



ACCREDITED TESTING LABORATORY (NR. 312)

for Electromagnetic Compatibility

Notified body No. 0438 according to EMC-Directive and Radio Equipment Directive

FCC Recognition as accredited EMC Test Laboratory No: 835627

TEST REPORT NR. EMV-E 114/19

Subject: Title 47 - Telecommunication
Chapter I - FEDERAL COMMUNICATIONS COMMISSION
Subchapter A - GENERAL
Part 15 - RADIO FREQUENCY DEVICES
October 1, 2018

The summary of the results can be found on page 2.

Ordered by: TTEch Computertechnik AG

Address: Schönbrunner Straße 7
1040 Wien
Austria

On: TTE Switch Lab Space
FCC ID: 2ATXITTESWLSP-12735

This report contains the pages 1 to 24.

Authorized person:

Test performed by:

Dipl.-Ing. Dr.techn. Kurt Lamedschwandner, M.B.A.

Ing. Michael Szobel

Date: 2019-07-31
Internal Order Number: EMC/E-2565

Comments:

The testing result refers exclusively to the testing subject.

The production or transmission of extracts of the present report is subject to authorization by the testing laboratory.

Akkreditierung Austria is a full member of the International Laboratory Accreditation Cooperation ILAC and a signatory of the MRA for "Testing, Calibration and Inspection".

1. Summary of all measurements and tests

Measurements according to FCC 47 CFR Part 15 Subpart B - Unintentional Radiators			
Chapter / Norm. Reference	Term	Details see chapter	Result
§15.107 ANSI C63.4-2014	Conducted limits - (AC power line)	4.1	PASS
§15.109 ANSI C63.4-2014	Radiated emission limits	4.2	PASS

Table 1: Summary Emission measurements

PASS	The DUT meets the requirements of the standard
FAIL	The DUT does not meet the requirements of the standard
n.a.	The Test is not applicable
n.p.	The Test was not performed

Table 2: General definitions for the report

All indications of Pass/Fail in this report are opinions expressed by Seibersdorf Laboratories based on interpretations and/or observations of test results.

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3. General information

3.1 Device under test (DUT)

DUT:	TTE-Switch Lab Space
FCC ID:	2ATXITTESWLSP-12735
P. number:	12735
Serial number:	0001
MFR:	5944N
Hardware revision:	V02.00.00
Firmware End System:	0x80017253
Firmware Switch:	0x23790100
Year of manufacturing:	21/2019

Manufacturer:	TTTech Computertechnik AG
Address:	Schönbrunner Straße 7 1040 Wien Austria

Description:

The TTE-Switch Lab Space is a high-performance deterministic Ethernet switch and provides 25 Ethernet ports in total:

- 6 double-speed 100/1000 Mbit/s ports
- 19 100 Mbit/s ports

One additional port is available for traffic monitoring. The TTE-Switch Lab Space has built-in mechanisms for traffic policing and fault isolation.

Virtual Links and Protocol Support:

The TTE-Switch Lab Space allows configuring up to 4096 virtual links (VL). Virtual links can be configured with 8 priorities and a bandwidth allocation gap (BAG) of 0.5 ms to 1600 ms. The network configuration is stored in the non-volatile memory of the switch (256 Mbit). It is optionally possible to configure IEEE 802.1Q VLANs. Profiled IP/UDP, redundancy management, and traffic shaping are implemented in hardware.

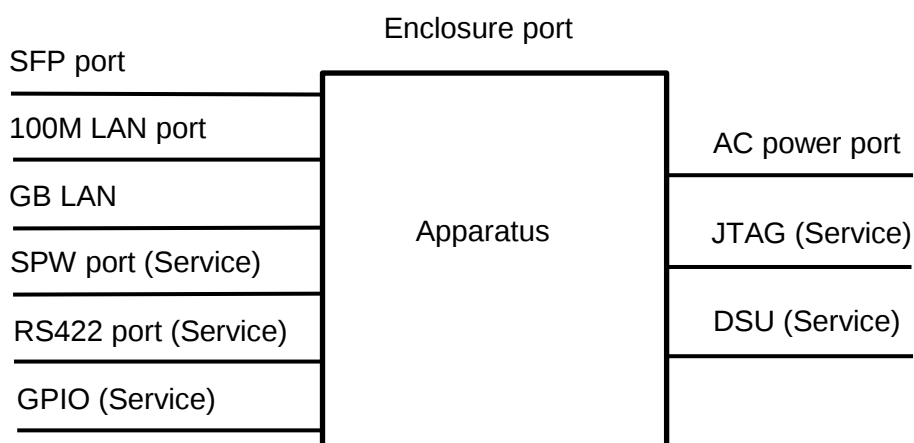
Data Loading and Diagnostics:

The TTE-Switch Lab Space features an integrated CPU for management. Switch management relies on SNMP. Data loading is possible through TFTP.

3.2 Test Configuration

The DUT was mounted by Mr. Sindrak, TTTech Computertechnik AG and Mr. Szobel, Seibersdorf Labor GmbH, in the Semi anechoic chamber (SAC3), the Test room 1 and the Test room 3 of the EMC-Test Laboratory Seibersdorf.

