



**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  
Report Produced by: -

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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<br>Furnival Street<br>Sheffield<br>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<br>effective date <b>October 1<sup>st</sup> 2012</b> ,<br>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: |                             |

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.

QMF21J - 3; 47CFR15.247, RNE ISSUE 01 SEP 2012

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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 <sup>1</sup> |
| 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 <sup>2</sup>         |
| 6. Duty cycle             | FCC Part 15C §15.35(c)                       | Not Applicable <sup>3</sup> |
| 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 <sup>4</sup> |

<sup>1</sup> 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.

<sup>2</sup> 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.

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

<sup>4</sup> EUT does not employ FHSS technology.

### 3 Equipment Under Test (EUT)

#### 3.1 Equipment Specification

|                                                    |                                                                                                                                                       |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| Applicant                                          | NXP Laboratories UK Ltd<br>Furnival Street<br>Sheffield<br>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 <sup>th</sup> 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

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### 3.4 EUT Modes

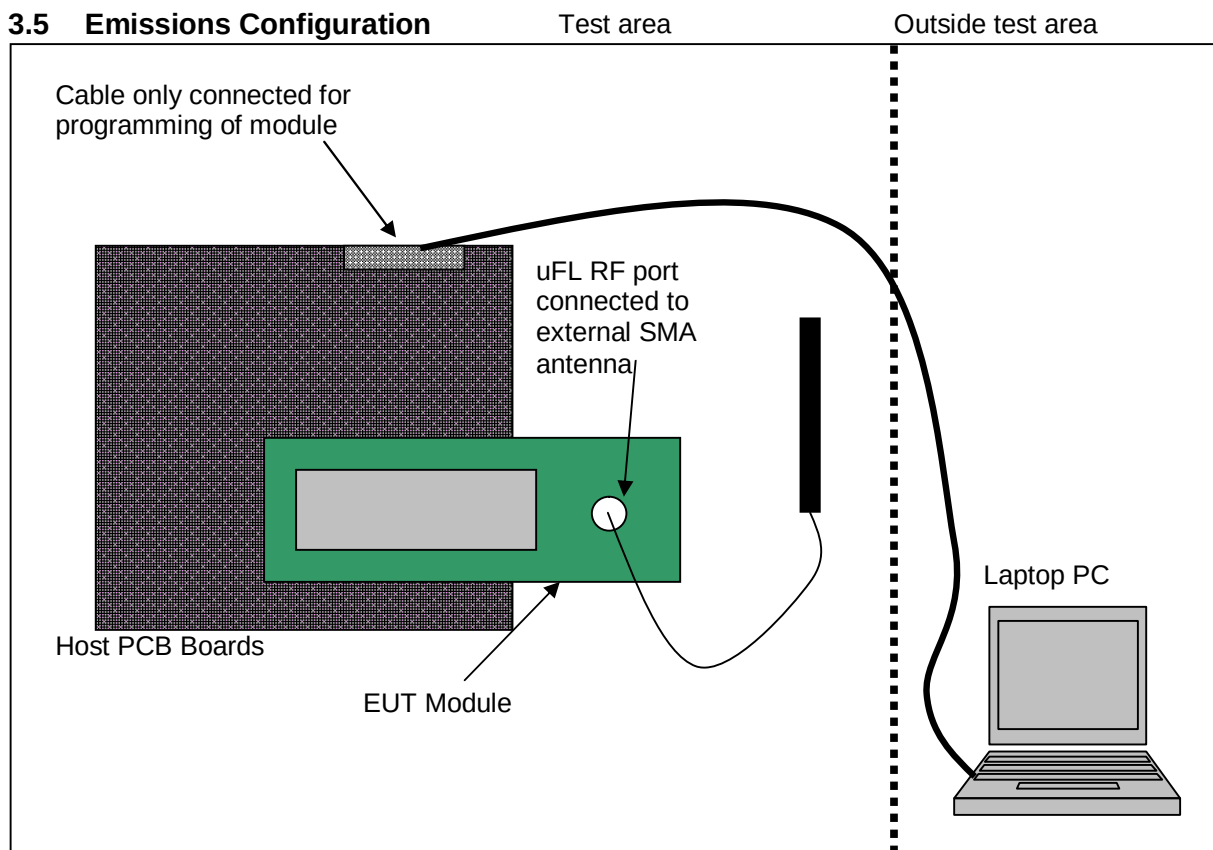
| Mode                   | Description of mode                                      | Used for Testing |
|------------------------|----------------------------------------------------------|------------------|
| Transmit Low           | Unit constantly transmitting packets on 2405MHz          | YES              |
| 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.

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### 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<br>1MHz RBW<br>(dBm) | Duty cycle adjustment<br>(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/<br>scheme | PEP<br>(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:**

|           |                      |                  |
|-----------|----------------------|------------------|
| <b>M:</b> | Temperature: 21°C    | Humidity: 32%    |
| <b>B:</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

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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

Analysers 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<br>J6538-3 Bandedge AV Low chan 1MHz RBW                     |
| High     | 73.2 <sup>Δ</sup>        | -                        | J6538-3 Bandedge PK Top chan 1MHz RBW (pow set 2)<br>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<br>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 54dBuV/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.

