EMC
TEST REPORT

Report No. : TS12100012-EME
Model No. : U50GRX, 2603143
Issued Date : Oct. 12, 2012

Applicant: **Darfon Electronics Corp**
167, SHANYING ROAD, GUEISHAN, TAOYUAN 33341, TAIWAN

Test Method/ Standard: **47 CFR FCC Part 15.249 & ANSI C63.4 2003**

Test By: **Intertek Testing Services Taiwan Ltd.**
No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li, Shiang-Shan District, Hsinchu City, Taiwan

Testing Laboratory
0597

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The test report was reviewed by: Jimmy Yang

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Summary of Tests

Test	Reference	Results
Radiated Emission test	15.249(a), (c), (d), 15.209	Pass
Emission on the Band Edge	15.209	Pass
Conducted Emission of AC Power	15.207	Pass
Calculation of Average Factor	15.35	Pass
20dB Bandwidth	15.215(c)	Pass

1. General information

1.1 Identification of the EUT

Product:	Dongle
Model No.:	U50GRX, 2603143
FCC ID.:	O62U50GRX
Frequency Range:	2408MHz ~ 2479MHz
Channel Number:	12 channels
Frequency of Each Channel:	Ch 8 (2408MHz), Ch 11 (2411MHz) , Ch 15 (2415MHz), Ch 20 (2420MHz), Ch 26 (2426MHz), Ch 35 (2435MHz), Ch 40 (2440MHz), Ch 49 (2449MHz), Ch 55 (2455MHz), Ch 65 (2465MHz), Ch 76 (2476MHz), Ch 79 (2479MHz)
Type of Modulation:	GFSK
Rated Power:	DC 5 V
Power Cord:	N/A
Data Cable:	N/A
Sample Received:	Jul. 26, 2012
Test Date(s):	Jul. 27, 2012~ Oct. 04, 2012
Note 1:	This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.
Note 2:	When determining the test conclusion, the Measurement Uncertainty of test has been considered.

1.2 Additional information about the EUT

The EUT is a Dongle, and was defined as information technology equipment.

The customer confirmed U50GRX is a series model to 2603143 (EUT), the different model numbers are served as marketing strategy.

For more detail features, please refer to User's manual as file name “Installation guide.pdf”

1.3 Antenna description

The EUT uses a permanently connected antenna.

Antenna Type : PCB printed antenna
Connector Type : Fixed

1.4 Peripherals equipment

Peripherals	Brand	Model No.	Serial No.	Data Cable
Notebook PC	DELL	Latitude D610	JXWZK1S	USB cable 1 meter × 1
Modem	Dynalink	V1456VQE	00V230A00051494	RSS-232 cable 1 meter × 1
Printer	HP	DeskJet 400	SG5CQ170C0	Parallel printer cable 1 meter × 1

2. Test specifications

2.1 Test standard

The EUT was performed according to the procedures in FCC Part 15 Subpart C Paragraph 15.249 for non-spread spectrum devices.

The test of radiated measurements according to FCC Part15 Section 15.33(a) had been conducted and the field strength of this frequency band was all meet limit requirement, thus we evaluate the EUT pass the specified test.

2.2 Operation mode

The EUT was supplied with DC 5 V from computer (Test voltage: 120 Vac, 60 Hz) and the transmission mode was running in control “SONiX USB MCU ISP Tool_RF_V1402” program.

The EUT configuration please refer to the “Spurious set-up photo.pdf”.

2.3 Test equipment

Equipment	Brand	Model No.	Serial No.	Calibration Date	Next Calibration Date
EMI Test Receiver	Rohde&schwarz	ESCS30	833364/011	2012/6/15	2013/6/15
EMI Test Receiver	Rohde & Schwarz	ESCI	100018	2011/12/6	2012/12/4
Spectrum Analyzer	Rohde&schwarz	FSP30	100137	2012/6/25	2013/6/25
Spectrum Analyzer	Rohde&schwarz	FSEK30	100186	2012/2/6	2013/2/5
Horn Antenna (1-18G)	Schwarzbeck	BBHA 9120 D	9120D-456	2010/08/31	2012/08/30
				2012/9/3	2014/9/3
Horn Antenna (14-42G)	SHWARZBECK	BBHA 9170	BBHA9170159	2010/09/03	2012/09/02
				2012/9/5	2014/9/5
Broadband Antenna	SCHWARZBECK	VULB 9168	9168-172	2011/7/26	2013/7/25
Pre-Amplifier	MITEQ	AFS44-00102650 --42-10P-44	1495287	2011/10/27	2013/10/26
Pre-Amplifier	MITEQ	JS4-26004000--2 7-8A	828825	2010/09/08	2012/09/08
				2012/9/8	2014/9/7
Two-Line -V-Network	Rohde&schwarz	ESH3-Z5	825562/003	2011/10/24	2012/10/23
Two-Line V-Network	Rohde&schwarz	ESH3-Z5	838979/014	2011/10/19	2012/10/18
Power Meter	Anritsu	ML2495A	0844001	2011/10/13	2012/10/12
Power Senor	Anritsu	MA2411B	0738452	2011/10/13	2012/10/12

Note: The above equipments are within the valid calibration period.

