

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Applicant: JANSSEN ENGINEERING GROUP INC. TAIWAN BRANCH
3F-5, No. 7-1 Sec. 1 Nan Chang Road, Taipei City 100 Taiwan

Product Name: 4-Circuit Electronic Control System

Brand Name: RIECO TITAN

Model No.: JEG-4LTX

Model Difference: N/A

Report Number: T190517W04-RP

FCC ID 2ATKVJANSSEN-4LTX

FCC Rule Part Part 15.231

Issue Date: Jul. 23, 2019

Date of Test: May 17, 2019 ~ Jul. 03, 2019

Date of EUT Received: May 17, 2019

Issued by: Compliance Certification Services Inc. Wugu Lab.
No. 11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891,
Taiwan. (R.O.C.)
service@ccsrf.com

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.

The test results of this report relate only to the tested sample (EUT) identified in this report.
The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc. (Wugu Laboratory).

Tested By:

Jerry Lu

Jerry Lu / Sr. Engineer

Approved By:

Kevin Tsai

Kevin Tsai / Deputy Manager



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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
T190517W04-RP	Rev.00	Initial creation of document	All	Jul. 10, 2019	Elle Chang
T190517W04-RP	Rev.01	Updated section 8	25	Jul. 19, 2019	Elle Chang
T190517W04-RP	Rev.02	Updated measurement procedure	24	Jul. 23, 2019	Elle Chang

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	4-Circuit Electronic Control System
Brand Name:	RIECO TITAN
Model No.:	JEG-4LTX
Model Difference:	N/A
Hardware Version:	N/A
Software Version:	N/A
Power Supply:	12Vdc from Alkaline Battery

Radio Technology:	433 MHz Short Range Radio
Operating Frequency	433.92MHz
Transmit Power	≤ 58.58 dBuV/m Max.
Modulation Technique	ASK
Number of Channels	1 Channel
Antenna Type	LOOP Antenna

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1.2 Test Methodology

FCC Part 15, Subpart C §15.231

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

1.3 Test Facility

Compliance Certification Services Inc. Wugu Lab. No.11, Wugong 6th Rd.,

Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.) (TAF code 1309)

FCC Designation number: TW1309

1.4 Special Accessories

There are no special accessories used while test was conducted.

1.5 Equipment Modifications

There was no modification incorporated into the EUT.

1.6 Radiated Emission Test Sites For Measurements From 9 kHz To 30 MHz

Radiated emission below 30MHz is measured in a 9m*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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2 SYSTEM TEST CONFIGURATION

2.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2 EUT Exercise

The Transmitter was operated in the normal operating mode. The Tx frequency was fixed which was for the purpose of the measurements.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed according to §15.207. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Radiated Emissions

The EUT is placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4 Configuration of Tested System

Fig. 2-1 Configuration of Tested System



Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
	N/A					

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3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207	AC Power Line Conducted Emission	N/A
§15.231	Radiated Emission	Compliant
§15.231(c)	20dB Bandwidth	Compliant
§15.35 (c)	Duty Cycle Test (Pulse Modulation)	Compliant
§15.231(a)(1)	Release Time Measurement	Compliant

4 DESCRIPTION OF TEST MODES

4.1 Operated in 433.92 MHz Band

1 channels are provided

CH	FREQUENCY
01	433.92MHZ

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4.2 The Worst Test Modes and Channel Details

RADIATED EMISSION TEST (BELOW 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
433.92 MHz	1	1	ASK	1	MAIN
RADIATED EMISSION TEST (ABOVE 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
433.92 MHz	1	1	ASK	1	MAIN

Note:

The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for 433MHz Transmitter for channel Low, Mid and High, the worst case H position was reported.

ANTENNA PORT CONDUCTED TEST					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)	ANTENNA PORT
433.92 MHz	1	1	ASK	1	MAIN

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5 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	+/- 1.2575
Emission bandwidth, 20dB bandwidth	+/- 0.0014
RF output power, conducted	+/- 1.14
Power density, conducted	+/- 1.40
3M Semi Anechoic Chamber / 30M~200M	+/- 4.12
3M Semi Anechoic Chamber / 200M~1000M	+/- 4.68
3M Semi Anechoic Chamber / 1G~8G	+/- 5.18
3M Semi Anechoic Chamber / 8G~18G	+/- 5.47
3M Semi Anechoic Chamber / 18G~26G	+/- 3.81
3M Semi Anechoic Chamber / 26G~40G	+/- 3.87

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.
2. Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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6 CONDUCTED EMISSIONS TEST

6.1 Standard Applicable

According to §15.207 and frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range MHz	Limits dB(uV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note 1.The lower limit shall apply at the transition frequencies 2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

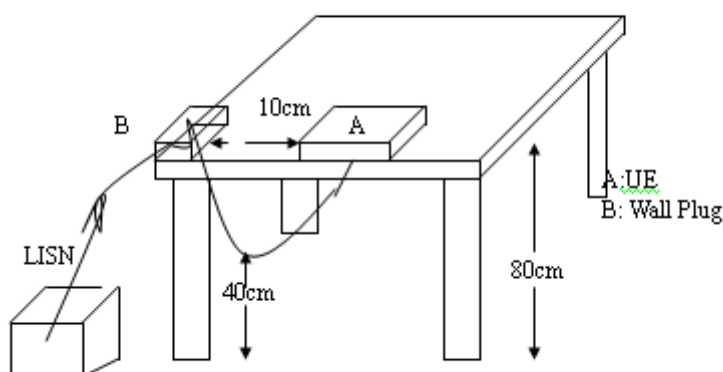
6.2 Measurement Equipment Used:

N/A

6.3 EUT Setup

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

6.4 Test SET-UP (Block Diagram of Configuration)



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6.5 Measurement Procedure

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

6.6 Measurement Result

N/A; Powered from battery.