△ 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) 30dBc in any 100kHz bandwidth outside the band of operation.

15.209 54dBuV/m @3m AVG in restricted bands.

15.35(b) 74dBuV/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

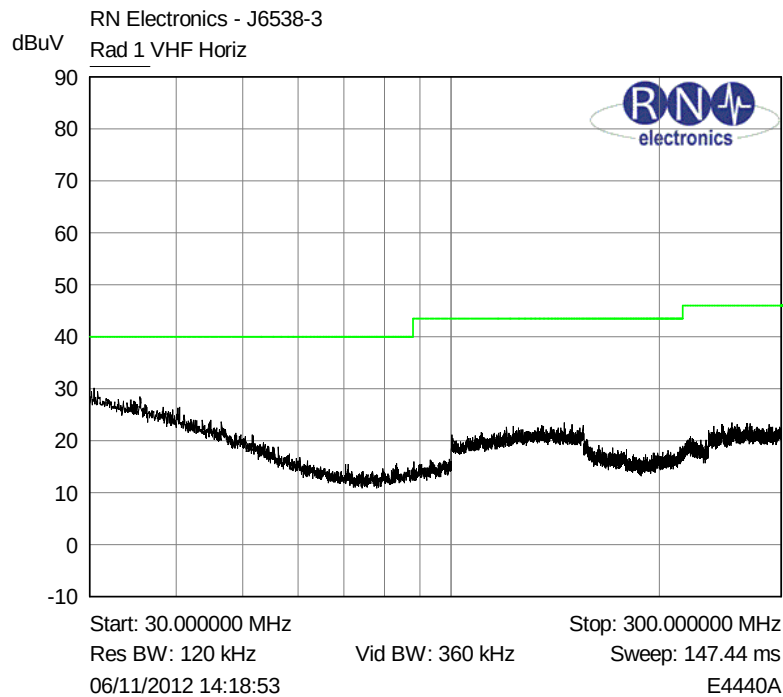
##### 5.8.3 Dwell time

## 6 Plots and Results

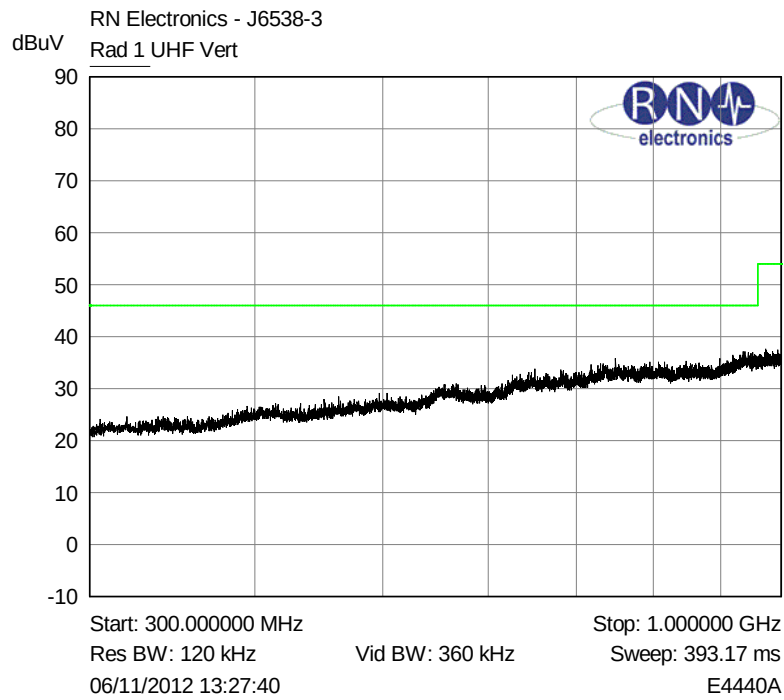
### 6.1 Conducted Emissions

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.

