Test report

ACO13_02

Product / EUT:	ISM entry module
Type designation:	ISM Online Zugangsmodul KH 12-48 V
Tested type:	ISM Online Zugangsmodul KH 12-48 V
EUT authorization:	☒ Certification ☐ Declaration of Conformity ☐ Verification
Production level:	03/2017
S/N:	12ABCDEF
Manufacturer:	ACD Elektronik GmbH Engelberg 2 88480 Achstetten / Germany
Test remit:	FCC Rules 47 CFR Part 15 – Subpart C – Intentional radiators in accordance with the procedures given in §15.207; 15.209; 15.225
The standards were:	☒ kept* ☐ not kept*
***Remark:**	☒ Validation covered by the accredited scope ☐ Validation not covered by the accredited scope according:_____ ☐ Validation of the EMC-requirements partly proceeded
Applicant:	ACD Elektronik GmbH Engelberg 2 88480 Achstetten / Germany
EUT-	
Date of arrival:	2017-03-06
Test ID:	PRO10_03
Date(s) of test:	2017-03-06; 2017-03-28

Burgrieden, 2017-05-16

Released by:

Principal engineer - Christian Vogelmann

Test laboratory:	☒ EMCE GmbH Ingenieurbüro für EMV-Prüfungen und Schaltungsentwicklung Untere Wiesen 1 / 88483 Burgrieden / Germany DAkkS-Registration No.: D-PL-12122-01-01 D-PL-12122-01-02 CAB-Registration No.: BnetzA-CAB-02/21-01/1 FCC-Registration No.: 219415
Responsible inspector:	Mr. Hauser EMCE GmbH Ingenieurbüro für EMV-Prüfungen und Schaltungsentwicklung
Contact person:	Mr. Schmid / ACD Elektronik GmbH
EUT-	
Description:	13.56 MHz RFID access module with CAN and V24 I/F.
Voltage supply:	12-48 VDC
Frequency list:	32 kHz; 4 MHz; 13.56 MHz; 16 MHz
Temperature range:	-30 °C to 70 °C
Approximate size:	(LxWxH) / mm - 73 x 67 x 67

Supplied / used equipment:

Designation	Type	Manufacturer	S/N
Power supply EUT	PA1131-02D	Dell	CN-09Y819-48010-36H-0043
Power supply laptop	PA-12	Dell	CN-0N6M89-48661-1C4-LBHS-A02
Laptop	Latitude E5530	Dell	N/a
Tag	13.56 MHz	N/a	F604BEC4
USB/CAN Adapter	PCAN USB I/F	Peak	IPEH-00202171028

Configuration: ☐ As-delivered condition*
☒ Modified*
* The conducted emission test was performed with loop antenna disconnected and antenna output terminated.

Cable designation	Type	Length	Remarks
AC power cable	3 wire	180 cm	n/a
DC power cable	2 wire	150 cm	n/a
CAN cable	Shielded	150 cm	n/a
V24 cable	Single wires	35 cm	n/a

Remarks: n/a

State of revision:

Source document	New Document	Date / Reviser	Modifications

Test equipment list of EMCE GmbH:

Inv.-No.	Designation	Type	Manufacturer	S/N	Calibration: Interval /valid until
001	Test receiver	ESS 5Hz - 1000MHz	Rohde & Schwarz	833776/008 Firmware: Main: 1.21 OTP: 02.01 GRA: 02.03	1 Year(s)/ 2017-10-31
003	LISN 1	ESH3-Z5	Rohde & Schwarz	835268/007	1 Year(s)/ 2017-08-31
004	LISN 2	ESH3-Z5	Rohde & Schwarz	835268/003	1 Year(s)/ 2017-08-31
007	Absorbing clamp	MDS 21	Schwarzbeck	942436	2 Year(s)/ 2017-06-08
008	Loop antenna 9kHz-30MHz	HFH2-Z2	Rohde & Schwarz	835776/0002	3 Year(s)/ 2019-11-25
009	Antenna 30-300MHz	VHBA9123 / BBA9106	Schwarzbeck	435	3 Year(s)/ 2018-10-27
010	Antenna 250-1200MHz	UHALP 9108A	Schwarzbeck	108	2 Year(s)/ 2018-11-04
011	Antenna 30-300MHz	VHBA9123 / BBA9106	Schwarzbeck	0403/94	2 Year(s)/ 2018-11-04
012	Antenna 250-1200MHz	UHALP 9108A	Schwarzbeck	166	3 Year(s)/ 2018-11-10
013	Antenna 9kHz-30MHz	Ø 1.5m	EMCE GmbH		1 Year(s)/ 2017-08-31
014	OATS	3m	EMCE GmbH		1 Year(s)/ 2017-08-31
015	OATS	10m	EMCE GmbH		1 Year(s)/ 2017-08-31
058	Receiver	ESIB 40	Rohde & Schwarz	100200/ Firmware 4.35	1 Year(s)/ 2017-07-07
059	Log.-per. antenna	HL050	Rohde & Schwarz	100006	3 Year(s)/ 2018-03-10
067	LISN	ESH2-Z5	Rohde & Schwarz	872460/043	1 Year(s)/ 2017-08-30
068	LISN	ESH2-Z5	Rohde & Schwarz	872460/042	1 Year(s)/ 2017-08-31
070	Pulse limiter + 10dB Attenuator	ESH3-Z2	Rohde & Schwarz	n/a	1 Year(s)/ 2017-08-31
073	Absorbing clamp	MDS21	Schwarzbeck	881757	2 Year(s)/ 2018-07-15
116	Vertical rod antenna	VAMP 9243	Schwarzbeck	9243-205	3 Year(s)/ 2020-01-20

Inv.-No.	Designation	Type	Manufacturer	S/N	Calibration: Interval /valid until
175	EMI Test receiver	ESR7	Rohde & Schwarz	101108 Firmware: FW V2.26	1 Year(s)/ 2017-07-20
224	SMB100A Signal Generator	SMB100A	Rohde & Schwarz	108055	3 Year(s)/ 2019-11-07

Scope:

1 EMC-Test(s)

1.1 Emission according 47 CFR Part 15 Subpart C - 03/24/2017

1.1.1 Terminal voltage according 47 CFR Part 15 Subpart C - 03/24/2017

☒ Full compliance
☐ Precompliance
☐ Test not requested*
☐ Test not carried out*

*

Test location

☒	Inv.-No.	Designation	Type (L x W x H)	Manufacturer	Location
☒	588	Shielded room # 2	8.3/5.8 x 5.5/2.9 x 3.4 m	EMC-Technik & Consulting GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	584	Shielded room # 3	3.6 x 3.6 x 2.5 m	Siemens AG	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	678	Shielded room # 4	4.0 x 4.0 x 3.5 m	EMC-Technik & Consulting GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	062	Semi anechoic chamber # 2	13.5 x 6.1 x 5.5 m	EMC-Technik & Consulting GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	679	Full anechoic chamber # 3	8.8 x 4.6 x 4.2 m	Albatross Projects GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	014	Open area test site	10 m	EMCE GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	015	Open area test site	3 m	EMCE GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	042	Voltage- / current source test site	0-382VDC 0-270VAC 1 x 10 kW/3 x 5 kW	Spitzenberger + Spies	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	n/a	Alternative test site	n/a	n/a	n/a

1.1.1.1 Test set up

According ANSI C63.4-2003

Used test equipment

☒	Inv.-No.	Designation	Type	Manufacturer	S/N
☒	001	Test receiver	ESS 5 Hz – 1000 MHz	Rohde & Schwarz	833776/008
	002	Probe	ESH2-Z3	Rohde & Schwarz	
	003	LISN 1	ESH3-Z5	Rohde & Schwarz	835268/007
	004	LISN 2	ESH3-Z5	Rohde & Schwarz	835268/003
	005	LISN 3	NNB 4/32T	Rolf Heine HF-Technik	4/32T-96015
	006	LISN	NNBM 8125	Schwarzbeck	8125371
	007	Absorbing clamp	MDS 21	Schwarzbeck	942436
	025	Current clamp BCI	F-120-2	FCC	47
	026	Coupling device network	CDN 801-M3-25	FCC	92
	030	Coupling device network	CDN-S9	EMCE GmbH	
	031	Coupling device network	CDN-S9	EMCE GmbH	
	036	Coupling device network	CDN-M5-25	EMCE GmbH	
	037	Coupling device network	CDN-S1	EMCE GmbH	
☒	042	AC-Source / Analyser / Norm impedance	EMV D5000/PAS	Spitzenberger + Spies	A274700/ 0 0501
	058	Test receiver	ESIB 40	Rohde & Schwarz	100200
	060	HF-coupling clamp	KEMA 801	Schaffner	20808
☒	067	LISN 5	ESH2-Z5	Rohde & Schwarz	0872460/043
☒	068	LISN 4	ESH2-Z5	Rohde & Schwarz	0872460/042
	073	Absorbing clamp	MDS 21	Schwarzbeck	881757

All used test equipment are checked resp. calibrated periodically.

☒ Test equipment was checked and complied to the requirements

Test/Measurement uncertainty

The measurement uncertainty in the test met the guideline of CISPR16-4-2 or better.

Measurement uncertainty of the terminal voltage with an extended coverage factor of k = 2:

Frequency	Measurement uncertainty
9 kHz – 150 kHz	4.0 dB
150 kHz – 30 MHz	3.6 dB

1.1.1.2 Test

Regulation

47 CFR Part 15 Subpart C - 03/24/2017

☐ 9 kHz – 30 MHz ☒ 150 kHz – 30 MHz

Mains supply
Limits: ☒ Section 15.207 ☐ __

Operation mode

EUT arrangement:	☒ Tabletop	☐ Floor standing
Power supply:	☒ 120 V/60 Hz	☐ 240 V/60 Hz
Rated voltage variation:	☐ 85 %	☐ 115 %

Port #	Designation	Remarks
# 1	AC power line - EUT	L1/N/PE
# 2	AC power line – Laptop	L1/N/PE
# 3		

Continuous operation, the EUT was supplied with the desktop power supply, the internal loop antenna was disconnected and the terminal terminated. CAN and V24 I/F active with data transmission.

Environmental conditions

Temperature:	15 – 35 °C
Humidity:	30 – 60 %
Air pressure:	860 – 1060 hPa

Environmental conditions during the test: ☒ kept ☐ not kept

Test - / Measurement procedure

Measurements are made with a receiver according CISPR guidelines. The required frequency range is scanned in an automatically operation. If the emanation is closer than 6 dB to the limits or more, the receiver will stop and measure the exact value with quasipeak or average detector. The frequency, the maximum reading and the limit will be printed out.

