

TEST REPORT

of the accredited test laboratory

TÜV Nr.: **2022-IN-AT-TICL-E-EX-000324-EMV-003-REV-3**

about
the following EMC - test/- research

Applicant: TTControl GmbH
Schoenbrunner Strasse 7
A-1040 Vienna

Product: **TTC 2038**
(FCC ID: 2AUIVTTC2030)

Serial Number: 07222780000027

Accredited FCC Part 15 (eCFR 10/31/2022) Subpart B - Unintentional
Standards: Radiators §15.109;
ANSI C63.4-2014

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Technik

TÜV®



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Certification Body,
Calibration Laboratory,
Verifizierungsstelle

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**examined by / Testing
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TÜV AUSTRIA GMBH**



28.06.2023

Michael Emminger

**approved by / Testing
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TÜV AUSTRIA GMBH**

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The results of this test report only refer to the provided equipment.

Contents

	Designation	page
1.	Applicant	3
2.	Description of EUT	4
3.	Standards / Final result	5
4.	Test results	6-9
Appendix	Designation	pages
1	Test equipment used	5
2	Photodocumentation	8
3	Calibration Data	1

1. Applicant

Company: TTControl GmbH

Department: ---

Address: Schoenbrunner Strasse 7
A-1040 Vienna

Contact person: Mr. Dipl.-Ing. Remigiusz Krzyzanowski

EUT received on: 07.11.2022

Tests were performed on: 07. + 08.11.2022

2. Description of EUT

EUT: TTC 2038

Serial Number: 07222780000027

Manufacturer: TTControl GmbH
Schoenbrunner Strasse 7
A-1040 Vienna

Description: TTControl GmbH provided the following configuration for the measurements:

- TTC 2038 (V: 00.03-B; SW: 060; PN: 14391)
- load

Operating mode: Testsoftware running

Technical data EUT: Mains voltage during the tests:
27 VDC / 11 ADC

Climatic conditions in the emc laboratory: Relative humidity: 40 %
Temperature: 23 °C

3. Standards / Final result

Name	Title	Deviation	Result
FCC Part 15 (eCFR 10/31/2022) Subpart B - Unintentional Radiators §15.109	Radio Frequency Devices	None	OK
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low- Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz. Maintenance of compliance is the responsibility of the manufacturer	None	OK
Result: Opinions and interpretation of testing laboratory OK: EUT passed NOK: EUT failed			

4. Test results

4. 1.) Radiated emission according to FCC Part 15

Class B Limits

$\leq 1 \text{ GHz} \rightarrow$ Quasi Peak Limit $> 1 \text{ GHz} \rightarrow$ Average Limit (Peak Limit 20 dB above average Limit)			
Frequency range	Limit	Bandwidth	Measurement distance
30 – 88 MHz	100 $\mu\text{V/m}$	120 kHz	3 m
88 – 216 MHz	150 $\mu\text{V/m}$	120 kHz	3 m
216 – 960 MHz	200 $\mu\text{V/m}$	120 kHz	3 m
960 MHz - 1000 MHz	500 $\mu\text{V/m}$	120 kHz	3 m
Above 1000 MHz	500 $\mu\text{V/m}$	1 MHz	3 m

Measuring apparatus parameters 30 to 1000 MHz

Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	30 MHz	30 MHz	Detector	Quasi Peak	Quasi Peak
Stop frequency	1000 MHz	1000 MHz	Measuring time	1 s	1 s
Stepsize	FFT	---	RF-attenuation	0dB	0dB
IF- Bandwidth	120 kHz	120 kHz	Preamplifier	20 dB	20 dB

Measuring apparatus parameters 1 GHz to 6 GHz

(Highest frequency generated or used in the device or on which the device operates or tunes: < 1000 MHz)

Parameter	Preview measurement	Final measurement	Parameter	Preview measurement	Final measurement
Start frequency	1 GHz	1 GHz	Detector	Max Peak / Average	Max Peak / Average
Stop frequency	6 GHz (min. 5th harmonic of the highest frequency)	6 GHz (min. 5th harmonic of the highest frequency)	Measuring time	10 ms	10 ms
Stepsize	FFT	---	RF-attenuation	0dB	0dB
IF- Bandwidth	1 MHz	1 MHz	Preamplifier	20 dB	20 dB

Measurement uncertainty

30-200 MHz horizontal: Expanded uncertainty $U_c = 4,06$ dB (Uncertainty budget = 5,06 dB)

