EMC Test Report 21-0188

Designation:	ERA CAT 2, COPPER TRANSPORT (7847569-00)
Manufacturer:	CommScope
Serial No(s):	TJBEAE2035A0522
Regulation(s):	FCC 47 CFR Part 15 Subpart B
Measurement Procedure(s):	ANSI C63.4:2014
Test Plan:	Not provided.
Test Result:	**Passed**

Date of issue:	22.10.2021		Signature:
Version:	03	Technical Reviewer:	Gerhard Gass Test Engineer Digital unterschrieben von Gerhard Gass DN: cn=Gerhard Gass, o=Bureau Veritas CPS, ou=EMC, email=gerhard.gass@de.bureauveritas.com, c=DE Datum: 2021.10.22 16:18:54 +02'00'
Date of delivery:	27.08.2021		
Performance Date:	31.08.2021	Report Reviewer:	Florian Mosandl Lab Manager Digitally signed by Florian Mosandl DN: cn=Florian Mosandl, l=DE, o=Bureau Veritas CPS, ou=ECL, email=Florian.Mosandl@BureauVeritas.com, c=Germany, givenName=Florian Mosandl Date: 2021.10.26 15:46:01 +02'00'

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BNetzA-CAB-19/21-20

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Laboratory accreditation no:	DAkkS D-PL-12024-06-04 BNETZA-CAB-19/21-20
FCC Designation Number:	DE0023
FCC Test Firm Registration:	366481
ISED CAB Identifier	DE0016
ISED Company Number	3475A

Versions management:

V 01	Initial release
V 02	Accessory/Peripheral Devices added at chapter 2.5
V 03	Highest internal frequency removed in chapter 2.1; Reference to §15.31(f)(1)] at chapter 4.2.1 for radiated emission measurements between 30MHz and 1GHz

Table of Contents

1 General

1.1 Purpose

This report documents the qualification testing for the Drive-Over-Reader system to FCC 47CFR Part 15 Subpart B Class B. The system is referred to as the EUT from here on for the purpose of this report. All emission testing was performed per ANSI C63.4 (methods of measurement of radio-noise emissions from low-voltage electrical and electronic equipment in the range of 9 kHz to 40 GHz).

(a) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

1.2 Requirements according to FCC 47 CFR Part 15 Subpart B

Test Description	Regulation	Remarks	Test Result
AC powerline conducted emission	§15.107	Refer to corresponding test chapter for details.	Pass
Electric field radiated emission 30 – 1000 MHz	§15.109	Refer to corresponding test chapter for details.	Pass
Electric field radiated emission above 1 GHz	§15.109	Refer to corresponding test chapter for details.	Pass

2 DUT Description

The following information and instructions of this chapter was provided by client.
The performance and statements of applicability of the tests is based on this information and this may therefore have an impact on the validity of the test verdict.

2.1 General Information

Designation	ERA CAT 2, COPPER TRANSPORT
Manufacturer	CommScope
Serial No(s)	TJBEAE2035A0522
Hardware Version	7847569-00 (ERA CAT2, Copper Transport)
Soft-/Firmware Version	2.8.900.3
Device Type	Table top
Equipment classification	Industrial environment
Supply voltage(s)	120 V
Supply voltage used for testing [1]	120 V

System-ports:			
Designation	Type	Shielding	Remarks
AC Mains input 2	L, N, PE	Unshielded	---
AC Mains input 3	L, N, PE	Unshielded	---

Test Plan:
Not provided.

[1] If not otherwise specified in the corresponding test chapter

2.2 DUT Description

The CAT Card provides power and 10 Gbps data over Cat6A Ethernet cables to Access Points (UAPs or Copper CAP Ls). For Power over Ethernet at least one 57 Vdc Power Rectifier Module must be installed in the Power Supply Subrack to use a CAT Card.
The existing ERA CAT card (7633228-02) will be initially modified by BOM changes to support only the new UAP/CAP-L 2.0 Remotes that are IEEE 802.3bt PoE compliant. This new ERA CAT will be designated CAT 2 with a new PCBA and top-level part number (7847568-00 [assembled PCB] and 7847569-00 [CAT 2 Card]) and a new front panel overlay (7847570-00) on the card to identify it as a CAT 2.

2.3 Grounding

The DUT was connected to ground during the test by a separate ground bonding stip connected to the EUT's dedicated grounding point.

2.4 Operating Modes

Mode	Description
Normal operation	Idle mode.

2.5 Accessory/Peripheral Devices

Device	Location	Material ID	Serial Number	MFG Date	Component
1.0.AUT.M1	FCC 15 Test CAT 2	7642132-00	SZBEAK1626A0005	2016	AUT, Auxiliary Transport
1.0.BKP	FCC 15 Test CAT 2	7642109-01	22519040255	2019	WCS, 4U Backplane Assembly
1.0.CAT.L1	FCC 15 Test CAT 2	7633228-01	SZBEAE1702A0011	2017	CAT, Copper Transport
1.0.CAT.L2	FCC 15 Test CAT 2	7847569-00	TJBEAE2035A0522	2020	ERA CAT2, Copper Transport for 2.0 Remote
1.0.OPT.L4	FCC 15 Test CAT 2	7642122-ENG-03	MA68	2014	Cover
1.0.PSU	FCC 15 Test CAT 2	7693531-00	psu_1_0	unknown	PSU Shelf, AC
1.0.PSU.2	FCC 15 Test CAT 2	7663610-00	psu12V_1_0_2	unknown	Power Supply Unit AC/DC IN 100-240V (12VDC)
1.0.PSU.3	FCC 15 Test CAT 2	7663468-00	psu55V_1_0_3	unknown	Power Supply Unit AC/DC IN 100-240V (55VDC)
1.0.RFD.R2	FCC 15 Test CAT 2	7633229-00	SZBEAG1623A0004	2016	RFD, RF Donor
1.0.SUI.M3	FCC 15 Test CAT 2	7642125-00	SZBEAC1934A0019	2019	SUI, System Interface
1.0.WCS	FCC 15 Test CAT 2	7635442-01	SZAEAH1905A0058	2019	WCS-4 Subrack

2.6 Modifications

None.

3 Description of EMC test laboratory

3.1 Climatic conditions during measurements

The climatic conditions were within the following ranges.
For ESD testing, the conditions during the test were denoted in the corresponding chapter.

