

5. 20dBc BW

5.1. Test Setup

Refer to the APPENDIX I.

5.2. Limit

Limit: Not Applicable

5.3. Test Procedure

1. The 20dBc bandwidth were measured with a spectrum analyzer connected to RF antenna connector(conducted measurement) while EUT was operating in transmit mode. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using $RBW \geq 1\%$ of the 20 dB bandwidth, $VBW \geq RBW$, Span = 3MHz.

5.4. Test Results

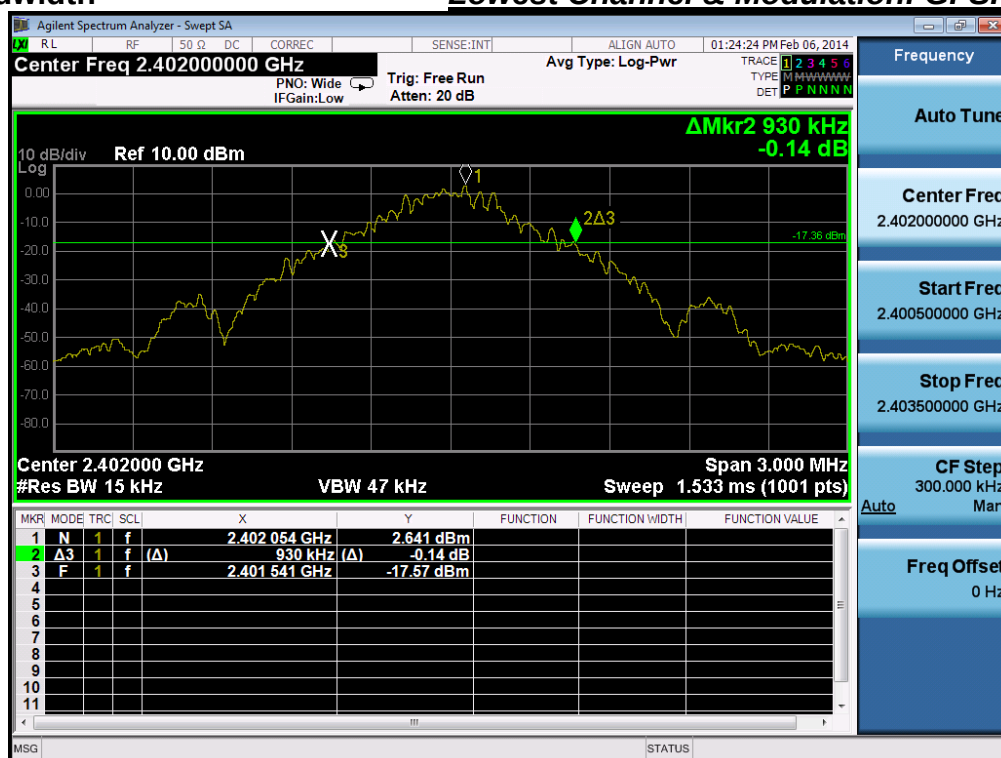
Ambient temperature : 20 °C
Relative humidity : 35 %

Modulation	Tested Channel	20 dBc BW (MHz)
<u>GFSK</u>	Lowest	0.930
	Middle	0.930
	Highest	0.936
<u>$\pi/4$DQPSK</u>	Lowest	1.320
	Middle	1.320
	Highest	1.311
<u>8DPSK</u>	Lowest	1.263
	Middle	1.290
	Highest	1.287

Note 1: See next pages for actual measured spectrum plots.

20dBc Bandwidth

Lowest Channel & Modulation: GFSK



20dBc Bandwidth

Middle Channel & Modulation: GFSK



20dBc Bandwidth

Highest Channel & Modulation: GFSK



20dBc Bandwidth

Lowest Channel & Modulation: $\pi/4$ DQPSK



20dBc Bandwidth

Middle Channel & Modulation: $\pi/4$ DQPSK

20dBc Bandwidth

Highest Channel & Modulation: $\pi/4$ DQPSK

20dBc Bandwidth

Lowest Channel & Modulation: 8DPSK



20dBc Bandwidth

Middle Channel & Modulation: 8DPSK



20dBc Bandwidth

Highest Channel & Modulation: 8DPSK



6. Time of Occupancy (Dwell Time)

6.1. Test Setup

Refer to the APPENDIX I.

6.2. Limit

Limit: Not Applicable

6.3. Test Procedure

The dwell time was measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function enabled.

The spectrum analyzer is set to:

Center frequency = 2441 MHz

RBW = 1 MHz

Trace = max hold

Span = zero

VBW = $\geq$ RBW

Detector function = peak

6.4. Test Results

Ambient temperature : 20 °C

Relative humidity : 35 %

- FH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	79	2.88	3.75	0.307
	2 DH 5	79	2.88	3.75	0.307
	3 DH 5	79	2.88	3.75	0.307

- AFH mode

Hopping mode	Packet Type	Number of hopping Channels	Burst On Time (ms)	Period (ms)	Test Result (sec)
Enable	DH 5	20	2.88	3.75	0.154
	2 DH 5	20	2.88	3.75	0.154
	3 DH 5	20	2.88	3.75	0.154

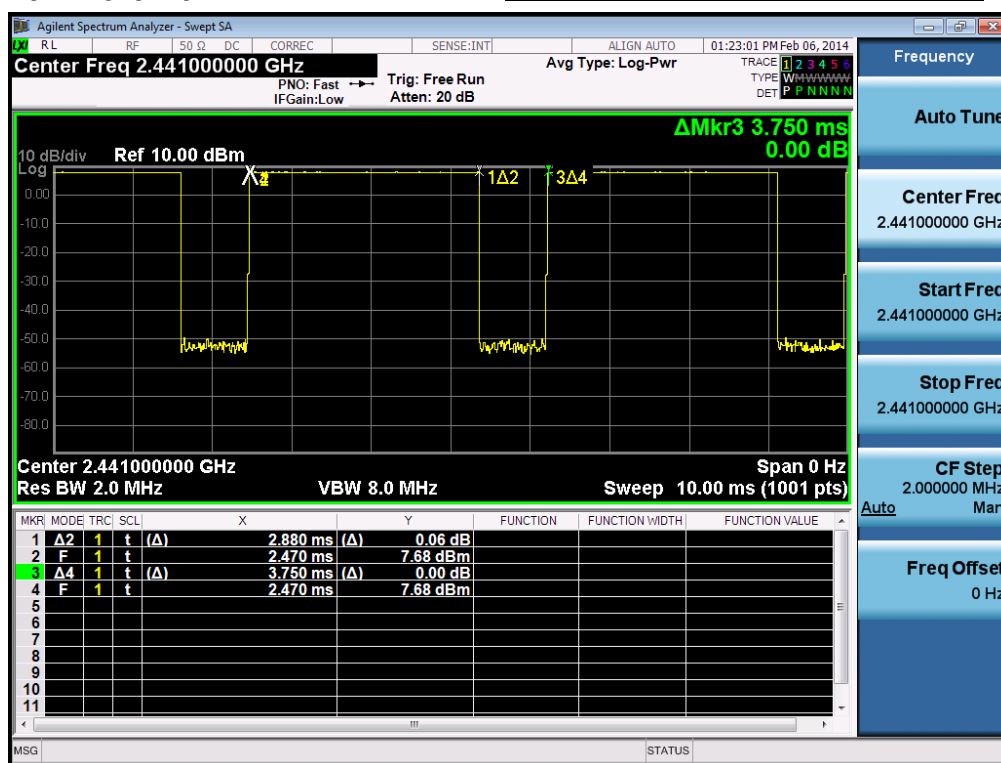
Note 1: Dwell Time = $0.4 \times \text{Hopping channel} \times \text{Burst ON time} \times ((\text{Hopping rate} \div \text{Time slots}) \div \text{Hopping channel})$