30-200 MHz vertical: Expanded uncertainty $U_c = 4,19$ dB (Uncertainty budget = 5,17 dB)

0,2-1 GHz horizontal: Expanded uncertainty $U_c = 4,43$ dB (Uncertainty budget = 5,45 dB)

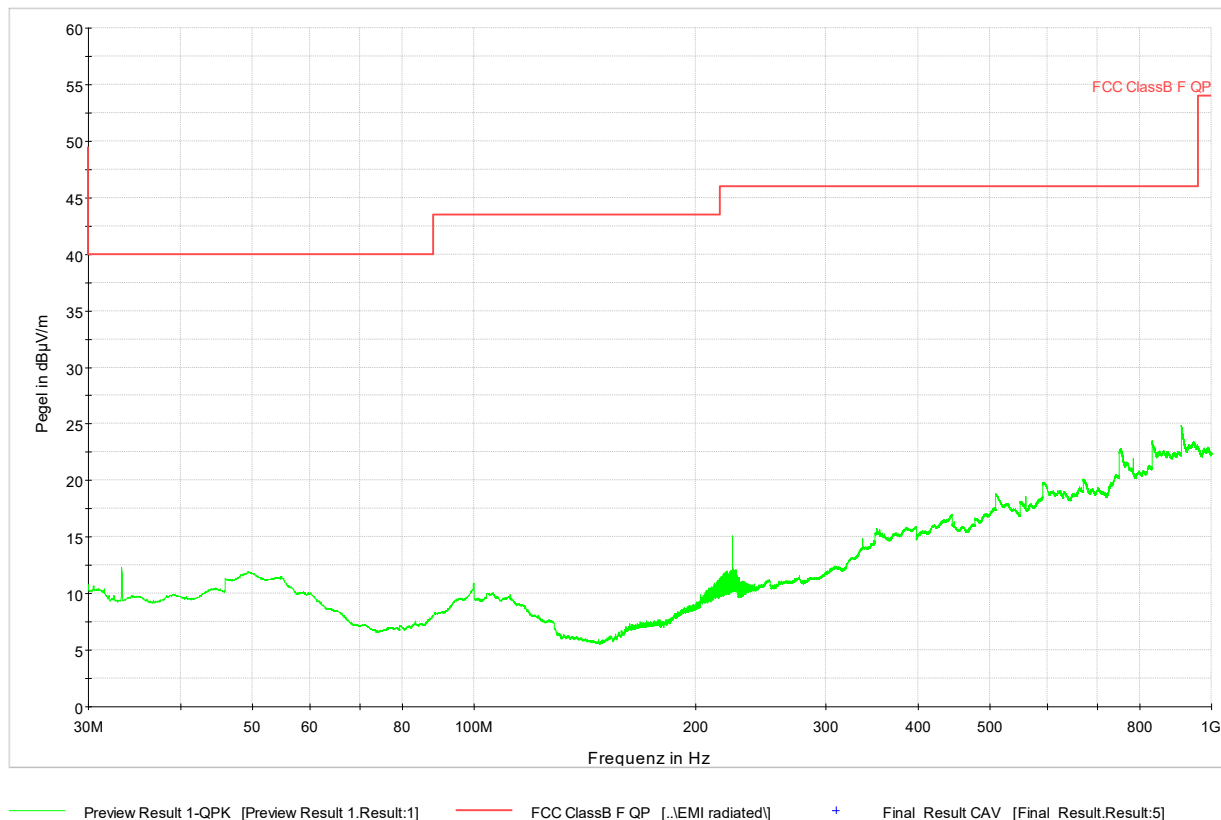
0,2-1 GHz vertical: Expanded uncertainty $U_c = 5,64$ dB (Uncertainty budget = 6,48 dB)

1-18 GHz: Expanded uncertainty $U_c = 4,40$ dB (Uncertainty budget = 5,17 dB)