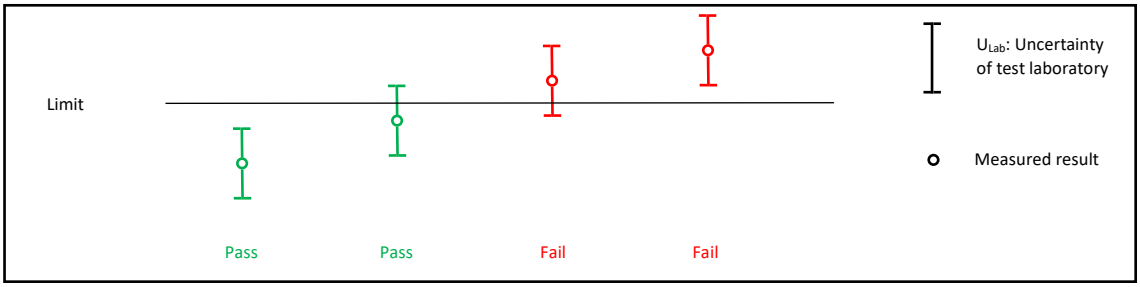
Ambient temperature:	15 – 35 °C
Relative humidity:	30 – 60 %
Air pressure:	860 – 1060 hPa

3.2 Decision of Conformity

The laboratory applies a decision rule following the "Binary Statement for Simple Acceptance Rule (*w*=0)" (chapter 4.2.1) of ILAC Guidelines on Decision Rules and Statements of Conformity (ILAC-G8:09/2019) or CISPR 16-4-2:2014, chapter 4.2. The client has agreed with application of the decision rule prior testing and demanded a statement of conformity by the test laboratory.
The calculations of the measurement uncertainty were performed in line with the requirements of ISO/IEC 17025:2017.

Statements of conformity are reported as:

- Pass - the measured value is below the acceptance limit
- Fail - the measured value is above the acceptance limit



There is a risk of a "False Accept" as well as a "False Reject" when the measured value plus the measurement uncertainty U_{Lab} is above respectively below the specification limit.

3.3 Measurement uncertainty

The table below shows the measurement uncertainties for each measurement method. The expanded uncertainty was calculated with worst case values over the complete frequency area.

Measurement method	Parameter	Description	Exp. Uncertainty (k=2)
Radiated emission	30 MHz – 1 GHz	Semi anechoic chamber	± 5,3 dB
	1 GHz – 6/18 GHz	Fully/Semi anechoic chamber	± 4,7/ 4,4 dB
Conducted emission	9 kHz - 150 kHz 150 kHz - 30 MHz	Semi anechoic chamber	± 3,8 dB ± 3,4 dB

4 Measurements acc. to FCC 47 CFR Part 15 Subpart B

4.1 AC powerline conducted emission

4.1.1 Overview

DUT	ERA CAT2, Copper Transport
Serial No.	TJBEAE2035A0522
Modification	None
Mode(s)	Normal operation (refer to chapter 2.4 for detailed information)

	Test Parameter	**Remarks**
Requirement(s)	§15.107	
Test method	ANSI C63.4:2014	
Limit	Class B	
Frequency Range	150 kHz – 30 MHz	
Resolution Bandwidth	9 kHz	
Detector (Final)	Quasipeak / CISPR-Average	
Coupling Device	V-LISN	
Supply Voltage	120 V / 60 Hz	
Port(s)	AC mains ports input 2 and input 3	
Line(s)	L, N	

