

# FCC Test Report

Product Name	Light Guided Operations
Model No.	GWS-GWCT
FCC ID.	WL6GWS-GWCT

Applicant	ELITEGROUP COMPUTER SYSTEMS CO., LTD.
Address	No.239, SEC. 2, TI DING BLVD, TAIPEI 11493, TAIWAN

Date of Receipt	Apr. 03, 2018
Issued Date	June 12, 2018
Report No.	1840026R-RFUSP24V00
Report Version	V1.0



The test results relate only to the samples tested.

The test results shown in the test report are traceable to the national/international standard through the calibration report of the equipment and evaluated measurement uncertainty herein.

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# Test Report

Issued Date: June 12, 2018

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Product Name	Light Guided Operations
Applicant	ELITEGROUP COMPUTER SYSTEMS CO., LTD.
Address	No.239, SEC. 2, TI DING BLVD, TAIPEI 11493, TAIWAN
Manufacturer	Golden Elite Technology (SHENZHEN) CO., LTD.
Model No.	GWS-GWCT
FCC ID.	WL6GWS-GWCT
EUT Rated Voltage	DC 3.7V (Power by Battery)
EUT Test Voltage	DC 3.7V (Power by Battery)
Trade Name	ECS
Applicable Standard	FCC CFR Title 47 Part 15 Subpart C: 2017 ANSI C63.4: 2014, ANSI C63.10: 2013 KDB 558074 D01 DTS Meas Guidance v04
Test Result	Complied

Documented By

:



( Senior Adm. Specialist / Joanne Lin )

Tested By

:



( Engineer / Nova Chu )

Approved By

:



( Director / Vincent Lin )

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**1. GENERAL INFORMATION**

**1.1. EUT Description**

Product Name	Light Guided Operations
Trade Name	ECS
Model No.	GWS-GWCT
FCC ID.	WL6GWS-GWCT
Frequency Range	2405-2480MHz
Channel Number	16CH
Type of Modulation	GFSK
Antenna Type	Chip Antenna
Channel Control	Auto
Antenna Gain	Refer to the table “Antenna List”

**Antenna List**

No.	Manufacturer	Part No.	Antenna Type	Peak Gain
1	pulse LARSEN	W3008GI	Chip Antenna	1dBi

Note: The antenna of EUT is conforming to FCC 15.203.

**Center Frequency of Each Channel:**

Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 01	2405	Channel 05	2425	Channel 09	2445	Channel 13	2465
Channel 02	2410	Channel 06	2430	Channel 10	2450	Channel 14	2470
Channel 03	2415	Channel 07	2435	Channel 11	2455	Channel 15	2475
Channel 04	2420	Channel 08	2440	Channel 12	2460	Channel 16	2480

Note:

1. The EUT is a Light Guided Operations with a built-in 2.4GHz transmitter.
2. These tests were conducted on a sample for the purpose of demonstrating compliance of 2.4GHz transmitter with Part 15 Subpart C Paragraph 15.247 for spread spectrum devices.
3. Regarding to the operation frequency, the lowest, middle and highest frequency are selected to perform the test.

Test Mode	Mode 1: Transmit
-----------	------------------

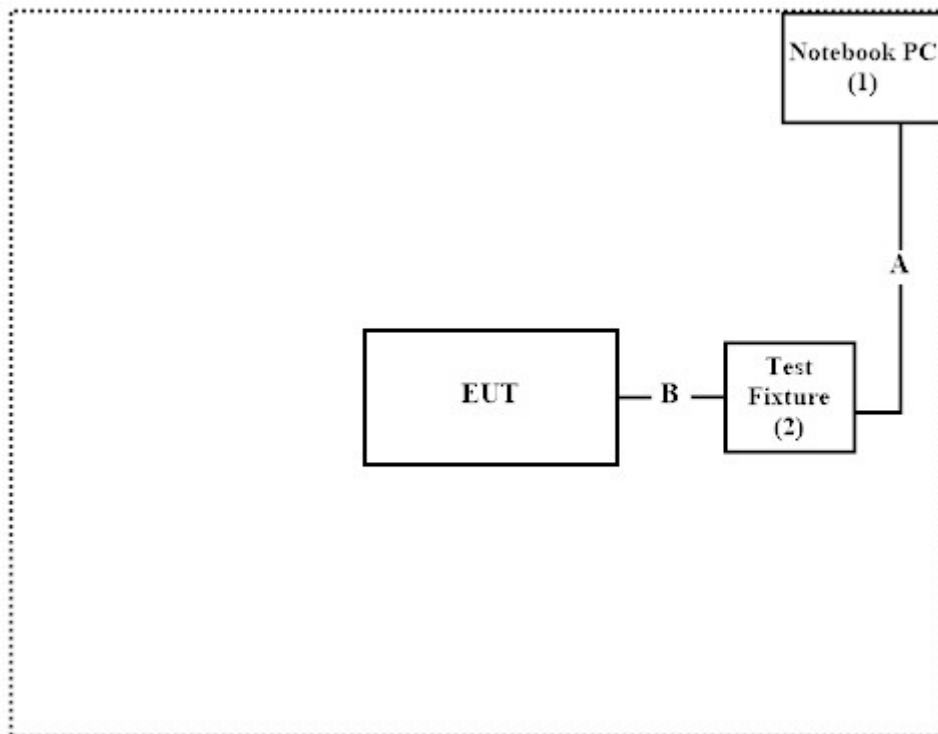
### 1.3. Tested System Details

The types for all equipment, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	Power Cord	
1	Notebook PC	DELL	Inspiron 15 3000	GT5JPJ2	N/A
2	Test Fixture	ECS	N/A	N/A	N/A

Signal Cable Type	Signal cable Description
A	USB Cable
	Non-Shielded, 1.8m

### 1.4. Configuration of Tested System



### 1.5. EUT Exercise Software

- (1) Setup the EUT as shown in Section 1.4.
- (2) Execute “WTcdb v1.0.0.1” on the Notebook.
- (3) Configure the test mode, the test channel.
- (4) Start the continuous Transmit.
- (5) Verify that the EUT works properly.

## 1.6. Test Facility

Ambient conditions in the laboratory:

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	20-35
Humidity (%RH)	25-75	50-65
Barometric pressure (mbar)	860-1060	950-1000

The related certificate for our laboratories about the test site and management system can be downloaded from DEKRA Testing and Certification Co., Ltd. Web Site:

<http://www.dekra.com.tw/english/about/certificates.aspx?bval=5>

The address and introduction of DEKRA Testing and Certification Co., Ltd. laboratories can be founded in our Web site: [http://www.dekra.com.tw/index\\_en](http://www.dekra.com.tw/index_en)

Site Description: Accredited by TAF  
Accredited Number: 3023

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FCC Accreditation Number: TW3023

## 1.7. List of Test Equipment

### For Conduction measurements /ASR1

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
X	EMI Test Receiver	R&S	ESR7	101601	2018.02.08	2019.02.07
X	Two-Line V-Network	R&S	ENV216	101306	2018.03.09	2019.03.08
X	Two-Line V-Network	R&S	ENV216	101307	2018.03.20	2019.03.19
X	Coaxial Cable	Quietek	RG400_BNC	RF001	2018.05.24	2019.05.23

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : QuieTek EMI 2.0 V2.1.113

### For Conducted measurements /ASR4

	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
X	Spectrum Analyzer	R&S	FSV30	103464	2018.01.23	2019.01.22
X	Power Meter	Anritsu	ML2496A	1548003	2017.12.11	2018.12.10
X	Power Sensor	Anritsu	MA2411B	1531024	2017.12.11	2018.12.10
X	Power Sensor	Anritsu	MA2411B	1531025	2017.12.11	2018.12.10
	Bluetooth Tester	R&S	CBT	101238	2018.01.18	2019.01.17

Note:

1. All equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : QuieTek Conduction Test System V8.0.110

### For Radiated measurements /ACB1

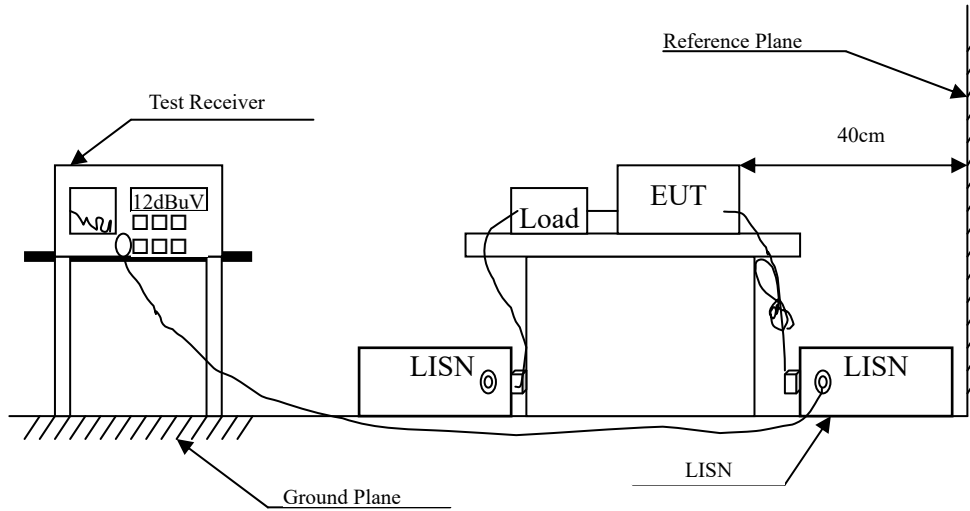
	Equipment	Manufacturer	Model No.	Serial No.	Cali. Data	Due. Data
X	Loop Antenna	AMETEK	HLA6121	49611	2018.01.26	2019.01.25
X	Bi-Log Antenna	SCHWARZBECK	VULB9168	9168-674	2018.04.02	2019.04.01
X	Horn Antenna	ETS-Lindgren	3117	00203800	2017.11.10	2018.11.09
X	Horn Antenna	Com-Power	AH-840	101087	2018.06.01	2019.05.31
X	Pre-Amplifier	EMCI	EMC001330	980316	2018.06.01	2019.05.31
X	Pre-Amplifier	EMCI	EMC051835SE	980311	2018.06.04	2019.06.03
X	Pre-Amplifier	EMCI	EMC05820SE	980310	2018.06.04	2019.06.03
X	Pre-Amplifier	EMCI	EMC184045SE	980314	2018.05.16	2019.05.15
	Filter	MICRO TRONICS	BRM50702	G251	2017.08.30	2018.08.29
	Filter	MICRO TRONICS	BRM50716	G188	2017.08.30	2018.08.29
X	EMI Test Receiver	R&S	ESR7	101602	2017.12.11	2018.12.10
X	Spectrum Analyzer	R&S	FSV40	101148	2018.02.08	2019.02.07
X	Coaxial Cable	SUHNER	SUCOFLEX 106	RF002	2018.05.25	2019.05.24
X	Mircoflex Cable	HUBER SUHNER	SUCOFLEX 102	MY3381/2	2017.08.11	2018.08.10

