

ELECTROMAGNETIC EMISSIONS **COMPLIANCE REPORT**



FCC Applicant:	DIGIMAX INNOVATIVE PRODUCTS LTD. 2F., No.196, Sec.2, Zhongxing Rd., Xindian Dist. New Taipei City
FCC Manufacturer:	Digisine Energytech Co. Ltd. 2F., No.196, Sec.2, Zhongxing Rd., Xindian Dist. New Taipei City
Product Name:	Hearing Aid
Brand Name:	Mimitakara, Digisine, Digimax
Model No.:	DP-6ELX, UP-6ELX
Model Difference:	For marketing segmentation
Report Number:	TERF2305001287ER
FCC ID	2BBAZ-6ELX
Date of EUT Received:	May 19, 2023
Date of Test:	May 22, 2023~June 27, 2023
Issue Date:	July 24, 2023

Men Cary

Approved By

Blue Yand

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.

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		
TERF2305001287ER	00	Original	Jul. 24, 2023	Candice Li			

Note:

- 1 . The remark "*" indicates modification of the report upon requests from certification body.
- 2 · Variant information of model numbers / trademarks 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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GENERAL INFORMATION 1

1.1 **Product Description**

Product Name:	Hearing Aid
Brand Name:	Mimitakara, Digisine, Digimax
Model No.:	DP-6ELX, UP-6ELX
Model Difference:	For marketing segmentation
Hardware Version:	V1
Firmware Version:	V1
EUT Series No.:	Conducted-D000101 Conduction-L: D000103/R: Z000103 Radiated-D000102
Power Supply:	3.7Vdc from Li-ion Rechargeable Battery
Test Software (Name/Version)	AWBTRDLAB / 1.0.9.22

1.2 **RF** Specification

Radio Technology:	BT BR+EDR	
Channel number:	mber: 79 channels	
Modulation type:	GFSK + π/4DQPSK + 8DPSK	
Transmit Power:	6.32 dBm	
Frequency Range:	2.402GHz – 2.480GHz	
Dwell Time:	\leq 0.4s	

1.3 Antenna Designation

Antenna	Supplier	Antenna Freq.		Peak Antenna
Type		Model No. (MHz)		Gain (dBi)
Multilayer Ceramic Antenna	Walsin	RFANT3216120A59F1T	2400~2500	2.93

Note:

Pre-scanned was done on the above antennas, measurements were demonstrated by using the an-1. tenna with the highest gain as the worst case scenarios.

Antenna information is provided by the applicant. 2.

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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 ANSI C63.10:2013

Test Facility 1.5

Laboratory	Test Site Address	Test Site Name	FCC Designa- tion number	IC CAB identifier
		SAC 1		
		SAC 2		
		SAC 3		
	No. 124 Mu Kung Dood, Now Toingi	Conduction 1		
	No.134, Wu Kung Road, New Taipei	Conducted 1	TW0027	
	Industrial Park, Wuku District, New	Conducted 2	100027	TW3702
	Taipei City, Taiwan.	Conducted 3	-	
		Conducted 4		
		Conducted 5		
SGS Taiwan Ltd.		Conducted 6		
Central RF Lab.	No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333	Conduction C	- - - - TW0028	
(TAF code 3702)		SAC C		
		SAC D		
		SAC G		
		Conducted A		
		Conducted B		
	labydan City, Taiwan 555	Conducted C		
		Conducted D]	
		Conducted E	_	
		Conducted F		
		Conducted G		1

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 is no special accessory used while test was conducted.

Equipment Modifications 1.7

There was no modification incorporated into the EUT.

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SYSTEM TEST CONFIGURATION 2

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.

Test Procedure 2.3

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 **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 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.

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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-ane choic 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.

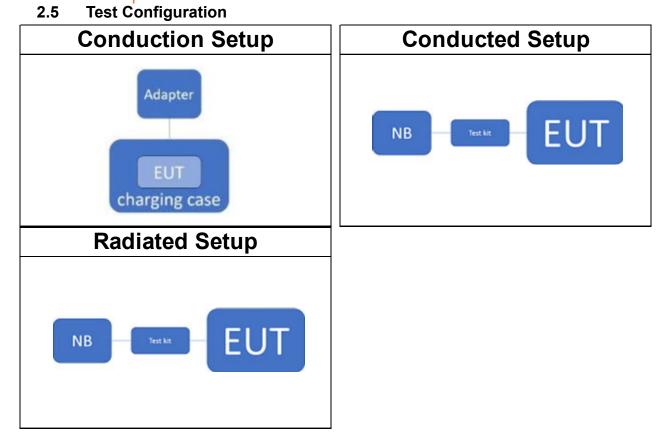
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2.6 Control Unit(s)

AC Power-Line Conducted Emission Test Site: Conduction 1							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
Adapter	SAMSUNG	EP-TA200	R37R7VBJGP6DK3	N/A	N/A		
charging case	Mimitakara	DP-6ELX	N/A	N/A	N/A		
USB cable	JUN YU LINK LIMITED	R14A1009I1	N/A	N/A	N/A		
	C	onducted Emission	Fest Site: Conducted	3			
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
Notebook	Lenovo	T440P	PC-014TAK	N/A	N/A		
Test Kit	SILICON LABS	CP2102	N/A	N/A	N/A		
		Radiated Emissic	on Test Site: SAC 3				
EQUIPMENT TYPE	QUIPMENT TYPE MFR MODEL NUMBER SERIAL NUMBER LAST CAL.		CAL DUE.				
Notebook	Lenovo	T440P	PC-083PYC 15/10	N/A	N/A		
Test Kit	Waveshare	FT232	N/A	N/A	N/A		

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3 SUMMARY OF TEST RESULTS

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b)(1)	Peak Output Power	Compliant
§15.247(a)(1)	Emission Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	Conducted & Radiated Band Edge and Spurious Emission	Compliant
§15.247(a)(1)	Frequency Separation	Compliant
§15.247(a)(1)(iii)	Number of hopping frequencyConTime of OccupancyCon	
§15.203	Antenna Requirement	Compliant

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DESCRIPTION OF TEST MODES 4

Operated in 2400 ~ 2483.5MHz Band 4.1

79 channels are provided for Bluetooth

ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY
1	2402 MHz	21	2422 MHz	41	2442 MHz	61	2462 MHz
2	2403 MHz	22	2423 MHz	42	2443 MHz	62	2463 MHz
3	2404 MHz	23	2424 MHz	43	2444 MHz	63	2464 MHz
4	2405 MHz	24	2425 MHz	44	2445 MHz	64	2465 MHz
5	2406 MHz	25	2426 MHz	45	2446 MHz	65	2466 MHz
6	2407 MHz	26	2427 MHz	46	2447 MHz	66	2467 MHz
7	2408 MHz	27	2428 MHz	47	2448 MHz	67	2468 MHz
8	2409 MHz	28	2429 MHz	48	2449 MHz	68	2469 MHz
9	2410 MHz	29	2430 MHz	49	2450 MHz	69	2470 MHz
10	2411 MHz	30	2431 MHz	50	2451 MHz	70	2471 MHz
11	2412 MHz	31	2432 MHz	51	2452 MHz	71	2472 MHz
12	2413 MHz	32	2433 MHz	52	2453 MHz	72	2473 MHz
13	2414 MHz	33	2434 MHz	53	2454 MHz	73	2474 MHz
14	2415 MHz	34	2435 MHz	54	2455 MHz	74	2475 MHz
15	2416 MHz	35	2436 MHz	55	2456 MHz	75	2476 MHz
16	2417 MHz	36	2437 MHz	56	2457 MHz	76	2477 MHz
17	2418 MHz	37	2438 MHz	57	2458 MHz	77	2478 MHz
18	2419 MHz	38	2439 MHz	58	2459 MHz	78	2479 MHz
19	2420 MHz	39	2440 MHz	59	2460 MHz	79	2480 MHz
20	2421 MHz	40	2441 MHz	60	2461 MHz		

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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 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.
- Investigation has been done on all the possible configurations for searching the worst case. 4

AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE					
Peak Output Power, 20dB Band Width, Spurious Emission								
0 to 78	0,39,78	GFSK	DH5					
0 to 78	0,39,78	π/4-DQPSK	2DH5					
0 to 78	0,39,78	8-DPSK	3DH5					
•	Band Edge							
0 to 78	0,78	GFSK/8-DPSK	DH5/3DH5					
	Frequency Separat	ion	•					
0 to 78	0,1,2,38,39,40,76,77, 78	GFSK π/4-DQPSK 8-DPSK	DH5 2DH5 3DH5					
Number of Hopping Frequency, Hopping Band edge								
0 to 78	0 to 78	GFSK/8-DPSK	DH5/3DH5					
Ti	me of Occupancy(Dwe	ell time)						
		GFSK	DH1/DH3/DH5					
0 to 78	39	π/4-DQPSK	2DH1/2DH3/2DH					
		8-DPSK	3DH1/3DH3/3DH					
AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE					
RADIATE	D EMISSION TEST (B	BELOW 1 GHz)						
0 to 78	39	GFSK	DH5					
RADIATE	D EMISSION TEST (A	BOVE 1 GHz)						
0 to 78	0,39,78	GFSK/8-DPSK	DH5/3DH5					
	AVAILABLE CHANNEL Peak Output Po 0 to 78 0 to 78 0 to 78 0 to 78 0 to 78 0 to 78 Number of H 0 to 78 Ti 0 to 78 AVAILABLE CHANNEL RADIATE 0 to 78 RADIATE	AVAILABLE CHANNELTESTED CHANNELPeak Output Power, 20dB Band Width0 to 780,39,780 to 780,39,780 to 780,39,780 to 780,39,780 to 780,39,780 to 780,78Frequency Separat0 to 780,1,2,38,39,40,76,77, 780 to 780 to 780 to 780 to 780 to 780 to 78O to 7839AVAILABLE CHANNELTESTED CHANNELAVAILABLE CHANNELTESTED CHANNEL0 to 7839AVAILABLE CHANNELTESTED CHANNEL0 to 7839AVAILABLE CHANNELTESTED CHANNELRADIATED EMISSION TEST (F0 to 7839	AVAILABLE CHANNELTESTED CHANNELMODULATIONPeak Output Power, 20dB Band Width, Spurious Emission0 to 780,39,78GFSK0 to 780,39,78m/4-DQPSK0 to 780,39,788-DPSK0 to 780,78GFSK/8-DPSKFrequency Separation0 to 780,12,38,39,40,76,77, 78GFSK m/4-DQPSK 8-DPSK0 to 780,1,2,38,39,40,76,77, 78GFSK 8-DPSK 8-DPSKNumber of Hopping Frequency, Hopping Band edge 0 to 78GFSK/8-DPSK0 to 780 to 78GFSK/8-DPSKNumber of Occupancy(Dwell time)GFSK 8-DPSK0 to 7839GFSKAVAILABLE CHANNELTESTED CHANNELMODULATIONAVAILABLE CHANNELTESTED CHANNELMODULATIONRADIATED EMISSION TEST (BELOW 1 GHz)0 to 78390 to 7839GFSK					

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MEASUREMENT UNCERTAINTY 5

Test Items	ι	Incertair	nty
AC Power Line Conducted Emission	+/-	2.32	dB
Output Power measurement	+/-	1	dB
Emission Bandwidth	+/-	1.53	Hz
Undesignable radiated emission measurement	+/-	1.68	dB
Frequency Separation	+/-	1.53	Hz
Number of hopping frequency	+/-	1.53	Hz
Time of Occupancy	+/-	1.53	Hz
Temperature	+/-	0.7	°C
Humidity	+/-	3	%
DC / AC Power Source		1	%

Radiated Spurio	us Er	nission	Meas	urement Uncertainty
	+/-	2.8	dB	9kHz~30MHz
Polarization: Vertical	+/-	4.82	dB	30MHz - 1000MHz
	+/-	4.37	dB	1GHz - 18GHz
	+/-	4.21	dB	18GHz - 40GHz
	+/-	2.8	dB	9kHz~30MHz
Polarization: Horizontal	+/-	4.54	dB	30MHz - 1000MHz
	+/-	4.37	dB	1GHz - 18GHz
	+/-	4.21	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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MEASUREMENT EQUIPMENT USED 6

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	02/18/2023	02/17/2024	
Pulse Limiter	SCHWARZBECK	VTSD 9561F-N	793	06/22/2023	06/21/2024	
LISN	SCHWARZBECK	NSLK 8127	01040	08/23/2022	08/22/2023	
Coaxial Cables	EMC Instruments Corp.	EMCCFD300-BM- BM-3000	161207	06/22/2023	06/21/2024	
Test Software	audix	e3	Ver. 9 210322	N.C.R	N.C.R	

6.2 **Conducted Measurement**

Conducted Emission Test Site: Conducted 3						
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.	
PXA Spectrum Analyzer	Keysight	N9030B	MY61330494	03/20/2023	03/19/2024	
Test Software	SGS	Radio Test Software	Ver. 21	N.C.R	N.C.R	
Power Meter	Anritsu	ML2496A	2138003	09/29/2022	09/28/2023	
Power Sensor	Anritsu	MA2411B	1911393	09/29/2022	09/28/2023	
Power Sensor	Anritsu	MA2411B	1911394	09/29/2022	09/28/2023	
DC Block	Mini-Circuits	BLK-18-S+	1	12/13/2022	12/12/2023	

