

EMC

TEST REPORT

Report No.: TS11020004-EME
Model No.: 2600990,
MA1GM-Z00
Issued Date: Feb. 25, 2011

Applicant: Darfon Electronics Corp.
167, Shanying Road, Gueishan, Taoyuan 333, Taiwan

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

Test By: Intertek Testing Services Taiwan Ltd.
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Summary of Tests

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



1. General information

1.1 Identification of the EUT

Product: 2.4 GHz wireless mouse
Model No.: 2600990
FCC ID.: O62MA1
Frequency Range: 2403 MHz ~ 2478 MHz
Channel Number: 76 channels
Frequency of Each Channel: 2403 MHz + 1k MHz; k=0~75
Type of Modulation: GFSK (Data rate: 2Mbps)
Rated Power: DC 1.5 V from battery
Power Cord: N/A
Data Cable: N/A
Sample Received: Feb. 01, 2011
Test Date(s): Feb. 10, 2011 ~ Feb. 15, 2011

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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 2.4 GHz wireless mouse, and was defined as information technology equipment.

The model, MA1GM-Z00, is identical to model 2600990 (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 : N/A



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 were all meet limit requirement, thus we evaluate the EUT pass the specified test.

2.2 Operation mode

The EUT was continuously transmitting during the test, and the GFSK data rate of EUT is 2 Mbps.

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

2.3 Test equipment

Equipment	Brand	Frequency range	Model No.	Last Cal.	Cal. interval
EMI Test Receiver	Rohde & Schwarz	9kHz~2.75GHz	ESCS 30	2010/9/3	1 year
EMI Test Receiver	Rohde & Schwarz	9kHz~3GHz	ESCI	2010/11/24	1 year
Spectrum Analyzer	Rohde & Schwarz	9kHz~30GHz	FSP 30	2010/8/16	1 year
Spectrum Analyzer	Rohde & Schwarz	20Hz~40GHz	FSEK 30	2011/1/18	1 year
Horn Antenna	SCHWARZBECK	1GHz~18GHz	BBHA9120D	2010/8/31	2 years
Bilog Antenna	SCHWARZBECK	25MHz~1.7GHz	VULB 9168	2009/9/22	2 years
Turn Table	HDGmbH	N/A	DS 420S	N/A	N/A
Antenna Tower	HDGmbH	N/A	MA 240	N/A	N/A
Pre-Amplifier	MITER	100MHz~26.5GHz	AFS42-00102 650	2009/10/27	2 years
LISN	Rohde & Schwarz	9KHz~30MHz	ESH3-Z5	2009/3/13	2 years
Power Meter	Anritsu	N/A	2495A	2010/10/20	1 year
Power Sensor	Anritsu	N/A	2411B	2010/10/20	1 year

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

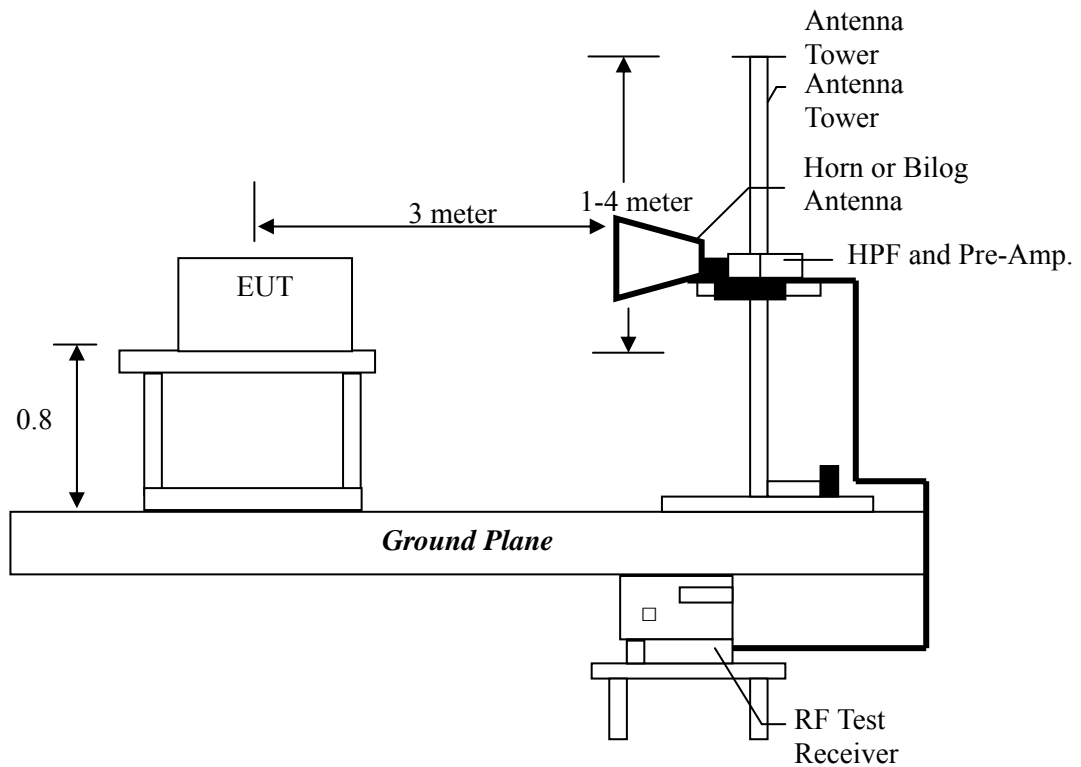
3. Radiated emission test FCC 15.249 (C)

