LAB N° 1356 L

Applicant:	CUSTOM S.p.A Via Berettine 2/B – 43010 Fontevivo – Parma - Italy Phone: 0521 680111
Trademark:	CUSTOM®
Test item:	Printer MP RANGER USB TH FI BLACK IT
Identification / Type No.:	**MP350**
FCC ID:	**OAH-5040120**
Order content:	RF exposure evaluation according to the following standard:
Test specification:	**47 CFR § 1.1310** **47 CFR § 2.1091**
Date of receipt:	22/02/2022
Internal storage No.:	A003216149-003
Testing period:	31/03/2022
Place of testing:	TÜV Rheinland Italia S.r.l. Via E. Mattei, 3 20005 Pogliano Milanese – Milano – Italy
Testing laboratory:	TÜV Rheinland Italia S.r.l. Via E. Mattei, 3 20005 Pogliano Milanese – Milano – Italy
Test result:	**PASS**

Tested by:	Francesco Lombardi	**Authorized by:**	Giovanni Molteni
Date: 16/09/2022	(Laboratory technician)	**Date:** 16/09/2022	(Laboratory Manager)
Position	Sachverständige(r)/Expert	**Position**	Sachverständige(r)/Expert

Condition of the test item at delivery: *Test item complete and undamaged*

The test results reported in this test report shall refer only to the samples tested.
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The equipment used during the specified testing period was calibrated according to our test laboratory calibration program. The equipment fulfils the requirements included in the relevant standards. The traceability of the test equipment used is ensured by compliance with the regulations of our management system. Detailed information regarding test conditions, equipment and measurement uncertainty is available in the test laboratory and could be provided on request.
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Test clauses with remark of * are subcontracted to qualified subcontractors and descripted under the respective test clause in the report. Deviations of testing specification(s) or customer requirements are listed in specific test clause in the report.
Unless otherwise agreed with the customer, a conformity assessment is always carried out based on the applied standards. At the customer's request, the statement on the conformity of the product tested in this test report is carried out according to the criteria/requirements of the applied standards. Evaluation conditions deviating from these are documented separately in the respective chapters.

0. Table of Contents

0. Table of Contents 3
1. General description of test item(s) 4
2. Equipment using during test 6
3. Radio module identification 8
4. Channel list Bluetooth Basic Rate / Enhanced Data Rate 11
5. Applied reference standards 12
6. FCC Calculation method and limits 13
7. Operating modes 16
8. EUT configuration 17
9. Climatic conditions 17
10. Statement of the measurement uncertainty 18
11. Measurement uncertainty 18
12. Example for interpretation of measuring results 19
13. Result summary section 20
14. Change history 20
15. RF exposure evaluation 21
16. List of test equipment 25

1. General description of test item(s)

Description	Printer MP RANGER USB TH FI BLACK IT
Model	MP350
Serial number	ESB1026121280071
Part number	911MM010100P33
Manufacturer	CUSTOM S.p.A
Country of manufacturer	Italy
Trademark	CUSTOM®
Power supply	DC Power
Supply voltage	Internal Battery (Technology: Lithium-ion)
Battery model name	INR18650-2S1P
Battery voltage-capacity	7.2V 2.6Ah 18.72Wh
Battery cycle	750
Battery life (print)	720 minutes x 300 tickets
Manufacturer (Battery)	Shenzhen Hypercell Co.,LTD
Equipment type	Intentional radiator
Hardware version	St145-c

Software version	1.22
Dimensions	149(L) x 53(H) x 122(P) mm
Weight	475gr (with battery included)
Printing width	76.2 mm and 80 mm
Operating temperature	From -10°C to +50°C
Operating humidity (RH)	Form 10% to 95%
Test sample obtaining:	☒ Sampling by customer ☐ Sampling by TÜV Rheinland Group ☐ others:

2. Equipment using during test

Equipment under test

No.	Product type	Manufacturer	Model	Comments
1	Printer MP RANGER USB TH FI BLACK IT	CUSTOM S.p.A.	MP350	---

Auxiliary Equipment / Peripherals

Nr.	Product type	Manufacturer	Model	Comments
1	Laboratory PC	DELL	---	- used to enable wireless communication (Bluetooth Low Energy, Bluetooth Enhanced Data Rate & Wi-Fi) on EUT, via software Printerset.
				- used ESP_RF_test_tool_v1.1.0, for setting the radio module in the following radio communications: BLE, BT EDR & Wi-Fi
2	Cradle 1 slot P-Ranger	CUSTOM S.p.A	---	- used to charge battery
3	Switching power adapter	CUSTOM S.p.A	POWER SUPPLY FOR CRADLE 4 SLOTS P-RANGER	- use to power supply cradle

Input/Output ports

No.	Name	Type	Cable length	Cable shielded	Comments
1	Enclosure port	Plastic	---	---	closed by snaps
2	AC power port	---	---	---	port not present
3	DC power port	Internal battery	---	---	Battery model: INR18650-2S1P
4	Signal control port	---			port not present
5	Wired network port	---			port not present

EUT modification

None

3. Radio module identification

Bluetooth Basic Rate / Enhanced Data Rate module & Antenna technical data	
Module manufacturer	ESPRESSIF
Radio type	Transceiver
Chip radio	ESP32-PICO-D4
Type of equipment	☐ stand-alone equipment ☒ combined equipment ☐ multi-radio equipment
ETS Category	Bluetooth - BR & EDR
Bluetooth Channel / Frequency	2402 - 2480MHz
Number of channels	79
Channel bandwidth	1MHz
Channel separation	1MHz
Modulation type	☒ Frequency hopping (FHSS) equipment (Bluetooth classic) ☐ Wideband data transmission (non-FHSS equipment) (BLE)
Sensitivity	-97 dBm
Transmit operating mode	☒ single antenna ☐ multiple antennas, no beamforming ☐ multiple antennas, with beamforming
With regard adaptivity, the type of equipment	☐ non-adaptive equipment ☐ adaptive equipment ☒ Equipment that can operate in both an adaptive and non-adaptive mode;
Spectrum access mechanism	☐ LBT (Listen Before Talk) Technique ☐ DAA (Detect And Avoid) Technique ☒ Duty cycle

Environmental equipment	☒ Test only in normal conditions ☐ Test in normal conditions and extreme conditions
Equipment that support a geo-location capability	☐ Yes ☒ No

Antenna	Description:	AMCA31-2R450G-S1F-T3
	Peak Gain:	0.5 dBi
	Type:	☐ External antenna ☒ Dedicated antenna ☐ Integral antenna
	Frequency	2450 MHz
	Impedance	50 Ω
	Manufacturer	ABRACON LLC

Antenna	Description:	Chip-Antenna WE-MCA
	Peak Gain:	0.5 dBi
	Type:	☐ External antenna ☒ Dedicated antenna ☐ Integral antenna
	Frequency	2400 - 2500 MHz
	Impedance	50 Ω
	Manufacturer	WÜRTH ELEKTRONIK

Note: The test has been performed with Antenna AMCA31-2R450G-S1F-T3, manufacturer Abracon.

4. Channel list Bluetooth Basic Rate / Enhanced Data Rate

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY	CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
0	**2402**	20	2422	40	2442	60	2462
1	2403	21	2423	41	2443	61	2463
2	2404	22	2424	42	2444	62	2464
3	2405	23	2425	43	2445	63	2465
4	2406	24	2426	44	2446	64	2466
5	2407	25	2427	45	2447	65	2467
6	2408	26	2428	46	2448	66	2468
7	2409	27	2429	47	2449	67	2469
8	2410	28	2430	48	2450	68	2470
9	2411	29	2431	49	2451	69	2471
10	2412	30	2432	50	2452	70	2472
11	2413	31	2433	51	2453	71	2473
12	2414	32	2434	52	2454	72	2474
13	2415	33	2435	53	2455	73	2475
14	2416	34	2436	54	2456	74	2476
15	2417	35	2437	55	2457	75	2477
16	2418	36	2438	56	2458	76	2478
17	2419	37	2439	57	2459	77	2479
18	2420	**38**	**2440**	58	2460	**78**	**2480**
19	2421	39	2441	59	2461		

