

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant:	Digi International Inc	Honking MN 553/3			
Product Name:	9350 Excelsior Blvd., Suite 700 Hopkins, MN ConnectCore 8X				
Brand Name:	Digi				
Model No.:	CC8X				
Model Difference:	N/A				
Report Number:	ER/2019/B0066				
FCC ID:	MCQ-CCIMX8				
IC:	1846A-CCIMX8				
FCC Rule Part:	§15.247, Cat: DSS				
IC RSS:	RSS-247 issue 2 Feb 2017				
Issue Date:	Jul. 06, 2020				
Date of Test:	Dec. 04, 2019 ~ Feb 07, 2020				
Date of EUT Received: We hereby certify tha	Dec. 04, 2019 t:				

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 tested as described in this report is in compliance with conducted and radiated emission limits.

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

CHUN-CHIEH. CHEN / Supervisor



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台灣檢驗科技股份有限公司

t (886-2) 2299-3279

f (886-2) 2298-0488 www.sqs.com.tw



Revision History						
Report Number	Revision	Description	Issue Date	Remark		
ER/2019/B0066	Rev.00	Original.	Jul. 06, 2020	Revised By: Susan Lin		

Note:

1 · Disclaimer

Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

2 The test data in this test report is fully leveraged from the TAF code 0513. Since the laboratory's TAF code has been updated to 3702, this test report is being issued by the laboratory of TAF code 3702.

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1 GENERAL INFORMATION

1.1 Product description

Product Name:	ConnectCore 8X		
Brand Name:	Digi		
Model No.:	CC8X		
Model Difference:	N/A		
Hardware Version:	55001984-02 rev 4P		
Software Version:	82004286 rev 4P		
EUT Serial Number:	F191001000424		
	5Vdc from AC/DC Adapter		
Power Supply:	Adapter: Model No.: GT-46180-1605, Supplier:. GlobTek, Inc.		
Radio Technology:	Bluetooth BR+EDR		
Channel number:	70 channels		

Channel number:	79 channels
Modulation type:	GFSK + π/4DQPSK + 8DPSK
Transmit Power:	10.98 dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	\leq 0.4s

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1.2 Antenna Designation

Antenna Type	Supplier	Antenna Part No.	Freq. (MHz)	Peak Antenna Gain (dBi)	Worst Antenna Gain
PCB	YAGEO	ANTX100P001B24553	2.4GHz	4.6	V
PCB	TAOGLAS	FXP830.07.0100C	2.4GHz	3.32	
Dipole	TAOGLAS	GW.48.A151	2.4GHz	3.42	V
РСВ	TAOGLAS	FXP522.A.07.A.001	2.4GHz	3.78 (Port 1) 3.15 (Port 2)	
Dipole	Linx	ANT-DB1-RAF-RPS	2.4GHz	2.5	
PCB	ethertronic	1001932	2.4GHz	2.5	
PCB	TAOGLAS	FXP831.07.0100C	2.4GHz	3.0	

Note: Pre-scanned was done on the above 7 antennas, the PCB (ANTX100P001B24553) and Dipole (GW.48.A151) results higher emission at 2.4GHz. Therefore, the completed set of measurement was done on the antenna to be presented on this test report.

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1.3 **Test Methodology of Applied Standards**

FCC Part 15, Subpart C §15.247 FCC KDB 558074 D01 15.247 Meas. Guidance v05r02 RSS-247 issue 2 Feb. 2017 RSS-Gen. issue 5, Amendment 1, March 2019 ANSI C63.10:2013

1.4 **Test Facility**

SGS Taiwan Ltd. Central RF Lab (TAF code 3702) No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803

FCC Designation number: TW0027

ISED CAB identifier: TW3702

1.5 **Special Accessories**

There is no special accessory used while test was conducted.

1.6 **Equipment Modifications**

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

Conducted Emissions 2.3.1

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.

Conducted Test (RF) 2.3.2

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*9m*6m semi-anechoic chamber, the measurements correspond to those obtained at an open-field test site.

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

2.4.2 For all conducted test items:

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

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2.5 Configuration of Tested System Fig. 2-1 Radiated Emission & Conducted (AC powerline) Emission

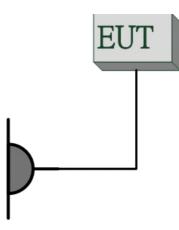


Fig. 2-2 Conducted (Antenna Port) Emission



Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2	Notebook	Lenovo	L430	R9-X11BG	Unshielded	Shielded

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SUMMARY OF TEST RESULTS 3

FCC Rules	IC Rules	Description Of Test	Result
§15.207(a)	RSS-Gen §8.8	AC Power Line Conducted Emission	Compliant
§15.247(b)(1)	RSS-247 §5.4 b	Peak Output Power	Compliant
§15.247(a)(1)	RSS-247 §5.1 b RSS-Gen §6.7	20dB & 99% Bandwidth	Compliant
§15.205 §15.209 §15.247(d)	RSS-247 §5.5 RSS-Gen §8.9 RSS-Gen §8.10	Conducted & Radiated Band Edge and Spurious Emission	Compliant
§15.247(a)(1)	RSS-247 §5.1 b	Frequency Separation	Compliant
§15.247(a)(1)(iii)	RSS-247 §5.1 d	Number of hopping frequency Time of Occupancy	Compliant
§15.203	N/A	Antenna Requirement	Compliant

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DESCRIPTION OF TEST MODES Δ

4.1 Operated in 2400 ~ 2483.5MHz Band

79 channels are provided for Bluetooth

ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY	ITEM	FREQUENCY
1	2402 MHz	21	2422 MHz	41	2442 MHz	71	2462 MHz
2	2403 MHz	22	2423 MHz	42	2443 MHz	72	2463 MHz
3	2404 MHz	23	2424 MHz	43	2444 MHz	73	2464 MHz
4	2405 MHz	24	2425 MHz	44	2445 MHz	74	2465 MHz
5	2406 MHz	25	2426 MHz	45	2446 MHz	75	2466 MHz
6	2407 MHz	26	2427 MHz	46	2447 MHz	76	2467 MHz
7	2408 MHz	27	2428 MHz	47	2448 MHz	77	2468 MHz
8	2409 MHz	28	2429 MHz	48	2449 MHz	78	2469 MHz
9	2410 MHz	29	2430 MHz	49	2450 MHz	79	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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The Worst Test Modes and Channel Details 4.2

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

MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	PACKET TYPE			
	RADIATED EMISSION TEST (BELOW 1 GHz)						
Bluetooth	2402 to 2480	2441	GFSK	DH5			
	RADIATED EMISSION TEST (ABOVE 1 GHz)						
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH5			
Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth BR+EDR Transmitter for channel Low, Mid and							

High, the worst case E2 position was reported.

	ANTENNA PORT CONDUCTED TEST						
MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	PACKET TYPE			
	I	Peak Output Power,	20dB Band Width				
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK, π/4-DQPSK, 8-DQPK	DH1/DH3/DH5			
	Band Edge						
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH5			
		Frequency S	Separation				
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH5			
		Number of hopp	ing frequency				
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH5			
	Time of Occupancy (Dwell time)						
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK, π/4-DQPSK, 8-DQPK	DH1/DH3/DH5			

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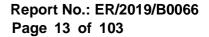
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MEASUREMENT UNCERTAINTY 5

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Peak Output Power	+/- 0.84 dB
20dB Bandwidth	+/- 51.33 Hz
100 KHz Bandwidth Of Frequency Band Edges	+/- 0.84 dB
Frequency Separation	+/- 51.33 Hz
Number of hopping frequency	+/- 51.33 Hz
Time of Occupancy	+/- 51.33 Hz
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission Measurement Uncertainty								
	9kHz~30MHz: +-2.3dB							
	30MHz - 180MHz: +/- 3.37dB							
Polarization: Vertical	180MHz -417MHz: +/- 3.19dB							
Polarization. Vertical	0.417GHz-1GHz: +/- 3.19dB							
	1GHz - 18GHz: +/- 4.04dB							
	18GHz - 40GHz: +/- 4.04dB							
	9kHz~30MHz: +-2.3dB							
	30MHz - 167MHz: +/- 4.22dB							
Polarization: Horizontal	167MHz -500MHz: +/- 3.44dB							
Polarization. Horizontai	0.5GHz-1GHz: +/- 3.39dB							
	1GHz - 18GHz: +/- 4.08dB							
	18GHz - 40GHz: +/- 4.08dB							

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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CONDUCTED EMISSION TEST 6

6.1 **Standard Applicable**

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

Frequency range	Lin dB(nits 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

Note

1. The lower limit shall apply at the transition frequencies

The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

6.2 **Measurement Equipment Used**

	Conducted Emission Test Site											
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.							
EMI Test Receiver	R&S	ESCI 3	100335	02/12/2019	02/11/2020							
LISN	SCHWARZBECK	NSLK 8127	8127-649	04/02/2019	04/01/2020							
Coaxial Cables	N/A	WK CE Cable	N/A	01/02/2020	01/01/2021							
Test Software	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R	N.C.R							

6.3 **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.

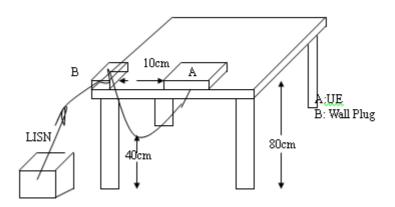
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6.4 Test SET-UP (Block Diagram of Configuration)



6.5 **Measurement Procedure**

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

6.6 Measurement Result

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

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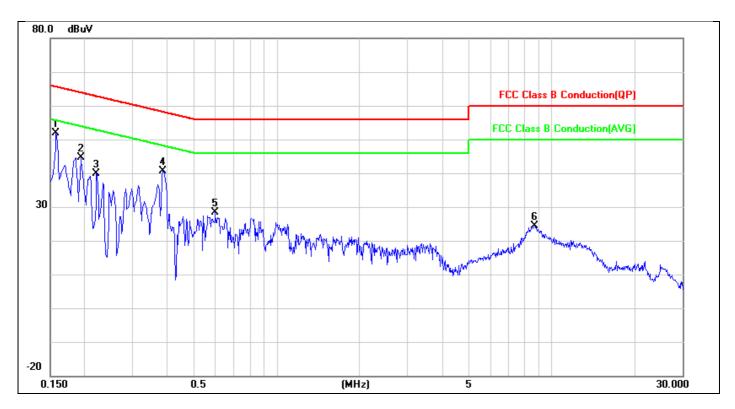
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AC POWER LINE CONDUCTED EMISSION TEST DATA

Dipole Antenna (Part No.: GW.48.A151)

Description:	Operation	Date:	2020/02/06
Line:	L1	Temp.(°C)/Hum.(%):	20.5(°C)/67%
Test Voltage:	AC 120V/60Hz	Test By:	Thomas
Report Number:	ER-2019-B0066		



No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Comment
NO.	IVIK.	(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)	Detector	Comment
1	*	0.1580	51.95	0.00	51.95	65.57	-13.62	peak	
2		0.1940	44.68	0.01	44.69	63.86	-19.17	peak	
3		0.2220	39.98	0.01	39.99	62.74	-22.75	peak	
4		0.3860	40.52	0.01	40.53	58.15	-17.62	peak	
5		0.5980	28.35	0.01	28.36	56.00	-27.64	peak	
6		8.6940	24.09	0.26	24.35	60.00	-35.65	peak	

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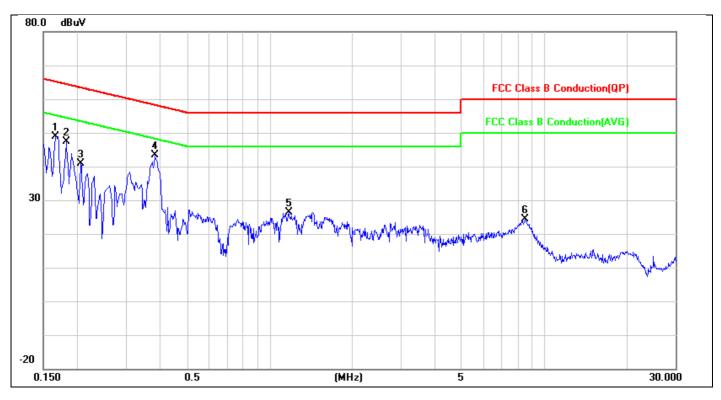
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Description: Line:	Operation N	Date: Temp.(°C)/Hum.(%):	2020/02/06 20.5(°C)/67%
Test Voltage:	AC 120V/60Hz	Test By:	Thomas
Report Number:	ER-2019-B0066		



No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Comment
NO.	IVIK.	(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)	Delector	Comment
1		0.1660	48.89	0.00	48.89	65.16	-16.27	peak	
2		0.1820	47.47	0.01	47.48	64.39	-16.91	peak	
3		0.2060	40.89	0.01	40.90	63.37	-22.47	peak	
4	*	0.3820	43.26	0.01	43.27	58.24	-14.97	peak	
5		1.1740	26.30	0.02	26.32	56.00	-29.68	peak	
6		8.5020	24.01	0.25	24.26	60.00	-35.74	peak	

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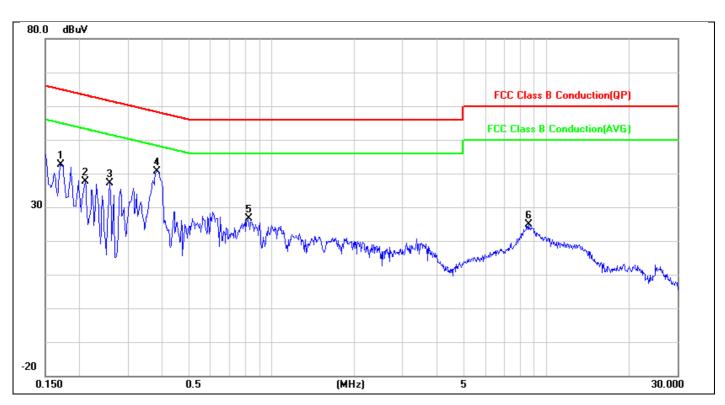
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PCB Antenna (Part No.: ANTX100P001B24553)

Description:	Operation	Date:	2020/02/06
Line:	L1	Temp.(°C)/Hum.(%):	20.5(°C)/67%
Test Voltage:	AC 120V/60Hz	Test By:	Thomas
Report Number:	ER-2019-B0066		



No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Commont
NO.	IVIK.	(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)	Detector	Comment
1		0.1700	42.54	0.00	42.54	64.96	-22.42	peak	
2		0.2100	37.70	0.01	37.71	63.21	-25.50	peak	
3		0.2580	37.15	0.01	37.16	61.50	-24.34	peak	
4	*	0.3820	40.55	0.01	40.56	58.24	-17.68	peak	
5		0.8260	26.56	0.02	26.58	56.00	-29.42	peak	
6		8.6180	24.57	0.25	24.82	60.00	-35.18	peak	

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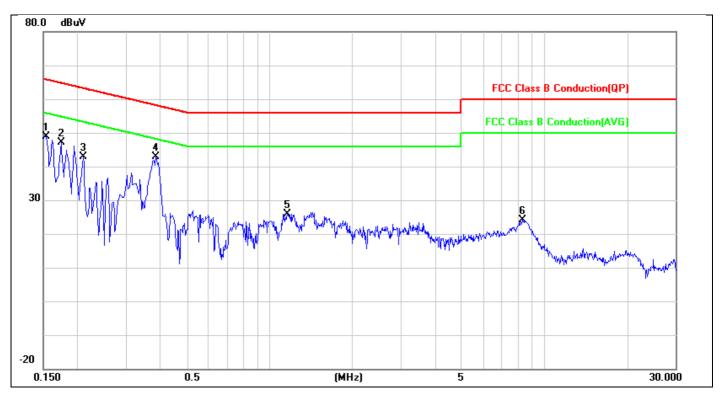
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Description: Line:	Operation N	Date: Temp.(°C)/Hum.(%):	2020/02/06 20.5(°C)/67%
Test Voltage:	AC 120V/60Hz	Test By:	Thomas
Report Number:	ER-2019-B0066		



No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector	Commont
NO.	IVIK.	(MHz)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dB)	Delector	Comment
1		0.1540	48.93	0.00	48.93	65.78	-16.85	peak	
2		0.1740	47.09	0.00	47.09	64.77	-17.68	peak	
3		0.2100	42.88	0.01	42.89	63.21	-20.32	peak	
4	*	0.3860	42.93	0.01	42.94	58.15	-15.21	peak	
5		1.1620	25.89	0.02	25.91	56.00	-30.09	peak	
6		8.3260	23.90	0.25	24.15	60.00	-35.85	peak	

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PEAK OUTPUT POWER MEASUREMENT 7

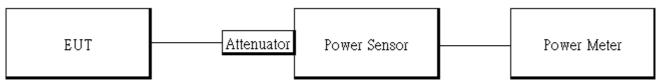
7.1 **Standard Applicable**

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. The e.i.r.p. shall not exceed 4 W. (ISED)

7.2 **Measurement Equipment Used**

Conducted Emission Test Site											
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.						
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020						
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2019	01/04/2020						
Power Meter	Anritsu	ML2496A	1804001	02/13/2019	02/12/2020						
Power Sensor	Anritsu	MA2411B	1726104	02/13/2019	02/12/2020						
Power Sensor	Anritsu	MA2411B	1726107	02/13/2019	02/12/2020						

7.3 **Test Set-up:**



7.4 **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. 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)
- 4. Record the max. reading.
- 5. Repeat above procedures until all default test channel is completed.

