

Test report 99367921

based on:
EN 60945 fourth edition 2002

Class A Shipborne AIS equipment
McMurdo
MT-1

Contents

MAIN MODULE.....	4
1 Introduction.....	4
2 Product.....	5
3 Test schedule.....	5
4 Product documentation	5
5 Hardware list.....	6
6 List of ports.....	6
7 Observations and comments	7
8 Uncertainty of measurement.....	7
9 Technical specifications.....	8
10 Summary	9
11 Conclusions.....	10
TEST RESULTS MODULE	11
1 Power supply – Methods of testing and test results according to EN60945 clause 7	12
1.1 Extreme power supply	12
1.2 Excessive conditions	12
1.3 Power supply short-term variation.....	12
1.4 Power supply failure	12
2 Durability and resistance to environmental conditions according to EN60945 clause 8	13
2.1 General (8.1)	14
2.2 Dry heat storage test (8.2).....	15
2.3 Dry heat functional test.....	16
2.4 Damp heat functional test	17
2.5 Low temperature functional test	18
2.6 Vibration	19
2.7 Corrosion.....	22
3 Electromagnetic emission clause 9	23
3.1 Summary.....	23
3.2 Conducted emissions 10 kHz - 150 kHz.....	24
3.3 Conducted emissions 150 kHz - 30 MHz	25
3.4 Radiated emissions 150 kHz - 30 MHz.....	26
3.5 Radiated emissions 30 MHz - 1 GHz.....	27
3.5.1 Plot radiated emissions 30 MHz - 1000 MHz Vertical	28
3.5.2 Plot radiated emissions 30 MHz - 1000 MHz Horizontal	28
3.6 Radiated emissions 156 MHz - 165 MHz	29
3.6.1 Plot radiated emissions 156 - 165 MHz Vertical	30
3.6.2 Plot radiated emissions 156 - 165 MHz Horizontal	30
3.7 Radiated emissions 1 GHz - 2 GHz	31
4 Immunity to electromagnetic environment clause 10	32
4.1 Summary.....	32
4.2 Immunity to conducted radio frequency disturbance (10.3)	33
4.3 Immunity to Radiated radio frequency disturbance (10.4)	34
4.4 Immunity to Fast Transients (10.5).....	35
4.5 Immunity to Surges (10.6)	36
4.6 Immunity to power supply short-term variation (10.7).....	37
4.7 Immunity to Power supply failure (10.8).....	38



Report number: 99367921

4.8	Immunity to electrostatic discharge, contact (10.9)	39
4.9	Immunity to electrostatic discharge, Air (10.9)	40
4.10	Immunity to electrostatic discharge, Coupling plane (10.9)	41
5	Special purpose tests according to EN 60945 clause 11	42
5.1	Acoustic noise and signals	43
5.2	Compass safe distance	44
6	Safety precautions according to EN 60945 clause 12	45
6.1	Protection against accidental access to dangerous voltages.....	46
6.2	Maintenance according to EN 60945 clause 13	47
7	Equipment manuals according to EN 60945 clause 14.....	48
8	Marking and identification according to EN 60945 clause 15.....	49
USED TEST EQUIPMENT MODULE		50
PHOTOGRAPHS MODULE.....		55
ADDITIONAL INFORMATION MODULE		70

This report comprises of five modules. The total number of pages exclusive of the pages enclosed in the additional information module is: 70.



Main module

1 Introduction

This report contains the result of tests performed by:

Telefication bv
Edisonstraat 12a
6902 PK Zevenaar
The Netherlands

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:1999. The accreditation covers the quality system of the laboratory as well as the specific activities as described in the authorized annex bearing the accreditation number L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie). The copyright of this test report is owned by Telefication bv and may not be reproduced except in full without the written approval of Telefication bv.

Ordering party:

Company name	:	McMurdo Ltd
Address	:	Silver Point, Airpoint Service Road
Zipcode	:	P03 5PB
City/town	:	Portsmouth
Country	:	United Kingdom
Date of order	:	14 January 2003

The above mentioned documentation will be filed at Telefication bv for a period of 10 years following the issue of this report.

5 Hardware list

The table below shows the release version of hardware used by various processes at date of testing.

Module	Hardware Nr.	PCB release version
Transmitter module	89-411	iss 2
TDMA & DSC Receiver	89-421 serial number 2295/002 mod 5	iss E 09-03
RX processing board	89-461 software VOC serial number 2003038303 R08	iss F
Control board	89-401 P16, checksum start prom 0xF400	iss D
Power supply	89-441	iss 2
GPS receiver	89-465 μ-BLOX AG: GPS-MS1E B9079-C010-01-02 SO242518 YK01/07	iss A
Screw_terminal	89-431	iss 3
Display Main PCB	89-201	Iss E

6 List of ports

The equipment under test is equipped with the following ports:

Port name	number of ports	Screened cable mandatory	Electrical specification
DC input	1	yes / no / na	DC voltage
VHF antenna	1	yes / no / na	Conducted VHF RF
GPS Receiver	1	yes / no / na	1.5GHz RF
61162-2 port Main, Aux/pilot, Long range, Display, RTCM, Sensor1, Sensor2, Sensor3	8	yes / no / na	RS422, NMEA0183, RTCM104
Alarm Relay output	1	yes / no / na	Open circuit
--	--	--	--

7 Observations and comments

This Test Report is a revised copy of Telefication Test Report 99367920. A more detailed description of the verification of the performance criteria was added and several type errors have been corrected.

This Test Report is complementary to Telefication Test Report 99367931.

All test were carried out at Telefication except for the vibration tests which were performed at the accredited Environmental Competence Centre of Thales BV , Hengelo, the Netherlands.

The environmental class of the presented equipment was determined to be class B (protected).

For the performance check used with the environmental tests, the EUT was set into autonomous mode and tests were carried out as specified in EN61993-2 clause 14.1.1.

For the performance check used with the EMC immunity tests, the EUT was set into autonomous mode with a reporting rate of 2 seconds as specified in EN61993-2 clause 13 (EMC tests). All unexpected behaviour of the EUT was monitored for loss of performance, in particular the following:

1. The reporting rate behaviour of the unit under test;
2. The sentences on the Mains PI port of the unit under test, especially for ALR and TXT messages which could indicate loss of performance;
3. The sentences output of the ancillary radio to monitor VDM messages from the unit under test;
4. The KDU information displayed. Especially the refresh counter (receive other ships);
5. A heading and velocity simulation instrument (software) was connected at one of the sensor input ports. The correct use of this information by the radio was monitored;
6. GPS information utilization;
7. The DC power consumption;
8. Undesirable VDL transmissions.

8 Uncertainty of measurement

The reported expanded uncertainty of measurement stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2$, which for normal distribution corresponds to coverage factor probability of approximately 95%.

9 Technical specifications

The applicant supplied the following technical specifications.

Power supply requirements	24 volt DC
Power consumption	75 Watt
Default frequencies	AIS-1 : 161.975 MHz AIS-2 : 162.025 MHz DSC : 156.525 MHz (channel 70)
Operating temperature	-15°C to +55°C
Storage temperature	-20°C to +70°C
GNSS receiver	Build-in GPS receiver
GNSS antenna	Patch antenna with build-in pre-amplifier
AIS/DSC transmitter RF power output	Low power : 2 Watt High Power : 12.5 Watt
Operating frequency range	156.025 - 162.025 MHz
Antenna output impedance (VDL link)	50 Ω
TDMA receiver sensitivity	PER < 10% @ - 107dBm
TDMA channel spacing	12.5 and 25 kHz
TDMA modulation	according ITU-R M.1371 SOTDMA
TDMA data rate	9600 bits/s
Frequency stability VDL link	<±1 ppm
DSC receiver sensitivity	BER <10 ⁻⁴ at -107 dBm
DSC frequency range	155.3 - 162.5 MHz
Channel spacing	25 kHz
Modulation	1300/2100 Hz pre-emphasis

10 Summary

The product is intended for use in the following application area:

Universal Automatic Identification System

The sample was tested according to the following specifications:

EN 60945, version 4 : 2002-10:	Clause 7	Excessive conditions
	Clause 8	Environmental
	Clause 9	Electromagnetic emission
	Clause 10	Electromagnetic immunity
	Clause 11	Special purpose
	Clause 12	Safety precautions
	Clause 13	Maintenance
	Clause 15	Marking and identification

11 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specification stated in chapter 10 of this report.

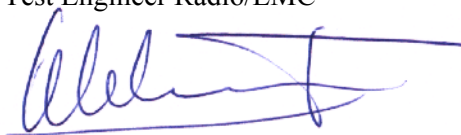
The results of the test as stated in this report are exclusively applicable to the product item as identified in this report. Telefication bv does not accept any responsibility for the results stated in this report, with respect to the properties of product items not involved in these tests.

All tests are performed by:

name : H.H. Lodewijk

function : Test Engineer Radio/EMC

signature :

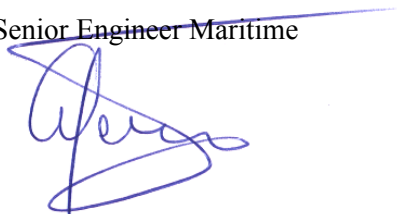


Review of test methods and report by:

name : M.W. Jansen

function : Senior Engineer Maritime

signature :



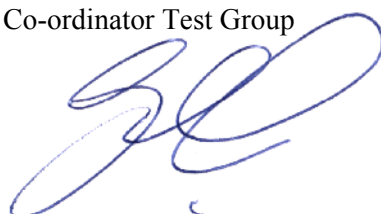
The above conclusions have been verified by the following signatory:

date : 18 November 2003

name : J.P. van de Poll

function : Co-ordinator Test Group

signature :



Test results module

1 Power supply – Methods of testing and test results according to EN60945 clause 7

1.1 Extreme power supply

EN 60945 reference : 7.1

Environment	Normal power supply	Extreme power supply	Result
Dry heat	Performance test	Performance check	P
Damp heat	Performance check	--	P
Low temperature	Performance test	Performance check	P
Normal temperature	Performance test	Performance test	P

The tests were carried out as specified in clause 8.

