TEST REPORT

of

FCC Part 15 Subpart C §15.209, §15.231

FCC ID : UVNTP2-TRUCKER-CS

Equipment Under Test	:	CAP Sensor
Model Name	:	TP2-TRUCKER-CS
Applicant	:	SEETRON INC.
Manufacturer	:	SEETRON INC.
Date of Receipt	:	2017.03.22
Date of Test(s)	:	2017.08.17 ~ 2017.09.05
Date of Issue	:	2017.10.26

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

Tested By:  **Date:** **2017.10.26**

Jaeha Chung

Technical Manager:  **Date:** **2017.10.26**

Jungmin Yang

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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, 15807

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.

Telephone : +82 31 688 0901
FAX : +82 31 688 0921

1.2. Details of applicant

Applicant : SEETRON INC.
Address : 201-403, 338 Songnae-daero, Wonmi-gu, Bucheon-si, Gyeonggi-do, 14502, Korea
Contact Person : So, Jae-Sung
Phone No. : +82 32 327 8123

1.3. Details of manufacturer

Company : Same as applicant
Address : Same as applicant

1.4. Description of EUT

Kind of Product	CAP Sensor
Model Name	TP2-TRUCKER-CS
Power Supply	DC 3 V (Lithium type of battery)
Frequency Range	Tx: 433.92 ㎒
Modulation Type	FSK
Antenna Type	Internal type

1.5. Test Equipment List

Equipment	Manufacturer	Model	S/N	Cal. Date	Cal. Interval	Cal. Due
Signal Generator	R&S	SMBV100A	255834	Jun. 15, 2017	Annual	Jun. 15, 2018
Spectrum Analyzer	Agilent	N9020A	MY53421758	Sep. 25, 2017	Annual	Sep. 25, 2018
Spectrum Analyzer	R&S	FSV30	100955	Mar. 20, 2017	Annual	Mar. 20, 2018
Test Receiver	R&S	ESU26	100109	Feb. 17, 2017	Annual	Feb. 17, 2018
Preamplifier	H.P.	8447F	2944A03909	Aug. 11, 2017	Annual	Aug. 11, 2018
Preamplifier	R&S	SCU-18	10117	Apr. 08, 2017	Annual	Apr. 08, 2018
High Pass Filter	Mini-Circuits	NHP-800+	VUU16801113-2	Jun. 14, 2017	Annual	Jun. 14, 2018
High Pass Filter	Wainwright Instrument GmbH	WHKX10-900-1000-18000-40SS	7	Mar. 30, 2017	Annual	Mar. 30, 2018
Loop Antenna	Schwarzbeck Mess-Elektronik	FMZB 1519	1519-0399	Aug. 23, 2017	Biennial	Aug. 23, 2019
Bilog Antenna	Schwarzbeck Mess-Elektronik	VULB9163	437	Oct. 21, 2016	Biennial	Oct. 21, 2018
Horn Antenna	R&S	HF906	100326	Feb. 01, 2016	Biennial	Feb. 01, 2018
Turn Table	Innco systems GmbH	DS 1200 S	N/A	N.C.R.	N/A	N.C.R.
Controller	Innco systems GmbH	CONTROLLER CO3000-4P	CO3000/963/38330516/L	N.C.R.	N/A	N.C.R.
Antenna Master	Innco systems GmbH	MA4640-XP-ET	MA4640/536/38330516/L	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.
Coxial Cable	SUCOFLEX	104 (3m)	MY3258414	N.C.R.	N/A	N.C.R.
Coxial Cable	SUCOFLEX	104 (10m)	MY3145814	N.C.R.	N/A	N.C.R.