- Time slots for DH5 = 6 slots (TX = 5 slot / RX = 1 slot)

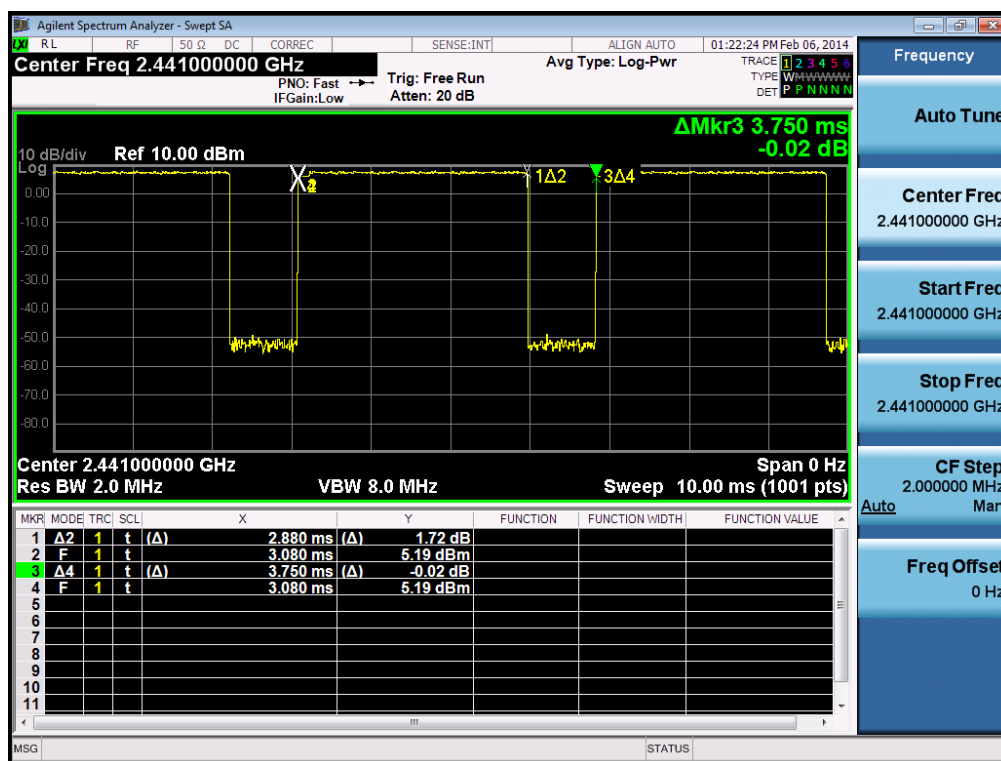
- Hopping Rate = 1600 for FH mode & 800 for AFH mode

Note 2: See next pages for actual measured spectrum plots.

Time of Occupancy (FH)

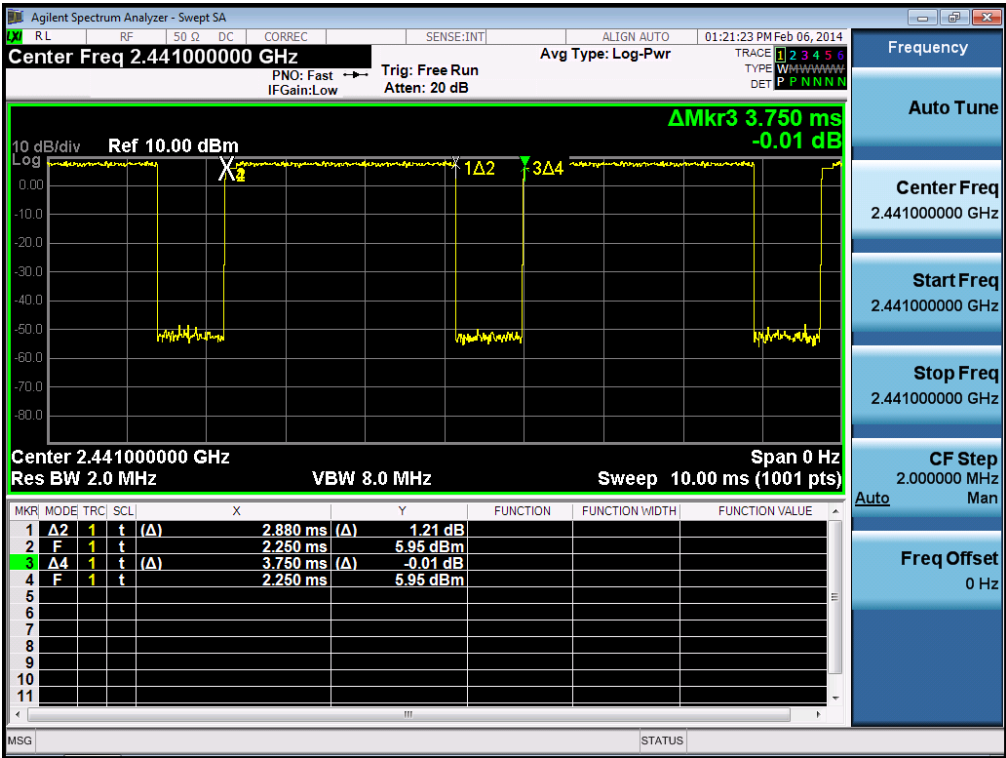
Hopping mode: Enable & GFSK

Time of Occupancy (FH)