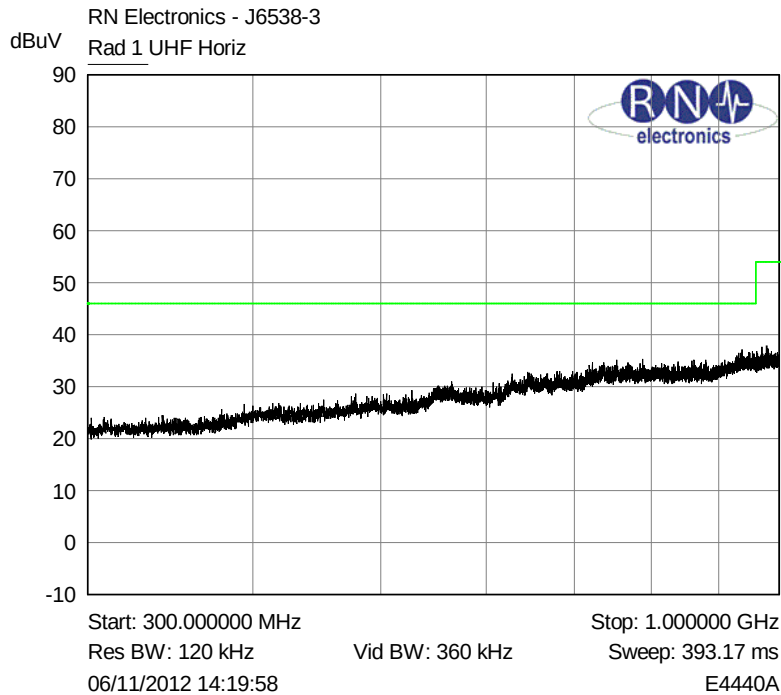
### 6.2 Radiated Emissions 30MHz – 1GHz



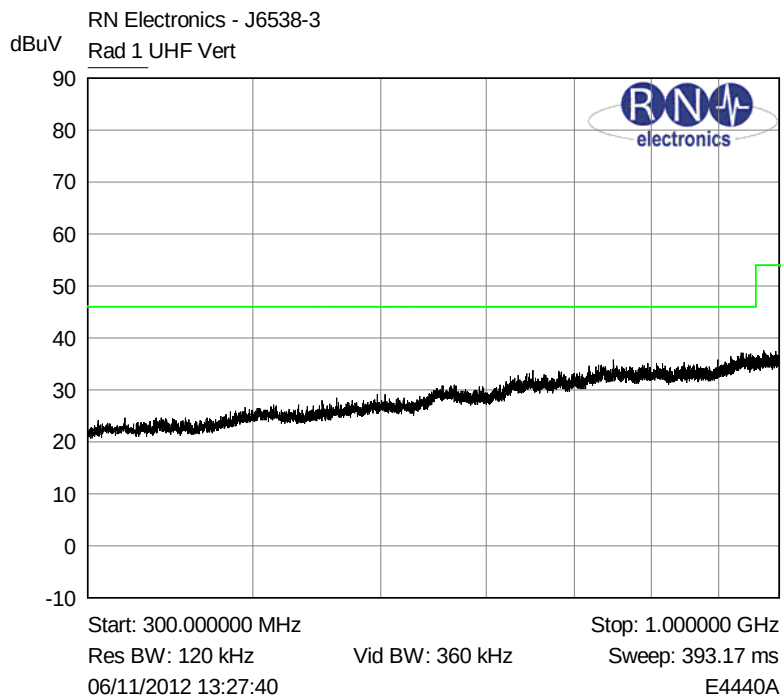
**Plot of peak horizontal emissions 30MHz - 300MHz against the quasi-peak limit line.**



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

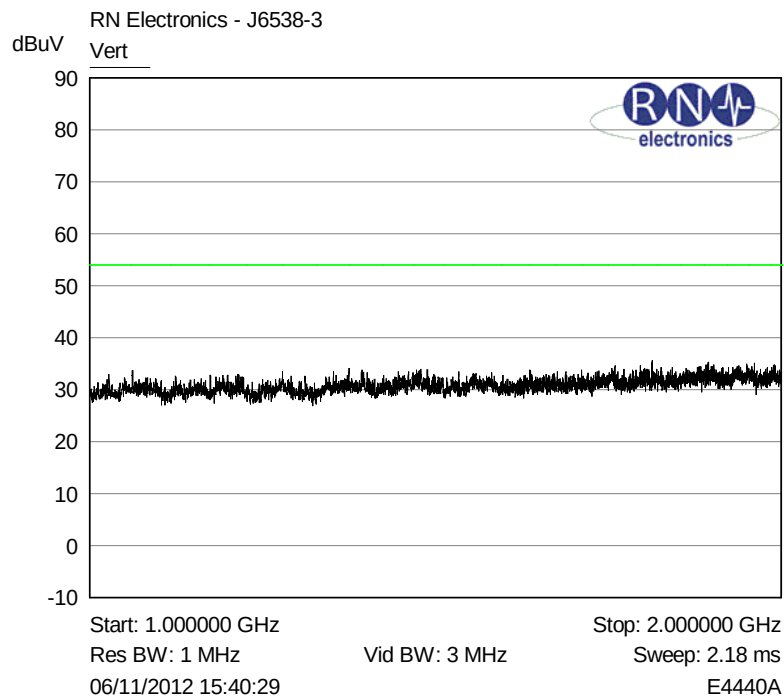
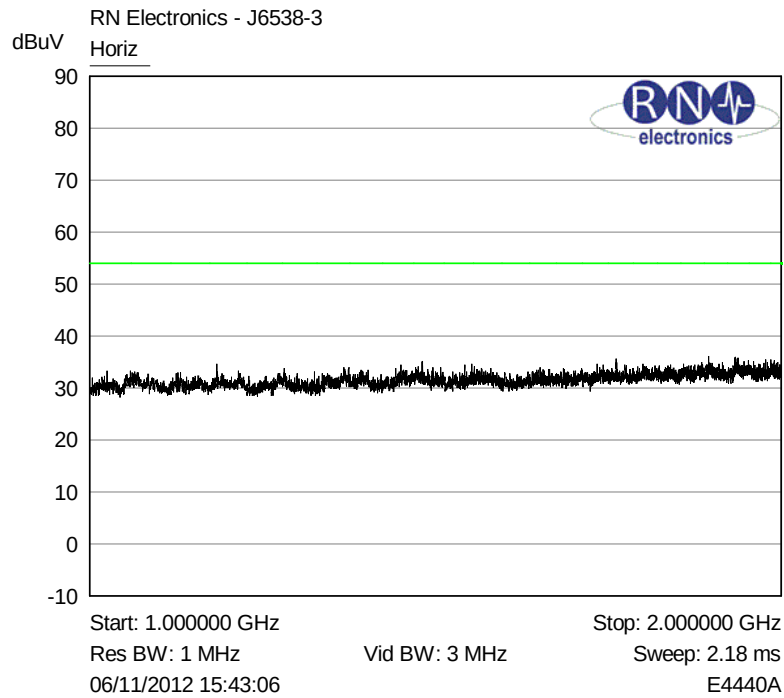