1.6. 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)	Transmission Time	Complied

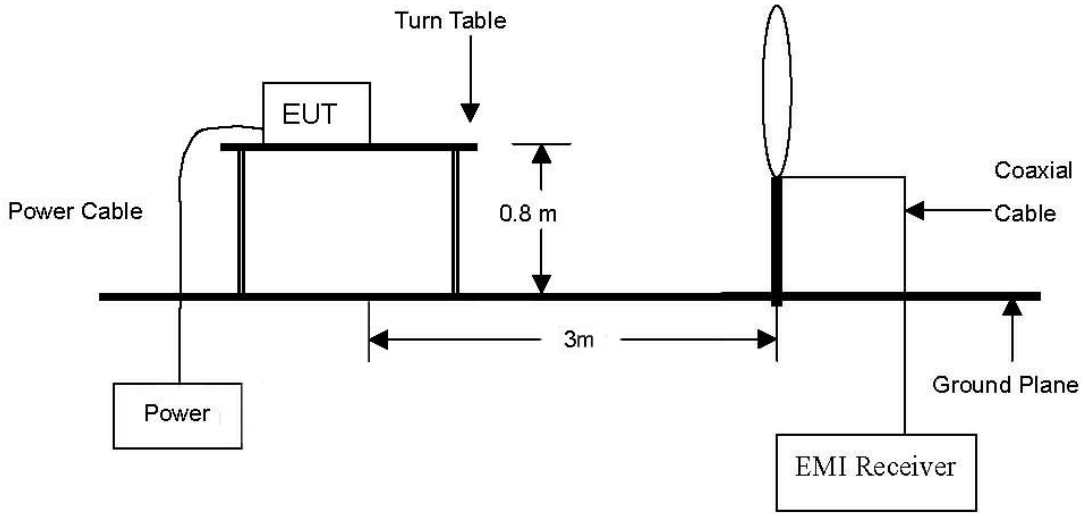
1.7. Test Report Revision

Revision	Report number	Date of issue	Description
0	F690501/RF-RTL011799	2017.09.07	Initial
1	F690501/RF-RTL011799-1	2017.10.26	Listed coaxial cable in the equipment list.

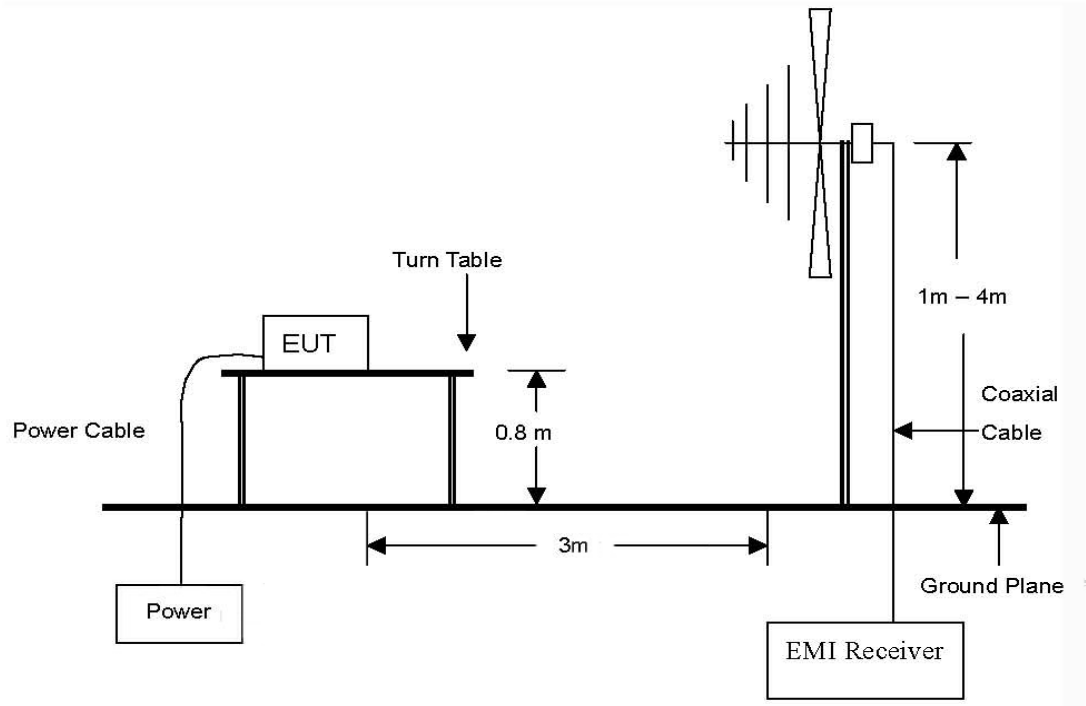
2. Field Strength of Fundamental and Spurious Emission

