



**TÜVRheinland®**



LAB N° 1356 L

Report No. 28120179 005

# Test Report

## Partial tests according to

### 47 CFR FCC Part 15 subpart C Par. 15.231

### Intentional Radiators

<b>Report reference no.</b> .....	28120179 005
<b>FCC Designation Number</b> .....	IT0008
<b>FCC Test Firm Registration #</b> .....	804595
<b>Tested by (name + signature)</b> .....	Roberto Radice \ Tester
<b>Approved by (name + signature)</b> .....	Andrea Bortolotti \ Reviewer
<b>Date of issue</b> .....	13/01/2021
<b>Total number of pages</b> .....	25 Pages
<b>Testing Laboratory</b> .....	TÜV Rheinland Italia S.r.l.
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<b>Applicant's name</b> .....	Marelli Europe S.p.A.
<b>Address</b> .....	Via Aldo Borletti 61/63 - 20011 Corbetta (MI) - Italy
<b>Test item description</b> .....	Keyless entry system
<b>Trade Mark</b> .....	Giobert
<b>Manufacturer</b> .....	GIOBERT S.P.A. - Via Pavia, 82   10098 CASCINE VICA   RIVOLI (TO) Italy
<b>Model/Type reference</b> .....	RKE358.01 (PN: D2508 3T); RKE358.01 (PN: D2508 2T)
<b>Ratings</b> .....	+3V battery type CR2032
<b>Sample</b> .....	
<b>Samples received on</b> .....	04/12/2020
<b>TUV reference samples</b> .....	200976/1 and 200976/2 (sampled by the applicant)
<b>Samples tested n.</b> .....	2
<b>Testing</b> .....	
<b>Start Date:</b> .....	11/12/2020
<b>End Date:</b> .....	11/12/2020
<p>The results referred in this report are only relevant to the samples tested and described in this report. Only complete reproduction of this test report is permitted without written authorisation of TÜV Rheinland Italia</p> <p>TRI refuses any responsibility about information supplied by the customer contained in this test report</p> <p>TÜV Rheinland Italia – Via Enrico Mattei, 3 – 20010 Pogliano Milanese (MI) – Italy</p> <p>Tel. +39 02 939687100 Fax. +39 02 939687323</p>	



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**RELEASE CONTROL RECORD**

Test report Number	Reason of change	Date of Issue
28120179 005	Original release	13/01/2021

**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. <sup>1</sup>
§ 15.231 (a)	Periodic operation (par.1)	PASS
	Periodic operation (par.2)	N.A. <sup>2</sup>
	Periodic operation (par.3)	N.A. <sup>3</sup>
	Periodic operation (par.4)	N.A. <sup>4</sup>
	Periodic operation (par.5)	N.A. <sup>5</sup>
§ 15.231 (b)	Radiated emission <1GHz (fundamental)	N.R.
§ 15.209	Radiated emission >1GHz (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. <sup>6</sup>
	Radiated emission (spurious)	N.A. <sup>6</sup>

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

### Legend:

Pass = Result within the limits

N/A = Not Applicable

N/R = Not requested by the Client



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## DECISION RULE

Statements of conformity (PASS or FAIL) to specifications are made in this report without taking measurement uncertainty into account.

Where statements of conformity are made in this report, the following decision rules are applied:

PASS – Results within limits/specifications

FAIL – Results exceed limits/specifications

## 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.**

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"(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

#### Keyless entry system

The PCB is mounted ever with all four buttons, remote control can lock / unlock all doors of car, unlock trunk and can perform, remote open / close of windows (if functionality is present).

Moreover, thanks to immobilizer function, when the key is inserted in the lock barrel it can allow the engine on (only for enabled keys).

RKE adds on the same PCB following functions:

- Transponder
- Radio frequency remote control

#### Transponder

When key is inserted in key cylinder switch and a switch-on is performed, the transponder is supplied by means of a carried signal at 125 kHz (magnetic field coupling) and it's queried from transceiver immobilizer (Base Station) with a BPLM modulation code request. The transponder answers with an amplitude modulation (Manchester Coding) transmitting the code. If the key is enabled (the code is recognized), immobilizer function allow engine on.

#### Radiofrequency (RF) remote control

RF transmission is performed using a PLL transmitter (NXP NCF2960), which works in frequency modulation (FSK) on 433.92 MHz band. When a button is pushed, carrier frequency is modulated from a baseband signal of 4.8 kBaud generated from logic circuits (NXP NCF2960). Generated signal is codified using a AES algorithm (NXP HT-AES).

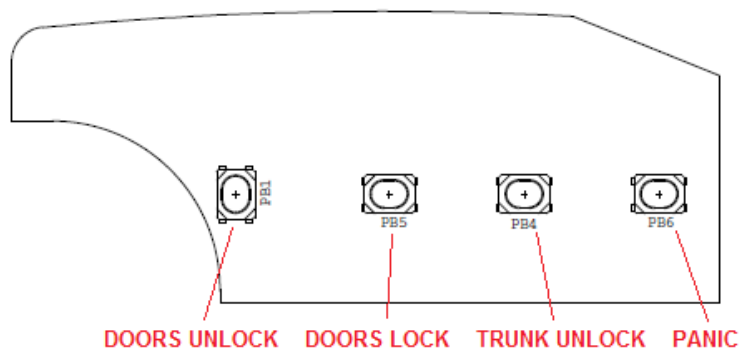
#### 4. Basic model and derived models

##### BASIC MODEL

Remote keyless entry with 4 push buttons (already certified: FCC ID: **2ADPXRKE35801** )

- Doors unlock;
- Doors lock;
- Trunk unlock;
- Panic function.

