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# Report On

RF Exposure Assessment of the  
Funk-Electronic Piciorgros GmbH  
TMO-100/DAN Tetra Modem

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TÜV SÜD Product Service, Octagon House, Concorde Way, Segensworth North,  
Fareham, Hampshire, United Kingdom, PO15 5RL  
Tel: +44 (0) 1489 558100. Website: [www.tuv-sud.co.uk](http://www.tuv-sud.co.uk)

**REPORT ON**

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**PREPARED FOR**

Funk-Electronic Piciorgros GmbH  
Clausiastasse 5  
D-51149  
Cologne-Porz  
Germany

**PREPARED BY**

**M Whiting**  
Project Manager

**APPROVED BY**

**M Jenkins**  
Authorised Signatory

**DATED**

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**This report has been up-issued to Issue 5 to change the Antenna Gain and Duty Cycle**



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## **SECTION 1**

### **REPORT SUMMARY**

RF Exposure Assessment of the  
Funk-Electronic Piciorgros GmbH  
TMO-100/DAN Tetra Modem



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## 1.1 INTRODUCTION

The information contained in this report is intended to show verification of the RF Exposure Assessment of the Funk-Electronic Piciorgros GmbH TMO-100/DAN Tetra Modem to the requirements of the applied test specifications.

Objective	To perform RF Exposure Assessment to determine the Equipment Under Test's (EUT's) compliance of the applied rules.
Applicant	Funk-Electronic Piciorgros GmbH
Manufacturer	Funk-Electronic Piciorgros GmbH
Manufacturing Description	Tetra Modem
Model Number(s)	TMO-100/DAN
Declared Variants	TMO-100/DA1, TMO-100/DA2, TMO-100/DA3, TMO-100/DA4, TMO-100/DA5, TMO-100/DVI
Test Specification/Issue/Date	EN 62311:2008 OET Bulletin 65 Edition 97-01 August 1997 RSS-102 Issue 5 March 2010 Radiocommunications (Electromagnetic Radiation – Human Exposure) Standard: 2003
Related Document(s)	Council Recommendation 1999/519/EC:1999 FCC CFR 47 Part 1: 2011 FCC CFR 47 Part 2: 2011 Health Canada's Safety Code 6 ARPANSA ICNIRP 1998 National Council on Radiation Protection and Measurements (NRP) - Report No. 86(1986) EN 50383:2002 IEEE Std C95.1-2005 Australian Standard 2772.2 – 1988



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## 1.2 BRIEF SUMMARY OF RESULTS

### 1.2.1 General Public Exposure Levels

Antenna Gain (Numeric)	Peak Output Power (mW)	Field	Calculated RF Exposure at 1.9 m (190cm)	General Public Exposure Limit	Application
19.953	5047	S	2.22 W/m <sup>2</sup>	2.280 W/m <sup>2</sup>	ICNIRP
		S	0.222 mW/cm <sup>2</sup>	0.304 mW/cm <sup>2</sup>	FCC 47 CFR § 1.1310
		S	2.22 W/m <sup>2</sup>	3.040 W/m <sup>2</sup>	Canada's RF Safety Code 6
		S	2.22 W/m <sup>2</sup>	2.280 W/m <sup>2</sup>	ARPANSA
		E	28.93 V/m	29.362 V/m	ICNIRP
		E	28.93 V/m	N/A V/m	FCC 47 CFR § 1.1310
		E	28.93 V/m	33.846 V/m	Canada's RF Safety Code 6
		E	28.93 V/m	29.255 V/m	ARPANSA
		H	0.08 A/m	0.079 A/m	ICNIRP
		H	0.08 A/m	N/A A/m	FCC 47 CFR § 1.1310
		H	0.08 A/m	0.090 A/m	Canada's RF Safety Code 6
		H	0.08 A/m	0.078 A/m	ARPANSA

The calculations have shown that they **meet** the General Public Exposure Levels described in the ICNIRP Guidelines, FCC 47 CFR § 1.1310 Guidelines, Health Canada's RF exposure guideline Safety Code 6 and the Australian ARPANSA limits at **190cm**, the point of investigation.



