

TEST REPORT

On behalf of

Bellman & Symfon AB

Product Name: Push Button Transmitter

Model No.: BE1240-433

FCC ID: 2APAKBE1240

Prepared For: Bellman & Symfon AB
Sodra Langebergsgatan 30, 43632 ASKIM, Sweden

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File No. : C1D1901066
Report No. : ACI-F18294A2
Date of Test : 2019.01.04-06
Date of Report : 2019.02.12

The statement is based on a single evaluation of one sample of the above-mentioned products. It does not imply an assessment of the whole production and does not permit the use of the test lab logo. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

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TEST REPORT

Applicant : Bellman & Symfon AB
EUT Description : Push Button Transmitter
(A) Model No. : Refer to Sec.2.1
(B) Power Supply : DC 6V
(C) Test Voltage : DC 6V

Test Procedure Used:

*FCC RULES AND REGULATIONS PART 15 SUBPART C
AND ANSI C63.10-2013*

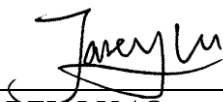
The device described above is tested by Audix Technology (Shanghai) Co., Ltd. to determine the maximum emission levels emanating from the device. The maximum emission levels are compared to the FCC Part 15 Subpart C limits.

The test results are contained in this test report and Audix Technology (Shanghai) Co., Ltd. is assumed full responsibility for the accuracy and completeness of these measurements. This report also shows that the EUT to be technically compliance with the FCC limits.

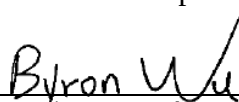
This report applies to above tested Sample only. This report shall not be reproduced in part without written approval of Audix Technology (Shanghai) Co., Ltd.

Date of Test : 2019.01.04-06 Date of Report : 2019.02.12

Producer :


JAREY LU / Supervisor

Reviewer :


BYRON WU / Deputy Assistant Manager

 For and on behalf of
Audix Technology (Shanghai) Co., Ltd.

Signatory :


Authorized Signature(s) BYRON KWO/Assistant General Manager

1 SUMMARY OF STANDARDS AND RESULTS

1.1 Description of Standards and Results

The EUT have been tested according to the applicable standards as referenced below:

Description / Test Item	Test Standard	Results	Meets Limit
EMISSION			
Conducted Emission	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	N/A	15.207
Radiated Emission and Fundamental Frequency	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	Pass	15.209(a) 15.231(b)
Emission Bandwidth	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	Pass	15.231(c)
Periodic Operated	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	Pass	15.231(a)(1)
Antenna Requirement	FCC Rules And Regulations Part 15 Subpart C And ANSI C63.10:2013	Pass	15.203
N/A is an abbreviation for Not Applicable.			

2 GENERAL INFORMATION

2.1 Description of Equipment Under Test

Description : Push Button Transmitter

Type of EUT : ☒ Production ☐ Pre-product ☐ Pro-type

Model Number : BE1240-433

Test Model : BE1240-433

Note#1 : The modified histories of report are as follows:

Report No.	Model No.	Rev. Summary	Edition No.	Data of Rev.
ACI-F18294	BE1240	Original Report.	0	2018.09.11
ACI-F18294A1	BE1240-433	1.Change Model name	Rev. A1	2018.11.09
ACI-F18294A2	BE1240-433	1.Optimize the antenna matching circuit	Rev. A2	2019.02.12

Note#2 : All test items were new test, based on the change (optimize antenna matching circuit) in this report.

Operating Freq. : 433.92MHz

Tested Freq. : 433.92MHz

Modulation : OOK

Antenna Info. : Antenna Type: Air Coil
Antenna Gain: -15.85dBi
The Antenna is unique coupling to the intentional radiator, that is comply with 15.203 requirement.

Test Mode : The EUT was a transmitter.

Applicant : Bellman & Symfon AB
Sodra Langebergsgatan 30, 43632 ASKIM, Sweden

Manufacturer : same as Applicant

Factory : TBD

2.2 Description of Test Facility

Name of Firm	: Audix Technology (Shanghai) Co., Ltd.
Site Location	: 3F and 4F, 34Bldg, 680 Guiping Rd., Caohejing Hi-Tech Park, Shanghai 200233, China.
Accredited by NVLAP, Lab Code	: 200371-0
FCC Designation Number	: CN5027
Test Firm Registration Number	: 954668

2.3 Measurement Uncertainty

Conducted Disturbance Expanded Uncertainty (0.15-30MHz):

U = 3.4dB

Radiated Emission Expanded Uncertainty (30-1000MHz):