Note:

1. Loop Antenna is calibrated every two year, the other equipments are calibrated every one year.
2. The test instruments marked with "X" are used to measure the final test results.
3. Test Software version : QuieTek EMI 2.0 V2.1.113

## 2. Conducted Emission

### 2.1. Test Setup



### 2.2. Limits

FCC Part 15 Subpart C Paragraph 15.207 (dB $\mu$ V) Limit		
Frequency MHz	Limits	
	QP	AV
0.15 - 0.50	66-56	56-46
0.50-5.0	56	46
5.0 - 30	60	50

Remarks: In the above table, the tighter limit applies at the band edges.



### 2.3. Test Procedure

The EUT and Peripherals are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all the interface cables must be changed according to ANSI C63.4: 2014 on conducted measurement.

Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9kHz.

The EUT was setup to ANSI C63.4, 2014; tested to DTS test procedure of FCC KDB-558074 for compliance to FCC 47CFR Subpart C requirements.

### 2.4. Uncertainty

±2.35dB

## 2.5. Test Result of Conducted Emission

Product : Light Guided Operations  
 Test Item : Conducted Emission Test  
 Power Line : Line 1  
 Test Date : 2018/06/01  
 Test Mode : Mode 1: Transmit (2440MHz)

Frequency MHz	Correct Factor dB	Reading Level dB $\mu$ V	Measurement Level dB $\mu$ V	Margin dB	Limit dB $\mu$ V
<b>LINE 1</b>					
<b>Quasi-Peak</b>					
0.157	9.560	36.535	46.095	-19.705	65.800
0.377	9.572	33.745	43.317	-16.197	59.514
0.695	9.580	21.929	31.509	-24.491	56.000
2.279	9.583	28.792	38.375	-17.625	56.000
9.681	9.648	18.272	27.920	-32.080	60.000
24.576	9.690	14.759	24.449	-35.551	60.000
<b>Average</b>					
0.157	9.560	35.285	44.846	-10.954	55.800
0.377	9.572	21.605	31.177	-18.337	49.514
0.695	9.580	16.993	26.573	-19.427	46.000
2.279	9.583	21.320	30.903	-15.097	46.000
9.681	9.648	14.205	23.853	-26.147	50.000
24.576	9.690	14.336	24.026	-25.974	50.000

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " " means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Product : Light Guided Operations  
 Test Item : Conducted Emission Test  
 Power Line : Line 2  
 Test Date : 2018/06/01  
 Test Mode : Mode 1: Transmit (2440MHz)

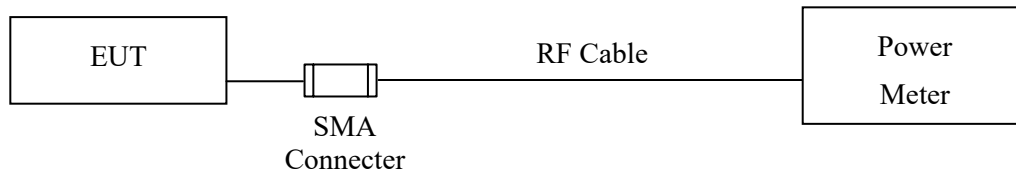
Frequency MHz	Correct Factor dB	Reading Level dB $\mu$ V	Measurement Level dB $\mu$ V	Margin dB	Limit dB $\mu$ V
<b>LINE 2</b>					
<b>Quasi-Peak</b>					
0.152	10.671	36.514	47.185	-18.758	65.943
0.375	9.849	32.673	42.522	-17.049	59.571
0.695	9.819	21.906	31.725	-24.275	56.000
2.281	9.711	28.545	38.256	-17.744	56.000
9.886	9.679	12.525	22.204	-37.796	60.000
23.991	9.786	0.279	10.065	-49.935	60.000
<b>Average</b>					
0.152	10.671	23.846	34.517	-21.426	55.943
0.375	9.849	20.961	30.810	-18.761	49.571
0.695	9.819	17.095	26.914	-19.086	46.000
2.281	9.711	21.033	30.744	-15.256	46.000
9.886	9.679	8.513	18.192	-31.808	50.000
23.991	9.786	-2.165	7.621	-42.379	50.000

## Note:

1. All Reading Levels are Quasi-Peak and average value.
2. "█" means the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

### 3. Peak Power Output

#### 3.1. Test Setup



#### 3.2. Limit

The maximum peak power shall be less 1Watt.

#### 3.3. Test Procedure

Tested according to DTS test procedure of KDB 558074 for compliance to FCC 47CFR 15.247 requirements. The maximum peak conducted output power using KDB 558074 section 9.1.3 PKPM1 Peak power meter method.

#### 3.4. Uncertainty

$\pm 0.86$  dB

### 3.5. Test Result of Peak Power Output

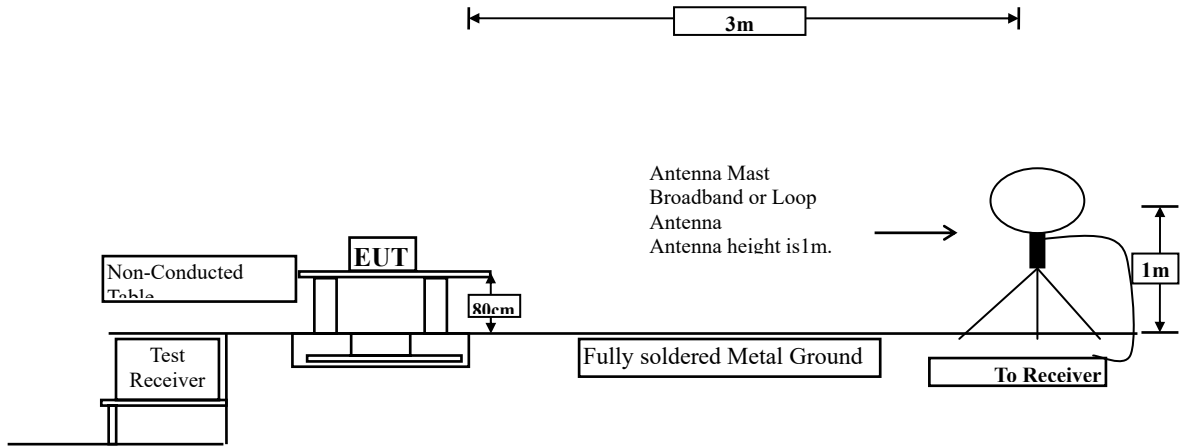
Product : Light Guided Operations  
Test Item : Peak Power Output  
Test Mode : Mode 1: Transmit  
Test Date : 2018/06/01

Channel No.	Frequency (MHz)	Measurement (dBm)		Required Limit	Result
		Average	Peak		
01	2405	5.01	5.16	1 Watt= 30 dBm	Pass
18	2440	4.95	5.02	1 Watt= 30 dBm	Pass
16	2480	4.68	4.75	1 Watt= 30 dBm	Pass

