018-10-18
☑	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2019-05-30
☑	Horn antenna	R&S	HF 906	EC 3049	2019-09-22
☐	Horn antenna	ETS	3117	EC 4792-1	2019-08-23
☑	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2020-07-09
☑	Pre-amplifier	R&S	Pre-amp 18	EC5881	2019-06-19
☑	Semi-anechoic chamber	Albatross project	-	EC 3048	2019-09-08
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☐	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2018-09-10
☐	Power sensor	Agilent	U2021XA	EC 5338-1	2019-03-03
☐	Vector Signal Generator	Agilent	N5182B	EC 5175	2019-03-06
☐	MXG Analog Signal Generator	Agilent	N5181A	EC 5338-2	2019-03-03
☐	Test Receiver	R&S	ESCI 7	EC 4501	2019-02-23
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
☑	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3323	2019-06-14
☑	Pressure meter	YM3	Shanghai Mengde	EC 3320	2019-06-28

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 Emissions

Test result: **Pass**

3.1 Limit

The radiated emissions which fall in the restricted bands, must also comply with the radiated emission limits specified 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 meters 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 meters 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.

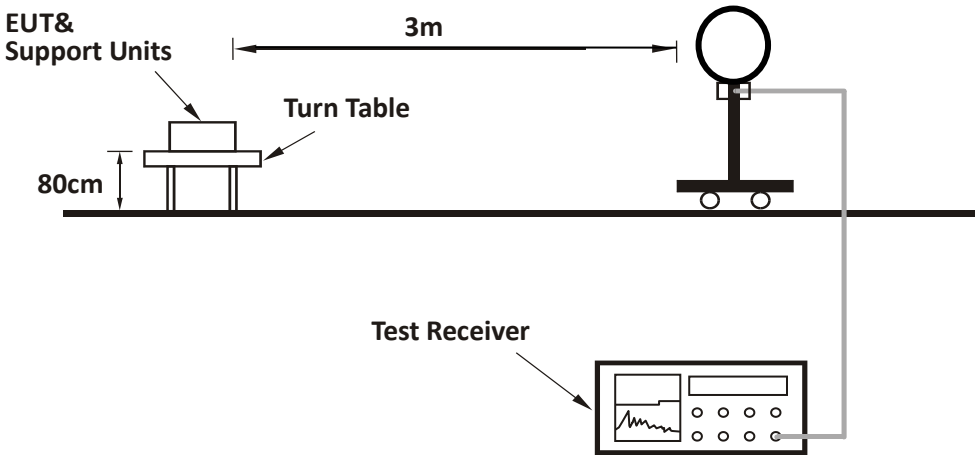
f) The test-receiver system was set to peak and average detector function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

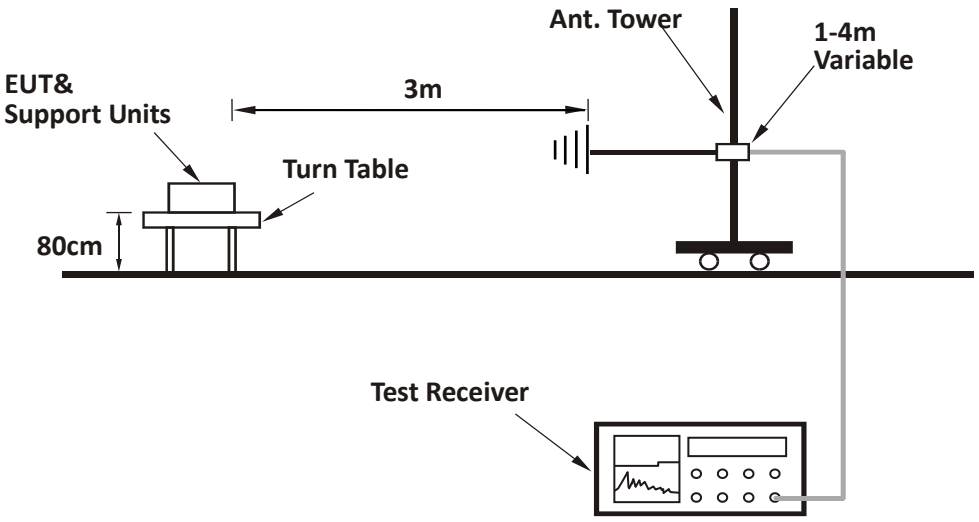
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
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 evaluated and the worst-case emissions were reported