3.1 Operating environment

Temperature: 22 °C
 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.



Radiated emissions were investigated 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 10Hz VBW record Average reading. (15.209 paragraphs), the Peak reading (1MHz RBW/VBW) recorded also on the report. 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 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	50	94	500	54

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 low channel.

EUT : 2600990
 Test Unit : 2.4 GHz wireless mouse
 Test Condition : Tx at low channel

Polarization (circle)	Frequency (MHz)	Detector	Corr. Factor (dB/m)	Reading (dBuV)	Calculated dBuV/m	Limit (dBuV/m)	Margin (dB)
Vertical	32.91	QP	12.60	11.48	24.07	40.00	-15.93
Vertical	35.82	QP	12.62	11.05	23.67	40.00	-16.33
Vertical	47.46	QP	12.84	16.28	29.12	40.00	-10.88
Vertical	60.07	QP	12.23	13.38	25.61	40.00	-14.39
Vertical	65.89	QP	12.23	10.12	22.35	40.00	-17.65
Vertical	107.60	QP	7.64	16.34	23.98	43.50	-19.52
Horizontal	46.49	QP	14.33	9.13	23.45	40.00	-16.55
Horizontal	505.30	QP	18.77	9.85	28.62	46.00	-17.38
Horizontal	551.86	QP	19.72	9.15	28.87	46.00	-17.13
Horizontal	673.11	QP	21.52	9.57	31.08	46.00	-14.92
Horizontal	870.99	QP	24.12	10.10	34.21	46.00	-11.79
Horizontal	958.29	QP	25.54	10.81	36.35	46.00	-9.65

Remark:

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

3.4.2 Measurement results: frequency above 1GHz

EUT : 2600990
 Test Condition : Tx at low channel

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)
4806.00	PK	V	35.1	38.54	42.62	-	46.06	74	-27.94
4806.00	AV	V	35.1	38.54	42.62	-14.334	31.73	54	-22.27
7209.00	PK	V	33.0	44.60	34.8	-	46.40	74	-27.60
7209.00	AV	V	33.0	44.60	34.8	-14.334	32.07	54	-21.93
4806.00	PK	H	35.1	38.54	38.15	-	41.59	74	-32.41
4806.00	AV	H	35.1	38.54	38.15	-14.334	27.26	54	-26.74
7209.00	PK	H	33.0	44.60	34.76	-	46.36	74	-27.64
7209.00	AV	H	33.0	44.60	34.76	-14.334	32.03	54	-21.97

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 : 2600990
Test Condition : Tx at middle channel

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	43.03	-	46.47	74	-27.53
4880.00	AV	V	35.1	38.54	43.03	-14.334	32.14	54	-21.86
7320.00	PK	V	33.0	44.60	38.92	-	50.52	74	-23.48
7320.00	AV	V	33.0	44.60	38.92	-14.334	36.19	54	-17.81
4880.00	PK	H	35.1	38.54	40.34	-	43.78	74	-30.22
4880.00	AV	H	35.1	38.54	40.34	-14.334	29.45	54	-24.55

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 : 2600990
 Test Condition : Tx at high channel