2.1. Test Setup

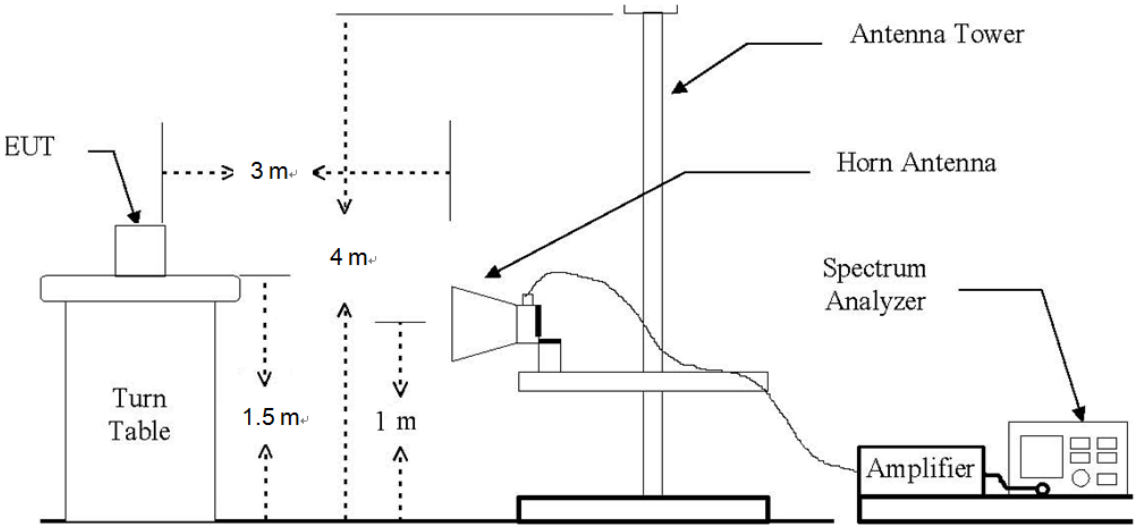
The diagram below shows the test setup that is utilized to make the measurements for emission below 30 ㎒.



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



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[1]	50 to 150[1]
174 – 260	1,500	150
260 – 470	1,500 to 5,000[1]	150 to 500[1]
Above 470	5,000	500

[1] 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 ㎒, ㎶/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 C63.10:2013

2.3.1. Test Procedures for emission below 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 1.5 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 at frequency above 1 ㎓.

2.4. Test Result

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

2.4.1. Field Strength of Fundamental

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

Freq. (㎒)	Detector	Ant. Pol.	Reading (dB㎶)	Antenna Factor (dB)	Cable Loss (dB)	Result (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
433.90	Peak	H	57.50	16.06	2.61	76.17	92.87	16.70
433.90	Average	H	39.78	16.06	2.61	58.45	72.87	14.42

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 X-axis.
Definition of DUT for three orthogonal planes is described in the test setup photos.

Note:
1. Correction Factor = Antenna Factor + Cable Loss
2. 3 m Limit (dB㎶/m) = 20log[16.6667(F(㎒))-2833.3333] = 72.87
3. Average Reading = Peak Reading + Duty Cycle Correction Factor
4. Duty Cycle Correction Factor: 20log(Tx on / 100 ㎳) = 20log(13/100) = -17.72
   - Tx on time = 13 ㎳
   - Tx on+off = 111.75 s (pulse train is 100 ㎳ instead of 111.75 s)

2.4.2. Spurious Emission

The following table shows the highest levels of radiated emissions on polarizations of horizontal.
The frequency spectrum from 9 ㎑ to 4 500 ㎒ was investigated.

