



FCC TEST REPORT / IC TEST REPORT

APPLICANT

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 Witness(es) at tests: **Mr. Bier (2018-05-18)**

EQUIPMENT UNDER TEST (EUT)

Equipment: **Ethernet Switch**
 Model/Type: **LCOS-SW-4P**
 Serial No.: **# none**

TEST

Arrival of EUT: **2018-05-18**
 Date of measurement: **2018-05-18, 2018-05-25, 2018-06-07**
 Standards: **47 CFR Part 15, Subpart B, class B**
ICES-003 Issue 6, class B
 Results: **Passed - Details see test result summary**
 Performed by: **Dipl.-Ing. Th. W. Stein**

LABORATORY

Test site: **Nemko GmbH & Co. KG, Pfinztal, (Germany)**
 FCC Reg. No.: **973501**
 IC File No.: **10921A-1**

TEST REPORT

Identification No.: **FC-1804-353260-001**
 Date of Report: **2018-06-07**

Provided by: **Dipl.-Ing. Th. W. Stein**
 Person responsible

Signature

Approved by: **Dipl.-Ing. P. Lukas**
 Person responsible

Signature

QMV-5.10-2 e / Rev 5.10

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1 General information

1.1 Description of Equipment under test (EUT)

The EuT is an 4-port ethernet switch for industrial use. Every port with 94 MBit/s traffic.

1.2 Technical data

Maximum internal frequency (CPU)	300 MHz
Power supply of EuT	24 V DC (is supplied with an external power transformer)

1.3 Climatic conditions

parameter	actual range
Ambient temperature	20 - 24 °C
Relative humidity	40 - 46 %
Atmospheric pressure	990 - 1000 mbar

1.4 Other comments

For conducted and radiated emission the AC-DC transformer was in use with AC 115 V / 60 Hz.

1.5 Test equipment

See list of test equipment in clause 4.

1.6 Project history

test report (Ident.-No.)	date of report	modification of the EuT	Change in standard in clause:
FC-1804-353260-001	2018-06-07	-	initial test report

2 Test Report Summary

2.1 General

The tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with:

47 CFR Part 15, Subpart B, class B
ICES-003 Issue 6, class B

The test methods have been in accordance with 47 CFR Part 15 and RSS where applicable.

- ☒ Production Unit
☐ Pre-production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.
Deviations from, additions to, or exclusions from the test specifications
are described in "Test results".



TEST REPORT NO.: FC-1804-353260-001

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2.2 Test Summary

Section in CFR 47		Result
15.109	Spurious radiated emissions	PASS
15.107	AC power line conducted emissions	PASS

Section in RSS		Result
ICES-003 clause 6.2	Spurious radiated emissions	PASS
ICES-003 clause 6.1	AC power line conducted emissions	PASS

Explanations:

PASS The EUT passed that particular test.

FAIL The EUT failed that particular test.

X The measurement was done, but there is no applicable performance criteria.

3 Test Results

3.1 Spurious radiated emissions

The test was performed as a compliance test. The test parameters concerned were as follows:

Parameter	Specification
Frequency range	30 - 2000 MHz (normal operation)
Limits FCC	§15.109 class B
Limits IC	ICES-003 clause 6.2 class B
Test uncertainty U95	4.17 dB (30 - 200 MHz) horizontal 4.77 dB (30 - 200 MHz) vertical 4.54 dB (200 - 1000 MHz) horizontal 6.38 dB (200 - 1000 MHz) vertical 7.07 dB (1 - 6 GHz)

Test method and limits

The test was performed in a test chamber according to ANSI C63.4-2009 / ANSI C63.4-2014:.. The EUT was placed on a non-conductive 0.8 m high support standing on the turntable (see fig. 1, 2). In order to find the maximum levels of the disturbance radiation the angle of the turntable, the height of the measuring antenna and the lay-out of the EUT cables were varied during the tests. The test was performed separately with the measuring antenna being both in horizontal and vertical polarizations.

Receiver bandwidth and measuring distance:

Frequency band MHz	Receiver bandwidth kHz	Measuring distance m
30-1000	120	3
1000-2000	1000	3

FCC Part 15.109 / ICES-003 class B limit values

Frequency band MHz	Quasi-peak $\mu\text{V/m}$	Quasi-peak $\text{dB}(\mu\text{V/m}) @3 \text{ m}$	Average $\text{dB}(\mu\text{V/m}) @3 \text{ m}$
30 - 88	100 @3 m	40.0 @3 m	-
88 - 216	150 @3 m	43.5 @3 m	-
216-960	200 @3 m	46.0 @3 m	-
960-1000	500 @3 m	54.0 @3 m	-
1000-2000	-	73.98 @3 m *)	53.98 @3 m

*) Peak

Test result: Passed.