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)
4956.00	PK	V	35.1	38.54	40.67	-	44.11	74	-29.89
4956.00	AV	V	35.1	38.54	40.67	-14.334	29.78	54	-24.22
7434.00	PK	V	33.0	44.6	39.53	-	51.13	74	-22.87
7434.00	AV	V	33.0	44.6	39.53	-14.334	36.80	54	-17.20
4956.00	PK	H	35.1	38.54	37.90	-	41.34	74	-32.66
4956.00	AV	H	35.1	38.54	37.90	-14.334	27.01	54	-26.99
7434.00	PK	H	33.0	44.6	37.06	-	48.66	74	-25.34
7434.00	AV	H	33.0	44.6	37.06	-14.334	34.33	54	-19.67

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 and harmonics emission

EUT : 2600990
 Test Condition : Tx at low channel

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)
2403.00	PK	H	32.86	67.22	-	100.08	113.9794	-13.90
2403.00	AV	H	32.86	67.22	-14.334	85.75	93.9794	-8.23

Remark:

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

EUT : 2600990
 Test Condition : Tx at middle channel

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	H	32.95	65.80	-	98.75	113.9794	-15.23
2440.00	AV	H	32.95	65.80	-14.334	84.42	93.9794	-9.56

Remark:

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

EUT : 2600990
Test Condition : Tx at high channel

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)
2478.00	PK	H	33.06	65.24	-	98.30	113.9794	-15.68
2478.00	AV	H	33.06	65.24	-14.334	83.97	93.9794	-10.01

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 15.249(d)

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 investigated cover the frequency range from 30 MHz to 1000 MHz using a receiver RBW of 120 kHz record QP reading, and the frequency over 1 GHz using a spectrum analyzer RBW of 1 MHz and 10 Hz VBW record Average reading. (15.209 paragraph), the Peak reading (1 MHz RBW/VBW) recorded also on the report.

