TEST REPORT

OF

FCC Part 15 Subpart C §15.209, §15.231
FCC ID : 2AD97-PIT3100

Equipment Under Test	:	Plug-in Type Transmitter
Model Name	:	PIT3100
Applicant	:	Korins Inc.
Manufacturer	:	Korins Inc.
Date of Test(s)	:	2015. 03. 01 ~ 2015. 03. 19
Date of Issue	:	2015. 03. 30

In the configuration tested, the EUT complied with the standards specified above.

Tested By: **Patrick Kang** **Date:** **2015. 03. 30**

Approved By: **Hyunchae You** **Date:** **2015. 03. 30**

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)
- Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 435-837

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx.

Phone No. : + 82 31 688 0901
Fax No. : + 82 31 688 0921

1.2. Details of applicant

Applicant : Korins Inc.
Address : Room613 Suntechcity 1, 474 Dunchondea-Ro, Jungwon-Gu, Seongnam-City, Gyeonggi-Do, 462-725 Korea
Contact Person : Choi, Won-Lim
Phone No. : +82 31 777 1588

1.3. Description of EUT

Kind of Product	Plug-in Type Transmitter
Model Name	PIT3100
Power Supply	AC 110 V
Frequency Range	433.075 0 ㎒ ~ 433.312 5 ㎒
Modulation Type	GFSK
Number of Channels	20 channels
Antenna Type	Helical Antenna

1.4. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal Date	Cal Interval	Cal Due.
Signal Generator	Agilent	E8257D	MY51501169	Jul. 17, 2014	Annual	Jul. 17, 2015
Spectrum Analyzer	Agilent	N9030A	MY53120526	Jul. 17, 2014	Annual	Jul. 17, 2015
Spectrum Analyzer	R&S	FSV30	103100	Jul. 16, 2014	Annual	Jul. 16, 2015
AC power Supply	KIKUSUI	PCR 500M	QC002962	Dec. 06, 2014	Annual	Dec. 06, 2015
Attenuator	Mini-Circuits	BW-N20W5+	0950-4	Dec. 23, 2014	Annual	Dec. 23, 2015
Preamplifier	H.P.	8447F	2944A03909	Aug. 27, 2014	Annual	Aug. 27, 2015
Preamplifier	R&S	SCU-18	10117	Dec. 26, 2014	Annual	Dec. 26, 2015
High Pass Filter	Mini-Circuits	NHP-800+	VUU16801113-2	Jul. 01, 2014	Annual	Jul. 01, 2015
High Pass Filter	Wainwright	WHK3.0/18G-10SS	344	Jun. 10, 2014	Annual	Jun. 10, 2015
Test Receiver	R&S	ESCI 7	100911	Dec. 24, 2014	Annual	Dec. 24, 2015
Loop Antenna	SCHWARZBECK	FMZB1519	1519-039	Jul. 09, 2013	Biennial	Jul. 09, 2015
Bilog Antenna	SCHWARZBECK	VULB9163	396	Jun. 07, 2013	Biennial	Jun. 07, 2015
Horn Antenna	R&S	HF906	100326	Dec. 10, 2013	Biennial	Dec. 10, 2015
Antenna Master	INN-CO	MM4000	N/A	N.C.R.	N/A	N.C.R.
Turn Table	INN-CO	DS 1200S	N/A	N.C.R.	N/A	N.C.R.
Anechoic Chamber	SY Corporation	L × W × H (9.6 m × 6.4 m × 6.6 m)	N/A	N.C.R.	N/A	N.C.R.
Two-Line V-Network	R&S	ENV216	100190	Dec. 25, 2014	Annual	Dec. 25, 2015
Shield Room	SY Corporation	L × W × H (6.5 m × 3.5 m × 3.5 m)	N/A	N.C.R.	N/A	N.C.R.

1.5. Summary of Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARD		
Section in FCC Part 15	**Test Item**	**Result**
15.209(a) 15.231(e)	Radiated emission, Spurious Emission and Field Strength of Fundamental	Complied
15.231(c)	Bandwidth of Operation frequency	Complied
15.231(e)	Limit of Transmission Time	Complied
15.207	Transmitter AC Power Line Conducted Emission	Complied

