



**FCC 47CFR part 15C
Test Report
For
DR1191 JN5168 Module
JN5168-001-M06**

Reference Standard: FCC 47CFR part 15C

Manufacturer: NXP Laboratories UK Ltd

For type of equipment and serial number, refer to section 3

Report Number: 11-6538-3-12 Issue 02

Supersedes report number 11-6538-3-12 Issue 01

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Certificate of Test 6538/3

The unit noted below has been tested by **R.N. Electronics Limited** and, where appropriate, conforms to the relevant subpart of FCC 47CFR Part 15. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

Equipment:	DR1191 JN5168 Module
Model Number:	JN5168-001-M06
Proposed FCC ID:	TYOJN5168M6
Unique Serial Number:	1
Manufacturer:	NXP Laboratories UK Ltd Furnival Street Sheffield S1 4QT
Customer Purchase Order Number:	GB628200059161
Full measurement results are detailed in Report Number:	11-6538-3-12 Issue 02
Test Standards:	FCC 47CFR Part 15.247 effective date October 1st 2012 , Class DTS Intentional Radiator

NOTE:

Certain tests were not performed based upon manufacturer's declarations. Certain other requirements are subject to manufacturer declaration only and have not been tested/verified. For details refer to section 3 of this report.

DEVIATIONS:

Deviations from the standards have been applied. For details refer to section 4.2 of this report.

This certificate relates only to the unit tested as identified by a unique serial number and in the condition at the time it was tested. It does not relate to any other similar equipment and performance of the product before or after the test cannot be guaranteed. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of unit not meeting the intentions of the standard or the requirements of the Directive, particularly under different conditions to those during testing. Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to one or more national authorities within the EU and (b) the modes of operation as instructed to us by the Customer based on their specific knowledge of the application and functionality of the EUT. Statements of compliance, where measurements were made, do not include the measurement uncertainty. The measurement uncertainty, where stated, is the expanded uncertainty based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Date of Test: 6th Nov 2012 - 9th Nov 2012

Test Engineer: Daniel Sims

Approved By:
Technical Director

Customer Representative:

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2 Summary of test results

The **DR1191 JN5168 Module** was tested to the following standards: -

FCC 47CFR Part 15.247 (effective date October 1st, 2012);
Class DTS Intentional Radiator

Any compliance statements are made reliant on the modes of operation as instructed to us by the Manufacturer based on their specific knowledge of the application and functionality of the equipment tested. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of equipment not meeting the intentions of the standard, particularly under different conditions to those during testing.

Title	Reference	Results
1. Conducted emissions	FCC Part 15C §15.207	Not Applicable ¹
2. Radiated emissions	FCC Part 15C §15.205, §15.209 and §15.247(d)	PASSED
3. Occupied bandwidth	FCC Part 15C §15.215(c), §15.247(a)(2)	PASSED
4. Peak conducted power	FCC Part 15C §15.247(b)	PASSED
5. Frequency tolerance	FCC Part 15C §15.215(c)	PASSED ²
6. Duty cycle	FCC Part 15C §15.35(c)	Not Applicable ³
7. Power Spectral Density	FCC Part 15C §15.247(e)	PASSED
8. Band edge compliance	FCC Part 15C §15.205, §15.209 and §15.247	PASSED
9. FHSS parameters	FCC Part 15C §15.247(a)(1)	Not Applicable ⁴

¹ EUT does not operate from the AC power lines nor contain provisions for operation while connected to AC power lines. N.b. although the EUT is intended to be powered from 3V dc supply (battery), it is also intended for modular approval. Any third party device it is incorporated into with a connection to the AC power line will require demonstration of compliance with the limits.

² No limits apply, however the requirement to contain the designated bandwidth of the emission within the specified frequency band includes the frequency stability of the transmitter over expected variations in temperature and supply voltage.

³ No limits apply, however duty cycle measurement performed to verify correction factors for average emissions.

⁴ EUT does not employ FHSS technology.

3 Equipment Under Test (EUT)

3.1 Equipment Specification

Applicant	NXP Laboratories UK Ltd Furnival Street Sheffield S1 4QT
Manufacturer of EUT	NXP Laboratories UK Ltd
Brand name of EUT	NXP Laboratories UK Ltd
Model Number of EUT	JN5168-001-M06
Proposed FCC ID	TYOJN5168M6
Serial Number of EUT	1
Date when equipment was received by RN Electronics	6 th Nov 2012
Date of test:	6th Nov 2012 - 9th Nov 2012
Customer order number:	GB628200059161
Visual description of EUT:	The EUT is a small PCB module. Canned on top, with uFL antenna port for RF i/o and on the bottom are header sockets for mounting onto a mother board.
Main function of the EUT:	IEEE 802.15.4/Zigbee Wireless Microcontroller Module
Height	30 mm
Width	16 mm
Depth	3 mm
Weight	5 g
Voltage	3V DC
Current required from above voltage source	not stated

3.2 EUT Configurations for testing

Frequency range	2405 – 2480 MHz
Normal use position	Portable (module for OEM integration)
Normal test signals	Internally generated IEEE 802.15.4 compliant test packets
Declared power level	22dBm at antenna port
Declared channel bandwidth	1.73 MHz
Highest frequency generated / used	2480 MHz
Lowest frequency generated / used	32 MHz

3.3 Functional Description

The DR1191 JN5168 High Power Module provides an easy way of interfacing to a wireless network based on the IEEE 802.15.4 protocol standard, where this network may additionally employ the ZigBee PRO or JenNet IP networking protocol. The module incorporates an NXP JN5168 wireless microcontroller.

Typical uses of the module include:

- A complete and stable hardware environment for the development of IEEE 802.15.4, ZigBee PRO and JenNet-IP applications.
- The basis of a packet sniffer for IEEE 802.15.4-based wireless communications

3.4 EUT Modes

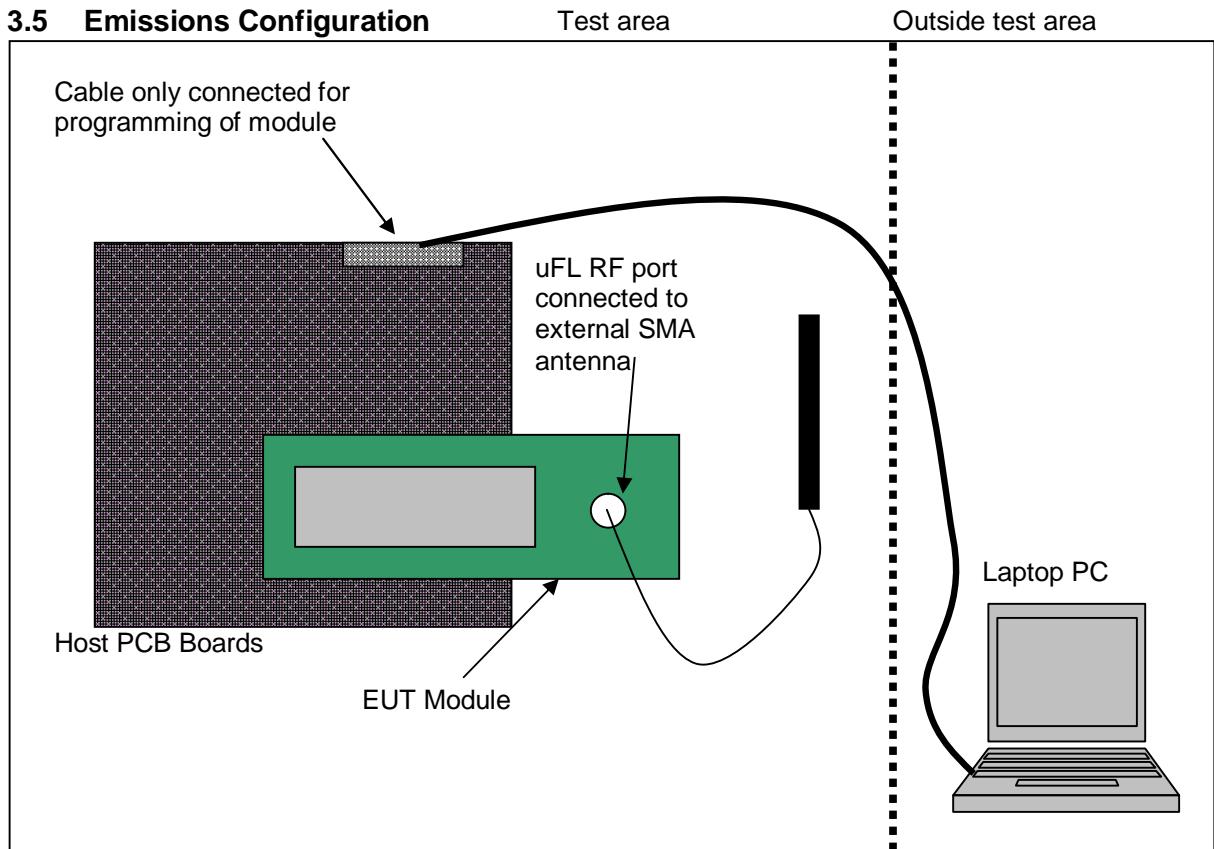
Mode	Description of mode	Used for Testing
Transmit Low	Unit constantly transmitting packets on 2405MHz	YES
Transmit Mid	Unit constantly transmitting packets on 2440MHz	YES
Transmit High	Unit constantly transmitting packets on 2480MHz	YES
Transmit High -1	Unit constantly transmitting packets on 2475MHz	YES
Transmit Other	Unit constantly transmitting on other available channels	NO
Receive	Unit receiving packets from networked RF device	NO
Transmit 1% duty cycle	Unit transmitting system modulation 1% duty cycle	YES

Description of ancillary equipment connected to the equipment under test, for the purpose of tests, can be found in Section 10.

Any modifications made to the EUT, whilst under test, can be found in Section 11.

This report was printed on: 16 January 2013

3.5 Emissions Configuration



The equipment under test was supplied by 3V DC from new batteries situated on the provided host PCB boards. The battery levels were monitored throughout tests to ensure the levels did not drop below the +/- 10% required. To change channels and select the correct modes for test a programming lead was connected and the unit programmed. The programming lead was removed for tests. Application programming software and a laptop was provided by NXP Laboratories UK Ltd.

For radiated emissions the support equipment was situated outside the chamber and the programming lead removed after each channel/mode change.

Top, top-1, middle & bottom channels were tested in Transmit continuous modulated mode. All power levels (except top channel which was changed to level 2 of 3 during testing) were left at the default (level 3 of 3) setting, as set by the selection of the root menu mode named "**High Power module**".

Bottom channel	= 2.405GHz
Middle channel	= 2.440GHz
Top – 1 channel	= 2.475GHz
Top channel	= 2.480GHz

The module had a uFL RF port which was attached to a dedicated antenna supplied by NXP Laboratories UK Ltd.

Separate antenna details: Manufacturer: Aveslink
 Model: E-2410-HA (2.2dBi vertical)

4 Specifications

4.1 Relevant Standards

The tests were performed by RN Electronics Engineer Daniel Sims who set up the tests, the test equipment, and operated it in accordance with the **R.N. Electronics Ltd** procedures manual, ANSI C63.10-2009, KDB 558074 v02 (Oct-2012), FCC Part 15 and those specifications incorporated by reference into 47CFR15 (e.g. ANSI C63.4-2003).

R.N. Electronics Ltd sites M and OATS are listed with the FCC. Registration Number 293246

4.2 Deviations

ANSI C63.10-2009 deviations:

The reference standard ANSI C63.4-2003 was used, not the latest ANSI C63.4-2009

FCC Part 15 deviations:

None.

4.3 Tests at Extremes of Temperature & Voltage

No tests were required at extremes of temperature and voltage.

4.4 Measurement Uncertainties

Parameter	Uncertainty
Transmitter Tests	
Conducted RF power	<± 1.0 dB
Occupied bandwidth	± 1.9 %
Radiated RF power	± 3.5 dB
Radiated spurious emissions	30MHz - 1000MHz ±5.1dB 1000MHz - 2000MHz ±4.5dB 1 – 18 GHz ±3.5dB 18 – 26.5 GHz ±3.9dB
Conducted spurious emissions	± 2.8 dB

5 Tests, Methods and Results

5.1 Conducted emissions

Not applicable. EUT does not operate from the AC power lines nor contain provisions for operation while connected to AC power lines. N.b. although the EUT is intended to be powered from 3V dc supply (battery), it is also intended for modular approval. Any third party device it is incorporated into with a connection to the AC power line will require demonstration of compliance with the limits.

5.2 Peak Conducted power

5.2.1 Test Methods

Test Requirements FCC Part 15C, Reference (15.247)

Test Method: FCC Part 15C, Reference (15.247)
KDB 558074, Clause 8.2.1 Option 1

5.2.1.1 Configuration of EUT

The EUT was measured on a bench using a spectrum analyser connected to the external RF port. The EUT was set to each mode and test signal in turn (see section 3.4) and highest power levels recorded.

5.2.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.

Average stated reading is maximum power observed using a spectrum analyser channel power measurement over the EBW with RBW 1MHz and span 1.5 x EBW.

Measurements were made on a test bench.

5.2.2 Test results

Test Environment: Temperature: 20°C Humidity: 40 %

Channel / scheme	Average Analyser reading 1MHz RBW (dBm)	Duty cycle adjustment (dB)	Total (dBm)	Result (mW)
Low	21.93	-	21.93	156
Mid	21.84	-	21.84	153
High - 1	21.68	-	21.68	147
High	13.71	-	13.71	23.5

LIMITS:

15.247(b)(3)

For systems using digital modulation in the 902-928, 2400-2483.5 or 5725-5850 MHz bands 1 Watt.

These results show that the EUT has **PASSED** this test.

5.2.2.1 Test Equipment used

E492, E252

See Section 10 for more details

5.3 Maximum Power Spectral Density

5.3.1 Test Methods

Test Requirements FCC Part 15C, Reference (15.247)

Test Method: FCC Part 15C, Reference (15.247)
KDB558074, Clause 9.2 Option 2

5.3.1.1 Configuration of EUT

The EUT was measured on a bench using a spectrum analyser connected to the external RF port. The EUT was set to each mode and test signal in turn (see section 3.4) and highest power levels recorded.

5.3.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. The emission from the EUT was maximised before taking any plots. Analyser settings of RBW 3kHz, VBW 3x and RMS detector were used.

5.3.2 Test results

Tests were performed using Test Site A.

Temperature of test Environment: 20°C

Table of results

Channel/ scheme	PEP (dBm/3kHz)
Low	4.2
Mid	4.4
High-1	4.2
High	-2.6

LIMITS:

15.247(e) +8dBm/3kHz.

These results show that the **EUT** has **PASSED** this test.

5.3.2.1 Test Equipment used

E492, E252

See Section 10 for more details.

5.4 Duty cycle

5.4.1 Test Methods

Test Requirements	FCC Part 15C, Reference (15.35)
Test Method:	ANSI C63.10, Reference (7.5)

5.4.1.1 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was operated in **Transmit Low and 1% duty cycle** modes.

5.4.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. The centre frequency of the analyser was set to that of the transmitter, and the span set to zero. The sweep time was adjusted so that either the pulse width or the periodic operation could be observed.

Test site 'M' has been listed with the FCC.

5.4.2 Test results

Tests were performed using Test Site **M**.

Temperature of test Environment: 21°C

Analyser plots for the dwell time and duty cycle can be found in Section 6.6 of this report.

State	Result (ms)	Plot reference
TX on 100ms period (transmit low mode)	100	TX Duty 100% selected On time
TX on 100ms period (transmit 1% duty cycle mode)	0.170	TX Duty 1% selected On time
Repetition rate (transmit 1% duty cycle mode)	8.18	TX Duty 1% selected repetition

Duty cycle measured in **Transmit Low** mode is 100%.

Duty cycle measured in **Transmit 1% duty cycle** mode is $100 \times 0.17/8.18 = 2.1\%$

LIMITS: Not applicable.