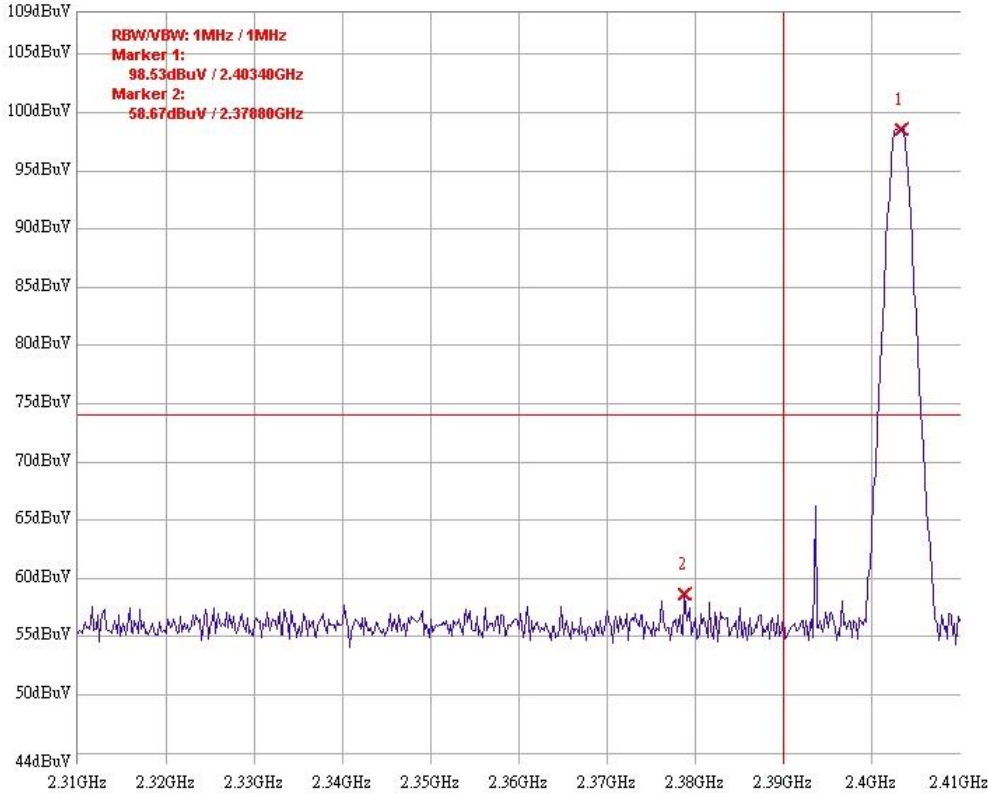
4.1 Measurement results

Test Unit : 2.4 GHz wireless mouse

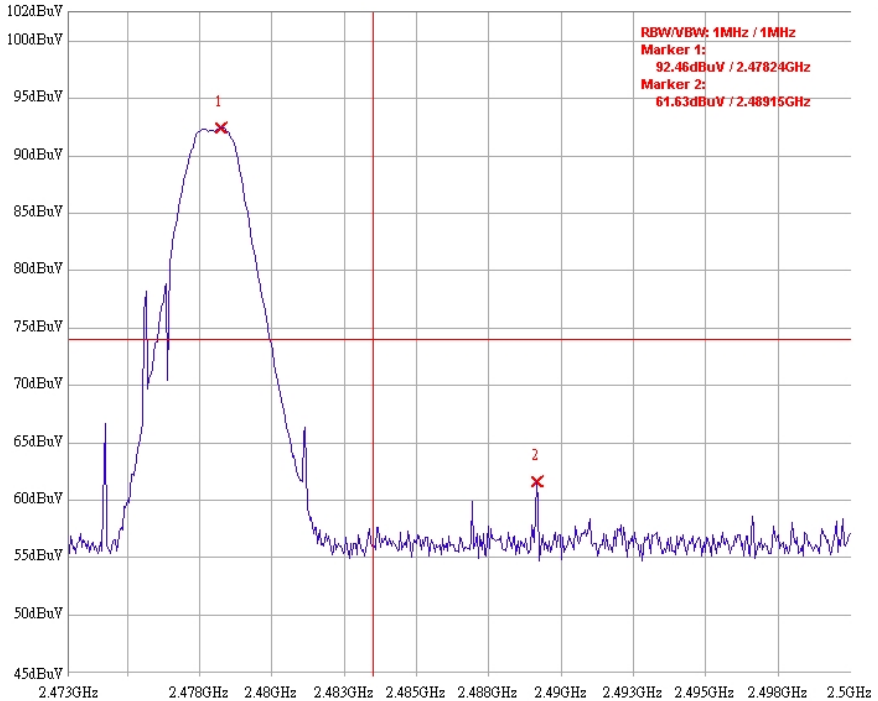
Channel	Measurement Freq.Band (MHz)	Detector	Average Factor (dB)	The Max. Field Strength in Restrict Band (dBuV/m)	Limit @ 3 m (dBuV/m)	Margin (dB)
0 (lowest)	2310-2390	PK	-	58.67	74	-15.33
0 (lowest)	2310-2390	AV	-14.334	44.336	54	-9.66
11 (highest)	2483.5-2500	PK	-	61.63	74	-4.74
11 (highest)	2483.5-2500	AV	-14.334	47.296	54	-6.70

Please see the plots below.

Band Edge @ low channel (PK)



Band Edge @ high channel (PK)



report number: TS11020004-EME
 Erend / Model: 達方/ MA1GM-Z00
 Remark: MOUSE high channel PK
 Sweep time: 2.5ms

5. 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.

The duty cycles of handset and base unit are exactly the same.

