

TEST REPORT # EMCC-011166ECD 2015-10-20**EQUIPMENT UNDER TEST:**

Trade Name: Genius
Component: Motorbrake
Type: T2080 Genius
Serial No: Sample #3, 211302873,
Sample #4, 211301490,
Sample #5, no serial number
Equipment Category: Short Range Equipment
Application: Motorbrake with Wireless Data Transfer
Manufacturer: EBE Elektro-Bau-Elemente GmbH
Address: Sielminger Straße 63
70771 Leinfelden-Echterdingen
Germany
Applicant: EBE Elektro-Bau-Elemente GmbH
Contact Person: Mr Alexander Bräckle
Phone: +49 711 79986-285
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RELEVANT STANDARD(S): 47 CFR Part 15C**MEASUREMENT PROCEDURE USED:**

- ☒ ANSI C63.4-2009 ☒ Other: ANSI C63.10-2009
☒ 558074 D01 DTS Meas Guidance v03r03 ☒ 447498 D01 RF Exposure Guidance v06

TEST REPORT PREPARED BY:

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TEST PERSONNEL:


Ludwig Kraft

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


Wolfgang Döring

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1 GENERAL INFORMATION

1.1 Purpose

The purpose of this report is to show compliance to the FCC regulations for unlicensed devices operating under section 15.247 of the Code of Federal Regulations title 47.

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 EMCCCons DR. RAŠEK GmbH & Co. KG.

1.3 Test Location

Company Name:	EMCCCons DR. RAŠEK GmbH & Co. KG
Street:	Moggast, Boelwiese 8
City:	91320 Ebermannstadt
Country:	Germany
Address of Labs I, II, III and Head Office:	EMCCCons DR. RAŠEK GmbH & Co. KG Moggast, Boelwiese 8 91320 Ebermannstadt Germany
Address of Labs IV and V:	EMCCCons DR. RAŠEK GmbH & Co. KG Stoernhofer Berg 15 91364 Unterleinleiter Germany
Test Laboratory:	EMCCCons DR. RAŠEK GmbH & Co. KG, Test Laboratory IV located at Stoernhofer Berg 15, 91364 Unterleinleiter, Germany the 3 m & 10 m semi-anechoic chamber site has been fully described in the report submitted to the FCC, and accepted in the letter dated December 22, 2010, Registration Number 878769.
Name for contact purposes:	Mr Ludwig Kraft
Phone:	+49 9194 9016
Fax:	+49 9194 8125
E-Mail:	l.kraft@emcc.de
Web:	www.emcc.de

1.4 Manufacturer

Company Name:	EBE Elektro-Bau-Elemente GmbH
Street:	Sielminger Straße 63
City:	70771 Leinfelden-Echterdingen
Country:	Germany

1.5 Applicant

Company Name: EBE Elektro-Bau-Elemente GmbH
Street: Sielminger Straße 63
City: 70771 Leinfelden-Echterdingen
Country: Germany

Name for contact purposes: Mr Alexander Bräckle
Phone: +49 711 79986-285
E-mail: alexander.braeckle@ebe-gmbh.de

1.6 Dates

Date of receipt of EUT: Sample #3 CW 24/2015, Sample # 4 CW 37/2015
Test Date: see table below

1.7 Ordering Information

Purchase Order and Date: 163813, dated 2015-03-15
Vendor Number: 209576

1.8 Climatic Conditions

Date	Temperature [°C]	Relative Humidity [%]	Air Pressure [hPa]	Lab	Customer attended tests
2015-07-20	28	47	975	IV	no
2015-07-21	28	50	975	IV	no
2015-09-21	23	44	977	IV	no
2015-09-22	24	41	966	IV	no
2015-09-25	24	42	980	IV	no
2015-09-28	23	38	993	IV	no

2 PRODUCT DESCRIPTION

2.1 Equipment Under Test (EUT)

Trade name:	Genius
Component:	Motorbrake
Type:	T2080 Genius
Serial No.:	Sample #3, 211302873 Sample #4, 211301490 Sample #5, no serial number
FCC ID	2AAMI-T2080
Application:	Motorbrake with Wireless Data Transfer
Power:	110 – 230 VAC
Radio Technologie	Bluetooth Low Energy
TX operating frequency:	2402 - 2480 MHz
TX rated output power:	$\leq 0\text{dBm e.i.r.p.}^1$
Modulation:	GMSK*
Lowest frequency in EUT:	4 MHz
Antenna:	Internal, integral
Interface ports:	None
Variants:	None

2.2 Intended Use

The Genius Motorbrake is part of the Genius Trainer system.

The Genius Motorbrake is linked via Bluetooth Low Energy protocol with a control device running the application software.



Photograph 2.2-1: EUT in VR Trainer application [photo taken from product website]

¹ As specified by the manufacturer.

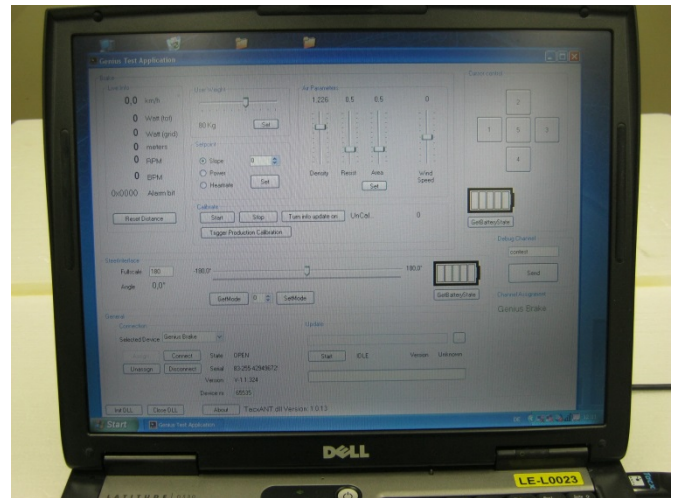
2.3 EUT Peripherals / Simulators

The following devices were used for setting the appropriate test mode:

- ANT+ USB Stick (provided by the manufacturer) used for test mode running
- Laptop PC (provided by the manufacturer) used for test mode running
- Application software (Genius Test Application, Version: 1.0.13 provided by manufacturer)
- Adapter cable with USB - RS232 converter



Photograph 2.3-1: Laptop PC with application software and ANT USB Stick used for test mode running



Photograph 2.3-2: Screenshot of the application software used for the test mode running

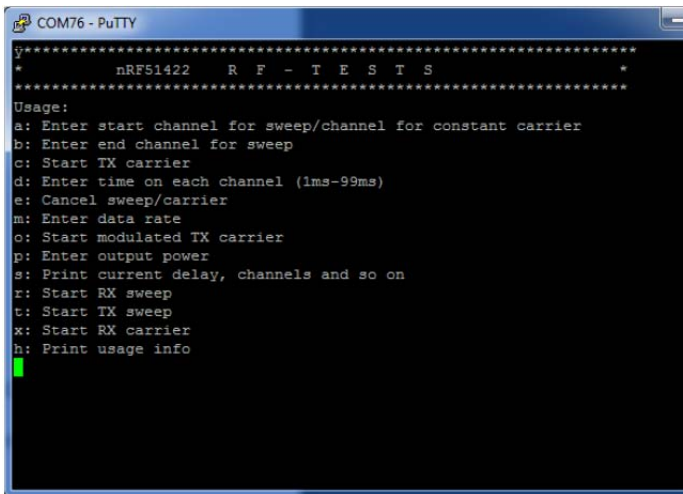


Photograph 2.3-3: Top view of ANT+ USB Stick used for test mode running



Photograph 2.3-4: Rear view of ANT+ USB Stick used for test mode running

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Photograph 2.3-5: Screen shot of the terminal program with the RF Test software used for the configuration of the RF transmitter in mode CW and modulated



Photograph 2.3-6: Connector cable with USB to serial converter and connector to the RF PCB used for the mode CW and modulated for test purpose, only

2.4 Mode of Operation during Testing

The EUT test mode running was set via ANT USB device and Genius Test Application software. The software was running on the Laptop PC with the ANT USB device connected.

The CW mode and modulated mode were configured with a test firmware provided by the customer. The EUT was configured with a terminal connected via a USB cable and an USB to serial converter (photograph 2.3-6).

The EUT was operated in a special CW test mode and in modulated test mode with random data, as provided by the customer. The configured modulation in mode 4 represents the modulation used in normal operation mode according to the customer.

Mode 1: standby

The EUT enter automatically the standby mode about 10 s after power on.
This mode was tested with EUT Sample #3.

Mode 2: running

This mode simulates a downhill bicycle ride with about 50 km/h. This mode was setup with the Genius Test Application software via Laptop and the ANT+ USB stick connected. The commands "contest" and "calsrt" were executed on the Genius Test Application to start this test mode.
This mode was tested with EUT Sample #3.

Mode 3: CW mode

The CW mode was tested with EUT Sample #4 and #5 . Find below the confiuration commands provided by the customer for CW mode.

"

Required Test Signal: Continuous Wave (CW) - TX Carrier without modulation (+4dBm, Channels 02, 80)

"a02" -> set frequency to 2402 MHz (or set other Channel as required)

"c" -> Start CW TX (carrier without modulation)

"

Mode 4: modulated

The modulated mode was tested with EUT Sample #4 and #5. Find below the confiuration commands provided by the customer for the Tx modulated mode.

"

Required Test Signal: Continuous TX Modulated (1 Mbit/s +4dBm, Channels 02, 50, 80)

Operation:

Output Power +4dBm and Data Rate 1 Mbit/s is default...

After Power On Reset enter:

"a02" -> set frequency to 2402 MHz (or set other Channel as required)

"o" -> Start modulated TX carrier

"

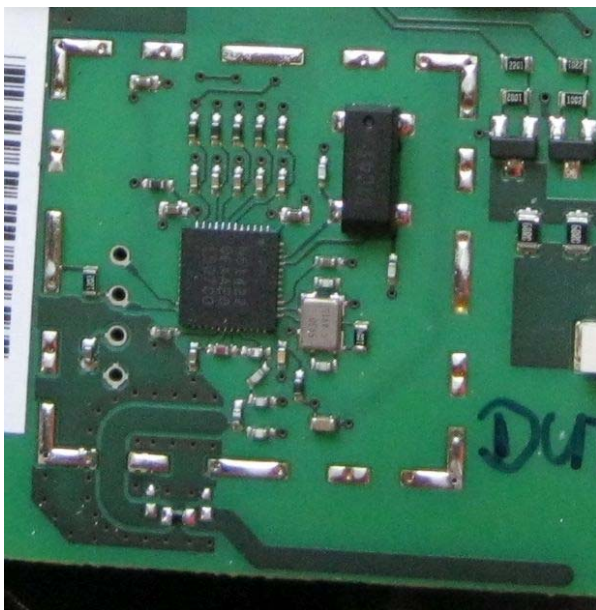
2.5 Modifications required for Compliance

Modification 1:

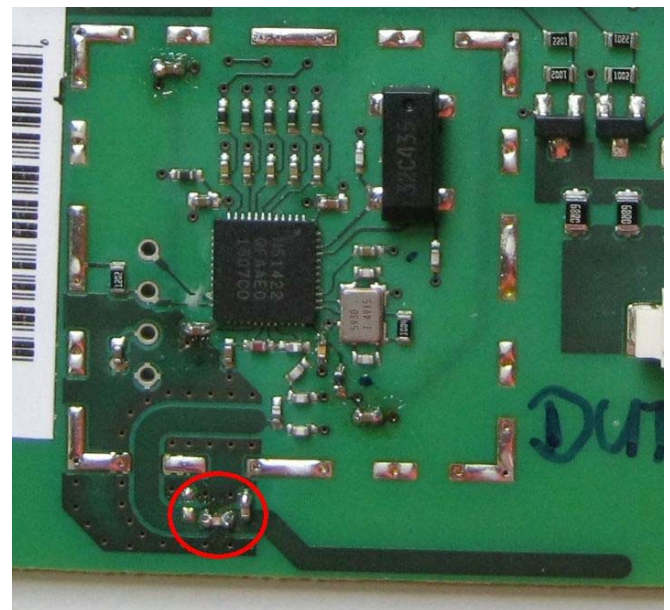
An LC Filter was added in the RF path to the antenna on the PCB board, see pictures below of the PCB board before and after the modification. In addition the output power configured at the RF chip was reduced from 4 dBm initially used to 0dBm. The command “p1” was executed on the terminal after setting the frequency.

Command example:

“p1”: set output power to 0dBm



Photograph 2.6-1: Detail of PCP of EUT sample #4 before modification



Photograph 2.6-2: Detail of PCP of EUT sample #4 with modification

The modification was done on Sample #4 and Sample #5, only.

The modification was required for compliance with spurious emissions requirement.

3 TEST RESULTS SUMMARY

Summary of test results for the following EUT:

Manufacturer: EBE Elektro-Bau-Elemente GmbH
Device: Genius Motorbrake
Type: T2080 Genius
Serial Number: Sample #3, 211302873
Sample #4, 211301490
Sample #5, no serial number

Requirement	47 CFR Section	Report Section	Test Result
Antenna Requirement	15.203	4	Compliant Sample #3, Sample #4
AC Line Conducted Emissions	15.207	5	Compliant Sample #3
DTS Bandwidth	15.247	6	Compliant Sample #5
Maximum Peak Power Conducted	15.247	7	Compliant Sample #5
Maximum Power Spectral Density Level in the Fundamental Emission	15.247	8	Compliant Sample #5
Emissions in non-restricted frequency bands	15.247	9	Compliant Sample #5
Emissions in restricted frequency bands	15.247 15.209, 15.205(a)	10	Compliant Sample #4
Band-edge Emissions	15.247	11	Compliant Sample #4
Radiofrequency radiated exposure Evaluation	1.1307	12	Compliant Sample #4, Sample #5

N.A. – Not applicable.

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 in ANSI C63.4 – 2009 & ANSI C63.10 – 2009 and all applicable Public Notices received prior to the date of testing. All emissions from the device 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: Ludwig Kraft

Issuance Date: 2015-10-20

4 ANTENNA REQUIREMENT

Test Requirement: FCC 47 CFR, Part 15C

4.1 Regulation

§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 Part 15C. The manufacturer may design the unit so that the user can replace a broken antenna, 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.

According to DA 00-2225 "OET Extends Effective Date of Antenna Connector Requirement Indefinitely", dated September 28, 2000, the OET extends the effective date of Public Notice, DA 00-1087, indefinitely.

4.2 Result

Manufacturer: EBE Elektro-Bau-Elemente GmbH
Device: Genius Motorbrake
Type: T2080 Genius
Serial Number: Sample #3, Sample #4

The antenna is a permanently attached internal antenna.

The EUT meets the requirements of this section.

5 CONDUCTED EMISSIONS TEST

Test Requirement: FCC 47 CFR, Part 15C

Test Procedure: ANSI C63.4-2009

5.1 Regulation

§15.207

(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 (dBuV)	
	Quasi-peak (QP)	Average (AV)
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

Section 15.207 (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 provision for, the use of battery chargers which permit operating while charging, AC adaptors 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.

5.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
EMI Test Receiver	Rohde & Schwarz ESU8	3846	2015-08	2016-08
V-LISN 50 ohms/(50 μ H + 5 ohms)	Rohde & Schwarz ESH2-Z5	1901	2015-09	2017-09
Pulse Limiter	Rohde & Schwarz ESH-Z2	1519	2015-09	2017-09
AC Power Source	AEG	0001	N.A.	N.A.
Multimeter	Agilent U1241A	2720	2015-01	2017-01

5.3 Test Procedures

For tabletop equipment, the EUT is placed on a 1 meter by 1.5 meters wide and 0.8 meter high nonconductive table that is placed above the groundplane. Ceiling or wall-mounted devices also is positioned on a tabletop for testing purposes. Floor standing equipment is placed either directly on the groundplane or on insulating material if normally placed on a nonconducting floor. The EUT is connected to its associated peripherals, with any excess I/O cabling bundled to approximately 1 meter. The EUT is

Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

connected to a dedicated LISN and all peripherals are connected to a second separate LISN circuit [NA]. The LISNs are bonded to the groundplane.

Conducted measurements are made on each current carrying conductor with respect to ground.

The EUT was tested as floor standing equipment placed on insulating material (1 cm height) plus additional spacer (5 cm insulating material) in order to establish a distance to ground as in real application. Test performed in “standby” and in “motor running” mode.

