FCC TEST REPORT

Test report No.:	**EMC- FCC- R0038**
FCC ID:	**YE4XSG2NA**
Type of equipment:	**CAR AUDIO VIDEO NAVIGATION SYSTEM**
Model Name:	**XSG2NA**
Brand Name:	**-**
Applicant:	**Glosys Inc.**
FCC Rule Part(s):	**FCC Part 15 Subpart C Section 15.203, Section 15.209 Section 15.207, Section 15.247**
Frequency Range:	**2402 MHz ~ 2480 MHz**
Test result:	**Complied**

The above equipment was tested by EMC compliance Testing Laboratory for compliance with the requirements of FCC Rules and Regulations.
The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Date of test: October 14, 2010 ~ October 25, 2010

Issued date: October 26, 2010

Tested by: ________________
KIM, CHANG MIN

Approved by: ________________ .
YOO, SUNG YOUNG

480-5 Shin-dong, Yeongtong-gu, Suwon-city, Gyunggi-do, 443-390, Korea
82 31 336 9919 (Main) 82 31 336 4767 (Fax)

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1. Client information

Applicant: Glosys Inc.
Address: #510, Venture Valley B/D, 958, GosaekDong, GwonseonGu, SuwonSi, GyeonggiDo, Korea
Telephone number: +82-31-291-1450
Facsimile number : +82-31-291-1450
Contact person: Byungbin Kong/Senior Research Engineer

Applicant: Glosys Inc.
Address: #510, Venture Valley B/D, 958, GosaekDong, GwonseonGu, SuwonSi, GyeonggiDo, Korea
Telephone number: +82-31-291-1450
Facsimile number : +82-31-291-1450
Contact person: Byungbin Kong/Senior Research Engineer

2. Laboratory information

<u>Address</u>
EMC Compliance Ltd.
480-5 Shin-dong, Yeongtong-gu, Suwon-city, Gyunggi-do, 443-390, Korea
Telephone Number: 82 31 336 9919   Facsimile Number: 82 31 336 4767

<u>Certificate</u>
CBTL Testing Laboratory, KOLAS NO.: 231
FCC Filing No.: 793334
VCCI Registration No.: C-1713, R-1606, T-258

<u>SITE MAP</u>

3. Description of E.U.T.

3.1 Basic description

Applicant :	Glosys Inc.
Address of Applicant:	#510, Venture Valley B/D, 958, GosaekDong, GwonseonGu, SuwonSi, GyeonggiDo, Korea
Manufacturer:	Glosys Inc.
Address of Manufacturer:	#510, Venture Valley B/D, 958, GosaekDong, GwonseonGu, SuwonSi, GyeonggiDo, Korea
Type of equipment:	CAR AUDIO VIDEO NAVIGATION SYSTEM
Basic Model:	XSG2NA
Brand name:	-
Serial number:	Proto Type

3.2 General description

Frequency Range	2402 MHz ~ 2480 MHz
Type of Modulation	Modulation technologies: FHSS Modulation : GFSK
Number of Channels	79 channels (channel spacing: 1 MHz)
Type of Antenna	Integral (Chip antenna)
Antenna Gain	3.438 dBi
Transmit Power	Under 6 dBm (declared by the applicant)
Power supply	DC 12V
Operating temperature	-20 ℃ ~ 55 ℃*
Dimension	
Weight	

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3.3 Test frequency

	Frequency
Low frequency	**2402 MHz**
Middle frequency	**2441 MHz**
High frequency	**2480 MHz**

3.4 Test Voltage

mode	Voltage
Norminal voltage	**DC 12V**

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4. Summary of test results

4.1 Standards & results

Rule Reference	Parameter	Report Section	Test Result
15.203, 15.247(b)(4)	Antenna Requirement	5.1	C
15.247(b)(1), (4)	Maximum Peak Output Power	5.2	C
15.247(a)(1)	Carrier Frequency Separation	5.3	C
15.247(a)(1)	20dB Channel Bandwidth	5.4	C
15.247(a)(iii) 15.247(b)(1)	Nunber of Hopping Channel	5.5	C
15.247(a) (iii)	Time of Occupancy(Dwell Time)	5.6	C
15.247(d), 15.205(a), 15.209(a)	Spurious Emission, Band Edge, and Restricted bands	5.7	C
15.247(e)	Peak Power Spectral Density	5.8	C
15.207(a)	Conducted Emissions	5.9	N/A*
15.247(i), 1.1307(b)(1)	RF Exposure	5.10	C

Note: C=complies
NC= Not complies
NT=Not tested
NA=Not Applicable

*The test is not applicable since the EUT is not the device that is designed to be connected to the public utility(AC) power line.

4.2 Uncertainty

Measurement Item	Combined Standard Uncertainty Uc	Expanded Uncertainty U = KUc (K = 2)
Conducted RF power	± 0.272 dB	± 0.544 dB
Radiated disturbance	± 1.943 dB	± 3.886 dB
Conducted disturbance	± 1.265 dB	± 2.53 dB

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5. Test results

5.1 Antenna Requirement

5.1.1 Regulation

According to §15.203, 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 of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.1.2 Result

-Complied

The transmitter has an integral PCB pattern antenna. The directional gain of the antenna is 3.438 dBi.

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5.2 Maximum Peak Output Power

5.2.1 Regulation

According to §15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

According to §15.247(b)(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

5.2.2 Measurement Procedure

1. Check the calibration of the measuring instrument (spectrum analyzer) using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface and make sure the spectrum analyzer is operated in its linear range.
4. Set the spectrum analyzer as follows: Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel RBW > the 20 dB bandwidth of the emission being measured VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold
5. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
6. Repeat above procedures until all frequencies measured were complete.

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5.2.3 Test Result

-Complied

Channel	Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-1.11	30.00	31.11
Middle	2441	1.37	30.00	28.63
High	2480	2.45	30.00	27.55

NOTE:

1. Since the directional gain of the integral antenna declared by the manufacturer (G_{ANT} = 3.438 dBi) does not exceed 6.0 dBi, there was no need to reduce the output power.
2. We took the insertion loss of the cable loss into consideration within the measuring instrument.

