

Pages : 23
Annexes : 2
Total no. of sheets: 35

Exempt from public disclosure
cf. Section 5a of the Freedom of Information Act.

**The Laboratory of the Norwegian Post
and Telecommunications Authority**

Office address: Gåsevikveien 8, Kjeller
Postal address: P.O.Box 96, N-2027 Kjeller
Telephone: +47 22 82 49 00
Facsimile: +47 22 82 49 90
E-mail: comlab@npt.no
<http://www.npt.no/comlab>
Enterprise no: NO 974 446 871

Test report : 00/08216/6

Item tested : F1 DSC

Type of equipment : Maritime VHF

Client : McMurdo Ltd.

Tested according to :

ETS 300 828, EN 301 025-1
IEC 945,
IEC 945, (IEC 60945 ed.4, data of circulation 2001-02-02)

Date of issue : 2001. 12. 21

Authorised by :


.....
Kjell Haga
Head of Section


.....

Technical Supervisor

The results detailed in this test report are only valid for the particular sample/s tested with configuration as implemented during the test procedure.

This test report shall not be reproduced except in full without the written approval of Comlab.

CONTENTS

1	GENERAL INFORMATION	3
1.1	Test Laboratory	3
1.2	Client Information	3
1.3	Manufacturer (if other than client)	3
2	TEST INFORMATION	4
2.1	Test Item	4
2.2	Test Environment	4
2.2.1	Normal Test Conditions	4
2.3	Test Period	4
2.4	Standards and Regulations	4
2.5	Test Engineer/s	4
2.6	Additional information	4
2.6.1	Test Methods	4
2.6.2	Selection Criteria	4
2.6.3	Test Equipment	4
3	TEST REPORT SUMMARY	5
3.1	Abbreviations	5
3.2	List of measurements	5
4	OTHER COMMENTS	6
5	EMISSION MEASUREMENTS	7
5.1	Cabinet Radiation Transmitter operating EN 301 025-1	7
5.2	Cabinet Radiation Transmitter in standby / Receiver EN 301 025-1	8
5.3	Radiated Emission on the Enclosure Port.	9
5.4	Conducted Emission on the Power Supply Port.	10
6	IMMUNITY TESTS	11
6.1	Electromagnetic Field Immunity on the Enclosure Port. Receiver	11
6.2	Electromagnetic Field Immunity on Enclosure Port. Transmitter	14
6.3	Conducted RF Immunity Test on Input/Output Ports. Receiver	16
6.4	Conducted RF Immunity Test on Input/Output Ports. Transmitter	18
6.5	Electrostatic Discharge (ESD) Immunity Test. EN 61000-4-2	20
6.6	Electrical Fast Transient/Burst (EFT/B) Immunity Test. EN 61000-4-4	21
7	TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS	22
	Annex 1 - Illustrations and plottings	11 pages
	Annex 2 - Photographs	1 page

1 GENERAL INFORMATION

1.1 Test Laboratory

Name : Comlab
Address : Gåsevikveien 8, P.O. Box 96
N-2007 Kjeller, Norway
Telephone : +47 22 82 49 00
Telefax : +47 22 82 49 90
Test service manager : Kjell Haga

Comlab is granted accreditation by Norwegian Accreditation under the registration number P031.

1.2 Client Information

Name : McMurdo Ltd.
Address : Silver Point
Airport Service Road
Portsmouth
PO3 5BP
United Kingdom
Telephone : + 44 2392623900
Telefax : + 44 2392623997
Contact:
Name : Steffen Kirknes

Address : Norbit AS
Stiklestadveien 1, N-7041 Trondheim
P.O.B. 1858, N-7440 Trondheim
Norway
Telephone : + 47 73 98 25 50
Telefax : + 47 73 98 25 51

1.3 Manufacturer (if other than client)

Name : -
Address : -
Telephone : -
Telefax : -

2 TEST INFORMATION

2.1 Test Item

Name : F1 DSC
Model/version : Standard
Serial number : 20
Software identity and version : -

2.2 Test Environment

2.2.1 Normal Test Conditions

Temperature : 21,5 - 22,5 °C
Relative humidity : 26,5 - 28,3 %
Normal test voltage : 13,2 V dc

The values are the limits registered during the test period.

2.3 Test Period

Test item received date : 071101
Test period : from 071101 to 061201

2.4 Standards and Regulations

ETS 300 828 (V1.1.1, 1998-03), EN 301 025-1 (V.1-1-2, 2000-08)
IEC 945 (third edition 1996-11)
IEC 945, (IEC 60945 ed.4, data of circulation 2001-02-02)

2.5 Test Engineer/s

Knut Risting Hanssen, Per Magne Tveiten, Egil Hauger

2.6 Additional information

2.6.1 Test Methods

Relevant standards.

2.6.2 Selection Criteria

According to clients wish.

2.6.3 Test Equipment

List of used test equipment, see page no. 22 and 23.

