DELTA Test Report

DANAK
TEST Reg. no. 19

Type approval testing of Sigma S6610, T4000 and T4400

Performed for Selco A/S

DANAK-198449
Project no.: A503163-1
Page 1 of 75
including 6 annexes

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Title	Type approval testing of Sigma S6610, T4000 and T4400
Test objects	SIGMA S6610, Power Management Module T4000, Auto Synchronizer T4400. Load Sharer Detailed information is given in Section 2.1 to 2.3. The test objects were received on 20 September 2005.
Report no.	DANAK-198449
Project no.	A503163-1
Test period	20 September 2005 to 24 March 2006
Client	Selco A/S Betonvej 10 4000 Roskilde Denmark
Manufacturer	Selco A/S
Specifications	IACS E10: Rev. 4 May 2004. Test Specification for Type Approval. ”Test specification applicable, but not confined, to all equipment used for: - Control, protection and safety; - internal communication”. IEC 60533: Second edition, 1999. “Electrical and electronic installations in ships - Electromagnetic compatibility”. IEC 60945: Fourth edition, 2002 “Maritime navigation and radio communication equipment and systems - General requirements - Methods of testing and required test results”. EN 61000-6-2:2001. “Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments”. EN 61000-6-4:2001. “Electromagnetic compatibility (EMC) – Part 6-4: Generic standards - Emission standard for industrial environments”. EN 50263:1999. "Electromagnetic compatibility (EMC) – Product standard for measuring relays and protection equipment”
Results	No malfunctions were detected. The criteria for compliance are listed in Section 3.2.

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1. Summary of test

1.1 Test requirements

Test	Test method
Visual inspection & Performance test	IACS E10:2004
Power supply variations	IEC 60945:2002 / IACS E10:2004
Power supply failure	IEC 60945:2002 / IACS E10:2004
Conducted low frequency interference	IEC 60533:1999 / IEC 61000-4-16:1998
Conducted radio frequency interference	EN 61000-4-6:2001
Electrical fast transients (burst)	EN 61000-4-4:1995
Electrostatic discharges	EN 61000-4-2:2001
Radiated radio frequency interference	EN 61000-4-3:2002
Surge transients	EN 61000-4-5:2001
Conducted emissions	CISPR 16-1:1999 / IEC 60945:2002
Radiated emissions	CISPR 16-1:1999 / CISPR 11:1999
Vibration (resonance search)	IEC 60068-2-6:1995
Vibration (endurance - random)	IEC 60068-2-64:1993
Insulation resistance	IACS E10:2004
Dry heat	IEC 60068-2-2:1974 + Amendments
Low temperature (cold)	IEC 60068-2-1:1990 + Amendments
Damp heat (cyclic)	IEC 60068-2-30 1980 + Amendments
High voltage	IACS E10:2004
Reverse polarity	IEC 60945:2002
Enclosure protection, IP 2X	IEC 60529:2001 / IEC 60945:2002
1 MHz burst	IEC 60255-22-1:1988

1.2 Conclusion

The test objects mentioned in this report meet the relevant requirements of the standards stated below.

- IACS E10:2004
- IEC 60533:1999
- IEC 60945:2002
- EN 61000-6-2:2001
- EN 61000-6-4:2001
- EN 60263:1999

The test results relate only to the specimens tested.

2. Test specimen(s)

2.1 Test object Sigma S6610, Power Management Module

Manufacturer	Selco A/S
Type	S6610
Serial no.	-
Supply voltage	24 VDC
Operational mode	Normal operational mode

2.2 Test object T4000, Auto-Synchroniser

Manufacturer	Selco A/S
Type	T4000-02
Serial no.	360455
Supply voltage	230 VAC
Operational mode	Normal operational mode

2.3 Test object T4400, Load Sharer

Manufacturer	Selco A/S
Type	T4400-33
Serial no.	379852
Supply voltage	230 VAC
Operational mode	Normal operational mode

2.4 AUX equipment: Sigma S6000 IO/P module

Manufacturer	Selco A/S
Model	S6000.0010
Serial no.	372034
Operational mode	S6610 CAN bus comm.

2.5 AUX equipment: Notebook

Manufacturer	IBM
Model	T23
Serial no.	Selco no: lapdkco003
Operational mode	S6610 RS485 comm. using monitoring software “Modbus OPC Configurator” version 3.0.2.1

2.6 AUX equipment: Multimeter

Manufacturer	Fluke
Model	Fluke 37
Serial no.	04422264
Operational mode	S6610, T4000, T4400 analogue output signal monitoring

3. General test conditions

3.1 Test set-up

A drawing of the test set-up is enclosed in Annex 6.

3.2 Criteria for compliance

No change of the actual operational states of the test specimens is allowed. However, temporary change is allowed during the power supply failure test.

The following acceptance criteria for compliance regarding accuracy of analogue parameters were in force:

- "Analog input": ±0.5 mA
- "Analog input": ±0.5 V
- "Analog output": ±0.5 mA
- "Analog output": ±0.5 V

In addition, the following generic acceptance criteria for compliance were in force during the EMC immunity testing:

- Performance Criterion A: (For continuous phenomena) : The EUT shall continue to operate as intended during and after the test. No degradation of performance or loss of function is allowed as defined in relevant equipment standard and the technical specification published by the manufacturer.
- Performance Criterion B: (For transient phenomena): The EUT shall continue to operate as intended after the tests. No degradation of performance or loss of function is allowed as defined in the technical specification published by the manufacturer. During the test, degradation or loss of function or performance which is self-recoverable is, however, allowed but no change of actual operating state or stored data is allowed.
- Performance Criterion C: Temporary degradation or loss of function or performance is allowed during and after the test, provided the function is self-recoverable, or can be restored by the operation of the controls as defined in the relevant equipment standard and in the technical specification published by the manufacturer.

3.3 Functional test

A functional test was performed before, during (if specified) and after each test. The functional test was carried out in accordance with the functional test procedure provided by the customer.

The functional test procedure is given in Annex 6.

3.4 Standard environment

Normal environmental condition:

Temperature	:	15°C to 35°C
Humidity	:	25 %RH to 75 %RH
Air pressure	:	86 kPa to 106 kPa (860 mbar to 1060 mbar)
Power supply voltage	:	U_{nom}. ±3%

4. Test and results

4.1 Visual inspection and performance test

Test method

IACS E10, Test No. 1 and 2.

Procedure

The conformance to drawings and the functional performance are demonstrated to the society surveyors present at DELTA during the type approval testing.

The functional test is also demonstrated.

Results

The conformance to drawings and the functional performance, including the functional test procedure, are demonstrated to the society surveyors after completion of the type approval testing, if requested.

4.2 Conducted emissions (CISPR 16-1)

Test method

CISPR 16-1 (1999-10): Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus.

Severity and procedure

(IACS E10:2004 & IEC 60533:1999 - General power distribution zone)

Frequency range	:	0.01 - 30 MHz		
Limits (quasi-peak)	:	0.01 - 0.15 MHz	:	120 - 69 dBµV
		0.15 - 0.50 MHz	:	79 dBµV
		0.50 - 30 MHz	:	73 dBµV

(IEC 60945:2002, IEC 60533:1999 and IACS E10:2004 - Bridge and Deck Zone)

Frequency range	:	0.01 - 30 MHz		
Limits (quasi-peak)	:	0.01 - 0.15 MHz	:	96 - 50 dBµV
		0.15 - 0.35 MHz	:	60 - 50 dBµV
		0.35 - 30 MHz	:	50 dBµV

The radio frequency voltage is measured at the power supply terminals of the test specimen, by a receiver through an artificial mains network.

The test specimen is energised and in normal operational mode during the measurement.

Results

The conducted emissions were within the specified limits. Test record sheets of the conducted emission measurements are enclosed in Annex 3.

4.3 Conducted emission (CISPR 11)

Test method

CISPR 11 (1999-08): Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement.

Severity and procedure

Frequency range	:	0.15 - 30 MHz		
Limits (quasi-peak)	:	0.15 - 0.50 MHz	:	79 dBµV quasi-peak
			:	66 dBµV average
		0.50 - 30 MHz	:	73 dBµV quasi-peak
			:	60 dBµV average

The radio frequency voltage is measured at the power supply terminals of the test specimen, by a receiver through an artificial mains network.

The test specimen is energised and in normal operational mode during the measurement.

Results

The conducted emissions were within the specified limits. Test record sheets of the conducted emission measurements are enclosed in Annex 3.

4.4 Radiated emissions (CISPR 16-1)

Test method

CISPR 16-1 (1999-10): Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus.

Severity and procedure

Severity and procedure

(IACS E10:2004 and IEC 60533:1999 - General power distribution zone)

Frequency range	:	0.15 - 2000 MHz		
Limits (quasi-peak)	:	0.15 - 30 MHz	:	80 - 50 dBµV/m
		30 - 100 MHz	:	60 - 54 dBµV/m
		100 - 2000 MHz	:	54 dBµV/m, except for
		156 - 165 MHz	:	24 dBµV/m

(IACS E10:2004 - Bridge and Deck Zone)

Frequency range	:	0.15 - 2000 MHz		
Limits (quasi-peak)	:	0.15 - 0.3 MHz	:	80 - 52 dBµV/m
		0.3 - 30 MHz	:	50 - 34 dBµV/m
		30 - 2000 MHz	:	54 dBµV/m, except for
		156 - 165 MHz	:	24 dBµV/m

(IEC 60945:2002 and IEC 60533:1999 - Bridge and Deck Zone)

Frequency range	:	0.15 - 2000 MHz		
Limits (quasi-peak)	:	0.15 - 0.3 MHz	:	80 - 52 dBµV/m
		0.3 - 30 MHz	:	52 - 34 dBµV/m
		30 - 2000 MHz	:	54 dBµV/m, except for
		156 - 165 MHz	:	24 dBµV/m

The electric field is measured with antennas at a distance of 3 m.

The test specimens are energised and in normal operational mode during the measurement.

Results

The radiated emissions were within the specified limits. Test record sheets of the radiated emission measurements are enclosed in Annex 4.

4.5 Radiated emission (CISPR 11)

Test method

CISPR 11 (1999-08): Industrial, scientific and medical (ISM) radio-frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement.

Severity and procedure

Frequency range	:	30 - 1000 MHz		
Limits (quasi-peak)	:	30 - 230 MHz	:	40 dBµV/m
		230 - 1000 MHz	:	47 dBµV/m

The electric field is measured with antennas at a distance of 10 m.

The test specimens are energised and in normal operational mode during the measurement

Results

The radiated emissions were within the specified limits. Test record sheets of the radiated emission measurements are enclosed in Annex 4.

4.6 Insulation resistance

Test method

IACS E10, Test No. 9.

Procedure

The insulation resistance is measured between shorted supply terminals and earth with 50 VDC for 24 VDC power ports and 500 VDC for 230 VAC power ports. The insulation resistance is to be above 100 MΩ (AC power ports) and 10 MΩ (DC power ports) initially, and above 10 MΩ (AC power ports) and 1 MΩ (DC power ports) after the low temperature and the damp heat exposures..

Results

Cable designation	Test condition	Test voltage [Vrms]	Duration [sec]	Insulation resistance [MΩ]
DC power ports of all externally powered test objects	Initial	50 VDC	60 sec.	>100 MΩ
	After Low temperature test	50 VDC	60 sec.	>100 MΩ
	After Damp heat test	50 VDC	60 sec.	>10 MΩ
AC power ports of all externally powered test objects	Initial	500 VDC	60 sec.	>1000 MΩ
	After Low temperature test	500 VDC	60 sec.	>1000 MΩ
	After Damp heat test	500 VDC	60 sec.	>100 MΩ

4.7 High voltage

Test method

IACS E10, Test No. 10.

Procedure

550 VAC, 50 Hz is applied between shorted supply terminals and earth for 1 minute for the 24 VDC supply line.

1500 VAC, 50 Hz is applied between shorted supply terminals and earth for 1 minute for the 230 VAC supply line.

No flashover, breakdown, etc. is acceptable.

Results

This test was omitted due to the presence of components for EMC protection.

4.8 Vibration

4.8.1 Resonance search

Test method

IEC 60068-2-6 (1995), Test Fc: Vibration (sinusoidal).

Severity and procedure

Frequency range	:	2 - 100 Hz		
Frequency/amplitude	:	2 - 25 Hz	:	±1.6 mm
		25 - 100 Hz	:	±4.0 g
Sweep rate	:	Max. 1 octave/min.		
Number of axes	:	3 mutually perpendicular		

The test specimens are de-energised during the exposure.

During the resonance search, the resonance frequencies are determined by means of stroboscopic light with slow motion facility and accelerometer measurements of the amplification factors (Q).

Resonance frequencies with an amplification factor above 2 are recorded.

Results

No amplification factors above 2 were recorded.

Place of measurement	Axis	Frequency	Amplification factor
T4000	X, Y and Z	2 - 100 Hz	< 2
T4400	X, Y and Z	2 - 100 Hz	< 2
S6610 PM	X, Y and Z	2 - 100 Hz	< 2

Measurement curves of the maximum amplification factors and resonance frequencies are enclosed in Annex 5.

4.8.2 Endurance vibration

The sinusoidal vibration test according to IACS E10 and IEC 60945 is replaced by random vibration test according to "Environmental test specification for instrumentation and automation equipment" No. 2.4, issued April 2001 by DNV.

This random vibration test will cover the requirements of the sinusoidal vibration test according to IACS E10 and IEC 60945.

Test method

IEC 60068-2-64 (1993), Test Fh: Vibration, broadband random (digital control).

Severity and procedure

Frequency range	:	2 - 100 Hz		
Acceleration spectral	:	2 - 25 Hz	:	+12 dB/octave
Density	:	25 - 100 Hz	:	0.2 g^2/Hz
Total RMS level	:	4.0 g		
Duration	:	150 minutes per axis		
Number of axes	:	3 mutually perpendicular		

The test specimens are energised and in normal operational mode during the exposures. A functional test is performed after the exposure in each axis.

A visual inspection is performed after the exposure.

Results

No malfunction was observed during the exposure and the function of the test specimens was OK after the exposure in each axis.

No damage was observed after the exposures.

4.9 Power supply variations (permanent)

Test method

IACS E10, Test No. 4

IEC 60945, Section 5.2.2.

Procedure (230 VAC supplied)

$U_{nom.}$	=	Nominal supply voltage	=	230 VAC
$f_{nom.}$	=	Nominal supply frequency	=	50 Hz

Exposures, each with a duration of 15 minutes, are performed at the following supply voltages and frequencies:

U	=	$U_{nom.}$ + 10%	=	253 VAC
U	=	$U_{nom.}$ - 10%	=	207 VAC
f	=	$f_{nom.}$ + 5%	=	52.5 Hz
f	=	$f_{nom.}$ - 5%	=	47.5 Hz

Procedure (24 VDC supplied)

$U_{nom.}$	=	Nominal supply voltage	=	24 VDC

Exposures, each with a duration of 15 minutes, are performed at the following supply voltages:

U_1	=	Un+30%	=	31.2 VDC
U_2	=	Un-25%	=	18.0 VDC

The test specimens are observed during the exposures, and a functional test is performed at the end of each exposure.

An additional power supply variations test is performed as part of the functional test during the low temperature and the dry heat test profiles.

Results

No malfunction was observed during the exposure, and the function of the test specimens was OK after the exposure.
Performance criterion: A.

4.10 Power supply variations (transient)

Test method

IACS E10, Test No. 4

IEC 60945, Section 5.2.2

Procedure

$U_{nom.}$	=	Nominal supply voltage	=	230 VAC
$f_{nom.}$	=	Nominal supply frequency	=	50 Hz

Ten exposures, 1/min, are carried out at each of the following combinations:

(230 VAC supplied)

- $U_{nom.}$ + 20% = 276 VAC Duration = 1.5 s
  $f_{nom.}$ + 10% = 55 Hz Duration = 5.0 s

- $U_{nom.}$ - 20% = 184 VAC Duration = 1.5 s
  $f_{nom.}$ - 10% = 45 Hz Duration = 5.0 s

The test specimen is observed during the exposures, and a functional test is performed at the end of each combination.

Results

No malfunction was observed during the exposure, and the function of the test specimen was OK after the exposure.
Performance criterion: A

4.11 Power supply failure

Test method

IACS E10, Test No. 3

IEC 60945, Section 7.4.

Procedure

The power supply is interrupted 3 times within 5 minutes with a break time of 60 seconds.
Normal power-up procedure is to be obtained after each power break.

Results

No malfunction was observed during the exposure, and the function of the test specimen was OK after each exposure.
Performance criterion: C.

4.12 Conducted low frequency interference

Test method

IEC 61000-4-16 (1998-01): Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz.

Severity and procedure

Frequency range	:	0.05 - 10 kHz
Amplitude (AC-supplied)	:	50 Hz to 15th harmonic :10% of $U_{nom.}$ 15th to 100th harmonic :10%-1% of $U_{nom.}$ 100th to 200th harmonic : 1% of $U_{nom.}$
Amplitude (DC-supplied)	:	0.05 - 10 kHz : 10% of $U_{nom.}$ min.3 Vrms
Maximum applied power	:	2.0 W

The impedance of the test generator is less than 1 Ω.

The test signal is superimposed on the power supply lines via a coupling transformer.

The test specimen is energised and in normal operational mode during the exposure. The test specimen is observed during the exposure, and a functional test is performed after the exposure

Results

No malfunction was observed during the exposure, and the function of the test specimen was OK after the exposure.
Performance criterion: A.

4.13 Conducted radio frequency interference

Test method

EN 61000-4-6 (2001-04), Ed. 1.1: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields.

