

# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

Applicant:	Murata Manufacturing Co., Ltd. 10-1, Higashikotari 1-chome, Nagaokakyo-shi, Kyoto 617-8555 Japan
Product Name:	Communication Module
Brand Name:	muRata
Model No.:	LBEQ6ZZ1BN
Model Difference:	N/A
Report Number:	ER/2019/A0012
FCC ID:	VPYLB1BN
IC:	772C-LB1BN
FCC Rule Part:	§15.247, Cat: DSS
IC RSS:	RSS-247 issue 2 Feb 2017
Issue Date:	Oct. 24, 2019
Date of Test:	Oct. 02, 2019 ~ Oct. 23, 2019
Date of EUT Re- ceived: We hereby certify that:	Oct. 02, 2019

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.

CHUN CHIEH CHEN / Asst. Supervisor



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Revision History					
Revision	Revision Description Issue Date Remark				
Rev.00	Original.	Oct. 24, 2019	Revised By: Yuri Tsai		

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#### **GENERAL INFORMATION** 1

# 1.1 Product description

Product Name:	Communication Module
Brand Name:	muRata
Model No.:	LBEQ6ZZ1BN
Model Difference:	N/A
Hardware Version:	1.0
Software Version:	1.0
Power Supply:	Typ. 3.3V, Min 3.0V, Max 3.6V from DC power supply

Radio Technology:	Bluetooth BR+EDR
Channel number:	79 channels
Modulation type:	GFSK + π/4DQPSK + 8DPSK
Transmit Power:	10.25 dBm
Frequency Range:	2.402GHz – 2.480GHz
Dwell Time:	$\leq$ 0.4s
Antenna Designation:	Dipole Antenna, Gain: 2.37dBi Model No: GW.59.3153; Supplier: Taoglas



# 1.2 Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.247 KDB 558074 D01 v05 DSS Meas. Guidance RSS-247 issue 2 Feb. 2017 RSS-Gen. issue 5 Mar. 2019 ANSI C63.10:2013

# 1.3 Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory (TAF code 0513) No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803

FCC Designation number: TW0001

Canada Registration Number: 4620A-4

## 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.

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

Radiated emission below 30MHz is measured in a 9m\*9m\*6m semi-anechoic chamber. the measurements correspond to those obtained at an open-field test site. There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

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# 2 SYSTEM TEST CONFIGURATION

# 2.1 EUT Configuration

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

# 2.2 EUT Exercise

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

# 2.3 Test Procedure

# 2.3.1Conducted Emissions

The EUT is a placed on a table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz. The CISPR Quasi-Peak and Average detector mode is employed. The two LISNs provide 50uH/50 ohm of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

# 2.3.2Conducted 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.

# 2.3.3Radiated 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.

# 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.

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

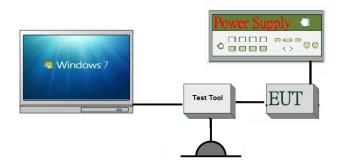
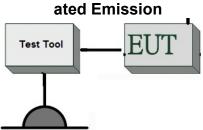
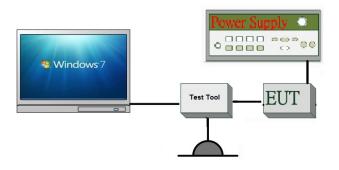


Fig 2-2 Conduction (AC Power Line) Radi-



# Fig. 2-3 Conducted (Antenna Port) Configuration



# Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Data Cable	Power Cord
1	Bluetooth Test Software	N/A	N/A	N/A	N/A	N/A
2	Notebook	Lenovo	L430	R9-XFG0X	Shielded	Unshielded
3	DC power supply	Agilent	E3640A	MY52410006	N/A	Unshielded
4	Test tool kit	N/A	N/A	N/A	N/A	N/A



#### SUMMARY OF TEST RESULTS 3

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

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#### **DESCRIPTION OF TEST MODES** 4

# 4.1 Operated in 2400 ~ 2483.5MHz Band

79 channels are provided for Bluetooth

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



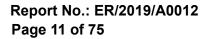
# 4.2 The Worst Test Modes and Channel Details

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

MODE	AVAILABLE FREQUENCY (MHz)	TESTED FREQUENCY (MHz)	MODULATION	PACKET TYPE	
	RADIATED EMISSION TEST (BELOW 1 GHz)				
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH5	
	RADIATED EMISSION TEST (ABOVE 1 GHz)				
Bluetooth	2402 to 2480	2402, 2441, 2480	GFSK	DH5	
<b>Note:</b> 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 H position was reported.

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





#### MEASUREMENT UNCERTAINTY 5

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

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

#### Note:

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



#### CONDUCTED EMISSION TEST 6

#### **Standard Applicable** 6.1

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

Frequency range	Limits dB(uV)			
MHz	Quasi-peak	Average		
0.15 to 0.50	66 to 56	56 to 46		
0.50 to 5	56	46		
5 to 30	60	50		

Note

1. The lower limit shall apply at the transition frequencies

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

# 6.2 Measurement Equipment Used

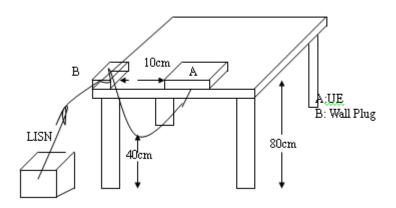
	Cond	ucted Emission Te	st Site		
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
EMI Test Re- ceiver	R&S	ESCI 3	100335	02/12/2019	02/11/2020
Coaxial Cables	N/A	WK CE Cable	N/A	11/26/2018	11/25/2019
LISN	SCHWARZBECK	NSLK 8127	8127-649	04/02/2019	04/01/2020
LISN	FCC	FCC-LISN-50/250- 25-2-01	4034	04/09/2019	04/08/2020
Test Software	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R	N.C.R

# 6.3 EUT Setup

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



# 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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## **Description:** Operation Date: 2019/10/23 Line: L1 Temp.(°C)/Hum.(%): 24(°C)/71% **Test Voltage:** AC 120V/60Hz Test By: Nick 80.0 dBu¥ FCC Class B Conduction(QP) FCC Class B Conduction(AVG) 40 abover while the What when the 0.0 0.150 5 30.000 0.5 (MHz)

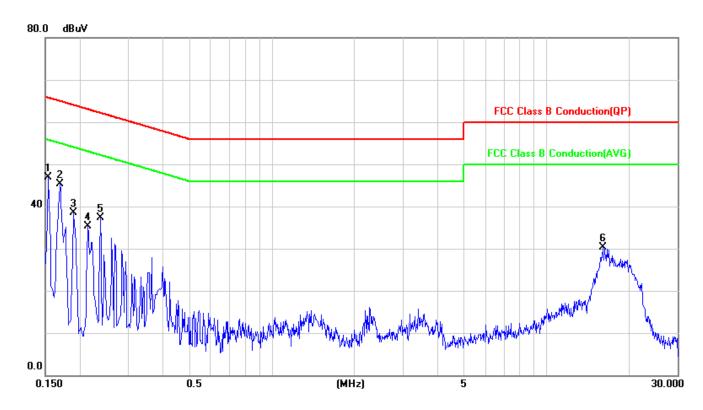
No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector
		(MHz)	dBuV	(dB)	(dBuV)	(dBuV)	(dB)	
1	*	0.1620	46.15	0.00	46.15	65.36	-19.21	peak
2		0.1700	43.25	0.00	43.25	64.96	-21.71	peak
З		0.1860	35.28	0.01	35.29	64.21	-28.92	peak
4		0.2100	36.53	0.01	36.54	63.21	-26.67	peak
5		0.2340	37.29	0.01	37.30	62.31	-25.01	peak
6		16.5900	29.52	0.35	29.87	60.00	-30.13	peak

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Description:	Operation	Date:	2019/10/23	
Line:	Ν	Temp.(°C)/Hum.(%):	24(°C)/71%	
Test Voltage:	AC 120V/60Hz	Test By:	Nick	



No.	Mk.	Freq.	Reading	Factor	Measurement	Limit	Over	Detector
		(MHz)	dBuV	(dB)	(dBuV)	(dBuV)	(dB)	
1	*	0.1540	46.91	0.03	46.94	65.78	-18.84	peak
2		0.1700	45.23	0.03	45.26	64.96	-19.70	peak
3		0.1900	38.54	0.03	38.57	64.04	-25.47	peak
4		0.2140	35.19	0.03	35.22	63.05	-27.83	peak
5		0.2380	37.26	0.03	37.29	62.17	-24.88	peak
6		16.0580	29.90	0.37	30.27	60.00	-29.73	peak

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#### PEAK OUTPUT POWER MEASUREMENT 7

# 7.1 Standard Applicable

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, The Limit: 1Watt. For all other frequency hopping systems in the 2400 -2483.5MHz band: The Limit: 0.125 Watts. The power limit for 1Mbps is 1watt, and 2Mbps, 3Mbps and AFH mode are 0.125 watts. The e.i.r.p. shall not exceed 4 W.

## 7.2 Measurement Equipment Used

Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
Power Meter	Anritsu	ML2496A	1804001	02/13/2019	02/12/2020		
Power Sensor	Anritsu	MA2411B	1726104	02/13/2019	02/12/2020		
Power Sensor	Anritsu	MA2411B	1726107	02/13/2019	02/12/2020		
DC Power Supply	Agilent	E3640A	MY52410006	12/04/2018	12/03/2019		

# 7.3 Test Set-up:

EUT	Power Sensor	Power Meter
-----	--------------	-------------

# 7.4 Measurement Procedure:

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

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# 7.5 Peak & Average Power Measurement Result

1M BR mode (Peak):

СН	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	10.25	10.593	125
Mid	2441	10.01	10.023	125
High	2480	9.93	9.840	125

1M BR mode (Average):

СН	Freq. (MHz)	Max. Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	9.83	9.625	125
Mid	2441	9.61	9.149	125
High	2480	9.67	9.276	125

2M EDR mode (Peak):

СН	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	9.64	9.204	125
Mid	2441	9.33	8.570	125
High	2480	9.21	8.337	125

2M EDR mode (Average):

СН	Freq. (MHz)	Max. Avg.Output include tune up tolerance Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	8.15	6.537	125
Mid	2441	7.54	5.680	125
High	2480	7.77	5.989	125



3M EDR	mode	(Peak):
--------	------	---------

СН	Freq. (MHz)	Peak Output Power (dBm)	Output Power (mW)	Limit (mW)
Low	2402	9.93	9.840	125
Mid	2441	9.65	9.226	125
High	2480	9.52	8.954	125

NOTE: cable loss as 0.5dB that offsets in the sp

#### 3M EDR mode (Average):

		Max. Avg.Output		
	Erog	include	Output	Limit
CH	Freq. (MHz)	tune up	Power	(mW)
		tolerance	(mW)	(11100)
		Power (dBm)		
Low	2402	7.71	5.907	125
Mid	2441	7.50	5.628	125
High	2480	7.55	5.694	125

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



# 7.6 EIRP Measurement Result

#### 1M BR mode EIRP

Channel	Frequency (MHz)	Max. Output include tune up tolerance Power (dBm)	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	9.83	1.87	14.804	4000
Mid	2441	9.61	1.87	14.073	4000
High	2480	9.67	1.87	14.269	4000

2M EDR mode EIRP

Channel	Frequency (MHz)	Max. Avg.Output include tune up tolerance	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	8.15	1.87	10.055	4000
Mid	2441	7.54	1.87	8.737	4000
High	2480	7.77	1.87	9.213	4000

