

COMPLIANCE TESTING REPORT

FCC TITLE 47 PART 15

SUBPARTS A & C

Client: Imarda NZ Ltd

Address: Level 2, 135 Broadway, Newmarket, Auckland 1023
New Zealand

Report Number: 0930COR_V301_FCC15C

Date of Testing: 19th May to 23rd Sep 2016

File Number: COR160421

Equipment Name: V301

Equipment Model Number: V301-336-IX

Equipment Serial Numbers: 02205535

Equipment FCC ID: TXXV301-IX

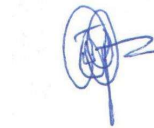
Equipment Description: Vehicle Tracking Device with Bluetooth

Result: **COMPLIES**

Tested by: Richard Turner
Steve Garnham




Approved by: Colin Gan



Date of Issue: 30th September 2016

AUSTEST (NSW) FCC REGISTRATION NUMBER 90455

Results appearing herein relate only to the sample(s) tested.

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Report Revision History:

Date	Report Number	Changes
23/08/2016	0823COR_V301_FCC15C	Original report
21/09/2016	0921COR_V301_FCC15C	Updated Annex B FCC Label with correct model number.
29/09/2016	0929COR_V301_FCC15C	Updated C63.10 version in Section 3. Updated page 17 plots, page 18 3 rd plot. Updated radiated emissions test setup photos above 1GHz in Appendix C.
30/09/2016	0930COR_V301_FCC15C	Updated project dates. Added Horn Antenna (ME1011) to Section 6.5. Section 10.2 point "c" edited to address 1.5m EUT height for measurements above 1GHz.

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1 TEST SUMMARY

Austest makes no claim regarding the consistency of production versions of the EUT.

The results in this report apply only to the tested EUT described in Section 0 of this report.

FCC Section	Test	Result	Notes
FCC Part 15, Subpart C – Intentional Radiators			
15.203	Antenna Requirement	COMPLIES	
15.205	Restricted Bands of Operation	COMPLIES	
15.207	Conducted Limits	NOT APPLICABLE	(iv)
15.209	Radiated Emission Limits, General Requirements	COMPLIES	
15.215	Additional Provisions to the General Radiated Limitations	COMPLIES	
15.247	Operation within the Bands 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz	NOT TESTED	(v)

Notes (applicable only if referenced in “Notes” column of above summary table):

- (i) EUT complies (the measurement results were below the applicable limits), but some emissions were within the range of measurement uncertainty of the limits.
- (ii) EUT complies (when modified as described in Section 2 of this report).
- (iii) There were deviations from the applied standard as described in Section 6.2 of this report.
- (iv) EUT is designed to be only powered from a vehicle’s battery supply.
- (v) Covered by test report 0731IMA_V301_FCC15C, under FCC ID: TXXV301.

2 MODIFICATIONS

No modifications were required to achieve compliance.

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3 REFERENCES

FCC Title47 Part 15 current as of May 2016
ANSI C63.10: 2013
DA 00-705, Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

4 EQUIPMENT UNDER TEST (EUT) DESCRIPTION

EUT Name:	V301
EUT Description:	Vehicle Tracking Device with Bluetooth
EUT Model:	V301-336-IX
EUT Serial Number:	00205535
EUT FCC ID:	TXXV301-IX
Manufacturer:	Imarda NZ Ltd.
Power Supply & Rating:	10 to 32VDC
Highest Clock/Operating Frequency:	Highest clock, specified by the client - 312MHz Highest possible operating frequency ~2480MHz (Bluetooth)
Lowest Internal Frequency source	32kHz clock
Transmit Frequency Range:	3G/GSM: Per Cinterion PHS8-P module specifications - Bluetooth: 2402MHz to 2480MHz
Transmit Power:	3G/GSM: Per Cinterion PHS8-P module specifications - Bluetooth: -6.3dBm
Modulation Technique:	3G/GSM: Per Cinterion PHS8-P module specifications - Bluetooth: GFSK
Number of Channels:	3G/GSM: Per Cinterion PHS8-P module specifications - Bluetooth: 79
Antenna Specifications:	- Cellular/GPS: Supplied Hirschmann GPS 18 90 LP/P antenna - Bluetooth: Internal RGFR9937380A3T surface mount antenna for Bluetooth, gain 2dBi

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The equipment under test (EUT) was a vehicle tracking device with Bluetooth.

