

TEST REPORT # EMCC-020547YB, 2016-09-09**EQUIPMENT UNDER TEST:**

Device: DOS048-004
Serial Number: 190716_001
FCC ID: 2A15Y-DOS048004
IC: None
Application: Microwave Doppler Radar Sensor
Manufacturer: AMG Microwave
Address: 11 rue Louis de Broglie
22300 Lannion
France
Applicant: EMITECH ANGERS
Phone: +33 2 4173 2627
Fax: +33 2 4173 2640

RELEVANT STANDARD(S):

47 CFR § 15.245
RSS-210 Issue 9, Annex F.1

MEASUREMENT PROCEDURE:

☒ ANSI C63.10-2013 ☒ RSS-Gen Issue 4 ☐ Other

TEST REPORT PREPARED BY:

Patrick Reusch
EMCCons DR. RAŠEK GmbH & Co. KG
Boelwiese 8
91320 Ebermannstadt
Germany
Phone: +49 9194 7262-0
Fax: +49 9194 7262-199
E-Mail: p.reusch@emcc.de

TEST PERSONNEL:

Patrick Reusch

**HEAD OF COMMERCIAL
EMC AND RADIO DEPT.:**
Wolfgang Döring

Test of AMG Microwave DOS048-004 to FCC and ISED rules

CONTENTS**Page**

1	General Information	3
1.1	Purpose	3
1.2	Limits and Reservations	3
1.3	Test Location	3
1.4	Manufacturer	4
1.5	Applicant	4
1.6	Dates and Test Location	4
1.7	Ordering Information	4
1.8	Climatic Conditions	4
2	Product Description	5
2.1	Equipment Under Test (EUT)	5
2.2	Intended Use	5
2.3	EUT Peripherals/Simulators	5
2.4	Mode of Operation during Testing and Test Set-up	5
2.5	Modifications Required for Compliance	5
3	Test Results Summary	6
4	Antenna Requirement	7
4.1	Regulation	7
4.2	Test Equipment	7
4.3	Test Procedures	7
4.4	Test Result	7
5	Occupied Bandwidth	8
5.1	Regulation	8
5.2	Test Equipment	8
5.3	Test Procedures	9
5.4	Test Result	10
5.5	Measurement Plots	11
6	Power Line Conducted Emissions Test	12
6.1	Regulation	12
6.2	Test Equipment	13
6.3	Test Procedures	13
6.4	Test Result	14
6.5	Measurement Plots	15
7	Radiated Emissions 9 kHz – 30 MHz	16
7.1	Regulation	16
7.2	Test Equipment	21
7.3	Test Procedures	21
7.4	Calculation of Field Strength Limits	22
7.5	Field Strength Calculation	22
7.6	Final Test Results	23
7.7	Measurement Prescan-Plots	24
8	Radiated Emissions 30 MHz – 1000 MHz	25
8.1	Regulation	25
8.2	Test Equipment	30
8.3	Test Procedures	30
8.4	Calculation of Field Strength Limits	31
8.5	Field Strength Calculation	31
8.6	Final Test Results	31
8.7	Measurement Prescan-Plots	32
9	Radiated Emissions 1 GHz – 100 GHz	33
9.1	Regulation	33
9.2	Test Equipment	38
9.3	Test Procedures	39
9.4	Calculation of Field Strength Limits	40
9.5	Field Strength Calculation	40
9.6	Final Test Results	42
9.7	Exploratory Measurement Plots	43
9.8	Final Measurement Plots	46
10	Measurement Uncertainty	49
11	List of Annexes	50

1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance with the FCC 47 CFR § 15.245 and Innovation, Science and Economic Development Canada (ISED) RSS-210 Annex F.1 requirements for the certification of licence-exempt intentional radiator.

1.2 Limits and Reservations

The test results in this report apply only to the particular equipment under test (EUT) as declared in this report. This test report shall not be reproduced except in full without the written permission of EMCCons DR. RAŠEK GmbH & Co. KG.

1.3 Test Location

Test Laboratory: EMCCons DR. RAŠEK GmbH & Co. KG

Accreditation No.: D-PL-12067-01-02

Address of Labs I, II, III
and Head Office:

EMCCons DR. RAŠEK GmbH & Co. KG
Boelwiese 8
91320 Ebermannstadt
GERMANY

Address of Labs IV and V: EMCCons DR. RAŠEK GmbH & Co. KG
Stoernhofer Berg 15
91364 Unterleinleiter
GERMANY

Laboratory: Test Laboratory IV

The 3 m & 10 m semi-anechoic chamber site has been fully described in a report submitted to the FCC and accepted in the letter dated December 24, 2013, Registration Number 878769.

The 3 m & 10 m semi-anechoic chamber site has been fully described in a report submitted to ISED. This 3m/10m alternative test site is approved by ISED under file number 3464C-1.

Phone: +49 9194 7262-0
Fax: +49 9194 7262-199
E-Mail: emc.cons@emcc.de
Web: www.emcc.de

Test of AMG Microwave DOS048-004 to FCC and ISED rules

1.4 Manufacturer

Company Name: AMG Microwave
Street: 11 rue Louis de Broglie
City: 22300 Lannion
Country: France

1.5 Applicant

Company Name: EMITECH ANGERS
Street: 15, rue de la Claie
City: 49070 Beaucouzé
Country: France

Name for contact purposes: Philippe Bourvon
Phone: +33 2 4173 2627
Fax: +33 2 4173 2640
E-Mail: p.bourvon@emitech.fr

1.6 Dates and Test Location

Date of receipt of EUT: 2016-08-23
Test Date: CW 34/2016
Test Location: Lab IV

1.7 Ordering Information

Purchase Order: BC-16-11006
Date: 2016-07-19
Vendor Number: None

1.8 Climatic Conditions

Date	Temperature [°C]	Relative Humidity [%]	Air Pressure [hPa]	Lab	Customer attended tests
2016-08-23	23	54	987	IV	no
2016-08-24	24	55	984	IV	no
2016-08-25	24	53	978	IV	no

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Trade Name:	DOS048-004
Serial Number:	190716_001
FCC ID:	2AI5Y-DOS048004
IC:	None
Application:	Microwave Doppler Radar Sensor
Transmit Frequency:	24.075 - 24.175 GHz, typical: 24.125 GHz
Modulation:	No Modulation, pulsed operation
Power Supply:	12 VDC
Antenna:	Internal
Variants:	None
Remarks:	None

The following information was delivered by the customer:

The product is in addition a doppler radar with following functions:

- *Movement detection*
- *Speed measurement*
- *Distance measurement*

2.2 Intended Use

The following information was delivered by the customer:

Movement detection + speed and distance measurement.

2.3 EUT Peripherals/Simulators

None.

2.4 Mode of Operation during Testing and Test Set-up

The equipment under test (EUT) was operated during the tests under the following conditions:

Normal Operation:

The EUT transmits one pulse with a length of approx. 3 μ s every 100 μ s.

The radiated emission test 9kHz – 30 MHz and 30 MHz – 1000 MHz was done in two EUT positions (orientation). Position 1 (Pos.1) upright and position 2 (Pos. 2) flat.

2.5 Modifications Required for Compliance

None.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

3 TEST RESULTS SUMMARY

Summary of test results for the following EUT:

Manufacturer: AMG Microwave
Device: DOS048-004
Serial No: 190716_001

Requirement	47 CFR Section	RSS Section	Report Section	Result
Antenna Requirement	15.203	---	4	Passed
Occupied Bandwidth	15.215		5	Passed
Conducted AC Power Line Emissions 150 kHz – 30 MHz	15.207	RSS-Gen 8.8	6	Passed
Radiated Emissions 9 kHz – 30 MHz	15.205, 15.209, 15.245	RSS-Gen 8.9, RSS-Gen 8.10, RSS-210 F.1	7	Passed
Radiated Emissions 30 MHz – 1000 MHz	15.205, 15.209, 15.245	RSS-Gen 8.9, RSS-Gen 8.10, RSS-210 F.1	8	Passed
Radiated Emissions 1 GHz – 100 GHz	15.205, 15.209, 15.245	RSS-Gen 8.9, RSS-Gen 8.10, RSS-210 F.1	9	Passed

N.A. – not applicable; N.T. – Not tested acc. to applicant's order.

The client has made the determination that EUT Condition, Characterization, and Mode of Operation are representative of production units and meet the requirements of the specifications referenced herein.

Consistent with Industry practice, measurement and test equipment not directly involved in obtaining measurement results but having an impact on measurements (such as cable loss, antenna factors, etc.) are factored into the "Correction Factor" documented in certain test results. Instrumentation employed for testing meets tolerances consistent with known Industry Standards and Regulations.

The measurements contained in this report were made in accordance with the procedures described in ANSI C63.10-2013. All requirements were found to be within the limits outlined in this report.

The test results in this report apply only to the particular equipment under test (EUT), as declared in this report.

Test Personnel: Patrick Reusch
Issuance Date: 2016-09-09

4 ANTENNA REQUIREMENT

Test Requirement: FCC 47 CFR, § 15.215

Test Procedure: None

4.1 Regulation

FCC §15.203 Antenna requirement.

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 §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 §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.

4.2 Test Equipment

None.

4.3 Test Procedures

None.

4.4 Test Result

Antenna is a fix installed PCB-Antenna. Refer to Appendix 2 of this report for detailed photographs.

Manufacturer: AMG Microwave

Device: DOS048-004

Serial No: 190716_001

The EUT meets the requirements of this section.

5 OCCUPIED BANDWIDTH

Test Requirement: FCC 47 CFR, § 15.215
ISED RSS-Gen 6.6
Test Procedure: ANSI C63.10-2013

5.1 Regulation

FCC §15.215 Additional provisions to the general radiated emission limitations.

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

ISED RSS-Gen 6.6 Occupied Bandwidth

The emission bandwidth (×dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated × dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3× the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

5.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Standard Gain Horn Ant.	Mid Century / MC 20/31B	1300	2016-08	2018-08
DC Power Supply	Goobay / DF-1730LCD	3489	n.a.	n.a.
Spectrum Analyzer	R&S / FSU50	3831	2016-08	2017-08
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
RF Cable	RB / LA1-008-1500	5612	2016-08	2017-08

5.3 Test Procedures

The measurement of the 20dB Bandwidth was performed according to the steps described in ANSI C63.10:2013 chapter 6.9.2:

- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.
 - b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.
 - c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (OBW/RBW)]$ below the reference level. Specific guidance is given in 4.1.5.2.
 - d) Steps a) through c) might require iteration to adjust within the specified tolerances.
 - e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target “-xx dB down” requirement; that is, if the requirement calls for measuring the -20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.
 - f) Set detection mode to peak and trace mode to max hold.
 - g) Determine the reference value: Set the EUT to transmit an unmodulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
 - h) Determine the “-xx dB down amplitude” using $[(\text{reference value}) - xx]$. Alternatively, this calculation may be made by using the marker-delta function of the instrument.
- [...]

The measurement of the 99% Bandwidth was performed according to the steps described in RSS-Gen chapter 6.6:

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately $3 \times RBW$.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

5.4 Test Result

20 dB Bandwidth:

Center Frequency [GHz]	Lower Bandedge [GHz]	Upper Bandedge [GHz]	20dB Bandwidth [MHz]
24.14022	24.13824	24.14228	4.0

99% Bandwidth:

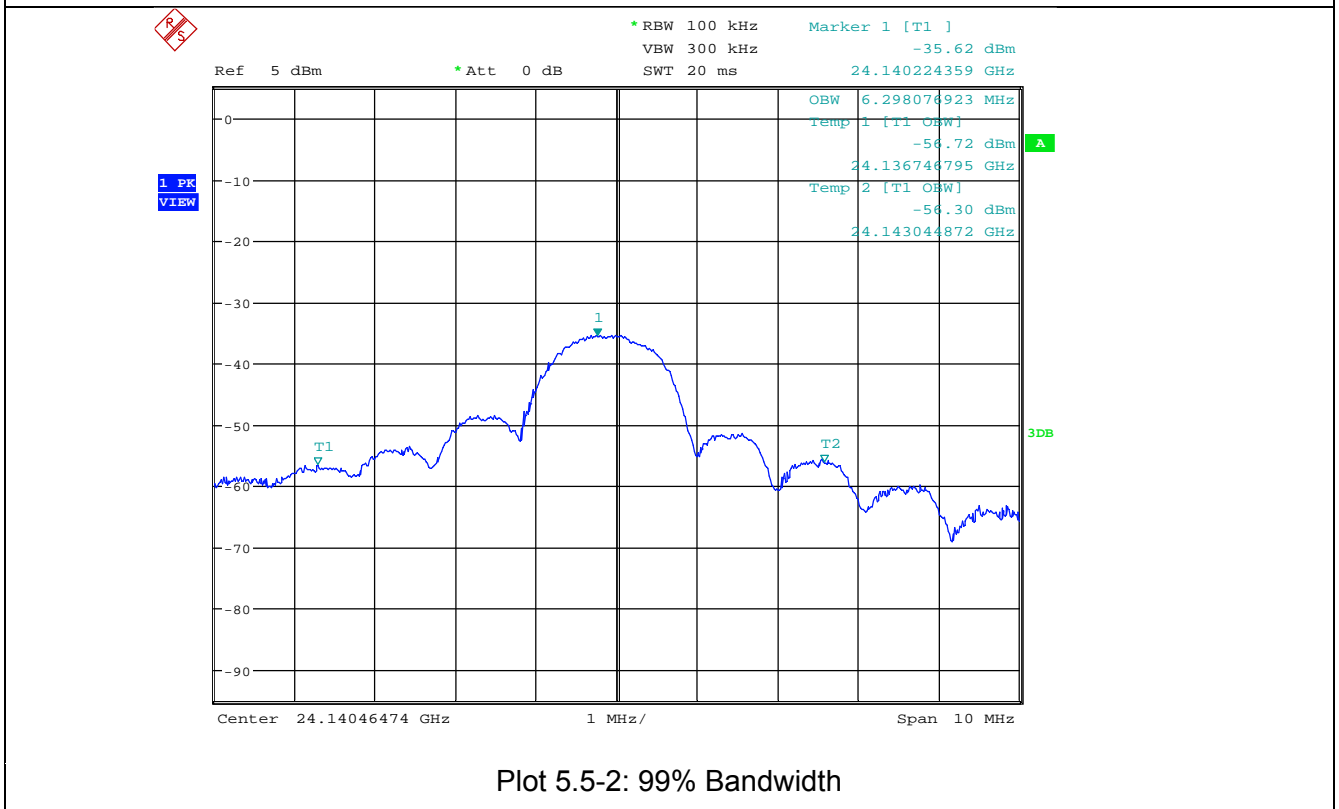
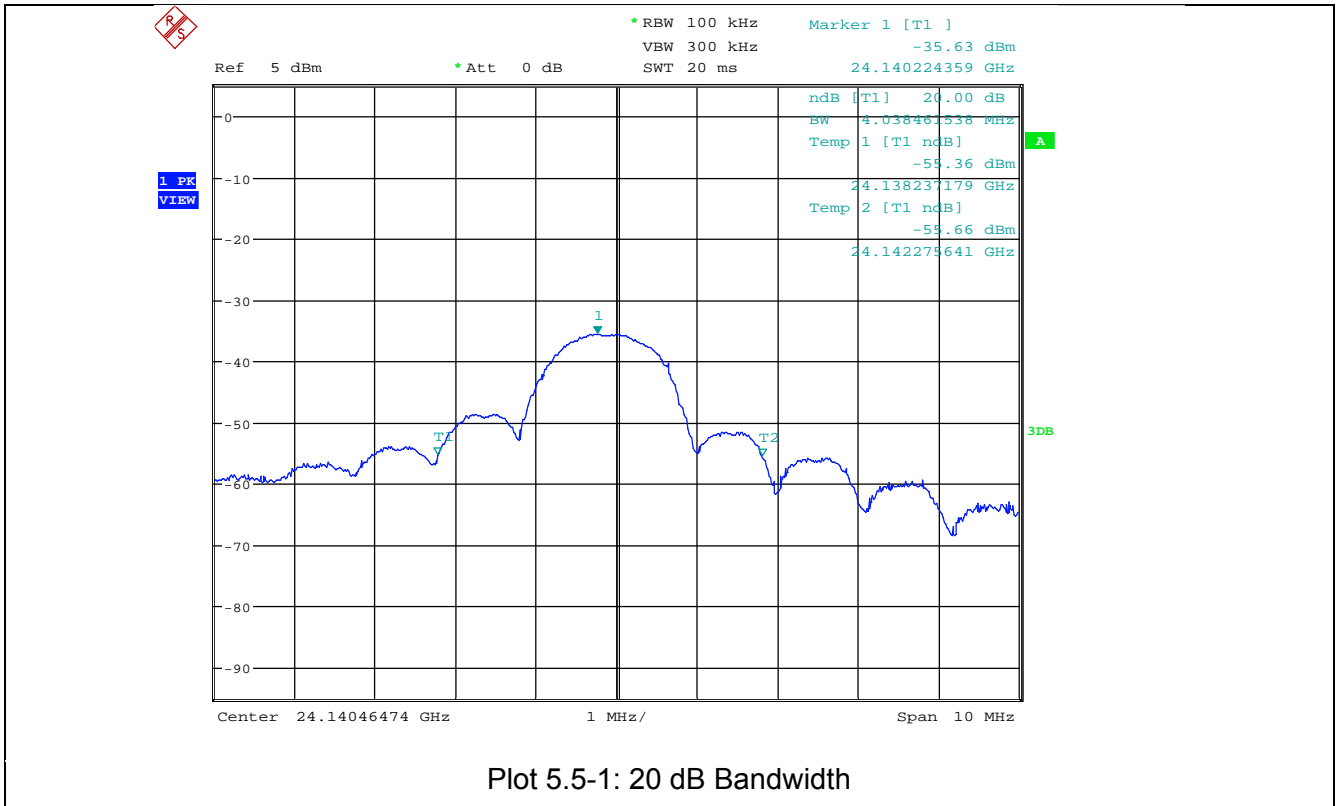
Center Frequency [GHz]	Lower Bandedge [GHz]	Upper Bandedge [GHz]	99% Bandwidth [MHz]
24.14022	24.13675	24.14304	6.3

Manufacturer: AMG Microwave
Device: DOS048-004
Serial No: 190716_001

The EUT meets the requirements of this section.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

5.5 Measurement Plots



6 POWER LINE CONDUCTED EMISSIONS TEST

Test Requirement: FCC 47 CFR, § 15.207
ISED RSS-Gen 8.8
Test Procedure: ANSI C63.10-2013

6.1 Regulation

FCC §15.207 Conducted limits.

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission [MHz]	Conducted Limit [dB μ V]	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
0.5-30	60	50

*Decreases with the logarithm of the frequency.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current system containing their fundamental emission within the frequency band 535–1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 μ V within the frequency band 535–1705 kHz, as measured using a 50 μ H/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in § 15.205, § 15.209, § 15.221, § 15.223, or § 15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

ISED RSS-Gen 8.8 AC Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz-30 MHz, shall not exceed the limits in Table 3.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with

Test of AMG Microwave DOS048-004 to FCC and ISED rules

a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in Table 3 below. The more stringent limit applies at the frequency range boundaries.

The conducted emissions shall be measured in accordance with the reference publication mentioned in Section 3.

Table 3 — AC Power Line Conducted Emissions Limits		
Frequency of Emission [MHz]	Conducted Limit [dBµV]	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5–5	56	46
0.5-30	60	50

Footnote *

* The level decreases linearly with the logarithm of the frequency.

6.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
60-Hz-Converter	AEG / DAMK4/DAGK4	0001	n.a.	n.a.
Pulse Limiter	R&S / ESH3-Z2	1519	2015-09	2017-09
V-LISN 50 ohms/(50 uH + 5 ohms)	R&S / ESH2-Z5	1901	2015-09	2017-09
EMI Test Receiver	R&S / ESU8	3846	2016-09	2017-09
BNC cable	BNC003m0	5551	2016-04	2017-04
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
DC Power Supply	Tektronix / PWS4205	4721	n.a.	n.a.

6.3 Test Procedures

The measurement was performed according to ANSI C63.10:2013 chapter 6.2:

The EUT was placed on a wooden table of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting wall of the screened room was located 40 cm to the rear of the EUT.

The excess length of the power cord of the ac adapter to the EUT was folded back and forth at the center of the lead to form a bundle not exceeding 40 cm in length.

LISN housing, measuring instrument case, reference ground plane and the vertical conducting wall of the screened room was bonded together.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

6.4 Test Result

Line: N			
Freq. [MHz]	Detector	Result [dBμV]	Margin [dB]
16.575	CISPR AV	22.0	28.0
20.000	CISPR AV	25.8	24.2
21.200	CISPR QP	20.6	39.4
22.600	CISPR AV	26.0	24.0
23.105	CISPR AV	23.6	26.4
23.730	CISPR QP	21.6	38.4
---	---	---	---

Line: L			
Freq. [MHz]	Detector	Result [dBμV]	Margin [dB]
15.065	CISPR AV	19.3	30.7
17.075	CISPR AV	22.3	27.7
20.000	CISPR AV	25.5	24.5
21.595	CISPR AV	26.1	23.9
22.175	CISPR QP	17.9	42.1
23.220	CISPR QP	19.1	40.9
23.605	CISPR AV	23.6	26.4

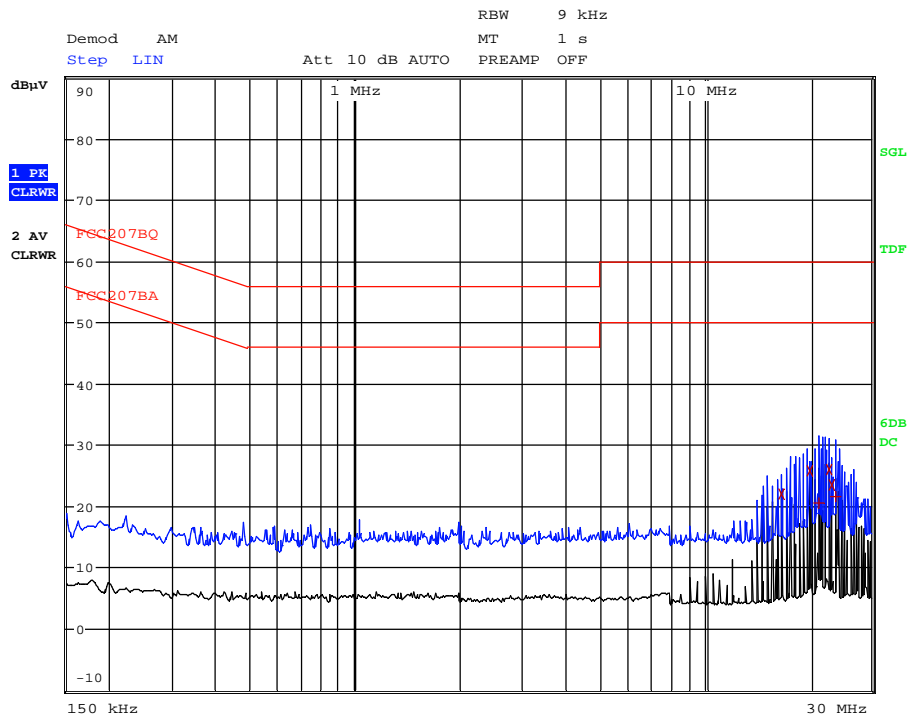
The tables above contain worst-case emissions, only. For further details refer to the test plots.

Manufacturer: AMG Microwave
Device: DOS048-004
Serial No: 190716_001

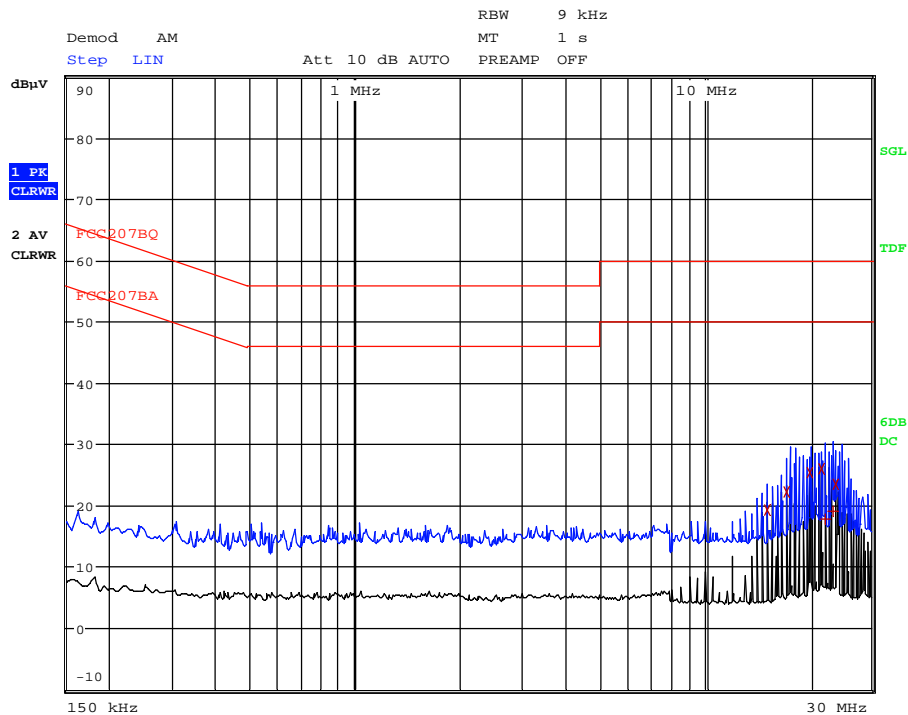
The EUT meets the requirements of this section.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

6.5 Measurement Plots



Plot 6.5-1: Line N



Plot 6.5-2: Line L

Note: the EUT was connected to a standard laboratory power supply provided by EMCC.

7 RADIATED EMISSIONS 9 kHz – 30 MHz

Test requirement: FCC 47 CFR §§ 15.205, 15.209, 15.245

ISED RSS-Gen 8.9, 8.10, RSS-210 F.1

Test procedure: ANSI C63.10-2013

7.1 Regulation

FCC §15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(₂)
13.36-13.41			

¹Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

²Above 38.6

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e) of this section, regardless of the field strength limits specified elsewhere in this subpart, the provisions of this section apply to emissions from any intentional radiator.

[...]

FCC §15.209 Radiated emission limits; general requirements.

(a) 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:

Test of AMG Microwave DOS048-004 to FCC and ISED rules

Frequency [MHz]	Field Strength [μV/m]	Measurement Distance [m]
0.009 - 0.490	2400/F[kHz]	300
0.490 - 1.705	24000/F[kHz]	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

FCC §15.245 Operation within the bands 902-928 MHz, 2435-2465 MHz, 5785-5815 MHz, 10500-10550 MHz, and 24075-24175 MHz.

(a) Operation under the provisions of this section is limited to intentional radiators used as field disturbance sensors, excluding perimeter protection systems.

(b) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (millivolts/meter)
902-928	500	1.6
2435-2465	500	1.6
5785-5815	500	1.6
10500-10550	2500	25.0
24075-24175	2500	25.0

Test of AMG Microwave DOS048-004 to FCC and ISED rules

(1) Regardless of the limits shown in the above table, harmonic emissions in the restricted bands below 17.7 GHz, as specified in §15.205, shall not exceed the field strength limits shown in §15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:

(i) For the second and third harmonics of field disturbance sensors operating in the 24075-24175 MHz band and for other field disturbance sensors designed for use only within a building or to open building doors, 25.0 mV/m.

(ii) For all other field disturbance sensors, 7.5 mV/m.

