ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant:	ADVANCED RADIOTECH CORPORATION No. 3, South 1st Road, Chien Chen District, Kaohsiung, Taiwan.
Manufacturer:	ADVANCED RADIOTECH CORPORATION No. 3, South 1st Road, Chien Chen District, Kaohsiung, Taiwan.
Product Name:	Industrial radio remote control system
Brand Name:	ARC
Model No.:	FLEX 2JB
Model Difference:	N/A
Report Number:	TERF2206000819ER
FCC ID	R4UARCFLEX2JB
Date of EUT Received:	June 7, 2022
Date of Test:	August 30, 2022~October 12, 2022
Issue Date:	October 20, 2022

Approved By CHUN-CHIEH, CHEN

Chun Chieh Chen

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT comply with FCC rule part §15.231.

The results of this report relate only to the sample identified in this report.

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Revision History

Report Number	Revision	Description	Issue Date	Revised By	Remark
TERF2206000819ER	00	Original.	September 28, 2022	Susan Lin	
TERF2206000819ER	01	Update data on page 4, 18, 19, 22, 23	October 14, 2022	Susan Lin	*
TERF2206000819ER	02	Update section 7.2	October 20, 2022	Susan Lin	*

Note:

1、 The remark "*" indicates modification of the report upon requests from certification body.

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1 GENERAL INFORMATION

1.1 Product Description

Product Name:	Industrial radio remote control system
Brand Name:	ARC
Model No.:	FLEX 2JB
Model Difference:	N/A
Hardware Version:	1.0
Firmware Version:	N/A
EUT Series No.:	TSSM2206000193L0
Power Supply:	Transmitter Operating Voltage: 1.5Vdc AA Battery*4 Charging Voltage:12Vdc from adapter
Test Software (Name/Version):	DIP2 selects test mode, then presses the button to switch the frequency.

1.2 RF specification

Radio Technology:	Short Range Radio
Operating Frequency:	433MHz~440MHz
Transmit Power:	≤ 86.12 dBuV/m Max.
Modulation Technique:	FSK
Number of Channels:	141 Channels
Channel Spacing:	50 kHz
Antenna Type:	PCB Antenna

Note: Antenna information is provided by the applicant.

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1.3 Test Methodology

FCC Part 15, Subpart C §15.231
ANSI C63.10:2013

1.4 Test Facility

Laboratory	Test Site Address	Test Site Name	FCC Designation number	IC CAB identifier
SGS Taiwan Ltd. Central RF Lab. (TAF code 3702)	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan.	SAC 1	TW0027	TW3702
		SAC 3		
		Conduction 1		
		Conducted 1		
		Conducted 2		
		Conducted 3		
		Conducted 4		
		Conducted 5		
		Conducted 6		
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C	TW0028	
		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
		Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		

Note: Test site name is remarked on the equipment list in each section of this report as an indication where measurements occurred in specific test site and address.

1.5 Special Accessories

There are no special accessories used while test was conducted.

1.6 Equipment Modifications

There was no modification incorporated into the EUT.

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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 a 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. 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 a 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.

2.4 Measurement Results Explanation Example

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

Radiated emission below 30MHz is measured in a 9m*6m*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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2.4.2 For all conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuation factor between EUT conducted port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly EUT RF output level.

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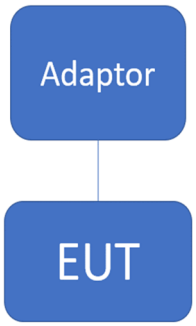
2.5 Test Configuration

Conducted Setup

Conduction Setup



Radiated Setup

2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Software	audix	e3	Ver. 9 210322	N.C.R	N.C.R
Adaptor	MEAN WELL	GE24I12	N/A	N/A	N/A

Radiated Emission Test Site: SAC 3					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Test Software	audix	e3	Ver. 9 210322	N.C.R	N.C.R

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3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207	AC Power Line Conducted Emission	Compliant
§15.231(e)	Radiated Emission	Compliant
§15.231(c)	Emission Bandwidth	Compliant
§15.35 (c)	Duty Cycle Test (Determining average factor from a complete pulse train)	Compliant
§15.231(a)(1)	Transmission Ceased Time	Compliant
§15.203	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operating Frequencies

CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)	CH	Frequency (MHz)
01	433.000	30	434.450	59	435.900	88	437.350	117	438.800
02	433.050	31	434.500	60	435.950	89	437.400	118	438.850
03	433.100	32	434.550	61	436.000	90	437.450	119	438.900
04	433.150	33	434.600	62	436.050	91	437.500	120	438.950
05	433.200	34	434.650	63	436.100	92	437.550	121	439.000
06	433.250	35	434.700	64	436.150	93	437.600	122	439.050
07	433.300	36	434.750	65	436.200	94	437.650	123	439.100
08	433.350	37	434.800	66	436.250	95	437.700	124	439.150
09	433.400	38	434.850	67	436.300	96	437.750	125	439.200
10	433.450	39	434.900	68	436.350	97	437.800	126	439.250
11	433.500	40	434.950	69	436.400	98	437.850	127	439.300
12	433.550	41	435.000	70	436.450	99	437.900	128	439.350
13	433.600	42	435.050	71	436.500	100	437.950	129	439.400
14	433.650	43	435.100	72	436.550	101	438.000	130	439.450
15	433.700	44	435.150	73	436.600	102	438.050	131	439.500
16	433.750	45	435.200	74	436.650	103	438.100	132	439.550
17	433.800	46	435.250	75	436.700	104	438.150	133	439.600
18	433.850	47	435.300	76	436.750	105	438.200	134	439.650
19	433.900	48	435.350	77	436.800	106	438.250	135	439.700
20	433.950	49	435.400	78	436.850	107	438.300	136	439.750
21	434.000	50	435.450	79	436.900	108	438.350	137	439.800
22	434.050	51	435.500	80	436.950	109	438.400	138	439.850
23	434.100	52	435.550	81	437.000	110	438.450	139	439.900
24	434.150	53	435.600	82	437.050	111	438.500	140	439.950
25	434.200	54	435.650	83	437.100	112	438.550	141	440.000
26	434.250	55	435.700	84	437.150	113	438.600		
27	434.300	56	435.750	85	437.200	114	438.650		
28	434.350	57	435.800	86	437.250	115	438.700		
29	434.400	58	435.850	87	437.300	116	438.750		

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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
433 MHz	1 to 141	1,141	FSK
RADIATED EMISSION TEST (ABOVE 1 GHz)			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
433 MHz	1 to 141	1,141	FSK

Note:

The field strength of radiated emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.

ANTENNA PORT CONDUCTED TEST			
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION
433 MHz	1 to 141	1,141	FSK

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty		
AC Power Line Conducted Emission	+/-	2.34	dB
Frequency Stability	+/-	1.53	Hz
Emission Bandwidth	+/-	1.53	Hz
Temperature	+/-	0.4	°C
Humidity	+/-	3.5	%
DC / AC Power Source	+/-	1	%

Radiated Spurious Emission Measurement Uncertainty				
Polarization: Vertical	**+/-**	**2.57**	**dB**	9kHz~30MHz
	+/-	**4.85**	**dB**	30MHz - 1000MHz
	+/-	**4.45**	**dB**	1GHz - 18GHz
	+/-	**4.24**	**dB**	18GHz - 40GHz
Polarization: Horizontal	**+/-**	**2.57**	**dB**	9kHz~30MHz
	+/-	**4.37**	**dB**	30MHz - 1000MHz
	+/-	**4.45**	**dB**	1GHz - 18GHz
	+/-	**4.24**	**dB**	18GHz - 40GHz

Note:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.
2. The conformity assessment statement in this report is based solely on the test results, measurement uncertainty is excluded.

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6 MEASUREMENT EQUIPMENT USED

6.1 Emission from AC power line

AC Power-Line Conducted Emission Test Site: Conduction 1					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESR 7	102525	02/17/2022	02/16/2023
Pulse Limiter	SCHWARZBECK	VTSD 9561F-N	793	06/22/2022	06/21/2023
LISN	SCHWARZBECK	NSLK 8127	01041	10/25/2021	10/24/2022
Coaxial Cables	N/A	Coaxial Cable	161207	12/07/2021	12/06/2022

6.2 Radio Emissions Measurement

Conducted Emission Test Site: Conducted 2					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
PXA Spectrum Analyzer	Keysight	N9030B	MY61330494	03/20/2022	03/19/2023
DC Block	Mini-Circuits	BLK-18-S+	1	12/14/2021	12/13/2022

6.3 Radiated Measurement

Radiated Emission Test Site: SAC 3					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Horn Antenna	SCHWARZBECK	BBHA9120D	1441	09/27/2021	09/26/2022
Bi-log Antenna	SCHWARZBECK	VULB9168	378	08/15/2022	08/14/2023
Loop Antenna	ETS.LINDGREN	6502	148045	09/29/2021	09/28/2022
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/27/2022	04/26/2023
EMI Test Receiver	R&S	ESCI 7	100759	08/22/2022	08/21/2023
Pre-Amplifier	HP	8449B	3008A00578	12/16/2021	12/15/2022
Pre-Amplifier	HP	8447D	2944A07676	12/16/2021	12/15/2022
Attenuator	Mini-Circuit	BW-S10W2+	4	12/14/2021	12/13/2022
Bandreject Filter 430-436	Titan	T04H86002600060S01	210619-2-6	12/14/2021	12/13/2022
1GHz High Pass Filter	Micro-Tronics	HPM50108	32	12/14/2021	12/13/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2636/2	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 104	340057/4	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 104PEA	800052/2	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2621/2	12/16/2021	12/15/2022
Coaxial Cable	Huber Suhner	SUCOFLEX 102	MY2617/2	12/16/2021	12/15/2022
Site Cal	SGS	SAC 3	N/A	01/01/2022	12/31/2022

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7 CONDUCTED EMISSIONS TEST

7.1 Standard Applicable

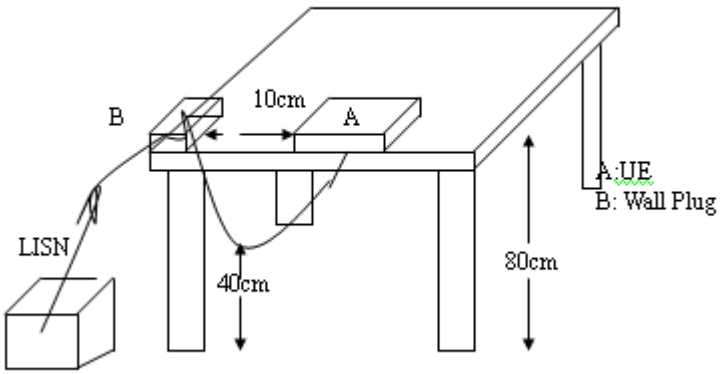
According to §15.207, frequency within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range MHz	Limits (dBuV)	
	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.		