All measurements and tests were performed at rated power. The power supply voltage of the DUT was 230 VAC / 50 Hz.



Type	Name	Cable type
AC power port	230 VAC	Unshielded
Ethernet port	SFP	LAN Cat 6a SSTP
Ethernet port	100M LAN	LAN Cat 6a SSTP
Ethernet port	GB LAN	LAN Cat 6a SSTP
SPW port	SPW (Service)	Shielded
RS422 port	RS422 (Service)	Shielded
JTAG 10pin port	JTAG (Service)	Unshielded or shielded
USB port (rear)	DSU (Service)	Shielded
GPIO port	GPIO (Service)	Unshielded or shielded

Table 3: Cable configuration

3.3 Standards / Documents

- [1] **Code of Federal Regulations**
Title 47 - Telecommunication
Chapter I - FEDERAL COMMUNICATIONS COMMISSION
Subchapter A - GENERAL
Part 15 - RADIO FREQUENCY DEVICES
October 1, 2017
- [2] **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
- [3] **CISPR 16-1-1:2010-11**
Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods -
Part 1-1: Radio Disturbance and Immunity Measuring Apparatus -
Measuring Apparatus, Ed. 3.1
- [4] **CISPR 16-1-2:2006-08**
Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods -
Part 1-2: Radio Disturbance and Immunity Measuring Apparatus - Ancillary equipment -
Conducted disturbances, Ed. 1.2
- [5] **CISPR 16-1-4:2010-04**
Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods -
Part 1-4: Radio Disturbance and Immunity Measuring Apparatus - Ancillary equipment -
Radiated disturbances, Ed. 3
- [6] **CISPR 16-2-1:2008 + A1:2010 + A2:2013**
Specification for radio disturbance and immunity measuring apparatus and methods
Part 2-1: Methods of measurement of disturbances and immunity -
Conducted disturbance measurements
- [7] **CISPR 16-2-3:2010 + A1:2010 + A2:2014**
Specification for radio disturbance and immunity measuring apparatus and methods
Part 2-3: Methods of measurement of disturbances and immunity -
Radiated disturbance measurements

3.4 Date and location of the measurements and tests

Date: 11 June 2019

Location: Semi anechoic chamber (SAC3)
Test room 1
EMC-Test Laboratory
2444 Seibersdorf
Austria

Temperature: 21°C – 25°C
Humidity: 35% - 50 % rel.

4. Measurements and tests – parameters and results

All indications of Pass/Fail in this report are opinions expressed by Seibersdorf Laboratories based on interpretations and/or observations of test results.

4.1 Measurement of the conducted emissions

4.1.1 Equipment

ID-No.	Identification	Type	SNo	Calibration Date	Calibration Interval	Manufacturer
E0127	Measurement receiver incl. Options	ESIB26	100136	20 Nov. 2018	2 years	Rohde & Schwarz
E0500	V-LISN	ESH3-Z5	861189/0007	25 Aug. 2017	2 years	Rohde & Schwarz
E0915	EMC Measurement Software EMC32	V 10.40.10	100280/101333	---	---	Rohde & Schwarz
E1143	Thermo-Hygrometer Test Room 1	608-H2	34803740	29 Jul. 2016	3 years	testo
LE0116	Semi Anechoic Chamber with Control Room, Test room 1 and Amplifier Room	SAC3+CR, TR1, AR	P28090	26 Jan. 2018	5 years	Albatross Projects

Table 4: Equipment

4.1.2 Procedure and setup

The measurement was done inside the Test room 1 of the EMC-Test Laboratory Seibersdorf. Measurement procedure and setup were according to ANSI C63.4.

Frequency range	0.15 to 30 MHz
Bandwidth	9 kHz
Stepsize	4 kHz
Detector pre- / final-measurement	PK / QP, AV
LISN used for AC supply lines	V-LISN

Table 5: Parameters

Frequency range (MHz)	Measurement uncertainty (dB)
0.15 to 30	+3.01 / -3.01

Table 6: Extended measurement uncertainty for V-LISN

4.1.3 Results

Measurement at	Frequency range [MHz]	Data see chapter 5.2	Result
L	0.15 – 30	Chart 1, Table 12, Table 13	PASS
N		Chart 2, Table 14, Table 15	PASS

Table 7: Results FCC

4.2 Radiated emissions measurement

4.2.1 Equipment

ID-No.	Identification	Type	SNo	Calibration Date	Calibration Interval	Manufacturer
E0127	Measurement receiver incl. Options	ESIB26	100136	20 Nov. 2018	2 years	Rohde & Schwarz
E0915	EMC Measurement Software EMC32	V 10.40.10	100280/101333	---	---	Rohde & Schwarz
E1143	Thermo-Hygrometer Test Room 1	608-H2	34803740	29 Jul. 2016	3 years	testo
E1677	Antenna (BiLog)	CBL6143A	32401	29 May 2018	2 years	Teseq
LE0116	Semi Anechoic Chamber with Control Room, Test room 1 and Amplifier Room	SAC3+CR, TR1, AR	P28090	26 Jan. 2018	5 years	Albatross Projects

Table 8: Equipment

4.2.2 Procedure and setup

The measurement was done inside the Semi anechoic chamber (SAC3) of the EMC-Test Laboratory Seibersdorf.

