

# Test Report

of

**Curo**

according to

EN 301 489-1 V2.2.3  
EN 301 489-17 V3.2.4

Performed by

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<b>Report no.:</b>	P22-0049-1	<b>Report date:</b>	2022-04-19
<b>Test started:</b>	2022-04-12	<b>Test ended:</b>	2022-04-19
<b>Test laboratory:</b>	EKTOS TRS A/S Peter Bangs Vej 17 7600 Struer Denmark	<b>Client:</b>	Enhanced Communication Technology A/S Sintrupvej 23 8220 Brabrand Denmark
<b>Contact person:</b>	Henrik Brosbøl	<b>Contact person:</b>	Henrik Mikkelsen
<b>Test specimens:</b>	Model: Curo		
<b>Test specifications:</b>	EN 301 489-1 V2.2.3 EN 301 489-17 V3.2.4  The tests relevant for the test specimens are listed in <i>section 1.1</i> .		
<b>Documentation:</b>	This test report shall not be reproduced except in full, without written approval of the laboratory.  The complete test documentation is archived for 10 years at the testing laboratory.		
<b>Test results:</b>	The test specimen complies with relevant parts of the test specifications.  The test results relate only to the specimen tested.		
<b>Test personnel:</b>	Volodymyr Hraivoronskyi		

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## Appendices

None.

## 1 SUMMARY

### 1.1 Test plan

Test plan according to EN 301 489-17 V3.2.4 with clauses from EN 301 489-1 V2.2.3

EN 301 489-1 V2.2.3

EN 301 489-17 V3.2.4

Clause	Name of the test	Test	Result
8.2	Enclosure of ancillary equipment measured on a stand-alone basis	X	PASSED
8.3	DC power input/output ports	NR <sup>1</sup>	-
8.4	AC mains power input/output ports	NR <sup>1</sup>	-
8.5	Harmonic current emission (AC mains input port)	NR <sup>1</sup>	-
8.6	Voltage fluctuations and flicker (AC mains input ports)	NR <sup>1</sup>	-
8.7	Telecommunication ports	NR <sup>1</sup>	-
9.2	Radio frequency electromagnetic field	X	PASSED
9.3	Electrostatic discharge	X	PASSED
9.4	Fast transients, common mode	NR <sup>1</sup>	-
9.5	Radio frequency, common mode	NR <sup>1</sup>	-
9.6	Transients and surges in the vehicular environment	NR <sup>2</sup>	-
9.7	Voltage dips and interruptions	NR <sup>1</sup>	-
9.8	Surges	NR <sup>1</sup>	-

PASSED

The test specimen complies with the essential requirements in the standard.

FAILED

The test specimen does not comply with the essential requirements in the standard.

REF

The test is covered by a test in another report and/or on a similar test specimen.

NR

The test is not relevant for the test specimen or has been waived by the manufacturer.

X

The test is performed.

Note 1: The test specimen is a battery powered device and has no power port.

Note 2: The test specimen is not intended for vehicular use.

## 1.2 Test specimen

<b>Manufacturer</b>	Enhanced Communication Technology A/S
<b>Model</b>	Curo
<b>Serial no.</b>	-
<b>Part no.</b>	V0.6.1
<b>Software</b>	V0.5.1
<b>Details</b>	-
<b>Supply voltage</b>	Powered by battery, charged via wireless charging
<b>Operational mode</b>	Wireless Bluetooth



Photo 1. Test specimen.

## 1.3 Auxiliary equipment

### 1.3.1 AC/DC adaptor

<b>Manufacturer</b>	Goobay
<b>Model</b>	43652
<b>Serial no.</b>	-
<b>Details</b>	-
<b>Supply voltage</b>	100 – 240 VAC
<b>Output voltage</b>	5 VDC / 2100 mA
<b>Operational mode</b>	Dedicated power supply for the auxiliary charger



Photo 2. AC/DC adaptor with the Charging station.

