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## Maximum Permissible Exposure (MPE) & Exposure evaluation

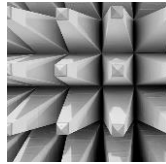
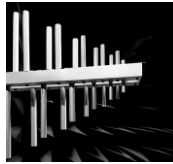
Report identification number: 1-1364/16-01-12

EUT: RoadLog made by Continental Automotive (online version)	
Certification numbers and labeling requirements	
FCC ID	2AHPQ3290X QIPPDS5-US (WWAN module) K7T-BPM2001 ( <b>BT module</b> )
IC number	21323-3290X 7830A-PDS5US (WWAN module) 2377A-BPM2001 (BT module)
HVIN (Hardware Version Identification Number)	3290X
PMN (Product Marketing Name)	RoadLog™
FVIN (Firmware Version Identification Number)	-/-
HMN (Host Marketing Name)	-/-

This test report is electronically signed and valid without handwriting signature. For verification of the electronic signatures, the public keys can be requested at the testing laboratory.

### Document authorized:

Thomas Vogler  
Testing Manager  
Radio Communications & EMC

**EUT technologies:**

a) Internal antenna

Case 1

Technologies:	Max. power:	Timebased AVG-Power:	Max. gain:	Max. EIRP
GSM 850 GPRS	35.0 dBm	29.0 dBm (2Slots)	0 dBi	29.0 dBm
BT/BTLE				16.0 dBm

Case 2

Technologies:	Max. power:	Timebased AVG-Power:	Max. gain:	Max. EIRP
WCDMA 850	25.0 dBm	100% Duty Cycle	0 dBi	25.0 dBm
BT/BTLE				16.0 dBm

Case 3

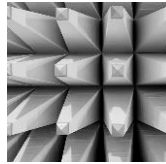
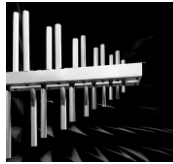
Technologies:	Max. power:	Timebased AVG-Power:	Max. gain:	Max. EIRP
PCS 1900 GPRS	32 dBm	26 dBm (2Slots)	3 dBi	29.0 dBm
BT/BTLE				16.0 dBm

Case 4

Technologies:	Max. power:	Timebased AVG-Power:	Max. gain:	Max. EIRP
WCDMA 1900	25 dBm	100% Duty Cycle	3 dBi	28.0 dBm
BT/BTLE				16.0 dBm

Notes:

- Maximum Power includes maximum tune-up tolerance of +2 dB for GSM and +1 dB for WCDMA.
- Corresponding to RF-test report 1-1364/16-01-07 a maximum gain of 0 dBi for the 850 MHz range and 3 dBi for the 1900 MHz range was assumed.
- For Bluetooth/Bluetooth LE the maximum declared EIRP of 16 dBm has been applied.



## b) External (roof-top) antenna

## Case 1

Technologies:	Max. power:	Timebased AVG-Power:	Max. gain:	Max. EIRP:
GSM 850 GPRS	35.0 dBm	29.0 dBm (2Slots)	tbd )*	29.0 dBm

## Case 2

Technologies:	Max. power:	Timebased AVG-Power:	Max. gain:	Min. pathloss:
WCDMA 850	25.0 dBm	100% Duty Cycle	tbd )*	24.0 dBm

## Case 3

Technologies:	Max. power:	Timebased AVG-Power:	Max. gain:	Min. pathloss:
PCS 1900 GPRS	32.0 dBm	26 dBm (2Slots)	tbd )*	26.0 dBm

## Case 4

Technologies:	Max. power: (AVG)	Timebased AVG-Power:	Max. gain:	Min. pathloss:
WCDMA 1900	25.0 dBm	100% Duty Cycle	tbd )*	24.0 dBm

## Notes:

- Maximum Power includes maximum tune-up tolerance of +2 dB for GSM and +1 dB for WCDMA.
- )\* max gain of external antenna is defined in the calculations below.