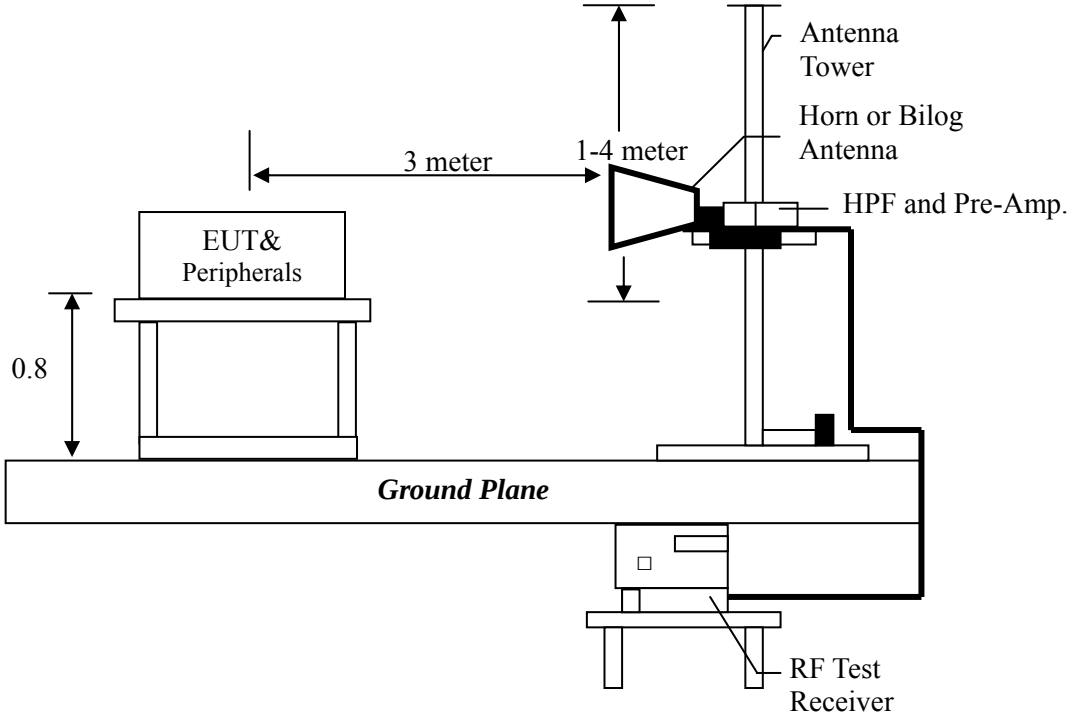
3. Radiated emission test

3.1 Operating environment

Temperature:	22	℃
Relative Humidity:	56	%
Atmospheric Pressure	1008	hPa

3.2 Test setup & procedure

The Diagram below shows the test setup, which is utilized to make these measurements.



The signal is maximized through rotation and placement in the three orthogonal axes.

Radiated emissions were invested cover the frequency range from 30MHz to 1000MHz using a receiver RBW of 120kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 1MHz VBW record peak reading. (15.209 paragraphs), the average reading is equal to peak reading plus average factor.
The EUT for testing is arranged on a wooden turntable. If some peripherals apply to the EUT, the peripherals will be connected to EUT and the whole system. During the test, all cables were arranged to produce worst-case emissions. The signal is maximized through rotation. The height of antenna and polarization is changing constantly for exploring for maximum signal level. The height of antenna can be up to 4 meters and down to 1 meter.

The measurement for radiated emission will be done at the distance of three meters unless the signal level is too low to measure at that distance. In the case of the reading under noise floor, a pre-amplifier is used and/or the test is conducted at a closer distance. And then all readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

The EUT configuration please refer to the "Spurious set-up photo.pdf".

3.3 Emission limit

3.3.1 Fundamental and harmonics emission limits

Frequency (MHz)	Field Strength of Fundamental		Field Strength of Harmonics	
	(mV/m@3m)	(dBuV/m@3m)	(uV/m@3m)	(dBuV/m@3m)
2400-2483.5	50000	93.9794	5000	73.9794

3.3.2 General radiated emission limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

Frequency MHz	15.209 Limits (dB μ V/m@3m)
30-88	40
88-216	43.5
216-960	46
Above 960	54

Remark:
1. In the above table, the tighter limit applies at the band edges.
2. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system

Measurement uncertainty was calculated in accordance with TR 100 028-1.

Parameter	Uncertainty
Radiated Emission	± 5.10 dB
Conducted Emission	± 2.786 dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of k=2.

3.4 Radiated spurious emission test data

3.4.1 Measurement results: frequencies equal to or less than 1 GHz

The test was performed on EUT under continuously transmitting mode. Low, middle and high channels were verified. The worst case occurred Tx at High channel.

