Report On

RF Exposure Assessment of the
Motorola Solutions Inc
RFD5500 + MC55AO UHF RFID reader for use with Motorola MC55 mobile computers

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Product Service

TÜV SÜD Product Service, Octagon House, Concorde Way, Segensworth North,
Fareham, Hampshire, United Kingdom, PO15 5RL
Tel: +44 (0) 1489 558100. Website: www.tuv-sud.co.uk

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PREPARED FOR

Motorola Solutions Inc
Jays Close
Viables Industrial Estate
Basingstoke
RG22 4PD

PREPARED BY

M Whiting
Project Manager

APPROVED BY

M Jenkins
Authorised Signatory

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This report has been up-issued to Issue 2 to correct typographical errors.

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SECTION 1

REPORT SUMMARY

RF Exposure Assessment of the
Motorola Solutions Inc
RFD5500 + MC55AO UHF RFID reader for use with Motorola MC55 mobile computers

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the RF Exposure Assessment of the Motorola Solutions Inc RFD5500 + MC55AO UHF RFID reader for use with Motorola MC55 mobile computers to the requirements of the applied test specifications.

Objective	To perform RF Exposure Assessment to determine the Equipment Under Test's (EUT's) compliance of the applied rules.
Applicant	Motorola Solutions Inc
Manufacturer	Motorola Solutions Inc
Manufacturing Description	UHF RFID reader for use with Motorola MC55 mobile computers
Model Number(s)	RFD5500 + MC55AO
Test Specification/Issue/Date	EN 62311:2008 OET Bulletin 65 Edition 97-01 August 1997 RSS-102 Issue 4 March 2010 Radiocommunications (Electromagnetic Radiation – Human Exposure) Standard: 2003
Related Document(s)	Council Recommendation 1999/519/EC:1999 FCC CFR 47 Part 1: 2011 FCC CFR 47 Part 2: 2011 Health Canada's Safety Code 6 ARPANSA ICNIRP 1998 National Council on Radiation Protection and Measurements (NRPC) - Report No. 86(1986) EN 50383:2002 IEEE Std C95.1-2005 Australian Standard 2772.2 – 1988

1.2 BRIEF SUMMARY OF RESULTS

1.2.1 General Public Exposure Levels

Antenna Gain (Numeric)	Peak Output Power (mW)	Field	Calculated RF Exposure at 0.23 m (23cm)	General Public Exposure Limit	Application
0.891	800	S	1.07 W/m^2	4.510 W/m^2	ICNIRP
		S	0.107 mW/cm^2	0.601 mW/cm^2	FCC 47 CFR § 1.1310
		S	1.07 W/m^2	6.013 W/m^2	Canada's RF Safety Code 6
		S	1.07 W/m^2	4.510 W/m^2	ARPANSA
		E	20.11 V/m	41.296 V/m	ICNIRP
		E	20.11 V/m	N/A V/m	FCC 47 CFR § 1.1310
		E	20.11 V/m	47.603 V/m	Canada's RF Safety Code 6
		E	20.11 V/m	41.146 V/m	ARPANSA
		H	0.05 A/m	0.111 A/m	ICNIRP
		H	0.05 A/m	N/A A/m	FCC 47 CFR § 1.1310
		H	0.05 A/m	0.126 A/m	Canada's RF Safety Code 6
		H	0.05 A/m	0.109 A/m	ARPANSA

The calculations have shown that they **meet** the General Public Exposure Levels described in the ICNIRP Guidelines, FCC 47 CFR § 1.1310 Guidelines, Health Canada's RF exposure guideline Safety Code 6 and the Australian ARPANSA limits at **23cm**, the point of investigation.

1.2.2 Occupational Exposure Levels

Antenna Gain (Numeric)	Peak Output Power (mW)	Field	Calculated RF Exposure at 0.23 m (23cm)	Occupational Exposure Limit	Application
0.891	800	S	1.07 W/m^2	22.550 W/m^2	ICNIRP
		S	0.107 mW/cm^2	3.007 mW/cm^2	FCC 47 CFR § 1.1310
		S	1.07 W/m^2	30.067 W/m^2	Canada's RF Safety Code 6
		S	1.07 W/m^2	22.550 W/m^2	ARPANSA
		E	20.11 V/m	90.100 V/m	ICNIRP
		E	20.11 V/m	N/A V/m	FCC 47 CFR § 1.1310
		E	20.11 V/m	106.318 V/m	Canada's RF Safety Code 6
		E	20.11 V/m	92.202 V/m	ARPANSA
		H	0.05 A/m	0.240 A/m	ICNIRP
		H	0.05 A/m	N/A A/m	FCC 47 CFR § 1.1310
		H	0.05 A/m	0.282 A/m	Canada's RF Safety Code 6
		H	0.05 A/m	0.244 A/m	ARPANSA

The calculations have shown that they **meet** the Occupational Exposure Levels described in the ICNIRP Guidelines, FCC 47 CFR § 1.1310 Guidelines, Health Canada's RF exposure guideline Safety Code 6 and the Australian ARPANSA limits at **23 cm,** the point of investigation.