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## 1.2.2 Occupational Exposure Levels

Antenna Gain (Numeric)	Peak Output Power (mW)	Field	Calculated RF Exposure at 1.9 m (190cm)	Occupational Exposure Limit	Application
19.953	5047	S	2.22 W/m <sup>2</sup>	11.400 W/m <sup>2</sup>	ICNIRP
		S	0.222 mW/cm <sup>2</sup>	1.520 mW/cm <sup>2</sup>	FCC 47 CFR § 1.1310
		S	2.22 W/m <sup>2</sup>	15.200 W/m <sup>2</sup>	Canada's RF Safety Code 6
		S	2.22 W/m <sup>2</sup>	11.400 W/m <sup>2</sup>	ARPANSA
		E	28.93 V/m	64.062 V/m	ICNIRP
		E	28.93 V/m	N/A V/m	FCC 47 CFR § 1.1310
		E	28.93 V/m	75.594 V/m	Canada's RF Safety Code 6
		E	28.93 V/m	65.557 V/m	ARPANSA
		H	0.08 A/m	0.171 A/m	ICNIRP
		H	0.08 A/m	N/A A/m	FCC 47 CFR § 1.1310
		H	0.08 A/m	0.201 A/m	Canada's RF Safety Code 6
		H	0.08 A/m	0.174 A/m	ARPANSA

The calculations have shown that they **meet** the Occupational Exposure Levels described in the ICNIRP Guidelines, FCC 47 CFR § 1.1310 Guidelines, Health Canada's RF exposure guideline Safety Code 6 and the Australian ARPANSA limits at **190 cm**, the point of investigation.



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## **1.3 PRODUCT INFORMATION**

### **1.3.1 Attestation**

The wireless device described within this report has been shown to be capable of compliance with the basic restrictions related to human exposure to electromagnetic fields for both General public and Occupational. The calculations shown in this report were made in accordance the procedures specified in the applied test specification(s).

### **1.3.2 Technical Description**

The Equipment under test was a Funk-Electronic Piciorgros GmbH TMO-100/DAN Tetra Modem. A full technical description can be found in the manufacturer's documentation.

All reported calculations were carried out on the relevant information supplied for the TMO-100/DAN Tetra Modem to demonstrate compliance with the applied test specification(s) the sample assessed was found to comply with the requirements of the applied rules.

## **1.4 SUMMARY**

The RF exposure assessment is based upon the following criteria:

The TMO-100/DAN Tetra Modem operates in the frequency range of 450 – 470 MHz.

Antenna Gain	13 dBi
Radio RF Transmit Power	5 W
Distance	1.9 m (190 cm)
Duty Cycle	100%





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## **SECTION 2**

### **TEST DETAILS**

## 2.1 RATIONALE FOR ASSESSMENT OF THE RF EXPOSURE

The aim of the assessment report is to evaluate the compliance boundary for a set of given input power(s) according to the basic restrictions (directly or indirectly via compliance with reference levels) related to human exposure to radio frequency electromagnetic fields.

The chosen assessment method to establish the compliance boundary in the far-field region is the reference method as defined in EN50383:2002 Clause 5.2; E-field or H-field calculation. The method of calculation used is defined in EN50383:2002; Clause 8.2.2, 8.2.3 and 8.2.4.

The calculated values have been compared with limits provided in the ICNIRP guidelines.

Calculations can be made in three separate regions, based on distance from the antenna. These are called:

- far-field region,
- radiating near-field region,
- reactive near-field region.

The theory that defines these regions is given in EN50383:2002 Annex A.

### Far-field region

As shown in EN50383 Annex A, the far-field calculations are accurate when the distance,  $r$ , from an antenna of length  $D$  to a point of investigation is greater than

$$r = \frac{2D^2}{\lambda}$$

Where,  $r$  is the distance from the antenna to the point of investigation.

### Radiating near-field region

The radiating near-field region of an antenna of length  $D$  as shown in EN50383 Annex A, this region is defined by

$$\frac{\lambda}{4} < r < \frac{2D^2}{\lambda}$$

### Reactive near-field region

The reactive near-field region of an antenna as shown in EN50383 Annex A, this region is defined by

$$r \leq \frac{\lambda}{4}$$

Where,  $r$  is the distance from the antenna to the point of investigation.

Recommend  $\lambda/4$  as the boundary between the radiated near-field and reactive near-field for RF exposure compliance assessment.



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## 2.2 DEFINED LIMITS

Normative Reference: ICNIRP Advice on Limiting Exposure to Electromagnetic Fields (0-300GHz). Table A4, Reference Levels for General Public Exposure to Time Varying Electric & Magnetic Fields. Vol 15 No.2. 2004. The defined limits are in accordance with 47 CFR § 1.1310 Radiofrequency radiation exposure limits.