EUT : U50GRX, 2603143
Worst Case : Tx at High channel (2479MHz)

Polarization (circle)	Frequency (MHz)	Detector	Corr. Factor (dB/m)	Reading (dBuV)	Calculated dBuV/m	Limit (dBuV/m)	Margin (dB)
Vertical	72.68	QP	10.39	24.23	34.62	40.00	-5.38
Vertical	144.46	QP	14.27	20.27	34.54	43.50	-8.96
Vertical	249.22	QP	12.22	23.75	35.96	46.00	-10.04
Vertical	270.56	QP	13.24	17.91	31.14	46.00	-14.86
Vertical	299.66	QP	13.95	11.69	25.64	46.00	-20.36
Vertical	798.24	QP	23.19	16.67	39.86	46.00	-6.14
Horizontal	72.68	QP	11.29	22.42	33.70	40.00	-6.30
Horizontal	84.32	QP	9.45	23.10	32.54	40.00	-7.46
Horizontal	249.22	QP	12.36	24.41	36.77	46.00	-9.23
Horizontal	365.62	QP	15.48	12.87	28.34	46.00	-17.66
Horizontal	400.54	QP	16.81	12.26	29.07	46.00	-16.93
Horizontal	798.24	QP	23.52	19.73	43.25	46.00	-2.75

Remark:
1. Corr. Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Corr. Factor

3.4.2 Measurement results: frequency above 1GHz

EUT : U50GRX, 2603143
Test Condition : Tx at Low channel (2408 MHz)

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Preamp. Gain (dB)	Correction Factor (dB/m)	Reading (dBuV)	Average Factor (dB)	Corrected Reading (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
4816.00	PK	V	35.1	38.54	50.32	-	53.76	54	-0.24
4816.00	PK	H	35.1	38.54	47.92	-	51.36	54	-2.64
9624.00	PK	H	32.7	49.3	36.13	-	52.73	54	-1.27

Remark:
1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor – Preamp. Gain
3. The frequency measured ranges from 1 GHz to 25 GHz. According to 15.31 (o), the amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported.
4. Average value = peak value + average factor

EUT : U50GRX, 2603143
Test Condition : Tx at Middle channel (2440 MHz)

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Preamp. Gain (dB)	Correction Factor (dB/m)	Reading (dBuV)	Average Factor (dB)	Corrected Reading (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
4880.00	PK	V	35.1	38.54	53.54	-	56.98	74	-17.02
4880.00	AV	V	35.1	38.54	53.54	-15.1934	41.79	54	-12.21
4880.00	PK	H	35.1	38.54	53.71	-	57.15	74	-16.85
4880.00	AV	H	35.1	38.54	53.71	-15.1934	41.96	54	-12.04

Remark:
1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor – Preamp. Gain
3. The frequency measured ranges from 1 GHz to 25 GHz. According to 15.31 (o), the amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported.
4. Average value = peak value + average factor

EUT : U50GRX, 2603143
Test Condition : Tx at High channel (2479 MHz)

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Preamp. Gain (dB)	Correction Factor (dB/m)	Reading (dBuV)	Average Factor (dB)	Corrected Reading (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
4958.00	PK	V	35.1	38.54	45.53	-	48.97	54	-5.03
4958.00	PK	H	35.1	38.54	45.52	-	48.96	54	-5.04

Remark:

1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor – Preamp. Gain
3. The frequency measured ranges from 1 GHz to 25 GHz. According to 15.31 (o), the amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported.
4. Average value = peak value + average factor

3.4.3 Measurement results: Fundamental emission

EUT : U50GRX, 2603143
Test Condition : Tx at Low channel (2408 MHz)

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBuV)	Average Factor (dB)	Corrected Reading (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
2408.00	PK	V	32.81	57.39	-	90.20	113.9794	-23.78
2408.00	AV	V	32.81	57.39	-15.1934	75.01	93.9794	-18.97
2408.00	PK	H	32.81	55.74	-	88.55	113.9794	-25.43
2408.00	AV	H	32.81	55.74	-15.1934	73.36	93.9794	-20.62

Remark:
1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor
3. Average value = peak value + average factor

EUT : U50GRX, 2603143
Test Condition : Tx at Middle channel (2440 MHz)

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBuV)	Average Factor (dB)	Corrected Reading (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
2440.00	PK	V	33	55.95	-	88.95	113.9794	-25.03
2440.00	AV	V	33	55.95	-15.1934	73.76	93.9794	-20.22
2440.00	PK	H	33	57.45	-	90.45	113.9794	-23.53
2440.00	AV	H	33	57.45	-15.1934	75.26	93.9794	-18.72

Remark:
1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor
3. Average value = peak value + average factor

EUT : U50GRX, 2603143
Test Condition : Tx at High channel (2479 MHz)

Frequency (MHz)	Spectrum Analyzer Detector	Ant. Pol. (H/V)	Correction Factor (dB/m)	Reading (dBuV)	Average Factor (dB)	Corrected Reading (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
2479.00	PK	V	33.12	60.16	-	93.28	113.9794	-20.70
2479.00	AV	V	33.12	60.16	-15.1934	78.09	93.9794	-15.89
2479.00	PK	H	33.12	58.63	-	91.75	113.9794	-22.23
2479.00	AV	H	33.12	58.63	-15.1934	76.56	93.9794	-17.42

Remark:

1. Correction Factor = Antenna Factor + Cable Loss
2. Corrected Level = Reading + Correction Factor
3. Average value = peak value + average factor

4. Radiated emission on the band edge FCC 15.209

Method of Measurement:

The frequency range from 30 MHz to 1000 MHz using Bilog Antenna.
The frequency range over 1 GHz using Horn Antenna.