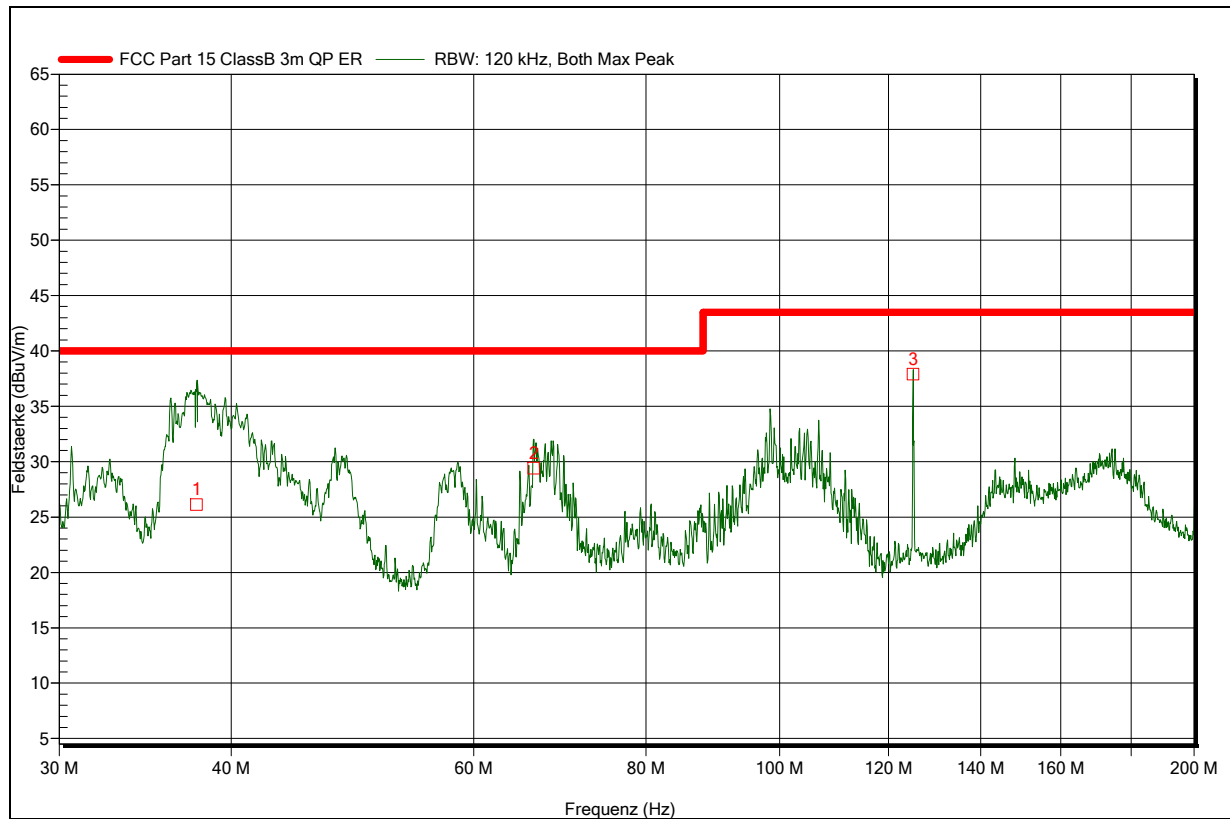
Test Equipment Used: (30 MHz < f < 200 MHz):
1-0040; 1-0361; 1-0364; 1-0604; 1-0619; 1-0624

Test Equipment Used: (200 MHz < f < 1 GHz):
1-0055; 1-0361; 1-0364; 1-0604; 1-0619; 1-0624

Test Equipment Used: (1 GHz > f > 2 GHz):
1-0361; 1-0611; 1-0614; 1-0615; 1-0619; 1-0620; 1-0624

3.2 Measurement results

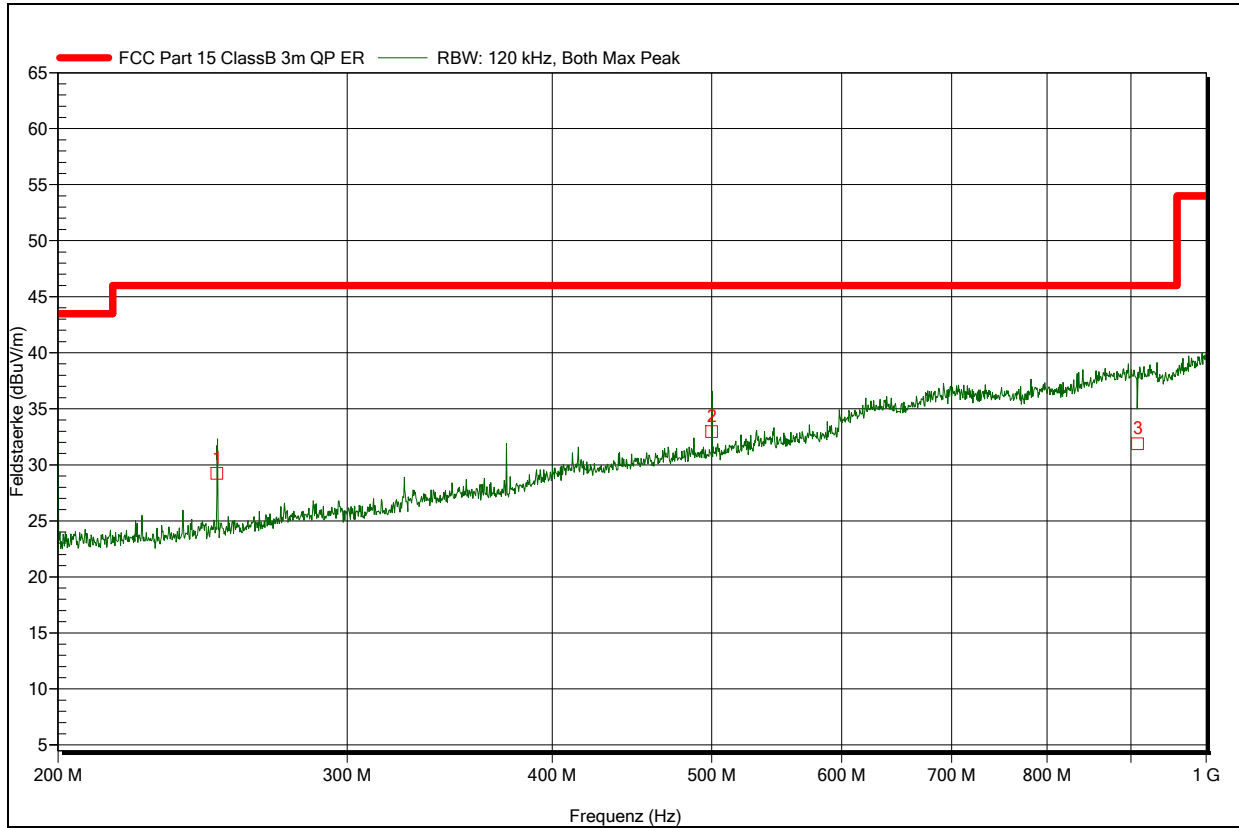
3.2.1 Diagram 353260-1ER (30 MHz – 200 MHz)



