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47 CFR §2.1093 - NEAR-FIELD INCIDENT POWER DENSITY PART 1 TEST REPORT

FCC ID:	**PY7-46195Y**
Device Type:	Portable Device
Report Issue Date:	February 28, 2024

Sony Corporation
1-7-1 Konan Minato-ku
Tokyo, 108-0075, Japan

Certification

FCC Equipment Class	**psPD over 4cm²** [W/m²]
5GM	9.77
FCC Limit	**10.00**

The measurement evaluations presented in this report is based on the maximum performance of the tested device(s) which has been shown to be capable of compliance for localized power density (PD) for uncontrolled environment/ general population exposure federal limits in 47CFR § 1.1310 and has been tested in accordance with the measurement procedures specified within this report.

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This document has been revised and replaces all previously issued versions of this document with the same test report s/n.

Steve Liu
President

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1. DUT Specifics

1.1. Device Under Test

Table 1-1
NR FR2 Information

NR Bands	Bandwidth (MHz)	UL Modulation	SCS (kHz)
n258, n261, n260	100, 50	DFT-s-OFDM: PI/2 BPSK, QPSK, 16QAM, 64QAM CP-OFDM: QPSK, 16QAM, 64QAM	120

The manufacturer has confirmed that the device is within operational tolerances expected for production units and has the same physical, mechanical, and thermal characteristics expected for production units. The serial number of the device used for each test is indicated alongside the results.

Software version 0.143 was used during testing.

1.2. Maximum Power Density Details

Table 1-2
Maximum psPD per Mode/Band

Equipment Class	Mode/Band	Frequency	Measured psPD (W/m^2 avg area $4cm^2$)	Reported psPD (W/m^2 avg area $4cm^2$)	TER
5GM	NR n258	24250 - 24450 24750 - 25250	4.45	9.77	0.858
5GM	NR n261	27500 - 28350	5.68	9.77	
5GM	NR n260	37000 - 40000	5.65	9.77	

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1.3. Time-Averaging Algorithm for RF Exposure Compliance

This device is enabled with the Qualcomm® Smart Transmit Gen2 feature. This feature implements a time-averaging algorithm in real time to control and manage transmitting power and ensure the time-averaged RF exposure is in compliance with FCC requirements all the time.

The Smart Transmit algorithm maintains the time-averaged transmit power, in turn, time-averaged RF exposure of SAR_design_target or PD_design_target, below the predefined time-averaged power limit (i.e., Plimit for sub-6 radio, and input.power.limit for 5G mmW NR), for each characterized technology and band.

Smart Transmit allows the device to transmit at higher power instantaneously when needed, but enforces power limiting to maintain time-averaged transmit power to input.power.limit.

Note that WLAN/BT operations are not enabled with Smart Transmit for this device.

1.4. PD_Design_Target and Uncertainty

PD_Design_Target (W/m^2)	6.31
PD_Regulatory_Limit (W/m^2)	10
Design Related Total Uncertainty (dB)	2.0

1.5. Surfaces Required for Testing

See RF Exposure part 0 report for data supporting the selection of surfaces required for power density part 1 testing. Note that additional surfaces may be evaluated per manufacturer request or to support TER calculations.

Antenna/Module	Back	Front	Top	Bottom	Right	Left
0	No	No	No	No	No	Yes
1	No	No	No	No	Yes	No

1.6. Test Guidance Applied

- IEC/IEEE 63195-1:2022
- FCC KDB 865664 D02 v01r02
- FCC KDB 447498 D01 v06
- TCBC Workshop Notes (Nov 2017, Oct 2018, Apr 2019, Nov 2019)

2. Input.Power.Limits

Input.power.limit calculations can be found in the RF Exposure Part 0 test report. When beams have a final input.power.limit that is higher than maximum input power allowed by the DUT, the DUT will operate at the maximum input power for that beam.