5.4 Test Results

EUT mode	Freq	Line	Detector	Result	Limit	Margin
	MHz			dBμV	dBμV	dB
running	0.155	N	AV	46.0	55.7	9.7
running	0.185	N	AV	42.0	54.3	12.3
running	0.200	N	AV	39.1	53.6	14.5
running	0.170	N	QP	50.0	65.0	14.9
running	0.185	N	QP	47.2	64.3	17.0
running	0.230	N	AV	33.9	52.5	18.6
running	0.150	L	AV	49.0	56.0	7.0
running	0.185	L	AV	42.8	54.3	11.5
running	0.155	L	QP	53.0	65.7	12.7
running	0.200	L	AV	40.3	53.6	13.3
running	0.240	L	AV	35.3	52.1	16.8
running	0.175	L	QP	47.0	64.7	17.7

The table above contains worst-case emission, only. For further details refer to the measurement plots below

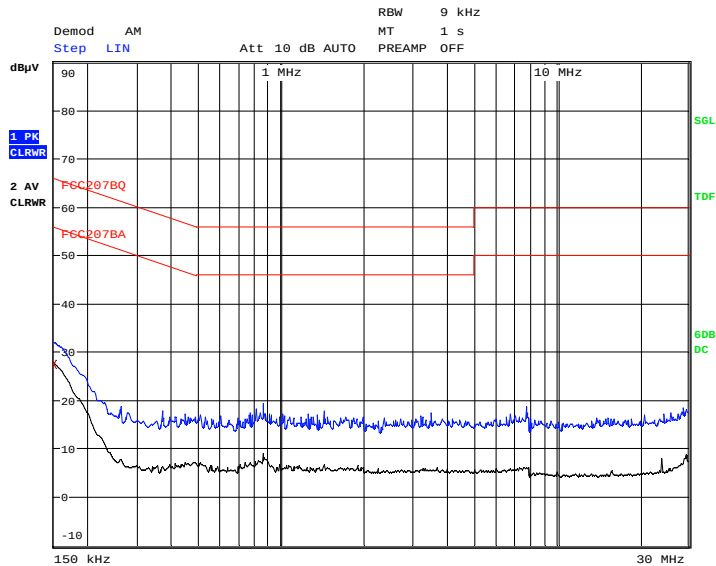
Manufacturer: EBE Elektro-Bau-Elemente GmbH
Device: Genius Motorbrake
Type: T2080 Genius
Serial Number: Sample #3

All emissions were found to be below the applicable limits.
The EUT meets the requirements of this section.

Test Personnel: Ludwig Kraft
Test Date: 2015-07-20

5.5 Measurement Plots

Test in mode 1 (standby) on line N:

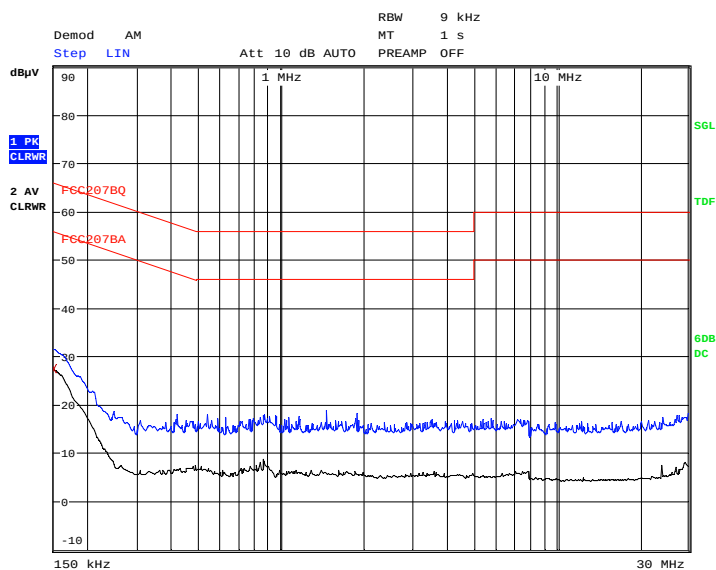


Manufacturer: EBE, EUT: #3, Mode: standby, Power: 115 Vac /

60 Hz, Line: N

Date: 20.JUL.2015 15:07:43

Test in mode 1 (standby) on line L:



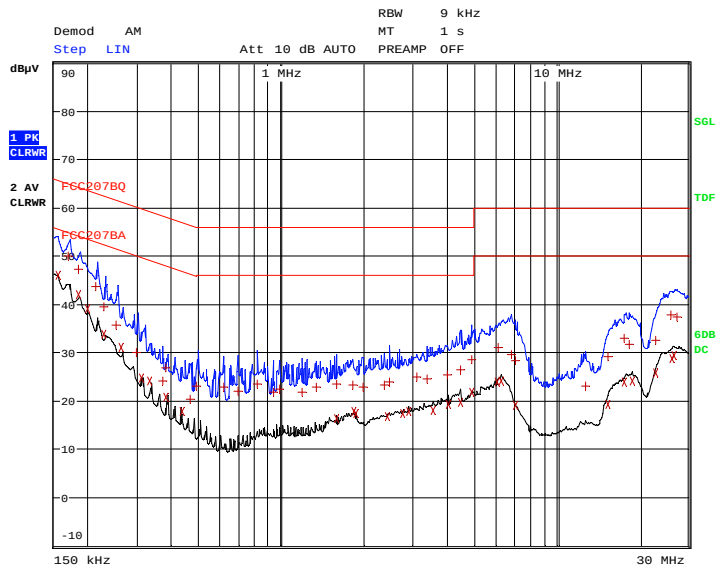
Manufacturer: EBE, EUT: #3, Mode: standby, Power: 115 Vac /

60 Hz, Line: L

Date: 20.JUL.2015 15:07:00

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Test in mode 2 (running) on line N:

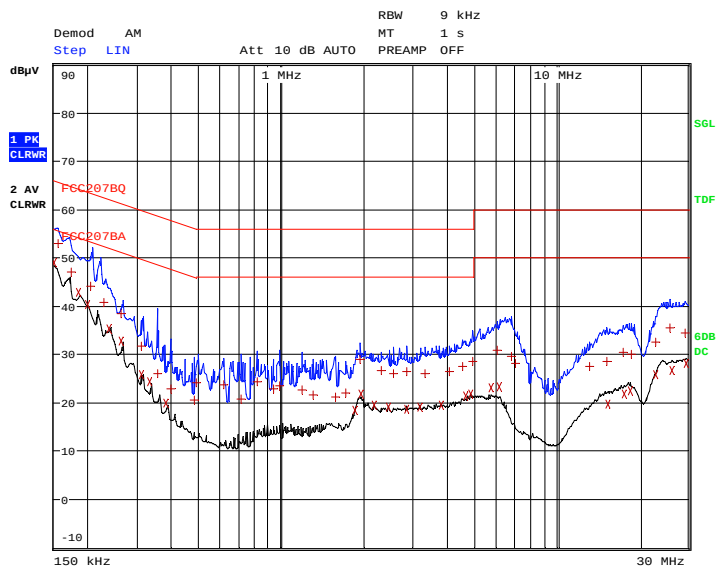


Manufacturer: EBE, EUT: #3, Mode: running, Power: 115 Vac /

60 Hz, Line: N

Date: 20.JUL.2015 15:19:47

Test in mode 2 (running) on line N:



Manufacturer: EBE, EUT: #3, Mode: running, Power: 115 Vac /

60 Hz, Line: L

Date: 20.JUL.2015 15:25:51

6 DTS BANDWIDTH

Test Requirement: FCC 47 CFR, §15.247

Test Procedure: ANSI C63.4-2009, Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247,v03r03

6.1 Regulation

§ 15.247

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

...

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

6.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Spectrum Analyser	Rohde & Schwarz FSU	3831	2015-07	2016-07
2W Attenuator	Omni Spectra	3187	2014-07	2016-07
DC Power Supply	Tektronix	4721	n.a.	n.a.
Multimeter	Agilent U1241A	2720	2015-01	2017-01

Test Procedure: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247,v03r03

8.1 Option 1:

a) Set RBW = 100 kHz.

b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.

c) Detector = Peak.

d) Trace mode = max hold.

e) Sweep = auto couple.

f) Allow the trace to stabilize.

g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

6.3 Test Results

EUT, mode	Frequency	Bandwidth	Limit	Margin
	GHz	kHz	kHz	kHz
Sample #5, modulated	2402	503.2	> 500	3.2
Sample #5, modulated	2440	506.4	> 500	6.4
Sample #5, modulated	2480	512.8	> 500	12.8

Manufacturer: EBE Elektro-Bau-Elemente GmbH

Device: Genius Motorbrake

Type: T2080 Genius

Serial Number: Sample #5, with modification 1

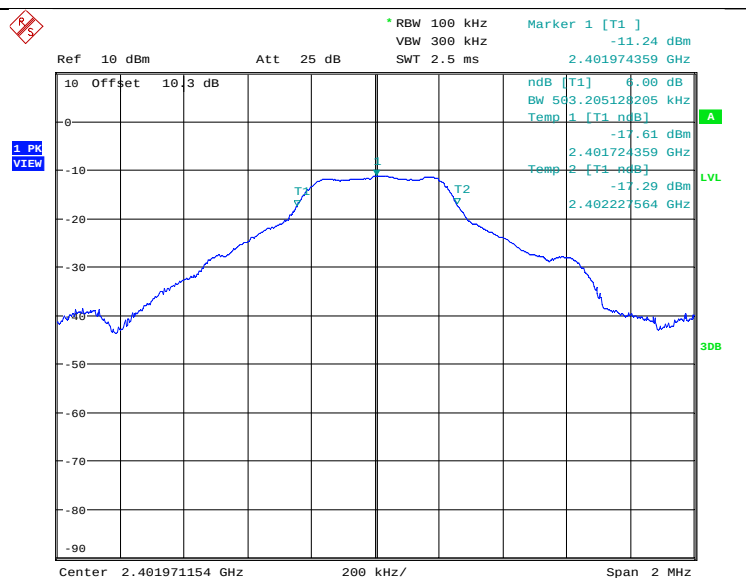
Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

The EUT meets the requirements of this section.

Test Personnel: Ludwig Kraft

Test Date: 2015-09-22

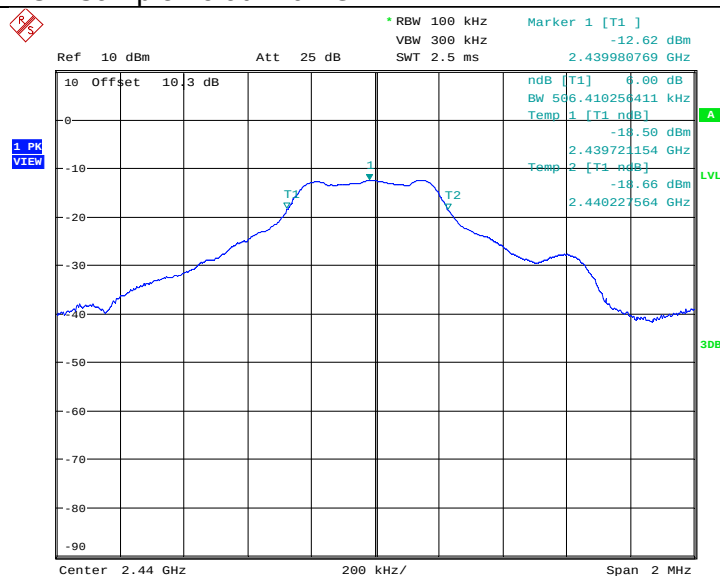
6.4 Measurement Plots



EUT settings: Freq 2402MHz, Power 0dBm, modulated

Date: 22.SEP.2015 14:12:11

EUT Sample #5 at 2402 GHz

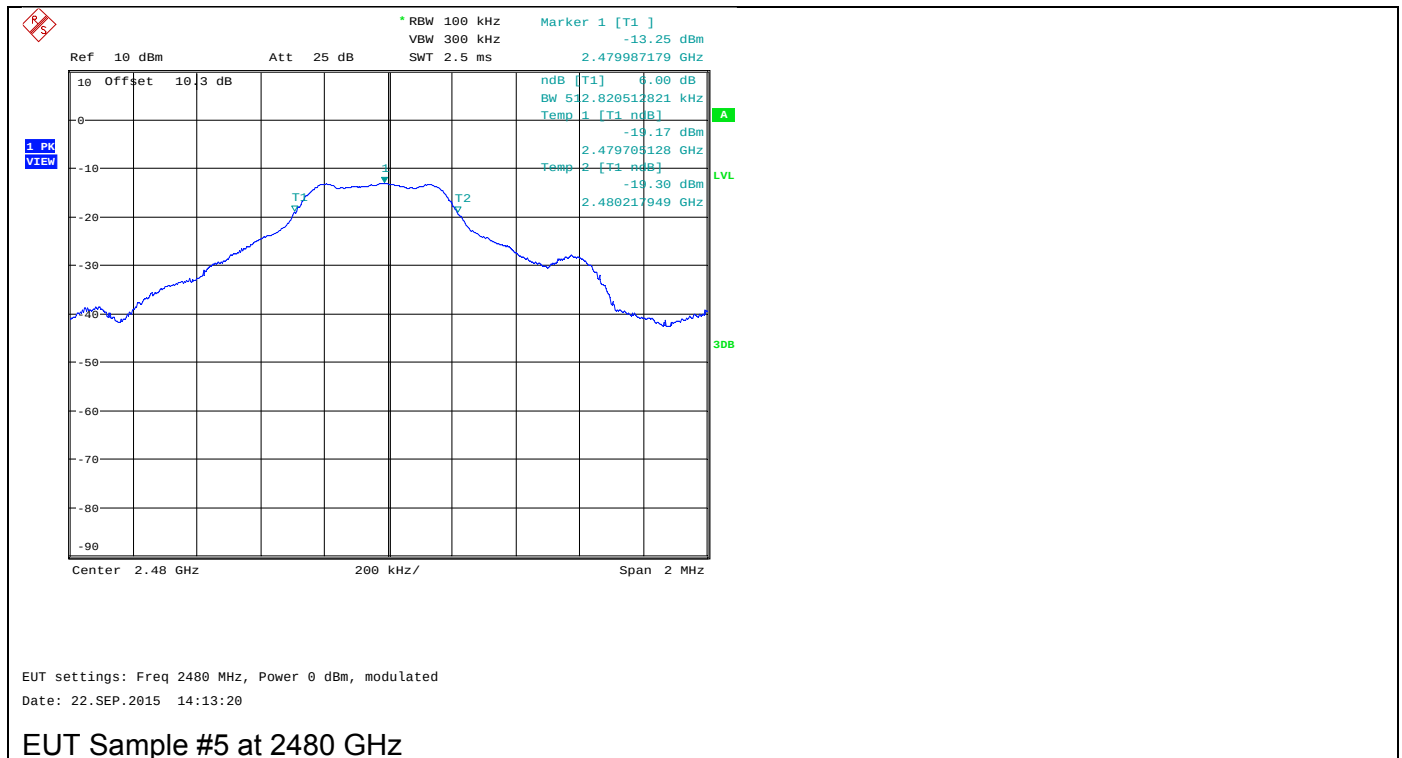


EUT settings: Freq 2440 MHz, Power 0 dBm, modulated

Date: 22.SEP.2015 14:12:45

EUT Sample #5 at 2440 GHz

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7 MAXIMUM PEAK POWER CONDUCTED

Test Requirement: FCC 47 CFR, §15.247

Test Procedure: ANSI C63.4-2009, Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247,v03r03

7.1 Regulation

§ 15.247

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

(2) For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

7.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Spectrum Analyser	Rohde & Schwarz FSU	3831	2015-07	2016-07
2W Attenuator	Omni Spectra	3187	2014-07	2016-07
DC Power Supply	Tektronix	4721	n.a.	n.a.
Multimeter	Agilent U1241A	2720	2015-01	2017-01

7.3 Test Procedures

Test Procedure: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247,v03r03

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

a) Set the RBW $\geq$ DTS bandwidth.

b) Set VBW $\geq 3 \times$ RBW.

Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

- c) Set span $\geq 3 \times \text{RBW}$
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level

7.4 Test Results

EUT, mode	Frequency	Power	Limit	Margin
	GHz	dBm	dBm	dB
Sample #5, modulated	2402	-11.0	30	41.0
Sample #5, modulated	2440	-12.3	30	41.3
Sample #5, modulated	2480	-13.0	30	43.0

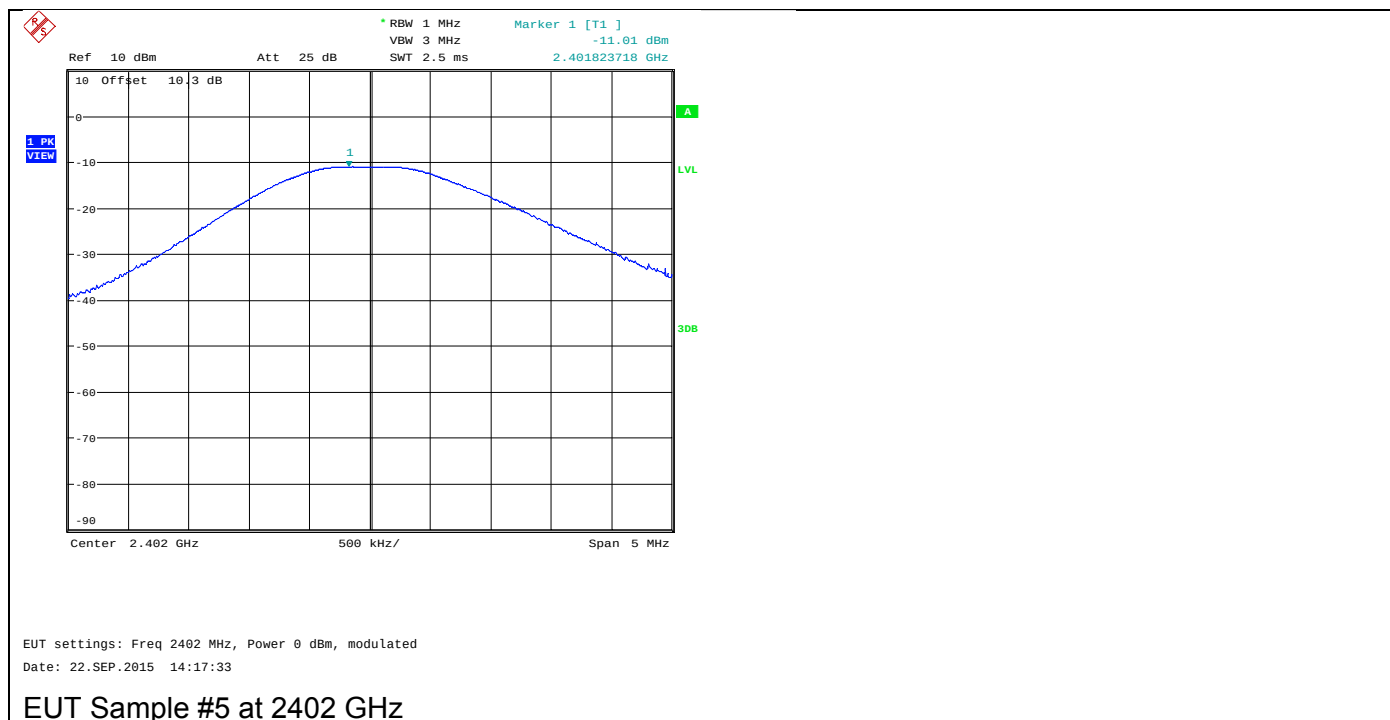
Manufacturer: EBE Elektro-Bau-Elemente GmbH
 Device: Genius Motorbrake
 Type: T2080 Genius
 Serial Number: Sample #5, with modification 1

The EUT meets the requirements of this section.

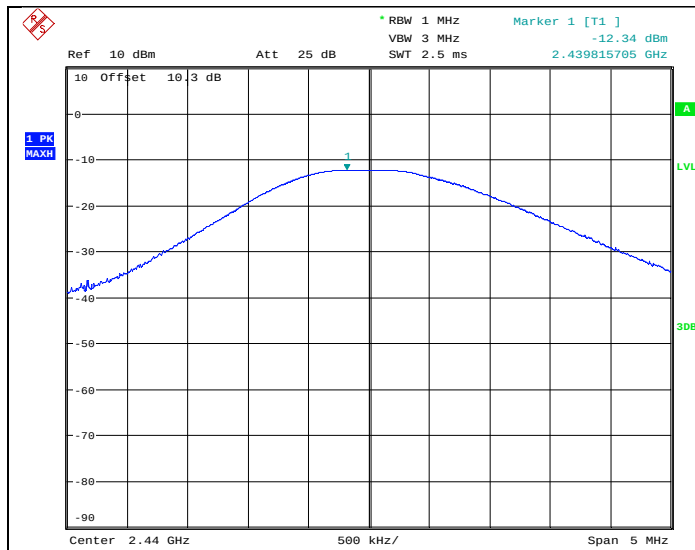
Test Personnel: Ludwig Kraft

Test Date: 2015-09-22

7.5 Measurement Plots



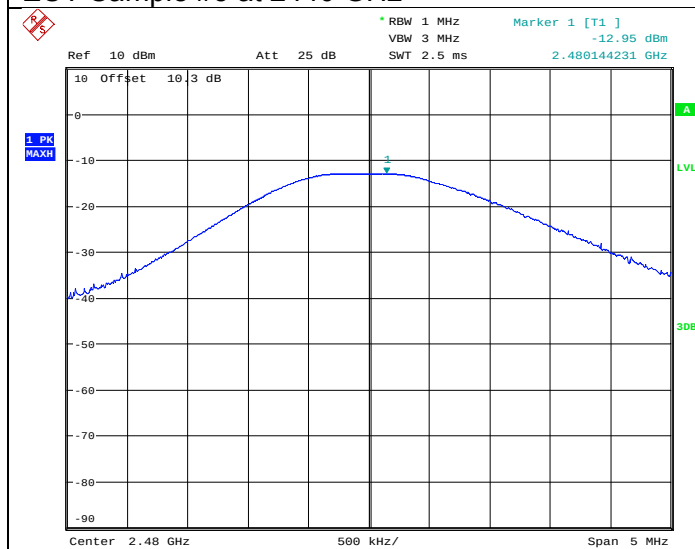
Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C



EUT settings: Freq 2440 MHz, Power 0 dBm, modulated

Date: 22.SEP.2015 14:21:01

EUT Sample #5 at 2440 GHz



EUT settings: Freq 2480 MHz, Power 0 dBm, modulated

Date: 22.SEP.2015 14:26:30

EUT Sample #5 at 2480 GHz

8 MAXIMUM POWER SPECTRAL DENSITY LEVEL IN THE FUNDAMENTAL EMISSION

Test Requirement: FCC 47 CFR, §15.247

Test Procedure: ANSI C63.4-2009, Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247,v03r03

8.1 Regulation

§ 15.247

(e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

8.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Spectrum Analyser	Rohde & Schwarz FSU	3831	2015-07	2016-07
2W Attenuator	Omni Spectra	3187	2014-07	2016-07
DC Power Supply	Tektronix	4721	n.a.	n.a.
Multimeter	Agilent U1241A	2720	2015-01	2017-01

8.3 Test Procedures

Test Procedure: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247,v03r03

Method PKPSD (peak PSD)

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq 3 \times \text{RBW}$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

8.4 Test Results

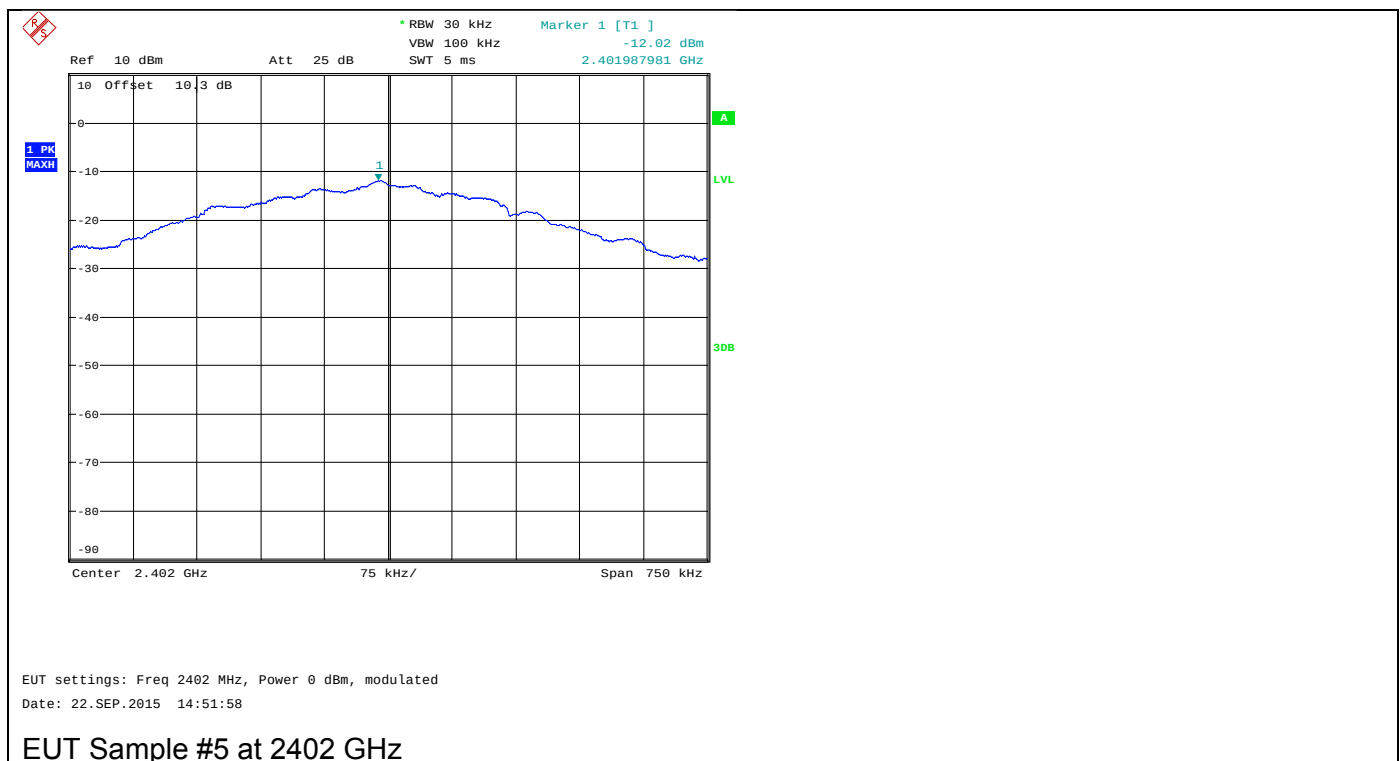
EUT, mode	Frequency	RBW	Level	Limit	Margin
	GHz	kHz	dBm	dBm	dB
Sample #5, modulated	2402	30	-12.0	8	20
Sample #5, modulated	2440	30	-13.2	8	21.2
Sample #5, modulated	2480	30	-14.0	8	22.0

Manufacturer: EBE Elektro-Bau-Elemente GmbH
 Device: Genius Motorbrake
 Type: T2080 Genius
 Serial Number: Sample #5, with modification 1

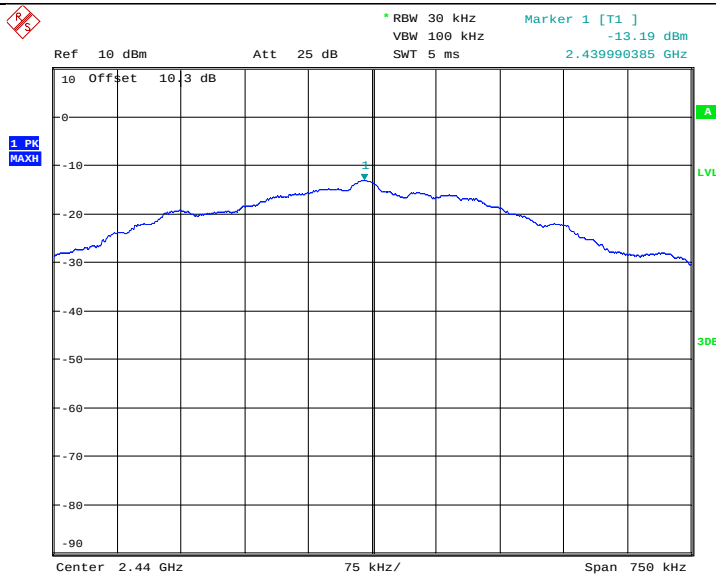
The EUT meets the requirements of this section.

Test Personnel: Ludwig Kraft
 Test Date: 2015-09-22

8.5 Measurement Plots



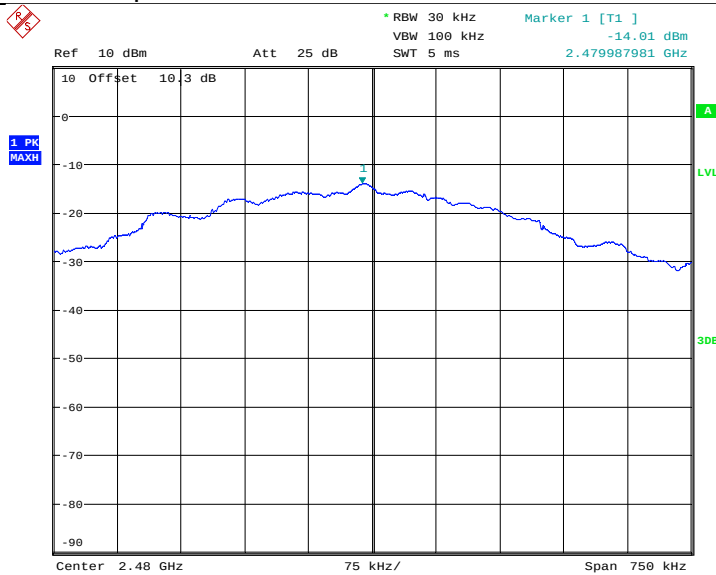
Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C



EUT settings: Freq 2440 MHz, Power 0 dBm, modulated

Date: 22.SEP.2015 14:55:03

EUT Sample #5 at 2440 GHz



EUT settings: Freq 2480 MHz, Power 0 dBm, modulated

Date: 22.SEP.2015 14:59:27

EUT Sample #5 at 2480 GHz

9 EMISSIONS IN NON-RESTRICTED FREQUENCY BANDS

9.1 Regulation

§ 15.247

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

9.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Spectrum Analyser	Rohde & Schwarz FSU	3831	2015-07	2016-07
2W Attenuator	Omni Spectra	3187	2014-07	2016-07
DC Power Supply	Tektronix	4721	n.a.	n.a.
Multimeter	Agilent U1241A	2720	2015-01	2017-01

9.3 Test Procedures

Test Procedure: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247,v03r03

Reference level measurement

Establish a reference level by using the following procedure:

- Set instrument center frequency to DTS channel center frequency.
- Set the span to ≥ 1.5 times the DTS bandwidth.
- Set the RBW = 100 kHz.
- Set the VBW $\geq 3 \times$ RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum PSD level.

Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Emission level measurement

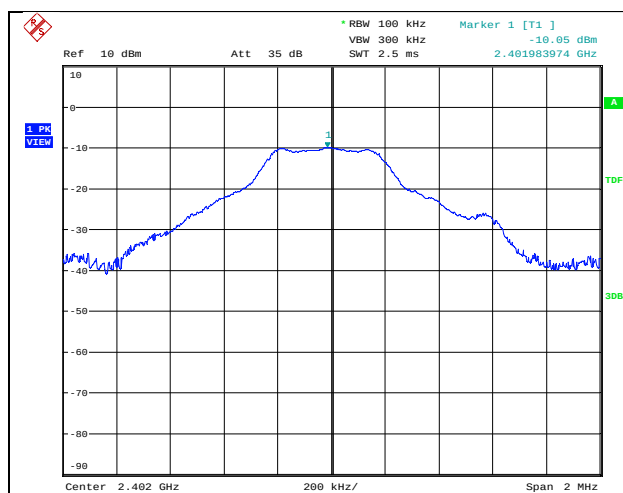
- Set the center frequency and span to encompass frequency range to be measured.
- Set the RBW = 100 kHz.
- Set the VBW $\geq 3 \times$ RBW.
- Detector = peak.

Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

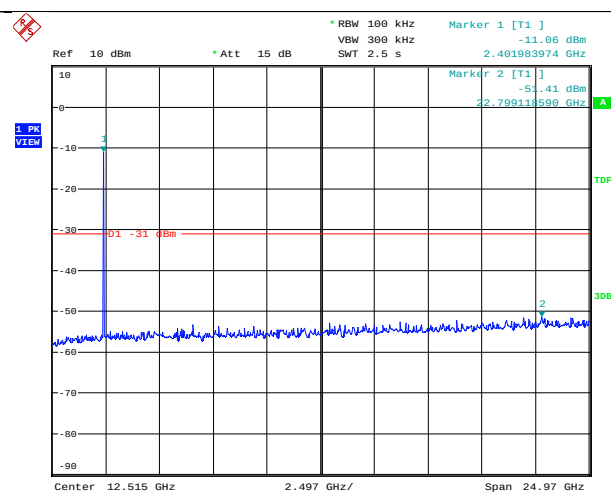
- e) Sweep time = auto couple.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use the peak marker function to determine the maximum amplitude level.

