Test Report

DANAK
Reg. no. 19

Type approval testing of T4800 Load Sharer

Performed for Selco A/S

DANAK-195724
Project no.: K251196-5
Page 1 of 20
6 annexes

2001-09-11

DELTA
Danish Electronics,
Light & Acoustics

Venlighedsvej 4
DK-2970 Hørsholm
Denmark

Tel. (+45) 45 86 77 22
Fax (+45) 45 86 58 98
www.delta.dk

The client has received this report in electronic form. DELTA keeps a paper copy of the report,

The general conditions are for practical reasons enclosed as the last page of the report, but are not included in the total number of pages.

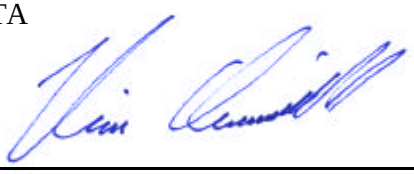
Title	Type approval testing of T4800 Load Sharer
Test object	T4800 Load Sharer
Report no.	DANAK-195724
Project no.	K251196-5
Test period	July 1999 - July 2000
Client	Selco A/S Meterbuen 6-12 DK-2740 Skovlunde Denmark
Contact person	Mr. Erik Mikkelsen
Manufacturer	Selco A/S
Specifications	IACS E10:1997 EN 60945:1997 EN 50082-2:1995 EN 50081-2:1993 EN 61000-6-2:1999
Results	No malfunctions were detected. The criteria for compliance are listed in *section 4.2*.
Test personnel	Niels Engel Henrik E. Nielsen Kennet Palm Olling Truelsen Søren Carlsen Daniela Coman
Date	2001-09-11
Project manager	 Niels Engel DELTA
Responsible	 Kim A. Schmidt, B.Sc.M.E. DELTA

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Table of contents *Page*

Annex 1 List of instruments (2 pages)

Annex 2 Photos (6 pages)

Annex 3 System briefing, Test set-up and Criteria for compliance (from Selco A/S) (3 pages)

Annex 4 Functional test procedure (from Selco A/S) (1 page)

Annex 5 Test record sheets regarding conducted emission (6 pages)

Annex 6 Test record sheets regarding radiated emission (3 pages)

1. General

1.1 Introduction

The present report concerns the type approval testing of T4800 Load Sharer manufactured by Selco A/S.

The relevant "Environmental Categories" (defined by Lloyd's Register of Shipping), "Location classes" (defined by Det Norske Veritas), " Environmental Categories" (defined by Germanischer Lloyd) and "Environmental conditions" (defined in IEC 60945) are as follows:

Lloyd's Register	:	Environmental Category	:	ENV3+ENV4
Det Norske Veritas	:	Temperature location class	:	B
		Vibration location class	:	B
		Enclosure location class	:	B
Germanischer Lloyd	:	Environmental Category	:	D
IEC 60945	:	Environmental condition	:	Protected

1.2 System briefing

A system briefing, provided by the client is enclosed in *annex 3*.

2. Summary of test

2.1 Test requirements

Test	Test method
Voltage dips and interruptions	EN 61000-4-11:1994
Power supply short term variation	IEC 60945:1996 / IACS E10:1997
Power supply variations	IEC 60945:1996 / IACS E10:1997
Power supply failure	IEC 60945:1996 / IACS E10:1997
Insulation resistance	IACS E10:1997
High voltage	IACS E10:1997
Conducted low frequency interference	IEC 60945:1996
Conducted radio frequency interference	EN 61000-4-6:1995
Electrical fast transients (burst)	EN 61000-4-4:1995
Electrostatic Discharges	EN 61000-4-2:1995
Radiated radio frequency interference	EN 61000-4-3:1995
Surge transients	EN 61000-4-5:1995
Conducted emission	CISPR 16-1:1993 / IEC 60945:1996
Radiated emission	CISPR 16-1:1993
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 + Amendment
Vibration (resonance search)	IEC 60068-2-6:1985
Vibration (random)	IEC 60068-2-64:1993

2.2 Conclusion

The test specimen mentioned in this report meets the relevant requirements of the standards stated below.

- IEC 60945:1996
- IACS E10:1997
- EN 50082-2:1995
- EN 50081-2:1993
- EN 61000-6-2:1999

The relevant requirements are mentioned in *section 2.1*.

The test results relate only to the specimen tested.

3. Test specimen(s)

3.1 Test object — T4800 Load Sharer

Manufacturer	Selco A/S
Model / type	T4800
Part no./Serial no.	T4800-33 / 343800
Supply voltage	230 VAC
Operational mode	Confer with system briefing *annex 3.*

3.2 AUX equipment — E7800 Motorized Potentiometer

Manufacturer	Selco A/S
Model / type	E7800
Part no.	-
Serial no.	-

3.3 AUX equipment — B9300 Power Ref. Unit

Manufacturer	Selco A/S
Model / type	B9300
Part no.	-
Serial no.	-

3.4 AUX equipment — Load Indicator

Manufacturer	Danotherm
Model / type	PQ 56 / -0,2-0-1mA, scale -20 – 100%
Part no.	-
Serial no.	-

4. General test conditions

4.1 Test set-up

A description and drawings of the test set-ups are enclosed in *annex 3.*

4.2 Criteria for compliance

The criteria for compliance are given in *annex 3.*

4.3 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 4*.

4.4 Standard environment definition

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)

Normal power supply voltage: U_{nom}. ±3%

5. Test and results

5.1 Voltage dips and interruptions

Procedure

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

(Voltage dips)

• Reduction	=	$U_{nom.}$ - 30%		Duration	=	0.5 periods
• Reduction	=	$U_{nom.}$ - 60%		Duration	=	5 periods
• Reduction	=	$U_{nom.}$ - 60%		Duration	=	50 periods

(Interruptions)

• Reduction	=	$U_{nom.}$ - 100%		Duration	=	250 periods

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

Results

No malfunction was observed during the exposures, and the function of the test specimens was OK at the end of each exposure.

5.2 Power supply short term variation

Procedure

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 specimens were observed during the exposures, and a functional test was performed at the end of each exposure.

Results

No malfunction was observed during the exposures, and the function of the test specimens was OK at the end of each exposure.

5.3 Power supply variations

Procedure

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

(230 VAC supplied)

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

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

Results

No malfunction was observed during the exposures, and the function of the test specimen was OK at the end of each exposure.

5.4 Power supply failure

Procedure

The power supply was 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

Normal power-up procedure was obtained after each power break.

5.5 Insulation resistance

Procedure

The insulation resistance was measured between shorted supply terminals and earth with 500 VDC. The insulation resistance is to be above 10 MΩ initially, and above 1 MΩ after the low temperature and the damp heat exposure described in *sections 5.16 and 5.17.*

Results

Insulation resistance [MΩ]	T4800
Initially	>1000 MΩ
After damp heat, cyclic test	>1000 MΩ
After Low temperature test (cold)	>1000 MΩ

5.6 High voltage

A test voltage of 1500 VAC, 50 Hz was applied between shorted supply terminals and earth for 1 minute.

No flashover, breakdown, etc. are acceptable.

This test may be omitted if the presence of transorbers, varistors etc. in the test specimens makes it impossible to apply the high voltage to the test specimens.

Results

No flashovers or breakdowns were observed during the exposures. The function of the test specimens was OK after end of exposures.

5.7 Conducted low frequency interference

Severity and procedure

IEC 60945, Third edition, 1996-11, Immunity to conducted low-frequency interference, clause 10.2.

Frequency range	:	50 Hz - 10 kHz
Amplitude (AC-supplied)	:	10% of $U_{nom.}$ 50 Hz-900 Hz
		10%-1% of $U_{nom.}$ 900 Hz-6 kHz
		1% of $U_{nom.}$ 6 kHz-10 kHz
Maximum applied power	:	2.0 W

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

The test signal was superimposed on the power supply lines via a coupling transformer. The test specimens were energised and in normal operational mode during the exposure. The test specimens were observed during the exposure, and a functional test was performed after the exposure.

Results

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

5.8 Conducted radio frequency interference

Severity and procedure

IEC 61000-4-6, First edition, 1996-03, Immunity to conducted disturbances induced by radio frequency fields.

Frequency range	:	10 kHz - 80 MHz		
Amplitude	:	0.01 - 0.15 MHz	:	3 Vrms
		0.15 - 80 MHz	:	10 Vrms
Modulation	:	80% AM, 400 Hz sine wave		

The test specimens are 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.

Exposure in the frequency range 0.01-0.15 MHz is carried out using an injection clamp, successively clamped on to each of the exposed cables.

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

Results

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

5.9 Electrical fast transients (burst)

Severity and procedure

IEC 61000-4-4, First edition, 1995-01, Electrical fast transient/burst immunity test.

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

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

The test signal was successively coupled to each power line and protective earth with reference to the ground plane.

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

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

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

Results

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

5.10 Electrostatic discharge

Severity and procedure

IEC 61000-4-2, First edition, 1995-01, Electrostatic discharge immunity test.

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, each test point

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

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

The test specimens were energised and in normal operational mode during the exposure.

Results

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

5.11 Radiated radio frequency interference

Severity and procedure

IEC 61000-4-3, First edition, 1995-02, radiated, radio frequency, electromagnetic field immunity test.

Frequency range	:	80-1000 MHz
Field strength	:	10 V/m
Modulation	:	80% AM, 400 Hz sine wave
Frequency range	:	895-905 MHz
Field strength	:	10 V/m
Modulation	:	PM 50%, 200Hz.

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

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

Results

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

5.12 Surge transients

Severity and procedure

IEC 61000-4-5, First edition, 1995-02, Surge Immunity test.

Amplitude power lines	:	2 kV line-to-earth, 1 kV line-to-line
Voltage rise time	:	1.2 µs (open circuit)
Voltage decay time	:	50 µs (open circuit)

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

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

Five transients were injected to the power lines using each polarity and coupling mode. The transient repetition rate was minimum 1 per minute.

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

Results

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

5.13 Conducted emission

Specifications

CISPR 16-1:1993, Specification for radio disturbance and immunity measuring apparatus and methods, and IEC 60945:1996, Conducted emissions, clause 9.2.

IEC 60945:1996

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 at the power supply terminals of the test specimen was measured by a receiver through an artificial mains network.

Measurements were made with the test specimen mounted on, and bonded to, an earth plane.