It is a variant of a FCC Certified model (FCC ID: TXXV301) with the only difference being the removal of the WiFi transceiver.

Housed in a small plastic case, containing two PCB's, three data/IO ports and DC power connections.

The EUT contained the following radios:

Cinterion PHS8-P 3G/GSM module (FCC ID: QIPPHS8-P)

Telit JF2 GPS module

CSR Bluecore4 Bluetooth transceiver, p/n BC41B143A06-ANN-E4

The EUT Bluetooth RF circuitry contained a TDK DEA252480BT-2024C2 filter.

For 3G/GSM and GPS operation the EUT was supplied with a Hirschmann GPS 18 90 LP/P external antenna assembly.

For Bluetooth operation the EUT contained an internal RGFRA9937380A3T surface mount antenna,

The EUT would normally be powered by connection to a vehicle's 12V/24V battery supply. The EUT also contains a rechargeable Li polymer battery pack (Himax 3.7V 2500mAh), located in the top plastic cover, and a PowerStor Aerogel 5.4V 1.5F super capacitor.

Derived Models:

No other model variants to be included under the same FCC ID: TXXV301-IX.

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5 EUT TEST SETUP & CONFIGURATION

Refer to the photographs in APPENDIX C – EUT TEST SETUP PHOTOGRAPHS for the EUT test setup and physical configuration.

The following cables and auxiliary equipment as supplied by the client were used:

Connection / Port	Connecting Cable	Source / Load
Cellular and GPS	Two 3m shielded coaxial cables, bundled	Permanently fitted to the supplied Hirschmann antenna assembly
Con 1	40cm unshielded 10 core cable	Supplied termination block
Con 2	40cm unshielded 12 core cable	Supplied termination block
Con 3	40cm unshielded 6 core cable	Supplied termination block
USB	Not connected	
Power	2.8m unshielded 3 core cable	DC bench supply

The EUT data IO ports (Con 1, 2 and 3) were connected to three termination blocks, which in turn were connected to a supplied termination box using a 60cm long unshielded multi-core cable. Client instructions indicated no additional connections were to be made to the termination box.

The EUT boots using test firmware located on the supplied SD card. Once boot up was complete, the red and green LEDs on the EUT blinked, as well as LEDs on the termination block. Client instructions indicated this as a normal operating state.

The EUT was supplied with a SIM card fitted. Test firmware inhibited 3G and GSM transmission.

The USB port was only used for maintenance and programming. Prior to measurement the USB port was connected to a test PC to setup and control the Bluetooth transmissions, following instructions supplied by the client. During measurement of radiated emissions no cable was connected to this port.

The EUT was tested within the allowed temperature and humidity range.

The EUT was externally powered by connection to a DC bench power supply, providing either 12V or 28VDC.

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5.1 EUT Operating Modes

Mode No.	Operating Mode Description
1	Bluetooth operation, constant transmission (duty cycle 100%) on selected frequencies. As advised by the client, transmit power set to level 0xff25 with modulation (TestID=6).

6 TEST SPECIFICATIONS

6.1 Accreditations & Listings

Austest Laboratories has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules and Test Site Criteria (ANSI C63.4-2009) by the FCC Laboratory Division for Certification testing under Parts 15 or 18 of the FCC Rules.

Austest Laboratories (NSW)'s Yarramalong test facilities are listed with the FCC under Registration Number 90455.

Austest Laboratories (NSW)'s Yarramalong test facilities are accredited by A2LA. The tests reported herein have been performed in accordance with its terms of accreditation.

6.2 Deviations from Standards and/or Accreditations

None.