### 1.3.2 Wooden charging station

<b>Manufacturer</b>	Enhanced Communication Technology A/S
<b>Model</b>	Curo
<b>Serial no.</b>	-
<b>Details</b>	Charger to charge 4x "Curo" wirelessly
<b>Supply voltage</b>	5 VDC from Micro-USB

### 1.3.3 Mobile phone

<b>Manufacturer</b>	Huawei
<b>Model</b>	AMN-LX9
<b>Serial no.</b>	WNPNU20104314260
<b>Software</b>	Android v. 9, EMUI v. 9.1.0, Curo Prosus Demo 0.1
<b>Details</b>	-
<b>Supply voltage</b>	Battery powered, charging from Micro-USB 5 VDC
<b>Operational mode</b>	Connected to the test specimen

### 1.4 I/O ports / cables to test specimens

I/O Port Cable	Type	Shielding	Max Cable length
Sensor port	3 wire	Unshielded	<3 m

### 1.5 Test set-up

The Test specimen is connected to an auxiliary mobile phone via Bluetooth link.

An app installed on a mobile phone shows the data sent from the test specimen via Bluetooth link.

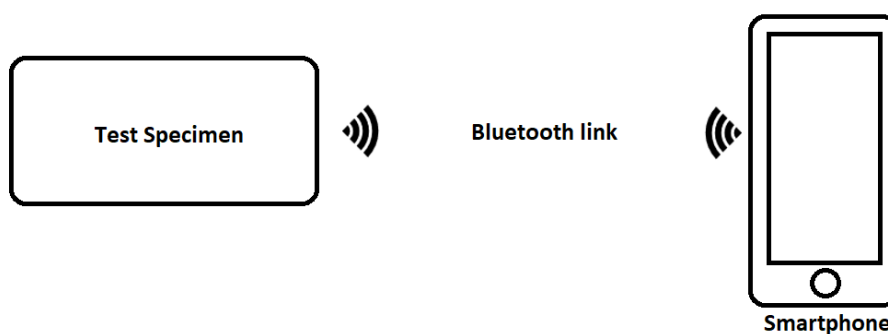


Figure 1. Test set-up.

### 1.6 Functional test procedure

The radio link between the test specimen and auxiliary mobile phone is monitored by means of:

- Blue LED on the test specimen shows the Bluetooth connection established and the data is transferring between the test specimen and the mobile phone;
- Curo Prosus Demo application on the mobile phone shows the connection status of the test specimen and real-time data from the sensor is shown on a screen.

**1.7 Performance criteria**

Bluetooth connection is established during the tests.

No interruption of the radio link or data transferring is allowed.

**1.7.1 General performance criteria from EN 301 489-1**

**1.7.1.1 Performance criteria for continuous phenomena**

During the test, the equipment shall:

- continue to operate as intended;
- not unintentionally transmit;
- not unintentionally change its operating state;
- not unintentionally change critical stored data.

**1.7.1.2 Performance criteria for transient phenomena**

For all ports and transient phenomena with the exception described below, the following applies:

- The application of the transient phenomena shall not result in a change of the mode of operation (e.g. unintended transmission) or the loss of critical stored data.
- After application of the transient phenomena, the equipment shall operate as intended.

For surges applied to symmetrically operated wired network ports intended to be connected directly to outdoor lines the following criteria applies:

- For products with only one symmetrical port intended for connection to outdoor lines, loss of function is allowed, provided the function is self-recoverable, or can be otherwise restored. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.
- For products with more than one symmetrical port intended for connection to outdoor lines, loss of function on the port under test is allowed, provided the function is self-recoverable. Information stored in non-volatile memory, or protected by a battery backup, shall not be lost.

**1.7.2 Performance criteria from EN 301 489-17**

Performance criteria in EN 301 489-17 V3.2.4.:

Criterion	During test	After test
A	Operate as intended No loss of function No unintentional responses	Operate as intended No loss of function No degradation of performance No loss of stored data or user programmable functions
B	May show loss of function No unintentional responses	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 A applies for immunity tests with phenomena of a continuous nature;

Performance criterion B applies for immunity tests with phenomena of a transient nature.

It was not possible to set the test specimen in standby mode, thus tests in standby mode were not performed.



## 2 TESTS

### 2.1 Radiated emission

<b>Test specimen</b>	Curo
<b>Test specification</b>	EN 301 489-17 V3.2.4 EN 301 489-1 V2.2.3, clause 8.2
<b>Test method</b>	EN 55032:2015+AC+A1+A11
<b>Frequency range</b>	30-6000 MHz
<b>Limits</b>	EN 55032:2015+AC+A1+A11, Class B, Distance 3 m
<b>Comments</b>	None
<b>Temperature / Humidity</b>	22°C / 38%RH
<b>Date of measurements</b>	2022-04-12
<b>Test personnel</b>	Volodymyr Hraivoronskyi

#### 2.1.1 Test setup

A measuring distance of 3 m was used during the tests.

