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VIRTUAL ACCESS IRELAND LTD. MPE REPORT

SCOPE OF WORK
MPE CALCULATION
ON THE GW1042M-QFR

REPORT NUMBER
104922051LEX-001

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MPE TEST REPORT

Report Number: 104922051LEX-001
Project Number: G104922051

Report Issue Date: 8/28/2022

Product Name: GW1042M-QFR

Standards: FCC Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

Tested by:
Intertek Testing Services NA, Inc.
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Lexington, KY 40510
USA

Client:
VIRTUAL ACCESS IRELAND LTD.
Unit 9B Beckett Way
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Report reviewed by

Brian Lackey, EMC Team Leader

Table of Contents

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Test Summary

Section	Test full name	Result
9	FCC Part 1.1310 Limits for Maximum Permissible Exposure (MPE) (Limits for General Population / Uncontrolled Exposure)	Pass

3 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	VIRTUAL ACCESS IRELAND LTD.
Address:	Unit 9B Beckett Way Park West Business Park Dublin D12 PK44 Ireland
Contact:	Nigel Ifill
Telephone:	+353 1 604 1800
Email:	nigel.ifill@virtualaccess.com
Manufacturer Information	
Manufacturer Name:	VIRTUAL ACCESS IRELAND LTD.
Manufacturer Address:	Unit 9B Beckett Way Park West Business Park Dublin D12 PK44 Ireland

4 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	GW1042M-QFR
Model Number	GW1042M-QFR
Serial Number	Sample #1
Embedded Module	Quectel EG25-G MiniPCIE
FCCID	XMR201903EG25G
Supported Transmit Bands	GSM 850, 1900 UMTS Band 2, 4, 5 LTE Bands 1,2,3,4,5,7,12,13,20,25,26,28,41 802.11b/g/n 2.4 GHz
Antenna Gain	Quectel EG25-G MiniPCIE 700/850/900 MHz : -0.1 dB[1] 1700/1800/1900/2100 : 3.1 dB[1] GW1042M-QFR 802.11b/g/n 2.4 GHz : 1.4 dBm[1]
Maximum Output Power	Quectel EG25-G MiniPCIE GSM 850 : 35 dBm[1] GSM 1900 : 32 dBm[1] UMTS Band 2, 4, 5 : 25 dBm[1] LTE Bands : 25 dBm[1] GW1042M-QFR 802.11b/g/n 2.4 GHz : 26.3 dBm
Receive Date	4/15/2022
Test Start Date	4/15/2022
Test End Date	8/26/2022
Device Received Condition	Good
Test Sample Type	Production
Ratings	12 VDC via an AC to DC power adapter
Description of Equipment Under Test (provided by client)	
The Virtual Access GW1000M Series router is a compact and rugged 4G/LTE router with WiFi for use in both vehicles and a wide range of site-based applications. The GW1000M enables 4G/LTE or 3G connectivity in a wide range of applications including telemetry, remote monitoring and WiFi services in buses, taxis and fleet vehicles. The product is equally at home in site locations offering primary WAN, 4G/LTE failover to fixed line connections. Its small size is ideal for M2M applications such as remote monitoring and control. The product line supports the following radio access technologies: LTE, HSPA+, HSPA, UMTS, EDGE, GPRS and GSM.	

4.1 Variant Models:

There were no variant models covered by this evaluation.

1 This information was provided by the client. Any deviations from these values may affect compliance.

5 Output Power

5.1 Quectel EG25-G MiniPCIE

This output power exhibit for the Quectel EG25-G MiniPCIE module was gathered from the FCC report HR/2019/100 1601 page 13.

Target TX Output Power	GSM850:35 dBm GSM1900: 32dBm UMTS BAND II: 25dBm UMTS BAND IV: 25dBm UMTS BAND V: 25dBm LTE BAND 2: 25dBm LTE BAND 4: 25dBm LTE BAND 5: 25dBm LTE BAND 7: 25dBm LTE BAND 12: 25dBm LTE BAND 13: 25dBm LTE BAND 25: 25dBm LTE BAND 26: 25dBm LTE BAND 38: 25dBm LTE BAND 41: 25dBm

* This information was provided by the client. Any deviations from these values may affect compliance.

5.2 WiFi Output Power

The output power of the WiFi module was measured. The results were taken from the Intertek Report 104922051LEX-001, section 8.

