Trumpf Laser GmbH
TEST REPORT

SCOPE OF WORK
RADIO TESTING - Protective glass monitoring module – PGM001A

REPORT NUMBER
2235011KAU-006b

ISSUE DATE

03-August-2020

PAGES
35

DOCUMENT CONTROL NUMBER
R_FCC 15-225_18-01 (25-January-2018)

TYPE:	PGM001A
DESCRIPTION:	Protective Glass Monitoring for a Laser Processing Optics with RFID-Reader
SERIAL NO:	000006

All measurement results refer to the equipment which was tested

MANUFACTURER:	Trumpf Laser GmbH
CUSTOMER NAME:	Trumpf Laser GmbH
ADDRESS (CUSTOMER):	Aichhalder Str. 39 78713 Schramberg Germany
REPORT NO:	2235011KAU-006b
TEST RESULT:	The equipment complies to 47 CFR Part 15, Subpart C, Intentional radiators, section 15.225 / RSS-210, Issue 10 and RSS-GEN, Issue 5 (Referring to the operating modes specified in this report).
TEST LABORATORY:	Intertek Deutschland GmbH Innovapark 20, 87600 Kaufbeuren Germany
FCC DESIGNATION NUMBER:	DE0014
FCC TEST FIRM REGISTRATION NUMBER:	359260
ISED CAB IDENTIFIER:	DE0014
ISED #:	24854
TEST ENGINEER:	R. Dressler Technical Manager EMC/ Radio
REVIEWER:	U. Gronert Senior Project Engineer

Details about Accreditations/Acceptances

EMC / Radio National

DAkkS Deutsche Akkreditierungsstelle D-PL-12085-01-01	The Intertek Deutschland EMC-Lab is accredited by the Deutsche Akkreditierungsstelle GmbH (DAkkS) Registration Number (EMC general): **D-PL-12085-01-01** Registration Number (EMC Med): **D-PL-12085-01-03**

International

IECEE CB SCHEME	The Intertek Deutschland EMC-Lab is accepted to participate in the IECEE (IEC Conformity assessment for Electrotechnical Equipment and Components) CB-Scheme CB Test Laboratory: **TL118**
FCC Federal Communications Commission	The Intertek Deutschland EMC-Lab is listed at the Federal Communications Commission (FCC) Designation Number: **DE0014** Test Firm Registration Number: **359260**
Bundesnetzagentur BNetzA-CAB-16/21-10	The *Bundesnetzagentur* recognizes Intertek Deutschland GmbH as Conformity Assessment Body in the sector electromagnetic compatibility (EMC).
Innovation, Science and Economic Development Canada	The Intertek Deutschland EMC-Lab is accredited for Innovation, Science and Economic Development Canada (ISED) ISED CAB IDENTIFIER: **DE0014** ISED #: **24854**

Automotive

KBA Anerkennungsstelle Anerkannt unter KBA-P 00046-03	The Intertek Deutschland EMC-Lab is recognized as technical service of the Kraftfahrt-Bundesamt (KBA) Registration Number: **KBA-P 00046-03**

SECTION 1
CONTENTS

SECTION 2
MEASUREMENT AND TEST SPECIFICATION

47 CFR Part 15, Subpart C, Intentional radiators, section 15.207 and section 15.225 / RSS-210, Issue 10 and RSS-GEN, Issue 5

Test methods in:

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices

No additions, deviations or exclusions have been made from standards and accreditation.

The test results detailed in this report apply only to the Protective Glass Monitoring Unit with the test setup described. Any modification such as a change, addition to or inclusion of another device into this product will require an additional evaluation.
The support equipment listed as part of the emission tests is required to properly exercise and test the device under test.

SECTION 3
GENERAL INFORMATION

Possible test case verdicts:		
Test case does not apply to the test object:	N/A (Not Applicable)	
Test object does meet the requirement:	P (Pass)	
Test object does not meet the requirements:	F (Fail)	
Samples arrived:	2019-05-20	
Testing:	2019-05-27 to 2019-06-07	
Decimal separator:	☒ Point	☐ Comma
Environmental conditions during testing:	Temperature:	15 °C - 35 °C
	Humidity:	20 % - 60 %
	Atmospheric pressure:	900 mbar - 1000 mbar
	If explicitly required by a basic standard the measured climatic conditions are documented in the corresponding test section.	

SECTION 4
SUMMARY OF TESTING

4.1 General annotation

The tests were performed in the order of the right column in the “Test Results – Overview” table.

4.2 Measurement uncertainty

For each test method, an uncertainty evaluation was carried out. The results of the evaluation can be provided upon request from Intertek Deutschland GmbH.

4.3 Document History

REVISION	DATE	REPORT	CHANGES	AUTHOR
Initial release	2020-08-03	2235011KAU-006b	Initial issue	RDR

SECTION 5
TEST RESULTS – OVERVIEW

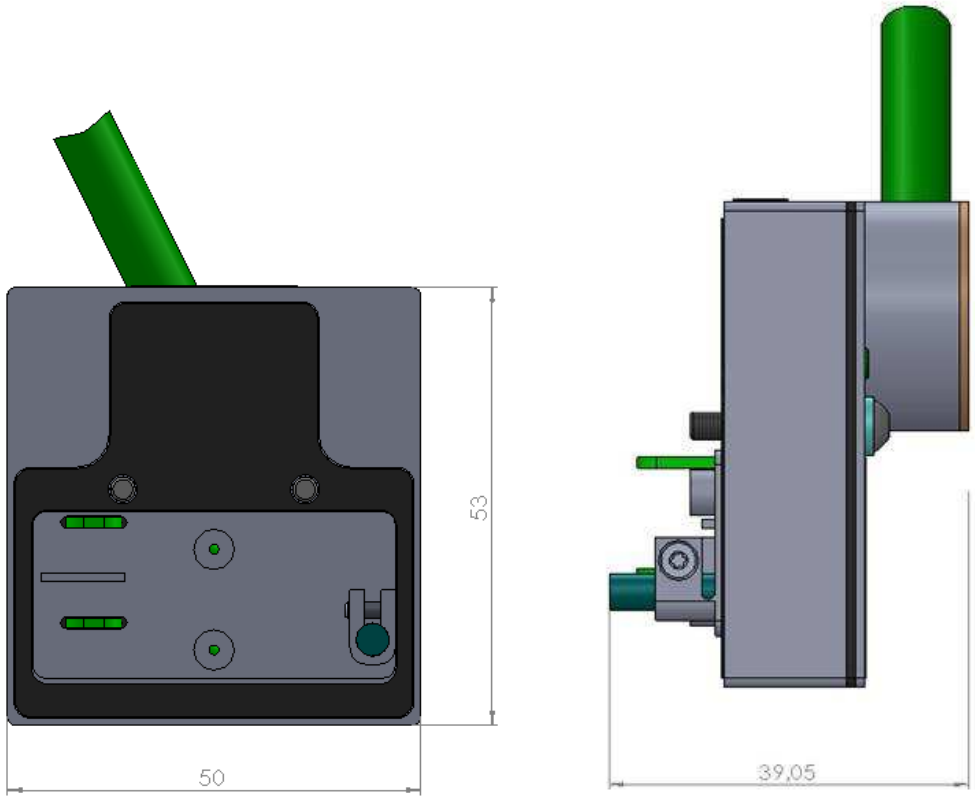
EMISSION	REQUESTED	VERDICT	DATE	NO
Conducted emissions (AC power-line, 0.15 MHz - 30 MHz)	see 7.1	P	2019-05-22	1
Field strength (13.110 MHz – 14.010 MHz)	see 7.2	P	2020-06-02	5
Radiated emissions (< 30 MHz)	see 7.3	P	2020-06-02	4
Radiated emissions (30 MHz - 1 GHz)	see 7.4	P	2020-06-02	6
Frequency Stability Test	see 7.5	P	2019-05-28	2
Occupied bandwidth test	see 7.6	P	2019-06-07	3

