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Laboratoire  
d'essai accrédité  
N°1-1633

# Rapport d'essai / Test report

N° 115578-R2-E

JDE : 106260

Portée  
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## DELIVRE A / ISSUED TO

: **INGENICO**  
Rue Claude Chappe  
B.P. 344  
07503 GUILHERAND GRANGES - FRANCE

## Objet / Subject

: Essais de compatibilité électromagnétique conformément aux normes  
**FCC CFR 47 Part 15, Subpart B et C.**  
*Electromagnetic compatibility tests according to the standards  
FCC CFR 47 Part 15, Subpart B and C*

## Matériel testé / Apparatus under test

- Produit / Product : **Lecteur de carte bancaire / Bank payment terminal**
- Marque / Trade mark : **INGENICO**
- Constructeur / Manufacturer : **INGENICO**
- Type sous test / Model under test : **IWL251-01T1541A IWL221-01T1539A**
- N° de série / serial number : **10266WL40000167 11040WL40001106**
- FCC ID : **XKB-IWL2XXGCL**

## Date des essais / Test date

: Du 12 Avril au 27 Mai 2011 /  
*From April 12<sup>th</sup> to May 27<sup>th</sup>, 2011*

## Lieu d'essai / Test location

: **LCIE SUD-EST**  
ZI Centr'Alp – 170 rue de Chatagnon  
38430 MOIRANS - France


Test réalisé par / Test performed by : Jonathan PAUC


Ce document comporte / Composition of document : 93 pages.

Ecrit par / Written by,  
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MOIRANS, 27 JUIN 2011 / JUNE 27<sup>th</sup>, 2011

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**1. TEST PROGRAM**

**Standard:** - FCC Part 15, Subpart B (Digital Devices)  
- ANSI C63.4 (2003)

EMISSION TEST	LIMITS			RESULTS (Comments)
Limits for conducted disturbance at mains ports 150kHz-30MHz <sub>Pa</sub> .	<b>Frequency</b>	<b>Quasi-peak value (dBµV)</b>	<b>Average value (dBµV)</b>	<b>COMPLY</b>
	150-500kHz	66 to 56	56 to 46	
	0.5-5MHz	56	46	
	5-30MHz	60	50	
Radiated emissions 30MHz-12.5GHz <sub>Pa</sub> .	<b>Measure at 3m</b> 30MHz-88MHz : 40 dBµV/m 88MHz-216MHz : 43.5 dBµV/m 216MHz-960MHz : 46.0 dBµV/m Above 960MHz : 54.0 dBµV/m			<b>COMPLY</b>

**Standard:** - FCC Part 15, Subpart C  
- ANSI C63.4 (2003)

EMISSION TEST	LIMITS			RESULTS (Comments)
Limits for conducted disturbance at mains ports 150kHz-30MHz <sub>Pa</sub> .	<b>Frequency</b>	<b>Quasi-peak value (dBµV)</b>	<b>Average value (dBµV)</b>	<b>COMPLY</b>
	150-500kHz	66 to 56	56 to 46	
	0.5-5MHz	56	46	
	5-30MHz	60	50	
Radiated emissions 9kHz-30MHz <sub>Pa</sub> .	<b>Measure at 300m</b> 9kHz-490kHz : 67.6dBµV/m /F(kHz) <b>Measure at 30m</b> 490kHz-1.705MHz : 87.6dBµV/m /F(kHz) 1.705MHz-30MHz : 29.5 dBµV/m			<b>COMPLY</b>
Radiated emissions 30MHz-1GHz* <sub>Pa</sub> .	<b>Measure at 3m</b> 30MHz-88MHz : 40 dBµV/m 88MHz-216MHz : 43.5 dBµV/m 216MHz-960MHz : 46.0 dBµV/m Above 960MHz : 54.0 dBµV/m			<b>COMPLY</b>
Fundamental frequency tolerance	<b>Operation within the band</b> <b>13.110-14.010 MHz §15.225</b>			<b>COMPLY</b>
Bandedge compliance	<b>Operation within the band</b> <b>13.110-14.010 MHz §15.225</b>			<b>COMPLY</b>

\*§15.33: The highest internal source of a testing device is defined like more the highest frequency generated or used in the testing device or on which the testing device works or agrees.

- If the highest frequency of the internal sources of the testing device is lower than 108 MHz, measurement must be only performed until 1GHz.
  - If the highest frequency of the internal sources of the testing device ranges between 108 MHz and 500 MHz, measurement must be only performed until 2GHz.
  - If the highest frequency of the internal sources of the testing device ranges between 500 MHz and 1 GHz, measurement must be only performed until 5GHz.
- If the highest frequency of the internal sources of the testing device is above 1 GHz, measurement must be only performed until 5 times the highest frequency or 40 GHz, while taking smallest of both.



## 2. SYSTEM TEST CONFIGURATION

### 2.1. JUSTIFICATION

The system was configured for testing in a typical fashion (as a customer would normally use it) see §2.6.

### 2.2. HARDWARE IDENTIFICATION

#### Equipment under test (EUT):

Maximum internal frequencies: 400MHz

<u>Terminal</u>	<u>Base</u>
IWL251-01T1541A Serial number: 10266WL40000167	IWL200-01B1326A Serial number: none
IWL221-01T1539A Serial number: 11040WL40001106	

#### *Power supply interface :*

- 1: 5Vdc (Through Micro-USB side connector)
- 2: 5Vdc (Through Base IWL 200)

<u>ID Power supply</u>	<u>Trademark</u>	<u>Ref</u>	<u>Connector</u>	<u>Cable</u>
PWS 1	SAGEM MONEL	FW 7650/151965	Jack	Length : 200mm
PWS 2	PHIHONG	PSA 105A-050	µUSB	Length : 200mm
PWS 3	INGENICO	FW 7601/152171	µUSB	Length : 200mm
PWS 4	INGENICO	FW 7650L/05	µUSB	Length : 200mm
PWS 5U	INGENICO	PSA C05R-050	µUSB (with adapter Jack <->µUsb)	Length : 200mm
PWS 5J	INGENICO	PSA C05R-050	Jack	Length : 200mm
PWS 6	INGENICO	FW 7601/152171	Jack	Length : 200mm
PWS 7	INGENICO	PSA 105A-050	Jack	Length : 200mm

#### Input/output - Terminal:

- 1 x DC power input Micro USB (5Vdc )
- 2 x SAM ports
- 1 x SIM port
- 1 x MicroSD card reader (IWL250)
- 1 x Base connector (4 Pins)

#### Auxiliaries equipment used during test:

- 2 x SAM Card
- 1 x SIM Card
- 1 x Micro USB
- 2 x Smartcards (EFT Contactless and EMV card)

#### Input/output - Base:

- 1 x DC power input Jack (5Vdc)

#### I/O cables used for testing:

See Power supply description tab

**2.3. RUNNING MODE**

<b>ID Running Mode</b>	<b>Function description</b>
<b>Running Mode 1</b>	<ul style="list-style-type: none"><li>- Printing process is performed</li><li>- CAM0 card reading process</li><li>- SAM1 card reading process</li><li>- SAM2 card reading process</li><li>- Contactless smart card reading process</li><li>- GPRS is activated</li></ul>
<b>Running Mode 2</b>	<ul style="list-style-type: none"><li>- Printing process is performed</li><li>- CAM0 card reading process</li><li>- SAM1 card reading process</li><li>- SAM2 card reading process</li><li>- Contactless smart card reading process</li><li>- Micro SD card reading process</li><li>- GPRS is activated</li></ul>

**2.4. EQUIPMENT MODIFICATIONS**

**IWL251-01T1541A** : On main PCB set a Ferrite 0402 (470ohms@100MHz) instead of resistor R109 (on  $\mu$ SDCARD clock)

**IWL221-01T1539A** : None

**2.5. EUT EXERCISE SOFTWARE**

Testcam               => TESTCAM0107  
Telium manager       => M2OS: 47786093  
Telium manager       => Version : 37770972



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**2.6. EUT CONFIGURATION**

<u>Configuration</u>	<u>EST</u>	<u>Power supply</u>	<u>Base</u>	<u>Running mode</u>
Configuration 1	IWL221-01T1539A	Internal Battery	NONE	Running mode 1
Configuration 2A	IWL221-01T1539A	PWS 4	NONE	Running mode 1
Configuration 2B	IWL221-01T1539A	PWS 5U	NONE	Running mode 1
Configuration 2C	IWL221-01T1539A	PWS 3	NONE	Running mode 1
Configuration 2D	IWL221-01T1539A	PWS 2	NONE	Running mode 1
Configuration 3A	IWL221-01T1539A	PWS 1	IWL200-01B1326A	Running mode 1
Configuration 3B	IWL221-01T1539A	PWS 5J	IWL200-01B1326A	Running mode 1
Configuration 3C	IWL221-01T1539A	PWS 6	IWL200-01B1326A	Running mode 1
Configuration 3D	IWL221-01T1539A	PWS 7	IWL200-01B1326A	Running mode 1
Configuration 4	IWL251-01T1541A	Internal Battery	NONE	Running mode 2
Configuration 5A	IWL251-01T1541A	PWS 4	NONE	Running mode 2
Configuration 5B	IWL251-01T1541A	PWS 5U	NONE	Running mode 2
Configuration 5C	IWL251-01T1541A	PWS 3	NONE	Running mode 2
Configuration 5D	IWL251-01T1541A	PWS 2	NONE	Running mode 2
Configuration 6A	IWL251-01T1541A	PWS 1	IWL200-01B1326A	Running mode 2
Configuration 6B	IWL251-01T1541A	PWS 5J	IWL200-01B1326A	Running mode 2
Configuration 6C	IWL251-01T1541A	PWS 6	IWL200-01B1326A	Running mode 2
Configuration 6D	IWL251-01T1541A	PWS 7	IWL200-01B1326A	Running mode 2

**3. RADIATED EMISSION DATA**

**3.1. CLIMATIC CONDITIONS**

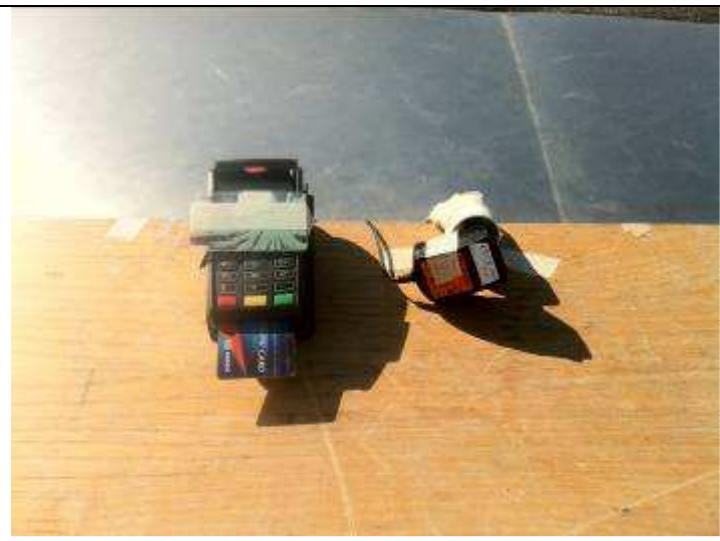
Date of test	: April 12 <sup>th</sup> ,2011	April 28 <sup>th</sup> , 2011	April 29 <sup>th</sup> , 2011
Test performed by	: J. PAUC	J PAUC	J PAUC
Atmospheric pressure	: 1002mb	990mb	990mb
Relative humidity	: 41%	39%	39%
Ambient temperature	: 23°C	22°C	23°C

**3.2. TEST SETUP**

The installation of EUT is identical for pre-characterization measurement in a 3 meters semi anechoic chamber and for measures on a 10 meters Open site.



*Typical Configuration (Power supply trough  $\mu$ USB port)*



*Typical Configuration (Base + power supply "Jack version")*

**3.3. TEST SEQUENCE AND RESULTS****3.3.1. Pre-characterization at 3 meters [9kHz-30MHz]**

A pre-scan of all the setup has been performed in a 3 meters semi anechoic chamber. The distance between EUT and antenna is 3 meters. For Pre-characterization, the loop antenna was rotated during the test for maximized the emission measurement. Measurement performed on 3 axis of EUT. Frequency band investigated is 9kHz to 30MHz. The pre-characterization graphs are obtained in PEAK detection.

See graph for 9kHz-30MHz band:

EMR#19	IWL221-01T1539A	(Configuration 2B) "worst case"	Pol 90°	(See annex 1)
EMR#20	IWL221-01T1539A	(Configuration 2B) "worst case"	Pol 0°	(See annex 1)
EMR#39	IWL251-01T1541A	(Configuration 6 B) "worst case"	Pol 0°	(See annex 1)
EMR#40	IWL251-01T1541A	(Configuration 6 B) "worst case"	Pol 90°	(See annex 1)





### 3.3.1. Pre-characterization [30MHz-1GHz]

For frequency band 30MHz to 1GHz, a pre-scan of all the setup has been performed in a 3 meters semi anechoic chamber.

The distance between EUT and antenna is 3 meters. Test is performed in horizontal (H) and vertical (V) polarization with a log-periodic antenna. The EUT is being rotated on 360° and on 3 axis during the measurement. The pre-characterization graphs are obtained in PEAK detection.

See graphs for 30MHz-1GHz (Worst cases):

EMR#1	IWL221-01T1539A	(Configuration 1)	H polarization	(See annex 1)
EMR#2	IWL221-01T1539A	(Configuration 1)	V polarization	(See annex 1)
EMR#3	IWL221-01T1539A	(Configuration 2A)	H polarization	(See annex 1)
EMR#4	IWL221-01T1539A	(Configuration 2A)	V polarization	(See annex 1)
EMR#5	IWL221-01T1539A	(Configuration 2B)	H polarization	(See annex 1)
EMR#6	IWL221-01T1539A	(Configuration 2B)	V polarization	(See annex 1)
EMR#7	IWL221-01T1539A	(Configuration 2C)	H polarization	(See annex 1)
EMR#8	IWL221-01T1539A	(Configuration 2C)	V polarization	(See annex 1)
EMR#9	IWL221-01T1539A	(Configuration 2D)	H polarization	(See annex 1)
EMR#10	IWL221-01T1539A	(Configuration 2D)	V polarization	(See annex 1)
EMR#11	IWL221-01T1539A	(Configuration 3A)	H polarization	(See annex 1)
EMR#12	IWL221-01T1539A	(Configuration 3A)	V polarization	(See annex 1)
EMR#13	IWL221-01T1539A	(Configuration 3B)	H polarization	(See annex 1)
EMR#14	IWL221-01T1539A	(Configuration 3B)	V polarization	(See annex 1)
EMR#15	IWL221-01T1539A	(Configuration 3C)	H polarization	(See annex 1)
EMR#16	IWL221-01T1539A	(Configuration 3C)	V polarization	(See annex 1)
EMR#17	IWL221-01T1539A	(Configuration 3D)	H polarization	(See annex 1)
EMR#18	IWL221-01T1539A	(Configuration 3D)	V polarization	(See annex 1)
EMR#21	IWL251-01T1541A	(Configuration 4)	H polarization	(See annex 1)
EMR#22	IWL251-01T1541A	(Configuration 4)	V polarization	(See annex 1)
EMR#23	IWL251-01T1541A	(Configuration 5A)	H polarization	(See annex 1)
EMR#24	IWL251-01T1541A	(Configuration 5A)	V polarization	(See annex 1)
EMR#25	IWL251-01T1541A	(Configuration 5B)	H polarization	(See annex 1)
EMR#26	IWL251-01T1541A	(Configuration 5B)	V polarization	(See annex 1)
EMR#27	IWL251-01T1541A	(Configuration 5C)	H polarization	(See annex 1)
EMR#28	IWL251-01T1541A	(Configuration 5C)	V polarization	(See annex 1)
EMR#29	IWL251-01T1541A	(Configuration 5D)	H polarization	(See annex 1)
EMR#30	IWL251-01T1541A	(Configuration 5D)	V polarization	(See annex 1)
EMR#31	IWL251-01T1541A	(Configuration 6A)	H polarization	(See annex 1)
EMR#32	IWL251-01T1541A	(Configuration 6A)	V polarization	(See annex 1)
EMR#33	IWL251-01T1541A	(Configuration 6B)	H polarization	(See annex 1)
EMR#34	IWL251-01T1541A	(Configuration 6B)	V polarization	(See annex 1)
EMR#35	IWL251-01T1541A	(Configuration 6C)	H polarization	(See annex 1)
EMR#36	IWL251-01T1541A	(Configuration 6C)	V polarization	(See annex 1)
EMR#37	IWL251-01T1541A	(Configuration 6D)	H polarization	(See annex 1)
EMR#38	IWL251-01T1541A	(Configuration 6D)	V polarization	(See annex 1)



**3.3.1. Pre-characterization at 3 meters [1GHz-2GHz]**

For frequency band 1GHz to 2GHz, a pre-scan of all the setup has been performed in a 3 meters semi anechoic chamber.

The distance between EUT and antenna is 3 meters. Test is performed in horizontal (H) and vertical (V) polarization with a Horn antenna. The EUT is being rotated on 360° and on 3 axis during the measurement. The pre-characterization graphs are obtained in PEAK detection.

*Non significatives frequencies observed above 1GHz*

**3.3.2. Characterization on 10 meters open site below 30 MHz**

The product has been tested according to ANSI C63.4 (2003), FCC part 15 subpart C. Radiated Emissions were measured on an open area test site. A description of the facility is on file with the FCC.

The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart C §15.225 limits in the frequency range 13.553MHz 13.567MHz. Measurement bandwidth was 9kHz.

Antenna height was 1m for both horizontal and vertical polarization.

Antenna was rotated around its vertical axis.

Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on 3 axis of EUT. A summary of the worst case emissions found in all test configurations and modes is shown on clauses 3.2.

**Worst case among all configurations described in §2.6**

Frequency (MHz)	QPeak Limit (dBµV/m) @ 30m	Qpeak (dBµV/m)	Qpeak-Limit (Margin dB)	Turntable Angle (deg)	Ant. Pol./ Angle (deg)	Tot Corr (dB)
13.56* <sup>1</sup>	84	30.05	<b>-53.95</b>	95	90	9.7
27.12* <sup>1</sup>	29.5	6.5	<b>-23</b>	95	90	7

\*<sup>1</sup>: Measure have been done at 10m distance and corrected according to requirements of 15.209.e) (M@30m = M@10m-19.1dB)

**Limits Sub clause §15.225**

Frequency (MHz)	Field strength (dBµV/m)	Measurement distance (m)
13.553-13.567	15 848 84 dBµV/m	30
13.410-13.553 13.567-13.710	334 50.5 dBµV/m	30
13.110-13.410 13.710-14.010	106 40.5 dBµV/m	30

See chapter 5 of this test report for band edge measurements.



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### 3.3.3. Characterization on 10 meters open site from 30MHz to 2GHz

The product has been tested at a distance of **10 meters** from the antenna and compared to the FCC part 15 subpart B §15.109 limits and C §15.209 limits. Measurement bandwidth was 120kHz from 30 MHz to 1GHz Antenna height search was performed from 1m to 4m for both horizontal and vertical polarization. Continuous linear turntable azimuth search was performed with 360 degrees range. Measurement performed on 3 axis of EUT.

A summary of the worst case emissions found in all test configurations and modes is shown on clause 3.2

#### Frequency range 30MHz- 1GHz "Worst case" (IWL221-01T1539A)

No	Frequency (MHz)	QPeak Limit (dBµV/m)	Qpeak * (dBµV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	PoI	Hgt (cm)	Tot Corr (dB)	Comments
1	396.72	46.0	45.30	-0.70	301	H	250	19.2	Configuration 3B
2	377.38	46.0	43.10	-2.90	301	H	250	18.6	Configuration 2A
3	33.72	40.0	38.0	-2.0	357	V	200	13	Configuration 2D
4	415.96	46.0	44.3	-1.70	332	H	200	19.7	Configuration 3B
5	387.04	46.0	44.8	-1.20	264	H	150	18.9	Configuration 3B

#### Frequency range 30MHz- 1GHz "Worst case" (IWL251-01T1541A)

No	Frequency (MHz)	QPeak Limit (dBµV/m)	Qpeak * (dBµV/m)	Qpeak-Limit (Margin, dB)	Angle (deg)	PoI	Hgt (cm)	Tot Corr (dB)	Comments
1	120.9549	43.5	37.70	-5.80	303	V	100	14.7	Configuration 5C
2	396.72	46.0	43.40	-2.60	301	H	250	19.2	Configuration 6B
3	377.381	46.0	45.60	-0.40	301	H	250	18.6	Configuration 6A
4	214.77	43.5	35.7	-7.8	357	H	200	13	Configuration 6A
5	32.231	40.0	39.2	-0.80	114	V	100	16.3	Configuration 5D

\*: Measure have been done at 10m distance and corrected according to requirements of 15.209.e)  
(M@3m = M@10m+10.5dB)

#### Frequency range 1GHz- 2GHz (IWL221-01T1539A & IWL251-01T1541A)

Measurements are performed using a PEAK and Average detection. (RBW = 1MHz)

No	Frequency (GHz)	Limit Average (dBµV/m)	Measure Average (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	PoI Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
Non significative frequency observed									

No	Frequency (GHz)	Limit Peak (dBµV/m)	Measure Peak (dBµV/m)	Margin (Mes-Lim) (dB)	Angle Table (deg)	PoI Ant.	Ht Ant. (cm)	Correc. factor (dB)	Comments
Non significative frequency observed									

RESULTS: PASS



### 3.4. FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follow:

$$FS = RA + AF + CF - AG$$

Where

- FS = Field Strength
- RA = Receiver Amplitude
- AF = Antenna Factor
- CF = Cable Factor
- AG = Amplifier Gain

Assume a receiver reading of 52.5dB $\mu$ V is obtained. The antenna factor of 7.4 and a cable factor of 1.1 are added. The amplifier gain of 29dB is subtracted, giving a field strength of 32 dB $\mu$ V/m.

$$FS = 52.5 + 7.4 + 1.1 - 29 = 32 \text{ dB}\mu\text{V/m}$$

The 32 dB $\mu$ V/m value can be mathematically converted to its corresponding level in  $\mu$ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } [(32\text{dB}\mu\text{V/m})/20] = 39.8 \mu\text{V/m.}$$



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#### 4. FUNDAMENTAL FREQUENCY TOLERANCE (15.225E)

##### 4.1. TEST CONDITIONS

Date of test : May 27<sup>th</sup>, 2010  
Test performed by : J. PAUC  
Atmospheric pressure : 1003mb  
Relative humidity : 40%  
Ambient temperature : 21°C

The frequency tolerance of the carrier signal shall be maintained within  $\pm 0.01\%$  of the operating frequency when the temperature is varied from  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  at the nominal power voltage and the primary power voltage is varied from 85% to 115% of the rated supply voltage at  $20^{\circ}\text{C}$ .

##### 4.2. Temperature and voltage fluctuation

Temperature has been set at  $+20^{\circ}\text{C}$ ,  $-20^{\circ}\text{C}$  and  $+50^{\circ}\text{C}$ .

Voltage is varied from : 4.25Vdc to 5.75Vdc  
Frequency of carrier: 13.56 MHz  
Upper limit: 13.561356 MHz  
Lower limit: 13.558644 MHz

##### IWL221-01T1539A

Temperature	-20°C	20°C	+50°C
<b>Voltage</b>			
Mains voltage: 5Vdc			
Frequency Drift (MHz)	- 0.000019	REF	- 0.000082
Carrier level (dBc)	- 1.80	REF	+ 0.00
Mains voltage: 4.25Vdc			
Frequency Drift (MHz)	- 0.000019	- 0.000007	- 0.000080
Carrier level (dBc)	- 1.80	+ 0.00	+ 0.00
Mains voltage: 5.75Vdc			
Frequency Drift (MHz)	- 0.000021	- 0.000009	- 0.000082
Carrier level (dBc)	- 2.10	- 1.40	- 0.60

Frequency drift measured is **82Hz** when the temperature is varied from  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  and voltage is varied from  $5\text{Vdc} \pm 15\%$  (EST mains power supply  $\mu\text{USB}$  port).

##### IWL251-01T1541A

Temperature	-20°C	20°C	+50°C
<b>Voltage</b>			
Mains voltage: 5Vdc			
Frequency Drift (MHz)	- 0.000014	REF	- 0.000067
Carrier level (dBc)	- 1.10	REF	- 0.10
Mains voltage: 4.25Vdc			
Frequency Drift (MHz)	- 0.000014	+ 0.000000	- 0.000067
Carrier level (dBc)	- 1.20	+ 0.00	- 0.10
Mains voltage: 5.75Vdc			
Frequency Drift (MHz)	- 0.000013	- 0.000003	- 0.000066
Carrier level (dBc)	- 1.30	- 0.20	- 0.10

Frequency drift measured is **67Hz** when the temperature is varied from  $-20^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$  and voltage is varied from  $5\text{Vdc} \pm 15\%$  (EST mains power supply  $\mu\text{USB}$  port).

**RESULTS: PASS**



L C I E

## 5. BAND-EDGE COMPLIANCE §15.209

### 5.1. CLIMATIC CONDITIONS

Date of test : May 27<sup>th</sup>, 2010  
Test performed by : J. PAUC  
Atmospheric pressure : 1003mb  
Relative humidity : 40%  
Ambient temperature : 21°C

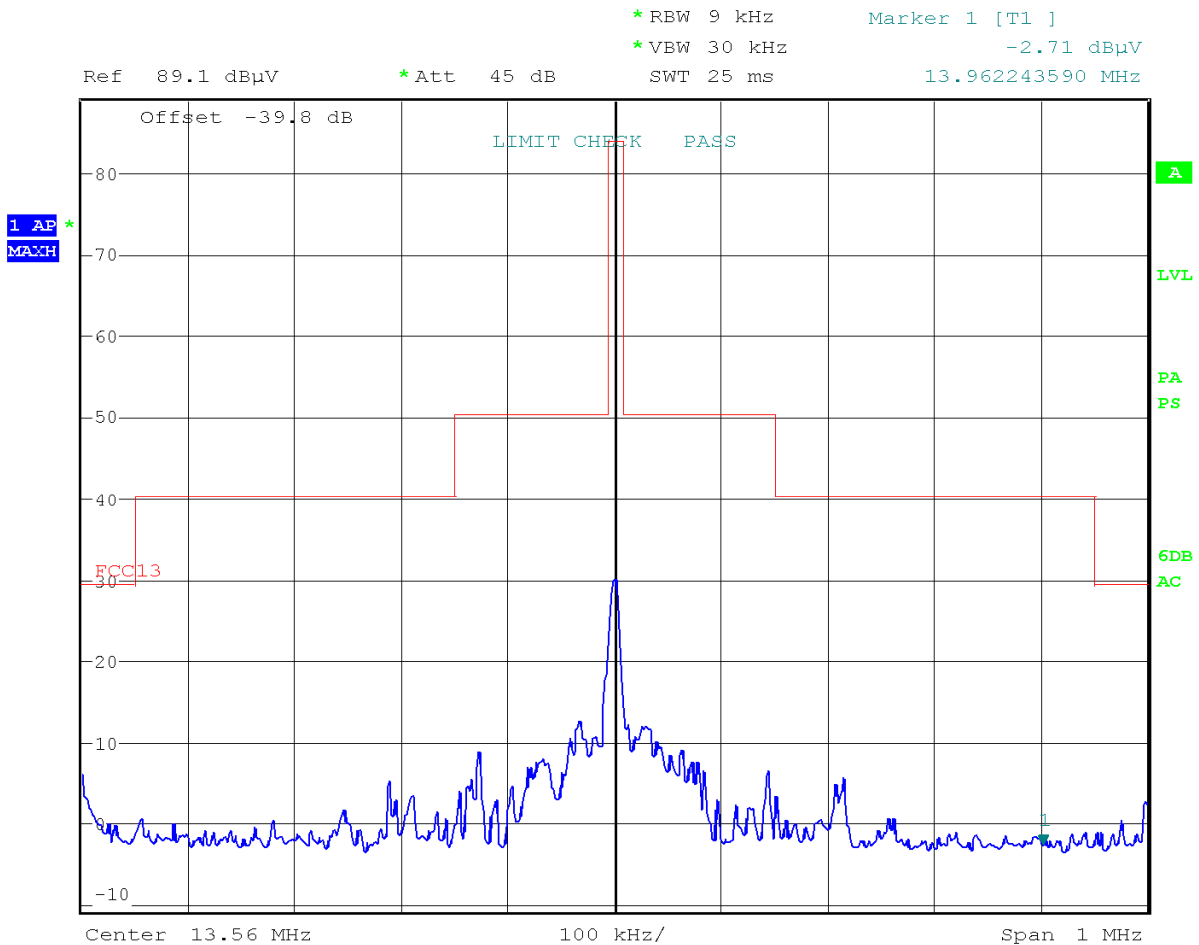
### 5.2. EQUIPMENT CONFIGURATION

See § 2.6.

### 5.3. Frequency band 13.110-14.010MHz

Following plots show radiated emission level in the frequency band 13.110-14.010MHz with a RBW of 9kHz and a quasi-peak detector. The graphs are obtained with a measuring receiver ESU8.

#### Worst case among all configuration described in §2.6



**6. CONDUCTED EMISSION DATA****6.1. CLIMATIC CONDITIONS**

Date of test	: May 4 <sup>th</sup> , 2011	May 5 <sup>th</sup> , 2011
Test performed by	: J. PAUC	J PAUC
Atmospheric pressure	: 1002mb	1001mb
Relative humidity	: 40%	40%
Ambient temperature	: 22°C	22°C

**6.2. SETUP FOR CONDUCTED EMISSIONS MEASUREMENT**

The product has been tested according to ANSI C63.4-(2003) and FCC Part 15 subpart B and C.

The product has been tested with 110V/60Hz power line voltage and compared to the FCC Part 15 subpart B §15.107 and C §15.207 limits. Measurement bandwidth was 9kHz from 150 kHz to 30 MHz.

Measurement is made with a Rohde & Schwarz ESU8 receiver in peak mode. This was followed by a Quasi-Peak, i.e. CISPR measurement for any strong signal. If the average limit is met when using a Quasi-Peak detector, the EUT shall be deemed to meet both limits and measurement with the average detector is unnecessary. The LISN (measure) is 50Ω / 50μH.

The Peak data are shown on plots in annex 1. Quasi-Peak and Average measurements are detailed in a table with frequencies and levels measured.

Interconnecting cables and equipment's were moved to position that maximized emission. A summary of the worst case emissions found in all test configurations and modes is shown on the following page.

### 6.3. TEST SETUP

The EUT is placed on the ground reference plane, at 80cm from the LISN. The distance between the EUT and the vertical ground plane is 40cm.

Auxiliaries are powered by another LISN.

The cable has been shorted to 1meter length. The EUT is powered trough the LISN (measure).



*Typical Configuration (Power supply trough  $\mu$ USB port)*





L C I E



*Typical Configuration (Base + power supply "Jack version")*

**6.4. TEST SEQUENCE AND RESULTS**

Measurements are performed on the phase (L1) and neutral (N) of power line voltage.  
Graphs are obtained in PEAK detection.  
Measures are also performed in Quasi-Peak and Average for any strong signal.

EMC#1	IWL221-01T1539A	(Configuration 2A)	Phase	(See annex 1)
EMC#2	IWL221-01T1539A	(Configuration 2A)	Neutral	(See annex 1)
EMC#3	IWL221-01T1539A	(Configuration 2B)	Phase	(See annex 1)
EMC#4	IWL221-01T1539A	(Configuration 2B)	Neutral	(See annex 1)
EMC#5	IWL221-01T1539A	(Configuration 2C)	Phase	(See annex 1)
EMC#6	IWL221-01T1539A	(Configuration 2C)	Neutral	(See annex 1)
EMC#7	IWL221-01T1539A	(Configuration 2D)	Phase	(See annex 1)
EMC#8	IWL221-01T1539A	(Configuration 2D)	Neutral	(See annex 1)
EMC#9	IWL221-01T1539A	(Configuration 3A)	Phase	(See annex 1)
EMC#10	IWL221-01T1539A	(Configuration 3A)	Neutral	(See annex 1)
EMC#11	IWL221-01T1539A	(Configuration 3B)	Phase	(See annex 1)
EMC#12	IWL221-01T1539A	(Configuration 3B)	Neutral	(See annex 1)
EMC#13	IWL221-01T1539A	(Configuration 3C)	Phase	(See annex 1)
EMC#14	IWL221-01T1539A	(Configuration 3C)	Neutral	(See annex 1)
EMC#15	IWL221-01T1539A	(Configuration 3D)	Phase	(See annex 1)
EMC#16	IWL221-01T1539A	(Configuration 3D)	Neutral	(See annex 1)
EMC#17	IWL251-01T1541A	(Configuration 5A)	Phase	(See annex 1)
EMC#18	IWL251-01T1541A	(Configuration 5A)	Neutral	(See annex 1)
EMC#19	IWL251-01T1541A	(Configuration 5B)	Phase	(See annex 1)
EMC#20	IWL251-01T1541A	(Configuration 5B)	Neutral	(See annex 1)
EMC#21	IWL251-01T1541A	(Configuration 5C)	Phase	(See annex 1)
EMC#22	IWL251-01T1541A	(Configuration 5C)	Neutral	(See annex 1)
EMC#23	IWL251-01T1541A	(Configuration 5D)	Phase	(See annex 1)
EMC#24	IWL251-01T1541A	(Configuration 5D)	Neutral	(See annex 1)
EMC#25	IWL251-01T1541A	(Configuration 6A)	Phase	(See annex 1)
EMC#26	IWL251-01T1541A	(Configuration 6A)	Neutral	(See annex 1)
EMC#27	IWL251-01T1541A	(Configuration 6B)	Phase	(See annex 1)
EMC#28	IWL251-01T1541A	(Configuration 6B)	Neutral	(See annex 1)
EMC#29	IWL251-01T1541A	(Configuration 6C)	Phase	(See annex 1)
EMC#30	IWL251-01T1541A	(Configuration 6C)	Neutral	(See annex 1)
EMC#31	IWL251-01T1541A	(Configuration 6D)	Phase	(See annex 1)
EMC#32	IWL251-01T1541A	(Configuration 6D)	Neutral	(See annex 1)

RESULT: PASS



L C I E

**7. TEST EQUIPMENT LIST (MOIRANS SITE)**

	N° LCIE	TYPE	COMPANY	REF	commentaire
<b>RADIATED EMISSION MEASUREMENT (PRE-SCAN SEMI-ANECHOIC CHAMBER #2)</b>					
	A5329032VO	Absorption clamp	LUTHI	MDS21	
	A5329044VO	Absorption clamp	RHODE ET SCHWARZ	85024A	
X	A4049060VO	Adapter quasi-peak	HEWLETT PACKARD	HP85650A	
X	A7102024VO	Amplifier 8 GHz	HEROTEK	A1080304A	
X	A7486006VO	Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447F	
	A7085008VO	Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447D	
	A7085009VO	Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447D	
	A7085010VO	Amplifier 10MHz – 1300 MHz	A-INFO INC	JXWBLA-T	
X	C2040146VO	Antenna Bi-Log XWing	TESEQ	CBL6144	
X	C2042027VO	Antenna horn	EMCO	3115	
	C2042028VO	Antenna horn 26GHz	SCHWARZBECK	BBHA 9170	
X	C2040052VO	Antenna Loop	ELECTRO-METRICS	EM-6879	
X	A5329045VO	Cable EMR (s-Anechoic chamber)			
X	A5329056VO	Cable Radiat EMI (Pre-amp/Analyzer)			
X	A5329057VO	Cable Radiat. EMI (Pre-amp/cage)			
X	A2642019	Measurement Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	
X	A4060030VO	Pre-selector RF	HEWLETT PACKARD	HP85685A	
X	A3169050VO	Radiated emission comb generator	BARDET		
X	D3044015VO	Semi-Anechoic chamber #2	SIEPEL		
X	A4060029VO	Spectrum analyzer	HEWLETT PACKARD	HP8568B	
X	A4060028VO	Spectrum analyzer display	HEWLETT PACKARD	HP85662A	
X	F2000404VO	Turntable chamber	ETS Lingren	Model 2165	
X	F2000393VO	Turntable controller chamber	ETS Lingren	Model 2066	
<b>RADIATED EMISSION MEASUREMENT (OPEN AREA TEST SITE)</b>					
	A5329032VO	Absorption clamp	LUTHI	MDS21	
	A5329044VO	Absorption clamp	RHODE ET SCHWARZ	85024A	
X	A4049059VO	Adapter quasi-peak	HEWLETT PACKARD	HP85650A	
	A7102024VO	Amplifier 8 GHz	HEROTEK	A1080304A	
	A7102026VO	Amplifier 8-26GHz	ALDETEC	ALS01452	
	A7085008VO	Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447D	
	A7085009VO	Amplifier 0.1MHz – 1300 MHz	HEWLETT PACKARD	8447D	
	A7085010VO	Amplifier 10MHz – 1300 MHz	A-INFO INC	JXWBLA-T	
X	C2040050VO	Antenna biconic	EMCO	3104C	
	C2040051VO	Antenna Bi-log	CHASE	CBL6111A	
	C2042027VO	Antenna horn	EMCO	3115	
	C2042028VO	Antenna horn 26GHz	SCHWARZBECK	BBHA 9170	
X	C2040056VO	Antenna log-periodic	EMCO	3146	
X	C2040052VO	Antenna Loop	ELECTRO-METRICS	EM-6879	
X	F2000288VO	Antenna mast	EMCO	1050	
X	A5329048VO	Cable EMR OATS	SUCOFLEX	106G	
X	A5329199VO	Cable OATS (Mast at 10m)	UTIFLEX		
X	A5329188VO	Cable OATS (Mast at 10m)	UTIFLEX		
	A5329076VO	Cable OATS (Mast at 3m)	UTIFLEX		
	A5329196VO	Cable OATS (Turntable)	UTIFLEX		
	A5329187VO	Cable OATS (Turntable)	UTIFLEX		
	A2640011VO	Measurement receiver 9kHz–30MHz	ROHDE ET SCHWARZ	ESH3	
X	A2642019	Measurement Receiver 20Hz – 8GHz	ROHDE & SCHWARZ	ESU8	
X	A4060027VO	Pre-selector RF	HEWLETT PACKARD	HP85685A	
X	A3169050VO	Radiated emission comb generator	BARDET		
X	A4060017VO	Spectrum analyzer	HEWLETT PACKARD	HP8568B	
	A4060018VO	Spectrum Analyzer 9KHz – 26.5GHz	HEWLETT PACKARD	8593E	
	A4060016VO	Spectrum analyzer 9kHz –1.8GHz	HEWLETT PACKARD	8591E	
X	A4060019VO	Spectrum analyzer display	HEWLETT PACKARD	HP85662A	
X	F2000403VO	Turntable	ETS LINDGREN	Model 2187	
X	F2000286VO	Turntable / Antenna mast controller	ETS LINDGREN	Model 2066	
<b>CONDUCTED MEASUREMENT EMISSION</b>					
	A5329061VO	Cable Conduct. EMI			
X	A5329060VO	Cable Conduct. EMI			
X	A5329189VO	Shielded cable	UTIFLEX		



