Gantner Electronic GmbH

TEST REPORT

SCOPE OF WORK
RADIO TESTING – RFID TERMINAL [GT7.2700]

REPORT NUMBER
2241159KAU-012

ISSUE DATE

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PAGES
40

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

TYPE:	GT7.2700
DESCRIPTION:	RFID Terminal
SERIAL NO (EUT 1):	**2015000133**
SERIAL NO (EUT 2)*:	**2015000246**

*The antenna of the RFID module was replaced by a terminating resistor.
All measurement results refer to the equipment which was tested

MANUFACTURER:	Gantner Electronic GmbH
CUSTOMER NAME:	Gantner Electronic GmbH
ADDRESS (CUSTOMER):	Bundesstr. 12 AT-6714 Nüziders AUSTRIA
REPORT NO:	2241159KAU-012
TEST RESULT:	The equipment complies to 47 CFR Part 15, Subpart C, Intentional radiators, section 15.207 and 15.225 / RSS-210, Issue 10 and RSS-GEN, Issue 5 for 13.56 MHz RFID module (Referring to the operating modes specified in this report). The 125 kHz RFID module was documented in another test 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:	M. Bensaid Project Engineer
REVIEWER:	R. Dressler Technical Manager EMC/ Radio

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** Registration Number (EMC Canada): **D-PL-12085-01-04** Registration Number (EMC FCC): **D-PL-12085-01-05**

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 GT7.2700 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:	2020-12-24 (EUT 1) and 2021-01-20 (EUT 2)	
Testing:	2020-12-30 to 2021-10-06	
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.	

Test sites:

Measurement Chamber	Type of chamber	IC Site filing #
ANECHOIC CHAMBER 1	Semi-anechoic 3 m	24854

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.

At least at one emission test the margin to the limit is less than 6 dB. A minimum margin of 3 - 6 dB is recommended for a serial production.

As a wish of the manufacturer/customer the 13.56 MHz RFID module is only measured in one operating mode (send mode). Therefore the RFID module was not measured in standby mode.

In practice, the 13.56 MHz RFID module, the 125 kHz RFID module and the Bluetooth module never transmit at the same time.

4.2 Identical types

The following variant models were not tested as part of this evaluation, but have been identified by the manufacturer as being electrically identical models to the model tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

The manufacturer/customer declared the following type(s) identical to the tested type:
GT7.2701

The differences are according to the manufacturer/customer:
The GT7.2701 is an GT7.2700 with a different housing. The housing materials are the same but in a slightly modified form.

4.3 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 (see section 7.7).

4.4 Document History

REVISION	DATE	REPORT	CHANGES	AUTHOR
Initial release	2021-10-06	2241159KAU-012	Initial issue	MBE

SECTION 5
TEST RESULTS – OVERVIEW

EMISSION	VERDICT	DATE	NO
Conducted emissions (0.15 MHz - 30 MHz)	P	2021-01-25 2021-05-29	6 7
Field strength (13.110 MHz – 14.010 MHz)	P	2020-12-30	3
Radiated emissions (< 30 MHz)	P	2020-12-30	2
Radiated emissions (30 MHz - 1 GHz)	P	2020-12-30	1
Frequency Stability Test	P	2020-01-18	4
20 dB bandwidth test	P	2021-10-06	8
Occupied bandwidth test	P	2021-01-19	5

SECTION 6
INFORMATION ABOUT THE EUT

6.1 Description of the EUT

Device tested as:			
☒ table-top EUT		☐ floor-standing EUT	
Dimensions:	Height:	Width:	Length:
	127.1 mm	151.1 mm	24.7 mm
Firmware version:	Special Firmware for EMC Testing		
Hardware version:	4.1		
EUT version:	☒ Production	☐ Prototype	☐ Used
Description: The GT7.2700 is a Multi-functional RFID terminal with LEGIC advant, Proxy and iCLASS® Reader. It has a Color display with Touchscreen, Ethernet, PoE, 1 relay output and 1 status input. The EUT has a Bluetooth module, 13.56 MHz RFID module and 125 kHz RFID module.			

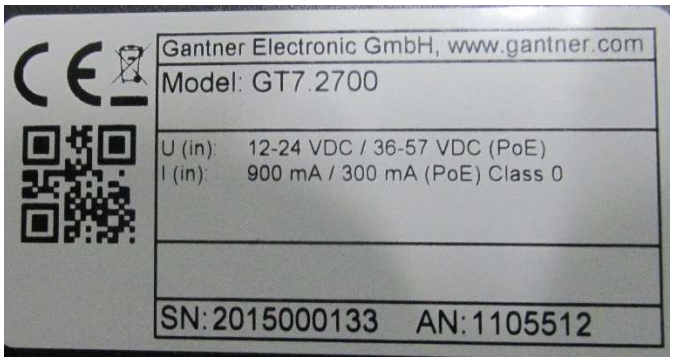
6.1.1 Technical data of the 13.56 MHz-RFID module

Transmitter frequency range: 13.56 MHz

Frequency agile or hopping:	☐ Yes	☒ No
Antenna:	☒ Internal antenna	☐ External antenna
Antenna connector:	☒ None, internal antenna	☐ Yes, type
Antenna type:	Internal PCB antenna	
Antenna gain:	-	
Power rating:	-	
Channel spacing:	-	
Receiving only mode supported:	☐ Yes	☒ No

6.1.2 Photo of the rating plate and of the EUT

GT7.2700



6.2 Power interface

MODE	VOLTAGE (V)	FREQUENCY (Hz)	COMMENT
Rated	36-57	DC	PoE
1	120 V (AC) / 48 V (DC)	(60Hz)AC/DC	PoE Injector

6.3 Peripheral devices used for testing

DEVICE	MANUFACTURER	TYPE	SN	FCC ID
PoE Injector	tP-link	TL-POE150S	22040D6006214	-
Power supply for PoE Injector	tP-link	T480050-2C1	-	-
Notebook	HP	HP ProBook 6560b	5CB20246BZ	QDS-BRCM 1043

6.4 Configuration mode

MODE	DESCRIPTION
1	The EUT was placed on the table and was connected to PoE Injector (see section 6.9).
2	The EUT was placed on the table and was connected to PoE Injector (see section 6.10).
3	The EUT was in the climatic chamber and was connected to PoE Injector (see section 6.11).