In the picture below the push buttons arrangement on the PCB.



**Figure 1 - Top view.**

##### DERIVED MODELS

Remote keyless entry with 3 push buttons  
Same PCB but without external Panic button

Remote keyless entry with 2 push buttons  
Same PCB but without external Panic button and Trunk Unlock button.



**Sample(1): RKE358.01**  
(PN: F358)  
4 BUTTONS



**Sample(2): RKE358.01**  
(PN: D2508 3T)  
3 BUTTONS



**Sample(3): RKE358.01**  
(PN: D2508 2T)  
2 BUTTONS



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5. Equipment Used During Test				
Use*	Product Type	Manufacturer	Model	Comments
EUT	Keyless entry system	GIOBERT S.P.A.	RKE358.01 (PN: D2508 3T) RKE358.01 (PN: D2508 2T)	-----
<p>Note:</p> <p>* Use :</p> <p>EUT - Equipment Under Test, AE - Auxiliary/Associated Equipment, or SIM - Simulator (Not Subjected to Test)</p> <p>No other Auxiliary/Associated Equipment was connected/installed on the EUT</p>				



## 6. Input/Output Ports

### CONNECTIONS

Port		Description	Connection	Cable lenght
1	Enclosure	Non-conductive surface	Pressure and screw	---
2	AC Power Port	Port not present	---	---
3	DC Power Port	Port not present – Internal 3V battery supplied	---	---
4	Signal port	Port not present	---	---
5	Antenna	Strip 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

## 7. Power Interface

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

**8. EUT Operation Modes**

Operation mode	Description
#1	Continuous Modulated RF Transmission at 433,92MHz
#2	Normal working condition

**9. 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 (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:

$$\text{Field Strength (dB}\mu\text{V/m)} = \text{RAW} - \text{AMP} + \text{CBL} + \text{ACF}$$

Where: RAW = Measured level before correction (dB $\mu$ V)

AMP = Amplifier Gain (dB)

CBL = Cable Loss (dB)

ACF = Antenna Correction Factor (dB/m)

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

Sample radiated emissions calculation @ 30 MHz

Measurement +Antenna Factor–Amplifier Gain+Cable loss=Radiated Emissions (dB $\mu$ V/m)

$$25 \text{ dB}\mu\text{V/m} + 17.5 \text{ dB} - 20 \text{ dB} + 1.0 \text{ dB} = 23.5 \text{ dB}\mu\text{V/m}$$

**10. Test Conditions and Results**

10.1 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)	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	§15.203	
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	

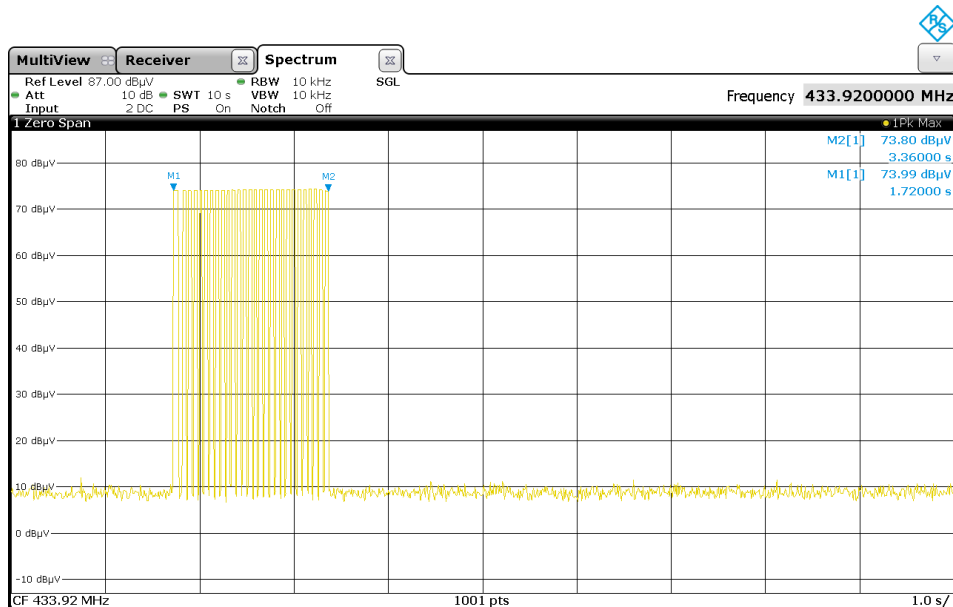


10.2 TEST: Periodic Operation			PASS
Parameters required prior to the test	Laboratory Ambient Temperature (°C)	15 to 35 °C	
	Relative Humidity (%)	30 to 60 %	
Parameters recorded during the test	Laboratory Ambient Temperature (°C)	22°C	
	Relative Humidity (%)	54%	
	Air pressure (hPa)	1020	
—	Power Supply / 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)		
<p>(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.</p> <p>(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.</p> <p>(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.</p> <p>(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.</p> <p>(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</p>			