3 TEST REPORT SUMMARY

3.1 Abbreviations

- P** Passed, the equipment fulfils the requirement
F Failed, the equipment does not fulfil the requirement
I Inconclusive, the test does not give a conclusive verdict
NA Not applicable, the requirement is not applicable
NT Not tested, the test is not performed even though the requirement is relevant

3.2 List of measurements

Standard		Measurement	Result (Pass/Fail)
EN 301 025-1	5.1	Cabinet Radiation.... Transmitter operating	P
EN 301 025-1	5.2	Cabinet Radiation.... Transmitter in standby	P
IEC 945, IEC 60945 ed.4	5.3	Radiated Emission on the Enclosure port	P
EN 300 828, IEC 945	5.4	Conducted Emission 0.01 - 30 MHz on the power supply Port	P
EN 300 828, IEC 945 IEC 60945 ed.4	6.1	Radiated, radio-frequency electromagnetic field -	P
	6.2	Immunity test	P
EN 300 828, IEC 945	6.3	Immunity to conducted disturbances, induced by radio-	P
	6.4	frequency fields	P
EN 61000-4-2	6.5	Electrostatic discharge (ESD) immunity test	P
EN 61000-4-4	6.6	Electrical fast transient/burst (EFT/B) immunity test	P

Result

Tested equipment complies with the requirements of relevant standards.

4 OTHER COMMENTS

Measurement conditions:

All measurements of conducted emission are performed inside a screened room with a size >2m x 2m x 2m.

Radiated, radio-frequency immunity tests are performed in a 10 m semi - anechoic chamber.

Specific conditions of use:

Modifications has been performed during the measurement.

Decoupling during the ESD test.

More turns on some ferrite cores. A 330 µF across the dc power line.

Better grounding on the transmitter power amplifier. This modifications was performed before the the two last measurements. (5.1/ 5.2, 5.4)

Electromagnetic field immunity, and fieldstrength measurements in the range 1-2 GHz are not accredited measurements.

The fieldstrength of 10 V/m in the frequency range 1-2 GHz, was monitored with a field probe at a distance of about 1 meter from the EUT.

Performance criteria:

Performance criteria A for continuous phenomena:

The EUT shall continue to operate as intended during and after the test. During the test sequence the EUT shall not change settings and shall not unintentionally transmit. No degradation of performance or loss of function below the level as defined in the relevant equipment standard and in the technical specification published by the manufacturer is allowed.

During the test the EUT shall be subjected to the performance check. The requirements of the performance check shall be met.

Performance criteria B for transient phenomena:

During the test sequence, degradation, or loss of function or performance which is self recoverable is allowed, but the EUT shall not unintentionally transmit or change actual operating state or stored data.

The EUT shall continue to operate as intended after the test. No degradation of performance or loss of function below the level as defined in the relevant equipment standard and in the technical specification published by the manufacturer is allowed.

After the test the EUT shall be subjected to the performance check. The requirements of the performance check shall be met.

5 EMISSION MEASUREMENTS**5.1 Cabinet Radiation Transmitter operating
Clause 8.9****EN 301 025-1**

Power level 20W. Ch. 16.

Spurious Emission Level			
Frequency MHz	Polariz. V/H	BW kHz	Level μ W
940,4	H	15	0,025
30 - 1000	V/H	15	< 0,025
1097,6	V	15	0,06
1000 - 2000	V/H	15	< 0,025
Measurement Uncertainty : +2,1dB / -2,5dB, (25-1000 MHz) +1,6 dB / -1,8 dB (1-8 GHz)			

Reference antenna: Up to 1 GHz: dipole. Above 1GHz: isotropic.
 Bandwidth (kHz) refers to the bandwidth of the measuring receiver.

A prescan has been performed in order to detect possible spurious emissions (30 - 2000 MHz)**Limits Clause 8.9.3**

Frequency	Level
30 MHz - 2 GHz	< 0,25 μ W

Test Equipment Used: LR 0061, LR 282, LR 1062, LR 1178, LR 1230, LR 1237, LR 1330

5.2 Cabinet Radiation Transmitter in standby / Receiver**EN 301 025-1****Clause 8.9, 10.7.**

Ch. 16.

Spurious Emission Level			
Frequency MHz	Polariz. V/H	BW kHz	Level nW
30 - 1000	V/H	15	< 0,2
1000 - 2000	V/H	15	< 0,2
Measurement Uncertainty : +2,1dB / -2,5dB, (25-1000 MHz) +1,6 dB / -1,8 dB (1-8 GHz)			

Reference antenna: Up to 1 GHz: dipole. Above 1GHz: isotropic.
 Bandwidth (kHz) refers to the bandwidth of the measuring receiver.