1.3 PRODUCT INFORMATION

1.3.1 Attestation

The wireless device described within this report has been shown to be capable of compliance with the basic restrictions related to human exposure to electromagnetic fields (10 MHz - 300 MHz) - General public. The calculations shown in this report were made in accordance the procedures specified in the applied test specification(s).

1.3.2 Technical Description

The Equipment under test was a Motorola Solutions Inc RFD5500 + MC55AO UHF RFID reader for use with Motorola MC55 mobile computers. A full technical description can be found in the manufacturer's documentation.

All reported calculations were carried out on the relevant information supplied for the RFD5500 + MC55AO UHF RFID reader for use with Motorola MC55 mobile computers to demonstrate compliance with the applied test specification(s) the sample assessed was found to comply with the requirements of the applied rules.

1.4 SUMMARY

The RF exposure assessment is based upon the following criteria:

The RFD5500 + MC55AO UHF RFID reader for use with Motorola MC55 mobile computers operates in the following frequency ranges
RFID: 902 – 928 MHz
Bluetooth: 2402 – 2480 MHz
WLAN (5GHz): 5150 – 5850 MHz

As the Motorola Solutions Inc RFD5500 + MC55AO UHF RFID reader for use with Motorola MC55 mobile computers incorporates **3 transmitters** the assessment has been carried out based on the worst case parameters. All calculations are therefore based on the **RFID** frequency band only.
S Values (Power Flux) for each Band were as follows:
RFID: 0.107 W/m²
Bluetooth: 0.00 W/m²
WLAN (5GHz): 0.55 W/m²

The applicant has declared that the RFID, Bluetooth and WLAN transmitters are capable of transmitting simultaneously, in order to determine whether the unit siarecompliant then each S Value is divided by the limit and then these values are added together, if the result is less than 1 then the unit is deemed to be compliant.
RFID: 0.107 W/m²/0.601W/m = 0.178
Bluetooth: 0.000 W/m²/1.000W/m = 0.000
WLAN (5GHz): 0.055 W/m²/1.000W/m = 0.055

0.178 + 0.000 + 0.055 = 0.233

0.233 <1 therefore the unit is compliant

Gain	-0.5 dBi
Power	0.8 W
Distance	0.23 m (23 cm)
Duty Cycle	100%

SECTION 2

TEST DETAILS

2.1 RATIONALE FOR ASSESSMENT OF THE RF EXPOSURE

The aim of the assessment report is to evaluate the compliance boundary for a set of given input power(s) according to the basic restrictions (directly or indirectly via compliance with reference levels) related to human exposure to radio frequency electromagnetic fields.
The chosen assessment method to establish the compliance boundary in the far-field region is the reference method as defined in EN50383:2002 Clause 5.2; E-field or H-field calculation. The method of calculation used is defined in EN50383:2002; Clause 8.2.2, 8.2.3 and 8.2.4.
The calculated values have been compared with limits provided in the ICNIRP guidelines.
Calculations can be made in three separate regions, based on distance from the antenna. These are called:

- far-field region,
- radiating near-field region,
- reactive near-field region.

The theory that defines these regions is given in EN50383:2002 Annex A.

Far-field region

As shown in EN50383 Annex A, the far-field calculations are accurate when the distance, r, from an antenna of length D to a point of investigation is greater than

$$r = \frac{2D^2}{\lambda}$$

Where, r is the distance from the antenna to the point of investigation.

Radiating near-field region

The radiating near-field region of an antenna of length D as shown in EN50383 Annex A, this region is defined by

$$\frac{\lambda}{4} < r > \frac{2D^2}{\lambda}$$

Reactive near-field region

The reactive near-field region of an antenna as shown in EN50383 Annex A, this region is defined by

$$r \leq \frac{\lambda}{4}$$

Where, r is the distance from the antenna to the point of investigation.
Recommend λ/4 as the boundary between the radiated near-field and reactive near-field for RF exposure compliance assessment.