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7.5 Peak & Average Power Measurement Result

1M BR mode (Peak):

СН	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	9.94	9.863	125
Mid	2441	10.98	12.531	125
High	2480	10.15	10.351	125

Max. Output include Output Freq. Limit CH Power tune up (MHz) (mW) tolerance (mW) Power (dBm) 2402 7.734 125 Low 8.88 Mid 2441 10.68 11.705 125 2480 9.75 9.449 125 High

2M EDR mode (Peak):

СН	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	9.11	8.147	125
Mid	2441	10.25	10.593	125
High	2480	9.34	8.590	125

3M EDR mode (Peak):

СН	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)		
Low	2402	9.52	8.954	125		
Mid	2441	10.60	11.482	125		
High	2480	9.73	9.397	125		
NOTE	NOTE: ashis lass as fold that affects in the smarter					

NOTE: cable loss as 1dB that offsets in the spectrum

2M EDR mode	(Average):
-------------	------------

СН	Freq. (MHz)	Max. Avg.Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	6.94	4.947	125
Mid	2441	8.15	6.537	125
High	2480	7.20	5.253	125

3M EDR mode (Average):

СН	Freq. (MHz)	Max. Avg.Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	6.96	4.970	125
Mid	2441	7.65	5.826	125
High	2480	7.20	5.253	125

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

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EIRP Measurement Result 7.6

1M BR mode EIRP

Channel	Frequency (MHz)	Max. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	8.88	4.60	22.304	4000
Mid	2441	10.68	4.60	33.758	4000
High	2480	9.75	4.60	27.251	4000

2M EDR mode EIRP

Channel	Frequency (MHz)	Max. Avg.Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	6.94	4.60	14.269	4000
Mid	2441	8.15	4.60	18.853	4000
High	2480	7.20	4.60	15.149	4000

3M EDR mode EIRP

Channel	Frequency (MHz)	Max. Avg.Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	6.96	4.60	14.335	4000
Mid	2441	7.65	4.60	16.803	4000
High	2480	7.20	4.60	15.149	4000

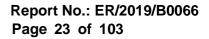
* Note: EIRP = Average Power + Gain

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20dB & 99% BANDWIDTH MEASUREMENT 8

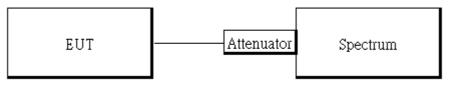
8.1 **Standard Applicable**

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

Measurement Equipment Used 8.2

Conducted Emission Test Site					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2019	01/04/2020

8.3 Test Set-up



8.4 **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 the spectrum analyzer as RBW=10 kHz (1 % of 20 dB Bandwidth.), VBW = 30 kHz, Span= large enough to capture all products of the modulation process. 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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8.5 20dB Bandwidth

GFSK

СН	20 dB BW (MHz)	2/3 BW (MHz)		
Low	0.9235	0.62		
Mid	0.9262	0.62		
High	0.9245	0.62		
π/4-DQPSK				

СН	20 dB BW (MHz)	2/3 BW (MHz)
Low	1.284	0.86
Mid	1.275	0.85
High	1.301	0.87
	14	

8-DPSK

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

8.6 99% Bandwidth

GFSK

<u>Mid</u> High

СН	99% BW (MHz)
Low	0.89817
Mid	0.89512
High	0.89782
π/4-DQPSK	
СН 99	99% BW
СН	(MHz)
Low	1.1790
Mid	1.1807
Mid High	1.1807 1.1811
High 8-DPSK	
High	1.1811

1.1811

1.1839

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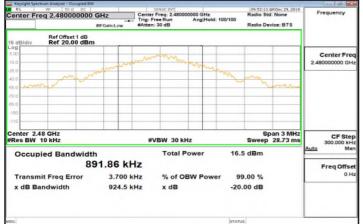
BW CH-Low (GFSK mode)



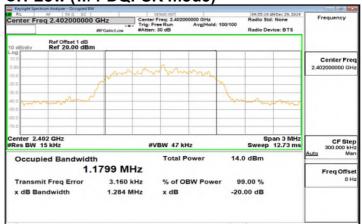
CH-Mid (GFSK mode)



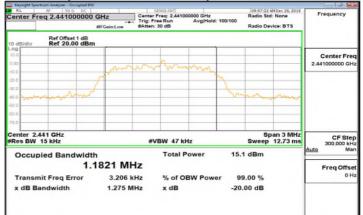
CH-High (GFSK mode)



CH-Low (π /4-DQPSK mode)



CH-Mid (π/4-DQPSK mode)



CH-High (π/4-DQPSK mode)

Center Fre	eq 2.480000000	GHz #IFGain:Low	Center Fr		0000 GHz Avg/Hold:	100/100	Radio De		Frequency
15 dB/div	Ref Offset 1 dB Ref 20.00 dBm								
-10.0		m	m	nim	ma	_			Center Free 2.480000000 GH:
25.0 40.0	man					has		ma	
70.0									
-1000		-						-	
-115									
Center 2.4 #Res BW 1			#VE	3W 47 kH	tz			an 3 MHz 12.73 ms	CF Ste 300.000 kH
Occupi	ied Bandwidth	813 MH	47	Total P	ower	14.	0 dBm		Auto Mai
	it Freq Error	3.421 k	Hz		BW Powe		9.00 %		Freq Offse 0 H
x dB Ba	ndwidth	1.301 M	Hz	x dB		-20	.00 dB		
66						STATU	s		

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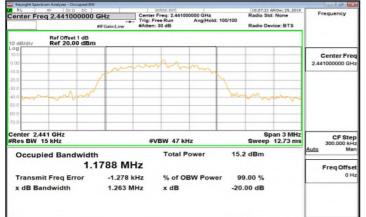
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CH-Low (8-DPSK mode)



CH-Mid (8-DPSK mode)



CH-High (8-DPSK mode)



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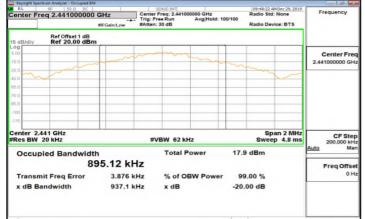
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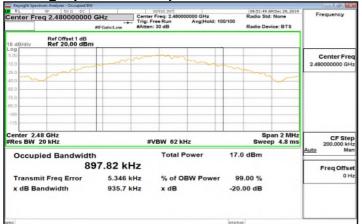
99% Bandwidth BW CH-Low (GFSK mode)

Erysight Spectrum Analyzer - Occupied B	M				Frequency
Center Freq 2.40200000	Trig	SEASE:INT hter Freq: 2.402000000 GHz g: Free Run AvgiHold ten: 30 dB	100/100	Radio Std: None Radio Device: BTS	Frequency
15 dB/div Ref Offset 1 dB Ref 20,00 dBr	n		_		Center Freq 2.402000000 GHz
5.00			-		
10,0				~	
6.0					-
		#VBW 62 kHz		Span 2 MH Sweep 4.8 ms	200.000 kH
Log 100 100 100 100 100 100 100 10	9 dBm	Freq Offse			
Transmit Freq Error x dB Bandwidth	6.923 kHz 941.8 kHz	% of OBW Powe x dB		9.00 % .00 dB	он

CH-Mid (GFSK mode)



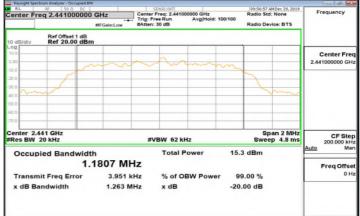
CH-High (GFSK mode)



CH-Low (π/4-DQPSK mode)

Keysight Spectre R.L.	um Analyzer - Occupied BW		SEASE: INT			Dec 39, 2019	Frequency		
	q 2.402000000	Trip	er Freq: 2.402000000 GHz Free Run Avg Hold: m: 30 dB	100/100	Radio Std: 1 Radio Devic	None	Frequency		
15 dB/div	Ref Offset 1 dB Ref 20.00 dBm						Center Free		
6.00			0.0						
10.0				~	~	-	2.402000000 GH		
40.0									
55.0									
70.0									
95.0									
100									
Fres BW 2			#VBW 62 kHz		Spa Sweep	n 2 MHz 4.8 ms	CF Ste 200.000 kH		
Occupi	ed Bandwidth		Total Power	14.2	dBm		Auto Ma		
Court.		790 MHz					Freq Offer		
Transmi	t Freq Error	4.041 kHz	% of OBW Powe	r 99	.00 %		Freq Offse 0 H		
x dB Bar		1.281 MHz	x dB		00 dB				

CH-Mid (π/4-DQPSK mode)



CH-High (π/4-DQPSK mode)

	MFGain:Low			Avg Hold: 100/1			Frequency
		-	m		~	[Center Fred 2.480000000 GH
\square					2		
						~	
		-					
9Hz kHz		#\	/BW 62 kHz		Spar Sweep	4.8 ms	CF Ster 200.000 kH
		ИHz	Total Pov	ver	14.3 dBm		Auto Mar Freg Offse
Freq Error Iwidth			% of OBV x dB		99.00 % -20.00 dB		0 H
	2Hz kHz d Bandw	Ref 20.00 dBm	Ref 20.00 dBm	Ref 20.00 dBm Ref 20.00 dBm 2Hz #VBW 62 kHz d Bandwidth Total Pov 1.1811 MHz Freq Error 4.362 kHz % of OBV	Ref 20.00 dBm and a second dB	Ref 20.00 dBm and a second dB	Ref 20.00 dBm Ref 20.00 dBm 2Hz #VBW 62 kHz Sweep 4.8 ms d Bandwidth Total Power 14.3 dBm 1.1811 MHz Freq Error 4.362 kHz % of OBW Power 99.00 %

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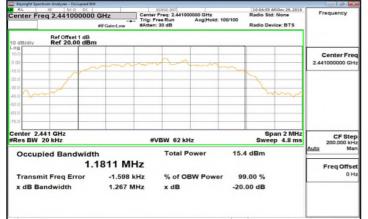
t (886-2) 2299-3279



CH-Low (8-DPSK mode)