SECTION 6
INFORMATION ABOUT THE EUT

6.1 Description of the EUT

☒ table-top EUT	☐ floor-standing EUT

Dimensions:



Firmware version:	PGM_45BD
Description:	See: Operational Description Beo D50 Smart

Transmitter frequency range:	13.56 MHz	
Frequency agile or hopping:	☐ Yes	☒ No
Antenna:	☒ Internal antenna	☐ External antenna
Antenna connector:	☒ None	☐ Yes, type
Type of modulation:	AM	
Type of used TAG:	One RFID-Transceiver Unit per cassette slot, according to ISO/IEC 15693 in the 13,56 MHz band for communication with RFID-Tags attached to a Protective Glass	
Temperature range:	☒ FCC requirement: -20°C to +50°C ☒ Customers spec. of EUT (just upper limit defined): +65°C ☒ Testing range: -20°C to +65°C	
Transmitter stand by mode supported:	☐ Yes	☒ No

6.1.1 Label artwork (general)

6.2 Power interface

MODE	VOLTAGE (V)	FREQUENCY (Hz)	COMMENT
1	120	60	The EUT was supplied over the control unit by the internal power supplies EUT (processing optics) is powered with 24 V DC

Power sources/associated test equipment

DEVICE	MANUFACTURER	TYPE	SN	ASSET NO.
Internal power supplies	Meanwell	SP-150-24	-	-
4 quadrant amplifier	Spitzenberger & Spies	PAS 5000	826149/005	PM KF 2555

6.3 Configuration mode

MODE	DESCRIPTION
1	See block diagram under 6.9

6.4 Operation mode

MODE	DESCRIPTION
1	Continuous transmission (normal mode); switching between the two antenna

6.5 Major subassemblies or internal peripherals

DEVICE	MANUFACTURER	TYPE	SN	FCC ID
Power supplies (2x)	Meanwell	SP-150-24	-	-

6.6 Peripheral devices used for testing

DEVICE	MANUFACTURER	TYPE	SN	FCC ID
Laser 19" control rack	Trumpf	E1TLS535RO	-	-
Panel PC	Spectra	AFL-10A	-	-

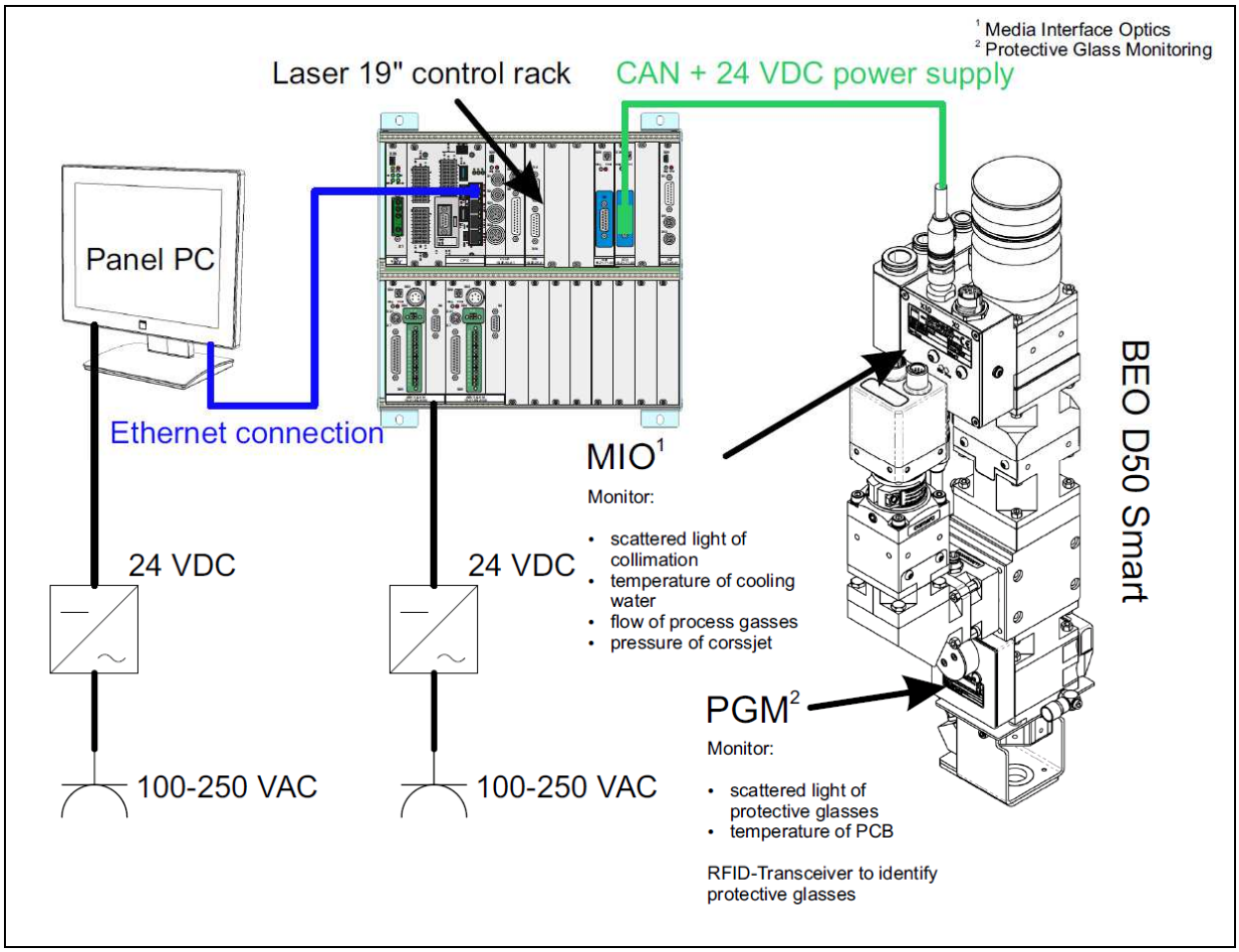
6.7 Supply and interconnecting cables used for testing