3.3 Test Configuration

For Radiated emission below 30MHz:



For Radiated emission 30MHz to 1GHz:



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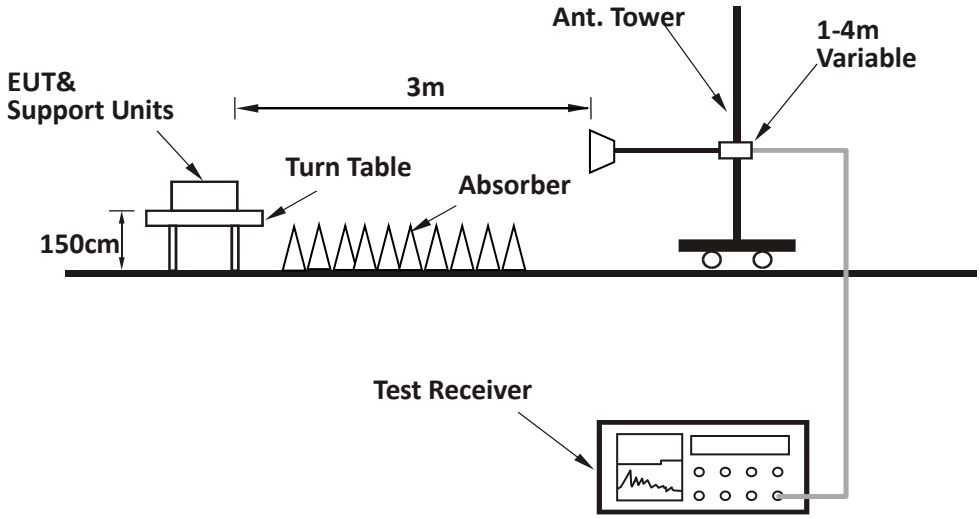
For Radiated emission above 1GHz:



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.

Test data below 1GHz:

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Correct Factor (dB/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	30.00	20.90	18.60	40.00	19.10	PK
H	245.77	37.00	13.50	46.00	9.00	PK
H	306.03	37.60	14.90	46.00	8.40	PK
H	407.11	32.20	17.70	46.00	13.80	PK
H	655.93	31.50	21.10	46.00	14.50	PK
H	943.63	32.00	23.90	46.00	14.00	PK
V	37.78	23.50	14.40	40.00	16.50	PK
V	59.16	23.20	7.00	40.00	16.80	PK
V	61.10	20.40	6.90	40.00	19.60	PK
V	171.90	21.00	10.70	43.50	22.50	PK
V	177.74	21.60	10.60	43.50	21.90	PK
V	323.53	30.90	15.50	46.00	15.10	PK
V	430.44	33.90	18.20	46.00	12.10	PK
V	617.05	38.40	20.90	46.00	7.60	PK
V	955.29	31.10	24.00	46.00	14.90	PK

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Test result of 1GHz to 25GHz:

Antenna 1:

CH	Polarization	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	V	2405.03	34.30	110.80	Fundamental	/	PK
	V	2390.00	34.30	62.10	74.00	11.90	PK
	V	2390.00	34.30	50.60	54.00	3.40	AV
	V	4809.61	-3.50	62.40	74.00	11.60	PK
	V	4809.61	-3.50	35.20	54.00	18.80	AV
	V	7208.42	2.00	62.10	74.00	11.90	PK
	V	7208.42	2.00	32.20	54.00	21.80	AV
	V	9621.24	4.90	52.00	54.00	2.00	PK
M	V	2440.16	34.50	111.60	Fundamental	/	PK
	H	4885.73	-3.30	63.40	74.00	10.60	PK
	H	4885.73	-3.30	36.00	54.00	18.00	AV
	H	7322.65	2.60	62.50	74.00	11.50	PK
	H	7322.65	2.60	32.80	54.00	21.20	AV
	V	9805.17	4.80	52.50	54.00	1.50	PK
H	V	2479.68	34.60	108.50	Fundamental	/	PK
	V	2483.50	34.60	73.20	74.00	0.80	PK
	V	2483.50	34.60	49.90	54.00	4.10	AV
	V	4949.90	-3.20	57.90	74.00	16.10	PK
	V	4949.90	-3.20	32.10	54.00	21.90	AV
	V	7446.89	2.70	65.10	74.00	8.90	PK
	V	7446.89	2.70	38.50	54.00	15.50	AV
	H	9929.85	5.00	48.60	54.00	5.40	PK

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Antenna 2:

CH	Polarization	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	V	2405.03	34.30	108.50	Fundamental	/	PK
	V	2390.00	34.30	61.80	74.00	12.20	PK
	V	2390.00	34.30	50.20	54.00	3.80	AV
	V	4809.61	-3.50	61.30	74.00	12.70	PK
	V	4809.61	-3.50	34.00	54.00	20.00	AV
	V	7208.42	2.00	61.30	74.00	12.70	PK
	V	7208.42	2.00	31.40	54.00	22.60	AV
	V	9621.24	4.90	51.50	54.00	2.50	PK
M	V	2440.16	34.50	109.40	Fundamental	/	PK
	H	4885.73	-3.30	62.30	74.00	11.70	PK
	H	4885.73	-3.30	35.10	54.00	18.90	AV
	H	7322.65	2.60	61.40	74.00	12.60	PK
	H	7322.65	2.60	31.60	54.00	22.40	AV
	V	9805.17	4.80	51.70	54.00	2.30	PK
H	V	2479.68	34.60	106.30	Fundamental	/	PK
	V	2483.50	34.60	71.40	74.00	2.60	PK
	V	2483.50	34.60	48.60	54.00	5.40	AV
	V	4949.90	-3.20	56.70	74.00	17.30	PK
	V	4949.90	-3.20	31.40	54.00	22.60	AV
	V	7446.89	2.70	64.30	74.00	9.70	PK
	V	7446.89	2.70	37.80	54.00	16.20	AV
	H	9929.85	5.00	47.50	54.00	6.50	PK

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Antenna 3:

CH	Polarization	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	V	2405.03	34.30	95.00	Fundamental	/	PK
	V	2390.00	34.30	61.70	74.00	12.30	PK
	V	2390.00	34.30	50.30	54.00	3.70	AV
	V	4809.61	-3.50	50.10	54.00	3.90	PK
	V	9621.24	4.90	46.30	54.00	7.70	PK
M	V	2440.16	34.50	95.20	Fundamental	/	PK
	H	4885.73	-3.30	50.50	54.00	3.50	PK
	V	9805.17	4.80	46.80	54.00	7.20	PK
H	V	2480.46	34.60	95.60	Fundamental	/	PK
	V	2483.50	34.60	66.40	74.00	7.60	PK
	V	2483.50	34.60	37.80	54.00	16.20	AV
	V	4949.90	-3.20	50.60	54.00	3.40	PK
	H	9929.85	5.00	46.60	54.00	7.40	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.