6.5 Operation mode

MODE	DESCRIPTION
1	Normal operation and the 13.56 MHz RFID module of the EUT was in continuous wave mode. The 125 kHz RFID module and the Bluetooth module were off. The RFID tag was placed in front of the EUT.
2	Normal operation. The antenna of the 125 kHz RFID module and the antenna of the 13.56 MHz RFID module were replaced by a terminating resistor. The Bluetooth module was off.
3	Normal operation. The 13.56 MHz RFID module was in transmission mode and the RFID tag was placed in front of the EUT. The Bluetooth module and 125 kHz RFID module were off.

6.6 Clock frequencies of the EUT

SOURCE	FREQUENCY
Processor module ICNova A20	PII Main Processor: up to 1 GHz; 3 Crystals: 25 MHz, 24 MHz and 32 kHz
RFID Reader 13.56 MHz	SPI @ 2 MHz
RFID Reader 125 kHz	UART 112 kbit
Co-Processor STM32L0	Crystal: 32 kHz
TFT Display	24Bit RGB, 9 MHz
Capacitive Touch Panel	I2C @ 400 kHz
Bluetooth	2402 GHz – 2480 GHz

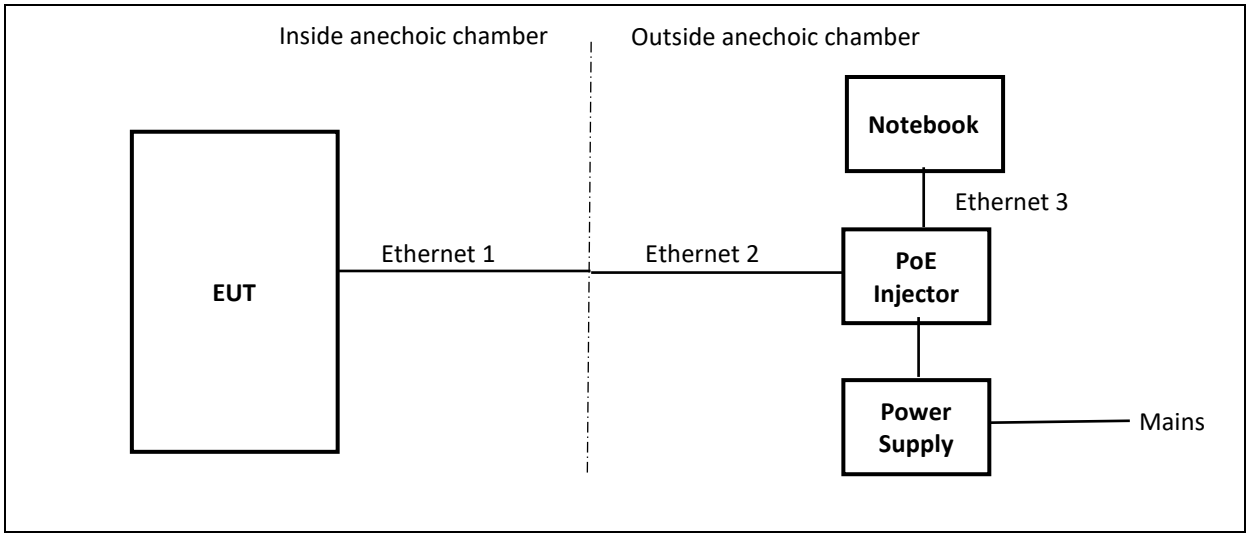
6.7 Supply and interconnecting cables used for testing

LINE	LENGTH (cm)	SHIELDING	FERRITE	TERMINATION
Ethernet 1	180	Y	N	-
Ethernet 2	100	Y	N	-
Ethernet 3	100	Y	N	-
Cable for power supply	160	N	N	-

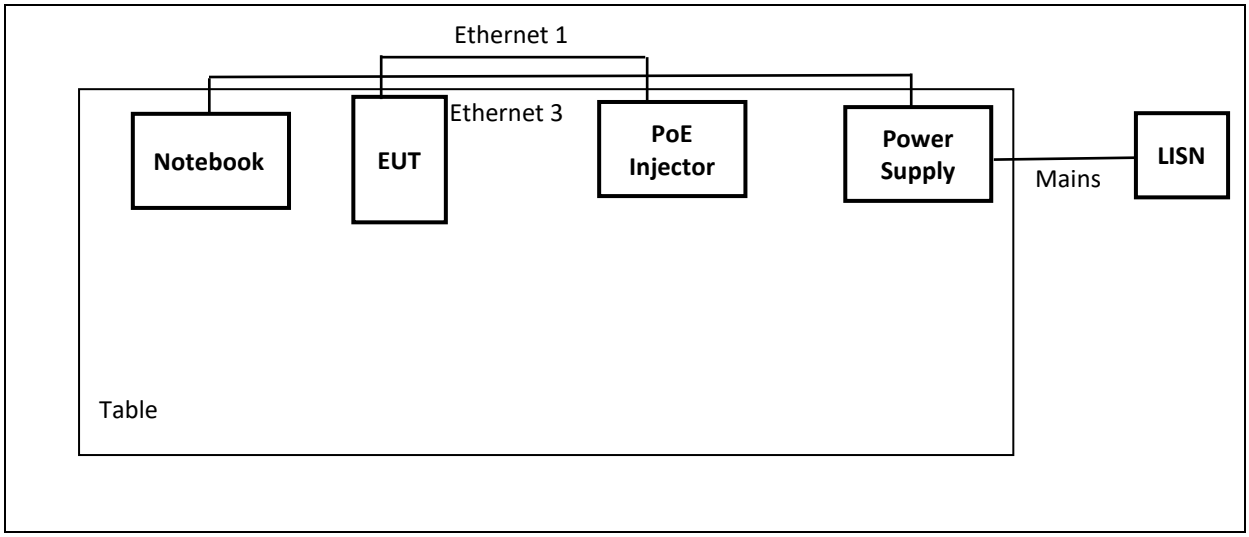
6.8 Antenna configuration

	DESCRIPTION
☐	Equipment with an external antenna connector
☒	Equipment without an external antenna connector (integral antenna)
☐	Equipment with more than one antenna

