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Report On

FCC and Industry Canada Testing of the
Frontier Silicon Ltd Tuscany FS2230 Module
In accordance with FCC CFR 47 Part 15B and ICES-003

COMMERCIAL-IN-CONFIDENCE

FCC ID: YYX-HA-FS2230-F

Document 75923564 Report 03 Issue 1 August 2013

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REPORT ON

FCC and Industry Canada Testing of the
Frontier Silicon Ltd Tuscany FS2230 Module
In accordance with FCC CFR 47 Part 15B and ICES-003

Document 75923564 Report 03 Issue 1

August 2013

PREPARED FOR

Frontier Silicon Ltd
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PREPARED BY

Natalie Bennett
Senior Administrator (Technical)

APPROVED BY

Simon Bennett
Authorised Signatory

DATED 27 August 2013

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC CFR 47 Part 15B and ICES-003. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

G Lawler

Product Service

CONTENTS

Product Service

SECTION 1

REPORT SUMMARY

FCC and Industry Canada Testing of the
Frontier Silicon Ltd Tuscany FS2230 Module
In accordance with FCC CFR 47 Part 15B and ICES-003

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the FCC and Industry Canada Testing of the Frontier Silicon Ltd Tuscany FS2230 Module to the requirements of FCC CFR 47 Part 15B and ICES-003.

Objective	To perform FCC and Industry Canada Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Frontier Silicon Ltd
Model Number(s)	FS2230
Serial Number(s)	RAD104661
Number of Samples Tested	1
Test Specification/Issue/Date	FCC CFR 47 Part 15B (2012) ICES-003 (2012)
Incoming Release Date	Application Form 20 August 2013
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	FS130751 18 July 2013
Start of Test	12 August 2013
Finish of Test	14 August 2013
Name of Engineer(s)	G Lawler

Product Service

1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 15B and ICES-003 is shown below.

Section	Spec Clause		Test Description	Result	Comments/Base Standard
	Pt 15B	ICES-003			
USB Connection to PC					
2.1	15.107	6.1	AC Line Conducted Emissions	Pass	
2.2	15.109	6.2	Radiated Emissions	Pass	

Product Service

1.3 APPLICATION FORM

EQUIPMENT DESCRIPTION	
Model Name/Number	Tuscany/FS2230
Part Number	HA-FS2230-aaaaaa (where aaaaaa indicates variant number)
FCC ID (if applicable)	YYX-HA-FS2230-F
Industry Canada ID (if applicable)	
Technical Description (Please provide a brief description of the intended use of the equipment)	The Tuscany FS2230 Module is an integrated wireless speaker module from Frontier Silicon. Tuscany FS2230 Module's flexible design enables production of audio devices featuring a combination of high-performance Bluetooth®, dual-band DAB/DAB+, FM with RDS and USB docking at low-cost. The module provides all interfaces necessary for a fully functional Bluetooth wireless speaker system with docking capability and digital /analogue radio, needing only power supply, display, keypad, audio amplifier and speakers to complete a product.

Types of Modulations used by the Equipment	
☒	FHSS
☐	Other forms of modulation
In case of FHSS Modulation	
In case of non-Adaptive Frequency Hopping equipment:	
	Number of Hopping Frequencies: 79
In case of Adaptive Frequency Hopping Equipment:	
	Maximum number of Hopping Frequencies: 79
	Minimum number of Hopping Frequencies: 20
Dwell Time: DH1: 405 µsec, DH3: 1.655 msec, DH5: 2.905 msec	
Minimum Channel Occupation Time: DH1: 405 µsec, DH3: 1.655 msec, DH5: 2.905 msec	
Adaptive / non-adaptive equipment:	
☐	non-adaptive Equipment
☐	adaptive Equipment without the possibility to switch to a non-adaptive mode
☒	adaptive Equipment which can also operate in a non-adaptive mode
In case of adaptive equipment:	
The Channel Occupancy Time implemented by the equipment: 405 µs to 2.905 ms	
☐	The equipment has implemented an LBT based DAA mechanism
In case of equipment using modulation different from FHSS:	
☐	The equipment is Frame Based equipment
☐	The equipment is Load Based equipment
☐	The equipment can switch dynamically between Frame Based and Load Based equipment
The CCA time implemented by the equipment: µs	
The value q as referred to in clause 4.3.2.5.2.2.2	
☒	The equipment has implemented an non-LBT based DAA mechanism
☐	The equipment can operate in more than one adaptive mode

