FCC TEST REPORT

Test report No.:	EMC- FCC- R0091
FCC ID:	O6ZC41-500
Type of equipment:	Client Receiver
Model Name:	C41-500
Applicant:	HUMAX Co., Ltd.
Max.RF Output Power:	3.43 dBm
FCC Rule Part(s):	FCC Part 15 Subpart C 15.247
Frequency Range:	2 425 MHz ~ 2 475 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: January 14, 2013 ~ January 17, 2013

Issued date: January 18, 2013

Tested by: YU, SANG HOON

Approved by: KIM, CHANG MIN

[Contents]

480-5 Shin-dong, Yeongtong-gu, Suwon-city, Gyunggi-do, 443-390, Korea
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1. Client information

Applicant:	HUMAX Co., Ltd
Address:	HUMAX Village, 11-4, Sunae-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-825, KOREA
Telephone number:	+82-31-776-6400
Facsimile number :	+82-31-776-6149
Contact person:	Inseok Seo / Senior Engineer

Manufacturer :	Flextronics Electronics Technology (ShenZhen) Co., Ltd.
Address:	89, YongFu Rd, TongFuYu Ind Park, FuYong, BaoAn, SHZ, 518103 C

2. Laboratory information

Address
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

Certificate
CBTL Testing Laboratory, KOLAS NO.: 231
FCC Filing No.: 508785
VCCI Registration No.: C-1713, R-1606, T-258

SITE MAP

3. Description of E.U.T.

3.1 Basic description

Applicant :	HUMAX Co., Ltd.
Address of Applicant:	HUMAX Village, 11-4, Sunae-dong, Bundang-gu, Seongnam-si, Gyeonggi-do, 463-825, KOREA
Manufacturer:	Flextronics Electronics Technology (ShenZhen) Co., Ltd.
Address of Manufacturer:	89, YongFu Rd, TongFuYu Ind Park, FuYong, BaoAn, SHZ, 518103 C
Type of equipment:	Client Receiver
Basic Model:	C41-500
Serial number:	Proto Type

3.2 General description

Communication	802.15.4(RF4CE)
Frequency Range	2 425 ~ 2 475 MHz
Type of Modulation	Modulation technologies: DSSS Modulation: O-QPSK
Number of Channels	3 ch
Antenna Gain	3.40 dBi
Type of Antenna	PCB Antenna
Firmware version	GP510 FW v1.1.0.0 CL 00026578
Power supply	DC 12 V, 1.5 A
Dimension	150 mm x 92 mm x 30 mm (W x D x H)

3.3 Test frequency

For all teset items, the low, middle and high channels of the modes were tested with above worst case data rate.

2400 ~ 2483.5 (MHz) : 802.15.4(RF4CE)

	CH	Frequency
Low frequency	15	2 425 MHz
Middle frequency	20	2 450 MHz
High frequency	25	2 475 MHz

3.4 Test Voltage

mode	Voltage
Norminal voltage	DC 12 V

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)(3)	Maximum Peak Output Power	5.2	C
15.247(e)	Peak Power Spectral Density	5.3	C
15.247(a)(2)	6 dB Channel Bandwidth	5.4	C
15.247(d), 15.205(a), 15.209(a)	Spurious Emission, Band Edge, and Restricted bands	5.5	C
15.207(a)	Conducted Emissions	5.6	C
15.247(i), 1.1307(b)(1)	RF Exposure	5.7	C
RSS-Gen, Issue 3,6	Receiver Spurious Emission (Radiated)	5.8	NA

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

4.2 Uncertainty

Measurement Item	Combined Standard Uncertainty Uc	Expanded Uncertainty U = KUc (K = 2)
Conducted RF power	± 0.29 dB	± 0.58 dB
Radiated disturbance	30 ㎒ ~ 300 ㎒ : + 2.43 dB, - 2.44 dB 300 ㎒~1 000 ㎒ : + 2.49dB, - 2.50 dB 1 ㎓ ~ 6 ㎓ : + 3.10 dB, - 3.10 dB 6 ㎓ ~ 18 ㎓ : + 3.21 dB, - 3.27 dB	30 ㎒ ~ 300 ㎒ : + 4.86 dB, - 4.88 dB 300 ㎒ ~ 1 000 ㎒ + 4.98dB, - 4.99 dB 1 ㎓ ~ 6 ㎓ : + 6.19 dB, - 6.20 dB 6 ㎓ ~ 18 ㎓ : + 6.41 dB, - 6.53 dB

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 antenna. The directional peak gain of the antenna is 3.40 dBi.

5.2 Maximum Peak Output Power

5.2.1 Regulation

According to §15.247(b)(3), For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

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

These test measurement settings are specified in section 8.0 of 558074 D01 DTS Meas Guidance.

5.2.2.1 Maximum Peak Conducted Output Power-Option2

1. This procedure provides an integrated measurement alternative when the maximumavailable RBW < EBW.
2. Set the RBW = maximum available (at least 1 MHz).
3. Set the VBW = 3 x RBW or maximum available setting (must be ≥ RBW).
4. Set the span to fully encompass the DTS bandwidth.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the spectrum analyzer's band/channel power measurement function with the band limits set equal to the DTS bandwidth edges (for some analyzers, this may require a manual override to ensure use of peak detector). If the spectrum analyzer does not have a band power function, sum the spectrum levels (in linear power units) at intervals equal to the RBW extending across the DTS channel bandwidth

5.2.3 Test Result

-Complied

Channel	Frequency (MHz)	Result (dBm)	Limit (dBm)	Margin (dB)
Low	2 425	3.43	30.00	26.57
Middle	2 450	3.02	30.00	26.98
High	2 475	2.39	30.00	27.61

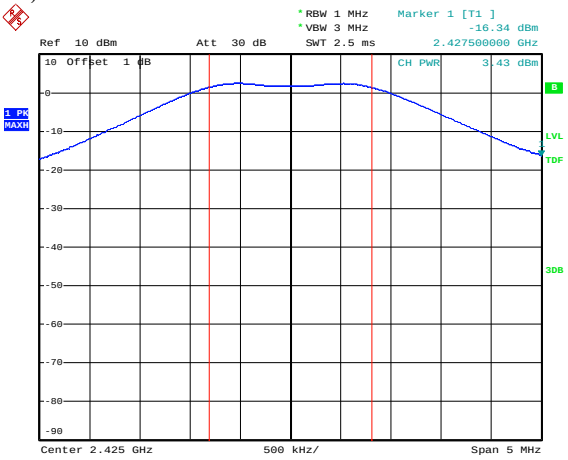
-NOTE:

1. Since the directional gain of the integral antenna declared by the manufacturer (G_{ANT} = 3.40 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.