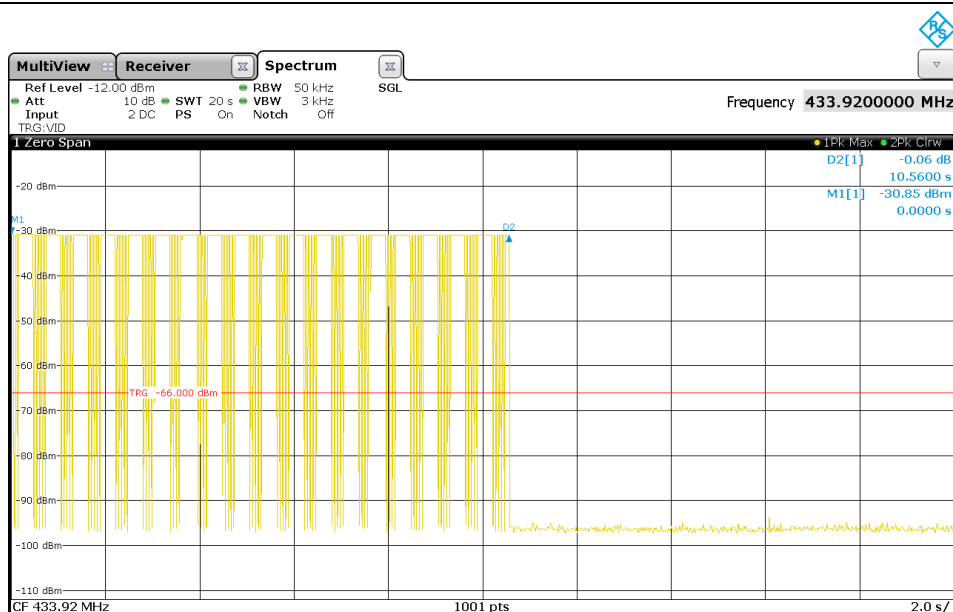
Test Equipment Used					
Description	Manufacturer	Model	Identifier	Calibration date	Calibration due
EMI Test Receiver	R&S	ESW44	2782867	05/2020	05/2021



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



The transmitter stops transmitting automatically after the release of the push button (M2)



When the push button is continuously pressed, the transmitter transmits for 10,560 seconds, then ceases to transmit even if the push button is still pressed.

**10.3 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:

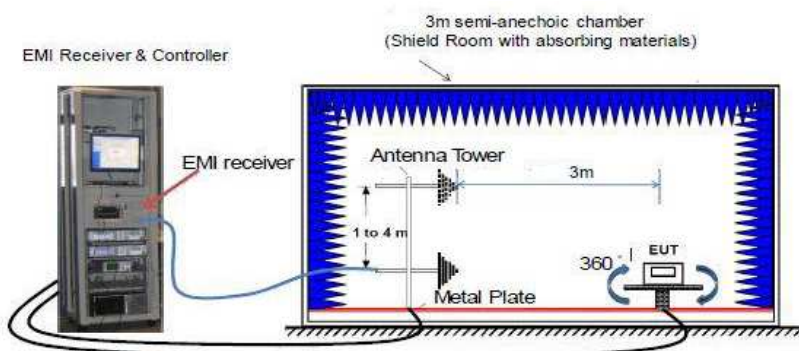
Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
40.66 - 40.70	2,250	225
70 - 130	1,250	125
130 - 174	1,250 to 3,750 **	125 to 375 **
174 - 260	3,750	375
260 - 470	3,750 to 12,500 **	375 to 1,250 **
Above 470	12,500	1,250

\*\* 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) =  $40 \log (300 \text{ meter} / 3 \text{ meter}) = +80 \text{ dB}$  Extrapolation (dB) =  $40 \log (30 \text{ meter} / 3 \text{ meter}) = +40 \text{ dB}$

Further information to test setup.

