Test Report

47 CFR FCC Part 15 subpart C Par. 15.231
Intentional Radiators

Report reference no. ..... :	28112979_001	
FCC Designation Number ..... :	IT0008	Firmato da:Roberto Radice Data: 20/09/2019 12:10:34
FCC Test Firm Registration # ..... :	804595	
Tested by (name + signature)…….:	Roberto Radice \ Tester	
Approved by (name + signature)……:	Giovanni Molteni \ TM	Firmato da:Giovanni Molteni Data: 26/09/2019 18:14:13
Date of issue ..... :	24/07/2019	
Total number of pages ..... :	28 Pages	
Testing Laboratory ..... :	TÜV Rheinland Italia S.r.l.	
Address ..... :	Via Mattei 3 - 20010 - Pogliano Milanese (MI) – Italy	
Applicant's name ..... :	TESEO S.p.A.	
Address ..... :	C.so A. Fleming 25/27/29 – 10040 – DRUENDO (TO) - Italy	
Test item description ..... :	Car remote control	
Trade Mark ..... :	Keyline	
Manufacturer ..... :	Keyline S.p.A.	
Model/Type reference ..... :	MAVIK	
Ratings ..... :	3,0 dc Lithium battery type CR2032	
FCC ID ..... :	2ACW2MAVIK	
Sample ..... :		
Samples received on ..... :	10/07/2019	
TUV reference samples ..... :	190659 (sampled by the applicant)	
Samples tested n. ..... :	1	
Testing ..... :		
Start Date: ..... :	11/07/2019	
End Date: ..... :	11/07/2019	

SUMMARY

RELEASE CONTROL RECORD		
Test report Number	**Reason of change**	**Date of Issue**
28112979_001	Original release	24/07/2019

1. Reference Standards

Standard	Description
FCC Part 15 (Subpart C)	§15.231 Periodic operation in the band 40,66 – 40,70 MHz and above 70MHz
FCC Part 15 (Subpart C)	§15.207 Conducted Limits
FCC Part 15 (Subpart C)	§15.209 Radiated emission limits; general requirements
FCC Part 15 (Subpart C)	§15.203 Antenna Requirement
ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American National Standard for Testing Unlicensed Wireless Devices

2. Summary of testing

§ 15.203	Antenna Requirements	PASS
§ 15.207	Power Line Conducted Emission	N.A.[1]
§ 15.231 (a)	Periodic operation (par.1)	PASS
	Periodic operation (par.2)	N.A.[2]
	Periodic operation (par.3)	N.A.[3]
	Periodic operation (par.4)	N.A.[4]
	Periodic operation (par.5)	N.A.[5]
§ 15.231 (b) § 15.209	Radiated emission (fundamental)	PASS
	Radiated emission (spurious)	PASS
§ 15.231 (c)	Bandwidth of emission (70MHz to 900MHz)	PASS
	Bandwidth of emission (above 900MHz)	N.A.
§ 15.231 (d)	Bandwidth of emission (40,66 to 40,70MHz)	N.A.
§ 15.231 (e)	Radiated emission (fundamental)	N.A.[6]
	Radiated emission (spurious)	N.A.[6]

N.A.[1]	Internal battery powered
N.A.[2]	The transmitter shall not transmit automatically.
N.A.[3]	No periodic transmission at regular predetermined intervals.
N.A.[4]	Transmitter not for alarm systems
N.A.[5]	The transmit not exceed the transmission duration limit of par. a1 and a2
N.A.[6]	The transmit not exceed the transmission duration limit of par. a

Possible test case verdicts:

- test case does not apply to the test object ....: N/A
- test object does meet the requirement .....: PASS
- test object does not meet the requirement ....: FAIL

General remarks:

The test results presented in this report relate only to the object tested.

The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.

This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(see Enclosure #)" refers to additional information appended to the report.
"(see appended table)" refers to a table appended to the report.

Throughout this report a comma is used as the decimal separator.

3. General product information

Keyline MAVIK is a car remote control that guarantee perfect synchronization with the original remote without altering the functionality and working simultaneously.

4. Equipment Used During Test

Use *	Product Type	Manufacturer	Model	Comments
EUT	Car remote control	KEYLINE	MAVIK	------

Note:

* Use :

EUT - Equipment Under Test,
AE - Auxiliary/Associated Equipment, or
SIM - Simulator (Not Subjected to Test)

No other Auxiliary/Associated Equipment was connected/installed on the EUT

5. Input/Output Ports

CONNECTIONS

Port		Description	Connection	Cable lenght
1	Enclosure	Non-conductive surface	---	---
2	AC Power Port	Port not present	---	---
3	DC Power Port	3,0 Vdc powered by internal lithium battery	---	---
4	Signal port	Port not present	---	---
5	Antenna	Integrated on PCB	---	---

*Note: AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
WN = Wired Network

6. Power Interface

Mode #	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
Rated	3,0	---	---	DC	---	None

7. EUT Operation Modes	
Operation mode	**Description**
#1	Continuous Modulated RF Transmission at 315MHz
#2	Normal working condition

8. EUT Configuration Modes		
Description		
Module connected to		
Par.	test	EUT Operation Modes
§ 15.231 (a)	Periodic operation (par.1)	#2
§ 15.231 (b) § 15.209	Radiated emission (fundamental) Radiated emission (spurious)	#1
§ 15.231 (c)	Bandwidth of emission (70MHz to 900MHz)	#1

The field strength is calculated by subtracting the Amplifier Gain and adding the Cable Loss and Antenna Correction Factor to the measured reading. The basic equation is as follows:

Field Strength (dBμV/m) = RAW - AMP + CBL + ACF

Where: RAW = Measured level before correction (dBμV)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

$$\mu V/m = 10^{\frac{dB\mu V/m}{20}}$$

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dBuV/m)

25 dBuV/m + 17.5 dB – 20 dB + 1.0 dB = 23.5 dBuV/m

11. Test Conditions and Results

11.1 TEST: Antenna requirements			PASS
Parameters required prior to the test	Laboratory Ambient Temperature (°C)	15 to 35 °C	
	Relative Humidity (%)	30 to 60 %	
Parameters recorded during the test	Laboratory Ambient Temperature (°C)	21°C	
	Relative Humidity (%)	56%	
	Air pressure (hPa)	1020	
—	Power Supply / Frequency	Application Point	
Fully configured sample tested at the power line frequency	3,0 Vdc	Enclosure	
Equipment mode:	Operation mode	#1	
FCC Standard	§15.203		

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

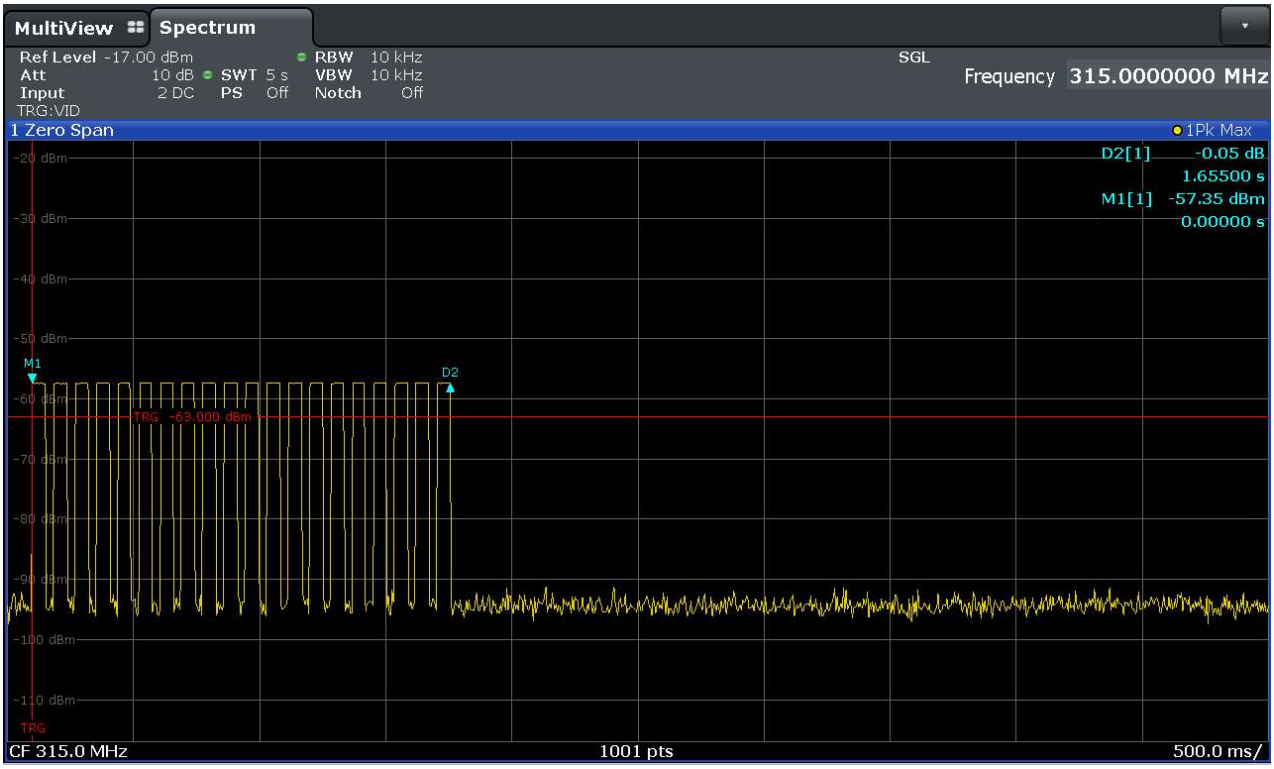
Antenna specifications	
N° of authorized antenna types	1
Antenna type	PCB antenna
Maximum total gain	< 6dBi
External power amplifiers	Not present