Severity and procedure

Frequency range	:	150 kHz - 80 MHz		
Amplitude	:	0.15 - 80 MHz	:	10 Vrms
Modulation	:	80% AM, 400 Hz sine wave 80% AM, 1 kHz sine wave		

The test specimen is supplied with power via a coupling/decoupling network.

The test signal is coupled to the power lines and signal lines via coupling networks. The coupling impedance is 150 Ω.

The test specimens are energised and in normal operational mode during the exposure. The test specimens are observed during the exposure, and a functional test is performed after the exposure.

Results

No malfunction was observed during the exposure, and the function of the test specimen was OK after the exposure.
Performance criterion: A.

4.14 Radiated radio frequency interference

Test method

EN 61000-4-3 (2002-03): Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test.

Severity and procedure

Frequency range	:	80 - 2000 MHz
Field strength	:	10 V/m
Modulation	:	80% AM, 400 Hz sine wave 80% AM, 1 kHz sine wave

The test is performed in a semi-anechoic room. The field is generated using linearly polarised broadband antennas.

The test specimens are energised and in normal operational mode during the exposure. The test specimens are observed during the exposure, and a functional test is performed after the exposure.

Results

No malfunction was observed during the exposure, and the function of the test specimens was OK after the exposure.
Performance criterion: A.

4.15 Surge voltage

Test method

EN 61000-4-5 (2001-04) Ed. 1.1: Testing and measurement techniques - Surge immunity test.

Severity and procedure

Amplitude AC power ports	:	1 & 2 kV line-to-earth, 0.5 & 1 kV line-to-line
Amplitude DC power ports	:	1 kV line-to-earth, 0.5 kV line-to-line
Amplitude signal lines	:	1 kV line-to-earth (lines >30 m)
Voltage rise time	:	1.2 µs (open circuit)
Voltage decay time	:	50 µs (open circuit)

The impedance of the test generator is 2 Ω for line-to-line coupling and 12 Ω for line-to-earth coupling.

The impedance of the test generator is 2 Ω for exposures on shielded signal lines.

The test specimens are supplied with power via a transient coupling network.

The test specimens are energised and in normal operational mode during the exposure. The test specimens are observed during the exposure, and a functional test is performed after the exposure.

Results

No malfunction was observed during the exposure, and the function of the test specimens was OK after the exposure.
Performance criterion: B.

4.16 Electrostatic discharge

Test method

EN 61000-4-2 (2001-04) Ed. 1.2: Testing and measurement techniques - Electrostatic discharge immunity test.

Severity and procedure

Air discharge	:	2, 4 and 8 kV
Contact discharge	:	2, 4 and 6 kV
Energy storage capacitance	:	150 pF
Discharge resistance	:	330 Ω
Polarity	:	+ and -
Number of discharges	:	10 per polarity at each test point

The discharges are applied only to such points and surfaces of the test specimen, which are accessible to personnel during normal use.

Contact discharges are applied to conductive surfaces and coupling planes, and air discharges are applied to insulating surfaces.

The test specimens are energised and in normal operational mode during the exposure. The test specimens are observed during the exposure, and a functional test is performed after the exposure.

Results

No malfunction was observed during the exposure, and the function of the test specimens was OK after the exposure.
Performance criterion: B.

4.17 Fast transients (burst)

Test method

EN 61000-4-4 (1995-01): Testing and measurement techniques - Section 4: Electrical fast transient/burst immunity test, Amendment 1 (2000-11), Amendment 2 (2001-07).

Severity and procedure

Amplitude	:	2 kV on power lines
	:	2 kV on earth port
		1 kV on signal lines
Pulse rise time	:	5 ns
Pulse duration	:	50 ns
Generator impedance	:	50 Ω
Repetition rate	:	5 kHz
Burst duration	:	15 ms
Burst period time	:	300 ms

The test specimens are supplied with power via a transient coupling network. The test signal is successively coupled to each power line and protective earth with reference to the ground plane.

The test signal is injected on the signal lines using a capacitive coupling clamp. The clamp is successively used on selected signal cables.

The test signal is injected on the power lines for 5 minutes, using each coupling mode and each polarity, and then on the signal lines for 5 minutes using each polarity.

The test specimens are energised and in normal operational mode during the exposure. The test specimens are observed during the exposure and a functional test is performed after the exposure.

Results

No malfunction was observed during the exposure, and the function of the test specimens was OK after the exposure.
Performance criterion: B.

4.18 Dry heat

Test method

IEC 60068-2-2 (1974), Test Bd: Dry heat for heat-dissipating specimen with gradual change of temperature, Amendment 1 (1993), Amendment 2 (1994).

Severity and procedure

The following two exposures are performed:

1. Temperature : 55°C
   Duration : 16 hours
   Humidity : Below 50 %RH

2. Temperature : 70°C
   Duration : 16 hours
   Humidity : Below 50 %RH

The test specimens are energised and in normal operating condition during the exposure. During the last hour of the exposure, a functional test is performed.

After recovery the functional test is repeated in standard environment.

Results

No malfunction was observed during the exposure and the function of the test specimen was OK during the last hour of the exposure and after recovery.

4.19 Low temperature (cold)

Test method

IEC 60068-2-1 (1990), Test Ad: Cold for heat-dissipating specimen with gradual change of temperature, Amendment 1 (1993), Amendment 2 (1994).

Severity and procedure

Temperature	:	-15°C
Duration	:	16 hours

The test specimens are de-energised during the exposure. However, during the last hour of the exposure the test specimen is energised and a functional test is performed. After recovery, a functional test and an insulation resistance test are performed in standard environment.

Results

No malfunction was observed during the exposure and the function of the test specimen was OK during the last hour of the exposure and after recovery.

4.20 Damp heat, cyclic

Test method

IEC 60068-2-30 (1980), Test Db: Damp heat cyclic (12 + 12 hours' cycle), Variant 1, Amendment 1 (1985).

Severity and procedure

Lower temperature	:	25°C
Humidity at lower temperature	:	>95 %RH
Upper temperature	:	55°C
Humidity at upper temperature	:	93 %RH
Number of cycles	:	2

During the first cycle, the test specimens are energised and in normal operational mode. A functional test is performed during the first 2 hours of the 55°C phase.

During the second cycle, the test specimens are de-energised. However, during the last 2 hours of the second 55°C phase, the test specimens are energised and a functional test is performed.

After recovery, the test specimens are energised and a functional test and an insulation resistance test are performed in standard environment.

Results

No malfunction was observed during the exposure, and the function of the test specimens was OK during the first and second cycle at 55°C and 93 %RH, and after recovery.

No corrosion attack was observed after the exposure.

4.21 Reverse polarity

Test method

IEC 60945:2002, Section 5.2.3.

Procedure (DC supplied)

The test specimens are subjected to an input from a power supply of reversed polarity for a period of 5 minutes.

After completion of the test and reset of the protection of the test specimens, if required, the power supply shall be connected normally and a performance check shall be carried out.

Results

The test specimens are equipped with reverse polarity protection diodes. Consequently, no current consumption or malfunction of the test specimens occurs during exposure. During and after completion of the test, the function of the test specimens was OK.

4.22 Enclosure protection, IP2X

Test method

IEC 60529 (2001-02): Degrees of protection provided by enclosures (IP Code).

Severity and procedure

The test specimen is subjected to a test corresponding to IEC 60529:2001, table 1, first characteristic numeral 2 (IP2X): “Protection against access to hazardous parts with a finger, and thus IEC 60945:2001, clause 12.1: “Protection against access to dangerous voltages.

Results

The test specimens have adequate protection against access to hazardous parts with a finger, i.e. no openings greater than 12 mm Ø were measured.

4.23 1 MHz burst

Specifications

IEC 60255-22-1 (1988):Electrical disturbance tests for measuring relays and protection equipment. Part 1: 1 MHz burst disturbance tests.

Severity and procedure

Amplitude	:	1 kV DM on power ports and I/O ports 2.5 kV CM on power ports and I/O ports 1 kV CM on communication ports
Frequency	:	1 MHz
Source impedance	.	200 Ohm
Rise time	:	75 ns
Repetition frequency	:	400 Hz

The test specimen is energised and in normal operational mode during the exposure. The test specimen is observed during the exposure and a functional test is performed after the exposure.

Results

No malfunction was observed during the exposure, and the function of the test specimens was OK after the exposure.

Annex 1

List of instruments

List of instruments

NO.	DESCRIPTION	MANUFACTURER	TYPE NO.
22631	VIBRATION CONTROLLER	SIGNAL STAR VECTOR	U2 Sys 5144
ACC. 91	ACCELEROMETER	BRUEL & KJÆR	4371
ACC. 93	ACCELEROMETER	BRUEL & KJÆR	4371
ACC.71A	ACCELEROMETER	BRUEL & KJÆR	4393
ACC. 72	ACCELEROMETER	BRUEL & KJÆR	4393
22630	ACCELEROMETER PREAMPLIFIER	BRUEL & KJÆR	2692
22589	ACCELEROMETER PREAMPLIFIER	BRUEL & KJÆR	2626
22601	ELECTRONIC VOLTMETER	HEWLETT-PACKARD	34401A
22591	OSCILLOSCOPE	KENWOOD	CS-1025
Y221	ELECTRODYNAMIC SHAKER	LING DYNAMIC SYS.	V 875-440T
U2501	SWITCHING POWER AMPLIFIER	LING DYNAMIC SYS.	SPA 50/30KCE
EVFGT-27	CLIMATIC TEST CHAMBER	DELTA	VKF10
EVFGT-28	CLIMATIC TEST CHAMBER	DELTA	VF10
29223	CURRENT PROBE	SINGER	91550-4
29342	REFLECTOMETER COUPLER, 600-4200 MHz	ROHDE & SCHWARZ	ZPD
29347	RF GENERATOR , 10 kHz-1 GHz	MARCONI	2022
29461	ARTIFICIAL MAINS NETWORK	ROHDE & SCHWARZ	ESH2/Z5
29680	IMPULSE VOLTAGE LIMITER	ROHDE & SCHWARZ	ESH3/Z2
29691	0.01 - 20 GHz. SYNTH. SWEEPER	HEWLETT-PACKARD	83620A
29694	1-12 GHz. HORN ANTENNA.	LOGIMETRICS	AN 8200 F
29703	LF POWER AMPLIFIER	BRUEL & KJÆR	2708
29754	RF POWER ATTENUATOR, 50 OHM, 6 dB, 150 W	NARDA	769-6
29781	DIGITAL MULTIMETER W. HPIB	HEWLETT-PACKARD	34401A
29786	HIGH POWER RF AMPLIFIER, 80-1000 MHz	AMPLIFIER RESEARCH	500W1000M5
29797	BILOG ANTENNA, 30-1000 MHz	CHASE ELECTRICS LTD	CBL 6111A
29815	3-LINE CDN NETWORK, IEC 61000-4-6	MEB	M3
29749	SHIELD-LINE CDN NETWORK, IEC 61000-4-6	DELTA EMC DEPT.	SHIELD LINE CDN
29827	ELECTRONIC SURGE GENERATOR	EM TEST	VCS 500
29832	DIFFERENTIAL HIGH VOLTAGE PROBE, DC-25 MHz	TEKTRONIX	P5200
29838	ESD GENERATOR, AIR AND CONTACT DIS-CHARGE	KEYTEK	MZ-15EC
29844	-40 dBc VOLTAGE SAMPLER, DC-100 MHz	DELTA EMC DEPT.	SAMPLER VER. 2
29846	RF GENERATOR, 9 kHz-2.4 GHz	MARCONI	2024
29861	EMI-SOFTWARE Ver. 1.60	ROHDE & SCHWARZ	ES-K1, PART: 1026.6790.02
29865	CAPACITIVE COUPLING CLAMP	DELTA EMC	IEC 1000-4-4

NO.	DESCRIPTION	MANUFACTURER	TYPE NO.
29866	LF INJECTION TRAFO, 6 x 6 TURNS	KNUD OVERGAARD	14311
29880	CURRENT PROBE AMPLIFIER FOR 29907 AND 29707	TEKTRONIX	AM503B
29884	PULSE / FUNCTION GENERATOR, 50 MHz	WAVETEK	81
29904	BROADBAND POWER AMPLIFIER, 10 kHz-250 MHz, 75 W	AMPLIFIER RESEARCH	75A250
29906	15 MHz FUNCTION / ARBITRARY WAVE GENERATOR	HEWLETT-PACKARD	33120A
29907	ACTIVE CURRENT PROBE HEAD FOR 29880	TEKTRONIX	A6302
29913	ELECTRICAL FAST TRANSIENT (BURST) GENERATOR	EM TEST	EFT 500
29915	DC COUPLED POWER AMPLIFIER / POWER SUPPLY	HEWLETT-PACKARD	467A
29916	AUTOMATIC TEST RECEIVER, 9 kHz-2.75 GHz	ROHDE & SCHWARZ	ESCS 30 1102.4500.30
29936	SAMPLING OSCILLOSCOPE, 100 MHz, 500 MS/s	TEKTRONIX	TDS 340A
29967	COAX RF DIODE DETECTOR, NEG. OUT-PUT, ROOM 5	HEWLETT-PACKARD	8471D
29975	DIGITAL MULTIMETER w. GPIB	HEWLETT-PACKARD	34401A
29984	RF POWER AMPLIFIER, 0.8-2.2 GHz, 200W	MILMEGA	AS0822-200
29985	BILOG ANTENNA 26-2000 MHz	SCHAFFNER/CHASE	6140A
49002	SINGLE CHANNEL POWER METER DIS-PLAY UNIT	ROHDE & SCHWARZ	NRVS
49003	THERMAL POWER SENSOR, DC-18 GHz	ROHDE & SCHWARZ	NRV-Z51
49024	COAX RF DIODE DETECTOR, NEG. OUT-PUT, CS TEST	HEWLETT-PACKARD	8471D
49034	"CABLE#42", 3 M, 50 OHM COAX CABLE, N-N (STRAIGHT)	CELLFLEX	
29332	ACTIVE LOOP ANTENNA	ROHDE & SCHWARZ	HFH-Z2
43028	MEGGER	AVO INTERNATIONAL	BM 80
30344	HIGH VOLTAGE APPARATUS	WILLY NIELSEN	W5

Annex 2

Photos

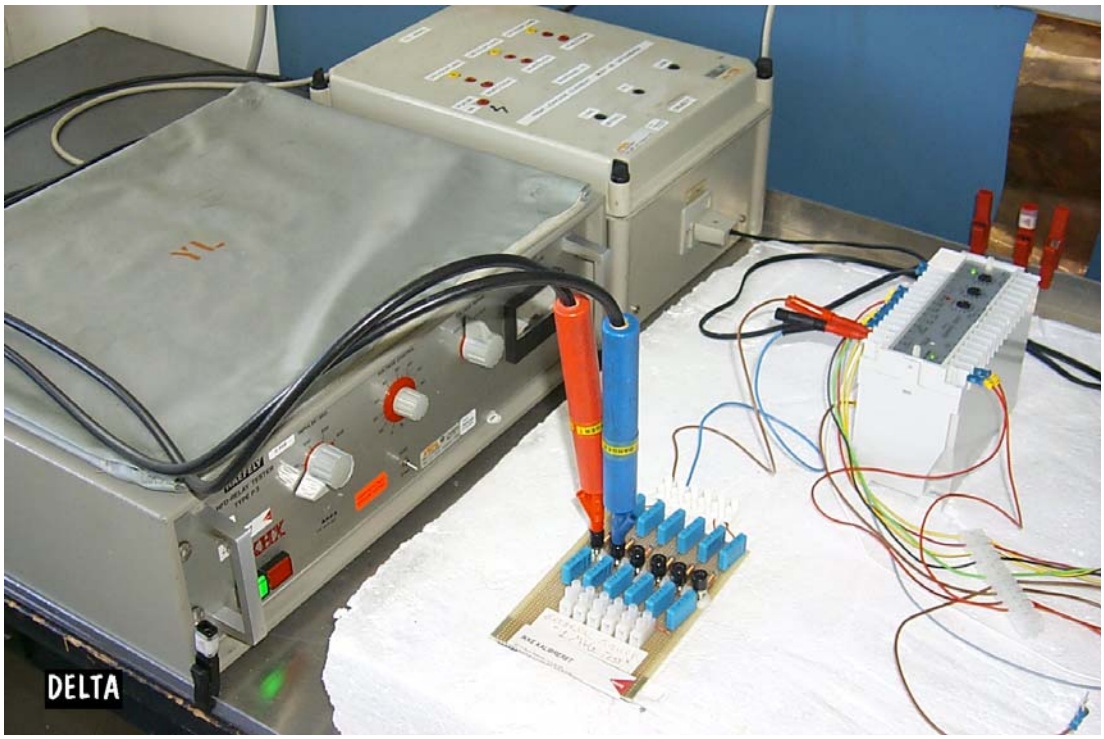


Photo 1. 1 MHz burst, e.g T4400.