**Plot of peak horizontal emissions 300MHz - 1GHz against the quasi-peak limit line.**



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

### 6.3 Radiated Emissions above 1GHz

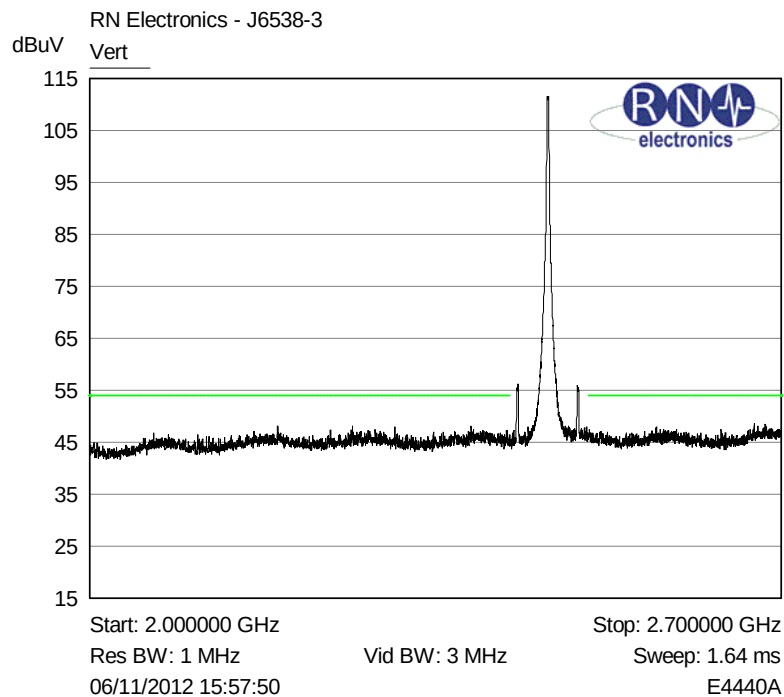
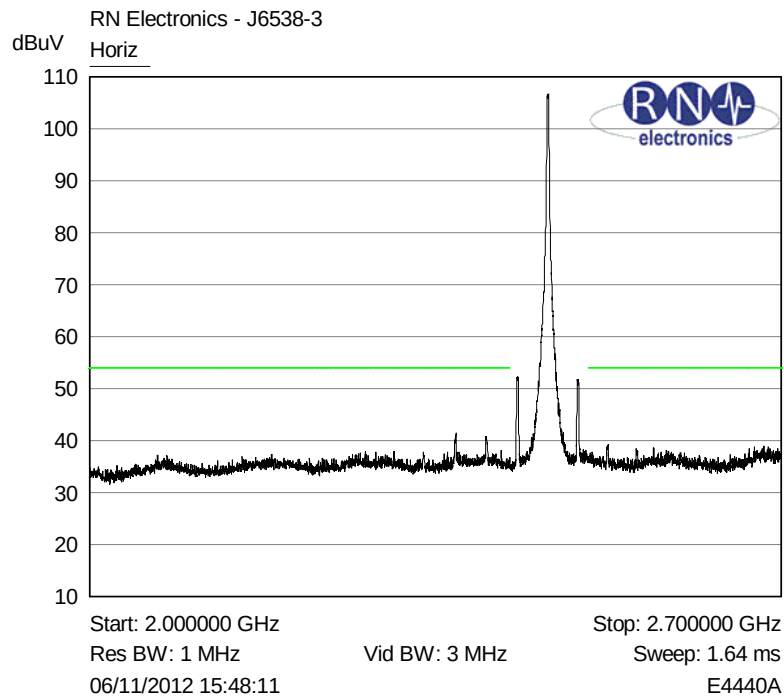