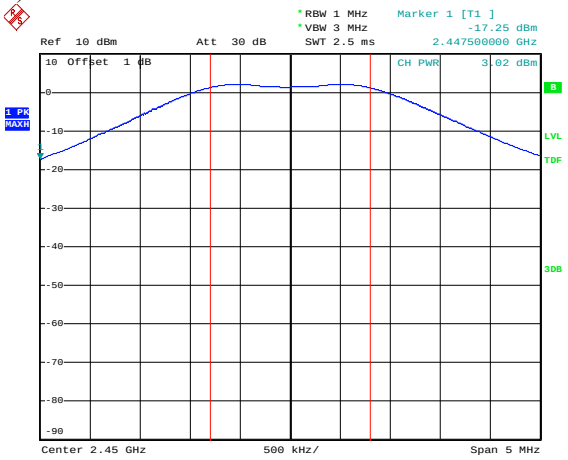
5.2.4 Test Plot

Figure 1. Plot of the Maximum Peak Output Power

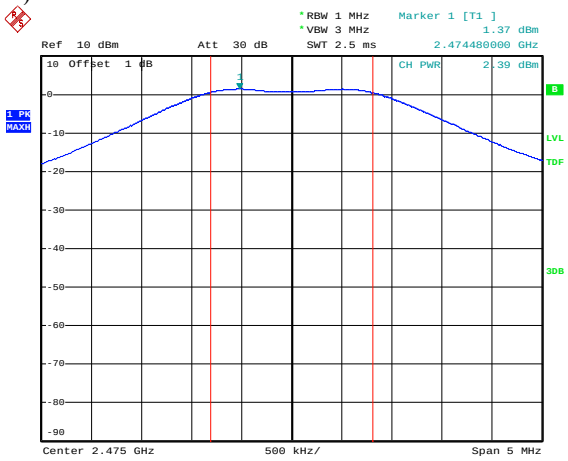
- Lowest Channel (2 425 MHz)



- Middle Chnnel (2 450 MHz)



- Highest Chnnel (2 475 MHz)



5.3 Peak Power Spectral Density

5.3.1 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.

5.3.2 Measurement Procedure

These test measurement settings are specified in section 9.0 of 558074 D01 DTS Meas Guidance.

5.3.2.1 Maximum Power Spectral Density level in the Fundmaeental Emission-Option1

Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS channel bandwidth.
3. Set the RBW ≥ 3 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = peak.
6. Sweep time = auto couple..
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.3.3 Test Result

-Complied

Channel	Result [dBm]	Limit [dBm]	Margin [dBm]
Low	-11.45	8.00	19.45
Middle	-11.50	8.00	19.50
High	-12.59	8.00	20.59

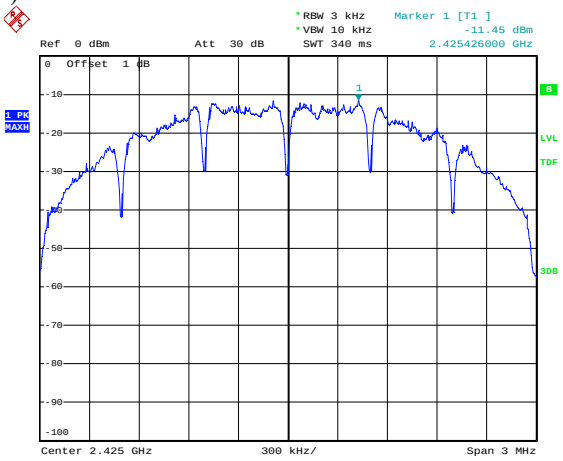
-NOTE:

1. Since the directional gain of the integral antenna declared by the manufacturer (G_{ANT} = 3.40 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.

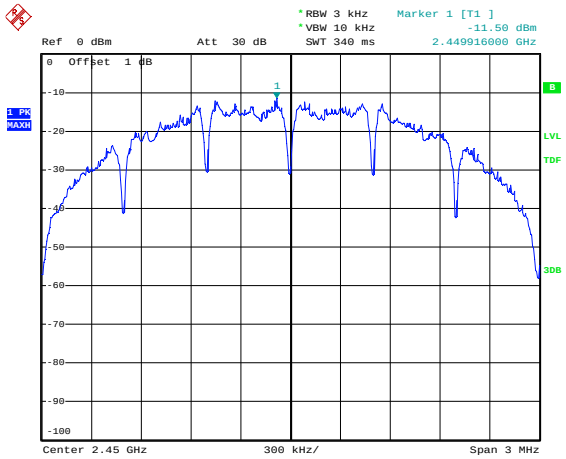
5.3.4 Test Plot

Figure 3. Plot of the Power Density (Conducted)

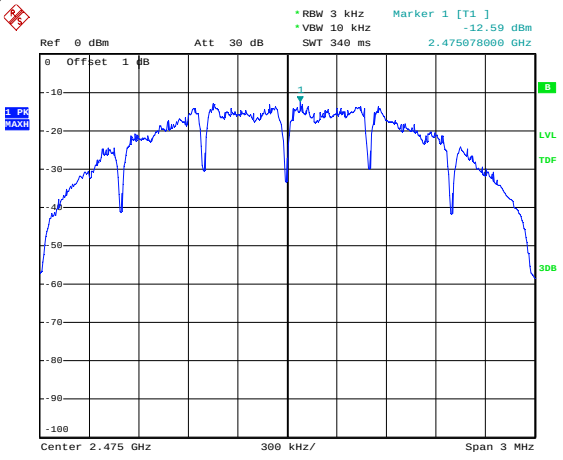
- Lowest Channel(2 425 MHz)



- Middle Chnnel (2 450 MHz)



- Highest Chnnel (2 475 MHz)



5.4 6 dB Bandwidth(DTS Channel Bandwidth)

5.4.1 Regulation

According to §15.247(a)(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.4.2 Measurement Procedure

These test measurement settings are specified in section 7.0 of 558074 D01 DTS Meas Guidance.

5.4.2.1 DTS Channel Bandwidth-Option 1

1. Set resolution bandwidth (RBW) = 1-5% or DTS BW, not to exceed 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.4.2.2 DTS Channel Bandwidth Measurement Procedure-Option 2

The automatic bandwidth measurement capability of a spectrum analyzer may be employed using the X dB bandwidth mode with X set to 6 dB, if it implements the functionality described above. When using this capability, care should be taken to ensure that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that may be ≥ 6 dB.

5.4.3 Test Result

-Complied

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Min. Limit (kHz)
Low	2 425	1.620	500
Middle	2 450	1.600	500
High	2 475	1.580	500

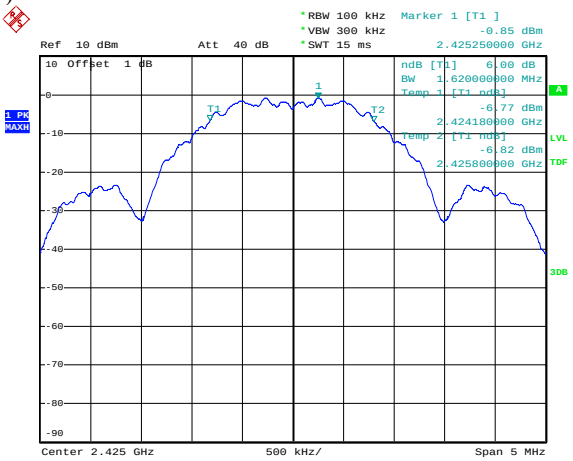
-NOTE:

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

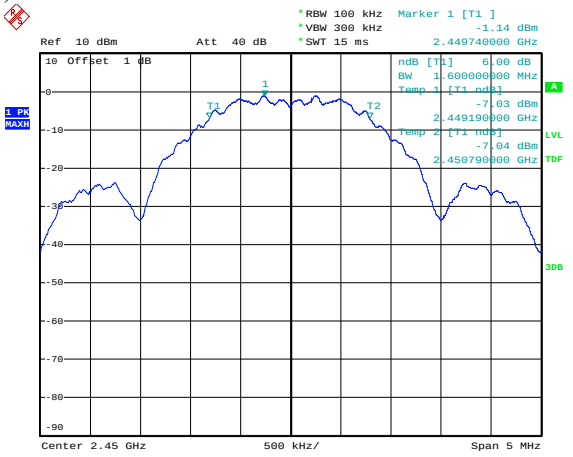
5.4.4 Test Plot

Figure 4. Plot of the 6dB Bandwidth (Conducted)