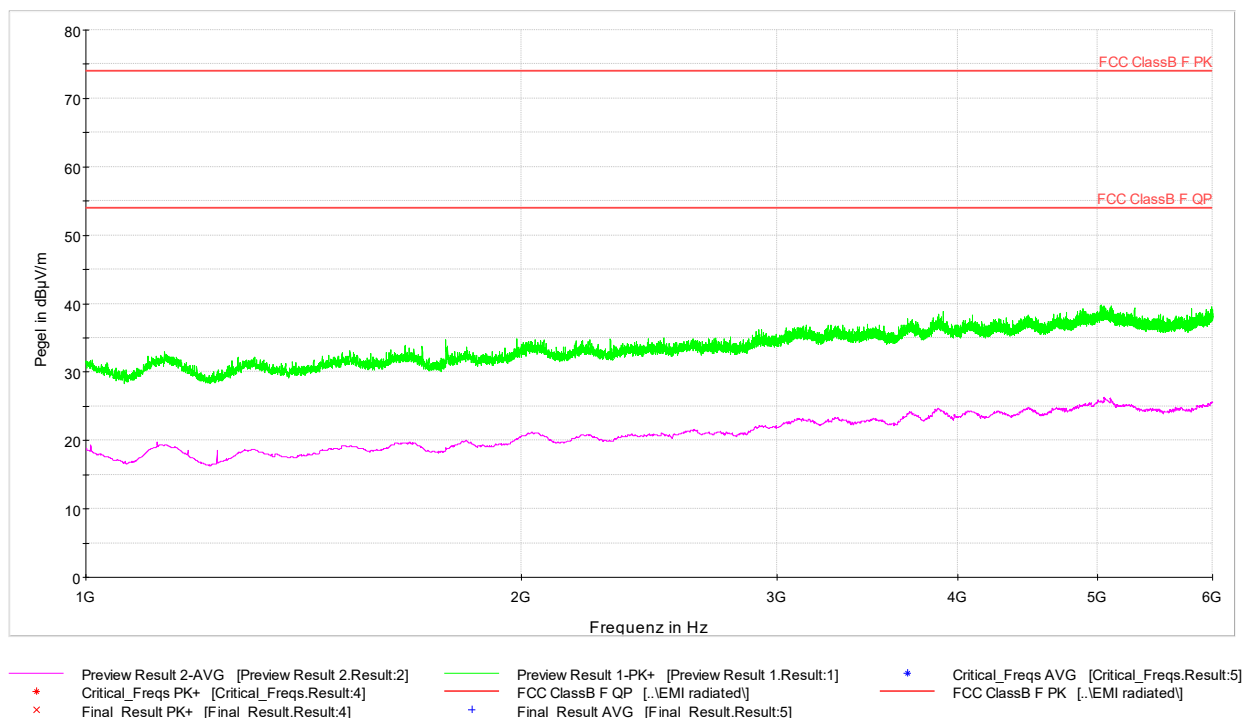
Operating mode	Measuring result
Normal operation	OK

Test result

4. 1.1.) Measurement diagram with QP-Detector (30 MHz - 1000 MHz)



4. 1.2.) Measurement with Peak- and Average Detector (1 GHz – 6 GHz)