(iii) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation unless their emissions in the restricted bands, other than the second and third harmonics from devices operating in the 24075-24175 MHz band, fully comply with the limits given in §15.209. Continuous operation of field disturbance sensors designed to be used in farm equipment, vehicles such as fork lifts that are intended primarily for use indoors or for very specialized operations, or railroad locomotives, railroad cars and other equipment which travels on fixed tracks is permitted. A field disturbance sensor will be considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g., putting a vehicle into reverse gear, activating a turn signal, etc.).

(2) Field strength limits are specified at a distance of 3 meters.

(3) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(4) The emission limits shown above are based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

ISED RSS-Gen 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency	Field Strength at 3m
[MHz]	[µV/m]
30 - 88	100
88 - 216	150
216 - 960	200
Above 960	500

Footnote *

Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

Table 5 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Below 30 MHz

Frequency	Electric Field Strength	Magnetic Field Strength (H-Field)	Measurement Distance
	[$\mu\text{V/m}$]	[$\mu\text{A/m}$]	[m]
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1,705-30 MHz	30	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector. Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the relevant RSS.

ISED RSS-Gen 8.10 Restricted Frequency Bands

Restricted bands, identified in Table 6, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

- Fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of Table 6 except for apparatus complying under RSS-287;
- Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and
- Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

MHz	MHz	GHz
0.090-0.110	240-285	9.0-9.2
2.1735-2.1905	322-335.4	9.3-9.5
3.020-3.026	399.9-410	10.6-12.7
4.125-4.128	608-614	13.25-13.4
4.17725-4.17775	960-1427	14.47-14.5
4.20725-4.20775	1435-1626.5	15.35-16.2
5.677-5.683	1645.5-1646.5	17.7-21.4
6.215-6.218	1660-1710	22.01-23.12
6.26775-6.26825	1718.8-1722.2	23.6-24.0
6.31175-6.31225	2200-2300	31.2-31.8
8.291-8.294	2310-2390	36.43-36.5
8.362-8.366	2655-2900	Above 38.6
8.37625-8.38675	3260-3267	
8.41425-8.41475	3332-3339	
12.29-12.293	3345.8-3358	
12.51975-12.52025	3500-4400	
12.57675-12.57725	4500-5150	
13.36-13.41	5350-5460	
16.42-16.423	7250-7750	
16.69475-16.69525	8025-8500	
16.80425-16.80475		
25.5-25.67		
37.5-38.25		
73-74.6		

Test of AMG Microwave DOS048-004 to FCC and ISED rules

MHz	MHz	GHz
74.8-75.2		
108-138		
156.52475-156.52525		
156.7-156.9		

Footnote *

Certain frequency bands listed in Table 6 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in the 200- and 300-series of RSSs, such as RSS-210 and RSS-310, which contain the requirements that apply to licence-exempt radio apparatus.

ISED RSS-210, F.1 Field Disturbance Sensors

This section sets out requirements for field disturbance sensors operating in the frequency bands shown in Table F1.

Perimeter protection systems, which employ a leaky transmission line as the radiating source, are excluded from the requirements of this annex.

The equipment shall comply with the following emission limits:

a) The average field strength measured at 3 m shall not exceed the limits shown in Table F1:

Table F1 — Field Strengths for Field Disturbance Sensors Operating at Different Frequencies		
Fundamental Frequencies (MHz)	Field Strength (mV/m)	
	Fundamental Emissions	Harmonic Emissions
902-928	500	1.6
2435-2465	500	1.6
5785-5815	500	1.6
10500-10550	2500	25
24075-24175	2500	25

b) Additionally, harmonic emissions falling into restricted bands listed in RSS-Gen, and which are below 17.7 GHz shall meet the general field strength limits specified in RSS-Gen.

c) Harmonic emissions falling into restricted bands listed in RSS-Gen and which are at and above 17.7 GHz shall not exceed the following field strength limits measured at a distance of 3 m:

i) 25 mV/m for the second and third harmonic emissions of field disturbance sensors operating in the band 24075-24175 MHz and for devices designed for use only within buildings or for intermittent use, such as to open building doors; and

ii) 7.5 mV/m for all other devices.

d) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation, unless their emissions in the restricted bands as listed in RSS-Gen, other than the second and third harmonic emissions from devices operating in the band 24075-24175 MHz, comply with the general field strength limits specified in RSS-Gen.

Continuous operation of field disturbance sensors designed to be used in farm equipment (i.e. fork lifts that are intended primarily for use indoors or for very specialized operations), or railroad locomotives, railroad cars, and other equipment which travel on fixed tracks, is permitted. A field disturbance sensor is considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g. putting a vehicle into reverse gear, activating a turn signal, etc.).

Test of AMG Microwave DOS048-004 to FCC and ISED rules

e) Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits specified in RSS-Gen, whichever is less stringent.

7.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Loop Antenna (including cable set)	R&S / HFH-Z2	374	2016-07	2018-07
DC Power Supply	Goobay / DF-1730LCD	3489	n.a.	n.a.
EMI Test Receiver	R&S / ESU8	3846	2016-09	2017-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
EMC Measurement Software	R&S / EMC32 v10.0.0	5392	n.a.	n.a.

7.3 Test Procedures

Measurement was performed in a semi-anechoic room at a test distance of 3 m. A calibrated loop antenna as specified in ANSI C63.10 was positioned with its plane vertical at the test distance from the EUT and rotated about its vertical axis for maximum response at each azimuth about the EUT. For certain applications, the loop antenna may also need to be positioned horizontally at the specified distance from the EUT. Instead of changing the loop antenna polarization to horizontal the EUT antenna was rotated by 90 degrees. I.e. tests performed for 2 EUT antenna polarizations. The center of the loop antenna was 1 m above the ground.

The EUT was tested on a 0.8 meter high tabletop.

The EUT is connected to its associated peripherals, with any excess I/O cabling bundled to approximately 1 meter.

In certain applications, a remotely located device may be connected to the EUT. In these cases, it is permissible for cabling from the remotely located device to the EUT or accessories to be placed directly on the reference ground plane or, if normally installed beneath the reference ground plane, beneath it. The remotely located device shall be located at a distance sufficient to ensure that it does not contribute to the measured level. This procedure evaluates the interference potential of the EUT, its accessories, and interconnecting cables or wires standing apart from the remotely located device, which in turn shall be evaluated separately, if required.

Measurement initially performed as a pre-scan in the full frequency range in order to find worst case emissions. Final measurement performed at worst-case emission frequencies in a FCC semi-anechoic room at the specified 3 m test distance.

Worst case emissions are listed under chapter: Final test results.

Radiated Emissions Test Characteristics	
Frequency range	9 kHz - 30 MHz
Test distance	3 m*
Test instrumentation resolution bandwidth	200 Hz (9 kHz - 150 kHz)
	10 kHz (150 kHz - 30 MHz)
Receive antenna height	1 m
Receive antenna polarization	Vertical

Test of AMG Microwave DOS048-004 to FCC and ISED rules

* According to Section 15.31 (f)(2): At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The 40 dB/decade factor was used.

7.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits for the band 1.705–30.0 MHz:

$\mu\text{V/m}$ at 30 meters = 30

30 $\mu\text{V/m}$ corresponds with 29.5 dB $\mu\text{V/m}$.

7.5 Field Strength Calculation

All emission measurements performed using the test receiver's transducer factor setting capability, i.e. the field strength value measured directly without the necessity of additional correction factors. For test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(2) the field strength is calculated by adding additionally an extrapolation factor of 40 dB/decade (inverse linear-distance for field strength measurements). The basic equation with a sample calculation is as follows:

$$\text{FS} = \text{FST} + \text{DF}$$

where

FS = Field Strength in dB $\mu\text{V/m}$

FST = Field Strength at test distance in dB $\mu\text{V/m}$

DF = Distance Extrapolation Factor in dB,

where $\text{DF} = 40 \log (\text{Dtest}/\text{Dspec})$ where Dtest = Test Distance and Dspec = Specified distance

Assume the tests performed at a reduced Test Distance of 3 m instead of the Specified Distance of 30 m giving a Distance Extrapolation Factor of $\text{DF} = 40 \log (3 \text{ m}/30 \text{ m}) = -40 \text{ dB}$.

Assuming a measured field strength level of 58.8 dB $\mu\text{V/m}$ is obtained. The Distance Factor of -40 dB is added, giving a field strength of 18.8 dB $\mu\text{V/m}$. The 18.8 dB $\mu\text{V/m}$ value can be mathematically converted to its corresponding level in $\mu\text{V/m}$.

$$\text{FS} = 58.8 - 40 = 18.8 \text{ [dB}\mu\text{V/m]}$$

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm } (18.8/20) = 8.7$$

7.6 Final Test Results

Frequency [kHz]	3m Result [dB(μV/m)]	Distance Correction [dB]	300m / 30m Result [dB(μV/m)]	300m / 30m Limit [dB(μV/m)]	Margin [dB]
		All emissions are more than 20 dB below the limit.			

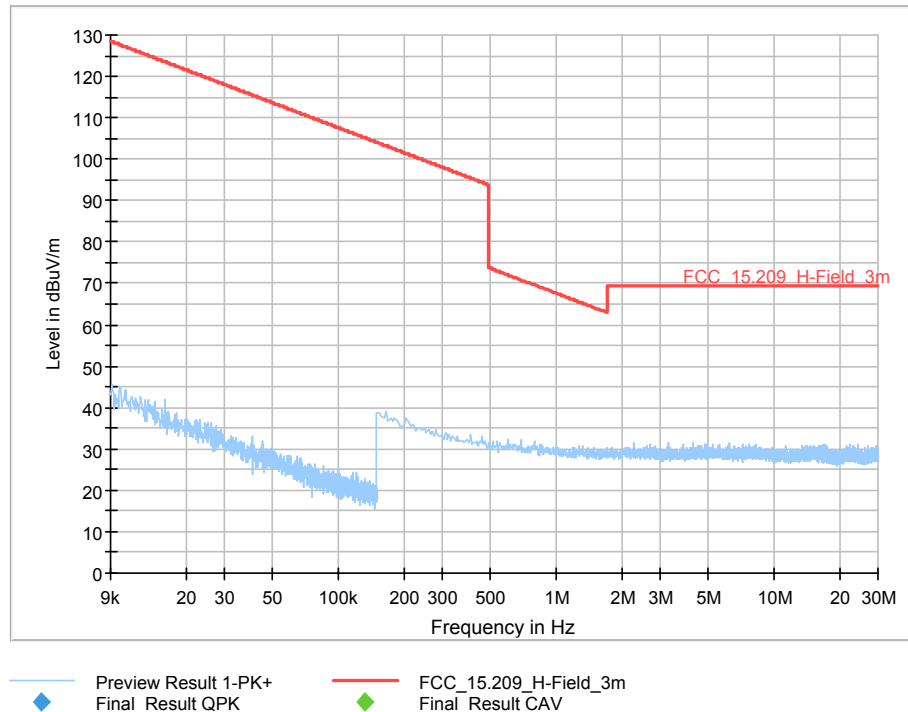
The table above contains worst-case emissions, only. For further details refer to the measurement plot.

Manufacturer: AMG Microwave
 Device: DOS048-004
 Serial No: 190716_001

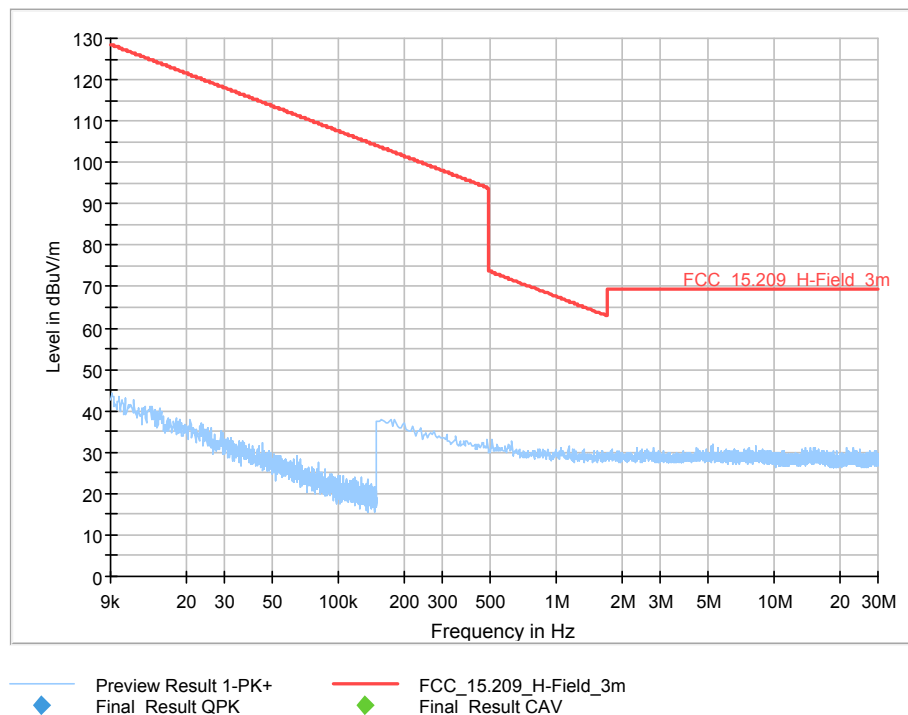
All measured emissions in the range 9 kHz to 30 MHz are below the specified limits.

The EUT meets the requirements of this section.

7.7 Measurement Prescan-Plots



Plot 7.7-1: EUT Pos. 1



Plot 7.7-2: EUT Pos. 2

Note: The plots show the field strength reading at 3 m distance. In order to compare the 3 m reading with the specified field strength limits a distance correction as described in chapter 7.4 (40 dB/decade) was applied to the limit (represented by the limit line „FCC_15.209_H-Field_3m“).

8 RADIATED EMISSIONS 30 MHz – 1000 MHz

Test Requirement: FCC 47 CFR, §§ 15.205, 15.209, 15.245
 ISED RSS-Gen 8.9, 8.10, RSS-210 F.1
 Test Procedure: ANSI C63.10-2013

8.1 Regulation

FCC §15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

¹Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

²Above 38.6

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e) of this section, regardless of the field strength limits specified elsewhere in this subpart, the provisions of this section apply to emissions from any intentional radiator.

