RF Exposure Report

Report No.:	SA200203E11A
FCC ID:	2AF5PML2410
Test Model:	ML2410
Series Model:	ML2410XY (where both X and Y can be A, B, C, D or blank)
Received Date:	Feb. 03, 2020
Test Date:	Feb. 21, 2020
Issued Date:	Mar. 31, 2020
Applicant:	MTRLC LLC
Address:	225 Franklin Street, 26th Floor, Boston, MA 02110 USA
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Hsin Chu Laboratory
Lab Address:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan
Test Location:	E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan
FCC Registration / Designation Number:	723255 / TW2022

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Release Control Record

Issue No.	Description	Date Issued
SA200203E11A	Original release.	Mar. 31, 2020

1 Certificate of Conformity

Product:	AC1900 LTE Router
Brand:	Motorola
Test Model:	ML2410
Series Model:	ML2410XY (where both X and Y can be A, B, C, D or blank)
Sample Status:	ENGINEERING SAMPLE
Applicant:	MTRLC LLC
Test Date:	Feb. 21, 2020
Standards:	FCC Part 2 (Section 2.1091) IEEE C95.3-2002
References Test Guidance:	KDB 447498 D01 General RF Exposure Guidance v06

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Phoenix Huang / Specialist , **Date:** Mar. 31, 2020

Approved by : Clark Lin / Technical Manager , **Date:** Mar. 31, 2020

2 RF Exposure

2.1 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)
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
300-1500	…	…	f/1500	30
1500-100,000	…	…	1.0	30

2 f = Frequency in MHz ; *Plane-wave equivalent power density

2.1 MPE 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

2.2 Classification

The antenna of this product, under normal use condition, is at least 38 cm away from the body of the user. So, this device is classified as **Mobile Device**.

2.3 Antenna Gain

WLAN Antenna							
Ant. No.	RF Chain No.	Brand	Ant. Net Gain	Frequency Range (GHz)	Antenna Type	Connector Type	Cable Length (mm)
1	WiFi Chain0	Airgain	4.3 dBi, 4.3 dBi, 5.5 dBi	2.4 to 2.49, 5.15 to 5.35, 5.47 to 5.85	PCB	i-pex(MHF)	140
2	WiFi Chain1	Airgain	3.2 dBi, 4.4 dBi, 4.1 dBi	2.4 to 2.49, 5.15 to 5.35, 5.47 to 5.85	PCB	i-pex(MHF)	170
3	WiFi Chain2	Airgain	4.6 dBi, 4.9 dBi, 5.4 dBi	2.4 to 2.49, 5.15 to 5.35, 5.47 to 5.85	PCB	i-pex(MHF)	100
WWAN Antenna							
Ant. No.	RF Chain No.	Brand	Ant. Net Gain	Frequency Range (MHz)	Antenna Type	Connector Type	Cable Length (mm)
1	LTE MAIN	Cortec	1.08 dBi 3.19 dBi	617 ~ 894 1710 ~ 2200	Dipole	SMA	280
2	LTE AUX	Cortec	1.08 dBi 3.19 dBi	617 ~ 894 1710 ~ 2200	Dipole	SMA	200

2.4 Calculation Result of Maximum Conducted Power

The 2.4GHz and 5GHz (U-NII-1 band and U-NII-3 band) maximum power was refer to the FCC test report (Report No.: RF200203E11, RF200203E11-1)

For WLAN

Operation Mode	Evaluation Frequency (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
WLAN (2.4GHz)	2412~2462	938.289	8.83	38	0.39497	1
WLAN (U-NII-1)	5180~5250	807.114	9.31	38	0.37945	1
WLAN (U-NII-2A)	5260~5320	227.505	9.31	38	0.10696	1
WLAN (U-NII-2C)	5500~5720	244.026	9.79	38	0.12813	1
WLAN (U-NII-3)	5745~5850	969.735	9.79	38	0.50919	1

NOTE:

1. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.
2. 2.4GHz: The directional gain is = $10 \log[(10^{G0/20} + 10^{G1/20} + 10^{G2/20})^2 / 3] = 8.83$ dBi
3. 5GHz:
   U-NII-1, U-NII-2A: The directional gain is = $10 \log[(10^{G0/20} + 10^{G1/20} + 10^{G2/20})^2 / 3] = 9.31$ dBi
   U-NII-2C, U-NII-3: The directional gain is = $10 \log[(10^{G0/20} + 10^{G1/20} + 10^{G2/20})^2 / 3] = 9.79$ dBi

For WWAN module < Worst Case> (FCC ID: XMR201808EC25AF)

Operation Mode	Evaluation Frequency (MHz)	Max Power (mW)	Antenna Gain (dBi)	Distance (cm)	Power Density (mW/cm^2)	Limit (mW/cm^2)
LTE B12	699.7~715.3	237	1.08	38	0.01675	0.46647

Note: *Limit of Power Density = F/1500

Conclusion:

The formula of calculated the MPE is:

CPD1 / LPD1 + CPD2 / LPD2 + ……etc. < 1

CPD = Calculation power density

LPD = Limit of power density

WLAN 2.4GHz + WLAN 5GHz + LTE B12 = 0.39497 / 1 + 0.50919 / 1 + 0.01675 / 0.46647 = 0.94007

Therefore the maximum calculations of above situations are less than the “1” limit.

Appendix

WWAN module
MPE Evaluation for FCC ID: XMR201808EC25AF Module (Brand: Quectel; Model: EC25-AF)

Mode	Equipment Category	Transmitter Range (MHz)		Maximum Output Power		Antenna Gain (dBi)	Power Density (mW/cm^2)		Ratio
		Start	Stop	(dBm)	(W)		Vaule	Limit	
WCDMA	WCDMA II	1852.4	1907.6	23.18	208	3.19	0.02389	1	0.02389
	WCDMA IV	1712.4	1752.6	23.46	222	3.19	0.02550	1	0.02550
	WCDMA V	826.4	846.6	23.20	209	1.08	0.01477	0.55093*	0.02681
LTE	Band 2	1850.7	1909.3	23.86	243	3.19	0.02791	1	0.02791
	Band 4	1710.7	1754.3	23.73	236	3.19	0.02711	1	0.02711
	Band 5	824.7	848.3	24.05	254	1.08	0.01795	0.5498*	0.03265
	Band 12	699.7	715.3	23.75	237	1.08	0.01675	0.46647*	0.03591
	Band 13	779.5	784.5	23.86	243	1.08	0.01717	0.51967*	0.03304
	Band 14	788.4	798	23.87	244	1.08	0.01724	0.5256*	0.03280
	Band 66	1710.7	1779.3	23.82	241	3.19	0.02768	1	0.02768
	Band 71	665.5	695.5	23.46	222	1.08	0.01569	0.44367*	0.03536

Note: *Limit of Power Density = F/1500

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