EMITECH GROUPE

RC-030-PTC-11-102855-4-A

E.M.C. PARTIAL TESTS REPORT

According to the standard:
FCC part 15 : 2013

Equipment under test:
WIRELESS TRANSMISSION RELAY (915 MHz module)
MODEL: TA-SCOPE RELAY

Company:
TA HYDRONICS

FCC Listed: 910 701

Distribution: Mr CHARLES **(Company:** TA HYDRONICS)

Number of pages: 40 with 6 annexes

Ed.	Date	Modified page(s)	Written by Name / Visa	Technical Verification and Quality Approval Name / Visa
0	03/02/14	Creation	F. LHEUREUX FL	B. Pellerin

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This document is the result of testing a specimen or a sample of the product submitted. It does not imply an assessment of the conformity of the whole production of the item tested.

NAME OF THE EQUIPMENT UNDER TEST (E.U.T.)	:	LDMS Project
Serial number	:	TX: SN 80010 RX: SN80011
Part number	:	Not communicated
Software Version	:	LDMS 0.6
MANUFACTURER'S NAME	:	TA HYDRONICS

APPLICANT'S ADDRESS:

Company	:	TA HYDRONICS
Address	:	Chaussée de Huy, 212 B-1325 CHAUMONT-GISTOUX BELGIUM
Person present during the tests	:	Mr CHARLES
Responsible	:	Mr CHARLES

DATE OF TESTS	:	18/11/2013 and 31/01/204
TESTS LOCATIONS	:	EMITECH Laboratory of Montigny-Le-Bretonneux (78) and Open area test site of Aunainville (28) - FRANCE
TESTS SUPERVISOR	:	-
TESTS OPERATOR	:	F. LHEUREUX

CONTENTS

1. INTRODUCTION

This document submits the results of Electromagnetic Compatibility tests performed on the equipment « WIRELESS TRANSMISSION RELAY (915 MHz module) MODEL: TA-SCOPE RELAY» (denominated hereafter E.U.T.: equipment under test) according to documents listed below.

2. REFERENCE DOCUMENTS

FCC part 15 Edition 2013
Code of federal regulations.
Title 47 - Telecommunication.
Chapter 1 - Federal communication commission.
Part 15 - Radio frequency devices.
Subpart B - Unintentional radiators.
Limits and methods of measurement of radio disturbance. Characteristic of information technology equipment.

ANSI C63.4 (2003)
Methods of Measurement of Radio-Noise Emissions from Low- voltage Electrical and Electronics Equipment in the range of 9 kHz to 40 GHz.

Public Notice DA 00-705
Filing and Measurement Guideline for Frequency Hopping Spread Spectrum Systems.

3. TEST METHODOLOGY

Radio performance tests procedures given in CFR 47 part 15:

Subpart B –Unintentional Radiators
- Paragraph 107: Conducted limits
- Paragraph 109: Radiated emission limits
- Paragraph 111: Antenna power conduction limits for receivers

Subpart C – Intentional Radiators
- Paragraph 203: Antenna requirement
- Paragraph 205: Restricted bands of operation
- Paragraph 207: Conducted limits
- Paragraph 209: Radiated emission limits; general requirements
- Paragraph 212: Modular transmitter
- Paragraph 215: Additional provisions to the general radiated emission limitations
- Paragraph 247: Operation within the bands 902-928 MHZ, 2400-2483.5 MHz and 5725-5850 MHz

4. SUMMARY OF TESTS RESULTS

The following table summarizes test results of the EUT.

Subpart B of the standard FCC part 15 – Unintentional radiators

Test procedure	Designation of test	Test results				Comments
		Pass	Fail	N.A.	N.P.	
15.107	Measurement of conducted emission on AC mains ports	X				
15.109	Radiated emission limits	X				

Subpart C of the standard FCC part 15 – Intentional radiators

Test procedure	Designation of test	Test results				Comments
		Pass	Fail	N.A.	N.P.	
15.203	Antenna Requirement	X				Note 1
15.205	Restricted bands of operation	X				
15.207	Measurement of conducted emission on AC mains ports	X				
15.209	Radiated emission limits; general requirements	X				*Note 2*
15.215	Additional provisions to the general radiated emission limitations					
	(a) Alternative to general radiated emission limits	X				
	(b) Unwanted emissions outside of § 15.247 frequency bands	X				*Note 3*
	(c) 20 dB bandwidth and band-edge compliance			X		
15.247	Intentional radiated emissions					
	a) frequency hopping and digitally modulated					
	a) (1) hopping mode	X				*Note 4*
	a) (1) (i) frequency hopping in the band 902-928 MHz	X				*Note 4*
	a) (1) (ii) frequency hopping in the band 5725–5850 MHz			X		
	a) (1) (iii) frequency hopping in the band 2400–2483.5 MHz			X		

Test procedure	Designation of test	Test results				Comments
		Pass	Fail	N.A.	N.P.	
	a) (2) systems using digital modulation in the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz (6 dB bandwith)			X		
	b) maximum peak conducted					
	b) (1) frequency hopping in the bands 2400–2483.5 MHz or 5725–5850 MHz			X		
	b) (2) frequency hopping in the band 902-928 MHz	X				Note 5
	b) (3) systems using digital modulation in the bands 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz			X		
	b) (4) maximum peak conducted > 6 dBi					
	b) (4) (i) frequency hopping in the band 2400–2483.5 MHz			X		
	b) (4) (ii) frequency hopping in the band 5725–5850 MHz			X		
	b) (4) (iii) fixed, point-to-point			X		
	c) directional antenna > 6 dBi					
	c) (1) fixed, point-to-point operation					
	c) (1) (i) in the band 2400–2483.5 MHz			X		
	c) (1) (ii) in the band 5725–5850 MHz			X		
	c) (1) (iii) fixed, point-to-point			X		
	c) (2) multiple directional beams in the band 2400–2483.5 MHz					
	c) (2) (i) information			X		
	c) (2) (ii) sum of the power supplied to all antennas			X		
	c) (2) (iii) one antenna for multiple directional beams			X		
	c) (2) (iv) single directional beam			X		
	d) intentional radiator	X				
	e) peak power spectral density			X		
	f) hybrid system			X		
	g) continuous data stream during the test			X		
	h) to avoid hopping on occupied channels			X		
	i) RF exposure compliance			X		P < 500 mW

N.A.: Not Applicable
N.P.: Not Performed

Note 1: Integrated antenna.

Note 2: See FCC part 15.207 (d).

Note 3: See FCC part 15.209. Unwanted emissions levels are all below the fundamental emission field strength level.

Note 4: The system hops to channel frequencies from a pseudo randomly ordered list of hopping frequencies.
Each frequency is used equally on the average by the transmitter, and separated by a minimum of 20 dB bandwidth of the hopping channel (269 kHz; see annex 6).

The frequency hopping system uses 48 channels

The timing by channel is 11.6 ms (see annex 6).