Table 2-1
5G NR n258/n261/n260 Antenna Module 0 input.power.limit

Beam ID	Paired Beam ID	n258 (dBm)	n261 (dBm)	n260 (dBm)
1	N/A	6.9	9.0	9.7
3	N/A	7.6	8.9	9.1
5	N/A	7.4	8.1	8.2
7	N/A	7.3	8.1	8.6
9	N/A	7.9	8.6	8.8
14	N/A	5.3	6.0	6.1
15	N/A	4.1	4.7	5.8
16	N/A	4.3	6.1	6.8
17	N/A	5.9	7.1	6.7
21	N/A	3.7	4.6	5.7
22	N/A	3.8	4.5	5.6
23	N/A	3.5	6.8	6.7
29	N/A	0.3	2.4	1.7
30	N/A	-0.5	0.7	2.2
31	N/A	0.2	0.8	2.6
32	N/A	1.6	1.1	3.0
33	N/A	2.4	5.4	2.9
38	N/A	-0.2	0.5	2.8
39	N/A	0.0	0.6	2.3
40	N/A	0.2	0.9	2.0
41	N/A	0.9	1.6	3.3
129	N/A	7.7	8.7	9.6
131	N/A	7.9	8.7	8.7
133	N/A	7.3	8.5	7.9
135	N/A	7.4	8.4	8.4
137	N/A	7.7	8.3	8.9
142	N/A	5.0	6.5	5.6
143	N/A	3.3	4.4	4.8
144	N/A	3.7	4.7	6.8
145	N/A	5.3	5.0	6.8
149	N/A	4.7	5.0	5.2
150	N/A	4.1	4.4	5.4
151	N/A	3.9	5.4	6.8
157	N/A	2.1	1.9	1.4
158	N/A	0.2	0.9	1.8
159	N/A	0.1	0.6	2.4
160	N/A	1.4	0.2	3.1
161	N/A	0.9	2.7	2.5
166	N/A	0.6	1.2	2.6
167	N/A	0.0	0.9	1.9
168	N/A	-0.4	0.3	1.5
169	N/A	-0.4	0.9	3.2
1	129	3.7	4.6	5.9
3	131	3.7	5.4	5.3
5	133	3.8	5.1	4.6
7	135	3.9	5.1	5.1
9	137	4.5	5.2	5.2
14	142	1.6	3.2	2.3
15	143	0.7	0.5	1.8
16	144	0.4	1.3	2.7
17	145	3.0	2.8	3.2
21	149	2.0	1.3	2.1
22	150	0.1	0.6	2.2
23	151	0.7	2.3	2.8
29	157	-2.1	-1.7	-1.9
30	158	-3.9	-3.0	-1.2
31	159	-3.1	-3.0	-1.0
32	160	-1.5	-3.0	-0.8
33	161	-2.2	0.4	-1.6
38	166	-3.1	-2.8	-1.3
39	167	-3.8	-3.0	-1.8
40	168	-3.6	-2.7	-1.8
41	169	-3.4	-2.3	-0.8

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Table 2-2
5G NR n258/n261/n260 Antenna Module 1 input.power.limit