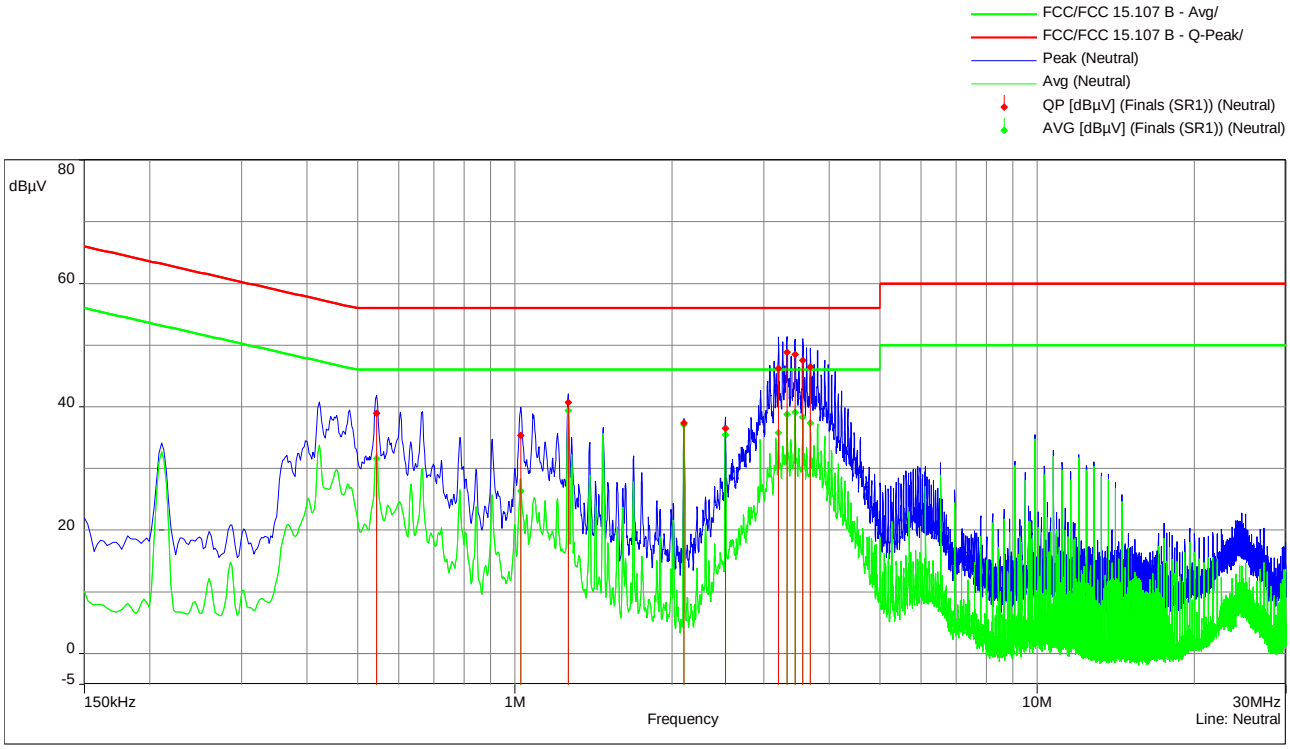
4.1.2 Result

Test location	SAC
Test engineer	Gass
Test Date	31.08.2021
Verdict	Pass

4.1.3 Test equipment

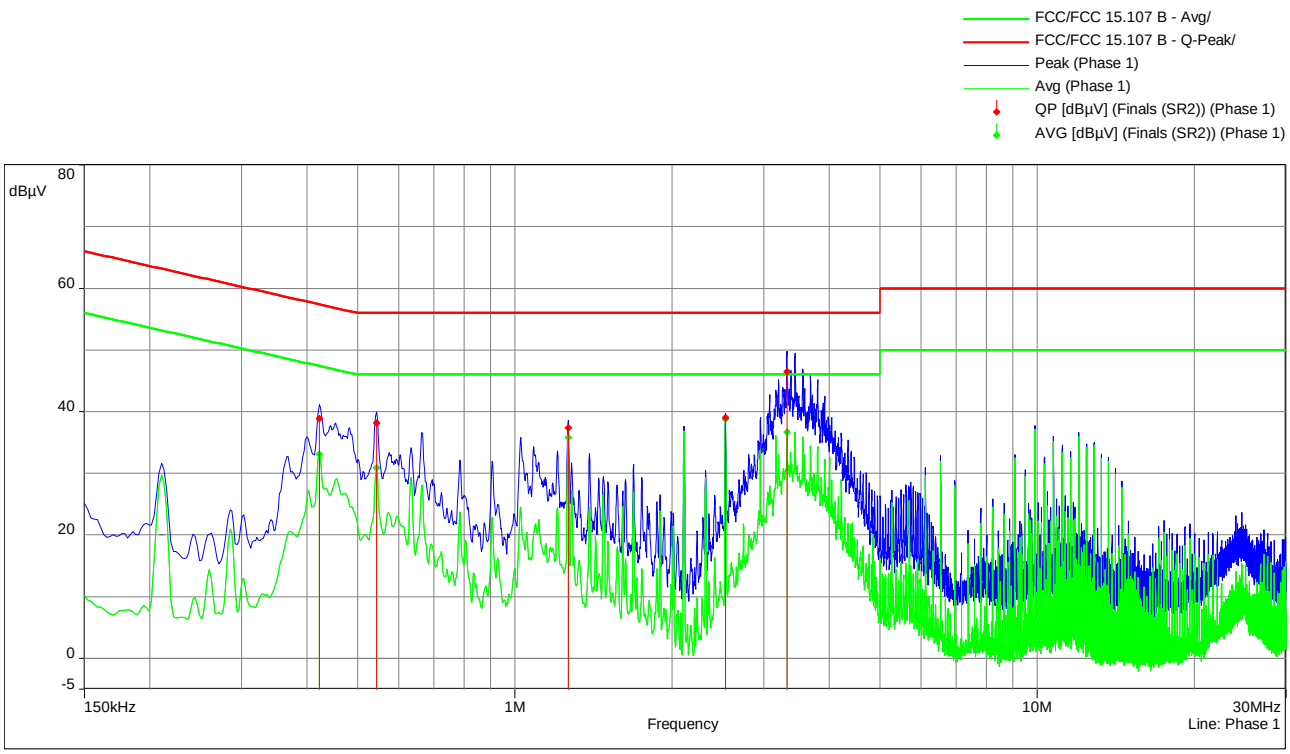
Designation	Type	Manufacturer	Inventory No.	Cal. Date	Next Cal.
EMI test receiver	ESU40	Rohde & Schwarz	E2025	08.12.2020	08.12.2021
Transient Limiter	ESH3-Z2	Rohde & Schwarz	K877	19.12.2019	19.12.2021
LISN (2x10 A)	ESH3-Z5	Rohde & Schwarz	K 679	23.03.2021	23.03.2023
Measurement Software	BAT-EMC, V3.20.0.10	Nexio	---	---	---

4.1.4 Detailed measurement data



Frequency (MHz)	QP (dBµV)	Limit QP (dBµV)	Margin QP (dB)	AVG (dBµV)	Limit AVG (dBµV)	Margin AVG (dB)
0.54375	38.93	56.00	17.07	31.60	46.00	14.40
1.0275	35.37	56.00	20.63	26.37	46.00	19.63
1.266	40.67	56.00	15.33	39.43	46.00	6.57
2.10975	37.38	56.00	18.62	37.14	46.00	8.86
2.5305	36.46	56.00	19.54	35.48	46.00	10.52
3.19875	46.25	56.00	9.75	35.79	46.00	10.21
3.32025	48.84	56.00	7.16	38.79	46.00	7.21
3.44175	48.46	56.00	7.54	39.11	46.00	6.89
3.56325	47.52	56.00	8.48	38.37	46.00	7.63
3.6825	46.47	56.00	9.53	37.37	46.00	8.63

Measurement 1: Line N from power supply input 2 and 3



Frequency (MHz)	QP (dBµV)	Limit QP (dBµV)	Margin QP (dB)	AVG (dBµV)	Limit AVG (dBµV)	Margin AVG (dB)
0.42225	38.83	57.40	18.57	33.09	47.40	14.31
0.54375	38.12	56.00	17.88	30.93	46.00	15.07
1.266	37.35	56.00	18.65	35.82	46.00	10.18
2.5305	39.00	56.00	17.00	38.74	46.00	7.26
3.32025	46.52	56.00	9.48	36.69	46.00	9.31

Measurement 2: Line L from power supply input 2 and 3

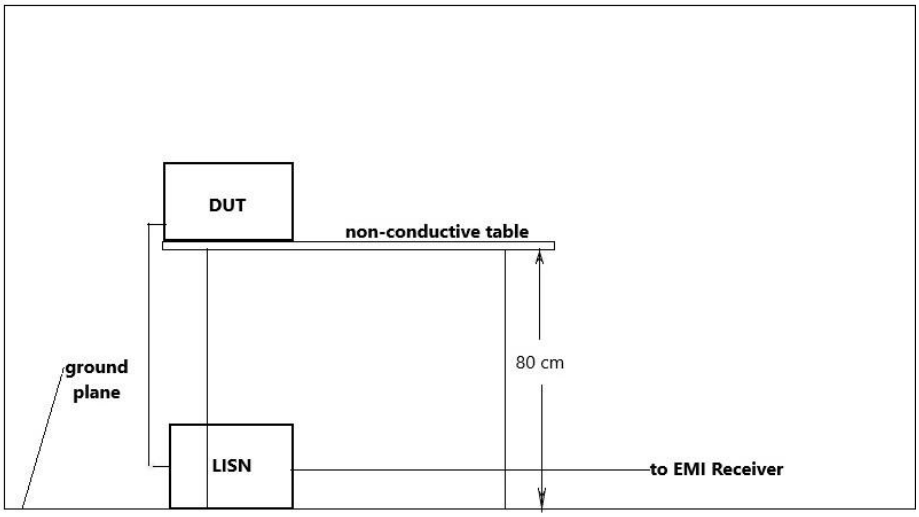
4.1.5 Measurement Procedure

The measurements were performed in line with ANSI C63.4:2014 with the DUT operating in the mode as indicated in the table above causing maximum emissions according to clients declaration, consistent with normal applications. The DUT load was adjusted within the range specified by client in order to maximize the emissions.

For this test, the DUT was placed at a distance of 80 cm from the LISN. A vertical ground reference plane was not used.

The 50 Ω measuring port is terminated into a 50 Ω EMI receiver and all other ports are terminated into 50 Ω loads.