3M EDR mode EIRP

Channel	Frequency (MHz)	Max. Avg.Output include tune up tolerance	Antenna Gain (dBi)	EIRP (mW)	Limit (mW)
Low	2402	7.71	1.87	9.086	4000
Mid	2441	7.50	1.87	8.657	4000
High	2480	7.55	1.87	8.758	4000

\* Note: EIRP = Average Power + Gain



# 8 20dB & 99% BANDWIDTH MEASUREMENT

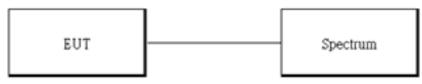
# 8.1 Standard Applicable

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

# 8.2 Measurement Equipment Used

Conducted Emission Test Site					
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.
TYPE		NUMBER	NUMBER	CAL.	
EXA Spectrum Analyz- er	Agilent	N9010A	MY5042019 5	05/02/2019	05/01/2020
DC Power Supply	Agilent	E3640A	MY5241000 6	12/04/2018	12/03/2019
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020

# 8.3 Test Set-up



# 8.4 Measurement Procedure

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set the spectrum analyzer as RBW=10 kHz (1 % of 20 dB Bandwidth.), VBW = 30 kHz, Span= 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

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### 8.5 20dB Bandwidth

# **GFSK**

	20 dB	2/3
СН	BW	BW
	(MHz)	(MHz)
Low	0.9247	0.62
Mid	0.9254	0.62
High	0.9247	0.62

#### π/4-DQPSK

20 dB	2/3
BW	BW
(MHz)	(MHz)
1.317	0.88
1.316	0.88
1.316	0.88
	<b>BW</b> (MHz) 1.317 1.316

#### 8-DPSK

	20 dB	2/3
СН	BW	BW
	(MHz)	(MHz)
Low	1.292	0.86
Mid	1.293	0.86
High	1.291	0.86

#### 8.6 99% Bandwidth

GFSK	
СН	99% Bandwidth (MHz)
Low	0.85768
Mid	0.86247
High	0.85589
π/4-DQPSP	ζ.
	99%
СН	99% Bandwidth
СН	
CH Low	Bandwidth
	Bandwidth (MHz)
Low	Bandwidth (MHz) 1.1668
Low Mid	Bandwidth (MHz) 1.1668 1.1665

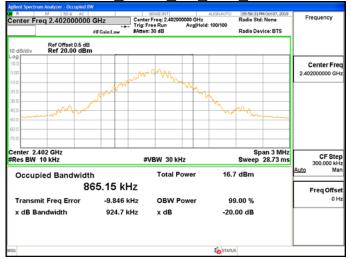
	99%
СН	Bandwidth
	(MHz)
Low	1.1662
Mid	1.1656
High	1.1655

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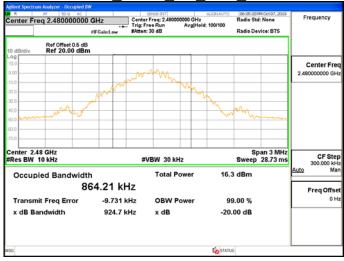
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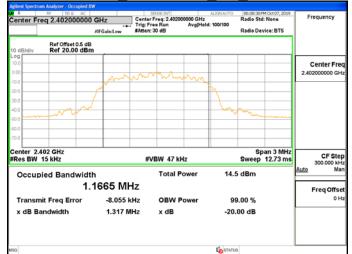
## OBW 20dB GFSK 1M DH5 2441MHz



# OBW 20dB GFSK 1M DH5 2480MHz



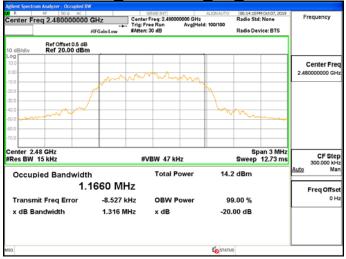
### OBW 20dB π/4DQPSK 2M 2402MHz



OBW 20dB π/4DQPSK 2M\_2441MHz



#### OBW 20dB π/4DQPSK 2M 2480MHz



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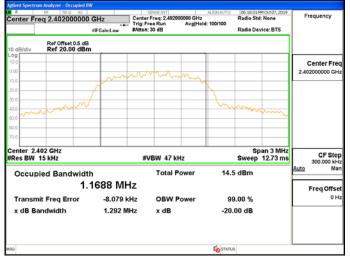
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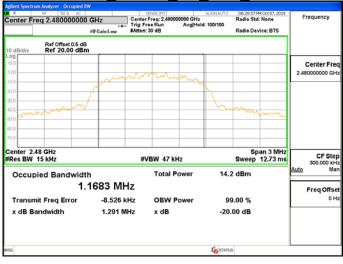
## OBW 20dB 8DPSK 3M DH5 2402MHz



#### OBW 20dB 8DPSK 3M DH5 2441MHz



# OBW 20dB 8DPSK 3M DH5 2480MHz



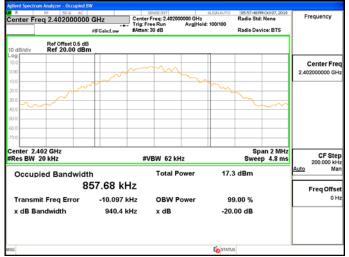
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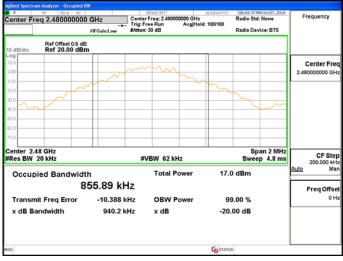
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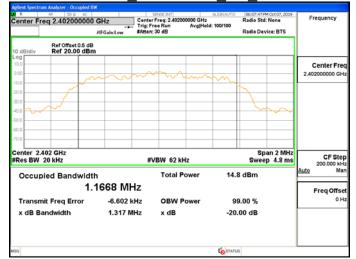
#### IC OBW 99% GFSK 1M DH5 2441MHz



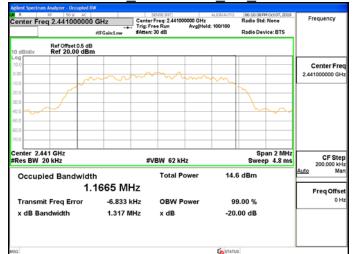
# IC OBW 99% GFSK 1M DH5 2480MHz



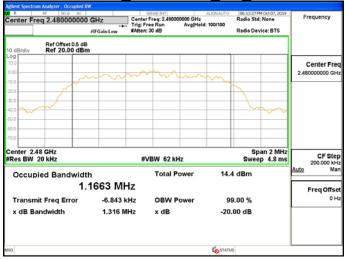
### IC OBW 99% π/4DQPSK 2M 2402MHz



IC OBW 99% π/4DQPSK 2M 2441MHz



#### IC OBW 99% π/4DQPSK 2M 2480MHz



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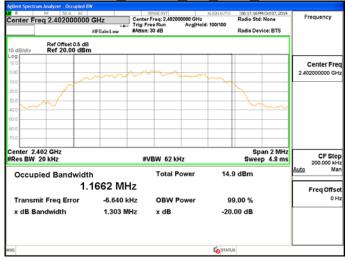
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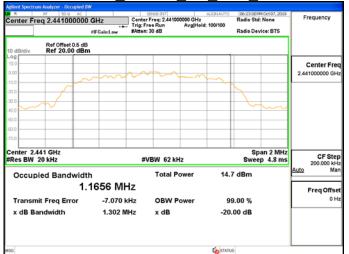
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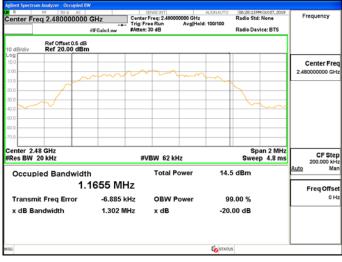
### IC OBW 99% 8DPSK 3M DH5 2402MHz



## IC OBW 99% 8DPSK 3M \_DH5\_2441MHz



# IC OBW 99% 8DPSK 3M DH5 2480MHz



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# 9 CONDUCTED BAND EDGES AND SPURIOUS EMISSION MEASUREMENT

# 9.1 Standard Applicable

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

# 9.2 Measurement Equipment Used

Conducted Emission Test Site						
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.	
EXA Spectrum An- alyzer	Agilent	N9010A	MY5042019 5	05/02/2019	05/01/2020	
DC Power Supply	Agilent	E3640A	MY5241000 6	12/04/2018	12/03/2019	
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020	

# 9.3 Test SET-UP



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# 9.4 Measurement Procedure

# 9.4.1Conducted Band Edge:

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set center frequency of spectrum analyzer = operating frequency.
- 5. Set the spectrum analyzer as RBW=100 kHz, VBW=300 kHz, Sweep = auto
- 6. Mark Peak. 2.3999GHz and 2.4836GHz and record the max. level.
- 7. Repeat above procedures until all frequency measured were complete.

# 9.4.2Conducted Spurious Emission:

- 1. To connect Antenna Port of EUT to Spectrum.
- 2. The testing follows ANSI C63.10:2013.
- 3. Set RBW = 100 kHz & VBW = 300 kHz, Detector = Peak, Sweep = Auto
- 4. Allow trace to fully stabilize.
- 5. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.
- 6. Repeat above procedures until all default test channel measured were complete.

# 9.5 Measurement Result

See next page for test plots.



# Band Edge\_GFSK\_1M\_DH5\_2402MHz



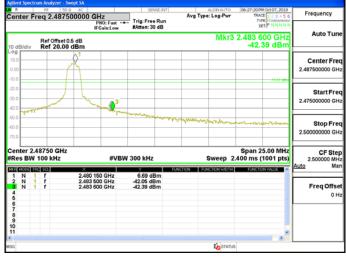
# Band Edge\_GFSK\_1M\_DH5\_2480MHz

R RF 50 Q AC enter Freq 2.487500000	GHz	SENSE3NT	ALIGNAUTO Avg Type: Log-Pwr	06:03:44 PM Oct 07, 2019 TRACE 1 2 3 4 5 6	Frequency
	PNO: Fast IFGain:Low	#Atten: 30 dB		DET P NNNNN	Auto Tur
Ref Offset 0.5 dB dB/div Ref 20.00 dBm			Mkr3	2.483 600 GHz -37.72 dBm	Auto Tur
					Center Fre
				-10.20 dBn	2.487500000 G
	- 2				Start Fre
0.0	L.				2.475000000 G
2.0			and the second	VWM AVAN - program	Stop Fr
0.0					2.50000000 G
enter 2.48750 GHz Res BW 100 kHz	#VBV	V 300 kHz	Sweep 2.	Span 25.00 MHz 400 ms (1001 pts)	CF Sto 2.500000 M
R MODE TRE SCL X	0 150 GHz	9.80 dBm	NCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> M
2 N 1 f 2.493 3 N 1 f 2.483 4 5	3 600 GHz 3 600 GHz	-37.01 dBm -37.72 dBm			Freq Offs 01
6 7 8 9 0					
		90 - C	STATUS	>	