Beam ID	Paired Beam ID	n258 (dBm)	n261 (dBm)	n260 (dBm)
0	N/A	8.4	8.7	8.3
2	N/A	7.7	8.0	8.6
4	N/A	7.6	7.9	8.4
6	N/A	8.2	8.4	9.1
8	N/A	8.2	9.2	9.6
10	N/A	6.5	5.9	5.9
11	N/A	4.4	4.1	6.1
12	N/A	4.0	5.4	5.8
13	N/A	6.5	5.6	6.6
18	N/A	5.5	4.8	5.8
19	N/A	4.1	4.2	5.5
20	N/A	5.1	4.7	5.4
24	N/A	4.4	2.9	2.7
25	N/A	0.6	0.8	2.7
26	N/A	0.5	0.7	2.9
27	N/A	0.5	0.7	2.9
28	N/A	1.5	1.6	2.3
34	N/A	0.8	1.1	2.6
35	N/A	0.3	0.8	3.0
36	N/A	0.5	0.8	2.8
37	N/A	0.7	1.1	2.4
128	N/A	8.5	8.7	8.6
130	N/A	8.2	8.5	8.2
132	N/A	7.9	8.2	7.7
134	N/A	8.0	8.3	8.4
136	N/A	8.8	8.9	9.6
138	N/A	6.1	6.2	6.0
139	N/A	4.2	4.5	5.1
140	N/A	5.1	4.8	5.1
141	N/A	7.1	6.5	6.1
146	N/A	4.3	5.2	5.2
147	N/A	4.3	4.6	5.7
148	N/A	5.0	5.8	4.9
152	N/A	1.1	1.9	2.6
153	N/A	0.5	1.1	2.0
154	N/A	0.4	0.8	2.4
155	N/A	0.8	0.9	2.0
156	N/A	2.8	2.9	1.8
162	N/A	0.9	1.3	2.5
163	N/A	0.4	0.7	2.1
164	N/A	0.6	0.8	2.7
165	N/A	1.8	1.8	2.5
0	128	4.5	4.8	4.9
2	130	4.4	4.9	5.0
4	132	3.9	4.3	4.6
6	134	4.2	4.5	5.2
8	136	5.0	5.5	5.8
10	138	3.0	2.6	2.5
11	139	1.1	1.6	3.7
12	140	2.0	1.6	1.9
13	141	3.1	2.7	2.9
18	146	2.1	1.8	2.4
19	147	1.4	1.2	1.6
20	148	1.5	1.7	1.8
24	152	-1.7	-1.6	-1.4
25	153	-2.6	-2.2	-1.3
26	154	-2.6	-2.3	-1.1
27	155	-2.5	-2.2	-1.0
28	156	-2.0	-1.8	-1.3
34	162	-2.7	-2.1	-1.1
35	163	-2.6	-2.3	-1.0
36	164	-2.6	-2.4	-1.2
37	165	-2.3	-2.2	-1.5

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3. Power Density Test Results

Table 3-1
Power Density Test Data

Module/ Antenna	Mode/Band	Channel	Frequency (MHz)	Beam ID	Paired Beam ID	input.power.limit (dBm)	Signal	Surface/Edge	DUT Serial No.	Measurement Distance (mm)	Power Drift (dB)	Normal psPD (W/m^2 avg area 4cm^2)	Total psPD (W/m^2 avg area 4cm^2)	Test Plot
0	NR n258	High	25200.0	29	N/A	0.3	CW	Left	0J2LA	2	0.05	2.090	3.510	-
0	NR n258	High	25200.0	145	N/A	5.3	CW	Left	0J2LA	2	0.03	2.650	3.510	-
0	NR n258	High	25200.0	14	142	1.6	CW	Left	0J2LA	2	0.01	3.070	4.450	A1
0	NR n261	Low	27550.1	33	N/A	5.4	CW	Left	0J2LA	2	0.10	3.810	4.930	-
0	NR n261	Mid	27925.0	135	N/A	8.4	CW	Left	0J2LA	2	0.04	4.300	5.680	A2
0	NR n261	Mid	27925.0	23	151	2.3	CW	Left	0J2LA	2	-0.03	3.420	4.620	-
0	NR n260	High	39949.9	41	N/A	3.3	CW	Left	0J2LA	2	-0.03	4.600	5.650	A3
0	NR n260	High	39949.9	169	N/A	3.2	CW	Left	0J2LA	2	-0.02	3.610	4.920	-
0	NR n260	High	39949.9	17	145	3.2	CW	Left	0J2LA	2	-0.06	3.980	5.130	-
0	NR n258	High	25200.0	1	129	3.7	CW	Left	0J2LA	5	0.06	2.020	2.500	-
0	NR n261	Low	27550.1	133	N/A	8.5	CW	Left	0J2LA	5	-0.05	3.480	3.990	-
0	NR n260	Low	37050.0	168	N/A	1.5	CW	Left	0J2LA	5	-0.03	3.680	4.000	-
1	NR n258	High	25200.0	8	N/A	8.2	CW	Right	0J2LA	2	-0.03	2.050	2.630	-
1	NR n258	High	25200.0	132	N/A	7.9	CW	Right	0J2LA	2	0.02	3.490	4.450	A4
1	NR n258	High	25200.0	2	130	4.4	CW	Right	0J2LA	2	0.04	2.460	3.740	-
1	NR n261	High	28300.0	37	N/A	1.1	CW	Right	0J2LA	2	0.02	3.540	4.700	-
1	NR n261	Mid	27925.0	153	N/A	1.1	CW	Right	0J2LA	2	0.01	4.170	4.930	A5
1	NR n261	Mid	27925.0	35	163	-2.3	CW	Right	0J2LA	2	0.02	3.110	3.450	-
1	NR n260	Mid	38500.0	28	N/A	2.3	CW	Right	0J2LA	2	0.05	4.220	4.890	A6
1	NR n260	Mid	38500.0	156	N/A	1.8	CW	Right	0J2LA	2	0.00	3.920	4.490	-
1	NR n260	High	39949.9	37	165	-1.5	CW	Right	0J2LA	2	0.09	3.350	4.520	-
1	NR n258	High	25200.0	8	N/A	8.2	CW	Right	0J2LA	5	0.09	1.170	1.400	-
1	NR n261	High	28300.0	153	N/A	1.1	CW	Right	0J2LA	5	-0.17	3.560	3.930	-
1	NR n260	Low	37050.0	28	N/A	2.3	CW	Right	0J2LA	5	-0.04	3.970	4.310	-