[...]

FCC §15.209 Radiated emission limits; general requirements.

(a) 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:

Test of AMG Microwave DOS048-004 to FCC and ISED rules

Frequency [MHz]	Field Strength [μV/m]	Measurement Distance [m]
0.009 - 0.490	2400/F[kHz]	300
0.490 - 1.705	24000/F[kHz]	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

FCC §15.245 Operation within the bands 902-928 MHz, 2435-2465 MHz, 5785-5815 MHz, 10500-10550 MHz, and 24075-24175 MHz.

(a) Operation under the provisions of this section is limited to intentional radiators used as field disturbance sensors, excluding perimeter protection systems.

(b) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (millivolts/meter)
902-928	500	1.6
2435-2465	500	1.6
5785-5815	500	1.6
10500-10550	2500	25.0
24075-24175	2500	25.0

Test of AMG Microwave DOS048-004 to FCC and ISED rules

(1) Regardless of the limits shown in the above table, harmonic emissions in the restricted bands below 17.7 GHz, as specified in §15.205, shall not exceed the field strength limits shown in §15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:

(i) For the second and third harmonics of field disturbance sensors operating in the 24075-24175 MHz band and for other field disturbance sensors designed for use only within a building or to open building doors, 25.0 mV/m.

(ii) For all other field disturbance sensors, 7.5 mV/m.

(iii) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation unless their emissions in the restricted bands, other than the second and third harmonics from devices operating in the 24075-24175 MHz band, fully comply with the limits given in §15.209. Continuous operation of field disturbance sensors designed to be used in farm equipment, vehicles such as fork lifts that are intended primarily for use indoors or for very specialized operations, or railroad locomotives, railroad cars and other equipment which travels on fixed tracks is permitted. A field disturbance sensor will be considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g., putting a vehicle into reverse gear, activating a turn signal, etc.).

(2) Field strength limits are specified at a distance of 3 meters.

(3) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(4) The emission limits shown above are based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

ISED RSS-Gen 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency	Field Strength at 3m
[MHz]	[µV/m]
30 - 88	100
88 - 216	150
216 - 960	200
Above 960	500

Footnote *

Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

Table 5 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Below 30 MHz

Frequency	Electric Field Strength	Magnetic Field Strength (H-Field)	Measurement Distance
	[$\mu\text{V/m}$]	[$\mu\text{A/m}$]	[m]
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1,705-30 MHz	30	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector. Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the relevant RSS.

ISED RSS-Gen 8.10 Restricted Frequency Bands

Restricted bands, identified in Table 6, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

- Fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of Table 6 except for apparatus complying under RSS-287;
- Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and
- Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

MHz	MHz	GHz
0.090-0.110	240-285	9.0-9.2
2.1735-2.1905	322-335.4	9.3-9.5
3.020-3.026	399.9-410	10.6-12.7
4.125-4.128	608-614	13.25-13.4
4.17725-4.17775	960-1427	14.47-14.5
4.20725-4.20775	1435-1626.5	15.35-16.2
5.677-5.683	1645.5-1646.5	17.7-21.4
6.215-6.218	1660-1710	22.01-23.12
6.26775-6.26825	1718.8-1722.2	23.6-24.0
6.31175-6.31225	2200-2300	31.2-31.8
8.291-8.294	2310-2390	36.43-36.5
8.362-8.366	2655-2900	Above 38.6
8.37625-8.38675	3260-3267	
8.41425-8.41475	3332-3339	
12.29-12.293	3345.8-3358	
12.51975-12.52025	3500-4400	
12.57675-12.57725	4500-5150	
13.36-13.41	5350-5460	
16.42-16.423	7250-7750	
16.69475-16.69525	8025-8500	
16.80425-16.80475		
25.5-25.67		
37.5-38.25		
73-74.6		

Test of AMG Microwave DOS048-004 to FCC and ISED rules

MHz	MHz	GHz
74.8-75.2		
108-138		
156.52475-156.52525		
156.7-156.9		

Footnote *

Certain frequency bands listed in Table 6 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in the 200- and 300-series of RSSs, such as RSS-210 and RSS-310, which contain the requirements that apply to licence-exempt radio apparatus.

ISED RSS-210, F.1 Field Disturbance Sensors

This section sets out requirements for field disturbance sensors operating in the frequency bands shown in Table F1.

Perimeter protection systems, which employ a leaky transmission line as the radiating source, are excluded from the requirements of this annex.

The equipment shall comply with the following emission limits:

a) The average field strength measured at 3 m shall not exceed the limits shown in Table F1:

Table F1 — Field Strengths for Field Disturbance Sensors Operating at Different Frequencies		
Fundamental Frequencies (MHz)	Field Strength (mV/m)	
	Fundamental Emissions	Harmonic Emissions
902-928	500	1.6
2435-2465	500	1.6
5785-5815	500	1.6
10500-10550	2500	25
24075-24175	2500	25

b) Additionally, harmonic emissions falling into restricted bands listed in RSS-Gen, and which are below 17.7 GHz shall meet the general field strength limits specified in RSS-Gen.

c) Harmonic emissions falling into restricted bands listed in RSS-Gen and which are at and above 17.7 GHz shall not exceed the following field strength limits measured at a distance of 3 m:

i) 25 mV/m for the second and third harmonic emissions of field disturbance sensors operating in the band 24075-24175 MHz and for devices designed for use only within buildings or for intermittent use, such as to open building doors; and

ii) 7.5 mV/m for all other devices.

d) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation, unless their emissions in the restricted bands as listed in RSS-Gen, other than the second and third harmonic emissions from devices operating in the band 24075-24175 MHz, comply with the general field strength limits specified in RSS-Gen.

Continuous operation of field disturbance sensors designed to be used in farm equipment (i.e. fork lifts that are intended primarily for use indoors or for very specialized operations), or railroad locomotives, railroad cars, and other equipment which travel on fixed tracks, is permitted. A field disturbance sensor is considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g. putting a vehicle into reverse gear, activating a turn signal, etc.).

Test of AMG Microwave DOS048-004 to FCC and ISED rules

e) Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits specified in RSS-Gen, whichever is less stringent.

8.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
VHF Test Dipole RX	Schwarzbeck / VHA 9103	899	2015-05	2017-05
Log Per. Antenna	Schwarzbeck / VUSLP 9111B	3203	2015-05	2017-05
N-Cable N/50	Rohde & Schwarz	55	2016-08	2017-08
DC Power Supply	Goobay / DF-1730LCD	3489	n.a.	n.a.
EMI Test Receiver	R&S / ESU8	3846	2016-09	2017-09
Digital Multimeter	Agilent / U1241B	3880	2016-05	2018-05
Web-Thermo-Hygrobarograph	W&T / 57613 Web-T/Rh/P	4717	2016-04	2018-04
EMC Measurement Software	R&S / EMC32 v10.0.0	5392	n.a.	n.a.

8.3 Test Procedures

The EUT was tested on a 0.8 meter high tabletop.

In certain applications, a remotely located device may be connected to the EUT. In these cases, it is permissible for cabling from the remotely located device to the EUT or accessories to be placed directly on the reference ground plane or, if normally installed beneath the reference ground plane, beneath it. The remotely located device shall be located at a distance sufficient to ensure that it does not contribute to the measured level. This procedure evaluates the interference potential of the EUT, its accessories, and interconnecting cables or wires standing apart from the remotely located device, which in turn shall be evaluated separately, if required.

With the EUT operating in "worst case" mode, emissions from the unit are maximized by adjusting the polarization and height of the receive antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions. All tests performed with the EUT placed in both vertical and horizontal polarizations on the nonconductive table.

Measurement initially performed as a pre-scan in the full frequency range in order to find worst case emissions. Final measurement performed at worst-case emission frequencies in a FCC listed semi-anechoic room at the specified 3 m test distance.

Worst case emissions are listed under chapter: test results.

Radiated Emissions Test Characteristics	
Frequency range	30 MHz – 1000 MHz
Test distance	3 m
Test instrumentation resolution bandwidth	120 kHz
Receive antenna height	1 m - 4 m
Receive antenna polarization	Vertical/Horizontal

8.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits for the restricted band 108-121.94 MHz:

$\mu\text{V/m}$ at 3 meters = 150

150 $\mu\text{V/m}$ corresponds with 43.5 dB $\mu\text{V/m}$.

8.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor. The basic equation with a sample calculation is as follows:

$$\text{FS} = \text{RA} + \text{AF} + \text{CF}$$

where

FS = Field Strength in dB $\mu\text{V/m}$

RA = Receiver Amplitude in dB μV

AF = Antenna Factor in dB(1/m)

CF = Cable Attenuation Factor in dB

Assume a receiver reading of 23.5 dB μV is obtained. The Antenna Factor of 7.4 dB(1/m) and a Cable Factor of 1.1 dB are added, giving a field strength of 32 dB $\mu\text{V/m}$. The 32 dB $\mu\text{V/m}$ value can be mathematically converted to its corresponding level in $\mu\text{V/m}$.

$$\text{FS} = 23.5 + 7.4 + 1.1 = 32 \text{ [dB}\mu\text{V/m]}$$

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

8.6 Final Test Results

Frequency [MHz]	Reading [dB(μV)]	Ant. factor [dB(1/m)]	Detector	Result [dB($\mu\text{V/m}$)]	Limit [dB($\mu\text{V/m}$)]	Margin [dB]	Polarisation h / v
74.7	21.35	7.0	QP	28.35	40	11.65	V
94.62	15.51	9.8	QP	25.31	43.5	18.19	H
165.62	8.69	16.6	QP	25.29	43.5	18.21	H
171.74	10.48	16.8	QP	27.28	43.5	16.22	H
190.9	6.49	17.4	QP	23.89	43.5	19.61	V
200.94	9.94	17.4	QP	27.34	43.5	16.16	H
210.02	12.05	17.6	QP	29.65	43.5	13.85	H

All tests performed at 3 m distance. The table above contains worst-case emissions, only. For further details refer to the pre-scan test plots.

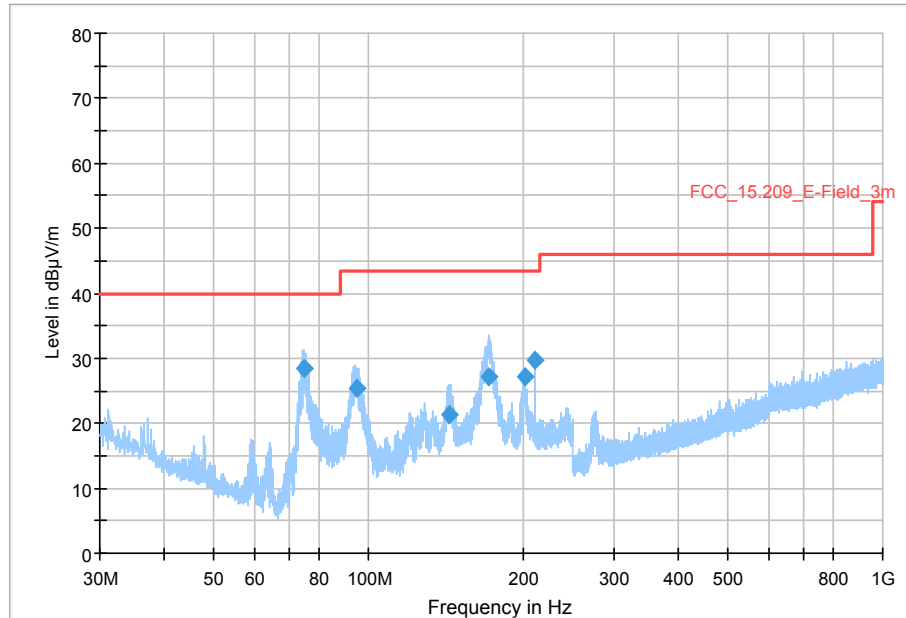
Manufacturer: AMG Microwave
Device: DOS048-004
Serial No: 190716_001

All measured emissions in the range 30 MHz to 1000 MHz are below the specified limits.

The EUT meets the requirements of this section.

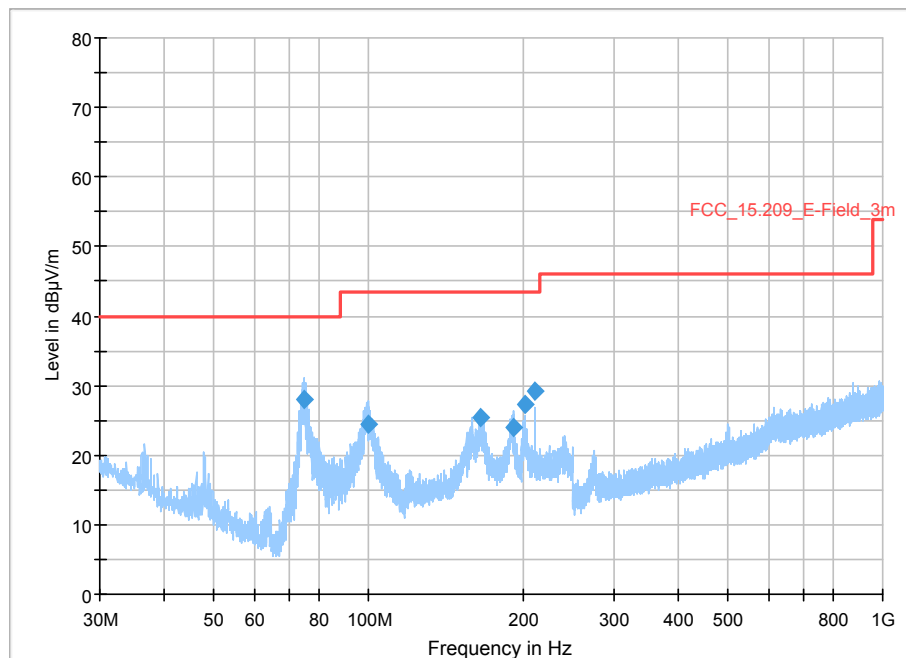
Test of AMG Microwave DOS048-004 to FCC and ISED rules

8.7 Measurement Prescan-Plots



— Preview Result 1-PK+ [Preview Result 1.Result:1]
 — FCC_15.209_E-Field_3m [..\EMI radiated\FCC_Part15]
 ◆ Final_Result QPK [Final_Result.Result:4]

Plot 8.7-1: EUT, Pos. 1



— Preview Result 1-PK+ [Critical_Freqs.Result:4] ◆ Final_Result QPK [Final_Result.Result:4]

Plot 8.7-2: EUT, Pos. 2

9 RADIATED EMISSIONS 1 GHz – 100 GHz

Test Requirement: FCC 47 CFR, §§ 15.205, 15.209, 15.245
 ISED RSS-Gen 8.9, 8.10, RSS-210 F.1
 Test Procedure: ANSI C63.10-2013

9.1 Regulation

FCC §15.205 Restricted bands of operation.