Reference levels for general public exposure to time-varying electric and magnetic fields (unperturbed rms values)

At 456 MHz		
Power density (W/m <sup>2</sup> )	= 2.280	ICNIRP
Power density (mW/cm <sup>2</sup> )	= 0.304	FCC 47 CFR § 1.1310
Power density (W/m <sup>2</sup> )	= 3.040	Canada's RF Safety Code 6
Power density (W/m <sup>2</sup> )	= 2.280	Australian Radiation Protection Series Publication No. 3
E-Field (Vm-1)	= 29.362	ICNIRP
E-Field (Vm-1)	= N/A	FCC 47 CFR § 1.1310
E-Field (Vm-1)	= 33.846	Canada's RF Safety Code 6
E-Field (Vm-1)	= 29.255	Australian Radiation Protection Series Publication No. 3
H-Field (Am-1)	= 0.079	ICNIRP
H-Field (Am-1)	= N/A	FCC 47 CFR § 1.1310
H-Field (Am-1)	= 0.090	Canada's RF Safety Code 6
H-Field (Am-1)	= 0.078	Australian Radiation Protection Series Publication No. 3

Reference levels for occupational exposure to time-varying electric and magnetic fields (unperturbed rms values)

At 456 MHz		
Power density (W/m <sup>2</sup> )	= 11.400	ICNIRP
Power density (mW/cm <sup>2</sup> )	= 1.520	FCC 47 CFR § 1.1310
Power density (W/m <sup>2</sup> )	= 15.200	Canada's RF Safety Code 6
Power density (W/m <sup>2</sup> )	= 11.400	Australian Radiation Protection Series Publication No. 3
E-Field (Vm-1)	= 64.062	ICNIRP
E-Field (Vm-1)	= N/A	FCC 47 CFR § 1.1310
E-Field (Vm-1)	= 75.594	Canada's RF Safety Code 6
E-Field (Vm-1)	= 65.557	Australian Radiation Protection Series Publication No. 3
H-Field (Am-1)	= 0.171	ICNIRP
H-Field (Am-1)	= N/A	FCC 47 CFR § 1.1310
H-Field (Am-1)	= 0.201	Canada's RF Safety Code 6
H-Field (Am-1)	= 0.174	Australian Radiation Protection Series Publication No. 3

## 2.3 ESTABLISHING WAVELENGTH AND 1/4 WAVELENGTH

Frequency (MHz)	$\lambda = \frac{3 \times 10^8}{f}$		$\frac{\lambda}{4}$	
	m	cm	m	cm
456	0.657894736842105	65.7894736842105	0.164473684210526	16.4473684210526
458	0.655021834061135	65.5021834061135	0.163755458515284	16.3755458515284
460	0.652173913043478	65.2173913043478	0.16304347826087	16.304347826087



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## 2.4 FAR FIELD CALCULATIONS

The following calculations are based on: 13 dBi gain antenna

P = 5.000 (Power (Watts)) or 5000 (Power milliwatts)  
G = 19.953 (Numeric Gain)  
r = 190 (Distance (centimetres)) or 1.9 (Distance (meters))

The power flux:

$$S = \frac{PG_{(\theta, \phi)}}{4\pi r^2}$$

S = 2.22 W/m<sup>2</sup>  
S = 0.222 mW/cm<sup>2</sup>

The electric field strength:

$$E = \frac{\sqrt{30PG_{(\theta, \phi)}}}{r}$$

E = 28.93 V/m

The magnetic field strength:

$$H = \frac{E}{\eta_0}$$

H = 0.08 A/m

The calculations meet the General Public Exposure Levels described in the ICNIRP Guidelines.  
The calculations meet the General Public Exposure Levels described in the FCC 47CFR§1.1310.  
The calculations meet the General Public Exposure Levels described in the Canada's RF Safety Code 6.  
The calculations meet the General Public Exposure Levels described in the Australian Radiation Protection Series Publication No. 3

The calculations meet the Occupational Exposure Levels described in the ICNIRP Guidelines.  
The calculations meet the Occupational Exposure Levels described in the FCC 47CFR§1.1310  
The calculations meet the Occupational Exposure Levels described in the Canada's RF Safety Code 6  
The calculations meet the Occupational Exposure Levels described in the Australian Radiation Protection Series Publication No. 3



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## **SECTION 3**

### **DISCLAIMERS AND COPYRIGHT**



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### **3.1      DISCLAIMERS AND COPYRIGHT**

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