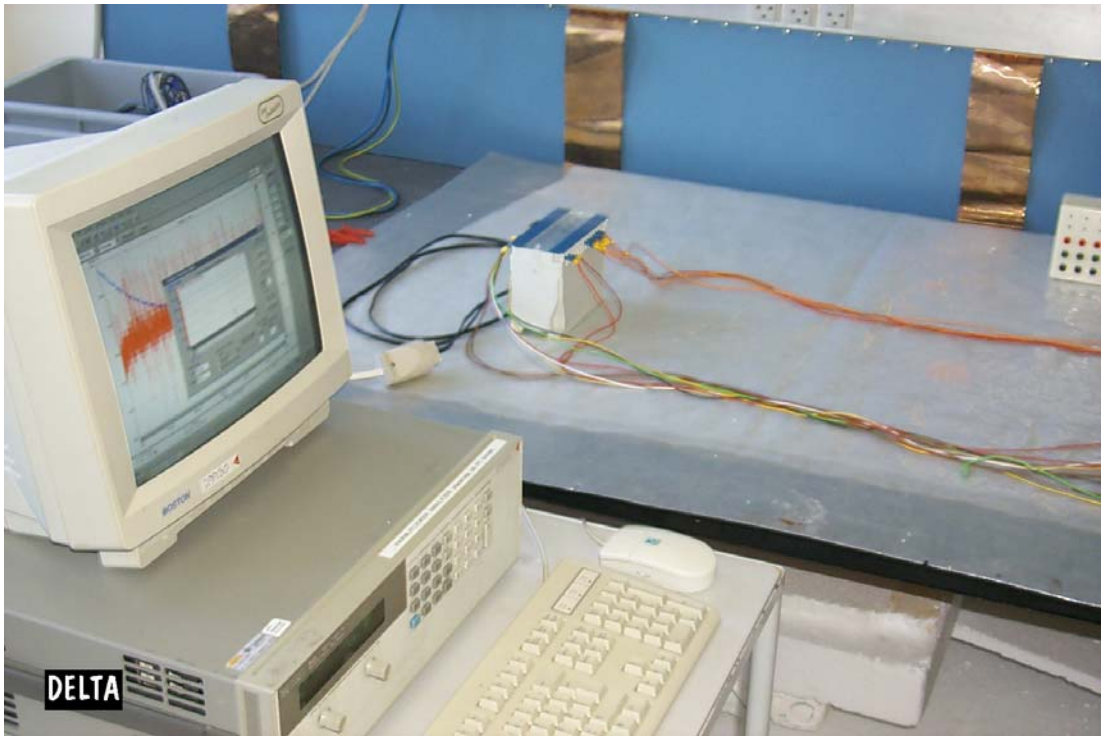


Photo 2. Power supply variations & failure, e.g. T4400.

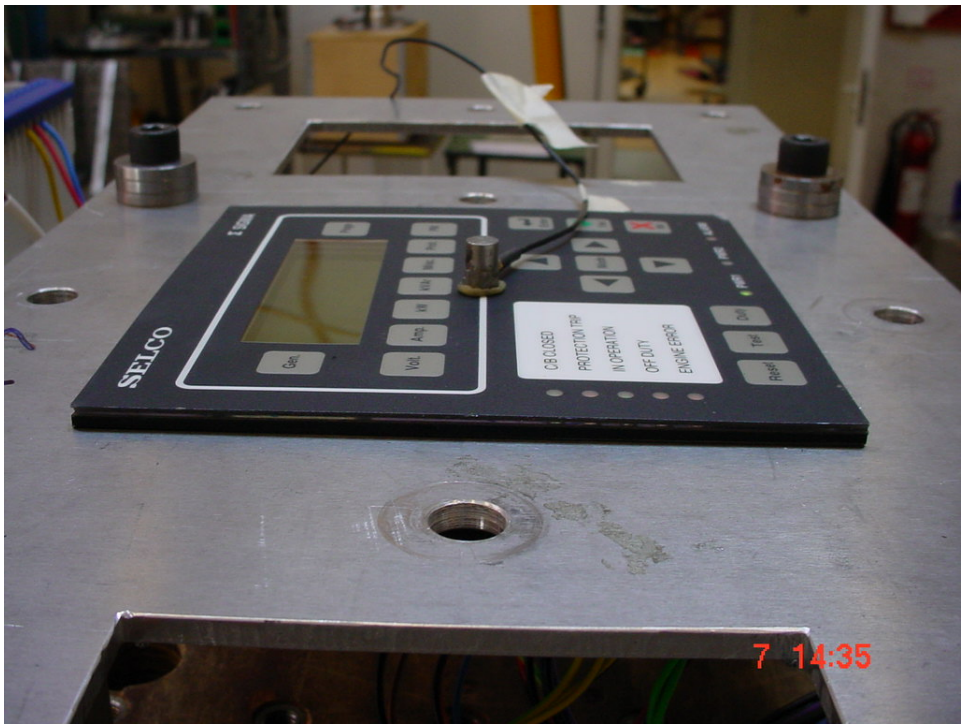


Photo 3. Vibration, resonance search, e.g. S6610.

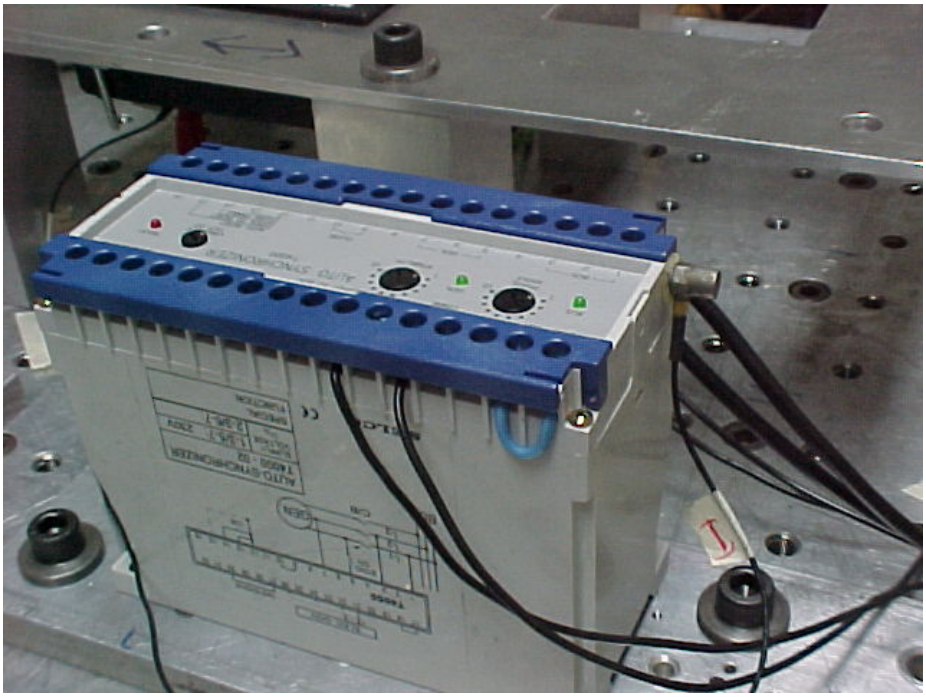


Photo 4. Vibration, resonance search, e.g. T4000.

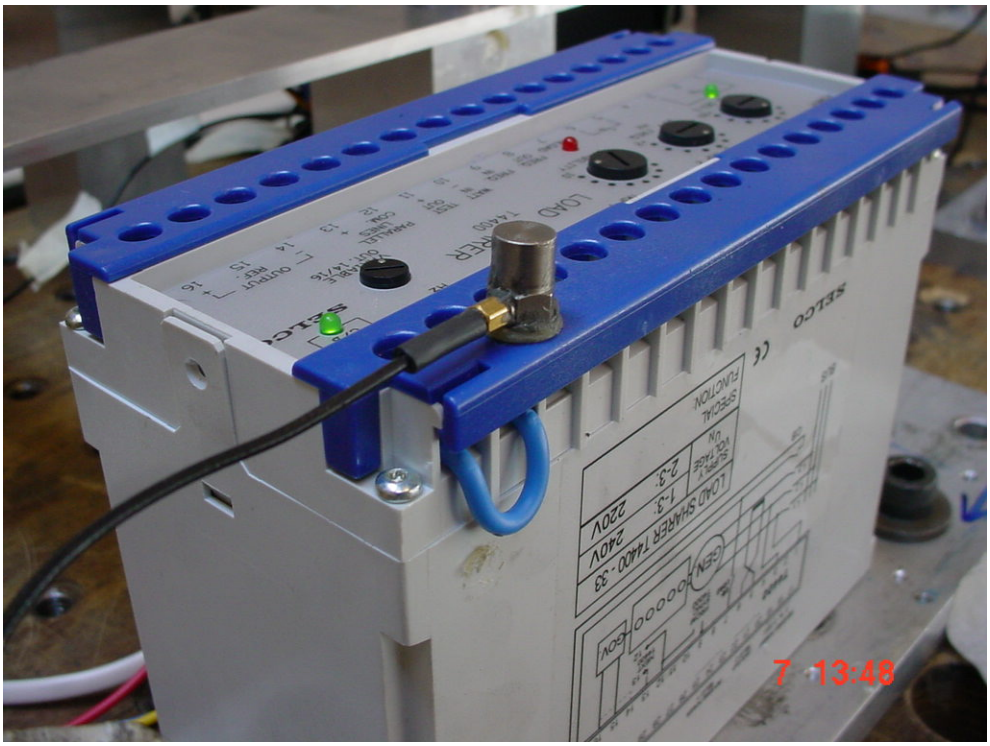


Photo 5. Vibration, resonance search, e.g. T4400.

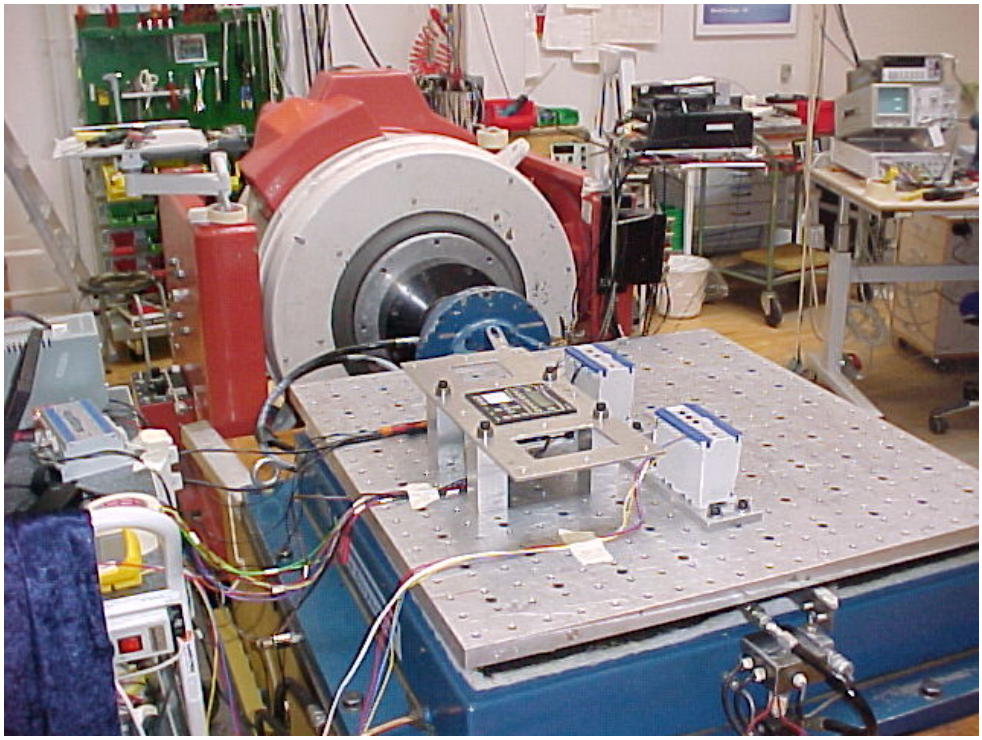


Photo 6. Vibration, endurance.

Photo 7. Climatic testing.

Photo 8. Radiated emissions (0.15 - 30 MHz). 3 m.

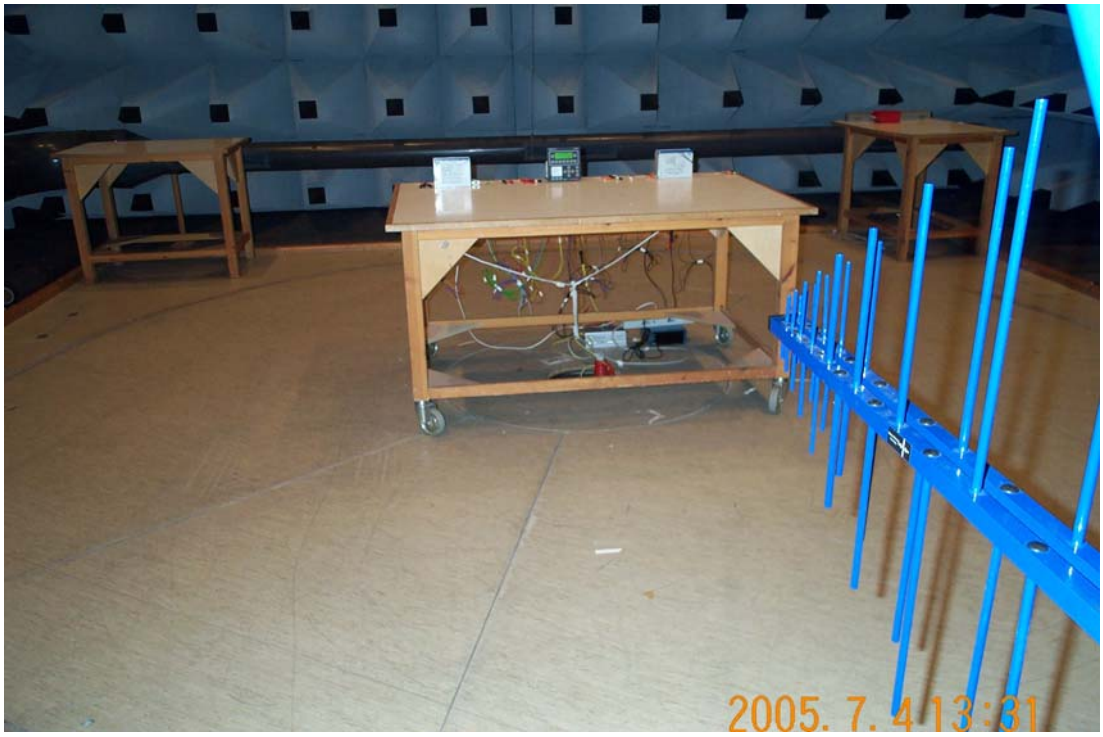


Photo 9. Radiated emissions (30 - 2000 MHz). 3 m.

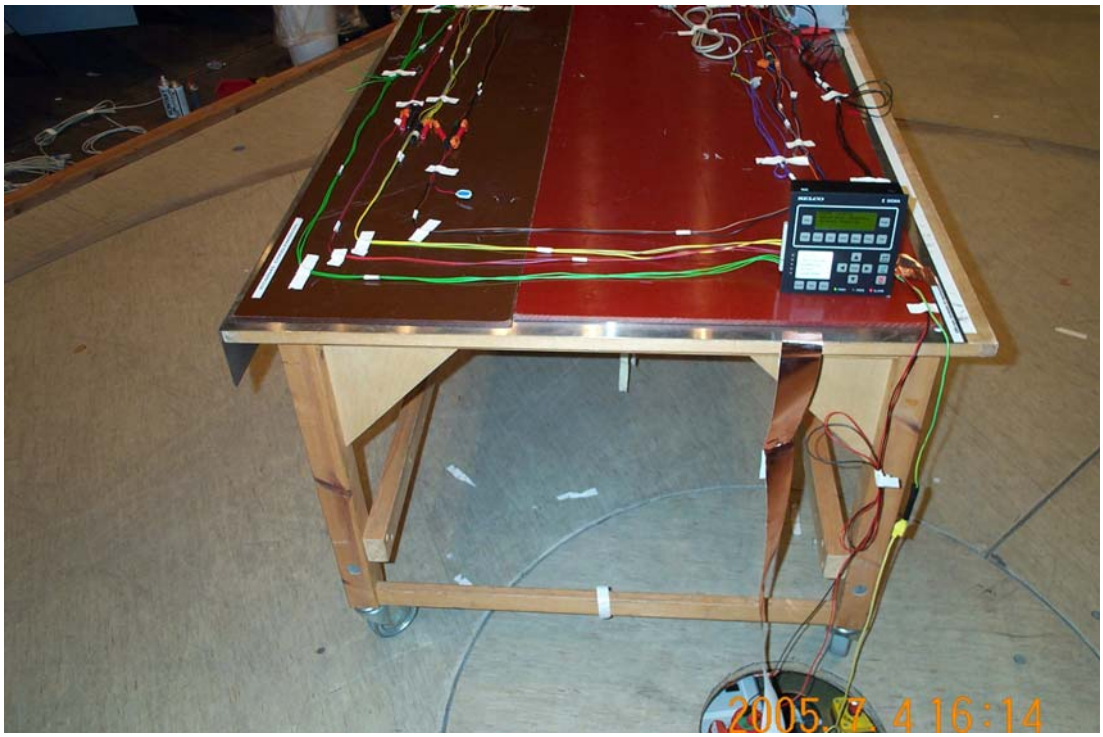


Photo 10. Conducted emissions, e.g. S6610.

Photo 11. Conducted radio frequency interference, e.g. S6610.

Photo 12. Conducted radio frequency interference, e.g. T4000.

