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RF Exposure and Transmitter Power Considerations for the Dataflex Design Communications Ltd. Wireless Router (includes Sierra Wireless SL8090 module; FCC ID: 2147C-SL8090)

FCC ID: 2AASBH601V2

Analysis for FCC Mobile use

The transmitter operation for the Dataflex Design Communications Ltd., Wireless Router covers 850 MHz, 1900 MHz and 2.4 GHz operating bands using GSM, UMTS and Wi-Fi technologies.

The following FCC Rule Parts and procedures are applicable:

Part 1.1310 – Radiofrequency radiation exposure limits

Part 2.1091 – Radiofrequency radiation exposure evaluation: mobile devices

Part 15.247(b)(3) - For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 Watt.

Part 15.247(b)(4) - The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

Part 22.913(a)(2)
The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

Part 24.232(c)
Mobile/ Portable stations are limited to 2 Watts EIRP peak power.

KDB447498 D01 v05
Mobile and Portable Devices RF Exposure Procedures and Equipment Authorisation Policies

The MPE calculation $S = EIRP/4 \pi R^2$ is used to calculate the safe operating distance for the user.

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MAXIMUM TRANSMITTER POWER CONSIDERATIONS

850 MHz Operation

For GSM 850MHz

Transmitter frequency range = 824.2 MHz to 848.8 MHz

Maximum conducted power = 1.683 W (from module grant)

Maximum specified antenna gain = 2.5 dBi (1.778 numeric)

EIRP = 1.683 x 1.778 = 2.992 W

For Class 10 GPRS/ EGPRS with 2 uplink timeslots, duty cycle = 25%

$EIRP_{eff}$ = 2.992 W / 4 = 748 mW

(With consideration of source based time averaging as per KDB 447498 Section 4.1(2))

ERP = 34.76 dBm (2.992 W EIRP) – 2.2 dBm dipole gain = 32.56 dBm = 1.803 W

For Class 10 GPRS/ EGPRS with 2 uplink timeslots, duty cycle = 25%

ERP_{eff} = 1803 W / 4 = 451 mW

For UMTS Band V 850 MHz

Transmitter frequency range = 826.4 MHz to 846.6 MHz

Maximum conducted power = 0.190 W (from module grant)

Maximum specified antenna gain = 2.5 dBi (1.778 numeric)

EIRP = 0.190 x 1.778 = 0.338 W

ERP = 25.29 dBm (0.338 W EIRP) - 2.2 dB (dipole gain) = 23.09 dBm = 0.204 mW

ERP = 204 mW

Therefore the Dataflex Design Communications Ltd., Wireless Router meets Part 22.913(a)(2) power limits (ERP 7 Watts).

Also the categorical exclusion provision of FCC Part 2.1091(c) applies as ERP_{eff} < 1.5W.

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1900 MHz Operation

For PCS 1900 MHz

Transmitter frequency range = 1850.2 MHz to 1909.8 MHz

Maximum conducted Power = 0.830 W (from module grant)

Maximum specified antenna gain = 2.5 dBi (1.778 numeric)

EIRP = 0.830 x 1.778 = 1.456 W

For Class 10 GPRS with 2 uplink timeslots, duty cycle = 25%

$EIRP_{eff}$ = 1.456 W / 4 = 369 mW

(With consideration of source based time averaging as per KDB 447498 Section 4.1(2))

For UMTS Band II 1900 MHz

Transmitter frequency range = 1852.4 MHz to 1907.6 MHz

Maximum conducted Power = 0.204 W (from module grant)

Maximum specified antenna gain = 2.5 dBi (1.778 numeric)

EIRP = 0.204 x 1.778 = 363 mW

EIRP = 363 mW

Therefore the Dataflex Design Communications Ltd., Wireless Router meets 24.232(c) power limits (EIRP 2 Watts).

Also the categorical exclusion provision of FCC Part 2.1091(c) applies as $EIRP_{eff}$ < 3.0W.

2400 MHz Operation

For WLAN 2450 MHz

Transmitter frequency range = 2412 MHz to 2462 MHz

Max. Conducted Transmitter Power P = 7.1 dBm (5.13 mW) (measured 802.11b).

Maximum specified antenna gain = 2.0 dBi

EIRP = 7.1 + 2.0 dBm = 9.1 dBm = 8.13 mW

Therefore the Dataflex Design Communications Ltd. Wireless Router meets Part 15.247(b)(3) & 15.247(b)(4) conducted power and antenna gain limits (1 W & 6 dBi respectively).