Product Service

In case of non-adaptive Equipment:		
The maximum RF Output Power (e.i.r.p.): 12 dBm		
The maximum (corresponding) Duty Cycle: 77 %		
Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared):		
N/A		
The worst case operational mode for each of the following tests:		
RF Output Power: DH1/DH3/DH5		
Power Spectral Density: DH1/DH3/DH5		
Duty cycle, Tx-Sequence, Tx-gap: DH5		
Dwell time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment): DH1		
Hopping Frequency Separation (only for FHSS equipment): DH1/DH3/DH5		
Medium Utilisation: DH5		
Adaptivity & Receiver Blocking: DH5		
Occupied Channel Bandwidth: 3DH1/3DH3/3DH5		
Transmitter unwanted emissions in the OOB domain: DH5		
Transmitter unwanted emissions in the spurious domain: DH5		
Receiver spurious emissions: N/A		
The different transmit operating modes (tick all that apply):		
☒	Operating mode 1: Single Antenna Equipment	
	☒	Equipment with only 1 antenna
	☐	Equipment with 2 diversity antennas but only 1 antenna active at any moment in time
	☐	Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode where only 1 antenna is used. (e.g. IEEE 802.11™ [i.3] legacy mode in smart antenna systems)
☐	Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming	
	☐	Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode)
	☐	High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1
	☐	High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2
NOTE: Add more lines if more channel bandwidths are supported.		
☐	Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming	
	☐	Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode)
	☐	High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1
	☐	High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2
NOTE: Add more lines if more channel bandwidths are supported.		
In case of Smart Antenna Systems:		
The number of Receive chains: N/A		
The number of Transmit chains: N/A		
☐	symmetrical power distribution	
☐	asymmetrical power distribution	
In case of beam forming, the maximum beam forming gain:		
NOTE: Beam forming gain does not include the basic gain of a single antenna.		

Product Service

Operating Frequency Range(s) of the equipment:	
Operating Frequency Range 1: 2402 MHz to 2480 MHz	BT for EU, FCC and Industry Canada (e.g Bluetooth for EU)
Operating Frequency Range 2: MHz to MHz	(e.g WLAN for EU)
Operating Frequency Range 3: MHz to MHz	(e.g Bluetooth for FCC and/or Industry Canada)
Operating Frequency Range 4: MHz to MHz	(e.g WLAN for FCC and/or Industry Canada)
NOTE: Add more lines if more Frequency Ranges are supported.	
Occupied Channel Bandwidth(s):	
Occupied Channel Bandwidth1: 0.8 MHz to 1.2 MHz	
Occupied Channel Bandwidth2: MHz to MHz	
NOTE: Add more lines if more channel bandwidths are supported.	
Type of Equipment (stand-alone, combined, plug-in radio device, etc.):	
☐ Stand-alone	
☐ Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment)	
☒ Plug-in radio device (Equipment intended for a variety of host systems)	
☐ Other	
The extreme operating conditions that apply to the equipment:	
Operating temperature range: -20 °C to +70 °C	
Operating voltage range: 2.97 V, 1.14 V V to 3.6 V, 1.26 V	☐ AC ☒ DC
Details provided are for the:	
☒ stand-alone equipment	
☒ combined (or host) equipment	
☒ test jig	

