

FCC PART 15.231

TEST REPORT

For

Shenzhen Sonoff Technologies Co.,Ltd.

1001, BLDG8, Lianhua Industrial Park, Shenzhen, GD, China

FCC ID: 2APN5T2EU


Report Type: Original Report	Product Type: 433MHz Wireless Stick-on Smart Wall Switch
Report Number:	DG1210421-12871E-00A
Report Date:	2021-05-24
Reviewed By:	Ivan Cao Assistant Manager 
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	433MHz Wireless Stick-on Smart Wall Switch
EUT Model:	T2EU3C-RF
Multiple Models:	T2EU1C-RF, T2EU2C-RF
Operation Frequency:	433.92MHz
Modulation Type:	ASK
Rated Input Voltage:	DC 6V from battery
Serial Number:	DG1210421-12871E-RF-S_34T
EUT Received Date:	2021.04.24
EUT Received Status:	Good

Note: The series product, models T2EU3C-RF, T2EU1C-RF, T2EU2C-RF are electrically identical, T2EU3C-RF, was fully tested. The difference between them was explained in the declaration letter.

Objective

This report is prepared on behalf of *Shenzhen Sonoff Technologies Co.,Ltd.* in accordance with Part 2, Subpart J, Part 15, Subparts A, and C of the Federal Communications Commission's rules.

The tests were performed in order to determine compliance with FCC Rules Part 15, Subpart C, and section 15.203, 15.205, 15.209, and 15.231 rules.

Test Methodology

All measurements detailed in this Test Report were performed in accordance with ANSI C63.10-2013 "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices".

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
Unwanted Emissions, radiated	30M~200MHz: 4.55 dB, 200M~1GHz: 5.92 dB, 1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB, 18G~26.5G: 5.47 dB, 26.5G~40G: 5.63 dB
Temperature	±1 °C
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.12, Pulong East 1st Road, Tangxia Town, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

Declarations

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol “▲”. Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured in testing mode which was provided by manufacturer.

The device operation frequency is 433.92 MHz.

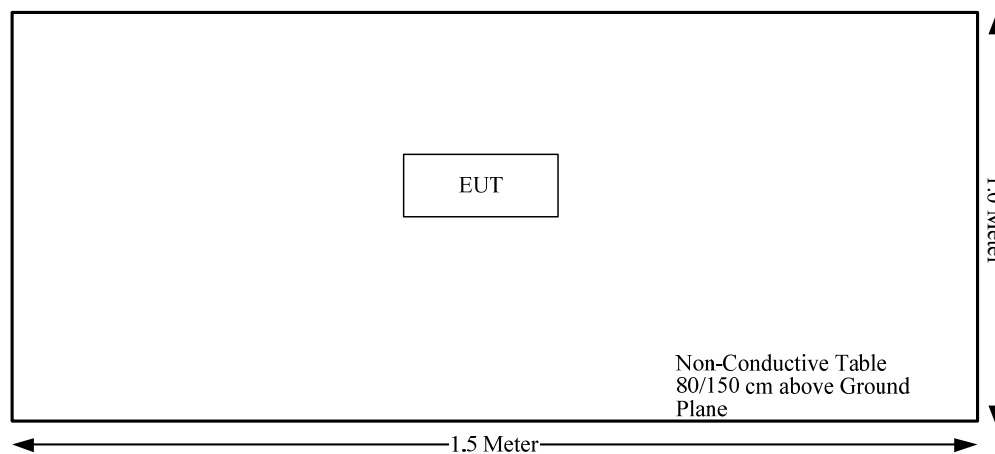
Equipment Modifications

No modifications were made to the unit tested.

EUT Exercise Software

No software was used in test.

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207 (a)	Conducted Emissions	Not applicable
§15.205, §15.209, §15.231 (b)	Radiated Emissions	Compliance
§15.231 (c)	20dB Bandwidth	Compliance
§15.231 (a)	Deactivation Testing	Compliance

Not Applicable: the device was powered by battery.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

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.

Antenna Connector Construction

The EUT has 1 internal antenna, which was permanently attached, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliant.

FCC §15.205, §15.209, §15.231 (b) - RADIATED EMISSIONS

Applicable Standard

FCC §15.205, §15.209, §15.231 (b)

(b) In addition to the provisions of §15.205, the field strength of emissions from intentional radiators operated under this section shall not exceed the following:

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	¹ 1,250 to 3,750	¹ 125 to 375
174-260	3,750	375
260-470	¹ 3,750 to 12,500	¹ 375 to 1,250
Above 470	12,500	1,250

¹Linear interpolations.

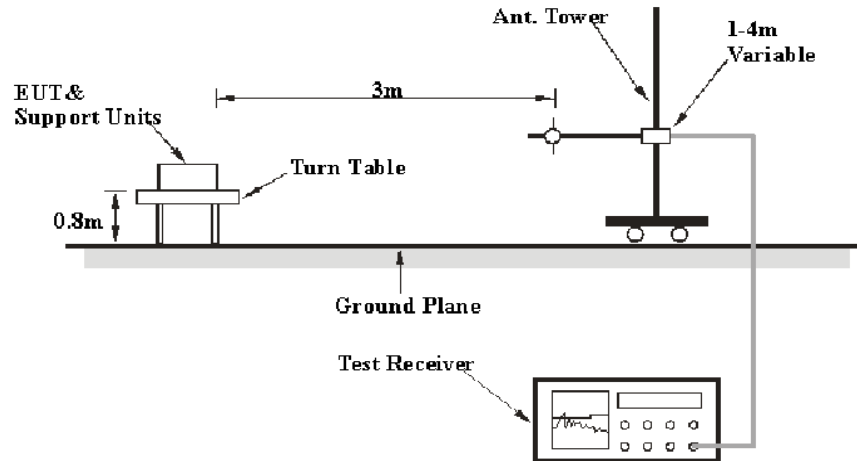
(1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.

(2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.

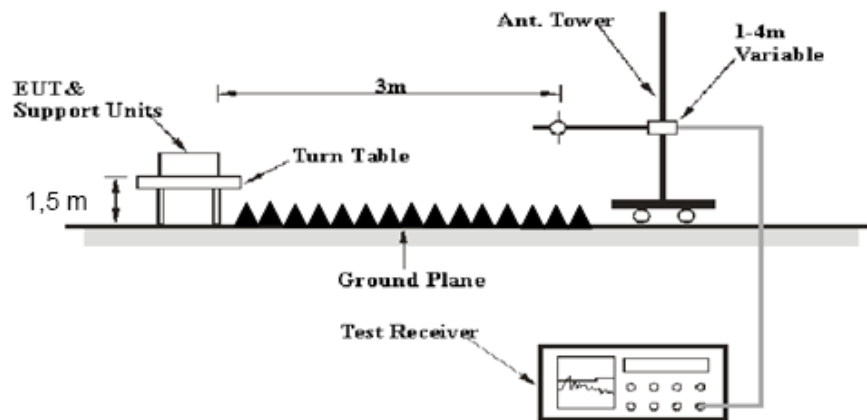
(3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

EUT Setup

Below 1 GHz:



Above 1 GHz:



The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15 § 15.209, 15.205 and 15.231.

EMI Test Receiver Setup

The system was investigated from 30 MHz to 5 GHz.

During the radiated emission test, the test receiver was set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	100 kHz	PK
1 GHz – 5 GHz	1 MHz	3 MHz	/	PK

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiation Below 1GHz					
Sunol Sciences	Antenna	JB3	A060611-1	2020-11-10	2023-11-10
R&S	EMI Test Receiver	ESR3	102453	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2020-05-06	2021-05-06
HP	Amplifier	8447D	2727A05902	2020-09-05	2021-09-05
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Radiation Above 1GHz					
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Agilent	Spectrum Analyzer	E4440A	SG43360054	2020-07-07	2021-07-07
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2020-09-05	2021-09-05
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	2020-09-05	2021-09-05
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

According to §15.231, Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Data**Environmental Conditions**

Test Item:	Radiated emissions (Below 1GHz)	Radiated emissions (Above 1GHz)
Temperature:	29.4°C	27.7°C
Relative Humidity:	46%	53%
ATM Pressure:	100.5kPa	100.3kPa
Tester:	Alex Hu	Lee Li
Test Date:	2021.05.08	2021.05.13

Test mode: Transmitting

Field Strength (Peak)

