

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Applicant:	Sharp Corporation, Mobile Communication B.U. 2-13-1, Hachihonmatsu-Iida, Higashi-hiroshima-shi, Hiroshima 739-0192, Japan
Manufacturer:	Sharp Corporation 1 Takumi-cho, Sakai-ku, Sakai-Shi, Osaka 590-8522, Japan
Product Name:	Smart Phone
Report Number:	ER/2018/90105
FCC ID:	APYHRO00263
FCC Rule Part:	§15.247, Cat: DSS
Issue Date:	Oct. 17, 2018
Date of Test:	Sep. 04, 2018 ~ Oct. 11, 2018
Data of EUT Pacaivad:	Sen 04 2018

Date of EUT Received: Sep. 04, 2018

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Electronics & Communication Laboratory 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.

Marcus Iseng

Tested By:

Approved By:

Marcus Tseng / Sr. Engineer CHUN, CHIZEH, CHIEN



Testing Laboratory

0513

Chun Chieh Chen / Asst. Supervisor

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Revision History

Report Number	Revision	Description	Effected Page	Issue Date	Revised By
ER/2018/90105	Rev.00	Initial creation of document	All	Oct. 17, 2018	Violetta Tang

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GENERAL INFORMATION 1

1.1 Product description

General:

Product Name:	Smart Phone
Hardware Version:	DVT
Software Version:	N/A
Power Supply:	3.85V from Rechargeable Li-ion Battery

Bluetooth BR+EDR:

Frequency Range:	2.402GHz – 2.480GHz	
Bluetooth Version	BT V5.0 (dual mode)	
Channel number:	79 channels	
Modulation type:	GFSK + π/4DQPSK + 8DPSK	
Transmit Power:	14.45dBm	
Antenna Designation:	Inverted-F Antenna, Gain: -4.1dBi	

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1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247

KDB 558074 D01 v05 DSS Meas. Guidance

ANSI C63.10:2013

Note: All test items have been performed and record as per the above standards.

1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.134, Wu Kung Road, Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803

(TAF code 0513)

FCC Registration Numbers are: 509634 / TW0001

1.4 Special Accessories

There is no special accessory used while test was conducted.

1.5 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.

2.3 Test Procedure

2.3.1 Conducted Emissions

The EUT is a placed on as turn 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 according to §15.207. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Radiated Emissions

The EUT is a placed on as turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plan. 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 hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated

emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

2.4 Measurement Results Explanation Example

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. Note:

The spectrum analyzer offset is derived from RF cable loss 0.4dB.

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2.5 Configuration of Tested System Fig. 2-1 Radiated Emission

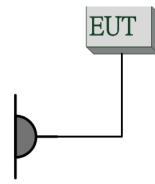


Fig. 2-2 AC Power Line Conducted Emission



Fig. 2-3 Conducted (Antenna Port) Emission

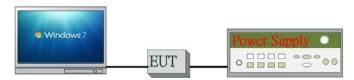


Table 2-1 Equipment Used in Tester	d System
------------------------------------	----------

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.	DC Power Supply	Anritsu	E3640A	MY52410006	N/A	Unshielded
3.	Notebook	Lenovo	T440P	P0000564	Shielded	Unshielded

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SUMMARY OF TEST RESULTS 3

FCC Rules	Description Of Test	Result
§15.207(a)	AC Power Line Conducted Emission	Compliant
§15.247(b)(1)	Peak Output Power	Compliant
§15.247(a)(1)	20dB Bandwidth	Compliant
§15.247(d)	Conducted Band Edge and Spurious Emission	Compliant
§15.247(d)	Radiated Band Edge and Spurious Emission	Compliant
§15.247(a)(1)	Frequency Separation	Compliant
§15.247(a)(1)(iii)	Number of hopping frequency	Compliant
§15.247(a)(1)(iii)	Time of Occupancy	Compliant
§15.203 §15.247(b)	Antenna Requirement	Compliant

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DESCRIPTION OF TEST MODES 4

4.1 Operated in 2400 ~ 2483.5MHz Band

79 channels are provided for Bluetooth

СН	FREQUENCY	СН	FREQUENCY	СН	FREQUENCY	СН	FREQUENCY
0	2402 MHz	20	2422 MHz	40	2442 MHz	70	2462 MHz
1	2403 MHz	21	2423 MHz	41	2443 MHz	71	2463 MHz
2	2404 MHz	22	2424 MHz	42	2444 MHz	72	2464 MHz
3	2405 MHz	23	2425 MHz	43	2445 MHz	73	2465 MHz
4	2406 MHz	24	2426 MHz	44	2446 MHz	74	2466 MHz
5	2407 MHz	25	2427 MHz	45	2447 MHz	75	2467 MHz
6	2408 MHz	26	2428 MHz	46	2448 MHz	76	2468 MHz
7	2409 MHz	27	2429 MHz	47	2449 MHz	77	2469 MHz
8	2410 MHz	28	2430 MHz	48	2450 MHz	78	2470 MHz
9	2411 MHz	29	2431 MHz	49	2451 MHz	79	2471 MHz
10	2412 MHz	30	2432 MHz	50	2452 MHz	70	2472 MHz
11	2413 MHz	31	2433 MHz	51	2453 MHz	71	2473 MHz
12	2414 MHz	32	2434 MHz	52	2454 MHz	72	2474 MHz
13	2415 MHz	33	2435 MHz	53	2455 MHz	73	2475 MHz
14	2416 MHz	34	2436 MHz	54	2456 MHz	74	2476 MHz
15	2417 MHz	35	2437 MHz	55	2457 MHz	75	2477 MHz
16	2418 MHz	36	2438 MHz	56	2458 MHz	76	2478 MHz
17	2419 MHz	37	2439 MHz	57	2459 MHz	77	2479 MHz
18	2420 MHz	38	2440 MHz	58	2460 MHz	78	2480 MHz
19	2421 MHz	39	2441 MHz	59	2461 MHz		

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4.2 The Worst Test Modes and Channel Details

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

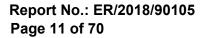
RADIATED EMISSION TEST (BELOW 1 GHz)					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE	
Bluetooth	0 to 78	39	GFSK	DH5	
	RADIATED EMISSION TEST (ABOVE 1 GHz)				
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE	
Bluetooth	0 to 78	0,39,78	GFSK	DH5	

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.

CONDUCTED TEST						
	Peak Output Power, 20dB Band Width, Dwell Time					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE		
	0 to 78	0,39,78	GFSK	DH5		
Bluetooth	0 to 78	0,39,78	π/4-DQPSK	2DH5		
	0 to 78	0,39,78	8-DPSK	3DH5		
		Band Edg	ge			
Bluetooth	0 to 78	0,78	GFSK/8-DPSK	DH5/3DH5		
	Frequency Separation					
Bluetooth	0 to 78	0,1,2	GFSK	DH5		
	Number of hopping frequency					
Bluetooth	0 to 78	0 to 78	GFSK	DH5		

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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:

	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 180MHz: +/- 3.37dB
Measurement uncertainty	180MHz -417MHz: +/- 3.19dB
(Polarization : Vertical)	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

	9kHz – 30MHz: +/- 2.87 dB
	30MHz - 167MHz: +/- 4.22dB
Measurement uncertainty	167MHz -500MHz: +/- 3.44dB
(Polarization : Horizontal)	0.5GHz-1GHz: +/- 3.39dB
-	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

This uncertainty represents an expanded uncertainty expressed at approximately the

95% confidence level using a coverage factor of k=2.

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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	

2. 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

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Receiver	R&S	ESCI7	100335	02/02/2018	02/01/2019
LISN	SCHWARZBECK	NSLK 8127	8127-649	05/18/2018	05/17/2019

6.3 EUT Setup

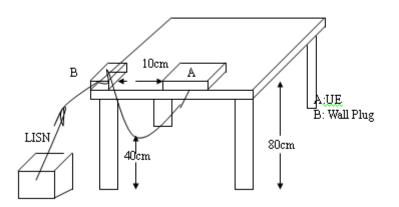
- 1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI 63.10:2013.
- 2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
- 3. The LISN was connected with 120Vac/60Hz power source.