Appendix 1

Test equipment used

☐ Anechoic Chamber with 3m measurement distance	NT-100	☐ Ant. tripod for EN61000-4-3 Model TP1000A	NT-156
☐ Stripline according to ISO 11452-5	NT-108	☐ Power quality analyzer Fluke 1760 (complete set)	NT-160 - NT-173
☐ MA4000 - Antenna mast 1 - 4 m height	NT-110/1	☐ Spectrumanalyzer – FSP7 9 kHz – 7 GHz	NT-200
☐ DS - Turntable 0 - 400 ° Azimuth	NT-111/1	☐ ESCI - Test receiver 9 kHz - 7 GHz	NT-203/1
☐ CO3000 Controller Mast+Turntable	NT-112/1	☐ ESR – Test receiver 20 Hz – 26,5 GHz	NT-207/1
☐ HUF-Z3 - Log. Per. Antenna 200 - 1000 MHz	NT-121	☐ Digital Radio Tester CMW500	NT-208/1
☐ FMZB1513 - Loop Antenna 9 kHz - 30 MHz	NT-122/1	☐ Noise-gen., ITU-R 559-2 20 Hz – 20 kHz	NT-209
☐ HFH-Z6 - Rod Antenna 9 kHz - 30 MHz	NT-123	☐ CMTA - Radiocommunication analyzer ; 0,1 - 1000 MHz	NT-210
☐ Dipole Antenna VHA9103 30 - 300 MHz	NT-124/1a	☐ 3271 - Spectrum analyzer 100 Hz - 26,5 GHz	NT-211
☐ Dipole Antenna UHA9105 300 - 1000 MHz	NT-124/1b	☐ Digital Radio Tester Aeroflex 3920	NT-212/1
☐ 3115 - Horn Antenna 1 - 18 GHz (immunity)	NT-125	☐ Mixer M28HW 26,5 GHz - 40 GHz	NT-214
☐ 3116 - Horn Antenna 18 - 40 GHz	NT-126	☐ RubiSource T&M Timing reference	NT-216
☐ SAS-200/543 - Bicon. Antenna 20 MHz - 300 MHz	NT-127	☐ Radiocommunicationanalyzer SWR 1180 MD	NT-217
☐ AT-1080 - Log. Per. Antenna 80 - 1000 MHz	NT-128	☐ Mixer FS-Z60 40 GHz – 60 GHz	NT-218/1
☐ HK-116 - bicon. Antenna 20 MHz - 300 MHz	NT-129	☐ Mixer FS-Z90 60 GHz – 90 GHz	NT-219/1
☐ HK-116 - bicon. Antenna 20 MHz - 300 MHz	NT-130	☐ DSO9104 Digital scope	NT-220/1
☐ 3146 - Log. Per. Antenna 200 – 1000 MHz	NT-131	☐ TPS 2014 Digital scope	NT-222
☐ VULB 9163 Trilog Antenna 30 – 3000 MHz	NT-131/1	☐ Artificial Ear according to IEC 60318	NT-224
☐ Loop Antenna H-Field	NT-132	☐ 1 kHz Sound calibrator	NT-225
☐ Horn Antenna 500 MHz - 2900 MHz	NT-133	☐ SRM-3006 Spectrumanalyzer	NT-233/1a
☐ Horn Antenna 500 MHz - 6000 MHz	NT-133/1	☐ E-field probe SRM 75 MHz – 3 GHz	NT-234
☐ Log. per. Antenna 800 MHz - 2500 MHz	NT-134	☐ Field Meter NBM-500 incl. E- and H-Field probes	NT-240a-e
☐ Log. per. Antenna 800 MHz - 2500 MHz	NT-135	☐ Magnetometer HP-01	NT-241/1
☐ BiConiLog Antenna 26 MHz – 2000 MHz	NT-137	☐ EFA-3 H-field- / E-field probe	NT-243
☐ Conical Dipol Antenna PCD8250	NT-138	☐ EHP-50F H-field- / E-field probe	NT-243/1
☐ HF 906 - Horn Antenna 1 - 18 GHz (emission)	NT-139	☐ Field Meter EMR-200 100 kHz – 3 GHz	NT-244
☐ HZ-1 Antenna tripod	NT-150	☐ E-field probe 100 kHz – 3 GHz	NT-245
☐ BN 1500 Antenna tripod	NT-151	☐ H-field probe 300 kHz – 30 MHz	NT-246

Division:
Industry & Energy

Test report number:
2022-IN-AT-TICL-E-EX-000324-EMV-003-REV-3

Page: 1 of 5

Date: 28.06.2023

Appendix 1 (continued)