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MPE CALCULATIONS

The following MPE calculation is used to calculate the safe operating distance for the highest (worst case) EIRP values in each operating band as stated above.

$$S = EIRP/4 \pi R^2$$

Where S = Power density

EIRP = Effective Isotropic Radiated Power (EIRP = P x G)

P = Conducted Transmitter Power

G = Antenna Gain (relative to an isotropic radiator)

R = distance to the centre of radiation of the antenna (safe operating distance)

For 850 MHz Operation (worst case GSM 850)

Values:

Transmitter frequency range = 824.2 MHz to 848.8 MHz

$EIRP_{eff}$ = 748 mW

R = 20cm

Power Density Requirement

From FCC Rule Part 1.1310 Table 1 - Limits for General Population/ Uncontrolled Exposure for GSM 850 MHz

$S = f/1500$ mW/cm^2 (f = operating frequency)

$S_{req1} = 824/1500 = 0.55$ mW/cm^2 (worst case)

Calculation:

$S = EIRP_{eff} /4 \pi R^2$

$S = 748/(12.56 \times 20^2)$

$S = 748/(5024)$

$S_1 = 0.149$ mW/ cm^2 (<0.55 mW/cm^2)

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For 1900 MHz Operation (worst case PCS 1900)

Values:

Transmitter frequency range = 1850.2 MHz to 1909.8 MHz

EIRP = 369 mW

R = 20cm

Power Density Requirement

From FCC Rule Part 1.1310 Table 1 - Limits for General Population/ Uncontrolled Exposure for 1900MHz

S_{req2} = 1.0 mW/cm^2

Calculation:

$S = EIRP/4 \pi R^2$

$S = 369/(12.56 \times 20^2)$

$S = 369/(5024)$

S_2 = 0.073 mW/ cm^2 (<1.0 mW/cm^2)

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For 2400 MHz Operation (worst case WLAN 802.11b)

Values:

Transmitter frequency range = 2412 MHz to 2462 MHz

EIRP = 8.13 mW

R = 20cm

Power Density Requirement

From FCC Rule Part 1.1310 Table 1 - Limits for General Population/ Uncontrolled Exposure for 2400MHz

S_{req3} = 1.0 mW/cm^2

Calculation:

$S = EIRP/4 \pi R^2$

$S = 8.13/(12.56 \times 20^2)$

$S = 8.13/(5024)$

S_3 = 0.0016 mW/ cm^2 (<1.0 mW/cm^2)

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KDB447498 D01 v05 Section 7.2 SIMULTANEOUS TRANSMISSION CONSIDERATIONS

Only one cellular transmitter can be operational at one time in simultaneous operation with WLAN. The following worst case scenarios are therefore considered for simultaneous transmission, all other combinations have lower power densities at the applicable frequencies:

Case 1: GSM 850 (GPRS) and WLAN

Case 2: PCS 1900 (GPRS) and WLAN

Worst case summation of calculated MPE ratios for the above simultaneously transmitting transmitters is calculated below:

Case 1: GSM 850 (GPRS) and WLAN

$$\Sigma MPE_{ratios} = (S_1/ S_{req1}) + (S_3/ S_{req3})$$

$$= (0.149/0.55) + (0.0016/1.0)$$

$$\mathbf{= 0.271 + 0.0016 = 0.2726}$$

Case 2: PCS 1900 (GPRS) and WLAN

$$\Sigma MPE_{ratios} = (S_2/ S_{req2}) + (S_3/ S_{req3})$$

$$= (0.073/1.0) + (0.0016/1.0)$$

$$\mathbf{= 0.073 + 0.0016 = 0.0746}$$

Σ of all three scenario MPE ratios <1.0, so in accordance with KDB447498 Section 7.2, simultaneous transmission test exclusion applies for all possible transmitter combinations.

Conclusion

The required 20cm RF exposure limits for General Population/ Uncontrolled Exposure FCC Rule Part 15.247(b)(3), 15.247(b)(4), 22.913(a)(2) and 24.232(c) maximum transmitter power limits will not be exceeded for the Dataflex Design Communications Ltd., Wireless Router using antennas having a maximum gain of 2.5 dBi (GSM, UMTS) and 2.0 dBi (WLAN) respectively.