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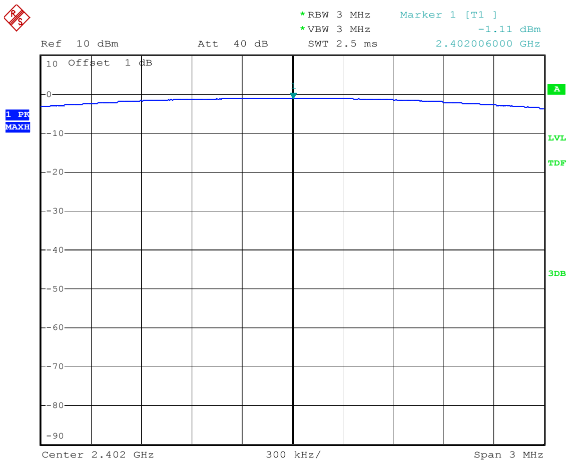
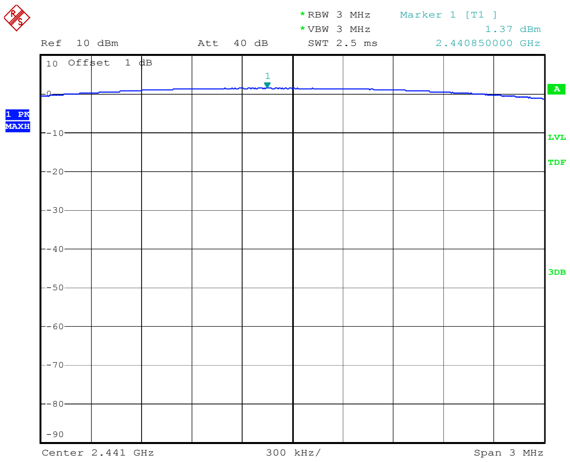
5.2.4 Test Plot

Figure 1. Plot of the Maximum Peak Output Power (Conducted)

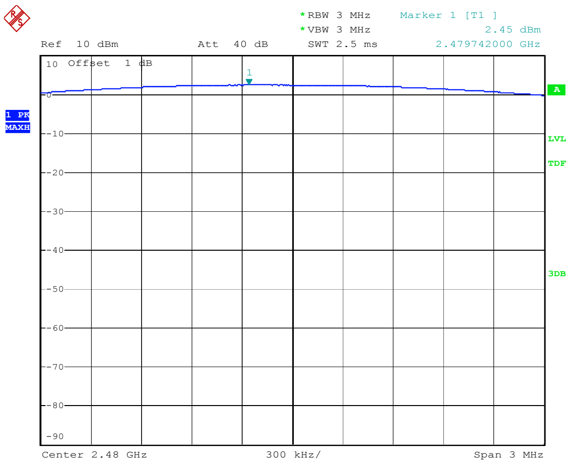
Lowest Channel
(2402 MHz)



Middle Channel
(2441 MHz)



Highest Channel
(2480 MHz)



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5.3 Carrier Frequency Separation

5.3.1 Regulation

According to §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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW

5.3.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable and attenuator.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface.
4. Set the spectrum analyzer as follows: Span = wide enough to capture the peaks of two adjacent channels Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span Video (or Average) Bandwidth (VBW) ≥ RBW Sweep = auto Detector function = peak Trace = max hold
5. Measure the separation between the peaks of the adjacent channels using the marker-delta function.
6. Repeat above procedures until all frequencies measured were complete.

5.3.3 Test Result

-Complied

Channel	Carrier frequency separation	Limit
Low	996 kHz	≥25 kHz or 20 dB bandwidth
Middle	1020 kHz	≥25 kHz or 20 dB bandwidth
High	978 kHz	≥25 kHz or 20 dB bandwidth

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

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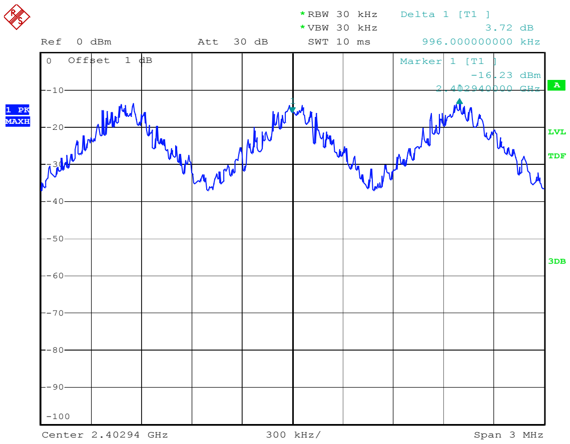
5.3.4 Test Plot

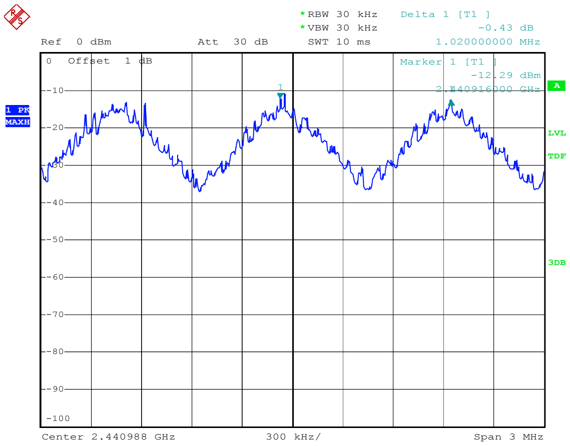
Figure 3. Plot of the Carrier Frequency Separation (Conducted)

- DC 3.7V

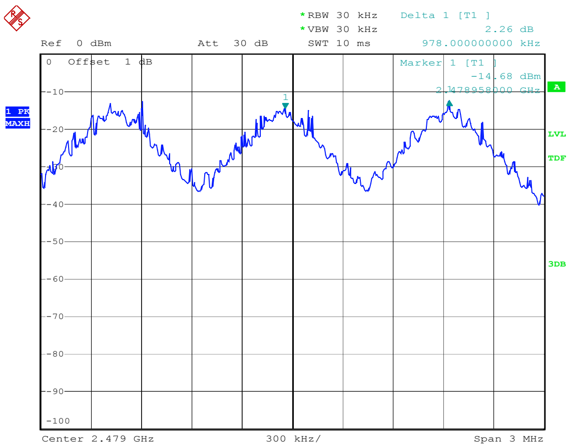
Lowest Channel
(2402 MHz)



Middle Channel
(2441 MHz)



Highest Channel
(2480 MHz)



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5.4 20 dB Channel Bandwidth

5.4.1 Regulation

According to §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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW

5.4.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable and attenuator.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface and make sure the spectrum analyzer is operated in its linear range.
4. Set the spectrum analyzer as follows:
   Span = approximately 2 to 3 times the 20 dB bandwidth,
   centered on a hopping channel
   RBW ≥ 1% of the 20 dB bandwidth
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
5. Set a reference level on it equal to the highest peak value.
6. Measure the frequency difference of two frequencies that were attenuated 20dB from the reference level. Record the frequency difference as the emission bandwidth.
7. Repeat above procedures until all frequencies measured were complete..