1.2 Excessive conditions

EN 60945 reference : 7.2

	Observation of the operational check	Result
a)	The equipment is designed to withstand an excessive voltage of 48 Volt. During the test, the protection circuitry was activated at a test voltage of 46 Volt	P
b)	The equipment was exposed to a power supply misconnection (reversed polarity) for the duration of 5 minutes. After resetting the protection, a confidence check was carried out.	P

1.3 Power supply short-term variation

EN 60945 reference : 7.3

For test results refer to clause 10.7

1.4 Power supply failure

EN 60945 reference : 7.3

For test results refer to clause 10.8

2 Durability and resistance to environmental conditions according to EN60945 clause 8

According to EN 60945:2002 fourth edition the following tests were performed:

Summary

Subclause	Category	Test	Phenomena	
8.1	a b c d		Pre test and visual inspection	P
8.2	a c d a b c	Storage Functional	Dry heat 70°C Dry heat 55°C	P
8.3	a b c	Functional	Damp heat 40°C 95% relative humidity	P
8.4	a a b c	Storage Functional Functional Functional	Low temperature -30°C Low temperature -20°C Low temperature -15°C Low temperature -25°C	P
8.5	a		Thermal shock 70°C -> 25°C	NA
8.6	a a		Drop on hard surface 1.00 m Drop into water 20 m	NA
8.7	a b c d		Vibration 2 - 13.6Hz 1mm, 13.6 - 100Hz 7m/s ² , resonance 2h	P
8.8	c		Rain 100 l/m, 30 minutes	NA
8.9	c		Immersion 600kPa 12h Immersion 100kPa 5min. Temporary immersion 1m 5min.	NA
8.10	a		Solar radiation 1120W/m ² 80h	NA
8.11	a		Oil resistance immersion 3h	NA
8.12	a b c d	Corrosion	Salt mist 5% NaCl 2h -> 40°C 95% humidity 7 days	NP

Category:

a	=	portable	c	=	exposed
b	=	protected	d	=	submerged
P	=	Pass	NA	=	Not applicable
NP	=	Not performed			

2.1 General (8.1)

EN 60945 reference : 8.1

A pre-test was carried out to verify the correct operation of the equipment. A performance check was carried out and the equipment was operational according to the product standard EN 61993-2.

The test software and equipment used are listed below:

Manufacturer	Version or serial number	dated
Sailsoft, NMEA protocol simulation software	1.6.1	June 2002

2.2 Dry heat storage test (8.2)

EN 60945 reference : 8.2
Basic standard : IEC 60068-2-2, IEC 60068-2-48

Temperature : 70°C
Duration : 10-16h
EUT : Not applicable to protected equipment!
Power supply : DC

Power supply variation	Voltage (V)	Result
Normal Power supply	24	NA
High voltage +30%	31.2	NA
Low voltage -10%	21.6	NA

Comments : The performance tests were performed after cooling down the EUT to normal temperature.
During the performance tests the EUT operated in accordance with its equipment standard.

2.3 Dry heat functional test

EN 60945 reference : 8.2
Basic standard : IEC 60068-2-2

Temperature : 55°C
Duration : 10-16h
EUT : Transceiver unit and KDU

Power supply : DC

Power supply variation	Voltage (V)	Result
Normal Power supply	24	P
High voltage +30%	31.2	P
Low voltage -10%	21.6	P

Comments : The performance check was carried out with the EUT switched on and the EUT was kept operational for sixteen hours. During the performance check the EUT operated in accordance with its equipment standard.

2.4 Damp heat functional test

EN 60945 reference : 8.3
Basic standard : IEC 60068-2-30

Temperature : 40°C
Relative humidity : 95%
Duration : 10-16h
EUT : Transceiver unit and KDU
Power supply : DC

Power supply variation	Voltage (V)	Result
Normal Power supply	24	P
High voltage +30%	31.2	P
Low voltage -10%	21.6	P

Comments : The performance check was carried out 30 minutes after the EUT was switched on and the EUT was kept operational for two hours. During the performance check the EUT operated in accordance with its equipment standard.

2.5 Low temperature functional test

EN 60945 reference : 8.4
Basic standard : IEC 60068-2-1

Temperature : -15°C
Duration : 10-16h
EUT : Transceiver unit and KDU
Power supply : DC

Power supply variation	Voltage (V)	Result
Normal Power supply	24	P
High voltage +30%	31.2	P
Low voltage -10%	21.6	P

Comments : The performance check was performed with the EUT switched on and the EUT was kept operational for two hours. During the performance test and checks the EUT operated in accordance with its equipment standard.

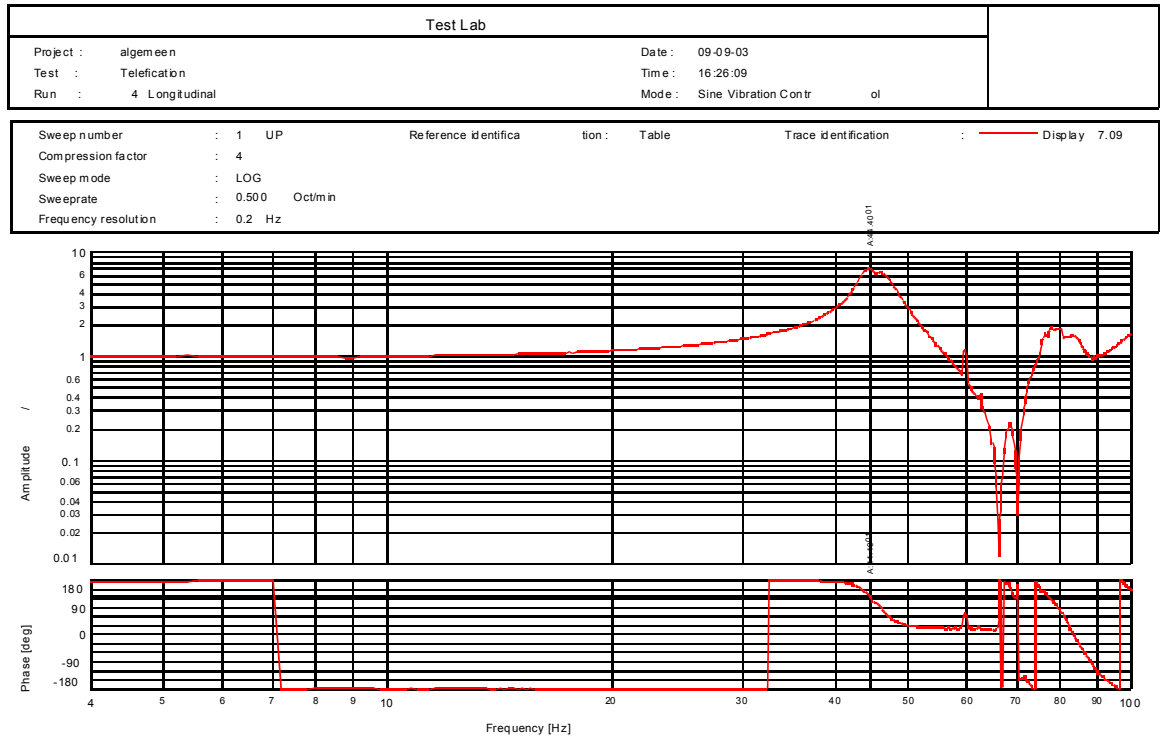
2.6 Vibration

EN 60945 reference : 8.7
 Basic standard : IEC 60068-2-6
 EUT : Transceiver unit and KDU
 Endurance test : 2 hours at 30 Hz if no resonance ($Q > 5$) occurs