Frequency (MHz)	Receiver Reading (dB μ V)	Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
		Polar (H/V)	Factor (dB/m)					
Operating Frequency: 433.92 MHz								
433.92	73.54	H	16.48	2.27	26.54	65.75	100.83	35.08
433.92	68.22	V	16.48	2.27	26.54	60.43	100.83	40.40
867.84	43.90	H	21.76	3.15	26.68	42.13	80.83	38.70
867.84	38.79	V	21.76	3.15	26.68	37.02	80.83	43.81
1301.76	57.02	H	24.53	1.57	26.15	56.97	74.00	17.03
1301.76	54.26	V	24.53	1.57	26.15	54.21	74.00	19.79
1735.68	40.47	H	26.19	1.65	25.81	42.50	80.83	38.33
1735.68	39.72	V	26.19	1.65	25.81	41.75	80.83	39.08
2169.60	53.35	H	27.64	1.74	25.54	57.19	80.83	23.64
2169.60	49.53	V	27.64	1.74	25.54	53.37	80.83	27.46
2603.52	43.63	H	28.67	1.88	26.19	47.99	80.83	32.84
2603.52	40.49	V	28.67	1.88	26.19	44.85	80.83	35.98
3037.44	53.15	H	30.19	2.18	26.00	59.52	80.83	21.31
3037.44	51.47	V	30.19	2.18	26.00	57.84	80.83	22.99
3471.36	48.90	H	31.23	2.39	25.88	56.64	80.83	24.19
3471.36	44.11	V	31.23	2.39	25.88	51.85	80.83	28.98
3905.28	52.14	H	32.19	2.58	25.77	61.14	74.00	12.86
3905.28	52.74	V	32.19	2.58	25.77	61.74	74.00	12.26
4339.20	43.26	H	32.33	2.85	25.74	52.70	74.00	21.30
4339.20	43.23	V	32.33	2.85	25.74	52.67	74.00	21.33
4773.12	50.15	H	32.85	3.13	25.63	60.50	74.00	13.50
4773.12	51.74	V	32.85	3.13	25.63	62.09	74.00	11.91

Field Strength (Average)

Frequency (MHz)	Peak Measurement@3m (dBµV/m)	Polar (H/V)	Duty Cycle Correction Factor (dB)	Average Amp. (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Operating Frequency: 433.92 MHz						
433.92	65.75	H	-9.39	56.36	80.83	24.47
433.92	60.43	V	-9.39	51.04	80.83	29.79
867.84	42.13	H	-9.39	32.74	60.83	28.09
867.84	37.02	V	-9.39	27.63	60.83	33.2
1301.76	56.97	H	-9.4	47.57	54.00	6.43
1301.76	54.21	V	-9.4	44.81	54.00	9.19
1735.68	42.50	H	-9.39	33.11	60.83	27.72
1735.68	41.75	V	-9.39	32.36	60.83	28.47
2169.60	57.19	H	-9.39	47.8	60.83	13.03
2169.60	53.37	V	-9.39	43.98	60.83	16.85
2603.52	47.99	H	-9.39	38.6	60.83	22.23
2603.52	44.85	V	-9.39	35.46	60.83	25.37
3037.44	59.52	H	-9.39	50.13	60.83	10.7
3037.44	57.84	V	-9.39	48.45	60.83	12.38
3471.36	56.64	H	-9.39	47.25	60.83	13.58
3471.36	51.85	V	-9.39	42.46	60.83	18.37
3905.28	61.14	H	-9.39	51.75	54.00	2.25
3905.28	61.74	V	-9.39	52.35	54.00	1.65
4339.20	52.70	H	-9.39	43.31	54.00	10.69
4339.20	52.67	V	-9.39	43.28	54.00	10.72
4773.12	60.50	H	-9.39	51.11	54.00	2.89
4773.12	62.09	V	-9.39	52.7	54.00	1.3

Duty Cycle Correction Factor Calculation:

Keys	Pulse 1 width (ms)	Pulse 1 Numbers	Pulse 2 width (ms)	Pulse 2 Numbers	T_{on+off} (ms)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)
Left	0.652	5	0.254	20	27.261	30.59	-10.29
Middle	0.667	5	0.254	20	27.130	31.02	-10.17
Right	0.652	5	0.297	20	27.130	33.91	-9.39

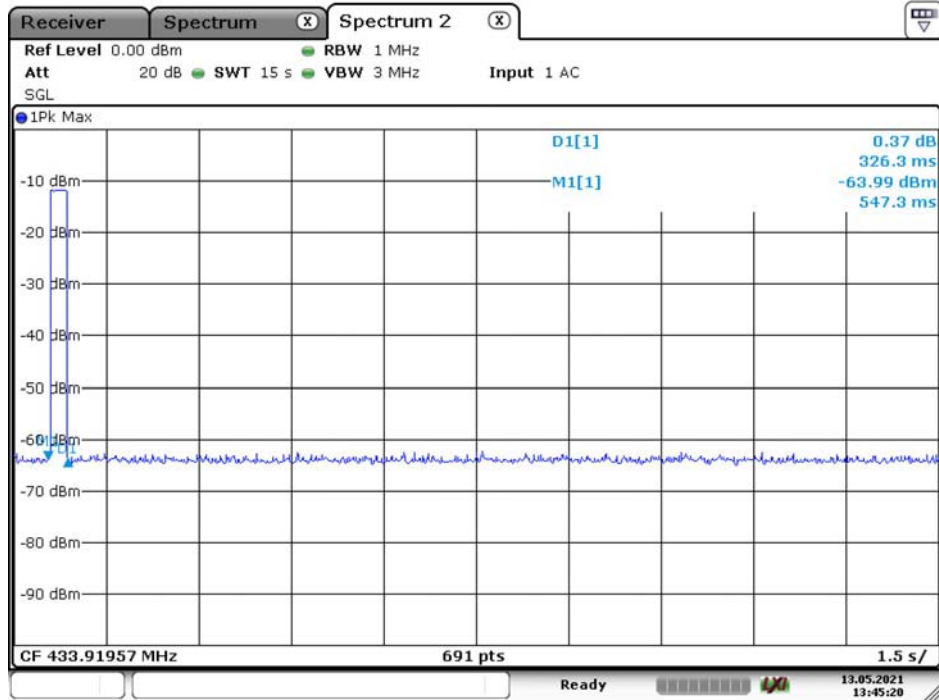
Note:

Duty cycle=(Pulse 1 Width*Pulse 1 Number + Pulse 2 Width*Pulse 2 Number)/Ton+off

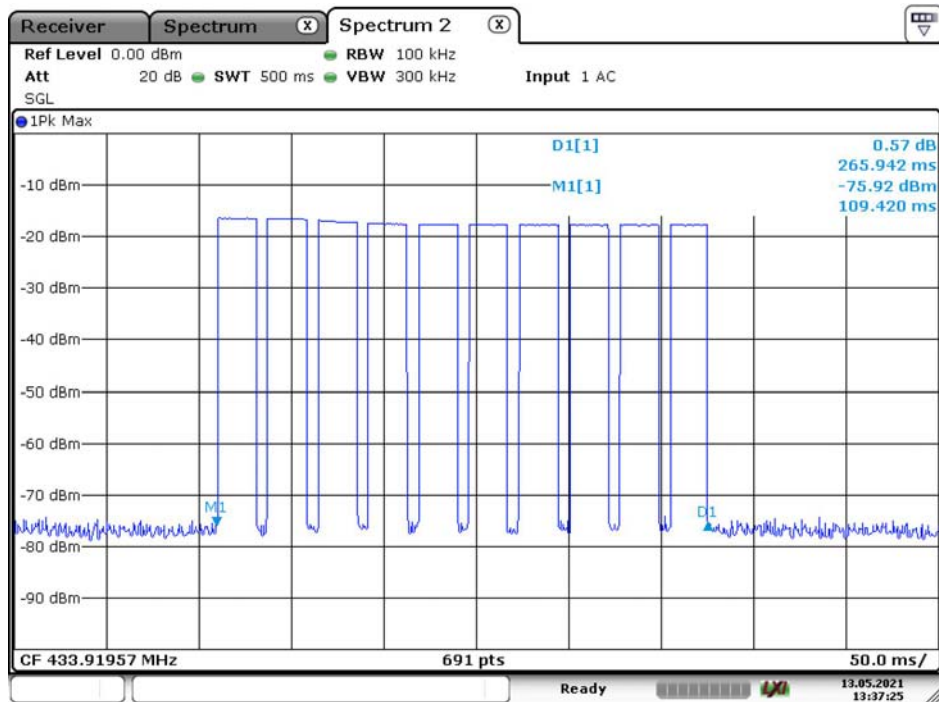
Duty Cycle Correction Factor= 20*log(Duty cycle)

Please refer to the following plots for duty cycle test:

Left Key

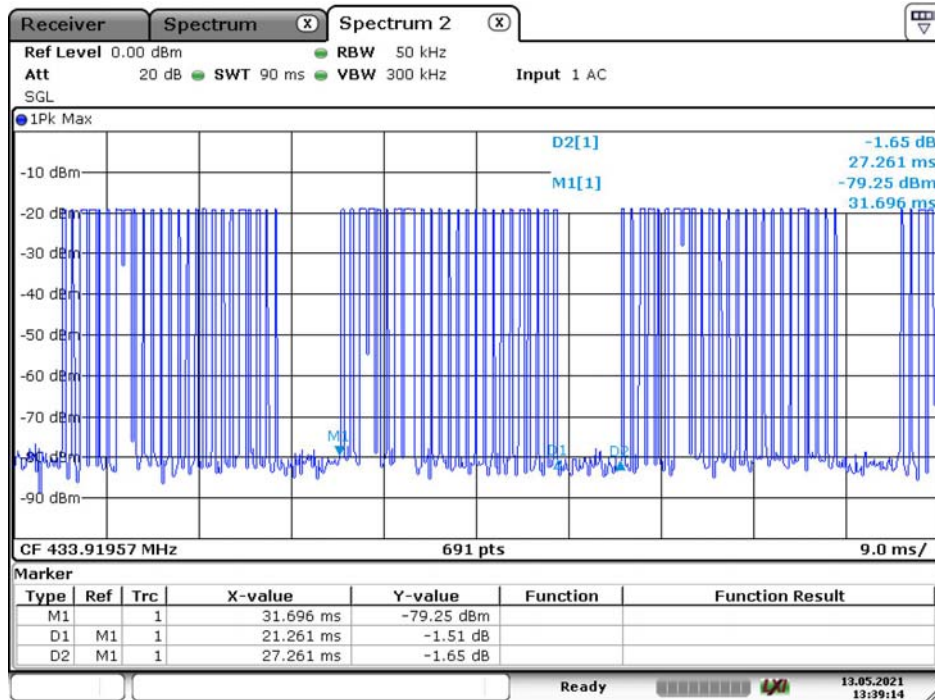


Date: 13.MAY.2021 13:45:20



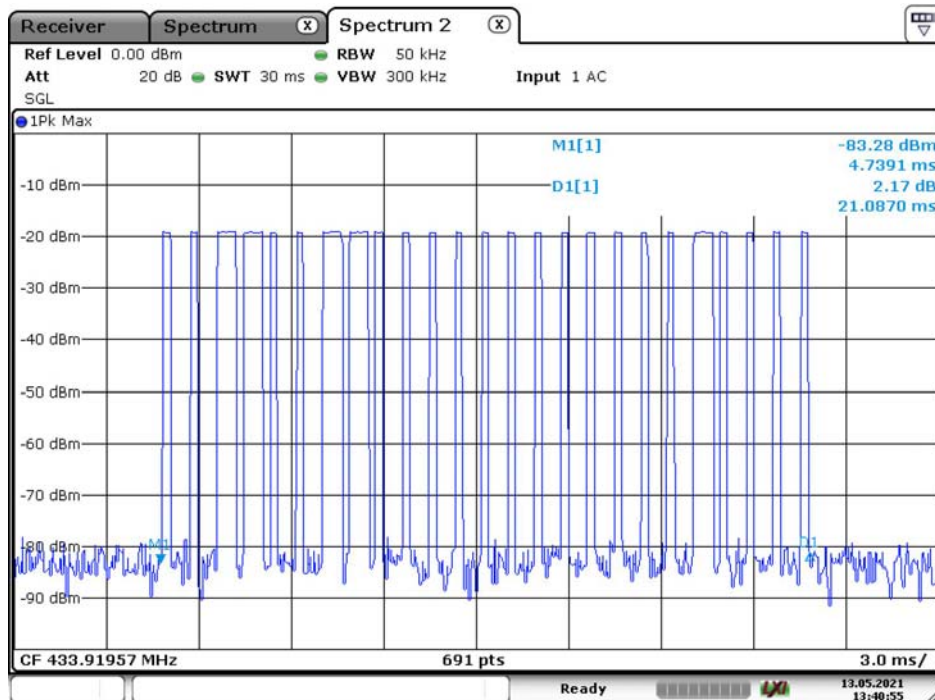
Date: 13.MAY.2021 13:37:25

$$T_{on+off}=27.261ms$$



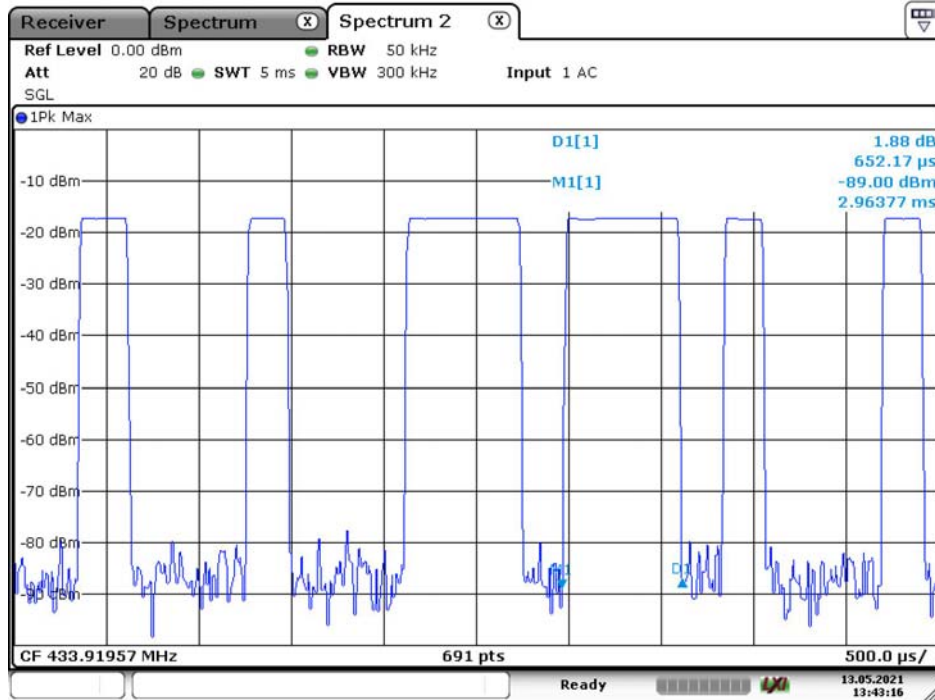
Date: 13.MAY.2021 13:39:13

$$T_{on1} = 5pcs, T_{on2} = 20pcs$$



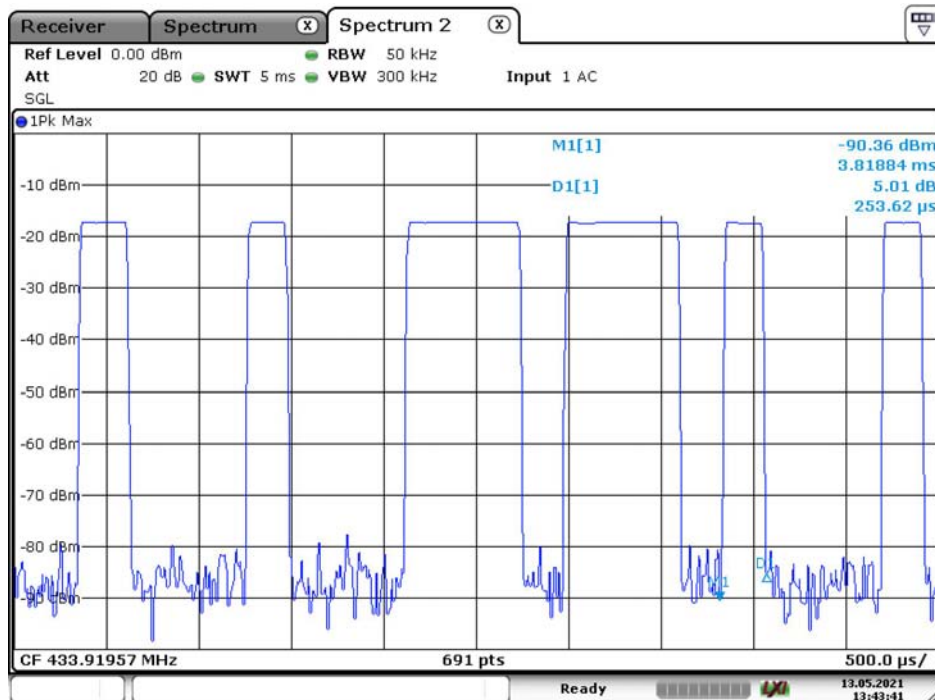
Date: 13.MAY.2021 13:40:55

$T_{on1} = 0.652ms$



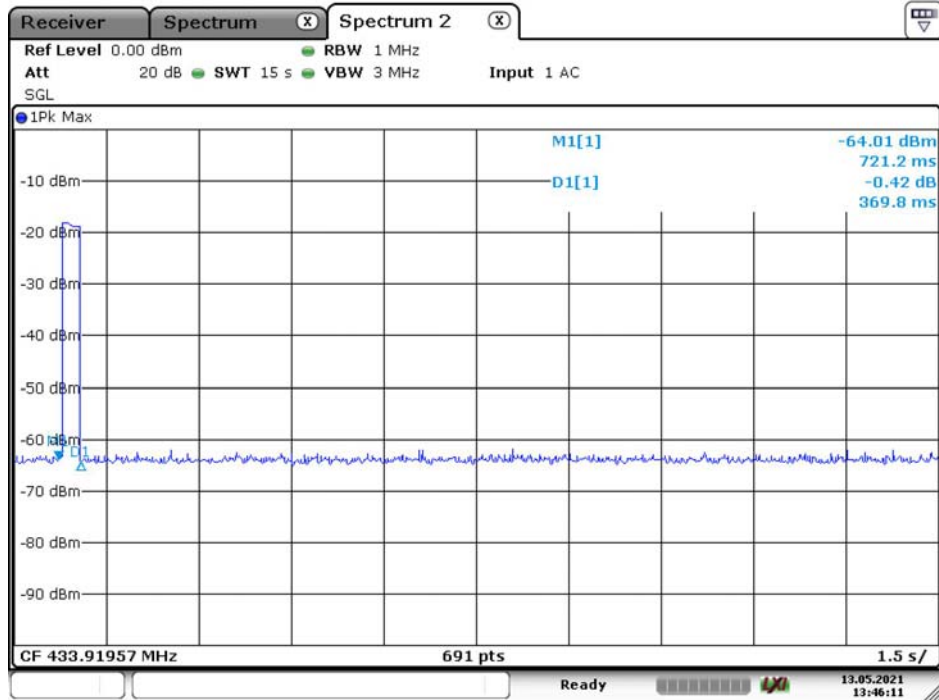
Date: 13.MAY.2021 13:43:16

