

Assessment report No:

NIE: 54099RAN.002

Assessment report

RF EXPOSURE TEST REPORT ACCORDING TO

FCC 47 CFR Part 2.1091

ISED RSS -102 Issue 5:2015

Identification of item tested.....:	WIRELESS POWER TRANSMISSION SYSTEM		
Trademark	Datalogic		
Model and /or type reference	JOYA TOUCH SINGLE SLOT DOCK LOCKING		
Other identification of the product	Serial number: E17E17502		
FCC ID	U4GJNGSSD		
IC	3862E-JNGSSD		
Final HW version	Beta		
Final SW version	1.01		
Features	WPT and NFC		
Manufacturer	DATALOGIC SRL Via S. Vitalino 13, 40012 Lippo di Calderara di Reno (BO) - Italy		
Test method requested, standard.....:	FCC 47 CFR Part 2.1091 Radiofrequency radiation exposure evaluation: mobile devices. ISED RSS-102 Issue 5 (2015-03) – Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)		
Summary	IN COMPLIANCE		
Approved by (name / position & signature)	Miguel Lacave Antennas Lab Manager		MIGUEL LACAVE GARCÍA 2017.12.22 13:22:21 +01'00'
Date of issue	2017-12-22		
Report template No.....:	FAN24_01		

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Competences and guarantees

In order to assure the traceability to other national and international laboratories, DEKRA has a calibration and maintenance program for its measurement equipment.

DEKRA guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA at the time of performance of the test.

DEKRA is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document.

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General conditions

1. This report is only referred to the item that has undergone the test.
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3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA.
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Uncertainty

Uncertainty (factor $k=2$) was calculated according to the DEKRA internal document PODT000.

Usage of samples

Samples under test have been selected by: the Client.

Sample **S/01** is composed of the following elements:

Control N°	Description	Model	Serial number	Reception date
54099/006	Multi Purpose device for retail	JOYA TOUCH SINGLE SLOT DOCK LOCKING	E17E17502	2017/07/03
54099/012	Charging Base	--	--	2017/07/03
54099/024	Multi Purpose device for retail	JOYA TOUCH SINGLE SLOT DOCK LOCKING	E16M01872	2017/11/13
54099/022	Charging Base	--	--	2017/11/13

Auxiliary elements used with sample **S/01**:

Control N°	Description	Model	Serial number	Reception date
54099/015	AC/DC Adaptor	EA10681U-120	--	2017/07/03
54099/019	Mains cord	--	--	2017/07/03

Test sample description

JOYA TOUCH SINGLE SLOT DOCK LOCKING is the battery charging station for JOYA TOUCH device, managing also NFC communication with the docked devices.

Identification of the client

DATALOGIC SRL

Via S. Vitalino 13, 40012 Lippo di Calderara di Reno (BO) - Italy

Testing period

Mobile Exposure test started on 2017-07-25 and finished on 2017-08-01.

Nerve Stimulation test started on 2017-11-14 and finished on 2017-11-15.

Battery level measurements test started on 2017-12-04 and finished on 2017-12-05.

The tests have been performed at DEKRA Testing and Certification, S.A.U.

Environmental conditions

The following limits were not exceeded during the tests:

Temperature	Min. = 15 °C
	Max. = 35 °C
Relative humidity	Min. = 30 %
	Max. = 60 %

Used instrumentation

	Last Cal. date	Cal. due date
1. Narda ELT-400 Exposure Level Tester	2017/10	2019/10
2. ETS-LINDGREN HI-6005	2016/04	2018/04

Assessment summary

Radiofrequency radiation exposure limits			
FCC 47 CFR § 2.1091			
Frequency (MHz)	Technology	Band	VERDICT (Pass/Fail)
0.130	Wireless Charging System	LF Band	Pass
13.56	NFC	ISM	Pass