# Band Edge\_8DPSK\_3M\_DH5\_2402MHz



#### Band Edge\_8DPSK\_3M DH5\_2480MHz



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# Hopping Band Edge GFSK 1M DH5 2402MHz

	rum Analyzer - Swept Si					
Center F	reg 2.3650000		SENSE:3NT	AUGNAUTO Avg Type: Log-Pwr	06:30:10 PM Oct 07, 2019 TRACE 1 2 3 4 5 6	Frequency
	Ref Offset 0.5 dB	PNO: Fast IFGain:Low	#Atten: 30 dB	Mkr	DET P NNNN 3 2.390 00 GHz	Auto Tun
0 dB/div	Ref 20.00 dBn				-54.56 dBm	
10.0 0.00						Center Free 2.365000000 GH
20.0					12	Start Fre 2.310000000 GH
50.0		unison mealli	wikitshuwitowi	antoanakakaka 🖓 🖓	¥-	Stop Fre 2.420000000 GH
enter 2.	36500 GHz 100 kHz	#VB\	V 300 kHz	Sweep 1	Span 110.0 MHz 0.53 ms (1001 pts)	CF Ste 11.000000 MH
3E MODE 1		2.415 05 GHz	9.80 dBm	FUNCTION FUNCTION WIDTH	FUNCTION VALUE	<u>Auto</u> Ma
2 N 3 N 4 5	1	2.399 90 GHz 2.390 00 GHz	-48.16 dBm -54.56 dBm			Freq Offse 0 H
7 8 9						
1					*	
3G				to STATUS		

#### Hopping Band Edge\_GFSK\_1M\_DH5\_2480MHz

					n Analyzer - Sv	pectru		
Frequency	06:45:37 PM Oct 07, 2019 TRACE 1 2 3 4 5 6	AUGNAUTO Avg Type: Log-Pwr	SINSE2NT	50 0 AC 7500000 GHz		r Fre		
	DET P NNNNN	••	#Atten: 30 dB	PNO: Fast IFGain:Low	q 2.4070		inci	00
Auto Tune	2.483 600 GHz -43.78 dBm	Mkr3		t 0.5 dB	Ref Offset 0 Ref 20.00		dB/di	
Center Freq 2.487500000 GHz	10 50 400				Ŵ	N		Log 10. 0.0
Start Freq 2.475000000 GHz			M. M. e.	A. MARA			0	-20 -30 -40
Stop Freq 2.50000000 GHz		timentumenta		- UNIVI			0	-50) -60) -70)
CF Step 2.500000 MHz Auto Man	Span 25.00 MHz .400 ms (1001 pts)	Sweep 2	3W 300 kHz		3750 GHz 00 kHz		es B	#R
Freq Offset 0 Hz		PUNCTURING	9.50 dBm -49.68 dBm -43.78 dBm	2.479 050 GHz 2.483 500 GHz 2.483 600 GHz 2.483 600 GHz	f f f	1	NNN	1 2 3 4 5 6
	,*							7 8 9 10 11
	5	to STATUS						MSG

# Hopping Band Edge\_8DPSK\_3M\_DH5\_2402MHz



#### Hopping Band Band Edge\_8DPSK\_3M\_DH5\_2480MHz

		2 AC	SENSE:3NT	ALIGNAUTO	06:51:23PM Oct 07, 2019	Frequency
penter F	req 2.4875	00000 GHz PN0: Fast =	Trig: Free Run	Avg Type: Log-Pwr	TRACE 1 2 3 4 5 6 TYPE MWWWWWW	Frequency
		IFGain:Low	#Atten: 30 dB		DET P NNNNN	
10 dB/div	Ref Offset 0 Ref 20.00			Mkr3	2.483 600 GHz -55.59 dBm	Auto Tun
10.0						Center Fre
	march					2.487500000 GH
-10.0					-16 30 (5%)	
20.0						Start Fre
30.0		- h				2.47500000 GH
-40.0		$\wedge$				
-50.0		- With 3	makundelan	and a second second second	and the second second	Stop Fre
-60.0			and the second decay			2.50000000 GH
-70.0						
	48750 GHz				Span 25.00 MHz	CF Ste
				0	400 ms (1001 pts)	2.500000 MH
#Res BW	100 KHZ	#VB	W 300 kHz	Sweep 2		
#Res BW	RC SCL	×	Y F	UNCTION FUNCTION WOTH		Auto Ma
MRR MODE TR	RC SCL	2.478 900 GHz 2.483 500 GHz	6.70 dBm -44.06 dBm			<u>Auto</u> Ma
1 N 1 2 N 1 3 N 1 4	RC SCL	× 2.478 900 GHz	5.70 dBm			Auto Ma
1 N 1 2 N 1 3 N 1 4 5	RC SCL	2.478 900 GHz 2.483 500 GHz	6.70 dBm -44.06 dBm			Auto Ma
1 N 1 2 N 1 3 N 1 4 5 6 7	RC SCL	2.478 900 GHz 2.483 500 GHz	6.70 dBm -44.06 dBm			
1 N 1 2 N 1 3 N 1 4 5 6 7	RC SCL	2.478 900 GHz 2.483 500 GHz	6.70 dBm -44.06 dBm			Auto Ma Freq Offse
MOR MODE 1 1 N 1 2 N 1 3 N 1 4 5	RC SCL	2.478 900 GHz 2.483 500 GHz	6.70 dBm -44.06 dBm			Auto Ma Freq Offse

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#### Spurious Emission GFSK 1M DH5 2402MHz

gilent Spectrum Analyzer					
enter Freq 13.0	50 P AC 15000000 GHz PN0: Fast = IFGain:Low	Trig: Free Run #Atten: 30 dB	AUGNAUTO Avg Type: Log-Pwr	05:59:32 PM Oct 07, 2019 TRACE 1 2 3 4 5 6 TYPE M WWWWW DET P N N N N N	Frequency
10 dB/div Ref 20.	et 0.5 dB .00 dBm		Mkr	4 25.876 2 GHz -35.66 dBm	Auto Tun
-og 10.0 10.0					Center Fre 13.015000000 GH
20.0				and the second second	Start Fre 30.000000 MF
50.0 60.0 70.0	0 <sup>2</sup> 0 <sup>3</sup>				Stop Fre 26.00000000 GH
Center 13.02 GHz Res BW 100 kHz	#VB	W 300 kHz	Sweep 2	Span 25.97 GHz 2.482 s (30001 pts)	CF Ste 2.597000000 GH Auto Ma
M003 HEX Sol   1 N 1 f   2 N 1 f   3 N 1 f   4 N 1 f   5 6 7 8   9 9 10 10   11 1 1 1	2.401 9 GHz 4.804 0 GHz 7.206 0 GHz 25.876 2 GHz	9.47 dBm -56.32 dBm -54.78 dBm -35.66 dBm	FLACTION WOTH	FUNCTION VALUE	Freq Offse 0 H
sa		64 - C	STATUS		

#### Spurious Emission GFSK 1M DH5 2441MHz



#### Spurious Emission GFSK 1M DH5 2480MHz



#### Spurious Emission\_m/4DQPSK\_2M\_2402MHz



Spurious Emission\_ $\pi/4DQPSK$ 2M 2441MHz



#### Spurious Emission π/4DQPSK 2M 2480MHz

R		50 g AC		SENSE2		ALISN AUTO	06:15:11 PM O	ct 07, 2019	English
enter F	req 13.0'	15000000	GHz PNO: Fast IFGain:Low	Trig: Free Run #Atten: 30 dB	Avg T	ype: Log-Pwr	TRACE TYPE DET	23456 NNNNN	Frequency
0 dB/div	Ref Offse Ref 20.0					Mkr	4 24.730 <sup>-</sup> -35.88		Auto Tur
10.0	01		_						Center Fre
	1								13.015000000 Gi
0.0								-14.79 dbn	
0.0								4	Start Fre
0.0								-Veral	30.000000 Mł
0.0		$Q^2$			No. of Concession, Name			_	Oton En
10.0						_			Stop Fre 26.00000000 Gi
0.0									
	3.02 GHz 100 kHz		#VB	N 300 kHz		Sweep 2	Span 25.9 2.482 s (300	01 pts)	CF Ste 2.597000000 GI Auto M
REMODE T	RC SOL	2.4	79 8 GHz	5.21 dBm	FUNCTION	FUNCTION WIDTH	FUNCTION V	ALLIE	Auto M
2 N 3 N	1	4.96	50 0 GHz 40 0 GHz	-53.50 dBm -55.55 dBm					Freq Offs
4 N 1	1	24.73	30 1 GHz	-35.88 dBm					01
6									
8 9 0									
0								~	
						<b>STATUS</b>			

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#### Spurious Emission 8DPSK 3M DH5 2402MHz

		er - Swept SA					
enter F	req 13.	50 0 AC 015000000	PNO: Fast =	Trig: Free Run	Avg Type: Log-Pw		Frequency
10 dB/div		set 0.5 dB 0.00 dBm	IFGain:Low	#Atten: 30 dB	Mk	r4 25.261 6 GHz -35.81 dBm	Auto Tun
0.00	01						Center Free 13.015000000 GH
20.0		02				-15.22 dbn	Start Fre 30.000000 MH
50.0 50.0 70.0		QT	Names .				Stop Fre 26.00000000 GH
Res BW	3.02 GH 100 kH		#VB	W 300 kHz		Span 25.97 GHz 2.482 s (30001 pts)	CF Ste 2.597000000 GH Auto Ma
1 N 2 N 3 N 6 6 7 8 9 10	FRE SCE 1 f 1 f 1 f 1 f 1 f	4.80	01 9 GHz 04 0 GHz 06 0 GHz 51 6 GHz	4.79 dBm -53.20 dBm -56.23 dBm -35.81 dBm	FUNCTION FUNCTION WOT	H FUNCTION VALUE	Freq Offse 0 H
sa					Lo STAT	>	

#### Spurious Emission 8DPSK 3M DH5 2441MHz



#### Spurious Emission 8DPSK 3M DH5 2480MHz

gilent Spectrum Analyzer - S					
Center Freq 13.01	5000000 GHz	SENSE INT	AUGNAUTO Avg Type: Log-Pwr	06-29:57 PM Oct 07, 2019 TRACE 1 2 3 4 5 6 TYPE MWWWWW	Frequency
Ref Offset		#Atten: 30 dB	Mkr	4 24.598 5 GHz -35.85 dBm	Auto Tur
10.0 0.00					Center Fre 13.015000000 GH
20.0				-14.32 dbs	Start Fre 30.000000 Mi
50.0					Stop Fr 26.00000000 G
Center 13.02 GHz Res BW 100 kHz	#VBI	V 300 kHz		Span 25.97 GHz 2.482 s (30001 pts)	CF Sto 2.597000000 G Auto M
ATE MODE TRE SCI 1 N 1 f 2 N 1 f 3 N 1 f 4 N 1 f 6 6 7	2,479 8 GHz 4,960 0 GHz 7,440 0 GHz 24,598 5 GHz	5.69 dBm -54.25 dBm -55.27 dBm -35.85 dBm	FUNCTION WOTH	FUNCTION VALUE	Freq Offs
8 9 10 11			Costatue	×	

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# 10 RADIATED BANDEDGE AND SPURIOUS EMISSION MEASUREMENT

# **10.1 Standard Applicable**

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

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

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

Note:

- 1. The lower limit shall apply at the transition frequencies.
- 2. Emission level  $(dB\mu V/m) = 20 \log Emission \, \text{level} \, (dB\mu V/m)$

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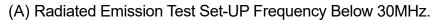
# **10.2 Measurement Equipment Used**

