RF Exposure Exhibit

EUT Name: TransAir PTC-3000

Model No.: PTC-3000 RF

CFR 47 Part 80, 90 and RSS 119: 2011

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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^2)	Average Time (minutes)
(A)Limits For Occupational / Control Exposures				
0.3-1.34	614	1.63	*(100)	6
1.34-30	1842/f	4.89/f	*($900/f^2$)	6
30-300	61.4	0.163	1.0	6
30-1500	…	…	F/300	6
1500-100000	…	…	1.0	6
(B)Limits For General Population / Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*($180/f^2$)	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-3000 will installed professionally in Lillee systems host and a minimum separation distance listed in the table below must be maintained between radiating structure and any person.

EUT is 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 2.08 m away from the body of any user for fixed installation. Warning statement to the user for keeping at least 2.08m 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 1.41 m away from the body of any user for fixed installation. Warning statement to the user for keeping at least 1.41 or more separation distance with the antenna should be included in user's manual.

These RF Exposure calculations are valid for FCC CFR 47 part 80, 90 & 95F and also for RSS119

1.3 Test Results

1.3.1 Antenna Gain

Model: PTC-3000 RF, FCCID: XTC-TRANSAIRP3RF; IC: 10249A-TAIRP3RF Fixed/ base Station mode Highest gain antenna 14.1dBi The Antenna type: Dual Yagi Model: SY2062 – SFF11SNM(U) Make: Sinclair
Other antennas used: TransAir 13; max gain 216- 222MHz band: 12.34dBi (E field) 13.96(H field)
Yagi Antenna Model: YA-200230M13-NF; max gain for 216 -222MHz band: 13 (Efield) 14.0 (H field)

1.3.2 Base Station Configuration

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

Band	Mode	Max Output Power at antenna Port dBm	Max Output Power at antenna Port watts	Channels available	Channels Used	Total EIRP	
						W	dBm
216-220	GMSK	45.5[2]	35.48	5	1	109.6[1]	50.4
216-220	16 QPSK	45.5[2]	35.48	5			
216-220	32 QPSK	45.5[2]	35.48	5			
220-222	16 QPSK	45.5[2]	35.48	200			
220-222	32 QPSK	45.5[2]	35.48	200			

Note 1: 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, Antenna height and gain and terrain as per FCC/ IC licensing procedures.

The highest measured power is +50.4dBm or 109.6W; average power.

Using the Friss transmission formula, the EIRP is Pout*G, and R is 20cm.

Pd= EIRP/(1600π)

Pd = (109600) / (1600π) = 21.80mW/cm2, which is above the limit.

Calculating the distance at which Power density equal the limit

Calculation uses the free space transmission formula:

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

Where: S is power density (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 = Sqroot (PG/4πs) d in Cm when PG in mW/cm^2 Limit extended to 220MHz permissible power density 0.2 mW/cm^2

d = Sqroot 109600/4π0.2

D= 208.82 or d = 2.08meters

1.3.3 Mobile Configuration

Model: PTC-3000RF, FCC ID: XTC-TRANSAIRP3RF; IC: 10249A-TAIRP3RF for Mobile mode highest antenna gain is 5.2dBi Model: TransAir 220MHz 3dBi PIFA Antenna. Make: Lilee Systems This antenna is designed for Locomotive use.

Calculations for this report are based on highest power measurement.

Band	Mode	Max Output Power at antenna Port dBm	Max Output Power at antenna Port watts	Channels available	Channels Used	Total EIRP	
						W	dBm
216-220	GMSK	44.5[2]	28.2	5	1	50[1]	46.9
216-220	16 QPSK	44.5[2]	28.2	5			
216-220	32 QPSK	44.5[2]	28.2	5			
220-222	16 QPSK	44.5[2]	28.2	200			
220-222	32 QPSK	44.5[2]	28.2	200			

Note1: The Max output power for mobile stations is factory set max limit at 44.5dBm. The EIRP calculation is based on max gain antenna of 5.2dBi and cable loss of 2.8dB.

Note 2: The equipment design prevents higher power than 44.5dBm or 28.2Watts by lockout/error message.

The total measured EIRP is +46.9dBm or 50.0Watts

Using the Friss transmission formula, the EIRP is Pout*G, and R is 20cm.

Pd= EIRP/(1600π)

Pd = (50000) / (1600π) = 9.947mW/cm2, which is above to the limit.

Calculation uses the free space transmission formula:

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

Where: S is power density (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 = Sqroot (PG/4π) d in Cm when PG in mW/cm^2 Limit extended to 220MHz permissible power density 0.2 mW/cm^2

d = Sqroot [50000//4π0.2]

D= 141Cms or d = 1.41 meters

1.3.4 Sample Calculation

The Friss transmission formula: $Pd = (Pout*G) / (4*\pi*R^2)$

Where;

Pd = power density in mW/cm^2
Pout = 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