Appendix A – FCC RF Exposure

FCC RF Exposure evaluation for mobile devices

Devices operating in standalone mobile device exposure conditions may contain a single transmitter or multiple transmitters that do not transmit simultaneously. A minimum test separation distance ≥ 20 cm is required between the antenna and radiating structures of the device and nearby persons to apply mobile device exposure limits. The distance must be at least 20 cm and fully supported by the operating and installation configurations of the transmitter and its antenna(s), according to the source-based time-averaged maximum power requirements of § 2.1091(d)(2). In cases where cable losses or other attenuations are applied to determine compliance, the most conservative operating configurations and exposure conditions must be evaluated. The minimum test separation distance required for a device to comply with mobile device exposure conditions must be clearly identified in the installation and operating instructions, for all installation and exposure conditions, to enable users and installers to comply with RF exposure requirements. For mobile devices that have the potential to operate in portable device exposure conditions, similar to the configurations described in § 2.1091(d)(4), a KDB inquiry is required to determine the SAR test requirements for demonstrating compliance.

When a device qualifies for the categorical exclusion provision of § 2.1091(c), the minimum test separation distance may be estimated, when applicable, by simple calculations according to plane-wave equivalent conditions, to ensure the transmitter and its antenna(s) can operate in manners that meet or exceed the estimated distance. The source-based time-averaged maximum radiated power, according to the maximum antenna gain, must be applied to calculate the field strength and power density required to establish the minimum test separation distance. When the estimated test separation distance becomes overly conservative and does not support compliance, MPE measurement or computational modeling may be used to determine the required minimum separation distance.

According to §1.1310 Radiofrequency radiation exposure limits, paragraph (e), the limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields are:

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3–3.0	614	1.63	* 100	6
3.0–30	1842/f	4.89/f	* 900/f ²	6
30–300	61.4	0.163	1.0	6
300–1,500			f/300	6
1,500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	* 100	30
1.34–30	824/f	2.19/f	* 180/f ²	30
30–300	27.5	0.073	0.2	30
300–1,500			f/1500	30
1,500–100,000			1.0	30

f = frequency in MHz * = Plane-wave equivalent power density

FCC Evaluation

The device under evaluation consists of a single slot dock battery charger, which also has NFC feature. During its normal use, the distance between the radiating parts of the device and the user will be greater than 20 cm.

1. WPT Evaluation Results

According to KDB 680106 D01, for devices designed for typical desktop applications, such a wireless charging pads, RF exposure evaluation should be conducted assuming a user separation distance of 10 cm. E and H field strength measurements or numerical modeling may be used to demonstrate compliance. Measurements should be made from all sides and the top of the primary/client pair, with the 10 cm measured from the center of the probe(s) to the edge of the device. Emissions between 100 kHz to 300 kHz should be assessed versus the limits at 300 kHz in Table 1 of Section 1.1310: 614 V/m and 1.63 A/m. Measurements were performed at 1%, 50% and 80% battery levels.