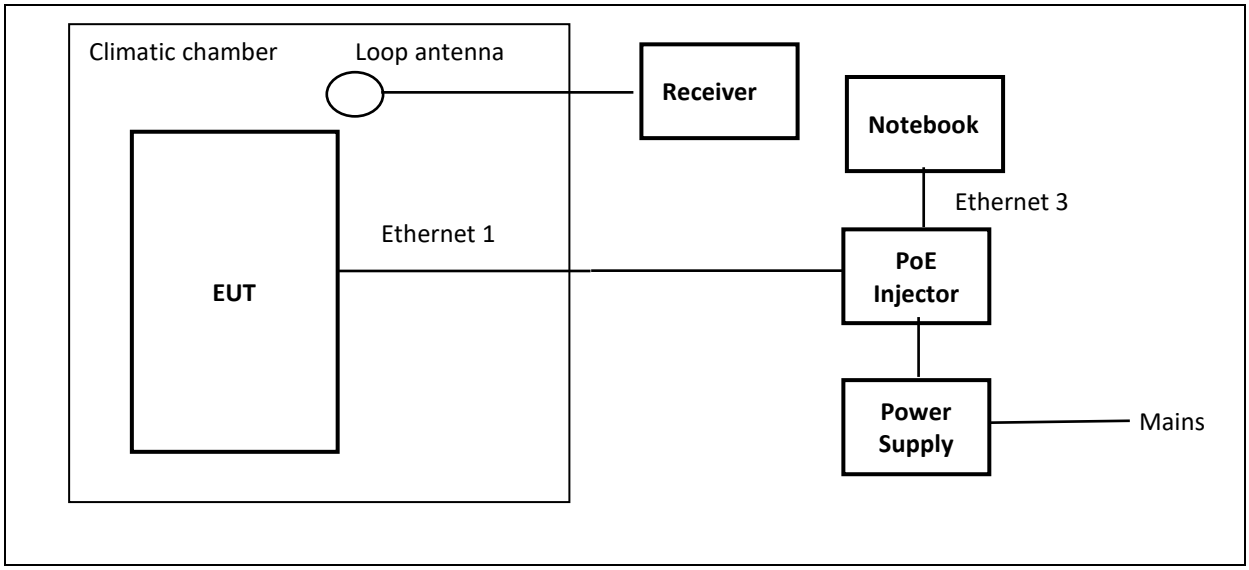
6.9 Block diagram of the test setup for radiated emissions (configuration mode 1)



6.10 Block diagram of the test setup for conducted emissions (configuration mode 2)



6.11 Block diagram of the test setup for 20 dB bandwidth-, Occupied bandwidth- and Frequency Stability-test (configuration mode 3)



SECTION 7

7.1 Conducted emissions

NORMATIVE REFERENCES			RESULT
Limits according to:	**FCC §15.207** **RSS-210, Issue 10**		**P**
Methods of measurement according to:	**ANSI C63.10** **RSS-Gen, Issue 5**		
Equipment mode	Power interface	1	
	EUT configuration mode	2	
	Operation mode	1 and 2	
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	2020-12 (1 year)
Receiver 9 kHz - 7 GHz	Rohde & Schwarz	ESR7	101757	PM KF 3371	2020-04 (1 year) 2021-04 (1 year)
V-Artificial mains-network, 2 Line	Rohde & Schwarz	ESH3-Z5	863367/018	PM KF 0142	2019-10 (2 years)
Test software	Rohde & Schwarz	EMC 32 V.8.54	-	PM KF 2983	-

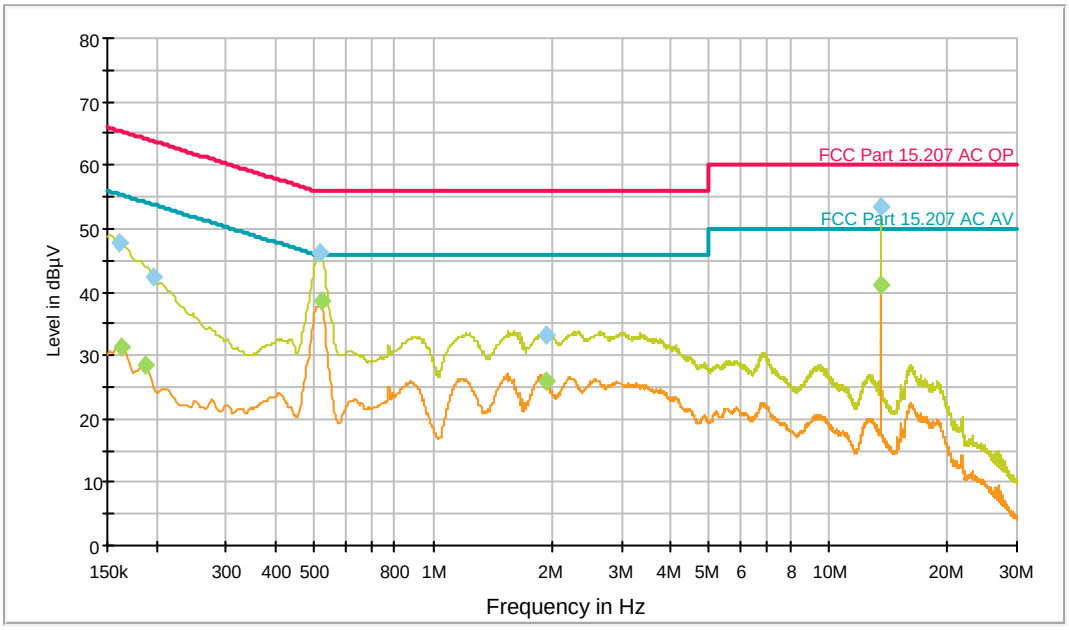
Comment
In the following diagram, the N and L line are merged.

Measurement results – Conducted emissions:

Common Information

EUT:	GT7.2700
Project No.:	41159
Test description:	Conducted Emissions
Test standard:	FCC 15 C
Tested port:	Mains
Test verdict:	Passed
Operating conditions:	Normal operation and the 13.56 MHz RFID module of the EUT was in continuous wave mode. The 125 kHz RFID module and the Bluetooth module were off. The RFID tag was placed in front of the EUT.
Operator name:	MBE
Date of testing:	29.05.2021

EN-CE-R32-LN01



FCC Part 15.207 AC QP [..\EMI conducted\FCC Part 15 Subpart C\]
FCC Part 15.207 AC AV [..\EMI conducted\FCC Part 15 Subpart C\]
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
0.161250	47.9	GND	L1	10.2	17.5	65.4	
0.197250	42.3	GND	L1	10.2	21.5	63.7	
0.514500	46.1	GND	N	10.2	9.9	56.0	
1.932000	33.3	GND	N	10.2	22.7	56.0	
13.560000	53.5	GND	N	10.7	6.5	60.0	

Final Result 2

Frequency (MHz)	CAverage-ClearWrite (dBµV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.163500	31.4	GND	L1	10.2	23.8	55.3	
0.188250	28.4	GND	L1	10.2	25.7	54.1	
0.521250	38.4	GND	N	10.2	7.6	46.0	
1.927500	25.9	GND	N	10.2	20.1	46.0	
13.560000	41.1	GND	N	10.7	8.9	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]