Product Service

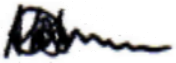
The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels:			
Antenna Type:			
☒ Integral Antenna			
Antenna Gain: 4 dBi			
If applicable, additional beamforming gain (excluding basic antenna gain): dB			
☒ Temporary RF connector provided			
☐ No temporary RF connector provided			
☐ Dedicated Antennas (equipment with antenna connector)			
☐ Single power level with corresponding antenna(s)			
☐ Multiple power settings and corresponding antenna(s)			
Number of different Power Levels:			
Power Level 1: dBm			
Power Level 2: dBm			
Power Level 3: dBm			
Power Level 4: dBm			
NOTE 1: Add more lines in case the equipment has more power levels.			
NOTE 2: These power levels are conducted power levels (at antenna connector).			
For each of the Power Levels, provide the intended antenna assemblies, their corresponding gains (G) and the resulting e.i.r.p. levels also taking into account the beamforming gain (Y) if applicable			
Power Level 1: 8 dBm			
Number of antenna assemblies provided for this power level:			
Assembly #	**Gain (dBi)**	**e.i.r.p (dBm)**	**Part number or model number**
1	**4**	**12**	**On Board PIFA**
2			
3			
4			
NOTE: Add more rows in case more antenna assemblies are supported for this power level.			
Power Level 2: dBm			
Number of antenna assemblies provided for this power level:			
Assembly #	**Gain (dBi)**	**e.i.r.p (dBm)**	**Part number or model number**
1			
2			
3			
4			
NOTE: Add more rows in case more antenna assemblies are supported for this power level.			
Power Level 3: dBm			
Number of antenna assemblies provided for this power level:			
Assembly #	**Gain (dBi)**	**e.i.r.p (dBm)**	**Part number or model number**
1			
2			
3			
4			
NOTE: Add more rows in case more antenna assemblies are supported for this power level.			

Product Service

The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:	
Details provided are for the: ☒ stand-alone equipment	
☒ combined (or host) equipment	
☒ test jig	
Supply Voltage ☐ AC mains State AC voltage	
☒ State DC voltage 3.3 V and 1.2 V	
In case of DC, indicate the type of power source	
☐ Internal Power Supply	
☒ External Power Supply or AC/DC adapter	
☐ Battery	
☐ Other:	
Describe the test modes available which can facilitate testing:	
CSR BTCLI Software	
The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], proprietary, etc.):	
Bluetooth	
Combination for testing (see clause 5.1.3.3 of EN 300 328 V1.8.1)	
From all combinations of conducted power settings and intended antenna assembly(ies) specified in clause 3.1 m), specify the combination resulting in the highest e.i.r.p. for the radio equipment. Unless otherwise specified in EN 300 328, this power setting is to be used for testing against the requirements of EN 300 328. In case there is more than one such conducted power setting resulting in the same (highest) e.i.r.p. level, the highest power setting is to be used for testing. See also EN 300 328, clause 5.1.3.3.	
Highest overall e.i.r.p. value: 14 dBm	
Corresponding Antenna assembly gain: 4 dBi	Antenna Assembly #: 1
Corresponding conducted power setting: 8 dBm	Listed as Power Setting #: Maximum
(also the power level to be used for testing) Maximum	
Additional information provided by the applicant	
Modulation	
ITU Class(es) of emission: 840KF9W / IM2G9W / IM2G9W	
Can the transmitter operate unmodulated? ☒ Yes ☐ No	
Duty Cycle	
The transmitter is intended for:	
☐ Continuous duty	
☐ Intermittent duty	
☒ Continuous operation possible for testing purposes	
About the UUT	
☐ The equipment submitted are representative production models	
☒ If not, the equipment submitted are pre-production models ?	
☒ If pre-production equipment are submitted, the final production equipment will be identical in all respects with the equipment tested	
☐ If not, supply full details	
☐ The equipment submitted is CE marked	
☐ In addition to the CE mark, the Class-II identifier (Alert Sign) is affixed.	

	Additional items and/or supporting equipment provided
☐	Spare batteries (e.g. for portable equipment)
☐	Battery charging device
☒	External Power Supply or AC/DC adapter
☒	Test Jig or interface box
☒	RF test fixture (for equipment with integrated antennas)
☒	Host System
	Manufacturer
	Model
	Model Name
☐	Combined equipment
	Manufacturer
	Model
	Model Name
☐	User Manual
☐	Technical documentation (Handbook and circuit diagrams)

I hereby declare that I am entitled to sign on behalf of the applicant and that the information supplied is correct and complete.