Measurement procedure and setup were according to the standard ANSI C63.4.

Frequency range	30 to 1000 MHz
Bandwidth	120 kHz
Step size	40 kHz
Detector pre- / final-measurement	PK / QP
Measurement distance	3 m
Orientations	0° - 360°
Height scan	1 m – 4 m

Table 9: Parameters

Frequency range (MHz)	Measurement uncertainty (dB)
30 – 200	+4.03 / -4.03
200 – 1000	+3.31 / -3.35

Table 10: Extended measurement uncertainty

4.2.3 Results

Orientation (°)	Polarization	Frequency range (MHz)	Data see chapter 5.2	Result
0 - 360	Horizontal	30 - 1000	Chart 3, Table 16, Table 17	PASS
0 - 360	Vertical	30 - 1000	Chart 4, Table 18	PASS

Table 11: Results FCC

5. Annex

5.1 Photos of the DUT and the configuration

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Photo 1: DUT

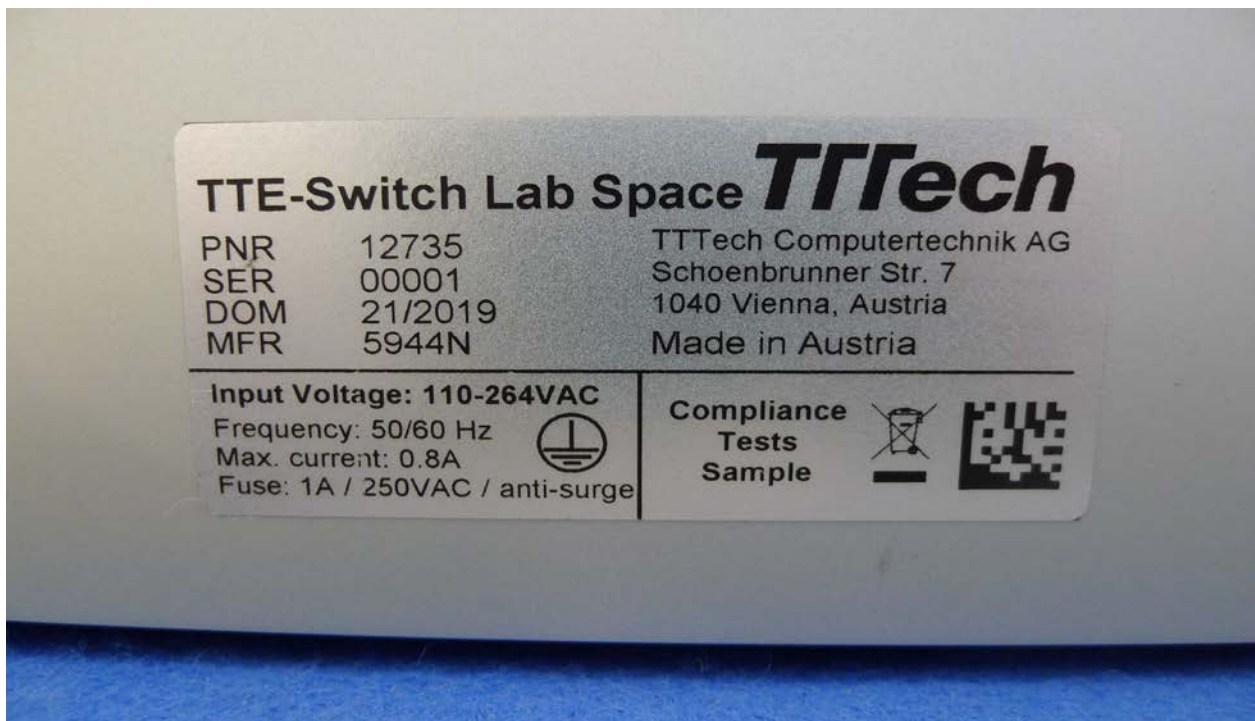
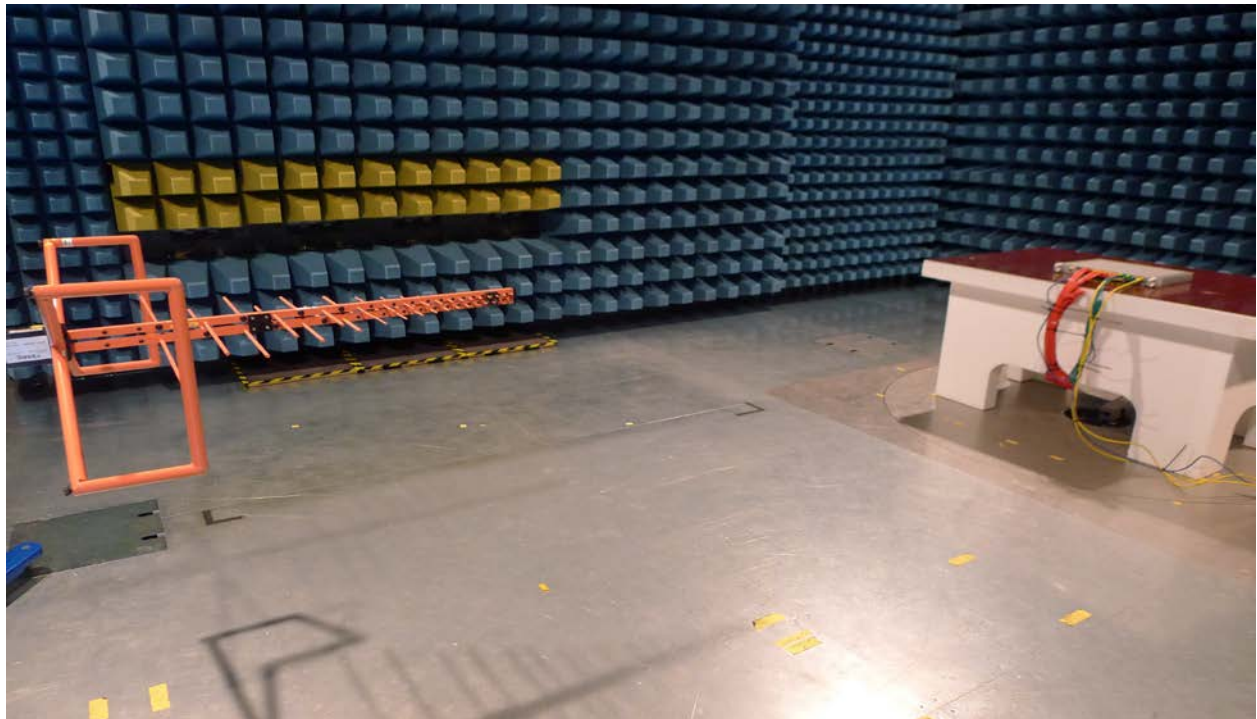