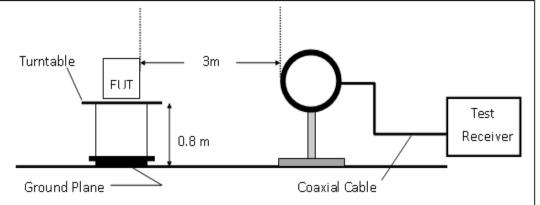
966 Chamber					
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.
Bi-log Antenna	TESEO	CBL 6112D	35242 & AT-N0555	01/10/2019	01/09/2020
Horn Antenna	Schwarzbeck	BBHA9170	07/02/1900	12/27/2018	12/26/2019
Horn Antenna	Schwarzbeck	BBHA9120D	D803	12/24/2018	12/23/2019
Loop Antenna	ETS.LINDGREN	6502	148045	10/08/2018	10/07/2019
PXA Spectrum Analyzer	Agilent	N9030A	MY53120760	04/22/2019	04/21/2020
EMI Test Receiver	R&S	ESCI 3	100335	02/12/2019	02/11/2020
Pre-Amplifier	EMC Instru- ments	EMC184045B	980135	01/02/2019	01/01/2020
Pre-Amplifier	EMC Instru- ments	EMC051825	980152	01/02/2019	01/01/2020
Pre-Amplifier	HP	8447D	2944A09469	01/02/2019	01/01/2020
Filter 2400-2483.5 MHz	EWT	EWT-14-0166	M1	01/02/2019	01/01/2020
High Pass Filter	WI	WHKX4.0/18G-1 0SS	22	01/02/2019	01/01/2020
Coaxial Cable	Huber Suhner	succoflex 102	MY2622/2	01/02/2019	01/01/2020
Coaxial Cable	Huber Suhner	succoflex 104A	800086/4a	01/02/2019	01/01/2020
Coaxial Cable	Huber Suhner	EMC 104-SM-SM-200 0	160123	01/02/2019	01/01/2020
Software	e3 V6.11-20180413				

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

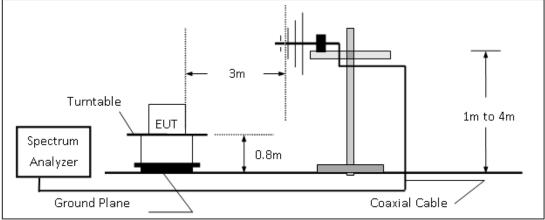


# 10.3 Test SET-UP

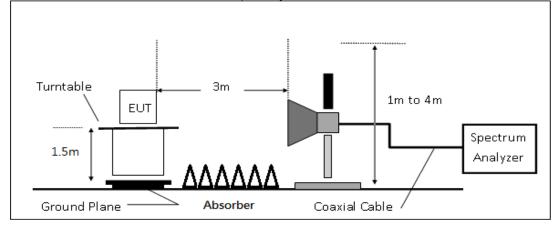




# (B) Radiated Emission Test Set-Up, Frequency form 30MHz to 1000MHz



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



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# **10.4 Measurement Procedure**

# 10.4.1 Radiated Emission

- 1. The testing follows the Measurement Procedure of ANSI C63.10:2013.
- 2. The EUT was placed on a turn table with 0.8m for frequency< 1GHz and 1.5m for frequency> 1GHz above ground plan.
- 3. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
- 4. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
- 5. Set the spectrum analyzer as RBW=120 kHz and VBW=300 kHz for Peak Detector (PK) and Quasi-peak (QP) at frequency below 1 GHz.
- 6. Set the spectrum analyzer as RBW=1 MHz, VBW=3 MHz for Peak Detector at frequency above 1 GHz.
- 7. Set the spectrum analyzer as RBW=1 MHz, VBW=10 Hz (Duty cycle > 98%) or VBW ≥ 1/T (Duty cycle < 98%) for Average Detector at frequency above 1 GHz.
- 8. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.
- 9. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 10. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. On spectrum, change spectrum mode in linear display mode, and reduce VBW = 10Hz if average reading is measured.
- 11. Repeat above procedures until all default test channel measured were complete.

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# **10.5 Field Strength Calculation**

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

# FS = RA + AF + CL - AG

*Where FS* = *Field Strength* RA = Reading Amplitude AF = Antenna Factor

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

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

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

# 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) & RSS-GEN §6.13.2 was not reported.

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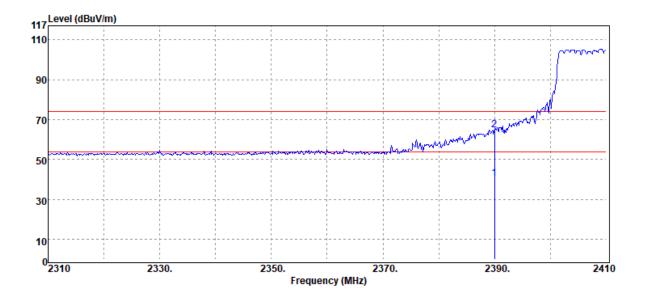
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### 10.7 Measurement Result:

### 10.7.1 Radiated Bandedge Result (Hopping Mode)

Report Number	:ER-2019-A0012	Test Date	:2019-10-05
Operation Mode	:BT BR Hopping	Temp./Humi.	:23.1/66
Test Channel	:2402 MHz	Antenna Pol.	:VERTICAL
Test Mode	:Bandedge CH Low	Engineer	:Nick
EUT Pol	:H Plane	-	



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2390.00	Average	33.11	7.57	40.68	54.00	-13.32
2390.00	Peak	57.03	7.57	64.60	74.00	-9.40

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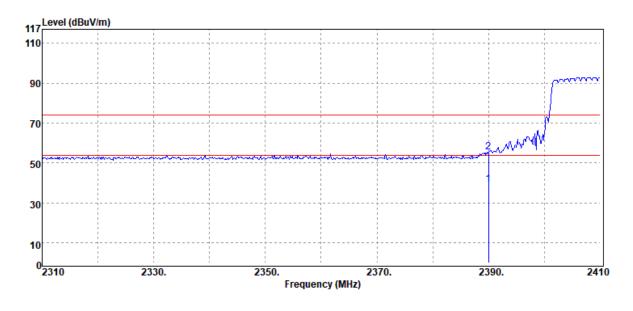


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT BR Hopping :2402 MHz :Bandedge CH Low :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick



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	31.88	7.57	39.45	54.00	-14.55
2390.00	Peak	47.94	7.57	55.51	74.00	-18.49

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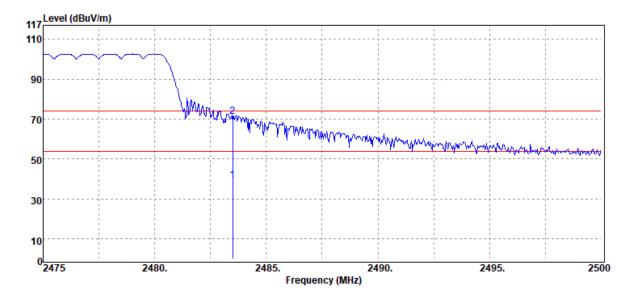


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT BR Hopping :2480 MHz :Bandedge CH High :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :VERTICAL :Nick



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	32.17	6.94	39.11	54.00	-14.89
2483.50	Peak	64.34	6.94	71.28	74.00	-2.72

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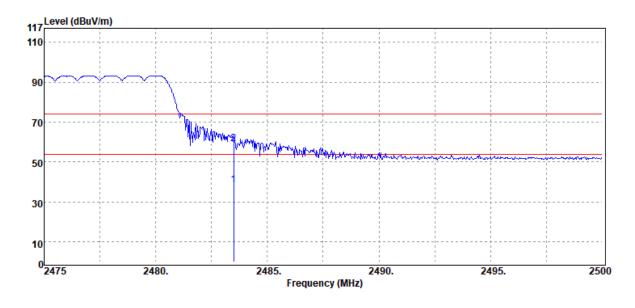


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT BR Hopping :2480 MHz :Bandedge CH High :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick



Detector	Spectrum	Factor	Actual	Limit	Margin
Mode	Reading Level		FS	@3m	
PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
Average	31.56	6.94	38.50	54.00	-15.50
Peak	52.25	6.94	59.19	74.00	-14.81
	Mode PK/QP/AV Average	ModeReading LevelPK/QP/AVdBµVAverage31.56	ModeReading LevelPK/QP/AVdBµVdBAverage31.566.94	ModeReading LevelFSPK/QP/AVdBµVdBdBµV/mAverage31.566.9438.50	Mode Reading Level FS @3m   PK/QP/AV dBμV dB dBμV/m dBμV/m   Average 31.56 6.94 38.50 54.00

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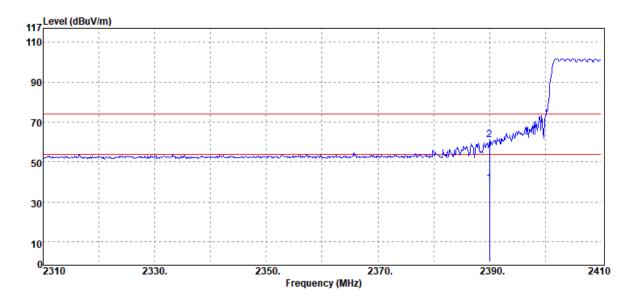


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT EDR Hopping :2402 MHz :Bandedge CH Low :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :VERTICAL :Nick



	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	31.77	7.57	39.34	54.00	-14.66
	2390.00	Peak	53.39	7.57	60.96	74.00	-13.04

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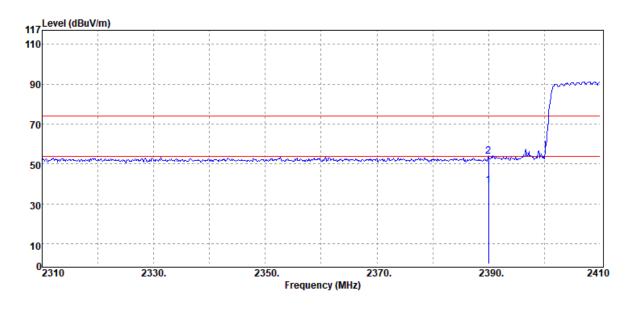


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT EDR Hopping :2402 MHz :Bandedge CH Low :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick



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	31.53	7.57	39.10	54.00	-14.90
2390.00	Peak	46.10	7.57	53.67	74.00	-20.33

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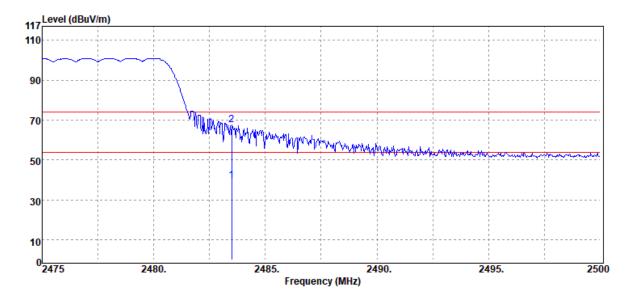


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT EDR Hopping :2480 MHz :Bandedge CH High :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :VERTICAL :Nick



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	32.86	6.94	39.80	54.00	-14.20
2483.50	Peak	60.74	6.94	67.68	74.00	-6.32

