



ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT



EUT Description Smart Lightbulb
Applicant: Ring LLC
Manufacturer: Ring LLC
Brand Name: ring
Model No. / ISED HVIN: 5AT1S3, 5AT3S4
ISED PMN: 5AT1S3, 5AT3S4
Report Number: TERF2504001284E2
FCC ID 2AEUPRB19001
IC: 20271-RB19001
Date of EUT Received: April 8, 2025
Date of Test: April 7, 2025~May 13, 2025
Issue Date: May 21, 2025

Approved By

Aken Huang

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 §15.247, ISED RSS-Gen and RSS-247.

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
TERF2504001284E2	00	FCC C2PC/ ISED C3PC for increased frequency range	May 21, 2025	Candice Li	

Note:

- 1、The remark "*" indicates modification of the report upon requests from certification body.
- 2、Variant information of model numbers is provided by the applicant, test results of this report are applicable to the sample EUT(s) received. And are assessed as electrically identical in RF characteristics, therefore, no further assessment required for the variant(s).

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1 GENERAL INFORMATION

1.1 Product Description

EUT Description	Smart Lightbulb
Brand Name:	ring
Model No. /ISED HVIN:	5AT1S3, 5AT3S4
Model Difference:	color temperature
Hardware Version:	MP
Firmware Version:	5.0.3-81(rev.1)
EUT Series No.:	N/A
Power Supply:	120V AC
Test Software (Name/Version)	J-Link Commander V7.96i

1.2 RF Specification

Radio Technology:	FSK 100 Kbps
Frequency Range:	902 – 928MHz
Channel number:	31 channels
Modulation type:	FSK DTS
Transmit Power:	13.62 dBm (Peak)

1.3 Antenna Designation

Antenna Type	Freq. (MHz)	Peak Antenna Gain (dBi)
Monopole Antenna	902~928	2.44

Note: Antenna information is provided by the applicant.

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1.4 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

FCC KDB 558074 D01 15.247 Meas Guidance v05r02

RSS-247 issue 3 Aug. 2023

RSS-Gen, Issue 5 April 2018, Amendment 2 (February 2021)

1.5 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 SAC 2 SAC 3 Conduction 1 Conducted 1 Conducted 2 Conducted 3 Conducted 4 Conducted 5 Conducted 6	TW0027	TW3702
	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C SAC C SAC D SAC G Conducted A Conducted B Conducted C Conducted D Conducted E Conducted F Conducted G	TW0028	

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.

1.6 Special Accessories

There are no special accessories used while test was conducted.

1.7 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

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

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. 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 Conducted Test (RF)

The active antenna port of the unlicensed wireless device is connected to the spectrum analyzer with attenuator to protect the instrumentation. If a second antenna port is available, it is tested at one operating frequency, with other port(s) appropriately terminated, to verify it has similar output characteristics as the fully tested port.

2.3.3 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 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.

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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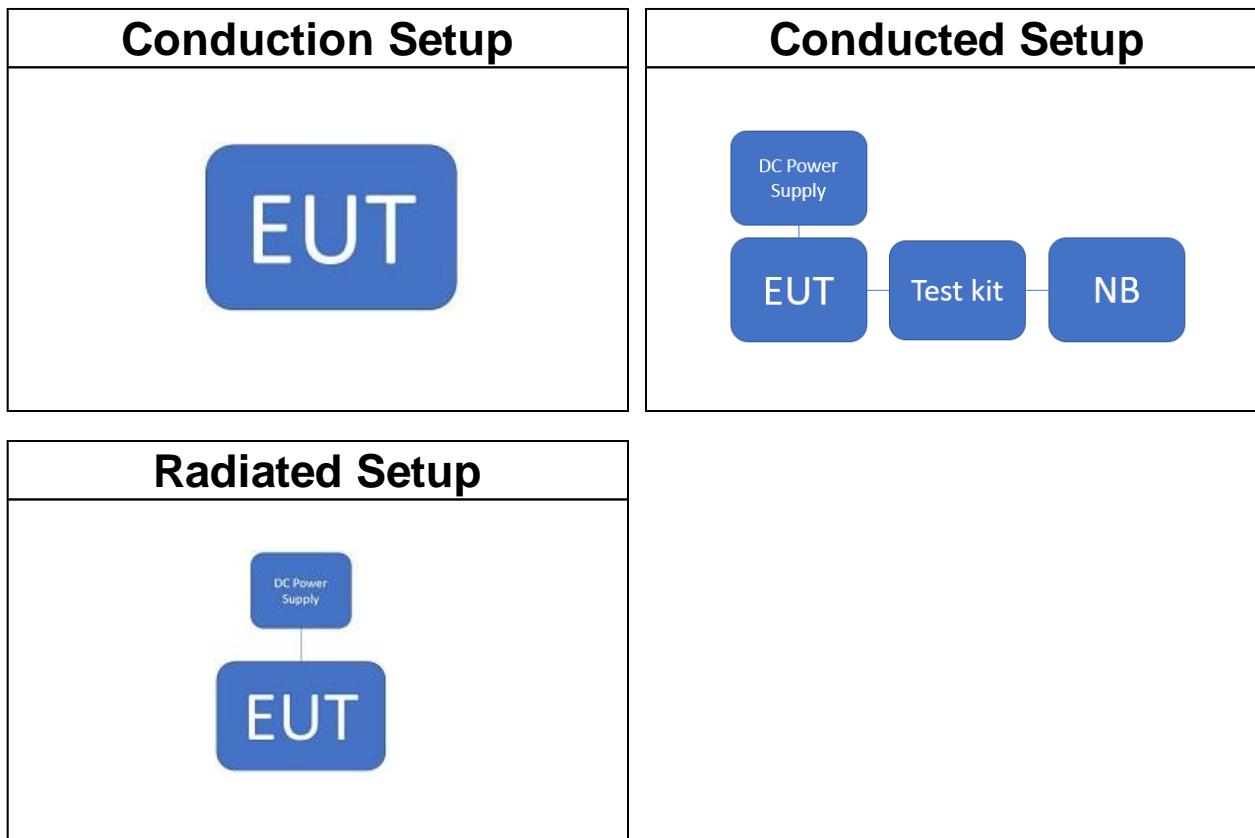
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2.5 Test Configuration



2.6 Control Unit(s)

Conducted Emission Test Site: Conducted F					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
Notebook	Lenovo	T14	P0003332	N/A	N/A
J-LINK BASE COMPACT	SEGGER	N/A	N/A	N/A	N/A

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3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§15.207(a)	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.247(b) (3)	RSS-247 §5.4 d	Peak Output Power	Compliant
§15.247(a)(2)	RSS-247 §5.2 a RSS-Gen §6.7	Emission Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5	Conducted Band Edge and Spurious Emission	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5	Radiated Band Edge and Spurious Emission	Compliant
§15.205	RSS-Gen § 8.10	Restricted Bands	Compliant
§15.247(e)	RSS-247 §5.2 b	Peak Power Density	Compliant
§15.203	N/A	Antenna Requirement	Compliant

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4 DESCRIPTION OF TEST MODES

4.1 Operating Frequencies

902~928 MHz							
CH	Freq. (MHz)	CH	Freq. (MHz)	CH	Freq. (MHz)	CH	Freq. (MHz)
1	902.9	11	910.9	21	918.9	31	926.9
2	903.7	12	911.7	22	919.7		
3	904.5	13	912.5	23	920.5		
4	905.3	14	913.3	24	921.3		
5	906.1	15	914.1	25	922.1		
6	906.9	16	914.9	26	922.9		
7	907.7	17	915.7	27	923.7		
8	908.5	18	916.5	28	924.5		
9	909.3	19	917.3	29	925.3		
10	910.1	20	918.1	30	926.1		

4.2 The Worst Test Modes and Channel Details

1. The EUT has been tested under operating condition.
2. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
3. Investigation has been done on all the possible configurations for searching the worst case.

The given UE is pre-scanned among below modes.

CONDUCTED TEST				
MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	DATA RATE (kbps)
FSK	902 to 928	902.9,914.9,926.9	FSK	100

TRANSMIT RADIATED EMISSION TEST			
MODE	FREQUENCY BAND (MHz)	TEST FREQUENCY (MHz)	MODULATION
FSK	902-928	902.9,914.9,926.9	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.

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5 MEASUREMENT UNCERTAINTY

Test Items	Uncertainty		
AC Power Line Conducted Emission	+/-	1.54	dB
Output Power measurement	+/-	0.97	dB
Emission Bandwidth	+/-	1.38	Hz
Conducted emission measurement	+/-	0.77	dB
Peak Power Density	+/-	0.61	dB
Temperature	+/-	0.6	°C
Humidity	+/-	3	%
DC / AC Power Source	+/-	1	%

Radiated Spurious Emission Measurement Uncertainty			
Polarization: Vertical	+/-	1.89	dB
	+/-	4.1	dB
	+/-	3.37	dB
	+/-	3.83	dB
Polarization: Horizontal	+/-	1.89	dB
	+/-	4.1	dB
	+/-	3.37	dB
	+/-	3.83	dB
Radiated Spurious Emission	+/-	2	dB
	+/-	1.59	dB
	+/-	1.71	dB
	+/-	1.64	dB
	+/-	3.84	dB
			33GHz-50GHz
			50GHz-60GHz
			60GHz-90GHz
			90GHz-140GHz
			140GHz-220GHz

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 C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
Coaxial Cable	EC Lab	RF-HY-CAB-250	RF-HY-CAB-250-01	03/27/2025	03/26/2026
EMI Test Receiver	R&S	ESCI	101342	04/23/2025	04/22/2026
LISN	SCHWARZBECK Mess-Elektronik	NSLK8127	974	06/26/2024	06/25/2025
Pulse Limiter	EC Lab	VTSD 9561F-N	485	03/27/2025	03/26/2026
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R

6.2 Conducted Measurement

Conducted Emission Test Site: Conducted F					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
Attenuator	Marvelous	MVE2213-10	RF04	11/14/2024	11/13/2025
Attenuator	Woken	WATT-218FS-10	RF12	11/14/2024	11/13/2025
DC Block	PASTERNACK	PE8210	RF38	11/14/2024	11/13/2025
DC Power Supply	Gwinsteck	SPS-3610	GEV856769	08/14/2024	08/13/2025
Power Meter	Anritsu	ML2496A	2138005	09/25/2024	09/24/2025
Power Sensor	Anritsu	MA2411B	1911395	09/25/2024	09/24/2025
Power Sensor	Anritsu	MA2411B	1911396	09/25/2024	09/24/2025
Spectrum Analyzer	KEYSIGHT	N9010B	MY63440390	02/13/2025	02/12/2026
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R

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6.3 Radiated Measurement

Radiated Emission Test Site: SAC C					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL. (mm/dd/yyyy)	CAL DUE. (mm/dd/yyyy)
3m Site NSA	SGS	966 chamber C	N/A	03/02/2025	03/01/2026
Active Loop Antenna	COM-POWER	AL-130R	10160105	12/11/2024	12/10/2025
Attenuator	Woken	WATT-218FS-10	RF11	11/14/2024	11/13/2025
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-300	11/06/2024	11/05/2025
Coaxial Cable	EMCI+Huber Suhner	RG 214/U+EMC104-SM-SM-6000+EMC105-SM-SM-12000+15	W13.01+150813+2310002+15	11/14/2024	11/13/2025
DC Power Supply	Agilent	E3640A	MY53170008	08/29/2024	08/28/2025
EMI Test Receiver	Anritsu	N9038A	MY52260216	11/20/2024	11/19/2025
Horn Antenna	Schwarzbeck	BBHA9120D	1187	02/05/2025	02/04/2026
Lowpass Filter	Woken	EWT-56-0019	RF163	11/14/2024	11/13/2025
Notch Filter	Titan Microwave	T04N800100050S01	RF212	11/14/2024	11/13/2025
Pre-Amplifier	EMC Instruments	EMC118A45SE	980789	11/14/2024	11/13/2025
Pre-Amplifier	EMC Instruments	EMC330	980091	11/14/2024	11/13/2025
Spectrum Analyzer	KEYSIGHT	N9010B	MY63440390	02/13/2025	02/12/2026
Test Software	audix	e3	E3 20923 SGS Ver.9 (C)	N.C.R	N.C.R

NOTE: N.C.R refers to Not Calibrated Required.

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7 CONDUCTED EMISSION TEST

7.1 Standard Applicable:

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range MHz	Limits (dB μ V)	
	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

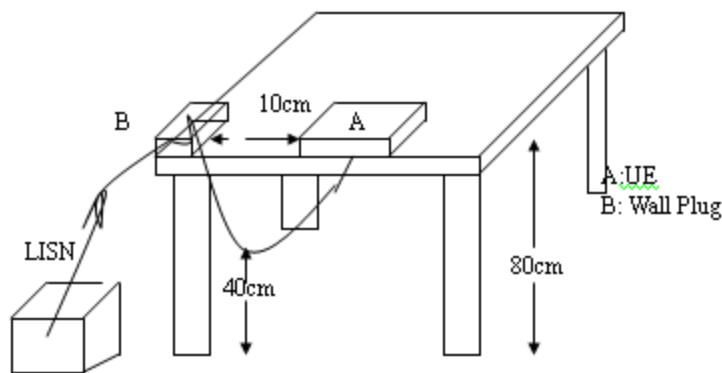
Note

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 with 120Vac/60Hz power source.