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
¹ 0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(₂)
13.36-13.41			

¹Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

²Above 38.6

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e) of this section, regardless of the field strength limits specified elsewhere in this subpart, the provisions of this section apply to emissions from any intentional radiator.

[...]

FCC §15.209 Radiated emission limits; general requirements.

(a) 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:

Test of AMG Microwave DOS048-004 to FCC and ISED rules

Frequency	Field Strength	Measurement Distance
[MHz]	[μ V/m]	[m]
0.009 - 0.490	2400/F[kHz]	300
0.490 - 1.705	24000/F[kHz]	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in §§ 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

FCC §15.245 Operation within the bands 902-928 MHz, 2435-2465 MHz, 5785-5815 MHz, 10500-10550 MHz, and 24075-24175 MHz.

(a) Operation under the provisions of this section is limited to intentional radiators used as field disturbance sensors, excluding perimeter protection systems.

(b) The field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental Frequency (MHz)	Field Strength of Fundamental (millivolts/meter)	Field Strength of Harmonics (millivolts/meter)
902-928	500	1.6
2435-2465	500	1.6
5785-5815	500	1.6
10500-10550	2500	25.0
24075-24175	2500	25.0

Test of AMG Microwave DOS048-004 to FCC and ISED rules

(1) Regardless of the limits shown in the above table, harmonic emissions in the restricted bands below 17.7 GHz, as specified in §15.205, shall not exceed the field strength limits shown in §15.209. Harmonic emissions in the restricted bands at and above 17.7 GHz shall not exceed the following field strength limits:

(i) For the second and third harmonics of field disturbance sensors operating in the 24075-24175 MHz band and for other field disturbance sensors designed for use only within a building or to open building doors, 25.0 mV/m.

(ii) For all other field disturbance sensors, 7.5 mV/m.

(iii) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation unless their emissions in the restricted bands, other than the second and third harmonics from devices operating in the 24075-24175 MHz band, fully comply with the limits given in §15.209. Continuous operation of field disturbance sensors designed to be used in farm equipment, vehicles such as fork lifts that are intended primarily for use indoors or for very specialized operations, or railroad locomotives, railroad cars and other equipment which travels on fixed tracks is permitted. A field disturbance sensor will be considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g., putting a vehicle into reverse gear, activating a turn signal, etc.).

(2) Field strength limits are specified at a distance of 3 meters.

(3) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

(4) The emission limits shown above are based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

ISED RSS-Gen 8.9 Transmitter Emission Limits for Licence-Exempt Radio Apparatus

Except when the requirements applicable to a given device state otherwise, emissions from licence-exempt transmitters shall comply with the field strength limits shown in Table 4 and Table 5 below. Additionally, the level of any transmitter emission shall not exceed the level of the transmitter's fundamental emission.

Table 4 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Above 30 MHz	
Frequency	Field Strength at 3m
[MHz]	[µV/m]
30 - 88	100
88 - 216	150
216 - 960	200
Above 960	500

Footnote *

Unless otherwise specified, for all frequencies greater than 1 GHz, the radiated emission limits for licence-exempt radio apparatus stated in applicable RSSs (including RSS-Gen) are based on measurements using a linear average detector function having a minimum resolution bandwidth of 1 MHz. If an average limit is specified for the EUT, then the peak emission shall also be measured with instrumentation properly adjusted for such factors as pulse desensitization to ensure the peak emission is less than 20 dB above the average limit.

Note: Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the specific RSS.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

Table 5 – General Field Strength Limits for Licence-Exempt Transmitters at Frequencies Below 30 MHz

Frequency	Electric Field Strength	Magnetic Field Strength (H-Field)	Measurement Distance
	[$\mu\text{V/m}$]	[$\mu\text{A/m}$]	[m]
9-490 kHz	2,400/F (F in kHz)	2,400/377F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/377F (F in kHz)	30
1,705-30 MHz	30	N/A	30

Note: The emission limits for the bands 9-90 kHz and 110-490 kHz are based on measurements employing a linear average detector. Transmitting devices are not permitted in restricted frequency bands unless stated otherwise in the relevant RSS.

ISED RSS-Gen 8.10 Restricted Frequency Bands

Restricted bands, identified in Table 6, are designated primarily for safety-of-life services (distress calling and certain aeronautical bands), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following restrictions apply:

- Fundamental components of modulation of licence-exempt radio apparatus shall not fall within the restricted bands of Table 6 except for apparatus complying under RSS-287;
- Unwanted emissions that fall into restricted bands of Table 6 shall comply with the limits specified in RSS-Gen; and
- Unwanted emissions that do not fall within the restricted frequency bands of Table 6 shall comply either with the limits specified in the applicable RSS or with those specified in this RSS-Gen.

MHz	MHz	GHz
0.090-0.110	240-285	9.0-9.2
2.1735-2.1905	322-335.4	9.3-9.5
3.020-3.026	399.9-410	10.6-12.7
4.125-4.128	608-614	13.25-13.4
4.17725-4.17775	960-1427	14.47-14.5
4.20725-4.20775	1435-1626.5	15.35-16.2
5.677-5.683	1645.5-1646.5	17.7-21.4
6.215-6.218	1660-1710	22.01-23.12
6.26775-6.26825	1718.8-1722.2	23.6-24.0
6.31175-6.31225	2200-2300	31.2-31.8
8.291-8.294	2310-2390	36.43-36.5
8.362-8.366	2655-2900	Above 38.6
8.37625-8.38675	3260-3267	
8.41425-8.41475	3332-3339	
12.29-12.293	3345.8-3358	
12.51975-12.52025	3500-4400	
12.57675-12.57725	4500-5150	
13.36-13.41	5350-5460	
16.42-16.423	7250-7750	
16.69475-16.69525	8025-8500	
16.80425-16.80475		
25.5-25.67		
37.5-38.25		
73-74.6		

Test of AMG Microwave DOS048-004 to FCC and ISED rules

MHz	MHz	GHz
74.8-75.2		
108-138		
156.52475-156.52525		
156.7-156.9		

Footnote *

Certain frequency bands listed in Table 6 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in the 200- and 300-series of RSSs, such as RSS-210 and RSS-310, which contain the requirements that apply to licence-exempt radio apparatus.

ISED RSS-210, F.1 Field Disturbance Sensors

This section sets out requirements for field disturbance sensors operating in the frequency bands shown in Table F1.

Perimeter protection systems, which employ a leaky transmission line as the radiating source, are excluded from the requirements of this annex.

The equipment shall comply with the following emission limits:

a) The average field strength measured at 3 m shall not exceed the limits shown in Table F1:

Table F1 — Field Strengths for Field Disturbance Sensors Operating at Different Frequencies		
Fundamental Frequencies (MHz)	Field Strength (mV/m)	
	Fundamental Emissions	Harmonic Emissions
902-928	500	1.6
2435-2465	500	1.6
5785-5815	500	1.6
10500-10550	2500	25
24075-24175	2500	25

b) Additionally, harmonic emissions falling into restricted bands listed in RSS-Gen, and which are below 17.7 GHz shall meet the general field strength limits specified in RSS-Gen.

c) Harmonic emissions falling into restricted bands listed in RSS-Gen and which are at and above 17.7 GHz shall not exceed the following field strength limits measured at a distance of 3 m:

i) 25 mV/m for the second and third harmonic emissions of field disturbance sensors operating in the band 24075-24175 MHz and for devices designed for use only within buildings or for intermittent use, such as to open building doors; and

ii) 7.5 mV/m for all other devices.

d) Field disturbance sensors designed to be used in motor vehicles or aircraft must include features to prevent continuous operation, unless their emissions in the restricted bands as listed in RSS-Gen, other than the second and third harmonic emissions from devices operating in the band 24075-24175 MHz, comply with the general field strength limits specified in RSS-Gen.

Continuous operation of field disturbance sensors designed to be used in farm equipment (i.e. fork lifts that are intended primarily for use indoors or for very specialized operations), or railroad locomotives, railroad cars, and other equipment which travel on fixed tracks, is permitted. A field disturbance sensor is considered not to be operating in a continuous mode if its operation is limited to specific activities of limited duration (e.g. putting a vehicle into reverse gear, activating a turn signal, etc.).

Test of AMG Microwave DOS048-004 to FCC and ISED rules

e) Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits specified in RSS-Gen, whichever is less stringent.

9.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Power Sensor	R&S	536	2015-10	2016-10
Standard Gain Horn Ant.	Mid Century / MC 22/31B	1229	2016-08	2018-08
RF Power Meter	R&S / NRVD	1265	2014-02	2016-10
Standard Gain Horn Ant.	Mid Century / MC 20/31B	1300	2016-08	2018-08
Standard Gain Horn Ant.	FMI/Pro NOVA / 2424-25	1333	n.a.	n. a.
Standard Gain Horn Ant.	Mid Century / MC 20/31B	1335	2016-08	2018-08
Waveguide - SMA-Adap.	FMI / 22093-KF20	1348	n. a.	n. a.
Precis.Var.Waveg. Attn.	FMI/Singer / 2611	1441	n.a.	n. a.
Waveguide Mixer	Tektronix / FS-Z110/WM782W	1546	n. a.	n. a.
Waveguide Mixer	Tektronix / FS-Z75/WM782V	1548	n. a.	n. a.
Tripler 60...90 GHz	Spacek Labs / AE-3X	1799	n. a.	n. a.
Thermistor Mount	Millitech / THM-22-RF000	2110	2015-08	2020-08
Tapered Transition	FMI/Pro NOVA / 23000-24	2111	n. a.	n. a.
RF Power Meter	Hewlett-Packard / 432 A	2112	n.a.	n. a.
Standard Gain Horn Ant.	FMI/Pro NOVA / 2424-25	2113	n. a.	n. a.
Signal Generator	Wiltron, Anritsu / 68369B	2286	2015-10	2017-10
Standard Gain Horn Ant.	Electrof./Tho / WG25-25	2591	n. a.	n. a.
Thermistor Mount	Millitech / THM-15-RF000	2597	2015-08	2020-08
Standard Gain Horn Ant.	Electrof./Tho / WG25-25	2599	n. a.	n. a.
Standard Gain Horn Ant.	Electrof./Tho / WG27-25	2600	n. a.	n. a.
Double Ridged Guide Ant.	Schwarzbeck / BBHA 9120D	3236	2015-06	2017-06
Spectrum Analyzer	Rohde & Schwarz / FSU50	3831	2016-08	2017-08
Web-Thermo-Hygrobarograph	Wiesemann & Theis GmbH WUT / 57613 Web-T/Rh/P	4717	2016-04	2018-04
DC Power Supply	Tektronix / PWS4205	4721		
Adaptor, Waveguide to Coax	FLANN / 23093-TF30 UG-383/U	4914	n. a.	n. a.
RF Cable	RB / LA1-008-1000	5611	2016-08	2017-08
RF Cable	RB / LA1-008-1500	5612	2016-08	2017-08
RF Cable	RB / LU8-002-1000	5614	2016-08	2017-08

9.3 Test Procedures

For emission measurements above 1 GHz, the EUT was placed at a height of 1.5 m above the floor on a support that is RF transparent for the frequencies of interest. The 1.5 m height EUT support was constructed using a low permittivity and low loss tangent ($\tan\delta$) material with a height of 1.5 m. Due to its dielectric properties for frequencies above 1 GHz, the use of styrene or building insulation foam is recommended, rather than, for example, wood. Support equipment was placed far enough away from the EUT, such that changes in relative position of the EUT and support equipment do not cause changes in measured values.

Exploratory radiated measurements were performed at the measurement distance or at a closer distance than that specified for compliance to determine the emission characteristics of the EUT and, if applicable, the EUT configuration that produces the maximum level of emissions. The frequencies of maximum emission were determined by manually positioning the antenna close to the EUT, and then moving the antenna over all sides of the EUT while observing a spectral display. It could be advantageous to have prior knowledge of the frequencies of emissions, although this may be determined from such a near-field scan. The near-field scan was only used to determine the frequency but not the amplitude of the emissions.

The final measurements were performed on a site meeting the requirements of 5.2. Using the orientation and equipment arrangement of the EUT based on the measurement results found during the preliminary (exploratory) measurements, the EUT arrangement, appropriate modulation, and modes of operation that produce the emissions that have the highest amplitude relative to the limit were selected for the final measurement. The final measurement shall follow all the procedures in ANSI C63.10 6.3 with the EUT operating on frequencies per 5.6.

Measurements were performed with the EUT rotated from 0° to 360°; the antenna height scanned in accordance with ANSI C63.10 6.6.3.1, 6.6.3.2, or 6.6.3.3, as appropriate; and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Variations in cable or wire placement were explored to maximize the measured emissions.

The emission signal was kept within the illumination area of the 3 dB beamwidth of the antenna so that the maximum emission from the EUT was measured.

Worst case emissions are listed under chapter: test results.

Radiated Emissions Test Characteristics	
Frequency range	1 GHz – 100 GHz
Test distance	3 m*
Test instrumentation resolution bandwidth	1 MHz
Receive antenna height	1.5 m
Receive antenna polarization	Vertical/Horizontal

* Test distance was reduced in order to fulfil the limit requirements, refer to final measurement table for details.