Details are as indicated below:



4.2 Electric field radiated emission in the frequency range 30 – 1000 MHz

4.2.1 Overview

DUT	ERA CAT2, Copper Transport
Serial No.	TJBEAE2035A0522
Modification	None
Mode(s)	Normal operation (refer to chapter 2.4 for detailed information)

	Test Parameter	**Remarks**
Requirement(s)	§15.109	
Test method	ANSI C63.4:2014	
Limit	Class B	
Frequency Range	30 – 1000 MHz	
Resolution Bandwidth	120 kHz	
Detector (Final)	Quasipeak	
Distance	10 m	Limit has been adjusted to correspond with measurement distance at 10m [referenced to §15.31(f)(1)]
Scan Heights	1 – 4 m	
Polarizations	horizontal & vertical	
Test site	Semi anechoic chamber (SAC)	
DUT Orientation(s)	1	DUT has a defined orientation
Supply Voltage	120 V /60 Hz	

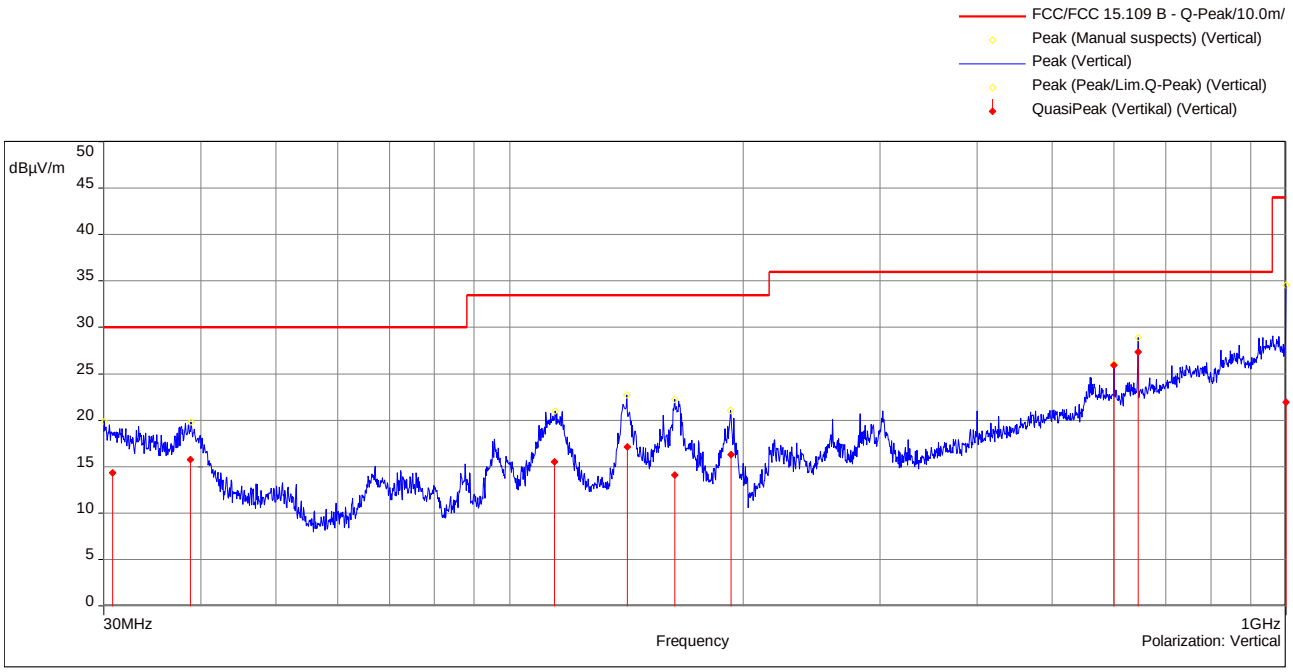
4.2.2 Result

Test location	SAC
Test engineer	Gass
Test Date	31.08.2021
Verdict	Pass

4.2.3 Test equipment

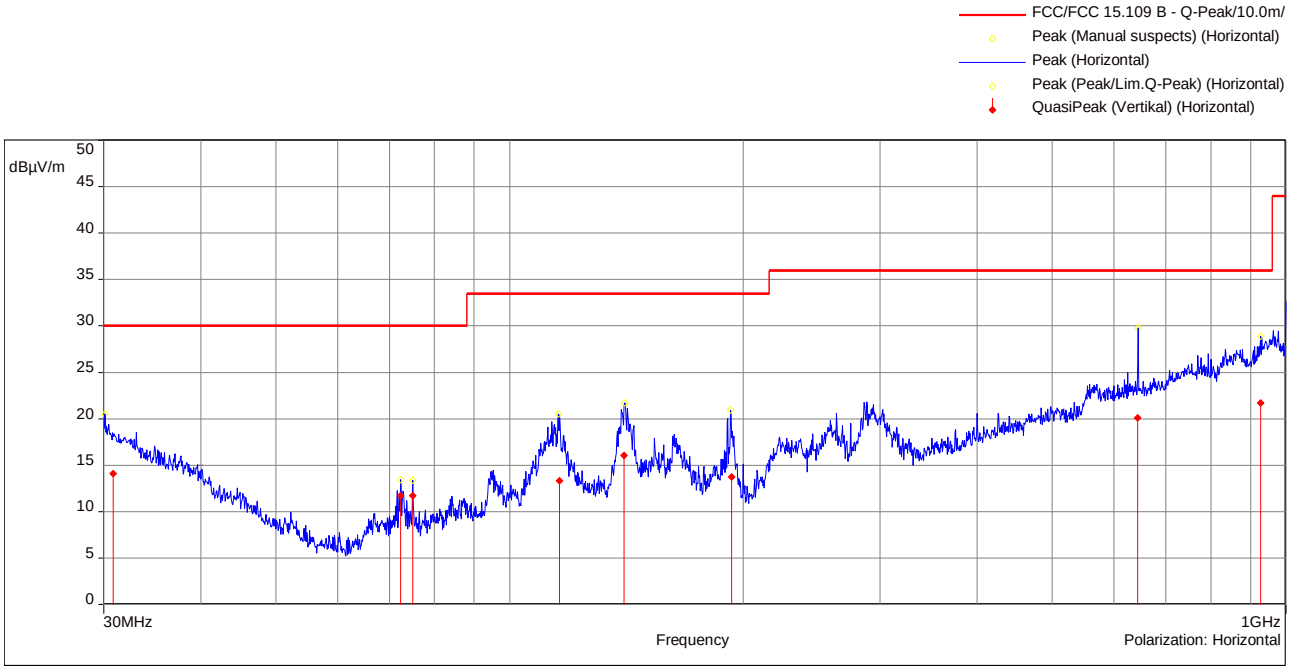
Designation	Type	Manufacturer	Inventory No.	Cal. Date	Next Cal.
EMI test receiver	ESU40	Rohde & Schwarz	E2025	08.12.2020	08.12.2021
Antenna	CBL 6111	Chase	K1026	19.02.2021	19.02.2023
Preamplifier	AM1431	Miteq	K1721	10.12.2020	10.12.2021
Measurement Software	BAT-EMC, V3.20.0.10	Nexio	---	---	---

