Test Report

DANAK
Reg. no. 19

Type approval testing of SIGMA Protection & Control modules S6000, S6100 and S6500

Performed for Selco A/S

DANAK-197219
Project no.: E501273-1
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6 annexes

16 October 2003

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Title	Type approval testing of SIGMA Protection & Control modules S6000, S6100 and S6500
Test objects	SIGMA S6000, IO/P SIGMA S6100, S/LS SIGMA S6500, UI
Report no.	DANAK-197219
Project no.	E501273-1
Test period	11 August to 3 October, 2003
Client	Selco A/S Meterbuen 6-12 2740 Skovlunde Denmark
Manufacturer	Selco A/S
Specifications	IACS E10: Corr.1 July 2003. Unified environmental test specification – Testing procedure for electrical control and monitoring, safety and protection, on board computer based systems and peripherals, loading instruments, internal communication and other electrical equipment as considered appropriate. IEC 60533: Second edition, 1999. “Electrical and electronic installations in ships – Electromagnetic compatibility”. EN 61000-6-2:1999. “Electromagnetic compatibility (EMC) part 6-2: Generic standards – Immunity for industrial environments”. EN 61000-6-4:2001. “Electromagnetic compatibility (EMC) – Part 6: Generic standards – Section 4: Emission standard for industrial environment”. 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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Date	16 October 2003
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1. Summary of test

1.1 Test requirements

Test	Test method
Visual inspection	IACS E10:2003
Performance test	IACS E10:2003
Power supply variations	IEC 60945:2002 / IACS E10:2003
Power supply failure	IEC 60945:2002 / IACS E10:2003
Power supply dips and interruptions	IEC 61000-4-11:1994
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 / CISPR 11:1999
Radiated emissions	CISPR 16-1:1999 / CISPR 11:1999
1 MHz burst	IEC 60255-22-1:1988
Vibration (resonance search)	IEC 60068-2-6:1995
Vibration (random)	IEC 60068-2-64:1993
Insulation resistance	IACS E10:2003
High voltage	IACS E10:2003
Dry heat	IEC 60068-2-2:1984 + Amendments
Low temperature (cold)	IEC 60068-2-1:1990 + Amendments
Damp heat (cyclic)	IEC 60068-2-30 1980 + Amendments

1.2 Conclusion

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

- IACS E10:2003
- IEC 60533:1999
- EN 61000-6-2:1999
- EN 61000-6-4:2001
- EN 50263:1999

The test results relate only to the specimens tested.

1.3 Modifications

The test specimens were modified before they passed the conducted radio frequency interference testing, the surge testing, the electrostatic discharge testing and the radiated emission measurements. Thus the test results mentioned in *chapter 4* apply to the modified test specimens only.

Detailed explanatory notes regarding the modifications are given in *annex 6*.

2. Test specimen(s)

2.1 Test object – SIGMA S6000, IO/P- InputOutput & Protection module

Manufacturer	Selco A/S
Model / type	SIGMA S6000
Part no.	S6000-00
Serial no.	-
Supply voltage	24 VDC
Operational mode	Simulated normal operational mode

2.2 Test object – SIGMA S6100, S/LS –Syncronization & Load Sharing module

Manufacturer	Selco A/S
Model / type	SIGMA S6100
Part no.	S6100-00
Serial no.	-
Supply voltage	24 VDC
Operational mode	Simulated normal operational mode

2.3 Test object – SIGMA S6500, UI – User Interface module

Manufacturer	Selco A/S
Model / type	SIGMA S6500
Part no.	S6500-00
Serial no.	-
Supply voltage	24 VDC
Operational mode	Simulated normal operational mode

2.4 AUX equipment – M4100 Alarm annunciator

Manufacturer	Selco A/S
Model / type	M4100
Part no.	M4100-22
Serial no.	365308

2.5 AUX equipment – M4100 Alarm annunciator

Manufacturer	Selco A/S
Model / type	M4100
Part no.	M4100-22
Serial no.	365310

2.6 AUX equipment – M3000 Analog alarm annunciator

Manufacturer	Selco A/S
Model / type	M3000, 24 Channels
Part no.	M3000-30
Serial no.	332916

2.7 AUX equipment – Simulator box

Manufacturer	Selco A/S
Model / type	JBH / analogue switches
Part no.	-
Serial no.	-

3. General test conditions

3.1 Test set-up

A description and a drawing of the test set-up are enclosed in *annex 3*.

3.2 Criteria for compliance

No change of the actual operational states of the SIGMA S6000, S6100 and S6500 are allowed. However, temporary change of operational state is allowed during the power supply failure test, provided that normal power-up procedure is obtained after the exposures.
In addition, the following acceptance criteria for compliance regarding accuracy of analogue parameters were in force:

- "VOLT": ±0.5 mA
- "VOLT": ±0.5 V
- "SPEED": ±0.5 mA
- "SPEED": ±0.5 V
- "Analog output": ±0.5 mA
- "Analog output": ±0.5 V
- "KW": ±0.5 V
- "KVar": ±0.3 V

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 3*.

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

Specification

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 the completion of the type approval testing.

4.2 Conducted emission (CISPR 16-1)

Specifications

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 E10:2003 & IEC 60533:1999 – 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

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

The test specimens are 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 4*.

4.3 Conducted emission (CISPR 11)

Specification

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 4*.

4.4 Radiated emission (CISPR 16-1)

Specifications

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 E10:2003 & IEC 60533:1999 – 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

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 5*.

4.5 Radiated emission (CISPR 11)

Specifications

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 specimen is 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 5*.

4.6 High voltage

Specification

IACS E10, Test No. 10

Procedure

550 VAC, 50 Hz is applied between shorted supply terminals and earth for 1 minute. No flashover, breakdown, etc. is acceptable.

Results

Cable designation	Test condition	Test voltage [Vrms]	Duration [sec. or msec.]	Remarks (Description of reaction)
DC Power (24 VDC)	Test voltage injected between shorted supply leads and protective earth	550 VAC	60 sec.	No flashover or breakdown was observed during the exposure. The insulation resistance was OK after the exposure.
	Note: Protection components removed prior to exposure.			

4.7 Insulation resistance

Specification

IACS E10, Test No. 9

Procedure

The insulation resistance is measured between shorted supply terminals and earth with 50 VDC. The insulation resistance is to be above 10 MΩ initially, and above 1 MΩ after the low temperature, the damp heat and the high voltage exposures.

Results

Cable designation	Test condition	Test voltage [Vrms]	Duration [sec]	Insulation resistance [M Ohms]
DC Power (24 VDC)	Before High voltage test	50 VDC	60 sec.	> 1000 M Ohms
	After High voltage test	50 VDC	60 sec.	> 1000 M Ohms
	Before Low temperature test	50 VDC	60 sec.	> 1000 M Ohms
	After Low temperature test	50 VDC	60 sec.	> 1000 M Ohms
	Before Damp heat test	50 VDC	60 sec.	> 1000 M Ohms
	After Damp heat test	50 VDC	60 sec.	> 160 M Ohms
	Note: Protection components removed prior to measurement.			

4.8 Vibration

4.8.1 Resonance search

Specifications

IEC 60068-2-6 (1985), 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.

4.8.2 Endurance vibration

The sinusoidal vibration test according to IACS E10 is replaced by random vibration test according to Certification Notes No. 2.4, issued May 1995 by DNV.

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

Specification

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

Specifications

IACS E10, Test No. 4

IEC 60945, Section 5.2.2

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.

4.10 Power supply failure

Specifications

IACS E10, Test No. 3

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 specimens was OK after each exposure.

4.11 Conducted low frequency interference

Specifications

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 (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 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.

4.12 Conducted radio frequency interference

Specifications

IEC 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 specimens was OK after the exposure.

4.13 Radiated radio frequency interference

Specifications

IEC 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.

4.14 Surge voltage

Specification

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

Severity and procedure

Amplitude AC power lines	:	1 & 2 kV line-to-earth, 0.5 & 1 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.

4.15 Electrostatic discharge

Specifications

IEC 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.

4.16 Fast transients (burst)

Specifications

IEC 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 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.

4.17 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.

4.18 Dry heat

Specification

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 : 2 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)

Specifications

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

The following two exposures are performed:

1. Temperature : -15°C
   Duration : 16 hours
2. Temperature : -25°C
   Duration : 2 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 specification

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 specimen 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.

Annex 1

List of instruments

(2 pages)

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
49007	HFD-RELAY TESTER / 1 MHz BURST	HAEFELY	P3

Annex 2

Photos

(9 pages)

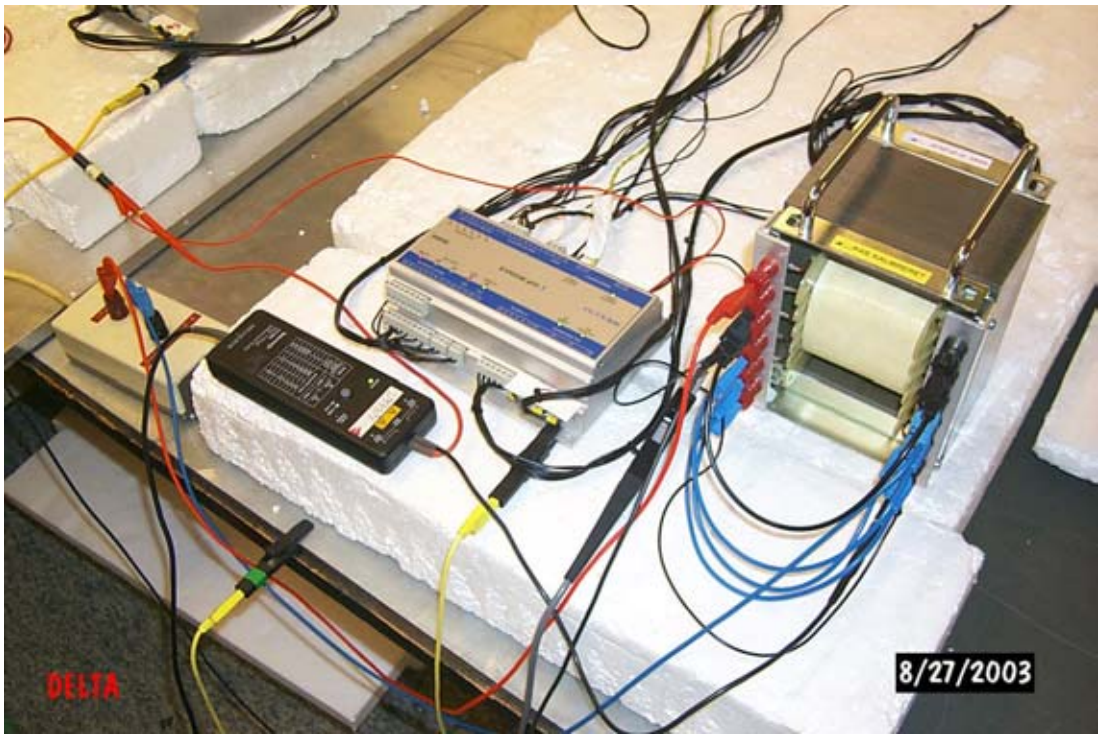


PHOTO 1. Conducted low frequency interference.

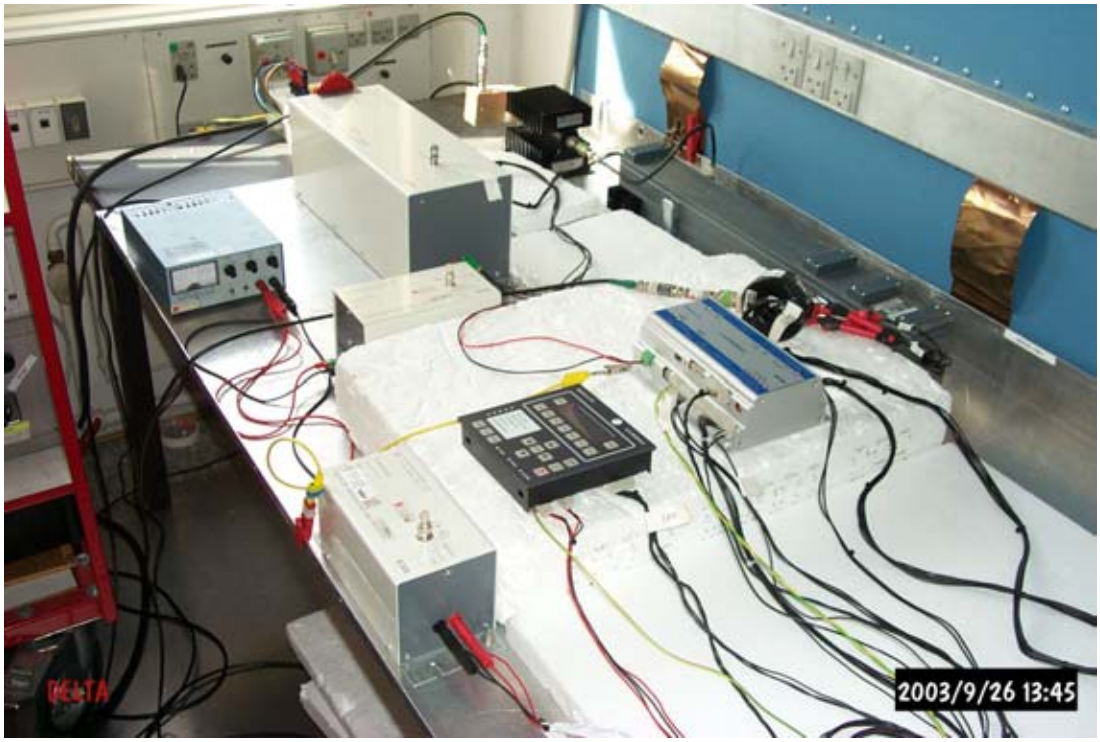


PHOTO 2. Conducted radio frequency interference.

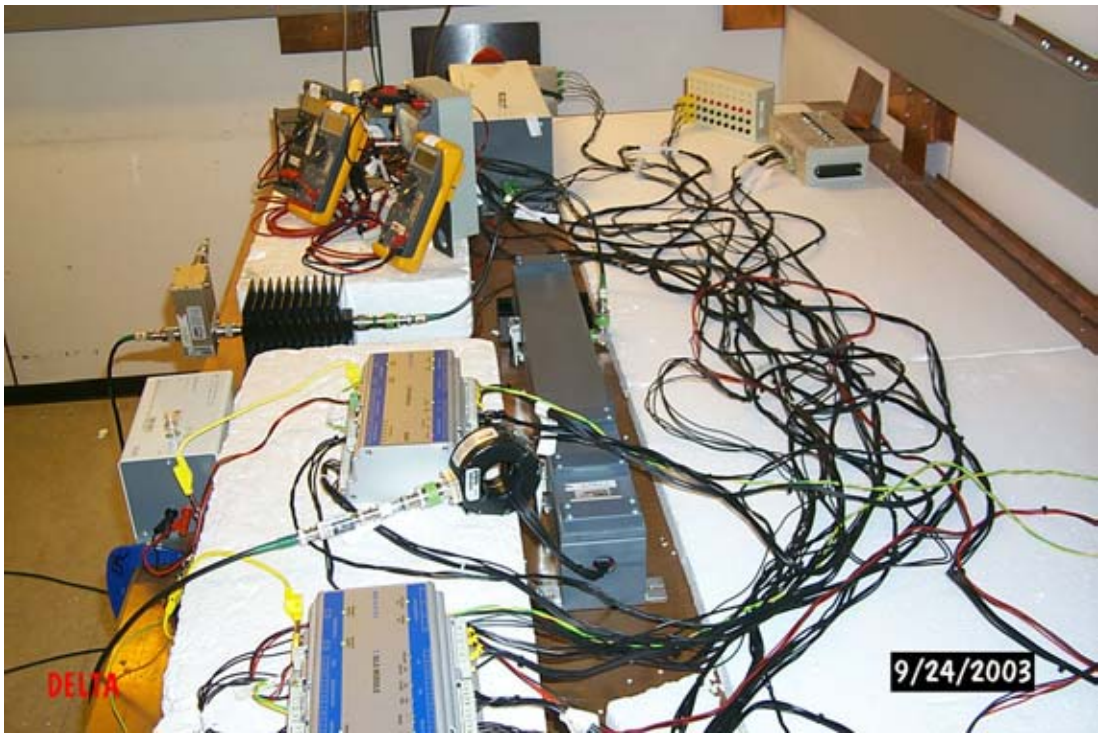


PHOTO 3. Conducted radio frequency interference.

PHOTO 4. Electrostatic discharge. (e.g. S6500).

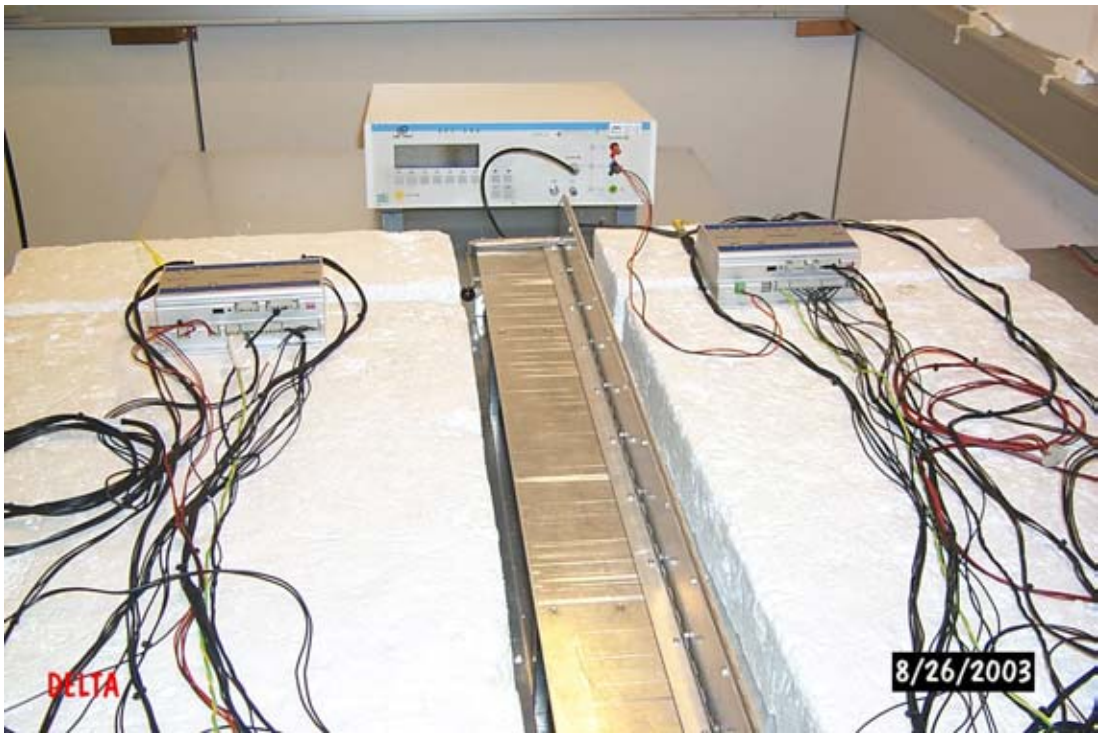


PHOTO 5. Electrical fast transients (burst).

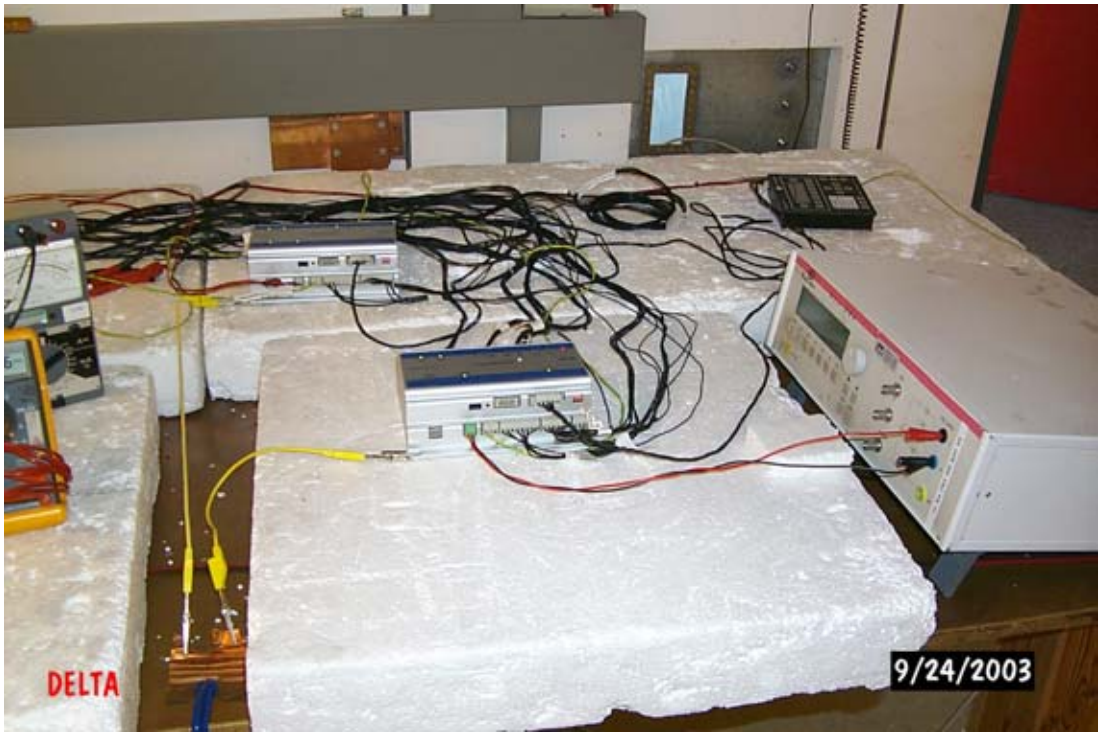


PHOTO 6. Surge transients (e.g. S6000).