**Prediction of MPE limit at given distance - FCC**

Equation from page 18 of OET Bulletin 65, Edition 97-01

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

where: S = Power density  
P = Power input to the antenna  
G = Antenna gain (declared by provider)  
R = Distance to the center of radiation of the antenna

Note: for BT/BTLE the worst case EIRP has been assumed as P = 16 dBm with gain G = 0 dBi

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 <sup>2</sup> )	Averaging Time (minutes)
300 -1500	f/1500	30
1500 - 100000	1.0	30

where f = Frequency (MHz)

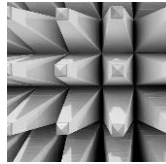
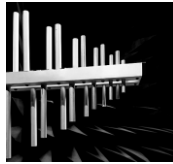
- a) Internal antenna

**Case 1 GSM850 and BT active simultaneously**

	> 1500 MHz	< 1500 MHz
Technology	BT 2.4 GHz	GSM 850
P Maximum power	16 dBm	29.0 dBm
R Distance	20 cm	20 cm
G Antenna gain	0 dBi	0 dBi
S MPE limit for uncontrolled exposure	1.0 mW/cm <sup>2</sup>	0.56 mW/cm <sup>2</sup>
<b>Calculated Power density:</b>	<b>0.0079 mW/cm<sup>2</sup></b>	<b>0.158 mW/cm<sup>2</sup></b>
<b>Colocation:</b>	<b>0.79 %</b>	<b>28.22 %</b>
<b>Sum (worst case/all transmitters active):</b>	<b>29.01 %</b>	

**Case 2 WCDMA850 and BT active simultaneously**

	> 1500 MHz	< 1500 MHz
Technology	BT 2.4 GHz	WCDMA 850
P Maximum power	16 dBm	25.0 dBm
R Distance	20 cm	20 cm
G Antenna gain	0 dBi	0 dBi
S MPE limit for uncontrolled exposure	1.0 mW/cm <sup>2</sup>	0.56 mW/cm <sup>2</sup>
<b>Calculated Power density:</b>	<b>0.0079 mW/cm<sup>2</sup></b>	<b>0.063 mW/cm<sup>2</sup></b>
<b>Colocation:</b>	<b>0.79 %</b>	<b>11.2 %</b>
<b>Sum (worst case/all transmitters active):</b>	<b>11.99 %</b>	



Case 3 PCS 1900 and BT active simultaneously

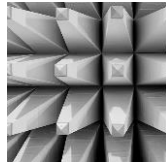
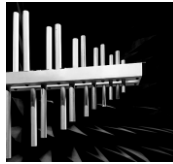
		> 1500 MHz		> 1500 MHz
	Technology	BT 2.4 GHz		PCS 1900
P	Maximum power	16 dBm		26 dBm
R	Distance	20 cm		20 cm
G	Antenna gain	0 dBi		3 dBi
S	MPE limit for uncontrolled exposure	1.0 mW/cm <sup>2</sup>		1.0 mW/cm <sup>2</sup>
	<b>Calculated Power density:</b>	<b>0.0079 mW/cm<sup>2</sup></b>		<b>0.158 mW/cm<sup>2</sup></b>
	<b>Colocation:</b>	<b>0.79 %</b>		<b>15.8 %</b>
	<b>Sum (worst case/all transmitters active):</b>	<b>16.59 %</b>		

Case 4 WCDMA 1900 and BT active simultaneously

		> 1500 MHz		> 1500 MHz
	Technology	BT 2.4 GHz		WCDMA 1700
P	Maximum power	16 dBm		25.0 dBm
R	Distance	20 cm		20 cm
G	Antenna gain	0 dBi		3 dBi
S	MPE limit for uncontrolled exposure	1.0 mW/cm <sup>2</sup>		1.0 mW/cm <sup>2</sup>
	<b>Calculated Power density:</b>	<b>0.0079 mW/cm<sup>2</sup></b>		<b>0.126 mW/cm<sup>2</sup></b>
	<b>Colocation:</b>	<b>0.79 %</b>		<b>12.6 %</b>
	<b>Sum (worst case/all transmitters active):</b>	<b>13.39 %</b>		

**This prediction demonstrates the following:**

The power density levels for FCC at a distance of 20 cm are below the maximum levels allowed by regulations.



