KENURE DEVELOPMENTS LIMITED
THE COMPLETE DESIGN AND CONTRACT MANUFACTURE SERVICE
Registered Office: Springlakes Deadbrook Lane Aldershot Hampshire GU12 4UH
Tel: (01252) 338554 Fax:(01252) 329105
Registration No: 2265402
ISO 9001 GB13/87609

RF Exposure and Transmitter Power Considerations for the Smart Route DataCollector

FCC ID: Q8Q-SRDC

The FCC requires that the calculated MPE be equal to or less than a given limit dependent on frequency at a distance of 20 cm from a device to the body of a user.

The transmitter operation for the Smart Route DataCollector covers the 902 MHz to 928 MHz ISM band. The Smart Route DataCollector also contains a 2G/3G WWAN modem (FCC ID: RI7HE910) using the GSM850, PCS1900 and UMTS 1700 operating bands.

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)(2) - The maximum peak conducted output power of the intentional radiator shall not exceed the following: For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels.

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

Part 27.50(d)(4) - Fixed, mobile, and portable (hand-held) stations operating in the 1710-1755 MHz band and mobile and portable stations operating in the 1695-1710 MHz and 1755-1780 MHz bands are limited to 1 watt EIRP

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

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Maximum Transmitter Power Considerations

For ISM Band 902 MHz to 928 MHz

Maximum conducted power = 30.0 dBm (1000 mW**)**

Maximum specified antenna gain = 2.2 dBi

EIRP = 30.0+ 2.2 = 32.2 dBm

= 1660 mW

Therefore the Smart Route DataCollector meets Part 15.247(b)(2) & 15.247(b)(4) conducted and de facto EIRP power limits (1 W and 4W respectively).

For GSM 850 MHz 2G Operation

Transmitter frequency range = 824.2 MHz to 848.8 MHz

Maximum conducted power = 33.0 dBm (2000 mW)

Specified antenna gain = 2.0 dBi

EIRP = 33.0 + 2.0 = 35.0 dBm

= 3162 mW

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

$EIRP_{eff}$ = 3162/4 = 791 mW

ERP = 35.0 - 2.2 = 32.8 dBm

= 1905 mW

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

ERP_{eff} = 1905/4 = 476 mW

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For GSM 850 MHz 3G Operation

Transmitter frequency range = 826.4 MHz to 846.4 MHz

Maximum conducted power = 26.6 dBm (460 mW)

Specified antenna gain = 2.0 dBi

EIRP = 26.6 + 2.0 = 28.6 dBm

= 724 mW

ERP = 28.6 - 2.2 = 26.4 dBm

= 437 mW

Therefore the Smart Route DataCollector 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 (with considerations of source based time averaging as per KDB 447498 Section 4.1(2))

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For PCS 1900 MHz 2G Operation

Transmitter frequency range = 1850.2 MHz to 1909.8 MHz

Maximum conducted power = 30.0 dBm (1000 mW)

Specified antenna gain = 2.0 dBi

EIRP = 30.0 + 2.0 = 32.0

= 1585 mW

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

$EIRP_{eff}$ = 1585/4 = 396 mW

For PCS 1900 MHz 3G Operation

Transmitter frequency range = 1852.4 MHz to 1907.6 MHz

Maximum conducted power = 26.4 dBm (437 mW)

Specified antenna gain = 2.0 dBi

EIRP = 26.4 + 2.0 = 28.4 dBm

= 692 mW

Therefore the Smart Route DataCollector 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 (with considerations of source based time averaging as per KDB 447498 Section 4.1(2))

For UMTS 1700 MHz 3G Operation

Transmitter frequency range = 1712.4 MHz to 1752.6 MHz

Maximum conducted power = 26.4 dBm (437 mW)

Specified antenna gain = 2.0 dBi

EIRP = 26.4 + 2.0 = 28.4 dBm

= 692 mW

Therefore the Smart Route DataCollector meets 27.50(d)(4) power limits (EIRP 1 Watt).

Also the categorical exclusion provision of FCC Part 2.1091(c) applies as $EIRP_{eff}$ < 3.0W (with considerations of source based time averaging as per KDB 447498 Section 4.1(2))

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MPE Calculations

The MPE calculation as given in ANSI C95.1 is used to calculate the safe operating distance for the user.

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

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 ISM Band 902 MHz to 928 MHz

Values:

Transmitter frequency range = 902.5 MHz to 927.5 MHz

EIRP = 1660 mW

R = 20 cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for ISM Band 902 MHz to 928 MHz

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

S_{req1} = 902.5/1500 = 0.61 mW/cm^2 (worst case)

Calculation:

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

$S = 1660/(12.56 \times 20^2)$

$S = 1660/(5024)$

S_1 = 0.33 mW/cm^2 (<0.61 mW/cm^2)

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For GSM 850 MHz (Worst case: 2G operation)

Values:

Transmitter frequency range = 824.2 MHz to 848.8 MHz

$EIRP_{eff}$ = 791 mW

R = 20 cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for 850 MHz

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

S_{req2} = 824/1500 = 0.55 mW/cm^2 (worst case)

Calculation:

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

$S = 791/(12.56 \times 20^2)$

$S = 791/(5024)$

S_2 = 0.16 mW/ cm^2 (<0.55 mW/cm^2)

For PCS 1900 MHz (Worst case: 3G operation)

Values:

Transmitter frequency range = 1852.4 MHz to 1907.6 MHz

$EIRP_{eff}$ = 692 mW

R = 20 cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for 1900 MHz

S_{req3} = 1.0 mW/cm^2

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Calculation:

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

$S = 692/(12.56 \times 20^2)$

$S = 692/(5024)$

$S_3 = 0.138$ mW/cm^2 (<1.0 mW/cm^2)

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For UMTS 1700 MHz

Values:

Transmitter frequency range = 1712.4 MHz to 1752.6 MHz

$EIRP_{eff}$ = 692 mW

R = 20 cm

Power Density Requirement

From table 1 (b) - Limits for General Population/ Uncontrolled Exposure of FCC Rule Part 1.1310 for 1700 MHz

S_{req4} = 1.0 mW/cm^2

Calculation:

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

$S = 692/(12.56 \times 20^2)$

$S = 692/(5024)$

S_4 = 0.138 mW/cm^2 (<1.0 mW/cm^2)

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KDB447498 D01 v05r02 Section 7.2 Simultaneous Transmission Considerations

Worst case summation of calculated MPE ratios for the 902 MHz to 928 MHz ISM band and the GSM850, PCS1900 or UMTS1700 simultaneously transmitting transmitters is:

ie: $\Sigma MPE_{ratios} = (S_1/ S_{req1}) + (S_2/ S_{req2})$

= (0.33/0.61) + (0.16/0.55)

= 0.54 + 0.29 = 0.83

Σ of MPE ratios<1.0, so in accordance with KDB447498 Section 7.2, simultaneous transmission test exclusion applies for the ISM Band 902 MHz to 928 MHz and GSM805 / PCS1900 / UMTS1700 transmitters.

Conclusion

The required 20 cm RF exposure limits for General Population/ Uncontrolled Exposure FCC Rule Part 15.247(b)(2), 22.913(a)(2), 24.232(c) and 27.50(d)(4) maximum transmitter power limits will not be exceeded for the Smart Route DataCollector using antennas having a maximum gain of 2.2 dBi and 2.0 dBi for the ISM and WWAN antennas respectively.