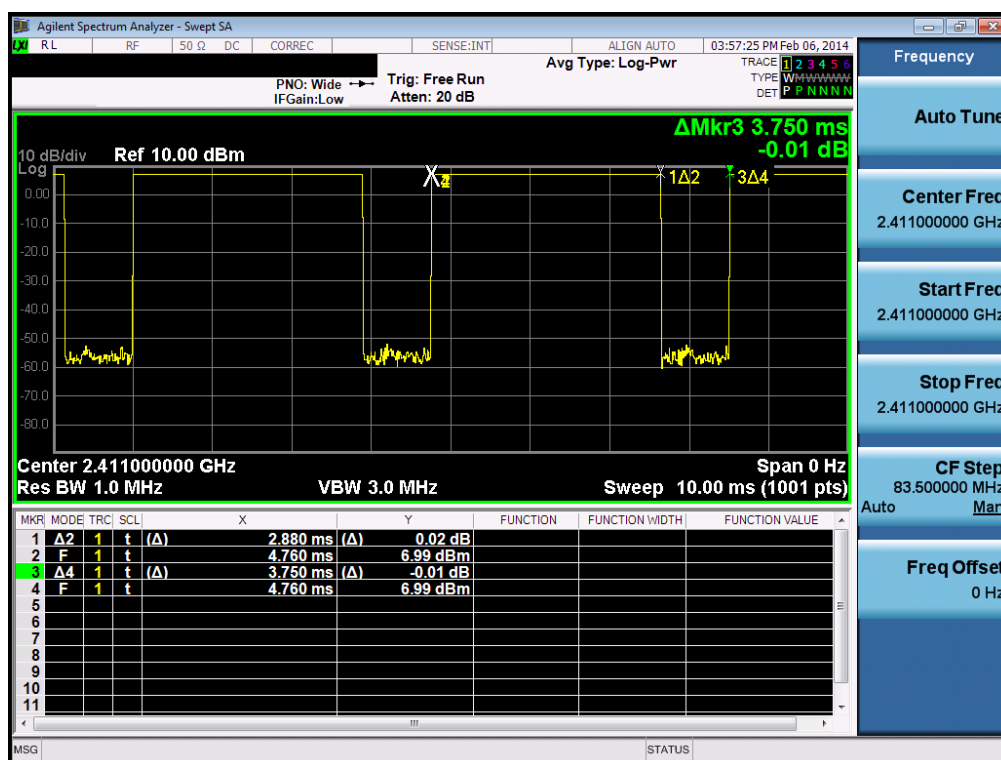
Hopping mode: Enable & $\pi/4$ -DQPSK

Time of Occupancy (FH)

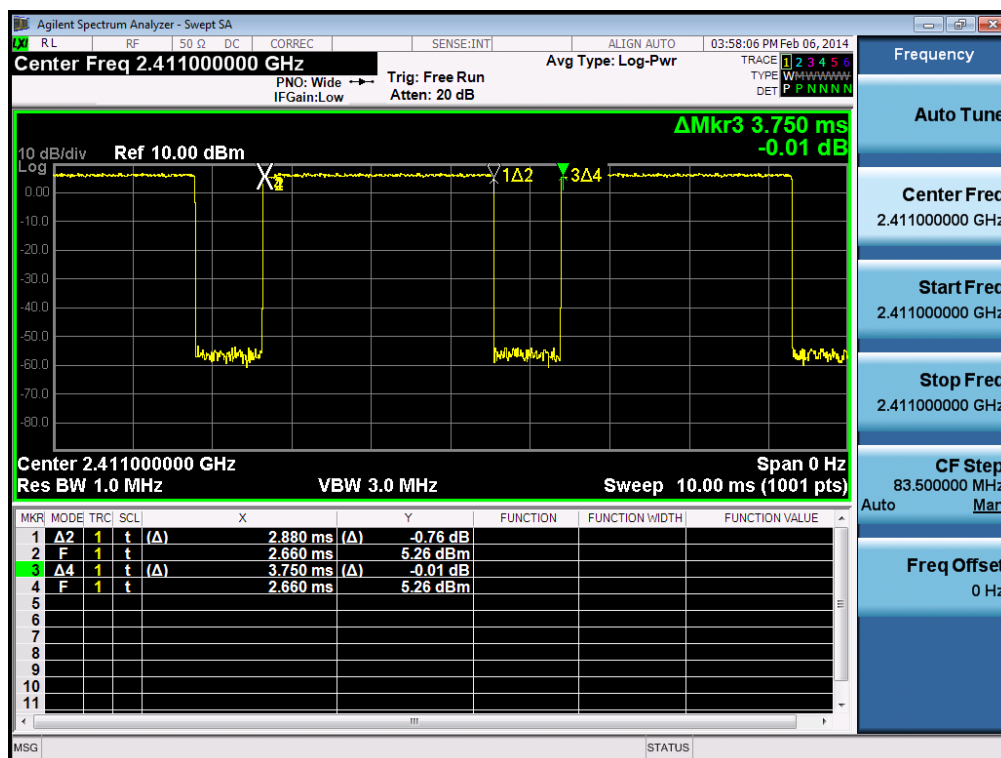
Hopping mode: Enable & 8DPSK



Time of Occupancy (AFH)

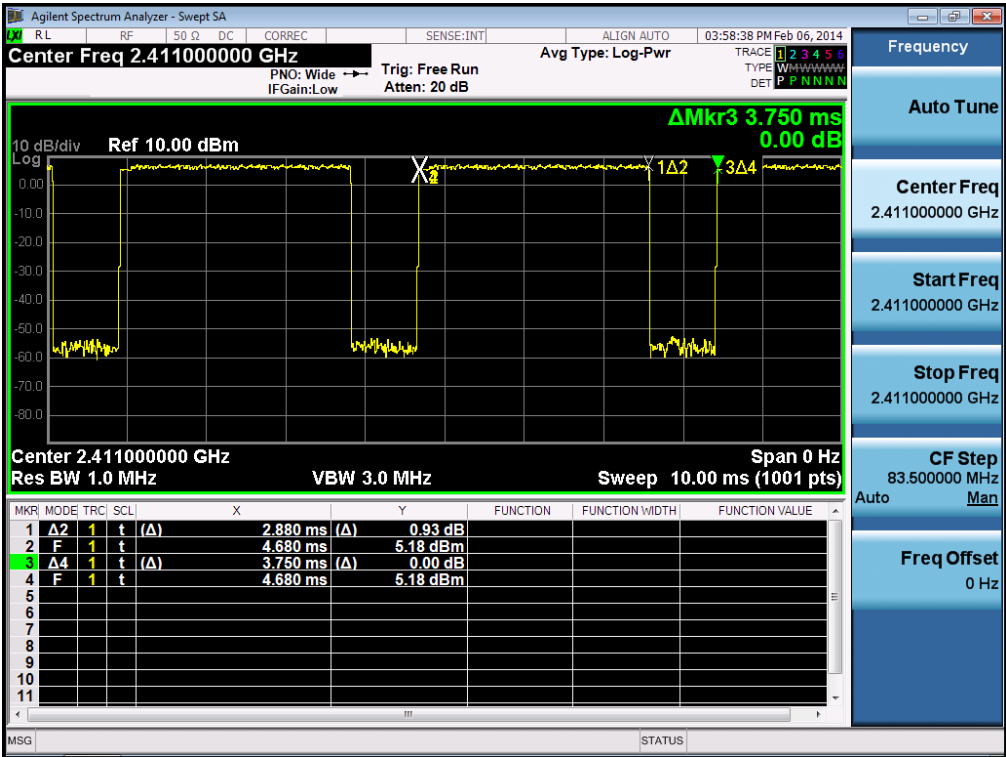
Hopping mode: Enable & GFSK

Time of Occupancy (AFH)

Hopping mode: Enable & π/4-QPSK

Time of Occupancy (AFH)

Hopping mode: Enable & 8DPSK



7. Maximum Peak Output Power Measurement

7.1. Test Setup

Refer to the APPENDIX I.

