RF Exposure evaluation for mobile devices

BOX827

FCC ID: XO2-BOX827
IC: 8713A-BOX827
Contains IC: 24529-NRF9160
Contains FCC ID: 2ANPO00NRF9160

Test Report Reference: MDE_HDW_2301_MPE_01

Test Laboratory:
7layers GmbH
Borsigstrasse 11
40880 Ratingen
Germany

Deutsche Akkreditierungsstelle
D-PL-12140-01-01
D-PL-12140-01-02
D-PL-12140-01-03

Administrative Data

Testing Laboratory

Company Name:	7layers GmbH
Address:	Borsigstr. 11 40880 Ratingen Germany

The test facility is accredited by the following accreditation organisation:

Laboratory accreditation no:	DAkkS D-PL-12140-01-01| -02 | -03
FCC Designation Number:	DE0015
FCC Test Firm Registration:	929146
ISED CAB Identifier	DE0007; ISED#: 3699A
Responsible for accreditation scope:	Marco Kullik

Project Data

Responsible for report:	Patrick Lomax
Date of Report:	02/04/2024

Applicant Data

Company Name:	H&D Wireless AB
Address:	Färögatan 33, Kista Science Tower 164 51 Kista Sweden
Contact Person:	Mikael Olsson

Report version control			
Version	**Release date**	**Change Description**	**Version validity**
initial	02/04/2024	--	valid
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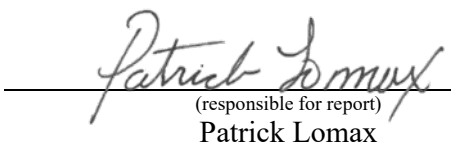

(responsible for report)
Patrick Lomax

General description of OUT

The device consists of an integrated NB-IOT / CAT M1 module which has been FCC and IC certified under the below IDs. The cellular output power is declared within the tune-up procedure of the cellular module manufacturer.
The device further consists of a Bluetooth low energy chipset with further incorporates a passive NFC tag.

Contains IC: 24529-NRF9160
Contains FCC ID: 2ANPO00NRF9160

Band (MHz)	Technology	Band	Max. RF output power (dBm)	Tune-up tolerance (dB)	Max. output power, including tune-up (dBm)
1900	LTE Cat-M1 / LTE Cat-NB1	2	23.0	+1/-3	24.0
1700		4	23.0	+1/-3	24.0
850		5	23.0	+1/-3	24.0
700		12	23.0	+1/-3	24.0
700		13	23.0	+1/-3	24.0
700	LTE Cat-M1	14	23.0	+1/-3	24.0
700	LTE Cat-M1 / LTE Cat-NB1	17	23.0	+1/-3	24.0
1900		25	23.0	+1/-3	24.0
850		26	23.0	+1/-3	24.0
1700		66	23.0	+1/-3	24.0

Standards
OET Bulletin 65 Edition 97-01 August 1997
FCC 47 CFR §1.1307
FCC 47 CFR §1.1310
RSS-102 Issue 6 – December 2023

Test limits

As specified in Table 1B of 47 CFR 1.1310 – Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure.

Frequency range (MHz)	*Power density (mW/cm²)*
300 – 1,500	f/1500
1,500 – 100,000	1.0

Limits specified per RSS-102, Issue 5.

Frequency range (MHz)	*Power density (W/m²)*	*Power density (mW/cm²)*
300 – 6000	$0.02619\ f^{0.6834}$	*mW/cm² = W/m² * 0.1*

Equation OET bulletin 65, page 18, edition 97-01: $S = \frac{PG}{4\pi R^2} = \frac{EIRP}{4\pi R^2}$

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 = 20cm

Co-Location Considerations

The calculation below is used to consider situations in which simultaneous exposure to fields of different frequencies occur. The calculation is performed by the sum of each relative exposure for each equipment according to the following criteria.

$$\sum_{1}^{N} \frac{S_{eqn}}{S_{Limn}} = \frac{S_{eq1}}{S_{Lim1}} + \frac{S_{eq2}}{S_{Lim2}} + \ldots + \frac{S_{eqN}}{S_{LimN}} \leq 1$$

Where:

S_{eq} is the power density of the electromagnetic field at a given distance by a specific transmitter and a defined frequency.

S_{lim} is the MPE limit for the frequency being evaluated.