Test equipment used

☐ E-field probe 3 MHz – 18 GHz	NT-247	☐ Prana N-MT 500 - RF-Amplifier 80 - 1000 MHz / 500 W	NT-332/1
☐ H-field probe 27 MHz – 1 GHz	NT-248	☐ BBA150 RF-Amplifier 1 GHz - 6 GHz	NT-333/1
☐ ELT-400 1 Hz – 400 kHz	NT-249	☐ APA01 – RF-Amplifier 0,5 GHz – 2,5 GHz	NT-334
☐ MDS 21 - Absorbing clamp 30 - 1000 MHz	NT-250	☐ Preamplifier 1 GHz - 4 GHz	NT-335
☐ FCC-203I EM Injection clamp	NT-251	☐ Preamplifier for GPS MKU 152 A	NT-336
☐ FCC-203I-DCN Ferrite decoupling network	NT-252	☐ Preamplifier 1 GHz – 18 GHz	NT-337/1
☐ PR50 Current Probe	NT-253	☐ DC Block 10 MHz – 18 GHz Model 8048	NT-338
☐ i310s Current Probe	NT-254/1	☐ 2-97201 Electronic load	NT-341
☐ Fluke 87 V True RMS Multimeter	NT-260	☐ TSX3510P - Power supply 0-30 V / 0 - 10 A	NT-344
☐ Model 2000 Digital Multimeter	NT-261	☐ TSX3510P - Power supply 0-30 V / 0 - 10 A	NT-345
☐ Fluke 87 V Digital Multimeter	NT-262/1	☐ VDS 200 Mobil-impuls-generator	NT-350
☐ ESH2-Z5-U1 Artificial mains network 4x25A	NT-300	☐ LD 200 Mobil-impuls-generator	NT-351
☐ ESH3-Z5-U1 Artificial mains network 2x10A	NT-301	☐ MPG 200 Mobil-Impuls-Generators	NT-352
☐ ESH3-Z6-U1 Artificial mains network 1x100A	NT-302	☐ EFT 200 Mobil-impuls-generator	NT-353
☐ ESH3-Z6-U1 Artificial mains network 1x100A	NT-302a	☐ AN 200 S1 Artificial Network	NT-354
☐ EZ10 T-Artificial Network	NT-305	☐ FP-EFT 32M 3 ph. Coupling filter (Burst)	NT-400/1
☐ SMG - Signal generator 0,1 - 1000 MHz	NT-310	☐ PHE 4500 - Mains impedance network	NT-401
☐ SMA100A - Signal generator 9 kHz - 6 GHz	NT-310/1	☐ IP 6.2 Coupling filter for data lines (Surge)	NT-403
☐ RefRad Reference generator	NT-312	☐ TK 9421 High Power Volt. Probe 150 kHz - 30 MHz	NT-409
☐ SMP 02 Signal generator 10 MHz - 20 GHz	NT-313	☐ ESH2-Z3 - Probe 9 kHz - 30 MHz	NT-410
☐ 40 MHz Arbitrary Generator TGA1241	NT-315	☐ IP 4 - Capacitive clamp (Burst)	NT-411
☐ Artificial mains network NSLK 8127-PLC	NT-316	☐ Highpass-Filter 100 MHz – 3 GHz	NT-412
☐ PSURGE 4.1 Surge generator	NT-324	☐ Highpass-Filter 600 MHz – 4 GHz	NT-413
☐ IMU4000 Immunity test system	NT-325/1a-e	☐ Highpass-Filter 1250 MHz – 4 GHz	NT-414
☐ VCS 500-M6 Surge-Generator	NT-326	☐ Highpass-Filter 1800 MHz – 16 GHz	NT-415
☐ Oscillatory Wave Simulator incl. Coupling networks	NT-328a+b+c		
☐ BTA-250 - RF-Amplifier 9 kHz - 220 MHz / 250 W	NT-330		

Division:
Industry & Energy

Test report number:
2022-IN-AT-TICL-E-EX-
000324-EMV-003-REV-3

Page: 2 of 5

Date: 28.06.2023

Appendix 1 (continued)

