


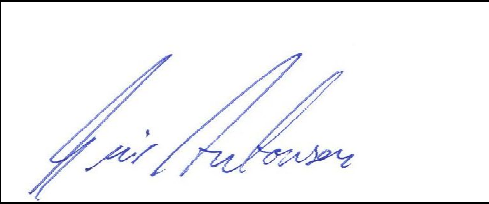


# Test Report

Product	AIS Transponder		
Name and address of the applicant	Jotron AS, P.O. Box 54, Østbyeien, N-3280 TJODALYNG		
Name and address of the manufacturer	Jotron AS, P.O. Box 54, Østbyeien, N-3280 TJODALYNG		
Model	TronAIS_TR-8000		
Rating	12 - 24 V DC (10.8 – 31.2 Extreme power) VHF RX/TX 156.025 to 162.025 MHz		
Brand name			
Serial number			
Additional information			
Tested according to	EN 60945 (2002) Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results		
Order number	161140		
Tested in period	2010-12-06 – 2011-02-14		
Issue date	2011-03-03		
Name and address of the testing laboratory	 P.O. Box 73 Blindern, N-0314 Oslo, Norway	Telephone (+47) 22 96 03 30 Fax (+47) 22 96 05 50	 ACCREDITED REPORT REF. NA-TEST 033 An accredited technical test executed under the Norwegian accreditation scheme
 Prepared by [Jan Gunnar Eriksen]		 Approved by [Geir Antonsen]	
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## REVISIONS

Revision #	Date	Order #	Description
00	2011-02-25	161140	-
01	2011-03-03	161140	Editorial corrections

## GENERAL REMARKS

This report applies only to the sample(s) tested. It is the manufacturer's responsibility to assure the additional production units of this product are manufactured with identical electrical and mechanical components. The manufacturer is responsible to the Competent Authorities in Europe for any modifications made to the product, which result in non-compliance to the relevant regulations.

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Opinions expressed within this report regarding general assessments and qualifications for PASS or FAIL to the standards limits and requirements, are not part of the current accreditation. Neither is opinions expressed regarding model variants covered by the testing of this report.

## CALIBRATION

All instruments used in the tests given in this test report are calibrated and traceable to national or international standards. Between calibrations all test set-ups are controlled and verified on a regular basis by periodic checks to ensure, with 95% confidence that the instruments remain within the calibrated levels.

## MEASUREMENT UNCERTAINTY

Measurement uncertainties are calculated or considered for all instruments and instrument set-ups used during these tests. Uncertainty figures are found in an appendix to this report.

Further information about measurement uncertainties is provided on request.

## EVALUATION OF RESULTS

If not explicitly stated otherwise in the standard, the test is passed if the measurement value is equal to or below the limit line, regardless of the uncertainty of the measurement. If the measurement value is above the limit line, the test is not passed - ref. IECEE/CTL (Sec) 056/94 (CTL = Committee of Testing Laboratories).

Evaluation of measurement results are only made after adding the measurement uncertainty to the obtained measurement data, as required by chapter 6.9 of EN 60945 (2002).

The instrumentation accuracy is within limits agreed by the IECEE/CTL (ref. Nemko proc. P227).

## DESCRIPTION OF TESTED DEVICE (EUT)

### SYSTEM DESCRIPTION

The EuT is a AIS (Automatic Identification Transceiver) in the VHF frequency band (156-165 MHz). The EuT composes a radio part and a display part.

#### TR-8000 CLASS A Transceiver

Hardware version: X85302R1026

Software version: TR8000 T1.x

#### TR-8000 Display Unit

Hardware version: X85402R1027

Software version: TR8000 D1.x

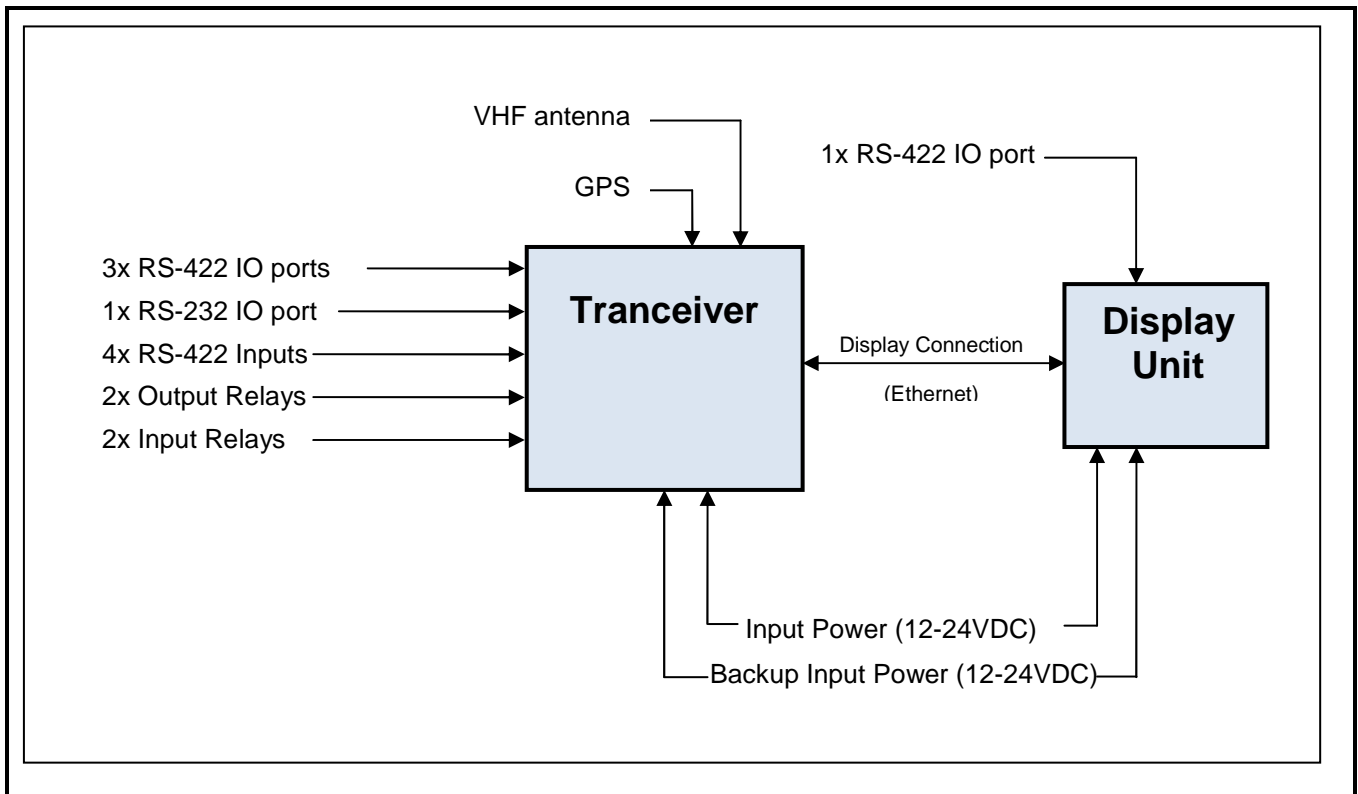
### MODEL VARIATIONS

The following model variations are considered covered by this report

VA no.	Variant	Comment	Investigated
1	TronAIS_TR-8000		YES

Note: Items that are shaded have been subject to testing documented in this report. Opinions expressed regarding application of test results to variant models are not part of our current accreditation.

### PRINCIPLE DIAGRAM



## SYSTEM COMPONENTS

SC no.	Description	Manufacturer	Type	Serial no.
1	Radio Transceiver	Jotron AS	Transceiver	S-0003
2	Display	Jotron AS	Display	S-0003

## PORTS AVAILABLE

This equipment is fitted with the following electrical ports.

PO no.	Port Name	Type	Count	Comment
1	DC power 12 - 24 V	Power	2	Radio unit
2	VHF antenna	RX/TX	1	Radio unit
3	GPS antenna	Input	1	Radio unit
4	RS-422	Input/Output	3	Radio unit
5	RS-422	Input	4	Radio unit
6	RS-232	Input/Output	1	Radio unit
7	Ethernet	Input/output	1	Radio unit
8	DC power 12 - 24 V	Power	2	Display unit
9	RS-422	Output	1	Display unit
10	Ethernet	Input/Output	1	Display unit

## CLOCK FREQUENCIES AND DISTRIBUTIONS

This equipment utilizes the following crystal oscillators and clocking schemes as described below:

XF no.	Frequency	Type	Purpose
1	12.8MHz	VcTcXo	DSP
2	44.545MHz	VCO	1.LO
3	201.025MHz - 207.025MHz	VCO	2.LO
4	312.05MHz - 324.05MHz	VCO	Tx_Lo
5	25MHz	Xo	Ethernet
6	400kHz	Dithered Oscillator	Isolated power for interfaces

## AVAILABLE OPERATING MODES

The following functional operating modes are available and are considered applicable under intended use.