During 10 s, any channel is used 7 times (see appendix 6), then 7 x 11.6 ms =81.2 ms, thus the average time of occupancy on any channel is less than 400 ms within a period of 10 seconds in normal operating mode.

Note 5: Conducted measurement is not possible (integral antenna), so we used the radiated method in open field.

Sample subject to the test complies with prescritions of the standard:

- FCC part 15 : 2013

According to limits, specified in this test report.

To declare or not compliance with the specification, it has not been given explicit account of the uncertainty associated with result(s).

5. CONDUCTED EMISSION

Standard: FCC Part 15 : 2013

Sections: § 107, 207

Test configuration:

Tested cable	Measure with	E.U.T. height
Power supply 115 Vac / 60 Hz	L.S.I.N.	80 cm

Frequencies band	Tested cable	Resolution bandwidth	Video bandwidth	Detection mode
150 kHz - 1 MHz	Power supply 115 Vac / 60 Hz	10 kHz	30 kHz	Peak
1 MHz - 30 MHz	Power supply 115 Vac / 60 Hz	10 kHz	30 kHz	Peak

Test method deviation: No

Test equipment list:

CATEGORY	BRAND	TYPE	Nr EMITECH
Cable	Cables & Connectiques	N-4m	2809
Limiter	Hewlett Packard	11947A	0240
LISN	Rohde & Schwarz	ESH2-Z5	0326
QP adapter	Hewlett Packard	HP 85650 A	0826
Receiver	Hewlett Packard	HP 8568 A	0822
Software	Nexio	BAT EMC v3.5.0.2	0000
Test enclosure	Emitech	JD	1804

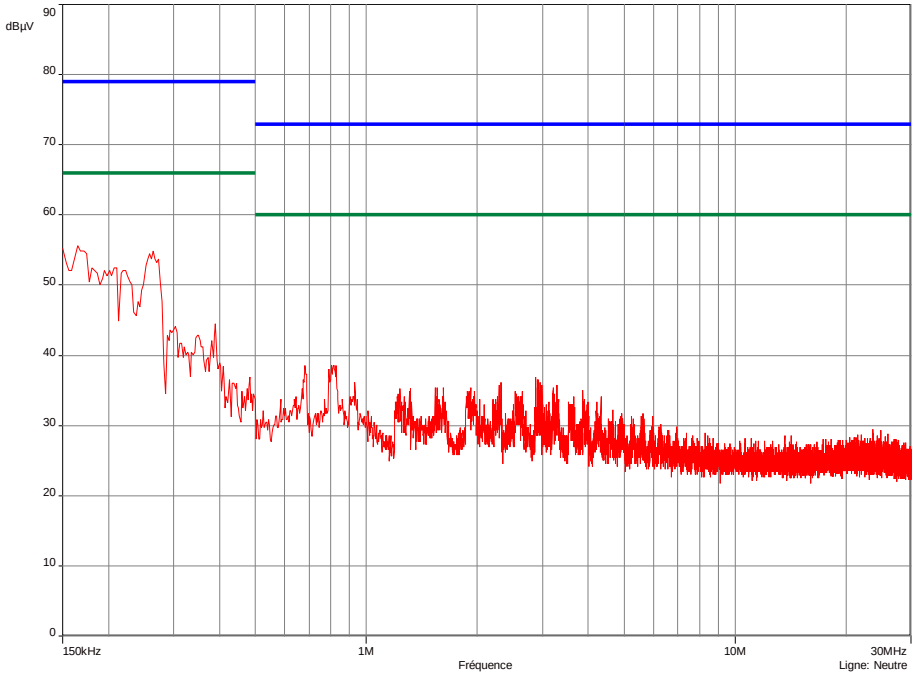
Results:

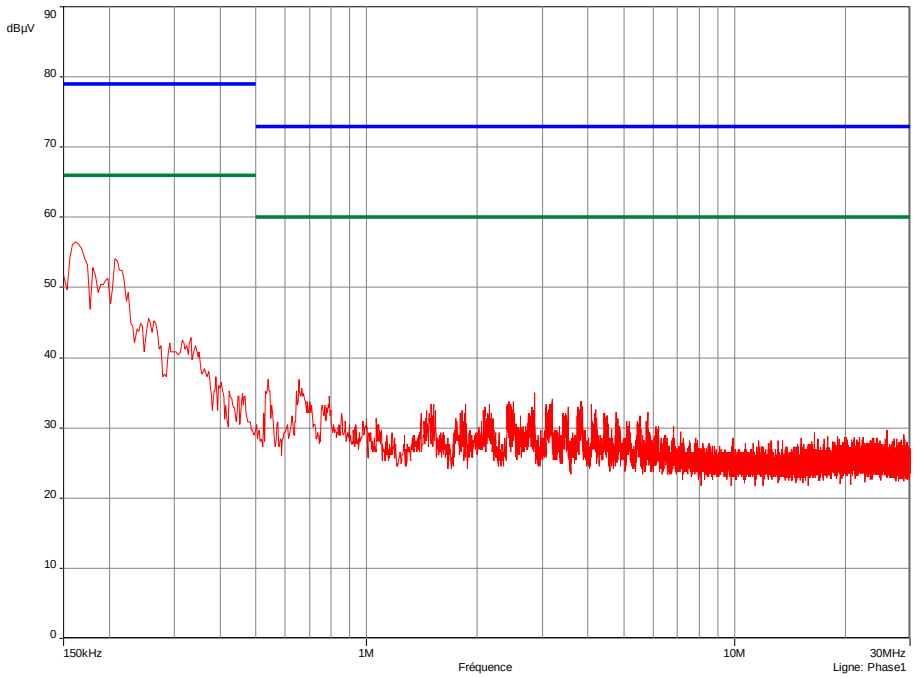
See curves hereafter. Limits on the curves are average limit (green) and quasi-peak limit (blue).

Curves 1 and 2

LDMS project

Conducted voltage emission (measurement): power supply 115 Vac / 60 Hz in peak detection





6. *UNINTENTIONAL RADIATED EMISSIONS AND TRANSMITTER UNWANTED EMISSION IN THE BAND 9 kHz – 10 GHz*

Standard: FCC PART 15 : 2013

Sections: §15.109; 15.205; 15.215; 15.209 and 15.247

Equipment under test arrangement:

The equipment under test (EUT) is placed on a non-conductive test table at 0.8 m above the horizontal metal ground plane.

For maximum meter reading at each frequency, the antenna height is adjusted between 1 m and 4 m above the ground plane. A 360 degrees rotation of the EUT is performed in vertical and horizontal polarization. The frequency azimuth and antenna height are presented in the table on the next pages.

The E.U.T. is blocked in continuous transmission.