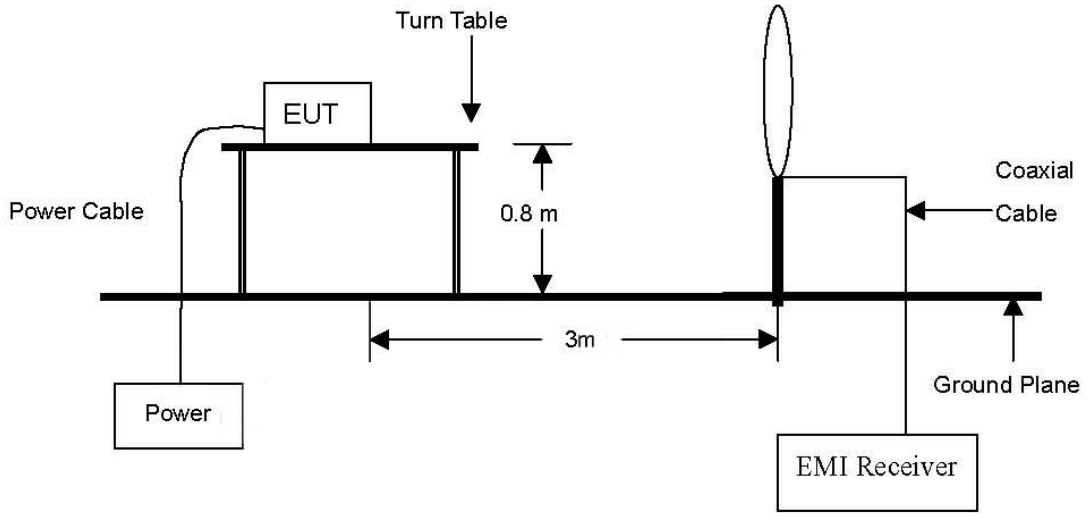
1.6. Test Report Revision

Revision	Report number	Date of issue	Description
0	F690501/RF-RTL008529	2015. 03. 24	Initial
1	F690501/RF-RTL008529-1	2015. 03. 30	Content for 15.231(a) in APPLIED STANDARD is deleted.

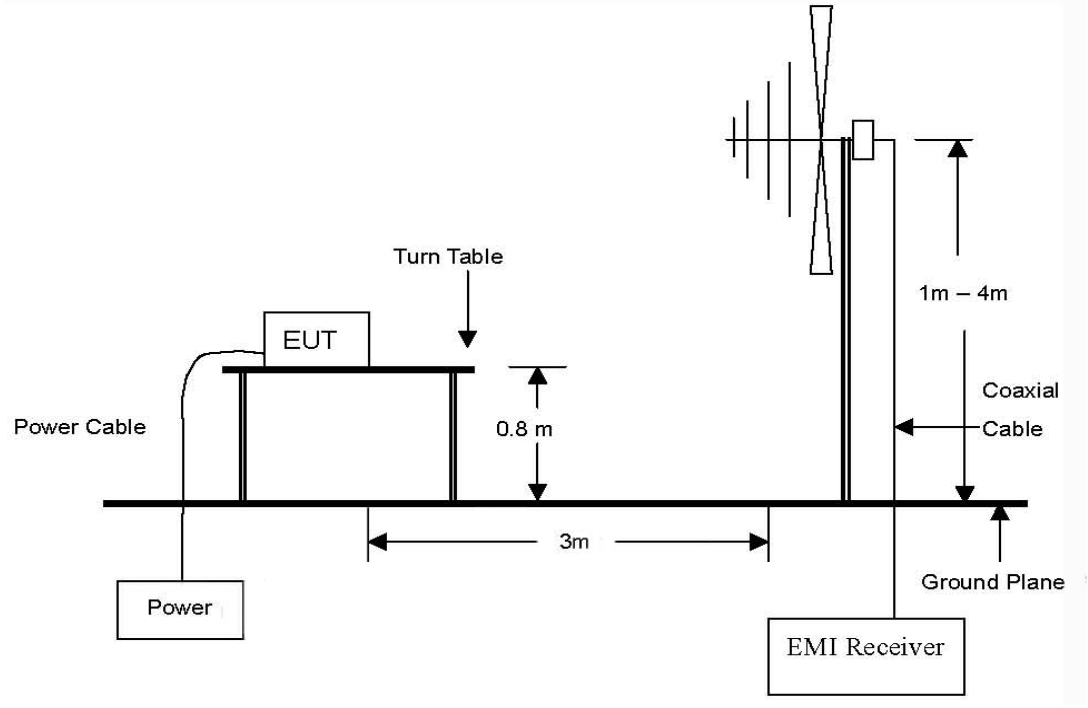
2. Field Strength of Fundamental

2.1. Test Setup

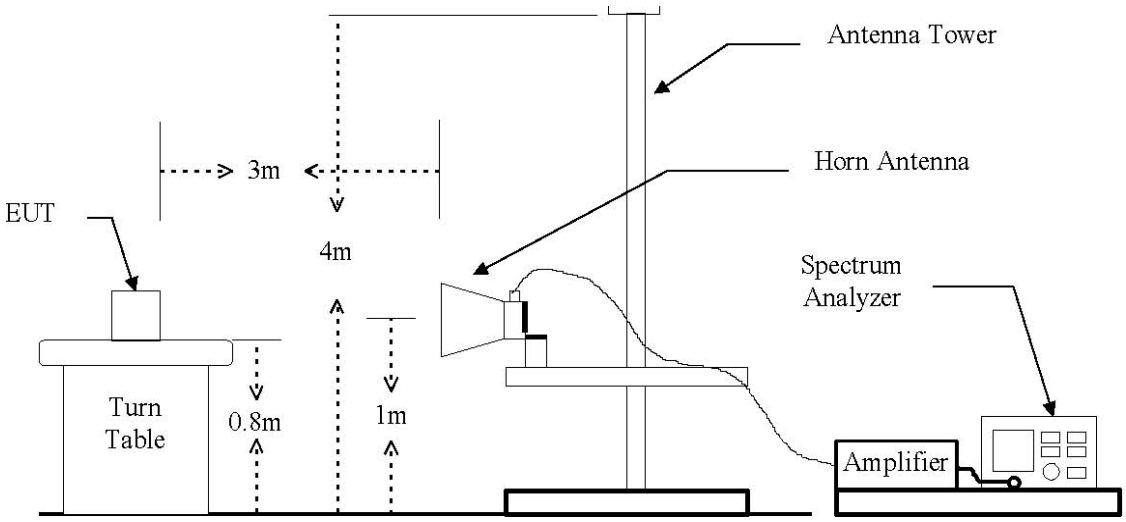
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 ㎒ to 1 ㎓ Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission .The spurious emissions were investigated form 1 ㎓ to the 10th harmonic of the highest fundamental frequency or 40 ㎓, whichever is lower.