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7 RADIATED EMISSION TEST

7.1 Standard Applicable

According to 15.231(b), the field strength of emissions from Intentional Radiators operated under this section shall not exceed the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental		Field Strength of Spurious	
	(dBuV/m)	(uV/m)	(dBuV/m)	(uV/m)
40.66 - 40.70	67.04	2,250	47	225
70 - 130	61.94	1,250	41.9	125
130 - 174	* 61.94 - 71.48	* 1,250 -3,750	* 41.9 – 51.48	* 125 to 375
174 - 260	71.48	3,750	51.48	375
260 - 470	* 71.48 - 81.94	* 3,750 - 12,500	* 51.48 - 54	* 375 to 1250
above 470	81.94	12,500	74	1250

Remark:

1. Emission level in dBuV/m=20 log (uV/m)
2. Measurement was performed at an antenna to the closed point of EUT distance of meters.
3. Only spurious frequency is permitted to locate within the Restricted Bands specified in provision of § 15.205
4. Emission spurious frequency which appearing within the Restricted Bands specified in provision of §15.205, then the general radiated emission limits in § 15.209 apply.
5. For the band 130-174MHz, uV/m at 3meters = 56.81818(F) – 6136.3636; For the band 260-470MHz uV/m at 3meters = 41.6667(F) – 7083.3333; Where F is the frequency in MHz.
6. 433.00 MHz limit = 41.6667 * 433.00 – 7083.3333= 10958.3478 uV/m = 80.80 dBuV/m
433.75 MHz limit = 41.6667 * 433.75 – 7083.3333= 10989.597825 uV/m = 80.82 dBuV/m
434.525 MHz limit = 41.6667 * 434.525 – 7083.3333= 11021.88952 uV/m = 80.85 dBuV/m

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7.2 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all frequency of the interest measured were complete.

7.3 Auxiliary Procedure (Setting on Spectrum to capture the reading of emission level):

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

Test was measured starting from 9kHz to 10th harmonic of the fundamental frequency, and data containing the worst result above 30MHz are shown on the test report.

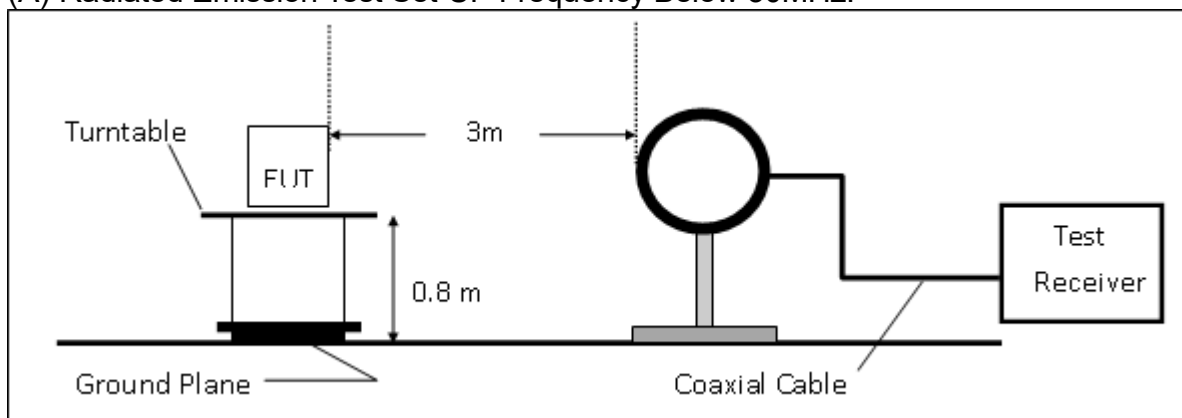
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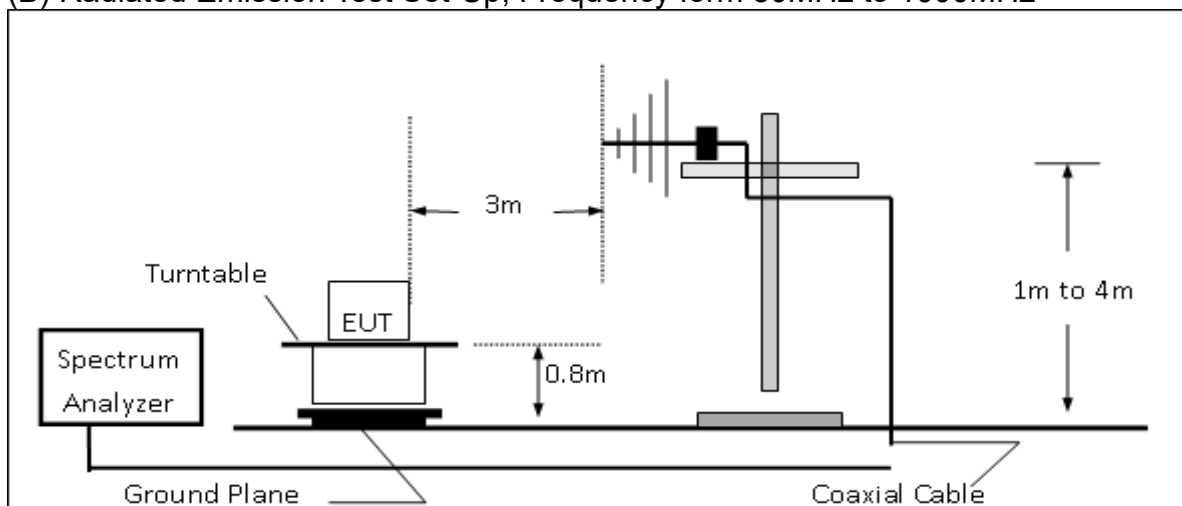
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7.4 Test SET-UP (Block Diagram of Configuration).