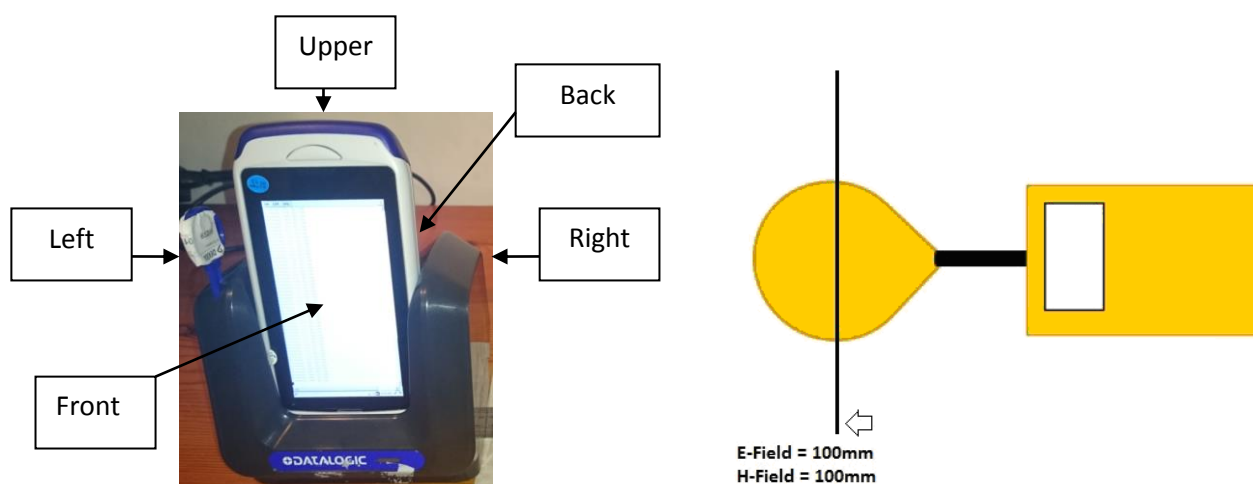


Figure 1: Measurement Setup

Measurements were performed using the equipment listed in the “Used Instrumentation” paragraph of this document. The measured values for each battery levels are listed in the following tables:

Frequency (MHz)	Battery Level	Battery charging mode	H-Field measurements [A/m]					Max [A/m]	Limit [A/m]	% Limit	Verdict
			Front	Back	Left	Right	Upper				
0.130	80%	Max output load	0.26	0.17	0.10	0.11	0.10	0.26	1.630	15.72	Pass
0.130	50%	Max output load	0.29	0.23	0.20	0.21	0.18	0.29	1.630	17.58	Pass
0.130	1%	Max output load	0.28	0.25	0.23	0.16	0.19	0.28	1.630	17.03	Pass

Table 1: H-field measurement values

Frequency (MHz)	Battery Level	Battery charging mode	E-Field measurements [V/m]					Max [V/m]	Limit [V/m]	% Limit	Verdict
			Front	Back	Left	Right	Upper				
0.130	80%	Max output load	0.24	0.04	0.10	0.09	0.22	0.24	614.0	0.04	Pass
0.130	50%	Max output load	0.31	0.07	0.14	0.12	0.25	0.31	614.0	0.04	Pass
0.130	1%	Max output load	0.29	0.11	0.26	0.14	0.34	0.34	614.0	0.04	Pass

Table 2: E-field measurements values

2. NFC Evaluation Results

As stated into DEKRA Testing and Certification, S.A.U. test report 54099RRF.001 the maximum measured field strength for the operating frequency is:

Frequency (MHz)	Maximum H-field strength (dBμA/m) measured at 10 m
13.56	-4.85

Table 3: Measurement Results

Using Field Strength Approach formula (linear terms), this value corresponds to an output power of 0.000154 mW

$$E.I.R.P = P_t \times G_t = (E \cdot d)^2 / 30$$

Where:

P_t = transmitter output power in watts

G_t = numeric gain of the transmitting antenna (unitless)

E = electric field strength in V/m, --- $10^{((dB\mu V/m)/20)/10^6}$.

For measuring equipment calibrated in dBμV/m, the reading should be reduced by 51.5 dB to be converted to dBμA/m, therefore $E = H + 51.5$ dB.

d = measurement distance in meters (m) = 10m

$$\text{So } P_t = (E \cdot d)^2 / (30 \times G_t)$$

H Field strength = -4.85 dBμA/m = 46.65 dBμV/m @ 10m

Antenna gain = 0.0 dBi, so numeric gain = 1.0

Therefore

$$P_t = \{ [10^{(46.56/20)/10^6} \times 10]^2 / (30 \times 1.0) \} \times 1000 \text{ mW} = 0.000154 \text{ mW} = -38.12 \text{ dBm}$$

The maximum output power for the 13.56 MHz transmission mode of the device is -38.12 dBm.