3.2.2 Table 353260-1ER Quasipeak (30 MHz – 200 MHz)

Peak No.	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Correction	Quasi-Peak Status	Angle	Height	Polarization
1	37,740 MHz	26,13 dBuV/m	40,00 dBuV/m	-13,87 dB	18,5 dB	Pass	61,00 Grad	1 m	Vertical
2	66,300 MHz	29,40 dBuV/m	40,00 dBuV/m	-10,6 dB	15,4 dB	Pass	281,00 Grad	1 m	Vertical
3	125,010 MHz	37,91 dBuV/m	43,50 dBuV/m	-5,59 dB	17,8 dB	Pass	81,00 Grad	4 m	Horizontal

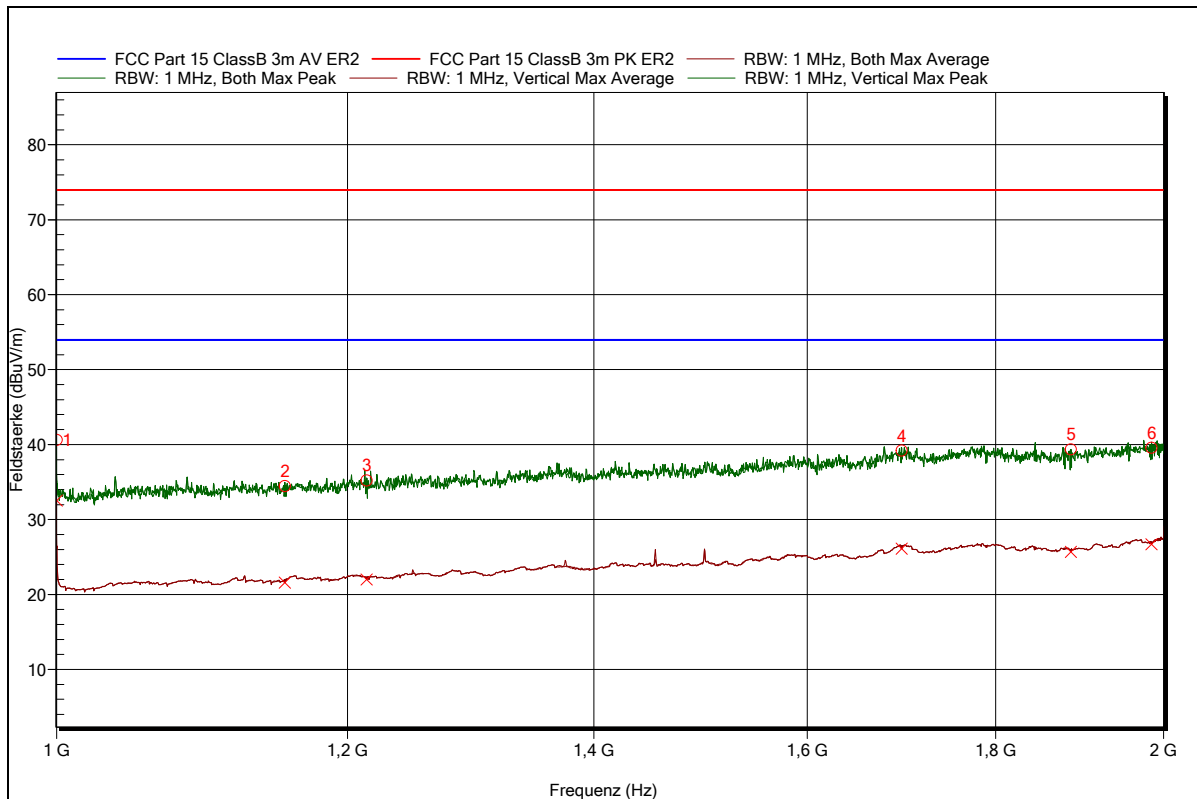
3.2.3 Diagram 353260-2ER (200 MHz – 1000 MHz)