PHOTO 7. Conducted emission. (e.g. CISPR 16-1).

PHOTO 8. Radiated emission (3 m).

PHOTO 9. Radiated emission (3 m).

PHOTO 10. Radiated emission (3 m).

PHOTO 11. Radiated emission (10 m).

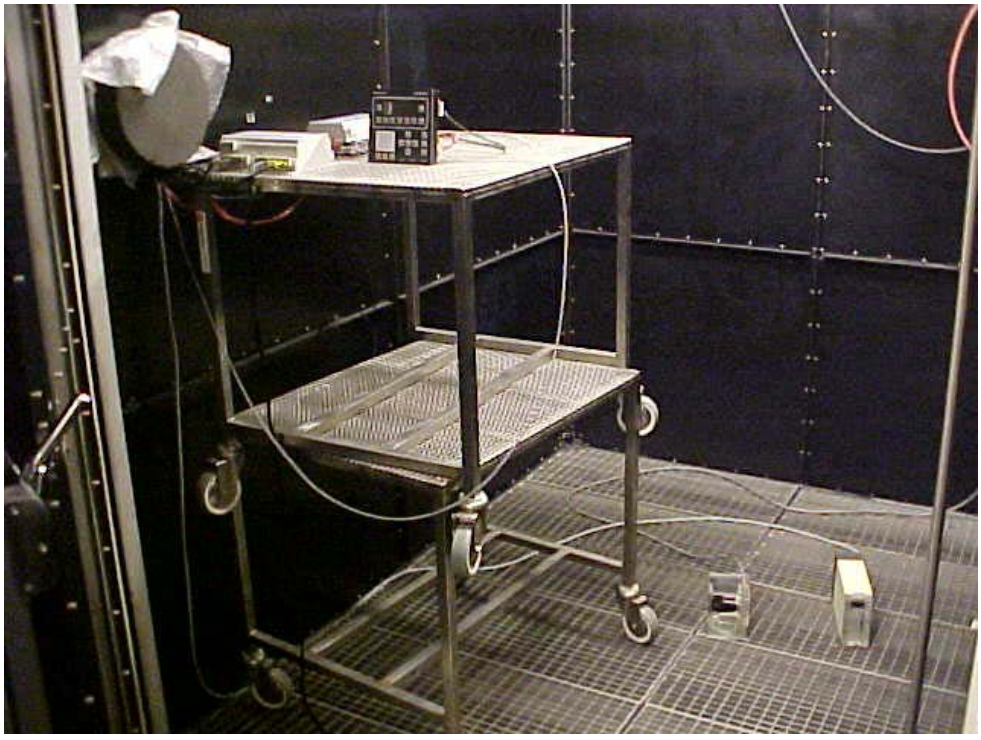


PHOTO 12. Climatic testing (low temperature, dry heat and damp heat).

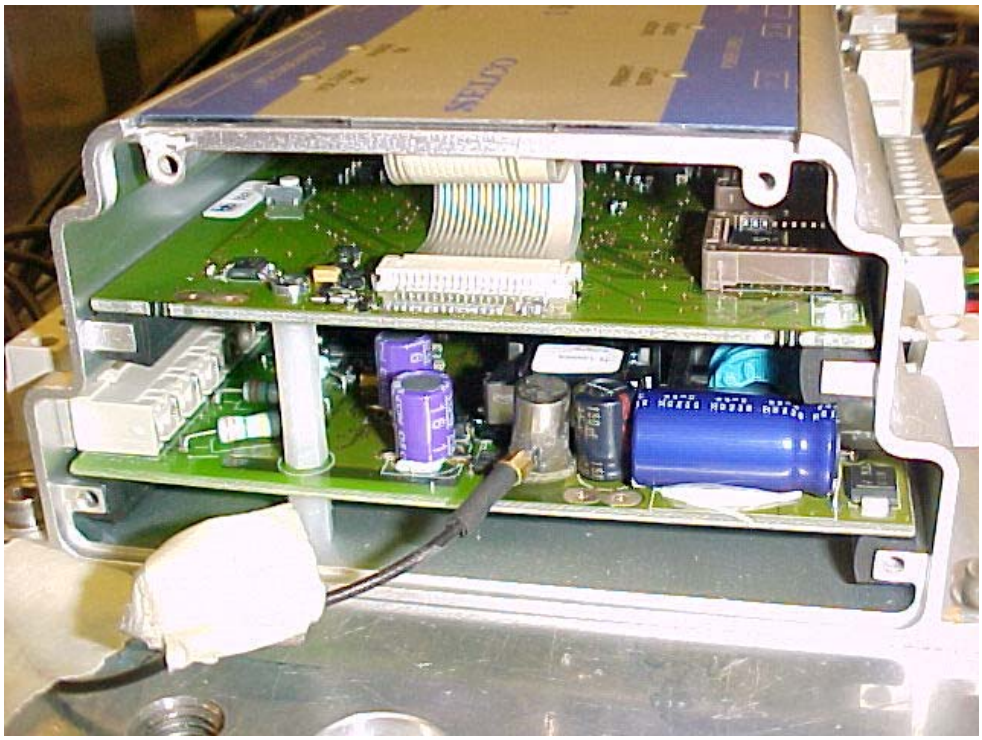


PHOTO 13. Vibration testing (resonance search), e.g. S6000.

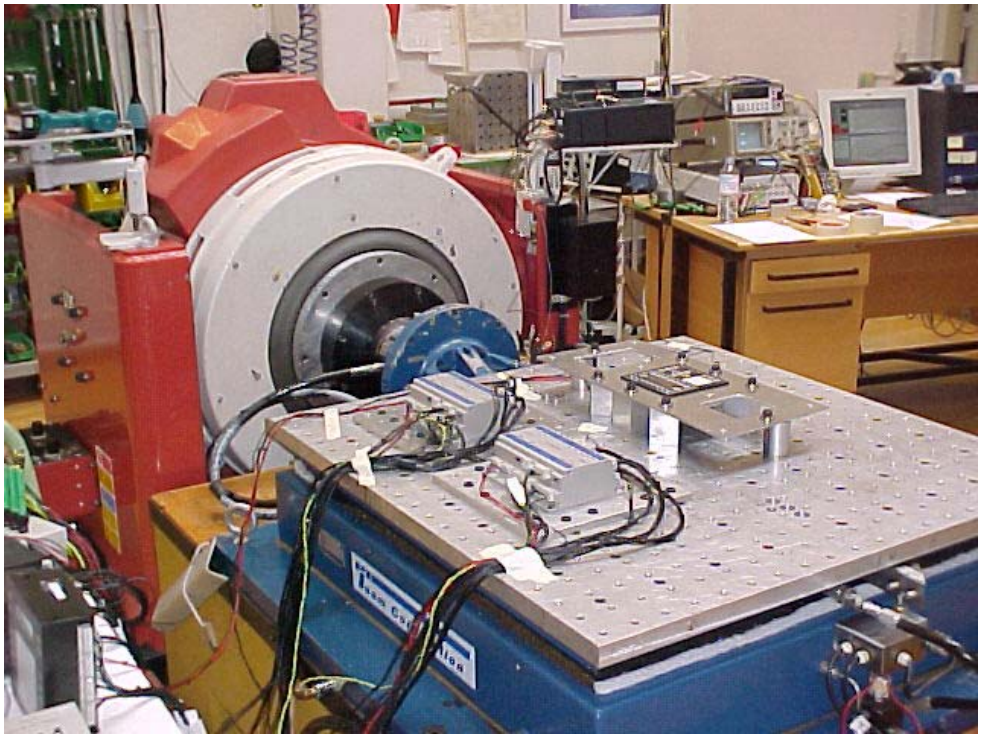


PHOTO 14. Vibration testing (endurance).

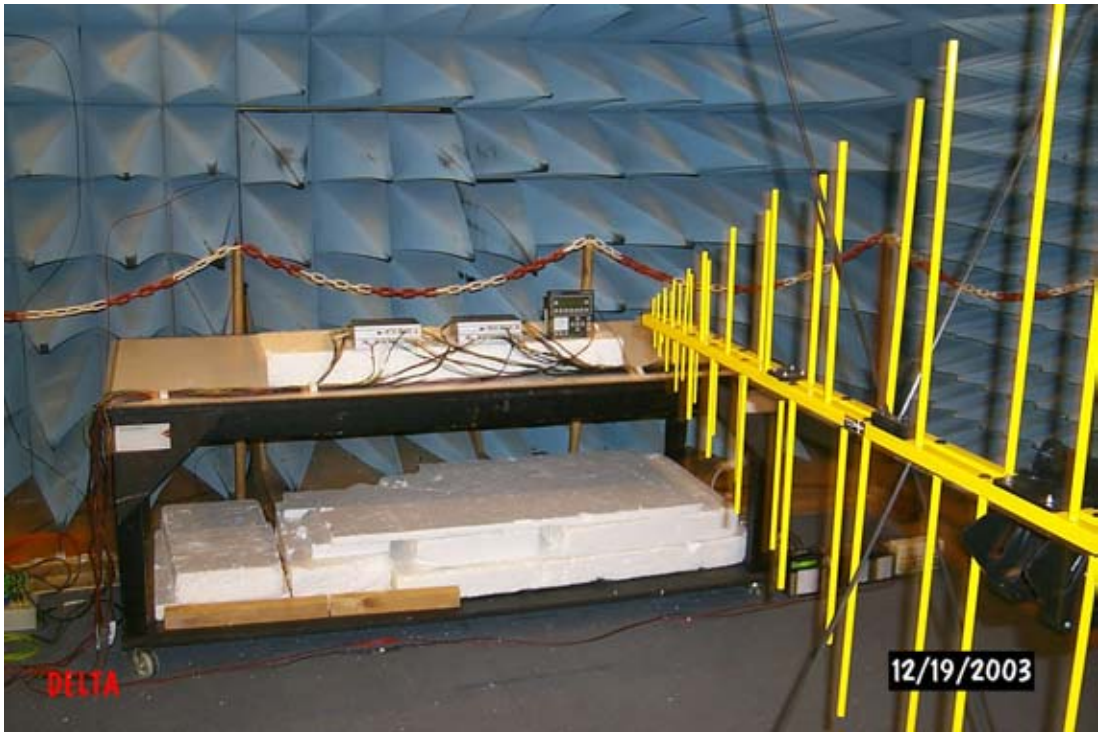


PHOTO 15. Radiated radio frequency interference (80-1000 MHz).

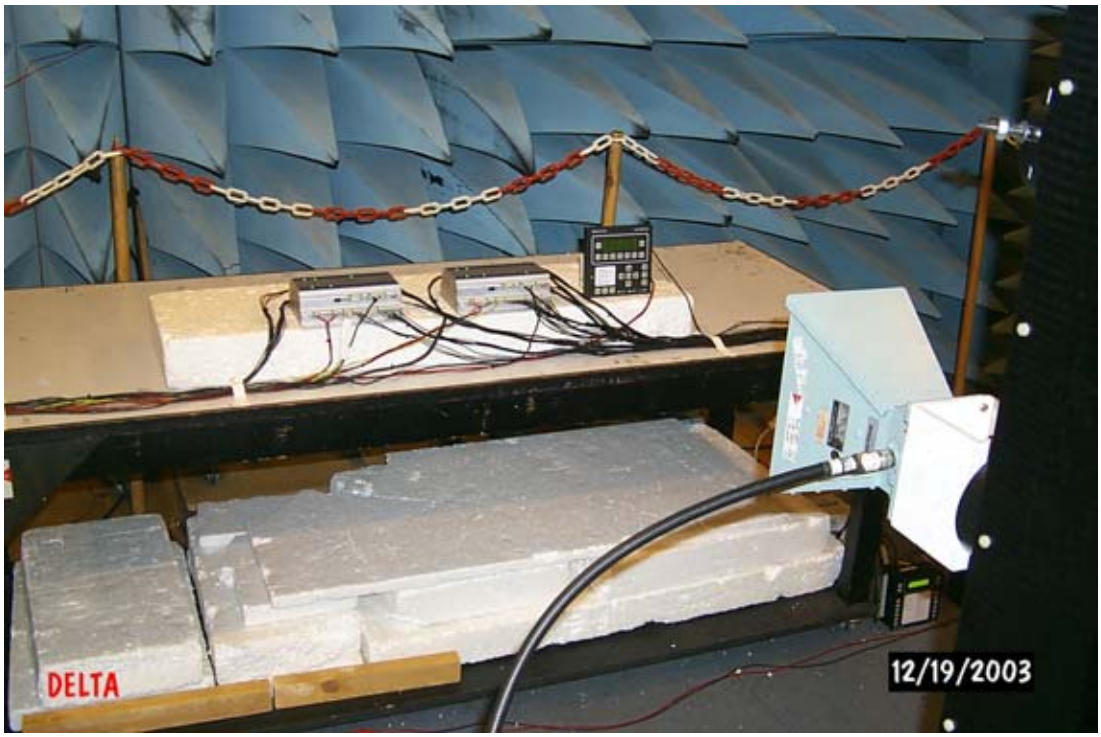


PHOTO 16. Radiated radio frequency interference (1000-2000 MHz).

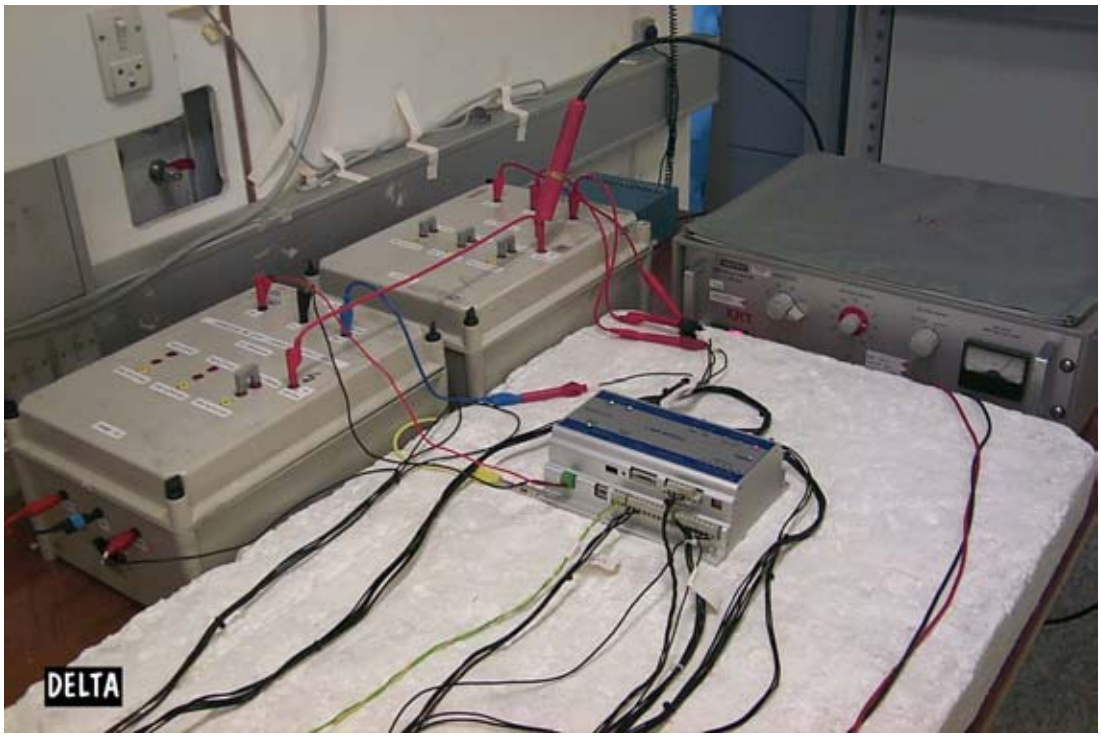


PHOTO 17. 1 MHz burst (e.g. S6000).

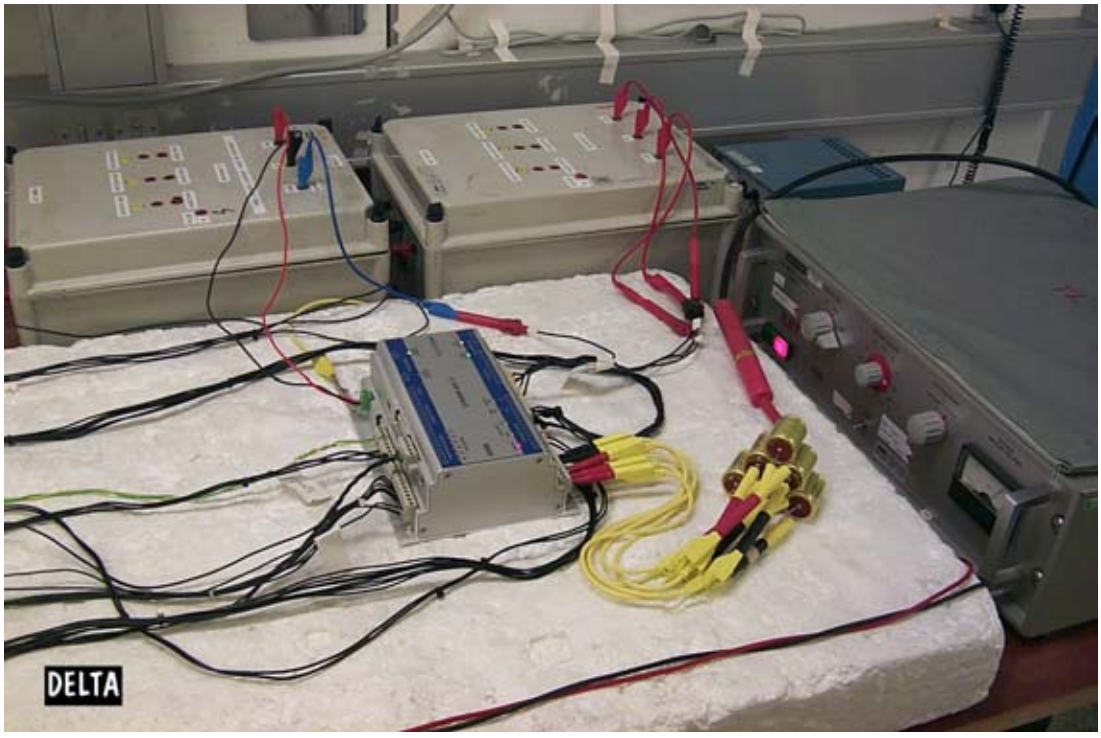


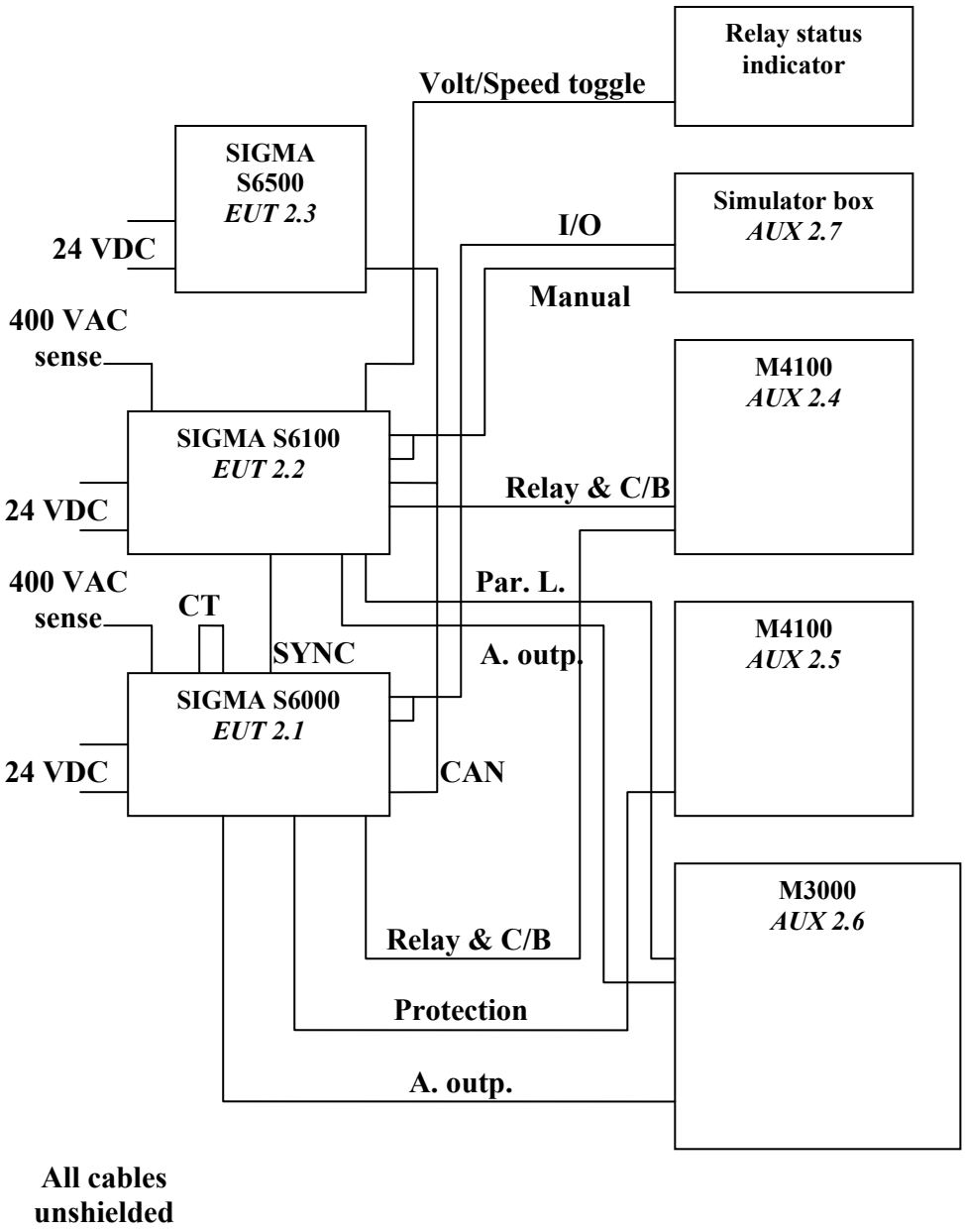
PHOTO 18. 1 MHz burst (e.g. S6000).