Frequency range: 9 kHz – 30 MHz
30 MHz - 1 GHz
1 GHz – 10 GHz

Detection mode: Quasi-peak for 9 kHz – 30 MHz
Quasi-peak for 30 MHz - 1 GHz
Average for 1 GHz – 10 GHz

Resolution bandwidth: 200 Hz for 9 kHz – 150 kHz
9 kHz for 150 kHz – 30 MHz
120 kHz for 30 MHz - 1 GHz
1 MHz for 1 GHz – 10 GHz

Measurement distance: 30 meters from 9 kHz to 30 MHz
3 meters from 30 MHz to 10 GHz

From 9 kHz to 30 MHz

Frequency range	Limit µV/m
9 – 490 kHz	2400/F (F in kHz) *
490 – 1705 kHz	24000/F (F in kHz)
1.705 – 30 MHz	30

* Limits in µV/m can be extrapolated to 30 m using 20 dB / decade.

From 30 MHz to 10 GHz

Frequency range (MHz)	Limit (dBµV/m)	µV/m
30 to 88	40.0	100
88 to 216	43.5	150
216 to 960	46.0	200
Above 960	54.0	500

Instrumentation test list:

CATEGORY	BRAND	TYPE	Nr EMITECH
Antenna	Schwarzbeck	Biconique VHA9103	0317
Antenna	Oritel	Cornet CM 42-25	1045
Antenna	Schwarzbeck	Log-périodique UHALP 9108	3106
Antenna	Emco	Cornet 3115	3374
Antenna	EMCO	Cadre Emco 6502	9579
Antenna mast	Maturo	AM 4.0-O	7625
Antenna mast	Maturo	MCU	7626
Cable	Câbles & Connectiques	N-13m	2452
Cable	-	N-2m	2805
Cable	Câbles & Connectiques	N-SMA	2864
Cable	-	N-30m	4359
Cable	-	N-8m	8021
Cable	Micro-Coax	N-13m	8063
Cable	C&C	N-15m	10229
Filter	Trilithic	Passe haut	1097
Filter	Micro-tronics	Passe haut	4691
Filtet	Trilithic	Passe haut	1529
Open area test site	Emitech	Site champ libre	0187
Preamplifier	Mini-Circuits	RF	0048
Preamplifier	MITEQ	HF	3229
Spectrum analyzer	Rohde & Schwarz	R&S FSP40	5175

Results:

Ambient temperature (°C): 06
Relative humidity (%): 92

Low channel:

FREQUENCY (MHz)	POLARIZATION	ANTENNA HEIGHT (cm)	AZIMUT (degrees)	MEASURE (dBµV/m)	LIMIT (dBµV/m)	Margin (dB)
149.926	V	100	193	40.4	43.5*	3.1
229.212	V	172	0	40.2	95.7	55.5
932.231	V	118	353	41.6	95.7	54.1
1805.54	V	215	165	60.9	95.7	34.8
1805.54	H	130	30	63.0	95.7	32.7
2708.33	V	230	317	52.7	54.0*	1.3
2708.33	H	130	43	53.5	54.0*	0.5
3610.98	V	112	317	53.0	54.0*	1.0
3610.98	H	115	270	52.3	54.0*	1.7
4513.85	V	270	0	44.6	54.0*	9.4
4513.85	H	155	0	44.7	54.0*	9.3

V: Vertical H: Horizontal

Middle channel:

FREQUENCY (MHz)	POLARIZATION	ANTENNA HEIGHT (cm)	AZIMUT (degrees)	MEASURE (dBµV/m)	LIMIT (dBµV/m)	Margin (dB)
149.926	V	100	193	40.4	43.5*	3.1
229.212	V	172	0	40.2	95.7	55.5
932.231	V	118	353	41.6	95.7	54.1
1829.51	V	160	211	60.6	95.7	35.1
1829.51	H	160	207	61.7	95.7	34.0
2744.27	V	160	306	53.0	54.0*	1.0
2744.27	H	130	60	53.7	54.0*	0.3
3659.04	V	205	0	50.5	54.0*	3.5
3659.04	H	215	0	52.0	54.0*	2.0
4573.83	V	270	300	44.5	54.0*	9.5
4573.83	H	130	10	48.9	54.0*	5.1

V: Vertical H: Horizontal

High channel:

FREQUENCY (MHz)	POLARIZATION	ANTENNA HEIGHT (cm)	AZIMUT (degrees)	MEASURE (dBµV/m)	LIMIT (dBµV/m)	Margin (dB)
149.926	V	100	193	40.4	43.5*	3.1
229.212	V	172	0	40.2	95.7	55.5
932.231	V	118	353	41.6	95.7	54.1
1854.53	V	215	9	63.6	95.7	32.1
1854.53	H	120	25	64.6	95.7	31.1
2781.79	V	115	295	53.2	54.0*	0.8
2781.79	H	130	40	53.4	54.0*	0.6
3709.04	V	160	300	45.4	54.0*	8.6
3709.04	H	170	0	49.6	54.0*	4.4
4636.21	V	210	296	42.9	54.0*	11.1
4636.21	H	125	0	45.7	54.0*	8.3

V: Vertical H: Horizontal

* Restricted bands of operation in 15.205, this limit corresponding at the 15.209 section.

Applicable limits: 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.

The highest level recorded in a 100 kHz bandwidth is 115.7 dBµV/m.
So the applicable limit is 95.7 dBµV/m.
In addition, radiated emissions which fall in the restricted band, 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)).

Receiver mode:

FREQUENCY (MHz)	POLARIZATION	ANTENNA HEIGHT (cm)	AZIMUT (degrees)	MEASURE (dBµV/m)	LIMIT (dBµV/m)
33.183	V	100	325	33.2	40.0
41.116	V	100	118	37.3	40.0
142.675	V	105	176	39.8	43.5

V: Vertical H: Horizontal

7. ADDITIONAL PROVISIONS TO THE GENERAL RADIATED EMISSION LIMITATIONS

Standard: FCC Part 15 : 2013

Section: § 15.215

Instrumentation test list:

CATEGORY	BRAND	TYPE	Nr EMITECH
Antenna	Schwarzbeck	Log-périodique UHALP 9108	3106
Antenna mast	Maturo	AM 4.0-O	7625
Antenna mast	Maturo	MCU	7626
Cable	Câbles & Connectiques	N-13m	2452
Cable	-	N-2m	2805
Cable	Câbles & Connectiques	N-SMA	2864
Open area test site	Emitech	Site champ libre	187
Preamplifier	Mini-Circuits	RF	48
Spectrum analyzer	Rohde & Schwarz	R&S FSP40	5175

Test set up:

The equipment under test (EUT) is placed on a non-conducted test table at 0.8 m above the horizontal metal ground plane.
For maximum meter reading at each frequency, the antenna height is adjusted between 1 m and 4 m above the ground plane. A 360 degrees rotation of the EUT is performed in vertical and horizontal polarization.

Test operating condition of the equipment:

The equipment under test is blocked in continuous transmission mode.