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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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Site Conduction Room

Temperature:

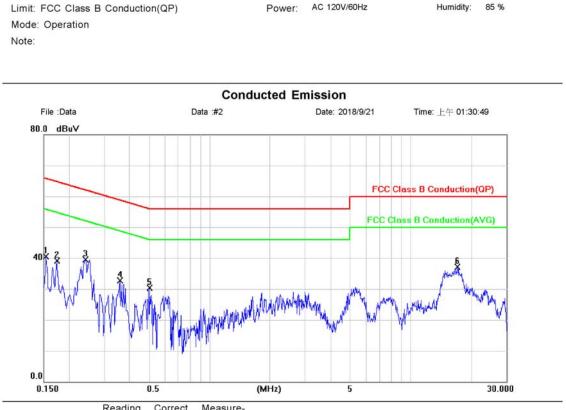
Humidity: 85 %

25 °C

AC POWER LINE CONDUCTED EMISSION TEST DATA

Phase:

L1



Mk.	Freq.	Level	Factor	measure- ment	Limit	Over		
	MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
	0.1540	40.41	0.04	40.45	65.78	-25.33	peak	
	0.1740	39.09	0.04	39.13	64.77	-25.64	peak	
*	0.2420	39.53	0.04	39.57	62.03	-22.46	peak	
	0.3580	32.71	0.04	32.75	58.77	-26.02	peak	
	0.5060	30.23	0.04	30.27	56.00	-25.73	peak	
	17.1940	36.70	0.39	37.09	60.00	-22.91	peak	
		MHz 0.1540 0.1740 * 0.2420 0.3580 0.5060	Mk. Freq. Level MHz dBuV 0.1540 40.41 0.1740 39.09 * 0.2420 39.53 0.3580 32.71 0.5060 30.23	Mk. Freq. Level Factor MHz dBuV dB 0.1540 40.41 0.04 0.1740 39.09 0.04 * 0.2420 39.53 0.04 0.3580 32.71 0.04 0.5060 30.23 0.04	Mk. Freq. Level Factor ment MHz dBuV dB dBuV 0.1540 40.41 0.04 40.45 0.1740 39.09 0.04 39.13 * 0.2420 39.53 0.04 39.57 0.3580 32.71 0.04 32.75 0.5060 30.23 0.04 30.27	Mk. Freq. Level Factor ment Limit MHz dBuV dB dBuV d	Mk. Freq. Level Factor ment Limit Over MHz dBuV dB dBuV dBuV dB dB dBuV dB dB dBuV dB dB dB dBuV dB dB	Mk. Freq. Level Factor ment Limit Over MHz dBuV dB dBuV dBuV dB Detector 0.1540 40.41 0.04 40.45 65.78 -25.33 peak 0.1740 39.09 0.04 39.13 64.77 -25.64 peak * 0.2420 39.53 0.04 39.57 62.03 -22.46 peak 0.3580 32.71 0.04 32.75 58.77 -26.02 peak 0.5060 30.23 0.04 30.27 56.00 -25.73 peak

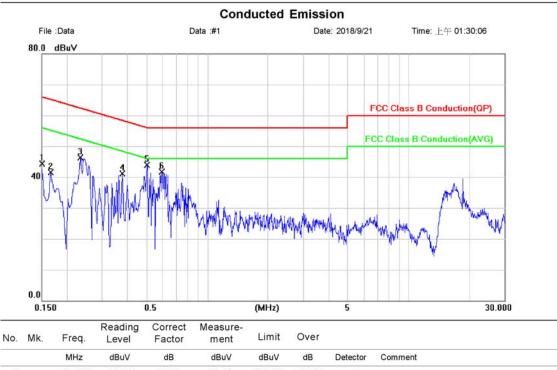
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Site Conduction Room Phase: Ν Temperature: 25 °C Limit: FCC Class B Conduction(QP) Power: AC 120V/60Hz Humidity: 85 % Mode: Operation Note:



1	0.1500	44.36	0.04	44.40	66.00	-21.60	peak
2	0.1660	41.48	0.04	41.52	65.16	-23.64	peak
3	0.2340	46.29	0.04	46.33	62.31	-15.98	peak
4	0.3780	40.97	0.04	41.01	58.32	-17.31	peak
5 *	0.5020	43.96	0.04	44.00	56.00	-12.00	peak
6	0.5940	41.66	0.04	41.70	56.00	-14.30	peak

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PEAK OUTPUT POWER MEASUREMENT 7

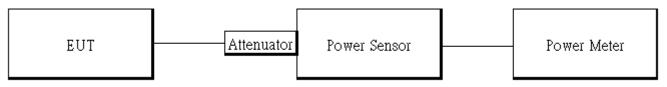
7.1 Standard Applicable

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.

7.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Power Meter	Anritsu	ML2496A	1804001	02/01/2018	01/31/2019
Power Sensor	Anritsu	MA2411B	1726104	02/01/2018	01/31/2019
Power Sensor	Anritsu	MA2411B	1726107	02/01/2018	01/31/2019
DC Power Supply	Anritsu	E3640A	MY52410006	11/28/2017	11/27/2018
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2018	01/01/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2018	01/01/2019
Coaxial Cables	N/A	WK CE Cable	N/A	01/02/2018	01/01/2019
Notebook	Lenovo	T440P	P0000564	N/A	N/A

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 C63.10:2013.
- 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 Measurement Result

1M BR	mode (Pea	ak):			1M BR mode (Average):				
СН	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)	СН	Freq. (MHz)	Max. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	14.34	27.164	1000	0	2402	13.25	21.135	1000
39	2441	14.45	27.861	1000	39	2441	13.48	22.284	1000
78	2480	14.21	26.363	1000	78	2480	13.18	20.797	1000
2M ED	R mode (Pe	eak):			2M EI)R mode (A			
СН	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)	СН	Freq. (MHz)	Max. Avg.Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	13.19	20.845	125	0	2402	10.39	10.940	125
39	2441	14.17	26.122	125	39	2441	11.61	14.488	125
78	2480	12.56	18.030	125	78	2480	9.77	9.484	125
3M ED	R mode (Pe	eak):			3M EI)R mode (A	0 ;		
СН	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)	СН	Freq. (MHz)	Max. Avg.Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
0	2402	13.50	22.387	125	0	2402	10.40	10.965	125
39	2441	14.30	26.915	125	39	2441	11.62	14.521	125
78	2480	12.77	18.923	125	78	2480	9.66	9.247	125

NOTE: cable loss as 0.4dB that offsets in the spectrum

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

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20DB BANDWIDTH MEASUREMENT 8

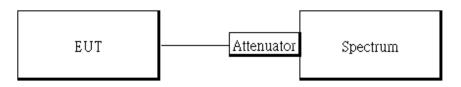
8.1 Standard Applicable

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

8.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY57120290	02/14/2018	02/13/2019
DC Power Supply	Anritsu	E3640A	MY52410006	11/28/2017	11/27/2018
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2018	01/01/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2018	01/01/2019
Coaxial Cables	N/A	WK CE Cable	N/A	01/02/2018	01/01/2019
Notebook	Lenovo	T440P	P0000564	N/A	N/A

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.
- 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= 3MHz, 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

NOTE:

1. For the plot of bandwidth measurement, the marker of the 20dB BW is arrow-mark.

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8.5 Measurement Result

GFS	۲		π/4-D	π/4-DQPSK 8-DPSK				
СН	20 dB BW	2/3 BW	СН	20 dB BW	2/3 BW	СН	20 dB BW	2/3 BW
	(MHz)	(MHz)		(MHz)	(MHz)		(MHz)	(MHz)
Low	0.878	0.59	Low	1.252	0.83	Low	1.242	0.83
Mid	0.876	0.58	Mid	1.252	0.83	Mid	1.246	0.83
High	0.879	0.59	High	1.275	0.85	High	1.243	0.83

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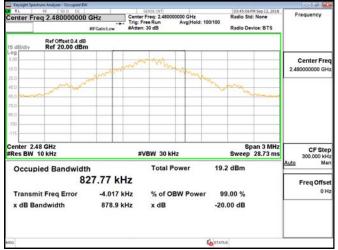
OBW 20dB GFSK 1M DH5 2402MHz



OBW 20dB GFSK 1M DH5 2441MHz



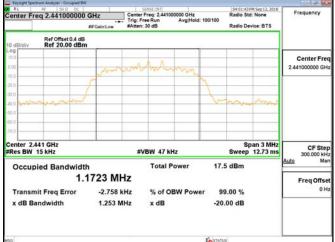
OBW 20dB GFSK 1M DH5 2480MHz



OBW 20dB π4DQPSK 2M DH5 2402MHz

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15 dB/div	Ref Offset 0.4 dB Ref 20.00 dBm	í.,		_					
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-70.0									
-100									
Center 2. #Res BW			#V	BW 47 kł	łz			an 3 MHz 12.73 ms	CF Ste 300.000 kH
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	1.1	1729 MH	z						Freq Offse
Transn	nit Freq Error	-1.758 k	Hz	% of OI	BW Powe	r 99	9.00 %		01
x dB B	andwidth	1.251 M	Hz	x dB		-20	00 dB		
150						STATU	*		