**LCIE**

	N° LCIE	TYPE	COMPANY	REF	commentaire
	A5329076VO	Shielded cable	UTIFLEX		
	A5329206VO	Shielded cable	UTIFLEX		
	A5329207VO	Shielded cable	UTIFLEX		
	A5329060VO	Shielded cable	UTIFLEX		
	A5329071VO	Shielded cable	UTIFLEX		
X	A3169049VO	Conducted emission comb generator	BARDET		
	A4040015	Clickmeter	SCHAFFNER	DIA1512D	
	A5329037VO	Current injection probe	SCHAFFNER	CIP8213	
	A1290017VO	Current probe	SCHAFFNER	CSP9160	
	A5329036VO	Direct Injection Module 100+50 Ohms	LCIE	MID01-100 ohms	
	A7156004VO	Direct Injection Module 100+50 Ohms	LUTHI	CR100A	
	A5329042VO	Ferrite Tube	LUTHI	FTC 101	
	A1092042VO	Ferrite Tube	LUTHI	FTC101	
	C2320059VO	LISN	EMCO	3810/2SH	
	C2320068VO	LISN	EMCO	3825/2	
	C2320061VO	LISN	TELEMETER ELECTRONIC	NNB-2/16Z	
	C2320062VO	LISN tri-phase ESH2-Z5	RHODE ET SCHWARZ	33852.19.53	
	C2320063VO	LISN tri-phase ESH2-Z5	RHODE ET SCHWARZ	33852.19.53	
X	C2320123VO	LISN	RHODE ET SCHWARZ	ENV216	
	A2640011VO	Measurement receiver 9kHz-30MHz	ROHDE ET SCHWARZ	ESH3	
X	A2642019VO	Measurement Receiver 20Hz - 8GHz	ROHDE & SCHWARZ	ESU8	
	C2320067VO	ISN 2 x 2 wires	RHODE ET SCHWARZ	ENY22	
	C2320066VO	ISN 4 wires	RHODE ET SCHWARZ	ENY41	
	C2320124VO	ISN 4 wires	TESEQ	T400A	
	D3044016VO	Semi-Anechoic chamber #1	SIEPEL		
	D3044017VO	Semi-Anechoic chamber #3	SIEPEL		
	D3044015VO	Semi-Anechoic chamber #2	SIEPEL		
X	D3044010VO	Faraday Cage	RAY PROOF		
X	A4049061VO	Transient limiter	HEWLETT PACKARD	11947A	
	A4089117VO	Voltage probe	LCIE		
<b>FUNDAMENTAL FREQUENCY TOLERANCE</b>					
X	D1022117VO	Climatic chamber	BIA CLIMATIC	CL 6-25	200 105 6
X	B2082009VO	Frequency Counter	Hewlett Packard	HP 5350B	
X	A2240015VO	Passive loop antenna	EMCO	7405-901	/
X		BNC cable 50Ω			
	A5329206VO	Shielded cable	UTIFLEX		
	C2040052VO	Antenna Loop	ELECTRO-METRICS	EM-6879	690234
	A4060018VO	Spectrum Analyzer 9KHz - 26.5GHz	HEWLETT PACKARD	8593E	3409u00537
X	A2642019	Measurement Receiver 20Hz - 8GHz	ROHDE & SCHWARZ	ESU8	100131
<b>BAND-EDGE COMPLIANCE</b>					
	A2240015VO	Passive loop antenna	EMCO	7405-901	/
		BNC cable 50Ω			
X	A5329198VO	Shielded cable	UTIFLEX		
X	C2040052VO	Antenna Loop	ELECTRO-METRICS	EM-6879	690234
	A4060018VO	Spectrum Analyzer 9KHz - 26.5GHz	HEWLETT PACKARD	8593E	3409u00537
X	A2642019	Measurement Receiver 20Hz - 8GHz	ROHDE & SCHWARZ	ESU8	100131

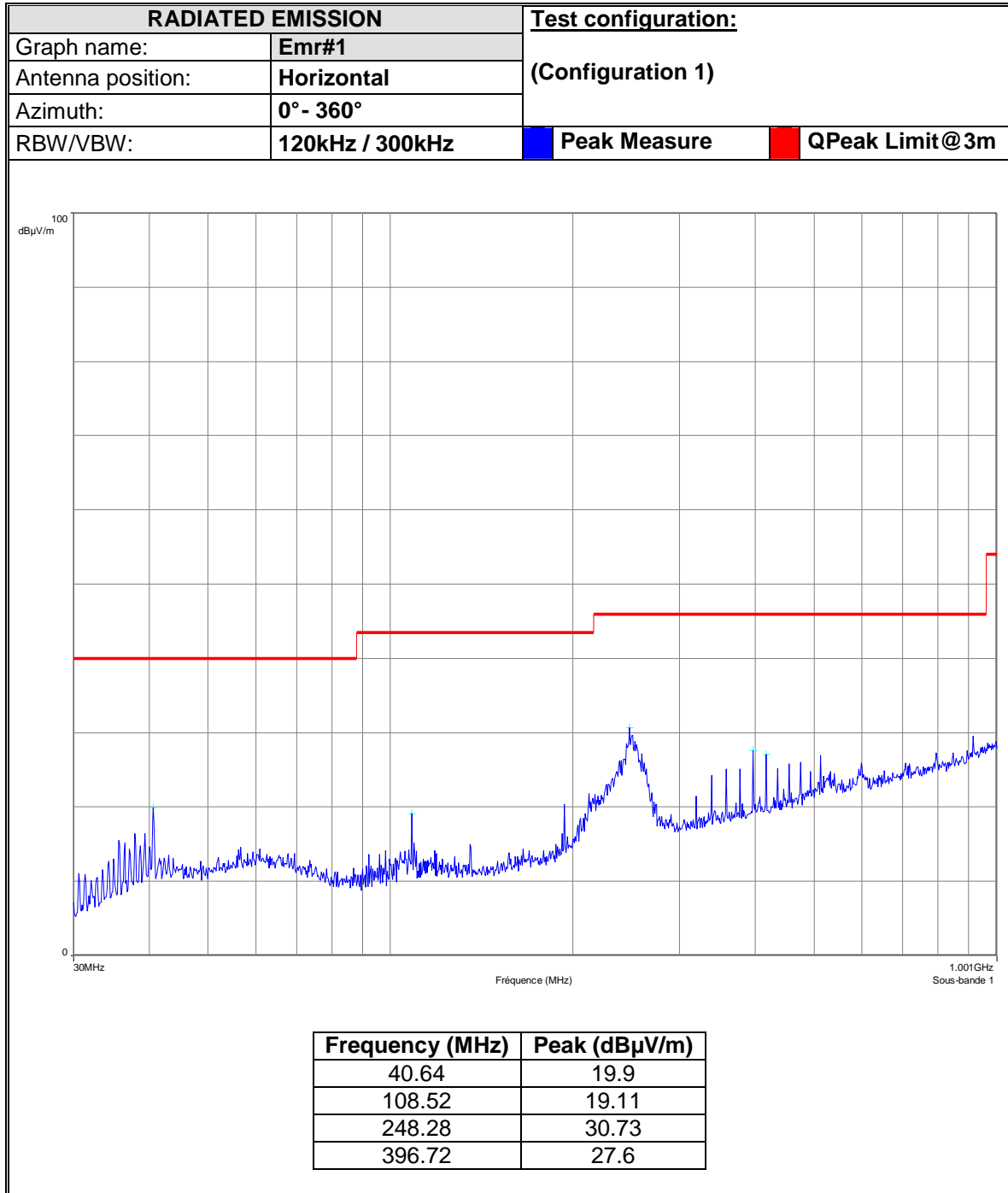
**8. UNCERTAINTIES CHART**

Type de mesure / Kind of measurement	Incertitude élargie laboratoire / Wide uncertainty laboratory (k=2) ± x	Incertitude limite du CISPR / CISPR uncertainty limit ± y
Mesure des perturbations conduites en tension sur le réseau d'énergie <i>Measurement of conducted disturbances in voltage on the power port</i>	3.57 dB	3.6 dB
Mesure des perturbations conduites en tension sur le réseau de télécommunication <i>Measurement of conducted disturbances in voltage on the telecommunication port.</i>	3.28 dB	A l'étude / Under consid.
Mesure des perturbations discontinues conduites en tension <i>Measurement of discontinuous conducted disturbances in voltage</i>	3.47 dB	3.6 dB
Mesure des perturbations conduites en courant <i>Measurement of conducted disturbances in current</i>	2.90 dB	A l'étude / Under consid.
Mesure du champ électrique rayonné sur le site en espace libre de Moirans <i>Measurement of radiated electric field on the Moirans open area test site</i>	5.07 dB	5.2 dB



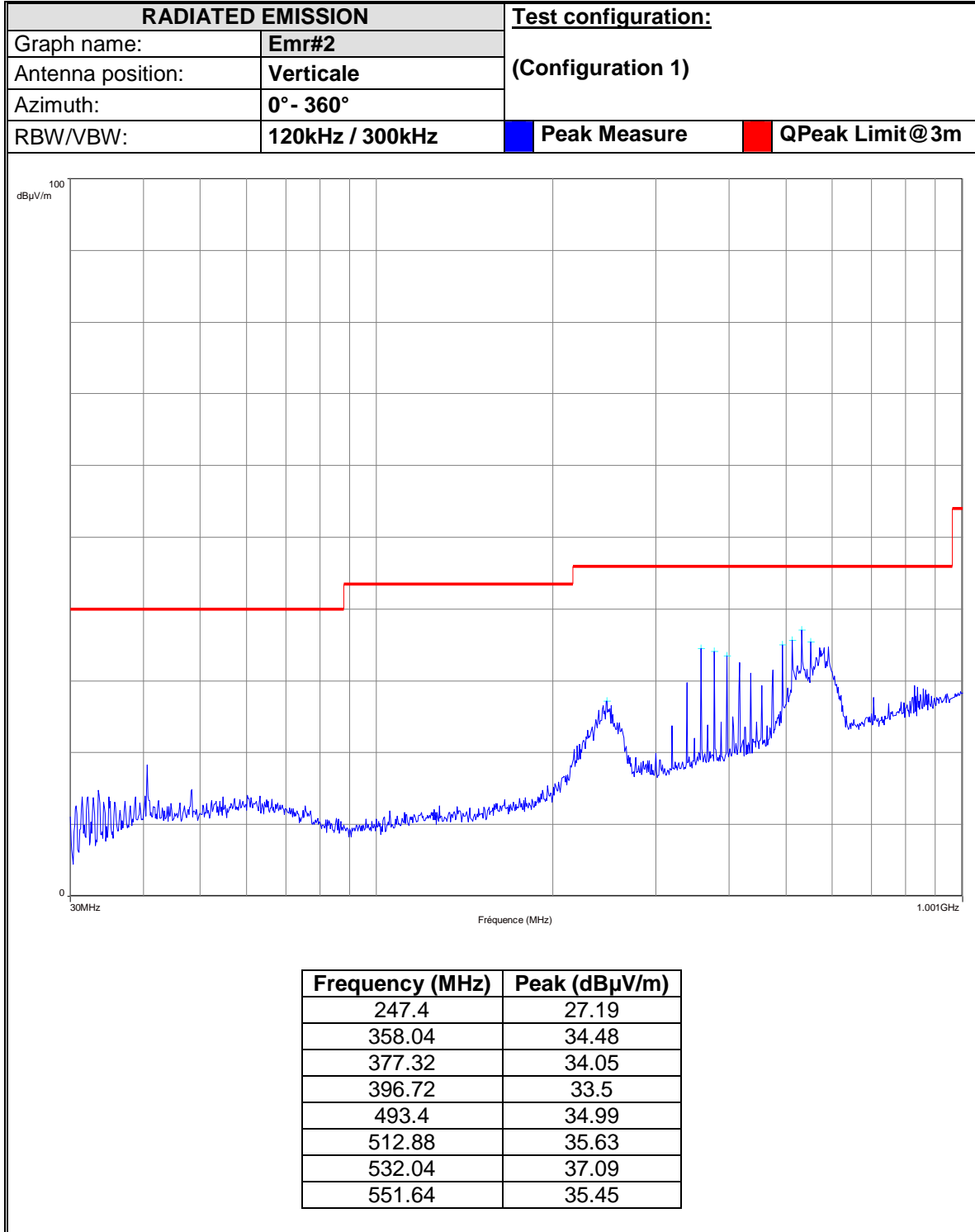
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9. ANNEX 1 (GRAPHS)



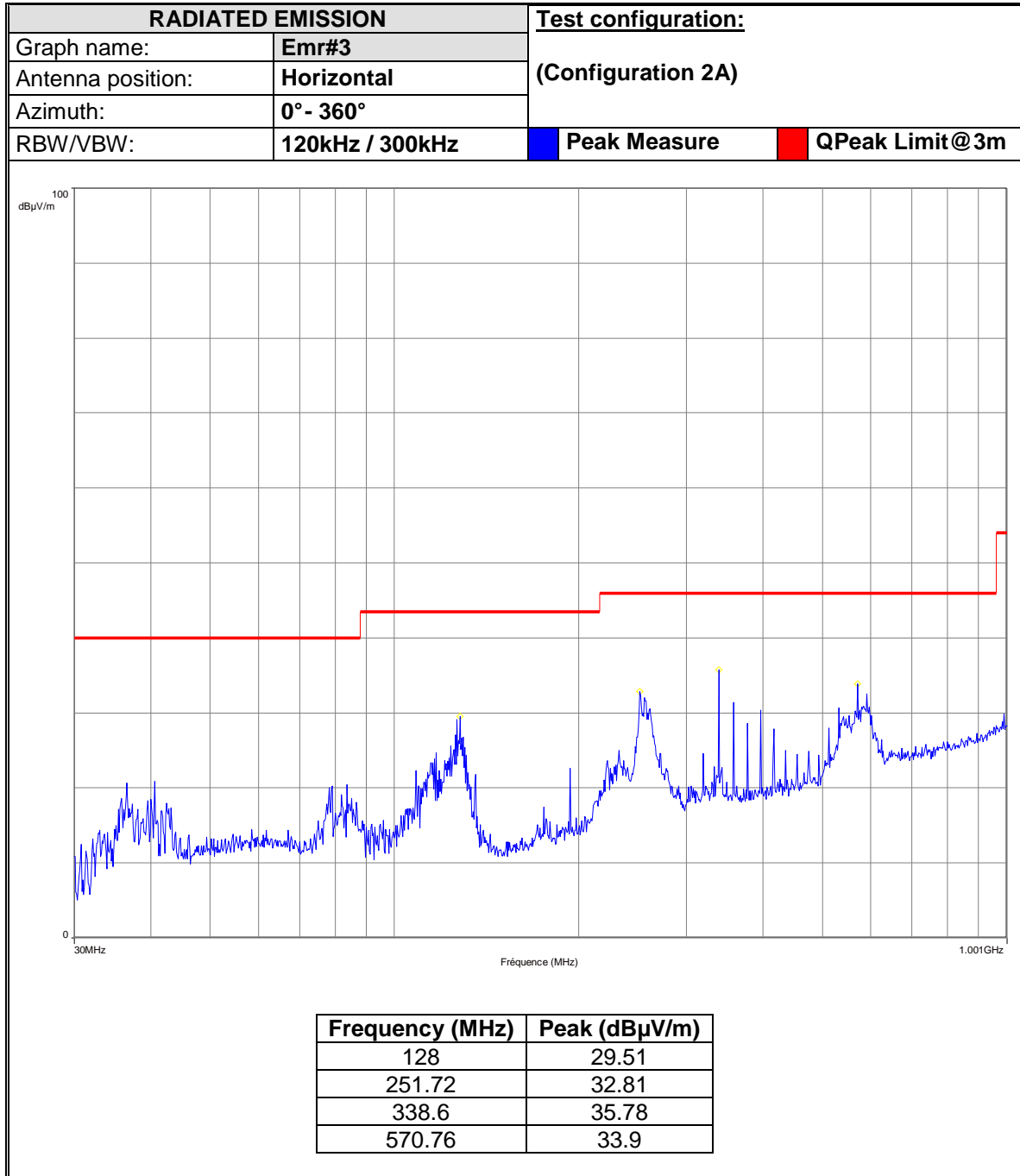


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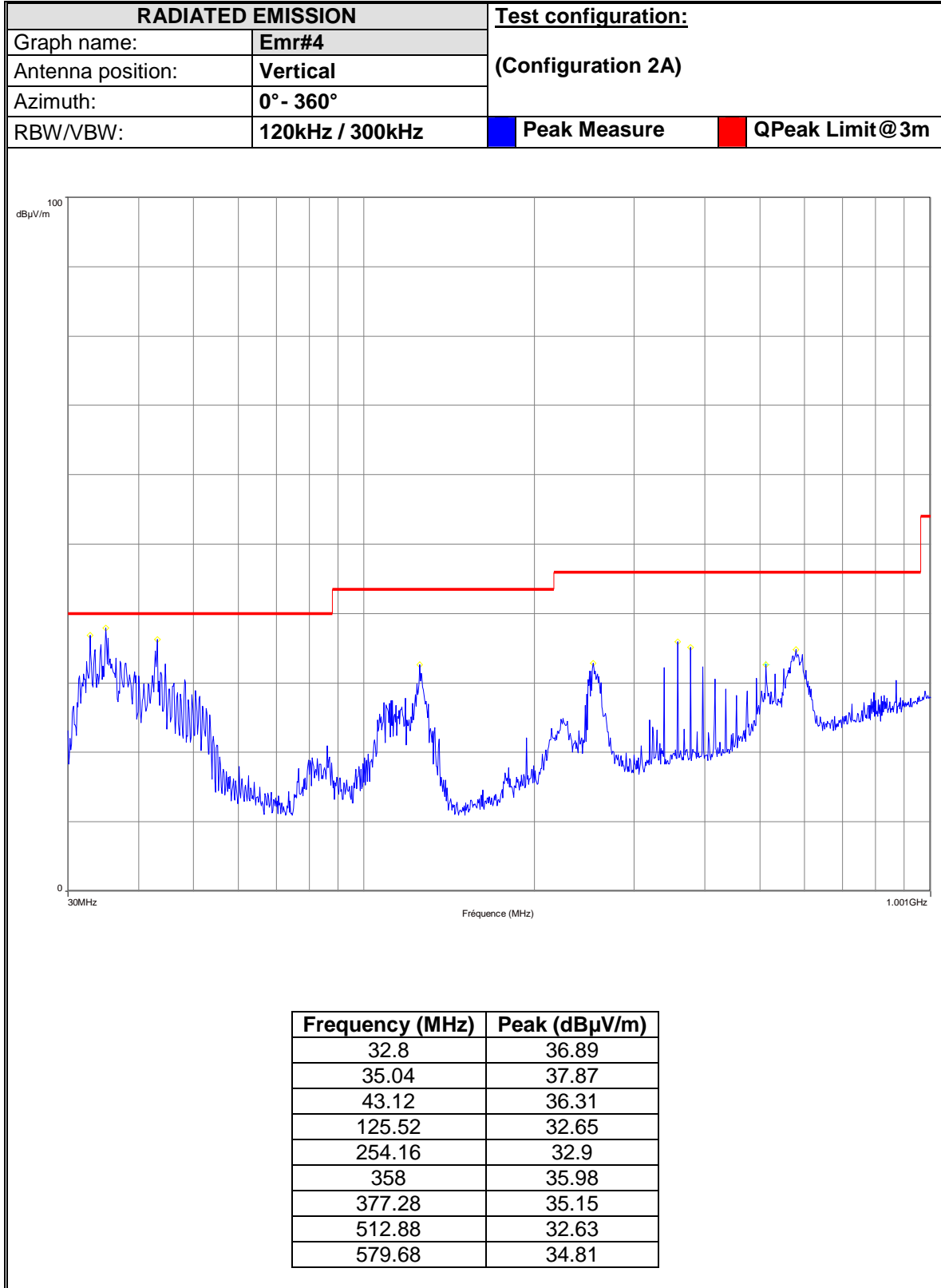
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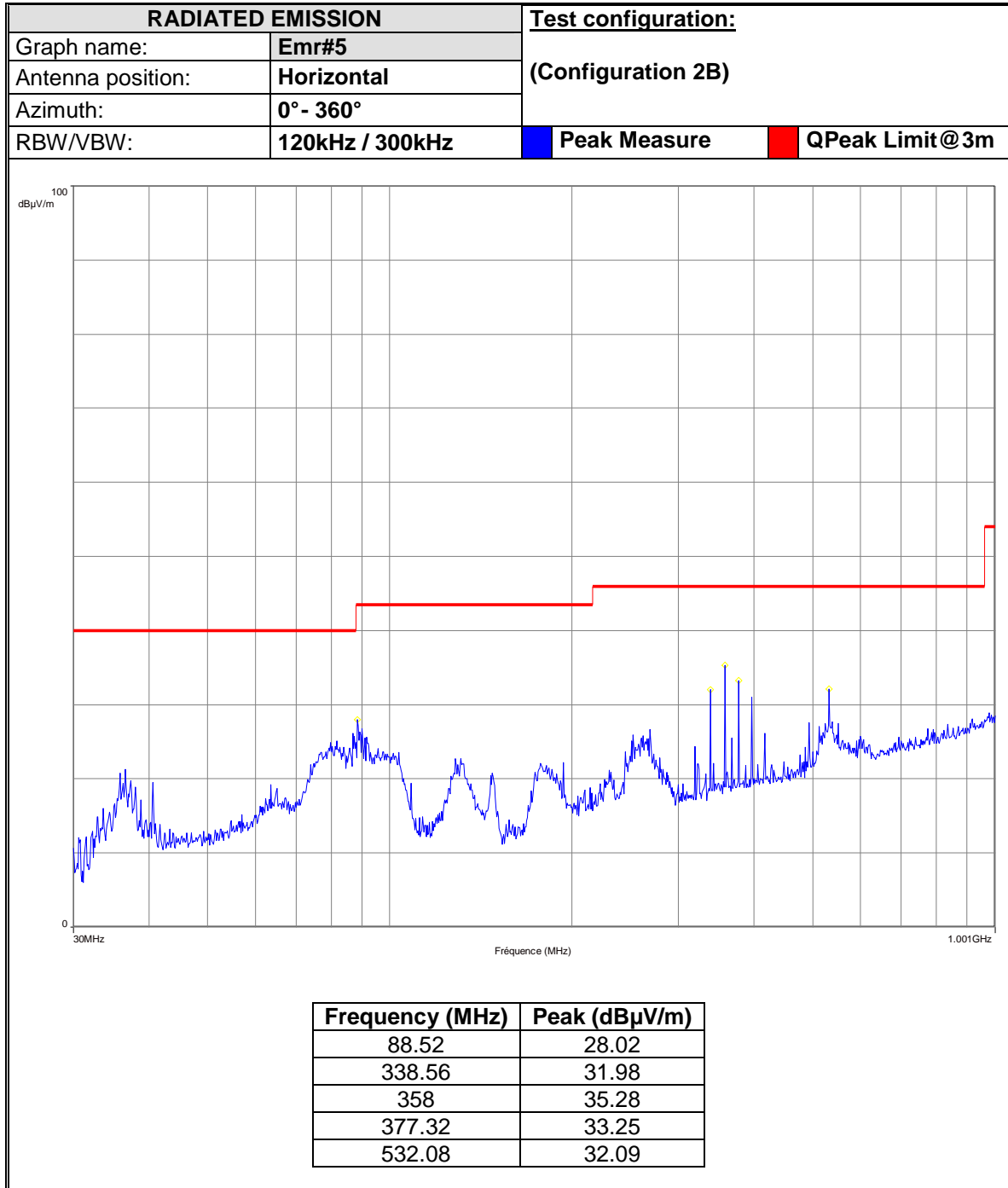


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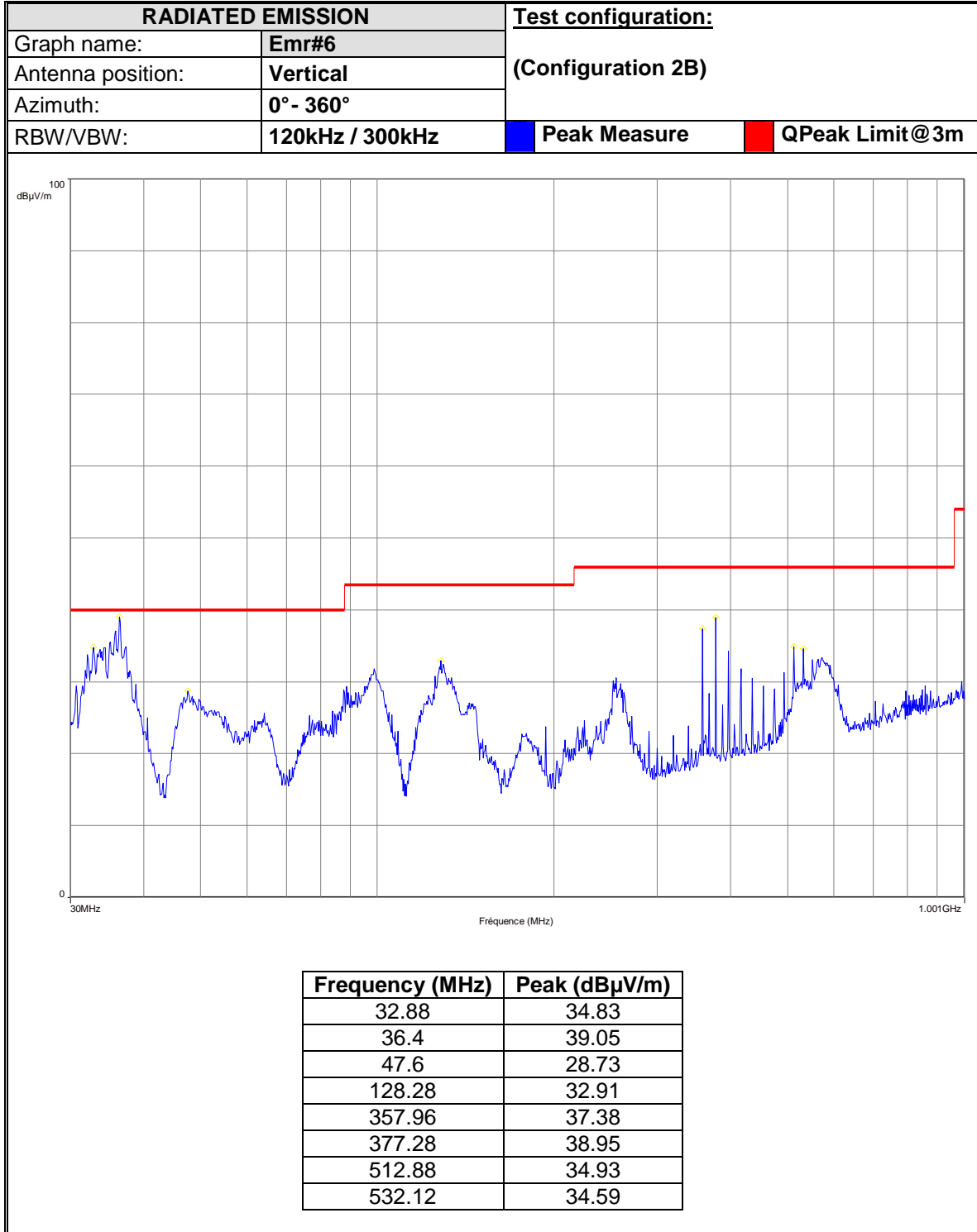


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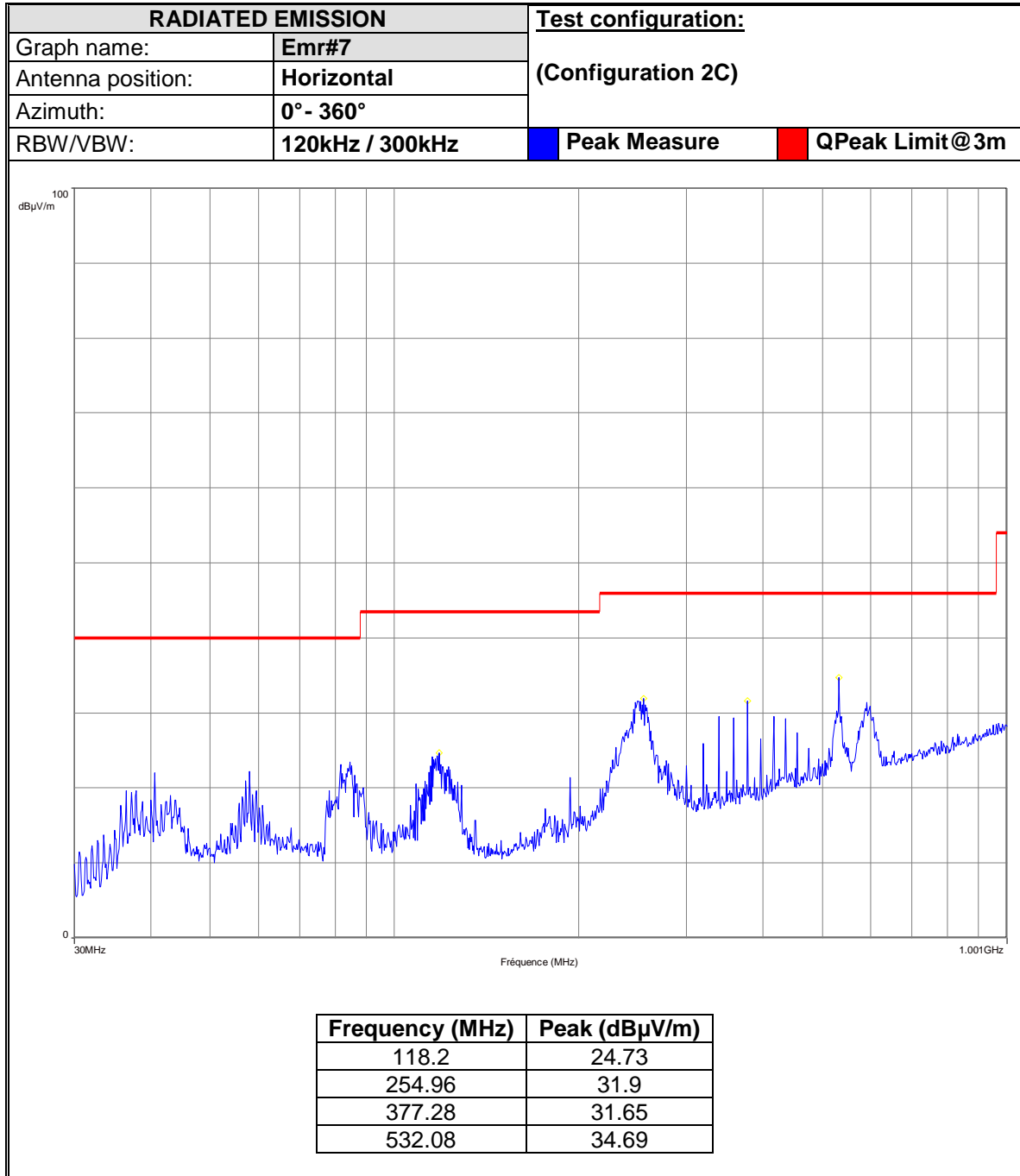


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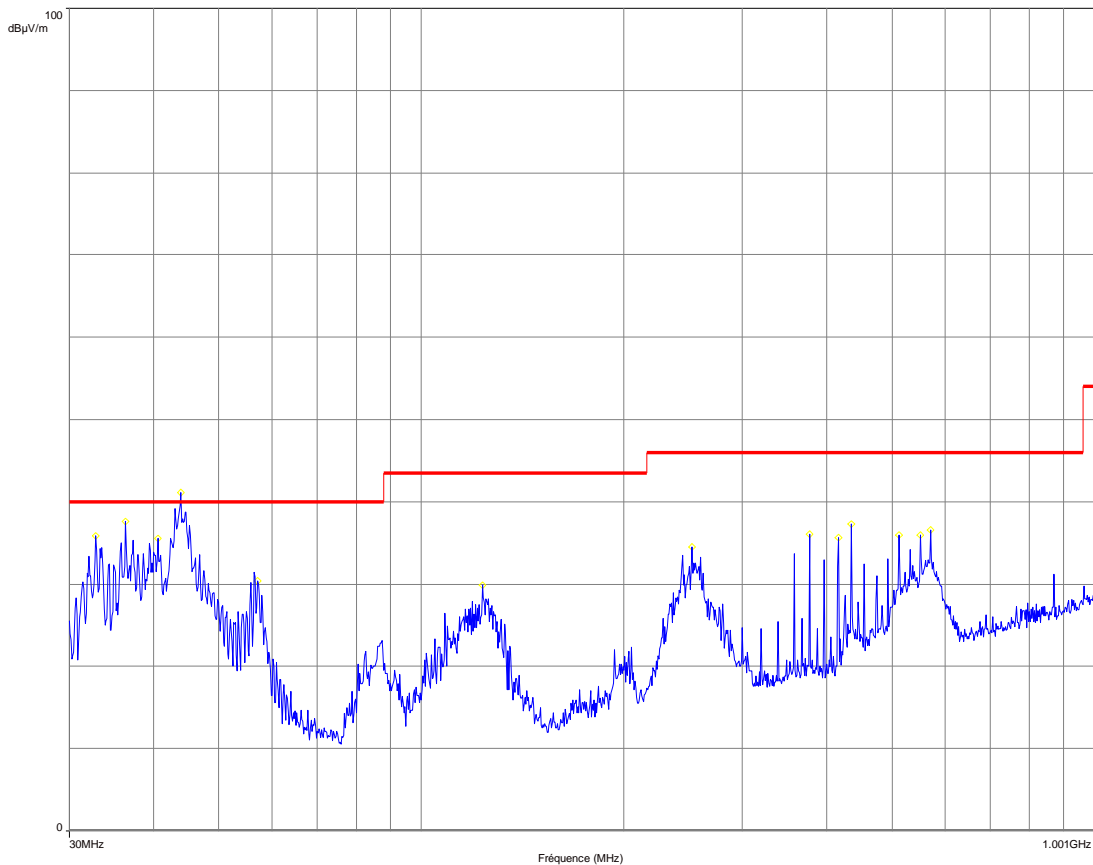
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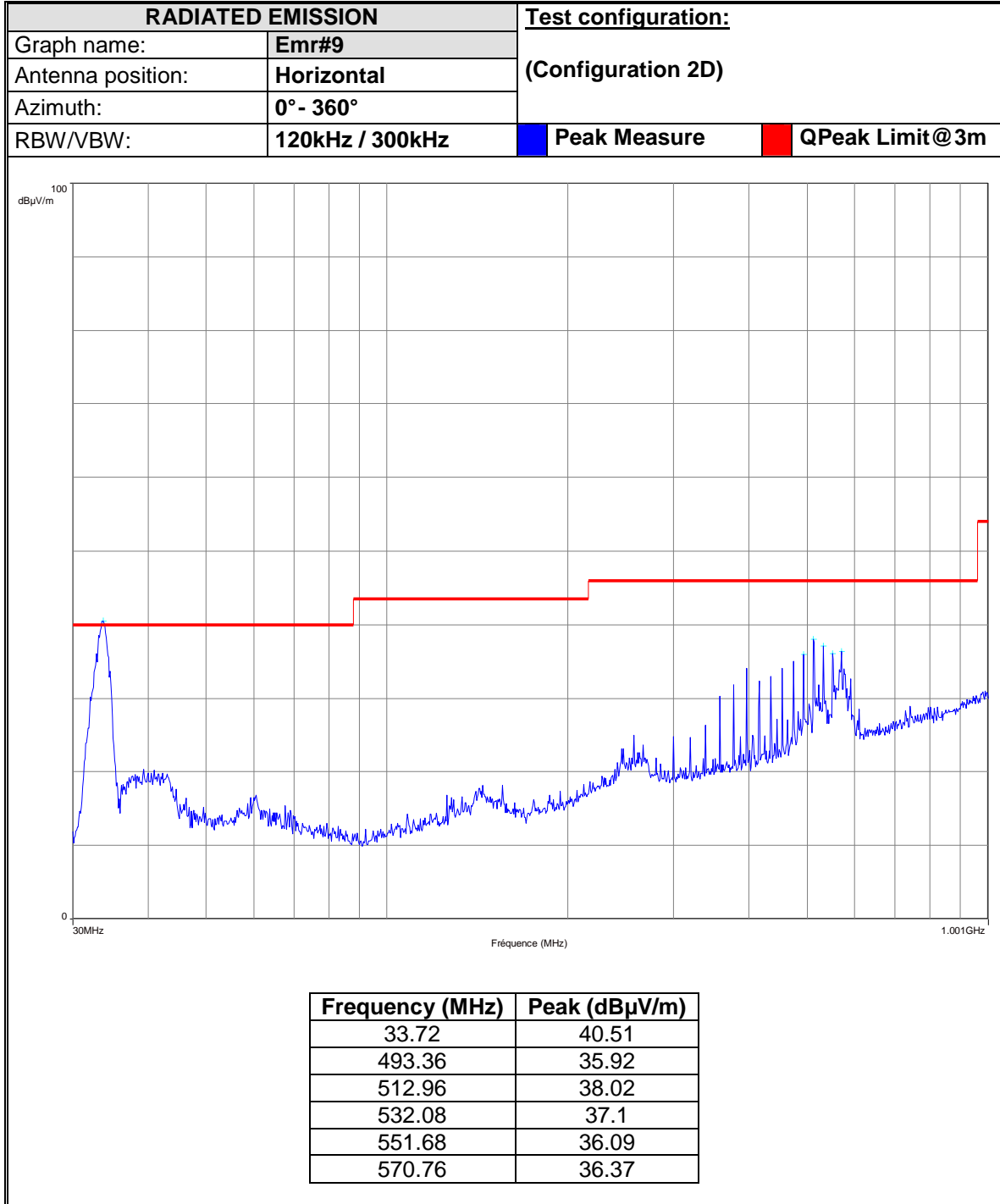
RADIATED EMISSION		Test configuration:	
Graph name:	Emr#8	(Configuration 2C)	
Antenna position:	Vertical		
Azimuth:	0° - 360°		
RBW/VBW:	120kHz / 300kHz	Peak Measure	QPeak Limit@3m



Frequency (MHz)	Peak (dBµV/m)
32.88	35.83
36.36	37.62
40.6	35.5
43.96	41.11
57.2	30.34
123.36	29.88
252	34.51
377.28	36.05
416	35.69
435.44	37.26
512.92	35.93
551.64	35.95
570.76	36.6
32.88	35.83
36.36	37.62
40.6	35.5
43.96	41.11