2.2. Limit

2.2.1. Radiated emission limits, general requirements

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:

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

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 ㎒, 76-88 ㎒, 174-216 ㎒ or 470-806 ㎒. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241

2.2.2. Periodic operation in the band 40.66-40.70 ㎒ and above 70 ㎒

According to 15.231(e), intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) and may be employed for any type of operation, including operation prohibited in paragraph (a), provided the intentional radiator complies with the provisions of paragraph (b) through (d) of this Section, except the field strength table in paragraph (b) is replaced by the following:

Fundamental Frequency (㎒)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
40.66 – 40.70	1,000	100
70 –130	500	50
130 – 174	500 to 1,500 **	50 to 150 **
174 – 260	1,500	150
260 – 470	1,500 to 5,000 **	150 to 500 **
Above 470	5,000	500

** linear interpolations

Where F is the frequency in ㎒, the formulas for calculating the maximum permitted fundamental field strengths are as follows : for the band 130-174 ㎒, uV/m at 3 meters = 22.72727(F)-2454.545; for the band 260-470 ㎒, ㎶/m at 3 meters = 16.6667(F)-2833.3333 The maximum permitted unwanted emission level is 20 ㏈ below the maximum permitted fundamental level.

2.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003.

2.3.1. Test Procedures for emission from 9 ㎑ to 30 ㎒

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
c. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
d. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

2.3.2. Test Procedures for emission from 30 ㎒ to 1 000 ㎒

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
c. The antenna is a broadband antenna, and its height 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 table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10 ㏈ lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 ㏈ margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

2.3.3. Test Procedures for emission above 1 ㎓

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection and frequency above 1 ㎓.

2.4. Test Result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

The following table shows the highest levels of radiated emissions on both polarizations of horizontal and vertical.

Channel (433.187 5 ㎒)

Freq. (㎒)	Detector	Ant. Pol.	Reading (dB㎶)	Antenna Factor (dB)	Cable Loss (dB)	Result (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
433.187 5	Peak	H	68.80	17.09	2.74	88.63	92.84	4.21
433.187 5	Average	H	50.18	17.09	2.74	70.01	72.84	2.83
433.187 5	Peak	V	60.35	17.46	2.74	80.55	92.84	12.29
433.187 5	Average	V	41.73	17.46	2.74	61.93	72.84	10.91

Remark:
To get a maximum emission level from the EUT, the EUT was moved throughout the X-axis, Y-axis and Z-axis. Worst case is Y-axis.
Definition of DUT for three orthogonal planes is described in the test setup photo.

Note:
1. 3 m Limit (dB㎶/m) = 20log[16.6667($F_{(㎒)}$)-2833.3333] = 72.84
2. Correction Factor = Antenna Factor + Cable Loss
3. Average Reading = Peak Reading (dB㎶/m) + 20log(Duty Cycle)
4. Duty Cycle Correction Factor = 20log(7.421 / 63.326) = -18.62

3. Spurious Emission

3.1. Test Setup

Same as section 2.1. of this report

3.2. Limit

Same as section 2.2. of this report

3.3. Test Procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003.

3.3.1. Test Procedures for emission from 9 ㎑ to 30 ㎒

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
c. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
d. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

3.3.2. Test Procedures for emission from 30 ㎒ to 1 000 ㎒

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. During performing radiated emission below 1 ㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference-receiving antenna.
c. The antenna is a broadband antenna, and its height 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 table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
f. If the emission level of the EUT in peak mode was 10 ㏈ lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 ㏈ margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

3.3.3. Test Procedures for emission above 1 ㎓

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection and frequency above 1 ㎓.

3.4. Test Result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

The following table shows the highest levels of radiated emissions on polarizations of horizontal.
The frequency spectrum from 9.00 ㎑ to 4 340.00 ㎒ was investigated.
All reading values are peak detector.

- Channel (433.187 5 ㎒)

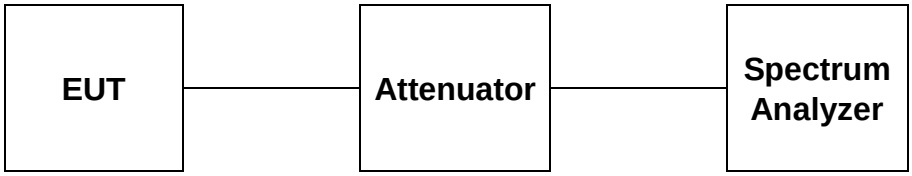
Radiated Emissions			Ant	Correction Factors		Total	FCC Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	Amp Gain +CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
866.375	42.30	Peak	H	23.28	-24.01	41.57	72.84	31.27
1 299.640	48.51	Peak	H	25.15	-37.57	36.09	72.84	36.75
1 732.750	50.31	Peak	H	26.93	-36.67	40.57	72.84	32.27
Above 1 800.000	Not Detected	-	-	-	-	-	-	-

Remark:

1. To get a maximum emission level from the EUT, the EUT was moved throughout the X-axis, Y-axis and Z-axis. Worst Case is Y-axis
   Definition of DUT for three orthogonal planes is described in the test setup photo.
2. 3 m Peak Limit (dB㎶/m) = 20log[16.6667($F_{(㎒)}$)-2833.3333] = 72.84
   3 m Average Limit (dB㎶/m) = 20log[16.6667($F_{(㎒)}$)-2833.3333] - 20 dB㎶/m = 52.84
3. Correction Factor = Antenna Factor + Cable Loss + Amp Gain
4. Average test would not be applied if the peak results were lower than the average limit.