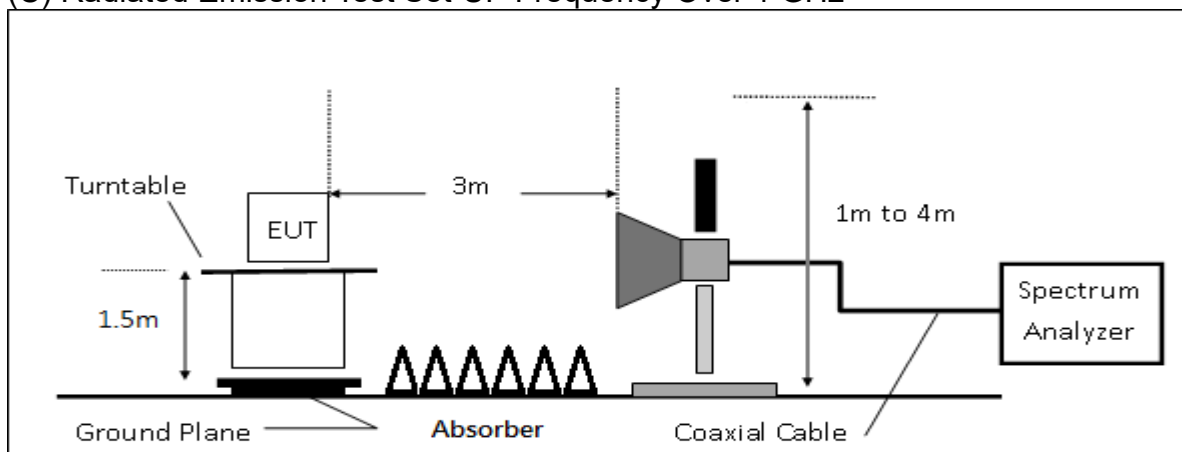
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



(B) Radiated Emission Test Set-UP, Frequency form 30MHz to 1000MHz



(C) Radiated Emission Test Set-UP Frequency Over 1 GHz



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7.5 Measurement Equipment Used:

966A Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bilog Antenna	Sunol Sciences	JB3	A030105	07/13/2018	07/12/2019
Cable	HUBER SUHNER	SUCOFLEX 104PEA	25157	02/26/2019	02/25/2020
Cable	HUBER SUHNER	SUCOFLEX 104PEA	20995	02/26/2019	02/25/2020
Digital Thermo-Hygro Meter	WISEWIND	1206	D07	01/30/2019	01/29/2020
double Ridged Guide Horn Antenna	ETC	MCTD 1209	DRH13M020 03	08/20/2018	08/19/2019
High Pass Filter	SOLVANG TECHNOLOGY INC.	STI15	9923	02/26/2019	02/25/2020
Loop Antenna	COM-POWER	AL-130	121051	03/22/2019	03/21/2020
Pre-Amplifier	EMEC	EM330	060609	02/26/2019	02/25/2020
Pre-Amplifier	HP	8449B	3008A00965	02/26/2019	02/25/2020
PSA Series Spectrum Analyzer	Agilent	E4446A	MY4618032 3	05/29/2019	05/28/2020
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Software	e3 V6.11-20180413				

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7.6 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

$$FS = RA + AF + CL - AG$$

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

Remark:

The limit of the emission level is expressed in dBuV/m, which converts $20 \cdot \log(\mu\text{V/m})$

