



Product Service

**Choose certainty.
Add value.**

Report On

RF Exposure Assessment of the
Frontier Silicon Ltd
Minuet/FS5332

FCC ID: YYX-FS5332
IC: 11458A-FS5332

Document 75934517 Report 08 Issue 1

July 2016



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

REPORT ON

RF Exposure Assessment of the
Frontier Silicon Ltd
Minuet/FS5332

Document 75934517 Report 08 Issue 1

July 2016

PREPARED FOR

Frontier Silicon Ltd
137 Euston Road,
London,
NW1 2AA

PREPARED BY

A handwritten signature in blue ink, appearing to read 'Ryan Henley', written over a horizontal line.

Ryan Henley
Project Manager

APPROVED BY

A handwritten signature in brown ink, appearing to read 'Simon Bennett', written over a horizontal line.

Simon Bennett
Authorised Signatory

DATED

29 July 2016



Product Service

CONTENTS

Section	Page No
1	REPORT SUMMARY 3
1.1	Introduction 4
1.2	Regional Requirements 5
1.3	Product Information 6
1.3.1	Technical Description 6
1.3.2	Supported Features 6
1.3.3	Antennas 6
1.3.4	EUT Configurations 6
1.4	Brief Summary of Results 7
1.4.1	Configuration 1 - Bluetooth with 1st Diversity Antenna 8
1.4.2	Configuration 2 - WLAN with 1st Diversity Antenna 9
1.4.3	Configuration 3 - RLAN with 1st Diversity Antenna 10
1.4.4	Configuration 4 - Bluetooth and RLAN with 1st Diversity Antenna 11
1.4.5	Configuration 5 - Bluetooth with 2nd Diversity Antenna 12
1.4.6	Configuration 6 - WLAN with 2nd Diversity Antenna 13
1.4.7	Configuration 7 - RLAN with 2nd Diversity Antenna 14
1.4.8	Configuration 8 - Bluetooth and RLAN with 2nd Diversity Antenna 15
2	TEST DETAILS 16
2.1	Rationale for Assessment of the RF Exposure 17
2.2	Test Result Details 18
2.2.1	Configuration 1 - Bluetooth with 1st Diversity Antenna 18
2.2.2	Configuration 2 - WLAN with 1st Diversity Antenna 19
2.2.3	Configuration 3 - RLAN with 1st Diversity Antenna 20
2.2.4	Configuration 4 - Bluetooth and RLAN with 1st Diversity Antenna 21
2.2.5	Configuration 5 - Bluetooth with 2nd Diversity Antenna 22
2.2.6	Configuration 6 - WLAN with 2nd Diversity Antenna 23
2.2.7	Configuration 7 - RLAN with 2nd Diversity Antenna 24
2.2.8	Configuration 8 - Bluetooth and RLAN with 2nd Diversity Antenna 25
2.2.9	Configuration 4 - Bluetooth and RLAN with 1st Diversity Antenna 26
2.2.10	Configuration 8 - Bluetooth and RLAN with 2nd Diversity Antenna 27
3	DISCLAIMERS AND COPYRIGHT 28
3.1	Disclaimers and Copyright 29



Product Service

SECTION 1

REPORT SUMMARY

RF Exposure Assessment of the
Frontier Silicon Ltd
Minuet/FS5332



Product Service

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the RF Exposure Assessment of the Frontier Silicon Ltd Minuet/FS5332 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	Frontier Silicon Ltd
Manufacturer	Frontier Silicon Ltd
Manufacturing Description	Minuet is a module, which when installed in a consumer audio product enables high quality audio streaming over Wi-Fi, Bluetooth and Ethernet.
Model Number(s)	Minuet/FS5332
Test Specification/Issue/Date	EN 62311:2008 CFR 47 Pt1.1310 Health Canada Safety Code 6 ARPANSA Radiation Protection Series No.3



Product Service

1.2 REGIONAL REQUIREMENTS

The table below shows the regional requirements that are referenced in this test report. A full list of the requirements is shown in Annex A.