$T_{on2} = 0.254ms$

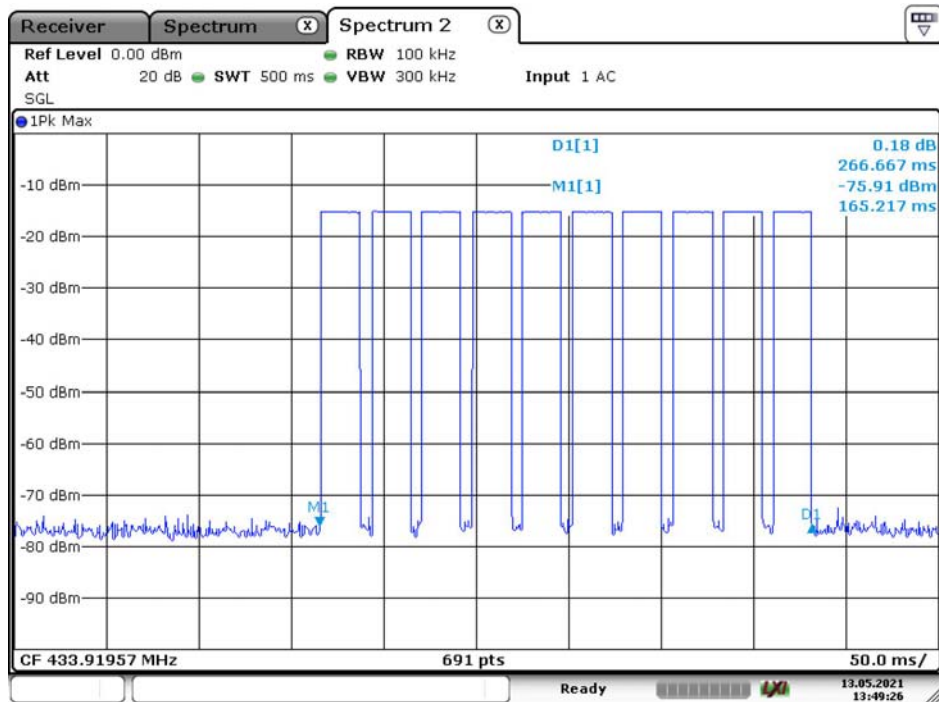


Date: 13.MAY.2021 13:43:40

Middle Key

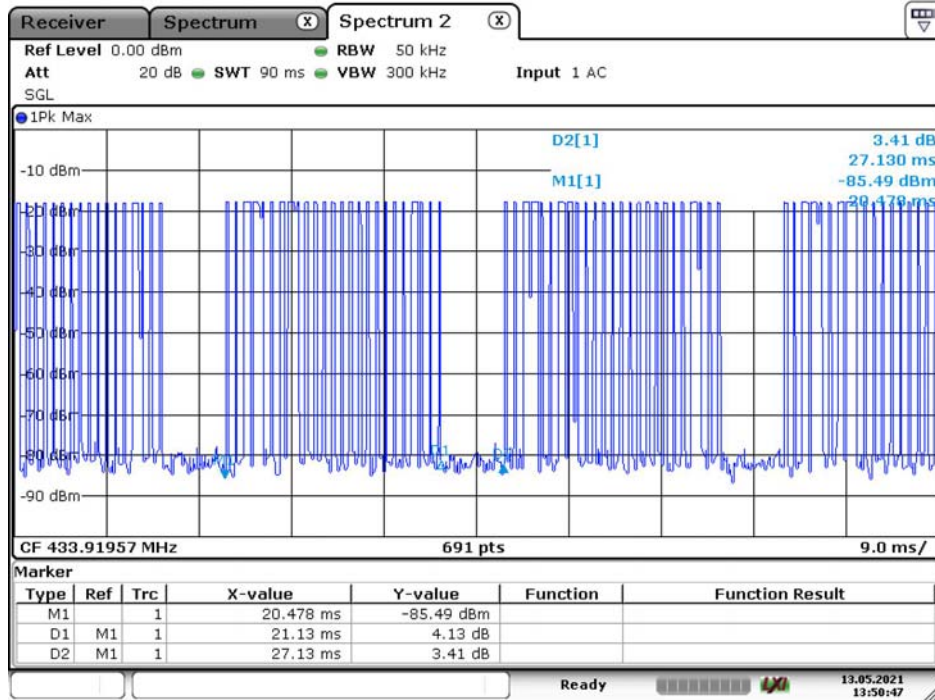


Date: 13.MAY.2021 13:46:11



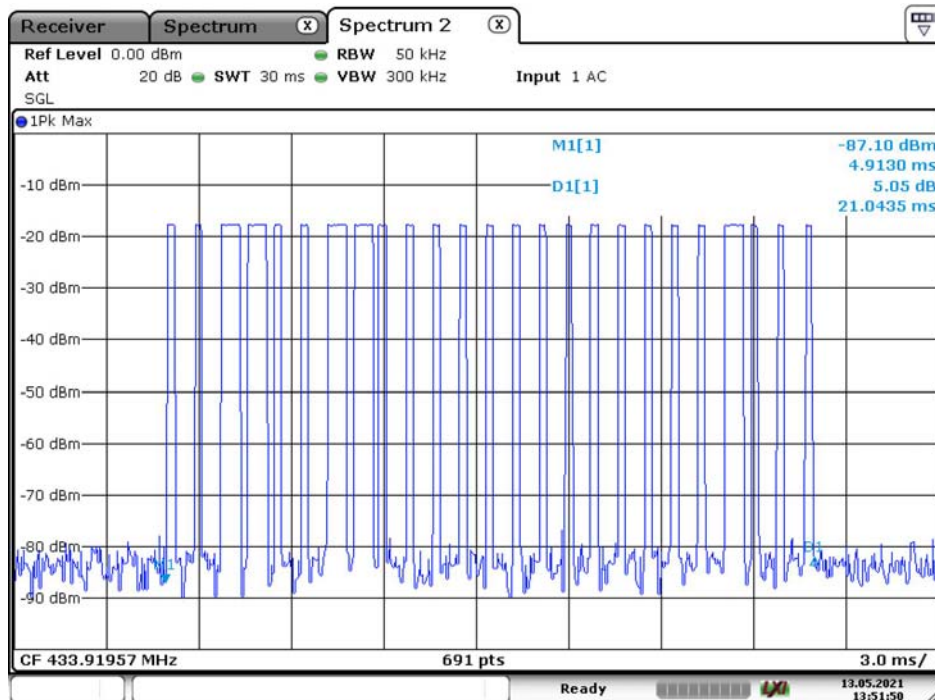
Date: 13.MAY.2021 13:49:26

$$T_{on+off} = 27.13ms$$



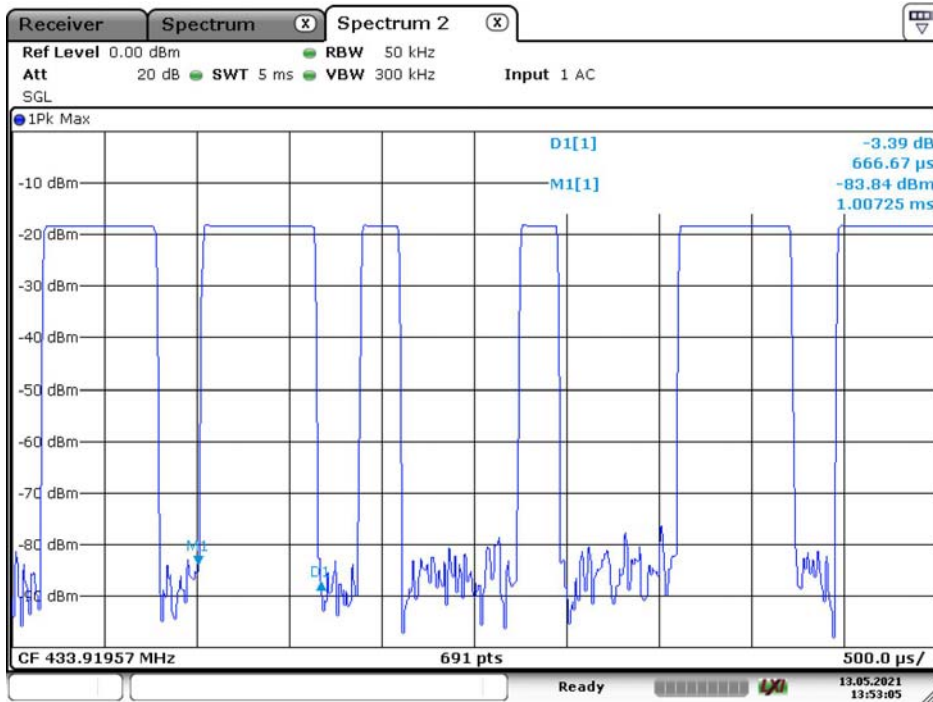
Date: 13.MAY.2021 13:50:47

$$T_{on1} = 5pcs, T_{on2} = 20pcs$$



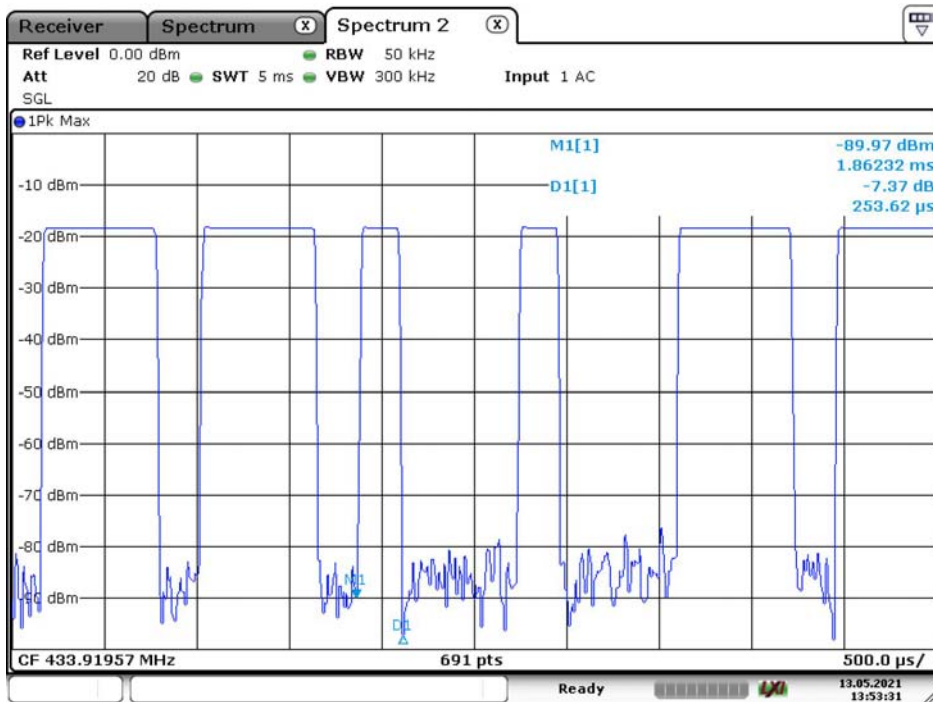