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

7.7 Test Results of Radiated Spurious Emissions form 9 KHz to 30 MHz

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

7.8 Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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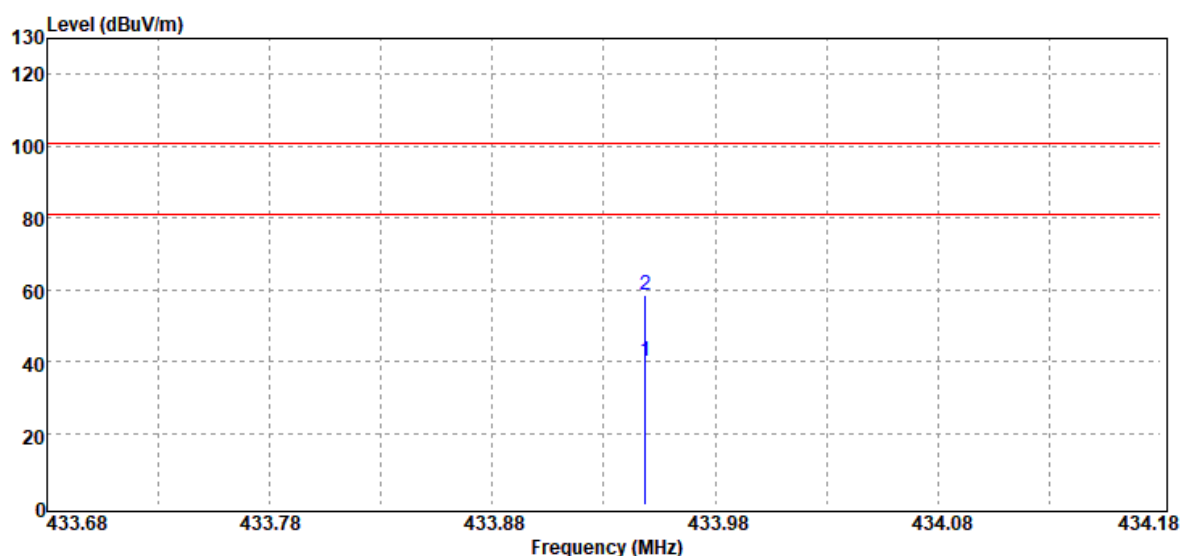
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7.9 Measurement Result

7.9.1 Radiated emission Main

Report Number :T190517W04
Operation Band :433M
Frequency :433.92 MHz
Operation Mode :Main
EUT Pol. :H Plan

Test Date :2019-06-27
Temp./Humi. :20/53
Antenna Pol. :VERTICAL
Engineer :Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
433.95	Average	-	-12.39	46.19	80.82	-34.63
433.95	Peak	62.80	-4.22	58.58	100.82	-42.24

Note: Average Actual = Peak Actual + Average Factor (-12.39)

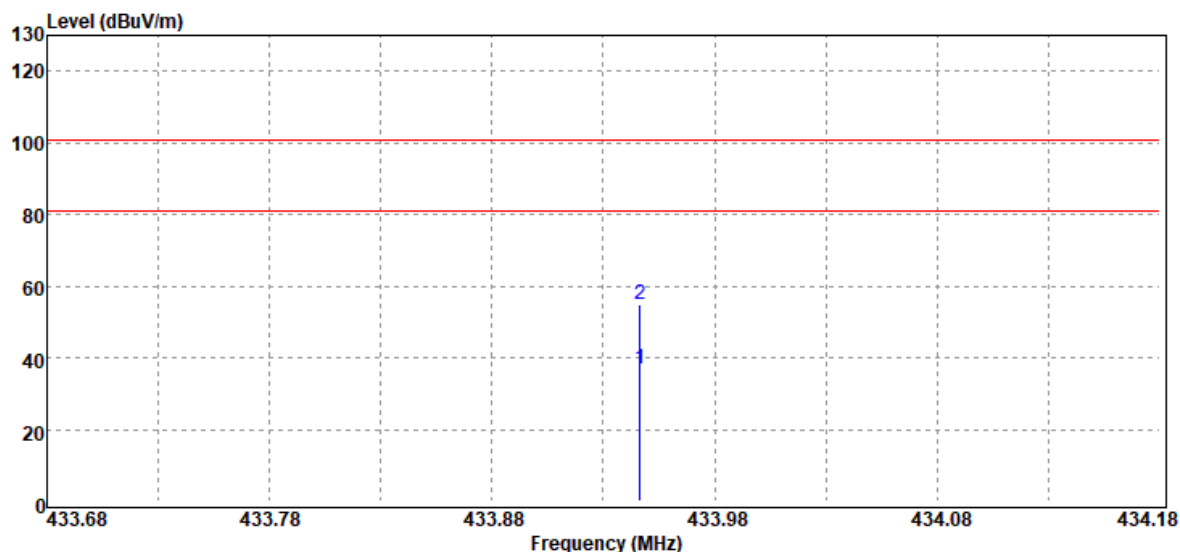
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Report Number : T190517W04
Operation Band : 433M
Frequency : 433.92 MHz
Operation Mode : Main
EUT Pol. : H Plan

Test Date : 2019-06-27
Temp./Humi. : 20/53
Antenna Pol. : HORIZONTAL
Engineer : Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
433.95	Average	-	-12.39	42.70	80.82	-38.12
433.95	Peak	59.31	-4.22	55.09	100.82	-45.73

Note: Average Actual = Peak Actual + Average Factor (-12.39)