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5.4.3 Test Result

-Complied

Channel	20dB Channel bandwidth	Limit	Carrier frequency separation
Low	820 kHz	<Carrier frequency separation	996 kHz
Middle	820 kHz	<Carrier frequency separation	1020 kHz
High	800 kHz	<Carrier frequency separation	978 kHz

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

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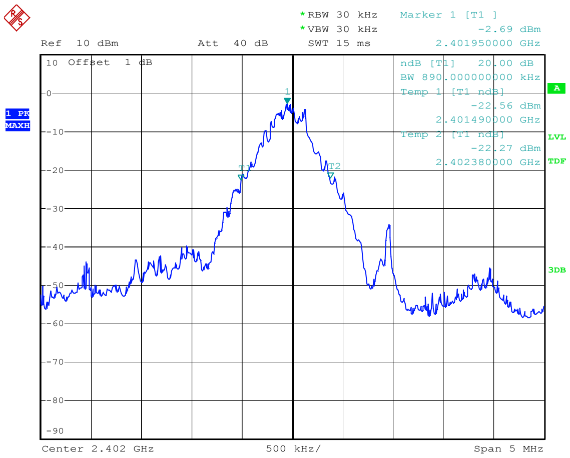
5.4.4 Test Plot

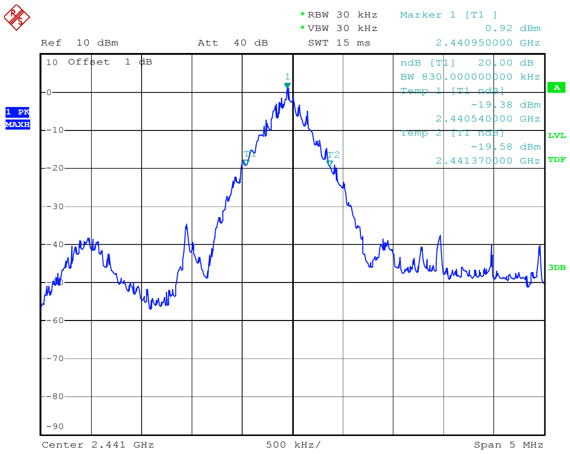
Figure 5. Plot of the 20dB Channel Bandwidth (Conducted)

- DH5

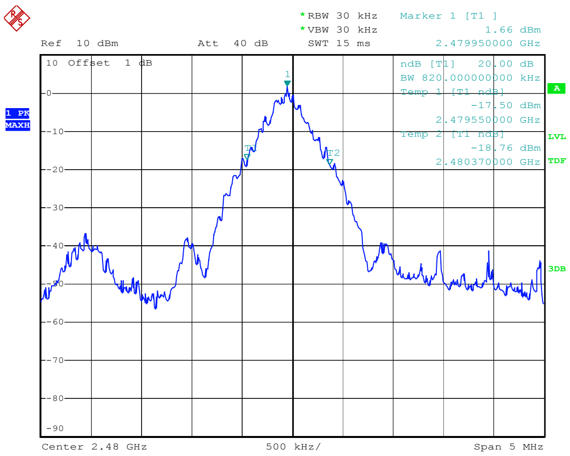
Lowest Channel
(2402 MHz)



Middle Channel
(2441 MHz)



Highest Channel
(2480 MHz)



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5.5 Number of Hopping Channels

5.5.1 Regulation

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. According to §15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

5.5.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable and attenuator.
3. Turn on the EUT and set the hopping function enabled by controlling it via UART interface.
4. Set the spectrum analyzer as follows: Span = the frequency band of operation RBW ≥ 1% of the span VBW ≥ RBW Sweep = auto Detector function = peak Trace = max hold
5. Record the number of hopping channels.

5.5.3 Test Result

-Complied

Frequency	Number of hopping channel	Limit
2042 – 2480 MHz	79	≥15

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

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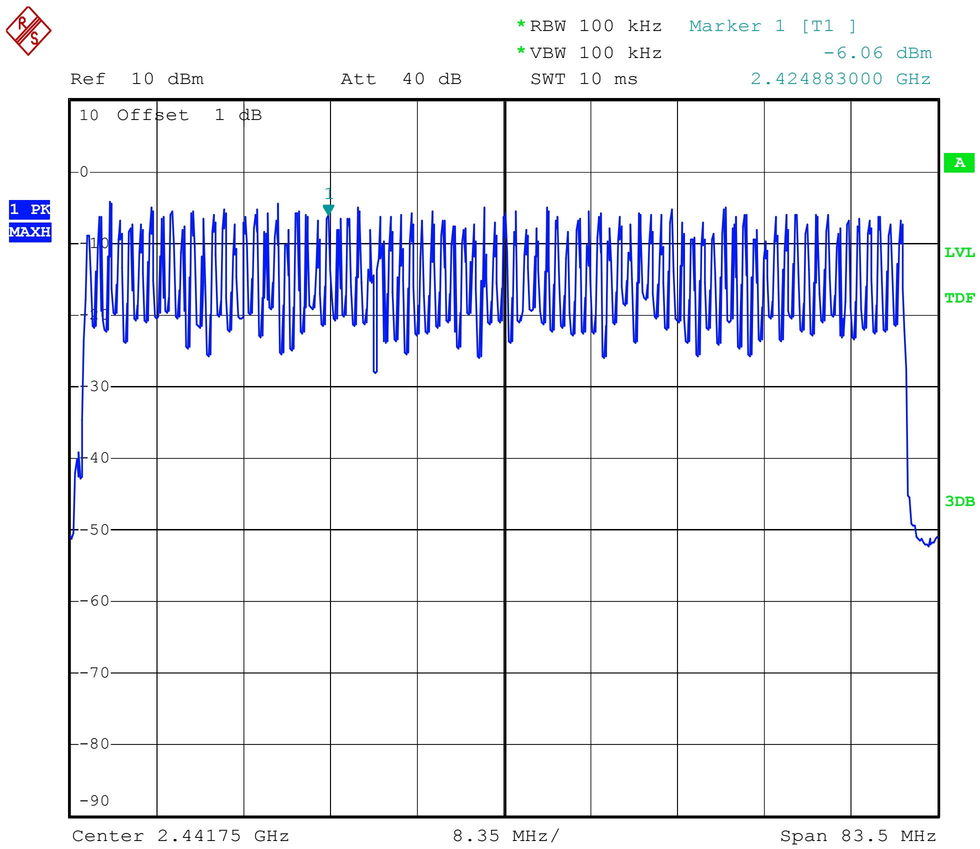
5.5.4 Test Plot

Figure 7. Plot of the Number of Hopping Channels (Conducted)



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5.6 Time of Occupancy(Dwell Time)

5.6.1 Regulation

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

5.6.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface.
4. Set the spectrum analyzer as follows: Span = zero span, centered on a hopping channel RBW = 1 MHz VBW ≥ RBW Sweep = as necessary to capture the entire dwell time per hopping channel Detector function = peak Trace = max hold
5. Measure the dwell time using the marker-delta function.
6. Repeat above procedures until all frequencies measured were complete.
7. Repeat this test for different modes of operation (e.g., data rate, modulation format, etc.), if applicable.