7.2. Limit

The maximum peak output power of the intentional radiator shall not exceed the following :

1. §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.
2. §15.247(b)(1), For frequency hopping systems operating in the 2 400 – 2 483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 – 5 805 MHz band: 1 Watt.

7.3. Test Procedure

1. The RF power output was measured with a Spectrum analyzer connected to the RF Antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using ;
Span = approximately 5 times of the 20 dB bandwidth, centered on a hopping channel
RBW $\geq$ 20 dB BW
VBW $\geq$ RBW
Sweep = auto
Detector function = peak
Trace = max hold

7.4. Test Results

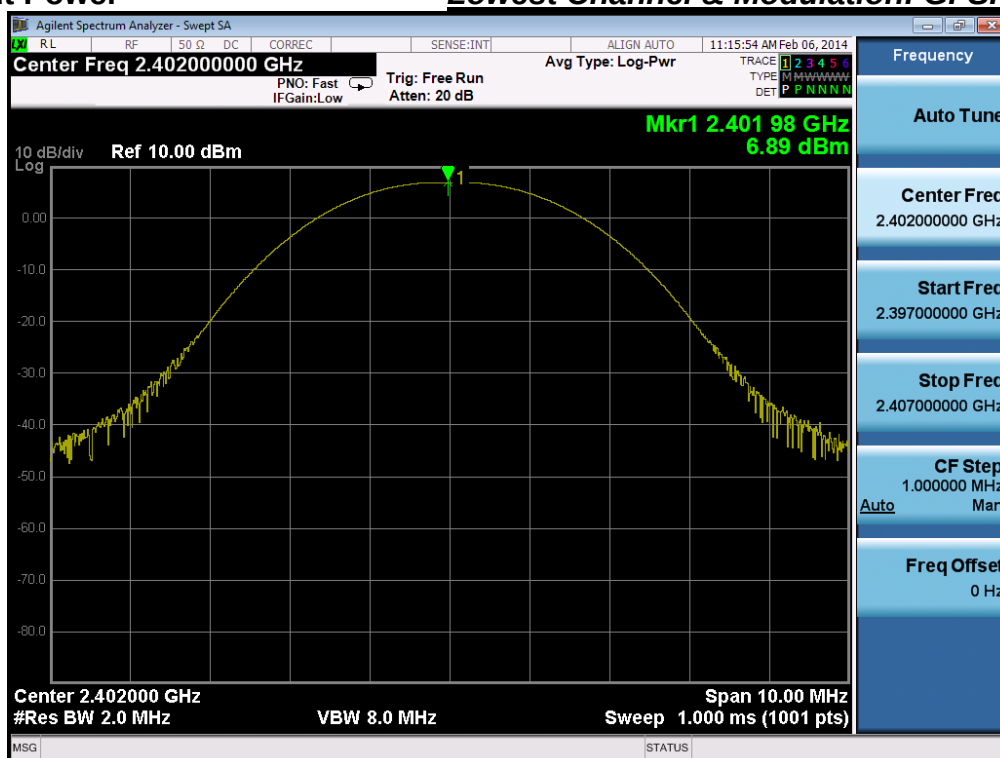
Ambient temperature : 20 °C
Relative humidity : 35 %

Modulation	Tested Channel	Peak Output Power	
		dBm	mW
<u>GFSK</u>	Lowest	6.89	4.887
	Middle	7.81	6.039
	Highest	8.77	7.540
<u>$\pi/4$DQPSK</u>	Lowest	6.92	4.920
	Middle	7.84	6.081
	Highest	8.79	7.568
<u>8DPSK</u>	Lowest	7.30	5.369
	Middle	8.22	6.637
	Highest	9.18	8.270

Note 1: See next pages for actual measured spectrum plots.

