

Page: 1 of 74

# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT





FCC Applicant: CASTLES TECHNOLOGY CO., LTD.

6F., NO. 207-5, SEC. 3, BEIXIN RD., XINDIAN DISTRICT,

NEW TAIPEI CITY 23143, TAIWAN (R.O.C)

FCC Manufacturer: CASTLES TECHNOLOGY CO., LTD.

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6F., NO. 207-5, SEC. 3, BEISHIN RD., XINDIAN DISTRICT,

NEW TAIPEI CITY 23143, Taiwan (R.O.C)

**Product Name:** Smart module

Brand Name: CASTLES TECHNOLOGY

Model No.: SNM758

Model Difference: N/A

Report Number: TERF2309002385E2

FCC ID WIYSNM758L

**IC**: 27350-SNM758L

Date of EUT Received: July 24, 2023

**Date of Test:** July 24, 2023 ~ November 01,2023

**Issue Date:** December 07, 2023

Approved By

Vito Pei

### We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. Central RF Lab The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT comply with FCC rule part §15.247, ISED RSS-247.

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

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Page: 2 of 74

Revision History							
Report Number	Revision	Description	Issue Date	Revised By	Remark		
TERF2309002385E2	00	Original	Nov. 3, 2023	Candice Li			
TERF2309002385E2	01	Modify Test Date, Section 2.5,2.6,4.2	Dec. 5, 2023	Candice Li	*		
TERF2309002385E2	02	Modify Section 2.6, 10.6.1	Dec. 7, 2023	Candice Li	*		

# Note:

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

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Page: 3 of 74

# **Contents**

1	GENERAL INFORMATION	4
2	SYSTEM TEST CONFIGURATION	6
3	SUMMARY OF TEST RESULTS	9
4	DESCRIPTION OF TEST MODES	10
5	MEASUREMENT UNCERTAINTY	12
6	MEASUREMENT EQUIPMENT USED	13
7	PEAK OUTPUT POWER MEASUREMENT	14
8	EMISSION BANDWIDTH MEASUREMENT	17
9	CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT	23
10	RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT	27
11	FREQUENCY SEPARATION	64
12	NUMBER OF HOPPING FREQUENCY	67
13	TIME OF OCCUPANCY (DWELL TIME)	69
14	ANTENNA RECHIREMENT	74

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Page: 4 of 74

# **GENERAL INFORMATION**

#### 1.1 **Product Description**

Product Name:	Smart module
Brand Name:	CASTLES TECHNOLOGY
Model No.:	SNM758
Model Difference:	N/A
Hardware Version:	N/A
Firmware Version:	N/A
EUT Series No.:	173232315138
Product Name of Host:	POS Terminal
Brand Name of Host:	CASTLES TECHNOLOGY
Model No. of Host:	S2L
Power Supply:	12Vdc from Adapter
Test Software (Name/Version)	Qualcomm® Radio Control Toolkit / 4.0.00206.0

### 1.2 **RF Specification**

Radio Technology:	BT BR+EDR
Channel number:	79 channels
Modulation type:	GFSK + π/4DQPSK + 8DPSK
Transmit Power:	8.58 dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	≦ 0.4s

### 1.3 **Antenna Designation**

Antenna	Supplier	Antenna	Freq.	Peak Antenna
Type		Part No.	(MHz)	Gain (dBi)
PIFA	AWAN	ALP6P-10000	2400~2500	0.39

# Note:

- Pre-scanned was done on the above antennas, measurements were demonstrated by using the antenna with the highest gain as the worst case scenarios.
- Antenna information is provided by the applicant.