Report Reference	Regional Requirement
EU	EN 62311:2008
FCC	CFR 47 Pt1.1310
IC	Health Canada Safety Code 6
AUS	ARPANSA Radiation Protection Series No.3



Product Service

1.3 PRODUCT INFORMATION

1.3.1 Technical Description

The Equipment under test was a Frontier Silicon Ltd Minuet/FS5332. 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 Minuet/FS5332 to demonstrate compliance with the applied test specification(s). The sample assessed was found to comply with the requirements of the applied rules.

1.3.2 Supported Features

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

Radio Access Technology	Bluetooth
	WLAN
	RLAN
Frequency Band	2400 MHz to 2483.5 MHz
	2400 MHz to 2483.5 MHz
	5150 MHz to 5850 MHz

1.3.3 Antennas

The following antennas are supported by the equipment under test.

No.	Model	Gain (dBi)
1	SW700M	2.3
2	SW700M	4.6
3	RFPCA431223	1.9
4	RFPCA431223	4.3

1.3.4 EUT Configurations

Configuration 1: 2.4 GHz Bluetooth transmitter with SW700M Antenna
Configuratiion 2: 2.4 GHz WLAN transmitter with SW700M Antenna
Configuratiion 3: 5 GHz RLAN transmitter with SW700M Antenna
Configuratiion 4: 2.4 GHz Bluetooth and 5 GHz RLAN transmitters with SW700M Antenna
Configuratiion 5: 2.4 GHz Bluetooth transmitter with RFPCA431223 Antenna
Configuratiion 6: 2.4 GHz WLAN transmitter with RFPCA431223 Antenna
Configuratiion 7: 5 GHz RLAN transmitter with RFPCA431223 Antenna
Configuratiion 8: 2.4 GHz Bluetooth and 5 GHz RLAN transmitters with RFPCA431223 Antenna



Product Service

1.4 BRIEF SUMMARY OF RESULTS

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 for both General Public and Occupational. The calculations shown in this report were made in accordance the procedures specified in the applied test specification(s).

Configuration	Required Compliance Boundary (m)	
	Occupational	General Population
Bluetooth with 1st Diversity Antenna	0.20	0.20
WLAN with 1st Diversity Antenna	0.20	0.20
RLAN with 1st Diversity Antenna	0.20	0.20
Bluetooth and RLAN with 1st Diversity Antenna	0.20	0.20
Bluetooth with 2nd Diversity Antenna	0.20	0.20
WLAN with 2nd Diversity Antenna	0.20	0.20
RLAN with 2nd Diversity Antenna	0.20	0.20
Bluetooth and RLAN with 2nd Diversity Antenna	0.20	0.20

Table 1 – Compliance Boundary Results



Product Service

1.4.1 Configuration 1 - Bluetooth with 1st Diversity Antenna

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.0236	50.0000	2.9856	137.0000	0.0079	0.3630
FCC*	0.0024	5.0000	N/A	N/A	N/A	N/A
IC	0.0236	31.6361	2.9856	109.2114	0.0079	0.2897
AUS	0.0236	50.0000	2.9856	137.0000	0.0079	0.3640

* Requirement and Result in mW/cm²

Table 2 – Occupational Results

The calculations show that the EUT complies with the occupational exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.0236	10.0000	2.9856	61.0000	0.0079	0.1620
FCC*	0.0024	1.0000	N/A	N/A	N/A	N/A
IC	0.0236	5.3508	2.9856	44.9105	0.0079	0.1191
AUS	0.0236	10.0000	2.9856	61.4000	0.0079	0.1630

* Requirement and Result in mW/cm²

Table 3 – General Population Results

The calculations show that the EUT complies with the general population exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.