OBW 20dB π4DQPSK 2M DH5 2441MHz



OBW 20dB π4DQPSK 2M DH5 2480MHz



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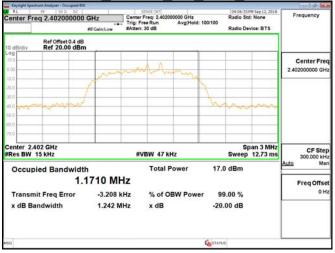
台灣檢驗科技股份有限公司

f (886-2) 2298-0488

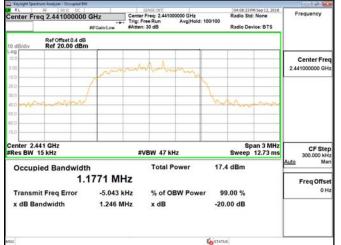
www.tw.sas.com



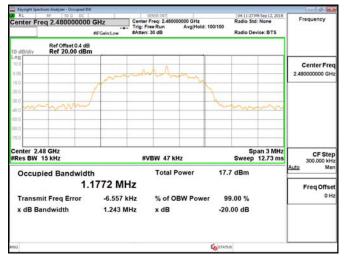
OBW 20dB 8DPSK 3M DH5 2402MHz



OBW 20dB 8DPSK 3M DH5 2441MHz



OBW 20dB_8DPSK_3M_DH5_2480MHz



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CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT 9

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

9.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY57120290	02/14/2018	02/13/2019
DC Power Supply	Anritsu	E3640A	MY52410006	11/28/2017	11/27/2018
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2018	01/01/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2018	01/01/2019
Coaxial Cables	N/A	WK CE Cable	N/A	01/02/2018	01/01/2019
Notebook	Lenovo	T440P	P0000564	N/A	N/A

9.3 Test SET-UP



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9.4 Measurement Procedure

Conducted Band Edge:

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 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
- Mark Peak, 2.3999GHz and 2.4836GHz and record the max. level.
- 7. Repeat above procedures until all frequency measured were complete.

Conducted Spurious Emission:

- 1. To connect Antenna Port of EUT to Spectrum.
- 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.

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where	FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

9.5 Measurement Result

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

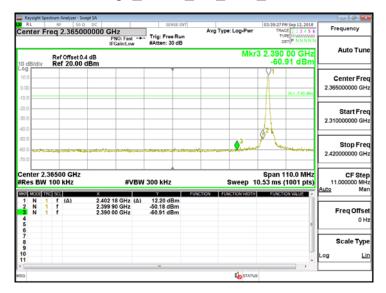
1. The occurrence of the spike on the conducted emission is the signal of the fundamental emission.

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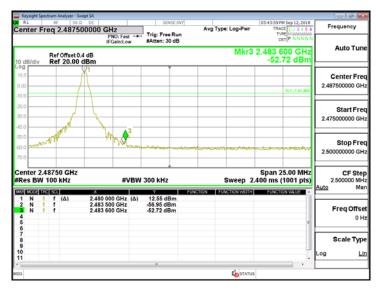
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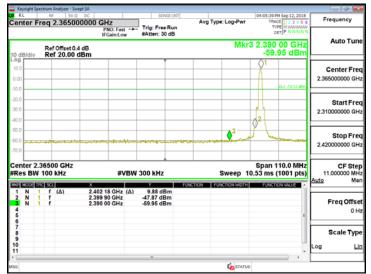
Band Edge GFSK 1M DH5 2402MHz



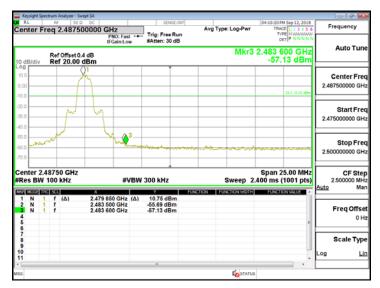
Band Edge GFSK 1M DH5 2480MHz



Band Edge 8DPSK 3M DH5 2402MHz



Band Edge 8DPSK 3M DH5 2480MHz



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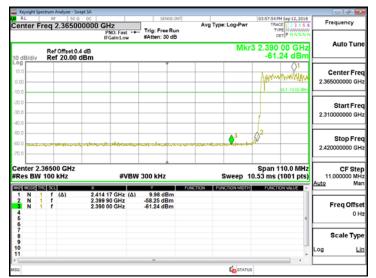
Hopping Band Edge_GFSK_1M_DH5_2402MHz



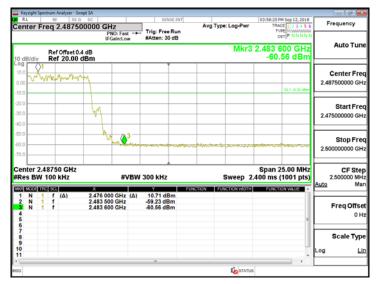
Hopping Band Edge GFSK 1M DH5 2480MHz



Hopping Band Edge 8DPSK 3M DH5 2402MHz



Hopping Band Edge 8DPSK 3M DH5 2480MHz



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Spurious Emission GFSK 1M DH5 2402MHz

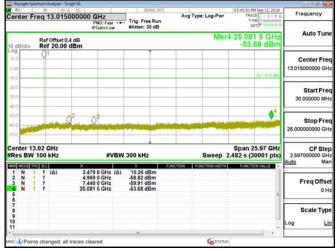
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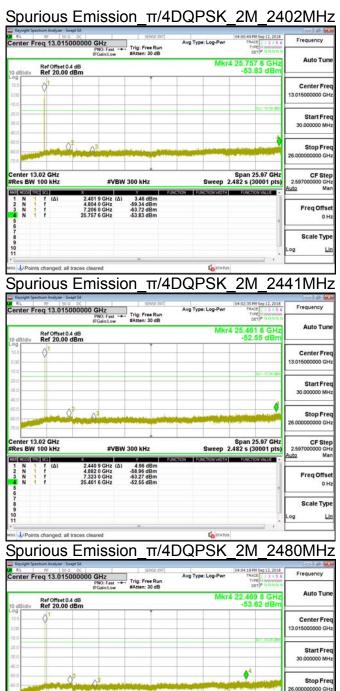
Spurious Emission_GESK_1M_DH5_2441MHz

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Spurious Emission GFSK 1M DH5 2480MHz

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Points changed; all traces cleared

r 13.02 GHz

#VBW 300 kHz

5.71 dBm -59.18 dBm -63.69 dBm -53.62 dBm

2.479 8 4.960 0 7.440 0 22.469 8

es BW 100 kH

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Span 25.97 GHz Sweep 2.482 s (30001 pts)

Co STA

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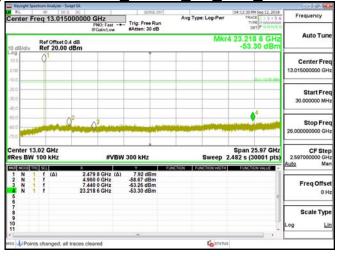
Spurious Emission 8DPSK 3M DH5 2402MHz

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Spurious Emission_8DPSK_3M_DH5_2441MHz

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Spurious Emission 8DPSK 3M DH5 2480MHz



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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.
- Emission level (dBµV/m) = 20 log Emission level (dBµV/m)

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10.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bi-log Antenna	SCHWAZBECK	VULB9168	378	12/29/2017	12/28/2018
Horn Antenna	Schwarzbeck	BBHA9120D	1441	08/16/2018	08/15/2019
Horn Antenna	Schwarzbeck	BBHA9170	184	12/12/2017	12/11/2018
Loop Antenna	ETS.LINDGREN	6502	148045	09/26/2017	09/25/2018
3m Site NSA	SGS	966 chamber	N/A	01/02/2018	01/01/2019
Spectrum Analyzer	Agilent	E4446A	MY51100003	05/15/2018	05/14/2019
EMI Test Receiver	R&S	ESCI7	100335	02/02/2018	02/01/2019
Pre-Amplifier	HP	8449B	3008A00578	01/02/2018	01/01/2019
Pre-Amplifier	HP	8447D	2944A07676	01/02/2018	01/01/2019
Pre-Amplifier	EMC Instru- ments	EMC184045B	980135	10/27/2017	10/26/2018
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2018	01/01/2019
2GHz High Pass Filter	Micro-Tronics	HPM50110	36	01/02/2018	01/01/2019
Filter 5150-5350 MHz	Micro-Tronics	BRM50703	1	01/02/2018	01/01/2019
Low Loss Cable	Huber Suhner	966_RX	9	01/02/2018	01/01/2019
Notebook	Lenovo	T440P	P0000564	N/A	N/A

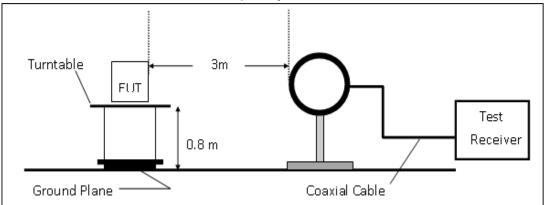
Note: N.C.R refers to Not Calibrated Required.

