





# Test Report Electromagnetic Compatibility

Product	Animal Monitoring Device	
Name and address of the applicant	DeLaval International AB Gustaf DeLavals väg 15 SE-14741 Tumba Sweden	
Name and address of the manufacturer	DeLaval International AB Gustaf DeLavals väg 15 SE-14741 Tumba Sweden	
Model	AM2	
Rating	3V DC (Battery)	
Trademark	DeLaval	
Additional information	/	
Tested according to	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7	FCC ID : UCS2150043281 IC : 6576A-2150043281
Project number	PRJ0039211	
Tested in period	2024-01-29 to 2024-01-30	
Issue date	2024-09-18	
Name and address of the testing laboratory	Nemko Scandinavia AS Philip Pedersens vei 11, 1366 Lysaker, Norway	NORWEGIAN ACCREDITATION TEST 033

An accredited technical test executed under the Norwegian accreditation scheme

Prepared by [Jørn Gustavsen]

Approved by [Roger Berget



#### REPORT REVISIONS

Report Edition	Date	Project	Description
REP024703A	2024-06-21	PRJ0039211	First issued
В	2024-09-18	PRJ0039211	Due to delete all pictures in the test report.



#### THIS REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATION(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 authorities 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 performed in this report.

Deviations from, additions to, or exclusions from the test specifications are described in "Test Report Summary".

This report was originally distributed electronically with digital signatures. For more information contact Nemko.

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# **DESCRIPTION OF TESTED ITEM(S)**

Product description:	Animal monitoring device that transmits registered activity data over radio
Model/type:	AM2
Serial number:	ME060116NC
Operating voltage:	3.0 V DC (Battery)
Maximum power/current:	30 mA
Insulation class:	/
Highest clock frequency:	30 MHz
Hardware version:	00
Software version:	1.1.0.5967
Model/type:	AM2
Serial number:	ME060170NC
Operating voltage:	3.0 V DC (Battery)
Maximum power/current:	30 mA
Insulation class:	
Highest clock frequency:	30 MHz
Hardware version:	00
Software version:	1.1.0.5967
Mounting position:	☐ Tabletop equipment
	☐ Wall/ceiling mounted equipment
	☐ Floor standing equipment
	Handheld equipment
	Rack mounted equipment
	Console equipment
	☐ Other: Strapped to a cow's or other cattle's neck using a collar.

#### **RF CHARACTERISTICS OF THE TRANSMITTER**

Туре	SRD 418MHz	SRD 433MHz
Frequency range:	417.33 – 418.32 MHz	433.330 – 434.320 MHz
Number of channels:	4	4
Channel BW:	1MHz	1MHz
Rated output power:	0.20 mW (Peak, Radiated)	-6 dBm (Radiated, e.r.p.)
Receiver category:	Portable-used	N/A (TX Only)
Classification:	N/A (TX Only)	Portable-used
Operating modes:	2-GFSK	TX
Types of modulation:	No	2-GFSK
Tunable bands:	No	No
User frequency adjustment:	Integral	None
Antenna type:	/	Integral
Antenna gain:	No	/
Antenna connection:	1	No
Number of antennas:	No	1
Antenna diversity/MIMO::		No

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#### **CRITICAL MODULES/PARTS**

Description	Manufacturer	Туре
Microcontroller unit with integrated radio transceiver	Silicon Laboratories	Si1062

#### **ACCESSORIES USED DURING TEST**

Description	Manufacturer	Туре
8-bit USB Debug Adapter	Silicon Laboratories	DEBUGADPTR1-USB
Trigger Box	DeLaval	-
Antenna	Procom	EFD 40/425
Monior Board	DeLaval	MONITOR AR2
System Controll	DeLaval	SC1
Laptop	Dell	Latitude 7490

### INPUT/OUTPUT PORTS

The specimen has no connecting ports.