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Page: 5 of 74

# **Test Methodology of Applied Standards**

FCC Part 15, Subpart C §15.247 FCC KDB 558074 D01 15.247 Meas. Guidance v05r02 RSS-247 issue 3 Aug. 2023 RSS-Gen, Issue 5 April 2018 ANSI C63.10:2013

### 1.5 **Test Facility**

Laboratory	Test Site Address	Test Site Name	FCC Designa- tion number	IC CAB identifier
		SAC 1		
		SAC 2		
		SAC 3		
	No 124 Wu Kung Dood New Toingi	Conduction 1		
	No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New	Conducted 1	TW0027	TW3702
	Taipei City, Taiwan.	Conducted 2	1 440027	
	raiper City, Taiwan.	Conducted 3		
		Conducted 4		
		Conducted 5		
SGS Taiwan Ltd.		Conducted 6		
Central RF Lab.		Conduction C		
(TAF code 3702)		SAC C		
		SAC D		
		SAC G		
	No 2 Kaji 1et Dd. Cujeban District	Conducted A		
	No.2, Keji 1st Rd., Guishan District,	Conducted B	TW0028	
	Taoyuan City, Taiwan 333	Conducted C		
		Conducted D		
		Conducted E		
		Conducted F		
		Conducted G		

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

#### 1.6 **Special Accessories**

There is no special accessory used while test was conducted.

#### 1.7 **Equipment Modifications**

There was no modification incorporated into the EUT.

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Page: 6 of 74

# SYSTEM TEST CONFIGURATION

#### 2.1 **EUT Configuration**

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

#### 2.2 **EUT Exercise**

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

#### **Test Procedure** 2.3

#### 2.3.1 Conducted Test (RF)

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

#### 2.3.2 Radiated Emissions

The EUT is a placed on a turn table. For emissions testing at or below 1 GHz, the table height shall be 0.8 m above the reference ground plane. For emission measurements above 1 GHz, the table height shall be 1.5 m. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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Page: 7 of 74

# **Measurement Results Explanation Example**

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

Radiated emission below 30MHz is measured in a 9m\*6m\*6m semi-ane choic chamber, the measurements correspond to those obtained at an open-field test site.

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

# 2.4.2 For all conducted test items:

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

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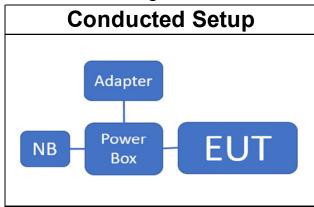
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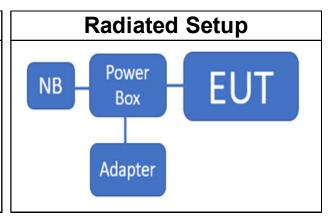
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Page: 8 of 74

# **Test Configuration**





### 2.6 Control Unit(s)

	Conducted Emission Test Site: Conducted G						
EQUIPMENT TYPE	MFR MODEL NUMBER SERIAL NUMBER LAST CAL. CAL DUI						
Power Box	CASTLES	SATURN-PX	N/A	N/A	N/A		
Adapter	ABP	AD0181-	N/A	N/A	N/A		
USB TypeC Cable	CHANG YANG ELECTRONICS CO., LTD.	CY-AS-HK0059	N/A	N/A	N/A		
Notebook	Lenovo	T470	P0001293	N/A	N/A		

Radiated Emission Test Site: SAC G							
EQUIPMENT TYPE	E MFR MODEL NUMBER SERIAL NUMBER LAST CAL. CAL DUE.						
Power Box	CASTLES	SATURN-PX	N/A	N/A	N/A		
Adapter	ABP	AD0181-	N/A	N/A	N/A		
USB TypeC Cable	CHANG YANG ELECTRONICS CO., LTD.	CY-AS-HK0059	N/A	N/A	N/A		
Notebook	Lenovo	T440p	P0000665	N/A	N/A		

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Page: 9 of 74

# 3 SUMMARY OF TEST RESULTS

FCC Rules	ISED Rules	Description Of Test	Result
§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	Emission 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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Page: 10 of 74

# **DESCRIPTION OF TEST MODES**

### 4.1 Operated in 2400 ~ 2483.5MHz Band

	•		2400~24	83.5 MHz			
СН	Freq. (MHz)	СН	Freq. (MHz)	СН	Freq. (MHz)	СН	Freq. (MHz)
0	2402	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	38	2440	58	2460	78	2480
19	2421	39	2441	59	2461		

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Page: 11 of 74

# The Worst Test Modes and Channel Details

- The EUT has been tested under operating condition.
- Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
- The field strength of radiated emission was measured as the EUT positioned in different orthogonal planes (E1/E2/H) based on actual usage of the EUT to pre-scan the emissions for determining the worst case scenario.
- Investigation has been done on all the possible configurations for searching the worst case.