7.2 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 to the power source and switched to 120Vac/60Hz and 240Vac/60Hz.

7.3 Test Set-up:



7.4 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.

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3. Repeat above procedures until all frequency measured were complete.

7.5 Measurement Result

Note: Refer to next page for measurement data and plots.
Note2: The * reveals the worst-case results that closest to the limit.

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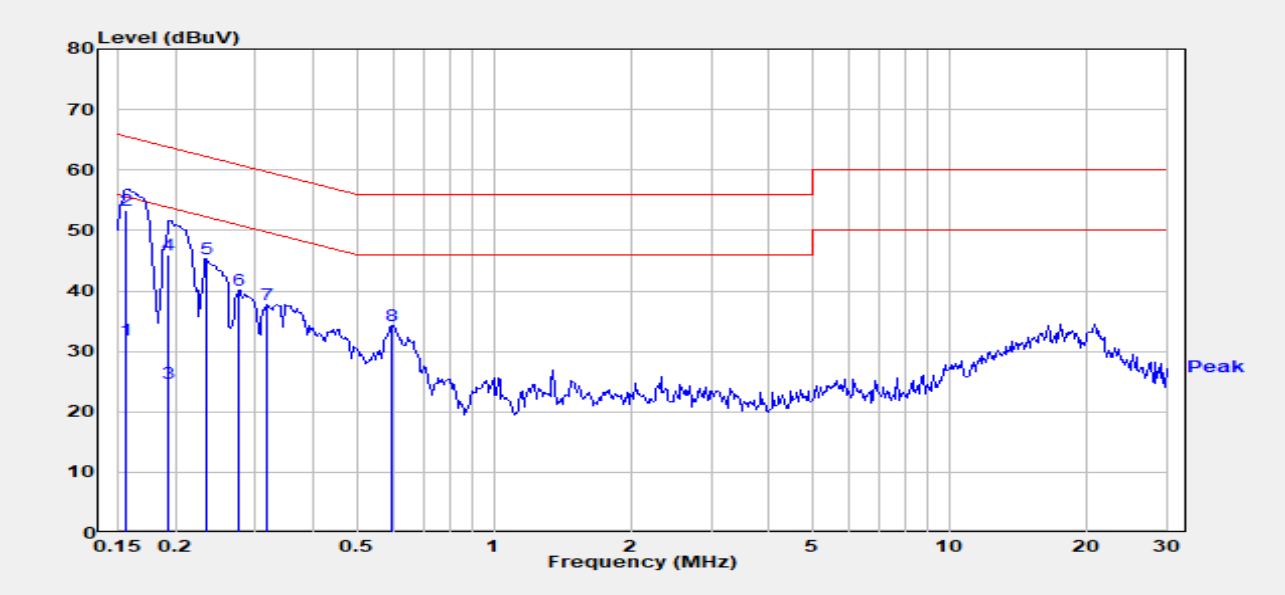
AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number	:TERF2206000819ER	Test Site	:Conduction 1
Test Mode	:Operation	Test Date	:2022-08-31
Power	:120V/60Hz	Temp./Humi.	:24.1/66
Probe	:L	Engineer	:Nick Lin
Note:	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.156	Average	21.72	10.22	31.94	55.68	-23.74
0.156	QP	43.16	10.22	53.38	65.68	-12.30
0.193	Average	14.46	10.22	24.68	53.90	-29.22
0.193	QP	35.75	10.22	45.97	63.90	-17.93
0.234	Peak	35.06	10.22	45.28	62.30	-17.02
0.275	Peak	29.89	10.22	40.11	60.96	-20.85
0.318	Peak	27.51	10.22	37.73	59.75	-22.02
0.598	Peak	24.11	10.25	34.36	56.00	-21.64

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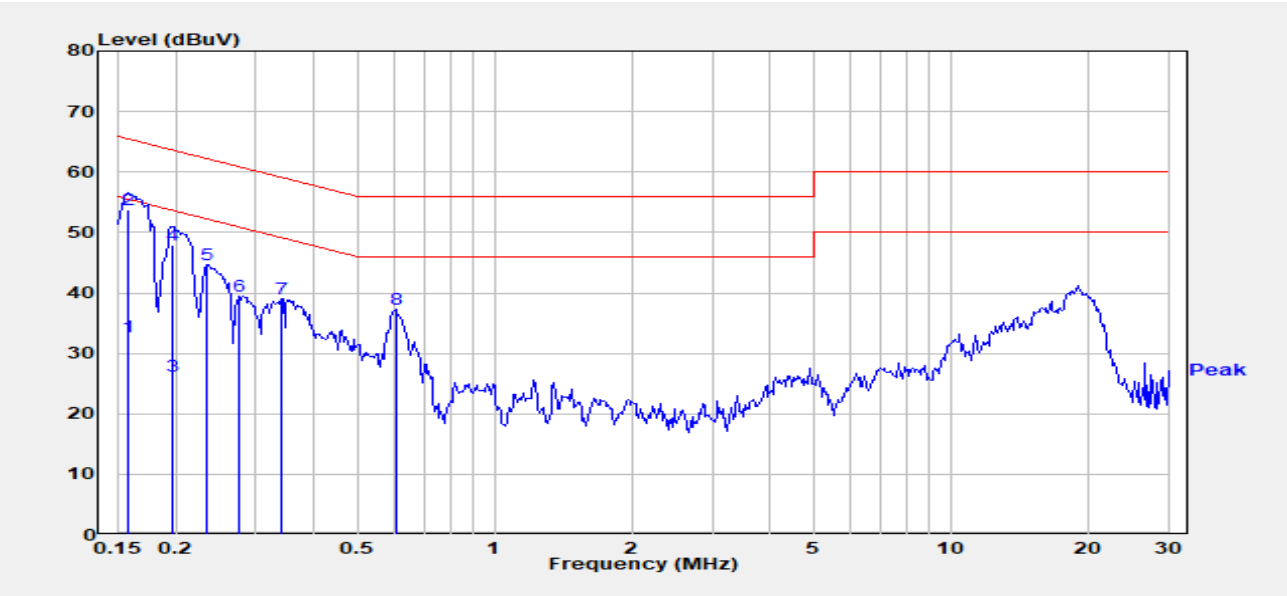
Report Number	:TERF2206000819ER	Test Site	:Conduction 1
Test Mode	:Operation	Test Date	:2022-08-31
Power	:120V/60Hz	Temp./Humi.	:24.1/66
Probe	:N	Engineer	:Nick Lin
Note:	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV	Limit dBµV	Margin dB
0.157	Average	22.41	10.25	32.66	55.62	-22.96
0.157	QP	43.54	10.25	53.79	65.62	-11.83
0.196	Average	15.76	10.39	26.15	53.77	-27.62
0.196	QP	37.42	10.39	47.81	63.77	-15.96
0.234	Peak	34.36	10.36	44.72	62.30	-17.58
0.275	Peak	29.16	10.32	39.48	60.96	-21.48
0.341	Peak	28.84	10.26	39.10	59.18	-20.07
0.607	Peak	26.97	10.25	37.22	56.00	-18.78

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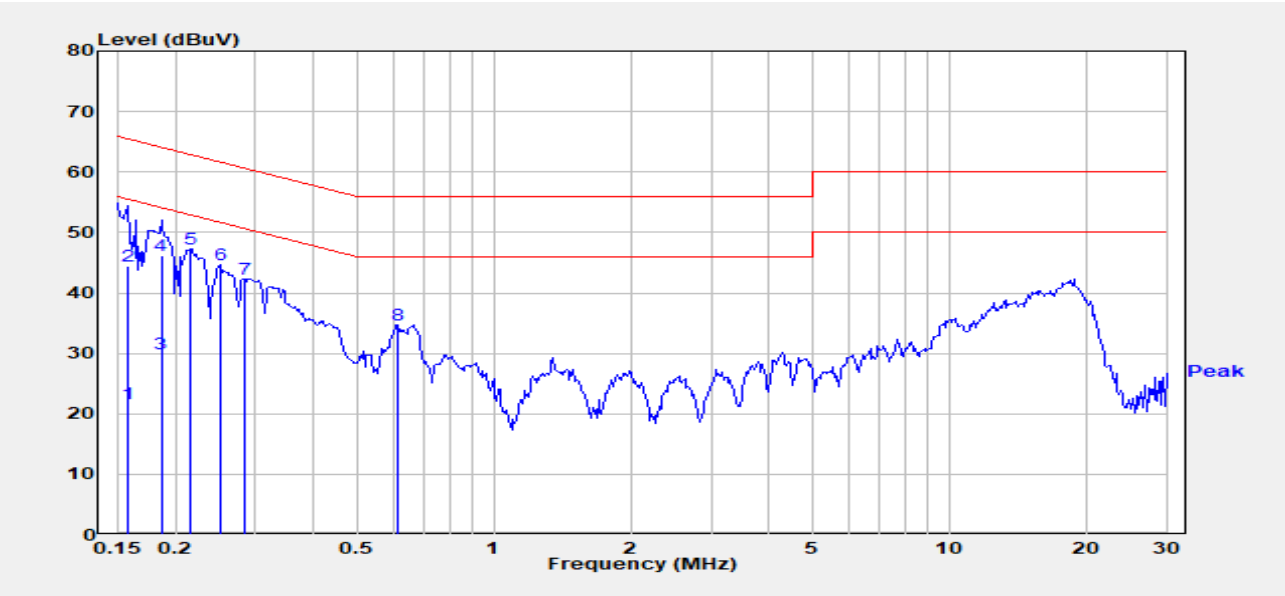
Report Number	:TERF2206000819ER	Test Site	:Conduction 1
Test Mode	:Operation	Test Date	:2022-10-12
Power	:240V/60Hz	Temp./Humi.	:23.4/67
Probe	:L	Engineer	:Nick Lin
Note:	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV	Limit dBµV	Margin dB
0.157	Average	11.37	10.25	21.62	55.62	-34.00
0.157	QP	34.23	10.25	44.48	65.62	-21.14
0.186	Average	19.76	10.25	30.01	54.21	-24.20
0.186	QP	35.83	10.25	46.08	64.21	-18.13
0.215	Peak	37.03	10.25	47.28	63.00	-15.72
0.251	Peak	34.31	10.25	44.56	61.73	-17.17
0.284	Peak	32.11	10.25	42.36	60.71	-18.35
0.616	Peak	24.50	10.28	34.79	56.00	-21.21