3.2.4 Table 353260-2ER Quasipeak (200 MHz – 1000 MHz)

Peak No.	Frequency	Quasi-Peak	Quasi-Peak Limit	Quasi-Peak Difference	Quasi-Peak Correction	Quasi-Peak Status	Angle	Height	Polarization
1	250,010 MHz	29,23 dBuV/m	46,00 dBuV/m	-16,77 dB	12,9 dB	Pass	169,00 Grad	2,6 m	Vertical
2	500,000 MHz	32,97 dBuV/m	46,00 dBuV/m	-13,03 dB	19,2 dB	Pass	133,00 Grad	1 m	Horizontal
3	908,000 MHz	31,88 dBuV/m	46,00 dBuV/m	-14,12 dB	24,6 dB	Pass	211,00 Grad	2,1 m	Vertical

3.2.5 Diagram 353260-ER2 (1000 MHz – 2000 MHz)



3.2.6 Table 353260-ER2 Peak (1000 MHz – 2000 MHz)

Peak No.	Frequency	Peak	Peak Limit	Peak Difference	Peak Correction	Peak Status	Angle	Height	Polarization
1	1,000 GHz	40,61 dBuV/m	73,98 dBuV/m	-33,37 dB	-11,9 dB	Pass	352,00 Grad	1 m	Vertical
2	1,154 GHz	34,45 dBuV/m	73,98 dBuV/m	-39,53 dB	-10,5 dB	Pass	230,00 Grad	1 m	Vertical
3	1,215 GHz	35,21 dBuV/m	73,98 dBuV/m	-38,77 dB	-10 dB	Pass	251,00 Grad	1 m	Vertical
4	1,697 GHz	39,21 dBuV/m	73,98 dBuV/m	-34,77 dB	-5,6 dB	Pass	203,00 Grad	1 m	Vertical
5	1,887 GHz	39,37 dBuV/m	73,98 dBuV/m	-34,61 dB	-5,8 dB	Pass	279,00 Grad	1 m	Vertical
6	1,985 GHz	39,57 dBuV/m	73,98 dBuV/m	-34,41 dB	-4,5 dB	Pass	348,00 Grad	1 m	Vertical

3.2.7 Table 353260-ER2 Average (1000 MHz – 2000 MHz)

Peak No.	Frequency	Average	Average Limit	Average Difference	Average Correction	Average Status	Angle	Height	Polarization
1	1,000 GHz	32,52 dBuV/m	53,98 dBuV/m	-21,46 dB	-11,9 dB	Pass	352,00 Grad	1 m	Vertical
2	1,154 GHz	21,56 dBuV/m	53,98 dBuV/m	-32,42 dB	-10,5 dB	Pass	230,00 Grad	1 m	Vertical
3	1,215 GHz	22,00 dBuV/m	53,98 dBuV/m	-31,98 dB	-10 dB	Pass	251,00 Grad	1 m	Vertical
4	1,697 GHz	26,10 dBuV/m	53,98 dBuV/m	-27,88 dB	-5,6 dB	Pass	203,00 Grad	1 m	Vertical
5	1,887 GHz	25,69 dBuV/m	53,98 dBuV/m	-28,29 dB	-5,8 dB	Pass	279,00 Grad	1 m	Vertical
6	1,985 GHz	26,71 dBuV/m	53,98 dBuV/m	-27,27 dB	-4,5 dB	Pass	348,00 Grad	1 m	Vertical

3.3 AC power line conducted emissions

The test was performed as a compliance test. The test parameters concerned were as follows:

Parameter	Specification
Frequency range	0.15 - 30 MHz
Limits FCC	§15.107 class B
Limits IC	ICES-003 clause 6.1 class B
Test uncertainty U95	4.06 dB (9 kHz - 150 kHz) 3.58 dB (150 kHz - 30 MHz)

Test method and limits

The test was performed according to ANSI C63.4-2009 / ANSI C63.4-2014 inside a shielded room where the floor and one of the walls of the test site comprised the reference ground plane (RGP). The test was performed at the AC input of the supplied AC/DC converter. For the duration of the test EUT and external supply were placed on a non-conductive support 0.8 m high 0.4 m apart from the vertical RGP (see fig. 3). The excess lengths of the cables of the EUT were made into bundles 30 -40 cm in length. The power input cable of the external supply was connected to an artificial mains network. The test was performed separately on each phase and also on the neutral wire.

The disturbances were first examined by performing a spectrum scan by using a peak detector. The general procedure in the conducted disturbance emission test is that no further measurements are necessary if the disturbance levels measured by using the peak detector are below the limit value defined for the measurement performed by using an average detector. If not, then at the test frequencies concerned the measurement is performed also by using a quasi -peak detector. If the disturbance levels measured by using the quasi-peak detector are below the limit value defined for the measurement performed by using an average detector, then measurements by using the average detector are not necessary.