A prescan has been performed in order to detect possible spurious emissions (30 - 2000 MHz)

Limits Clause 8.9.3 / 10.8.3

Frequency	Level
30 MHz - 2 GHz	< 2 nW

Test Equipment Used: : LR 0061, LR 282, LR 1062, LR 1178, LR 1230, LR 1237, LR 1330

5.3 Radiated Emission on the Enclosure Port.

IEC 945, IEC 60945 ed. 4

Clause 9

Frequency range	Limits Q-Peak	Measurement Uncertainty ²⁾	Annex no.:	Pass / Fail
150 kHz - 300 kHz	80 dB μ V/m - 52 dB μ V/m *	+1,8 / -2,1 dB	1 ¹⁾ (page 1)	P
300 kHz - 30 MHz	52 dB μ V/m - 34 dB μ V/m *	+1,8 / -2,1 dB	1 (page 1)	P
30 MHz – 200 MHz	54 dB μ V/m, except 156 MHz - 165 MHz	+3,3 / -4,4 dB (up to 200 MHz) +2,9 / -3,6 dB	1 (page 2 and 3)	P
156 MHz – 165 MHz	24 dB μ V/m *	+3,3 / -4,4 dB	1 (page 4 and 5)	P
200 MHz - 2 GHz	54 dB μ V/m **	+2,9 / -3,6 dB (from 200 MHz)	1 (page 6, 7, 8 and 9)	P

1) The noise level are mainly caused by external noise.

2) Measurement Uncertainty at a measuring distance of 10 m.

The annexes show a peak value. However this values are far below the limits.

* Limits in IEC 945

** Limits in IEC 60945 ed. 4.

Test Equipment Used: LR 0061, LR 0285, LR 1062, LR 1178, LR 1237, LR 1414

5.4 Conducted Emission on the Power Supply Port.

EN 300 828, IEC 945 (Clause 9)

Scan (Max Peak)

EMC receiver with following settings:

Frequency			Settings		
Start	Stop	Step	IF BW	Detector	Meas Time
10 KHz	150 kHz	0,1 kHz	200 Hz	MaxPeak	5.0 mS
0.150 MHz	30.0 MHz	4.5 kHz	9 kHz	MaxPeak	5.0 mS

Cable configuration during test

According to IEC 945

EUT mode during test

Receive and transmitting modes.

Results

See annex no.: 1 page 10 and 11 for "Max Peak"-plot

Each plot consists of two measurements.; voltage on the plus /minus terminal to earth.

Comments:

If no signals greater than the Q-peak limit are found, it is assumed that the Q-peak measurements are not necessary to perform.

Conducted Emission at the power supply port (Q-peak and Average detector):

EUT RX ch 16 TX ch 14	Frequency	Detector (Q-peak/Average)	Level, Voltage (dB μ V)	Result (Pass/Fail)
RX	-	P	<< limit	Pass
TX	-	P	<< limit	Pass
Limits: 96 - 50 dB μ V 60 - 50 μ V 50 μ V	0.01 kHz - 0,150 kHz 0,150 kHz - 350 kHz 350 kHz - 30 MHz	Q-peak Q-peak Q-peak		
Measurement Uncertainty : +2,9 / -4,1 dB				

Test Equipment Used: LR 0061, LR 1063, LR 1074, LR 1076, LR 1089, LR 1090

6 IMMUNITY TESTS

6.1 Electromagnetic Field Immunity on the Enclosure Port. Receiver

EN 300 828,
IEC 945, IEC 60945 ed.4 (Clause 10)

The test is performed in a semi anechoic chamber.

Test signal

Test generator settings:

Frequency				Settings		
Start	Stop	Step	Dwell-time	Modulation	Mod.freq.	Field strength
80 MHz	1000 MHz	1 %	Ca.2.0 sec.	80 %	400 Hz	10V/m (-0/+6dB)
1000 MHz	2000 MHz	10 MHz	ca.2.0 sec.	80 %	400 Hz	10V/m (-0/+6dB)

Exclusion band (if any):

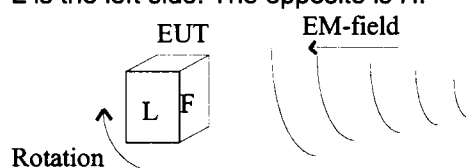
146,025 MHz-172,025 MHz. Unless otherwise stated; the test is performed **without** an exclusion band.

Cable configuration during test

See test setup. Annex 2.

EUT configuration during test

F is the initial position. (Front facing the EM field, EUT upside down). The opposite side of F is B.
L is the left side. The opposite is H.



EUT mode during test

The EUT was monitored on channel 16 and 70. The SINAD ratio was observed.

The speaker terminal was terminated i 8 Ω . Unless otherwise noted the level was 160-170 mV.

The demodulated output of ch. 70 was terminated in 32 Ω outside the EUT (screened multicable)

Performance criteria for EUT

Performance criteria A.

Criteria : 20 dB SINAD for ch. 16, and 8 dB SINAD for ch. 70 (DSC).

See note on the next side.