11.2 TEST: Periodic Operation			PASS
Parameters required prior to the test	Laboratory Ambient Temperature (°C)	15 to 35 °C	
	Relative Humidity (%)	30 to 60 %	
Parameters recorded during the test	Laboratory Ambient Temperature (°C)	22°C	
	Relative Humidity (%)	54%	
	Air pressure (hPa)	1020	
—	Power Supply / Frequency	Application Point	
Fully configured sample tested at the power line frequency	3,0 Vdc	Enclosure	
Equipment mode:	Operation mode	#1	
FCC Standard	§15.231 (A)		

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.
(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.
(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.
(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.
(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmission are under the control of a professional installer and do not exceed ten seconds after a manually operated switch

Test Equipment Used					
Description	Manufacturer	Model	Identifier	Calibration date	Calibration due
EMI Test Receiver	R&S	ESW44	2782867	06/2019	06/2020

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.



When the push button is pressed, the transmitter transmits for 1,655 seconds, then ceases to transmit even if the push button is still pressed.

So the transmitter stops transmitting automatically after 1,655 seconds.

11.3 TEST: Radiated Emission			PASS
Parameters required prior to the test	Laboratory Ambient Temperature (°C)	15 to 35 °C	
	Relative Humidity (%)	30 to 60 %	
Parameters recorded during the test	Laboratory Ambient Temperature (°C)	22°C	
	Relative Humidity (%)	54%	
	Air pressure (hPa)	1020	
—	Power Supply / Frequency	Application Point	
Fully configured sample tested at the power line frequency	3,0 Vdc	Enclosure	
Equipment mode:	Operation mode	#1	
FCC Standard	§15.205; §15.209; §15.231 (B)		

Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table :

(b) In addition to the provisions of Section 15.205, the field strength of emissions from intentional radiators operated under this Section shall not exceed the following:

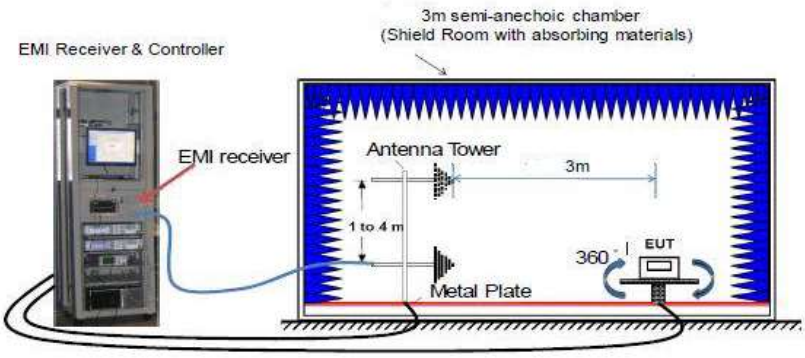
Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
40.66 - 40.70	2,250	225
70 - 130	1,250	125
130 - 174	1,250 to 3,750 **	125 to 375 **
174 - 260	3,750	375
260 - 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

** linear interpolations

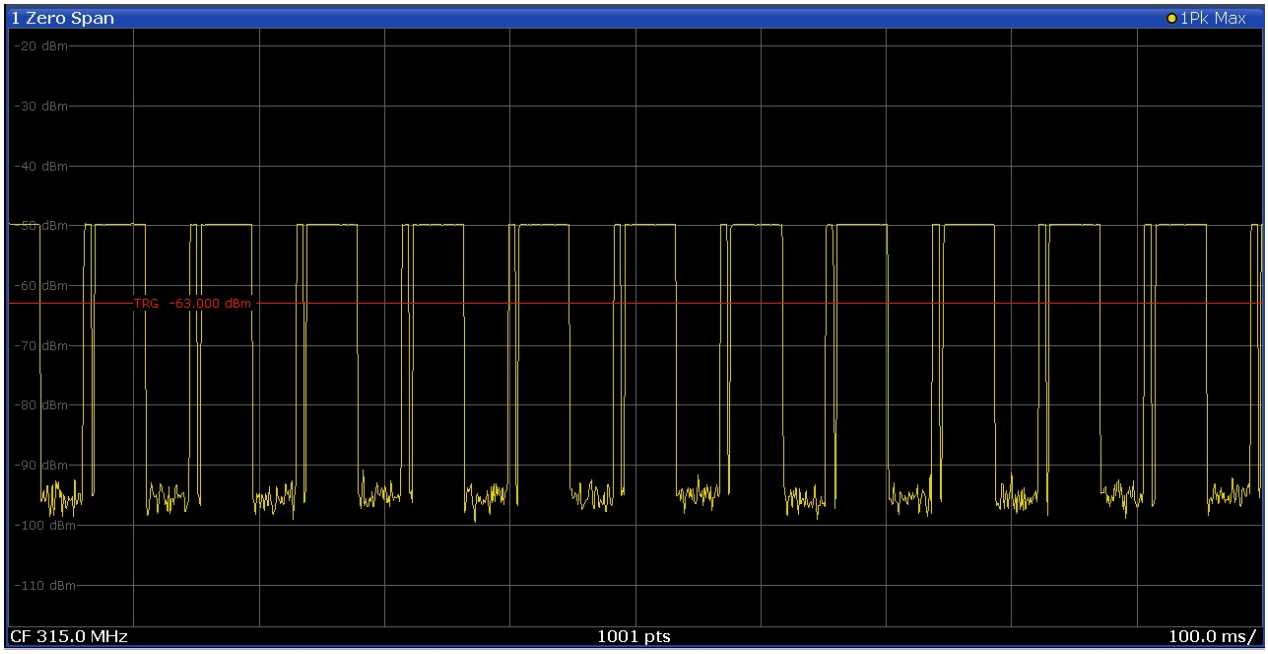
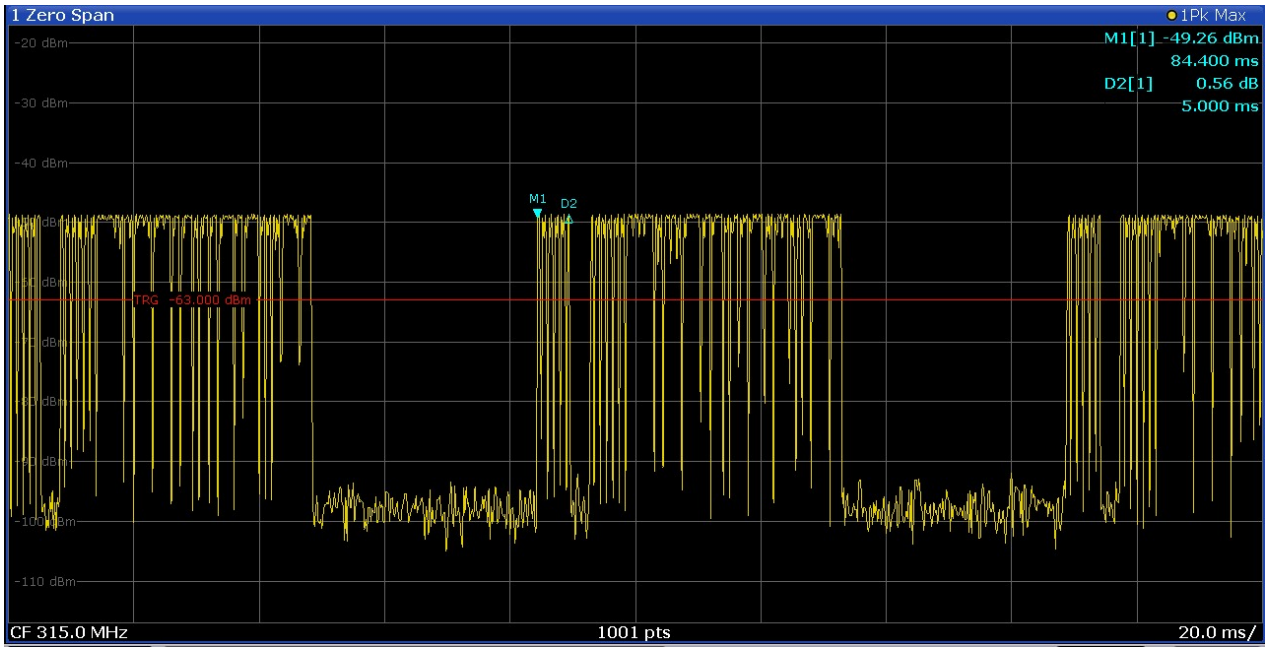
Remark: In accordance with part 15.31 (f) (2), where the measurement distance was specified to be 30 or 300 meters, a correction factor was applied in order to permit measurement to be performed at a separation distance. The applied formula for limits at 3 meter is:Extrapolation (dB) = 40log (300meter / 3meter) = +80db Extrapolation (dB) = 40log (30meter / 3meter) = +40db

