

# RF Exposure Exhibit

**EUT Name:** TransAir PTC-3004

**Model No.:** PTC-3004

CFR Part 1.1310 and RSS 102

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# 1 Test Methodology

In this document, we evaluate the RF Exposure to human body due the intentional transmission from the transmitter (EUT). The limit for Maximum Permissible Exposure (MPE) specified in FCC 1.1310 is followed. Through the Friis transmission formula and the maximum gain of the antenna, we can calculate the distance, away from the product, where the limit of MPE is reached.

Although the Friis transmission formula is a far field assumption, the calculated result of that is an over-prediction for near field power density. We will take that as the worst case to specify the safety range.

## 1.1 RF Exposure Limit

According to FCC 1.1310 table 1: The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b)

### LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm <sup>2</sup> )	Average Time (minutes)
<b>(A)Limits For Occupational / Control Exposures</b>				
0.3-1.34	614	1.63	*(100)	6
1.34-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	6
30-300	61.4	0.163	1.0	6
30-1500	...	...	F/300	6
1500-100000	...	...	1.0	6
<b>(B)Limits For General Population / Uncontrolled Exposure</b>				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f <sup>2</sup> )	30
30-300	27.5	0.073	0.2	30
30-1500	...	...	F(MHz)/1500MHz	30
1500-100000	...	...	1.0	30

F = Frequency in MHz

\*=Plane wave equivalent density

## **1.2 EUT Operating Condition**

TransAir PTC-3004 will be installed professionally in Lillie systems host and a minimum separation distance listed in the table below must be maintained between radiating structure and any person. Software provided enables to transmit on 216 to 222MHz, 3G and Wi-Fi band channels simultaneously.

RF exposure for co-location and simultaneous transmission is evaluated in this report.

EUT can be software configured for mobile or fixed installation.

### **Fixed installation with highest gain antenna of 14.1dBi**

The antenna of the product, under normal use condition, should be at 2.25 m away from the body of any user for fixed installation. Warning statement to the user for keeping at least 2.25m or more separation distance with the antenna should be included in user's manual.

### **Mobile installation with highest gain antenna of 5.2dBi**

The antenna of the product, under normal use condition, should be at 1.50 m away from the body of any user for fixed installation. Warning statement to the user for keeping at least 1.50 or more separation distance with the antenna should be included in user's manual.

## **1.3 Test Results**

### **1.3.1 Antenna Gain**

3 G Module FCC ID: QIPHC25 Antenna: AR001-GR108 GSM Quad-band Stubby highest gain 2dBi for 824 to 849Mhz and 3dBi for 1850 to 1910Mhz band

Wifi Module FCC ID: SWX-SR71E Antenna: 2.4 / 4.9 / 5.8 GHz Tri Band Rubber Duck; Model: RP-SMA highest gain: 6dBi

PTC radio: FCCID: XTC-TRANSAIRP3004; IC: 10249A-TAIRP3004 Fixed/ base Station mode Highest gain antenna 14.1dBi

### 1.3.2 Base Station/ Fixed Station Configuration

Calculations for this report are based on highest permitted power for each band.

Band	Mode	Output Power dBm	Antenna gain (Max)	EIRP/ERP		Channels Available	Channels Used	Total EIRP	
				dBm	W			W	dBm
824.2-848.8	3G	32.5 (1.699W)	2.0	34.5	2.81	1	1	2.81	34.4
824.2-848.8	3G	27.8(0.603W)	2.0	30.8	1.2				
826.4-846.6	3G	27.07(0.502)	2.0	29.07	0.933				
1850.2-1909.8	3G	30.0 ( 1.0)	3.0	33	2.0	1	1	2.0	33.0
1850.2-1909.8	3G	28.0 (0.631)	3.0	31	1.25				
1852.2-1907.6	3G	26.9(0.49)	3.0	29.9	0.977				
2400 - 2483.5	OFDM	19.4	6.0	21.4	0.137	11	3	0.411	26.14
2401 - 2483.5	CCK	22.4	6.0	24.4	0.275				
5150 - 5250	OFDM	15.4	6.0	17.4	0.055	4	3	0.164	22.15
5725 - 5850	OFDM	19.4	6.0	21.4	0.136	5	3	0.409	26.12
216-220	GMSK	45.5 <sup>2</sup>	14.1	35.48	-	5	1		
216-220	16 QPSK	45.5 <sup>2</sup>	14.1	35.48	-	5			
216-220	32 QPSK	45.5 <sup>2</sup>	14.1	35.48	-	5			

Table continued on next page

220-222	16 QPSK	45.5°	14.1	50.4	-	200		109.6	50.4
220-222	32 QPSK	45.5°	14.1	50.4	-	200			
Totals:							8	114.56	50.59

Note 1: For PTC radio the output power for fixed stations is factory set max limit at 45.5dBm. The above calculation is based on max gain antenna of 14.1dBi and cable loss of 9.2dB. The equipment design prevents higher power by lockout/error message.

Note2: Power is variable actual power is chosen at the time installation depending on cable losses, ant height and gain and terrain as per FCC/ IC licensing procedures.

The highest measured power is +50.59dBm or 114.56W; average power.

Using the Friss transmission formula, the EIRP is  $P_{out} * G$ , and R is 20cm.

$P_d = EIRP / (1600\pi)$

$P_d = (114560) / (1600\pi) = 22.79 \text{ mW/cm}^2$ , which is above the limit.

#### Calculating the distance at which Power density equals the limit

Calculation uses the free space transmission formula:

$$S = (PG) / (4 \pi d^2)$$

Where: S is power density ( $\text{W/m}^2$ ), P is output power (W), G is antenna gain relative to isotropic, d is separation distance from the transmitting antenna (m).