9.4 Calculation of Field Strength Limits

E.g. radiated spurious emissions field strength limits for the 2nd and 3rd harmonics acc. to FCC § 15.245 and RSS-210 F.1:

Fundamental emission field strength at 3 meter: 2500 mV/m

2500 mV/m corresponds with 128 dBμV/m.

Harmonic emission field strength at 3 meter: 25 mV/m

25 mV/m corresponds with 88 dBμV/m.

9.5 Field Strength Calculation

The field strength in a specific distance is calculated by the equation as follows:

$$FS = PWR + G_{subst} + 104.77 - 20 \log(D_{test})$$

where

FS = Field Strength in dBμV/m

PWR = Power Meter Reading at the feed point of the substitution antenna in dBm

G_{subst} = Gain of the substitution antenna in dBi

D_{test} = Test Distance

Note: due the measuring at the feed point of the substitution antenna, no cable or mixer losses have to be taken into account.

Assume a power meter reading (PWR) of 0 dBm is obtained. The gain of the substitution antenna is 20 dBi. The resulting field strength in 3 m is 115.2 dBμV/m.

The 115.2 dBμV/m value can be mathematically converted to its corresponding level in μV/m:

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm}(115.2/20) = 575\,440\, \mu\text{V/m} = 575.4\, \text{mV/m}$$

For a test distance other than what is specified, but fulfilling the requirements of Section 15.31 (f)(1) the field strength is calculated by adding additionally an extrapolation factor of 20 dB/Decade (inverse linear distance for field strength measurements). The basic equation with a sample calculation is as follows:

$$FS = FST + DF$$

where

FS = Field Strength in dBμV/m

FST = Field Strength at test distance on dBμV/m

DF = Distance Extrapolation Factor in dB

$$\text{where } DF = 20 \log(D_{test}/D_{spec})$$

where

D_{spec} = Specified

Distance D_{test} = Test Distance

Assume the tests performed at a reduced distance of 1.0 m instead of the Specified Distance if 3.0 m giving a Distance Extrapolation Factor of $DF = 20 \log(1.0\, \text{m} / 3.0\, \text{m}) = -9.5\, \text{dB}$.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

For pulsed emissions, the measured peak field strength is corrected by an AV correction factor.

$$DCF = 20 \log (T_{on} / 100\text{ms})$$

where

DCF = Duty Cycle Correction Factor in dB

Ton = Total On-Time in one 100ms period

Assuming a maximum On-Time (Ton) of 10 ms in one 100ms period, the corresponding DCF is -20 dB.

$$FSAV = FS + DCF$$

where

FSAV = Average Field Strength in dBμV/m

FS = Peak Field Strength in dBμV/m

DCF = Duty Cycle Correction Factor in dB

Assuming a peak field strength of 50 dBμV/m, the value for the average field strength with a AV correction factor of -12dB corresponds with 38 dBμV/m.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

9.6 Final Test Results

All tests performed at the denoted distance with the denoted resolution bandwidth. The table below contains worst-case emissions, only. For further details refer to the pre-scan and final measurement test plots.

Peak Results:

Freq. [GHz]	Dtest [m]	BW [kHz]	PWR [dBm]	Gsubst [dBi]	DCF [dB]	DF [dB]	Result [dBμV/m]	PK-Limit [dBμV/m]	Margin [dB]
24.12	1	1000	4.5	20	0.0	-9.5	119.7	148	28.3
48.28	1	1000	-37.0	25	0.0	-9.5	83.2	108	24.8
72.42	1	1000	-33.2	25	0.0	-9.5	87.0	108	21.0

Note: specified limits are based on average measurements. However, the peak value must not be more than 20 dB of the average limit.

Average Results:

Freq. [GHz]	Dtest [m]	BW [kHz]	PWR [dBm]	Gsubst [dBi]	DCF [dB]	DF [dB]	Result [dBμV/m]	AV-Limit [dBμV/m]	Margin [dB]
24.12	1	1000	4.5	20	-30.4	-9.5	89.3	128	38.7
48.28	1	1000	-37.0	25	-30.4	-9.5	52.8	88	35.2
72.42	1	1000	-33.2	25	-30.4	-9.5	56.6	88	31.4

Note: the DCF is calculated by the equations of chapter 9.5 of this report. The data is based on a measured pulse ON-time of 3.03 μs and a pulse repetition time of 100 μs. This leads to a total ON-time of 3.03 ms in any 100 ms period.

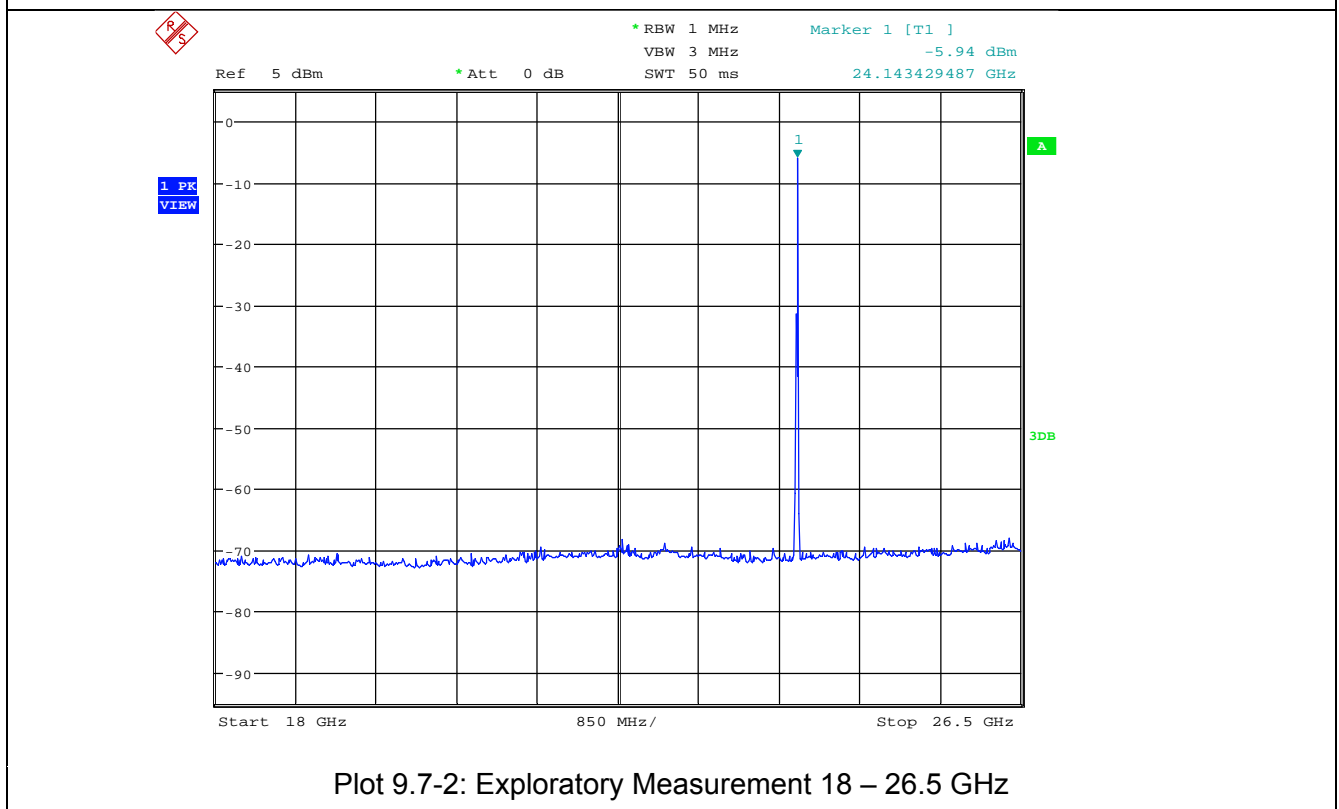
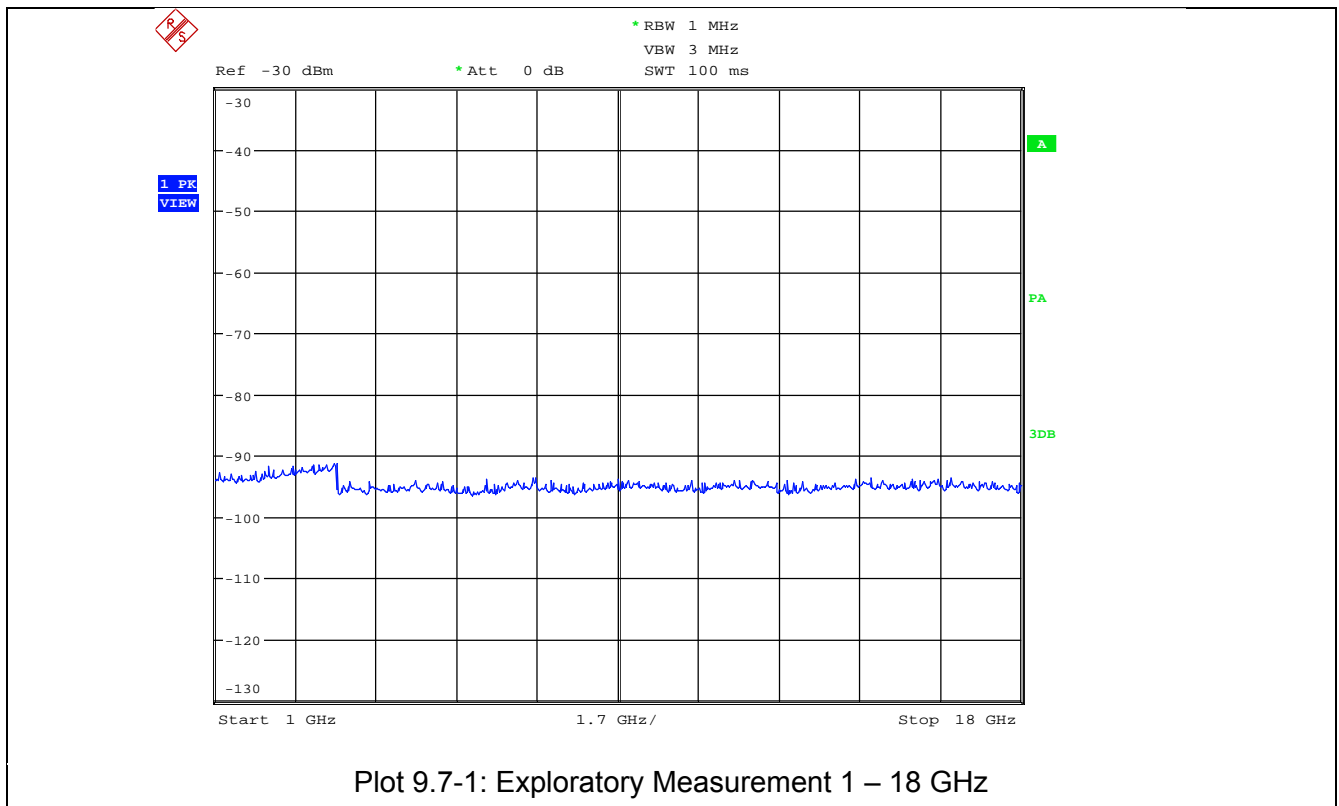
Manufacturer: AMG Microwave
Device: DOS048-004
Serial No: 190716_001

All measured emissions in the range 1 GHz to 100 GHz are below the specified limits.

The EUT meets the requirements of this section.

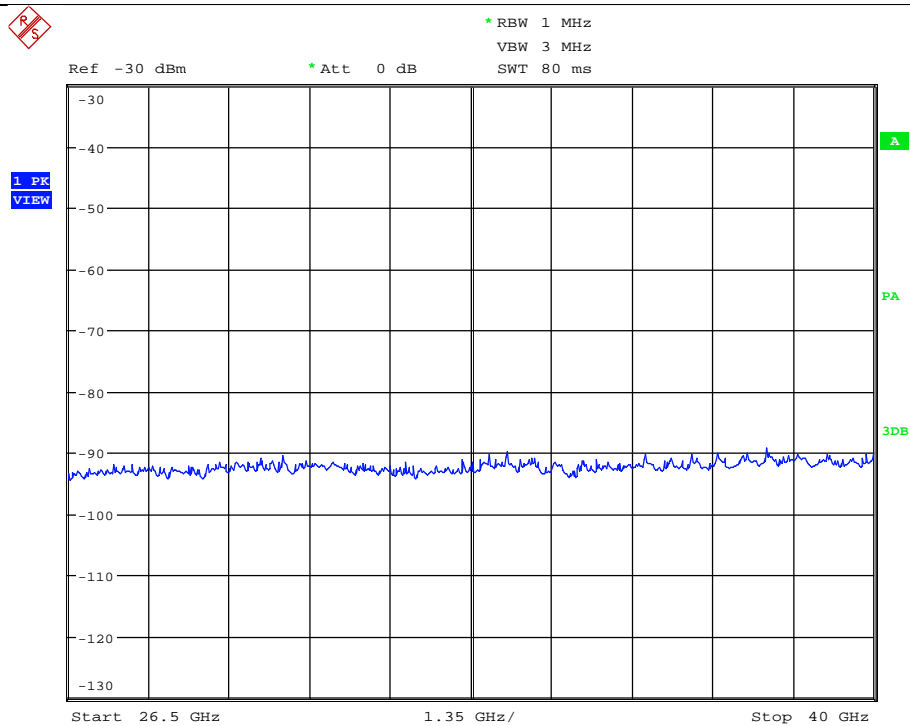
Test of AMG Microwave DOS048-004 to FCC and ISED rules

9.7 Exploratory Measurement Plots

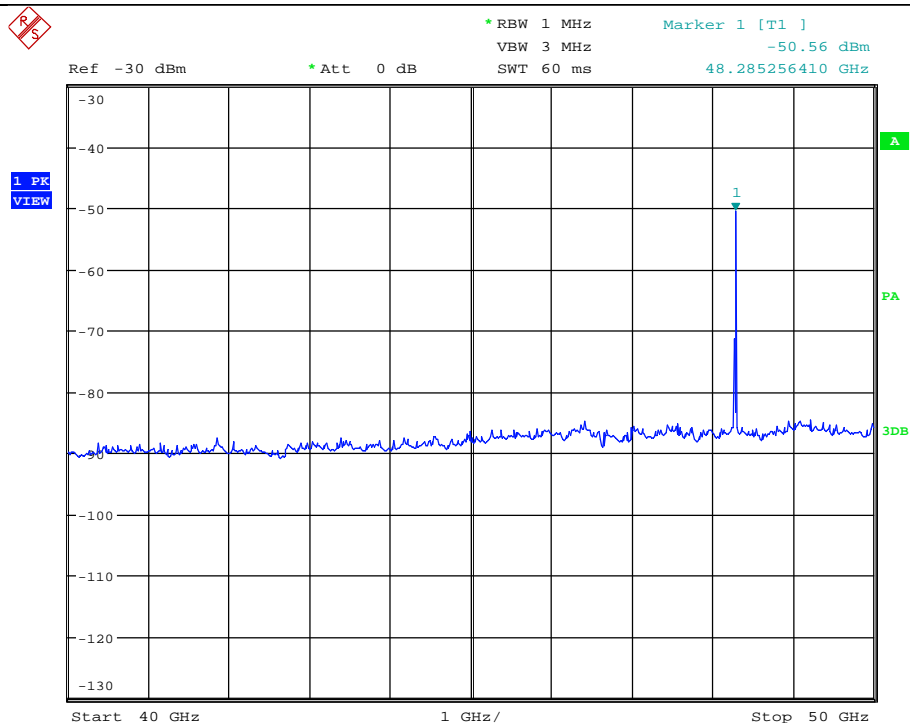


Note: Exploratory measurements performed at closer distance with no additional correction factors, therefore the plots are just showing the measurement receiver's reading.