ANTNNA PORT CONDUCTED TEST					
MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	PACKET TYPE	
Pea	k Output Power, 2	20dB Band Width, 99%	6 OBW, Spurious En	nission	
	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 Edge					
Bluetooth	0 to 78	0,78	GFSK/8-DPSK	DH5/3DH5	
Frequency Separation					
		0,1,2,38,39,40,76,77,	GFSK	DH5	
Bluetooth	0 to 78	78	π/4-DQPSK	2DH5	
		70	8-DPSK	3DH5	
	Number of H	opping Frequency, Ho	opping Band edge		
Bluetooth	0 to 78	0 to 78	GFSK/8-DPSK	DH5/3DH5	
	Tiı	me of Occupancy(Dwe	ell time)		
			GFSK	DH1/DH3/DH5	
Bluetooth	0 to 78	39	π/4-DQPSK	2DH1/2DH3/2DH5	
			8-DPSK	3DH1/3DH3/3DH5	
	1	· · · · · · · · · · · · · · · · · · ·			
MODE	AVAILABLE	TESTED	MODULATION	PACKET	
WODL	CHANNEL	CHANNEL	MODULATION	TYPE	
	TRANSMIT RA	DIATED EMISSION T	EST (BELOW 1 GHz	)	
Bluetooth	0 to 78	39	GFSK/8-DPSK	DH5/3DH5	
	TRANSMIT RA	DIATED EMISSION T	EST (ABOVE 1 GHz)		
Bluetooth	0 to 78	0,39,78	GFSK/8-DPSK	DH5/3DH5	

Note: The field strength of radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for channel Low, Mid and High, the worst case position was reported.

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Page: 12 of 74

# **MEASUREMENT UNCERTAINTY**

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

Radiated Spurious Emission Measurement Uncertainty								
	+/-	2.8	dB	9kHz~30MHz				
Polarization: Vertical	+/-	4.82	dB	30MHz - 1000MHz				
	+/-	4.37	dB	1GHz - 18GHz				
	+/-	4.21	dB	18GHz - 40GHz				
	+/-	2.8	dB	9kHz~30MHz				
Dolorization, Harizantal	+/-	4.54	dB	30MHz - 1000MHz				
Polarization: Horizontal	+/-	4.37	dB	1GHz - 18GHz				
	+/-	4.21	dB	18GHz - 40GHz				

### Note:

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

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Page: 13 of 74

# MEASUREMENT EQUIPMENT USED

#### 6.1 **Conducted Measurement**

	Conducted Emission Test Site: Conducted G										
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.						
Spectrum Analyzer	KEYSIGHT	N9010B	MY60240506	06/20/2023	06/19/2024						
Power Meter	Anritsu	ML2496A	1512003	09/08/2023	09/07/2024						
Power Sensor	Anritsu	MA2411B	1339378	09/08/2023	09/07/2024						
Power Sensor	Anritsu	MA2411B	1339379	09/08/2023	09/07/2024						
Test Software	SGS Taiwan	Radio Test Software	Ver.21	N.C.R	N.C.R						
Attenuator	Woken	WATT-218FS-10	RF16	11/16/2022	11/15/2023						
DC Block	PASTERNACK	PE8210	RF158	11/16/2022	11/15/2023						