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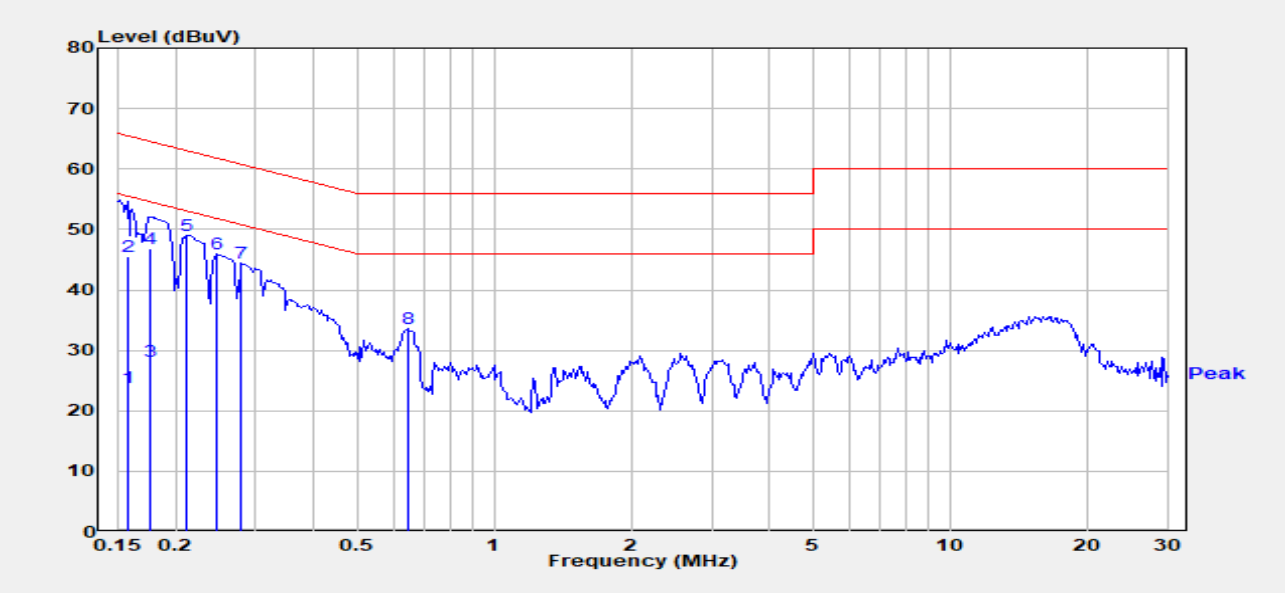
Report Number	:TERF2206000819ER	Test Site	:Conduction 1
Test Mode	:Operation	Test Date	:2022-10-12
Power	:240V/60Hz	Temp./Humi.	:23.4/67
Probe	:N	Engineer	:Nick Lin
Note:	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV	Limit dBµV	Margin dB
0.157	Average	13.57	10.25	23.82	55.62	-31.80
0.157	QP	35.23	10.25	45.48	65.62	-20.14
0.176	Average	17.83	10.25	28.08	54.66	-26.58
0.176	QP	36.59	10.25	46.84	64.66	-17.82
0.212	Peak	38.84	10.25	49.09	63.13	-14.04
0.247	Peak	35.66	10.25	45.91	61.85	-15.95
0.279	Peak	34.09	10.25	44.34	60.83	-16.49
0.645	Peak	23.26	10.29	33.55	56.00	-22.45

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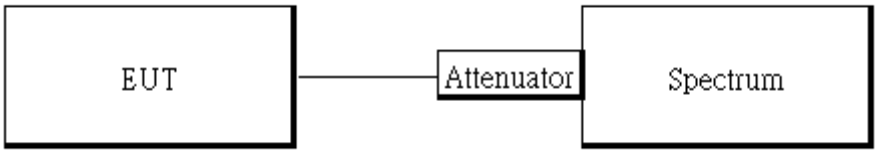
8 DUTY CYCLE MEASUREMENT

8.1 Applicable Standard

According to 15. 35(c), 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.

8.2 Test Setup



8.3 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT normal operating mode.
3. Set SPA Center Frequency = fundamental frequency, RBW≥ OBW, VBW≥ RBW, Span =0 Hz.
4. Set SPA detector=peak or average. Mark delta.

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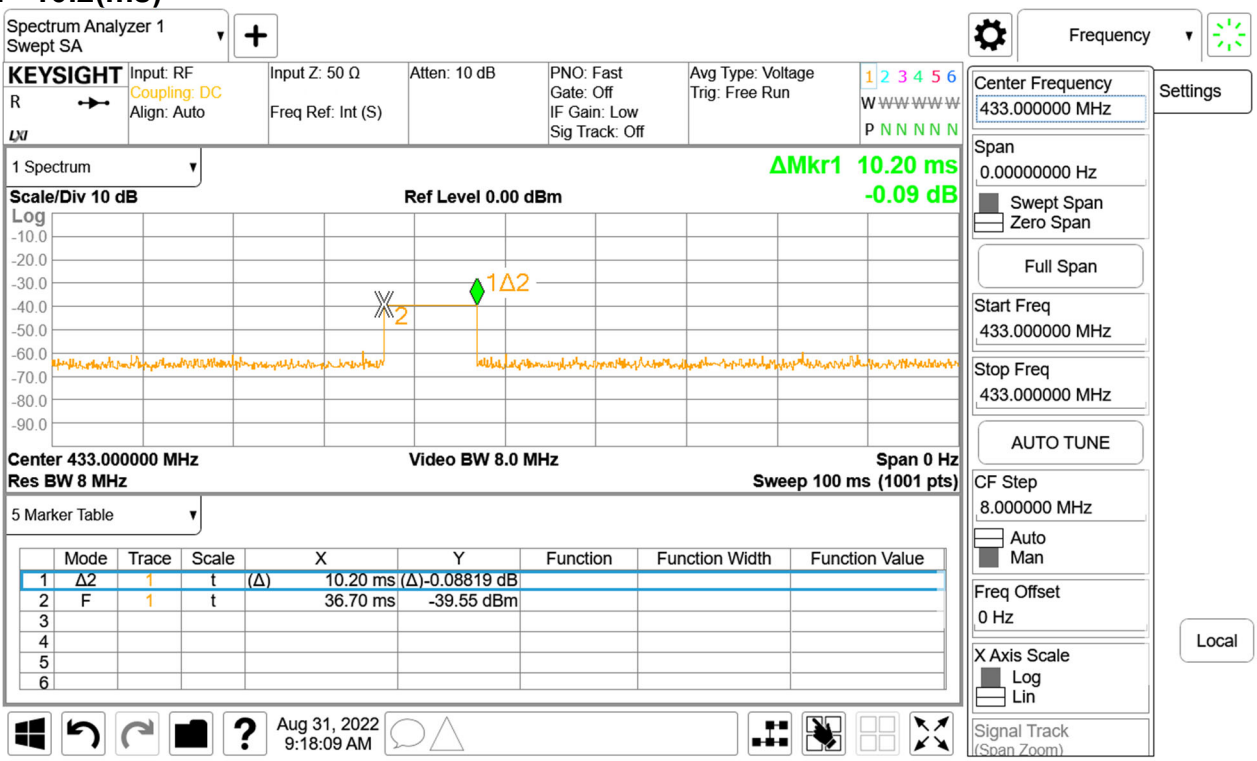
8.4 Measurement Results:

Ton (ms)	TP=Ton+Toff (ms)	Avg correction factor(dB) = 20log(Ton/TP)
10.2	100	-19.83

Ton =10.2(ms)



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9 EMISSION BANDWIDTH

9.1 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.

9.2 Test Setup

Refer to section 8.2 of this report.

9.3 Measurement Procedure

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. Set EUT as transmitting mode.
3. Set SPA Center Frequency = fundamental frequency, RBW=1% to 5% OBW, VBW= 3 x RBW, Span = large enough to capture all products of the modulation process.
4. Set SPA -20dB Occupied bandwidth.

9.4 Measurement Results

The center frequency f_c are 433MHz and 440MHz, according to the Rules, section 15.231(C), the Bandwidth of Center Frequency at -20dB should be calculated as following:

433 X 0.0025 = 1.0825 (MHz)

440 X 0.0025 = 1.1 (MHz)

CH	20dB Bandwidth (kHz)	Limit(kHz)	Result
Low	51.02	1082.5	Pass
High	50.76	1100	Pass