Test of AMG Microwave DOS048-004 to FCC and ISED rules



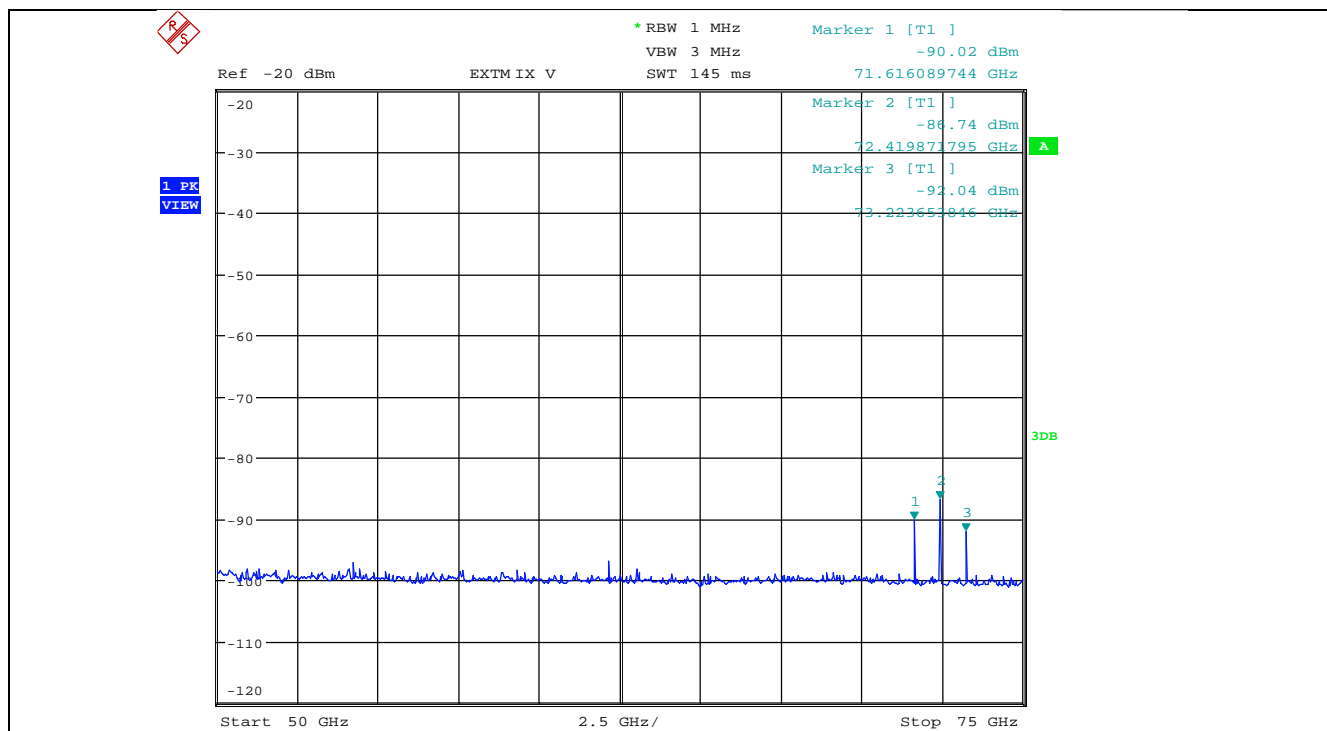
Plot 9.7-3: Exploratory Measurement 26.5 – 40 GHz



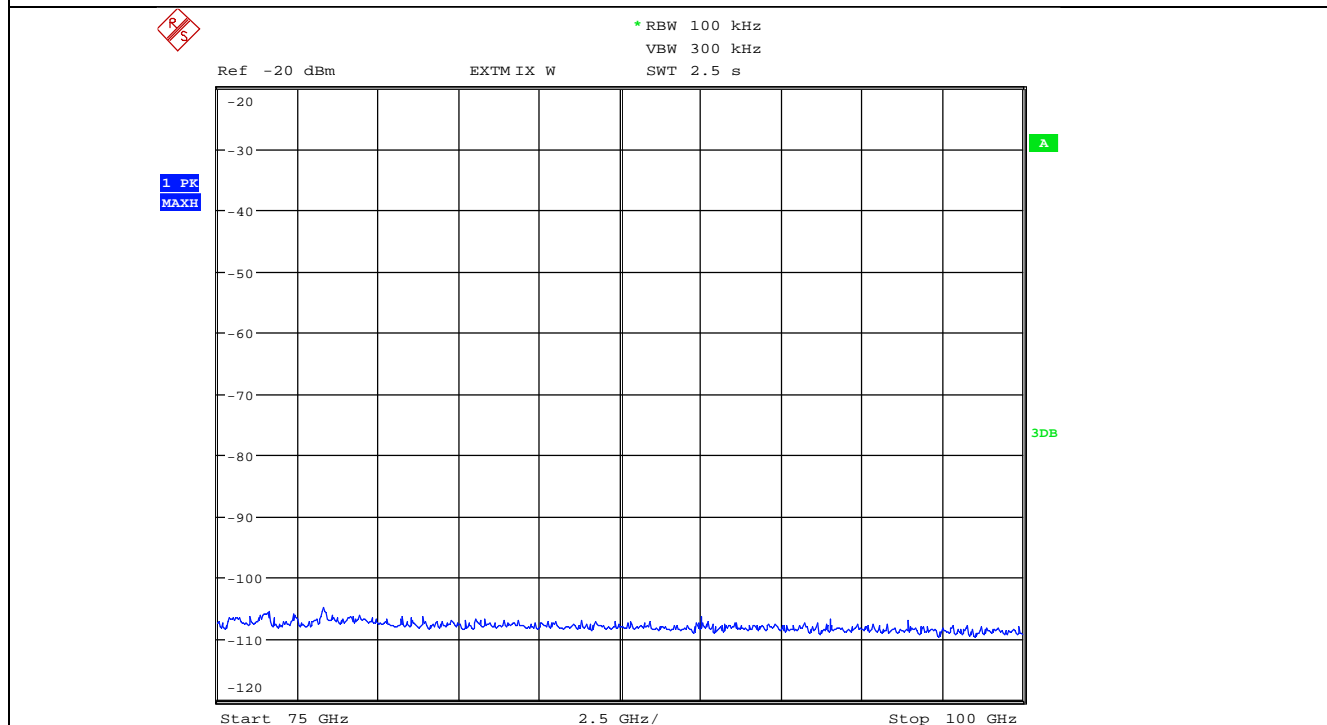
Plot 9.7-4: Exploratory Measurement 40 – 50 GHz

Note: Exploratory measurements performed at closer distance with no additional correction factors, therefore the plots are just showing the measurement receiver's reading.

Test of AMG Microwave DOS048-004 to FCC and ISED rules



Plot 9.7-5: Exploratory Measurement 50 – 75 GHz

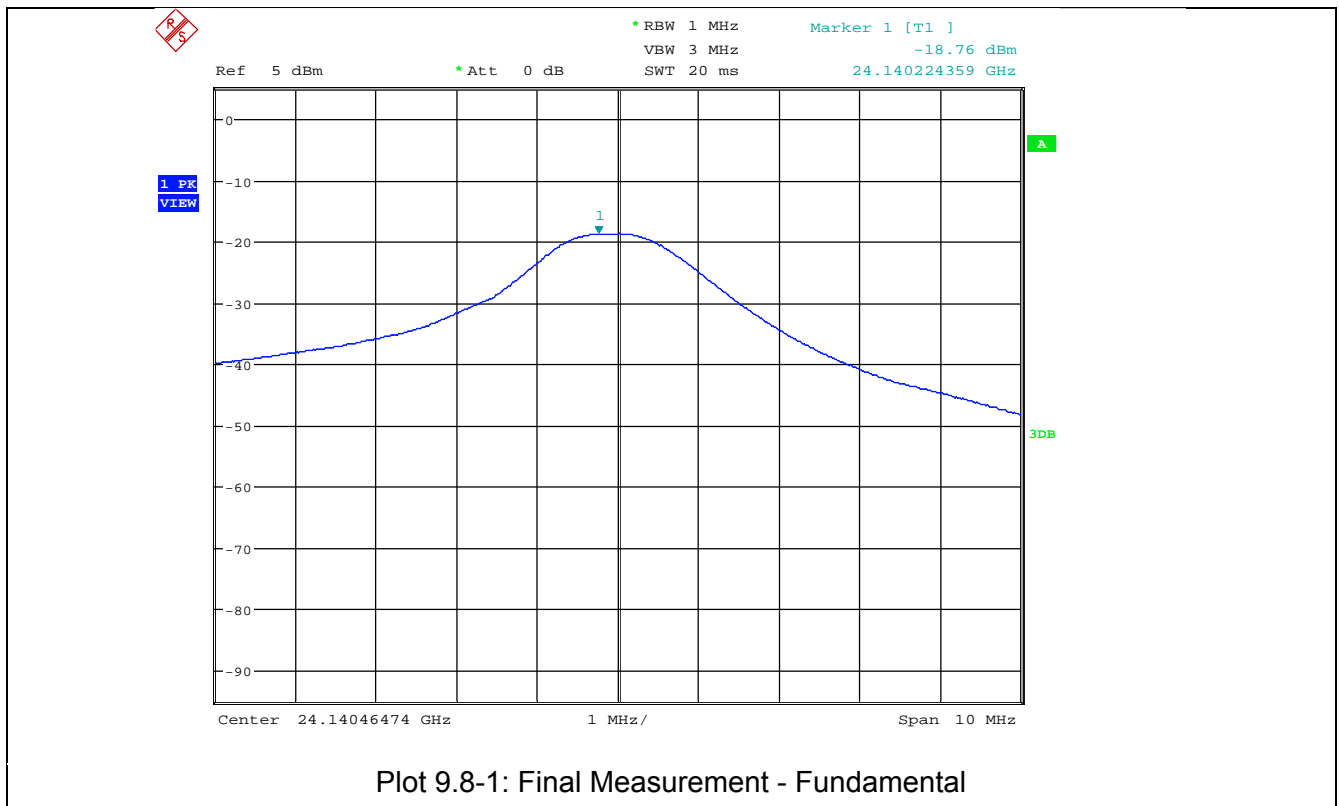


Plot 9.7-6: Exploratory Measurement 75 – 100 GHz

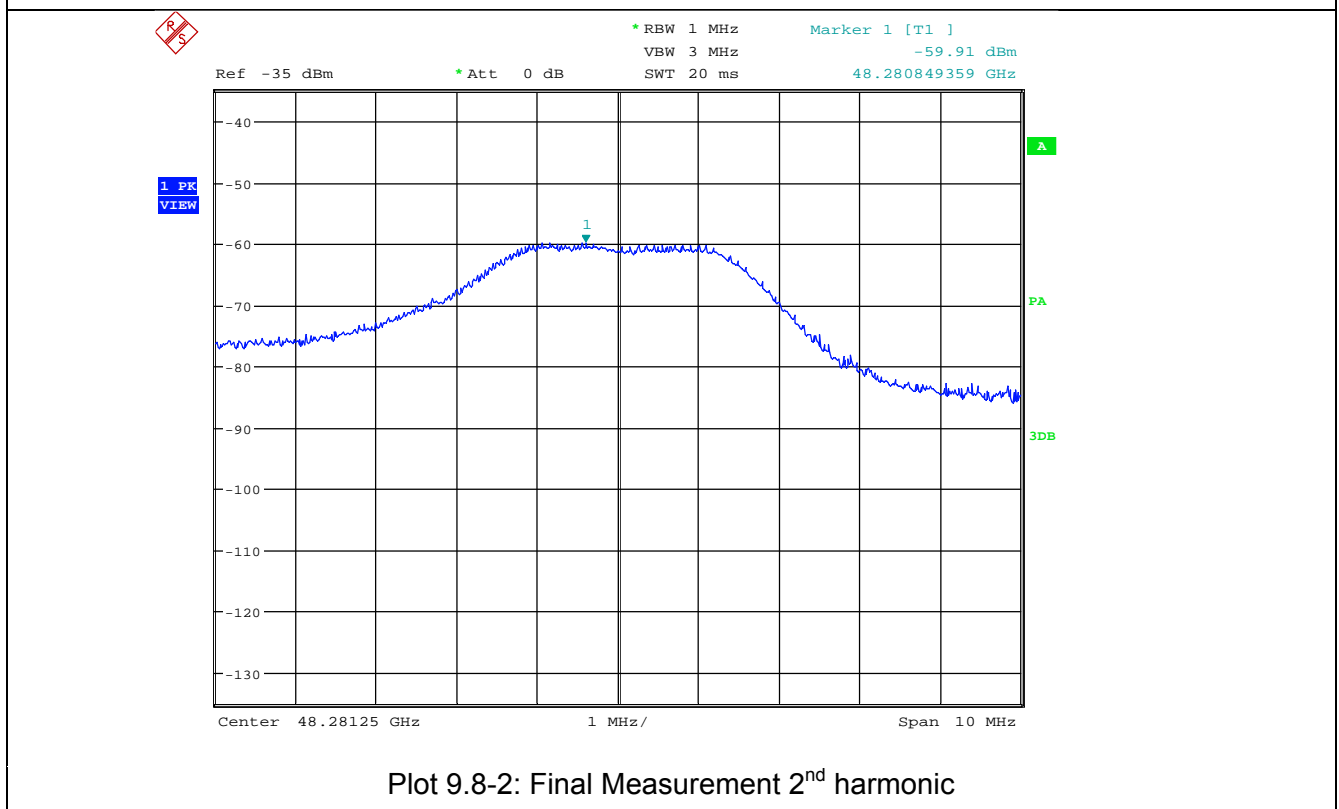
Note: Exploratory measurements performed at closer distance with no additional correction factors, therefore the plots are just showing the measurement receiver's reading.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