7.3 Test Setup



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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.
3. Repeat above procedures until all phases of power being supplied by given UE are completed.

7.5 Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The test data reveals the worst-case results that closest to the limit.

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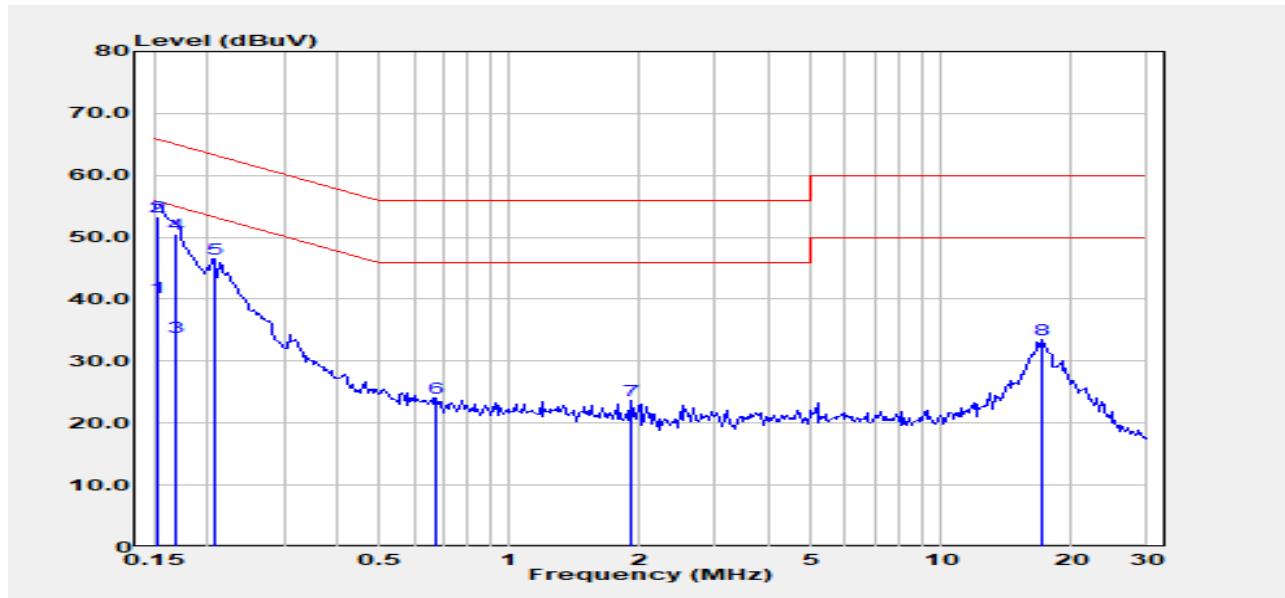
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number :TERF2504001284E2 Test Site :Conduction C
 Test Mode :FSK 100Kbps 249bytes Test Date :2025-05-13
 Power :120V/60Hz Temp./Humi. :23.6°C/57%
 Probe :L1 Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V	Limit dB μ V	Margin dB
0.153	Average	29.70	10.65	40.35	55.82	-15.47
0.153	QP	42.60	10.65	53.25	65.82	-12.57
0.169	Average	23.20	10.65	33.85	55.03	-21.18
0.169	QP	39.90	10.65	50.55	65.03	-14.48
0.208	Peak	35.95	10.65	46.60	63.27	-16.68
0.675	Peak	13.41	10.65	24.05	56.00	-31.95
1.908	Peak	12.98	10.76	23.74	56.00	-32.26
17.109	Peak	22.30	11.11	33.42	60.00	-26.58

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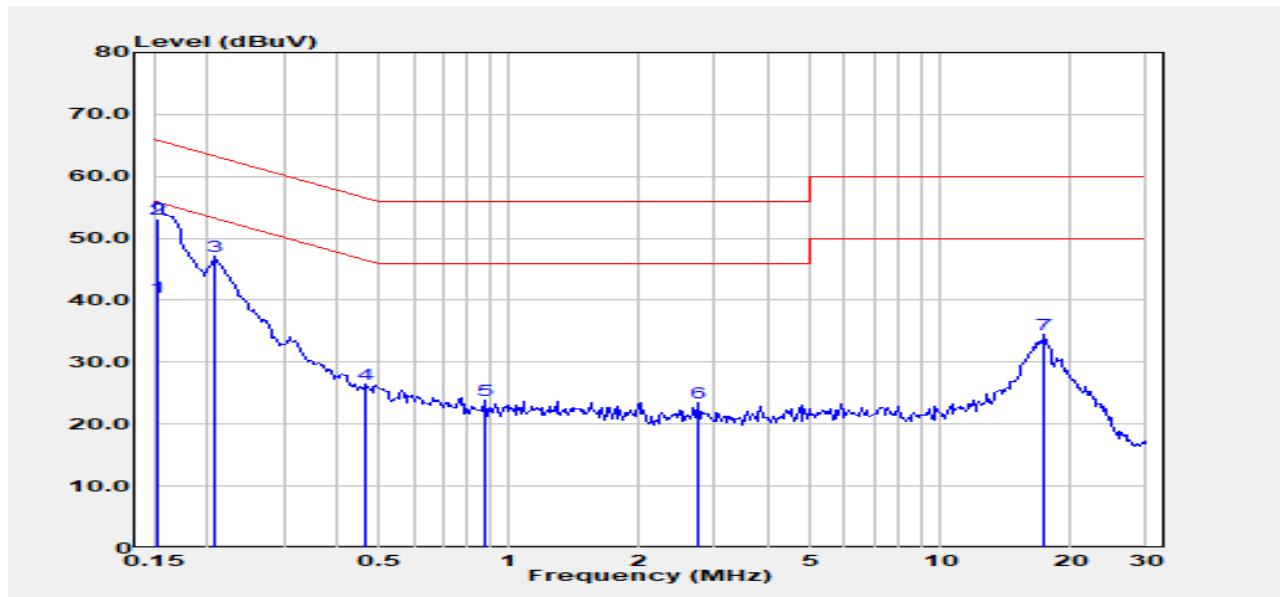
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Report Number :TERF2504001284E2
 Test Mode :FSK 100Kbps 249bytes
 Power :120V/60Hz
 Probe :N

Test Site :Conduction C
 Test Date :2025-05-13
 Temp./Humi. :23.6°C/57%
 Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V	Limit dB μ V	Margin dB
0.153	Average	29.80	10.66	40.46	55.82	-15.36
0.153	QP	42.50	10.66	53.16	65.82	-12.66
0.208	Peak	36.46	10.65	47.11	63.27	-16.16
0.466	Peak	15.79	10.61	26.40	56.58	-30.18
0.880	Peak	13.16	10.66	23.82	56.00	-32.18
2.736	Peak	12.66	10.81	23.47	56.00	-32.53
17.475	Peak	23.40	11.12	34.52	60.00	-25.48

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8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable:

8.1.1 FCC

For systems using digital modulation in the 902-928 MHz bands, the limit for peak output power is 1Watt.

If the transmitting antenna of directional gain greater than 6dBi are used the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the Antenna exceeds 6dBi. (FCC only)

In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of Antenna exceeds 6dBi.

8.1.2 ISED

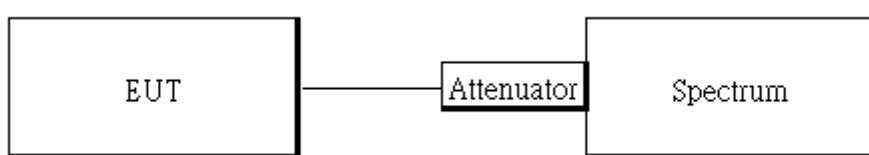
For systems using digital modulation in the 902-928 MHz bands, the limit for peak output power is 1Watt and the e.i.r.p. shall not exceed 4 W.

Note:

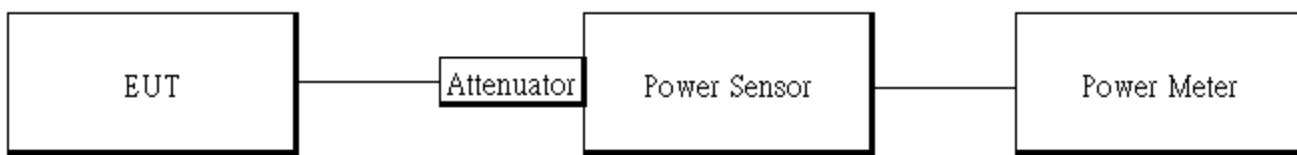
When the antenna gain is greater than 6 dBi, the power limit attenuated accordingly.

8.2 Test Setup

8.2.1 Duty Cycle



8.2.2 Output Power



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8.3 Measurement Procedure:

8.3.1 Duty Cycle

1. Place the EUT on the table and set it in transmitting mode.
2. Set span = Zero
3. RBW = 8MHz, VBW = 8MHz,
4. Detector = Peak

8.4 Output Power

1. Place the EUT on the table and set it in transmitting mode.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
4. Record the max. Reading as observed from Power Meter.
5. Repeat above procedures until all test default channel measured was complete.

8.5 Duty Factor:

Duty Cycle

Mode	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
FSK 100Kbps 249bytes	100.00	0.00	0.00	0.01

FSK 100Kbps 249bytes_LowCH-902.9MHz



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8.6 Output Power:

8.6.1 Peak & Avg

FSK 100Kbps 249bytes

CH	Frequency (MHz)	Power set	Peak Output Power (dBm)	Required Limit (dBm)
Low	902.9	15	13.62	30
Mid	914.9	15	13.49	30
High	926.9	15	13.39	30
CH	Frequency (MHz)	Power set	Avg. Output Power (dBm)	Required Limit (dBm)
Low	902.9	15	13.59	30
Mid	914.9	15	13.46	30
High	926.9	15	13.35	30

*Note:

1. Measured by power meter, cable loss 10.3 dB + Duty cycle factor has been offset to the power meter for Avg. power and cable loss has been offset for Peak power measurement.

2. The antenna gain is grater than 6 dBi, therefore the power limit attenuation has been applied in the test results. 30-(antenna gain-6)=30

8.6.2 EIRP

IC

EIRP FSK 100Kbps 249bytes

CH	Frequency (MHz)	Power set	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit
Low	902.9	15	13.59	-1.69	11.90	4W= 36 dBm
Mid	914.9	15	13.46	-1.69	11.77	4W= 36 dBm
High	926.9	15	13.35	-1.69	11.66	4W= 36 dBm

* Note: EIRP = Average Power + Gain

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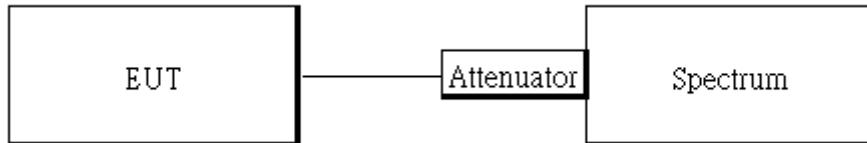
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9 EMISSION BANDWIDTH MEASUREMENT

9.1 Standard Applicable

The minimum 6 dB bandwidth shall be at least 500 kHz .

9.2 Test Setup



9.3 Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

9.3.1 6dB BW measurements

1. The testing follows the Measurement Procedure of the KDB 558074 D01.
2. Set the spectrum analyzer as

RBW= 100 kHz ,
 VBW = 3 X RBW,
 Span= 2 to 5 times of the OBW,
 Sweep=auto, Detector = Peak, and Max hold.
3. Mark the upper and lower frequencies of -6dB.
4. Repeat above procedures until all test default channel is completed.

9.3.2 99% BW measurements

1. The testing follows the Measurement Procedure of the RSS-Gen section 6.7.
2. Set the spectrum analyzer as

RBW= 1 % to 5% of 99%,
 VBW \geq 3 X RBW,
 Span= large enough to capture all products of the modulation process
 Sweep=auto, Detector = Peak, and Max hold.
3. Mark the upper and lower frequencies of 99%.
4. Repeat above procedures until all test default channel is completed.

