

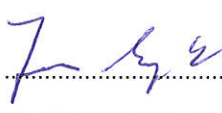


EMC TEST REPORT FCC 47 CFR Part 15B, ISED ICES-003 Issue 6	
Report Reference No	G0M-1812-7889-EF0115B-V01
Testing Laboratory	Eurofins Product Service GmbH
Address	Storkower Str. 38c 15526 Reichenwalde Germany
Accreditation	 <p>A2LA Accredited Testing Laboratory, Certificate No.: 1983.01 FCC Filed Test Laboratory, Reg.-No.: 96970 ISED Testing Laboratory site: 3470A-2</p>
Applicant	Leica Geosystems AG
Address	Heinrich Wild Strasse 9435 Heerbrugg SWITZERLAND
Test Specification	
Standard	47 CFR Part 15 Subpart B ISED ICES-003 Issue 6 ANSI C63.4:2014
Non-Standard Test Method	None
Equipment under Test (EUT):	
Product Description	Field Controller Win EC7
Model(s)	CS20
Additional Model(s)	None
Brand Name(s)	Leica Geosystems
Hardware Version(s)	V1.00
Software Version(s)	V4.97
FCC-ID	RFD-CSNGV
IC	3177A-CSNGV
Test Result	PASSED

Possible test case verdicts:		
required by standard but not tested	N/T	
not required by standard	N/R	
required by standard but not appl. to test object	N/A	
test object does meet the requirement	P(PASS)	
test object does not meet the requirement	F(FAIL)	
Testing:		
Date of receipt of test item	2019-01-07	
Report:		
Compiled by	Stefan Dose	
Tested by (+ signature) (Responsible for Test)	Stefan Dose	
	Matthias Handrik	
Approved by (+ signature) (Deputy Head of Lab)	Jens Marquardt	
Date of Issue	2019-05-17	
Total number of pages	40	
General Remarks:		
<p>The test results presented in this report relate only to the object tested.</p> <p>The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report.</p> <p>This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.</p>		
Additional Comments:		

ABBREVIATIONS AND ACRONYMS

Acronyms	
Acronym	Description
EUT	Equipment Under Test
FCC	Federal Communications Commission
ISED	Innovation, Science and Economic Development Canada
T _{NOM}	Nominal operating temperature
V _{NOM}	Nominal supply voltage

VERSION HISTORY

Version History			
Version	Issue Date	Remarks	Revised By
01	2019-05-17	Initial Release	

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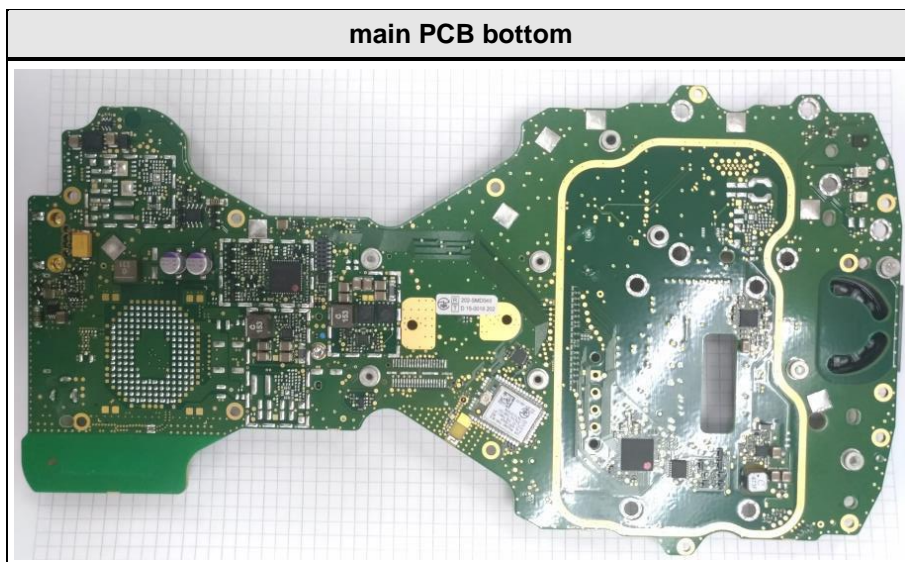
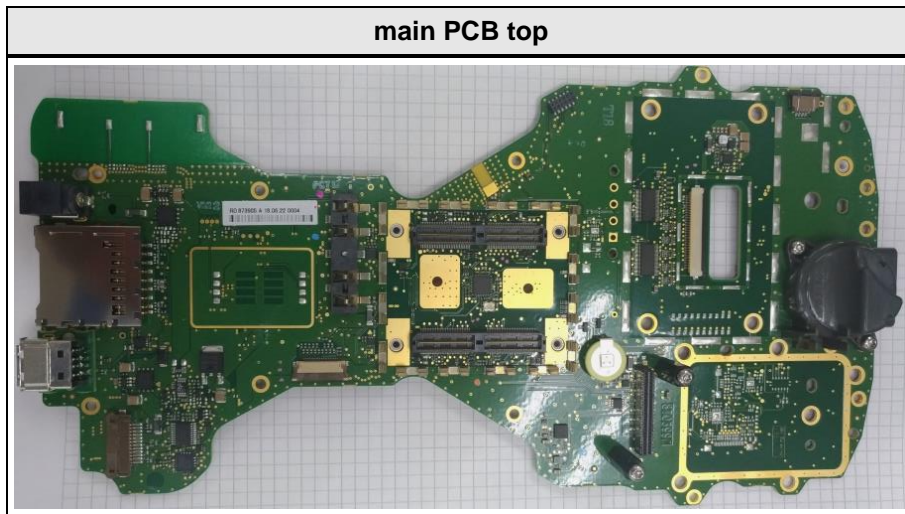
1 Equipment (Test Item) Under Test

Description	Field Controller Win EC7	
Model	CS20	
Additional Model(s)	None	
Brand Name(s)	Leica Geosystems	
Serial Number(s)	2400556	
Hardware Version(s)	V1.00	
Software Version(s)	V4.97	
FCC-ID	RFD-CSNGV	
IC	3177A-CSNGV	
Class	Class B	
Equipment type	Table top	
Highest internal frequency [MHz]	2480	
Radio Module	Type	Bluetooth & WLAN module
	Model	TIWI-BLE
	Manufacturer	Laird Technologies (LSR)
	FCC-ID	RFD-BTWCO
	IC	3177A-BTWCO
Supply Voltage	V_{NOM}	11.1VDC (battery) / 15VDC (AC/DC-adaptor)
AC/DC-Adaptor	Model	GEV276
	Vendor	Leica Geosystems
	Input	100-240VAC (47-63Hz), 1A
	Output	15VDC, 2.66A
Manufacturer	Leica Geosystems AG Heinrich Wild Strasse 9435 Heerbrugg SWITZERLAND	

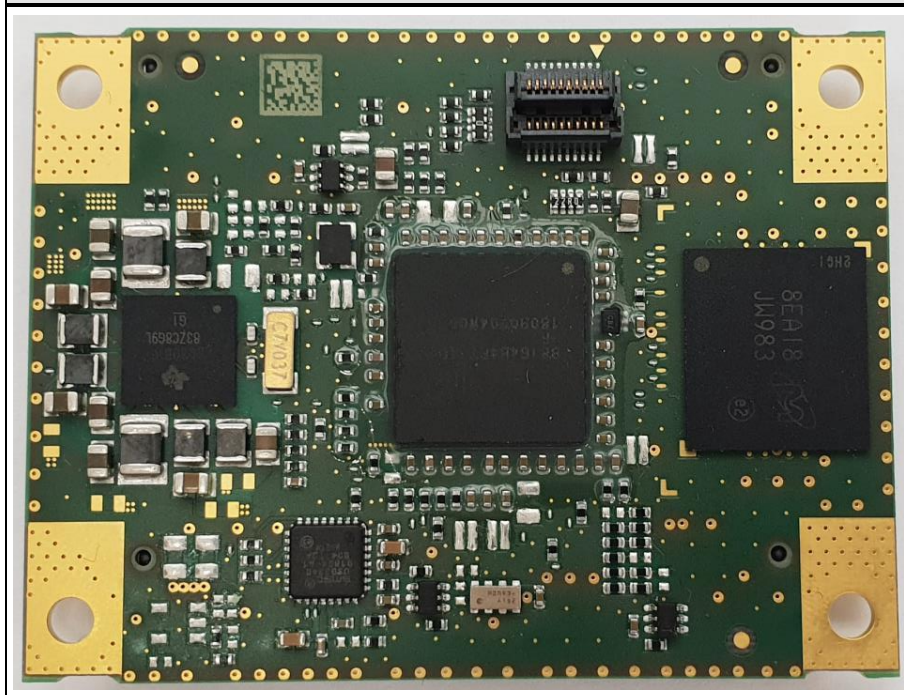
1.1 Equipment Ports

Name	Type	Attributes	Comment
Power	DC	Count: 1 Direction: In Service only: No	-
RS232 (Lemo)	IO	Count: 1 Direction: IO Service only: No	-
USB (Host)	IO	Count: 1 Direction: IO Service only: No	-
USB	IO	Count: 1 Direction: IO Service only: No	-
SD Card	IO	Count: 1 Direction: IO Service only: No	-
Description:			
AC	AC mains power input/output port		
DC	DC power input/output port		
IO	Input/Output port		
TP	Telecommunication port		
NE	Non-electrical port		