9.4 Test Results

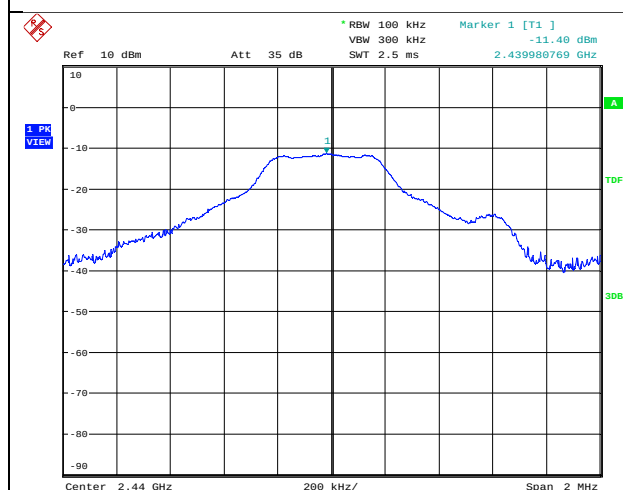
EUT, mode	Frequency	Reference level	Emission level	Delta	Limit	Margin
	GHz	dBm	dBm	dB	dB	dB
Sample #5, modulated	2402	-10.1	-51.4	41.3	20	21.3
Sample #5, modulated	2440	-11.4	-51.2	39.8	20	19.8
Sample #5, modulated	2480	-12.2	-50.7	38.5	20	18.5



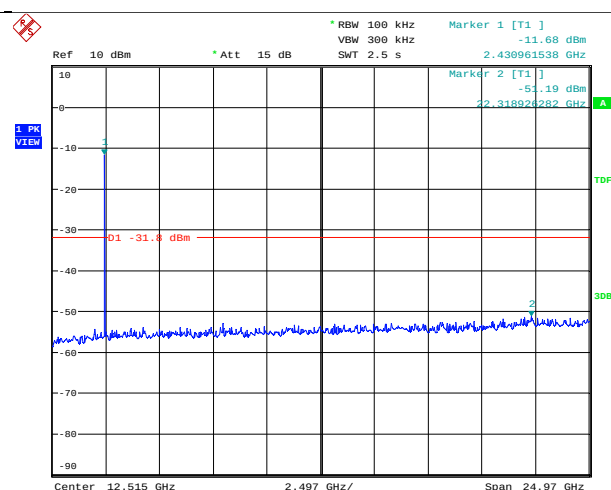
EUT settings: Freq 2402 MHz, Power 0 dBm, modulated
Date: 22.SEP.2015 16:56:52



EUT settings: Freq 2402 MHz, Power 0 dBm, modulated
Date: 20.OCT.2015 16:17:24

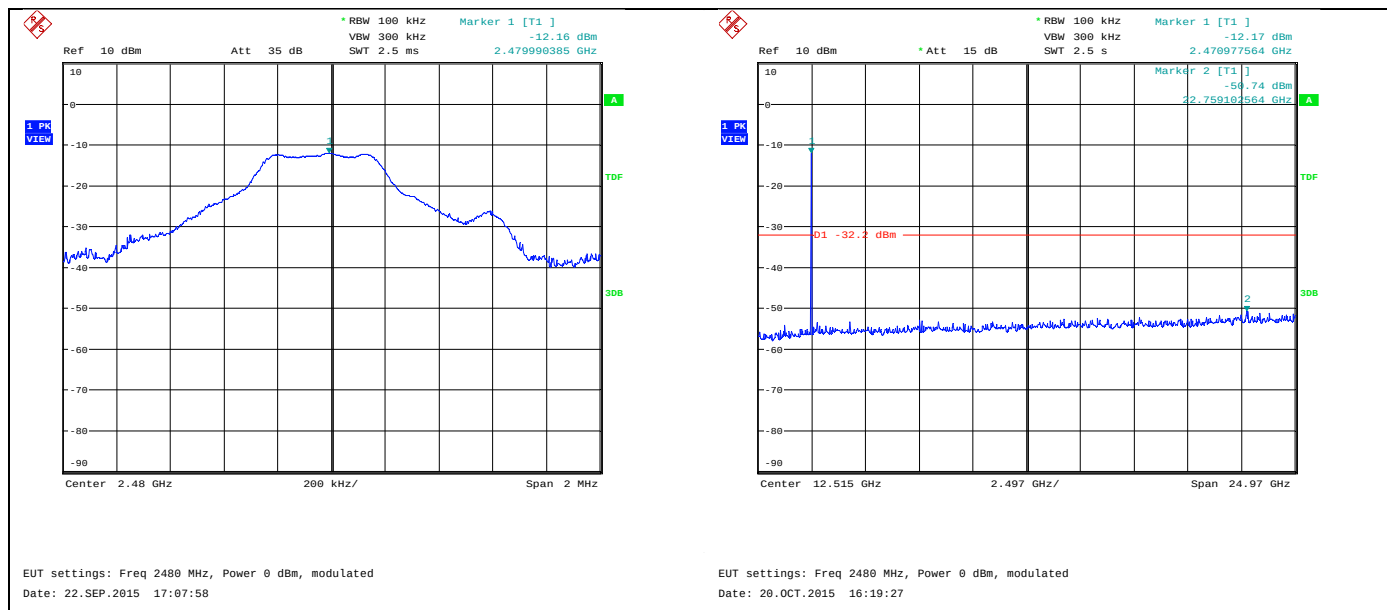


EUT settings: Freq 2440 MHz, Power 0 dBm, modulated
Date: 22.SEP.2015 17:01:54



EUT settings: Freq 2440 MHz, Power 0 dBm, modulated
Date: 20.OCT.2015 16:18:42

Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C



Manufacturer: EBE Elektro-Bau-Elemente GmbH
Device: Genius Motorbrake
Type: T2080 Genius
Serial Number: Sample #5, with modification 1

The EUT meets the requirements of this section.

Test Personnel: Ludwig Kraft
Test Date: 2015-09-22

10 EMISSIONS IN RESTRICTED FREQUENCY BANDS

Test Requirement: FCC 47 CFR, §15.247

Test Procedure: ANSI C63.4-2009

10.1 Regulation

§ 15.247

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

§15.209

(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:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement distance (meters)
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

(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.

(f) In accordance with Section 15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the

Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in Section 15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in Section 15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in Section 15.109 that are applicable to the incorporated digital device.

§ 15.205 Restricted bands of operation.

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			

10.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Spectrum Analyser	Rohde & Schwarz FSU	3831	2015-07	2016-07
Double Ridged Guide Ant.	Schwarzbeck BBHA 9120D	3235	2015-06	2017-06
EMI Test Receiver	Rohde & Schwarz ESS	303	2015-03	2016-03
Loop Antenna	Rohde & Schwarz	374	2014-06	2016-06
Biconilog. Antenna	EMCO 3143	898	2015-05	2017-05

10.3 Test Procedures

The EUT was tested on a 0.8 meter high support. For testing frequencies above 1 GHz the support height was 1.5 m for better alignment with the receive antenna.

With the EUT operating in a fixed transmitting frequency 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 on the nonconductive platform. Worst case emissions are listed under chapter: Test Results.

Radiated Emissions Test Characteristics	
Frequency range	9 kHz – 25 GHz
Test distance	3 m*
Test instrumentation resolution bandwidth	200 Hz (9 kHz – 150 kHz)
	10 kHz (150 kHz - 30 MHz)
	120 kHz (30 MHz - 1,000 MHz)
	1 MHz (1,000 MHz – 25 GHz)
Test instrumentation video bandwidth	3 MHz (10 Hz**)
Receive antenna scan height	1 m - 4 m
Receive antenna polarization	Horizontal (H-field, $f < 30$ MHz)
	Vertical/Horizontal (E-field, $f > 30$ MHz)

* According to Section 15.31 (f)(1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. (...) When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements). 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).

H-field measurement up to 30 MHz was performed in a semi-anechoic room at a test distance of 3 m. A calibrated loop antenna as specified in ANSI C63.4 clause 4.1.5.1 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.

** Average measurement was performed with a 10 Hz video bandwidth.

10.4 Calculation of Field Strength Limits

The maximum permitted unwanted emission level – except for harmonics - is the general radiated limits in §15.209 (54 dB μ V/m for frequencies above 960 MHz). For harmonics a limit of 500 μ V/m corresponding with 54 dB μ V/m applies. → Above 960 MHz the applicable limit for all emissions outside of the specified frequency band (2400 – 2483.5 MHz) is 54 dB μ V/m.

10.5 Calculation of Average Correction Factor

The average correction factor is computed by analyzing the "worst case" on time in any 100 mSec time period and using the formula:

Corrections Factor (dB) = $20 \cdot \log$ (worst case on time/100 mSec)

Procedure during test:

The relationship between average and peak mode reading has been confirmed by direct measurement using video averaging for the fundamental frequency level measurement. The obtained by measurement correction factor (difference between peak measurement with VBW of 3 MHz and peak measurement with VBW of 10 Hz) for the fundamental level was used for calculation of the average reading of the

spurious emission level. This calculation performed for peak results higher or close to the average limit, only. [N.A. CW peak results are below AV limit.]

10.6 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:

$$FS = RA + AF + CF$$

where

FS = Field Strength in dB μ V/m

RA = Receiver Amplitude in dB μ V

AF = Antenna Factor in dB(1/m)

CF = Cable Attenuation Factor in dB

Assume a receiver reading of 23.5 dB μ V 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 μ V/m. The 32 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

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

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

10.7 Test Results

9 kHz – 30 MHz:

EUT: Sample #3 mode standby and running

All emissions 20 dB below margin. For further details refer to the pre-scan test plots on following pages.

30MHz – 1 GHz:

EUT: Sample #3,mode standby and running, Sample #4 mode modulated

EUT mode	Frequency	RA	AF + CF	Result	Limit	Margin
	MHz	dB μ V	dB (1/m)	dB μ V/m	dB μ V/m	dB
run	41.91	28.8	10.3	39.1	40	0.9
run	39.0	27.4	11.2	38.6	40	1.4
run	288.01	26.8	17.6	44.4	46	1.6
run	30.0	18.3	14.5	32.8	40	7.2
run	122.62	14.1	9.4	23.6	43.5	19.9

The table above contains worst-case emissions only. For further details refer to the pre-scan test plots on following pages.

1 GHz – 25 GHz:

EUT: Sample #4, mode;CW, EUT frequency:2402 GHz, 2440 GHz, 2480GHz

EUT Frequency	Spurious Emission Frequency	Average Result	Limit	Margin
MHz	MHz	dB μ V/m	dB μ V/m	dB
2402	4802	45.2	54	8.8
2402	7206	50.2	54	3.8
2440	4880	46.8	54	7.2
2440	7320	45.5	54	8.5
2480	4960	47.0	54	7.0

The tables above contains worst-case emissions only. For further details refer to the pre-scan test plots on following pages.

Measurement was performed in worst case operation mode.

Manufacturer: EBE Elektro-Bau-Elemente GmbH
Device: Genius Motorbrake
Type: T2080 Genius
Serial Number: Sample #3 (150 Khz – 1000 MHz)
Sample #4, with modification 1 (30 MHz – 25 GHz)

The EUT meets the requirements of this section.

Test Personnel: Ludwig Kraft
Test Date: 2015-07-20/21, 2015-09-21/25

10.7.1 Magnetic Field (f = 9 kHz to 30 MHz)

Prescan d = 3 m (standby)

EMCCons DR. RAŠEK

21. Jul 15 13:28

Radiated Emissions H Field in SAR, d=3m

EUT: #3
 Manuf: EBE
 Op Cond: standby
 Operator: L. Kraft
 Test Spec: FCC 15C
 Comment: 4 directions, Ant 2 pol, EUT 2 dir

Scan Settings (2 Ranges)

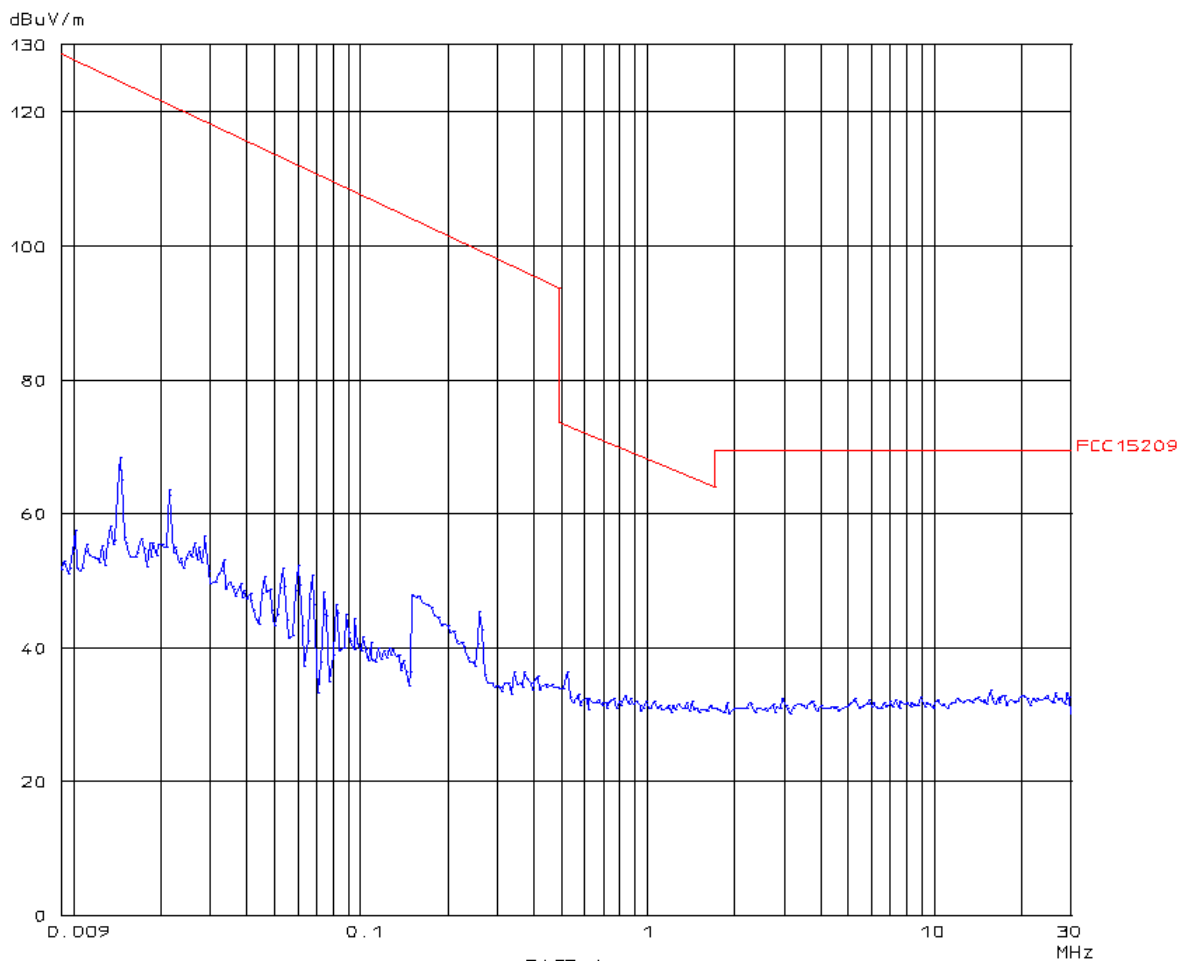
Frequencies			Receiver Settings						
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
9k	150k	100Hz	200Hz	PK	10ms	AUTO	LN	OFF	
150k	30M	5k	10k	PK	5ms	AUTO	LD	OFF	

Final Measurement: X Hor-Max / + Vert-Max

Meas Time: 1 s

Subranges: 25

Acc Margin: 30dB



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Prescan d = 3 m (running mode)