Measurements were only taken to demonstrate the validity of the constantly on and 1% duty cycle modes.

Note, the EUT is a module for OEM integration and as such the duty is dependent upon the final application.

The manufacturer has declared a duty cycle of 1% and quotes IEEE 802.15.4: "The specifications of IEEE Std 802.15.4-2003 are tailored for applications with low power and low data rates (a maximum of 250 kb/s and down to 20 kb/s). Typical applications for IEEE 802.15.4 devices are anticipated to run with low duty cycles (under 1%). This will make IEEE 802.15.4 devices less likely to cause interference to other standards".

IEEE 802.15.4 also quotes a nominal packet length of 0.01472ms (40 data bytes) and for <10% duty cycle restrictions up to 6 packets per 100ms.

For purposes of test the equipment was operated with the transmitter continuously on. For a 10% duty cycle, the power measured would be reduced by $20 \log (0.10) = -20\text{dB}$. According to the declared duty cycle, therefore, the emissions observed, in section 5.5 & 5.7, are below the limit after averaging for pulse rate.

5.4.2.1 Test Equipment used

E412, E268, TMS82, E252

See Section 10 for more details.

5.5 Radiated emissions

5.5.1 Test Methods

Test Requirements	FCC Part 15C, Reference (15.209)
Test Method:	ANSI C63.10, Reference (6.4 – 6.6.)

5.5.1.1 Configuration of EUT

The EUT was placed on a 0.8m high non conductive turntable. The dedicated antenna was supported vertically. The front edge of the EUT was initially positioned facing the measurement antenna. The EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed with new batteries. The EUT was operated in **Transmit Low, Mid, High** modes.

5.5.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.

30MHz - 1GHz, measurements were made on a site listed with the FCC. The equipment was rotated 360° and the antenna scanned 1 – 4 metres in both horizontal and vertical polarisations to record the worst case emissions.

Above 1GHz, measurements were made in a semi-anechoic chamber with appropriate absorbing material for use in this range. The EUT was raised and antenna was placed 1.5m above the ground in line with the EUT, which was rotated through 360° to record the worst case emissions.

At least 6 signals within 20dB and all signals within 10dB of the limit were investigated.

5.5.2 Test results

Tests were performed using Test Site M and B (above 1GHz).

Test Environment:

M:	Temperature: 21°C	Humidity: 32%
B:	Temperature: 17-21°C	Humidity: 32-53%

Analyser plots for the Quasi-Peak / Average values as applicable for the middle channel can be found in Section 6.2 and 6.3 of this report.

Tables of results for all channels follow:

Below 1GHz Tables

No emissions observed within 20dB of limits.

Above 1GHz Tables

Transmit High Emissions - Horizontal

Signal No.	Freq (MHz)	Peak Amp (dBuV)	Peak- Lim1 (dB)	AV Amp (dBuV)	AV - Lim1 (dB)	AV – Lim1 after correction*
1	4960	49.9	-24.1	40.3	-13.7	-33.7
2	14880	48.0	-26.0	34.2	-19.8	-39.8

Transmit High Emissions - Vertical

Signal No.	Freq (MHz)	Peak Amp (dBuV)	Peak- Lim1 (dB)	AV Amp (dBuV)	AV - Lim1 (dB)	AV – Lim1 after correction*
1	4960	55.5	-18.5	47.5	-6.5	-26.5

Transmit Mid Emissions - Horizontal

Signal No.	Freq (MHz)	Peak Amp (dBuV)	Peak- Lim1 (dB)	AV Amp (dBuV)	AV - Lim1 (dB)	AV – Lim1 after correction*
1	4880	47.9	-26.1	38.9	-15.1	-35.1
2	7320	61.6	-12.4	49.6	-4.4	-24.4
3	9760	55.4	-18.6	43.2	-10.8	-30.8
4	12200	68.4	-5.6	56.7	2.7	-17.3
5	14640	57.0	-17.0	45.5	-8.5	-28.5
6	17080	53.2	-20.8	41.0	-13.0	-33.0
7	21960	52.8	-21.2	41.0	-13.0	-33.0

Transmit Mid Emissions - Vertical

Signal No.	Freq (MHz)	Peak Amp (dBuV)	Peak- Lim1 (dB)	AV Amp (dBuV)	AV - Lim1 (dB)	AV – Lim1 after correction*
1	4880	53.1	-20.9	44.0	-10	-30.0
2	7320	64.3	-9.7	52.6	-1.4	-21.4
3	9760	54.2	-19.8	41.9	-12.1	-32.1
4	12200	66.4	-7.6	55.0	1	-19.0
5	14640	55.2	-18.8	43.8	-10.2	-30.2
6	17080	54.0	-20.0	41.8	-12.2	-32.2
7	19520	47.0	-27.0	35.0	-19.0	-39.0
8	21960	55.7	-18.3	43.5	-10.5	-30.5

Transmit Low Emissions - Horizontal

Signal No.	Freq (MHz)	Peak Amp (dBuV)	Peak- Lim1 (dB)	AV Amp (dBuV)	AV - Lim1 (dB)	AV – Lim1 after correction*
1	4810	50.0	-24.0	42.1	-11.9	-31.9
2	7215	62.2	-11.8	51.2	-2.8	-22.8
3	9620	55.3	-18.7	43.9	-10.1	-30.1
4	12025	69.5	-4.5	58.0	4	-16.0
5	14430	58.2	-15.8	46.7	-7.3	-27.3
6	16835	55.2	-18.8	42.7	-11.3	-31.3
7	19240	47.8	-26.2	36.0	-18	-38.0
8	21645	54.8	-19.2	43.0	-11	-31.0

* Note: EUT tested in a continuous transmit mode for ease of test. Where average limits apply, duty cycle correction may then be calculated as per FCC 15.35. TX on time in 100ms period. See section 5.4 Duty cycle within this report.

File name NXP LABORATORIES UK LTD.6538-3 (FCC RADIO).DOCX

The contents of this report, apart from the referenced ANSI C63.4-2003, are beyond the scope of UKAS Testing Laboratory No. 2360 accreditation.

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Transmit Low Emissions - Vertical

Signal No.	Freq (MHz)	Peak Amp (dBuV)	Peak- Lim1 (dB)	AV Amp (dBuV)	AV - Lim1 (dB)	AV - Lim1 after correction*
1	4810	54.7	-19.3	46.2	-7.8	-27.8
2	7215	61.9	-12.1	51.7	-2.3	-22.3
3	9620	54.4	-19.6	41.7	-12.3	-32.3
4	12025	67.1	-6.9	56.8	2.8	-17.2
5	14430	58.3	-15.7	46.7	-7.3	-27.3
6	16835	53.5	-20.5	41.2	-12.8	-32.8
7	19240	47.5	-26.5	35.5	-18.5	-38.5
8	21645	55.7	-18.3	43.3	-10.7	-30.7

* Note: EUT tested in a continuous transmit mode for ease of test. Where average limits apply, duty cycle correction may then be calculated as per FCC 15.35. TX on time in 100ms period. See section 5.4 Duty cycle within this report.

n.b. there are also two side band signals 32MHz from the carrier centre frequency – see band edge test , section 5.7, for results of these.

LIMITS:

15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
15.247(d) other emissions, outside the intentional band, must be attenuated by at least 30dB from the level of the fundamental / meet the general limits of 15.209.

n.b. the general limits of 15.209 are as drawn on the respective plots.

These show that the **EUT** has **PASSED** this test.

5.5.2.1 Test Equipment used

E410, E411, E412, TMS933, E252, E268, E342, E429, TMS78, TMS79, TMS82
See Section 10 for more details

5.6 Occupied bandwidth

5.6.1 Test Methods

Test Requirements FCC Part 15C, Reference (15.215)

Test Method: ANSI C63.10, Reference (6.9)

5.6.1.1 Configuration of EUT

The EUT was configured for maximum output power and measured at the antenna port. The EUT was operated in **Transmit Low, Mid and High** modes.

5.6.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. A 100kHz RBW, 3x VBW, auto sweep time and max hold settings were used for the 6dB bandwidth.

5.6.2 Test results

Tests were performed using Test Site **K**.

Temperature of test Environment: 22°C

Analyser plots for the 6dB bandwidth can be found in Section 6.4 of this report.

Channel	Result	Plot reference
Low	1.36MHz	J6538-3, Low channel 6dB BW
Mid	1.54MHz	J6538-3, Mid channel 6dB BW
High	1.57MHz	J6538-3, High channel 6dB BW

LIMITS:

15.247(a)(2) The minimum 6dB bandwidth shall be at least 500kHz.

These results show that the **EUT** has **PASSED** this test.

5.6.2.1 Test Equipment used

E412, E252

See Section 10 for more details.

5.7 Band Edge Compliance

5.7.1 Test Methods

Test Requirements FCC Part 15C, Reference (15.215 and 15.247)

Test Method: FCC Part 15C, Reference (15.215)
ANSI C63.10-2009, Reference clause 6.9.3

5.7.1.1 Configuration of EUT

The EUT was configured for maximum output power and measured at the antenna port. The EUT was operated in **Transmit Low, High and High - 1** modes.

5.7.1.2 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. The emission from the EUT was maximised before taking the plots. Due to the influence of high in-band signals when using the specified resolution bandwidth the Marker Delta method was employed for the upper restricted band edge tests.

5.7.2 Test results

Tests were performed using Test Site A.

Temperature of test Environment: 22-24°C

Analyser plots for the Band Edge Compliance can be found in Section 6.6 of this report. These show the 30dBc requirement of 15.247(d) are met at the band edges of 2400 and 2483.5 MHz:

Channel	Fundamental PK reading (dBuV/m)	Band edge PK reading (dBuV/m)	Plot reference
Low	114.9	70.9	J6538-3 Bandedge PK Low chan 100kHz RBW
High	107.7	70.0	J6538-3 Bandedge PK Top chan 100kHz RBW (pow set 2)
High - 1	116.0	60.0	J6538-3 Bandedge PK 2.475GHz chan 100kHz RBW

Restricted band edge plots are also shown in section 6.6. The following tables list the field strengths observed in the adjacent restricted bands, which are required to meet the tighter 15.209 limits:

Channel	Band PK reading (dBuV/m)	Band AV reading (dBuV/m)	Plot reference
Low	63.3	58.8*	J6538-3 Bandedge PK Low chan 1MHz RBW J6538-3 Bandedge AV Low chan 1MHz RBW
High	73.2 ¹	-	J6538-3 Bandedge PK Top chan 1MHz RBW (pow set 2) J6538-3 Mkr delta high channel pwr lvl 2 of 3
High - 1	68.0	56.5*	J6538-3 Bandedge AV 2.475GHz chan 1MHz RBW J6538-3 Bandedge PK 2.475GHz chan 1MHz RBW

The band edge readings were performed with a peak detector (max held plot) and with the EUT set in a constant 100% transmit state.

*The limit is 54dB_{UV}/m for Average emissions. According to 15.35(c): when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. For a 10% duty cycle, the power measured would be reduced by $20 \log (0.10) = 20\text{dB}$. According to the declared duty cycle, therefore, the emissions observed are below the limit after averaging for pulse rate.

Δ Delta Marker method used due to the influence of high in band signal at band edge.

LIMITS:

15.215(c) The 20dB bandwidth of the emission must be contained within the designated frequency band.

15.247(d) 30dB_C in any 100kHz bandwidth outside the band of operation.

15.209 54dB_{UV}/m @3m AVG in restricted bands.

15.35(b) 74dB_{UV}/m @3m PK in restricted bands.

The restricted band edges closest to the EUT frequency of 2400-2483.5MHz are 2390 & 2483.5MHz.

Further wider span plots have been taken to show the fact that there are no spurious emissions above the restricted limits of 15.209.

These results show that the **EUT** has **PASSED** this test.

5.7.2.1 Test Equipment used

E492, E252

See Section 10 for more details.

5.8 FHSS Parameters

Test following tests were not applicable as the EUT does not employ FHSS Technology.

5.8.1 Frequency Separation

5.8.2 Number of hopping Channels

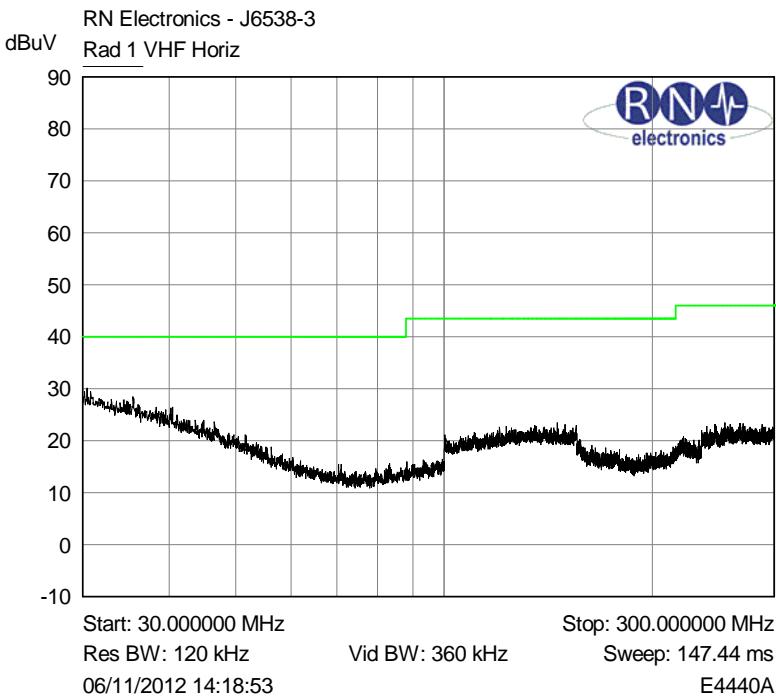
5.8.3 Dwell time

6 Plots and Results

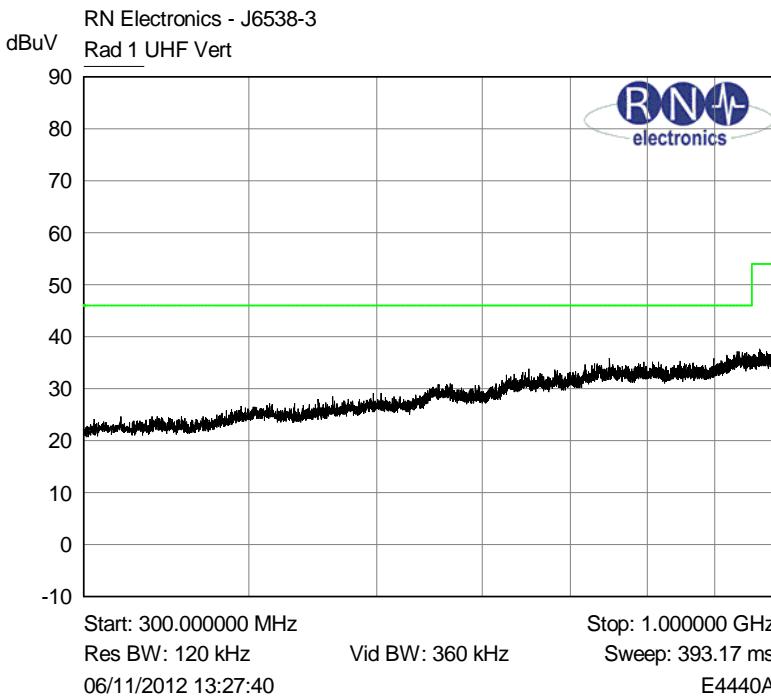
6.1 Conducted Emissions

Not applicable. EUT does not operate from the AC power lines nor contain provisions for operation while connected to AC power lines. N.b. although the EUT is intended to be powered from 3V dc supply (battery), it is also intended for modular approval. Any third party device it is incorporated into with a connection to the AC power line will require demonstration of compliance with the limits.