The EUT was placed 80 cm above ground on a non-conductive table.

The auxiliary equipment was positioned near the wall behind absorbers.

Exploratory radiated emission measurements in the frequency range 30 – 1000 MHz with reflective floor were made by rotating the turntable between 0-360° and varying the antenna height between 1-4 m, in both horizontal and vertical antenna polarization.

Exploratory radiated emission measurements in the frequency range 1-6 GHz with absorbers on the floor were made by rotating the turntable between 0-360° and an antenna height of 1.0 m, in both horizontal and vertical antenna polarization.

Based on the preliminary measurements the frequencies with the highest emissions are selected for final radiated emission measurements. Final measurements were made by rotating the turntable and changing the height of the antenna to maximize the emission level.

The smallest beamwidth ( $\theta_{3dB}$ ) used between 1-6 GHz was 32.4° at 4 GHz. This resembles a beamwidth ( $w$ ) of 1.74 m at a distance of 3 m.

1 GHz High-Pass filter is used during the measurements at 1 – 3 GHz;

3 GHz High-Pass filter is used during the measurements at 3 – 6 GHz.



**Photo 3. Radiated emission test setup. 30 - 1000 MHz.**

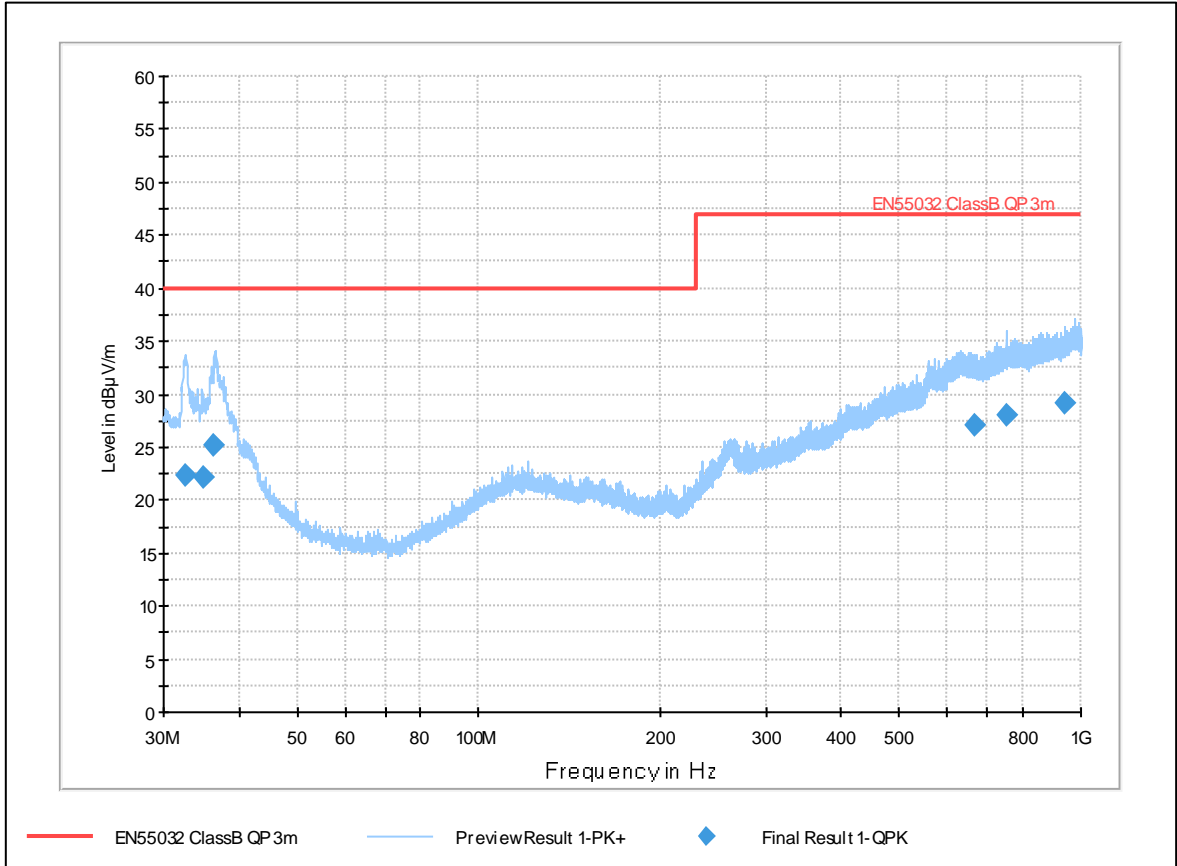


**Photo 4. Radiated emission test setup. 1 - 6 GHz.**

**2.1.2 Test results**

The measured test results were below the limits.

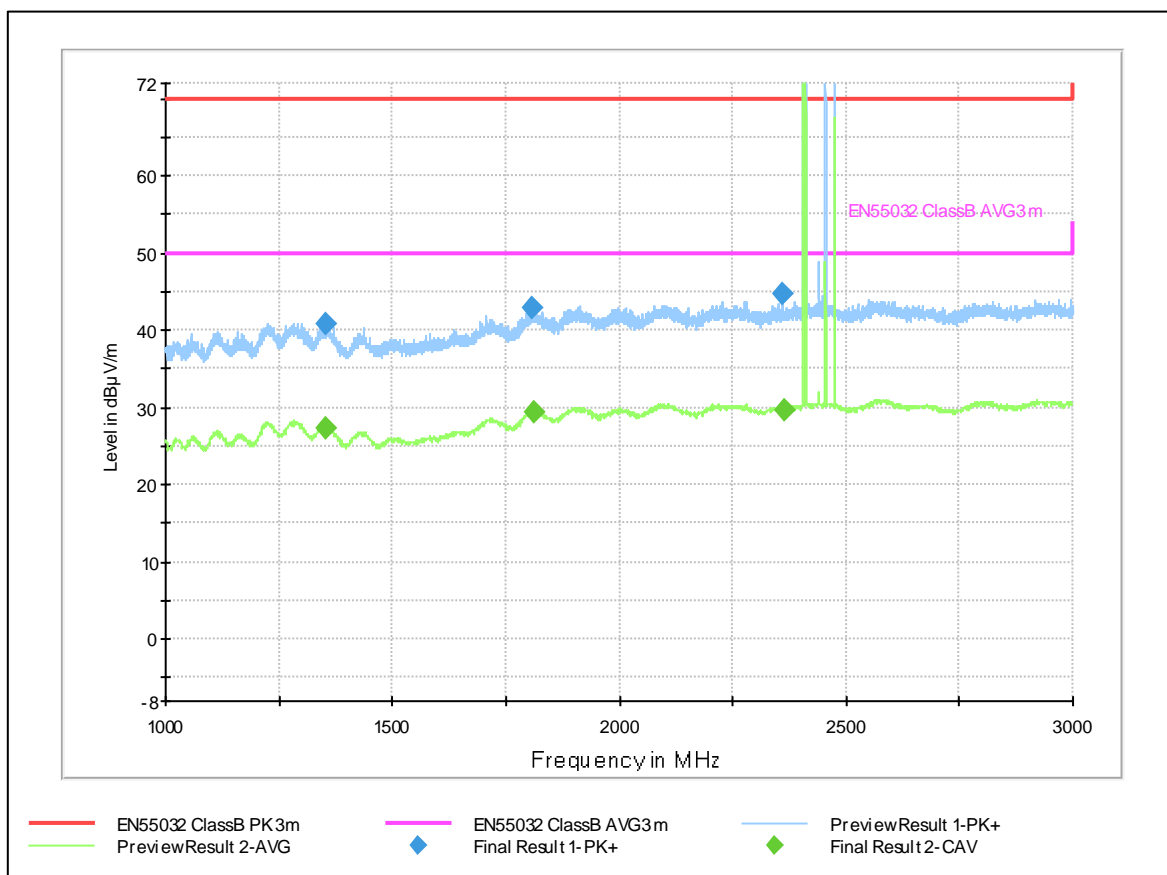
The measurement time during final measurements were 15 s.