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

IACS E10:1997 (Bridge and deck zone)

Frequency range	:	0.01-30 MHz		
Limits (quasi-peak)	:	0.01-0.15 MHz	:	96-52 dBµV
		0.15-0.35 MHz	:	60-52 dBµV
		0.35-30 MHz	:	52 dBµV

EN 50081-2:1993

Frequency range	:	0.15-30 MHz		
Limits (quasi-peak)	:	0.15-0.5 MHz	:	79 dBµV
		0.5-5.0 MHz	:	73 dBµV
		5.0-30 MHz	:	73 dBµV
Limits (average)	:	0.15-0.5 MHz	:	66 dBµV
		0.5-5.0 MHz	:	60 dBµV
		5.0-30 MHz	:	60 dBµV

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

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

Results

The conducted emissions were within the specified limits.

The detailed test record sheets are enclosed in *annex 5.*

5.14 Radiated emission

Severity and procedure

CISPR 16-1: 1993, Specification for radio disturbance and immunity measuring apparatus and methods.

IACS E10:1997 (Bridge and deck zone)

Frequency range	:	0.15-1000 MHz		
Limits (quasi-peak)	:	0.15-0.30 MHz	:	80-50 dBµV/m
		0.30-30 MHz	:	50-34 dBµV/m
		30-1000 MHz	:	54 dBµV/m, except for
		156-165 MHz	:	24 dBµV/m.

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

EN 50081-2:1993

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

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

The test specimens were energised and in normal operational mode during the measurements.

Results

The radiated emissions were within the specified limits.

The detailed test record sheets are enclosed in *annex 6.*

5.15 Dry heat

Severity and procedure

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

The following two exposures are performed:

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

Followed by

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

The test specimen was energised and in normal operational mode during the exposure. A performance check, i.e. a functional test as described in *section 4.3*, was performed at extreme power supply conditions, as stated in *section 5.3*, during the last hour of each exposure.
After recovery the functional test was repeated in standard environment.

Results

No malfunction was observed during the exposures, and the function of the test specimens was OK during the last hour of each exposure and after recovery.

No malfunction was observed during the performance check at extreme power supply conditions.

5.16 Low temperature (cold)

Severity and procedure

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

Temperature	:	-20°C
Duration	:	16 hours

The test specimens were de-energised during the exposure. However, during the last hour of the exposure the test specimens were energised and a functional test was performed.

An additional performance check i.e. a functional test as described in *section 4.3* was performed at extreme power supply conditions (refer to *section 5.3)* during the last hour of the exposure.

After recovery a functional test was performed in standard environment.

Results

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

No malfunction was observed during the performance check at extreme power supply conditions.

5.17 Damp heat (cyclic)

Severity and procedure

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

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 were energised and in normal operational mode. A functional test was performed during the first 2 hours of the 55°C phase.

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

After recovery the test specimens were energised and a functional test and an insulation resistance test according to *section 5.5* were 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 of the exposure at 55°C and 93% RH and after recovery.

5.18 Vibration (resonance search)

Severity and procedure

IEC 60068-2-6 (1985), Test Fc: Vibration (sinusoidal).

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 were de-energised during the exposure.

During the resonance search, the resonance frequencies were 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 were recorded.

Results

No amplification factors above 2 were measured.

5.19 Vibration (endurance)

Specification

The sinusoidal vibration according to IACS E10:1997 and EN 60945:1997 was replaced by random vibration according to Certification Notes No. 2.4, issued May 1995 by DNV (increased from 1 grms to 4 grms).

Severity and procedure

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

Frequency range	:	10-100 Hz		
Acceleration spectral	:	10-25 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 were energised and in normal operational mode during the exposures. A functional test was performed after the exposure in each axis.

Results

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

Neither wear nor damage of the test specimen was observed at the visual inspection performed after the exposures.

Annex 1

List of instruments

(2 pages)

List of instruments

NO.	DESCRIPTION	MANUFACTURER	TYPE NO.
29245	OSCILLOSCOPE	TEKTRONIX	465B
29300	MEASURING RECEIVER	ROHDE & SCHWARZ	ESH3, 335.8017.52
29301	ARTIFICIAL MAINS NETWORK	ROHDE & SCHWARZ	ESH2/Z5
29410	CURRENT PROBE AMPLIFIER FOR 29411, 29707 AND 29907	TEKTRONIX	TM501 & AM503T
29411	ACTIVE CURRENT PROBE HEAD FOR 29410 AND 29880	TEKTRONIX	A6302
29461	ARTIFICIAL MAINS NETWORK	ROHDE & SCHWARZ	ESH2/Z5
29615	LOG. PERIODIC ANTENNA, 200-1000 MHz	EMCO	3146
29697	FERRITE TUBE CLAMP	LUTHI	FTC 101
29700	DC POWER SUPPLY	HEWLETT-PACKARD	6274B
29703	LF POWER AMPLIFIER	BRUEL & KJÆR	2708
29704	HIGH FREQ. GEN 10 kHz – 1 GHz.	MARCONI	2022
29715	3 CHANNEL SIGNAL INJECTION BOX	EC	DS 5103
29751	ELECTRICAL FAST TRANSIENT (BURST) GENERATOR	EM TEST	EFT 500
29753	BICONICAL ANTENNA, 20-300 MHz	EMCO	3109
29754	RF POWER ATTENUATOR, 50 OHM, 6 dB, 150 W	NARDA	769-6
29785	HIGH POWER RF AMPLIFIER, 10 kHz-220 MHz	AMPLIFIER RESEARCH	1000L
29786	HIGH POWER RF AMPLIFIER, 80-1000 MHz	AMPLIFIER RESEARCH	500W1000M5
29797	BILOG ANTENNA, 30-1000 MHz	CHASE ELECTRICS LTD	CBL 6111A
29798	RF ATTENUATOR, 50 OHM, 10 dB, DC-12.4 GHz	SUHNER	6810.17.A
29806	BROADBAND POWER AMPLIFIER, 10 kHz-220 MHz, 75 W	AMPLIFIER RESEARCH	75A220
29812	2-LINE CDN NETWORK, IEC 801-6	MEB	M2
29813	2-LINE CDN NETWORK, IEC 801-6	MEB	M2
29815	3-LINE CDN NETWORK, IEC 801-6	MEB	M3
29816	3-LINE CDN NETWORK, IEC 801-6	MEB	M3
29832	DIFF. HIGH VOLT. PROBE DC-25 MHz	TEKTRONIX	P5200
29838	ESD GENERATOR, AIR AND CONT. DISCH.	KEYTEK	MZ-15EC
29842	-40 dBc VOLTAGE SAMPLER, DC-100 MHz	DELTA EMC DEPT.	SAMPLER_VER_2
29846	RF GENERATOR, 9 kHz-2.4 GHz	MARCONI	2024
29856	DIGITAL MULTIMETER w. HPIB	HEWLETT-PACKARD	34401A
29859	AC/DC SOURCE W. HARMONIC/FLICKER TEST OPTION	HEWLETT-PACKARD	6842A
29861	EMI-SOFTWARE Ver. 1.50c	ROHDE & SCHWARZ	ES-K1, PART: 1026.6790.02
29864	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
29884	PULSE/FUNCTION GENERATOR, 50 MHz	WAVETEK	81
29895	COAX RF DIODE DETECTOR, NEG. OUT-PUT	HEWLETT-PACKARD	8471D
29899	2-LINE CDN NETWORK, IEC 801-6	MEB	M2
29906	15 MHz FUNCTION / ARBITRARY WAVE GENERATOR	HEWLETT-PACKARD	33120A
29908	INSTRUMENTATION PC WITH GPIB	BANZHAF	BOSTON
29911	DIGITAL MULTIMETER w. HPIB	HEWLETT-PACKARD	34401A
29916	AUTOMATIC TEST RECEIVER, 9 kHz-2.75 GHz	ROHDE & SCHWARZ	ESCS 30 1102.4500.30
29967	COAX RF DIODE DETECTOR, NEG. OUT-PUT	HEWLETT-PACKARD	8471D
29977	RF PWR. ATT., 50 OHM, 6 dB, 150 W	NARDA	769-6
22597	VIBRATION CONTROLLER	GENRAD	2514
Acc. 94	ACCELEROMETER	BRUEL & KJÆR	4371
Acc. 72	ACCELEROMETER	BRUEL & KJÆR	4393
Acc. 75	ACCELEROMETER	BRUEL & KJÆR	4393
Acc. 76	ACCELEROMETER	BRUEL & KJÆR	4393
22573	ACCELEROMETER PREAMPLIFIER	BRUEL & KJÆR	2635
22575	ACCELEROMETER PREAMPLIFIER	BRUEL & KJÆR	2626
22585	ACCELEROMETER PREAMPLIFIER	BRUEL & KJÆR	2626
22613	ACCELEROMETER PREAMPLIFIER	BRUEL & KJÆR	2692
22610	SCOPEMETER	TEKTRONIX	123
22616	OSCILLOSCOPE	ISOTECH	ISR620
Y220	ELECTRODYNAMIC SHAKER	MB	EL250
U2503	SWITCHING POWER AMPLIFIER	LING DYNAMIC SYS.	DPA 16
U2421	CLIMATIC TEST CHAMBER	EC/DELTA	VKF 50
43028	MEGGER	AVO INTERNATIONAL	BM 80
23982	HIGH VOLTAGE APPARATUS	WILLY NIELSEN	W5

Annex 2

Photos

(6 pages)