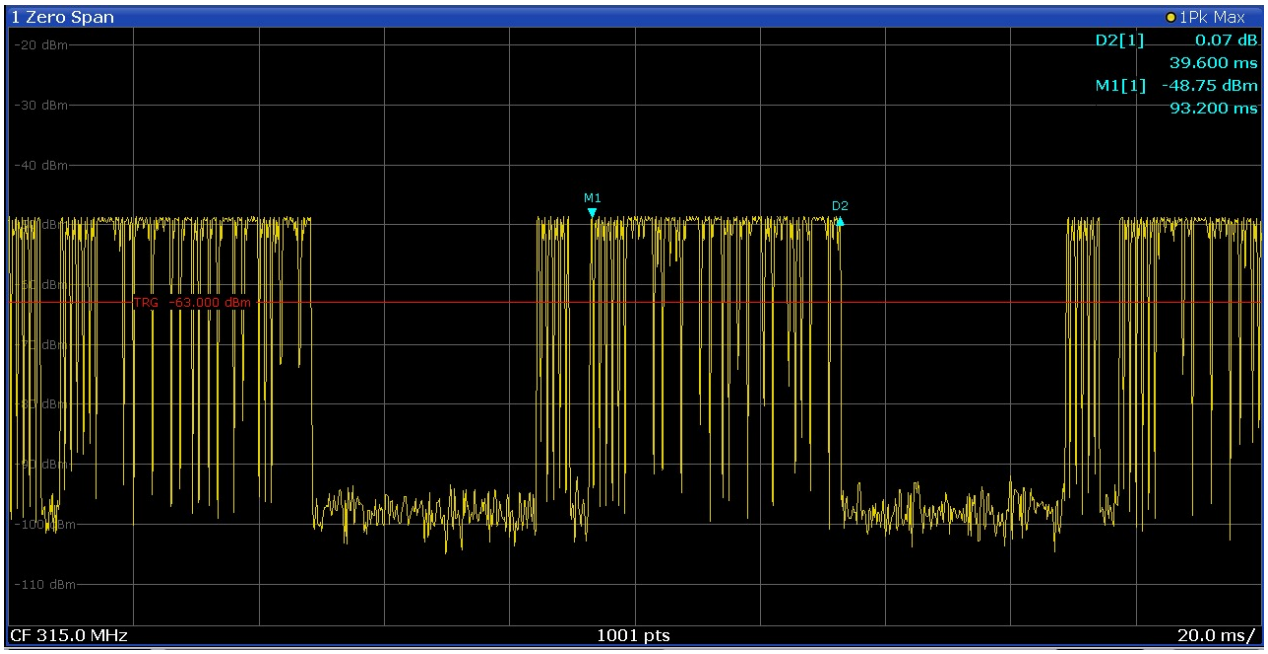
Further information to test setup.

For frequencies above 1GHz, the anechoic material is also placed on the metallic floor between EUT and Antenna

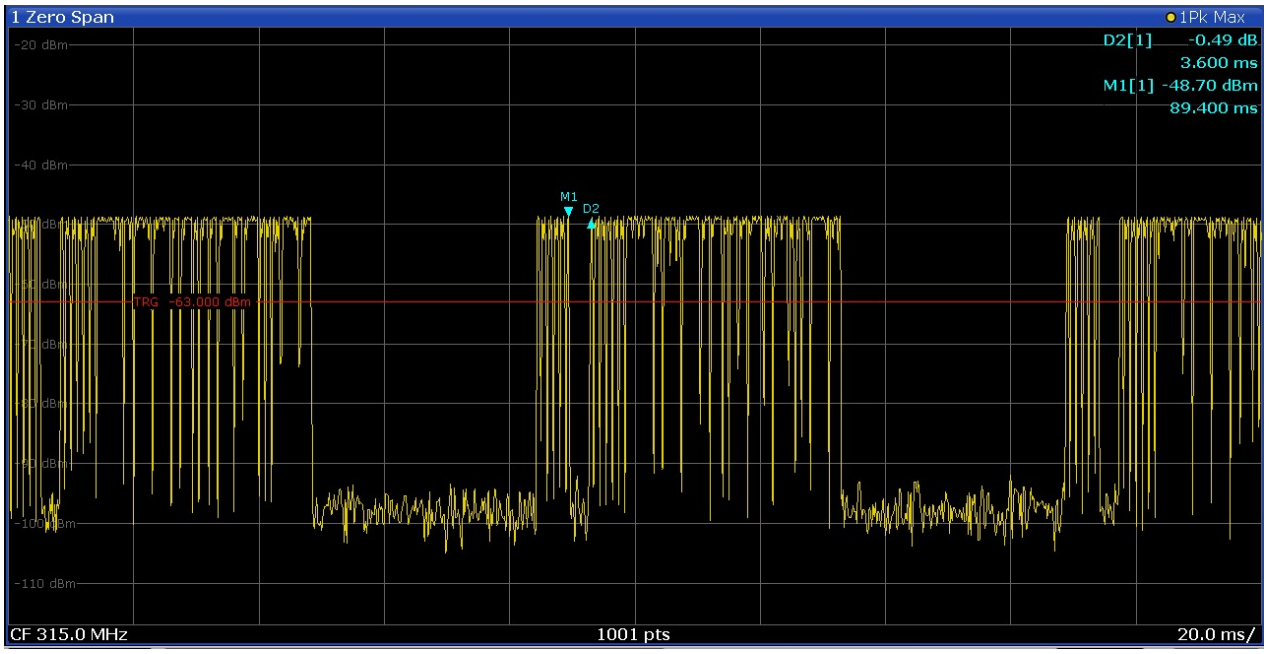


Test Equipment Used					
Description	Manufacturer	Model	Identifier	Calibration date	Calibration due
CSSA	ETS Lindgren	FACT3	2782378	10/2018	10/2020
EMI Test Receiver	R&S	ESW44	2782867	06/2019	06/2020
Loop Antenna	EMCO	6512	2782356	02/2017	02/2020
Antenna BiConiLog	ETS Lindgren	3124E-PA	2782348	04/2017	04/2020
Antenna Horn with Preamplifier	ETS Lindgren	3117-PA	2782349	04/2017	04/2020
Highpass Filter	Wainwright Instr.	WHKX10-1170-1300	2782705	05/2019	05/2020