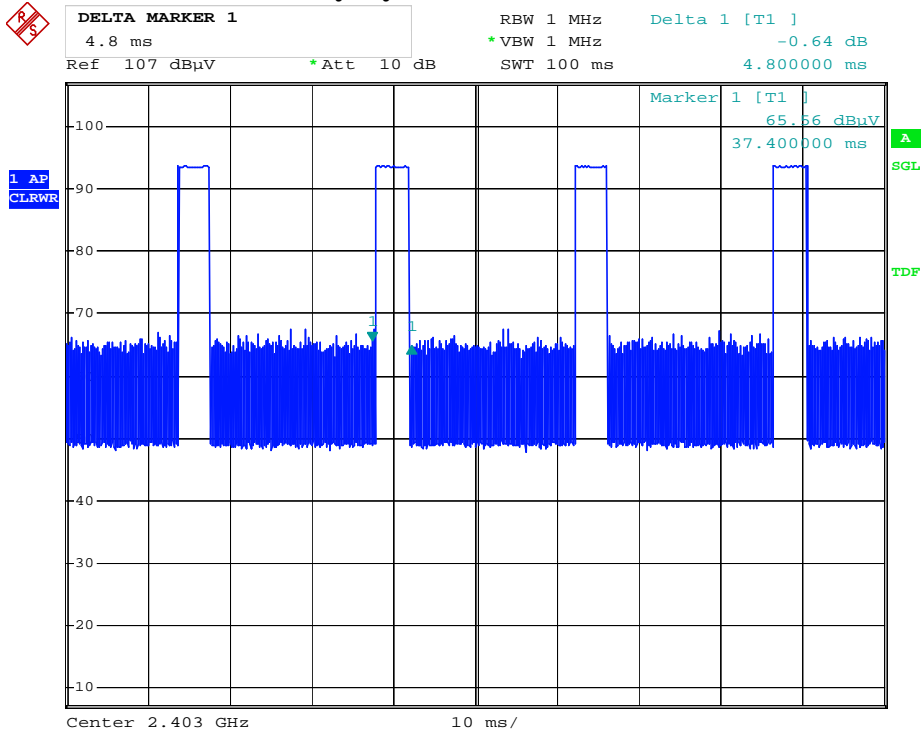
Duty cycle correction factor in dB = $20 \log (\text{on-time}/100\text{ms})$ or $20 \log (\text{on-time}/\text{period})$ #If period is less than 100ms

$$\text{Duty Cycle} = 4.8 \times 4\text{ms} / 100\text{ms} = 0.192$$

$$\text{Therefore, duty cycle correction factor} = 20 \log_{10} (0.192) = -14.334 \text{ dB}$$

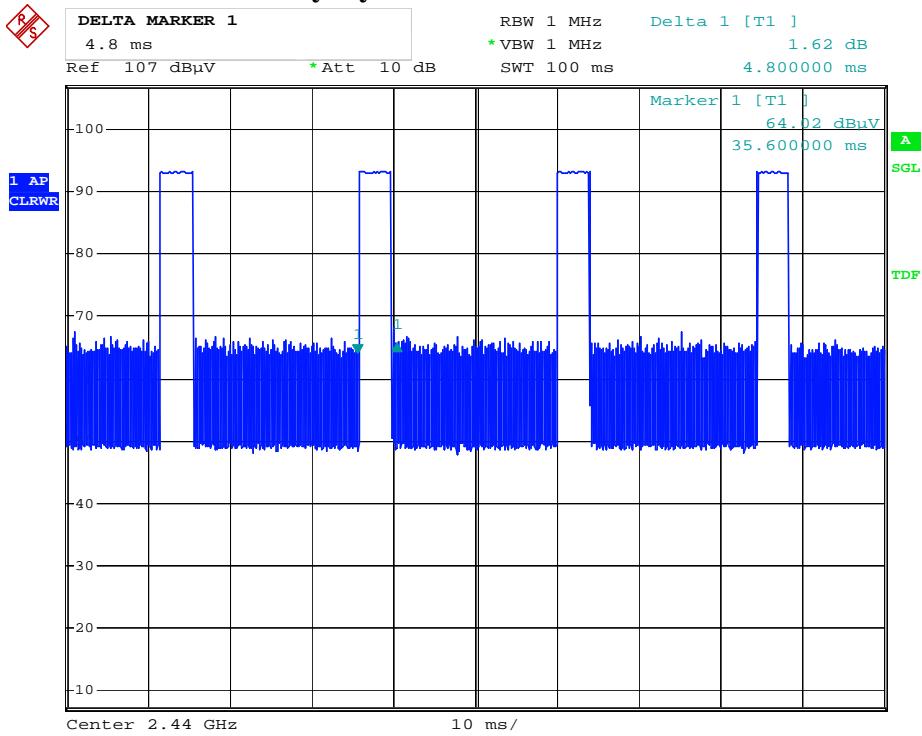
Please see the plot below.