EMCCons DR. RASEK

21. Jul 15 14:30

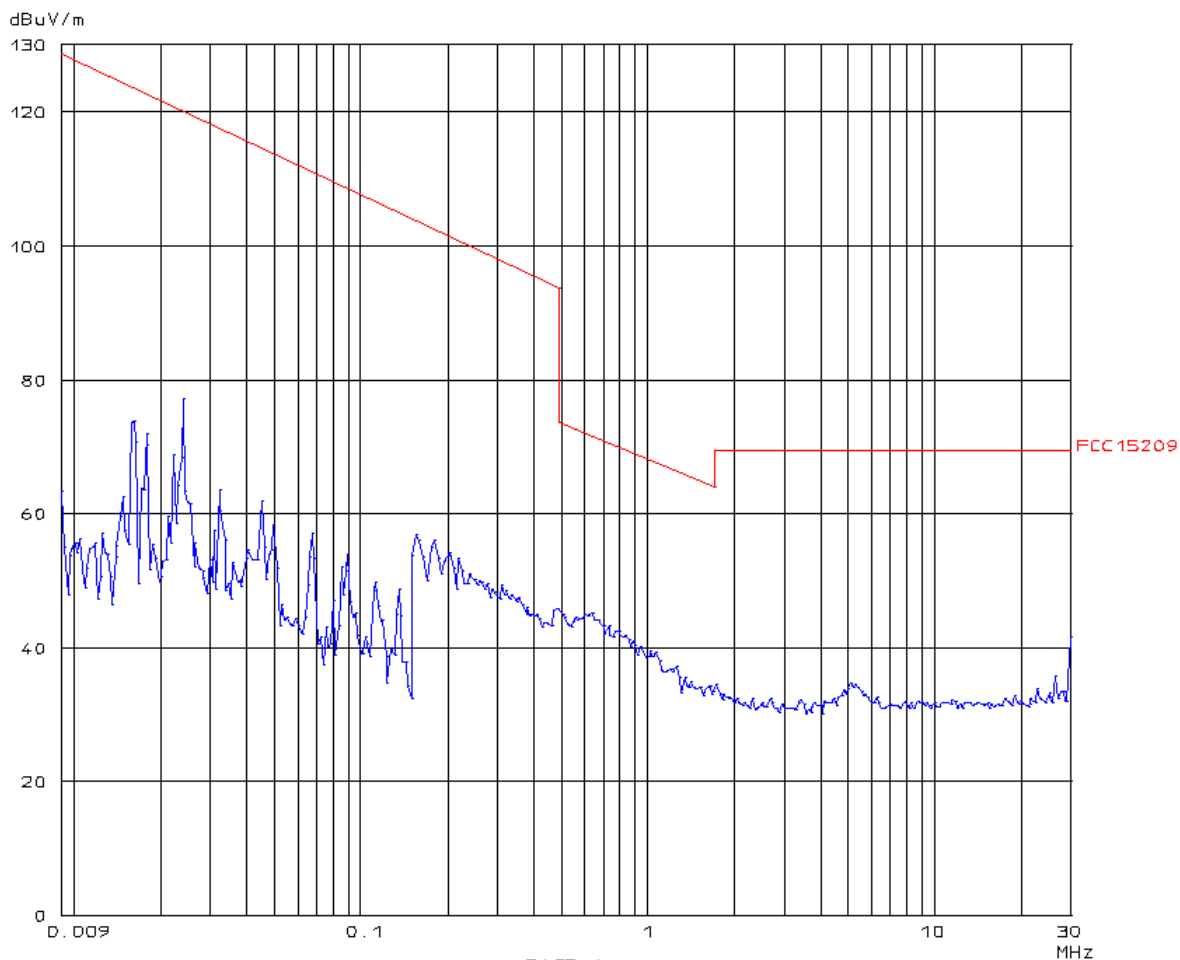
Radiated Emissions H Field in SAR, d=3m

EUT: #3
 Manuf: EBE
 Op Cond: running
 Operator: L. Kraft
 Test Spec: FCC 15C
 Comment: 4 directions, Ant 2 pol. EUT axis hor

Scan Settings (2 Ranges)

Frequencies			Receiver Settings						
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge	
9k	150k	100Hz	200Hz	PK	10ms	AUTO	LN	OFF	
150k	30M	5k	10k	PK	5ms	AUTO	LO	OFF	
								60dB	
								30dB	

Final Measurement: x Hor-Max / + Vert-Max
 Meas Time: 1 s
 Subranges: 25
 Acc Margin: 30dB



PAGE 1

10.7.2 Electric Field (f = 30 MHz to 1 GHz)

Prescan d = 3 m (standby)

EMCC DR. RAŠEK

20. Jul 15 16:08

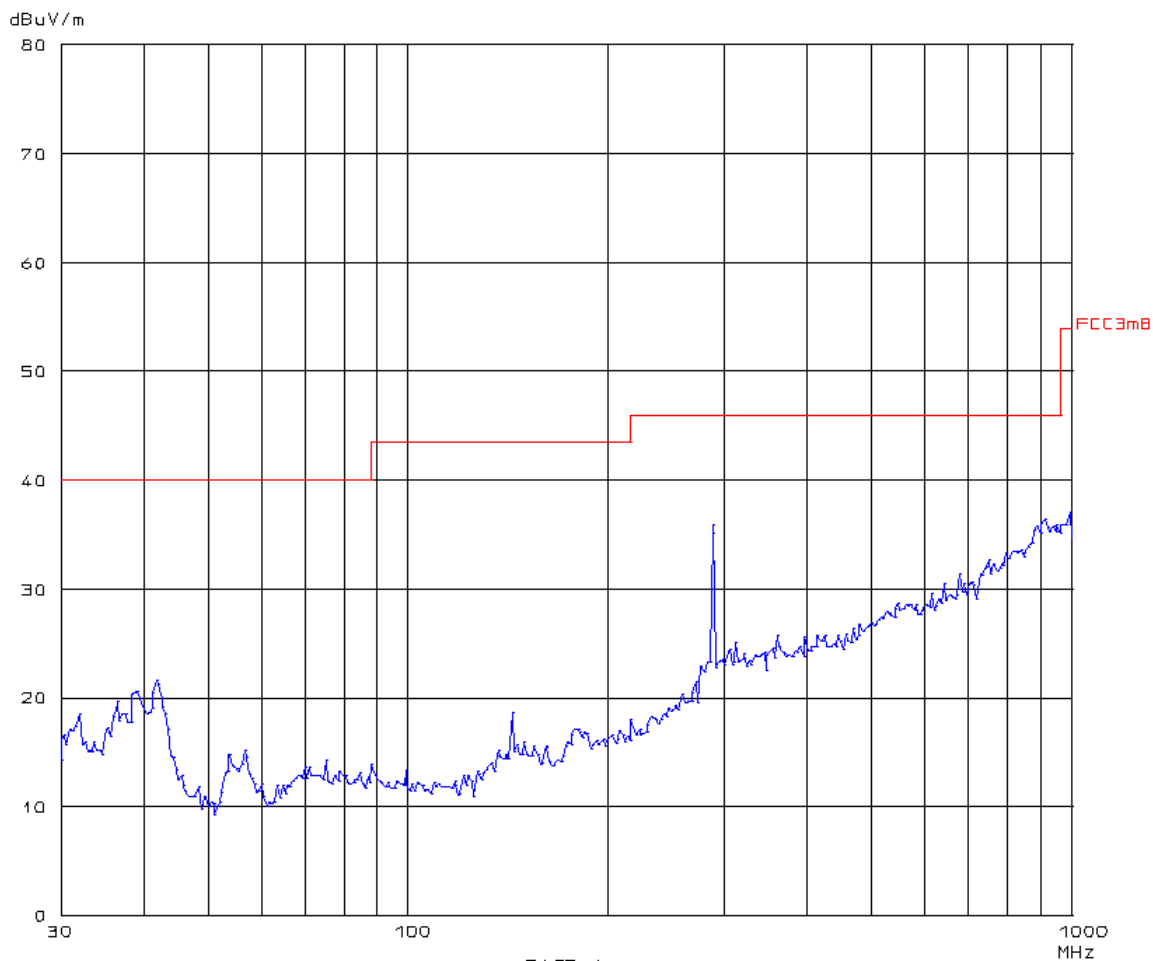
Radiated Emissions Prescan in SAR, d=3m

EUT: #3
 Manuf: EBE
 Op Cond: standby
 Operator: L. Kraft
 Test Spec: FCC 15
 Comment: 4 directions, 3\4 heights

Fast Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30M	1000M	40k	120k	PK	0.10ms	0dB	LN ON	60dB

Transducer	No.	Start	Stop	Name
	21	30M	1000M	89826K33



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Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

Prescan d = 3 m (running mode)

EMCC DR. RAŠEK

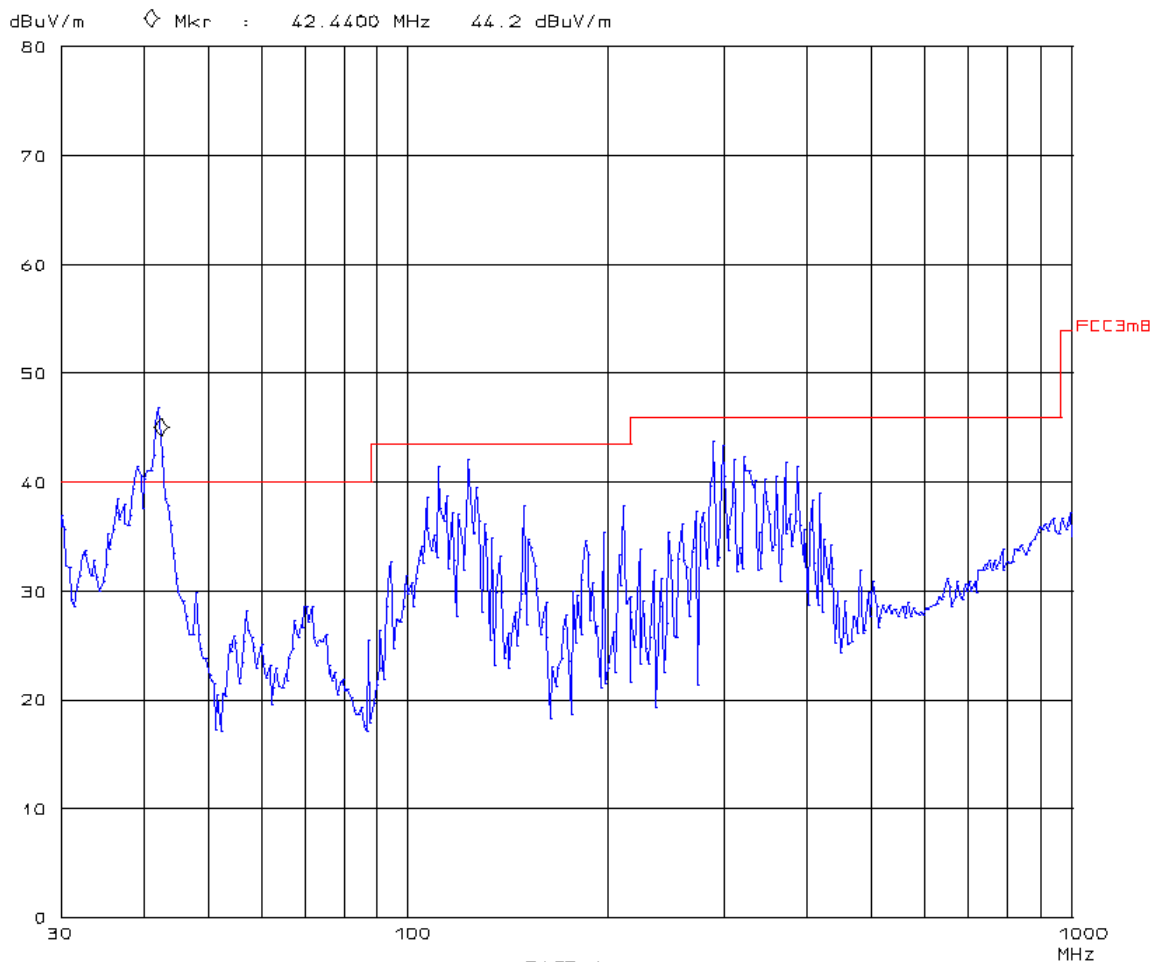
21. Jul 15 08:43

Radiated Emissions Prescan in SAR, d=3m

EUT: #3
 Manuf: EBE
 Op Cond: running
 Operator: L. Kraft
 Test Spec: FCC 15
 Comment: 4 directions, 3\4 heights

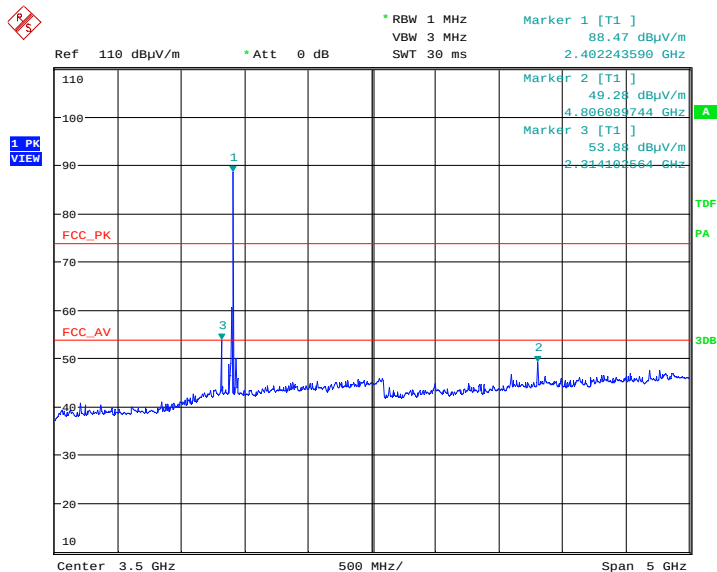
Fast Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30M	1000M	40k	120k	PK	0.10ms	0dB	LN ON	60dB
			Transducer	No.	Start	Stop	Name	
				21	30M	1000M	89B26K33	



Prescan result, the final measurement was below the limit. See final measurement result above.

10.7.3 Electric Field (f = 1 GHz to 25 GHz)

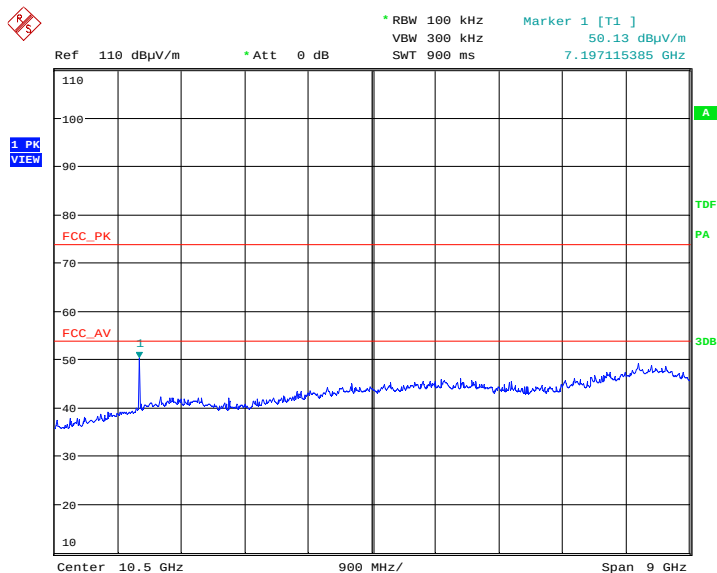


EUT: #4 mod 1, Freq 2402MHz, Power 0dBm, modulated; Ant. pol

: vert

Date: 21.SEP.2015 16:04:20

Prescan plot 1-6 GHz, CW mode, EUT frequency 2402 GHz, distance 3 m, antenna vert.



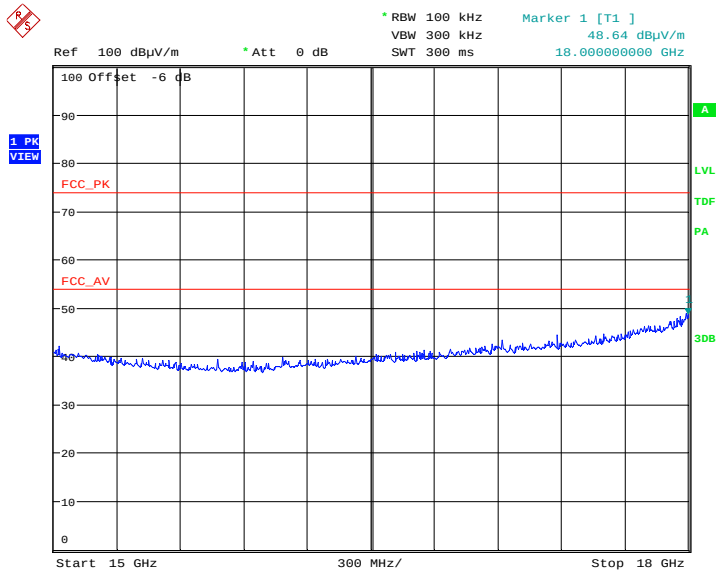
EUT: #4 mod 1, Freq 2402MHz, Power 0dBm, modulated; Ant. pol

: vert

Date: 21.SEP.2015 17:38:35

Prescan plot 6-15 GHz, CW mode, EUT frequency 2402 GHz, distance 3 m, antenna vert

Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

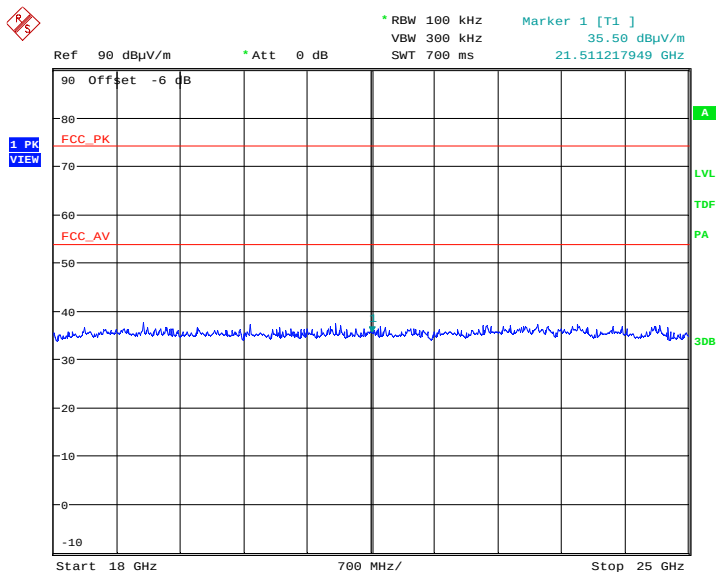


EUT: #4 mod 1, Freq 2402MHz, Power 0dBm, modulated; Ant. pol

: vert

Date: 25.SEP.2015 14:23:45

Prescan plot 15-18 GHz, CW mode, EUT frequency 2402 GHz, distance 1.5 m, antenna vert