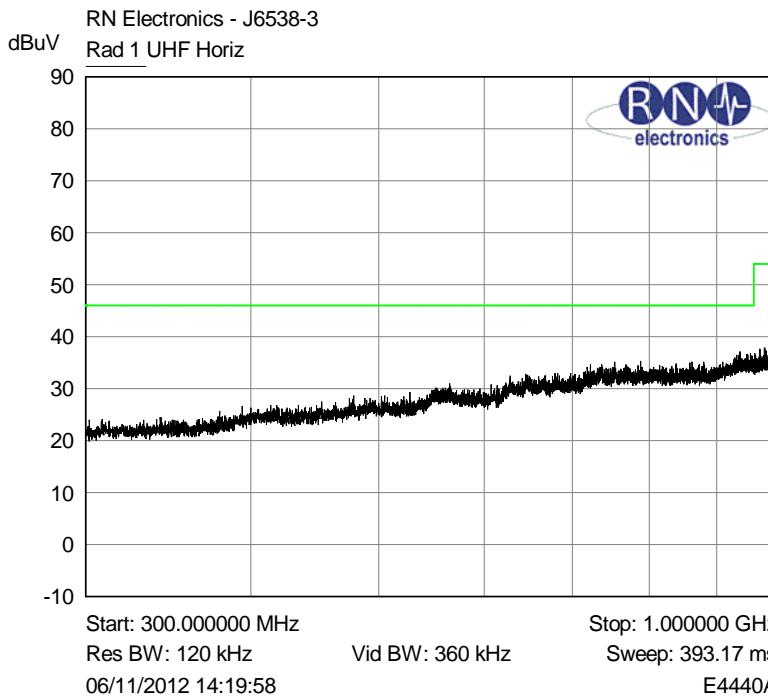
6.2 Radiated Emissions 30MHz – 1GHz



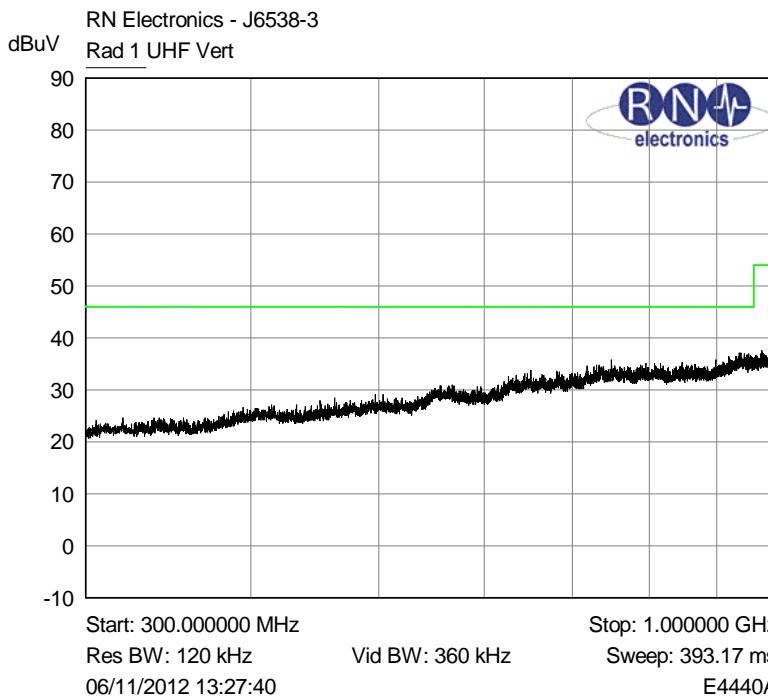
Plot of peak horizontal emissions 30MHz - 300MHz against the quasi-peak limit line.



Plot of peak vertical emissions 30MHz - 300MHz against the quasi-peak limit line.

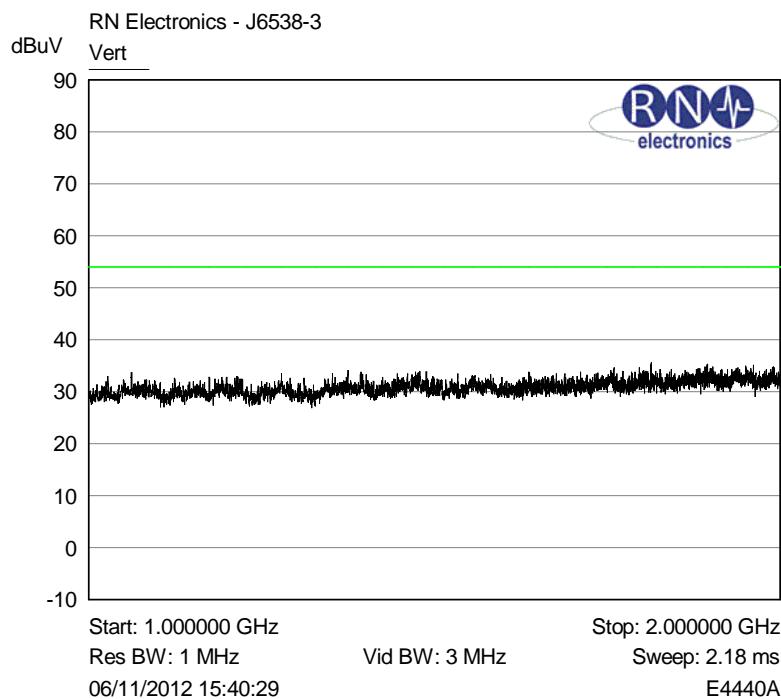
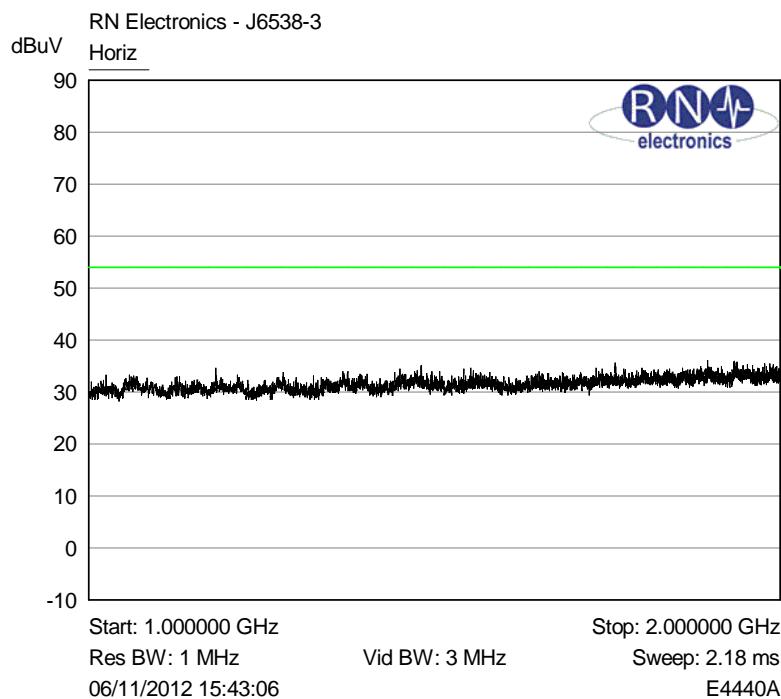


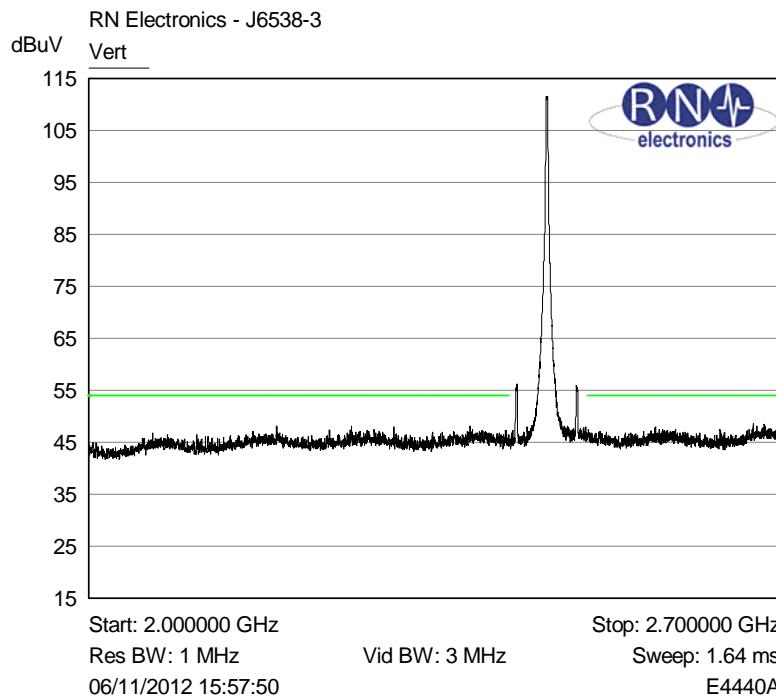
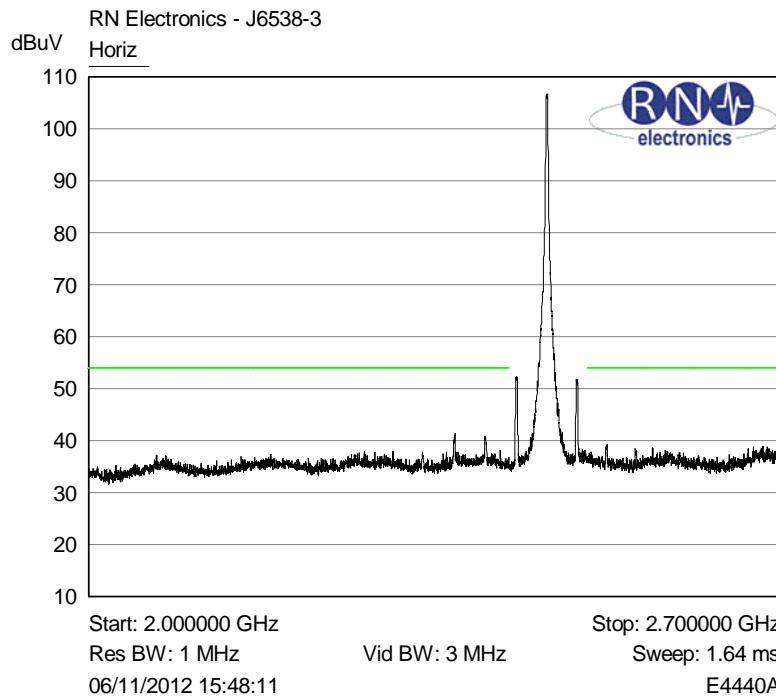
Plot of peak horizontal emissions 300MHz - 1GHz against the quasi-peak limit line.

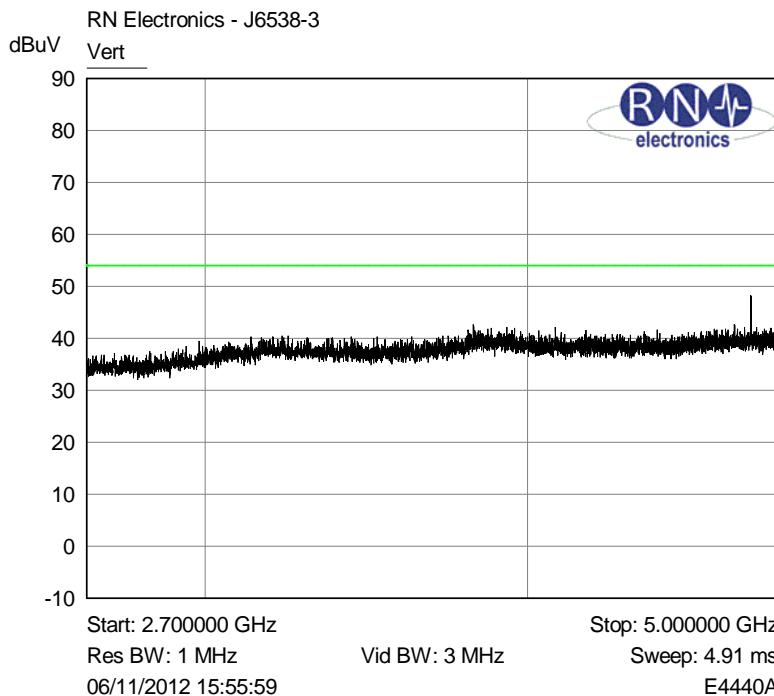
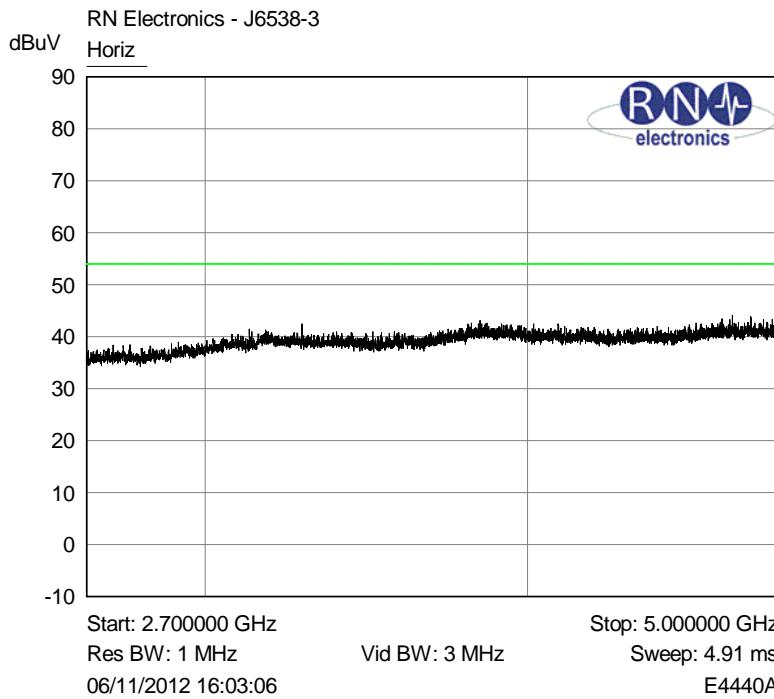


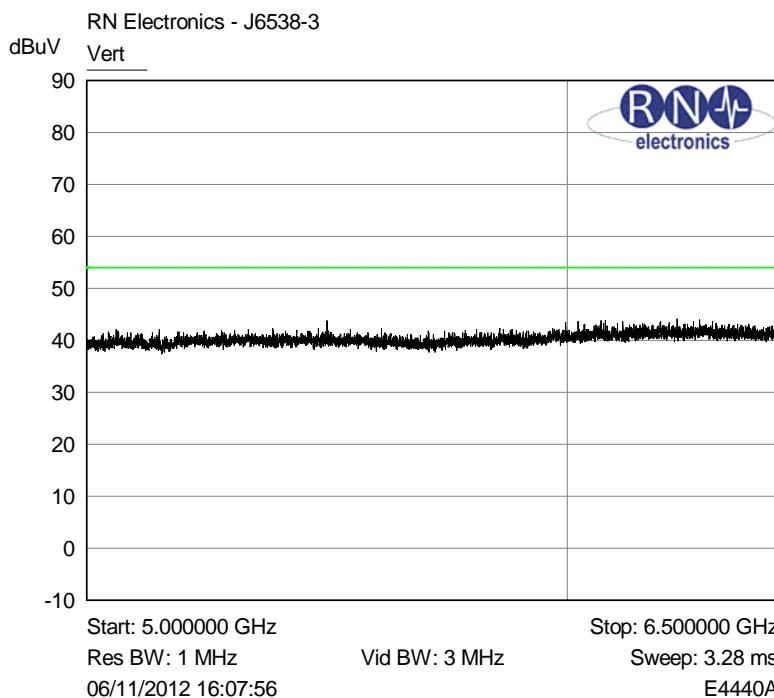
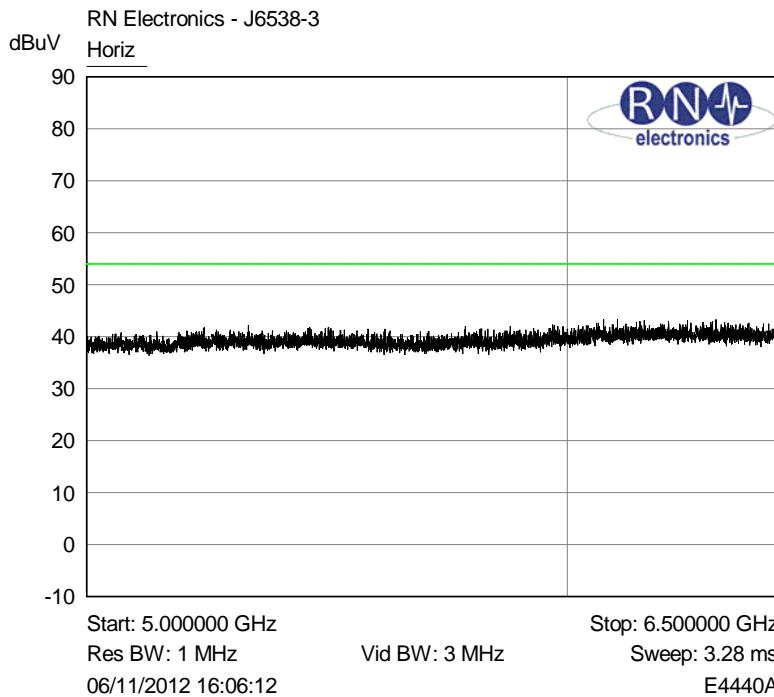
Plot of peak vertical emissions 300MHz - 1GHz against the quasi-peak limit line.