Photo 2: DUT label



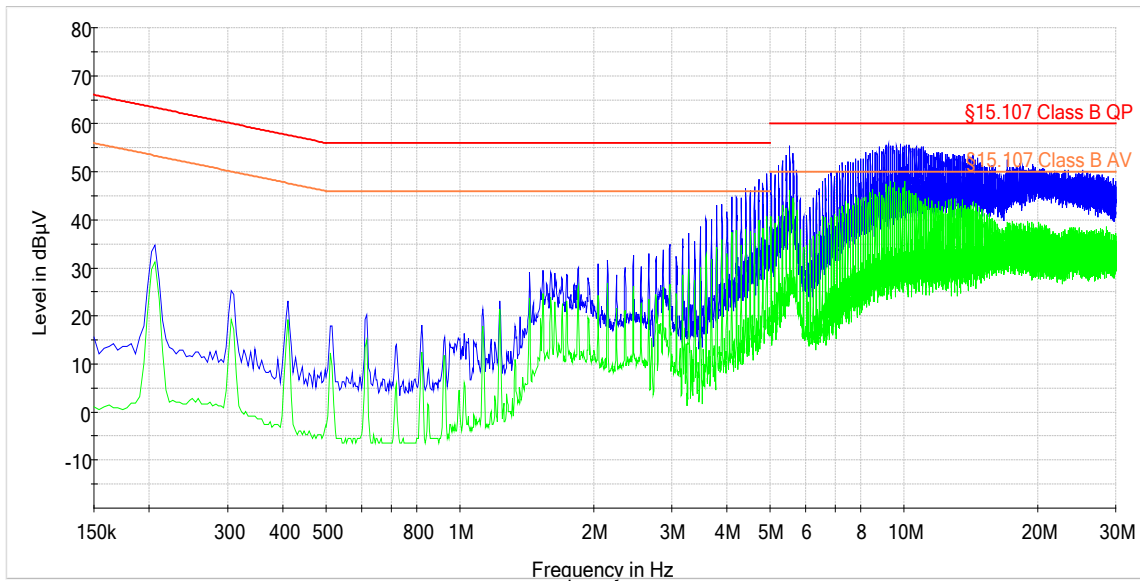
**Photo 3: Setup in the Semi anechoic chamber (SAC3)
radiated emissions measurement (30 MHz – 1000 MHz)**



**Photo 4: Setup in the Test room 1
Conducted emissions measurement at AC power lines (150 kHz – 30 MHz)**

5.2 Charts

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— PK+ MAXH
— §15.107 Class B QP
— §15.107 Class B AV
— AVG MAXH

E-2565 TTTech 11.06.2019 MS
TTE Switch Lab Space
Normalbetrieb, 20% Bandbreite auf alle Ethernet-Ports
29 L