4.2.4 Detailed measurement data



Frequency (MHz)	QuasiPeak (dBµV/m)	Margin (dB)	Limit (dBµV/m)	Angle (°)	Hight (m)	Polarization
30.78	14.34	15.66	30.00	139.10	2.40	Vertical
38.77	15.75	14.25	30.00	-90.00	1.00	Vertical
114.25	15.50	18.00	33.50	129.20	1.41	Vertical
141.88	17.12	16.38	33.50	50.60	1.00	Vertical
163.27	14.11	19.39	33.50	23.90	1.00	Vertical
192.67	16.31	17.19	33.50	-160.70	1.16	Vertical
599.98	25.93	10.07	36.00	-52.80	2.87	Vertical
644.53	27.37	8.63	36.00	98.20	2.09	Vertical
999.81	21.93	22.07	44.00	-45.70	2.15	Vertical

Measurement 3: Vertical polarization



Frequency (MHz)	QuasiPeak (dBµV/m)	Margin (dB)	Limit (dBµV/m)	Angle (°)	Hight (m)	Polarization
30.87	14.09	15.91	30.00	-109.10	3.65	Horizontal
72.34	11.71	18.29	30.00	-80.70	3.97	Horizontal
75.01	11.74	18.26	30.00	104.80	4.00	Horizontal
115.84	13.29	20.21	33.50	66.40	3.99	Horizontal
140.35	16.08	17.42	33.50	-80.50	4.00	Horizontal
193.06	13.71	19.79	33.50	-80.50	3.37	Horizontal
644.44	20.10	15.90	36.00	66.10	3.84	Horizontal
927.88	21.69	14.31	36.00	-2.50	1.25	Horizontal

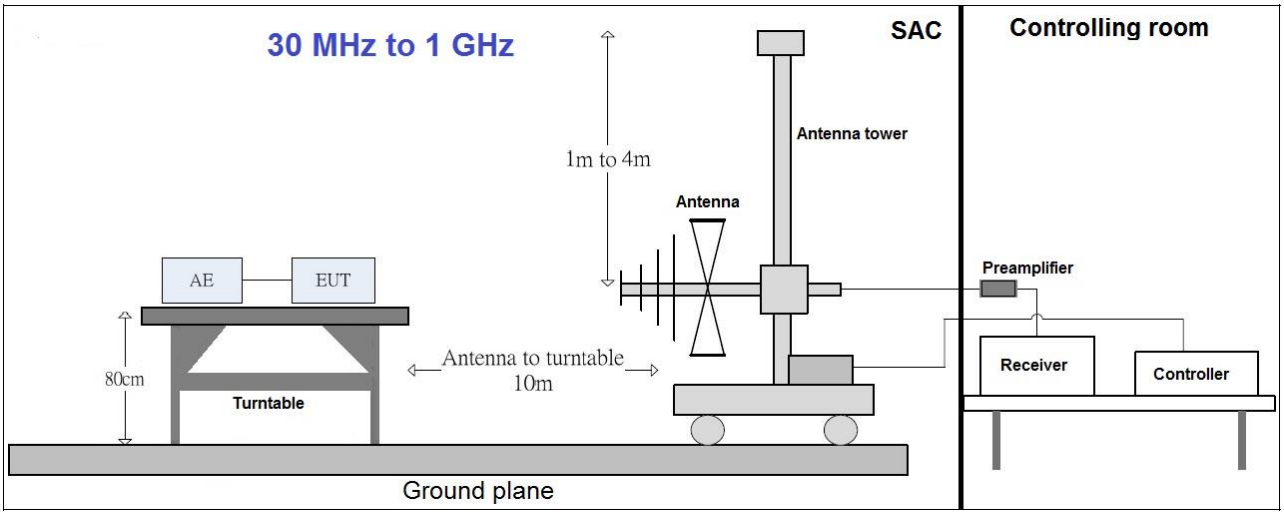
Measurement 4: Horizontal polarization

4.2.5 Measurement Procedure

The measurements were made in the operating mode, with the EUT producing the maximum emission, consistent with normal applications. The EUT load was adjusted within the range specified by manufacturer in order to maximize the emission.

For this test, the EUT was placed on the turntable at a distance of 10 m from the receive antenna. The EUT was positioned on a 10 cm high wooden pallet or on a nonconductive table. The connecting lines to the EUT were fed in from above (as in the installation). The system ground was connected to the ground plane. The turntable was connected directly to the ground system of the test chamber.

While EUT power is on, an operator manually scans the selected frequency range using an EMI test receiver to identify signals being generated by the EUT. At this time the operator determines which signals generated by EUT are significant enough to assign to the final data list in the computer. The signals on the final list are automatically characterized while the antenna is in both horizontal and vertical polarity. The tower and turntable are controlled by the operator. The maximized signal indication on the receiver is then combined with the calibration factors, cable insertion loss and the proper antenna factors to provide the emission level in dB µV/m which is compared directly with the requirement stored in the program libraries. The maximum RFI field strength was determined during the measurement by rotating the turntable (±180 degrees) and varying the height of the receive antenna (h = 1 ... 4 m).



Step 1: Preliminary scan
This is a preliminary test to identify the highest amplitudes relative to the limit.
Settings for step 1:
- Antenna distance: 10 m
- Detector: Peak-Maxhold / Quasipeak (FFT-based)
- Frequency range: 30 – 1000 MHz
- Frequency steps: 30 kHz
- IF–Bandwidth: 120 kHz
- Measuring time / Frequency step: 100 ms
- Turntable angle range: –180° to 180°
- Turntable step size: 15°
- Height variation range: 1 – 4 m
- Height variation step size: 2 m
- Polarisation: Horizontal + Vertical

Intention of this step is, to determine the radiated EMI-profile of the EUT. Afterwards the relevant emissions for the final measurement are identified.

Step 2: Adjustment measurement
In this step the accuracy of the turntable azimuth and antenna height will be improved. This is necessary to find out the maximum value of every frequency.
For each frequency, which was determined the turntable azimuth and antenna height will be adjusted. The turntable azimuth will slowly vary by ± 45° around this value. During this action, the value of emission is continuously measured. The turntable azimuth at the highest emission will be recorded and adjusted. In this position, the antenna height will also slowly vary by ± 100 cm around the antenna height determined. During this action, the value of emission is also continuously measured. The antenna height of the highest emission will also be recorded and adjusted.
- Detector: Peak – Maxhold
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 100 ms
- Turntable angle range: ± 30 ° around the determined value
- Antenna Polarisation: max. value determined in step 1

Step 3: Final measurement with QP detector
With the settings determined in step 3, the final measurement will be performed:
EMI receiver settings for step 4:
- Detector: Quasi-Peak
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 120 kHz
- Measuring time: 1 s

After the measurement a plot will be generated which contains a diagram with the results of the preliminary scan and a chart with the frequencies and values of the results of the final measurement.