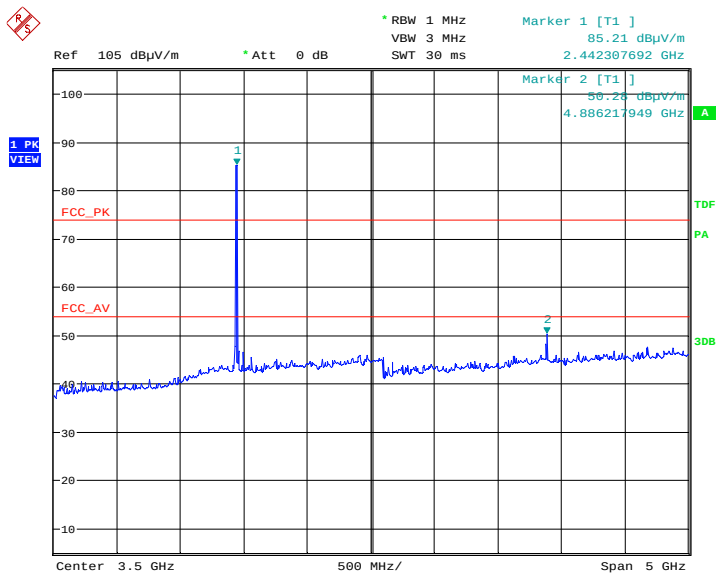
EUT: #4 mod , Freq 2402MHz, Power 0dBm, modulated; Ant. pol:

vert

Date: 25.SEP.2015 16:38:15

Prescan plot 18-25 GHz, CW mode, EUT frequency 2402 GHz, distance 1.5 m, antenna vert

Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

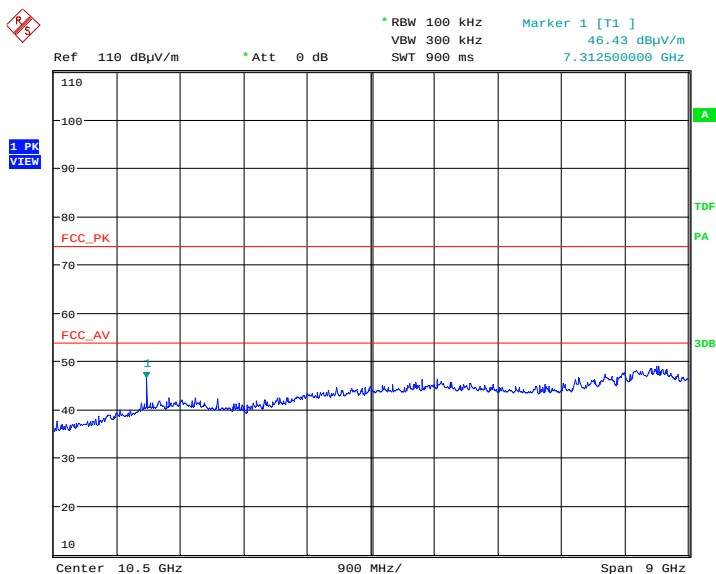


EUT: #4 mod 1, Freq 2440MHz, Power 0dBm, modulated; Ant. pol

: vert

Date: 21.SEP.2015 14:06:17

Prescan plot 1-6 GHz, CW mode, EUT frequency 2440 GHz, distance 3 m, antenna vert.



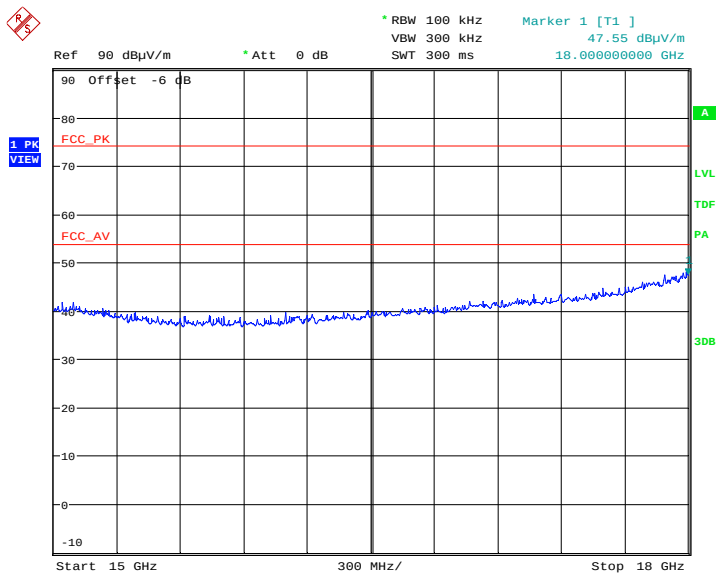
EUT: #4 mod 1, Freq 2440MHz, Power 0dBm, modulated; Ant. pol

: vert

Date: 21.SEP.2015 17:47:12

Prescan plot 6-15 GHz, CW mode, EUT frequency 2440 GHz, distance 3 m, antenna vert.

Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

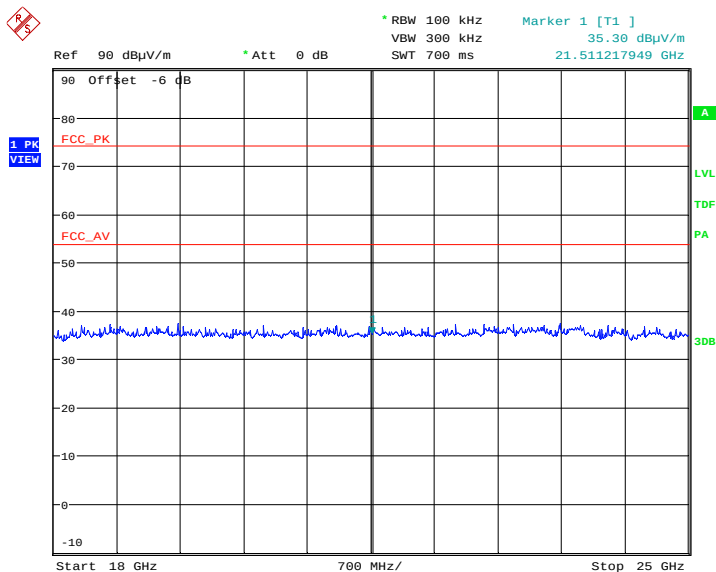


EUT: #4 mod , Freq 2440MHz, Power 0dBm, modulated; Ant. pol:

vert

Date: 25.SEP.2015 14:42:12

Prescan plot 15-18 GHz, CW mode, EUT frequency 2440 GHz, distance 1.5 m, antenna vert.



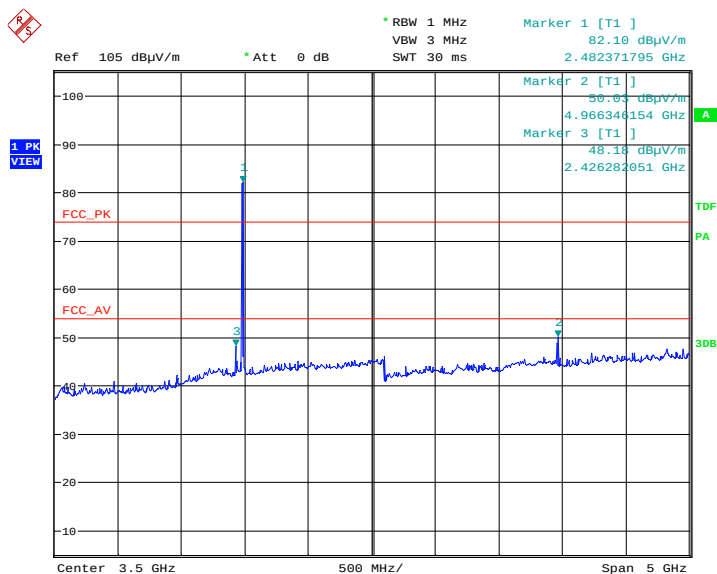
EUT: #4 mod , Freq 2440MHz, Power 0dBm, modulated; Ant. pol:

vert

Date: 25.SEP.2015 16:22:33

Prescan plot 18-25 GHz, CW mode, EUT frequency 2440 GHz, distance 1.5 m, antenna vert

Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

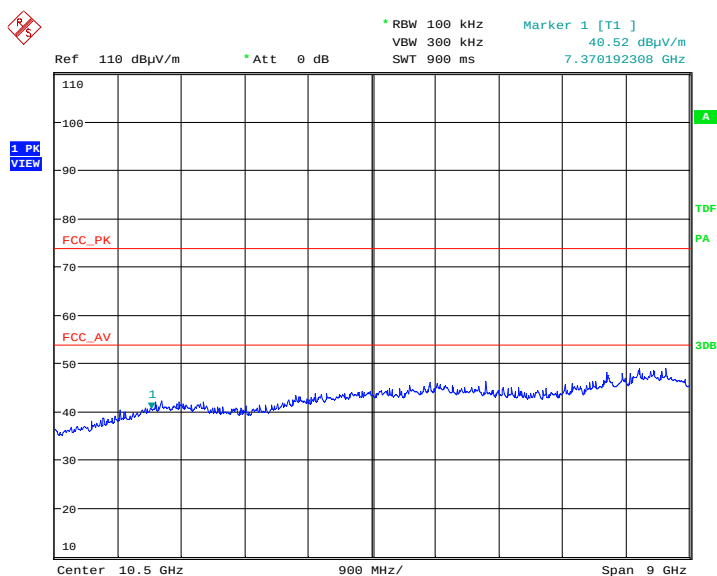


EUT: #4 mod 1, Freq 2480MHz, Power 0dBm, modulated; Ant. pol

: vert

Date: 21.SEP.2015 15:13:14

Prescan plot 1-6 GHz, CW mode, EUT frequency 2480 GHz, distance 3 m, antenna vert



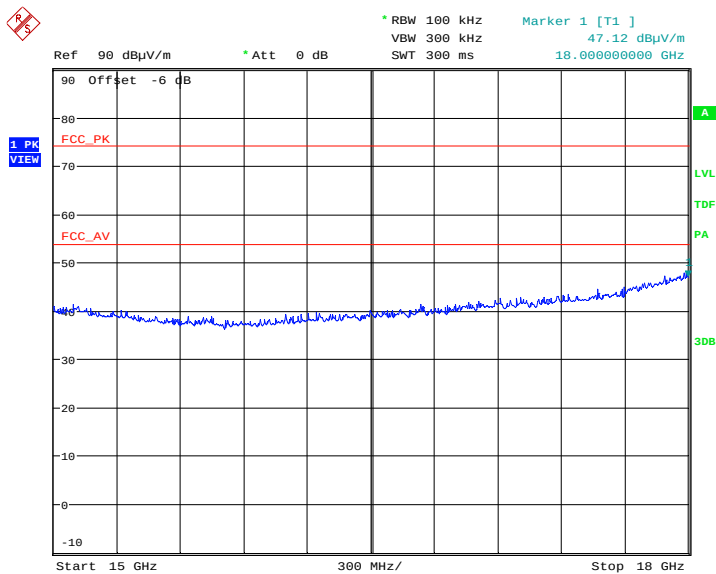
EUT: #4 mod 1, Freq 2480MHz, Power 0dBm, modulated; Ant. pol

: vert

Date: 21.SEP.2015 18:36:36

Prescan plot 6-15 GHz, CW mode, EUT frequency 2480 GHz, distance 3 m, antenna vert

Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

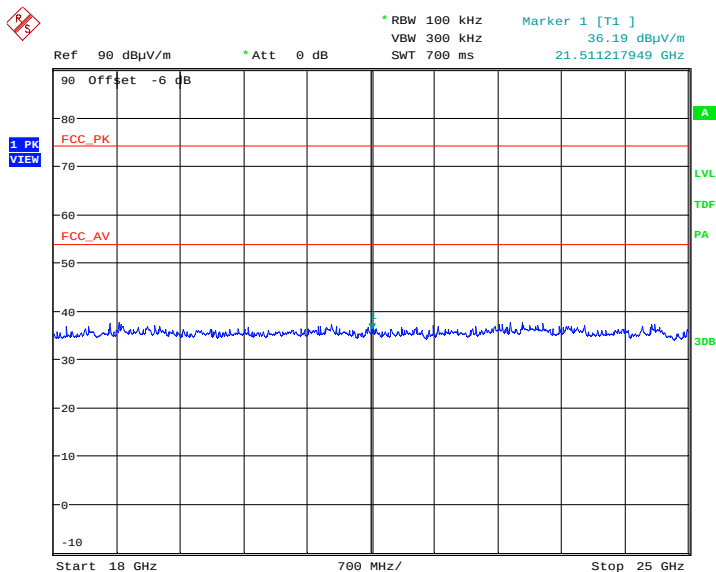


EUT: #4 mod , Freq 2480MHz, Power 0dBm, modulated; Ant. pol:

vert

Date: 25.SEP.2015 15:03:51

Prescan plot 15-18 GHz, CW mode, EUT frequency 2480 GHz, distance 1.5 m, antenna vert



EUT: #4 mod , Freq 2480MHz, Power 0dBm, modulated; Ant. pol:

vert

Date: 25.SEP.2015 15:52:23

Prescan plot 18-25 GHz, CW mode, EUT frequency 2480 GHz, distance 1.5 m, antenna vert

11 BAND-EDGE EMISSIONS

Test Requirement: FCC 47 CFR, §15.247

Test Procedure: ANSI C63.10 – 2009 §6.9.2

11.1 Regulation

§15.247

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

11.2 Test Equipment

Type	Manufacturer/ Model No.	EMCC Ident No.	Last Calibration	Next Calibration
Spectrum Analyser	Rohde & Schwarz FSU	3831	2015-07	2016-07
Double Ridged Guide Ant.	Schwarzbeck BBHA 9120D	3235	2015-06	2017-06

11.3 Test Procedure

Connect the spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described below (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).

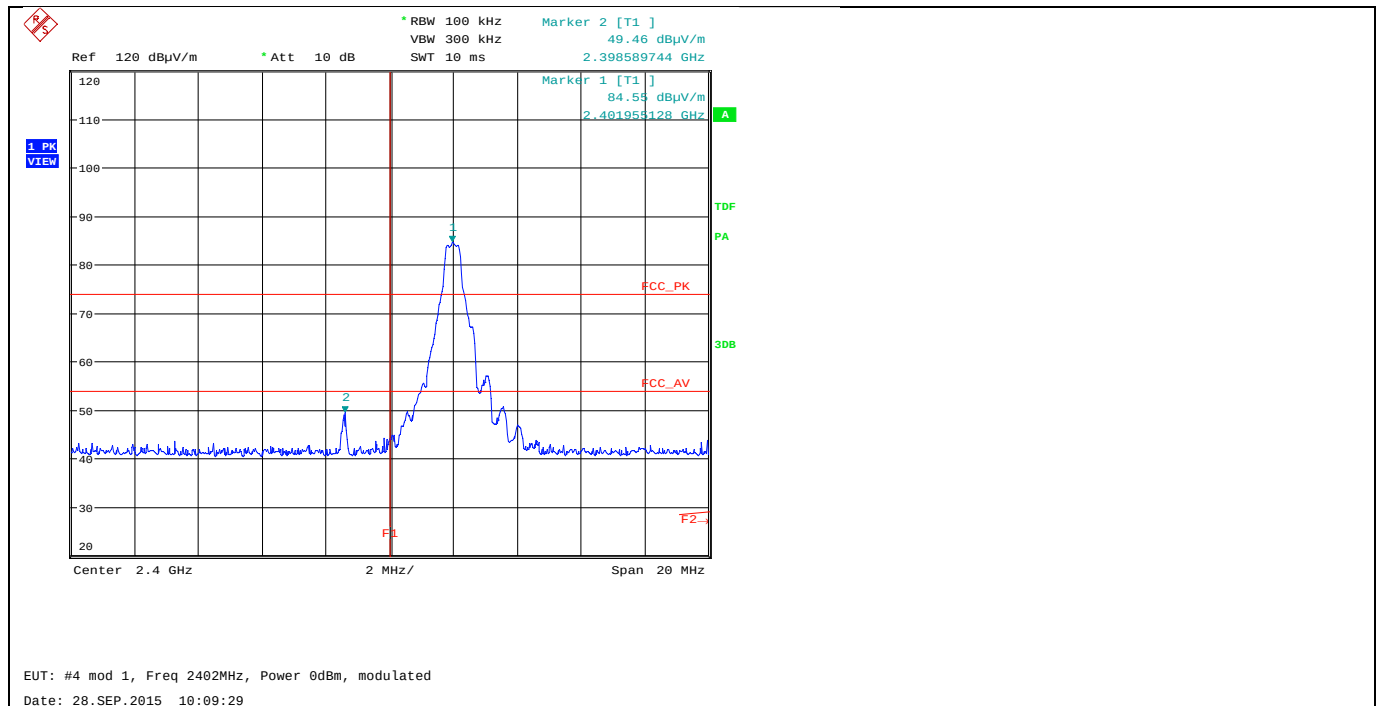
- Span: Set Span for minimum 50 MHz
- Reference Level: 110 dBμV (corrected for gains and losses of test antenna factor, preamp gain and cable loss)
- Attenuation: 10 dB
- Sweep Time: Coupled
- Resolution Bandwidth: Up to and including 1 GHz $\geq$ 100 kHz
- Resolution Bandwidth: Above 1 GHz = 1 MHz
- Video Bandwidth: Below 1 GHz = 300 kHz
- Video Bandwidth: Up from and including 1 GHz $\geq$ 3 MHz for peak and 10 Hz for average
- Detector: Peak

Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot.