	UTIL Trip	: Free Run	Avg Hold: 100/100	Radio Std: None Radio Device: BTS	Frequency
Ref Offset 1 dB Ref 20.00 dBm					
		~~~		<u></u>	Center Fred 2.402000000 GH
20 kHz		#VBW 62 ki	Hz	Span 2 MHz Sweep 4.8 ms	Hz CF Step ns 200.000 kHz Auto Man
		Total P	ower 14	I.3 dBm	Freq Offset
it Freq Error Indwidth	717 Hz 1.268 MHz	% of O x dB			0 Hz
	Ref Officet 1 dB Ref 20.00 dBm 02 GHz 20 kHz lied Bandwidti 1.*	Provide the second seco	Ref 20.00 dBm Ref 20.00 dBm 02 GHz 20 kHz 20 kHz 1.1781 MHz it Freq Error 717 Hz % of O	Ref Offset 1 dB Ref 2000 dBm 202 GHz 200 kHz #VBW 62 kHz it Freq Error 717 Hz % of OBW Power 1	Ref 20.000 dBm Ref 20.000 dBm Ref 20.000 dBm 22 GHz 20 kHz 20 kHz 1.1781 MHz it Freq Error 717 gr Fres Bur Avg Held: 100100 Radio Device: BTS Radio Device: BTS Ref 20.00 dBm Total Power 14.3 dBm 1.1781 MHz it Freq Error 717 Hz % of OBW Power 99.00 %

## CH-Mid (8-DPSK mode)



## CH-High (8-DPSK mode)



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# 9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

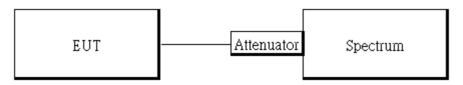
## 9.1 Standard Applicable

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.

## 9.2 Measurement Equipment Used

Conducted Emission Test Site									
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.				
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020				
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2019	01/04/2020				

### 9.3 Test SET-UP



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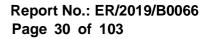
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#### 9.4 **Measurement Procedure**

#### 9.4.1 **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.
- 4. 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. 2.3999GHz and 2.4836GHz and record the max. level.
- 7. Repeat above procedures until all frequency measured were complete.

## 9.4.2 Conducted Spurious Emission:

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

#### 9.5 **Measurement Result**

See next page for test plots.

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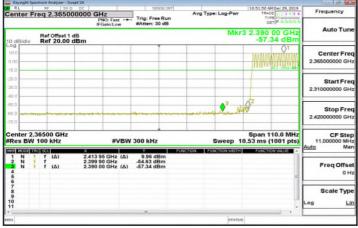
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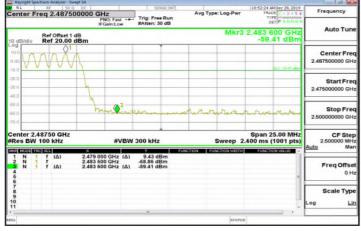
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## Hopping mode BR Band Edge CH-Low



# BR Band Edge CH-High



# EDR Band Edge CH-Low



# EDR Band Edge CH-High



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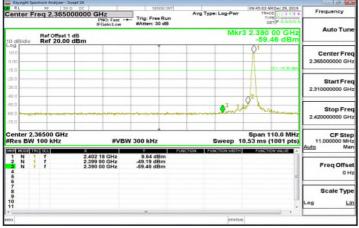
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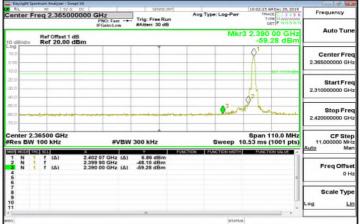
## *Non-Hopping BR Band Edge CH-Low*



# BR Band Edge CH-High



# EDR Band Edge CH-Low



# EDR Band Edge CH-High



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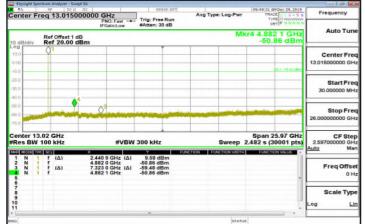
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### Spurious Emission_GFSK_1M_DH5_2402MHz

SC



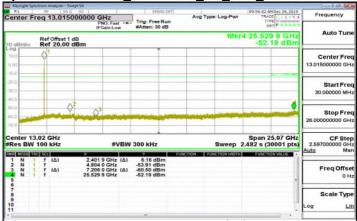
### Spurious Emission_GFSK_1M_DH5_2441MHz



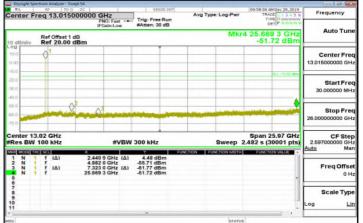
### Spurious Emission_GFSK_1M_DH5_2480MHz

Repsight Spertnum Anatyrer - Swept SA					010-00
enter Freq 13.01500000	PNO: Fast	Trig: Free Run	Avg Type: Log-Pwr	09:52:56 AM Dec 29, 2019 TRACE 12.3.4.5.5 TYPE NORMANN PET P 5 M M	Frequency
o dB/div Ref Offset 1 dB	IFGain:Low	EAtten: 30 dB	Mkr	4 4.960 0 GHz -50.58 dBm	Auto Tun
00 01 100 01 100 00				0.7 00.00 miles	Center Fre 13.015000000 GH
20.0 30.0 40.0					Start Fre
	0				Stop Fre 26.00000000 GH
enter 13.02 GHz Res BW 100 kHz	#VBW	300 kHz	Sweep 2	Span 25.97 GHz 482 s (30001 pts)	CF Ste 2.597000000 Ge Auto Ma
1 N 1 f (Δ) 2. 2 N 1 f 4. 3 N 1 f (Δ) 7. 4 N 1 f 4. 5	479 8 GHz (Δ) 960 0 GHz 440 0 GHz (Δ) 960 0 GHz	9.31 dBm -50.58 dBm -60.66 dBm -50.58 dBm		FORE THEN WALLE	Freq Offs 0 F
6 7 8 9 10 11					Scale Typ
95		m	STATUS		

### Spurious Emission_π4DQPSK_2M_DH5_2402MHz



### Spurious Emission_m4DQPSK_2M_DH5_2441MHz



### Spurious Emission_π4DQPSK_2M_DH5_2480MHz

RL AF 50.0 DC		SENSE JNT	1	10:00:43 AMDec 29, 2019	Frequency
enter Freq 13.01500000	PNO: Fast	Trig: Free Run #Atten: 30 dB	Avg Type: Log-Pwr	TYPE PANANA	Frequency
Ref Offset 1 dB			Mkr4	25.736 0 GHz -52.28 dBm	Auto Tune
og 10.0 0.00					Center Fre 13.015000000 GH
00.0 20.0 30.0				au in rue-	Start Fre 30.000000 MH
	Q ³				Stop Fre 26.000000000 GH
Center 13.02 GHz Res BW 100 kHz	#VBW	300 kHz		Span 25.97 GHz 82 s (30001 pts)	CF Ste 2.597000000 GH Auto Ma
1 N 1 f (Δ) 2.4 2 N 1 f (Δ) 4.9 3 N 1 f (Δ) 7.4	1798 GHz (Δ) 160 0 GHz 140 0 GHz (Δ) 136 0 GHz	1,87 dBm -55.21 dBm -61.81 dBm -62.28 dBm	PUNCTION	FUCHION WODE	Freq Offse 0 H
6 7 8 9 10					Scale Typ
82			STATUS		

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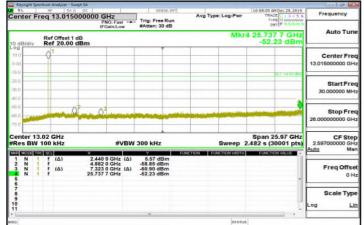
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### Spurious Emission_8DPSK_3M_DH5_2402MHz

	10:04:23 AM Dec 29, 2019				Store - Strept SA	atrum #	igM Spr	Sey.
Hz Auto Tune	TRACE 23455 TYPE NUMBER	Avg Type: Log-Pwr	Trig: Free Run	PNO: Fast	3.015000000		er Fi	
	-51.67 dBm	Mkr4	#Atten: 30 dB	IFGain:Low	ffset 1 dB 20.00 dBm			
					20.00 dBm		/div	10.0
Start Fre 30.000000 MH	Dur 15 Kluthn							20.0
Stop Fre 26.00000000 GH				) ³	¢²	-		0.0
CF Ste 2:597000000 GH Auto Ma	Span 25.97 GHz .482 s (30001 pts)		300 kHz	#VBW		100	er 13 BW	Res
Freq Offse	ENVETION WANTE	FUNCTION WOTH	4.58 dBm -54.73 dBm -58.34 dBm -51.67 dBm	01 9 GHz (Δ) 04 0 GHz 06 0 GHz (Δ) 14 3 GHz	4.8 7.2			12346
Scale Typ								67890
								11
		STATUS						95

### Spurious Emission_8DPSK_3M_DH5_2441MHz



### Spurious Emission_8DPSK_3M_DH5_2480MHz

	eitrum Anatyres - Skiep					- ) # -
Center F	req 13.01500		Trig: Free Run	Avg Type: Log-Pwr	10:11:17 AMDec 29, 2019 TRACE 3 - 5 - 5 TVPE N M M M	Frequency
10 dB/div	Auto Tune					
og 10.0 0.00	01					Center Free 13.015000000 GH
10.0 20.0 30.0					Q.2. 10 (B) alter	Start Free 30.000000 MH
60.0 70.0						Stop Free 26.000000000 GH
Center 13 #Res BW	100 kHz	#VBW	300 kHz		Span 25.97 GHz 2.482 s (30001 pts)	CF Step 2.597000000 GH Auto Mar
1 N 2 N 3 N 6	f (Δ) f (Δ) f (Δ)	2.480 7 GHz (Δ) 4.960 0 GHz 7.440 0 GHz (Δ) 4.960 0 GHz (Δ)	3,42 dBm -52.09 dBm -63.05 dBm -62.09 dBm	PICTION FUNCTION WIDTH	EUX-HON WATE	Freq Offse 0 H:
6 7 8 9 10 11						Scale Type
esca				STATUS		

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# 10 RADIATED BANDEDGE 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 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.
- 2. Emission level ( $dB\mu V/m$ ) = 20 log Emission level ( $\mu V/m$ )

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#### **Measurement Equipment Used** 10.2

966 Chamber									
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.				
Bi-log Antenna	SCHWAZBECK	VULB9168	378	01/04/2019	01/03/2020				
Horn Antenna	Schwarzbeck	BBHA9120D	1441	08/20/2019	08/19/2020				
Horn Antenna	Schwarzbeck	BBHA9170	184	12/25/2018	12/24/2019				
Attenuator	Mini-Circuit	BW-S10W2+	4	01/05/2019	01/04/2020				
3m Site NSA	SGS	966 chamber	N/A	01/05/2019	01/04/2020				
Loop Antenna	ETS.LINDGREN	6502	148045	10/15/2019	10/14/2020				
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/22/2019	04/21/2020				
EMI Test Receiver	R&S	ESCI 7	1166.5950.07	07/04/2019	07/03/2020				
Pre-Amplifier	HP	8449B	3008A00578	01/05/2019	01/04/2020				
Pre-Amplifier	HP	8447D	2944A07676	01/05/2019	01/04/2020				