#### **OPERATING MODES**

OP no.	Description	Applied fo	or testing
		Emissions	Immunity
OP1	Operating, send and receive packages @ 433MHz	$\boxtimes$	$\boxtimes$
OP2	Operating, send and receive packages @ 418MHz	$\boxtimes$	

#### **PHOTOS AND DRAWINGS**

Photo of the test item:	/	/
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#### **OTHER INFORMATION**

Modifications:	
Additional information:	

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### **TEST ENVIRONMENT**

Test laboratory:		
	☐ LYSAKER (Philip Pedersens vei 11, N-1366 Lysaker, Norway)	
Laboratory accreditation:	Norsk Akkreditering – TEST 033 P06 – Electromagnetic Compatibility ACCREDITATION TEST 033	
Environmental conditions:	The climatic conditions during the tests are within limits specified by the manufacturer for the operation of the product and the test equipment.  The climatic conditions during tests are within the following limits:	
	Ambient temperature: 15 – 35 °C Relative humidity: 25 – 75 %RH Atmospheric pressure: 86 – 106 kPa	
	If explicitly required by the test standard, or the requirements are tighter than the above; the climatic conditions are recorded and documented separately in this test report.	
Calibration:	All instruments used in the tests of this test report are calibrated and traceable to national or international standards. Between calibrations test set-ups are controlled and verified on a regular basis by intermediate checks to ensure, with 95% confidence that the instruments remain within their calibrated levels.  The instrumentation accuracy is within limits agreed by the IECEE/CTL and defined by Nemko.	
Measurement uncertainties:	Uncertainty in EMC emission measurements stated in this report are calculated from the standard measurement uncertainties multiplied by the coverage factor k=2. It was determined in accordance with CISPR 16-4-2. The true value is in the corresponding interval with a probability of 95%.  Uncertainties for continuous immunity tests are calculated based on the same principles as for EMC emission uncertainties.  For Harmonics and Flicker measurements the measurement uncertainty is calculated based on the same principles as for EMC emission uncertainties.  Uncertainties for transient immunity are kept within the requirements of the relevant basic standard.  Further information about measurement uncertainties is provided on request.	
Decision rules:	As specified by CISPR 16-4-2; if our measurement uncertainty U <sub>LAB</sub> is less than or equal to U <sub>CISPR</sub> , compliance is deemed to occur if no measured disturbance level exceeds the limit hence "PASS" is indicated, and non-compliance is deemed to occur if any measured disturbance level exceeds the limits hence "FAIL" is indicated.  For continuous immunity tests, uncertainties are not considered when applying the calibrated test levels. Tests are performed at the test levels specified by the test standard. PASS and FAIL decisions are based on behaviour observations of the specimen.  For transient immunity tests, uncertainties are not considered if the test equipment is kept within the requirements of the relevant basic standard. Tests are performed at the test levels specified by the test standard. PASS and FAIL decisions are based on behaviour observations of the specimen.  For Harmonics and Flicker measurements the measurement uncertainty is considered, and measurements are marked if necessary. In doing so, the associated uncertainty of measurement has been considered.  Further information about decision rules is provided on request.	

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#### **EVALUATION OF PERFORMANCE**

#### **PERFORMANCE TESTS**

Performance checks:	Checking received messages are between 3500 and 3600.	
Performance tests:	Checking received messages are between 3500 and 3600.	
Monitoring during tests:	Received messages was moitored with SC1 connected to laptop to monitor received messages.	

#### Information:

Performance check is a short functional test carried out during or after a technical test to confirm that the equipment operates.

Performance test is a measurement, or a group of measurements carried out during and/or after a technical test to confirm that the equipment complies with selected parameters as defined in the equipment standard.

Monitoring during tests describes which functions were monitored and how.