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5.6.3 Test Result

-Complied

-DH5

Channel	Reading	Hopping rate	Number of Channels	Actual	Limit
Low	2.91 ms	266.667 hops/s	79	0.310 s	0.4 s
Middle	2.91 ms	266.667 hops/s	79	0.310 s	0.4 s
High	2.91 ms	266.667 hops/s	79	0.310 s	0.4 s

Actual = Reading × (Hopping rate / Number of channels) × Test period
Test period = 0.4 [seconds / channel] × 79 [channel] = 31.6 [seconds]
NOTE:

1. The EUT makes worst case 1600 hops per second or 1 time slot has a length of 625μs with 79 channels. A DH5 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.
2. We took the insertion loss of the cable loss into consideration within the measuring instrument.

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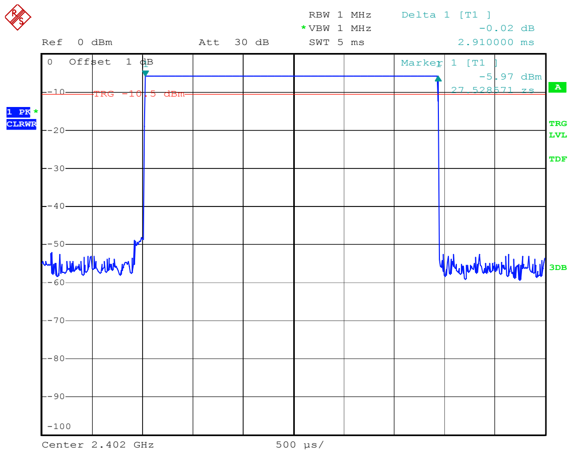
5.6.4 Test Plot

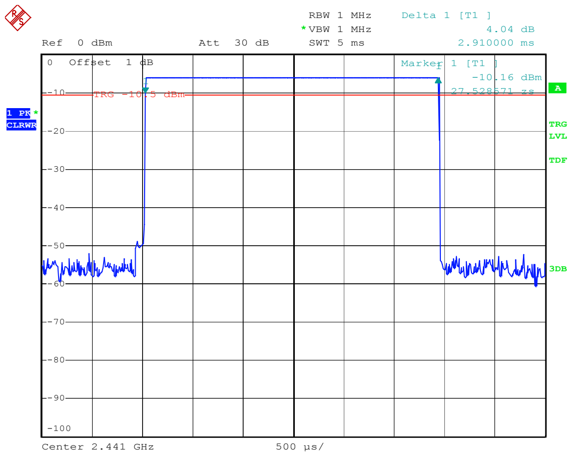
Figure 8. Plot of the Time of Occupancy (Conducted)

- DH5

Lowest Channel
(2402 MHz)



Middle Channel
(2441 MHz)



Highest Channel
(2480 MHz)

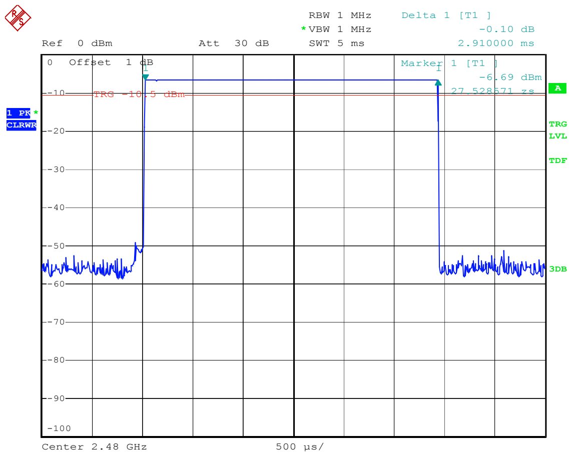


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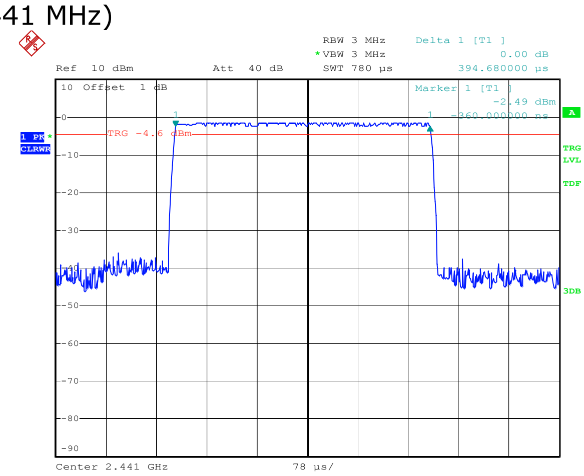
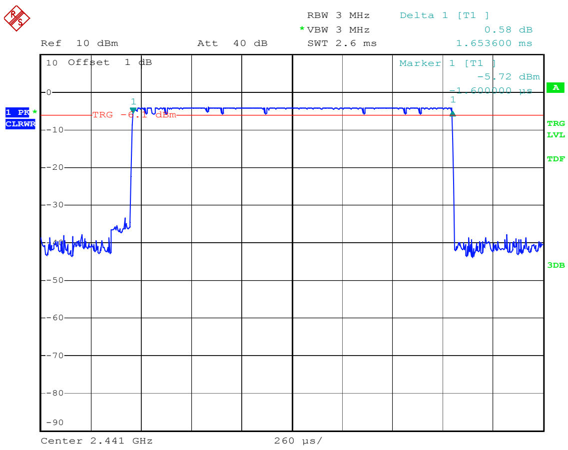
Figure 8. Plot of the Time of Occupancy (Conducted)

- Middle Channel(2441 MHz)

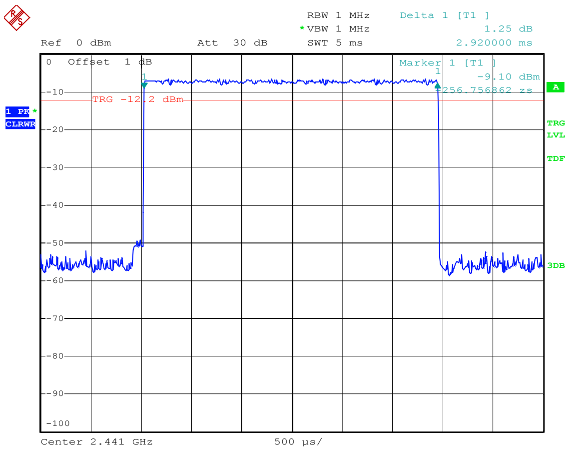
DH1



DH3



DH5



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5.7 SPURIOUS EMISSION, BAND EDGE, AND RESTRICTED BANDS

5.7.1 Regulation

According to §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 a radiated 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, as permitted under paragraph (b)(3) of this section, 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)).
According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency (MHz)	Field strength (μV/m @ 3m)	Field strength (dBμV/m @ 3m)
30–88	100	40.0
88–216	150	43.5
216–960	200	46.0
Above 960	500	54.0

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

** The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

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5.7.2 Measurement Procedure

1) Band-edge Compliance of RF Conducted Emissions
2)

1. Set the spectrum analyzer as follows:
   Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge, as well as any modulation products which fall outside of the authorized band of operation
   RBW ≥ 1% of the span
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.
3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.