Signature:  Name: Abdul Wahed Dewan

Position held: Principal RF Engineer Date: 20 August 2013

1.4 PRODUCT INFORMATION

1.4.1 Technical Description

The Equipment Under Test (EUT) was a Frontier Silicon Ltd Tuscany FS2230 Module. A full technical description can be found in the manufacturer's documentation.

1.5 TEST CONDITIONS

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure.

The EUT was powered from a 3.3 V DC and 1.2 V DC supply.

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards were made during testing.

1.7 MODIFICATION RECORD

Modification 0 - No modifications were made to the test sample during testing.

Product Service

SECTION 2

TEST DETAILS

FCC and Industry Canada Testing of the
Frontier Silicon Ltd Tuscany FS2230 Module
In accordance with FCC CFR 47 Part 15B and ICES-003

2.1 AC LINE CONDUCTED EMISSIONS

2.1.1 Specification Reference

FCC CFR 47 Part 15B, Clause 15.107
ICES-003, Clause 6.1

2.1.2 Equipment Under Test and Modification State

Tuscany FS2230 Module S/N: RAD104661 - Modification State 0

2.1.3 Date of Test

14 August 2013

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Test Procedure

The EUT is set up on a test table 800mm above a horizontal ground plane. A vertical ground plane is also required and is placed 400mm from the EUT. Where a EUT is floor standing it will be stood on but insulated from the ground plane by up to 12mm.

The EUT is powered through a Line Impedance Stabilisation Network (LISN) which is bonded to the ground plane. The EUT is located so that the distance between the EUT and the LISN is no less than 800mm. Where possible the cable between the mains input of the EUT and the LISN is 1m. Where this is not possible the cable is non inductively bundled with the bundle not exceeding 400mm in length.

A preliminary profile of the Conducted Emissions is obtained over the frequency range 150kHz to 30MHz. Any points of interest are noted for formal measurements.

During formal measurements, the measuring receiver is tuned to the emission of interest where Quasi – Peak and Average measurements are performed in a 9kHz Video and Resolution Bandwidth.