#### **GENERAL PERFORMANCE CRITERIA**

For the specimen to pass each test, it shall meet the following general criteria:

During test	After test
Performance criterion A: Operate as intended. No loss of function. No unintentional responses.	Performance criterion A: Operate as intended. No loss of function. No degradation of performance. No loss of stored data or user programmable functions.
Performance criterion B: May be loss of function (one or more). No unintentional responses.	Performance criterion B: Operate as intended. Lost function(s) shall be self-recoverable. No degradation of performance. No loss of stored data or user programmable functions.
Performance criterion C: May be loss of function (one or more).	Performance criterion C: Lost function(s) shall be recoverable by the operator. Operate as intended after recovering. No degradation of performance.

#### Information:

In the subsequent test sections of this report, the required and actual specimen performance during immunity testing is indicated by the nomenclatures as given by the table above (A, B or C, CT, TT, CR or TR).

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#### TRANSMITTER PERFORMANCE CRITERIA

For the specimen to pass each test, the transmitter functions shall meet the following criteria:

During continuous tests	During transient tests			
Performance criterion CT:  During and after the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.  During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data.  If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.	Performance criterion TT:  After the test, the apparatus shall continue to operate as intended.  No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended.  In some cases this permissible performance level may be replaced by a permissible loss of performance.  During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed.  If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.			
Modification by the manufacturer: Not modified	Modification by the manufacturer: Not modified			
Information:				

In the subsequent test sections of this report, the required and actual specimen performance during immunity testing is indicated by the nomenclatures as given by the table above (CT, TT).

#### RECEIVER PERFORMANCE CRITERIA

For the specimen to pass each test, the receiver functions shall meet the following criteria:

Performance criterion CR: During and after the test, the apparatus shall continue to operate	Performance criterion TR :
as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer when the apparatus is used as intended. In some cases this permissible performance level may be replaced by a permissible loss of performance.  During the test the EUT shall not unintentionally transmit or change its actual operating state and stored data.  If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.	After the test, the apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a permissible performance level specified by the manufacturer, when the apparatus is used as intended.  In some cases this permissible performance level may be replaced by a permissible loss of performance.  During the EMC exposure to an electromagnetic phenomenon, a degradation of performance is, however, allowed. No change of the actual mode of operation (e.g. unintended transmission) or stored data is allowed.  If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be deduced from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended.
Modification by the manufacturer: Not modified	Modification by the manufacturer: Not modified

In the subsequent test sections of this report, the required and actual specimen performance during immunity testing is indicated by the nomenclatures as given by the table above (CR or TR).

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#### **TEST REPORT SUMMARY**

#### **APPLIED STANDARDS**

Standards	Titles
ETSI EN 301 489-01 V2.2.3	Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements
ETSI EN 301 489-03 V2.1.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 246 GHz
FCC CFR 47 Subpart 15B	Digital devices - Unintentinal radiators, Class B Digital Device
ISED Canada ICES-003, Issue 7	Spectrum Management and Telecommunications Policy. Interference-Causing Equipment Standard. Information Technology Equipment (Including Digital Apparatus - Limits and Methods of Measurement (Issue 7, June 2020)

<sup>\* :</sup> An asterisk (\*) placed after the standard name indicates standards that are not within the laboratory scope of accreditation.

#### **TEST SUMMARY**

Requirements – Tests	Reference standards	Verdict
Conducted Emissions	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7 CISPR 16-2-1:2017, Ed.3.1	N/A
Radiated Emissions (Below 1GHz)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7 CISPR 16-2-3:2019, Ed.4.1	PASS
Radiated Emissions (Above 1GHz)	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 FCC CFR 47 Subpart 15B ISED Canada ICES-003, Issue 7 CISPR 16-2-3:2019, Ed.4.1	N/A
Harmonic Current Emissions	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 EN IEC 61000-3-2:2021, Ed.5.1	N/A
Voltage Variations/Fluctuations/Flicker	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 EN 61000-3-3:2021, Ed.3.2	N/A
Electrostatic Discharge (ESD) Immunity	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 EN 61000-4-2:2009, Ed.2.0	PASS
Radiated RF Disturbance Immunity	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 EN 61000-4-3:2020, Ed.4.0	PASS
Electric Fast Transients Immunity	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 EN 61000-4-4:2012, Ed.3.0	N/A
Surge Immunity	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 EN 61000-4-5:2017, Ed.3.1	N/A