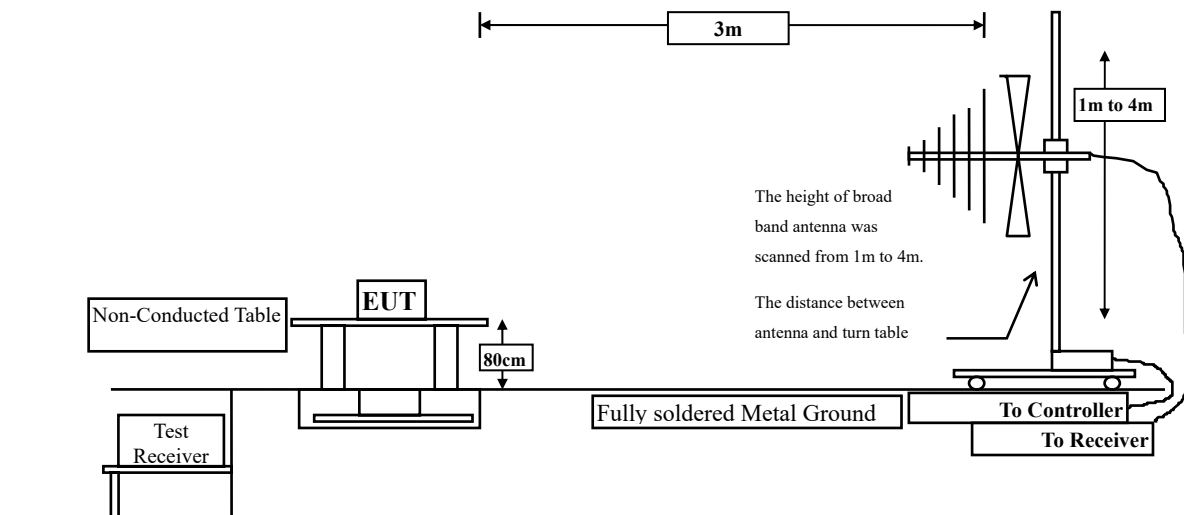
## 4. Radiated Emission

### 4.1. Test Setup

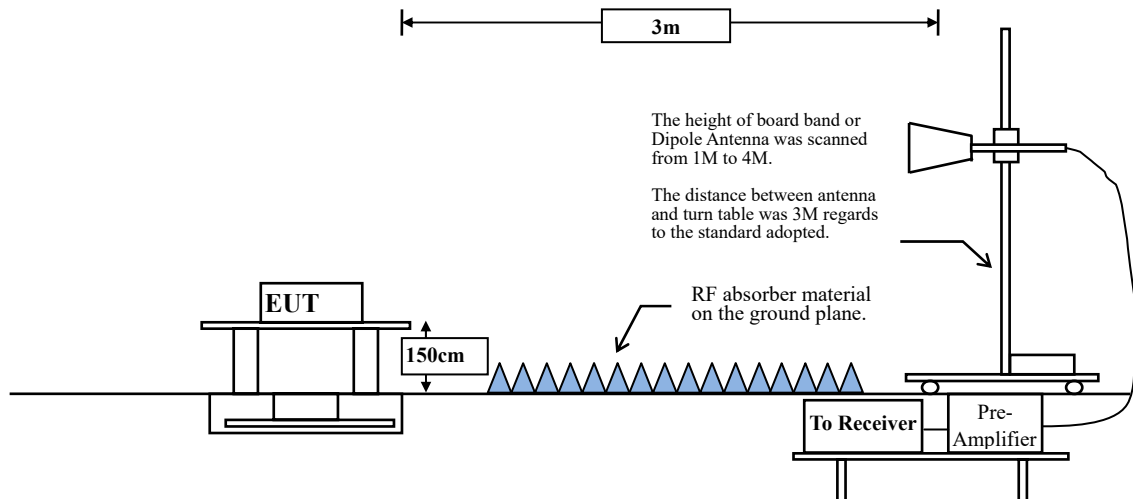
Radiated Emission Under 30MHz



Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



## 4.2. Limits

### ➤ General Radiated Emission Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

<b>FCC Part 15 Subpart C Paragraph 15.209 Limits</b>		
Frequency MHz	Field strength (microvolts/meter)	Measurement distance (meter)
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

- Remarks:
1. RF Voltage (dB $\mu$ V) = 20 log RF Voltage (uV)
  2. In the Above Table, the tighter limit applies at the band edges.
  3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

### 4.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013 and tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Measuring the frequency range below 1GHz, the EUT is placed on a turn table which is 0.8 meter above ground, when measuring the frequency range above 1GHz, the EUT is placed on a turn table which is 1.5 meter above ground.

The turn table is rotated 360 degrees to determine the position of the maximum emission level.

The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned between 1 meter and 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10: 2013 on radiated measurement.

The resolution bandwidth below 30MHz setting on the field strength meter is 9kHz and 30MHz~1GHz is 120kHz and above 1GHz is 1MHz.

Radiated emission measurements below 30MHz are made using Loop Antenna and 30MHz~1GHz are made using broadband Bilog antenna and above 1GHz are made using Horn Antennas.

The measurement is divided into the Preliminary Measurement and the Final Measurement.

The suspected frequencies are searched for in Preliminary Measurement with the measurement antenna kept pointed at the source of the emission both in azimuth and elevation, with the polarization of the antenna oriented for maximum response. The antenna is pointed at an angle towards the source of the emission, and the EUT is rotated in both height and polarization to maximize the measured emission. The emission is kept within the illumination area of the 3 dB bandwidth of the antenna. The measurement frequency range from 9kHz - 10th Harmonic of fundamental was investigated.



### RBW and VBW Parameter setting:

According to KDB 558074 section 12.2.4. Peak power measurement procedure

RBW = as specified in Table 1.

$VBW \geq 3 \times RBW$ .

**Table 1 —RBW as a function of frequency**

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

According to KDB 558074 section 12.2.5. Average power measurement procedure

RBW = 1MHz.

VBW = 10Hz, when duty cycle  $\geq 98\%$

$VBW \geq 1/T$ , when duty cycle  $< 98\%$

( T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
GFSK	100.00	1.0000	1000	10

Note: Duty Cycle Refer to Section 9

## 4.4. Uncertainty

Horizontal polarization :

30-300MHz:  $\pm 4.08$ dB ; 300M-1GHz:  $\pm 3.86$ dB ; 1-18GHz:  $\pm 3.77$ dB ; 18-40GHz:  $\pm 3.98$ dB

Vertical polarization :

30-300MHz:  $\pm 4.81$ dB ; 300M-1GHz:  $\pm 3.87$ dB ; 1-18GHz :  $\pm 3.83$ dB ; 18-40GHz:  $\pm 3.98$ dB

#### 4.5. Test Result of Radiated Emission

Product : Light Guided Operations  
 Test Item : Harmonic Radiated Emission  
 Test Mode : Mode 1: Transmit (2405MHz)  
 Test Date : 2018/05/25

Frequency MHz	Correct Factor dB	Reading Level dB $\mu$ V	Measurement Level dB $\mu$ V/m	Margin dB	Limit dB $\mu$ V/m
<b>Horizontal</b>					
<b>Peak Detector:</b>					
4810.000	-6.116	53.510	47.394	-26.606	74.000
7215.000	-3.103	50.290	47.187	-26.813	74.000
9620.000	-0.709	47.560	46.851	-27.149	74.000
<b>Average Detector:</b>					
--					54.000
<b>Vertical</b>					
<b>Peak Detector:</b>					
4810.000	-6.116	54.450	48.334	-25.666	74.000
7215.000	-3.103	52.080	48.977	-25.023	74.000
9620.000	-0.709	49.530	48.821	-25.179	74.000
<b>Average Detector:</b>					
--					54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Light Guided Operations  
 Test Item : Harmonic Radiated Emission  
 Test Mode : Mode 1: Transmit (2440MHz)  
 Test Date : 2018/05/25

Frequency MHz	Correct Factor dB	Reading Level dB $\mu$ V	Measurement Level dB $\mu$ V/m	Margin dB	Limit dB $\mu$ V/m
<b>Horizontal</b>					
<b>Peak Detector:</b>					
4880.000	-6.069	52.650	46.581	-27.419	74.000
7320.000	-3.027	48.600	45.573	-28.427	74.000
9760.000	-0.527	47.290	46.762	-27.238	74.000
<b>Average Detector:</b>					
--					54.000
<b>Vertical</b>					
<b>Peak Detector:</b>					
4880.000	-6.069	53.440	47.371	-26.629	74.000
7320.000	-3.027	51.040	48.013	-25.987	74.000
9760.000	-0.527	49.520	48.992	-25.008	74.000
<b>Average Detector:</b>					
--					54.000

## Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Light Guided Operations  
 Test Item : Harmonic Radiated Emission  
 Test Mode : Mode 1: Transmit (2480MHz)  
 Test Date : 2018/05/25

Frequency MHz	Correct Factor dB	Reading Level dB $\mu$ V	Measurement Level dB $\mu$ V/m	Margin dB	Limit dB $\mu$ V/m
<b>Horizontal</b>					
<b>Peak Detector:</b>					
4960.000	-6.055	52.410	46.355	-27.645	74.000
7440.000	-2.861	47.340	44.478	-29.522	74.000
9920.000	-0.306	46.190	45.884	-28.116	74.000
<b>Average Detector:</b>					
--					54.000
<b>Vertical</b>					
<b>Peak Detector:</b>					
4960.000	-6.055	52.730	46.675	-27.325	74.000
7440.000	-2.861	48.440	45.578	-28.422	74.000
9920.000	-0.306	47.310	47.004	-26.996	74.000
<b>Average Detector:</b>					
--					54.000

Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The average measurement was not performed when the peak measured data under the limit of average detection.
5. The emission levels of other frequencies are very lower than the limit and not show in test report.