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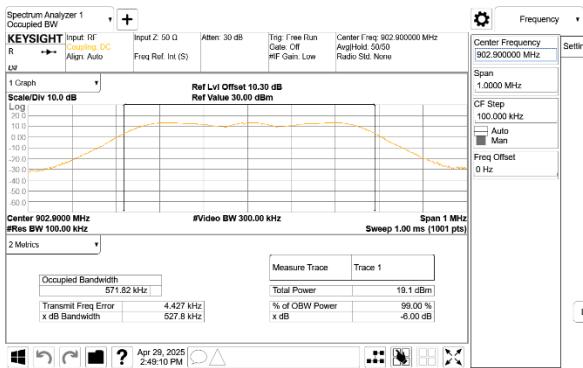
9.4 Measurement Result:

9.4.1 6dB BW measurements

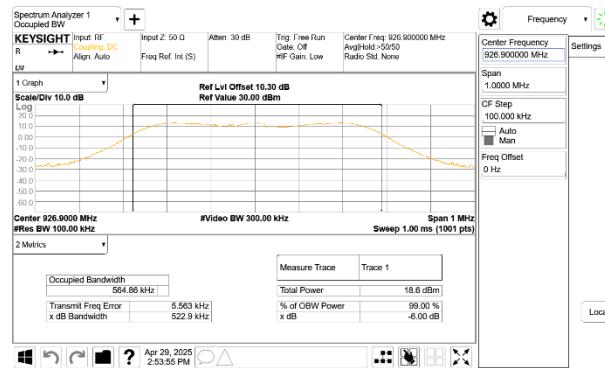
FSK 100Kbps 249bytes

Frequency (MHz)	6dB BW (MHz)	Required BW (MHz)	Result
902.9	0.5278	≥ 0.5	PASS
914.9	0.531	≥ 0.5	PASS
926.9	0.5229	≥ 0.5	PASS

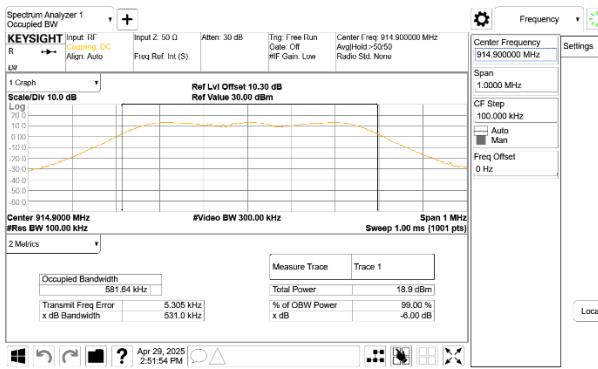
OBW_FSK 100Kbps 249bytes_LowCH-902.9MHz



OBW_FSK 100Kbps 249bytes_HighCH-926.9MHz



OBW_FSK 100Kbps 249bytes_MidCH-914.9MHz



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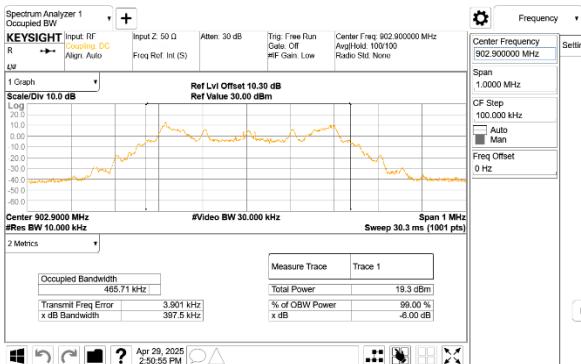
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9.4.2 99% Bandwidth

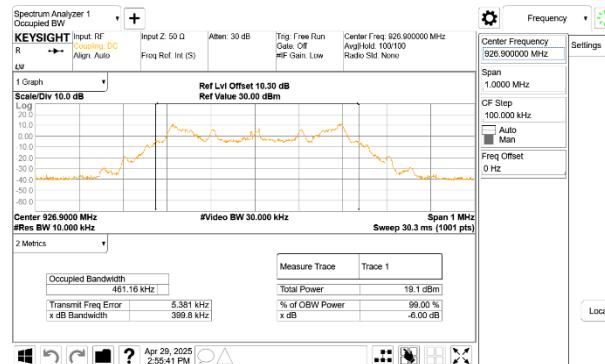
FSK 100Kbps 249bytes

Frequency (MHz)	99%Bandwidth (MHz)
902.9	0.46571
914.9	0.47779
926.9	0.46116

IC OBW_FSK 100Kbps 249bytes _LowCH-902.9MHz



IC OBW_FSK 100Kbps 249bytes _HighCH-926.9MHz



IC OBW_FSK 100Kbps 249bytes _MidCH-914.9MHz



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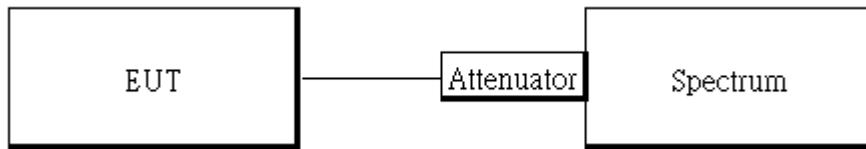
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10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

10.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a) & RSS-Gen §8.10, must also comply with the radiated emission limits specified in §15.209(a) & RSS-Gen §8.9.

10.2 Test Setup



10.3 Measurement Procedure

10.3.1 Reference Level of Emission Limit:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 100kHz & VBW = 300 kHz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

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10.3.2 Conducted Band Edge:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
4. Set start to edge frequency, and stop frequency of spectrum analyzer so as to encompass the spectrum to be examined.
5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Detector = Peak, Sweep = auto
6. Set DL as the limit = OFDM reading on marker of reference level measurement – 20dBm.
7. Mark the highest readings of the emissions outside of 902-928 MHz.
8. Repeat above procedures until all default test channel (low, middle, and high) was complete.

10.3.3 Conducted Spurious Emission:

1. To connect Antenna Port of EUT to Spectrum.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set RBW = 100 kHz & VBW=300 kHz, Detector =Peak, Sweep = Auto
4. Allow trace to fully stabilize.
5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
6. Repeat above procedures until all default test channel measured were complete.

10.4 Measurement Result

FSK 100Kbps 249bytes

Frequency (MHz)	RF Power Density (dBm)	Reference Level of Limit = PSD - 20dB (dBm)
902.9	13.41	-6.59
914.9	13.21	-6.79
926.9	13.06	-6.94

*Note:

1. cable loss as 10.3dB that offsets in the spectrum
2. Refer to next page for plots.

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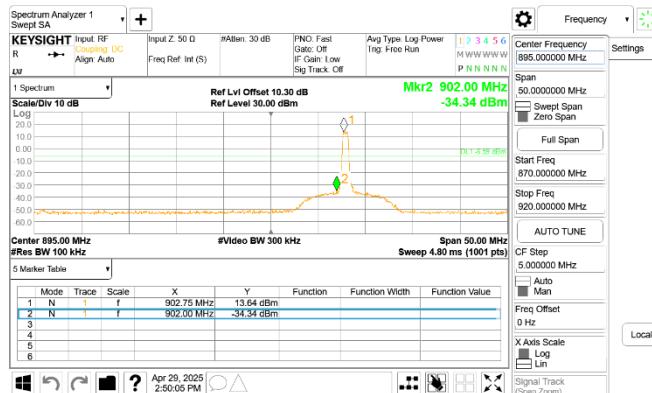
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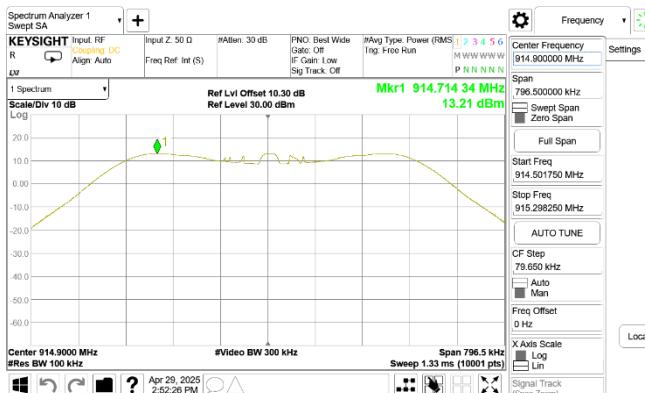
Reference Level _FSK 100Kbps 249bytes_LowCH-902.9MHz



Band Edge_FSK 100Kbps 249bytes_LowCH-902.9MHz



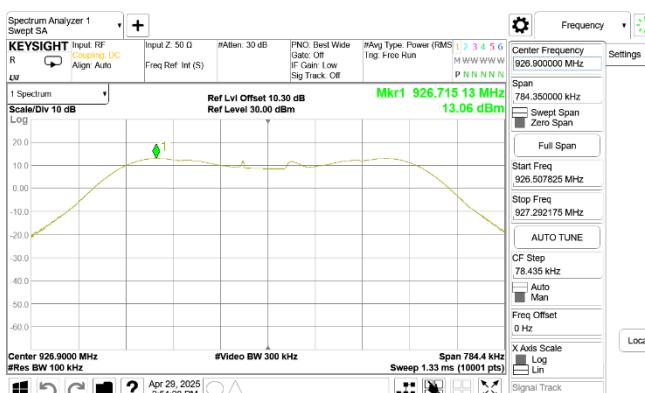
Reference Level _FSK 100Kbps 249bytes_MidCH-914.9MHz



Band Edge_FSK 100Kbps 249bytes_HighCH-926.9MHz



Reference Level _FSK 100Kbps 249bytes_HighCH-926.9MHz



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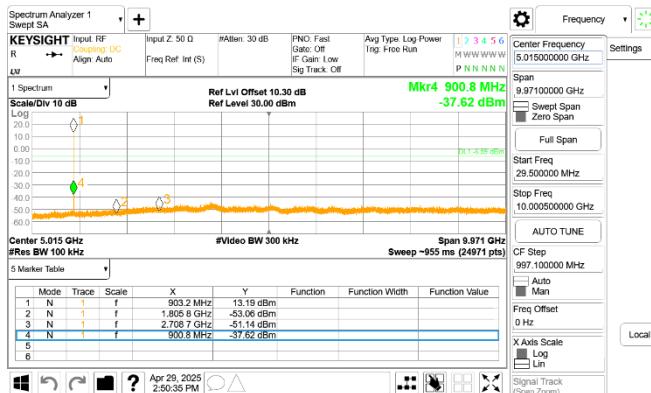
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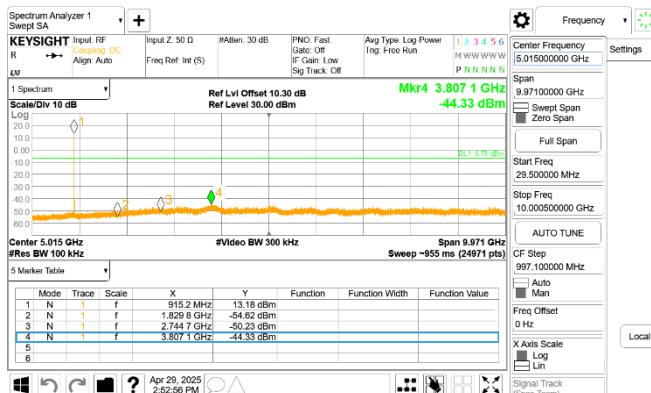
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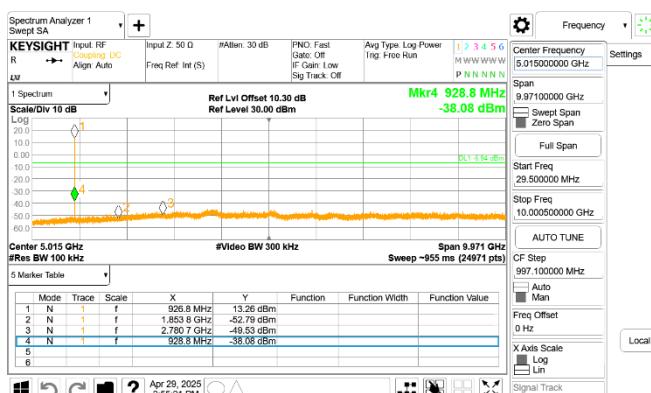
Spurious_Emission_FSK 100Kbps 249bytes_LowCH-902.9MHz



Spurious_Emission_FSK 100Kbps 249bytes_MidCH-914.9MHz



Spurious_Emission_FSK 100Kbps 249bytes_HighCH-926.9MHz



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11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

11.1 Standard Applicable

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. In addition, radiated emissions which fall in the restricted bands must also comply with the §15.209 and RSS-Gen §8.9 Table 5 and 6 limit as below.