Product Service

1.4.2 Configuration 2 - WLAN with 1st Diversity Antenna

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.3379	50.0000	11.2858	137.0000	0.0299	0.3630
FCC*	0.0338	5.0000	N/A	N/A	N/A	N/A
IC	0.3379	31.7019	11.2858	109.3249	0.0299	0.2900
AUS	0.3379	50.0000	11.2858	137.0000	0.0299	0.3640

* Requirement and Result in mW/cm²

Table 4 – Occupational Results

The calculations show that the EUT complies with the occupational exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.3379	10.0000	11.2858	61.0000	0.0299	0.1620
FCC*	0.0338	1.0000	N/A	N/A	N/A	N/A
IC	0.3379	5.3660	11.2858	44.9743	0.0299	0.1193
AUS	0.3379	10.0000	11.2858	61.4000	0.0299	0.1630

* Requirement and Result in mW/cm²

Table 5 – General Population Results

The calculations show that the EUT complies with the general population exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.



Product Service

1.4.3 Configuration 3 - RLAN with 1st Diversity Antenna

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.5738	50.0000	14.7072	137.0000	0.0390	0.3630
FCC*	0.0574	5.0000	N/A	N/A	N/A	N/A
IC	0.5738	46.3233	14.7072	132.1528	0.0390	0.3505
AUS	0.5738	50.0000	14.7072	137.0000	0.0390	0.3640

* Requirement and Result in mW/cm²

Table 6 – Occupational Results

The calculations show that the EUT complies with the occupational exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.5738	10.0000	14.7072	61.0000	0.0390	0.1620
FCC*	0.0574	1.0000	N/A	N/A	N/A	N/A
IC	0.5738	9.0112	14.7072	58.2815	0.0390	0.1546
AUS	0.5738	10.0000	14.7072	61.4000	0.0390	0.1630

* Requirement and Result in mW/cm²

Table 7 – General Population Results

The calculations show that the EUT complies with the general population exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.



Product Service

1.4.4 Configuration 4 - Bluetooth and RLAN with 1st Diversity Antenna

The tables below show the summed fractional results from the antenna port summary in section 2.2. Where the result is less than one, the EUT is deemed compliant.

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m as a Fraction of the Limit		
	S Field	E Field	H Field
EU	0.0119	0.1291	0.1293
FCC	0.0119	N/A	N/A
IC	0.0131	0.1386	0.1386
AUS	0.0119	0.1291	0.1289

Table 8 – Occupational Results

The calculations show that the EUT complies with the occupational exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m as a Fraction of the Limit		
	S Field	E Field	H Field
EU	0.0597	0.2900	0.2897
FCC	0.0597	N/A	N/A
IC	0.0681	0.3188	0.3188
AUS	0.0597	0.2882	0.2879

Table 9 – General Population Results

The calculations show that the EUT complies with the general population exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.



Product Service

1.4.5 Configuration 5 - Bluetooth with 2nd Diversity Antenna

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.0216	50.0000	2.8512	137.0000	0.0076	0.3630
FCC*	0.0022	5.0000	N/A	N/A	N/A	N/A
IC	0.0216	31.6361	2.8512	109.2114	0.0076	0.2897
AUS	0.0216	50.0000	2.8512	137.0000	0.0076	0.3640

* Requirement and Result in mW/cm²

Table 10 – Occupational Results

The calculations show that the EUT complies with the occupational exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.0216	10.0000	2.8512	61.0000	0.0076	0.1620
FCC*	0.0022	1.0000	N/A	N/A	N/A	N/A
IC	0.0216	5.3508	2.8512	44.9105	0.0076	0.1191
AUS	0.0216	10.0000	2.8512	61.4000	0.0076	0.1630

* Requirement and Result in mW/cm²

Table 11 – General Population Results

The calculations show that the EUT complies with the general population exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.