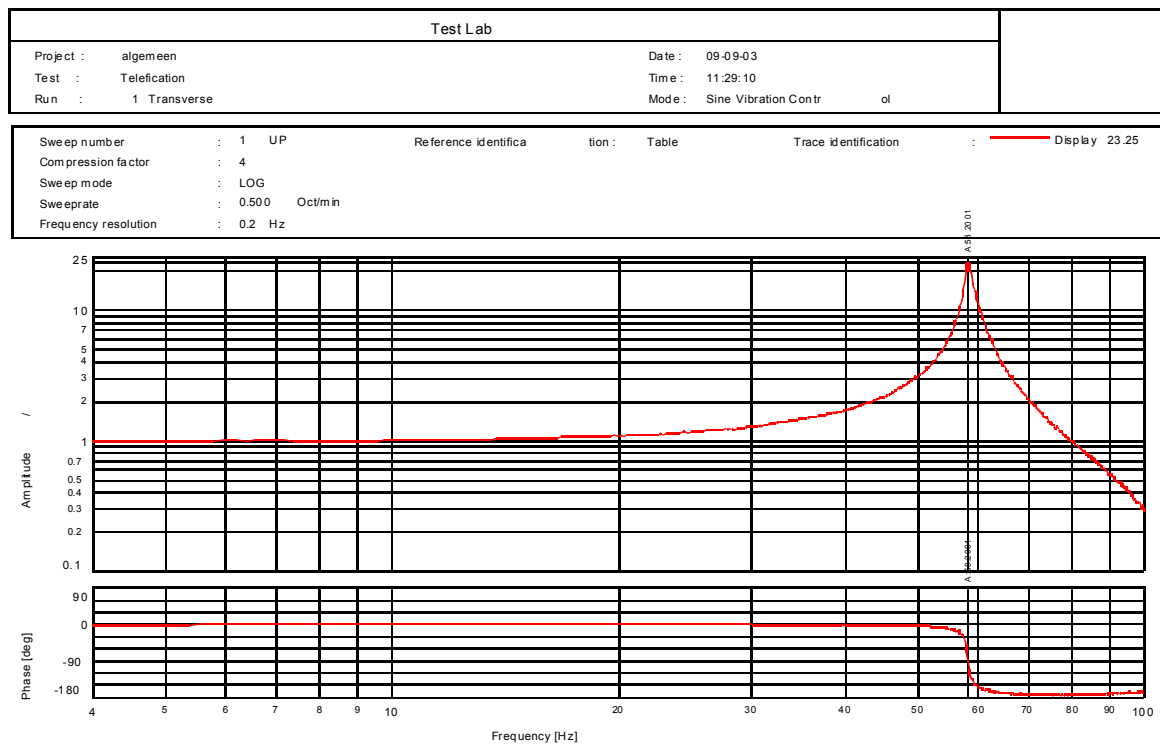
Vertical vibration direction test					
EUT	Frequency (Hz)	Acceleration table (m/s^2)	Acceleration EUT (m/s^2)	Q	Result
Transceiver	5-100	7.0	-	< 2	P
Display	5-100	7.0	-	< 2	P
Horizontal vibration direction 1 test					
EUT	Frequency (Hz)	Acceleration table (m/s^2)	Acceleration EUT (m/s^2)	Q	Result
Transceiver	5-100	7.0	-	< 2	P
Display	45	7.0	49.7	7.1	P
Horizontal vibration direction 2 test					
EUT	Frequency (Hz)	Acceleration table (m/s^2)	Acceleration EUT (m/s^2)	Q	Result
Transceiver	5-100	7.0	-	< 2	P
Display	58	7.0	163.1	23.3	P

Comments : Performance checks were carried out during each endurance test period and before the end of each endurance period.
 There was no degradation of performance during and after the test.
 At frequencies where resonance occurred, an endurance test was carried out.
 If no resonance occurred than an endurance test was carried out at 30 Hz.
 For all test : test time = 2 hours

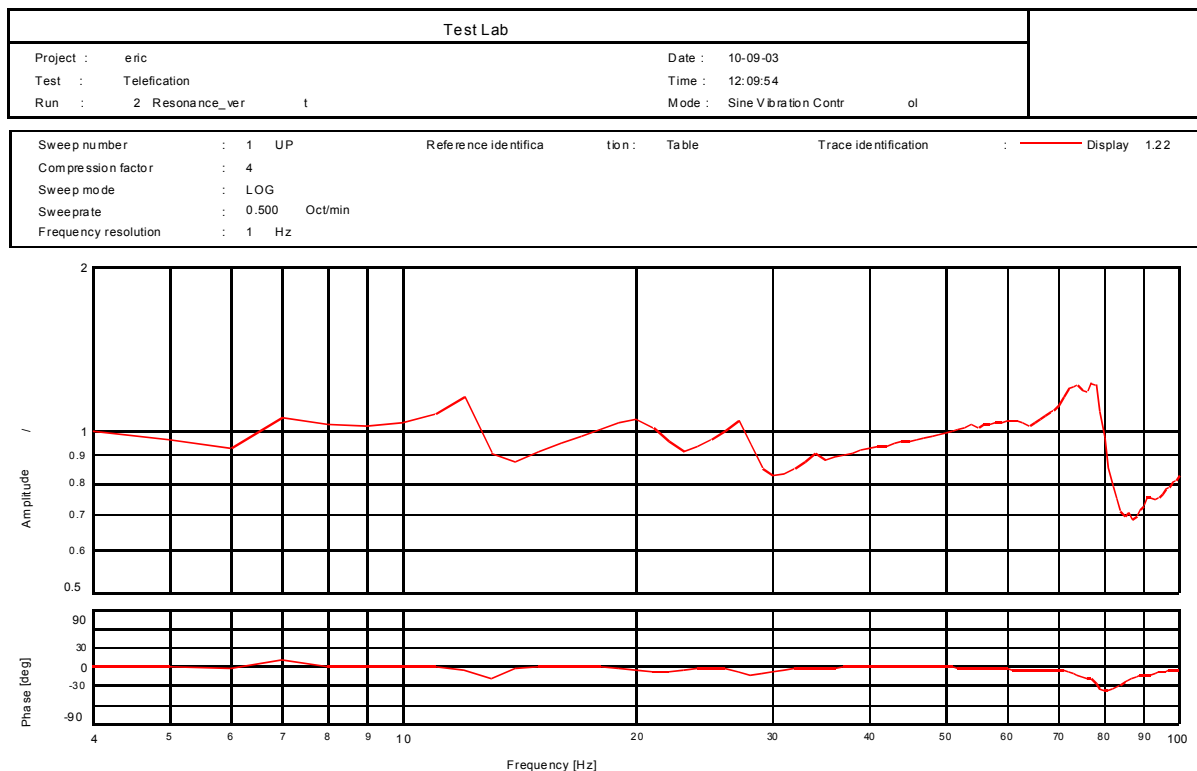
Longitudinal direction:



Transversal direction:



Horizontal direction 2:



Test equipment used at vibration testing.

This equipment is the property of Thales BV, Environmental Competence Centre , Hengelo

Item	Type	Manufacturer
Vibration control computer	HP 9000 type 715/64 (software revision 3.8)	Hewlett Packard
Vibration control front-end	Type 35654	Hewlett Packard
Shaker	Type 894-440	Ling Dynamic
Acceleration sensor	Type 4384	Brüel & Kjaer
Amplifier	Type 5011	Kistler

2.7 Corrosion

EN 60945 reference : 8.12
Basic standard : IEC 60068-2-52
EUT : --

Test	Result
The corrosion test is waived in accordance with clause 4.1 of EN 60945. The manufacturer's statement regarding evidence that EUT will be prepared separately from this test report.	NP

Comment: On request of the applicant this test was excluded.

3 Electromagnetic emission clause 9

3.1 Summary

According to EN 60945 :2002 the following tests were performed:

Port	Subclause	Category	Phenomenon	Result
DC-input	9.2	b c d	Conducted emissions	P
AC-input	9.2	b c d	Conducted emissions	NA
Enclosure	9.3	a b c	Radiated emissions	P

Result:

P = pass

F = fail

NA = not applicable

NP = not performed

Category:

a = portable

b = protected

c = exposed

d = submerged

3.2 Conducted emissions 10 kHz - 150 kHz

EN 60945 reference : 9.2
 Basic standard : CISPR 16-1
 Port : DC-input, 24Vdc
 Frequency range : 10 kHz - 150 kHz
 Measurement bandwidth : 200 Hz
 Length power cable : 0.3 m
 EUT : Transceiver unit + KDU (protected) in receive condition

Signal measured on +24 volt DC

Frequency (kHz)	Level (dB μ V)	Result
35.9	41.0	P
46.9	46.9	P
72.3	38.7	P
113.6	49.3	P
Measurement uncertainty		3.7 dB
Limit: 96 dB μ V @ 10 kHz descending to 50 dB at 150 kHz		

Signal measured on 0 volt DC

Frequency (kHz)	Level (dB μ V)	Result
35.9	40.2	P
46.9	46.1	P
72.3	38.1	P
113.6	47.2	P
Measurement uncertainty		3.7 dB
Limit: 96 dB μ V @ 10 kHz descending to 50 dB at 150 kHz		

Remark: Other conducted emission levels are >10 dB below the limit.

Test equipment used: (Item numbers)	24, 25, 26, 76
-------------------------------------	----------------

3.3 Conducted emissions 150 kHz - 30 MHz

EN 60945 reference	:	9.2
Basic standard	:	CISPR 16-1
Port	:	DC-input, 24Vdc
Frequency range	:	150 kHz - 30 Mhz
Measurement bandwidth	:	10 kHz
Length power cable	:	0.5 m
EUT	:	Transceiver unit + KDU (protected) in receive condition

Signal measured on +24 volt DC

Frequency (kHz)	Level (dBμV)	Result
215.2	46.2	P
342.7	37.5	P
426.3	31.7	P
567.9	33.5	P
637.3	25.5	P
682.7	26.7	P
797.4	31.5	P
Measurement uncertainty		3.7 dB
Limit: 60 dBμV @ 150 kHz descending to 50 dBμV @ 350 kHz 350 kHz < 50 dBμV > 30 MHz		

Signal measured on 0 volt DC

Frequency (kHz)	Level (dBμV)	Result
215.2	44.2	P
342.7	36.8	P
426.3	30.2	P
567.9	31.7	P
637.3	25.3	P
682.7	25.6	P
797.4	31.2	P
Measurement uncertainty		3.7 dB
Limit: 60 dBμV @ 150 kHz descending to 50 dBμV @ 350 kHz 350 kHz < 50 dBμV > 30 MHz		

Remark: Other conducted emission levels are >10 dB below the limit.

Test equipment used: (Item numbers)	24, 25, 26, 76
-------------------------------------	----------------

3.4 Radiated emissions 150 kHz - 30 MHz

EN 60945 reference : 9.3
 Basic standard : CISPR 16-1
 Frequency range : 150 kHz - 30 Mhz
 Measurement bandwidth : 10 kHz
 EUT : Transceiver unit + KDU (protected) in receive condition

Field measurement results were obtained with a Large Loop Antenna (H-field).