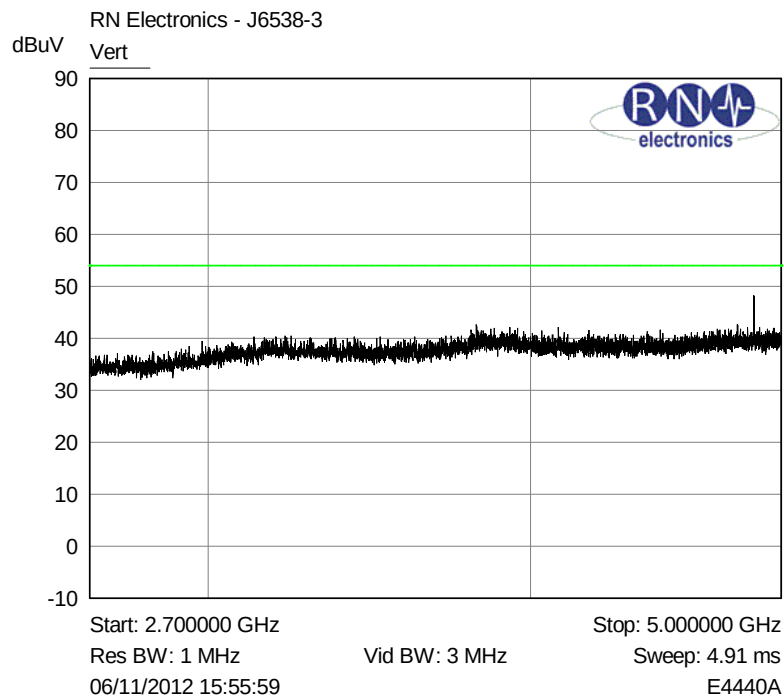
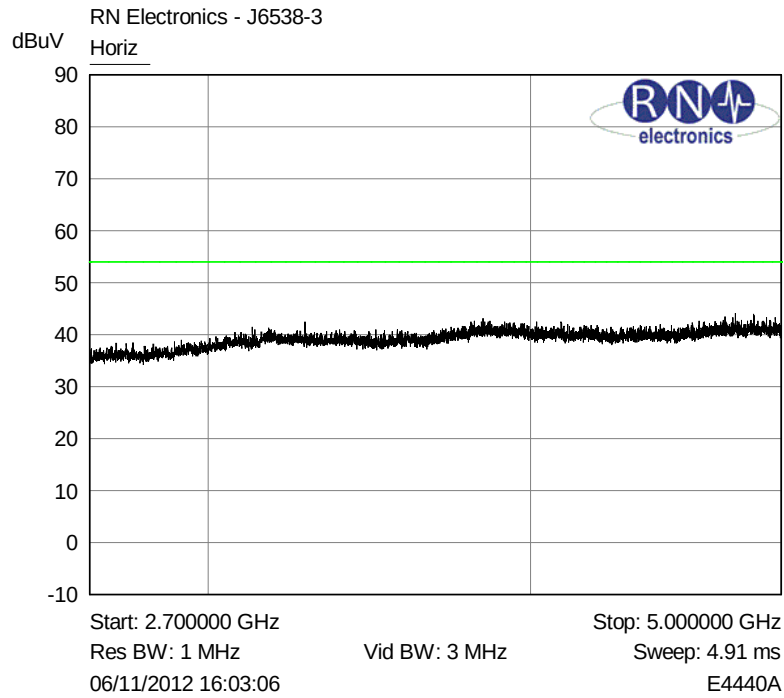
File name NXP LABORATORIES UK LTD.6538-3 (FCC RADIO).DOCX