Product Service

1.4.6 Configuration 6 - WLAN with 2nd Diversity Antenna

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.3081	50.0000	10.7778	137.0000	0.0286	0.3630
FCC*	0.0308	5.0000	N/A	N/A	N/A	N/A
IC	0.3081	31.7019	10.7778	109.3249	0.0286	0.2900
AUS	0.3081	50.0000	10.7778	137.0000	0.0286	0.3640

* Requirement and Result in mW/cm²

Table 12 – Occupational Results

The calculations show that the EUT complies with the occupational exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.3081	10.0000	10.7778	61.0000	0.0286	0.1620
FCC*	0.0308	1.0000	N/A	N/A	N/A	N/A
IC	0.3081	5.3660	10.7778	44.9743	0.0286	0.1193
AUS	0.3081	10.0000	10.7778	61.4000	0.0286	0.1630

* Requirement and Result in mW/cm²

Table 13 – General Population Results

The calculations show that the EUT complies with the general population exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.



Product Service

1.4.7 Configuration 7 - RLAN with 2nd Diversity Antenna

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.5355	50.0000	14.2079	137.0000	0.0377	0.3630
FCC*	0.0535	5.0000	N/A	N/A	N/A	N/A
IC	0.5355	46.3233	14.2079	132.1528	0.0377	0.3505
AUS	0.5355	50.0000	14.2079	137.0000	0.0377	0.3640

* Requirement and Result in mW/cm²

Table 14 – Occupational Results

The calculations show that the EUT complies with the occupational exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m					
	S Field (W/m ²)		E Field (V/m)		H Field (A/m)	
	Result	Limit	Result	Limit	Result	Limit
EU	0.5355	10.0000	14.2079	61.0000	0.0377	0.1620
FCC*	0.0535	1.0000	N/A	N/A	N/A	N/A
IC	0.5355	9.0112	14.2079	58.2815	0.0377	0.1546
AUS	0.5355	10.0000	14.2079	61.4000	0.0377	0.1630

* Requirement and Result in mW/cm²

Table 15 – General Population Results

The calculations show that the EUT complies with the general population exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.



Product Service

1.4.8 Configuration 8 - Bluetooth and RLAN with 2nd Diversity Antenna

The tables below show the summed fractional results from the antenna port summary in section 2.2. Where the result is less than one, the EUT is deemed compliant.

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m as a Fraction of the Limit		
	S Field	E Field	H Field
EU	0.0111	0.1245	0.1247
FCC	0.0111	N/A	N/A
IC	0.0122	0.1336	0.1336
AUS	0.0111	0.1245	0.1243

Table 16 – Occupational Results

The calculations show that the EUT complies with the occupational exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.

Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m as a Fraction of the Limit		
	S Field	E Field	H Field
EU	0.0557	0.2797	0.2793
FCC	0.0557	N/A	N/A
IC	0.0635	0.3073	0.3072
AUS	0.0557	0.2778	0.2776

Table 17 – General Population Results

The calculations show that the EUT complies with the general population exposure levels described in the EN 62311:2008, CFR 47 Pt1.1310, Health Canada Safety Code 6 and ARPANSA Radiation Protection Series No.3 at the point of investigation, 0.20 m.



Product Service

SECTION 2

TEST DETAILS



Product Service

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 the relevant specifications.

The RF exposure assessment is based upon the following criteria:

The Minuet/FS5332 operates with the following transmitters active on the antenna ports shown in Section 1.3.3. For each transmitter, the Radio Access Technology (RAT), EIRP inclusive of antenna gain and duty cycle, gain of the antenna and lowest frequency of operation are shown as they contribute to the calculation of S Field, E field and H field values according to the following formulas.

The power flux (S Field):

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

The electric field strength (E Field):

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

The magnetic field strength (H Field):

$$H = \frac{E}{\eta_0}$$

Where:

P = Average Power (W)

G = Antenna Gain (dBi)

r = Distance (cm) or (m)

$\eta_0 = 377$



Product Service

2.2 TEST RESULT DETAILS

The frequencies shown in the tables below have been chosen based on the lowest possible frequency that the EUT can transmit.