And according to §15.33(a) (1) & RSS-Gen §6.13.2.a, for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

Frequency (MHz)	Field strength (microvolts/meter)	Distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

1. The lower limit shall apply at the transition frequencies.

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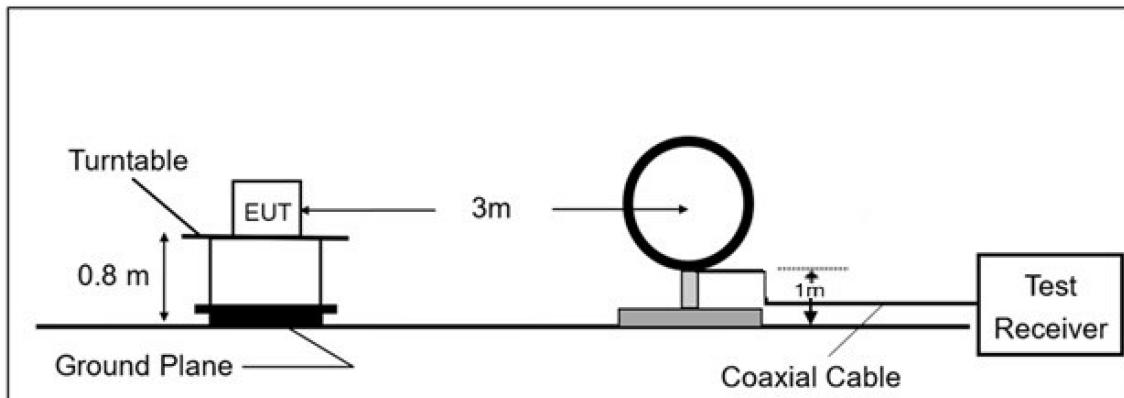
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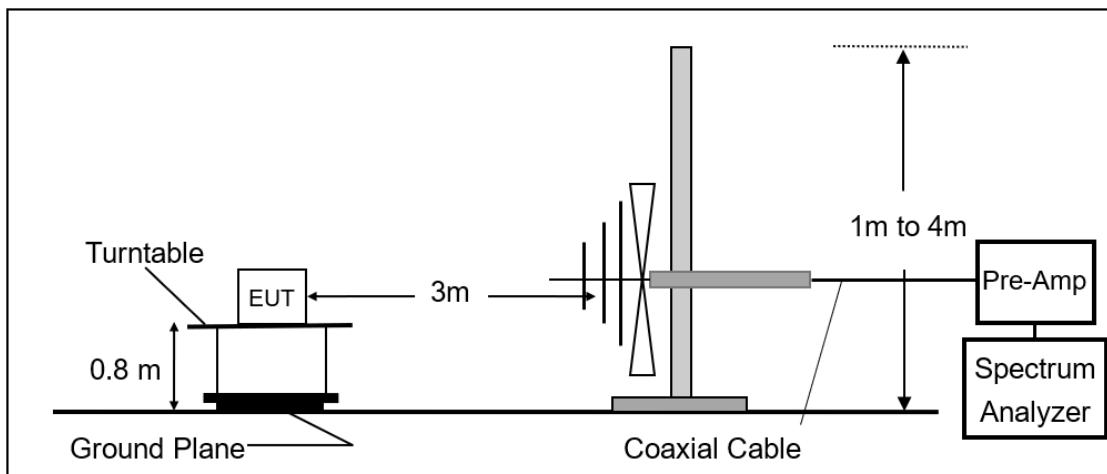
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11.2 Test Setup

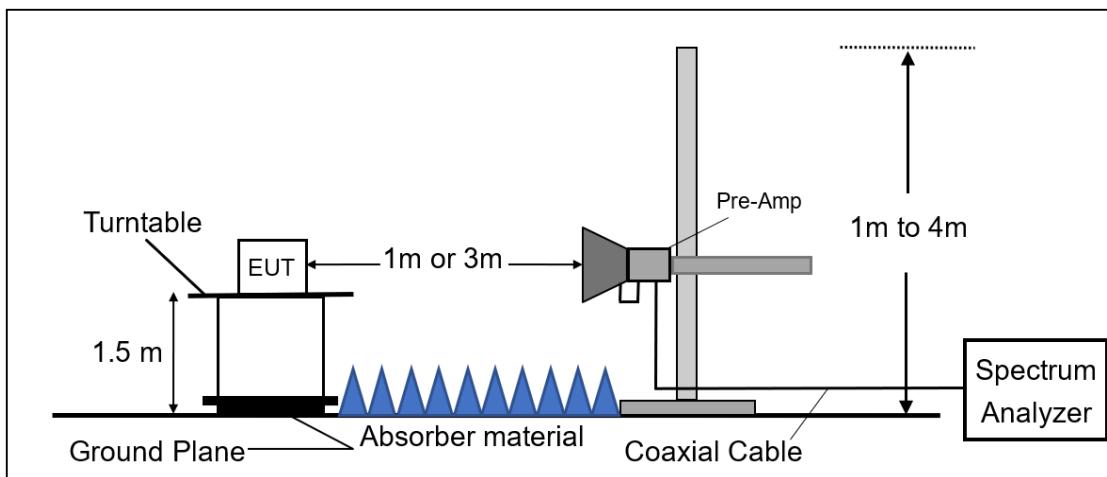
(A) Radiated Emission Test Set-Up, Frequency Below 30MHz.



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



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



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11.3 Measurement Procedure

1. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
2. The EUT was placed on a turn table with 0.8m for frequency < 1GHz and 1.5m for frequency > 1GHz above ground plane.
3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
5. Set the spectrum analyzer as RBW=100 kHz and VBW=300 kHz for Peak Detector
6. (PK) at frequency between 30MHz and 1 GHz.
7. Use receiver mode as RBW=120 kHz for Quasi-peak (QP) at frequency between 30MHz and 1 GHz.
8. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Maximum Emission Measurements at frequency above 1 GHz.
9. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW \geq 1/T (Duty cycle < 98%) for Average Emission Measurements at frequency above 1 GHz.
10. 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.
11. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
12. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
13. Repeat above procedures until all default test channel measured were complete.

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11.4 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:

$$\mathbf{FS = RA + AF + CL - AG}$$

Where FS = Field Strength

CL = Cable Attenuation Factor (Cable Loss)

RA = Reading Amplitude

AG = Amplifier Gain

AF = Antenna Factor

The limit of the emission level is expressed in $dB\mu V/m$, which converts $20 * \log(uV/m)$

Actual $FS(dB\mu V/m) = SPA \cdot Reading\ level(dB\mu V) + Factor(dB)$

$Factor(dB) = Antenna\ Factor(dB/m) + Cable\ Loss(dB) - Pre_Amplifier\ Gain(dB)$

11.5 Test 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) & RSS-GEN §6.13.2 was not reported.

11.6 Measurement Result:

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

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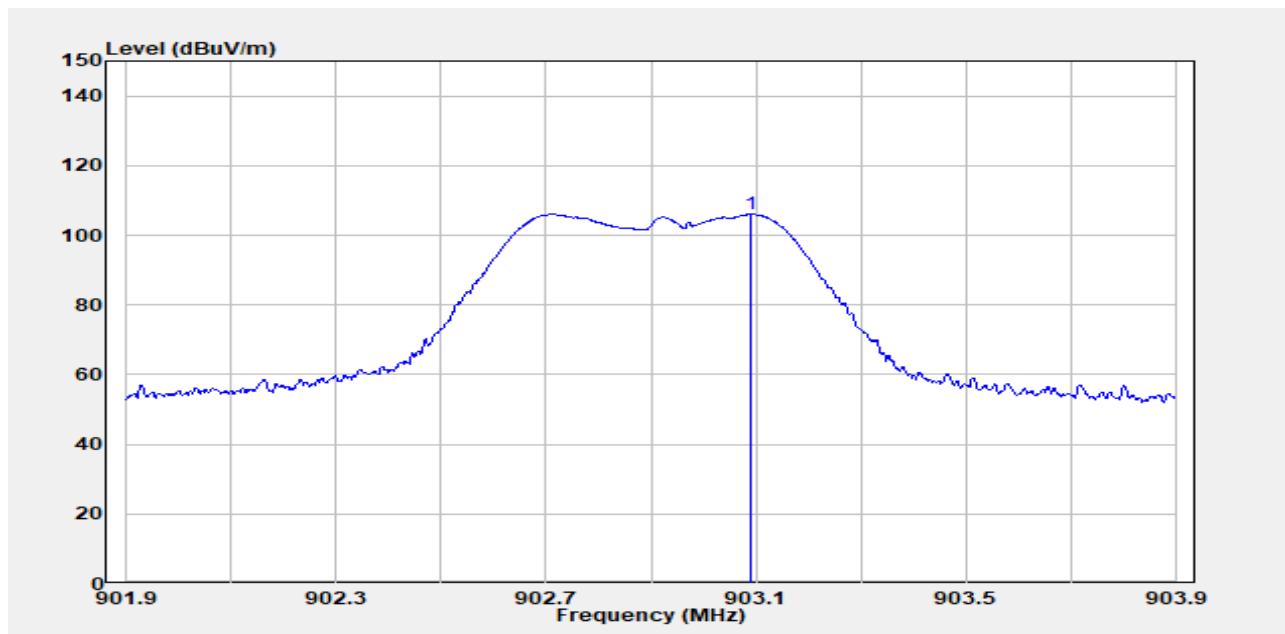
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11.6.1 Radiated Main and Band Edge Measurement Result**Main**

Report Number	:TERF2504001284E2	Test Site	:SAC C
Operation Mode	:FSK 100Kbps 249bytes	Test Date	:2025-04-17
Test Frequency	:902.9 MHz	Temp./Humi.	:22.6°C/55%
Test Mode	:Main	Antenna Pol.	:Vertical
EUT Pol	:H Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
903.09	Peak	105.56	0.38	105.94	-	-

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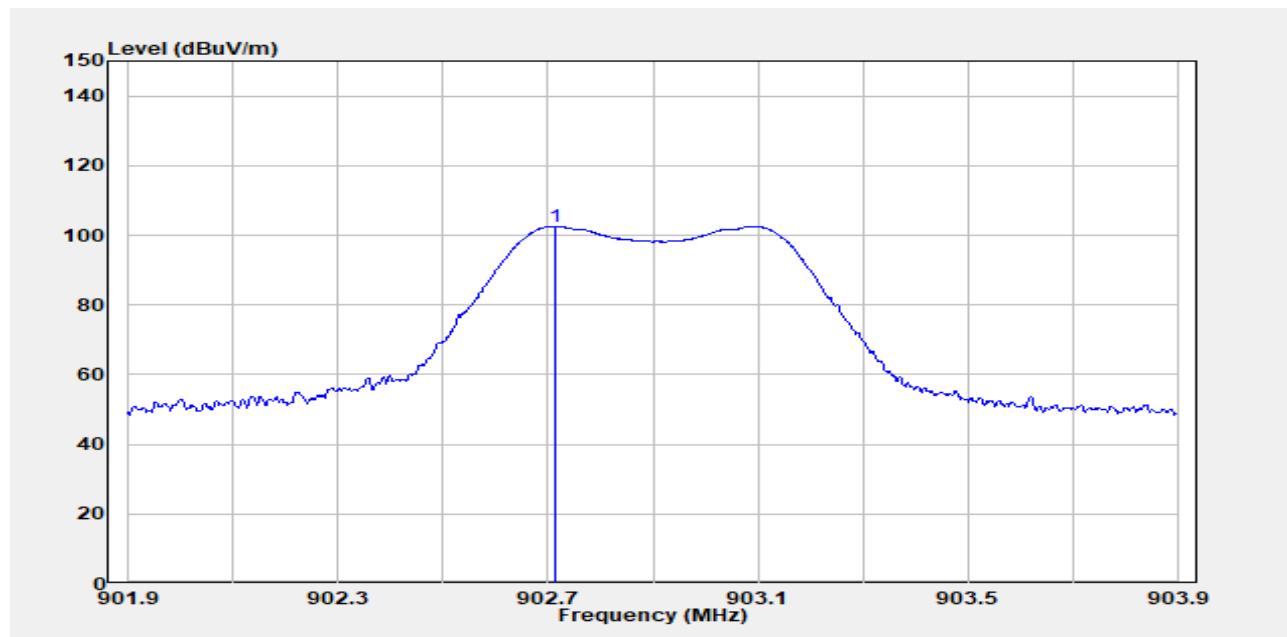
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Report Number :TERF2504001284E2
 Operation Mode :FSK 100Kbps 249bytes
 Test Frequency :902.9 MHz
 Test Mode :Main
 EUT Pol :H Plane

Test Site :SAC C
 Test Date :2025-04-17
 Temp./Humi. :22.6°C/55%
 Antenna Pol. :Horizontal
 Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
902.71	Peak	102.20	0.37	102.57	-	-