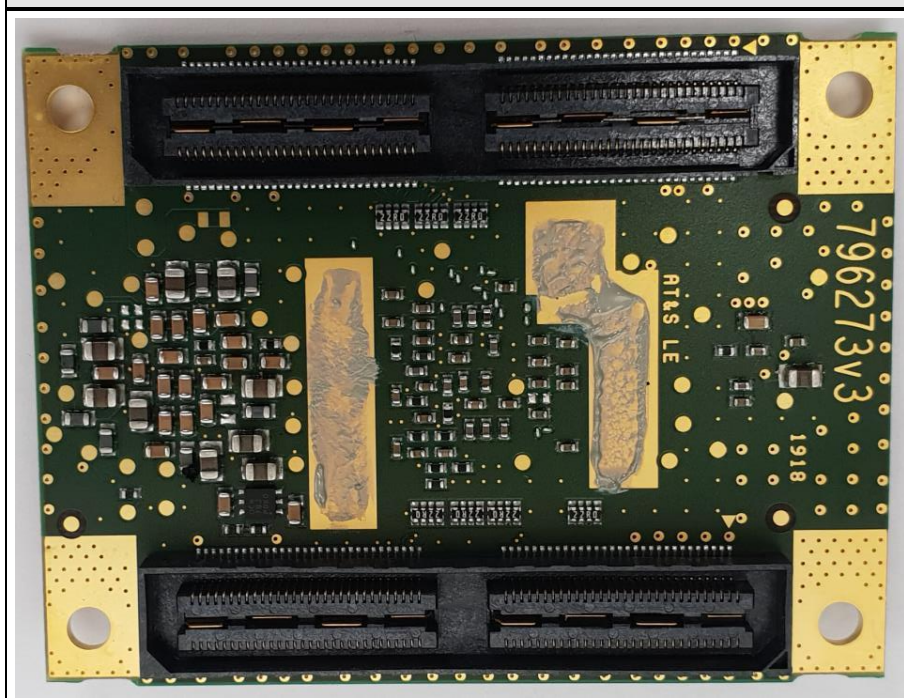
1.2 Equipment Photos - Internal



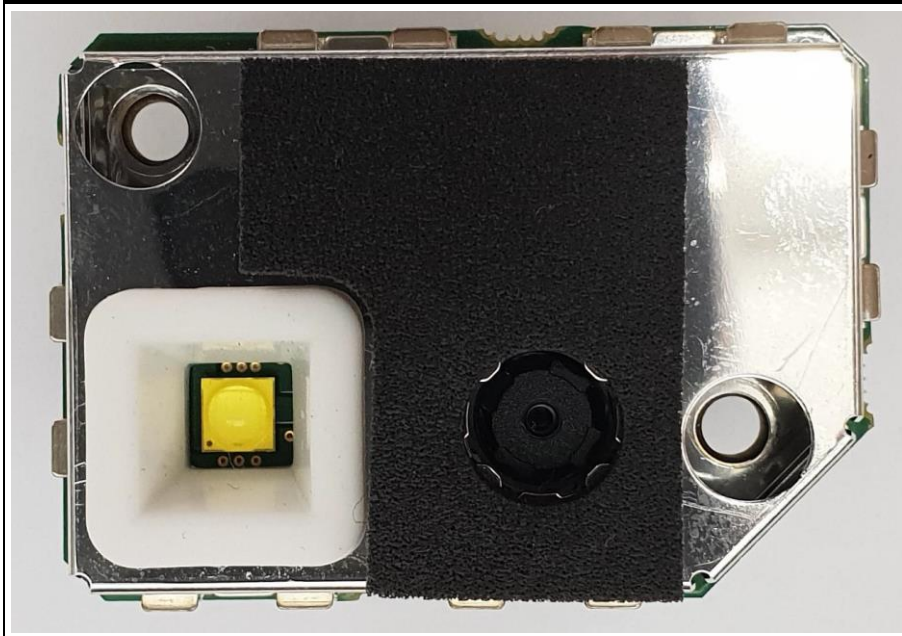
core module board top



core module board back



camera board top



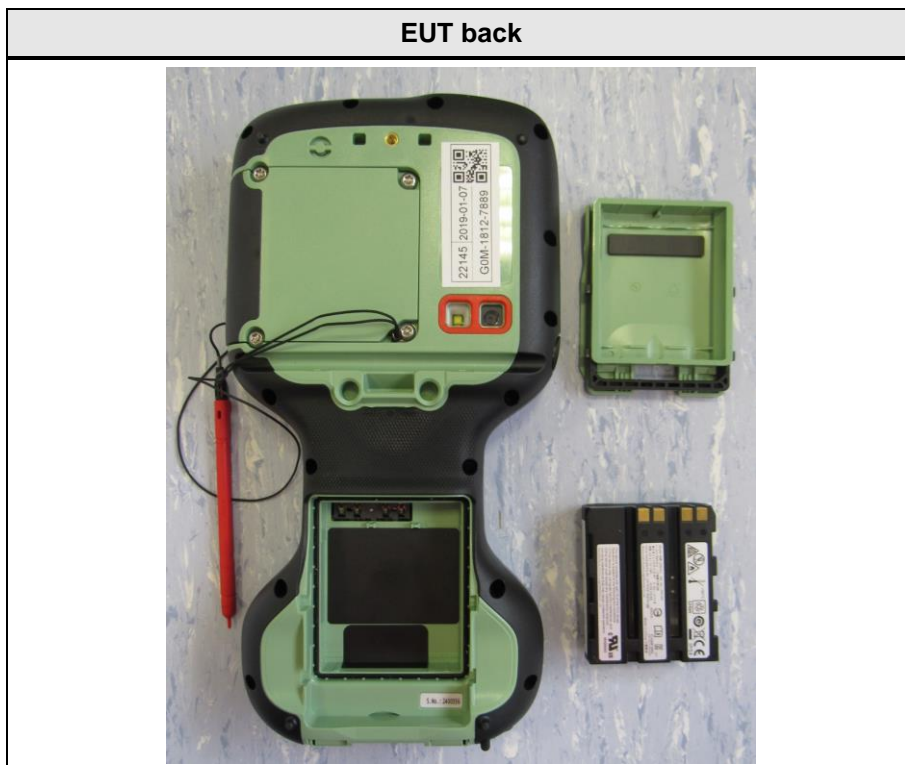
camera board bottom



WLAN-BT-module



1.3 Equipment Photos - External





1.4 Support Equipment

Product Type	Device	Manufacturer	Model	Comment
AE	GNSS System (GS16)	Leica Geosystems	GS16	Art-No. 838034
AE	Fritz!Box	AVM	7050	WLAN Access Point
AE	AC/DC Power Supply	Leica Geosystems	GEV276	Art-No. 822787
AE	Li-Ion Battery 11.1V/2.8Ah	Leica Geosystems	GEB331	ArtNo. 799190
Description:				
AE	Auxiliary Equipment			
SIM	Simulator			
CBL	Connecting Cable			
Comment:				

1.5 Operational Modes

Mode #	Description
1	Charging – EUT is being charged via external AC/DC-adapter
2	Battery – EUT is only being powered via internal battery
Comment:	

1.6 EUT Configuration

Configuration #	Description
1	EUT is powered up (as described in chapter "1.5 Operational Modes") and connected: <ul style="list-style-type: none"> - via WLAN to access point - via Bluetooth to GNSS sensor (GS16) Access point and GS16 are placed inside test-chamber (corner)
Comment:	

1.7 Sample emission level calculation

The following is a description of terms and a sample calculation, as appears in the radiated emissions data table. The numbers used in the calculation are for example only. There is no direct correlation to the specific data taken for the product described in this document:

Reading:

This is the reading obtained on the spectrum analyser in dBµV. Any external preamplifiers used are taken into account through internal analyser settings.

A.F.:

This is the antenna factor for the receiving antenna. It is a conversion factor, which converts electric fields strengths to voltages, which can be measured directly on the spectrum analyser. It is treated as a loss in dB. Cable losses have been included with the A.F. to simplify the calculations. The antenna factor is used in calculations as follows:

$$\text{Reading on Analyser (dB}\mu\text{V)} + \text{A.F. (dB/m)} = \text{Net field strength (dB}\mu\text{V/m)}$$

Net:

This is the net field strength measurement (as shown above).

Limit:

This is the FCC Class B radiated emission limit (in units of dBµV/m). The FCC limits are given in units of µV/m. The following formula is used to convert the units of µV/m to dBµV/m:

$$\text{Limit (dB}\mu\text{V/m)} = 20 \cdot \log(\mu\text{V/m})$$

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example only:

Reading + AF	= Net Reading	:	Net reading - FCC limit	= Margin
+21.5 dBµV + 26 dB/m	= 47.5 dBµV/m	:	47.5 dBµV/m - 57.0 dBµV/m	= -9.5 dB

2 Result Summary

FCC 47 CFR Part 15B, ISED ICES-003 Issue 6				
Reference	Requirement	Reference Method	Result	Remarks
Emission				
FCC 15.109 ICES-003, 8, 6.1	Radiated emissions	ANSI C63.4:2014	PASS	-
FCC 15.107 ICES-003, 8, 6.2	AC power line conducted emissions	ANSI C63.4:2014	PASS	-
Comment:				

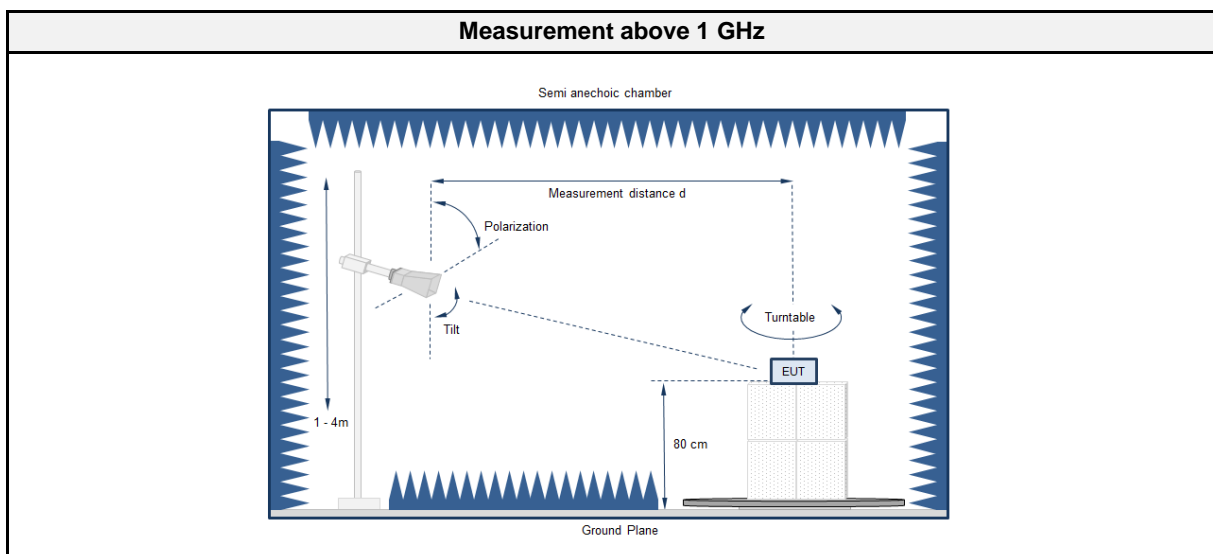
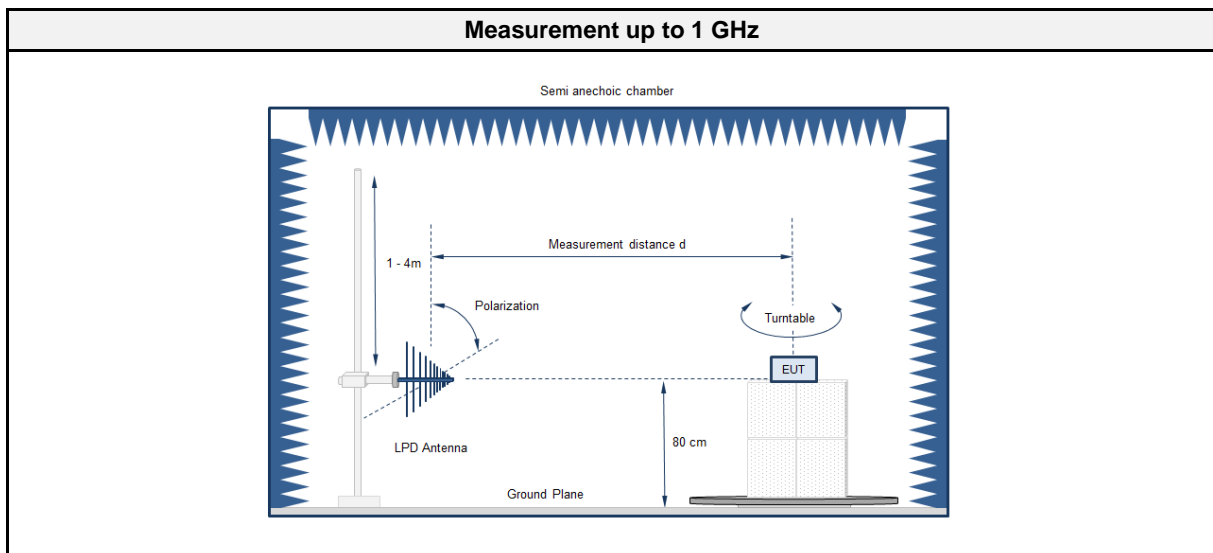
Possible Test Case Verdicts	
PASS	Test object does meet the requirements
FAIL	Test object does not meet the requirements
N/T	Required by standard but not tested
N/R	Not required by standard for the test object