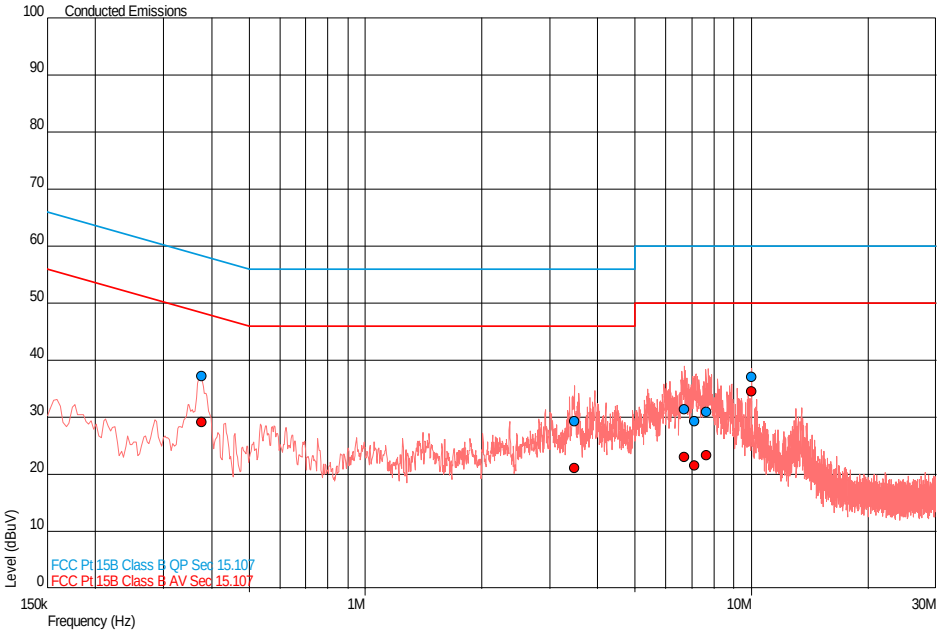
2.1.6 Environmental Conditions

Ambient Temperature	24.1°C
Relative Humidity	42.0%

Product Service

2.1.7 Test Results

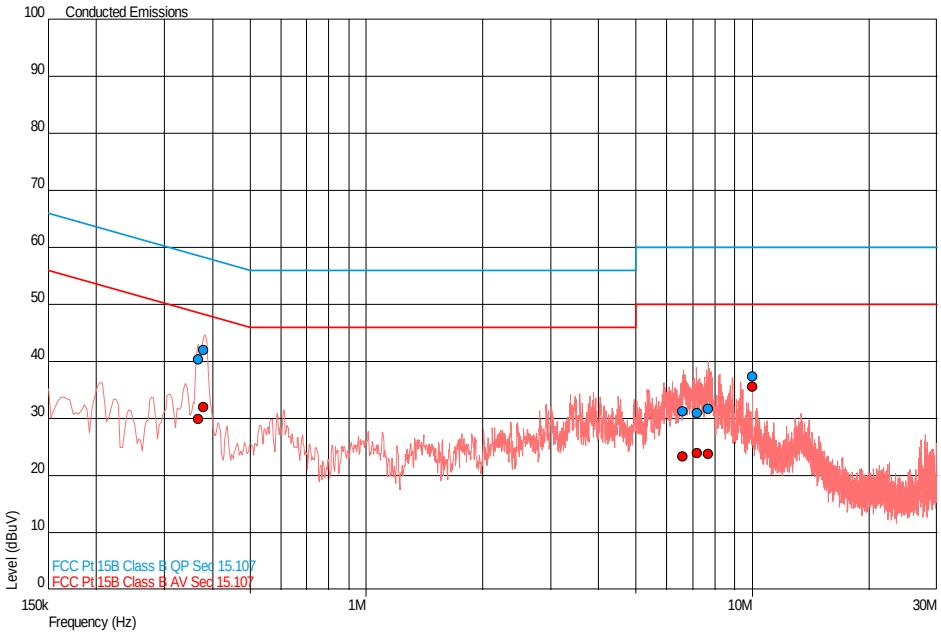
Live Line



Frequency (MHz)	QP Level (dBµV)	QP Limit (dBµV)	QP Margin (dBµV)	AV Level (dBµV)	AV Limit (dBµV)	AV Margin (dBµV)
0.377	37.3	58.4	-21.1	29.2	48.4	-19.2
3.481	29.3	56.0	-26.7	21.1	46.0	-24.9
6.708	31.4	60.0	-28.6	23.1	50.0	-26.9
7.102	29.3	60.0	-30.7	21.6	50.0	-28.4
7.625	30.9	60.0	-29.1	23.3	50.0	-26.7
10.000	37.0	60.0	-23.0	34.6	50.0	-15.4

Product Service

Neutral Line



Frequency (MHz)	QP Level (dBµV)	QP Limit (dBµV)	QP Margin (dBµV)	AV Level (dBµV)	AV Limit (dBµV)	AV Margin (dBµV)
0.367	40.3	58.6	-18.2	29.9	48.6	-18.7
0.378	42.1	58.3	-16.2	32.0	48.3	-16.3
6.602	31.3	60.0	-28.7	23.4	50.0	-26.6
7.173	31.0	60.0	-29.0	23.9	50.0	-26.1
7.672	31.7	60.0	-28.3	23.8	50.0	-26.2
10.000	37.4	60.0	-22.6	35.6	50.0	-14.4

2.2 RADIATED EMISSIONS

2.2.1 Specification Reference

FCC CFR 47 Part 15B, Clause 15.109
ICES-003, Clause 6.2

2.2.2 Equipment Under Test and Modification State

Tuscany FS2230 Module S/N: RAD104661 - Modification State 0

2.2.3 Date of Test

12 August 2013 & 13 August 2013

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Test Procedure

A preliminary profile of the Spurious Radiated Emissions is obtained up to the 5th harmonic of the EUT's highest internally generated fundamental frequency. For frequencies from 30MHz to 18GHz the EUT is placed on a test table 800mm above the ground plane. For frequencies above 18GHz, the EUT height is increased by 200mm to a height of 1000mm. This is to ensure the beam width of the measuring antenna gives sufficient vertical coverage of the EUT.