Test result

Limits for continuous disturbances: ☒ kept ☐ not kept

Remarks: n/a

Protocol scope

☒ Readings - continuous emanation
☒ Diagram - continuous emanation

EMCE GmbH Ing_buero fuer EMV_Pruefungen

28. Mar 17 10:05

Terminal voltage

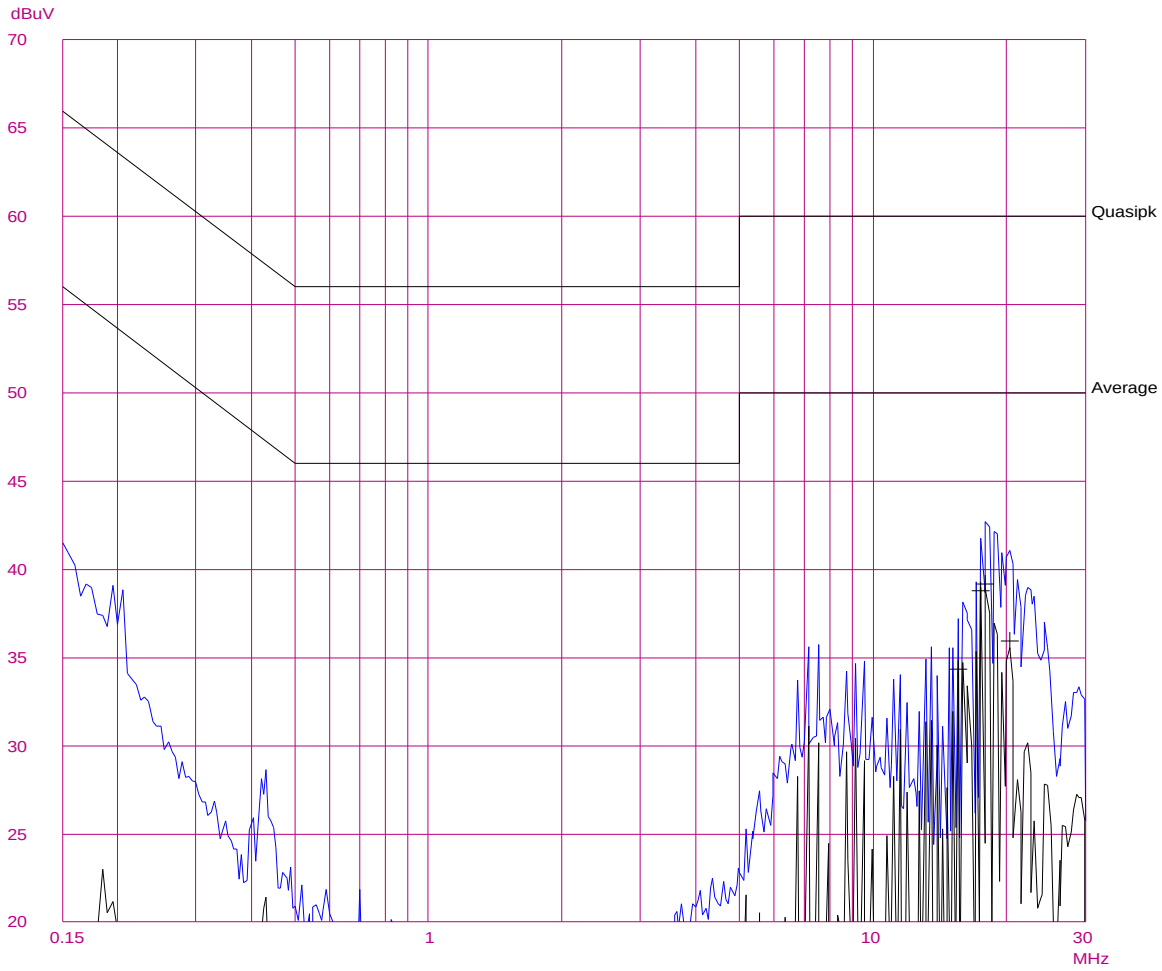
EUT:	ISM Online Zugangsmodul KH 12-48V
Manuf:	ACD Elektronik GmbH
Op Cond:	RFID active, antenna terminated
Operator:	P. Hauser
Test Spec:	CFR Part 15 Subpart C
Comment:	Test_ID PRO10_03
	ACO13_01, Phase L1 - EUT

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten Preamp OpRge
150k	30M	5k	10k	PK+AV	20ms AUTO LN OFF	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 50
Acc Margin: 16dB

Transducer No.	Start	Stop	Name
3	2	1Hz	1000M	Ca_#1006
	20	9k	30M	Lim_#070



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Terminal voltage

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Test Spec:	CFR Part 15 Subpart C
Comment:	Test_ID PRO10_03
	ACO13_01, Phase L1 - EUT

Scan Settings (1 Range)

Frequencies			Receiver Settings				
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	20ms	AUTO	LN OFF	60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV

no Results

Frequency MHz	AV Level dBuV	AV Limit dBuV
15.52000	34.3	50.0
17.51000	38.8	50.0
17.91000	39.1	50.0
20.30000	35.9	50.0

* limit exceeded

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28. Mar 17 10:17

Terminal voltage

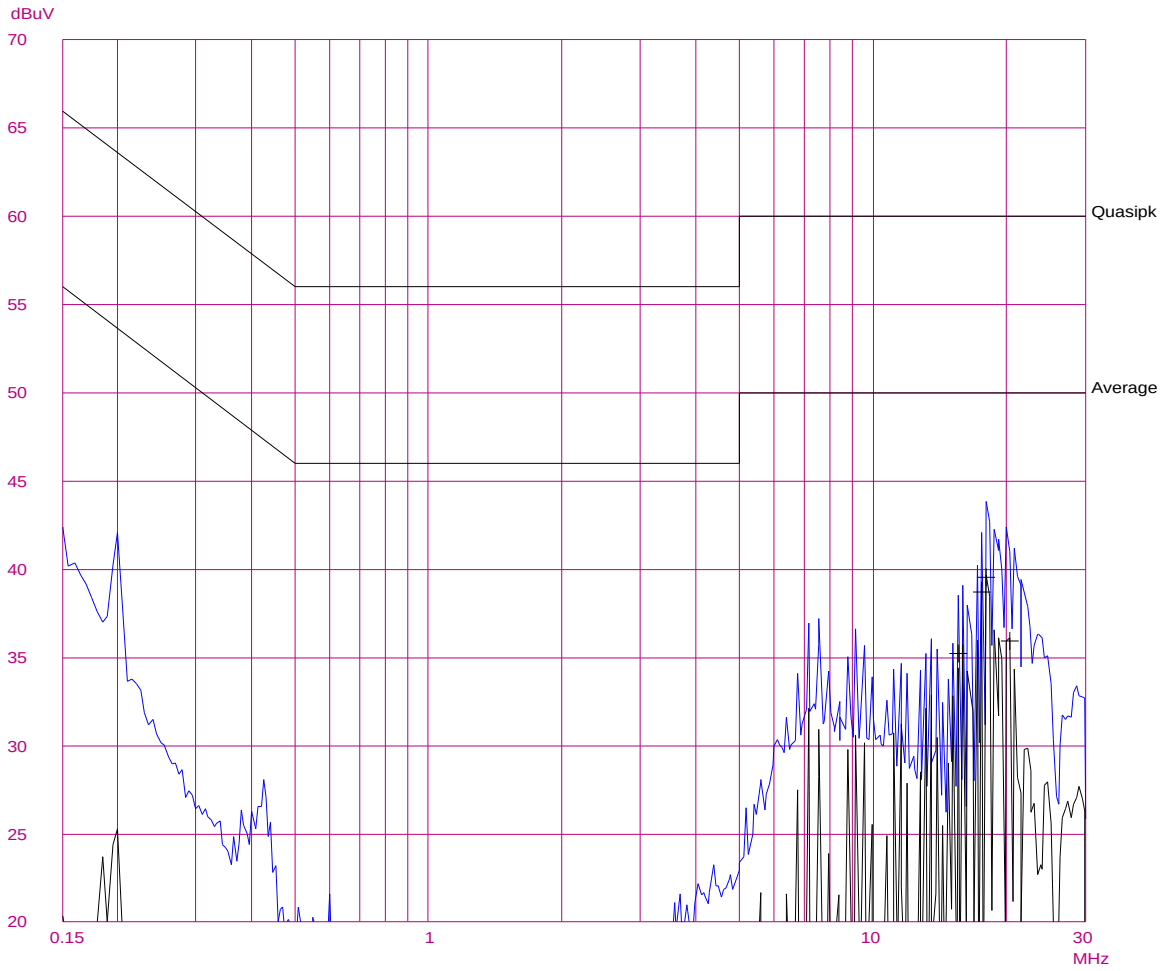
EUT:	ISM Online Zugangsmodul KH 12-48V
Manuf:	ACD Elektronik GmbH
Op Cond:	RFID active, antenna terminated
Operator:	P. Hauser
Test Spec:	CFR Part 15 Subpart C
Comment:	Test_ID PRO10_03
	ACO13_02, Phase N - EUT

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten Preamp OpRge
150k	30M	5k	10k	PK+AV	20ms AUTO LN OFF	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 50
Acc Margin: 16dB

Transducer No.	Start	Stop	Name
3	2	1Hz	1000M	Ca_#1006
	20	9k	30M	Lim_#070



EMCE GmbH Ing_buero fuer EMV_Pruefungen 28. Mar 17 10:17

Terminal voltage

EUT:	ISM Online Zugangsmodul KH 12-48V
Manuf:	ACD Elektronik GmbH
Op Cond:	RFID active, antenna terminated
Operator:	P. Hauser
Test Spec:	CFR Part 15 Subpart C
Comment:	Test_ID PRO10_03
	ACO13_02, Phase N - EUT

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten Preamp OpRge
150k	30M	5k	10k	PK+AV	20ms AUTO LN OFF	60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV

no Results

Frequency MHz	AV Level dBuV	AV Limit dBuV
15.54000	35.2	50.0
17.53000	38.7	50.0
17.93000	39.5	50.0
20.32500	35.9	50.0

* limit exceeded

EMCE GmbH Ing_buero fuer EMV_Pruefungen

28. Mar 17 10:28

Terminal voltage

EUT:	ISM Online Zugangsmodul KH 12-48V
Manuf:	ACD Elektronik GmbH
Op Cond:	RFID active, antenna terminated
Operator:	P. Hauser
Test Spec:	CFR Part 15 Subpart C
Comment:	Test_ID PRO10_03
	ACO13_03, Phase L1 - laptop

Scan Settings (1 Range)

|--------- Frequencies ----------||---------- Receiver Settings ----------|

Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150k	30M	5k	10k	PK+AV	20ms	AUTO	LN OFF	60dB