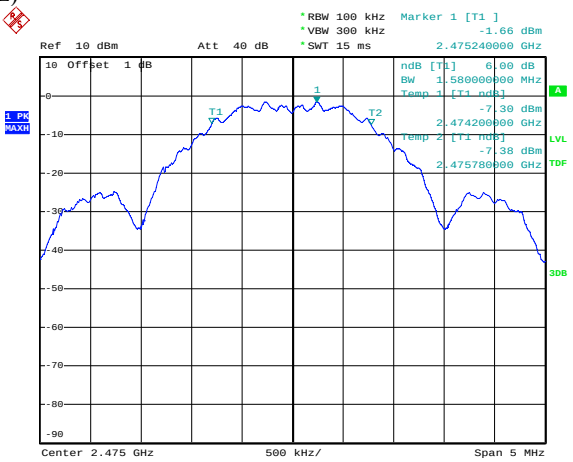
- Lowest Channel (2 425 MHz)



- Middle Channel (2 450 MHz)



- Highest Channel (2 475 MHz)



5.5 SPURIOUS EMISSION, BAND EDGE, AND RESTRICTED BANDS

5.5.1 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.

5.5.2 Measurement Procedure

5.5.2.1 Band-edge Compliance of RF Conducted Emissions

5.5.2.1.1 Reference Level Measurement

Establish the reference level by using the peak PSD procedure from Section 9.1 to measure the PSD level in any 100 kHz bandwidth (*i.e.*, set RBW = 100 kHz and VBW ≥ 300 kHz) within the DTS channel bandwidth (the channel found to contain the maximum PSD level can be used to establish the reference level).

5.5.2.1.2 Unwanted Emissions Level Measurement

1. Set start frequency to DTS channel edge frequency.
2. Set stop frequency so as to encompass the spectrum to be examined.
3. Set RBW = 100 kHz.
4. Set VBW ≥ 300 kHz.
5. Detector = peak.
6. Trace Mode = max hold.
7. Sweep = auto couple.
8. Allow the trace to stabilize (this may take some time, depending on the extent of the span).
9. Use peak marker function to determine maximum amplitude of all unwanted emissions within any 100 kHz bandwidth.

5.5.2.2 Conducted Spurious Emissions

Set the spectrum analyzer as follows:

1. 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.
2. RBW = 100 kHz
3. VBW ≥ RBW
4. Sweep = auto
5. Detector function = peak
6. Trace = max hold
7. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
8. 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.

5.5.2.1 Radiated Spurious Emissions

1. The preliminary and final rdiated measurements were performed to determine the frequency producing the maximum emissions in at a 10m anechoic chamber. The EUT was tested at a distance 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 9 kHz to 30 MHz using the loop antenna, and from 30 to 1000 MHz using the TRILOG broadband antenna, and from 1 000 MHz to 26 500 MHz using the horn antenna.
4. 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.

- Sample calculation

The field strength is calculated adding the antenna Factor, cable loss and, Antenna pad adding, subtracting the amplifier gain from the measured reading.

** The sample calculation is as follow:

Result = M.R + C.F(A.F + C.L +3 dB Att – A.G)
M.R = Meter Reading
C.F = Correction Factor
A.F = Antenna Factor
C.L = Cable Loss
A.G = Amplifier Gain
3 dB Att = 3 dB Attenuator

If M.R is 30 dB, A.F 12 dB, C.L 5 dB, 3 dB, A.G 35 dB
The result is : 30 + 12 + 5 + 3 – 35 = 15 dB(μV/m)

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5.5.3 Test Result

-complied

1. Band-edge & Conducted Spurious Emissions was shown in figure 5.
   Note: We took the insertion loss of the cable into consideration within the measuring instrument.
2. Band edge compliance of Radiated Emissions(Restricted Bands) was shown in figure 6.
3. Measured value of the Field strength of spurious Emissions (Radiated)

Low channel (2 425 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 30 MHz (3m Distance)							
below 30 MHz	**Not Detected**	-	-	-	-	-	-
Quasi-Peak DATA. Emissions below 1GHz							
39.51	120	H	47.4	- 14.8	32.6	40.0	7.4
78.52	120	V	41.3	- 17.5	23.8	40.0	16.2
123.48	120	V	42.0	- 15.5	26.5	43.5	17.0
831.71	120	H	42.6	- 0.3	42.3	46.0	3.7
Peak DATA. Emissions above 1GHz							
Above 1 GHz	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1GHz							
Above 1 GHz	**Not Detected**	-	-	-	-	-	-

Middle channel (2 450 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 30 MHz (3m Distance)							
below 30 MHz	**Not Detected**	-	-	-	-	-	-
Quasi-Peak DATA. Emissions below 1GHz							
33.88	120	H	43.7	- 15.4	28.3	40.0	11.7
60.07	120	V	36.0	- 14.4	21.6	40.0	18.4
77.05	120	V	41.8	- 17.1	24.7	40.0	15.3
123.12	120	V	44.1	- 15.5	28.6	43.5	14.9
841.72	120	H	37.2	- 0.2	37.0	46.0	9.0
Peak DATA. Emissions above 1GHz							
Above 1 GHz	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1GHz							
Above 1 GHz	**Not Detected**	-	-	-	-	-	-

High channel (2 475 MHz)

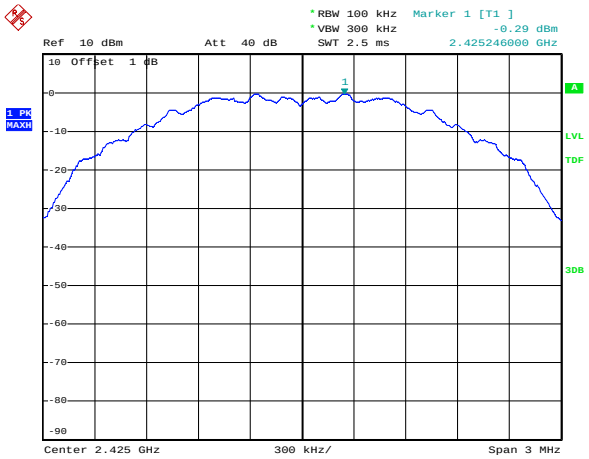
Frequency [MHz]	Receiver Bandwidth [kHz]	Pol. [V/H]	Reading [dB(μV)]	Factor [dB]	Result [dB(μV/m)]	Limit [dB(μV/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 30 MHz (3m Distance)							
below 30 MHz	**Not Detected**	-	-	-	-	-	-
Quasi-Peak DATA. Emissions below 1GHz							
30.12	120	V	36.6	- 15.7	20.9	40.0	19.1
78.34	120	V	41.2	- 17.4	23.8	40.0	16.2
120.25	120	V	44.8	- 15.8	29.0	43.5	14.5
841.72	120	H	41.0	- 0.2	40.8	46.0	5.2
Peak DATA. Emissions above 1GHz							
Above 1 GHz	**Not Detected**	-	-	-	-	-	-
Average DATA. Emissions above 1GHz							
Above 1 GHz	**Not Detected**	-	-	-	-	-	-