Test equipment used

☐	RF-Attenuator 10 dB DC – 18 GHz / 50 W	NT-417/1	☐	SW 9605 - Current probe 150 kHz – 30 MHz	NT-465/1
☐	RF-Attenuator 6 dB DC – 18 GHz / 50 W	NT-418	☐	95242-1 – Current probe 1 MHz – 400 MHz	NT-468
☐	RF-Attenuator 3 dB DC – 18 GHz / 50 W	NT-419	☐	94106-1L-1 – Current probe 100 kHz – 450 MHz	NT-471
☐	RF-Attenuator 20 dB DC - 1000 MHz / 25 W	NT-421	☐	WHKX12-2700-3000-18000 3 GHz Highpass filter	NT-472
☐	RF-Attenuator 30 dB DC - 1000 MHz / 1 W	NT-423	☐	WHKX10-3870-4500-18000 4,5 GHz Highpass filter	NT-473
☐	RF-Attenuator 30 dB	NT-424	☐	CDN S9 USB3.0 Coupling decoupling network	NT-474
☐	RF-Attenuator 6 dB DC - 1000 MHz / 1 W	NT-425	☐	CDN S2 XLR3-1 Coupling decoupling network	NT-475
☐	RF-Attenuator 6 dB DC - 1000 MHz / 1 W	NT-426	☐	CDN S8 RJ45 Coupling decoupling network	NT-476
☐	RF-Attenuator 6 dB	NT-428	☐	GA 1240 Power amplifier according to EN 61000-4-16	NT-480
☐	RF-Attenuator 0 dB - 81 dB	NT-429	☐	Coupling networks according to EN 61000-4-16	NT-481 - NT-483
☐	WRU 27 - Band blocking 27 MHz	NT-430	☐	Van der Hoofden Test Head	NT-484
☐	WHJ450C9 AA - High pass 450 MHz	NT-431	☐	WRCJV12-5820-5850-5950-5980 5,9 GHz Band Reject Filter	NT-490
☐	WHJ250C9 AA - High pass 250 MHz	NT-432	☐	WHKX10-5670-6300-18000 6 GHz Highpass filter	NT-491
☐	RF-Load 150 W	NT-433	☐	WHK12-935-1000-7000 1 GHz Highpass filter	NT-492
☐	Impedance transducer 1:4 ; 1:9 ; 1:16	NT-435	☐	EMC Video/Audiosystem	NT-511/1
☐	RF-Attenuator DC – 18 GHz 6 dB	NT-436	☐	EMC32 Version 10.60.20 Test software	NT-520/1
☐	RF-Attenuator DC – 18 GHz 6 dB	NT-437	☐	SRM-TS Version 1.3 software for SRM-3000	NT-522
☐	RF-Attenuator DC – 18 GHz 10 dB	NT-438	☐	SRM-TS Version 1.3.1 software for SRM-3006	NT-522/1
☐	RF-Attenuator DC – 18 GHz 20 dB	NT-439	☐	Spitzenberger und Spies Test software V4.1	NT-525
☐	I+P 7780 Directional coupler 100 - 2000 MHz	NT-440	☐	Vertical coupling plane (ESD)	NT-531
☐	ESH3-Z2 - Pulse limiter 9 kHz - 30 MHz	NT-441	☐	Test cable #4 for EN 61000-4-6	NT-553
☐	Power Divider 6 dB/1 W/50 Ohm	NT-443	☐	Test cable #3 for conducted emission	NT-554
☐	Directional coupler 0,1 MHz – 70 MHz	NT-444	☐	Test cable #5+#6 ESD-cable (2x470k)	NT-555 + NT-556
☐	Directional coupler 0,1 MHz – 70 MHz	NT-445	☐	Test cable #8 Sucoflex 104EA	NT-559
☐	Tube imitations according to EN 55015	NT-450	☐	Test cable #9 (for outdoor measurements)	NT-580
☐	FCC-801-M3-16A Coupling decoupling network	NT-458	☐	Test cable #10 (for outdoor measurements)	NT-581
☐	FCC-801-M2-50A Coupling decoupling network	NT-459	☐	Test cable #13 Sucoflex 104PE	NT-584
☐	FCC-801-M5-25 Coupling decoupling network	NT-460	☐	Test cable #21 for SRM-3000	NT-592
☐	FCC-801-T4 Coupling decoupling network	NT-463	☐	Shield chamber	NT-600
☐	FCC-801-C1 Coupling decoupling network	NT-464	☐	Climatic chamber	M-1200

Division:
Industry & Energy

Test report number:
2022-IN-AT-TICL-E-EX-
000324-EMV-003-REV-3

Page: 3 of 5

Date: 28.06.2023

Appendix 1 (continued)