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Radiated Measurement 6.3

Radiated Emission Test Site: SAC 3						
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.	
Horn Antenna	SCHWARZBECK	BBHA9170	184	12/30/2022	12/29/2023	
Horn Antenna	SCHWARZBECK	BBHA9120D	1441	09/27/2022	09/26/2023	
Bi-log Antenna	SCHWARZBECK	VULB9168	378	08/15/2022	08/14/2023	
Loop Antenna	ETS.LINDGREN	6502	148045	10/05/2022	10/04/2023	
Spectrum Analyzer	Agilent	E4446A	MY51100003	10/28/2022	10/27/2023	
EMI Test Receiver	R&S	ESCI 7	100759	08/22/2022	08/21/2023	
Pre-Amplifier	EMC Instruments	EMC118A45SEE	980868	12/13/2022	12/12/2023	
Pre-Amplifier	EMC Instruments	EMC184045B	980135	10/27/2022	10/26/2023	
Pre-Amplifier	HP	8447D	2944A07676	12/13/2022	12/12/2023	
Attenuator	Mini-Circuit	BW-S10W2+	4	12/13/2022	12/12/2023	
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	12/13/2022	12/12/2023	
High Pass Filter	WI	WHKX4.0/18G-10SS	22	12/13/2022	12/12/2023	
Coaxial Cable	Huber Suhner	SUCOFLEX 104PEA	MY4251/4PEA	12/13/2022	12/12/2023	
Coaxial Cable	EMCInstruments	EMC 107-SM-SM- 500	221104	12/13/2022	12/12/2023	
Coaxial Cable	EMCInstruments	EMC 107-SM-SM- 1000	221103	12/13/2022	12/12/2023	
Coaxial Cable	EMCInstruments	EMC 107-SM-SM- 1500	221110	12/13/2022	12/12/2023	
Coaxial Cable	EMCInstruments	EMC 107-SM-SM- 8000	221109	12/13/2022	12/12/2023	
Site Cal	SGS	SAC 3	N/A	01/01/2023	12/31/2023	
Test Software	audix	e3	Ver. 9 210322	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 within 150 kHz to 30MHz shall not exceed the limit table as below.

Frequency range	Limits dB(uV)			
MHz	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		
NL (

Note

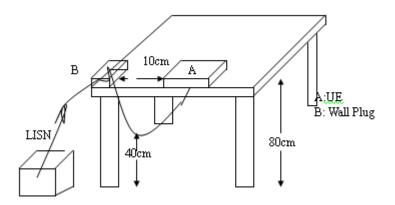
1. The lower limit shall apply at the transition frequencies

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 63.10:2013.
- 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



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 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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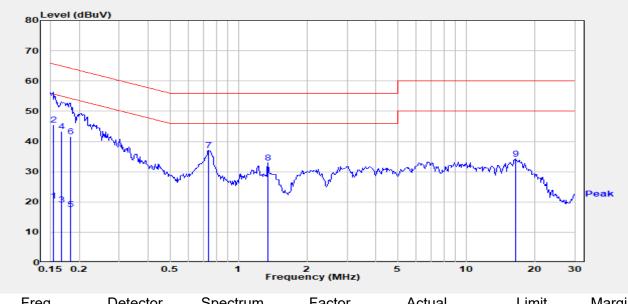
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Report Number : TERF2305001287ER Test Mode :Operation (BT) :120V/60Hz Power Probe :L

Test Site :Conduction 1 Test Date :2023-06-27 Temp./Humi. :26.9°C/59% Engineer :Nick Lin



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV	dBµV	dB
0.153	Average	10.23	10.25	20.48	55.81	-35.33
0.153	QP	35.34	10.25	45.59	65.81	-20.22
0.167	Average	8.79	10.25	19.04	55.11	-36.07
0.167	QP	33.07	10.25	43.32	65.11	-21.79
0.183	Average	7.25	10.25	17.50	54.34	-36.84
0.183	QP	31.45	10.25	41.70	64.34	-22.64
0.741	Peak	26.70	10.31	37.01	56.00	-18.99
1.349	Peak	22.28	10.67	32.95	56.00	-23.05
16.482	Peak	23.50	10.85	34.35	60.00	-25.65

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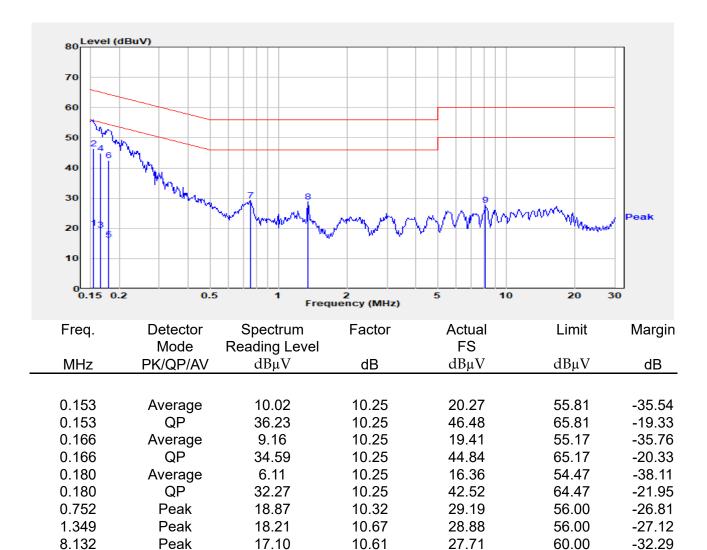
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Report No.: TERF2305001287ER Page: 17 of 73



Report Number	:TERF2305001287ER
Test Mode	:Operation (BT)
Power	:120V/60Hz
Probe	:N

Test Site	:Conduction 1
Test Date	:2023-06-27
Temp./Humi.	:26.9℃/59%
Engineer	:Nick Lin



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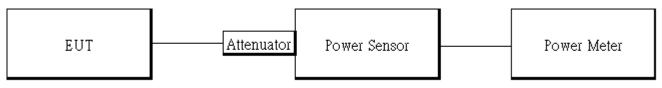


8 PEAK OUTPUT POWER MEASUREMENT

8.1 Standard Applicable

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, The Limit: 1Watt. For all other frequency hopping systems in the 2400 – 2483.5MHz band: The Limit: 0.125 Watts. The power limit for 1Mbps is 1watt, and 2Mbps, 3Mbps and AFH mode are 0.125 watts.

8.2 Test Setup



8.3 Measurement Procedure:

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10 Measurement Guidelines.
- 3. Duty cycle of test signal is < 98 %, duty factor shall be considered.
- Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (Max Hold, Detector = Peak, RBW >=20dB bandwidth)
- 5. Record the max. reading.
- 6. Repeat above procedures until all default test channel is completed.

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Peak & Average Power Measurement Result 8.4

1M BR mode (Peak):

СН	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	default	5.63	3.656	1000
Mid	2441	default	6.18	4.150	1000
High	2480	default	6.32	4.285	1000

1M BR mode (Average):

СН	Freq. (MHz)	Power set	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)		
Low	2402	default	5.62	3.647	1000		
Mid	2441	default	6.12	4.092	1000		
High	2480	default	6.29	4.255	1000		

2M EDR mode (Peak):

СН	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	default	4.66	2.924	125
Mid	2441	default	5.20	3.311	125
High	2480	default	5.41	3.475	125

3M EDR mode (Peak):

СН	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	default	5.09	3.228	125
Mid	2441	default	5.62	3.648	125
High	2480	default	5.81	3.811	125

2M EDR mode	e (Average):				
сн	Freq. (MHz)	Power set	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	default	2.33	1.711	125
Mid	2441	default	2.94	1.969	125
High	2480	default	3.21	2.096	125

3M EDR mode (Average):

СН	Freq. (MHz)	Power set	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	default	2.44	1.755	125
Mid	2441	default	2.98	1.988	125
High	2480	default	3.24	2.110	125

*Note: Max. Output include tune up tolerance Power measured by using average detector.

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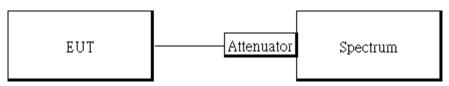


9 EMISSION BANDWIDTH MEASUREMENT

9.1 Standard Applicable

For frequency hopping systems operating in the 2400 MHz-2483.5 MHz no limit for 20dB bandwidth.

9.2 Test Setup



9.3 Measurement Procedure

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- Set the spectrum analyzer as RBW= 1 % to 5% of OBW, VBW = 3 X RBW, Span= 2 to 5 times of the OBW, Sweep=auto, Detector = Peak, and Max hold for 20dB Bandwidth test.
- 5. Mark the peak frequency and -20dB (upper and lower) frequency
- 6. Repeat above procedures until all test default channel is completed

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GFSK

СН	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.9265	0.62
Mid	0.9241	0.62
High	0.9258	0.62

π/4-DQPSK

СН	20 dB BW	2/3 BW
	(MHz)	(MHz)
Low	1.240	0.83
Mid	1.241	0.83
High	1.241	0.83
_		

8-DPSK

СН	20 dB BW	2/3 BW
СП	(MHz)	(MHz)
Low	1.263	0.84
Mid	1.261	0.84
High	1.262	0.84

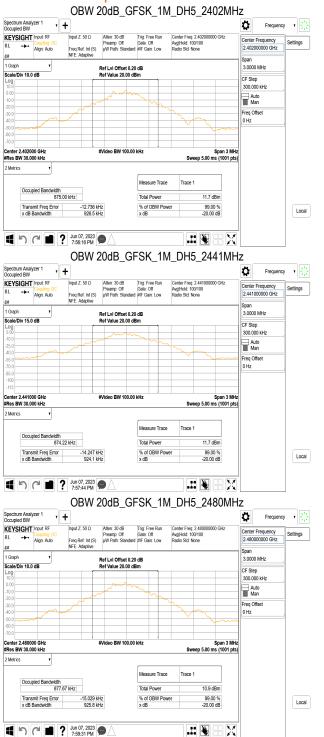
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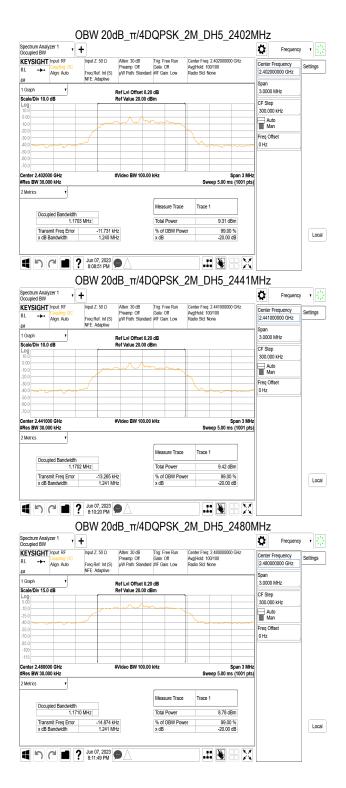
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f (886-2) 2298-0488



OBW 20dB 8DPSK 3M DH5 2402MHz + Spectrum Analyzer 1 Occupied BW Frequency v Ö KEYSIGHT Input: RF Atten: 30 dB Trig: Free Run Preamp: Off Gate: Off µW Path: Standard #IF Gain: Low ut 7: 50 0 Center Freq: 2.4020 Avg[Hold: 100/100 Radio Std: None Center Fr Center Frequency 2.402000000 GHz Settings Align: Auto Ref: Int (S) L)a 3.0000 MHz 1 Graph Ref LvI Offset 0.20 dB Ref Value 20.00 dBm Scale/Div 15.0 dB CF Step 300.000 kHz Auto Man Freq Offset 0 Hz Center 2.402000 GHz #Res BW 30.000 kHz #Video BW 100.00 kHz Span 3 MHz Sweep 5.00 ms (1001 pts) Metrics Measure Trace Trace 1 Occupied Bandwidth 1.1791 MHz Total Powe 9.30 dBm % of OBW Power x dB Transmit Freq Error x dB Bandwidth -13.503 kHz 1.263 MHz 99.00 % -20.00 dB Local Un 07, 2023 .# 🕃 🗄 🗙 OBW 20dB_8DPSK_3M_DH5_2441MHz Spectrum Analyzer 1 Occupied BW Frequency v + Ö KEYSIGHT Input: RF Atten: 30 dB Trig: Free Run Preamp: Off Gate: Off µW Path: Standard #IF Gain: Low iput Z: 50 Ω Center Freq: 2.441000000 GHz Avg[Hold: 100/100 Radio Std: None Center Frequency ettings -Freq Ref: Int (S) NFE: Adaptive Align: Auto 2.441000000 GH L)0 I Graph Ref LvI Offset 0.20 dB Ref Value 20.00 dBm 3.0000 MHz Scale/Div 10.0 dB CF Step 300.000 kHz Auto Man Freq Offset 0 Hz Center 2.441000 GHz #Res BW 30.000 kHz Span 3 Mi is (1001 pf #Video BW 100.00 kHz eo 5.00 m 2 Metrics Measure Trace Trace 1 Occupied Bandwidth 1.1816 MHz Total Powe 9.37 dBm Transmit Freq Error x dB Bandwidth 13.862 kHz 1.261 MHz % of OBW Power x dB 99.00 % -20.00 dB Local 【う C 目 ? Jun 07, 2023 .# 🕃 🗄 🗶 OBW 20dB_8DPSK_3M_DH5_2480MHz Spectrum Analyzer 1 Occupied BW Ö • 🔆 · + Frequency KEYSIGHT Input: RF RL + 1Z: 50 Ω Atten: 30 dB Trig: Free Run Preamp: Off Gate: Off Ref: Int (S) μW Path: Standard #IF Gain: Low iput Z: 50 Ω Center Freq: 2.48 Avg[Hold:>100/10 Radio Std: None equency Settings Align: Auto Free L)0 3.0000 MHz Ref LvI Offset 0.20 dB Ref Value 20.00 dBm Scale/Div 10.0 dB CF Step 300.000 kHz Auto Man Freq Offset 0 Hz enter 2.480000 GHz #Video BW 100.00 kHz Span 3 MHz Sweep 5.00 ms (1001 pts) Res BW 30.000 kHz Metrics Measure Trace Trace 1 Occupied Bandwidth 1.1842 MHz Total Power 8.76 dBm Transmit Freq Error x dB Bandwidth % of OBW Powe x dB 99.00 % -20.00 dB -14.698 kHz 1.262 MHz Local Un 07, 2023 .# 🖲 🗄 🗶