#### 6.2 **Radiated Measurement**

	Radiated Emission Test Site: SAC G									
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.					
Broadband Antenna	SCHWARZBECK	VULB 9168	1206	01/17/2023	01/16/2024					
Horn Antenna	Schwarzbeck	BBHA9170	184	12/30/2022	12/29/2023					
Horn Antenna	RF SPIN	DRH18-E	210105A18E	04/18/2023	04/17/2024					
Loop Antenna	ETS.LINDGREN	6502	14303	05/23/2023	05/22/2024					
3m Site NSA	SGS	966 chamber G	N/A	03/30/2023	03/29/2024					
Spectrum Analyzer	KEYSIGHT	N9010A	MY51440113	07/17/2023	07/16/2024					
Test Software	audix	e3	E3 20923 SGS Ver.9 ( C )	N.C.R	N.C.R					
Pre-Amplifier	EMC Instruments	EMC18405SEE	980881	10/25/2022	10/24/2023					
Pre-Amplifier	EMC Instruments	EMC330N	980781	03/15/2023	03/14/2024					
Pre-Amplifier	EMC Instruments	EMC118A45SE	980815	03/15/2023	03/14/2024					
Coaxial Cable	EMC Instruments	EMCCFD400-NM- NM-8000-5000-2000	210216 ` 210217 ` 210218	03/15/2023	03/14/2024					
Coaxial Cable	EMC Instruments	EMC104-SM-SM- 8000-5000-5000	210219 ` 210220 ` 210221	03/15/2023	03/14/2024					
Coaxial Cable	EMC Instruments	EMC105-NM-NM- 5000-15000	210224 ` 210306	03/15/2023	03/14/2024					

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

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Page: 14 of 74

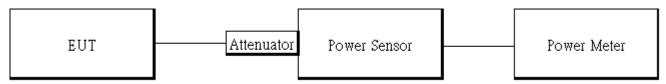
# PEAK OUTPUT POWER MEASUREMENT

#### 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.

#### 7.2 **Test Setup**



#### 7.3 **Measurement Procedure:**

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

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Page: 15 of 74

# 7.4 Peak & Average Power Measurement Result

### 1M BR mode (Peak):

1M BK mode (	геак):				
СН	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8	7.13	5.164	1000
Mid	2441	8	8.21	6.622	1000
High	2480	8	6.91	4.909	1000

### 1M BR mode (Average):

СН	Freq. (MHz)	Power set	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8	6.96	4.970	1000
Mid	2441	8	8.04	6.374	1000
High	2480	8	6.75	4.736	1000

### 2M EDR mode (Peak):

СН	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8	7.11	5.140	125
Mid	2441	8	8.14	6.516	125
High	2480	8	7.03	5.047	125

### 2M EDR mode (Average):

ZIII EDIN IIIOGO	(Attorago).				
СН	Freq. (MHz)	Power set	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8	4.60	2.887	125
Mid	2441	8	5.20	3.314	125
High	2480	8	4.53	2.840	125

### 3M EDR mode (Peak):

СН	Freq. (MHz)	Power set	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8	7.55	5.689	125
Mid	2441	8	8.58	7.211	125
High	2480	8	7.36	5.445	125

### 3M EDR mode (Average):

СН	Freq. (MHz)	Power set	Avg. Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8	4.64	2.913	125
Mid	2441	8	5.10	3.239	125
High	2480	8	4.43	2.776	125

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

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Page: 16 of 74

# 7.5 EIRP Measurement Result

### 1M BR mode EIRP

Channel	Frequency (MHz)	Power set	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	8	6.96	0.39	5.437	4000
Mid	2441	8	8.04	0.39	6.972	4000
High	2480	8	6.75	0.39	5.181	4000

### 2M EDR mode EIRP

Channel	Frequency (MHz)	Power set	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	8	4.60	0.39	3.158	4000
Mid	2441	8	5.20	0.39	3.626	4000
High	2480	8	4.53	0.39	3.107	4000

### 3M EDR mode EIRP

Channel	Frequency (MHz)	Power set	Avg. Output Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	8	4.64	0.39	3.187	4000
Mid	2441	8	5.10	0.39	3.543	4000
High	2480	8	4.43	0.39	3.037	4000

\* Note: EIRP = Average Power + Gain

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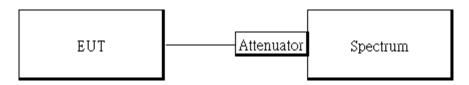
Page: 17 of 74

# 8 EMISSION BANDWIDTH MEASUREMENT

# 8.1 Standard Applicable

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

# 8.2 Test Setup



# 8.3 Measurement Procedure

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 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= 1 % to 5% of OBW,

VBW = 3 X RBW

Span= 2 to 5 times of the OBW,

Sweep=auto,

Detector = Peak, and Max hold for 20dB Bandwidth test.