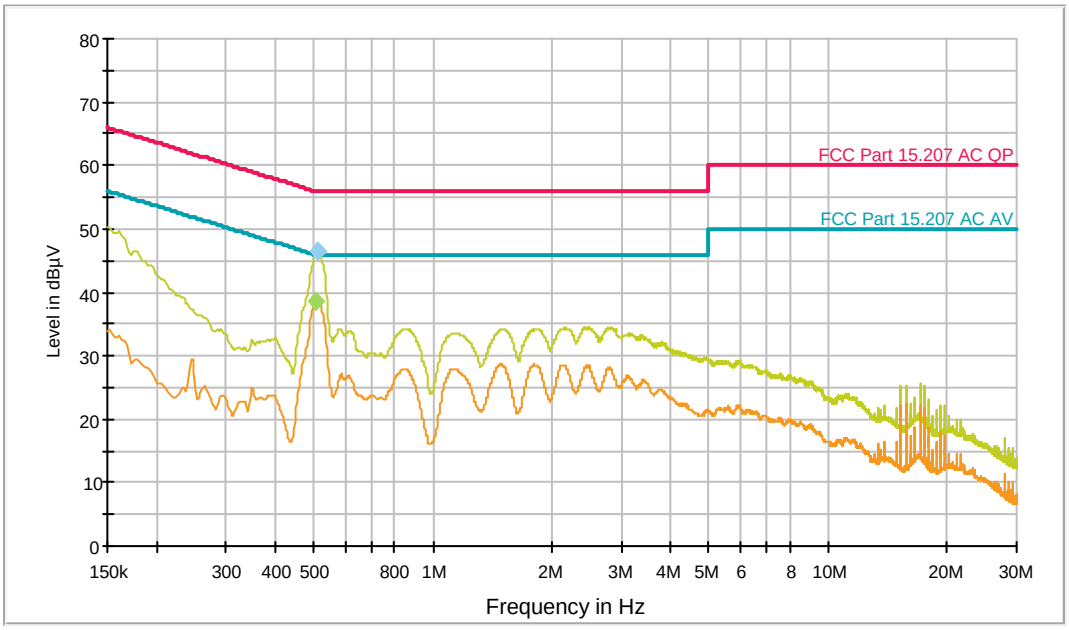
Data Reduction:
Limit Line #1: FCC Part 15.207 AC QP
Limit Line #2: FCC Part 15.207 AC AV
Peak Search: 6 dB , Maximum Results: 10
Subrange Maxima: 10 Subranges , Maxima per Subrange: 1
Acceptance Offset: -10 dB
Maximum Number of Results: 20
After Data Reduction: Interactive data reduction

Report Settings:
Report Template: Standard Report_EMC KF_Conducted Emission

Common Information

EUT:	GT7.2700
Project No.:	41159
Test description:	Conducted Emissions
Test standard:	FCC 15 C
Tested port:	Mains
Test verdict:	Passed
Operating conditions:	The antenna of the 125 kHz RFID module and the antenna of the 13.56 MHz RFID module were replaced by a terminating resistor.
Operator name:	MBE
Date of testing:	25.01.2021

EN-CE-R32-LN01



FCC Part 15.207 AC QP [..\EMI conducted\FCC Part 15 Subpart C\]
FCC Part 15.207 AC AV [..\EMI conducted\FCC Part 15 Subpart C\]
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
0.510000	46.6	GND	N	10.2	9.4	56.0	

Final Result 2

Frequency (MHz)	CAverage-ClearWrite (dBµV)	PE	Line	Corr. (dB)	Margin (dB)	Limit (dBµV)	Comment
0.505500	38.7	GND	N	10.2	7.3	46.0	

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 15.207 AC QP
Limit Line #2: FCC Part 15.207 AC AV
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.

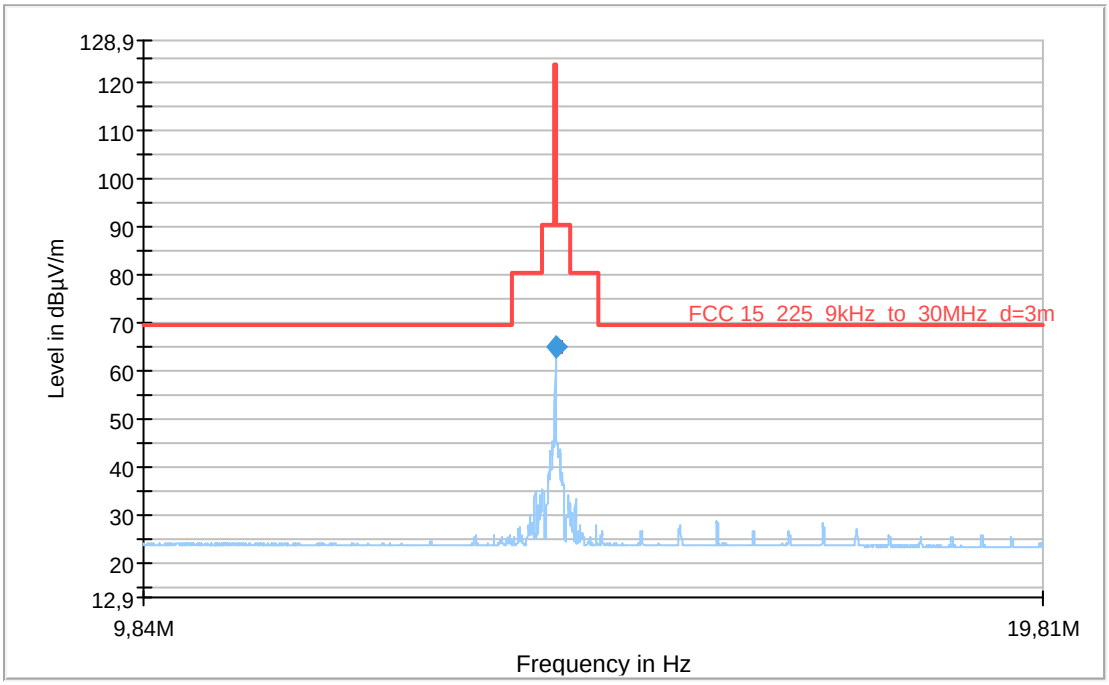
Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber (30 – 1000 MHz)	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	2020-08 (1 years)
Test software	Rohde & Schwarz	EMC 32 V.10.50.40	-	PM KF 2983-2	-

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

Common Information

EUT:	GT7.2700
Test Verdict:	Passed
Test Description:	FCC Part 15 C, 9 kHz - 30 MHz
Operating Conditions:	Normal operation and the 13.56 MHz RFID module of the EUT was in continuous wave mode. The 125 kHz RFID module and the Bluetooth module were off.
Operator Name:	MBE
Project Number:	41159
Date	30.12.2020



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_d=3m [..\zF radiated\FCC Part 15C\]
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)
13.557750	65.23	---	124.00	58.77	1000.0	9.000	V	176.0

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

Frequency (MHz)	Corr. (dB/m)	Comment
13.557750	20	-

Comment
The 13.56 MHz RFID transmitter was operated in CW mode. Therefore, the bandwidth of the transmitting signal is smaller than the measuring bandwidth of the measuring receiver. Thus, a measurement with a larger measurement bandwidth was not necessary.