FCC Part 15.107 / ICES-003 class B limit values

Frequency MHz	Quasi-peak dB μ V	Average dB μ V
0.15 – 0.5	66 - 56	56 -46
0.5 – 5	56	46
5 – 30	60	50

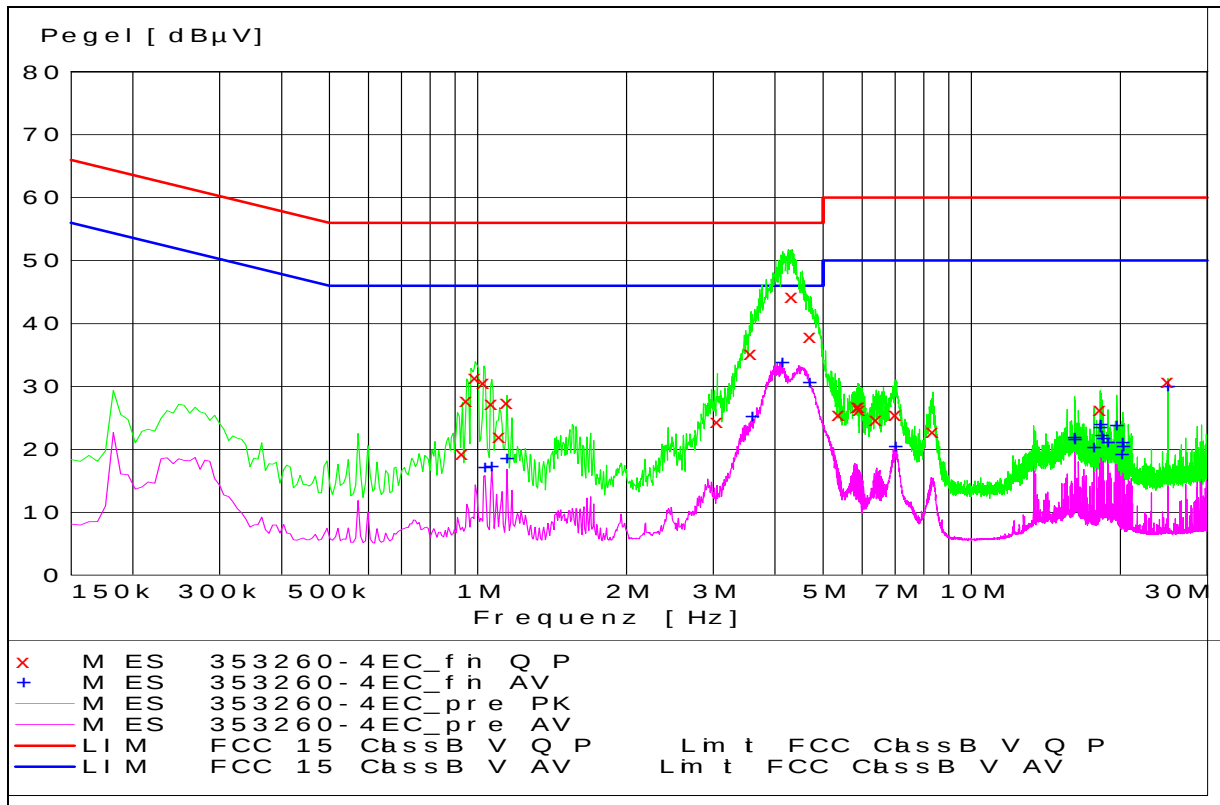
Test result: Passed

Test Equipment Used:

1-0054; 1-0069; 1-0071; 1-0072; 1-0361; 1-0364

3.4 Measurement results

3.4.1 Diagram 353260-1EC (0.15 - 30 MHz)



3.4.2 Table Final measurements 353260-1EC_fin QP (0.15 - 30 MHz)

Frequenz MHz	Pegel dBμV	Transd dB	Limit dBμV	Margin dB	Line	PE
0.930000	19.30	10.00	56.00	36.70	L1	GND
0.949500	27.80	10.00	56.00	28.20	L1	GND
0.988500	31.50	10.00	56.00	24.50	L1	GND
1.027500	30.60	10.00	56.00	25.40	L1	GND
1.066500	27.30	10.00	56.00	28.70	L1	GND
1.105500	22.00	10.00	56.00	34.00	L1	GND
1.144500	27.50	10.00	56.00	28.50	L1	GND
3.055500	24.40	10.10	56.00	31.60	L1	GND
3.575500	35.30	10.20	56.00	20.70	L1	GND
4.329500	44.30	10.20	56.00	11.70	L1	GND
4.719500	38.00	10.20	56.00	18.00	L1	GND
5.395500	25.50	10.30	60.00	34.50	L1	GND
5.889500	26.90	10.30	60.00	33.10	L1	GND
5.915500	26.80	10.30	60.00	33.20	L1	GND
5.941500	26.30	10.30	60.00	33.70	L1	GND
6.403000	24.80	10.30	60.00	35.20	L1	GND
7.014000	25.60	10.40	60.00	34.40	L1	GND
8.366000	22.80	10.40	60.00	37.20	L1	GND
18.246000	26.30	11.00	60.00	33.70	L1	GND
24.999500	30.80	11.10	60.00	29.20	N	GND