5.5.4 Test Plot

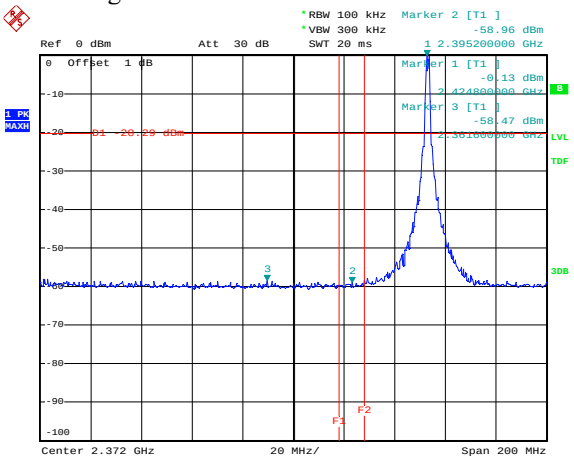
Figure 5. Plot of the Band-edge & Conducted Spurious Emissions

- Lowest Channel (2 425 MHz)

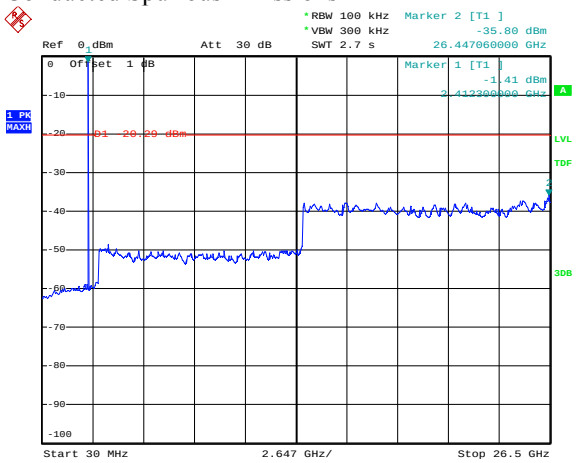
Reference



Band-edge

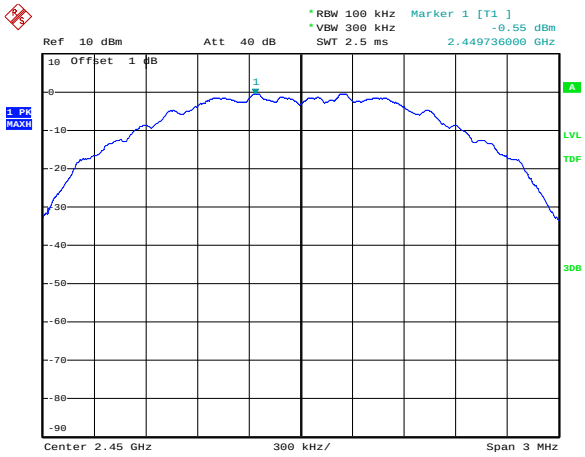


Conducted Spurious Emissions

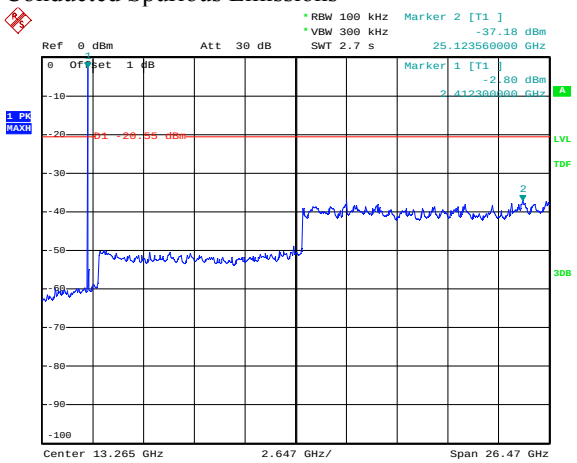


- Lowest Channel (2 450 MHz)

Reference

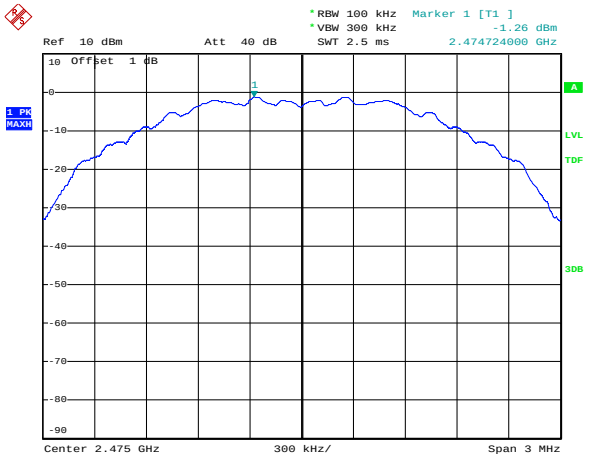


Conducted Spurious Emissions

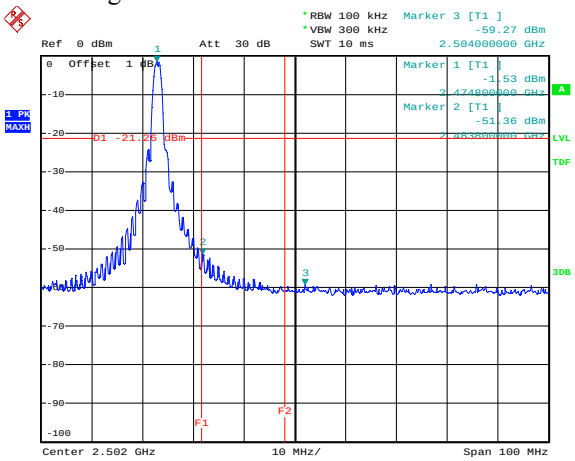


- Lowest Channel (2 475 MHz)

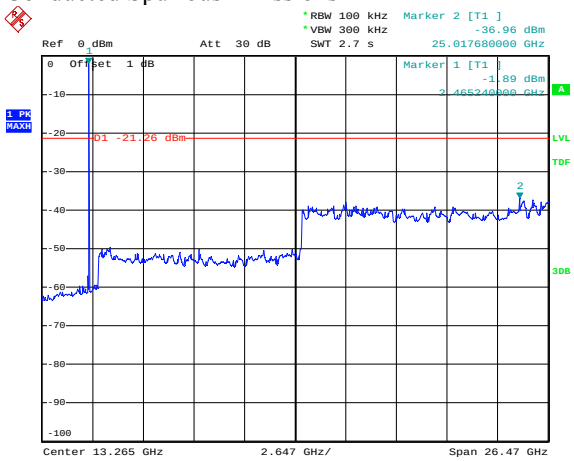
Reference



Band-edge



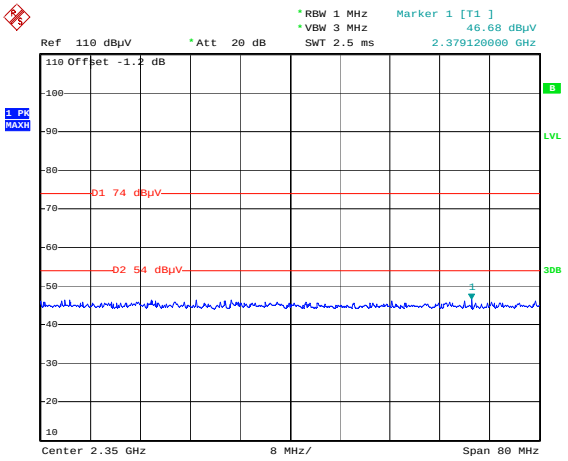
Conducted Spurious Emissions



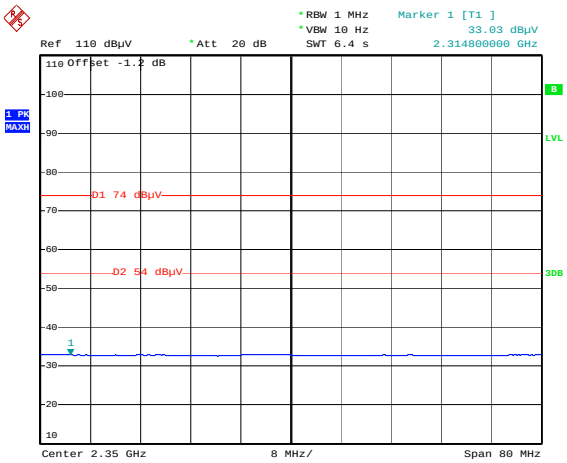
5.5.4 Test Plot (Continue)