EMI Auto Test Template: FCC-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 - 352 deg , Step Size = 22 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.

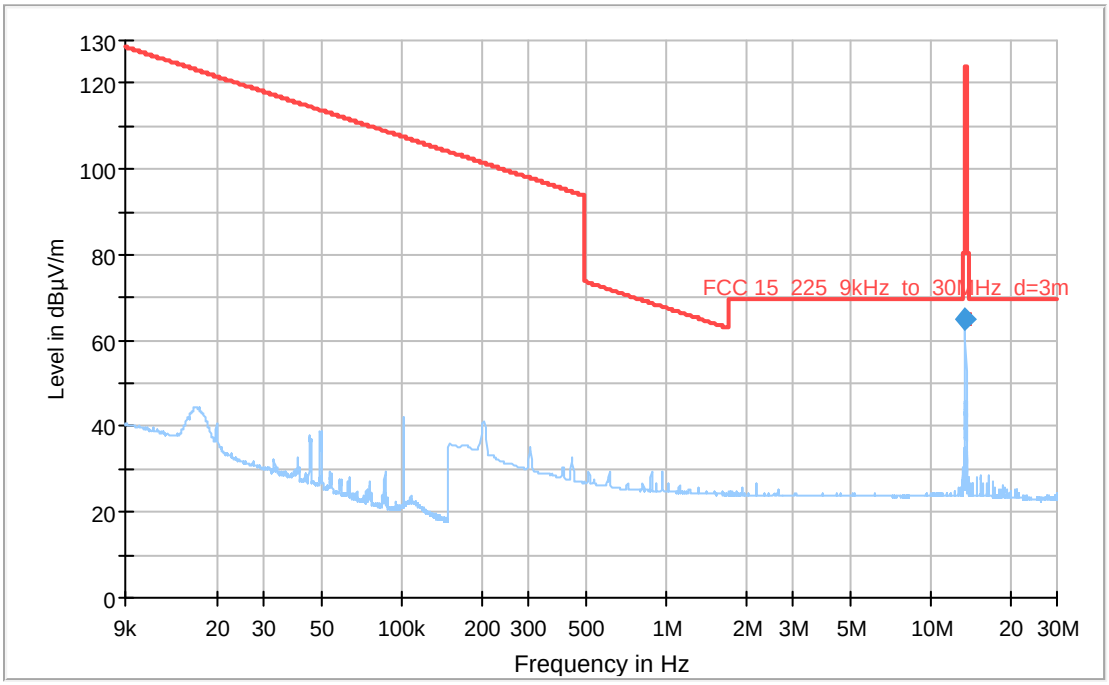
Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber (30 – 1000 MHz)	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	2020-08 (1 years)
Test software	Rohde & Schwarz	EMC 32 V.10.50.40	-	PM KF 2983-2	-

Measurement results – Radiated emissions < 30 MHz:

Common Information

EUT:	GT7.2700
Test Verdict:	Passed
Test Description:	FCC Part 15 C, 9kHz - 30 MHz
Operating Conditions:	Normal operation and the 13.56 MHz RFID module of the EUT was in continuous wave mode. The 125 kHz RFID module and the Bluetooth module were off.
Operator Name:	MBE
Project Number:	41159
Date	30.12.2020



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_d=3m [..\zF radiated\FCC Part 15C\]
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)
13.557750	65.23	---	124.00	58.77	1000.0	9.000	V	176.0

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

Frequency (MHz)	Corr. (dB/m)	Comment
13.557750	20	17:00:01 - 30.12.2020

Comment
The 13.56 MHz RFID transmitter was operated in CW mode. Therefore, the bandwidth of the transmitting signal is smaller than the measuring bandwidth of the measuring receiver. Thus, a measurement with a larger measurement bandwidth was not necessary.

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

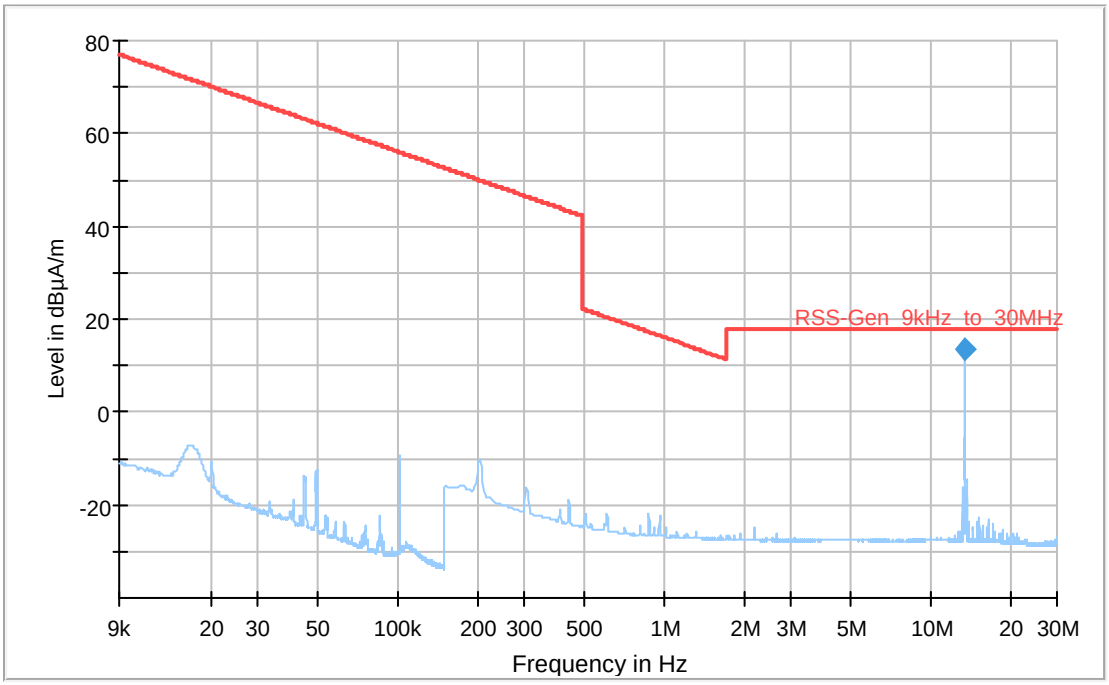
Hardware Setup: EN-RE-R12-AN23
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 9 kHz - 30 MHz
Graphics Level Range: 0 dBµV/m - 130 dBµV/m