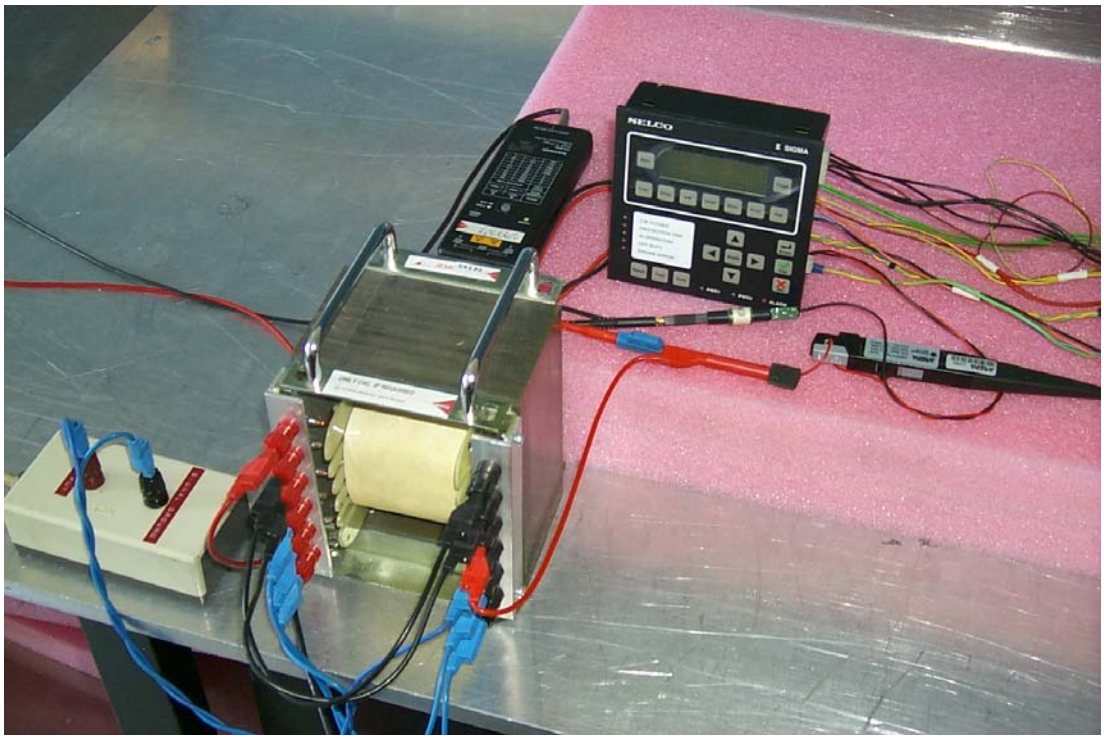


Photo 13. Conducted low frequency interference, e.g. S6610.

Photo 14. Fast transients (burst), e.g. T4000.

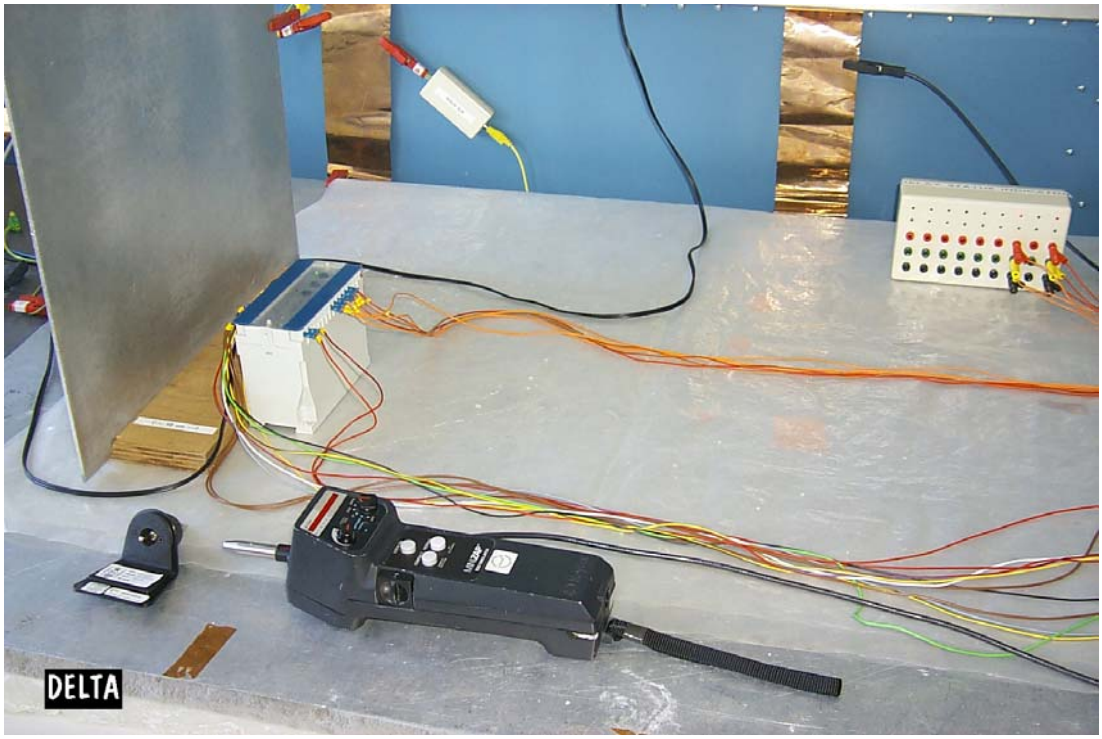


Photo 15. Electrostatic discharge, e.g. T4400.

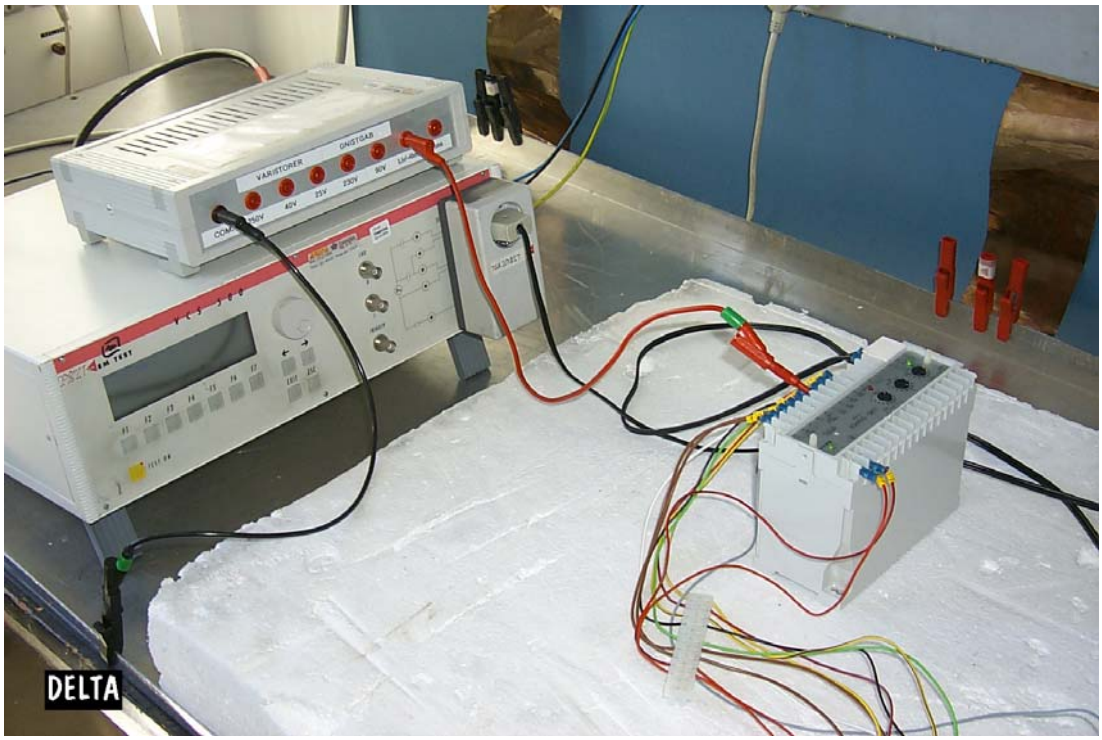


Photo 16. Surge, e.g. T4400.

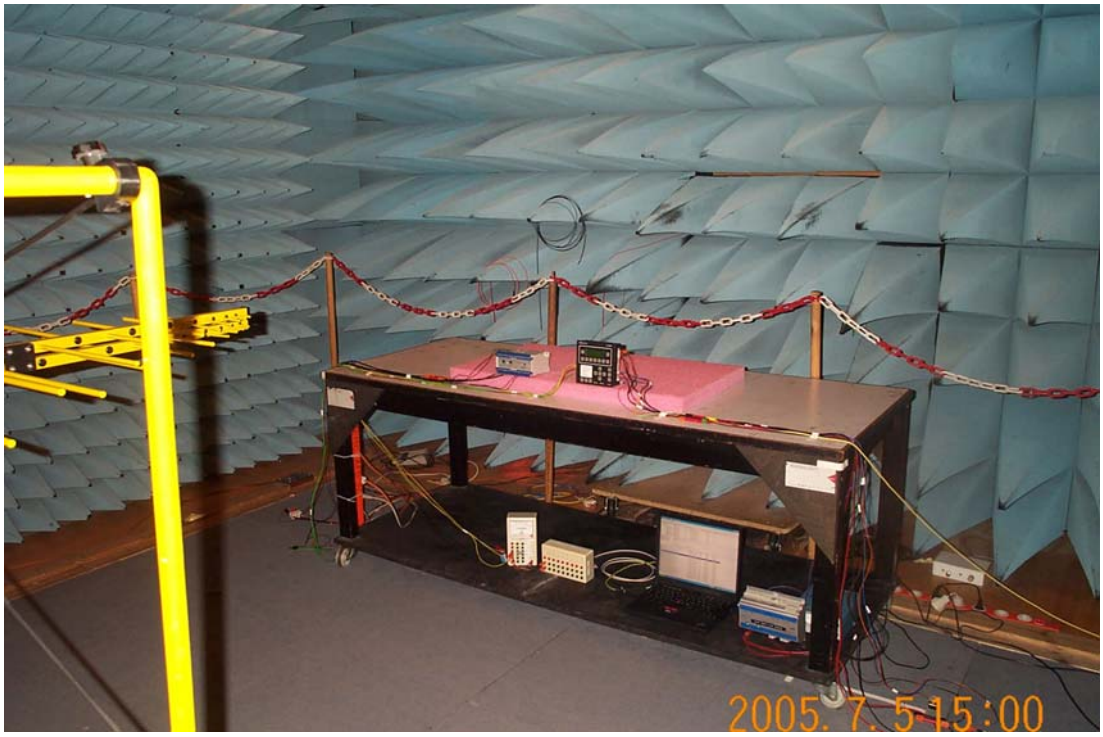


Photo 17. Radiated radio frequency interference (80-1000 MHz), e.g. S6610 & T4000.

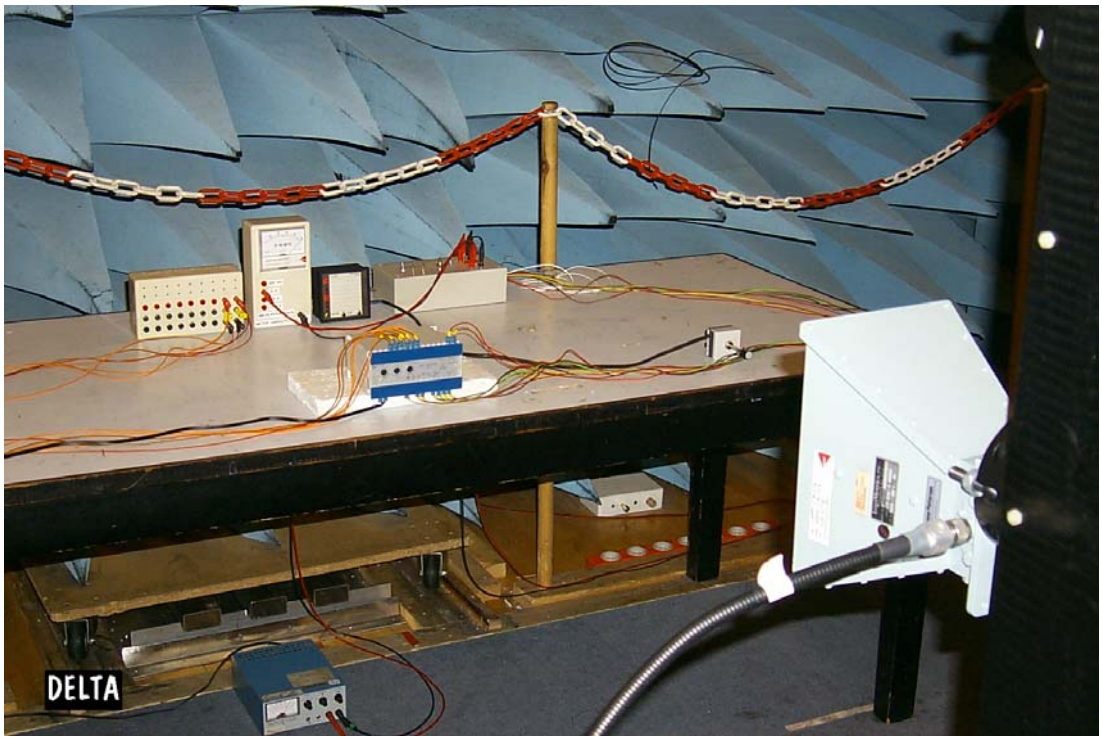
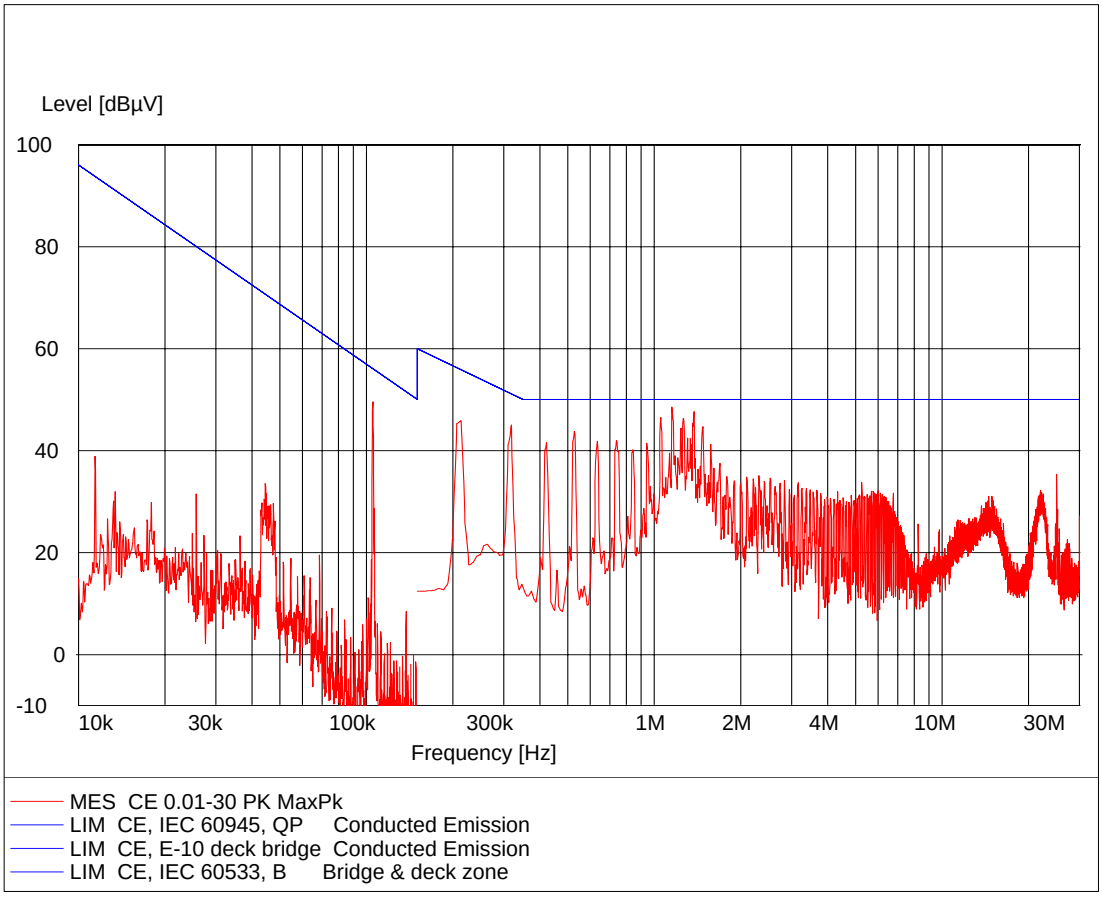


Photo 18. Radiated radio frequency interference (1000-2000 MHz), e.g. T4400.

