Report on the Exposure Calculation for Domino UK of the Laird Wi-Fi & Bluetooth Module, Quality Management Module - Dual RFID System, Models: SSD40NBT, EPT038882 In accordance with EU, FCC, Canada, Australia, New Zealand

Product Service

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COMMERCIAL-IN-CONFIDENCE

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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Jennifer Harris	28 November 2018	
Authorised Signatory	Matthew Russell	28 November 2018	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

ENGINEERING STATEMENT
The calculations shown in this report were made in accordance with the procedures described in EU, FCC, Canada, Australia, New Zealand regional requirements.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Calculation	Pete Dorey	28 November 2018	

EXECUTIVE SUMMARY
The calculation of exposure for this product was found to be compliant at 20 cm with EU, FCC, Canada, Australia, New Zealand regional requirements.

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Product Service

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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	28 November 2018

1.2 Introduction

Objective	To perform electromagnetic field exposure assessment to determine the equipment under test's (EUT's) compliance with the applied specifications.
Applicant	Domino UK Limited
Manufacturer	Laird Technologies
Model Number(s)	SSD40NBT, EPT038882
Hardware Version(s)	EPT038882: R02, SSD40NBT: Not available
Software Version(s)	EPT038882: 5.2 SSD40NBT: V22.3.4.13
Specification/Issue/Date	• EU: EN 62311:2008 Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz to 300 GHz) • FCC: CFR 47 Pt1.1310:2016 • ISED Canada: Health Canada Safety Code 6:2015 • Australia: ARPANSA Radiation Protection Series No.3:2002 • NZS 2772.1:1999 Radiofrequency fields, Maximum exposure levels, 3 kHz to 300 GHz
Order Number Date	289994 13 June 2017
Related Document(s)	• Directive 2013/35/EU on minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (electromagnetic fields). • European Council Recommendation 1999/519/EC of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz), Official Journal, L199, of 1999-7-30, p.59-70. • OET65:97 Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields • IEEE C95.3:2002 IEEE Recommended Practice for Measurements and Computations of Radio Frequency

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Electromagnetic Fields with Respect to Human Exposure to Such Fields, 100 kHz–300 GHz

- RSS-102 Issue 5 Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
- AS/NZS 2772.2:2016 Radiofrequency fields, Part 2: principles and methods of measurement and computation, 3 kHz to 300 GHz

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1.3 Brief Summary of Results

The wireless device described within this report was compliant with the restrictions related to human exposure to electromagnetic fields for both general public and worker/occupational exposures.

The calculations shown in this report were made in accordance with the procedures specified in the applied test specification(s).

1.3.1 Single Transmitter Configuration

Regional Requirement	RAT	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.25 m							
			S Power Density (W/m^2)		E Field (V/m)		H Field (A/m)		B Field (µT)	
			Result	Limit	Result	Limit	Result	Limit	Result	Limit
EU	WiFi	2412	0.09	N/A	5.90	140.00	0.0156	N/A	0.0197	0.4500
EU	Bluetooth	2402	0.00	N/A	0.93	140.00	0.0025	N/A	0.0031	0.4500
EU	Dual RFID	13.56	0.00	N/A	0.03	61.00	0.0001	N/A	0.0001	0.2000
FCC	WiFi	2412	0.09	50.00	5.90	N/A	0.0156	N/A	0.0197	N/A
FCC	Bluetooth	2402	0.00	50.00	0.93	N/A	0.0025	N/A	0.0031	N/A
FCC	Dual RFID	13.56	0.00	N/A	0.03	135.84	0.0001	0.3606	0.0001	N/A
CANADA	WiFi	2412	0.09	31.70	5.90	109.32	0.0156	0.2900	0.0197	N/A
CANADA	Bluetooth	2402	0.00	31.64	0.93	109.21	0.0025	0.2897	0.0031	N/A
CANADA	Dual RFID	13.56	0.00	10.00	0.03	61.40	0.0001	0.1630	0.0001	N/A
AUSTRALIA / NEW ZEALAND	WiFi	2412	0.09	50.00	5.90	137.00	0.0156	0.3640	0.0197	N/A
AUSTRALIA / NEW ZEALAND	Bluetooth	2402	0.00	50.00	0.93	137.00	0.0025	0.3640	0.0031	N/A
AUSTRALIA / NEW ZEALAND	Dual RFID	13.56	0.00	10.00	0.03	61.40	0.0001	0.1630	0.0001	N/A