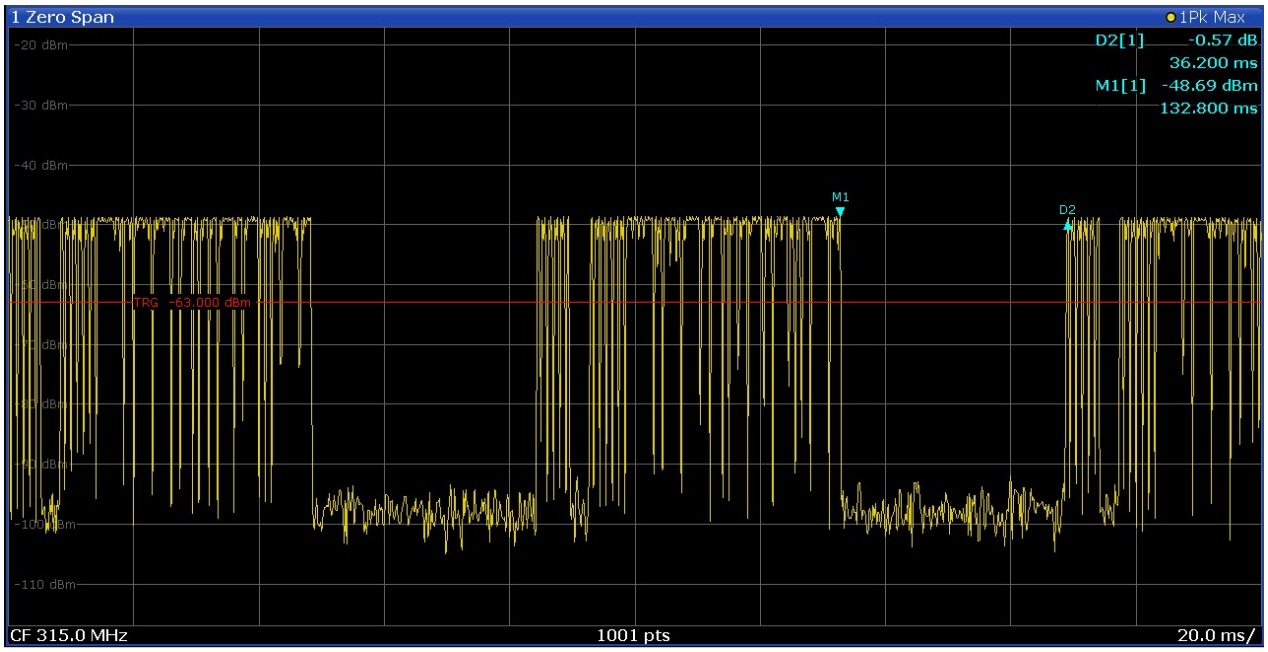
Pulse train duration §15.35 (c)

Pulse train in 1000ms.

First packet of burst duration:5ms



Second packet of burst duration:39,60ms



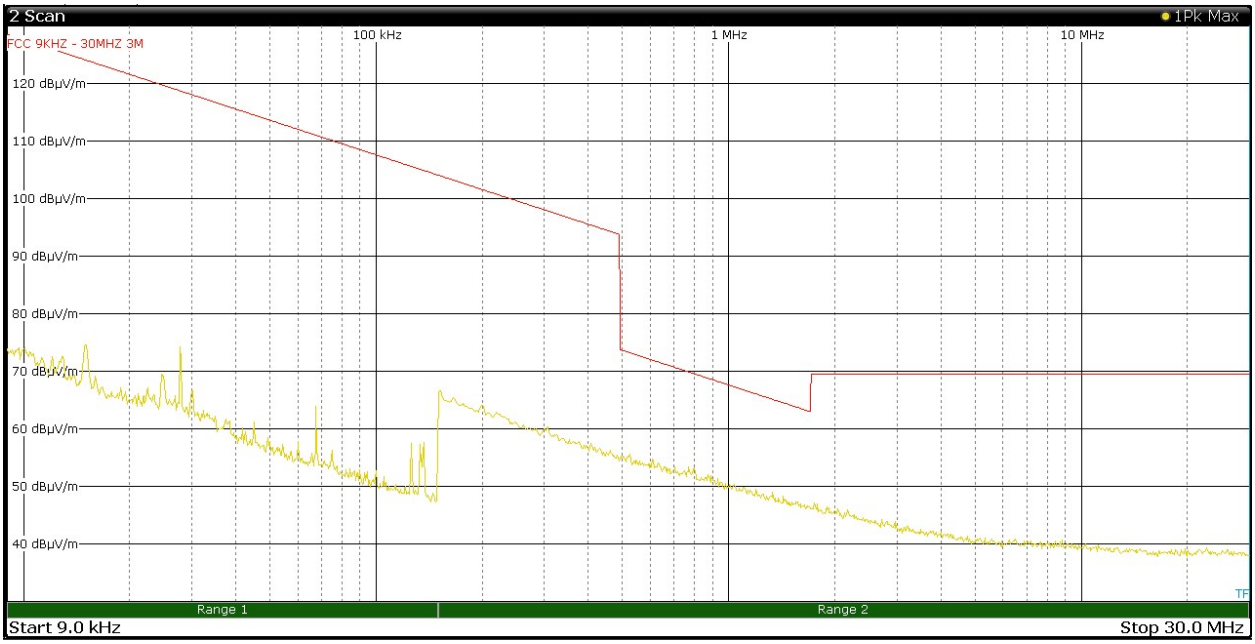
First OFF time of burst duration:3,60ms



Second OFF time of burst duration:36,20ms

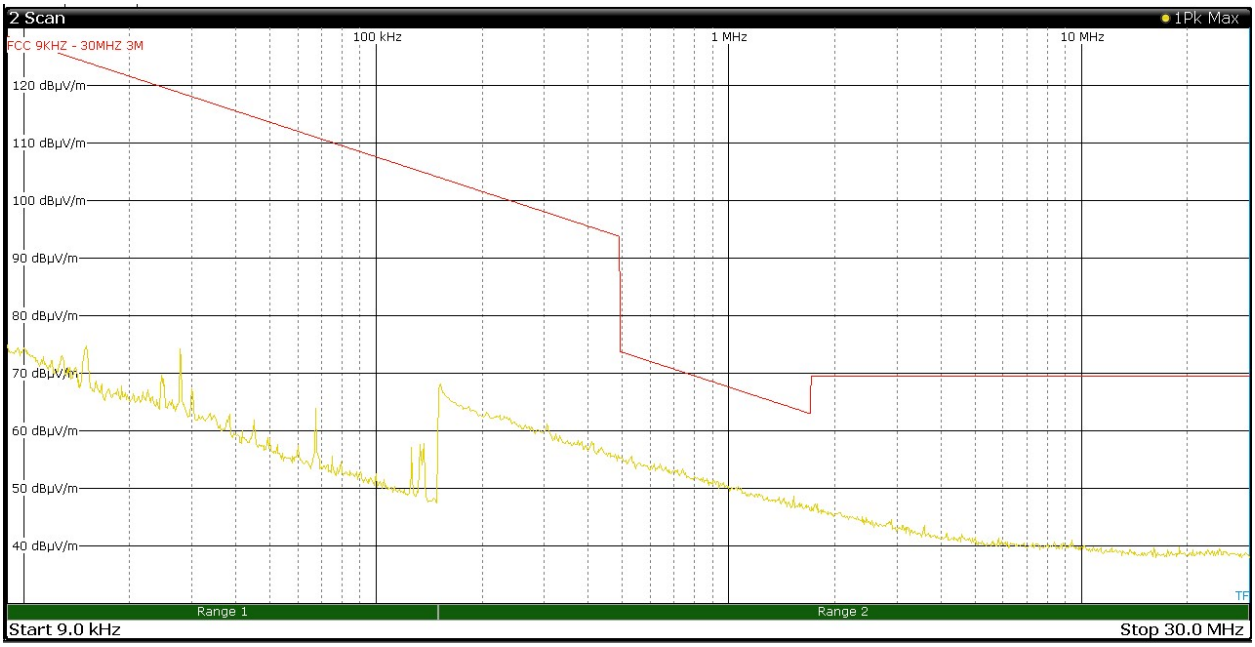
Calculated Average Factor
(c) Unless otherwise specified, e.g. Section 15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.
Average Factor = 20log (Ton /Ton+Toff) = 20log (44,60ms/84,40ms) = -5,54dB