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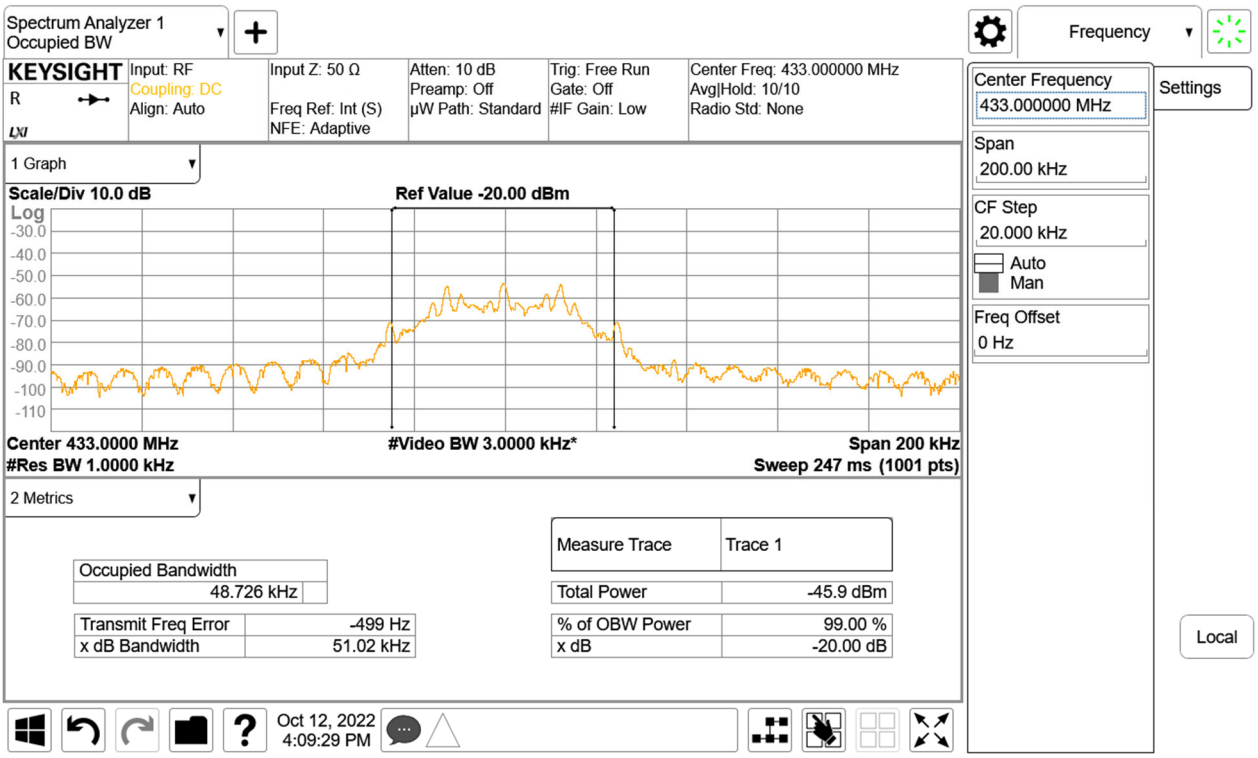
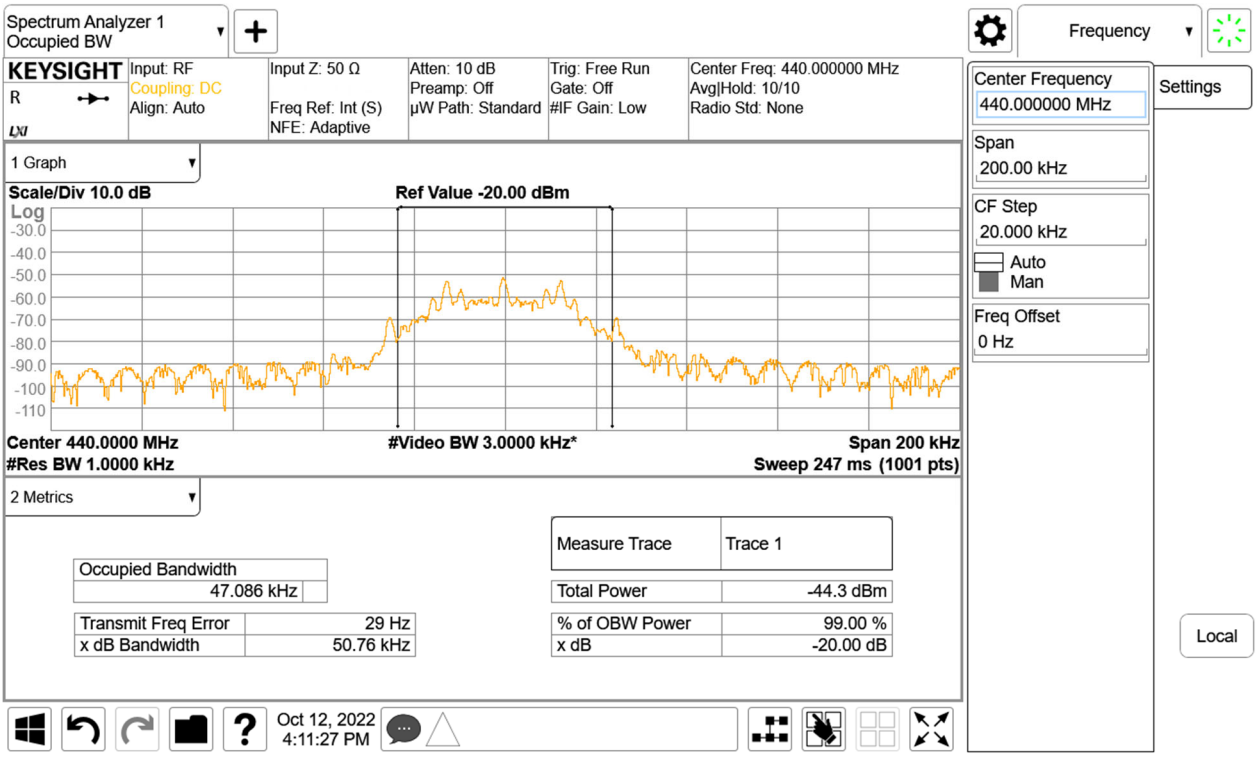
433MHz



440MHz



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10 TRANSMISSION CEASED 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 Test Setup

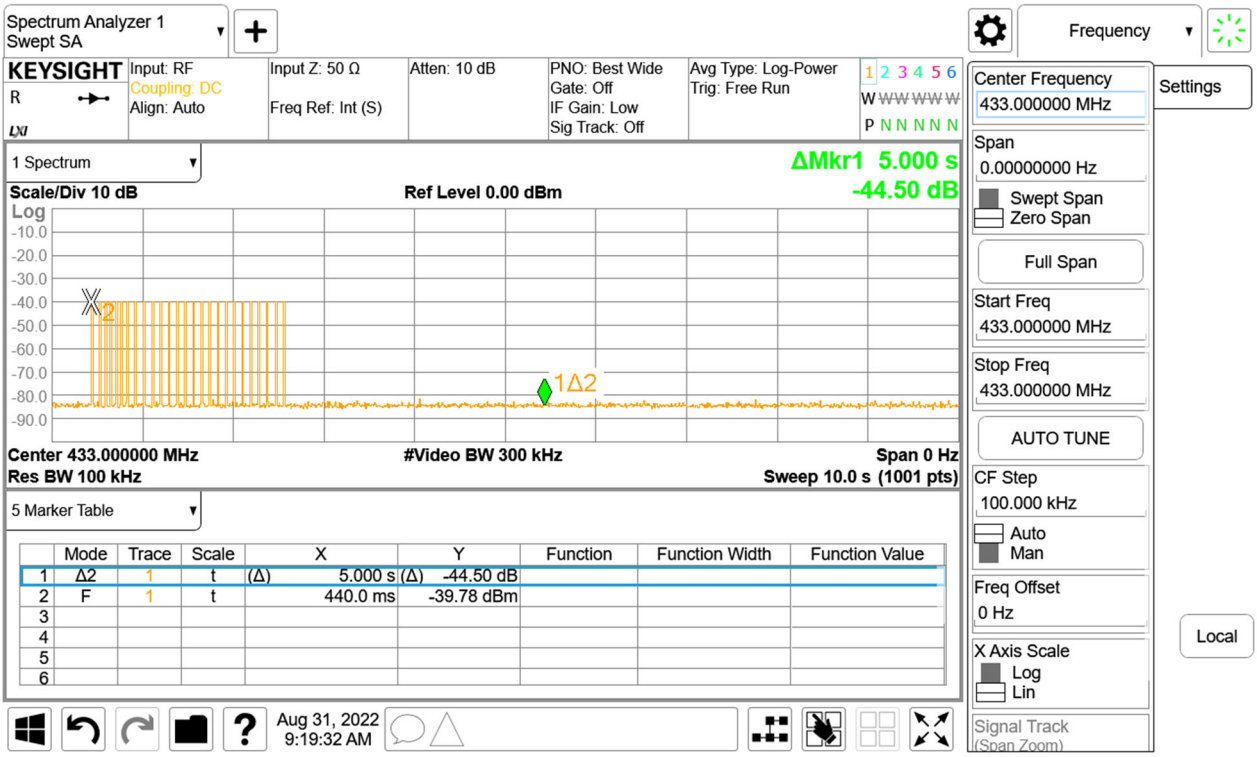
Refer to 8.2 of this report.

10.2 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≥ RBW, 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.

10.3 Measurement Results

The release time is less than 5 s.



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11 RADIATED EMISSION TEST

11.1 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 – 61.94	* 375 to 1250
above 470	81.94	12,500	61.94	1250

11.2 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.

Fundamental Frequency (MHz)	**41.6667(F) – 7083.3333 (uV/m)**	**Limit (dBuV/m)**
433.005	10958.5561	80.79
440	11250.0147	81.02

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11.3 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.

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

(1) Span = wide enough to fully capture the emission being measured
(2) RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz, VBW ≥ RBW,
Sweep = auto, Detector function = peak, Trace = max hold
(3) For average measurement: use duty cycle correction factor method per 15.35(c)
Duty Cycle = On time/100 milliseconds
On time = N1*L1+N2*L2+…+N(n-1)*L(n-1)+N(n)*L(n)
Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.
Average Emission Level = Peak Emission Level + 20*log (duty Cycle)

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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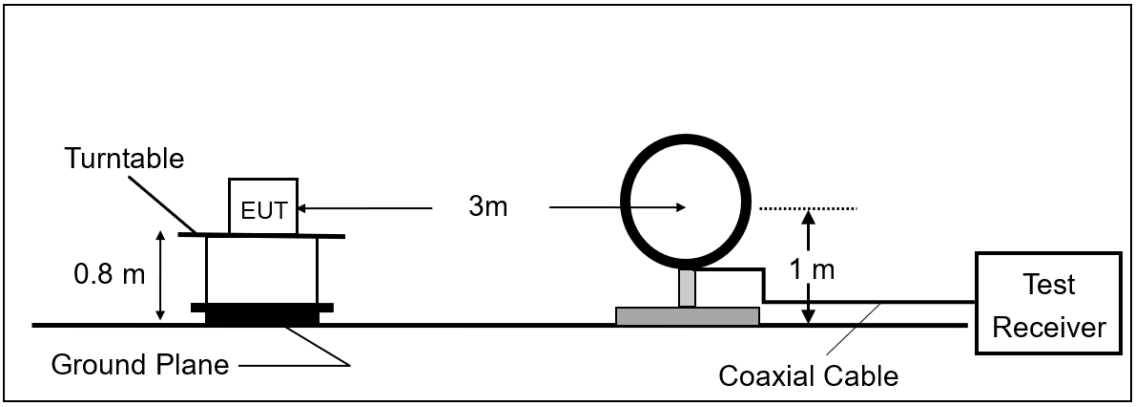
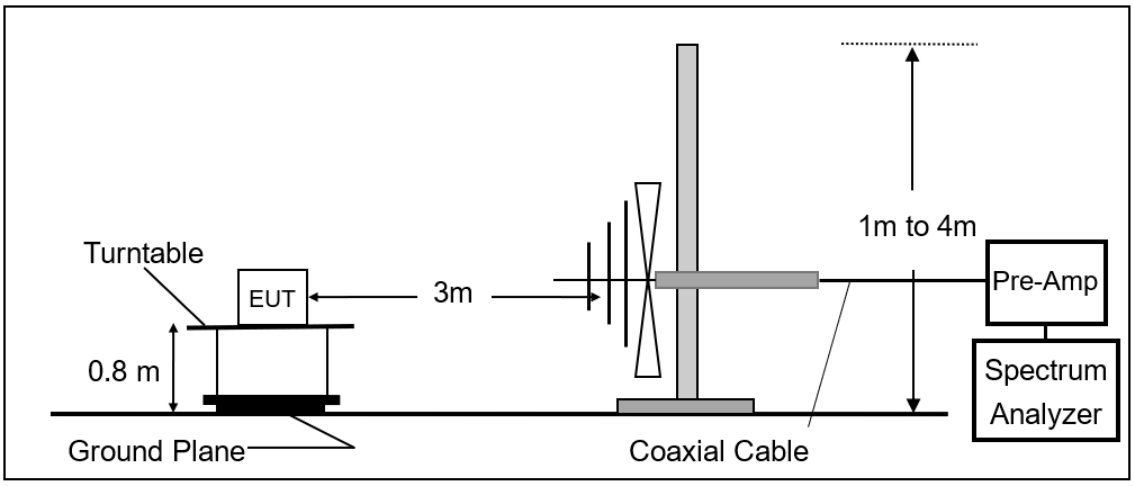
11.5 Test Setup