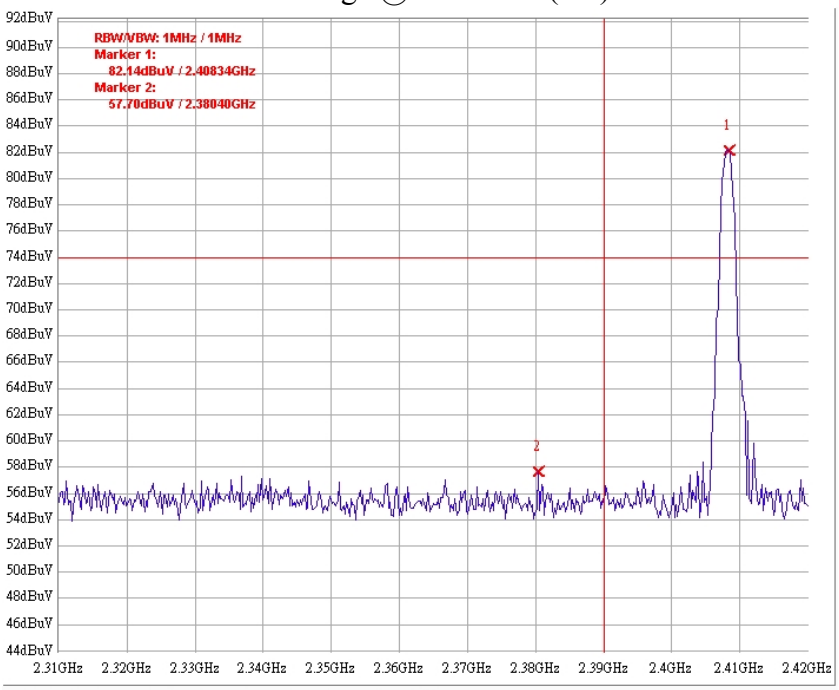
Radiated emissions were invested cover the frequency range from 30 MHz to 1000 MHz using a receiver RBW of 120 kHz record QP reading, and the frequency over 1GHz using a spectrum analyzer RBW of 1MHz and 1MHz VBW record peak reading. (15.209 paragraphs), the average reading is equal to peak reading plus average factor.

Channel	Measurement Freq.Band (MHz)	Detector	Average Factor (dB)	The Max. Field Strength in Restrict Band (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
8 (lowest)	2310-2390	PK	-	57.70	74	-16.3
8 (lowest)	2310-2390	AV	-15.1934	42.5066	54	-11.4934
79 (highest)	2483.5-2500	PK	-	59.63	74	-14.37
79 (highest)	2483.5-2500	AV	-15.1934	44.4366	54	-9.5634

Remark: Average value = peak value + average factor

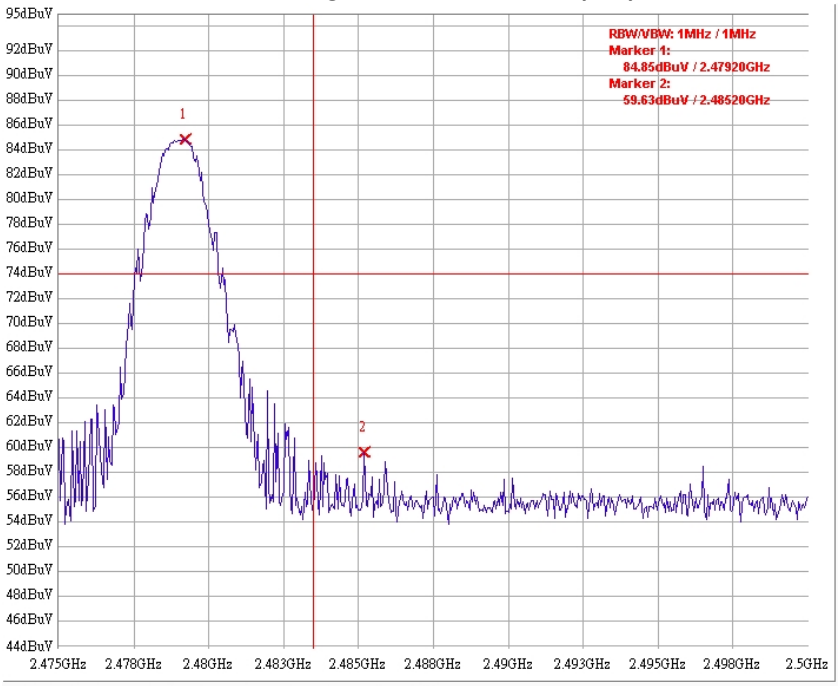
Please see the plots below.