Results:

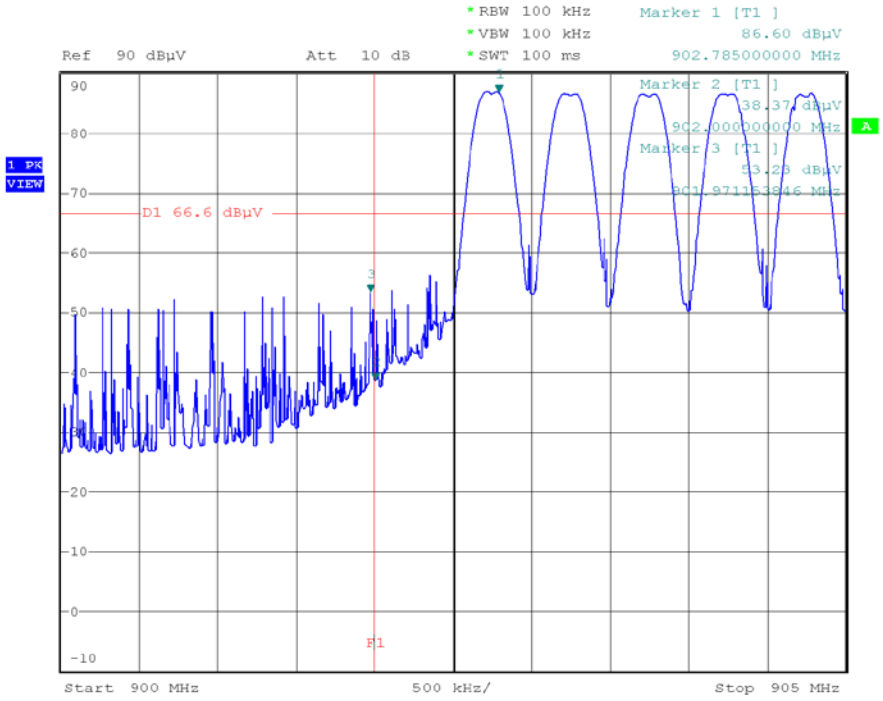
Ambient temperature (°C): 06
Relative humidity (%): 92

Fundamental frequency (MHz)	Field Strength Level of fundamental (dBµV/m)	Detector (Peak or Average)	Frequency of maximum Band-edges Emission (MHz)	Delta Marker (dB) *	Calculated Max Out of Band Emission Level (dBµV/m) **	Limits (dBµV/m)	Margin (dB)
902.785	115.7	Peak	901.971	-33.4	82.3	95.7	13.4
927.284	112.3	Peak	928.037	-35.3	77.0	92.3	15.3

* according to step 2 of Marker-Delta Method DA 00-705.
** according to step 3 of Marker-Delta Method :
Calculated Emission Level = Field Strength Level – Delta Marker Level

See occupied bandwidth graphs in following pages.

Test conclusion: RESPECTED STANDARD



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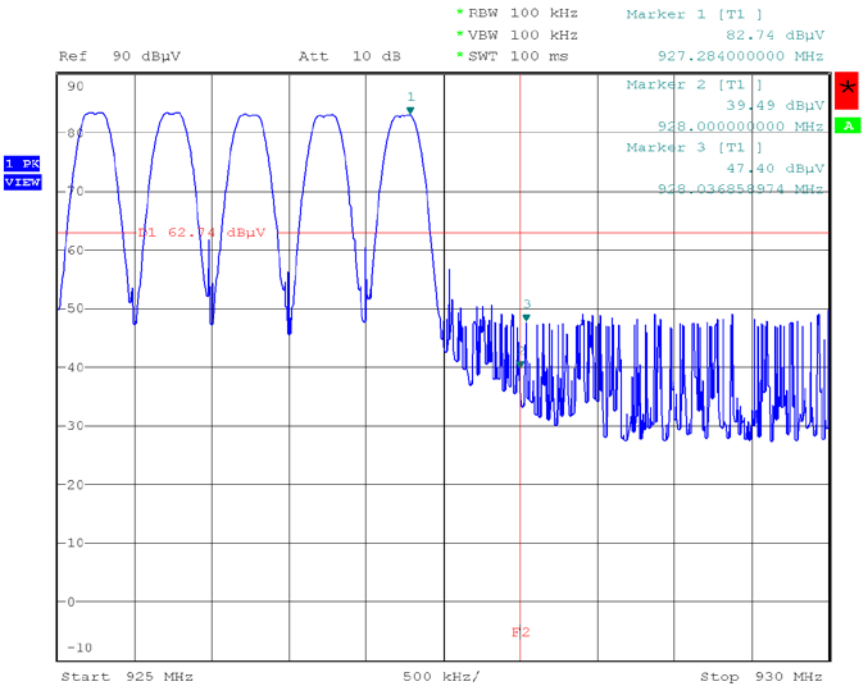

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8. TRANSMITTER OUTPUT POWER

Standard: FCC PART 15 : 2013

Section: 15.247 b) (2)

Test configuration:

The system is tested in an open area test site (OATS).

The test unit is placed on a rotating table, 0.8 m from a ground plane. Zero degree azimuth corresponds to the back of the equipment under test.

The level was maximised in antenna height, azimuth and polarization. The maximum level measured on the spectrum analyser was recorded.

A measurement of the electro-magnetic field is realized, with a resolution bandwidth adjusted at 120 kHz (detector quasi-peak).

Distance of antenna: 3 meters

Instrumentation test list:

CATEGORY	BRAND	TYPE	Nr EMITECH
AC Power supply	SECAS	CF1000 50/60	2102
Antenna	Schwarzbeck	UHALP 9108	3106
Antenna mast	Maturo	AM 4.0-O	7625
Cable	Micro-Coax	N-13m	8063
Cable	Câbles & Connectiques	N-13m	2452
Cable	-	N-2m	2805
Open area test site	Emitech	Aunainville	187
Receiver	Rohde & Schwarz	ESVS10	1216
Turntable	Maturo	MCU	7626

Equipment under test operating condition:

EUT is in continuous transmission mode.

Measure conditions:

Ambient temperature (°C): 06
Relative humidity (%): 92

Results:

Power source: 120 Va.c

FREQUENCY (MHz)	POLARIZATION	ANTENNA HEIGHT (cm)	AZIMUT (degrees)	MEASURE (dBµV/m)	P (Watt)	LIMIT (Watt)
902.785	V	170	0	115.7	68×10^{-3}	250×10^{-3}
914.787	V	110	170	113.0	36×10^{-3}	250×10^{-3}
927.284	V	110	200	112.3	31×10^{-3}	250×10^{-3}

V: Vertical
H: Horizontal
$P = [(e^2 \times d)] / (30 \times g)$ with → e = Measure in V/m; d = 3 meters; g = 2.15 dBi

□□□ *End of report - 6 annexes to be forwarded* □□□

ANNEX 1:

Photographies of the equipment under test

EQUIPMENT UNDER TEST (E.U.T.) PHOTOGRAPHIES

LDMS project

E.U.T. Photographies:

E.U.T. Photographies:

E.U.T. Photography:


ANNEX 2:

Test set up

Measurement of electromagnetic field in open area test site:

Measurement of electromagnetic field in open area test site:

Measurement of electromagnetic field in open area test site:

Measurement of electromagnetic field in open area test site:


Conducted emission:

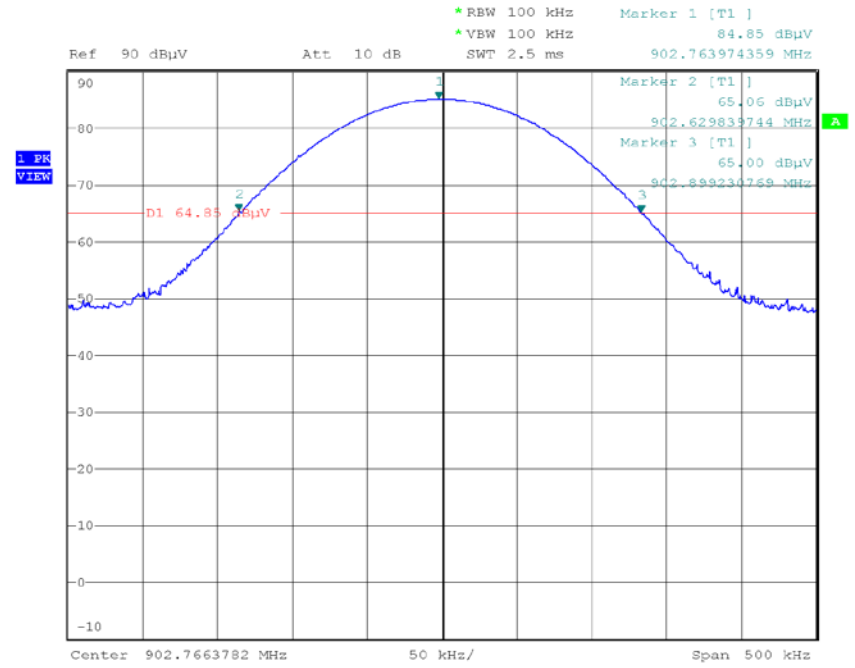

ANNEX 3:

Calibration dates

N° EMITECH	LAST CALIBRATION	CALIBRATION DUE DATE
1216	12/12/2013	12/02/2014
0187	15/03/2013	15/03/2016
3106	27/04/2012	27/04/2014
2452	24/10/2012	24/10/2014
2805	01/08/2013	01/08/2015
10229	01/03/2012	01/03/2014
3374	08/02/2012	08/02/2016
2864	14/12/2011	14/12/2013
8063	06/08/2012	06/08/2014
1097	15/03/2013	15/03/2015
1529	15/03/2013	15/03/2015
4691	15/03/2013	15/03/2015
5175	27/03/2012	27/03/2014
9579	22/10/2012	22/10/2014
4359	07/03/2012	07/03/2014
0317	19/08/2010	19/08/2014
9710	05/12/2012	25/02/2014
8021	22/02/2013	22/02/2015

ANNEX 4:

Occupied bandwidth and Channel separation



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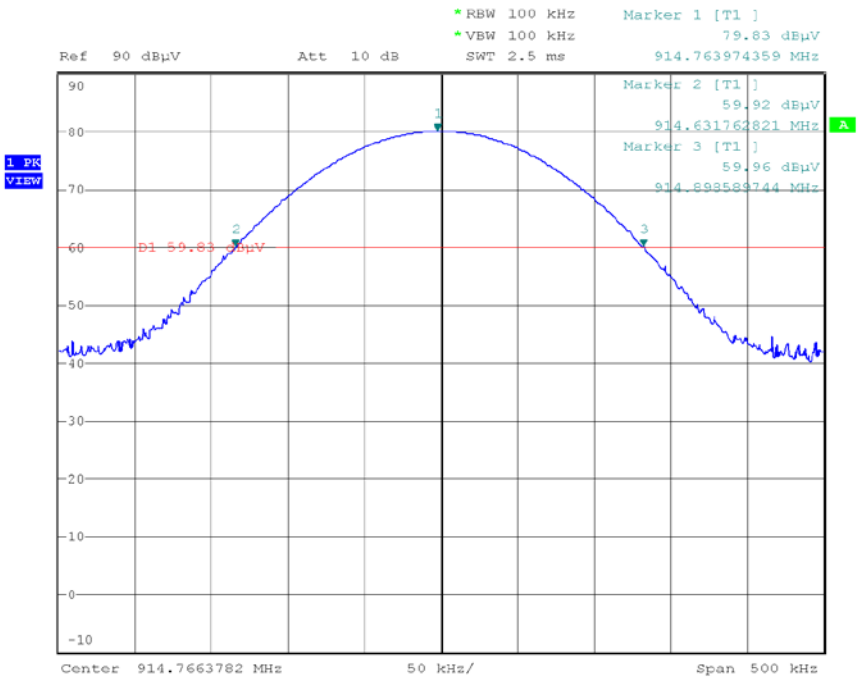

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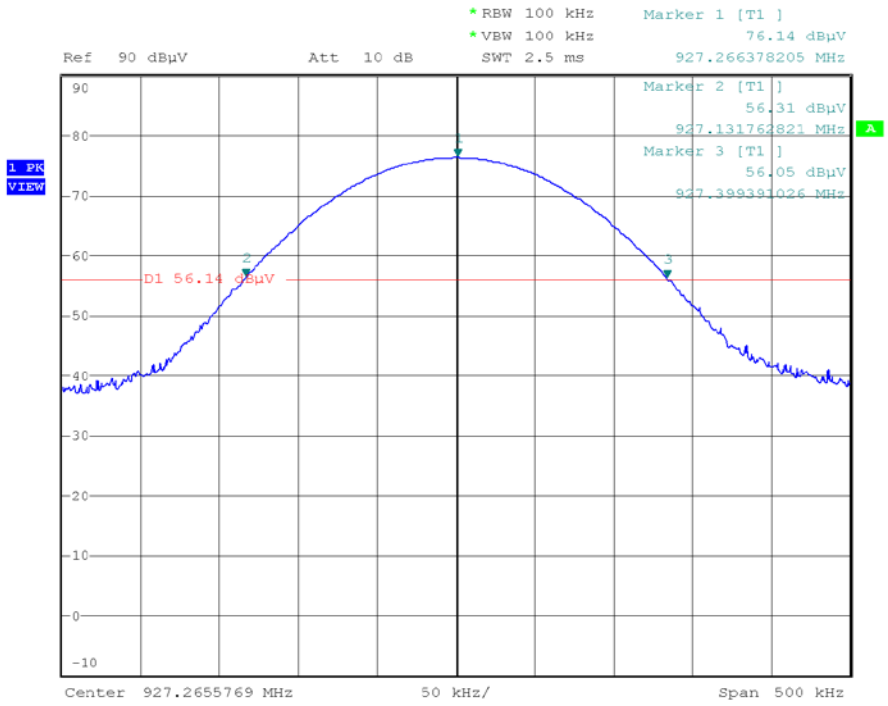