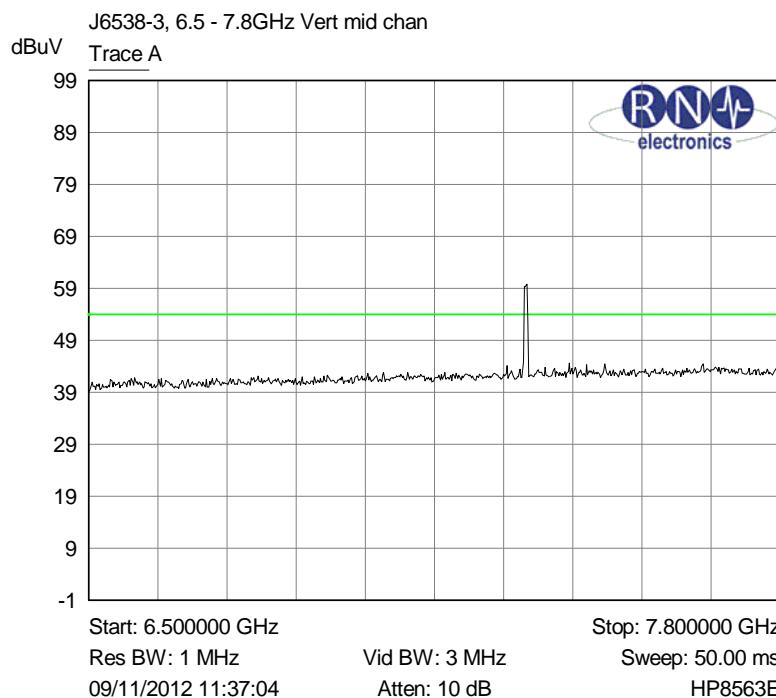
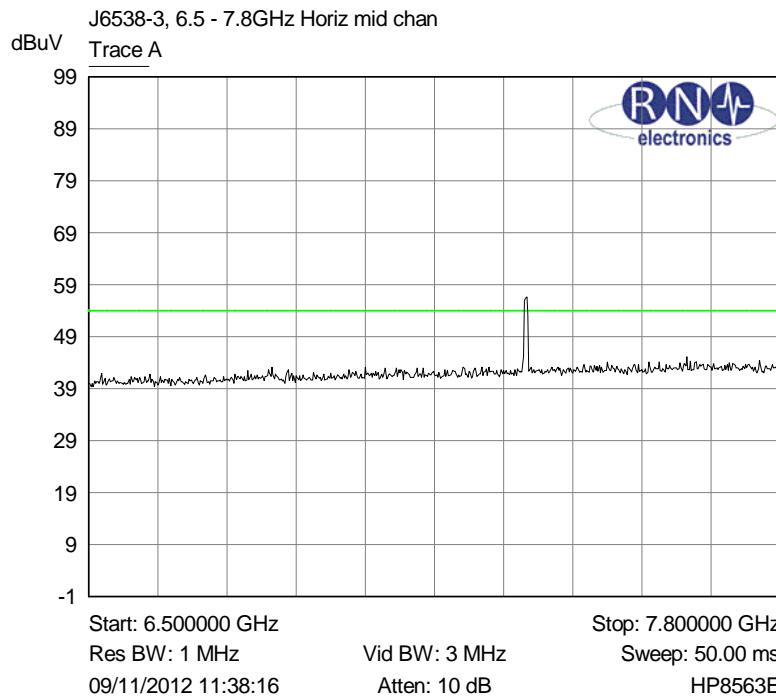
6.3 Radiated Emissions above 1GHz

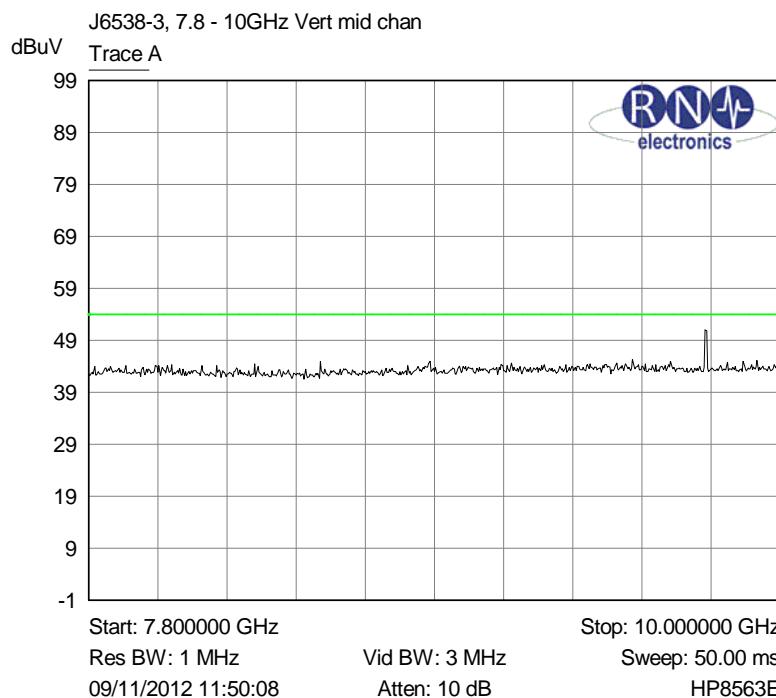
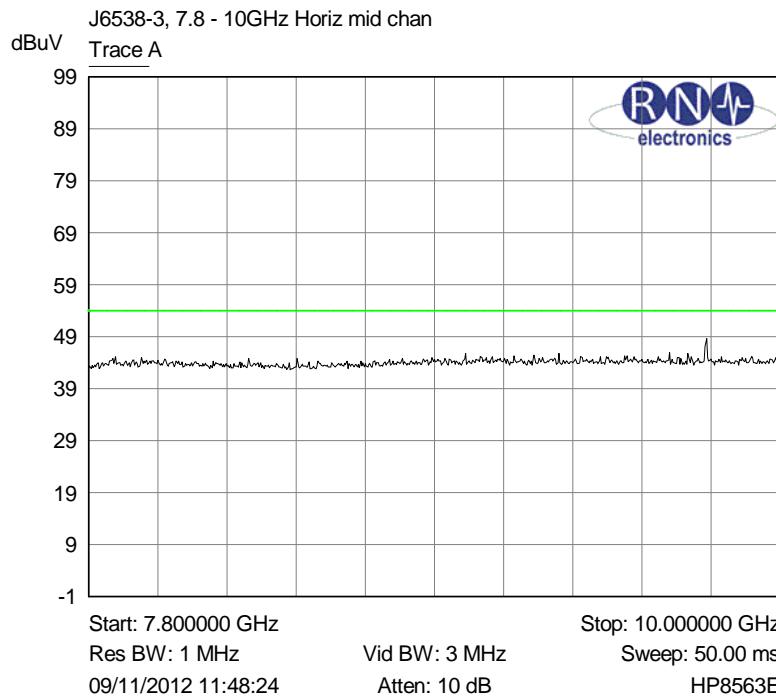


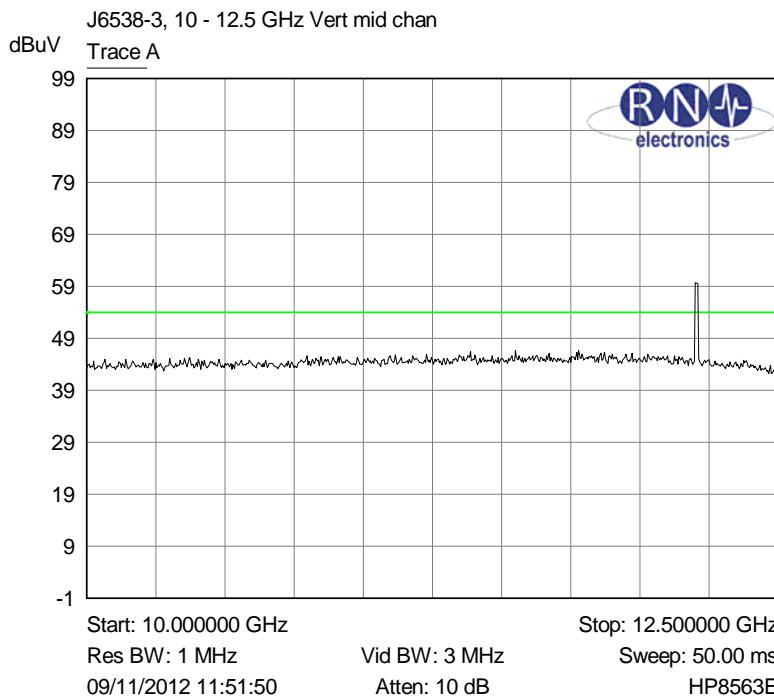
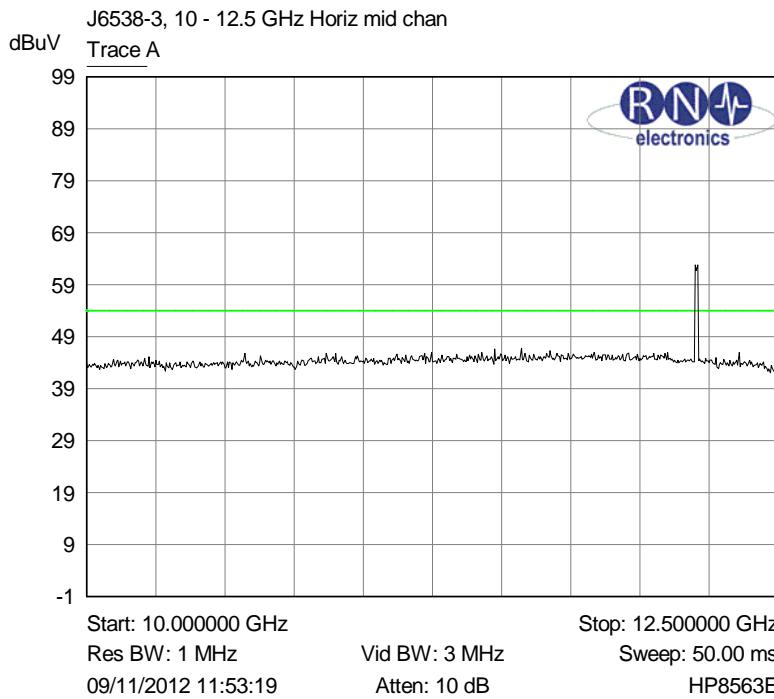


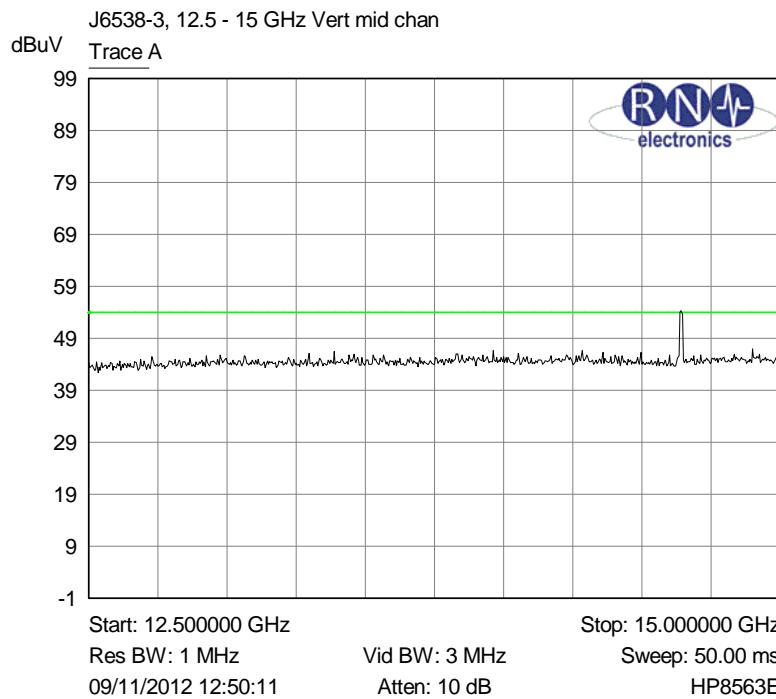
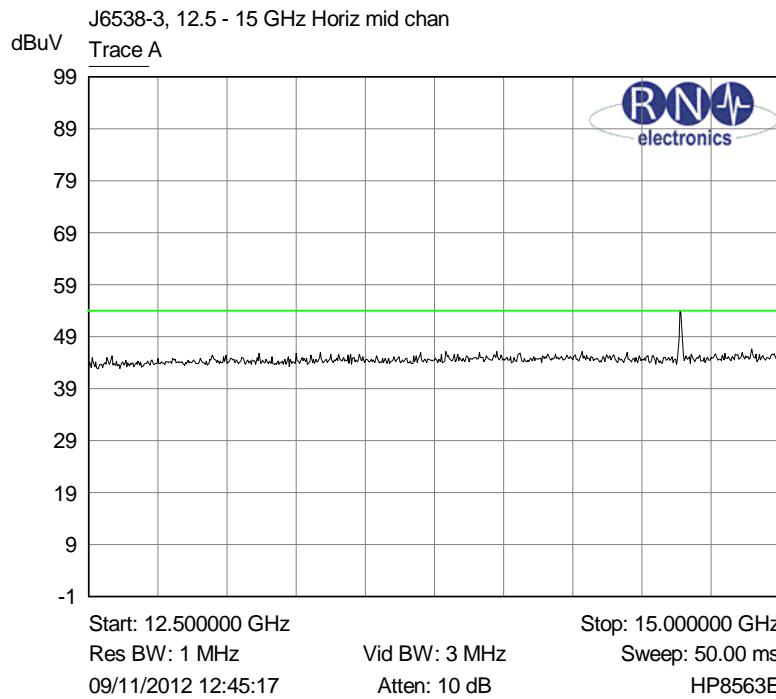