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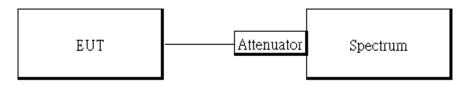


10 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

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), must also comply with the radiated emission limits specified in §15.209(a).

10.2 Test Setup



10.3 **Measurement Procedure**

10.3.1 **Conducted Band Edge:**

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- Set center frequency of spectrum analyzer = operating frequency.
- 5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Sweep = auto
- 6. Mark Peak, below 2.4GHz and above 2.4835GHz and record the max. level.
- 7. Repeat above procedures until all frequency measured were complete.

10.3.2 **Conducted Spurious Emission:**

- 1. To connect Antenna Port of EUT to Spectrum.
- 2. The testing follows ANSI C63.10:2013.
- 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

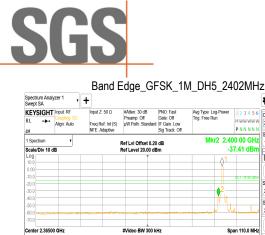
See next page for test plots.

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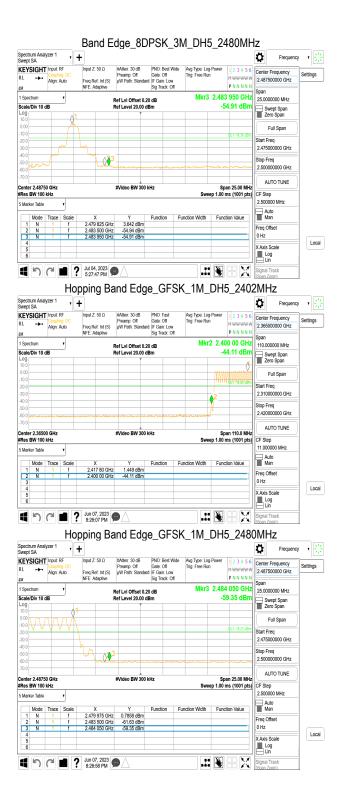
Report No.: TERF2305001287ER Page: 25 of 73



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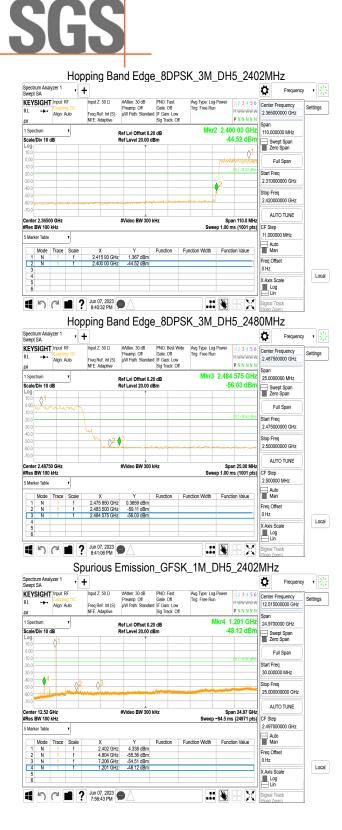
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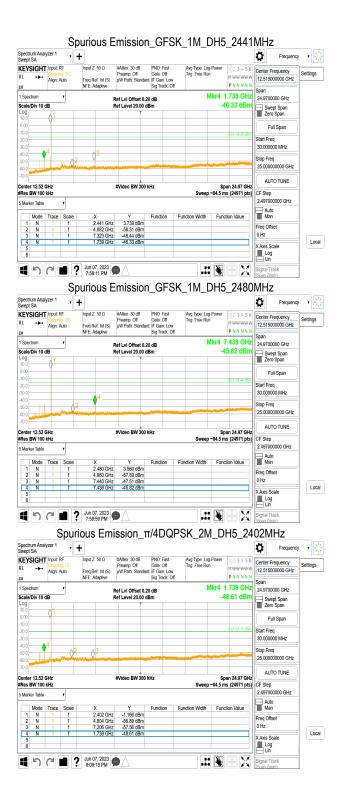
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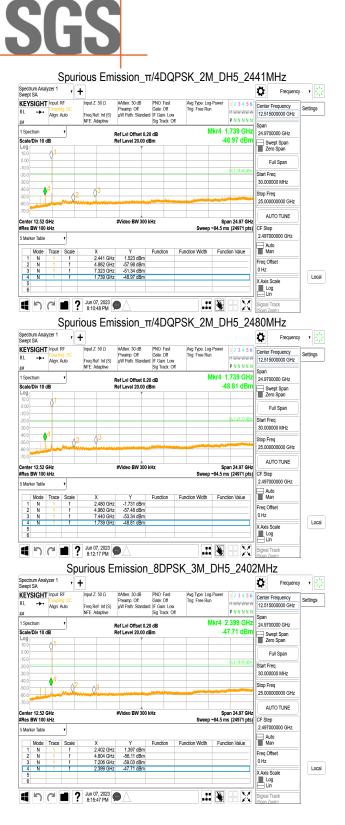
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11 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

Standard Applicable 11.1

11.1.1 **Duty Cycle Correction Factor**

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.

11.1.2 Spurious Emission

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 limit as below. And according to §15.33(a) (1), 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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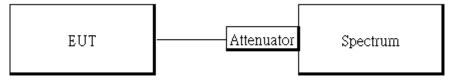
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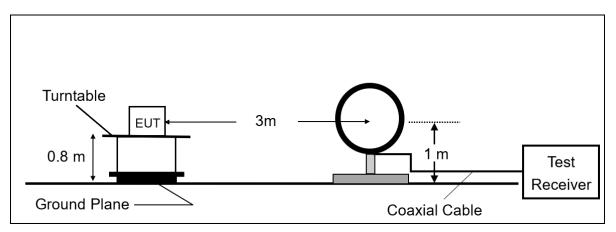
Test Setup 11.2

11.2.1 **Duty Cycle Correction Factor**

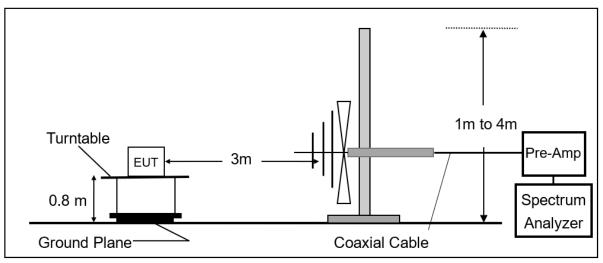


11.2.2 **Radiated Emission**

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



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



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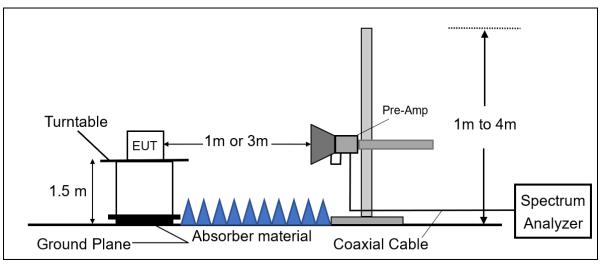
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(C) Radiated Emission Test Set-Up, Frequency Above 1 GHz.



11.3 Measurement Procedure

11.3.1 Duty Cycle Correction Factor

- 1.Adjust and configure any EUT switches, controls, or input data streams to ensure that the EUT is transmitting or encoded to obtain the "worst-case" pulse ON time.
- 2. The testing follows ANSI C63.10:2013.
- 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 center frequency of spectrum analyzer = operating frequency.
- 5.Set the spectrum analyzer as RBW, VBW=1MHz, 3MHz, Span = 0Hz, Detector = Peak, Adjust Sweep=100ms.
- 6. Repeat above procedures until all frequency of the interest measured were complete.

11.3.2 Radiated Emission

- 1. The testing follows the Measurement Procedure of ANSI C63.10:2013.
- 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 (PK) at frequency between 30MHz and 1 GHz.
- 6. Use receiver mode as RBW=120 kHz for Quasi-peak (QP) at frequency between 30MHz and 1 GHz.

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- 7. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Maximum Emission Measurements at frequency above 1 GHz.
- 8. According to C63.10:2013 Section 7.5 Procedure for determining the average value of pulsed emissions with duty cycle correction factor 20 log (Ton/100ms).
- 9. 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.
- 10. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 11. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 12. Repeat above procedures until all default test channel measured were complete.

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:

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 dBuV/m, which converts 20*log(uV/m)

Actual FS(dB μ V/m) = SPA. Reading level(dB μ V) + Factor(dB) Factor(dB) = Antenna Factor(dB μ V/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Average value($dB\mu V/m$)=Peak Actual FS($dB\mu V/m$)+ Duty Cycle Correction Factor(dB) Duty Cycle Correction Factor(dB) = 20 log ($T_{on}/100 \text{ ms}$)

11.5 Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz

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

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11.6 Measurement Result:

11.6.1 **Duty Cycle Correction Factor**

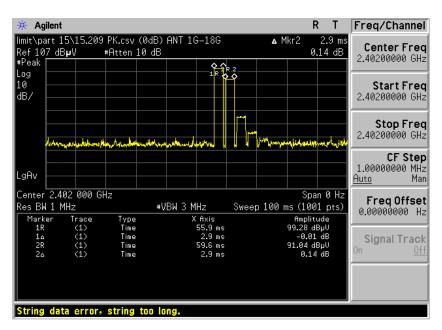
Time ON of 100ms:	5.800	ms	
Duty Cycle=5.8ms / 100	0ms: 0.058	%	
Duty Cycle correction fa	actor=20 LOG 0.058=	-24.73	dB

Bluetooth 3M

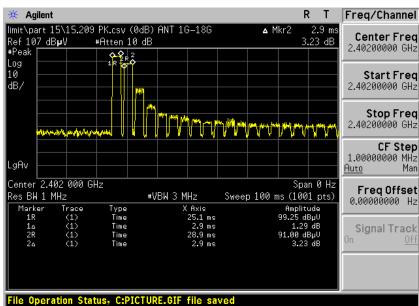
Time ON of 100ms:	5.800	ms	
Duty Cycle=5.8ms / 100)ms: 0.058	%	
Duty Cycle correction fa	actor=20 LOG 0.058=	-24.73	dB

11.6.2 Duty Cycle test plot

BR



EDR



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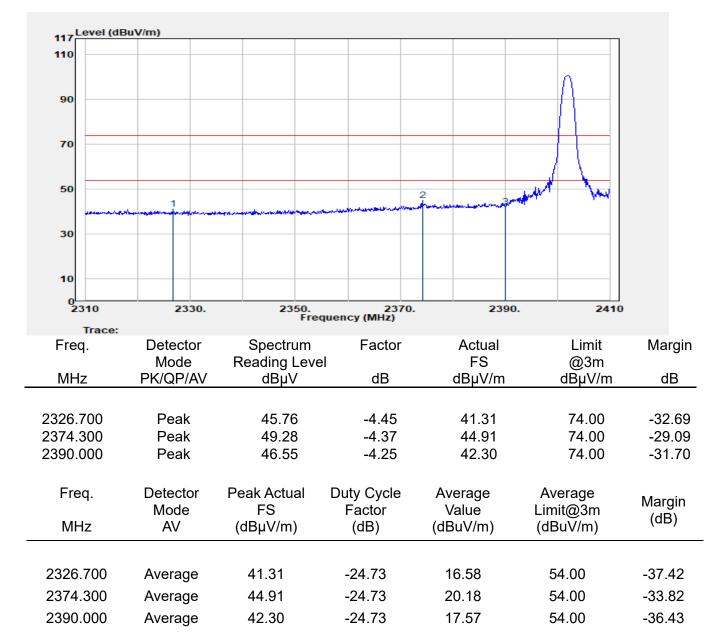
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11.6.3 Bandedge Result