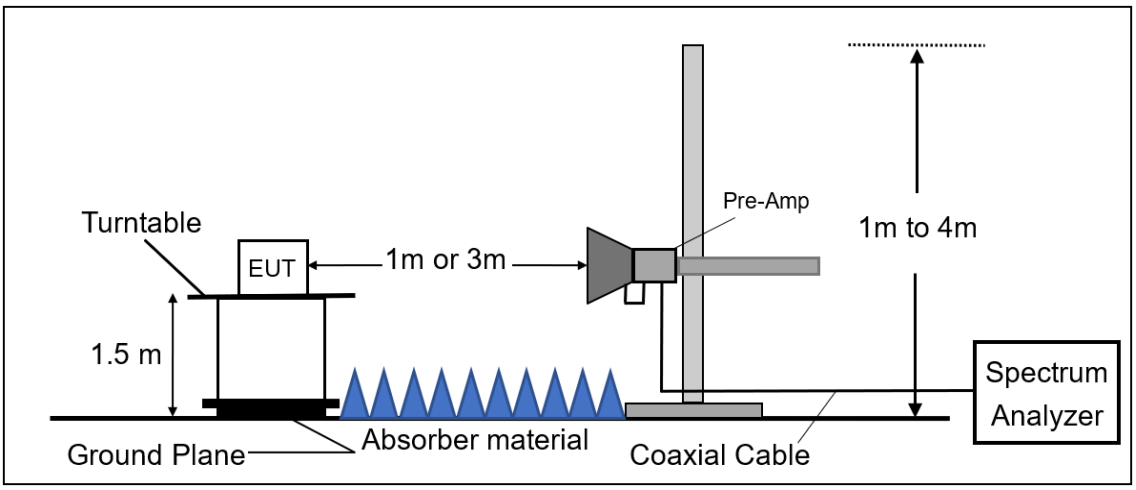
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



(B) Radiated Emission Test Set-Up, Frequency From 30MHz to 1000MHz.



(C) Radiated Emission Test Set-Up, Frequency Above 1GHz.



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11.6 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*log(uV/m)

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

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

11.7 Measurement Results of Radiated Spurious Emissions from 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.

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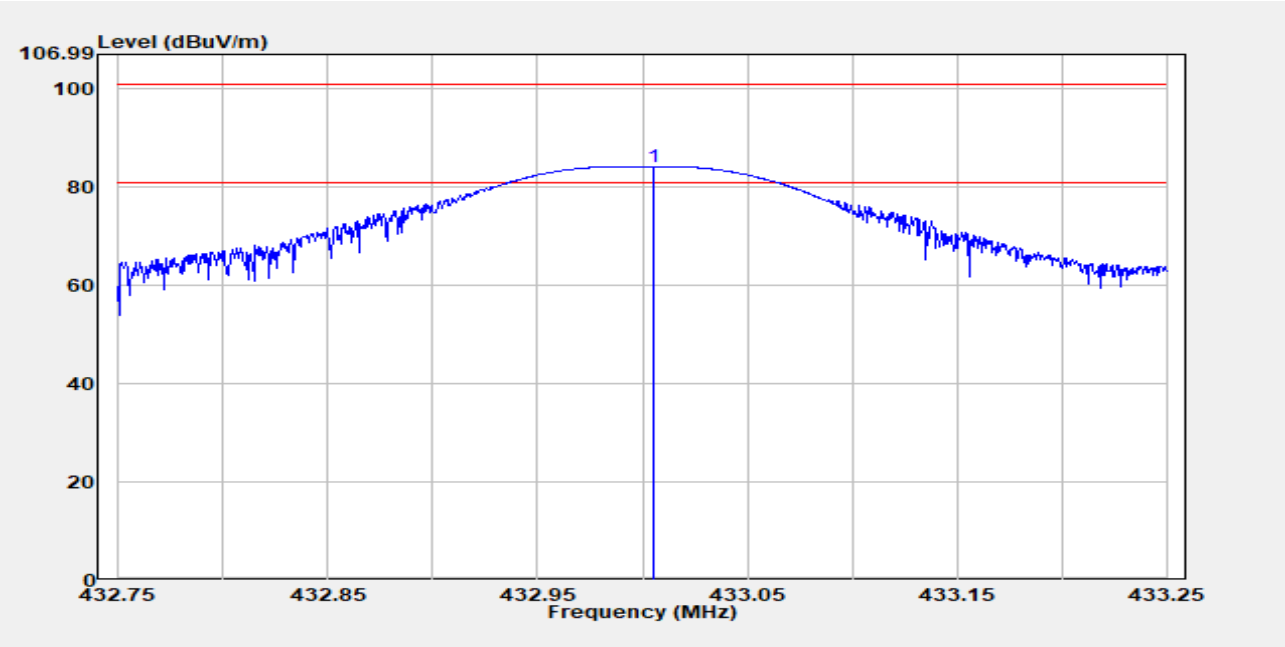
11.8 Measurement Result

11.8.1 Field Strength of Fundamental

Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:433 MHz	Temp./Humi.	:25.3/62
Test Mode	:Main	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
433.005	Peak	88.10	-3.93	84.18	100.79	-16.61
433.005	Average	---	-19.83	64.35	80.79	-16.44

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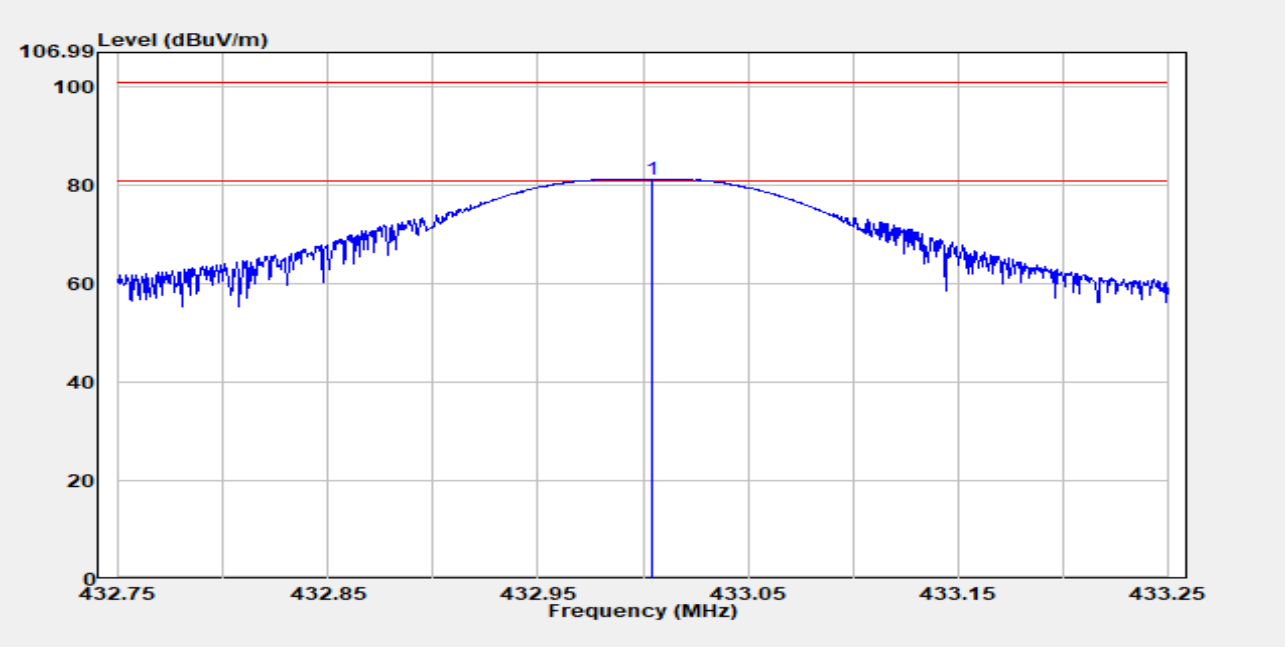
Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:433 MHz	Temp./Humi.	:25.3/62
Test Mode	:Main	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
433.004	Peak	85.23	-3.93	81.30	100.79	-19.49
433.004	Average	---	-19.83	61.47	80.79	-19.32

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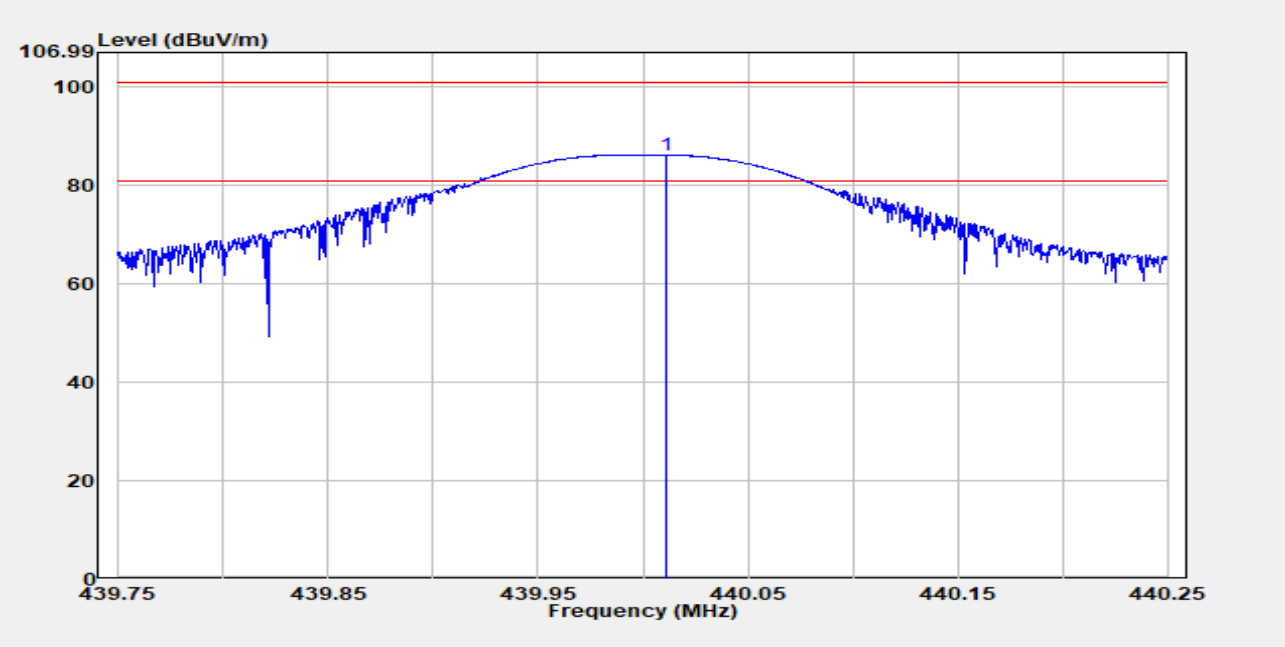
Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:440 MHz	Temp./Humi.	:25.3/62
Test Mode	:Main	Antenna Pol.	:VERTICAL
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
440.011	Peak	89.69	-3.57	86.12	101.02	-14.90
440.011	Average	---	-19.83	66.29	81.02	-14.73