In order to perform the assessment, the following equations have been used for the calculations:

$$\text{Power density: } S[mW/cm^2] = \frac{P_{E.I.R.P.}[mW]}{4\pi R^2[cm]}$$

$$\text{Minimum compliance distance: } R_{min}[m] = \sqrt{\frac{P_{E.I.R.P.}[mW]}{4\pi S[mW/cm^2]}}$$

Where:

S = power density

$P_{E.I.R.P.}$ = Equivalent isotropically radiated power

R = distance to the center of radiation of the antenna (evaluation distance)

R_{min} = distance to the center of radiation of the antenna

NFC Transmission:

Maximum output power (dBm):	-38.12
Maximum antenna gain (dBi):	0.0
Minimum use distance (m):	0.2
Worst Case Frequency (MHz):	13.56
Maximum E.I.R.P (dBm):	-38.12
Maximum E.I.R.P (mW):	0.00015
Power density reference level (mW/cm ²):	0.98

Power density at minimum use distance:

Power density (mW/cm ²):	0.000000031
Verdict:	PASS

The power density level for this transmission mode is below power density reference level.

Minimum compliance distance for this technology:

Minimum distance to meet reference level (cm):	0.01
Verdict:	PASS

The minimum use distance for the device is greater than minimum compliance distance to meet the reference level.

3. Multiple frequencies assessment

When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the maximum exposure toward the total exposure at a fixed location. The sum of the ratios of the exposure from each source to the corresponding maximum exposure for the frequency of each source must be evaluated.

The exposure complies with the maximum permissible exposure if the sum of the ratios is less than unity:

$$\sum_{i=1}^n \frac{S_i}{MPE_i} < 1$$

Where

S_i is the power density of each source;

MPE_i is the power density basic restriction of each source.

The device under test is able to transmit simultaneously using WPT and NFC technologies, therefore the multiple frequencies calculation will be as follow:

$$\frac{0.26}{1.63} + \frac{0.000000031}{0.98} = 0.16 < 1 \text{ Limit}$$

Appendix B – ISED RF Exposure

ISED RF Exposure evaluation for mobile devices

According to RSS-102 Issue 5, Paragraph “4. Exposure Limits”, Industry of Canada has adopted the RF field strength limits established in Health Canada’s RF exposure guideline, Safety code 6:

**Table 4: RF Field Strength Limits for Devices Used by the General Public
(Uncontrolled Environment)**

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ $f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $f^{0.25}$	0.1540/ $f^{0.25}$	8.944/ $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 $f^{0.3417}$	0.008335 $f^{0.3417}$	0.02619 $f^{0.6834}$	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10 ⁻⁴ $f^{0.5}$	6.67 x 10 ⁻⁵ f	616000/ $f^{1.2}$
Note: f is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

ISED Evaluation Results for Mobile Exposure

The device under evaluation consists of a single slot dock battery charger, which also has NFC feature. During its normal use, the distance between the radiating parts of the device and the user will be greater than 20 cm.

1. WPT Evaluation Results

According to RSS-216- Issue 2, RF exposure shall be evaluated with the client devices charged/powered by the source device at maximum output power. Additionally, all transmitters, including those not used for wireless power transfer, must be active simultaneously and at maximum power. For WPT devices designed for desktop applications (e.g. wireless charging pads), RF exposure shall be evaluated at 10 cm away from all sides and from the top of the WPT device / system. The 10 cm shall be as measured from the probe centre to the WPT device / system edge.