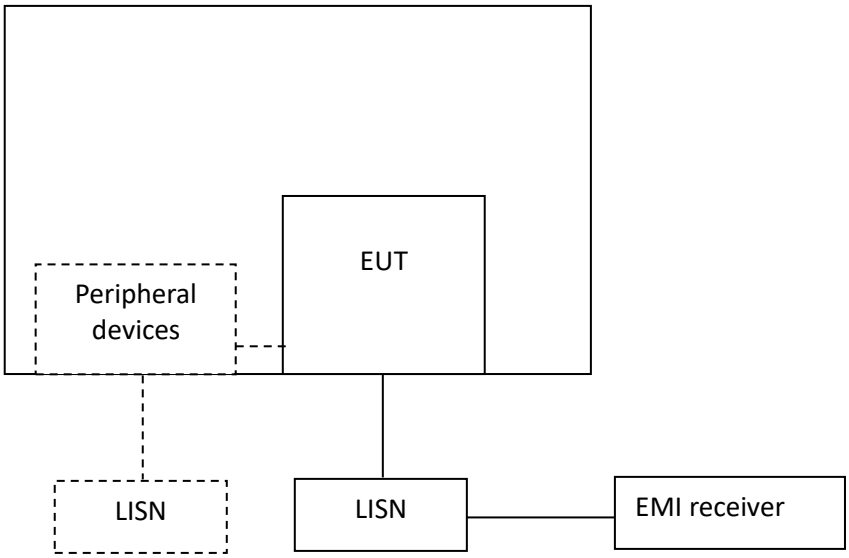
4 Power line conducted emission

Test result: **Pass**

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.

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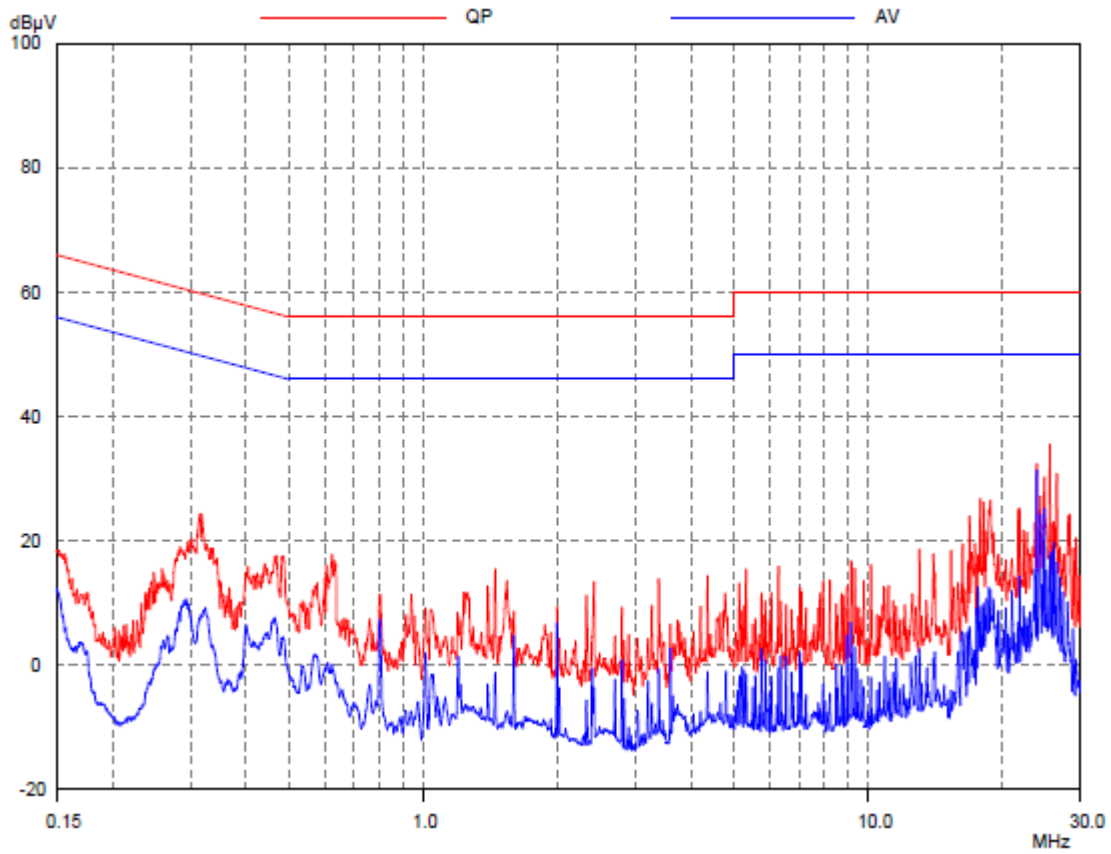
4.4 Test Results of Power line conducted emission