Figure 6. Plot of the Band Edge (Radiated Restricted Bands)

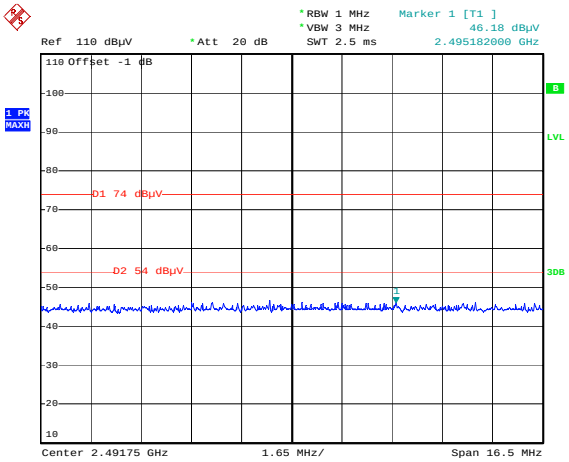
Lowest Channel(2 425 MHz): Peak



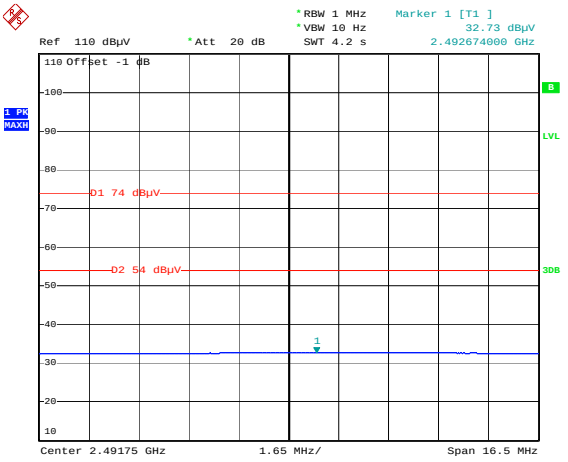
Lowest Channel(2 425 MHz): Average



Highest Channel(2 475 MHz): Peak



Highest Channel(2 475 MHz): Average



* **offset = Factor (ANT Factor+ Amp Gain + Cable Loss) [dB]**
= -1.2 dB (2 425 MHz)
= -1.0 dB (2 475 MHz)

5.6 Conducted Emission

5.6.1 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.

5.6.2 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.

5.6.3 Test Result

-complied

2 425 MHz

Frequency [MHz]	Correction Factor		Line	Quasi-peak				Average			
	LISN	Cable		Limit [dBuV]	Reading [dBuV]	Result [dBuV]	Margin [dB]	Limit [dBuV]	Reading [dBuV]	Result [dBuV]	Margin [dB]
0.162	9.90	0.06	N	65.36	31.74	41.70	23.66	55.36	14.51	24.47	30.89
0.168	9.90	0.06	H	65.06	32.05	42.01	23.05	55.06	15.28	25.24	29.82
0.180	9.90	0.07	N	64.49	29.20	39.17	25.32	54.49	11.01	20.98	33.51
0.186	9.91	0.07	H	64.21	28.87	38.85	25.36	54.21	14.76	24.74	29.47
0.207	9.91	0.07	H	63.32	26.61	36.59	26.73	53.32	13.83	23.81	29.51
0.207	9.90	0.07	N	63.32	25.74	35.71	27.61	53.32	11.08	21.05	32.27
0.249	9.91	0.07	H	61.79	23.39	33.37	28.42	51.79	14.11	24.09	27.70
0.270	9.91	0.07	H	61.12	20.89	30.87	30.25	51.12	12.06	22.04	29.08
0.270	9.90	0.07	N	61.12	19.91	29.88	31.24	51.12	10.51	20.48	30.64
0.411	10.02	0.07	N	57.63	20.00	30.09	27.54	47.63	13.12	23.21	24.42
0.420	10.03	0.07	H	57.45	16.64	26.74	30.71	47.45	7.84	17.94	29.51
0.432	10.03	0.07	H	57.21	15.99	26.09	31.12	47.21	9.34	19.44	27.77
0.450	10.02	0.07	N	56.88	14.22	24.31	32.57	46.88	4.88	14.97	31.91
14.280	10.51	0.18	H	60.00	13.29	23.98	36.02	50.00	6.84	17.53	32.47
14.790	10.45	0.18	N	60.00	12.86	23.49	36.51	50.00	4.84	15.47	34.53
14.910	10.59	0.18	H	60.00	13.38	24.15	35.85	50.00	7.01	17.78	32.22
15.100	10.45	0.18	N	60.00	12.84	23.47	36.53	50.00	5.20	15.83	34.17
17.580	10.54	0.19	N	60.00	10.52	21.25	38.75	50.00	5.04	15.77	34.23

Note:

1. This measurement was performed the worst case data were reported.

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2 450 MHz

Frequency [MHz]	Correction Factor		Line	Quasi-peak				Average			
	LISN	Cable		Limit [dBuV]	Reading [dBuV]	Result [dBuV]	Margin [dB]	Limit [dBuV]	Reading [dBuV]	Result [dBuV]	Margin [dB]
0.165	9.90	0.06	H	65.21	31.91	41.87	23.34	55.21	16.55	26.51	28.70
0.165	9.90	0.06	N	65.21	32.07	42.03	23.18	55.21	13.96	23.92	31.29
0.189	9.90	0.07	N	64.08	28.34	38.31	25.77	54.08	11.62	21.59	32.49
0.192	9.91	0.07	H	63.95	28.97	38.95	25.00	53.95	14.00	23.98	29.97
0.204	9.90	0.07	N	63.45	26.95	36.92	26.53	53.45	11.08	21.05	32.40
0.207	9.91	0.07	H	63.32	26.82	36.80	26.52	53.32	14.17	24.15	29.17
0.249	9.90	0.07	N	61.79	22.94	32.91	28.88	51.79	11.62	21.59	30.20
0.252	9.91	0.07	H	61.69	22.91	32.89	28.80	51.69	14.06	24.04	27.65
0.417	10.02	0.07	N	57.51	20.30	30.39	27.12	47.51	11.41	21.50	26.01
0.420	10.03	0.07	H	57.45	16.56	26.66	30.79	47.45	8.81	18.91	28.54
0.432	10.03	0.07	H	57.21	16.09	26.19	31.02	47.21	9.43	19.53	27.68
0.861	9.95	0.07	N	56.00	10.31	20.33	35.67	46.00	0.33	10.35	35.65
0.873	9.95	0.07	H	56.00	11.13	21.15	34.85	46.00	0.78	10.80	35.20
14.040	10.51	0.18	H	60.00	12.67	23.36	36.64	50.00	6.52	17.21	32.79
14.360	10.41	0.18	N	60.00	11.86	22.45	37.55	50.00	4.23	14.82	35.18
14.780	10.59	0.18	H	60.00	13.42	24.19	35.81	50.00	6.70	17.47	32.53
14.810	10.45	0.18	N	60.00	13.14	23.77	36.23	50.00	5.12	15.75	34.25
15.110	10.45	0.18	N	60.00	13.14	23.77	36.23	50.00	4.80	15.43	34.57