6.3 Test Facility

Testing was performed in New South Wales at Austest Laboratories (NSW)'s Yarramalong test facilities located at 46 Glenola Farm Lane in Yarramalong Valley, New South Wales, Australia.

Radiated emission testing was performed at an Open Area Test Site (OATS), where some ambient signals may exceed the continuous disturbance limit. The possibility of missing an emission during testing was removed by use of pre-scans, performed in a shielded enclosure, prior to the final OATS measurements.

6.4 Measurement Uncertainties

The following uncertainties are for a 95% level of confidence, with a coverage factor, $k=2$.

Test	Measurement Uncertainty
Radiated Emissions	$\pm 4.7\text{dB}$
Frequency	± 5 part in 10^{10}

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6.5 Test Equipment

Test Equipment	Brand & Model	Serial No./ID	Cal. Date	Cal. Due Date
EMI Receiver	HP 8574B	ME 72	12 Jun 2015	12 Jun 2017
Test Software	HP85969PC	-		Verified
Spectrum Analyser	HP 8593E	ME 584	06 Aug 2015	06 Aug 2017
Biconical Array Antenna	Emco EM6912	ME 297	03 Sep 2015	03 Sep 2017
Log-Periodic Array Antenna	Emco EM6950	ME 298	03 Sep 2015	03 Sep 2017
DRG Horn Antenna (1 – 18GHz)	AH Systems SAS-571	ME 107	31 May 2013	31 May 2016
DRG Horn Antenna (1 – 18GHz)	AH Systems SAS-571	ME1011	16 Oct 2014	16 Oct 2017
DRG Horn Antenna (18 – 25GHz)	AH Systems SAS-200/574	ME 600	13 Jan 2011	13 Jan 2017
Loop Antenna	EM-6876	ME 225	09 Sep 2015	09 Sep 2017
Pre-Amplifier (30MHz-1GHz)	HP 8447E	ME 100	01 Jun 2015	01 Jun 2017
Pre-Amplifier (1GHz-25GHz)	RE 218A	ME 651	03 Aug 2015	03 Aug 2017
Pre-Amplifier (4.5GHz–25GHz)	RE 518A	ME 650	03 Aug 2015	03 Aug 2017
Attenuator	Omni Spectra 10dB	1022627	27 Sep 2013	27 Sep 2016
Coaxial Cables	Suhner	Various	22 Oct 2015	22 Oct 2017
Multimeter	Yokogawa TY720	ME 765	29 Sep 2015	29 Sep 2017
Variable DC Power Supply	GWInstek GPS-3030D	-		Verified

All test equipment was checked and performance verified prior to testing.

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7 FCC Part 15C, Section 15.203 – ANTENNA REQUIREMENT

The EUT complied with the requirement of this Section since client had stated that it would only be installed by trained professional installers.

8 FCC Part 15C, Section 15.205 – RESTRICTED BANDS OF OPERATION

The EUT complied with the requirements of this Section since it did not operate within the listed Restricted Bands of Operation. Out of band emissions falling within the Restricted Bands of Operation were found to be below limits specified in section 15.209.

9 FCC Part 15C, Section 15.207 - CONDUCTED LIMITS NOT APPLICABLE.

The EUT was designed to be installed in a vehicle and would not be connected to an AC mains supply.

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10 FCC Part 15C, Section 15.209 - RADIATED EMISSION LIMITS, GENERAL REQUIREMENTS

Test Date:	19 & 20 May and 23 Sep 2016	Temperature:	20-26°C
Test Officer:	Richard Turner	Humidity:	54-68%
Test Location:	Austest Laboratories (NSW)		

10.1 EUT Operating Mode

- a. Mode 1 – Bluetooth operation, frequency hopping disabled.

