RF Exposure Evaluation Declaration

FCC ID:	2AD6M-X30
APPLICANT:	P2 Mobile Technologies Limited
Application Type:	Certification
Product:	X33 Tri-5GHz MeshRanger, X32 Dual 5GHz MeshRanger, X32e Dual 5GHz MeshRanger
Model No.:	X33, X32, X32e
Trademark:	P2 Wireless
Test Procedure(s):	KDB 447498 D01v06
FCC Classification:	Digital Transmission System (DTS) Unlicensed National Information Infrastructure (UNII)

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ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

Revision History

Report No.	Version	Description	Issue Date	Note
1612RSU01203	Rev. 01	Initial report	04-10-2017	Invalid
1612RSU01203	Rev. 02	Added calculation of the 2.4G & 5G collocation	05-05-2017	Valid

1. PRODUCT INFORMATION

1.1. Equipment Description

Product Name	X33 Tri-5GHz MeshRanger, X32 Dual 5GHz MeshRanger, X32e Dual 5GHz MeshRanger
Model No.	X33, X32, X32e
Brand Name	P2 Wireless
Wi-Fi Specification	802.11a/b/g/n/ac
Frequency Range	**2.4GHz:** For 802.11b/g/n-HT20: 2412 ~ 2462 MHz For 802.11n-HT40: 2422 ~ 2452 MHz **5GHz:** For 802.11a/n-HT20/ac-VHT20 5180~5240MHz, 5745~5825MHz For 802.11n-HT40/ac-VHT40: 5190~5230MHz, 5755~5795MHz For 802.11ac-VHT80: 5210MHz, 5775MHz For 802.11ac-VHT80+80: 5210 MHz + 5775 MHz
Type of Modulation	802.11b: DSSS 802.11g/a/n/ac: OFDM
Maximum Average Output Power	**For 2.4GHz Band:** 802.11b: 23.65dBm 802.11g: 23.75dBm 802.11n-HT20: 26.10dBm 802.11n-HT40: 26.09dBm **For 5GHz Band:** 802.11a: 25.73dBm 802.11n-HT20: 25.86dBm 802.11n-HT40: 25.40dBm 802.11ac-VHT20: 25.51 802.11ac-VHT40: 25.56 802.11ac-VHT80: 25.06dBm 802.11ac-VHT80+80: 15.32dBm(5210MHz), 13.98dBm(5775MHz)

1.2. Antenna Description

Antenna Type	Antenna No.	Frequency Band (MHz)	Tx Paths	Per Chain Max Antenna Gain (dBi)		Directional Gain (dBi)
				Ant 0	Ant 1	
The Antenna of Radio A						
Panel Antenna	#3	5150 ~ 5250	2	22.20	22.20	25.21
		5725 ~ 5850	2	21.80	21.80	24.81
The Antenna of Radio B						
Panel Antenna	#2	5150 ~ 5250	2	20.00	20.00	23.01
		5725 ~ 5850	2	20.00	20.00	23.01
The Antenna of Radio C						
Dipole Antenna	#1	2412 ~ 2462	2	4.50	4.50	7.51
		5150 ~ 5250	2	7.00	7.00	10.01
		5725 ~ 5850	2	7.00	7.00	10.01

1. The EUT supports Cyclic Delay Diversity (CDD) technology at 802.11a/b/g mode, and that CDD signal is correlated.
   For CDD transmissions, directional gain is calculated as follows, NANT = 2, NSS = 1.
   Three antennas have the same gain, GANT, Directional gain = GANT + Array Gain, where Array Gain is as follows.
   - For power spectral density (PSD) measurements on all devices,
     Array Gain = 10 log (N_{ANT}/ N_{SS}) dB = 3.01;
   - For power measurements on IEEE 802.11 devices,
     Array Gain = 0 dB for $N_{ANT} \leq 4$;
2. The EUT supports Beam Forming technology at 802.11n/ac mode, and that Beam Forming signal is correlated.
   Correlated signals include, but are not limited to, signals transmitted in any of the following modes:
   - Unequal Antenna gains, with equal transmit powers. For Antenna gains given by G_1, G_2, …, G_N dBi transmit signals are correlated, then
   - Directional gain = $10*\log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2/N_{ANT}]$ dBi [Note the “20”s in the denominator of each exponent and the square of the sum of terms; the object is to combine the signal levels coherently.]

   For example: 5150 ~ 5250MHz Directional Gain = $10*\log[(10^{22.20/20} + 10^{22.20/20})^2/2]$ = 25.21dBi

2. RF Exposure Evaluation

2.1. Limits

According to FCC 1.1310: The criteria listed in the following table shall be used to evaluate the environment 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				
300-1500	--	--	f/300	6
1500-100,000	--	--	5	6
(B) Limits for General Population/ Uncontrolled Exposures				
300-1500	--	--	f/1500	6
1500-100,000	--	--	1	30

f= Frequency in MHz

Calculation 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 = 3.1416
r = distance between observation point and center of the radiator in cm

Pd is the limit of MPE, $1mW/cm^2$. If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.

2.2. Test Result of RF Exposure Evaluation

Product	X33 Tri-5GHz MeshRanger, X32 Dual 5GHz MeshRanger, X32e Dual 5GHz MeshRanger
Test Item	RF Exposure Evaluation

Antenna Gain: refer to the section 1.2

For Radio A:

Test Mode	Frequency Band (MHz)	Maximum EIRP (dBm)	Safety Distance (cm)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
802.11a/n-HT20/ n-H40/ac-VHT20 ac-VHT40/ac-VHT80/ ac-VHT80+80	5150 ~ 5250, 5725 ~ 5850	52.68	125	0.9440	1

For Radio B:

Test Mode	Frequency Band (MHz)	Maximum EIRP (dBm)	Safety Distance (cm)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
802.11a/n-HT20/ n-H40/ac-VHT20 ac-VHT40/ac-VHT80/ ac-VHT80+80	5150 ~ 5250, 5725 ~ 5850	51.29	125	0.6854	1

For Radio C:

Test Mode	Frequency Band (MHz)	Maximum EIRP (dBm)	Safety Distance (cm)	Power Density (mW/cm^2)	Limit of Power Density (mW/cm^2)
802.11b/g/n-HT20/ n-HT40	2412 ~ 2462	33.13	125	0.0105	1
802.11a/n-HT20/ n-H40/ac-VHT20 ac-VHT40/ac-VHT80/ ac-VHT80+80	5150 ~ 5250, 5725 ~ 5850	35.19	125	0.0168	1

CONCULISON:

Both of the Max Power Density at r (125 cm) = 0.9440mW/cm^2 (Radio A 5GHz) + 0.0105mW/cm^2 (Radio C 2.4GHz) = 0.9590< 1mW/cm^2

So the EUT complies with the FCC requirement.

The End