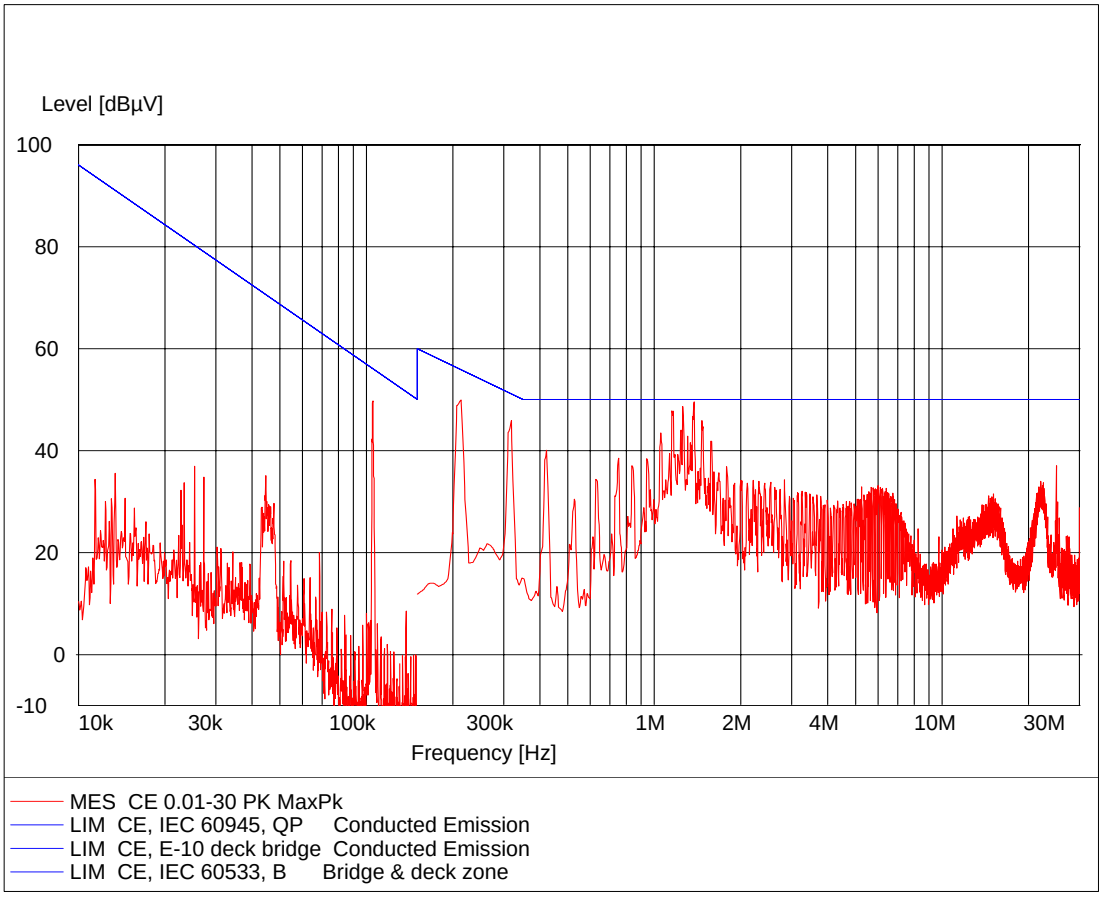
Annex 3

Test record sheets - Conducted emissions

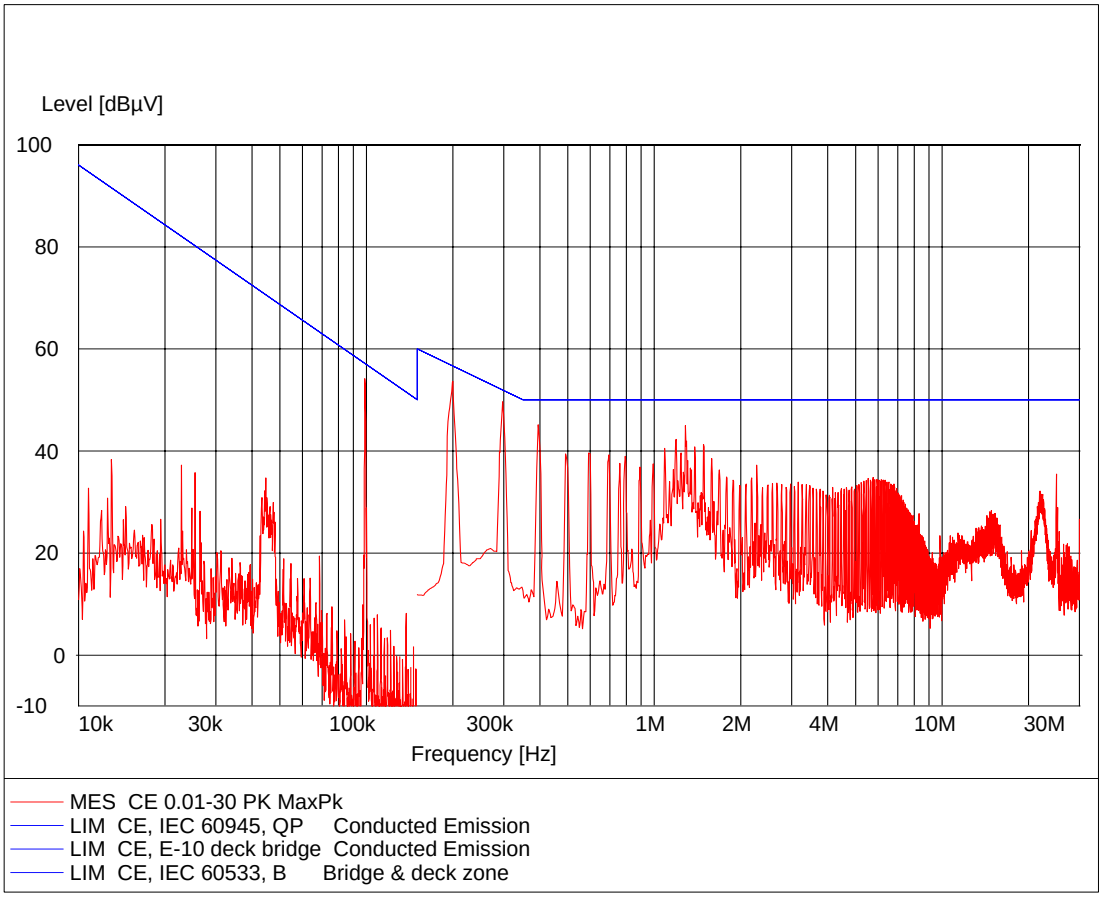
EUT:	S6610
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 24 VDC. (PIN 3,4) 24 VDC
Test Site:	EMC-5
Operator:	HEN - A503163
Test Specification:	IEC 60945. IACS E10. IEC 60533.
Comment:	Sheet 17
Start of Test:	2005-07-04



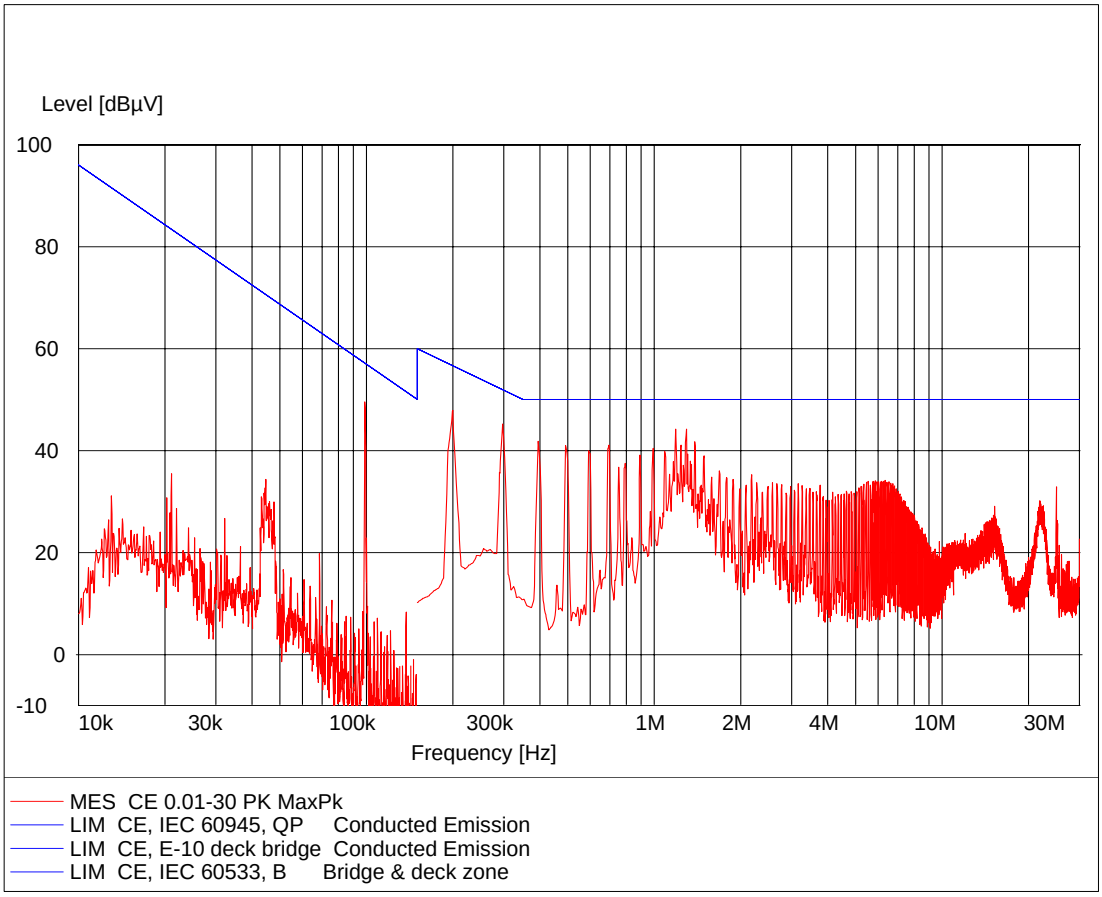
EUT:	S6610
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. (PIN 3,4) 24 VDC
Test Site:	EMC-5
Operator:	HEN - A503163
Test Specification:	IEC 60945. IACS E10. IEC 60533.
Comment:	Sheet 18
Start of Test:	2005-07-04



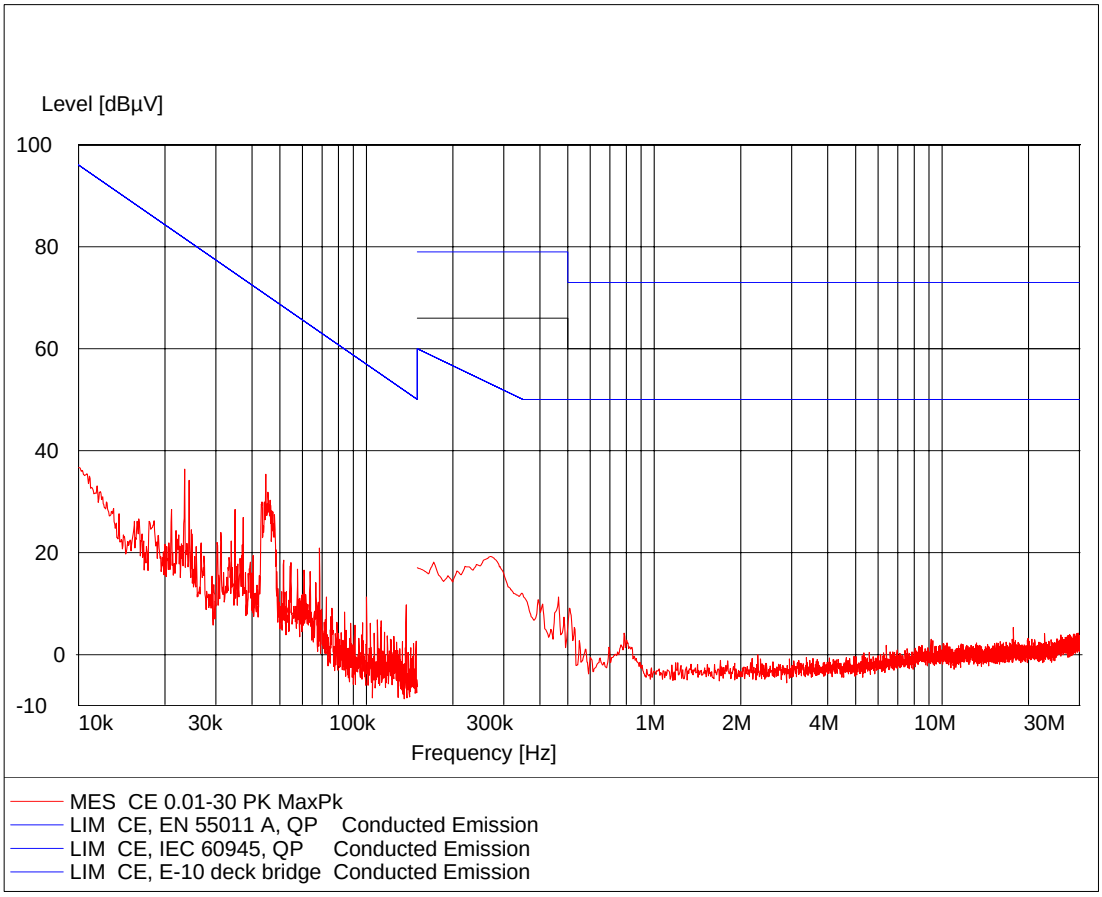
EUT:	S6610
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. (PIN 1,2) 24 VDC
Test Site:	EMC-5
Operator:	HEN - A503163
Test Specification:	IEC 60945. IACS E10. IEC 60533.
Comment:	Sheet 15
Start of Test:	2005-07-04



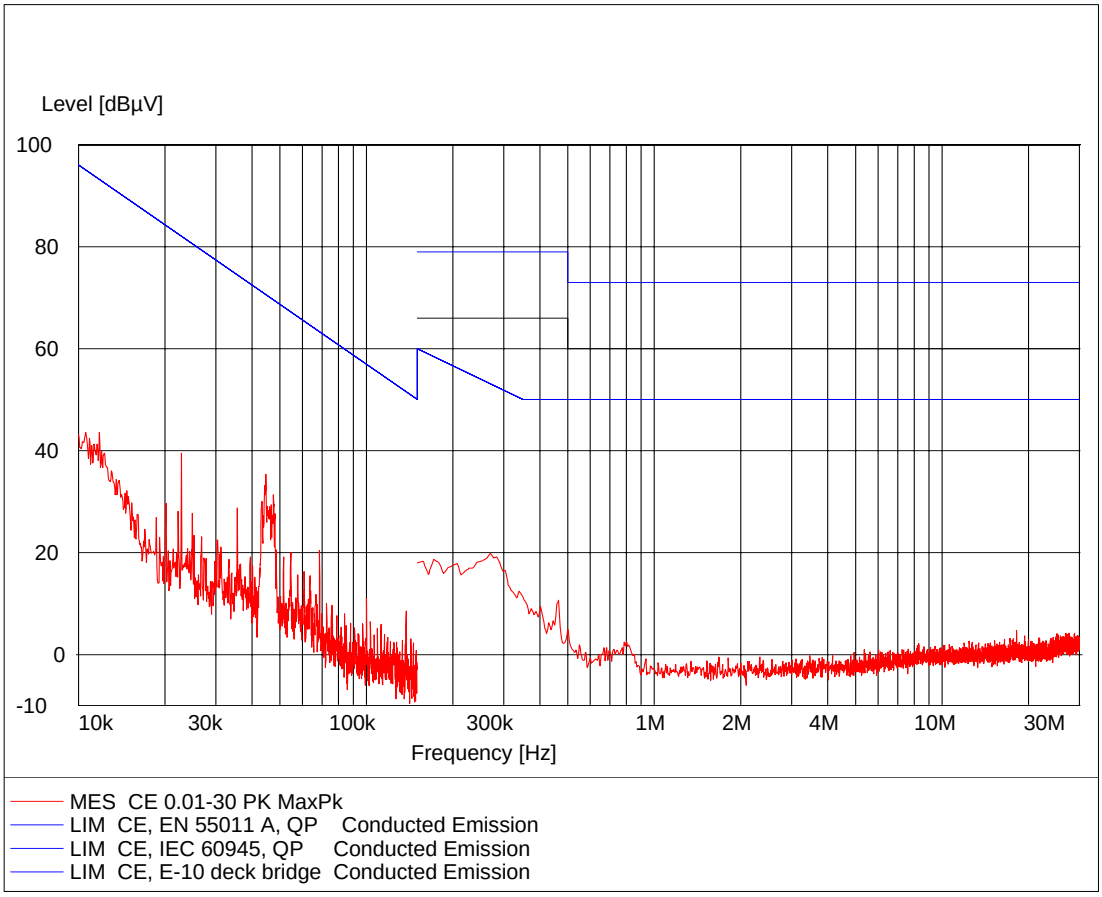
EUT:	S6610
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 24 VDC. (PIN 1,2) 24 VDC
Test Site:	EMC-5
Operator:	HEN - A503163
Test Specification:	IEC 60945. IACS E10. IEC 60533.
Comment:	Sheet 16
Start of Test:	2005-07-04



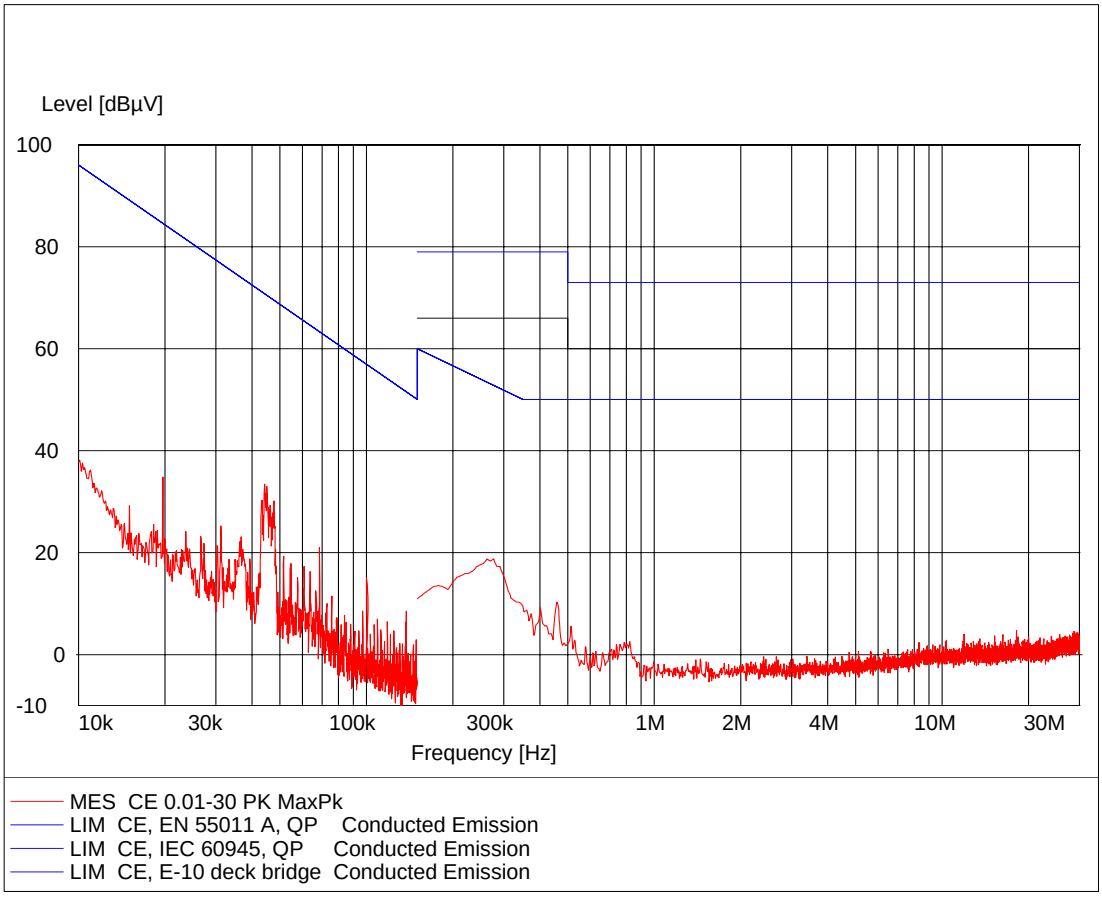
EUT:	T4000
Manufacturer:	Selco A/S
Operating Condition:	Line no.: Neutral. 230 VAC
Test Site:	EMC-5
Operator:	HEN - A503163
Test Specification:	IEC 60945. IACS E10. IEC 60533. EN 55011 A
Comment:	Sheet 13
Start of Test:	2005-07-04