4. Bandwidth of Operation Frequency

4.1. Test Setup



4.2. Limit

The bandwidth of the emission shall be no wider than 0.25 % of the center frequency for devices operating above 70 ㎒ and below 900 ㎒. Bandwidth is determined at the points 20 ㏈ down from the modulated carrier.

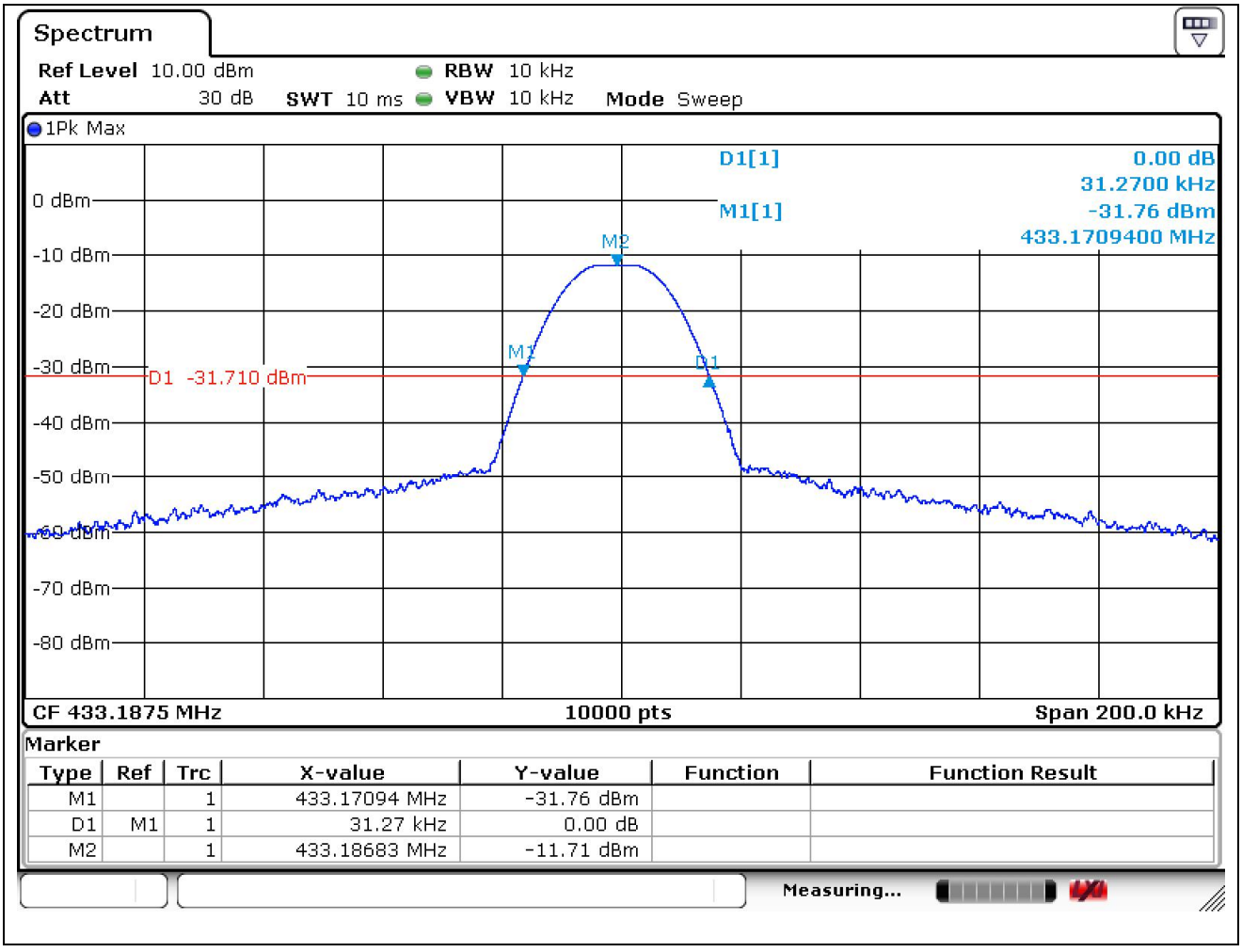
4.3. Test Procedure

1. The transmitter output is connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW=10 ㎑, VBW=10 ㎑ and Span=200 ㎑.
3. The bandwidth of fundamental frequency was measured and recorded.

