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Murata Electronics North America MPE REPORT

SCOPE OF WORK

MPE CALCULATION
ON THE LBAD0XX1SC TYPE 1SC LTE CATM1 MODULE

REPORT NUMBER

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MPE TEST REPORT

Report Number: 103652106LEX-007b

Project Number: G103652106

Report Issue Date: 5/13/2019

Product Name: Type 1SC LTE CATM1 Module

Model: LBAD0XX1SC

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

Industry Canada Standards: RSS-102 Issue 5

Tested by:

Intertek Testing Services NA, Inc.
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Client:

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1 Client Information

This product was tested at the request of the following:

Client Information	
Client Name:	Murata Electronics North America
Address:	2200 Lake Park Dr Smyrna, GA 30080 USA
Contact:	Ryan Anderson
Telephone:	1 (678) 684-2004
Email:	randerson@murata.com
Manufacturer Information	
Manufacturer Name:	Murata Electronics North America
Manufacturer Address:	2200 Lake Park Dr Smyrna, GA 30080 USA



2 Description of Equipment under Test and Variant Models

Equipment Under Test	
Product Name	Type 1SC LTE CATM1 Module
Model Number	LBAD0XX1SC
Serial Number	Test Sample 1
Supported Transmit Bands	2, 4, 5, 12, 13, 14, 17, 25, 26
Receive Date	8/6/2018
Test Start Date	8/6/2018
Test End Date	9/27/2018
Device Received Condition	Good
Test Sample Type	Production
Software Version	ES2
Hardware Version	RK_02_01_01_00_41
Rated Voltage	3.3VDC
Description of Equipment Under Test (provided by client)	
The Type 1SC LTE CATM1 Module is an LTE CATM1 modem designed to be used in IoT monitoring and control applications.	

3 Variant Models:

There were no variant models covered by this evaluation.



4 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.



5 RSS-102 Issue 5 Exposure Limits:

**Table 4: RF Field Strength Limits for Devices Used by the General Public
(Uncontrolled Environment)**

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous*
0.1-10	-	0.73/ <i>f</i>	-	6**
1.1-10	87/ <i>f</i> ^{0.5}	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ <i>f</i> ^{0.25}	0.1540/ <i>f</i> ^{0.25}	8.944/ <i>f</i> ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> ^{0.3417}	0.008335 <i>f</i> ^{0.3417}	0.02619 <i>f</i> ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i> ^{1.2}
Note: <i>f</i> is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

6 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 and RSS-102 Issue 5. 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.

Since the device under test is a module that can be used with numerous different antennas, the calculation was performed in a manner to show the maximum allowable antenna gain at which the MPE limits would still be met with zero margin.

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

$$\text{Conducted Power}_{mW} = 10^{\text{Conducted Power (dBm)}/10}$$

$$\text{Power Density} = \frac{\text{Conducted Power}_{mW} \times \text{Ant. Gain}}{4\pi \times (20_{cm})^2}$$



7 Results:

The calculated maximum power density at 20cm distance was equal to or less than the required limits for general population exposure for FCC and RSS-102 Issue 5 provided that the antenna chosen has a gain of equal or lesser value than that which is shown in the table below.

FCC MPE Data

Duty Cycle	100 (%)				
Separation Dist.	20 (cm)				
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Maximum Allowed Antenna Gain (dBi)	MPE Value (mW/cm ²)	MPE Limit (mW/cm ²)
LTE Band 2	1850	23	14.01	1.00	1.00
LTE Band 4	1710	23	14.01	1.00	1.00
LTE Band 5	824	23	11.41	0.55	0.55
LTE Band 12	699	23	10.70	0.47	0.47
LTE Band 13	777	23	11.16	0.52	0.52
LTE Band 14	788	23	11.22	0.53	0.53
LTE Band 17	704	23	10.73	0.47	0.47
LTE Band 25	1850	23	14.01	1.00	1.00
LTE Band 26	814	23	11.36	0.54	0.54

RSS-102 Issue 5 MPE Data

Duty Cycle	100 (%)				
Separation Dist.	20 (cm)				
Operating Mode	Frequency (MHz)	Declared Max Cond. Power (Inc. Tolerance) (dBm)	Maximum Allowed Antenna Gain (dBi)	MPE Value (W/m ²)	MPE Limit (W/m ²)
LTE Band 2	1850	23	20.52	4.48	4.48
LTE Band 4	1710	23	20.29	4.24	4.24
LTE Band 5	824	23	18.12	2.58	2.58
LTE Band 12	699	23	17.63	2.30	2.30
LTE Band 13	777	23	17.95	2.47	2.47
LTE Band 14	788	23	17.99	2.50	2.50
LTE Band 17	704	23	17.65	2.31	2.31
LTE Band 25	1850	23	20.52	4.48	4.48
LTE Band 26	814	23	18.09	2.55	2.55



8 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	5/13/2019	103652106LEX-007b	BCT	BZ	Original Issue