Pre-Amplifier	EMC Instruments	EMC184045B	980135	01/05/2019	01/04/2020				
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	01/05/2019	01/04/2020				
High Pass Filter	WI	WHKX4.0/18G-10SS	22	01/05/2019	01/04/2020				
Low Loss Cable	Huber Suhner	966_RX	9	01/05/2019	01/04/2020				

Note: The measurement was taken place with the long duration of the time, and additional equipment list as shown above indicate those equipment of which has been subject to undertake the calibration in intermediate period of time of the measurement.

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	966 Chamber				
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bi-log Antenna	SCHWAZBECK	VULB9168	378	01/03/2020	01/02/2021
Horn Antenna	Schwarzbeck	BBHA9170	184	12/25/2019	12/24/2020
Attenuator	Mini-Circuit	BW-S10W2+	4	01/05/2020	01/04/2021
3m Site NSA	SGS	966 chamber	N/A	01/05/2020	01/04/2021
Pre-Amplifier	HP	8449B	3008A00578	01/05/2020	01/04/2021
Pre-Amplifier	HP	8447D	2944A07676	01/05/2020	01/04/2021
Pre-Amplifier	EMC Instruments	EMC184045B	980135	01/05/2020	01/04/2021
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	01/05/2020	01/04/2021
High Pass Filter	WI	WHKX4.0/18G-10SS	22	01/05/2020	01/04/2021
Low Loss Cable	Huber Suhner	966_RX	9	01/05/2020	01/04/2021

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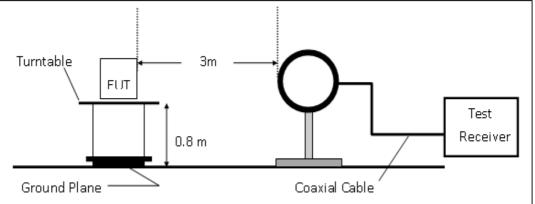
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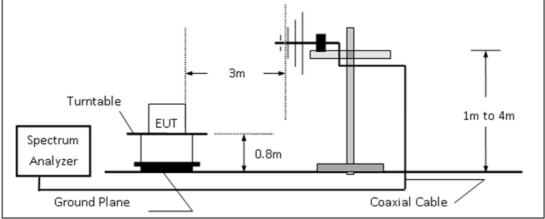


#### 10.3 Test SET-UP

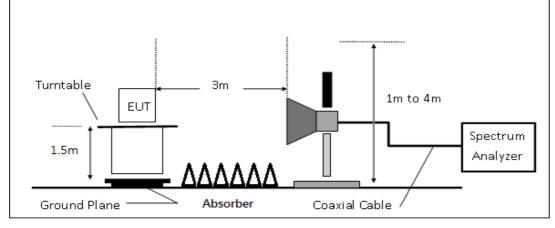
(A) Radiated Emission Test Set-UP Frequency Below 30MHz.



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



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



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### 10.4 Measurement Procedure

### 10.4.1 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 plan.
- 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=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
- 6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
- 7. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
- 8. 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.
- 9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 10. 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.
- 11. Repeat above procedures until all default test channel measured were complete.

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#### 10.5 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 RA = Reading Amplitude AF = Antenna Factor

CL = Cable Attenuation Factor (Cable Loss) AG = Amplifier Gain

The limit of the emission level is expressed in dBuV/m, which converts 20*log(uV/m)

Actual  $FS(dB\mu V/m) = SPA$ . Reading level( $dB\mu V$ ) + Factor(dB)  $Factor(dB) = Antenna Factor(dB\mu V/m) + Cable Loss(dB) - Pre_Amplifier Gain(dB)$ 

#### Test Results of Radiated Spurious Emissions form 9 kHz to 30 MHz 10.6

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.

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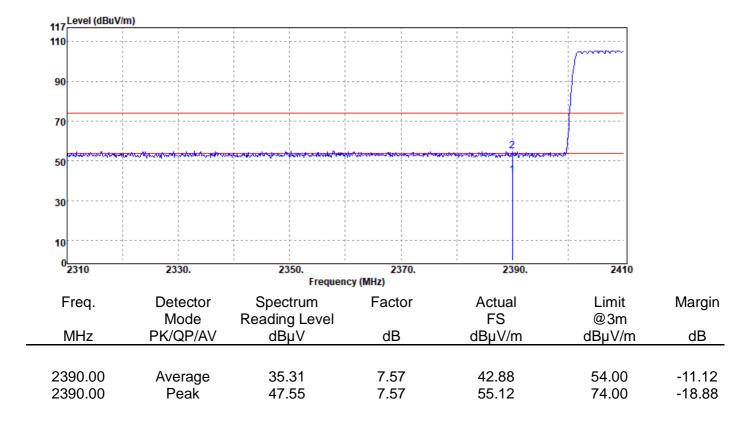
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### 10.7 **Measurement Result:** 10.7.1 Radiated Bandedge Result (Hopping Mode)

### Dipole Antenna (Part No.: GW.48.A151)

Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:BR Hopping	Temp./Humi.	:21.8/45
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		



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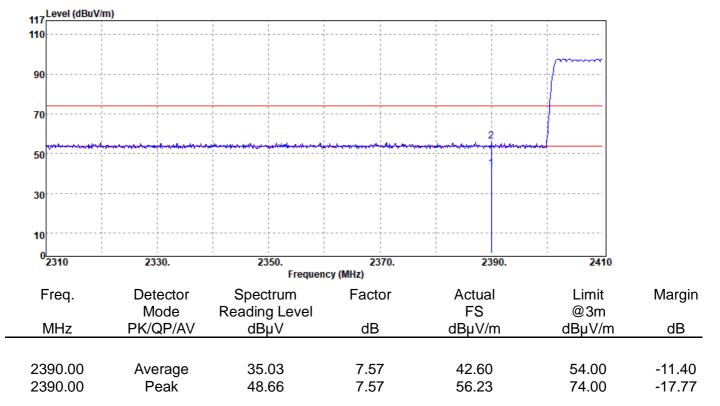
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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:BR Hopping	Temp./Humi.	:21.8/45
Test Channel	:2402 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		



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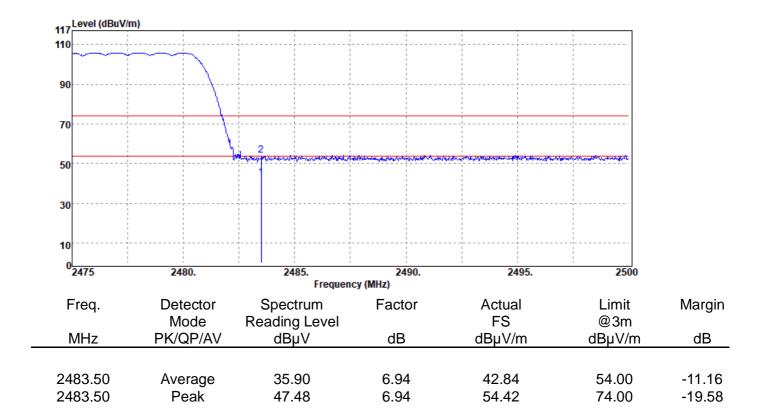
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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:BR Hopping	Temp./Humi.	:21.8/45
Test Channel	:2480 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		

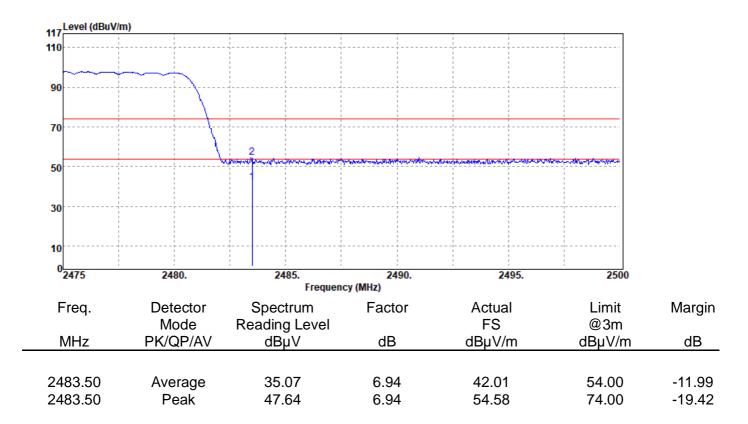


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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:BR Hopping	Temp./Humi.	:21.8/45
Test Channel	:2480 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		



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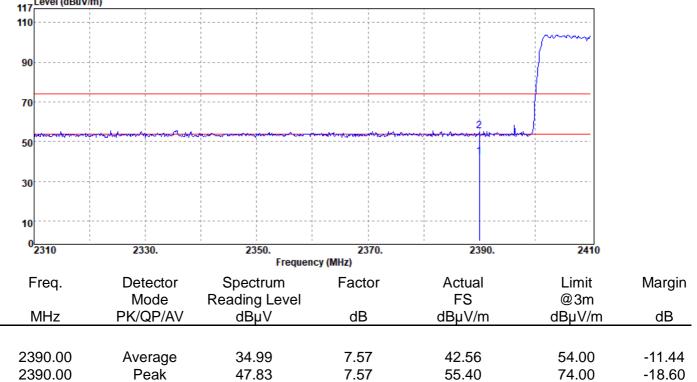
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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:EDR Hopping	Temp./Humi.	:21.8/45
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		
Level (dBuV/m)			



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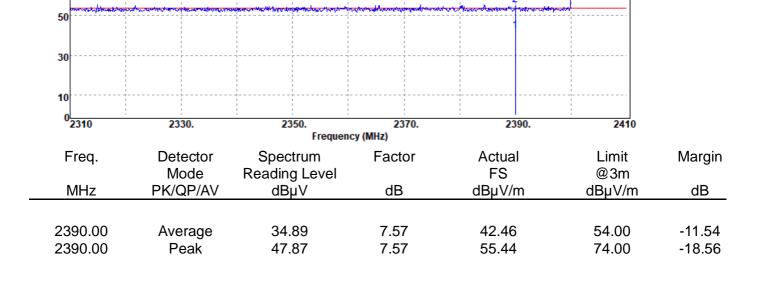
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Report Number	:ER/2019/B0066		Test Da	ate	:2019-12	2-04
Operation Mode	:EDR Hopping		Temp./	Humi.	:21.8/45	
Test Channel	:2402 MHz		Antenn	na Pol.	:HORIZO	ONTAL
Test Mode	:Bandedge CH Low		Engine	er	:Thomas	;
EUT Pol	:E2 Plane					
117 Level (dBuV/m)						
		1	1			
			1		1	
117 Level (dBuV/m) 110						



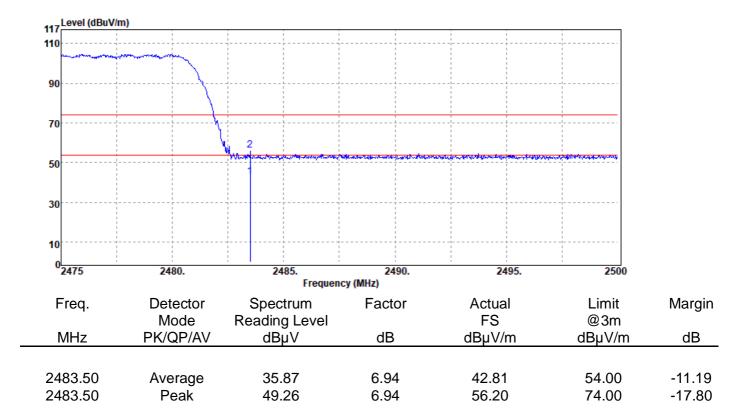
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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:EDR Hopping	Temp./Humi.	:21.8/45
Test Channel	:2480 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		



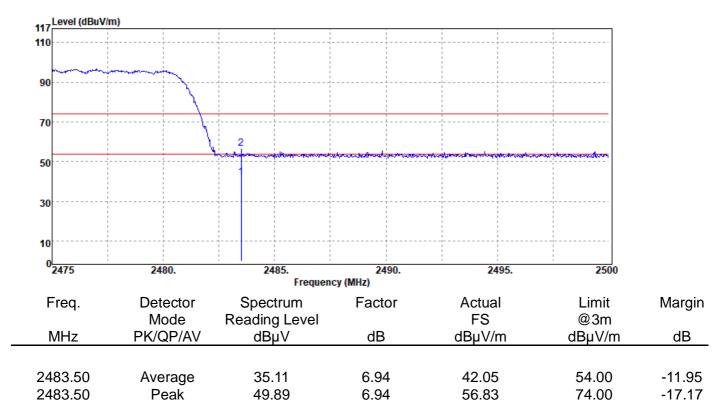
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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:EDR Hopping	Temp./Humi.	:21.8/45
Test Channel	:2480 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		



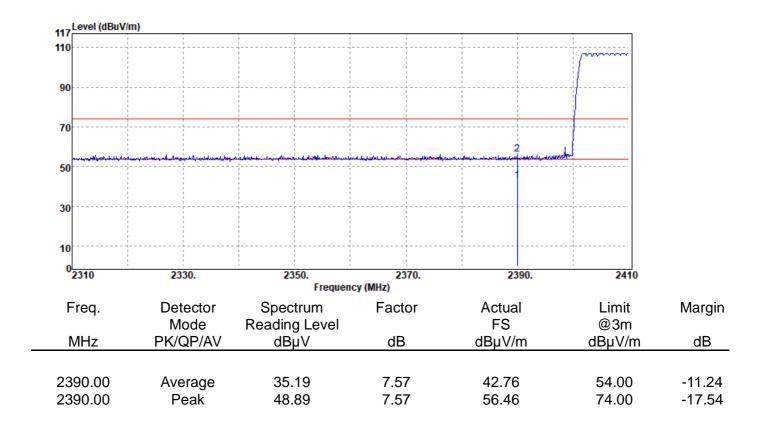
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### PCB Antenna (Part No.: ANTX100P001B24553)

Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:BR Hopping	Temp./Humi.	:22.2/59
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		



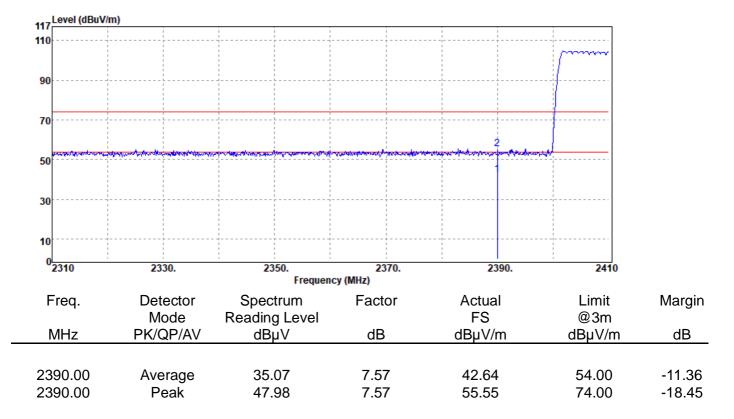
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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:BR Hopping	Temp./Humi.	:22.2/59
Test Channel	:2402 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		

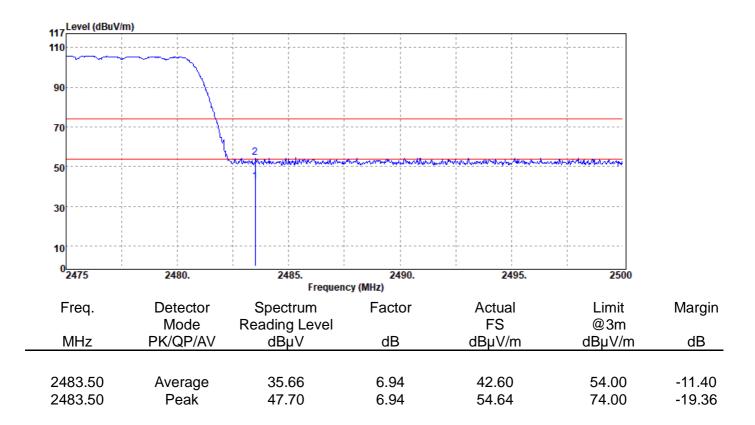


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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:BR Hopping	Temp./Humi.	:22.2/59
Test Channel	:2480 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		

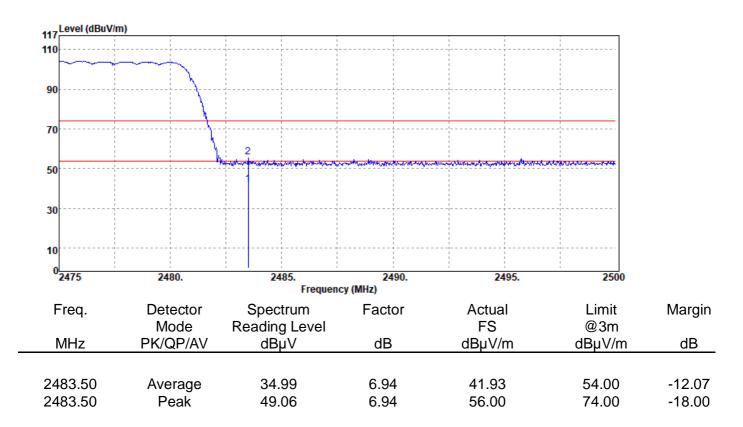


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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:BR Hopping	Temp./Humi.	:22.2/59
Test Channel	:2480 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		



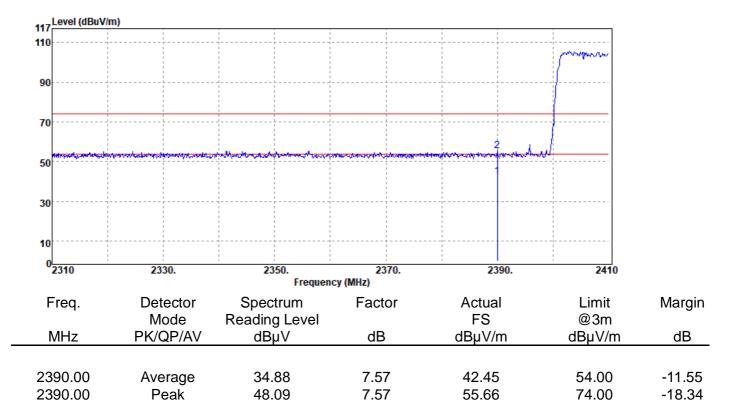
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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:EDR Hopping	Temp./Humi.	:22.2/59
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		



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10

Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:EDR Hopping	Temp./Humi.	:22.2/59
est Channel	:2402 MHz	Antenna Pol.	:HORIZONTAL
est Mode	:Bandedge CH Low	Engineer	:Thomas
UT Pol	:E2 Plane		
117 Level (dBuV/m)			mmy
90			
70		<b>.</b>	

⁰ 2310	2330.	2350.	2370.	2390.	2410	
		Frequenc	y (MHz)			
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
•	Mode	Reading Level		FS	@3m	U
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
		•			•	
2390.00	Average	34.81	7.57	42.38	54.00	-11.62