Note:

1. This measurement was performed the worst case data were reported.

2 475 MHz

Frequency [MHz]	Correction Factor		Line	Quasi-peak				Average			
	LISN	Cable		Limit [dBuV]	Reading [dBuV]	Result [dBuV]	Margin [dB]	Limit [dBuV]	Reading [dBuV]	Result [dBuV]	Margin [dB]
0.159	9.90	0.06	N	65.52	32.19	42.15	23.37	55.52	14.46	24.42	31.10
0.162	9.90	0.06	H	65.36	32.13	42.09	23.27	55.36	16.80	26.76	28.60
0.171	9.90	0.06	H	64.91	30.74	40.70	24.21	54.91	12.86	22.82	32.09
0.174	9.90	0.06	N	64.77	28.88	38.84	25.93	54.77	7.61	17.57	37.20
0.186	9.91	0.07	H	64.21	28.93	38.91	25.30	54.21	15.17	25.15	29.06
0.192	9.91	0.07	H	63.95	28.69	38.67	25.28	53.95	13.65	23.63	30.32
0.249	9.90	0.07	N	61.79	22.56	32.53	29.26	51.79	12.13	22.10	29.69
0.414	10.02	0.07	N	57.57	20.50	30.59	26.98	47.57	13.50	23.59	23.98
0.867	9.95	0.07	N	56.00	11.01	21.03	34.97	46.00	0.64	10.66	35.34
0.882	9.96	0.07	H	56.00	10.14	20.17	35.83	46.00	0.71	10.74	35.26
0.882	9.95	0.07	N	56.00	10.28	20.30	35.70	46.00	0.52	10.54	35.46
14.330	10.51	0.18	H	60.00	13.43	24.12	35.88	50.00	7.00	17.69	32.31
15.140	10.59	0.18	H	60.00	13.37	24.14	35.86	50.00	6.88	17.65	32.35
15.730	10.48	0.18	N	60.00	12.73	23.39	36.61	50.00	4.89	15.55	34.45
18.000	10.68	0.19	H	60.00	9.68	20.55	39.45	50.00	4.43	15.30	34.70
24.000	10.66	0.21	N	60.00	27.11	37.98	22.02	50.00	26.18	37.05	12.95

Note:

1. This measurement was performed the worst case data were reported.

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5.6.4 Test plot

2 425 MHz_H

EMC Compliance LTD

EUT: 2425
Manuf:
Op Cond: H
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

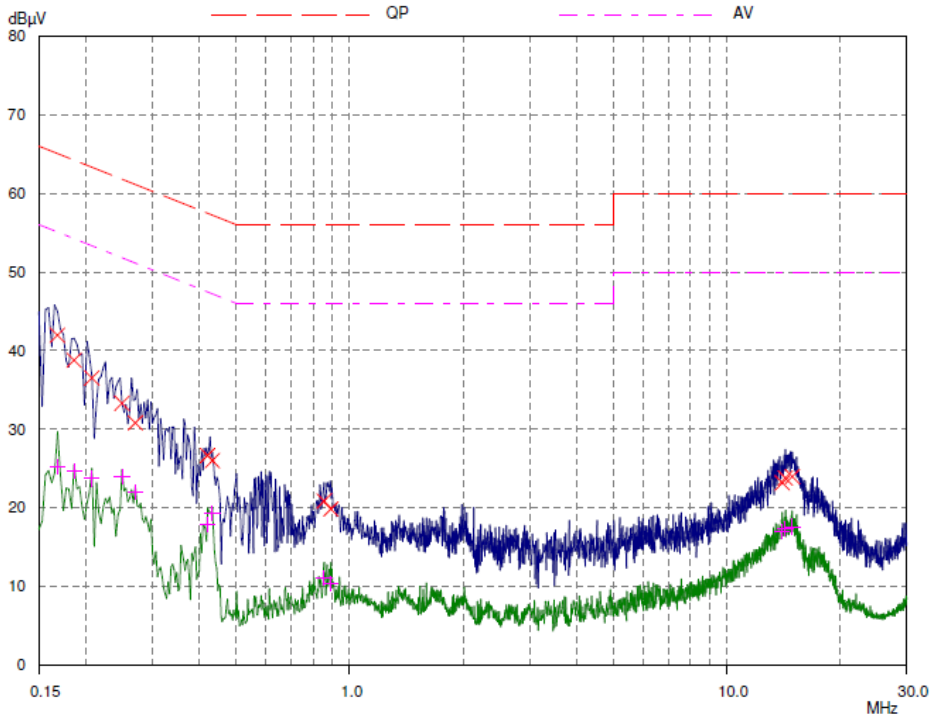
Result File: 2425_h.dat :

Scan Settings (2 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	3MHz	3kHz	10kHz	PK+AV	5msec	Auto	OFF	60dB
3MHz	30MHz	10kHz	10kHz	PK+AV	2msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	150kHz	30MHz	H

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



2 425 MHz_N

EMC Compliance LTD

EUT: 2425
Manuf:
Op Cond: N
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

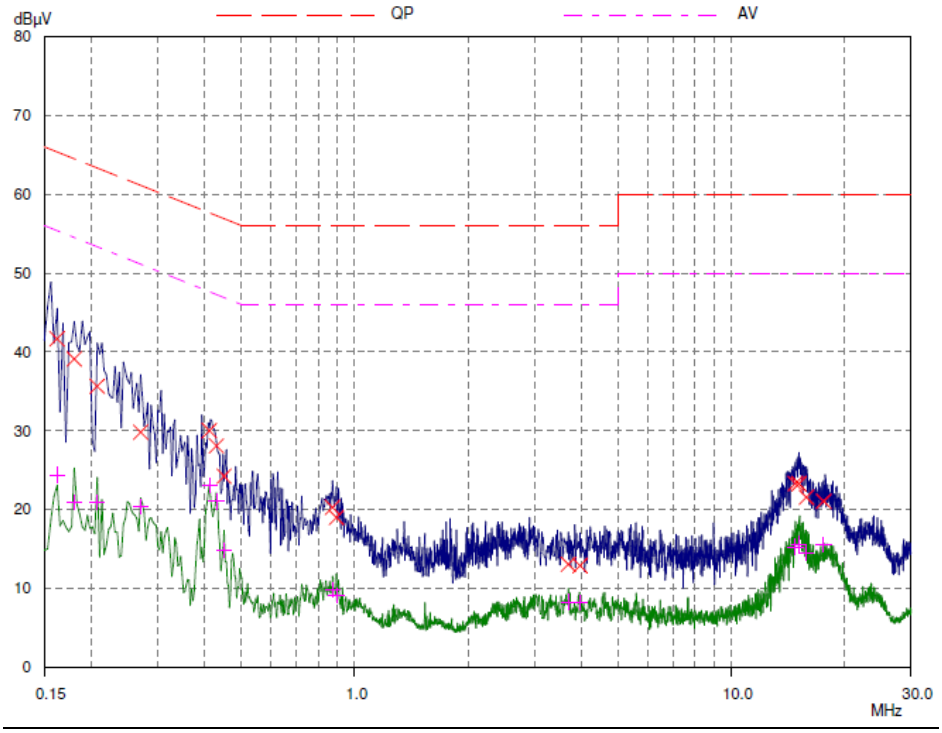
Result File: 2425_n.dat :