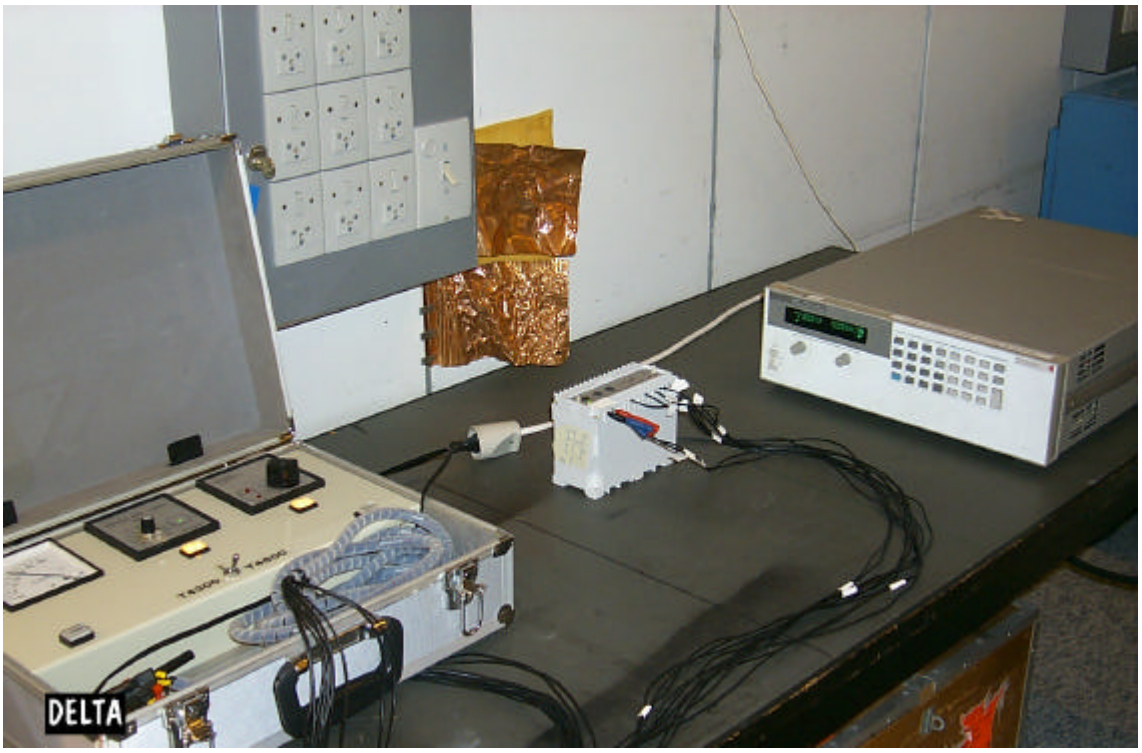


PHOTO 1. Power supply variations

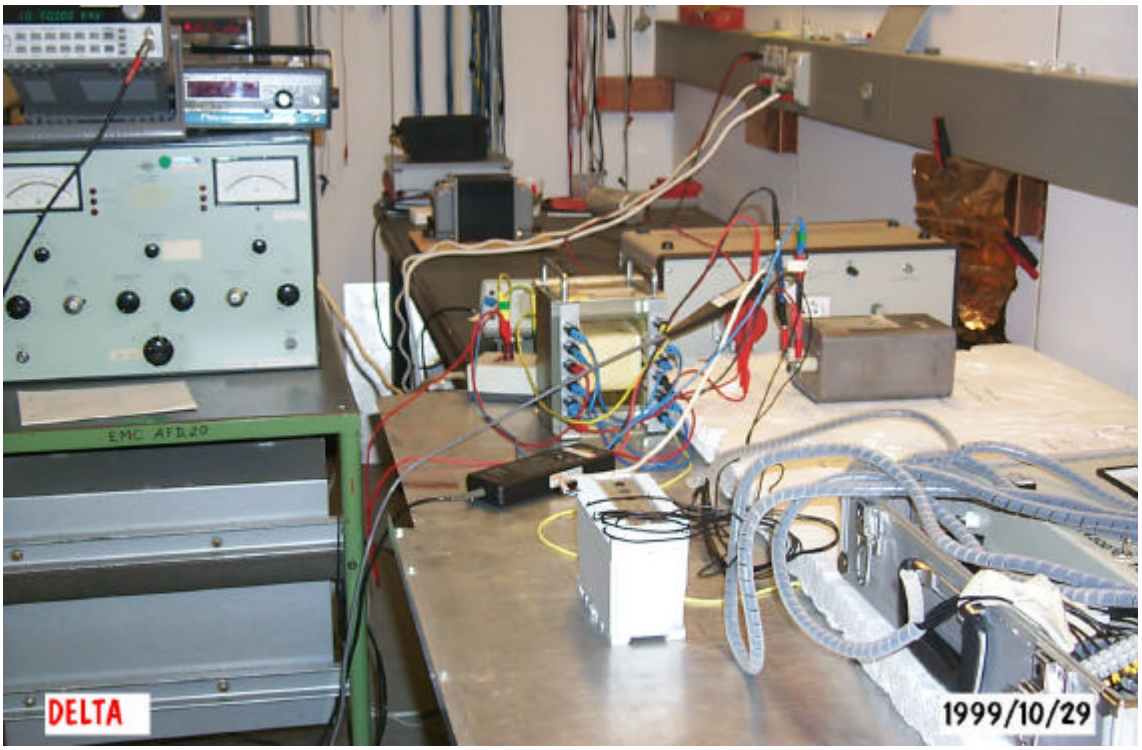


PHOTO 2. Conducted low frequency interference

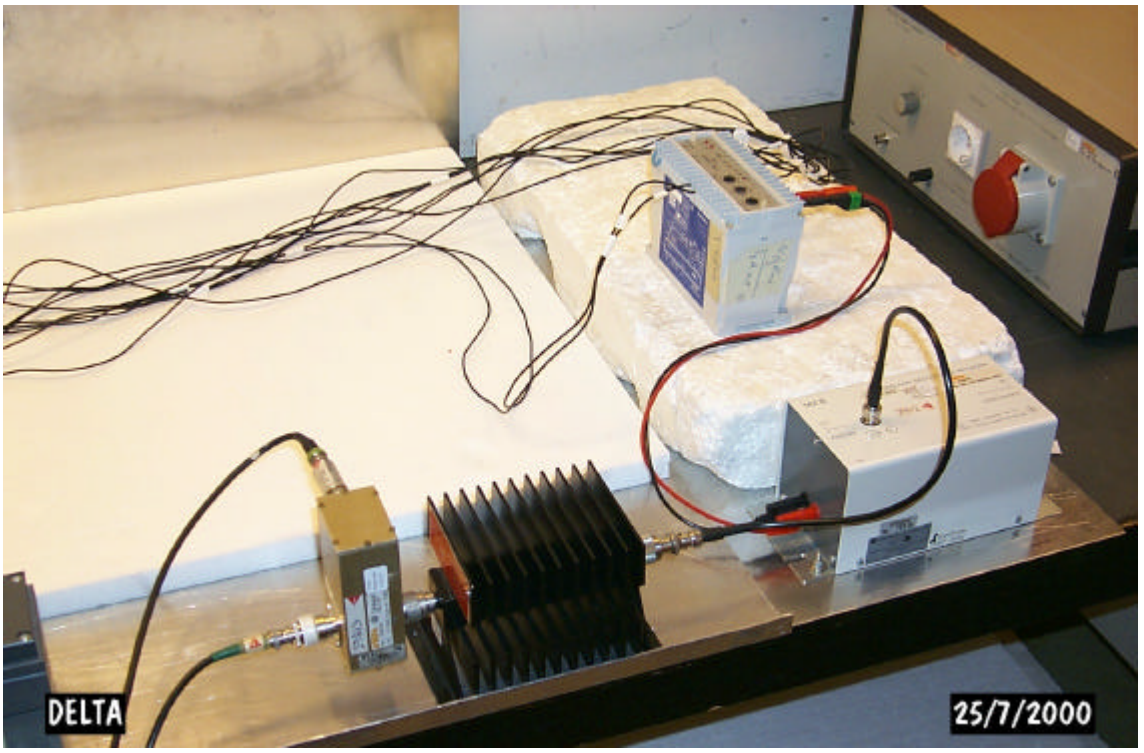


PHOTO 3. Conducted radio frequency interference

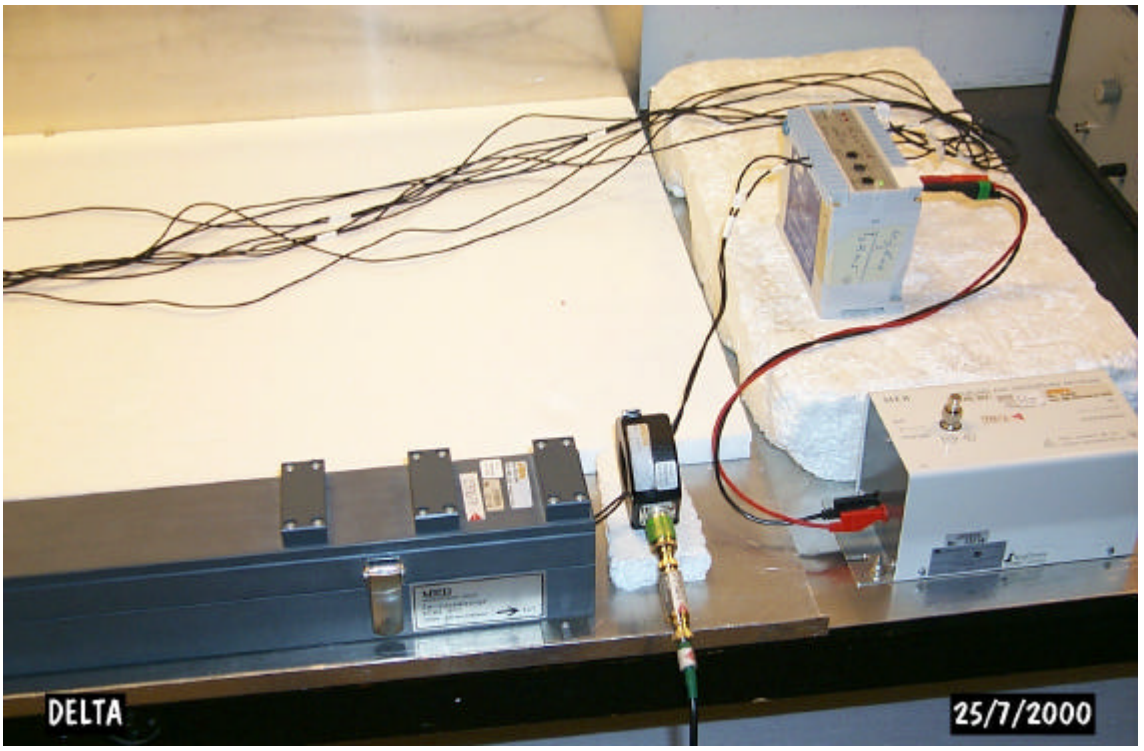


PHOTO 4. Conducted radio frequency interference

PHOTO 5. Electrostatic discharge