Annex 3

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

(8 pages)

Test set-up


Relay status indicator
Volt/Speed toggle
SIGMA S6500
EUT 2.3
24 VDC
I/O
Simulator box
AUX 2.7
Manual
400 VAC sense
M4100
AUX 2.4
SIGMA S6100
EUT 2.2
Relay & C/B
24 VDC
400 VAC sense
Par. L.
CT
SYNC
A. outp.
M4100
AUX 2.5
SIGMA S6000
EUT 2.1
24 VDC
CAN
M3000
AUX 2.6
Relay & C/B
Protection
A. outp.
All cables unshielded

System briefing

S6000 SIGMA IO/P Module

SIGMA is an integrated generator protection and control system. Ease of use, quality and cost effectiveness were the key targets when SELCO set out to design the SIGMA concept.

The SELCO S6000 SIGMA IO/P Module provides data acquisition and complete protection for a single generator. The S6000 measures the voltages across all three phases as well as the current running through each phase. The voltage and current signals are digitally sampled by the built-in signal processor and converted to true RMS values. The S6000 will continuously do real-time calculations of voltage, current, frequency, active/reactive power, VA, power factor etc. The S6000 can connect to generators with or without neutral. The S6000 includes six programmable protection functions: Short Circuit, Over Current, Reverse Power, Overload, Excitation Loss and Voltage Establishment. The protection functions can be configured with regard to trip level, delay and relay function. The protection works on all three phases. A dedicated LED and open collector output is provided for each protection function.
Load shedding can be done at two individual levels. Each level controls a dedicated built-in relay. Measured and calculated parameters can be provided as VDC og mA signals on three isolated analogue outputs. The span of each analogue output is programmable. The RS485 MODBUS-RTU connection provides easy interfacing to SCADA systems and PLC's. Measured calculated parameters are easily accessed by any device capable of operating as a MODBUS master. Configuration parameters can also be accessed and altered through MODBUS-RTU. An RS232 connection is provided for point-to-point configuration. The S6000 can be remotely configured by "clear text" commands issued from a standard terminal emulator (e.g. Windows HyperTerminal). The complete configuration can be stored as text files.

Together with the S6100 and S6500, the S6000 will provide a simple yet powerful solution to a full scale control system. Such a system will provide protection, auto-synchronization, load sharing, indication and SCADA connectivity.
A single variant supports nominal voltages in the range 63 to 690 VAC. Secondary CT current must be specified upon delivery (5 or 1 A).
The S6000 is designed to comply with marine requirements. The design of the circuitry and metal casing provides the best possible protection from EMC and environmental stress. The S6000 is intended for switch board installation. Measurements are 145 x 190 x 64 mm.

S6100 SIGMA S/LS Module

SIGMA is an integrated generator protection and control system. Ease of use, quality and cost effectiveness were the key targets when SELCO set out to design the SIGMA concept.

The SELCO S6100 SIGMA S/LS Module provides frequency control, voltage control, automatic synchronization and active/reactive load sharing. The S6100 has dedicated interfaces for both conventional and electronic governors and automatic voltage regulators. Manual control is also possible though external push buttons. The S6100 reads generators parameters from the S6000 IO/P module (connected through the CAN bus). The S6100 will also measure the Bus bar voltages across all three phases. The bus bar voltage measurements are digitally sampled by the built-in signal processor and converted to true RMS values. The S6100 will continuously do real-time calculations of derived parameters.
The S6100 can connect to generators with or without neutral. The S6100 includes voltage control, frequency control, voltage matching, automatic or manual synchronisation and automatic or manual active/reactive load sharing. The control algorithms are based on three phase measurements. Built-in relays are provided for control of conventional governors and AVR's. Isolated analogue outputs are provided for control of electronic governors and AVR's. The S6100 will work with or without droop. The S6100 can operate in parallel with the SELCO T4400 or T4800 load sharers. The RS485 MODBUS-RTU connection provides easy interfacing to SCADA systems and PLC's. Measured calculated parameters are easily accessed by any device capable of operating as a MODBUS master. Configuration parameters can also be accessed and altered through MODBUS-RTU. An RS232 connection is provided for point-to-point configuration.
The S6000 can be remotely configured by "clear text" commands issued from a standard terminal emulator (e.g. Windows HyperTerminal). The complete configuration can be stored as text files. Together with the S6000 and S6500, the S6100 will provide a simple yet powerful solution to a full scale control system. Such a system will provide protection, auto-synchronization, load sharing, indication and SCADA connectivity. A single variant supports nominal voltages in the range 63 to 690 VAC. Secondary CT current must be specified upon delivery (5 or 1 A). The S6100 is designed to comply with marine requirements. The design of the circuitry and metal casing provides the best possible protection from EMC and environmental stress. The S6100 is intended for switch board installation. Measurements are 145 x 190 x 64 mm.

S6500 SIGMA UI Module

SIGMA is an integrated generator protection and control system. Ease of use, quality and cost effectiveness were the key targets when SELCO set out to design the SIGMA concept.

The SELCO S6500 SIGMA UI Module is a flush mountable user interface for the SIGMA range of modules. The S6500 fills the role of a flush mount digital multimeter as well as a configuration terminal. The S6500 will provide real-time readings of voltages, currents, active/reactive load, VA, frequency etc. A single S6500 can support up to 16 S6000 and S6100 modules. The S6500 can be used to monitor and alter parameters in parallel with an operating SCADA system.

The S6500 measures 144 x 144 x 75 mm.

Functional test procedure

General performance verification is performed as follows:

1. Change to “VOLT” or “AMP” mode
2. S6500 “MENU”
3. Select “GENERATOR MODULE”
4. Select “SIGMA IO/P”->”PROTECTION”->”SHORT CIRCUIT”
5. Change “TRIP LEVEL” 0% - press “YES”
6. “C/B TRIP” & “SC” activated on S6000 & M4100
7. Change “TRIP LEVEL” 120% - press “YES”
8. Press “C/B reset” on simulator box
9. “C/B TRIP” & “SC” de-activated on S6000
10. Reset M4100’s
11. Select “SIGMA IO/P”->”PROTECTION”->”OVER CURRENT”
12. Change “TRIP LEVEL” 0% - press “YES”
13. “C/B TRIP” & “OC” activated on S6000 & M4100
14. Change “TRIP LEVEL” 100% - press “YES”
15. Press “C/B reset” on simulator box
16. “C/B TRIP” & “OC” de-activated on S6000
17. Reset M4100’s
18. Select “SIGMA IO/P”->”PROTECTION”->”OVER LOAD”
19. Change “TRIP LEVEL” 0% - press “YES”
20. “C/B TRIP” & “OL” activated on S6000 & M4100
21. Change “TRIP LEVEL” 100% - press “YES”
22. Press “C/B reset” on simulator box
23. “C/B TRIP” & “OL” de-activated on S6000

24. Reset M4100's
25. Select "SIGMA IO/P"->"PROTECTION"->"REVERSE POWER"
26. Change "TRIP LEVEL" 0% - press "YES"
27. "C/B TRIP" & "RP" activated on S6000 & M4100
28. Change "TRIP LEVEL" -7% - press "YES"
29. Press "C/B reset" on simulator box
30. "C/B TRIP" & "RP" de-activated on S6000
31. Reset M4100's
32. Select "SIGMA IO/P"->"PROTECTION"->"EXCITATION LOSS"
33. Change "TRIP LEVEL" 0% - press "YES"
34. "C/B TRIP" & "EL" activated on S6000 & M4100
35. Change "TRIP LEVEL" -5% - press "YES"
36. Press "C/B reset" on simulator box
37. "C/B TRIP" & "EL" de-activated on S6000
38. Reset M4100's
39. Select "SIGMA IO/P"->"PROTECTION"->"VOLTAGE ESTABLISH"
40. Change "LOWER TRIP LEVEL" 100% - press "YES"
41. "C/B TRIP" & "VE" activated on S6000 & M4100
42. Change "LOWER TRIP LEVEL" 80% - press "YES"
43. Press "C/B reset" on simulator box
44. "C/B TRIP" & "VE" de-activated on S6000
45. Reset M4100's
46. Select "SIGMA IO/P"->"PROTECTION"->"NONE ESSENTIALS 1"
47. Change "TRIP LEVEL" 0% - press "YES"
48. "NE1" activated on S6000 & M4100

49. Change “TRIP LEVEL” 100% - press “YES”
50. Press “NE reset” on simulator box
51. “NE1” de-activated on S6000
52. Reset M4100’s
53. Select “SIGMA IO/P”->”PROTECTION”->”NONE ESSENTIALS 2”
54. Change “TRIP LEVEL” 0% - press “YES”
55. “NE2” activated on S6000 & M4100
56. Change “TRIP LEVEL” 100% - press “YES”
57. Press “NE reset” on simulator box
58. “NE2” de-activated on S6000
59. Reset M4100’s
60. “C/B state” of simulator box “OFF” -> “C/B” LED’s “OFF”
61. Interchange phase S & T -> “PHASE” LED’s “OFF” on S6000 & S6100
62. Re-establish phase S & T -> “PHASE” LED’s “ON” on S6000 & S6100
63. Press “UNLOAD” on simulator box -> “UNLOAD” LED “ON” on S6100
64. Press “C/B CLOSE BLOCK” on simulator box -> “C/B BLOCK” LED “ON” on S6100
65. “C/B state” of simulator box “ON” -> “C/B” LED’s “ON”
66. Press “SPEED INCR” on simulator box -> “SPEED” volt/amp on M3000 increases
67. Press “SPEED DECR” on simulator box -> “SPEED” volt/amp on M3000 decreases
68. Set “SPEED” level to 4,5V/12 mA
69. Press “VOLT INCR” on simulator box -> “VOLT” volt/amp on M3000 increases
70. Press “VOLT DECR” on simulator box -> “VOLT” volt/amp on M3000 decreases
71. Set “VOLT” level to 4,5V/12 mA
72. Change to “RELAY” mode
73. S6500 “MENU”

74. Select “GENERATOR MODULE”
75. Select “SIGMA S/LS”->”SYSTEM”->”GOVERNOR”->”CONVENTIONAL->”YES”
76. Activate “DECR” or “INCR” on simulator box -> “SPEED” or “VOLT” relay’s toggle
77. Re-establish “VOLT” or “AMP” mode
78. Remove 24 VDC from “BACKUP SUPPLY” from S6000, S6100 & S6500
79. “ALARM” LED’s & “ALARM” relay’s of S6000 & S6100 activated
80. “POWER 2” LED on S6500 “OFF”
81. Re-establish 24 VDC supply -> Alarms of & power LED’s “ON”
82. Reset M4100’s

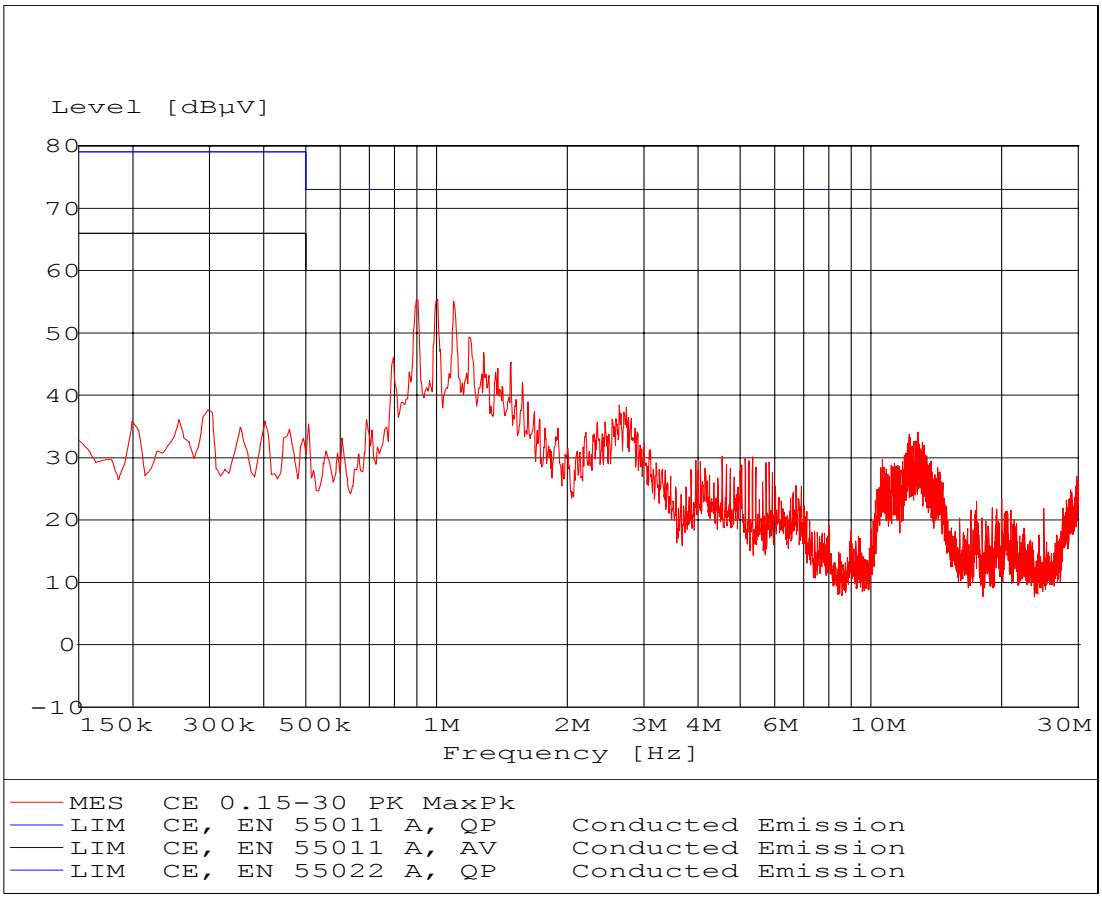
Annex 4

Test record sheets – Conducted emissions

(24 pages)

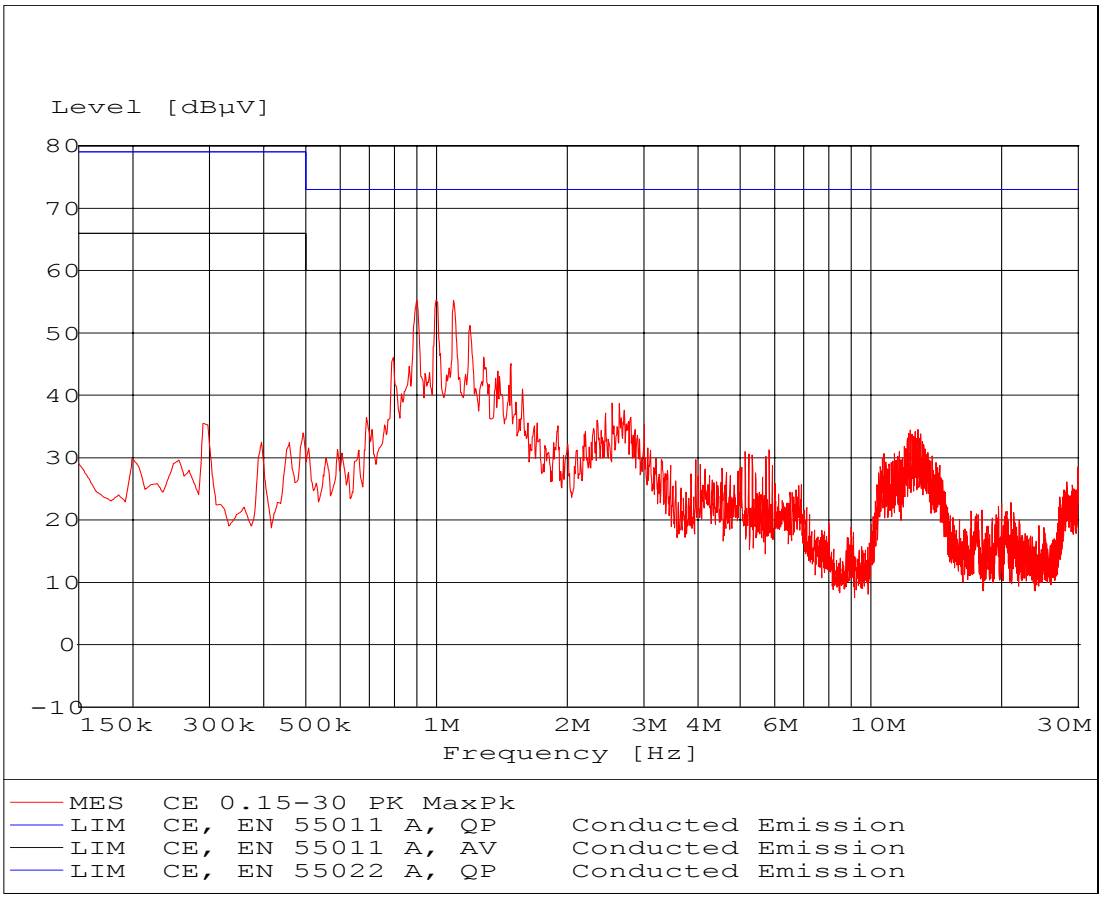
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6500, UI
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
Comment:	Sheet 9
Start of Test:	2003-08-19



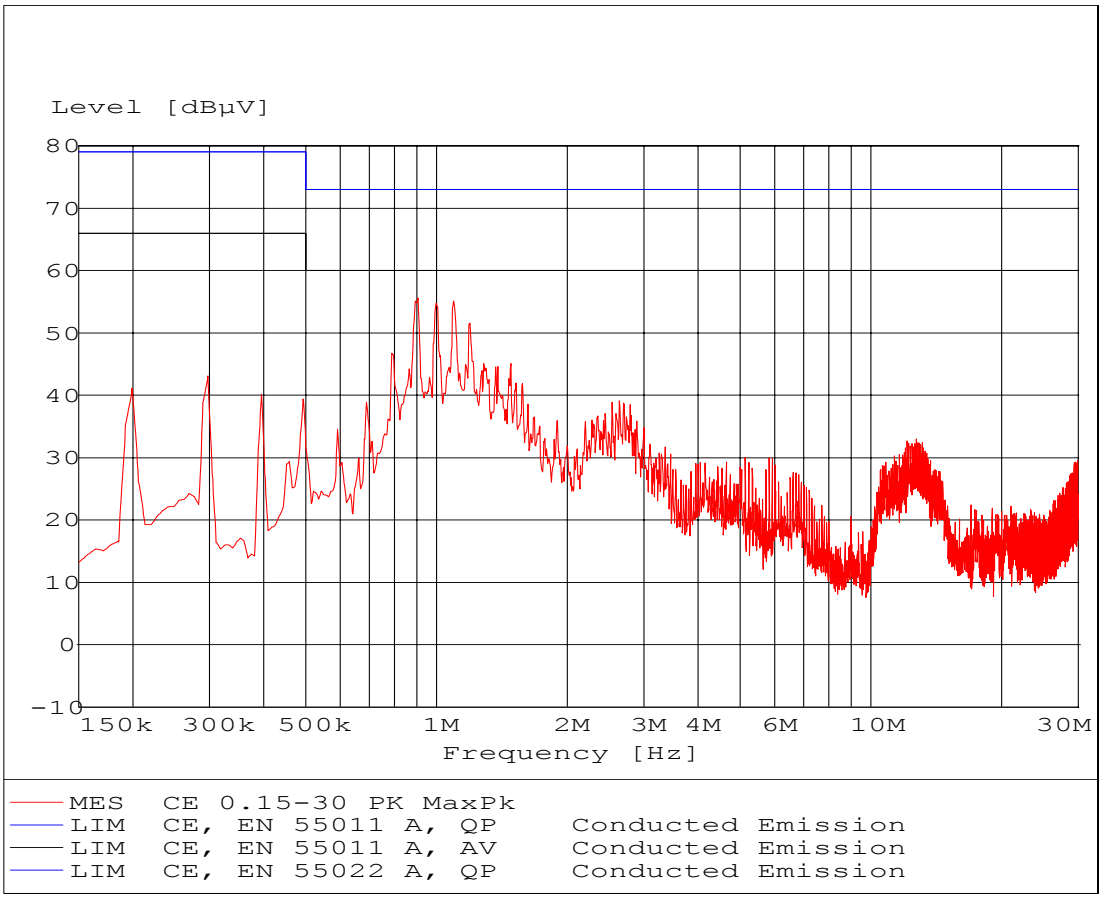
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6500, UI
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
Comment:	Sheet 10
Start of Test:	2003-08-19



