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**Electromagnetic Compatibility
MPE Calculation**

For the

**DTC Communications
Model MBOX4
FCC ID: H25MBOX4DS**

Tested under

**Title 47 of the Code of Federal Regulations (CFR),
Part 15 Subpart C**

MET Report: EMC26417-MPE_Rev1

April 29, 2009

Prepared For:

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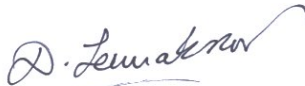
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Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the applicable limits. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Title 47 of the CFR, Part 15, Subpart C under normal use and maintenance.

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 15.247(b) Peak Power Output and RF Exposure

Test Purpose:

The MBOX4 has 2 configurations. The purpose of this report is to show the Co-location of three modules for each configuration.

Configuration #1 consists of Sierra Wireless, FCC ID: N7N-MC5725, Sony Corporation, FCC ID: AK8SNCACFW5 and DTC Communications, FCC ID: H25MBOX4DS.

Configuration #2 consists of Sierra Wireless, FCC ID: N7NMC8781, Sony Corporation, FCC ID: AK8SNCACFW5 and DTC Communications, FCC ID: H25MBOX4DS.

The difference between the 2 configurations is the Sierra Wireless radios. The N7NMC8781 is the AT&T version and the N7NMC5725 is the Verizon version.

RF Exposure Requirements:

§1.1307(b)(1) and §1.1307(b)(2): Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit:

§1.1310: As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Calculation – DTC Communications Transmitter: 2451 – 2482.5MHz (FCC ID: H25MBOX4DS)

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

MPE Limit Calculation: EUT's operating frequencies @ **2451 – 2482.5MHz**; highest conducted power = 30.58dBm (peak) therefore, Limit for Uncontrolled exposure: 5W EIRP

EUT maximum antenna gain = **9.4dBi**.

where, S = Power Density (mW/cm²)
P = Power Input to antenna (1142.878mW)
G = Antenna Gain (8.70numeric)

$$S = (1142.878 * 8.70 / 4 * 3.14 * 20.0^2) = (9954.054 / 5024) = \mathbf{1.981mW/cm^2} \text{ @ 20cm separation}$$
$$R = (1142.878 * 8.70 / 4 * 3.14 * 1.0)^{1/2} = (9954.054 / 12.56)^{1/2} = \mathbf{28.15cm}$$

MPE Calculation – Sierra Wireless Module: 824.7-848.31MHz & 1851.25-1908.75MHz (FCC ID: N7N-MC5725)

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

MPE Limit Calculation: EUT's operating frequencies @ **824.7- 848.31MHz**; highest conducted power = 25.13dBm (peak) therefore, Limit for Uncontrolled exposure: 0.56 mW/cm² or 5.6 W/m²

EUT maximum antenna gain = **5.1 dBi**.

where, S = Power Density (mW/cm²)
P = Power Input to antenna (325.8367mW)
G = Antenna Gain (3.23 numeric)

$$S = (325.8367 * 3.23 / 4 * 3.14 * 20.0^2) = (1054.387 / 5024) = \mathbf{0.210mW/cm^2} \text{ @ 20cm separation}$$

MPE Limit Calculation: EUT's operating frequencies @ **1851.25 – 1908.75MHz**; highest conducted power = 24.84dBm (peak) therefore, Limit for Uncontrolled exposure: 1 mW/cm² or 10 W/m²

EUT maximum antenna gain = **4.15 dBi**.

where, S = Power Density (mW/cm²)
P = Power Input to antenna (304.7895mW)
G = Antenna Gain (2.60 numeric)

$$S = (304.7895 * 2.60 / 4 * 3.14 * 20.0^2) = (792.5013 / 5024) = \mathbf{0.158mW/cm^2} \text{ @ 20cm separation}$$

MPE Calculation – Sierra Wireless Module: 824.2 – 848.8MHz & 1850.2 – 1909.8MHz (FCC ID: N7NMC8781)

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

MPE Limit Calculation: EUT's operating frequencies @ **824.2- 848.8MHz**; highest conducted power = 31.90dBm (peak) therefore, Limit for Uncontrolled exposure: 0.56 mW/cm² or 5.6 W/m²

EUT maximum antenna gain = **5 dBi**.

where, S = Power Density (mW/cm²)
P = Power Input to antenna (1548.817mW)
G = Antenna Gain (3.16numeric)

$$\begin{aligned} S &= (1548.817 * 3.16 / 4 * 3.14 * 20.0^2) = (4897.788 / 5024) = 0.974 \text{mW/cm}^2 \text{ @ 20cm separation} \\ R &= (1548.817 * 3.16 / 4 * 3.14 * 1.0)^{1/2} = (4897.788 / 12.56)^{1/2} = 19.74 \text{cm} \\ \text{EIRP} &= 32 + 5 = 37 \text{dBm} = 5012 \text{mW} \\ \text{Power Density} &= \text{EIRP} * \text{Duty Cycle} / (4\pi R^2) \\ &= 5012 * 0.5 / 5024 = \mathbf{0.50 \text{mW/cm}^2} \end{aligned}$$

MPE Limit Calculation: EUT's operating frequencies @ **1850.2 – 1909.8MHz**; highest conducted power = 28.80dBm (peak) therefore, Limit for Uncontrolled exposure: 1 mW/cm² or 10 W/m²

EUT maximum antenna gain = **4 dBi**.

where, S = Power Density (mW/cm²)
P = Power Input to antenna (758.5776mW)
G = Antenna Gain (2.51 numeric)

$$\begin{aligned} S &= (758.5776 * 2.51 / 4 * 3.14 * 20.0^2) = (1905.461 / 5024) = \mathbf{0.379 \text{mW/cm}^2} \text{ @ 20cm separation} \\ R &= (758.5776 * 2.51 / 4 * 3.14 * 1.0)^{1/2} = (1905.461 / 12.56)^{1/2} = 12.31 \text{cm} \end{aligned}$$