Table 1 – Worker/Occupational Exposure Results

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

Regional Requirement	RAT	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.25 m							
			S Power Density (W/m^2)		E Field (V/m)		H Field (A/m)		B Field (µT)	
			Result	Limit	Result	Limit	Result	Limit	Result	Limit
EU	WiFi	2412	0.09	10.00	5.90	61.00	0.0156	0.1600	0.0197	0.2000
EU	Bluetooth	2402	0.00	10.00	0.93	61.00	0.0025	0.1600	0.0031	0.2000
EU	Dual RFID	13.56	0.00	2.00	0.03	28.00	0.0001	0.0730	0.0001	0.0920
FCC	WiFi	2412	0.09	10.00	5.90	N/A	0.0156	N/A	0.0197	N/A
FCC	Bluetooth	2402	0.00	10.00	0.93	N/A	0.0025	N/A	0.0031	N/A
FCC	Dual RFID	13.56	0.00	N/A	0.03	60.77	0.0001	0.1615	0.0001	N/A
CANADA	WiFi	2412	0.09	5.37	5.90	44.97	0.0156	0.1193	0.0197	N/A
CANADA	Bluetooth	2402	0.00	5.35	0.93	44.91	0.0025	0.1191	0.0031	N/A
CANADA	Dual RFID	13.56	0.00	2.00	0.03	27.46	0.0001	0.0728	0.0001	N/A
AUSTRALIA / NEW ZEALAND	WiFi	2412	0.09	10.00	5.90	61.40	0.0156	0.1630	0.0197	N/A
AUSTRALIA / NEW ZEALAND	Bluetooth	2402	0.00	10.00	0.93	61.40	0.0025	0.1630	0.0031	N/A
AUSTRALIA / NEW ZEALAND	Dual RFID	13.56	0.00	2.00	0.03	27.40	0.0001	0.0729	0.0001	N/A

Table 2 – General Public Exposure Results

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

1.3.2 Multiple Transmitters

Regional Requirement	Configuration	Calculated RF exposure level at compliance boundary of 0.25 m			
		S Power Density (W/m^2)	E Field (V/m)	H Field (A/m)	B Field (µT)
		Summation for simultaneous exposure; value to be <1			
EU	WiFi & Dual RFID	N/A	0.0018	N/A	0.0019
EU	Bluetooth & Dual RFID	N/A	0.000045	N/A	0.000048
FCC	WiFi & Dual RFID	0.0018			
FCC	Bluetooth & Dual RFID	0.00005			
CANADA	WiFi & Dual RFID	0.0029	0.0029	0.0029	N/A
CANADA	Bluetooth & Dual RFID	0.000073	0.000073	0.000073	N/A
AUSTRALIA / NEW ZEALAND	WiFi & Dual RFID	0.0018	0.0019	0.0018	N/A
AUSTRALIA / NEW ZEALAND	Bluetooth & Dual RFID	0.000047	0.000047	0.000047	N/A

Table 3 – Worker/Occupational Exposure Results

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

Regional Requirement	Configuration	Calculated RF exposure level at compliance boundary of 0.25 m			
		S Power Density (W/m^2)	E Field (V/m)	H Field (A/m)	B Field (µT)
		Summation for simultaneous exposure; value to be <1			
EU	WiFi & Dual RFID	0.0092	0.0093	0.0096	0.0097
EU	Bluetooth & Dual RFID	0.000233	0.000236	0.000241	0.000244
FCC	WiFi & Dual RFID	0.0092			
FCC	Bluetooth & Dual RFID	0.00023			
CANADA	WiFi & Dual RFID	0.0172	0.0172	0.0172	N/A
CANADA	Bluetooth & Dual RFID	0.000434	0.000434	0.000434	N/A
AUSTRALIA / NEW ZEALAND	WiFi & Dual RFID	0.0092	0.0092	0.0092	N/A
AUSTRALIA / NEW ZEALAND	Bluetooth & Dual RFID	0.000233	0.000233	0.000232	N/A