## b) External antenna

Case 1 GSM850

		< 1500 MHz
	Technology	GSM 850
P	Maximum power	29.0 dBm
R	Distance	20 cm
G	Antenna gain	0 dBi
S	MPE limit for uncontrolled exposure	0.56 mW/cm <sup>2</sup>
	<b>Calculated Power density:</b>	<b>0.158 mW/cm<sup>2</sup></b>
		<b>28.22 %</b>
	<b>Max antenna gain for 100% limit</b>	<b>2.14 dBi</b>

Case 2 WCDMA 850

		< 1500 MHz
	Technology	WCDMA 850
P	Maximum power	25.0 dBm
R	Distance	20 cm
G	Antenna gain	0 dBi
S	MPE limit for uncontrolled exposure	1.0 mW/cm <sup>2</sup>
	<b>Calculated Power density:</b>	<b>0.126 mW/cm<sup>2</sup></b>
		<b>12.6 %</b>
	<b>Max antenna gain for 100% limit</b>	<b>2.14 dBi</b>

Case 3 PCS 1900

		> 1500 MHz
	Technology	PCS 1900
P	Maximum power	26 dBm
R	Distance	20 cm
G	Antenna gain	0 dBi
S	MPE limit for uncontrolled exposure	1.0 mW/cm <sup>2</sup>
	<b>Calculated Power density:</b>	<b>0.08 mW/cm<sup>2</sup></b>
		<b>7.92 %</b>
	<b>Max antenna gain</b>	<b>1.0 dBi</b>

Case 4 WCDMA 1900

		> 1500 MHz
	Technology	WCDMA 1900
P	Maximum power	25.0 dBm
R	Distance	20 cm
G	Antenna gain	0 dBi
S	MPE limit for uncontrolled exposure	1.0 mW/cm <sup>2</sup>
	<b>Calculated Power density:</b>	<b>0.048 mW/cm<sup>2</sup></b>
		<b>4.77 %</b>
	<b>Max antenna gain</b>	<b>1.0 dBi</b>

Note : Max. antenna gain limitation in the 850 MHz band has been derived from RSS-102 limit  
 Max. antenna gain limitation in the 1900 MHz band is caused by FCC part 24 E EIRP limit : max. 2 W  
 (33.0 dBm) burst power

**This prediction demonstrates the following:**

The power density levels for FCC at a distance of 20 cm are below the maximum levels allowed by regulations when used with an antenna with **maximum gain 2.14 dBi in the 850 MHz band and 1.0 dBi in the 1900 MHz band.**

**Prediction of MPE limit at given distance - IC**

RSS-102, Issue 5, 2.5.2

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $4.49/f^{0.5}W$  (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than  $1.31 \times 10^{-2} f^{0.6834} W$  (adjusted for tune-up tolerance), where  $f$  is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

a) Internal antenna

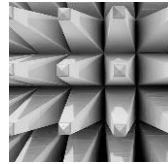
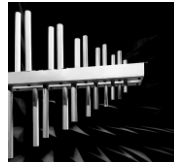
Note: for BT/BTLE the worst case EIRP has been assumed as P = 16 dBm with gain G = 0 dBi

Case 1 GSM850 and BT active simultaneously

	Technology	GSM 850		BT 2.4 GHz	-/-
P	Max power	29.0 dBm		16 dBm	<b>Sum</b>
G	Antenna gain	0 dBi		0 dBi	
S	MPE limit for uncontrolled exposure	1300 mW		2700 mW	
	Calculated output power:	794 mW		39.8 mW	
	<b>Colocation GSM 850 + BT 2.4 GHz</b>	<b>61.1 %</b>		---	<b><u>62.6 %</u></b>
	<b>Colocation GSM 850 + BT 2.4 GHz</b>	---		<b>1.47 %</b>	