**Figure 2. Radiated emission test results. 30 - 1000 MHz.**

Frequency [MHz]	QP [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
32.610000	22.4	120.0	143.0	V	31.0	17.6	40.0	PASSED
34.910000	22.1	120.0	343.0	V	90.0	17.9	40.0	PASSED
36.390000	25.3	120.0	288.0	V	90.0	14.7	40.0	PASSED
667.780000	27.0	120.0	273.0	V	145.0	20.0	47.0	PASSED
755.450000	28.1	120.0	197.0	H	156.0	18.9	47.0	PASSED
939.630000	29.2	120.0	212.0	H	135.0	17.8	47.0	PASSED

**Table 1. Radiated emission test results. 30 - 1000 MHz.**



**Figure 3. Radiated emission test results. 1 - 3 GHz.**

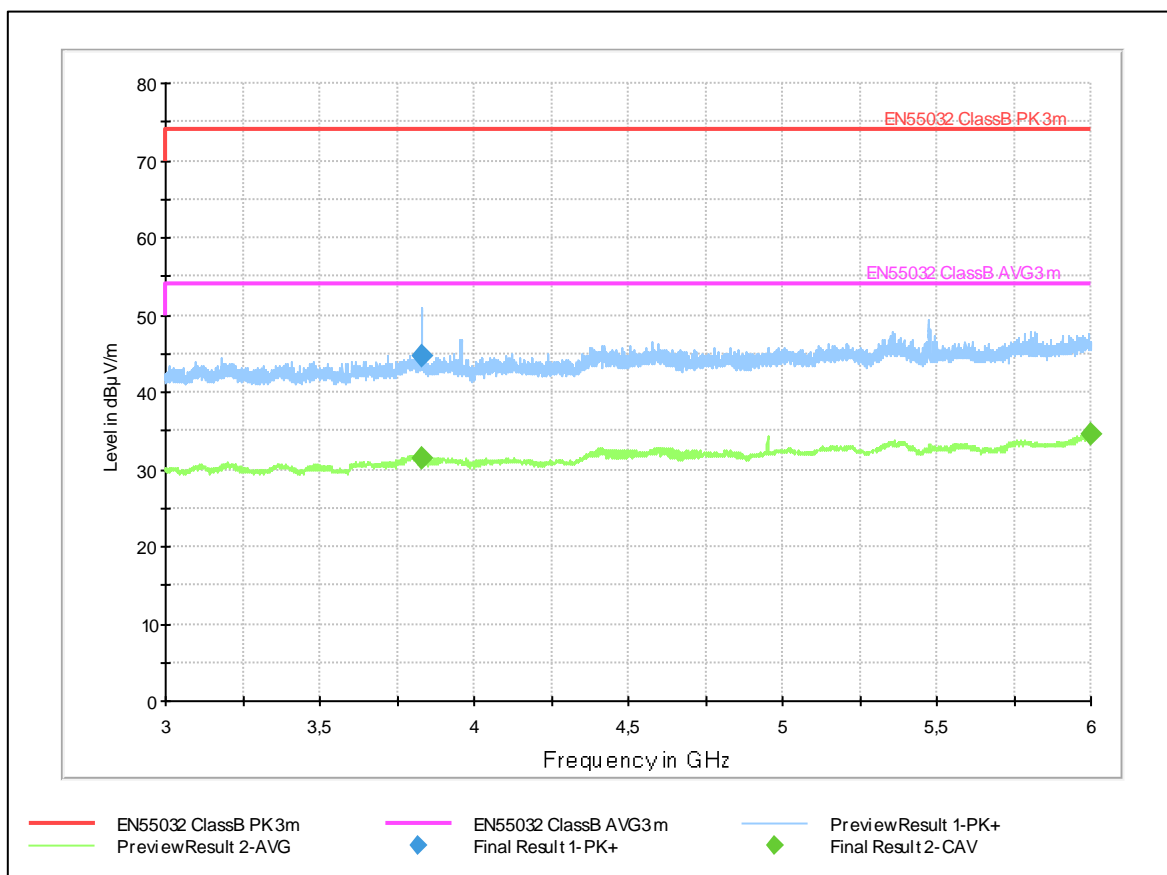
The emission in the 2.4 GHz band is caused by the Bluetooth radio link and can be ignored.