5. Applied reference standards

47 CFR § 1.1310	Radiofrequency radiation exposure limits
47 CFR § 2.1091	Radiofrequency radiation exposure evaluation: mobile devices
447498 D01 General RF Exposure Guidance v06	RF exposure procedures and equipment authorization policies for mobile and portable devices

6. FCC Calculation method and limits

Table 1 below sets forth limits for Maximum Permissible Exposure (MPE) to radiofrequency electromagnetic fields.

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)
(i) 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
(ii) 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 SAR limits

Region	Occupational SAR values (W/Kg)	General public SAR values (W/Kg)
Whole body SAR averaging mass = entire body	0,4	0,08
Partial body SAR averaging mass = 1g	8,0	1,6
Hands, wrists, feet and ankles SAR averaging mass = 10g	20	4

FCC SAR exemption
General SAR test exclusion guidance according to KDB 447498 (Par. 4.3)

Standalone SAR test exclusion considerations:

Unless specifically required by the published RF exposure KDB procedures, standalone 1-g head or body and 10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when the corresponding SAR Test Exclusion Threshold condition(s), listed below, is (are) satisfied. These test exclusion conditions are based on source-based time-averaged maximum conducted output power of the RF channel requiring evaluation, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The minimum test separation distance defined in 4.1 f) is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander. To qualify for SAR test exclusion, the test separation distances applied must be fully explained and justified, typically in the SAR measurement or SAR analysis report, by the operating configurations and exposure conditions of the transmitter and applicable host platform requirements, according to the required published RF exposure KDB procedures. When no other RF exposure testing or reporting are required, a statement of justification and compliance must be included in the equipment approval, in lieu of the SAR report, to qualify for SAR test exclusion. When required, the device specific conditions described in the other published RF exposure KDB procedures must be satisfied before applying these SAR test exclusion provisions; for example, handheld PTT two-way radios, handsets, laptops and tablets, etc.

a) For 100 MHz to 6 GHz and test separation distances ≤ 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, and ≤ 7.5 for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- The values 3.0 and 7.5 are referred to as numeric thresholds in step b) below

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm, and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm according to 4.1 f) is applied to determine SAR test exclusion.

b) For 100 MHz to 6 GHz and test separation distances > 50 mm, the 1-g and 10-g SAR test exclusion thresholds are determined by the following (also illustrated in Appendix B):32

1) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·(f(MHz)/150)]} mW, for 100 MHz to 1500 MHz

2) {[Power allowed at numeric threshold for 50 mm in step a)] + [(test separation distance – 50 mm)·10]} mW, for > 1500 MHz and ≤ 6 GHz

c) For frequencies below 100 MHz, the following may be considered for SAR test exclusion (also illustrated in Appendix C):

1) For test separation distances > 50 mm and < 200 mm, the power threshold at the corresponding test separation distance at 100 MHz in step b) is multiplied by [1 + log(100/f(MHz))]

2) For test separation distances ≤ 50 mm, the power threshold determined by the equation in c) 1) for 50 mm and 100 MHz is multiplied by ½

3) SAR measurement procedures are not established below 100 MHz.
When SAR test exclusion cannot be applied, a KDB inquiry is required to determine SAR evaluation requirements for any SAR test results below 100 MHz to be acceptable.