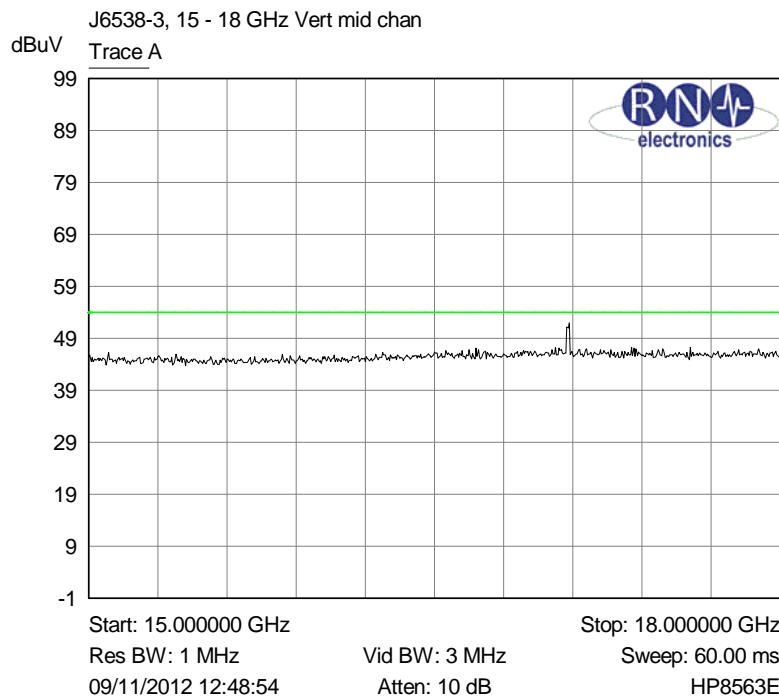
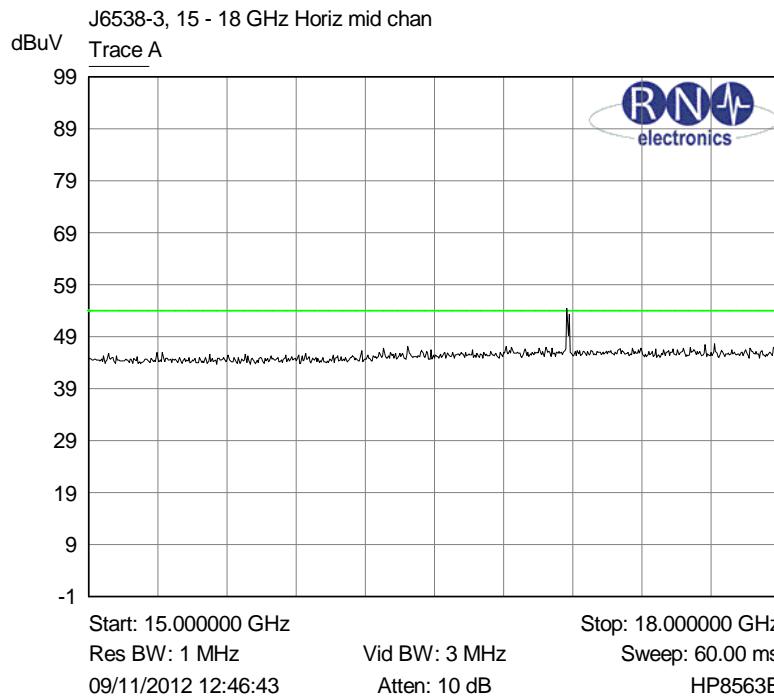


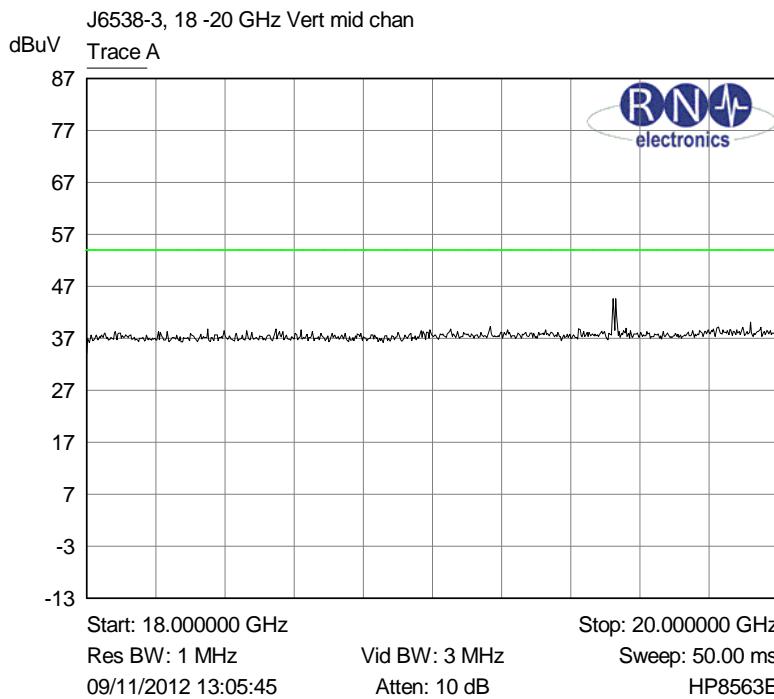
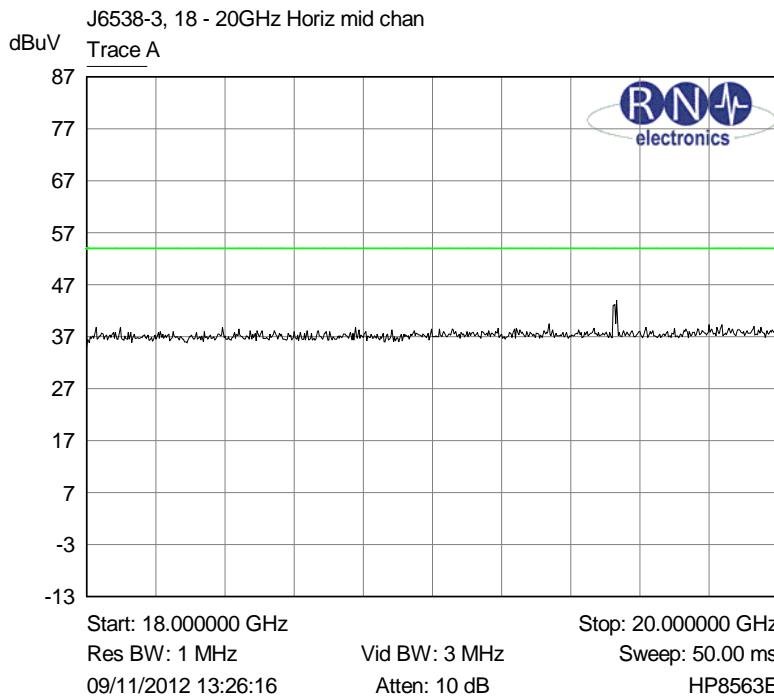


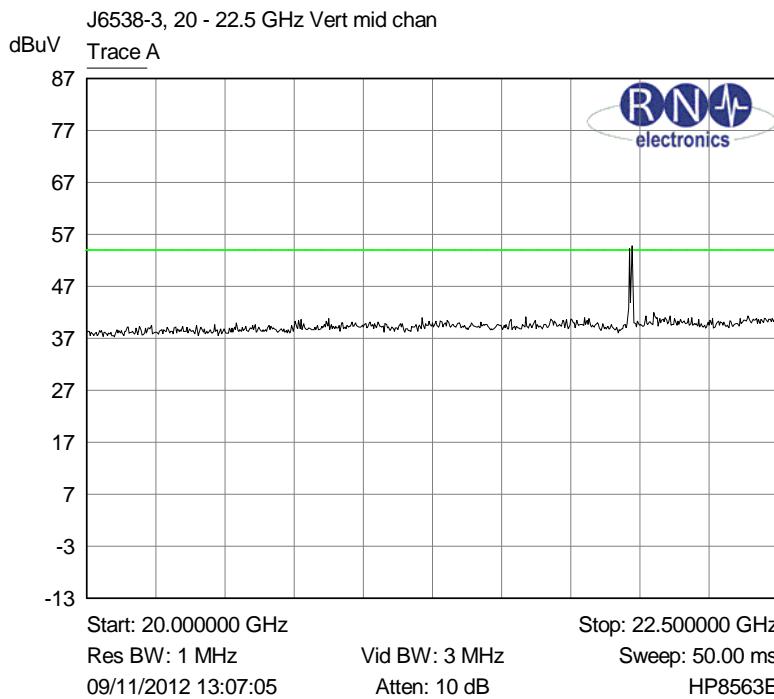
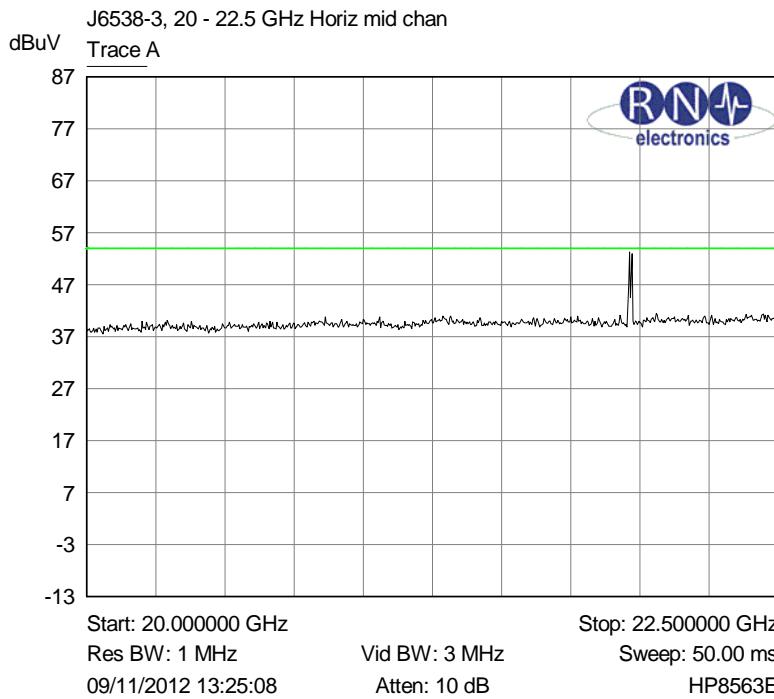


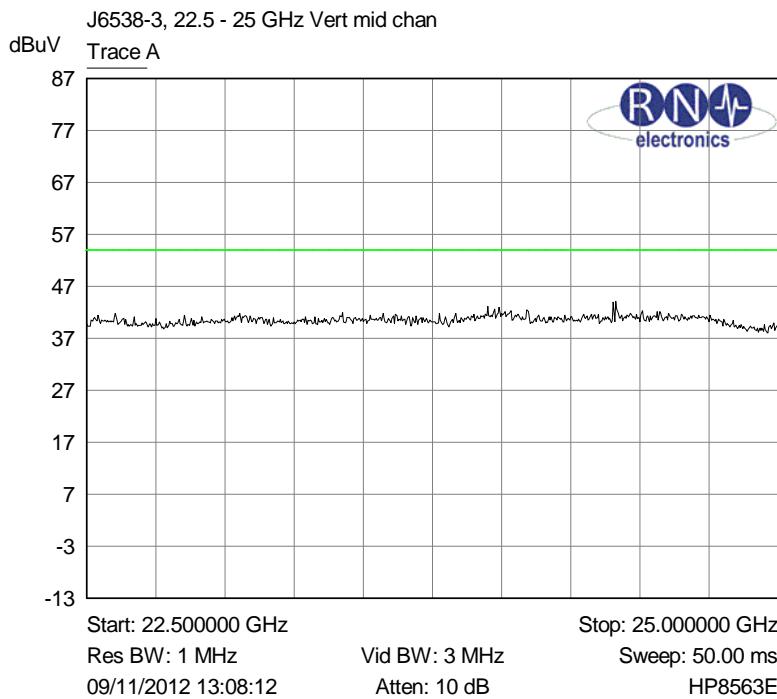
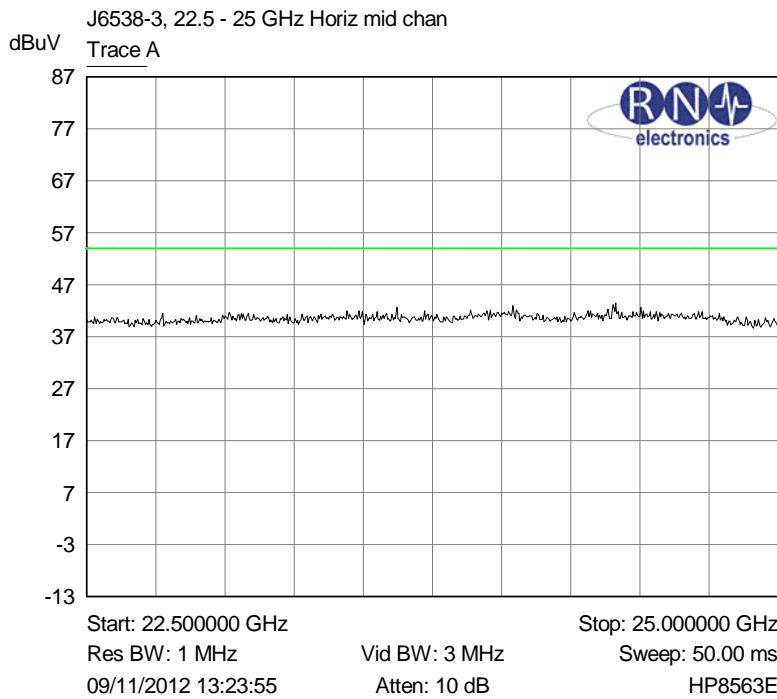




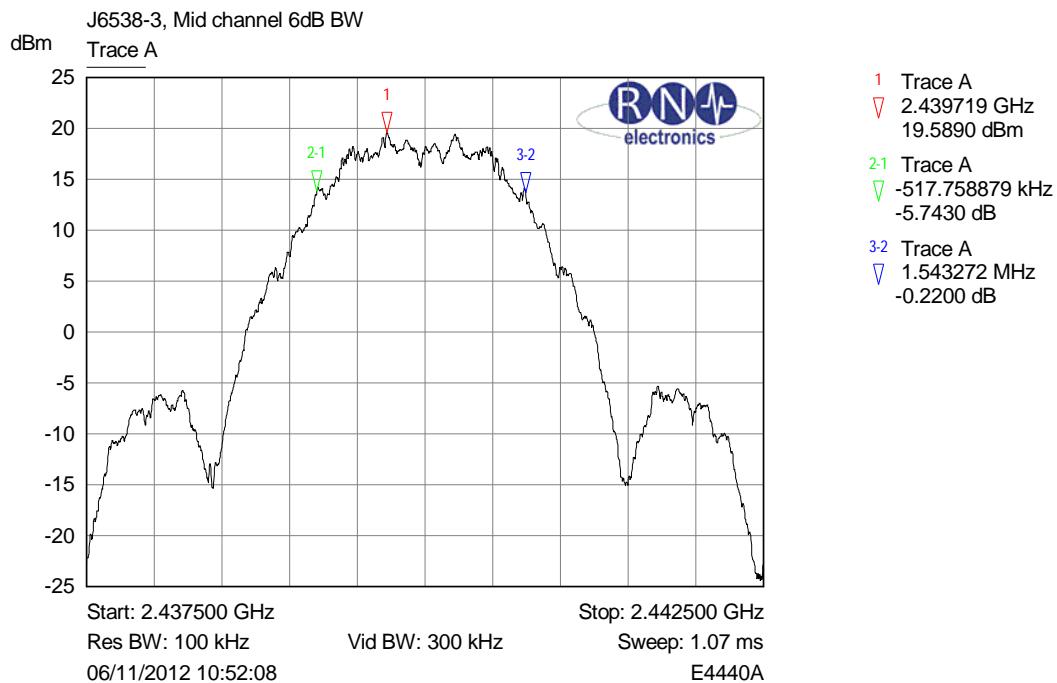
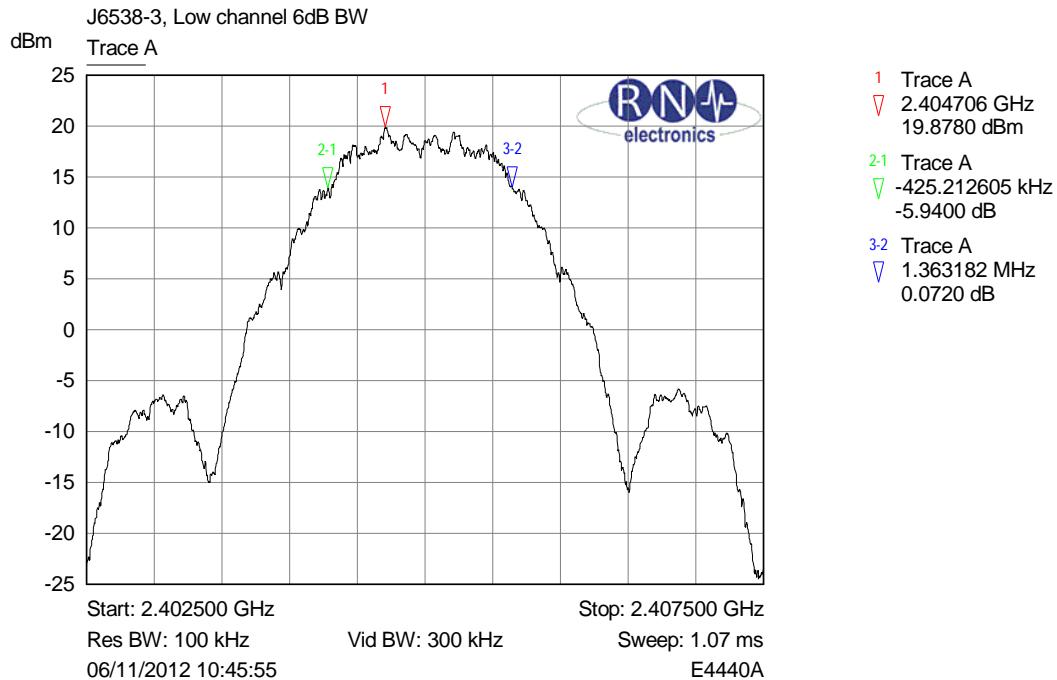