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





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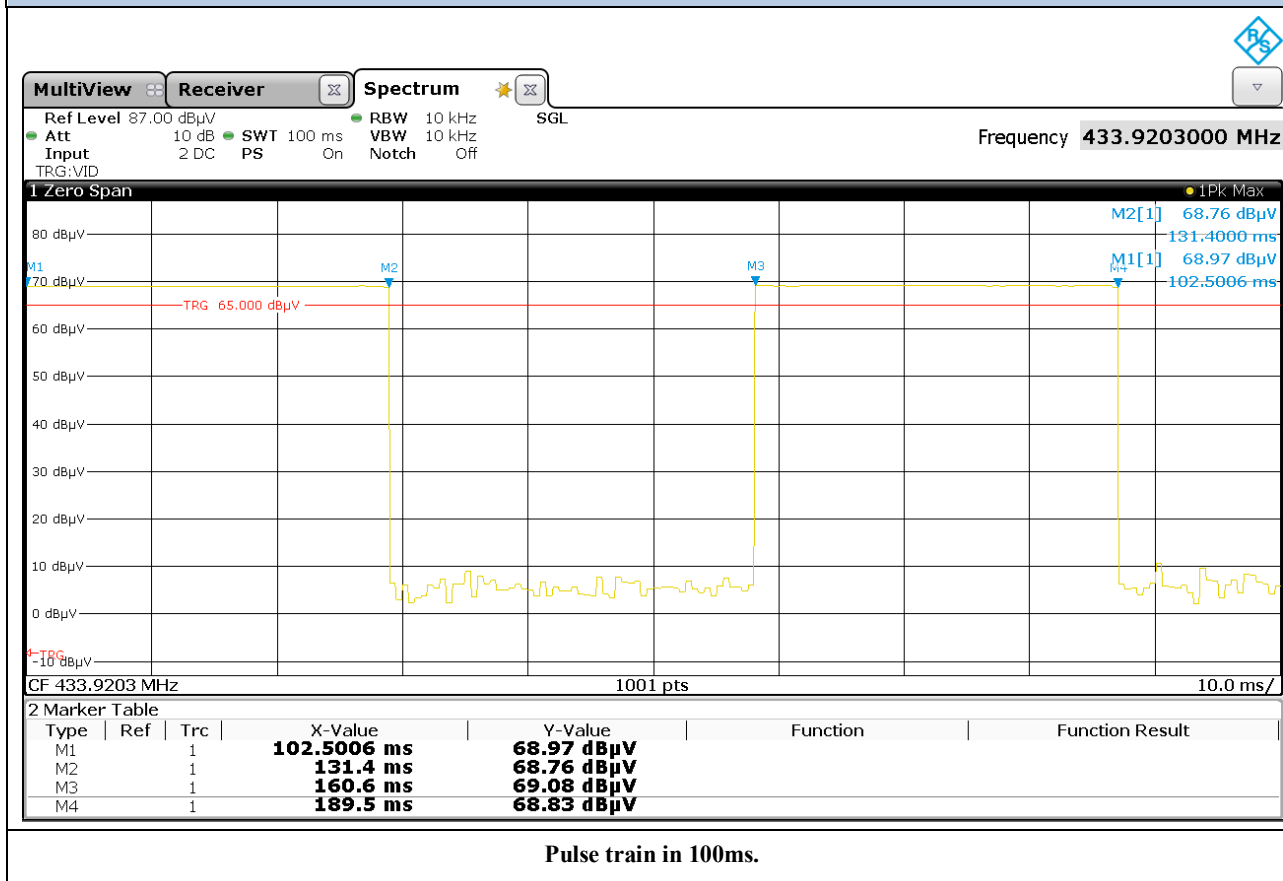
Report No. 28120179 005

Test Equipment Used

Description	Manufacturer	Model	Identifier	Calibration date	Calibration due
CSSA	ETS Lindgren	FACT3	2782378	05/2020	05/2022
EMI Test Receiver	R&S	ESW44	2782867	05/2020	05/2021
Antenna Horn with Preamplifier	ETS Lindgren	3117-PA	2782349	08/2020	08/2023
Highpass Filter	Wainwright Instr.	WHKX10-1170-1300	2782705	12/2020	12/2021



Pulse train duration §15.35 (c)



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.

$$\text{Average Factor} = 20\log (T_{on} / T_{on} + T_{off}) = 20\log (57,80\text{ms}/100\text{ms}) = -4,76\text{dB}$$



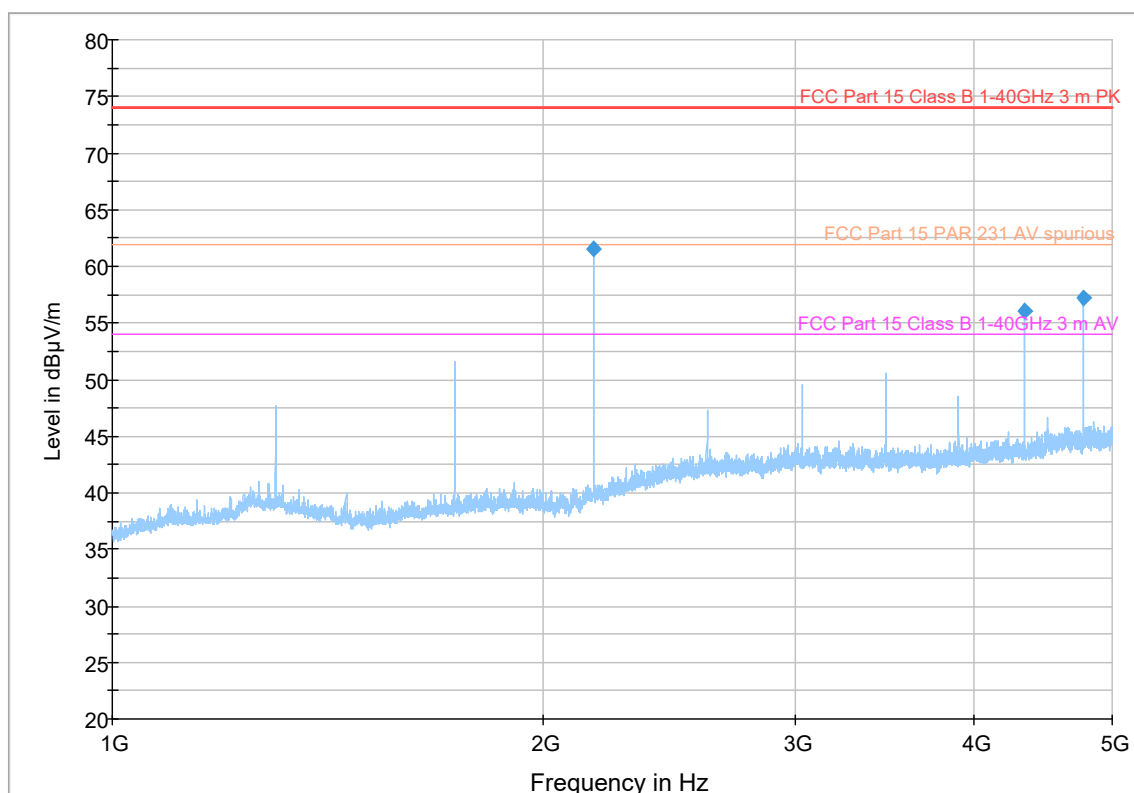
**MODEL RKE358.01 (PN: D2508 3T)**

Graphical representation of Radiated Emission Measurement

Operation Mode: (#1) (X axis)

