RF Exposure Evaluation Declaration

FCC ID:	2ABLK-8X4G-1
APPLICANT:	Calix Inc.

Application Type:	Certification
Product:	WIFI dual band 4 GE LAN GPON HGU
Model No.:	844G-1, 854G-1
Brand Name:	Calix
FCC Classification:	Digital Transmission System (DTS)
	Unlicensed National Information Infrastructure (UNII)

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CERTIFICATE #3628.01

Revision History

Report No.	Version	Description	Issue Date
1408RSU00405	Rev. 01	Initial report	08-06-2014

1. PRODUCT INFORMATION

1.1. Equipment Description

Product Name	WIFI dual band 4 GE LAN GPON HGU
Model No.	844G-1, 854G-1
Frequency Range	**For 2.4G Band:** 802.11b/g/n: 2412 ~ 2462 MHz **For 5.0G Band:** 802.11a/n/ac: 5150 ~ 5250MHz; 5725 ~ 5850MHz
Type of Modulation	802.11b: DSSS 802.11g/a/n/ac: OFDM
Maximum Average Output Power	**For 2.4G Band:** 802.11b: 20.98dBm 802.11g: 21.24dBm 802.11n-HT20: 20.65dBm 802.11n-HT40: 19.70dBm **For 5.0G Band:** 802.11a: 21.99dBm 802.11n-HT20: 21.38dBm 802.11n-HT40: 21.75dBm 802.11ac-VHT20: 21.67dBm 802.11ac-VHT40: 21.69dBm 802.11ac-VHT80: 21.12dBm

Note: There are different Fiber modules of model number, and evaluated the different Fiber module in “FCC DOC report”.

1.2. Antenna Description

Antenna Type	Frequency Band (GHz)	T_X Paths	Directional Gain (dBi)	
			Non Beam Forming	Beam Forming
PCB Antenna	2.4	2	1.90	--
	5.2	4	2.17	8.04
	5.8	4	2.70	8.70

Note:

1. Transmit at 2.4GHz support two antennas, and support four antennas at 5GHz transmit.
2. The EUT supports Beam Forming mode, and the Beam Forming support 802.11n/ac, not include 802.11a.
3. Correlated signals include, but are not limited to, signals transmitted in any of the following modes:
   - Any transmit Beam Forming mode, whether fixed or adaptive (e.g., phased array modes, closed loop MIMO modes, Transmitter Adaptive Antenna modes, Maximum Ratio Transmission (MRT) modes, and Statistical Eigen Beam Forming (EBF) modes).
4. 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.]

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*r2)

Where
Pd = power density in mW/cm2
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	WIFI dual band 4 GE LAN GPON HGU
Test Item	RF Exposure Evaluation

Antenna Gain: The maximum Gain measured in fully anechoic chamber is 1.90dBi for 2.4GHz, 2.17dBi for 5.2GHz, 2.03dBi for 5.3GHz, 2.55dBi for 5.6GHz and 2.70dBi for 5.8GHz in logarithm scale.

For 2.4G ISM Band:

Test Mode	Frequency Band (MHz)	Maximum Average Output Power (dBm)	Power Density at R = 20 cm (mW/cm^2)	Limit (mW/cm^2)
802.11b	2412 ~ 2462	20.98	0.0386	1
802.11g	2412 ~ 2462	21.24	0.0410	1
802.11n-HT20	2412 ~ 2462	20.65	0.0307	1
802.11n-HT40	2422 ~ 2452	19.70	0.0288	1

For 5G UNII Band:

Test Mode	Frequency Band (MHz)	Maximum Average Output Power (dBm)	Power Density at R = 20 cm (mW/cm^2)	Limit (mW/cm^2)
802.11a	5180 ~ 5240	15.66	0.0121	1
	5725 ~ 5825	21.99	0.0586	1
802.11n-HT20	5180 ~ 5240	15.93	0.0128	1
	5725 ~ 5825	21.38	0.0509	1
802.11n-HT40	5190 ~ 5230	16.42	0.0144	1
	5755 ~ 5795	21.75	0.0554	1
802.11ac-VHT20	5180 ~ 5240	15.89	0.0127	1
	5725 ~ 5825	21.38	0.0509	1
802.11ac-VHT40	5190 ~ 5230	16.08	0.0133	1
	5755 ~ 5795	21.69	0.0547	1
802.11ac-VHT80	5210	15.87	0.0127	1
	5775	21.12	0.0479	1

CONCULISON:

Both of the WLAN 2.4GHz Band and WLAN 5GHz Band can transmit simultaneously. Therefore, the Max Power Density at R (20 cm) = 0.0410mW/cm^2+ 0.0586mW/cm^2 = 0.0996mW/cm^2 < 1mW/cm^2. So the EUT complies with the requirement.

The End