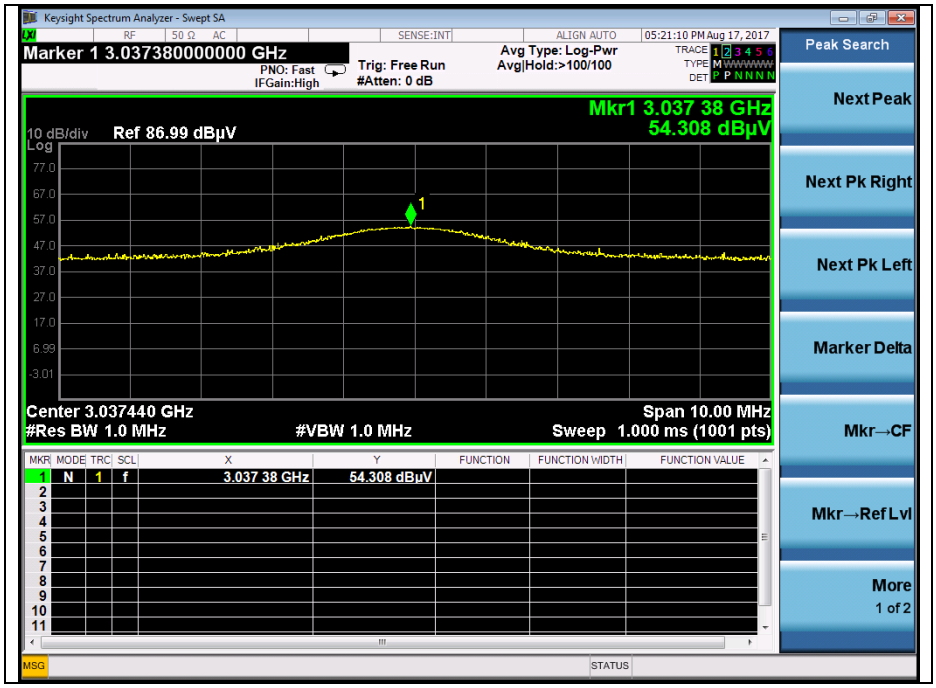
Radiated Emissions			Ant.	Correction Factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detect Mode	Pol.	AF (dB/m)	Amp Gain + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
3 037.77	54.31	Peak	H	29.93	-29.74	54.50	72.87	18.37
3 037.77	36.59	Average	H	29.93	-29.74	36.78	52.87	16.09

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 X-axis.
   Definition of DUT for three orthogonal planes is described in the test setup photos.
2. - 3 m Peak Limit (dB㎶/m) = 20log[16.6667(F(㎒))-2833.3333] = 72.87
   - 3 m average limit (dB㎶/m) = 20log[16.6667(F(㎒))-2833.3333] - 20 = 52.87
3. Correction Factors = AF + Amp Gain + CL
4. Actual = Reading + AF + Amp Gain + CL
5. "*" means the restricted band.
6. Spurious Emission test results meet both peak and average limit.
7. According to § 15.31(o), Emission levels are not reported much lower than the limits by over 20 ㏈.
8. Average Reading = Peak Reading + Duty Cycle Correction Factor
   Duty Cycle Correction Factor: 20log(Tx on / 100 ㎳) = 20log(13/100) = -17.72
   - Tx on time = 13 ㎳
   - Tx on+off = 111.75 s (pulse train is 100 ㎳ instead of 111.75 s)

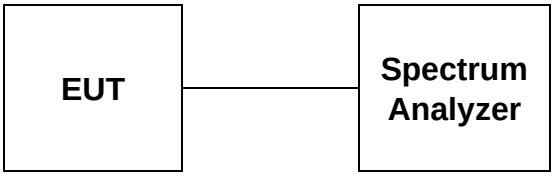
The Plot of Spurious Emission

7th Harmonic (Peak)



3. Bandwidth of Operation Frequency

3.1. Test Setup



3.2. Limit

According to §15.231(c), the bandwidth of the emission shall be no wider than 0.25 % of the center frequency for devices operating above 70 ㎒ and below 900 ㎒. For devices operating above 900 ㎒, the emission shall be no wider than 0.5 % of the center frequency. Bandwidth is determined at the points 20 ㏈ down from the modulated carrier.