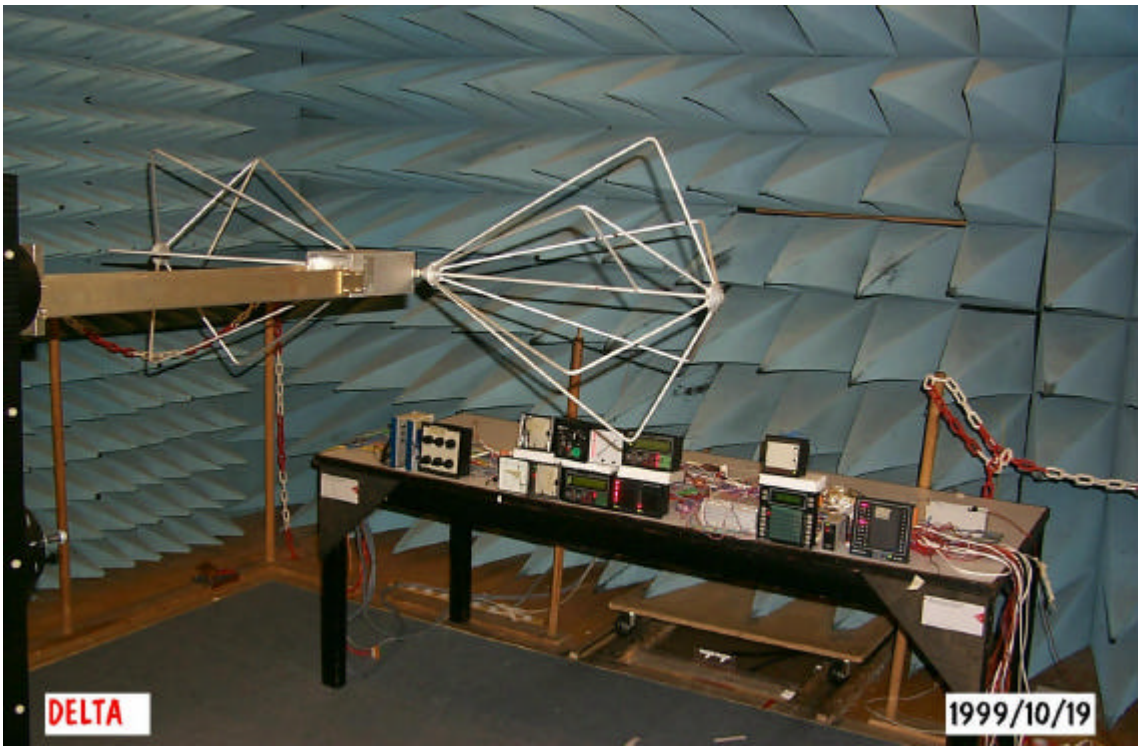


PHOTO 6. Radiated radio frequency interference

PHOTO 7. Surge transients

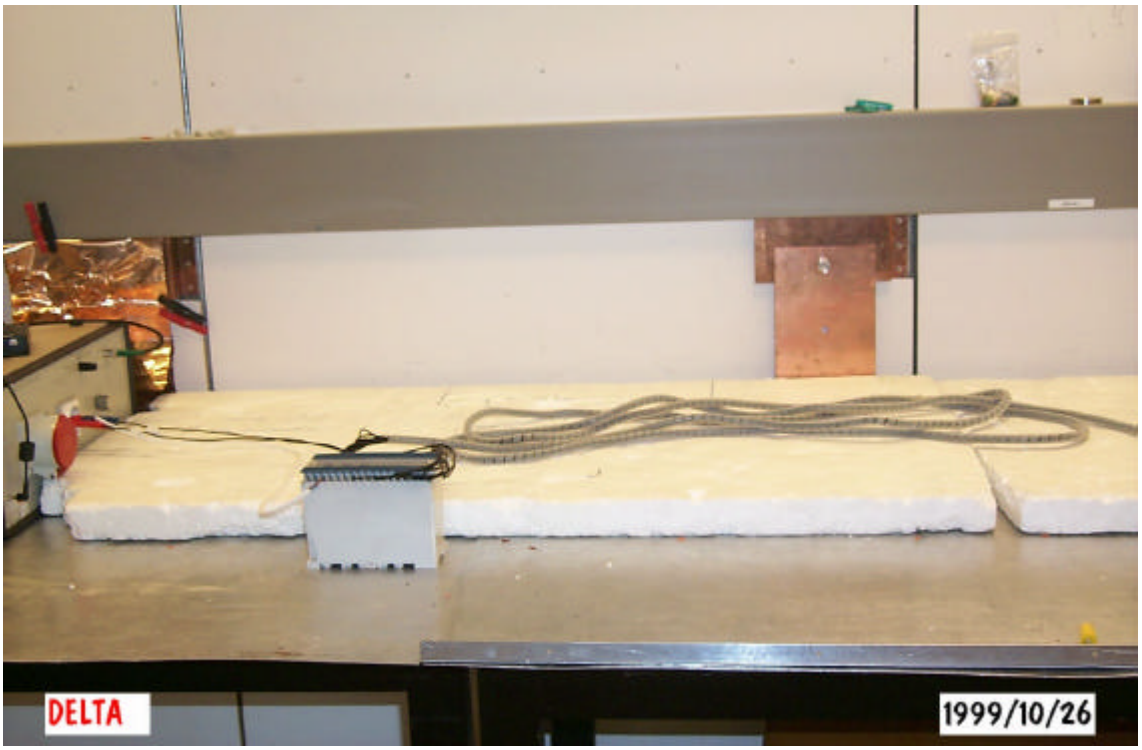


PHOTO 8. Conducted emission

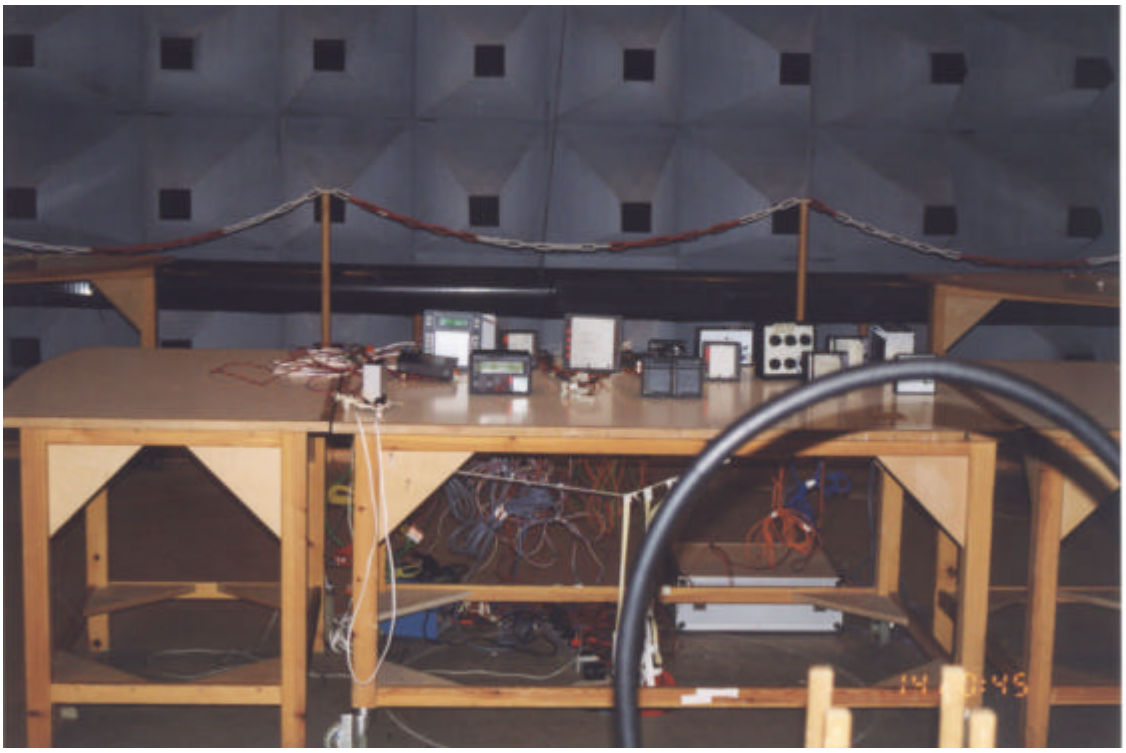


PHOTO 9. Radiated emission

PHOTO 10. Radiated emission

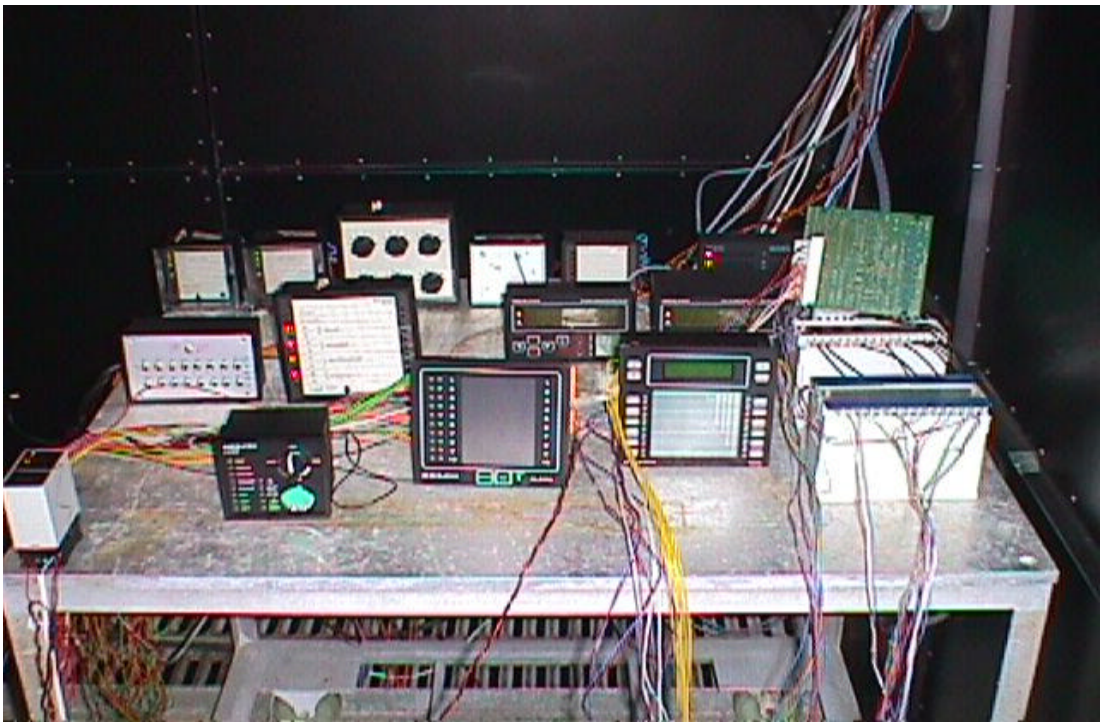


PHOTO 11. Climatic testing (low temperature, dry heat and damp heat)