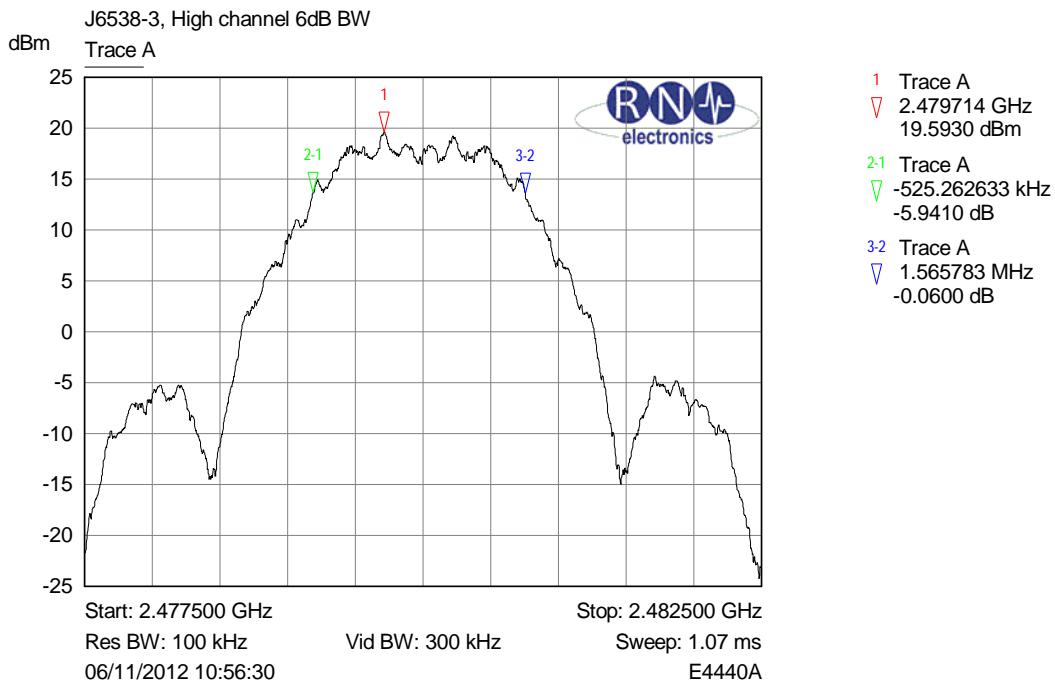






6.4 6dB Bandwidth





File name NXP LABORATORIES UK LTD.6538-3 (FCC RADIO).DOCX

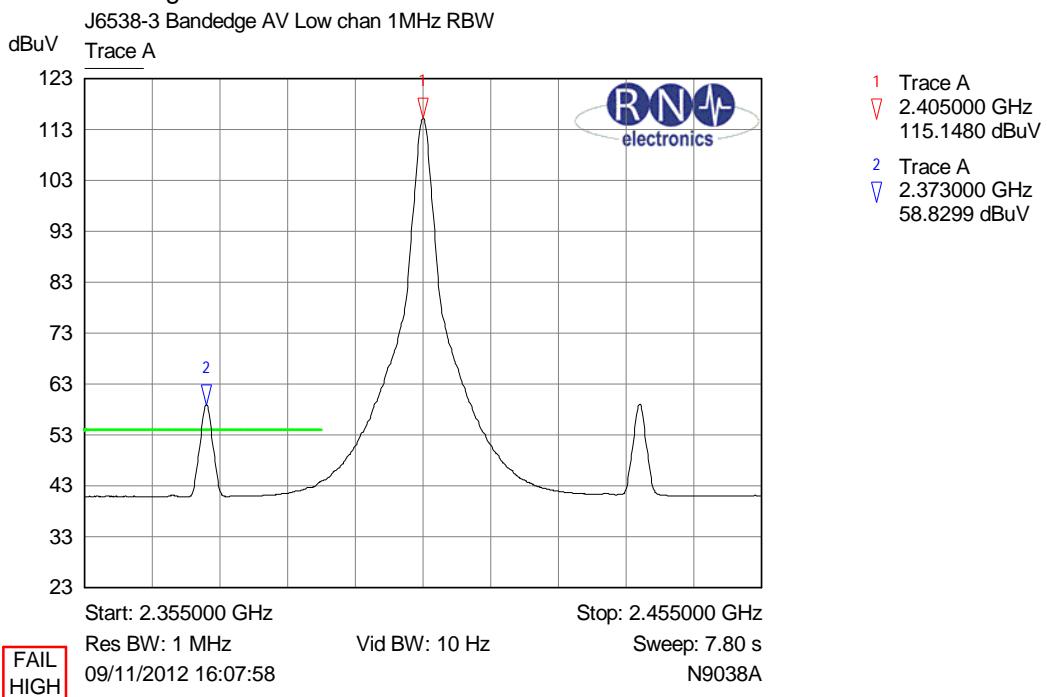
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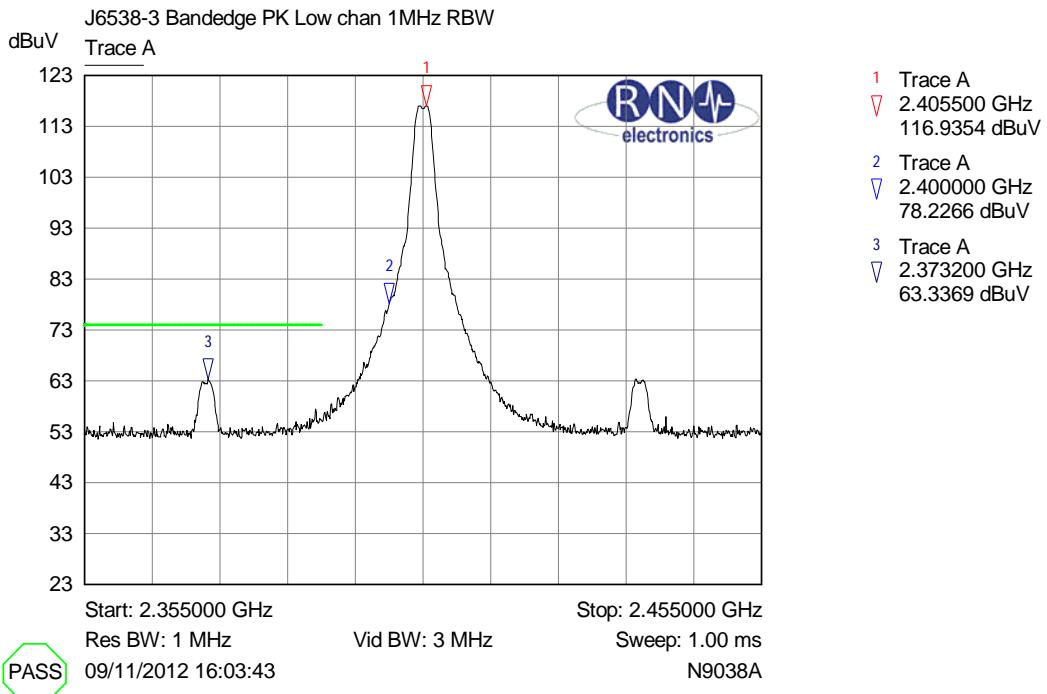
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6.5 Band Edge Compliance

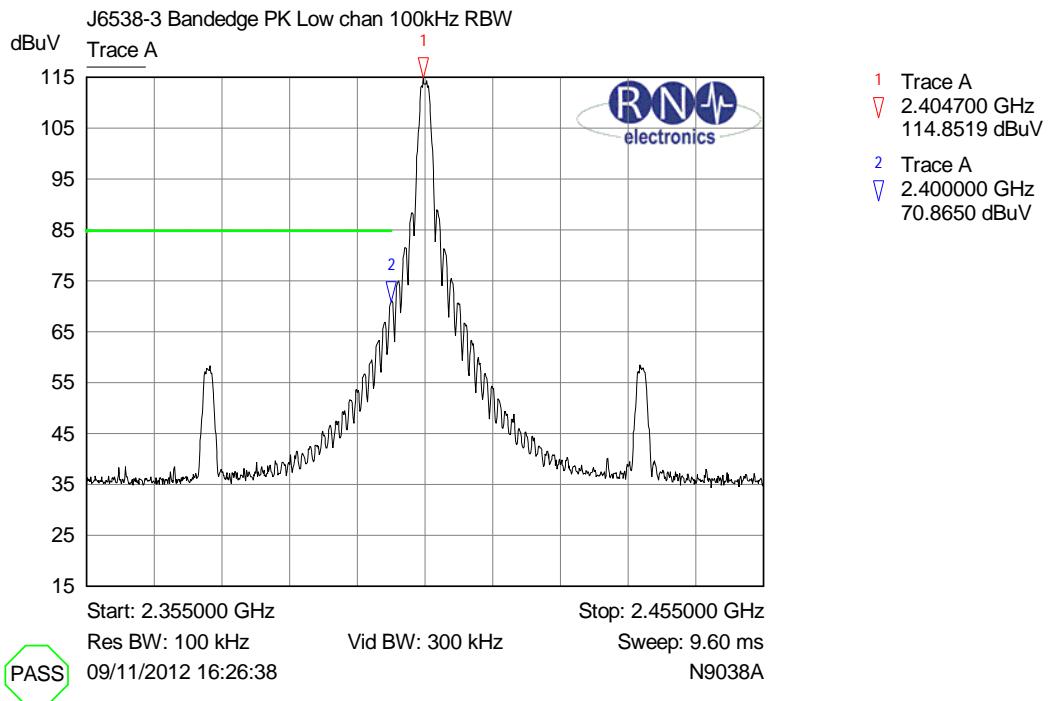
Lower Band Edge.



The above avg plot shows a possible problem frequency against the average restricted band limits at the adjacent lower restricted band (2310 – 2390 MHz).

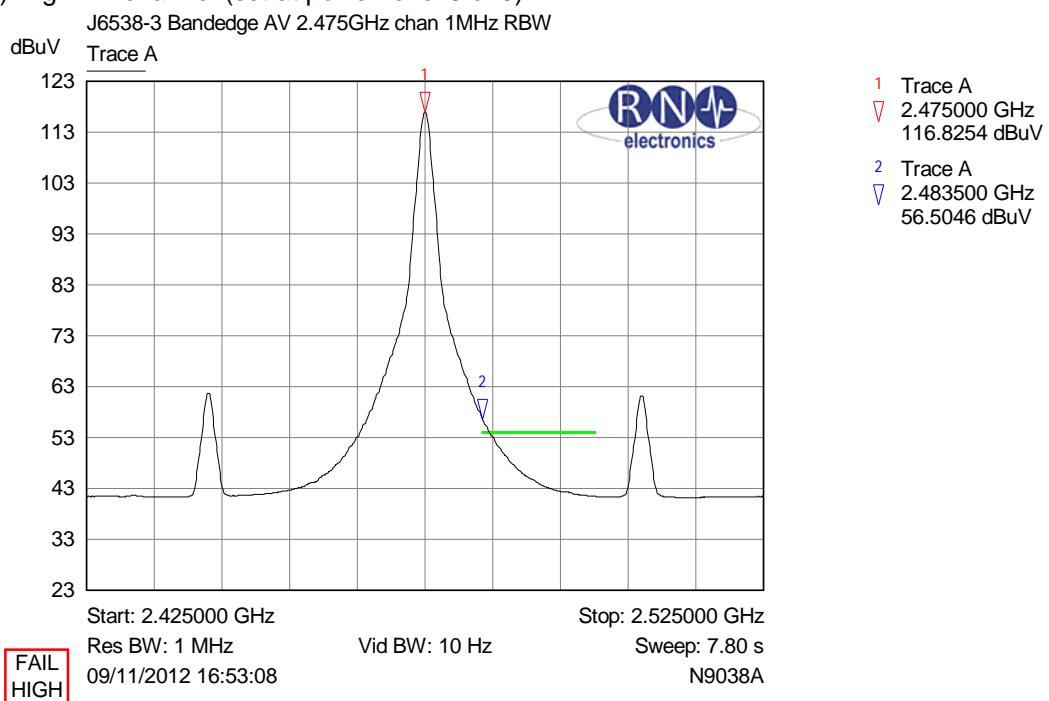


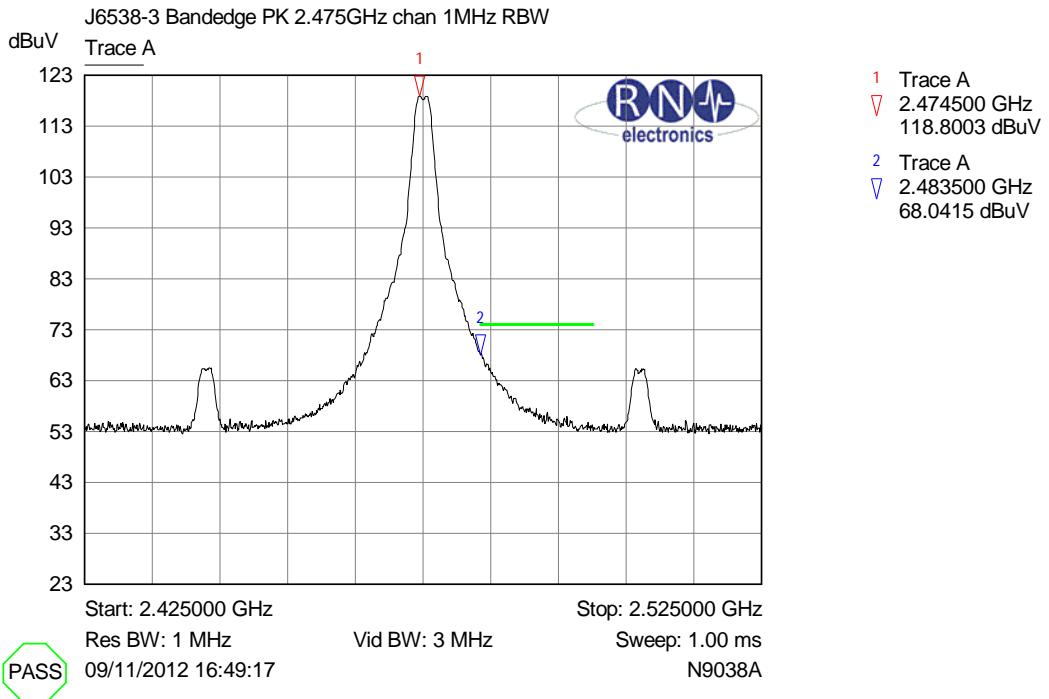
The above peak plot shows compliance with the peak restricted band limits at the adjacent lower restricted band (2310 – 2390 MHz). Also, the peak of the signal at 2373MHz will, after duty cycle correction, comply with the average 54dBuV/m limit.