7. Operating modes

No.	Description
1	Continuous Bluetooth - BR & EDR Modulation RF Transmission at maximum power, at Low channel. Radio module (model ESP32-PICO-D4), set via ESP_RF_test_tool_v1.1.0, with the following parameters: ChipType: ESP32 BaudRate: 115200 Load bin: ESP32_RF_TEST_BIN_V1.4.6_20181019.bin Test Mode: BT TX Power Level: 8 Channel: 0/2402MHz Date Rate: 1M_DH1_1010; 2M_DH1_1010; 3M_DH1_1010 1M_DH3_1010; 2M_DH3_1010; 3M_DH3_1010 1M_DH5_1010; 2M_DH5_1010; 3M_DH5_1010
2	Continuous Bluetooth - BR & EDR Modulation RF Transmission at maximum power, at Middle channel. Radio module (model ESP32-PICO-D4), set via ESP_RF_test_tool_v1.1.0, with the following parameters: ChipType: ESP32 BaudRate: 115200 Load bin: ESP32_RF_TEST_BIN_V1.4.6_20181019.bin Test Mode: BT TX Power Level: 8 Channel: 38/2440MHz Date Rate: 1M_DH1_1010; 2M_DH1_1010; 3M_DH1_1010 1M_DH3_1010; 2M_DH3_1010; 3M_DH3_1010 1M_DH5_1010; 2M_DH5_1010; 3M_DH5_1010
3	Continuous Bluetooth - BR & EDR Modulation RF Transmission at maximum power, at High channel. Radio module (model ESP32-PICO-D4), set via ESP_RF_test_tool_v1.1.0, with the following parameters: ChipType: ESP32 BaudRate: 115200 Load bin: ESP32_RF_TEST_BIN_V1.4.6_20181019.bin Test Mode: BT TX Power Level: 8 Channel: 78/2480MHz Date Rate: 1M_DH1_1010; 2M_DH1_1010; 3M_DH1_1010 1M_DH3_1010; 2M_DH3_1010; 3M_DH3_1010 1M_DH5_1010; 2M_DH5_1010; 3M_DH5_1010

8. EUT configuration

The test setup was made in accordance with mentioned FF standards.

Measurements and tests were executed under ”worst case” conditions. Typical EUT arrangements or operating modes were chosen or assumed which let suspect maximum emission or susceptibility (a so called ”unfavourable configuration”).

Details of test setup or adjustments are (particularly) shown inside the photo documentation.
As far as not mentioned otherwise these statements are valid for all following tests.

9. Climatic conditions

Ambient Temperature	10 – 40 °C
Relative Humidity	10 – 90 %
Air pressure	Not specified