10.2 Test Method

- a. Measurements were performed in accordance with ANSI C63.10-2009 and DA 00-705.
- b. Set the measuring receiver BW settings to:
 - i. 9kHz (150kHz to 30MHz) EMI Receiver BW.
 - ii. 120kHz (30MHz to 1GHz) EMI Receiver BW.
 - iii. 1MHz (above 1GHz) RBW, 1MHz or more VBW, using a Spectrum Analyser for Peak measurements.
 - iv. 1MHz (above 1GHz) RBW, 10Hz VBW with linear detection, using a Spectrum Analyser for Average measurements.
- c. The EUT was set up on a non-conductive turntable, 0.8m above the OATS conductive ground plane, and at the indicated test distance away from the measuring antenna for measurements below 1GHz. Above 1GHz, the EUT was set up at a height of 1.5m above the conductive ground plane with the addition of a 0.7m high table. The material specification for the top 0.7m table meets the ANSI C63.10:2013 requirements – i.e. it is non-conductive and of low permeability.
- d. To maximise emissions, rotate the EUT through 360° and adjust the measuring antenna height between 1m to 4m in the following antenna orientations:
 - i. Loop antenna (150kHz to 30MHz) – Coaxial and coplanar orientations.
 - ii. Biconical and Log-Periodic antennas (30MHz to 1GHz) - Both vertical and horizontal polarizations.
 - iii. Horn antenna (above 1GHz) - Both vertical and horizontal polarizations.
- e. Measure the maximised emission and repeat the above for all measurement frequencies.
- f. Average level measurements were not made where the peak level did not exceed the average limit.
- g. Check linearity of the measuring system, reducing gain when required.

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10.3 Sample Calculation Example

The final radiated emission levels were obtained from the measurement equipment software which automatically applied all the stored calibration factors. The calibration / correction factors were applied as follows:

$$E = V + AF + L_{cbl} - G_{pre}$$

Where:

- E = Radiated Electric Field Strength in dB μ V/m at the specified distance.
- V = EMI Receiver measured signal input voltage in dB μ V.
- AF = Antenna Factor of the measuring antenna in dB/m.
- L_{cbl} = Total cable insertion loss in dB.
- G_{pre} = Preamplifier gain in dB.

Frequency (MHz)	Receiver Level, V (dB μ V)	AF (dB/m)	L _{cbl} (dB)	G _{pre} (dB)	Corrected Level, E (dB μ V/m)
100.0	40.0	12.0	2.9	22.5	32.4

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10.4 Test Results

Preliminary measurements indicated radiated emission levels were not affected by DC supply voltage. Final measurements were performed with the EUT connected to a 12VDC supply.

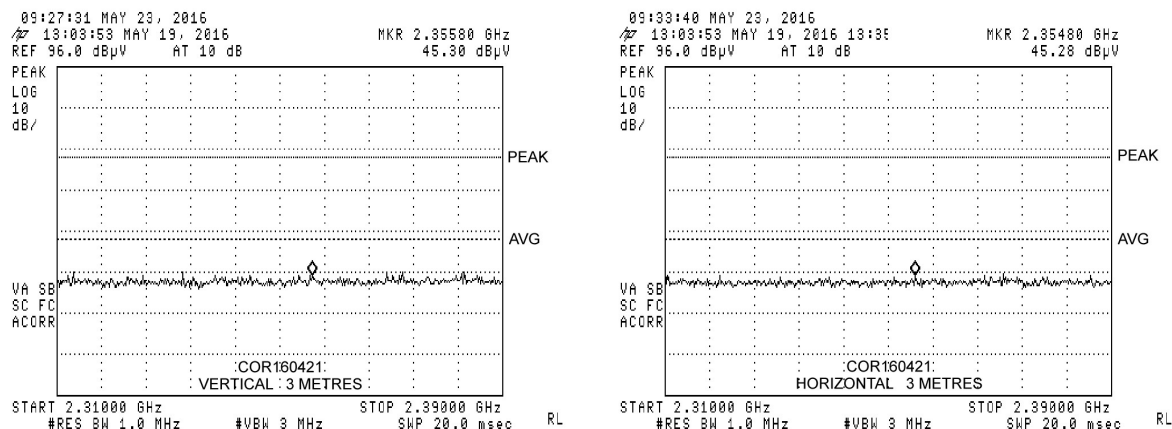
10.4.1 Band edge measurements at 3m distance

15.209 limit: 500 μ V/m using average detection. Peak limit set to 20dB above the average limit.