Report Number	:TERF2305001287ER	Test Site	:SAC 3
Operation Mode	:BR	Test Date	:2023-06-13
Test Frequency	:2402 MHz	Temp./Humi.	:24.8°C/62%
Test Mode	:Bandedge	Antenna Pol.	:Vertical
EUT Pol	:H Plane	Engineer	:Nick Lin



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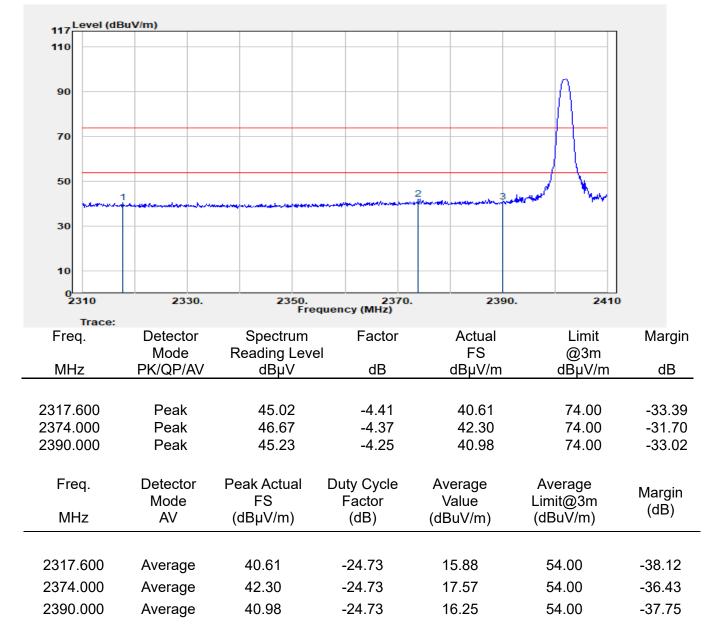
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f (886-2) 2298-0488



Report Number	:TERF2305001287ER
Operation Mode	:BR
Test Frequency	:2402 MHz
Test Mode	:Bandedge
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Horizontal
Engineer	:Nick Lin



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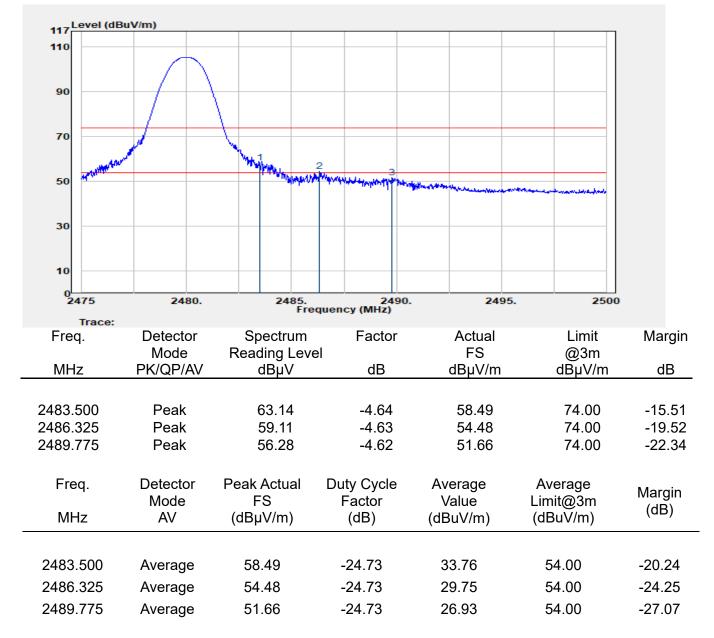
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Report Number	:TERF2305001287ER
Operation Mode	:BR
Test Frequency	:2480 MHz
Test Mode	:Bandedge
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Vertical
Engineer	:Nick Lin



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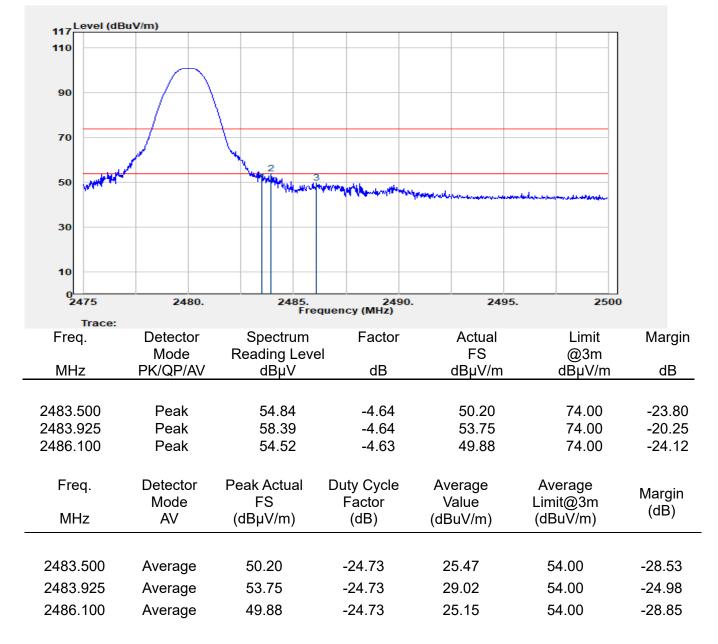
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Report Number	:TERF2305001287ER
Operation Mode	:BR
Test Frequency	:2480 MHz
Test Mode	:Bandedge
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Horizontal
Engineer	:Nick Lin



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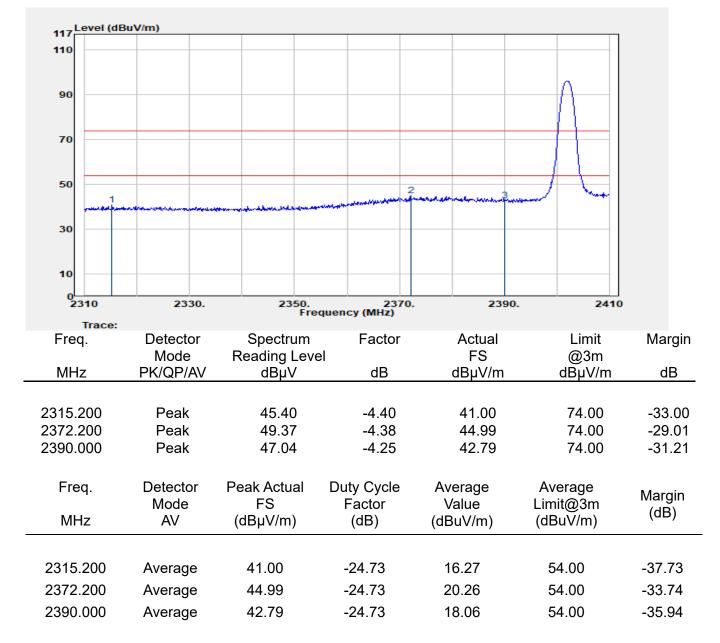
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Report Number	:TERF2305001287ER
Operation Mode	:EDR 3M
Test Frequency	:2402 MHz
Test Mode	:Bandedge
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Vertical
Engineer	:Nick Lin



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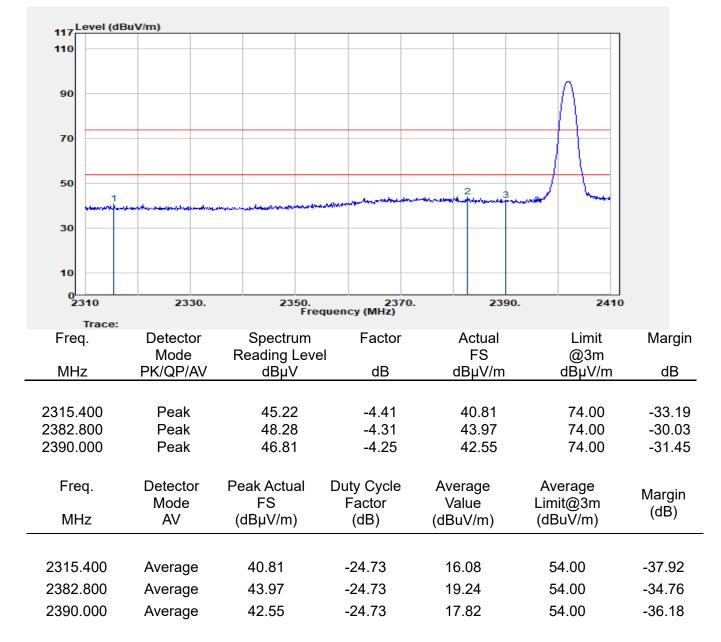
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Report Number	:TERF2305001287ER
Operation Mode	:EDR 3M
Test Frequency	:2402 MHz
Test Mode	:Bandedge
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Horizontal
Engineer	:Nick Lin



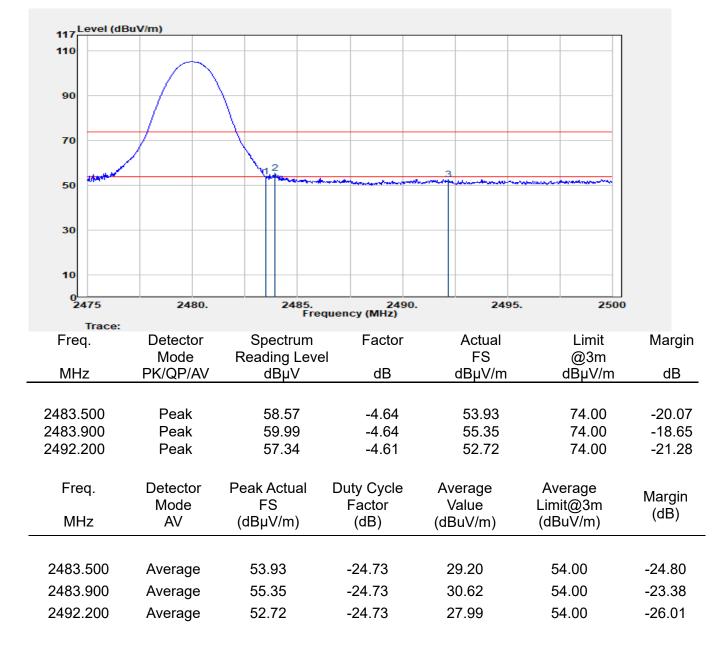
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Report Number :TERF2305001287ER **Operation Mode** :EDR 3M Test Frequency :2480 MHz Test Mode :Bandedge EUT Pol :H Plane

Test Site :SAC 3 Test Date :2023-06-13 Temp./Humi. :24.8°C/62% Antenna Pol. :Vertical Engineer :Nick Lin



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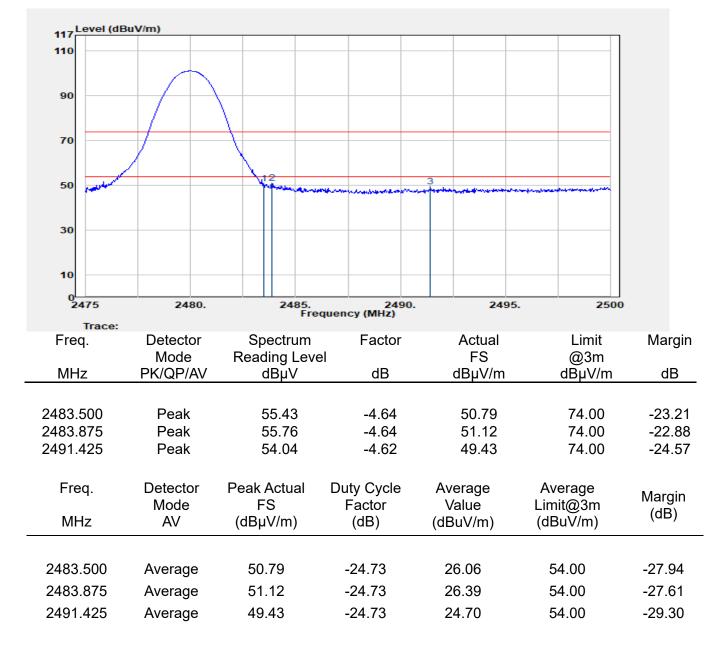
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Report Number :TERF2305001287ER **Operation Mode** :EDR 3M Test Frequency :2480 MHz Test Mode :Bandedge EUT Pol :H Plane

Test Site :SAC 3 :2023-06-13 Test Date Temp./Humi. :24.8°C/62% Antenna Pol. :Horizontal Engineer :Nick Lin