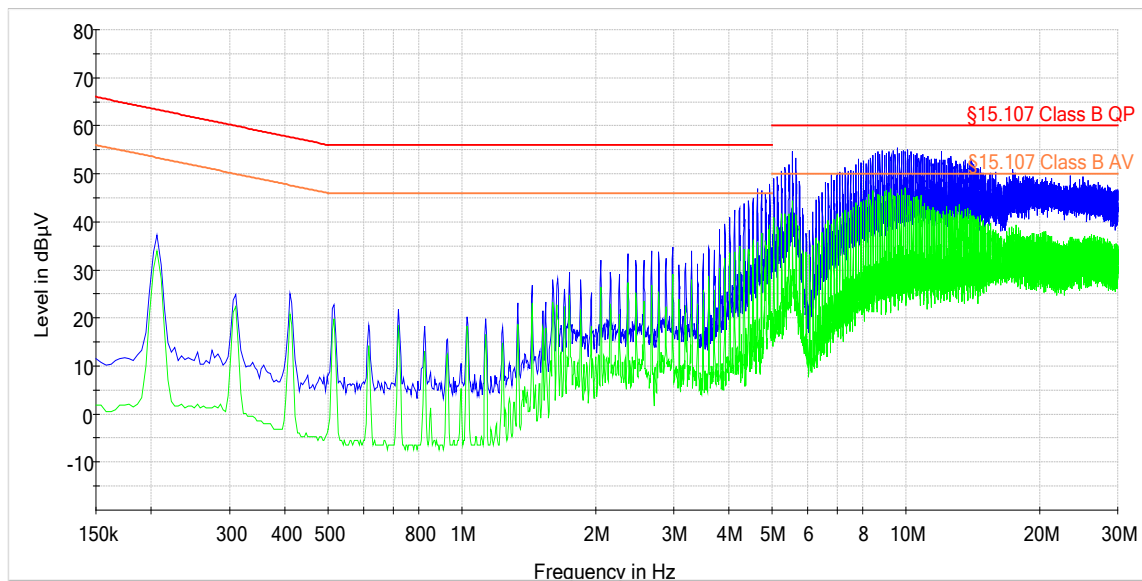
Chart 1: Conducted emissions, 0.15 - 30 MHz, L

Frequency [MHz]	Peak [dBμV]	Meas. Time [ms]	Bandwidth [kHz]	Line [°]	Margin – PK [dB]	Limit – QPK [dBμV]
5,5320	55,5	50,0	9,000	L	4,5	60,0
8,8120	55,3	50,0	9,000	L	4,7	60,0
8,8160	54,5	50,0	9,000	L	5,5	60,0
9,0160	54,4	50,0	9,000	L	5,6	60,0
9,0200	54,6	50,0	9,000	L	5,4	60,0
9,1160	55,6	50,0	9,000	L	4,4	60,0
9,1240	55,2	50,0	9,000	L	4,8	60,0
9,2200	55,1	50,0	9,000	L	4,9	60,0
9,2240	55,9	50,0	9,000	L	4,1	60,0
9,3280	55,5	50,0	9,000	L	4,5	60,0
9,4240	54,8	50,0	9,000	L	5,2	60,0
9,4320	55,5	50,0	9,000	L	4,5	60,0
9,6360	55,5	50,0	9,000	L	4,5	60,0
9,6400	54,7	50,0	9,000	L	5,3	60,0
9,8360	55,0	50,0	9,000	L	5,0	60,0
9,8400	55,4	50,0	9,000	L	4,6	60,0
9,8440	55,8	50,0	9,000	L	4,2	60,0
9,9400	55,3	50,0	9,000	L	4,7	60,0
10,0440	55,4	50,0	9,000	L	4,6	60,0
10,1480	55,6	50,0	9,000	L	4,4	60,0
10,2520	55,6	50,0	9,000	L	4,4	60,0
10,6640	55,3	50,0	9,000	L	4,7	60,0
10,9680	55,1	50,0	9,000	L	4,9	60,0
10,9720	55,3	50,0	9,000	L	4,7	60,0
11,0680	55,2	50,0	9,000	L	4,8	60,0

Table 12: Final result, 0.15-30 MHz, L, Peak

Frequency [MHz]	Average [dBμV]	Meas. Time [ms]	Bandwidth [kHz]	Line [°]	Margin – AVG [dB]	Limit – AVG [dBμV]
5,5320	46,2	50,0	9,000	L	3,8	50,0
8,4040	45,8	50,0	9,000	L	4,2	50,0
8,5040	46,3	50,0	9,000	L	3,7	50,0
8,6080	45,4	50,0	9,000	L	4,6	50,0
8,8120	45,7	50,0	9,000	L	4,3	50,0
8,9200	45,1	50,0	9,000	L	4,9	50,0
9,1240	47,4	50,0	9,000	L	2,6	50,0
9,2240	47,0	50,0	9,000	L	3,0	50,0
9,3280	48,2	50,0	9,000	L	1,8	50,0
9,4280	46,7	50,0	9,000	L	3,3	50,0
9,4320	45,4	50,0	9,000	L	4,6	50,0
9,5320	47,9	50,0	9,000	L	2,1	50,0
9,6320	46,0	50,0	9,000	L	4,0	50,0
9,6360	45,8	50,0	9,000	L	4,2	50,0
9,7360	46,8	50,0	9,000	L	3,2	50,0
9,8360	45,6	50,0	9,000	L	4,4	50,0
9,8400	45,4	50,0	9,000	L	4,6	50,0
9,9400	46,7	50,0	9,000	L	3,3	50,0
10,0440	48,0	50,0	9,000	L	2,0	50,0
10,1480	46,0	50,0	9,000	L	4,0	50,0
10,2520	46,1	50,0	9,000	L	3,9	50,0
10,3520	45,6	50,0	9,000	L	4,4	50,0
10,4560	45,6	50,0	9,000	L	4,4	50,0
10,5560	45,2	50,0	9,000	L	4,8	50,0
10,6600	45,6	50,0	9,000	L	4,4	50,0