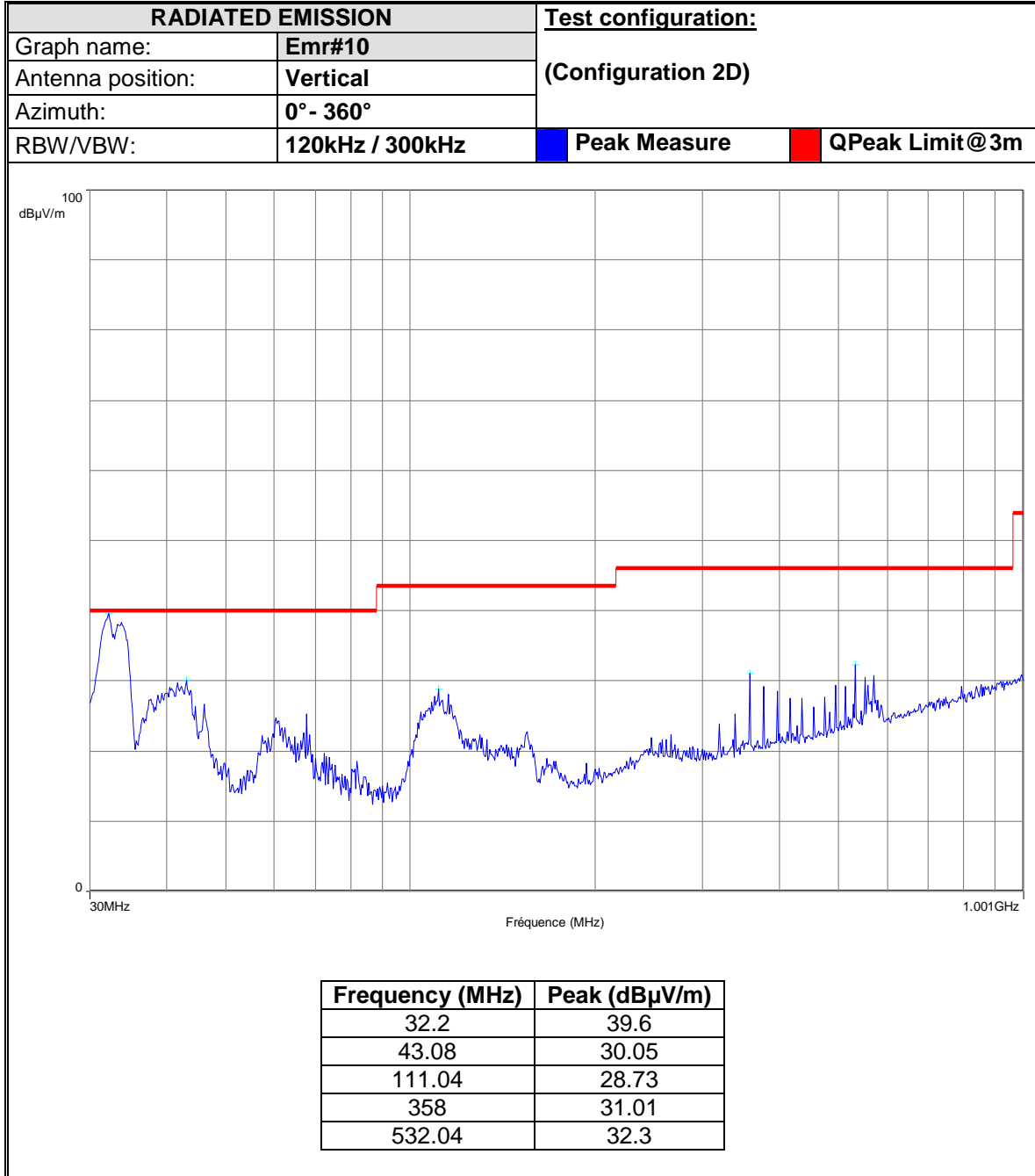


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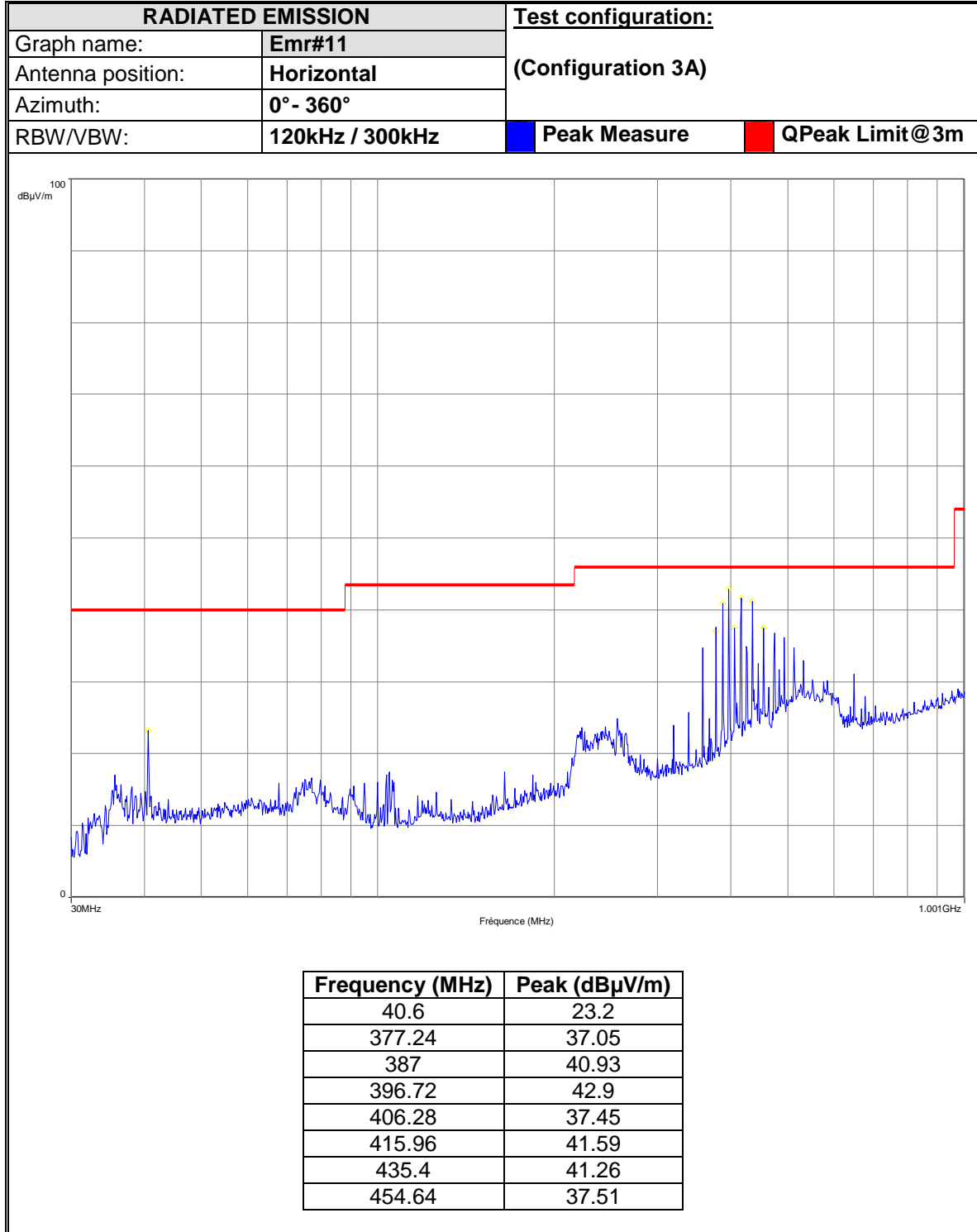


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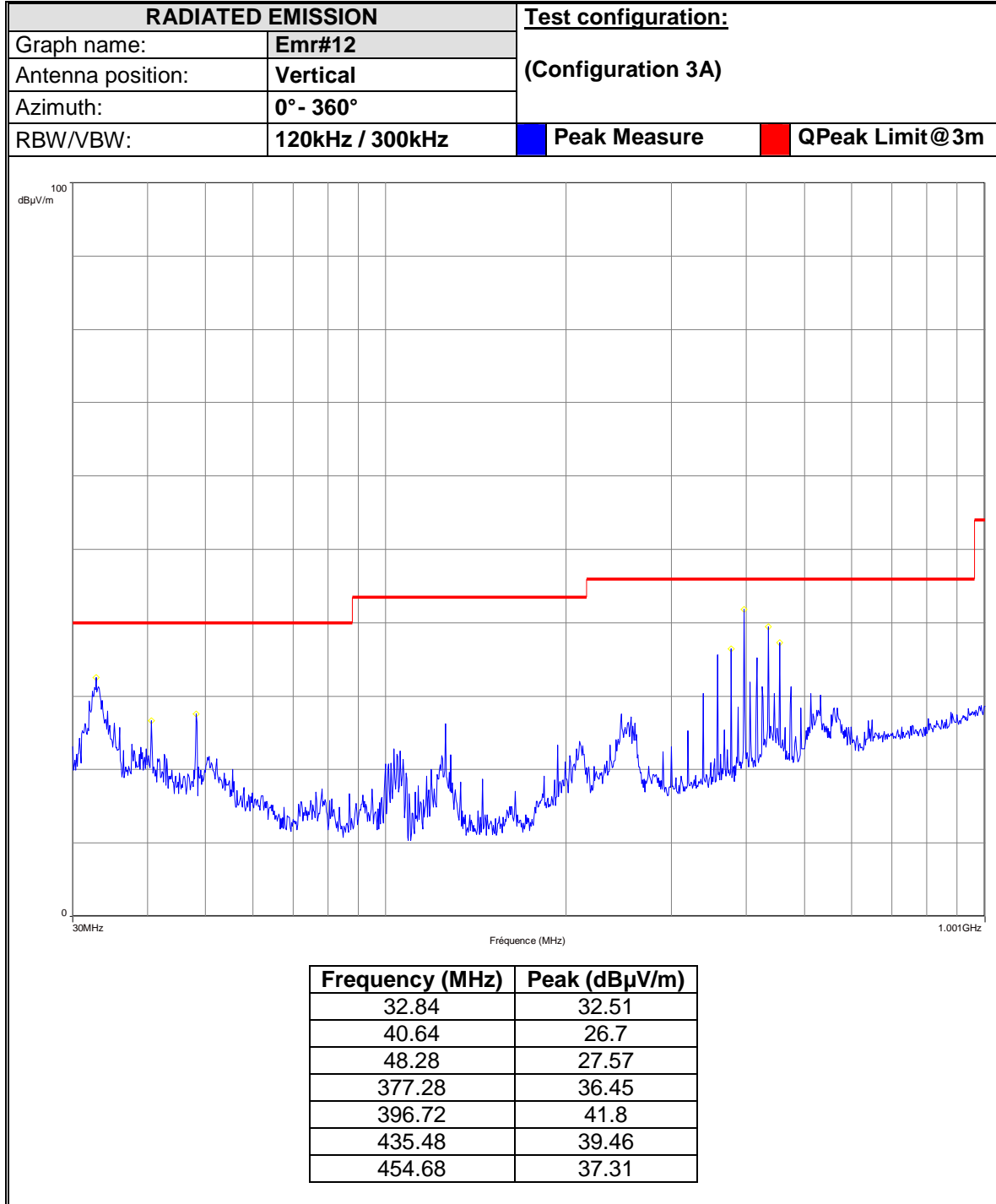
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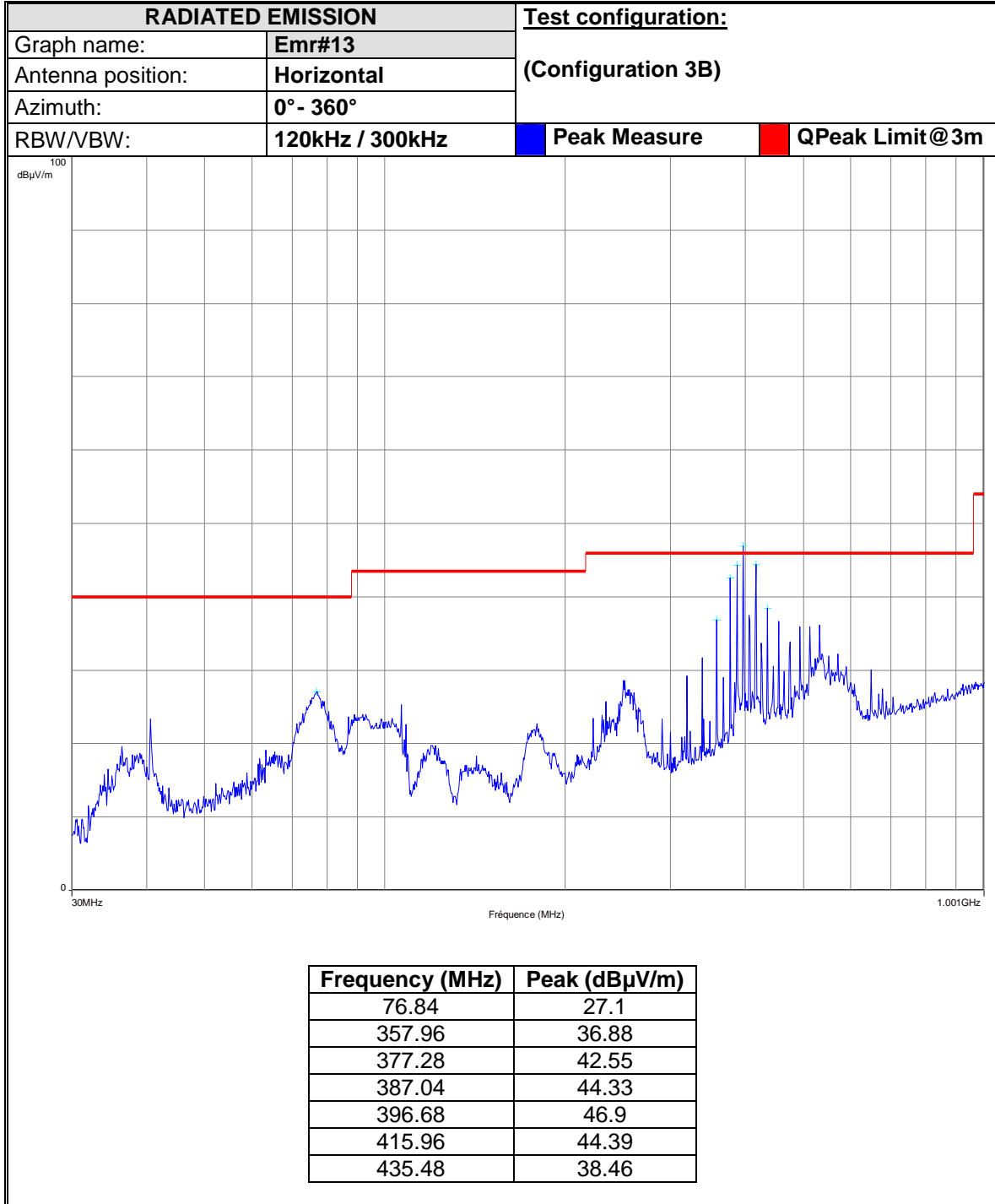


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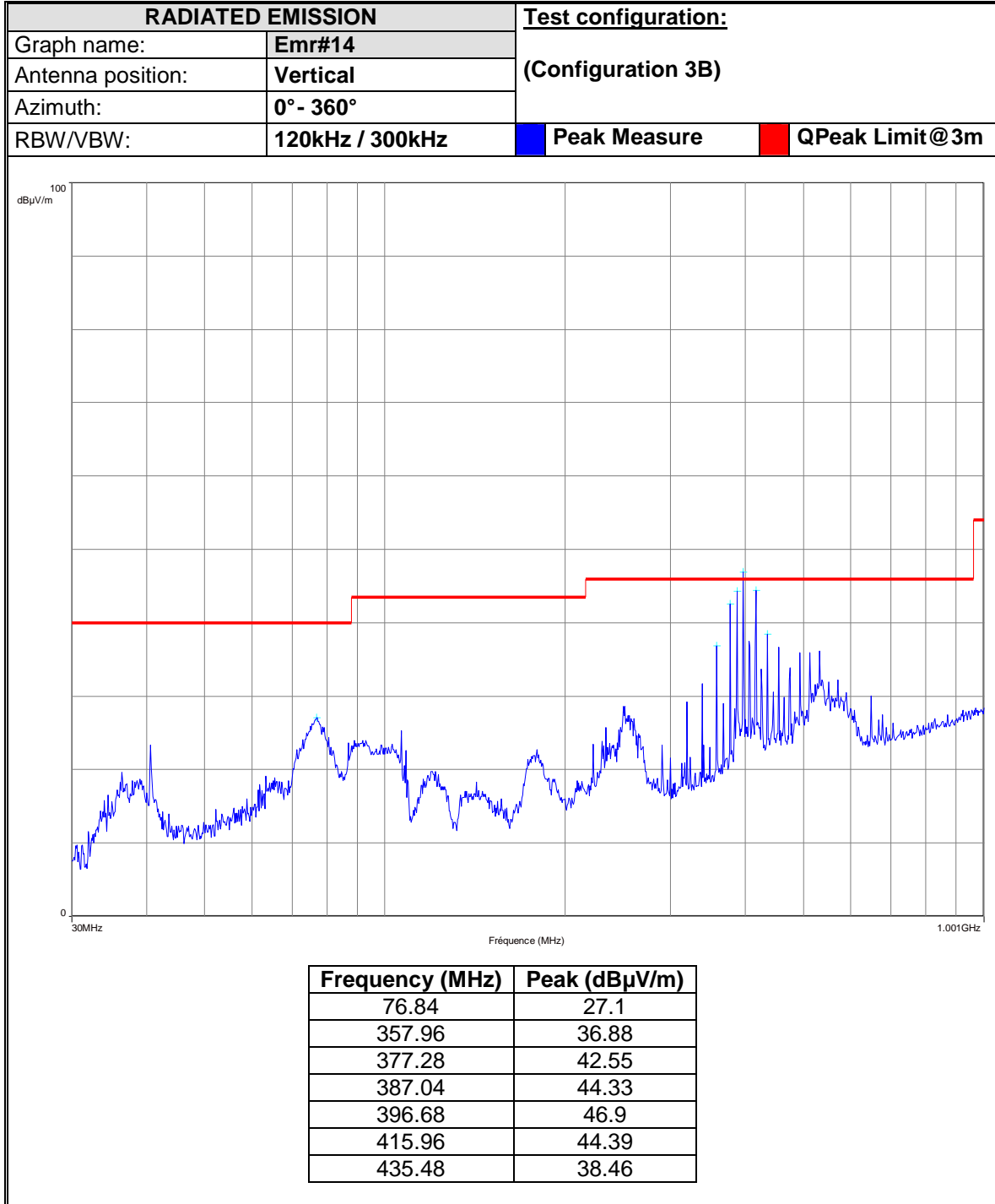


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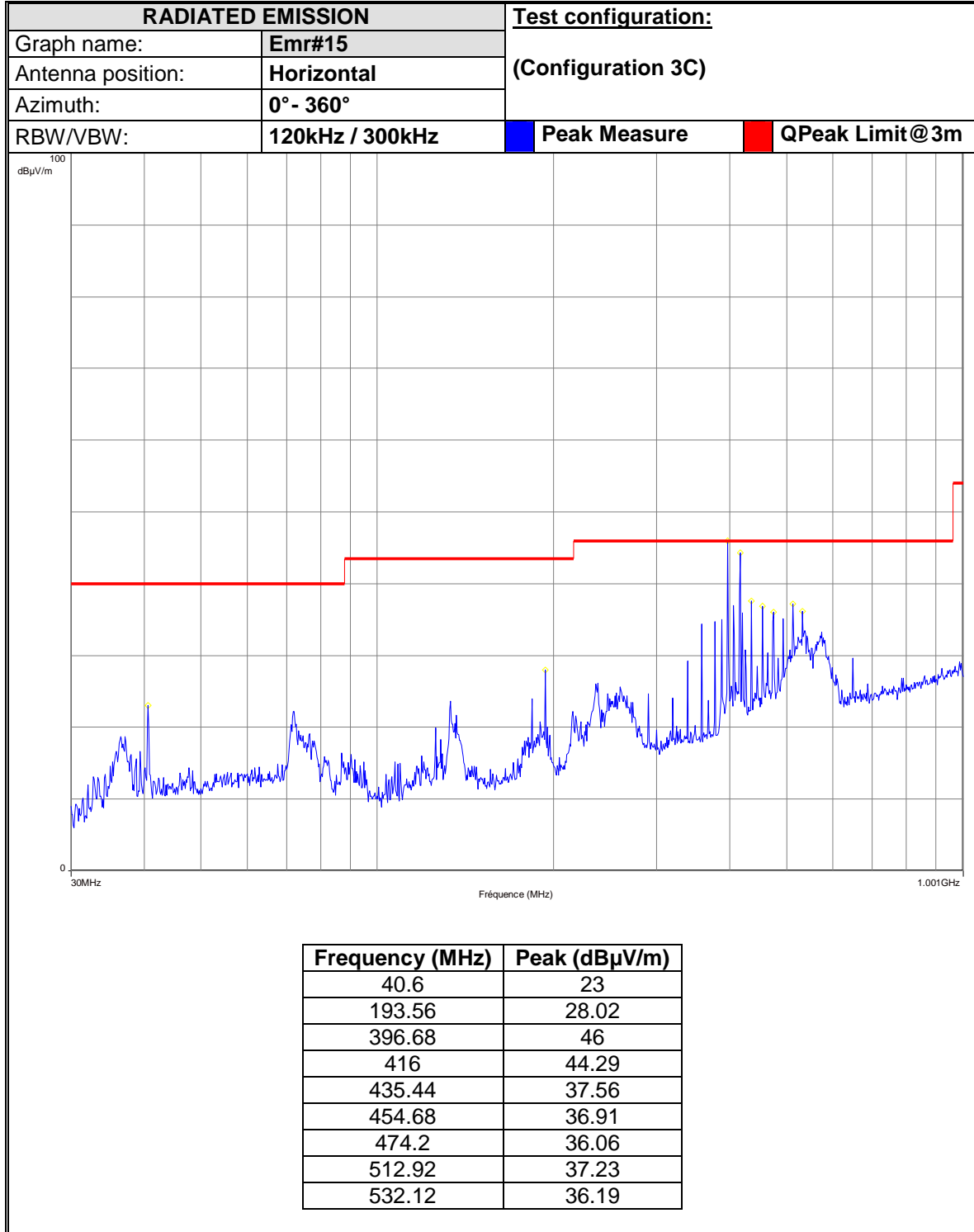


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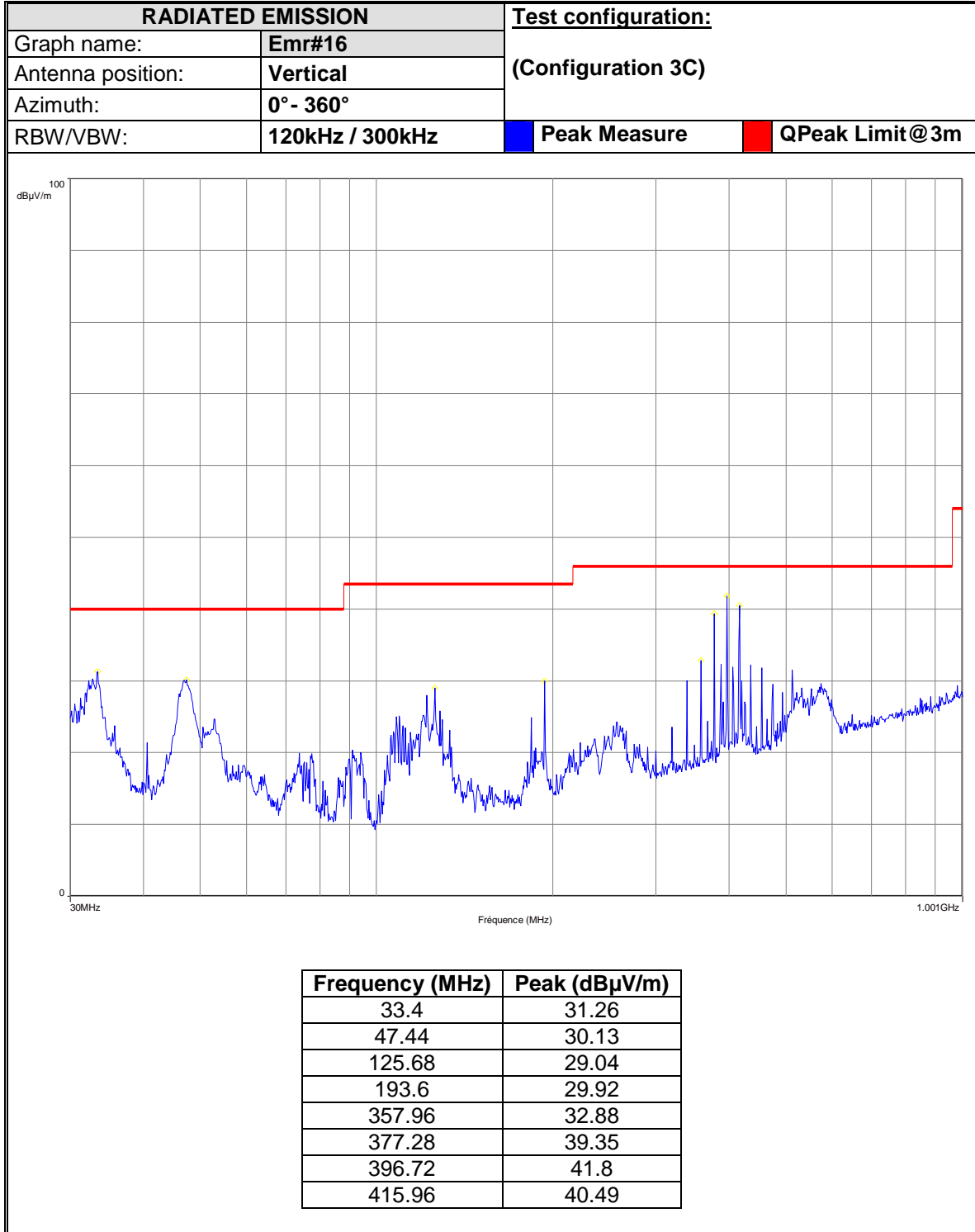


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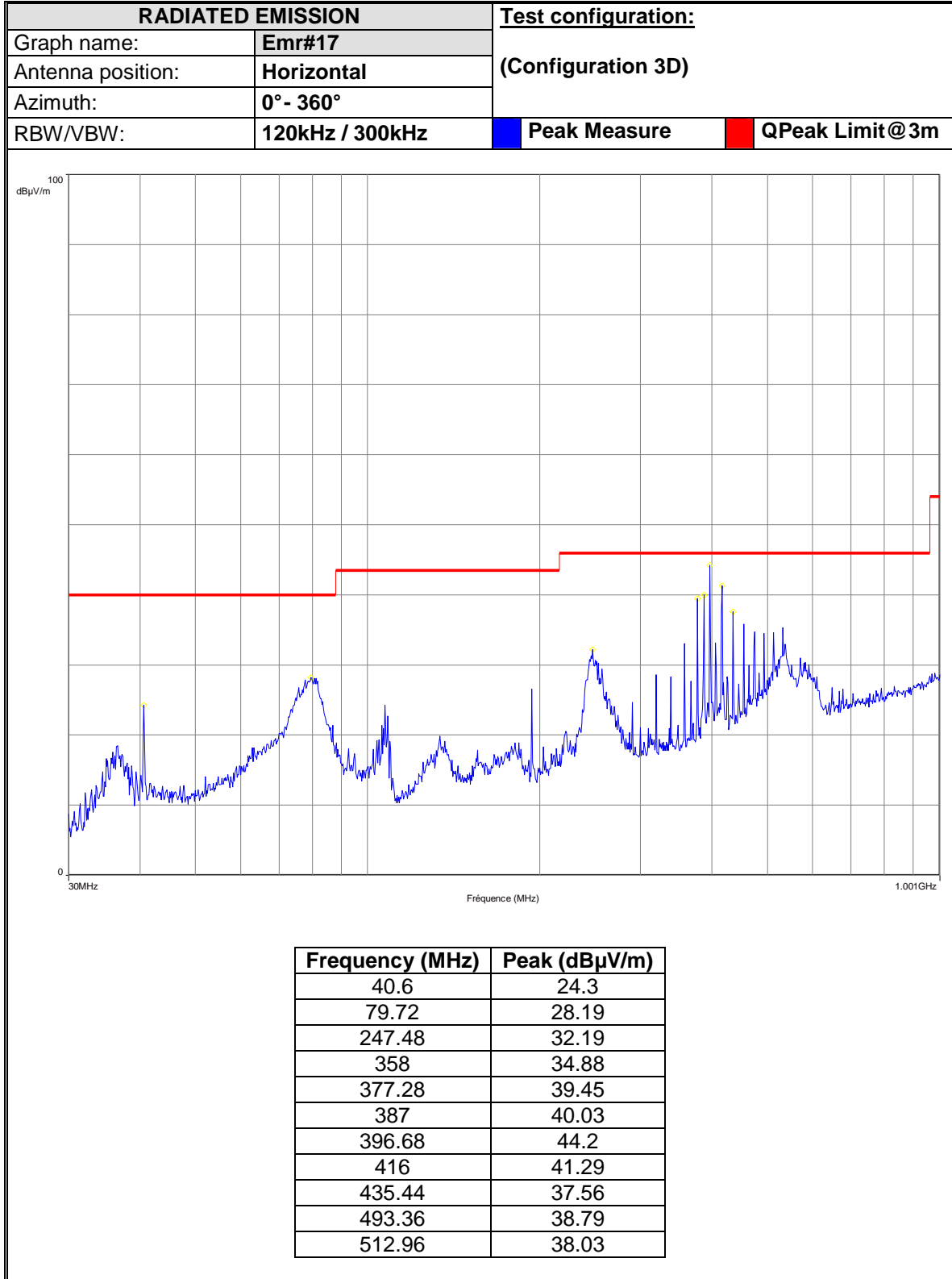


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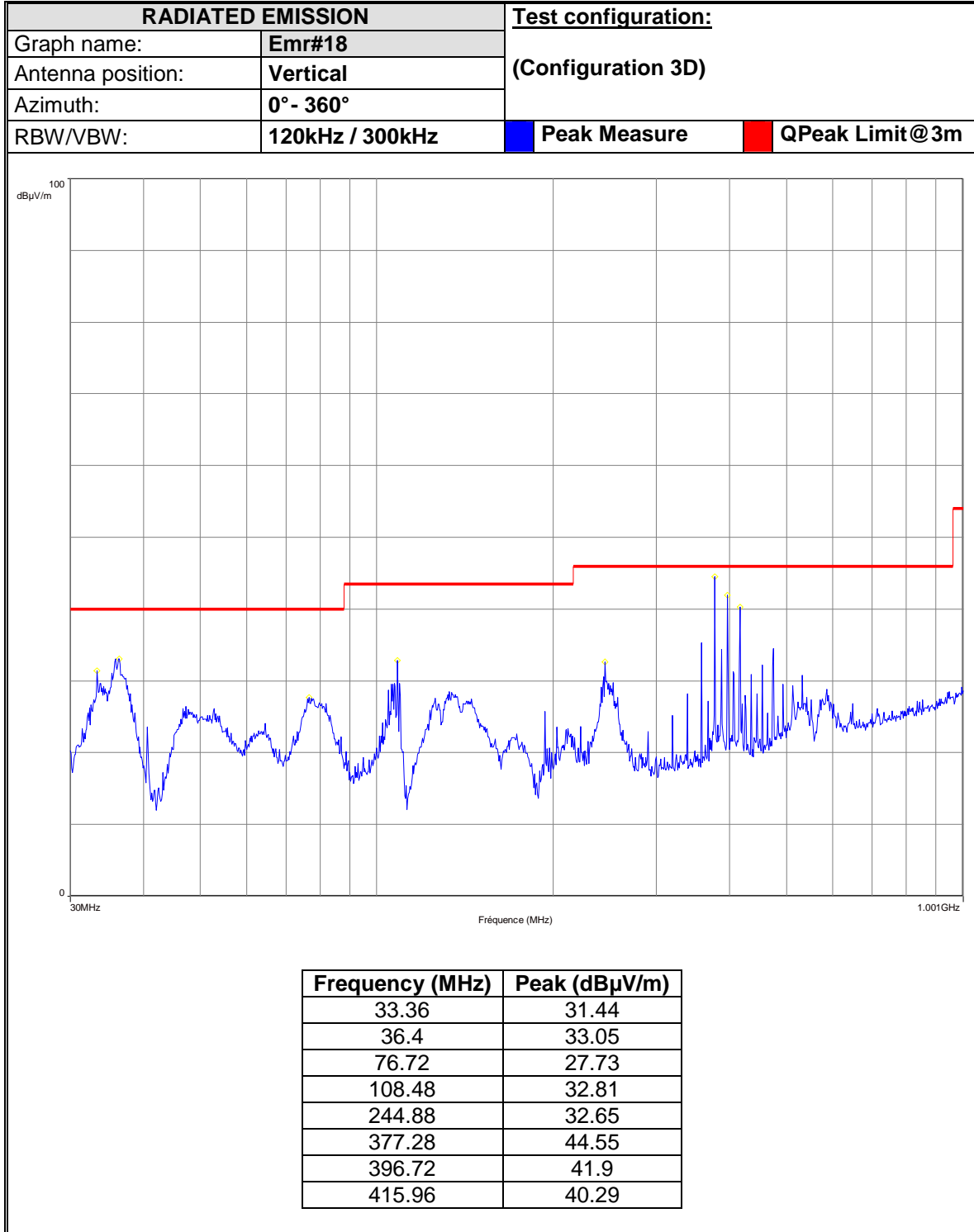


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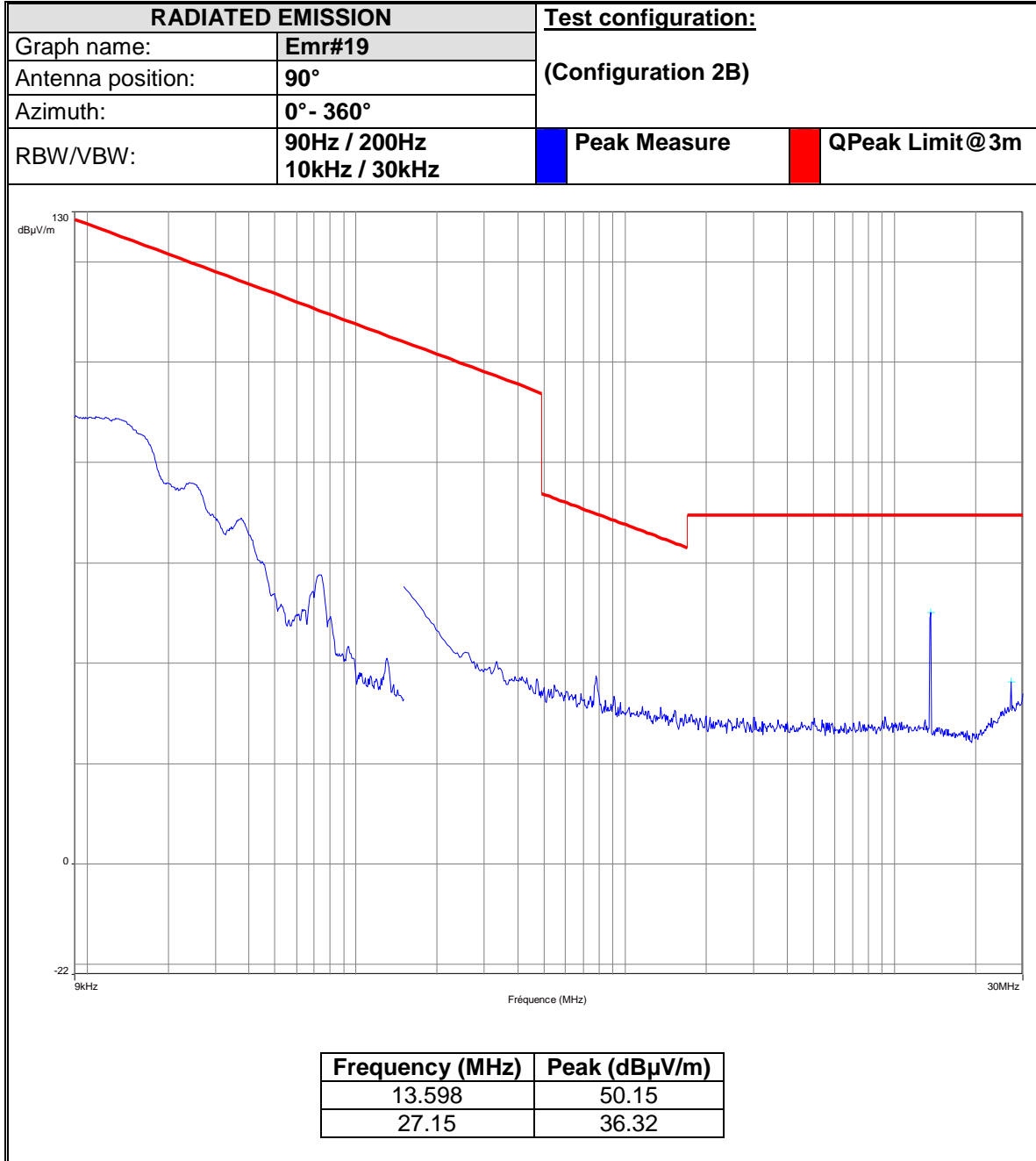