Product : Light Guided Operations  
 Test Item : General Radiated Emission  
 Test Mode : Mode 1: Transmit (2440MHz)  
 Test Date : 2018/05/24

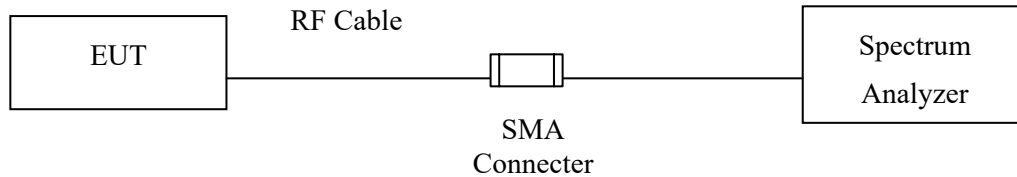
Frequency MHz	Correct Factor dB	Reading Level dB $\mu$ V	Measurement Level dB $\mu$ V/m	Margin dB	Limit dB $\mu$ V/m
<b>Horizontal</b>					
79.470	-15.522	43.410	27.887	-12.113	40.000
191.990	-13.662	52.833	39.171	-4.329	43.500
331.670	-9.630	40.373	30.743	-15.257	46.000
576.110	-4.619	33.595	28.976	-17.024	46.000
832.190	-1.234	33.467	32.233	-13.767	46.000
998.060	0.842	34.326	35.168	-18.832	54.000
<b>Vertical</b>					
30.000	-12.250	49.869	37.619	-2.381	40.000
191.990	-13.662	49.336	35.674	-7.826	43.500
332.640	-9.608	38.997	29.389	-16.611	46.000
532.460	-5.516	38.304	32.788	-13.212	46.000
830.250	-1.263	34.033	32.770	-13.230	46.000
999.030	0.854	35.081	35.935	-18.065	54.000

## Note:

1. All Readings below 1GHz are Quasi-Peak, above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. Correct Factor = Antenna factor + Cable loss – Amplifier gain.
4. The emission levels of other frequencies are very lower than the limit and not show in test report.
5. No emission found between lowest internal used/generated frequency to 30MHz.

## 5. RF Antenna Conducted Test

### 5.1. Test Setup



### 5.2. Limits

According to FCC Section 15.247(d). 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 measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

### 5.3. Test Procedure

The EUT was tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 100 kHz, Set VBW > RBW, scan up through 10th harmonic.

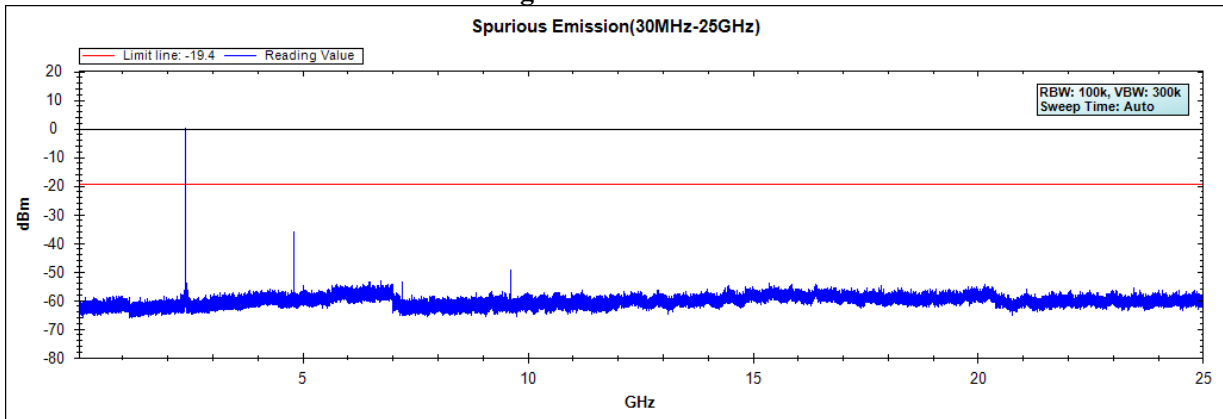
### 5.4. Uncertainty

±1.23dB

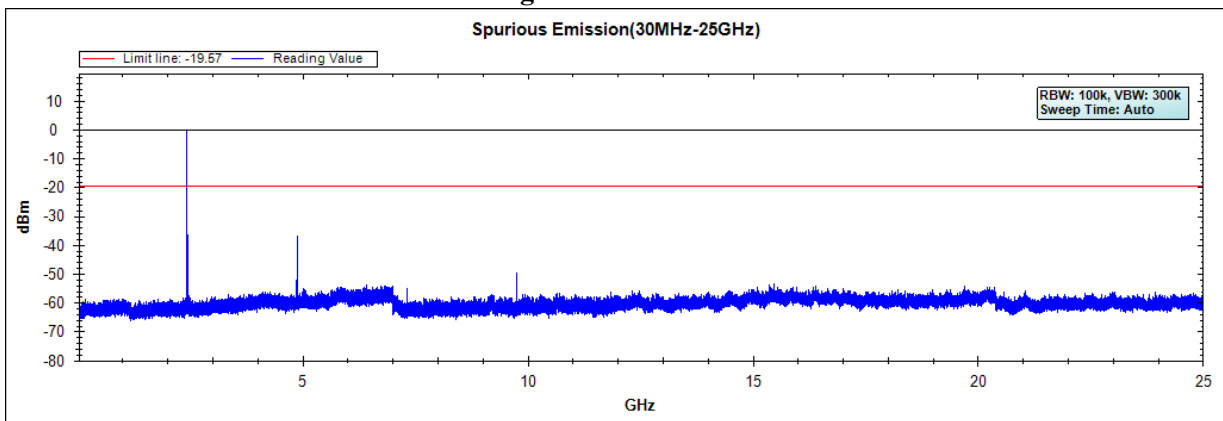
### 5.5. Test Result of RF Antenna Conducted Test

Product : Light Guided Operations  
Test Item : RF Antenna Conducted Test  
Test Mode : Mode 1: Transmit  
Test Date : 2018/06/05

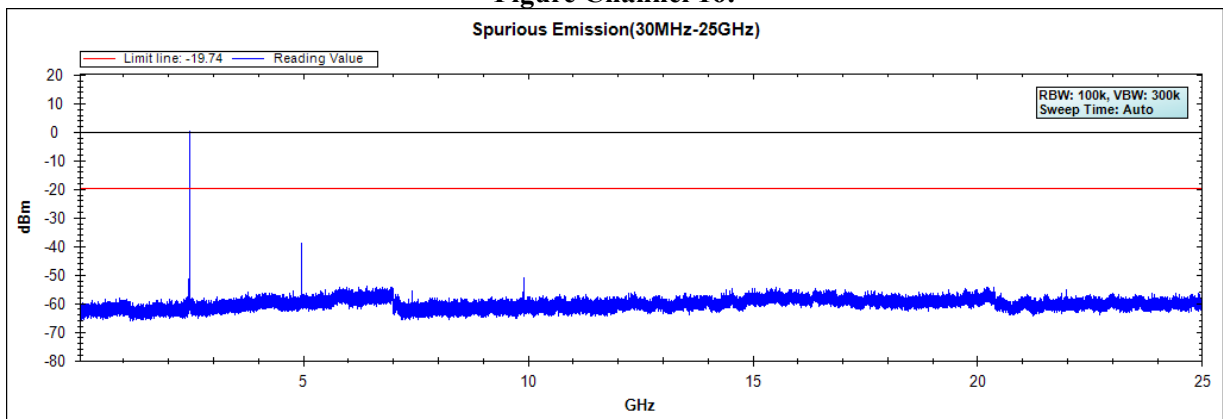
**Figure Channel 01:**



**Figure Channel 08:**



**Figure Channel 16:**

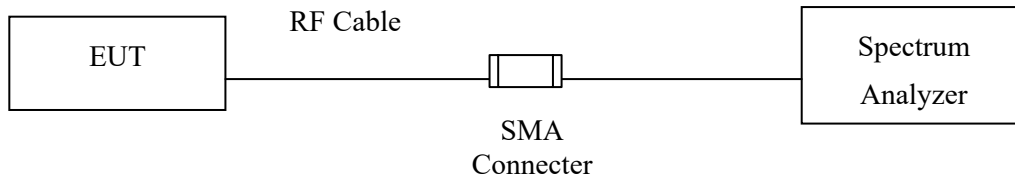


Note: The above test pattern is synthesized by multiple of the frequency range.

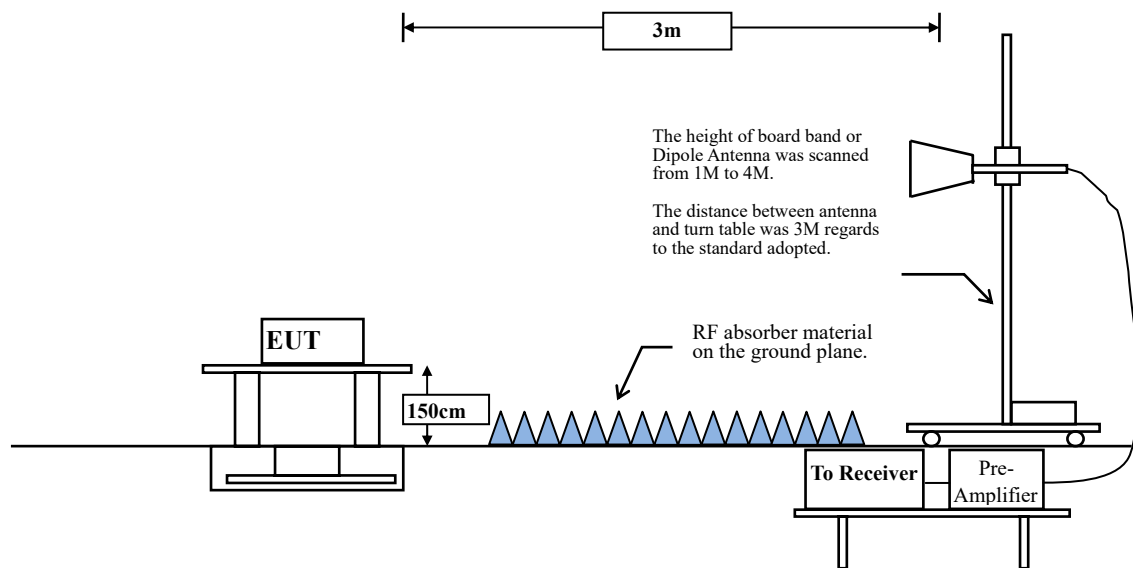
## 6. Band Edge

### 6.1. Test Setup

#### RF Conducted Measurement



#### RF Radiated Measurement:





## 6.2. Limit

According to FCC Section 15.247(d). 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 measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

## 6.3. Test Procedure

The EUT was setup according to ANSI C63.10, 2013 and tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.