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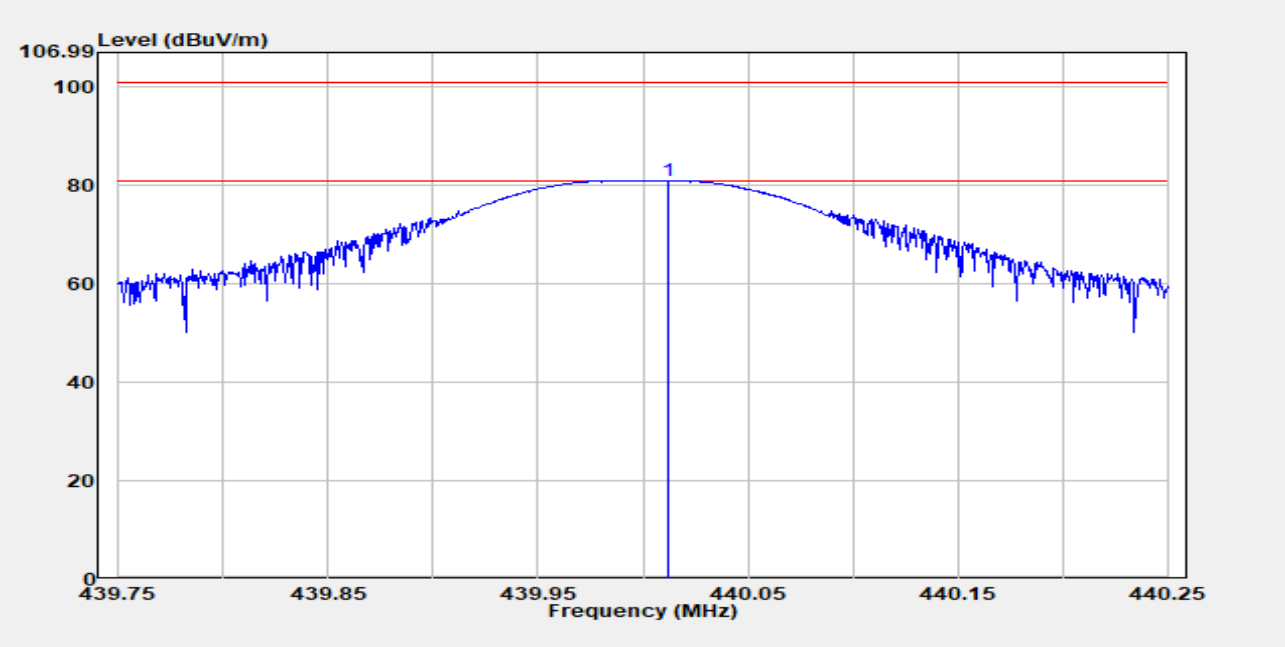
Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:440 MHz	Temp./Humi.	:25.3/62
Test Mode	:Main	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
440.012	Peak	84.60	-3.57	81.04	101.02	-19.98
440.012	Average	---	-19.83	61.21	81.02	-19.81

Note: Average Actual = Peak Actual + Average Factor

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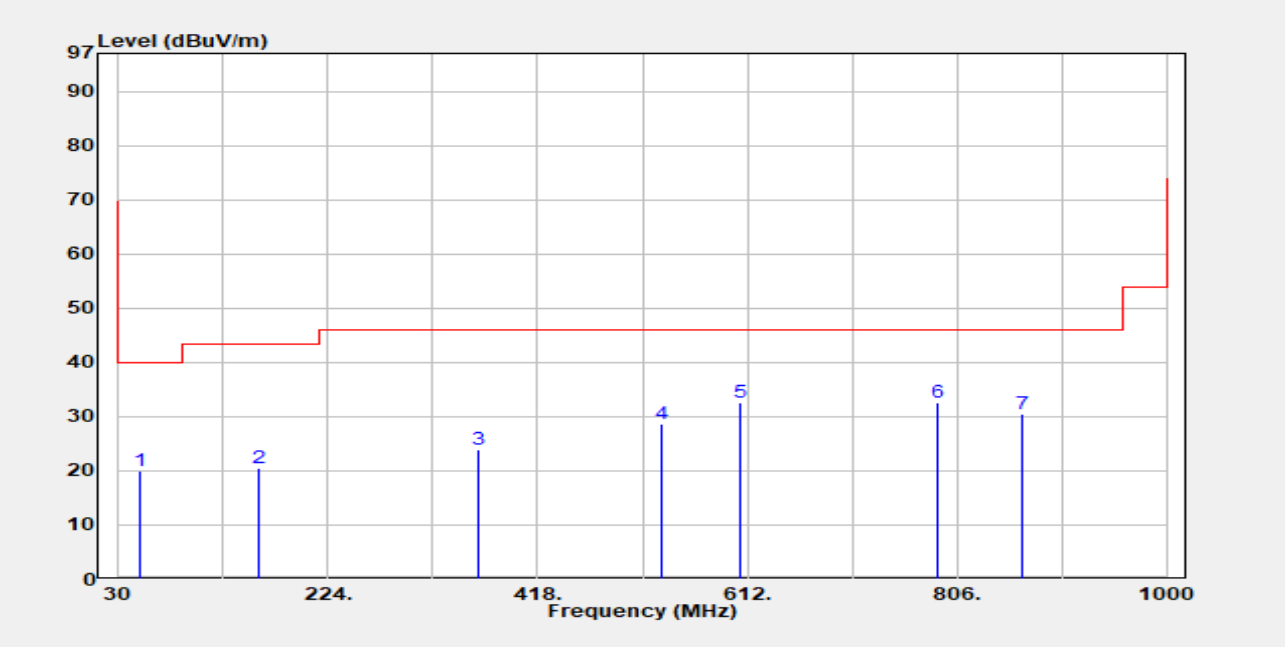
11.8.2 Field Strength of Spurious Emission

Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:433 MHz	Temp./Humi.	:25.3/62
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
50.370	Peak	28.47	-8.42	20.05	40.00	-19.95
159.010	Peak	28.12	-7.67	20.45	43.50	-23.05
363.680	Peak	27.57	-3.70	23.87	46.00	-22.13
533.430	Peak	28.80	-0.07	28.73	46.00	-17.27
605.210	Peak	31.51	1.18	32.69	46.00	-13.31
787.570	Peak	28.95	3.59	32.54	46.00	-13.46
866.000	Peak	26.97	3.55	30.52	46.00	-15.48

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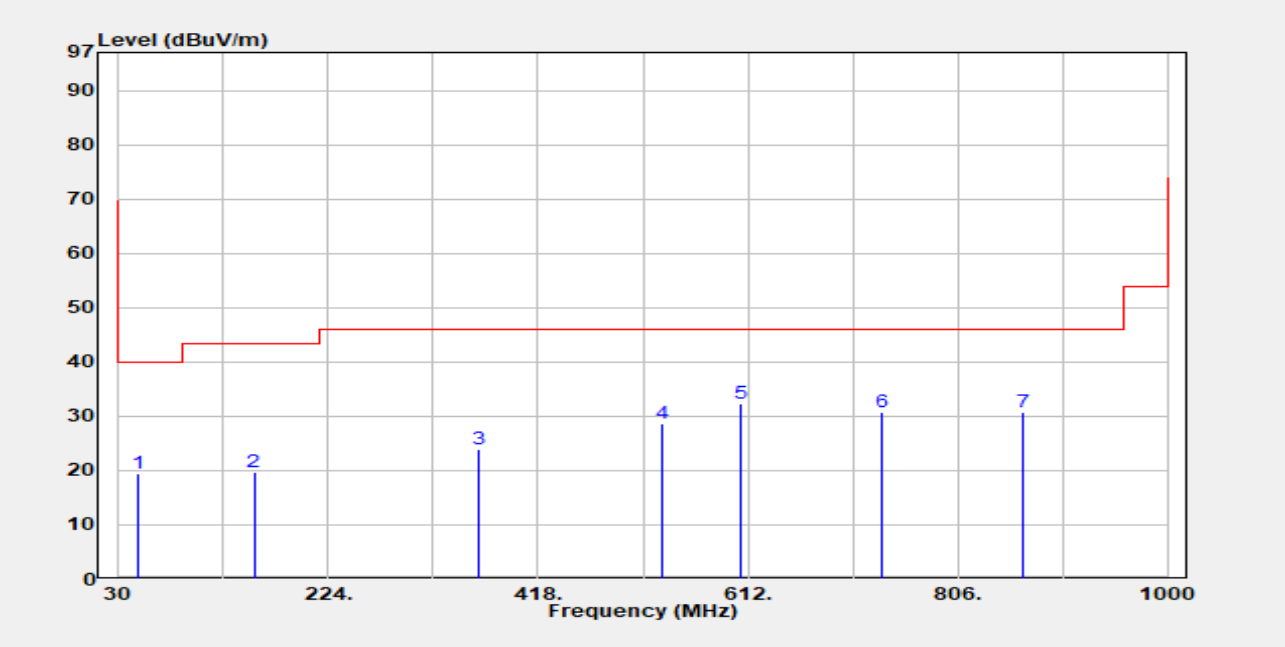
Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:433 MHz	Temp./Humi.	:25.3/62
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
47.460	Peak	28.02	-8.56	19.46	40.00	-20.54
155.130	Peak	27.15	-7.43	19.72	43.50	-23.78
363.680	Peak	27.72	-3.70	24.02	46.00	-21.98
533.430	Peak	28.61	-0.07	28.54	46.00	-17.46
605.210	Peak	31.18	1.18	32.37	46.00	-13.63
736.160	Peak	29.04	1.76	30.80	46.00	-15.20
866.000	Peak	27.19	3.55	30.74	46.00	-15.26