U = 3.99dB

Radiated Emission Expanded Uncertainty (1000M-26.5GHz):

U = 4.98dB

6 dB Bandwidth Expanded Uncertainty : U = 6×10^{-8} MHz

Maximum Peak Output Power Expanded Uncertainty : U = 0.84 dB

Power Spectral Density Expanded Uncertainty : U = 0.38 dB

3 RADIATED EMISSION AND FUNDAMENTAL FREQUENCY

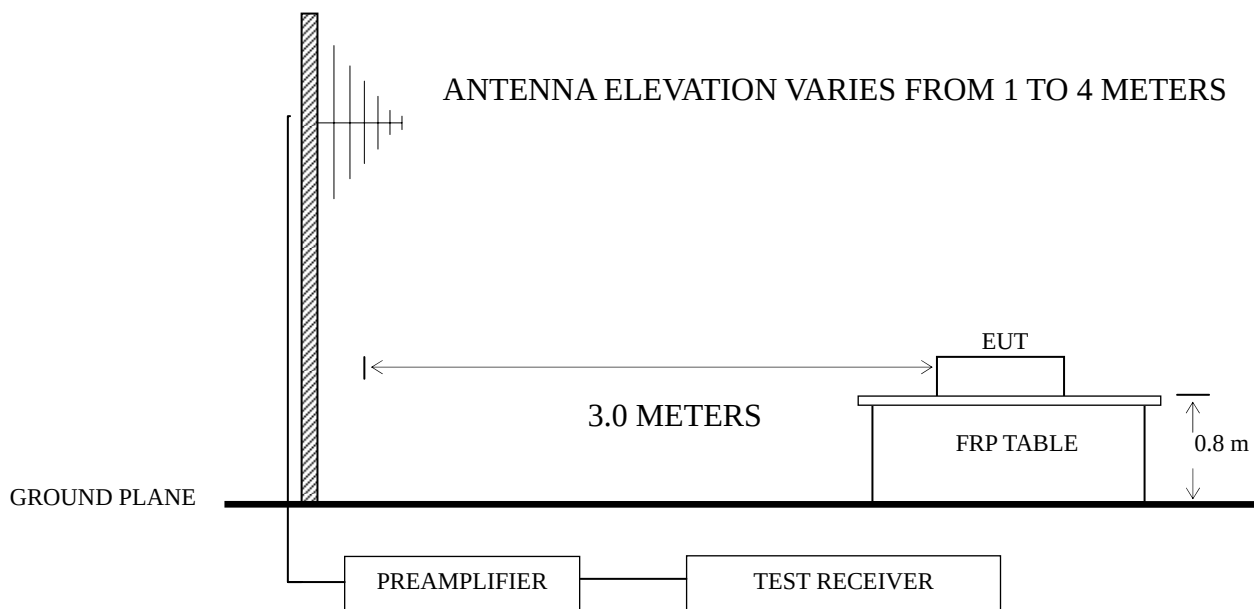
3.1 Test Equipment

The following test equipment are used during the radiated emission test in a semi-anechoic chamber:

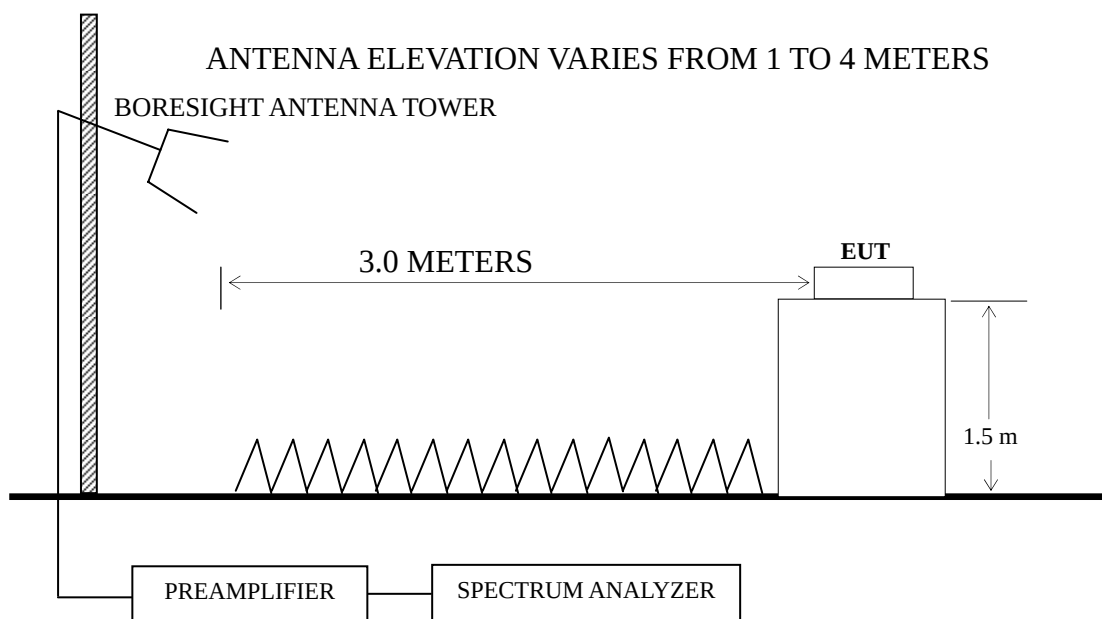
Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Preamplifier	Agilent	8447D	2944A10548	Apr 26, 2018	Apr 25, 2019
2.	Preamplifier	HP	8449B	3008A00864	Mar 8, 2018	Mar 7, 2019
3.	Spectrum Analyzer	Agilent	N9010A	MY52221182	Jan 3, 2019	Jan 2, 2020
4.	Test Receiver	R&S	ESCI	101303	Apr 26, 2018	Apr 25, 2019
5.	Bi-log Antenna	Schwarz beck	VULB 9168	708	Jul 20, 2018	Jul 19, 2019
6.	Horn Antenna	EMCO	3115	9607-4878	Jun 02, 2018	Jun 01, 2019
7.	Horn Antenna	EMCO	3116	00062643	Sep 08, 2017	Sep 08, 2019
8.	Software	Audix	E3	SET00200 9912M295-2	--	--

3.2 Block Diagram of Test Setup

3.2.1 Below 1GHz



3.2.2 Above 1GHz



3.3 Radiated Emission Limit (§15.209)

In any 100kHz bandwidth outside the frequency band, the radio frequency power produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205 must also comply with the radiated emission limits specified as below.

Frequency (MHz)	Distance (m)	Field strength limits ($\mu\text{V/m}$)	
		($\mu\text{V/m}$)	dB($\mu\text{V/m}$)
0.009 ~ 0.490	300	$67.6 - 20 \log f(\text{kHz})$	$2400/f \text{ kHz}$
0.490 ~ 1.705	30	$87.6 - 20 \log f(\text{kHz})$	$24000/f \text{ kHz}$
1.705 ~ 30	30	29.5	30
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
Above 960	3	500	54.0

- NOTE 1 - Emission Level dB ($\mu\text{V/m}$) = $20 \log$ Emission Level ($\mu\text{V/m}$)
- NOTE 2 - The tighter limit applies at the band edges.
- NOTE 3 - Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
- NOTE 4 - The limits shown are based on Quasi-peak value detector below or equal to 1GHz and Average value detector above 1GHz.
- NOTE 5 - Above 1 GHz, the limit on peak emission is 20 dB above the maximum permitted average emission limit applicable to the EUT

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

¹:Linear Interpolations

- NOTE 1 - Emission Level dB ($\mu\text{V/m}$) = $20 \log$ Emission Level ($\mu\text{V/m}$)
- NOTE 2 - The tighter limit applies at the band edges.
- NOTE 3 - Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
- NOTE 4 - Where limit of Fundamental Freq. is calculated by:
 $41.6667 \times 433.92 - 7083.3333 = 10996.681164 \mu\text{V/m} = 80.83 \text{dB}\mu\text{V/m}$
- NOTE 5 - The limits in this table are based on CFR 47 Part 15.231(b).

3.4 Test Configuration

The EUT (listed in Sec.2.1) and the simulators (listed in Sec.2.2) were installed as shown on Sec.3.2 to meet FCC requirements and operating in a manner that tends to maximize its emission level in a normal application.

3.5 Operating Condition of EUT

3.5.1 Setup the EUT as shown in Sec. 3.2.

3.5.2 Turn on the power of all equipment.

3.5.3 Turn the EUT on the test mode, and then test.

3.6 Test Procedures

Radiated emission test applies to harmonics/spurs that fall in the restricted bands listed in Section 15.205. The maximum permitted average field strength is listed in Section 15.209. A pre-amp is necessary for this measurement. For measurement above 1 GHz, set RBW = 1MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak-average

correction factor, derived from the appropriate duty cycle calculation.