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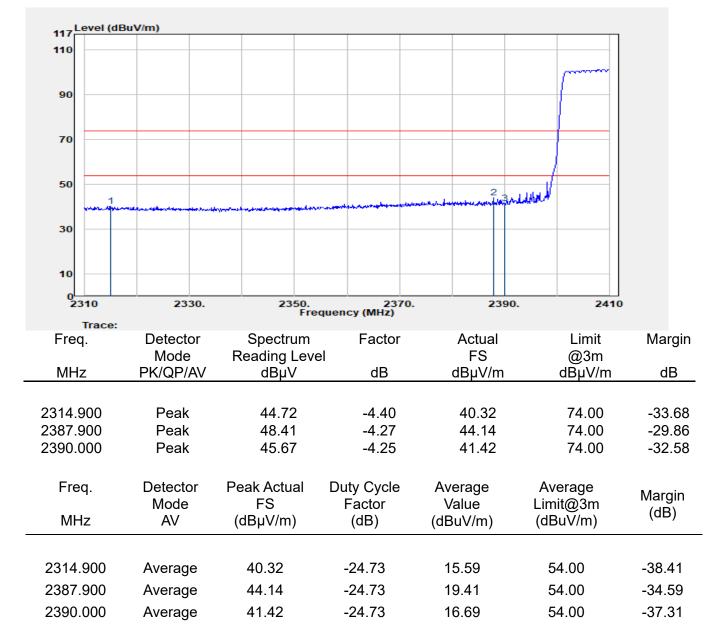
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Report Number	:TERF2305001287ER
Operation Mode	:BR Hopping
Test Frequency	:2402 MHz
Test Mode	:Bandedge
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Vertical
Engineer	:Nick Lin



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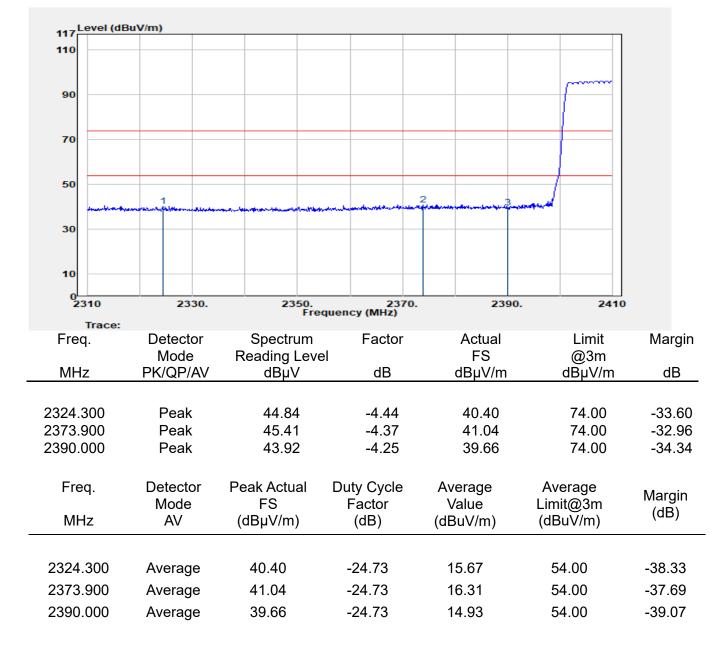
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Report Number	:TERF2305001287ER
Operation Mode	:BR Hopping
Test Frequency	:2402 MHz
Test Mode	:Bandedge
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Horizontal
Engineer	:Nick Lin



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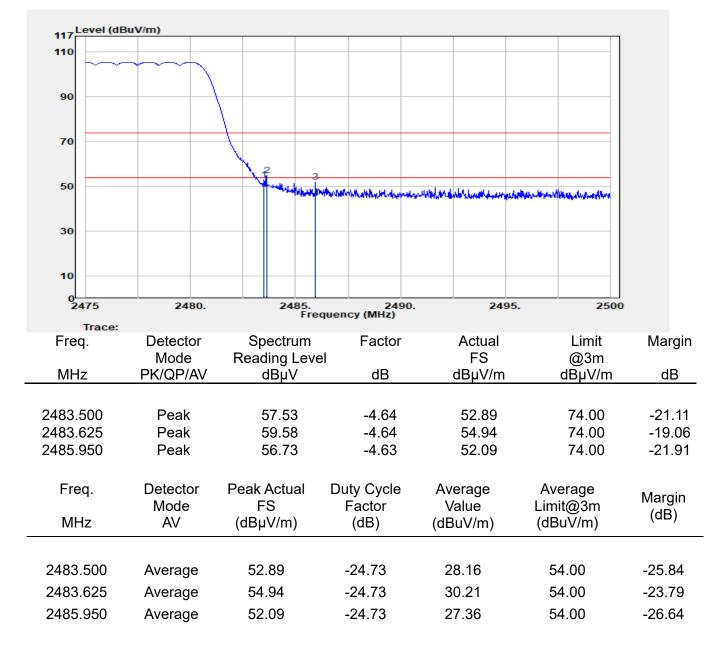
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Report Number :TERF2305001287ER **Operation Mode** :BR Hopping Test Frequency :2480 MHz Test Mode :Bandedge EUT Pol :H Plane

Test Site :SAC 3 :2023-06-13 Test Date Temp./Humi. :24.8°C/62% Antenna Pol. :Vertical Engineer :Nick Lin



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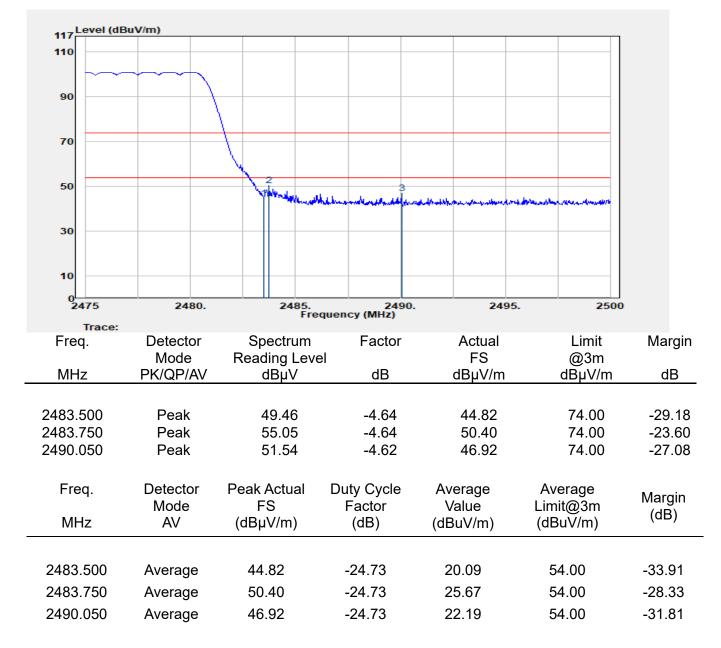
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Report Number :TERF2305001287ER **Operation Mode** :BR Hopping Test Frequency :2480 MHz Test Mode :Bandedge EUT Pol :H Plane

Test Site :SAC 3 :2023-06-13 Test Date Temp./Humi. :24.8°C/62% Antenna Pol. :Horizontal Engineer :Nick Lin



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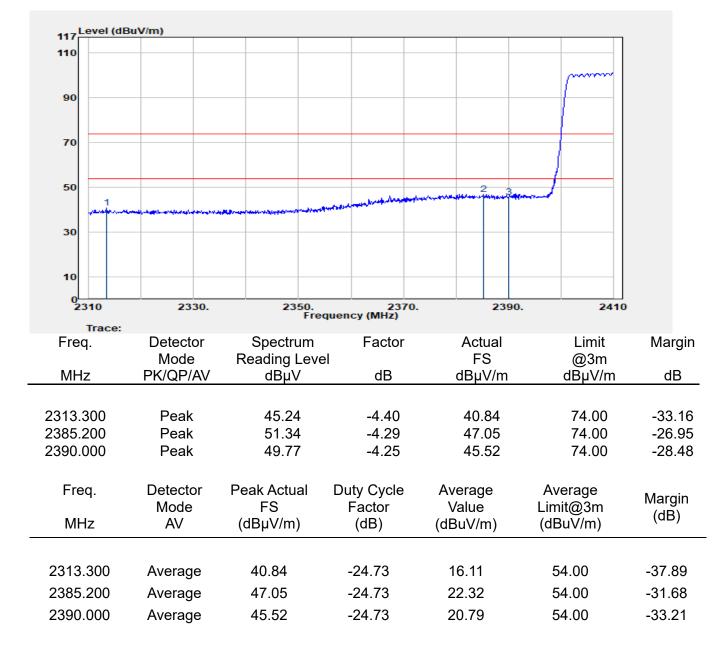
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Report Number :TERF2305001287ER **Operation Mode** :EDR 3M Hopping Test Frequency :2402 MHz Test Mode :Bandedge EUT Pol :H Plane

Test Site :SAC 3 :2023-06-13 Test Date Temp./Humi. :24.8°C/62% Antenna Pol. :Vertical Engineer :Nick Lin



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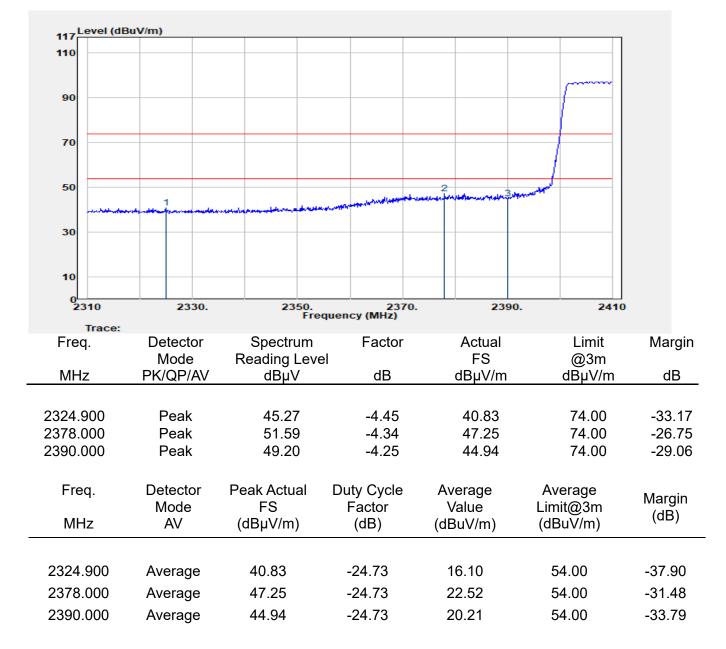
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f (886-2) 2298-0488
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Report Number :TERF2305001287ER **Operation Mode** :EDR 3M Hopping Test Frequency :2402 MHz Test Mode :Bandedge EUT Pol :H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Horizontal
Engineer	:Nick Lin



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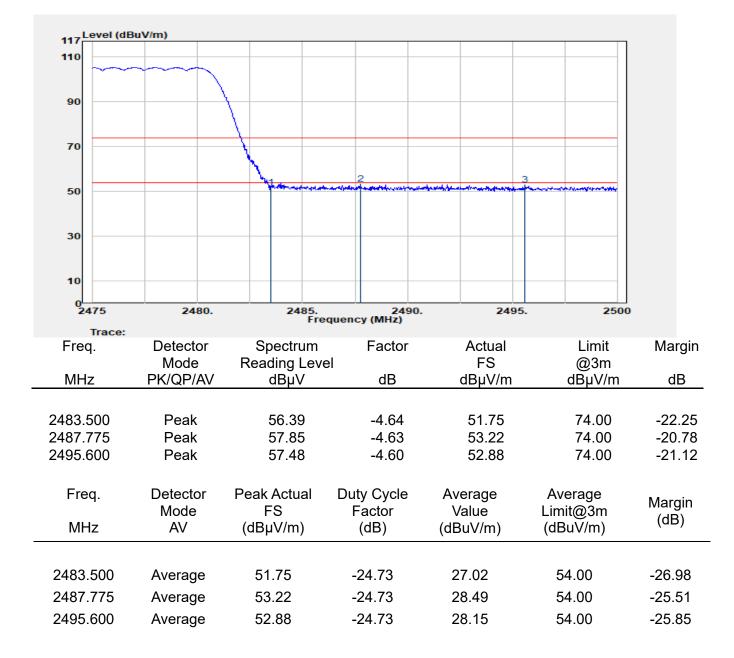
t (886-2) 2299-3279

f (886-2) 2298-0488



Report Number :TERF2305001287ER **Operation Mode** :EDR 3M Hopping Test Frequency :2480 MHz Test Mode :Bandedge EUT Pol :H Plane

Test Site :SAC 3 :2023-06-13 Test Date Temp./Humi. :24.8°C/62% Antenna Pol. :Vertical Engineer :Nick Lin



