EMF Exposure Evaluation Report

For

Purism, SPC

Test Standards:	EN 62311:2008 EN 62479:2010 EN 50663:2017
Product Description:	Librem Mini
Evaluation Model:	LMv1-01
Report No.:	EC2005029RE04
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Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2020.06.15	Valid	Original Report

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1. General Description

1.1. Applicant

Purism, SPC
One Market Street, 36th Floor, San Francisco, CA 94105, USA

1.2. Manufacturer

Purism, SPC
One Market Street, 36th Floor, San Francisco, CA 94105, USA

1.3. General Description of EUT

Product	Librem Mini	
Model NO.	LMv1-01	
Additional NO.	N/A	
Difference Description	N/A	
Nominal Voltage	AC230V/50Hz for adapter	
Extreme Temperature	0℃ and 45℃	
Modulation Type	**WLAN**	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM GFSK for BT LE
	RLAN	256QAM,64QAM, 16QAM, QPSK, BPSK for OFDM
	Bluetooth	GFSK, π/4-DQPSK, 8DPSK
Operating Frequency	**WLAN**	2412-2472MHz for 11b/g/n(HT20) 2422-2462 for 11n(HT40)
	RLAN	5725-5850MHz for ac80(VHT80)
	Bluetooth	2402MHz~2480MHz
Region of body	Head and trunk	
Exposure tier	General public	
HW Version	N/A	
SW Version	N/A	

NOTE:

1. The above EUT information is declared by manufacturer and for more detailed feature description, please refer to the manufacturer's specifications or user's manual.

2. For the test results, the EUT had been tested with all conditions. But only the worst case was shown in

test report.

3. The EUT was powered by the following adapters:

MODEL:	ADS-40SI-19-3 19040E
INPUT:	100-240V~50/60Hz 1.0A MAX
OUTPUT:	19V DC 2.1A
DC LINE:	2.5 m

1.4. Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of:

EN 62311:2008: Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz – 300 GHz).

EN 62479:2010: Assessment of the compliance of low power electronic and electrical equipment with the basic restrictions related to human exposure to electromagnetic fields (10 MHz to 300 GHz)

EN 50366:2017: Generic standard for assessment of low power electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (10 MHz - 300 GHz)

2. Conformity assessment methods

2.1. General considerations

An analysis can be made to investigate which parts emit EMF. A description of the several parts of an equipment is recommended in order to determine what parts are emitting EMF.Table 1 gives the characteristics and parameters of the equipment to be considered. Table 2 gives a list of possible assessment methods.

Table 1 – Characteristics and parameters of the equipment to be considered

Information needed	Further detailed description of the information needed
Frequency	Frequency of emissions
Waveform	Waveform and other information such as duty factor for establishment of peak- and/or average emission
Multiple frequency sources	Does the equipment produce fields at more than one frequency or fields with a high harmonic content? Are the emissions simultaneous?
Emission of electric fields	Voltage differences and any coupling parts e.g., metallic surfaces charged at a voltage potential
Emission of magnetic fields	Current flow and any coupling parts e.g., coils, transducers or loops
Emission of electromagnetic fields	Generation or transmission of high frequency signals and any radiating parts e.g., antennas, loops, transducers and external cables
Contact currents	Possibility of touching conducting surfaces when either the surface or the person is exposed to electromagnetic fields?
Whole body exposure	Fields produced by equipment extend over region occupied by the whole body
Partial body exposure	Fields produced by equipment extend over only part of region occupied by the body, or over region occupied by limbs
Duration/time variation	Duty cycle of emissions, on/off time of power used or emitted by equipment. Variation of power use or emissions during production process
Homogeneity	Extent to which the strength of the fields varies over the body or region of the body that is exposed. Shall be measured without the presence of a body
Far/near field	Are exposures in near field? (see Annex A) Propagating near field? Far field?
Pulsed/transient fields	Are the emissions pulse-modulated or true pulses? Are there occasional or periodic transients in the field?
Information needed	**Further detailed description of the information needed**
Physical size	Is the equipment so small that any significant exposure will be to part of the body? In relation to the wavelength (operating frequency) Is it so big that different parts will contribute to exposures "independently"?
Power	What is the emitted power? What is the power consumption? If there is an antenna system, what is the effective radiated power?
Distance (source to user)	What is the spatial relationship between the equipment and the operator or user when it is used normally? The distance used for the assessment shall be specified by the manufacturer and be consistent with the intended usage of the equipment
Intended usage	How is the equipment commonly used? Conditions of intended usage producing the highest emission or absorption? Operating conditions? How does the intended usage affect the spatial relationship between the equipment and the user? Can the usage affect the emission characteristics of the equipment? Can the equipment be part of a system?
Interaction sources/user	Do the emitted fields change if the equipment is close to the body? Does the equipment couple to the body during use?