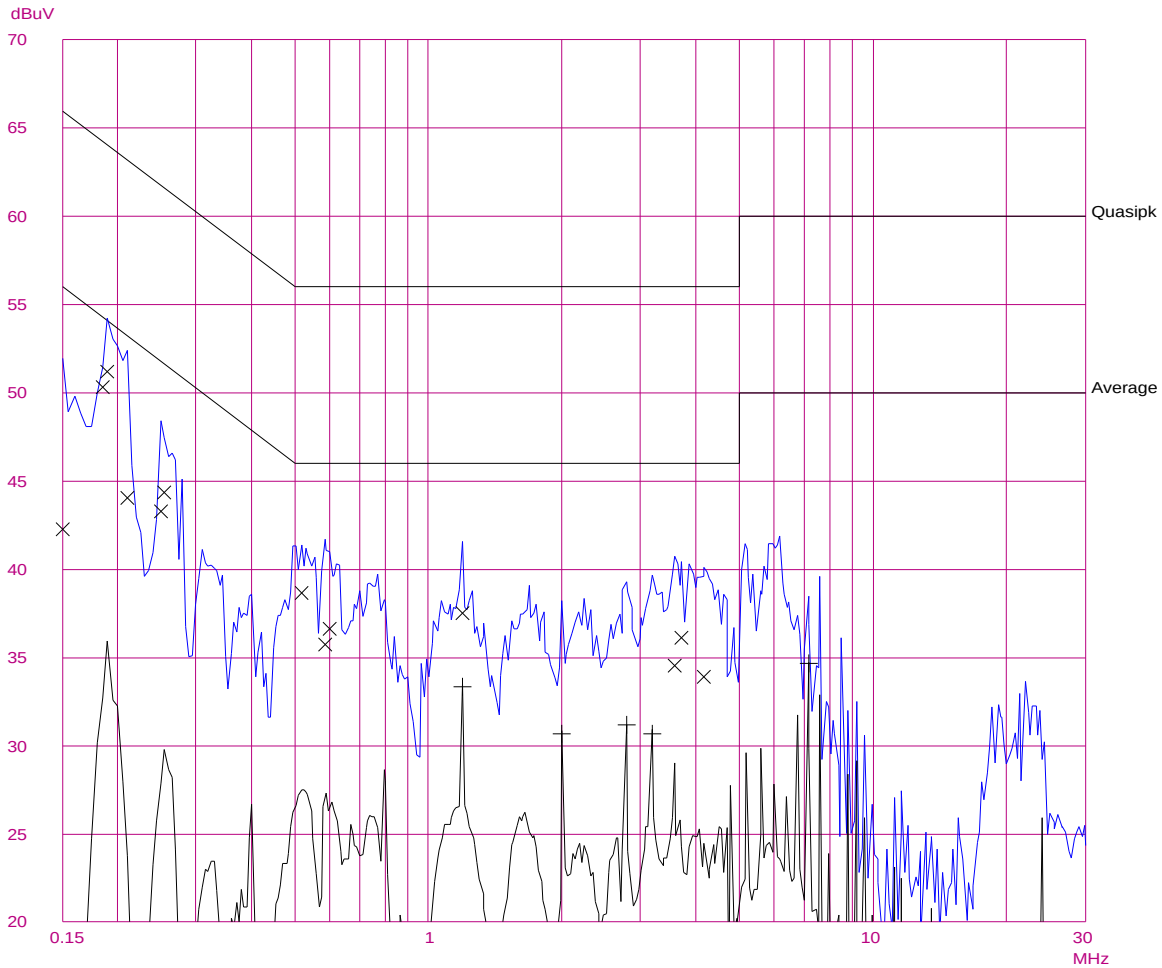
Final Measurement: x QP / + AV

Meas Time: 1 s

Subranges: 50

Acc Margin: 16dB

Transducer No.	Start	Stop	Name
3	2	1Hz	1000M	Ca_#1006
	20	9k	30M	Lim_#070



EMCE GmbH Ing_buero fuer EMV_Pruefungen 28. Mar 17 10:28

Terminal voltage

EUT:	ISM Online Zugangsmodul KH 12-48V
Manuf:	ACD Elektronik GmbH
Op Cond:	RFID active, antenna terminated
Operator:	P. Hauser
Test Spec:	CFR Part 15 Subpart C
Comment:	Test_ID PRO10_03
	ACO13_03, Phase L1 - laptop

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten Preamp OpRge
150k	30M	5k	10k	PK+AV	20ms AUTO LN OFF	60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.15000	42.3	66.0
0.18500	50.3	64.3
0.19000	51.2	64.1
0.21000	44.0	63.2
0.25000	43.3	61.8
0.25500	44.3	61.6
0.52000	38.6	56.0
0.58500	35.7	56.0
0.60000	36.6	56.0
1.19500	37.5	56.0
3.58500	34.5	56.0
3.71500	36.1	56.0
4.17000	33.9	56.0

Frequency MHz	AV Level dBuV	AV Limit dBuV
1.19500	33.3	46.0
1.99500	30.6	46.0
2.79000	31.1	46.0
3.19000	30.6	46.0
7.17500	34.6	50.0

* limit exceeded

EMCE GmbH Ing_buero fuer EMV_Pruefungen

28. Mar 17 10:40

Terminal voltage

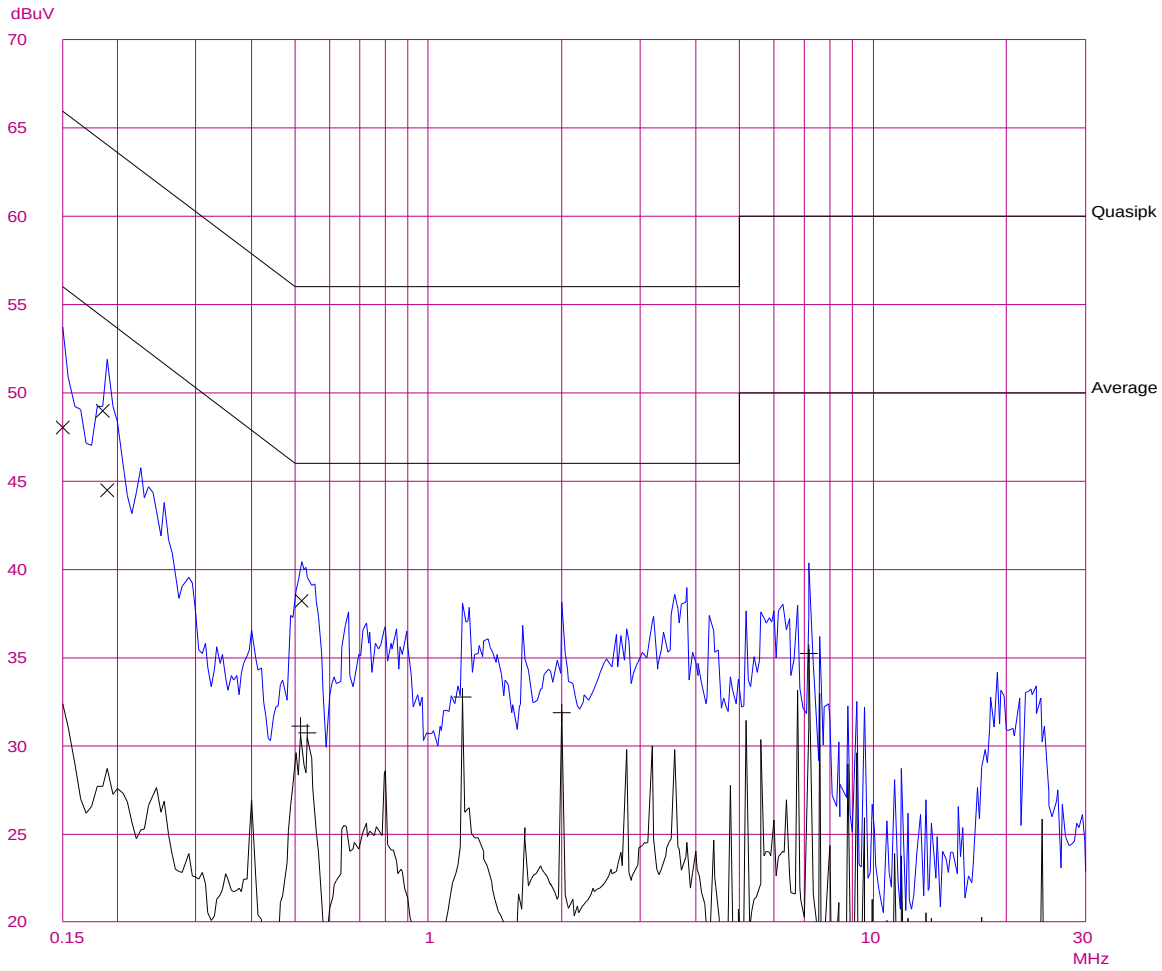
EUT:	ISM Online Zugangsmodul KH 12-48V
Manuf:	ACD Elektronik GmbH
Op Cond:	RFID active, antenna terminated
Operator:	P. Hauser
Test Spec:	CFR Part 15 Subpart C
Comment:	Test_ID PRO10_03
	ACO13_04, Phase N - laptop

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten Preamp OpRge
150k	30M	5k	10k	PK+AV	20ms AUTO LN OFF	60dB

Final Measurement: x QP / + AV
Meas Time: 1 s
Subranges: 50
Acc Margin: 16dB

Transducer No.	Start	Stop	Name
3	2	1Hz	1000M	Ca_#1006
	20	9k	30M	Lim_#070



EMCE GmbH Ing_buero fuer EMV_Pruefungen

28. Mar 17 10:40

Terminal voltage

EUT:	ISM Online Zugangsmodul KH 12-48V
Manuf:	ACD Elektronik GmbH
Op Cond:	RFID active, antenna terminated
Operator:	P. Hauser
Test Spec:	CFR Part 15 Subpart C
Comment:	Test_ID PRO10_03
	ACO13_04, Phase N - laptop

Scan Settings (1 Range)

Frequencies			Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten Preamp OpRge
150k	30M	5k	10k	PK+AV	20ms AUTO LN OFF	60dB

Final Measurement Results:

Frequency MHz	QP Level dBuV	QP Limit dBuV
0.15000	48.0	66.0
0.18500	49.0	64.3
0.19000	44.4	64.1
0.52000	38.2	56.0

Frequency MHz	AV Level dBuV	AV Limit dBuV
0.51500	31.0	46.0
0.53500	30.7	46.0
1.19500	32.8	46.0
1.99500	31.8	46.0
7.18000	35.2	50.0