4.4. Test Result

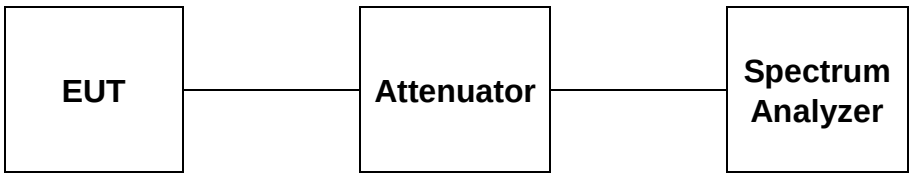
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Carrier Frequency (㎒)	Bandwidth of the emission (㎑)	Limit (㎑)	Remark
433.187 5	31.27	1 082.97	The point 20 dB down from the modulated carrier



5. Limit of Transmission Time

5.1. Test Setup



5.2. Limit

Devices Operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

5.3. Test Procedure

1. The transmitter output is connected to the spectrum analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 1 ㎒, VBW = 1 ㎒, Span= 0 ㎐
3. The bandwidth of fundamental frequency was measured and recorded.

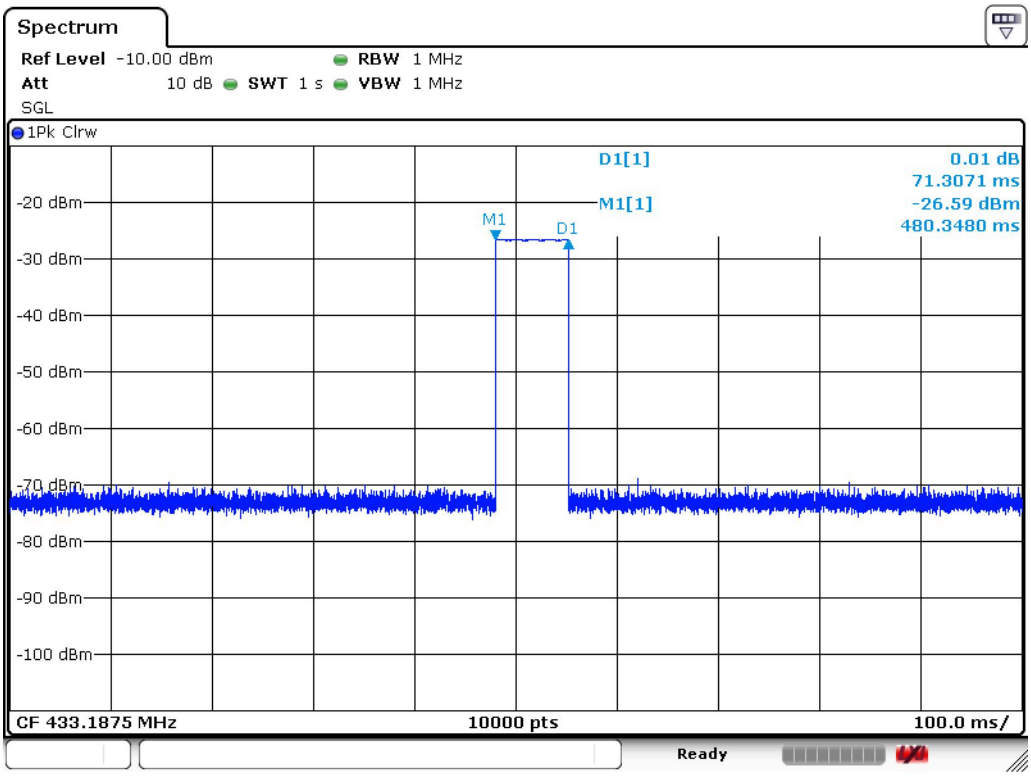
5.4. Test Result

Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

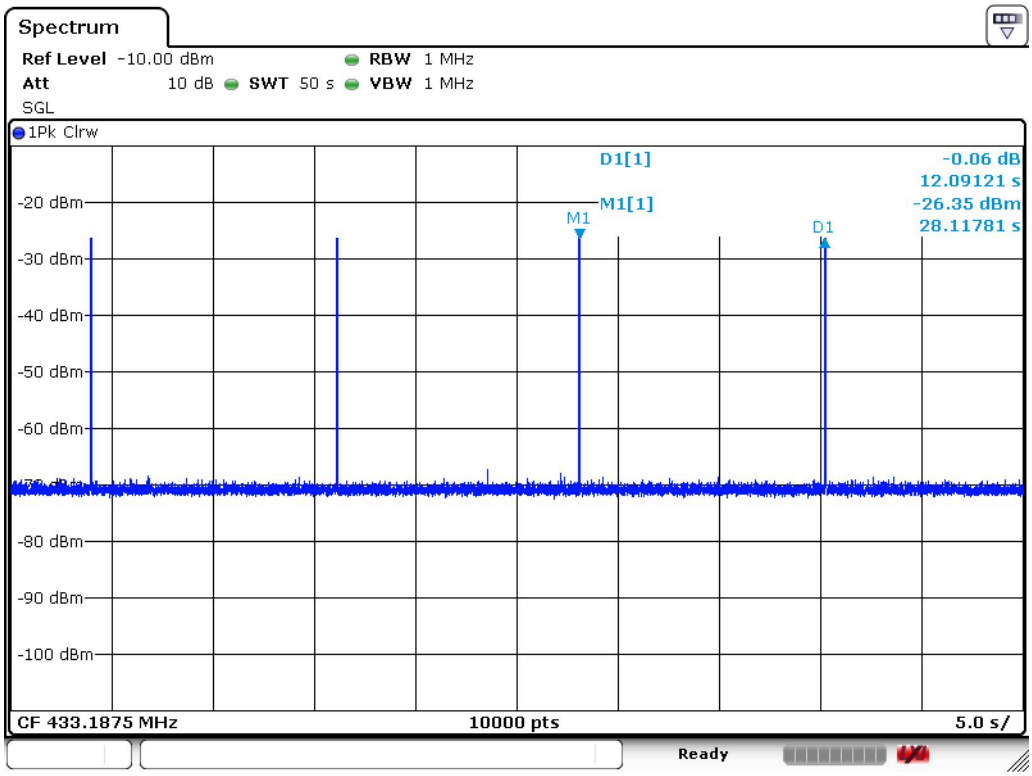
Frequency (MHz)	Transmission Time (s)		Silent Duration (s)		Silent Period Versus Transmission Time Ratio		Result
	Measured	Limit	Measured	Limit	Measured	Limit	
433.187 5	0.071	Same or less than 1 s	12.091	Same or greater than 10 s	170.296	At least 30 times the duration of the transmission	Pass