Frequency: 1GHz – 5GHz

Full Spectrum



Frequency (MHz)	Peak Level (dBµV/m)	PK Limit (dBµV/m)	Average Level (dBµV/m)	AV Limit (dBµV/m)	Result
1301,750000*	47,63	74,00	42,87	54,00	PASS
1735,750000	51,60	81,94	46,84	61,94	PASS
2169,500000	61,54	81,94	56,78	61,94	PASS
2603,500000	47,20	81,94	42,44	61,94	PASS
3037,500000	49,52	81,94	44,76	61,94	PASS
3471,250000	50,54	81,94	45,78	61,94	PASS
3905,250000*	48,53	74,00	43,77	54,00	PASS
4339,000000*	56,03	74,00	51,27	54,00	PASS
4773,000000*	57,26	74,00	52,50	54,00	PASS
*Restricted band (par. 15.205)					
Average Level = Peak Level + Average Factor (-4,76dB)					

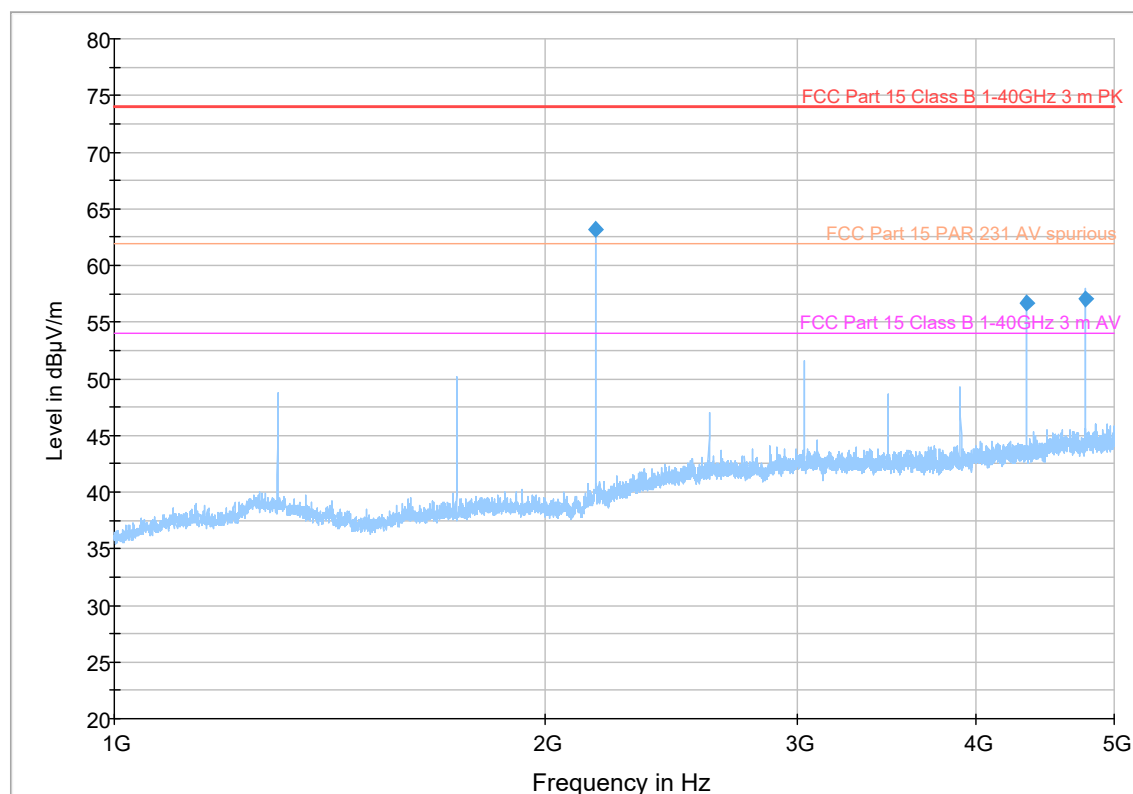


Graphical representation of Radiated Emission Measurement

Operation Mode: (#1) (Y axis)

Frequency: 1GHz – 5GHz

Full Spectrum



Frequency (MHz)	Peak Level (dBµV/m)	PK Limit (dBµV/m)	Average Level (dBµV/m)	AV Limit (dBµV/m)	Result
1301,750000*	48,83	74,00	44,07	54,00	PASS
1735,750000	50,22	81,94	45,46	61,94	PASS
2169,500000	63,13	81,94	58,37	61,94	PASS
2603,500000	47,02	81,94	42,26	61,94	PASS
3037,500000	51,57	81,94	46,81	61,94	PASS
3471,250000	48,72	81,94	43,96	61,94	PASS
3905,250000*	49,34	74,00	44,58	54,00	PASS
4339,000000*	56,66	74,00	51,90	54,00	PASS
4773,000000*	57,10	74,00	52,34	54,00	PASS
*Restricted band (par. 15.205)					
Average Level = Peak Level + Average Factor (-4,76dB)					