* limit exceeded

1.1.2 Radio disturbances according 47 CFR Part 15 Subpart C - 03/24/2017

☒ Full compliance
☐ Precompliance
☐ Test not requested*
☐ Test not carried out*

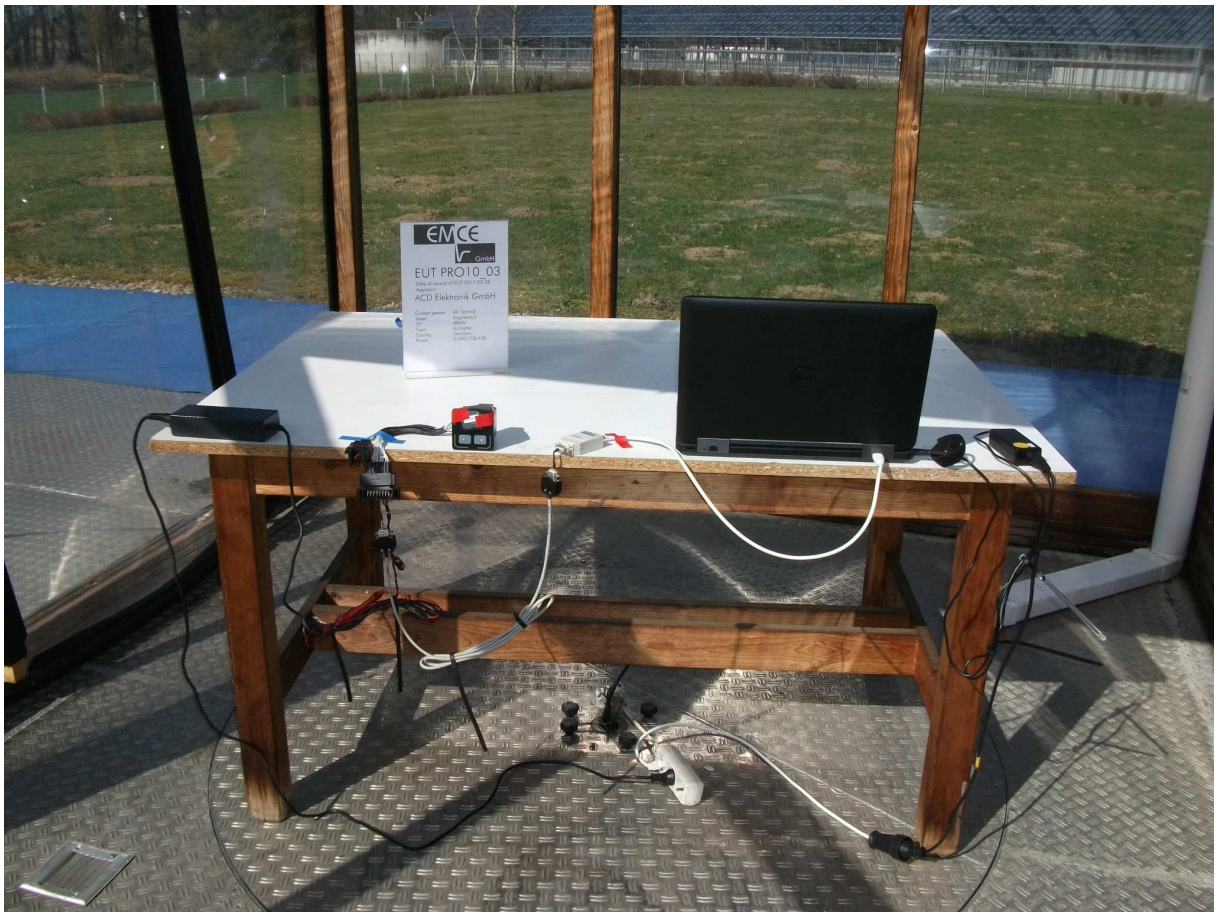
*
____

Test location

☒	Inv.-No.	Designation	Type (L x W x H)	Manufacturer	Location
	588	Shielded room # 2	8.3/5.8 x 5.5/2.9 x 3.4 m	EMC-Technik & Consulting GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	584	Shielded room # 3	3.6 x 3.6 x 2.5 m	Siemens AG	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	678	Shielded room # 4	4.0 x 4.0 x 3.5 m	EMC-Technik & Consulting GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
☒	062	Semi anechoic chamber # 2	13.5 x 6.1 x 5.5 m	EMC-Technik & Consulting GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	679	Full anechoic chamber # 3	8.8 x 4.6 x 4.2 m	Albatross Projects GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
☒	014	Open area test site	10 m	EMCE GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
☒	015	Open area test site	3 m	EMCE GmbH	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	042	Voltage-/current source test site	0-382VDC 0-270VAC 1 x 10 kW/3 x 5 kW	Spitzenberger + Spies	EMCE GmbH Untere Wiesen 1 88483 Burgrieden
	n/a	Alternative test site	n/a	n/a	n/a

1.1.2.1 Test set up

According ANSI C63.10-2013



Used test equipment

☒	Inv.-No.	Designation	Type	Manufacturer	S/N
☒	001	Test receiver	ESS 5 Hz – 1000 MHz	Rohde & Schwarz	833776/008
	003	LISN 1	ESH3-Z5	Rohde & Schwarz	835268/007
	004	LISN 2	ESH3-Z5	Rohde & Schwarz	835268/003
	005	LISN 3	NNB 4/32T	Rolf Heine HF-Technik	4/32T-96015
	006	LISN	NNBM 8125	Schwarzbeck	8125371
	007	Absorbing clamp	MDS 21	Schwarzbeck	942436
☒	008	Antenna 9 kHz – 30 MHz	HFH2-Z2	Rohde & Schwarz	835776/0002
☒	009	Antenna 30 – 300 MHz	VHBA9123 / BBA9106	Schwarzbeck	435
☒	010	Antenna 250 – 1200 MHz	UHALP 9108A	Schwarzbeck	108
☒	011	Antenna 30 – 300 MHz	VHBA9123 / BBA9106	Schwarzbeck	0408/94
☒	012	Antenna 250 – 1200 MHz	UHALP 9108A	Schwarzbeck	166
	013	Antenna 9 kHz – 30 MHz	Loop antenna 1.5 m ∅	EMCE GmbH	
	025	Current clamp BCI	F-120-2	FCC	47
	041	HZ-10	Shielded coil	Rohde & Schwarz	849788/020
☒	042	AC-Source / Analyser / Norm impedance	EMV D5000/PAS	Spitzenberger + Spies	A274700/ 0 0501
☒	058	Test receiver	ESIB 40	Rohde & Schwarz	100200
	059	Logper. Antenna	HL050	Rohde & Schwarz	100006
	060	HF coupling clamp	KEMA 801	Schaffner	20808
	063	Logper. Antenna	HL023 A2	Rohde & Schwarz	
	067	LISN 5	ESH2-Z5	Rohde & Schwarz	0872460/043
	068	LISN 4	ESH2-Z5	Rohde & Schwarz	0872460/042
	073	Absorbing clamp	MDS 21	Schwarzbeck	881757
	116	Vertical rod antenna	VAMP 9243	Schwarzbeck	9243-205

All used test equipment are checked resp. calibrated periodically.

☒ Test equipment was checked and complied to the requirements

Test / Measurement uncertainty

The measurement uncertainty in the test met the guideline of CISPR16-4-2 or better.

Measurement uncertainty of the radiated emission with an extended coverage factor of k = 2:

Frequency	Measurement uncertainty
9 kHz – 30 MHz	on request
30 MHz – 300 MHz	4.4 dB
300 MHz – 1 GHz	3.4 dB
1 GHz – 18 GHz	on request

1.1.2.2 Test – Radiated emission fundamental

Regulation

47 CFR Part 15 Subpart C – 03/24/2017

	☒ 9 kHz – 30 MHz	☐ 150 kHz – 1 GHz
	☐ 30 MHz – 1000 MHz	☐ 1 – 18 GHz
Limits:	☐ Section 15.209*	☒ Section 15.225*

* The limits for frequencies below 30MHz were corrected for a closer measuring distance by using an extrapolation factor of 40 dB/decade..

Test distance:	☐ 3 m	☐ 5 m
	☒ 10 m	☐ 30 m

Operation mode

EUT arrangement:	☒ Tabletop	☐ Floor standing
Power supply - laptop:	☒ 120 V/60 Hz	☐ 240 V/60 Hz
Power supply - EUT:	☐ 120 V/60 Hz	☒ 19 VDC
Rated voltage variation:	☐ 85 %	☐ 115 %

Port #	Designation	Remarks
# 1	AC power line - EUT	L1/N/PE
# 2	AC power line - laptop	L1/N/PE
# 3		

Continuous operation of the RFID reader, supplied with the desktop power supply. No tag inside of the field, this operation mode shows highest emanations. During the test the CAN and the V24 I/F was active.

Environmental conditions

Temperature:	15 - 35 °C
Humidity:	30 - 60 %
Air pressure:	860 - 1060 hPa

Environmental conditions during the test:	☒ kept
	☐ not kept

Test - / Measurement procedure

The test was performed at an antenna to EUT distance of 10m in the frequency range ≤30MHz and at 3m distance for frequencies ≥30MHz. Measurements were made with a CISPR receiver with quasi-peak. The average detector is used in the frequency bands 9-90kHz, 110-490kHz and above 1000MHz. For pulse modulated devices with a pulse repetition frequency of 20Hz or less, peak detector is used (15.35a Note). The frequency, the measured value, antenna information and the limit will be printed out.
The reported test results are calculated with the following formula:

Field strength (dBµV/m) = Reading (dBµV) + AF (dB/m) + CF (dB)

AF = Correction factor for the antenna
CF = Correction factor for the cable loss

$Limit_{10m}$ (dBµV/m) = Limit (dBµV/m) + LCF_{10m} (dB)

$Limit_{10m}$ Limit calculated for 10m test distance
LCF_{10m} = Limit Correction factor for 10m test distance
LCF_{10m} for 30m antenna distance = 20dB
LCF_{10m} for 100m antenna distance = 40dB
LCF_{10m} for 300m antenna distance = 60dB

Test result - fundamental

Frequency	Field strength	$Limit_{10m}$	Margin	Ant.-	Ant.-	Detector	Receiver	Supply voltage	Remarks
				Distance	Polar.	Peak /	6dB BW		
MHz	dBµV/m	dBµV/m	dB	m	H/V	QP / AV	kHz		
13.5600	53.1	104.0	50.9	10.0	V	QP	10	19 VDC	
13.5600	53.1	104.0	50.9	10.0	V	QP	10	10.2 VDC	
13.5600	53.0	104.0	51.0	10.0	V	QP	10	55.2 VDC	