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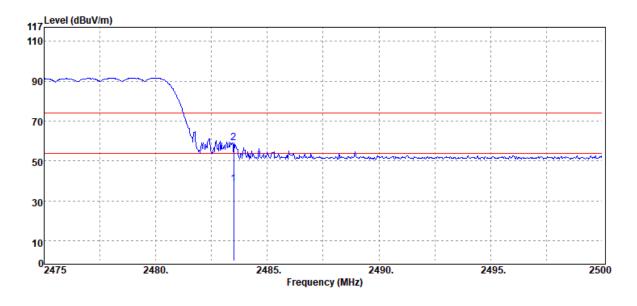


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT EDR Hopping :2480 MHz :Bandedge CH High :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick



	Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
2	2483.50	Average	31.54	6.94	38.48	54.00	-15.52
2	2483.50	Peak	52.32	6.94	59.26	74.00	-14.74

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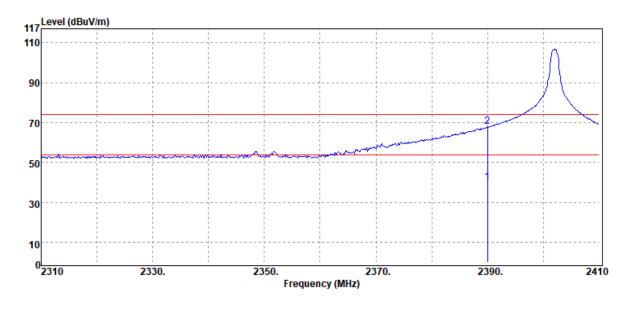
# 10.7.2 Radiated Bandedge Result (Non-Hopping Mode)

**Report Number Operation Mode** Test Channel Test Mode EUT Pol

:ER-2019-A0012 :BT BR :2402 MHz :Bandedge CH Low :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :VERTICAL :Nick



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	32.53	7.57	40.10	54.00	-13.90
2390.00	Peak	60.37	7.57	67.94	74.00	-6.06

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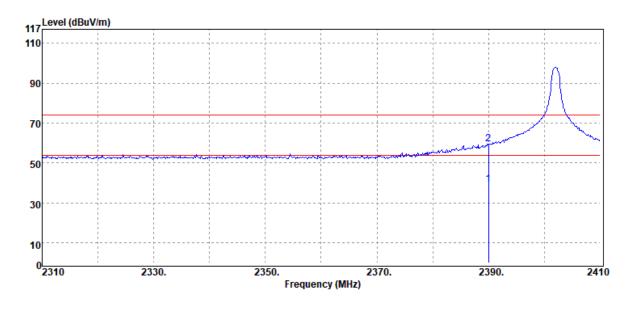


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT BR :2402 MHz :Bandedge CH Low :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick



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	31.89	7.57	39.46	54.00	-14.54
2390.00	Peak	51.84	7.57	59.41	74.00	-14.59

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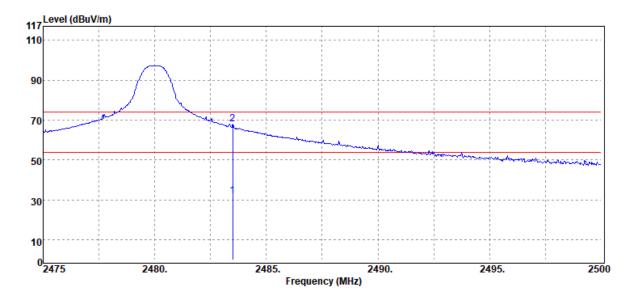


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT BR :2480 MHz :Bandedge CH High :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :VERTICAL :Nick



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	25.22	6.94	32.16	54.00	-21.84
2483.50	Peak	60.99	6.94	67.93	74.00	-6.07

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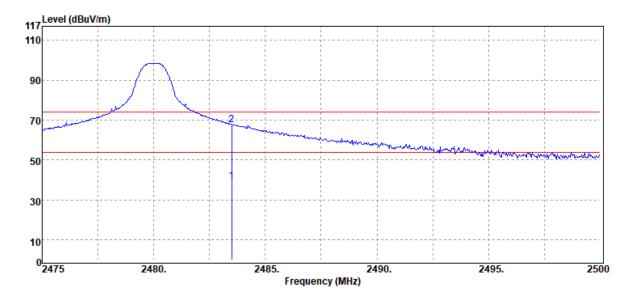


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT BR :2480 MHz :Bandedge CH High :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick

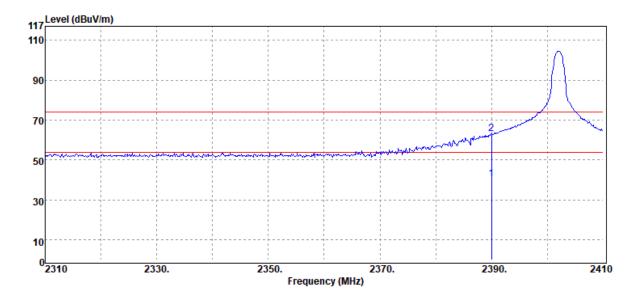


	Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
_	MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
	2483.50	Average	32.24	6.94	39.18	54.00	-14.82
	2483.50	Peak	60.84	6.94	67.78	74.00	-6.22

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**Report Number** :ER-2019-A0012 Test Date :2019-10-05 **Operation Mode** :BT EDR Temp./Humi. :23.1/66 **Test Channel** :2402 MHz Antenna Pol. :VERTICAL Test Mode :Bandedge CH Low Engineer :Nick EUT Pol :H Plane



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	32.93	7.57	40.50	54.00	-13.50
2390.00	Peak	55.47	7.57	63.04	74.00	-10.96

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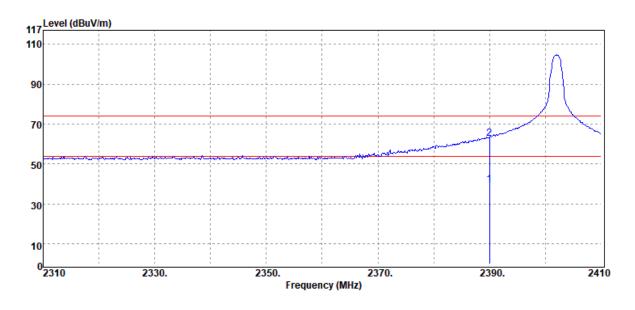


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT EDR :2402 MHz :Bandedge CH Low :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick



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	31.91	7.57	39.48	54.00	-14.52
2390.00	Peak	55.30	7.57	62.87	74.00	-11.13

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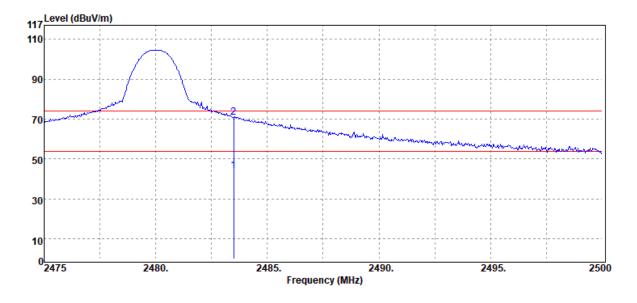


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT EDR :2480 MHz :Bandedge CH High :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :VERTICAL :Nick



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	37.00	6.94	43.94	54.00	-10.06
2483.50	Peak	63.82	6.94	70.76	74.00	-3.24
2100.00	roun	00.02	0.04	10.10	74.00	0.21

Report No.: ER/2019/A0012 Page 52 of 75

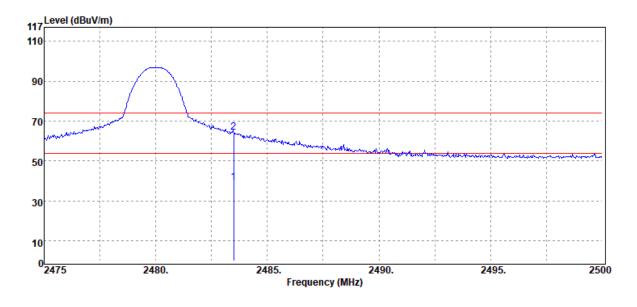


**Report Number Operation Mode Test Channel** Test Mode EUT Pol

:ER-2019-A0012 :BT EDR :2480 MHz :Bandedge CH High :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick



	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	32.17	6.94	39.11	54.00	-14.89
	2483.50	Peak	57.62	6.94	64.56	74.00	-9.44

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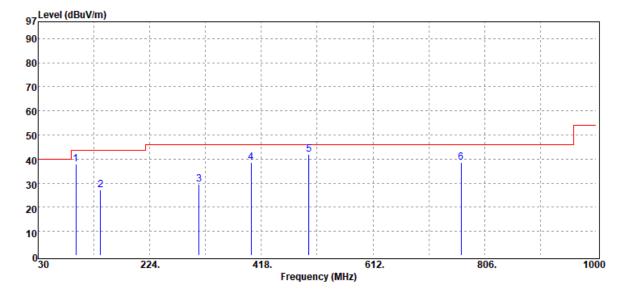


## 10.7.3 Radiated Spurious Emission form 30MHz to 1000MHz:

- **Report Number Operation Mode** Test Channel Test Mode EUT Pol
- :ER-2019-A0012 :BT BR :2441 MHz :Tx CH Mid :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :VERTICAL :Nick



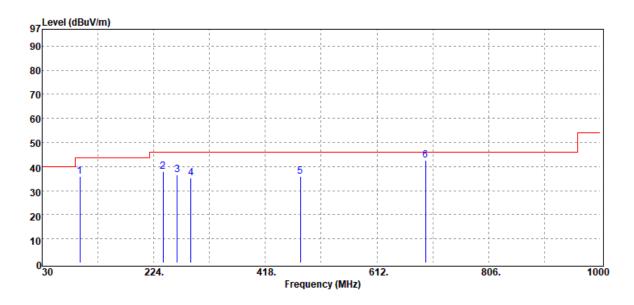
Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
95.96	Peak	51.05	-13.12	37.93	43.50	-5.57
138.64	Peak	39.19	-11.86	27.33	43.50	-16.17
309.36	Peak	37.79	-8.22	29.57	46.00	-16.43
400.54	Peak	44.57	-6.07	38.50	46.00	-7.50
500.45	Peak	46.41	-4.31	42.10	46.00	-3.90
765.26	Peak	39.86	-1.36	38.50	46.00	-7.50



:ER-2019-A0012 :BT BR :2441 MHz :Tx CH Mid :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick



Freq.	Detector Mode	Spectrum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
95.96	Peak	49.15	-13.12	36.03	43.50	-7.47
240.49	Peak	48.18	-10.24	37.94	46.00	-8.06
264.74	Peak	44.95	-8.47	36.48	46.00	-9.52
288.99	Peak	43.96	-8.70	35.26	46.00	-10.74
479.11	Peak	41.29	-5.51	35.78	46.00	-10.22
696.39	Peak	44.81	-2.29	42.52	46.00	-3.48

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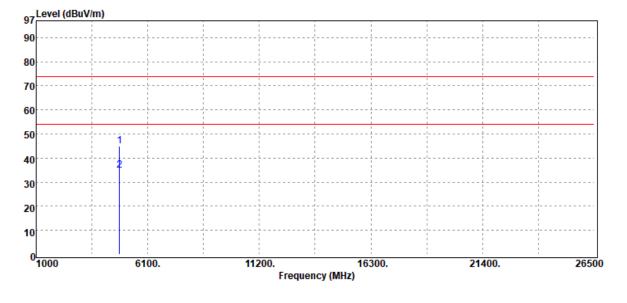
### 10.7.4 Radiated Spurious Emission above 1 GHz:

**Report Number Operation Mode** Test Channel Test Mode EUT Pol

:ER-2019-A0012 :BT BR :2402 MHz :Tx CH Low :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :VERTICAL :Nick



Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	-
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4804.00	Peak	30.41	14.57	44.98	74.00	-29.02
4804.00	Average	20.46	14.57	35.03	54.00	-18.97

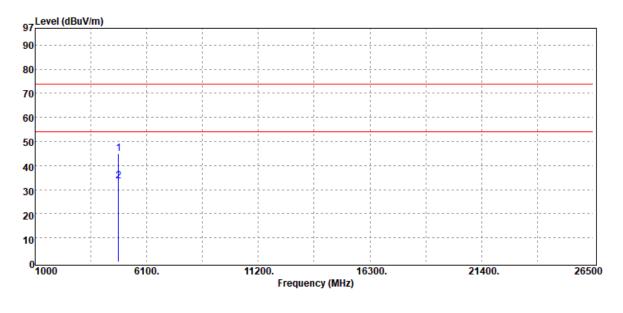
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:ER-2019-A0012 :BT BR :2402 MHz :Tx CH Low :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick



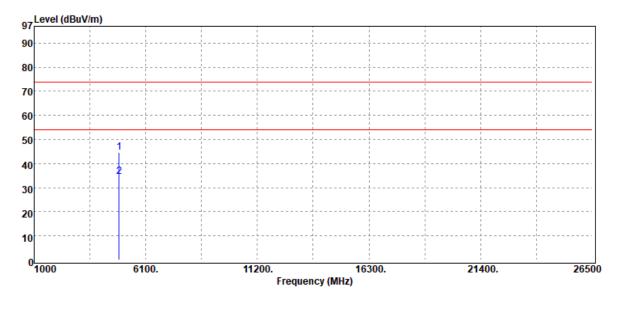
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	-
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4804.00	Peak	30.42	14.57	44.99	74.00	-29.01
4804.00	Average	18.95	14.57	33.52	54.00	-20.48



:ER-2019-A0012 :BT BR :2441 MHz :Tx CH Mid :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :VERTICAL :Nick



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	Peak	29.46	15.08	44.54	74.00	-29.46
4882.00	Average	19.65	15.08	34.73	54.00	-19.27

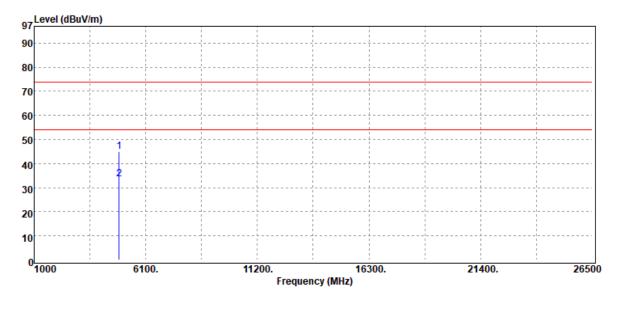
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:ER-2019-A0012 :BT BR :2441 MHz :Tx CH Mid :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick



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	Peak	30.02	15.08	45.10	74.00	-28.90
4882.00	Average	18.55	15.08	33.63	54.00	-20.37

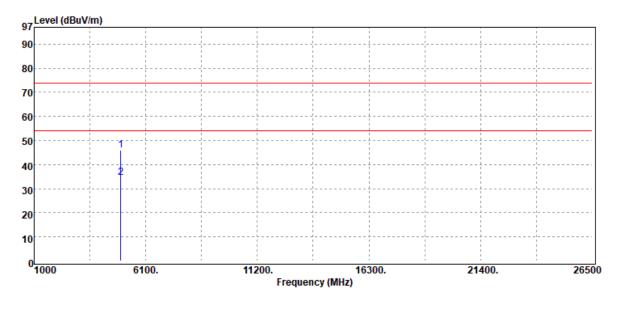
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:ER-2019-A0012 :BT BR :2480 MHz :Tx CH High :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :VERTICAL :Nick



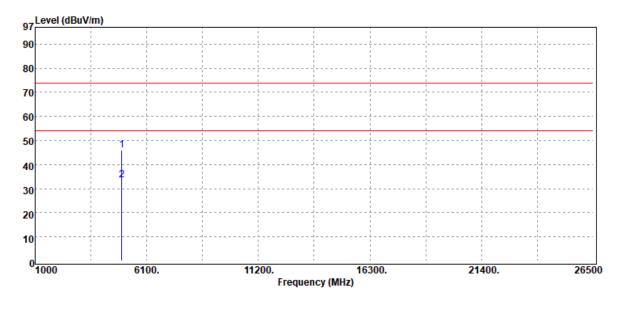
Freq.	Detector	Spectrum	Factor	Actual	Limit	Margin
	Mode	Reading Level		FS	@3m	
MHz	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
4960.00	Peak	30.72	15.13	45.85	74.00	-28.15
4960.00	Average	19.37	15.13	34.50	54.00	-19.50



:ER-2019-A0012 :BT BR :2480 MHz :Tx CH High :H Plane

Test Date Temp./Humi. Antenna Pol. Engineer

:2019-10-05 :23.1/66 :HORIZONTAL :Nick



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	Peak	30.95	15.13	46.08	74.00	-27.92
4960.00	Average	18.49	15.13	33.62	54.00	-20.38



# **11 FREQUENCY SEPARATION**

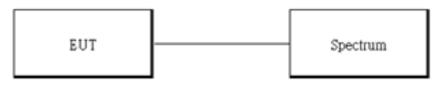
# **11.1 Standard Applicable**

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

Conducted Emission Test Site							
EQUIPMENT TYPE			SERIAL NUMBER	LAST CAL.	CAL DUE.		
EXA Spectrum An- alyzer	Agilent	N9010A	MY5042019 5	05/02/2019	05/01/2020		
DC Power Supply	Agilent	E3640A	MY5241000 6	12/04/2018	12/03/2019		
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020		

## 11.3 Test Set-up



### **11.4 Measurement Procedure**

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set center frequency of spectrum analyzer = middle of hopping channel.
- 5. Set the spectrum analyzer as RBW, VBW=100 kHz, Adjust Span to 5MHz, Sweep = auto.
- 6. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

### **11.5 Measurement Result**

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

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### **11.6 Frequency Separation Test Plots**

### Frequency Separation GFSK 1M DH5 CH0CH1CH2 nt Spectrum Analyzer - Swept S Center Freq 2.403000000 GHz PNO: Wide IFGain:Low Frequency Avg Type: Log-Pwr RACE Trig: Free Run Atten: 30 dB Auto Tune ∆Mkr3 1.000 MHz Ref Offset 0.5 dB Ref 20.00 dBm 0.03 dB 0 dB/div /\1∆2 //4∿ 3/4 10.0 濒っ **Center Freq** 0.00 2.403000000 GHz 10.0 20. Start Fred 30. 2.400500000 GHz 40.1 -50.0 Stop Freq -60.0 2.405500000 GHz Span 5.000 MHz Center 2.403000 GHz CF Step Sweep 1.000 ms (1001 pts) #Res BW 100 kHz #VBW 100 kHz 500.000 kHz Man Auto FUNCTION FUNCTION WIDTH EUNCTION V MKR MODE TRC SCL Δ2 1.000 MHz (Δ) -0.53 dB (Δ) 1 f f f 2.402 000 GHz 1.000 MHz (Δ) 9.34 dBm 0.03 dB 8.81 dBm F Δ4 F Freq Offset (Δ) 4 5 7 8 9 10 2.403 000 GHz 0 H2 > **I**STATUS

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# **12 NUMBER OF HOPPING FREQUENCY**

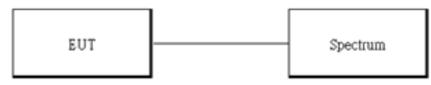
# 12.1 Standard Applicable

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

## **12.2 Measurement Equipment Used**

Conducted Emission Test Site								
EQUIPMENTMFRMODELSERIALTYPENUMBERNUMBER		LAST CAL.	CAL DUE.					
EXA Spectrum An- alyzer	Agilent	N9010A	MY5042019 5	05/02/2019	05/01/2020			
DC Power Supply	Agilent	E3640A	MY5241000 6	12/04/2018	12/03/2019			
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020			

## 12.3 Test Set-up



## **12.4 Measurement Procedure**

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C63.10:2013.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
- 5. Set the spectrum analyzer as RBW=430kHz, VBW=1.5MHz., Detector = Peak
- 6. Max hold, view and count how many channel in the band.

## 12.5 Measurement Result

## Tabular Data of Total Channel Number

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

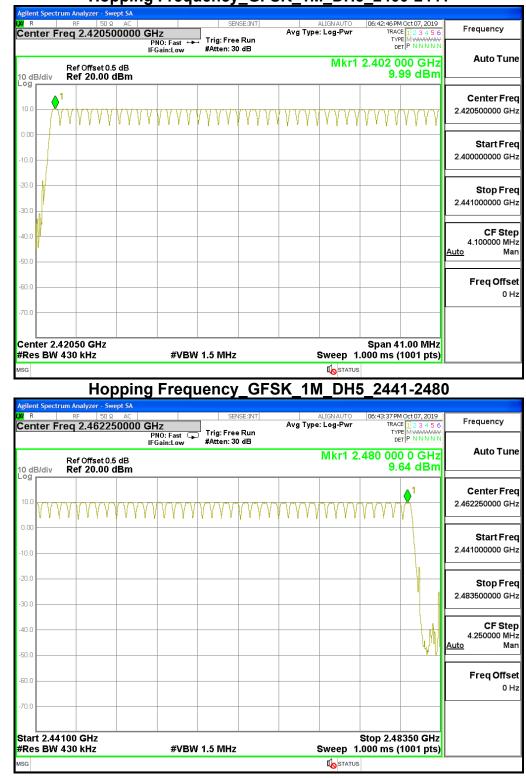
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### **12.6 Channel Number Test Plots**



### Hopping Frequency\_GFSK\_1M\_DH5\_2400-2441



### TIME OF OCCUPANCY (DWELL TIME) 13

# **13.1 Standard Applicable**

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

## 13.2 Measurement Equipment Used

Conducted Emission Test Site							
EQUIPMENT TYPE	MFR	MODEL NUMBER	SERIAL NUMBER	LAST CAL.	CAL DUE.		
EXA Spectrum An- alyzer	Agilent	N9010A	MY5042019 5	05/02/2019	05/01/2020		
DC Power Supply	Agilent	E3640A	MY5241000 6	12/04/2018	12/03/2019		
DC Block	Mini-Circuits	BLK-18-S+	1	01/02/2019	01/01/2020		

## 13.3 Test Set-up



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### **13.4 Measurement Procedure**

- 1. Place the EUT on the table and set it in transmitting mode.
- 2. The testing follows ANSI C6310:2015.
- 3. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
- 4. Set center frequency of spectrum analyzer = operating frequency.