Note:
1. Silent Period Versus Transmission Time Ratio
   - Silent Period : 12.091 (s)
   - Transmission Time : 0.071 (s)
   - Ratio : Silent Period / Transmission Time
     = 12.091 (s) / 0.071 (s) = 170.296

Transmission Time

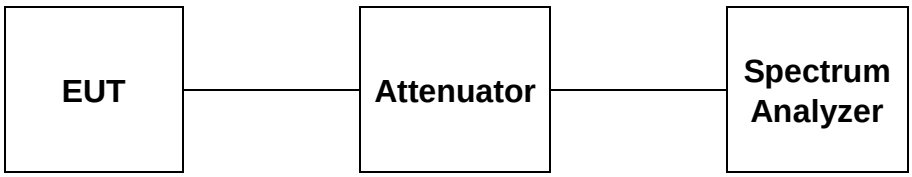


Silent Duration



6. Duty Cycle Correction Factor

6.1. Test Setup



6.2. Limit

Nil (No dedicated Limit specified in the Rules)

6.3. Test Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna ort to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW = 1 ㎒, VBW = 1 ㎒, Span = 0 ㎐, Sweep Time = 500 ㎳

6.4. Test Result

Ambient temperature	:	(23 ± 1) ℃
Relative humidity	:	47 % R.H.

CALCULATION :

Average Reading = Peak Reading (dB㎶/m) + 20log(Duty Cycle)

In order to determine possible Maximum Modulation percentage, alternations are made to the EUT.
We measured :

T_{on+off}	T_{on}	M % = (T_{on} / T_{on+off}) * 100 %	Duty Correction Factor
63.326 ㎳	7.421 ㎳	11.72	-18.62 ㏈

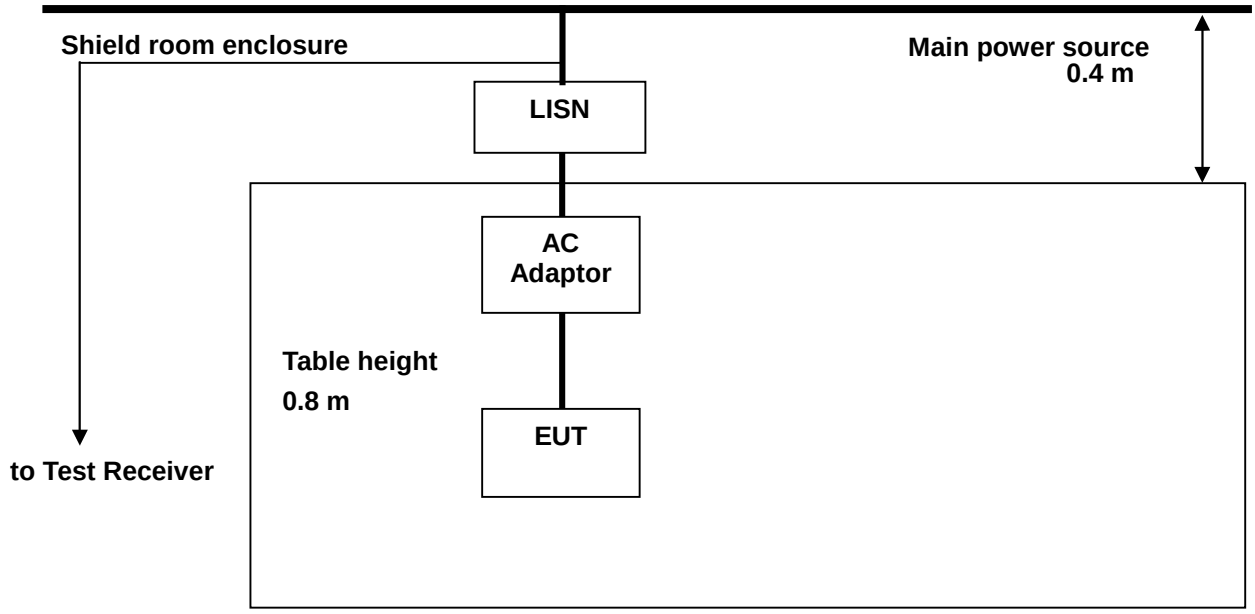
T_{on+off} = 63.326 ㎳
T_{on} = 7.421 ㎳
Duty Cycle = 20log(T_{on} / T_{on+off}) = 20log(0.117 2) = -18.62 ㏈

Remark:
1. T_{on+off} <100 ms. Use 63.326 ms for calculation

6.5. Test Plot

7. Transmitter AC Power Line Conducted Emission

7.1. Test Setup



7.2. Limit

According to §15.207(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 ㎕H /50 ohm line impedance stabilization network(LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency of Emission (㎒)	Conducted limit (dB㎶)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

* Decreases with the logarithm of the frequency.