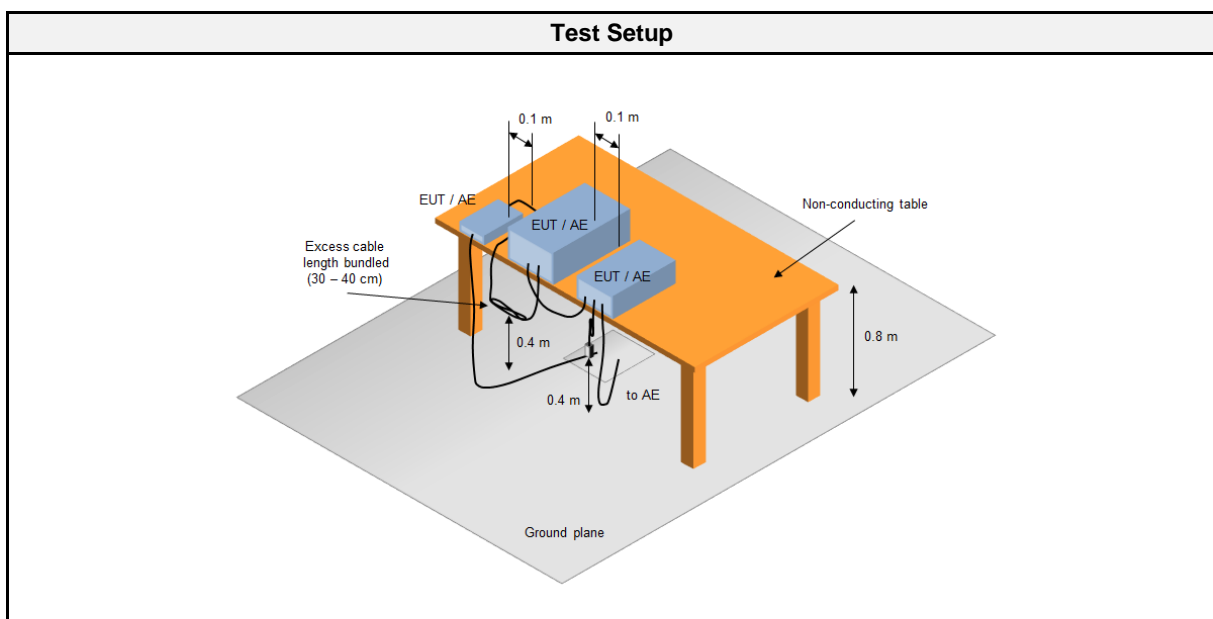
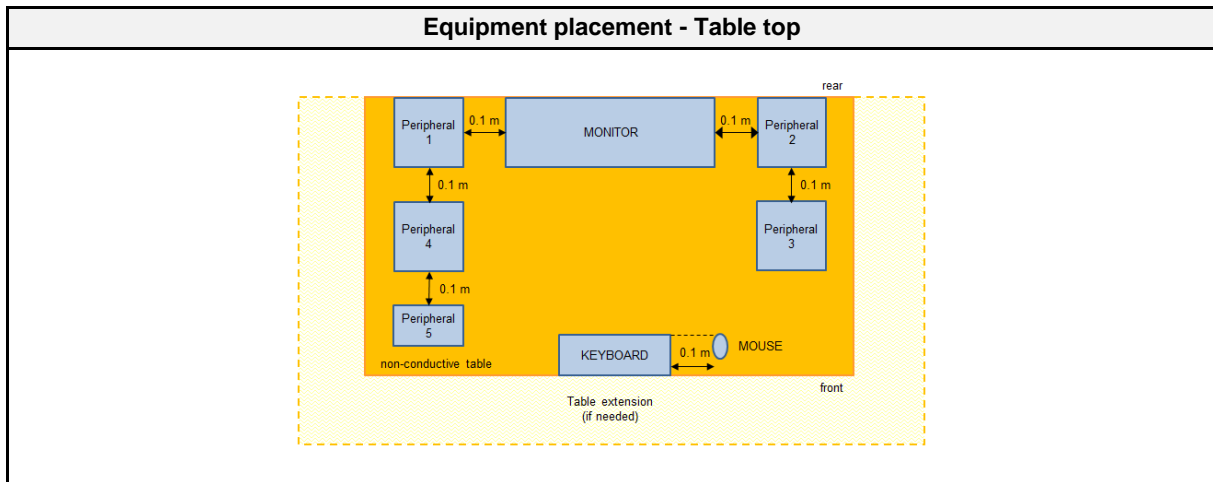
2.1 Test Conditions and Results - Radiated emissions acc. to ANSI C63.4

2.1.1 Information

Test Information	
Reference	FCC 15.109, ICES-003, 8, 6.1
Reference method	ANSI C63.4:2014 Section 8
Equipment class	Class B
Equipment type	Table top
Highest internal frequency [MHz]	2480
Measurement range	30 MHz to 12400 MHz
Temperature [°C]	22
Humidity [%]	27 - 28
Operator	Stefan Dose supervised by Matthias Handrik
Date	2019-01-14

2.1.2 Setup





2.1.3 Equipment

Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	Radimation	2016.1.10

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Anechoic chamber	Frankonia	AC1	EF00062	2018-07	2021-07
EMI Test Receiver	Keysight	N9038A-526/WXP	EF01070	2018-08	2019-08
Biconical Antenna	R&S	HK 116	EF00186	2018-03	2020-03
LPD Antenna	R&S	HL 223	EF00187	2016-05	2019-05
Horn antenna	Schwarzbeck	BBHA 9120D (1-18GHz)	EF00018	2016-09	2019-09

2.1.4 Procedure

Exploratory measurement	
1.	The EUT was placed on a non-conductive table at a height of 0.8m.
2.	The EUT and support equipment, if needed, were set up to simulate typical usage.
3.	Cables, of type and length specified by the manufacturer, were connected to at least one port of each type and were terminated by a device or simulating load of actual usage.
4.	The antenna was placed at a distance of 3 or 10 m.
5.	The received signal was monitored at the measurement receiver.
6.	This procedure has to be performed in both antenna polarizations, horizontal and vertical.
7.	The arrangement of the equipment with the maximum emission level is shown on the setup picture at item 1.3

Final measurement	
1.	The EUT was placed on a 0.8 m non-conductive table at a 3 m distance from the receive antenna. The antenna output was connected to the measurement receiver.
2.	A biconical antenna was used for the frequency range 30 – 200 MHz, a logarithmic periodical antenna was used for the frequency range from 200 – 1000 MHz. Above one 1 GHz a Double Ridged Broadband Horn antenna was used. The antenna was placed on an adjustable height antenna mast.
3.	The EUT and cable arrangement were based on the exploratory measurement results.
4.	Emissions were maximized at each frequency by rotating the EUT and adjusting the receive antenna height and polarization. The maximum values were recorded.
5.	The test data of the worst-case conditions were recorded and shown on the next pages.

2.1.5 Limits

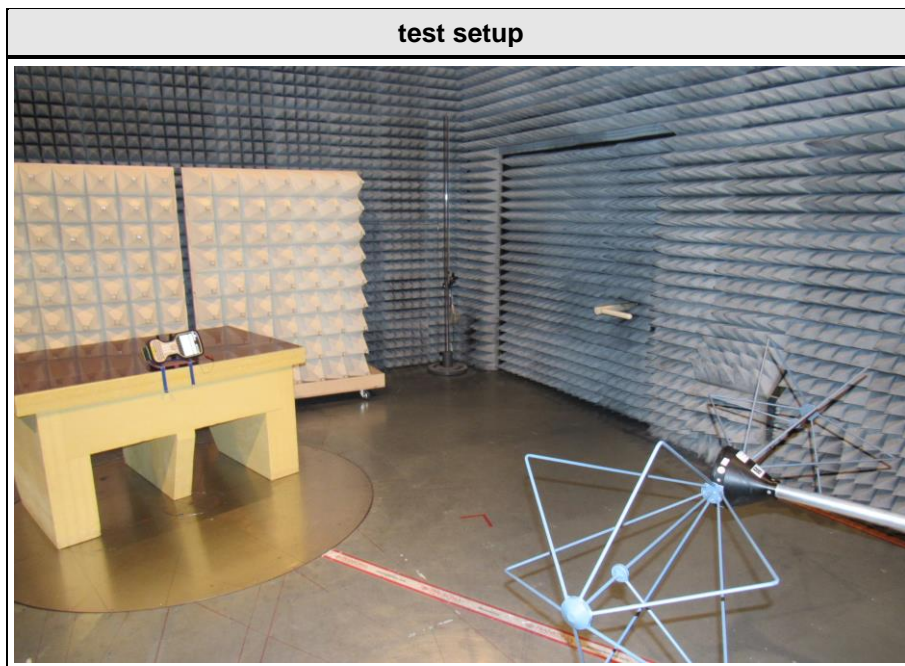
Class B @ 3 m		
Frequency [MHz]	Detector	Limit [dB μ V/m]
30 - 88	Quasi-peak	40
88 - 216	Quasi-peak	43.5
216 - 960	Quasi-peak	46
960 - 1000	Quasi-peak	54
> 1000	Peak Average	74 54

Class A @ 10 m		
Frequency [MHz]	Detector	Limit [dB μ V/m]
30 - 88	Quasi-peak	39
88 - 216	Quasi-peak	43.5
216 - 960	Quasi-peak	46.5
960 - 1000	Quasi-peak	49.5
> 1000	Peak Average	69.5 49.5