During characterisation the turntable azimuth is adjusted from 0 to 360 degrees with the measuring antenna in one polarity. It is then repeated for the other polarity. Any frequencies of interest are noted for formal measuring later. The distance from the measuring antenna to the boundary of the EUT is 3m. Above 18GHz this distance may be reduced to 1m.

During formal measurement the spectrum analyser is tuned to the frequency of the emission. The turntable azimuth is adjusted from 0 to 360 degrees to determine the point at which the maximum emission level occurs. Then the height of the measuring antenna is adjusted from a height of 1m to 4m to determine the height at which the maximum emission level occurs. Once the point of maximum emission has been determined the emission is measured. Emissions in the 30MHz to 1GHz range are measured using a CISPR Quasi – Peak detector function in a 120kHz bandwidth. Emissions in the range 1GHz to 40GHz require Peak and Average measurements. The Peak measurements are made using a peak detector with 1MHz Resolution and Video bandwidths. The average measurements employ a peak detector with a Resolution bandwidth of 1MHz and a Video bandwidth of 10Hz. If measurements are made at a 1m measuring distance, then 10dB is added to the specification limit.

2.2.6 Environmental Conditions

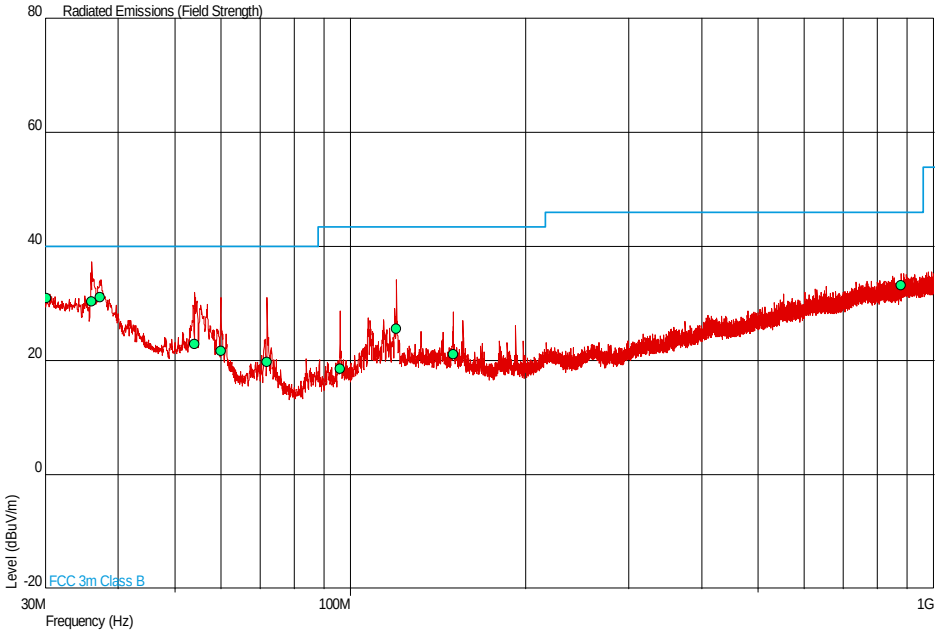
Ambient Temperature	24.1 - 24.2°C
Relative Humidity	33.0 - 36.0%