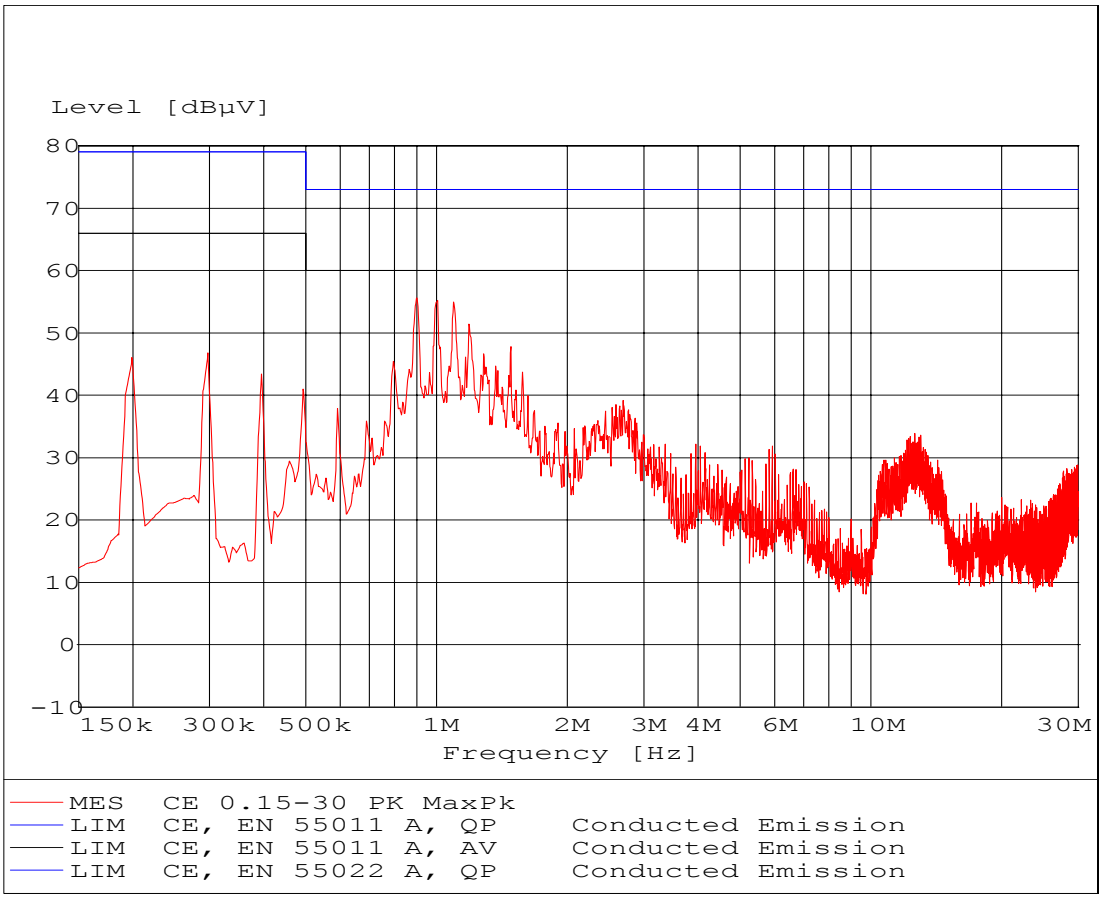
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6500, UI
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Backup power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
Comment:	Sheet 11
Start of Test:	2003-08-19



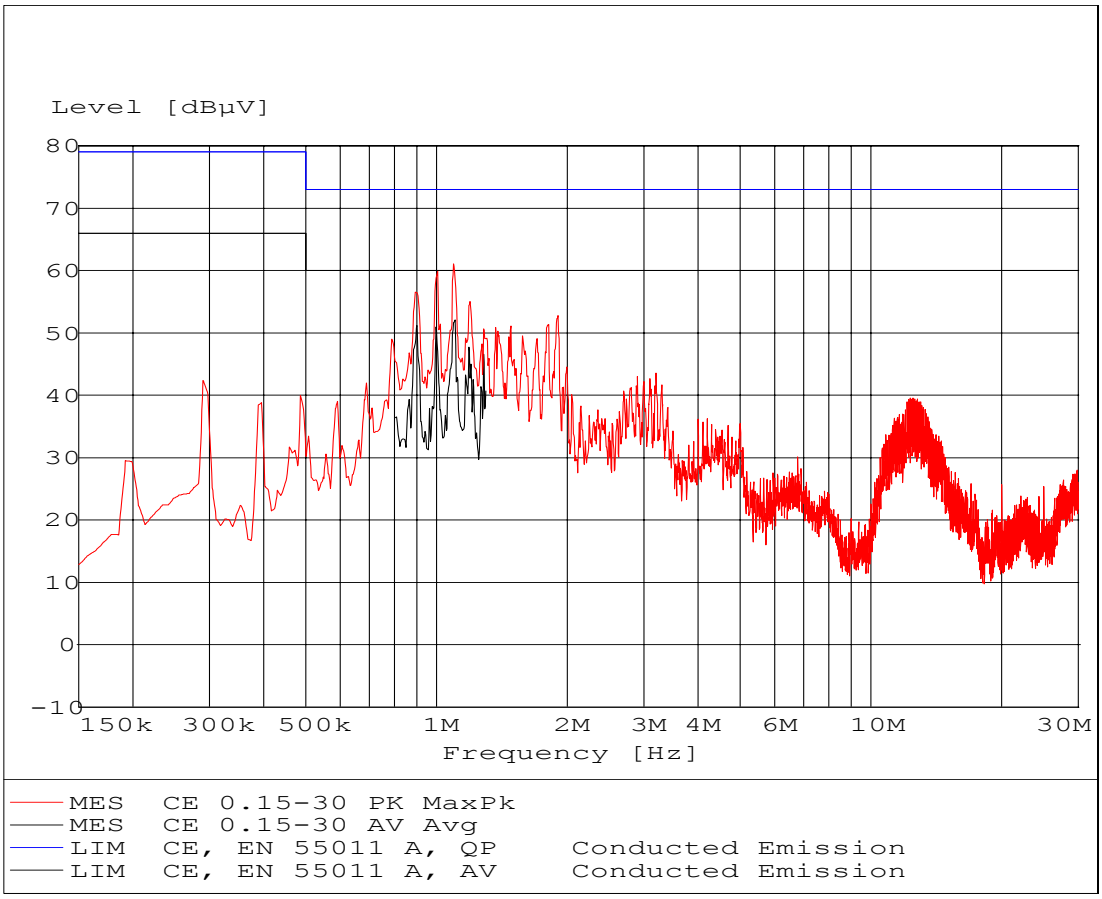
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6500, UI
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Backup power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
Comment:	Sheet 12
Start of Test:	2003-08-19



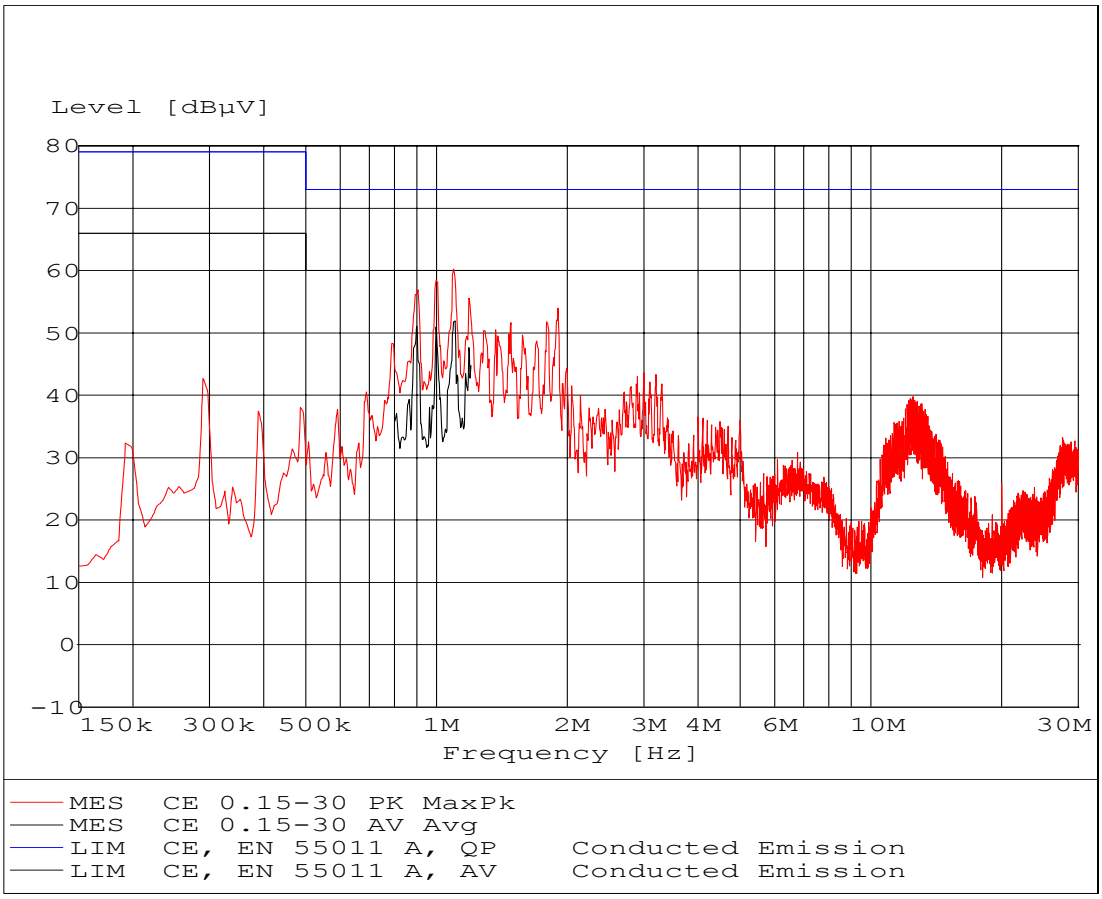
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6100, S/LS
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
Comment:	Sheet 13
Start of Test:	2003-08-19



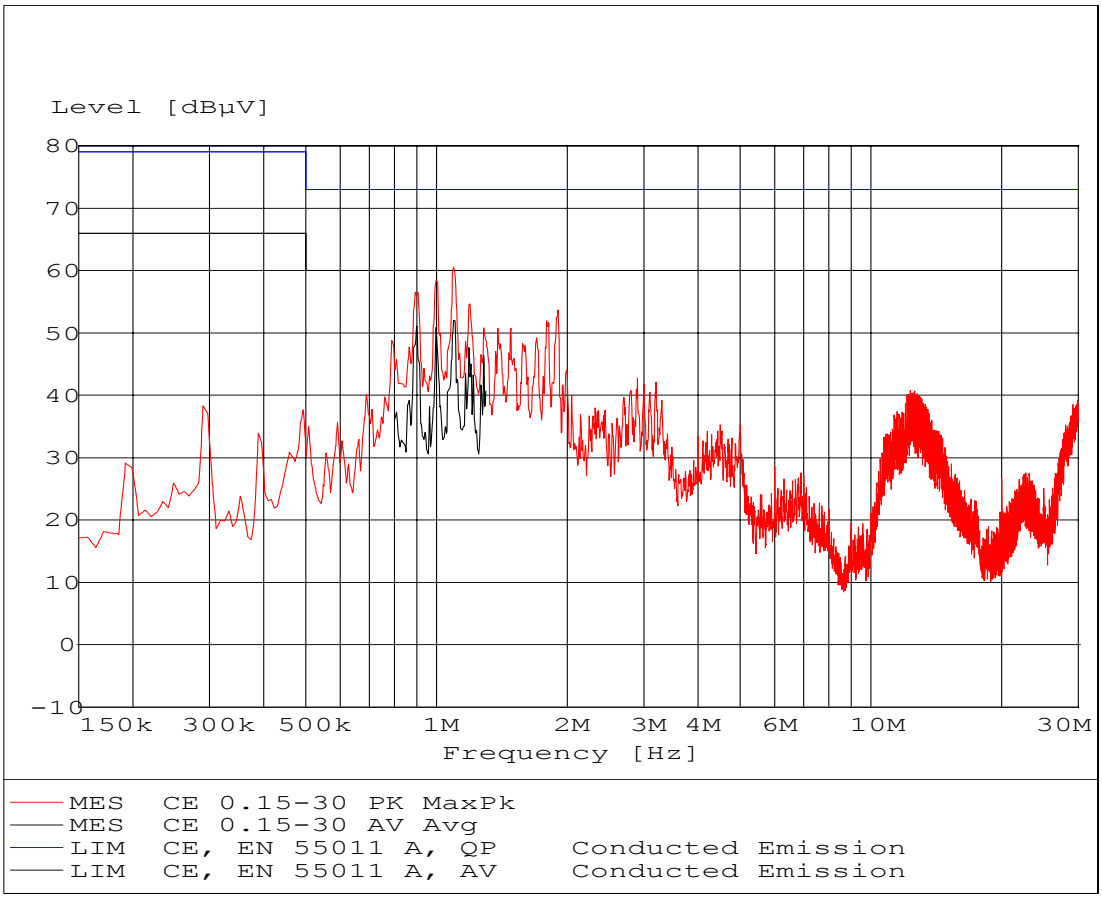
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6100, S/LS
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
Comment:	Sheet 14
Start of Test:	2003-08-19



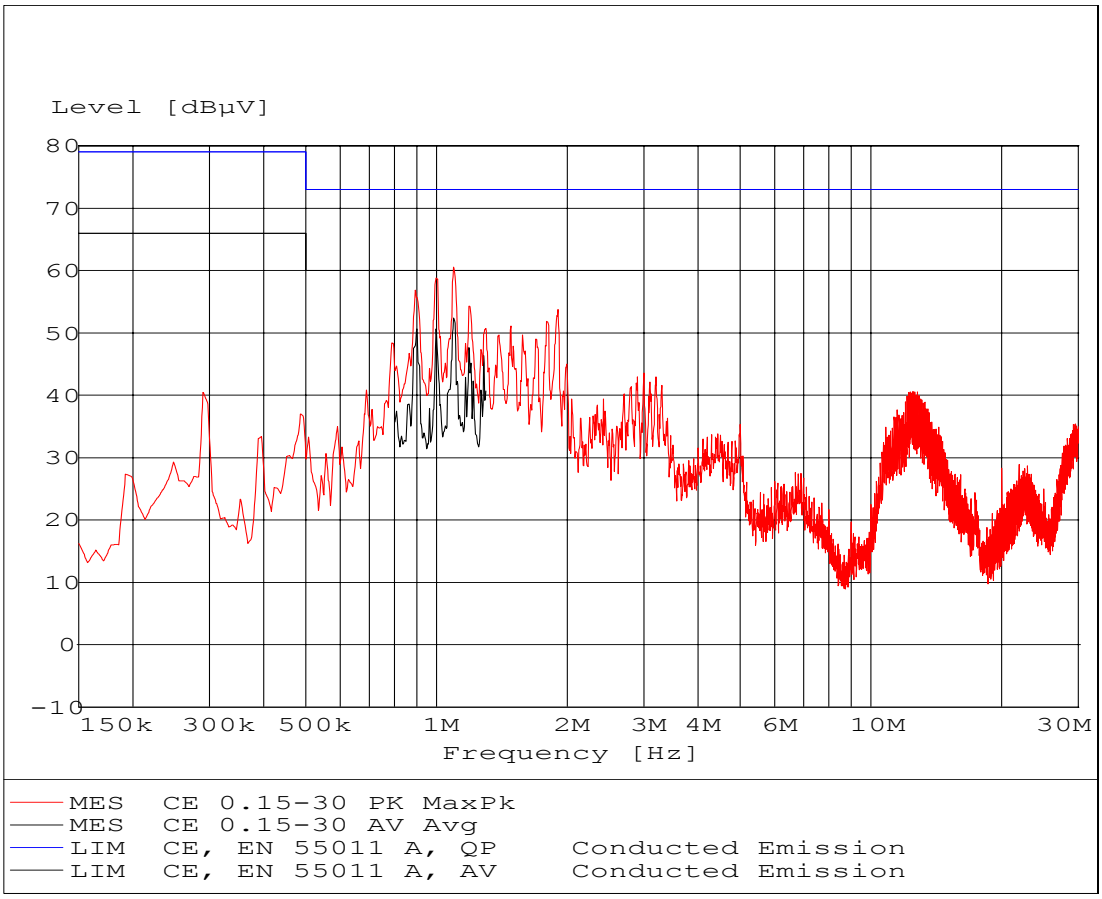
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6100, S/LS
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Backup power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
Comment:	Sheet 15
Start of Test:	2003-08-19



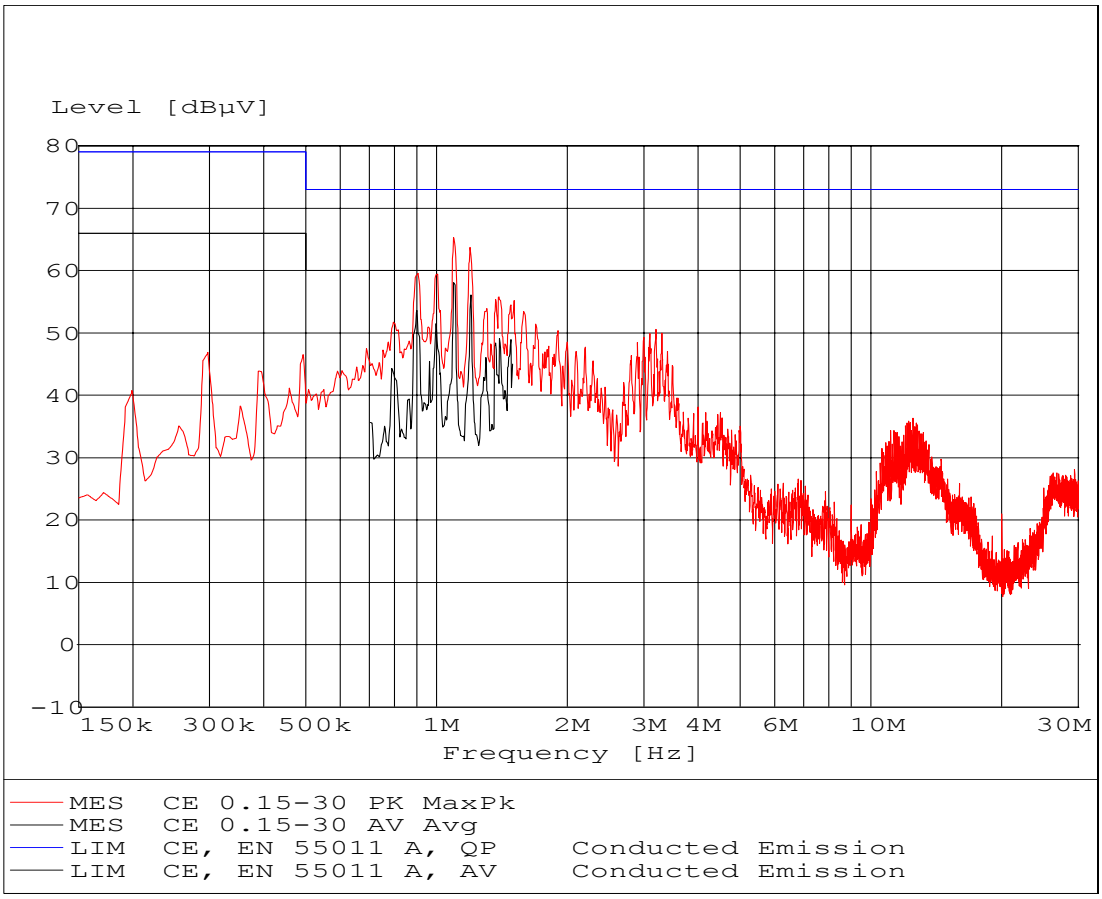
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6100, S/LS
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Backup power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
Comment:	Sheet 16
Start of Test:	2003-08-19