Date: 13.MAY.2021 13:51:50

$T_{on1} = 0.667ms$



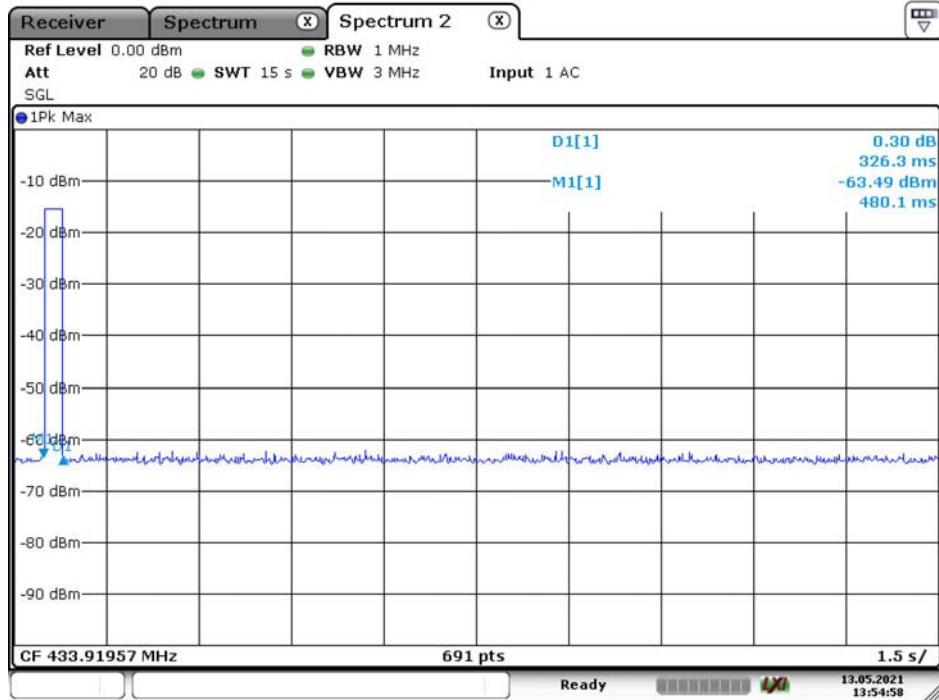
Date: 13.MAY.2021 13:53:05

$T_{on2} = 0.254ms$

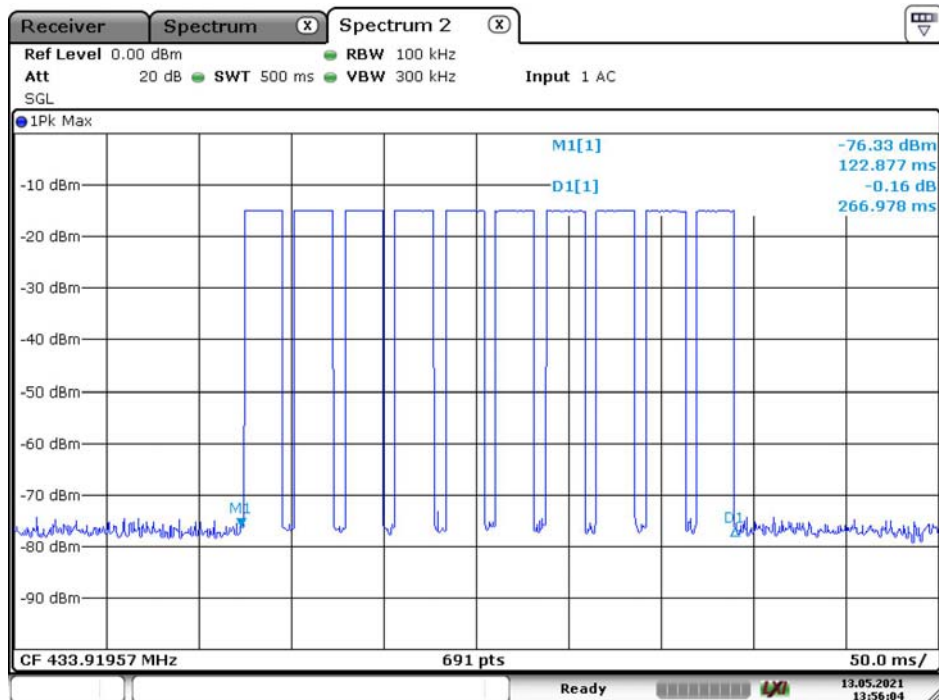


Date: 13.MAY.2021 13:53:31

Right Key

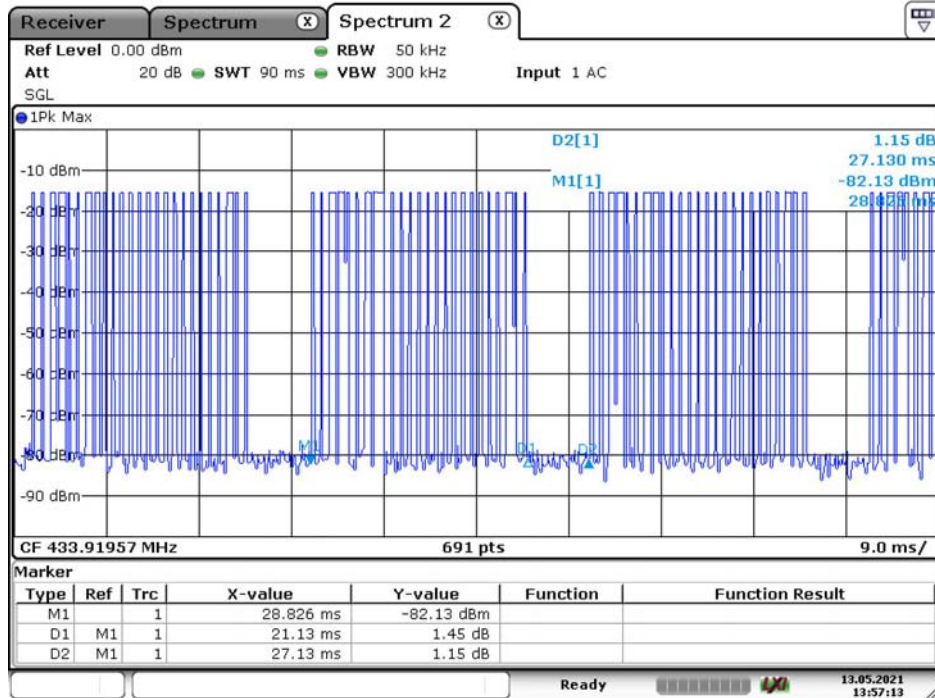


Date: 13.MAY.2021 13:54:58



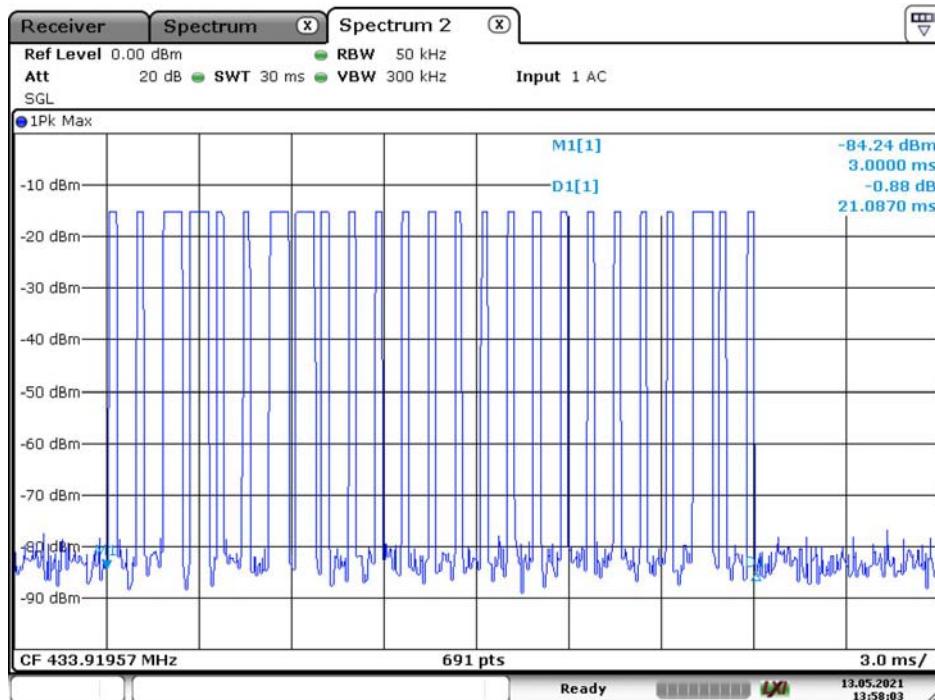
Date: 13.MAY.2021 13:56:03

$$T_{on+off} = 27.13ms$$



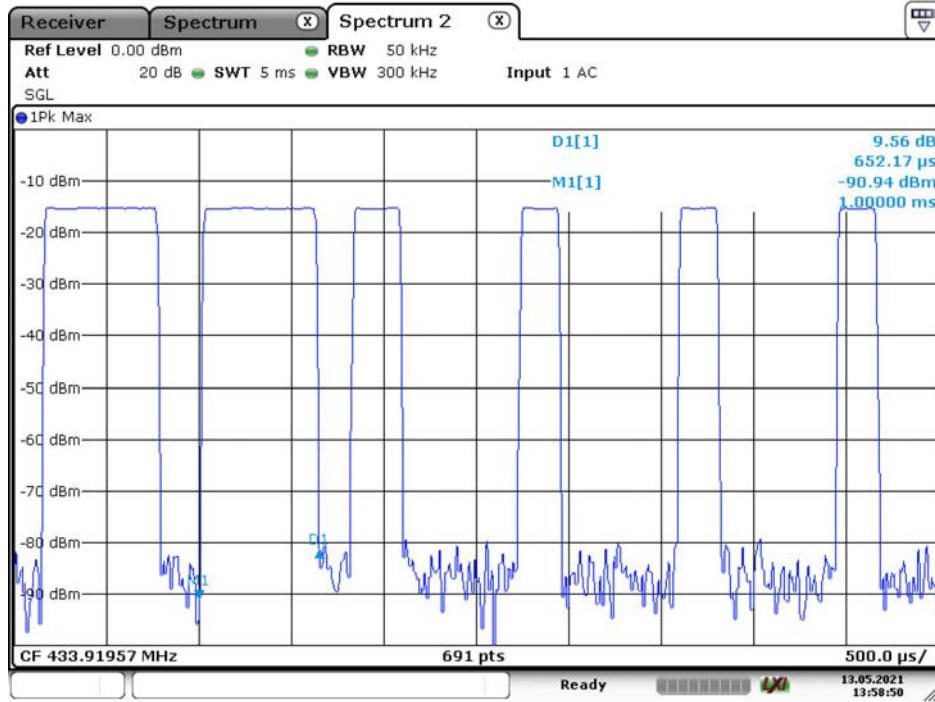
Date: 13.MAY.2021 13:57:13