### RBW and VBW Parameter setting:

According to KDB 558074 section 12.2.4. Peak power measurement procedure

RBW = as specified in Table 1.

$VBW \geq 3 \times RBW$ .

**Table 1 —RBW as a function of frequency**

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

According to KDB 558074 section 12.2.5. Average power measurement procedure

RBW = 1MHz.

VBW = 10Hz, when duty cycle  $\geq 98\%$

$VBW \geq 1/T$ , when duty cycle  $< 98\%$

( T refers to the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.)

2.4GHz band	Duty Cycle (%)	T (ms)	1/T (Hz)	VBW (Hz)
GFSK	100.00	1.0000	1000	10

Note: Duty Cycle Refer to Section 9

## 6.4. Uncertainty

Conducted:  $\pm 1.23\text{dB}$

Radiated:

Horizontal polarization : 1-18GHz:  $\pm 3.77\text{dB}$

Vertical polarization : 1-18GHz :  $\pm 3.83\text{dB}$

### 6.5. Test Result of Band Edge

Product : Light Guided Operations  
 Test Item : Band Edge  
 Test Mode : Mode 1: Transmit (2405MHz)  
 Test Date : 2018/05/24

#### RF Radiated Measurement (Horizontal):

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Result
01 (Peak)	2389.565	10.261	35.992	46.252	74.00	54.00	Pass
01 (Peak)	2390.000	10.262	35.919	46.181	74.00	54.00	Pass
01 (Peak)	2400.000	10.304	52.985	63.288	--	--	--
01 (Peak)	2405.652	10.326	91.306	101.632	--	--	--
01 (Average)	2390.000	10.262	24.196	34.458	74.00	54.00	Pass
01 (Average)	2400.000	10.304	41.456	51.759	--	--	--
01 (Average)	2405.072	10.324	88.947	99.271	--	--	--

Figure Channel 01: Horizontal (Peak)

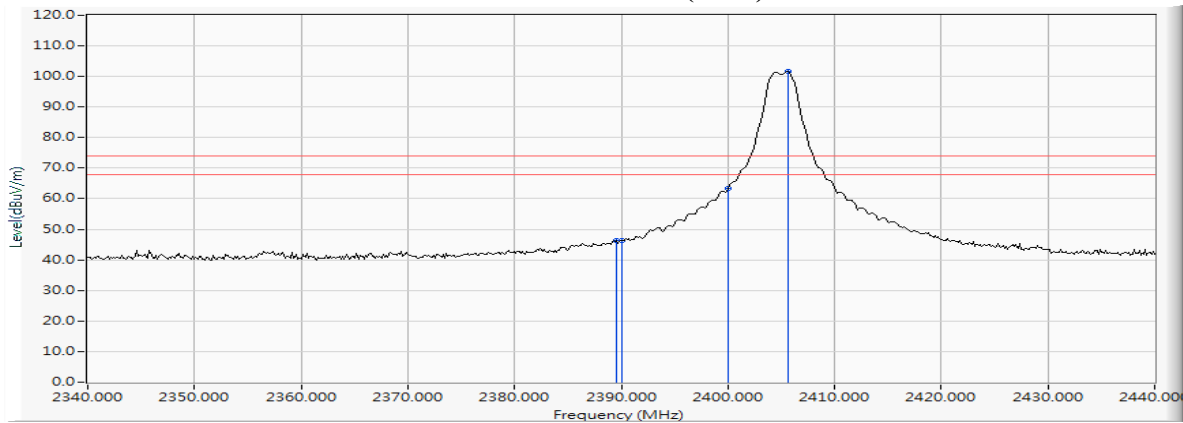
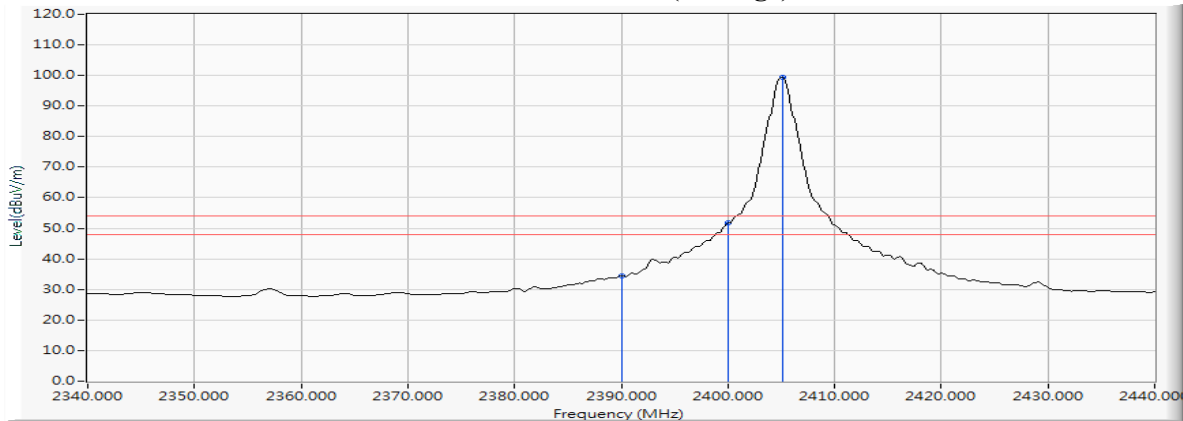


Figure Channel 01: Horizontal (Average)



Note:

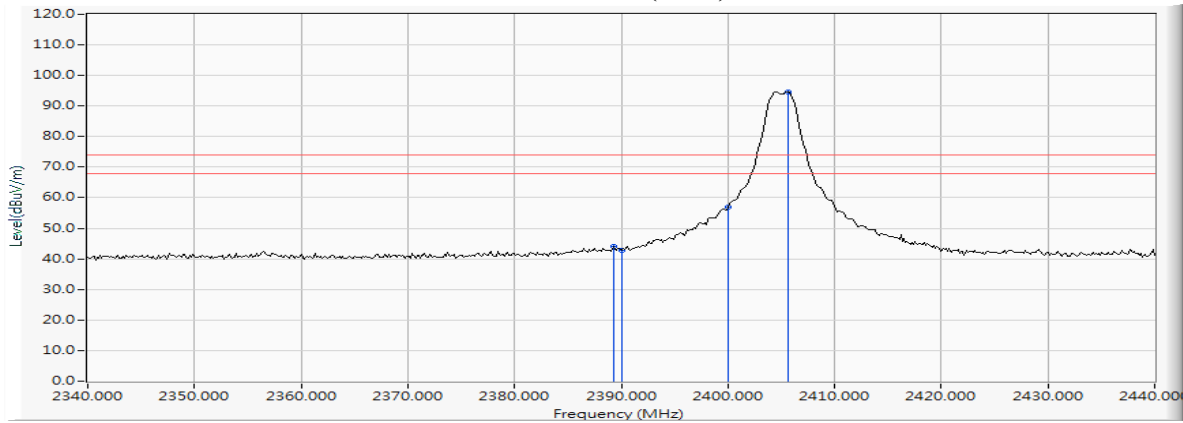
1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Light Guided Operations  
 Test Item : Band Edge  
 Test Mode : Mode 1: Transmit (2405MHz)  
 Test Date : 2018/05/24

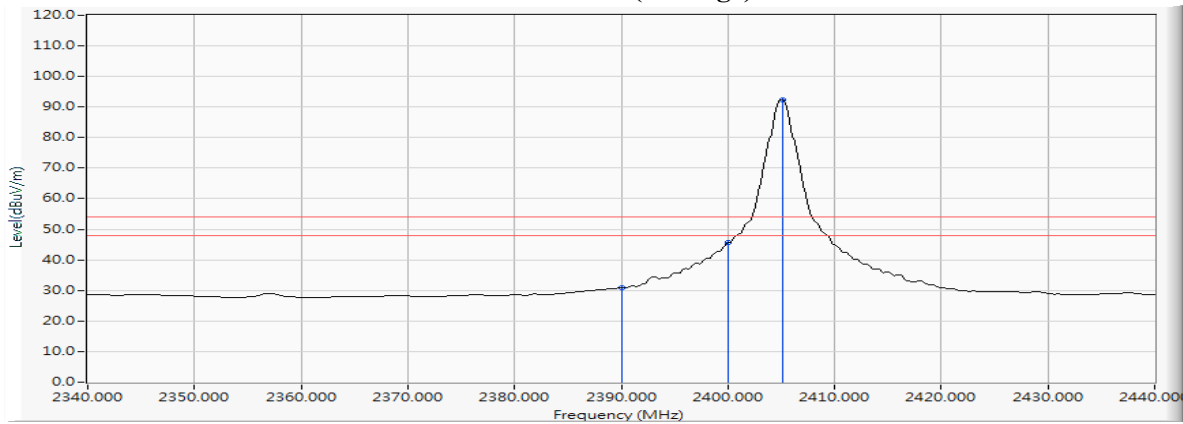
**RF Radiated Measurement (Vertical):**

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Result
01 (Peak)	2389.275	10.260	33.878	44.137	74.00	54.00	Pass
01 (Peak)	2390.000	10.262	32.641	42.903	74.00	54.00	Pass
01 (Peak)	2400.000	10.304	46.581	56.884	--	--	--
01 (Peak)	2405.652	10.326	84.409	94.735	--	--	--
01 (Average)	2390.000	10.262	20.618	30.880	74.00	54.00	Pass
01 (Average)	2400.000	10.304	35.227	45.530	--	--	--
01 (Average)	2405.072	10.324	82.044	92.368	--	--	--