3.4.3 Table Final measurements 353260-1EC_fin AV (0.15 - 30 MHz)

Frequenz MHz	Pegel dB μ V	Transd dB	Limit dB μ V	Margin dB	Line	PE
1.034000	17.20	10.00	46.00	28.80	L1	GND
1.066500	17.40	10.00	46.00	28.60	L1	GND
1.144500	18.50	10.00	46.00	27.50	L1	GND
3.595000	25.20	10.20	46.00	20.80	L1	GND
4.141000	33.80	10.20	46.00	12.20	L1	GND
4.706500	30.60	10.20	46.00	15.40	L1	GND
7.027000	20.40	10.40	50.00	29.60	L1	GND
16.166000	21.90	10.90	50.00	28.10	N	GND
16.231000	21.50	10.90	50.00	28.50	N	GND
17.693500	20.30	11.00	50.00	29.70	N	GND
18.246000	23.50	11.00	50.00	26.50	N	GND
18.304500	24.00	11.00	50.00	26.00	N	GND
18.363000	22.20	11.00	50.00	27.80	N	GND
18.486500	21.80	11.00	50.00	28.20	N	GND
18.915500	21.20	11.10	50.00	28.80	N	GND
19.708500	23.80	11.10	50.00	26.20	L1	GND
20.196000	19.20	11.10	50.00	30.80	L1	GND
20.261000	21.10	11.10	50.00	28.90	L1	GND
20.319500	20.40	11.10	50.00	29.60	L1	GND
24.999500	30.00	11.10	50.00	20.00	N	GND

4 Test equipment used

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the test house.

Ref No	Instrument/ ancillary	Manufacturer	Type of instrument/ ancillary	Cal. Date	Cal. Due
1-0037	Artificial mains network, 3ph	Rohde & Schwarz	ESH2-Z5	2017-09	2018-09
1-0040	Biconical antenna	Rohde & Schwarz	HK116	2015-08	2018-08
1-0054	Pulse limiter	Rohde & Schwarz	ESH3-Z2	2017-09	2018-09
1-0055	LopPer antenna	Rohde & Schwarz	HL223	2015-08	2018-08
1-0069	Measuring receiver	Rohde & Schwarz	ESHS 10	2017-09	2018-09
1-0071	EMI-Software ES-K1	Rohde & Schwarz	ES-K1 V 1.4	-	-
1-0072	Artificial mains network, 1ph	Rohde & Schwarz	ESH3-Z5	2017-09	2018-09
1-0080	Turntable	H. Deisel	DS 420	-	-
1-0200	Trilog antenna	Schwarzbeck	VULB 9163	2015-12	2018-12
1-0361	Semi anechoic chamber	Reinhold & Mahla	3m	2017-06	2020-06
1-0364	Antenna cable 2	Kabelwerk Eupen	RF/Cord CMS / RG 214-N/7	2016-09	2019-09
1-0604	EMI test receiver	Rohde & Schwarz	ESU8	2017-09	2018-09
1-0611	Signal analyzer	Rohde & Schwarz	FSV 40	2017-09	2018-09
1-0614	Log.-per. antenna	Schwarzbeck Mess-Elektronik	STLP 9148	2016-11	2019-11
1-0615	Pre amplifier	Schwarzbeck Mess-Elektronik	BBV-9718	2017-09	2018-09
1-0619	Coaxial cable (to SAC)	Huber+Suhner	SF106/2x11N-651/2m	2016-09	2019-09
1-0620	Antenna cable 3	Huber+Suhner	SF106/2x11N-651/3m	2016-09	2019-09
1-0624	EMI-Software Radimation	DARE	Radimation	-	-
1-0870	10 dB Attenuator	mini circuits	BW-N10W5+	2016-09	2019-09
1-0781	Pre amplifier	Schwarzbeck	BBV 9721	2017-09	2018-09
1-0782	Antenna cable	Huber & Suhner	FB142A	2015-07	2018-07
1-0806	Controller	Innco	CO 3000	-	-
1-0807	Antenna mast	Innco	MA-400-XPET	-	-
1-0925	Coaxial cable	Harbour	SMA	2017-09	2018-09
1-0927	Coaxial cable	Harbour	SMA	2017-09	2018-09