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**TEST REPORT** 

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Requirements – Tests	Reference standards	Verdict
Conducted RF Disturbance Immunity	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 EN 61000-4-6:2014, Ed.4.0	N/A
Voltage Dips and Interruptions Immunity	ETSI EN 301 489-01 V2.2.3 ETSI EN 301 489-03 V2.1.1 EN IEC 61000-4-11:2020, Ed.3.0	N/A

PASS : Tested and complied with the requirements

FAIL : Tested and failed the requirements

N/A : 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 a test item that are not within Nemko's scope of accreditation

# : A grid (#) placed after the verdict in the Result column indicates a test item that are only partly covered by Nemko's scope of

accreditation. Further information or details may be provided within the test chapter

#### ABOUT REFERENCE STANDARDS AND TEST LEVELS

Product standards with dated references to basic standards may have been performed according to the newest edition of the basic standard. This may impact the compliance criteria or technical performance of the test, still this is adequate if the test is expected to confirm compliance to the intention of the product standard. The table above lists the actual editions of the basic standards which have been used during testing.

The choice of immunity test levels could be higher than those specified by the reference standards when we consider the nature of the specimen and its intended use or based on customer requests.

#### **NOTES**

None

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# **Test Results**

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TEST REPORT

Report No. REP024703B

# **RADIATED EMISSIONS (BELOW 1GHZ)**

#### **TEST DESCRIPTION**

Method			
The reference method for this	s test is listed in the table under clau	se TEST SUMMARY.	
Set-up			
·	formed in a semi-anechoic chamber		orovided.
The specimen was energized	and in normal operating mode durin	g the measurement.	
☐ The specimen and its cable	es were elevated 10 cm above the sit	e ground plane and placed in the co	entre of the turntable.
	es were placed on a table 80 cm abov		
	were applied to cables leaving the te	est volume.	
☐ A CDNE was applied to the	power supply cable.		
Antenna type = Hybrid bilog a	antenna		
	cm above the ground reference plan	ne.	
Specimen rotation = 0-360°.			
☐ Band-ston filter(s) was use	d to suppress the wanted RF transmi	ission hand to protect the measure	ment equinment
Bana stop inter(s) was use	a to suppliess the wanted in transmi	ission sand to protect the measure	ment equipment.
Frequency range:	Measurement distance:		
☐ 30-300MHz	⊠ 3m		
⊠ 30-1000MHz	□ 5m		
☐ Other:	□ 10m		
Conditions			
The measuring bandwidth is 1	120 kHz in the frequency range 30 M	Hz – 1000 MHz. Frequency sweeps	with RBW = 120 kHz and VBW
= 1 MHz was applied with a sv	weep time of 20 ms (step size resolut	tion < 60 kHz ).	
Measurement uncertainty: +	4.9 dB (3m distance in SAC10); ± 4.6	dB (3m distance in SAC3): + 4.6 dB	(10m distance in SAC10)
		as (o alotalise o. 100), = 110 as	(2011 0.0001.00 11. 07.020)
Instruments used during mea	asurement		
	Antenna, Hybrid: Sunol / JB3 (N-4525		
	EMI Receiver: R&S / ESU40 (LR-1639)		
•	Preamplifier: Sonoma / 310N (LR-168	50) (U8/2U24)	
		Conformity	
		Verdict:	Pass
		Test engineer:	Jørn Gustavsen