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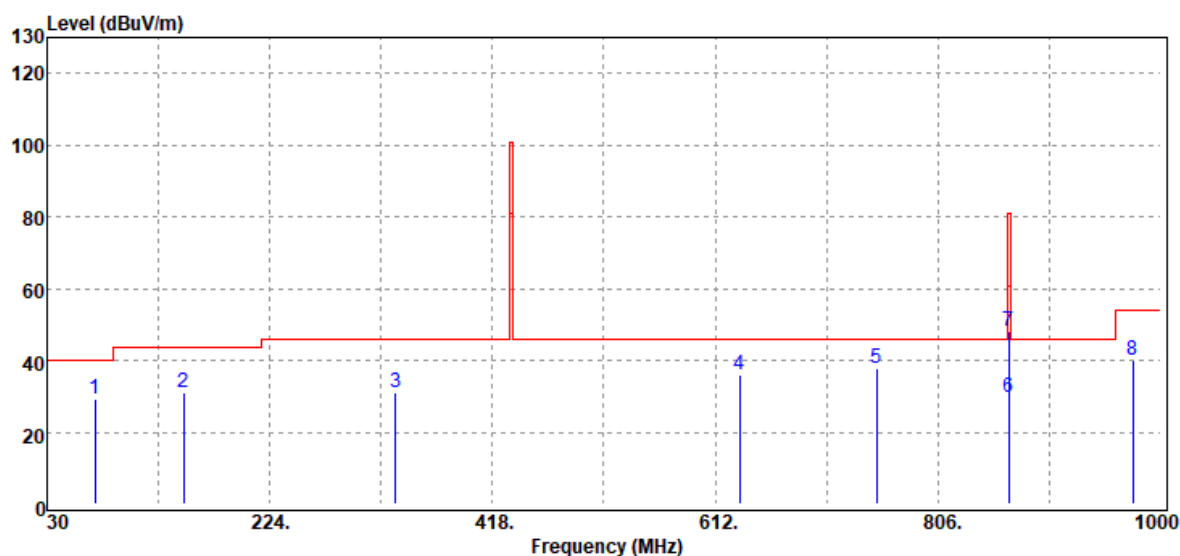
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7.9.2 Radiated Spurious Emission

Below 1GHz:

Report Number :T190517W04
 Operation Band :433M
 Frequency :433.92 MHz
 Operation Mode :Tx
 EUT Pol :H Plan

Test Date :2019-06-27
 Temp./Humi. :20/53
 Antenna Pol. :VERTICAL
 Engineer :Jerry
 setting :



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
71.71	Peak	43.85	-14.74	29.11	40.00	-10.89
149.31	Peak	41.11	-10.10	31.01	43.50	-12.49
333.61	Peak	38.29	-7.22	31.07	46.00	-14.93
633.34	Peak	35.99	-0.21	35.78	46.00	-10.22
752.65	Peak	35.42	2.17	37.59	46.00	-8.41
867.88	Average	-	-12.39	35.93	60.82	-24.89
867.88	Peak	45.40	2.92	48.32	80.82	-32.50
975.75	Peak	34.54	5.54	40.08	54.00	-13.92

Note: Average Actual = Peak Actual + Average Factor (-12.39)

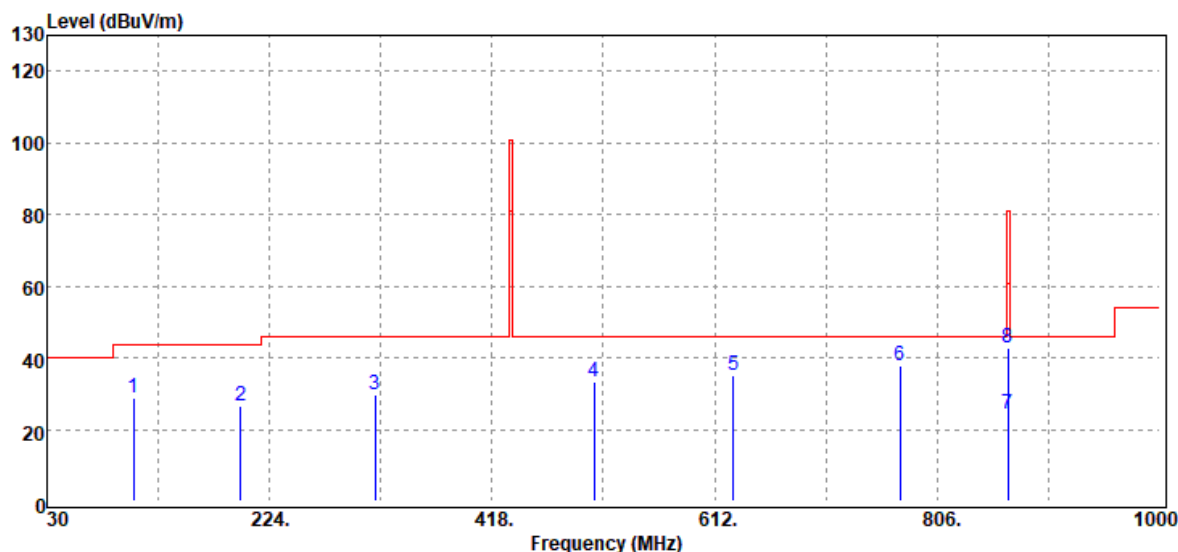
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Report Number :T190517W04
Operation Band :433M
Frequency :433.92 MHz
Operation Mode :Tx
EUT Pol :H Plan

Test Date :2019-06-27
Temp./Humi. :20/53
Antenna Pol. :HORIZONTAL
Engineer :Jerry
setting :



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
105.66	Peak	39.90	-11.02	28.88	43.50	-14.62
198.78	Peak	35.70	-9.26	26.44	43.50	-17.06
316.15	Peak	37.28	-7.59	29.69	46.00	-16.31
507.24	Peak	35.93	-2.85	33.08	46.00	-12.92
628.49	Peak	35.76	-0.50	35.26	46.00	-10.74
773.99	Peak	36.16	1.52	37.68	46.00	-8.32
867.88	Average	-	-12.39	30.18	60.82	-30.64
867.88	Peak	39.65	2.92	42.57	80.82	-38.25