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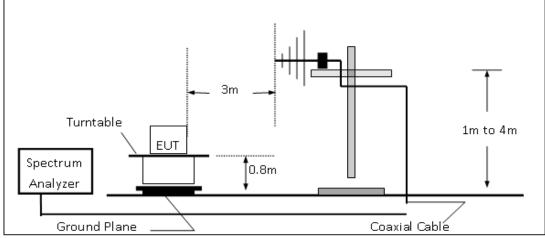


10.3 Test SET-UP

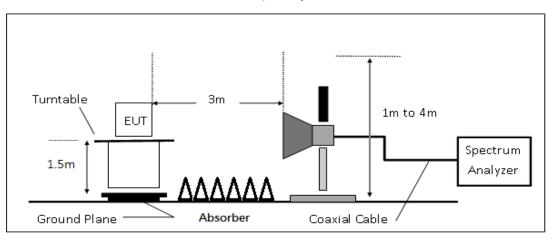




(B) Radiated Emission Test Set-Up, Frequency form 30MHz to 1000MHz



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



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10.4 Measurement Procedure

Radiated Emission

- 1. The testing follows ANSI C63.10:2013.
- 2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 0.8m 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. Use the follow spectrum analyzer setting:
 - (1) Span = wide enough to fully capture the emission being measured
 - (2) RBW = 1 MHz for $f \ge 1$ GHz, 100 kHz for f < 1 GHz, VBW \ge RBW, Sweep = auto, Detector function = peak, Trace = max hold
 - (3) For average measurement: use duty cycle correction factor method per 15.35(c)

Duty Cycle = On time/100 milliseconds

On time = N1*L1=N2*L2+...+N(n-1)*LN(n-1)+N(n)*L(n)

Where N1 is number of type 1 pulses, L1 is length of type 1 pulses, etc.

Average Emission Level = Peak Emission Level + 20*log (duty Cycle)

- 6. 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.
- 7. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 8. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 9. Repeat above procedures until all frequency of the interest measured were complete.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only

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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	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

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

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

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

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

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

10.7 Measurement Result

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

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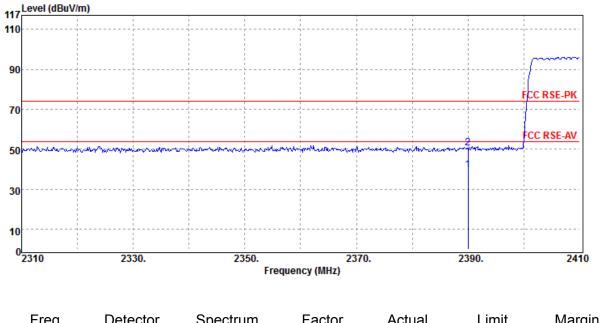


Radiated Band Edge Measurement Result: (Hopping Mode)

Operation Band
Fundamental Frequency
Operation Mode
EUT Pol.

:BR Hopping :2402 MHz :Bandedge CH LOW :E2 Plane

:2018-09-18 Test Date Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :VERTICAL Measurement Antenna Pol.



	ricq.	Deteotor	opeourum	i uotoi	710100	Enne	Margin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	2390.00	Average	39.51	0.20	39.71	54.00	-14.29	
	2390.00	Peak	50.53	0.20	50.73	74.00	-23.27	

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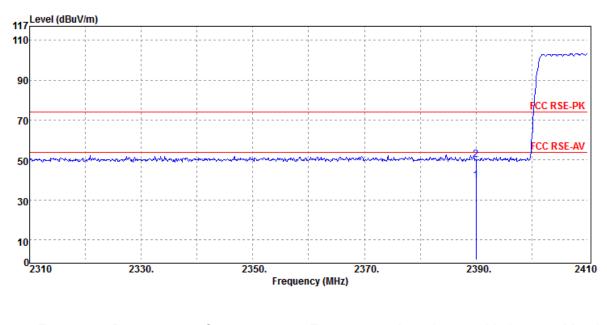
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Operation Band Fundamental Frequency Operation Mode EUT Pol.

:BR Hopping :2402 MHz :Bandedge CH LOW :E2 Plane

Test Date :2018-09-18 Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :HORIZONTAL Measurement Antenna Pol.



	Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	2390.00	Average	39.28	0.20	39.48	54.00	-14.52	
	2390.00	Peak	50.17	0.20	50.37	74.00	-23.63	

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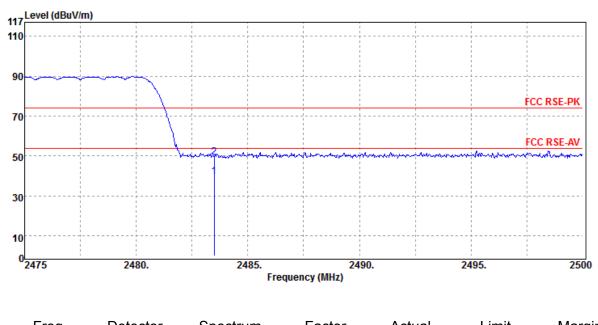
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Operation Band Fundamental Frequency **Operation Mode** EUT Pol.

:BR Hopping :2480 MHz :Bandedge CH HIGH :E2 Plane

Test Date :2018-09-18 Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :VERTICAL Measurement Antenna Pol.



⊢req.	Detector	Spectrum	Factor	Actual	Limit	Margin	
	Mode	Reading Level		FS	@3m		
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
2483.50	Average	39.19	0.53	39.72	54.00	-14.28	
2483.50	Peak	48.95	0.53	49.48	74.00	-24.52	

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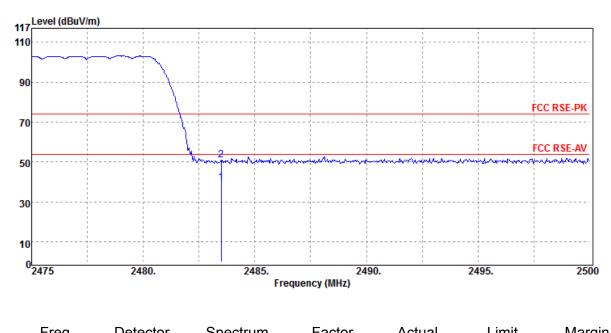
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Operation Band Fundamental Frequency **Operation Mode** EUT Pol.

:BR Hopping :2480 MHz :Bandedge CH HIGH :E2 Plane

Test Date :2018-09-18 :23 deg_C / 62 RH Temp./Humi. Engineer :Tin :HORIZONTAL Measurement Antenna Pol.



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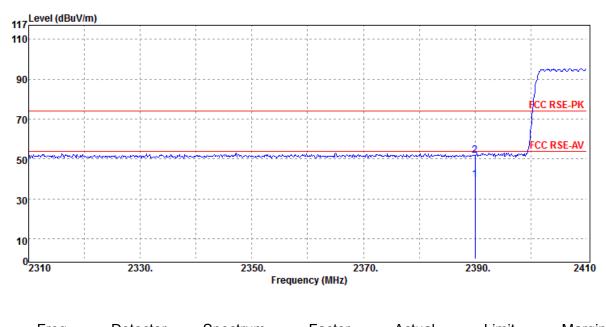
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Operation Band Fundamental Frequency **Operation Mode** EUT Pol.

:EDR Hopping :2402 MHz :Bandedge CH LOW :E2 Plane

Test Date :2018-09-18 Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :VERTICAL Measurement Antenna Pol.



	Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
	2390.00	Average	39.62	0.20	39.82	54.00	-14.18	
	2390.00	Peak	51.77	0.20	51.97	74.00	-22.03	

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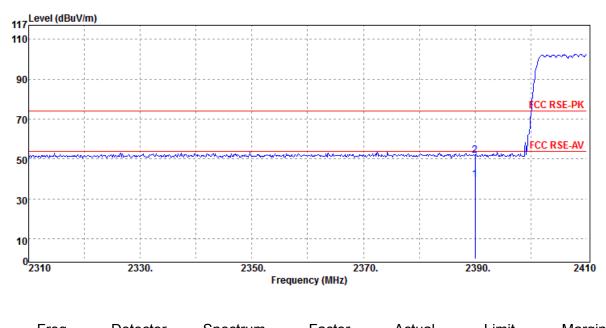
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Operation Band Fundamental Frequency **Operation Mode** EUT Pol.

:EDR Hopping :2402 MHz :Bandedge CH LOW :E2 Plane

Test Date :2018-09-18 Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :HORIZONTAL Measurement Antenna Pol.



		•		Actual	Limit	wargin	
	Mode	Reading Level		FS	@3m		
Μ	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
239	0 Average	39.41	0.20	39.61	54.00	-14.39	
239	00 Peak	51.48	0.20	51.68	74.00	-22.32	
239	0	51.48	0.20	51.68	74.00		-22.32

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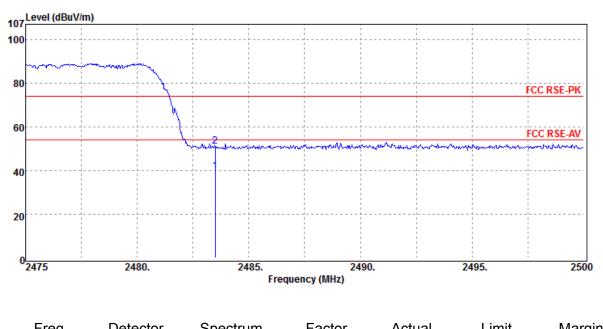
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Operation Band Fundamental Frequency **Operation Mode** EUT Pol.