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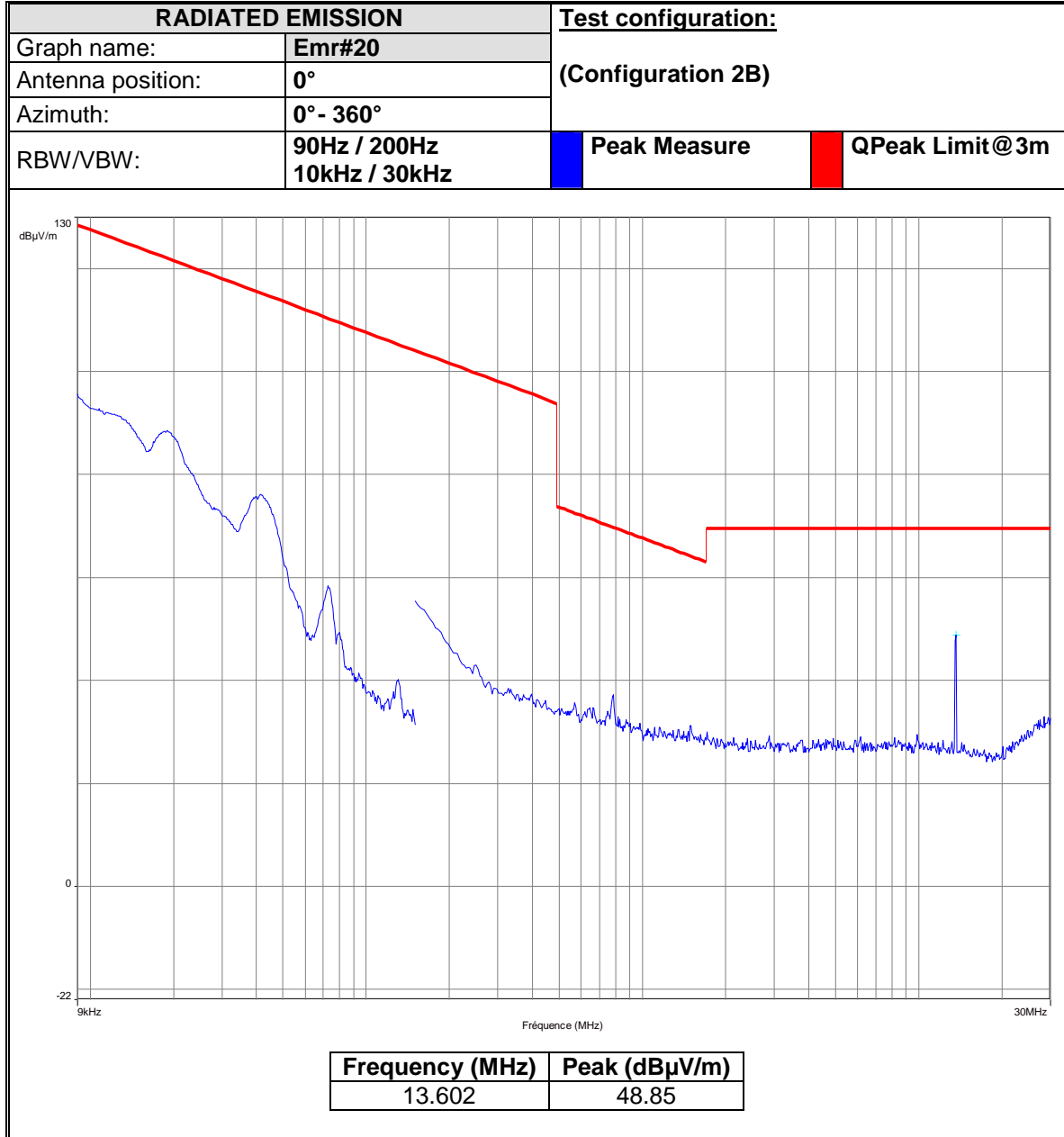
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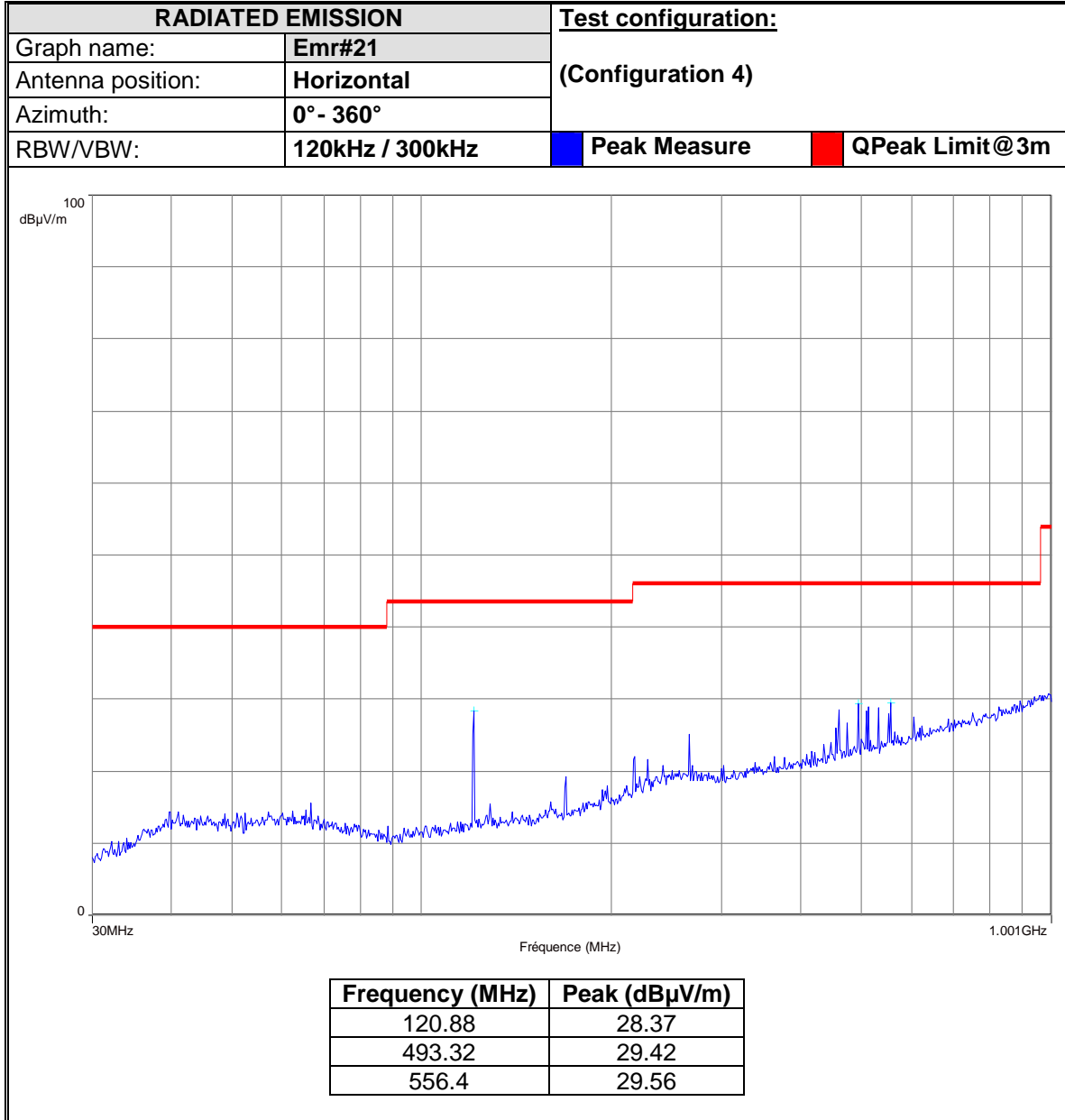


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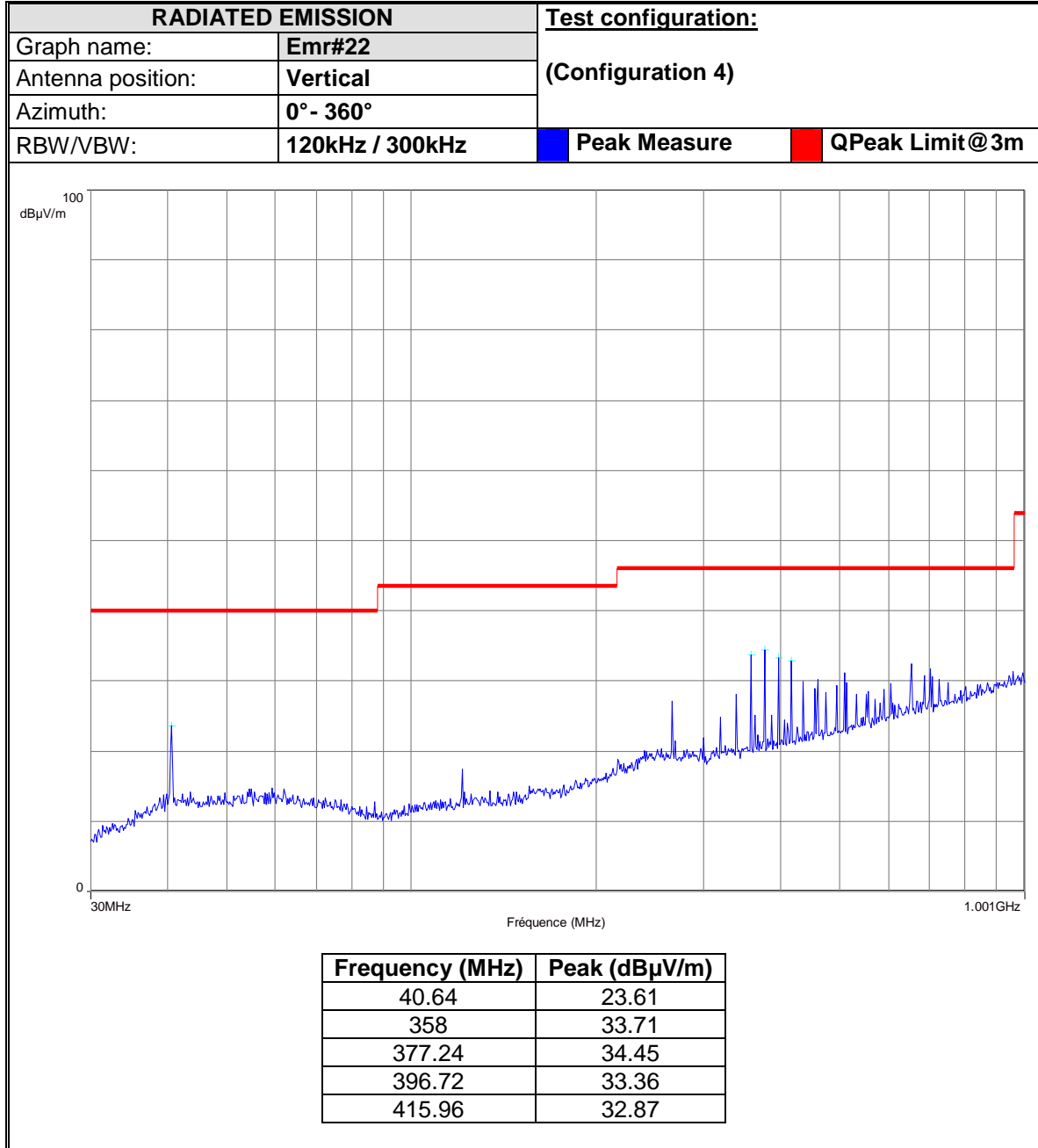


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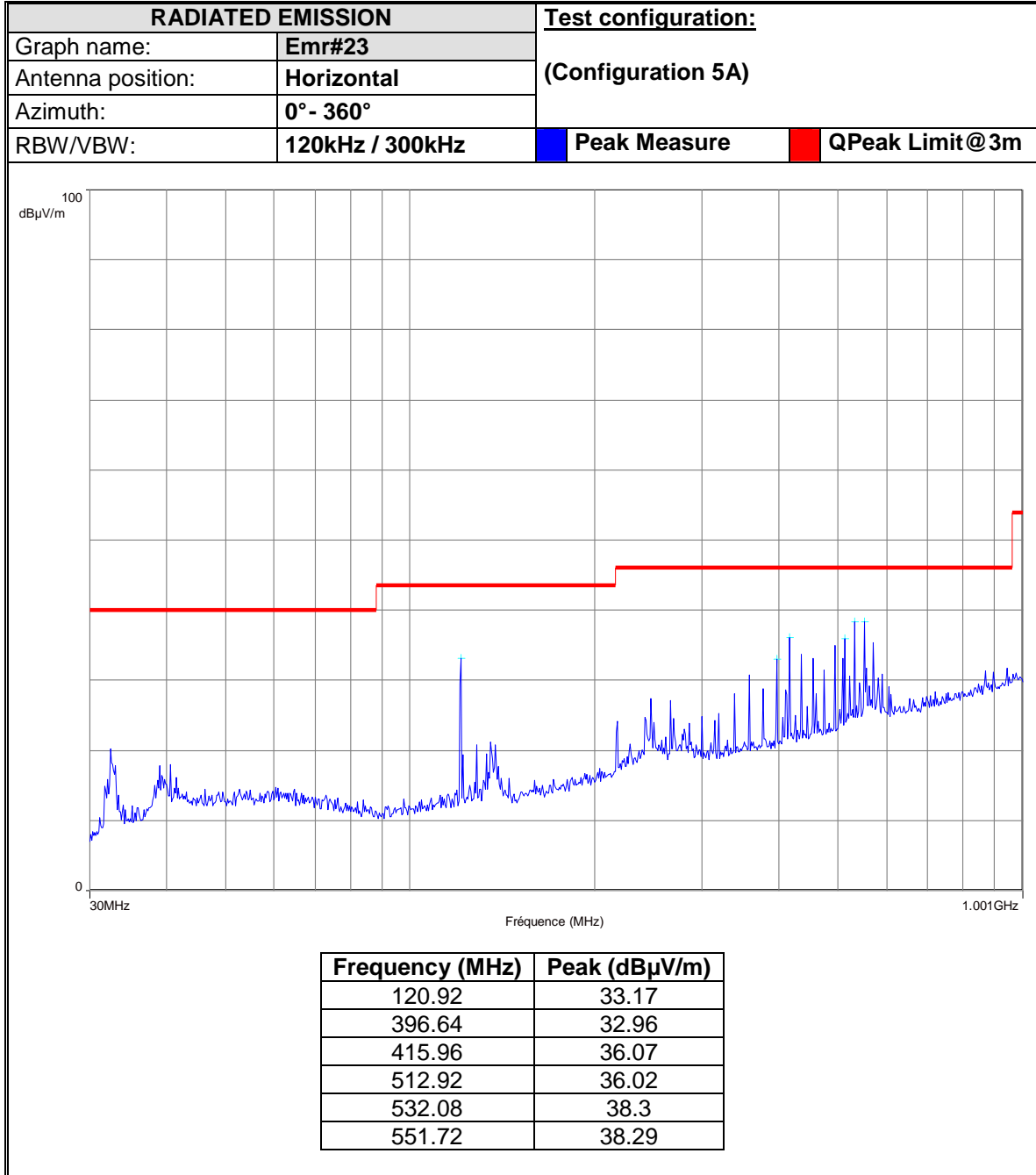


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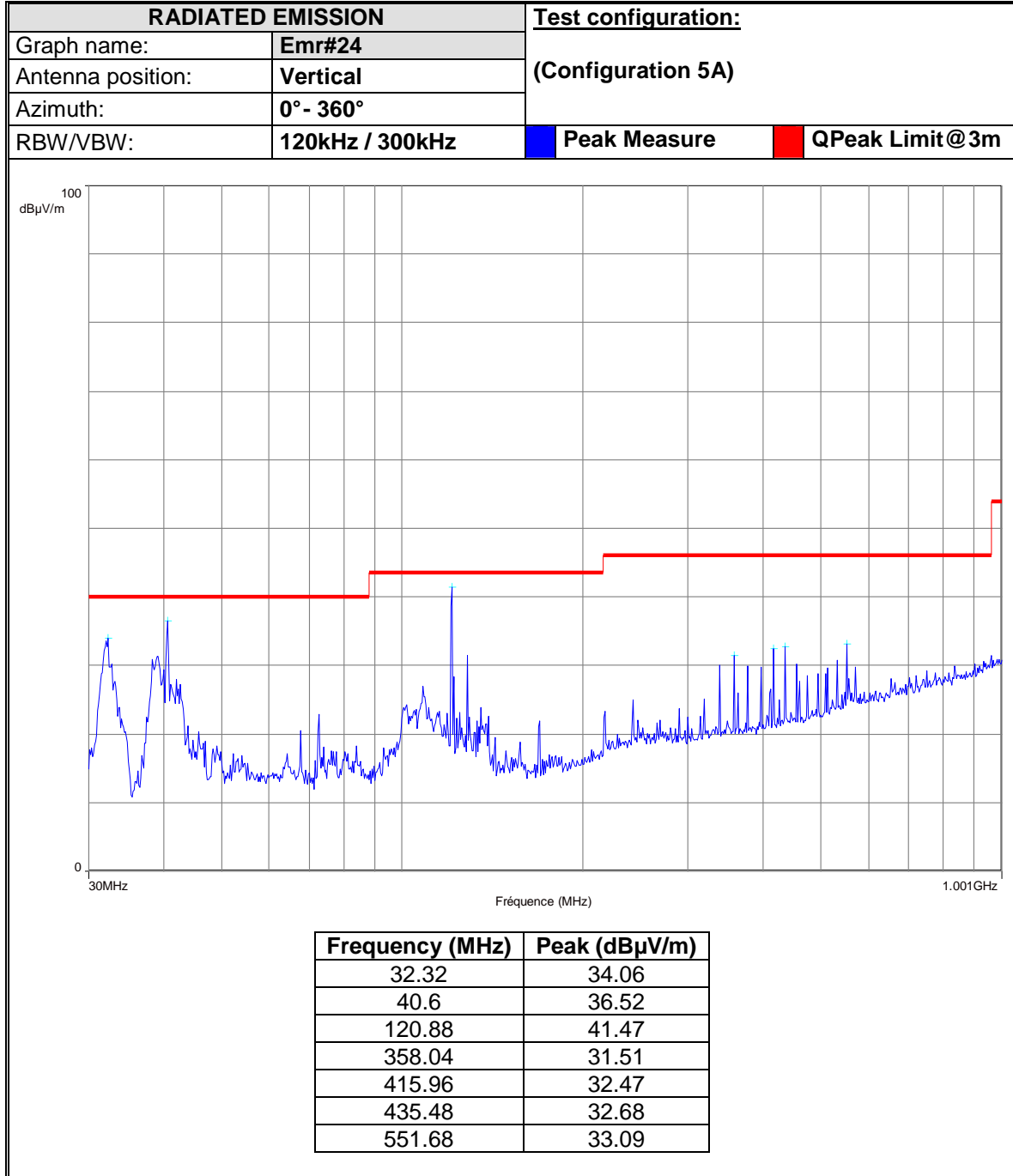


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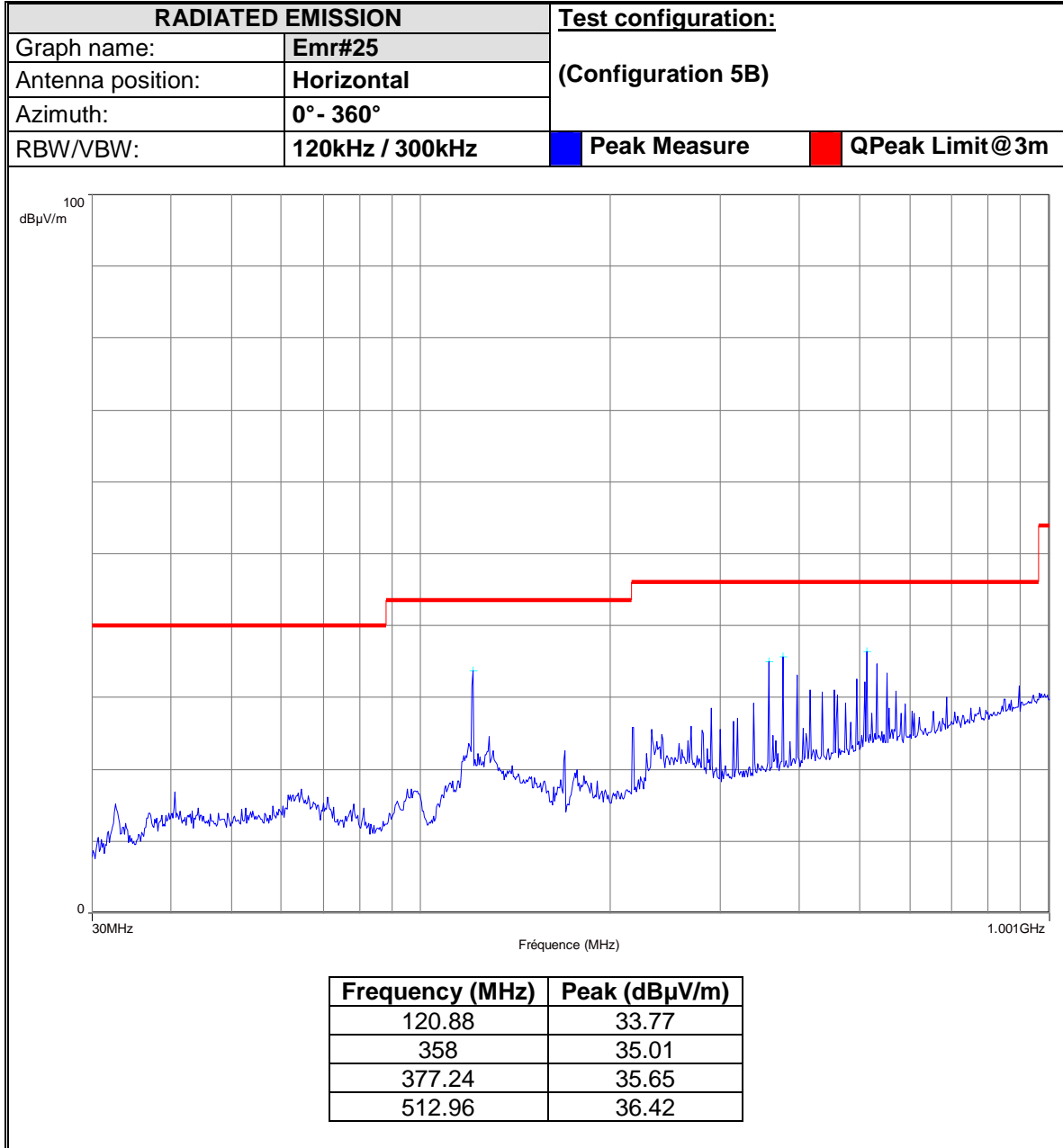


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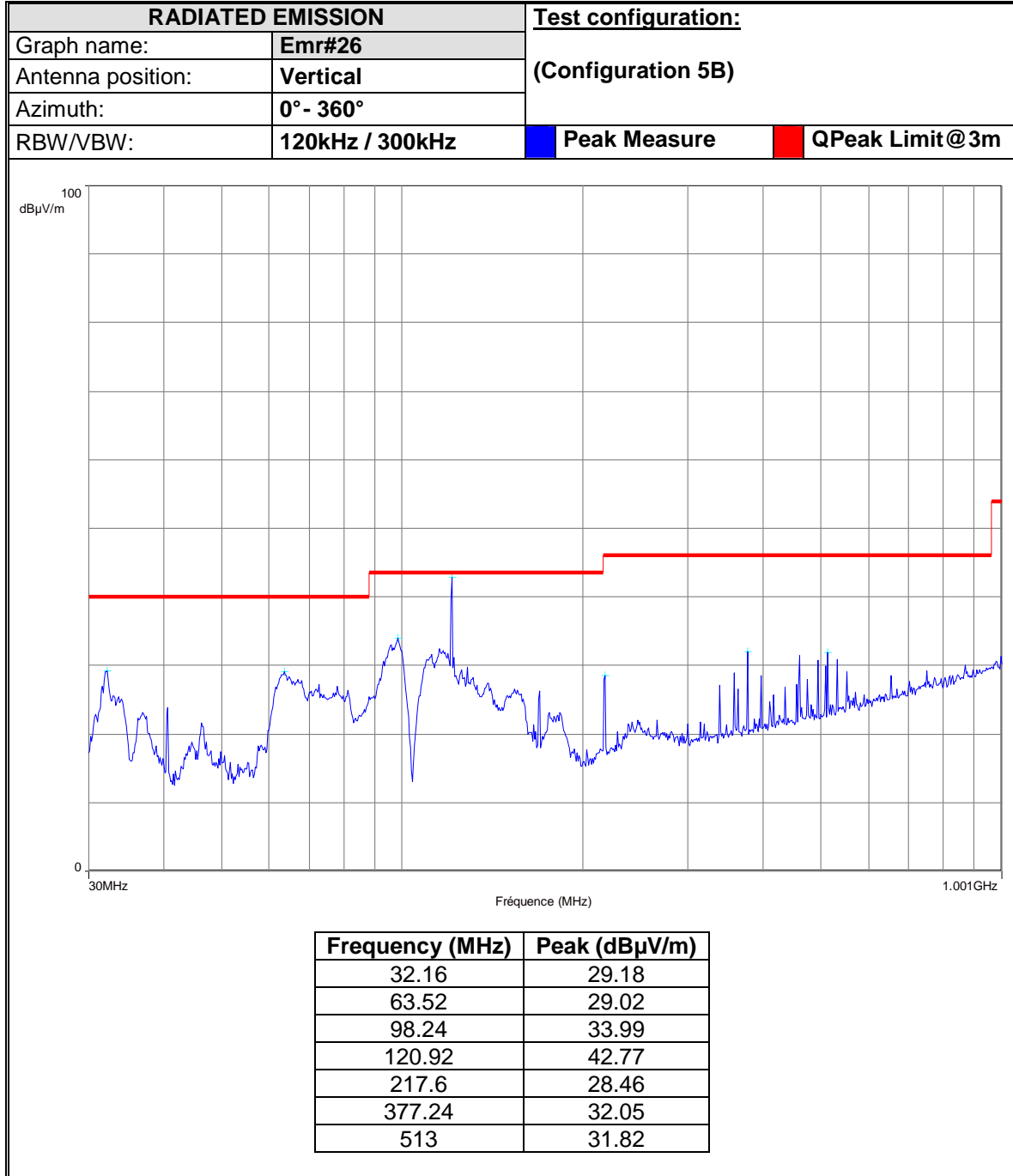


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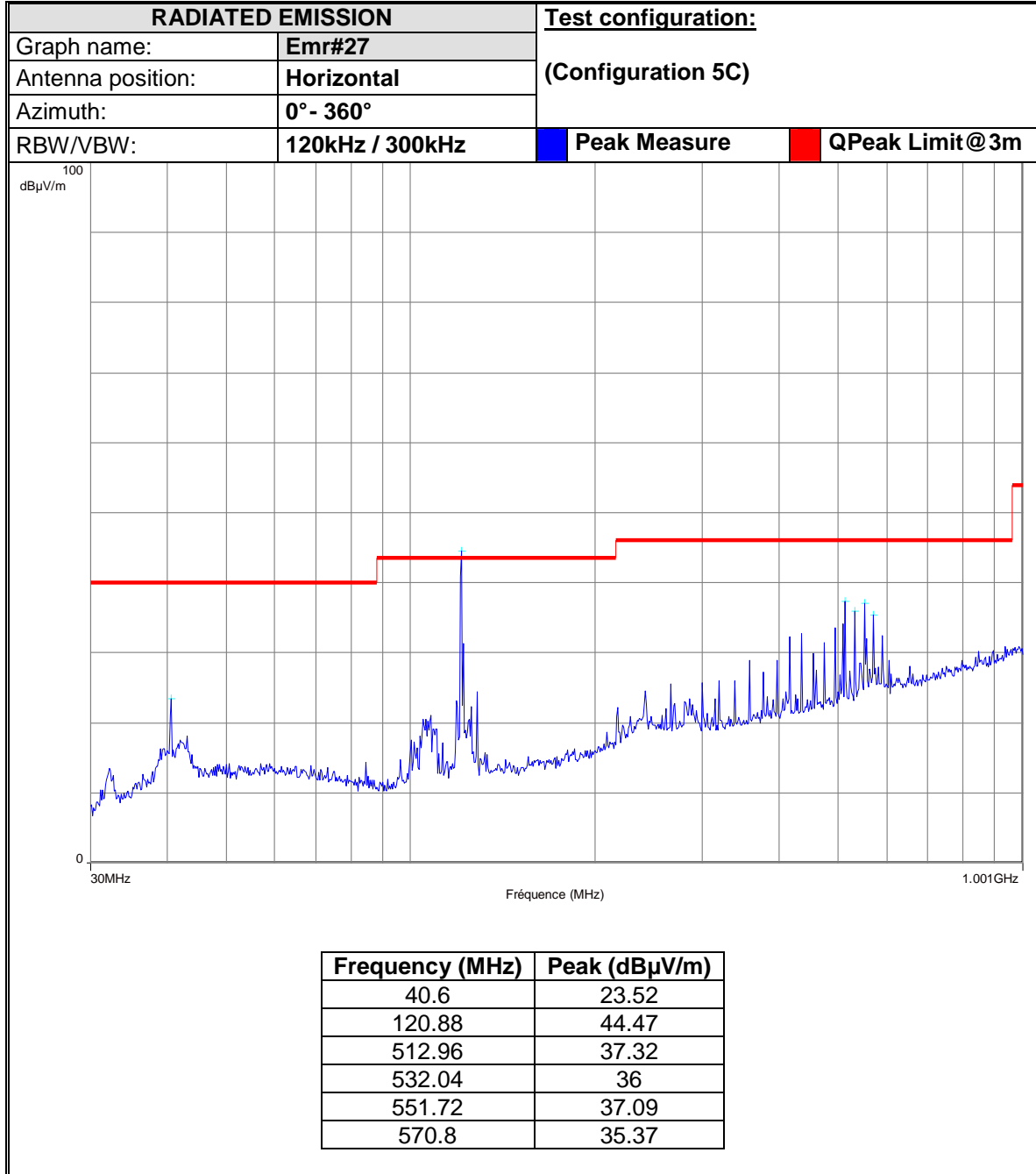


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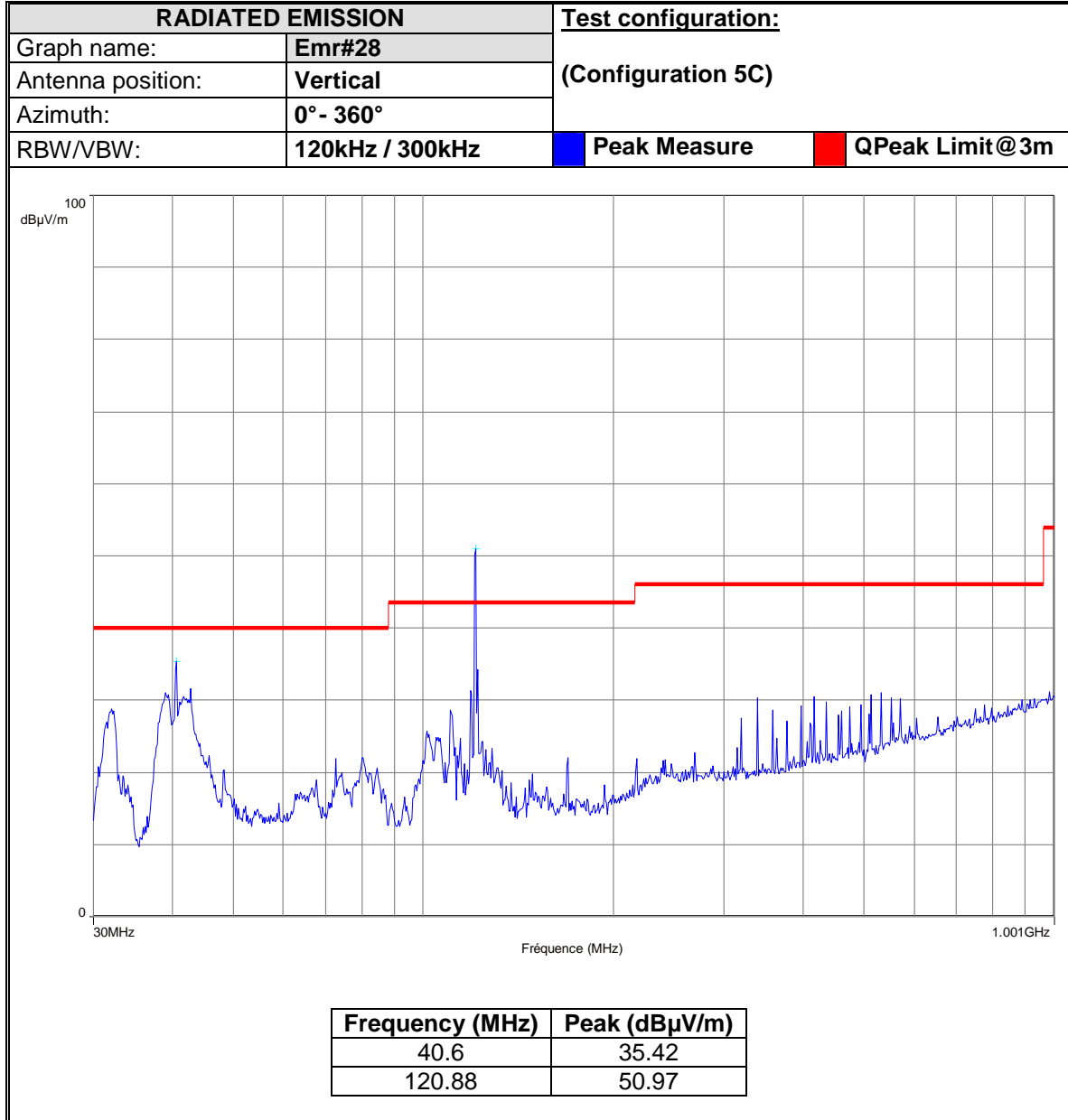
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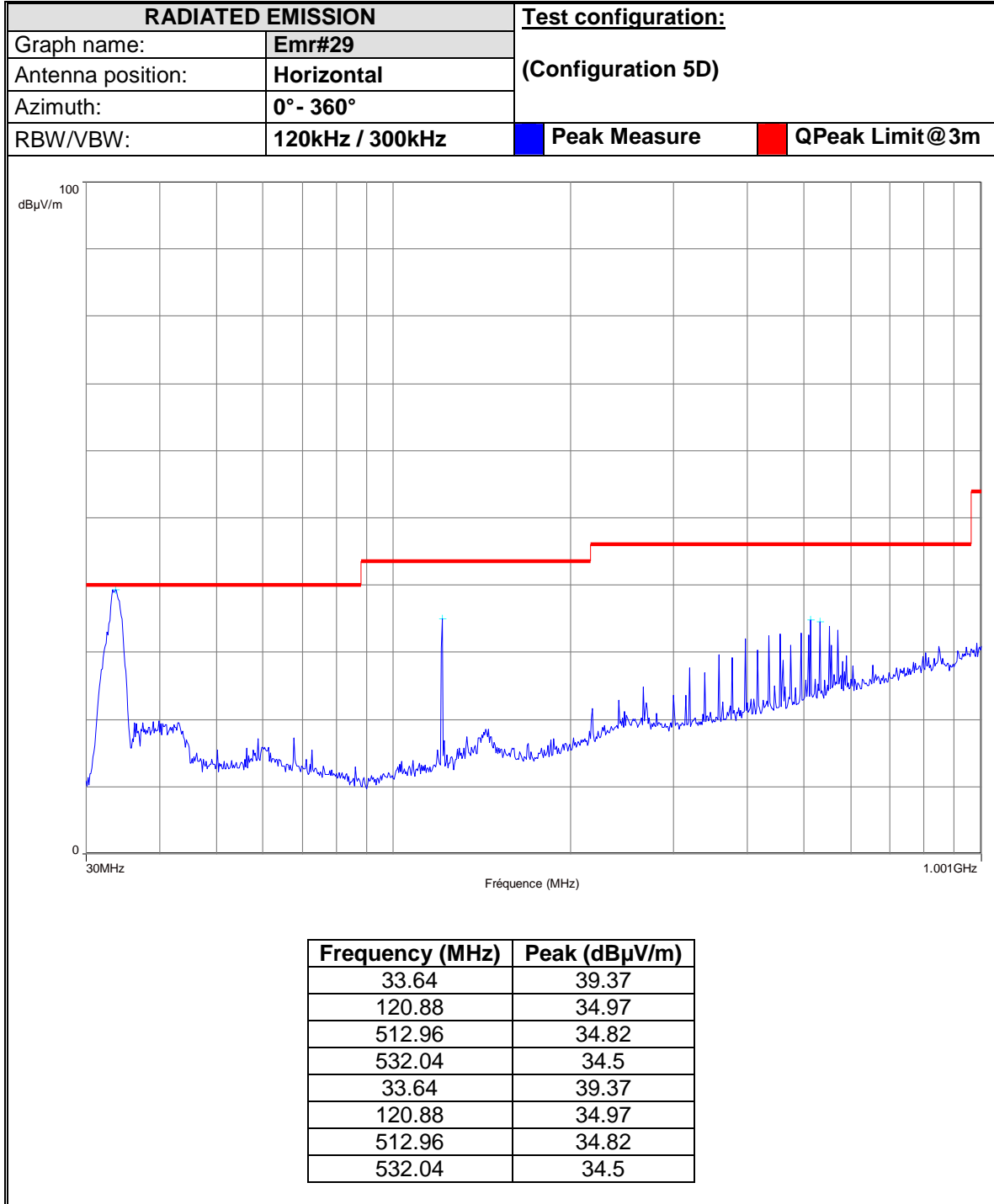


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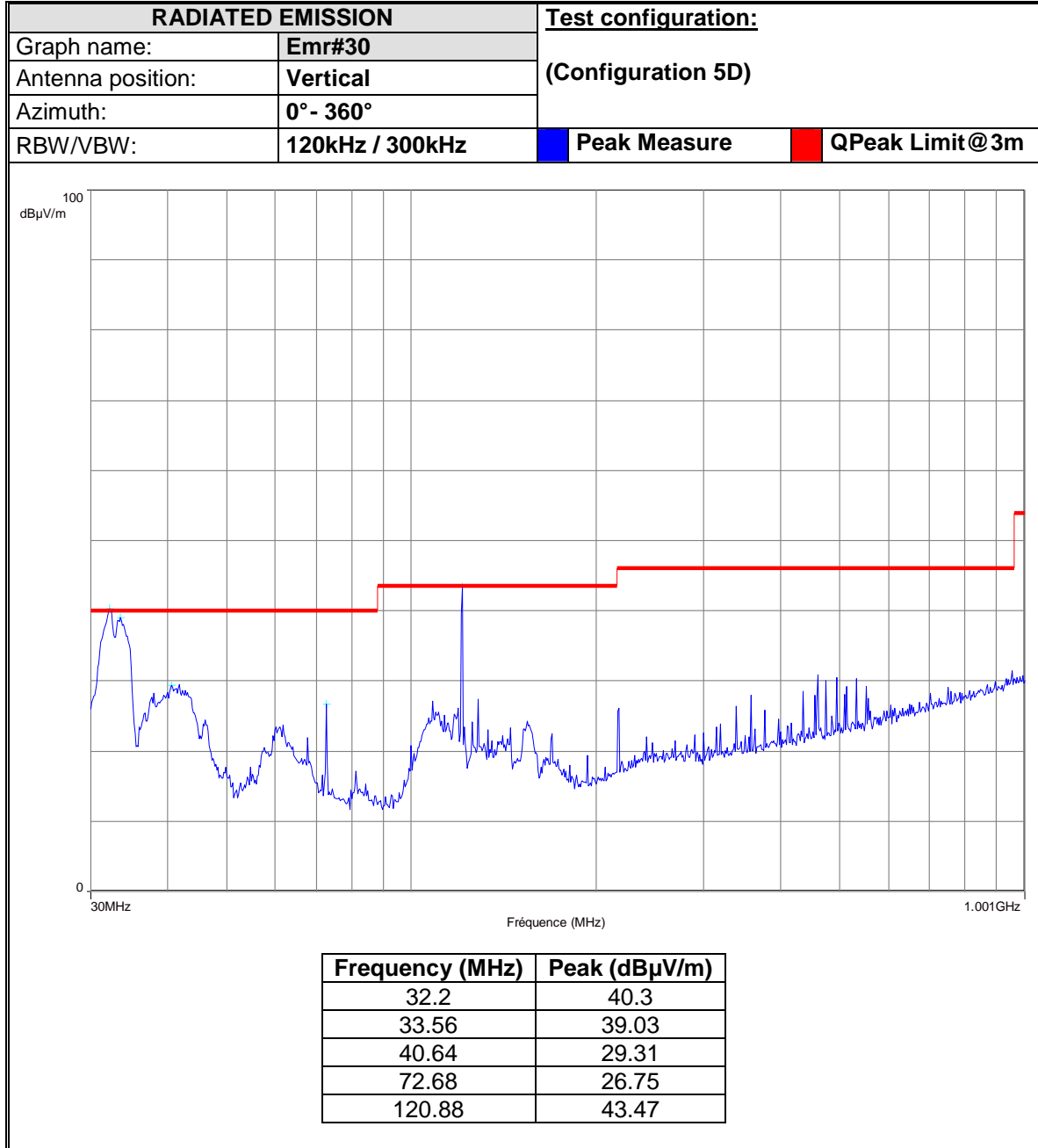