Frequency [MHz]	Peak [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
1351.700000	41.0	1000	259.0	V	191.0	29.0	70.0	PASSED
1808.800000	42.9	1000	245.0	H	285.0	27.1	70.0	PASSED
2359.950000	44.7	1000	100.0	H	173.0	25.3	70.0	PASSED

**Table 2. Radiated emission test results. 1 - 3 GHz. Peak detector.**

Frequency [MHz]	Average [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
1351.550000	27.4	1000	186.0	V	7.0	22.6	50.0	PASSED
1810.200000	29.3	1000	213.0	V	105.0	20.7	50.0	PASSED
2362.900000	29.6	1000	306.0	V	99.0	20.4	50.0	PASSED

**Table 3. Radiated emission test results. 1 - 3 GHz. Average detector.**



**Figure 4. Radiated emission test results. 3 - 6 GHz.**

Frequency [MHz]	Peak [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
3830.450000	44.8	1000	100.0	V	126.0	29.2	74.0	PASSED
6000.750000	48.2	1000	213.0	V	54.0	25.8	74.0	PASSED

**Table 4. Radiated emission test results. 3 - 6 GHz. Peak detector.**

Frequency [MHz]	Average [dBµV/m]	BW [kHz]	Height [cm]	Pol.	Azimuth [deg]	Margin [dB]	Limit [dBµV/m]	Result
3830.100000	31.4	1000	158.0	V	56.0	22.6	54.0	PASSED
5999.950000	34.6	1000	211.0	V	35.0	19.4	54.0	PASSED

**Table 5. Radiated emission test results. 3 - 6 GHz. Average detector.**

Date  
2022-04-19Reference  
P22-0049-1Page  
14 (20)**2.1.3 Test equipment**

Description	Supplier	Model	Tag no.
Antenna, Bilog, 30 MHz-2 GHz	Chase	CBL6112A	30113668
Antenna Horn	ETS Lindgren	3117	30090254
Amplifier 0,5GHz – 26,5GHz	Agilent	83017A	30090219
EMI Test Receiver 20 Hz-26.5 GHz	Rohde&Schwarz	ESU26	30090172
High pass filter 1 GHz	Wainwright	WHKS1000-10SS	30113917
High pass filter 3 GHz	Wainwright	WHJS3000-10SS	30090086

**Table 6. Radiated emission test equipment.**

## 2.2 Radio frequency electromagnetic field

<b>Test specimen</b>	Curo
<b>Test specification</b>	EN 301 489-17 V3.2.4 EN 301 489-1 V2.2.3, clause 9.2
<b>Test method</b>	EN 61000-4-3:2006+A1+A2
<b>Performance criterion</b>	A
<b>Frequency range</b>	80 MHz to 6000 MHz
<b>Exclusion band</b>	-
<b>Field strength</b>	3 V/m
<b>Modulation</b>	80% AM, 1000 Hz sine wave
<b>Step size / dwell time</b>	1% / 1 s
<b>Comments</b>	None
<b>Temperature / Humidity</b>	24°C / 37%RH, 22°C / 38%RH
<b>Date of measurements</b>	2022-04-11, 2022-04-12
<b>Test personnel</b>	Volodymyr Hraivoronskyi

### 2.2.1 Test setup

The tests were performed in a semi anechoic chamber with absorbers on floor. The test specimen was placed on a non-conductive foam table.

The auxiliary equipment was positioned near the wall behind absorbers.