The EUT was placed on a turntable. Below 1 GHz, the table height is 80 cm above the reference ground plane. Above 1 GHz, the table height is 1.5 m. The turntable rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna, which was mounted on an antenna tower. The antenna moved up and down between 1 meter and 4 meters to find out the maximum emission level. Broadband antenna (Calibrated Bilog Antenna) or Horn antenna was used as receiving antenna. Both horizontal and vertical polarizations of the antenna were set on measurement. In order to find the maximum emission, all of the interference cables were manipulated according to ANSI C63.10: 2013 requirements during radiated emission test.

The bandwidth of Test Receiver R&S ESCI was set at 9 kHz from 9kHz to 30MHz.

The bandwidth of Test Receiver R&S ESCI was set at 120 kHz from 30MHz to 1000MHz.

The bandwidth of the VBW was set at 1MHz and RBW was set at 1MHz for peak emission measurement above 1GHz and 1MHz RBW, 10Hz VBW for average emission above 1GHz for Spectrum Agilent N9010A.

The frequency range from 30 MHz to 25 GHz (Up to 10th harmonics from fundamental frequency) was checked.

For Emission above 1GHz, Average Emission Level = Peak Emission Level + DCCF, as DCCF(Duty Cycle Correction Factor) = $20\log(TX_{on} / TX_{on+off})$.

3.7 Test Results

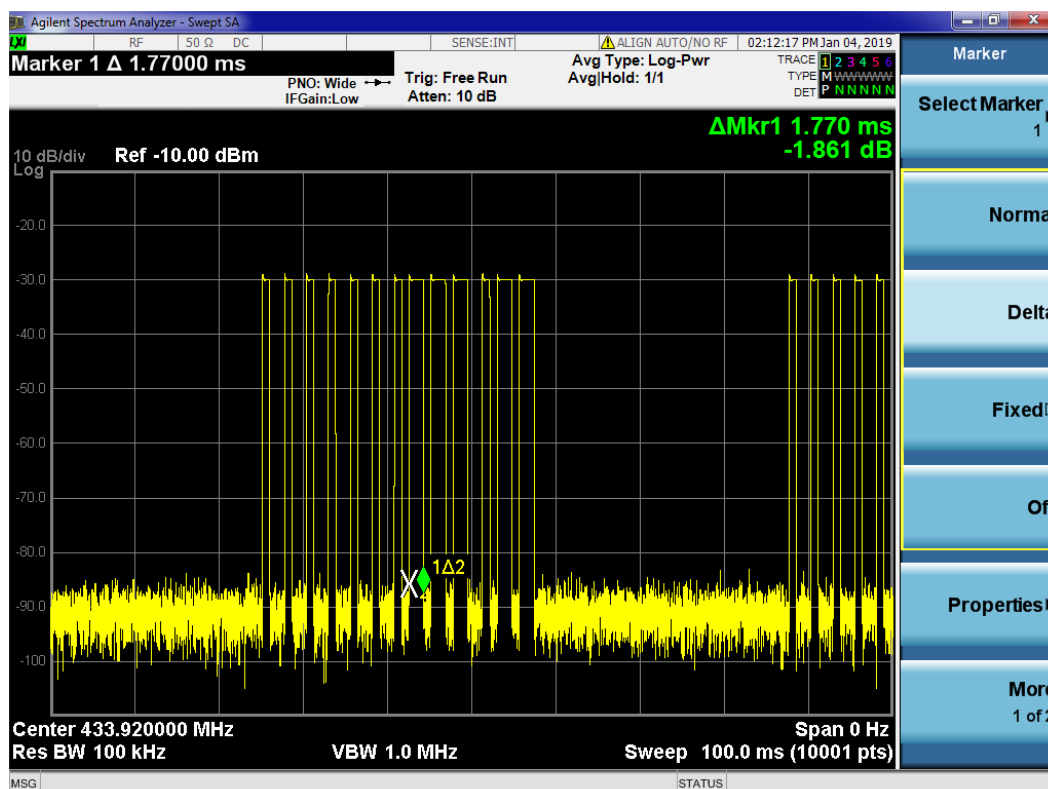
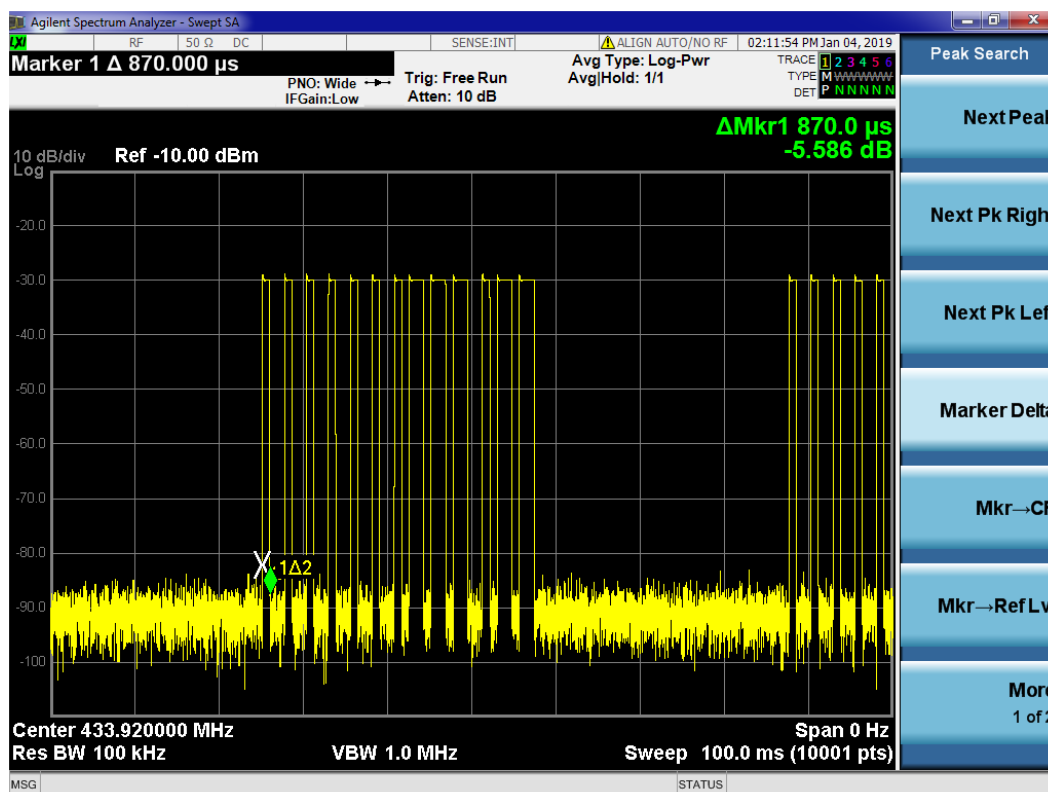
<PASS>