Case 2 WCDMA 850 and BT active simultaneously

	Technology	WCDMA 850		BT 2.4 GHz	-/-
P	Max power	25.0 dBm		16 dBm	<b>Sum</b>
G	Antenna gain	0 dBi		0 dBi	
S	MPE limit for uncontrolled exposure	1300 mW		2700 mW	
	Calculated output power:	316 mW		39.8 mW	
	<b>Colocation GSM 850 + BT 2.4 GHz</b>	<b>24.3 %</b>		---	<b><u>25.8 %</u></b>
	<b>Colocation GSM 850 + BT 2.4 GHz</b>	---		<b>1.47 %</b>	



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Case 3 PCS 1900 and BT active simultaneously

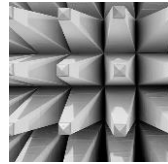
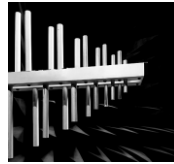
	Technology	PCS 1900		BT 2.4 GHz	-/-
P	Max power	26.0 dBm		16 dBm	<b>Sum</b>
G	Antenna gain	3 dBi		0 dBi	
S	MPE limit for uncontrolled exposure	2280 mW		2700 mW	
	Calculated output power:	794 mW		39.8 mW	
	<b>Colocation PCS 1900 + BT 2.4 GHz</b>	<b>34.8 %</b>		---	<b>36.3 %</b>
	<b>Colocation PCS 1900 + BT 2.4 GHz</b>	---		<b>1.47 %</b>	

Case 4 WCDMA 1900 and BT active simultaneously

	Technology	WCDMA 1900		BT 2.4 GHz	-/-
P	Max power	25.0 dBm		16 dBm	<b>Sum</b>
G	Antenna gain	3 dBi		0 dBi	
S	MPE limit for uncontrolled exposure	2113 mW		2700 mW	
	Calculated output power:	631 mW		39.8 mW	
	<b>Colocation WCDMA 1700 + BT 2.4 GHz</b>	<b>29.9 %</b>		---	<b>31.4 %</b>
	<b>Colocation WCDMA 1700 + BT 2.4 GHz</b>	---		<b>1.47 %</b>	

**Conclusion:** for applications where minimum distance to radiating element is 20cm Annex C of RSS-102 should be filled out.





## b) External antenna

Case 1 GSM850

	Technology	GSM 850
P	Max power	29.0 dBm
G	Antenna gain	0 dBi
S	MPE limit for uncontrolled exposure	1300 mW
	Calculated output power:	794 mW
		<b>61.1 %</b>
	<b>Max antenna gain for 100% limit</b>	<b>2.14 dBi</b>

Case 2 WCDMA 850

	Technology	WCDMA 850
P	Max power	24.0 dBm
G	Antenna gain	0 dBi
S	MPE limit for uncontrolled exposure	1300 mW
	Calculated output power:	251 mW
		<b>19.3 %</b>
	<b>Max antenna gain for 100% limit</b>	<b>2.14 dBi</b>

Case 3 PCS 1900

	Technology	PCS 1900
P	Max power	26.0 dBm
G	Antenna gain	0 dBi
S	MPE limit for uncontrolled exposure	2280 mW
	Calculated output power:	398 mW
		<b>17.5 %</b>
	<b>Max antenna gain</b>	<b>1.0 dBi</b>

Case 4 WCDMA 1900

	Technology	WCDMA 1900
P	Max power	24.0 dBm
G	Antenna gain	0 dBi
S	MPE limit for uncontrolled exposure	2113 mW
	Calculated output power:	251 mW
		<b>11.9 %</b>
	<b>Max antenna gain</b>	<b>1.0 dBi</b>

Note : max. antenna gain limitation in the 850 MHz band has been derived from RSS-102 limit  
 Max antenna gain limitation in the 1900 MHz band is caused by FCC part 24 E EIRP limit : max. 2 W (33.0 dBm) burst power

**Conclusion:** for applications where minimum distance to radiating element is 20cm Annex C of RSS-102 should be filled out.