- 5. Mark the peak frequency and -20dB (upper and lower) frequency
- 6. Set the spectrum analyzer as

RBW= 1 % to 5% of 99% Bandwidth,

VBW ≥ 3 X RBW,

Span= large enough to capture all products of the modulation process,

Sweep=auto,

Detector = Peak, and Max hold for 99% Bandwidth test.

- 7. Mark the peak frequency and 99%dB (upper and lower) frequency
- 8. Repeat above procedures until all test default channel is completed

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Page: 18 of 74

# **GFSK**

СН	20 dB BW (MHz)	2/3 BW (MHz)
Low	0.9573	0.64
Mid	0.9587	0.64
High	0.9558	0.64

# π/4-DQPSK

СН	20 dB BW	2/3 BW
СП	(MHz)	(MHz)
Low	1.280	0.85
Mid	1.281	0.85
High	1.281	0.85

### 8-DPSK

СН	20 dB BW	2/3 BW
СП	(MHz)	(MHz)
Low	1.292	0.86
Mid	1.291	0.86
High	1.291	0.86

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Page: 19 of 74

### **GFSK**

OI OIX	
СН	99% BW (MHz)
1	` '
Low	0.89782
Mid	0.89779
High	0.89845

# π/4-DQPSK

СН	99% BW (MHz)
Low	1.1708
Mid	1.1710
High	1.1710

# 8-DPSK

СН	99% BW (MHz)
Low	1.1712
Mid	1.1728
High	1.1720

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Page: 20 of 74

#### OBW 20dB GFSK 1M DH5 2402MHz OBW 20dB π/4DQPSK 2M DH5 2402MHz Spectrum Analyzer 1 Occupied BW 7 + Frequency v Frequency v ٥ ٥ Trig: Free Run Gate: Off #IF Gain: Low Trig: Free Run Gate: Off #IF Gain: Low KEYSIGHT Input RF KEYSIGHT Input RF nut 7: 50 O Settings 2.402000000 GHz Settings 2 402000 1 Graph 1 Graph Scale/Div 10.0 dB Scale/Div 10 0 dR CF Step 300.000 kHz CF Step 300.000 kHz Auto Man Auto Man Freq Offset 0 Hz Freq Offset 0 Hz Occupied Bandwidth 900.09 kHz Occupied Bandy vidth 1.1715 MHz Total Power 16.0 dBm Total Power 14.2 dBm % of OBW Power x dB Transmit Freq Error x dB Bandwidth % of OBW Power x dB Transmit Freq Error x dB Bandwidth -25.031 kHz 957.3 kHz 99.00 % -20.00 dB (15) C (18, 2023) 2:02:58 PM (1 C) C (18, 2023 2:09:28 PM .# 🖫 🖁 💢 OBW 20dB\_π/4DQPSK\_2M\_DH5\_2441MHz OBW 20dB\_GFSK\_1M\_DH5\_2441MHz Frequency v Ö Ö Frequency v KEYSIGHT Input: RF Trig: Free Run Gate: Off #IF Gain: Low Center Freq: 2.441000000 GHz KEYSIGHT Input: RF Trig: Free Run Gate: Off #IF Gain: Low Center Frequency 2.441000000 GHz Settings Center Frequency 2.441000000 GHz Settings Freq Ref: Int (S) 1 Graph 3 0000 MH 1 Graph 3,0000 MH: Scale/Div 10 0 dR cale/Div 10 0 dB Auto Man Auto Man #Video BW 100.00 kHz Occupied Bandwidth 1.1722 MHz Occupied Bandwidth 900.05 kHz Total Power 15.7 dBm Total Power 14.0 dBm Transmit Freq Error % of OBW Power x dB Transmit Freq Error x dB Bandwidth % of OBW Power 99.00 % -20.00 dB 99.00 % -20.00 dB ## 🕌 💥 ## # X Oct 18, 2023 2:04:46 PM Oct 18, 2023 2:11:04 PM OBW 20dB\_GFSK\_1M\_DH5\_2480MHz OBW $20dB_{\pi}/4DQPSK_{2}M_{D}H5_{2}480MHz$ Spectrum Analyzer 1 Occupied BW Frequency v Frequency • Ö Ö KEYSIGHT Input: RF RL → Coupling: L Align: Auto KEYSIGHT Input RF Trig: Free Run Gate: Off #IF Gain: Low out Z: 50 Ω Input Z: 50 Ω Trig: Free Run Gate: Off #IF Gain: Low Settings Fren Ref: Int (S) 2.480000000 GHz Fren Ref: Int (S) 2.480000000 GHz 3.0000 MHz 3.0000 MHz Scale/Div 10.0 dB Scale/Div 10.0 dR 300.000 kH; Auto Man Auto Man Freq Offset 0 Hz Freq Offset 0 Hz Occupied Bandwidth 898.12 kHz Occupied Bandwidth 1.1715 MHz