$d = \sqrt{PG / 4\pi}$  d in Cm when PG in  $\text{mW/cm}^2$  Limit extended to 220MHz  
permissible power density  $0.2 \text{ mW/cm}^2$

$$d = \sqrt{114560 / 4\pi \cdot 0.2}$$

D= 224.5 cms or d = 2.25 meters

### 1.3.3 Mobile Configuration

3 G Module FCC ID: QIPHC25 Antenna: AR001-GR108 GSM Quad-band Stubby antenna gain 2dBi

Wifi Module FCC ID: Antenna: 2.4 / 4.9 / 5.8 GHz Tri Band Rubber Duck Antenna RP-SMA

PTC radio: FCC ID: XTC-TRANSAIRP3004; IC: 10249A-TAIRP3004 for Mobile mode highest antenna gain is 3.0dBi

Calculations for this report are based on highest power measurement.

Band	Mode	Output Power dBm (watts)	Antenna gain (Max)	EIRP		Channels Available	Channels Used	Total EIRP	
				dBm	W			W	dBm
824.2-848.8	3G	32.5 (1.699)	2.0	34.5	2.81	-	1	2.81	34.4
824.2-848.8	3G	27.8 (0.603)	2.0	30.8	1.2	-			
826.4-846.6	3G	27.07(0.502)	2.0	29.07	0.933	-			
1850.2-1909.8	3G	30.0 ( 1.0)	3.0	33	2.0	-		2.0	33.0
1850.2-1909.8	3G	(0.631)	3.0	33	2.0	-			
1852.2-1907.6	3G	(0.49)	3.0	33	2.0	-			
2400 - 2483.5	OFDM	19.4	6.0	21.4	0.137	11	3	0.411	26.14
2401 - 2483.5	CCK	22.4	6.0	24.4	0.275				
5150 - 5250	OFDM	15.4	6.0	17.4	0.055	4	3	0.164	22.15
5725 - 5850	OFDM	19.4	6.0	21.4	0.136	5		0.409	26.12
216-220	GMSK	34	3	37	30.0	5	1	50.0	
216-220	16 QPSK	34	3	37	30	5			
216-220	32 QPSK	34	3	37	30	5			
220-222	GMSK	43.9	3	46.9	50	5			
220-222	16 QPSK	43.9	3	46.9	50	5			
220-222	32 QPSK	43.9	3	46.9	50	5			
Totals:							8	55.799	47.46

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Note1: The Max output power for mobile stations PTC radio is factory set max limit at 44.5dBm. The EIRP, calculation is based on max gain antenna of 5.2dBi and cable loss of 2.2dB. Power is limited to 30 watts erp as per RSS119 para 5.4.2

Note2: The PTC radio module design prevents higher power than 44.5dBm or 28.2Watts by lockout/error.

Note 3: The antenna gain in the above table is adjusted taking account cable loss of 2.2dB. The highest gain antenna for PTC radio was 5.2dBi

The total simultaneous measured power is +47.46dBm or 55.8W

Using the Friss transmission formula, the EIRP is  $P_{out} * G$ , and R is 20cm.

$$P_d = EIRP / (1600\pi)$$

$$P_d = (55800) / (1600\pi) = 11.10 \text{ mW/cm}^2,$$

which is above to the limit.

Calculation uses the free space transmission formula:

$$S = (PG) / (4\pi d^2)$$

Where: S is power density ( $\text{W/m}^2$ ), P is output power (W), G is antenna gain relative to isotropic, d is separation distance from the transmitting antenna (m).

$$d = \sqrt{PG / 4\pi} \quad d \text{ in Cm when } PG \text{ in } \text{mW/cm}^2 \text{ Limit extended to 220MHz permissible power density } 0.2 \text{ mW/cm}^2$$

$$d = \sqrt{55800 / 4\pi \cdot 0.2}$$

$$D = 149 \text{ Cms or } d = 1.50 \text{ meters}$$



### 1.3.4 Sample Calculation

The Friss transmission formula:  $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where;

$P_d$  = power density in mW/cm<sup>2</sup>

$P_{out}$  = output power to antenna in mW

$G$  = gain of antenna in linear scale

$\pi \approx 3.1416$

$R$  = distance between observation point and center of the radiator in cm

Ref. : David K. Cheng, *Field and Wave Electromagnetics*, Second Edition, Page 640, Eq. (11-133).

### 1.3.5 PTC family Radio configuration

Ports	Model #: PTC-3201	Model #: PTC-3202	Model #: PTC-3203	Model #: PTC-3204	Model #: PTC-3001	Model #: PTC-3004	Model #: PTC-3006
Console	x	x	x	x	x	x	x
Eth0/1	x	x	x	x	x	x	x
220MHz PRI (N-type antenna port)	x	x	x		x	x	x
220MHz SEC (N-type antenna port)	x	x			x	x	x
GPS (antenna port; can use TNC to SMA male connector)	x	x		x	x	x	x
3G (antenna port; can use TNC to SMA male connector)		x		x	x	x	x
WiFi PRI (antenna port; can use TNC to SMA male connector)				x	x	x	x
WiFi SEC (antenna port; can use TNC to SMA male connector)					x	x	x
DC IN	x	x	x	x	x	x	x
Serial port 1			x		x	x	x
Serial port 2			x		x	x	x

NAS622 chassis mounting kit with four screws	x	x	x	x		x	x
2 GB USB Flash Drive	x	x	x	x	x	x	x
Short name/ size description	2MCU	2MCU	2MCU	2MCU	1U	4MCU	6MCU