Product Service

2.2.7 Test Results

Channel 1

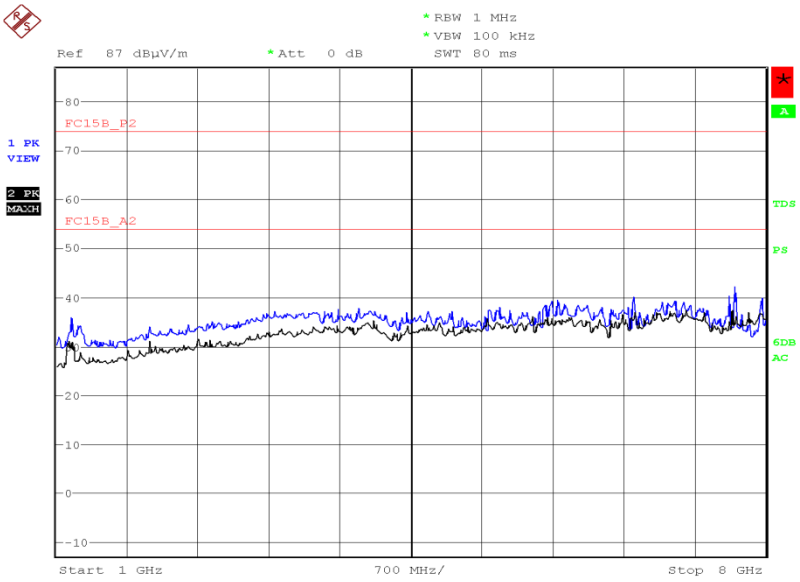
30 MHz to 1 GHz



Frequency (MHz)	QP Level (dBµV/m)	QP Level (µV/m)	QP Limit (dBµV/m)	QP Limit (µV/m)	QP Margin (dBµV/m)	QP Margin (µV/m)	Angle (Deg)	Height (m)	Polarity
30.188	31.0	35.5	40.0	100	-9.0	64.5	229	1.00	Horizontal
35.993	30.4	33.1	40.0	100	-9.6	66.9	50	1.00	Vertical
37.229	31.1	35.9	40.0	100	-8.9	64.1	110	1.00	Vertical
54.003	23.0	14.1	40.0	100	-17.0	85.9	359	1.00	Vertical
59.982	21.8	12.3	40.0	100	-18.2	87.7	114	1.00	Vertical
72.025	19.8	9.8	40.0	100	-20.2	90.2	155	1.00	Vertical
96.000	18.6	8.5	43.5	150	-24.9	141.5	129	1.00	Vertical
119.999	25.5	18.8	43.5	150	-18.0	131.2	114	1.00	Vertical
150.085	21.1	11.4	43.5	150	-22.4	138.6	105	1.00	Vertical
879.011	33.2	45.7	46.0	200	-12.8	154.3	304	1.00	Vertical

Product Service

1 GHz to 8 GHz



Date: 13.AUG.2013 17:22:29

Product Service

SECTION 3

TEST EQUIPMENT USED

Product Service

3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
Section 2.1 – AC Line Conducted Emissions					
Power Supply Unit	Farnell	LT-30-2	41	-	O/P Mon
LISN (1 Phase)	Chase	MN 2050	336	12	28-Mar-2014
Screened Room (5)	Rainford	Rainford	1545	36	25-Dec-2013
Transient Limiter	Hewlett Packard	11947A	2377	12	13-Feb-2014
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	11-Oct-2013
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	-	TU
Section 2.2 - Radiated Emissions					
Antenna (Double Ridge Guide)	Link Microtek Ltd	AM180HA-K-TU2	230	24	13-Sep-2013
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	12	3-Apr-2014
Antenna (Bilog)	Schaffner	CBL6143	287	24	18-Jan-2014
Filter (High Pass)	Lorch	SHP7-7000-SR	566	12	20-Feb-2014
Signal Generator (10MHz to 40GHz)	Rohde & Schwarz	SMR40	1002	12	6-Sep-2013
Pre-Amplifier	Phase One	PS04-0086	1533	12	27-Sep-2013
Pre-Amplifier	Phase One	PSO4-0087	1534	12	28-Sep-2013
Screened Room (5)	Rainford	Rainford	1545	36	25-Dec-2013
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Amplifier (1 - 8GHz)	Phase One	PS06-0060	3175	12	9-Aug-2014
Amplifier (8 - 18GHz)	Phase One	PS06-0061	3176	12	9-Aug-2014
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	11-Oct-2013
3 GHz High Pass Filter	K&L Microwave	11SH10-3000/X18000-O/O	3552	12	1-Feb-2014
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Tilt Antenna Mast	maturo Gmbh	TAM 4.0-P	3916	-	TU
Mast Controller	maturo Gmbh	NCD	3917	-	TU

TU – Traceability Unscheduled
O/P MON – Output Monitored with Calibrated Equipment

Product Service

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	MU
Radiated Emissions	30MHz to 1GHz: ± 5.1 dB 1GHz to 40GHz: ± 6.3 dB
AC Line Conducted Emissions	±3.2 dB

SECTION 4

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation.

Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).