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

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

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

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

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

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

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

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### 13.5 Tabular Result of the Measurement

### **GFSK (1Mbps)**

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	1/T (kHz)	VBW setting (kHz)
	DH1	124.80	400ms	2.56	3.00
Low	DH3	262.40	400ms	0.61	1.00
	DH5	308.80	400ms	0.35	1.00
	DH1	124.80	400ms	2.56	3.00
Mid	DH3	262.40	400ms	0.61	1.00
	DH5	308.80	400ms	0.35	1.00
High	DH1	126.40	400ms	2.53	3.00
	DH3	262.40	400ms	0.61	1.00
	DH5	308.80	400ms	0.00	1.00

### π/4 DQPSK (2Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	1/T (kHz)	VBW setting (kHz)
	2DH1	126.40	400ms	2.53	3.00
Mid	2DH3	262.40	400ms	0.61	1.00
	2DH5	308.80	400ms	0.35	1.00

8-DPSK (3Mbps)

Channel	PACKET TYPE	Measurement Result (ms)	Limit (ms)	1/T (kHz)	VBW setting (kHz)
	3DH1	126.40	400ms	2.53	3.00
Mid	3DH3	264.00	400ms	0.61	1.00
	3DH5	308.80	400ms	0.35	1.00



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

# GFSK (1Mbps):

CH Low	DH1 time slot =	0.390 *	(1600/2/79) *	31.6 =	124.80 (ms)
	DH3 time slot =	1.640 *	(1600/4/79) *	31.6 =	262.40 (ms)
	DH5 time slot =	2.895 *	(1600/6/79) *	31.6 =	308.80 (ms)
CH Mid	DH1 time slot =	0.390 *	(1600/2/79) *	31.6 =	124.80 (ms)
	DH3 time slot =	1.640 *	(1600/4/79) *	31.6 =	262.40 (ms)
	DH5 time slot =	2.895 *	(1600/6/79) *	31.6 =	308.80 (ms)
CH High <b>π/4 -DQPS</b> CH Mid	DH1 time slot = DH3 time slot = DH5 time slot = <b>K (2Mbps):</b> 2DH1 time slot=	0.395 * 1.640 * 2.895 * 0.395 *	(1600/2/79) * (1600/4/79) * (1600/6/79) * (1600/2/79) *	31.6 = 31.6 = 31.6 = 31.6 =	126.40 (ms) 262.40 (ms) 308.80 (ms) 126.40 (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=	0.395 *	(1600/2/79) *	31.6 =	126.40 (ms)
	3DH3 time slot=	1.650 *	(1600/4/79) *	31.6 =	264.00 (ms)
	3DH5 time slot=	2.895 *	(1600/6/79) *	31.6 =	308.80 (ms)



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

## GFSK (1Mbps):

DH5 time sl =	2.895	(ms) <sup>-</sup>	*	(800/6/20)* 8 =	154.40	(ms)
$\pi/4$ -DQPSK (2Mbps						
2DH5 time :=	2.895	(ms) <sup>-</sup>	*	(800/6/20)* 8 =	154.40	(ms)
8-DPSK (3Mbps):						
3DH5 time :=	2.895	(ms) <sup>-</sup>	*	(800/6/20)* 8 =	154.40	(ms)

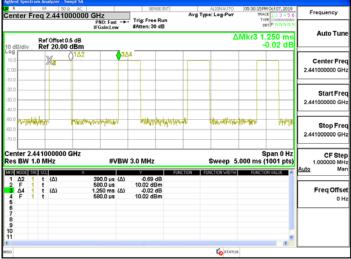
### 13.6 Measurement Result

Note: Refer to next page for plots.

### Dwell Time\_GFSK\_1M\_DH1\_2402MHz

Agilent Spec	trum Analyzer - Swept SA		SE:INT ALIGNAL	TO 05:29:31PM Oct 07, 2019	
	Freq 2.402000000	GHz	Avg Type: Log-F		Frequency
	Ref Offset 0.5 dB	PNO: Fast Trig: Free IFGain:Low #Atten: 30		ΔMkr3 1.250 ms	Auto Tur
0 dB/div 0 g 10.0	Ref 20.00 dBm	∆1∆2 3∆4		-0.02 dB	Center Fre 2.402000000 GH
20.0					Start Fre 2.402000000 GF
50.0 50.0 70.0	tering the second s	agtersonaveran	2403/04444204901	Narpopal Million	Stop Fre 2.402000000 GH
es BW	2.402000000 GHz 1.0 MHz	#VBW 3.0 MHz		Span 0 Hz 5.000 ms (1001 pts)	CF Ste 1.000000 M Auto M
1 Δ2 2 F 3 Δ4 4 F 6 7	Tric SGL ×   1 t (Δ)   1 t 1   1 t (Δ)   1 t (Δ)	390.0 μs (Δ) -0.54 d 1.016 ms 10.24 dB 1.250 ms (Δ) -0.02 d 1.016 ms 10.24 dB	im iB	DTH FUNCTION VALUE A	Freq Offs 01
8 9 10					

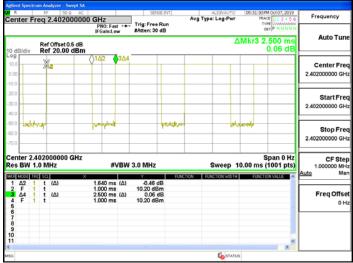
# Dwell Time GFSK 1M DH1 2441MHz



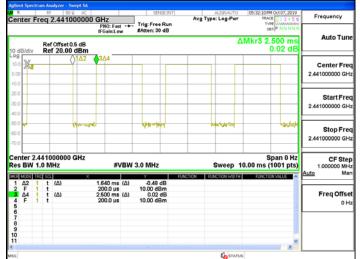
### Dwell Time GFSK 1M DH1 2480MHz

	RF 50.9 AC		SENSE:INT	ALISNAUTO	05:50:44 PM Oct 07, 2019	Frequency
nter F	req 2.48000000	GHz	Trig: Free Run	Avg Type: Log-Pwr	TRACE 1 2 3 4 5 6	Frequency
		PNO: Fast IFGain:Low	#Atten: 30 dB		DETPNNNN	
	Ref Offset 0.5 dB			Δ	Mkr3 1.250 ms	Auto Tur
0 dB/div	Ref 20.00 dBm				-0.32 dB	
0.0		1∆2	2			
		·· · V	3∆4	7		Center Fre
1.00	×	2	- T			2.48000000 GH
10.0						
20.0						Start Fre
30.0						2.48000000 GH
40.0						
50.0	harvatahangagagaat	- HATE	1000 WWW MICH	proprint free to	-Alternation Mathematical	
60.0	the second second second		die weerstelden	out to sole 1	for the second second	Stop Fre
						2.480000000 GH
70.0						
enter 2.	480000000 GHz	#1/6	W 2 0 MHz	Swaan 6	Span 0 Hz	CF Ste
Center 2. Res BW 1	1.0 MHz	#VE	SW 3.0 MHz		.000 ms (1001 pts)	CF Ste 1.000000 MH
Center 2. Res BW 1	1.0 MHz		Y	Sweep 5.	000 ms (1001 pts)	CF Ste 1.000000 MH
Center 2. tes BW 1 1 Δ2 1 2 F	1.0 MHz	395.0 µs (/	Δ) 6.72 dB -2.02 dBm		.000 ms (1001 pts)	CF Ste 1.000000 Mł <u>Auto</u> Mł
Center 2. tes BW 1 1 Δ2 1 2 F	1.0 MHz	395.0 µs (/ 1.245 ms 1.250 ms (/	Δ) 6.72 dB -2.02 dBm Δ) -0.32 dB		.000 ms (1001 pts)	CF Ste 1.000000 Mi Auto Mi Freq Offs
Center 2. Res BW 1 1 A2 1 2 F 1 3 A4 1 4 F 1 5	1.0 MHz	395.0 µs (/	Δ) 6.72 dB -2.02 dBm		.000 ms (1001 pts)	CF Ste 1.000000 Mi Auto Mi Freq Offs
Center 2. Ces BW 1 1 Δ2 1 2 F 1 3 Δ4 1 4 F 1 6 7	1.0 MHz	395.0 µs (/ 1.245 ms 1.250 ms (/	Δ) 6.72 dB -2.02 dBm Δ) -0.32 dB		.000 ms (1001 pts)	CF Ste 1.000000 Mi Auto Mi Freq Offs
Center 2. Ces BW 1 1 Δ2 1 2 F 1 3 Δ4 1 4 F 1 6 7	1.0 MHz	395.0 µs (/ 1.245 ms 1.250 ms (/	Δ) 6.72 dB -2.02 dBm Δ) -0.32 dB		.000 ms (1001 pts)	CF Ste 1.000000 Mi Auto Mi Freq Offs
Center 2, 2 es BW 1 1 Δ2 1 2 F 1 3 Δ4 1 4 F 1 6 7 8 9	1.0 MHz	395.0 µs (/ 1.245 ms 1.250 ms (/	Δ) 6.72 dB -2.02 dBm Δ) -0.32 dB		.000 ms (1001 pts)	CF Ste 1.000000 Mi Auto Mi Freq Offs
center 2, ces BW 1 1 Δ2 1 2 F 1 3 Δ4 1 4 F 1 6	1.0 MHz 1.0 MHz 1.0 X	395.0 µs (/ 1.245 ms 1.250 ms (/	Δ) 6.72 dB -2.02 dBm Δ) -0.32 dB		.000 ms (1001 pts)	CF Ste 1.000000 MH

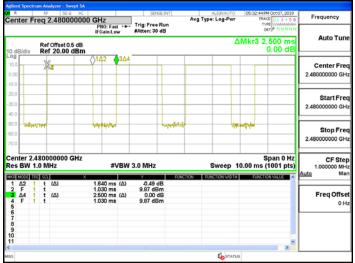
### Dwell Time\_GFSK\_1M\_DH3\_2402MHz



### Dwell Time GFSK 1M DH3 2441MHz



### Dwell Time GFSK 1M DH3 2480MHz



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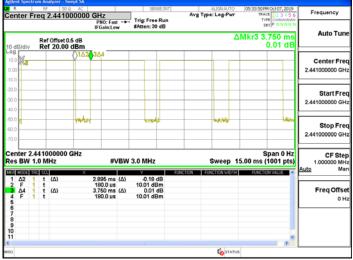
www.tw.sgs.com



### Dwell Time\_GFSK\_1M\_DH5\_2402MHz

gilent Spectrum Analyzer - Swe R RF S0 Q					
enter Freq 2.40200	0000 GHz	SENSE:INT A	vg Type: Log-Pwr TR	PM Oct 07, 2019 ACT 12 3 4 5 6 Frequencies	lency
		en: 30 dB		DETPNNNNN	ito Tur
0 dB/div Ref 20.00 d				3.750 ms AL -0.01 dB	
0g 10.0	∆1∆203∆4			Cer	nter Fre
0.00				2.40200	0000 Gł
20.0					
0.0				2.40200	tart Fr 0000 G
0.0		all the set			
0.0 •••••	of the	*climon	www.		top Fr
0.0				2.40200	0000 G
enter 2.402000000 G	Hz #VBW 3.0 I	/W2	Sweep 15.00 ms	Span 0 Hz	CF Ste 0000 M
KR MODE TRC SCL	X	FUNCTION	•	Auto Auto	0000 M
1 Δ2 1 t (Δ) 2 F 1 t	1.125 ms 10.	0.51 dB 21 dBm			eq Offs
3 Δ4 1 t (Δ) 4 F 1 t		0.01 dB 21 dBm		Fre	0110
6 7					
8 9 10					
1					
a			<b>STATUS</b>		