Frequency (kHz)	Level (dB μ V)	Result
*	*	P
--	--	
--	--	
--	--	
Measurement uncertainty		+1.9 / -2.1 dB
Limit: 60 dB μ V @ 150 kHz descending to 50 dB μ V @ 350 kHz 350 kHz < 50 dB μ V > 30 MHz		

* All emissions > 10 dB below the limit

Test equipment used: (Item numbers)	68, 76, 83
-------------------------------------	------------

3.5 Radiated emissions 30 MHz - 1 GHz

EN 60945 reference : 9.3
Basic standard : CISPR 16-1
Frequency range : 30 MHz - 1 GHz
Measurement bandwidth : 100 kHz
Distance ant. EUT : 3m
EUT : Transceiver unit + KDU (protected) in receive condition

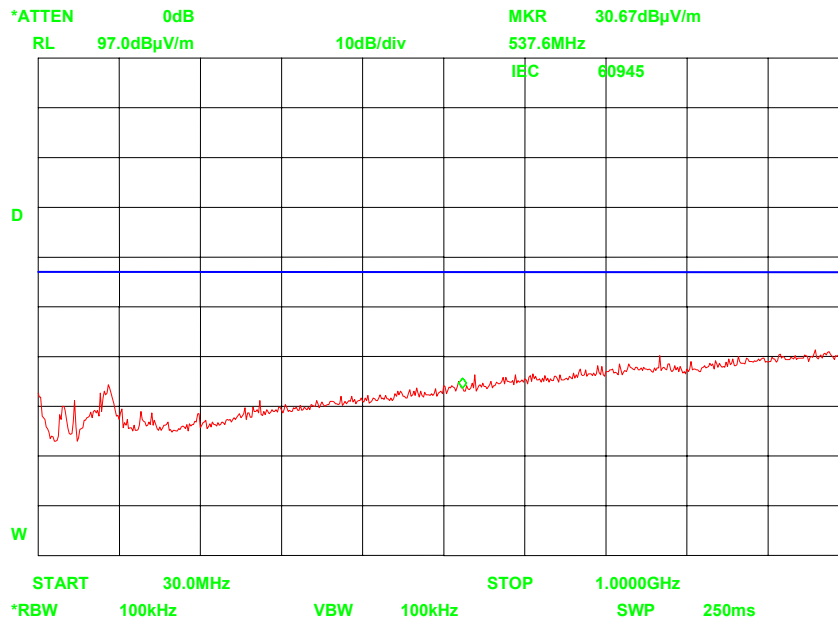
Field measurement results were obtained with a Log-periodic antenna.

Frequency (kHz)	Level (dBμV)	Polarization	Result
*	*	H/V	P
--		--	--
--		--	--
--		--	--
Measurement uncertainty		3.3 dB	
Limit: 54 dBμV/m			

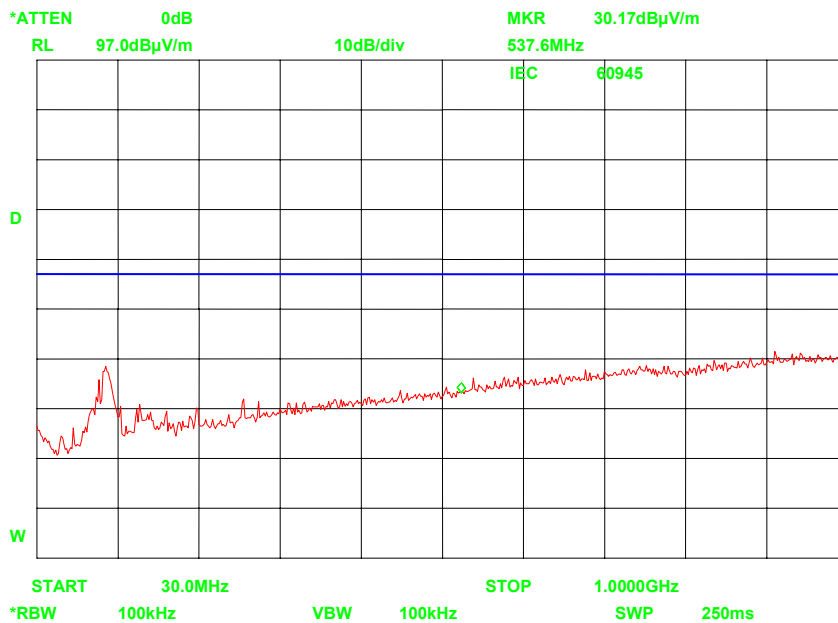
* All emissions > 10 dB below the limit

Test equipment used: (Item numbers)	12, 28, 32, 69, 76
-------------------------------------	--------------------

3.5.1 Plot radiated emissions 30 MHz - 1000 MHz Vertical



3.5.2 Plot radiated emissions 30 MHz - 1000 MHz Horizontal



3.6 Radiated emissions 156 MHz - 165 MHz

EN 60945 reference : 9.3
Basic standard : CISPR 16-1
Frequency range : 156 MHz - 165 MHz
Measurement bandwidth : 10 kHz
Distance ant. EUT : 3m
EUT : Transponder unit in receive condition

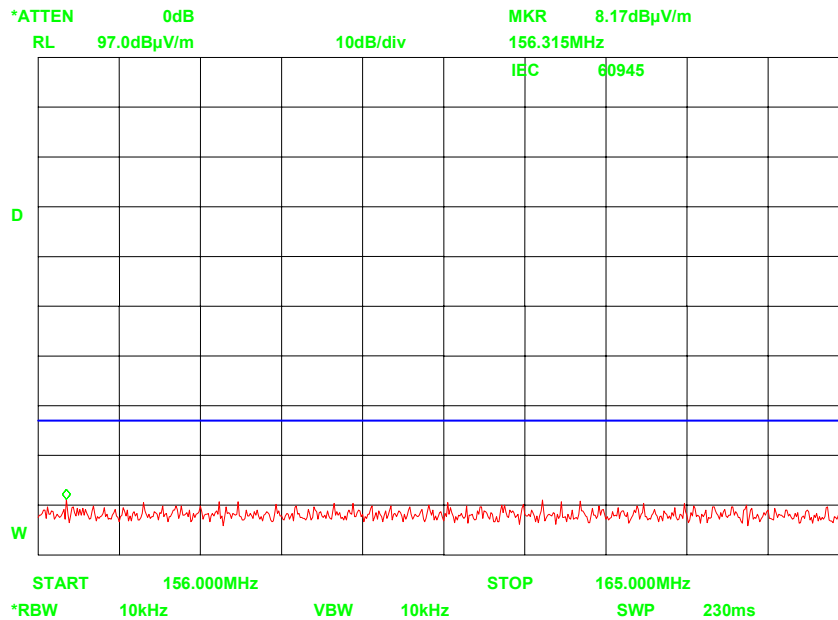
Field measurement results were obtained with a Log-periodic antenna.

Frequency (kHz)	Level (dBμV)	Polarization	Result
*	*	H/V	P
--		--	--
--		--	--
--		--	--
Measurement uncertainty		3.3 dB	
Limit: 24 dBμV/m			

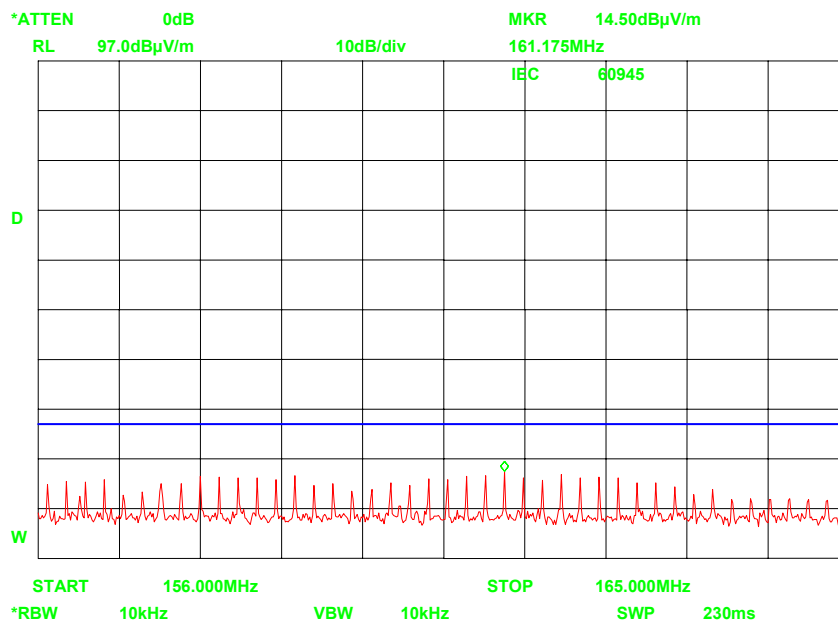
* All emissions > 6 dB below the limit

Test equipment used: (Item numbers)	12, 28, 32, 69, 76
-------------------------------------	--------------------

3.6.1 Plot radiated emissions 156 - 165 MHz Vertical



3.6.2 Plot radiated emissions 156 - 165 MHz Horizontal



3.7 Radiated emissions 1 GHz - 2 GHz

EN 60945 reference : 9.3
Basic standard : CISPR 16-1
Frequency range : 1 GHz - 2 GHz
Measurement bandwidth : 100 kHz
Distance ant. EUT : 3m
EUT : Transponder unit in receive condition

Field measurement results were obtained with a broadband horn antenna.

Frequency (kHz)	Level (dBμV)	Polarization	Result
*	*	H/V	P
--		--	--
--		--	--
--		--	--
Measurement uncertainty		6.0 dB	
Limit: 24 dBμV/m			

* No emissions could be detected.