Table 4 – General Public Exposure Results

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

1.4 Product Information

1.4.1 Technical Description

This report applies to the following radio modules that are used in a range of Domino printers:

- Laird Wi-Fi and Bluetooth Module with Radiall Larsen Antenna R380.500.314
- Domino Quality Management Module - Dual RF ID System

Note that WiFi and Bluetooth do not operate both together.

1.4.2 Transmitter Description

The following radio access technologies and frequency bands are supported by the equipment under test.

Radio Access Technology	Antenna Port	Frequency Band	Minimum Frequency	Output Power	Duty Cycle
		MHz	MHz	dBm	%
WiFi	1	2400-2483.5	2412	16	100
Bluetooth	1	2400-2483.5	2402	0	100
Dual RFID	2	13.553-13.567	13.56	-26.62 Note 1	84 Note 2

Table 5 – Transmitter Description

Note 1: Power specified is EIRP = Pt x Gi; derived from manufacturers electric field strength measurement of 68.61 dBµV/m at 3 m measured peak radiated power from antenna.

Note 2: Dual RFID: Each antenna transmits every 50mS for 21mS. (42% duty) Transmissions are interleaved between antenna. There is a 4mS gap between antenna 1 and antenna 2 transmissions. (Tags present). Therefore, effective duty cycle for Dual RFID is 84%.

1.4.3 Antenna Description

The following antennas are supported by the equipment under test.

Antenna No	Radio Access Technology	Antenna Model	Gain	Antenna length	Minimum Separation Distance
			dBi	cm	cm
1	WiFi & Bluetooth	Radiall Larsen Antenna	1.6 ±1 dB, 2.6 max	18	30 (25)Note 2
2	Dual RFID	6.1 cm x 5.1 cm - 3 turn PCB trace	N/ANote 1	6.1	25

Table 6 – Antenna description

Note 1: Antenna gain not specified separately as the EIRP specified in Table 5 includes antenna gain.

Note 2: Although 30 cm separation specified by the manufacturer, a separation of 25 cm was applied to equal the Dual RFID separation to simplify the combined exposure calculation.

1.4.4 Equipment Configuration

Two configurations:

1. WiFi and Dual RFID
2. Bluetooth and Dual RFID

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2 Assessment Details

2.1 Assessment Method

The assessment method is by calculation of the power density S, electric field strength E, magnetic field strength H or magnetic flux density B.

The calculation uses the spherical model applicable under far field conditions.

$$S = E \times H = \frac{E^2}{\eta} = H^2 \times \eta = \frac{P \times G_i}{4 \times \pi \times r^2}$$

Where:
η - Impedance of free space (377 ohm in far field)
P – Transmitter power W
G_i – Antenna gain ratio relative to isotropic
R – Separation distance m

The magnetic flux density is related to the magnetic field strength by a constant:

$$B = \mu_o \times H$$

Where:
μo – Permeability of free space 4xπ E-7 H/m

Where additional calculations are required by the regional specifications these are detailed below.

The far field region boundary depends on the frequency and wavelength and also on the antenna dimension. The boundary of the far field region is calculated below to demonstrate the validity of using the spherical model.

2.2 Individual Antenna Port Exposure Results

2.2.1 Calculation of Exposure at Specified Separation Distance

The frequencies shown in the tables below have been chosen based on the lowest possible frequency that the EUT can transmit. A full list of the regional requirements is shown in Annex A.