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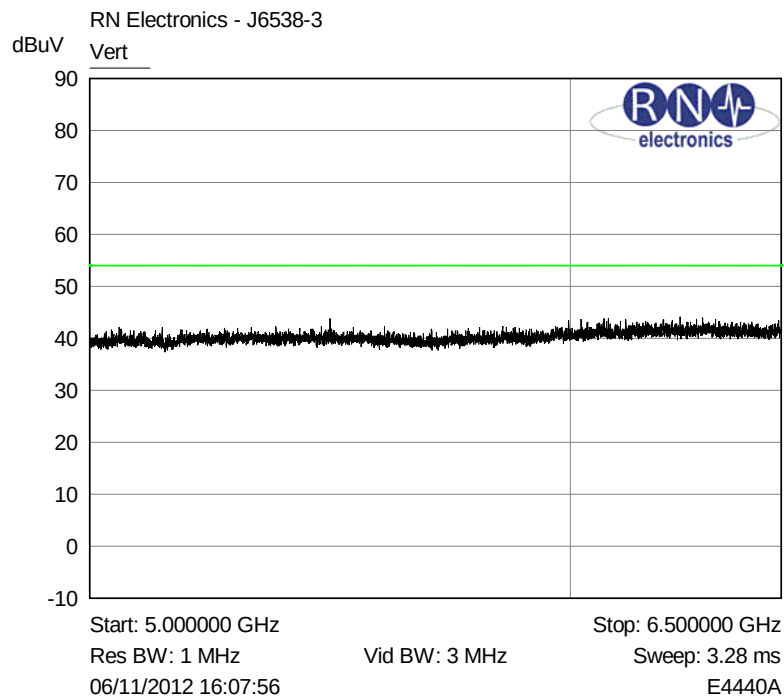
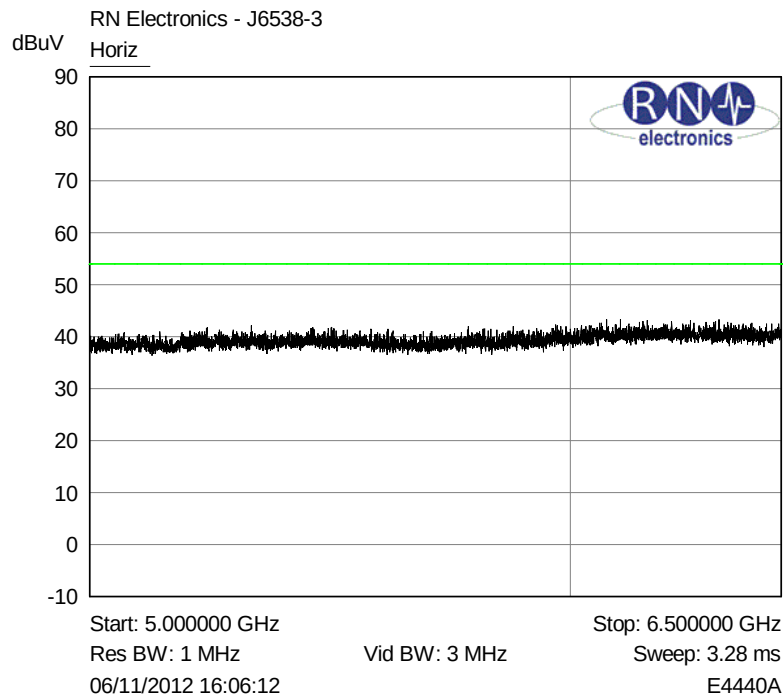
File name NXP LABORATORIES UK LTD.6538-3 (FCC RADIO).DOCX