2) Spurious RF Conducted Emissions:

1. Set the spectrum analyzer as follows:
   Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
   RBW = 100 kHz
   VBW ≥ RBW
   Sweep = auto
   Detector function = peak
   Trace = max hold
2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.

5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

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3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360˚.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 30 to 1000 MHz using the TRILOG broadband antenna, and from 1000 MHz to 18000 MHz using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

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5.7.3 Test Result

-complied

1. Band edge compliance of RF Conducted Emissions was shown in figure 10.
2. Band edge compliance of RF Radiated Emissions was shown in figure 11.
3. Spurious RF conducted Emissions were shown in the Figure 12.

   Note: We took the insertion loss of the cable into consideration within the measuring instrument.

4. Measured value of the Field strength of spurious Emissions (Radiated)

   - **Low channel (2402 MHz)**

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 1GHz							
114.896	120	V	53.9	-16.4	37.5	43.5	6.0
114.896	120	H	53.5	-16.4	37.1	43.5	6.4
402.125	120	H	50.2	-10.6	39.6	46.0	6.4
402.125	120	H	50.1	-10.6	39.5	46.0	6.5
421.272	120	H	53.1	-10.3	42.8	46.0	3.2 **
421.274	120	H	53.0	-10.3	42.7	46.0	3.3 **
431.944	120	H	52.2	-10.1	42.1	46.0	3.9
440.386	120	H	51.7	-9.8	41.9	46.0	4.1
459.554	120	H	49.9	-9.4	40.5	46.0	5.5
459.589	120	H	48.3	-9.4	38.9	46.0	7.1
478.803	120	H	47.5	-9.1	38.4	46.0	7.6
728.978	120	V	43.3	-4.4	38.9	46.0	7.1
850.499	120	V	41.6	-2.2	39.4	46.0	6.6
Peak DATA. Emissions above 1GHz							
1601.5	1000	V	51.1	-4.6	46.5	74.0	27.5
1601.5	1000	H	50.3	-4.6	45.7	74.0	28.3
4804	1000	H	46.9	4.4	51.3	74.0	22.7
4804	1000	V	51.2	4.4	55.6	74.0	18.4
Average DATA. Emissions above 1GHz							
1601.5	1000	V	41.9	-4.6	37.3	54.0	16.7
1601.5	1000	H	45.1	-4.6	40.5	54.0	13.5
4804	1000	H	34.2	4.4	38.6	54.0	15.4
4804	1000	V	42.4	4.4	46.8	54.0	7.2

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- Middle channel (2441 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 1GHz							
114.875	120	H	54.3	-16.4	37.9	43.5	5.6
114.875	120	V	54.5	-16.4	38.1	43.5	5.4
172.348	120	H	49.5	-14.5	35.0	43.5	8.5
421.244	120	H	53.1	-10.3	42.8	46.0	3.2**
432.008	120	H	52.2	-10.1	42.1	46.0	3.9
440.423	120	H	51	-9.8	41.2	46.0	4.8
440.553	120	H	52	-9.8	42.2	46.0	3.8
459.541	120	H	49	-9.4	39.6	46.0	6.4
459.542	120	H	51.2	-9.4	41.8	46.0	4.2
478.687	120	H	47.6	-9.1	38.5	46.0	7.5
728.991	120	V	44.1	-4.4	39.7	46.0	6.3
850.469	120	V	41.5	-2.2	39.3	46.0	6.7
Peak DATA. Emissions above 1GHz							
1626.8	1000	V	51.2	-4.4	46.8	74.0	27.2
1626.8	1000	H	52.1	-4.4	47.7	74.0	26.3
4882	1000	H	50.4	4.6	55.0	74.0	19.0
4882	1000	V	51.3	4.6	55.9	74.0	18.1
Average DATA. Emissions above 1GHz							
1626.8	1000	V	45.1	-4.4	40.7	54.0	13.3
1626.8	1000	H	48.1	-4.4	43.7	54.0	10.3
4882	1000	H	37.4	4.6	42.0	54.0	12.0
4882	1000	V	42.0	4.6	46.6	54.0	7.4

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- High channel (2480 MHz)

Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 1GHz							
114.9	120	V	54.1	-16.4	37.7	43.5	5.8
114.9	120	H	53.9	-16.4	37.5	43.5	6.0
383.0	120	H	49.9	-11.2	38.7	46.0	7.3
402.2	120	H	48.8	-10.6	38.2	46.0	7.8
421.4	120	H	53.0	-10.3	42.7	46.0	3.3**
432.0	120	H	52.6	-10.1	42.5	46.0	3.5**
440.4	120	H	52.2	-9.8	42.4	46.0	3.6**
440.5	120	H	48.7	-9.8	38.9	46.0	7.1
459.5	120	H	48.1	-9.4	38.7	46.0	7.3
729.0	120	V	43.0	-4.4	38.6	46.0	7.4
850.5	120	V	41.0	-2.2	38.8	46.0	7.2
Peak DATA. Emissions above 1GHz							
1652.5	1000	V	47.8	-4.3	44.2	74.0	29.8
1652.7	1000	H	53.0	-4.3	48.7	74.0	25.3
4960.0	1000	H	48.4	4.8	53.2	74.0	20.8
4960.0	1000	V	51.4	4.8	56.2	74.0	17.8
Average DATA. Emissions above 1GHz							
1652.5	1000	V	48.5	-4.3	43.5	54.0	10.5
1652.7	1000	H	49.5	-4.3	45.2	54.0	8.8
4960.0	1000	H	36.2	4.8	41.0	54.0	13.0
4960.0	1000	V	41.4	4.8	46.2	54.0	7.8

Factor(dB) = ANT Factor+ Amp Gain + Cable Loss
Margin (dB) = Limit - Result
[Result = Reading – Factor]
1. H = Horizontal, V = Vertical Polarization
2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

* The spurious emission at the frequency does not fall in the restricted bands.
** The measured result is within the test standard limit by a margin less than the measurement uncertainty; it is therefore not possible to state compliance based on the 95 % level of confidence. However, the result indicates that compliance is more probable than non-compliance.

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.