:EDR Hopping :2480 MHz :Bandedge CH HIGH :E2 Plane

Test Date :2018-09-18 :23 deg_C / 62 RH Temp./Humi. Engineer :Tin :VERTICAL Measurement Antenna Pol.



	Fleq.	Delector	Spectrum	Factor	Actual		Margin	
		Mode	Reading Level		FS	@3m		
-	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	2483.50	Average	39.16	0.53	39.69	54.00	-14.31	
	2483.50	Peak	50.64	0.53	51.17	74.00	-22.83	

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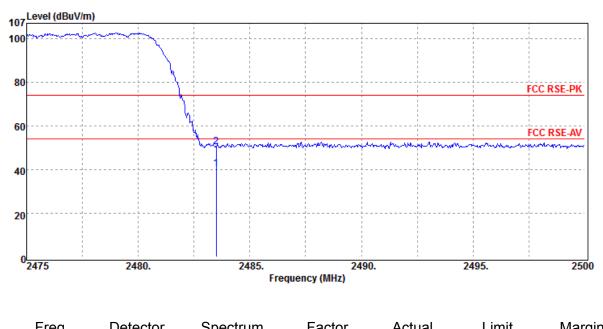
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Operation Band Fundamental Frequency **Operation Mode** EUT Pol.

:EDR Hopping :2480 MHz :Bandedge CH HIGH :E2 Plane

Test Date :2018-09-18 :23 deg_C / 62 RH Temp./Humi. Engineer :Tin :HORIZONTAL Measurement Antenna Pol.



	Fieq.	Delector	Spectrum	Factor	Actual	LIIIII	wargin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	2483.50	Average	39.70	0.53	40.23	54.00	-13.77	
	2483.50	Peak	49.76	0.53	50.29	74.00	-23.71	

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.



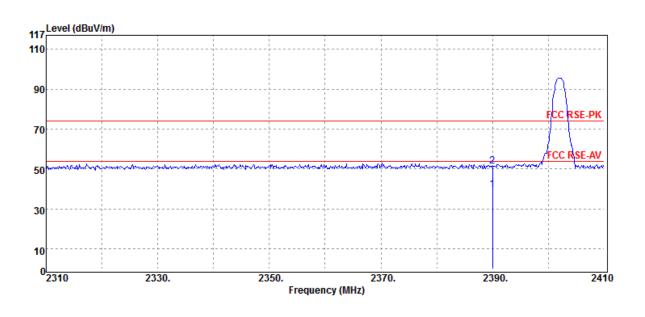
Radiated Band Edge Measurement Result: (Non-Hopping Mode)

Operation Band Fundamental Frequency **Operation Mode** EUT Pol.

:BR(1M) :2402 MHz :Bandedge CH LOW :E2 Plane

Test Date Temp./Humi. Engineer Measurement Antenna Pol.

:2018-09-18 :23 deg_C / 62 RH :Tin :VERTICAL



	Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	2390.00	Average	39.42	0.20	39.62	54.00	-14.38	
	2390.00	Peak	51.37	0.20	51.57	74.00	-22.43	

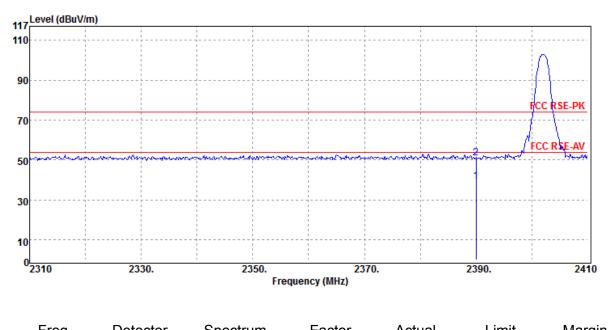
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Operation Band :BR(1M) Fundamental Frequency :2402 MHz **Operation Mode** :Bandedge CH LOW EUT Pol. :E2 Plane

Test Date :2018-09-18 Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :HORIZONTAL Measurement Antenna Pol.



	Freq.	Detector	Spectrum	Factor	Actual	Limit	wargin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	2390.00	Average	39.20	0.20	39.40	54.00	-14.60	
	2390.00	Peak	50.76	0.20	50.96	74.00	-23.04	

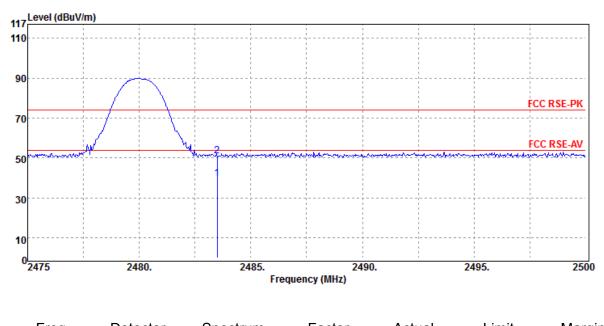
Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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:BR(1M) **Operation Band** Fundamental Frequency :2480 MHz **Operation Mode** :Bandedge CH HIGH EUT Pol. :E2 Plane

Test Date :2018-09-18 Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :VERTICAL Measurement Antenna Pol.



⊢req.	Detector	Spectrum	Factor	Actual	Limit	Margin	
	Mode	Reading Level		FS	@3m		
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
2483.50	Average	39.18	0.53	39.71	54.00	-14.29	
2483.50	Peak	50.33	0.53	50.86	74.00	-23.14	

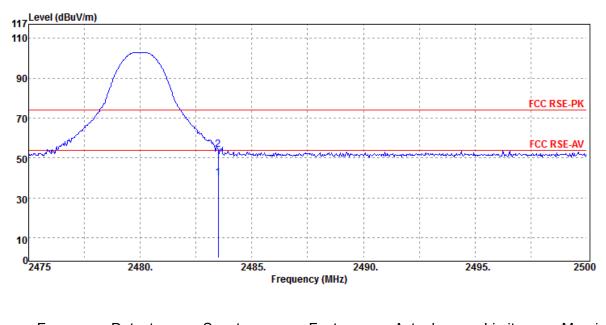
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:BR(1M) **Operation Band** Fundamental Frequency :2480 MHz **Operation Mode** :Bandedge CH HIGH EUT Pol. :E2 Plane

Test Date :2018-09-18 Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :HORIZONTAL Measurement Antenna Pol.



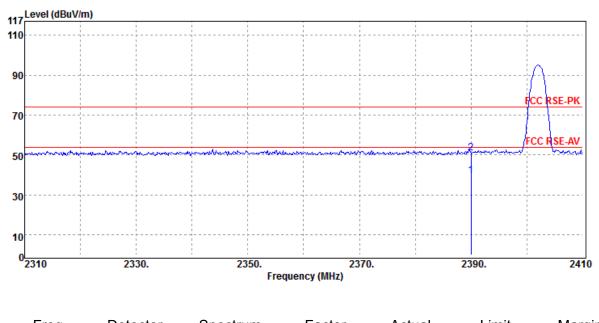
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin	
	Mode	Reading Level		FS	@3m		
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
2483.50	Average	39.48	0.53	40.01	54.00	-13.99	
2483.50	Peak	53.74	0.53	54.27	74.00	-19.73	

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.



Operation Band :EDR(3M) Fundamental Frequency :2402 MHz **Operation Mode** :Bandedge CH LOW EUT Pol. :E2 Plane

Test Date :2018-09-18 Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :VERTICAL Measurement Antenna Pol.



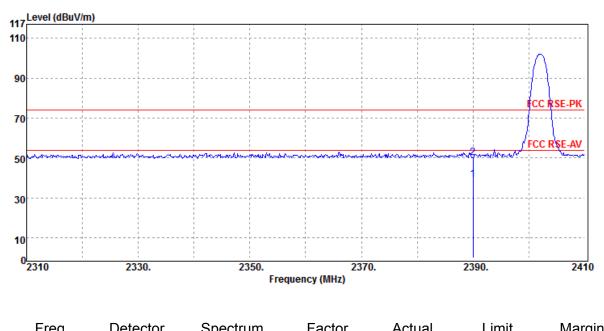
	Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	2390.00	Average	39.64	0.20	39.84	54.00	-14.16	
	2390.00	Peak	50.72	0.20	50.92	74.00	-23.08	

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Operation Band :EDR(3M) Fundamental Frequency :2402 MHz **Operation Mode** :Bandedge CH LOW EUT Pol. :E2 Plane

Test Date :2018-09-18 :23 deg_C / 62 RH Temp./Humi. Engineer :Tin :HORIZONTAL Measurement Antenna Pol.