$Limit_{10m}$ Limit calculated for 10m test distance

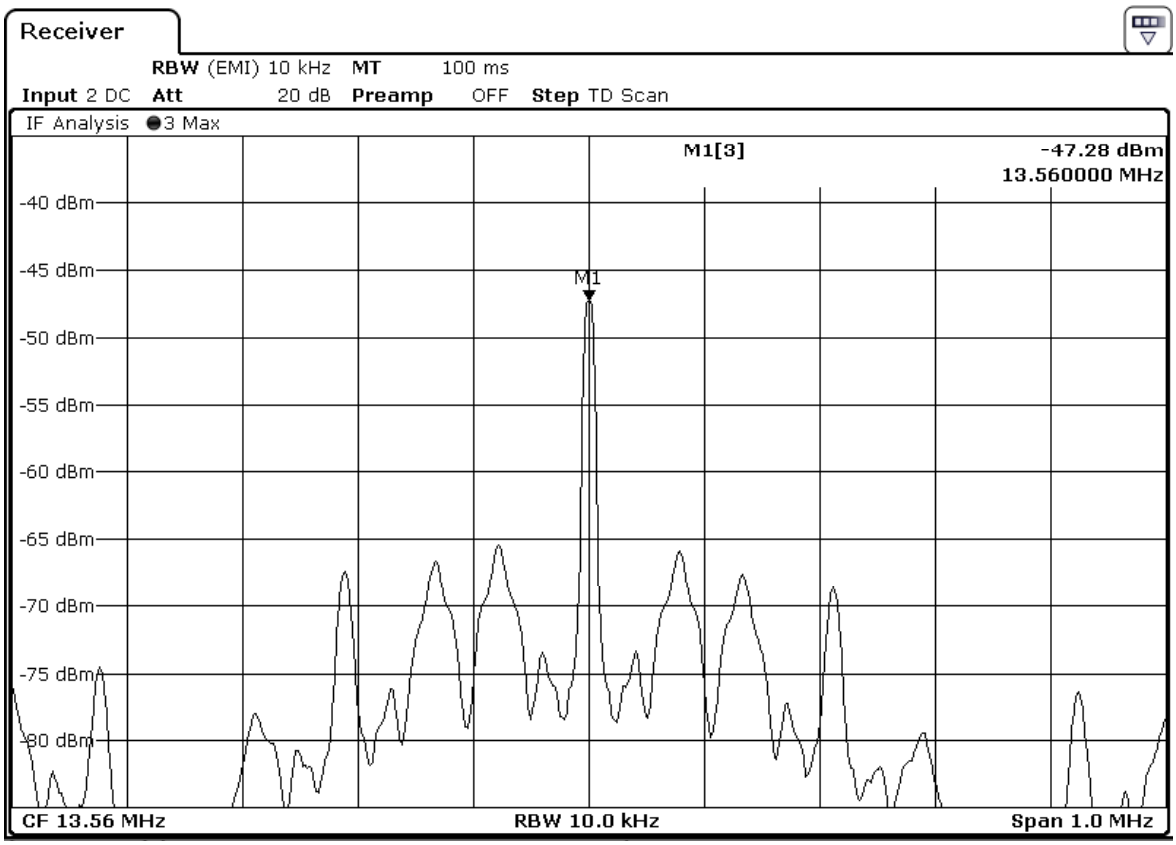
Limits for radiated disturbances: ☒ kept ☐ not kept

Remarks: n/a

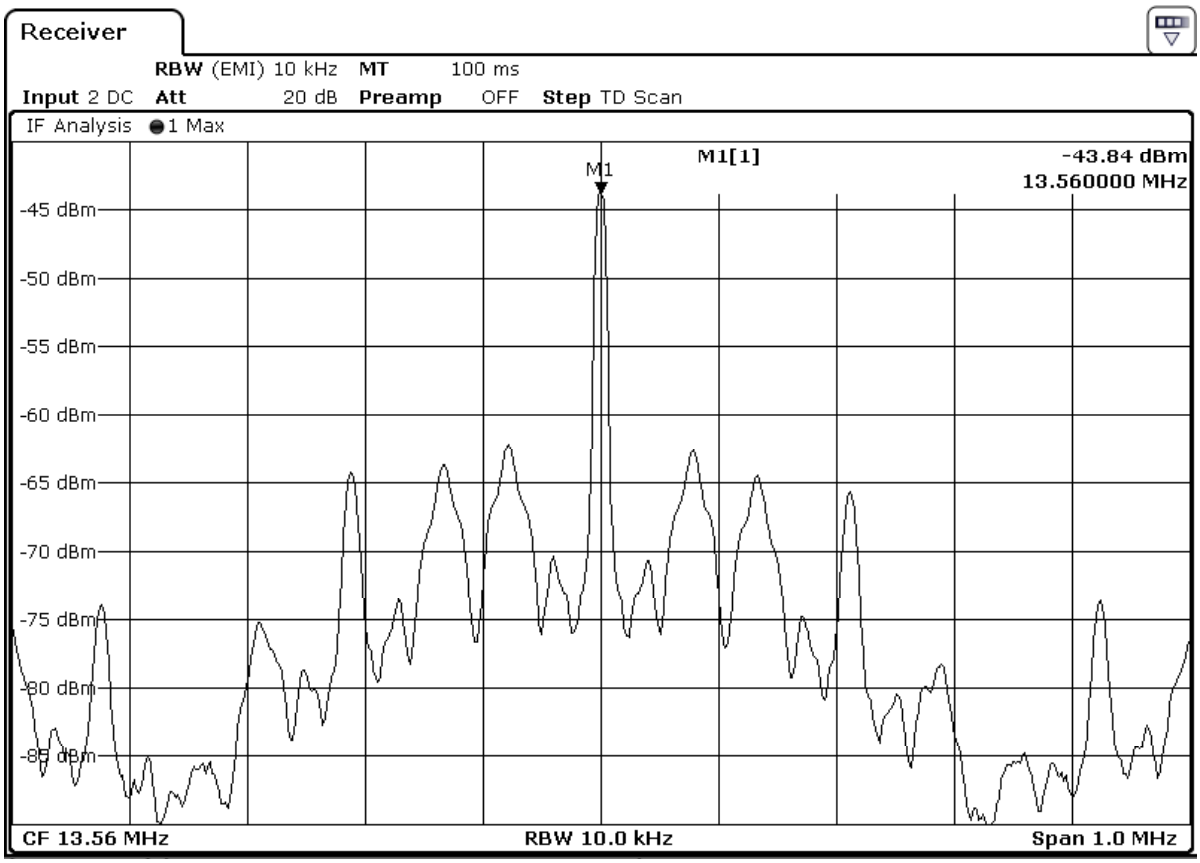
Table - fundamental frequency vs. temperature at 12 VDC supply voltage

Ambient temperature / °C	Frequency of fundamental / MHz at start	Frequency of fundamental / MHz after 2min	Frequency of fundamental / MHz after 5min	Frequency of fundamental / MHz after 10min
70	13.5600	13.5600	13.5600	13.5600
60	13.5600	13.5600	13.5600	13.5600
50	13.5600	13.5600	13.5600	13.5600
40	13.5600	13.5600	13.5600	13.5600
30	13.5600	13.5600	13.5600	13.5600
20	13.5600	13.5600	13.5600	13.5600
10	13.5600	13.5600	13.5600	13.5600
0	13.5600	13.5600	13.5600	13.5600
-10	13.5600	13.5600	13.5600	13.5600
-20	13.5600	13.5600	13.5600	13.5600
-30	13.5600	13.5600	13.5600	13.5600