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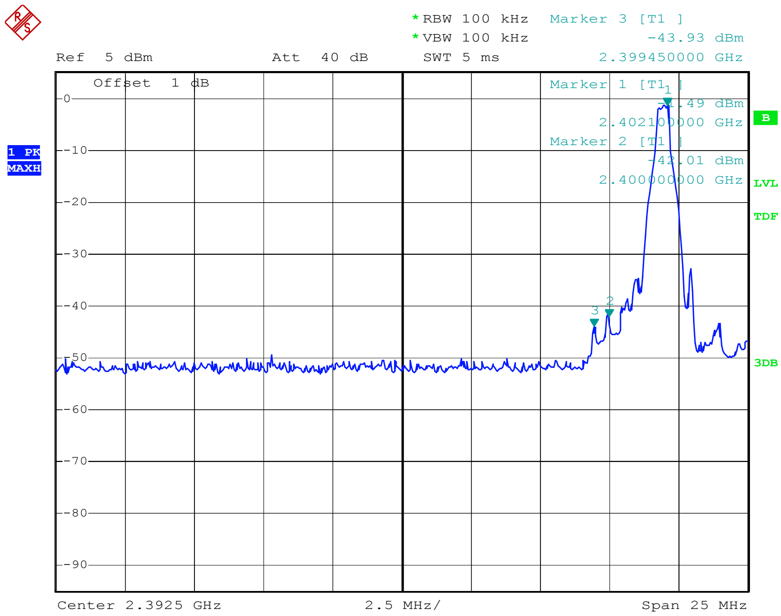
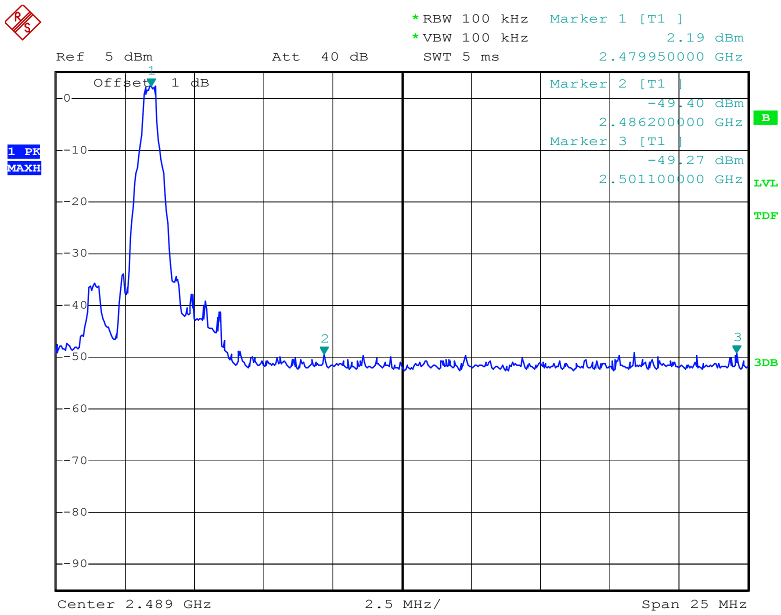
5.7.4 Test Plot

Figure 10. Plot of the Band Edge (Conducted)

Lowest Channel
(2402 MHz)



Highest Channel
(2480 MHz)



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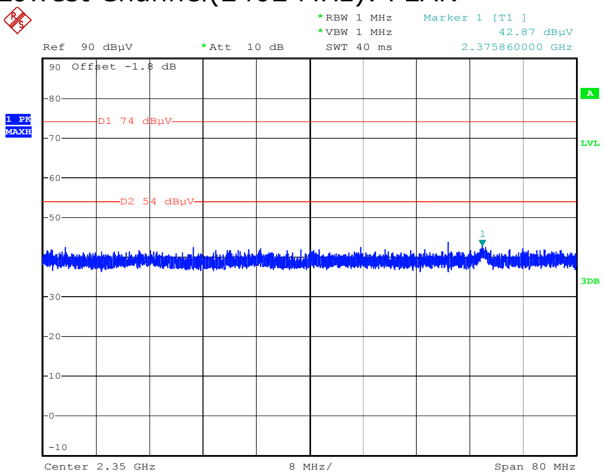
5.7.4 Test Plot (Continue)

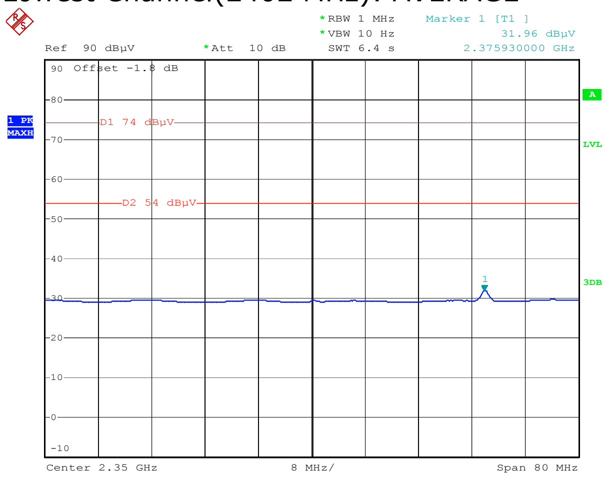
Figure 11. Plot of the Band Edge (Radiated)

- Worst case: vertical pol.