Scan Settings (2 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	3MHz	3kHz	10kHz	PK+AV	5msec	Auto	OFF	60dB
3MHz	30MHz	10kHz	10kHz	PK+AV	2msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	150kHz	30MHz	N

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



2 450 MHz_H

EMC Compliance LTD

EUT: 2450
Manuf:
Op Cond: H
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

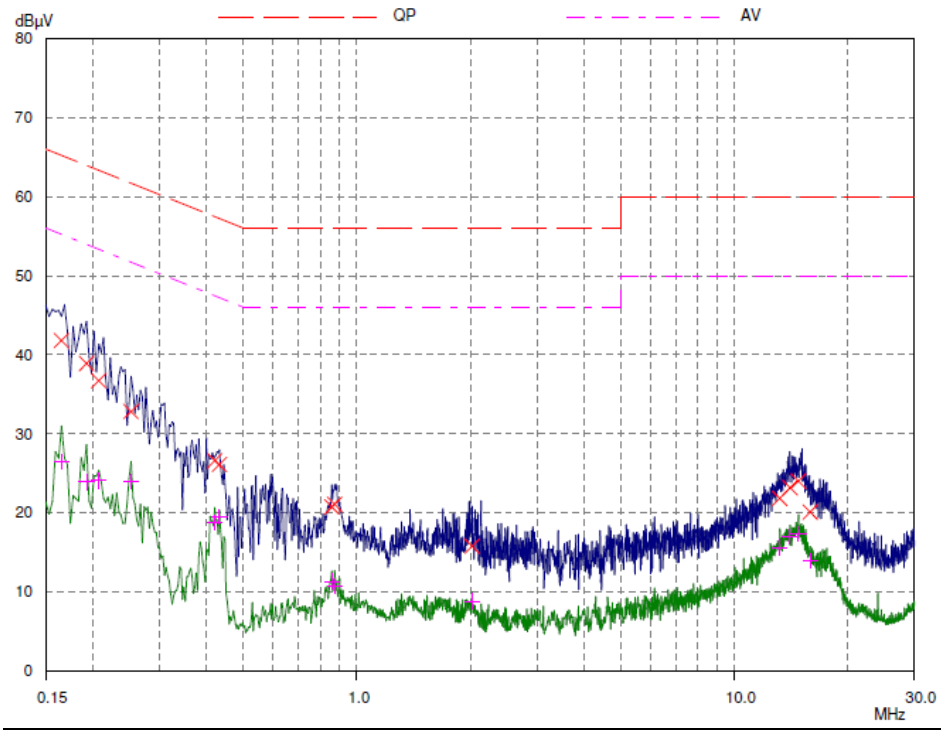
Result File: 2450_h.dat :

Scan Settings (2 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	3MHz	3kHz	10kHz	PK+AV	5msec	Auto	OFF	60dB
3MHz	30MHz	10kHz	10kHz	PK+AV	2msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	150kHz	30MHz	H

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



2 450 MHz_N

EMC Compliance LTD

EUT: 2450
Manuf:
Op Cond: N
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

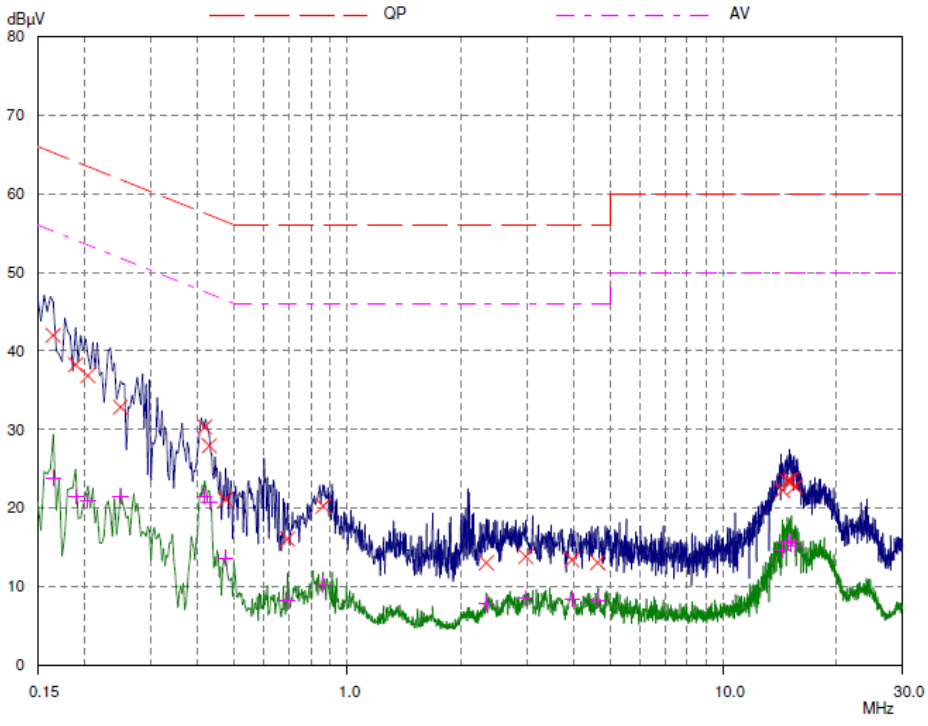
Result File: 2450_n.dat :

Scan Settings (2 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	3MHz	3kHz	10kHz	PK+AV	5msec	Auto	OFF	60dB
3MHz	30MHz	10kHz	10kHz	PK+AV	2msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	150kHz	30MHz	H

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



2 475 MHz_H

EMC Compliance LTD

EUT: 2475
Manuf:
Op Cond: H
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

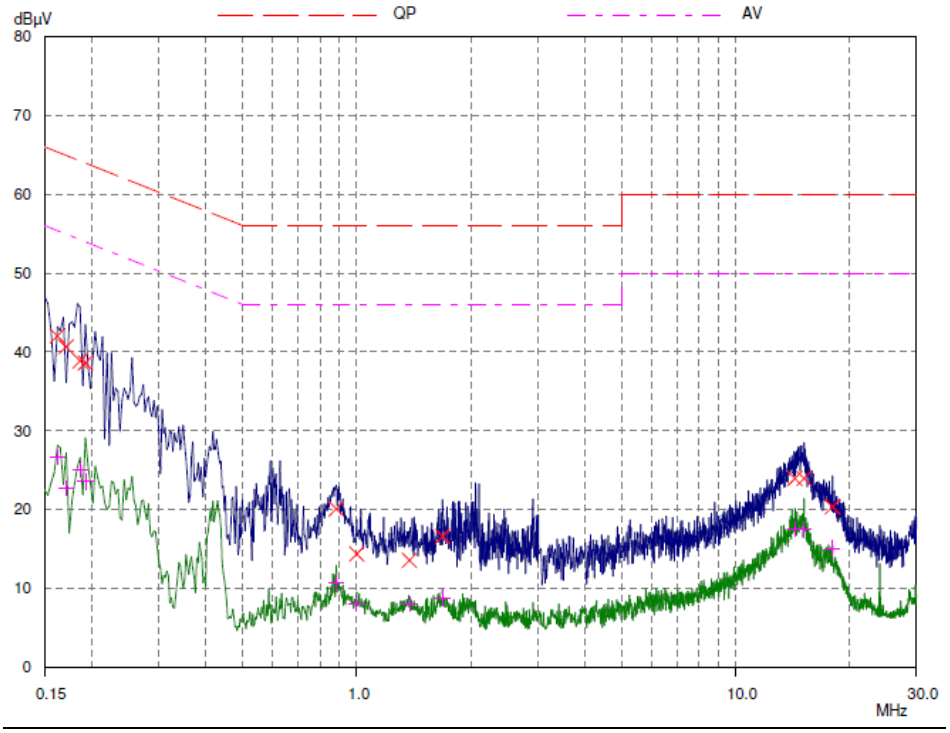
Result File: 2475_h.dat :