Plot – fundamental frequency at temperature edges

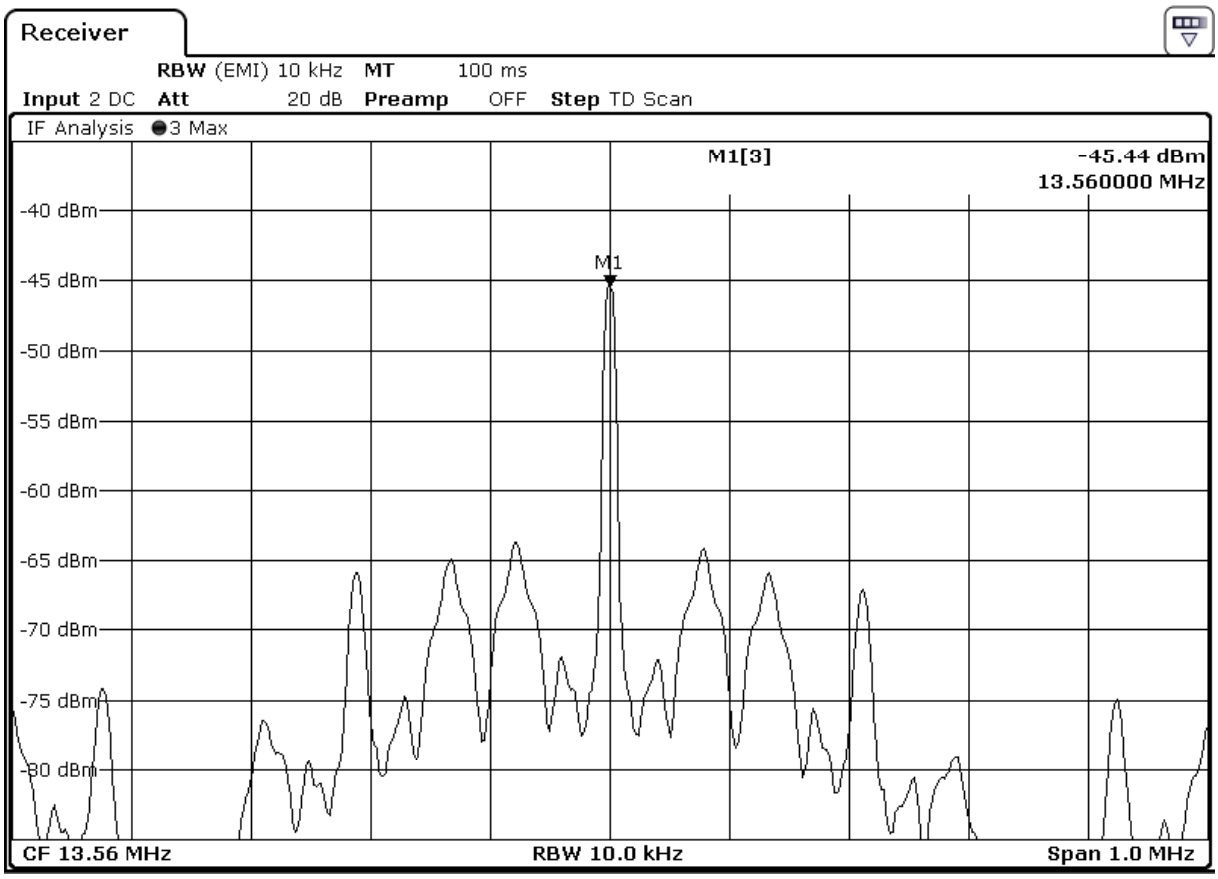


Supply voltage: 12 VDC; temperature 70°C

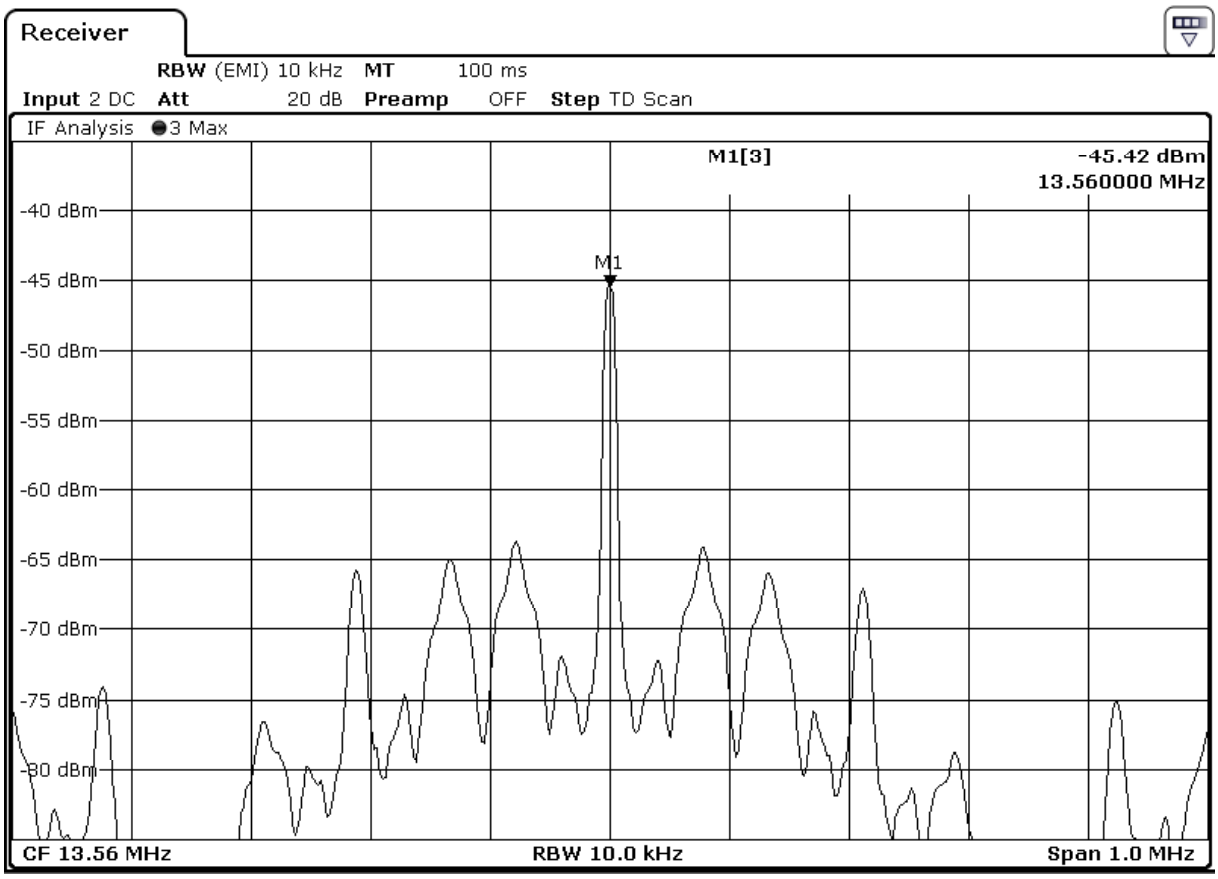


Supply voltage: 12 VDC, temperature –30 °C

Plot – fundamental frequency at supply voltage edges



Supply voltage: 10.2 VDC, temperature 20 °C



Supply voltage: 55.2 VDC, temperature 20 °C

1.1.2.3 Test – Spurious emissions

Regulation

47 CFR Part 15 Subpart C – 03/24/2017

	☒ 9 kHz – 30 MHz	☐ 150 kHz – 1 GHz
	☒ 30 MHz – 1000 MHz	☐ 1 – 18 GHz
Limits:	☒ Section 15.209*	☐ __
Test distance:	☒ 3 m	☐ 5 m
	☒ 10 m	☐ 30 m

Operation mode

EUT arrangement:	☒ Tabletop	☐ Floor standing
Power supply - laptop:	☒ 120 V/60 Hz	☐ 240 V/60 Hz
Power supply - EUT:	☐ 120 V/60 Hz	☒ 19 VDC
Rated voltage variation:	☐ 85 %	☐ 115 %

Port #	Designation	Remarks
# 1	AC power line - EUT	L1/N/PE
# 2	AC power line - laptop	L1/N/PE
# 3		

Continuous operation of the RFID reader, supplied with the desktop power supply. No tag in field, this operation mode shows highest emanations. During the test the CAN and the V24 I/F was active.

Environmental conditions

Temperature [10 - 40°C]:	17°C
Relative humidity [10 - 90%]:	72%
Environmental conditions during the test:	☒ kept
	☐ not kept

Test - / Measurement procedure

The test was performed at an antenna to EUT distance of 10m in the frequency range ≤30MHz and at 3m distance for frequencies ≥30MHz. Measurements were made with a CISPR receiver with quasi-peak. The average detector is used in the frequency bands 9-90kHz, 110-490kHz and above 1000MHz. For pulse modulated devices with a pulse repetition frequency of 20Hz or less, peak detector is used (15.35a Note). The frequency, the measured value, antenna information and the limit will be printed out.
The reported test results are calculated with the following formula:

Field strength (dBµV/m) = Reading (dBµV) + AF (dB/m) + CF (dB)

AF = Correction factor for the antenna
CF = Correction factor for the cable loss

$Limit_{10m}$ (dBµV/m) = Limit (dBµV/m) + LCF_{10m} (dB)

$Limit_{10m}$ Limit calculated for 10m test distance
LCF_{10m} = Limit Correction factor for 10m test distance
LCF_{10m} for 30m antenna distance = 20dB
LCF_{10m} for 100m antenna distance = 40dB
LCF_{10m} for 300m antenna distance = 60dB

Test result

Limits for intentional radiators: ☒ kept ☐ not kept

Level of the fundamental > unwanted emission: ☒ kept ☐ not kept

Protocol scope

☒ Readings - Antenna horizontal polarized.
☒ Diagram - Antenna horizontal polarized.
☒ Readings - Antenna vertical polarized.
☒ Diagram - Antenna vertical polarized.

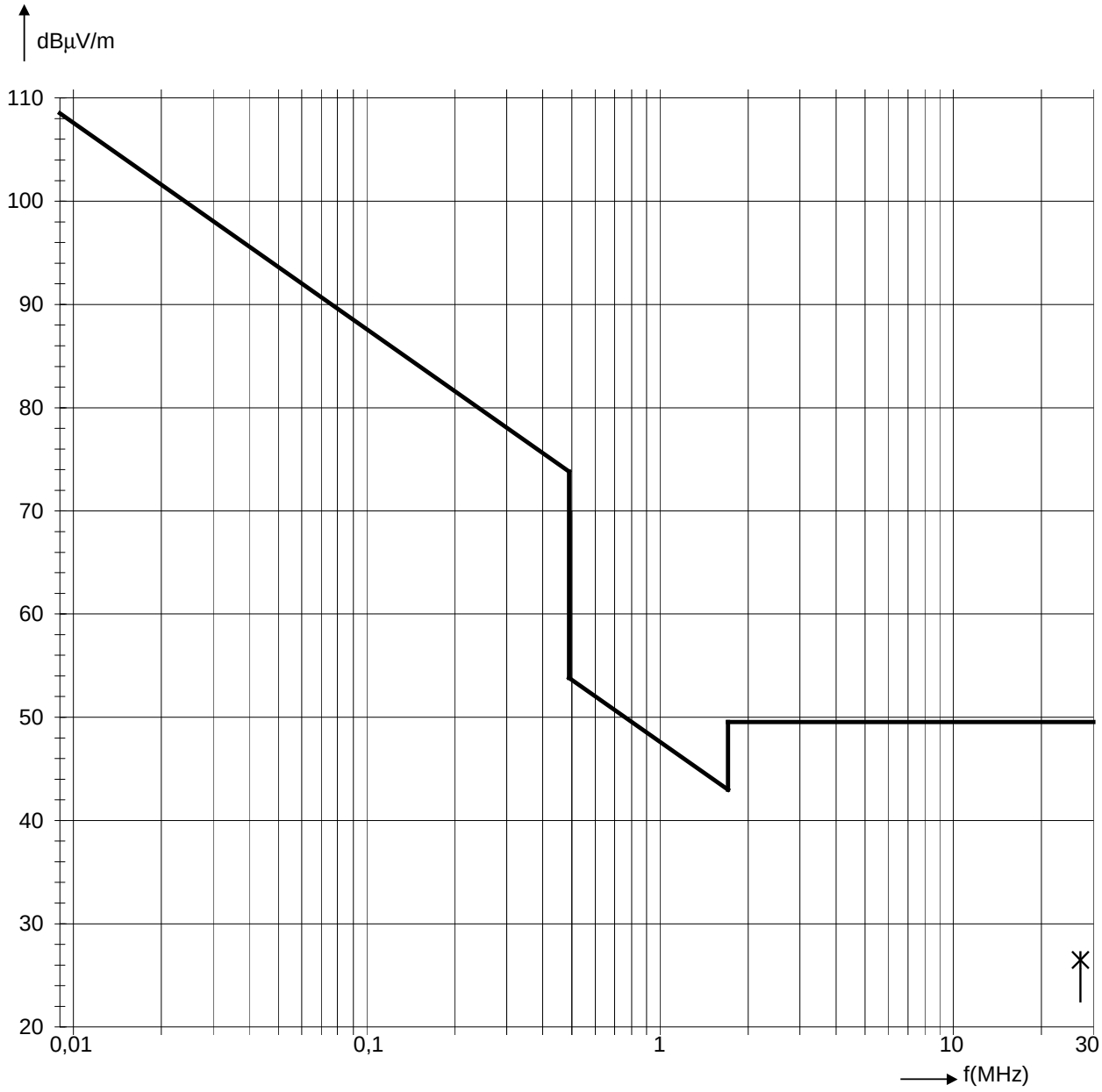
Readings - Antenna vertical polarized, Antenna loop lowest height 1m

Frequency	Field strength	$Limit_{10m}$	Margin	Ant.-	Ant.-	Detector	Receiver	Remarks
				Distance	Polar.	Peak /	6dB BW	
MHz	dBµV/m	dBµV/m	dB	m	H/V	QP / AV	kHz	
27.12	26.5	49.5	23.0	10.0	V	QP	10	