2.1.6 Results

Test Results			
Operational mode	EUT Configuration	Verdict	Remark
1 / 2	1	PASS	-

2.1.7 Setup Photos



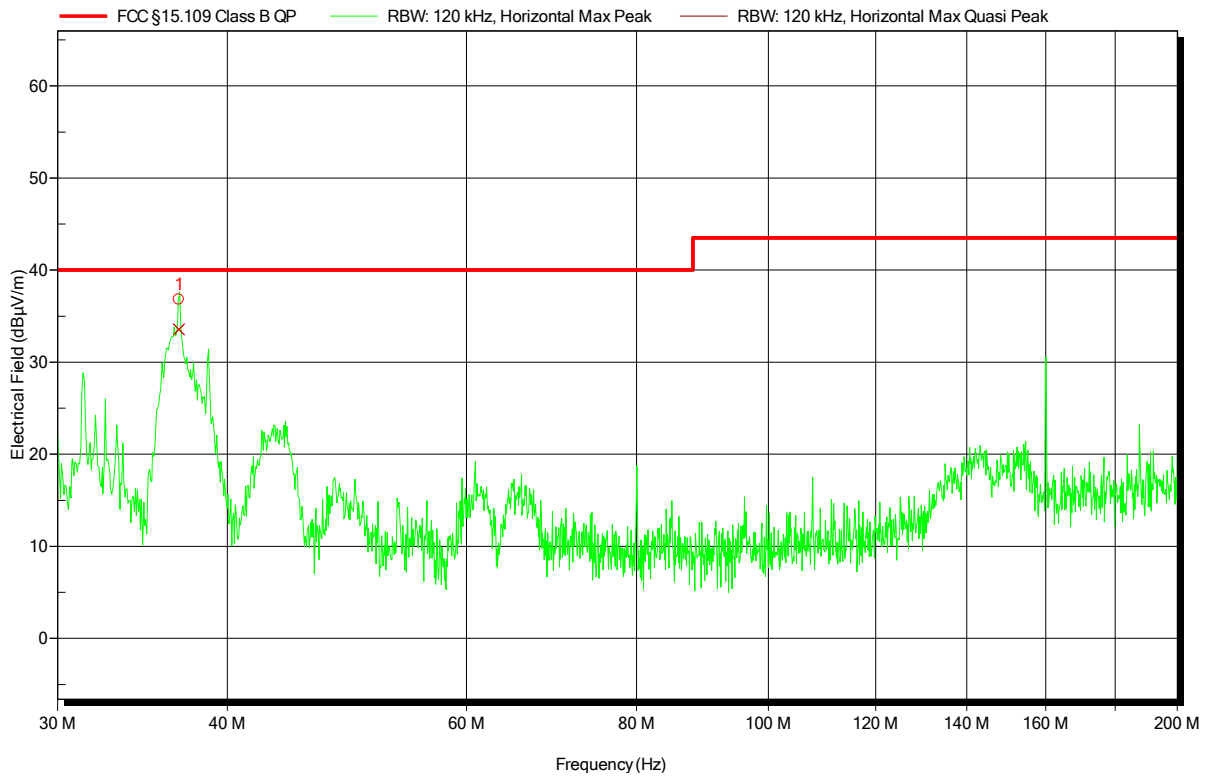
2.1.8 Records

Radiated emissions under normal conditions according to FCC part 15B

Project number: G0M-1812-7889

Applicant: Leica Geosystems AG
 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 22°C, Unom: 120 VAC / 60Hz
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement distance: 3m
 Mode: 1 (charging)
 Test Date: 2019-01-14
 Note:

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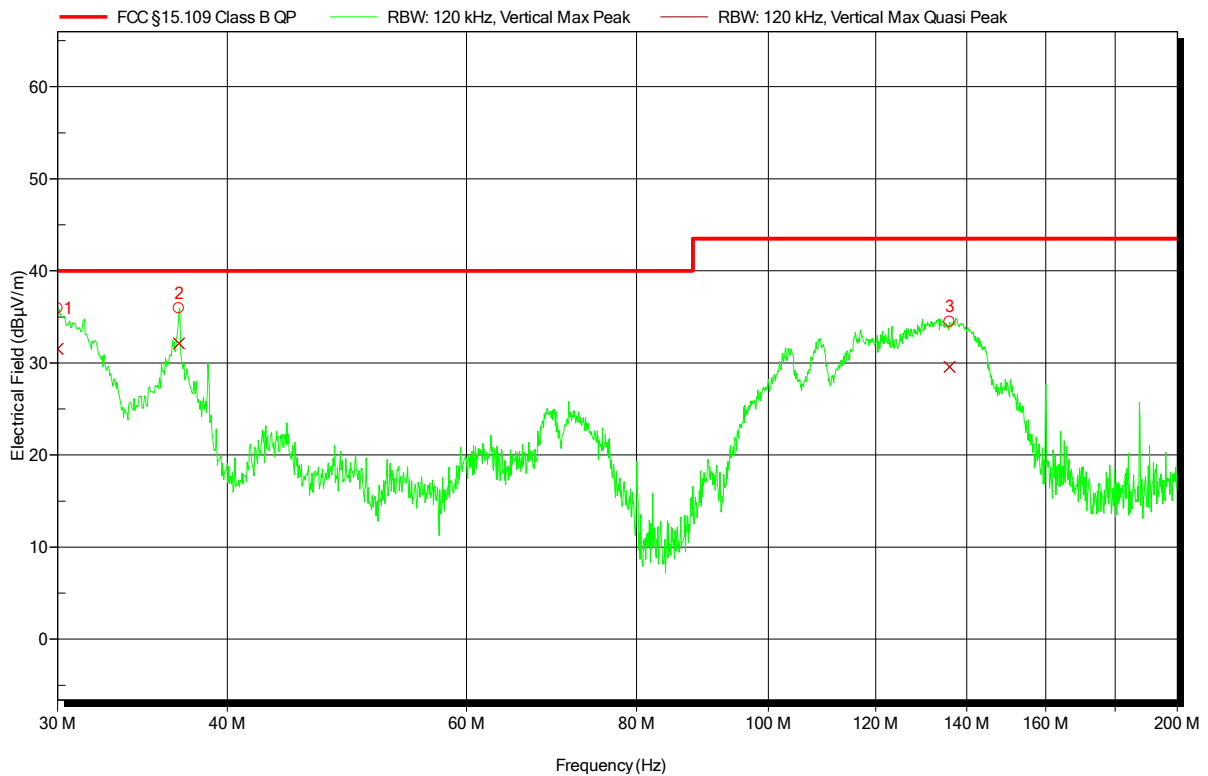
Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	36.864 MHz	33.56 dBµV/m	40 dBµV/m	-6.44 dB	Pass	0 Degree	1 m

Radiated emissions under normal conditions according to FCC part 15B

Project number: G0M-1812-7889

Applicant: Leica Geosystems AG
 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 22°C, Unom: 120 VAC / 60Hz
 Antenna: Rohde & Schwarz HK 116, Vertical
 Measurement distance: 3m
 Mode: 1 (charging)
 Test Date: 2019-01-14
 Note:

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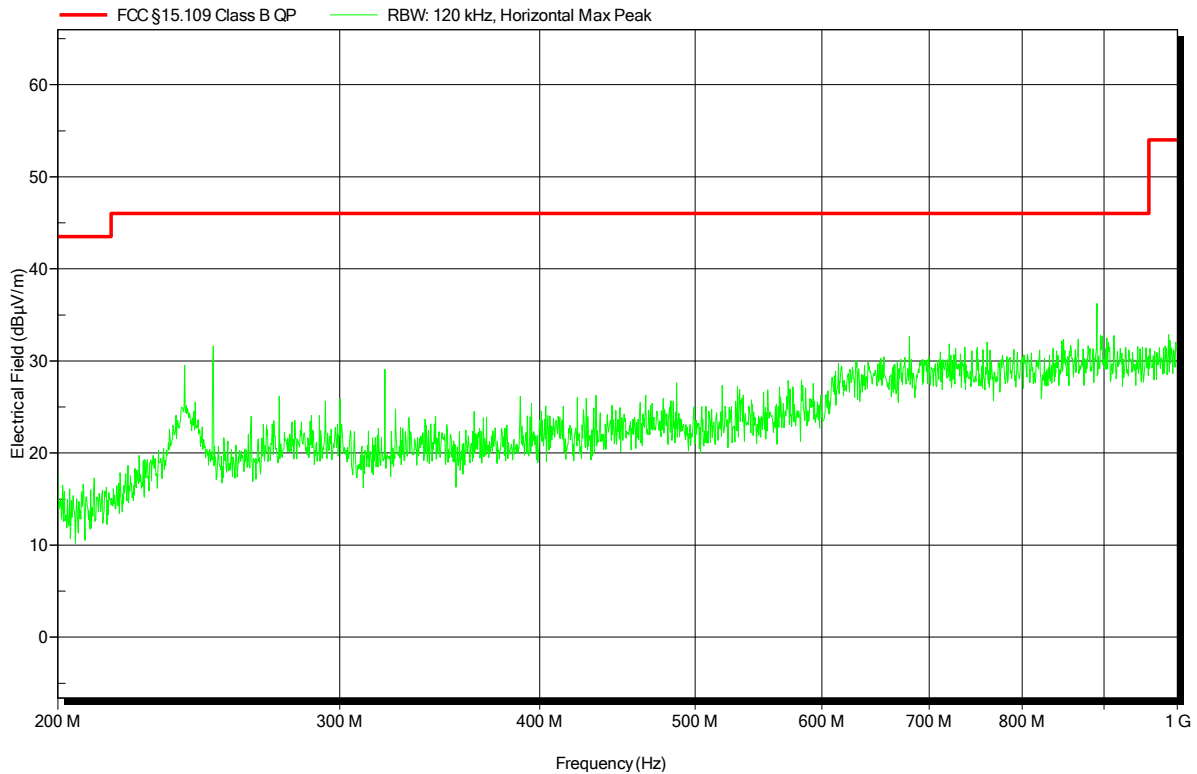
Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	30.006 MHz	31.53 dBµV/m	40 dBµV/m	-8.47 dB	Pass	0 Degree	1 m
2	36.864 MHz	32.13 dBµV/m	40 dBµV/m	-7.87 dB	Pass	0 Degree	1 m
3	135.968 MHz	29.57 dBµV/m	43.52 dBµV/m	-13.96 dB	Pass	0 Degree	1 m

Radiated emissions under normal conditions according to FCC part 15B

Project number: G0M-1812-7889

Applicant: Leica Geosystems AG
 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 22°C, Unom: 120 VAC / 60Hz
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement distance: 3m
 Mode: 1 (charging)
 Test Date: 2019-01-14
 Note:

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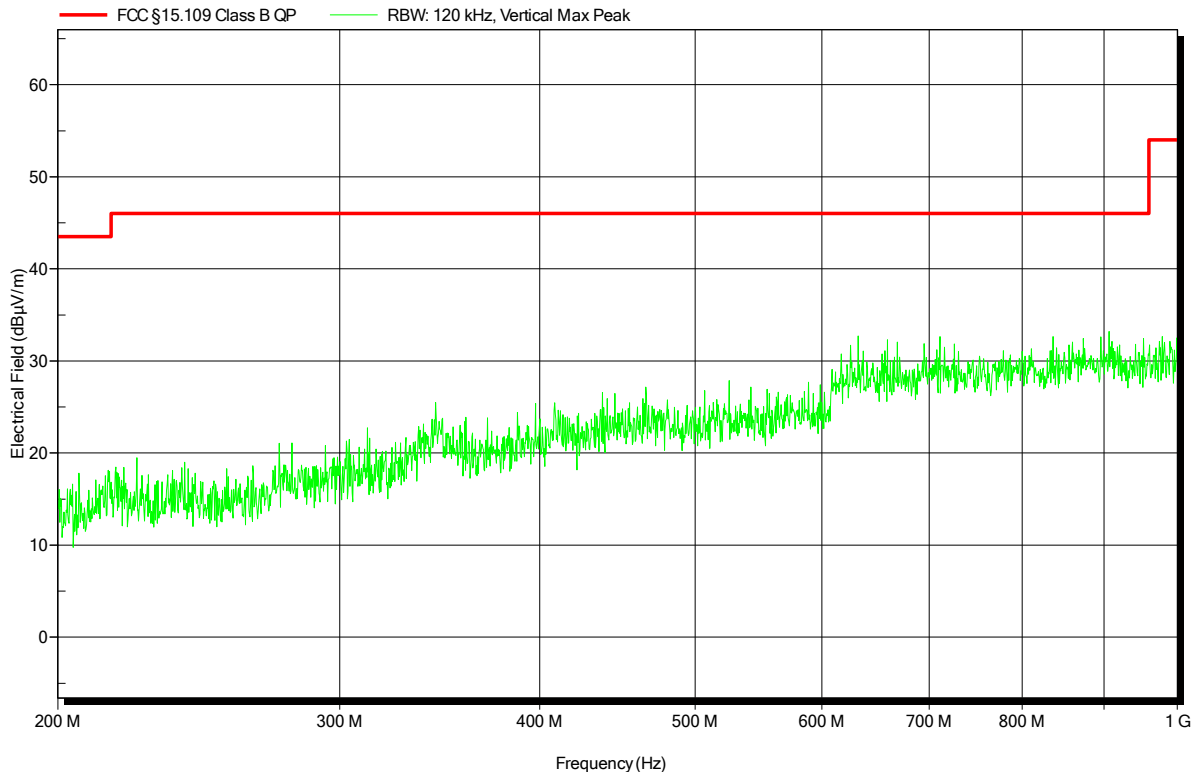


Radiated emissions under normal conditions according to FCC part 15B

Project number: G0M-1812-7889

Applicant: Leica Geosystems AG
 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 22°C, Unom: 120 VAC / 60Hz
 Antenna: Rohde & Schwarz HL 223, Vertical
 Measurement distance: 3m
 Mode: 1 (charging)
 Test Date: 2019-01-14
 Note:

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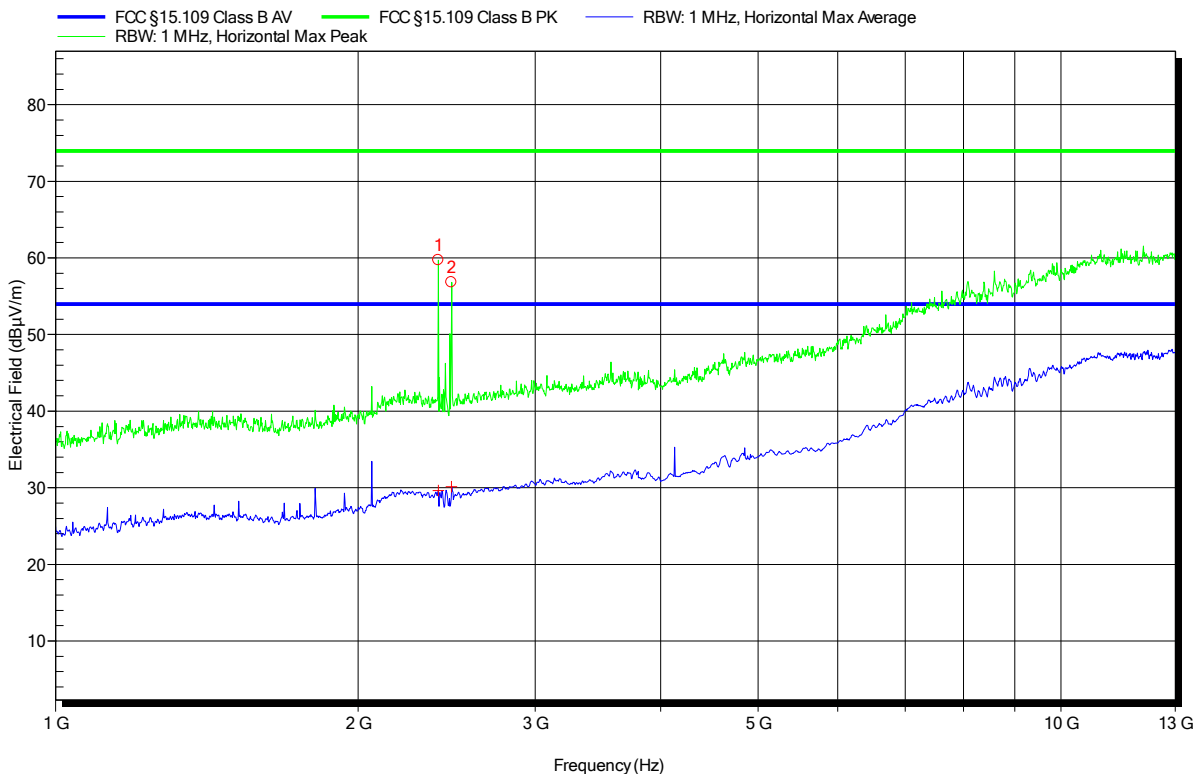


Radiated emissions under normal conditions according to FCC part 15B

Project number: G0M-1812-7889

Applicant: Leica Geosystems AG
 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 22°C, Unom: 120 VAC / 60Hz
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 3m
 Mode: 1 (charging)
 Test Date: 2019-01-14
 Note:

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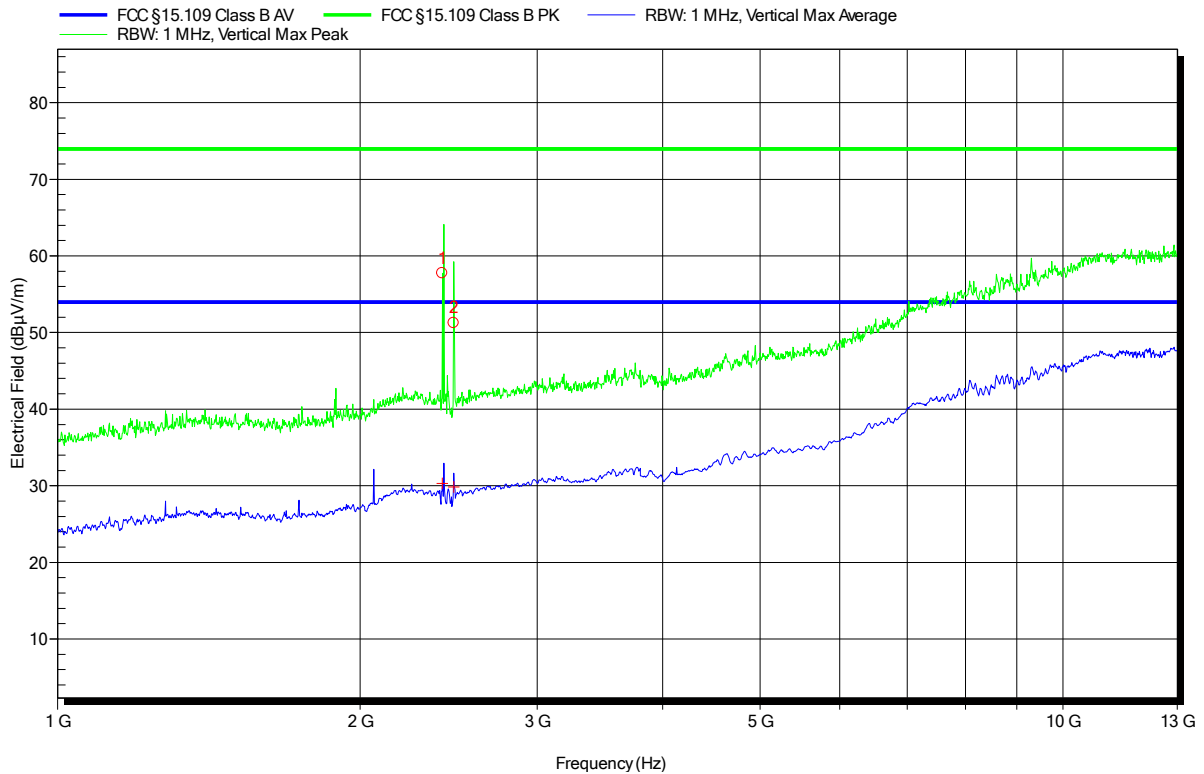
Peak Number	Frequency	Peak	
1	2.403 GHz	59.71 dBµV/m	WLAN- / BT-carrier
2	2.477 GHz	56.8 dBµV/m	

Radiated emissions under normal conditions according to FCC part 15B

Project number: G0M-1812-7889

Applicant: Leica Geosystems AG
 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 22°C, Unom: 120 VAC / 60Hz
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 3m
 Mode: 1 (charging)
 Test Date: 2019-01-14
 Note:

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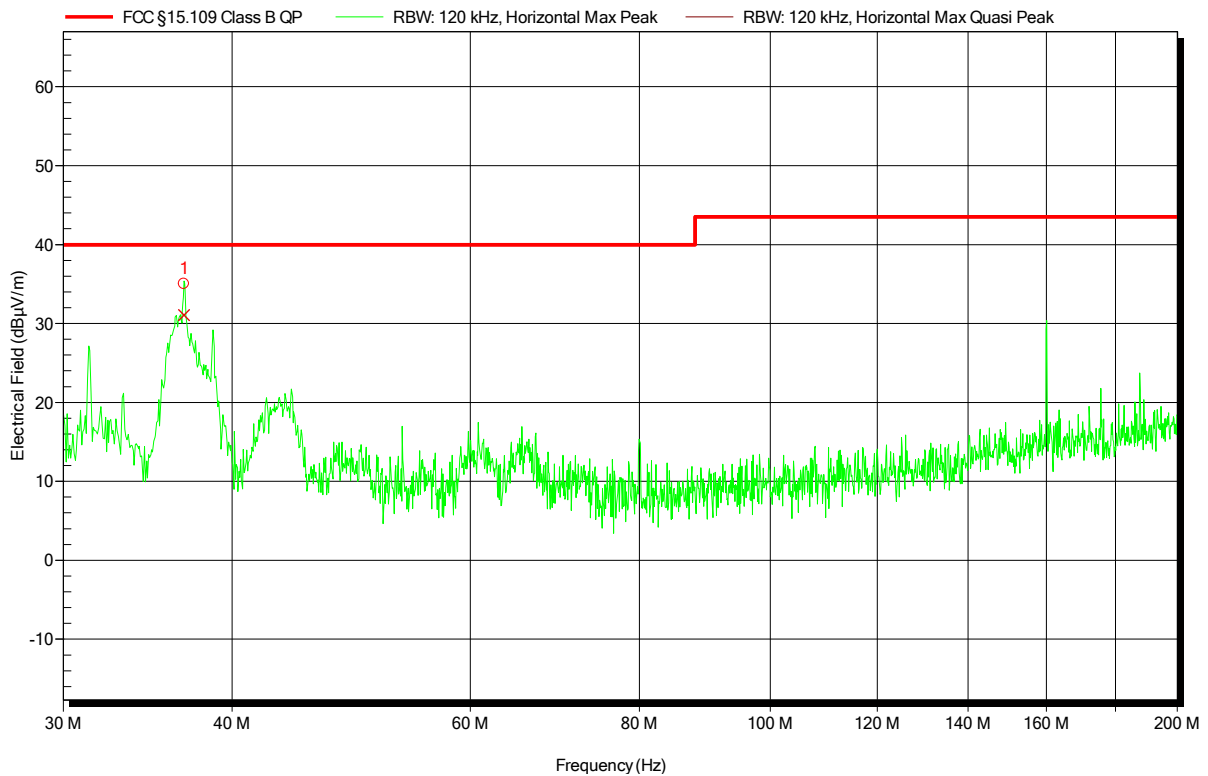
Peak Number	Frequency	Peak	
1	2.415 GHz	57.73 dBµV/m	WLAN- / BT-carrier
2	2.479 GHz	51.25 dBµV/m	