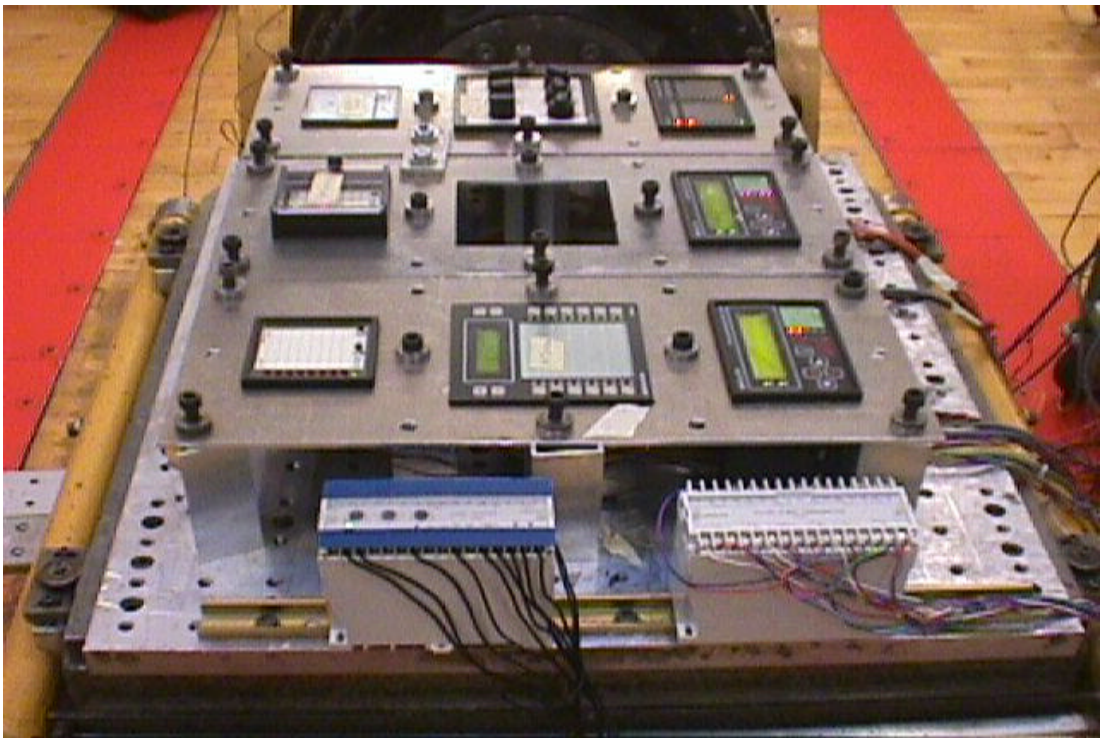


PHOTO 12. Vibration testing

Annex 3

System briefing, Test set-up and Criteria for compliance (from Selco A/S)

(3 pages)

System briefing:

T4800 Load Sharer

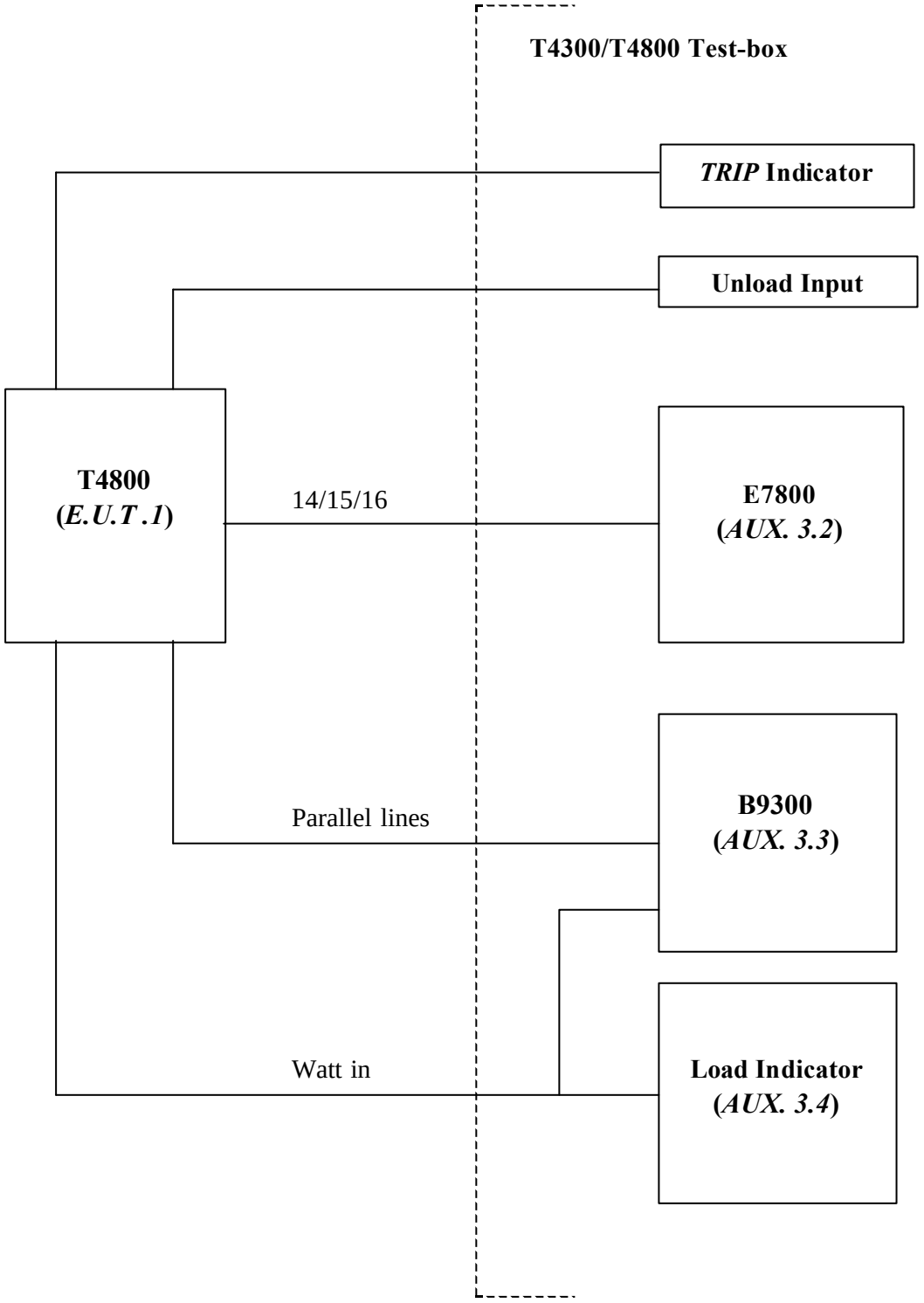
Load Sharer T4800 provides automatic load sharing and system frequency control of generators running in parallel. The load on each generator is compared with the load of the other generators and adjusted via the electric servomotor on the speed governor or a motorised potentiometer until balance is obtained.

An unloading function is built into the unit to facilitate a smooth transfer of the load from a generator before being taken out of service, by an automatic tripping signal to the breaker.

The unit also has reverse power protection. One load sharing unit T4800 is required for each diesel generator in parallel operation. The load sharers must be interconnected with a 2 wire screened cable.

When applied with Power Reference Unit B9300 one or several generators in parallel operation with the grid can be controlled.

Test set-up


T4300/T4800 Test-box
TRIP Indicator
Unload Input
T4800
(*E.U.T .1*)
14/15/16
E7800
(*AUX. 3.2*)
Parallel lines
B9300
(*AUX. 3.3*)
Watt in
Load Indicator
(*AUX. 3.4*)

Criteria for compliance

No change of the actual operational state of the T4800 Load Sharer is allowed. However temporary change of operational state is allowed during the power supply failure and interruptions tests, provided that normal power-up procedure is obtained after the exposures.
Neither electrical nor mechanical wear or damage of the test specimen shall be observed during or after the tests.

No changes of the “INCR” and “DECR” LED’s state are allowed.

The overall maximum permissible measurement deviation is ±2% of full-scale deflection.

Annex 4

Functional test procedure (from Selco A/S)

(1 page)

Functional test procedure T4800

The following steps are carried out in order to verify the function of the T4800 Load sharer:

- Power on the T4300/T4800 test box (230 VAC)

- Initial T4300/T4800 test box set-up

  1. Set the B9300 power Ref. Unit to 50%
  2. Activate “LOAD ON”
  3. Activate “M. POT ON”
  4. Deactivate “UNLOAD”

- Initial T4800 set-up

  1. Set “LOAD DEV.” to 0%
  2. Set “SYS. FREQ.” to 50 Hz.
  3. Set “STABILITY” to 1

- After approx. 15-30 sec. the T4800 has reached a balanced position. The indications on the unit should now be as follows:

  1. The “UN” indicator LED is turned steady on.
  2. The “UNLOAD” indicator LED is turned steady off.
  3. The ”DECR” indicator LED is turned steady off.
  4. The “INCR” indicator LED is turned steady off.

- Load regulation test:

  Increase the B9300 power Ref. Unit to 70%. The “INCR” indicator LED on the T4800 will start flashing. In the beginning fast and then slower and slower until the T4800 has reached a steady position where the indicator LED is steady off.

- Unload test:

  Activate the “UNLOAD” button on the T4300/T4800 test box. Check the following:

  1. The “UNLOAD” indicator LED is turned steady on.
  2. The ”DECR” indicator LED is turned steady on for a period after the LED has started flashing. In the beginning fast and then slower and slower until the T4800 is full unloaded where the indicator LED is turned steady off.
  3. Watch the “TRIP” indicator on the T4300/T4800 test box. When 5% load is reached the indicator will light for half a second. The actual load is indicated on the SELCO Load Indicator.

Function test has now been carried out. Return to the initial settings.