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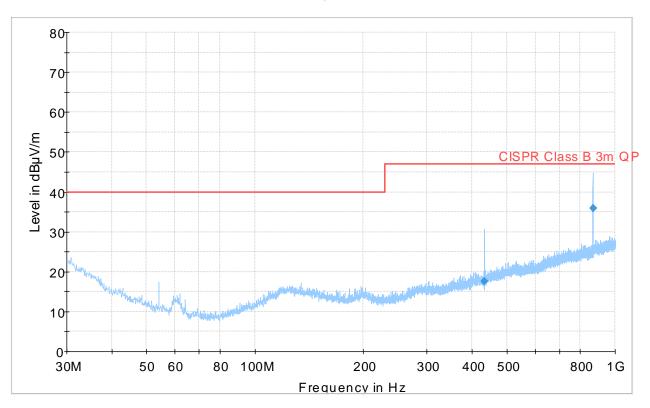




**EMISSION SPECTRUM (CISPR LIMITS)** 

Model: AM2 (433MHz)

#### Full Spectrum



#### **MEASUREMENTS DATA**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
433.780942	17.51	46.00	28.49	15000.0	120.000	400.0	V	67.0	-6.9
867.306754	35.85	46.00	10.15	15000.0	120.000	137.0	Н	124.0	0.5

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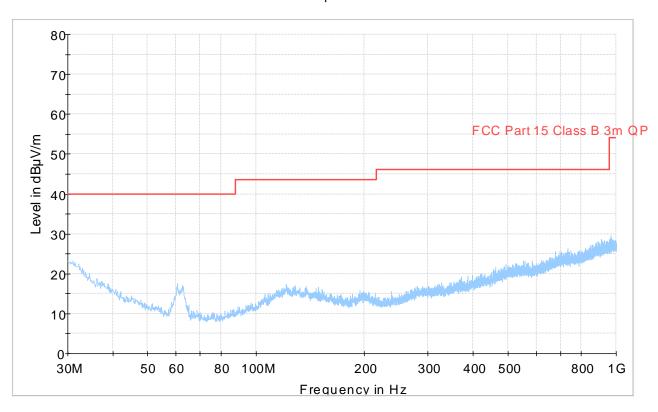




**EMISSION SPECTRUM (FCC LIMITS)** 

Model: AM2 (418MHz)

#### Full Spectrum



#### **MEASUREMENTS DATA**

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)

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# **ELECTROSTATIC DISCHARGE (ESD) IMMUNITY**

21.7 ºC

54 %RH

1008 hPA

Temperature: Humidity:

Atmos. pressure:

#### **TEST DESCRIPTION**

Method The reference method for this test is listed in the table under clause TEST SUMMARY.
Set-up The specimen was energized and in normal operating condition.
$\square$ Floor standing equipment. Specimen was elevated 10 cm above the ground reference plane. $\boxtimes$ Table top equipment. Specimen was placed on a test table 80 cm above the reference ground plane. A horizontal coupling plane (HCP) of 160x80 cm was placed on the test table, just beneath the specimen, and connected to the reference plane via a cable with two $470k\Omega$ resistors located one in each end of the cable. The specimen was separated from the HCP by a 0.5mm insulating support.
A vertical coupling plane (VCP) of 50x50 cm was placed 10 cm from the specimen exterior. This VCP is connected to the reference plane via a cable with two $470k\Omega$ resistors located one in each end of the cable.
The ESD generator's reference ground was connected to the reference ground plane.
Procedure  ☑ Indirect contact discharges were applied to the mid edge of the VCP.  ☑ Indirect contact discharges were applied to the mid edge of the HCP.  ☐ Direct contact discharges were applied to various selected test points of the specimen at conductive surfaces,  ☐ Direct air discharges were applied to various selected test points of the specimen at non-conductive surfaces.
Discharges were applied at increasing levels to each test point.
Uncertainty figures: Peak voltage: ± 10 %; Transient shape: ± 30 %
A functional test was performed before and after the exposure. The specimen was observed during exposure in order to detect unintended responses.
Instruments used during measurement Instrument list: ESD Generator: EMTest / Dito (LR-1733) (02/2024)