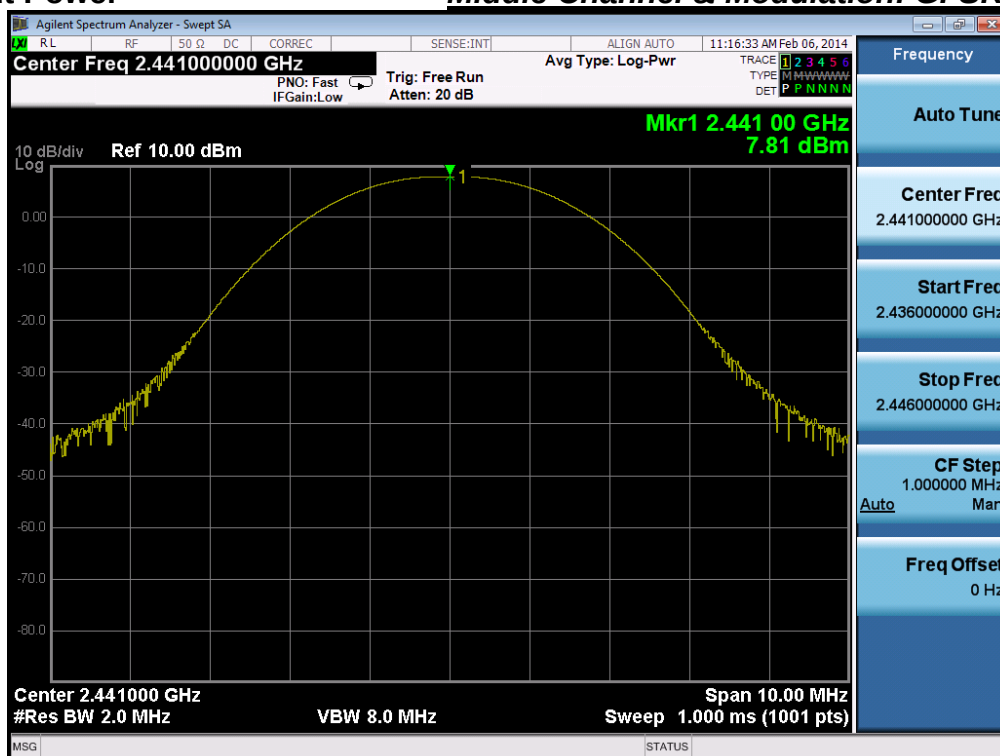
Peak Output Power

Lowest Channel & Modulation: GFSK

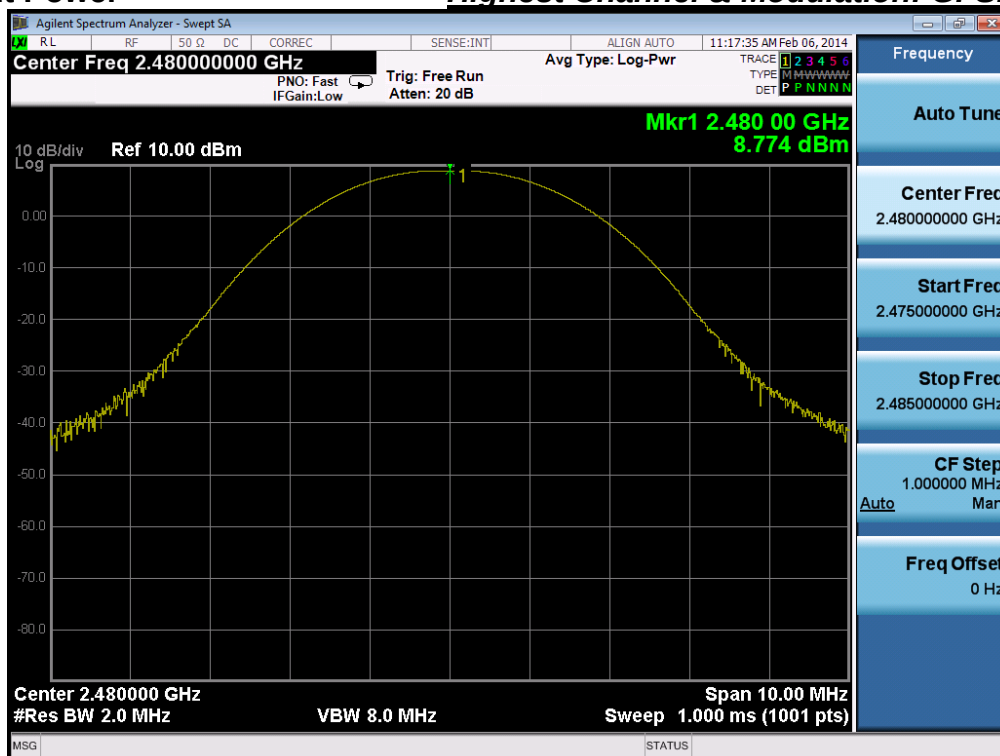


Peak Output Power

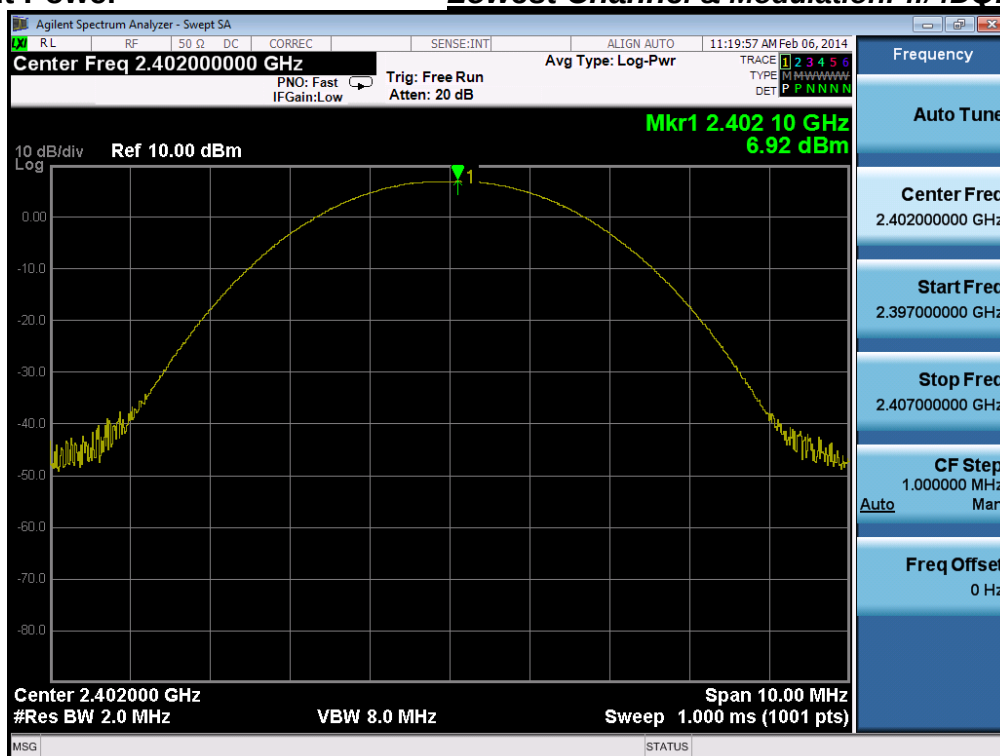
Middle Channel & Modulation: GFSK



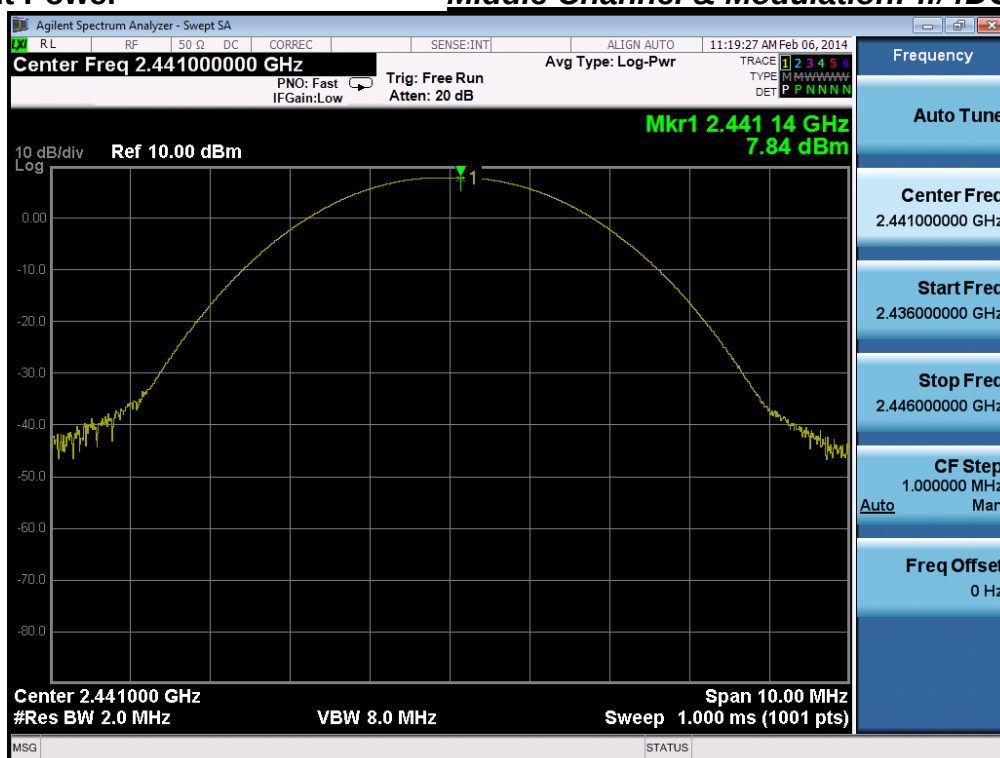
Peak Output Power

Highest Channel & Modulation: GFSK

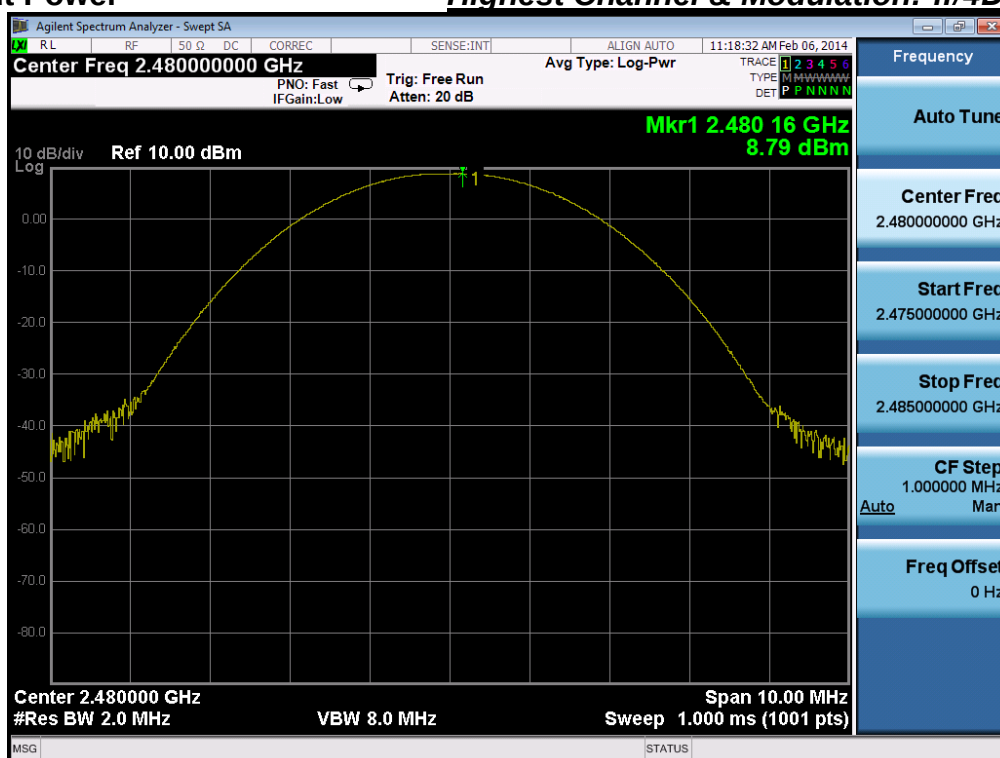
Peak Output Power

Lowest Channel & Modulation: $\pi/4$ DQPSK

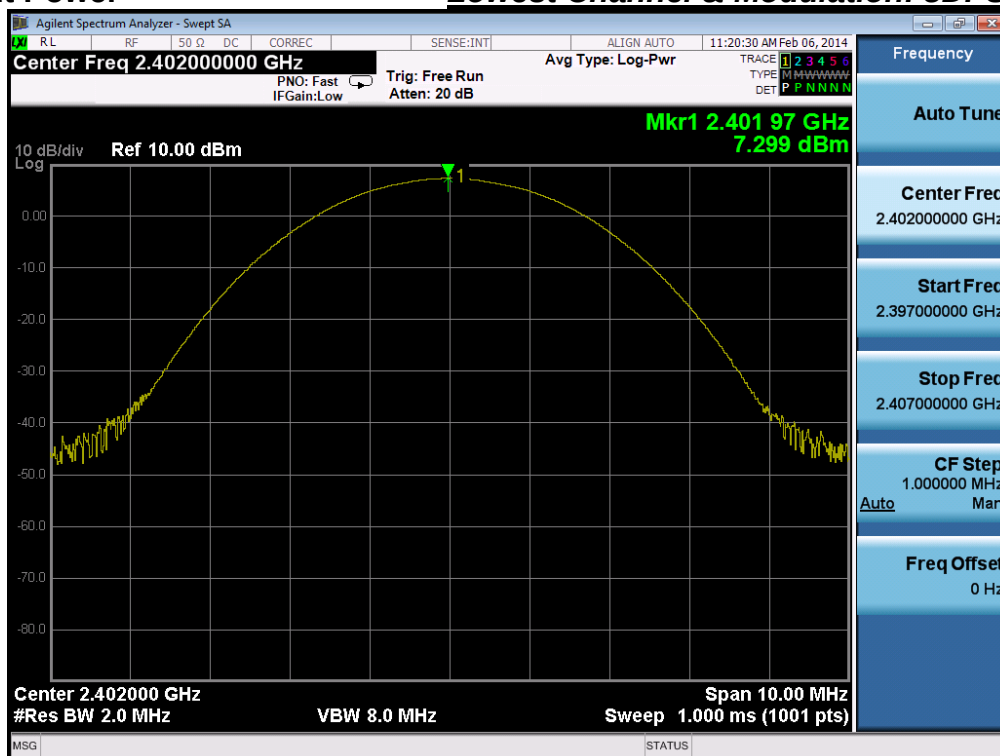
Peak Output Power

Middle Channel & Modulation: $\pi/4$ DQPSK

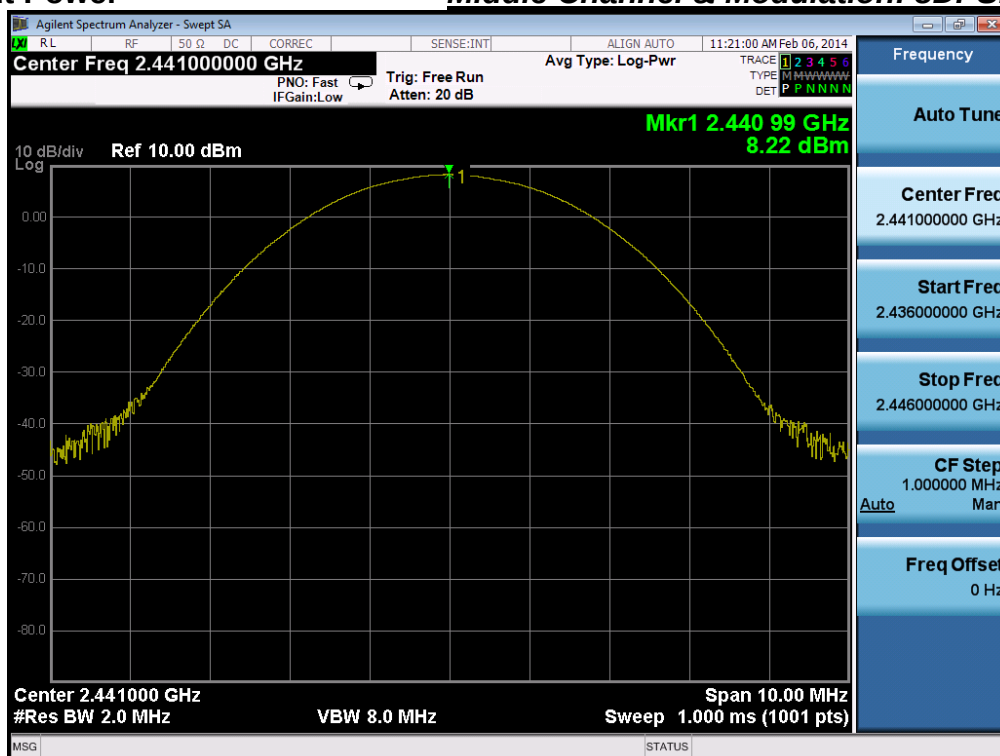
Peak Output Power