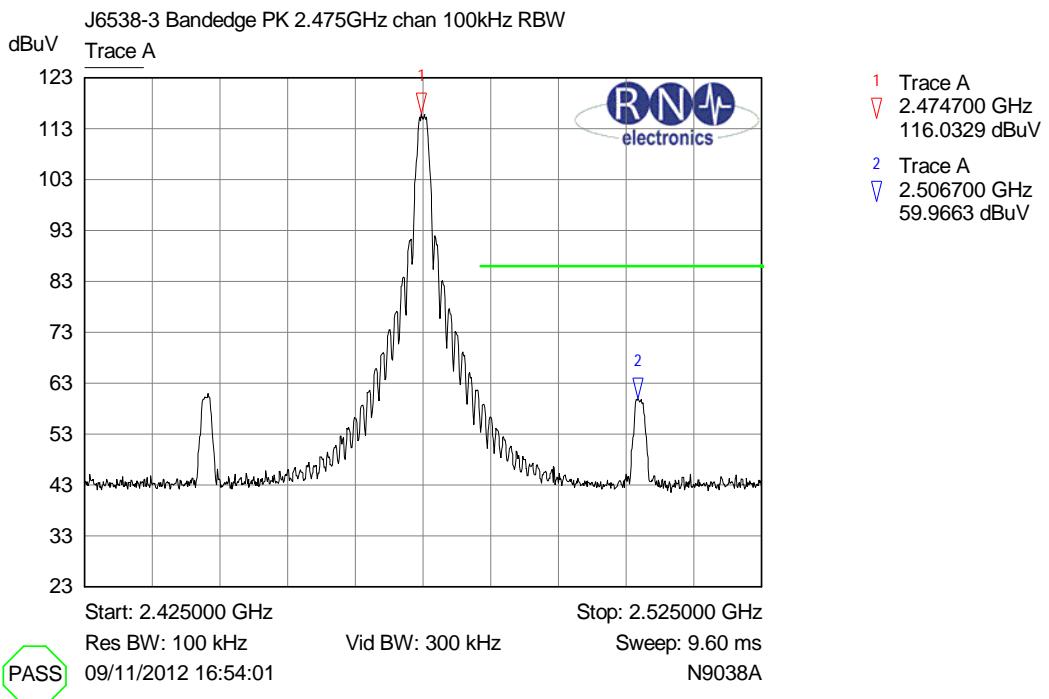
Upper Band Edge

1) High – 1 channel (set at power level 3 of 3).



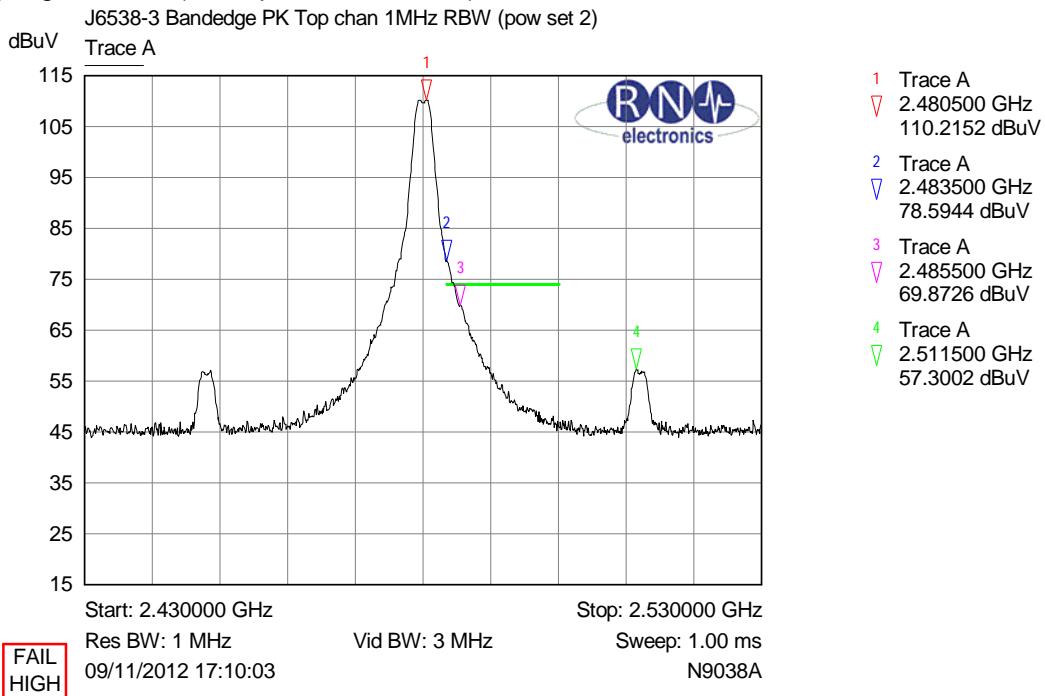


The above peak plot shows compliance with the peak restricted band limits at the adjacent upper restricted band (2483.5 – 2500 MHz). Also, the peak of the signal at 2483.5MHz will, after duty cycle correction, comply with the average 54dBuV/m limit.

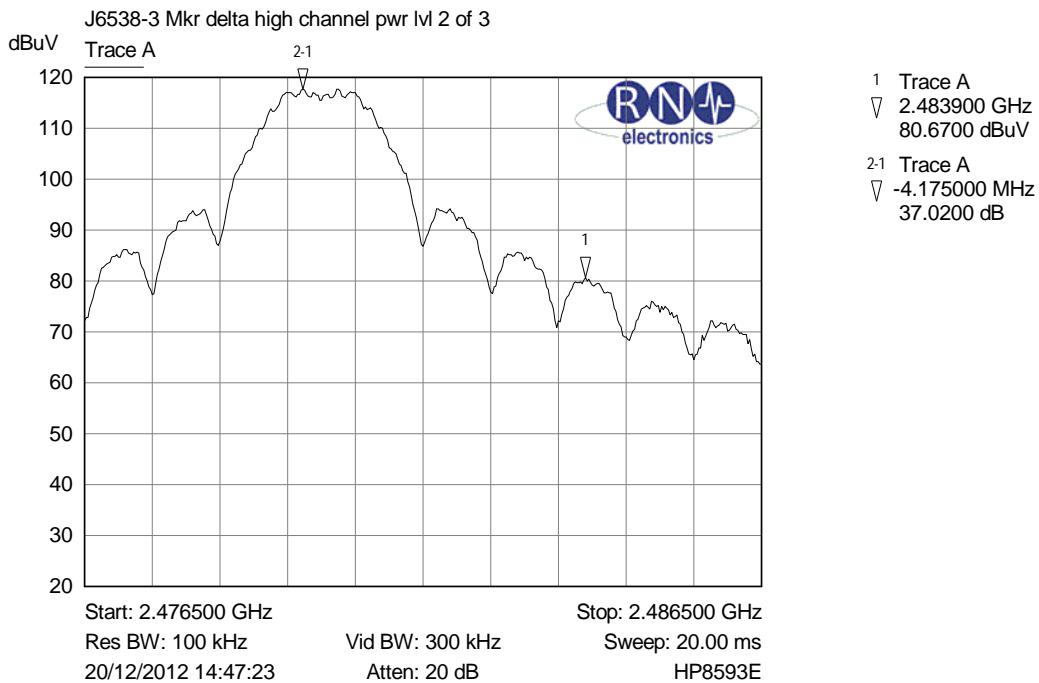


The above peak plot shows compliance with the out of band (spurious emission) 30dBc in 100kHz RBW limit.

2) High channel (set at power level 2 of 3).

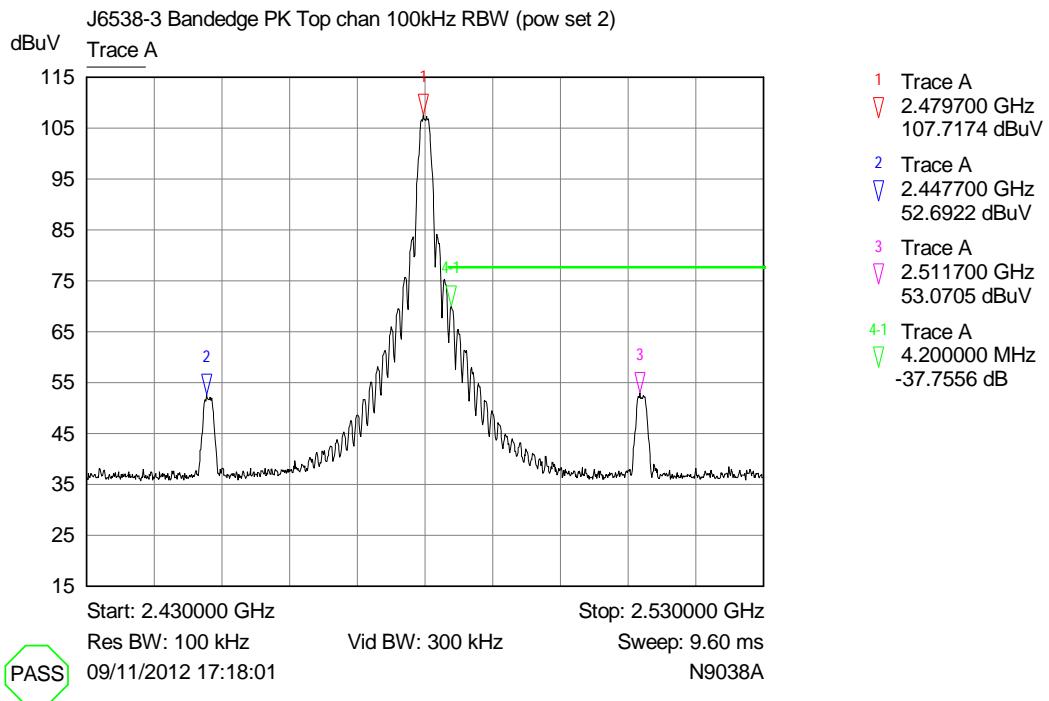


The above peak plot shows a possible problem at the upper restricted band (2483.5 – 2500MHz) against the peak limits, however it also shows compliance is achieved within 2 standard bandwidths (marker 3 is below the limit line), therefore the marker delta method is used for further analysis 2483.5 – 2485.5 MHz below:



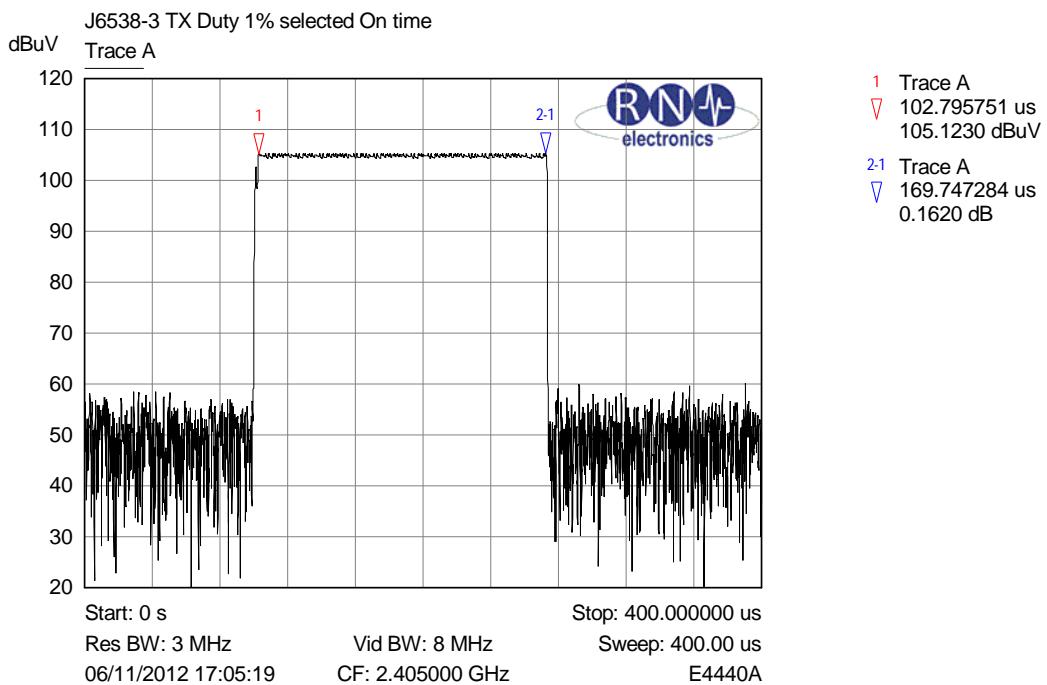
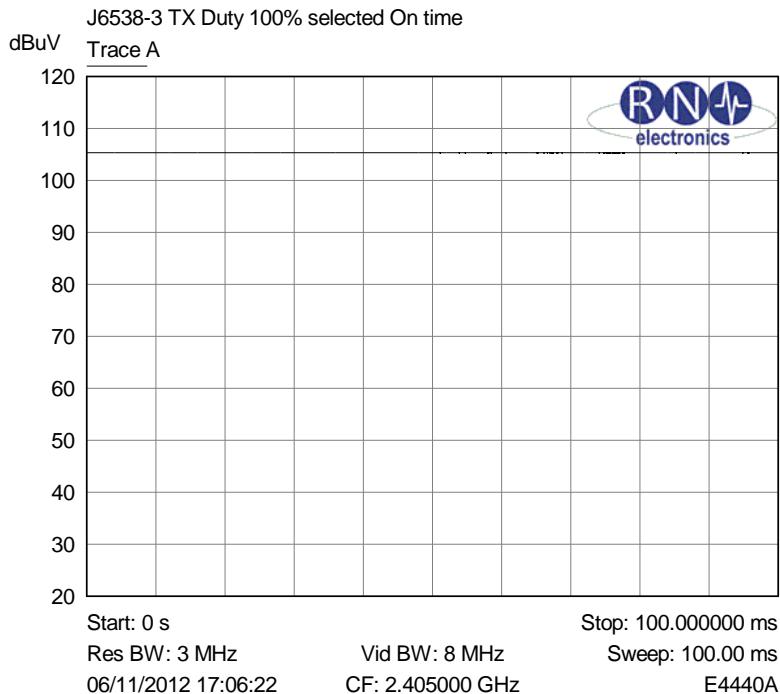
The above plot shows a delta of 37.0dB. The peak upper restricted band emission is therefore $110.2 - 37.0 = 73.2$ dBuV/m compared to a limit of 74dBuV/m. I.e. PASS.