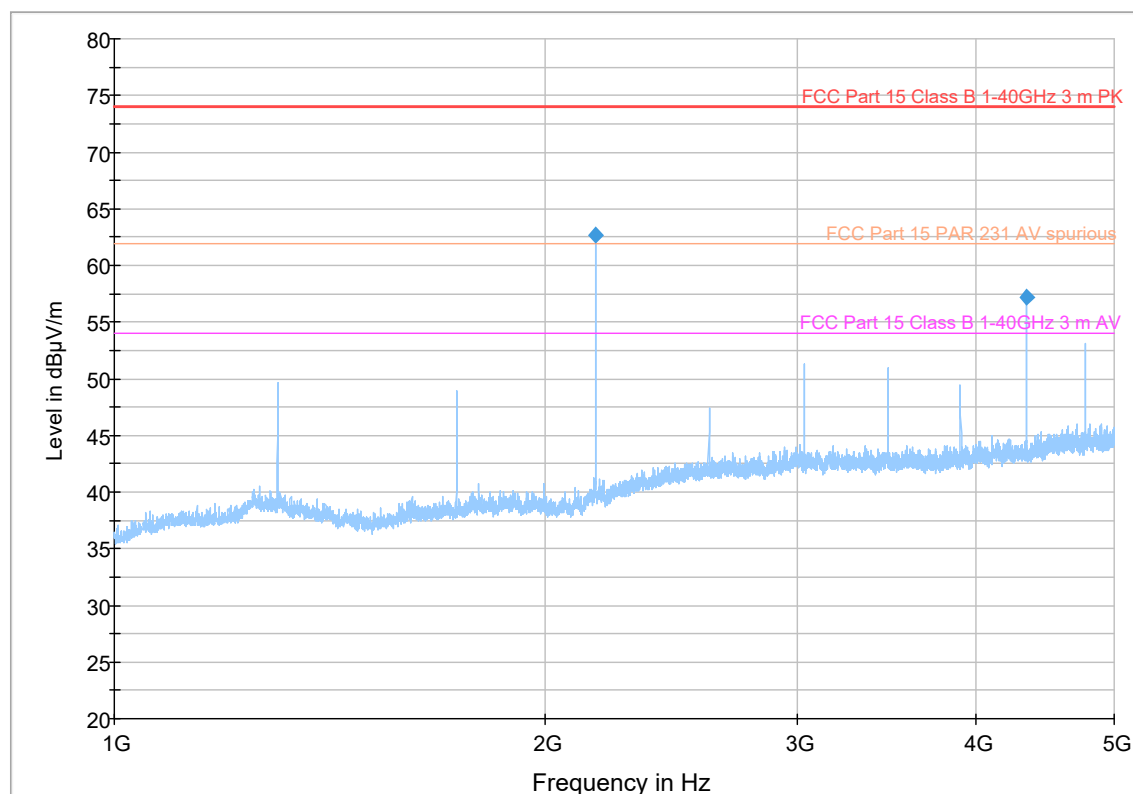


Graphical representation of Radiated Emission Measurement

Operation Mode: (#1) (Z axis)

Frequency: 1GHz – 5GHz

Full Spectrum



Frequency (MHz)	Peak Level (dBµV/m)	PK Limit (dBµV/m)	Average Level (dBµV/m)	AV Limit (dBµV/m)	Result
1301,750000*	49,66	74,00	44,90	54,00	PASS
1735,750000	48,85	81,94	44,09	61,94	PASS
2169,500000	62,70	81,94	57,94	61,94	PASS
2603,500000	47,33	81,94	42,57	61,94	PASS
3037,500000	51,35	81,94	46,59	61,94	PASS
3471,250000	51,02	81,94	46,26	61,94	PASS
3905,250000*	49,39	74,00	44,63	54,00	PASS
4339,000000*	57,23	74,00	52,47	54,00	PASS
4773,000000*	52,80	74,00	48,04	54,00	PASS
*Restricted band (par. 15.205)					
Average Level = Peak Level + Average Factor (-4,76dB)					