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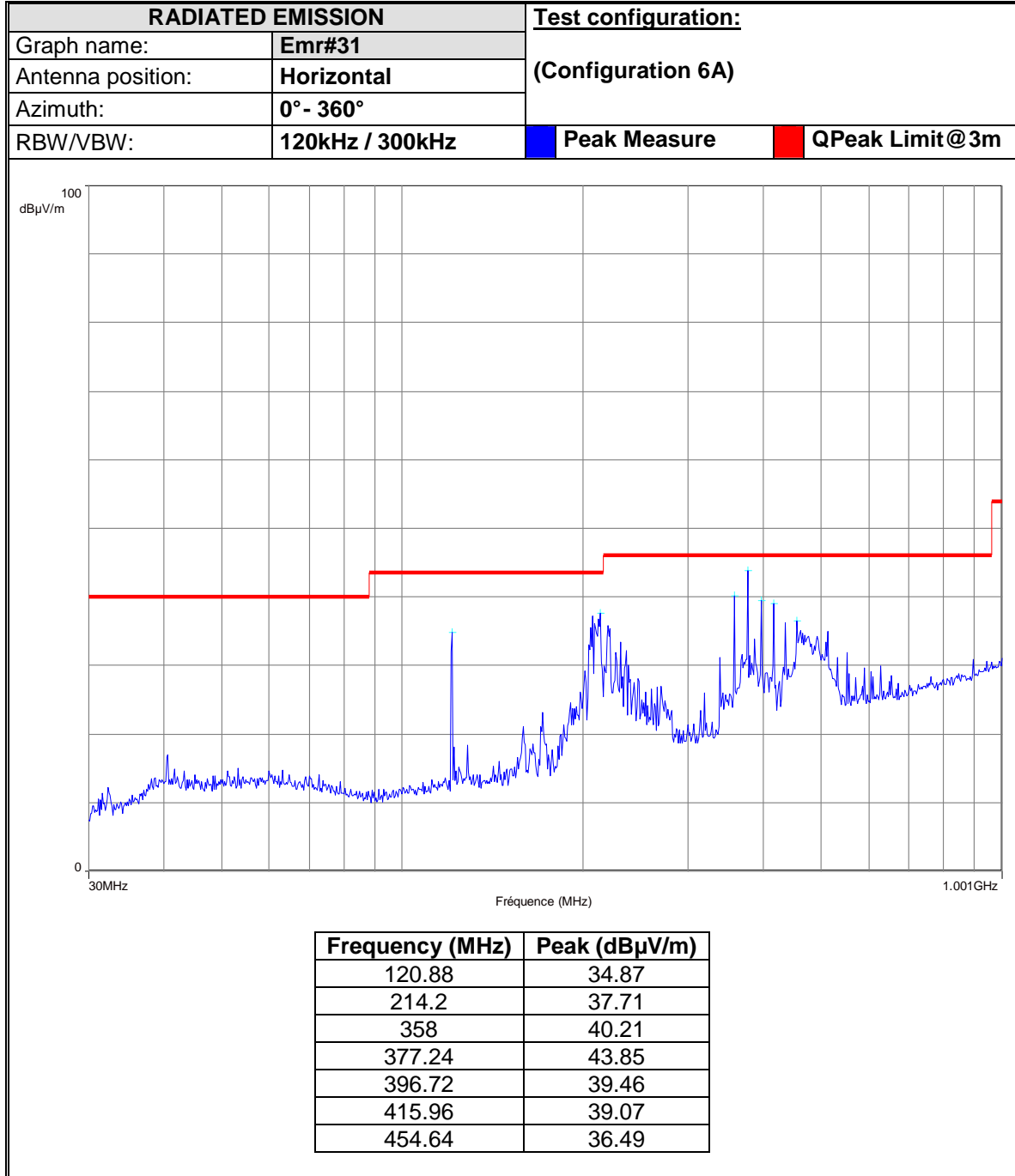


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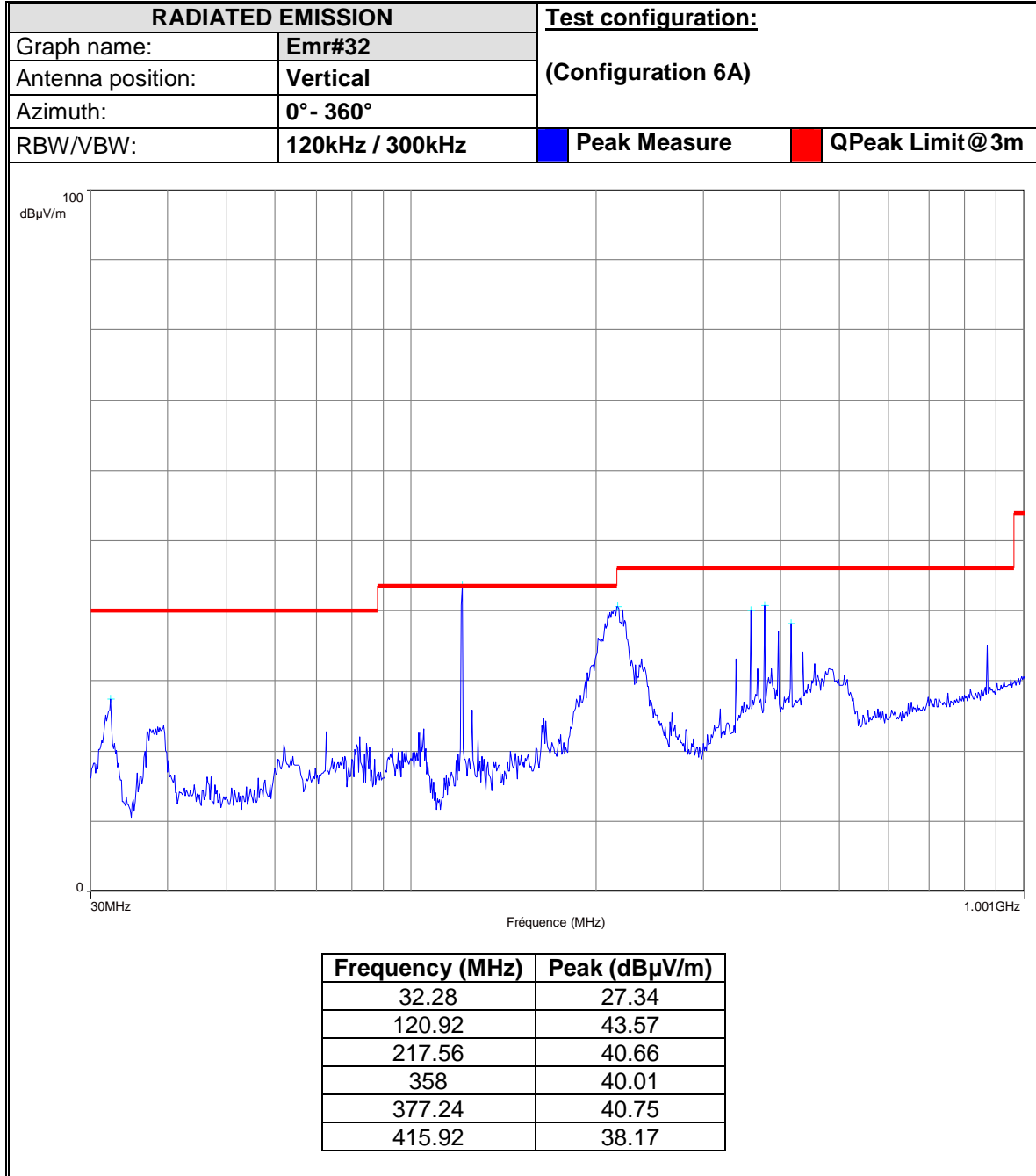


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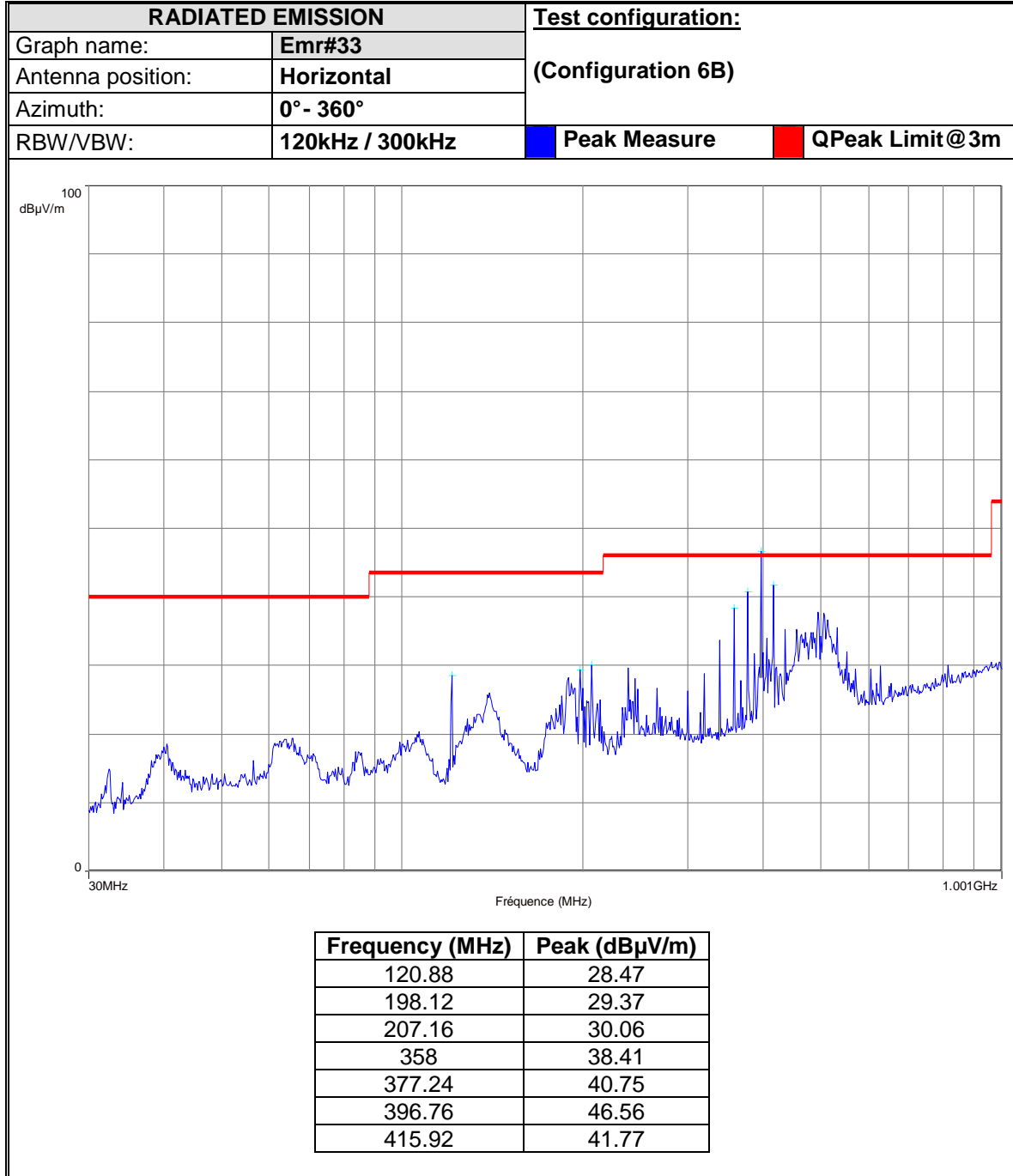


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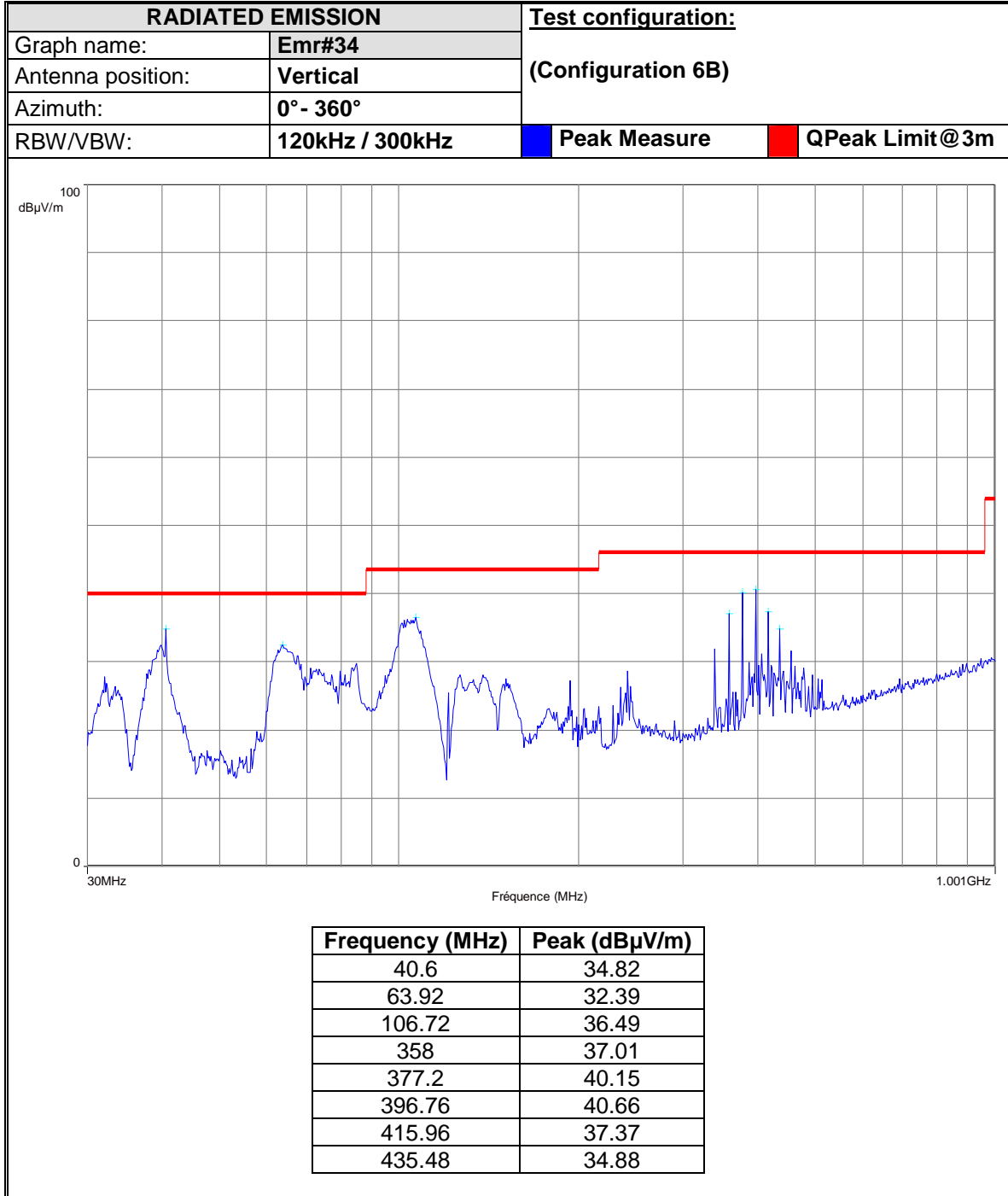


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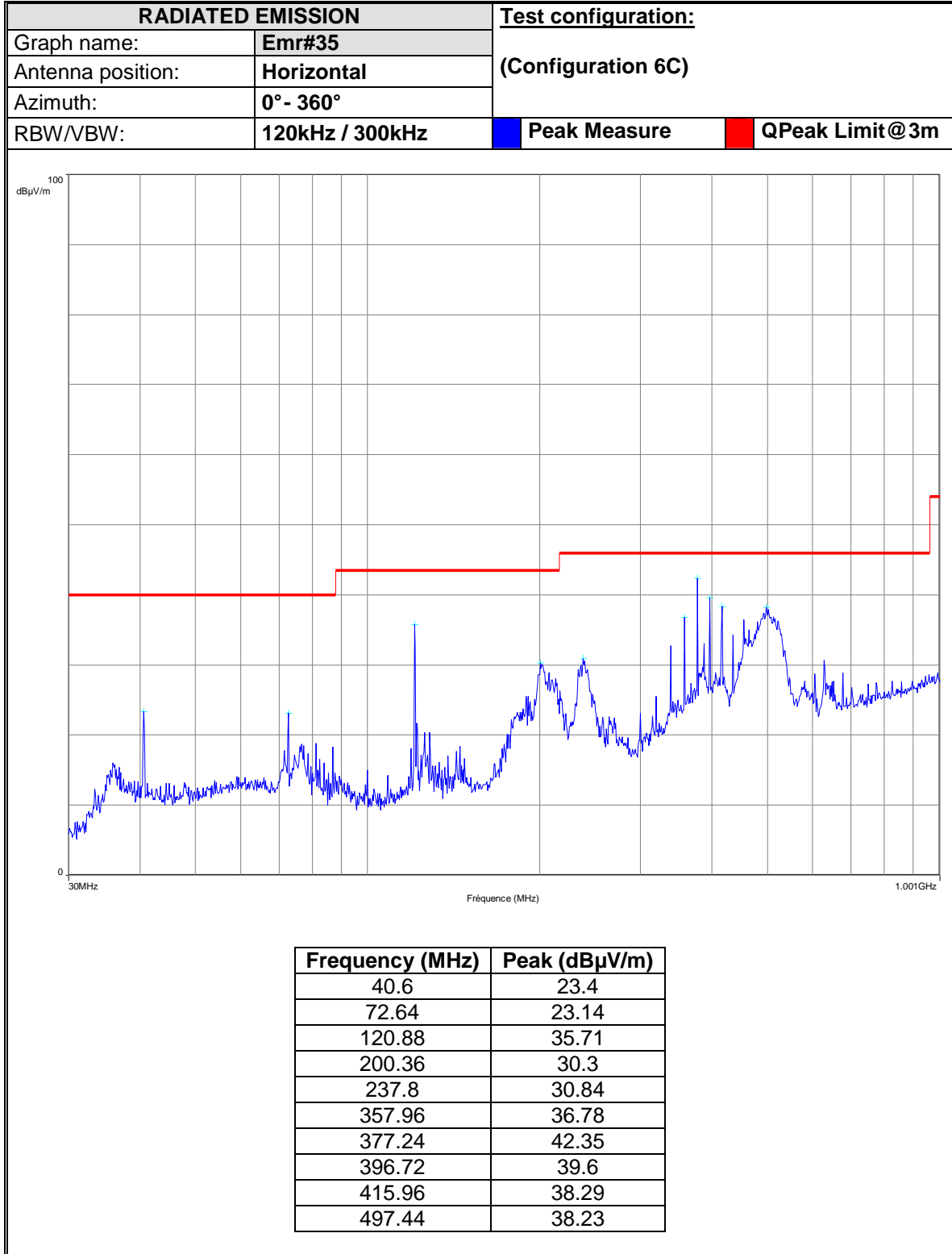


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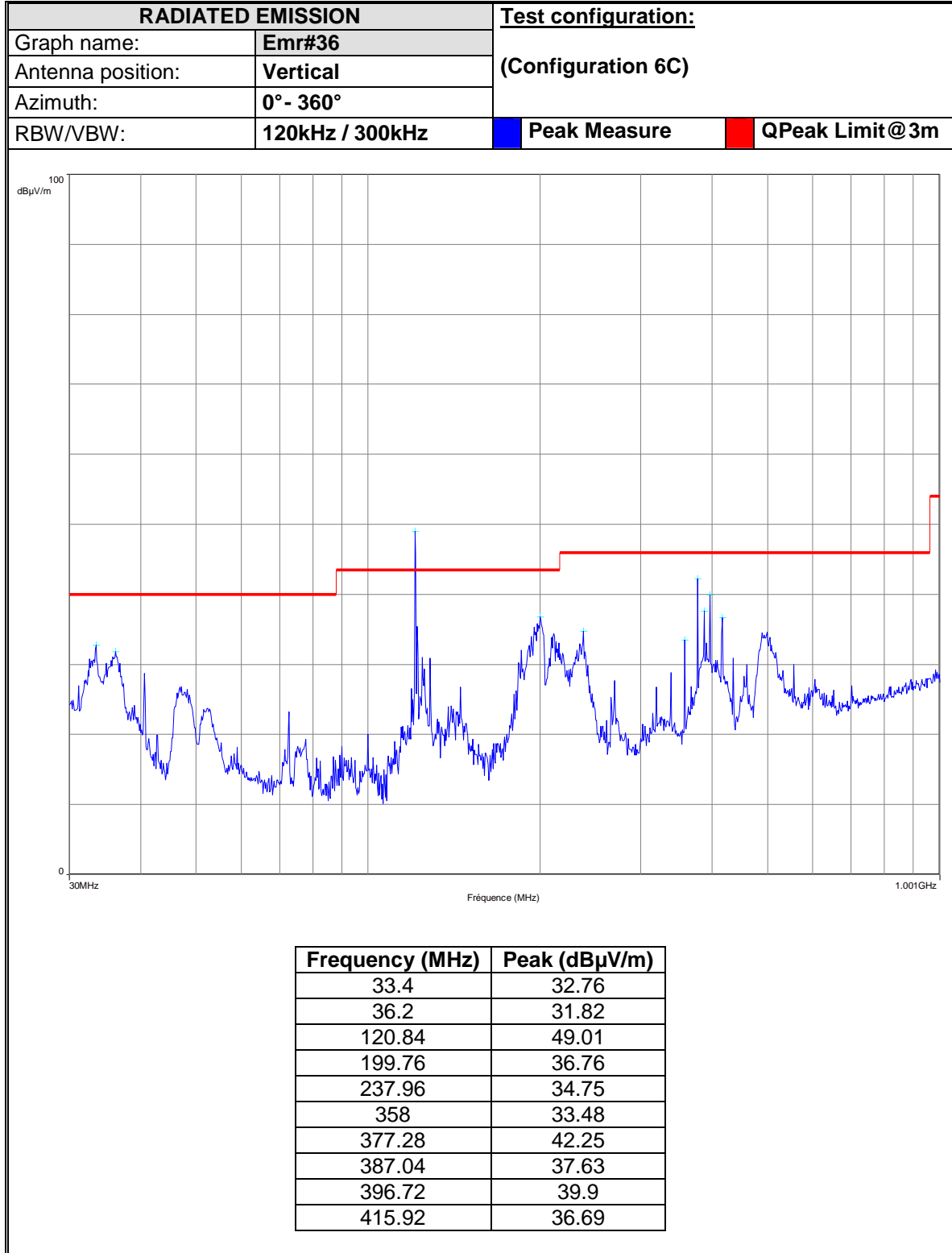
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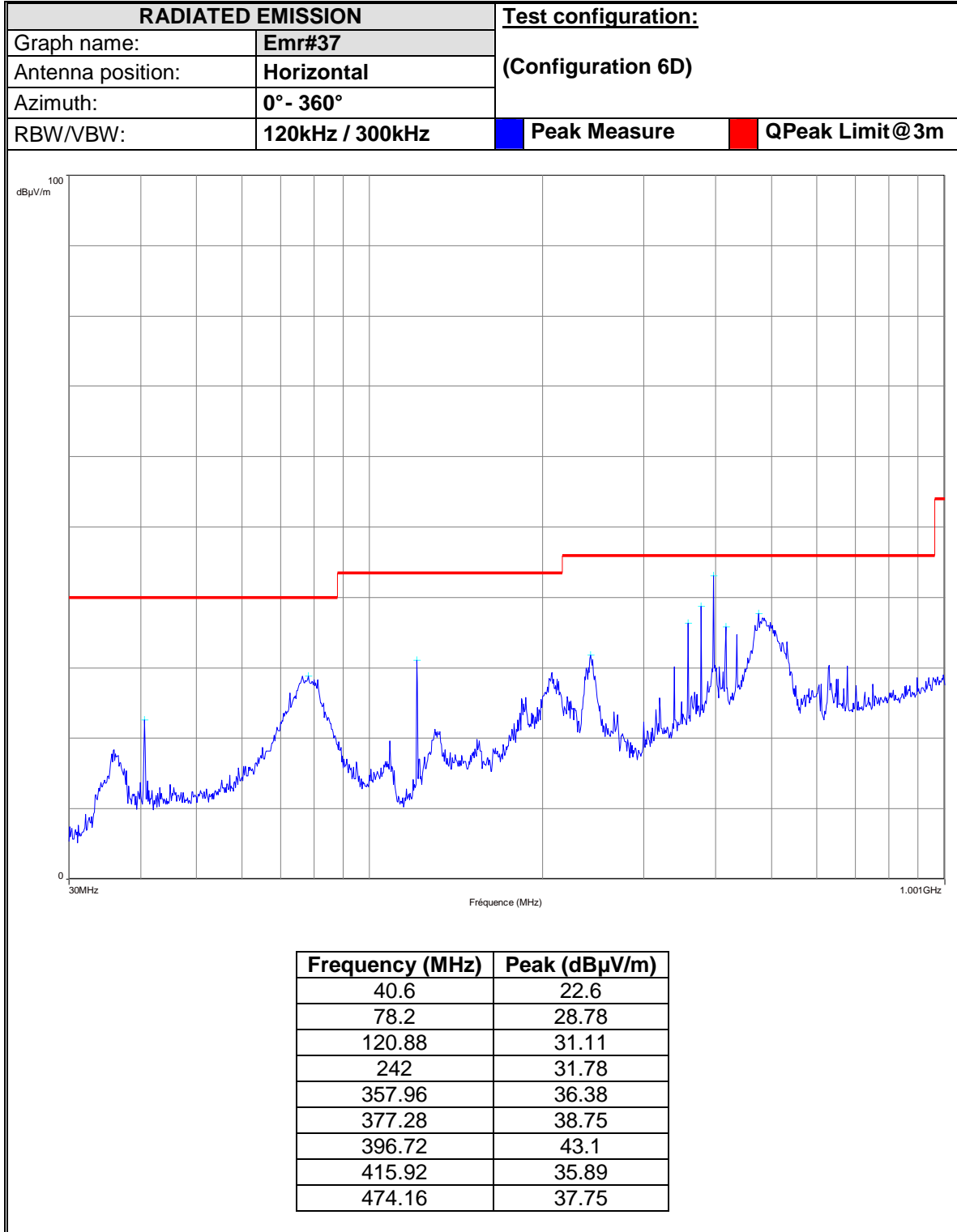


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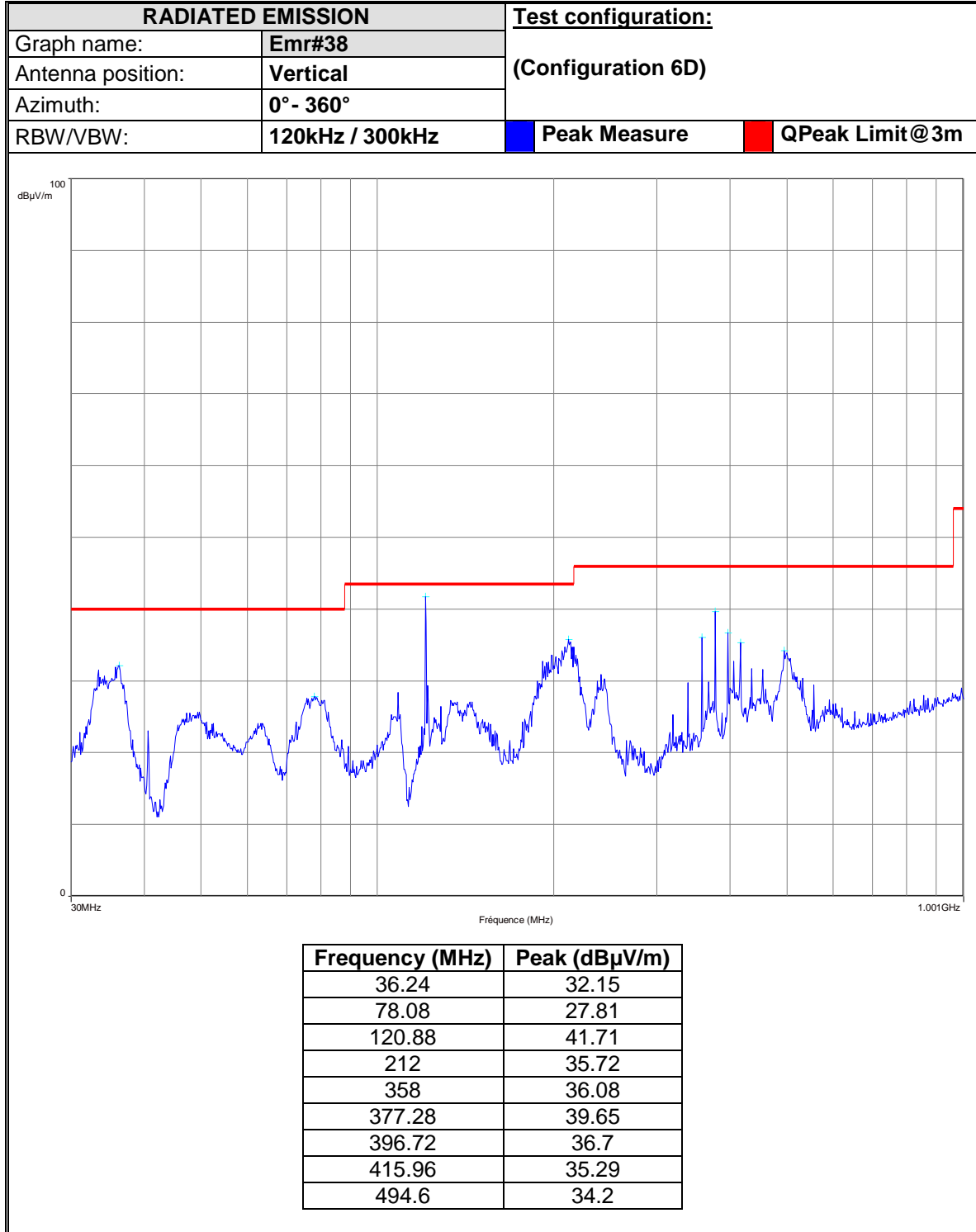


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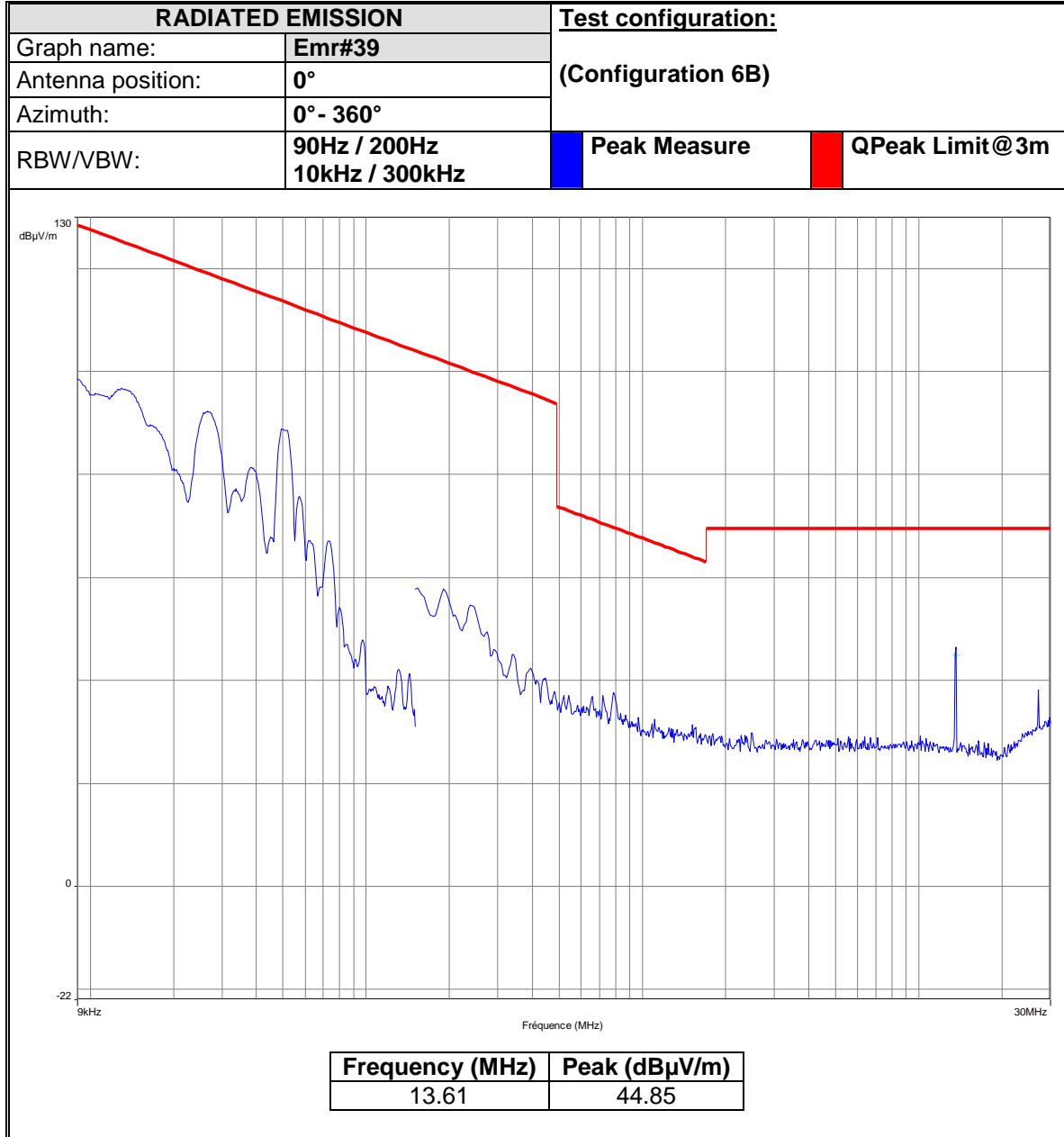


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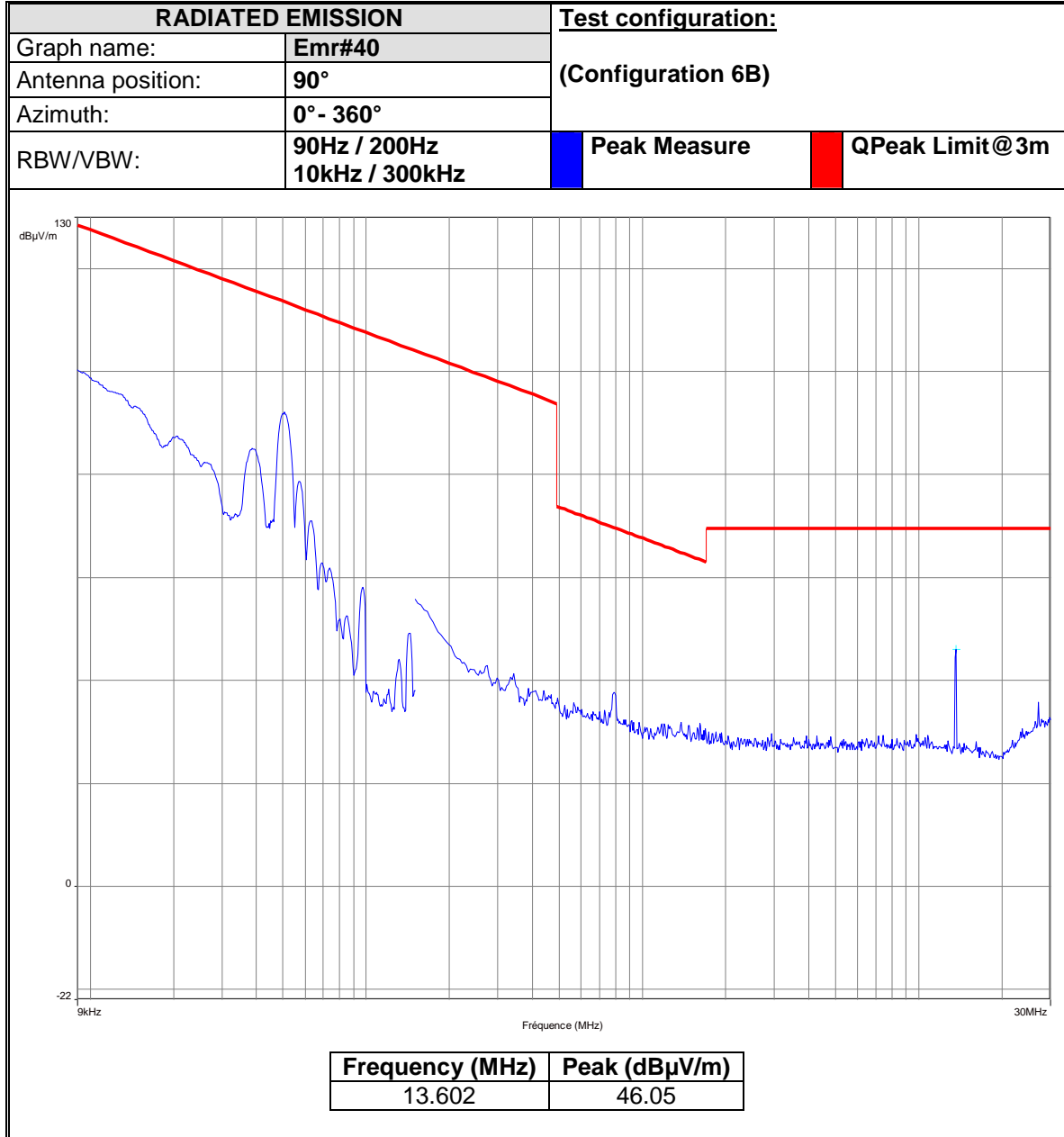