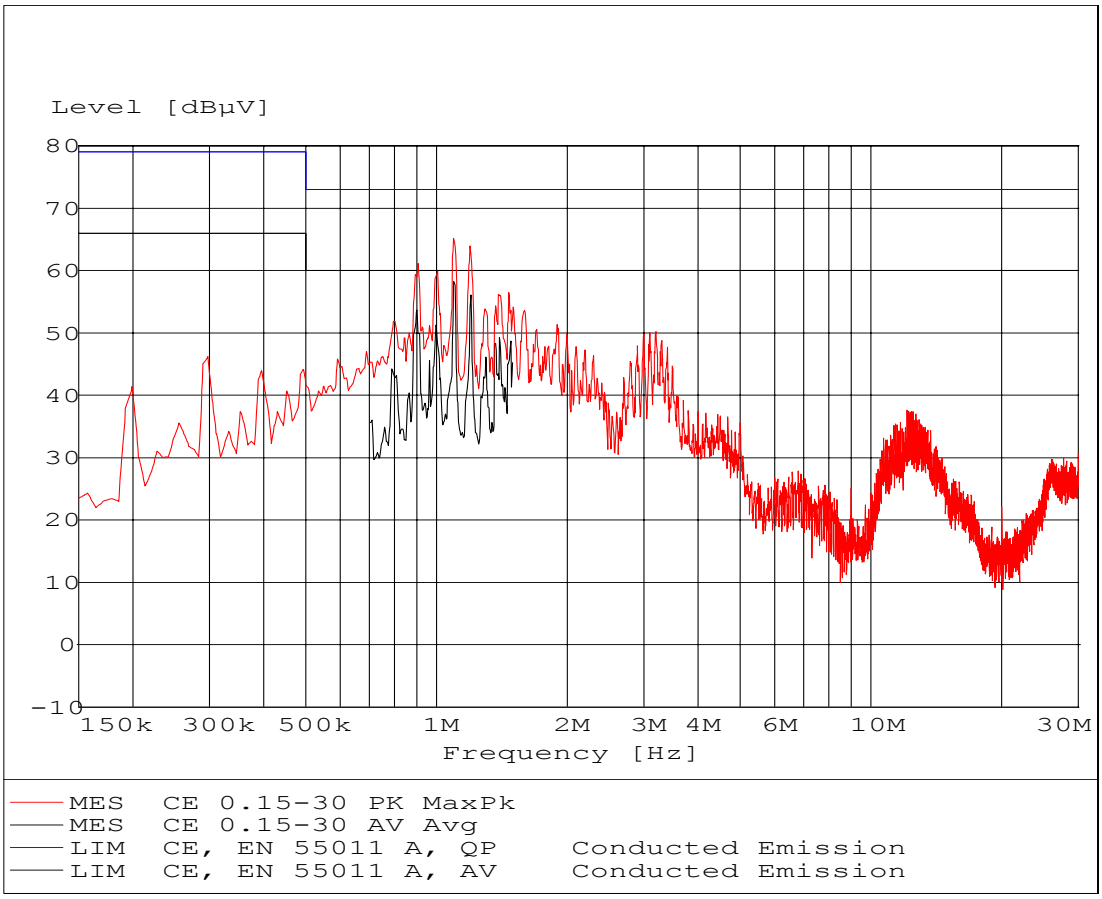
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6000, IO/P
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
Comment:	Sheet 17
Start of Test:	2003-08-19



DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6000, IO/P
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
Comment:	Sheet 18
Start of Test:	2003-08-19



DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6000, IO/P
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Backup power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
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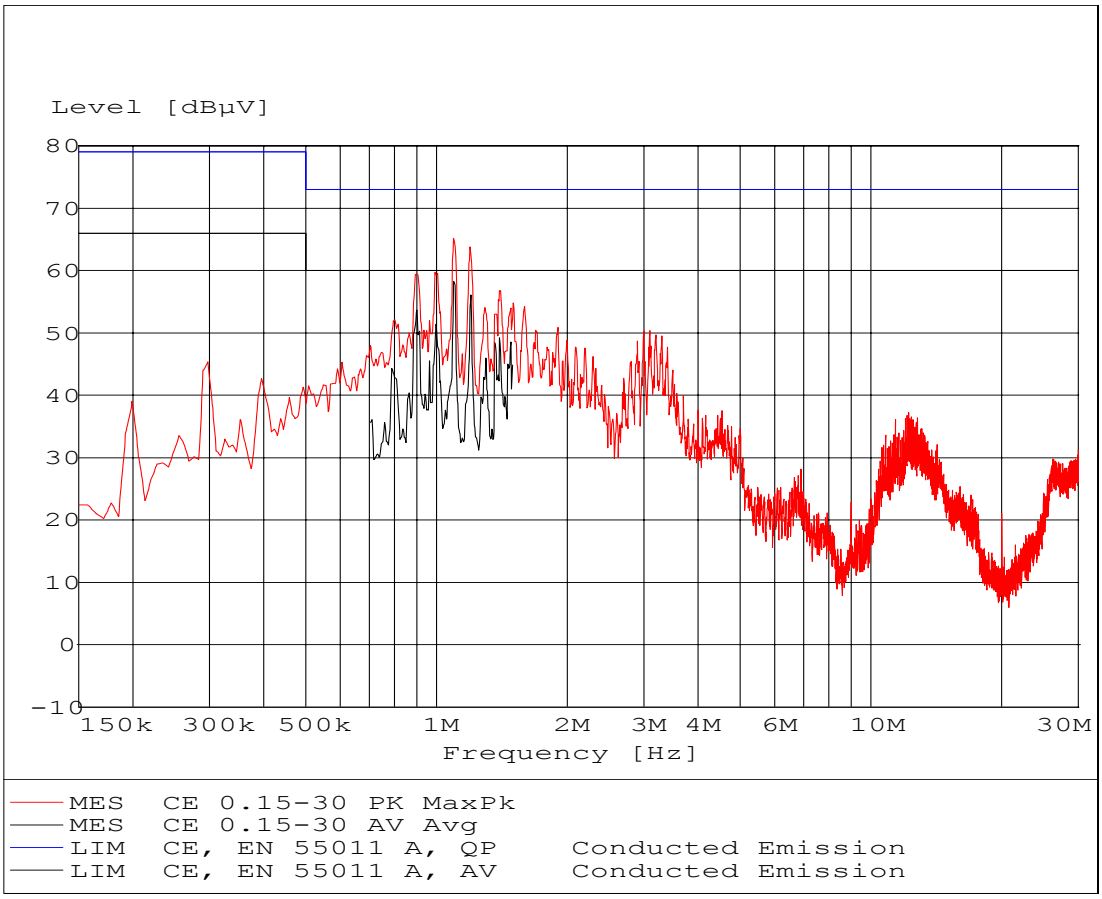

DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6000, IO/P
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Backup power
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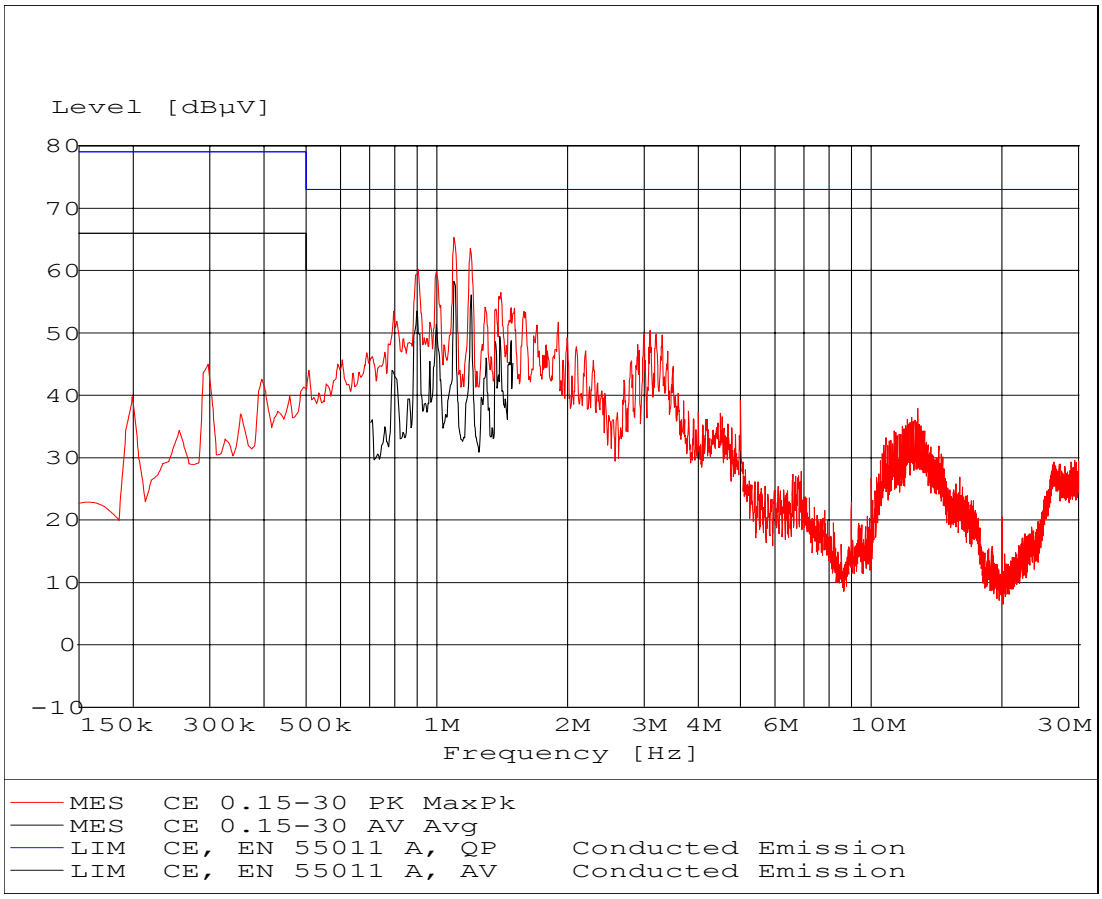
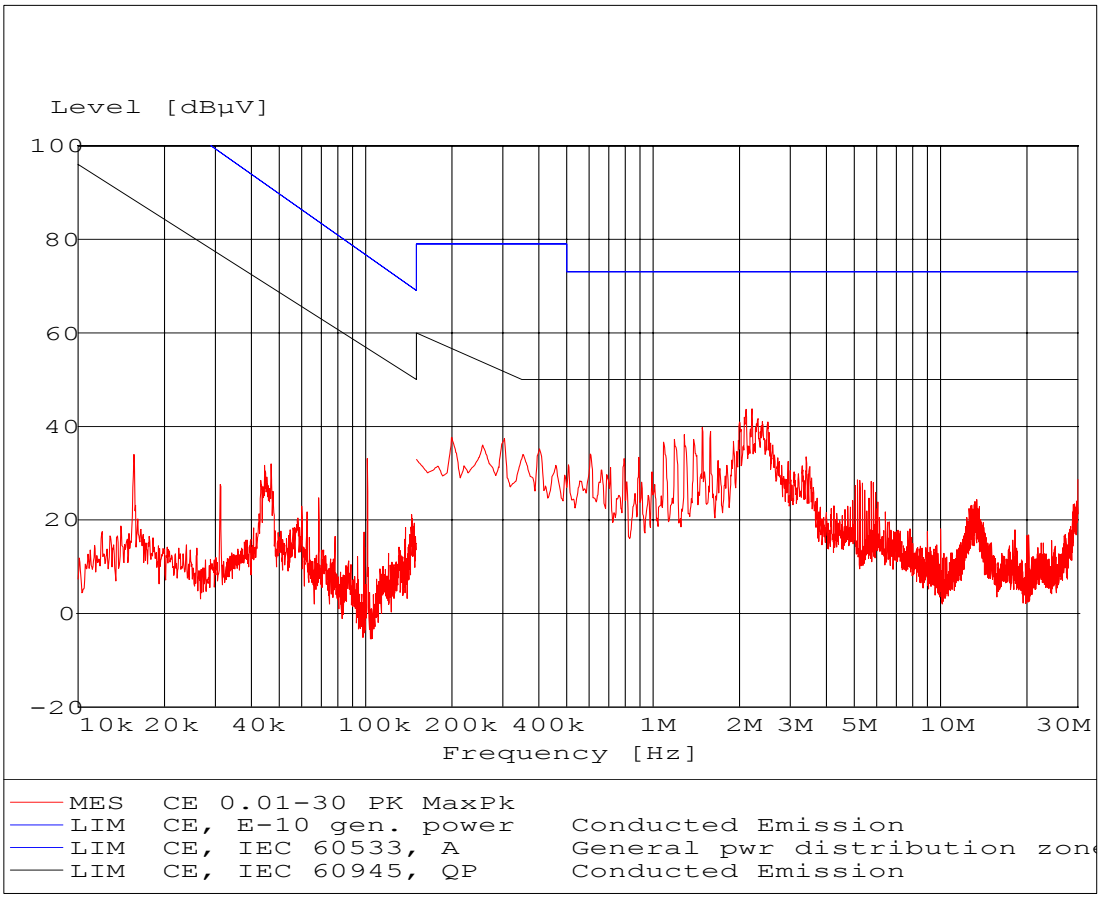
Operator:	HEN - E501273
Test Specification:	EN 55011 A. EN 55022 A
Comment:	Sheet 20
Start of Test:	2003-08-19



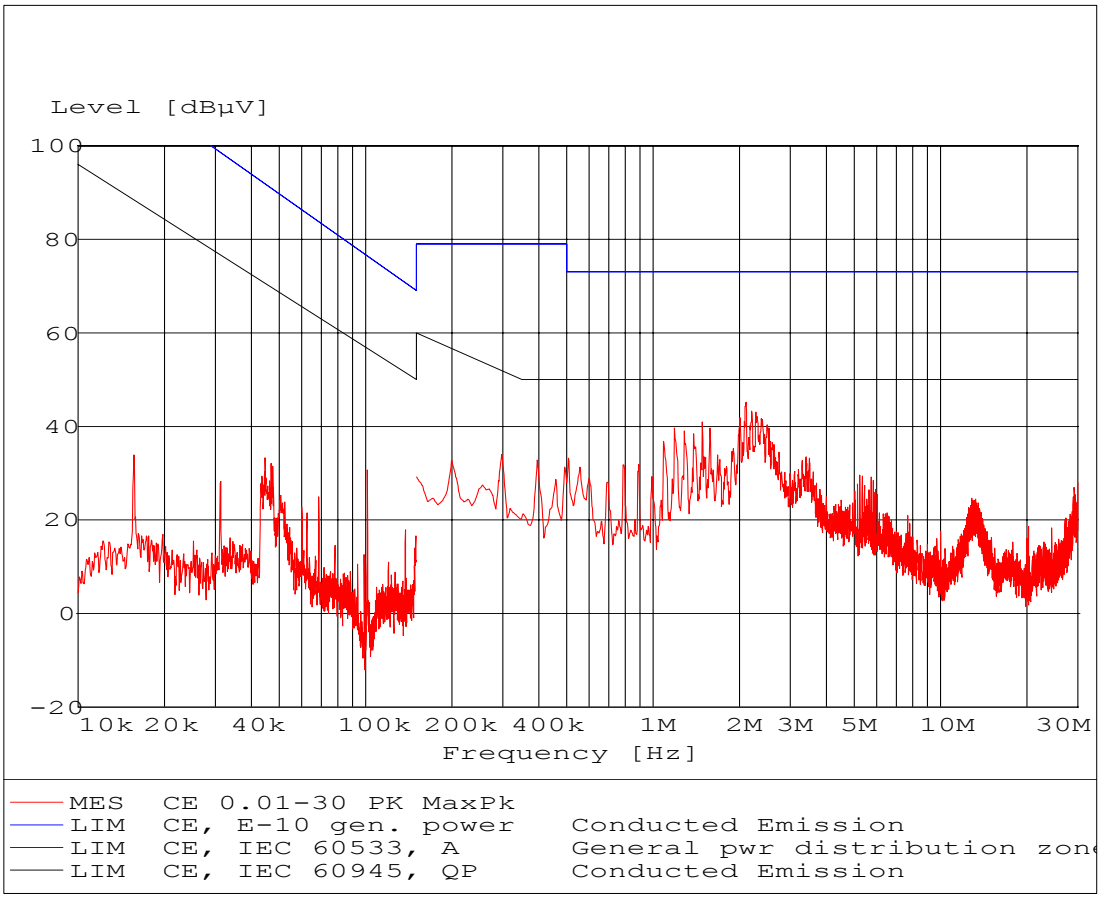
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6500, UI
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533. IEC 60945
Comment:	Sheet 21
Start of Test:	2003-08-20



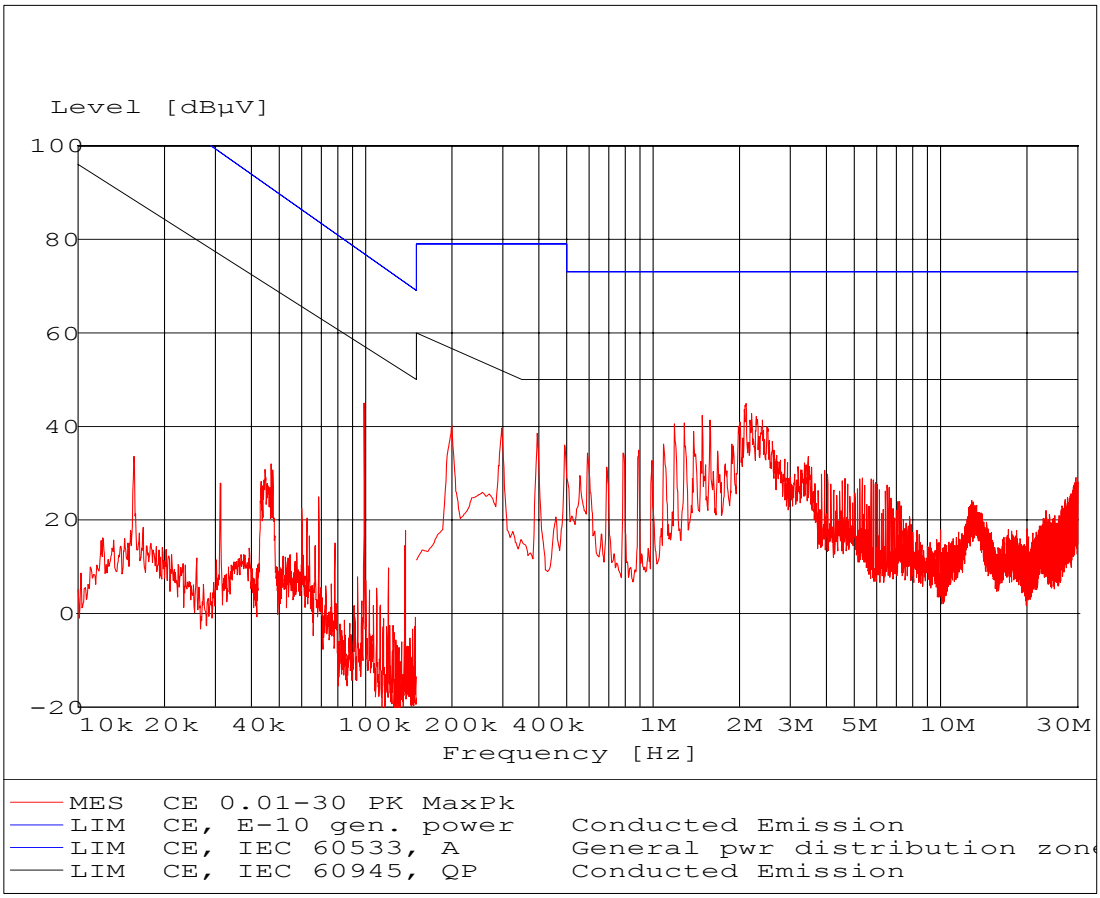
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6500, UI
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533. IEC 60945
Comment:	Sheet 22
Start of Test:	2003-08-20