8.4 Test Data: WiFi0

Operating Mode	Frequency (MHz)	Conducted Power (dBm)	Limit		Margin (dB)
			(mW)	(dBm)	
802.11b	2412	22.09	1000	30.00	7.91
	2437	21.49			8.51
	2462	20.43			9.57
802.11g	2412	26.33			3.67
	2437	25.48			4.52
	2462	24.23			5.77
802.11n 20MHz	2412	26.30			3.70
	2437	25.38			4.62
	2462	24.28			5.72

8.5 Test Data: WiFi1

Operating Mode	Frequency (MHz)	Conducted Power (dBm)	Limit		Margin (dB)
			(mW)	(dBm)	
802.11b	2412	21.80	1000	30.00	8.20
	2437	20.79			9.21
	2462	20.81			9.19
802.11g	2412	26.27			3.73
	2437	25.20			4.80
	2462	23.92			6.08
802.11n 20MHz	2412	26.22			3.78
	2437	25.18			4.82
	2462	23.95			6.05

6 Antenna Gain

6.1 2J77243Ma Cellular Antenna Gain

The antenna gain for the Cellular antenna was taken from the 2J product data sheet 2J7724Ma page 2.

Cable 1

Parameters	CELLULAR / LTE Antenna		
Standards	2G,3G and 4G		
Band (MHz)	700/850/900	1700/1800/1900/2100	2600
Frequency (MHz)	698-960	1710-2170	2500-2700
Return Loss (dB)	~-7.2	~-15.4	~-15.7
VSWR	~2.7:1	~1.5:1	~1.4:1
Efficiency (%)	~39	~52	~50
Peak Gain (dBi)	~-0.1	~2.9	~3.5
Average Gain (dB)	~-4.2	~-2.9	~-3.0
Impendance (Ohm)	50		
Polarisation	Linear		
Radiation Pattern	Omni-Directional		
Max. Input Power (W)	25		
Connector Type	SMA-Male Standard (Other Connectors Available)		
Cable Length	300 cm Standard (Any Cable Length Available)		
Cable Type	LL100 Standard (Other Cables Available)		

Cable 2

Parameters	CELLULAR / LTE Antenna		
Standards	2G,3G and 4G		
Band (MHz)	700/850/900	1700/1800/1900/2100	2600
Frequency (MHz)	698-960	1710-2170	2500-2700
Return Loss (dB)	~-6.9	~-15.6	~-15.3
VSWR	~2.7:1	~1.5:1	~1.5:1
Efficiency (%)	~38	~52	~53
Peak Gain (dBi)	~-0.1	~3.1	~2.7
Average Gain (dB)	~-4.3	~-2.9	~-2.8
Impendance (Ohm)	50		
Polarisation	Linear		
Radiation Pattern	Omni-Directional		
Max. Input Power (W)	25		
Connector Type	SMA-Male Standard (Other Connectors Available)		
Cable Length	300 cm Standard (Any Cable Length Available)		
Cable Type	LL100 Standard (Other Cables Available)		

* This information was provided by the client. Any deviations from these values may affect compliance.

6.2 2h77243Ma WiFi Antenna Gain

The antenna gain information was taken from 2J data sheet for the WiFi antenna 2h77243Ma, page 2.

Parameters	2.4/5.0 GHz ISM Antenna	
Standards	WiFi, BT, ZigBee, ISM	
Band (MHz)	2.4 Ghz	5.0 Ghz
Frequency (MHz)	2410-2490	4920-5925
Return Loss (dB)	~-8.9	~-9.6
VSWR	~2.1:1	~2.8:1
Efficiency (%)	~35	~60
Peak Gain (dBi)	~1.4	~3.2
Average Gain (dB)	~-4.5	~-2.2
Impendance (Ohm)	50	
Polarisation	Linear	
Radiation Pattern	Omni-Directional	
Max. Input Power (W)	25	
Connector Type	Most RF Connectors (RP-SMA-Male-RA Standard)	

* This information was provided by the client. Any deviations from these values may affect compliance.

7 FCC Limits

§ 1.1310: The criteria listed in table 1 shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

Part 1.1310 Limits for Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f^2)	6
30–300	61.4	0.163	1.0	6
300–1500	.....	.....	f/300	6
1500–100,000	.....	.....	5	6
(B) 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

f = frequency in MHz
* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

8 Test Procedure

An MPE evaluation for was performed in order to show that the device was compliant with the general population exposure limits from FCC §2.1091, RSS-102 Issue 5, and IEC 62311. The maximum power density was calculated for each transmitter band at a separation distance of 20cm using the maximum declared output power including tune up tolerance.