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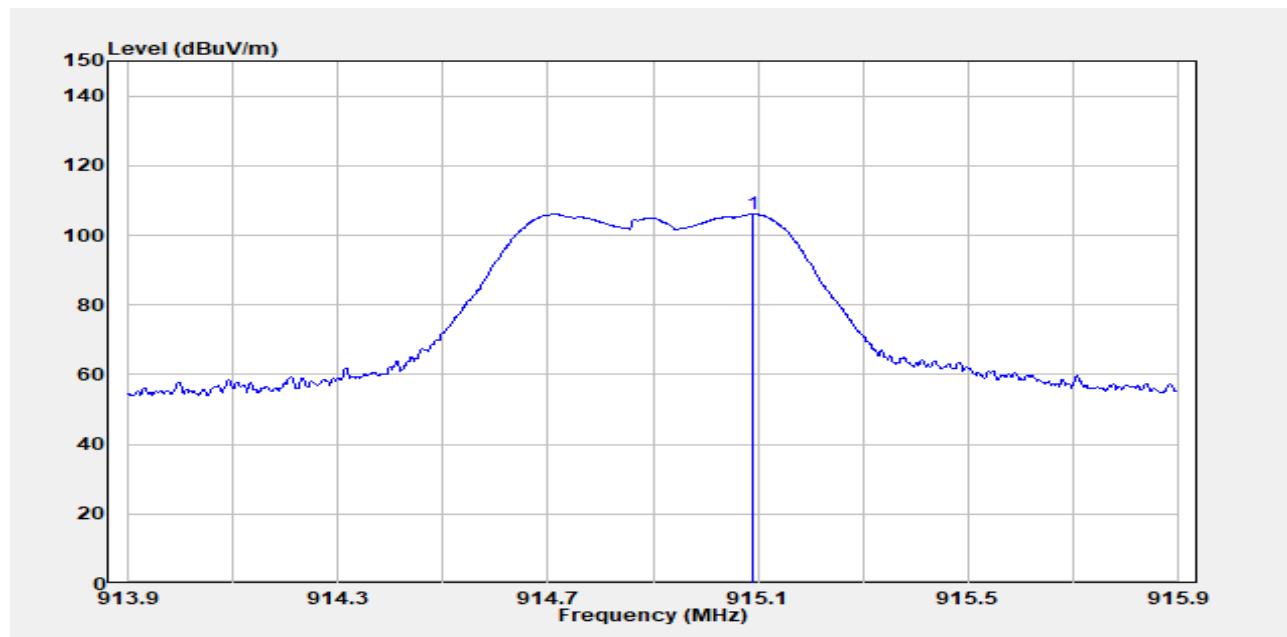
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Report Number :TERF2504001284E2
 Operation Mode :FSK 100Kbps 249bytes
 Test Frequency :914.9 MHz
 Test Mode :Main
 EUT Pol :H Plane

Test Site :SAC C
 Test Date :2025-04-17
 Temp./Humi. :22.6°C/55%
 Antenna Pol. :Vertical
 Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
915.09	Peak	105.13	0.85	105.98	-	-

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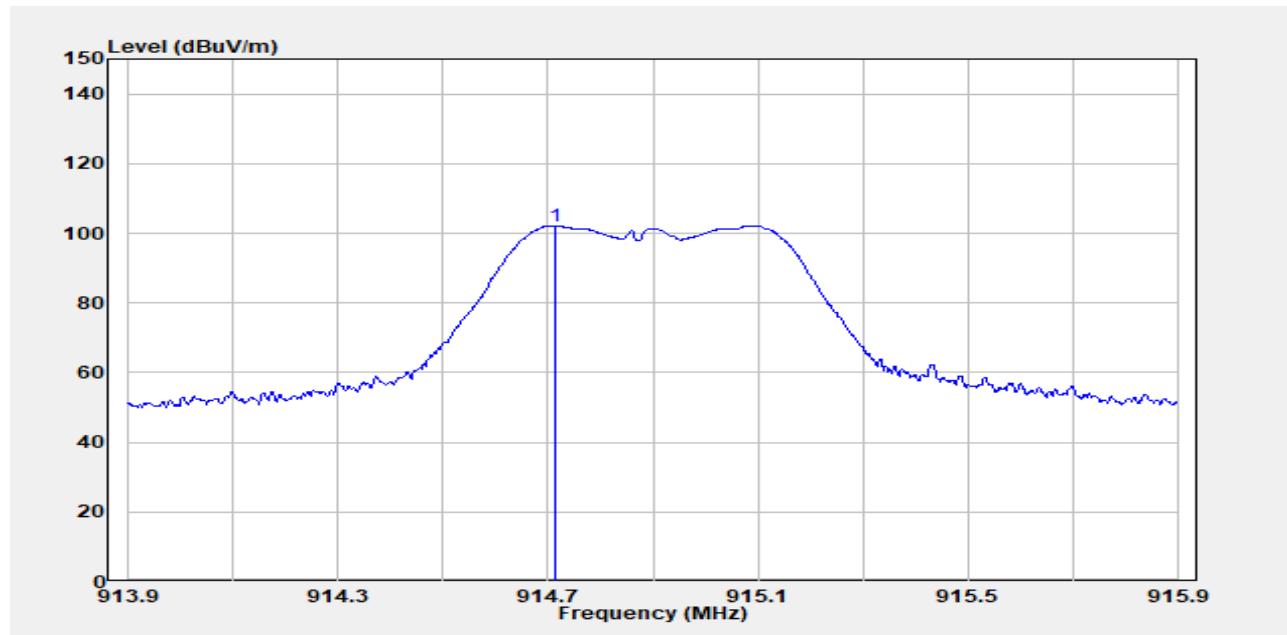
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Report Number :TERF2504001284E2
 Operation Mode :FSK 100Kbps 249bytes
 Test Frequency :914.9 MHz
 Test Mode :Main
 EUT Pol :H Plane
 Test Site :SAC C
 Test Date :2025-04-17
 Temp./Humi. :22.6°C/55%
 Antenna Pol. :Horizontal
 Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
914.71	Peak	101.36	0.84	102.20	-	-

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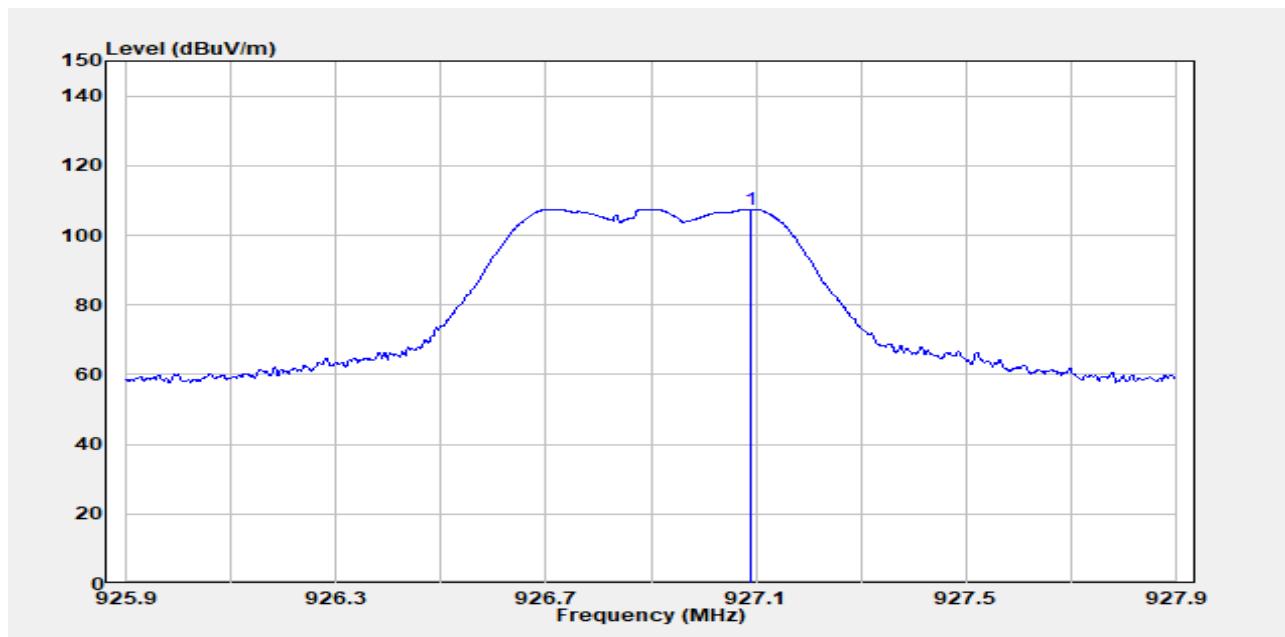
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Report Number :TERF2504001284E2 Test Site :SAC C
 Operation Mode :FSK 100Kbps 249bytes Test Date :2025-04-17
 Test Frequency :926.9 MHz Temp./Humi. :22.6°C/55%
 Test Mode :Main Antenna Pol. :Vertical
 EUT Pol :H Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
927.09	Peak	106.24	1.27	107.51	-	-

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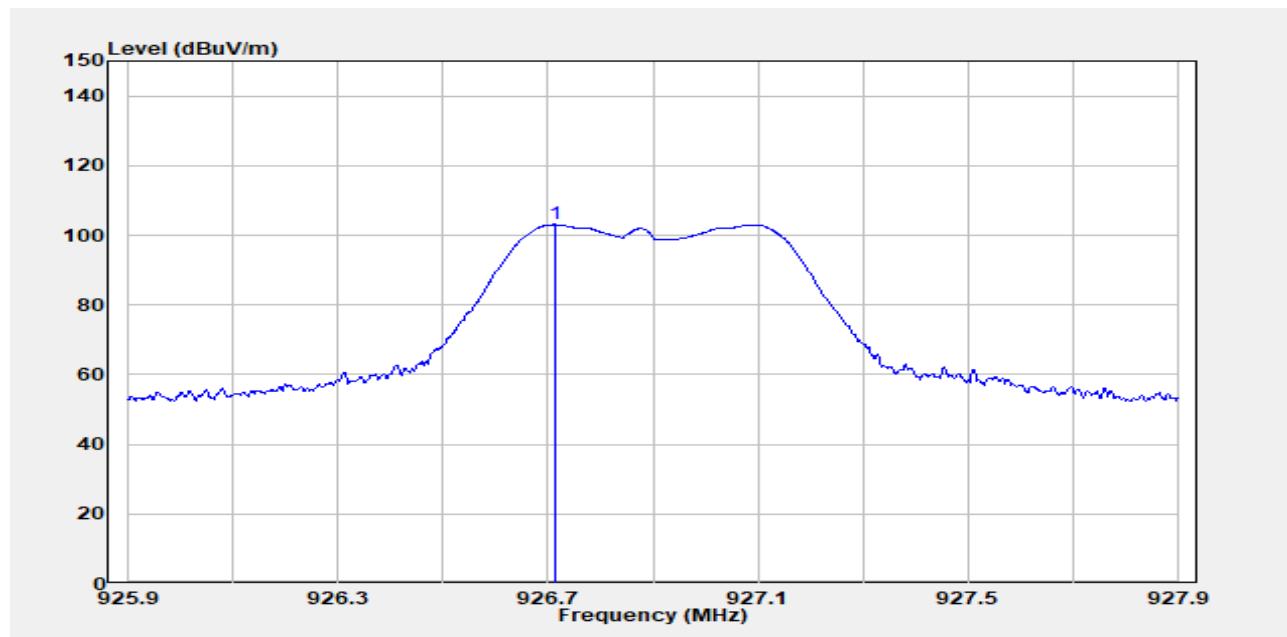
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Report Number :TERF2504001284E2
 Operation Mode :FSK 100Kbps 249bytes
 Test Frequency :926.9 MHz
 Test Mode :Main
 EUT Pol :H Plane

Test Site :SAC C
 Test Date :2025-04-17
 Temp./Humi. :22.6°C/55%
 Antenna Pol. :Horizontal
 Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
926.71	Peak	101.78	1.27	103.05	-	-

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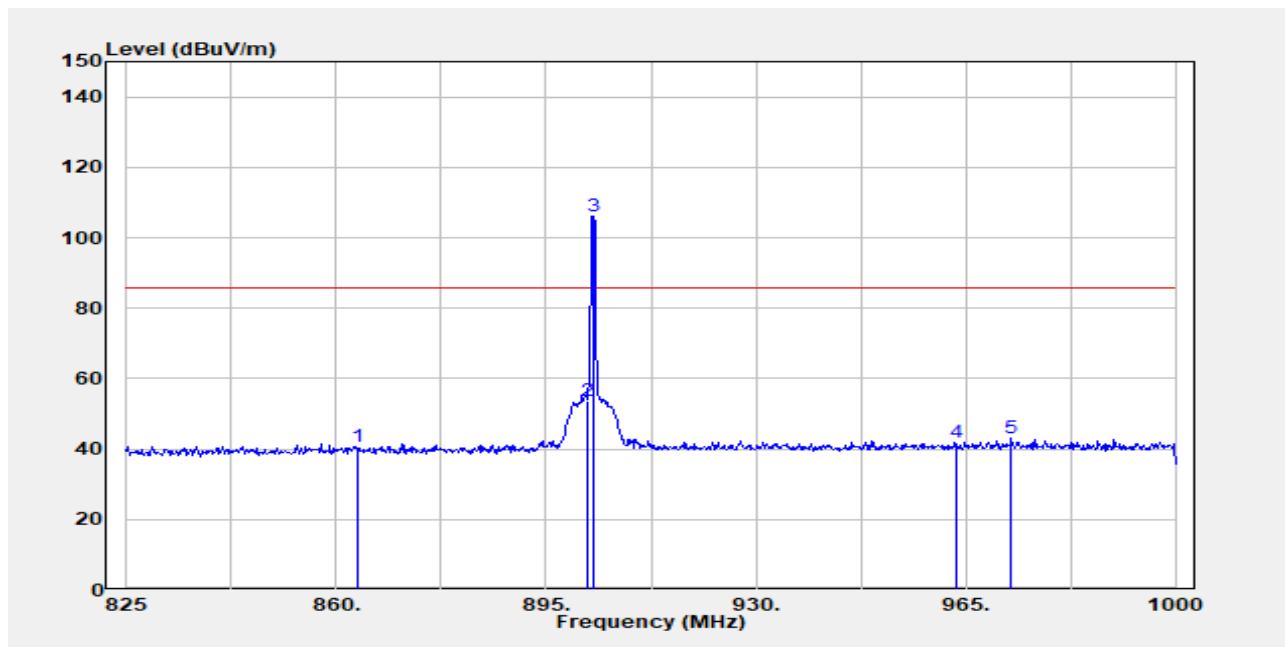
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Bandedge