FU no.	Operating mode	Comment	Investigated
1	AIS mode	Normal operating mode	Yes

## ACCESSORIES APPLIED DURING TEST

AE no.	Description	Manufacturer	Type	Serial no.
1	None			

**EQUIPMENT MODIFICATIONS**

The following equipment modifications were required to achieve compliance with the applied standards.

MO no.	Modification	Purpose
1	None	

**ADDITIONAL INFORMATION RELATED TO TESTING**

No further information.

## GENERAL TEST CONDITIONS

### TEST LABORATORY

The following Nemko test sites have been utilized for the tests documented in this report:

Site	
<input type="checkbox"/>	<b>GAUSTAD</b> (Gaustadalleen 30, N-0314 Oslo, Norway)
<input checked="" type="checkbox"/>	<b>KJELLER</b> (Instituttveien 6, N-2027 Kjeller, Norway)
<input type="checkbox"/>	<b>SKAR</b> (Maridalsveien 621, N-0890 Oslo, Norway)

### LABORATORY ACCREDITATIONS



#### Norsk Akkreditering – TEST 033

P06 – Electromagnetic Compatibility  
P17 – Environmental Tests



VCCI – Membership No. 3220

### POWER SUPPLIED TO EUT

Filtered electrical power was available for operation of EuT in all the test sites.

**Voltage type:** 24V DC

**Grounding:** Grounded as required in respective test.

### AMBIENT CONDITIONS

All EMC tests and measurements were performed in a shielded enclosure or in a controlled environment suitable for the tests conducted.

Normal ambient test conditions:

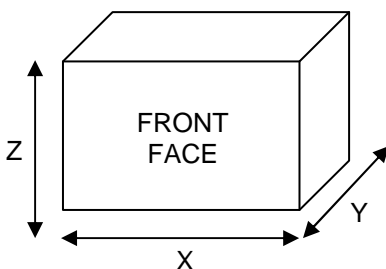
**Ambient temperature:** 20 - 23°C

**Relative humidity:** 20 - 50%RH

**Atmospheric pressure:** 98 - 102kPa

Note: The climatic conditions in the test areas are automatically controlled and recorded continuously.

### DEFINITION OF AXIS CONVENTIONS



## EVALUATION OF PERFORMANCE

### FUNCTIONAL TESTS AND CHECKS

In order to verify acceptable performance by the EuT during and after the applied tests, the following functions were monitored:

<b>Performance checks:</b> A short functional test carried out during or after a technical test to confirm that the equipment operates:	<b>Performance tests:</b> A measurement or a group of measurements carried out during or after a technical test to confirm that the equipment complies with selected parameters as defined in the equipment standard:	<b>Monitoring methods:</b> Which functions were monitored and how:
<b>Description:</b>	<b>Description:</b> Transmission of AIS signals to EuT and reception of confirmation.  Reception of GPS signal with display of position on display.  Transmission/Reception of RS-422 and -232 signals to/from EuT.  Transmission of Ethernet signal between radio unit and display unit	<b>Description:</b> On auxiliary PC  On display  On auxiliary PC and display  On auxiliary PC and display

### PERFORMANCE CRITERIA

In order to pass each test, the EuT shall meet the following criteria:

<b>Performance criterion A:</b> The device shall continue to operate as intended both during and after the test. No degradation of performance or loss of function is allowed below the expected performance level of the device	<b>Performance criterion B:</b> The device shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below the expected performance level of the device	<b>Performance criterion C:</b> Temporary loss of function during test is allowed, provided the function is self-recoverable or can be restored by the operation of the controls
<b>Modified by the manufacturer:</b> Not modified	<b>Modified by the manufacturer:</b> Not modified	<b>Modified by the manufacturer:</b> Not modified

## SUMMARY OF TESTING

### APPLIED STANDARDS

» EN 60945 (2002)

*Maritime navigation and radiocommunication equipment and systems - General requirements - Methods of testing and required test results*

### APPLIED TESTS

Test items	Test methods	Result
Mains Port Disturbance Voltage	EN 60945 (2002)	PASS
Radiated Disturbance (LF)	EN 60945 (2002)	PASS
Radiated Disturbance (RF)	EN 60945 (2002)	PASS
Electrostatic Discharges	EN 60945 (2002) EN 61000-4-2 (2009), Ed.2.0	PASS
Radiated RF Field	EN 60945 (2002) EN 61000-4-3 (2008), Ed.3.1	PASS
Electric Fast Transients	EN 60945 (2002) EN 61000-4-4 (2010), Ed.2.1	PASS
Surge	EN 60945 (2002) EN 61000-4-5 (2006), Ed.2.0	NA
Conducted RF Disturbance	EN 60945 (2002) EN 61000-4-6 (2009), Ed.3.0	PASS
Power supply short term variation	EN 60945 (2002) EN 61000-4-11 (2004), Ed.2.0	NA
Power Supply Failure	EN 60945 (2002) EN 61000-4-11 (2004), Ed.2.0	PASS
Low Temperature	EN 60945 (2002) EN 60068-2-1 (2007), Ed.6.0	PASS
Dry Heat	EN 60945 (2002) EN 60068-2-2 (2007), Ed.5.0	PASS
Damp Heat	EN 60945 (2002) EN 60068-2-30 (2005), Ed.3.0	PASS
Corrosion	EN 60945 (2002) EN 60068-2-52 (1996), Ed.2.0	PASS
Vibration	EN 60945 (2002) EN 60068-2-6 (2008), Ed.6.0	PASS
Drop	EN 60945 (2002)	NA
Ingress Protection (IP)	EN 60945 (2002) IEC 60529 (2001), Ed.2.1	PASS
Compass Safe	EN 60945 (2002) EN ISO 694 (2001)	125 (Display) / 95 cm (Transceiver)
Extreme Power Supply	EN 60945 (2002) IEC 60092-101 (1994)	PASS



- PASS : Tested and complied with the requirements  
FAIL : Tested and failed the requirements  
NA : Test not relevant to this specimen (evaluated by the test laboratory)  
- : Test not performed (instructed by the applicant)  
\* : An asterisk (\*) placed after the verdict in the Result column indicates test items that are not within Nemko's scope of accreditation  
# : A grid (#) placed after the verdict in the Result column indicates test items that are only partly covered by Nemko's scope of accreditation. Further information is detailed in the test section

## DEVIATIONS AND EVALUATIONS

Product standards with dated references to basic standards may be modified by Nemko AS to test according to the newest edition of the basic standard. This may impact the compliance criteria or technical performance of the test, still this is considered to be adequate as long as the test is expected to confirm compliance to the intention of the product standard. The table above lists the edition of the basic standards used during testing.

# Test Results

## EMISSION – MAINS PORT DISTURBANCE VOLTAGE

### TEST DESCRIPTION

#### Method

The reference method for this test is listed in the table under clause APPLIED TESTS.

#### Set-up

The measurements were performed in a shielded enclosure. EuT was connected to an Artificial Mains Network (AMN) and placed on a wooden table 10cm (floor-standing) or 80cm (tabletop) above the grounded floor and 40cm from the reference ground plane (wall). EuT was connected to the AMN by its power cable, which was adjusted to 100cm length by folding.

#### Procedure

A screening test was first performed to decide the most disturbing operating mode of the EuT, maximizing the cable layout and deciding the proper dwell time for the measurements.

Then measurements were run between each of the current carrying wires of the power cord, and ground.

The frequency was swept in the range specified under Severity.

A comparison of the results obtained from the different wires was then performed to find the highest level at each frequency. This worst-case sweep with peak detector is presented below.

At the frequencies where the peak level of the emission was exceeding the applicable [limit - offset], the emission was also measured with the quasi-peak detector and, if required, with the average detector.

#### Instruments used during measurement

Instrument list:            Test Receiver R&S ESAI (LR 1089/90) (3-2011)  
                                      AMN R&S ESH2-Z5 (LR 1076) (03-2011)

#### Comments

No recorded comments.