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14.8 dBm

# # H X

Total Power

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Oct 18, 2023 2:06:16 PM

Total Power

% of OBW Power

13.1 dBm

99.00 % -20.00 dB

# # H X



Page: 21 of 74

#### OBW 20dB 8DPSK 3M DH5 2402MHz IC OBW 99% GFSK 1M DH5 2402MHz Spectrum Analyzer 1 Occupied BW 7 + Frequency v Spectrum Analyzer 1 Occupied BW Frequency v ٥ ٥ Trig: Free Run Gate: Off #IF Gain: Low Trig: Free Run Gate: Off #IF Gain: Low KEYSIGHT Input RF rt 7: 50 O Atten: 30 dB KEYSIGHT Input RF # 7: 50 O Settings Center Frequency 2.402000000 GHz Settings 2 40200 1 Graph 1 Graph Scale/Div 10.0 dB Scale/Div 10 0 dp CF Step 300.000 kHz CF Step 200.000 kHz Auto Man Auto Man Freq Offset 0 Hz Freq Offset 0 Hz #Video BW 100.00 kHz #Video BW 100.00 kHz Occupied Bandwidth 1.1727 MHz Occupied Bandwidth 897.82 kHz Total Power 14.3 dBm Total Power 16.0 dBm % of OBW Power x dB % of OBW Power x dB Transmit Freq Error x dB Bandwidth Transmit Freq Error x dB Bandwidth 99.00 % -20.00 dB 99.00 % -20.00 dB (1 5 C 1 ? Oct 18, 2023 2:02:36 PM .# 🖫 🖁 💢 OBW 20dB\_8DPSK\_3M\_DH5\_2441MHz IC OBW 99%\_GFSK\_1M\_DH5\_2441MHz Frequency v Ö Ö Frequency v , + KEYSIGHT Input: RF Trig: Free Run Gate: Off #IF Gain: Low Center Freq: 2.441000000 GHz KEYSIGHT Input: RF Atten: 30 dB Trig: Free Run Gate: Off #IF Gain: Low 2.441000000 GHz Center Frequency 2.441000000 GHz Settings Settings 1 Graph 3 0000 MH 1 Graph 2,0000 MH Scale/Div 10 0 dB Scale/Div 10 0 dR Auto Man Auto Man #Video BW 100.00 kHz Occupied Bandwidth 1.1734 MHz Occupied Bandwidth 897.79 kHz Total Power 14.1 dBm Total Power 15.7 dBm Transmit Freq Error % of OBW Power x dB % of OBW Power x dB Transmit Freq Error x dB Bandwidth 99.00 % -20.00 dB 99.00 % -20.00 dB .# 👺 👭 💢 .# 👺 👭 💢 (1 15, 2023) 2:15:59 PM Oct 18, 2023 2:04:25 PM OBW 20dB\_8DPSK\_3M\_DH5\_2480MHz IC OBW 99%\_GFSK\_1M\_DH5\_2480MHz Spectrum Analyzer 1 Occupied BW Frequency v Ö Frequency • Ö KEYSIGHT Input: RF RL → Coupling: I Align: Auto KEYSIGHT Input RF nput Z: 50 Ω Trig: Free Run Gate: Off #IF Gain: Low nput Z: 50 Ω Trig: Free Run Gate: Off #IF Gain: Low Settings Settings Fren Ref: Int (S) 2.480000000 GHz Fren Ref: Int (S) 2.480000000 GHz 3.0000 MHz 2.0000 MHz Scale/Div 10.0 dB Scale/Div 10.0 dR 300.000 kH; Auto Man Auto Man Freq Offset 0 Hz Freq Offset 0 Hz Occupied Bandwidth 898.45 kHz Occupied Bandwidth 1.1736 MHz Total Power 13.2 dBm Total Power 14.8 dBm % of OBW Power % of OBW Power 99.00 % -20.00 dB