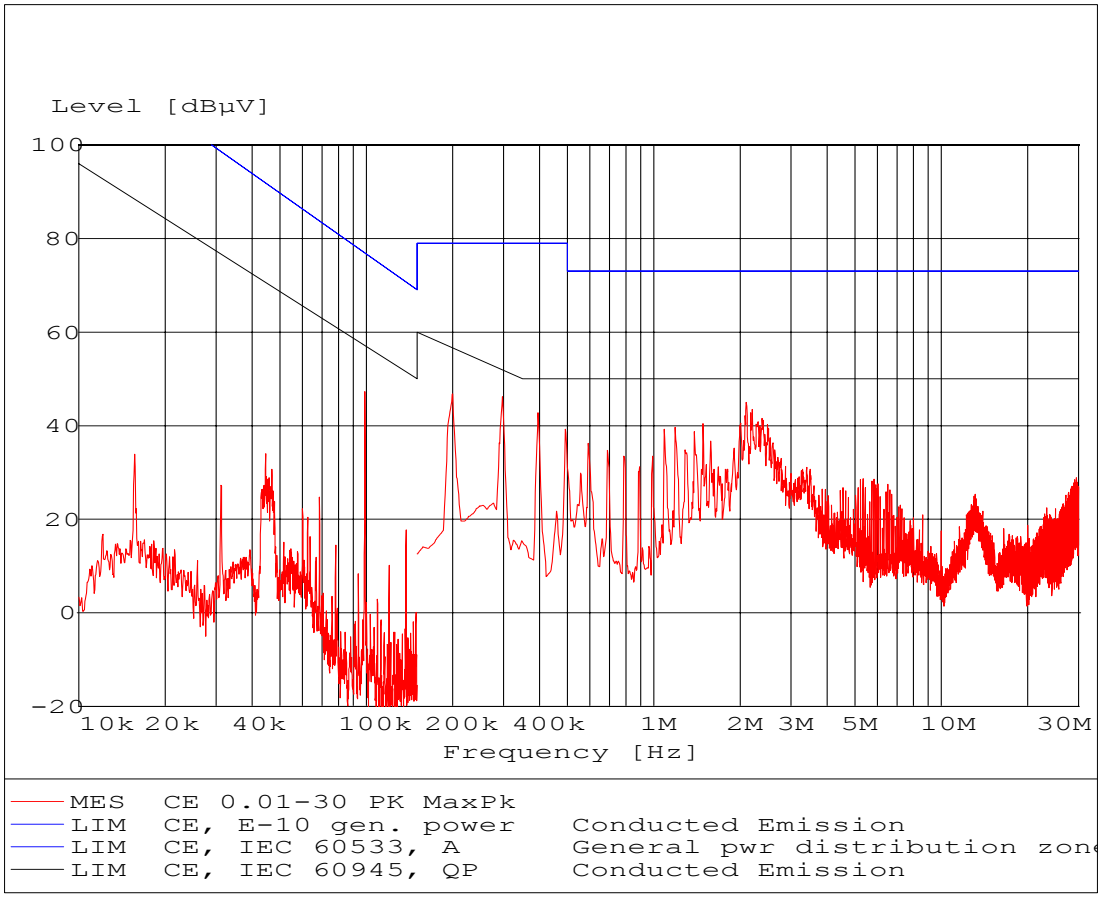
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6500, UI
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Backup power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533. IEC 60945
Comment:	Sheet 23
Start of Test:	2003-08-20



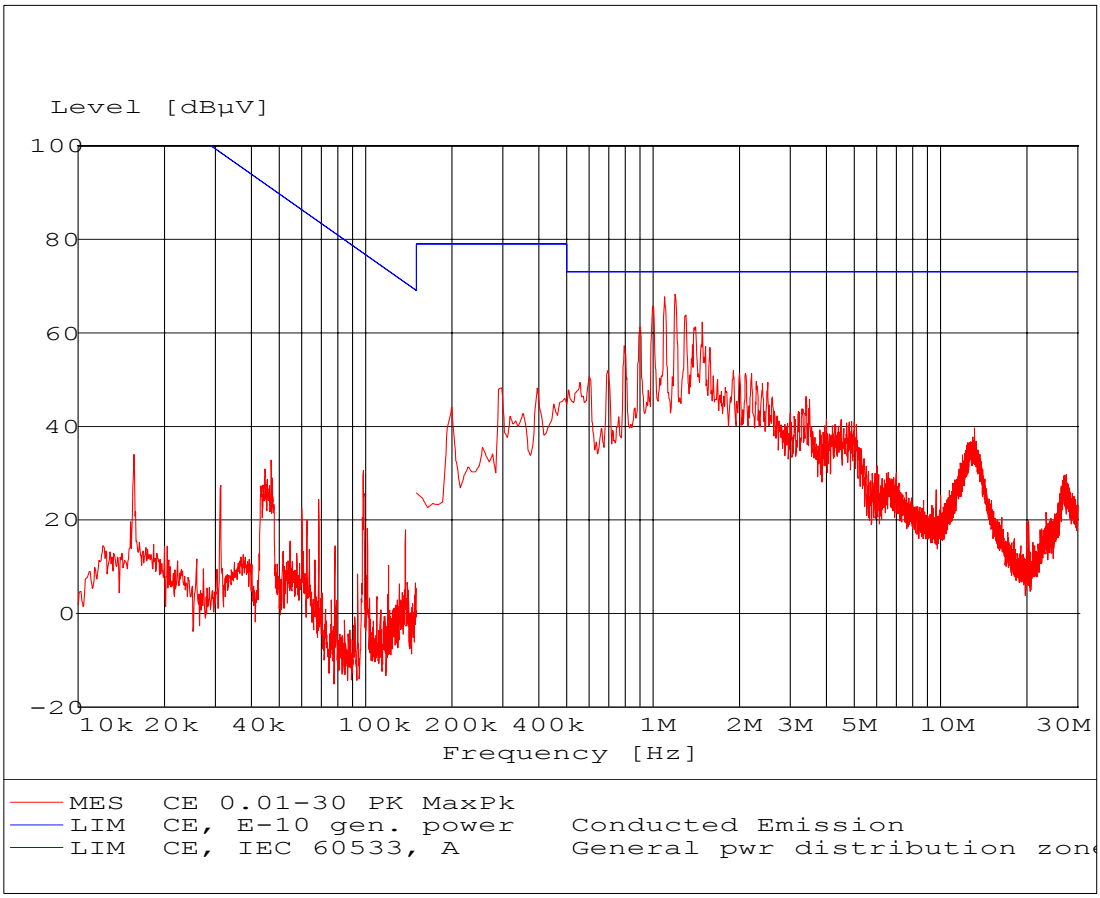
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6500, UI
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Backup power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533. IEC 60945
Comment:	Sheet 24
Start of Test:	2003-08-20



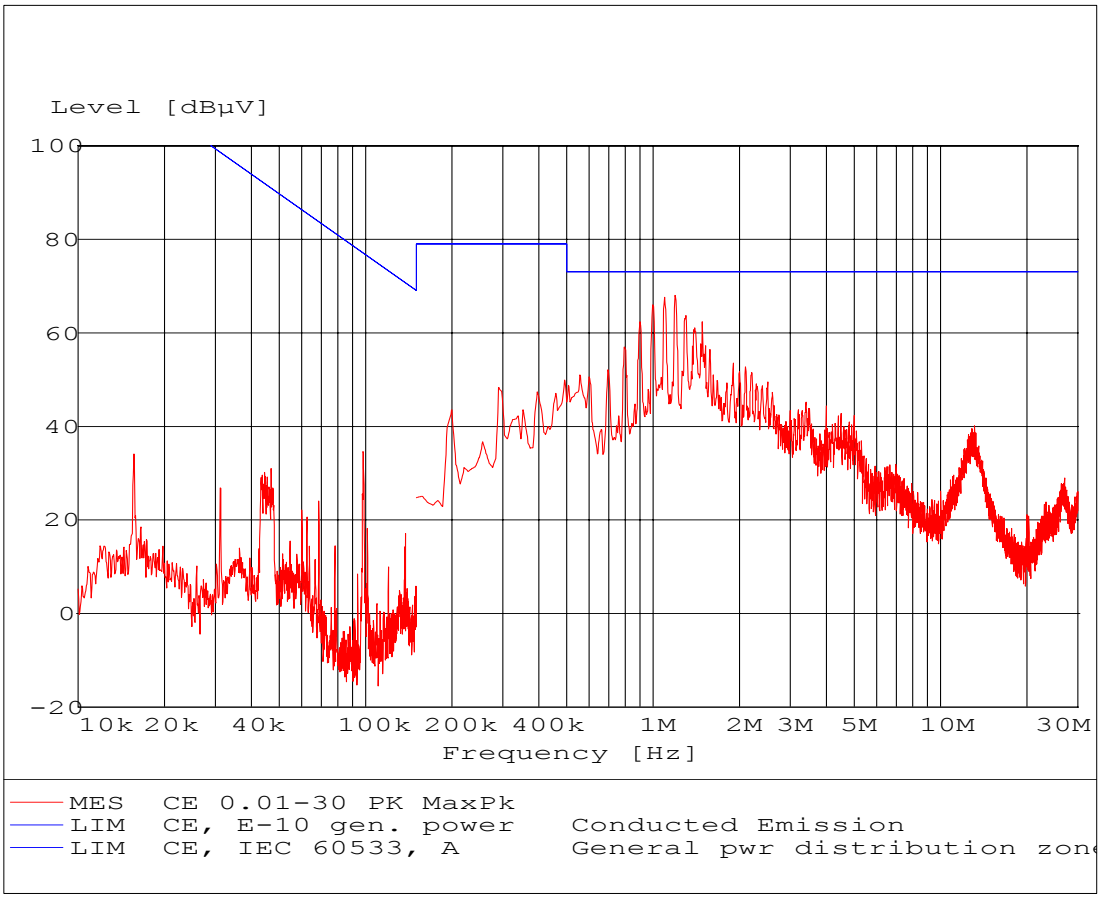
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6000, IO/P
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533. IEC 60945
Comment:	Sheet 25
Start of Test:	2003-08-20



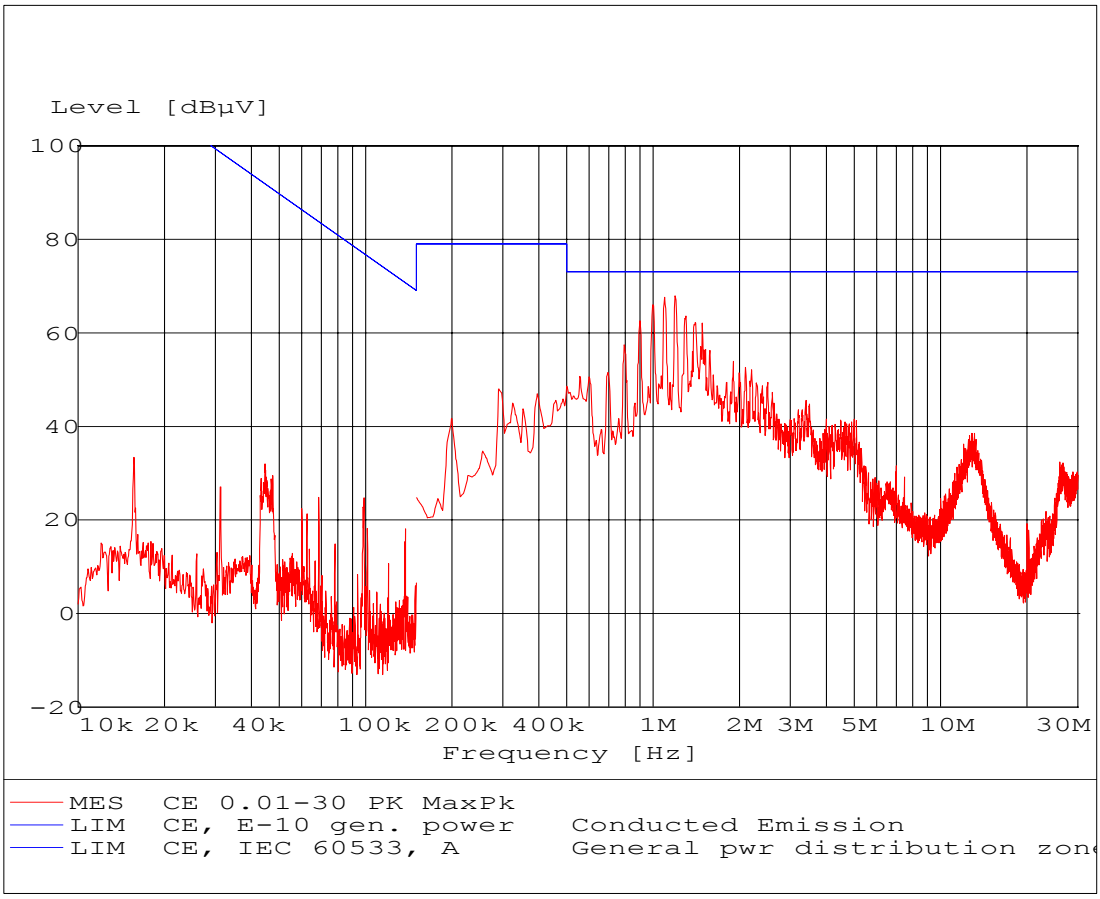
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6000, IO/P
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533.
Comment:	Sheet 26
Start of Test:	2003-08-20



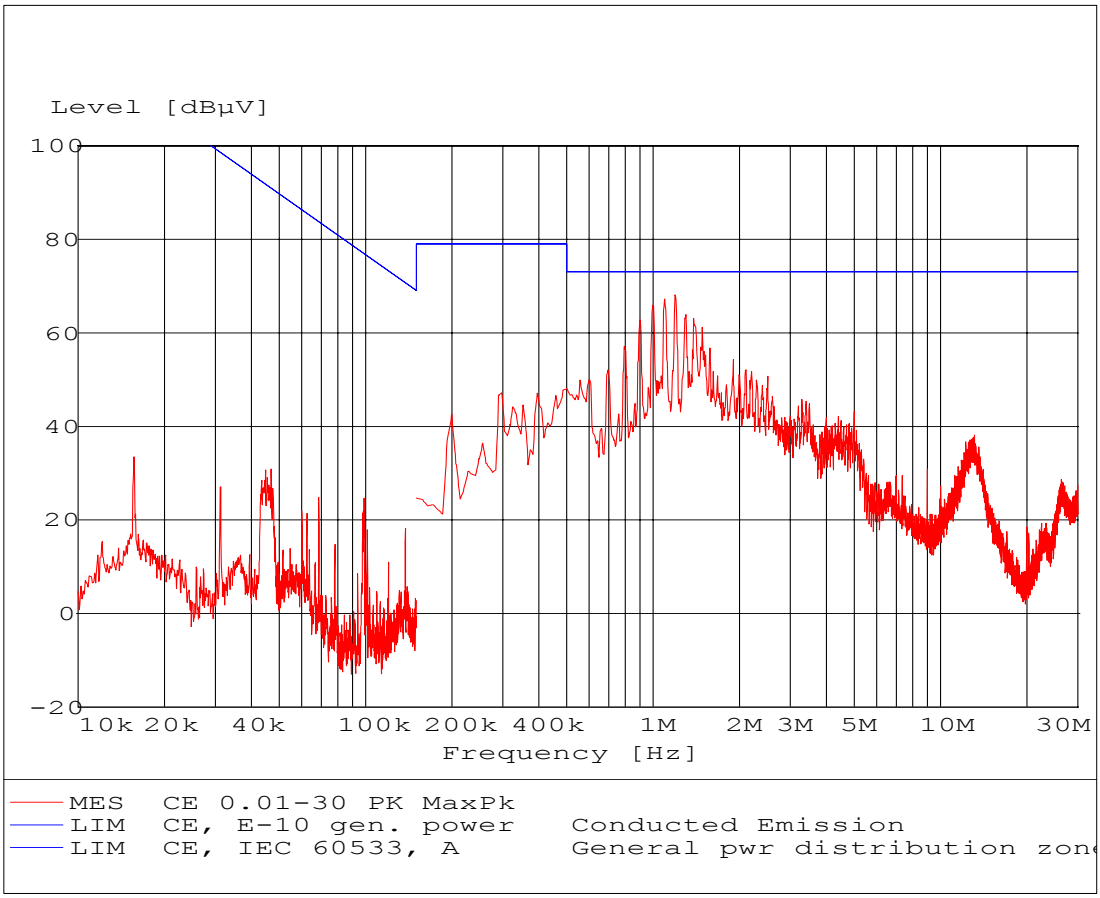
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6000, IO/P
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Backup power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533.
Comment:	Sheet 27
Start of Test:	2003-08-20



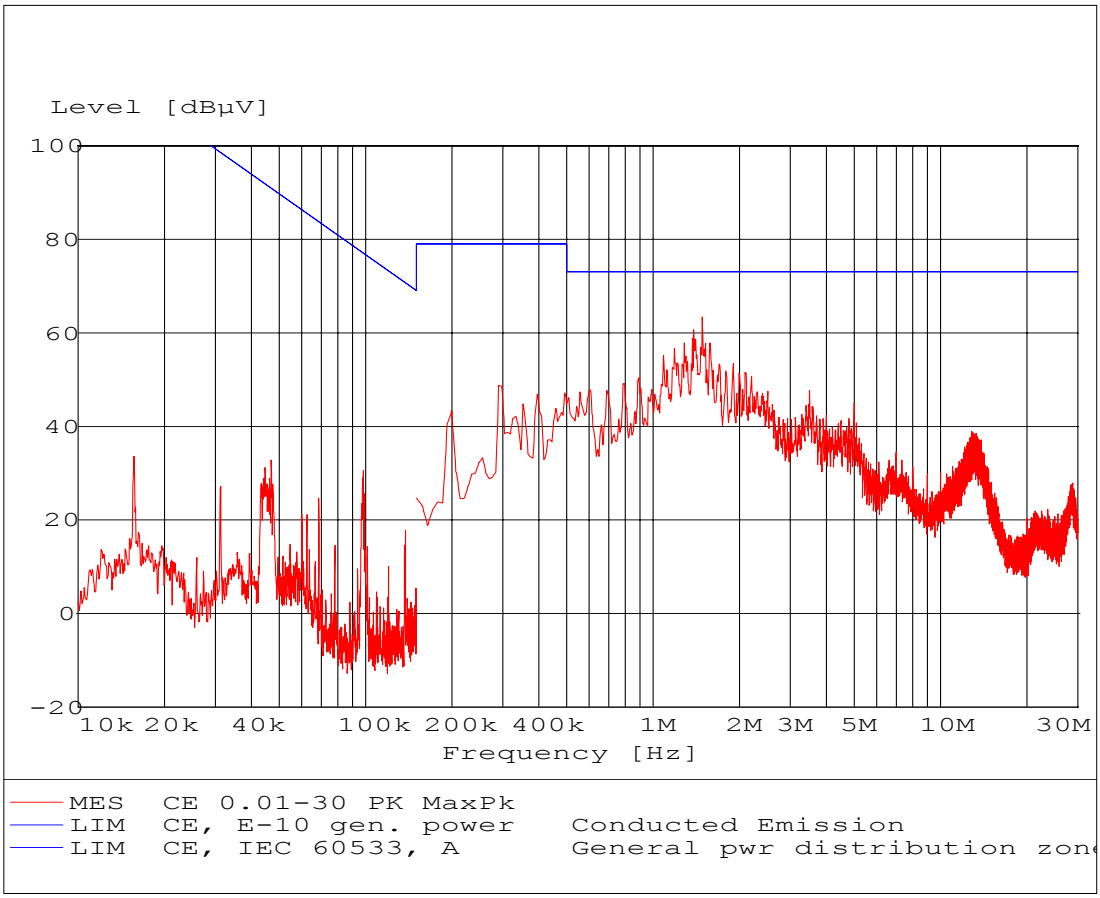
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6000, IO/P
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Backup power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533.
Comment:	Sheet 28
Start of Test:	2003-08-20