2.2.1 Configuration 1 - Bluetooth with 1st Diversity Antenna

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	1	Bluetooth	0.012	100	2.3	2402	0.0236	2.9856	0.0079

Table 18 – Occupational Transmitter Summary

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	1	Bluetooth	0.012	100	2.3	2402	0.0236	2.9856	0.0079

Table 19 – General Population Transmitter Summary



Product Service

2.2.2 Configuration 2 - WLAN with 1st Diversity Antenna

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	1	WLAN	0.170	100	2.3	2412	0.3379	11.2858	0.0299

Table 20 – Occupational Transmitter Summary

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	1	WLAN	0.170	100	2.3	2412	0.3379	11.2858	0.0299

Table 21 – General Population Transmitter Summary



Product Service

2.2.3 Configuration 3 - RLAN with 1st Diversity Antenna

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	2	RLAN	0.288	100	4.6	5150	0.5738	14.7072	0.0390

Table 22 – Occupational Transmitter Summary

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	2	RLAN	0.288	100	4.6	5150	0.5738	14.7072	0.0390

Table 23 – General Population Transmitter Summary



Product Service

2.2.4 Configuration 4 - Bluetooth and RLAN with 1st Diversity Antenna

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	1	Bluetooth	0.012	100	2.3	2402	0.0236	2.9856	0.0079
2	1	2	RLAN	0.288	100	4.6	5150	0.5738	14.7072	0.0390

Table 24 – Occupational Transmitter Summary

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	1	Bluetooth	0.012	100	2.3	2402	0.0236	2.9856	0.0079
2	1	2	RLAN	0.288	100	4.6	5150	0.5738	14.7072	0.0390

Table 25 – General Population Transmitter Summary

The following tables show the regional requirements for the frequencies used in the RF exposure calculation. A full list of the requirements is shown in Annex A.

Frequency (MHz)	Occupational Limit			General Population Limit		
	S Field (W/m ²)	E Field (V/m)	H Field (A/m)	S Field (W/m ²)	E Field (V/m)	H Field (A/m)
2402	50.0000	137.0000	0.3630	10.0000	61.0000	0.1620
5150	50.0000	137.0000	0.3630	10.0000	61.0000	0.1620

Table 26 – EN 62311:2008 Limits

Frequency (MHz)	Occupational Limit			General Population Limit		
	S Field (mW/cm ²)	E Field (V/m)	H Field (A/m)	S Field (mW/cm ²)	E Field (V/m)	H Field (A/m)
2402	5.0000	-	-	1.0000	-	-
5150	5.0000	-	-	1.0000	-	-

Table 27 – CFR 47 Pt1.1310 Limits

Frequency (MHz)	Occupational Limit			General Population Limit		
	S Field (W/m ²)	E Field (V/m)	H Field (A/m)	S Field (W/m ²)	E Field (V/m)	H Field (A/m)
2402	31.6361	109.2114	0.2897	5.3508	44.9105	0.1191
5150	46.3233	132.1528	0.3505	9.0112	58.2815	0.1546

Table 28 – Health Canada Safety Code 6 Limits

Frequency (MHz)	Occupational Limit			General Population Limit		
	S Field (W/m ²)	E Field (V/m)	H Field (A/m)	S Field (W/m ²)	E Field (V/m)	H Field (A/m)
2402	50.0000	137.0000	0.3640	10.0000	61.4000	0.1630
5150	50.0000	137.0000	0.3640	10.0000	61.4000	0.1630

Table 29 – ARPANSA Radiation Protection Series No.3 Limits



Product Service

2.2.5 Configuration 5 - Bluetooth with 2nd Diversity Antenna

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	3	Bluetooth	0.011	100	1.9	2402	0.0216	2.8512	0.0076

Table 30 – Occupational Transmitter Summary

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	3	Bluetooth	0.011	100	1.9	2402	0.0216	2.8512	0.0076

Table 31 – General Population Transmitter Summary



Product Service

2.2.6 Configuration 6 - WLAN with 2nd Diversity Antenna

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	3	WLAN	0.155	100	1.9	2412	0.3081	10.7778	0.0286