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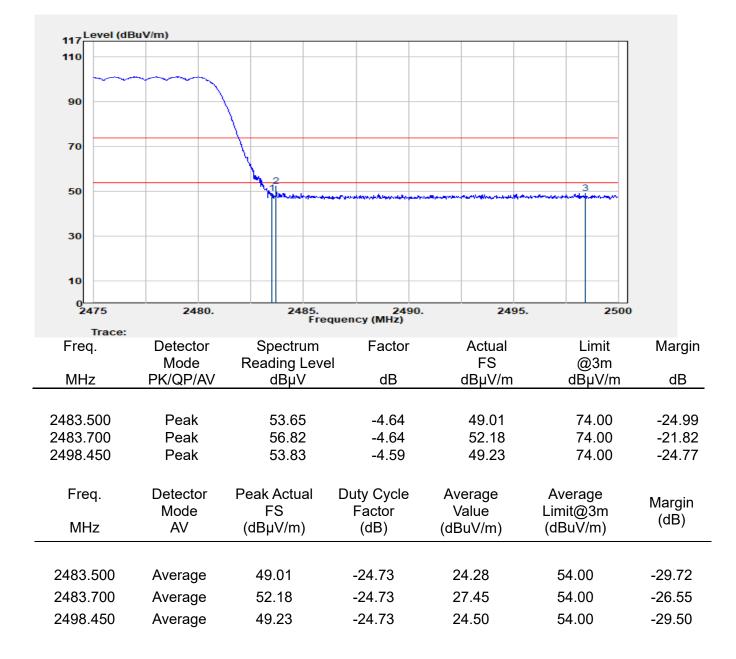
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Report Number :TERF2305001287ER **Operation Mode** :EDR 3M Hopping Test Frequency :2480 MHz Test Mode :Bandedge EUT Pol :H Plane

Test Site :SAC 3 :2023-06-13 Test Date Temp./Humi. :24.8°C/62% Antenna Pol. :Horizontal Engineer :Nick Lin



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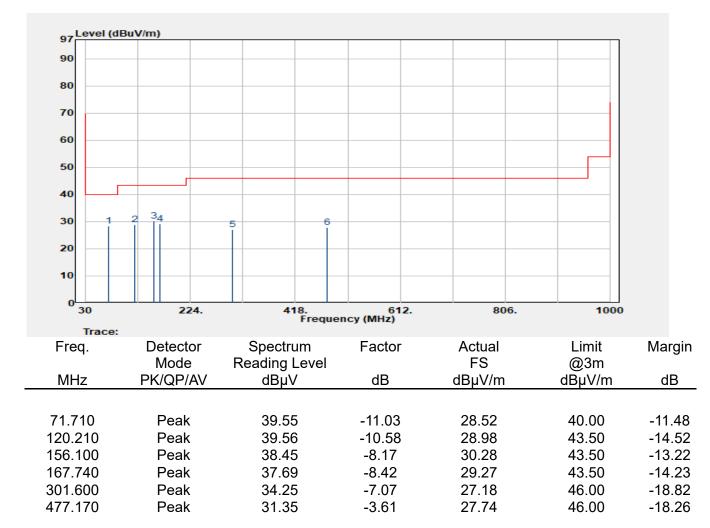
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Report No.: TERF2305001287ER Page: 49 of 73



11.6.4 Radiated Spurious Emission

Report Number	:TERF2305001287ER	Test Site	:SAC 3
Operation Mode	:BR	Test Date	:2023-06-13
Test Frequency	:2441 MHz	Temp./Humi.	:24.8°C/62%
Test Mode	:Tx	Antenna Pol.	:Vertical
EUT Pol	:H Plane	Engineer	:Nick Lin



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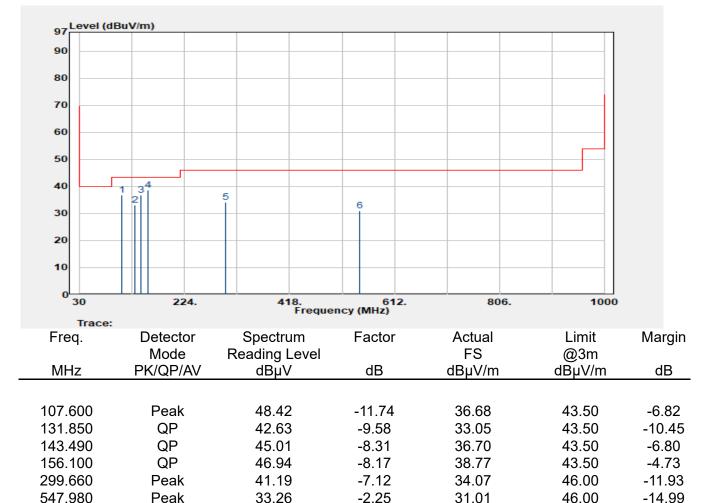
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Report No.: TERF2305001287ER Page: 50 of 73



Report Number	:TERF2305001287ER
Operation Mode	:BR
Test Frequency	:2441 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Horizontal
Engineer	:Nick Lin



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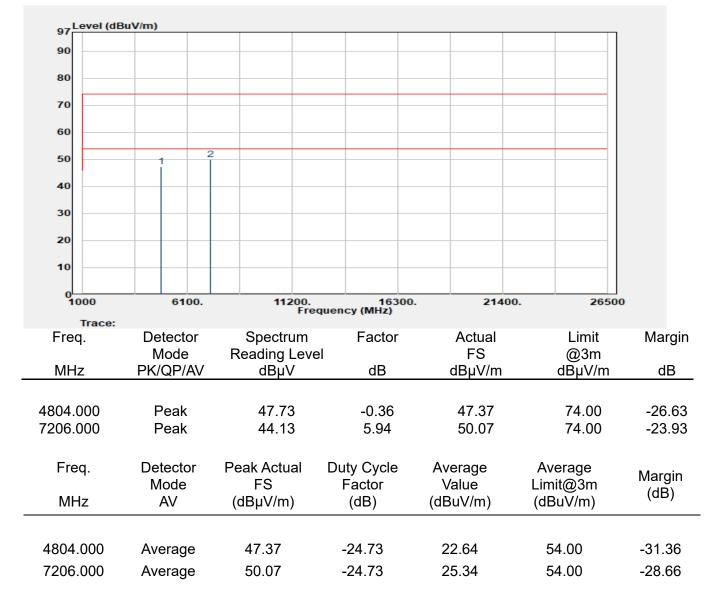
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Report Number	:TERF2305001287ER
Operation Mode	:BR
Test Frequency	:2402 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Vertical
Engineer	:Nick Lin



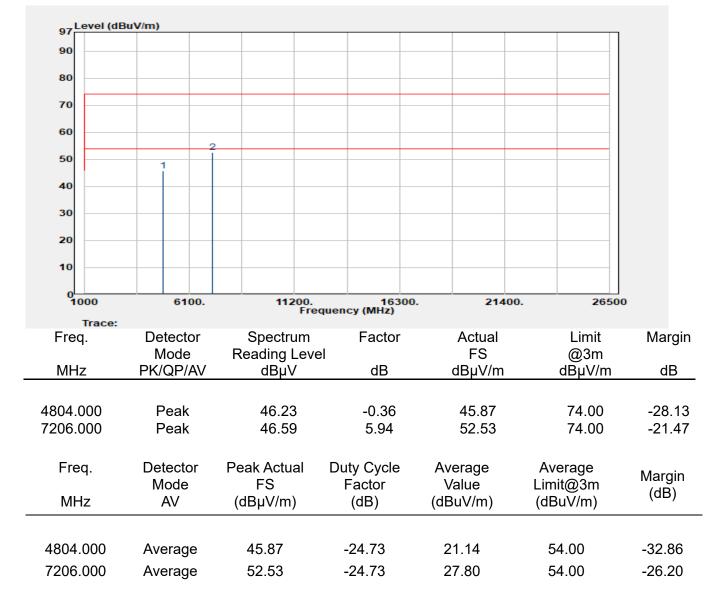
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Report Number	:TERF2305001287ER
Operation Mode	:BR
Test Frequency	:2402 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Horizontal
Engineer	:Nick Lin



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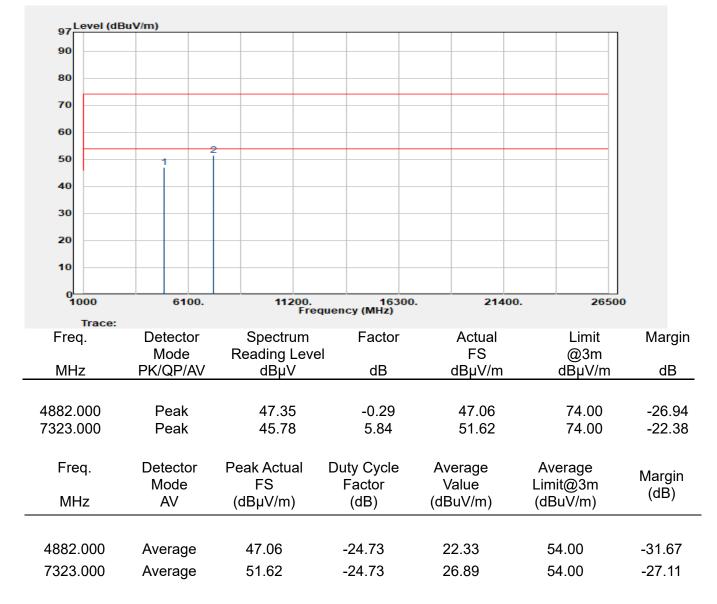
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Report Number	:TERF2305001287ER
Operation Mode	:BR
Test Frequency	:2441 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8°C/62%
Antenna Pol.	:Vertical
Engineer	:Nick Lin



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Report Number	:TERF2305001287ER
Operation Mode	:BR
Test Frequency	:2441 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Horizontal
Engineer	:Nick Lin



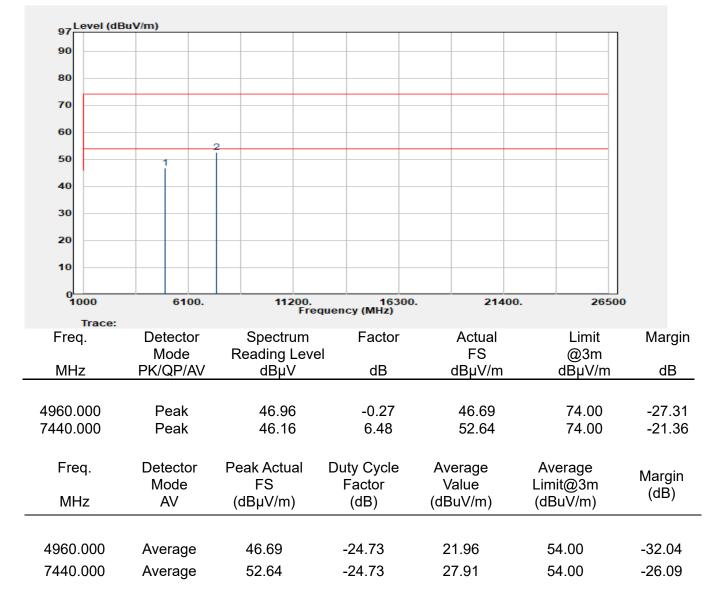
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Report Number	:TERF2305001287ER
Operation Mode	:BR
Test Frequency	:2480 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8°C/62%
Antenna Pol.	:Vertical
Engineer	:Nick Lin



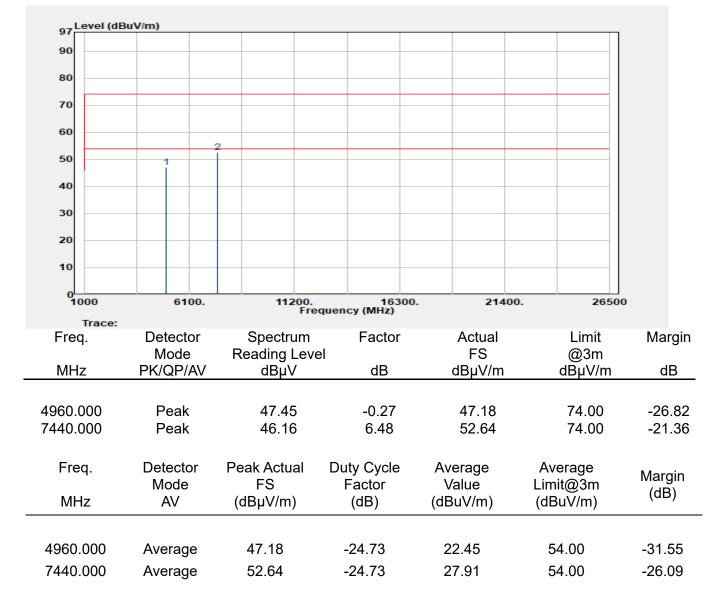
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Report Number	:TERF2305001287ER
Operation Mode	:BR
Test Frequency	:2480 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Horizontal
Engineer	:Nick Lin