7.3. Test Procedures

AC conducted emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

1. The test procedure is performed in a 6.5 m × 3.6 m× 3.6 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W)× 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

7.4. Test Results

The following table shows the highest levels of conducted emissions on both phase of Hot and Neutral line.

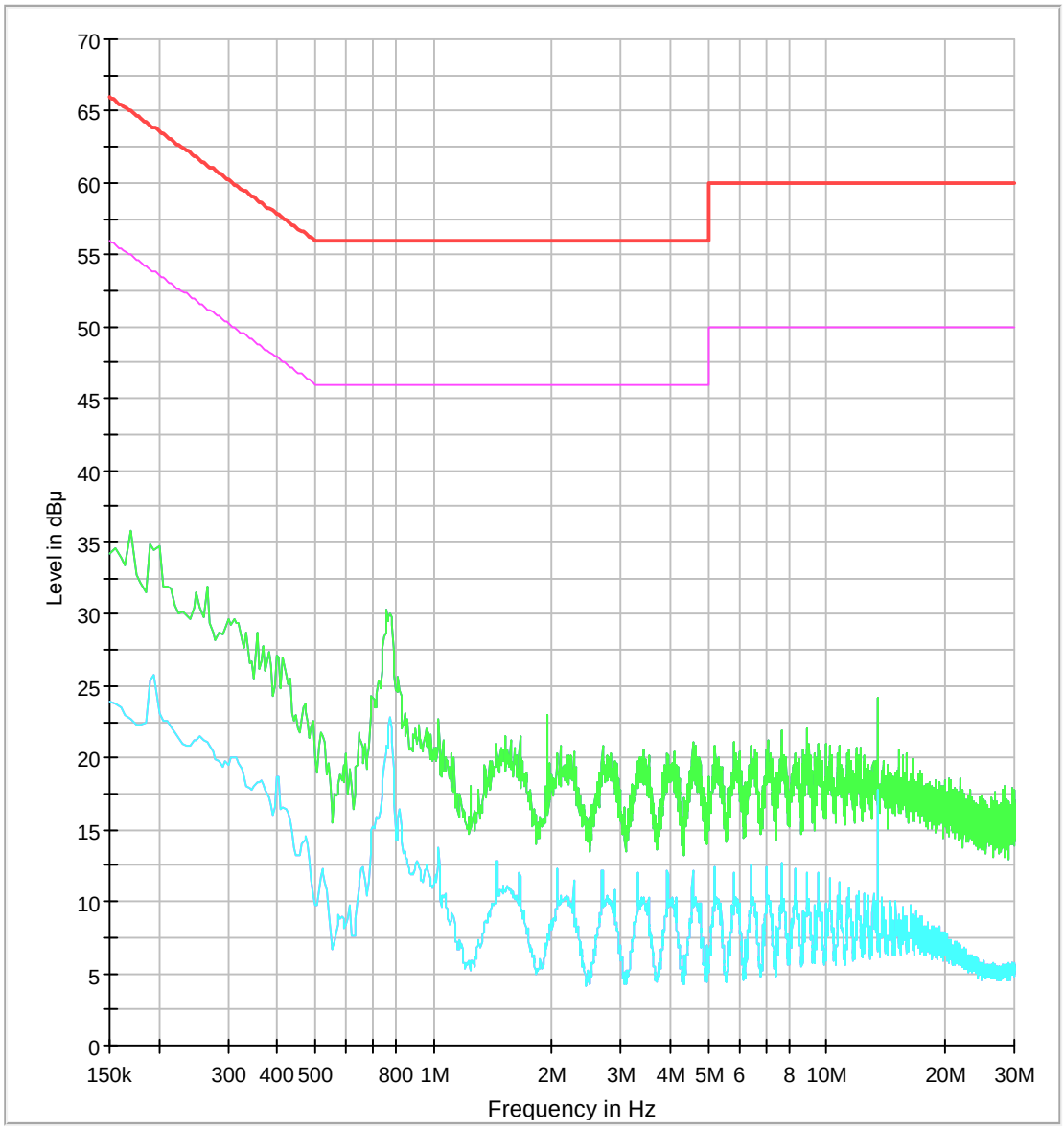
Ambient temperature : (24 ± 1) ℃
Relative humidity : 47 % R.H.