Conformity

Test engineer:

Pass

Jørn Gustavsen

Verdict:

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#### **PHOTO OF SELECTED TEST POINTS**



Test Poin★	Applied Level [kV]	Discharge Type	Discharges per test level	Required Criteria	Complied Criteria	Result
Plastic Enclosure	±2, ±4, ±8	Air	10	В	А	PASS
НСР	±4	Contact	10	В	Α	PASS
VCP	±4	Contact	10	В	А	PASS

#### **OBSERVATIONS**

No malfunctions were recorded during or after the applied test(s). Observations showed no unintended responses during test(s).

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# **RADIATED RF DISTURBANCE IMMUNITY**

#### **TEST DESCRIPTION**

<b>Method</b> The reference method for t	his test is listed in the table	under clause TEST S	UMMARY.	
<b>Set-up</b> The tests were performed a	t 3 meter antenna distance	in an anechoic char	nber.	
☐ The specimen was placed ☑ The specimen was placed				
each cable was exposed to t Interconnecting cables spec	the electromagnetic field. ified $\leq$ 300 cm whose lengt ified $>$ 300 cm and other cannot be reasonable.	h exceeded 100 cm	were bundled to achieve 10	os arranged so that 100 cm of 00 cm length. Or 100 cm, and the remaining
Procedure The specimen was exposed requires testing each side or antenna height during test was to be compared to the compared	f the specimen twice, once			
	en: (handheld) tom (handheld)	☐ 1.5x10 <sup>-3</sup> dec	ep rate: h 3 sec dwell time ades/sec (80 – 1000MHz) ades/sec (1000 – 2000MH;	2)
Frequency range:  □ 80MHz – 1000MHz  □ 1400MHz – 2000MHz  □ 2000MHz – 2700MHz  □ 80MHz – 2000MHz  ⊠ 80MHz – 6000MHz	Modulation: ☑ 80% AM @ 1 ☐ 80% AM @ 4 ☐ 50% PM @ 2	00Hz		certainty figures: Id level: ± 2.4 dB
A functional test was perfor unintended responses.	med before and after the $\epsilon$	exposure. The specin	nen was observed during ex	oposure in order to detect
Instruments used during m	easurement			
Instrument list:		50 (LR-1805) (N/A) 5 (LR-1756) (10/2024 100A (LR-1603) (01/ 8SN (LR-1803) (06/20 8SN (LR-1804) (06/20	) (2027) (255) (225)	
			Verdict:	Pass
			Test engineer:	Jørn Gustavsen

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#### **DETAILED TEST LOG**

Frequency range [MHz]	Field strength [V/m]	Polarization	Required Criteria	Complied Criteria	Result
80 - 1000	3	HOR	Α	Α	PASS
80 - 1000	3	VER	А	А	PASS
1400 - 2000	3	HOR	Α	А	PASS
1400 - 2000	3	VER	Α	А	PASS
2000 - 2700	3	HOR	Α	Α	PASS
2000 - 2700	3	VER	Α	А	PASS
1000 - 6000	3	HOR	А	А	PASS
1000 - 6000	3	VER	А	Α	PASS

<sup>□</sup> Additional tests were performed at discrete spot frequencies with 3V/m test level. Spot frequencies which were tested: 80 MHz, 120 MHz, 160 MHz, 230 MHz, 434 MHz, 460 MHz, 600 MHz, 863 MHz, 900 MHz, 1800 MHz, 2600 MHz, 3500 MHz, and 5000 MHz

#### **OBSERVATIONS**

No malfunctions were recorded during or after the applied test(s). Observations showed no unintended responses during test(s).

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# **Annexes**

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# **PHOTOS**

Test set-up for EMC emissions measurements	
Radiated Emission	
Test set-up for EMC immunity tests	
Radiated RF Disturbance Immunity	Electrostatic Discharge (ESD) Immunity

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