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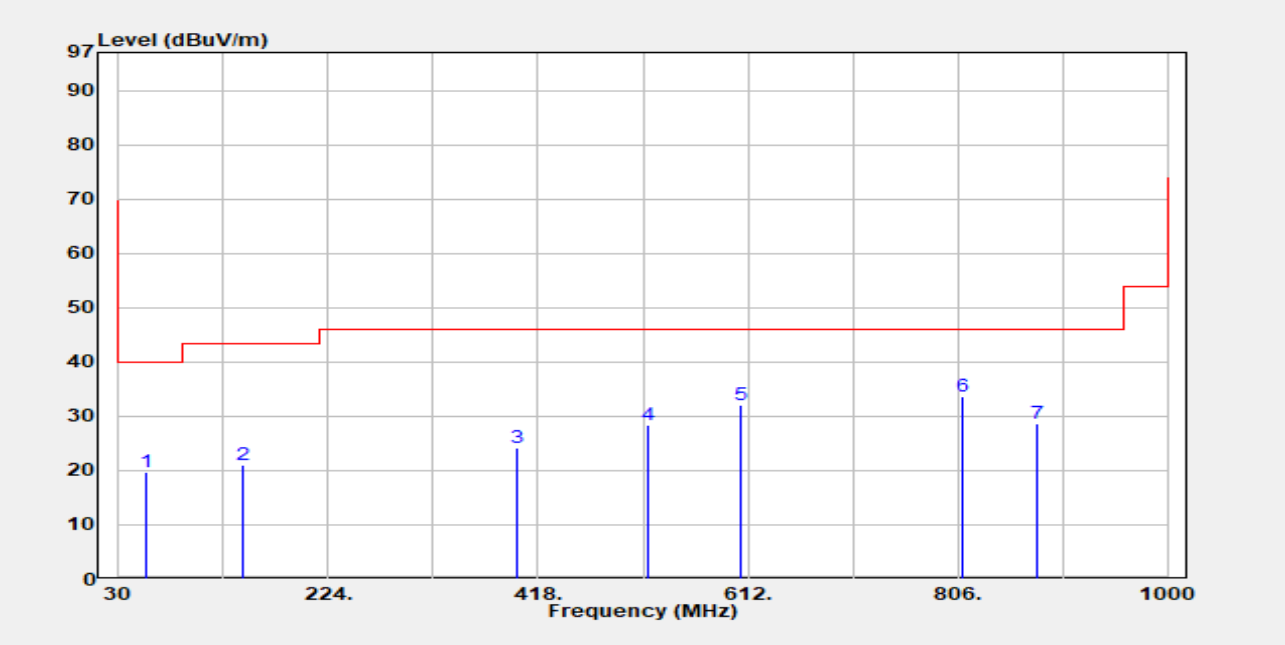
Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:440 MHz	Temp./Humi.	:25.3/62
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
55.220	Peak	28.38	-8.65	19.72	40.00	-20.28
145.430	Peak	29.01	-7.88	21.13	43.50	-22.37
397.630	Peak	28.77	-4.62	24.15	46.00	-21.85
519.850	Peak	28.19	0.12	28.30	46.00	-17.70
605.210	Peak	30.97	1.18	32.16	46.00	-13.84
810.850	Peak	29.64	4.10	33.75	46.00	-12.25
880.000	Peak	25.64	2.94	28.58	46.00	-17.42

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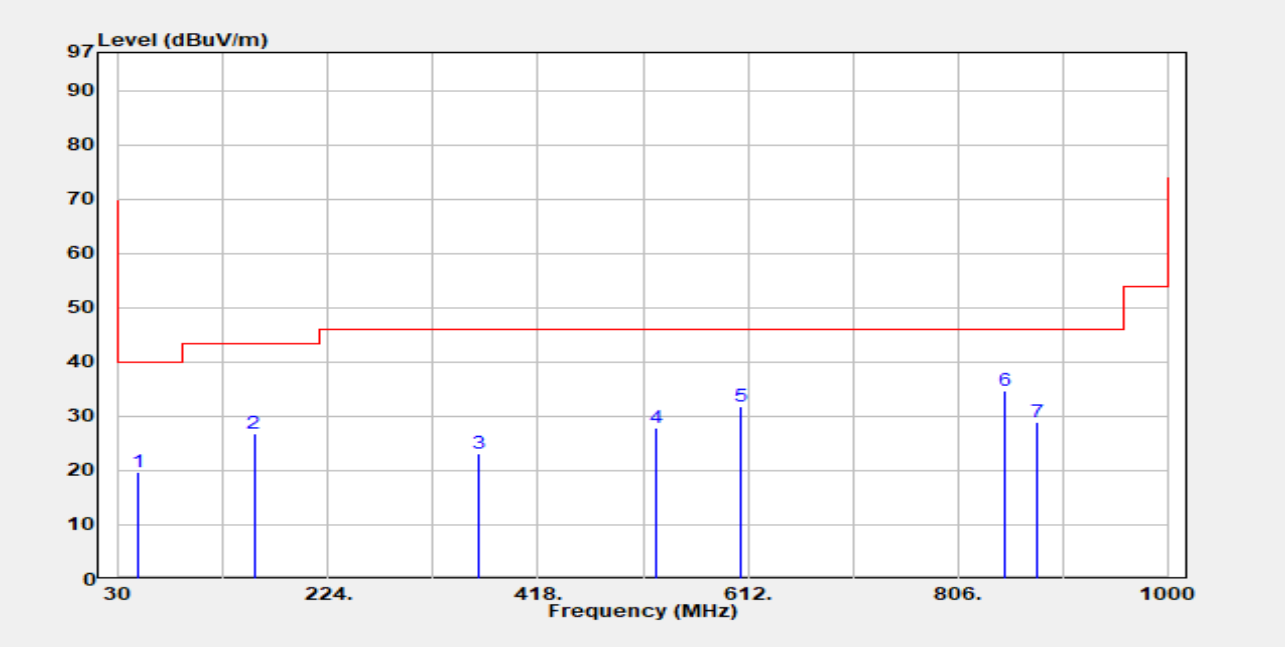
Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:440 MHz	Temp./Humi.	:25.3/62
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBµV	Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	Margin dB
48.430	Peak	28.02	-8.39	19.63	40.00	-20.37
155.130	Peak	34.36	-7.43	26.93	43.50	-16.57
362.710	Peak	26.85	-3.78	23.07	46.00	-22.93
526.640	Peak	27.99	-0.06	27.93	46.00	-18.07
605.210	Peak	30.61	1.18	31.80	46.00	-14.20
849.650	Peak	30.03	4.57	34.60	46.00	-11.40
880.000	Peak	26.00	2.94	28.94	46.00	-17.06

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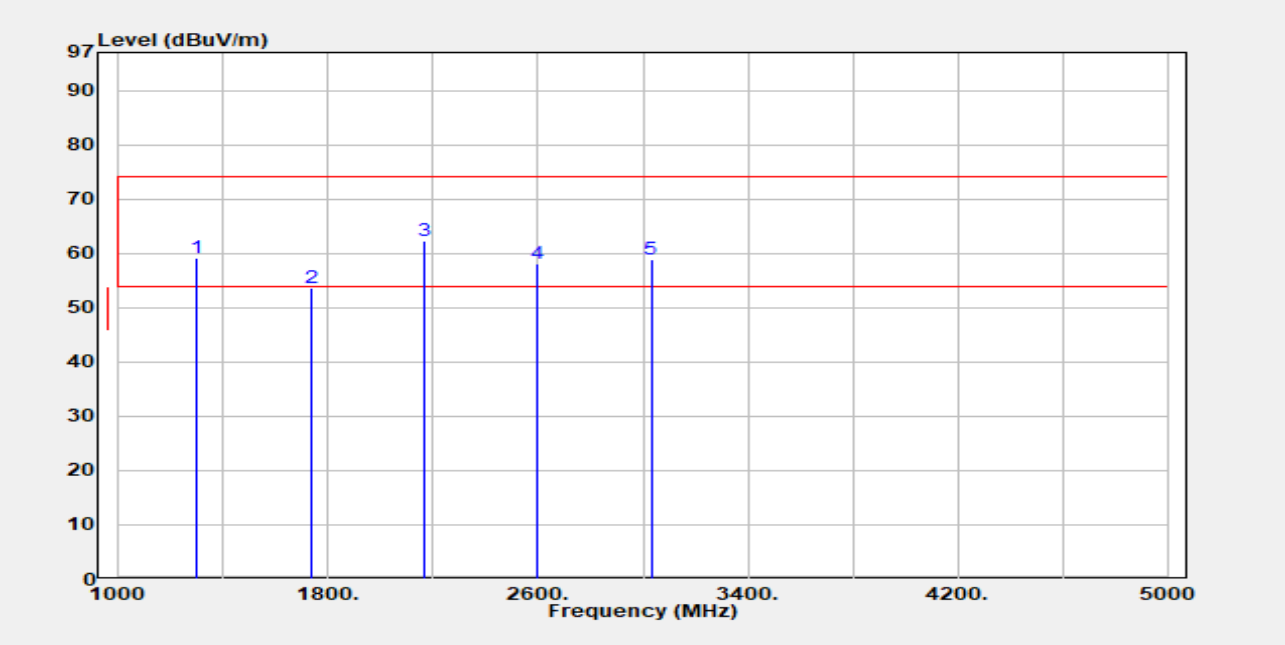
Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:433 MHz	Temp./Humi.	:25.3/62
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
1299.000	Peak	61.14	-2.04	59.1	74.00	-14.90
1299.000	Average	---	-19.83	39.27	54.00	-14.73
1732.000	Peak	55.9	-2.18	53.72	74.00	-20.28
1732.000	Average	---	-19.83	33.89	54.00	-20.11
2165.000	Peak	61.22	1.06	62.28	74.00	-11.72
2165.000	Average	---	-19.83	42.45	54.00	-11.55
2598.000	Peak	56.45	1.65	58.1	74.00	-15.90
2598.000	Average	---	-19.83	38.27	54.00	-15.73
3031.000	Peak	55.99	2.82	58.81	74.00	-15.19
3031.000	Average	---	-19.83	38.98	54.00	-15.02