**Figure Channel 01: Vertical (Peak)**



**Figure Channel 01: Vertical (Average)**



Note:

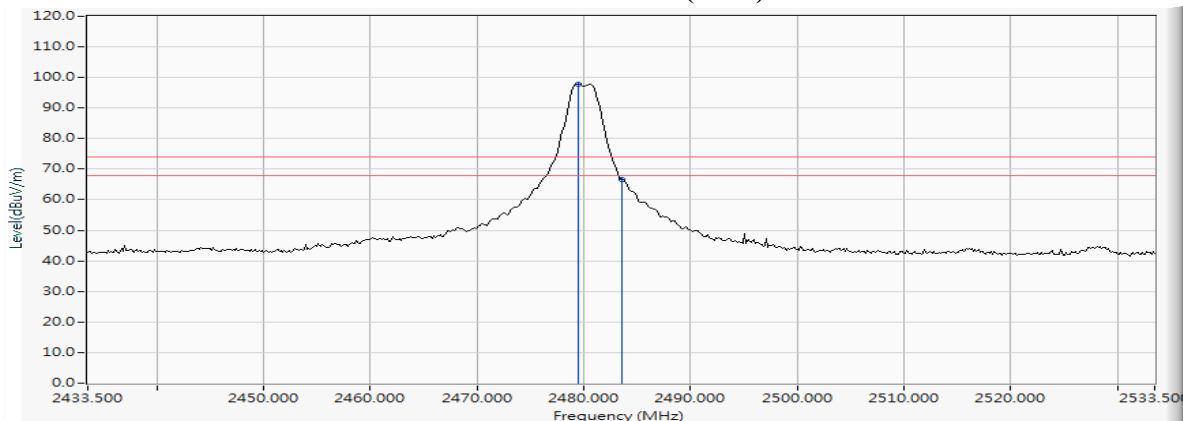
1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Light Guided Operations  
 Test Item : Band Edge  
 Test Mode : Mode 1: Transmit (2480MHz)  
 Test Date : 2018/05/24

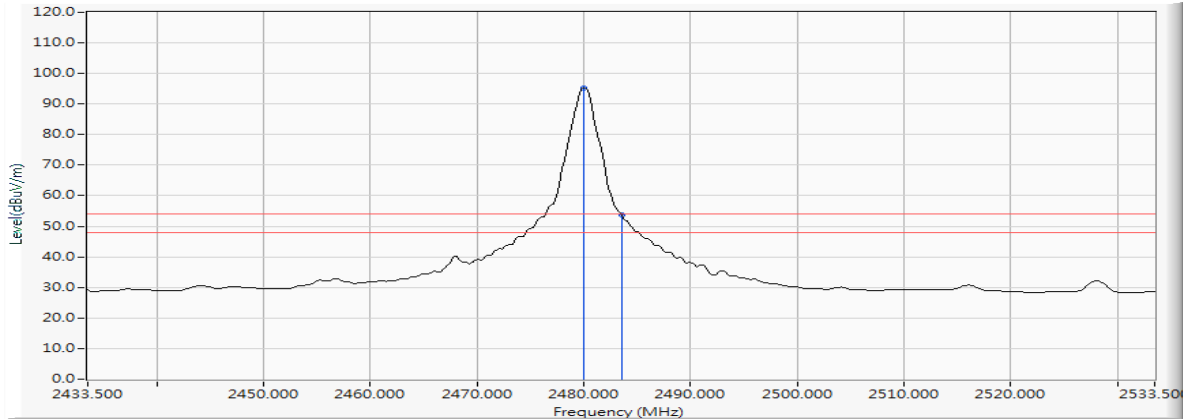
**RF Radiated Measurement (Horizontal):**

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Result
16 (Peak)	2479.442	10.625	87.335	97.961	--	--	--
16 (Peak)	2483.500	10.640	56.094	66.735	74.00	54.00	Pass
16 (Average)	2480.022	10.628	84.746	95.374	--	--	--
16 (Average)	2483.500	10.640	43.202	53.843	74.00	54.00	Pass

**Figure Channel 16: Horizontal (Peak)**



**Figure Channel 16: Horizontal (Average)**



Note:

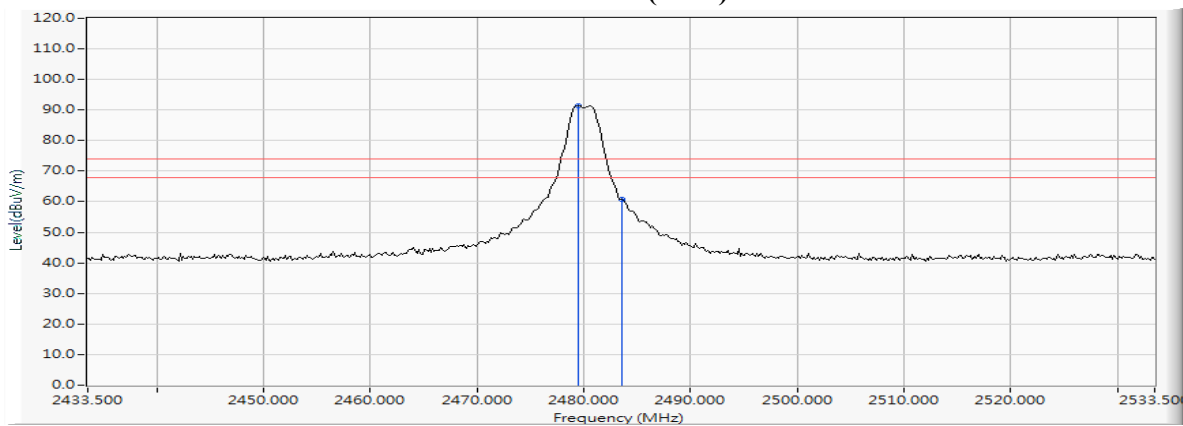
1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

Product : Light Guided Operations  
 Test Item : Band Edge  
 Test Mode : Mode 1: Transmit (2480MHz)  
 Test Date : 2018/05/24

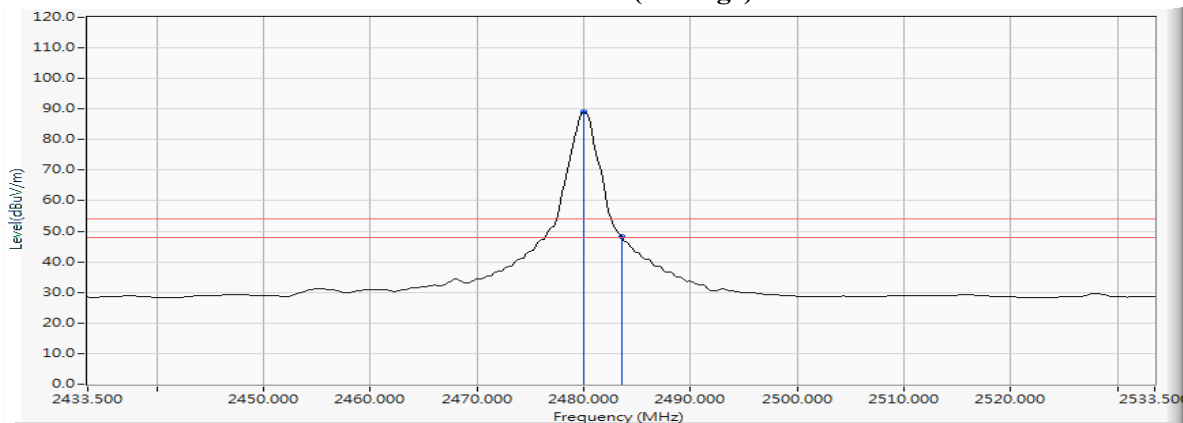
**RF Radiated Measurement (Vertical):**

Channel No.	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBμV)	Emission Level (dBμV/m)	Peak Limit (dBμV/m)	Average Limit (dBμV/m)	Result
16 (Peak)	2479.442	10.625	80.884	91.510	--	--	--
16 (Peak)	2483.500	10.640	50.080	60.721	74.00	54.00	Pass
16 (Average)	2480.022	10.628	78.348	88.976	--	--	--
16 (Average)	2483.500	10.640	37.684	48.325	74.00	54.00	Pass

**Figure Channel 16: Vertical (Peak)**



**Figure Channel 16: Vertical (Average)**

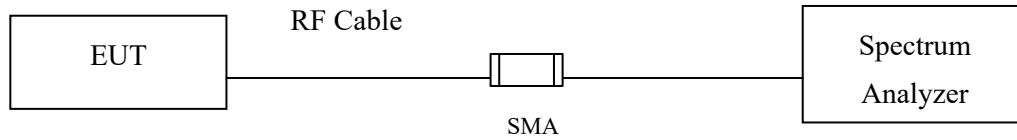


Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Measurement Level = Reading Level + Correct Factor.
3. The average measurement was not performed when the peak measured data under the limit of average detection.

## 7. 6dB Bandwidth

### 7.1. Test Setup



### 7.2. Limits

The minimum bandwidth shall be at least 500 kHz.