2390.00	Peak	48.37	7.57	55.94	74.00	-18.06

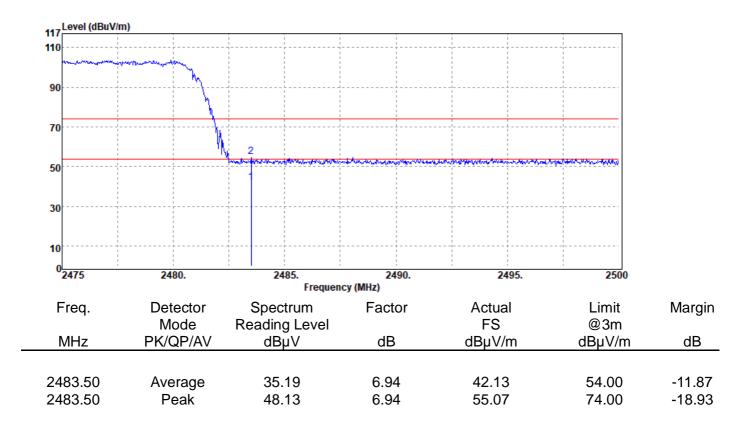
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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:EDR Hopping	Temp./Humi.	:22.2/59
Test Channel	:2480 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		



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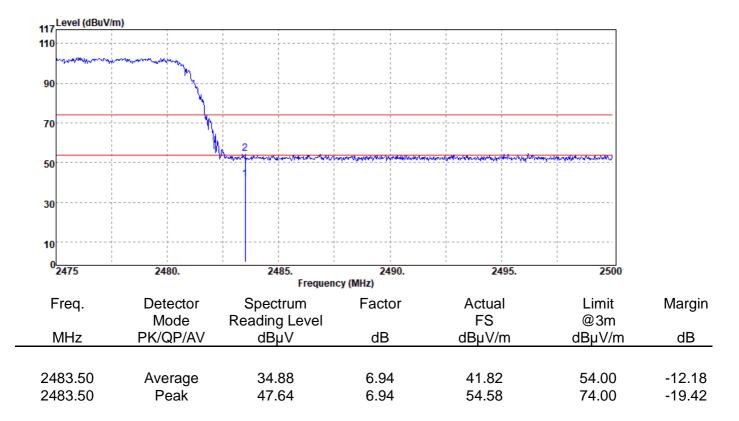
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f (886-2) 2298-0488 www.sgs.com.tw



Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:EDR Hopping	Temp./Humi.	:22.2/59
Test Channel	:2480 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		



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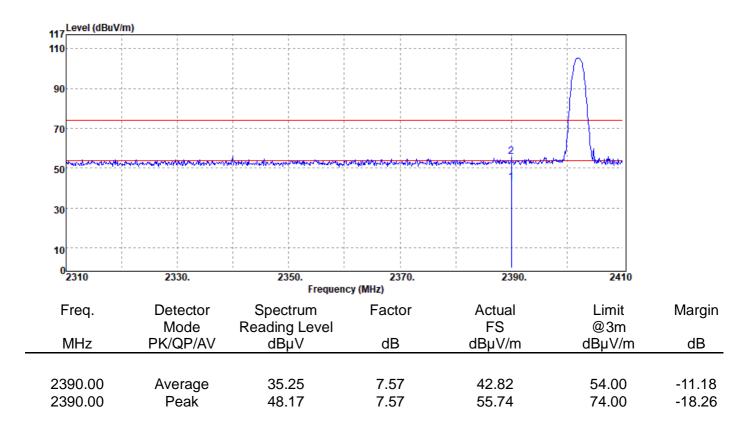
Report No.: ER/2019/B0066 Page 57 of 103



### 10.7.2 Radiated Bandedge Result (Non-Hopping Mode)

## Dipole Antenna (Part No.: GW.48.A151)

:ER/2019/B0066	Test Date	:2019-12-04
:BR(1M)	Temp./Humi.	:21.8/45
:2402 MHz	Antenna Pol.	:VERTICAL
:Bandedge CH Low	Engineer	:Thomas
:E2 Plane		
	:BR(1M) :2402 MHz :Bandedge CH Low	:BR(1M)Temp./Humi.:2402 MHzAntenna Pol.:Bandedge CH LowEngineer



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2410

Margin

dB

-11.38

-18.97

Limit

@3m

dBµV/m

54.00

74.00

2390.

Actual

FS

dBµV/m

42.62

55.03



70

50

30

10

0<mark>_____</mark>2310

Freq.

MHz

2390.00

2390.00

2330.

Detector

Mode

PK/QP/AV

Average

Peak

Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:BR(1M)	Temp./Humi.	:21.8/45
Test Channel	:2402 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	EUT Pol :E2 Plane		
117 Level (dBuV/m)			
110			
			0
90			

2370.

Factor

dB

7.57

7.57

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2350.

Spectrum

Reading Level

dBµV

35.05

47.46

Frequency (MHz)

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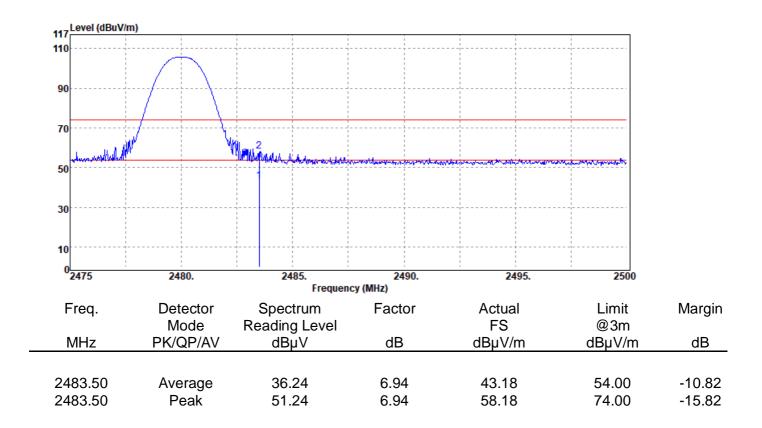
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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:BR(1M)	Temp./Humi.	:21.8/45
Test Channel	:2480 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		

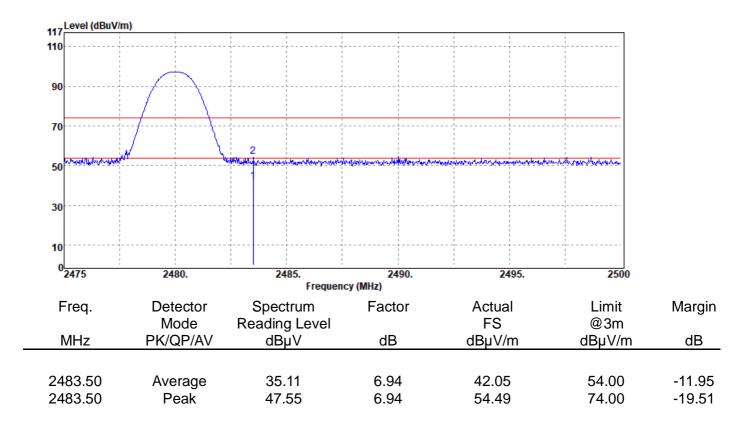


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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:BR(1M)	Temp./Humi.	:21.8/45
Test Channel	:2480 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		

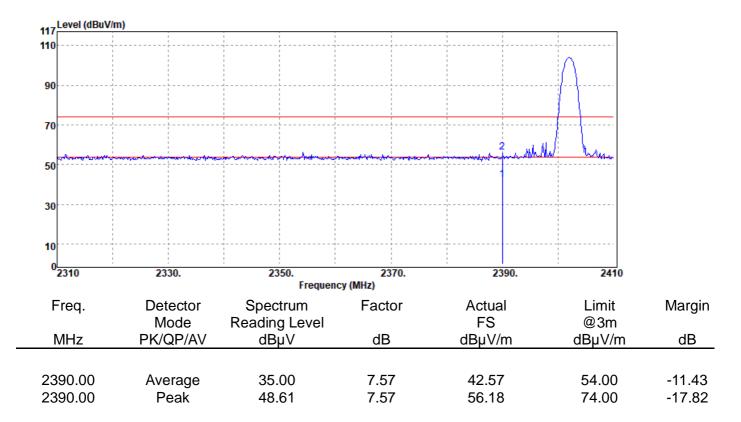


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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:EDR(3M)	Temp./Humi.	:21.8/45
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		



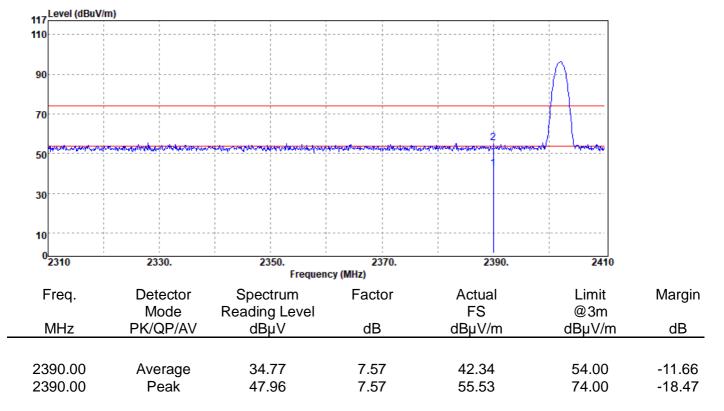
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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:EDR(3M)	Temp./Humi.	:21.8/45
Test Channel	:2402 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		

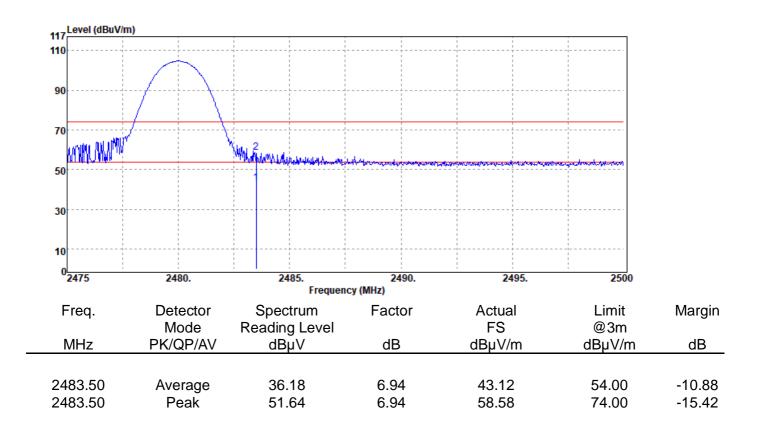


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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:EDR(3M)	Temp./Humi.	:21.8/45
Test Channel	:2480 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		



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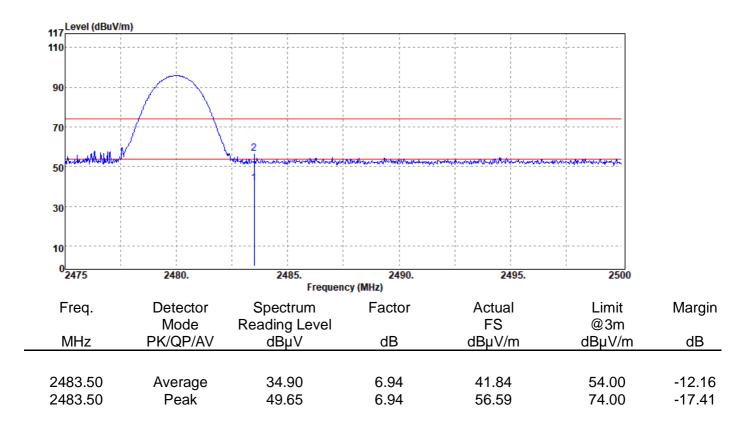
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Report Number	:ER/2019/B0066	Test Date	:2019-12-04
Operation Mode	:EDR(3M)	Temp./Humi.	:21.8/45
Test Channel	:2480 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		



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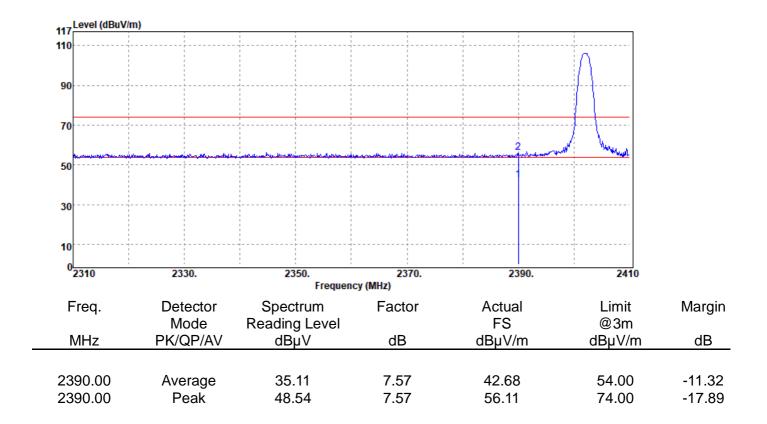
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### PCB Antenna (Part No.: ANTX100P001B24553)

Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:BR(1M)	Temp./Humi.	:22.2/59
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		



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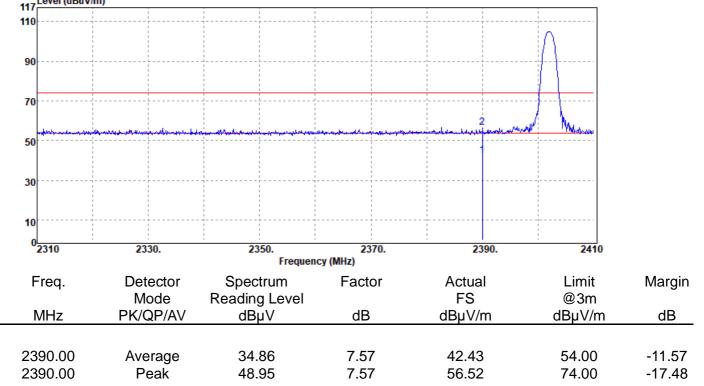
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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:BR(1M)	Temp./Humi.	:22.2/59
Test Channel	:2402 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		
Level (dBuV/m)			

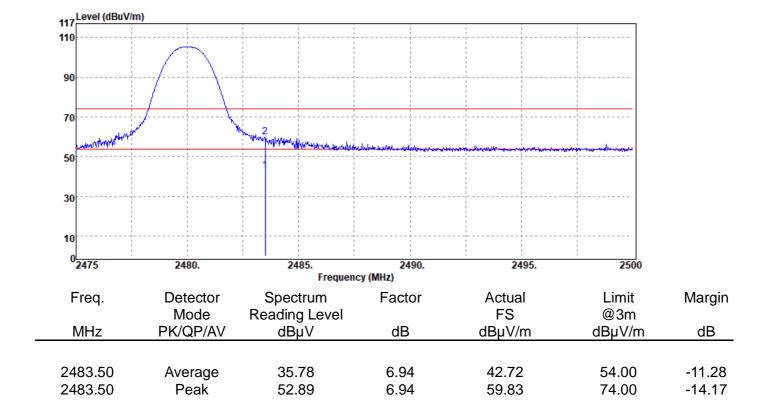


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:ER/2019/B0066	Test Date	:2019-12-13
:BR(1M)	Temp./Humi.	:22.2/59
:2480 MHz	Antenna Pol.	:VERTICAL
:Bandedge CH High	Engineer	:Thomas
:E2 Plane		
	:BR(1M) :2480 MHz :Bandedge CH High	:BR(1M)Temp./Humi.:2480 MHzAntenna Pol.:Bandedge CH HighEngineer



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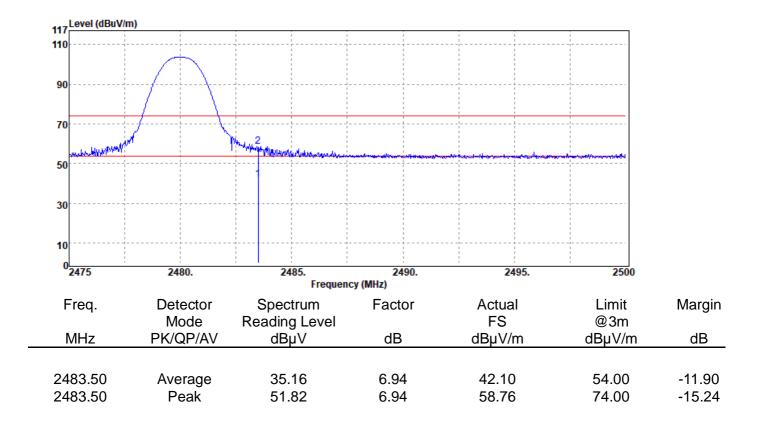
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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:BR(1M)	Temp./Humi.	:22.2/59
Test Channel	:2480 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		

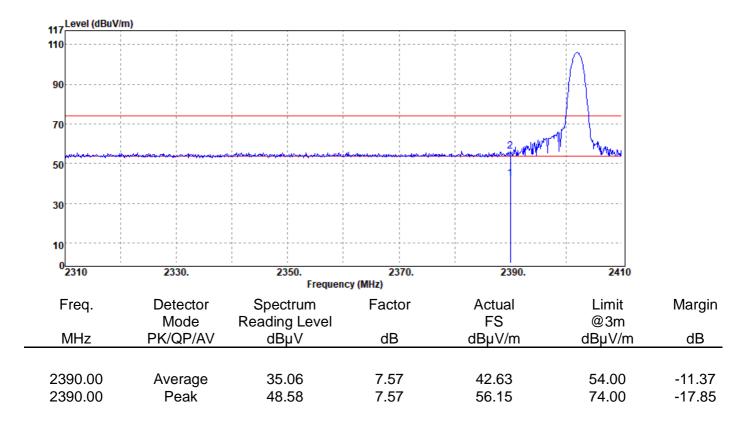


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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:EDR(3M)	Temp./Humi.	:22.2/59
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		



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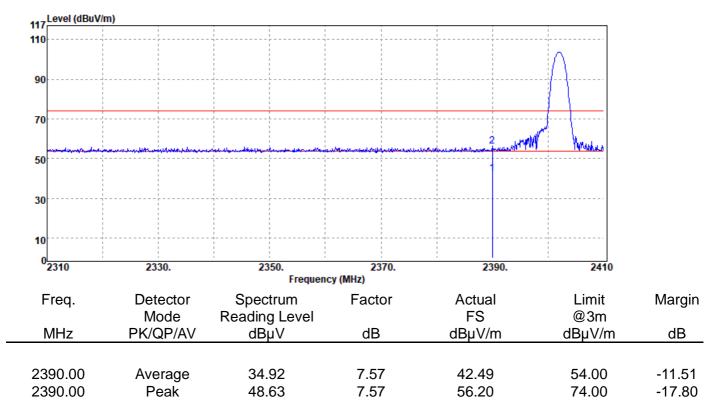
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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:EDR(3M)	Temp./Humi.	:22.2/59
Test Channel	:2402 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		

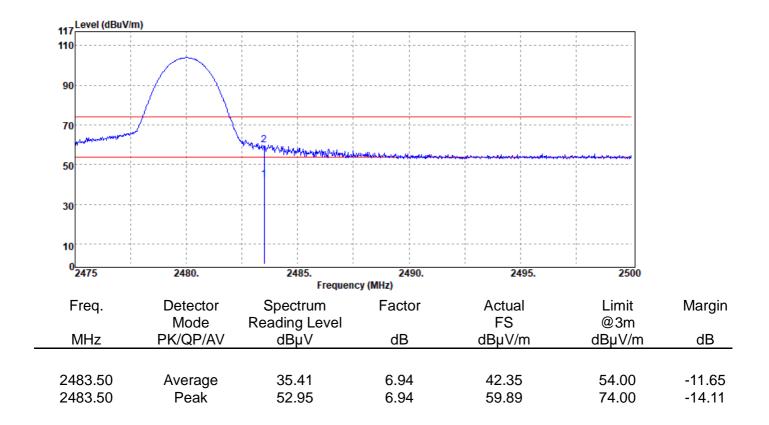


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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:EDR(3M)	Temp./Humi.	:22.2/59
Test Channel	:2480 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		

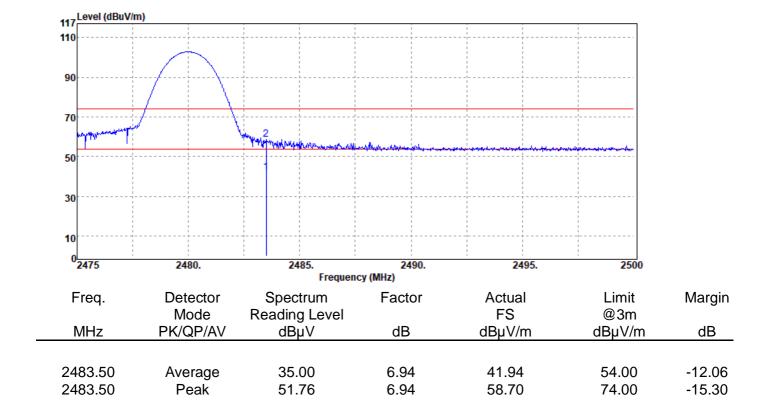


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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:EDR(3M)	Temp./Humi.	:22.2/59
Test Channel	:2480 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Bandedge CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		



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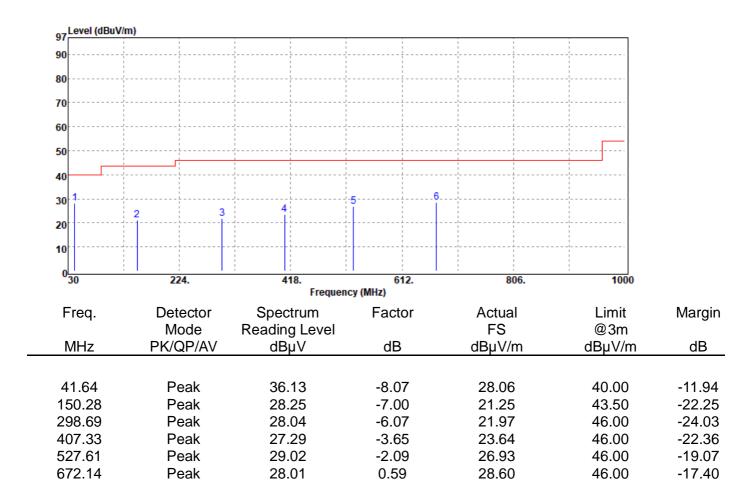
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## 10.7.3 Radiated Spurious Emission form 30MHz to 1000MHz:

## Dipole Antenna (Part No.: GW.48.A151)

Report Number	:ER/2019/B0066	Test Date	:2020-02-04
Operation Mode	:BR(1M)	Temp./Humi.	:20.2/65
Test Channel	:2441 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Mid	Engineer	:Thomas
EUT Pol	:E2 Plane		



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Report Number	:ER/2019/B0066	Test Date	:2020-02-04
Operation Mode	:BR(1M)	Temp./Humi.	:20.2/65
Test Channel	:2441 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Mid	Engineer	:Thomas
EUT Pol	:E2 Plane		

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90	     		1 1 1	1 1 1 1 	1	
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80	1 1 1 1 1					
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60	     	· · · · · · · · · · · · · · · · · · ·				
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40	· · · · · · · · · · · · · · · · · · ·					
30	33	5				
1 20	2					
10						
030	224.	418.	612.	806.	1000	
	224.				1000	
		Frequenc	:y (MHz)			
Freq.	Detector	Frequence Spectrum		Actual	Limit	Margin
		Frequenc	:y (MHz)			Margin dB
Freq.	Detector Mode	Frequenc Spectrum Reading Level	r <mark>y (MHz)</mark> Factor	Actual FS	Limit @3m	-
Freq.	Detector Mode	Frequenc Spectrum Reading Level	r <mark>y (MHz)</mark> Factor	Actual FS	Limit @3m	-
