



Radio Frequency Exposure Evaluation Report

For:

21Net LTD

Model Name:

21NtBox v1

Product Description:

Mobile Access Router

FCC ID: 2AG5P-21NETBOX V1

Per:

CFR Part 1 (1.1307 & 1.1310), Part 2 (2.1091),
FCC KDB 447498 D01 General RF Exposure Guidance v06

Report number: EMC_21NET-002-15001_FCC_MPE_REV3

DATE: August 09, 2016



CETECOM Inc.

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1 Assessment

This RF Exposure evaluation report provides information about compliance of the below identified device with the RF Exposure limits for mobile devices as defined in FCC CFR Part 1 (1.1307 & 1.1310), Part 2 (2.1091). In addition, maximum antenna gain or minimum distance towards the human body is calculated, respectively, where relevant.

The device meets the limits as stipulated by the above given FCC and IC rule parts based on available if a minimum distance of 100cm to the human body is maintained.

Company	Description	Model #
21Net LTD	Mobile Access Router	21NetBox v1

Responsible for the Test Laboratory:

Aug 09, 2016 Compliance Franz Engert
(Manager Compliance Services)

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Date	Section	Name	Signature
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Responsible for the Report:

Aug 09, 2016 Compliance James Donnellan
(Sr. EMC Test Engineer)

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Date	Section	Name	Signature
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2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the Test Report

Company Name:	CETECOM Inc.
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Compliance Manager:	Franz Engert
Project Engineer:	Yu-Chien Ho

2.2 Identification of the Client / Manufacturer

Applicant's Name:	21Net LDT
Street Address:	Leuvensesteenweg 350
City/Zip Code	Boortmeerbeek, 3190
Country	Belgium

3 Equipment under Assessment

Model #:	21NetBox v1
Product Description:	Mobile Access Router
FCC-ID:	2AG5P-21NETBOX V1
Technology/ Type(s) of Modulation:	GPRS/EGPRS 850/1900MHz GMSK/8-PSK WCDMA/UMTS Band II, IV, V / QPSK / HPSK (CDMA2000) LTE 2, 4, 5, 13, 17, 25 / OFDM, OFDMA, SC-FDMA CDMA BC0/BC1/BC10 GPRS voice and circuit switched data are supported by the module but disabled in the host product
Operating Frequency Ranges (MHz):	GPRS 850: 824 - 849 MHz; GPRS 1900: 1850 - 1910 MHz; WCDMA/UMTS FDD BAND II: 1852 - 1908 MHz; WCDMA/UMTS FDD BAND IV: - MHz; WCDMA/UMTS FDD BAND V: 824 - 849 MHz; CDMA BC0: 815 – 849 MHz; CDMA BC1: 1850 – 1910 MHz; CDMA BC10: 806 – 901 MHz WCDMA/UMTS FDD BAND II: 1852 - 1908 MHz; WCDMA/UMTS FDD BAND IV: - MHz; WCDMA/UMTS FDD BAND V: 824 - 849 MHz; LTE Band 2: 1850 - 1910 MHz; LTE Band 4: 1710 - 1755 MHz; LTE Band 5: 824 – 849 MHz; LTE Band 13: 777 - 787 MHz; LTE Band 17: 704 - 716 MHz; LTE Band 25: 1805 – 1915 MHz;
Antenna info:	N/A
Co-located Transmitters/ Antennas?	☐ Yes ☒ No
Device Category:	☒ Fixed Installation ☐ Mobile ☐ Portable ☐ Mixed Mobile and Portable
Exposure Category:	☐ Occupational/ Controlled ☒ General Population/ Uncontrolled
Power Supply/ Rated Operating Voltage Range:	Vmin: 10V DC / Vnom: 24V DC / Vmax: 50.4V DC
operating temperature range	Tlow: -40 ° C/ Thom: 23 ° C/ Tmax: 70 ° C
Test Sample Status:	Prototype

4 RF Exposure Limits and FCC and IC Basic Rules

For the specific described radio apparatus the following basic limits and rules apply for FCC and IC.

4.1 Power Density Limits acc. to FCC 1.1310(e):

FCC

Frequency Range (MHz)	Power density (mW/cm ²)	Averaging time (minutes)
300 – 1500	$f \text{ (MHz)} / 1500$	30
1500 – 100.000	1.0	30

4.2 Routine Environmental Evaluation Categorical Exclusion Limits acc. to FCC 2.109 (rounded to 1 decimal point):

FCC

operating frequency < 1.5GHz: excluded if ERP < 1.5W / 31.8dBm (EIRP: 33.9);
operating frequency > 1.5GHz: excluded if ERP < 3.0W / 34.8dBm (EIRP: 36.9);

4.3 EMC Output Power Limits (ERP/EIRP) acc. to FCC part 22/24 (to be additionally taken into account for maximum antenna gain considerations)

part 22: 7W ERP / 38.5dBm (IC: 11.5W / 40.6dBm EIRP)

part 24: 2W EIRP / 33.0dBm

Per KDB 447498 D01 FCC allows calculative estimation of RF exposure for mobile applications when routine environmental evaluation categorical exclusion applies and also for fixed applications.

When categorical exclusion cannot be claimed for mobile applications MPE measurement is required for TCB approval.

4.4 RF Exposure Estimation (MPE Estimation)

Having available the source based average output power and peak antenna gain or the ERP/EIRP of the specified device and for a known minimum distance of it's radiating structures from the body of persons according to it's use cases (at least 20cm) the power density at that distance can be estimated by the following formula for plane-wave equivalent conditions (far-field conditions), when ground reflection is neglected.