Mode 1 – Bluetooth operation - Restricted band 2310 to 2390MHz

TX power level setting 0xff25

No emissions levels were found above the system noise floor. No change when low, middle and high channels were selected. Disturbances >20dB below limits.



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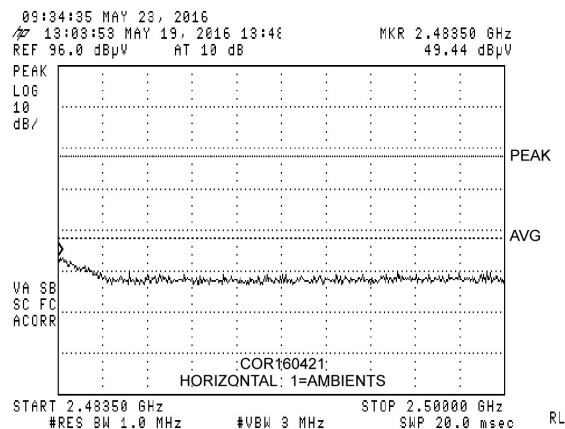
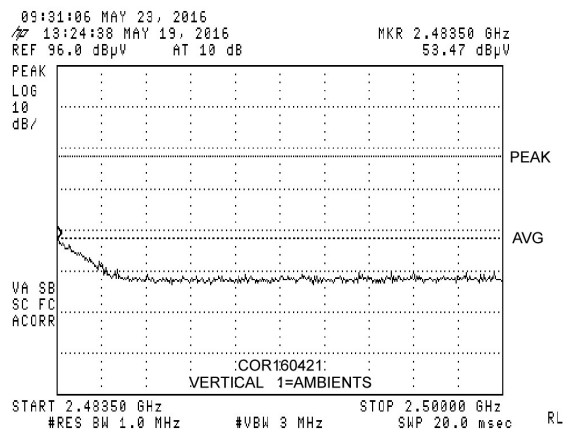


Mode 1 – Bluetooth operation - Restricted band 2483.5 to 2500MHz

TX power level setting 0xff25

Highest emissions occurred with constant transmission on the selected high channel (2480MHz).

Frequency MHz	Polarisation	Level dBµV/m		Limit dBµV/m		ΔPk Limit dB	Δ Avg Limit dB
		Peak	Average	Peak	Average		
2483.5	Vertical	53.5	-	74.0	54.0	20.5	-
2483.5	Horizontal	49.4	-	74.0	54.0	24.6	-



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10.4.2 Radiated Disturbances: 9kHz to 150kHz

Mode 1 – Bluetooth operation

TX power level setting 0xff25

Preliminary measurements indicated no significant intentional radiated emissions below 30MHz. All intentional radiation was greater than 20dB below the limits specified in section 15.209.

10.4.3 Radiated Disturbances: 150kHz to 30MHz at 3m distance

Mode 1 – Bluetooth operation

TX power level setting 0xff25

Preliminary measurements indicated no significant intentional radiated emissions below 30MHz. All intentional radiation was greater than 20dB below the limits specified in section 15.209.