LINE	LENGTH (cm)	SHIELDING
Electrical supply cable (D-SUB to M12 Y-Hybrid); Trumpf-No. 2249187 (1.5 m) Murr Elektronik Art.-No. 7000-47051-831 1000 (10 m)	11.5	Y
AC mains	1.5	N

6.8 Clock frequencies of the EUT

SOURCE	FREQUENCY ()
Oscillator G1	8
µ-Controller (internal)	168
Oscillator G2	27.12
CR95HF (internal PLL)	13.56

6.9 Block diagram of the test setup



SECTION 7

7.1 Conducted emissions

NORMATIVE REFERENCES			RESULT
Limits according to:	**FCC §15.207** **RSS-210, Issue 10, section**		**P**
Methods of measurement according to:	**ANSI C63.4**		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	
Test requirements	Frequency range	150 kHz - 30 MHz	

Test equipment

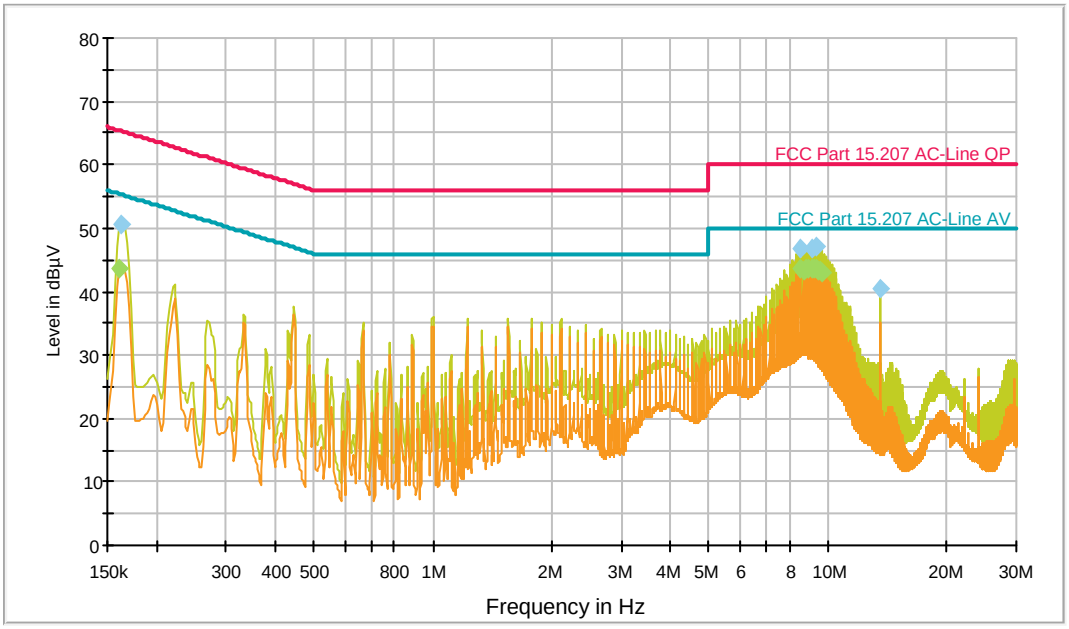
DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Shielded cabin	ETS LINDGREN	RFSD 100	3598	PM KF 2955-2	-
Pulse Limiter 10 dB 9 kHz - 200 MHz	Schwarzbeck	VTSD 9561-F N	9561-F N242	PM KF 3059	2019-01 (1 year)
Receiver 10 Hz - 7 GHz	Rohde & Schwarz	ESR7	101095	PM KF 2441	2018-10 (1 year)
V-Artificial mains-network, 2 Line	Rohde & Schwarz	ESH3-Z5	838576/016	PM KF 0141	2019-02 (2 years)
V-Artificial mains-network, 2 Line	Rohde & Schwarz	ESH3-Z5	863367/018	PM KF 0142	2017-10 (2 years)
Test software	Rohde & Schwarz	EMC 32 V.8.54	-	PM KF 2983	-

Comment
In the following diagram, the N and L line are merged.
To demonstrate compliance with the conducted limits (§15.207) this test was performed with two interconnected Meanwell SP-150-24 power supply units mounted in the control unit.

Measurement results – Conducted emissions:

EUT:	PGM001A installed into Trumpf BEO D50 Smart Processing optics
Project No.:	35011
Test description:	Conducted Emissions, 150 kHz - 30 MHz
Test standard:	FCC Part 15 Subpart C, § 15.207
Tested port:	Mains
Test verdict:	Passed
Operating conditions:	Continuous normal operation, 120 V, 60 Hz, laser program, EUT grounded separately
Operator name:	SBE
Date of testing:	2019-05-22

EN-CE-R32-LN01



FCC Part 15.107 AC QP, Class B [..\EMI conducted\FCC Part 15 Subpart B\]
FCC Part 15.107 AC AV, Class B [..\EMI conducted\FCC Part 15 Subpart B\]
Preview Result 1-QPK [Preview Result 1.Result:1]
Preview Result 2-CAV [Preview Result 2.Result:2]
Final Result 1-QPK [Final Result 1.Result:1]
Final Result 2-CAV [Final Result 2.Result:1]

Final Result 1

Frequency (MHz)	QuasiPeak-ClearWrite (dBµV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.163500	50.6	GN	N	10.3	14.7	65.3	
8.549250	46.9	GN	L1	10.7	13.1	60.0	
9.102750	47.0	GN	L1	10.7	13.0	60.0	
9.325500	47.2	GN	L1	10.7	12.8	60.0	
13.560000	40.6	GN	N	10.8	19.4	60.0	