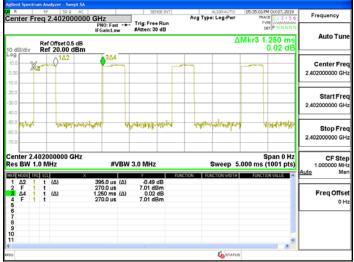
# Dwell Time GFSK 1M DH5 2441MHz



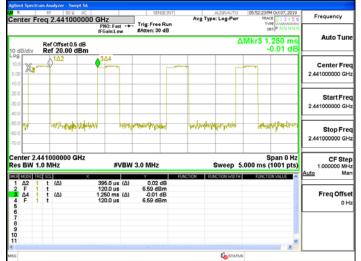
### Dwell Time GFSK 1M DH5 2480MHz

gilent Spectrum Analyzer - Swept SA				
R RF 50 R AC	SENSE:	ALIGNAUTO Avg Type: Log-Pwr		Frequency
Ref Offset 0.5 dB	PN0: Fast Trig: Free Ro IFGain:Low #Atten: 30 dl		ΔMkr3 3.750 ms -0.02 dB	Auto Tun
	162324			Center Fre 2.480000000 GH
20.0 30.0 40.0				Start Fre 2.480000000 GH
50.0 (Yeekso) 60.0 70.0	and trap	iva) kutu	**	Stop Fre 2.48000000 GF
Center 2.480000000 GHz Res BW 1.0 MHz	#VBW 3.0 MHz	Sweep	Span 0 Hz 15.00 ms (1001 pts)	CF Ste 1.000000 Mi Auto Mi
$\begin{array}{c} 1 & \Delta 2 & 1 \\ 2 & F & 1 & t & (\Delta) \\ 4 & F & 1 & t & (\Delta) \\ 4 & F & 1 & t & (\Delta) \\ 5 & 0 & 0 & 0 \\ 7 & 0 & 0 & 0 \\ 7 & 0 & 0 & 0 \\ 10 & 0 & 0 & 0 \\ 11 & 0 & 0 & 0 \\ 11 & 0 & 0 & 0 \\ 11 & 0 & 0 & 0 \\ 11 & 0 & 0 & 0 \\ 12 & 0 $	2.895 ms (Δ) 0.20 dB 870.0 μs 9.90 dBm 3.750 ms (Δ) 0.02 dB 870.0 μs 9.90 dBm			Freq Offs 0 H
80		() STAT		

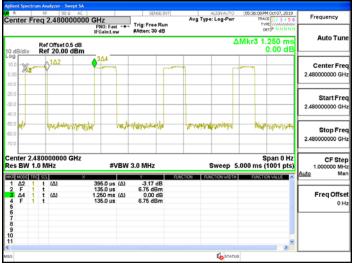
### Dwell Time\_π/4DQPSK\_2M\_DH1\_2402MHz



### Dwell Time π/4DQPSK 2M DH1 2441MHz



### Dwell Time $\pi/4DQPSK$ 2M DH1 2480MHz



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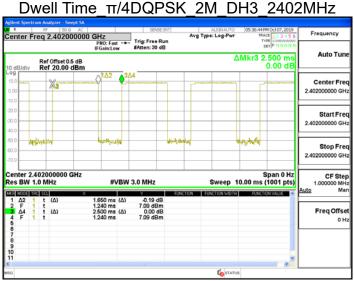
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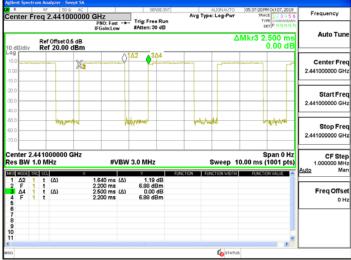
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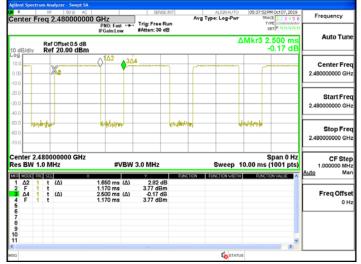
# SGS



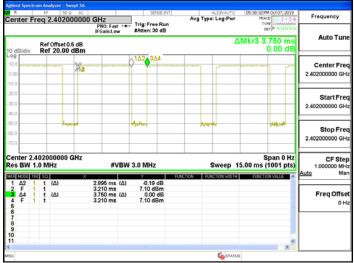
# Dwell Time π/4DQPSK 2M DH3 2441MHz



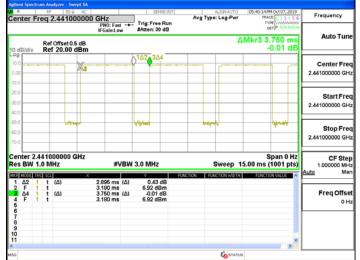
### Dwell Time π/4DQPSK 2M DH3 2480MHz



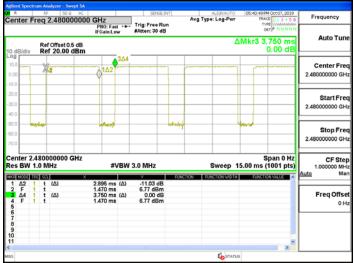
## Dwell Time\_π/4DQPSK\_2M\_DH5\_2402MHz



### Dwell Time π/4DQPSK 2M DH5 2441MHz



### Dwell Time π/4DQPSK 2M DH5 2480MHz



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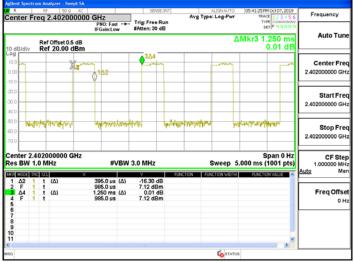
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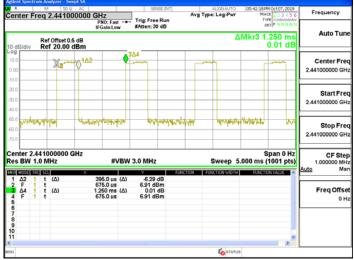
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# Dwell Time\_8DPSK\_3M\_DH1\_2402MHz

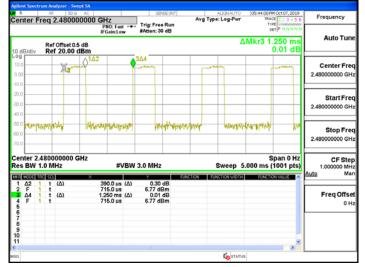
SG



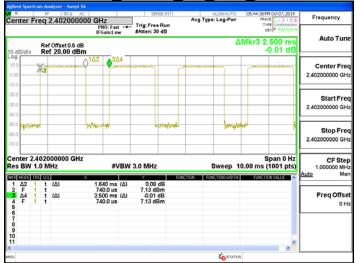
### Dwell Time 8DPSK 3M DH1 2441MHz



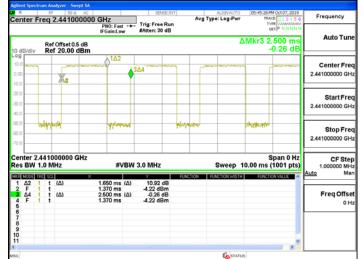
Dwell Time 8DPSK 3M DH1 2480MHz



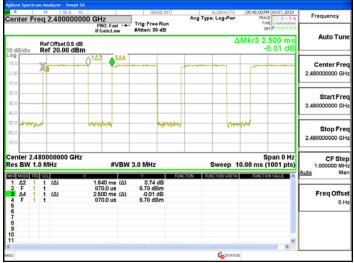
### Dwell Time\_8DPSK\_3M\_DH3\_2402MHz



### Dwell Time 8DPSK 3M DH3 2441MHz



### Dwell Time 8DPSK 3M DH3 2480MHz



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### Dwell Time\_8DPSK\_3M\_DH5\_2402MHz

Agilent Spectrum Analyzer -					
Center Freq 2.402		SENSE:INT	AUGNAUTO Avg Type: Log-Pwr	05:48:13 PM Oct 07, 2019 TRACE 1 2 3 4 5 6 Type	Frequency
Ref Offset	0.5 dB	Trig: Free Run #Atten: 30 dB	Δ	Mkr3 3.750 ms	Auto Tune
10 dB/div Ref 20.0	0 dBm 3Δ4 1Δ2	······		-0.03 dB	Center Free 2.402000000 GH:
-10.0					Start Free 2.402000000 GH
-50.0 <b>477,447</b> -60.0 -70.0	- Lagd gad	Horden	wayed.		Stop Free 2.402000000 GH
Center 2.40200000 Res BW 1.0 MHz	0 GHz #VBW 3	3.0 MHz		Span 0 Hz 5.00 ms (1001 pts)	CF Step 1.000000 MH Auto Ma
1 Δ2 1 t (Δ) 2 F 1 t 3 Δ4 1 t (Δ) 4 F 1 t 5 6 7 8	2.895 ms (Δ) 865.0 μs 3.750 ms (Δ) 855.0 μs	-12.33 dB 7.13 dBm -0.03 dB 7.13 dBm			Freq Offse 0 H:
9 10 11 <		at a second s	Co STATUS	,*	

# Dwell Time 8DPSK 3M DH5 2441MHz

enter Freq 2.4410	00000 GHz PNO: Fast	Trig: Free Run	Avg Type: Log-Pwr	TRACE 123456 TYPE WWWWWW	Frequency
Ref Offset 0.	IFGain:Low	#Atten: 30 dB	ΔΜ	kr3 3.750 ms 0.00 dB	Auto Tune
00 10.0	×a	162,364			Center Fre 2.441000000 GH
0.0					Start Fre 2.441000000 GH
0.0		Ashiro -		JU.A.	Stop Fre 2.441000000 GH
enter 2.441000000 es BW 1.0 MHz		W 3.0 MHz	Sweep 15.0	Span 0 Hz 10 ms (1001 pts)	CF Ste 1.000000 MH Auto Ma
$1 \Delta 2 1 t (\Delta)$ $2 F 1 t (\Delta)$ $2 A 4 1 t (\Delta)$ $4 F 1 t (\Delta)$ 6 7 7 8 9 0	2.895 ms (, 3.720 ms 3.750 ms (, 3.720 ms	4) -0.03 dB 6.93 dBm			Freq Offse 0 H
8 9 0 1				*	

### Dwell Time 8DPSK 3M DH5 2480MHz

Frequency	TRACE 1 2 3 4 5 6 TYPE		e: Log-Pwr	Avg	SENSE INT		GHz PNO: Fast	° AC 000000		eq 2	er Fr	R nt
Auto Tu	0er PNNNNN 3 3.750 ms 0.00 dB	۵Mkr	4		Atten: 30 dB		IFGain:Lov		Offset		div	dB
Center Fr 2.480000000 G				-	<u>1∆2_3∆4</u>	-		*		-		9 0.0 .00
Start Fr 2.480000000 G						_						1.0
Stop Fr 2.480000000 G	ورەينىپا		al years			-		7.4.A.		+		1.0 1.0 1.0
CF St 1.000000 N Auto M	Span 0 Hz ns (1001 pts)		Sweep 1	INCTION	.0 MHz	BW :	#V	GHz		0 M	r 2.4 W 1.	es l
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# **14 ANTENNA REQUIREMENT**

### 14.1 Standard Applicable

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device. If the transmitting antenna is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi.

## 14.2 Antenna Connected Construction

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

~ End of Report ~

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. 除非另有說明,此報告結果僅對測試之樣品負責,同時此樣品僅保留90天。本報告未經本公司書面許可,不可部份復製。 This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <u>www.sgs.com/terms and conditions.htm</u> and, for elec-tronic format documents, subject to Terms and Conditions for Electronic Documents at <u>www.sgs.com/terms e-document.htm</u>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law