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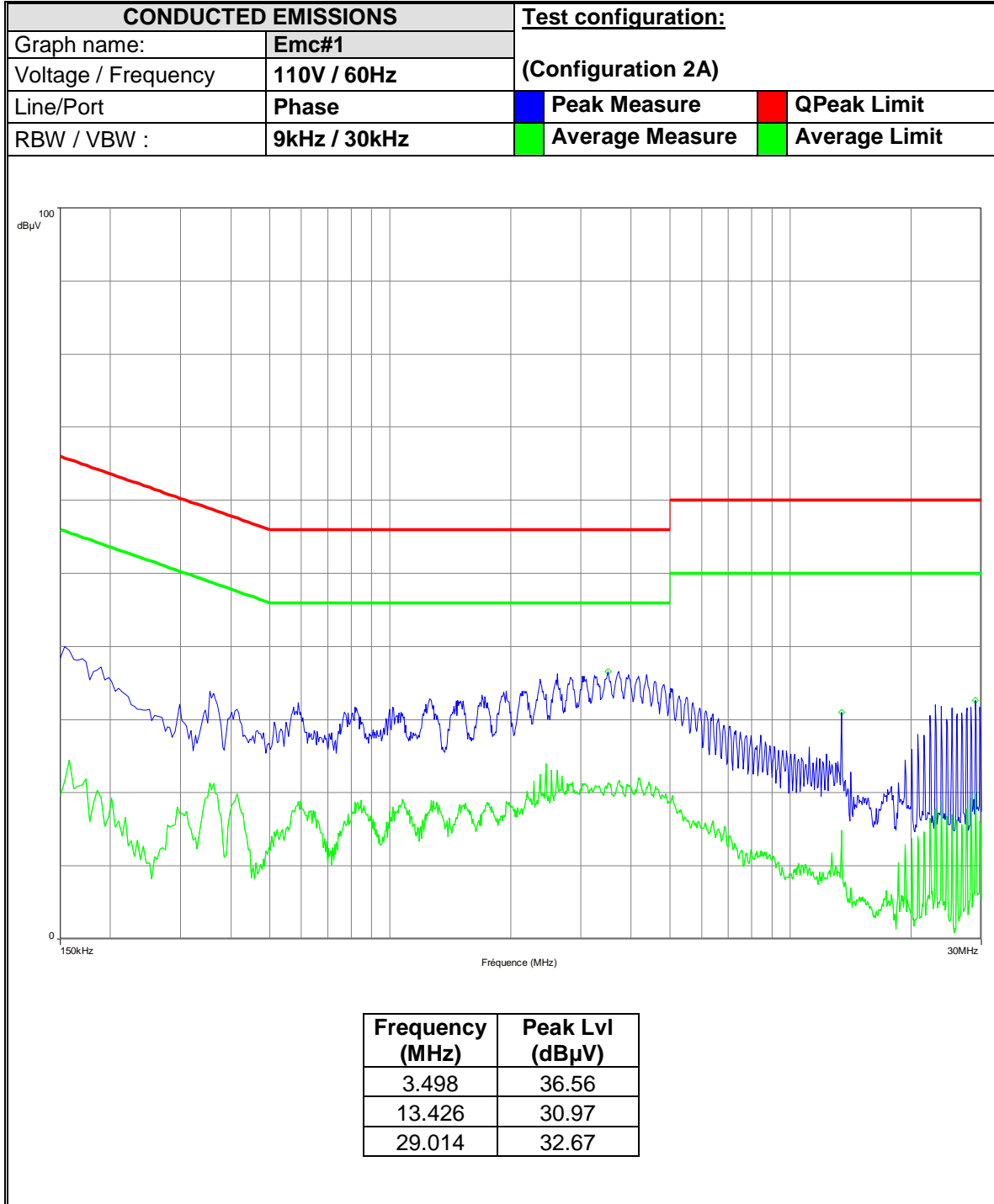


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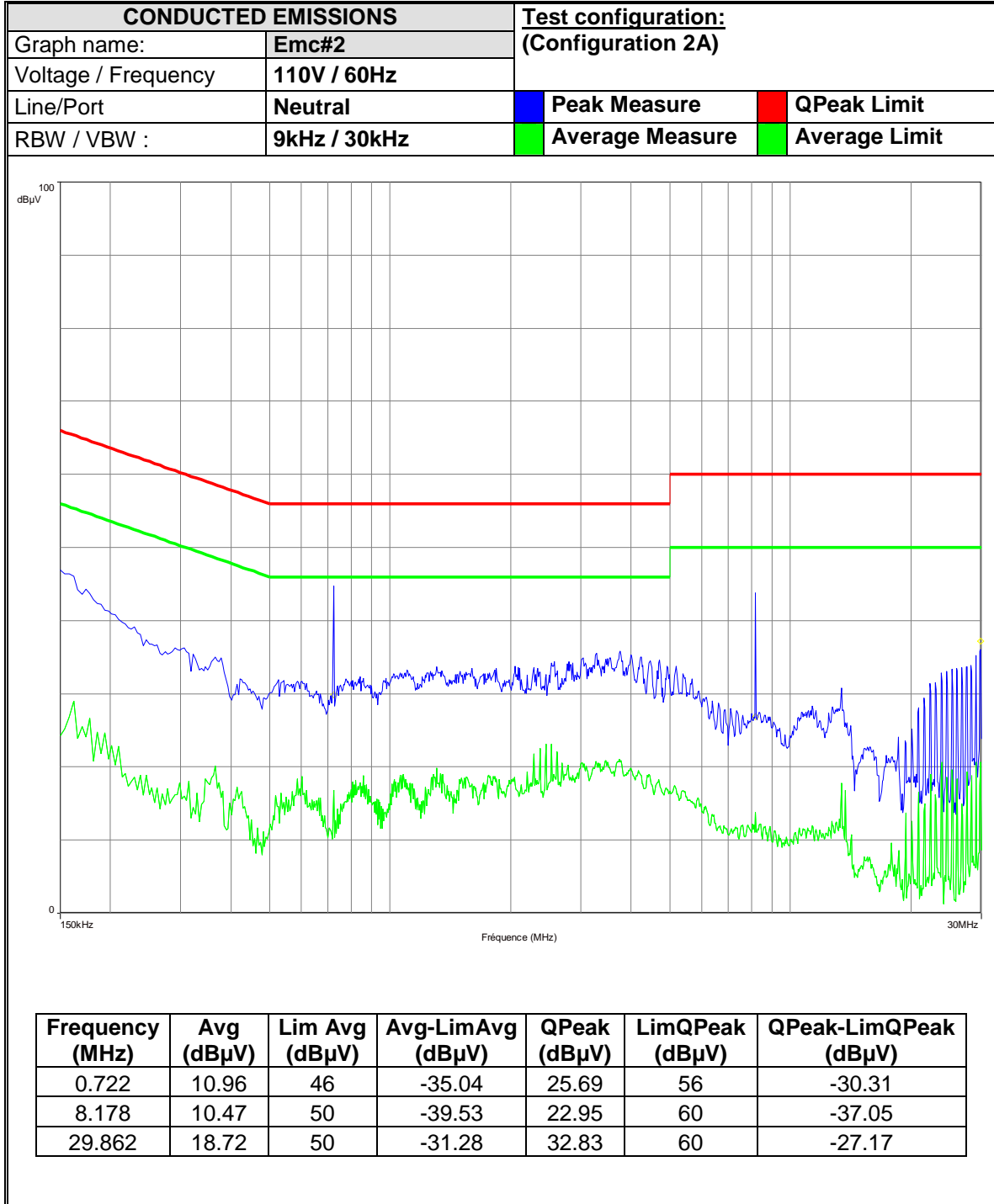


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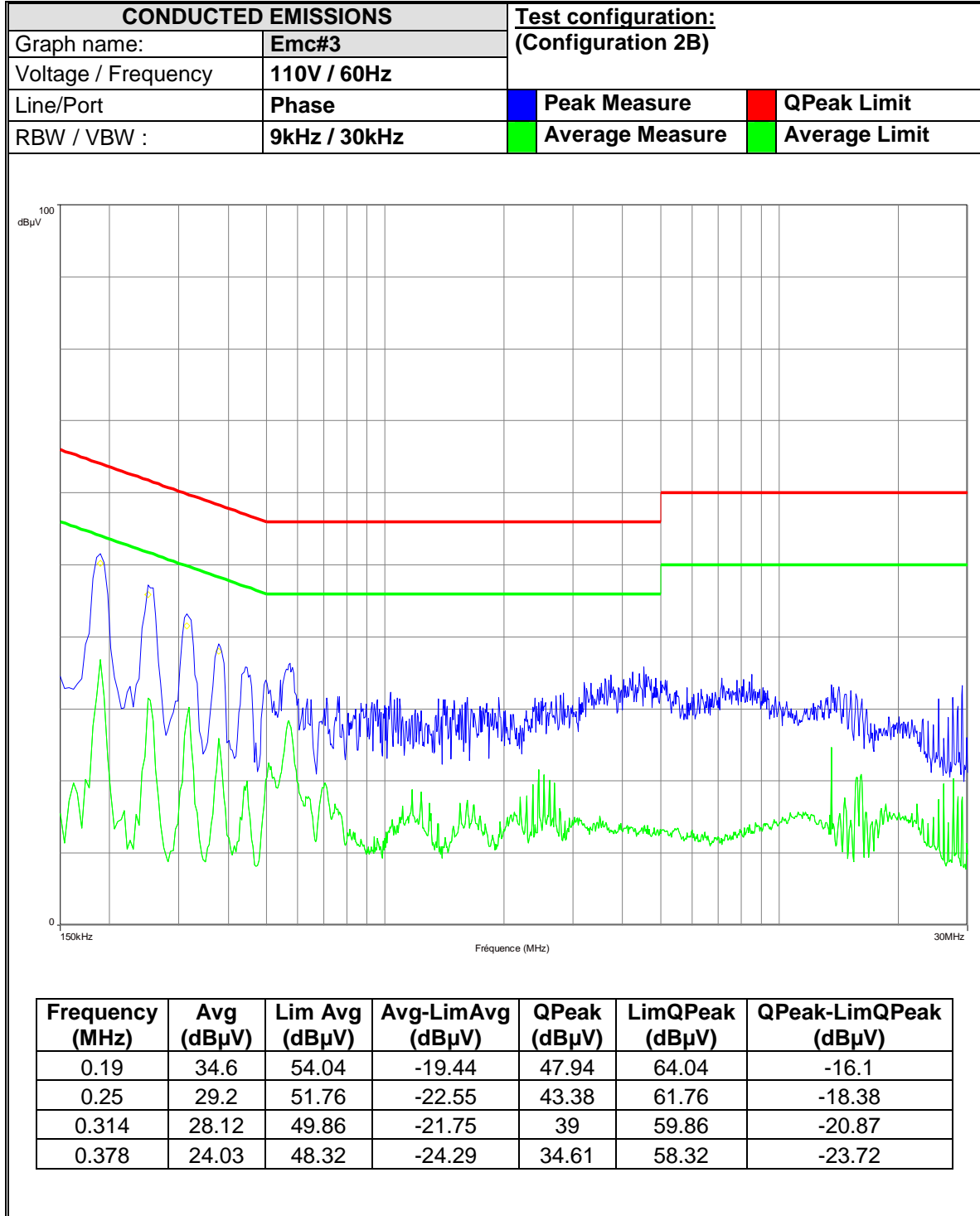


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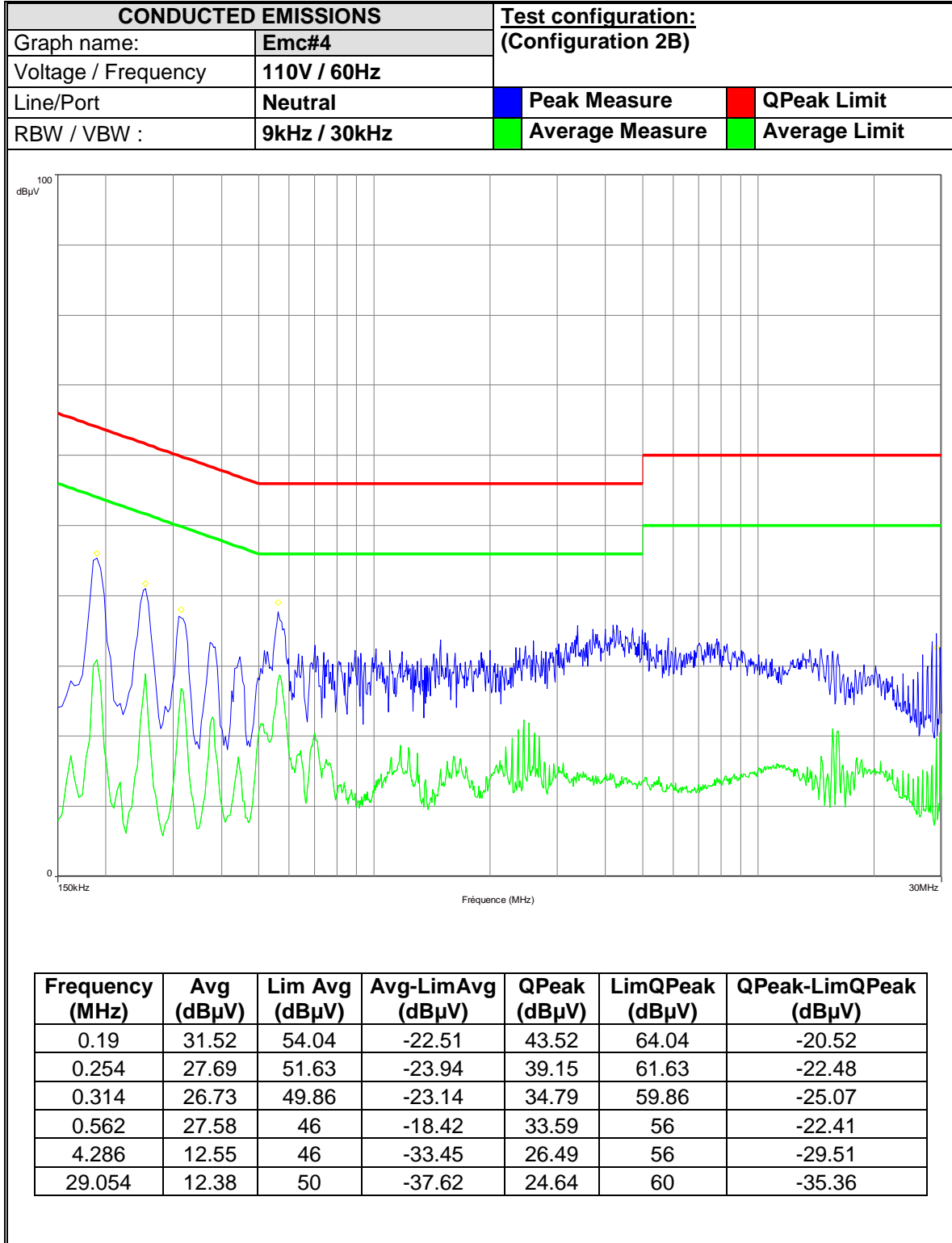
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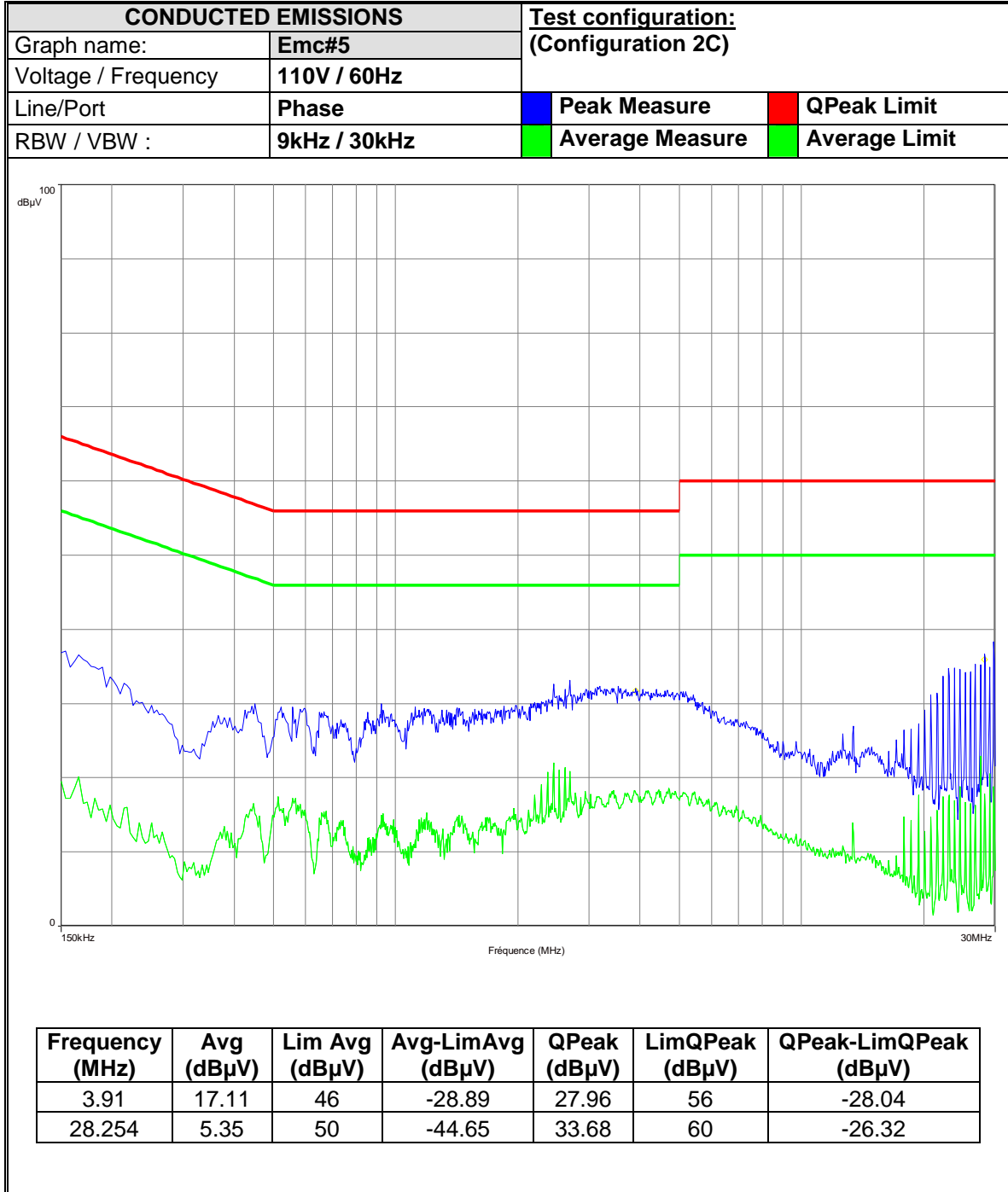


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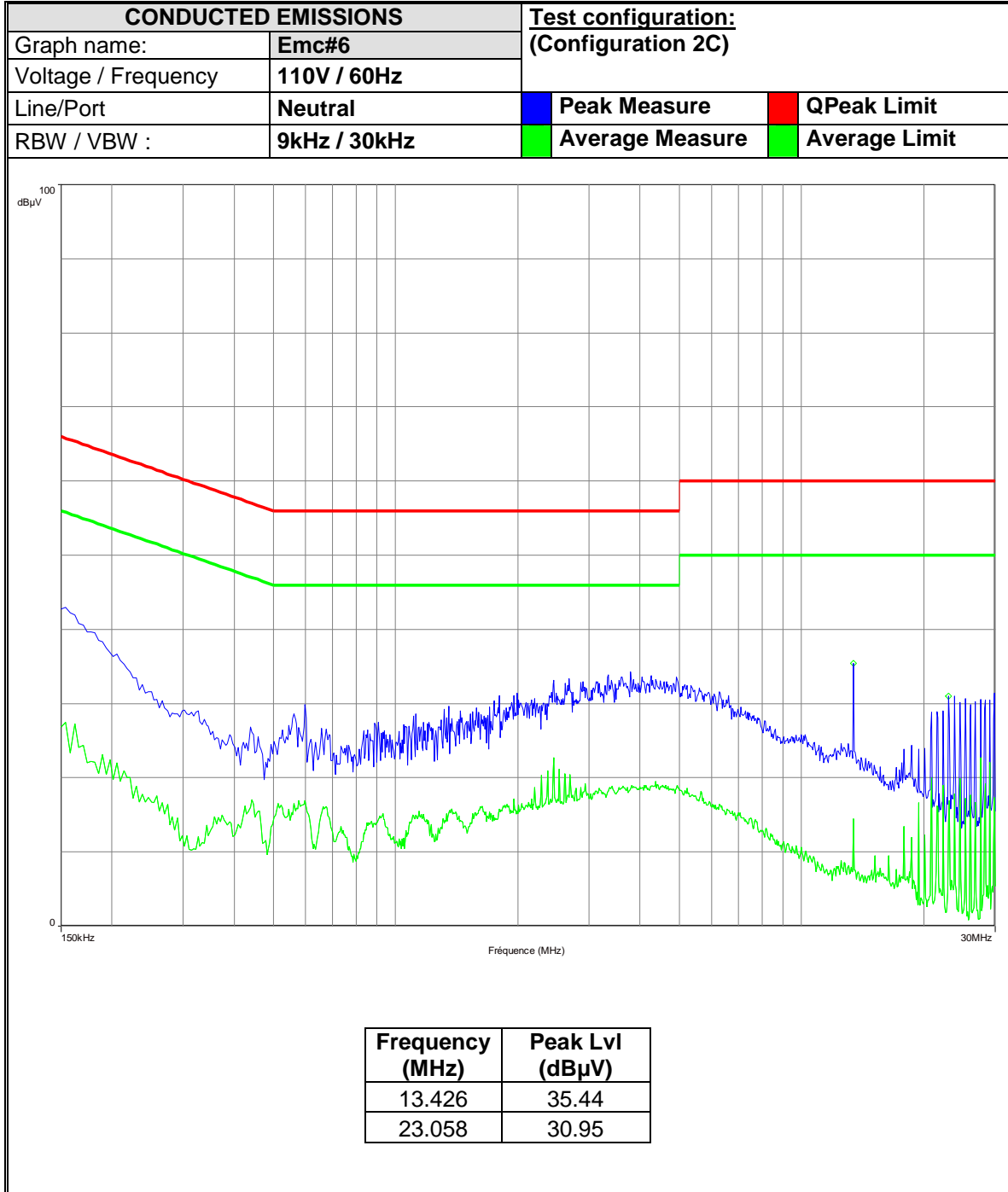


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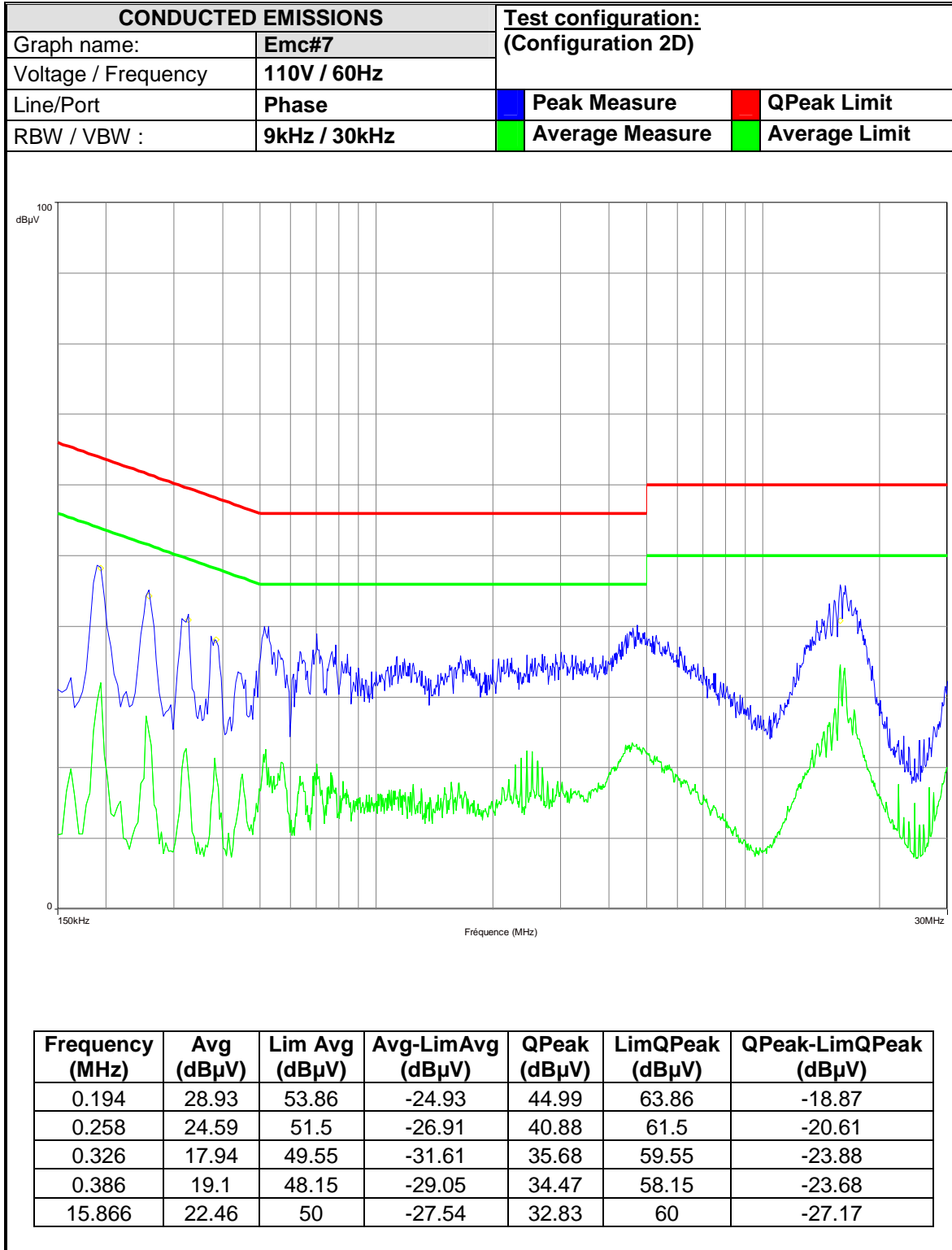


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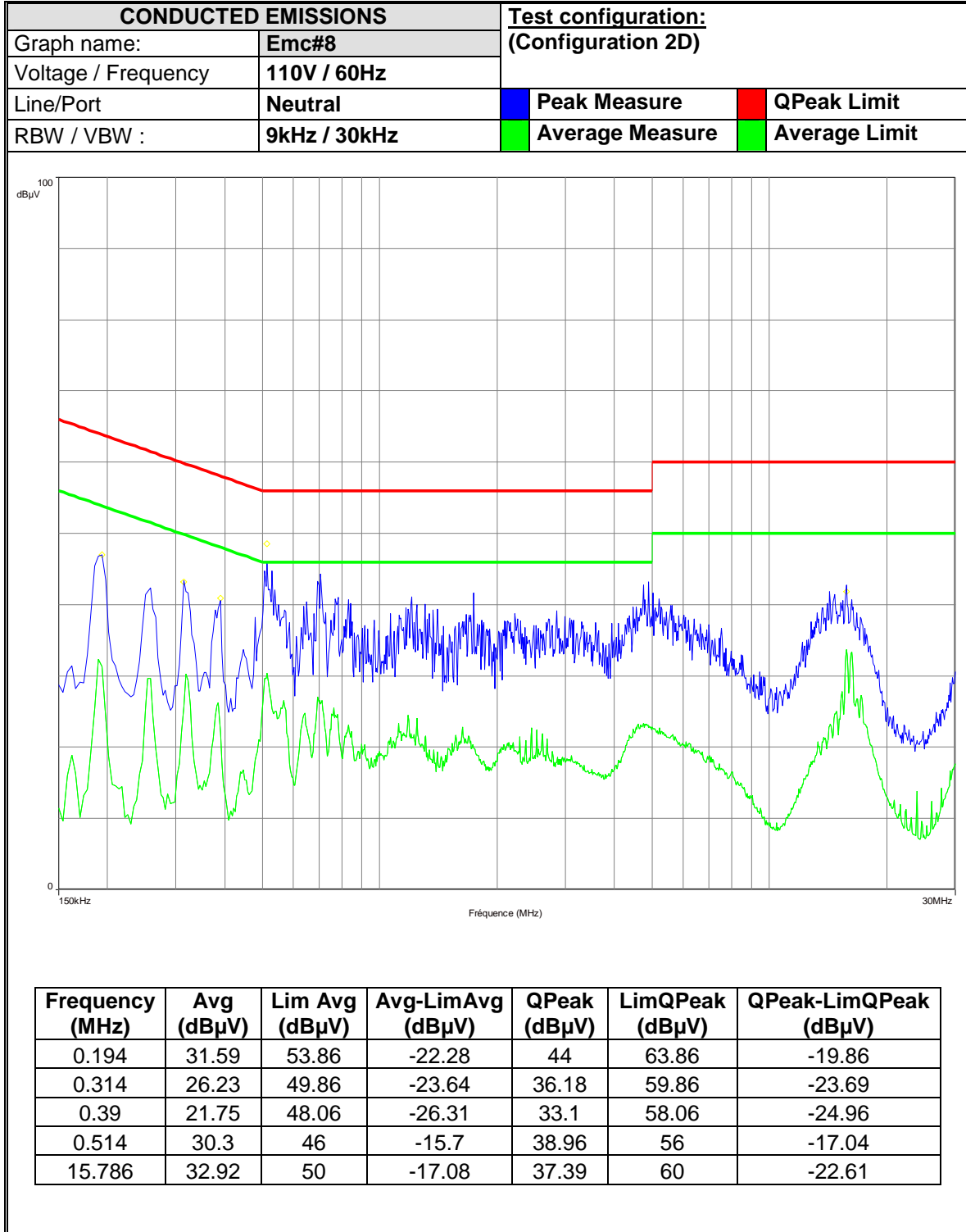


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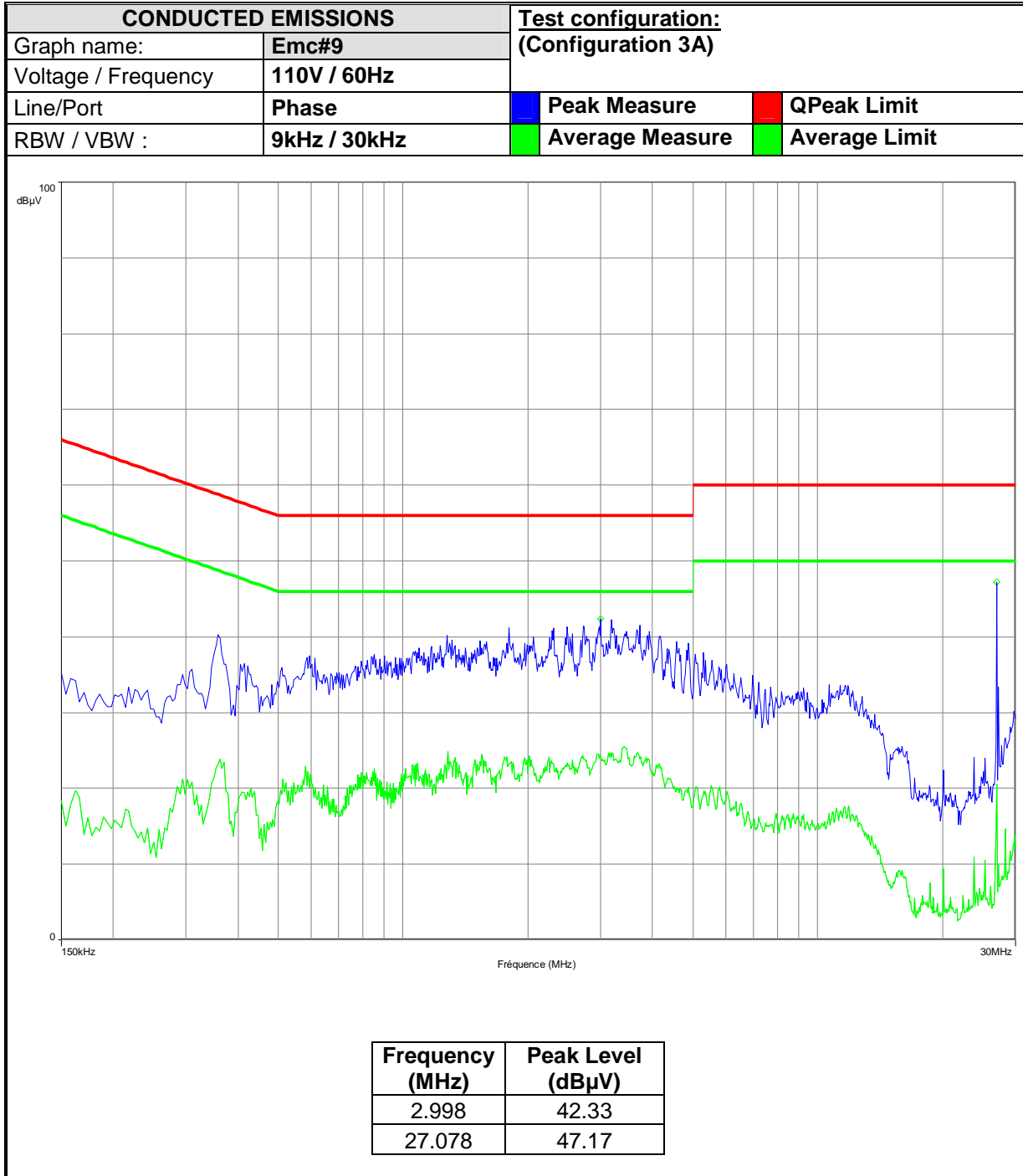


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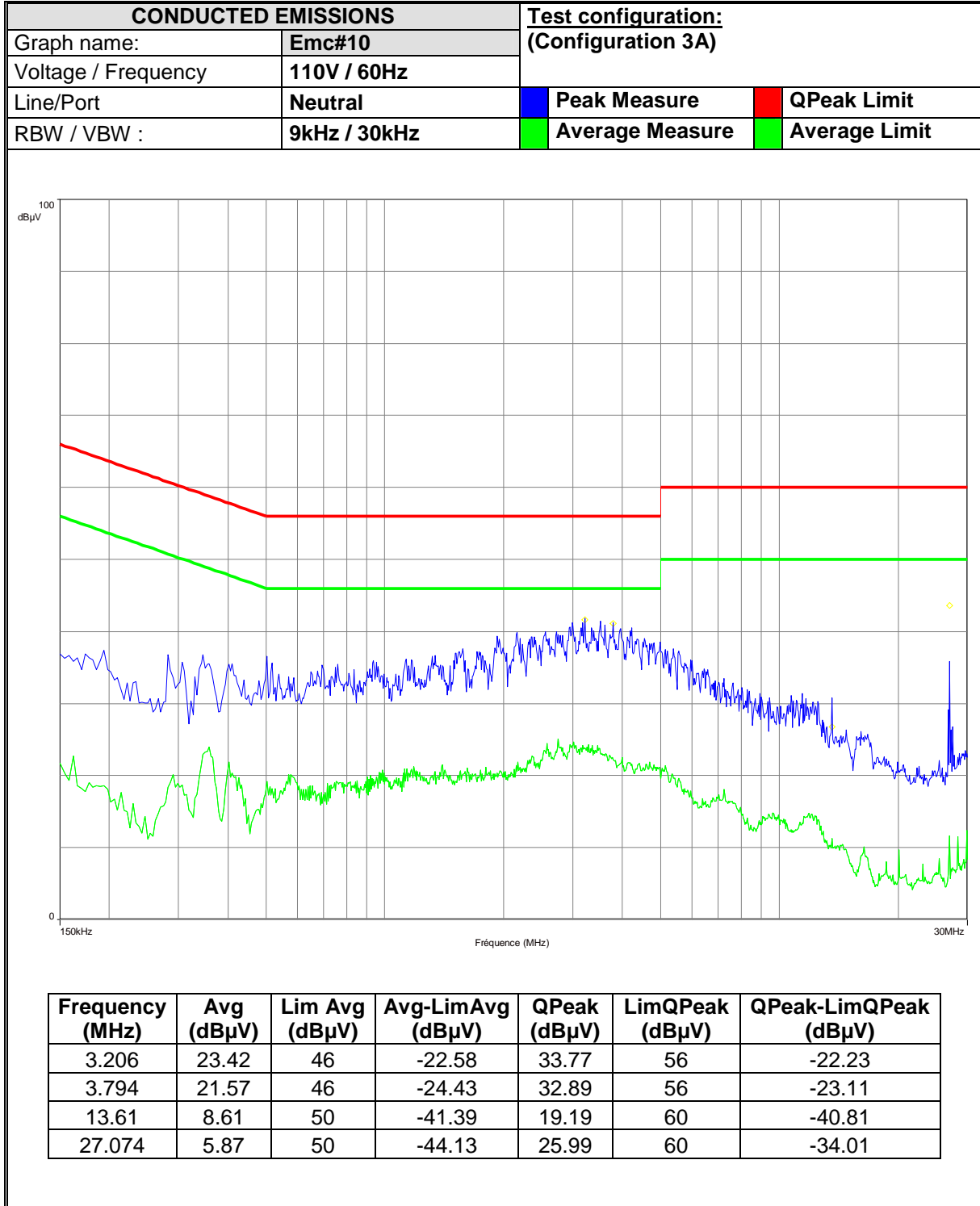