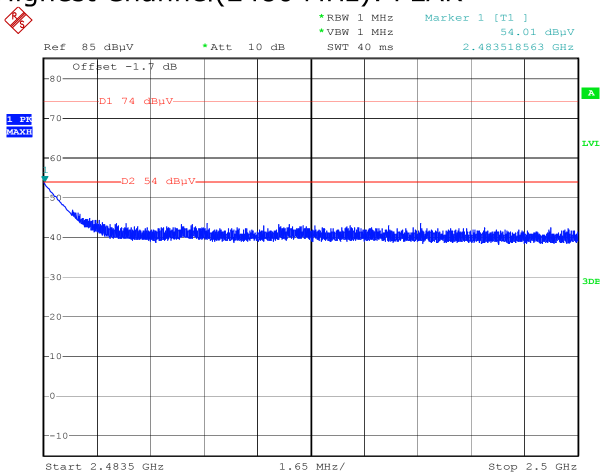
Lowest Channel(2402 MHz): PEAK



Lowest Channel(2402 MHz): AVERAGE



Highest Channel(2480 MHz): PEAK



Highest Channel(2480 MHz): AVERAGE

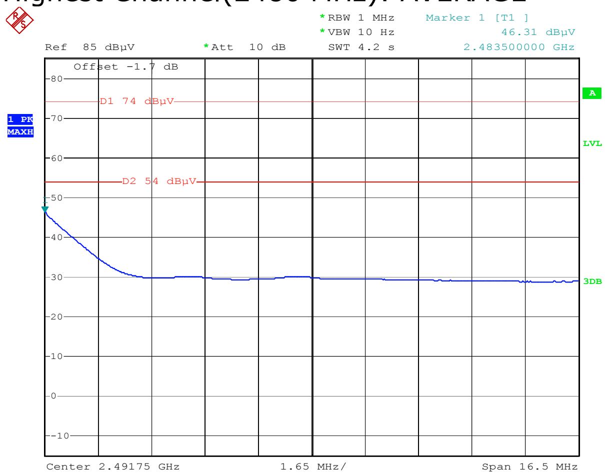


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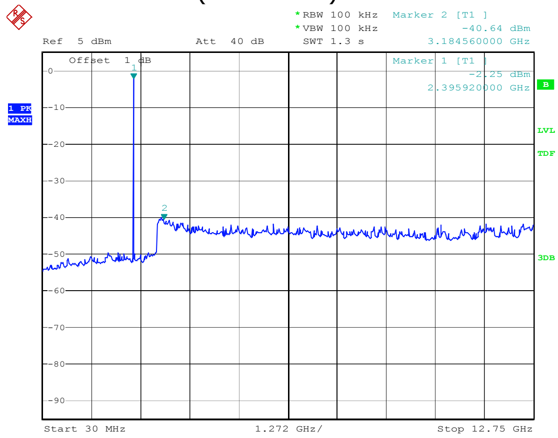
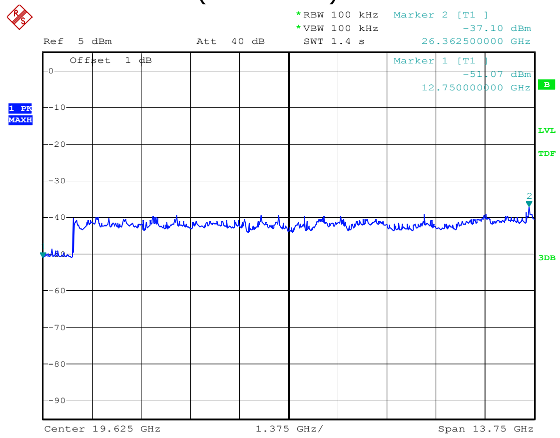
Figure 12. Plot of the Spurious RF conducted emissions

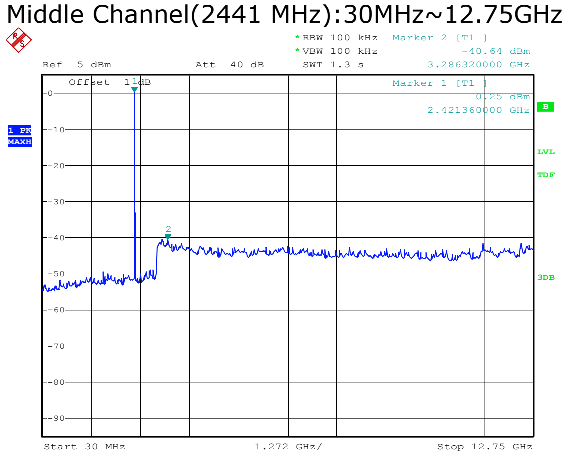
Lowest Channel(2402 MHz):30MHz~12.75GHz



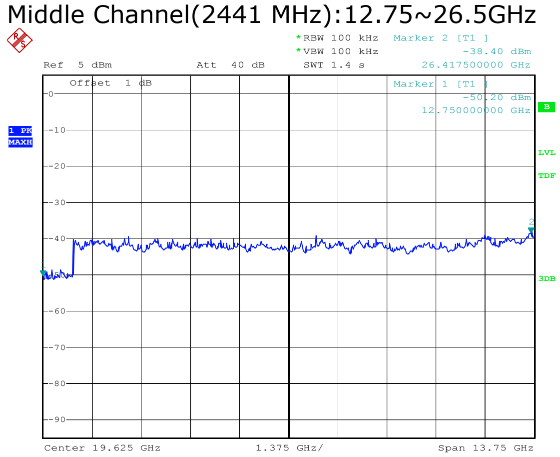
Lowest Channel(2402 MHz):12.75~26.5GHz



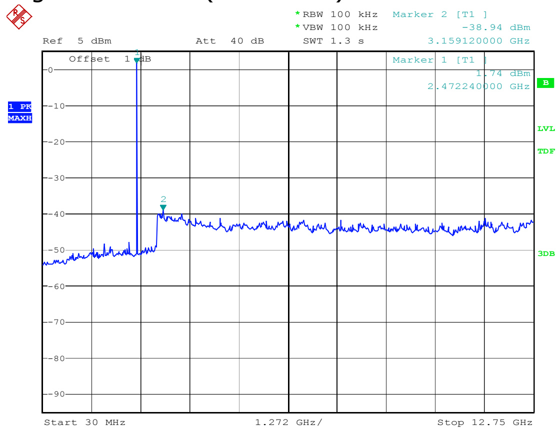
Middle Channel(2441 MHz):30MHz~12.75GHz



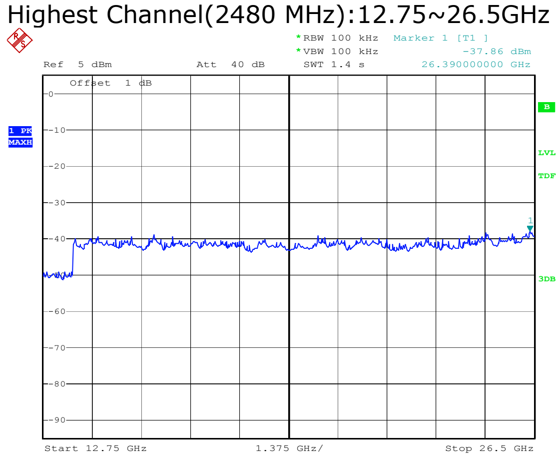
Middle Channel(2441 MHz):12.75~26.5GHz



Highest Channel(2480 MHz):30MHz~12.75GHz



Highest Channel(2480 MHz):12.75~26.5GHz



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5.8 Peak Power Spectral Density

5.8.1 Regulation

According to §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

5.8.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable and attenuator.
3. Turn on the EUT and set it to any one measured frequency within its operating range by controlling it via UART interface and make sure the spectrum analyzer is operated in its linear range.
4. Set the spectrum analyzer to MAX HOLD mode with RBW = 3kHz.
5. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
6. Repeat above procedures until all frequencies measured were complete.

5.8.3 Test Result

-Complied

Channel	Actual (dBm)	Limit (dBm)	Margin (dB)
Low	-12.56	8.00	20.56
Middle	-9.93	8.00	17.93
High	-8.63	8.00	16.63

NOTE: We took the insertion loss of the cable loss into consideration within the measuring instrument.