$Limit_{10m}$ Limit calculated for 10m test distance

Diagram - Antenna vertical polarized

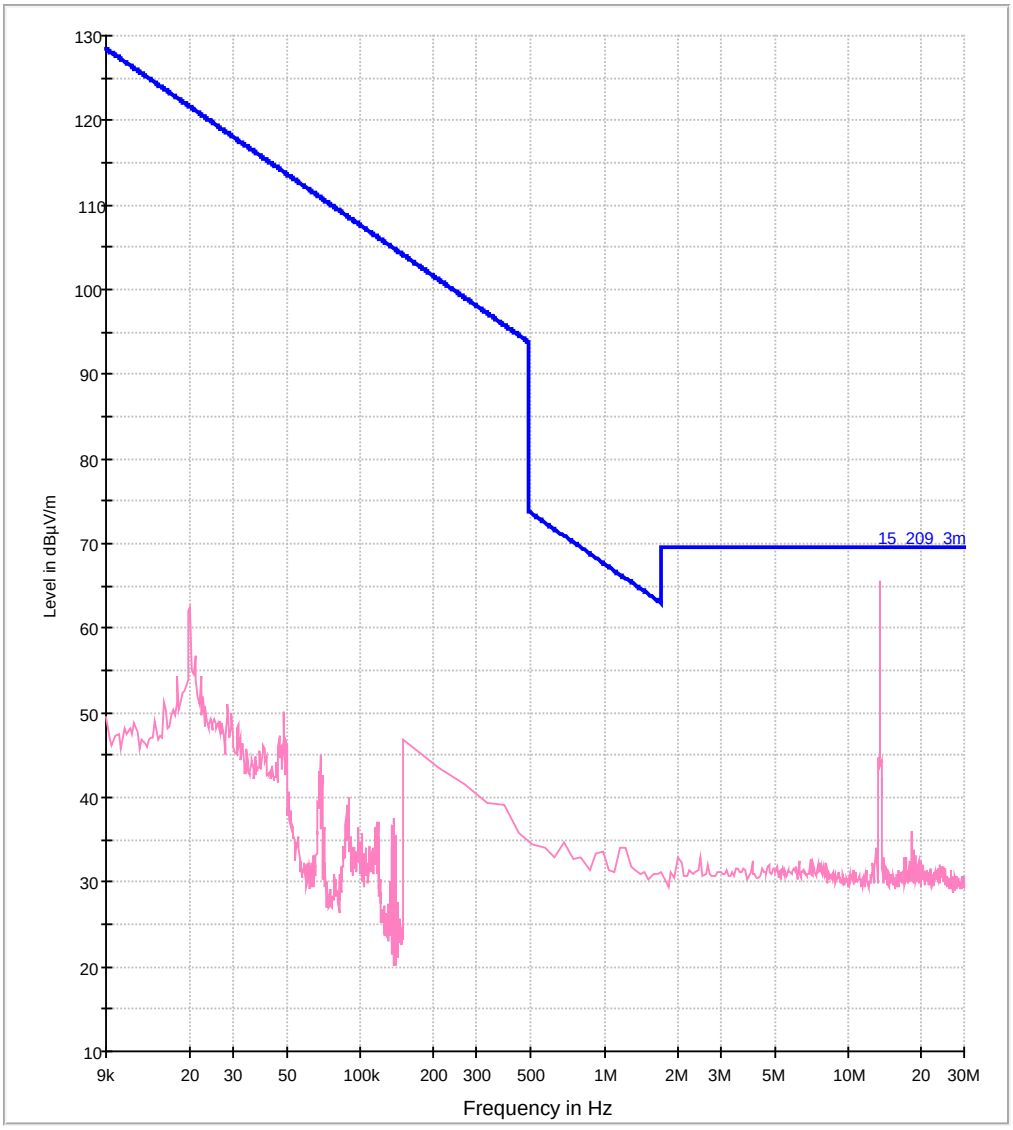
Limits according FCC Rules 47 CFR Part 15 – Subpart C
☒ Section 15.209 – Corrected to 10m distance EUT-Antenna



EUT Information

EUT Name:	ISM Online Zugangsmodul KH 12-48 VDC
Test_ID: / SN:	PRO10_03
Customer:	ACD Elektronik GmbH
Operational condition:	CAN, V24 active, Field on, no tag in field
Test specification:	47 CFR Part 15 §209
Antenna information:	Distance EUT-Ant.: 3.0m / Polarisation: V / Ant.Height: 1.5m
Operator:	P. Hauser
File #:	ACO10_12

Magnetic Field Strength dBµV with Sweep_SAC2

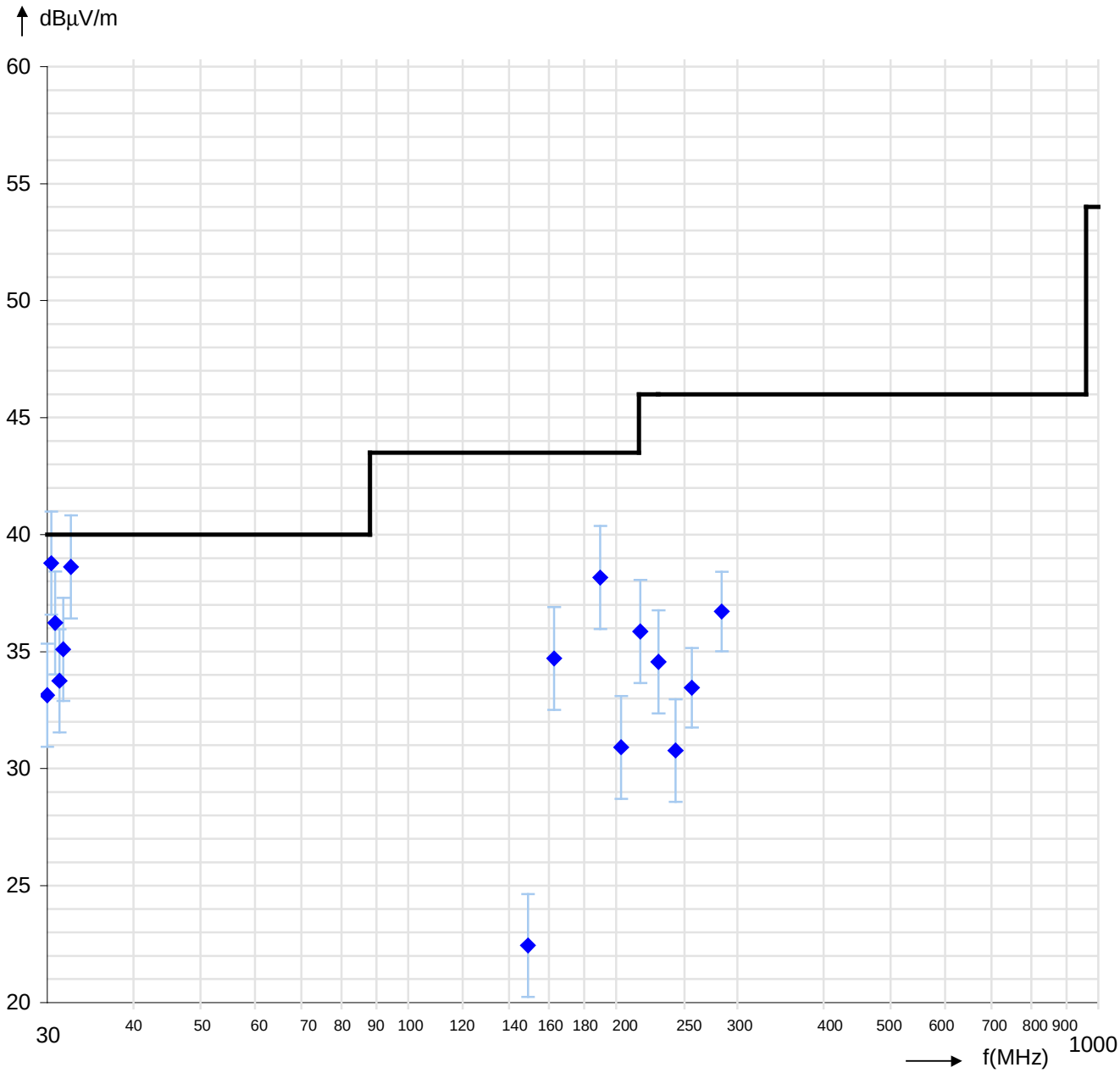


Readings – Antenna vertical polarized

Frequency	Readings	+ AF Antenna correction factor	+ KF Cable correction factor	Field strength	Limit	Margin	Antenna-Height	Antenna-Polarization	Turn Table-Position
MHz	dBµV	dB/m	dB	dBµV/m	dBµV/m	dB	m	hor./ver.	Degree
30.000	20.1	12.3	0.8	33.1	40.0	6.9	1.0	V	40
30.400	25.9	12.1	0.8	38.8	40.0	1.2	1.0	V	40
30.800	23.5	12.0	0.8	36.2	40.0	3.8	1.0	V	40
31.250	21.2	11.8	0.8	33.8	40.0	6.2	1.0	V	40
31.650	22.7	11.6	0.8	35.1	40.0	4.9	1.0	V	40
32.460	26.5	11.3	0.8	38.6	40.0	1.4	1.0	V	40
149.150	8.5	12.1	1.8	22.4	43.5	21.1	1.0	V	90
162.710	20.0	12.8	1.9	34.7	43.5	8.8	1.0	V	85
189.830	21.7	14.4	2.0	38.2	43.5	5.3	1.0	V	90
203.390	13.1	15.7	2.1	30.9	43.5	12.6	1.0	V	90
216.950	17.9	15.8	2.2	35.9	46.0	10.1	1.0	V	90
230.510	15.5	16.8	2.3	34.6	46.0	11.4	1.0	V	100
244.070	11.3	17.1	2.3	30.8	46.0	15.2	1.0	V	90
257.620	16.1	14.9	2.4	33.5	46.0	12.5	1.0	V	100
284.740	19.7	14.5	2.5	36.7	46.0	9.3	1.0	V	100