Report Number	:TERF2504001284E2	Test Site	:SAC C
Operation Mode	:FSK 100Kbps 249bytes	Test Date	:2025-04-17
Test Frequency	:902.9 MHz	Temp./Humi.	:22.6°C/55%
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:H Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
863.50	Peak	40.31	0.41	40.72	85.94	-45.22
902.00	Peak	53.33	0.36	53.69	85.94	-32.25
902.90	Peak	105.71	0.38	106.09	-	-
963.43	Peak	40.48	1.55	42.03	85.94	-43.91
972.70	Peak	41.28	1.67	42.95	85.94	-42.99

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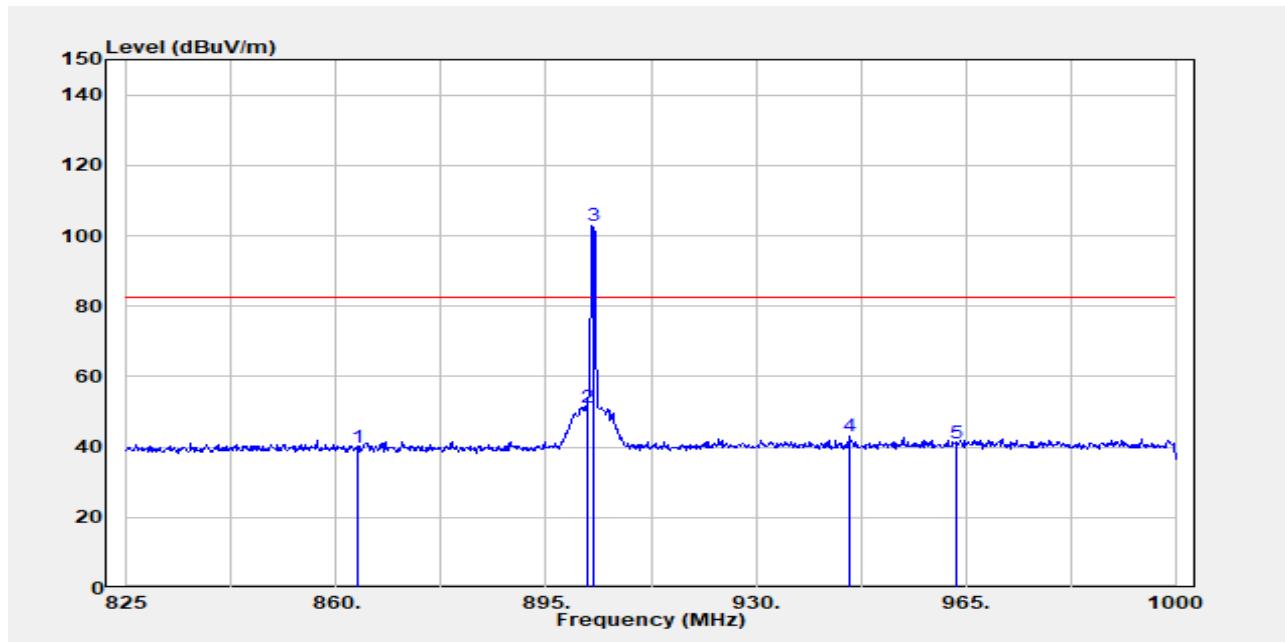
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Report Number :TERF2504001284E2 Test Site :SAC C
 Operation Mode :FSK 100Kbps 249bytes Test Date :2025-04-17
 Test Frequency :902.9 MHz Temp./Humi. :22.6°C/55%
 Test Mode :Bandedge Antenna Pol. :Horizontal
 EUT Pol :H Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
863.50	Peak	39.61	0.41	40.02	82.57	-42.55
902.00	Peak	50.82	0.36	51.18	82.57	-31.39
902.90	Peak	102.31	0.38	102.69	-	-
945.58	Peak	41.78	1.30	43.08	82.57	-39.49
963.43	Peak	39.69	1.55	41.24	82.57	-41.33

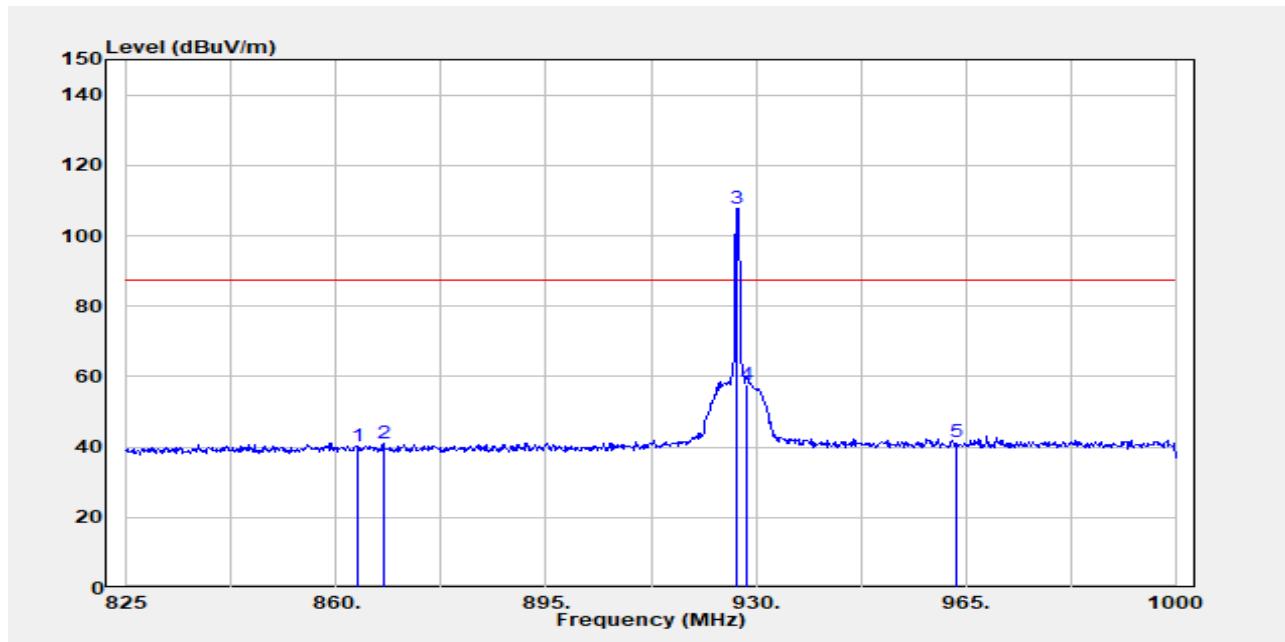
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Report Number :TERF2504001284E2 Test Site :SAC C
 Operation Mode :FSK 100Kbps 249bytes Test Date :2025-04-17
 Test Frequency :926.9 MHz Temp./Humi. :22.6°C/55%
 Test Mode :Bandedge Antenna Pol. :Vertical
 EUT Pol :H Plane Engineer :Alex Li



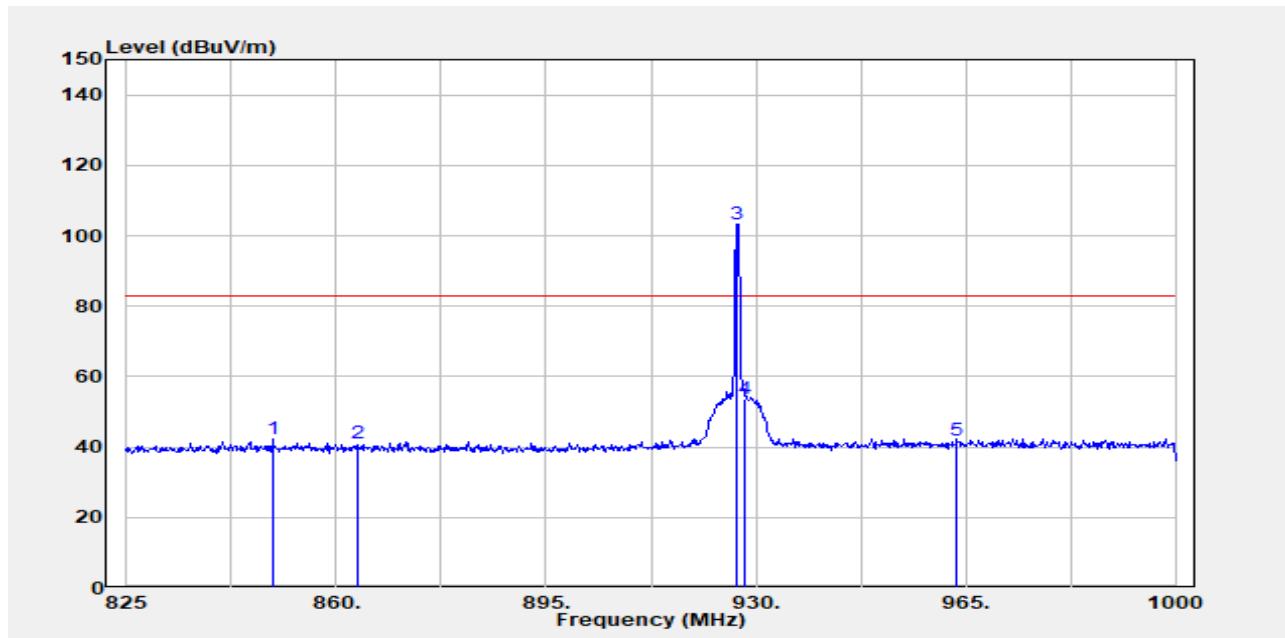
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
863.500	Peak	39.94	0.41	40.35	87.51	-47.16
867.875	Peak	40.76	0.36	41.12	87.51	-46.39
926.900	Peak	106.53	1.27	107.80	-	-
928.425	Peak	56.30	1.27	57.57	87.51	-29.94
963.425	Peak	39.74	1.55	41.29	87.51	-46.22

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Report Number :TERF2504001284E2 Test Site :SAC C
 Operation Mode :FSK 100Kbps 249bytes Test Date :2025-04-17
 Test Frequency :926.9 MHz Temp./Humi. :22.6°C/55%
 Test Mode :Bandedge Antenna Pol. :Horizontal
 EUT Pol :H Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
849.33	Peak	41.99	0.27	42.26	83.05	-40.79
863.50	Peak	40.58	0.41	40.99	83.05	-42.06
926.90	Peak	101.94	1.27	103.21	-	-
928.08	Peak	52.31	1.26	53.57	83.05	-29.48
963.43	Peak	40.15	1.55	41.70	83.05	-41.35

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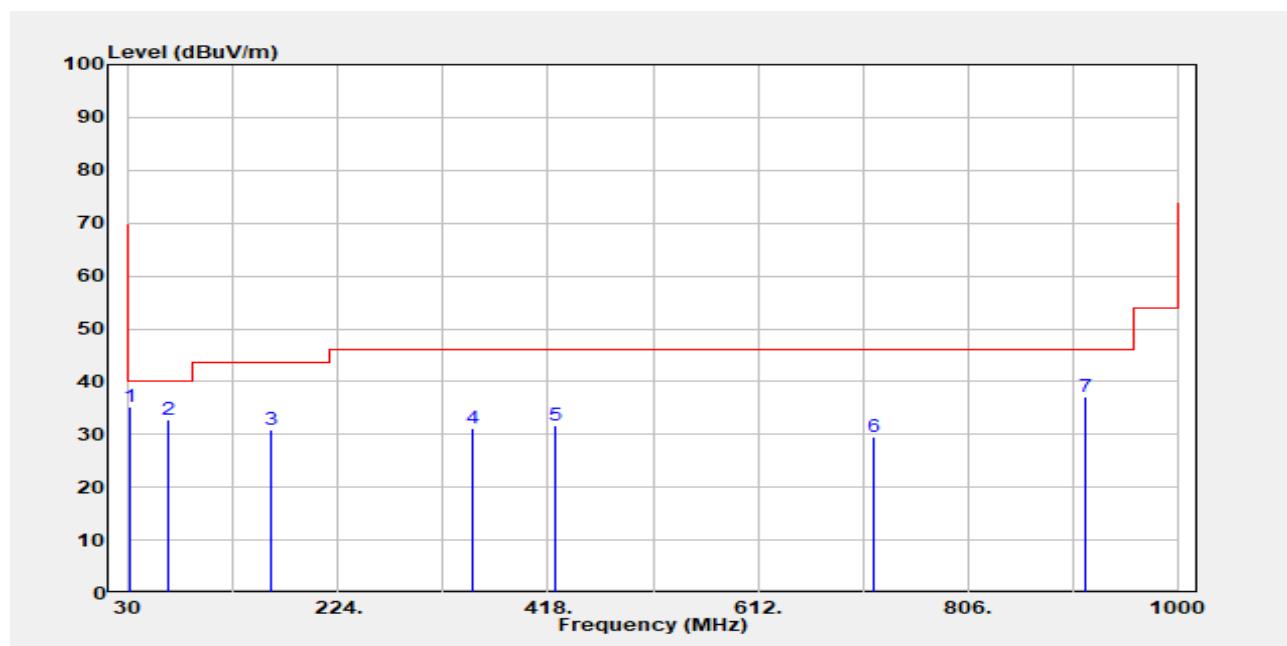
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11.6.2 Radiated Spurious Emission