Freq. MHz	Detector Mode PK/QP/AV	Frequence Spectrum Reading Level dBµV	ry (MHz) Factor dB	Actual FS dBµV/m	Limit @3m dBµV/m	dB
Freq. MHz 41.64	Detector Mode PK/QP/AV Peak	Frequence Spectrum Reading Level dBµV 28.98	Factor dB -8.07	Actual FS dBµV/m 20.91	Limit @3m dBµV/m 40.00	dB -19.09
Freq. MHz 41.64 155.13	Detector Mode PK/QP/AV Peak Peak	Frequence Spectrum Reading Level dBµV 28.98 28.54	ey (MHz) Factor dB -8.07 -7.05	Actual FS dBµV/m 20.91 21.49	Limit @3m dBµV/m 40.00 43.50	dB -19.09 -22.01
Freq. MHz 41.64 155.13 224.97	Detector Mode PK/QP/AV Peak Peak Peak	Frequence Spectrum Reading Level dBµV 28.98 28.54 35.13	Factor 6B -8.07 -7.05 -8.90	Actual FS dBµV/m 20.91 21.49 26.23	Limit @3m dBµV/m 40.00 43.50 46.00	dB -19.09 -22.01 -19.77

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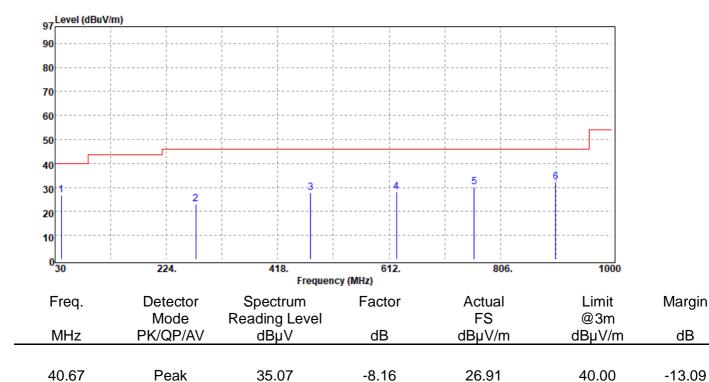
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## PCB Antenna (Part No.: ANTX100P001B24553)

Report Number	:ER/2019/B0066	Test Date
Operation Mode	:BR(1M)	Temp./Hun
Test Channel	:2441 MHz	Antenna Po
Test Mode	:Tx CH Mid	Engineer
EUT Pol	:E2 Plane	

Test Date	:2020-02-04
Temp./Humi.	:20.2/65
Antenna Pol.	:VERTICAL
Engineer	:Thomas



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29.61

30.51

28.65

27.28

27.17

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-6.58

-2.72

-0.62

2.99

5.22

23.03

27.79

28.03

30.27

32.39

46.00

46.00

46.00

46.00

46.00

-22.97

-18.21

-17.97

-15.73

-13.61

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275.41

475.23

624.61

760.41

902.03

Peak

Peak

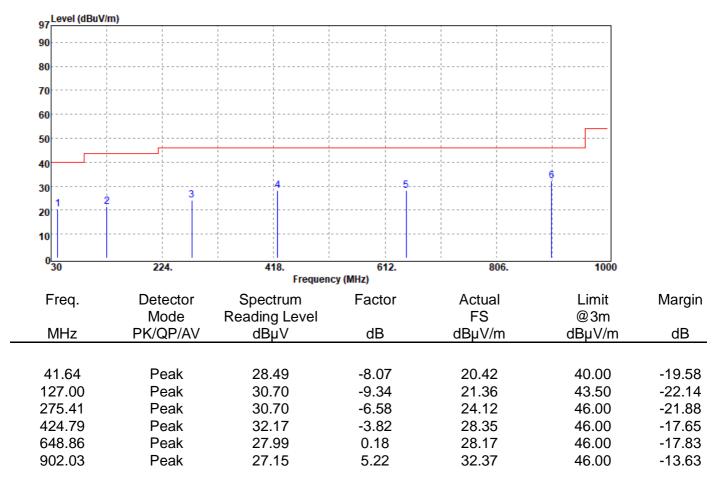
Peak

Peak

Peak



Report Number	:ER/2019/B0066	Test Date	:2020-02-04
Operation Mode	:BR(1M)	Temp./Humi.	:20.2/65
Test Channel	:2441 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Mid	Engineer	:Thomas
EUT Pol	:E2 Plane		



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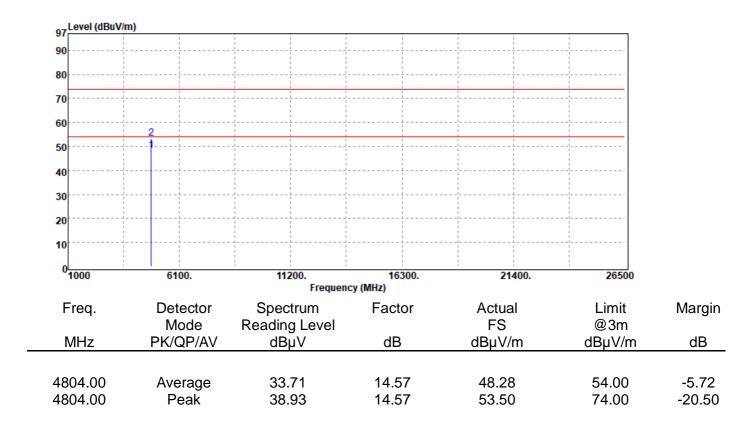
Report No.: ER/2019/B0066 Page 77 of 103



## 10.7.4 Radiated Spurious Emission above 1 GHz:

## Dipole Antenna (Part No.: GW.48.A151)

Report Number	:ER/2019/B0066	Test Date	:2019-12-05
Operation Mode	:BR(1M)	Temp./Humi.	:21.3/58
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		



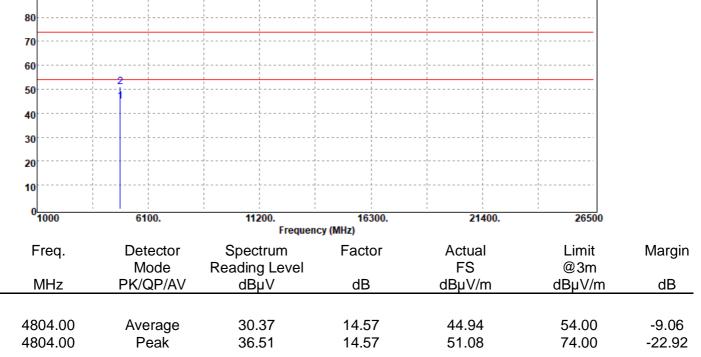
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時かう方利説明¹ 几枚古铝禾電列測試之後品具 1 一向中山後回電床留列人⁶ 本報言本総中公司音面町可¹ 个 可面顶接受⁶ This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <u>http://www.sgs.com.tw/Terms-and-Conditions</u> and for electronic format documents, subject to Terms and Conditions for Electronic Documents at <u>http://www.sgs.com.tw/Terms-and-Conditions</u>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the Client's instructions. The there are the present the company's findings at the time of their rights and obligations under the instruction the company's the company's and big to the company's findings at the time of the right and obligations under the instruction the company's the responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

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Report Number	:ER/2019/B0066	Test Date	:2019-12-05
Operation Mode	:BR(1M)	Temp./Humi.	:21.3/58
Test Channel	:2402 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		
97 <mark>Level (dBuV/m)</mark>			
90			

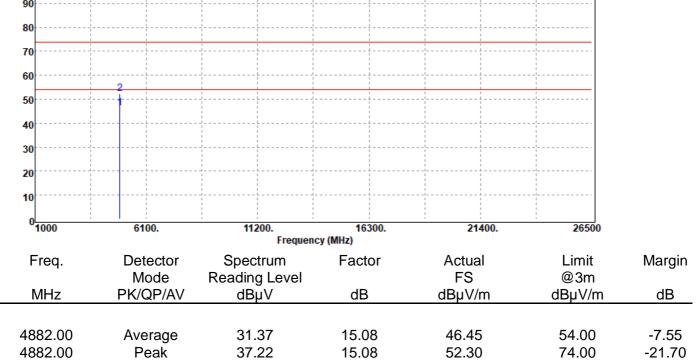


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Report Number	:ER/2019/B0066		Test Date	:2019-12-05
Operation Mode	:BR(1M)		Temp./Humi.	:21.3/58
Test Channel	:2441 MHz		Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Mid		Engineer	:Thomas
EUT Pol	:E2 Plane			
97 Level (dBuV/m)		: :	: :	;
90				



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Report Number Operation Mode Test Channel Test Mode EUT Pol	:ER/2019/B0066 :BR(1M) :2441 MHz :Tx CH Mid :E2 Plane		Test Date Temp./Humi. Antenna Pol. Engineer	:2019-12-05 :21.3/58 :HORIZONTAL :Thomas
97 Level (dBuV/m)				
90		· · · · · · · · · · · · · · · · · · ·		-
80				
70				
60			· · · · · · · · · · · · · · · · · · ·	
	2			
50	1			
40			- <mark>1</mark>	- <b>-</b>
30				
20				 
10			· · · · · · · · · · · · · · · · · · ·	

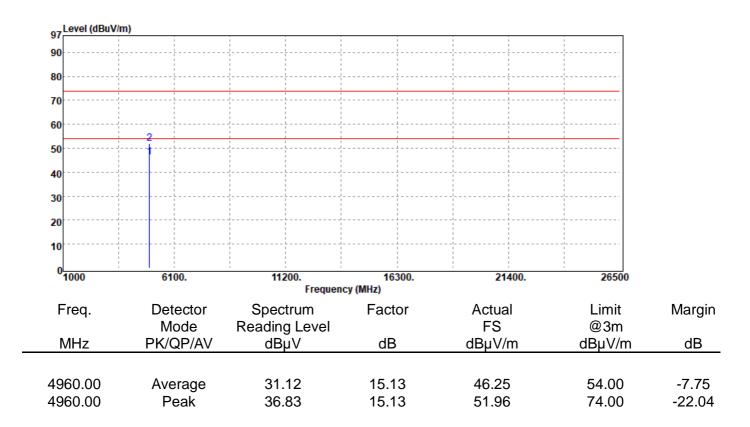
0 <mark></mark> 1000	6100.	11200. Frequent	16300. cy (MHz)	21400.	26500	
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4882.00 4882.00	Average Peak	27.21 32.49	15.08 15.08	42.29 47.57	54.00 74.00	-11.71 -26.43

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Report Number	:ER/2019/B0066	Test Date	:2019-12-05
Operation Mode	:BR(1M)	Temp./Humi.	:21.3/58
Test Channel	:2480 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		



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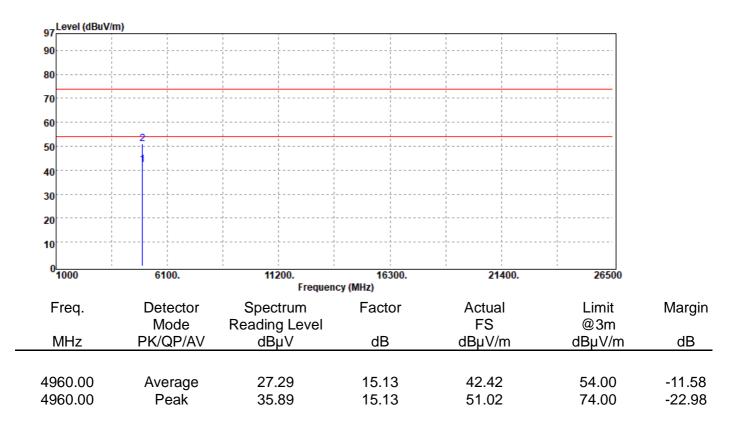
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Report Number	:ER/2019/B0066	Test Date	:2019-12-05
Operation Mode	:BR(1M)	Temp./Humi.	:21.3/58
Test Channel	:2480 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH High	Engineer	:Thomas
EUT Pol	:E2 Plane		



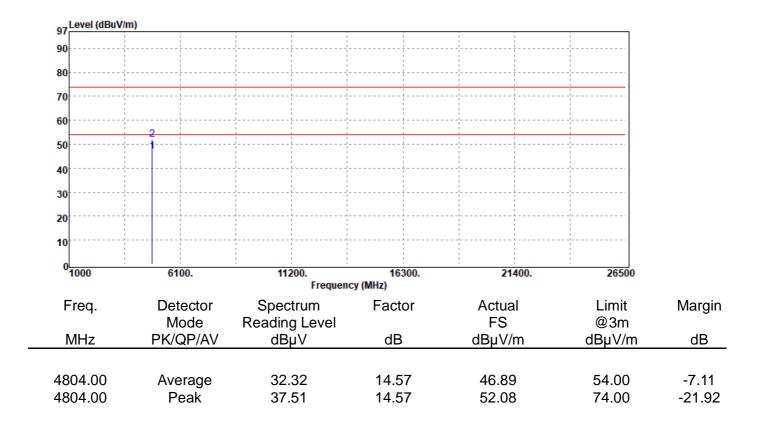
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## PCB Antenna (Part No.: ANTX100P001B24553)

Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:BR(1M)	Temp./Humi.	:22.2/59
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		



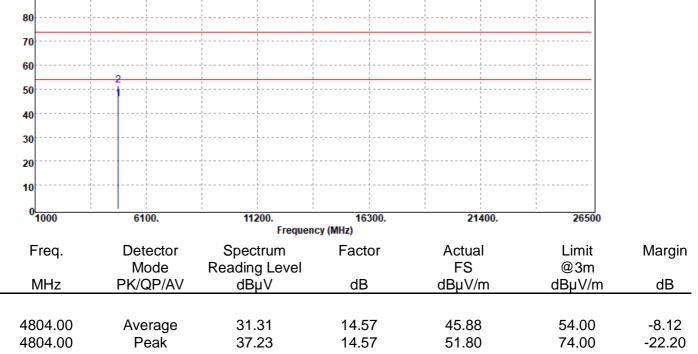
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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:BR(1M)	Temp./Humi.	:22.2/59
Test Channel	:2402 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH Low	Engineer	:Thomas
EUT Pol	:E2 Plane		
97 Level (dBuV/m)		· · · · ·	
90			

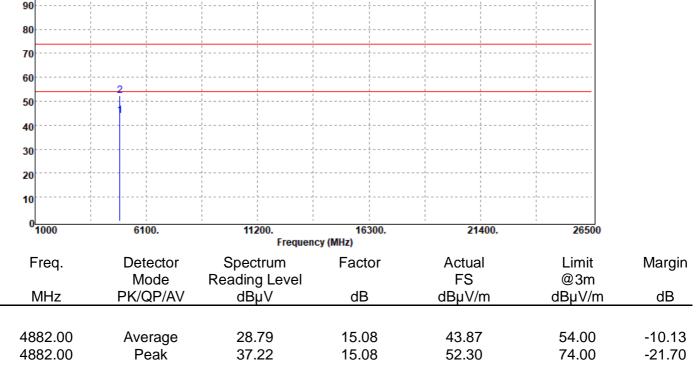


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Report Number	:ER/2019/B006	6		Tes	st Date	:2019-12-1	3
Operation Mode	:BR(1M)			Tei	mp./Humi.	:22.2/59	
Test Channel	:2441 MHz			An	tenna Pol.	:VERTICAL	-
Test Mode	:Tx CH Mid			En	gineer	:Thomas	
EUT Pol	:E2 Plane						
97 Level (dBuV/m)							
51							



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·2019-12-13

26500

Margin

dB

-10.92

-23.69

Limit

@3m

dBµV/m

54.00

74.00

Test Date

21400.

Actual

FS

dBµV/m

43.08

50.31



Report Number

10

0 1000

Freq.

MHz

4882.00

4882.00

6100.

Detector

Mode

PK/QP/AV

Average

Peak

·FR/2019/B0066

Deration Mode Test Channel Test Mode	:ER/2019/B0000 :BR(1M) :2441 MHz :Tx CH Mid :E2 Plane				Temp./ Antenr Engine	Humi. Ia Pol.	:2019-1 :22.2/59 :HORIZ :Thoma
97 Level (dBuV/m)							
90		·		1 1 1 1 			
80				         			       
70			 				
60		-	   				
50	2						
40	1		- - 				
30		·					· · ·
20				   			

16300.

Factor

dB

15.08

15.08

Frequency (MHz)

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11200.

Spectrum

Reading Level

dBµV

28.00

35.23

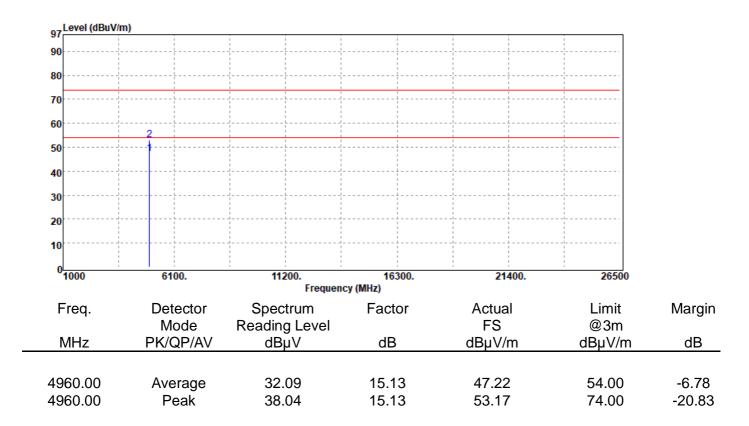
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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:BR(1M)	Temp./Humi.	:22.2/59
Test Channel	:2480 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Tx CH high	Engineer	:Thomas
EUT Pol	:E2 Plane		



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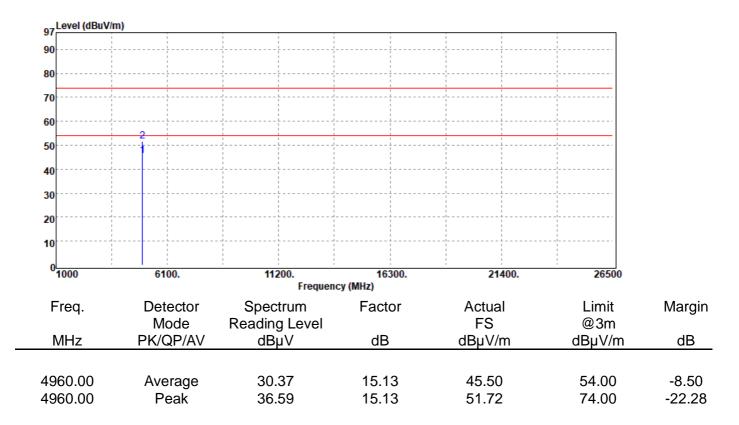
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Report Number	:ER/2019/B0066	Test Date	:2019-12-13
Operation Mode	:BR(1M)	Temp./Humi.	:22.2/59
Test Channel	:2480 MHz	Antenna Pol.	:HORIZONTAL