9.8 Final Measurement Plots



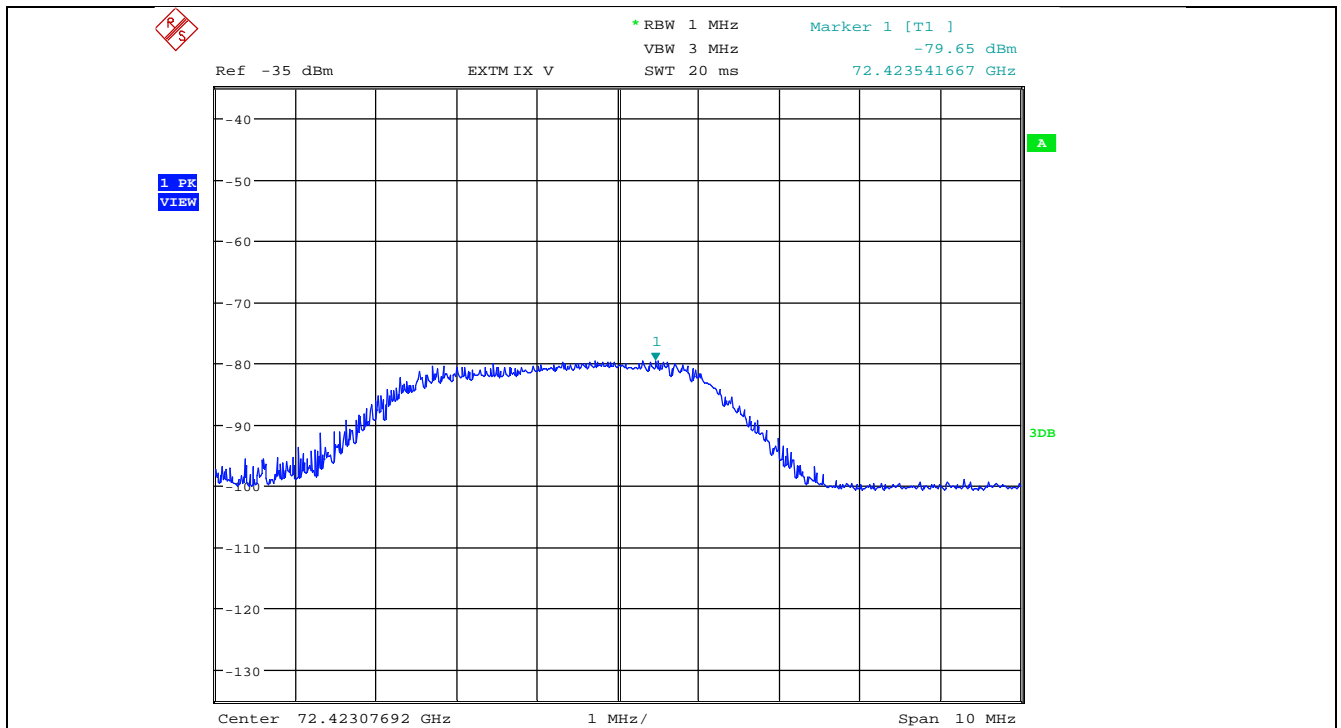
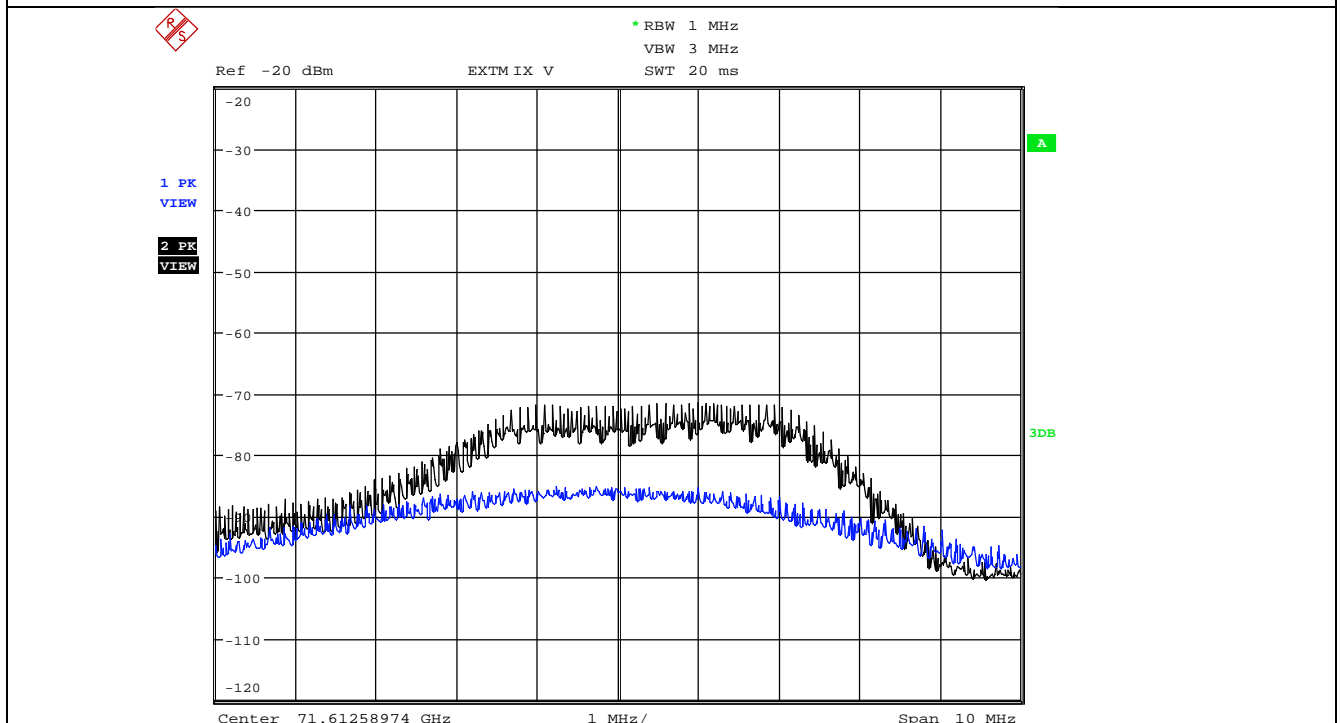
Plot 9.8-1: Final Measurement - Fundamental



Plot 9.8-2: Final Measurement 2nd harmonic

Note: Final measurements performed at closer distance with no additional correction factors. The receiver's reading was used for substitution measurements. Therefore the plots are not showing the final results.

Test of AMG Microwave DOS048-004 to FCC and ISED rules

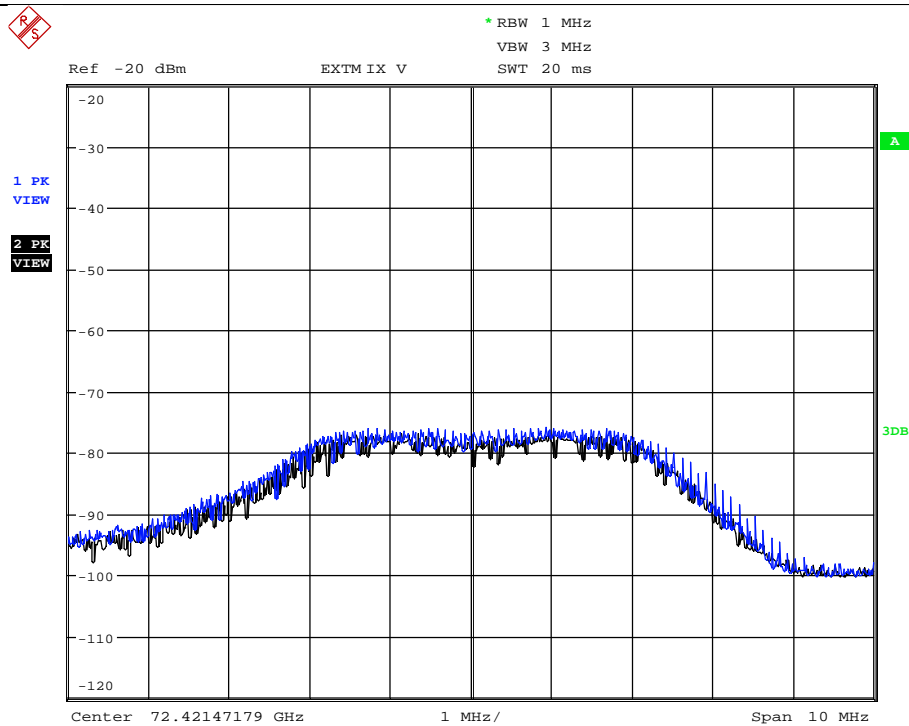

Plot 9.8-3: Final Measurement 3rd harmonic


Plot 9.8-4: Signal ID Plot of Emission #1 in range 50 – 75 GHz

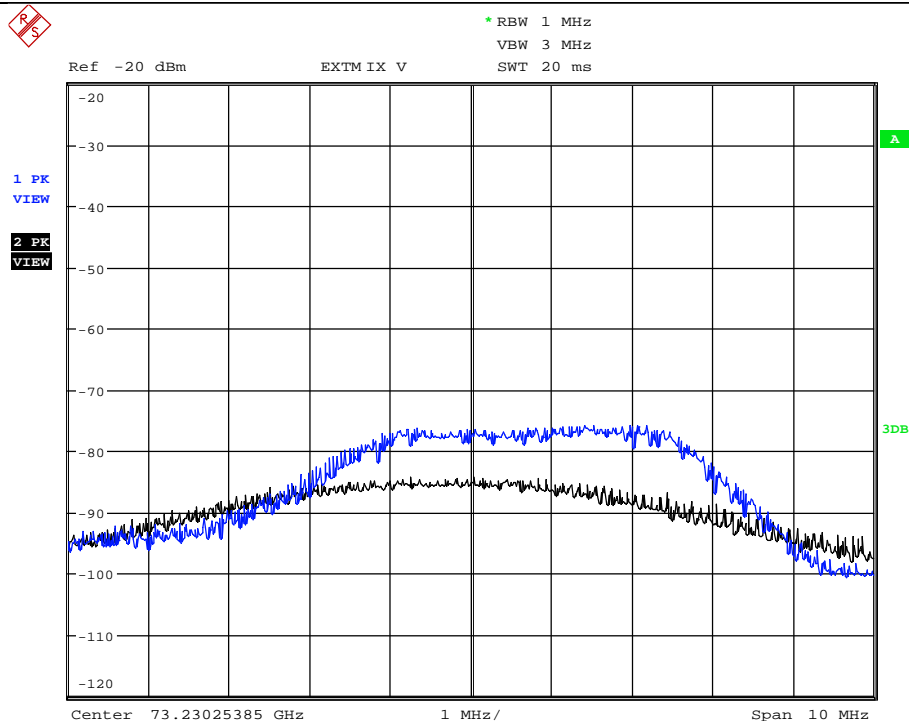
Note: Final measurements performed at closer distance with no additional correction factors. The receiver's reading was used for substitution measurements. Therefore the plots are not showing the final results.

Note 2: Signal ID Plots are for proving the authenticity of emissions. Emissions which are identified as images caused by the mixer are disregarded in the following processes.

Test of AMG Microwave DOS048-004 to FCC and ISED rules



Plot 9.8-5: Signal ID Plot of Emission #2 in range 50 – 75 GHz



Plot 9.8-6: Signal ID Plot of Emission #3 in range 50 – 75 GHz

Note 2: Signal ID Plots are for proving the authenticity of emissions. Emissions which are identified as images caused by the mixer are disregarded in the following processes.

10 MEASUREMENT UNCERTAINTY

Measurement	Measurement Uncertainty
Conducted Emissions (150 kHz – 30 MHz)	± 3.5 dB
Radiated Emissions, H field (9 kHz – 30 MHz)	± 3.0 dB
Radiated Emissions (30 MHz – 1 GHz)	± 5.7 dB
Radiated Emissions (1 GHz – 18 GHz)	± 5.3 dB
Radiated Emissions with substitution (1 GHz – 75 GHz)	± 5.3 dB

The reported uncertainty values are based on a standard uncertainty multiplied by a coverage factor of $k=2.0$, providing a level of confidence of 95 %.

The given values have been calculated on the basis of the following documents:

CISPR 16-4: 2002;

UKAS: LAB34, The Expression of Uncertainty in EMC Testing, August 2002;

ISO: Guide to the Expression of Uncertainty in Measurement, 1993.

11 LIST OF ANNEXES

Following annexes are separated parts from this test report.

Description	Pages
Annex 1: Photographs of test set-up	6
Annex 2: Photographs of equipment under test (EUT)	6