RF Exposure Calculated Part 15

Maximum Permissible Exposure at 20 cm

1. Declaration of RF exposure compliance

Transmitter(s) Installed	60 GHz mmWave radio 2.4 GHz band Bluetooth and Bluetooth Low Energy radio 2.4 GHz band Wi-Fi radio
Model number:	OA1
Manufacturer:	Density Inc
Judgement of Compliance	Compliant
Compliance Distance	20 cm
Radiated Transmitter Power (EIRP) Conducted Transmitter Power (dBm)	60 GHz mmWave radio: -7.509 dBm (from test report data) Bluetooth Low Energy: 10.81 dBm (from module FCC approval report, FCC ID: NDD9576111602 Bluetooth EDR: 7.04 dBm (from module FCC approval report, FCC ID: NDD9576111602) Wi-Fi: 21.65 dBm (from module FCC approval report, FCC ID: NDD9576111602)
4.3.1. Maximum Permissible Exposure considerations are:	During normal operation, user and user extremities must be at least 20 cm removed from any transmitting antenna. Simultaneous operation combinations: 1. mmWave + BLE + Wi-Fi 2. mmWave + BT-EDR + Wi-Fi
Verdict	Compliant with 20 cm zone

2. Attestation

ATTESTATION: I attest that the calculations were performed or supervised by me; that the calculations were based on the worst-case power output at the worst-case frequency of the transmitting device. All possible configurations have been considered when calculating the worst case Maximum Permissible Exposure requirements as detailed below.

Signature:	
Date:	March 4, 2021
Name:	James Cunningham, EMC/MIL/WL Supervisor

3. Revision History

40930-3TRFWL	Original report issued
409030-3R1TRFWL	Updated with new EIRP values

Both the MPE limits listed in Table 1 of paragraph (e) of this section and the SAR limits as set forth in paragraph (a) through (c) of this section and in §2.1093 of this chapter are for continuous exposure, that is, for indefinite time periods. Exposure levels higher than the limits are permitted for shorter exposure times, as long as the average exposure over the specified averaging time in Table 1 is less than the limits. Detailed information on our policies regarding procedures for evaluating compliance with all of these exposure limits can be found in the FCC's *OET Bulletin 65,* "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields," and in supplements to *Bulletin 65,* all available at the FCC's Internet Web site: *http://www.fcc.gov/oet/rfsafety.*

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)
(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

Measured and Calculated Result

Prediction of MPE limit at a given distance

Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = \frac{PG}{4\pi R^2}$$

where:
S = power density
P = power input to the antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

	TX Type 1 mmWave	TX Type 2 BLE	TX Type 3 BT-EDR	Tx Type 4 Wi-Fi	
Maximum peak output power at device output terminal:	-12.509	9.21	5.44	20.06	dBm
Cable and Jumper loss:	0	0	0	0	dB
Maximum peak output power at antenna input terminal (dBm):	-12.509	9.21	5.44	20.06	dBm
Maximum peak output power at antenna input terminal (mW):	0.06	8.34	3.50	101.39	mW
Single Antenna gain (typical):	5	1.6	1.6	1.6	dBi
Number of Antennae:	1	1	1	1	
Total Antenna gain (typical) (dBi):	5	1.6	1.6	1.6	dBi
Total Antenna gain (typical) (linear):	3.16	1.45	1.45	1.45	(numeric)
Prediction distance:	20	20	20	20	cm
Prediction frequency:	62525	2442	2442	2442	MHz
MPE limit for uncontrolled exposure at prediction frequency:	1	1	1	1	mW/cm^2
Power density at prediction frequency:	3.5305E-05	0.00239734	0.00100631	0.02915521	mW/cm^2
	0.00035305	0.02397343	0.01006306	0.29155208	W/m^2
Tx On time:	1	1	1	1	ms
Tx period time:	1	1	1	1	ms
Average Factor:	100	100	100	100	%
Average Power density at prediction frequency:	0.00035305	0.02397343	0.01006306	0.29155208	W/m^2
Maximum allowable antenna gain:	49.5216986	27.8026986	31.5726986	16.9528386	dBi
Margin of Compliance:	44.5216986	26.2026986	29.9726986	15.3528386	dB

	mmWave		BLE		BT-EDR		Wi-Fi			
mmWave+BLE+Wi-Fi	0.00004	+	0.00240	+	---	+	0.02916	=	0.002433	<1.0
mmWave+BT-EDR+Wi-Fi	0.00004	+	----	+	0.00101	+	0.02916	=	0.001042	<1.0