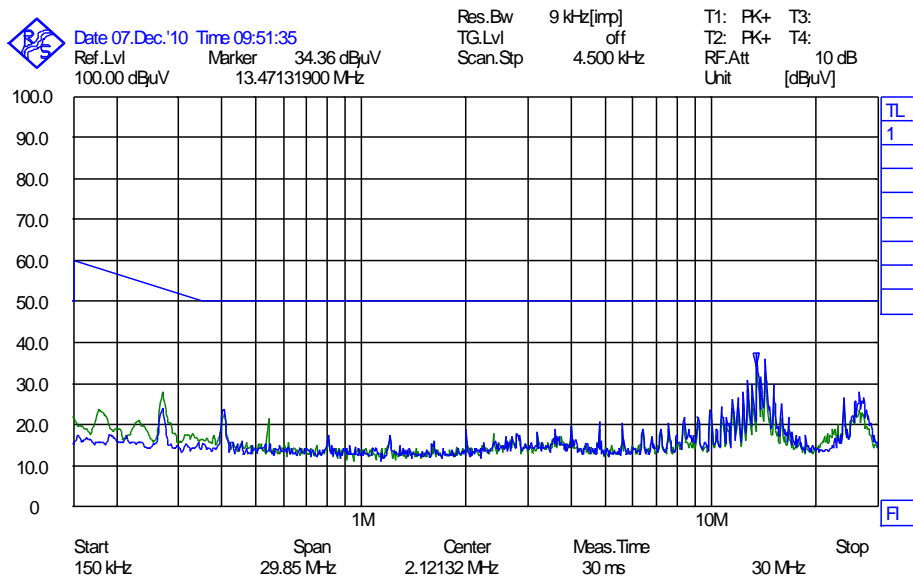
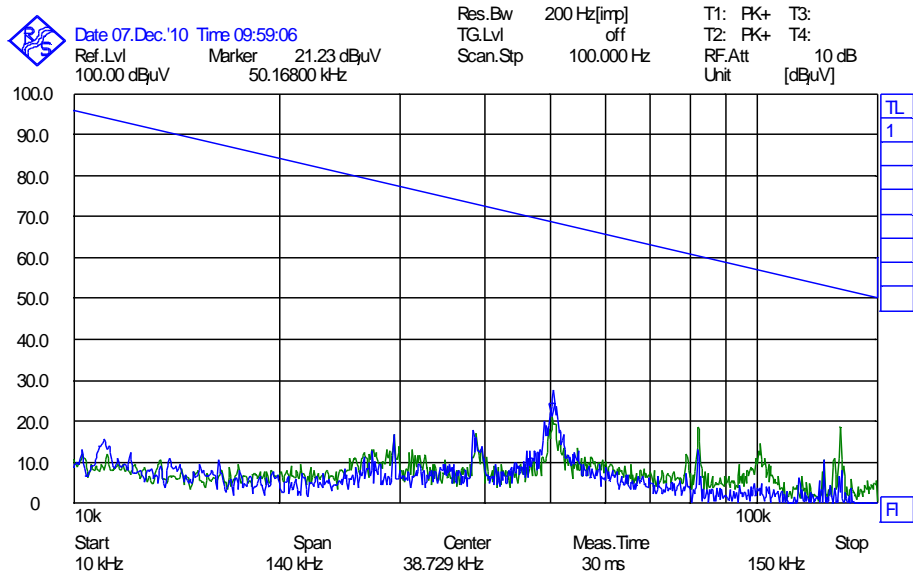
#### Severity

Port:	Power port DC 24 V
Frequency range:	10-150 kHz / 0,150-30 MHz
Frequency step:	100 Hz / 4,5 kHz
Dwell time:	30 mSec
Bandwidth:	200 Hz / 9 kHz

#### Conformity

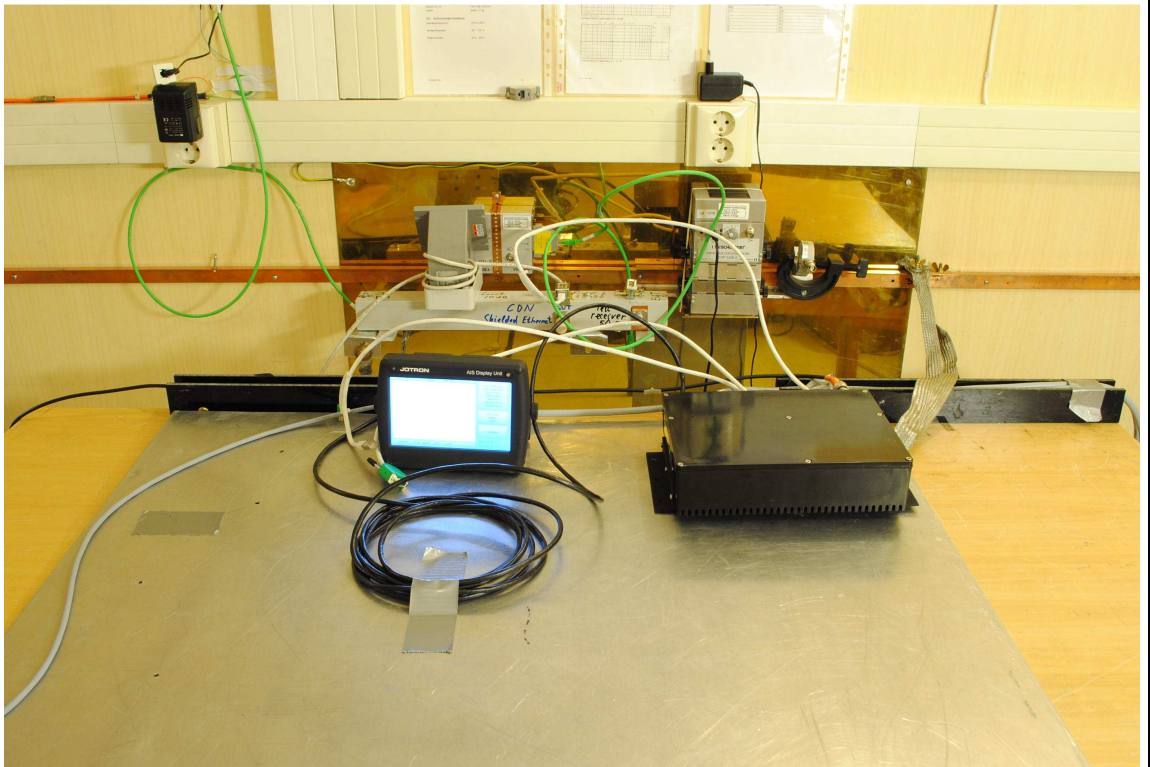
Verdict:	PASS
Test engineer:	Jan G Eriksen

### DISTURBANCE PREVIEW



### QUASI PEAK DETECTOR DATA

All spurious measurements in “peak” mode are well below Quasi-Peak limit.



Notes: Test set-up for Conducted RF Disturbance

## EMISSION – RADIATED DISTURBANCE (150 kHz – 30 MHz)

### TEST DESCRIPTION

#### Method

The reference method for this test is listed in the table under clause APPLIED TESTS.

#### Set-up

All measurements are performed in a 10m semi-anechoic chamber. EuT is connected to filtered mains supply and placed on a wooden table 10 cm (floor-standing) / 80 cm (tabletop) above the ground plane, in the centre of the turntable. The measuring antenna is located 3 meters from EuT and 100cm above the ground plane.

#### Procedure

A screening test was first performed to decide the most disturbing operating mode of the EuT, maximizing the cable layout and deciding the proper dwell time for the measurements.

A set of preliminary measurements are then run with a peak detector across the frequency range, for 0°, 90°, 180° and 270° turntable azimuths. The frequency is swept in the range specified under Severity.

A comparison of the levels measured at each measurement positions is then performed, and the highest level at each frequency is stored. This "Worst Case" sweep with peak detector is presented in the report.

At the frequencies where the peak values of the emission are exceeding the applicable [limit - offset], the emission is also measured with the quasi-peak detector: Cables connected to EuT are fixed to cause maximum emission, and a maximum emitting point is searched by tuning the turntable azimuth 0 - 360°.

The quasi-peak detector measurement is performed at the maximum emitting point and compared to the limit. The emission level is calculated in the following matter:  $E_{level} = E_{reading} + E_{antenna} + E_{cable}$ .