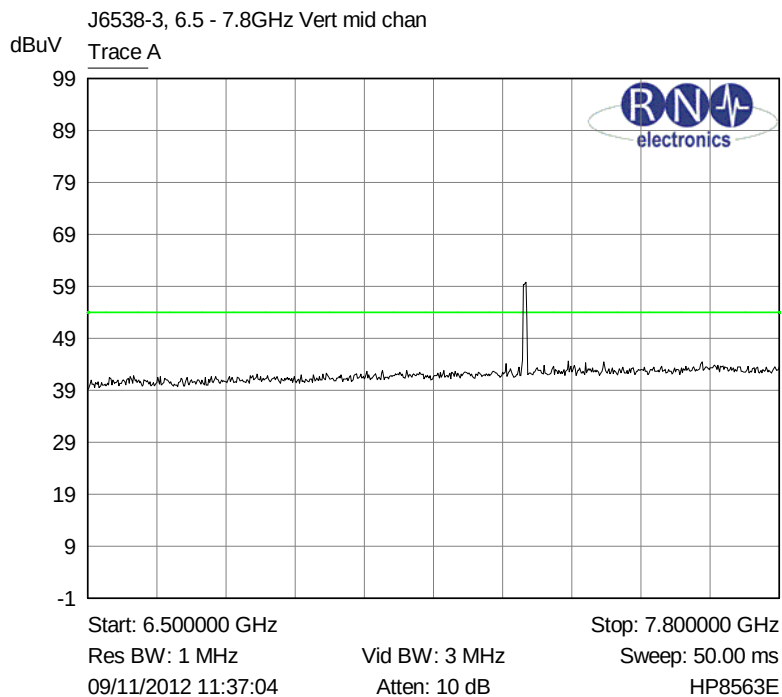
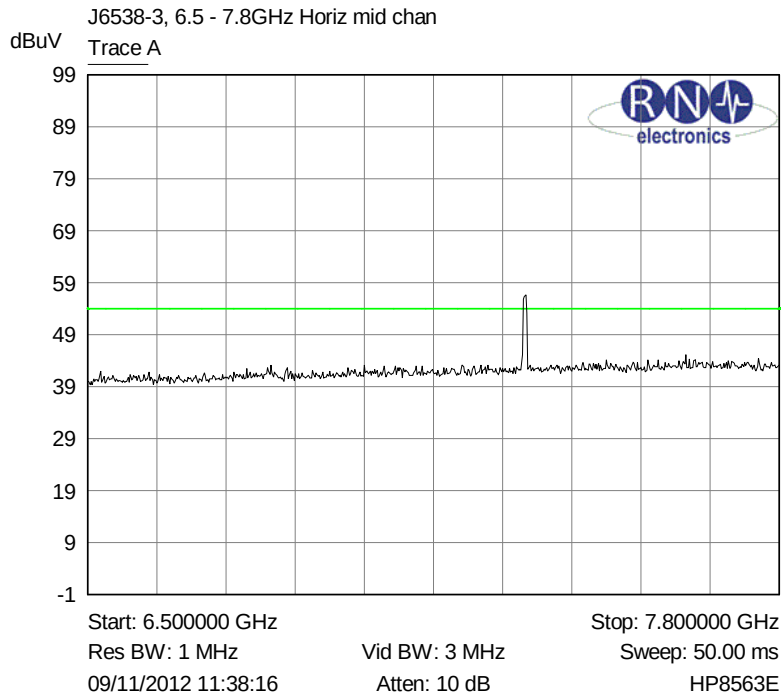
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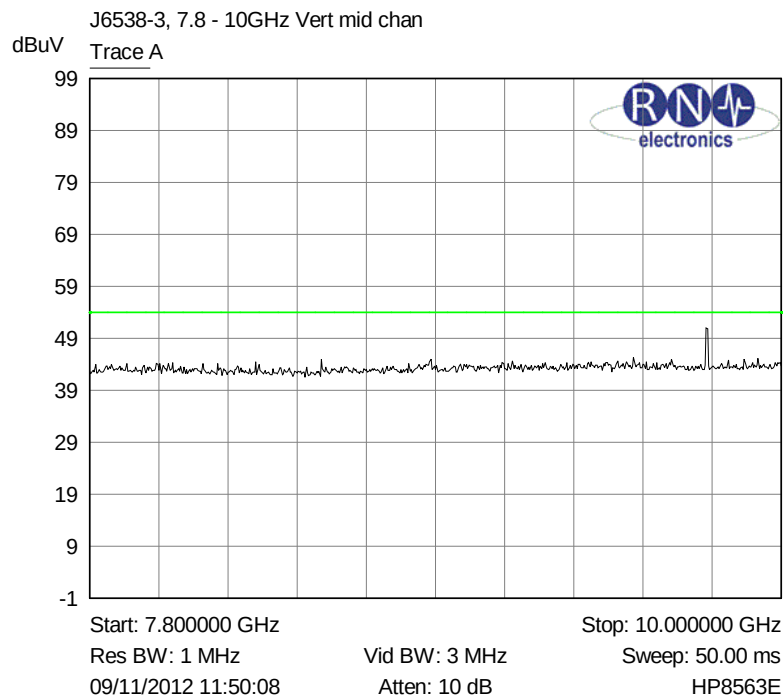
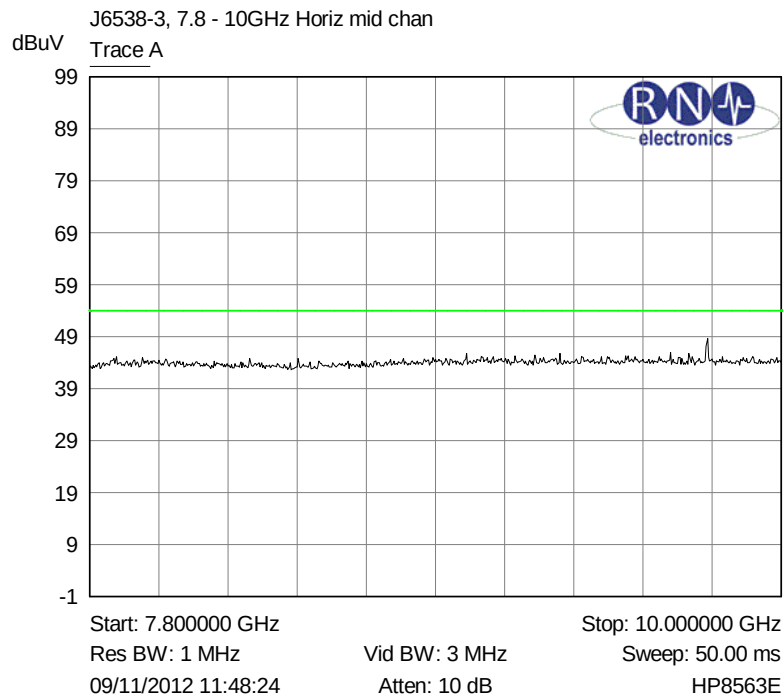