Annex 5

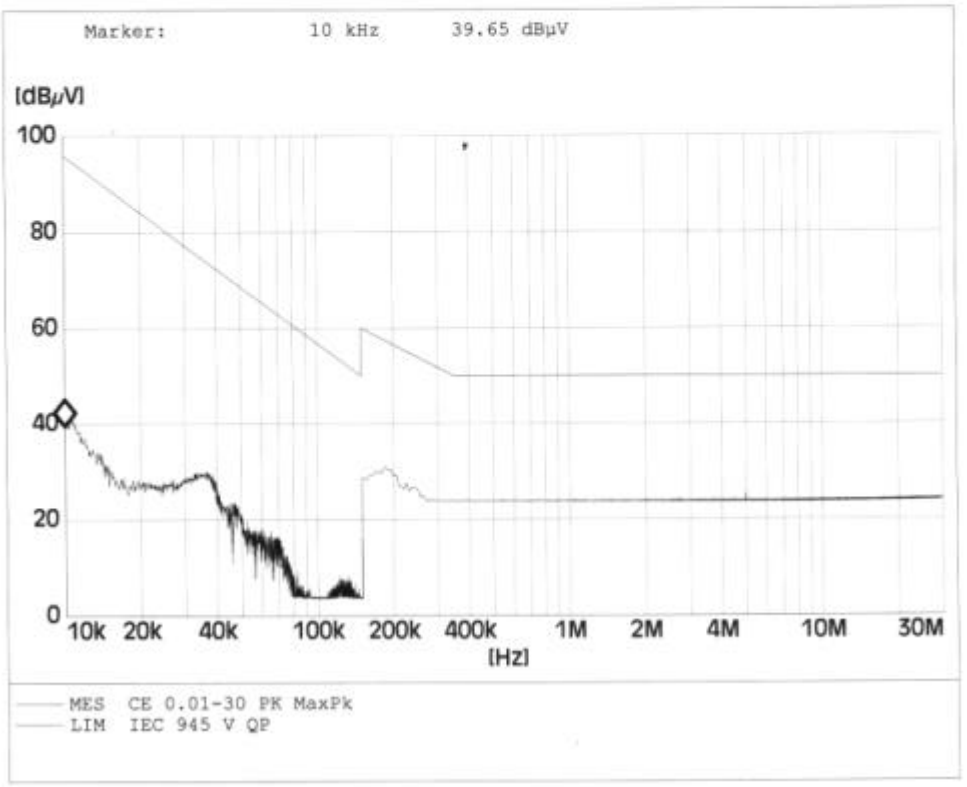
Test record sheets regarding conducted emission

(6 pages)

DELTA Electronics Testing

Conducted emission

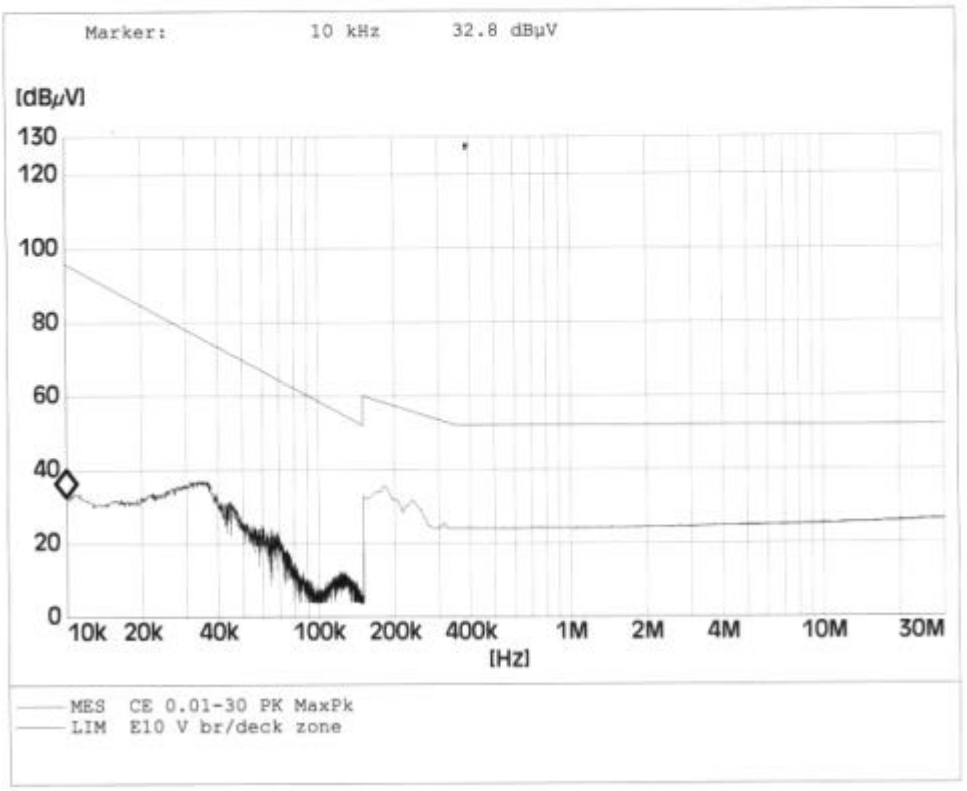
EUT:	Load sharer T4800
Manufacturer:	SELCO
Operating Condition:	Load 60%
Test Site:	Room 3
Operator:	DAC
Test Specification:	IEC 60945
Comment:	Sheet 15. Line: phase (230 VAC)
Start of Test:	1999-10-26



DELTA Electronics Testing

Conducted emission

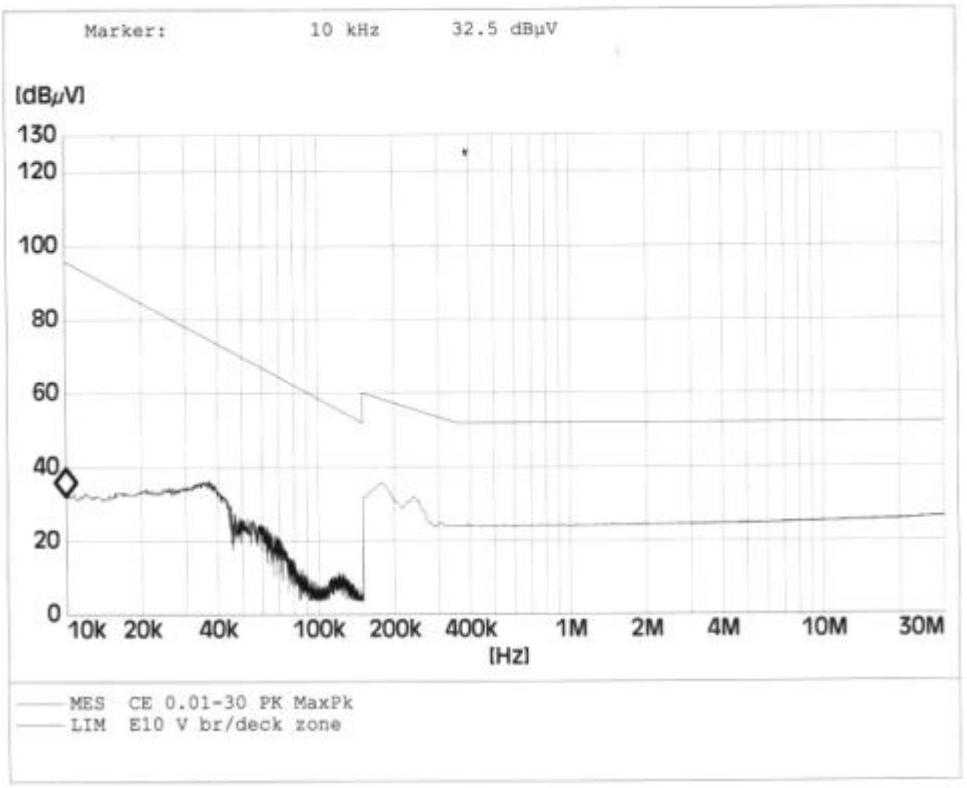
EUT:	Load Sharer T4800
Manufacturer:	SELCO
Operating Condition:	60% Load. Power ref unit ON, Load ON, M Pot ON.
Test Site:	Room 3
Operator:	DAC
Test Specification:	E10 Bridge and deck zone.
Comment:	Sheet 29. Line: N (230 VAC)
Start of Test:	1999-10-26



DELTA Electronics Testing

Conducted emission

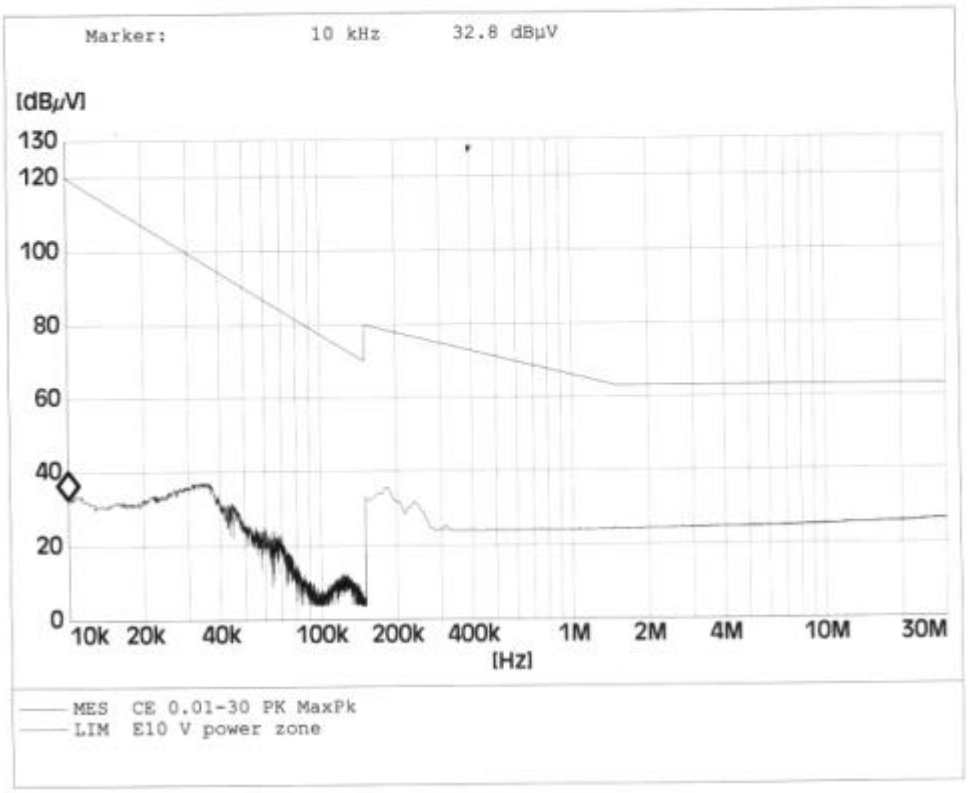
EUT:	Load Sharer T4800
Manufacturer:	SELCO
Operating Condition:	60% Load. Power ref unit ON, Load ON, M Pot ON.
Test Site:	Room 3
Operator:	DAC
Test Specification:	E10 Bridge and deck zone.
Comment:	Sheet 30. Line: Phase (230 VAC)
Start of Test:	1999-10-26