4.2.6 Field Strength Calculations

FS = SA + AF + CL

Where:

FS = Total Field Strength
SA = EMC test receiver Reading
AF = Antenna Factor
CL = Cable Loss

4.3 Electric field radiated emission in the frequency range 1 – 26 GHz

4.3.1 Overview

DUT	ERA CAT2, Copper Transport
Serial No.	TJBEAE2035A0522
Modification	None
Mode(s)	Normal operation (refer to chapter 2.4 for detailed information)

	Test Parameter	**Remarks**
Requirement(s)	§15.109	
Test method	ANSI C63.4:2014	
Limit	Class B	
Frequency Range	1 – 26 GHz	5th harmonic of the highest frequency acc. to §15.33(b)
Resolution Bandwidth	1 MHz	
Detector (Final)	Peak / Average	
Distance	3 m	
Scan Heights	1 – 4 m	
Polarizations	horizontal & vertical	
Test site	Semi anechoic chamber (SAC) with rf absorbers on floor	
DUT Orientation(s)	1	DUT has a defined orientation
Supply Voltage	120 V /60 Hz	

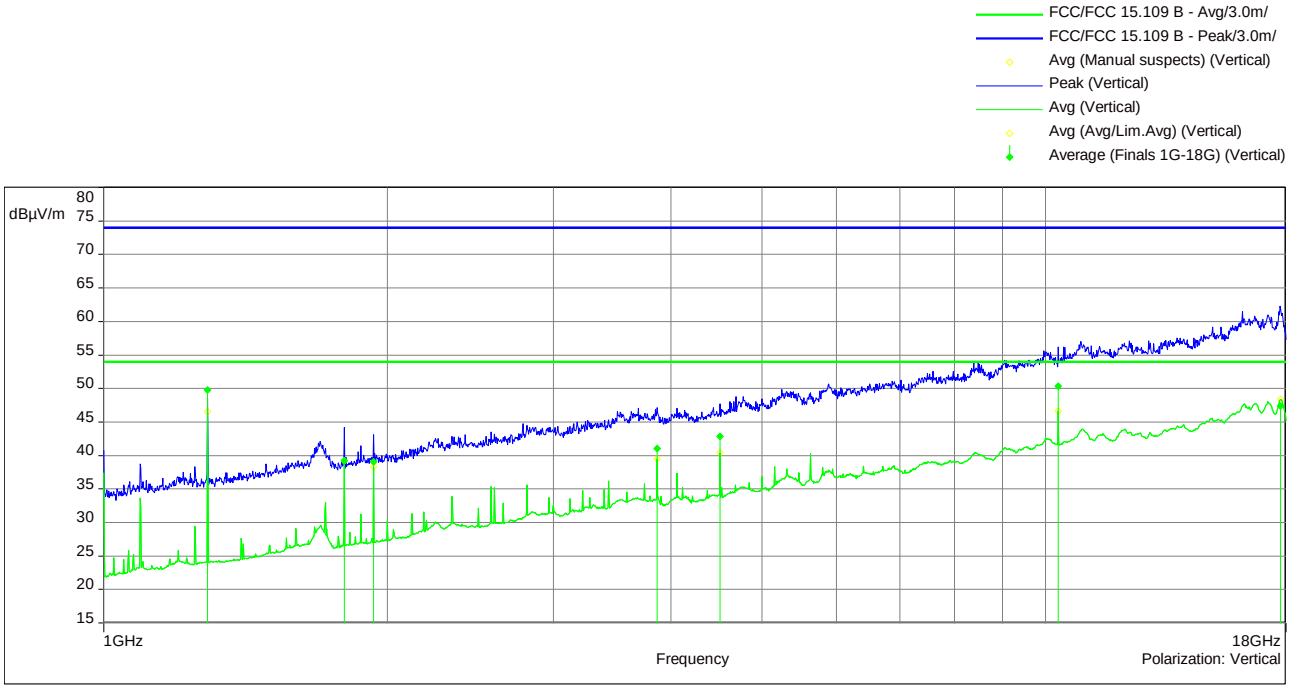
4.3.2 Result

Test location	SAC
Test engineer	Gass
Test Date	31.08.2021
Verdict	Pass

4.3.3 Test equipment

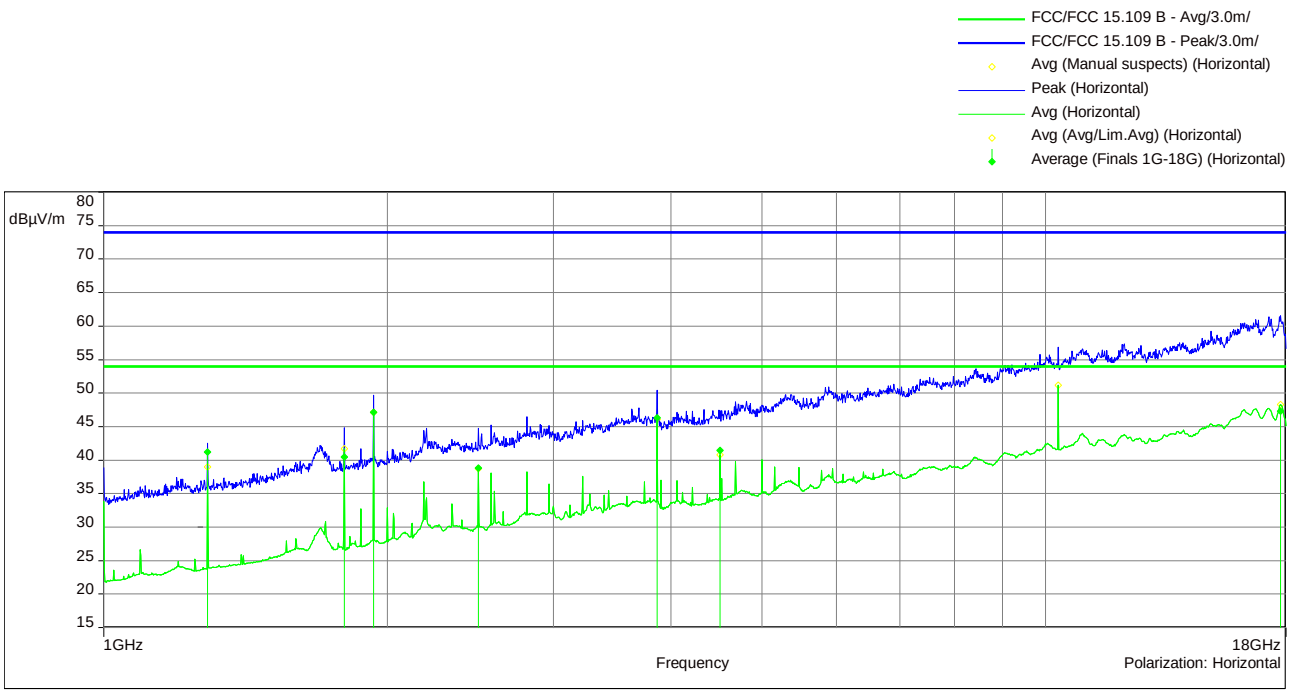
Designation	Type	Manufacturer	Inventory No.	Cal. Date	Next Cal.
EMI test receiver	ESU40	Rohde & Schwarz	E2025	08.12.2020	08.12.2021
Antenna	HL025	Rohde & Schwarz	K1114	23.02.2021	23.02.2022
Antenna	MWH-1826 / B	ARA Inc.	K1042	10.2020	10.2022
Preamplifier	AFS4-00102000	Miteq	K838	10.12.2020	10.12.2021
Preamplifier	JS43-1800-4000	Miteq	K1104	04.2021	04.2023
Measurement Software	BAT-EMC, V3.20.0.10	Nexio	---	---	---