Radiated emissions under normal conditions according to FCC part 15B

Project number: G0M-1812-7889

Applicant: Leica Geosystems AG
 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 22°C, Unom: 11.1VDC
 Antenna: Rohde & Schwarz HK 116, Horizontal
 Measurement distance: 3m
 Mode: 2 (battery)
 Test Date: 2019-01-14
 Note:

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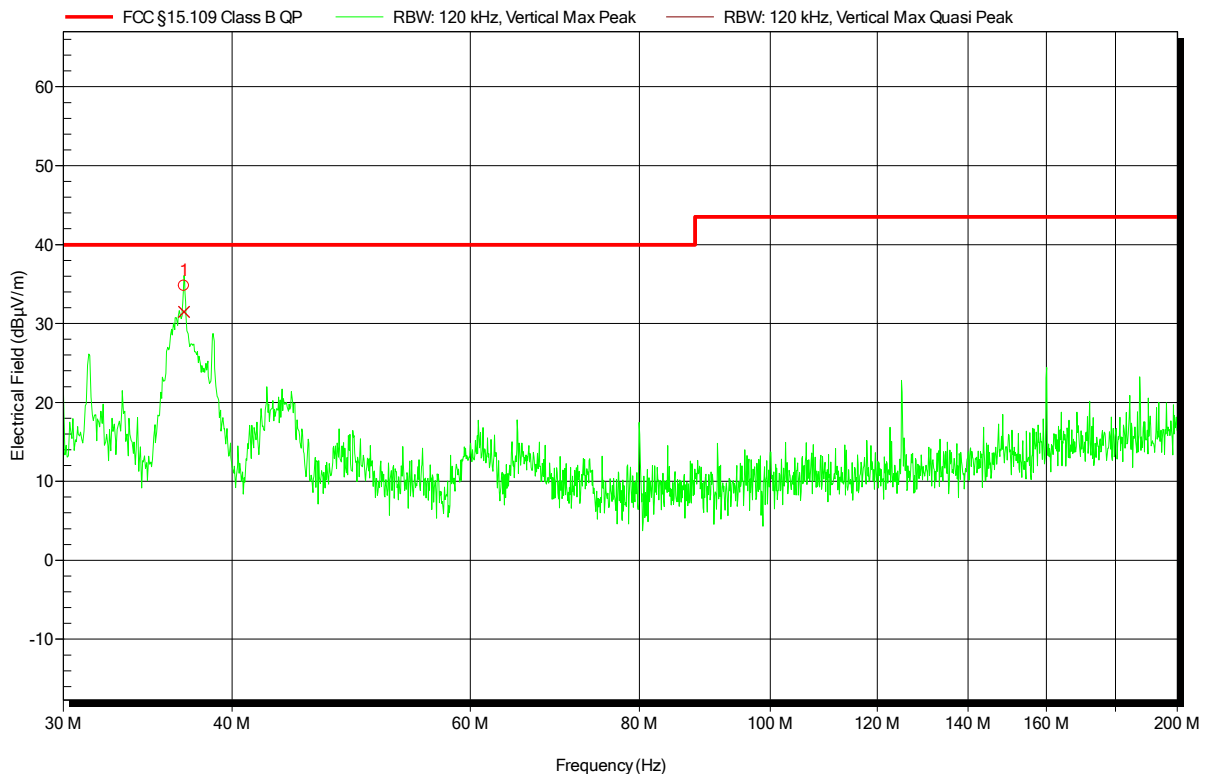
Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	36.846 MHz	31.06 dBµV/m	40 dBµV/m	-8.94 dB	Pass	0 Degree	1 m

Radiated emissions under normal conditions according to FCC part 15B

Project number: G0M-1812-7889

Applicant: Leica Geosystems AG
 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 22°C, Unom: 11.1VDC
 Antenna: Rohde & Schwarz HK 116, Vertical
 Measurement distance: 3m
 Mode: 2 (battery)
 Test Date: 2019-01-14
 Note:

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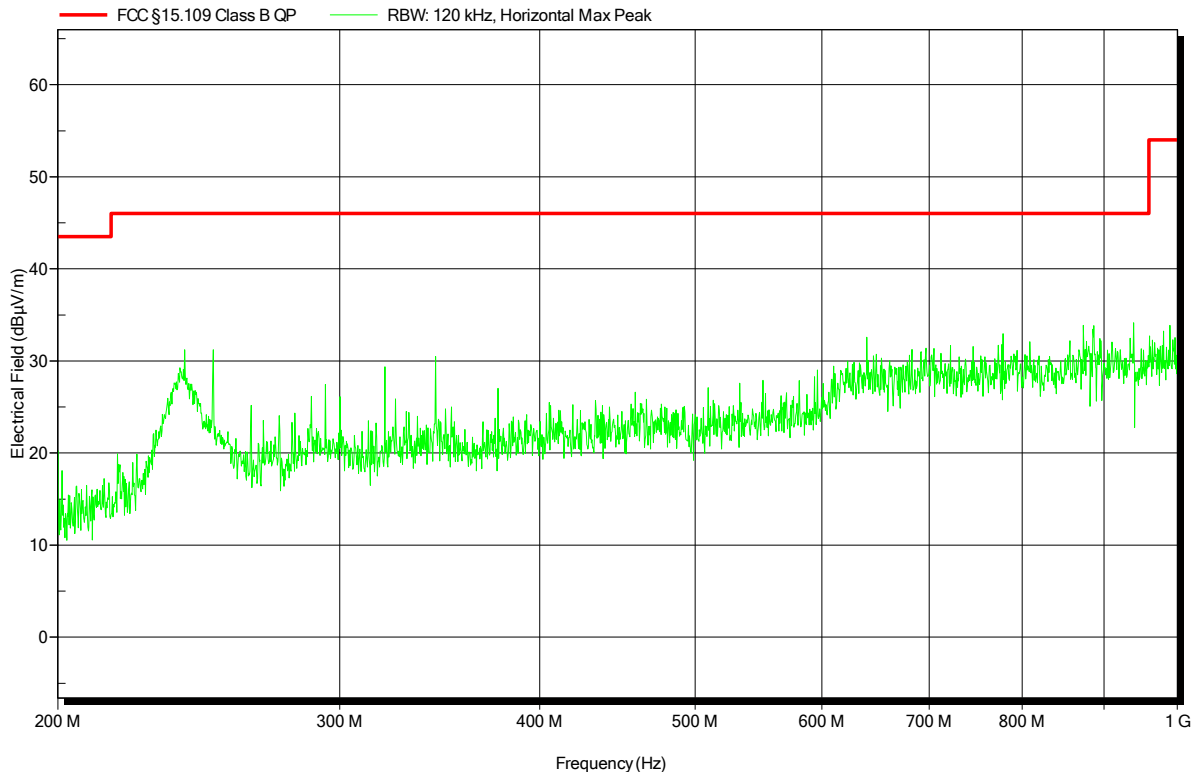
Peak Number	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Status	Angle	Height
1	36.858 MHz	31.46 dBµV/m	40 dBµV/m	-8.54 dB	Pass	0 Degree	1 m

Radiated emissions under normal conditions according to FCC part 15B

Project number: G0M-1812-7889

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 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 22°C, Unom: 11.1VDC
 Antenna: Rohde & Schwarz HL 223, Horizontal
 Measurement distance: 3m
 Mode: 2 (battery)
 Test Date: 2019-01-14
 Note:

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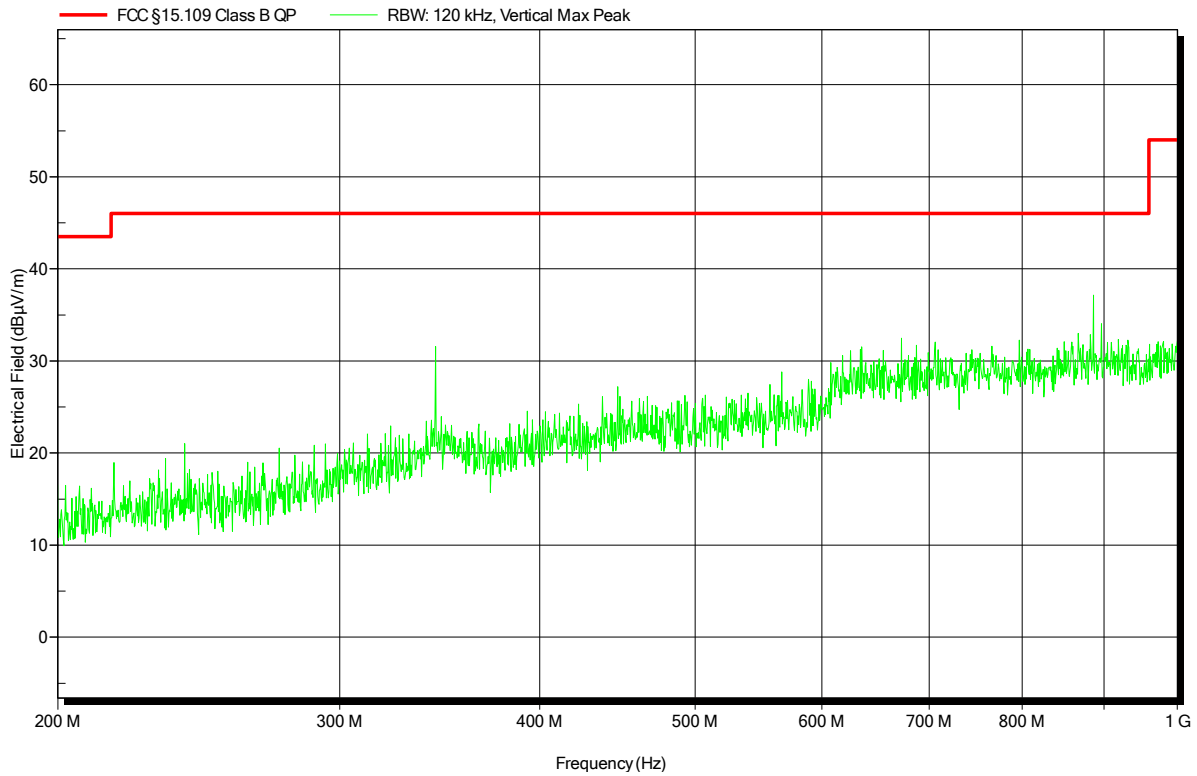