Graphical representation of Radiated Emission Measurement
Operation Mode: #1
Frequency: 9kHz – 30MHz (X axis)



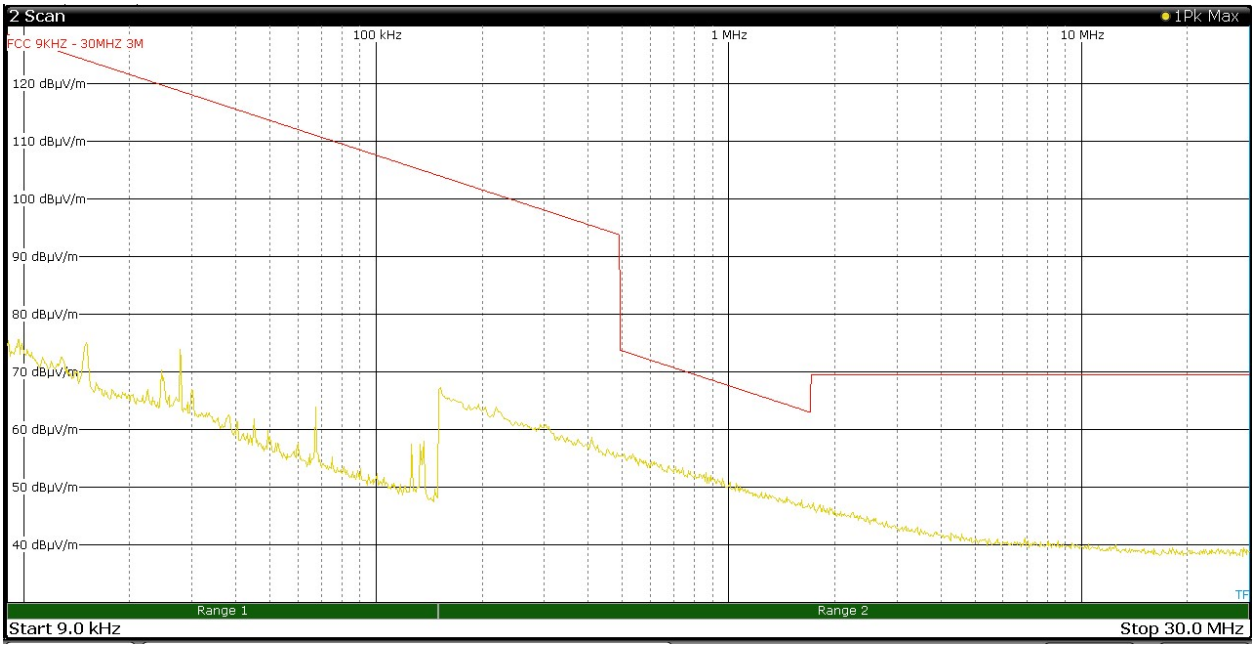
level measured at 3m distance.

Graphical representation of Radiated Emission Measurement
Operation Mode: #1
Frequency: 9kHz – 30MHz (Y axis)



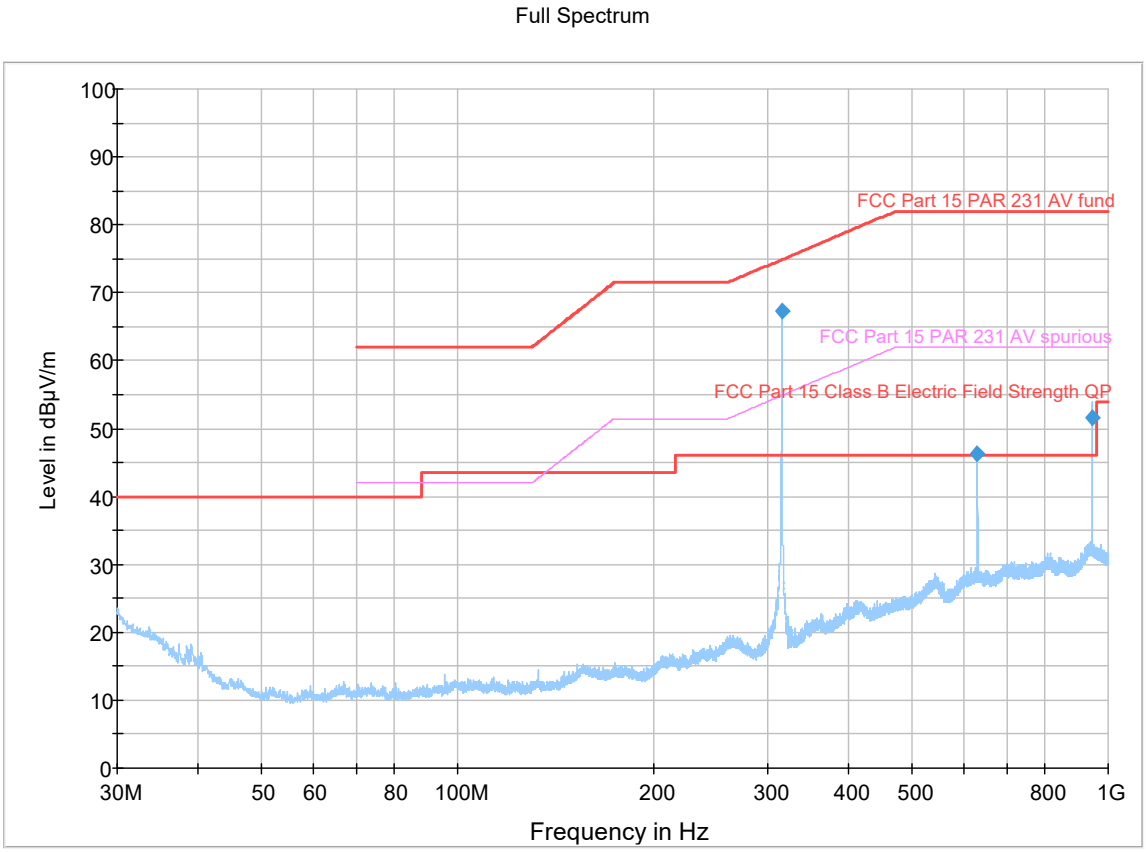
level measured at 3m distance.

Graphical representation of Radiated Emission Measurement
Operation Mode: #1
Frequency: 9kHz – 30MHz (Z axis)



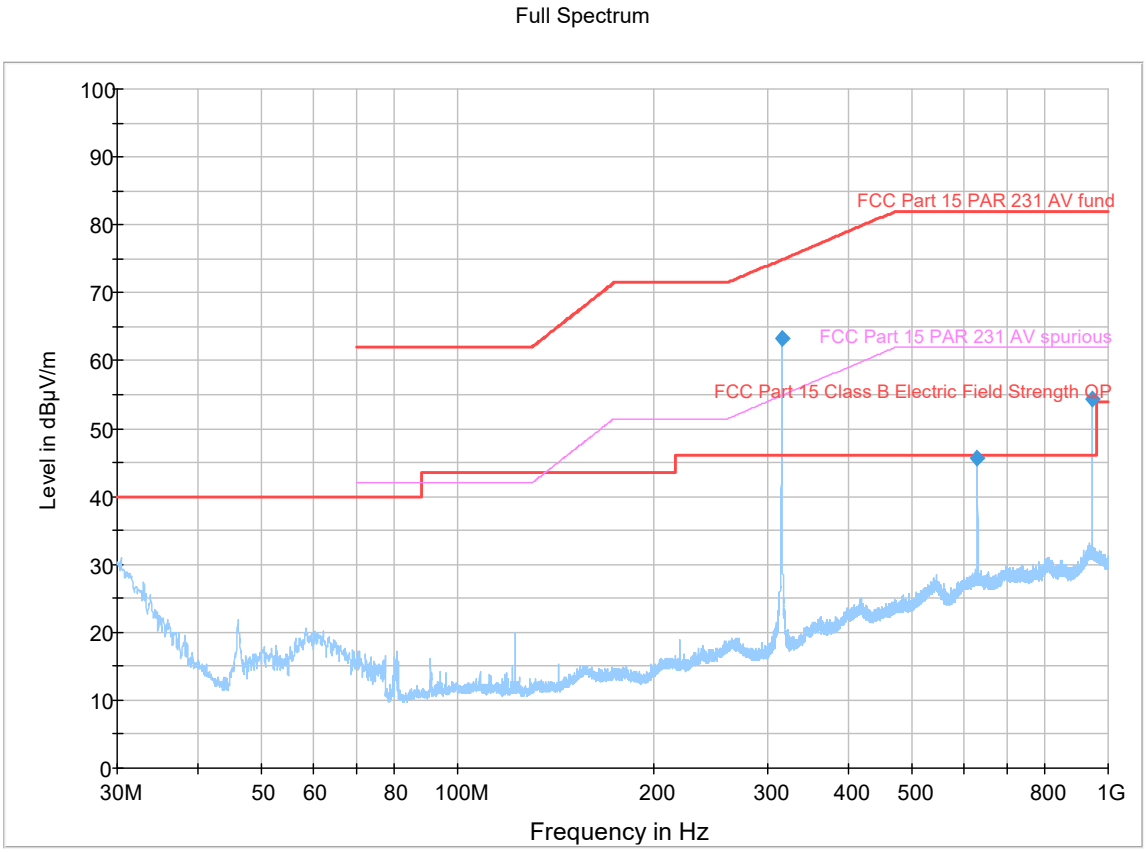
level measured at 3m distance.