$$T_{on1} = 5pcs, T_{on2} = 20pcs$$



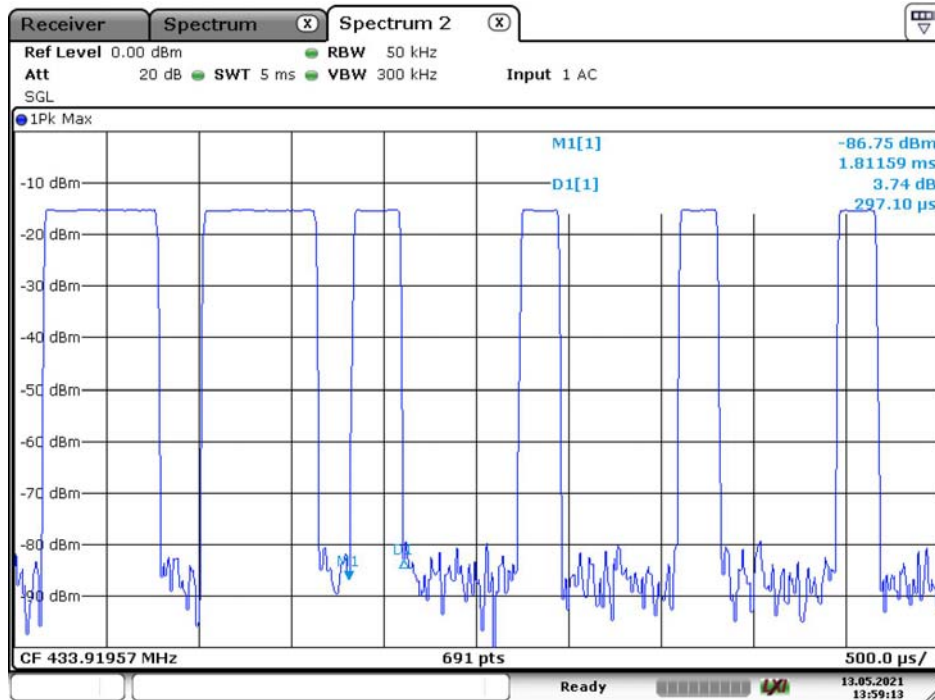
Date: 13.MAY.2021 13:58:03

$$T_{on1} = 0.652ms$$



Date: 13.MAY.2021 13:58:50

$$T_{on2} = 0.297ms$$

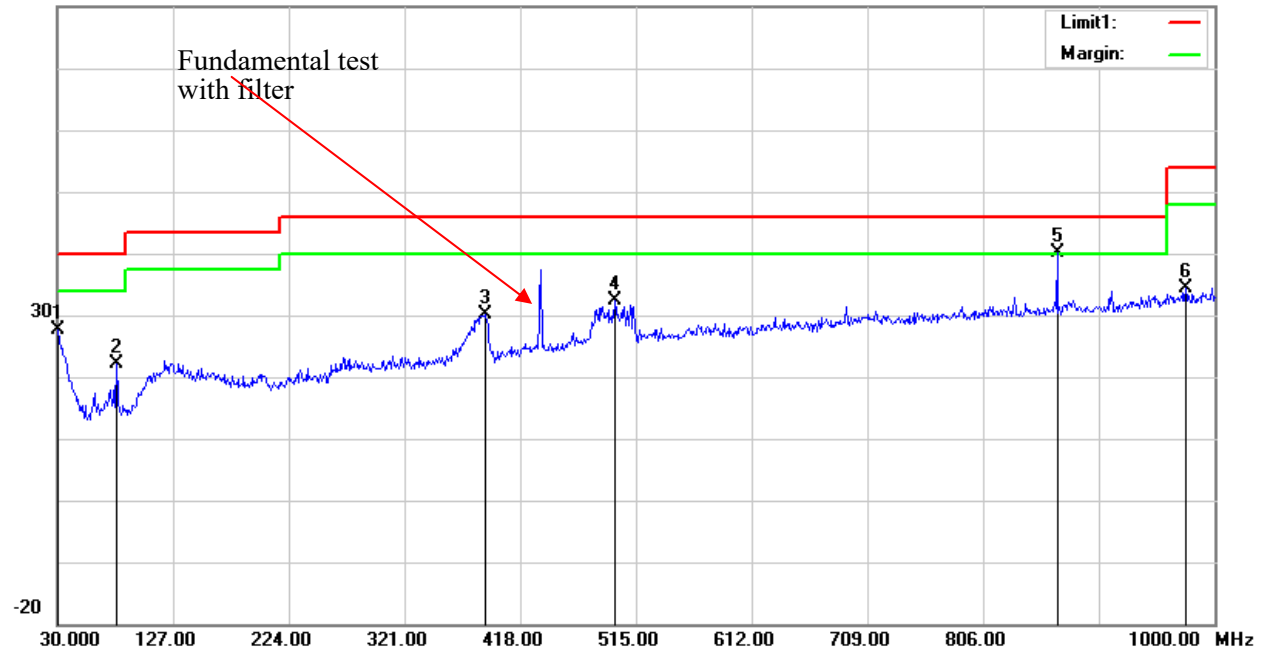


Date: 13.MAY.2021 13:59:13

30MHz-1GHz

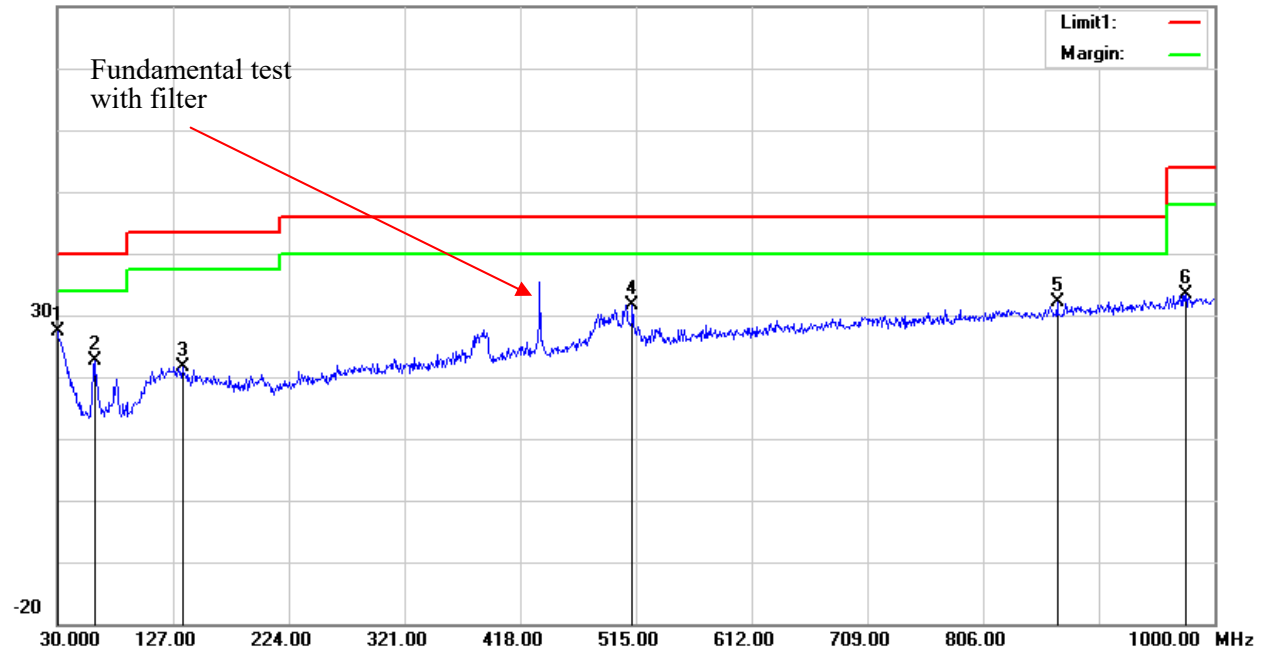
Horizontal:

80.0 dBuV/m



Vertical:

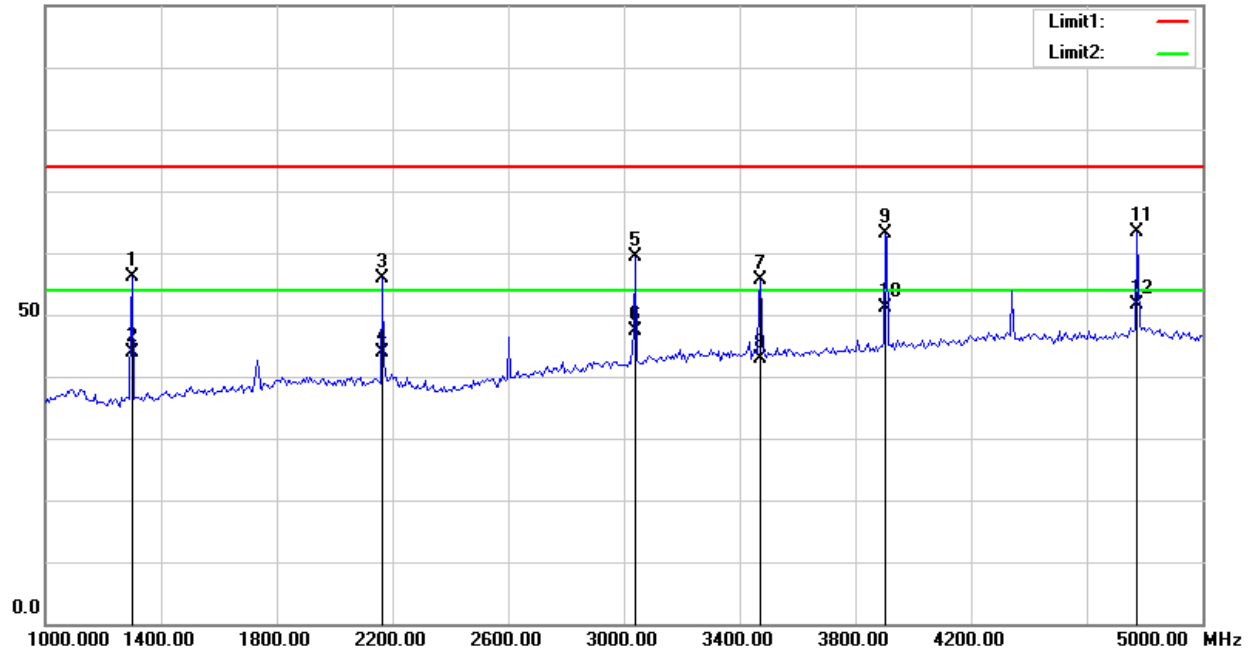
80.0 dBuV/m



Above 1GHz:

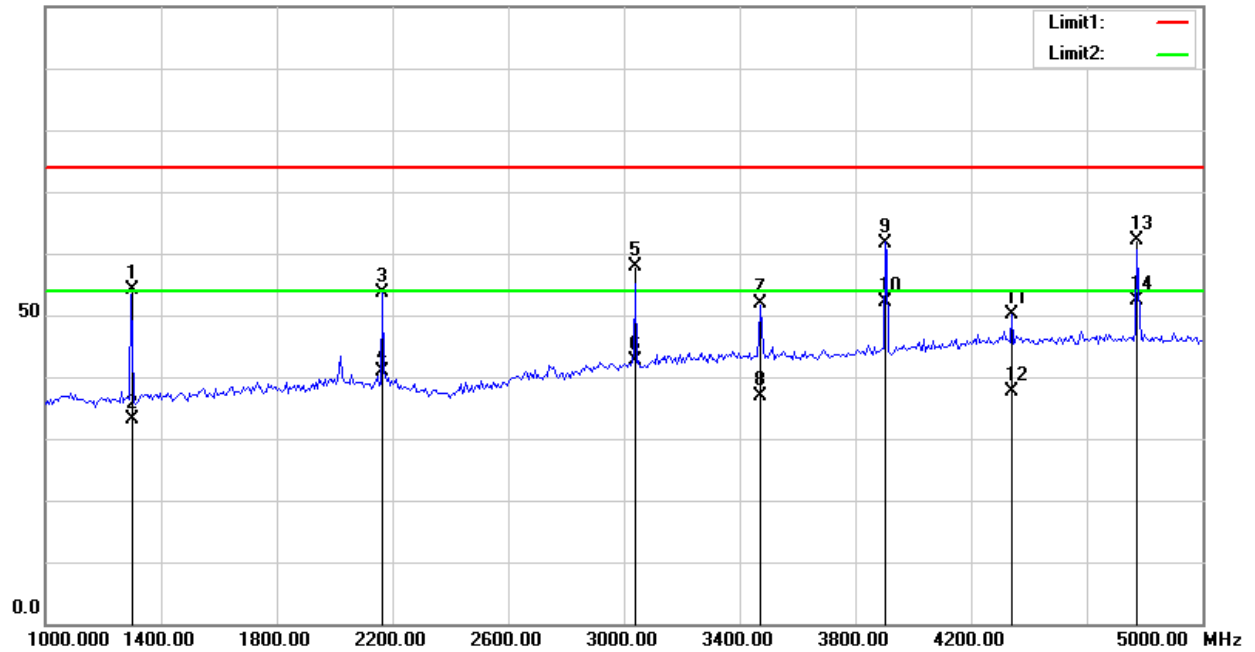
Horizontal:

100.0 dBuV/m



Vertical:

100.0 dBuV/m



FCC §15.231(c) – 20 dB BANDWIDTH TESTING

Requirement

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESR3	102453	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2020-09-05	2021-09-05

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Procedure

The waveform was received by the spectrum analyzer/EMI Test Receiver, plot the 20 dB bandwidth.

