Analysis of operating and installation requirements to satisfy FCC & IC Regulations for RF exposure compliance for the PTP58500 and 58600 Products using External Sectored Antennas

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Abstract

This document analyses the operating and installation requirements to ensure limits for RF Exposure Compliance are not exceeded by the PTP58500 and PTP58600 range of products with external sectored antennas. The guidelines in FCC Bulletin 65 are used for the analysis.

Revision History

Version	Date	Comments	Author
0.001	27 Jan 2010	Initial Issue	CF
0.002	27 Jan 2010	Corrected typo in Table in Para 5.2.2.	CF
0.003	2 Feb 2010	Added reference to RSS102 Corrected S to $10mW/cm^2$ in Para 3 and added limit in W/m^2 Added calculations in W/m^2 to satisfy Canadian Regs	CF

Operational Parameters of the PTP58500.58600 Products

1 Scope

The purpose of this brief working paper is to identify the RF power produced by the PTP58500 and PTP58600 equipments under various operating conditions. This mean RF power plus the antenna gain used in specific installations identifies the effective power density (dBm/cm^2) that is to be compared against allowed limits for human exposure. Whilst these products are professionally installed and the installations are expected to be remote from the 'general population' it is sensible to calculate the expected exposure limits to provide guidance to installers.

2 References

Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields:
OET Bulletin 65, Edition 97-01, August 1997 [1]
RSS 102, Issue 2, November 2005

3 Background

Reference [1] identifies how the radiated power density should be calculated for different distances from the antenna. The variables used are Radiated Power Density (S), conducted power (P), Antenna Gain (G) and distance (R) . The formula given is

$$S= (P * G)/(4 * Pi * R^2)$$

The limit allowed for S depends on whether the exposure risk is to a member of the public or not. The products concerned are approved by the FCC under the Part 15.247 (ISM) Rules.
The general regulatory requirements for the USA and Canada that all products approved as intentional radiators under Part 15 meet the radio frequency radiation requirements for the "general population/uncontrolled environment" case. At the frequency of operation of these products, this requires that the value of S to be used is 10mW/cm^2 or 10W/m^2. It is clear from [1] that the power to be used should be the maximum transmitted power, subject to any allowance for source-based time-averaging.
Notes
a) the FCC require that the power density be calculated at a minimum distance of 20cm
b) the value of P * G is the same as the transmitted EIRP.

4 PTP Product Specific Issues

4.1 FCC Regulations

The PTP58500 and PTP58600 are approved under FCC Part 15.247 with the Transmitted power limit of 1W being given in subpart 247(b)(3). For Fixed Point to Point operation, unlimited antenna gain is allowed as defined in subpart 247(c)(1)(ii).

4.2 PTP58500 and PTP58600 Power Capability

These products do not have the capability to generate the full 1W conducted power during the transmitter burst. The Maximum Transmit Power (conducted) from the products is set as below.

PTP58500	PTP58600
Max Power = 27dBm	Max Power = 25dBm

This power is measured as an average value across a transmit burst and is the combined power from both antenna ports. Calibrated power control loops ensure that this power is not exceeded on either product.
The external antennas considered here have a maximum gain of 17dBi.

4.3 Dual Polarisation

The products all use dual polarised antennas, with each polarisation connected to an identical transceiver circuit inside the unit.

4.4 Power Control

The power levelling loops in the products measure the transmitted power on each polarisation at all times and limit each to the Maximum Transmit Power shown in Para 4.2, less 3dB.
The products operate on a TDD basis using the same frequency for up/down link. The transmit duty cycle resulting from the TDD operation is typically just less than 50% but for asymmetric data flow, it may be up to 80%.
The FCC regulations allow source-based time averaging to be used in working out the EIRP value for the exposure calculation. This reduces the effective mean conducted power and EIRP from the levels of conducted power and EIRP that would be applicable if the products were to transmit with a duty cycle of 100%.

It should be noted that this is very much a worst case analysis as the products operate with Receiver driven Transmit power control. The power levels quoted in this document are those applicable to the lowest order modulation modes (BPSK) whereas the normal operating modes are 64 QAM or above with power levels reduced by 6dB compared to the levels shown above.