DELTA Electronics Testing

Conducted emission

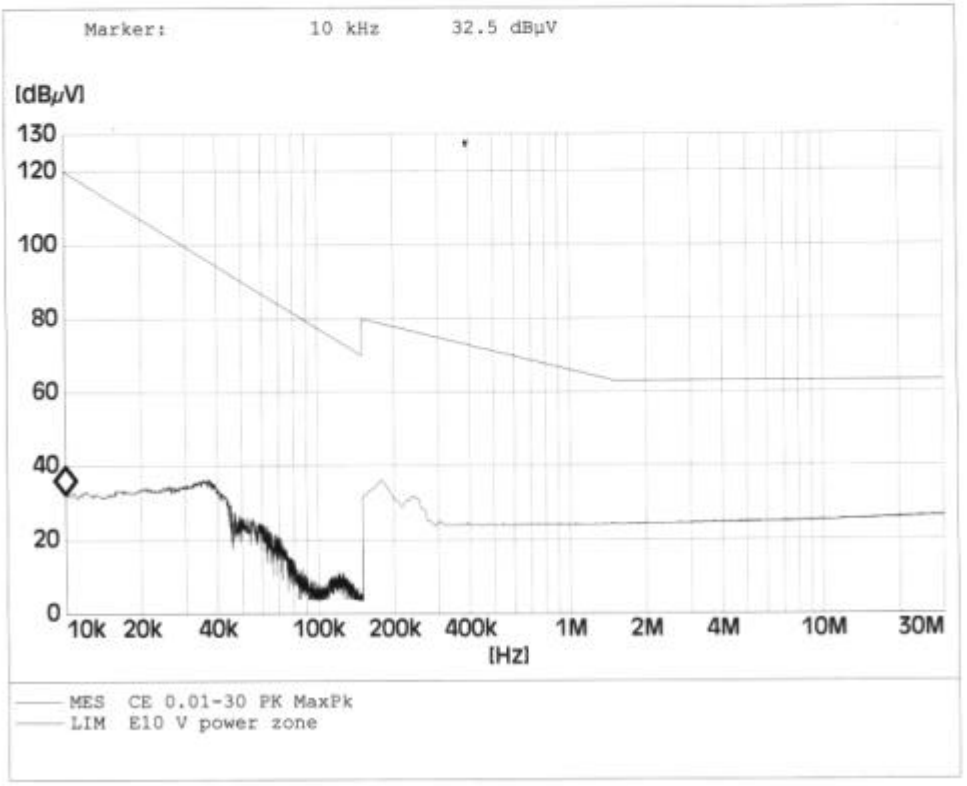
EUT:	Load Sharer T4800
Manufacturer:	SELCO
Operating Condition:	60% Load. Power ref unit ON, Load ON, M Pot ON.
Test Site:	Room 3
Operator:	DAC
Test Specification:	E10 Power distribution zone
Comment:	Sheet 29. Line: N (230 VAC)
Start of Test:	1999-10-26

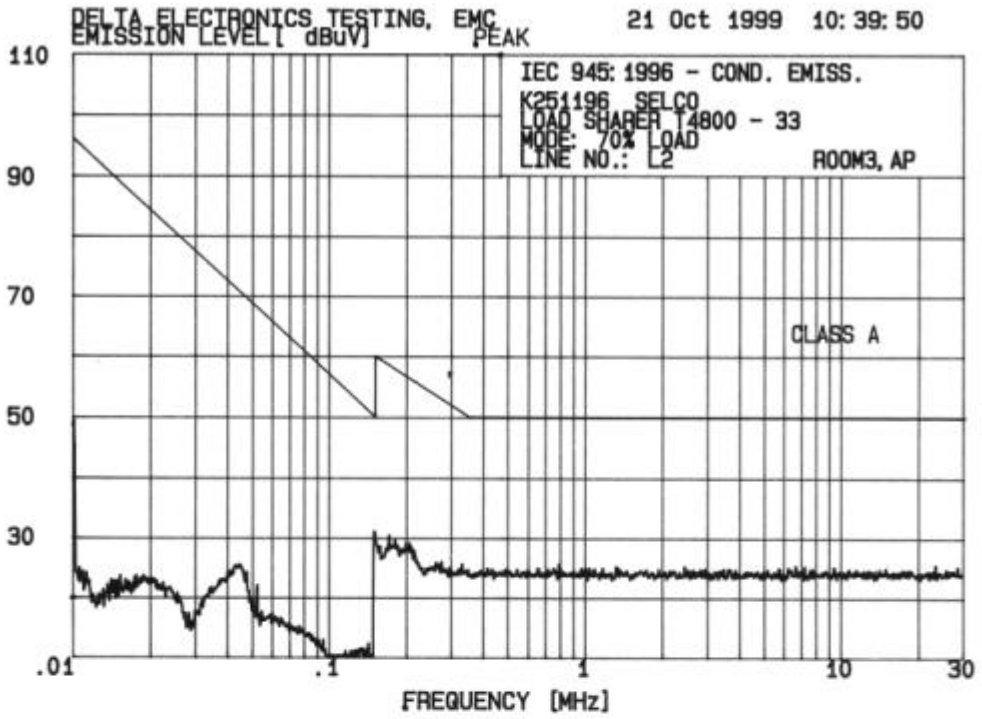


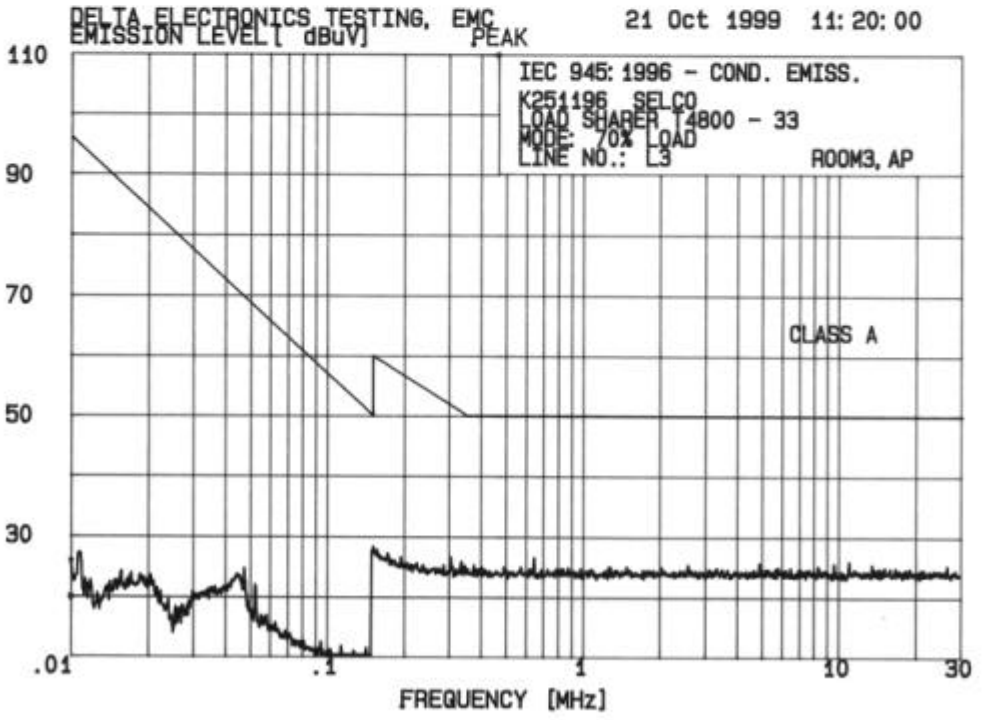
DELTA Electronics Testing

Conducted emission

EUT:	Load Sharer T4800
Manufacturer:	SELCO
Operating Condition:	60% Load. Power ref unit ON, Load ON, M Pot ON.
Test Site:	Room 3
Operator:	DAC
Test Specification:	E10 Power distribution zone
Comment:	Sheet 30. Line: Phase (230 VAC)
Start of Test:	1999-10-26




DELTA ELECTRONICS TESTING, EMC
21 Oct 1999 10:39:50
EMISSION LEVEL[dBuV]
PEAK
IEC 945:1996 - COND. EMISS.
K251196 SELCO
LOAD SHARER T4800 - 33
MODE: 70% LOAD
LINE NO.: L2
ROOM3, AP
CLASS A
110
90
70
50
30
.01
.1
1
10
30
FREQUENCY [MHz]


DELTA ELECTRONICS TESTING, EMC
21 Oct 1999 11:20:00
EMISSION LEVEL[dBuV]
PEAK
IEC 945:1996 - COND. EMISS.
K251196 SELCO
LOAD SHARER T4800 - 33
MODE: 70% LOAD
LINE NO.: L3
ROOM3, AP
CLASS A
110
90
70
50
30
.01
.1
1
10
30
FREQUENCY [MHz]

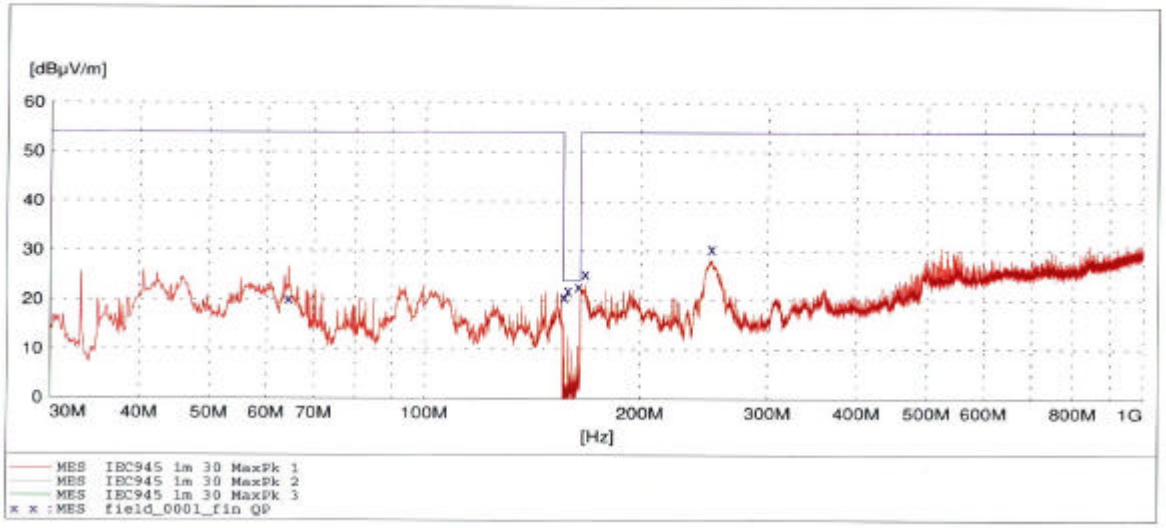
Annex 6

Test record sheets regarding radiated emission

(3 pages)