Report Number	:TERF2504001284E2	Test Site	:SAC C
Operation Mode	:FSK 100Kbps 249bytes	Test Date	:2025-04-17
Test Frequency	:914.9 MHz	Temp./Humi.	:22.6°C/55%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:H Plane	Engineer	:Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
30.97	QP	48.70	-13.39	35.31	40.00	-4.69
65.89	Peak	46.60	-13.79	32.81	40.00	-7.19
161.92	Peak	43.04	-12.02	31.02	43.50	-12.48
348.16	Peak	41.08	-9.89	31.19	46.00	-14.81
423.82	Peak	39.26	-7.48	31.78	46.00	-14.22
718.70	Peak	31.76	-2.16	29.60	46.00	-16.40
914.90	Peak	36.15	0.85	37.00	46.00	-9.00

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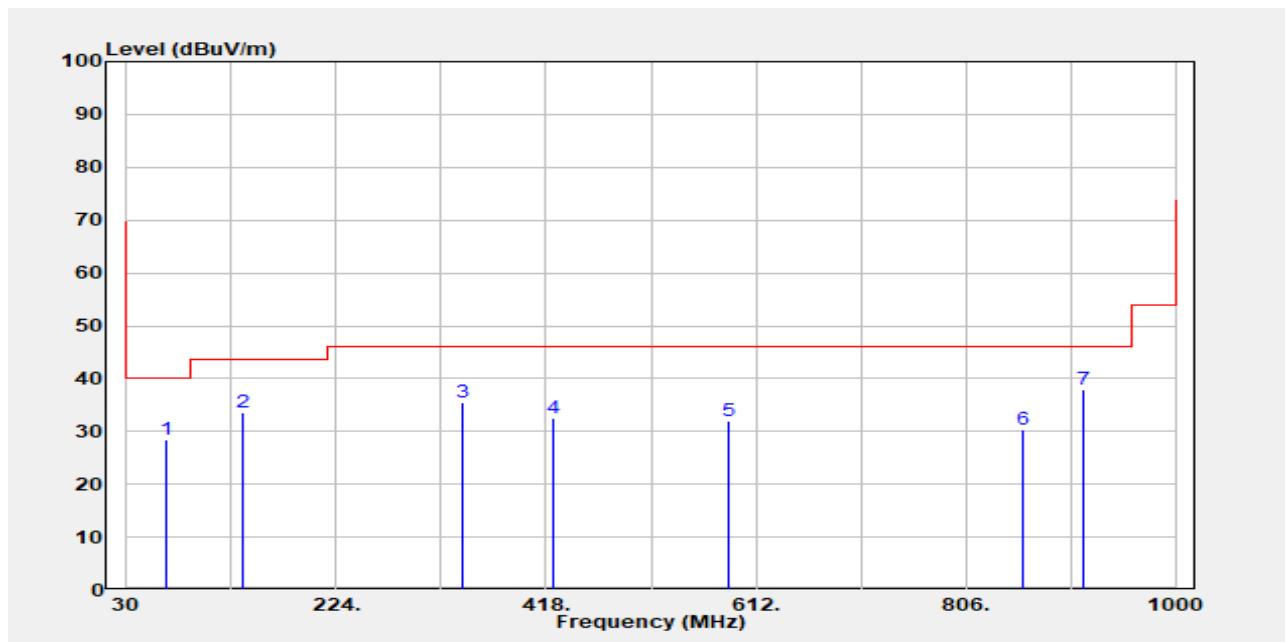
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Report Number :TERF2504001284E2 Test Site :SAC C
 Operation Mode :FSK 100Kbps 249bytes Test Date :2025-04-17
 Test Frequency :914.9 MHz Temp./Humi. :22.6°C/55%
 Test Mode :Tx Antenna Pol. :Horizontal
 EUT Pol :H Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
65.89	Peak	42.12	-13.79	28.33	40.00	-11.67
137.67	Peak	46.41	-12.91	33.50	43.50	-10.00
341.37	Peak	45.36	-9.97	35.39	46.00	-10.61
423.82	Peak	39.95	-7.48	32.47	46.00	-13.53
586.78	Peak	36.05	-3.97	32.08	46.00	-13.92
858.38	Peak	29.95	0.37	30.32	46.00	-15.68
914.90	Peak	37.18	0.85	38.03	46.00	-7.97

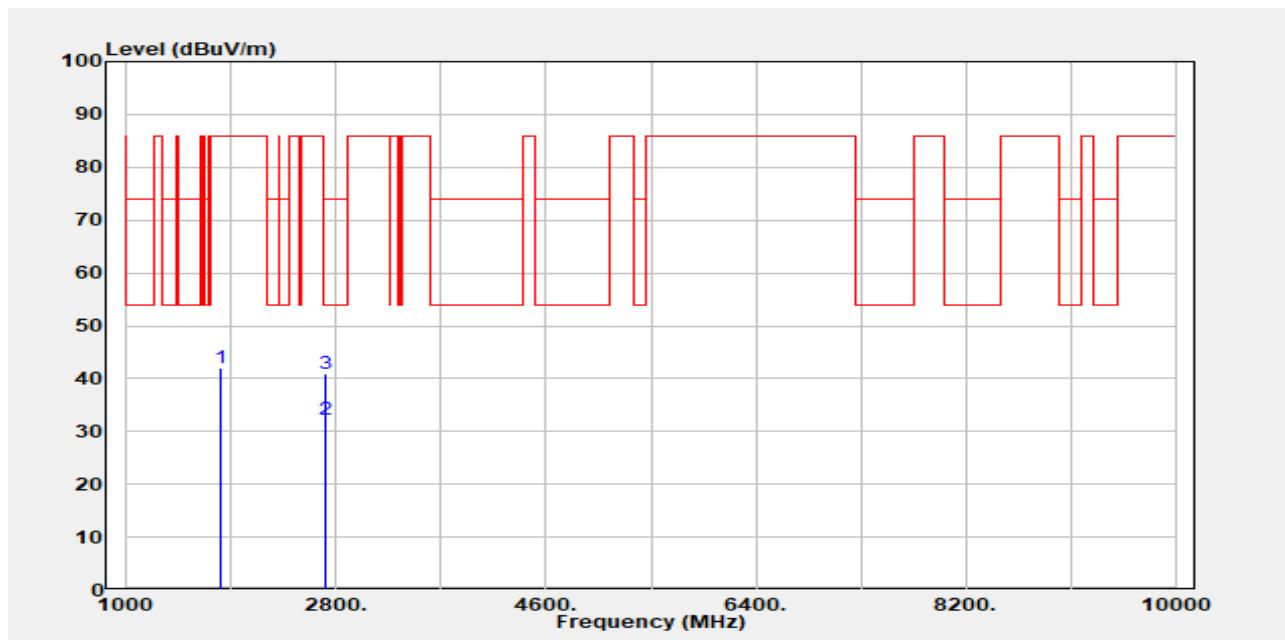
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Report Number :TERF2504001284E2
 Operation Mode :FSK 100Kbps 249bytes
 Test Frequency :902.9 MHz
 Test Mode :Tx
 EUT Pol :H Plane

Test Site :SAC C
 Test Date :2025-04-18
 Temp./Humi. :23.2°C/51%
 Antenna Pol. :Vertical
 Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
1805.800	Peak	48.45	-6.35	42.10	85.94	-43.84
2708.700	Average	35.92	-3.73	32.19	54.00	-21.81
2708.700	Peak	44.59	-3.73	40.86	74.00	-33.14

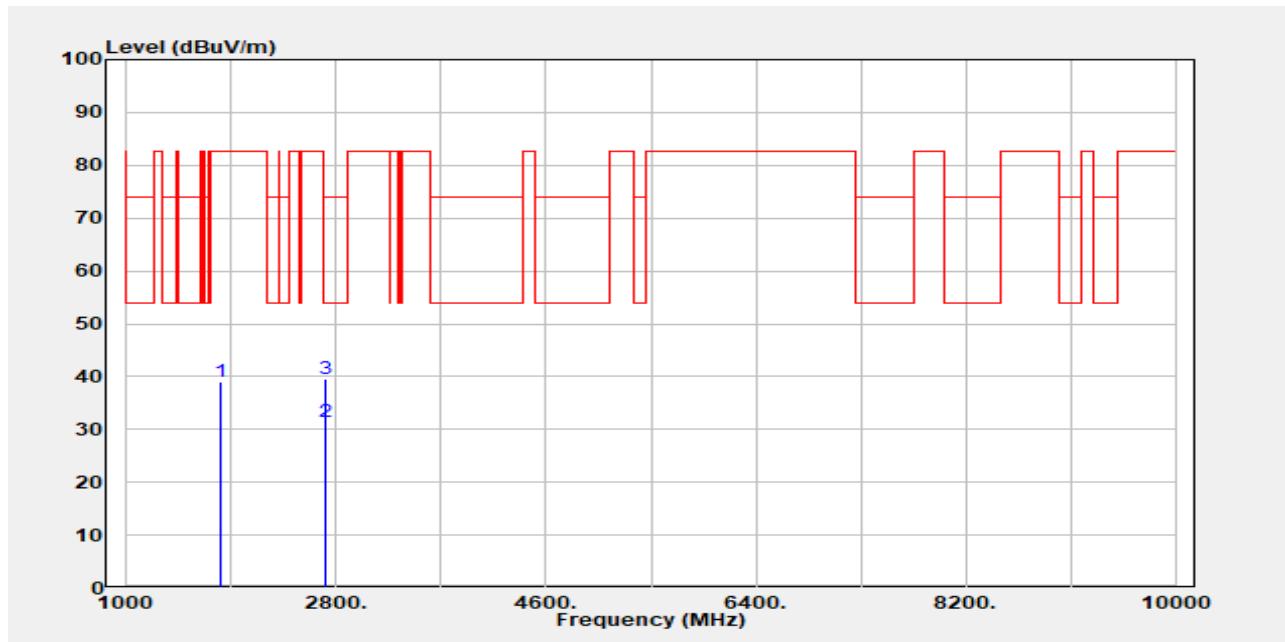
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 Operation Mode :FSK 100Kbps 249bytes
 Test Frequency :902.9 MHz
 Test Mode :Tx
 EUT Pol :H Plane

Test Site :SAC C
 Test Date :2025-04-18
 Temp./Humi. :23.2°C/51%
 Antenna Pol. :Horizontal
 Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
1805.800	Peak	45.36	-6.35	39.01	82.57	-43.56
2708.700	Average	35.12	-3.73	31.39	54.00	-22.61
2708.700	Peak	43.41	-3.73	39.68	74.00	-34.32

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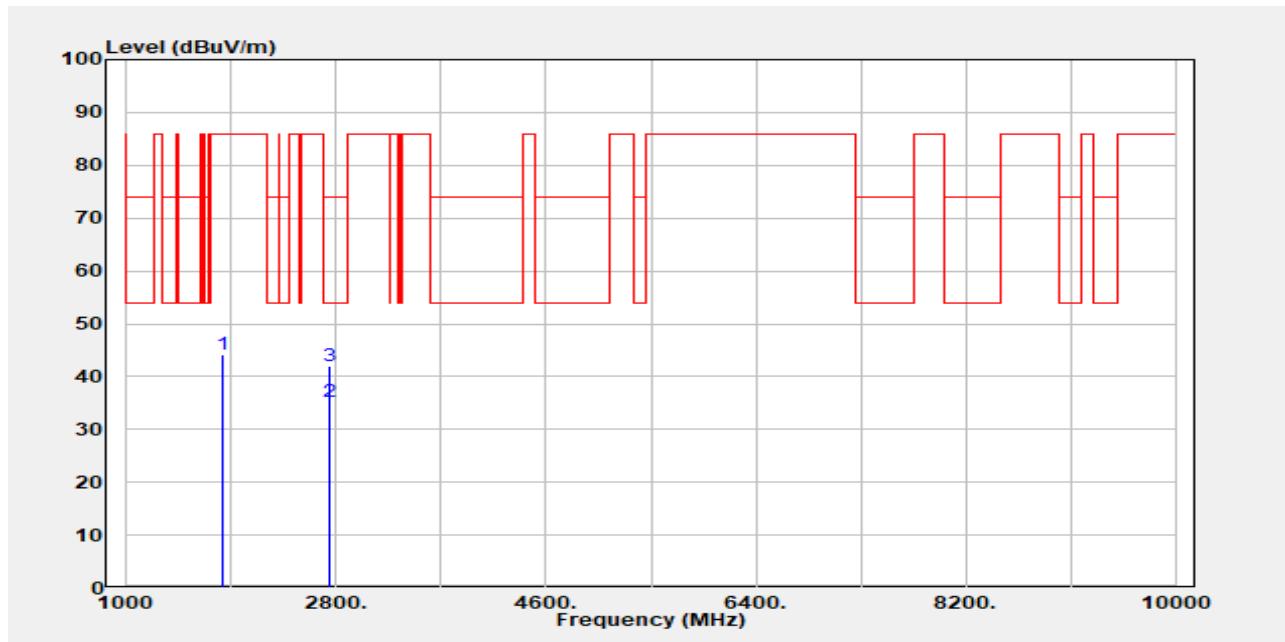
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Report Number :TERF2504001284E2 Test Site :SAC C
 Operation Mode :FSK 100Kbps 249bytes Test Date :2025-04-18
 Test Frequency :914.9 MHz Temp./Humi. :23.2°C/51%
 Test Mode :Tx Antenna Pol. :Vertical
 EUT Pol :H Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
1829.80	Peak	50.66	-6.36	44.30	85.98	-41.68
2744.70	Average	38.66	-3.48	35.18	54.00	-18.82
2744.70	Peak	45.58	-3.48	42.10	74.00	-31.90