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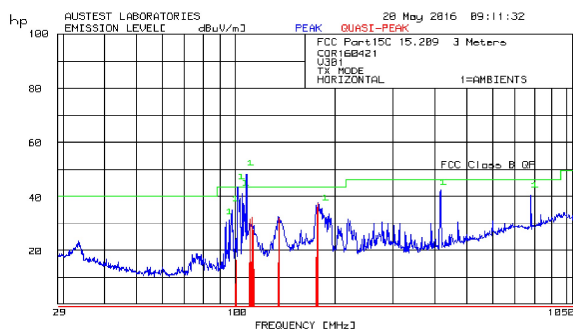
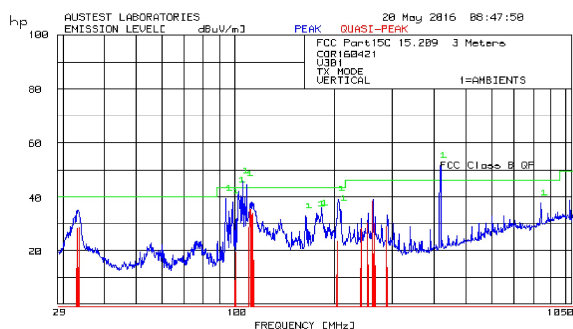
10.4.4 Radiated Disturbances: 30MHz to 1000MHz at 3m distance

Mode 1 – Bluetooth operation

The highest measured radiation level was 6.2dB below the quasi-peak limit specified in section 15.209 at 177.3MHz. Emission levels were not affected by RF frequency selection. Final measurement made using channel 2441MHz with TX power level setting 0xf25.

Frequency (MHz)	Qp level at 3m	Antenna Pol	QP Limit @ 3m		QP Pass Margin (dB)
			(dBμV/m)	(μV/m)	
177.3*	37.3	Horizontal	43.5	150	6.2
176.1*	36.0	Horizontal	43.5	150	7.5
260.0	38.4	Vertical	46.0	200	7.6
110.9	35.3	Vertical	43.5	150	8.2
113.3	34.1	Vertical	43.5	150	9.4
112.1	33.3	Vertical	43.5	150	10.2

*Frequencies not within a restricted band, refer FCC Title 47 section 15.205.



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10.4.5 Radiated Disturbances: 1000MHz to 10000MHz at 3m distance

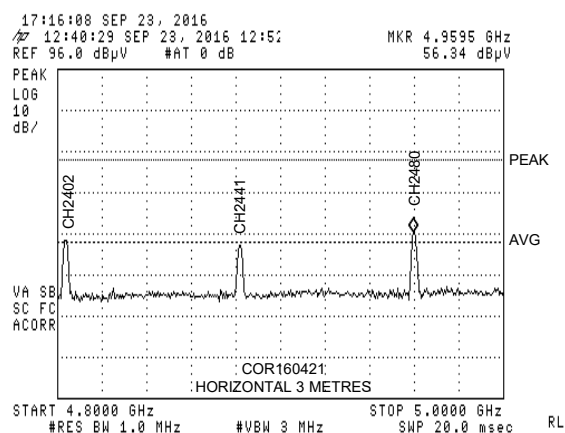
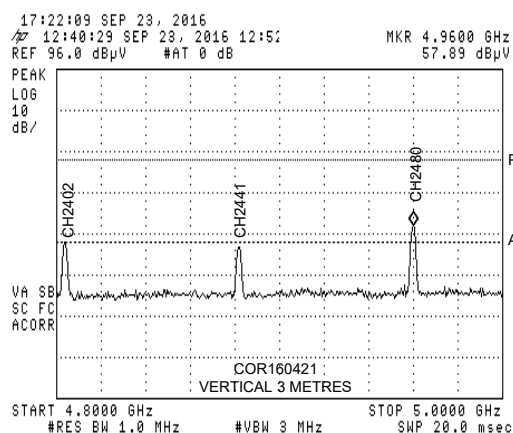
Mode 1 – Bluetooth operation

TX power level setting 0xff25

Highest measured intentional radiation as follows:

Frequency MHz	Polarisation	Level dBμV/m		Limit dBμV/m		ΔPk Limit dB	Δ Avg Limit dB
		Peak	Average	Peak	Average		
4804.0	Vertical	57.4	46.0	74.0	54.0	16.6	8.0
4882.0	Vertical	55.5	43.8	74.0	54.0	18.5	10.2
4960.0	Vertical	52.6	-	74.0	54.0	21.4	-
4804.0	Horizontal	50.6	-	74.0	54.0	23.4	-
4881.9	Horizontal	53.4	-	74.0	54.0	20.6	-
4960.0	Horizontal	55.7	44.2	74.0	54.0	18.3	9.8

Emission levels within the bands 1602MHz to 1654MHz were found to be greater than 20dB below the peak level.