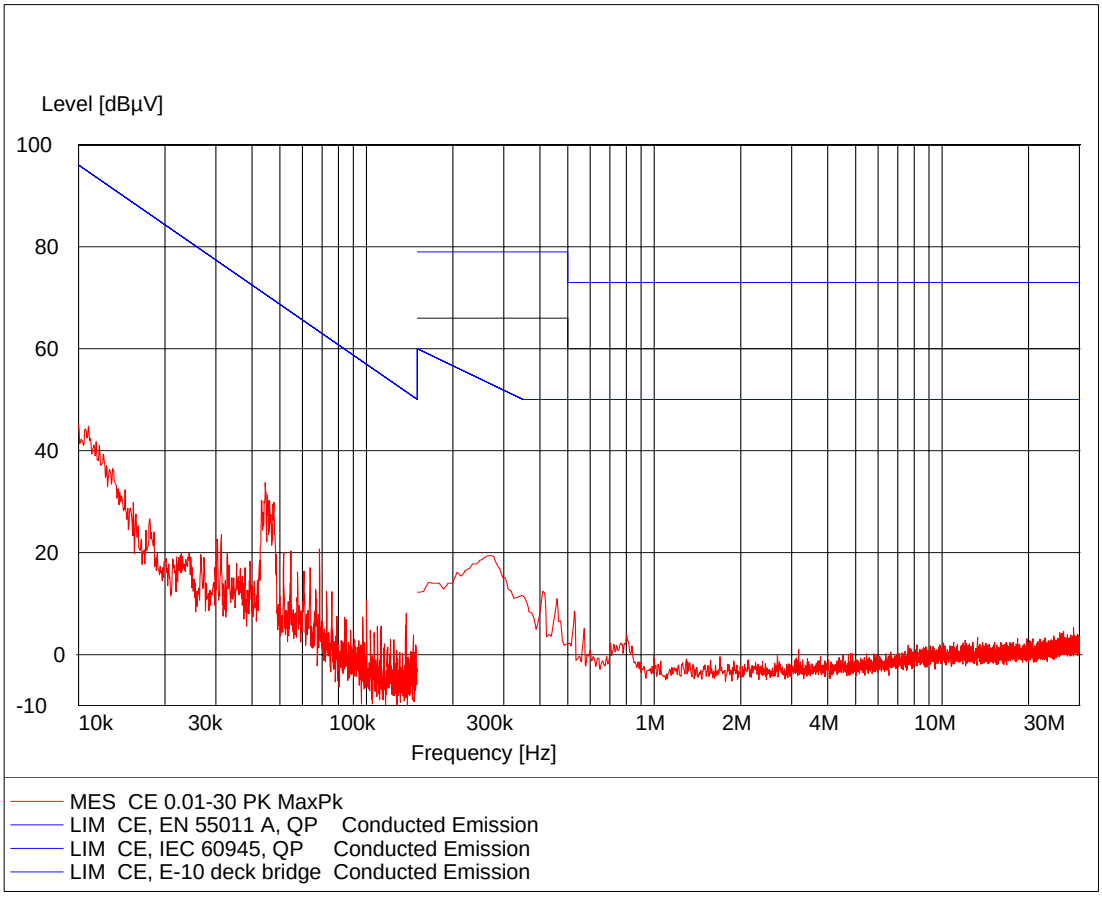
EUT: T4000
Manufacturer: Selco A/S
Operating Condition: Line no.: Line 1. 230 VAC
Test Site: EMC-5
Operator: HEN - A503163
Test Specification: IEC 60945. IACS E10. IEC 60533. EN 55011 A
Comment: Sheet 14
Start of Test: 2005-07-04



EUT:	T4400
Manufacturer:	Selco A/S
Operating Condition:	Line no.: Neutral. 230 VAC
Test Site:	EMC-5
Operator:	HEN - A503163
Test Specification:	IEC 60945. IACS E10. IEC 60533. EN 55011 A
Comment:	Sheet 11
Start of Test:	2005-07-04



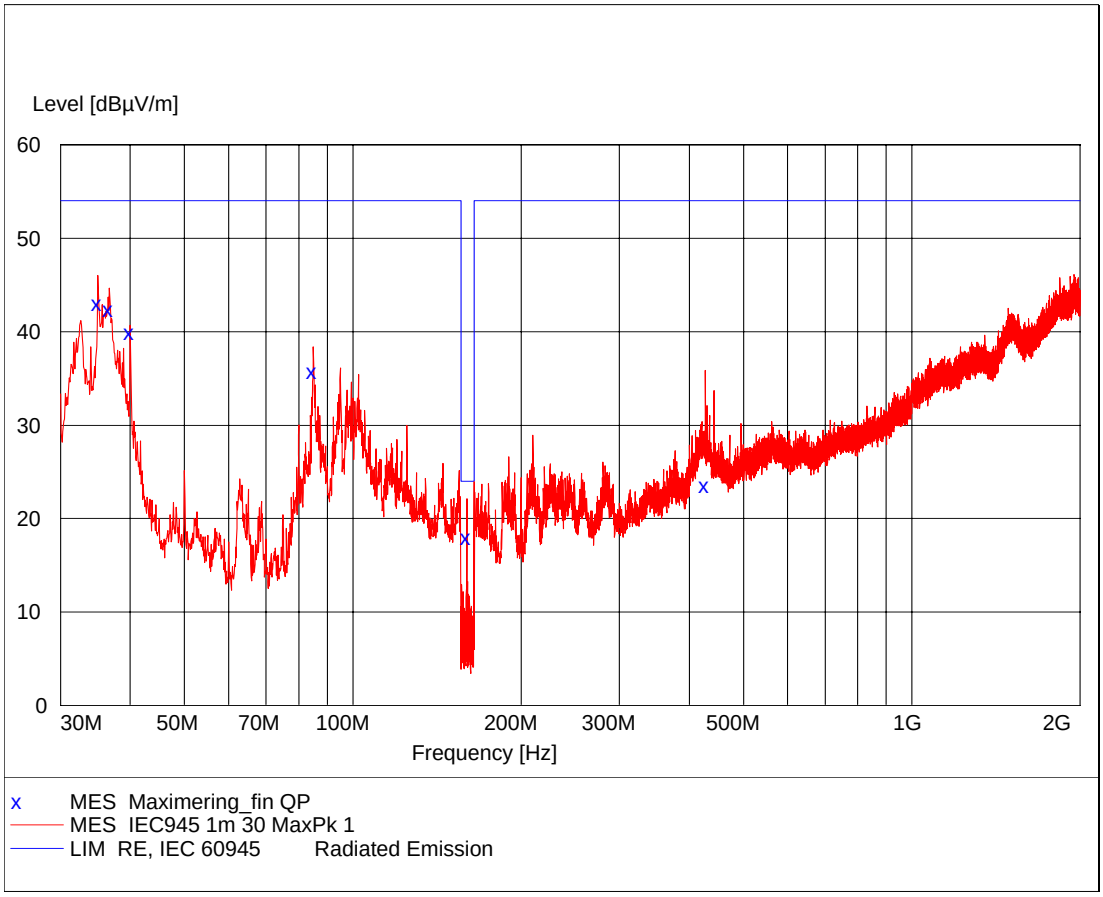
EUT:	T4400
Manufacturer:	Selco A/S
Operating Condition:	Line no.: Line 1. 230 VAC
Test Site:	EMC-5
Operator:	HEN - A503163
Test Specification:	IEC 60945. IACS E10. IEC 60533. EN 55011 A
Comment:	Sheet 12
Start of Test:	2005-07-04



Annex 4

Test record sheets - Radiated emissions

EUT: S6610
Manufacturer: Selco A/S
Operating Condition: Peakscan 1mV and final QP measurements
Test Site: EMC-5
Operator: HEN - A503163
Test Specification: IEC 60945:2005,IACS E10:2004 IEC 60533:1999
Comment: Sheet 24
Start of Test: 2005-09-30

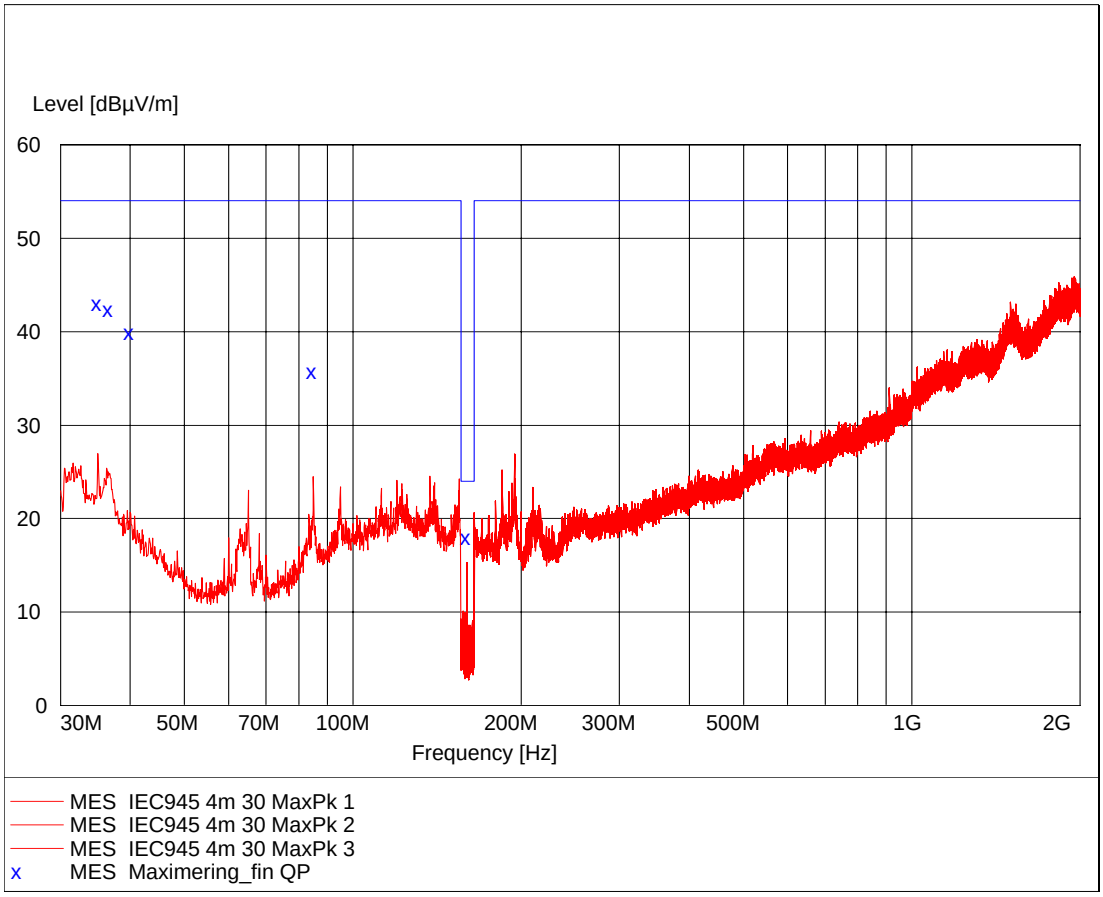


MEASUREMENT RESULT: "Maximering_fin QP"

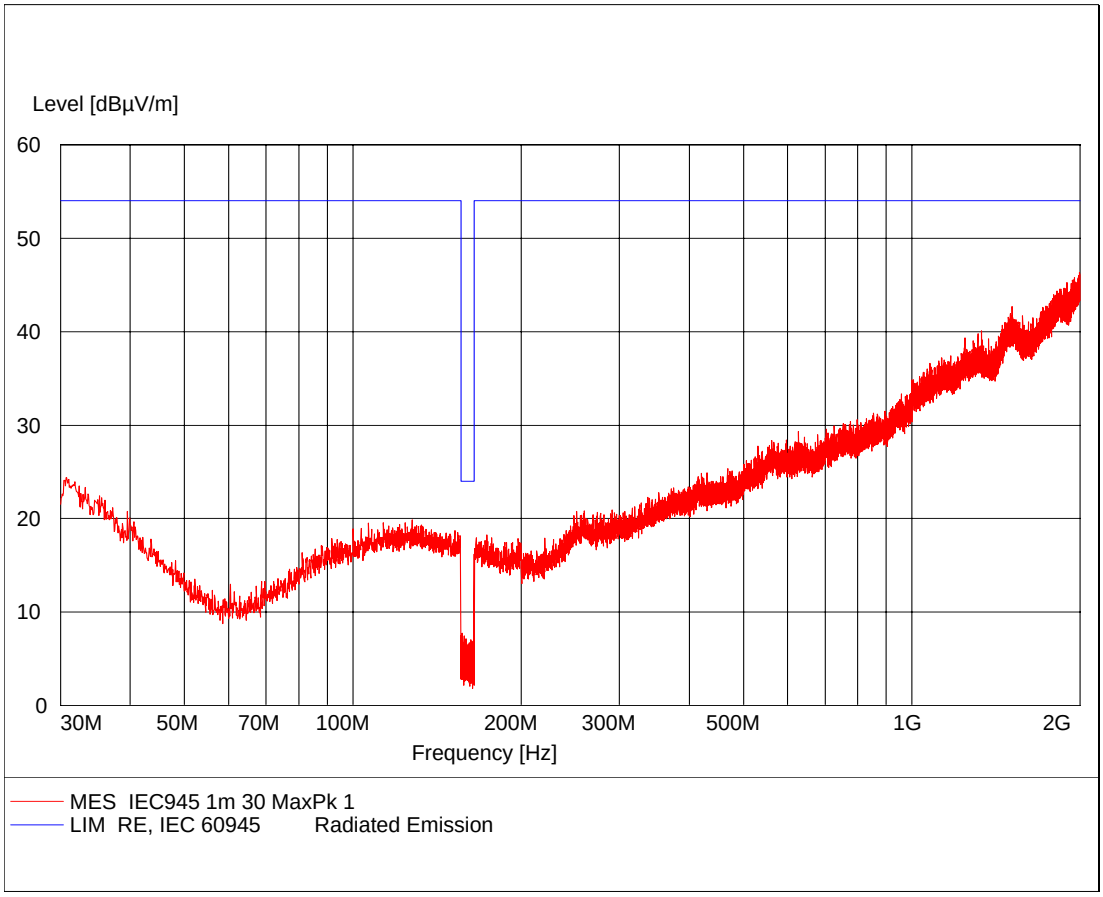
2005-09-30 15:52

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Polarisation
35.000000	43.00	18.4	54.0	11.0	101.0	358.00	VERTICAL
36.700000	42.40	17.5	54.0	11.6	101.0	337.00	VERTICAL
40.000000	39.90	15.8	54.0	14.1	101.0	227.00	VERTICAL
85.000000	35.70	11.3	54.0	18.3	123.0	8.00	VERTICAL
159.990000	18.00	13.1	24.0	6.0	111.0	74.00	VER BW 10 KH
427.400000	23.50	20.3	54.0	30.5	150.0	358.00	VERTICAL