Regional Requirement	Antenna Port	RAT	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.25 m							
				S Power Density (W/m²)		E Field (V/m)		H Field (A/m)		B Field (μT)	
				Result	Limit	Result	Limit	Result	Limit	Result	Limit
EU	1	WiFi	2412	0.09	N/A	5.90	140.00	0.0156	N/A	0.0197	0.4500
EU	1	Bluetooth	2402	0.00	N/A	0.93	140.00	0.0025	N/A	0.0031	0.4500
EU	2	Dual RFID	13.56	0.00	N/A	0.03	61.00	0.0001	N/A	0.0001	0.2000
FCC	1	WiFi	2412	0.09	50.00	5.90	N/A	0.0156	N/A	0.0197	N/A
FCC	1	Bluetooth	2402	0.00	50.00	0.93	N/A	0.0025	N/A	0.0031	N/A
FCC	2	Dual RFID	13.56	0.00	N/A	0.03	135.84	0.0001	0.3606	0.0001	N/A
CANADA	1	WiFi	2412	0.09	31.70	5.90	109.32	0.0156	0.2900	0.0197	N/A
CANADA	1	Bluetooth	2402	0.00	31.64	0.93	109.21	0.0025	0.2897	0.0031	N/A
CANADA	2	Dual RFID	13.56	0.00	10.00	0.03	61.40	0.0001	0.1630	0.0001	N/A

Regional Requirement	Antenna Port	RAT	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.25 m							
				S Power Density (W/m^2)		E Field (V/m)		H Field (A/m)		B Field (µT)	
				Result	Limit	Result	Limit	Result	Limit	Result	Limit
AUSTRALIA / NEW ZEALAND	1	WiFi	2412	0.09	50.00	5.90	137.00	0.0156	0.3640	0.0197	N/A
AUSTRALIA / NEW ZEALAND	1	Bluetooth	2402	0.00	50.00	0.93	137.00	0.0025	0.3640	0.0031	N/A
AUSTRALIA / NEW ZEALAND	2	Dual RFID	13.56	0.00	10.00	0.03	61.40	0.0001	0.1630	0.0001	N/A

Table 7 – Worker/Occupational Individual Transmitter Result

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

Regional Requirement	Antenna Port	RAT	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.25 m							
				S Power Density (W/m^2)		E Field (V/m)		H Field (A/m)		B Field (µT)	
				Result	Limit	Result	Limit	Result	Limit	Result	Limit
EU	1	WiFi	2412	0.09	10.00	5.90	61.00	0.0156	0.1600	0.0197	0.2000
EU	1	Bluetooth	2402	0.00	10.00	0.93	61.00	0.0025	0.1600	0.0031	0.2000
EU	2	Dual RFID	13.56	0.00	2.00	0.03	28.00	0.0001	0.0730	0.0001	0.0920
FCC	1	WiFi	2412	0.09	10.00	5.90	N/A	0.0156	N/A	0.0197	N/A
FCC	1	Bluetooth	2402	0.00	10.00	0.93	N/A	0.0025	N/A	0.0031	N/A
FCC	2	Dual RFID	13.56	0.00	N/A	0.03	60.77	0.0001	0.1615	0.0001	N/A
CANADA	1	WiFi	2412	0.09	5.37	5.90	44.97	0.0156	0.1193	0.0197	N/A
CANADA	1	Bluetooth	2402	0.00	5.35	0.93	44.91	0.0025	0.1191	0.0031	N/A
CANADA	2	Dual RFID	13.56	0.00	2.00	0.03	27.46	0.0001	0.0728	0.0001	N/A
AUSTRALIA / NEW ZEALAND	1	WiFi	2412	0.09	10.00	5.90	61.40	0.0156	0.1630	0.0197	N/A
AUSTRALIA / NEW ZEALAND	1	Bluetooth	2402	0.00	10.00	0.93	61.40	0.0025	0.1630	0.0031	N/A
AUSTRALIA / NEW ZEALAND	2	Dual RFID	13.56	0.00	2.00	0.03	27.40	0.0001	0.0729	0.0001	N/A