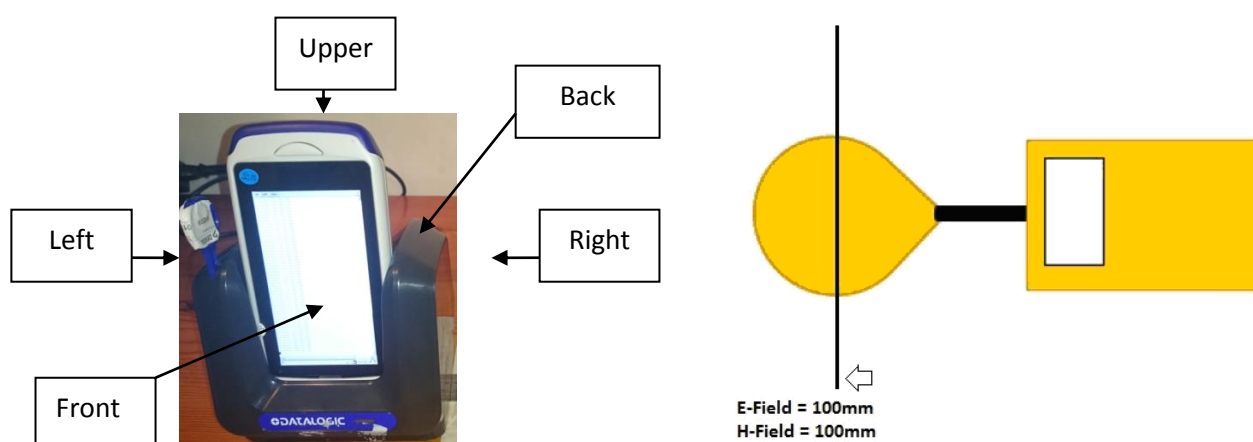


Figure 1: MPE Measurement Setup

Measurements were performed using the equipment listed in the “Used Instrumentation” paragraph of this document. The maximum measured values are listed in the following tables:

Frequency (MHz)	Battery Level	Battery charging mode	H-Field measurements [A/m]					Max [A/m]	Limit [A/m]	% Limit	Verdict
			Front	Back	Left	Right	Upper				
0.130	80%	Max output load	0.26	0.17	0.10	0.11	0.10	0.26	5.615	4.56	Pass
0.130	50%	Max output load	0.29	0.23	0.20	0.21	0.18	0.29	5.615	5.10	Pass
0.130	1%	Max output load	0.28	0.25	0.23	0.16	0.19	0.28	5.615	4.94	Pass

Table 4: H-field measurement values

2. NFC Evaluation Results

As stated into DEKRA Testing and Certification, S.A.U. test report 54099RRF.001 the maximum measured field strength for the operating frequency is:

Frequency (MHz)	Maximum H-field strength (dBμA/m) measured at 10 m
13.56	-4.85

Table 4: Measurement Results

Using Field Strength Approach formula (linear terms), this value corresponds to an output power of 0.000154 mW

$$E.I.R.P = P_t \times G_t = (E \cdot d)^2 / 30$$

Where:

P_t = transmitter output power in watts

G_t = numeric gain of the transmitting antenna (unitless)

E = electric field strength in V/m, --- $10^{((dBuV/m)/20)/10^6}$.

For measuring equipment calibrated in dBμV/m, the reading should be reduced by 51.5 dB to be converted to dBμA/m, therefore $E = H + 51.5$ dB

d = measurement distance in meters (m) → 10m

$$\text{So } P_t = (E \cdot d)^2 / (30 \times G_t)$$

H Field strength = -4.85 dBuA/m = 46.65 dBμV/m @ 10m

Antenna gain = 0.0 dBi, so numeric gain = 1.0

Therefore

$$P_t = \{ [10^{(46.65/20)/10^6} \times 10]^2 / (30 \times 1.0) \} \times 1000 \text{ mW} = 0.000154 \text{ mW} \rightarrow -38.12 \text{ dBm}$$

The maximum output power for the 13.56 MHz transmission mode of the device is -38.12 dBm.