Test equipment used: (Item numbers)	54, 75, 76
-------------------------------------	------------

4 Immunity to electromagnetic environment clause 10

4.1 Summary

According to EN 60945:2002 the following tests were performed:

Port	Subclause Category	Phenomena	Performance criterion	Result
AC-input	10.3 b c d	Conducted RF common mode 0.01-80.00 MHz, AM80% 400Hz	A	NA
DC-input	10.3 b c d	Conducted RF common mode 0.01-80.00 MHz, AM80% 400Hz	A	P
Signal/control line(s)	10.3 b c d	Conducted RF common mode 0.15-80.00 MHz, AM80% 400Hz	A	P
Enclosure	10.4 a b c	RF-field 10 V/m, AM80% 400Hz 80 - 2000 MHz	A	P
AC-input	10.5 b c d	EFT +/- 2 kV common mode	B	NA
DC-input	10.5 b c d	EFT +/- 1 kV common mode	B	P
Signal/control line(s)	10.5 b c d	EFT +/- 1 kV common mode	B	P
AC-input	10.6 b c d	Surges 1 kV line-earth 0.5 kV line-line	B	NA
AC-input	10.7 b c d	Power supply short-term variation volt. +/-20%, freq. +/-10%	B	NA
AC-input	10.8 b c d	Power supply failure, 60sec common mode	C	NA
DC-input	10.8 b c d	Power supply failure, 60sec common mode	C	P
Enclosure	10.9 a b c	ESD, 6 kV contact, 8 kV air	B	P

Result:

P = pass

F = fail

NA = not applicable

NP = not performed

Category:

a = portable

b = protected

c = exposed

d = submerged

4.2 Immunity to conducted radio frequency disturbance (10.3)

EN 60945 reference : 10.3
 Basic standard : EN 61000-4-6
 Port : DC input, Sensor-3, Main, VHF antenna, KDU
 Frequency range : 150 kHz - 80 MHz
 Test level : 3 Volt (Sweep), 10 Volt (Spot frequencies)
 Modulation : AM, 400Hz / 80%
 Dwell time : 5 seconds
 Sweep rate : 1.5×10^{-3} decades / s
 Performance criterion : A, ref. par 10.1 of EN 60945

Frequency (MHz)	Coupl. dev.	Test Level (V _{rms})	Comments	Result
Range 0.15 - 80.00 1 % frequency steps	CDN	3V	1	P
Range 0.15 - 80.00 Spot frequencies	CDN	10V	1, 4	P
Range 0.15 - 80.00 10 % frequency steps	--	--	--	--

Comments:

1. There is no degradation of performance of the EUT during and after the test.
2. There is no degradation of performance of the EUT after the test.
3. The degradation of performance during the test is permissible and within the limits specified by the manufacturer.
4. The 10 volt test is performed on the following frequencies: 2, 3, 4, 6.2, 8.2, 12.6, 16.5, 18.8, 22 and 25 MHz.

Measurement uncertainty : +/- 1.3 dB

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approx. 95%, but excluding the effect of measurement system repeatability.

Test equipment used: (Item numbers)	38, 39, 42, 43, 44, 46, 50, 51, 64, 88, 90
-------------------------------------	--

4.3 Immunity to Radiated radio frequency disturbance (10.4)

EN 60945 reference : 10.4
Basic standard : EN 61000-4-3
Port : Enclosure
Frequency range : 80 MHz - 2 GHz
Test level : 10 Volt/m
Modulation : AM, 400Hz / 80%
Dwell time : 5 seconds
Sweep rate : $<1.5 \times 10^{-3}$ decades / s (80 MHz - 1GHz MHz)
: $<0.5 \times 10^{-3}$ (1 - 2 GHz)
Calculated exclusion band : 147.9 - 170.1 MHz (5% Fh)
Performance criterion : A, ref. par 10.1 of EN 60945

Frequency (MHz)	Test Level (V/m)	Polarisation H/V	Comments	Result
Range 80 - 2000 1 % frequency steps	10	H/V	1	P
Range 80 - 1000 10 % frequency steps	--	--	--	--

Comments:

1. There is no degradation of performance of the EUT during and after the test.
2. There is no degradation of performance of the EUT after the test.
3. The degradation of performance during the test is permissible and within the limits specified by the manufacturer.
4. --

Measurement uncertainty : +/- 1.8 dB

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k=2$, providing a level of confidence of approx. 95%, but excluding the effect of measurement system repeatability.

Test equipment used: (Item numbers)	11, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 32, 54, 84, 85, 86, 87, 89, 90
-------------------------------------	--

4.4 Immunity to Fast Transients (10.5)

EN 60945 reference : 10.5
Basic standard : EN 61000-4-4
Port : AC Power and Signal ports
Atmospheric pressure : between 86 kPa and 106 kPa
Temperature : 25 °C
Relative humidity : 42 %
Performance criterion : B, ref. par 10.1 of EN 60945

Port	Coupl. dev.	Test Volt. (kV)	Polarity +/-	Comments	Result
Display signal port	Clamp	1	+/-	1, 2	P
Main signal port	Clamp	1	+/-	1, 2	P
Sensor 3	Clamp	1	+/-	1, 2	P
VHF RF	Clamp	1	+/-	1, 2	P
GNSS (GPS)	Clamp	1	+/-	1, 2	P
--	--	--	--	--	--
--	--	--	--	--	--

Comments:

1. There is no change of actual operating mode or loss of stored data (messages) after the test.
2. There is no degradation of performance of the EUT after the test.
3. The degradation of performance after the test is permissible and within the limits specified by the manufacturer.
4. --

Measurement uncertainty : It has been demonstrated that EFT generator and its coupling networks meet the specified requirements in the standard with at least a 95% confidence.

Test equipment used: (Item numbers)	1, 2, 3, 4, 90
-------------------------------------	----------------

4.5 Immunity to Surges (10.6)

EN 60945 reference : 10.6
Basic standard : EN 61000-4-5
Port : AC Power
Atmospheric pressure : between 86 kPa and 106 kPa
Temperature : 25 °C
Relative humidity : 42 %
Performance criterion : B, ref. par 10.1 of EN 60945

Port	Mode	Coupl. dev.	Test Volt. (kV)	Polarity +/-	Comments	Result
AC-supply	LE		1	+/-	1, 2	NA
AC-supply	LL		0.5	+/-	1, 2	NA

Comments:

1. There is no change of actual operating mode or loss of stored data (messages) after the test.
2. There is no degradation of performance of the EUT after the test.
3. The degradation of performance after the test is permissible and within the limits specified by the manufacturer.
- 4.--

Measurement uncertainty :: It has been demonstrated that the surge generator and its coupling networks meet the specified requirements in the standard with at least a 95% confidence.

Test equipment used: (Item numbers)	--
-------------------------------------	----

4.6 Immunity to power supply short-term variation (10.7)

EN 60945 reference : 10.7
Basic standard : EN 61000-4-11
Port : AC Power
Atmospheric pressure : between 86 kPa and 106 kPa
Temperature : 25 °C
Relative humidity : 42 %
Performance criterion : B, ref. par 10.1 of EN 60945

Port	Duration (seconds)	Comments	Result
Voltage: +20%	1.5	1, 2	NA
Frequency: +10%	5	1, 2	NA
Voltage: -20%	1.5	1, 2	NA
Frequency: -10%	5	1, 2	NA

Comments:

1. There is no change of actual operating mode or loss of stored data (messages) after the test.
2. There is no degradation of performance of the EUT after the test.
3. The degradation of performance after the test is permissible and within the limits specified by the manufacturer.
4. --

Test equipment used: (Item numbers)	--
-------------------------------------	----

4.7 Immunity to Power supply failure (10.8)

EN 60945 reference : 10.8
Basic standard : EN 61000-4-11
Port : DC supply
Atmospheric pressure : between 86 kPa and 106 kPa
Temperature : 25 °C
Relative humidity : 42 %
Nominal voltage : 24 volt
Performance criterion : B, ref. par 10.1 of EN 60945

Test			Performance criterion	Comments	Result
nr.	supply	time			
1	break	60 s	C	1	P
2	break	60 s	C	1	P
3	break	60 s	C	1	P
4	--	--	--	--	--
5	--	--	--	--	--
6	--	--	--	--	--

Comments:

1. There is no corruption of operational software or loss of essential data (messages) after the test.
2. There is no degradation of performance of the EUT after the test.
3. The degradation of performance after the test is permissible and within the limits specified by the manufacturer.
- 4.--

Measurement uncertainty : Not applicable

Test equipment used: (Item numbers)	48, 90
-------------------------------------	--------

4.8 Immunity to electrostatic discharge, contact (10.9)

EN 60945 reference : 10.9
 Basic standard : EN 61000-4-2
 Atmospheric pressure : between 86 kPa and 106 kPa
 Temperature : 25 °C
 Relative humidity : 42 %
 Performance criterion : B, ref. par 10.1 of EN 60945

Position	Test Volt. (kV)	Number of Discharges	Polarity +/-	Comments	Result
Transceiver unit Front, Rear, sides, metal screws	6	10	+	1,2	P
	6	10	-	1, 2	P
Transceiver unit Rear, bus connector	6	10	+	1, 2	P
	6	10	-	1, 2	P
KDU mounting bracket	6	10	+	1, 2	P
	6	10	-	1, 2	P
KDU sub-D connector cap	6	10	+	1, 2	P
	6	10	-	1, 2	P
--	--	--	--	--	--
	--	--	--	--	--
--	--	--	--	--	--
	--	--	--	--	--

Comments:

1. There is no corruption of operational software or loss of essential data (messages) after the test.
2. There is no degradation of performance of the EUT after the test.
3. The degradation of performance after the test is permissible and within the limits specified by the manufacturer.
4. --

Measurement uncertainty : It has been demonstrated that the ESD generator meets the specified requirements in the standard with at least a 95% confidence.