Test equipment used

☒	Anechoic Chamber 3 m / 5 m measuring distance	EMV-100	☐	HF- Amplifier 9 kHz-225 MHz BBL200	EMV-300/1
☒	Turntabel 6 m diameter	EMV-101	☐	HF- Amplifier 80 -1000 MHz BBA150	EMV-301
☒	Antenna mast + controller	EMV-102+ EMV-103	☐	HF- Amplifier 0,8 - 6 GHz BBA150	EMV-302
☒	EMC Video/Audiosystem	EMV-104	☐	High Power Ant. 20-200 MHz HPBA-2510	EMV-303/1
☒	EMC Software EMC32 Version 10.60.20	EMV-105	☐	High Power Ant. 20-200 MHz S12018-21	EMV-303/2
☒	Hornantenna 1 – 18 GHz HF 907	EMV-110	☐	Log.per Antenna 80-2700 MHz STLP 9128 E special	EMV-304
☒	Antennapre.amp. 1 – 18 GHz BBV 9718 D	EMV-111/1	☐	Log.per Antenna 0,7 – 9 GHz STLP9149	EMV-305
☒	Trilog Antenna 30-3000 MHz VULB9163	EMV-112	☐	HF- Amplifier 9 kHz-250 MHz BBA150 (low noise)	EMV-306
☐	Monopol 9 kHz – 30 MHz VAMP 9243	EMV-113	☐	ISO11451-2 TLS 10 kHz – 30 MHz	EMV-307
☐	Antennapre.amp 18 – 40 GHz BBV 9721	EMV-114	☐	Load Dump Generator LD 200N	EMV-350
☐	Hornantenna 200 – 2000 MHz AH-220	EMV-115	☐	Ultra Compact Symulator UCS 200N100	EMV-351
☐	DC Artificial Network PVDC 8300	EMV-150	☐	Automotive Power fail module PFM 200N100.1	EMV-352
☐	AC Artificial Network NNLK 8121 RC	EMV-151	☐	Voltage Drop Symulator VDS 200Q100	EMV-353
☐	AC Artificial Network NNLK 140	EMV- 153a-d	☐	Arb. Generator AutoWave	EMV-354
☒	EMI Receiver ESW44	EMV-200/1	☐	Ultra Compact Symulator UCS 500N7	EMV-355
☐	Signalgenerator 9 kHz – 40 GHz N5173B	EMV-201	☐	Coupling decoupling network CNI 503B7 / 32 A	EMV-356
☒	GPS Frequency normal B-88	EMV-202	☐	Coupling decoupling network CNI 503B7 / 63 A	EMV-357
☒	DC Power supply N5745A	EMV-203	☐	Telecom Surge Generator TSurge 7	EMV-358
☐	Spektrum Analyzator FSV40	EMV-205	☐	Coupling decoupling network CNI 508N2	EMV-359
☐	Thd Multimeter Model 2015	EMV-206	☐	Coupling decoupling network CNV 504N2.2	EMV-360
☐	Poweramplifier PAS15000	EMV- 207/abc	☐	Immunity generator NSG4060/NSG4060-1	EMV-361
☐	Inrush Current Source	EMV- 208/abc	☐	Coupling network CDND M316-2	EMV-362
☐	Arb.-generator Sycore	EMV-209	☐	Coupling network CT419-5	EMV-363
☐	Harmonics/Flicker analyzer ARS 16/3	EMV-210	☐	ESD Generator NSG 437	EMV-364
☐	Power Supply Regatron AC	EMV-214	☐	Pulse Limiter VTSD 9561-F BNC	EMV-405
☐	Power Supply Regatron DC	EMV-215	☐	Transient emission BSM200N40+BS200N100	EMV- 450+451
☐	Harmonics/Flicker analyser Zimmer	EMV-216	☐	Cap. Coupling Clamp HFK	EMV-455
☐	Flicker Impedanz Newtons4th 753	EMV-218	☐	Mag. Field System MS100N+MC26100+MC2630	EMV- 456-458
☐	Comemso	EMV-219			

Division:
Industry & Energy

Test report number:
2022-IN-AT-TICL-E-EX-
000324-EMV-003-REV-3

Page: 4 of 5

Date: 28.06.2023

Appendix 1 (continued)

Test equipment used

Division:
Industry & Energy

Test report number:
2022-IN-AT-TICL-E-EX-
000324-EMV-003-REV-3

Page: 5 of 5

Date: 28.06.2023

☐	Coupling network CDN M2-100A	EMV-459
☐	Coupling network CDN M3-32A	EMV-460
☐	Coupling network CDN M5-100A	EMV-461
☐	Current Clamp CIP 9136A	EMV-462
☐	DC Artificial Network HV-AN 150	EMV-464+465
☐	Coupling Clamp EM 101	EMV-466
☐	Decoupling Clamp FTC 101	EMV-467
☐	Power attenuator 10 dB / 250 Watt	EMV-469/2
☐	HV AMN NNHV 8123 800A	EMV-472
☐	HV AMN NNHV 8123 800A	EMV-473

Appendix 3

Calibration Data

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due
Receiver	Rohde & Schwarz	ESW44	EMV-200/1	03.11.2021	03.12.2022
Anechoic Chamber	Frankonia	---	EMV-100	13.01.2022	13.01.2023
Horn antenna	Rohde & Schwarz	HF907	EMV-110	07.02.2022	07.02.2024
Pre. Amp.	Schwarzbeck	BBV9718D	EMV-111/1	09.02.2022	09.02.2023
Trilog Antenna	Schwarzbeck	VULB9163	EMV-112	11.11.2021	11.11.2023