

RF Exposure Evaluation Report

Applicant: Advantech Czech s.r.o.
Address: Sokolská 71, Ústí nad Orlicí 562 04, Czech Republic

Product: Cellular router
Model No.: ICR-1745
Brand Name: Advantech Czech s.r.o.
Standards: EN IEC 62311:2020

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1. General Information

1.1. Manufacturer

Advantech Czech s.r.o.

Sokolská 71, Ústí nad Orlicí 562 04, Czech Republic

1.2. Product Information

Product Name	Cellular router
Model No.	ICR-4261, ICR-4461
Operating Temperature	-35 to 75 °C
Operation Vol	9-48 V DC
WCDMA Band:	I, V, VIII
LTE Band:	1, 3, 5, 7, 8, 20, 28, 38, 40, 41, 42, 43,
5G NR:	n1, n3, n5, n7, n8, n20, n28, n38, n40, n41 n77, n78
GNSS Specification:	-
Remark:	
1. The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.	

2. RF Exposure Measurement

The scope of this standard is limited to apparatus which is intended for use by the general public as defined in the Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (Official Journal L 199 of 30 July 1999).

This generic standard applies to electronic and electrical apparatus for which no dedicated product or product family standard regarding human exposure to electromagnetic fields applies.

This generic standard does not cover equipment, which fulfils the requirements given in EN 50371 or is medical equipment as defined in the Council Directive 93/42/EEC of 14 June 1993 concerning medical devices.

The frequency range covered is 0 Hz to 300 GHz.

The object of this standard is to demonstrate the compliance of such apparatus with the basic restrictions or reference levels on exposure of the general public related to electric, magnetic, electromagnetic fields and induced and contact current.

2.1. Limits

The electronic and electro-technical apparatus shall comply with the basic restriction as specified in Annex II of Council Recommendation 1999/519/EC.

The reference levels in the Council Recommendation 1999/519/EC on public exposure to electromagnetic fields are derived from the basic restrictions using worst-case assumptions about exposure.

According to EN50385, the reference level listed in the following table 2 shall be used to evaluate the environment impact of human exposure human exposure to electromagnetic fields (0 Hz - 300 GHz) as specified in 1999/519/EC.

Table 2

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 (μ T)	Equivalent plane wave power density Seq (W/m ²)
0-1 Hz	–	3.2×10^4	4×10^4	–
1-8 Hz	10000	$3.2 \times 10^4/f^2$	$4 \times 10^4/f^2$	–
8-25 Hz	10000	$4000/f$	$5000/f$	–
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	0.73	0.092	2
400-2000 MHz	$1.375 f^{1/2}$	$0.0037 f^{1/2}$	$0.0046 f^{1/2}$	$f/200$
2-300G Hz	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, Seq , E_2 , H_2 , and B_2 are to be averaged over any six-minute period.
3. For frequencies exceeding 10 GHz, Seq , 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.

2.2. Assessment methods

Under normal use of condition, this device has a separation distance of at least 20cm between the antenna and the body of the user. A radiation exposure statement” this equipment should be installed and operated with minimum distance between the antenna and your body” is shown on the user manual, so human exposure to the electromagnetic field of this product is at far-field region under normal use.

Far-field region Calculation Formula:

P watts are radiated, from a point, uniformly over the surface of sphere of radius r.

In free space

$$E = \eta_0 H = [30 * P * G(\theta, \Phi)]^{0.5} / r$$

Where

G = antenna gain relative to an isotropic antenna

θ, Φ = elevation and azimuth angles to point of

investigation r = distance from observation point to the antenna (m)

η = characteristic impedance of free space

Compliance Distance Calculation Formula:

The power flux:

$$S = \frac{P * G(\theta, \Phi)}{4 * \pi * r^2}$$

So Compliance distance as following:

$$r = \sqrt{\frac{P * G}{4 * \pi * S}}$$

P = input power of the antenna

G = antenna gain relative to an isotropic antenna $\theta,$

Φ = elevation and azimuth angles.

r = distance from the antenna to the point of investigation

2.3. Test Result of RF Exposure Evaluation

Output Power Into Antenna & RF Exposure Evaluation Distance:

Operating Band	Frequency (MHz)	Antenna Gain (dBi)	Maximum power (dBm)	Maximum EIRP (dBm)	Average EIRP (mW)	Power density at 20 cm (W/m ²)	Limit (W/m ²)	Power density / Limit
WCDMA VIII	880	2.00	25.00	27.00	501.19	1.00	4.40	0.227
WCDMA V	824	1.00	25.00	26.00	398.11	0.79	4.12	0.192
WCDMA I	1920	1.00	25.00	26.00	398.11	0.79	9.60	0.083
LTE Band 1	1920	2.00	25.00	27.00	501.19	1.00	9.60	0.104
LTE Band 3	1710	2.00	25.00	27.00	501.19	1.00	8.55	0.117
LTE Band 5	824	1.00	25.00	26.00	398.11	0.79	4.12	0.192
LTE Band 7	2500	3.80	25.00	28.80	758.58	1.51	10.00	0.151
LTE Band 8	880	1.00	25.00	26.00	398.11	0.79	4.40	0.180
LTE Band 20	832	1.00	25.00	26.00	398.11	0.79	4.16	0.190
LTE Band 28	703	0.20	25.00	25.20	331.13	0.66	3.52	0.188
LTE Band 38 PC2	2570	3.80	28.00	31.80	1513.56	3.01	10.00	0.301
LTE Band 40	2300	3.90	25.00	28.90	776.25	1.55	10.00	0.155
LTE Band 41 PC2	2496	3.80	28.00	31.80	1513.56	3.01	10.00	0.301
LTE Band 42 PC2	3400	3.40	28.00	31.40	1380.38	2.75	10.00	0.275
LTE Band 43 PC2	3600	3.40	28.00	31.40	1380.38	2.75	10.00	0.275
5G NR n1	1920	2.00	28.00	30.00	1000.00	1.99	9.60	0.207
5G NR n3	1710	2.00	28.00	30.00	1000.00	1.99	8.55	0.233
5G NR n5	824	1.00	28.00	29.00	794.33	1.58	4.12	0.384
5G NR n7	2500	3.80	28.00	31.80	1513.56	3.01	10.00	0.301
5G NR n8	880	1.00	25.00	26.00	398.11	0.79	4.40	0.180
5G NR n20	832	1.00	25.00	26.00	398.11	0.79	4.16	0.190
5G NR n28	703	0.20	28.00	28.20	660.69	1.32	3.52	0.374
5G NR n38 PC2	2570	3.80	28.00	31.80	1513.56	3.01	10.00	0.301
5G NR n38 MIMO	2570	3.80	31.00	34.80	3019.95	6.01	10.00	0.601
5G NR n40	2300	3.90	28.00	31.90	1548.82	3.08	10.00	0.308
5G NR n41 PC2	2496	3.80	28.00	31.80	1513.56	3.01	10.00	0.301
5G NR n41 MIMO	2496	3.80	31.00	34.80	3019.95	6.01	10.00	0.601
5G NR n77 PC2	3300	3.40	28.00	31.40	1380.38	2.75	10.00	0.275
5G NR n77 MIMO	3300	3.40	31.00	34.40	2754.23	5.48	10.00	0.548
5G NR n78 PC2	3300	3.40	28.00	31.40	1380.38	2.75	10.00	0.275
5G NR n78 MIMO	3300	3.40	31.00	34.40	2754.23	5.48	10.00	0.548

Note:

1. For conservativeness, the lowest frequency of each band is used to determine the MPE limit of that band.
2. Chose the maximum power to do MPE analysis.
3. The MIMO mode is completely uncorrelated, so selected the higher SISO gain among all antennas as MIMO gain to perform MPE calculation.

2.4. Collocated Power Density Calculations

LTE inter-band ULCA

Maximum WWAN LTE Power Density / Limit	Maximum WWAN LTE Power Density / Limit	Sum (Power Density / Limit) of WWAN LTE + WWAN LTE
0.301	0.301	0.602

5G NR inter-band ULCA

Maximum WWAN 5G NR Power Density / Limit	Maximum WWAN 5G NR Power Density / Limit	Sum (Power Density / Limit) of WWAN 5G NR + WWAN 5G NR
0.384	0.384	0.768

LTE + 5G NR

Maximum WWAN LTE Power Density / Limit	Maximum WWAN 5G NR Power Density / Limit	Sum (Power Density / Limit) of WWAN LTE + WWAN 5G NR
0.301	0.384	0.685

Note:

1. Always choose the worst evaluation value of NR and LTE standalone band to do analysis
2. Sum(Power Density / Limit): This is a summation of [(power density for each transmitter/antenna included in the simultaneous transmission) / (corresponding MPE limit)], for WWAN LTE + WWAN 5G NR and inter-band ULCA.
3. Considering all transmitter of the EIRP performance listed in the table above, the aggregated (power density / limit) is smaller than 1, and MPE collocated transmitters are compliant.

Conclusion:

According to 1999/519/EC, the RF Exposure is CE compliant.