Diagram radio disturbances – Antenna vertical polarized

Limits: ☒ Section 15.209* ☐ __

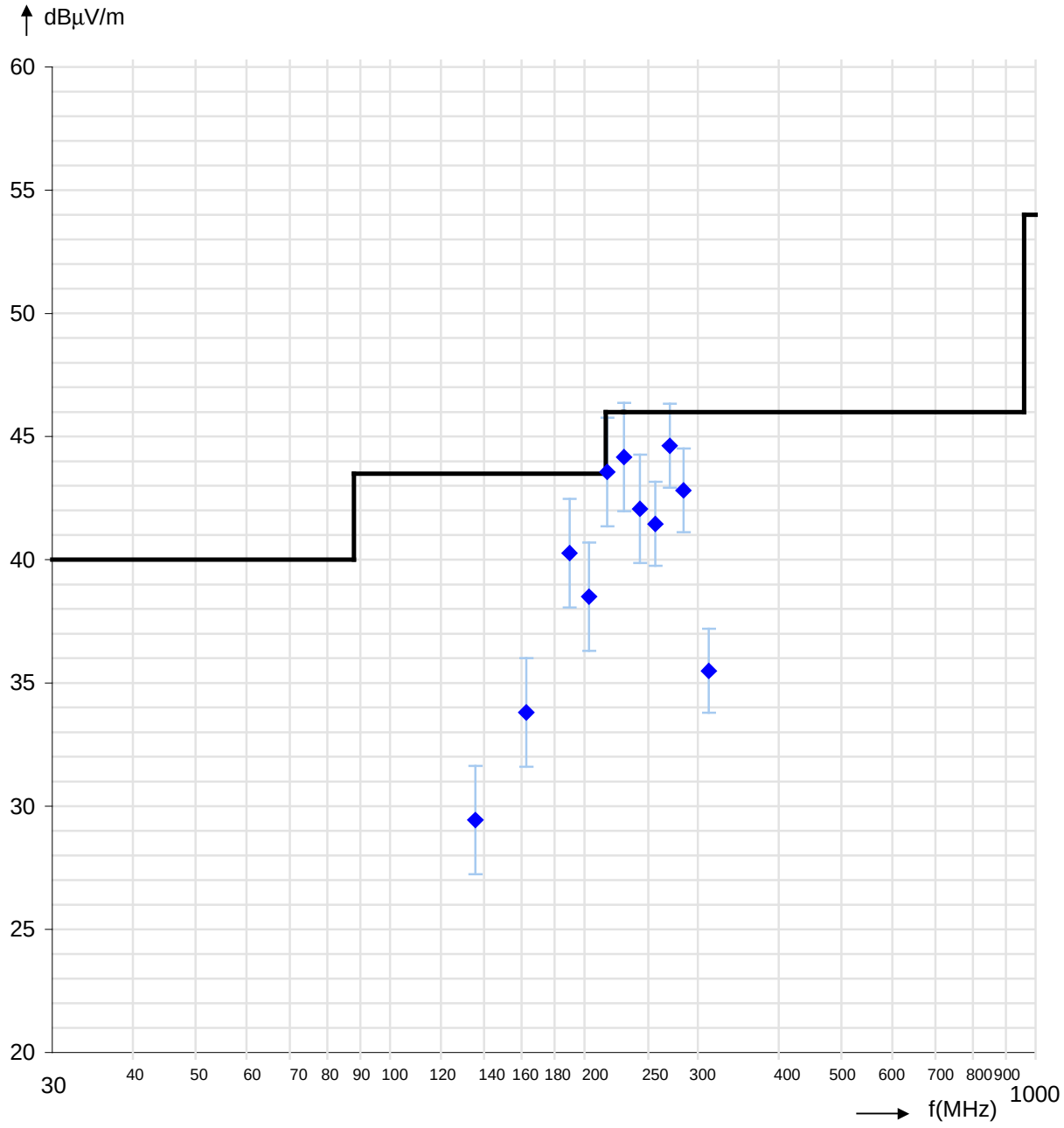


Readings - Antenna horizontal polarized

Frequency	Readings	+ AF Antenna correction factor	+ KF Cable correction factor	Field strength	Limit	Margin	Antenna-Height	Antenna-Polarization	Turn Table-Position
MHz	dBµV	dB/m	dB	dBµV/m	dBµV/m	dB	m	hor./ver.	Degree
135.590	16.2	11.5	1.7	29.4	43.5	14.1	2.6	H	100
162.710	19.1	12.8	1.9	33.8	43.5	9.7	2.0	H	110
189.830	23.8	14.4	2.0	40.3	43.5	3.2	1.9	H	130
203.390	20.7	15.7	2.1	38.5	43.5	5.0	1.7	H	120
216.950	25.6	15.8	2.2	43.6	46.0	2.4	1.5	H	130
230.510	25.1	16.8	2.3	44.2	46.0	1.8	1.5	H	130
244.070	22.6	17.1	2.3	42.1	46.0	3.9	1.5	H	120
257.630	24.1	14.9	2.4	41.5	46.0	4.5	1.4	H	120
271.190	27.8	14.4	2.5	44.6	46.0	1.4	1.4	H	140
284.750	25.8	14.5	2.5	42.8	46.0	3.2	1.4	H	100
311.870	19.0	13.8	2.7	35.5	46.0	10.5	1.3	H	110

Diagram radio disturbances – Antenna horizontal polarized

Limits: ☒ Section 15.209* ☐ __



1.1.2.4 Restricted bands of operation

Regulation

47 CFR Part 15 Subpart C – 03/24/2017

Requirement: ☒ Section 15.205(a)

Limit spurious emission:
☒ Section 15.209
☒ CISPR quasi peak detector (f ≤ 1GHz)
☐ Average detector(f > 1GHz)

Operation mode

EUT arrangement:	☒ Tabletop	☐ Floor standing
Power supply - laptop:	☒ 120 V/60 Hz	☐ 240 V/60 Hz
Power supply - EUT:	☐ 120 V/60 Hz	☒ 19 VDC
Rated voltage variation:	☐ 85 %	☐ 115 %

Continuous operation of the RFID reader, supplied with the desktop power supply. No tag in field, this operation mode shows highest emanations. During the test the CAN and the V24 I/F was active.

Environmental conditions

Temperature [10 - 40°C]:	23°C
Relative humidity [10 - 90%]:	39%

Environmental conditions during the test:
☒ kept
☐ not kept

Test - / Measurement procedure

Position the EUT in front of the measuring antenna. The analyzer is set to peak detector and the trace mode to max. hold. Set the analyzer to the identified fundamental and the sweep is continued until the trace is stabilized. The frequencies of the maximum of the envelope and the outermost points attenuated by 20dB to the maximum are noted.

Test result

Measured fundamental: 13.5600 MHz
20dB-Emission Bandwidth: 0.26787 MHz

Fundamental out of restricted bands: ☒ kept ☐ not kept

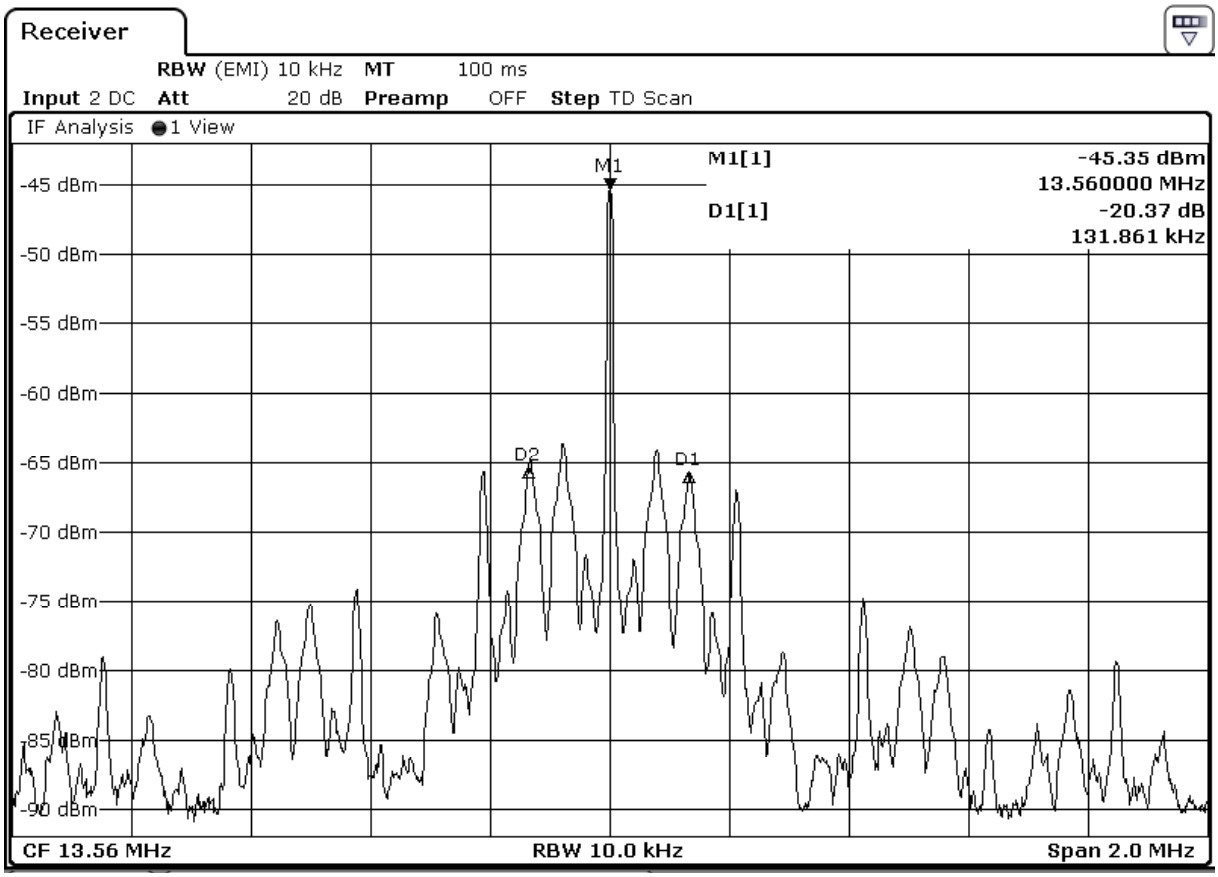
Limit spurious emission: ☒ kept ☐ not kept

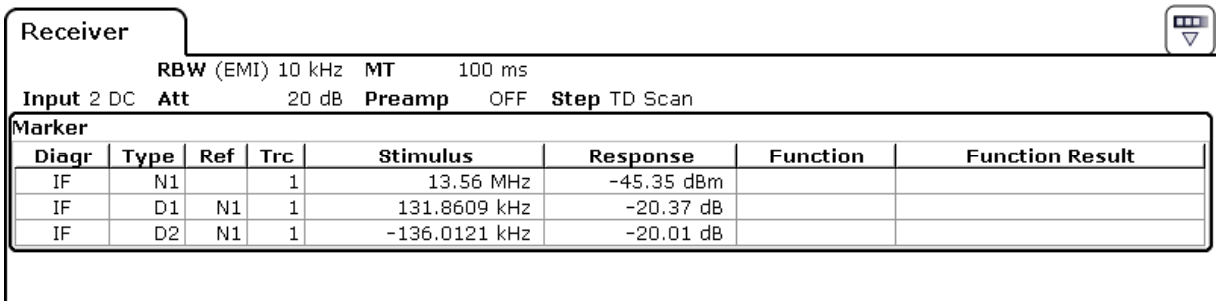
Remarks: n/a

Protocol scope

☒ Diagram – 20dB-Emission bandwidth.

Occupied bandwidth





Diagr	Type	Ref	Trc	Stimulus	Response	Function	Function Result
IF	N1		1	13.56 MHz	-45.35 dBm		
IF	D1	N1	1	131.8609 kHz	-20.37 dB		
IF	D2	N1	1	-136.0121 kHz	-20.01 dB		

Occupied bandwidth BW = D1 – D2 = 131.86 kHz - -136.01 kHz=267.87 kHz

1.1.2.5 Antenna requirement

Regulation

47 CFR Part 15 Subpart C – 03/24/2017

Requirement:
- ☒ Section 15.203
- ☒ Permanent attached
- ☐ Unique coupling to the intentional radiator

Test result

Requirement:
- ☒ kept
- ☐ not kept

Authorized antenna:
- ☐ Print antenna
- ☒ Internal antenna
- ☐ External antenna

Remarks: n/a

2 Summary

Regulation	Class / Test level	Result	Remark(s)
FCC Rules CFR 47 Part 15 Subpart C			
Terminal voltage 0.15-30 MHz	Section 15.207	Limits kept	
Radiated emissions 0.009-30 MHz	Sections 15.209; 15.225	Limits kept	
Radiated emissions 30-1000 MHz	Section 15.209	Limit kept	
Occupied bandwidth	Section 15.215(c)	Requirement kept	
Restricted bands	Section 15.205(a)	Requirement kept	
Antenna requirement	Section 15.203	Requirement kept	

Burgrieden, 2017-05-16

Report generated by:

Acceptance inspector – Peter Hauser