Band Edge @ channel 8 (PK)



Brand / Model : 達方電子 2.4GHz wireless keyboard dongle U50GRX,2603143
Remark : ch 8, 2408MHz swt :5ms pk
Tested by : hugo

Band Edge @ channel 79 (PK)



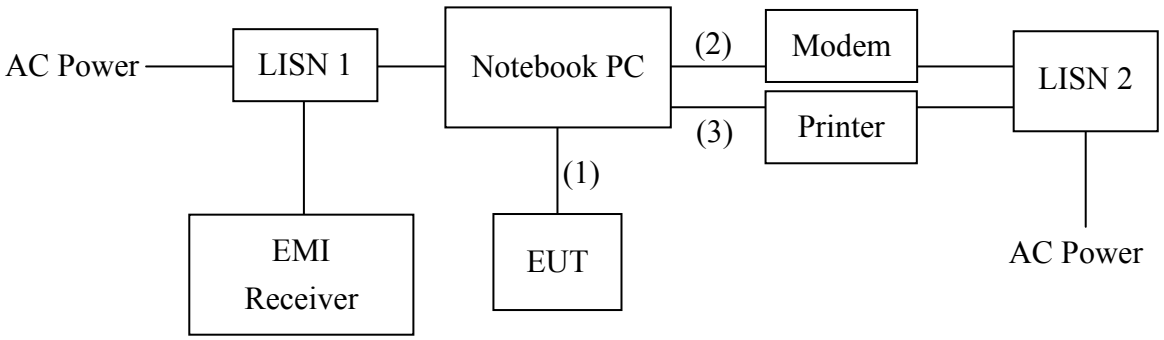
Brand / Model : 達方電子 2.4GHz wireless keyboard dongle U50GRX,2603143
Remark : ch 79, 2479MHz swt :2.5ms pk
Tested by : hugo

5. Conducted emission test FCC 15.207

5.1 Operating environment

Temperature:	22	℃
Relative Humidity:	53	%
Atmospheric Pressure	1008	hPa

5.2 Test setup & procedure



(1) USB cable 1 meter
(2) RS-232 cable1 meter
(3) Parallel printer cable 1 meter

The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50 ohm/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination.
Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4/1992 on conducted measurement.
The bandwidth of the field strength meter (R & S Test Receiver ESCS 30) is set at 9kHz.

The EUT configuration please refer to the "Conducted set-up photo.pdf".

5.3 Emission limit

Freq. (MHz)	Conducted Limit (dBuV)	
	Q.P.	Ave.
0.15~0.50	66 – 56*	56 – 46*

0.50~5.00	56	46
5.00~30.0	60	50

*Decreases with the logarithm of the frequency.

5.4 Uncertainty of Conducted Emission

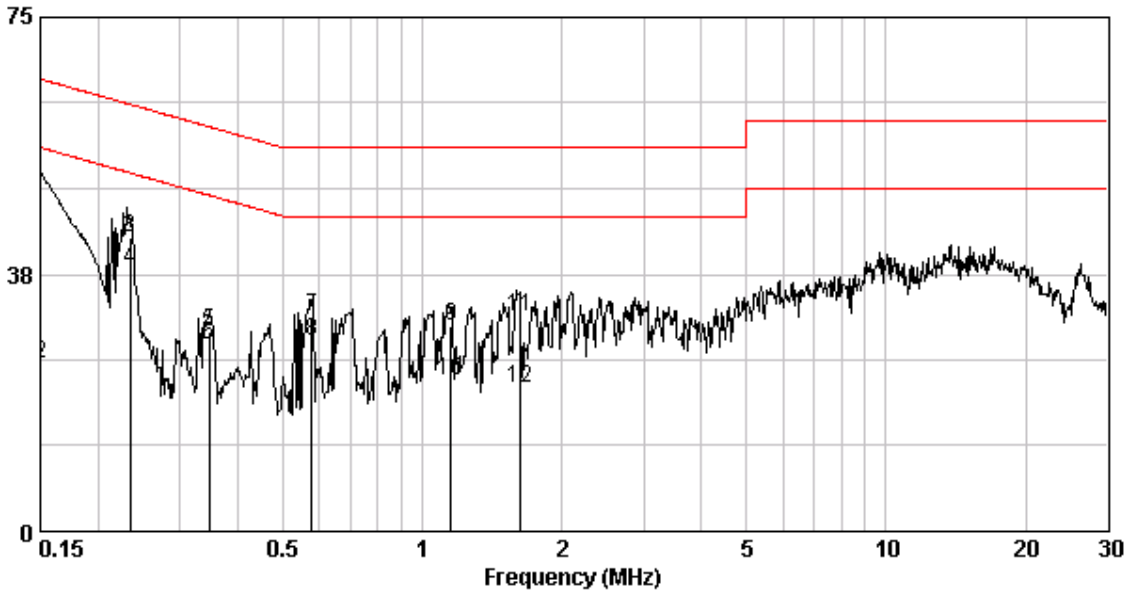
Expanded uncertainty (*k*=2) of conducted emission measurement is ± 2.786 dB.