Radiated emissions under normal conditions according to FCC part 15B

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 EUT Name: Field Controller Win EC7
 Model: CS20
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 Operator: Mr. Dose
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 Antenna: Rohde & Schwarz HL 223, Vertical
 Measurement distance: 3m
 Mode: 2 (battery)
 Test Date: 2019-01-14
 Note:

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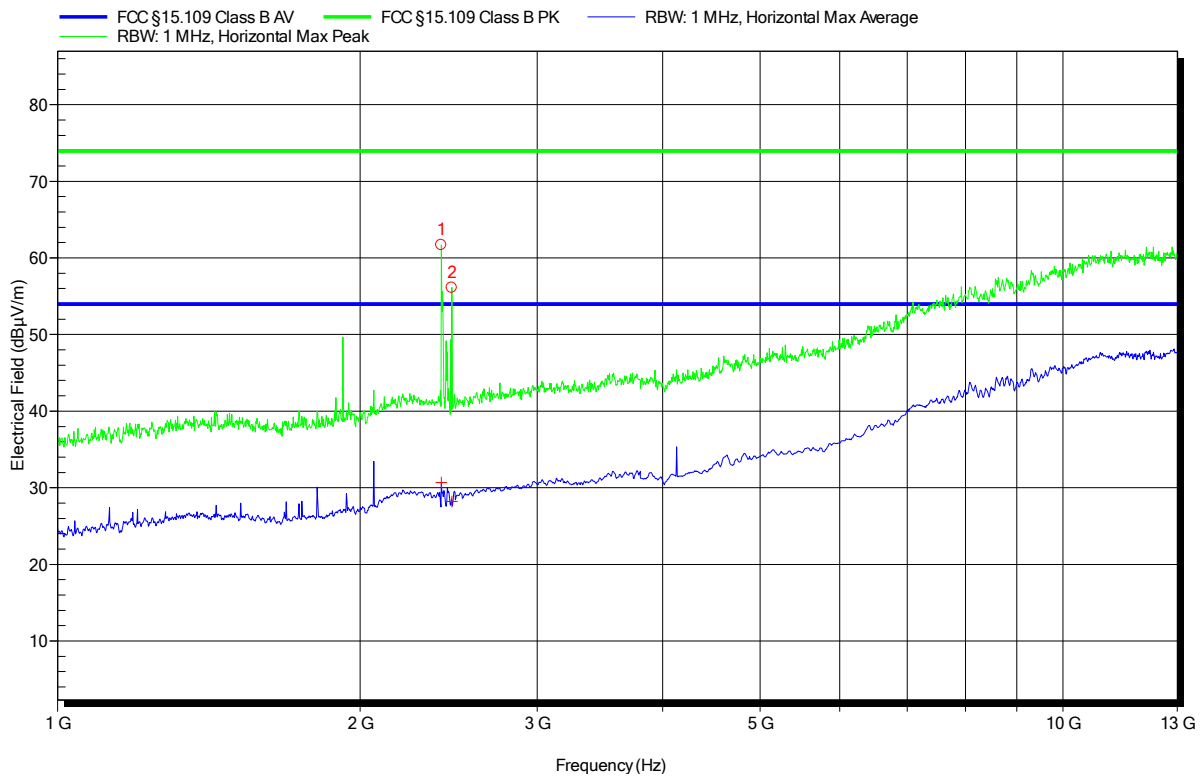


Radiated emissions under normal conditions according to FCC part 15B

Project number: G0M-1812-7889

Applicant: Leica Geosystems AG
 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 22°C, Unom: 11.1VDC
 Antenna: Schwarzbeck BBHA 9120D, Horizontal
 Measurement distance: 3m
 Mode: 2 (battery)
 Test Date: 2019-01-14
 Note:

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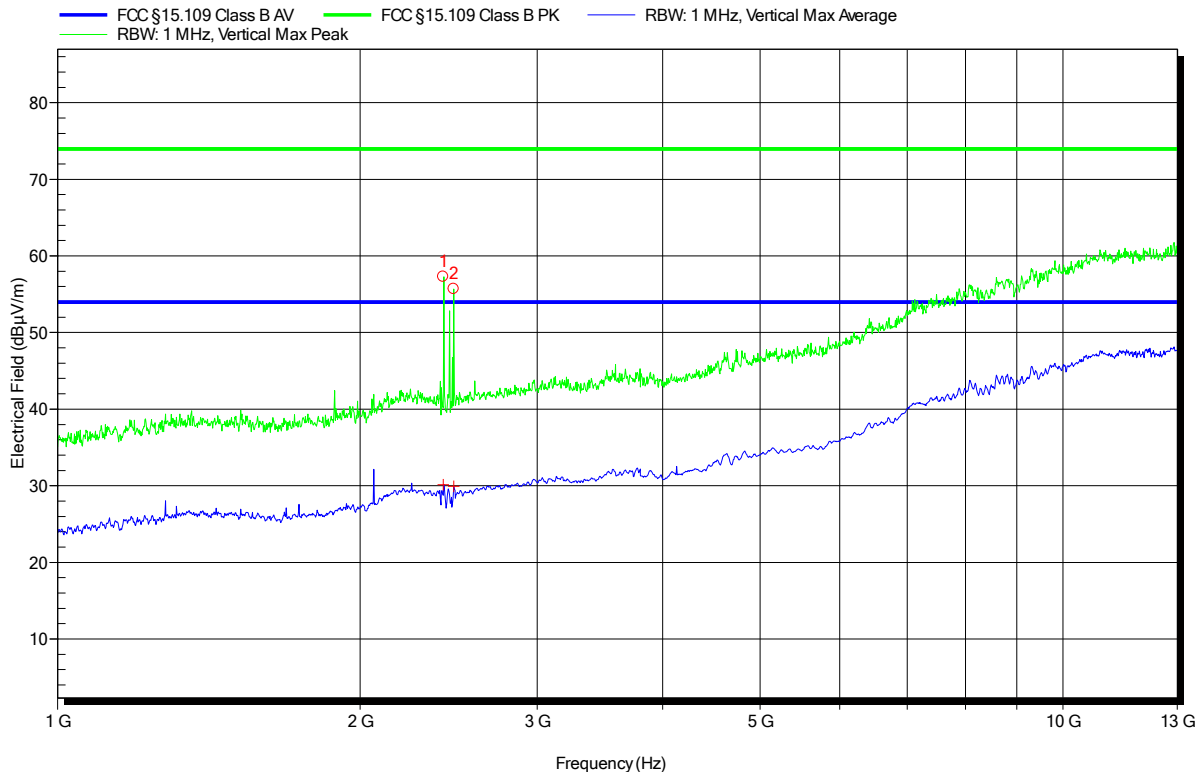
Peak Number	Frequency	Peak	
1	2.41 GHz	61.68 dBµV/m	WLAN- / BT-carrier
2	2.468 GHz	56.12 dBµV/m	

Radiated emissions under normal conditions according to FCC part 15B

Project number: G0M-1812-7889

Applicant: Leica Geosystems AG
 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 22°C, Unom: 11.1VDC
 Antenna: Schwarzbeck BBHA 9120D, Vertical
 Measurement distance: 3m
 Mode: 2 (battery)
 Test Date: 2019-01-14
 Note:

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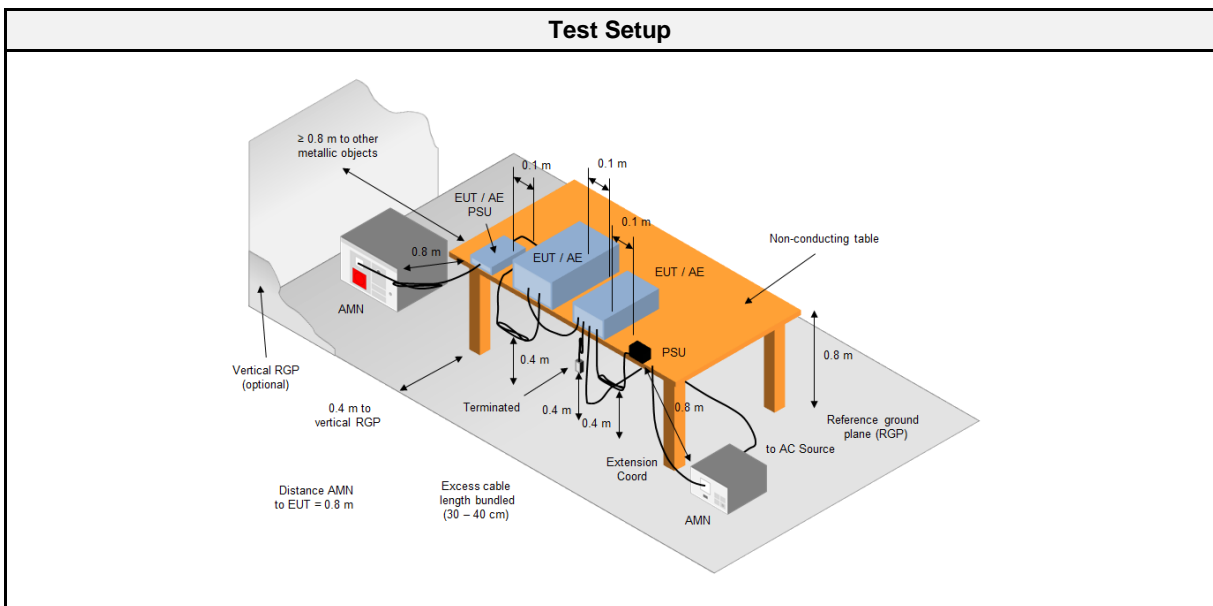
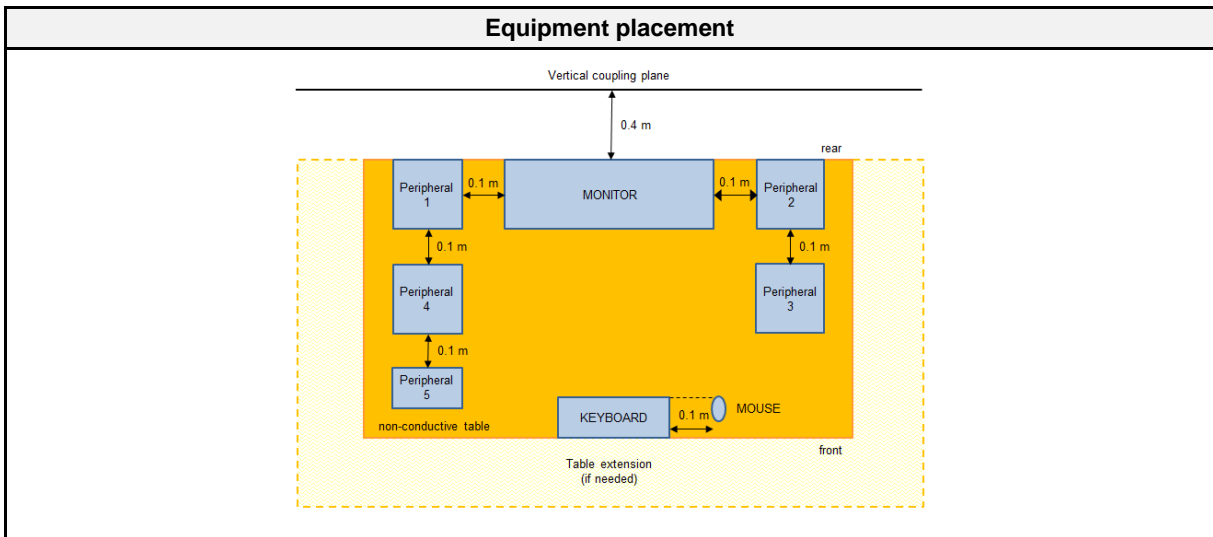
Peak Number	Frequency	Peak	
1	2.42 GHz	57.29 dBµV/m	
2	2.478 GHz	55.67 dBµV/m	WLAN- / BT-carrier