Table 2 – List of possible assessment methods

Assessment methods	Applicability area and limitations	Reference
Far field calculation	Electromagnetic fields far from source. Very small microwave equipment not used close to body, or large lower-frequency transmitters at greater distances. That region of the field of an antenna where the angular field distribution is essentially independent of the distance from the antenna. In this region (also called the free space region), the field has a predominantly plane-wave character, i.e., locally uniform distribution of electric field strength and magnetic field strength in planes transverse to the direction of propagation	See Annex A
Near field calculation	Electromagnetic fields very close to the source. There can be an interaction between the radiated fields from the source and the user	See Annex A
Simulation with/without a phantom	Evaluation of measurement results inside the phantom representing a body	See Annex B
Numerical modelling	Calculation only	See Annex C
Body/limb current	Measurement or calculation	See Annex C or D
SAR	Calculation and measurements; 100 kHz – 10 GHz. For modelling	See Annex E See Annex C
E and *H* measurement	Near or far field. Direct measurement for comparison with reference levels or as input for more detailed assessment	See Annex F
Source modelling	Prediction of exposures from calculation of emissions at a specific distance	See Annex G
Direct measurement of physical properties: Contact current		See Annex D, E or F
The physical characteristics and intended use of the equipment may have an impact on the choice of assessment method. E.g., radiators of EMF intended for use in close proximity to the body shall be assessed differently from transmitters intended for fixed installations in buildings.		

The following generic procedure for assessment of equipment involves a decision tree drawing on information from Tables 1 and 2.

(1) The equipment should be characterised to determine the nature of EMF emissions and also the intended usage conditions.

An assessment shall be performed: Fields and body currents should be determined at the typical user position under normal operating conditions giving the highest emission– e.g., based on limited pre-tests, but consistent with the normal operating conditions as specified by the manufacturer.

(2) By measurement or calculation (see 8.1). If these quantities are below the relevant reference levels, taking into account waveform/frequency content, and any allowed time and spatial averaging then the equipment is deemed to meet the requirements in this standard. If not, then go to paragraph (3).

(3) Measured emission values should be compared with any product-specific compliance criteria (e.g., kind of emission, operating frequency (range), limits) that can be derived for the equipment (Clause 5). If the emission values are below the product-specific compliance criteria then the equipment is deemed to meet the requirements in this standard. If no product-specific compliance criteria (by e.g., the manufacturer) have been specified for an E-field, H-field or contact current which is to be assessed, or if compliance criteria have been specified but not met, then go to paragraph (4).

(4) Further assessment involving more detailed measurement, calculation and source/exposure modelling should be undertaken (see 8.2) to allow comparison of exposure levels with all relevant basic restrictions on exposure. If the exposures are below the basic restrictions then the equipment is deemed to meet the requirements in this standard. If not, then the equipment is deemed not to comply with the requirements in this standard.

This process is summarized in the flowchart in Figure 1.