5.5 Conducted emission data FCC 15.207

Phase: Line
Model No.: U50GRX, 2603143
Test Condition: Standby mode

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Margin (dB) Qp	Av
0.150	0.15	45.11	66.00	24.56	56.00	-20.89	-31.44
0.234	0.14	42.83	62.30	38.21	52.30	-19.47	-14.09
0.346	0.15	29.26	59.05	27.25	49.05	-29.79	-21.80
0.576	0.16	31.27	56.00	27.79	46.00	-24.73	-18.21
1.153	0.19	30.00	56.00	22.05	46.00	-26.00	-23.95
1.619	0.20	31.20	56.00	20.94	46.00	-24.80	-25.06

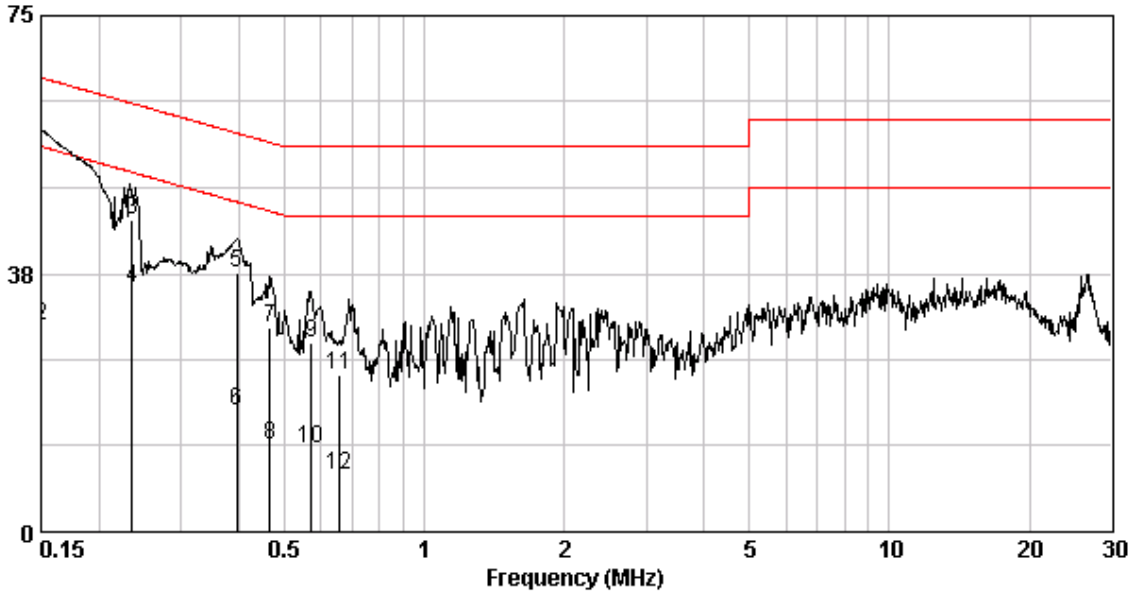
Remark:
1. Correction Factor (dB)= LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) = Level (dBuV) – Limit (dBuV)



Phase: Neutral
Model No.: U50GRX, 2603143
Test Condition: Standby mode

Frequency (MHz)	Corr. Factor (dB)	Level Qp (dBuV)	Limit Qp (dBuV)	Level Av (dBuV)	Limit Av (dBuV)	Margin (dB) Qp	Margin (dB) Av
0.150	0.28	51.16	66.00	29.85	56.00	-14.84	-26.15
0.235	0.26	45.20	62.26	35.35	52.26	-17.06	-16.91
0.396	0.25	37.56	57.95	17.56	47.95	-20.39	-30.39
0.466	0.25	29.69	56.58	12.51	46.58	-26.89	-34.07
0.573	0.26	27.34	56.00	12.01	46.00	-28.66	-33.99
0.658	0.26	22.77	56.00	8.29	46.00	-33.23	-37.71

Remark:
1. Correction Factor (dB)= LISN Factor (dB) + Cable Loss (dB)
2. Margin (dB) = Level (dBuV) – Limit (dBuV)



6. Calculation of Average Factor

The specification for output field strengths in accordance with the FCC rules specify measurements with an average detector. During testing, a spectrum analyzer incorporating a peak detector was used. Therefore, a reduction factor can be applied to the resultant peak signal level and compared to the limit for measurement instrumentation incorporating an average detector.

The time period over which the duty cycle is measured in 100 ms or the repetition cycle, whichever is a shorter time frame. The duty cycle is measured by placing the spectrum analyzer in zero span mode.

Mode	channel	Pulse time (ms)	Number of pulse during time period	Time period (ms)	Duty cycle %	Duty cycle correction factor
GFSK	ch 8	0.176352705	1	1.014028	17.39%	-15.1934
	ch 40	0.176352705	1	1.014028	17.39%	-15.1934
	ch 79	0.176352705	1	1.014028	17.39%	-15.1934

Remark:

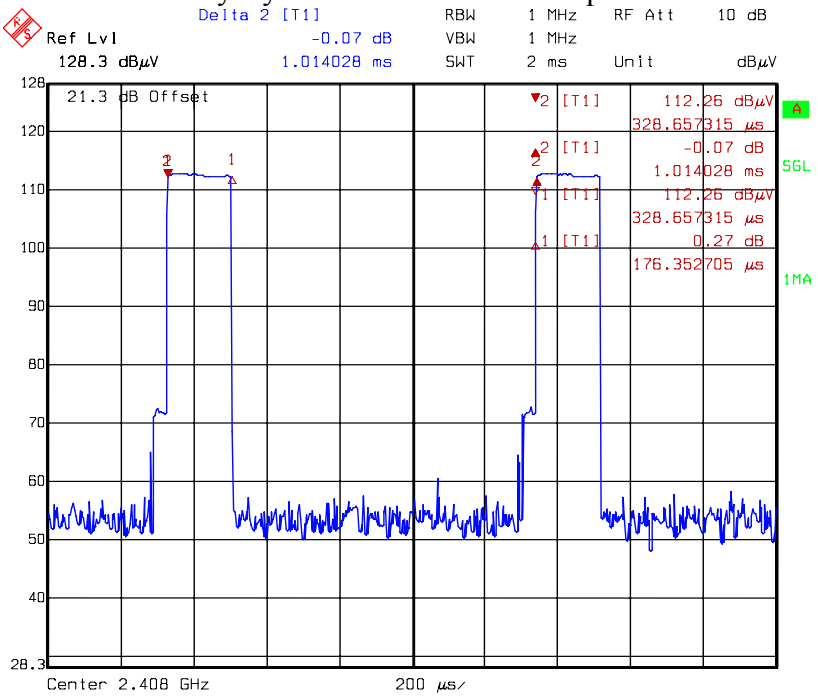
Duty cycle correction factor in dB = 20log (on-time/100ms) or 20log (on-time/period)

If period is less than 100ms. Therefore,

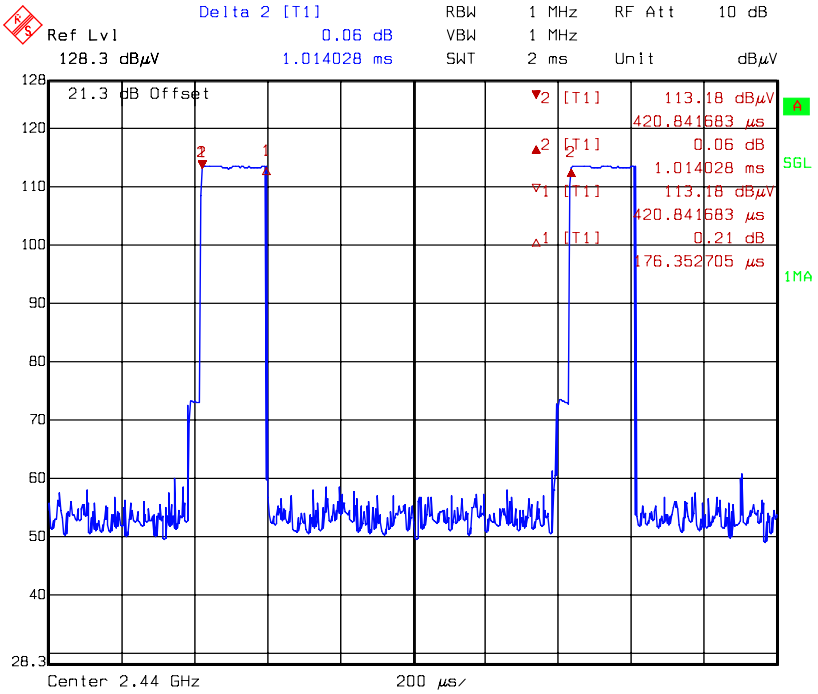
the duty cycle correction factor will be 20 $\log_{10}$ (0.176352705/1.014028) = -15.1934dB.

Please see the plot below.