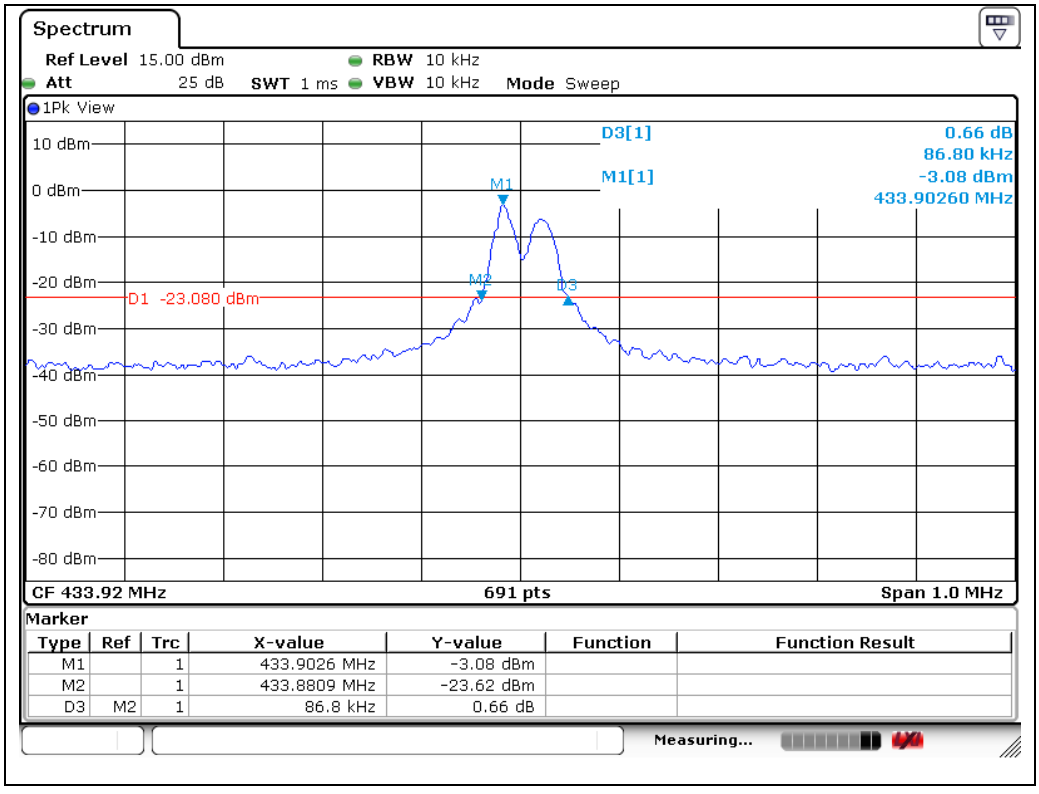
3.3. Test Procedure

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 = 1 ㎒.
3. The bandwidth of fundamental frequency was measured and recorded.

3.4. Test Result

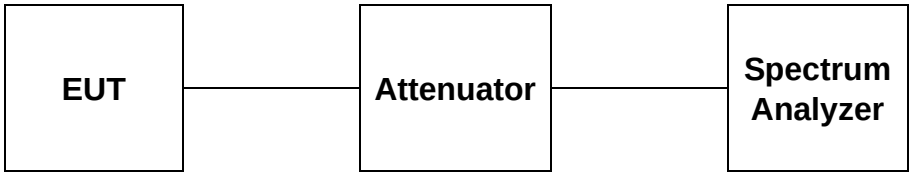
Ambient temperature : (23 ± 1) ℃
Relative humidity : 47 % R.H.

Carrier Frequency (㎒)	Bandwidth of Operation Frequency (㎑)	Limit (㎑)	Remark
433.92	86.80	1 084.80	The point 20 ㏈ down from the modulated carrier



4. Transmission Time

4.1. Test Setup



4.2. 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.

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=1 ㎒ VBW=1 ㎒, Span=0 ㎐.
3. The bandwidth of fundamental frequency was measured and recorded.