Operational mode	Band	Frequency range	Antenna Gain (dBi)
Bluetooth LE	IMS	2402 - 2480	3.5
LTE Cat-M1	2	1850 - 1910	3.5
LTE Cat-M1	4	1710 - 1755	2
LTE Cat-M1	5	824 - 849	1.6
LTE Cat-M1	8	897.5 - 900.5	1.6
LTE Cat-M1	12	699 - 716	0.4
LTE Cat-M1	13	777 - 787	0.4
LTE Cat-M1	14	788 - 798	0.4
LTE Cat-M1	17	704 - 716	0.4
LTE Cat-M1	25	1850 - 1915	3.5
LTE Cat-M1	26	814 - 849	0.4
LTE Cat-M1	66	1710 - 1780	3.5
LTE NB-IoT	2	1850 - 1910	3.5
LTE NB-IoT	4	1710 - 1755	3.5
LTE NB-IoT	5	824 - 849	1.6
LTE NB-IoT	8	897.5 - 900.5	1.6
LTE NB-IoT	12	699 - 716	0.4
LTE NB-IoT	13	777 - 787	0.4
LTE NB-IoT	17	704 - 716	0.4
LTE NB-IoT	25	1850 - 1915	3.5
LTE NB-IoT	26	814 - 849	0.4
LTE NB-IoT	66	1710 - 1780	3.5

Operational Mode	Band	Calc Frequency (MHz)	Output Power - conducted- (dBm)	Output Power - conducted- (mW)	IC Limit (mW/cm²)	FCC Limit (mW/cm²)	Power Density value (mW/cm²)	Verdict	FCC (Seq / SLim)	ISED (Seq / SLim)
Bluetooth LE	IMS	2402	5.20	3.31	0.5351	1.00	0.0015	Pass	0.0015	0.0028
LTE Cat-M1	2	1850	24.00	251.19	0.4476	1.00	0.1119	Pass	0.1119	0.2499
LTE Cat-M1	4	1710	24.00	251.19	0.4242	1.00	0.0792	Pass	0.0792	0.1867
LTE Cat-M1	5	824	24.00	251.19	0.2576	1.00	0.0722	Pass	0.0722	0.2804
LTE Cat-M1	8	897.5	24.00	251.19	0.2730	1.00	0.0722	Pass	0.0722	0.2645
LTE Cat-M1	12	699	24.00	251.19	0.2302	1.00	0.0548	Pass	0.0548	0.2381
LTE Cat-M1	13	777	24.00	251.19	0.2474	1.00	0.0548	Pass	0.0548	0.2215
LTE Cat-M1	14	788	24.00	251.19	0.2498	1.00	0.0548	Pass	0.0548	0.2193
LTE Cat-M1	17	704	24.00	251.19	0.2313	1.00	0.0548	Pass	0.0548	0.2369
LTE Cat-M1	25	1850	24.00	251.19	0.4476	1.00	0.1119	Pass	0.1119	0.2499

LTE Cat-M1	26	814	24.00	251.19	0.2554	1.00	0.0548	Pass	0.0548	0.2145
LTE Cat-M1	66	1710	24.00	251.19	0.4242	1.00	0.1119	Pass	0.1119	0.2637
LTE NB-IoT	2	1850	24.00	251.19	0.4476	1.00	0.1119	Pass	0.1119	0.2499
LTE NB-IoT	4	1710	24.00	251.19	0.4242	1.00	0.1119	Pass	0.1119	0.2637
LTE NB-IoT	5	824	24.00	251.19	0.2576	1.00	0.0722	Pass	0.0722	0.2804
LTE NB-IoT	8	897.5	24.00	251.19	0.2730	1.00	0.0722	Pass	0.0722	0.2645
LTE NB-IoT	12	699	24.00	251.19	0.2302	1.00	0.0548	Pass	0.0548	0.2381
LTE NB-IoT	13	777	24.00	251.19	0.2474	1.00	0.0548	Pass	0.0548	0.2215
LTE NB-IoT	17	704	24.00	251.19	0.2313	1.00	0.0548	Pass	0.0548	0.2369
LTE NB-IoT	25	1850	24.00	251.19	0.4476	1.00	0.1119	Pass	0.1119	0.2499
LTE NB-IoT	26	814	24.00	251.19	0.2554	1.00	0.0548	Pass	0.0548	0.2145
LTE NB-IoT	66	1710	24.00	251.19	0.4242	1.00	0.1119	Pass	0.1119	0.2637

Simultaneous transmission

Sum of (S_{eqn} / S_{Limn}) Max BT + CATM Max	0.1134	0.2832
	Passed	
Sum of (S_{eqn} / S_{Limn}) Max BT + NB-IOT MAX	0.1134	0.2832
	Passed	

End of report.