Note: Average Actual = Peak Actual + Average Factor (-12.39)

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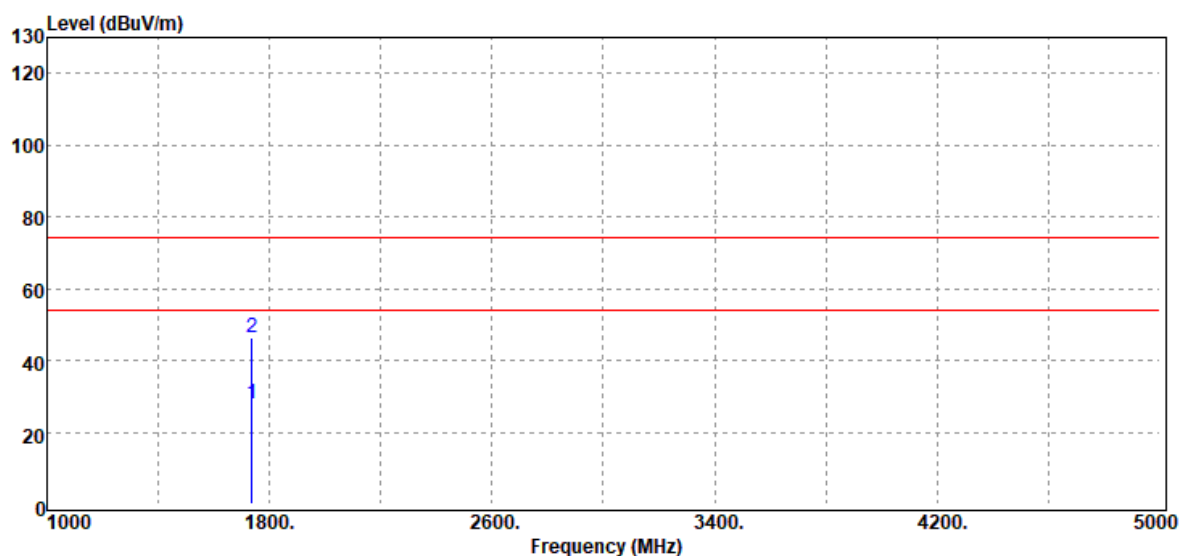
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Above 1GHz:

Report Number :T190517W04
 Operation Band :433M
 Frequency :433.92 MHz
 Operation Mode :Tx
 EUT Pol. :H Plan

Test Date :2019-06-28
 Temp./Humi. :20/53
 Antenna Pol. :VERTICAL
 Engineer :Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
1735.76	Average	-	-12.39	33.75	54.00	-20.25
1735.76	Peak	52.11	-5.97	46.14	74.00	-27.86

Note: Average Actual = Peak Actual + Average Factor (-12.39)

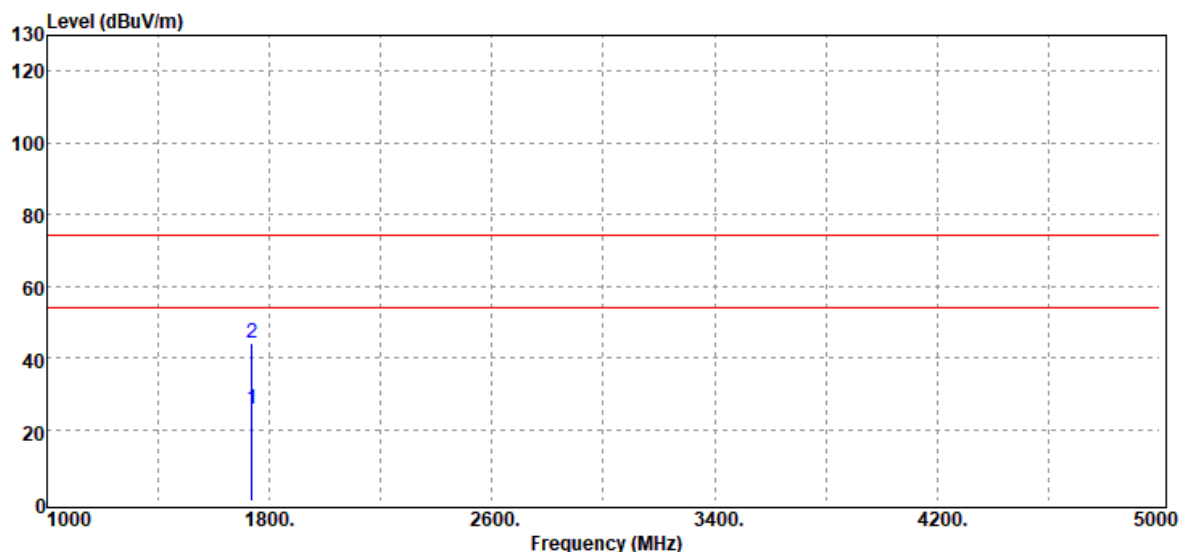
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Report Number :T190517W04
Operation Band :433M
Frequency :433.92 MHz
Operation Mode :Tx
EUT Pol. :H Plan

Test Date :2019-06-27
Temp./Humi. :20/53
Antenna Pol. :HORIZONTAL
Engineer :Jerry



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBuV	Factor dB	Actual FS dBuV/m	Limit @3m dBuV/m	Margin dB
1735.76	Average	-	-12.39	31.70	54.00	-22.30
1735.76	Peak	50.06	-5.97	44.09	74.00	-29.91

Note: Average Actual = Peak Actual + Average Factor (-12.39)

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8 20 DB OCCUPIED BANDWIDTH

8.1 Applicable Standard

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 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

8.2 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as normal operation
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 620KHz, Span =50KHz.
4. Set SPA -20dB Occupied bandwidth.