Test Mode	:Tx CH high	Engineer	:Thomas
EUT Pol	:E2 Plane		



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# **11 FREQUENCY SEPARATION**

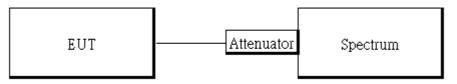
#### **Standard Applicable** 11.1

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.

#### 11.2 **Measurement Equipment Used**

Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020		
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2019	01/04/2020		

## 11.3 Test Set-up



#### 11.4 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 spectrum analyzer as RBW, VBW=100 kHz, Adjust Span to 5MHz, Sweep = auto.
- 6. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

#### 11.5 Measurement Result

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

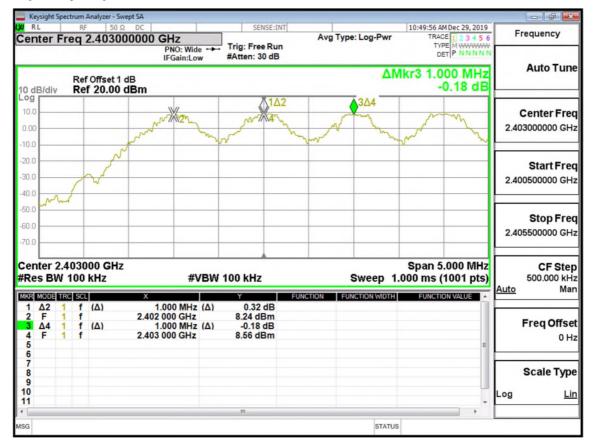
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## 11.6 Frequency Separation Test Plots



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# **12 NUMBER OF HOPPING FREQUENCY**

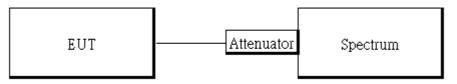
## 12.1 Standard Applicable

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

## 12.2 Measurement Equipment Used

Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020		
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2019	01/04/2020		

## 12.3 Test Set-up



## **12.4 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=430kHz, VBW=1.5MHz., Detector = Peak
- 6. Max hold, view and count how many channel in the band.

## 12.5 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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#### 12.6 **Channel Number Test Plots**



#### 2.441GHz-2.4835GHz



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# 13 TIME OF OCCUPANCY (DWELL TIME)

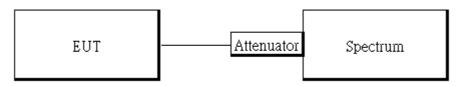
## 13.1 Standard Applicable

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.

## 13.2 Measurement Equipment Used

Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
EXA Spectrum Analyzer	Agilent	N9010A	MY50420195	05/02/2019	05/01/2020		
DC Block	Mini-Circuits	BLK-18-S+	1	01/05/2019	01/04/2020		

## 13.3 Test Set-up



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## 13.4 Measurement Procedure

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C6310:2015.
- 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 =  $2 \sim 8ms$ .

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

In AFH mode, hopping rate is 800 hop/s with 6 slots in 20 hopping channels with channel hopping rate (800 / 6 / 20) in Occupancy Time Limit (0.4 * 20 ) (S), Hop Over Occupancy Time comes to  $(800 / 6 / 20)^*(0.4 * 20) = 53.33$ 

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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## 13.5 Tabular Result of the Measurement

## GFSK (1Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	1/T (kHz)	VBW setting (kHz)
	DH1	121.60	400ms	2.63	3.00
Low	DH3	262.40	400ms	0.61	1.00
	DH5	307.20	400ms	0.35	1.00
	DH1	123.20	400ms	2.60	3.00
Mid	DH3	262.40	400ms	0.61	1.00
	DH5	308.80	400ms	0.35	1.00
	DH1	123.20	400ms	2.60	3.00
High	DH3	262.40	400ms	0.61	1.00
	DH5	307.20	400ms	0.00	1.00

### π/4 DQPSK (2Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	1/T (kHz)	VBW setting (kHz)
	2DH1	124.80	400ms	2.56	3.00
Mid	2DH3	262.40	400ms	0.61	1.00
	2DH5	308.80	400ms	0.35	1.00

#### 8-DPSK (3Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	1/T (kHz)	VBW setting (kHz)
	3DH1	124.80	400ms	2.56	3.00
Mid	3DH3	262.40	400ms	0.61	1.00
	3DH5	308.80	400ms	0.35	1.00

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## GFSK (1Mbps):

CH Low	DH1 time slot DH3 time slot	=	1.640 *	(1600/2/79) (1600/4/79)		31.6 = 31.6 =	262.40 (ms)
	DH5 time slot	=	2.880 *	(1600/6/79)	*	31.6 =	307.20 (ms)
CH Mid	DH1 time slot DH3 time slot			(1600/2/79) (1600/4/79)		31.6 = 31.6 =	( )
	DH5 time slot	=	2.895 *	(1600/6/79)	*	31.6 =	308.80 (ms)
CH High	DH1 time slot	=	0.385 *	(1600/2/79)	*	31.6 =	123.20 (ms)
	DH3 time slot	=	1.640 *	(1600/4/79)	*	31.6 =	262.40 (ms)
	DH5 time slot	=	2.880 *	(1600/6/79)	*	31.6 =	307.20 (ms)

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

CH Mid	2DH1 time slot $=$	0.390 *	(1600/2/79) *	3′	1.6 =	124.80 (ms)
	2DH3 time slot $=$	1.640 *	(1600/4/79) *	3	1.6 =	262.40 (ms)
	2DH5 time slot $=$	2.895 *	(1600/6/79) *	3	1.6 =	308.80 (ms)

### 8-DPSK (3Mbps):

CH Mid	3DH1 time slot =	0.390 *	(1600/2/79) *	31.6	=	124.80	(ms)
	3DH3 time slot $=$	1.640 *	(1600/4/79) *	31.6	=	262.40	(ms)
	3DH5 time slot =	2.895 *	(1600/6/79) *	31.6	=	308.80	(ms)

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

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GFSK (1Mbps) for AFH Mode									
Hopping Channel	PACKET TYPE	Measurement Result	Limit						
Number	PACKETTIPE	(ms)	(ms)						
20	DH5	153.60	400ms						
π/4 DQPSK (2Mbps) for AFH Mode									
Hopping Channel	PACKET TYPE	Measurement Result	Limit						
Number	PACKETTIPE	(ms)	(ms)						
20	2DH5	154.40	400ms						
	8-DPSK (3Mbps	s) for AFH Mode							
Hopping Channel	PACKET TYPE	Measurement Result	Limit						
Number	FAGRETTIPE	(ms)	(ms)						
20	3DH5	154.40	400ms						

## 13.6 Measurement Result

Note: Refer to next page for plots.

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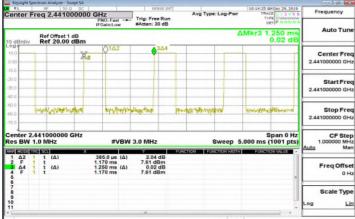
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#### Dwell Time_GFSK_1M_DH1_2402MHz

		nitiyuer - Skept											
Center	Freq 2	2.402000		GHz		Trig: Fre	MBEON		vg Type	: Log-Pwr	TYEE	123455	Frequency
	Pat	Offset 1 dB		PNO: Fast IFGain:Los		#Atten: 3	0 dB				DMkr3 1.1	250 ms	Auto Tune
10 dB/div		20.00 dB		A142	_	_	3Δ4				-0	.01 dB	
10.0	T		Ma		-							- [	Center Free 2.402000000 GH
-10.0													Start Free 2.402000000 GH
-90.0	hyuan	tern Manihesha	1	Mana	Albert M	harapad		Auger Storte	L.M.M.L	N	www.www	dermaler	Stop Free 2.402000000 GH
Res BW	1.0 M		z	#V	BW :	3.0 MHz				Sweep 4	Sp 5.000 ms (1	oan 0 Hz 001 pts)	CF Ster 1.000000 MH Auta Ma
1 A2 2 F		(Δ)	×	380.0 µs	(Δ)	0.08 9.43 d	dB	FUNCTION	FU	ICTION WIDTH	FUNCTION	WALNE -	
3 64 4 F 6	11	(Δ)		1.250 ms 1.150 ms	(Δ)	-8.01 9,43 d	dB						Freq Offse 0 H
7 8 9													Scale Type
10 11													Log Lit
esca			-		-	n	-	_		STATU	16		

### Dwell Time_GFSK_1M_DH1_2441MHz



### Dwell Time GFSK 1M DH1 2480MHz

Keysight Spertrum Anatyrer - Swept SA				
Center Freq 2.48000000	O GHZ		TYPE UNLANDAL	Frequency
Ref Offset 1 dB	IFGain:Low #Atten: 3	0 dB	ΔMkr3 1.250 ms 0.02 dB	Auto Tun
00 - Ma	<u>0142</u> 3∆4			Center Fre 2.480000000 GH
20.0 20.0 40.0				Start Fre 2.46000000 GH
000 wateriety angle	water from the first	ily analytic and	historica taka yanahta	Stop Fre 2.480000000 GH
enter 2.490000000 GHz es BW 1.0 MHz	#VBW 3.0 MHz		Span 0 Hz veep 5.000 ms (1001 pts)	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	385.0 us (Δ) 3.01 940.0 us 6.03 d 1.250 ms (Δ) 0.02 940.0 us 6.03 d	dB Bm dB		Freq Offs 0 H
6 7 8 9 10				Scale Typ
5/3			STATUS	

#### Dwell Time_GFSK_1M_DH3_2402MHz



#### Dwell Time_GFSK_1M_DH3_2441MHz



#### Dwell Time GFSK 1M DH3 2480MHz

0.0			SENSE UNTI		nyrer - Swept 54	hum Ar	15pei		
Frequency	10:16:19 AM Dec 29, 2019 TRACE 23 4 5 5 TYPE WWWWWWW DET P R M R M N	Avg Type: Log-Pwr	Trig: Free Run	GHz	480000000 G	eq 2	Fr		
Auto Tun			#Atten: 30 dB	IFGain:Low					
	Mkr3 2.500 ms 0.01 dB	•			ffset 1 dB 20.00 dBm		iv:	1614	
Center Fre				2 3∆4	Q142		Wat		101
2.480000000 GH						4	X	-	1.00
				-		+	+		0.0