Preview Measurements:
Antenna height: 0 - 1000 cm , Step Size = 0 cm , Positioning Speed = 1
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 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

Common Information

EUT:	GT7.2700
Test Verdict:	Passed
Test Description:	RSS-Gen, 9 kHz - 30 MHz
Operating Conditions:	Normal operation and the 13.56 MHz RFID module of the EUT was in continuous wave mode. The 125 kHz RFID module and the Bluetooth module were off.
Operator Name:	MBE
Project Number:	41159
Date	30.12.2020



Preview Result 1-QPK [Preview Result 1.Result:1]
RSS-Gen_9kHz_to_30MHz [..\zF radiated\RSS-Gen\]
QPK [Critical_Freqs.Result:4]
AVG [Critical_Freqs.Result:5]
Final_Result QPK [Final_Result.Result:4]
Final_Result AVG [Final_Result.Result:5]

Final_Result

Frequency (MHz)	QuasiPeak (dBµA/m)	Average (dBµA/m)	Limit (dBµA/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)
13.557750	13.73	---	18.04	4.31	1000.0	9.000	V	176.0

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

Frequency (MHz)	Corr. (dB/m)	Comment
13.557750	20.0	30.12.2020 17:00

EMI Auto Test Template: EN-RE-R17-AN24

Hardware Setup: EN-RE-R12-AN24
Measurement Type: Open-Area-Test-Site (SAC/FAR)
Frequency Range: 9 kHz - 30 MHz
Graphics Level Range: -40 dBµA/m - 80 dBµA/m

Preview Measurements:
Antenna height: 0 - 1000 cm , Step Size = 0 cm , Positioning Speed = 1
Polarization: H + V
Turntable position: 0 - 352 deg , Step Size = 22 deg , Positioning Speed = 8
Scan Test Template: EN-RE-R12-AN24_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.

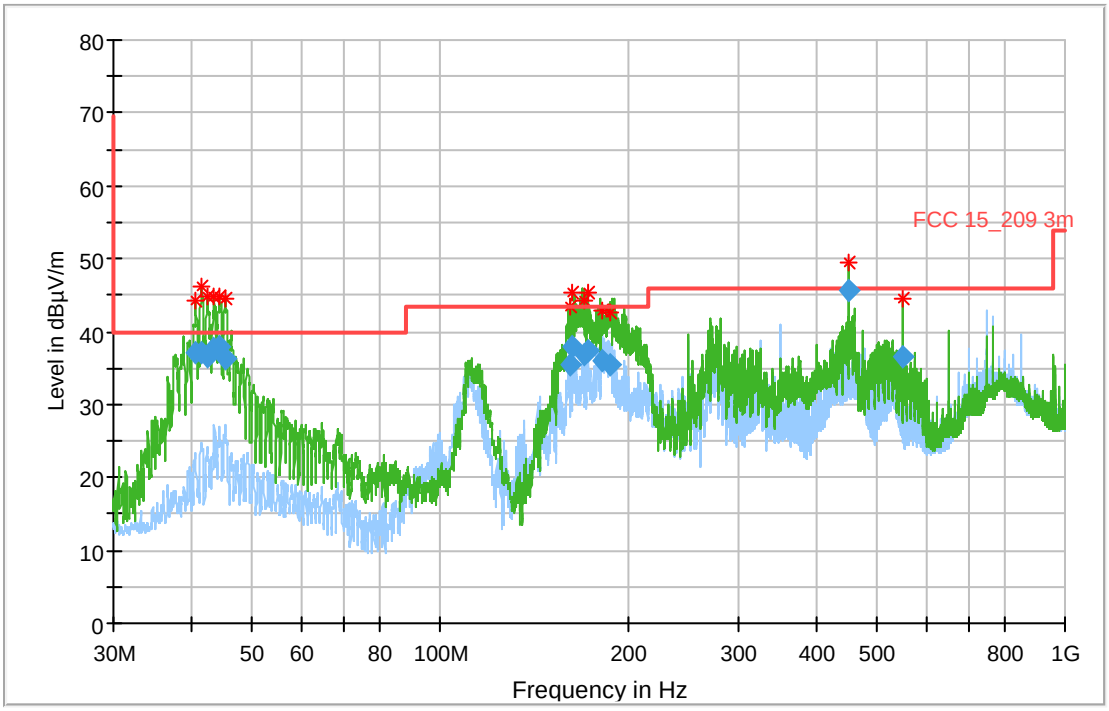
Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Semi-Anechoic chamber (30 – 1000 MHz)	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)
Trilog broadband antenna	Schwarzbeck	VULB 9163	9163-974	PM KF 3196	2019-01 (2 years)
Test software	Rohde & Schwarz	EMC 32 V.10.50.40	-	PM KF 2983-2	-

Measurement results – Radiated emissions 30 MHz to 1 GHz:

Common Information

EUT:	GT7.2700
Test Verdict:	Passed
Test Description:	FCC Part 15 C, 30 MHz - 1 GHz
Operating Conditions:	Normal operation and the 13.56 MHz RFID module of the EUT was in continuous wave mode. The 125 kHz RFID module and the Bluetooth module were off.
Operator Name:	MBE
Project Number:	41159
Date	30.12.2020



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)	Corr. (dB/m)
40.680000	37.11	40.00	2.89	1000.0	120.000	100.0	V	102.0	14
41.550000	37.19	40.00	2.81	1000.0	120.000	100.0	V	54.0	14
42.360000	36.55	40.00	3.45	1000.0	120.000	100.0	V	139.0	14
43.500000	37.63	40.00	2.37	1000.0	120.000	103.0	V	307.0	14
44.400000	37.82	40.00	2.18	1000.0	120.000	100.0	V	117.0	14
45.270000	36.39	40.00	3.61	1000.0	120.000	114.0	V	120.0	14
161.010000	35.60	43.52	7.92	1000.0	120.000	100.0	V	-7.0	9
162.990000	38.02	43.52	5.50	1000.0	120.000	100.0	V	32.0	10
170.010000	36.95	43.52	6.57	1000.0	120.000	100.0	V	41.0	10
171.960000	37.47	43.52	6.05	1000.0	120.000	100.0	V	41.0	10
181.560000	35.97	43.52	7.55	1000.0	120.000	103.0	V	286.0	11
187.440000	35.40	43.52	8.12	1000.0	120.000	100.0	V	20.0	12
450.000000	45.73	46.02	0.29	1000.0	120.000	109.0	V	218.0	18
549.990000	36.70	46.02	9.32	1000.0	120.000	119.0	V	333.0	20