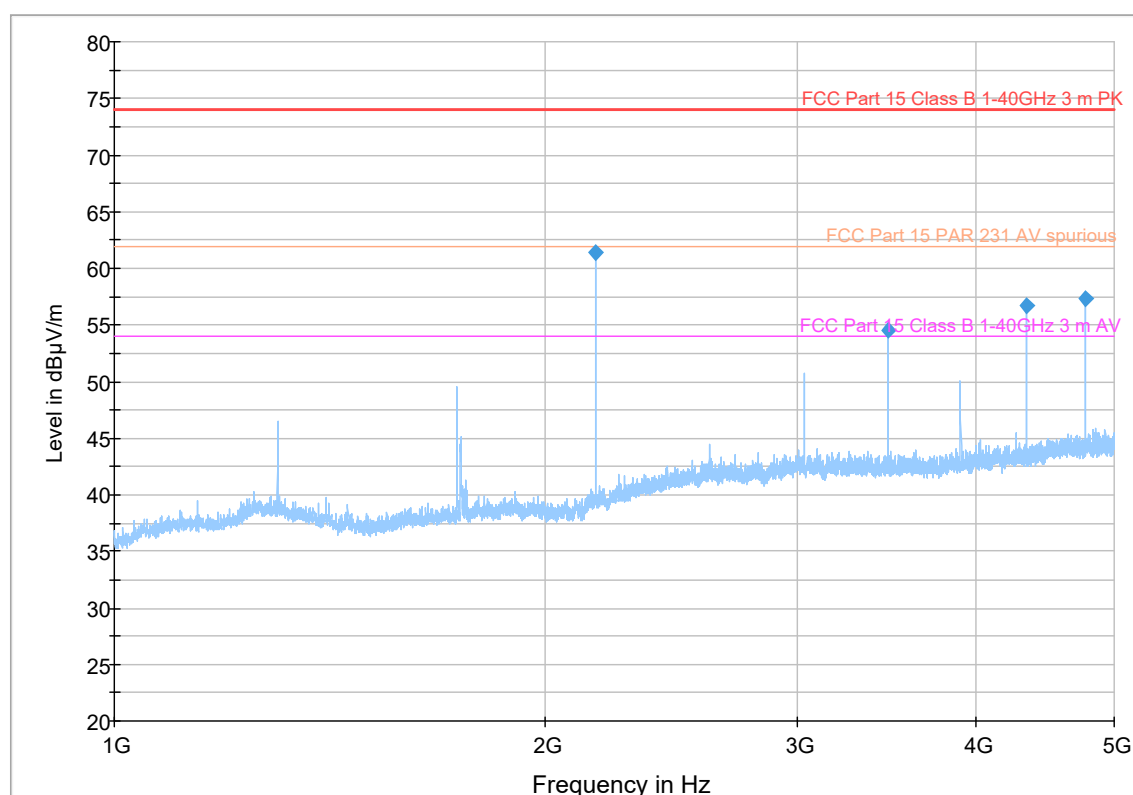
**MODEL RKE358.01 (PN: D2508 2T)**

Graphical representation of Radiated Emission Measurement

Operation Mode: (#1) (X axis)

Frequency: 1GHz – 5GHz

Full Spectrum



Frequency (MHz)	Peak Level (dBµV/m)	PK Limit (dBµV/m)	Average Level (dBµV/m)	AV Limit (dBµV/m)	Result
1301,750000*	46,44	74,00	41,68	54,00	PASS
1735,750000	49,58	81,94	44,82	61,94	PASS
2169,500000	61,44	81,94	56,68	61,94	PASS
2603,500000	44,46	81,94	39,70	61,94	PASS
3037,500000	50,71	81,94	45,95	61,94	PASS
3471,250000	54,48	81,94	49,72	61,94	PASS
3905,250000*	50,07	74,00	45,31	54,00	PASS
4339,000000*	56,66	74,00	51,90	54,00	PASS
4773,000000*	57,30	74,00	52,54	54,00	PASS
*Restricted band (par. 15.205)					
Average Level = Peak Level + Average Factor (-4,76dB)					

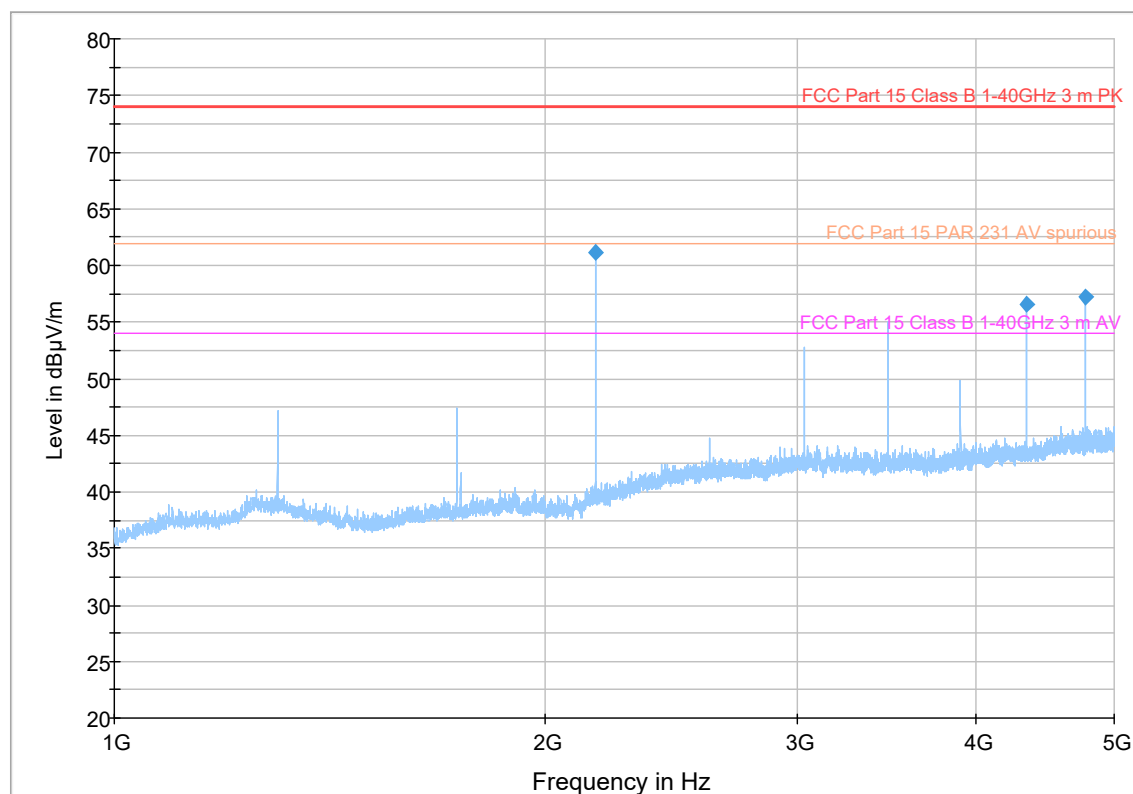


Graphical representation of Radiated Emission Measurement

Operation Mode: (#1) (Y axis)