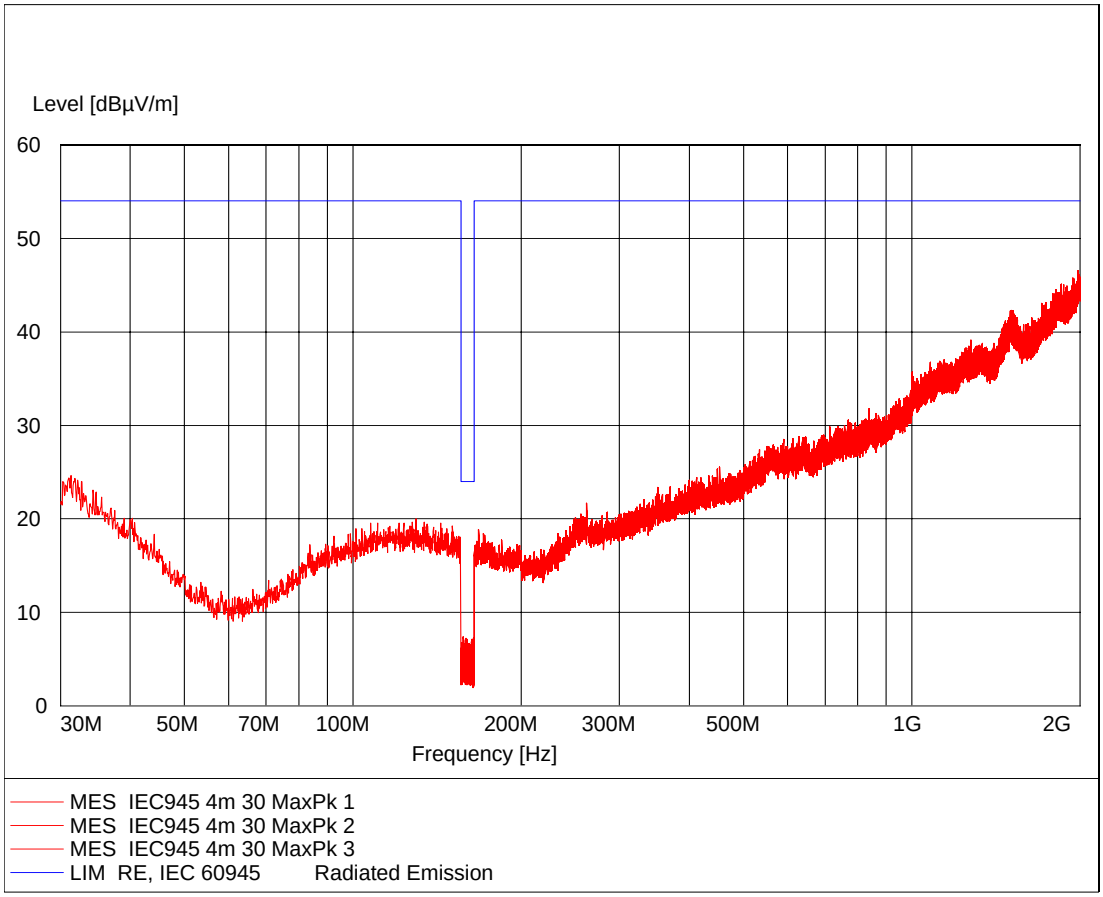
EUT: S6610
Manufacturer: Selco A/S
Operating Condition: Peakscan 3mH
Test Site: EMC-5
Operator: HEN - A503163
Test Specification: IEC 60945:2005,IACS E10:2004 IEC 60533:1999
Comment: Sheet 25
Start of Test: 2005-09-30



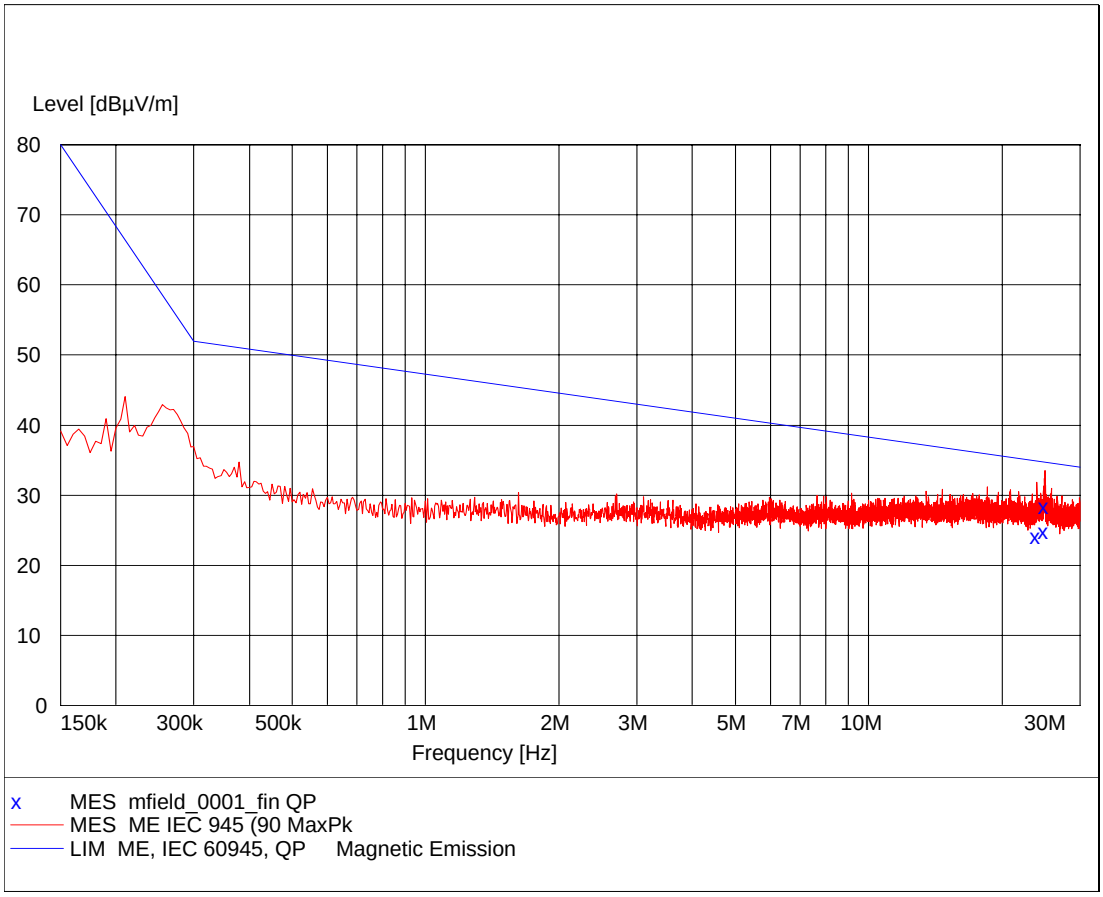
EUT: T4000, T4400
Manufacturer: Selco A/S
Operating Condition: Peakscan 1mV andfinal QP measurements
Test Site: EMC-5
Operator: HEN - A503163
Test Specification: IEC 60945:2002 IACS E10:2004 IEC 60533:1999
Comment: Sheet 7
Start of Test: 2005-07-04



EUT: T4000, T4400
Manufacturer: Selco A/S
Operating Condition: Peakscan 3mH
Test Site: EMC-5
Operator: HEN - A503163
Test Specification: IEC 60945:2002 IACS E10:2004 IEC 60533:1999
Comment: Sheet 8
Start of Test: 2005-07-04



EUT: S6610, T4000, T4400
Manufacturer: Selco A/S
Operating Condition: Ant : 90 Deg. Peakscan & final QP
Test Site: EMC-5
Operator: KKJ - A503163
Test Specification: IEC 60945:2002 IACS E10:2004 IEC 60533:1999
Comment: Sheet 1
Start of Test: 2005-11-09

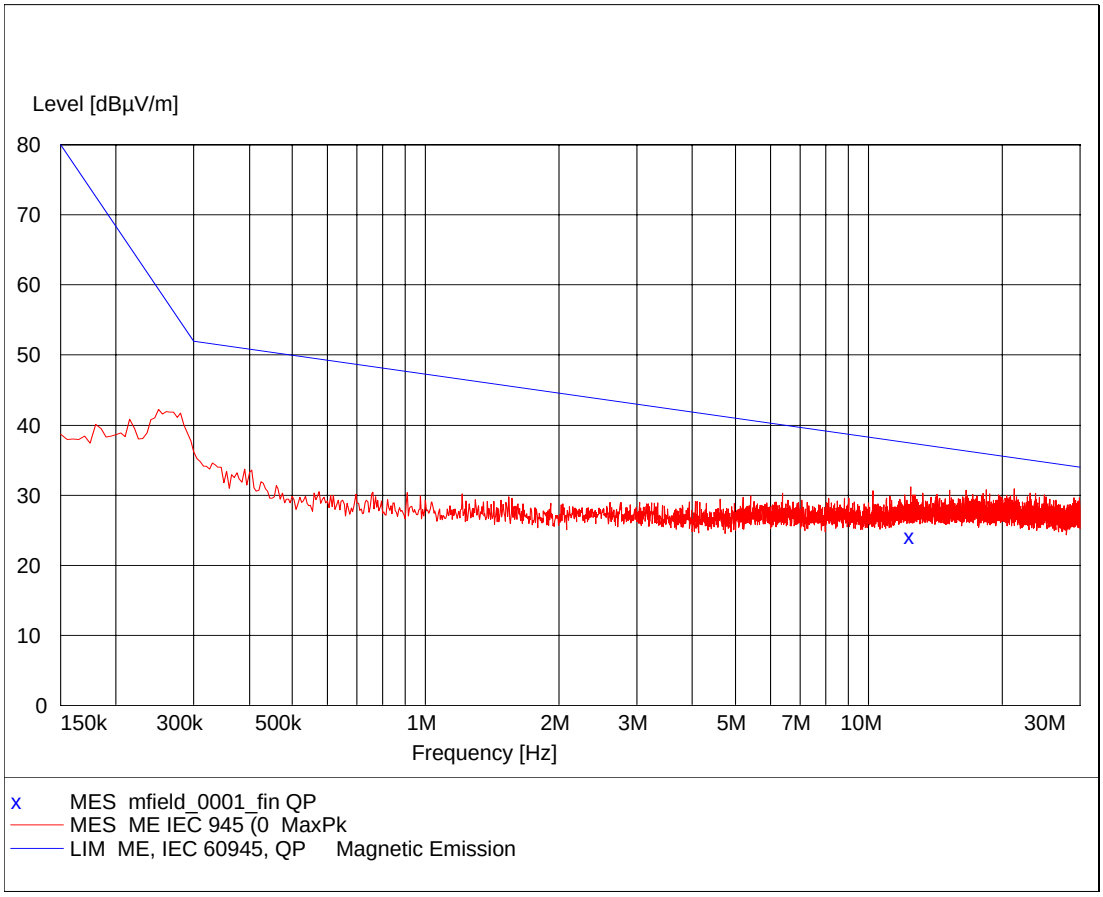


MEASUREMENT RESULT: "mfield_0001_fin QP"

2005-11-09 15:58

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Loop	Azimuth deg
23.965000	24.10	21.8	34.9	10.8	90 deg	40.00
24.900000	24.80	21.9	34.7	10.0	90 deg	93.00
25.005000	28.40	21.9	34.7	6.3	90 deg	250.00

EUT: S6610, T4000, T4400
Manufacturer: Selco A/S
Operating Condition: Ant : 0 Deg. Peakscan & final QP
Test Site: EMC-5
Operator: KKJ - A503163
Test Specification: IEC 60945:2002 IACS E10:2004 IEC 60533:1999
Comment: Sheet 2
Start of Test: 2005-11-09

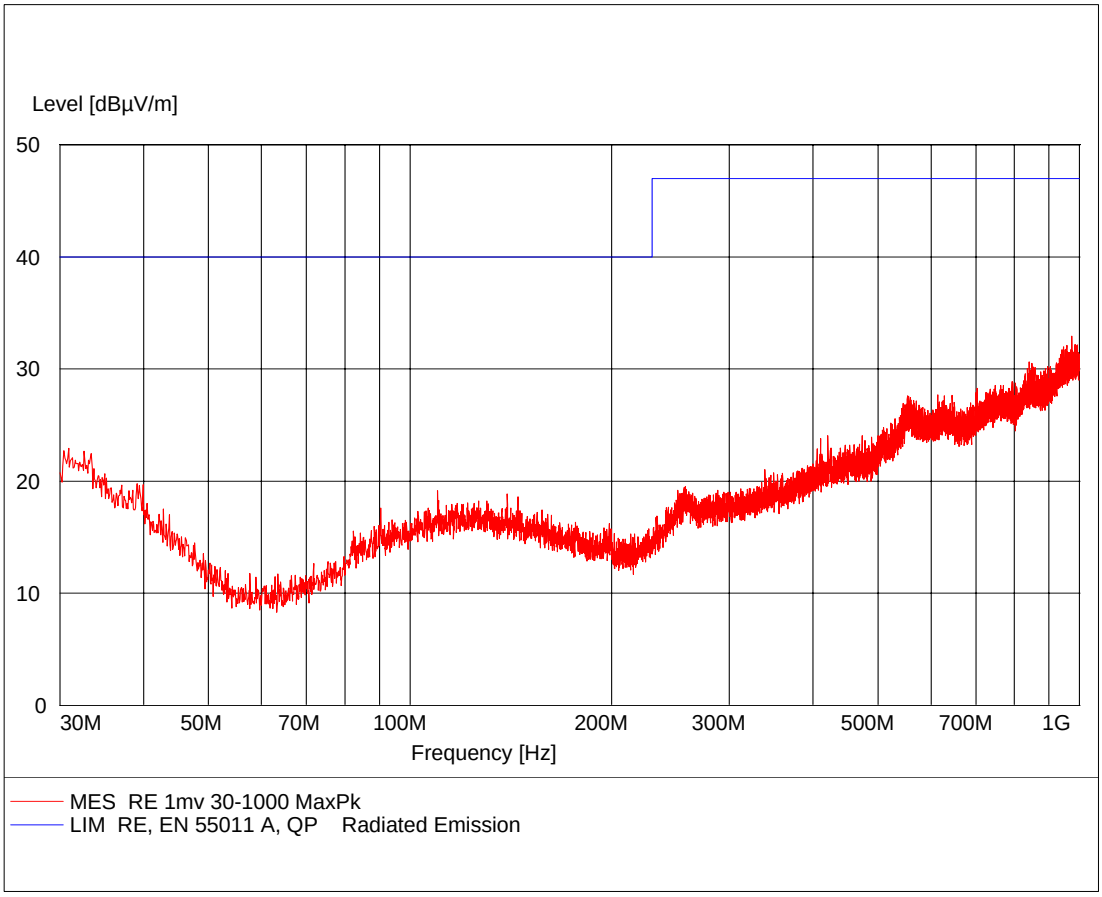


MEASUREMENT RESULT: "mfield_0001_fin QP"

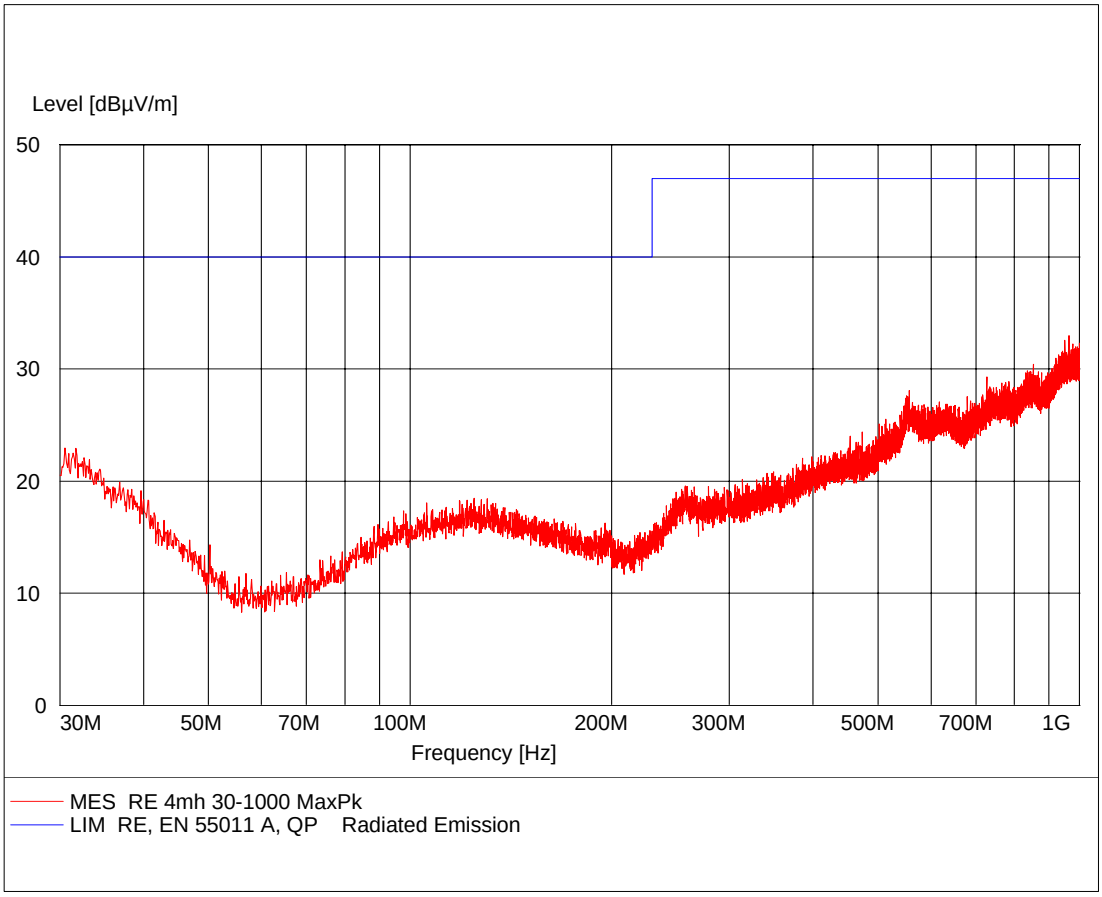
2005-11-09 16:49

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Loop	Azimuth deg
12.440000	24.10	20.2	37.4	13.3	0 deg	1.00

EUT:	S6610, T4000, T4400
Manufacturer:	Selco A/S
Operating Condition:	Peakscan 1mV & final QP
Test Site:	EMC-5
Operator:	HEN - A503163
Test Specification:	EN 55011 A (10m)
Comment:	Sheet 3
Start of Test:	2005-07-04