3.1. Testing Notes

1. Input.power.limit calculations can be found in the RF Exposure Part 0 test report.
2. Beam IDs for power density testing were chosen based on the highest simulated power density for each surface and distance while considering the applied permanent backoff.
3. One beam for each polarization (SISO: V and H) and one paired beam (MIMO: V+H) were chosen for power density measurements at 2mm for each antenna/band, each based on the channel with the highest simulated power density.
4. DUT was controlled via manufacturer software to ensure stable transmission for specific beam IDs and frequencies for the duration of each power density test.
5. CW signal was used for power density testing per FCC guidance. Additional testing for other parameters was not required.
6. See Total Exposure Ratio (TER) appendix for simultaneous transmission analysis involving NR FR2.
7. GEN2 Smart Transmit verifications can be found in the Total Exposure Ratio (TER) appendix.
8. Power density measurements were performed on two planes with a distance of $\lambda/4$mm between planes.
9. DUT battery was charged completely before starting each power density test. DUT may have been connected to AC power outlet for battery life due to length of some power density tests. If a test was performed this way, it was confirmed that this setup did not affect the power density results.
10. If distances larger than 2mm were evaluated for power density, beams were chosen for power density testing based on the highest percentage of the worst case 2mm simulation while considering the applied permanent backoff.

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4. General Introduction

Title 47 of the Code of Federal Regulations (CFR) pertains to United States Federal regulation for Telecommunications. The Federal Communications Commission (FCC) is the agency responsible for implementing and enforcing these regulations. The rules define a radiofrequency device as any device which in its operation is capable of emitting radiofrequency energy by radiation, conduction, or other means.

47CFR §2.1093(b) states, “A portable device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that the RF source's radiating structure(s) is/are within 20 centimeters of the body of the user.”

Also, 47CFR §2.1093(d)(6) states, that General population/uncontrolled exposure limits defined in §1.1310 “apply to portable devices intended for use by consumers or persons who are exposed as a consequence of their employment and may not be fully aware of the potential for exposure or cannot exercise control over their exposure.”

47CFR §2.1093(d)(2) states that evaluation of compliance within FCC’s limits can be demonstrated by laboratory measurements. This test report serves this purpose.