The test level was ≥ 15 V/m

6.1 Electromagnetic Field Immunity on the Enclosure Port. Receiver EN 300 828, IEC 945, IEC 60945 ed. 4 (Clause 10)

Results :

Polarization		Frequency (MHz)	EUT position (side facing EM- field)	Field strength (V/m)	Criteria (se Note)		
V	H				During test, dB SINAD		After test
					Ch. 16	Ch. 70	
	H	180	F	10	24,8	*	None degradation
	H	318	F	10	>25	*	-
	H	389	F	10	28	*	-
	H	80-1000	B	10	>25	*	-
	H	146,3	R	10	21,9	*	-
	H	170,8	R	10	21,2	*	-
	H	380,5	R	10	25,9	*	-
	H	722,3	R	10	28,9	*	-
	H	1000-2000	F	≥15	>30**	*	-
	H	1020	L	≥15	>30**	-	-
	H	1020	L	10	*	23,4**	-
	H	1000-2000	B	≥15	>30**	>30**	-
Field generation uncertainty: +2,1/-2,4 dB (80 -1000 MHz) < 3dB (1000-2000 MHz), Field Probe							

** Speaker level 1 V across 8 Ω. 125 mW.

An increasing speaker level will greatly improve the SINAD ratio.

The previous speaker level 160-170 mV across 8 Ω, 32-36 mW, is a relative low level.

Note:

Numbering refers to the following criterias:

- *) None or slight degradation of the SINAD ratio; several dB above the limit's.
Otherwise normal performance within the specification limits.
- 1) Normal performance within the specification limits.
- 2) Temporary degradation or loss of function or performance which is self-recoverable.
- 3) Temporary degradation or loss of function or performance which requires operator intervention or system reset.
- 4) Degradation or loss of function which is not recoverable due to damage of equipment (components) or software, or loss of data.

Test Equipment Used: LR 0282, LR 1006, LR 1062, LR 1087, LR 1201, LR 1330, LR 1347, LR 1352, LR 1354, LR 1404

6.1 Electromagnetic Field Immunity on the Enclosure Port. Receiver EN 300 828, IEC 945, IEC 60945 ed. 4 (Clause 10)

Results :

Polarization		Frequency (MHz)	EUT position (side facing EM- field)	Field strength (V/m)	Criteria (se Note)		
V	H				During test, dB SINAD		After test
					Ch. 16	Ch. 70	
V		164,6	R	10	14,8	*	None degradation
V		258,4	R	10	22,9	*	-
V		148,7(147,7**)	B	10	21,7(29,3**)	*	-
V		161,8	B	10	13,1	*	-
V		184,6	B	10	21,3	*	-
V		195,5	B	10	22,6	*	-
V		1000	B	10	*	24	-
V		128,5	F	10	21,4	*	-
V		154	F	10	17,8	*	-
V		830	F	10	*	>15	-
V		830	F	10	*	>15	-
V		986,6	F	10	*	19,7	-
V		1000	F	10	*	17,5 (28,4**)	-
V		1000-2000	B, L	>15	>30**	>30**	-
V		1000-2000	F	10	*	28,4**	-
Field generation uncertainty: +2,1/-2,4 dB (80 -1000 MHz) < 3dB (1000-2000 MHz), Field Probe							

** Speaker level 1 V across 8 Ω . 125 mW.

An increasing speaker level will dramatically improve the SINAD ratio.

The previous speaker level 160-170 mV across 8 Ω , 32-36 mW, is a relative low level.

Note:

Numbering refers to the following criterias:

- *) None or slight degradation of the SINAD ratio; several dB above the limit's.
Otherwise normal performance within the specification limits.
- 1) Normal performance within the specification limits.
- 2) Temporary degradation or loss of function or performance which is self-recoverable.
- 3) Temporary degradation or loss of function or performance which requires operator intervention or system reset.
- 4) Degradation or loss of function which is not recoverable due to damage of equipment (components) or software, or loss of data.

Test Equipment Used: LR 0282, LR 1006, LR 1062, LR 1087, LR 1201, LR 1330, LR 1347, LR 1352, LR 1354, LR 1404

6.2 Electromagnetic Field Immunity on Enclosure Port. Transmitter

**EN 300 828,
IEC 945, IEC 60945 ed.4 (Clause 10)**

The test is performed in a semi anechoic chamber.

Test signal

Test generator settings:

Frequency				Settings		
Start	Stop	Step	Dwell-time	Modulation	Mod.freq.	Field strength
80 MHz	1000 MHz	1 %	Ca.2.0 sec.	80 %	400 Hz	10V/m (-0/+6dB)
1000 MHz	2000 MHz	10 MHz	ca.2.0 sec.	80 %	400 Hz	10V/m (-0/+6dB)

Exclusion band (if any):

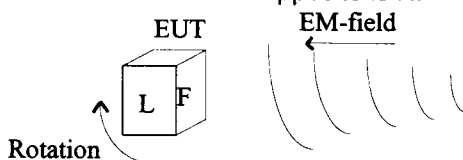
146,025 MHz-172,025 MHz. Unless otherwise stated; the test is performed **without** an exclusion band.

Cable configuration during test

See test setup. Annex 1.