Test Curve:

Positive line:



Negative line:

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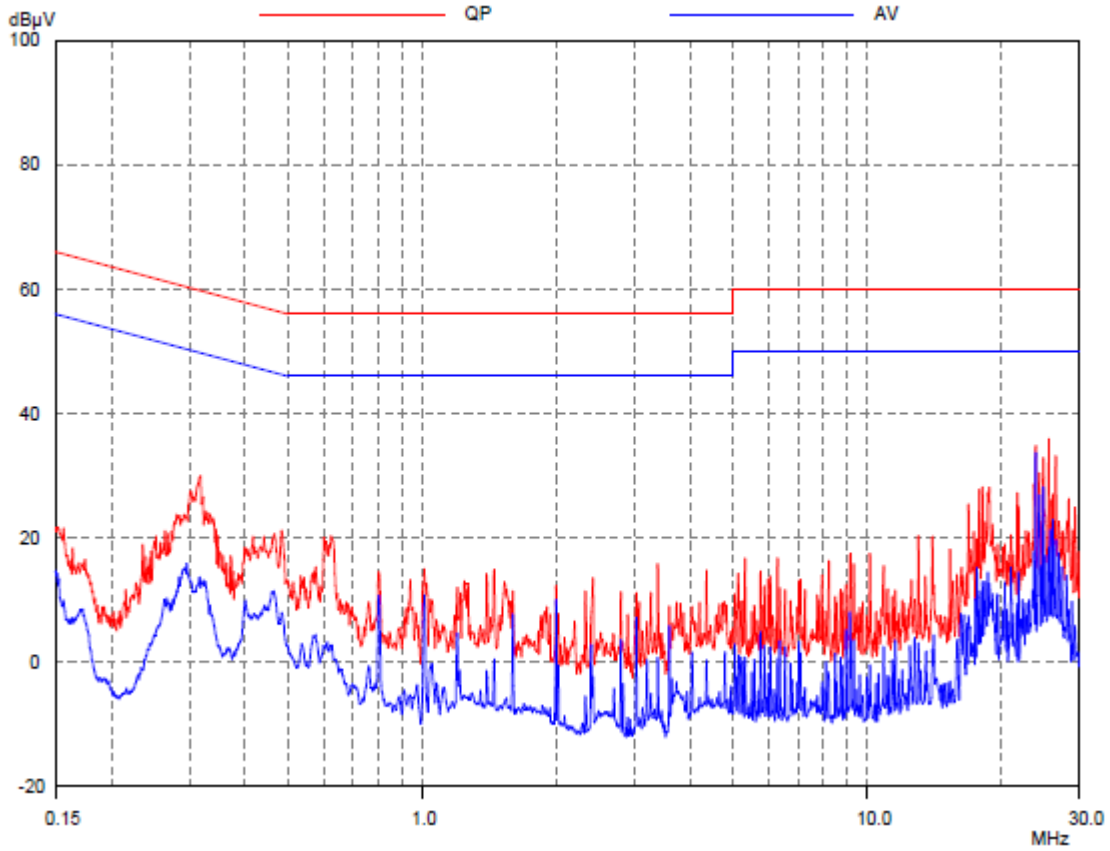

Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(µV)	Limit dB(µV)	Margin (dB)	level dB(µV)	limit dB(µV)	Margin (dB)
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-
-	-	-	-	-	-	-

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.

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