2.2 DEFINED LIMITS

Normative Reference: ICNIRP Advice on Limiting Exposure to Electromagnetic Fields (0-300GHz). Table A4, Reference Levels for General Public Exposure to Time Varying Electric & Magnetic Fields. Vol 15 No.2. 2004. The defined limits are in accordance with 47 CFR § 1.1310 Radiofrequency radiation exposure limits.

Reference levels for general public exposure to time-varying electric and magnetic fields (unperturbed rms values)

At 902 MHz

Power density (W/m^2)	= 4.510	ICNIRP
Power density (mW/cm^2)	= 0.601	FCC 47 CFR § 1.1310
Power density (W/m^2)	= 6.013	Canada's RF Safety Code 6
Power density (W/m^2)	= 4.510	Australian Radiation Protection Series Publication No. 3
E-Field (Vm-1)	= 41.296	ICNIRP
E-Field (Vm-1)	= N/A	FCC 47 CFR § 1.1310
E-Field (Vm-1)	= 47.603	Canada's RF Safety Code 6
E-Field (Vm-1)	= 41.146	Australian Radiation Protection Series Publication No. 3
H-Field (Am-1)	= 0.111	ICNIRP
H-Field (Am-1)	= N/A	FCC 47 CFR § 1.1310
H-Field (Am-1)	= 0.126	Canada's RF Safety Code 6
H-Field (Am-1)	= 0.109	Australian Radiation Protection Series Publication No. 3

Reference levels for occupational exposure to time-varying electric and magnetic fields (unperturbed rms values)

At 902 MHz

Power density (W/m^2)	= 22.550	ICNIRP
Power density (mW/cm^2)	= 3.007	FCC 47 CFR § 1.1310
Power density (W/m^2)	= 30.067	Canada's RF Safety Code 6
Power density (W/m^2)	= 22.550	Australian Radiation Protection Series Publication No. 3
E-Field (Vm-1)	= 90.100	ICNIRP
E-Field (Vm-1)	= N/A	FCC 47 CFR § 1.1310
E-Field (Vm-1)	= 106.318	Canada's RF Safety Code 6
E-Field (Vm-1)	= 92.202	Australian Radiation Protection Series Publication No. 3
H-Field (Am-1)	= 0.240	ICNIRP
H-Field (Am-1)	= N/A	FCC 47 CFR § 1.1310
H-Field (Am-1)	= 0.282	Canada's RF Safety Code 6
H-Field (Am-1)	= 0.244	Australian Radiation Protection Series Publication No. 3

2.3 ESTABLISHING WAVELENGTH AND 1/4 WAVELENGTH

Frequency (MHz)	$\lambda = \frac{3x10^8}{f}$		$\frac{\lambda}{4}$	
	m	cm	m	cm
902	0.332594235033259	33.2594235033259	0.0831485587583149	8.31485587583149
915	0.327868852459016	32.7868852459016	0.0819672131147541	8.19672131147541
928	0.323275862068966	32.3275862068966	0.0808189655172414	8.08189655172414

2.4 FAR FIELD CALCULATIONS

The following calculations are based on: -0.5 dBi gain antenna

P = 0.8 (Power (Watts)) or 800 (Power milliwatts)
G = 0.891 (Numeric Gain)
r = 23 (Distance (centimetres)) or 0.23(Distance (meters))

The power flux:

$$S = \frac{PG_{(\theta,\phi)}}{4\pi r^2}$$

S = 1.07 W/m2

S= 0.107 mW/cm^2

The electric field strength:

$$E = \frac{\sqrt{30PG}_{(\theta,\phi)}}{r}$$

E = 20.11 V/m

The magnetic field strength:

$$H = \frac{E}{\eta_o}$$

H = 0.05 A/m

The calculations meet the General Public Exposure Levels described in the ICNIRP Guidelines.
The calculations meet the General Public Exposure Levels described in the FCC 47CFR§1.1310.
The calculations meet the General Public Exposure Levels described in the Canada's RF Safety Code 6.
The calculations meet the General Public Exposure Levels described in the Australian Radiation Protection Series Publication No. 3

The calculations meet the Occupational Exposure Levels described in the ICNIRP Guidelines.
The calculations meet the Occupational Exposure Levels described in the FCC 47CFR§1.1310
The calculations meet the Occupational Exposure Levels described in the Canada's RF Safety Code 6
The calculations meet the Occupational Exposure Levels described in the Australian Radiation Protection Series Publication No. 3

SECTION 3

DISCLAIMERS AND COPYRIGHT

3.1 DISCLAIMERS AND COPYRIGHT

This report relates only to the actual item/items tested.