#### Instruments used during measurement

Instrument list:            Test Receiver R&S ESN (LR 1237) (09-2011)  
                                  Loop Antenna R&S HFH2-Z2 (LR 285) (10-2011)

#### Comments

No recorded comments.

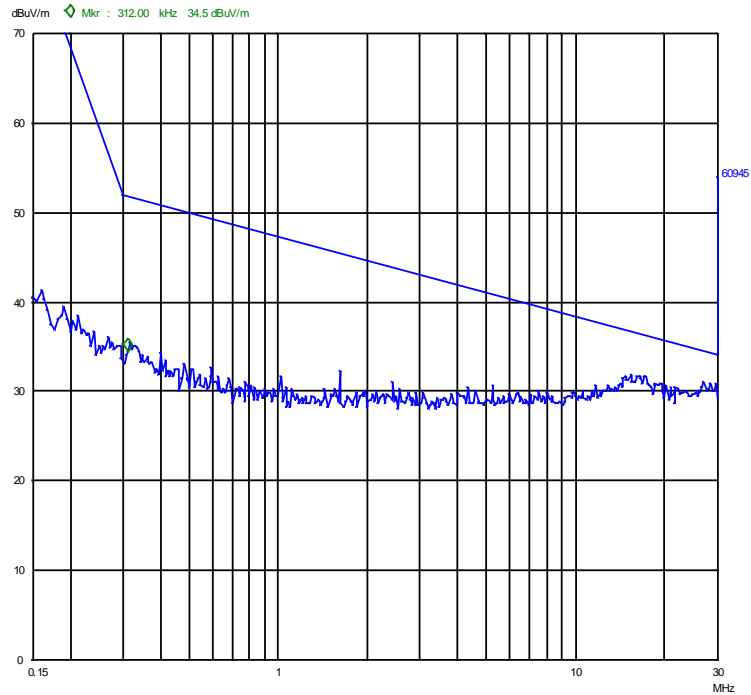
#### Severity

Port:	Enclosure Port
Frequency range:	150 kHz – 30 MHz
Frequency step:	4,5 kHz
Dwell time:	30 msec
Bandwidth:	9 kHz
Meas. distance:	3 m

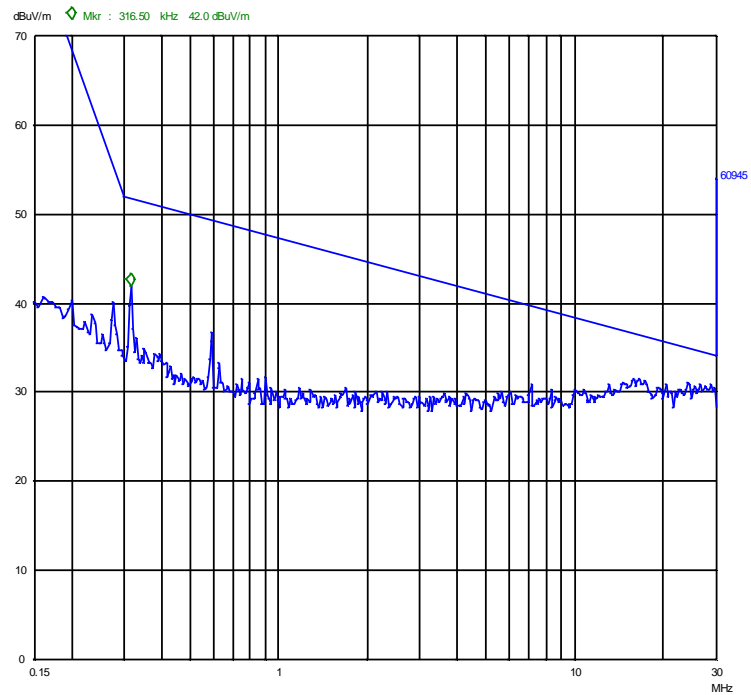
#### Conformity

Verdict:	PASS
Test engineer:	Jan G Eriksen

**DISTURBANCE PREVIEW**



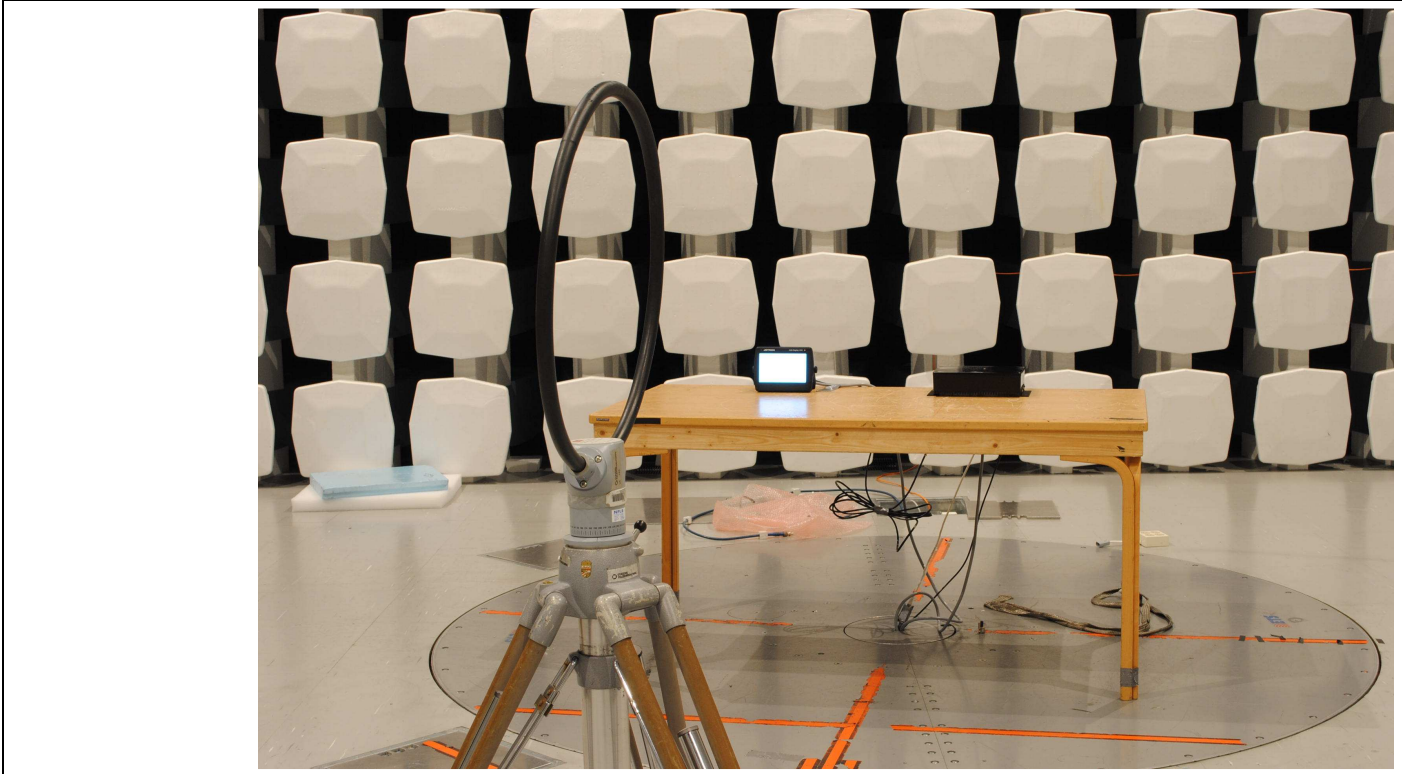
Loop antenna longitudinal



Loop antenna perpendicular

**QUASI PEAK DETECTOR DATA**

All spurious signals in Peak-mode are well below Quasi-Peak limit



Notes: Test set-up for Radiated Disturbance 0,150-30 MHz



## EMISSION – RADIATED DISTURBANCE (30 – 2000 MHz)

### TEST DESCRIPTION

#### Method

The reference method for this test is listed in the table under clause APPLIED TESTS.

#### Set-up

All measurements are performed in a 10m semi-anechoic chamber. EuT is connected to filtered mains supply and placed on a wooden table 10 cm (floor-standing) / 80 cm (tabletop) above the ground plane, in the centre of the turntable. The measuring antenna is located 10 meters from EuT.

#### Procedure

A screening test was first performed to decide the most disturbing operating mode of the EuT, maximizing the cable layout and deciding the proper dwell time for the measurements.