Scan Settings (2 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	3MHz	3kHz	10kHz	PK+AV	5msec	Auto	OFF	60dB
3MHz	30MHz	10kHz	10kHz	PK+AV	2msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	150kHz	30MHz	H

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



2 475 MHz_N

EMC Compliance LTD

EUT: 2475
Manuf:
Op Cond: N
Operator:
Test Spec: FCC Class B Conducted Emission
Comment:

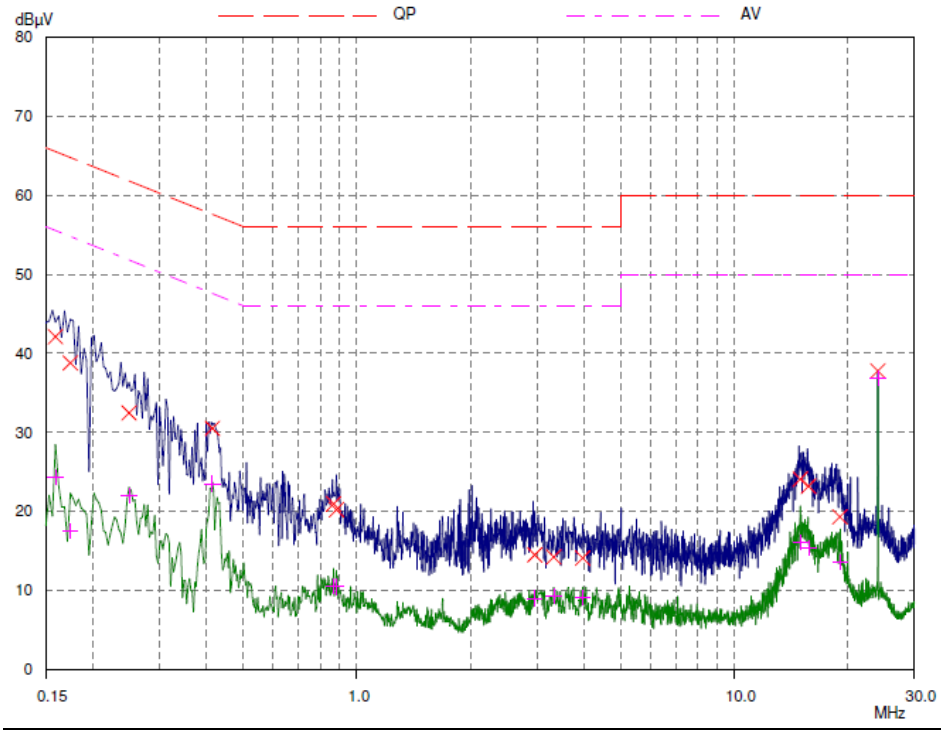
Result File: 2475_n.dat :

Scan Settings (2 Ranges)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	3MHz	3kHz	10kHz	PK+AV	5msec	Auto	OFF	60dB
3MHz	30MHz	10kHz	10kHz	PK+AV	2msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
	22	150kHz	30MHz	N

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Peaks: 8
Acc Margin: 25 dB



5.7 RF Exposure

5.7.1 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 ~ 1 500	/	/	f/1 500	30
1 500 ~ 15 000	/	/	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 = 2.20 [mW] (3.43 dBm) Antenna gain = 2.19 (3.40 [dBi])	
100 mW, at 20 cm from an antenna 6 [dBi]	S = PG/4πR² = 100 × 3.98 / (4 × π × 400) = 0.079 2 [mW/cm^2] < 1.0 [mW/cm^2]
2.20 mW, at 20 cm from an antenna 3.40 [dBi]	S = PG/4πR² = 0.000 96 [mW/cm^2] < 1.0 [mW/cm^2]
2.20 mW, at 2.5 cm from an antenna 3.40 [dBi]	S = PG/4πR² = 0.061 36 [mW/cm^2] < 1.0 [mW/cm^2]

5.7.2 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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5.7.3 Calculation Result of RF Exposure

- 2 400 ~ 2 483.5 MHz (RF4CE)

Channel	Frequency [MHz]	Ant Gain [mW]	power [dBm]	power [mW]	Power Density at 20 cm [mW/cm^2]	Power Density at 2.5 cm [mW/cm^2]
Lowest	2 425	2.19	3.43	2.20	0.000 96	0.061 36
Middle	2 450	2.19	3.02	2.00	0.000 87	0.055 84
Highest	2 475	2.19	2.39	1.73	0.000 75	0.048 30

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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	13.12.07
☐	Temp & humidity chamber	Taekwang	TK-500	TK002	13.09.03
☐	Frequency Counter	HP	53150A	US39250565	13.09.04
☐	Spectrum Analyzer	Agilent	E4440A	MY46186407	13.06.27
■	Spectrum Analyzer	R & S	FSP40	100209	13.10.23
■	Signal Generator	R & S	SMR40	100007	13.06.27
☐	Vector Signal Generator	R & S	SMBV100A	257566	14.01.07
☐	Wideband Power Sensor	R & S	NRP-Z81	100677	13.05.04
☐	Modulation Analyzer	HP	8901B	3538A05527	13.10.25
☐	Audio Analyzer	HP	8903B	3729A19213	13.10.23
☐	AC Power Supply	Kikusui	PCR2000W	GB001619	13.10.23
■	DC Power Supply	Tektronix	PS2520G	TW50517	13.02.06
☐	DC Power Supply	Tektronix	PS2521G	TW53135	13.10.23
☐	Attenuator	HP	8494A	2631A09825	13.10.24
☐	Attenuator	HP	8496A	3308A16640	13.10.24
☐	Attenuator	BIRD	50-A-MFN-20	0403002	13.10.24
☐	Power Divider	Weinschel	1580-1	NX375	13.10.23
☐	Power Divider	Weinschel	1580-1	NX380	13.09.09
☐	Power Divider	Weinschel	1594	671	13.09.10
☐	Power Divider	Krytar	7005265	143244	13.09.03
■	EMI Test Receiver	R&S	ESCI	100710	13.11.06
■	LOOP Antenna	EMCO	EMCO6502	9205-2745	13.05.23
■	BILOG Antenna	Schwarzbeck	VULB 9168	9168-440	13.09.21
■	HORN Antenna	ETS	3115	00086706	13.11.21
■	HORN Antenna	ETS	3116	00086632	13.11.15
■	Amplifier	Sonoma	310N	293004	13.11.06
■	Amplifier	Agilent	8449B	3008A01802	13.05.04
■	Attenuator	HP	8491A	27444	13.11.06
■	Antenna Mast	Innco Systems	MA4000-EP	303	-
■	Turn Table	Innco Systems	DT2000S-1t	079	-
☐	Highpass Filter	Wainwright	WHK2.5/ 18G-10SS	61	13.04.15
☐	Highpass Filter	Wainwright	WHKX6.5/ 18G-8SS	2	13.06.05
■	Test Receiver	R & S	843276/003	ESHS10	13.06.15
■	LISN	R & S	100267	ESH3-Z5	13.07.05
■	LISN	Schwarzbeck	8121-472	NNLK8121	13.07.13

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