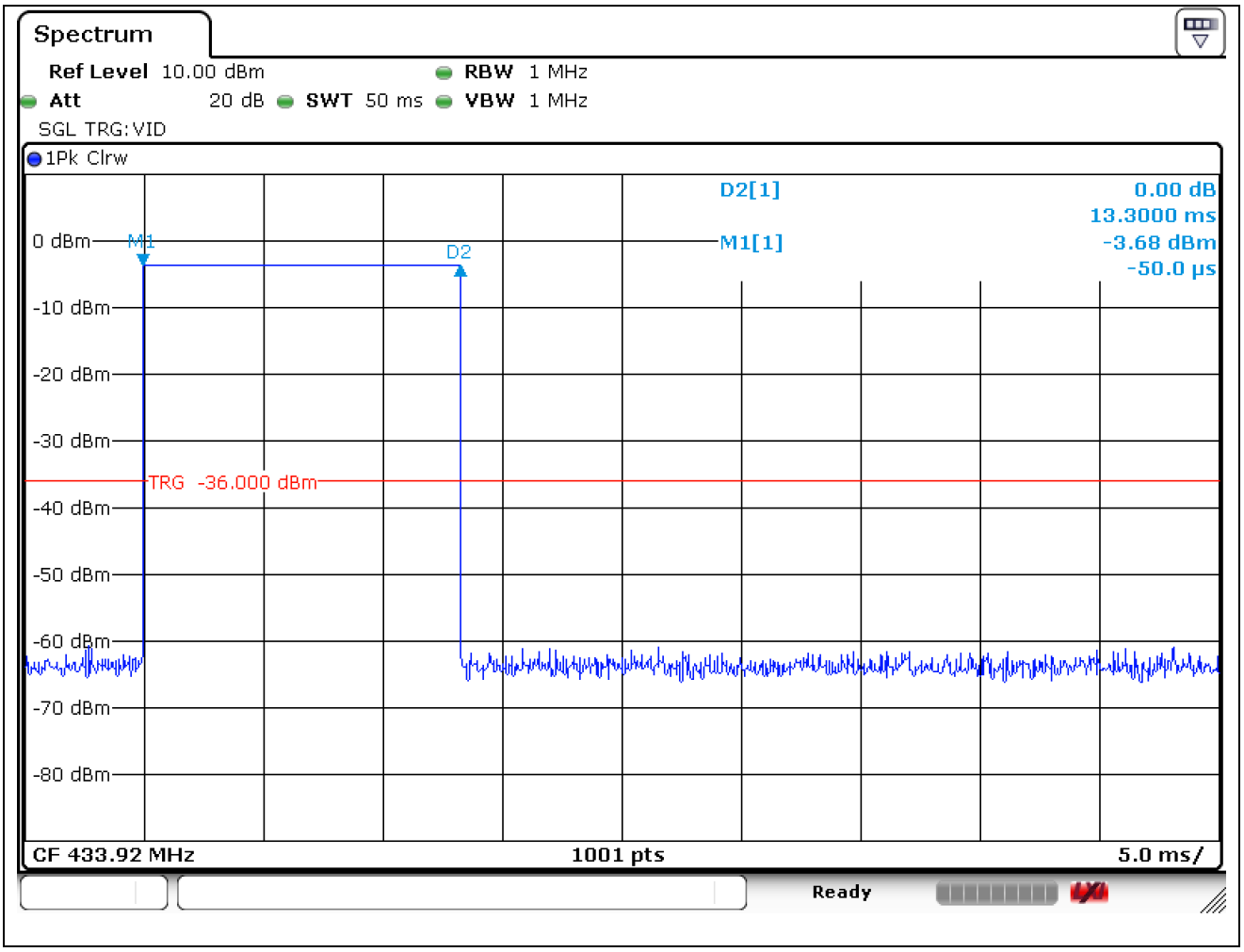
4.4. Test Result

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

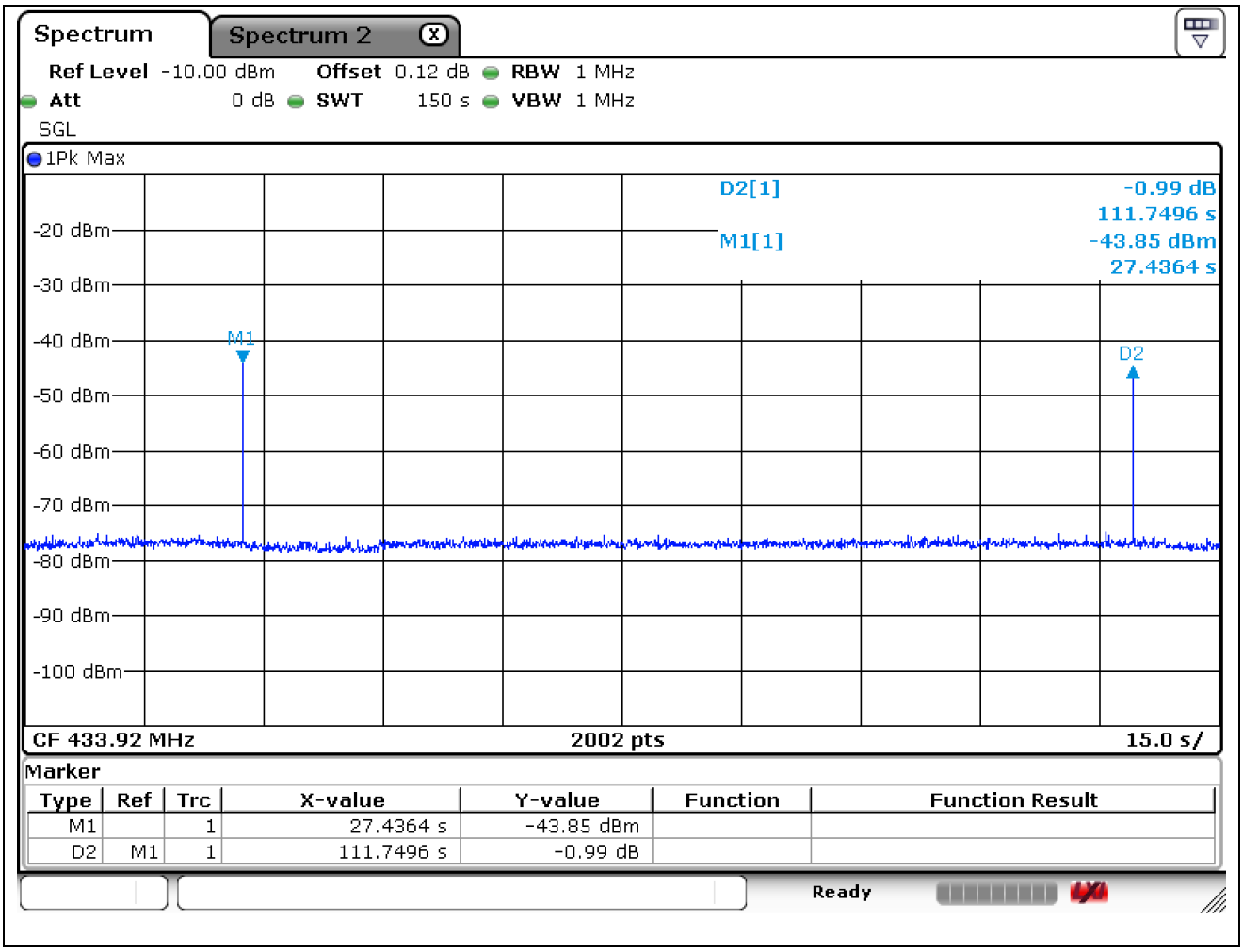
Frequency (㎒)	Transmission Time		Silent Duration (s)		Silent Period Versus Transmission Time Ratio		Result
	Measured (s)	Limit	Measured (s)	Limit	Ratio	Limit	
433.92	0.013	Same or less than 1 s	111.750	Same or greater than 10 s	8 596.154	At least 30 times the duration of the transmission	Pass

Note:
1. Silent Period Versus Transmission Time Ratio
- Silent Period : 111.750 s
- Transmission Time : 0.013 s
- Ratio : Silent Period / Transmission Time
= 111.750 (s) / 0.013 (s) = 8 596.154

Transmission Time



Silent Period



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