A set of preliminary measurements are then run with a peak detector across the frequency range, for horizontal and vertical polarizations of the antenna, and for 0° turntable azimuth. The frequency is swept in the range specified under Severity.

A comparison of the levels measured at each measurement positions is then performed, and the highest level at each frequency is stored. This "Worst Case" sweep with peak detector is presented in the report.

At the frequencies where the peak values of the emission are exceeding the applicable [limit - offset], the emission is also measured with the quasi-peak detector: Cables connected to EuT are fixed to cause maximum emission, and a maximum emitting point is searched by tuning the turntable azimuth 0 - 360° and then tuning the antenna height 100 - 400cm above the ground plane.

The quasi-peak detector measurement is performed at the maximum emitting point and compared to the limit. The emission level is calculated in the following matter:  $E_{level} = E_{reading} + E_{antenna} + E_{cable}$ .

#### Instruments used during measurement

Instrument list:

- Test Receiver R&S ESN (LR 1237) (09-2011)
- Test Receiver R&S ESCI (N 4259) (11-2011)
- Antenna R&S HK-116 (LR-1260) (05-2013)
- Antenna R&S HL-223 (LR-1261) (05-2013)
- Antenna EMCO 3115 (LR-1330) (08-2013)
- Preamp HP 10855A (LR-1322) (08-2011)
- Preamp HP 8449B (LR-1445) (08-2011)

#### Comments

The AIS transceiver was active during measurement. In the plots below this is visible at 161,985 MHz in the VHF-band. No other spurious was visible in the VHF-band.

All harmonics from the AIS transceiver was below the 54 dBuV/m limit in the rest of the band – see plots and table.

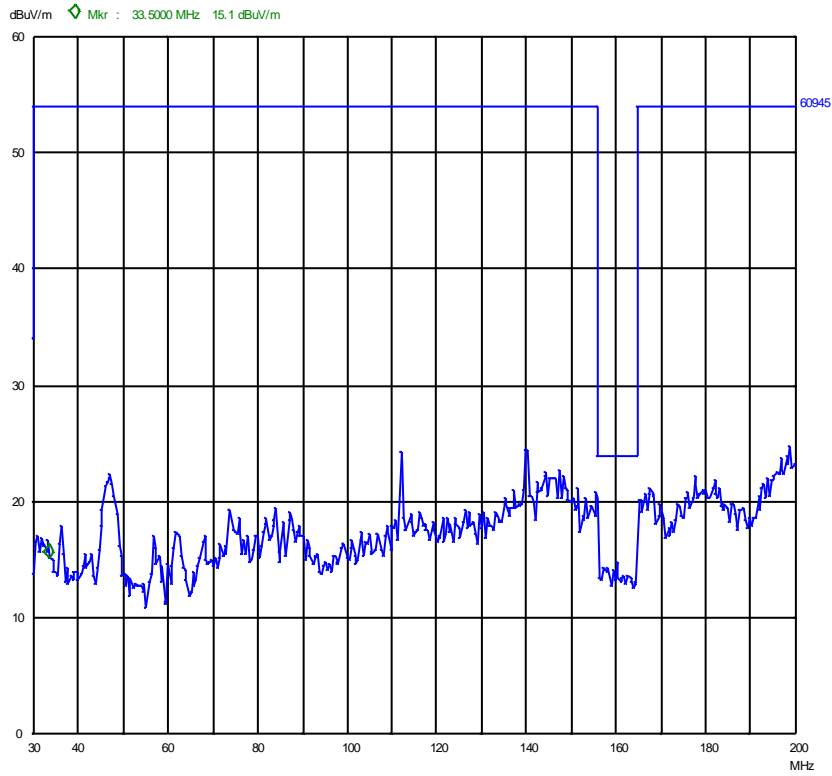
#### Severity

Port:	Enclosure Port
Frequency range:	30 MHz – 2000 MHz
Frequency step:	50 kHz 4,5 kHz in 156-165 MHz range
Dwell time:	30 mSec
Bandwidth:	120 kHz 9 kHz in 156-165 MHz range
Meas. distance:	3 meters