Frequency range : 0.15 ㎒ – 30 ㎒
Measured Bandwidth : 9 ㎑

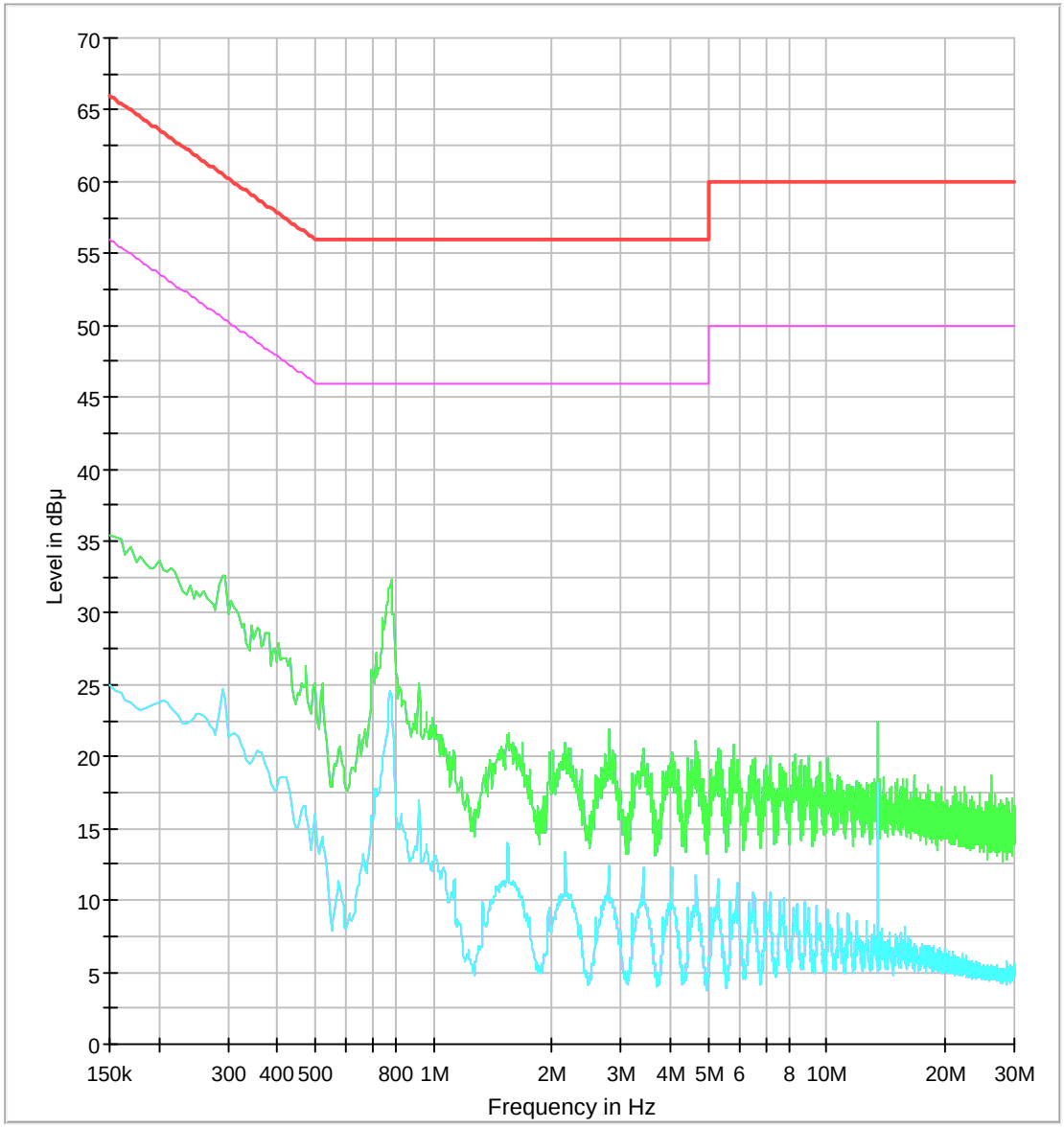
- Channel (433.187 5 ㎒)

FREQ.	LEVEL(dB㎶)		LINE	LIMIT(dB㎶)		MARGIN(dB)	
(㎒)	Q-Peak	Average		Q-Peak	Average	Q-Peak	Average
0.17	28.30	24.70	N	64.96	54.96	36.66	30.26
0.19	27.40	23.90	N	64.04	54.04	36.64	30.14
0.26	26.20	23.70	N	61.43	51.43	35.23	27.73
0.77	26.30	22.50	N	56.00	46.00	29.70	23.50
13.56	26.10	22.30	N	60.00	50.00	33.90	27.70
21.99	20.20	18.20	N	60.00	50.00	39.80	31.80
0.15	21.10	16.10	H	66.00	56.00	44.90	39.90
0.29	16.40	14.90	H	60.52	50.52	44.12	35.62
0.78	18.00	14.00	H	56.00	46.00	38.00	32.00
1.55	7.60	4.20	H	56.00	46.00	48.40	41.80
13.56	10.30	9.00	H	60.00	50.00	49.70	41.00
26.20	10.20	8.50	H	60.00	50.00	49.80	41.50

Test mode: (Neutral)



Test mode: (Hot)



NOTE;

1. Line (H): Hot, Line (N): Neutral
2. Traces shown in plot made using a peak detector and average detector
3. The limit for Class B device(s) from 150 ㎑ to 30 ㎒ are specified in Section of the Title 47 CFR.
4. Deviations to the Specifications: None.

8. Antenna requirements

According to FCC 47 CFR §15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 antennas of this E.U.T are permanently attached.
- The E.U.T Complies with the requirement of §15.203.