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

Frequency (MHz)	Corr. (dB/m)	Comment
40.680000	**14**	**RFID**
41.550000	**14**	**-**
42.360000	**14**	**-**
43.500000	**14**	**-**
44.400000	**14**	**-**
45.270000	**14**	**-**
161.010000	**9**	**-**
162.990000	**10**	**-**
170.010000	**10**	**-**
171.960000	**10**	**-**
181.560000	**11**	**-**
187.440000	**12**	**-**
450.000000	**18**	**-**
549.990000	**20**	**-**

Comment

The source of the frequency 40.68 MHz is only the radio part of the device and of the 13.56 MHz RFID module. The other frequencies are excluded from the evaluation and must be evaluated according to FCC Part 15B, class A and ICES-003, class A.

EMI Auto Test Template: FCC-RE-R17-AN34

Hardware Setup: EN-RE-R17-AN34
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-R17-AN34_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-R17-AN34_ZOOM

Adjustment:
- Antenna height: Range = 180 cm , Measuring Speed = 1
- Turntable position: Range = 60 deg , Measuring Speed = 2
- Template for Single Meas.: EN-RE-R17-AN34_ADJ

Final Measurements:
- Template for Single Meas.: EN-RE-R17-AN34_FIN_15s

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
Receiver: [ESR 7]					
30 MHz - 200 MHz	40 kHz	QPK	120 kHz	1 s	20 dB
200 MHz - 1 GHz	40 kHz	QPK	120 kHz	1 s	20 dB
1 GHz - 3 GHz	400 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 5, section 6.11**		**P**
Methods of measurement according to:	**ANSI C63.10, section 9.14**		
Equipment mode	Power interface	1	
	EUT configuration mode	3	
	Operation mode	3	

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 for the RFID module:	-20 degree to + 60 degree
Voltage range:	0.85 x 120 V and 1.15*120 V

Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Temperature Chamber	HT4010	Heraeus-Vötsch	45021	PM KF 1402	2020-03 (1 year)
Receiver 10 Hz - 40 GHz	Rohde & Schwarz	FSV40	101400	PM KF 2783	2020-08 (1 year)
Loop antenna	Rohde & Schwarz	HZ-10	100055	PM KF 0965	2020-05 (3 year)

Measurement results – Frequency stability measurement:

Temperature °C	Carrier at 20°C MHz	Upper limit: 13.561356 MHz
		Lower limit: 13.558644 MHz
		Measured frequency under temperature influence:
+60	13.55988	13.56004
+50		13.55995
+40		13.55989
+30		13.55985
+20		13.55988
+10		13.55994
0		13.56009
-10		13.56003
-20		13.56013

Comment

The EUT was supplied with the power supply unit.
The AC supply voltage was varied from 102 to 138 V.
The voltage variations had no influence on the transmission level.

Voltage V	Temperature	Upper limit: 13.561356 MHz
		Lower limit: 13.558644 MHz
		Measured frequency under AC supply voltage variation:
102	20°C	13.55988
138		13.55988

7.6 20 dB bandwidth

NORMATIVE REFERENCES			RESULT
Limits according to:	**FCC §15.115 (c)**		**P**
Methods of measurement according to:	**RSS-Gen, Issue 5, 6.7**		
Equipment mode	Power interface	1	
	EUT configuration mode	3	
	Operation mode	3	

Limits

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

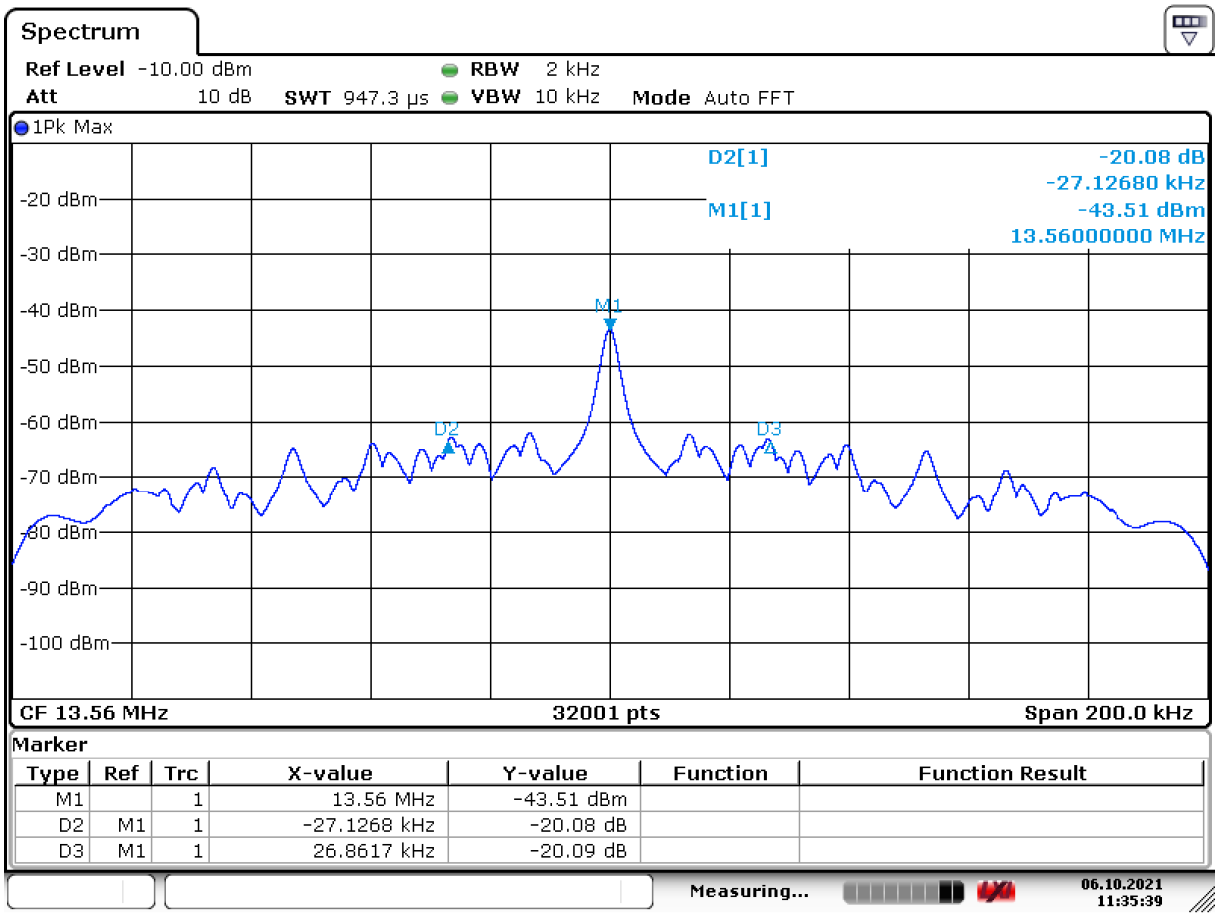
Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Receiver 10 Hz - 40 GHz	Rohde & Schwarz	FSV40	101400	PM KF 2783	2021-08 (1 year)
Loop antenna	Rohde & Schwarz	HZ-10	100055	PM KF 0965	2020-05 (3 year)