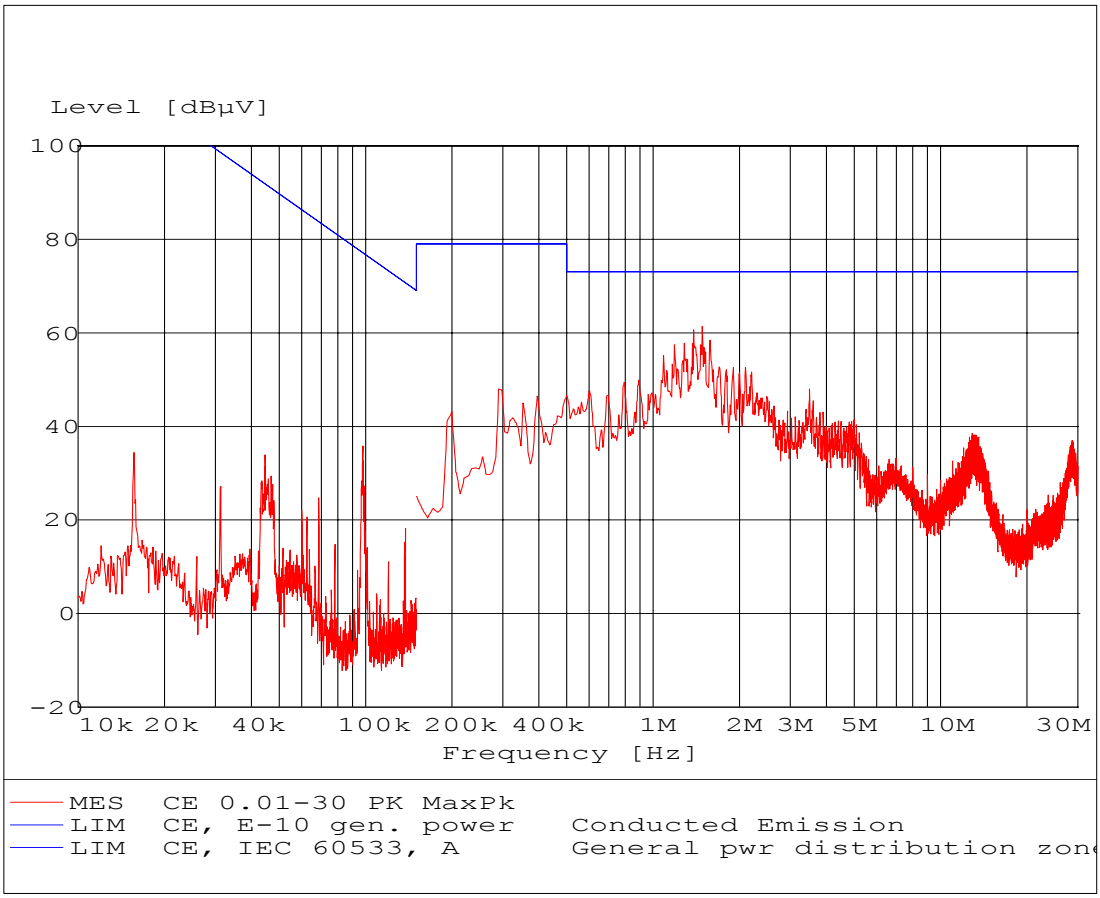
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6100, S/LS
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533.
Comment:	Sheet 29
Start of Test:	2003-08-20



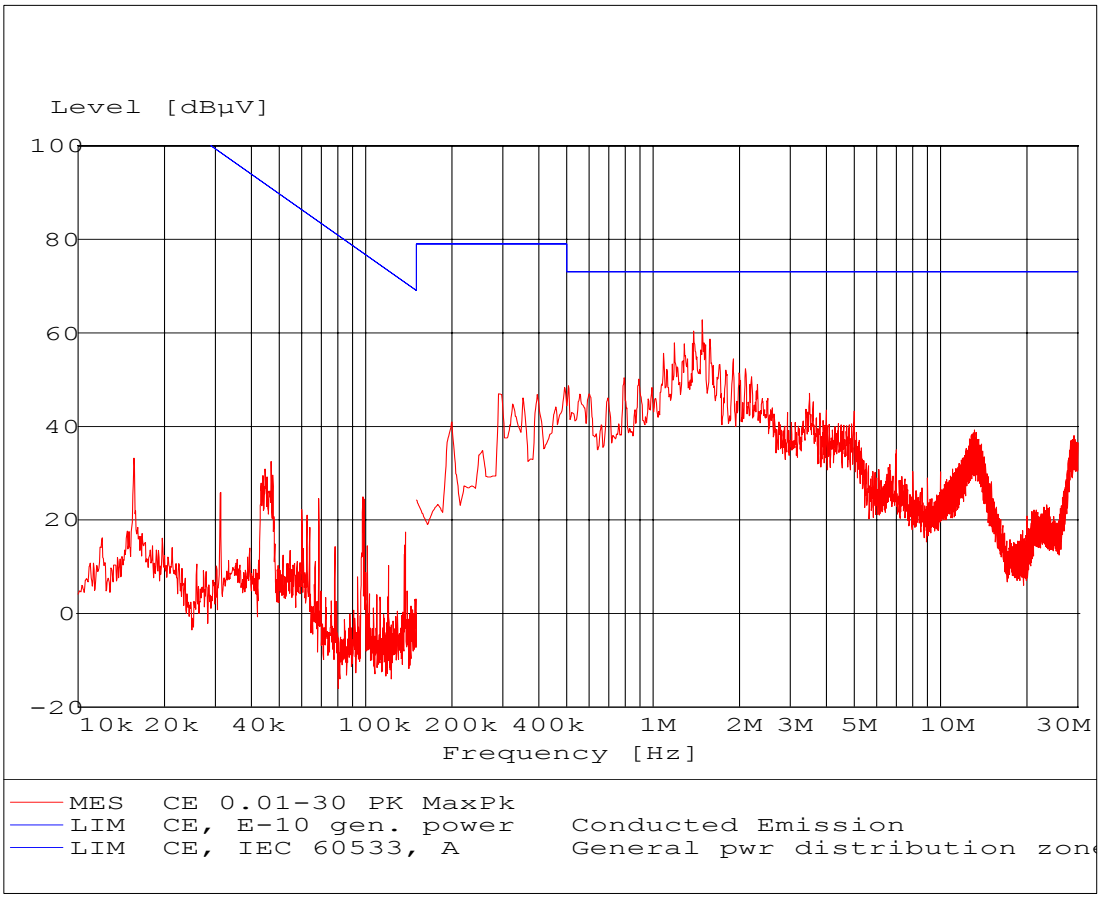
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6100, S/LS
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Mains power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533.
Comment:	Sheet 30
Start of Test:	2003-08-20



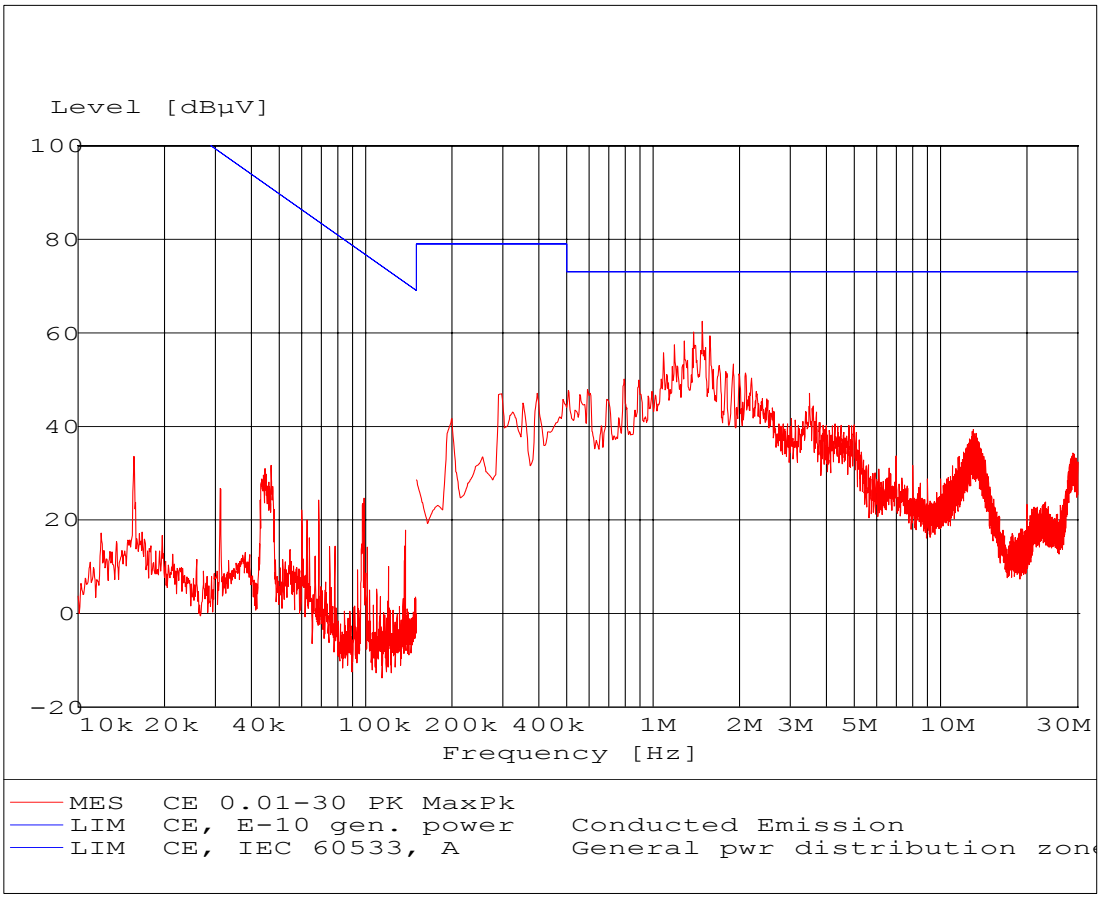
DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6100, S/LS
Manufacturer:	Selco A/S
Operating Condition:	Line no.: +24 VDC. Backup power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533.
Comment:	Sheet 31
Start of Test:	2003-08-20



DELTA Electronics Testing, EMC Section

EUT:	SIGMA S6100, S/LS
Manufacturer:	Selco A/S
Operating Condition:	Line no.: 0 VDC. Backup power
Test Site:	EMC-5
Operator:	HEN - E501273
Test Specification:	E10. IEC 60533.
Comment:	Sheet 32
Start of Test:	2003-08-20



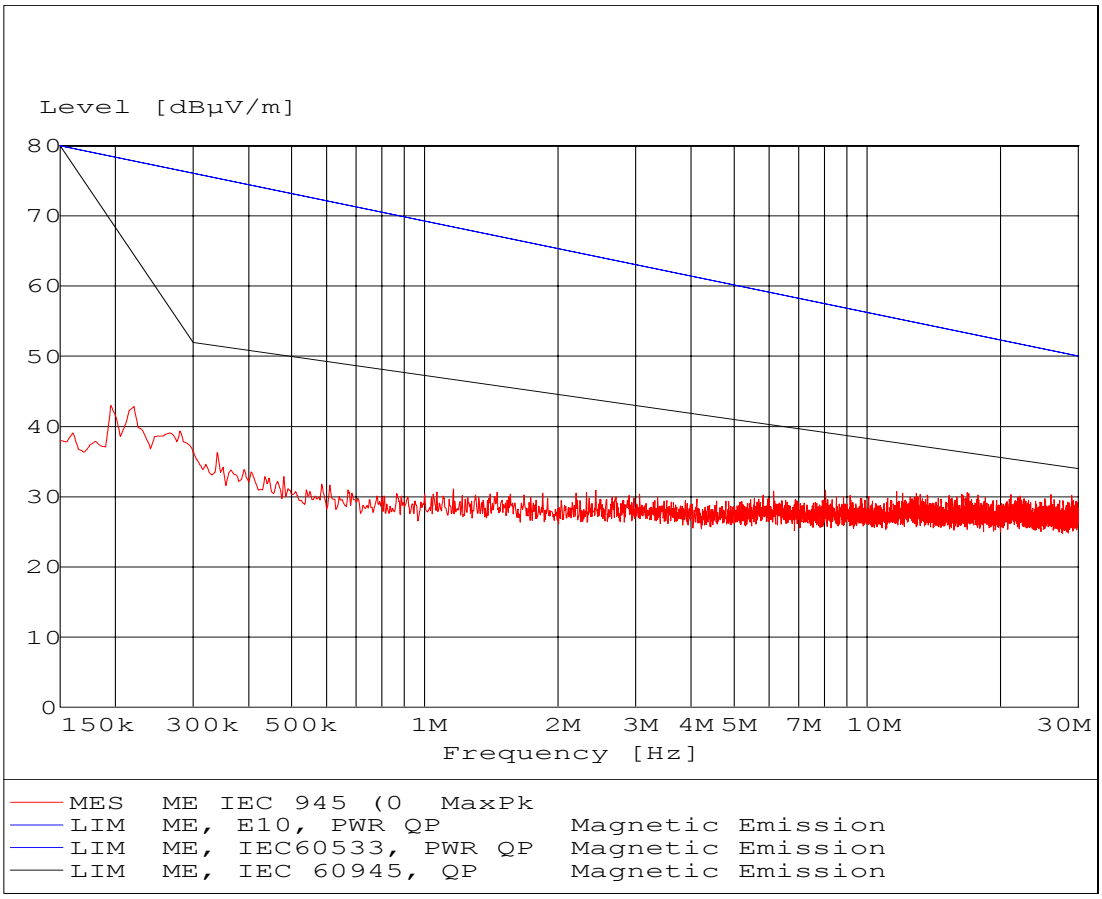
Annex 5

Test record sheets – Radiated emissions

(8 pages)

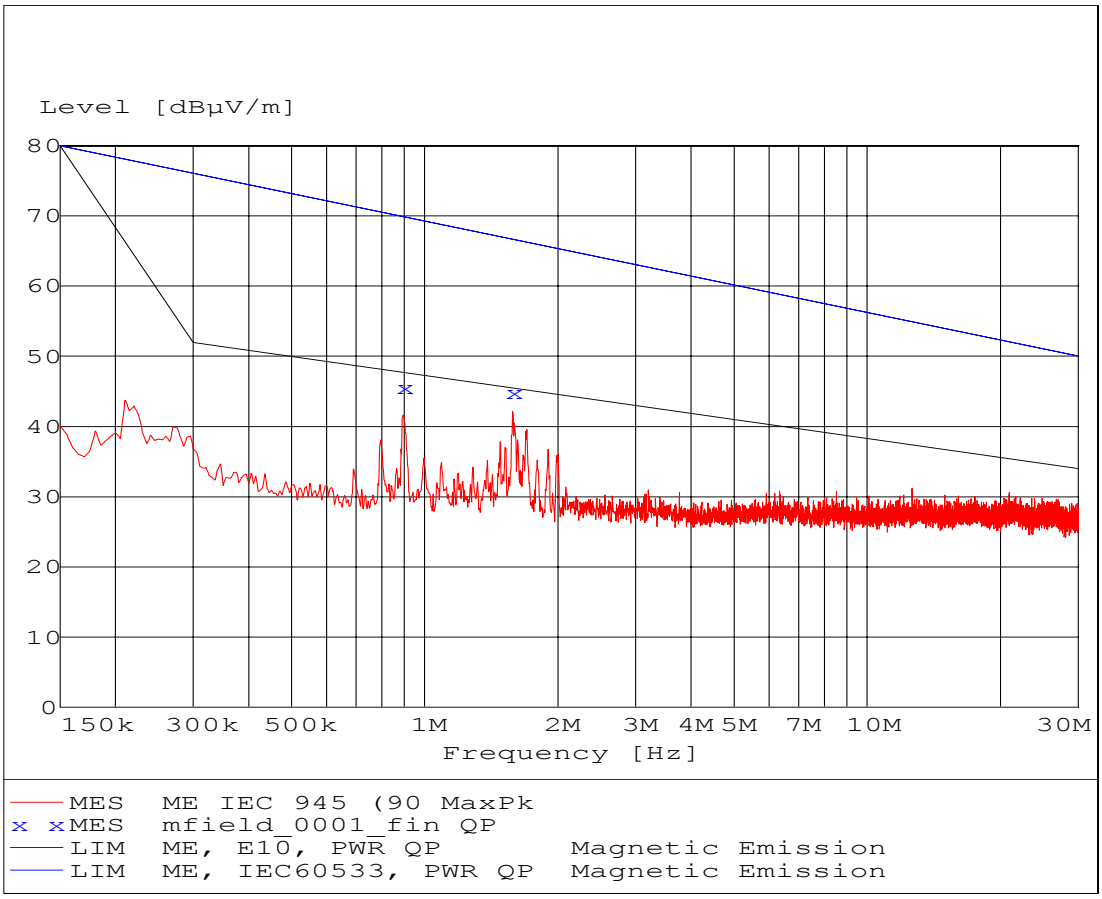
DELTA Electronics Testing, EMC Section

EUT: SIGMA S6000,IO/P. SIGMA S6100,S/LS. SIGMA S6500,UI
Manufacturer: Selco A/S
Operating Condition: Ant 0 deg
Test Site: EMC-5
Operator: HEN - E501273
Test Specification: E10. IEC 60533. IEC 60945
Comment: Sheet 7
Start of Test: 2003-08-19



DELTA Electronics Testing, EMC Section

EUT: SIGMA S6000,IO/P. SIGMA S6100,S/LS. SIGMA S6500,UI
Manufacturer: Selco A/S
Operating Condition: Ant 90 deg
Test Site: EMC-5
Operator: HEN - E501273
Test Specification: E10. IEC 60533. IEC 60945
Comment: Sheet 8
Start of Test: 2003-08-19



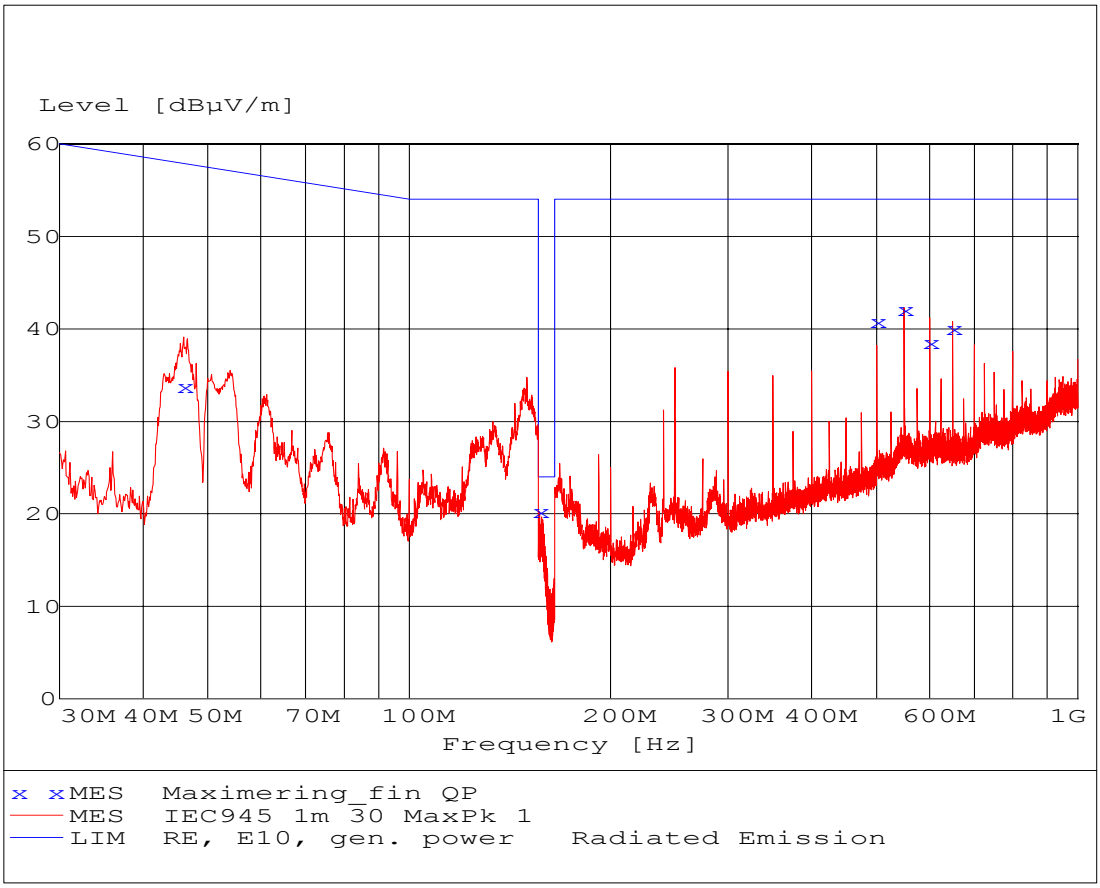
MEASUREMENT RESULT: "mfield_0001_fin QP"

2003 08 19 15:34

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Loop	Azimuth deg
0.895000	45.60	20.2	47.8	2.2	90 d	160.00
1.580000	44.80	20.2	45.5	0.7	90 d	187.00

DELTA Electronics Testing, EMC Section

EUT: SIGMA S6000,IO/P. SIGMA S6100,S/LS. SIGMA S6500,UI
Manufacturer: Selco A/S
Operating Condition: Ant. 1 m vertical. 24 VDC
Test Site: EMC-5
Operator: HEN - E501513/E501273
Test Specification: E10. IEC 60533
Comment: Sheet 1
Start of Test: 2003-09-25