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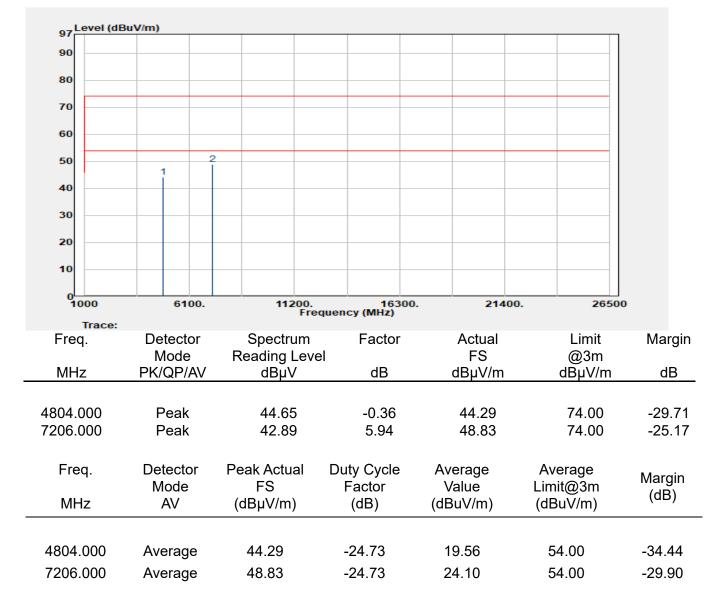
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Report Number	:TERF2305001287ER
Operation Mode	:EDR 3M
Test Frequency	:2402 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Vertical
Engineer	:Nick Lin



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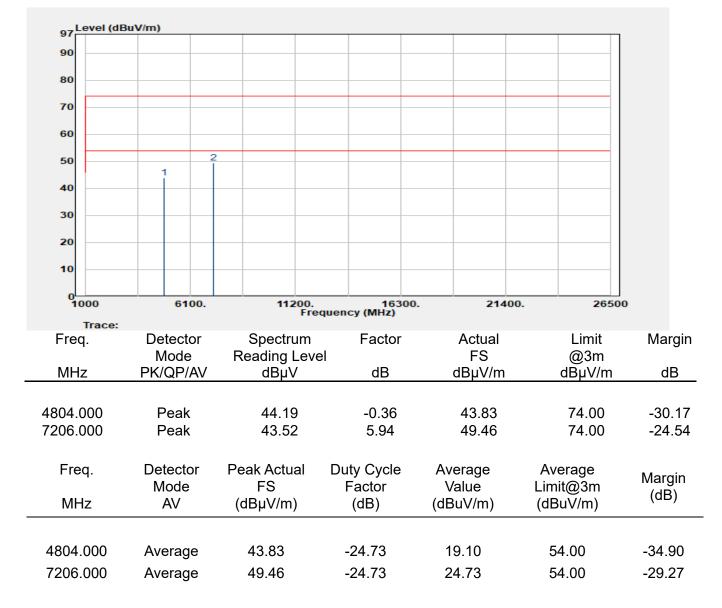
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Report Number	:TERF2305001287ER
Operation Mode	:EDR 3M
Test Frequency	:2402 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Horizontal
Engineer	:Nick Lin



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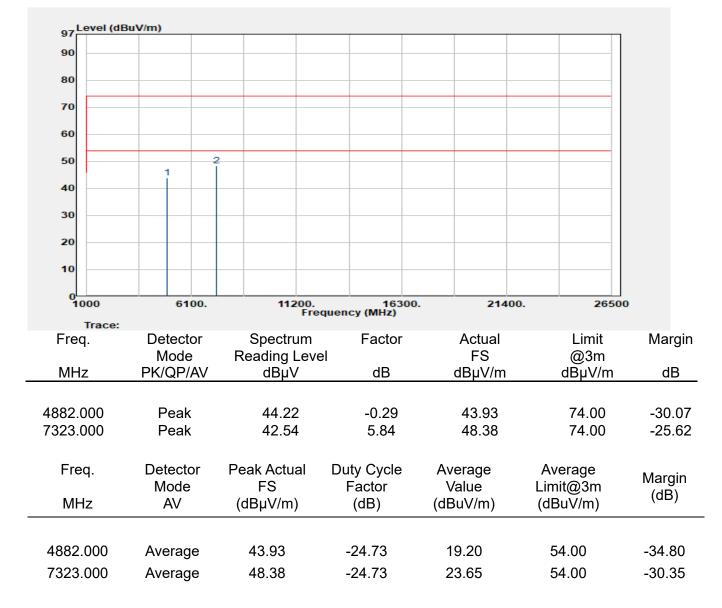
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Report Number	:TERF2305001287ER
Operation Mode	:EDR 3M
Test Frequency	:2441 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site :SAC 3 :2023-06-13 Test Date Temp./Humi. :24.8°C/62% Antenna Pol. :Vertical Engineer :Nick Lin



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Report Number	:TERF2305001287ER
Operation Mode	:EDR 3M
Test Frequency	:2441 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Horizontal
Engineer	:Nick Lin



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Report Number	:TERF2305001287ER
Operation Mode	:EDR 3M
Test Frequency	:2480 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site	:SAC 3
Test Date	:2023-06-13
Temp./Humi.	:24.8℃/62%
Antenna Pol.	:Vertical
Engineer	:Nick Lin



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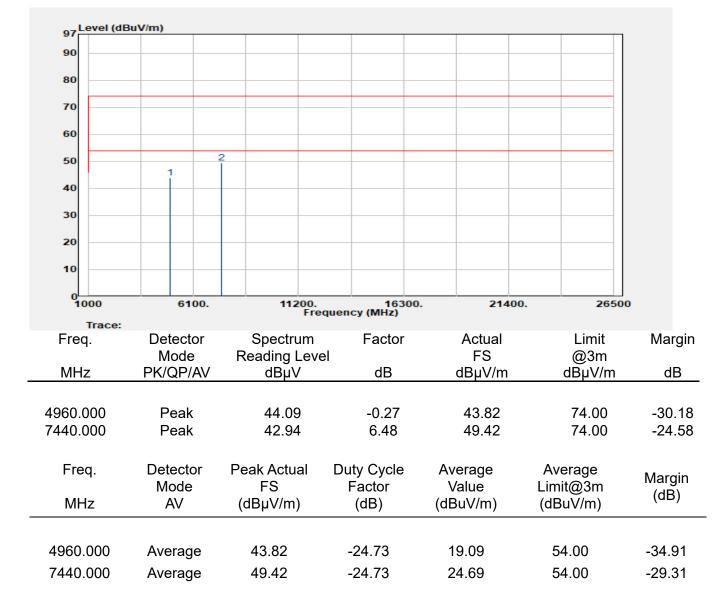
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Report Number	:TERF2305001287ER
Operation Mode	:EDR 3M
Test Frequency	:2480 MHz
Test Mode	:Tx
EUT Pol	:H Plane

Test Site :SAC 3 :2023-06-13 Test Date Temp./Humi. :24.8°C/62% Antenna Pol. :Horizontal Engineer :Nick Lin



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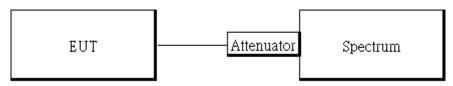


12 FREQUENCY SEPARATION

12.1 Standard Applicable

Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25 kHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

12.2 Test Setup



12.3 Measurement Procedure

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 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 center frequency of spectrum analyzer = middle of hopping channel.
- 5. Set the RBW approximately 30% of the channel spacing, $VBW \ge RBW$.
- 6. Adjust Span to Wide enough to capture the peaks of two adjacent channels.
- 7. Sweep = auto.
- 8. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

12.4 Measurement Result

Channel separation (MHz)	Limit	Result
1	≧25 kHz or 2/3 times 20dB bandwidth	PASS

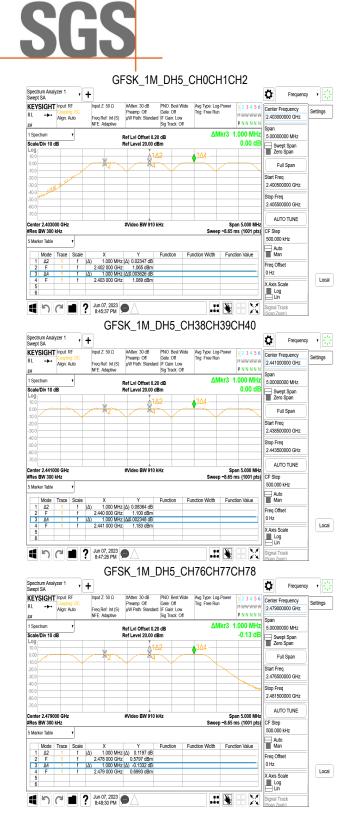
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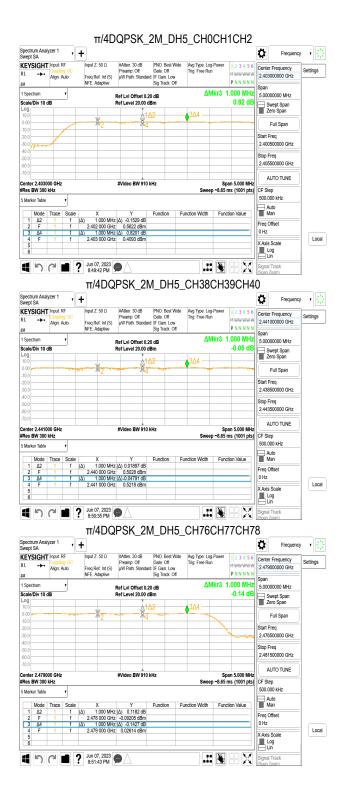
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8DPSK 3M DH5 CH0CH1CH2 Spectrum Analyzer 1 Swept SA • 🔆 · + Ö Frequency PNO: Best Wide Gate: Off J IF Gain: Low Sig Track: Off KEYSIGHT Input: RF RL + Aim: Auto ut 7: 50 0 #Atten: 30 dB Avg Type: Log-Po Trig: Free Run Center Fr Preamp: µW Path Settings 2 40300000 GH Align: Auto Int (S) PNNNN L)a ΔMkr3 1.000 MHz 5.0000000 MHz 1 Spectrun Ref LvI Offset 0.20 dB Ref Level 20.00 dBm Scale/Div 10 dE 0.26 d Swept Span Zero Span Full Span Start Freq 2.400500 Stop Freq 2.4055000 AUTO TUNE Center 2.403000 GHz #Res BW 300 kHz #Video BW 910 kHz Span 5.000 MHz Sweep ~8.65 ms (1001 pts) CF Step 500.000 kHz Auto Man Mode Trace Scal Function Width Function Value Function X Y 1.000 MHz (Δ)0.002156 dB 2.402 000 GHz 1.007 dBm 1.000 MHz (Δ) 0.2645 dB 2.403 000 GHz 1.009 dBm . (Δ) Δ2 Freq Offse 3 (Δ) 0 Hz Local X Axis Scale Log X 8DPSK_3M_DH5_CH38CH39CH40 Spectrum Analyzer 1 Swept SA Ö Frequency T + #Atten: 30 dB Preamp: Off µW Path: Stan PNO: Best Wide Gate: Off IF Gain: Low Sig Track: Off KEYSIGHT Input: RF ut Z: 50 Ω Avg Type: Log-Powe Trig: Free Run Center Frequency ettings +-Ref: Int (S) 2.441000000 GHz Align: Aut PNNNN Ļя Snar ΔMkr3 1.000 MHz Spectr Ref LvI Offset 0.20 dB Ref Level 20.00 dBm 5.00000000 MHz Scale/Div 10 dB 1.42 d Swept Span Zero Span Full Span Start Fred 2.438500000 GHz Stop Freq 2.443500000 GHz AUTO TUNE enter 2.441000 G Res BW 300 kHz BW 910 kH Span 5.000 MHz weep ~8.65 ms (1001 pts) CF Step 500.000 kH 5 Marker Table Auto Man Function Function Width Function Value Trace S ie X Y (Δ) 1.000 MHz (Δ) -1.522 dB 2.440 000 GHz 0.8580 dBm (Δ) 1.000 MHz (Δ) 1.423 dB 2.441 000 GHz -0.6642 dBm -0.6642 dBm Freq Offs 0 Hz 3 44 Local X Axis Scale らで ■ ? Jun 07, 2023 8:53:51 PM Х # 😽 1 8DPSK_3M_DH5_CH76CH77CH78 Spectrum Analyzer 1 Swept SA Ö + <u>*</u> wept SA • **+** Frequency PNO: Best Wide Gate: Off Avg Type: Trig: Free Center Frequency 2.479000000 GHz Settings Preamp: Off µW Path: Stan Align: Auto ef: Int (S) IF Gain: Sig Trad PNNNN L)0 AMkr3 1 000 MHz 5.00000000 MHz Ref LvI Offset 0.20 dB Ref Level 20.00 dBm . Scale/Div 10 dl 0.46 d Swept Span Full Spa 2.476500000 GHz Stop Freq 2.481500000 GHz AUTO TUNE er 2 479000 GH eo BW 910 kH E 000 N #Res BW 300 kH Sweep ~8.65 ms (10 ots) CF Step 500.000 kHz Marker Tabl Auto Man Mode A2 Function Width Functio Trace So Function ie X Y (Δ) 1.000 MHz (Δ) 0.2365 dB 2.478 000 GHz 0.04857 dBm (Δ) 1.000 MHz (Δ) 0.4599 dB 2.479 000 GHz 0.2851 dBm Freq Offse 0 Hz 3 <u>1</u>4 Local X Axis Sc Log Un 07, 2023 Х .# 😵

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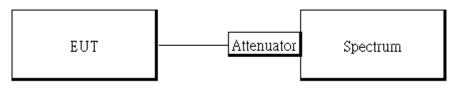


13 NUMBER OF HOPPING FREQUENCY

Standard Applicable 13.1

Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

13.2 Test Setup



13.3 **Measurement Procedure**

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 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 spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
- 5. Set the spectrum analyzer as RBW = 30% of the channel spacing, VBW \geq RBW., Detector = Peak
- 6. Max hold, view and count how many channel in the band.

