

RF Exposure / RF Technical Brief

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ATTN: Reviewing Engineer

RF exposure information for the equipment IPn4G (FCC ID: NS9IPN4GNBG30, IC: 3143A-IPN4GNBG30)

1. Introduction:

The device **IPn4G** (FCC ID: **NS9IPN4GNBG30**, IC: **3143A-IPN4GNBG30**) is designed to be used only for fixed and mobile applications.

This product integrates a **Novatel Wireless' Expedite® E371** PCI Express Mini Card (FCC ID: **PKRNVWE371**, IC: **3229A-E371**). The Novatel Wireless' Expedite® E371 PCI Express Mini Card is granted with a modular approval for mobile applications and the highest antenna gains allowed for use with this module for mobile RF exposure conditions are 3.5 dBi (850 MHz), 5.0 dBi (700 MHz), 5.0 dBi (1700 MHz), and 3.0 dBi (1900 MHz).

The antenna(s) used for **IPn4G** transmitter and the antenna used for **Novatel Wireless' Expedite® E371** PCI Express Mini Card are co-located and can transmit simultaneously.

All the antennas must be installed to provide a separation distance of at least 20 cm from all the persons.

2. MPE limits:

The table below is excerpted from RSS-102, Issue 4, 4.2, titled "RF Limits for Devices used by the General Public":

Frequency Range (MHz)	Power density (W/m ²)	Power density (mW/cm ²)	Averaging time (minutes)
300 – 1500	f (MHz)/150	f (MHz) /1500	6
1500 – 15000	10	1.0	6

The table below is excerpted from Table 1B of 47 CFR 1.1310 titled Limits for Maximum Permissible Exposure (MPE), Limits for General Population/Uncontrolled Exposure:

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

3. Compliance criteria:

Power density of individual transmitters is calculated using the equation:

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

where: S = power density (in appropriate units, e.g. mW/cm²)
P = power input to the antenna (in appropriate units, e.g., mW)
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 (appropriate units, e.g., cm)

3.1. Standalone compliance criteria:

Power density must be lower than the MPE limits stated in item 2.

3.2. Simultaneous transmission compliance criteria

The sum of the MPE ratios (Power density/MPE limit) for all simultaneous transmitting antennas incorporated in the device based on the calculated power density is ≤ 1.0 .

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4. Compliance calculations:

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4.1. Standalone transmission - Novatel Wireless' Expedite® E371 PCI Express Mini Card