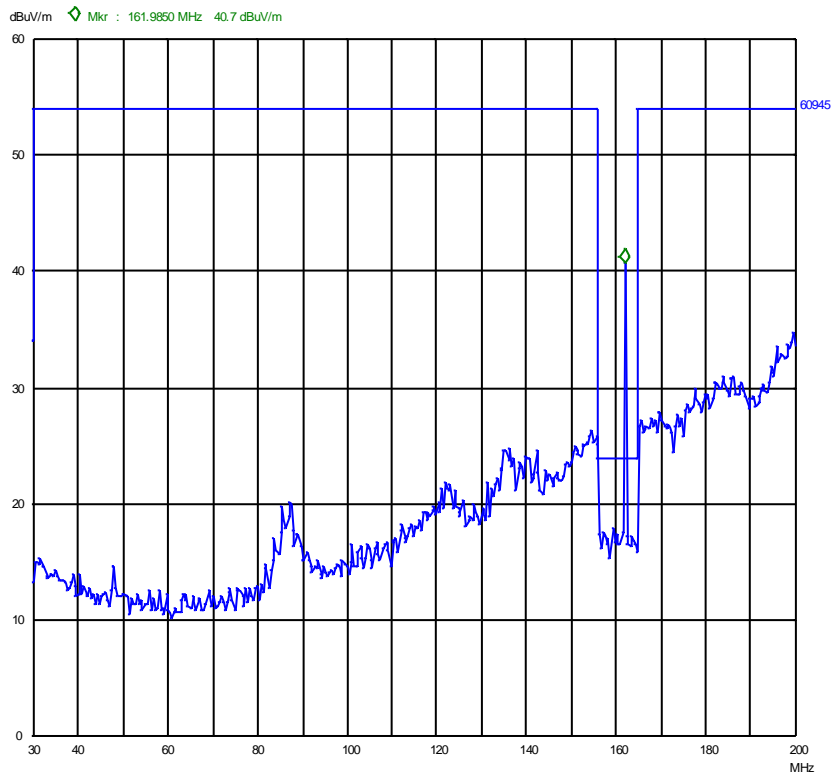
#### Conformity

Verdict:	PASS
Test engineer:	Jan G Eriksen

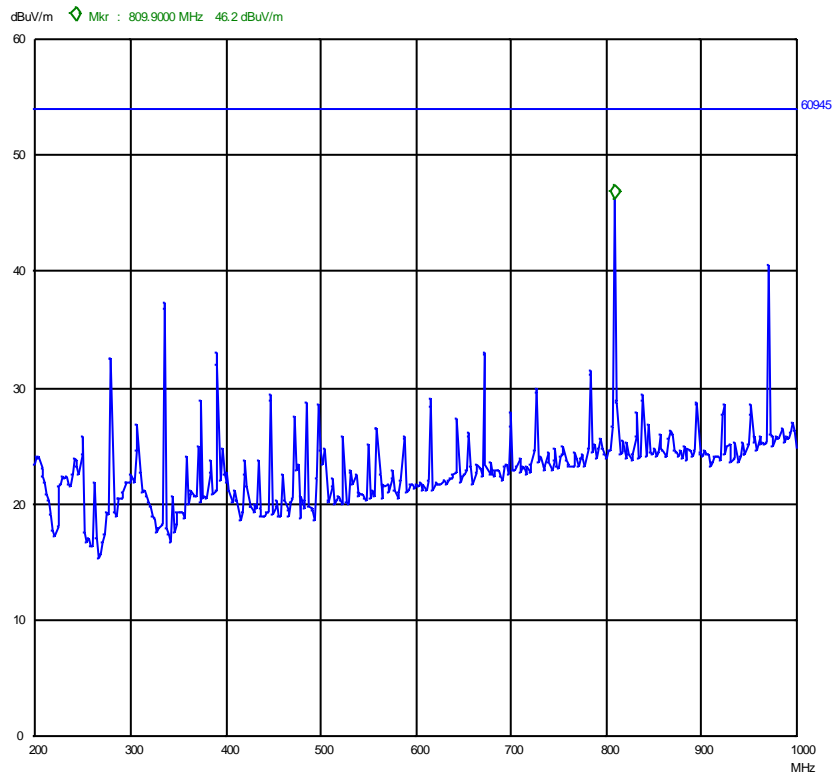
**DISTURBANCE PREVIEW**



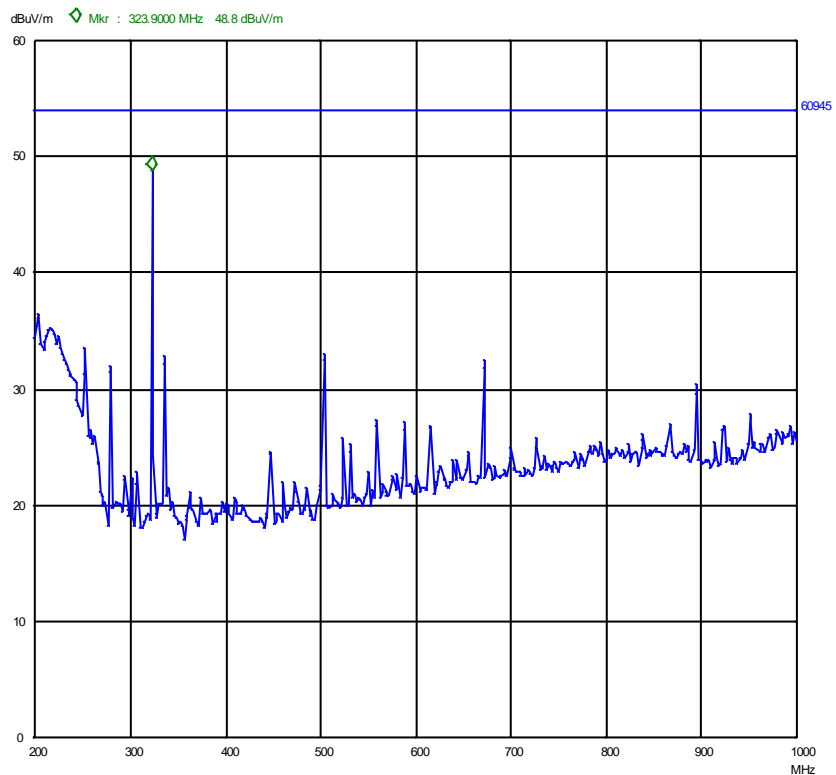
Vertical polarisation



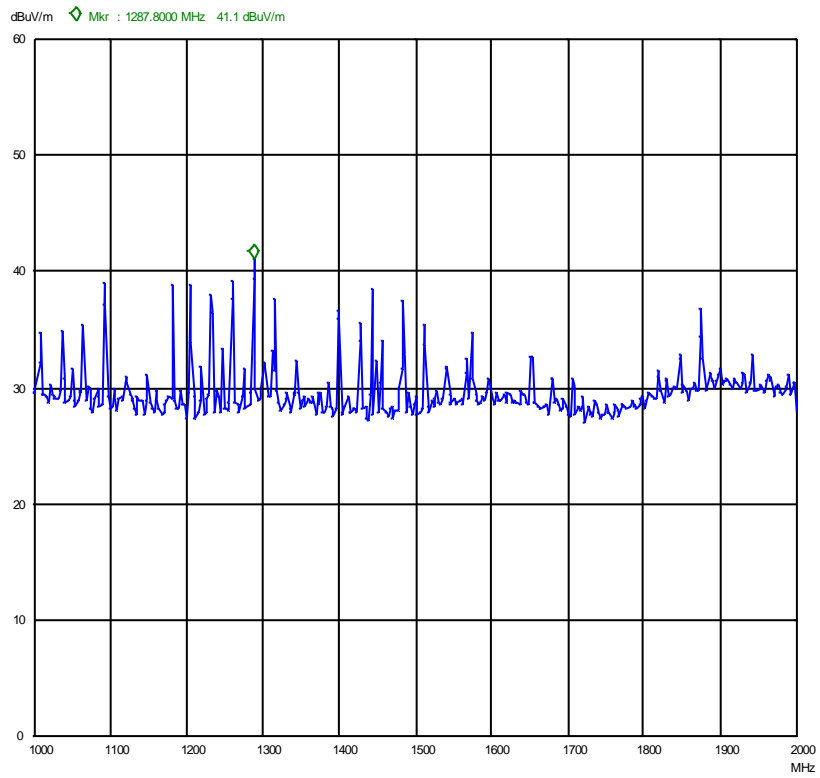
Horizontal polarisation (marker on TX signal)



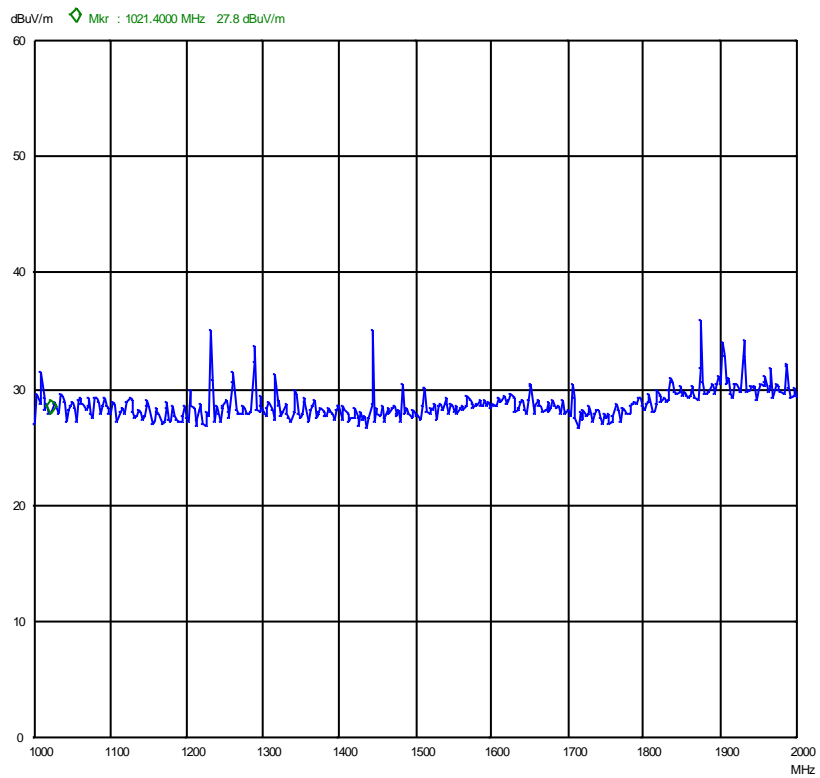
Vertical polarisation



Horizontal polarisation



Vertical polarisation



Horizontal polarisation

**QUASI PEAK DETECTOR RESULTS**

Frequency [MHz]	Level [dBuV]	Limit [dBuV]	Margin [dB]	Height [cm]	Azimuth [deg]	Polarisation [Hor/Ver]	Verdict [Pass/Fail]
223,000	29,4	54	24,6	160	340	Hor	Pass
280,000	34,0	54	20,0	110	330	Hor	Pass
323,95	43,3	54	10,7	130	0	Ver	Pass
336,000	34,4	54	19,6	190	0	Ver	Pass
392,000	28,2	54	25,8	165	0	Ver	Pass
485,925	44,9	54	9,1	130	0	Ver	Pass
504,000	31,0	54	23,0	170	0	Hor	Pass
647,9	39,0	54	15,0	170	350	Ver	Pass
672,000	34,4	54	19,6	170	330	Ver	Pass
809,875	42,7	54	11,3	120	0	Ver	Pass
971,85	44,7	54	9,3	110	340	Ver	Pass
1092,000	32,9	54	22,1	145	0	Ver	Pass
1288,000	39,5	54	14,5	155	10	Ver	Pass
1288,000	40,2	54	13,8	160	335	Hor	Pass
1443,278	40,0	54	14,0	150	0	Ver	Pass
1443,278	39,5	54	14,5	135	240	Hor	Pass



Notes: Test set-up for Radiated Disturbance 30-2000 MHz

# IMMUNITY – ELECTROSTATIC DISCHARGES

## TEST DESCRIPTION

### Method

The reference method for this test is listed in the table under clause APPLIED TESTS.

### Set-up

A ground reference plane is located on the floor, and connected to earth via a low impedance connection. The return cable of the ESD generator is connected to the reference plane.

EuT is placed on a wooden table 10 cm (floor standing) / 80 cm (tabletop) above the reference plane, and all cables attached to the EuT is isolated the same way.

A vertical coupling plane (VCP) of 50x50 cm is placed 10 cm from the EuT's exterior. This VCP is connected to the reference plane via a cable with two 470kΩ resistors located one in each end of the cable.