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# # H X

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Oct 18, 2023

# # H X



Page: 22 of 74

#### IC OBW 99%\_π/4DQPSK\_2M\_DH5\_2402MHz IC OBW 99% 8DPSK 3M DH5 2402MHz Spectrum Analyzer 1 Occupied BW Frequency v Spectrum Analyzer 1 Occupied BW Frequency v Ö ٥ Trig: Free Run Gate: Off #IF Gain: Low Trig: Free Run Gate: Off #IF Gain: Low KEYSIGHT Input RF ut 7: 50.0 Atten: 30 dB KEYSIGHT Input RF ut 7: 50 O Settings Center Frequency 2.402000000 GHz Settings 2 402000 1 Graph 1 Graph Scale/Div 10.0 dB CF Step 200.000 kHz CF Step 200.000 kHz Auto Man Auto Man Freq Offset 0 Hz Freq Offset 0 Hz #Video BW 100.00 kHz #Video BW 100.00 kHz Occupied Bandy Occupied Bandw vidth 1.1708 MHz nidth 1.1712 MHz Total Power 14.2 dBm Total Power 14.3 dBm Transmit Freq Error x dB Bandwidth % of OBW Power x dB Transmit Freq Error x dB Bandwidth % of OBW Power x dB -28.850 kHz 1.278 MHz 99.00 % -20.00 dB 99.00 % -20.00 dB 1 Oct 18, 2023 2:09:06 PM .# 🖫 🖁 💢 (1 1 C 1 2 Oct 18, 2023 2:14:03 PM .# 🖫 🖁 💢 IC OBW 99%\_π/4DQPSK\_2M\_DH5\_2441MHz IC OBW 99%\_8DPSK\_3M\_DH5\_2441MHz Frequency • Ö Ö Frequency v , + Center Freq: 2.441000000 GHz Avg|Hold: 100/100 Radio Std: None KEYSIGHT Input: RF Trig: Free Run Gate: Off #IF Gain: Low Center Freq: 2.441000000 GHz KEYSIGHT Input: RF Trig: Free Run Gate: Off #IF Gain: Low 2.441000000 GHz Center Frequency 2.441000000 GHz Settings Settings Freq Ref: Int (S) Freq Ref: Int (S) 1 Graph 2 0000 MH 1 Graph 2,0000 MH Scale/Div 10 0 dB Scale/Div 10 0 dR Auto Man Auto Man Freq Offse 0 Hz Freq Offset 0 Hz #Video BW 100.00 kHz Occupied Bandwidth 1.1728 MHz Occupied Bandwidth 1.1710 MHz Total Power 14.0 dBm Total Power 14.0 dBm Transmit Freq Error % of OBW Power x dB Transmit Freq Error x dB Bandwidth % of OBW Power 99.00 % -20.00 dB 99.00 % -20.00 dB .# 🐺 🖳 💢 Oct 18, 2023 2:10:42 PM (1 15, 2023) Oct 18, 2023 IC OBW 99%\_π/4DQPSK\_2M\_DH5\_2480MHz IC OBW 99%\_8DPSK\_3M\_DH5\_2480MHz Spectrum Analyzer 1 Occupied BW Frequency v Frequency • Ö Ö KEYSIGHT Input: RF RL → Coupling: L Align: Auto KEYSIGHT Input RF Trig: Free Run Gate: Off #IF Gain: Low Input Z: 50 Ω Input Z: 50 Ω Trig: Free Run Gate: Off #IF Gain: Low Settings Fren Ref: Int (S) 2.480000000 GHz Fren Ref: Int (S) 2.480000000 GHz 2.0000 MH: 2.0000 MHz Scale/Div 10.0 dB Scale/Div 10.0 dR 200.000 kH; Auto Man Auto Man Freq Offset 0 Hz Freq Offset 0 Hz Occupied Bandwidth 1.1720 MHz Occupied Bandwidth 1.1710 MHz Total Power 13.1 dBm Total Power 13.1 dBm % of OBW Power 99.00 % -20.00 dB

