June 02, 2017

TUV SUD BABT
Octagon House, Concorde Way
Segensworth Rd N, Fareham
PO15 5RL

Attention: Director of Certification

FCC ID: XPY2AGQN4NNN
IC: 8595A-2AGQN4NNN

RE: ***Antenna gain calculation per guidance from KDB 447498 D01 Mobile Portable RF Exposure v06 and RSS-102 Issue 5 March 2015.***

EUT	u-blox San Diego, Inc. SARA-R410M LTE Cat-M1 Module
Input Power of the Antenna	25.0 dBm / 0.316 mW (LTE Band 2, 4, 5 and 12)
Frequency	699.7 MHz (LTE B12) to 1909.3 MHz (LTE B2)
FCC Limit (§1.1310 (d)(4))	4.66467 W/m^2 @ 699.7 MHz
	10 W/m^2 @ 1909.3 MHz
RSS-102 RF Limits (Table 4)	2.30329 W/m^2 @ 699.7 MHz
	4.24313 W/m^2 @ 1710.7 MHz (worst case channel above 1GHz LTE Band 4)
User separation distance	20 cm

Equation for predicting RF field was used to determine the maximum antenna gain that can be used with the EUT and still comply with the requirements:

$$S = \frac{PG}{4\pi r^2}$$

Where: S=the power flux

P=input power of the antenna

G=antenna gain relative to an isotropic antenna

r=distance from the antenna to the point of investigation

From this formula, using 0.230329 mW/cm^2 as *S* (worst case than FCC limit), 20 cm as *r* then the antenna gain *G* is calculated. This is the maximum antenna gain in dBi that can be used with the EUT while still in compliance with the power density requirements.

$$G = \frac{4\pi r^2 S}{P}$$

$$G = \frac{4\pi(20\ cm)^2(0.230329\ mW/cm^2\ )}{316.0\ mW}$$

$$G = \frac{1157.76}{316.0\ mW}$$

Therefore *G* = **3.67 dBi** for Band 12 and **4.1 dBi** for Band 5 (using the same calculation approach)

Using the same calculation for LTE Band 2:

$$G = \frac{4\pi(20\ cm)^2(0.424313\ \ mW/cm^2\ )}{316.0\ mW}$$

$$G = \frac{2132.83}{316.0\ mW}$$

Therefore *G* = **6.74 dBi** for Band 4 and **7.12 dBi** for Band 2 (using the same calculation approach)

Sincerely,

Ferdie S. Custodio
Name
Authorized Signatory
Title: Senior EMC/Wireless Test Engineer