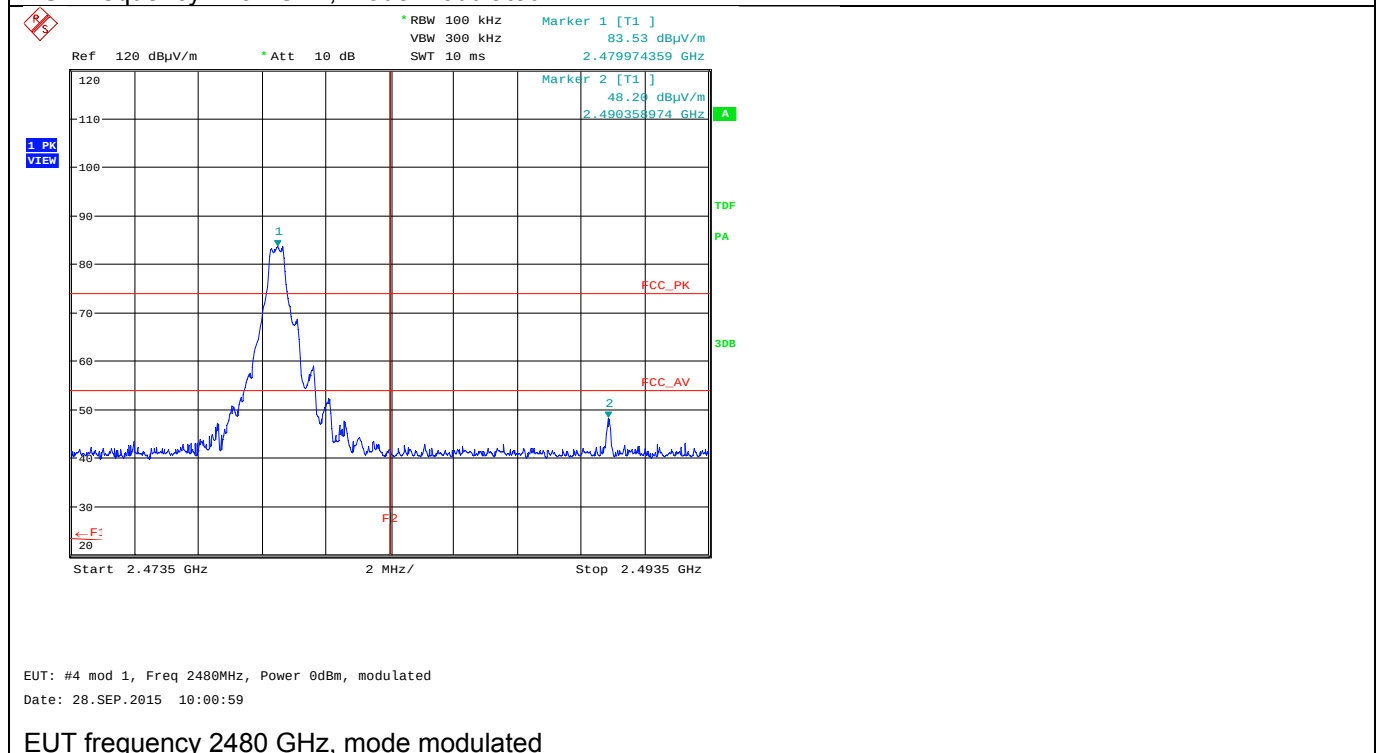
Radio Tests on Genius Motorbrake Type T2080 Genius to 47 CFR Part 15C

11.4 Test Results

Frequency	Reading	Limit	Margin
MHz	dBμV/m	dBμV/m	dB
2399	49.5	54.0	4.5
2490	48.2	54.0	5.8



EUT frequency 2402 GHz, mode modulated



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Manufacturer: EBE Elektro-Bau-Elemente GmbH
Device: Genius Motorbrake
Type: T2080 Genius
Serial Number: Sample #4, with modification 1

The EUT meets the requirements of this section.

Test Personnel: Ludwig Kraft
Test Date: 2015-09-25/28

12 RADIOFREQUENCY RADIATED EXPOSURE EVALUATION

Test Requirement: FCC 47 CFR, §1.1307

Test Procedure: 447498 D01 General RF Exposure Guidance v06

12.1 Regulation

§1.1307

(b) In addition to the actions listed in paragraph (a) of this section, Commission actions granting construction permits, licenses to transmit or renewals thereof, equipment authorizations or modifications in existing facilities, require the preparation of an Environmental Assessment (EA) if the particular facility, operation or transmitter would cause human exposure to levels of radiofrequency radiation in excess of the limits in §§ 1.1310 and 2.1093 of this chapter. Applications to the Commission for construction permits, licenses to transmit or renewals thereof, equipment authorizations or modifications in existing facilities must contain a statement confirming compliance with the limits unless the facility, operation, or transmitter is categorically excluded, as discussed below. Technical information showing the basis for this statement must be submitted to the Commission upon request. Such compliance statements may be omitted from license applications for transceivers subject to the certification requirement in § 25.129 of this chapter.

12.2 Test Procedure

Excerpt from D01 General RF Exposure Guidance v06 chapter 4.3.1 Standalone SAR test exclusion considerations.

a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f_{\text{(GHz)}}}] \leq 3.0$ for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR,³⁰ where

- $f_{\text{(GHz)}}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation³¹
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as *numeric thresholds* in step b) below

The test exclusions are applicable only when the minimum *test separation distance* is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

³⁰ This is equivalent to the formula written as: $[(\text{max. power of channel, including tune-up tolerance, mW}) / (60 / \sqrt{f_{\text{(GHz)}}} \text{ mW})] \cdot [20 \text{ mm} / (\text{min. test separation distance, mm})] \leq 1.0$ for 1-g SAR; also see Appendix A for approximate exclusion threshold numerical values at selected frequencies and distances.

³¹ Unless stated otherwise, the same rounding requirements should be applied to all similar equations in this document.

Excerpt from D01 General RF Exposure Guidance v06 Appendix A.

SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm
Approximate SAR Test Exclusion Power Thresholds at Selected Frequencies and Test Separation Distances are illustrated in the following Table. The equation and threshold in 4.3.1 must be applied to determine SAR test exclusion.

MHz	5	10	15	20	25	mm
2450	10	19	29	38	48	<i>SAR Test Exclusion Threshold (mW)</i>

12.3 Result

For worst case consideration the maximum peak power conducted from chapter 7 was used.

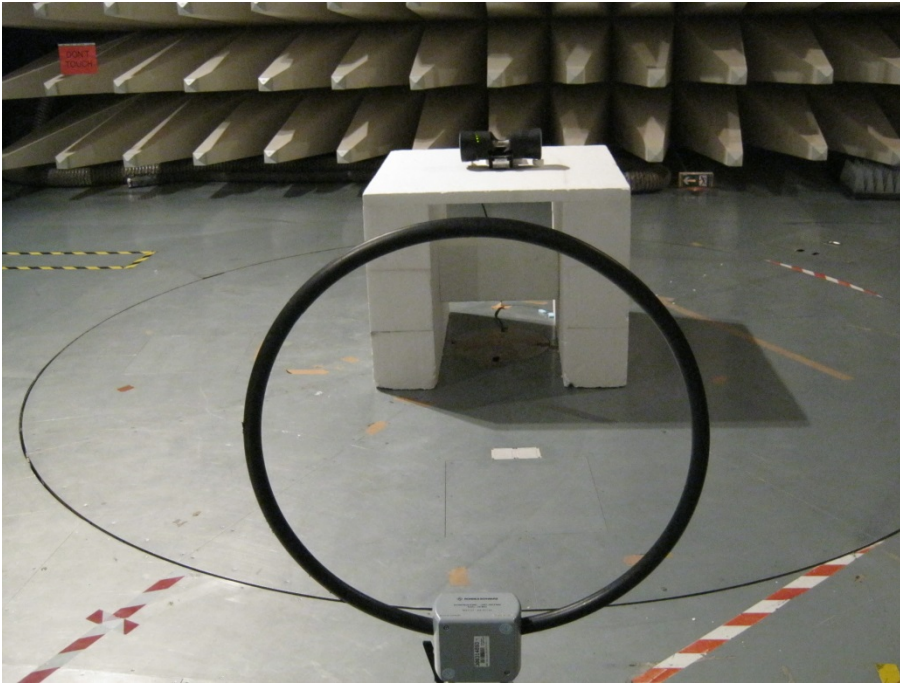
EUT, mode	Frequency	Power	Power	Limit @ 5 mm
	GHz	dBm	mW	mW
Sample #5, modulated	2402	-11.0	0.079	10
Sample #5, modulated	2440	-12.3	0.059	10
Sample #5, modulated	2480	-13.0	0.050	10

Manufacturer: EBE Elektro-Bau-Elemente GmbH
Device: Genius Motorbrake
Type: T2080 Genius
Serial Number: Sample #5 with modification 1

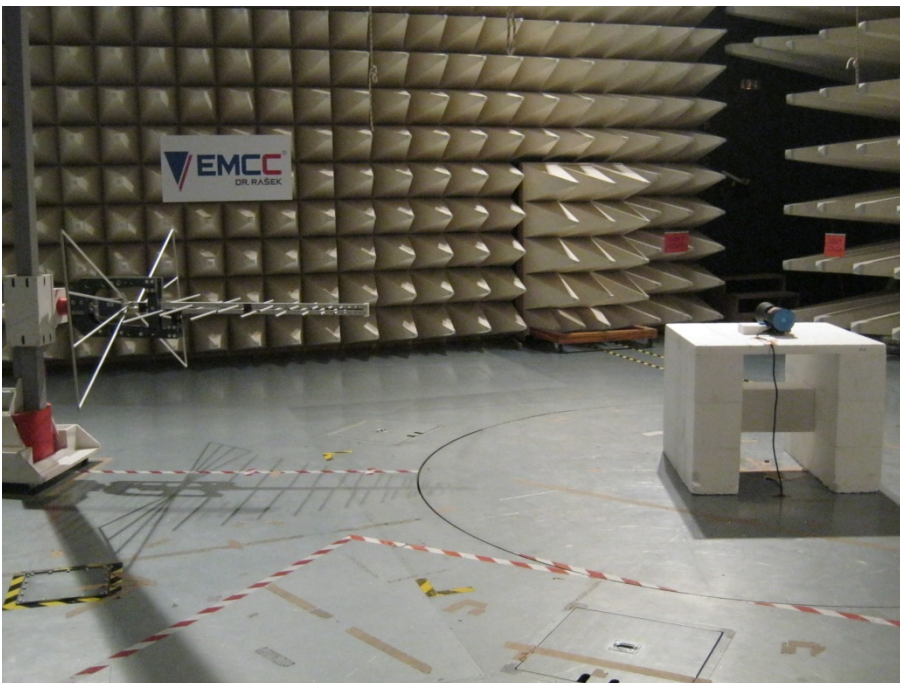
The EUT fulfils the exclusion requirements.

Test Personnel: Ludwig Kraft
Test Date: 2015-10-20

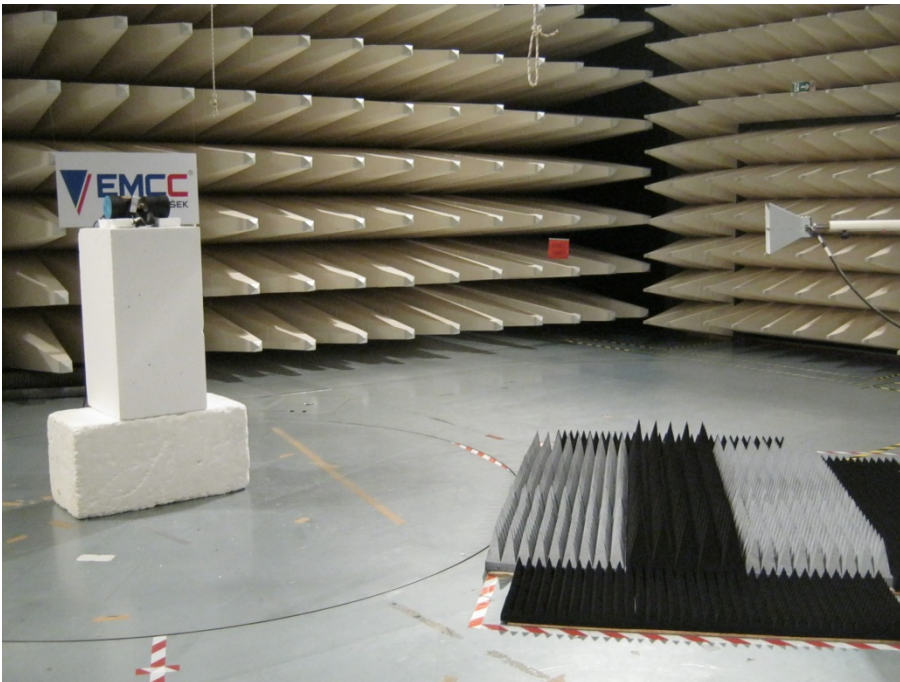
Appendix 1 - Photographs of test setup



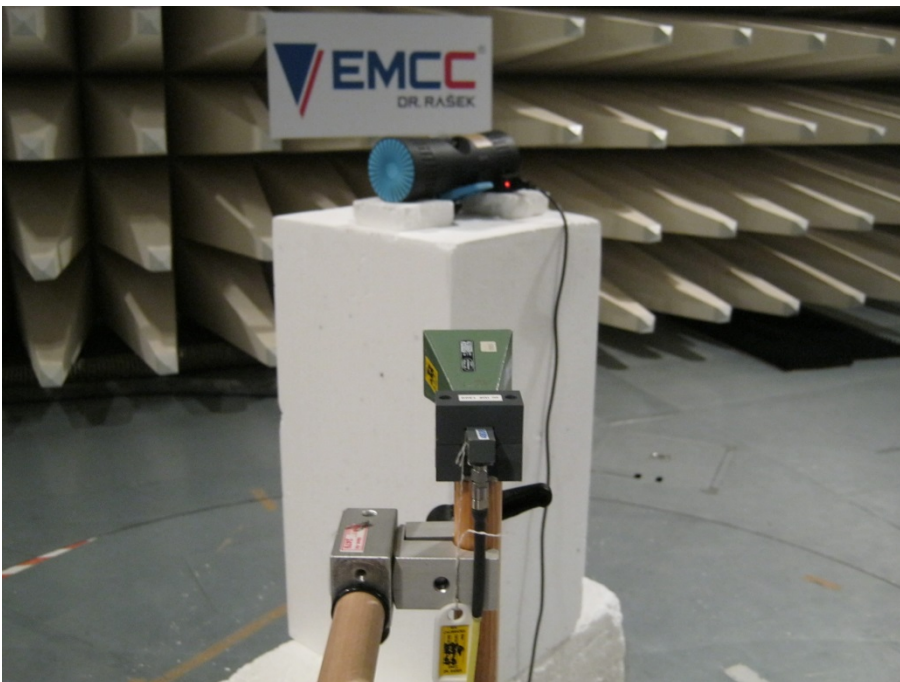
Photograph A1-1: H-Field measurement



Photograph A1-2: Prescan measurement below 1 GHz (SAC)