In case of tabletop equipment, a horizontal coupling plane (HCP) of 160x80 cm is located on the table, and connected to the reference plane the same way as the VCP. EuT is separated from the HCP by a 0.5mm insulating support.

### Procedure

Direct contact and air discharges are applied to the EuT enclosure. Indirect contact discharges are applied to the mid edge of the HCP and VCP.

Contact discharges are applied to various selected test points of the EuT at conductive surfaces, and to the HCP and VCP. Air discharges are applied to various selected test points of the EuT at non-conductive surfaces.

Discharges are applied at increasing levels to each test point.

### Instruments used during measurement

Instrument list: ESD generator Schaffner NSG 435 (LR-1281) (03-2011)

### Comments

No recorded comments.

### Severity

Port: Enclosure Port

### Conformity

Verdict: PASS

Test engineer: Jan G Eriksen

**Description of test points**

- All metal part of radio unit (contact)
- All connector shells on radio unit (contact)
- All parts of display unit; monitor, on/off button (air)
- Vertical and Horizontal coupling planes (contact)

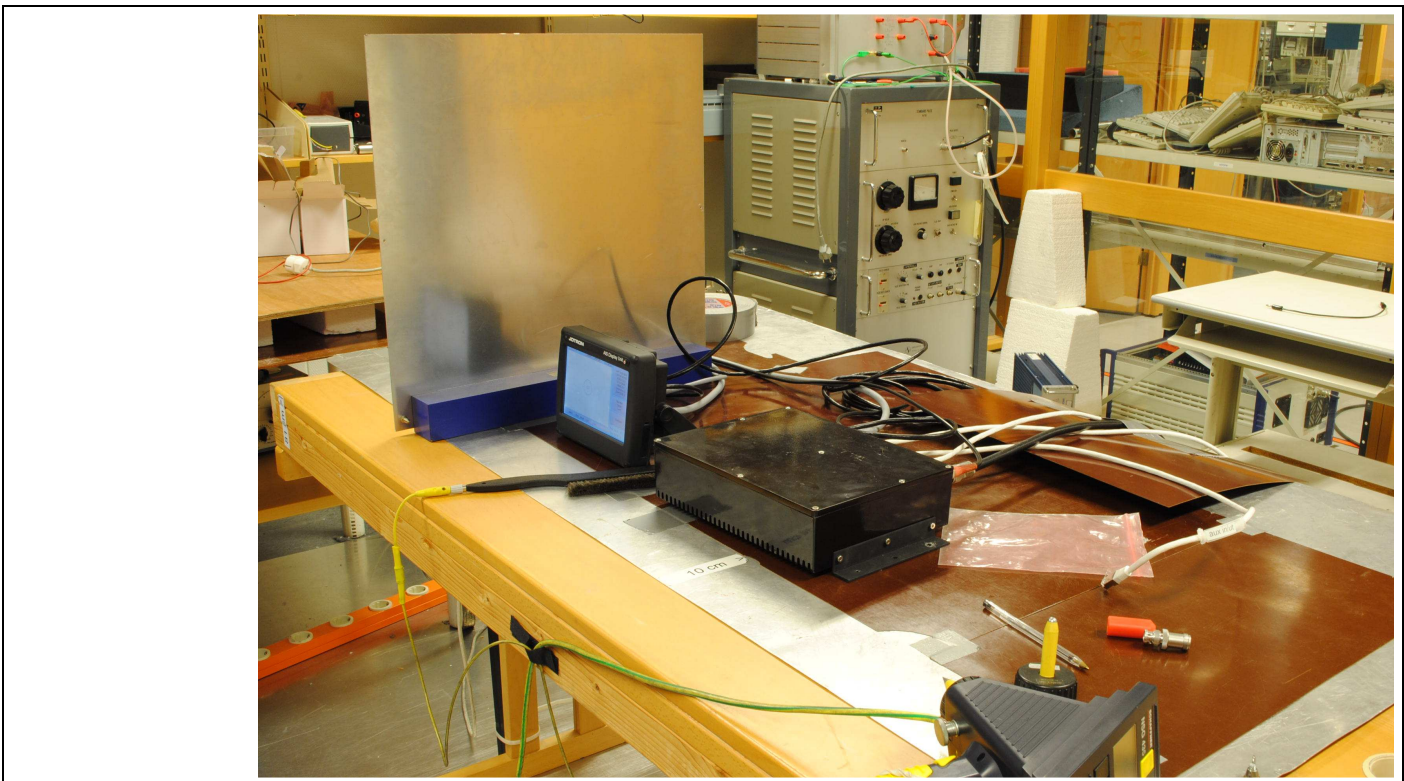
**DETAILED TEST LOG**

Note: The choice of test levels could differ from the procedure, based on the nature of EuT.  
 Note: An asterisk (\*) indicates tests not within the scope of accreditation.  
 Note: Possible test case performances: <space> = Not tested, or letters indicating level of performance.  
 Note: ND = No Discharge, indicates discharge attempts, which have given no actual observable discharge.

Test Point	Applied Level [kV]	Discharge Type	Discharges per test level	Required Criteria	Complied Criteria	Result
Display monitor	±8	Air	10	B	A	PASS
Display buttons	±8	Air	10	B	A	PASS
Radio metal parts	±6	Contact	10	B	A	PASS
Radio contact shells	±6	Contact	10	B	A	PASS
HCP	±6	Contact	10	B	A	PASS
VCP	±6	Contact	10	B	A	PASS

**CONCLUSION**

No operation errors were detected during or after the applied test(s)



Notes: Test set-up for ESD



# IMMUNITY – RADIATED RF DISTURBANCE

## TEST DESCRIPTION

### Method

The reference method for this test is listed in the table under clause APPLIED TESTS.

### Set-up

The tests are performed at 3 meter antenna distance in an anechoic chamber. EuT is placed on a wooden table 10 cm (floor standing) / 80 cm (tabletop) above the floor.

The EuT is placed within the calibrated volume, and the cables connected to EuT is arranged so that 100 cm of each cable is exposed to the electromagnetic field.

Interconnecting cables specified  $\leq 300$  cm whose length exceeded 100 cm are bundled to achieve 100 cm length.

Interconnecting cables specified  $> 300$  cm and other cables connected to the EuT are exposed for 100 cm, and the remaining cable length is decoupled with the use of ferrites.

### Procedure

The EuT is exposed to a RF electromagnetic field generated by one or more antennas. The field is applied with the antennas facing each of the four faces of the EuT ( $0^\circ$ ,  $180^\circ$ ). The polarization of the field requires testing each side of the EuT twice, once with the antenna horizontally and again with the antenna vertically. The antenna height during test is 150 cm.

A field level and type as specified below is applied in the defined frequency range. The frequency is swept through the range with a step width and a dwell time per frequency as specified below.

### Instruments used during measurement

Instrument list:

- RF Generator R&S SMT03 (LR-1230) (11-2012)
- Power Meter R&S NRVD (LR-1347) (03-2012)
- Power Probe NRV-Z5 R&S (LR-1372) (05-2011)
- Coupler Narda 3020B (LR-287) (05-2011)
- Coupler Amplifier Research DC6180 (LR-1404) (05-2010)
- Antenna R&S HL023-A1 (LR-282) (NA)
- Antennas EMCO 3161-1 & 2 (LR 1178 & 79) (NA)
- Antenna EMCO 3115 (LR 1330) (08-2013)
- Field Probe AR FP4080 (LR-1424) (06-2011)

### Comments

No recorded comments.

### Severity

Port:	Enclosure Port
Frequency range:	80 – 2000 MHz
Step size:	1 %
Dwell time:	3 seconds
Modulation:	80 % AM, 400 Hz
Field generation:	Testing has been performed in an anechoic chamber using antennas to apply the field

### Conformity

Verdict:	PASS
Test engineer:	Jan G Eriksen



### DETAILED TEST LOG

Note: The choice of test levels could differ from the procedure, based on the nature of EuT.  
 Note: An asterisk (\*) indicates tests not within the scope of accreditation.  
 Note: Possible test case performances: <space> = Not tested, or letters indicating level of performance.

Frequency range [MHz]	Field strength [V/m]	Azimuth [deg]	Polarization	Required Criteria	Complied Criteria	Result
80 - 2000	10	0°	HOR	A	A	PASS
80 - 1000	10	180°	HOR	A	A	PASS
80 - 1000	10	0°	VER	A	A	PASS
80 - 1000	10	180°	VER	A	A	PASS

### CONCLUSION

No operation errors were detected during or after the applied test(s)



Notes: Test set-up for Radiated RF Field immunity

# IMMUNITY – ELECTRIC FAST TRANSIENTS

## TEST DESCRIPTION

### Method

The reference method for this test is listed in the table under clause APPLIED TESTS.