EUT configuration during test

F is the initial position. (Front facing the EM field, EUT upside down). The opposite side of F is B.
L is the left side. The opposite is H.

**EUT mode during test**

The EUT was monitored on channel 16 with max. transmitting power (ca. 20 W). The SINAD ratio of the demodulated output was observed. The RF spectrum, frequency, and power was also observed. The EUT was modulated via an acoustic coupler.

Performance criteria for EUT

Performance criteria A.

Criteria : 20 dB SINAD.

See note on the next side.

The test level was ≥ 15 V/m

6.2 Electromagnetic Field Immunity on Enclosure Port. Transmitter

EN 300 828,
IEC 945, IEC 60945 ed. 4 (Clause 10)

Results :

Polarization		Frequency (MHz)	EUT position (side facing EM- field)	Field strength (V/m)	Criteria (se Note)	
V	H				During test dB sinad	After test
X		770	F	10	30	None degradation
X		80-1000	B	15	>28	-
X		80-1000	L	15	>28	-
	X	80-1000	L	15	>28	-
	X	80-1000	B	15	>28	-
	X	80-1000	F	15	>29	-
	X	1000-2000	all	10	>25	-
X		1000-2000	all	10	>25	-
Field generation uncertainty: +2,1/-2,4 dB (80 -1000 MHz) < 3dB (1000-2000 MHz), Field Probe						

Note:

Numbering refers to the following criterias:

- *) None or slight degradation of the SINAD ratio; several dB above the limit's.
Otherwise normal performance within the specification limits.
- 1) Normal performance within the specification limits.
- 2) Temporary degradation or loss of function or performance which is self-recoverable.
- 3) Temporary degradation or loss of function or performance which requires operator intervention or system reset.
- 4) Degradation or loss of function which is not recoverable due to damage of equipment (components) or software, or loss of data.

Test Equipment Used: LR 0282, LT 0642, LR 1006, LR 1018, LR 1062, LR 1087, LR 1201, LR 1259, LR 1330, LR 1337, LR 1347, LR 1352, LR 1354, LR 1404

6.3 Conducted RF Immunity Test on Input/Output Ports. Receiver**EN 300 828,
IEC 945 (Clause 10)****Test signal**

Test generator settings:

Frequency				Settings		
Start	Stop	Step	Dwell-time	Modulation	Mod.freq.	Voltage
10 kHz	150 kHz	10 kHz	2 sec.	80 %	400 Hz	3V (EMF)
150 kHz	5 MHz	50 kHz	2 sec.	80 %	400 Hz	3V (EMF)*
5 MHz	80 MHz	1 %	2 sec.	80 %	400 Hz	3V (EMF)*

* 10V (EMF) at some spot frequencies.

Exclusion band (if any):

None

Test method:

All measurements in the frequency range 10 kHz - 150 kHz are performed with a clamp.

All measurements up to 80 MHz on the multicable are also performed with a clamp.

EUT mode during test

The EUT was monitored on channel 16 and 70. The SINAD ratio was observed.

The speaker terminal was terminated i 8 Ω . Unless otherwise noted the level was 160-170 mV.The demodulated output of ch. 70 was terminated in 32 Ω outside the EUT (screened multicable)**Performance criteria for EUT**

Performance criteria A.

Criteria : 20 dB SINAD for ch. 16, and 8 dB SINAD for ch. 70 (DSC).

See note below.

Results

Port (DC, Ant, Speaker, multicable)	Frequency (MHz)	Voltage (V EMF)	Criteria (se Note)		
			During test , dB SINAD		After test
			Ch. 16	Ch. 70	
Speaker, DC	10 kHz-80 MHz	5	> 35	> 35	None degradation
Ant	10 kHz-80 MHz	3	> 35	> 33	None degradation
Multicable	10 kHz-80 MHz	3	> 36	> 35	None degradation
Measurement uncertainty: +3,3 / -3,7dB					

Note:

Numbering refers to the following criterias:

- 1) Normal performance within the specification limits.
- 2) Temporary degradation or loss of function or performance which is self-recoverable.
- 3) Temporary degradation or loss of function or performance which requires operator intervention or system reset.
- 4) Degradation or loss of function which is not recoverable due to damage of equipment (components) or software, or loss of data.

Test Equipment Used: LR 0061, LR 1010, LR 1025, LR 1066, LR 1087, LR 1091, LR 1117, LR 1152, LR 1153, LR 1155, LR 1201, LR 1312, LR 1313, LR 1315, LR 1316, LR 1318, LR 1320, LR 1353