Test Data

Environmental Conditions

Temperature:	27.7~29.4°C
Relative Humidity:	46~53 %
ATM Pressure:	100.3~100.5 kPa
Tester:	Alex Hu
Test Date:	2021.05.08~2021.05.13

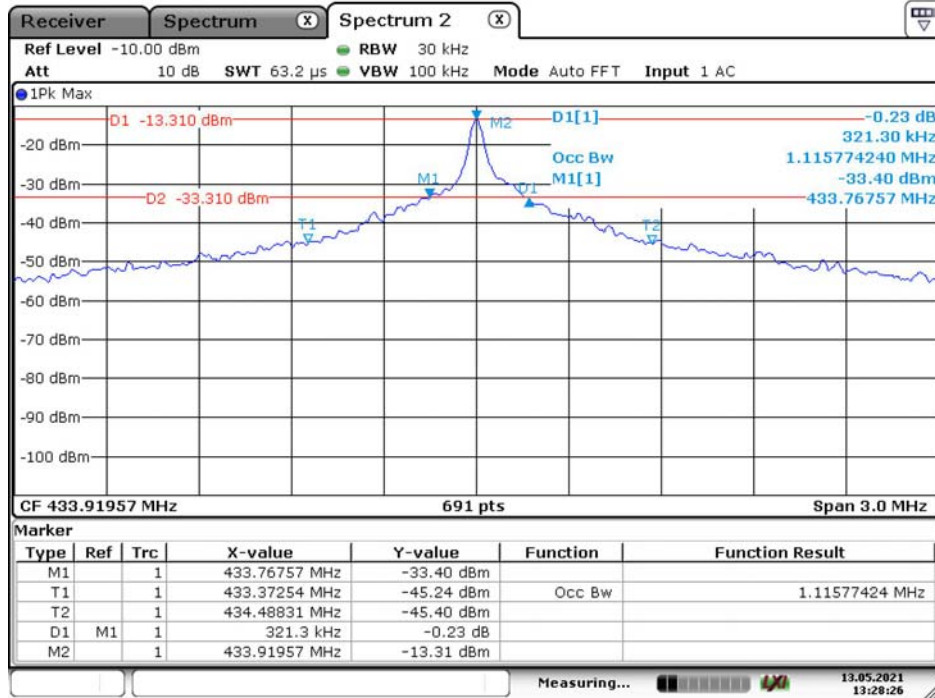
Test Mode: Transmitting

Please refer to following table and plot.

Channel Frequency (MHz)	20 dB Bandwidth (kHz)	Limit (kHz)	Result
433.92	321	1084.8	Pass

Note: Limit = 0.25% * Center Frequency = 0.25%*433.92MHz = 1084.8 kHz

20 dB Bandwidth: 321 kHz



Date: 13.MAY.2021 13:28:26

FCC §15.231(a) - DEACTIVATION TESTING

Applicable Standard

Per 15.231(a) (1), a manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESR3	102453	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2020-09-05	2021-09-05

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

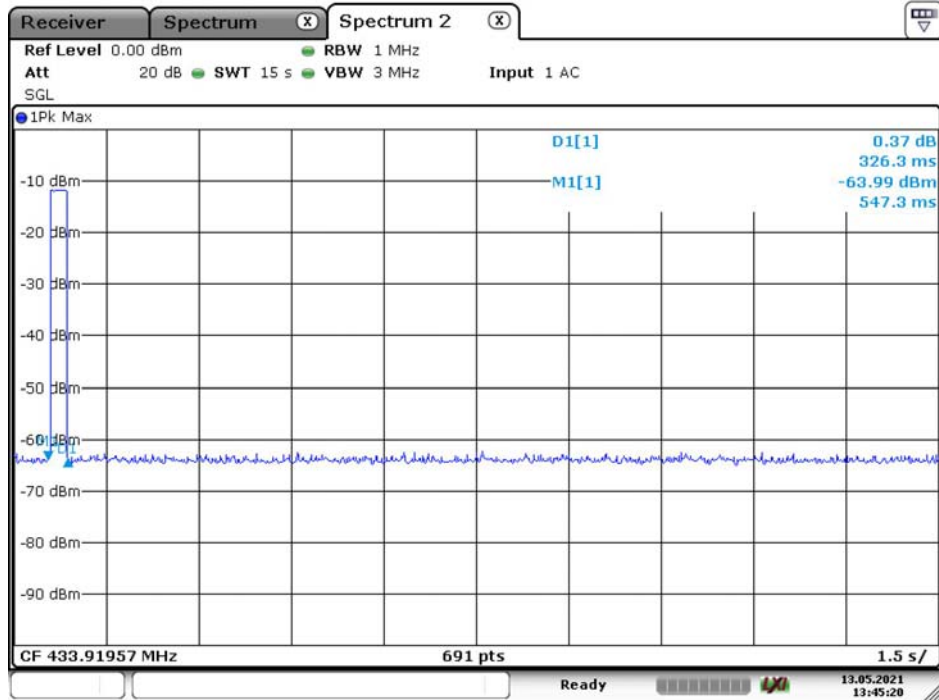
Temperature:	27.7~29.4°C
Relative Humidity:	46~53 %
ATM Pressure:	100.3~100.5 kPa
Tester:	Alex Hu
Test Date:	2021.05.08~2021.05.13

Test Mode: Transmitting

Test Result: Compliance. Please refer to following plot.

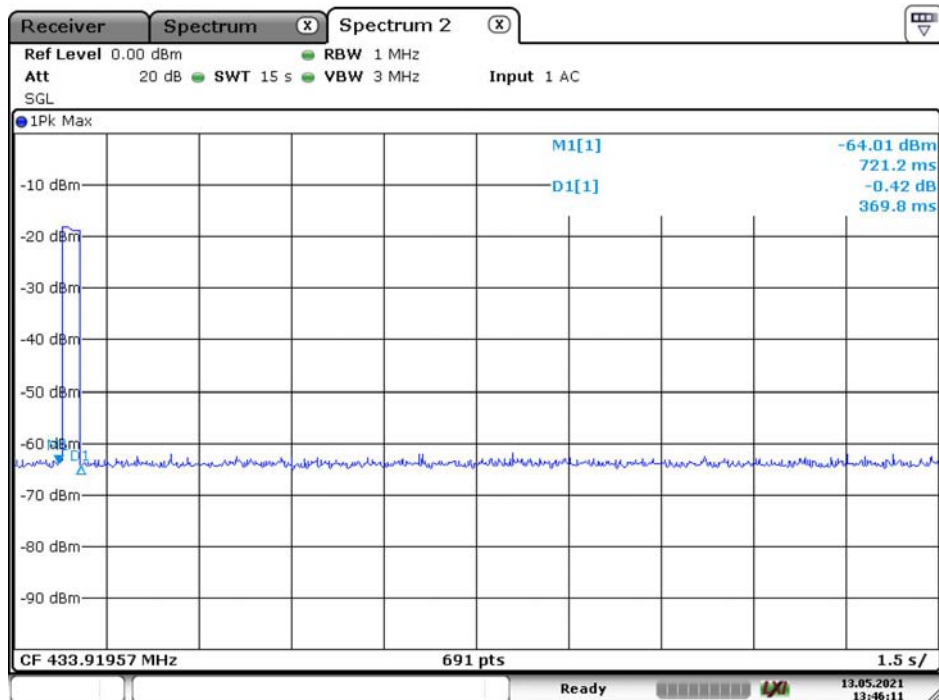
Keys	Maximum Deactivate Time (s)	Limit (s)
Left	0.326	<5
Middle	0.370	<5
Right	0.326	<5

Left Key



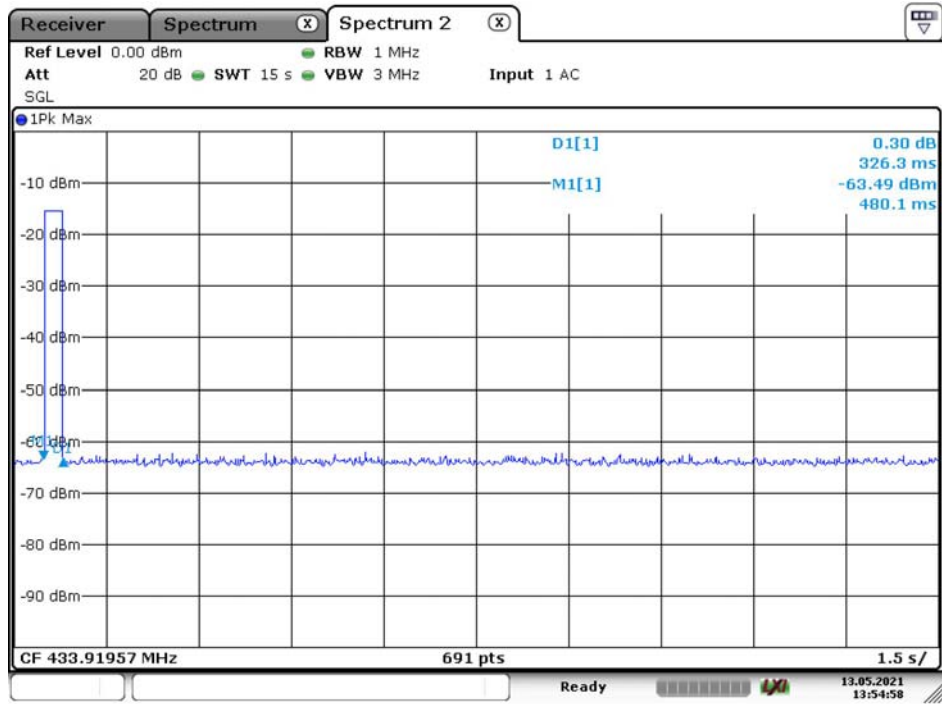
Date: 13.MAY.2021 13:45:20

Middle Key



Date: 13.MAY.2021 13:46:11

Right Key



Date: 13.MAY.2021 13:54:58

*****END OF REPORT*****