Final Result 2

Frequency (MHz)	CAverage-ClearWrite (dBµV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.161250	43.5	GN	N	10.3	11.9	55.4	
8.549250	43.7	GN	L1	10.7	6.3	50.0	
8.661750	43.3	GN	L1	10.7	6.7	50.0	
8.772000	43.6	GN	L1	10.7	6.4	50.0	
8.882250	43.6	GN	L1	10.7	6.4	50.0	
9.105000	43.7	GN	L1	10.7	6.3	50.0	
9.215250	43.5	GN	L1	10.7	6.5	50.0	
9.327750	43.6	GN	L1	10.7	6.4	50.0	
9.438000	43.3	GN	L1	10.7	6.7	50.0	
9.548250	43.3	GN	L1	10.7	6.7	50.0	
9.660750	43.0	GN	L1	10.7	7.0	50.0	

EMI Auto Test Template: EN-CE-R32-LN01

Hardware Setup: EN-CE-R32-LN01
Measurement Type: 2 Line LISN
Frequency Range: 150 kHz - 30 MHz
Graphics Level Range: 0 dBµV - 80 dBµV

Preview Measurements:
Scan Test Template: EN-CE-R32-LN01_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
9 kHz - 150 kHz	50 Hz	QPK; CAV	200 Hz	1 s	20 dB
150 kHz - 30 MHz	2.25 kHz	QPK; CAV	9 kHz	1 s	0 dB

Receiver: [ESR 7]

Data Reduction:
Limit Line #1: FCC Part 15.107 AC QP, Class B
Limit Line #2: FCC Part 15.107 AC AV, Class B
Peak Search: 6 dB , Maximum Results: 10
Subrange Maxima: 10 Subranges , Maxima per Subrange: 1
Acceptance Offset: -10 dB
Maximum Number of Results: 20
After Data Reduction: Interactive data reduction

Report Settings:
Report Template: Standard Report_EMC KF_Conducted Emission

7.2 Field strength 13.110 MHz – 14.010 MHz (Emission Mask)

NORMATIVE REFERENCES			RESULT
Limits according to:	**FCC §15.225 (a) – (c)** **RSS-210, Issue 10, section B4**		**P**
Methods of measurement according to:	**ANSI C63.10, section 6.3, 6.4** **RSS-Gen 6.13, 8.9**		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	
Test requirements	Frequency range	13.110 MHz – 14.010 MHz	
	Measurement time	1 s	
	Antenna height	1 m	

Limits

The limits below 30 MHz are given for different measurement distances. The limits below 30 MHz are converted to 3 m by using the extrapolation factor 40 dB/decade (according to §15.31).

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)	Field strength (dBµV/m)	Measurement distance (m)
13.110 - 13.410	106	40.5	30	80.5	3
13.410 - 13.553	334	50.5	30	90.5	3
13.553 - 13.567	15848	84.0	30	124.0	3
13.567 - 13.710	334	50.5	30	90.5	3
13.710 - 14.010	106	40.5	30	80.5	3

Test setup details

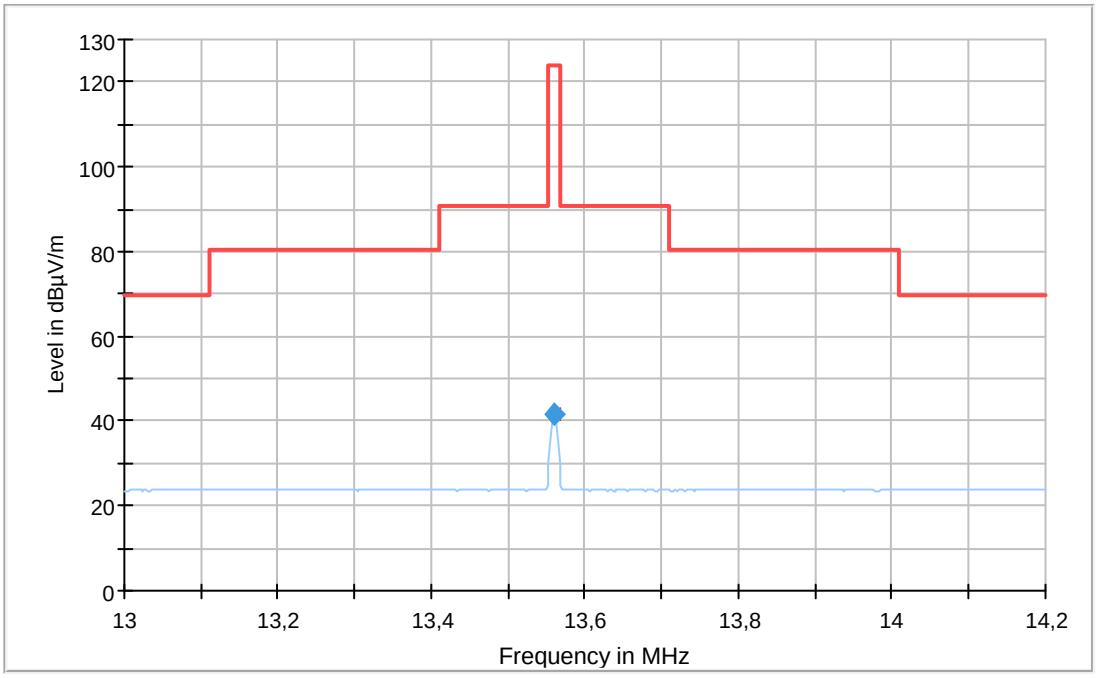
Compliance with the spectrum mask is tested using a spectrum analyzer with resolution bandwidth set to 10 kHz or 9 kHz CISPR. The video bandwidth shall be at least three times greater than the resolution bandwidth.
The test was carried out automatically by the test receiver.
The EUT is a table-top EUT and was standing on a table made of Styrodur with a Pertinax plate on top and the dimensions 1.6 m x 1.0 m x 0.8 m (Length x Width x Height).
The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector.

Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber	Siepel	REF W460SLB	-	PM KF 1150-01	2019-12 (3 years)
Turntable	Inn-Co	-	-	PM KF 2949-04	-
Tower	Inn-Co	MA4484-XPET	-	PM KF 2949-03	-
Controller	Inn-Co	CO 3000	4970815	PM KF 2949	-
Receiver 9 kHz- 7 GHz	Rohde & Schwarz	ESR7	101757	PM KF 3371	2020-04 (1 year)
Loop antenna 9 kHz- 30 MHz	Rohde & Schwarz	HFH2-Z2	881058/48	PM KF 1401	2019-10 (2 years)
DC power supply for HFH2-Z2	Rohde & Schwarz	HZ-9	101865	PM KF 3455	-
RF-cable	Rohde & Schwarz	HFU2-Z5	11673862	PM KF 1646	2019-12 (1 year)
RF-cable Kabel Micro-Coax UTIFLEX	Rosenberger	LA3-020-5500	010-1788635	PM-KF-3187	2020-06 (1 years)
RF-cable Kabel Micro-Coax UTIFLEX	Rosenberger	LA2-001-7200	010-1786350	PM-KF-3188	2020-03 (1 years)
Test software	Rohde & Schwarz	EMC 32 V.10.01.00	-	PM KF 2983-2	-

Measurement results – Field strength 13.110 MHz – 14.010 MHz (Emission Mask):

EUT:	PGM001A
Test Verdict:	Pass
Test Description:	Field Strength, 13 MHz - 14.2 MHz
Operating Conditions:	Continuous transmission (normal mode); switching between the two antenna
Operator Name:	RDR
Project Number:	35011
Date	02.06.2020



Preview Result 1-QPK [Preview Result 1.Result:1]
Critical_Freqs AVG [Critical_Freqs.Result:5]
Critical_Freqs QPK [Critical_Freqs.Result:4]
FCC 15_225_9kHz_to_30MHz_at_d=3m [..\EMI radiated\z_Alt\FCC-EMI-MF\]
Final_Result QPK [Final_Result.Result:4]
Final_Result AVG [Final_Result.Result:5]

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)
13.560000	41.40	---	124.00	82.60	---	---	H	0.0

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
13.560000	20	20:25:20 - 02.06.2020

EMI Auto Test Template: EN-RE-R17-AN23

Hardware Setup: EN-RE-R12-AN23
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 9 kHz - 30 MHz
Graphics Level Range: 0 dBµV/m - 130 dBµV/m

Preview Measurements:
Antenna height: 0 - 1000 cm , Step Size = 0 cm , Positioning Speed = 1
Polarization: H + V
Turntable position: 0 - 315 deg , Step Size = 45 deg , Positioning Speed = 8
Scan Test Template: EN-RE-R12-AN23_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
9 kHz - 150 kHz	50 Hz	QPK	200 Hz	1 s	0 dB
150 kHz - 30 MHz	2,25 kHz	QPK	9 kHz	1 s	0 dB

Anechoic chamber

Test procedure

The test site is an anechoic chamber suitable for radiated emission measurements in the frequency range of 9 kHz – 30 MHz It includes automatic turntable of radius 2 m. It enables manual and fully automatic measurements.
To find the highest level of radiation

- the height of the antenna is 1m with antenna in horizontal and vertical polarization;
- the turntable is rotated in range from 0° to 360°.

The system was configured for testing in a typical worst case fashion (as a customer may use it). All interface cables were moved to determine the position which resulted in the highest emission levels.

Correction factors

The field strength is calculated by adding the antenna factor and cable attenuation.
The calculations are performed automatically by the measurement software EMC 32.
As example consider the following input values and result:

FREQUENCY (MHZ)	RECEIVER READING U (dBµV)	ANTENNA FACTOR AF (dB/m)	CABLE ATTENUATION A (dB)	CORRECTION ANTENNA + CABLE (dB)	RADIATED FIELD STRENGTH E (dBµV/m)
30.0	20	20.6	0.8	21.4	41.4

E = U + AF + A

7.3 Radiated emissions < 30 MHz

NORMATIVE REFERENCES			RESULT
Limits according to:	**FCC §15.225 (d), §15.209** **RSS-210, Issue 10, section B4**		**P**
Methods of measurement according to:	**ANSI C63.10, section 6.3, 6.4** **RSS-Gen 6.13, 8.9**		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	
Test requirements	Frequency range	9 kHz - 30 MHz	
	Antenna height	1 m	

Limits

The limits below 30 MHz are given for different measurement distances. The limits below 30 MHz are converted to 3 m by using the extrapolation factor 40 dB/decade (according to §15.31).

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	67.6 - 20 · log(F(kHz))	300
0.490 - 1.705	24000/F(kHz)	87.6 - 20 ·log(F(kHz))	30
1.705 - 13.110	30	29.5	30
14.010 - 30.000	30	29.5	30
Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission.			

Test setup details

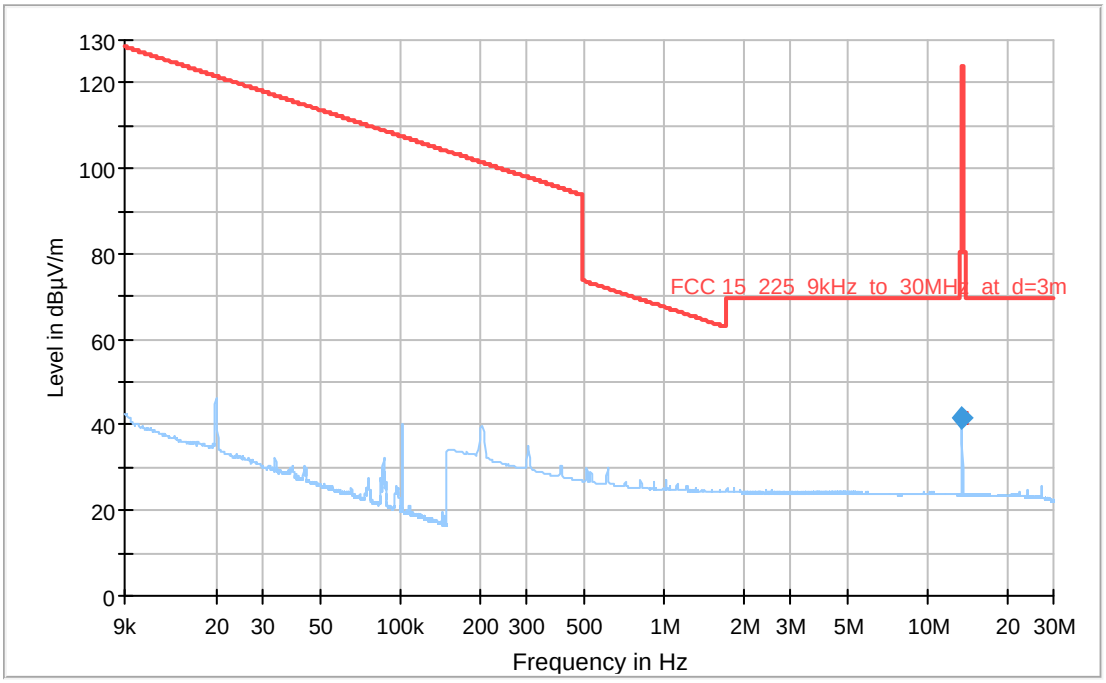
Compliance with the spectrum mask is tested using a spectrum analyzer with resolution bandwidth set to 10 kHz or 9 kHz CISPR. The video bandwidth shall be at least three times greater than the resolution bandwidth.
The test was carried out automatically by the test receiver.
The EUT is a table-top EUT and was standing on a table made of Styrodur with a Pertinax plate on top and the dimensions 1.6 m x 1.0 m x 0.8 m (Length x Width x Height).
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.

Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber	Siepel	REF W460SLB	-	PM KF 1150-01	2019-12 (3 years)
Turntable	Inn-Co	-	-	PM KF 2949-04	-
Tower	Inn-Co	MA4484-XPET	-	PM KF 2949-03	-
Controller	Inn-Co	CO 3000	4970815	PM KF 2949	-
Receiver 9 kHz- 7 GHz	Rohde & Schwarz	ESR7	101757	PM KF 3371	2020-04 (1 year)
Loop antenna 9 kHz- 30 MHz	Rohde & Schwarz	HFH2-Z2	881058/48	PM KF 1401	2019-10 (2 years)
RF-cable	Rohde & Schwarz	HFU2-Z5	11673862	PM KF 1646	2019-12 (1 year)
RF-cable Kabel Micro-Coax UTIFLEX	Rosenberger	LA3-020-5500	010-1788635	PM-KF-3187	2020-06 (1 years)
RF-cable Kabel Micro-Coax UTIFLEX	Rosenberger	LA2-001-7200	010-1786350	PM-KF-3188	2020-03 (1 years)
Test software	Rohde & Schwarz	EMC 32 V.10.01.00	-	PM KF 2983-2	-

Measurement results – Radiated emissions < 30 MHz:

EUT:	PGM001A
Test Verdict:	Pass
Test Description:	Spurious Emissions, 9kHz-30MHz
Operating Conditions:	Continuous transmission (normal mode); switching between the two antenna
Operator Name:	RDR
Project Number:	35011
Date	02.06.2020



Preview Result 1-QPK [Preview Result 1.Result:1]
Critical_Freqs AVG [Critical_Freqs.Result:5]
Critical_Freqs QPK [Critical_Freqs.Result:4]
FCC 15_225_9kHz_to_30MHz_at_d=3m [..\EMI radiated\z_Alt\FCC-EMI-MF\]
Final_Result QPK [Final_Result.Result:4]
Final_Result AVG [Final_Result.Result:5]

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)
13.560000	41.40	---	124.00	82.60	---	---	H	0.0

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
13.560000	20	20:25:20 - 02.06.2020

EMI Auto Test Template: EN-RE-R17-AN23

Hardware Setup: EN-RE-R12-AN23
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 9 kHz - 30 MHz
Graphics Level Range: 0 dBµV/m - 130 dBµV/m

Preview Measurements:
Antenna height: 0 - 1000 cm , Step Size = 0 cm , Positioning Speed = 1
Polarization: H + V
Turntable position: 0 - 315 deg , Step Size = 45 deg , Positioning Speed = 8
Scan Test Template: EN-RE-R12-AN23_PRE

Subrange	**Step Size**	**Detectors**	**IF BW**	**Meas. Time**	**Preamp**
Receiver: [ESR 7]					
9 kHz - 150 kHz	50 Hz	QPK	200 Hz	1 s	0 dB
150 kHz - 30 MHz	2,25 kHz	QPK	9 kHz	1 s	0 dB

Anechoic chamber

Test procedure

The test site is an anechoic chamber suitable for radiated emission measurements in the frequency range of 9 kHz – 30 MHz It includes automatic turntable of radius 2 m. It enables manual and fully automatic measurements.
To find the highest level of radiation

- the height of the antenna is 1m with antenna in horizontal and vertical polarization;
- the turntable is rotated in range from 0° to 360°.

The system was configured for testing in a typical worst case fashion (as a customer may use it). All interface cables were moved to determine the position which resulted in the highest emission levels.

Correction factors

The field strength is calculated by adding the antenna factor and cable attenuation.
The calculations are performed automatically by the measurement software EMC 32.
As example consider the following input values and result:

FREQUENCY (MHZ)	RECEIVER READING U (dBµV)	ANTENNA FACTOR AF (dB/m)	CABLE ATTENUATION A (dB)	CORRECTION ANTENNA + CABLE (dB)	RADIATED FIELD STRENGTH E (dBµV/m)
30.0	20	20.6	0.8	21.4	41.4

E = U + AF + A

7.4 Radiated emissions 30 MHz to 1 GHz

NORMATIVE REFERENCES			RESULT
Limits according to:	**FCC §15.225 (d), §15.209 RSS-210, Issue 10, section B4**		**P**
Methods of measurement according to:	**ANSI C63.10, section 6.3, 6.5 RSS-Gen 6.13, 8.9**		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	
Test requirements	Frequency range	30 MHz - 1 GHz	

Limits

Frequency (MHz)	Field strength (µV/m)	Field strength (dBµV/m)	Measurement distance (m)
30 – 88	100	40.0	3
88 – 216	150	43.5	3
216 – 960	200	46.0	3
Above 960	500	54.0	3

Test setup details

The EUT is a table-top EUT and was standing on a table made of Styrodur with a Pertinax plate on top and the dimensions 1.6 m x 1.0 m x 0.8 m (Length x Width x Height).
Overview sweeps performed with peak detectors and final measurement with quasi-peak detectors.
The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector.