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Generation	Frequency band	Frequency range (MHz)	Mode	Average power (dBm)	Antenna gain (dBi)	Total power (W)	Duty Cycle (%)	Evaluation distance (cm)	Power Density (mW/cm ²)	FCC-IC MPE limit (mW/cm ²)	MPE ratio (Power Density / FCC-IC MPE limit)
2G	GPRS 850	824,2 - 848,8	GPRS	32,50	3,5	3,98	25%	20	0,198	0,55	0,36A
2G	EGPRS 850	824,2 - 848,8	EGPRS	26,04	3,5	0,90	50%	20	0,089	0,55	0,16A
2G	GPRS 1900	1850,2 - 1909,8	GPRS	29,00	3	1,58	25%	20	0,079	1,00	0,08A
2G	EGPRS 1900	1850,2 - 1909,8	EGPRS	25,00	3	0,63	50%	20	0,063	1,00	0,06A
3G	FDD IV	1712,4 - 1752,6	UMTS, Rel 99	24,05	5	0,80	100%	20	0,160	1,00	0,16A
3G	FDD IV	1712,4 - 1752,6	UMTS, HSDPA	23,90	5	0,78	100%	20	0,154	1,00	0,15A
3G	FDD V	826,4 - 846,0	UMTS, Rel 99	24,33	3,5	0,61	100%	20	0,121	0,55	0,22A
3G	FDD V	826,4 - 846,0	UMTS, HSDPA	24,35	3,5	0,61	100%	20	0,121	0,55	0,22A
3G	FDD II	1852,4 - 1907,6	UMTS, Rel 99	23,53	3	0,45	100%	20	0,089	1,00	0,09A
3G	FDD II	1852,4 - 1907,6	UMTS, HSDPA	23,70	3	0,47	100%	20	0,093	1,00	0,09A
4G (LTE)	FDD 17	706,5 - 713,5	5MHz, QPSK	23,80	5	0,76	100%	20	0,151	0,47	0,32A
4G (LTE)	FDD 17	706,5 - 713,5	5MHz, 16QAM	22,46	5	0,56	100%	20	0,111	0,47	0,24A
4G (LTE)	FDD 17	709,0 - 711,0	10MHz, QPSK	23,85	5	0,77	100%	20	0,153	0,47	0,32A
4G (LTE)	FDD 17	709,0 - 711,0	10MHz, 16QAM	23,54	5	0,71	100%	20	0,142	0,47	0,30A
4G (LTE)	FDD 4	1710,7 - 1754,3	1.4MHz, QPSK	23,81	5	0,76	100%	20	0,151	1,00	0,15A
4G (LTE)	FDD 4	1710,7 - 1754,3	1.4MHz, 16QAM	23,16	5	0,65	100%	20	0,130	1,00	0,13A
4G (LTE)	FDD 4	1711,5 - 1753,5	3MHz, QPSK	23,90	5	0,78	100%	20	0,154	1,00	0,15A
4G (LTE)	FDD 4	1711,5 - 1753,5	3MHz, 16QAM	22,79	5	0,60	100%	20	0,120	1,00	0,12A
4G (LTE)	FDD 4	1712,5 - 1752,5	5MHz, QPSK	23,55	5	0,72	100%	20	0,142	1,00	0,14A
4G (LTE)	FDD 4	1712,5 - 1752,5	5MHz, 16QAM	22,68	5	0,59	100%	20	0,117	1,00	0,12A
4G (LTE)	FDD 4	1715,0 - 1750,0	10MHz, QPSK	23,75	5	0,75	100%	20	0,149	1,00	0,15A
4G (LTE)	FDD 4	1715,0 - 1750,0	10MHz, 16QAM	22,39	5	0,55	100%	20	0,109	1,00	0,11A
4G (LTE)	FDD 4	1717,5 - 1747,5	15MHz, QPSK	23,53	5	0,71	100%	20	0,142	1,00	0,14A
4G (LTE)	FDD 4	1717,5 - 1747,5	15MHz, 16QAM	23,02	5	0,63	100%	20	0,126	1,00	0,13A
4G (LTE)	FDD 4	1720,0 - 1745,0	20MHz, QPSK	23,53	5	0,71	100%	20	0,142	1,00	0,14A
4G (LTE)	FDD 4	1720,0 - 1745,0	20MHz, 16QAM	22,87	5	0,61	100%	20	0,122	1,00	0,12

Maximum MPE ratio: 0,36

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4.2. Standalone transmission - IPn4G

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Frequency band	Frequency range (MHz)	Mode	Average power (dBm)	Antenna gain (dBi)	Total power (W)	Duty Cycle (%)	Evaluation distance (cm)	Power Density (mW/cm ²)	FCC-IC MPE limit (mW/cm ²)	MPE ratio (Power Density / FCC-IC MPE limit)
2,4 GHz	2412 - 2462	802.11b	15,82	2	0,06	100%	20	0,012	1,00	0,01A
2,4 GHz	2412 - 2462	802.11g	15,97	2	0,06	100%	20	0,012	1,00	0,01

Maximum MPE ratio: 0,01

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4.3. Simultaneous transmission

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Maximum MPE ratio of Novatel Wireless' Expedite® E371 PCI Express Mini Card: 0,36


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Maximum MPE ratio of IPn4G: 0,01

= **0,37 ≤ 1**

Signed on behalf of Microhard Systems Inc in Calgary on Feb. 19, 2013

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