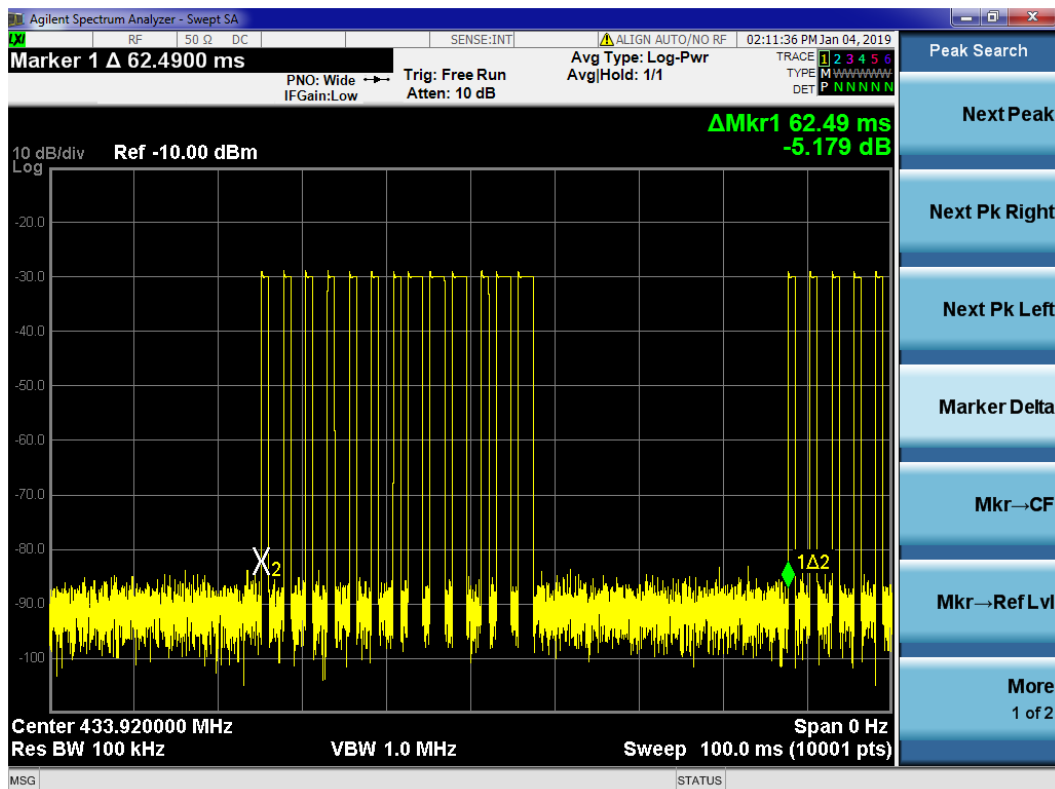
The frequency and amplitude of the highest radiated emission relative the limit is reported. All the emissions not reported below are too low against the FCC limit.