Duty Cycle @ low channel



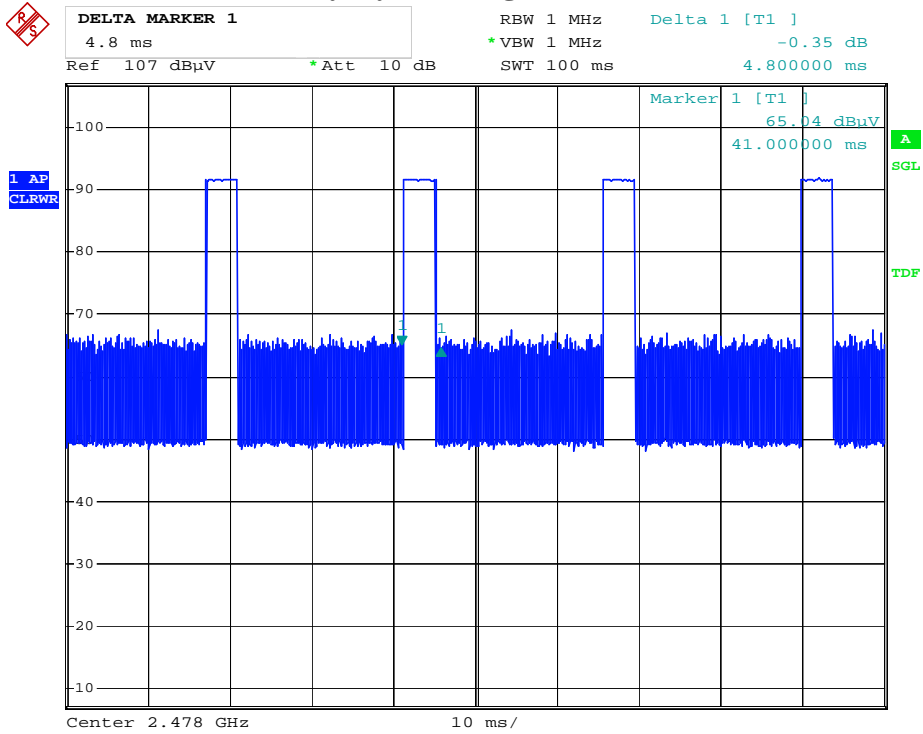
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Duty Cycle @ middle channel



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Duty Cycle @ high channel



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6. 20dB Bandwidth test

6.1 Operating environment

Temperature: 22 °C
Relative Humidity: 56 %
Atmospheric Pressure: 1008 hPa

6.2 Test setup & procedure

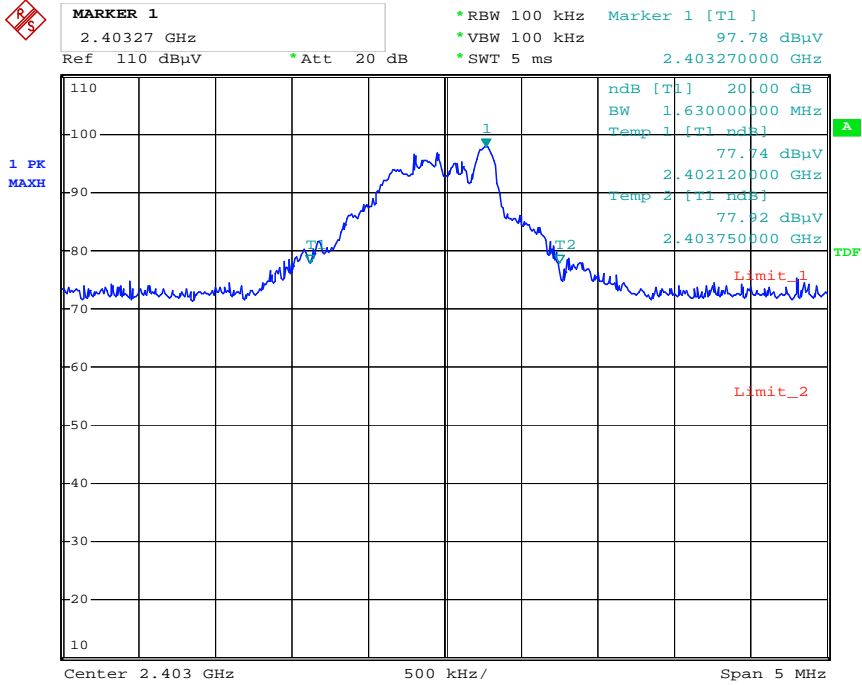
The 20dB bandwidth was measured using a 50 ohm spectrum analyzer with the resolutions bandwidth set at 100 kHz, the video bandwidth \geq RBW, and the SPAN may equal to approximately 2 to 3 times the 20dB bandwidth. The test was performed at 3 channels (lowest, middle and highest channel). The maximum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