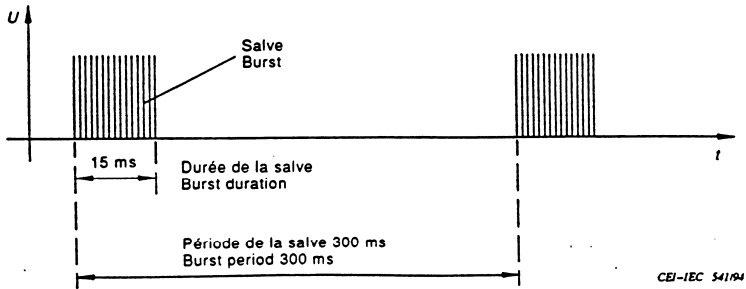
### Set-up

A ground reference plane is located on the floor, and connected to earth via a low impedance connection. The EFT/B generator's reference ground is connected to the reference plane.

EuT is placed on a wooden table 10 cm above the reference plane, and all cables attached to the EuT are isolated the same way.

### Procedure

Transients are applied at increasing levels to each single line of the AC or DC mains port using a coupling network (both one and one line separately, and then all lines at once), and other remaining ports using a capacitive coupling clamp.



### Instruments used during measurement

Instrument list: EFT/B Generator Haefely Junior (LR-1297) (03-2011)  
 Transient Coupling Clamp IP4A-93 Haefely (LR-1301) (03-2011)

### Comments

RS-232 port on Display unit is a service port and was not tested.

### Severity

Port: All Signal Ports of Radio and Display units  
 Duration: 10 mins each port

### Conformity

Verdict: PASS  
 Test engineer: Jan G Eriksen

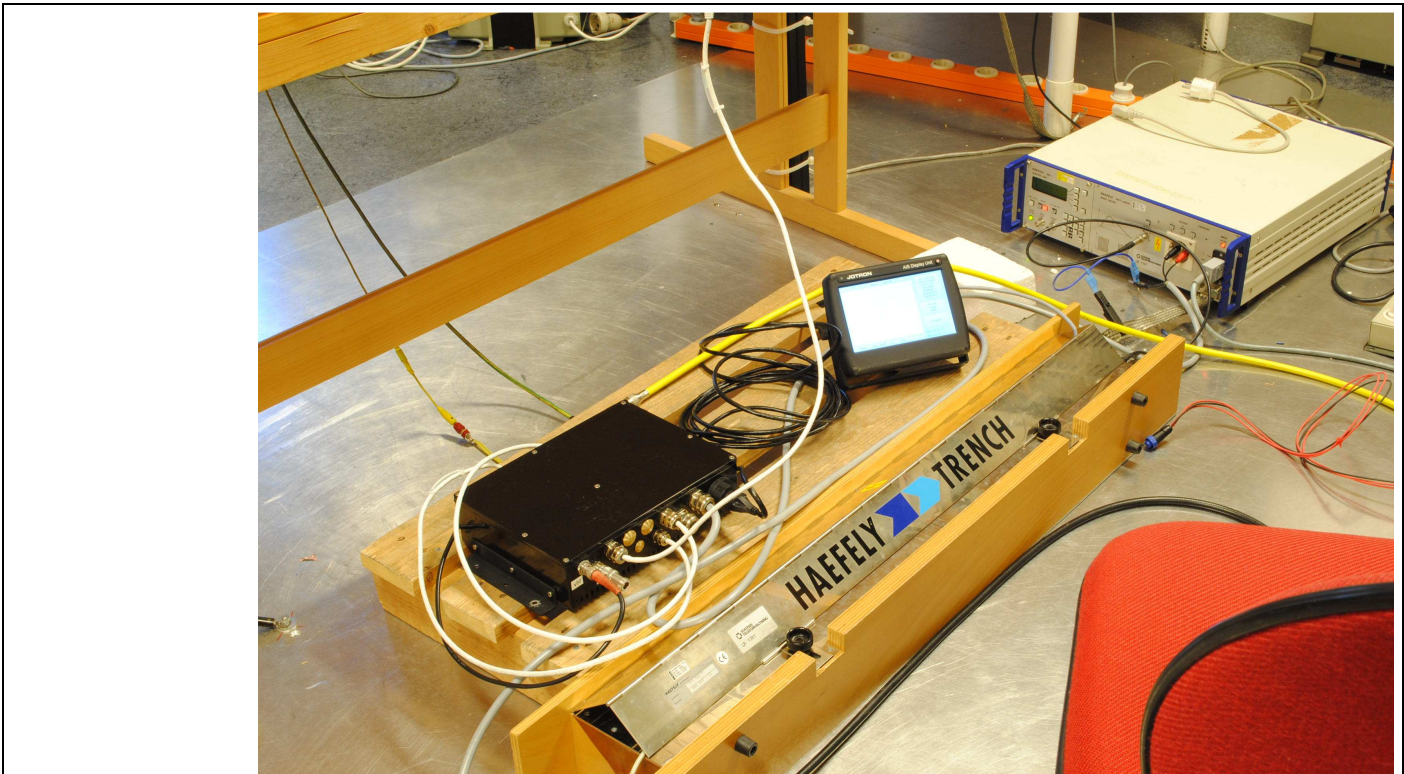
### DETAILED TEST LOG

Note: The choice of test levels could differ from the procedure, based on the nature of EuT.  
 Note: An asterisk (\*) indicates tests not within the scope of accreditation.  
 Note: Possible test case performances: <space> = Not tested, or letters indicating level of performance.

Port	Applied Level [kV]	Injection Method	Required Criteria	Complied Criteria	Result
Radio unit:					
Signal Port Antenna VHF	±1	CLAMP	B	B	PASS
Antenna GPS	±1	CLAMP	B	B	PASS
Ethernet to display unit	±1	CLAMP	B	B	PASS
RS-422	±1	CLAMP	B	B	PASS
RS-232	±1	CLAMP	B	B	PASS
Display unit:					
Ethernet to radio unit	±1	CLAMP	B	B	PASS
RS-422	±1	CLAMP	B	B	PASS

### CONCLUSION

No operation errors were detected during or after the applied test(s)



Notes: Test set-up for Electric Fast Transients

# IMMUNITY – CONDUCTED RF DISTURBANCE

## TEST DESCRIPTION

### Method

The reference method for this test is listed in the table under clause APPLIED TESTS.

### Set-up

The test is performed on a large ground reference plane. EuT is placed on a wooden table 10 cm above the reference plane. Cables for AC mains and cables going to and from support equipment plus interconnecting cables are isolated from the ground plane by a 5 cm isolating support.

### Procedure

Disturbance is applied via a coupling/decoupling network (CDN) or a capacitive coupling clamp (EM Clamp) to each port separately.

All ports on EuT not subject to testing are furnished with decoupling networks to achieve RF isolation of the EuT during test. As decoupling networks Nemko use the CDNs normally used to apply the disturbance.

One of the CDNs have a 50Ω termination attached to its RF input port, this CDN behaves as true 150Ω loop. Which CDN to select is decided according to the priority given in §7.2 of the reference standard.

For AC ports, DC ports, coax lines and 2- or 4-lines balanced communication lines a CDN is used to apply the disturbance. On other multiple signal cables an EM Clamp is used to apply the disturbance.

A signal level/type as specified below is applied in the defined frequency range. The frequency is swept through the range with a step width and a dwell time per frequency as specified below.

### Instruments used during measurement

Instrument list: RF Generator HP 8656B (LR-1026) (10-2011),  
 Voltmeter R&S URV5 (LR-192) (10-2011),  
 Coupler Werlatone 2630 (LR-1321) (05-2011)  
 CDN Fischer 801-M2-16 (LR 1312) (06-2012)  
 Injection Clamp Fischer (LR 1482) (06-2012)  
 CDN Nemko (LR 1474) (NA)

### Comments

RS-232 port on Display unit is a service port and was not tested

### Severity

Port:	All ports on Radio unit and Display units
Frequency range:	0,150-30 MHz
Step size:	1 %
Dwell time:	3 seconds
Modulation:	80 % AM, 400 Hz

### Conformity

Verdict:	PASS
Test engineer:	Jan G Eriksen