Note: According to ANSI C63.4

10. Statement of the measurement uncertainty

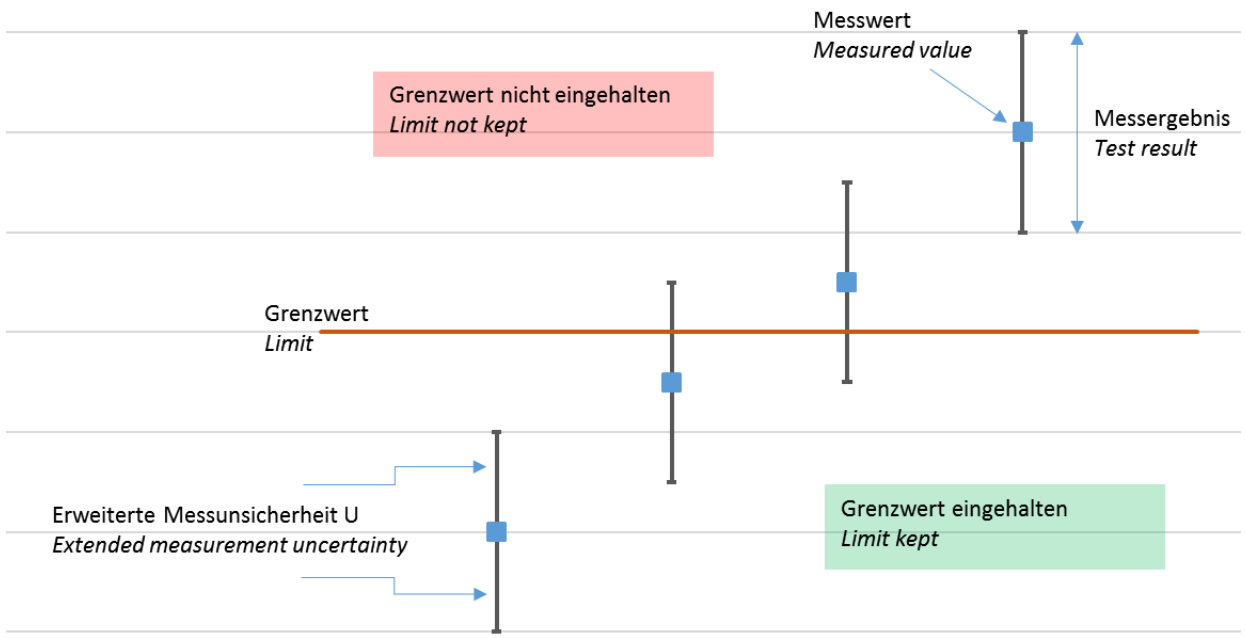
The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16-4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the quality system acc. to ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation.

The manufacturer has the sole responsibility of continued compliance of the device

11. Measurement uncertainty

Test Method	Uncertainty (95%)	Coverage factor k
TX Carrier Power – Conducted (1GHz – 8GHz)	1,5 dB	2,0

12. Example for interpretation of measuring results



Example for interpretation of measuring results

Measured value	***Limit***	***Extended measurement uncertainty*** **(k=2)**	***Test result***
48.9 dBµV @ 16.5 MHz	50 dBµV	2.2 dB	46.7 dBµV – 51.1 dBµV

Decision rule :	Statements of conformity (PASS or FAIL) to specifications are made in this report without taking measurement uncertainty into account. Where statements of conformity are made in this report, the following decision rules are applied: **PASS** – Results within limits/specifications **FAIL** – Results exceed limits/specifications

13. Result summary section

Requirement – Test case	Operating modes	Result
Radiofrequency radiation exposure	1, 2, 3	**PASS**

14. Change history

Test report number	List of revisions	Date
IT2234N0 001	First edition	16/09/2022

15. RF exposure evaluation

Test date	31/03/2022
Applied Standard	47 CFR § 2.1091
Temperature	23,1°
Humidity	54%
Tested by	Francesco Lombardi
Model	MP350
Internal Storage No.	1 (Storage no. A003216149-003)
Operating mode	1, 2, 3
Tested terminals	Antenna connector
Result	PASS

EUT classification

☐ Fixed: device physically secured at one fixed location and cannot be easily re-located.

☒ Mobile: transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons (47 cfr 2.1091)

☐ Portable: transmitting device designed to be used so that the radiating structure(s) of the device is/are within 20 centimeters of the body of the user (47 cfr 2.1093)

Test Result

Operation mode: 1 (Channel 0 – Frequency 2402)

Data Rate	Frequency (MHz)	Conducted Output Power		Antenna Gain		Separation Distance (r)	(S) Power density	(S) Power density Limit
		dBm	mW	dBi	Numeric (G)	(cm)	(mW/cm²)	(mW/cm²)
1M_DH1_1010	2402	2.25	1.68	0.5	1.12	20	0,00037	1
1M_DH3_1010	2402	2.40	1.74	0.5	1.12	20	0,00038	1
1M_DH5_1010	2402	2.25	1.68	0.5	1.12	20	0,00037	1
2M_DH1_1010	2402	4.29	2.68	0.5	1.12	20	0,00060	1
2M_DH3_1010	2402	4.07	2.55	0.5	1.12	20	0,00057	1
2M_DH5_1010	2402	3.85	2.42	0.5	1.12	20	0,00054	1
3M_DH1_1010	2402	4.27	2.67	0.5	1.12	20	0,00059	1
3M_DH3_1010	2402	3.99	2.50	0.5	1.12	20	0,00056	1
3M_DH5_1010	2402	3.85	2.42	0.5	1.12	20	0,00054	1