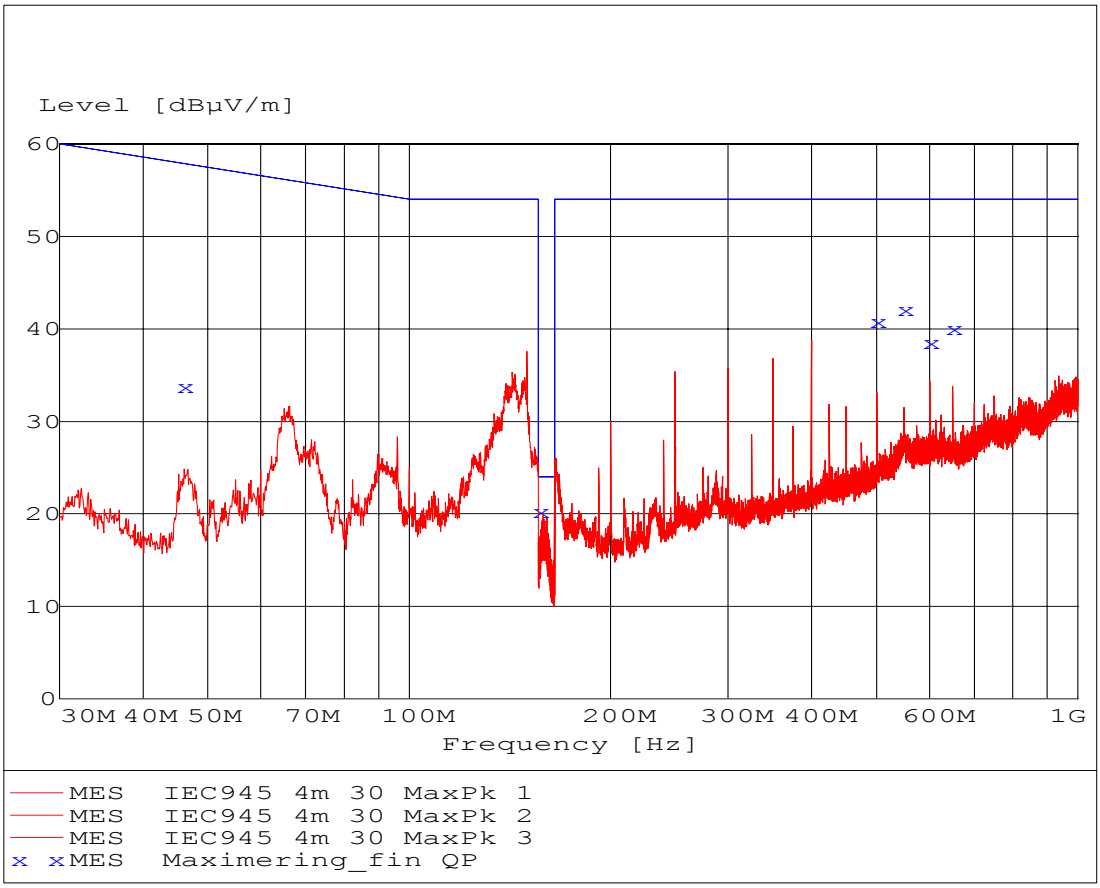


MEASUREMENT RESULT: "Maximering_fin QP"
2003 09 25 15:06

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Polarisation
46.000000	33.80	11.4	57.9	24.1	101.0	77.00	VERTICAL
156.700000	20.20	13.7	24.0	3.8	110.0	0.00	VERTICAL
499.980000	40.80	22.2	54.0	13.2	169.0	53.00	HORIZONTAL
549.980000	42.10	24.7	54.0	11.9	123.0	199.00	VERTICAL
599.980000	38.60	24.3	54.0	15.4	111.0	2.00	VERTICAL
649.980000	40.00	24.8	54.0	14.0	110.0	327.00	VERTICAL

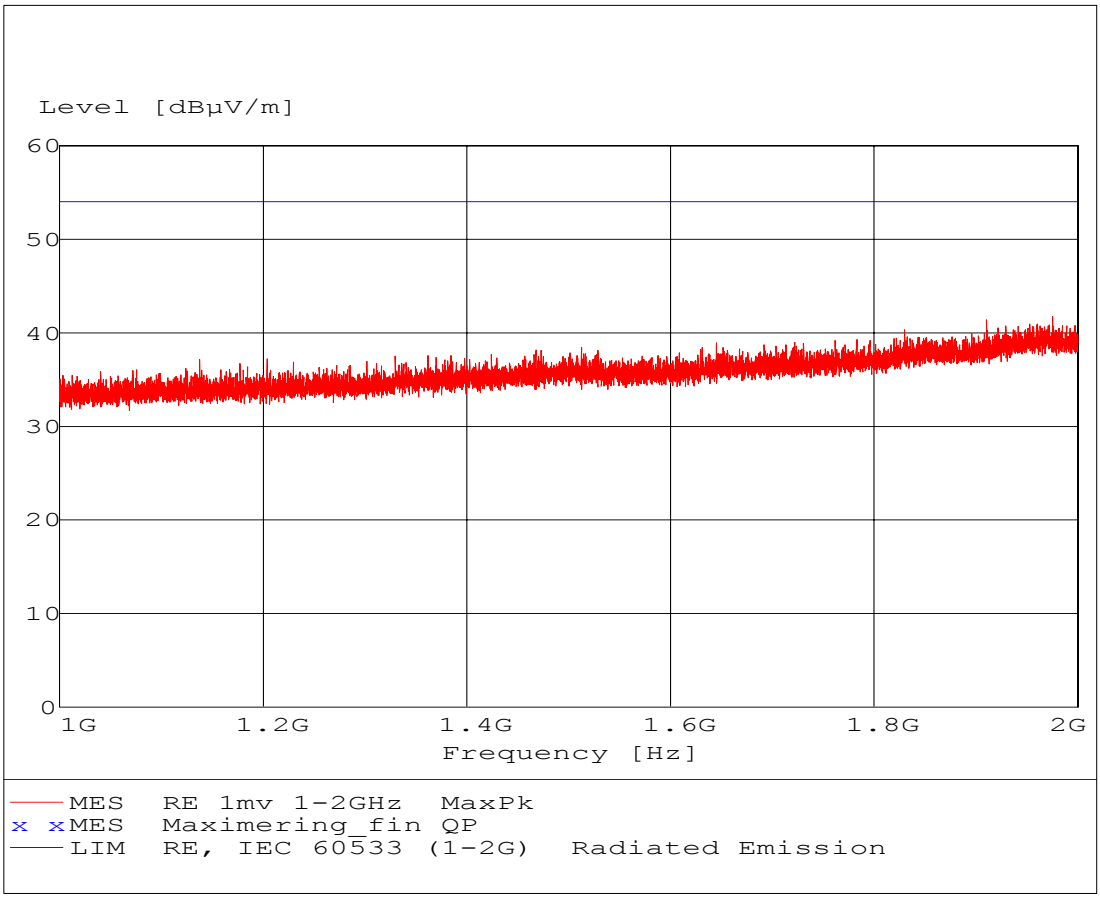
DELTA Electronics Testing, EMC Section

EUT: SIGMA S6000,IO/P. SIGMA S6100,S/LS. SIGMA S6500,UI
Manufacturer: Selco A/S
Operating Condition: Ant. 3 m horizontal. 24 VDC
Test Site: EMC-5
Operator: HEN - E501513/E501273
Test Specification: E10. IEC 60533
Comment: Sheet 2
Start of Test: 2003-09-25



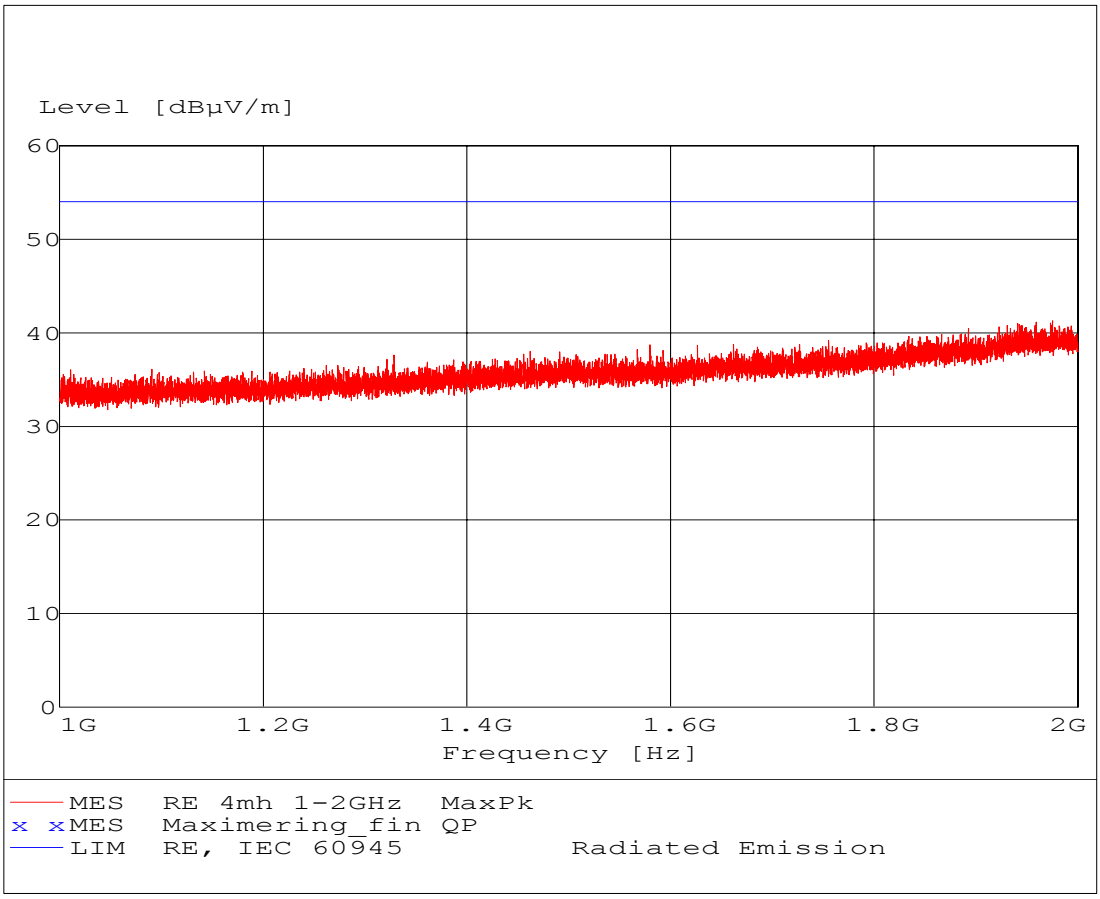
DELTA Electronics Testing, EMC Section

EUT: SIGMA S6000,IO/P. SIGMA S6100,S/LS. SIGMA S6500,UI
Manufacturer: Selco A/S
Operating Condition: Ant 1 m vertical
Test Site: EMC-5
Operator: HEN - E501273
Test Specification: E10. IEC 60533
Comment: Sheet 5
Start of Test: 2003-08-19



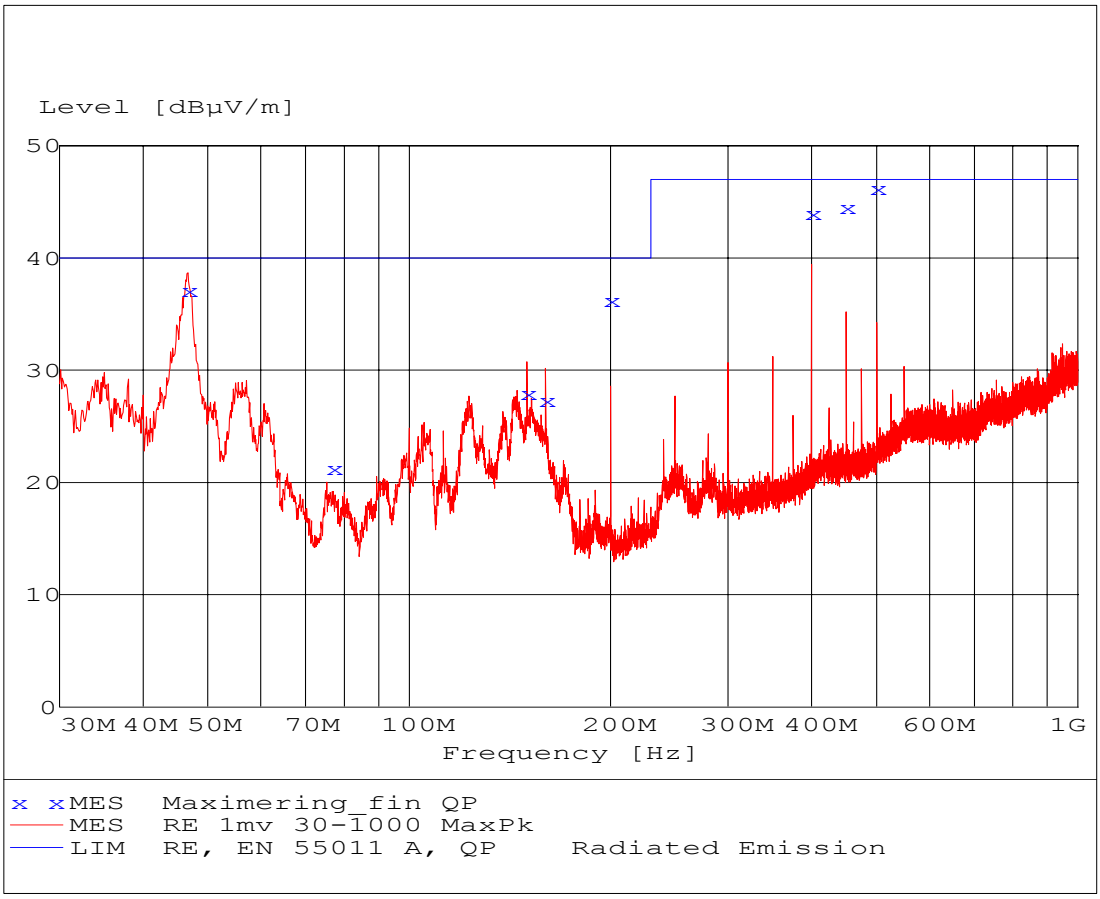
DELTA Electronics Testing, EMC Section

EUT: SIGMA S6000,IO/P. SIGMA S6100,S/LS. SIGMA S6500,UI
Manufacturer: Selco A/S
Operating Condition: Ant 3 m horizontal
Test Site: EMC-5
Operator: HEN - E501273
Test Specification: E10. IEC 60533
Comment: Sheet 6
Start of Test: 2003-08-19



DELTA Electronics Testing, EMC Section

EUT: SIGMA S6000,IO/P. SIGMA S6100,S/LS. SIGMA S6500,UI
Manufacturer: Selco A/S
Operating Condition: Ant 1 m vertical
Test Site: EMC-5
Operator: HEN - E501273
Test Specification: EN 55011 A. EN 55022 A
Comment: Sheet 1
Start of Test: 2003-08-19



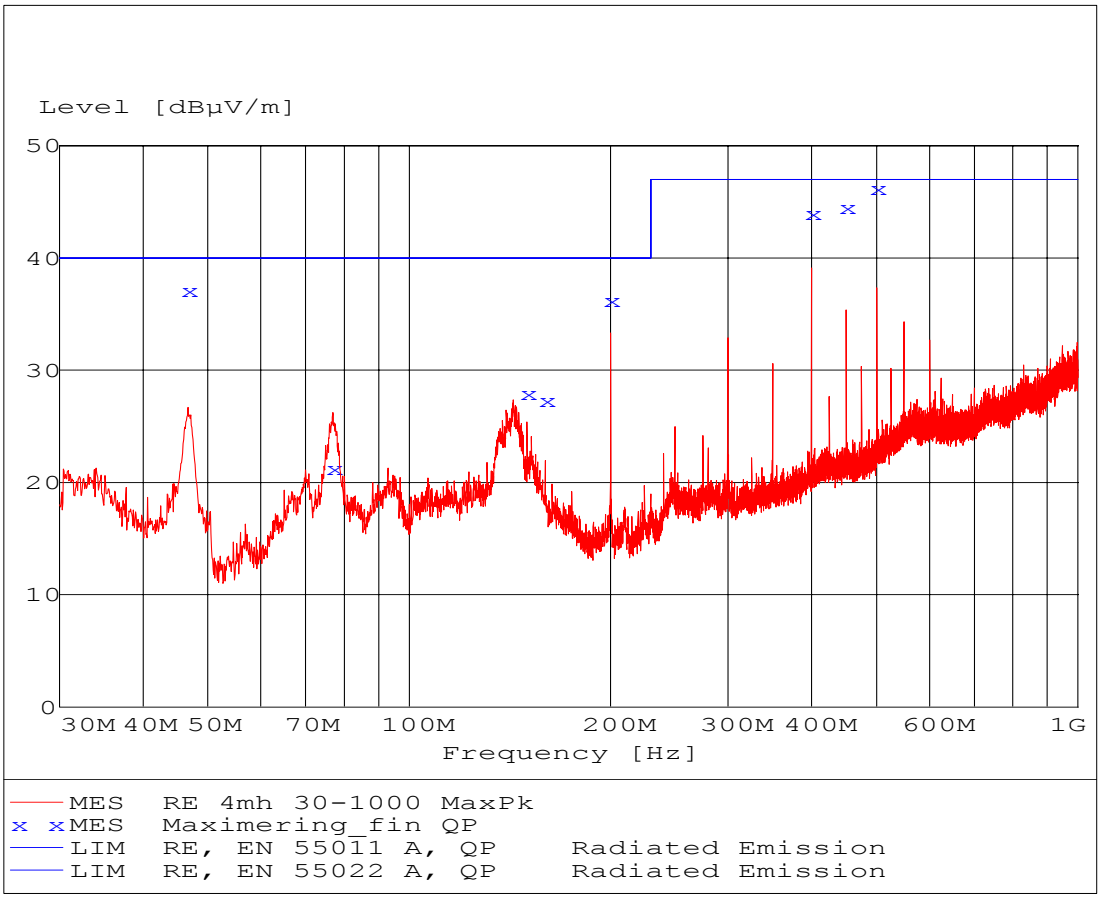
MEASUREMENT RESULT: "Maximering_fin QP"

2003 08 19 11:37

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Polarisation
46.700000	37.10	10.8	40.0	2.9	101.0	274.00	VERTICAL
76.900000	21.30	8.3	40.0	18.7	391.0	0.00	HORIZONTAL
149.990000	27.90	12.7	40.0	12.1	101.0	0.00	VERTICAL
160.000000	27.30	11.7	40.0	12.7	101.0	358.00	VERTICAL
199.990000	36.20	11.4	40.0	3.8	376.0	114.00	HORIZONTAL
399.990000	44.00	18.2	47.0	3.0	283.0	165.00	HORIZONTAL
449.980000	44.50	19.4	47.0	2.5	177.0	291.00	HORIZONTAL
499.980000	46.20	20.4	47.0	0.8	190.0	178.00	HORIZONTAL

DELTA Electronics Testing, EMC Section

EUT: SIGMA S6000,IO/P. SIGMA S6100,S/LS. SIGMA S6500,UI
Manufacturer: Selco A/S
Operating Condition: Ant 4 m horizontal
Test Site: EMC-5
Operator: HEN - E501273
Test Specification: EN 55011 A. EN 55022 A
Comment: Sheet 2
Start of Test: 2003-08-19



Annex 6

Explanatory notes regarding modifications (from Selco A/S)

(2 pages)

Modifications

The following modifications were made before the SIGMA modules passed the conducted radio frequency interference testing, the surge testing, the electrostatic discharge testing and the radiated emission measurements.

S6000:

- Varistor between Primary supply kl.1 (+24V) and earth
- Varistor between Primary supply kl.2 (GND) and earth
- Varistor between Primary supply kl.1 (+24V) and Primary supply kl.2 (GND)
- Varistor between Backup supply kl.1 (+24V) and earth
- Varistor between Backup supply kl.2 (GND) and earth
- Varistor between Backup supply kl.1 (+24V) and Backup supply kl.2 (GND)
- 1nF kapacitor placed between GND_MH and earth on MCU board
- 100nF kapacitor placed between analog outputs kl.1 and earth
- 100nF kapacitor placed between analog outputs kl.2 and earth
- 100nF kapacitor placed between analog outputs kl.4 and earth
- 100nF kapacitor placed between analog outputs kl.5 and earth
- 100nF kapacitor placed between analog outputs kl.7 and earth
- 100nF kapacitor placed between analog outputs kl.8 and earth

S6100:

- Varistor between Primary supply kl.1 (+24V) and earth
- Varistor between Primary supply kl.2 (GND) and earth
- Varistor between Primary supply kl.1 (+24V) and Primary supply kl.2 (GND)
- Varistor between Backup supply kl.1 (+24V) and earth
- Varistor between Backup supply kl.2 (GND) and earth
- Varistor between Backup supply kl.1 (+24V) and Backup supply kl.2 (GND)

- 1nF kapacitor placed between GND_MH and earth on MCU board
- 100nF kapacitor placed between analog outputs kl.1 and earth
- 100nF kapacitor placed between analog outputs kl.2 and earth
- 100nF kapacitor placed between analog outputs kl.5 and earth
- 100nF kapacitor placed between analog outputs kl.6 and earth

S6500:

- Varistor between Primary supply kl.1 (+24V) and earth
- Varistor between Primary supply kl.2 (GND) and earth
- Varistor between Primary supply kl.1 (+24V) and Primary supply kl.2 (GND)
- Varistor between Backup supply kl.1 (+24V) and earth
- Varistor between Backup supply kl.2 (GND) and earth
- Varistor between Backup supply kl.1 (+24V) and Backup supply kl.2 (GND)
- SW2 removed