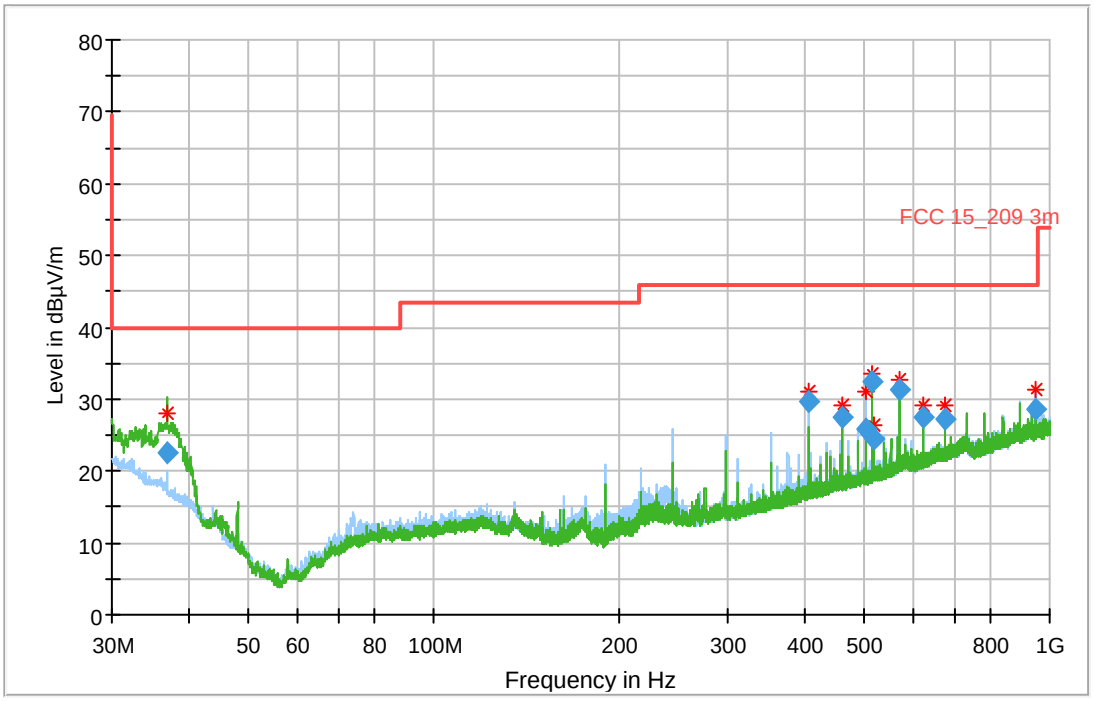
Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber	Siepel	REF W460SLB	-	PM KF 1150-01	2019-12 (3 years)
Turntable	Inn-Co	-	-	PM KF 2949-04	-
Tower	Inn-Co	MA4484-XPET	-	PM KF 2949-03	-
Controller	Inn-Co	CO 3000	4970815	PM KF 2949	-
Receiver 9 kHz- 7 GHz	Rohde & Schwarz	ESR7	101757	PM KF 3371	2020-04 (1 year)
Antenna 30 MHz - 3GHz	Rohde & Schwarz	HL 562	100354	PM KF 1123	2020-05 (2 years)
RF-cable	Rohde & Schwarz	HFU2-Z5	11673862	PM KF 1646	2019-12 (1 year)
RF-cable Kabel Micro-Coax UTIFLEX	Rosenberger	LA3-020-5500	010-1788635	PM-KF-3187	2020-06 (1 years)
RF-cable Kabel Micro-Coax UTIFLEX	Rosenberger	LA2-001-7200	010-1786350	PM-KF-3188	2020-03 (1 years)
Test software	Rohde & Schwarz	EMC 32 V.10.50.40	-	PM KF 2983-2	-

Measurement results – Radiated emissions 30 MHz to 1 GHz:

EUT:	PGM001A
Test Verdict:	Pass
Test Description:	Spurious Emissions, 30-1000MHz
Operating Conditions:	Continuous transmission (normal mode); switching between the two antenna
Operator Name:	RDR
Project Number:	35011
Date	02.06.2020

Overview sweeps performed with peak detectors and final measurement with quasi-peak detectors.



Preview Result 1H-PK+ [Preview Result 1H.Result:2]
Preview Result 1V-PK+ [Preview Result 1V.Result:2]
Critical_Freqs PK+ [Critical_Freqs.Result:4]
FCC 15_209 3m [..\EMI radiated\FCC Part 15C\]
Final_Result QPK [Final_Result.Result:4]

Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
36.870000	22.43	40.00	17.57	1000.0	120.000	100.0	V	33.0
406.800000	29.82	46.02	16.20	1000.0	120.000	100.0	H	229.0
461.040000	27.50	46.02	18.52	1000.0	120.000	100.0	H	301.0
504.000000	25.89	46.02	20.13	1000.0	120.000	190.0	H	238.0
515.280000	32.34	46.02	13.68	1000.0	120.000	186.0	H	237.0
519.990000	24.37	46.02	21.65	1000.0	120.000	175.0	H	233.0
569.520000	31.39	46.02	14.63	1000.0	120.000	192.0	H	197.0
623.760000	27.42	46.02	18.60	1000.0	120.000	112.0	H	230.0
678.000000	27.17	46.02	18.85	1000.0	120.000	164.0	H	217.0
949.200000	28.53	46.02	17.49	1000.0	120.000	100.0	H	284.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
36.870000	16	22:19:26 - 02.06.2020
406.800000	16	22:07:09 - 02.06.2020
461.040000	17	22:09:47 - 02.06.2020
504.000000	18	22:14:36 - 02.06.2020
515.280000	18	22:16:04 - 02.06.2020
519.990000	18	22:17:32 - 02.06.2020
569.520000	19	22:11:32 - 02.06.2020
623.760000	20	22:05:48 - 02.06.2020
678.000000	20	22:13:04 - 02.06.2020
949.200000	24	22:08:30 - 02.06.2020

EMI Auto Test Template: FCC-RE-R17-AN08

Hardware Setup: EN-RE-R12-AN08
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 30 MHz - 1 GHz
Graphics Level Range: 0 dBµV/m - 80 dBµV/m

Preview Measurements:
- Antenna height: 100 - 355 cm , Step Size = 85 cm , Positioning Speed = 8
- Polarization: H + V
- Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
- Graphics Display: Show separate traces for horizontal and vertical polarization
- Scan Test Template: EN-RE-R12-AN08_PRE

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
30 MHz - 1 GHz	30 kHz	PK+	120 kHz	0,1 s	20 dB
1 GHz - 3 GHz	250 kHz	PK+	1 MHz	0,1 s	20 dB

Frequency Zoom:
- Zoom Scan Template: EN-RE-R12-AN08_ZOOM

Adjustment:
- Antenna height: Range = 90 cm , Measuring Speed = 3
- Turntable position: Range = 30 deg , Measuring Speed = 3
- Template for Single Meas.: EN-RE-R12-AN08_MAX

Final Measurements:
- Template for Single Meas.: EN-RE-R12-AN08_FIN

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
30 MHz - 1 GHz	40 kHz	QPK	120 kHz	1 s	20 dB
1 GHz - 3 GHz	40 kHz	QPK	1 MHz	1 s	20 dB

Anechoic chamber

Test procedure

The test site is an anechoic chamber suitable for radiated emission measurements in the frequency range of 30 MHz – 18 GHz (40 GHz). It includes automatic antenna mast of height 4 m and turntable of radius 2 m. It enables both manual and fully automatic measurements. To find the highest level of radiation

- the height of the antenna is scanned in range 1m to 4 m with antenna in horizontal and vertical polarization;
- the turntable is rotated in range from 0° to 360°.

The system was configured for testing in a typical worst case fashion (as a customer may use it). All interface cables were moved to determine the position which resulted in the highest emission levels.