5 Photos of the EuT

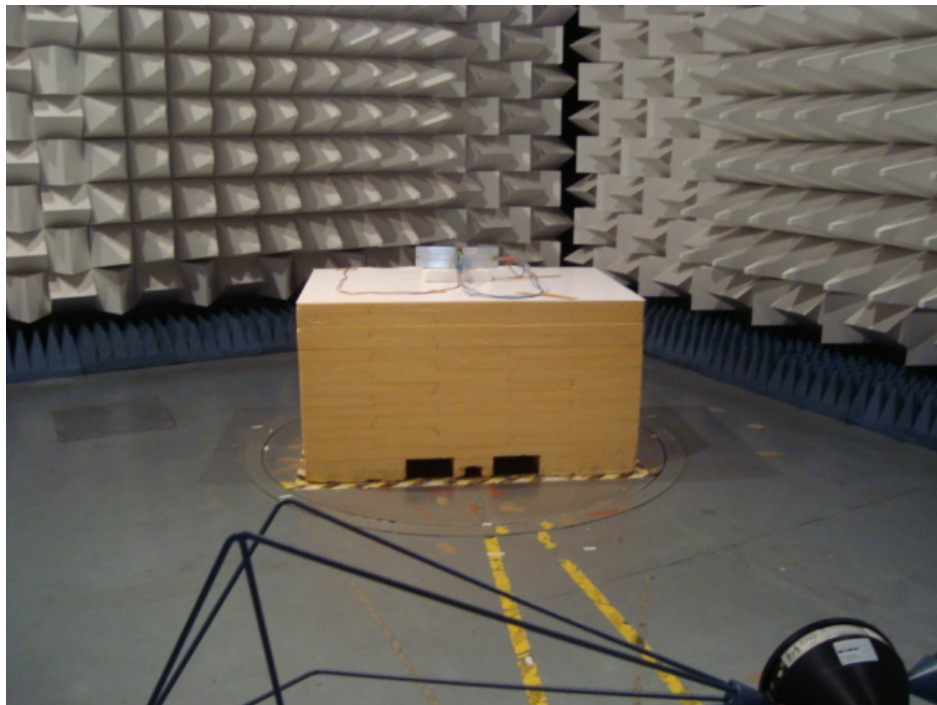


Figure 1 EUT / test set up - spurious radiated emissions ($30 \text{ MHz} < f < 200 \text{ MHz}$)

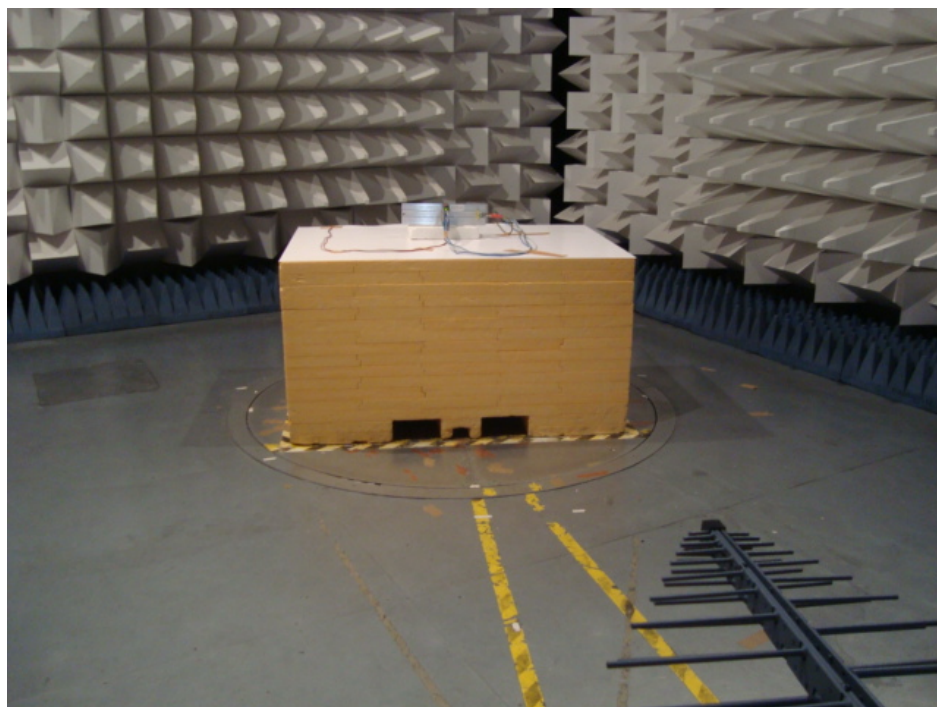


Figure 2 EUT / test set up - spurious radiated emissions ($200 \text{ MHz} < f < 1000 \text{ MHz}$)