Table 8 – General Public Individual Transmitter Result

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

2.3 Combined Antenna Port RF Exposure Results

As the frequency of operation for each transmitter is not the same, in order to evaluate compliance with the limit which is dependent on frequency, the fractional exposure value is calculated: The calculated S power density is divided by the limit to get a fractional exposure value. The calculated E and H fields are divided by the limit and squared to get a fractional exposure value. The summation of the fractional RF exposure results for each transmitter provides the combined result. Any values less than one are compliant with the limit. <The compliance boundary distance has been calculated to ensure the summation is ≤1.>

2.3.1 Configuration 1: WiFi and Dual RFID

EU EN 62311 specifies the method of summation in clause 8.3 with results as follows:

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	WiFi	2412	N/A	0.0018	N/A	0.0019
2	Dual RFID	13.56	N/A	0.0000	N/A	0.0000
Summation			N/A	0.0018	N/A	0.0019

Table 9 – EU Worker/Occupational Combined Exposure

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of <?>m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	WiFi	2412	0.0092	0.0093	0.0096	0.0097
2	Dual RFID	13.56	0.0000	0.0000	0.0000	0.0000
Summation			0.0092	0.0093	0.0096	0.0097

Table 10 – EU General Public Combined Exposure

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

FCC OET 65 specifies the method of summation in clause; Multiple-Transmitter Sites and Complex Environments; with results as follows:

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	WiFi	2412	0.0018	N/A	N/A	N/A
2	Dual RFID	13.56	N/A	0.0000	0.0000	N/A
Summation			0.0018			

Table 11 – FCC Worker/Occupational Combined Exposure

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	WiFi	2412	0.0092	N/A	N/A	N/A
2	Dual RFID	13.56	N/A	0.0000	0.0000	N/A
Summation			0.0092			

Table 12 – FCC General Public Combined Exposure

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

CANADA Health Canada Safety Code 6 specifies the method of summation in clause 2.2.1 Note 6 with results as follows:

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	WiFi	2412	0.0029	0.0029	0.0029	N/A
2	Dual RFID	13.56	0.0000	0.0000	0.0000	N/A
Summation			0.0029	0.0029	0.0029	N/A

Table 13 – CANADA Worker/Occupational Combined Exposure

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	WiFi	2412	0.0172	0.0172	0.0172	N/A
2	Dual RFID	13.56	0.0000	0.0000	0.0000	N/A
Summation			0.0172	0.0172	0.0172	N/A

Table 14 – CANADA General Public Combined Exposure

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

AUSTRALIA / NEW ZEALAND ARPANSA Radiation Protection Series No.3 specifies the method of summation in clause 3.4 with results as follows:

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	WiFi	2412	0.0018	0.0019	0.0018	N/A
2	Dual RFID	13.56	0.0000	0.0000	0.0000	N/A
Summation			0.0018	0.0019	0.0018	N/A

Table 15 – AUSTRALIA / NEW ZEALAND Worker/Occupational Combined Exposure

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	WiFi	2412	0.0092	0.0092	0.0092	N/A
2	Dual RFID	13.56	0.0000	0.0000	0.0000	N/A
Summation			0.0092	0.0092	0.0092	N/A

Table 16 – AUSTRALIA / NEW ZEALAND General Public Combined Exposure

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

2.3.2 Configuration 2: Bluetooth and Dual RFID

EU EN 62311 specifies the method of summation in clause 8.3 with results as follows:

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	Bluetooth	2402	N/A	0.000045	N/A	0.000048
2	Dual RFID	13.56	N/A	0.000000	N/A	0.000000
Summation			N/A	0.000045	N/A	0.000048

Table 17 – EU Worker/Occupational Combined Exposure

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of <?>m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	Bluetooth	2402	0.000232	0.000235	0.000240	0.000243
2	Dual RFID	13.56	0.000001	0.000001	0.000001	0.000001
Summation			0.000233	0.000236	0.000241	0.000244

Table 18 – EU General Public Combined Exposure

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

FCC OET 65 specifies the method of summation in clause; Multiple-Transmitter Sites and Complex Environments; with results as follows:

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	Bluetooth	2402	0.00005	N/A	N/A	N/A
2	Dual RFID	13.56	N/A	0.00000	0.00000	N/A
Summation			0.00005			