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

where: S = power density (mW/cm² or W/m²)

P = power input to the antenna (mW or W)

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 (cm or m)

5 Evaluations

5.1 Routine Environmental Evaluation Applicability

As the product specification suggests merely the use of an antenna configuration that meets EIRP and MPE limits a routine evaluation through calculation has been performed as below in 5.2 and following.

5.2 Compliance with MPE (Power Density) limits for single transmitter operation

Power Density Calculation for a distance between the transmitter and the human body of 100cm							
Band of Operation (MHz)	Frequency Range in uplink worst case for limit is lowest frequency in MHz	Max conducted output power (dBm) + tune up	Maximum declared gain incl. cable losses	Max EIRP (dBm)	Power Density (mW/cm ²) @ 100cm distance	FCC Limit (mW/cm ²)	Verdict
GPRS850	824	33	6.5	39.5	0.071	0.549	PASS
EDGE850	824	28	6.5	34.5	0.022	0.549	PASS
GPRS1900	1850	30	3	33	0.016	1	PASS
EDGE1900	1850	27	3	30	0.008	1	PASS
CDMA BC0	824	24.5	6.5	31	0.010	0.549	PASS
CDMA BC1	1850	24.5	3	27.5	0.004	1	PASS
CDMA BC10	816	24.5	6.5	31	0.010	0.544	PASS
WCDMA II	1850	24	3	27	0.004	1	PASS
WCDMA IV	1710	24	6	30	0.008	1	PASS
WCDMA V	824	24	6.5	30.5	0.009	0.549	PASS
LTE Band 2/25	1850	24	3	27	0.004	1	PASS
LTE Band 4	1710	24	6	30	0.008	1	PASS
LTE Band 5	824	24	6.5	30.5	0.009	0.549	PASS
LTE Band 13	777	24	9	33	0.016	0.518	PASS
LTE Band 17	704	24	9	33	0.016	0.469	PASS

Power values are taken from the declared values of the modular report as these represent the worst case. All powers measured in the modular report and all powers measured during the output power verification were lower. Gain values have been taken from Table 1 worst case declaration in operational description.

Conclusion:

- The equipment fulfills the FCC and limits for the minimum distance between the antenna of a single active transmitter and the human body of 100cm with the declared gains.

5.3 Maximum allowed Antenna Gain – Gmax

The maximum antenna gains have been declared in Table1 the operational description from Mai 10th 2016. These gains have been used for the worst case MPE calculations in this report.

5.4 Routine Environmental Evaluation Applicability Simultaneous Transmission

- Simultaneous transmission on all 4 included radio modules is a typical use case of the product. The worst case radio in terms of MPE ratio is the GPRS 850. The worst cases for the other radios below depict the use of that specific radio together with 3 other modules active on GPRS 850. The limit is met for all distances between antenna and human body bigger than 100cm as declared.

Power Density Calculation for a distance between the transmitter and the human body of 100cm						
Band of Operation (MHz) A	Power Density @ 100cm (mW/cm ²) B	FCC Limit worst case (mW/cm ²) C	Single transmitter MPE ratio D	simultaneous transmitter MPE ratio for the radio in column one combined with 3 other radios on LTE Band 17 E	FCC Limit (ratio) F	Verdict
GPRS850	0.071	0.549	0.129	0.52	1.00	Pass
EDGE850	0.022	0.549	0.041	0.43	1.00	Pass
GPRS1900	0.016	1	0.016	0.40	1.00	Pass
EDGE1900	0.008	1	0.008	0.40	1.00	Pass
CDMA BC0	0.010	0.549	0.018	0.41	1.00	Pass
CDMA BC1	0.004	1	0.004	0.39	1.00	Pass
CDMA BC10	0.010	0.544	0.018	0.41	1.00	Pass
WCDMA II	0.004	1	0.004	0.11	1.00	Pass
WCDMA IV	0.008	1	0.008	0.11	1.00	Pass
WCDMA V	0.009	0.549	0.016	0.12	1.00	Pass
LTE Band 2/25	0.004	1	0.004	0.11	1.00	Pass
LTE Band 4	0.008	1	0.008	0.11	1.00	Pass
LTE Band 5	0.009	0.549	0.016	0.12	1.00	Pass
LTE Band 13	0.016	0.518	0.031	0.13	1.00	Pass
LTE Band 17	0.016	0.469	0.034	0.14	1.00	Pass

Note: The simultaneous transmission in column E has been calculated as $E = 3 \times (B_{\text{GPRS850}} / C_{\text{GPRS850}}) + B_A / C_A$

Conclusion:

- The equipment fulfills the FCC limits for simultaneous transmission of the included 4 radio modules for distances between the antenna and the human body of 100cm and more.

6 Revision History

Date	Report Name	Changes to report	Report prepared by
March 14, 2016	EMC_21NET-002-15001_FCC_MPE	First Version	Yu-Chien Ho
July 22, 2016	EMC_21NET-002-15001_FCC_MPE_REV1	Changed minimum distance to 60cm according to customer declaration. Changed gain to maximum possible driven by simultaneous transmission on GPRS 850. Add formula for calculation of simultaneous transmitter ratios.	Franz Engert
August 02, 2016	EMC_21NET-002-15001_FCC_MPE_REV2	Change distance to 100cm based on operational description from Mai 10 th 2016. Take out GPRS and CDMA as they are not supported any longer according to this latest operational description.	Franz Engert
August 09, 2016	EMC_21NET-002-15001_FCC_MPE_REV3	Customer is adding CDMA2000 BC0, BC1, BC10 and GPRS/GPRS/EGPRS 850 and 1900 to operational description. Including these bands into calculation.	Franz Engert