Table 13: Final result, 0.15-30 MHz, L, Average



— PK+ MAXH
— §15.107 Class B QP
— §15.107 Class B AV
— AVG MAXH

E-2565 TTTech 11.06.2019 MS
TTE Switch Lab Space
Normalbetrieb, 20% Bandbreite auf alle Ethernet-Ports
30 N

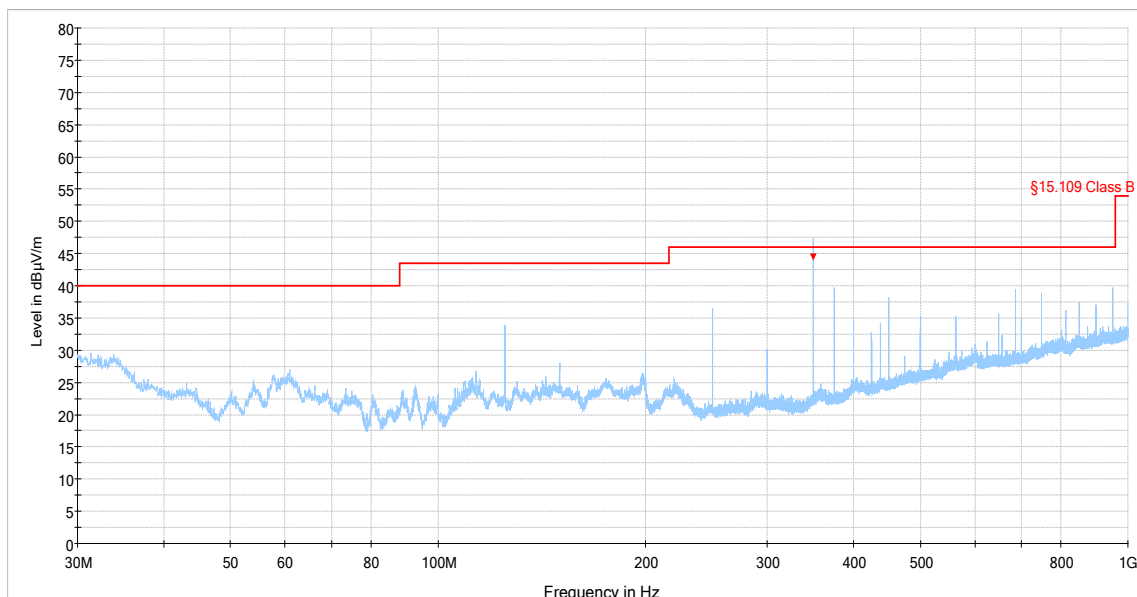
Chart 2: Conducted emissions, 0.15 - 30 MHz, N

Frequency [MHz]	Peak [dBμV]	Meas. Time [ms]	Bandwidth [kHz]	Line [°]	Margin – PK [dB]	Limit – QPK [dBμV]
5,5560	54,7	50,0	9,000	N	5,3	60,0
8,5360	54,2	50,0	9,000	N	5,8	60,0
8,6400	54,6	50,0	9,000	N	5,4	60,0
8,8480	54,8	50,0	9,000	N	5,2	60,0
9,0520	54,3	50,0	9,000	N	5,7	60,0
9,1560	54,7	50,0	9,000	N	5,3	60,0
9,1600	54,3	50,0	9,000	N	5,7	60,0
9,3600	54,8	50,0	9,000	N	5,2	60,0
9,3640	54,4	50,0	9,000	N	5,6	60,0
9,5640	55,5	50,0	9,000	N	4,5	60,0
9,5720	55,1	50,0	9,000	N	4,9	60,0
9,6720	54,3	50,0	9,000	N	5,7	60,0
9,7720	54,4	50,0	9,000	N	5,6	60,0
9,7760	54,7	50,0	9,000	N	5,3	60,0
9,8720	54,3	50,0	9,000	N	5,7	60,0
9,8760	54,8	50,0	9,000	N	5,2	60,0
9,8800	54,5	50,0	9,000	N	5,5	60,0
9,9800	54,7	50,0	9,000	N	5,3	60,0
10,0880	55,0	50,0	9,000	N	5,0	60,0
10,2880	54,6	50,0	9,000	N	5,4	60,0
10,2920	54,5	50,0	9,000	N	5,5	60,0
10,3960	54,1	50,0	9,000	N	5,9	60,0
10,6000	54,3	50,0	9,000	N	5,8	60,0
12,0360	54,6	50,0	9,000	N	5,4	60,0
12,6520	53,8	50,0	9,000	N	6,2	60,0