Test equipment used: (Item numbers)	5, 6, 90
-------------------------------------	----------

4.9 Immunity to electrostatic discharge, Air (10.9)

EN 60945 reference : 10.9
 Basic standard : EN 61000-4-2
 Atmospheric pressure : between 86 kPa and 106 kPa
 Temperature : 25 °C
 Relative humidity : 42 %
 Performance criterion : B, ref. par 10.1 of EN 60945

Position	Test Volt. (kV)	Number of Discharges	Polarity +/-	Comments	Result
Display Unit, Plastic cover LCD	8	0	+	1	P
	8	0	-	1	P
Display unit, Push button	8	0	+	1	P
	8	0	-	1	P
Display unit, Enclosure	8	0	+	1	P
	8	0	-	1	P
--	--	--	--	--	--
	--	--	--	--	--
	--	--	--	--	--

Comments:

1. There is no corruption of operational software or loss of essential data (messages) after the test.
2. There is no degradation of performance of the EUT after the test.
3. The degradation of performance after the test is permissible and within the limits specified by the manufacturer.
4. --

Measurement uncertainty : It has been demonstrated that the ESD generator meets the specified requirements in the standard with at least a 95 % confidence.

Test equipment used: (Item numbers)	5, 7, 90
-------------------------------------	----------

4.10 Immunity to electrostatic discharge, Coupling plane (10.9)

EN 60945 reference : 10.9
Basic standard : EN 61000-4-2
Atmospheric pressure : between 86 kPa and 106 kPa
Temperature : 25 °C
Relative humidity : 42 %
Performance criterion : B, ref. par 10.1 of EN 60945

Position	Test Volt. (kV)	Number of Discharges	Polarity +/-	Comments	Result
Display Unit, Plastic cover LCD	6	10	+	1	P
	6	10	-	1	P
--	--	--	--	--	--
	--	--	--	--	--
--	--	--	--	--	--
	--	--	--	--	--
	--	--	--	--	--

Comments:

1. There is no corruption of operational software or loss of essential data (messages) after the test.
2. There is no degradation of performance of the EUT after the test.
3. The degradation of performance after the test is permissible and within the limits specified by the manufacturer.
4. --

Measurement uncertainty : It has been demonstrated that the ESD generator meets the specified requirements in the standard with at least a 95 % confidence.

Test equipment used: (Item numbers)	5, 7, 90
-------------------------------------	----------

5 Special purpose tests according to EN 60945 clause 11

According to EN 60945: 2002 fourth edition the following checks were performed:

Summary

Subclause	Performance requirement	Result
11.1	Acoustic noise and signals	P
11.2	Compass safe distance	NP

Results:

P : = pass

F : = fail

NA : = not applicable

NP : = not performed

5.1 Acoustic noise and signals

EN 60945 reference : 11.1
EUT : transceiver

Acoustic parameter	Observation	Result
Acoustic noise power	The product is not capable of generating any significant noise. Therefore this test has not been performed.	NP
Acoustic noise power of an alarm	Between 75 dB(A) and 85 dB(A)	NA

Measurement equipment: No Sound level meter was used.

5.2 Compass safe distance

EN 60945 reference : 11.2
Basic standard : ISO/R 694 and IEC 61000-4-8

Unit	Compass safe distance standard	Compass safe distance Steering	Result
Transceiver unit	--	--	NP

Comment: On request of the applicant this test was excluded.

6 Safety precautions according to EN 60945 clause 12

According to EN 60945:2002 fourth edition the following checks were carried out:

Summary

Subclause	Performance requirement	Result
12.1	Protection against accidental access to dangerous voltages	P
12.2	Electromagnetic radio frequency radiation	NP
12.3	Emission from visual display	NA
12.4	X-radiation	NA

Results:

P : = pass

F : = fail

NA : = not applicable

NP : = not performed

6.1 Protection against accidental access to dangerous voltages

EN 60945 reference : 12.1
Basic standard : IEC 60529, IEC 60071-2
EUT : Transceiver

Observation	Result
There are no openings in the EUT where the test probe can reach hazardous parts	P

6.2 Maintenance according to EN 60945 clause 13

According to EN 60945:2002 fourth edition the following checks were performed:

Observation	Result
The EUT is so designed that the main units can be replaced readily, on-board repair is possible without elaborate recalibration or readjustment.	P
The EUT is so constructed that it is readily accessible for inspection and maintenance purposes.	P

Results:

P : = pass

F : = fail

NA : = not applicable

NP : = not performed

7 Equipment manuals according to EN 60945 clause 14

According to EN 60945:2002 fourth edition the following checks were performed:

Observation	Result
The equipment manuals are checked according to the equipment standard EN 60945 clause 14 and EN 61993-2 clause 4.3	NP

Comment: On request of the applicant this test was excluded.

Results:

P : = pass

F : = fail

NA : = not applicable

NP : = not performed

8 Marking and identification according to EN 60945 clause 15

According to EN 60945:2002 fourth edition the following checks were performed:

Observation	Result
The equipment is marked with the following identification: a) Identification of the manufacturer. b) Equipment type identification. c) Serial number of the unit.	P

Results:

P : = pass

F : = fail

NA : = not applicable

NP : = not performed

Used test equipment module

This module contains the total list of test equipment used.

The following measurement equipment is used at Telefication:

Ref	Description	Ident.	Manufacturer	Model
1	EFT generator	TE 00760	Keytek	E411
2	EFT/surge coupler	TE 00759	Keytek	E4551
3	Capacitive clamp	TE 00761	Keytek	CCL-4/S
4	Controller (A07)	TE 00023	Keytek	E103
5	ESD simulator	TE 00516	Keytek	MZ-15/EC
6	ESD air discharge tip	TE 00755	Keytek	TPA-2
7	ESD contact discharge tip	TE 00709	Keytek	TPC-2
8	Surge comb. wave generator	TE 00757	Keytek	E501A
9	Surge telecom wave gen.	TE 00022	Keytek	E502A
10	Surge coupler/decoupler	TE 00758	Keytek	E571
11	Logper/bow-tie antenna (Anec)	TE 00700	EMCO	3143
12	Biconical antenna	TE	Schwarzbeck	BBA 9106
13	RF amplifier	TE 00750	Kalmus	737FC
14	RF generator	TE 00474	Adret	7200A
15	Isotropic field sensor	TE 00748	Holaday	HI-4422
16	Fiber optic RS232 interface	--	Holaday	HI-4413G
17	System readout	TE 00749	Holaday	HI-4416
18	Antenna tower	--	HD	AS 620p
19	Turntable	--	HD	DS 412
20	Turntable controller	--	HD	HD 050
21	RF voltmeter	TE 00707	Boonton	9200B
22	40 dB coupler	TE 00752	Kalmus	DC100HHR
23	RF probe (2x)	TE 00753 TE 00754	Boonton	952001B
24	Artificial mains network	TE 00208	R & S	ESH2-Z5

Ref	Description	Ident.	Manufacturer	Model
25	Test receiver	TE 00205	R & S	ESH3
26	Pulse limiter	TE 00227	R & S	ESH3-Z2
27	Spectrum analyzer	TE 00094 TE 00095	R & S	FSB Display
28	Test receiver	TE 00091	R & S	ESV(P)
29	Antenna mast	--	EMCO	1070
30	Turn table	--	EMCO	1060-2M
31	Absorbing clamp	TE 00777	R & S	MDS 21
32	Anechoic chamber	--	Euroshield	RFD-F-100
33	Open Area Test Site	--	Telefication	--
34	Power/Arb waveform source	TE 00711	Keytek	EP72
35	Reference impedance	TE 00712	Keytek	ERI-1
36	Power analyzer	TE 00763	Xitron Technologies	2501AH
37	AC power simulator	TE 00762	Kikusui	PCR4000L
38	RF Signal generator 5.4 GHz	TE 00379	Marconi	2042
39	RF amplifier	TE 00515	Amplifier Research	25A250A
40	T-network	TE 00026	R & S	ESH3-Z4
41	--	--	--	--
42	Power meter	TE 00414	R & S	NRVS
43	Measurement probe	TE 00415	R & S	URV5-Z4
44	Attenuator 6 dB	TE 00514	Narda	766-6
45	Pulse generator	TE 00225	HP	8012 B
46	Coaxial coupl./dec. network	TE 00766	Telefication	CDN-S1
47	Voltage swell/DIP/interrupt source	TE 00710	Keytek	EP62

Ref	Description	Ident.	Manufacturer	Model
48	Digital multi-meter	TE 00329	Fluke	Fluke 87
49	--	--	--	--
50	EM clamp	TE 00764	Lüthi	EM101
51	Ferrite tube	TE 00765	Lüthi	FTC101
52	Distortion meter	TE 00416	HP	HP 8903 B
53	Artificial Mains Network	TE	Telefication	JOZ191194
54	Double Ridged Guide Antenna	TE 00532	EMCO	3115
55	Log periodic antenna	TE 00744	EMCO	3147
56	Modulation analyzer	TE 00412	R & S	FAM
57	Audio amplifier	TE 00517	Solar Electronics	6552-1A
58	Acoustic Pipe Coupler	TE 00775	Telefication	JOZ110395
59	Antenna	--	Kathrein	K 51164
60	Pulse modulator	TE 00708	Schaffner	CPM9830
61	RF power amplifier	TE 00714	Schaffner	CBA9546
62	Adjustable transformer	--	KSL	RU8
63	100 µF decoupling capacitor	TE 00769	Telefication	JOZ
64	Mains coupling/decoupling Network	TE 00767	Telefication	CDN-M2/M3
65	Coupling/decoupling device for screened cables	TE 00771	MEB	CDN-S25
66	Audio isolation transformer	TE 00772	Solar	6220-2
67	Current probe	TE 00773	Eaton	93686-2
68	Triple loop antenna	TE	Telefication	--
69	Pre-amplifier	TE 00344	R&S	ESV-Z3