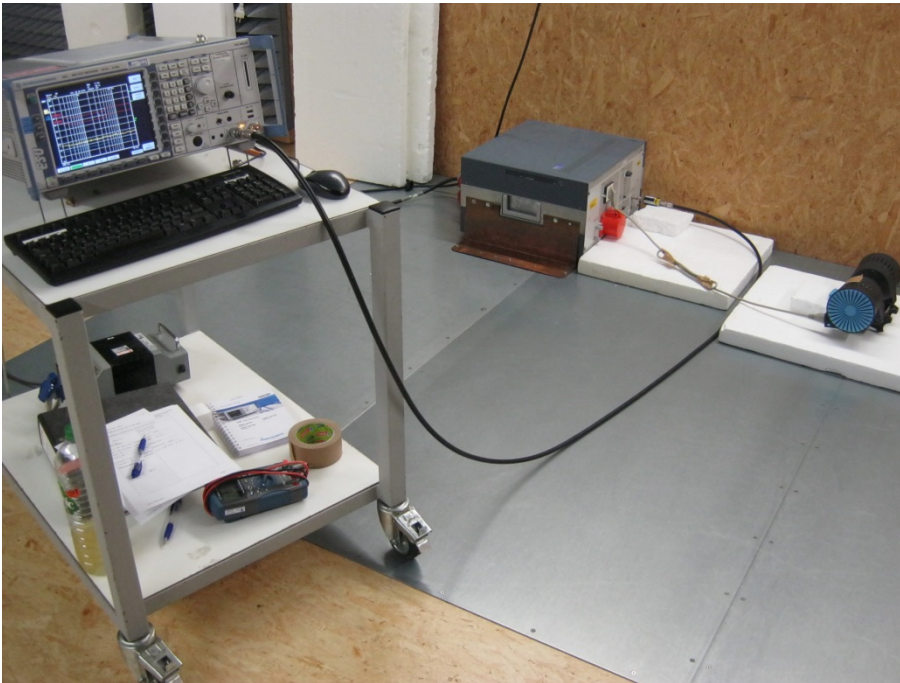


Photograph A1-3: Carrier measurement (SAC), spurious measurement 1 – 18 GHz

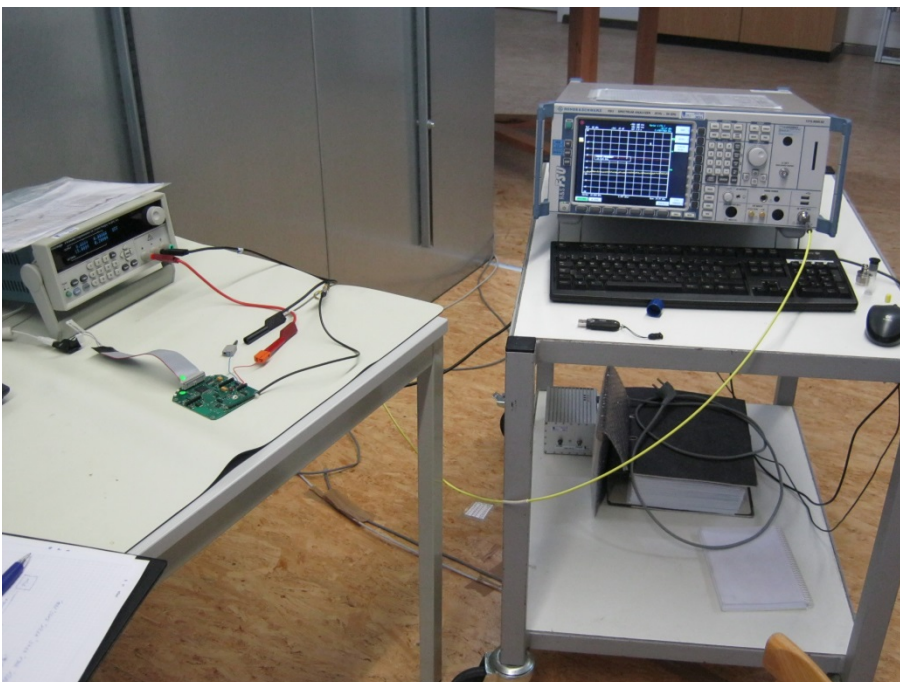


Photograph A1-4: Measurement above 18 GHz (SAC)

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Photograph A1-5: Conducted Emission Measurement



Photograph A1-6: Conducted RF Measurement

APPENDIX 2 - PHOTOGRAPHS OF EUT; EXTERNAL VIEW



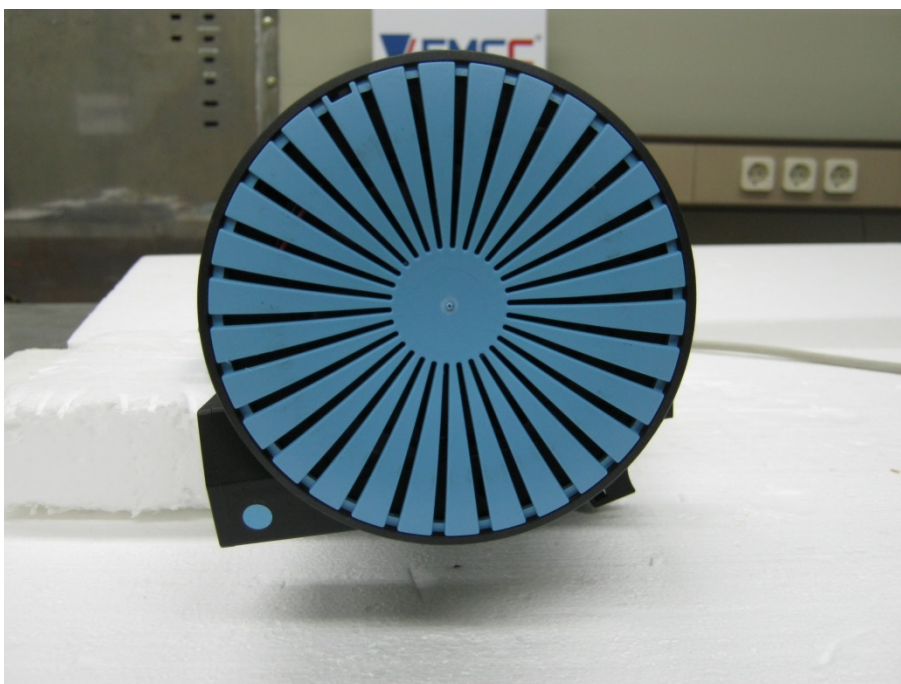
Photograph A2-1: Top view EUT Sample #3



Photograph A2-2: Bottom view EUT Sample #3

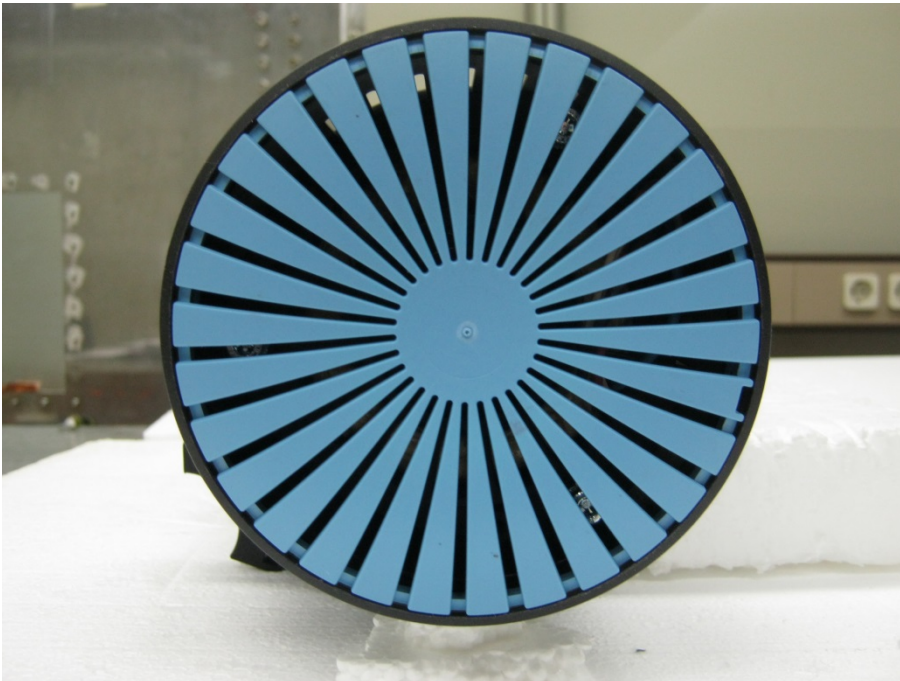


Photograph A2-3: Detail EUT label Sample #3



Photograph A2-4: Right side view EUT Sample #3

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Photograph A2-5: Left side view EUT #Sample #3



Photograph A2-6: Back side view Sample #4

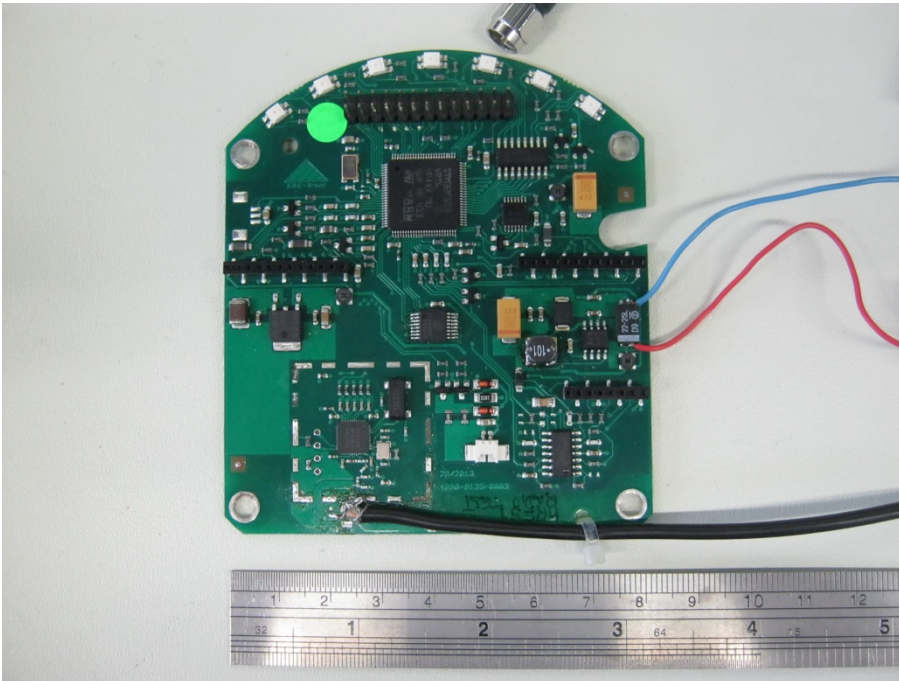


Photograph A2-7: Top side view Sample #4 with connection cable

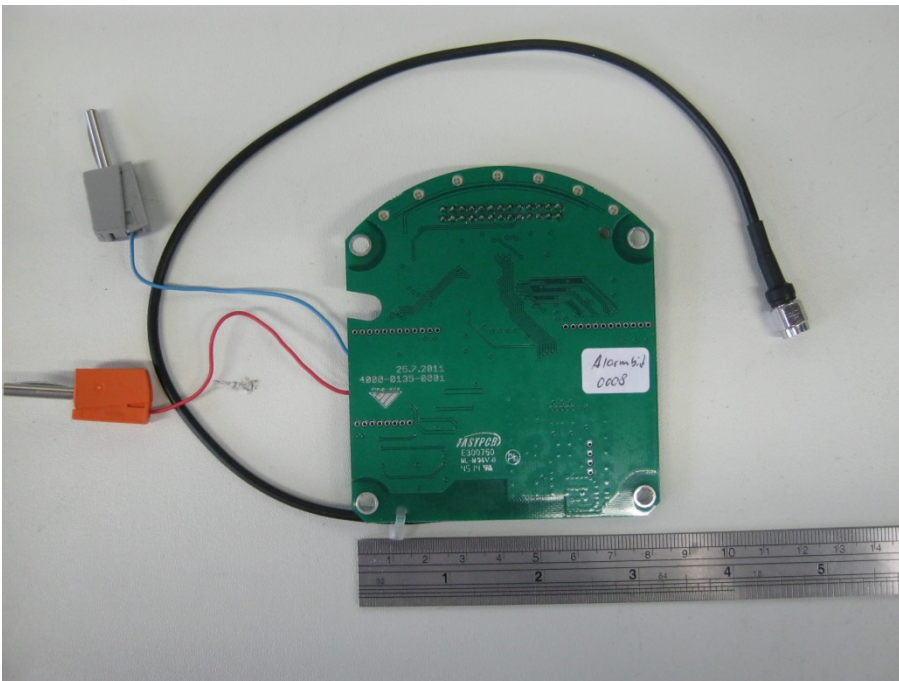


Photograph A2-8: Detail view Sample #4, connector for cable

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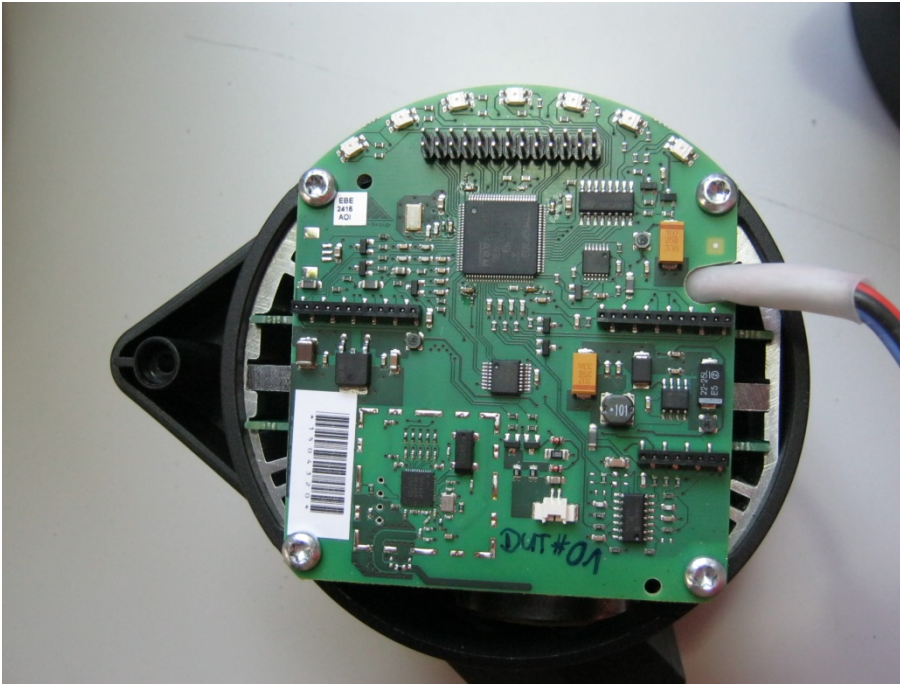


Photograph A2-9: Top view Sample #5, PCB board with RF connector and Power supply cable

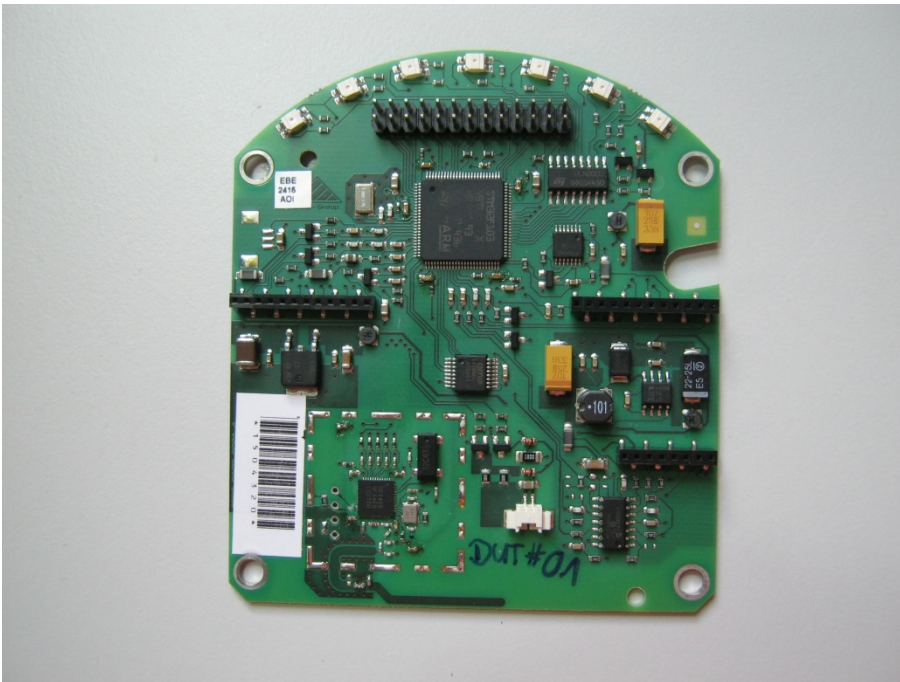


Photograph A2-10: Bottom view Sample #5, PCB board with RF connector and Power supply cable

APPENDIX 3 - PHOTOGRAPHS OF EUT; INTERNAL VIEW



Photograph A3-1: Internal view – Transceiver board without modification, Top view



Photograph A3-2: Internal view – Transceiver board with modification, Top view



Photograph A3-3: Internal view, right side, plastic cover removed



Photograph A3-4: Internal view, left side, plastic cover removed