The emission levels recorded below is data of EUT configured in Lying direction, for Lying direction was the maximum emission direction during the test. The data of Side & Standing direction are too low against the official limit to be reported.

DCCF:

TX _{on} (ms)	TX _{on+off} (ms)	DCCF
0.87*8+1.77*5=15.81	62.49	-11.94
DCCF(Duty Cycle Correction Factor) = 20log (TX _{on} / TX _{on+off})		





Worst case emission < 1GHz

EUT : Push Button Transmitter Temperature : 22°C

Model No. : BE1240-433 Humidity : 51%RH

Test Mode : Transmitting Date of Test : 2019.01.06

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	45.058	27.05	18.77	0.73	28.15	18.4	40	21.6	QP
	53.318	26.45	19.61	0.79	28.13	18.72	40	21.28	QP
	150.538	26.46	20.18	1.36	27.6	20.4	43.5	23.1	QP
	282.985	26.21	19.72	1.83	27.08	20.68	46	25.32	QP
	744.866	26.35	27.33	2.94	27.45	29.17	46	16.83	QP
	942.131	26.38	28.88	3.35	26.85	31.76	46	14.24	QP
Vertical	49.881	26.88	19.07	0.76	28.14	18.57	40	21.43	QP
	62.871	26.56	18.7	0.85	28.1	18.01	40	21.99	QP
	160.909	26.07	20.1	1.41	27.55	20.03	43.5	23.47	QP
	312.179	25.49	20.08	1.92	27.1	20.39	46	25.61	QP
	682.348	27.03	26.61	2.83	27.57	28.9	46	17.1	QP
	938.833	25.01	28.8	3.33	26.85	30.29	46	15.71	QP

Radiated Emission > 1GHz

EUT : Push Button Transmitter Temperature : 22°C

Model No. : BE1240-433 Humidity : 51%RH

Test Mode : Transmitting Date of Test : 2019.01.04

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	1334.389	50.34	25.46	3.98	37.97	41.81	74	32.19	Peak
	1745.842	49.65	27.35	4.45	37.31	44.14	74	29.86	Peak
	2914.448	50.09	30.35	5.77	36.77	49.44	74	24.56	Peak
	3752.111	50.37	32.01	6.63	36.01	53	74	21	Peak
	4456.338	48.36	33.03	7.27	36.06	52.6	74	21.4	Peak
	5505.541	46.81	34.7	8.23	36.74	53	74	21	Peak
Vertical	1504.591	49.17	26.37	4.19	37.68	42.05	74	31.95	Peak
	1965.002	49.16	28.26	4.66	36.94	45.14	74	28.86	Peak
	2924.911	49.66	30.35	5.77	36.77	49.01	74	24.99	Peak
	3731.996	50.31	31.99	6.63	36.03	52.9	74	21.1	Peak
	4778.879	47.51	33.76	7.53	36.27	52.53	74	21.47	Peak
	5605.076	46.62	34.8	8.41	36.81	53.02	74	20.98	Peak

Polarization	Frequency (MHz)	Peak Emission Level dB (μV/m)	Duty Cycle Correction Factor (dB)	Average Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	1334.389	41.81	-11.94	29.87	54	24.13	Average
	1745.842	44.14	-11.94	32.2	54	21.8	Average
	2914.448	49.44	-11.94	37.5	54	16.5	Average
	3752.111	53	-11.94	41.06	54	12.94	Average
	4456.338	52.6	-11.94	40.66	54	13.34	Average
	5505.541	53	-11.94	41.06	54	12.94	Average
Vertical	1504.591	42.05	-11.94	30.11	54	23.89	Average
	1965.002	45.14	-11.94	33.2	54	20.8	Average
	2924.911	49.01	-11.94	37.07	54	16.93	Average
	3731.996	52.9	-11.94	40.96	54	13.04	Average
	4778.879	52.53	-11.94	40.59	54	13.41	Average
	5605.076	53.02	-11.94	41.08	54	12.92	Average