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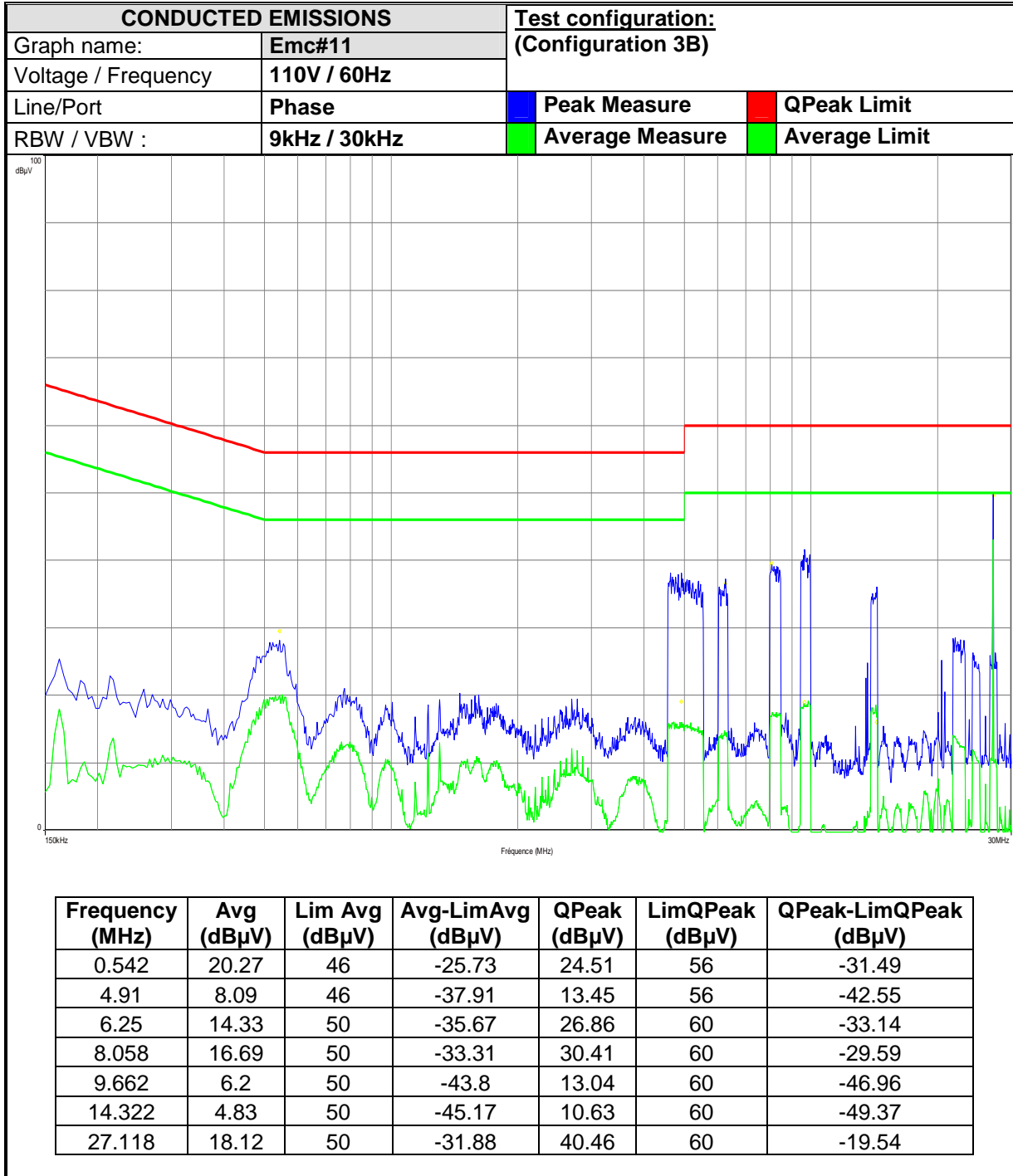


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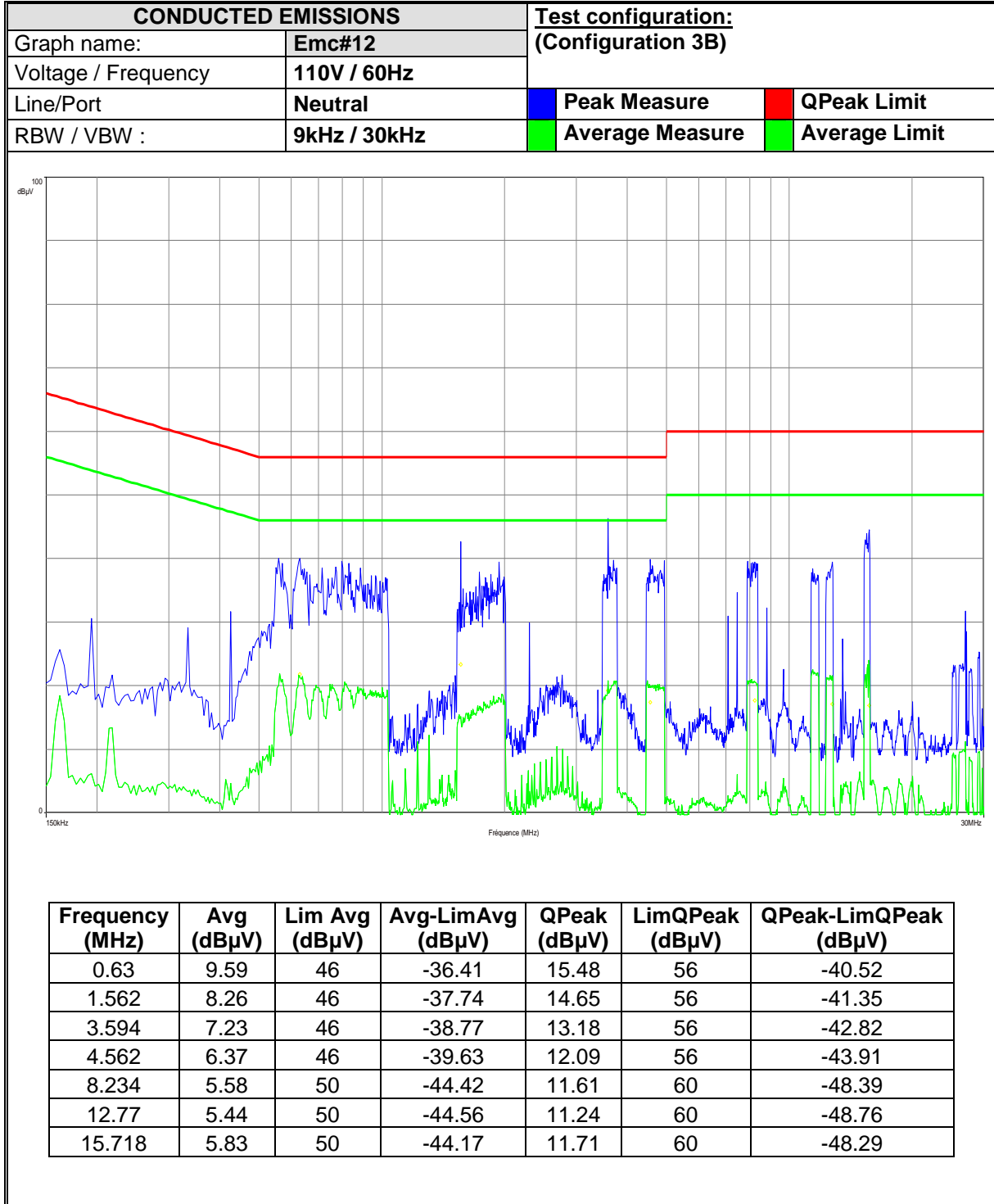
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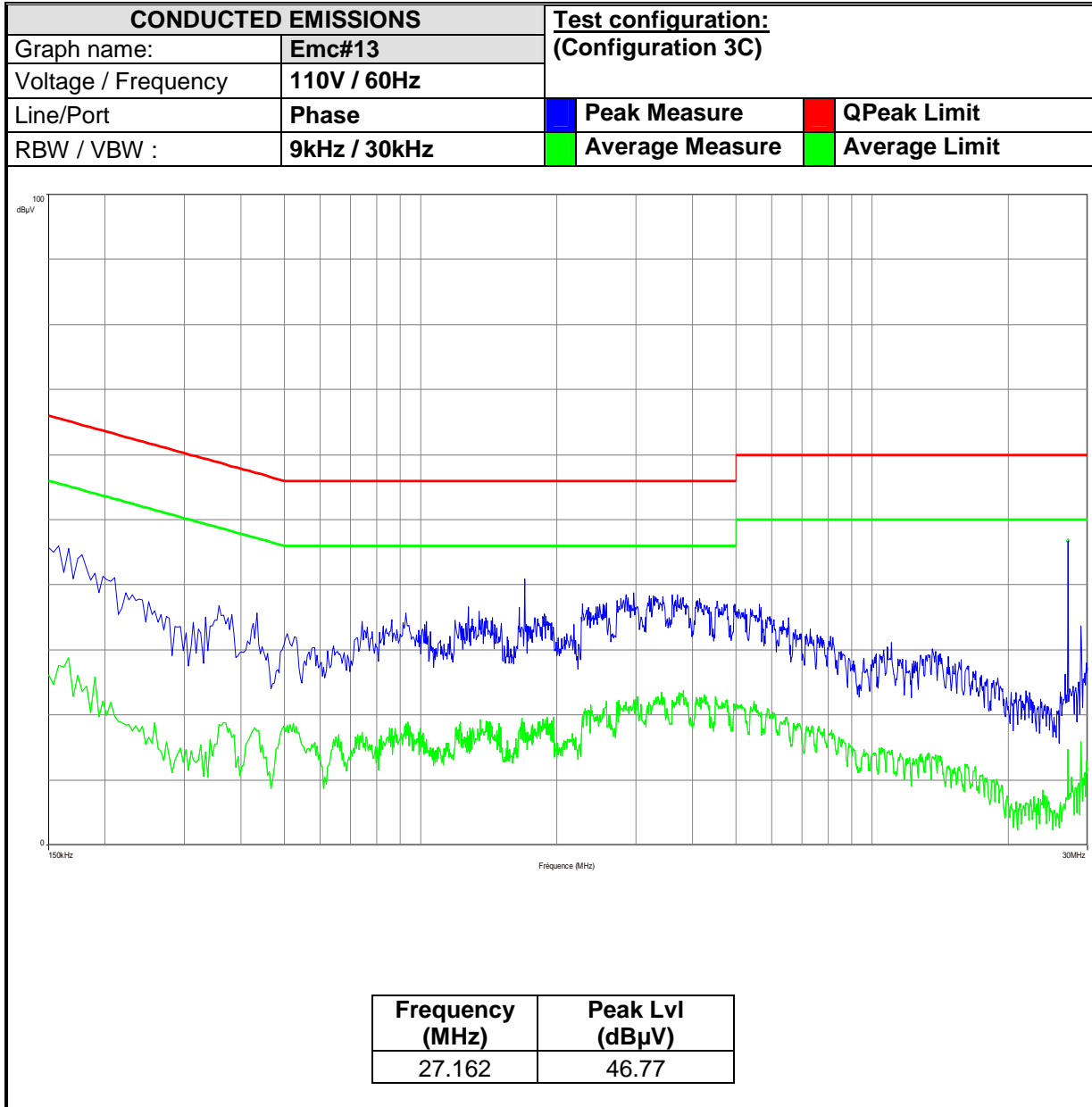


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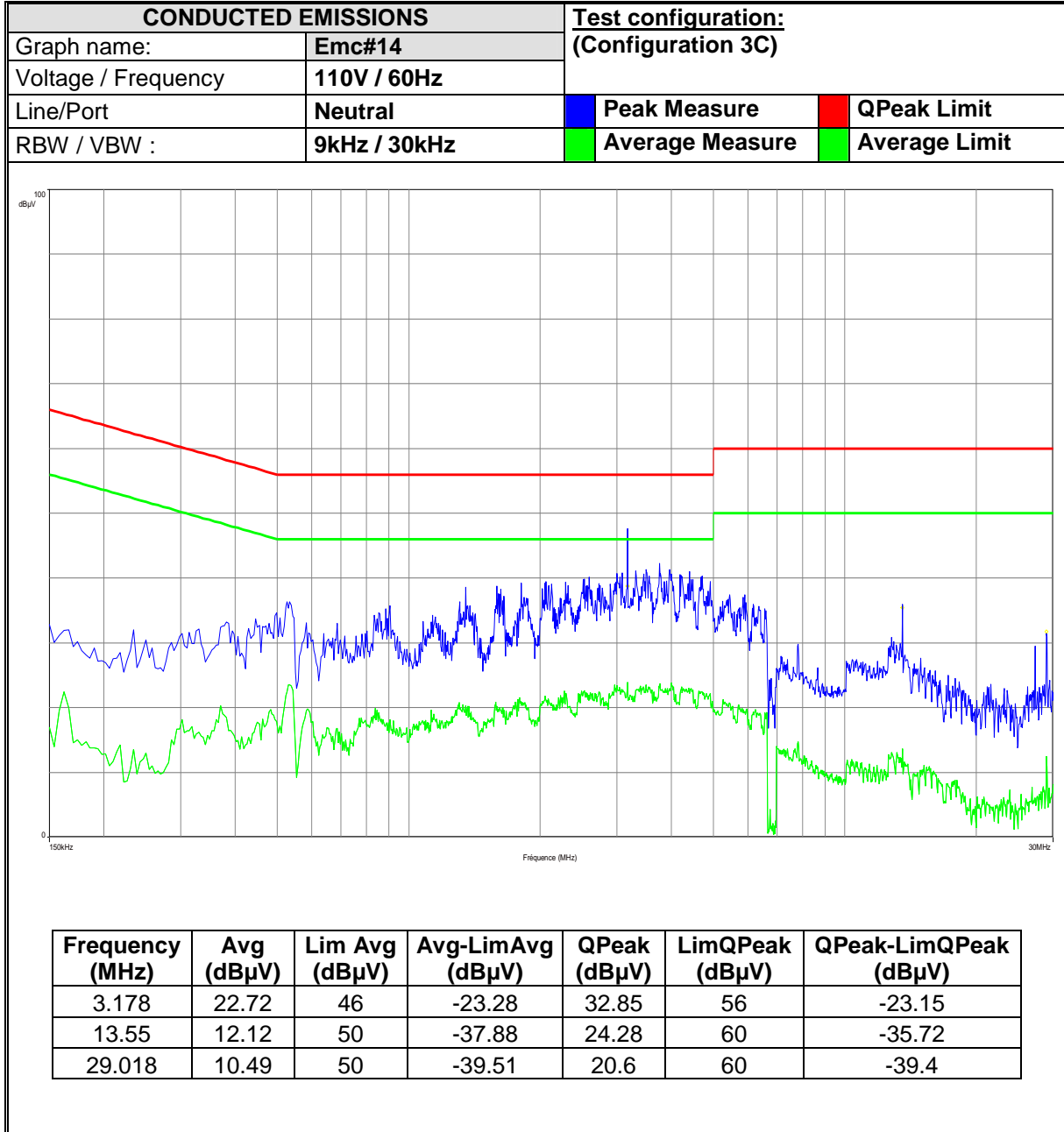


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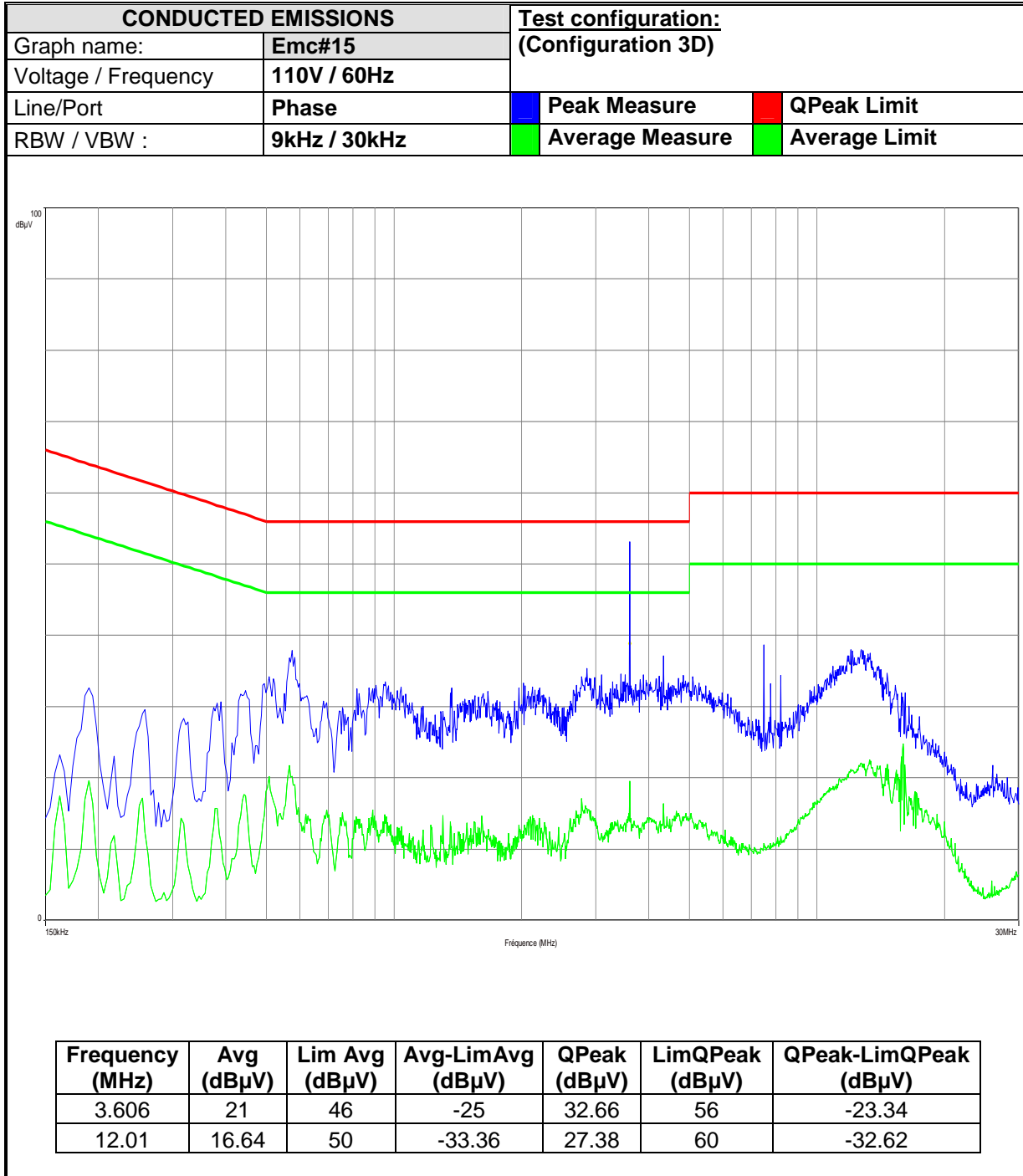


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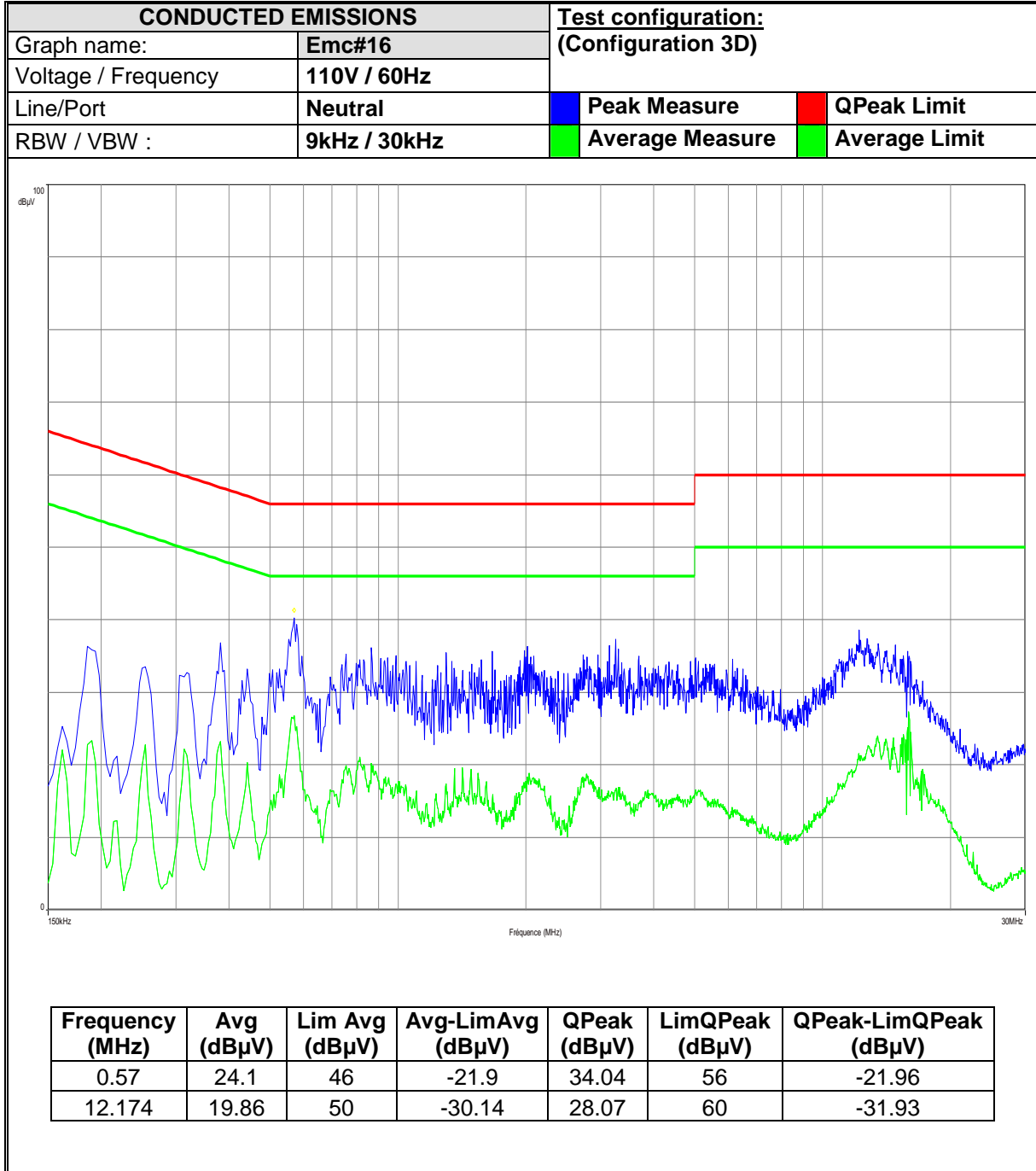


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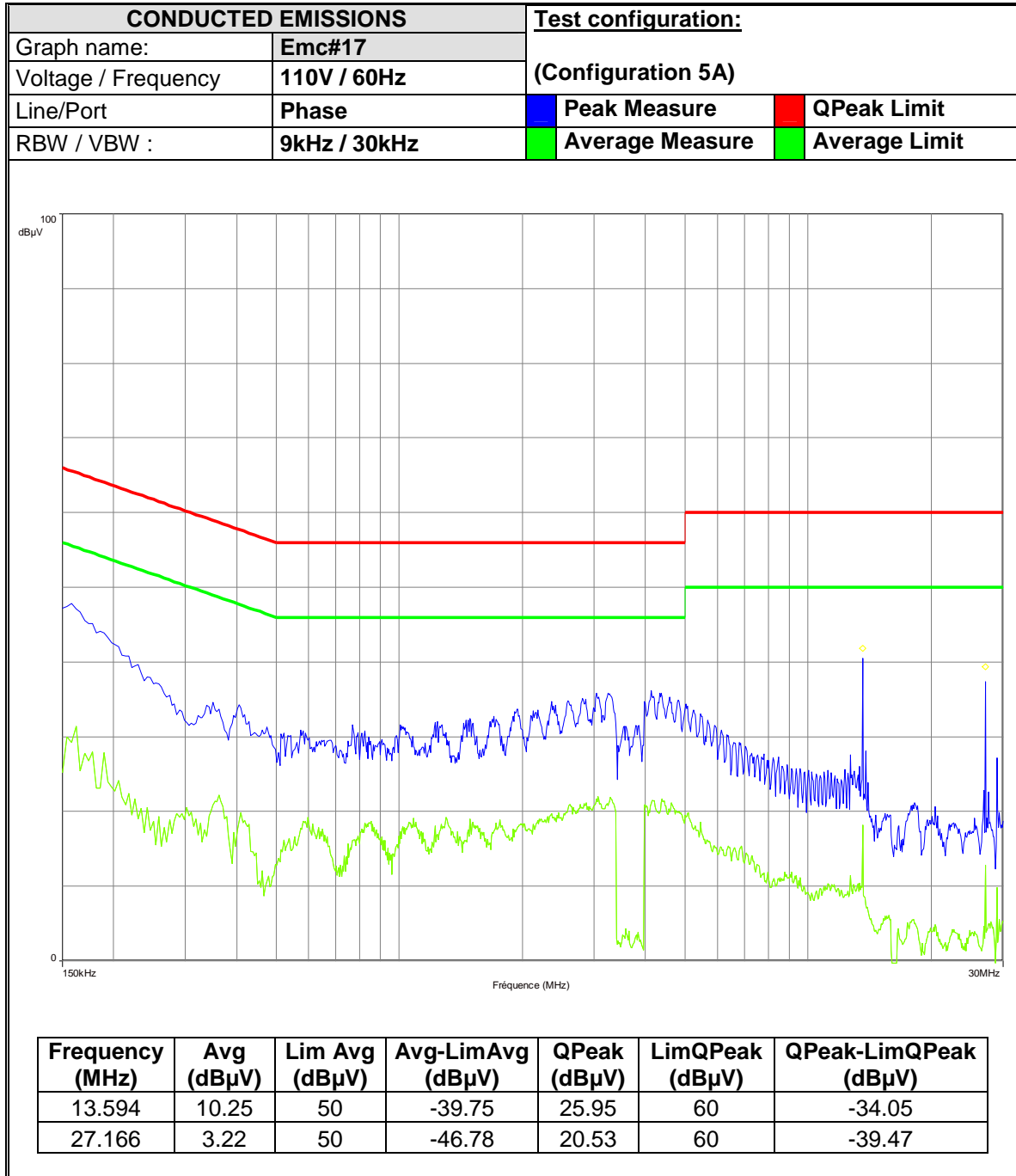


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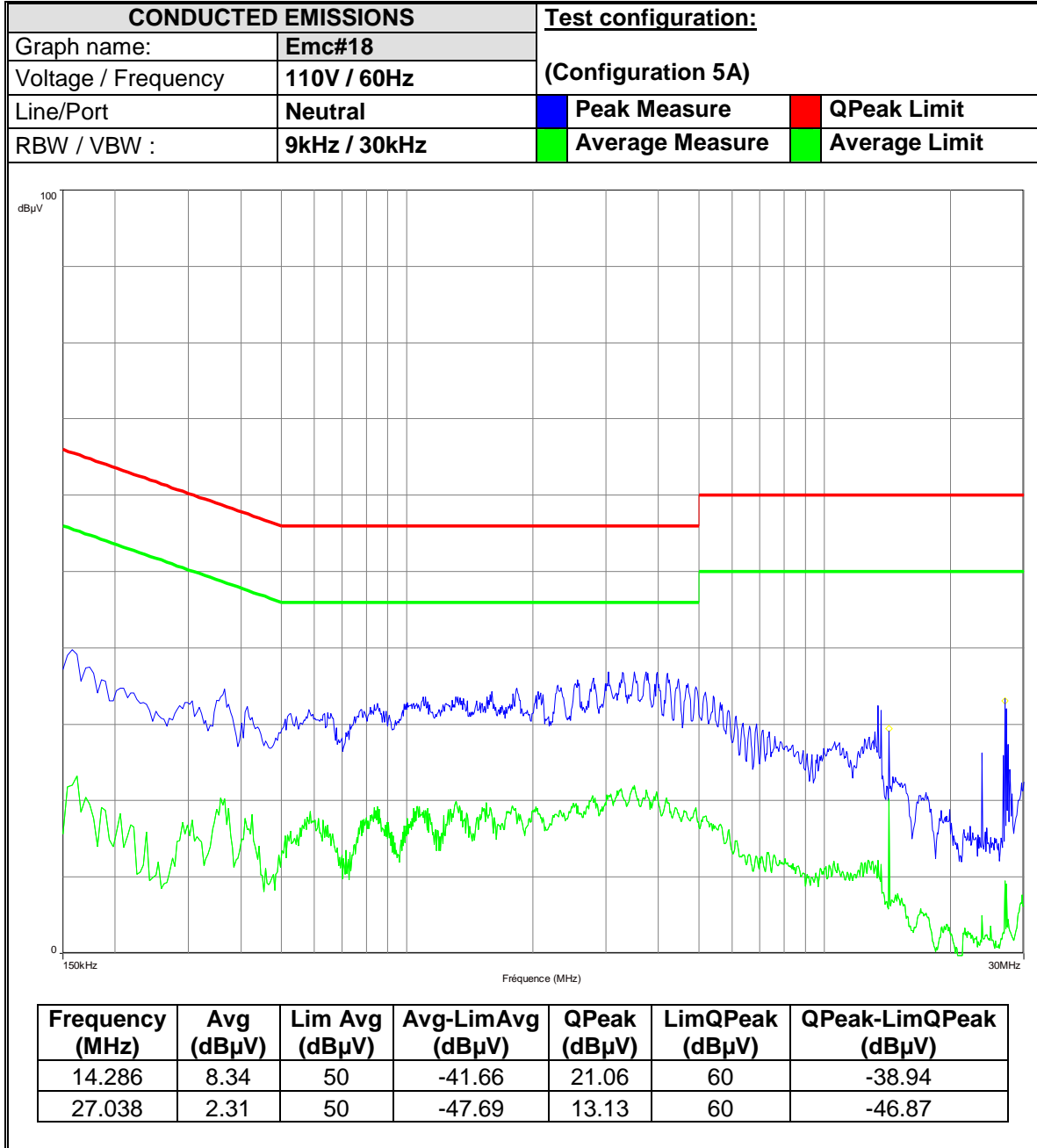


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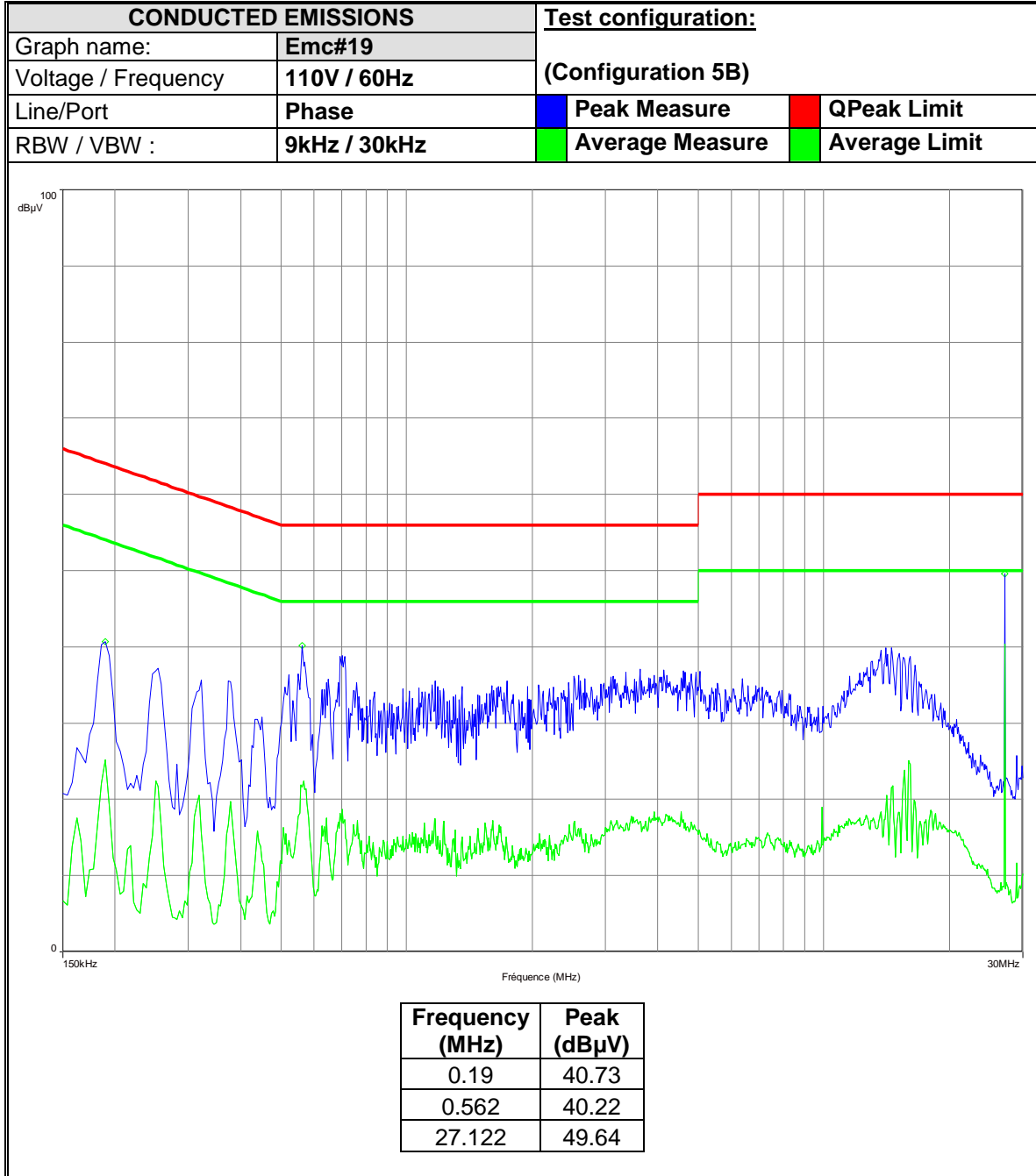


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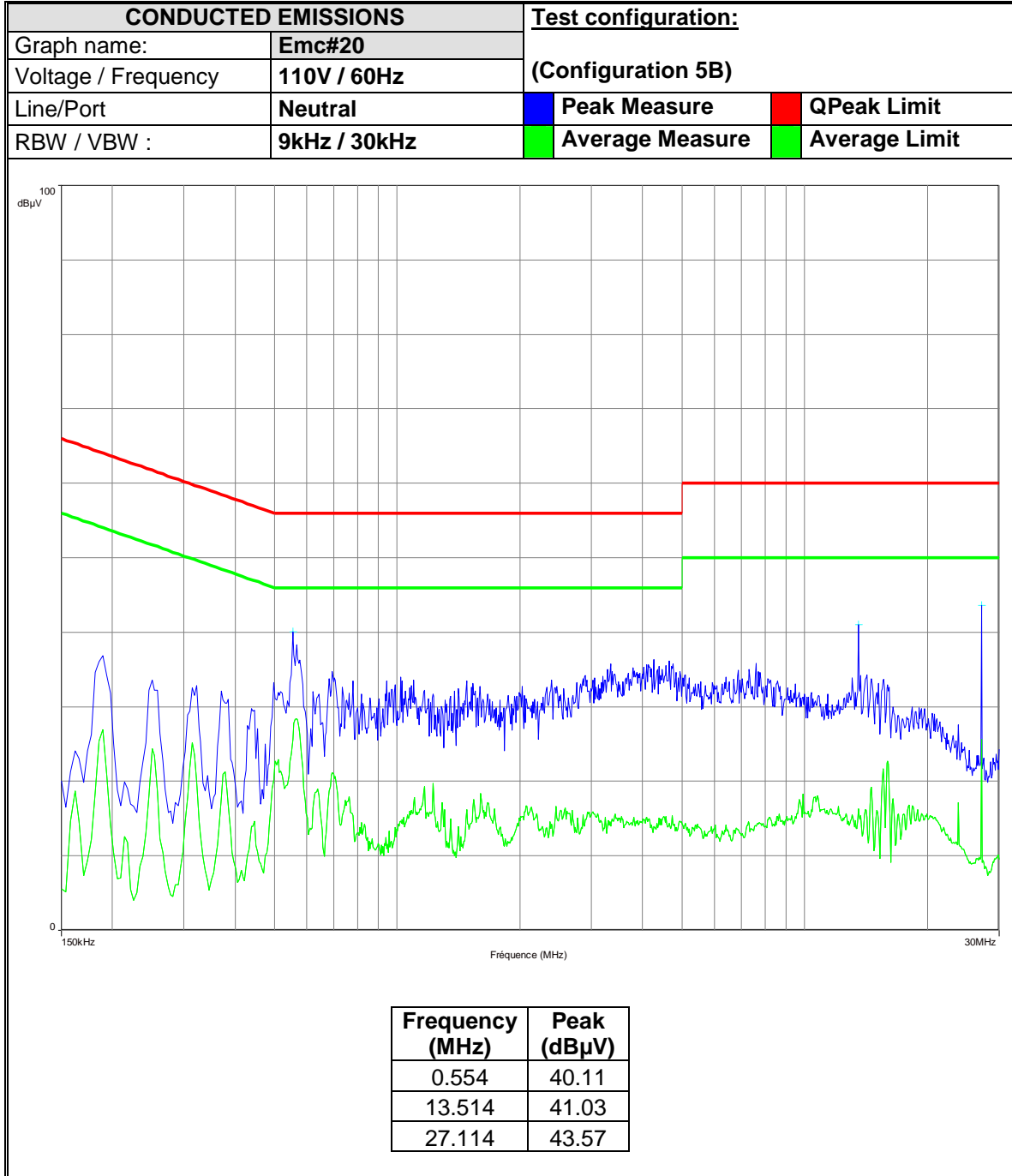
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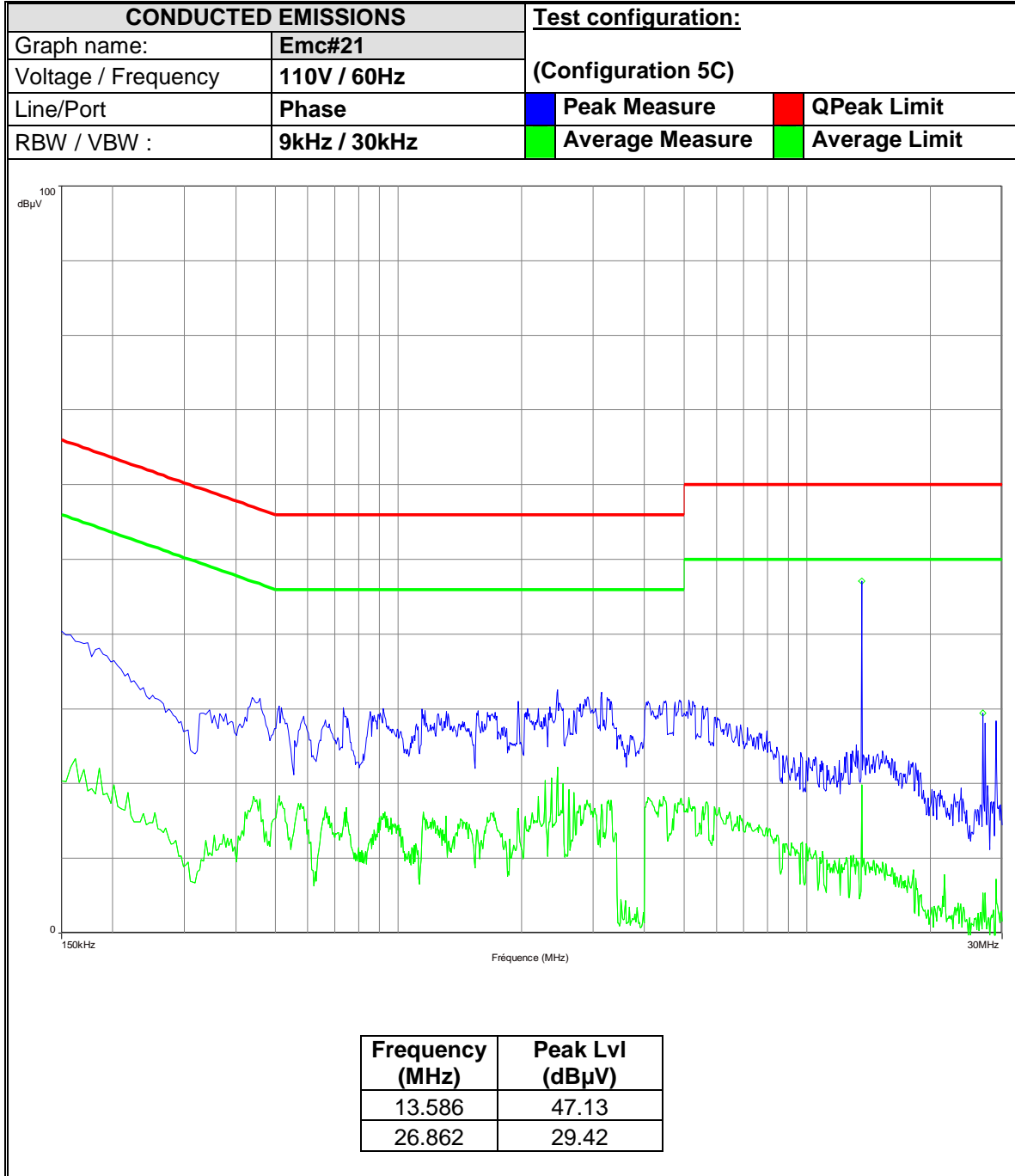