8.3 Test SET-UP (Block Diagram of Configuration)



8.4 Measurement Equipment Used:

SGS Conducted Emission Test Site No.A					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
DC Block	PASTERNAK	PE8210	RF256	02/26/2019	02/25/2020
Spectrum Analyzer	Agilent	N9010A	MY53400256	11/21/2018	11/20/2019

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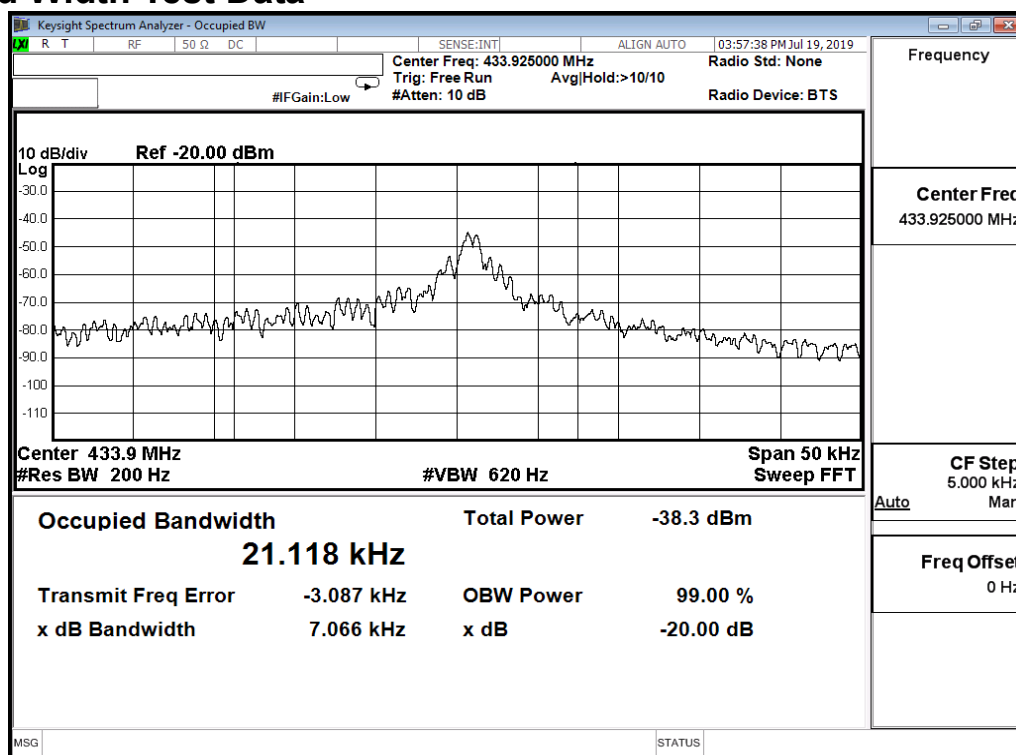
8.5 Measurement Results

The center frequency f_c is **433.923MHz**, according to the Rules, section 15.231(C), the Bandwidth of Center Frequency at -20dB should be calculated as following:

$$433.923 \times 0.0025 = 1.0848 \text{ (MHz)}$$

20dB Bandwidth (kHz)
7.066
Limit = 1084.8 kHz

20dB Band Width Test Data



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9 DUTY CYCLE MEASUREMENT

9.1 Applicable Standard

According to 15.35(c) Unless otherwise specified, e.g., §§15.255(b), and 15.256(l)(5), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to Supplier's Declaration of Conformity.

9.2 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set ETU normal operating mode.
3. Set SPA Center Frequency = fundamental frequency, RBW, VBW= 100kHz, Span =0 Hz. Adjacent sweep.
4. Set SPA View. Mark delta.

9.3 Test SET-UP (Block Diagram of Configuration)

Same as 8.3 Radiated Emission Measurement.

9.4 Measurement Equipment Used:

Same as 8.3 Radiated Emission Measurement.