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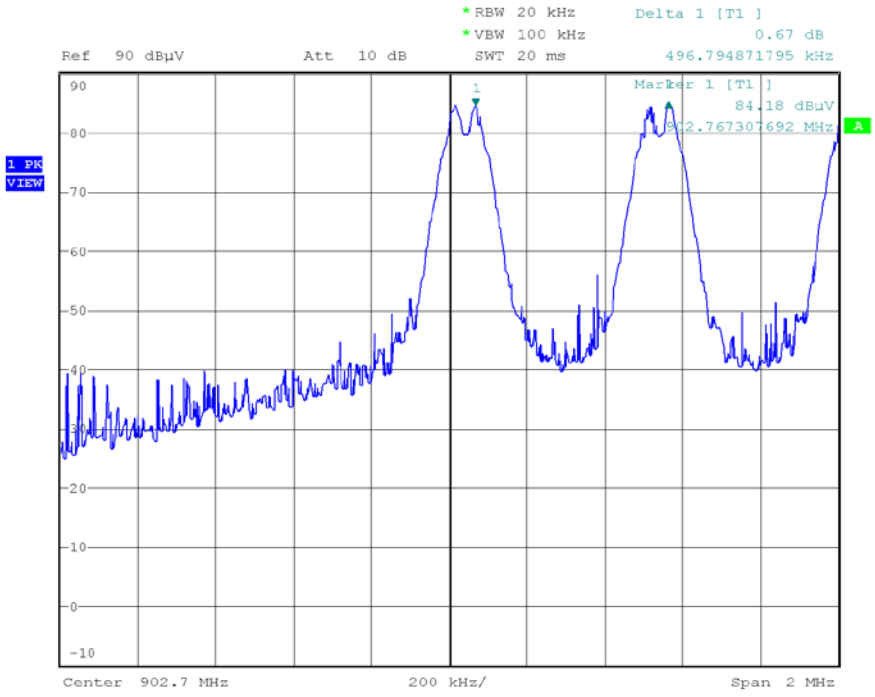

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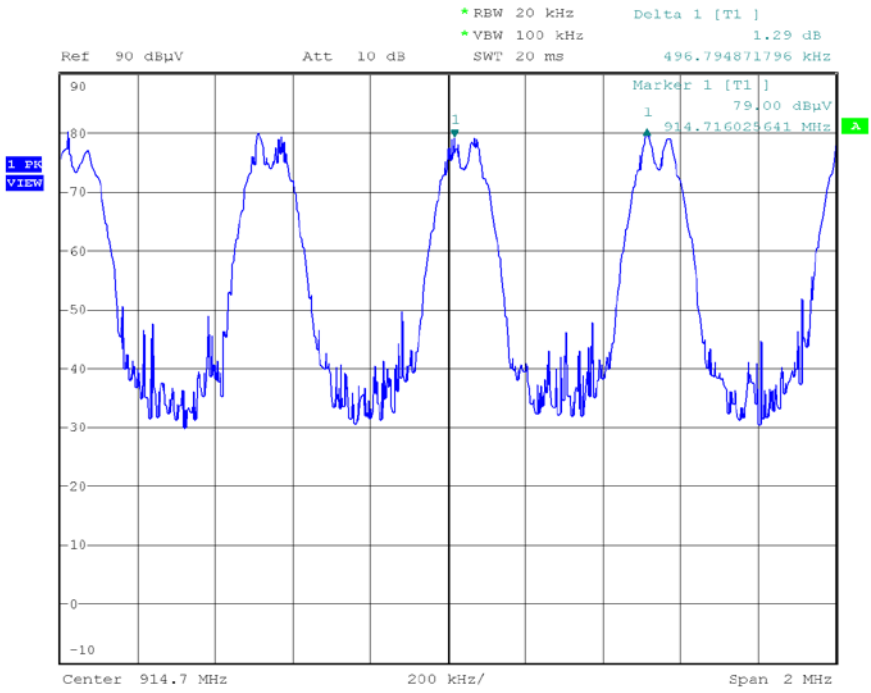

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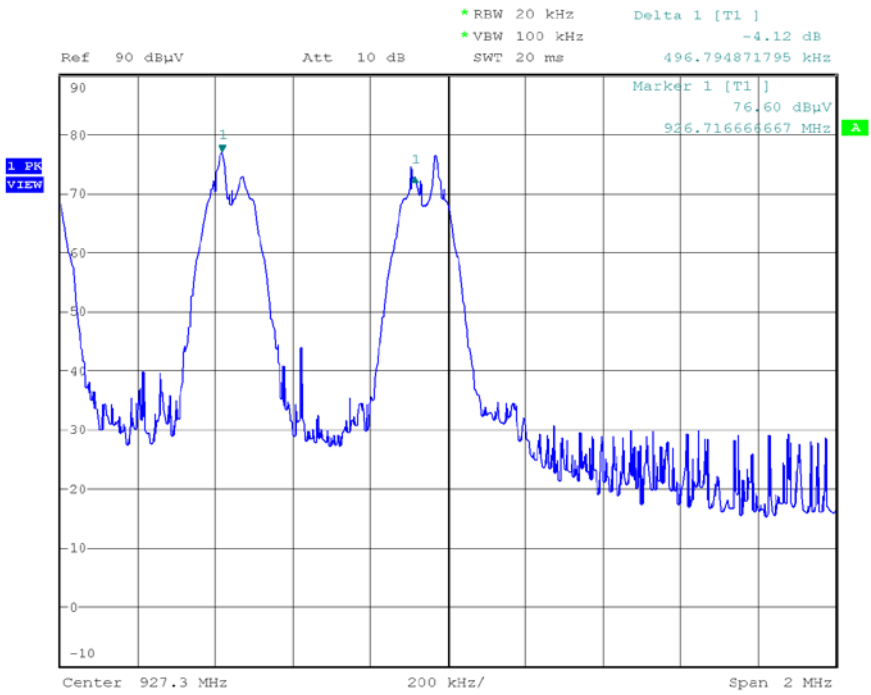