Fundamental frequency:

EUT : Push Button Transmitter Temperature : 22°C

Model No. : BE1240-433 Humidity : 51%RH

Test Mode : Transmitting Date of Test : 2019.01.04

Polarization	Frequency (MHz)	Meter Reading dB (μV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	433.92	83.77	22.4	2.26	27.74	80.69	100.83	20.14	Peak
Vertical	433.94	84.11	22.4	2.26	27.74	81.03	100.83	19.8	Peak

Polarization	Frequency (MHz)	Peak Emission Level dB (μV/m)	Duty Cycle Correction Factor (dB)	Average Emission Level dB (μV/m)	Limits dB (μV/m)	Margin (dB)	Remark
Horizontal	433.92	80.69	-11.94	68.75	80.83	12.08	Average
Vertical	433.94	81.03	-11.94	69.09	80.83	11.74	Average

TEST ENGINEER: Jarey

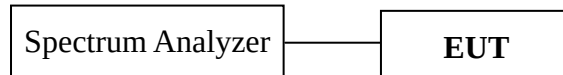
4 EMISSION BANDWIDTH

4.1 Test Equipment

The following test equipment was used during the Emission Bandwidth measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	Jan 3, 2019	Jan 2, 2020

4.2 Block Diagram of Test Setup



4.3 Specification Limits (§15.231(c))

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

4.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

4.5 Test Procedure

The transmitter output was connected to the spectrum analyzer. The bandwidth of 99% power bandwidth was measure by spectrum analyzer with settings: Span = between 1.5 times and 5.0 times of the OBW, RBW = 1% to 5% of the OBW, VBW $\geq 3 \times$ RBW, Detector = Peak, Trace = Max Hold.

Use the -20dB power bandwidth function of the instrument and report the measured bandwidth.

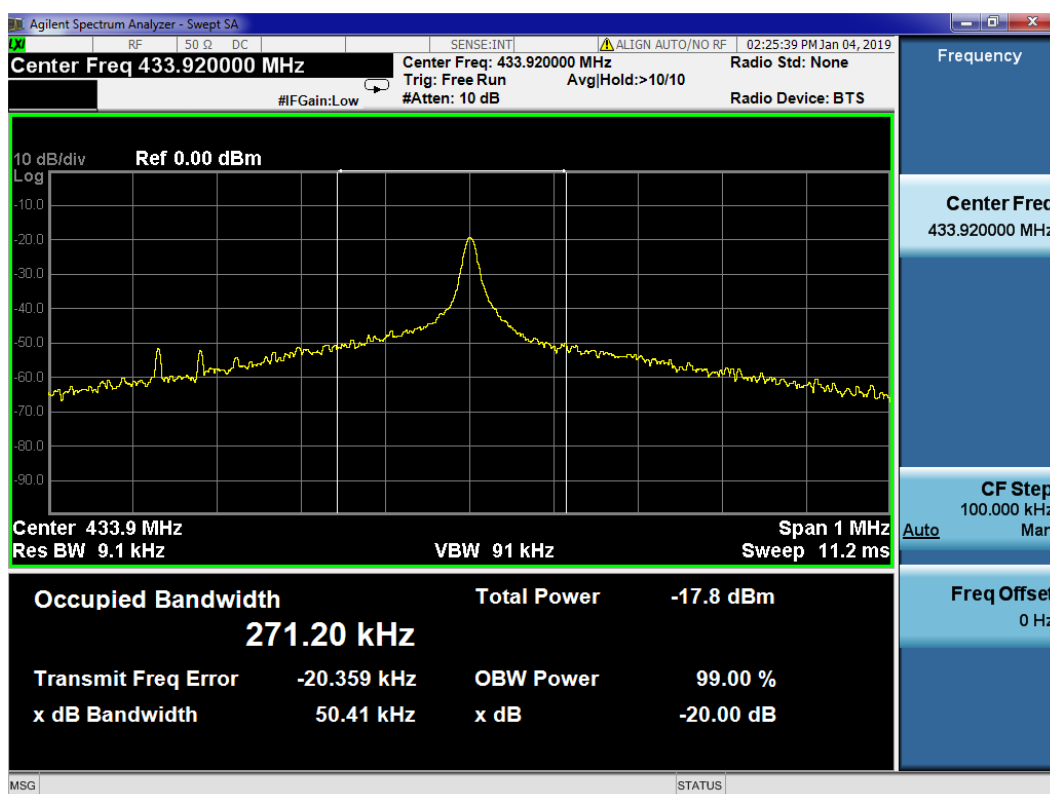
4.6 Test Results

PASSED.