Graphical representation of Radiated Emission Measurement
Operation Mode: (#1) (X axis)
Frequency: 30MHz – 1GHz



Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)	AV Limit (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
315,000000	67,40	61,86	75,62	1000,0	120,000	104,0	H	84,0	14,7
629,970000	46,18	40,64	55,62	1000,0	120,000	138,0	H	263,0	24,3
944,970000	51,62	46,08	55,62	1000,0	120,000	104,0	H	266,0	27,9
Average Level = Peak Level + Average Factor (-5,54dB)									

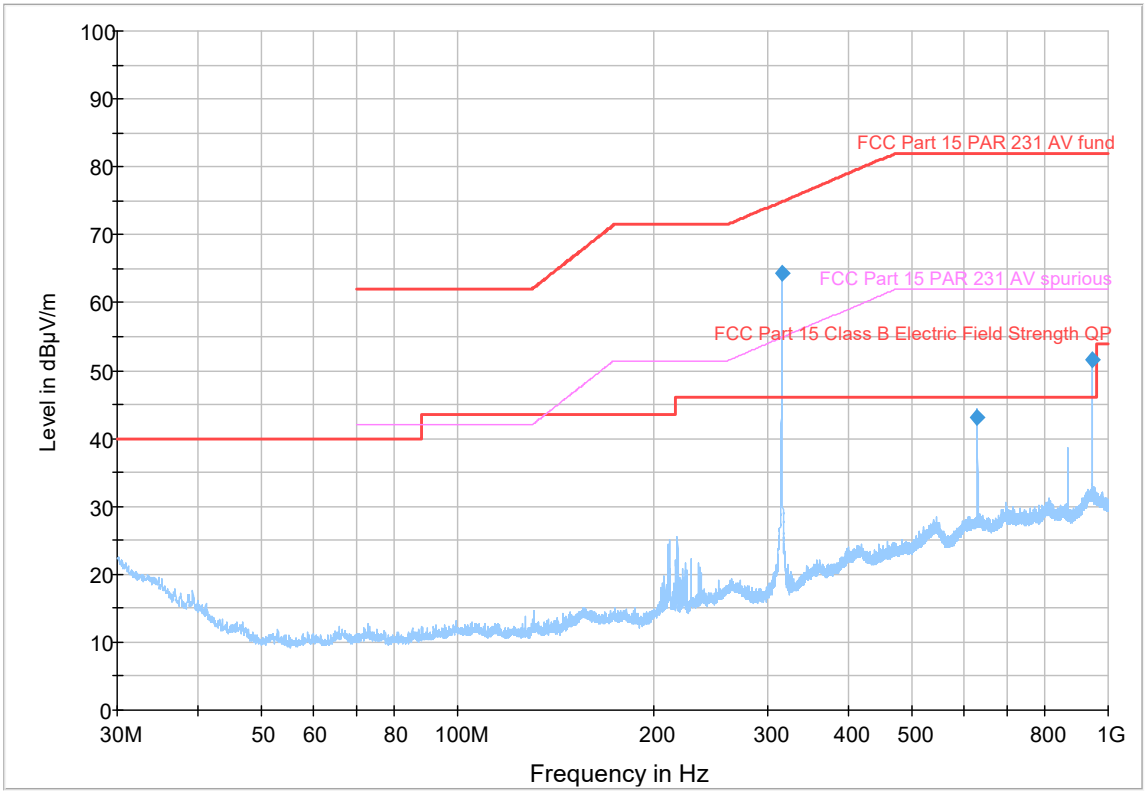
Graphical representation of Radiated Emission Measurement
Operation Mode: (#1) (Y axis)
Frequency: 30MHz – 1GHz



Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)	AV Limit (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
315,000000	63,30	59,76	75,62	1000,0	120,000	175,0	V	277,0	14,7
629,970000	45,55	40,01	55,62	1000,0	120,000	100,0	V	101,0	24,3
944,970000	54,35	48,81	55,62	1000,0	120,000	113,0	V	92,0	27,9
Average Level = Peak Level + Average Factor (-5,54dB)									

Graphical representation of Radiated Emission Measurement
Operation Mode: (#1) (Z axis)
Frequency: 30MHz – 1GHz

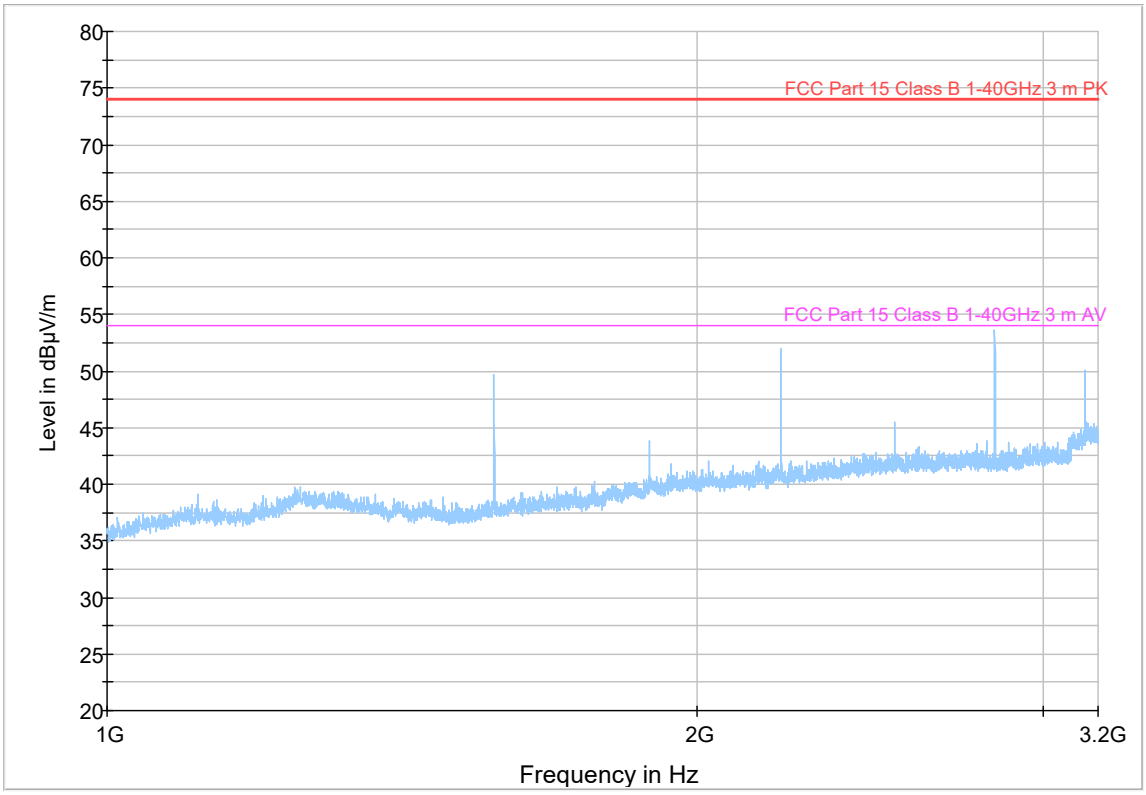
Full Spectrum



Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)	AV Limit (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
315,000000	64,27	58,73	75,62	1000,0	120,000	125,0	H	173,0	14,7
629,970000	43,03	37,49	55,62	1000,0	120,000	155,0	H	176,0	24,3
944,970000	51,68	46,14	55,62	1000,0	120,000	154,0	H	344,0	27,9
Average Level = Peak Level + Average Factor (-5,54dB)									