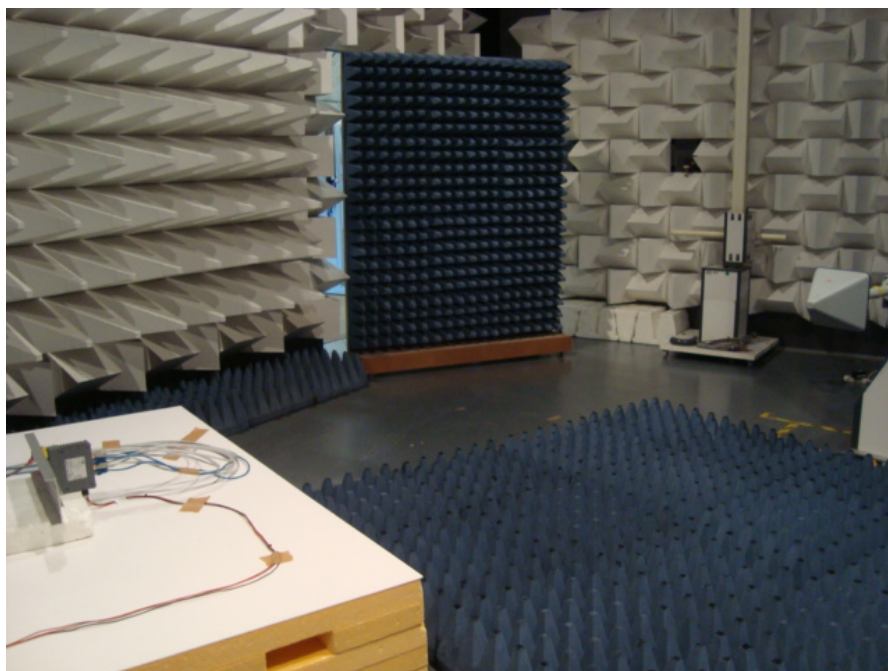


Figure 3 EUT / test set up - spurious radiated emissions (> 1 GHz)

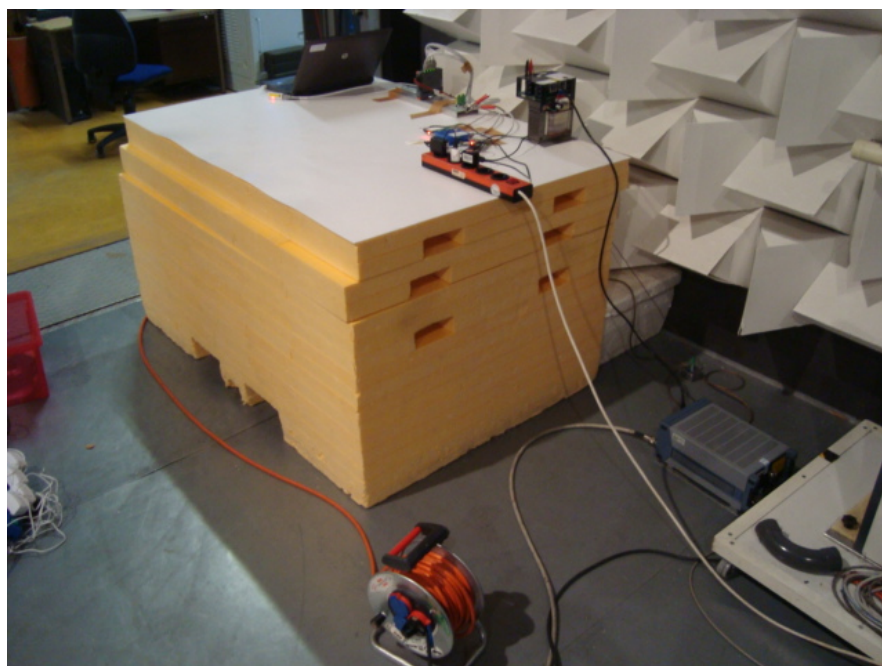


Figure 4 EUT / test set up - spurious conducted emissions

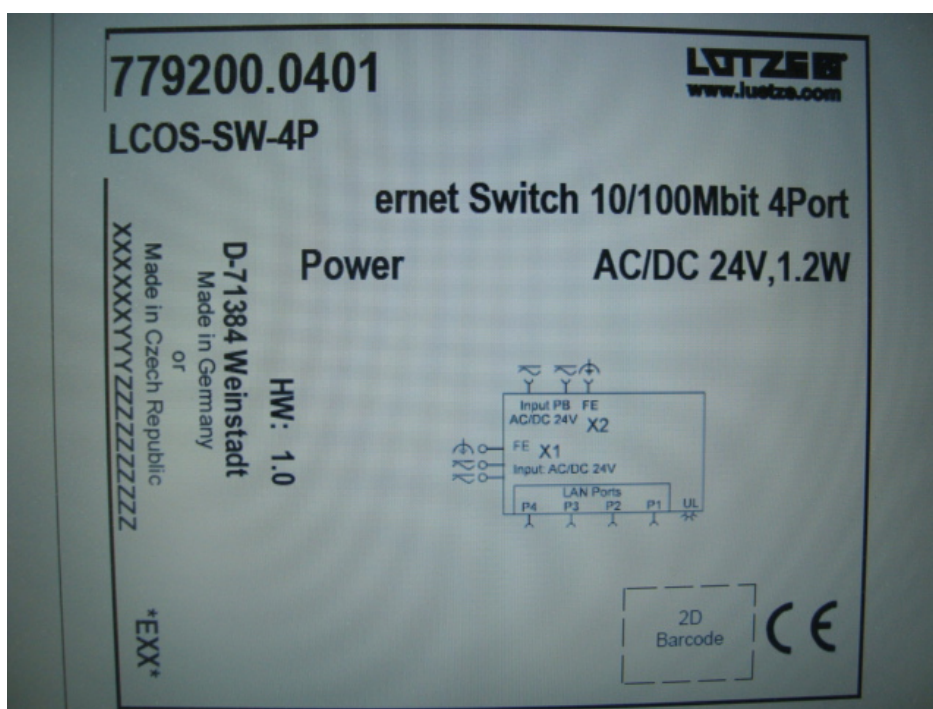


Figure 5 EUT / type label



Figure 6 EUT / LCOS-SW-4P