DELTA Electronics Testing

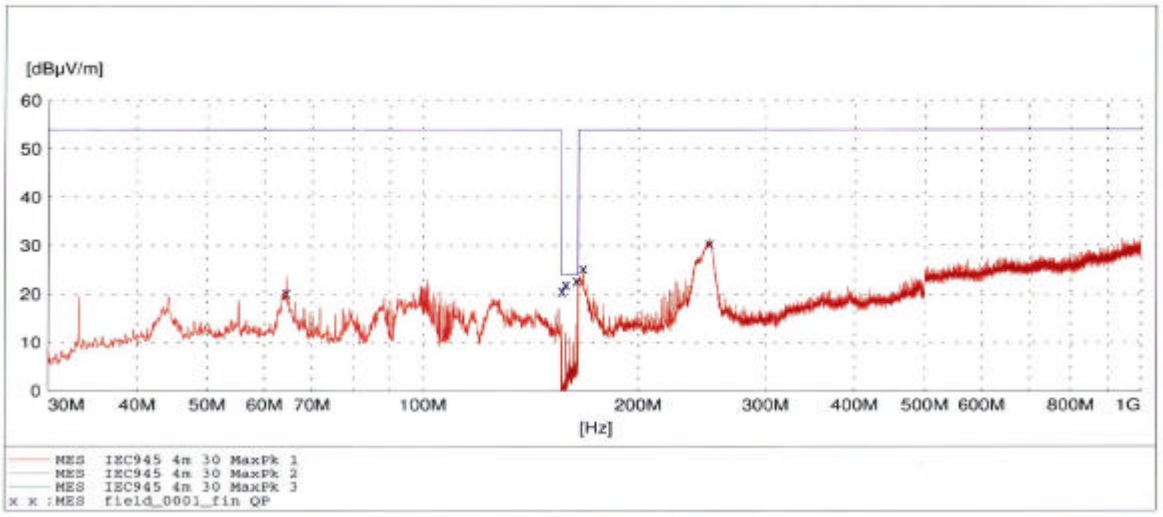
EUT:	H1500,H2000,T4800,M1500,M500,M4100,M3000,M6000,M6100, M 6050, M 1060
Manufacturer:	Selco,
Operating Condition:	Ant. 1 m vertical.
Test Site:	EMC-5
Operator:	HEN K251196
Test Specification:	IEC 945, E10,
Comment:	Sheet 8
Start of Test:	1999-10-14



Page 1/2 15-10-99 11:12 CE

DELTA Electronics Testing

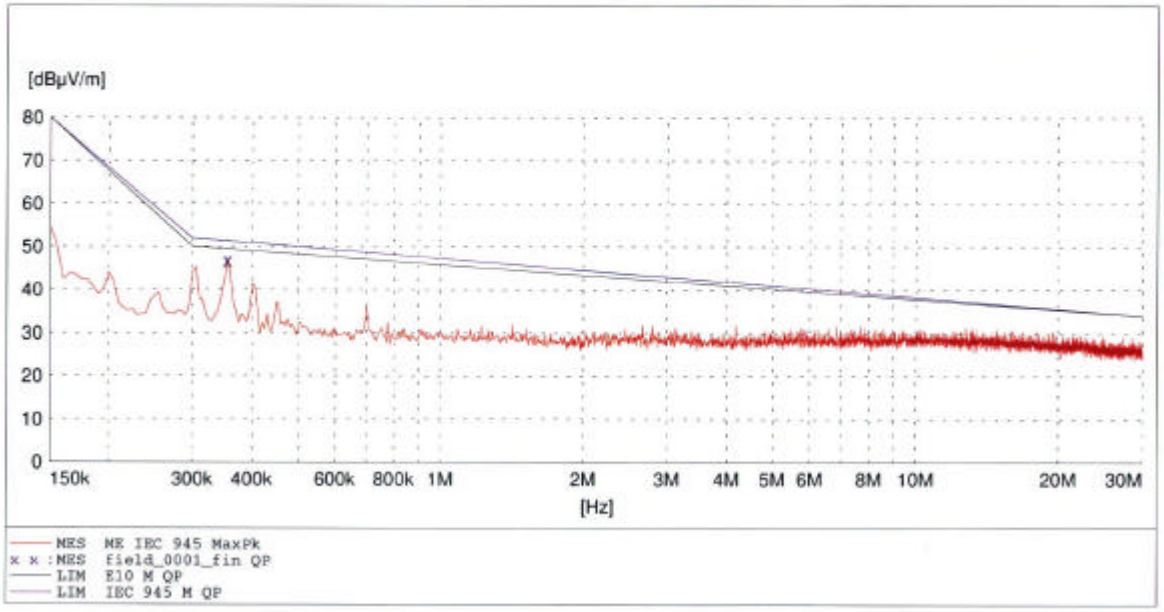
EUT:	H1500,H2000,T4800,M1500,M500,M4100,M3000,M6000,M6100, M 6050, M 1060
Manufacturer:	Selco,
Operating Condition:	Ant. 4 m horizontal.
Test Site:	EMC-5
Operator:	HEN K251196
Test Specification:	IEC 945, E10.
Comment:	Sheet 9
Start of Test:	1999-10-14



Page 1/1 15-10-99 11:13 CE

DELTA Electronics Testing

EUT:	Selco system.
Manufacturer:	Selco.
Operating Condition:	Radial
Test Site:	EMC-5
Operator:	JN K251196
Test Specification:	IEC 945, E10.
Comment:	Sheet 6
Start of Test:	1999-10-14



Page 1/2 14-10-99 20:27 CE

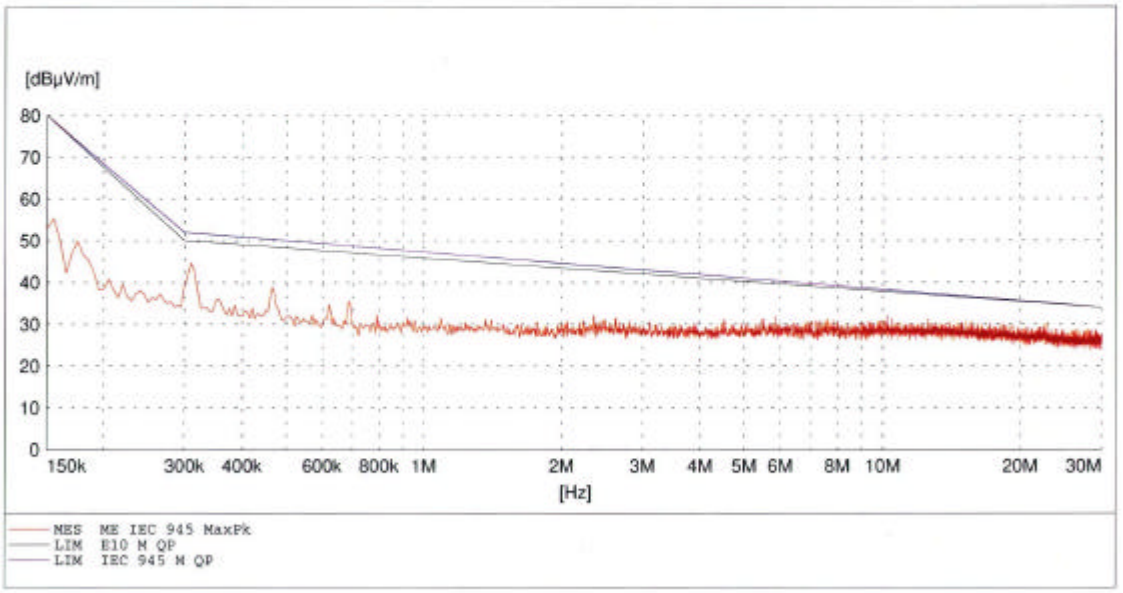
MEASUREMENT RESULT: "field_0001_fin QP"

14-10-99 20:20

Frequency kHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Azimuth	Orientation
355.000	46.90	20.0	0.0	0.0	180.000	Radial

DELTA Electronics Testing

EUT:	Selco system.
Manufacturer:	Selco.
Operating Condition:	Axial
Test Site:	EMC-5
Operator:	JN K251196
Test Specification:	IEC 945, E10.
Comment:	Sheet 7
Start of Test:	1999-10-14



Page 1/1 14-10-99 20:40 CE

Liability

The following provisions shall apply in respect of accredited testing and calibration tasks conductedby DELTA Danish Electronics, Light & Acoustics (herein- after DELTA) and of test reports and calibration certificates issued by DELTA.

1. DELTA shall not be liable for any loss or damage unless it is established that such loss or damage results from negligence or breach of duty on the part of DELTA.

2. The procedures used for testing/calibration and the preparation of the present test report/calibration certificate are based on the knowledge and techniques available to DELTA at the time of testing/calibration. DELTA shall not be held liable should subsequent technical developments indicate that such knowledge or techniques were inadequate or incorrect.

3. DELTA shall not be liable for loss or damage

- in cases where theproduct causing such loss or damage has not been tested by DELTA, except where it is established that such product is identical to one tested or examined by DELTA, or
- in cases where such loss or damage results from a property of a product or of a use, to which such product is put, which either has not been tested or examined and described in the present report or differs from DELTA's description in that report of the properties of the product or of uses to which it might be put.

4. DELTA will in no event be liable for consequential losses such as, but not limited to, loss of profit.

5. Should a third party enter a claim for compensation which exceeds the limits for DELTA's liability as set out in § 1-4 above, then defence against any such claim shall be the responsibility of the Client if DELTA so re quires, and all costs of such defence and of any litigation in connection therewith shall be borne by the Client. Should DELTA be held liable or otherwise be ordered to make payments in excess of the limits set out in § 1-4, then the Client shall be obliged to indemnify and hold DELTA harmless in respect of such excess.

6. Any dispute arising out of or relating to this Test Report shall be referred to Copenhagen Arbitration. The interpretation and performance of this Test Report shall be governed by and construed in accordance with the laws of Denmark.

DANAK (Danish Accreditation)

DANAK was established in 1991 in pursuance of the Industry and Trade Promotion Act No. 394 of 13 June 1990. The scheme is a continuation of the accreditation scheme established in 1973 under the auspices of the former Danish National Testing Board (STP).

The requirements to the accredited testing laboratories are laid down in the Danish Agency for Development of Trade and Industry Statutory Order No. 258 of 11 April 1994 on accreditation of laboratories to perform technical testing etc.

The standards DS/EN 45001 „General criteria for the operation of testing laboratories" and DS/EN 45002 „General criteria for the assessment of testing laboratories" are integrated parts of the statutory order.

In order to obtain accreditation to perform technical testing it is, among other things, required:

- that the testing laboratory and its personnel are free from any commercial, financial and other pressures which might influence their technical judgement.
- that the testing laboratory operates a quality system which is documented.
- that the testing laboratory is furnished with items of equipment required for correct performance of the tests and measurements which the laboratory is accredited to perform.
- that the testing laboratory has sufficient personnel, having the necessary education, training, technical knowledge and experience for their assigned functions.
- that the testing laboratory has procedures for traceable calibration of equipment used for accredited testing.
- that accredited testing is performed after fully documented methods.
- that the testing laboratory has records which contain sufficient information to permit repetition of the test.
- that the testing laboratory is assessed and surveyed by DANAK on a regular basis.
- that the accredited laboratory shall take out an insurance which will cover liability in connection with accredited testing

Test reports carrying the logo of DANAK are used to report accredited testing and the logo shows that the testing has been performed in accordance with the rules of accreditation.