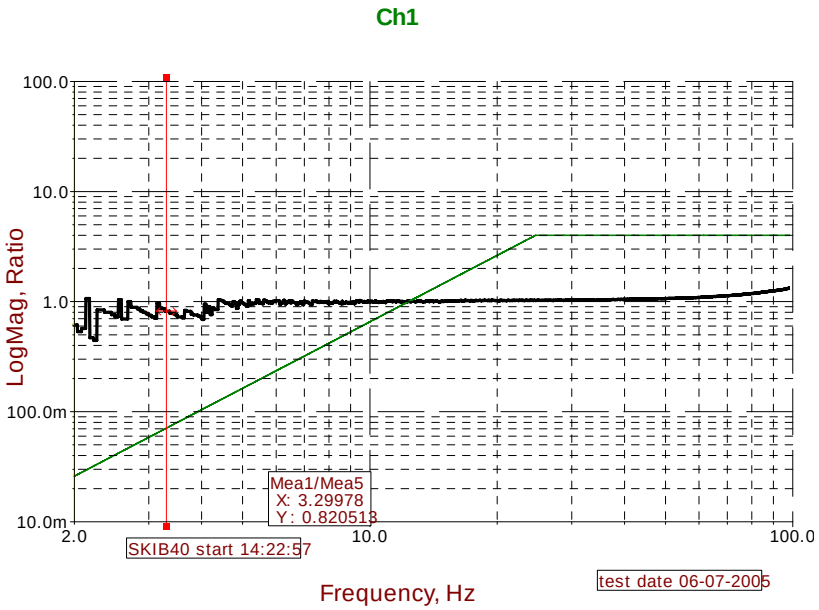


EUT:	S6610, T4000, T4400
Manufacturer:	Selco A/S
Operating Condition:	Peakscan 4mH
Test Site:	EMC-5
Operator:	HEN - A503163
Test Specification:	EN 55011 A (10m)
Comment:	Sheet 4
Start of Test:	2005-07-04

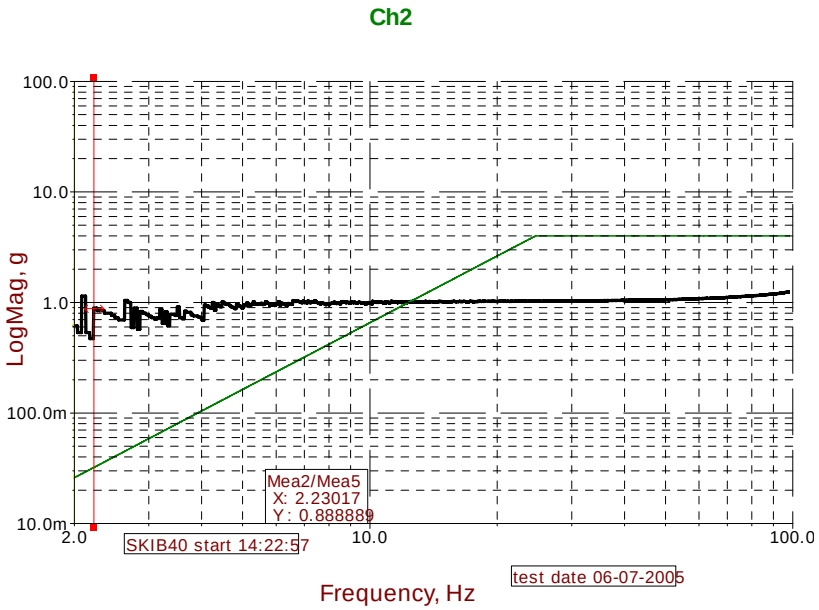


Annex 5

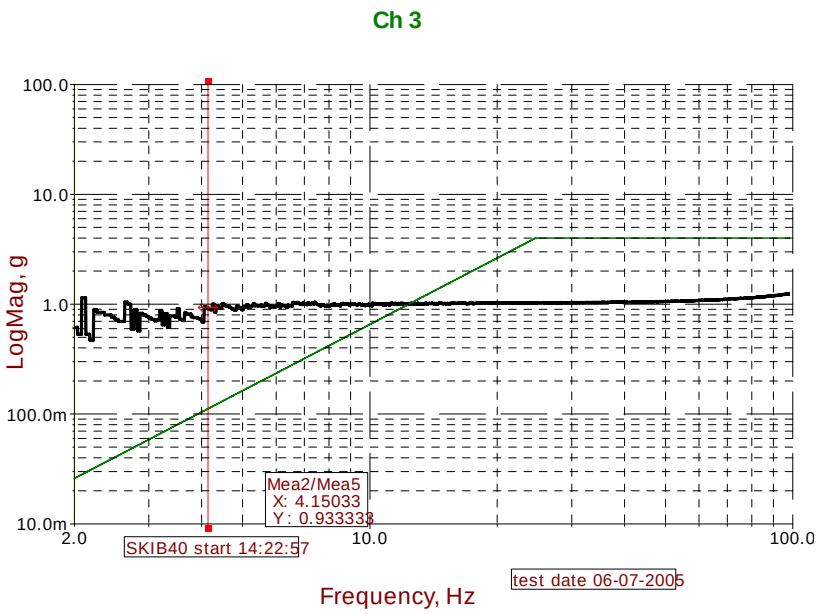
Measurement curves - Vibration



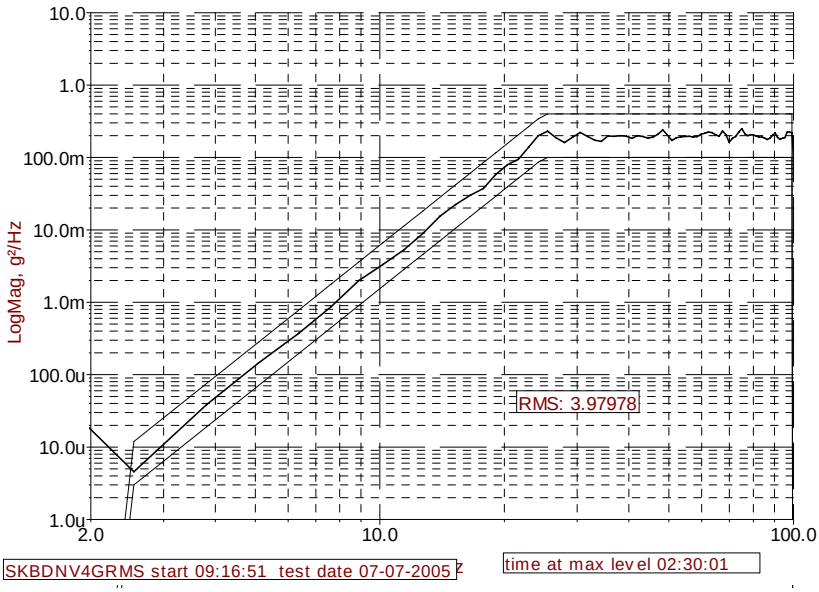
Curve 01. Resonance search, Y-Axis (max. ampl. fact.) T4000.



Curve 02. Resonance search, Y-Axis (max. ampl. fact.) T4400.



Curve 03. Resonance search, Y-Axis (max. ampl. fact.) S6610.



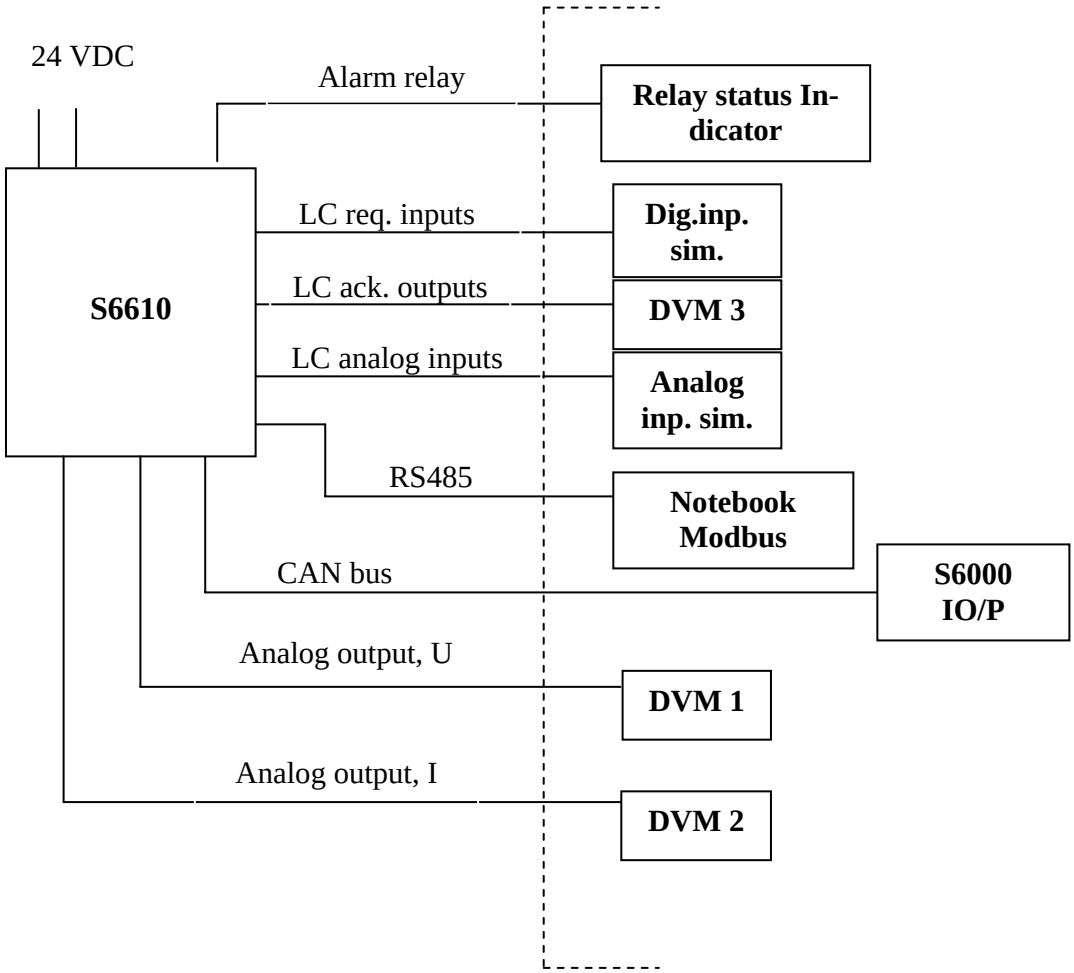
Curve 04. Endurance, e.g. X-axis.

Annex 6

Test set-up and functional test procedure (from Selco A/S)

(This annex is informative and
not part of the accredited report)

Test set-up S6610

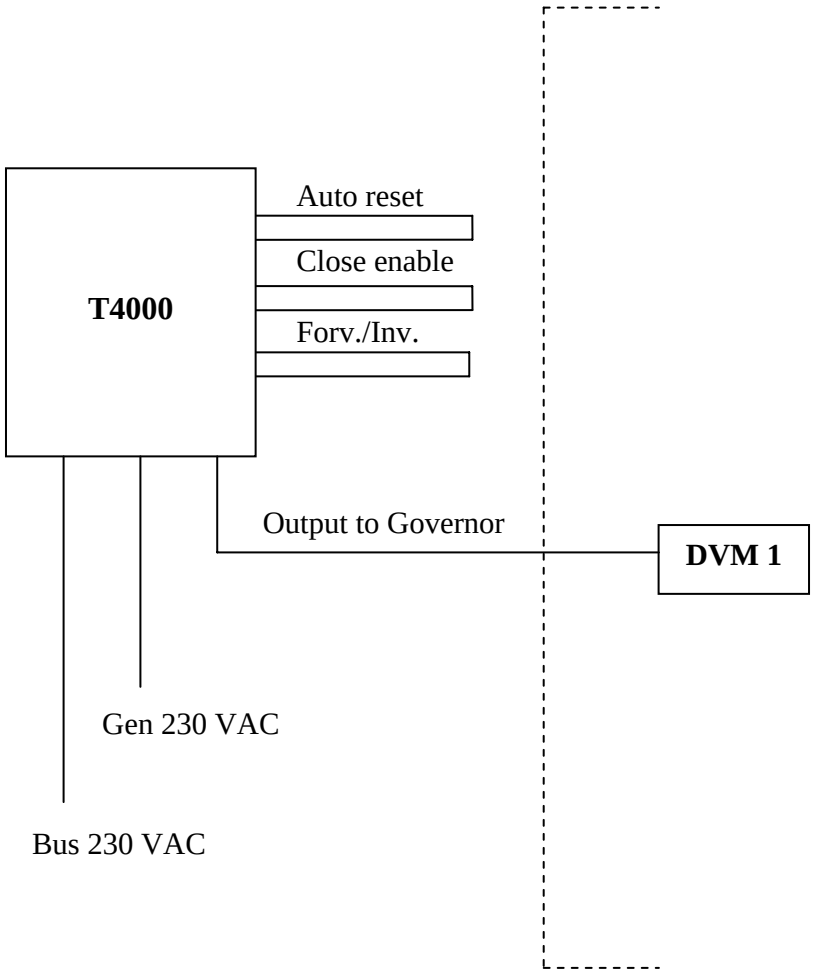


Functional test procedure S6610

General performance verification is performed as follows:

1. Apply 24VDC to the powersupply 1 and 2
2. Apply 9VDC batteri to LC analog input 1
3. Measure 9VDC on Analog output 1
4. Measure 12mA on Analog output 2
5. Apply GND to LC REQ. INPUT 1
6. Measure LC ACK. OUTPUT 1 is on
7. Apply a PC with a RS485 communication to the RS485 input
8. Open the modbus server on the pc and see that the communication is OK
9. Attach a S6000 module to the CAN BUS
10. See the S6000 module on the display
11. Attach a relay boks on the alarm relay
12. Disconnect powersupply 1 and see the relay alter its state

Test set-up T4000

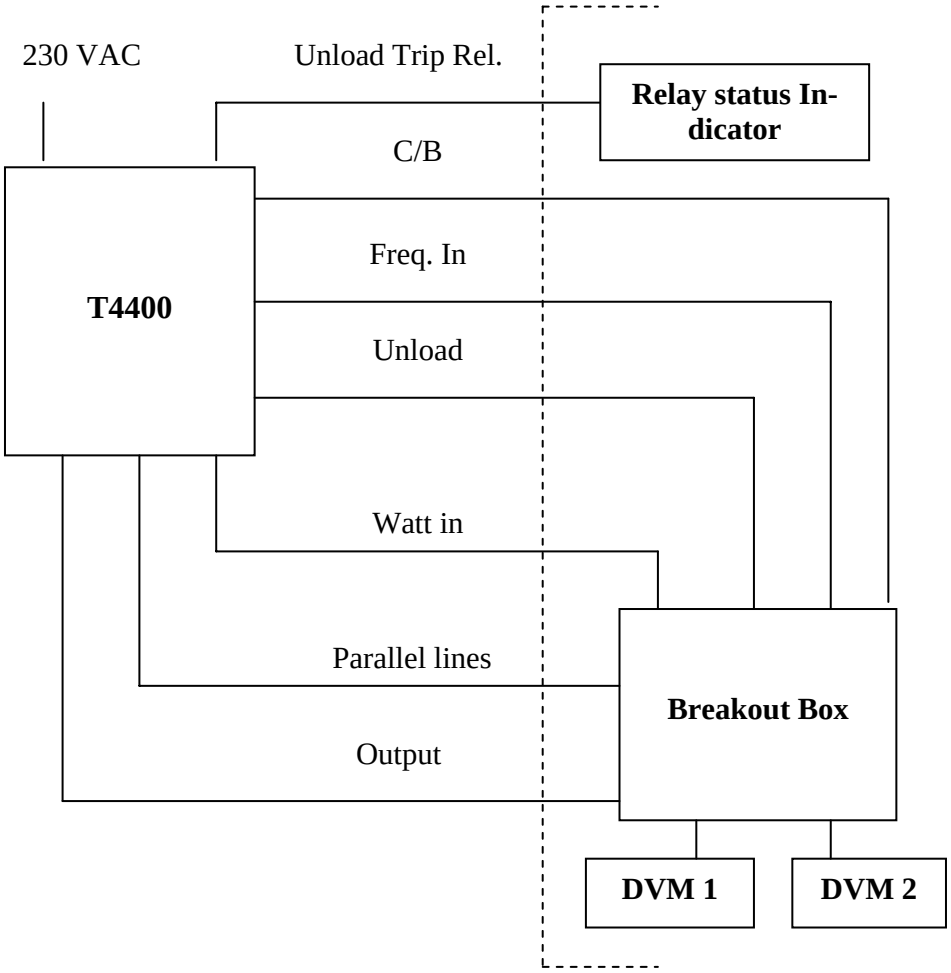


Functional test procedure T4000

General performance verification is performed as follows:

1. Apply 220VAC to the BUS input
2. Bus led goes on
3. Apply 220VAC to the GEN input (same phase as BUS input)
4. Gen led goes on
5. Relay led goes on
6. Close relay goes on
7. Measure 0VDC on terminal 21 and 22
8. Reverse the voltage on the BUS input
9. Relay led goes off
10. Close relay goes off
11. Measure 6VDC on terminal 21 and 22

Test set-up T4400



Functional test procedure T4400

General performance verification is performed as follows:

1. Apply 220VAC to Un
2. Un led goes on
3. Connect terminal 31 and 32 together
4. C/B led goes on
5. Apply 1 VDC to WATT IN with terminal 12 as GND
6. Measure 6VDC on Test OUT with teminal 12 as GND