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5. Background on Radiofrequency (RF) Exposure Limits

5.1. Controlled Environment

Controlled environments are defined as locations where the RF field intensities have been adequately characterized by means of measurement or calculation and exposure is incurred by persons who are: aware of the potential for RF field exposure, cognizant of the intensity of the RF fields in their environment, aware of the potential health risks associated with RF field exposure and able to control their risk using mitigation strategies. In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

5.2. Uncontrolled Environment

Uncontrolled environments are defined as locations where either insufficient assessment of RF fields have been conducted or where persons who are allowed access to these areas have not received proper RF field awareness/safety training and have no means to assess or, if required, to mitigate their exposure to RF fields. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed, or in which persons who may not be made fully aware of the potential for exposure, or cannot exercise control over their exposure. Members of the general public would fall under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

5.3. RF Exposure Limits for 6 - 100 GHz

Per FCC 47 CFR §1.1310, the power density limits are applied for frequencies between 6 GHz and 100 GHz as shown below. Note that 10 W/m^2 is equivalent to 1 mW/cm^2.

Table 5-1
Human Exposure to RF Radiation Limits in 47 CFR §1.1310

Environment	Power Density (W/m^2)	Average Time (minutes)
Uncontrolled / General Population	10	30
Controlled	50	6

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5.4. General FCC Policy on Human Exposure to RF

Quoted from the FCC OET website:

The FCC is required by the National Environmental Policy Act of 1969, among other things, to evaluate the effect of emissions from FCC-regulated transmitters on the quality of the human environment. Several organizations, such as the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE) ,and the National Council on Radiation Protection and Measurements (NRCP) have issued recommendations for human exposure to RF electromagnetic fields.

On August 1, 1996, the Commission adopted the NCRP's recommended Maximum Permissible Exposure limits for field strength and power density for the transmitters operating at frequencies of 300 kHz to 100 GHz. In addition, the Commission adopted the specific absorption rate (SAR) limits for devices operating within close proximity to the body as specified within the ANSI/IEEE C95.1-1992 guidelines. (See Report and Order, FCC 96-326)

The Commission's requirements are detailed in Parts 1 and 2 of the FCC's Rules and Regulations [47 C.F.R. 1.1307(b), 1.1310, 2.1091, 2.1093]. The potential hazards associated with RF electromagnetic fields are discussed in the FCC's RF Safety FAQ.

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6. RF Safety Laboratory Power Density Measurement System

6.1. Power Density Measurement Hardware and Software

Peak spatially averaged power density (psPD) measurements are performed using a DASY8 robot system with cDASY8 module mmWave software. The DASY8 is made by SPEAG in Switzerland and consists of a 6-axis robot, robot controller, computer, dosimetric probe, and probe alignment light beam unit.

6.2. E-Field Probe

Manufacturer	Schmid & Partner Engineering AG
Model	EUmmWVx
Description	E-field probe for high precision power density (PD) measurements
Frequency Range	750 MHz - 110 GHz
Dynamic Range	< 20 - 10,000 V/m with PRE-10 (min < 50 - 3,000 V/m)
Overall Length (mm)	320
Body Diameter (mm)	8
Tip Length (mm)	23
Tip Diameter (mm)	8
Probe Tip to Sensor X Calibration Point (mm)	1.5
Probe Tip to Sensor Y Calibration Point (mm)	1.5
Applications	High precision dosimetric measurements of devices and transmitters above 6 GHz
Compatibility	DASY8 robot + cDASY8 module mmWave software

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6.3. Peak Spatially Averaged Power Density (psPD) Measurements

Electromagnetic field reconstruction is based on Maxwell's equations and uses the Gerchberg-Saxton algorithm to calculate power density. The general measurement procedure is as follows:

1. Measure the local E-field at a point within the measurement region and where the field is higher than the noise level. This reference level will be used to assess output DUT drift during the measurement.
2. Measure the E-field over the measurement region. Measurement techniques are determined by the measurement system manufacturer. In the near-field, a step size of λ/4 or less is required.
3. Check that the peak is captured. Calculate the psPD on the evaluation surface from the measured fields and ensure the psPD is accurately calculated according to the equation below. Averaging area, A, and averaging shape is specified by the applicable exposure limits or regulatory requirements.

$$psPD = \frac{1}{2A_{av}} \iint_{A_{av}} \|Re\{E \times H\}\| dA$$

4. Measure the local E-field at the same location chosen in the first step. The DUT drift is estimated as the difference between the squared amplitude of the field values taken. When measurement drift was greater than 5%, the psPD measurement and drift measurements were repeated.