MPE test exclusion condition:

$$S = \frac{\text{Max. power of channel (mW)} \times \text{Antenna Gain (numerical)}}{4\Pi \times r^2 \text{ (cm)}}$$

MPE evaluation is not required because the value is less than exemption limit (separation distance 20cm)

Test Result

Operation mode: 2 (Channel 38 – Frequency 2440)

Data Rate	Frequency (MHz)	Conducted Output Power		Antenna Gain		Separation Distance (r)	(S) Power density	(S) Power density Limit
		dBm	mW	dBi	Numeric (G)	(cm)	(mW/cm²)	(mW/cm²)
1M_DH1_1010	2440	0.39	1.09	0.5	1.12	20	0,00024	1
1M_DH3_1010	2440	0.07	1.01	0.5	1.12	20	0,00022	1
1M_DH5_1010	2440	-0.21	0.95	0.5	1.12	20	0,00021	1
2M_DH1_1010	2440	2.14	1.63	0.5	1.12	20	0,00036	1
2M_DH3_1010	2440	1.83	1.52	0.5	1.12	20	0,00033	1
2M_DH5_1010	2440	1.73	1.49	0.5	1.12	20	0,00033	1
3M_DH1_1010	2440	2.05	1.60	0.5	1.12	20	0,00035	1
3M_DH3_1010	2440	1.61	1.45	0.5	1.12	20	0,00032	1
3M_DH5_1010	2440	1.34	1.36	0.5	1.12	20	0,00030	1

MPE test exclusion condition:

$$S = \frac{\text{Max. power of channel (mW)} \times \text{Antenna Gain (numerical)}}{4\Pi \times r^2 \text{ (cm)}}$$

MPE evaluation is not required because the value is less than exemption limit (separation distance 20cm)

Test Result

Operation mode: 3 (Channel 78 – Frequency 2480)

Data Rate	Frequency (MHz)	Conducted Output Power		Antenna Gain		Separation Distance (r)	(S) Power density	(S) Power density Limit
		dBm	mW	dBi	Numeric (G)	(cm)	(mW/cm²)	(mW/cm²)
1M_DH1_1010	2480	2.08	1.61	0.5	1.12	20	0,00035	1
1M_DH3_1010	2480	1.69	1.47	0.5	1.12	20	0,00033	1
1M_DH5_1010	2480	1.51	1.41	0.5	1.12	20	0,00031	1
2M_DH1_1010	2480	3.69	2.34	0.5	1.12	20	0,00052	1
2M_DH3_1010	2480	3.34	2.16	0.5	1.12	20	0,00048	1
2M_DH5_1010	2480	3.28	2.13	0.5	1.12	20	0,00047	1
3M_DH1_1010	2480	3.38	2.18	0.5	1.12	20	0,00048	1
3M_DH3_1010	2480	3.37	2.17	0.5	1.12	20	0,00048	1
3M_DH5_1010	2480	2.72	1.87	0.5	1.12	20	0,00042	1

MPE test exclusion condition:

$$S = \frac{\text{Max. power of channel (mW)} \times \text{Antenna Gain (numerical)}}{4\Pi \times r^2 \text{ (cm)}}$$

MPE evaluation is not required because the value is less than exemption limit (separation distance 20cm)

16. List of test equipment

Equipment	Type	Inventory no.	Manufacturer	Last calibration date	Calibration due date
Test stand: RF exposure evaluation					
EMI Receiver	ESU40	2782345	Rohde&Schwarz	11/2021	11/2022

--- END OF TEST REPORT ---