Highest Channel & Modulation: $\pi/4$ DQPSK

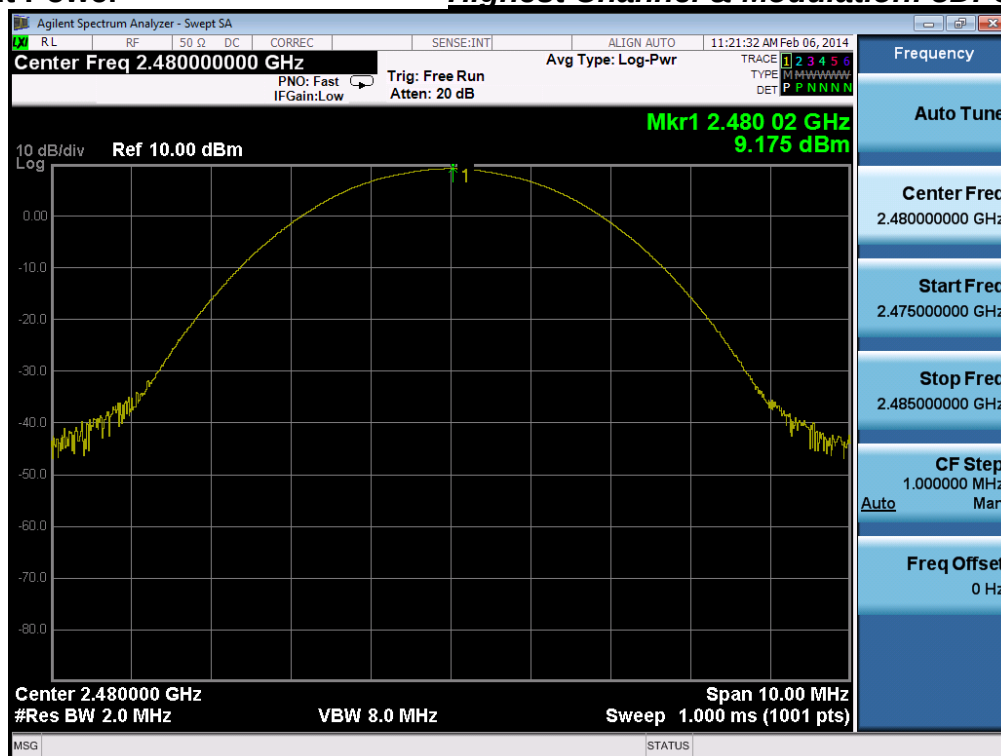
Peak Output Power

Lowest Channel & Modulation: 8DPSK

Peak Output Power

Middle Channel & Modulation: 8DPSK

Peak Output Power

Highest Channel & Modulation: 8DPSK

8. Transmitter AC Power Line Conducted Emission

8.1. Test Setup

Refer to test setup photo.

8.2. Limit

According to §15.207(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohm line impedance stabilization network(LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

8.3. Test Procedures

Conducted emissions from the EUT were measured according to the dictates of ANSI C63.4-2009