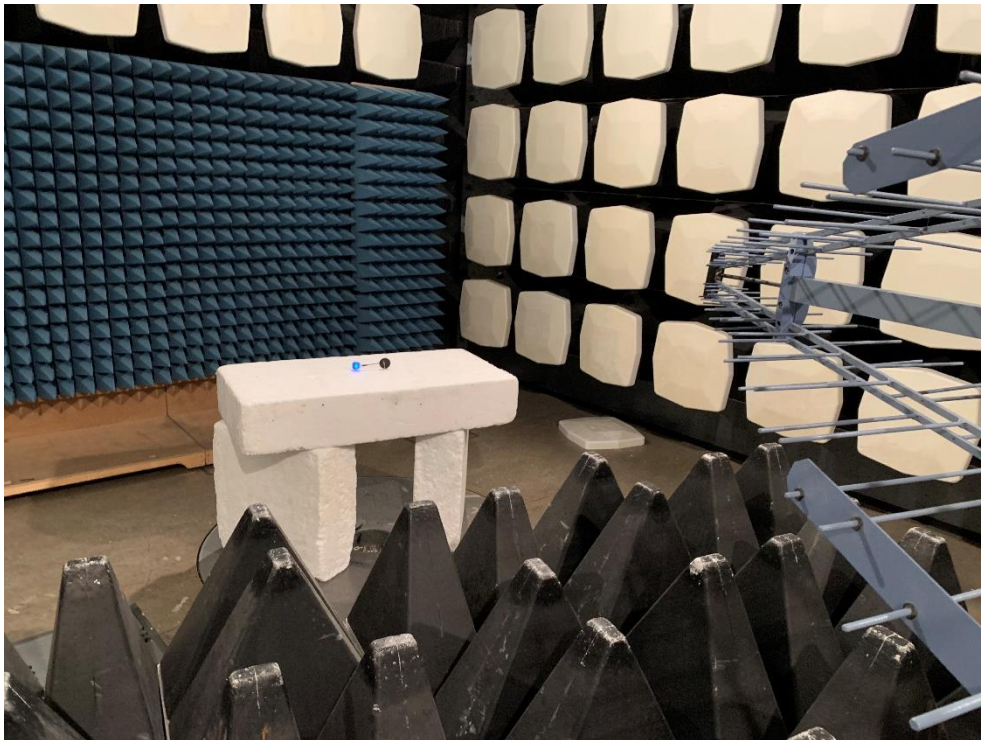
A communication link was established between the test specimen and the auxiliary equipment.

From 80 - 1000 MHz the distance was 2.0 m and antenna height was 1.55 m.

From 1 - 6.0 GHz the distance was 1.5 m and antenna height was 1.30 m.

The immunity field was applied to 2 sides of the test specimen: Front and back.

Functional tests were performed before, during and after testing.



**Photo 5. Radio frequency electromagnetic field test setup. 80 - 1000 MHz.**



**Photo 6. Radio frequency electromagnetic field test setup. 1 -6 GHz.**



### 2.2.2 Test results

No change in actual operating state or stored data was observed. No unintentional responses occurred. The test specimen continued to operate as intended before, during and after the test.

Frequency [MHz]	Specimen side facing antenna	Field strength [V/m]	Result
80 - 6000	0° (Front)	3	PASSED
80 - 6000	180° (Back)	3	PASSED

**Table 7. Radio frequency electromagnetic field test results.**

### 2.2.3 Test equipment

Description	Supplier	Model	Tag no.
Amplifier 80-1000 MHz	Bonn Amplifiers	BLWA 0810-160/75D	30090179
Amplifier 1 GHz - 6 GHz	Rfenable	RFe-700-6000	30090410
Power Meter Digital	Rohde&Schwarz	NRVD	30114078
Power Probe 10 MHz-18 GHz	Rohde&Schwarz	NRV-Z1	30114079
Power Probe 10 MHz-18 GHz	Rohde&Schwarz	NRV-Z1	30113491
Signal generator 10 kHz – 20 GHz	Rohde&Schwarz	SMP02	30113799
Antenna Horn 1-6 GHz	Rfenable	LB-660-NF	30090411
Antenna VHF-UHF EMS	Rohde&Schwarz	HL046	30090418

**Table 8. Radio frequency electromagnetic field test equipment.**

## 2.3 Electrostatic discharge

<b>Test specimen</b>	Curo
<b>Test specification</b>	EN 301 489-17 V3.2.4 EN 301 489-1 V2.2.3, clause 9.3
<b>Test method</b>	EN 61000-4-2:2009
<b>Performance criterion</b>	B
<b>Discharges</b>	Cont. discharge: $\pm 4\text{kV}$ Air discharge: $\pm 2\text{kV}$ , $\pm 4\text{kV}$ , $\pm 8\text{kV}$
<b>Comments</b>	None
<b>Temperature / Humidity</b>	23°C / 35%RH
<b>Atmospheric pressure</b>	1020 hPa
<b>Date of measurements</b>	2022-04-19
<b>Test personnel</b>	Volodymyr Hraivoronskyi

### 2.3.1 Test setup

Indirect discharges were performed on the vertical and horizontal coupling planes. Non-conductive parts were investigated with an air discharge tip at the specified levels. Conductive parts were investigated with an contact discharge tip at the specified levels. The applied charge was removed with a conductive brush between each discharge. Only surfaces accessible during normal use was investigated.