6.3 Conducted RF Immunity Test on Input/Output Ports. Receiver EN 300 828, IEC 945 (Clause 10)

Test signal

10 V (EMF) at some spot frequencies.

Results

Port (DC, Ant, Speaker, multicable)	Frequency (MHz)	Voltage (V EMF)	Criteria (se Note)		
			During test , dB SINAD		After test
			Ch. 16	Ch. 70	
Speaker, DC	2, 3, 4, 6.2, 8.2 , 12.6	10	> 33	> 35	None degradation
Speaker, DC	16.5, 18.8, 22, 25	10	> 35	> 35	None degradation
Ant	2, 6.2, 8.2 , 12.6	10	> 35	> 26	None degradation
Ant	16.5, 18.8, 22, 25	10	> 35	> 29	None degradation
Ant	3, 4	10	> 35	> 20	None degradation
Multicable	2, 3, 4, 6.2, 8.2 , 12.6	10	> 36	> 36	None degradation
Multicable	16.5, 18.8, 22, 25	10	> 36	> 36	None degradation
Measurement uncertainty: +3,3 / -3,7dB					

Note:

Numbering refers to the following criterias:

- 1) Normal performance within the specification limits.
- 2) Temporary degradation or loss of function or performance which is self-recoverable.
- 3) Temporary degradation or loss of function or performance which requires operator intervention or system reset.
- 4) Degradation or loss of function which is not recoverable due to damage of equipment (components) or software, or loss of data.

Test Equipment Used: LR 0061, LR 1010, LR 1025, LR 1066, LR 1087, LR 1091, LR 1117, LR 1152, LR 1153, LR 1155, LR 1201, LR 1312, LR 1313, LR 1315, LR 1316, LR 1318, LR 1320, LR 1353

6.4 Conducted RF Immunity Test on Input/Output Ports. Transmitter**EN 300 828,
IEC 945 (Clause 10)****Test signal**

Test generator settings:

Frequency				Settings		
Start	Stop	Step	Dwell-time	Modulation	Mod.freq.	Voltage
10 kHz	150 kHz	10 kHz	2 sec.	80 %	400 Hz	3V (EMF)
150 kHz	5 MHz	50	2 sec.	80 %	400 Hz	3V (EMF)*
5 MHz	80 MHz	1 %	2 sec.	80 %	400 Hz	3V (EMF)*

* 10V (EMF) at some spot frequencies.

Exclusion band (if any):

None

Test method:

All measurements in the frequency range 10 kHz - 150 kHz are performed with a clamp.

All measurements up to 80 MHz on the multicable are also performed with a clamp.

EUT mode during test

The EUT was monitored on channel 16 with max. transmitting power (20 W). The SINAD ratio of the demodulated output was observed. The RF spectrum, frequency, and power was also observed.

The EUT was modulated via the multicable.

Performance criteria for EUT

Performance criteria A.

Criteria : 20 dB SINAD.

See note below.

Results

Port (DC, Ant, Speaker, Multicablel)	Frequency (MHz)	Voltage (V EMF)	Criteria (se Note)	
			During test	After test
DC, Ant, Speaker, Multikabel	10 kHz-80 MHz	3	1	None degradation
Measurement uncertainty: +3,3 / -3,7dB				

Note:

Numbering refers to the following criterias:

- 1) Normal performance within the specification limits.
- 2) Temporary degradation or loss of function or performance which is self-recoverable.
- 3) Temporary degradation or loss of function or performance which requires operator intervention or system reset.
- 4) Degradation or loss of function which is not recoverable due to damage of equipment (components) or software, or loss of data.

Test Equipment Used: LR 0061, LR 1006, LR 1010, LR 1066, LR 1117, LR 1152, LR 1153, LR 1155, LR 1201, LR 1312, LR 1313, LR 1315, LR 1316, LR 1318, LR 1320, LR 1353

6.4 Conducted RF Immunity Test on Input/Output Ports. Transmitter EN 300 828, IEC 945 (Clause 10)

Test signal

10 V (EMF) at some spot frequencies.

Results

Port (DC, Ant, Speaker, Multicablel)	Frequency (MHz)	Voltage (V EMF)	Criteria (se Note)	
			During test	After test
DC, Ant, Speaker, Multicablel	2, 3, 4, 6.2, 8.2 , 12.6	10	1	None degradation
DC, Ant, Speaker, Multicablel	16.5, 18.8, 22, 25	10	1	None degradation
Measurement uncertainty: +3,3 / -3,7dB				

Note:

Numbering refers to the following criterias:

- 1) Normal performance within the specification limits.
- 2) Temporary degradation or loss of function or performance which is self-recoverable.
- 3) Temporary degradation or loss of function or performance which requires operator intervention or system reset.
- 4) Degradation or loss of function which is not recoverable due to damage of equipment (components) or software, or loss of data.