For each transmitter the maximum RF exposure at a 20 cm distance using the formula:

$$ConductedPower_{mW} = 10^{ConductedBwer(dBm)/10}$$

$$PowerDensity = \frac{ConductedPower_{mW} \times Ant.Gain}{4\pi \times (20_{cm})^2}$$

For transmitters that could operate simultaneously, the MPE to limit ratio for each was calculated and then summed. If the sum of the MPE to limit ratios was less than 1, that specific combination of transmitters was deemed to comply.

9 Results:

The calculated maximum power density at 20cm distance was equal to or less than the required limits for general population exposure for FCC Part 1.1310, RSS-102 Issue 5, and IEC 62311: 2019.

Additionally, to demonstrate compliance for simultaneous transmission between the Quectel EG25-G MiniPCIE Cellular Radio and the integrated WiFi of the GW1042M-QFR worst-case limit to MPE ratios for each radio were summed. Since that sum was less than 1 that combination of radios is deemed to comply with the simultaneous transmission RF exposure criteria.

$0.1182_{802.11n\_40MHz\_2.4} + 0.1606_{GSM1900} = 0.2788$

Since 0.2788 is less than 1.0 the device complies with the simultaneous transmission requirement.

FCC MPE Data

Duty Cycle	100 (%)							
Separation Dist.	20 (cm)							
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (mW/cm^2)	MPE Limit (mW/cm^2)	Margin to Limit (mW/cm^2)	MPE / Limit Ratio (for Co-Location)
LTE Band 2	1850.0	25	25.00	3.1	0.1284	1.0000	0.8716	0.1284
LTE Band 4	1710.0	25	25.00	3.1	0.1284	1.0000	0.8716	0.1284
LTE Band 5	824.0	25	25.00	-0.1	0.0615	0.5493	0.4879	0.1119
LTE Band 7	2500.0	25	25.00	3.5	0.1408	1.0000	0.8592	0.1408
LTE Band 12	699.0	25	25.00	-0.1	0.0615	0.4660	0.4045	0.1319
LTE Band 13	777.0	25	25.00	-0.1	0.0615	0.5180	0.4565	0.1187
LTE Band 25	1850.0	25	25.00	3.1	0.1284	1.0000	0.8716	0.1284
LTE Band 26	814.0	25	25.00	-0.1	0.0615	0.5427	0.4812	0.1133
LTE Band 41	2496.0	25	25.00	3.5	0.1408	1.0000	0.8592	0.1408
UMTS Band 2	1850.0	25	25.00	3.1	0.1284	1.0000	0.8716	0.1284
UMTS Band 5	850.0	25	25.00	-0.1	0.0615	0.5667	0.5052	0.1085

Duty Cycle	100 (%)							
Separation Dist.	20 (cm)							
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (mW/cm^2)	MPE Limit (mW/cm^2)	Margin to Limit (mW/cm^2)	MPE / Limit Ratio (for Co-Location)
802.11b 2.4	2402.0	22.09	22.09	1.4	0.0444	1.0000	0.9556	0.0444
802.11g 2.4	2402.0	26.33	26.33	1.4	0.1180	1.0000	0.8820	0.1180
802.11n 20MHz 2.4	2402.0	26.30	26.30	1.4	0.1171	1.0000	0.8829	0.1171
802.11n 40MHz 2.4	2402.0	26.34	26.34	1.4	0.1182	1.0000	0.8818	0.1182

Duty Cycle	12.5 (%)							
Separation Dist.	20 (cm)							
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Duty Cycle Adjusted Cond. Output Power (dBm)	Antenna Gain (dB)	MPE Value (mW/cm^2)	MPE Limit (mW/cm^2)	Margin to Limit (mW/cm^2)	MPE / Limit Ratio (for Co-Location)
GSM 1900	1850.0	35	25.97	3.1	0.1606	1.0000	0.8394	0.1606
GSM 850	824.0	32	22.97	-0.1	0.0385	0.5493	0.5108	0.0701

10 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	8/28/2022	104922051LEX-001			Original Issue