Table 19 – FCC Worker/Occupational Combined Exposure

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	Bluetooth	2402	0.00023	N/A	N/A	N/A
2	Dual RFID	13.56	N/A	0.00000	0.00000	N/A
Summation			0.00023			

Table 20 – FCC General Public Combined Exposure

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

CANADA Health Canada Safety Code 6 specifies the method of summation in clause 2.2.1 Note 6 with results as follows:

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	Bluetooth	2402	0.000073	0.000073	0.000073	N/A
2	Dual RFID	13.56	0.000000	0.000000	0.000000	N/A
Summation			0.000073	0.000073	0.000073	N/A

Table 21 – CANADA Worker/Occupational Combined Exposure

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	Bluetooth	2402	0.000433	0.000433	0.000433	N/A
2	Dual RFID	13.56	0.000001	0.000001	0.000001	N/A
Summation			0.000434	0.000434	0.000434	N/A

Table 22 – CANADA General Public Combined Exposure

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

AUSTRALIA / NEW ZEALAND ARPANSA Radiation Protection Series No.3 specifies the method of summation in clause 3.4 with results as follows:

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	Bluetooth	2402	0.000046	0.000047	0.000046	N/A
2	Dual RFID	13.56	0.000000	0.000000	0.000000	N/A
Summation			0.000047	0.000047	0.000047	N/A

Table 23 – AUSTRALIA / NEW ZEALAND Worker/Occupational Combined Exposure

The calculations show that the EUT complies with the worker/occupational exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

Antenna Port	RAT	Frequency (MHz)	Calculated RF exposure level at compliance boundary of 0.25 m as a fraction of the limit			
			S Power Density	E Field	H Field	B Field
1	Bluetooth	2402	0.000232	0.000232	0.000231	N/A
2	Dual RFID	13.56	0.000001	0.000001	0.000001	N/A
Summation			0.000233	0.000233	0.000232	N/A

Table 24 – AUSTRALIA / NEW ZEALAND General Public Combined Exposure

The calculations show that the EUT complies with the general public exposure levels described in in the listed specifications in Annex A at the point of investigation, 0.25 m.

2.4 Far Field Region Boundary Results

The far field region boundary calculation result is shown in Table 25:

Near Field / Far Field Boundary		
RAT Name	SAR recommended within this boundary	Antennas - on axis Far Field Region (Ref: IEEE C95.3 Annex B.2, EN 62311 Annex A, Technical Guide for Interpretation and Compliance Assessment of Health Canada's Radiofrequency Exposure Guidelines 7.1)
	Region I: Reactive Near Field Boundary (Wave Impedance Dependent) λ/4 (m)	$2D^2/\lambda$ (m)
WiFi	0.0311	0.5210
Bluetooth	0.0312	0.5188
Dual RFID	5.5310	0.0003

Table 25 – Far Field Boundary

The far field boundary for WiFi and Bluetooth is 0.52 m. The 0.25 m compliance boundary is within this distance and within the radiating near field but beyond the reactive near field and therefore the approach described in section 2.1 is an over estimate of the exposure and therefore a conservative assessment.

The far field boundary for Dual RFID is 5.5 m. The 0.25 m compliance boundary is within this distance and within the reactive near field and therefore the approach described in section 2.1 is an approximate assessment. However, the Dual RFID exposure contributions are insignificant and therefore the calculation is acceptable for this report to estimate combined exposure contributions. Since the exposure is within the reactive near field a SAR assessment is recommended. A separate series of SAR exclusion assessment reports has been issued for the Dual RFID, refer to Documents 75939449-02, 03 and 04.

2.5 Uncertainty

The basic computation formulas presented in section 2.1 are conservative formulas for the estimation of RF field strength or power density. No uncertainty estimations are required when using these formulas but there is clear guidance on where and when these formulas are applicable.

For the estimate of S, E or H to be conservative, the transmitter power P and antenna gain G_i values shall be the upper bounds of uncertainty therefore maximum values are used.

The spherical formula is valid under far field conditions which are established in section 2.4.