MPE Calculation – Sony Corporation Transmitter: 2412 - 2462MHz (FCC ID: AK8SNCACFW5)

Equation from page 18 of OET 65, Edition 97-01

$$S = PG / 4\pi R^2 \quad \text{or} \quad R = \sqrt{PG / 4\pi S}$$

MPE Limit Calculation: EUT's operating frequencies @ **2412 – 2462MHz**; highest conducted power = 18.52dBm (peak) therefore, Limit for Uncontrolled exposure: 1 mW/cm² or 10 W/m²

EUT maximum antenna gain = **6.4 dBi**.

where, S = Power Density (mW/cm²)
P = Power Input to antenna (71.12135mW)
G = Antenna Gain (4.36numeric)

$$S = (71.12135 * 4.36 / 4 * 3.14 * 20.0^2) = (310.456 / 5024) = \mathbf{0.062mW/cm^2} \text{ @ 20cm separation}$$

EUT maximum antenna gain = **0.11 dBi**.

where, S = Power Density (mW/cm²)
P = Power Input to antenna (71.12135mW)
G = Antenna Gain (1.02numeric)

$$S = (71.12135 * 1.02 / 4 * 3.14 * 20.0^2) = (72.94575 / 5024) = \mathbf{0.015mW/cm^2} \text{ @ 20cm separation}$$

Configuration #1 – Co-Location of Sierra Wireless Module, FCC ID: N7N-MC5725, Sony Corporation Transmitter, FCC ID: AK8SNCACFW5 & DTC Communications Transmitter, FCC ID: H25MBOX4DS

MPE Summary:

FCC ID	Frequency Range	MPE Result (mW/cm ²)	Limit (mW/cm ²)
H25MBOX4DS	2451-2582.5MHz	1.981	1
AK8SNCACFW5	2412-2462MHz	0.062	1
N7N-MC5725	824.7 – 848.3MHz	0.210	0.56
	1851.25 – 1908.75MHz	0.158	1

Test Requirements: $[MPE(f1) + MPE(f2) + MPE(f3)/ \text{limit}(f1) + / \text{limit}(f2) + / \text{limit}(f3)] < 1$

Test Results:

MPE(f1)	MPE(f2)	MPE(f3)	Calculation [MPE(f1) + MPE(f2) + MPE(f3)/ limit(f1) + / limit(f2) + / limit(f3)]	MPE Result (mW/cm ²) @ 20cm distance
Frequency (MHz)	Frequency (MHz)	Frequency (MHz)		
2451-2582.5	824.7 – 848.3	2412 - 2462	$1.981/1 + 0.210/.56 + 0.062/1 = 1.981/1 + 0.375/1 + 0.062/1$	2.41 mW/cm ²
2451-2582.5	1851.25 – 1908.75	2412 - 2462	$1.981/1 + 0.158/1 + 0.062/1$	2.20 mW/cm ²

MPE(f1)	MPE(f2)	MPE(f3)	Calculation [PG(f1) + PG(f2) + PG(f3)/ 4πS]	MPE Result cm
Frequency (MHz)	Frequency (MHz)	Frequency (MHz)		
2451-2582.5	824.7 – 848.3	2412 - 2462	$(9954.054 + 1882.83 + 310.456/12.56)^{1/2}$	31.10cm
2451-2582.5	1851.25 – 1908.75	2412 - 2462	$(9954.054 + 792.50 + 310.456/12.56)^{1/2}$	29.67cm

Configuration #2 – Co-Location of Sierra Wireless Module, FCC ID: N7NMC8781, Sony Corporation Transmitter, FCC ID: AK8SNCACFW5 & DTC Communications Transmitter, FCC ID: H25MBOX4DS

MPE Summary:

FCC ID	Frequency Range	MPE Result (mW/cm ²)	Limit (mW/cm ²)
H25MBOX4DS	2451-2582.5MHz	1.981	1
AK8SNCACFW5	2412-2462MHz	0.062	1
N7NMC8781	824.2 – 848.8MHz	0.50	0.56
	1850.2 – 1909.8MHz	0.379	1

Test Requirements: $[MPE(f1) + MPE(f2) + MPE(f3) / \text{limit}(f1) + / \text{limit}(f2) + / \text{limit}(f3)] < 1$

Test Results:

MPE(f1)	MPE(f2)	MPE(f3)	Calculation	MPE Result
Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	$[MPE(f1) + MPE(f2) + MPE(f3) / \text{limit}(f1) + / \text{limit}(f2) + / \text{limit}(f3)]$	(mW/cm ²) @ 20cm distance
2451-2582.5	824.2 – 848.8	2412 - 2462	$1.981/1 + .50/.56 + 0.062/1 = 1.981/1 + .89/1 + 0.062/1$	2.93 mW/cm ²
2451-2582.5	1850.2 – 1909.8	2412 - 2462	$1.981/1 + 0.379/1 + 0.062/1$	2.42 mW/cm ²

MPE(f1)	MPE(f2)	MPE(f3)	Calculation	MPE Result
Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	$[PG(f1) + PG(f2) + PG(f3) / 4\pi S]$	cm
2451-2582.5	824.2 – 848.8	2412 - 2462	$(9954.054+4475+310.456/12.56)^{1/2}$	34.26cm
2451-2582.5	1850.2 – 1909.8	2412 - 2462	$(9954.054+1905.461+310.456/12.56)^{1/2}$	31.13cm