9.5 Measurement Results:

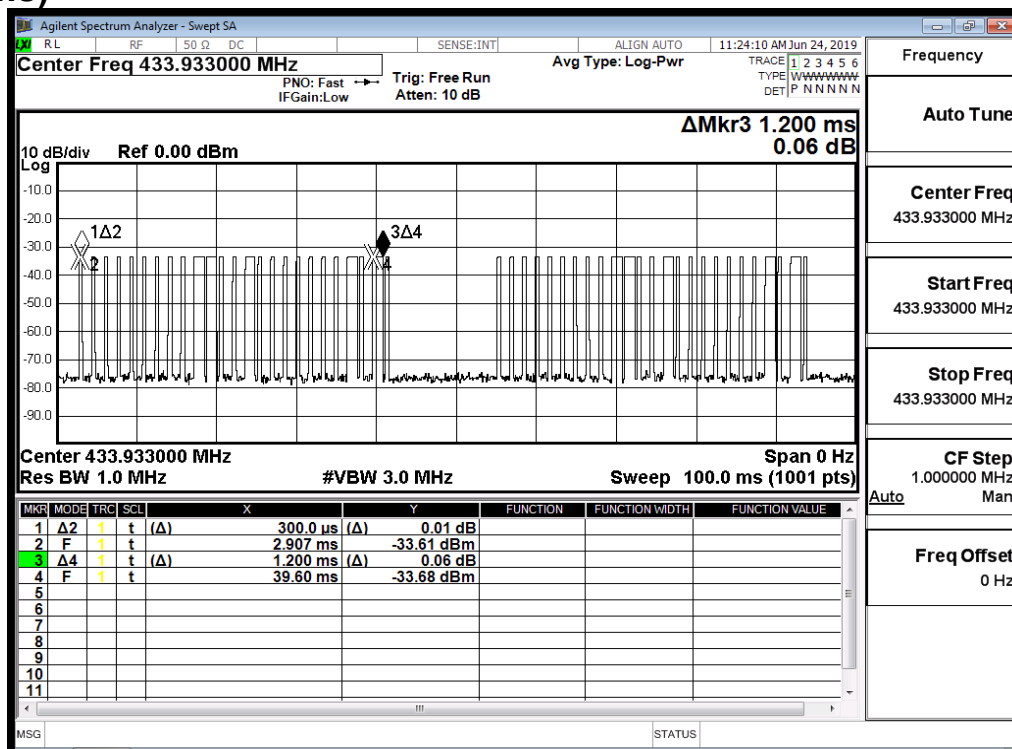
Ton (ms)	TP=Ton+Toff (ms)	Avg correction(dB) = 20log(Ton/TP)
24	100	-12.395

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Ton =24 (ms)



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10 RELEASE TIME MEASUREMENT:

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.

10.1 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set SPA Center Frequency = fundamental frequency, RBW=100KHz, VBW=100KHz, Span =0Hz. Sweep Time= 5s.
3. Set EUT as normal operation and press Transmitter bottom for 2 s approximately,
4. Set SPA Max hold. Delta Mark.

10.2 Test SET-UP (Block Diagram of Configuration)

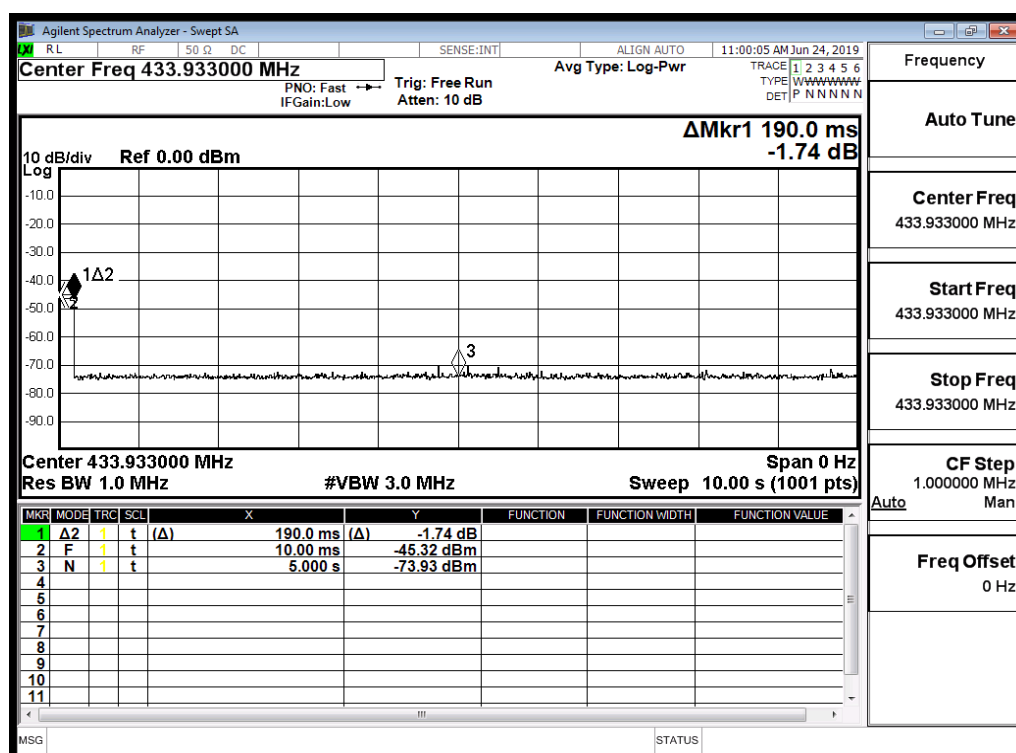
Same as 8.3 Radiated Emission Measurement.

10.3 Measurement Equipment Used:

Same as 8.3 Radiated Emission Measurement.

10.4 Measurement Results

The release time is less than 5 s.



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11 ANTENNA REQUIREMENT

11.1 Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

11.2 Antenna Connected Construction:

The antenna is designed as permanently attached and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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