Table 32 – Occupational Transmitter Summary

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	3	WLAN	0.155	100	1.9	2412	0.3081	10.7778	0.0286

Table 33 – General Population Transmitter Summary



Product Service

2.2.7 Configuration 7 - RLAN with 2nd Diversity Antenna

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	4	RLAN	0.269	100	4.3	5150	0.5355	14.2079	0.0377

Table 34 – Occupational Transmitter Summary

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	4	RLAN	0.269	100	4.3	5150	0.5355	14.2079	0.0377

Table 35 – General Population Transmitter Summary



Product Service

2.2.8 Configuration 8 - Bluetooth and RLAN with 2nd Diversity Antenna

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	3	Bluetooth	0.011	100	1.9	2402	0.0216	2.8512	0.0076
2	1	4	RLAN	0.269	100	4.3	5150	0.5355	14.2079	0.0377

Table 36 – Occupational Transmitter Summary

Antenna Port	Tx No.	Ant No.	RAT	EIRP (W)	Duty Cycle (%)	Gain (dBi)	Frequency (MHz)	RF Exposure Level at compliance boundary of 0.20 m		
								S Field (W/m ²)	E Field (V/m)	H Field (A/m)
1	1	3	Bluetooth	0.011	100	1.9	2402	0.0216	2.8512	0.0076
2	1	4	RLAN	0.269	100	4.3	5150	0.5355	14.2079	0.0377

Table 37 – General Population Transmitter Summary

The following tables show the regional requirements for the frequencies used in the RF exposure calculation. A full list of the requirements is shown in Annex A.

Frequency (MHz)	Occupational Limit			General Population Limit		
	S Field (W/m ²)	E Field (V/m)	H Field (A/m)	S Field (W/m ²)	E Field (V/m)	H Field (A/m)
2402	50.0000	137.0000	0.3630	10.0000	61.0000	0.1620
5150	50.0000	137.0000	0.3630	10.0000	61.0000	0.1620

Table 38 – EN 62311:2008 Limits

Frequency (MHz)	Occupational Limit			General Population Limit		
	S Field (mW/cm ²)	E Field (V/m)	H Field (A/m)	S Field (mW/cm ²)	E Field (V/m)	H Field (A/m)
2402	5.0000	-	-	1.0000	-	-
5150	5.0000	-	-	1.0000	-	-

Table 39 – CFR 47 Pt1.1310 Limits

Frequency (MHz)	Occupational Limit			General Population Limit		
	S Field (W/m ²)	E Field (V/m)	H Field (A/m)	S Field (W/m ²)	E Field (V/m)	H Field (A/m)
2402	31.6361	109.2114	0.2897	5.3508	44.9105	0.1191
5150	46.3233	132.1528	0.3505	9.0112	58.2815	0.1546

Table 40 – Health Canada Safety Code 6 Limits

Frequency (MHz)	Occupational Limit			General Population Limit		
	S Field (W/m ²)	E Field (V/m)	H Field (A/m)	S Field (W/m ²)	E Field (V/m)	H Field (A/m)
2402	50.0000	137.0000	0.3640	10.0000	61.4000	0.1630
5150	50.0000	137.0000	0.3640	10.0000	61.4000	0.1630

Table 41 – ARPANSA Radiation Protection Series No.3 Limits



2.2.9 Configuration 4 - Bluetooth and RLAN with 1st Diversity Antenna

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 calculated RF exposure fields are divided by the limit to get a fractional exposure value. Any values less than one are compliant with the limit. Table 2 shows a summary of each antenna port and the summation of the fractional RF exposure results of each transmitter.