Test Equipment Used: LR 0061, LR 1006, LR 1010, LR 1066, LR 1117, LR 1152, LR 1153, LR 1155, LR 1201, LR 1312, LR 1313, LR 1315, LR 1316, LR 1318, LR 1320, LR 1353

6.5 Electrostatic Discharge (ESD) Immunity Test.**EN 61000-4-2****The Electrostatic Discharges were applied according to the following test plan:**

Discharges applied to EUT		ESD generator:			Result
Application mode:	Test point	Voltage [kV]	Coupling mode:	Number of discharges	
DA	EUT Enclosure, metal body in general	±6	CD	> 10	P
DA	EUT Enclosure, metal part located at connectors	±6	CD	> 10	P
DA	EUT Enclosure, plastic body front panel and microphone	±8	AD	> 10	p
IA	Horizontal Coupling Plane (HCP) both RX&TX	±6	CD	> 10	p
IA	Vertical Coupling Plane (VCP) both RX&TX on 4 sides	±6	CD	> 10	p

ABBREVIATIONS USED IN THE TABLE:

Application mode: DA = Direct application of discharges; IA = Indirect application of discharges
Coupling mode: CD = Contact discharges mode; AD = Air discharges mode

Cable configuration during test

The cables from the EUT were isolated from the Horizontal Coupling Plane (HCP) by positioned them on insulating bakelite plates (0.5 mm thick).

The EUT was fed via 1 m 12 VDC cable, and the case grounded to the floor ground plane via 1m cable.

-Test set-up and condition at the control port during the test:

The control port was connected to a cable of 3,5m length.

-Test set-up and condition at the radio communication port during the test:

The transceiver operated into a cable with an attenuator during all testing.

Test set-up

The test set-up was according to IEC 1000-4-2 clause 7.1. A Ground Reference Plane (GRP) of 5mm thick aluminium, (2m×4m) was placed on the floor. The GRP was connected to the protective earth with a 10 mm² thick copper cable.

The EUT was tested as a TABLE TOP EQUIPMENT according to

IEC 1000-4-2, clause 7.1.1 and the test set-up consists of the following: A wooden table (0.8 m high) was located on the GRP. A Horizontal Coupling Plane (HCP) consisting of 1.5mm thick aluminium(0.8m×1.6m) was placed on the table. An insulating bakelite plate (0.5 mm thick) was placed on the HCP and the EUT was placed on the insulating plate during the test. The cables from the EUT were isolated from the HCP by positioned them on insulating bakelite plates (0.5 mm thick).

EUT mode during test

The transceiver was tested in both transmit and receive mode.

-Monitoring of the communication during test

The receiver audio was monitored by ear, and transmission frequency was monitored on a communication test set.

Test Level:

The test level was selected on basis of 300 828 art 9.2

Performance criteria for EUT

Performance criteria B.

Self recovery.

Results

The results complies with the performance criteria described above during the ESD test.

During the testing additional SMD capacitors were added into the circuit boards.

This was done after the EFT/burst test.

Comments:

28,5 %RH 21,5 °C

An external capacitor of 330µF was placed on the supply line. Future production units are scheduled to have a similar capacitor on the circuitboard.

Test Equipment Used during the ESD test: ESD Generator, LR 1281

6.6 Electrical Fast Transient/Burst (EFT/B) Immunity Test.**EN 61000-4-4****The Electrical Fast Transients were applied as follows:****DC power supply input port (common mode):**

Test voltage peak [kV]	Repetition rate [kHz]	Test period [s]	Result
±2	5	180	P

Comments: The EUT was tested according to IEC 1000-4-4 clause 7.2.2.

Control port and coaxial cable:

Test voltage peak [kV]	Repetition rate [kHz]	Test period [s]	Result
±2	5	180	P
±2	5	180	P

Comments: The test set-up was according to IEC 1000-4-4 clause 7.2.2. The EFT/B were applied to the capacitive coupling clamp.

Cable configuration during test

The cables from the EUT were isolated from the Horizontal Coupling Plane (HCP) by positioning them on 0,5 mm thick bakelite plates.

12VDC port was tested with common mode coupling from the AC socket on PFET junior. Two 3 m cables were spread and connected to the coaxial cable jacket to increase coupling.

During test on the RF and control ports these cables were stretched through the capacitive coupling clamp.

Test set-up

The test set-up was according to IEC 1000-4-4 clause 7.2. A Ground Reference Plane (GRP) of 5mm thick aluminium (2m×4m) was placed on the floor. The GRP was connected to the protective earth with a 10 mm² thick copper cable. The EFT/B-generator including the coupling/decoupling network was placed on the GRP and connected to the GRP with short double 25 mm wide copper braids. The EUT was tested as a TABLE TOP EQUIPMENT and placed on a wooden table (0.8 m high) located on the GRP during the test.

EUT mode during test

See description for ESD-test.

Test Level:

The test level was selected on basis of 300 828 art 9.3

Performance criteria for EUT

Performance criteria B.

Self recovery.

Results

The results complies with the performance criteria discribed above during the EFT/B test.

After the EFT/burst testing, additional SMD capacitors were added into the circuit boards to comply with ESD requirements.

Comments:

27,1% RH 21,4°C

An external capacitor of 330µF was placed on the supply line. Future production units are scheduled to have a similar capacitor on the circuitboard.