	Fieq.	Delector	Spectrum	Factor	Actual	LIITIIL	wargin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
	2390.00	Average	39.21	0.20	39.41	54.00	-14.59	
	2390.00	Peak	49.96	0.20	50.16	74.00	-23.84	

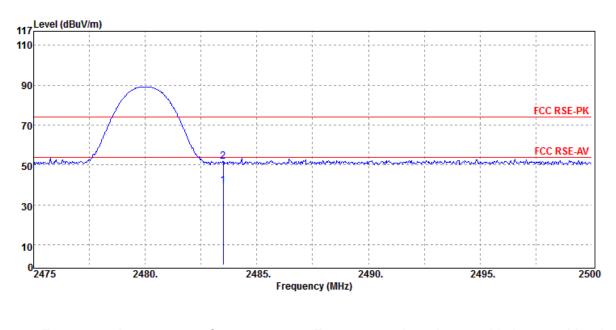
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Operation Band :EDR(3M) **Fundamental Frequency** :2480 MHz **Operation Mode** :Bandedge CH HIGH EUT Pol. :E2 Plane

Test Date :2018-09-18 Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :VERTICAL Measurement Antenna Pol.



	Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	2483.50	Average	39.22	0.53	39.75	54.00	-14.25	
	2483.50	Peak	51.18	0.53	51.71	74.00	-22.29	

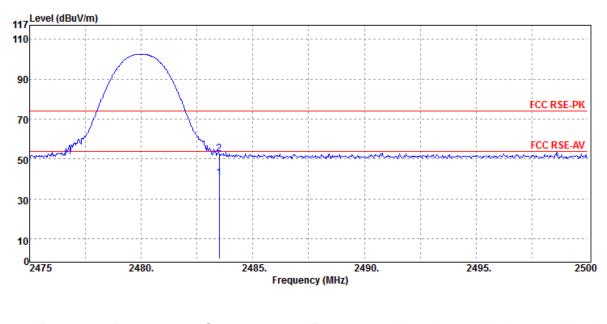
Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.

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Operation Band :EDR(3M) Fundamental Frequency :2480 MHz **Operation Mode** :Bandedge CH HIGH EUT Pol. :E2 Plane

Test Date :2018-09-18 Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :HORIZONTAL Measurement Antenna Pol.



	Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	2483.50	Average	39.94	0.53	40.47	54.00	-13.53	
	2483.50	Peak	51.95	0.53	52.48	74.00	-21.52	

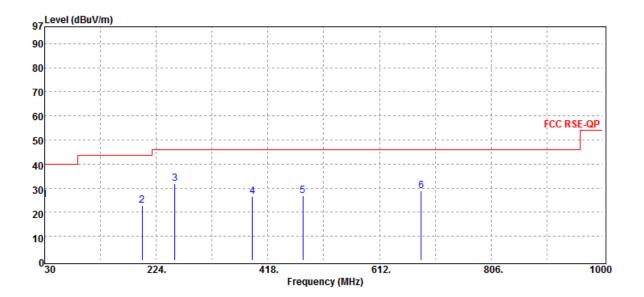
Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.



Radiated Spurious Emission Measurement Result: (Worst Case)

For Frequency from 30MHz to 1000MHz

Operation Band	:BR(1M)	Test Date	:2018-09-18
Fundamental Frequency	:2441 MHz	Temp./Humi.	:23 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL

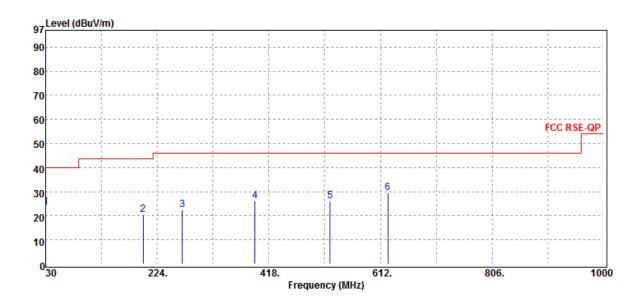


Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
30.00	Peak	33.97	-8.96	25.01	40.00	-14.99
199.75	Peak	32.02	-9.26	22.76	43.50	-20.74
256.01	Peak	39.11	-7.13	31.98	46.00	-14.02
390.84	Peak	29.99	-3.62	26.37	46.00	-19.63
479.11	Peak	28.94	-2.10	26.84	46.00	-19.16
684.75	Peak	27.28	1.58	28.86	46.00	-17.14

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.



Operation Band	:BR(1M)	Test Date	:2018-09-18
Fundamental Frequency	:2441 MHz	Temp./Humi.	:23 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
30.00	Peak	32.34	-8.96	23.38	40.00	-16.62
199.75	Peak	29.71	-9.26	20.45	43.50	-23.05
267.65	Peak	29.22	-6.74	22.48	46.00	-23.52
393.75	Peak	29.52	-3.42	26.10	46.00	-19.90
524.70	Peak	27.67	-1.56	26.11	46.00	-19.89
624.61	Peak	28.80	0.71	29.51	46.00	-16.49



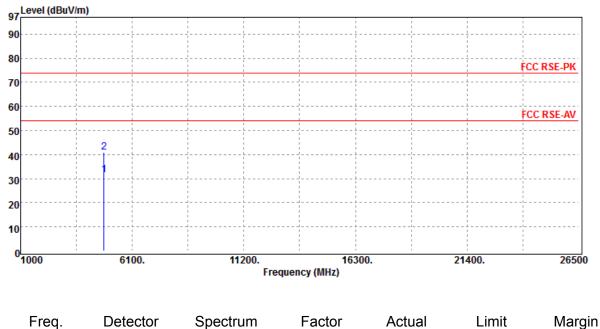
Radiated Spurious Emission Measurement Result: (Worst Case)

For Frequency above 1 GHz

Operation Band Fundamental Frequency Operation Mode EUT Pol.

:BR(1M) :2402 MHz :Tx CH LOW :E2 Plane

Test Date :2018-09-18 Temp./Humi. :23 deg_C / 62 RH Engineer :Tin :VERTICAL Measurement Antenna Pol.

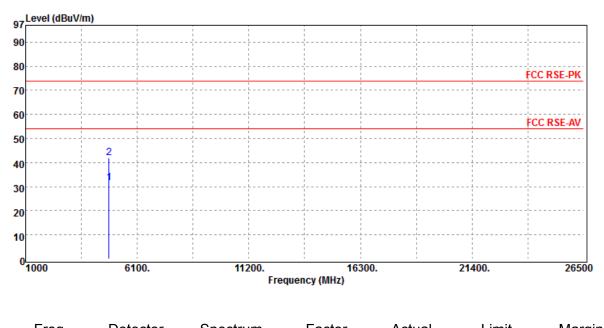


	•		•				•	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	4804.00	Average	25.88	5.65	31.53	54.00	-22.47	
	4804.00	Peak	35.43	5.65	41.08	74.00	-32.92	

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.



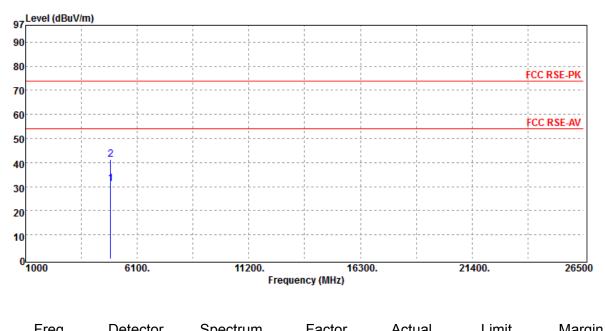
Operation Band	:BR(1M)	Test Date	:2018-09-18
Fundamental Frequency	:2402 MHz	Temp./Humi.	:23 deg_C / 62 RH
Operation Mode	:Tx CH LOW	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL



	⊢req.	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
-	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	4804.00	Average	25.93	5.65	31.58	54.00	-22.42	
	4804.00	Peak	36.36	5.65	42.01	74.00	-31.99	



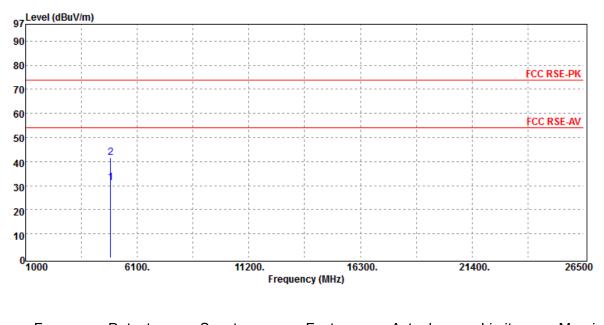
Operation Band Fundamental Frequency	:BR(1M) :2441 MHz	Test Date Temp./Humi.	:2018-09-18 :23 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL



	Freq.	Delector	Spectrum	Factor	Actual	LIMIL	wargin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
	4882.00	Average	25.22	5.90	31.12	54.00	-22.88	
	4882.00	Peak	35.30	5.90	41.20	74.00	-32.80	