### 7.3. Test Procedure

The EUT was setup according to ANSI C63.10 2013; tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Set RBW = 1-5% of the emission bandwidth,  $VBW \geq 3 * RBW$

### 7.4. Uncertainty

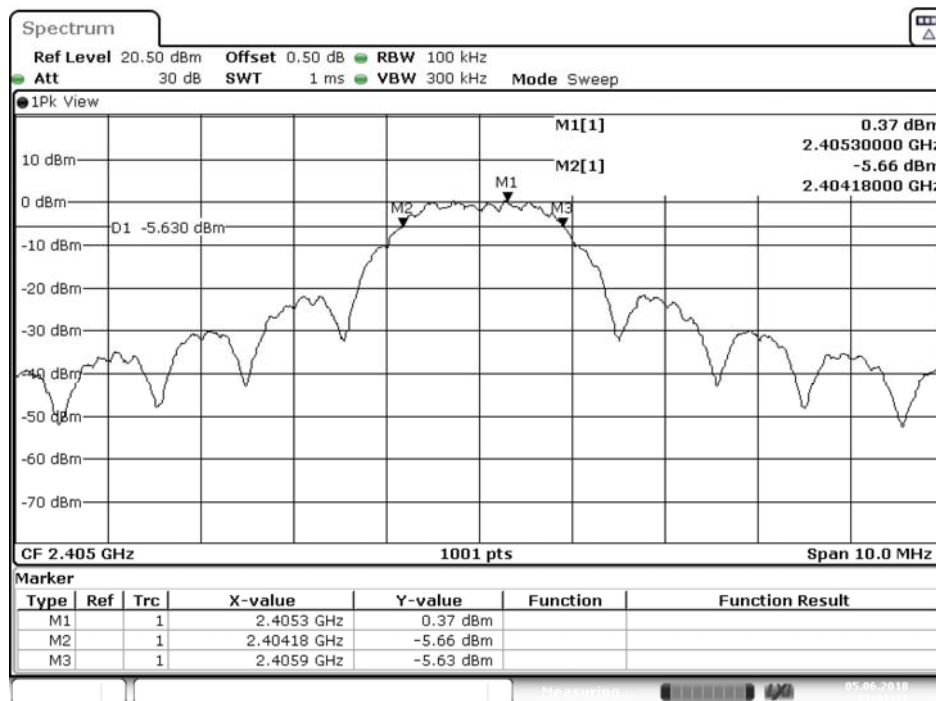
$\pm 279.2 \text{ Hz}$

### 7.5. Test Result of 6dB Bandwidth

Product : Light Guided Operations  
 Test Item : 6dB Bandwidth Data  
 Test Mode : Mode 1: Transmit

Channel No.	Frequency (MHz)	Measurement Level (kHz)	Required Limit (kHz)	Result
01	2405	1720	>500	Pass
08	2440	1770	>500	Pass
16	2480	1760	>500	Pass

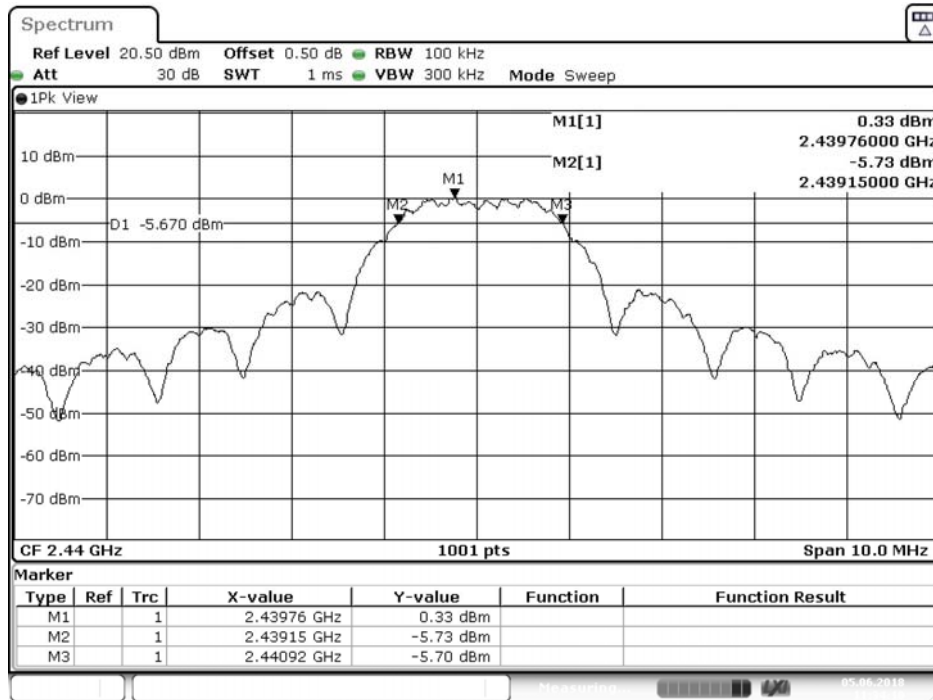
Figure Channel 01:



Date: 5 JUN.2018 11:31:21

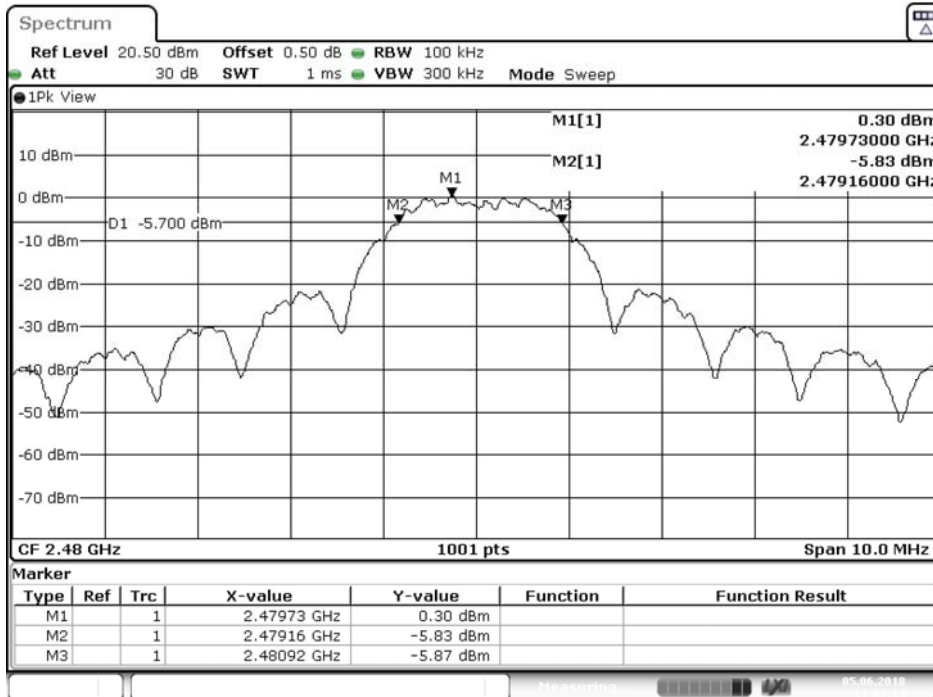


Figure Channel 08:



Date: 5 JUN.2018 11:34:10

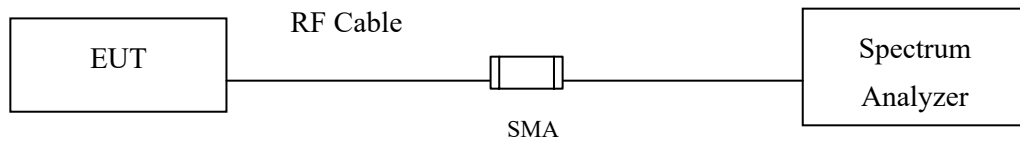
Figure Channel 16:



Date: 5 JUN.2018 11:37:14

## 8. Power Density

### 8.1. Test Setup



### 8.2. Limits

The transmitted power density averaged over any 1 second interval shall not be greater +8dBm in any 3kHz bandwidth.

### 8.3. Test Procedure

The EUT was setup according to ANSI C63.10: 2013, the maximum power spectral density using KDB 558074 section 10.2 PKPSD (peak PSD) method.