1. The test procedure is performed in a 6.5 m $\times$ 3.5 m $\times$ 3.5 m (L $\times$ W $\times$ H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) $\times$ 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

8.4. Test Results

AC Line Conducted Emissions (Graph) & Modulation: GFSK

Results of Conducted Emission

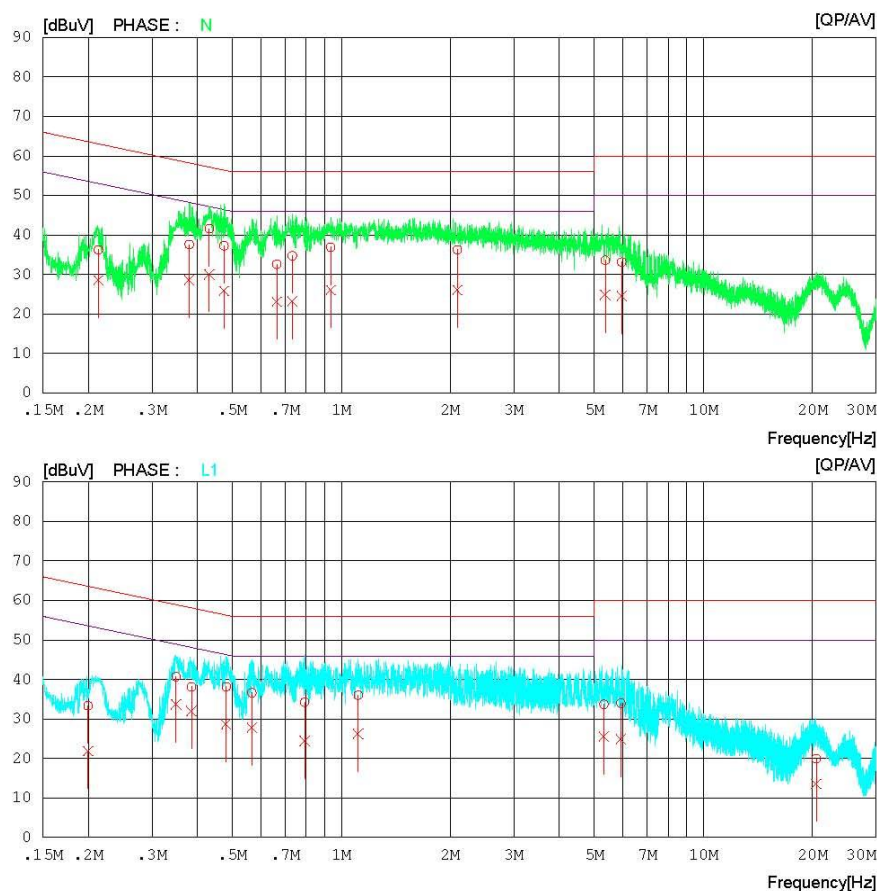
Digital EMC
Date : 2014-02-06

Model No. : LG-D165g
Type :
Serial No. : Identical prototype
Test Condition : BT

Reference No. :
Power Supply : 120 V 60 Hz
Temp/Humi. : 21 °C 35 % R.H.
Operator : J.J.LEE