4.3.4 Detailed measurement data



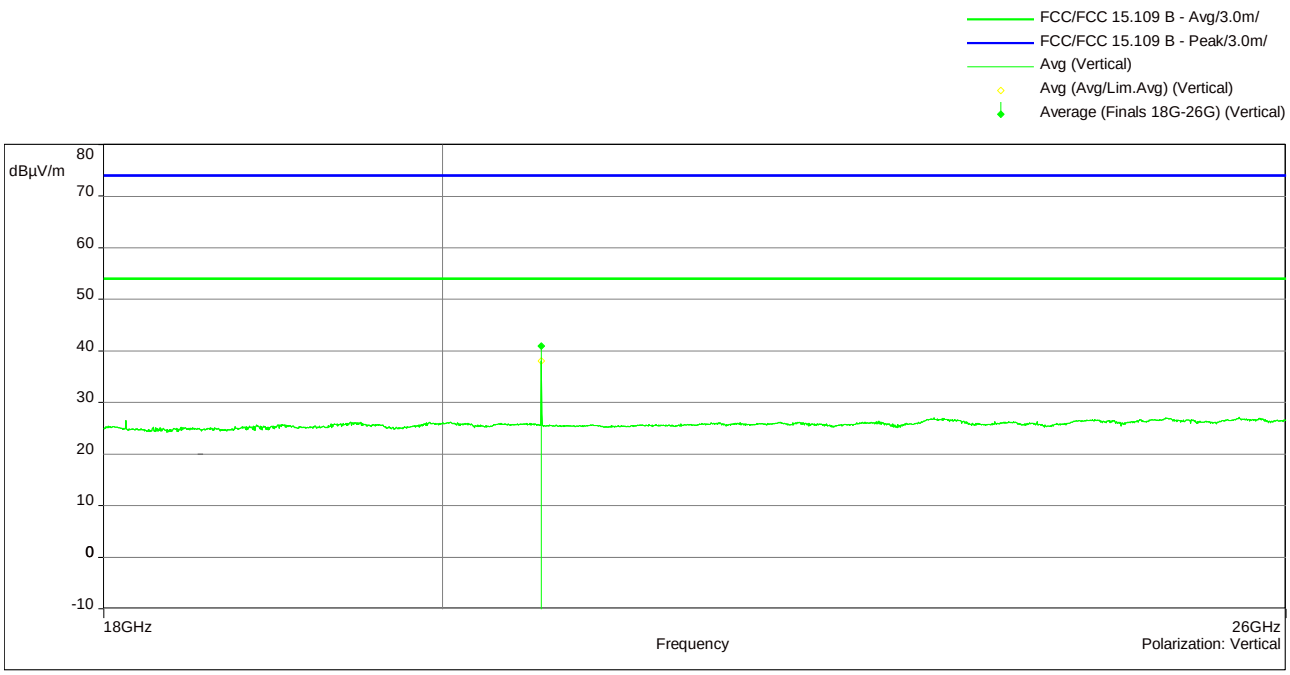
Frequency (MHz)	Average (dBµV/m)	Margin AVG	Limit AV (dBµV/m)	Height (m)	Angle (°)	Polarization
1289	49.79	4.21	54.00	2.23	-114.00	vertical
1800	39.23	14.77	54.00	1.29	-57.70	vertical
1933.5	39.06	14.94	54.00	1.49	-118.40	vertical
3867.25	41.00	13.00	54.00	2.05	-24.90	vertical
4511.75	42.84	11.16	54.00	1.52	-134.20	vertical
10312.5	50.37	3.63	54.00	2.27	-11.60	vertical
17765.5	47.35	6.65	54.00	3.08	119.00	vertical

Measurement 5: 1 – 18 GHz vertical polarization



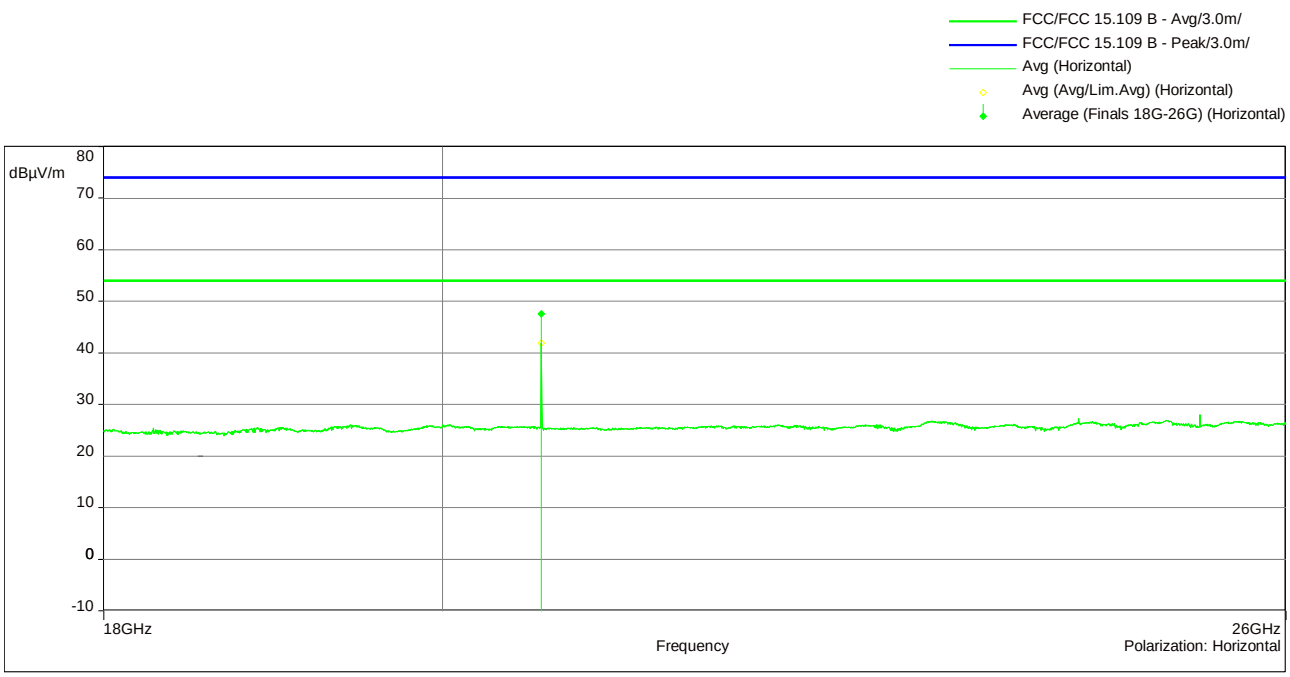
Frequency (MHz)	Average (dBµV/m)	Margin AVG	Limit AV (dBµV/m)	Height (m)	Angle (°)	Polarization
1289	41.20	12.80	54.00	2.33	-41.70	horizontal
1800	40.50	13.50	54.00	1.56	7.40	horizontal
1933.5	47.17	6.83	54.00	2.02	-68.80	horizontal
2500	38.81	15.19	54.00	1.55	65.80	horizontal
3867.25	46.33	7.67	54.00	1.46	32.80	horizontal
4511.75	41.41	12.59	54.00	1.63	-169.40	horizontal
17755.25	47.31	6.69	54.00	2.74	30.30	horizontal