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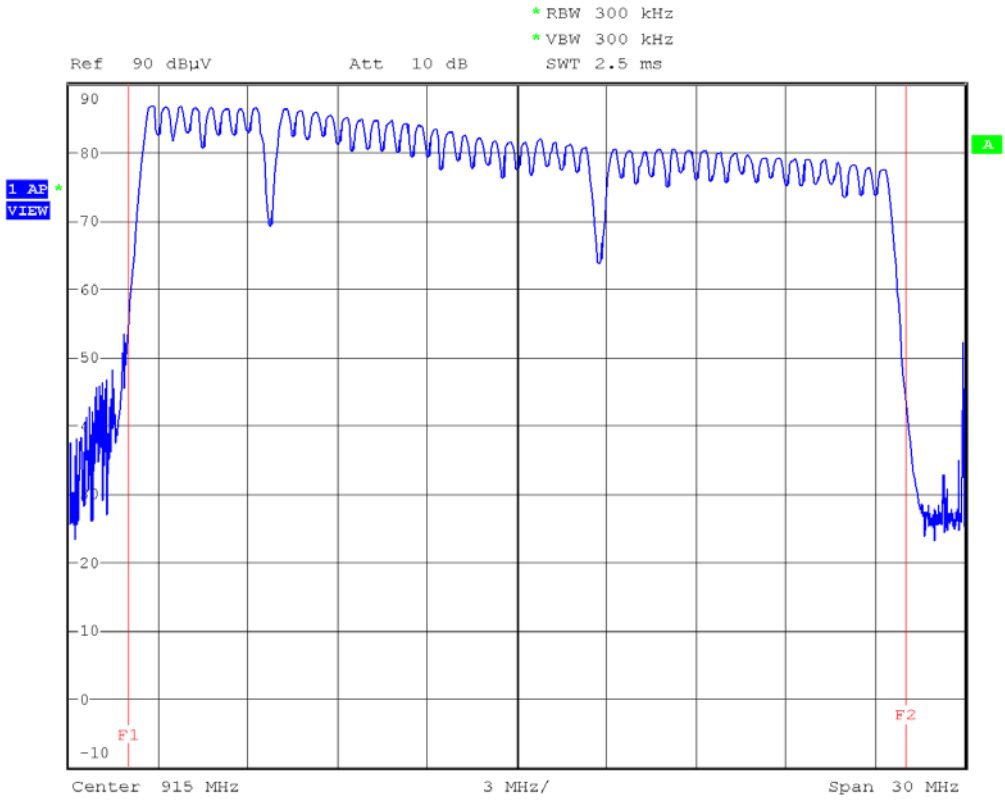
ANNEX 5:

Number of hopping channels



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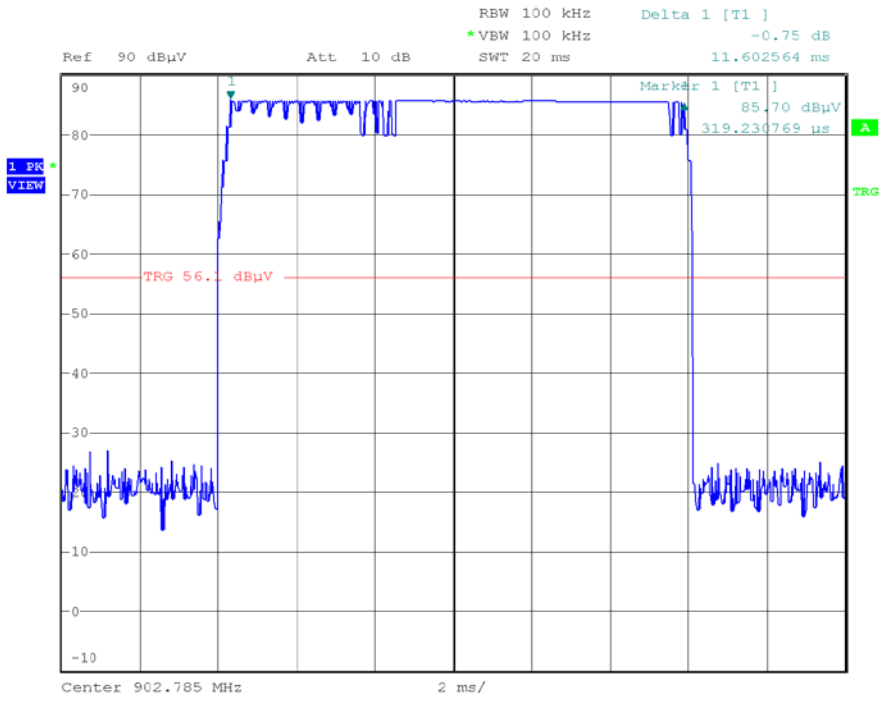
ANNEX 6:

Time of occupancy on any frequency



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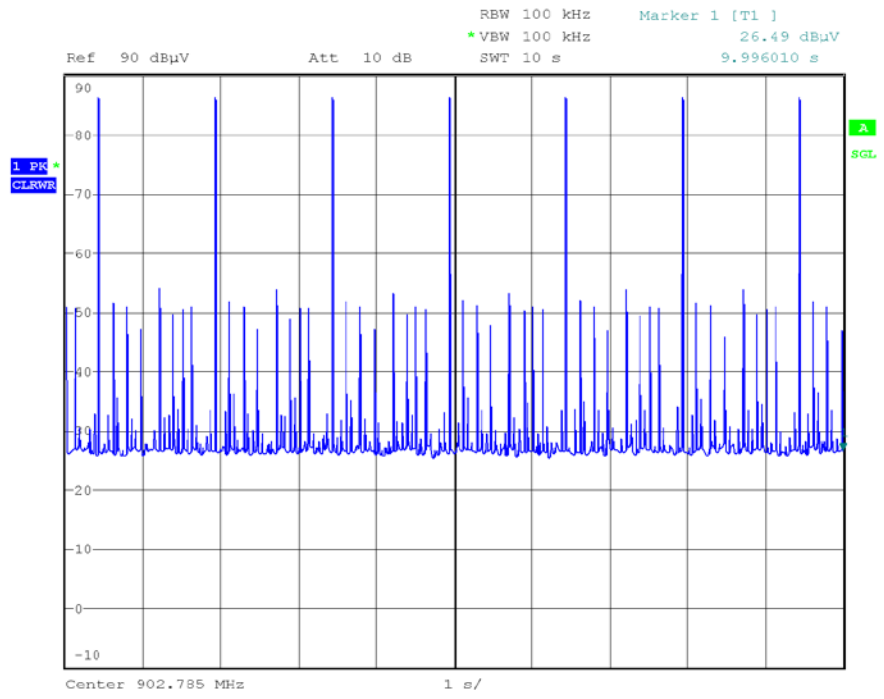