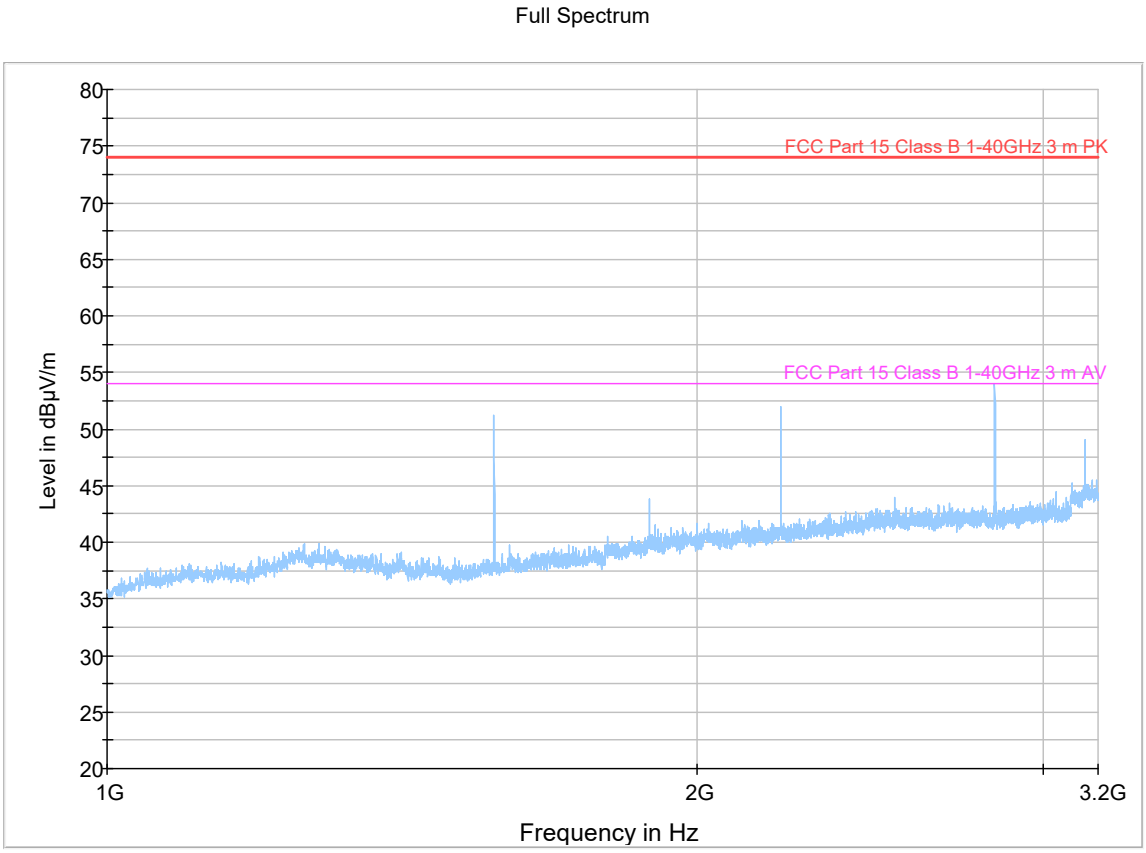
Graphical representation of Radiated Emission Measurement
Operation Mode: (#1) (X axis)
Frequency: 1GHz – 3,2GHz

Full Spectrum



Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)	PK Limit (dBµV/m)	AV Limit (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1260,000000	39,32	33,78	75,62	55,62	1000	100,0	H	90,0	-12,2
1575,000000*	49,74	44,20	74,00	54,00	1000	150,0	V	315,0	-13,3
1890,000000	43,77	38,23	75,62	55,62	1000	100,0	H	270,0	-10,8
2205,000000*	51,97	46,43	74,00	54,00	1000	150,0	H	90,0	-9,5
2520,000000	45,41	39,87	75,62	55,62	1000	100,0	H	135,0	-8,4
2835,000000*	53,63	48,09	74,00	54,00	1000	100,0	H	135,0	-8,0
3150,000000	50,00	44,46	75,62	55,62	1000	150,0	H	135,0	-7,2
*Restricted band (par. 15.205)									
Average Level = Peak Level + Average Factor (-5,54dB)									

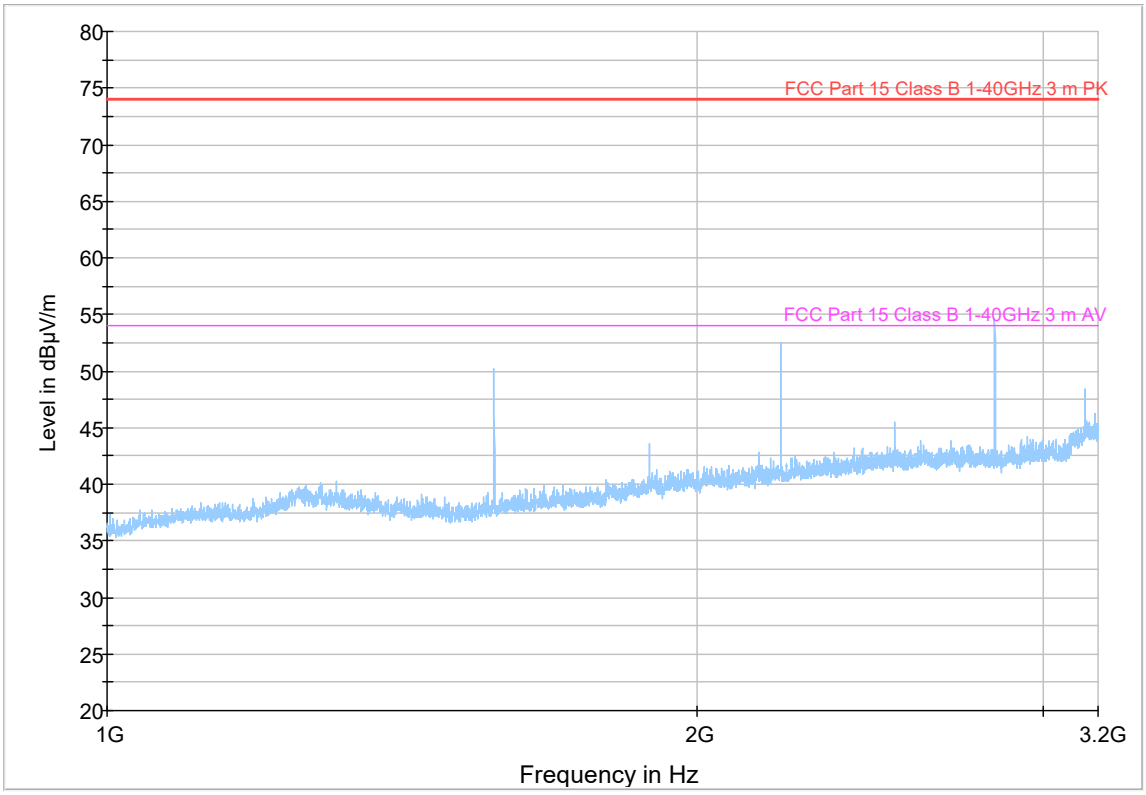
Graphical representation of Radiated Emission Measurement
Operation Mode: (#1) (Y axis)
Frequency: 1GHz – 3,2GHz



Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)	PK Limit (dBµV/m)	AV Limit (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1260,000000	39,88	34,34	75,62	55,62	1000	100,0	V	0,0	-12,2
1575,000000*	51,25	45,71	74,00	54,00	1000	150,0	V	0,0	-13,3
1890,000000	43,81	38,27	75,62	55,62	1000	150,0	V	90,0	-10,8
2205,000000*	51,99	46,45	74,00	54,00	1000	150,0	V	315,0	-9,5
2520,000000	43,92	38,38	75,62	55,62	1000	100,0	V	315,0	-8,4
2835,000000*	53,96	48,42	74,00	54,00	1000	200,0	V	0,0	-8,0
3150,000000	49,01	43,47	75,62	55,62	1000	100,0	V	270,0	-7,2
*Restricted band (par. 15.205)									
Average Level = Peak Level + Average Factor (-5,54dB)									

Graphical representation of Radiated Emission Measurement
Operation Mode: (#1) (Z axis)
Frequency: 1GHz – 3,2GHz

Full Spectrum



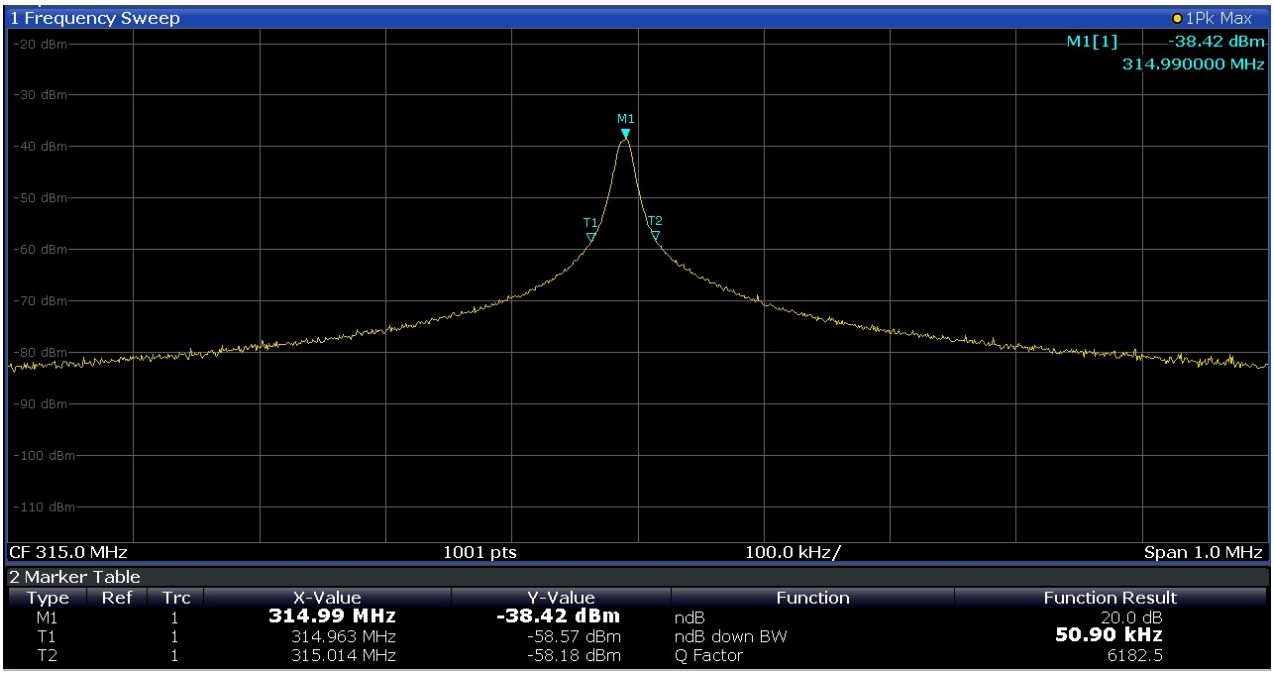
Frequency (MHz)	Peak Level (dBµV/m)	Average Level (dBµV/m)	PK Limit (dBµV/m)	AV Limit (dBµV/m)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1260,000000	39,76	34,22	75,62	55,62	1000	150,0	H	180,0	-12,2
1575,000000*	50,15	44,61	74,00	54,00	1000	150,0	H	315,0	-13,3
1890,000000	43,50	37,96	75,62	55,62	1000	150,0	H	180,0	-10,8
2205,000000*	52,43	46,89	74,00	54,00	1000	150,0	H	180,0	-9,5
2520,000000	45,42	39,88	75,62	55,62	1000	100,0	H	135,0	-8,4
2835,000000*	54,68	49,14	74,00	54,00	1000	100,0	H	0,0	-8,0
3150,000000	48,46	42,92	75,62	55,62	1000	100,0	H	135,0	-7,2
*Restricted band (par. 15.205)									
Average Level = Peak Level + Average Factor (-5,54dB)									

11.4 TEST: Bandwidth of emission (70MHz to 900MHz)			PASS
Parameters required prior to the test	Laboratory Ambient Temperature (°C)	15 to 35 °C	
	Relative Humidity (%)	30 to 60 %	
Parameters recorded during the test	Laboratory Ambient Temperature (°C)	22°C	
	Relative Humidity (%)	54%	
	Air pressure (hPa)	1020	
—	Power Supply / Frequency	Application Point	
Fully configured sample tested at the power line frequency	3,0 Vdc	Enclosure	
Equipment mode:	Operation mode	#1	
FCC Standard	§ 15.231 (C)		

(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

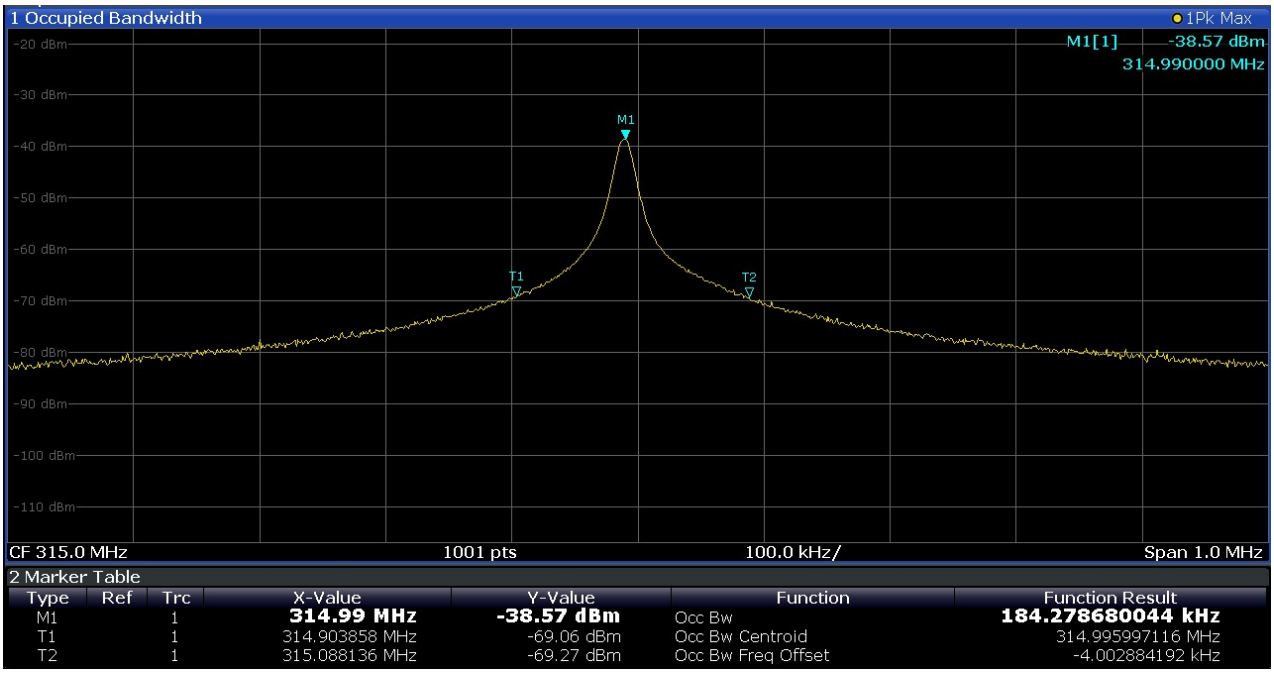
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Calibration date	Calibration due
EMI Test Receiver	R&S	ESW44	2782867	06/2019	06/2020

Bandwidth of emission (at 20dB point)



Measured level: 50,90kHz

Limit: 0,0025 x 315MHz = 787,5kHz

Bandwidth of emission (99%)

Bandwidth at 99%: 184,278kHz

END OF TEST REPORT