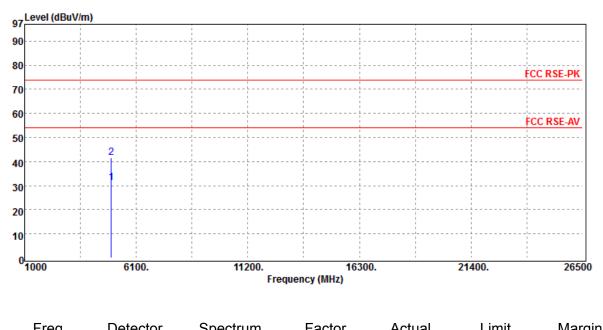
Operation Band	:BR(1M)	Test Date	:2018-09-18
Fundamental Frequency	:2441 MHz	Temp./Humi.	:23 deg_C / 62 RH
Operation Mode	:Tx CH MID	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL



	Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	4882.00	Average	25.44	5.90	31.34	54.00	-22.66	
	4882.00	Peak	35.67	5.90	41.57	74.00	-32.43	



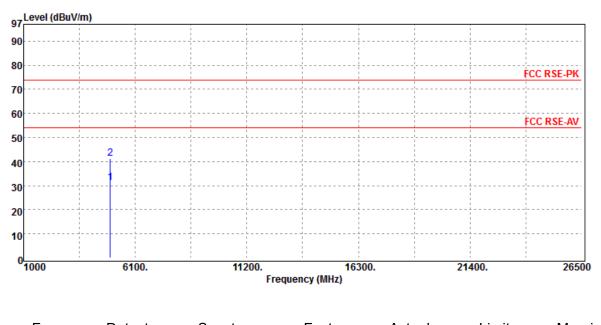
Operation Band	:BR(1M)	Test Date	:2018-09-18
Fundamental Frequency	:2480 MHz	Temp./Humi.	:23 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:VERTICAL



	Fieq.	Delector	Spectrum	Factor	Actual	LIITIIL	wargin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	_
	4960.00	Average	25.11	6.05	31.16	54.00	-22.84	
	4960.00	Peak	35.41	6.05	41.46	74.00	-32.54	



Operation Band	:BR(1M)	Test Date	:2018-09-18
Fundamental Frequency	:2480 MHz	Temp./Humi.	:23 deg_C / 62 RH
Operation Mode	:Tx CH HIGH	Engineer	:Tin
EUT Pol.	:E2 Plane	Measurement Antenna Pol.	:HORIZONTAL



	Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin	
		Mode	Reading Level		FS	@3m		
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB	
	4960.00	Average	25.31	6.05	31.36	54.00	-22.64	
	4960.00	Peak	35.30	6.05	41.35	74.00	-32.65	



11 FREQUENCY SEPARATION

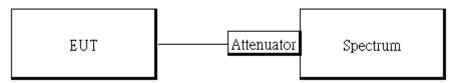
11.1 Standard Applicable

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

11.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY57120290	02/14/2018	02/13/2019
DC Power Supply	Anritsu	E3640A	MY52410006	11/28/2017	11/27/2018
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2018	01/01/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2018	01/01/2019
Coaxial Cables	N/A	WK CE Cable	N/A	01/02/2018	01/01/2019
Notebook	Lenovo	T440P	P0000564	N/A	N/A

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.

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11.5 Measurement Result

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

Frequency Separation Test Data

	m Analyzer - Swept SA							
	RF <u>50 Ω</u> DC 2.40300000	0 GHz			g Type: Log-Pwr	03:54:56 PM Sep 12, 201 TRACE 1 2 3 4 5 TYPE M WWWW	6 H	requency
	ef Offset 0.4 dB	PNO: Wide IFGain:Low			Δι	Mkr3 1.000 MH: -0.05 dE		Auto Tune
Log 10.0 0.00		witten	mark	1 <u>02</u>	3 <u>0</u> 4	and the second	2.4	Center Freq 03000000 GHz
-20.0 -30.0 -40.0	m						2.4	Start Fred 00500000 GH:
-50.0 4							2.4	Stop Fre 05500000 GH
Center 2.403 #Res BW 10		#V	BW 100 kHz	FUNCTION	Sweep 1	Span 5.000 MH I.000 ms (1001 pts FUNCTION VALUE		CF Ster 500.000 kH Mai
2 F 1 3 Δ4 1	f (Δ)	1.000 MHz 02 000 GHz 1.000 MHz 03 000 GHz	10.79 di	3m dB			=	Freq Offse 0 H
6 7 8 9 10								Scale Type
11							Log	Lir
MSG			m		I STATU	s		

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12 NUMBER OF HOPPING FREQUENCY

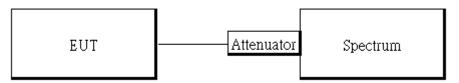
12.1 Standard Applicable

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

12.2 Measurement Equipment Used

EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY57120290	02/14/2018	02/13/2019
DC Power Supply	Anritsu	E3640A	MY52410006	11/28/2017	11/27/2018
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2018	01/01/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2018	01/01/2019
Coaxial Cables	N/A	WK CE Cable	N/A	01/02/2018	01/01/2019
Notebook	Lenovo	T440P	P0000564	N/A	N/A

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=430 kHz, 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 – 2.441GHz	40	
2.441 GHz – 2.4835GHz	39	>15
2.4GHz ~2.4835GHz	(40+39) = 79	

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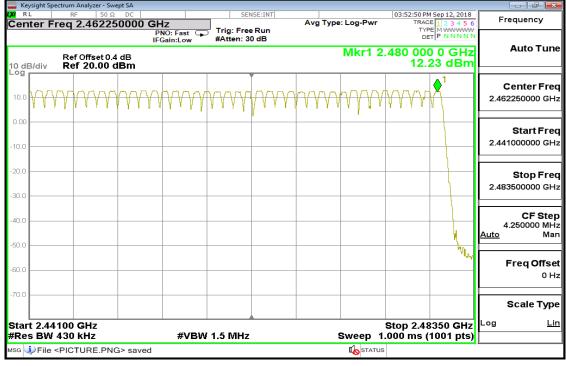


Channel Number

Hopping Frequency_GFSK_1M_DH5_2400-2441 MHz

ISG																		los.	TATUS	5						
Center #Res B							#V	BW	1.5	ыМ	Hz								-	.00	Spar 0 m	1 4′ s (′	1.00 1001	MHz pts)	Log	<u>Li</u>
70.0																										Scale Typ
60.0																										Freq Offse 0 ⊢
50.0														-											<u>Auto</u>	e Ma
40.0																										CF Ste 4.100000 MH
20.0																									2.4	Stop Fre 141000000 G⊦
10.0						-																			2.4	Start Fre 100000000 GF
10.0		W	٧¥	YY	$\gamma\gamma$	Y	γγ	γ	۲Y	γ	\cap	ſŢ	YY	Y	γ	ſγ	N	ſ	γ	ſY	γγ	γ	γv	γγ	2.4	Center Fre \$20500000 GF
0 dB/div		ef Offs ef 20									_							М	kr1	2.			00 ()3 d			Auto Tur
Funce	FIEC	1 2.42	2030	000	F	PNO:	:Fast n:Low			rig: F \tter		Run dB						-				TYPI DE	E M₩₩ T P N I	NNN N		8
Center	Eroc	RF	50 Ω 2050			47				_	5LI	ISE:IN			Ave		e: L	oa-F	wr				E 1 2 3	,2018		Frequency

Hopping Frequency_GFSK_1M_DH5_2441-2480 MHz



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13 TIME OF OCCUPANCY (DWELL TIME)

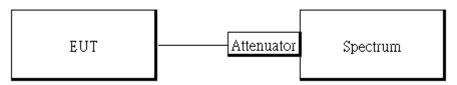
13.1 Standard Applicable

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

	-	r	1	r	r
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EXA Spectrum Analyzer	Agilent	N9010A	MY57120290	02/14/2018	02/13/2019
DC Power Supply	Anritsu	E3640A	MY52410006	11/28/2017	11/27/2018
Attenuator	Mini-Circuit	BW-S10W2+	2	01/02/2018	01/01/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2018	01/01/2019
Coaxial Cables	N/A	WK CE Cable	N/A	01/02/2018	01/01/2019
Notebook	Lenovo	T440P	P0000564	N/A	N/A

13.3 Test Set-up



13.4 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 = operating frequency.
- 5. Set the spectrum analyzer as RBW, VBW=1MHz, 3MHz, Span = 0Hz, Detector = Peak, Adjust Sweep = 2~8ms.
- 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

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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.