Antenna Port	EIRP (W)	Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m as a Fraction of the Limit		
			S Field	E Field	H Field
1	0.012	EU	0.0005	0.0218	0.0218
		FCC	0.0005	N/A	N/A
		IC	0.0007	0.0273	0.0273
		AUS	0.0005	0.0218	0.0218
2	0.288	EU	0.0115	0.1074	0.1075
		FCC	0.0115	N/A	N/A
		IC	0.0124	0.1113	0.1113
		AUS	0.0115	0.1074	0.1072

Table 42 – Occupational Antenna Port Summary

Antenna Port	EIRP (W)	Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m as a Fraction of the Limit		
			S Field	E Field	H Field
1	0.012	EU	0.0024	0.0489	0.0489
		FCC	0.0024	N/A	N/A
		IC	0.0044	0.0665	0.0665
		AUS	0.0024	0.0486	0.0486
2	0.288	EU	0.0574	0.2411	0.2408
		FCC	0.0574	N/A	N/A
		IC	0.0637	0.2523	0.2523
		AUS	0.0574	0.2395	0.2393

Table 43 – General Population Antenna Port Summary



2.2.10 Configuration 8 - Bluetooth and RLAN with 2nd Diversity Antenna

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 calculated RF exposure fields are divided by the limit to get a fractional exposure value. Any values less than one are compliant with the limit. Table 2 shows a summary of each antenna port and the summation of the fractional RF exposure results of each transmitter.

Antenna Port	EIRP (W)	Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m as a Fraction of the Limit		
			S Field	E Field	H Field
1	0.011	EU	0.0004	0.0208	0.0208
		FCC	0.0004	N/A	N/A
		IC	0.0007	0.0261	0.0261
		AUS	0.0004	0.0208	0.0208
2	0.269	EU	0.0107	0.1037	0.1038
		FCC	0.0107	N/A	N/A
		IC	0.0116	0.1075	0.1075
		AUS	0.0107	0.1037	0.1035

Table 44 – Occupational Antenna Port Summary

Antenna Port	EIRP (W)	Regional Requirement	Calculated RF exposure level at compliance boundary of 0.20 m as a Fraction of the Limit		
			S Field	E Field	H Field
1	0.011	EU	0.0022	0.0467	0.0467
		FCC	0.0022	N/A	N/A
		IC	0.0040	0.0635	0.0635
		AUS	0.0022	0.0464	0.0464
2	0.269	EU	0.0535	0.2329	0.2326
		FCC	0.0535	N/A	N/A
		IC	0.0594	0.2438	0.2438
		AUS	0.0535	0.2314	0.2312

Table 45 – General Population Antenna Port Summary



Product Service

SECTION 3

DISCLAIMERS AND COPYRIGHT



Product Service

3.1 DISCLAIMERS AND COPYRIGHT

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

This report must not be reproduced, except in its entirety, without the written permission of
TÜV SÜD Product Service

© 2016 TÜV SÜD Product Service



Product Service

ANNEX A

REGIONAL REQUIREMENTS



Product Service

Frequency Range (MHz)	Power Density (W/m ²)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)
0.065 - 1	-	610/f	1.6/f
1 - 10	-	610/f	1.6/f
10 - 400	10	61	0.162
400 - 2000	f/40	3*f ^{0.5}	0.00796*f ^{0.5}
2000 - 300000	50	137	0.363

Table A.1 – EN 62311:2008 Occupational Limits

Frequency Range (MHz)	Power Density (W/m ²)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)
0.003 - 0.15	-	87	5
0.15 - 1	-	87/f	0.73/f
1 - 10	-	87/f ^{0.5}	0.73/f
10 - 400	2	27	0.071
400 - 2000	f/200	1.375*f ^{0.5}	0.00364*f ^{0.5}
2000 - 300000	10	61	0.162

Table A.2 – EN 62311:2008 General Population Limits

Frequency Range (MHz)	S Field (mW/cm ²)	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 – CFR 47 Pt1.1310 Occupational Limits

Frequency Range (MHz)	S Field (mW/cm ²)	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 – CFR 47 Pt1.1310 General Population Limits

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 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 Population 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



Product Service

1 - 10	$1000/f^2$	614	$1.63/f$
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 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 Population Limits