Measurement 6: 1 – 18 GHz horizontal polarization



Frequency (MHz)	Average (dBµV/m)	Margin AVG	Limit AV (dBµV/m)	Height (m)	Angle (°)	Polarization
20625	1	40.96	13.04	54.00	1.38	vertical

Measurement 7: 18 – 26 GHz vertical polarization



Frequency (MHz)	Average (dBµV/m)	Margin AVG	Limit AV (dBµV/m)	Height (m)	Angle (°)	Polarization
20625	2	47.60	6.40	54.00	1.37	horizontal

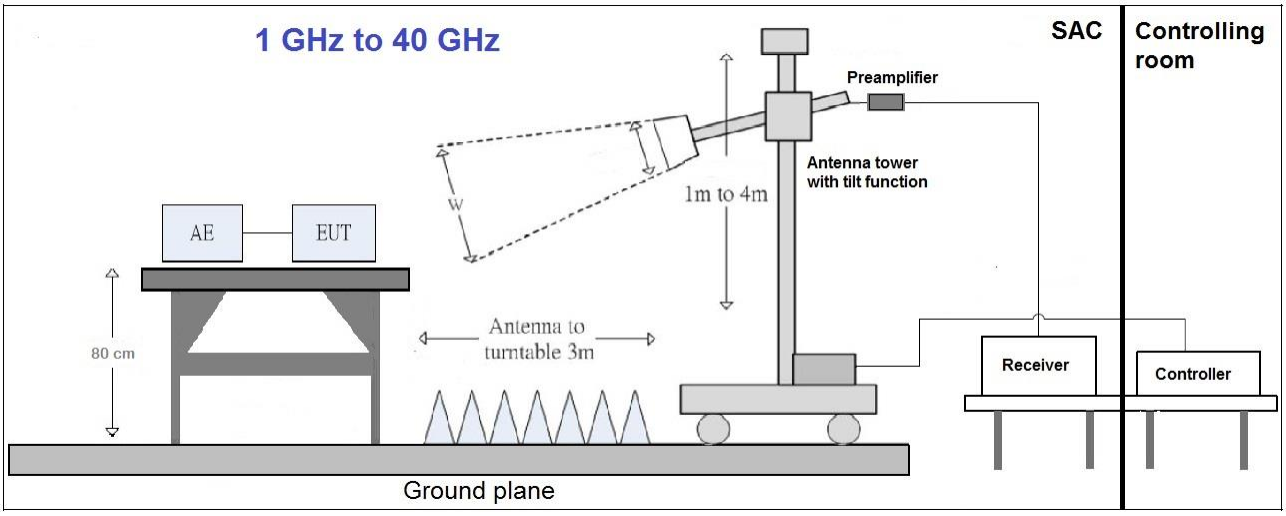
Measurement 8: 18 – 26 GHz horizontal polarization

4.3.5 Measurement Procedure

The measurements were made in the operating mode, with the EUT producing the maximum emission, consistent with normal applications. The EUT load was adjusted within the range specified by manufacturer in order to maximize the emission.

For this test, the EUT was placed on the turntable at a distance of 3 m from the receive antenna. The EUT was positioned on a 10 cm high wooden pallet or on a non-conductive table. The connecting lines to the EUT were fed in from above (as in the installation). The system ground was connected to the ground plane. The turntable was connected directly to the ground system of the test chamber.

While EUT power is on, an operator manually scans the selected frequency range using an EMI test receiver to identify signals being generated by the EUT. At this time the operator determines which signals generated by EUT are significant enough to assign to the final data list in the computer. The signals on the final list are automatically characterized while the antenna is in both horizontal and vertical polarity. The tower and turntable are controlled by the operator. The maximized signal indication on the receiver is then combined with the calibration factors, cable insertion loss and the proper antenna factors to provide the emission level in dB µV/m which is compared directly with the requirement stored in the program libraries. The maximum RFI field strength was determined during the measurement by rotating the turntable (±180 degrees) and varying the height of the receive antenna (h = 1 ... 4 m).



The following modifications apply to the measurement procedure for the frequency range above 1 GHz:

Step 1:
The Equipment Under Test (EUT) was set up on a non-conductive support at 0.8 m height in the semi-anechoic chamber. Absorbers are placed around and between the turn table and the antenna tower.
The turn table step size (azimuth angle) for the preliminary measurement is 15 °.

Step 2:
The maximum RFI field strength was determined during the measurement by rotating the turntable (±180 degrees) and varying the height of the receive antenna (h = 1 ... 4 m) with an additional tilt function of the antenna. The turn table azimuth will slowly vary by ± 15°.
EMI receiver settings (for all steps):
- Detector: Peak, Average
- IF Bandwidth = 1 MHz

Step 3:
Spectrum analyzer settings for step 3:
- Detector: Peak / Average
- Measured frequencies: in step 1 determined frequencies
- IF – Bandwidth: 1 MHz
- Measuring time: 1 s

4.3.6 Field Strength Calculations

FS = SA + AF + CL

Where:
FS = Total Field Strength
SA = EMC test receiver Reading
AF = Antenna Factor
CL = Cable Loss

5 PHOTO REPORT

Please see separate photo reports.

Annex A: Accreditation certificate (for information)

The accreditation relates to competences stated on the accreditation certificate. The current certificate is available on the homepage of the DAkkS and can be downloaded under accredited bodies with the processing number:
https://www.dakks.de/en

Annex B: Additional information provided by client

None.

****** End of test report *****