13.5 Tabular Result of the Measurement

GFSK (1Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	1/T (kHz)	VBW setting (kHz)
	DH1	123.20	400ms	2.60	3.00
0	DH3	262.40	400ms	0.61	1.00
	DH5	307.20	400ms	0.35	1.00
	DH1	123.20	400ms	2.60	3.00
39	DH3	262.40	400ms	0.61	1.00
	DH5	307.20	400ms	0.35	1.00
	DH1	121.60	400ms	2.63	3.00
78	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
39	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	123.20	400ms	2.60	3.00
39	3DH3	262.40	400ms	0.61	1.00
	3DH5	308.80	400ms	0.35	1.00

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

GFSK (1M	bps):				
CH Low	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)
CH Mid	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)
CH High	DH1 time slot	= 0.380 *	(1600/2/79) *		121.60 (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) *	31.6 =	124.80 (ms)
	2DH3 time slot	=	1.640 *	(1600/4/79) *	31.6 =	262.40 (ms)
	2DH5 time slot	=	2.895 *	(1600/6/79) *	31.6 =	308.80 (ms)

8-DPSK (3Mbps):

CH Mid	3DH1 time slot =	=	0.385 *	(1600/2/79) *	31.6 =	123.20 (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)

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

GFSK (1Mbps):

DH5 time slot = $\pi/4$ -DQPSK (2Mbps):	2.880	(ms) *	(800/6/20) * 8 =	153.60 (ms)
2DH5 time slot = 8-DPSK (3Mbps):	2.895	(ms) *	(800/6/20) * 8 =	154.40 (ms)
3DH5 time slot =	2.895	(ms) *	(800/6/20) * 8 =	154.40 (ms)

13.6 Measurement Result

Note: Refer to next page for plots.

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Dwell Time GFSK 1M DH1 2402MHz

	03:18:23 PM Sep 12, 2018		SENSE-INT	1	Analyzer - Swept SA	IS IS	ight Spect	Key
Frequency	TRACE 1 2 3 4 5 6 TYPE VINNING N	Avg Type: Log-Pwr	Trig: Free Run #Atten: 30 dB	GHz PNO: Fast	2.402000000		er Fre	
Auto Tuni	Mkr3 1.250 ms -0.01 dB	Δ	BALLER. OV OD	P-GBR.LOW	Offset 0.4 dB 20.00 dBm		letter 1	10 di
Center Free 2.402000000 GH				364	162	0	Xa	10.0 0.00
Start Free 2.402000000 GH								-10.0 -20.0 -30.0 -40.0
Stop Free 2.402000000 GH	neter-entreasting	ere-lationspecter	man way	Hinter	phone and the second	4	-	-50.0 -68.0 -70.0
CF Stej 1.000000 MH Auto Ma	Span 0 Hz 000 ms (1001 pts)	Sweep 5.	3.0 MHz	#VBW	00000 GHz Hz		er 2.4 BW 1.	
Auto Mar Freq Offse 0 H	FUNCTION VALUE	NCTION FUNCTION WOTH	-13.57 dB 12.90 dBm -0.01 dB 12.90 dBm	385.0 μs (Δ) 100.0 μs 1.250 ms (Δ) 100.0 μs	(Δ) (Δ)	t	2 1 F 1 4 1 F 1	1 2
Scale Type								6789 10 11
		G STATUS				-		*

Dwell Time GFSK 1M DH1 2441MHz



Dwell Time GFSK 1M DH1 2480MHz



Dwell Time GFSK 1M DH3 2402MHz



DH3 Dwell Time GFSK 1M 2441MHz



Dwell Time GFSK 1M DH3 2480MHz



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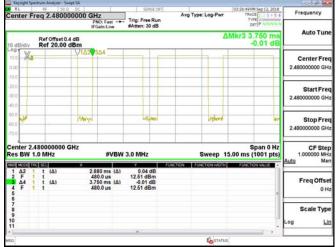
Dwell Time GFSK 1M DH5 2402MHz

				0 0 0
GHz		Avg Type: Log-Pwr	TRACE 1 2 3 4 5 6	Frequency
PNO: East ++++			DET P MONTAN	
		Δ	Mkr3 3.750 ms 0.00 dB	Auto Tun
	162 364			
				Center Free 2.402000000 GH
_				
				Start Fre
				2.402000000 GH
	adar	1404	الملطاف	Stop Fre
				2.402000000 GH
#VBW 3	3.0 MHz	Sweep 15	Span 0 Hz .00 ms (1001 pts)	CF Ste 1.000000 MH
		CTION FUNCTION WOTH	FUNCTION VALUE	Auto Ma
3.420 ms 3.750 ms (Δ)	12.18 dBm 0.00 dB]	Freq Offse
0.420 110	12.10 0.011			04
				Scale Typ
				Log Li
	1.00		1.1	
	#VBW 3 2.80 ms (Δ) 3.420 ms	PhD:Fast Trig:Free Run #Atten: 30 dB #CainLow #Atten: 30 dB #VBW 3.0 MHz #VBW 3.0 MHz #VBW 3.0 MHz 2500 ms (Δ) 3.06 dB J.420 ms (Δ) 2.06 dB UL J.550 ms (Δ) 2.06 dB UL	10 CHZ Avg Type: Log-Pwr PRO: Fait Trig: Free Run PRO: Fait Vitic PRO: Fait Vitic Image: State Vitic I	CHL Trg: Free Run #Atten: 30 dB Avg Type: Log-Perr Model Trg: 23 + 5 or Control Trg: 24 + 5 or Contro <thtrg: +="" 24="" 5="" or<br="">Control</thtrg:>

Dwell Time GFSK 1M DH5 2441MHz



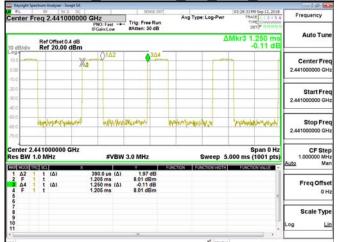
Dwell Time GFSK 1M DH5 2480MHz



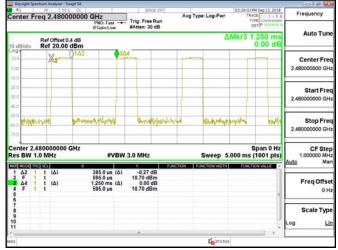
Dwell Time π4DQPSK 2M DH1 2402MHz



Dwell Time π4DQPSK 2M DH1 2441MHz



Dwell Time π4DQPSK 2M DH1 2480MHz



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Dwell Time π4DQPSK 2M DH3 2402MHz



Dwell Time π4DQPSK 2M DH3 2441MHz



Dwell Time π4DQPSK 2M DH3 2480MHz



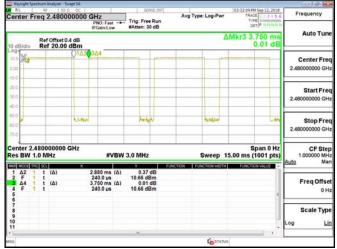
Dwell Time π4DQPSK 2M DH5 2402MHz



Dwell Time π4DQPSK 2M DH5 2441MHz



Dwell Time π4DQPSK 2M DH5 2480MHz



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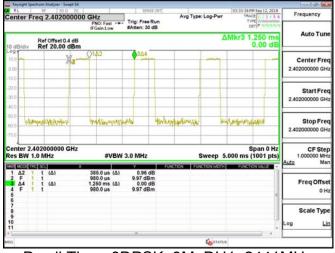
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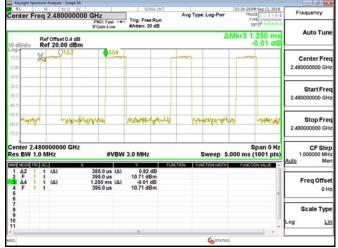
Dwell Time 8DPSK 3M DH1 2402MHz



Dwell Time 8DPSK 3M DH1 2441MHz



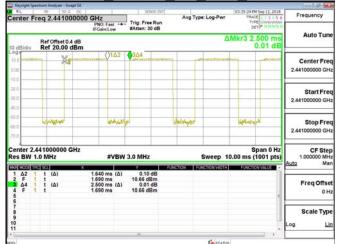
Dwell Time 8DPSK 3M DH1 2480MHz



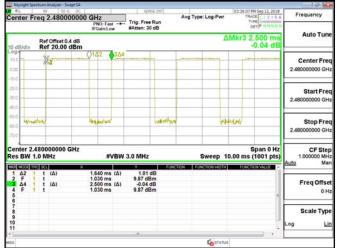
Dwell Time 8DPSK 3M DH3 2402MHz



3M DH3 Dwell Time 8DPSK 2441MHz



Dwell Time 8DPSK 3M DH3 2480MHz



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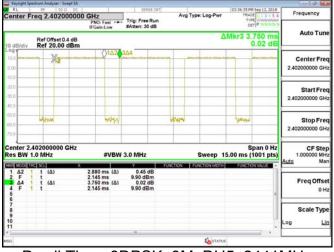
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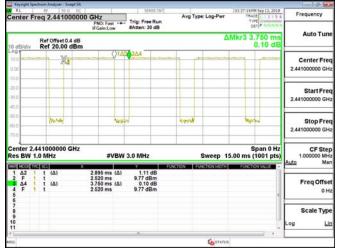
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Dwell Time 8DPSK 3M DH5 2402MHz



Dwell Time 8DPSK 3M DH5 2441MHz



Dwell Time 8DPSK 3M DH5 2480MHz



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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 as permanently attached and no consideration of replacement. Please see EUT photo for details.

~ End of Report ~

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