4.5 Antenna Cable Losses

In the case of external antennas, the need to adjust azimuth and elevation of the antennas imposes minimum limits on the cable losses that can be achieved between the products and the antennas. This limitation is approximately 1dB.

5 Analysis

5.1 Transmitted Levels

The Radiated Power Density can be assessed on the basis of the antenna gain for each polarisation and the linear sum of the transmitter powers on the two polarisations.

5.2 Radiation Levels

5.2.1 Calculations at 20cm Spacing

The table below shows the result of calculating the radiated power density using the formula given in Ref [1] at a distance of 20cm from the antenna and confirms that the power density level is below the limit given in Ref [1] for general population/ uncontrolled environments at that distance.

Limits in mW/cm^2

PTP58500

Total Power in burst	27	dBm
Less TDD duty cycle (80%)	-1.0	dB
Total Mean Power	401	mW
Minimum Cable Loss	1	dB
Antenna Gain	17	dBi
Total Mean EIRP	15962	mW
Power Density Limit	1	mW/cm2
Radiated Density at 20cm	3.2	mW/cm2

PTP58600

Total Power in burst	25	dBm
Less TDD duty cycle (80%)	-1.0	dB
Total Mean Power	253	mW
Minimum Cable Loss	1	dB
Antenna Gain	17	dBi
Total Mean EIRP	10071	mW
Power Density Limit	1	mW/cm2
Radiated Density at 20cm	2.0	mW/cm2

Limits in W/m^2

PTP58500

Total Power in burst	27	dBm
Less TDD duty cycle (80%)	-1.0	dB
Total Mean Power	401	mW
Minimum Cable Loss	1	dB
Antenna Gain	17	dBi
Total Mean EIRP	15.96	W
Power Density Limit	10	W/m2
Radiated Density at 20cm	31.8	W/m2

PTP58600

Total Power in burst	25	dBm
Less TDD duty cycle (80%)	-1.0	dB
Total Mean Power	253	mW
Minimum Cable Loss	1	dB
Antenna Gain	17	dBi
Total Mean EIRP	10.07	W
Power Density Limit	10	W/m2
Radiated Density at 20cm	20.0	W/m2

5.2.2 Calculations at the Exposure Limit

The table below shows the result of calculating the radiated power density using the formula given in Ref [1] in order to find out the minimum spacing from the antenna at which the radiation has fallen to the 'general population/uncontrolled environment' limit.

Limits in mW/cm^2

PTP58500

Total Power in burst	27	dBm
Less TDD duty cycle (80%)	-1.0	dB
Total Mean Power	401	mW
Minimum Cable Loss	1	dB
Antenna Gain	17	dBi
Total Mean EIRP	15962	mW
Power Density Limit	1	mW/cm2
Separation Distance at Power Density Limit	0.36	m

PTP58600

Total Power in burst	25	dBm
Less TDD duty cycle (80%)	-1.0	dB
Total Mean Power	253	mW
Minimum Cable Loss	1	dB
Antenna Gain	17	dBi
Total Mean EIRP	10071	mW
Power Density Limit	1	mW/cm2
Separation Distance at Power Density Limit	0.28	m

Limits in W/m^2

PTP58500

Total Power in burst	27	dBm
Less TDD duty cycle (80%)	-1.0	dB
Total Mean Power	401	mW
Minimum Cable Loss	1	dB
Antenna Gain	17	dBi
Total Mean EIRP	15.96	W
Power Density Limit	10	W/m2
Separation Distance at Power Density Limit	0.36	m

PTP58600

Total Power in burst	25	dBm
Less TDD duty cycle (80%)	-1.0	dB
Total Mean Power	253	mW
Minimum Cable Loss	1	dB
Antenna Gain	17	dBi
Total Mean EIRP	10.07	W
Power Density Limit	10	W/m2
Separation Distance at Power Density Limit	0.28	m

6 Conclusion

The equipment meets the limit for general population exposure at worst case distances as shown below.

PTP58500	PTP58600
0.36m	**0.28m**

Installers must ensure that all installations provide at least this level of separation from the antenna face and anyone from the ‘general population’.
If antennas with lower gain than 17dBi are used, it is recommended that these minimum distances are maintained.