Ref	Description	Ident.	Manufacturer	Model
70	800 mm strip line	--	Telefication	--
71	Measurement probe	TE 00009	R & S	URV5-Z2
72	Standard gain horn antenna	TE 00602	Scientific Atlanta	12-1.7
73	Frequency doubler	TE 00569	HP	11721A
74	Microwave amplifier	TE 00124	HP	8349A
75	Preamplifier	TE 00092	HP	8449B
76	Spectrum analyzer	TE 00481	HP	8563E
77	Controller (A010)	TE 00713	Keytek	E103
78	Arbitrary waveform generator	TE 00144	HP	33120A
79	Power supply	TE 00362	Kepco	BOP100
80	Oscilloscope	TE 00129	Nicolet	Pro34
81	Coupling/decoupling network	TE 00796	Schaffner	ISN T444
82	Environmental chamber	TE 00741	CTS	C-40/350
83	Pre-amplifier 0.01 - 30 MHz, 20dB	TE 00036	JOZ	20dB
84	RF Power amplifier 1 - 2 GHz, 30 Watt	TE 00714	Schaffner	GRF5046
85	DC Power supply	TE 00170	Delta	SM 7020
86	Power supply 0 - 100 volt, 1 Ampere	TE 01057	HP	HP6634A
87	RF signal generator 5.4 GHz	TE 00427	Marconi	2042
88	CDN 4 wire (2x2) balanced	TE 00201	R & S	EZ10
89	CDN screened 25 wire	TE 00771	MEB	S25
90	DC Power supply	TE 00849	Delta	SM 6020

Photographs module

List of Photographs

Photograph 1: <i>Assembled view transponder</i>	56
Photograph 2: <i>Display MT-1 VDU</i>	57
Photograph 3: <i>Label Transponder</i>	58
Photograph 4: <i>Display rear side enclosure</i>	59
Photograph 5: <i>Radiated immunity 1 - 2 GHz Set-up</i>	60
Photograph 6: <i>Radiated immunity 1 - 2 GHz test equipment</i>	61
Photograph 7: <i>Radiated immunity 30 MHz - 1 GHz</i>	62
Photograph 8: <i>Radiated emissions 150 kHz - 30 MHz</i>	63
Photograph 9: <i>Conducted immunity</i>	64
Photograph 10: <i>Damp heat set-up</i>	65
Photograph 11: <i>ESD</i>	66
Photograph 12: <i>EFT</i>	67
Photograph 13: <i>Vibration(1)</i>	68
Photograph 14: <i>Vibration(2)</i>	69

Photograph 1: *Assembled view transponder*



Photograph 2: *Display MT-1 VDU*



Photograph 3: *Label Transponder*



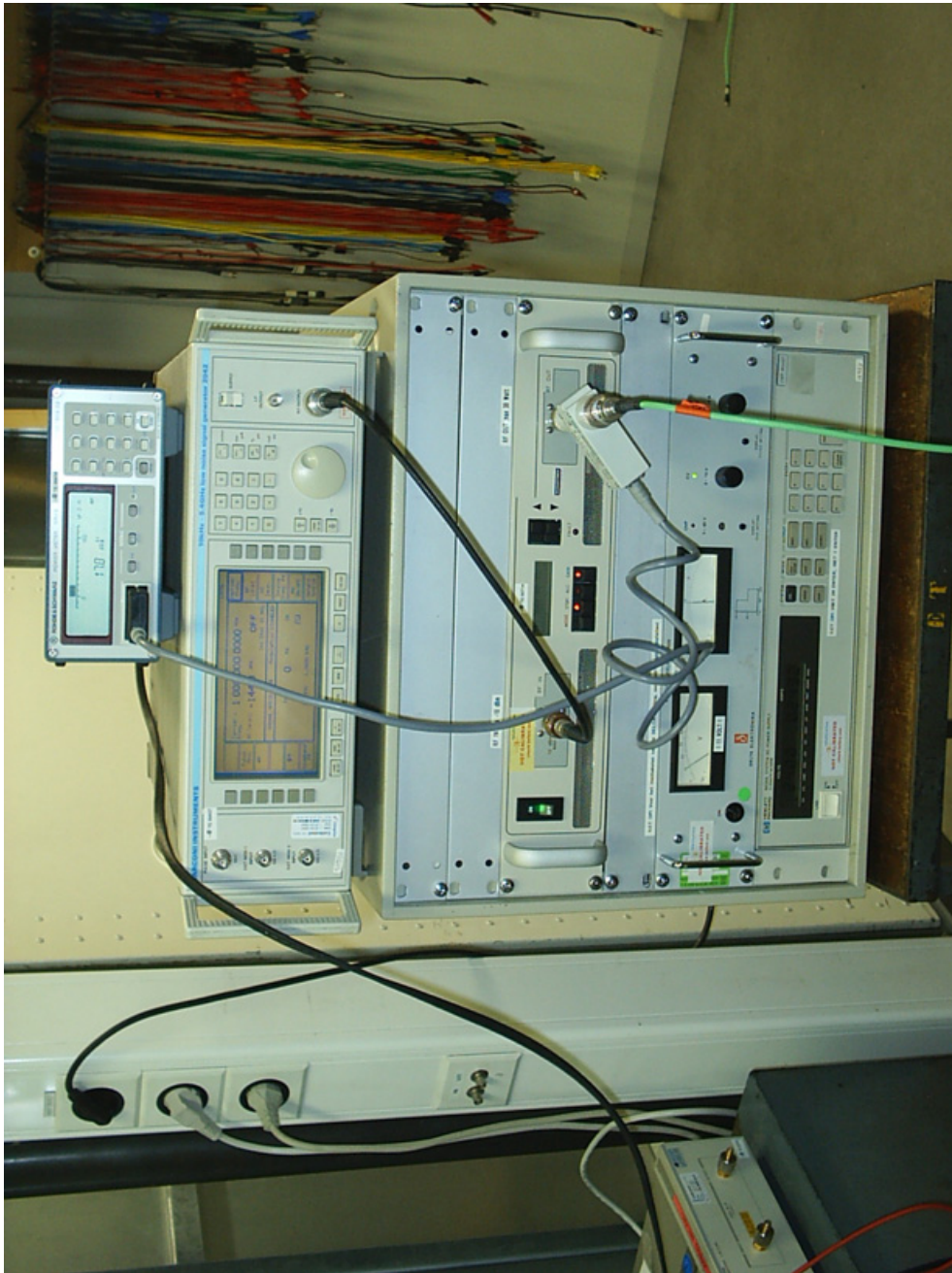
Photograph 4: *Display rear side enclosure*



Photograph 5: *Radiated immunity 1 - 2 GHz Set-up*



Photograph 6: *Radiated immunity 1 - 2 GHz test equipment*



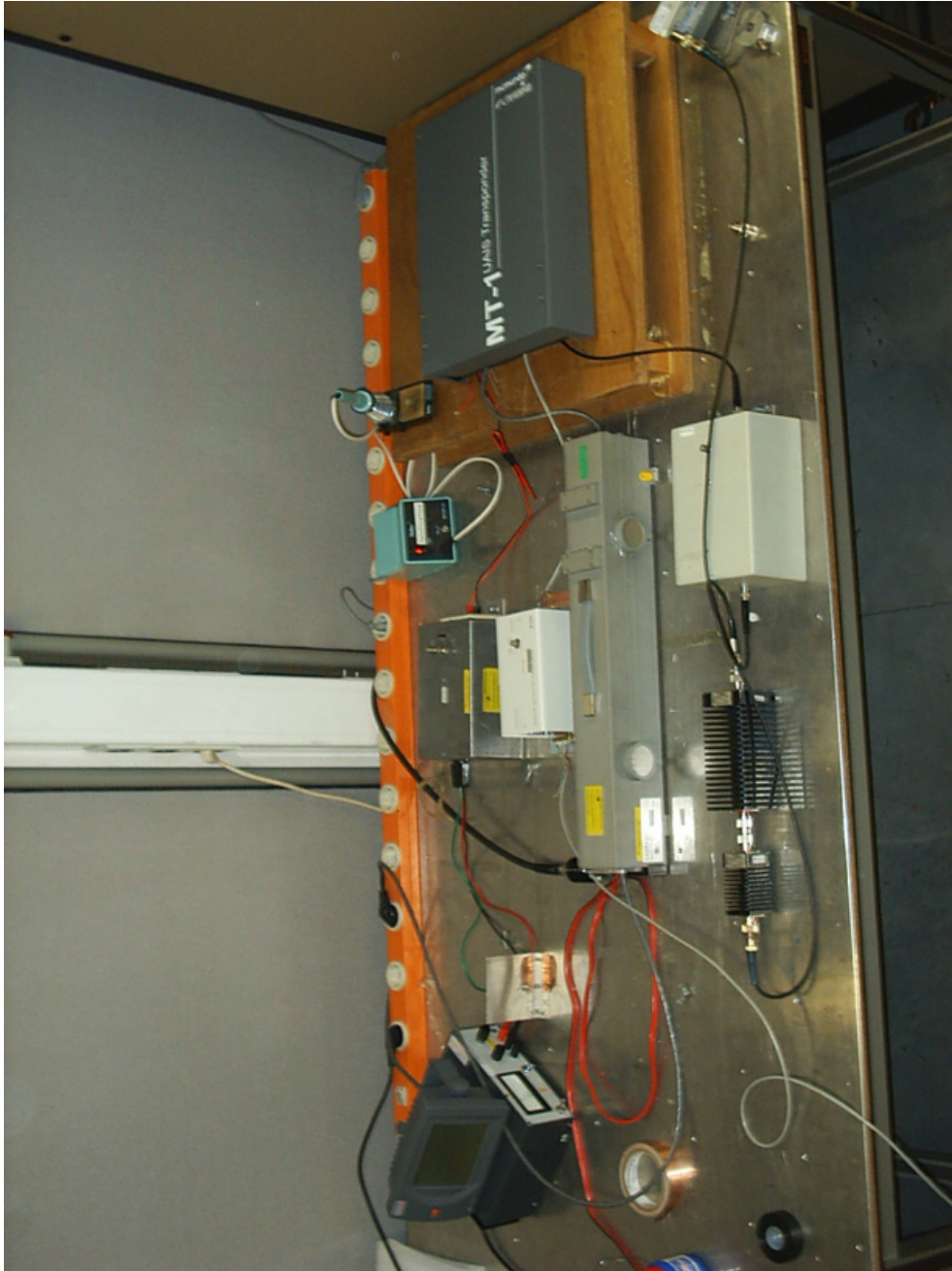
Photograph 7: *Radiated immunity 30 MHz - 1 GHz*