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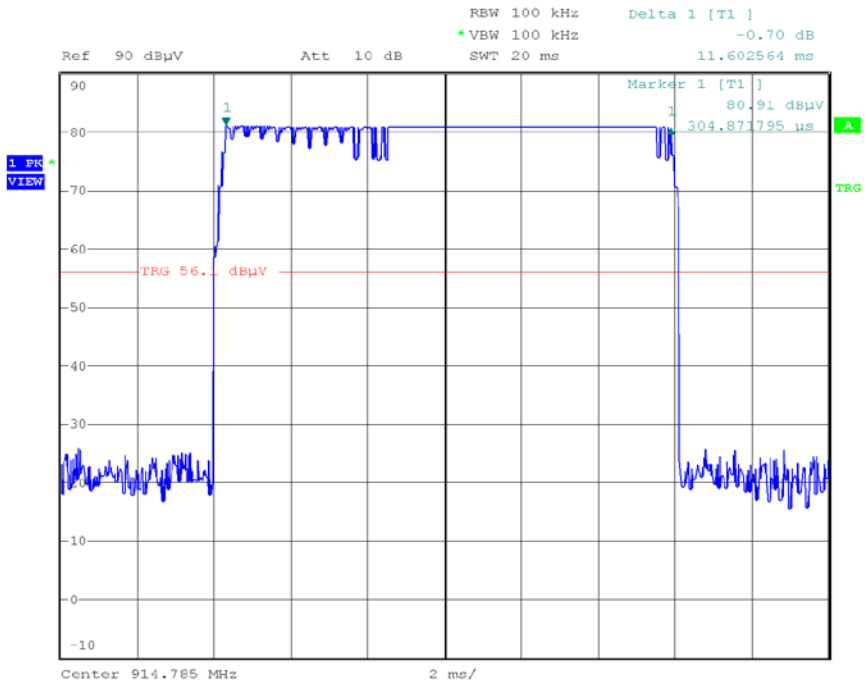

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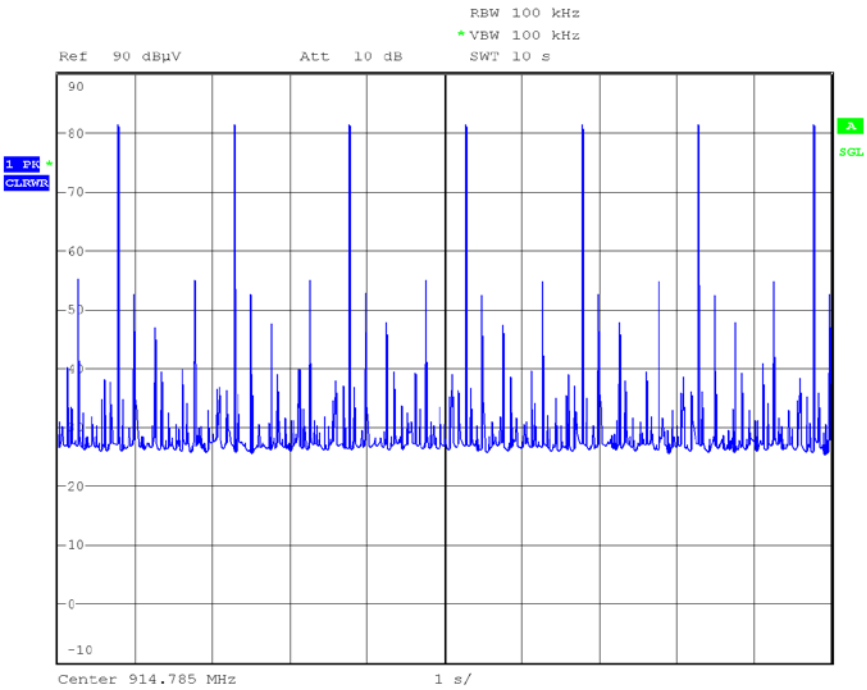

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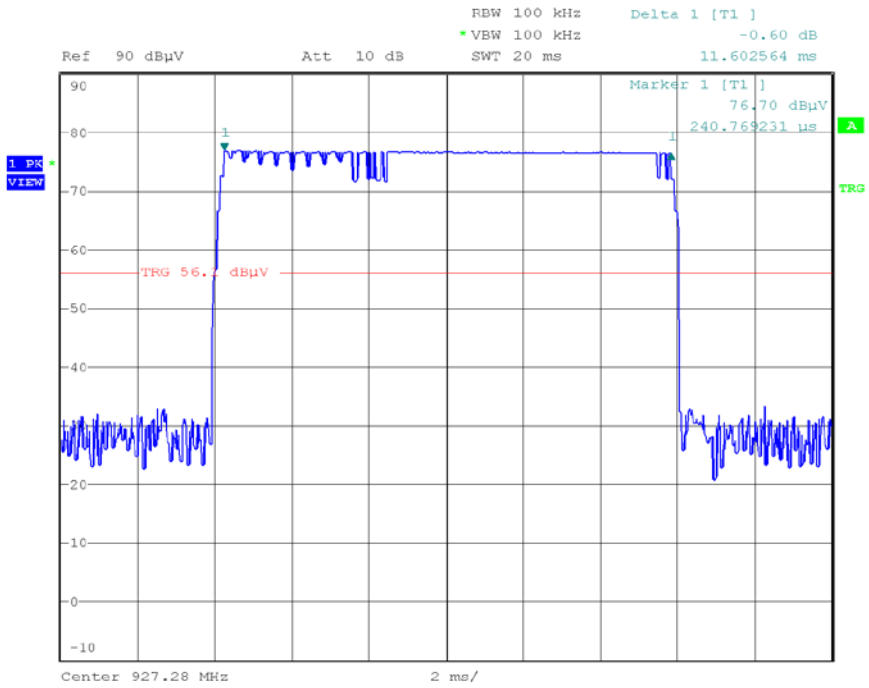

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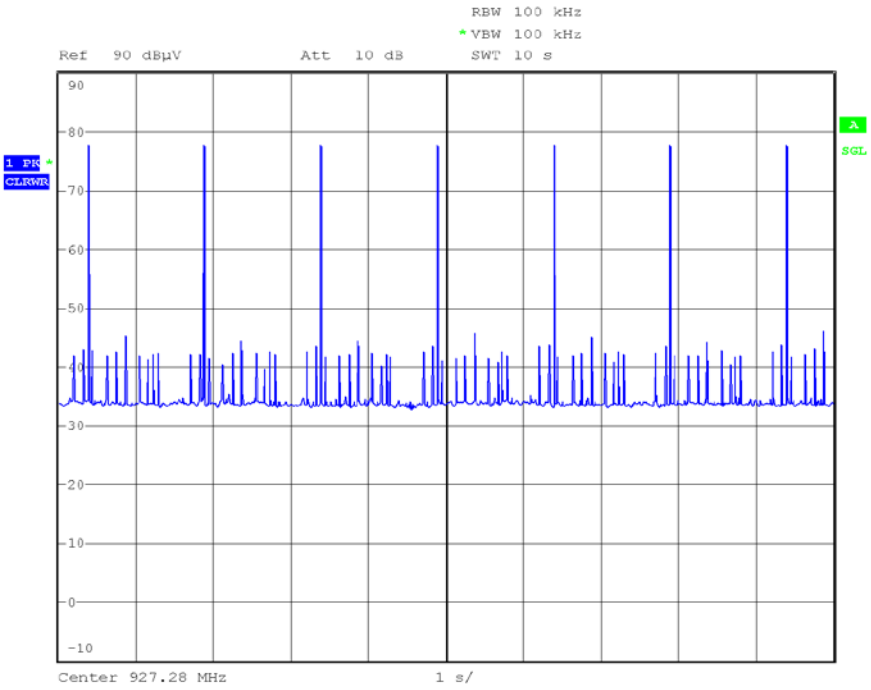

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