Correction factors

The field strength is calculated by adding the antenna factor and cable attenuation.
The calculations are performed automatically by the measurement software EMC 32.
As example consider the following input values and result:

FREQUENCY (MHZ)	RECEIVER READING U (dBµV)	ANTENNA FACTOR AF (dB/m)	CABLE ATTENUATION A (dB)	CORRECTION ANTENNA + CABLE (dB)	RADIATED FIELD STRENGTH E (dBµV/m)
30.0	20	20.6	0.8	21.4	41.4

E = U + AF + A

7.5 Frequency stability measurement

NORMATIVE REFERENCES			RESULT
Limits according to:	**FCC §15.225 (e)** **RSS-210, Issue 10, section B4** **RSS-Gen Issue 4, section 6.11**		**P**
Methods of measurement according to:	**ANSI C63.10, section 9.14**		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	

Limits

Limit:	The frequency tolerance of the carrier signal shall be maintained within ±0.01 % (±100 ppm) of the carrier frequency under nominal conditions.
Temperature range:	-20°C to +65°C
Voltage range:	102 V – 138 V

Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Temperature chamber	Heraeus-Vötsch	HT4010	45021	PM KF 1402	2019-03 (1 year)
Spectrum analyser	Rohde & Schwarz	FSV40	837356/012	PM KF 2783	2018-09 (1 year)
Loop antenna	Rohde & Schwarz	HZ-10	100055	PM KF 0965	2017-04 (3 year)
Near field probes	EMCO	EMCO 7405	1405	PM KF 0139	---

Measurement results – Frequency stability measurement:

Temperature °C	Carrier at 20°C and 120 V MHz	Upper limit: 13.561723 MHz
		Lower limit: 13.559011MHz
		Measured frequency under temperature influence:
+65		13.5599
+60	13.560367	13.560767
+50		13.5597
+40		13.5601
+30		13.560167
+20		13.560367
+10		13.560167
0		13.5601
-10		13.5599
-20		13.559767

Comment

The AC voltage variation from 102 V to 138 V showed frequency variations of 13.559967 MHz at 102 V and 13.560501 MHz at 138 V.

7.6 Occupied bandwidth

NORMATIVE REFERENCES			RESULT
Limits according to:	**RSS-Gen, Issue 4, 6.6**		**P**
Methods of measurement according to:	**RSS-Gen, Issue 4, 6.6**		
Equipment mode	Power interface	1	
	EUT configuration mode	1	
	Operation mode	1	

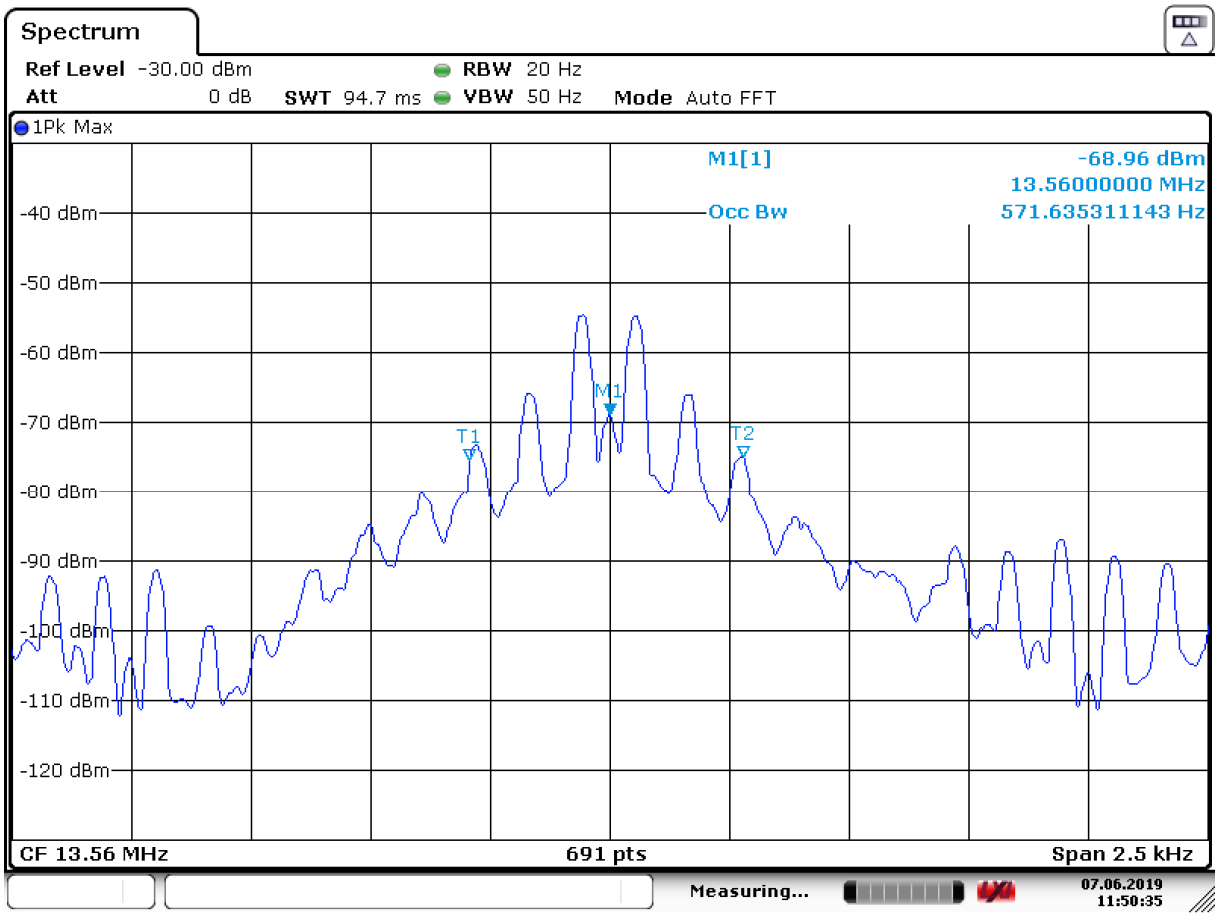
Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Temperature chamber	Heraeus-Vötsch	HT4010	45021	PM KF 1402	2019-03 (1 year)
Spectrum analyser	Rohde & Schwarz	FSV40	837356/012	PM KF 2783	2018-09 (1 year)
Loop antenna	Rohde & Schwarz	HZ-10	100055	PM KF 0965	2017-04 (3 year)

Comment

The 99% occupied bandwidth is 571.635 Hz.

Measurement results – 99% occupied bandwidth:



Date: 7.JUN.2019 11:50:35

End of test report