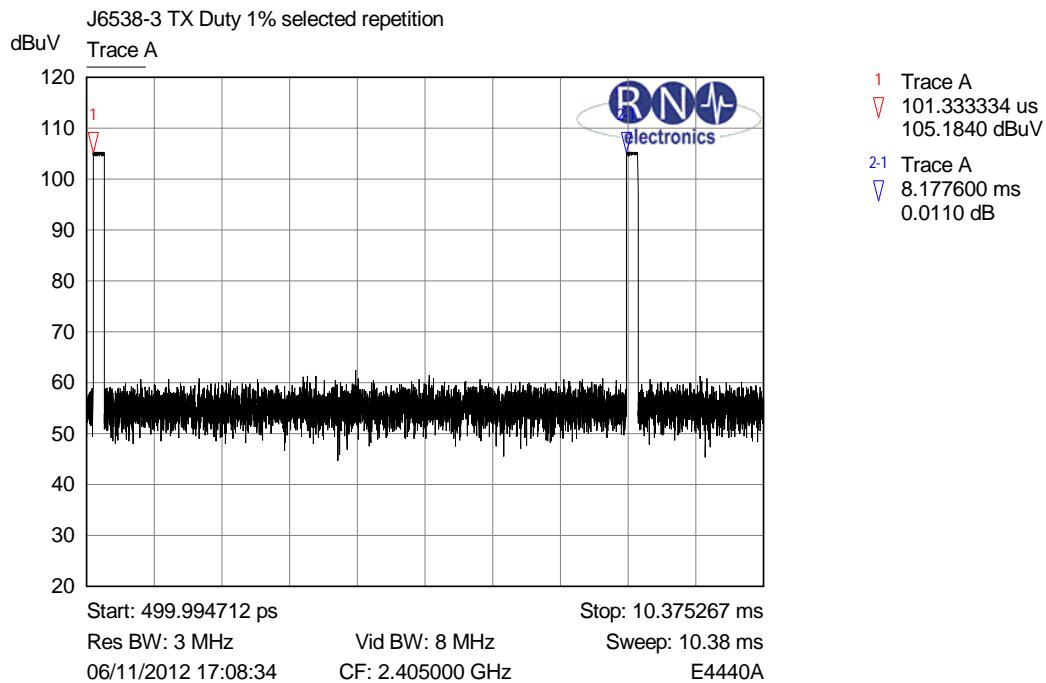
The average restricted band limit, 54dBuV/m @ 3m , is also therefore complied with after duty cycle correction.



The above peak plot shows compliance with the out of band (spurious emission) 30dBc in 100kHz RBW limit.

6.6 Duty cycle





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7 Explanatory Notes

7.1 Explanation of Table of Signals Measured

Measurements are made as required by the standard. These measurements are made and recorded using detectors, either peak, quasi peak or average dependant on the test. A table of results has been given following the relevant plots. This table looks similar to the one illustrated below dependant on the measurements required by the test: -

Signal No.	Freq (MHz)	Peak Amp (dB μ V)	Pk - Lim 1 (dB)	QP Amp (dB μ V)	QP - Lim1 (dB)	Av Amp (dB μ V)	Av - Lim1 (dB)
1	12345	54.9	-10.5	48.0	-12.6	37.6	-14.4

Column One - Labelled Signal No. is an incremental number that the receiver has given to each signal that has been measured.

Column Two - Labelled Freq (MHz) is the approximate frequency of the signal received.

Column Three - Labelled Peak Amp (dB μ V) is the level of received signal that was measured in dB above 1 μ V using the peak detector.

Column Four - Labelled Pk - Lim1 (dB) is the difference in level from the peak signal given to the active limit line. If this column appears in the table the peak detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

Column Five - Labelled QP Amp (dB μ V) is the level of received signal that was measured in dB above 1 μ V using the quasi-peak detector.

Column Six - Labelled QP - Lim1 (dB) is the difference in level from the quasi-peak signal given to the active limit line. If this column appears in the table the quasi-peak detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

Column Seven - Labelled Av Amp (dB μ V) is the level of received signal that was measured in dB above 1 μ V using the average detector.

Column Eight - Labelled Av - Lim1 (dB) is the difference in level from the average signal given to the active limit line. If this column appears in the table the average detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

Only signals highlighted in red are deemed to exceed the limit of the detector required.

7.2 Explanation of limit line calculations for radiated measurements

The limits given in the test standard are normally expressed as absolute values (e.g. in μ V/m at a specified distance), whereas the measured values are expressed as peak, quasi peak or average values in dB μ V/m referenced to the measuring instrument inputs. RN Electronics calibrate the test set-up to account for any path losses, antenna gains, etc. so that the value read at the receiver relates directly to the absolute value required, except that it is expressed in dB relative to one microVolt and may need to take account of any alternative measuring distance used. Examples:

- (a) limit of 500 μ V/m equates to $20 \cdot \log (500) = 54$ dB μ V/m.
- (b) limit of 300 μ V/m at 10m equates to $20 \cdot \log (300 \cdot 10/3) = 60$ dB μ V/m at 3m

8 Photographs



Photograph of the EUT as viewed from in front of the antenna, site M.

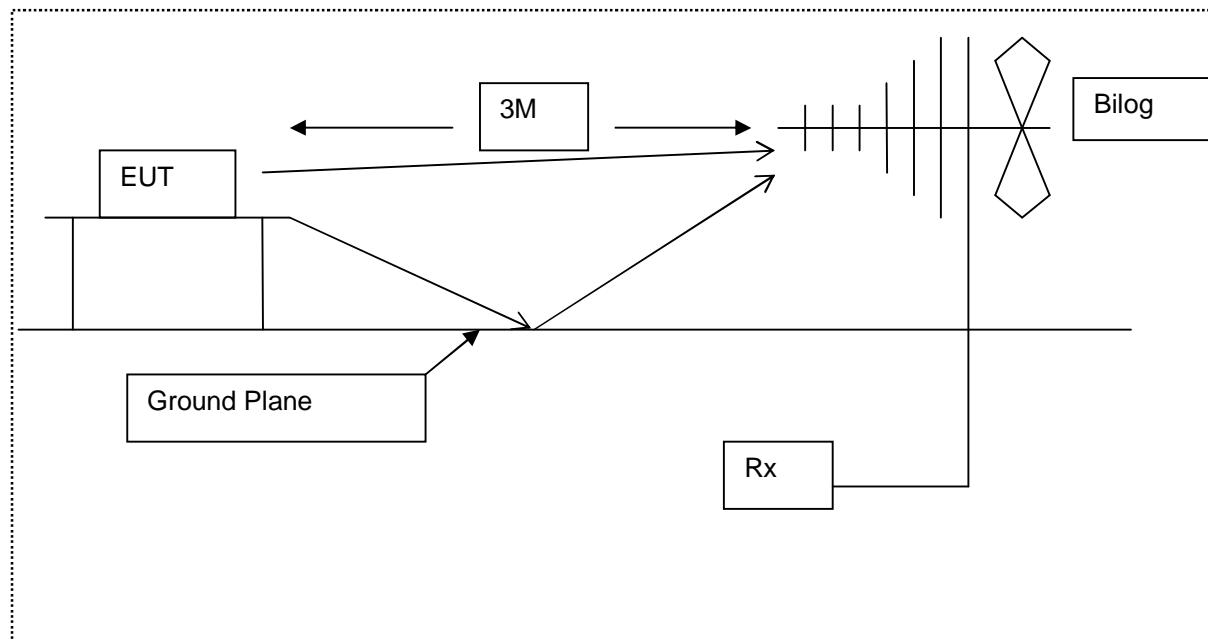
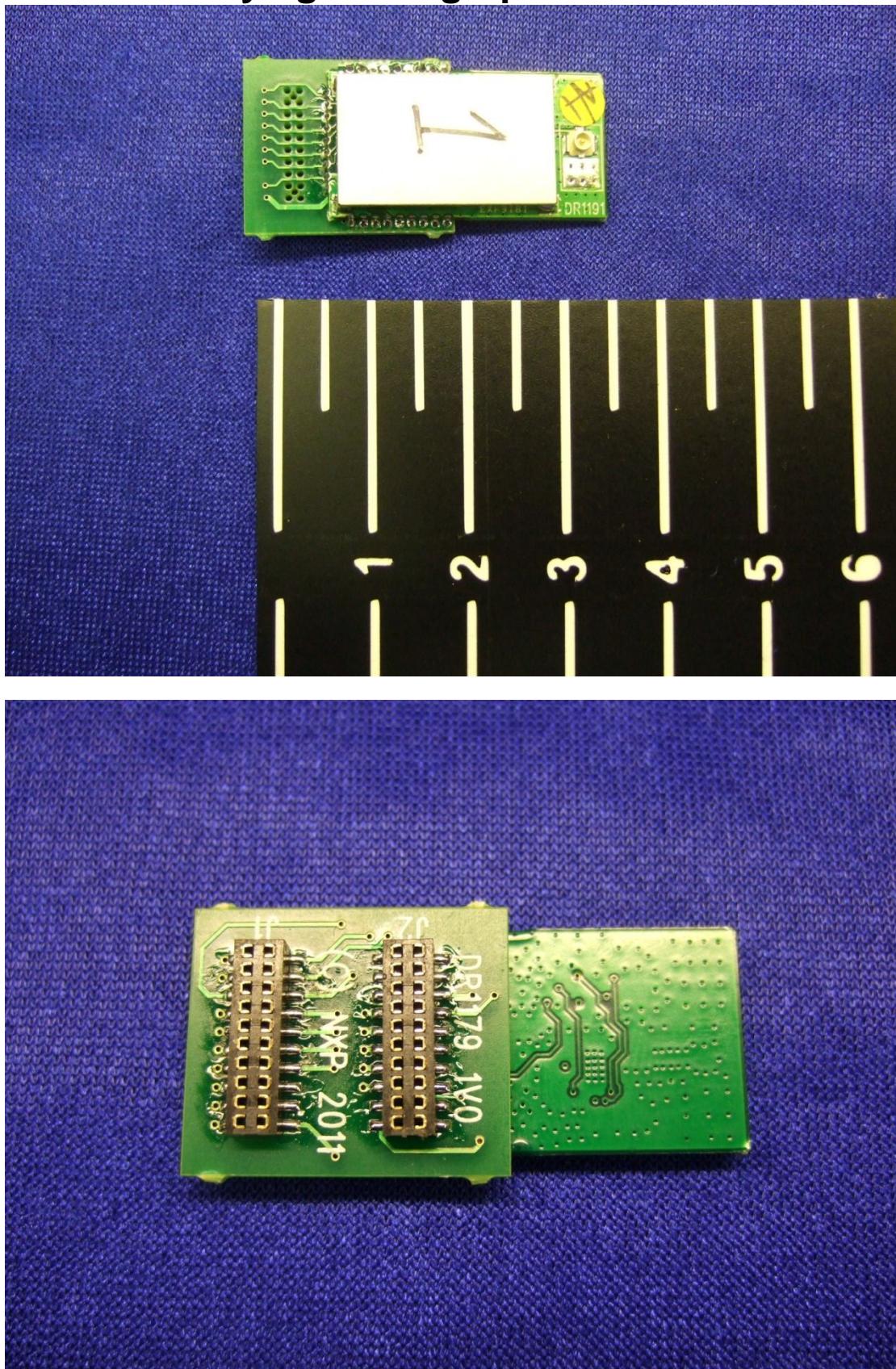


Diagram of the radiated emissions test setup 30MHz-1GHz.



Photograph of radiated emissions set-up 18-26GHz

Identifying Photographs of the EUT



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9 Signal Leads

Port Name	Cable Type	Connected
Header	N/A	Yes, mounted directly onto ancillary Carrier Board.

10 Test Equipment Calibration list

The following table lists the test equipment used, last calibration date and calibration interval. All test equipment used has been maintained within the calibration requirements of **R.N. Electronics Ltd.** test facility quality system. Calibration intervals are regularly reviewed dependent on equipment manufacturer's recommendations and actual usage of the equipment.

RN No.	Model	Description	Manufacturer	Period	Last Cal
E252	6810.19.A	Suhner	10 dB Attenuator	12	01-May-12
E342	8563E	HP	Spectrum Analyser 26.5 GHz	24	29-Mar-11
E268	BHA 9118	Schaffner	1-18 GHz Horn Antenna	24	14-Apr-11
E410	N5181A	Agilent Technologies	3 GHz MXG Signal Generator	12	18-Oct-12
E411	N9039A	Agilent Technologies	9 kHz - 1 GHz RF Filter Section	12	18-Oct-12
E412	E4440A	Agilent Technologies	3 Hz - 26.5 GHz PSA	12	18-Oct-12
E429	-	RN Electronics	5 Switch Filter Box 0.91 GHz - 16.3 GHz	12	10-Nov-11
E492	N9038A	Agilent Technologies	20Hz - 8.4GHz MXE EMI Receiver	12	06-Feb-12
TMS78	3160-08	ETS Systems	Std Gain Horn Antenna 12.4-18 GHz	24	03-Nov-12
TMS79	3160-09	ETS Systems	Std Gain Horn Antenna 18-26.5 GHz	24	03-Nov-12
TMS82	8449B	Agilent	Pre Amplifier 1 - 26 GHz	12	14-Nov-11
TMS933	CBL6141A	York EMC	Bilog Antenna 30MHz - 2GHz	24	09-Sep-12

11 Auxiliary equipment

11.1 Auxiliary equipment supplied by NXP Laboratories UK Ltd.

Auxiliary equipment used for the purpose of test supplied by the above has been listed below

Item No.	Model No.	Description	Manufacturer	Serial No.
1	DR1174	Carrier board	NXP	-
2	DR1201	LCD expansion board	NXP	-
3	PP21L	Laptop Inspiron 13000	Dell	00045-633-785-363

11.2 Auxiliary equipment supplied by RN Electronics Limited

Auxiliary equipment used for the purpose of test supplied by the above has been listed below

None

12 Modifications

In order for the EUT to produce the results shown within this report the following modifications, if any, were implemented.

12.1 Modifications before test

There were no modifications made by R.N. Electronics Ltd before testing commenced.

12.2 Modifications during test

There were no modifications made by R.N. Electronics Ltd during testing, however the high channel (2480MHz) power setting was changed from default level 3 of 3 to level 2 of 3. The adjacent channel (2475MHz) was therefore also tested at full power (level 3 of 3) to ensure band edge compliance.

13 Compliance information

Products subject to the Declaration of Conformity procedure are required to be supplied with a compliance information statement. A copy of this statement may be included here:

Not applicable. The EUT is subject to the Certification authorisation procedure.

14 Description of Test Sites

Site A	Radio / Calibration Laboratory and anechoic chamber
Site B	Semi-anechoic chamber
Site B1	Control Room for Site B
Site C	Transient Laboratory
Site D	Screened Room (Conducted Immunity)
Site E	Screened Room (Control Room for Site D)
Site F	Screened Room (Conducted Emissions) VCCI Registration No. C-2823
Site K	Screened Room (Control Room for Site M)
Site M	3m Semi-anechoic chamber (indoor OATS) FCC Registration No. 293246
Site Q	Fully-anechoic chamber
Site OATS	3m and 10m Open Area Test Site FCC Registration No. 293246 IC Registration No. 5612A-1 VCCI Registration No. R-2580
Site R	Screened Room (Conducted Immunity)
Site S	Safety Laboratory
Site T	Transient Laboratory

15 Abbreviations and Units

%	Percent	Hz	Hertz
µV	microVolts	IF	Intermediate Frequency
µW	microWatts	kHz	kiloHertz
AC	Alternating Current	LO	Local Oscillator
ALSE	Absorber Lined Screened Enclosure	mA	milliAmps
AM	Amplitude Modulation	max	maximum
Amb	Ambient	mbar	milliBars
ANSI	American National Standards Institute	MHz	MegaHertz
°C	Degrees Celsius	min	minimum
CFR	Code of Federal Regulations	mm	milliMetres
CS	Channel Spacing	ms	milliSeconds
CW	Continuous Wave	mW	milliWatts
dB	deciBels	NA	Not Applicable
dBµV	deciBels relative to 1µV	OATS	Open Area Test Site
dBc	deciBels relative to Carrier	OFDM	Orthogonal Frequency Division Multiplexing
dBm	deciBels relative to 1mW	ppm	Parts per million
DC	Direct Current	QAM	Quadrature Amplitude Modulation
EIRP	Equivalent Isotropic Radiated Power	QPSK	Quadrature Phase Shift Keying
ERP	Effective Radiated Power	Ref	Reference
EUT	Equipment Under Test	RF	Radio Frequency
FCC	Federal Communications Commission	RTP	Room Temperature and Pressure
FM	Frequency Modulation	s	Seconds
FSK	Frequency Shift Keying	Tx	Transmitter
g	Grams	V	Volts
GHz	GigaHertz		