Product Service

ANNEX A

REGIONAL REQUIREMENTS

Frequency Range (MHz)	Power Density (W/m^2)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m) (Converted from µT)	Magnetic Flux Density (µT)
0.1 - 1	-	610	N/A	2/f
1 - 10	-	610/f	N/A	2/f
10 - 400		61	N/A	0.2
400 - 2000		3*f^0.5	N/A	1E-2*f^0.5
2000 - 6000		140	N/A	0.45
6000 -300000	50	140	N/A	0.45

Table A.1 – EU: Action levels in Directive 2013/35/EU Annex III Table B1 Worker/Occupational Limits

Frequency Range (MHz)	Power Density (W/m^2)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Magnetic Flux Density (µT)
0.003 - 0.15	-	87	5	6.25
0.15 - 1	-	87	0.73/f	0.92/f
1 - 10	-	87/f^0.5	0.73/f	0.92/f
10 - 400	2	28	0.073	0.092
400 - 2000	f/200	1.375*f^0.5	0.0037*f^0.5	0.0046*f^0.5
2000 - 300000	10	61	0.16	0.2

Table A.2 – EU: Council Recommendation 1999/519/EC Annex II Table 1 General Public Limits

Frequency Range (MHz)	Power Density (mW/cm^2)[Note 1]	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)
0 - 0.3	-	-	-
0.3 - 3	100	614	1.63
3 - 30	900/f^2	1842/f	4.89/f
30 - 300	1	61.4	0.163
300 - 1500	f/300	-	-
1500 - 100000	5	-	-

Table A.3 – FCC CFR 47 Pt1.1310 (2016) Worker/Occupational Limits

Frequency Range (MHz)	Power Density (mW/cm^2)[Note 1]	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)
0 - 0.3	-	-	-
0.3 - 3	100	614	1.63
3 - 30	180/f^2	824/f	2.19/f
30 - 300	0.2	27.5	0.073
300 - 1500	f/1500	-	-
1500 - 100000	1	-	-

Table A.4 – FCC CFR 47 Pt1.1310 (2016) General Public Limits

Note 1: The calculations and limits presented in this report for power density are in units of W/m^2. The conversion factor is; 1 mW/cm^2 = 10 W/m^2.

Frequency Range (MHz)	Power Density (W/m^2)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)
10 - 20	10	61.4	0.163
20 - 48	44.72/f^0.5	129.8/f^0.25	0.3444/f^0.25
48 - 100	6.455	49.33	0.1309
100 - 6000	0.6455*f^0.5	15.60*f^0.25	0.04138*f^0.25
6000 - 150000	50	137	0.364

Table A.5 – Health Canada Safety Code 6 Worker/Occupational Limits

Frequency Range (MHz)	Power Density (W/m^2)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)
10 - 20	2	27.46	0.0728
20 - 48	8.944/f^0.5	58.07/f^0.25	0.1540/f^0.25
48 - 300	1.291	22.06	0.05852
300 - 6000	0.02619*f^0.6834	3.142*f^0.3417	0.008335*f^0.3417
6000 - 15000	10	61.4	0.163

Table A.6 – Health Canada Safety Code 6 General Public Limits

Frequency Range (MHz)	Power Density (W/m^2)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)
0.1 - 1	-	614	1.63/f
1 - 10	1000/f^2	614/f	1.63/f
10 - 400	10	61.4	0.163
400 - 2000	f/40	3.07*f^0.5	0.00814*f^0.5
2000 - 300000	50	137	0.364

Table A.7 – ARPANSA Radiation Protection Series No.3 Worker/Occupational Limits

Frequency Range (MHz)	Power Density (W/m^2)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)
0.1 - 0.15	-	86.8	4.86
0.15 - 1	-	86.8	0.729/f
1 - 10	-	86.8/f^0.5	0.729/f
10 - 400	2	27.4	0.0729
400 - 2000	f/200	1.37*f^0.5	0.00364*f^0.5
2000 - 300000	10	61.4	0.163

Table A.8 – ARPANSA Radiation Protection Series No.3 General Public Limits