Table 14: Final result, 0.15-30 MHz, N, Peak

Frequency [MHz]	Average [dBμV]	Meas. Time [ms]	Bandwidth [kHz]	Line [°]	Margin – AVG [dB]	Limit – AVG [dBμV]
8,2320	45,7	50,0	9,000	N	4,3	50,0
8,4360	46,6	50,0	9,000	N	3,4	50,0
8,6400	45,8	50,0	9,000	N	4,2	50,0
8,7480	45,6	50,0	9,000	N	4,4	50,0
8,8520	45,3	50,0	9,000	N	4,7	50,0
8,9520	46,3	50,0	9,000	N	3,7	50,0
9,0520	45,5	50,0	9,000	N	4,5	50,0
9,0560	46,5	50,0	9,000	N	3,5	50,0
9,1560	46,1	50,0	9,000	N	3,9	50,0
9,2560	45,6	50,0	9,000	N	4,4	50,0
9,2600	46,8	50,0	9,000	N	3,2	50,0
9,3600	45,5	50,0	9,000	N	4,5	50,0
9,4640	45,4	50,0	9,000	N	4,6	50,0
9,5720	45,9	50,0	9,000	N	4,1	50,0
9,6720	45,5	50,0	9,000	N	4,5	50,0
9,7760	46,7	50,0	9,000	N	3,3	50,0
9,8760	45,5	50,0	9,000	N	4,5	50,0
9,9760	44,2	50,0	9,000	N	5,8	50,0
9,9800	47,0	50,0	9,000	N	3,0	50,0
10,0840	45,6	50,0	9,000	N	4,4	50,0
10,1840	45,5	50,0	9,000	N	4,5	50,0
10,3960	45,3	50,0	9,000	N	4,7	50,0
10,4960	45,1	50,0	9,000	N	4,9	50,0
10,6000	45,4	50,0	9,000	N	4,6	50,0
10,8040	45,5	50,0	9,000	N	4,5	50,0

Table 15: Final result, 0.15-30 MHz, N, Average



— Preview Result 1H-PK+
— §15.109 Class B
▼ Final_Result QPK

E-2565 TTTech 11.06.2019 MS
TTE Switch Lab Space
Normalbetrieb, 20% Bandbreite auf alle Ethernet-Ports
02 0°-360° 1m-4m H

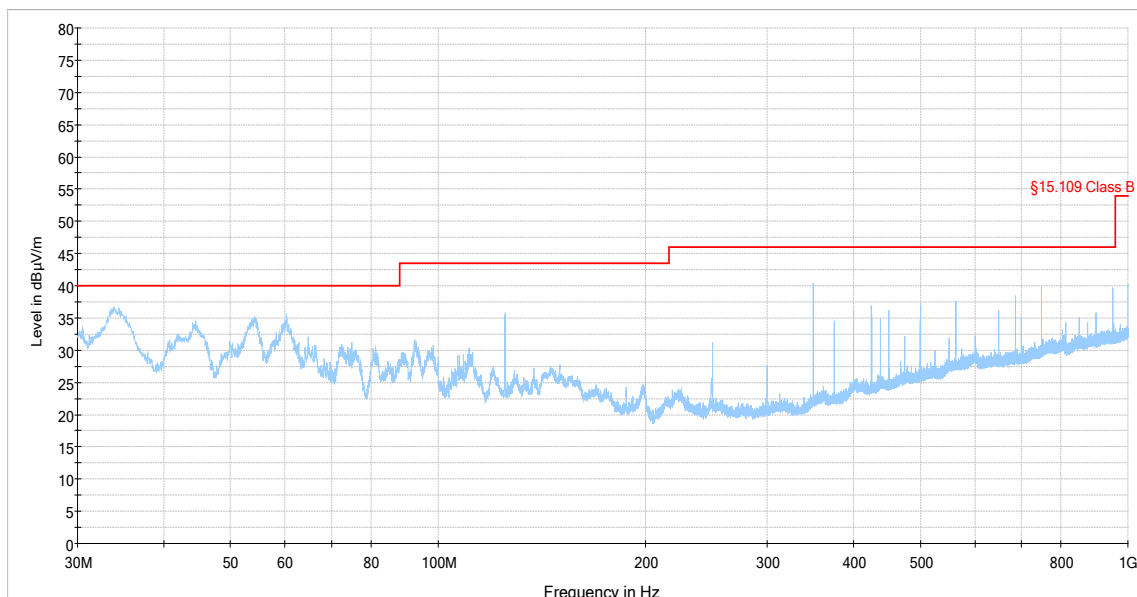
Chart 3: Radiated emissions, 30 - 1000 MHz, horizontal