Comment

The 20-bandwidth is 53.9885 kHz.

Measurement results – 20 dB bandwidth:



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7.7 Occupied bandwidth

NORMATIVE REFERENCES			RESULT
Limits according to:	**RSS-Gen, Issue 5, 6.7**		**P**
Methods of measurement according to:	**RSS-Gen, Issue 5, 6.7**		
Equipment mode	Power interface	1	
	EUT configuration mode	3	
	Operation mode	3	

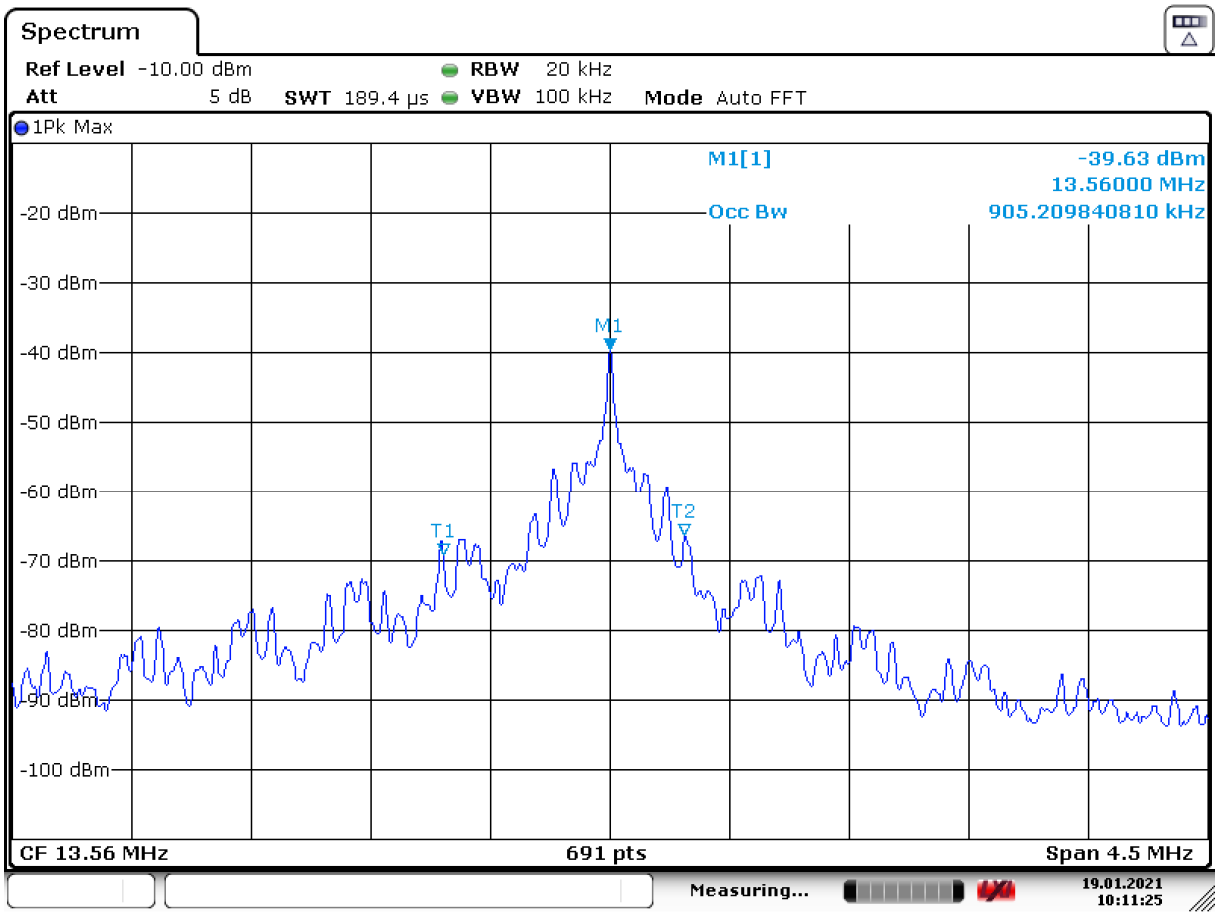
Test equipment

DESCRIPTION	MANUFACTURER	TYPE	SN	ASSET NO.	CALIBRATION
Temperature Chamber	HT4010	Heraeus-Vötsch	45021	PM KF 1402	2020-03 (1 year)
Receiver 10 Hz - 40 GHz	Rohde & Schwarz	FSV40	101400	PM KF 2783	2020-08 (1 year)
Loop antenna	Rohde & Schwarz	HZ-10	100055	PM KF 0965	2020-05 (3 year)

Comment

The 99% occupied bandwidth is 905.21 kHz.

Measurement results – 99% occupied bandwidth:



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7.8 Measurement uncertainty evaluation

Measurement uncertainty for conducted emissions, LISN, 150 kHz -30 MHz	± 2.3 dB
Measurement uncertainty for radiated magnetic field, 9 kHz – 30 MHz	± 4.9 dB
Measurement uncertainty for radiated emission, 30 MHz - 1000 MHz	± 5.9 dB
Measurement uncertainty for OBW	± 4.3 %
601 points resolution (Spectrum analyzer)	± 0.83 %
30000 points resolution (Spectrum analyzer)	± 0.016 %
Measurement uncertainty for Frequency error	± 1 x 10^{-8}

End of test report