2.2 Test Conditions and Results - Conducted emissions acc. to ANSI C63.4

2.2.1 Information

Test Information	
Reference	FCC 15.107, ICES-003, 8, 6.2
Reference method	ANSI C63.4:2014 Section 12
Measurement range	150 kHz to 30 MHz
Equipment class	Class B
Equipment type	Table top
Temperature [°C]	24
Humidity [%]	26
Operator	Stefan Dose supervised by Matthias Handrik
Date	2019-01-11

2.2.2 Setup



2.2.3 Equipment

Test Software			
Description	Manufacturer	Name	Version
EMC Software	DARE Instruments	Radimation	2016.1.10

Test Equipment					
Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Pulse Limiter	Rohde & Schwarz Vertriebs GmbH	ESH3-Z2	EF01222	2018-07	2019-07
AMN	R&S	ESH3-Z5	EF00036	2017-01	2019-01
EMI Test Receiver	R&S	ESR 7	EF00943	2018-07	2019-07

2.2.4 Procedure

Exploratory measurement
<ol style="list-style-type: none"> The EUT was placed on a non-conductive table 0.8 m above the reference ground plane and 0.4 m away from the vertical conducting plane (ANSI C63.4: 2014 item 7.3.1) The power cord that is normally supplied or recommended by the manufacturer was connected to the LISN. The distance between the outer edge of the EUT and the LISN shall be set to 0.8 m. A longer power cord shall be bundled to this length (bundling shall not exceed 40 cm in length). The LISN measurement port was connected to a measurement receiver I/O cables were bundled not longer than 0.4 m Measurement was performed in the frequency range 0.15 – 30MHz on each current-carrying conductor To maximize the emissions the cable positions were manipulated The worst configuration of EUT and cables is shown on a test setup picture at item 1.3

Final measurement
<ol style="list-style-type: none"> The EUT was placed on a non-conductive table 0.8 m above the reference ground plane and 0.4 m away from the vertical conducting plane (ANSI C63.4: 2014 item 7.3.1) The power cord that is normally supplied or recommended by the manufacturer was connected to the LISN. The distance between the outer edge of the EUT and the LISN shall be set to 0.8 m. A longer power cord shall be bundled to this length (bundling shall not exceed 40 cm in length). The LISN measurement port was connected to a measurement receiver The EUT and cable arrangement were based on the exploratory measurement results The test data of the worst-case conditions were recorded and shown on the next pages

2.2.5 Limits

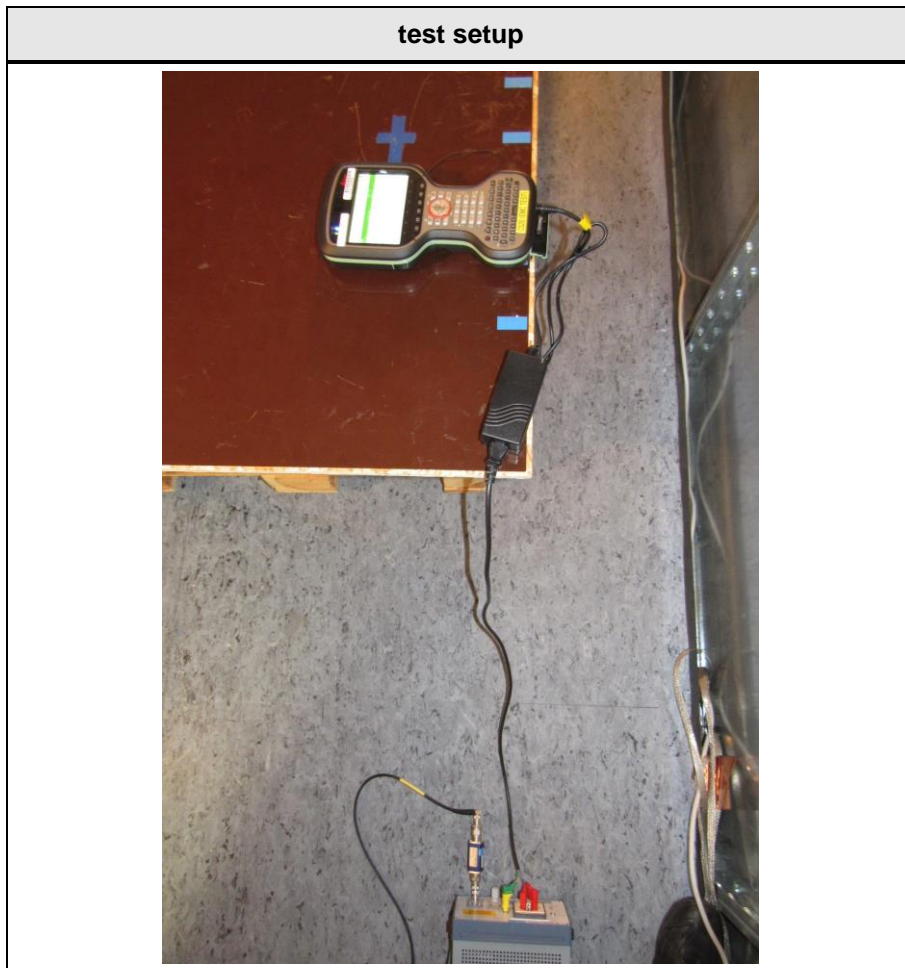
Class B		
Frequency [MHz]	Quasi-peak Limit [dBµV]	Average Limit [dBµV]
0.15 - 0.5	66 - 56 *	56 - 46 *
0.5 - 5	56	46
5 - 30	60	50

* Decreases with the logarithm of the frequency

2.2.6 Results

AC power line conducted emissions					
Port	Coupling	Operational mode	EUT Configuration	Verdict	Remark
Power	AMN	1	1	PASS	-

2.2.7 Setup Photos



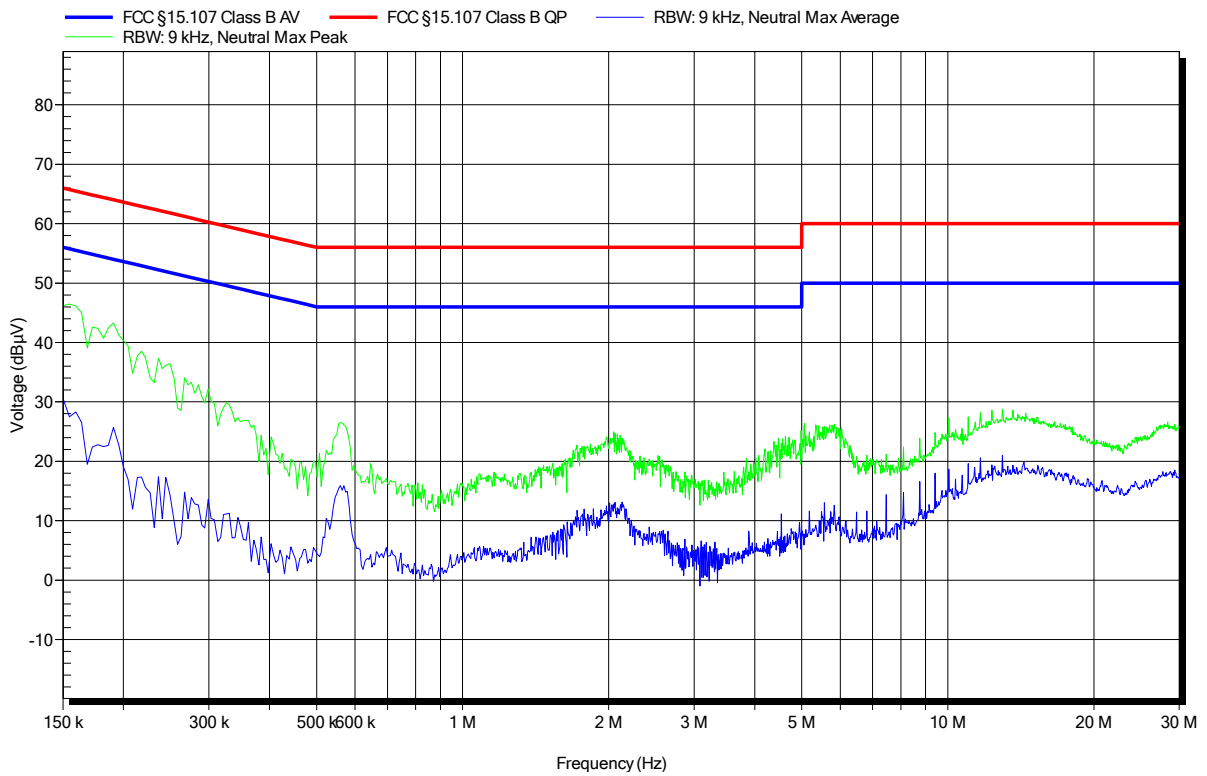
2.2.8 Records

EMI voltage test in the ac-mains according to FCC part 15B

Project number: G0M-1812-7889

Applicant:	Leica Geosystems AG
EUT Name:	Field Controller Win EC7
Model:	CS20
Test Site:	Eurofins Product Service GmbH
Operator:	Mr. Dose
Test Conditions:	Tnom: 24°C, Unom: 120 VAC / 60Hz
LISN:	ESH3-Z5 (N)
Mode:	1 (charging)
Test Date:	2019-01-11
Note:	

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EMI voltage test in the ac-mains according to FCC part 15B

Project number: G0M-1812-7889

Applicant: Leica Geosystems AG
 EUT Name: Field Controller Win EC7
 Model: CS20
 Test Site: Eurofins Product Service GmbH
 Operator: Mr. Dose
 Test Conditions: Tnom: 24°C, Unom: 120 VAC / 60Hz
 LISN: ESH3-Z5 (L)
 Mode: 1 (charging)
 Test Date: 2019-01-11
 Note:

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