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# # H X



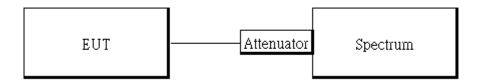
Page: 23 of 74

# 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 Test Setup



# 9.3 Measurement Procedure

# 9.3.1 Conducted Band Edge:

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 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, below 2.4GHz and above 2.4835GHz and record the max. level.
- 7. Repeat above procedures until all frequency measured were complete.

# 9.3.2 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
- 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.

# 9.4 Measurement Result

See next page for test plots.

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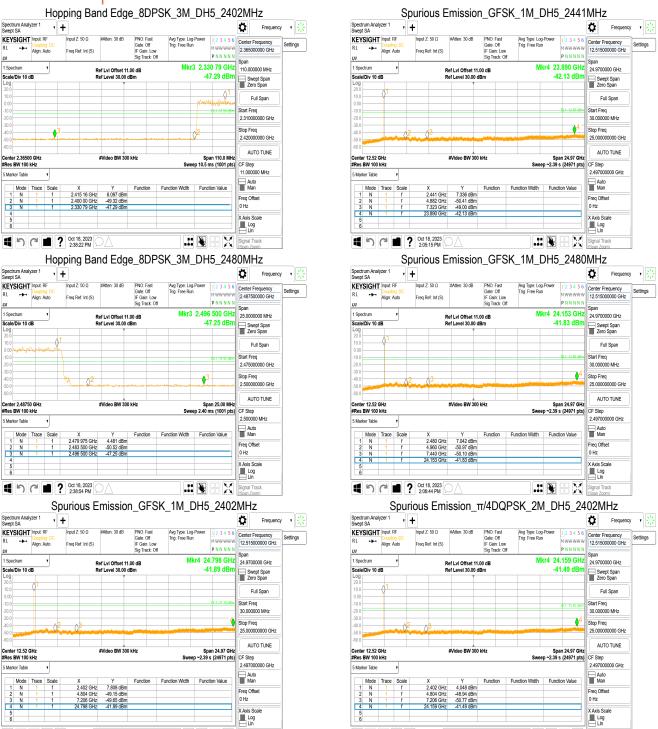
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Page: 25 of 74



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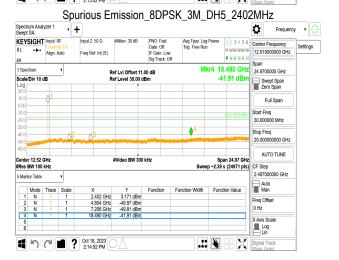
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Page: 26 of 74

### Spurious Emission π/4DQPSK 2M DH5 2441MHz Ö KEYSIGHT Input RF nut 7: 50.0 Settings 12 515000000 GHz PNNNNI Mkr4 23.820 GHz Span 24.9700000 GHz -41.52 dBn Swept Span Zero Span Full Span •4 25.000000000 GHz Center 12.52 GHz #Res BW 100 kHz #Video BW 300 kHz Auto Man Function Width Function Value Freq Offse 0 Hz Log Lin (18, 2023) 2:11:33 PM .:: 🔻 X Spurious Emission\_π/4DQPSK\_2M\_DH5\_2480MHz





Spectrum Analyzer \* ٥ KEYSIGHT Input RF nt 7: 50 O Center Frequency 12.515000000 GHz Settings PNNNN Mkr4 23.755 GHz 24.9700000 GHz 1 Spectrum -42.07 dBr Swept Span Zero Span Full Span •4 Stop Freq 25.000000000 GH AUTO TUNE Center 12.52 GHz #Video BW 300 kHz Span 24.97 GHz Sweep ~2.39 s (24971 pts) #Res BW 100 kH: 2.497000000 GH Auto Man Function Width Function Value Freq Offset

0 Hz

X Axis Scale

Log
Lin

Spurious Emission 8DPSK 3M DH5 2441MHz



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