13.4 Measurement Result

Tabular Data of Total Channel Number

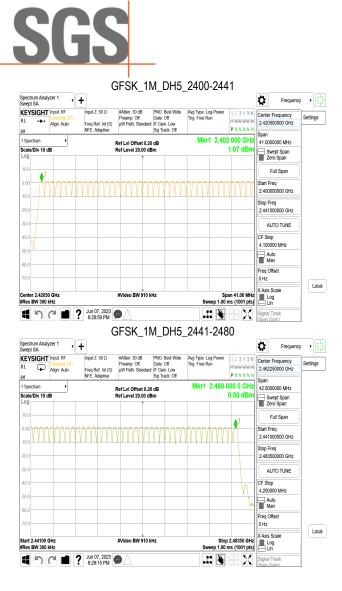
	Channel Number	Limit
2.4 GHz – 2.441 GHz	40	
2.441 GHz – 2.4835 GHz	39	>15
2.4 GHz ~2.4835 GHz	(40+39) = 79	

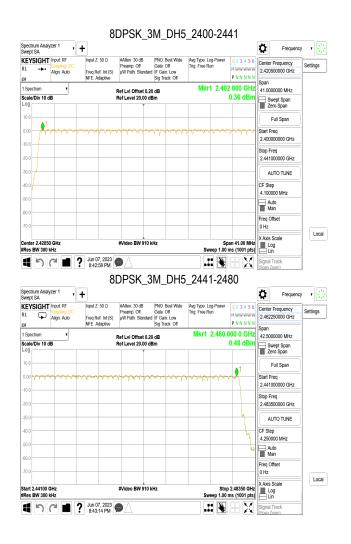
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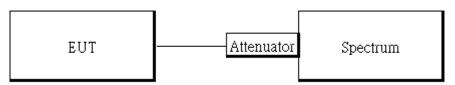


14 TIME OF OCCUPANCY (DWELL TIME)

Standard Applicable 14.1

Frequency hopping systems operating in the 2400MHz-2483.5MHz. The average time of occupancy on any frequency shall not greater than 0.4 s within period of 0.4 seconds multiplied by the number of hopping channel employed.

14.2 Test Setup



14.3 **Measurement Procedure**

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 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 center frequency of spectrum analyzer = operating frequency.

5. Set the spectrum analyzer as RBW, VBW=1MHz, 3MHz, Span = 0Hz, Detector = Peak, Adjust Sweep = $2 \sim 8 \text{ms}$.

6. Repeat above procedures until all frequency of the interest measured were complete.

Formula Deduced: time occupancy of one time slot X Hopping rate / total slot in one channel / total channel that hops X period of working channels.

Where, standard hopping rate is 1600 hops/s, slot in one channel for DH1, DH3, and DH5 is 2, 4, and 6, respectively.

DH1 consists of single time slot of the uplink, and one slot of the downlink Total Slot: 2 DH3 consists of three time slot of the uplink, and one slot of the downlink. Total Slot: 4 DH5 consists of five time slot of the uplink, and one slot of the downlink. Total Slot: 6

Note: the result of the complete test default channel at 1Mbps is recorded on the test report, 2Mbps, and 3Mbps only records the measurement result at middle channel that reveals no much deviation.

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14.4 Measurement Result

GFSK (1Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
	DH1	152.00	400
Mid	DH3	280.00	400
	DH5	316.80	400

π/4 DQPSK (2Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
	2DH1	156.80	400
Mid	2DH3	281.60	400
	2DH5	318.40	400

8-DPSK (3Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)
	3DH1	156.80	400
Mid	3DH3	281.60	400
	3DH5	318.40	400

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GFSK (1Mbps):

CH Mid	DH1 time slot	=	0.475 *	(1600/2/79)	*	31.6 =	152.00 (ms)
	DH3 time slot	=	1.750 *	(1600/4/79)	*	31.6 =	280.00 (ms)
	DH5 time slot	=	2.970 *	(1600/6/79)	*	31.6 =	316.80 (ms)

$\pi/4$ -DQPSK (2Mbps):

CH Mid	2DH1 time slot =	0.490 *	(1600/2/79) *	31.6 =	156.80 (ms)
	2DH3 time slot =	1.760 *	(1600/4/79) *	31.6 =	281.60 (ms)
	2DH5 time slot =	2.985 *	(1600/6/79) *	31.6 =	318.40 (ms)

8-DPSK (3Mbps):

CH Mid	3DH1 time slot =	0.490 *	(1600/2/79)	*	31.6 =	156.80 (ms)
	3DH3 time slot =	1.760 *	(1600/4/79)	*	31.6 =	281.60 (ms)
	3DH5 time slot =	2.985 *	(1600/6/79)	*	31.6 =	318.40 (ms)

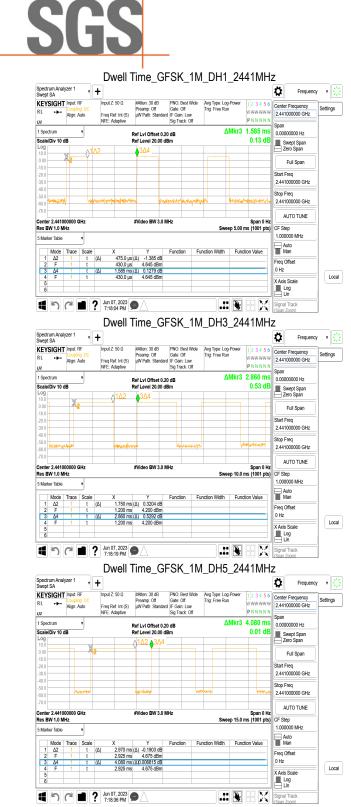
A period time = 0.4 (s) * 79 = 31.6 (s)

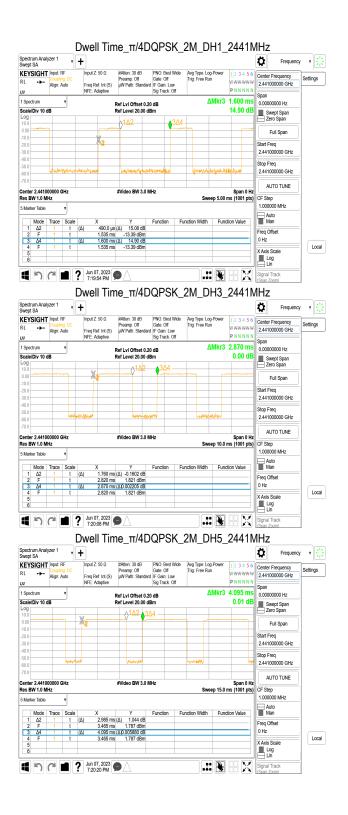
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pectrum Analyzer 1 vept SA	+	e_8DPSK_3			Trequence	y • 👌
EYSIGHT Input: RF	Input Z: 50 Ω #Atter	: 30 dB PNO: Best Wid	le Avg Type: Log-Power	123456		
L ++ Coupling: DC Align: Auto	Pream	p: Off Gate: Off ath: Standard IF Gain: Low	Trig: Free Run	WWWWWW	Center Frequency 2.441000000 GHz	Settings
a Paigit, Paio	NFE: Adaptive	Sig Track: Off		PNNNN	Span	
Spectrum v	Ref Lvi	Offset 0.20 dB	∆Mkr3	1.600 ms	0.00000000 Hz	
icale/Div 10 dB		vel 20.00 dBm		1.77 dB	Swept Span	-
.0g	Δ1Δ2	3∆4			Zero Span	
0.00					Full Span	
10.0					Start Freq	<u></u>
30.0					2.441000000 GHz	
10.0					Stop Freq	
50.0	experimental	water preserve	manual	heapporters	2.441000000 GHz	
70.0						
enter 2.441000000 GHz	#Vide	o BW 3.0 MHz		Span 0 Hz	AUTO TUNE	
es BW 1.0 MHz			Sweep 5.00	ms (1001 pts)	CF Step	
Marker Table V					1.000000 MHz	-
Mode Trace Scale	Х	Y Function	Function Width Func	tion Value	Man	
1 <u>Δ2</u> 1 t 2 F 1 t	(Δ) 490.0 µs (Δ) 900.0 µs 0.05	1.829 dB 505 dBm			Freq Offset	
3 <u>∆</u> 4 1 t	Δ) 1.600 ms (Δ)	1.768 dB			0 Hz	
4 F 1 t	900.0 µs 0.05	305 dBm			X Axis Scale	Local
6					Log Lin	
	Jun 07, 2023 👝 🔿				Signal Track	i
	7:20:59 PM	7	•••		(Span Zoom)	
	Dwell Time	e_8DPSK_3	3M DH3 24	441M⊢	z	
pectrum Analyzer 1						
wept SA	+				Frequence	y , 💥
EYSIGHT Input RF Coupling DC	Input Z: 50 Ω #Atter Pream	: 30 dB PNO: Best Wid p: Off Gate: Off	de Avg Type: Log-Power Trig: Free Run	1 2 3 4 5 6	Center Frequency	Settings
L + Align: Auto	Freq Ref: Int (S) µW Pa	ath: Standard IF Gain: Low		W WW WW W	2.441000000 GHz	
a l	NFE: Adaptive	Sig Track: Off		-	Span	
Spectrum v	Ref Lvi	Offset 0.20 dB rel 20.00 dBm	ДМКГЗ	2.870 ms	0.00000000 Hz	-
cale/Div 10 dB				0.01 dB	Swept Span Zero Span	
10.0	1 <u>Δ2</u>	304				1
0.00					Full Span	
20.0					Start Freq	
30.0					2.441000000 GHz	-
50.0					Stop Freq	
60.0	herder i state de serie de se	h/w/h	N/MAN	- Marken	2.441000000 GHz	-
70.0					AUTO TUNE	1
enter 2.441000000 GHz es BW 1.0 MHz	#Vide	b BW 3.0 MHz	Sween 10.0	Span 0 Hz ms (1001 pts)	CF Step	-
Marker Table			61100p 1010		1.000000 MHz	
					Auto	-
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2 F 1 t	1.500 ms 1.1	795 dBm			Freq Offset 0 Hz	
4 F 1 t	Δ) 2.870 ms (Δ) 0.0 1.500 ms 1.1	795 dBm				Local
5					X Axis Scale Log	
					Lin	
50 6	Jun 07, 2023		.# 😽	\mathbb{H}	Signal Track (Span Zoom)	
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pectrum Analyzer 1	+				Trequenc	y •
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L ++ Coupling: DC Align: Auto	Pream		Trig: Free Run	1 2 3 4 3 0 W WW WW W	Center Frequency 2.441000000 GHz	Settings
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Spectrum Spe		o BW 3.0 MHz	Sweep 15.0	Span 0 Hz	Stop Freq 2.44100000 GHz AUTO TUNE CF Step	
y Sportum	x (Δ) 2.985 ms (Δ) 0.0	2866 dB	Sweep 15.0	Span 0 Hz ms (1001 pts)	Stop Freq 2.441000000 GHz AUTO TUNE CF Step 1.000000 MHz Auto Man	
y Sportum	x (a) 2.985 ms (Δ) 0.0 1.066 ms (Δ) 0.0 1.066 ms (Δ) 0.0 1.066 ms (Δ) 0.0	P BW 3.0 MHz Y Function 2866 dB 362 dBm 362 dBm 363 800 dB	Sweep 15.0	Span 0 Hz ms (1001 pts)	Stop Freq 2.441000000 GHz AUTO TUNE CF Step 1.000000 MHz Auto	
y Sportum	x (a) 2.985 ms (Δ) 0.0 1.066 ms (Δ) 0.0 1.066 ms (Δ) 0.0 1.066 ms (Δ) 0.0	2866 dB	Sweep 15.0	Span 0 Hz ms (1001 pts)	Stop Freq 2.441000000 GHz AUTO TUNE CF Step 1.000000 MHz Man Freq Offset 0 Hz X Avis Scale	
y Sportum	x (a) 2.985 ms (Δ) 0.0 1.066 ms (Δ) 0.0 1.066 ms (Δ) 0.0 1.066 ms (Δ) 0.0	P BW 3.0 MHz Y Function 2866 dB 362 dBm 362 dBm 363 800 dB	Sweep 15.0	Span 0 Hz ms (1001 pts)	Stop Freq 2.441000000 GHz AUTO TUNE CF Step 1.000000 MHz Auto Man Freq Offset 0 Hz	

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15 ANTENNA REQUIREMENT

15.1 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.

15.2 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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