### 8.4. Uncertainty

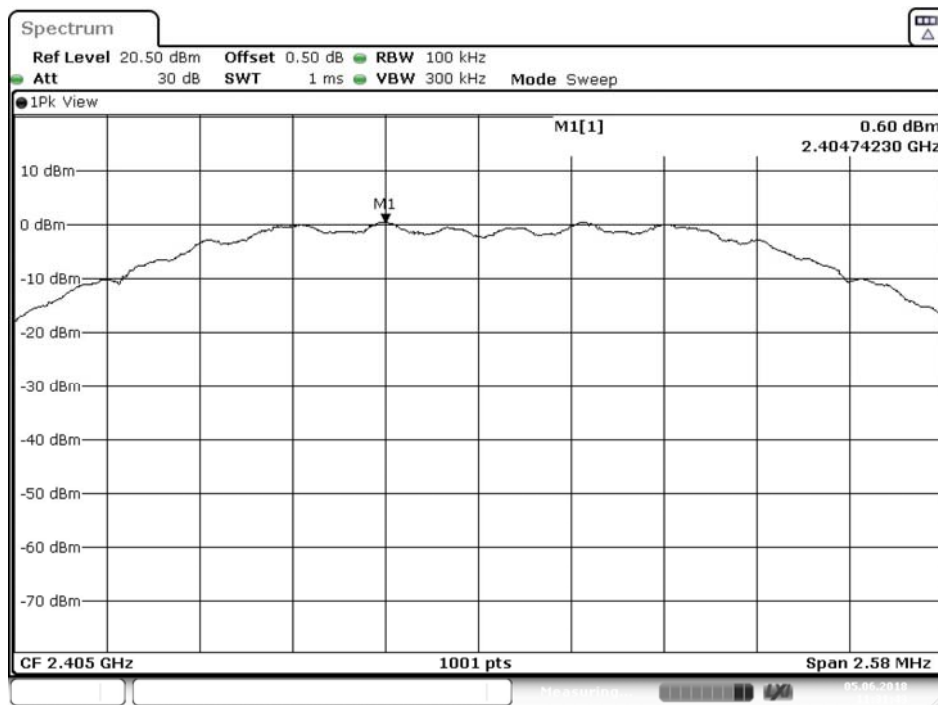
$\pm 1.23\text{dB}$

### 8.5. Test Result of Power Density

Product : Light Guided Operations  
 Test Item : Power Density Data  
 Test Mode : Mode 1: Transmit

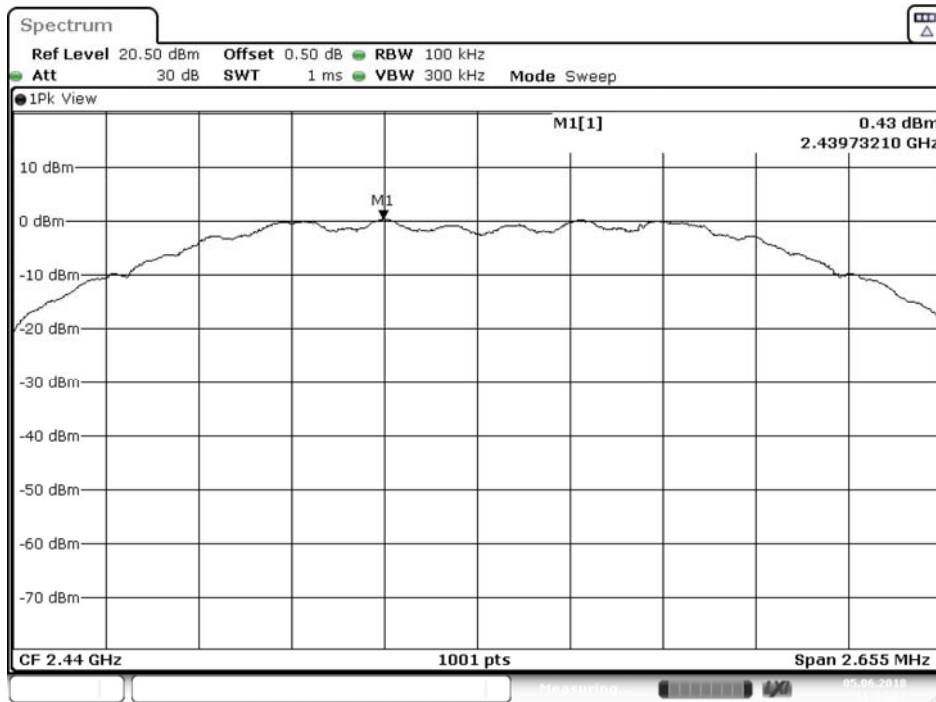
Channel No.	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Result
01	2405	0.600	≤ 8dBm	Pass
08	2440	0.430	≤ 8dBm	Pass
16	2480	0.260	≤ 8dBm	Pass

Figure Channel 01:



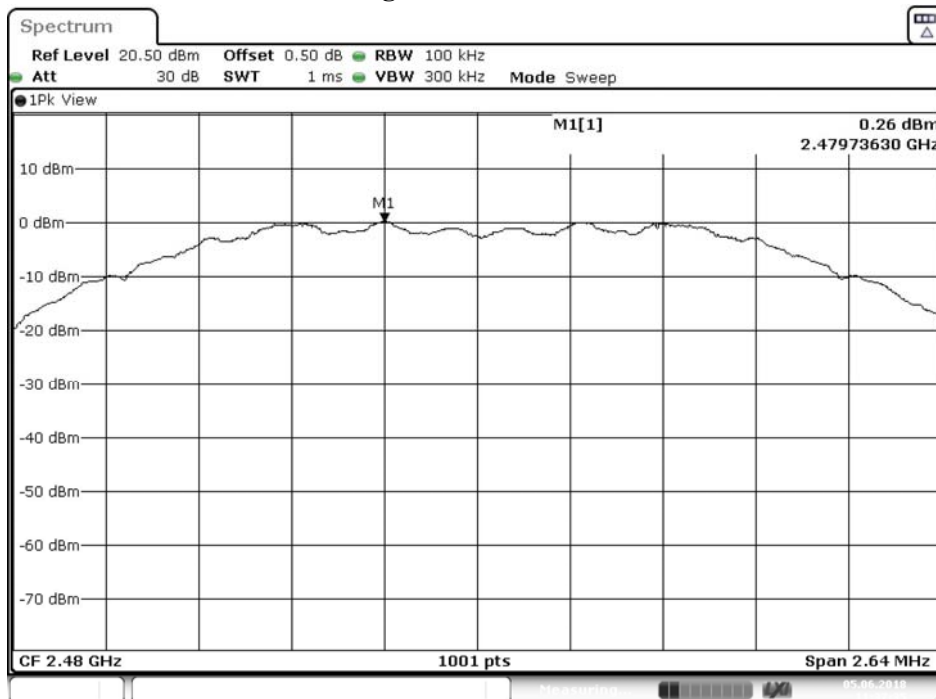
Date: 5 JUN.2018 11:31:44

Figure Channel 08:



Date: 5 JUN.2018 11:34:33

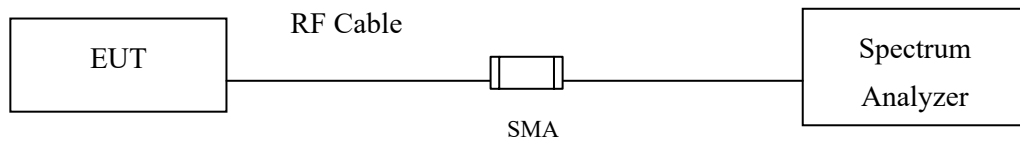
Figure Channel 16:



Date: 5 JUN.2018 11:37:35

## 9. Duty Cycle

### 9.1. Test Setup



### 9.2. Test Procedure

The EUT was setup according to ANSI C63.10 2013; tested according to DTS test procedure of KDB558074 for compliance to FCC 47CFR 15.247 requirements.

### 9.3. Uncertainty

$\pm 2.31\text{msec}$

### 9.4. Test Result of Duty Cycle

Product : Light Guided Operations  
 Test Item : Duty Cycle  
 Test Mode : Mode 1: Transmit

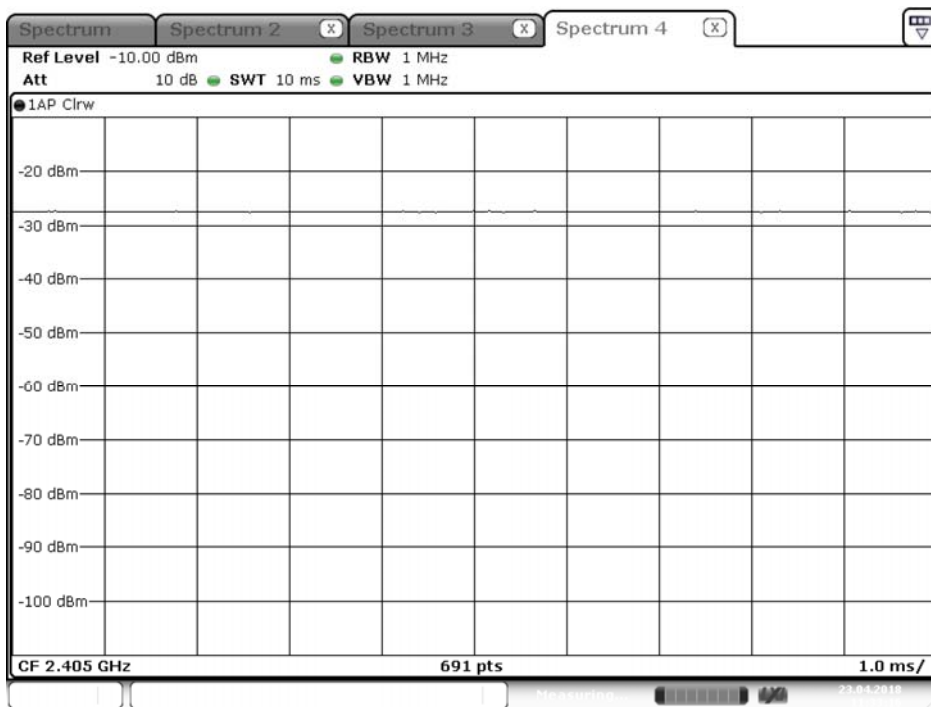
Duty Cycle Formula:

$$\text{Duty Cycle} = \text{Ton} / (\text{Ton} + \text{Toff})$$

$$\text{Duty Factor} = 10 \text{ Log} (1/\text{Duty Cycle})$$

Results:

2.4GHz band	Ton (ms)	Ton + Toff (ms)	Duty Cycle (%)	Duty Factor (dB)
GFSK	1.0000	1.0000	100.00	0.00



Date: 23.APR.2018 11:33:16

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**10. EMI Reduction Method During Compliance Testing**

No modification was made during testing.