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6.4. RF Safety Laboratory Power Density System Measurement Uncertainty

Power Density Uncertainty for DUTs According to IEC/IEEE 63195-1							
Symbol	Description	Unc. (+/- dB)	Probab. Distri.	Div.	ci	Std. Unc. (+/- dB)	vi
Measurement System							
CAL	Calibration	0.49	N	1	1	0.49	∞
COR	Probe correction	0.00	R	√3	1	0.00	∞
FRS	Frequency Response	0.20	R	√3	1	0.12	∞
SCC	Sensor cross coupling	0.00	R	√3	1	0.00	∞
ISO	Isotropy	0.50	R	√3	1	0.29	∞
LIN	Linearity	0.20	R	√3	1	0.12	∞
PSC	Probe scattering	0.00	R	√3	1	0.00	∞
PPO	Probe postitioning offset	0.30	R	√3	1	0.17	∞
PPR	Probe positioning repeatability	0.04	R	√3	1	0.02	∞
SMO	Sensor mechanical offset	0.00	R	√3	1	0.00	∞
PSR	Probe spatial resolution	0.00	R	√3	1	0.00	∞
FLD	Field impedance dependance	0.00	R	√3	1	0.00	∞
MED	Measurement drift	0.05	R	√3	1	0.03	∞
APN	Amplitude and phase noise	0.04	R	√3	1	0.02	∞
TR	Measurement area truncation	0.00	R	√3	1	0.00	∞
DAQ	Data acquisition	0.03	N	1	1	0.03	∞
SMP	Sampling	0.00	R	√3	1	0.00	∞
REC	Field reconstruction	0.60	R	√3	1	0.35	∞
SNR	Signal-to-noise raio	0.00	R	√3	1	0.00	∞
TRA	FTE/MEO	0.00	R	√3	1	0.00	∞
SCA	Power density scaling	0.00	R	√3	1	0.00	∞
SAV	Spatial averaging	0.10	R	√3	1	0.06	∞
DUT and Environmental							
PC	Probe coupling with DUT	0.00	R	√3	1	0.00	∞
MOD	Modulation response	0.40	R	√3	1	0.23	∞
IT	Integration time	0.00	R	√3	1	0.00	∞
RT	Response time	0.00	R	√3	1	0.00	∞
DH	Device holder influence	0.10	R	√3	1	0.06	∞
DA	DUT alignment	0.00	R	√3	1	0.00	∞
AC	RF ambient conditions	0.04	R	√3	1	0.02	∞
TEM	Laboratory temperatures	0.05	R	√3	1	0.03	∞
REF	Laboratory reflections	0.04	R	√3	1	0.02	∞
MSI	Immunity / secondary reception	0.00	R	√3	1	0.00	∞
DRI	Drift of the DUT	0.21	R	√3	1	0.12	∞
					Combined Standard Uncertainty	0.76	∞
					Expanded Standard Uncertainty and Effective Degrees of Freedom (k=2)	1.52	

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7. Power Density Testing Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due
Control Company	4040	Ambient Thermometer	230581656	8/28/2023	8/28/2025
SPEAG	5G-Veri30	30 GHz System Verification Source	1114	10/10/2023	10/10/2024
SPEAG	EUmmWV4	E-field Probe	9690	10/9/2023	10/9/2024
SPEAG	DAE4ip	Data Acquisition Electronics with integrated power	1838	10/9/2023	10/9/2024
Staubli	TX2-90XL	DASY8 Robot TX2-90XL	F/23/0052572/A/003	-	-
Staubli	SCS9C	DASY8 Robot Controller CS9C	F/23/0052572/C/003	-	-
SPEAG	DASY8 Server	DASY8 Robot Measurement Server	10147	-	-

8. Conclusion

The power density evaluation indicates that the DUT is capable of compliance with the RF radiation exposure limits of the FCC, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.