Frequency: 1GHz – 5GHz

Full Spectrum



Frequency (MHz)	Peak Level (dBµV/m)	PK Limit (dBµV/m)	Average Level (dBµV/m)	AV Limit (dBµV/m)	Result
1301,750000*	47,13	74,00	42,37	54,00	PASS
1735,750000	47,33	81,94	42,57	61,94	PASS
2169,500000	61,13	81,94	56,37	61,94	PASS
2603,500000	44,65	81,94	39,89	61,94	PASS
3037,500000	52,78	81,94	48,02	61,94	PASS
3471,250000	55,04	81,94	50,28	61,94	PASS
3905,250000*	49,80	74,00	45,04	54,00	PASS
4339,000000*	56,56	74,00	51,80	54,00	PASS
4773,000000*	57,14	74,00	52,38	54,00	PASS
*Restricted band (par. 15.205)					
Average Level = Peak Level + Average Factor (-4,76dB)					

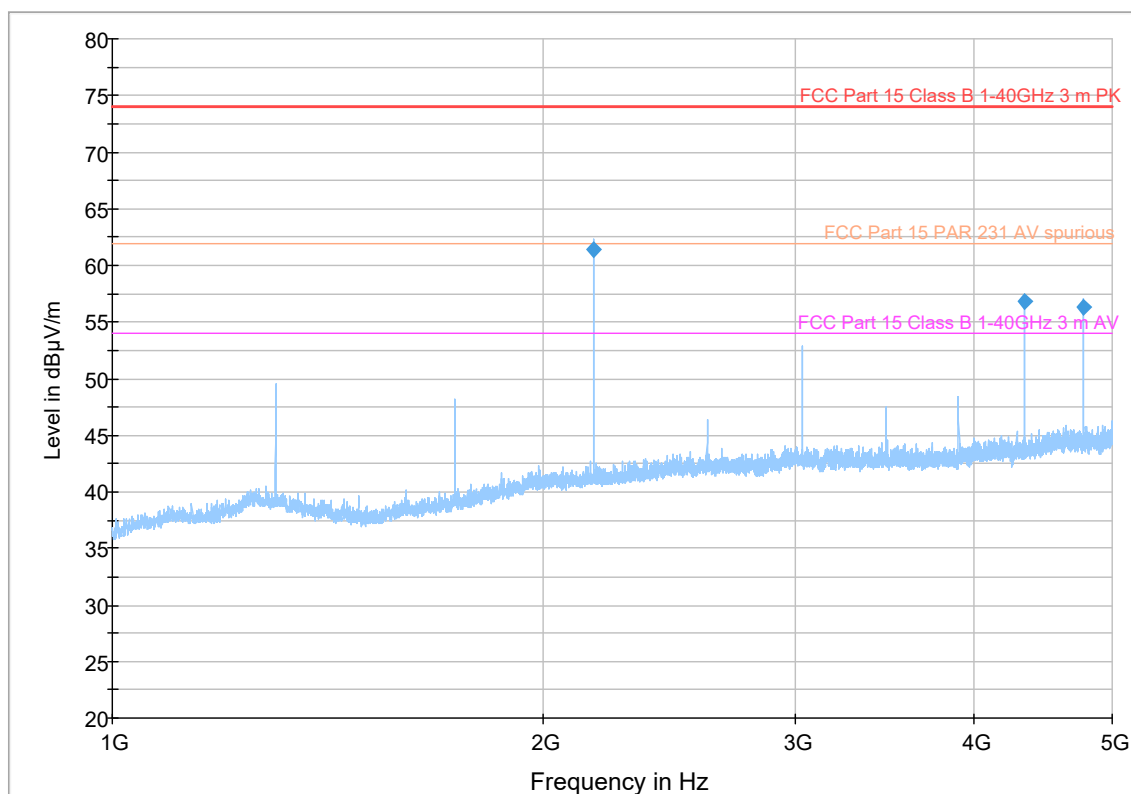


Graphical representation of Radiated Emission Measurement

Operation Mode: (#1) (Z axis)

Frequency: 1GHz – 5GHz

Full Spectrum



Frequency (MHz)	Peak Level (dBµV/m)	PK Limit (dBµV/m)	Average Level (dBµV/m)	AV Limit (dBµV/m)	Result
1301,750000*	49,61	74,00	44,85	54,00	PASS
1735,750000	48,21	81,94	43,45	61,94	PASS
2169,500000	61,40	81,94	56,64	61,94	PASS
2603,500000	46,35	81,94	41,59	61,94	PASS
3037,500000	52,82	81,94	48,06	61,94	PASS
3471,250000	47,47	81,94	42,71	61,94	PASS
3905,250000*	48,44	74,00	46,68	54,00	PASS
4339,000000*	56,80	74,00	52,04	54,00	PASS
4773,000000*	56,36	74,00	51,60	54,00	PASS
*Restricted band (par. 15.205)					
Average Level = Peak Level + Average Factor (-4,76dB)					



10.4 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	05/2020	05/2021



Bandwidth of emission (at 20dB point)