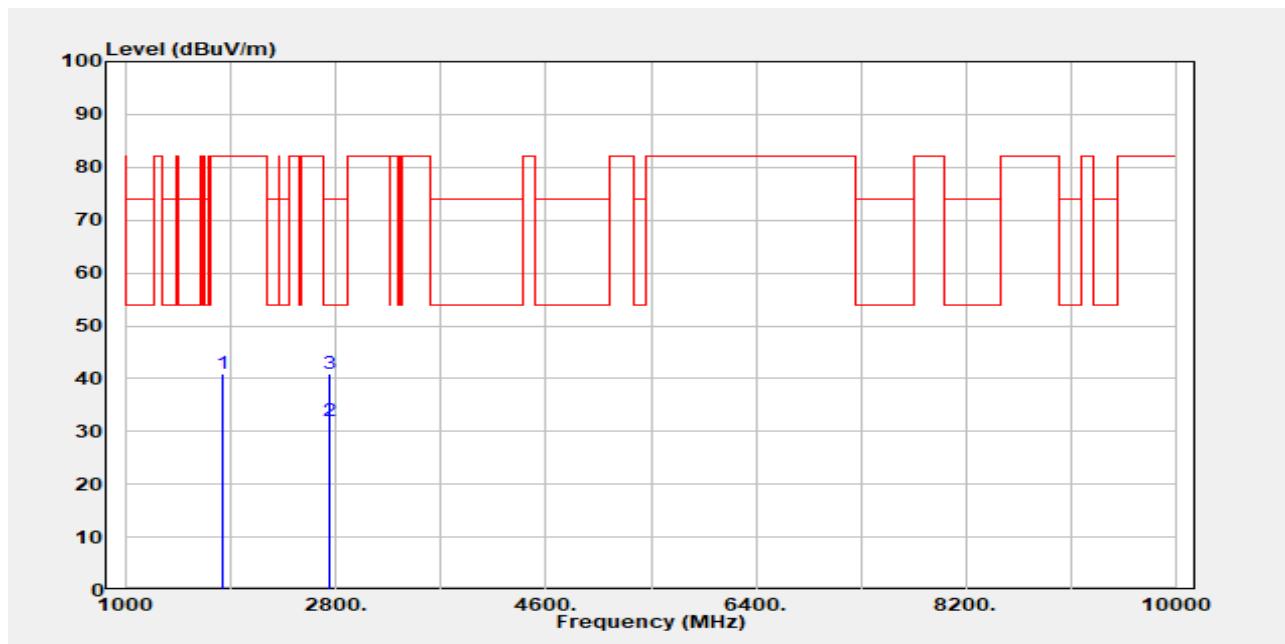
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Report Number :TERF2504001284E2
 Operation Mode :FSK 100Kbps 249bytes
 Test Frequency :914.9 MHz
 Test Mode :Tx
 EUT Pol :H Plane

Test Site :SAC C
 Test Date :2025-04-18
 Temp./Humi. :23.2°C/51%
 Antenna Pol. :Horizontal
 Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
1829.800	Peak	47.36	-6.36	41.00	82.20	-41.20
2744.700	Average	35.48	-3.48	32.00	54.00	-22.00
2744.700	Peak	44.30	-3.48	40.83	74.00	-33.17

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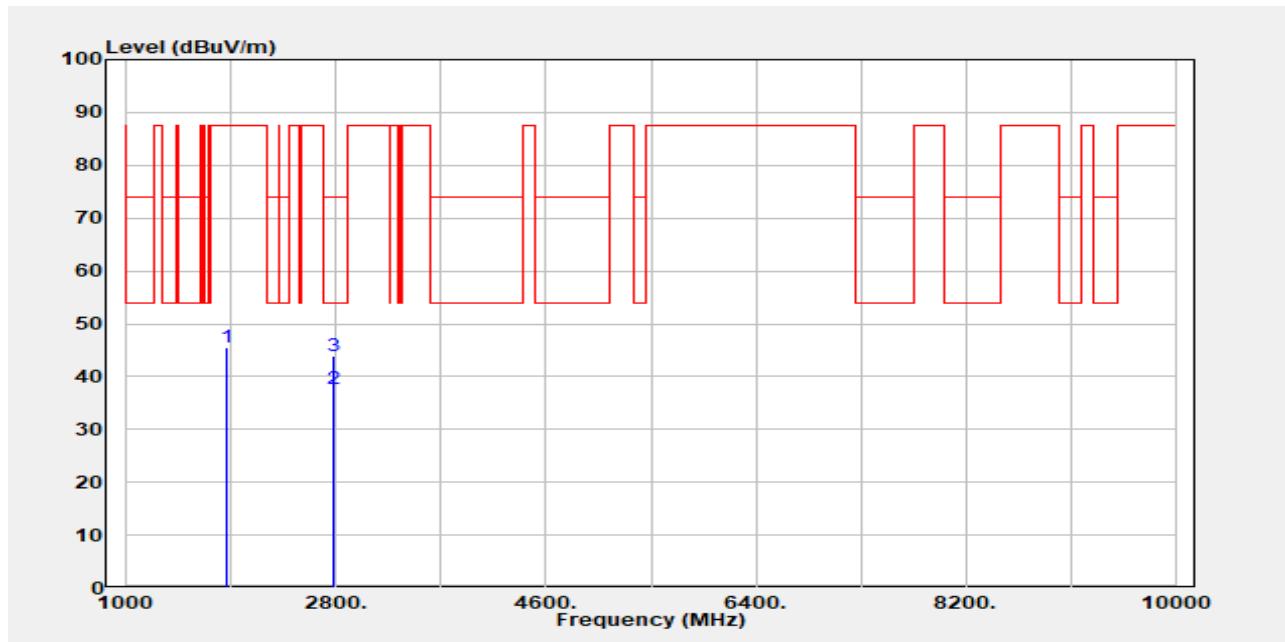
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Report Number :TERF2504001284E2 Test Site :SAC C
 Operation Mode :FSK 100Kbps 249bytes Test Date :2025-04-18
 Test Frequency :926.9 MHz Temp./Humi. :23.2°C/51%
 Test Mode :Tx Antenna Pol. :Vertical
 EUT Pol :H Plane Engineer :Alex Li



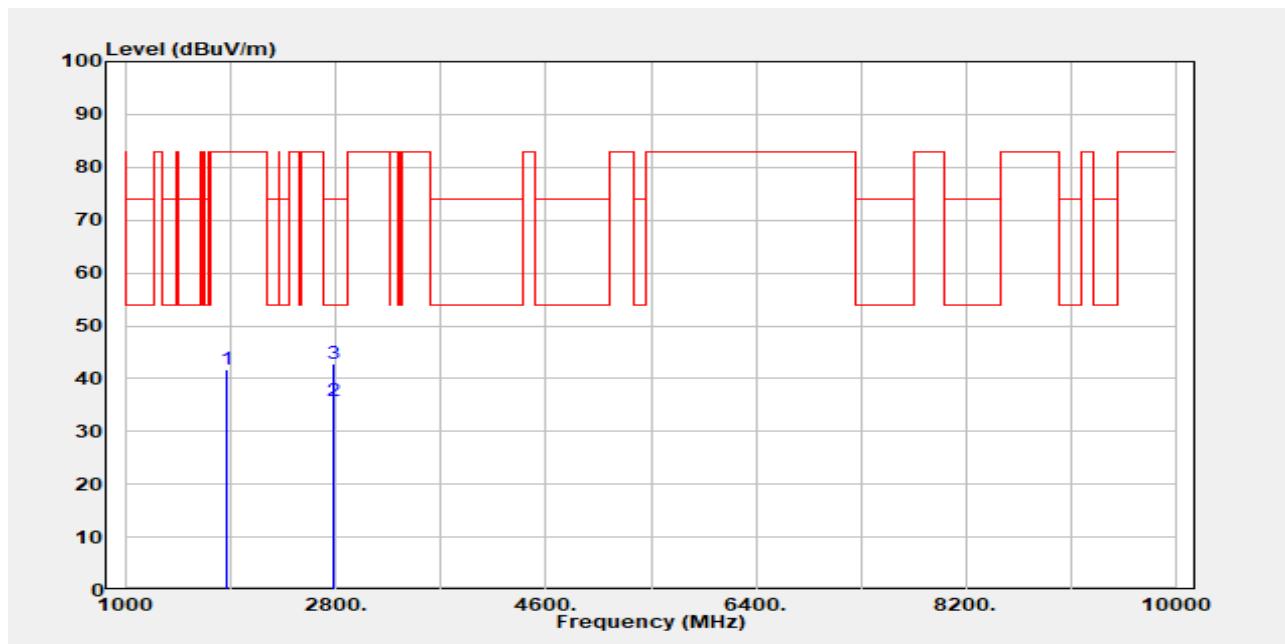
Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
1853.800	Peak	51.85	-6.19	45.66	87.51	-41.85
2780.700	Average	41.01	-3.23	37.77	54.00	-16.23
2780.700	Peak	47.05	-3.23	43.81	74.00	-30.19

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Report Number :TERF2504001284E2 Test Site :SAC C
 Operation Mode :FSK 100Kbps 249bytes Test Date :2025-04-18
 Test Frequency :926.9 MHz Temp./Humi. :23.2°C/51%
 Test Mode :Tx Antenna Pol. :Horizontal
 EUT Pol :H Plane Engineer :Alex Li



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Reading Level dB μ V	Factor dB	Actual FS dB μ V/m	Limit @3m dB μ V/m	Margin dB
1853.800	Peak	47.99	-6.19	41.80	83.05	-41.25
2780.700	Average	38.92	-3.23	35.69	54.00	-18.31
2780.700	Peak	46.03	-3.23	42.79	74.00	-31.21

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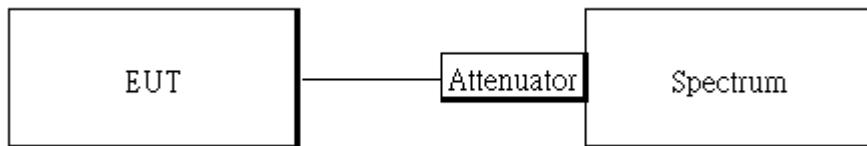
12 POWER SPECTRAL DENSITY

12.1 Standard Applicable:

Per Part 15.247 (e) & RSS-247 section 5.2 b

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3 kHz band during any time interval of continuous transmission.

12.2 Test Setup



12.3 Measurement Procedure:

1. Set analyzer center frequency to DTS channel center frequency.
2. The testing follows the Measurement Procedure of FCC KDB 558074 D01 DTS Meas. Guidance.
3. Set the span to 1.5 times the DTS channel bandwidth.
4. Set the RBW = 3 kHz. & the VBW = 10 kHz
5. Set Detector = peak
6. Sweep time = auto couple.
7. Set Trace mode = max hold
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.

12.4 Measurement Result:

FSK 100Kbps 249bytes

Frequency (MHz)	RF Power Density (dBm/3kHz)	Maximum Limit (dBm/3kHz)	Result
902.9	6.96	8	PASS
914.9	7.75	8	PASS
926.9	7.24	8	PASS

*Note:

1. cable loss as 10.3dB that offsets in the spectrum

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PSD_FSK 100Kbps 249bytes_LowCH-902.9MHz



PSD_FSK 100Kbps 249bytes_MidCH-914.9MHz



PSD_FSK 100Kbps 249bytes_HighCH-926.9MHz



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13 ANTENNA REQUIREMENT

13.1 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.

13.2 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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