Frequency [MHz]	Peak [dBμV/m]	Meas. Time [ms]	Bandwidth [kHz]	Azimuth [deg]	Height [cm]	Pol [°]	Margin – PK [dB]	Limit – QPK [dBμV/m]
349,9200	37,3	50,0	120,000	90,0	100,0	H	8,7	46,0
349,9500	43,3	50,0	120,000	90,0	100,0	H	2,7	46,0
350,0100	47,3	50,0	120,000	90,0	100,0	H	-1,3	46,0
350,0400	45,1	50,0	120,000	90,0	100,0	H	0,9	46,0
350,0700	40,2	50,0	120,000	90,0	100,0	H	5,8	46,0
374,9700	37,9	50,0	120,000	90,0	100,0	H	8,1	46,0
375,0000	39,7	50,0	120,000	90,0	100,0	H	6,3	46,0
375,0300	38,6	50,0	120,000	90,0	100,0	H	7,4	46,0
450,0000	38,2	50,0	120,000	0,0	250,0	H	7,8	46,0
687,4800	38,4	50,0	120,000	90,0	100,0	H	7,6	46,0
687,5100	39,4	50,0	120,000	90,0	100,0	H	6,6	46,0
687,5400	37,9	50,0	120,000	90,0	100,0	H	8,1	46,0
749,9700	37,7	50,0	120,000	270,0	150,0	H	8,3	46,0
750,0000	38,9	50,0	120,000	270,0	150,0	H	7,1	46,0
750,0300	37,8	50,0	120,000	270,0	150,0	H	8,2	46,0
850,0200	37,4	50,0	120,000	90,0	100,0	H	8,6	46,0
949,9500	37,4	50,0	120,000	180,0	150,0	H	8,6	46,0
949,9800	39,7	50,0	120,000	180,0	150,0	H	6,3	46,0
950,0100	39,8	50,0	120,000	180,0	150,0	H	6,2	46,0
950,0400	38,0	50,0	120,000	90,0	100,0	H	8,0	46,0

Table 16: Pre measurement Peak result, 30-1000 MHz, horizontal

Frequency [MHz]	QuasiPeak [dBμV/m]	Meas. Time [ms]	Bandwidth [kHz]	Azimuth [deg]	Height [cm]	Pol [°]	Margin – QPK [dB]	Limit – QPK [dBμV/m]
350,0100	44,46	1000,0	120,000	90,0	100,0	H	3,54	46,0

Table 17: Final QuasiPeak result, 30-1000 MHz, horizontal



— Preview Result 1V-PK+
— §15.109 Class B

E-2565 TTTech 11.06.2019 MS
TTE Switch Lab Space
Normalbetrieb, 20% Bandbreite auf alle Ethernet-Ports
01 0°-360° 1m-4m V

Chart 4: Radiated emissions, 30 - 1000 MHz, vertical

Frequency [MHz]	Peak [dB μ V/m]	Meas. Time [ms]	Bandwidth [kHz]	Azimuth [deg]	Height [cm]	Pol [°]	Margin – PK [dB]	Limit – QPK [dB μ V/m]
33,6000	36,3	50,0	120,000	0,0	100,0	V	3,7	40,0
33,6300	36,2	50,0	120,000	0,0	100,0	V	3,8	40,0
33,7800	36,3	50,0	120,000	0,0	100,0	V	3,7	40,0
33,8100	36,6	50,0	120,000	0,0	100,0	V	3,4	40,0
33,8400	36,5	50,0	120,000	0,0	100,0	V	3,5	40,0
33,9000	36,4	50,0	120,000	180,0	100,0	V	3,6	40,0
33,9300	36,5	50,0	120,000	180,0	100,0	V	3,5	40,0
33,9600	36,5	50,0	120,000	180,0	100,0	V	3,5	40,0
33,9900	36,2	50,0	120,000	180,0	100,0	V	3,8	40,0
34,0200	36,1	50,0	120,000	0,0	100,0	V	3,9	40,0
34,0500	36,1	50,0	120,000	180,0	100,0	V	3,9	40,0
34,0800	36,2	50,0	120,000	180,0	100,0	V	3,8	40,0
34,4100	36,4	50,0	120,000	180,0	100,0	V	3,6	40,0
34,4400	36,5	50,0	120,000	180,0	100,0	V	3,5	40,0
34,4700	36,4	50,0	120,000	180,0	100,0	V	3,6	40,0
34,5000	36,2	50,0	120,000	180,0	100,0	V	3,8	40,0
44,5200	34,5	50,0	120,000	270,0	100,0	V	5,5	40,0
54,2100	35,1	50,0	120,000	270,0	100,0	V	4,9	40,0
54,2400	35,2	50,0	120,000	270,0	100,0	V	4,8	40,0
54,3600	35,0	50,0	120,000	270,0	100,0	V	5,0	40,0
54,3900	35,0	50,0	120,000	270,0	200,0	V	5,0	40,0
60,3000	35,2	50,0	120,000	270,0	100,0	V	4,8	40,0
60,3300	35,3	50,0	120,000	270,0	100,0	V	4,7	40,0
60,3600	34,8	50,0	120,000	270,0	100,0	V	5,2	40,0
350,0100	40,5	50,0	120,000	90,0	100,0	V	5,5	46,0

Table 18: Final Peak result, 30-1000 MHz, vertical