6.3 Measured data of modulated bandwidth test results

Channel	Frequency (MHz)	Bandwidth (MHz)
low	2403	1.63
middle	2440	1.73
high	2478	1.71

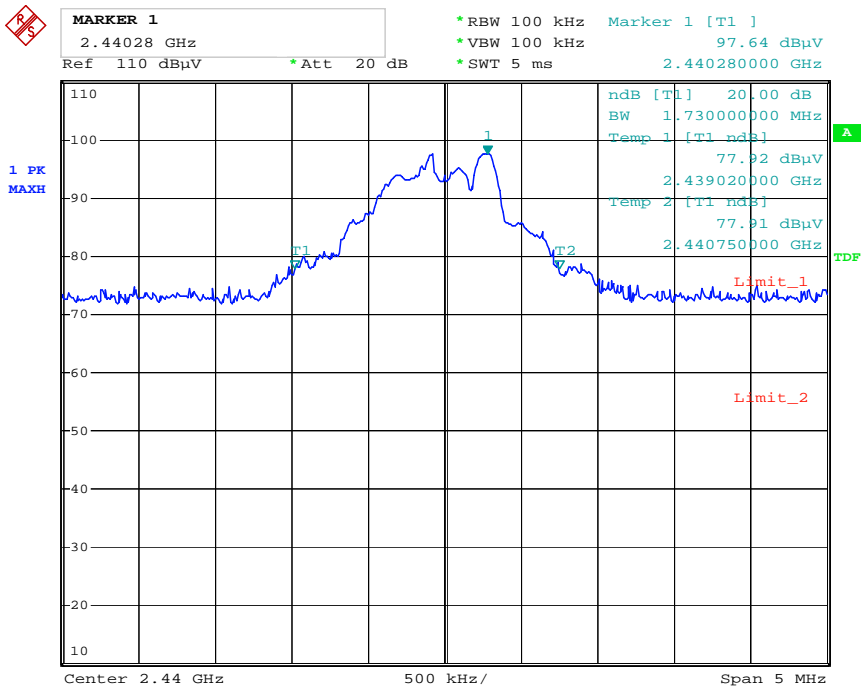
Please see the plot below.

20 dB Bandwidth @ low channel



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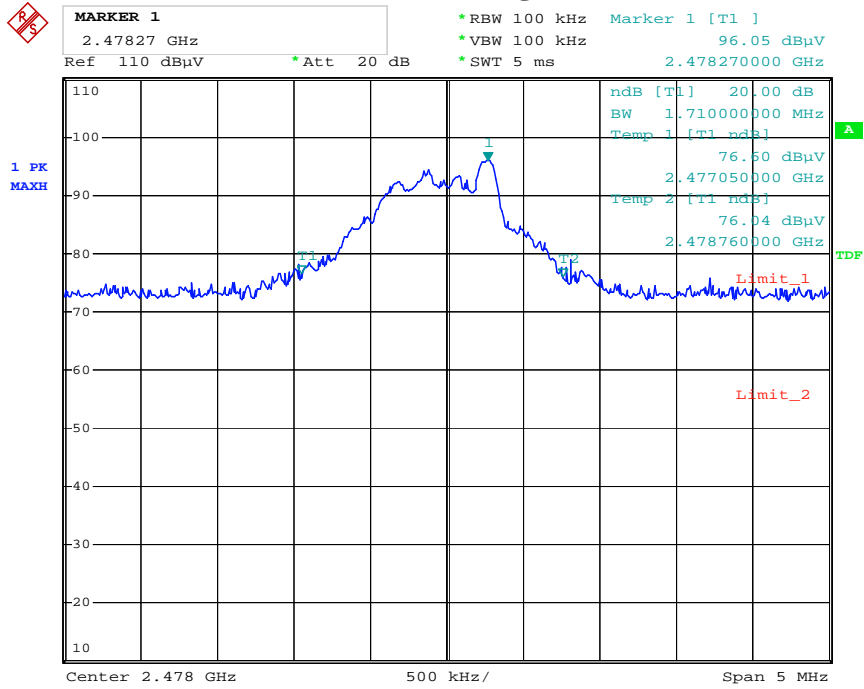
20 dB Bandwidth @ middle channel



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20 dB Bandwidth @ high channel



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