Test Equipment Used during the test: EFT/B Generator, LR 1297; Capacitive coupling clamp: LR 1301

7 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

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

C	No	Instrument/Ancillary	Manufacturer	Type
LR	1259	Acoustic Coupler	Comlab	-----
LT	5219	AF Power Amplifier	B&K	2706
TF	----	Amplifier	Amp.Res.	25S1G4
LR	1354	Amplifier	Amp.Res.	500W100A
LR	1260	Antenna Biconical	R&S	HK 116
LR	1333	Antenna Dipole	R&S	HZ-13 633,0840,00
LR	1333	Antenna Dipole	R&S	HZ-13 633,0840,00
LR	1334	Antenna Dipole	R&S	HZ-13 633,0840,00
LR	1178	Antenna Horn	EMCO	3161-01
LR	1330	Antenna Horn	EMCO	3115
LR	0282	Antenna Log-periodic	R&S	HL 023A1
LR	0285	Antenna Loop	R&S	HFH2-Z2
LT	0642	Artificial Mouth	B&K	4227
LR	0061	Attenuator	Bird	8321
LR	1006	Attenuator	Narda	765-10
LR	1201	Attenuator	Narda	768-20
LR	1318	Attenuator	Narda	765-6
LR	1016	Audio Analyzer	HP	HP3581A
LR	1301	Coupling Clamp, EFT/B	Haefely	IP4A
LR	1312	Coupling Decoupling Network	Fischer	FCC-801-M2-16
LR	1313	Coupling Decoupling Network	Fischer	FCC-801-C1/50N
LR	1314	Coupling Decoupling Network	Fischer	FCC-801-M3-16
LR	1320	Coupling Decoupling Network	Fischer	FCC-801-T2
LR	1351	Coupling Decoupling Network	Fischer	FCC-801-M1-16
LR	1305	Coupling Network (EMC)	Haefely	IP6.2
LR	1306	Decouper Network (EMC)	Haefely	DEC1A
LR	1414	Deskjet	HP	959c
LR	1404	Directional Coupler	Amplifier Research	DC 6180
LR	1089	EMI Receiver (Display)	R&S	ESAI-D
LR	1090	EMI Receiver (RF-part)	R&S	ESAI-RF
LR	1237	EMI-Receiver	R&S	ESN
LR	1281	ESD pistol	Schaffner	NSG435
LT	5322	Feeding Bridge	ComLab	Matebru-93
LT	5146	Generator Func	Wavetec	23
LR	1018	Generator, AF	R&S	SPN
LR	1117	Generator, AF/./UHF	R&S	SMHU58
LR	1297	Generator, EFT/B	Haefely	PEFT Junior
LR	1025	Generator, MF/./UHF	HP	HP8657B
LR	1230	Generator, RF	R&S	SMT03
LR	1353	GTEM System Interface	EMC Aut	SI-200
LR	1155	GTEM, amplifier, RF	Amp.Res.	25A100M1
LR	1156	GTEM, Amplifier, RF	Amp.Res.	25W1000M1
LR	1175	GTEM, field probe	EMC Auto.	FP 3000
LR	1153	GTEM, Switch Module	EMC Aut.	SM-1
LR	1152	GTEM, System Interface	EMC Aut.	SI100, A8
LR	1171	GTEM-cell	EMCO	5311
LR	1091	Hybrid	Anza	H-9
LR	1074	Impulse Limiter	R&S	ESH3-Z2
LR	1298	Line Interference tester	Haefely	PLINE 1610

TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

LT	0573	Measurement Amplifier	B&K	2610
LT	5340	Measurement Amplifier	B&K	2636C
LT	0682	Microphone	B&K	4134
LT	5191	Microphone Amplifier	B&K	2639
LT	5300	Microphone Amplifier	B&K	2633
LR	0302	Multimeter, Digital	Fluke	77
LR	1063	Plotter	HP	HP7475
LR	1347	Power Meter RF	R&S	NRVD 857.8008.02
LR	0015	Power Supply	Oltronix	B32-10R
LT	5149	Power Supply	Farnell	D100-1
LR	1062	Power Supply, program.	HP	HP6032A
TF	----	Probe Field	Holyday Ind.	H5E 479
LR	1352	Probe Field	Amp.Res.	FP4000
LR	1011	Probe, current	R&S	ESH2-Z1
LR	1315	Probe, current	Fischer	F-33-2
LR	1316	Probe, current (injection)	Fischer	F-120-9
LR	1066	Radiocomm Analyzer	R&S	CMTA 54
LR	1087	Radiocomm Analyzer	R&S	CMTA 54
LR	1335	Radiocomm Analyzer	R&S	CMD60 1050,9008,60
LR	1010	Spectrum Analyzer	HP	HP8561A
LR	1337	Spectrum Analyzer	R&S	FSEK 1088,3494,30
LR	1307	Surge tester	Haefely	PSURGE
LT	5438	Test Head	Brüel & Kjær	4602
LR	1271	T-nettverk	R&S	EZ-10
LR	1075	T-network	R&S	ESH3-Z4
LR	1254	T-network	Schwarzbeck	NTFM8132
LR	1076	Two-line V-network	R&S	ESH3-Z5