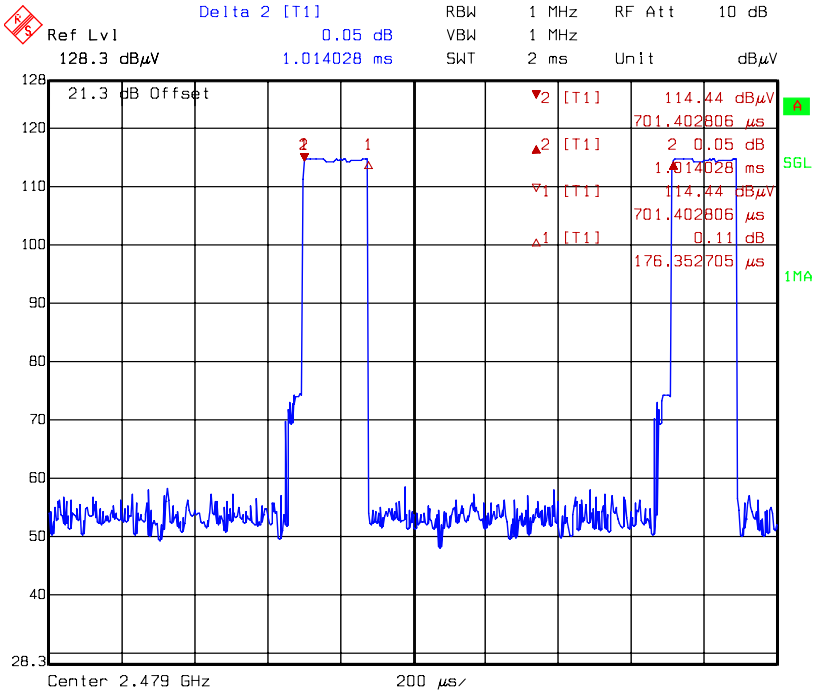
Duty Cycle at low channel: 8 of pulse



Duty Cycle at middle channel: 40 of pulse



Duty Cycle at high channel: 79 of pulse



7. 20dB Bandwidth test

7.1 Operating environment

Temperature: 22 ℃
Relative Humidity: 56 %
Atmospheric Pressure: 1008 hPa

7.2 Test setup & procedure

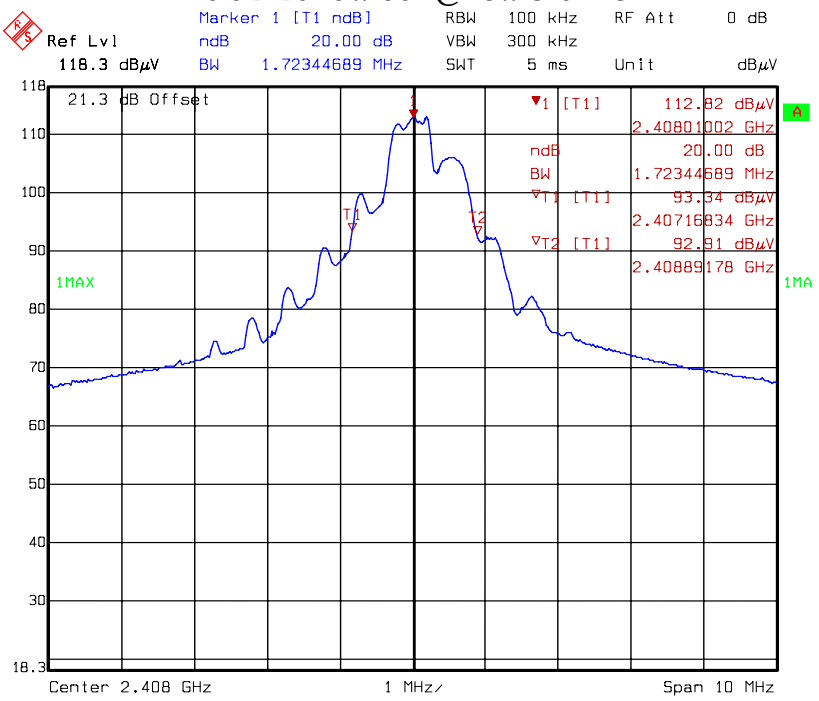
The 20dB bandwidth was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at 100 kHz, the video bandwidth≧RBW, and the SPAN may equal to approximately 2 to 3 times the 20dB bandwidth. The test was performed at 3 channels (lowest, middle and highest channel). The maximum 20dB modulation bandwidth is in the following Table.

7.3 Measured data of modulated bandwidth test results

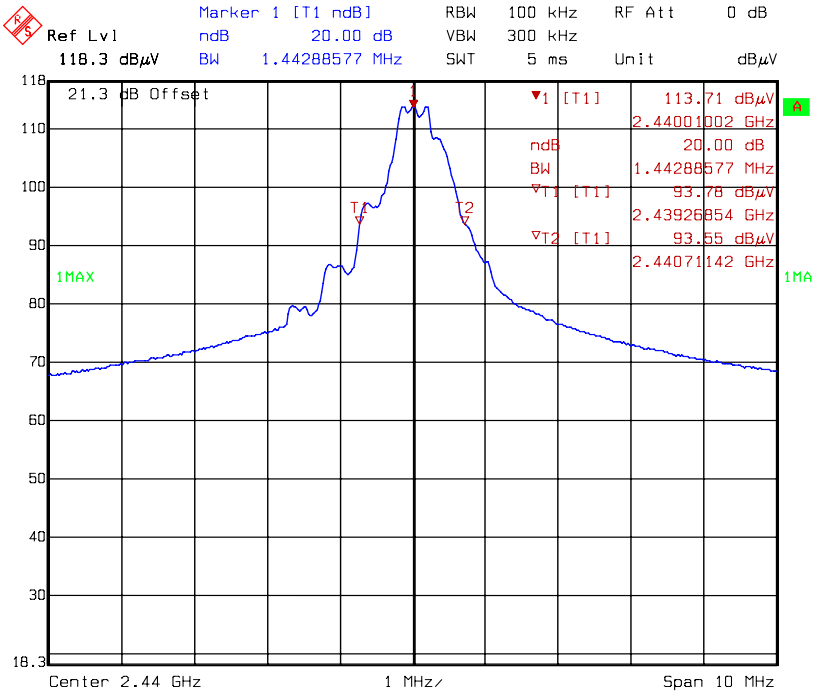
Channel	Frequency (MHz)	Bandwidth (MHz)
Low	2408	1.723
Middle	2440	1.443
High	2479	1.122

Please see the plot below.

20 dB Bandwidth @ low channel



20 dB Bandwidth @ middle channel



20 dB Bandwidth @ high channel