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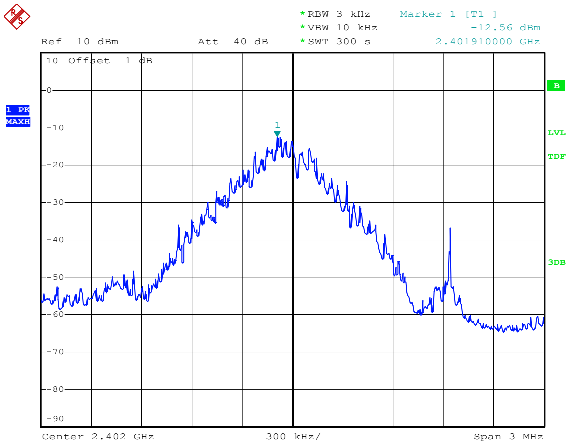
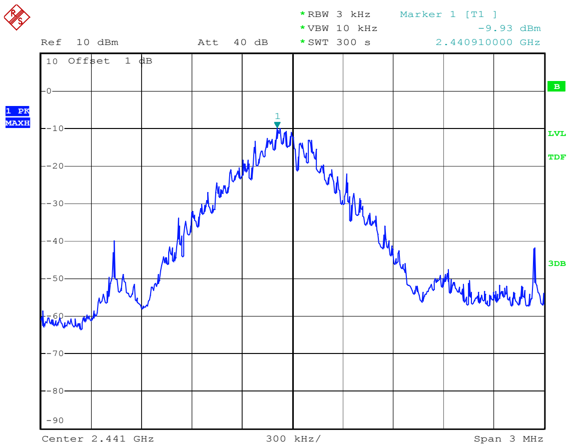
5.8.4 Test Plot

Figure 16. Plot of the Peak Power Spectral Density (Conducted)

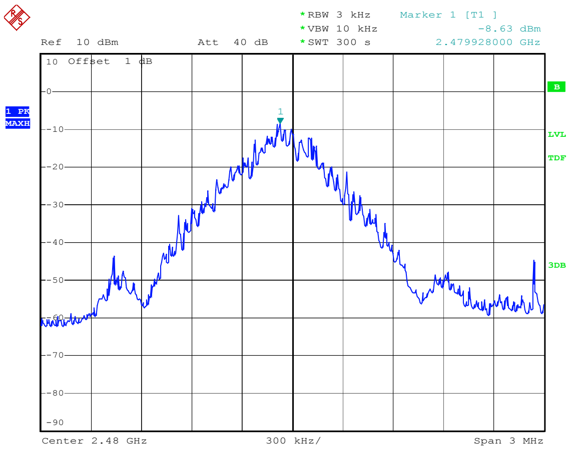
Lowest Channel
(2402 MHz)



Middle Channel
(2441 MHz)



Highest Channel
(2480 MHz)



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5.9 Conducted Emission- N/A

-

5.9.1 Regulation

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 50μH/50Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Qausi-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.

According to §15.107(a), for unintentional device, except for Class A digital devices, line conducted emission limits are the same as the above table.

5.9.2 Measurement Procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50Ω/50μH LISN, which is an input transducer to a Spectrum Analyzer or an EMI/Field Intensity Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to PEAK amplitude within a bandwidth of 10 kHz or to QUASI-PEAK and AVERAGE within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

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5.10 RF Exposure

5.10.1 Regulation

According to §15.247(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See § 1.1307(b)(1) of this Chapter.

Limits for Maximum Permissive Exposure: RF exposure is calculated.

Frequency Range	Electric Field Strength [V/m]	Magnetic Field Strength [A/m]	Power Density [mW/cm^2]	Averaging Time [minute]
Limits for General Population / Uncontrolled Exposure				
0.3 ~ 1.34	614	1.63	*(100)	30
1.34 ~ 30	824 /f	2.19/f	*($180/f^2$)	30
30 ~ 300	27.5	0.073	0.2	30
300 ~ 1500	/	/	f/1500	30
1500 ~ 15000	/	/	1.0	30

*f=frequency in MHz, *= plane-wave equivalent power density*

MPE (Maximum Permissive Exposure) Prediction

Predication of MPE limit at a given distance: Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2 \quad \left(\Rightarrow R = \sqrt{PG/4\pi S}\right)$$

S=power density [mW/cm^2]
P=Power input to antenna [mW]
G=Power gain of the antenna in the direction of interest relative to an isotropic radiator
R= distance to the center of radiation of the antenna [cm]

EUT: Maximum peak output power = 1.758[mW](= 2.45 dBm) Antenna gain=2.207(=3.438[dBi])	
100 mW, at 20 cm from an antenna 6[dBi]	$S = PG/4\pi R^2 = 100 \times 3.98 / (4 \times \pi \times 400)$ $= 0.0792$ [mW/cm^2] < 1.0 [mW/cm^2]
1.758 mW, at 20 cm from an antenna 3.438[dBi]	$S = PG/4\pi R^2 = 0.0007$ [mW/cm^2] < 1.0 [mW/cm^2]
1.758 mW, at 2.5 cm from an antenna 3.438[dBi]	$S = PG/4\pi R^2 = 0.0494$ [mW/cm^2] < 1.0 [mW/cm^2]

5.10.2 RF Exposure Compliance Issue

The information should be included in the user’s manual:
This appliance and its antenna must not be co-located or operation in conjunction with any other antenna or transmitter. A minimum separation distance of 20 cm must be maintained between the antenna and the person for this appliance to satisfy the RF exposure requirements.

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6. Test equipment used for test

	Description	Manufacture	Model No.	Serial No.	Next Cal Date.
□	Temp & humidity chamber	taekwang	TK-04	TK001	10.12.11
□	Temp & humidity chamber	taekwang	TK-500	TK002	11.09.07
■	Power Meter	Agilent	E4416A	GB41292365	11.11.01
■	Frequency Counter	HP	5351B	3049A01295	11.11.01
■	Spectrum Analyzer	Agilent	E4407B	US39010142	11.11.01
■	Spectrum Analyzer	R & S	FSP40	100209	11.11.01
■	Signal Generator	HP	E4432B	GB39340611	11.11.01
□	Modulation Analyzer	HP	8901B	3538A05527	10.11.01
□	Audio Analyzer	HP	8903B	3729A19213	11.01.08
□	Audio Analyzer	HP	8903B	3729A18248	10.11.01
□	AC Power Supply	KIKUSUI	PCR2000W	GB001619	11.11.01
■	DC Power Supply	Tektronix	PS2520G	TW50517	11.02.17
□	DC Power Supply	Tektronix	PS2521G	TW53135	11.11.01
□	Dummy Load	BIRD	8141	7560	-
□	Dummy Load	BIRD	8401-025	799	-
■	EMI Test Receiver	R&S	ESCI	100001	11.08.17
■	Attenuator	HP	8494A	2631A09825	10.11.01
■	Attenuator	HP	8496A	3308A16640	10.11.01
■	Attenuator	R&S	RBS1000	D67079	10.11.01
□	Attenuator	BIRD	50-A-MFN-20	0403002	10.11.01
■	Attenuator	HP	11581A	29738	11.01.09
■	Power sensor	Agilent	E9321A	US40390422	10.11.03
□	Power sensor	Agilent	E9325A	US40420186	10.11.03
□	LOOP Antenna	EMCO	EMCO6502	9205-2745	11.05.22
■	BILOG Antenna	Schwarzbeck	VULB 9168	375	10.11.30
■	HORN Antenna	ETS	3115	00062589	10.12.22
□	Power Divider	HP	11636A	05441	11.08.25
■	Signal Generator	HP	E4421B	GB40052295	10.11.01
□	Power Divider	Weinschel	1580-1	NX375	11.09.27
□	Power Divider	Weinschel	1580-1	NX380	11.08.25
□	Power Divider	Weinschel	1594	671	11.09.02

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