Start Fre								1	0.0
2.48000000 GH						_	-	1	10.0
Stop Fre	W	Mangarow	and a start and a start and	under	Liphen	-	-	141	0.0
2.480000000 GH								1	50.0 70.0
CF Ste	Span 0 Hz				0000 GHz	8000	2.4	nter	er
1,000000 MH Auto Ma	.00 ms (1001 pts)	Sweep 10	3.0 MHz	#VBW	z	0 MH	V 1.	s Bl	es
	FUNCTION VALUE	ION FUNCTION WOTH	3.62 dB	1.640 ms (Δ)	× 1.	501	TRO	Δ2	1
Freq Offs 0 H			6,03 dBm 0,01 dB 6,03 dBm	590.0 μs 2.500 ms (Δ) 590.0 μs	5	t	1	F A4 F	2040
Scale Typ									6789
Log L									10
			п			_	-	_	1
		STATUS							83

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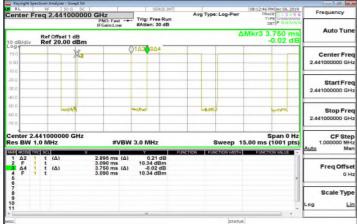
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# Dwell Time_GFSK_1M_DH5_2402MHz



#### Dwell Time_GFSK_1M_DH5_2441MHz



#### Dwell Time_GFSK_1M_DH5_2480MHz

Keysight Spectrum Analyzer - Swept 5A								
Center Freq 2.480000000	GHZ PNO: Fast Trig: Free		09/51:13 AMDec 29, 2019 Pwr TRACE 1 2 3 4 5 5 TYPE P 1 1 0 1 0 1	Frequency				
Ref Offset 1 dB ΔMkr3 3.750 ms   10 dB/div Ref 20.00 dBm								
100 Xa	\$1 <u>62</u> 364			Center Fre 2.480000000 GH				
-30.0				Start Fre 2.48000000 GH				
90.0 0.0 70.0	rula	-teart/b.v.	liner	Stop Fre 2.48000000 Ga				
Center 2.480000000 GHz Res BW 1.0 MHz	#VBW 3.0 MHz	Swee Function	Span 0 Hz p 15.00 ms (1001 pts)	CF Ste 1.000000 Mi Auto Mi				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	2.880 ms (Δ) 0.06 c 2.790 ms 9.57 dE 3.750 ms (Δ) 0.00 c 2.790 ms 9.57 dE	8 11	NOTH FURCTION WADE	Freq Offs 0 +				
6 7 8 9 10 11				Scale Typ				
e la companya de la		s	*					

#### Dwell Time_π4DQPSK_2M_DH1_2402MHz



#### Dwell Time_π4DQPSK_2M_DH1_2441MHz



#### Dwell Time_π4DQPSK_2M_DH1_2480MHz



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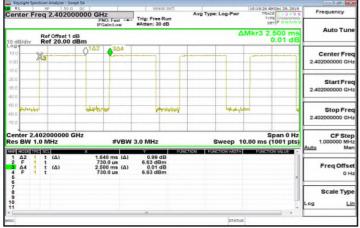
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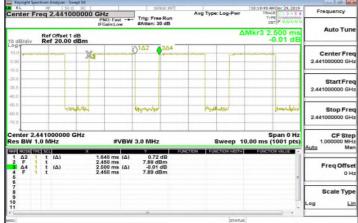


### Report No.: ER/2019/B0066 Page 100 of 103

#### Dwell Time_π4DQPSK_2M_DH3_2402MHz



#### Dwell Time_π4DQPSK_2M_DH3_2441MHz



#### Dwell Time_π4DQPSK_2M_DH3_2480MHz

sysight Spectrum Analyzer - Swept SA				010
ter Freg 2.48000000 GH	Z D: Fast Trig: Free Run	Avg Type: Log-Pwr	120:38 AM Dec 29, 2019 TRACE 12 3 4 5 5 Type Www.www.	Frequency
Ref Offset 1 dB	ain:Low #Atten: 30 dB	ΔMi	r3 2.500 ms 0.00 dB	Auto Tur
0 ¹²² 304				Center Fr 2.480000000 G
				Start Fr 2.480000000 G
40.0407	halestrak	Tequerra	mar	Stop Fr 2.48000000 G
nter 2,490000000 GHz BW 1.0 MHz	#VBW 3.0 MHz	Sweep 10.00	Span 0 Hz 0 ms (1001 pts)	CF St 1.000000 M Auta N
Δ2 1 t (Δ) 1.64 F 1 t 90, Δ4 1 t (Δ) 2.50	0 ms (Δ) 0.92 dB 00 μs 6.77 dBm 0 ms (Δ) 0.00 dB 00 μs 6.77 dBm			Freq Offe
				Scale Ty
		STATUS		

#### Dwell Time_π4DQPSK_2M_DH5_2402MHz



#### Dwell Time_π4DQPSK_2M_DH5_2441MHz



#### Dwell Time π4DQPSK 2M DH5 2480MHz

	ertrum Ankly	Wer-Swept SA							
Center Fi	req 2.4	80000000	PNO: Fast	SENSE1	Avg Type: Log-Pw	09:59:00 AMDec 29, 2019 TRACE 29, 2019 TYPE 2015			
Ref Offset1dB ΔMkr3 3.750 ms 30 dB/div Ref 20.00 dBm 0.01 dB									
10:0 0:00		Ma		0142 344			Center Fre 2.480000000 GH		
30.0 30.0 40.0							Start Fre 2.480000000 GH		
50 0 50 0 70 0		eru, de pa		and and	hynthia	mente	Stop Fre 2.480000000 GH		
enter 2. tes BW 1	.0 MHz	000 GHz	#VE	3W 3.0 MHz	Sweep	Span 0 Hz 15.00 ms (1001 pts)	CF Ste 1,000000 Mi Auto Ma		
1 42 2 F 3 44 4 F		1	2.895 ms ( 3.210 ms 3.756 ms ( 3.216 ms	5,44 dBm			Freq Offs 0 H		
6 7 8 9 10							Scale Typ		
e l				п	STA	rus ·			

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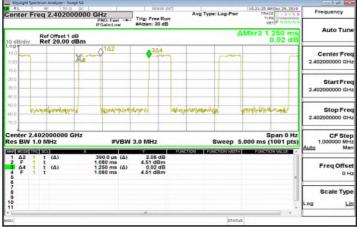
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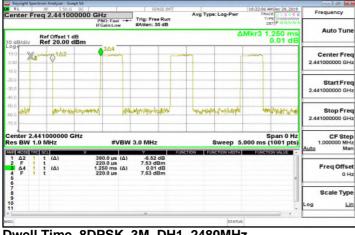
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#### Dwell Time_8DPSK_3M_DH1_2402MHz



## Dwell Time_8DPSK_3M_DH1_2441MHz



## Dwell Time_8DPSK_3M_DH1_2480MHz

enter Fr	eq 2.4800	0 00	GH ₇	_	SEMSE 3	Avg T	ype: Log-Pwr	10:22:56 AM Dec 29, 2019 TRACE	Frequency
	Ref Offset		PNO: Fast IFGain:Los	 W	Trig: Free Run #Atten: 30 dB			Det P NAME	Auto Tur
0 dB/div	Ref 20.00							-0.01 dB	
10.0		Xa	142		304	1	-	F	Center Fre 2.480000000 G8
0.0									Start Fre 2.480000000 GH
20 0 000 000 000 000 000 000 000 000 00	nyhfurnialanga hay	yun	any any and	ternet.	4.44	Unintertation	whe	norther patricities	Stop Fre 2.48000000 G8
es BW 1.			#\	BW :	.0 MHz			Span 0 Hz 5.000 ms (1001 pts)	
2 F 1 2 F 1 3 Δ4 1 4 F 1	t (Δ) t t (Δ) t	×	390.0 µs 1.075 ms 1.250 ms 1.075 ms		0.96 dB 5,54 dBm -0.01 dB 5,54 dBm	FUNCTION	FUNCTION WOTH	FUNCTION WALLE	FreqOffs
6 7 8 9									Scale Typ
11					n				
RG .							STATU	9	

## Dwell Time_8DPSK_3M_DH3_2402MHz



## Dwell Time_8DPSK_3M_DH3_2441MHz



## Dwell Time_8DPSK_3M_DH3_2480MHz

	ertrum Analyre - Si							0 0 0
Center F	req 2.4800	00000 GH2	O Fast +m 1	rig: Free Run Atten: 30 dB	Avg Type: Log-	Pwr T	2 AMDec 29, 2019 RACE 1 2 3 4 5 5 TYPE WWWWWWW DET P R M R M	Frequency
10 dB/div	Auto Tun							
10.0		×3	Q ^{1Δ}	2 344	T F		7 7	Center Fre 2.480000000 GH
20.0 90.0								Start Fre 2.480000000 GH
50 0 50 0 70 0	AUPA	ww	- Heart	(Jean)	manappa		Manushie	Stop Fre 2.48000000 GH
Center 2, Res BW 1		GHz	#VBW 3.		Swee	ep 10.00 m	Span 0 Hz s (1001 pts)	CF Ste 1,000000 MH Auto Ma
1 Δ2 2 F 3 Δ4 4 F	t (Δ) t (Δ) t	1.64 2.24 2.50	0 ms (Δ) 0 ms 6 ms (Δ) 8 ms	-1.41 dB 6,84 dBm -0.01 dB 6,84 dBm	PURCHUR		- TICH 022.0F	Freq Offs 0 H
6 7 8 9 10								Scale Typ
esc .				п		STATUS		

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#### Dwell Time_8DPSK_3M_DH5_2402MHz

Keysight Spectrum Analyzer -									
Center Freq 2.402		SENSE JNT	Avg Type: Log-Pwr	10:02:40 AM Dec 29, 2019 TRACE 1 2 3 4 5 5 TYPE WHAT A 10 10 10 10 10 10 10 10 10 10 10 10 10	Frequency				
Ref Offset 1 dB 0.00 dB 10 dB/div Ref 20.00 dBm 0.00 dB									
00 100 100	102 304				Center Fre 2.402000000 GH				
0.0					Start Fre 2.402000000 GH				
a o a o	wei	emi	pendel	44.0	Stop Fre 2.402000000 GH				
enter 2,402000000 es BW 1.0 MHz	#VB	W 3.0 MHz		Span 0 Hz 5.00 ms (1001 pts)	CF Ste 1.000000 MH				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	2,895 ms (/ 165.0 us 3,750 ms (/ 165.0 us	() -5.95 dB 6.83 dBm	FUNCTION WIDTH	EMERGIA WADE	Freq Offse 0 H				
6 7 8 9 10					Scale Typ				
23			STATUS						

#### Dwell Time_8DPSK_3M_DH5_2441MHz



#### Dwell Time_8DPSK_3M_DH5_2480MHz

Repsight Spertrum Anatyrer - Swept SA AL RF S0 D DC		SENSE INT		10:09:36 AM Dec 29, 2019					
Center Freq 2.48000000	PNO: Fast	Trig: Free Run	Avg Type: Log-Pwr	TRACE 123435	Frequency				
Ref Offset 1 dB 70 dB/dl/ Ref 20.00 dBm 0.01 dB									
	304				Center Fre 2.480000000 GF				
20.0					Start Fre 2.48000000 GH				
	4	halille.	rhad	1000	Stop Fre 2.480000000 Ge				
Center 2,490000000 GHz Res BW 1.0 MHz	#VBW	3.0 MHz		Span 0 Hz 00 ms (1001 pts)	CF Ste 1,000000 Mi Auta Mi				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	2.880 ms (Δ) 240.0 μs 3.750 ms (Δ) 240.0 μs	0,80 dB 6,93 dBm 0,01 dB 6,93 dBm	NCTION FUNCTION WOTH	EUNCTION WALLE	Freq Offs 01				
6 7 8 9 10 11					Scale Typ				
sg		п	STATUS						

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# **14 ANTENNA REQUIREMENT**

## 14.1 Standard Applicable

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

If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

## 14.2 Antenna Connected Construction

The antenna is designed with unique RF connector and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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