Photograph 8: *Radiated emissions 150 kHz - 30 MHz*



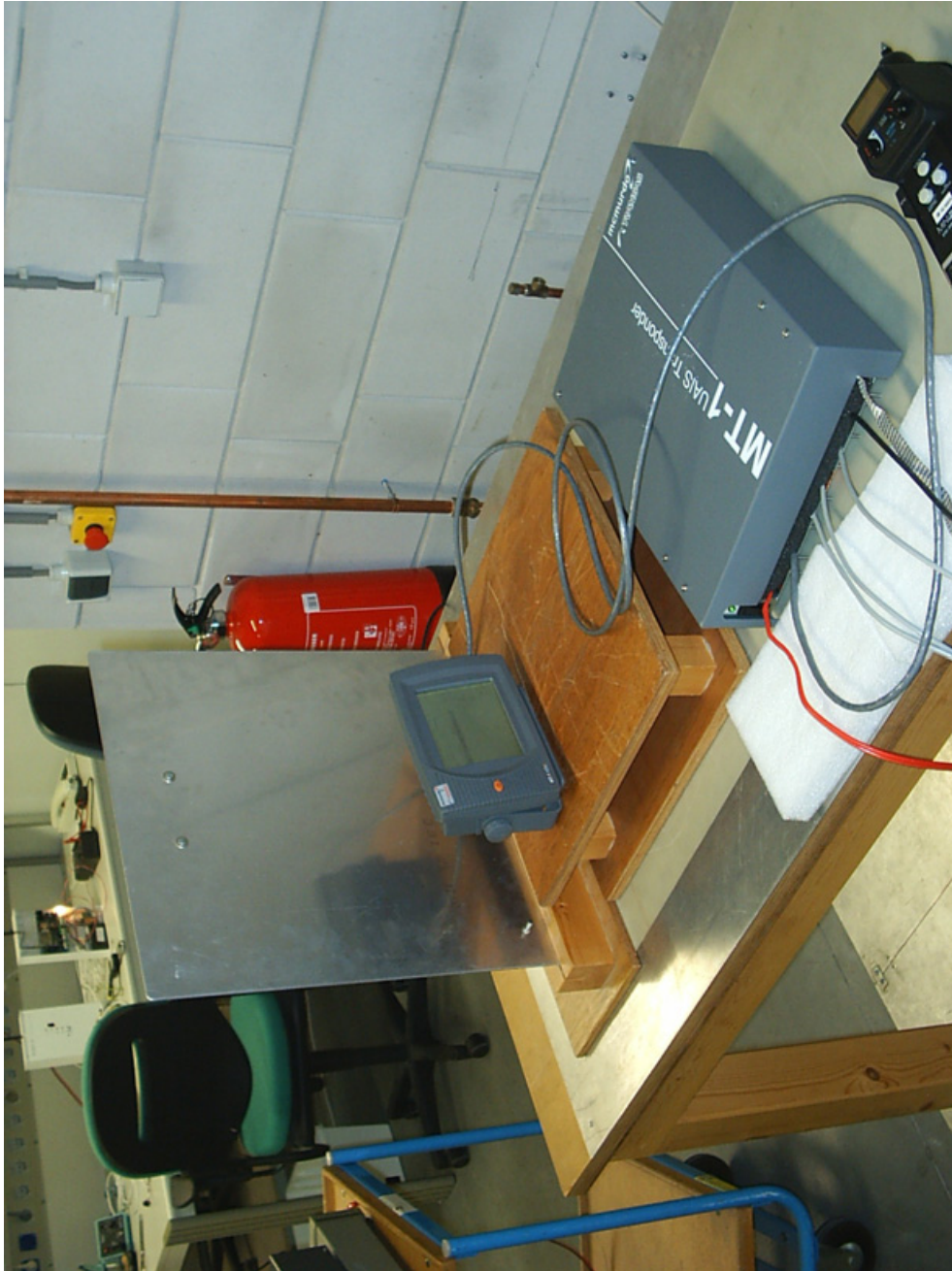
Photograph 9: *Conducted immunity*



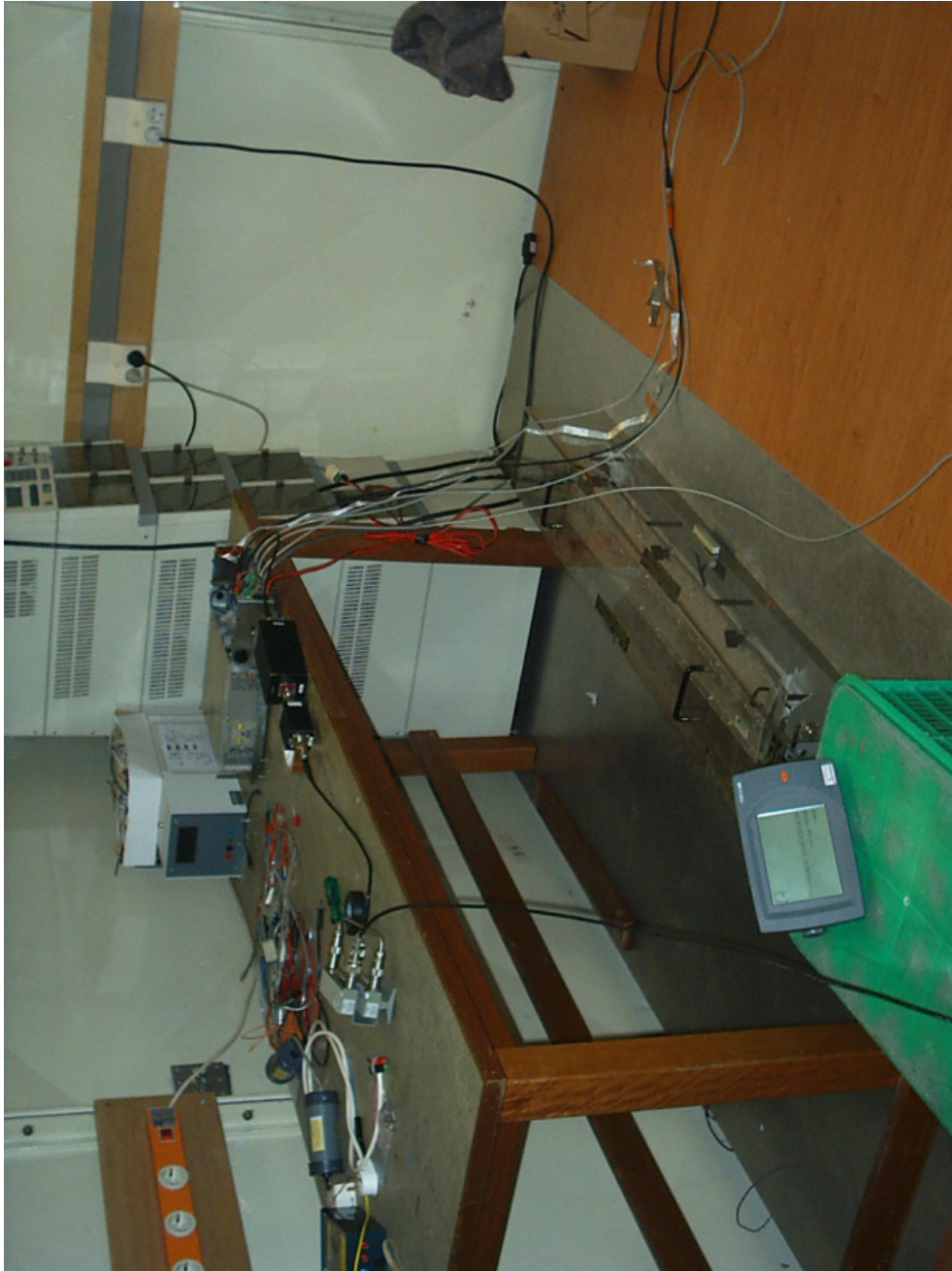
Photograph 10: *Damp heat set-up*



Photograph 11: *ESD*



Photograph 12: *EFT*



Photograph 13: *Vibration(1)*



Photograph 14: *Vibration(2)*



Additional information module

This module contains no pages of information provided by the applicant.