All the test results are attached in next pages.

(Test Date: 2019.01.04 Temperature: 23°C Humidity: 51 %)

Modulation	Frequency (MHz)	20dB Bandwidth (kHz)	Tolerance (%)	Limit (%)
OOK	433.92	50.41	0.012	0.25



5 PERIODIC OPERATED

5.1 Test Equipment

The following test equipment was used during the maximum peak output power measurement:

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Spectrum Analyzer	Agilent	N9010A	MY52221182	Oct 17, 2017	Oct 16, 2018

5.2 Block Diagram of Test Setup

The Same as Section. 4.2.

5.3 Specification Limits ((§15.231(a)(1))

The operation of this device is manually operated transmitter that is automatically deactivated the transmitter within not more than 5 seconds of being released.

5.4 Operating Condition of EUT

The switch ON/OFF was used to enable the EUT to change the channel one by one.

5.5 Test Procedure

The transmitter output was connected to the spectrum analyzer.

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

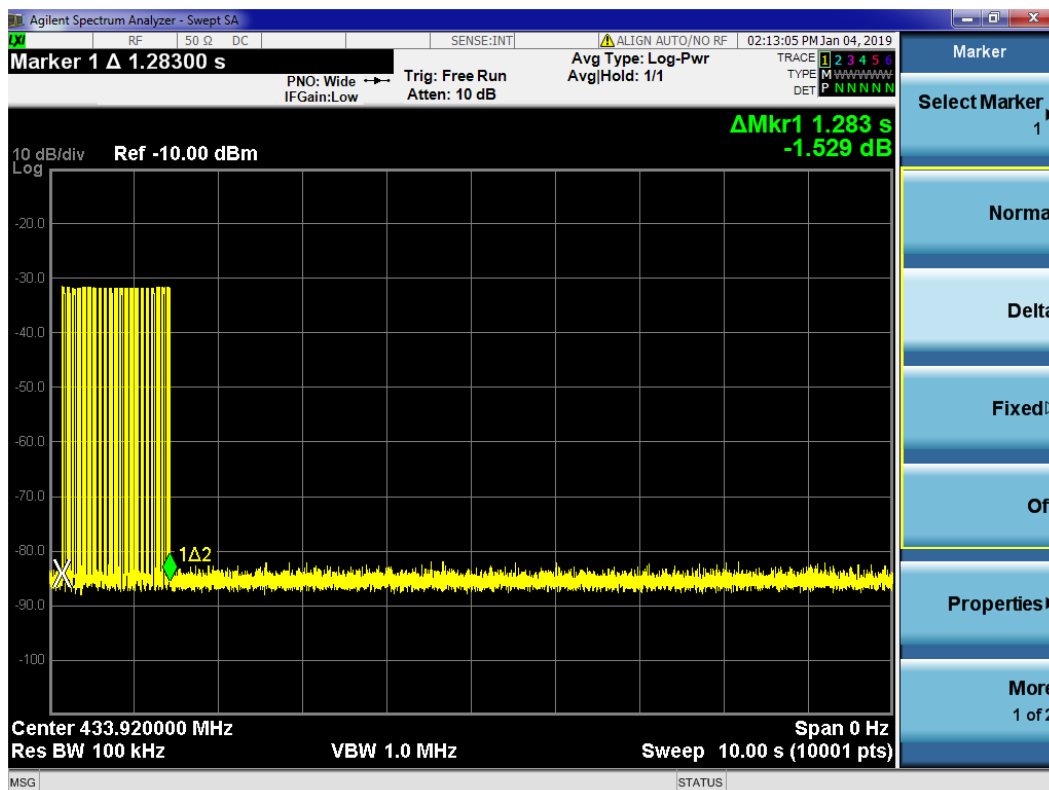
- Set the RBW $\geq 100\text{kHz}$.
- Set VBW $\geq [3 \times \text{RBW}]$.
- Set span = 0.
- Sweep time $\geq 5\text{s}$.
- Detector = peak.
- Trace mode = clear/write.
- Sweep = Single sweep.
- Use delta marker function to determine the peak amplitude level.

5.6 Test Results

PASSED. All the test results are listed below.

(Test Date: 2019.01.04 Temperature: 23°C Humidity: 51 %)

Modulation	Frequency (MHz)	Periodic Operated (s)	Limit (s)
OOK	433.92	1.283	5



6 DEVIATION TO TEST SPECIFICATIONS

None.