Memo : Hopping

LIMIT : FCC P15.207 QP
FCC P15.207 AV



AC Line Conducted Emissions (List) & Modulation: **GFSK**Results of Conducted EmissionDigital EMC
Date : 2014-02-06

Model No.	: LG-D165g	Reference No.	:
Type	:	Power Supply	: 120 V 60 Hz
Serial No.	: Identical prototype	Temp/Humi.	: 21 °C 35 % R.H.
Test Condition	: BT	Operator	: J.J.LEE

Memo : Hopping

LIMIT : FCC P15.207 QP
FCC P15.207 AV

NO	FREQ [MHz]	READING		C.FACTOR [dB]	RESULT		LIMIT		MARGIN		PHASE
		QP [dBuV]	AV [dBuV]		QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	QP [dBuV]	AV [dBuV]	
1	0.21351	36.2	28.4	0.1	36.3	28.5	63.1	53.1	26.8	24.6	N
2	0.38030	37.5	28.5	0.1	37.6	28.6	58.3	48.3	20.7	19.7	N
3	0.43178	41.5	29.9	0.1	41.6	30.0	57.2	47.2	15.6	17.2	N
4	0.47481	37.2	25.7	0.1	37.3	25.8	56.4	46.4	19.1	20.6	N
5	0.66402	32.5	23.0	0.1	32.6	23.1	56.0	46.0	23.4	22.9	N
6	0.73259	34.5	23.1	0.2	34.7	23.3	56.0	46.0	21.3	22.7	N
7	0.93525	36.7	25.8	0.2	36.9	26.0	56.0	46.0	19.1	20.0	N
8	2.09280	36.0	25.7	0.3	36.3	26.0	56.0	46.0	19.7	20.0	N
9	5.35680	33.1	24.3	0.5	33.6	24.8	60.0	50.0	26.4	25.2	N
10	5.94780	32.6	24.0	0.5	33.1	24.5	60.0	50.0	26.9	25.5	N
11	0.19975	33.3	21.8	0.1	33.4	21.9	63.6	53.6	30.2	31.7	L1
12	0.34969	40.6	33.6	0.1	40.7	33.7	59.0	49.0	18.3	15.3	L1
13	0.38550	38.0	31.9	0.1	38.1	32.0	58.2	48.2	20.1	16.2	L1
14	0.48100	38.1	28.6	0.1	38.2	28.7	56.3	46.3	18.1	17.6	L1
15	0.56633	36.5	27.7	0.1	36.6	27.8	56.0	46.0	19.4	18.2	L1
16	0.79226	34.1	24.3	0.2	34.3	24.5	56.0	46.0	21.7	21.5	L1
17	1.11360	35.8	26.0	0.2	36.0	26.2	56.0	46.0	20.0	19.8	L1
18	5.31320	33.2	25.0	0.5	33.7	25.5	60.0	50.0	26.3	24.5	L1
19	5.91680	33.5	24.4	0.5	34.0	24.9	60.0	50.0	26.0	25.1	L1
20	20.50480	19.2	12.9	0.7	19.9	13.6	60.0	50.0	40.1	36.4	L1

9. Antenna Requirement

■ Procedure:

Describe how the EUT complies with the requirement that either its antenna is permanently attached, or that it employs a unique antenna connector, for every antenna proposed for use with the EUT.

■ Conclusion: **Comply**

The internal antenna is attached on the main PCB using the special spring tension. (Refer to Internal Photo file.)

■ Minimum Standard:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions.

10. Occupied Bandwidth(99%)

- **Procedure: (RSS-Gen Issue 3)**
- The 99% power bandwidth was measured with a calibrated spectrum analyzer.
- Spectrum analyzer plots are included on the following pages.

- **Measurement Data:** NA

- **Minimum Standard:**

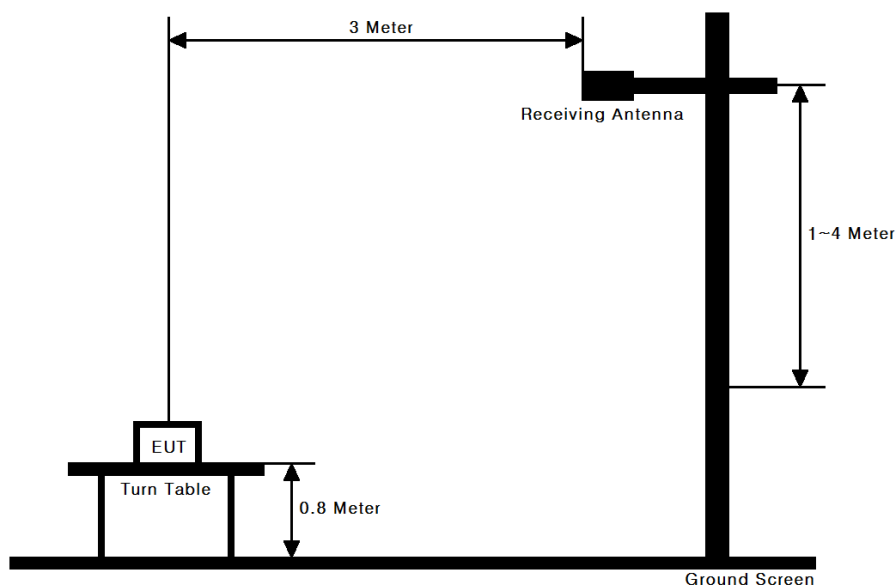
N/A

APPENDIX I

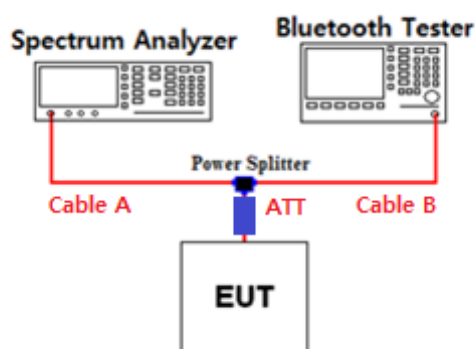
Test set up Diagrams & Path loss Information

▪Radiated Measurement

The diagram below shows the test setup that is utilized to make the measurements for emission from 9kHz to 25GHz Emissions.



▪Conducted Measurement



Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	8.95	15	11.22
1	9.25	20	11.97
2.402 & 2.441 & 2.480	9.63	25	12.58
5	10.13	-	-
10	10.79	-	-

Note. 1: The path loss from EUT to Spectrum analyzer were measured and used for test.

Path loss (= S/A's Correction factor) = Cable A + Power splitter + ATT