Peak Detection – 4800MHz to 5000MHz

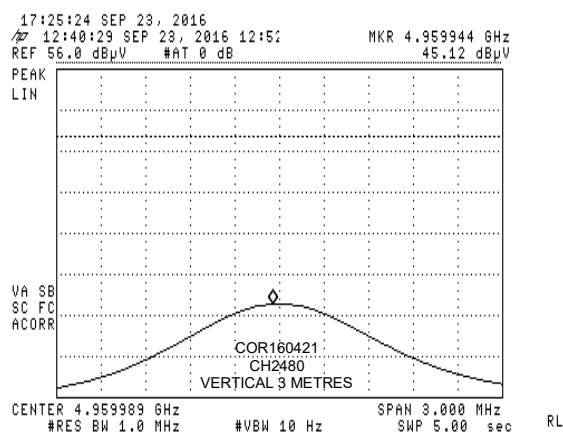
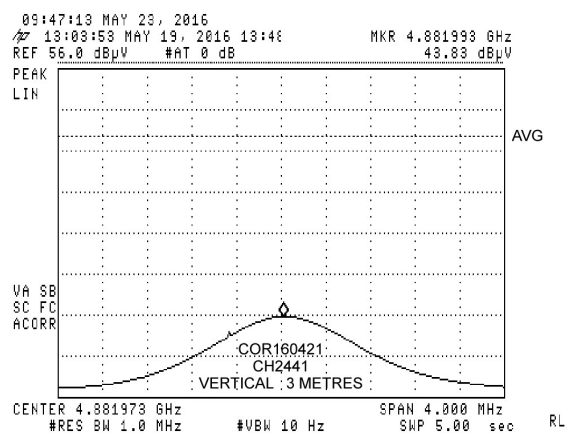
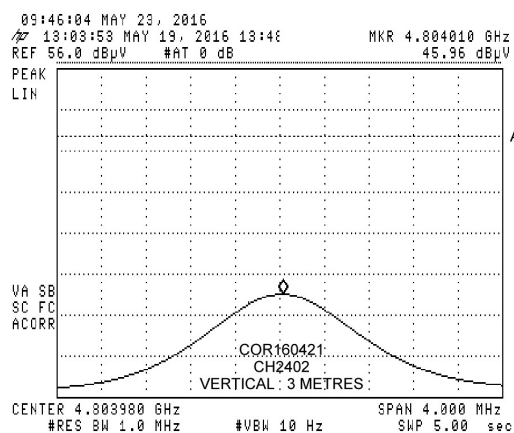
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Average Detection

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10.4.6 Radiated Disturbances: 10000MHz to 18000MHz at 1m distance

15.209 limit: 500µV/m using average detection at 3 metre distance. Peak limit set to 20dB above the average limit.

Any measured field strength levels performed at a 1 metre distance would be extrapolated to a 3 metre distance using the extrapolation factor of 20dB/decade as specified in section 15.31(f)(1).

Mode 1 – Bluetooth operation

TX power level setting 0xff25

No significant intentional radiation found.

10.4.7 Radiated Disturbances: 18000MHz to 25000MHz

Mode 1 – Bluetooth operation

TX power level setting 0xff25

Preliminary measurements indicated no significant radiation between 18000MHz and 25000MHz.

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2/9 Packard Avenue, Castle Hill NSW 2154 Australia Ph: +612 9680 9990



**11 FCC Part 15C, Section 15.247 – OPERATION WITHIN THE BANDS
902-928MHz, 2400-2483.5MHz, AND 5725-5850MHz**

NOT TESTED

Refer to previous testing covered by report 0731IMA_V301_FCCPT15C and found to be compliant.

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