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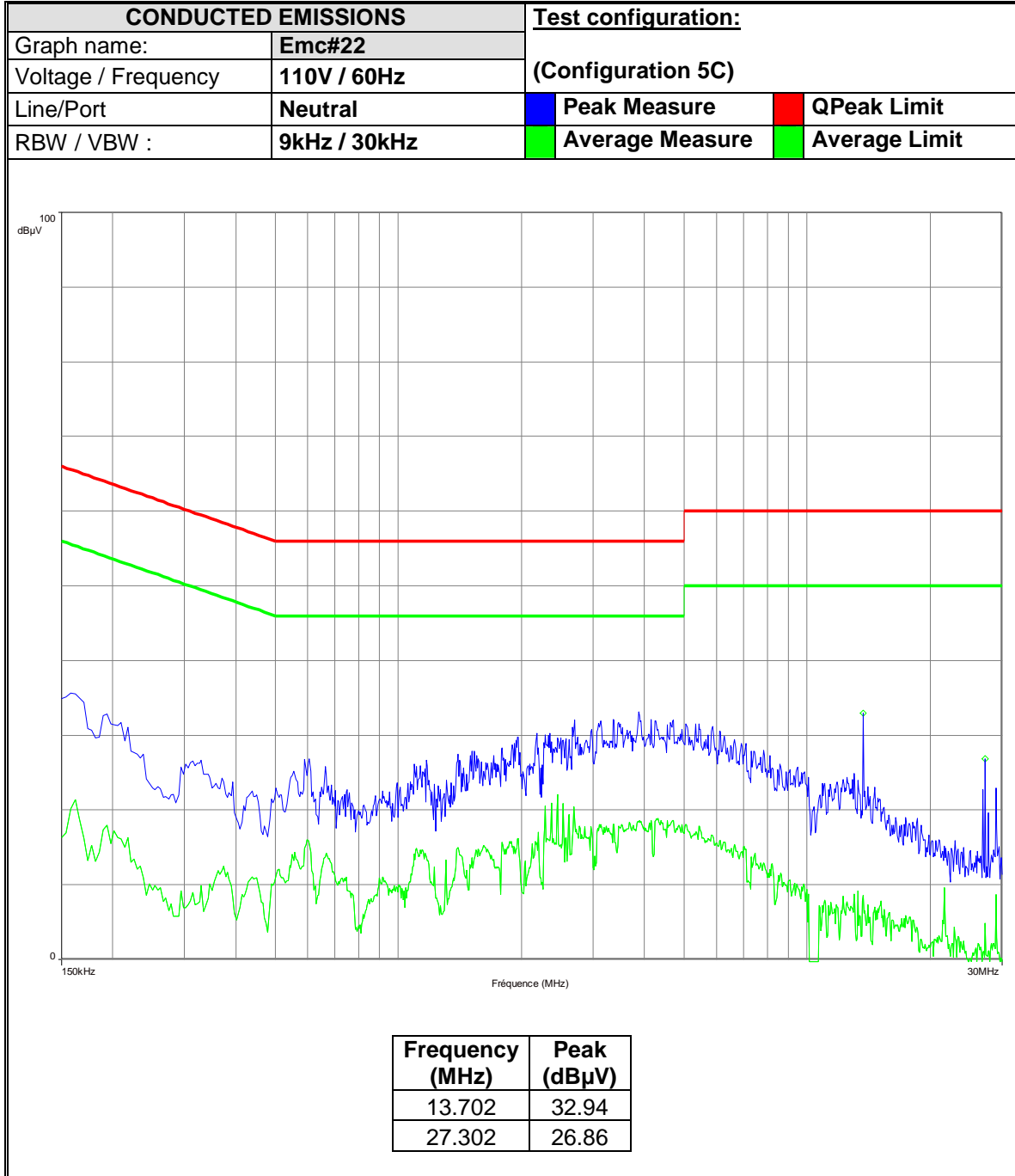


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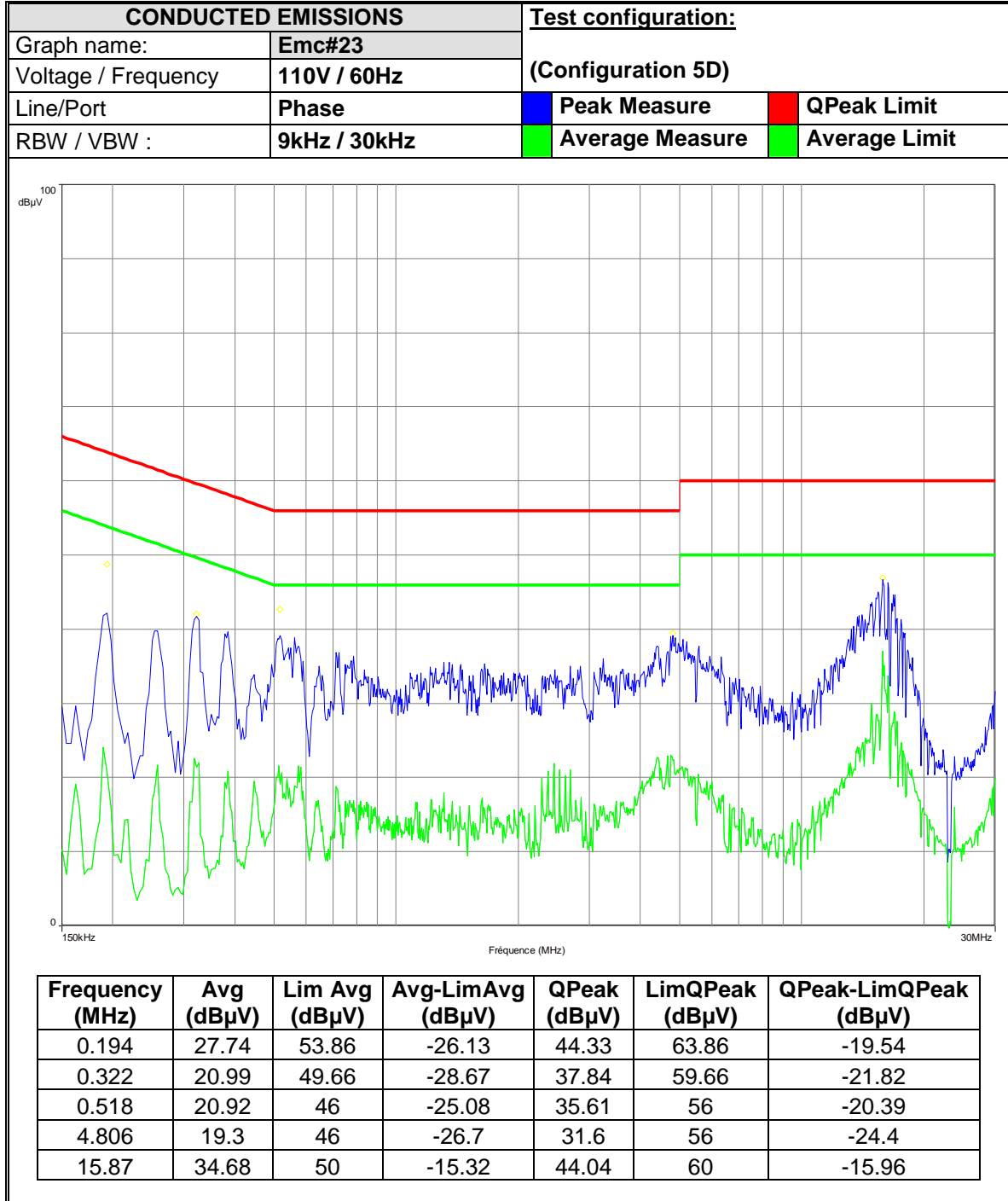


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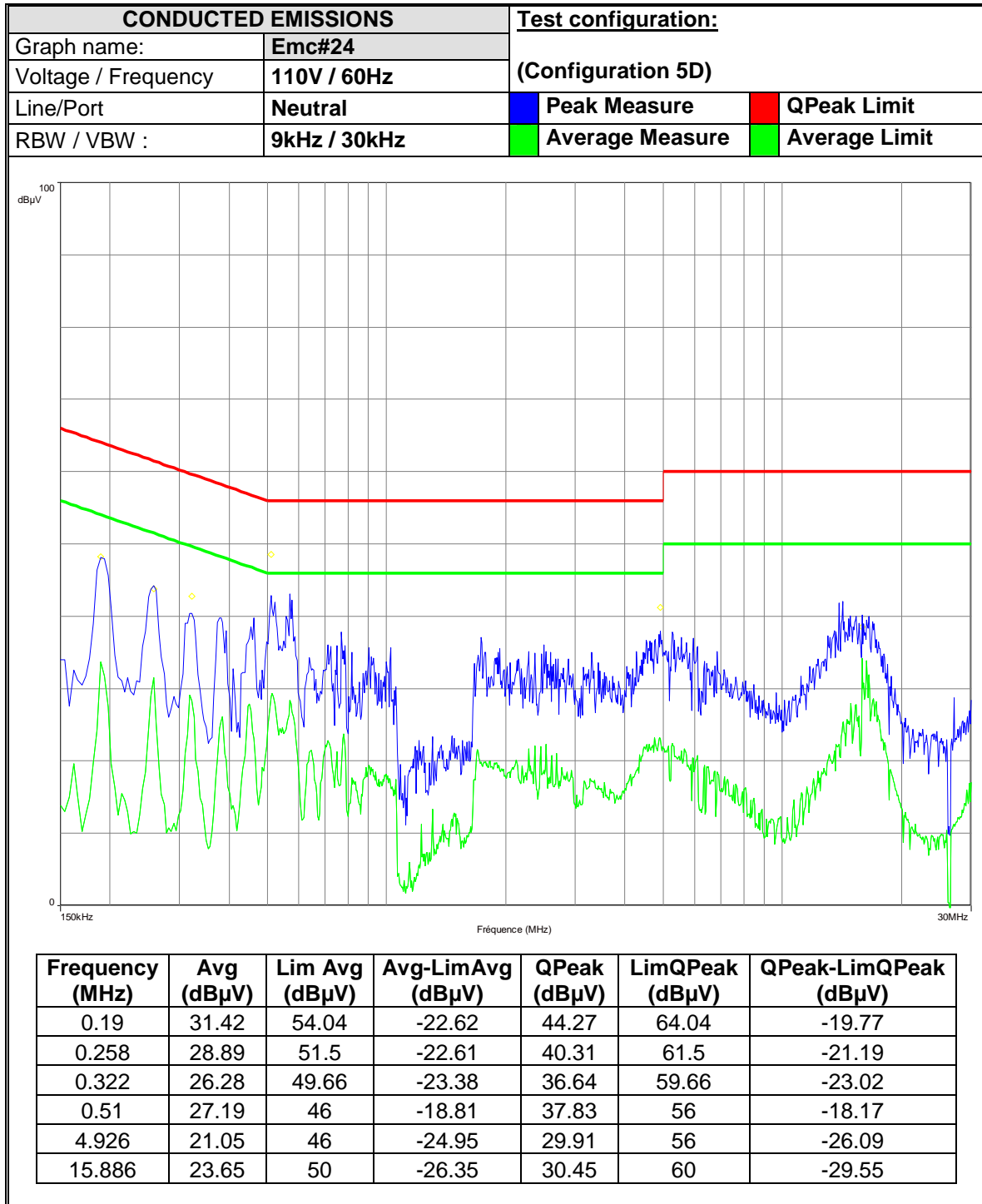


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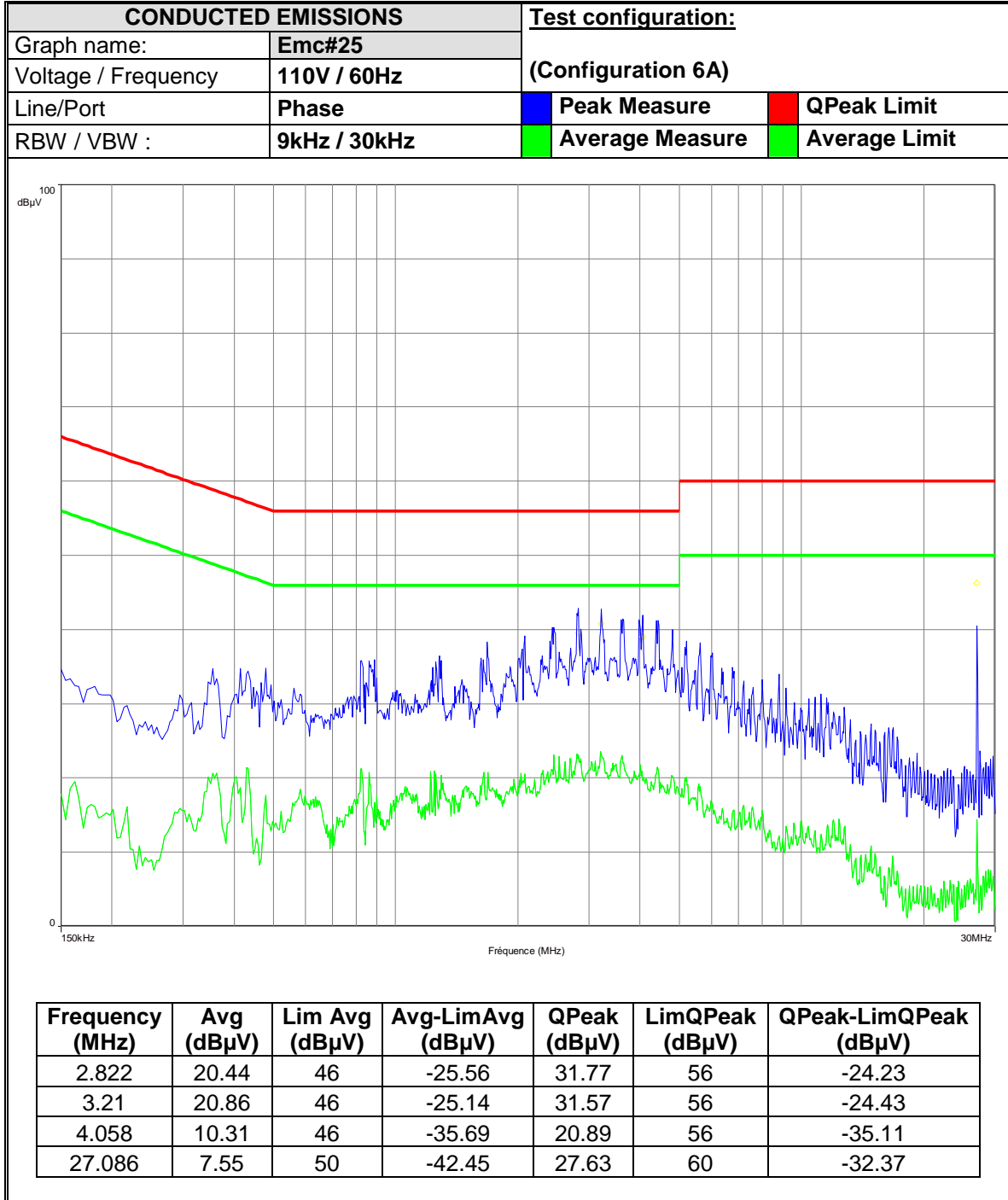


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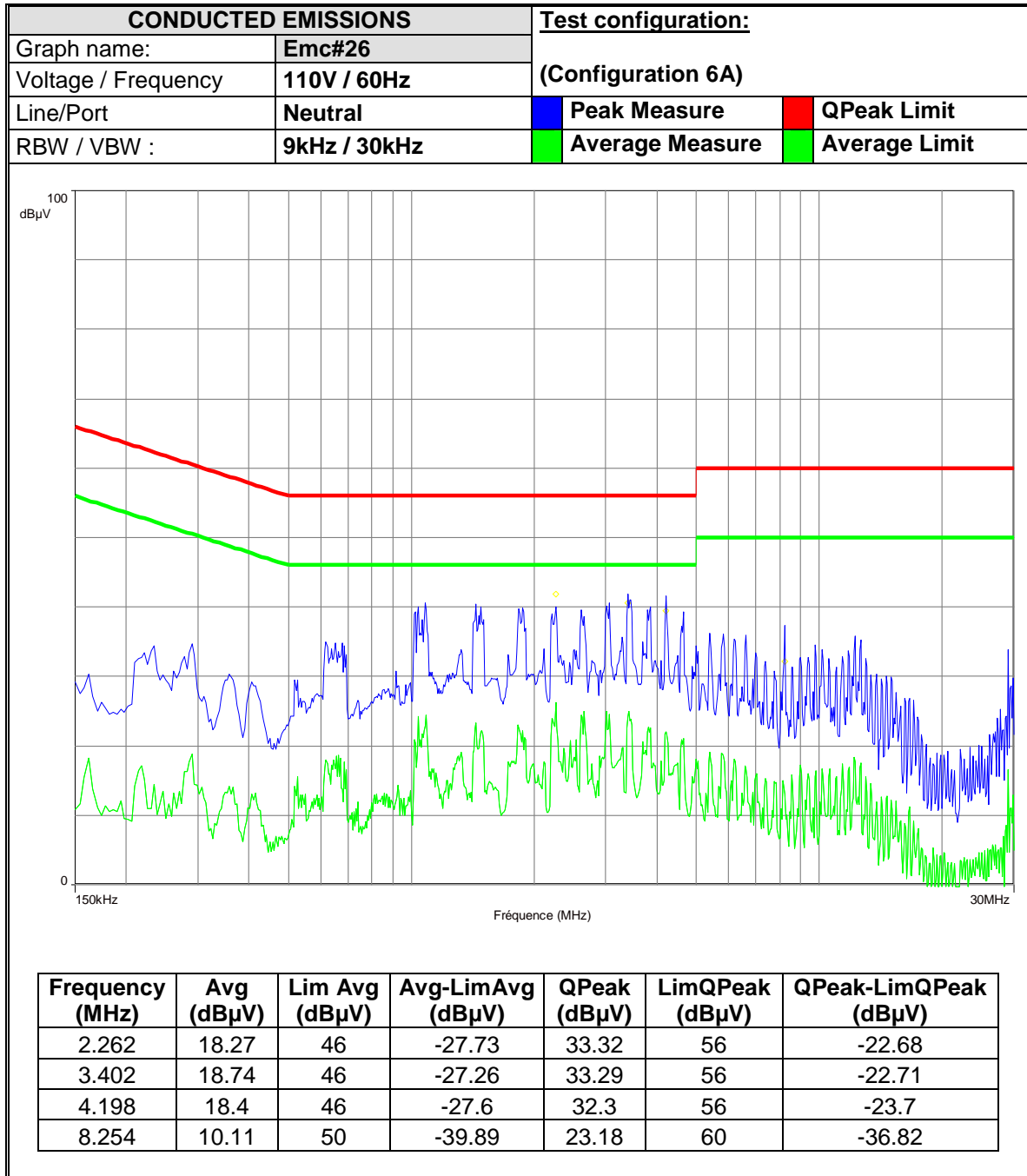


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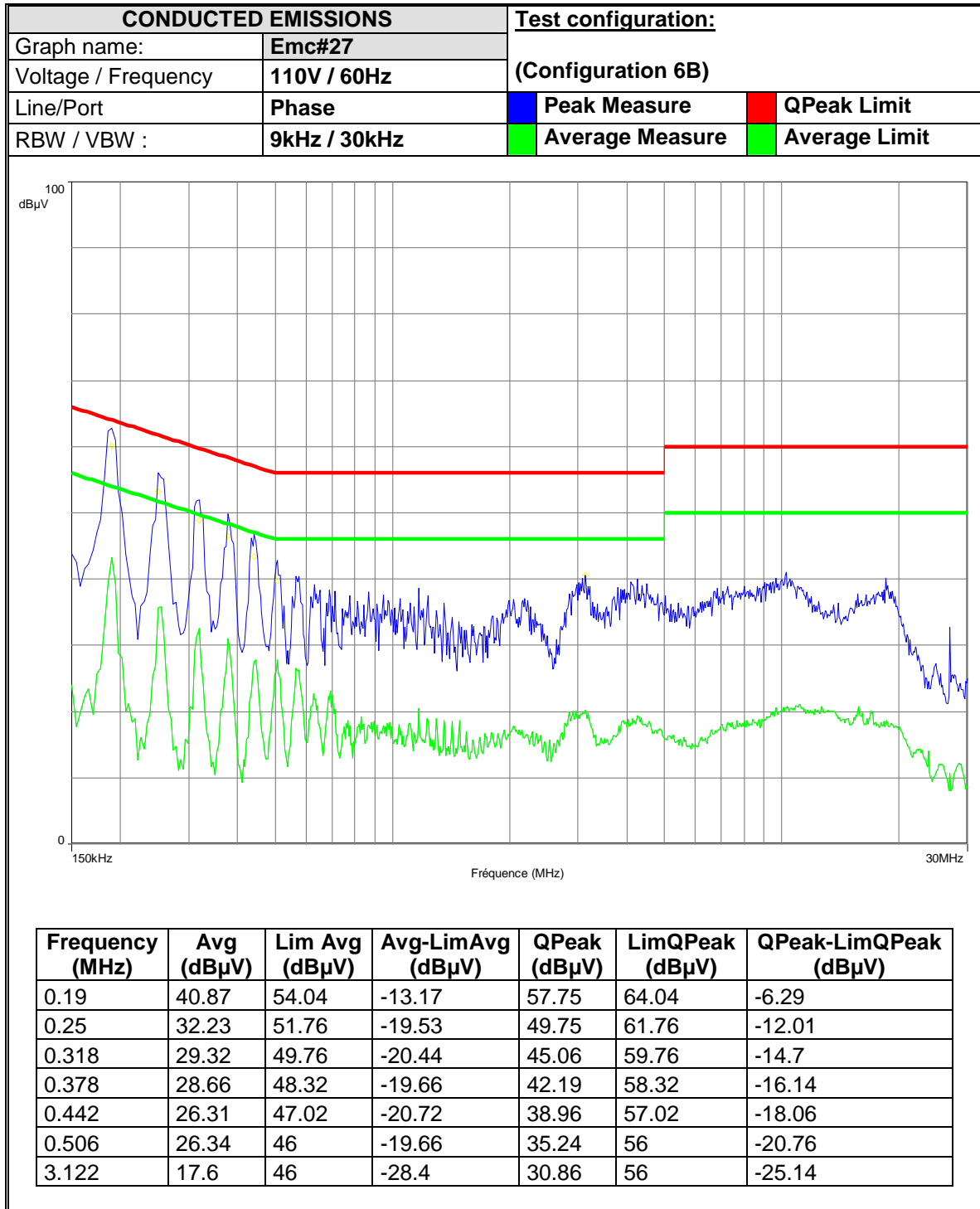


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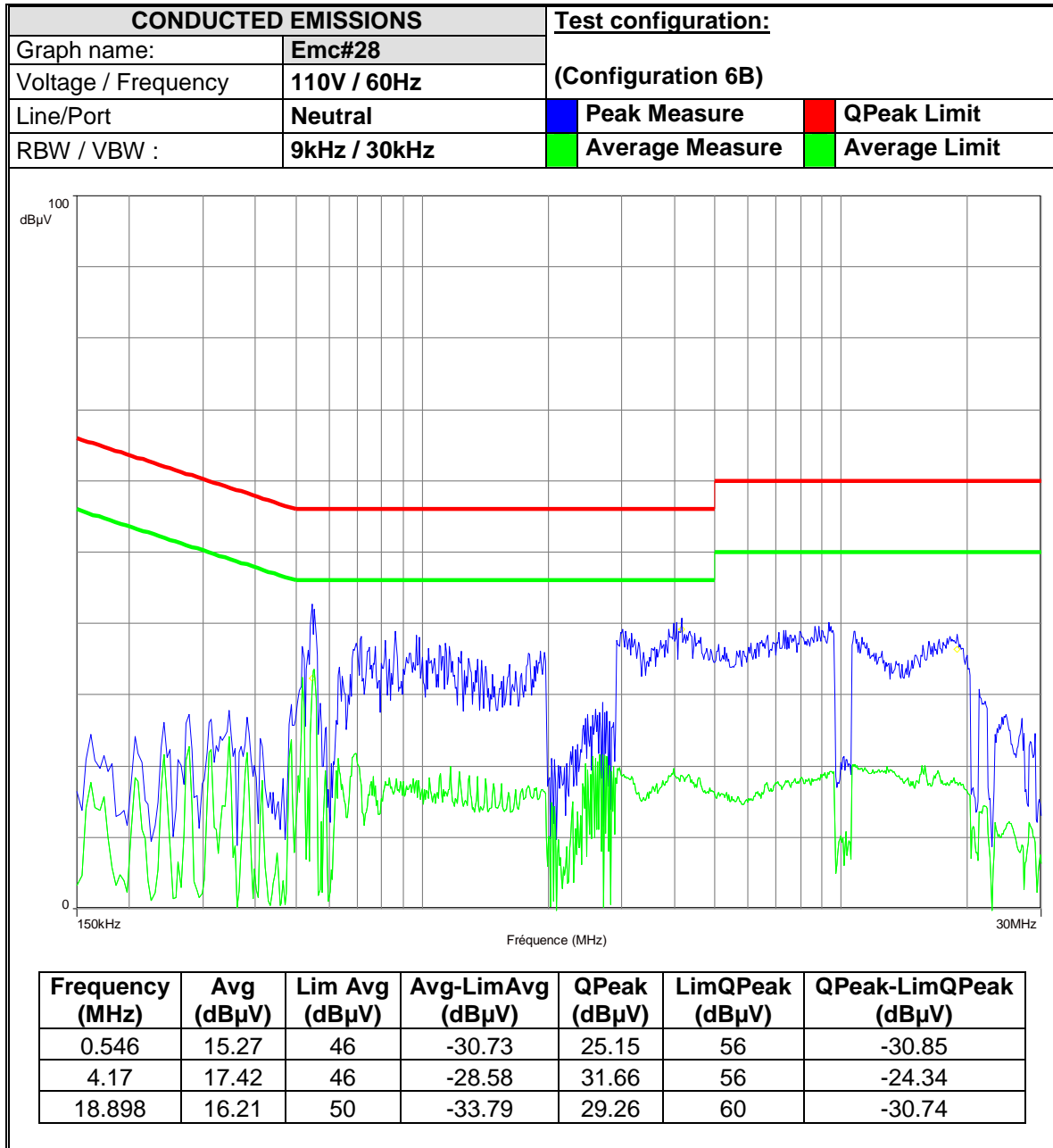
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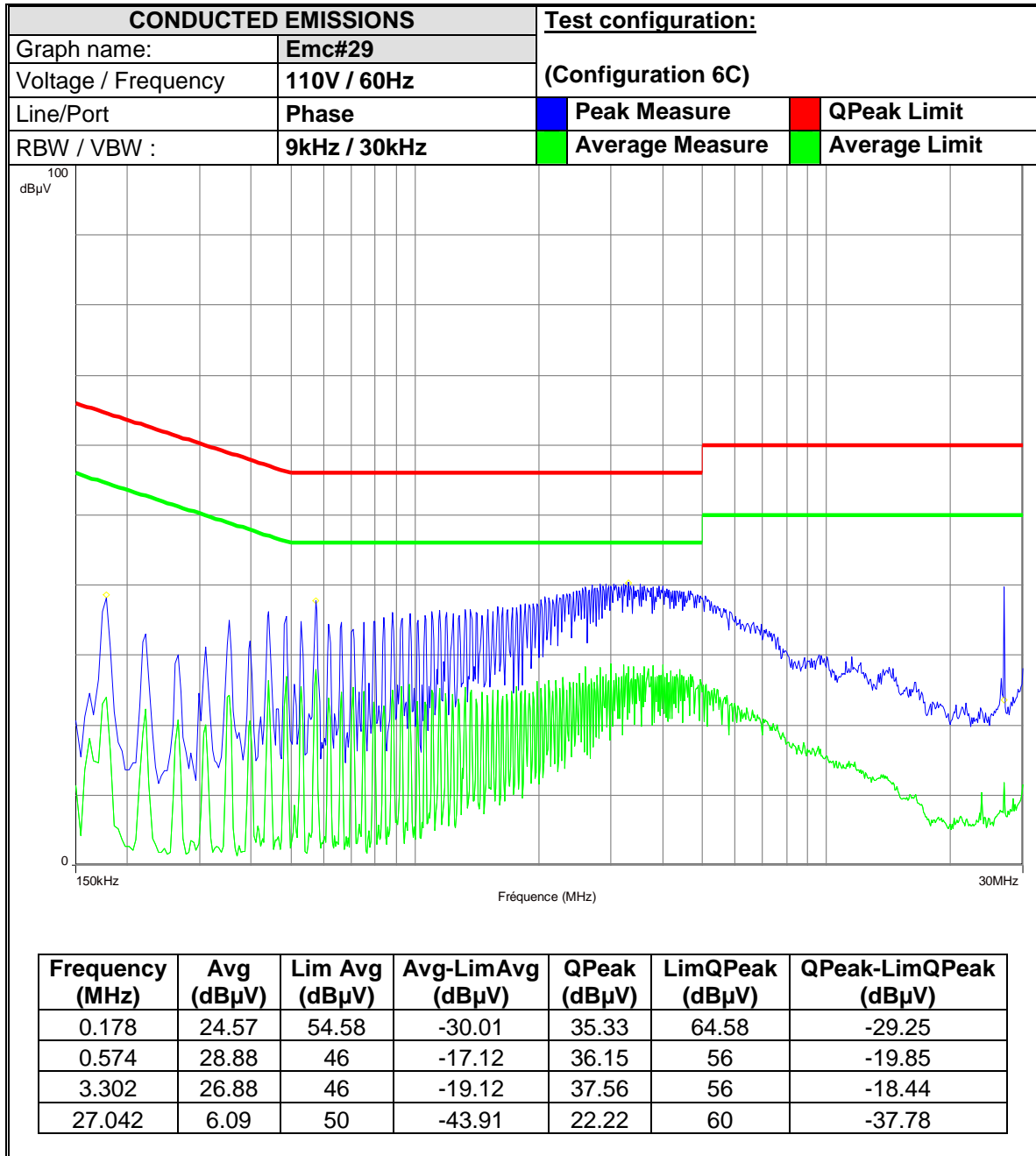


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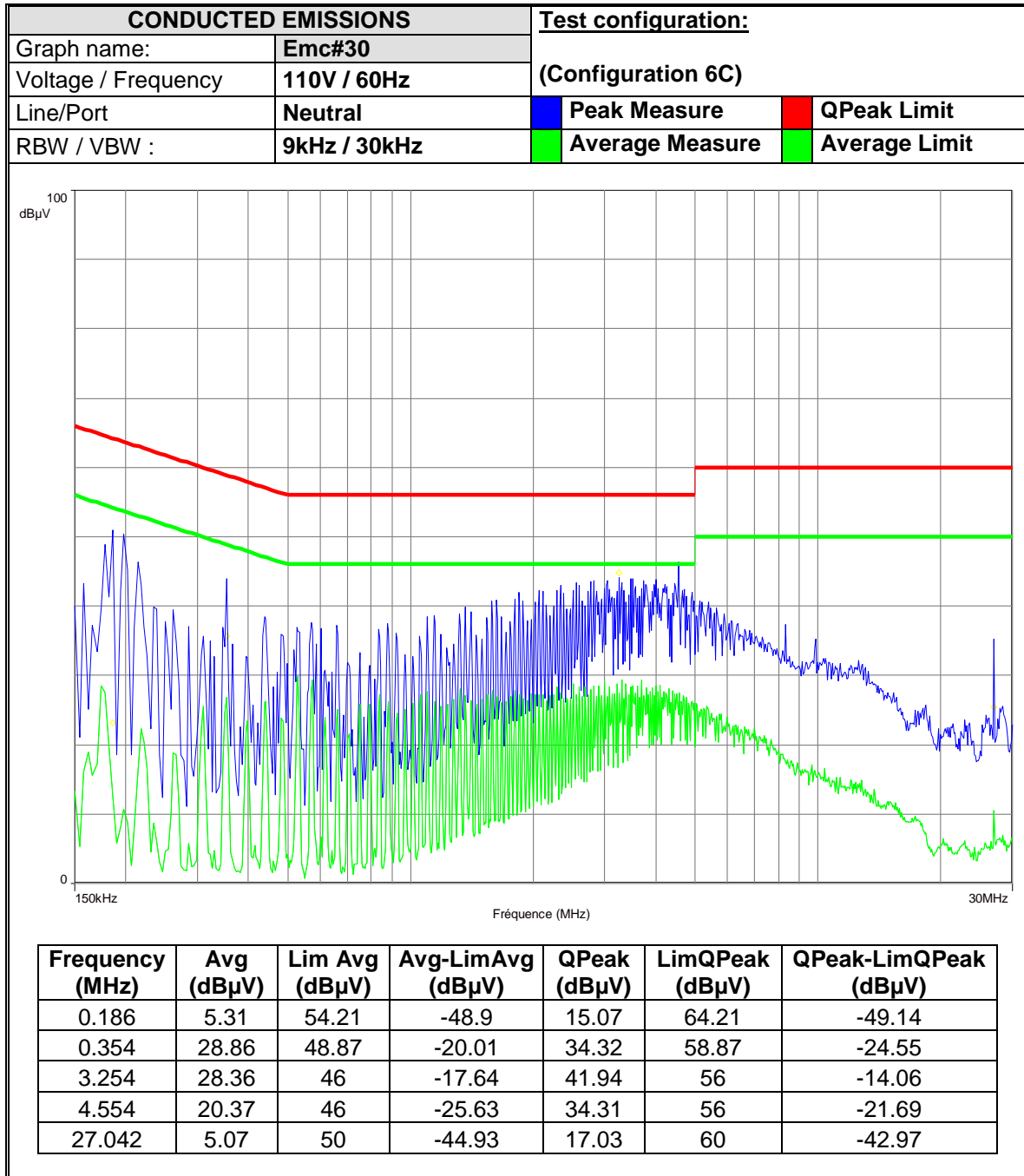


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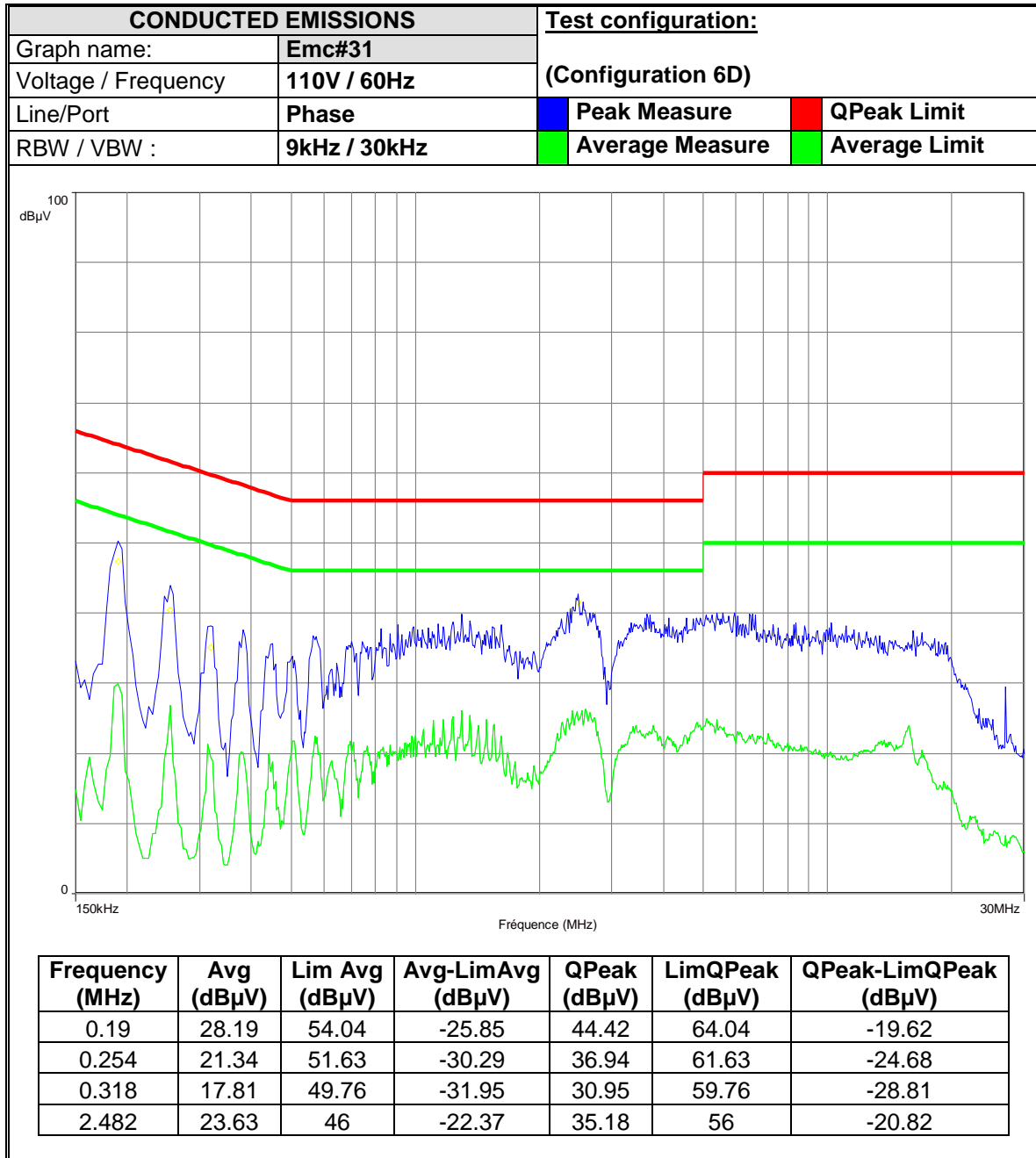


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