In order to perform the assessment, the following equations have been used for the calculations:

$$\text{Power density: } S[mW/cm^2] = \frac{P_{E.I.R.P.}[mW]}{4\pi R[cm]^2}$$

$$\text{Minimum compliance distance: } R_{min}[m] = \sqrt{\frac{P_{E.I.R.P.}[mW]}{4\pi S[mW/cm^2]}}$$

Where:

S = power density

$P_{E.I.R.P.}$ = Equivalent isotropically radiated power

R = distance to the center of radiation of the antenna (evaluation distance)

R_{min} = distance to the center of radiation of the antenna

NFC Transmission:

Maximum output power (dBm):	-38.12
Maximum antenna gain (dBi):	0.0
Minimum use distance (cm):	20.0
Worst Case Frequency (MHz):	13.56
Maximum E.I.R.P (dBm):	-38.12
Maximum E.I.R.P (mW):	0.00015
Power density reference level (W/m ²):	2.0

Power density at minimum use distance:

Power density (W/m ²):	0.00000031
Verdict:	PASS

The power density level for this transmission mode is below power density reference level.

Minimum compliance distance for this technology:

Minimum distance to meet reference level (cm):	0.01
Verdict:	PASS

The minimum use distance for the device is greater than minimum compliance distance to meet the reference level.

3. Multiple frequencies assessment

When multiple sources are introduced into an environment, it becomes necessary to address the sources interdependently, since each source will contribute some percentage of the maximum exposure toward the total exposure at a fixed location. The sum of the ratios of the exposure from each source to the corresponding maximum exposure for the frequency of each source must be evaluated.

The exposure complies with the maximum permissible exposure if the sum of the ratios is less than unity:

$$\sum_{i=1}^n \frac{S_i}{MPE_i} < 1$$

Where

S_i is the power density of each source;

MPE_i is the power density basic restriction of each source.

The device under test is able to transmit simultaneously using WPT and NFC technologies, therefore the multiple frequencies calculation will be as follow:

$$\frac{0.26}{5.62} + \frac{0.00000031}{2} = 0.046 < 1 \text{ Limit}$$

ISED Nerve Stimulation Evaluation Results

According to RSS-102 Issue 5, Nerve Stimulation exposure limits shall be evaluated for transmission into the frequency range from 0.003 to 10 MHz. Supplementary Procedure SPR-002, Issue 1, for Radio Standards Specification RSS-102 sets out the general test methods to be followed when carrying out an assessment to the nerve stimulation exposure requirements of RSS-102.

According to Supplementary Procedure SPR-002, “Annex E – E.1.1. Passively Used Table-Top Devices”, measurements have been performed installing the device at the edge of a 80 cm tall and non-metallic constructed table, placing the measurement probe at the compliance distance away from the edge of the table. A compliance distance of 10 cm from the probe edge to the WPT device/system edge has been used for the measurements.