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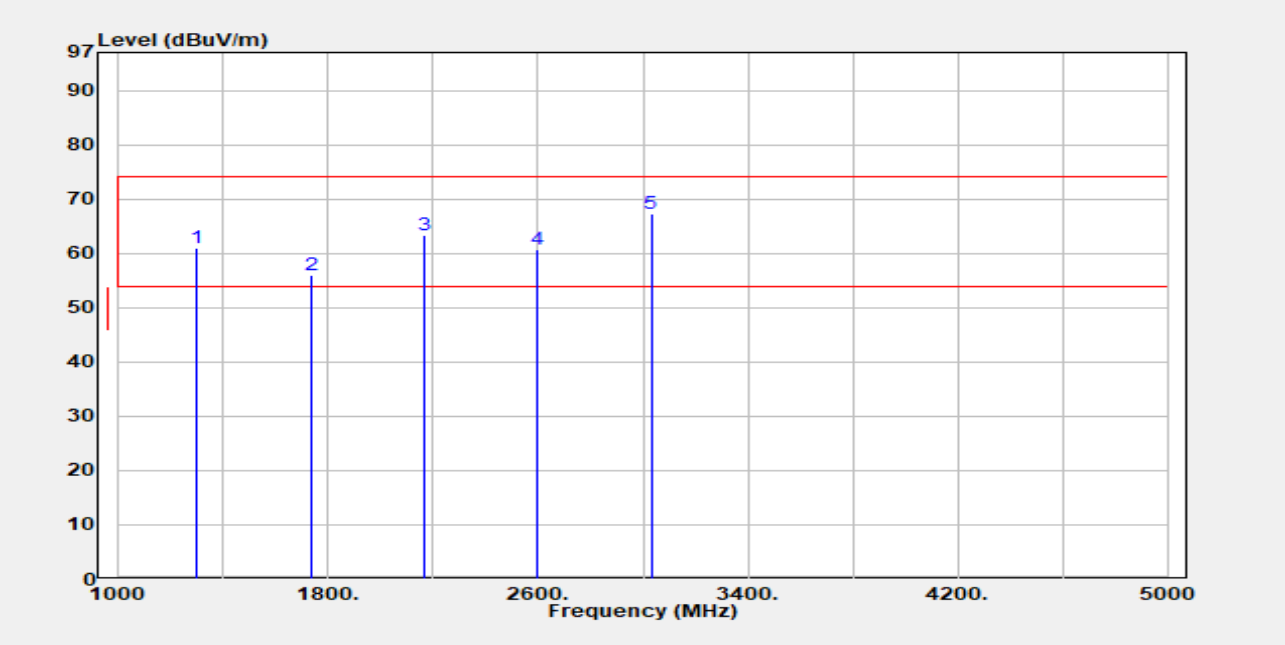
Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:433 MHz	Temp./Humi.	:25.3/62
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
1299.000	Peak	63.14	-2.04	61.1	74.00	-12.90
1299.000	Average	---	-19.83	41.27	54.00	-12.73
1732.000	Peak	58.17	-2.18	55.99	74.00	-18.01
1732.000	Average	---	-19.83	36.16	54.00	-17.84
2165.000	Peak	62.31	1.06	63.37	74.00	-10.63
2165.000	Average	---	-19.83	43.54	54.00	-10.46
2598.000	Peak	59.01	1.65	60.66	74.00	-13.34
2598.000	Average	---	-19.83	40.83	54.00	-13.17
3031.000	Peak	64.43	2.82	67.25	74.00	-6.75
3031.000	Average	---	-19.83	47.42	54.00	-6.58

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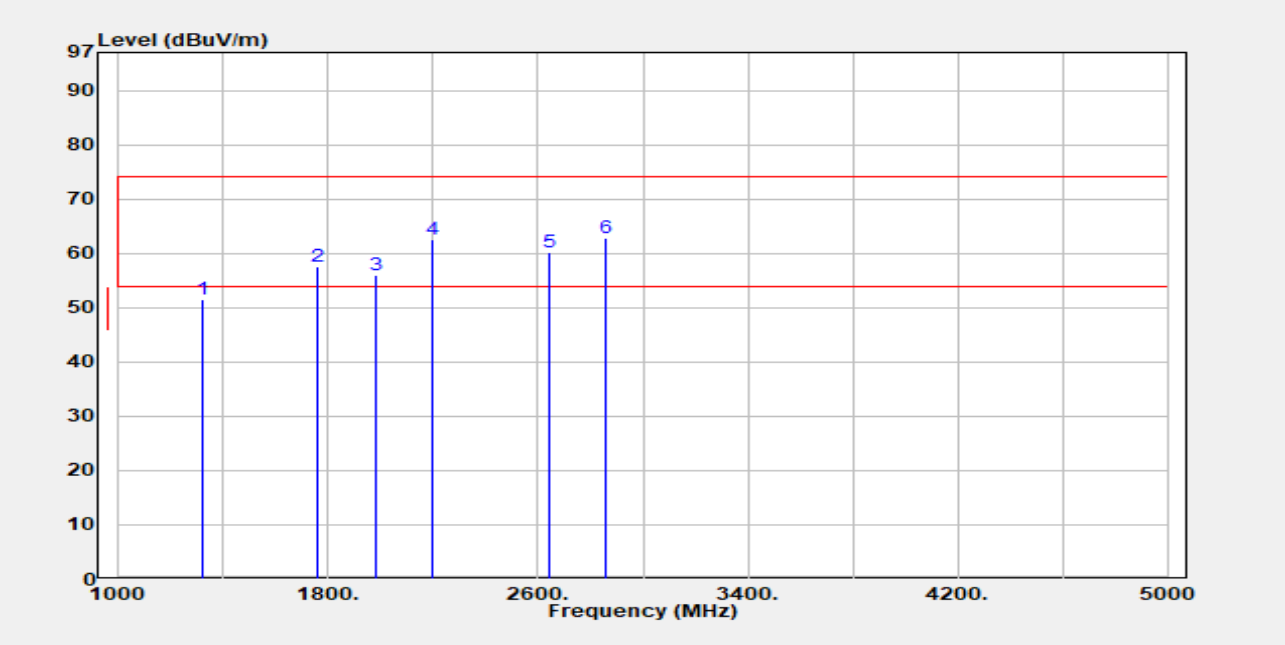
Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:440 MHz	Temp./Humi.	:25.3/62
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
1320.000	Peak	53.51	-1.91	51.6	74.00	-22.40
1320.000	Average	---	-19.83	31.77	54.00	-22.23
1760.000	Peak	59.81	-2.23	57.58	74.00	-16.42
1760.000	Average	---	-19.83	37.75	54.00	-16.25
1980.000	Peak	56.92	-1.03	55.89	74.00	-18.11
1980.000	Average	---	-19.83	36.06	54.00	-17.94
2200.000	Peak	61.39	1.3	62.69	74.00	-11.31
2200.000	Average	---	-19.83	42.86	54.00	-11.14
2640.000	Peak	58.69	1.48	60.17	74.00	-13.83
2640.000	Average	---	-19.83	40.34	54.00	-13.66
2860.000	Peak	60.1	2.85	62.95	74.00	-11.05
2860.000	Average	---	-19.83	43.12	54.00	-10.88

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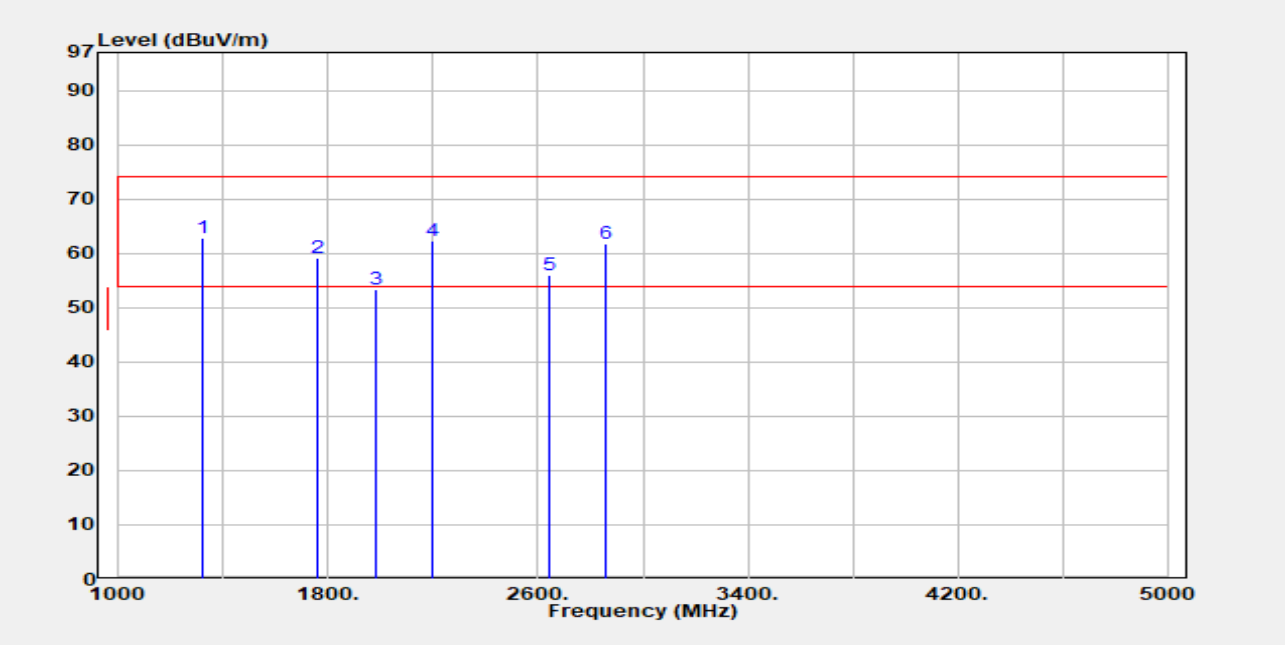
Report Number	:TERF2206000819ER	Test Site	:SAC 3
Operation Mode	:UHF Band	Test Date	:2022-08-30
Test Frequency	:440 MHz	Temp./Humi.	:25.3/62
Test Mode	:Tx	Antenna Pol.	:Horizontal
EUT Pol	:E2 Plane	Engineer	:Nick Lin



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dBμV	Factor dB	Actual FS dBμV/m	Limit @3m dBμV/m	Margin dB
1320.000	Peak	64.75	-1.91	62.84	74.00	-11.16
1320.000	Average	---	-19.83	43.01	54.00	-10.99
1760.000	Peak	61.45	-2.23	59.22	74.00	-14.78
1760.000	Average	---	-19.83	39.39	54.00	-14.61
1980.000	Peak	54.41	-1.03	53.38	74.00	-20.62
1980.000	Average	---	-19.83	33.55	54.00	-20.45
2200.000	Peak	60.9	1.3	62.2	74.00	-11.80
2200.000	Average	---	-19.83	42.37	54.00	-11.63
2640.000	Peak	54.61	1.48	56.09	74.00	-17.91
2640.000	Average	---	-19.83	36.26	54.00	-17.74
2860.000	Peak	58.96	2.85	61.81	74.00	-12.19
2860.000	Average	---	-19.83	41.98	54.00	-12.02

Note: Average Actual = Peak Actual + Average Factor

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12 ANTENNA REQUIREMENT

12.1 Standard Applicable:

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. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of §§ 15.211, 15.213, 15.217, 15.219, 15.221, or § 15.236. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

12.2 Antenna Connected Construction:

The antenna complies with this requirement and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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