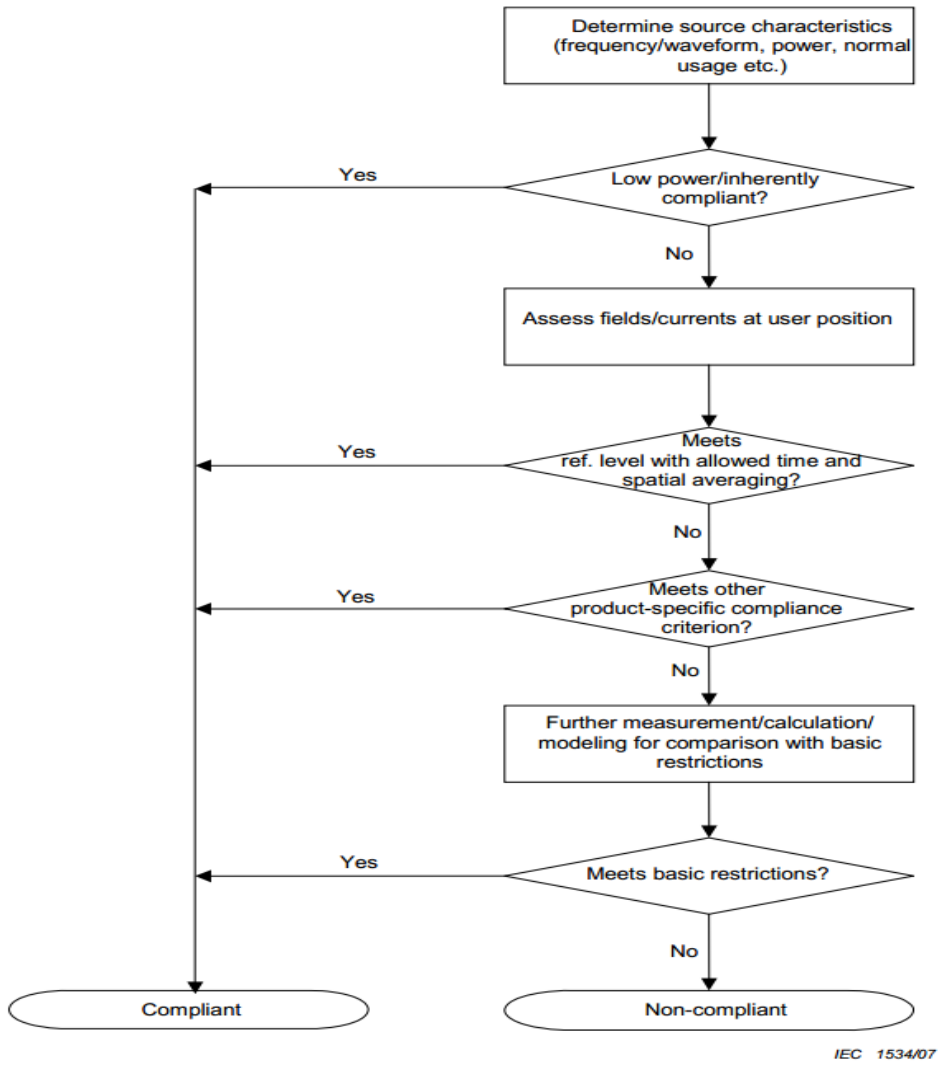

Figure 1 – Assessment flowchart

3. Compliance criteria

The electronic and electrotechnical apparatus shall comply with the basic restriction as specified in Annex III of Council Recommendation 1999/519/EC.

The table of the reference field levels shown as below is given in Annex III of the Council Recommendation 1999/519/EC.

Reference levels for electric, magnetic and electromagnetic fields (0 Hz to 300 GHz, unperturbed rms values)

Frequency range	E-field strength (V/m)	H-field strength (A/m)	B-field (μT)	Equivalent plane wave power density S_{eq} (W/m²)
0-1 Hz	—	$3,2 \times 10^4$	4×10^4	—
1-8 Hz	10 000	$3,2 \times 10^4/f^2$	$4 \times 10^4/f^2$	—
8-25 Hz	10 000	4 000/f	5 000/f	—
0,025-0,8 kHz	250/f	4/f	5/f	—
0,8-3 kHz	250/f	5	6,25	—
3-150 kHz	87	5	6,25	—
0,15-1 MHz	87	0,73/f	0,92/f	—
1-10 MHz	$87/f^{1/2}$	0,73/f	0,92/f	—
10-400 MHz	28	0,073	0,092	2
400-2 000 MHz	$1,375\ f^{1/2}$	$0,0037\ f^{1/2}$	$0,0046\ f^{1/2}$	f/200
2-300 GHz	61	0,16	0,20	10

Notes:

1. f as indicated in the frequency range column.
2. For frequencies between 100 kHz and 10 GHz, S_{eq}, E^2, H^2, and B^2 are to be averaged over any six-minute period.
3. For frequencies exceeding 10 GHz, S_{eq}, E^2, H^2, and B^2 are to be averaged over any $68/f^{1.05}$ -minute period (f in GHz).
4. No E-field value is provided for frequencies < 1 Hz, which are effectively static electric fields. For most people the annoying perception of surface electric charges will not occur at field strengths less than 25 kV/m. Spark discharges causing stress or annoyance should be avoided.

The field calculation does not take into account the antenna size, which is assumed to be a point source. An ideal isotropic antenna is used as a reference to compare the performance of practical antennas: P watts is radiated, from a point, uniformly over the surface of sphere of radius r.

The Pointing vector gives the power density: $$S = E \times H = \frac{E^2}{\eta} = \frac{P}{4\pi r^2}$$

Where:
S = Power Density
P = P watts is radiated
r = Distance from Transmitting Antenna

4. Assess Result

Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum Power (dBm)	Maximum EIRP (dBm)	Average EIRP (mW)	Power Density at 20cm (W/m^2)	Limit (W/m^2)	Result
BT 2.4GHz Band	2402	3	4.63	7.63	5.79	0.012	10	PASS
WLNA 2.4GHz Band	2412	3	14.93	17.93	62.09	0.124	10	PASS
RLNA 5GHz Band IV	5745	5	10.85	15.85	38.46	0.077	10	PASS

Simulation Transmission

EUT can only work in 2.4G WiFi+ Bluetooth mode or 5G WiFi+ Bluetooth mode

The formula of calculated the Simulation Transmission MPE is:

CPD1 /LPD1 + CPD2 /LPD2 + …… etc. < 1

CPD = Calculation Maximum Power Density

LPD = Limit of Power Density

Mode	Calculate	Limit	Result
2.4G WiFi+ Bluetooth	0.0135	1.0	PASS
5G WiFi+ Bluetooth	0.0088	1.0	PASS

Note:

1. For conservativeness, the lowest uplink frequency of each band is used to determine the MPE limit of that band.
2. The maximum EIRP of Bluetooth 5.79mW is less than 20mW and meet the requirement of EN 62479: 2010, Therefore, the EUT is deemed to comply with EMF basic restrictions.

---------- End of the report----------