Functional tests were performed before, during and after testing.

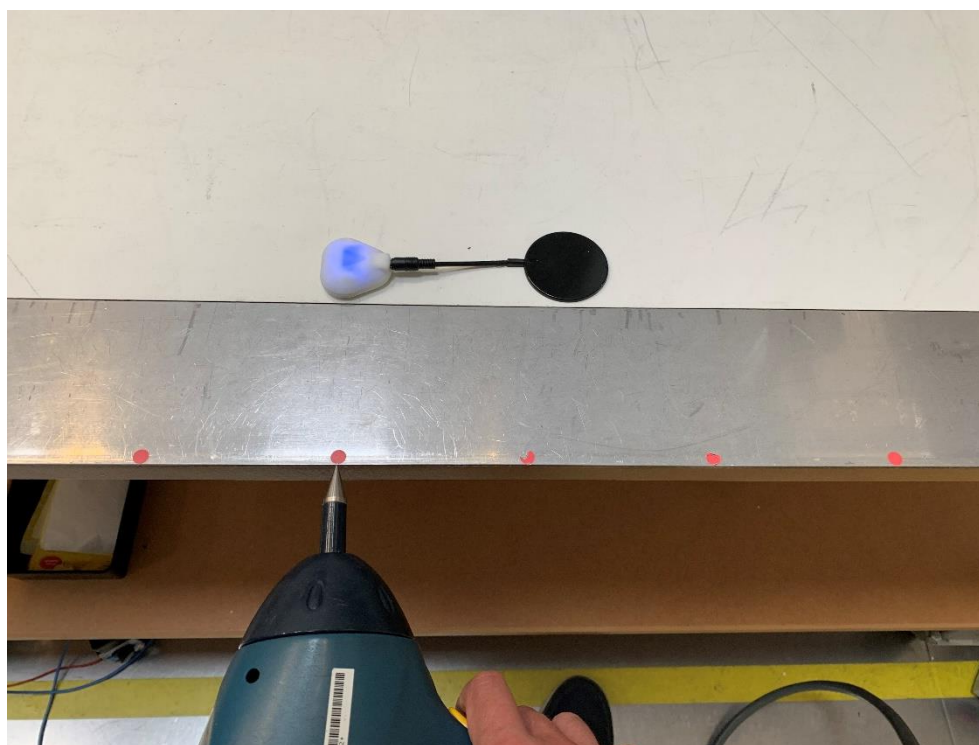


Photo 7. Electrostatic discharge test setup.

**2.3.2 Test results**

No change in actual operating state or stored data was observed. No unintentional responses or unintentional transmissions occurred. The test specimen continued to operate as intended before, during and after the test.

Direct contact discharges were not possible to any of the conductive parts of the test specimen. Air discharges were not possible at any of the non-conductive parts of the test specimen at any of the test levels.



**Photo 8. Electrostatic discharge tests.**

Direct contact discharge		Indirect contact discharge		Air discharge	
Voltage	Result	Voltage	Result	Voltage	Result
±4 kV	PASSED	±4 kV	PASSED	±2 kV	PASSED
				±4 kV	PASSED
				±8 kV	PASSED

**Table 9. Electrostatic discharge test results.**

**2.3.3 Test equipment**

Description	Supplier	Model	Tag no.
ESD Simulator	Schaffner	NSG 438	30090242

**Table 10. Electrostatic discharge test equipment.**

### 3 MEASURING UNCERTAINTIES

Compliance evaluation is based on a shared risk principle with respect to the measurement uncertainty.

#### 3.1 EMC

<i>EMC tests</i>	Frequency [MHz]	Polarization	Expanded Uncertainty [dB] (k=2)
Radiated emission	30 - 200	Vertical	<b>4.73</b>
	200 - 3000	Vertical	<b>4.97</b>
	3000-6000	Vertical	<b>3.76</b>
	30 - 200	Horizontal	<b>4.72</b>
	200 - 3000	Horizontal	<b>5.08</b>
	3000-6000	Horizontal	<b>3.77</b>
Radiated Immunity			<b>1.92</b>
Electrostatic discharge	I <sub>peak</sub> , ±10 % I at 30 ns, ±30 % I at 60 ns, ±30 %		