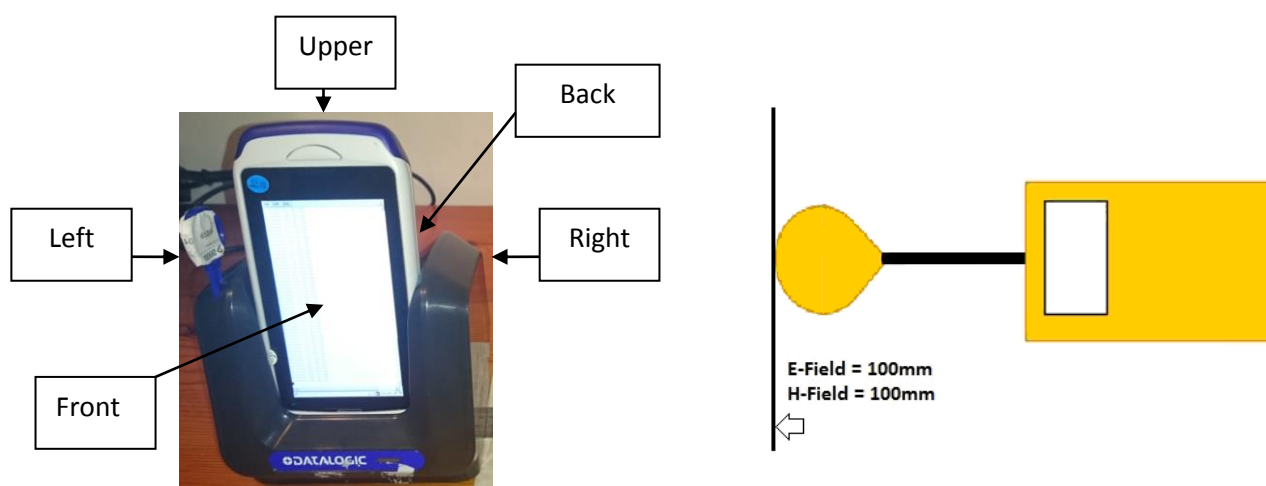


Figure 2: Nerve Stimulation Measurement Setup

Measurements were performed using the equipment listed in the “Used Instrumentation” paragraph of this document, following the measurement method shown in paragraph 6.6.1.1 of “Supplementary Procedure for Assessing Compliance with RSS-102 Nerve Stimulation Exposure Limits SPR-002”. Measured values for each configuration are listed in the following table:

Frequency (MHz)	Battery charging mode	H-Field measurements [A/m]					Max [A/m]	Limit [A/m]	% Limit	Verdict
		Front	Back	Left	Right	Upper				
0.130	Max output load	1.42	1.25	1.12	1.11	1.09	1.42	90.0	1.58	Pass

Table 5: H-field measurement values and ISED limit for Nerve Stimulation

Frequency (MHz)	Battery charging mode	E-Field measurements [V/m]					Max [V/m]	Limit [V/m]	% Limit	Verdict
		Front	Back	Left	Right	Upper				
0.130	Max output load	6.41	4.09	4.54	4.21	5.94	6.41	83.0	7.72	Pass

Table 6: E-field measurements values and ISED limit for Nerve Stimulation

All H-Field and E-Field values are in compliance to values shown into “Table 4: RF Field Strength Limits for Devices Used by the General Public” for the frequency range used by the device.

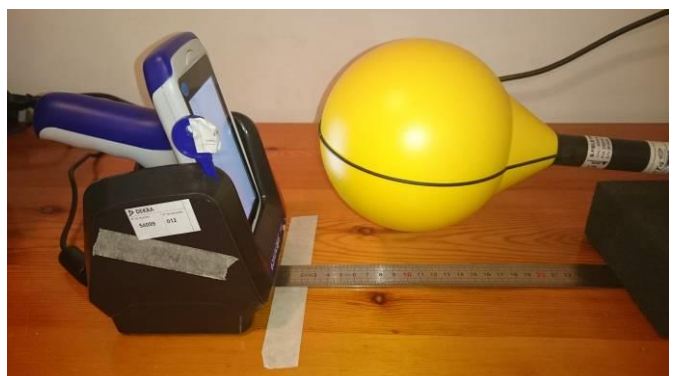
Appendix C – Photographs

- **Equipment view**



- **Mobile Exposure measurement setup views**

Front



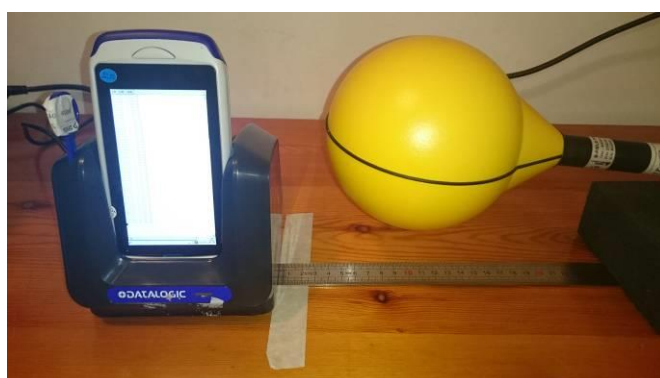
Back



Left



Right



Upper



- **Nerve stimulation measurement setup (Front face view example).**