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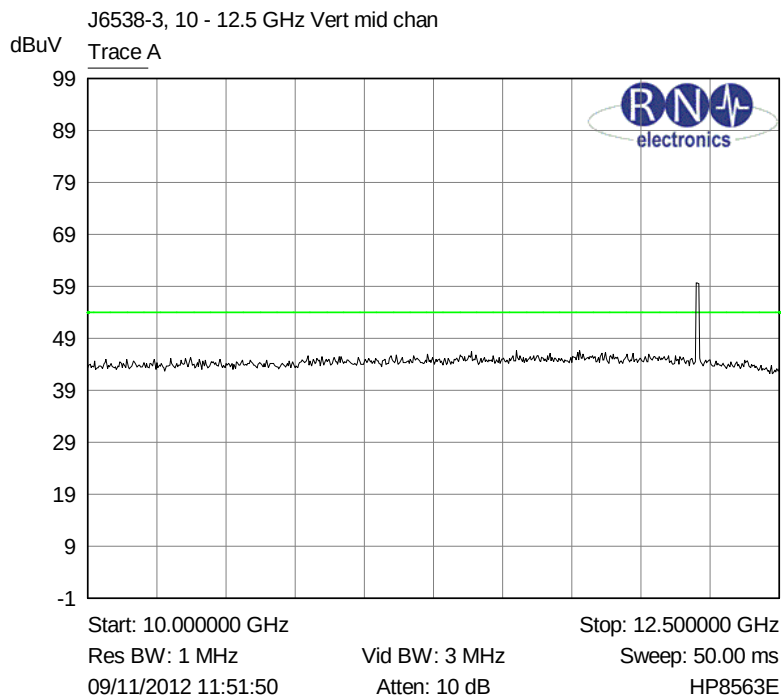
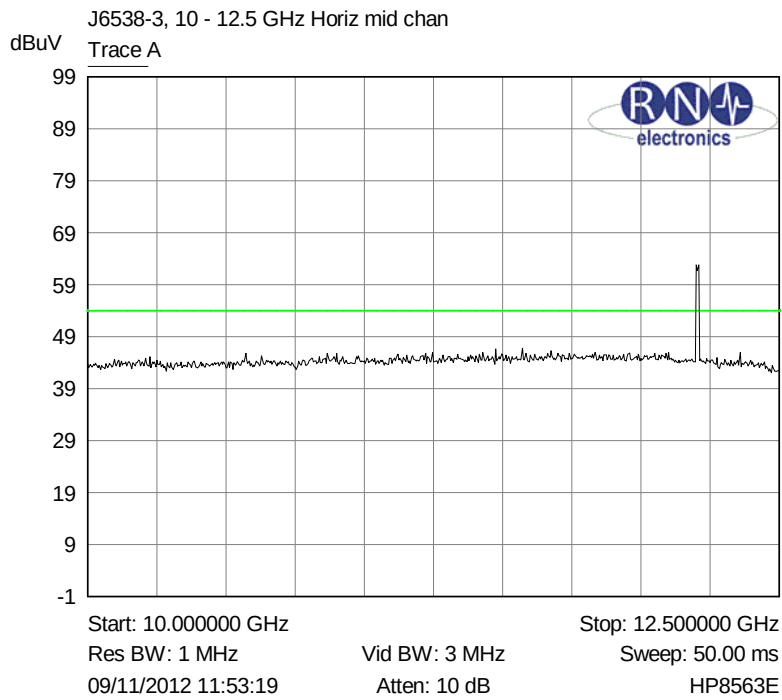
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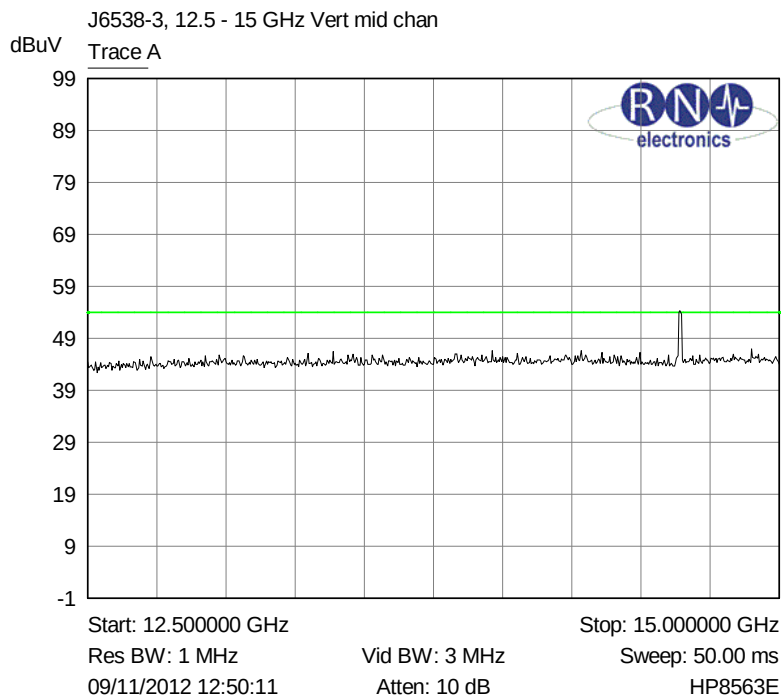
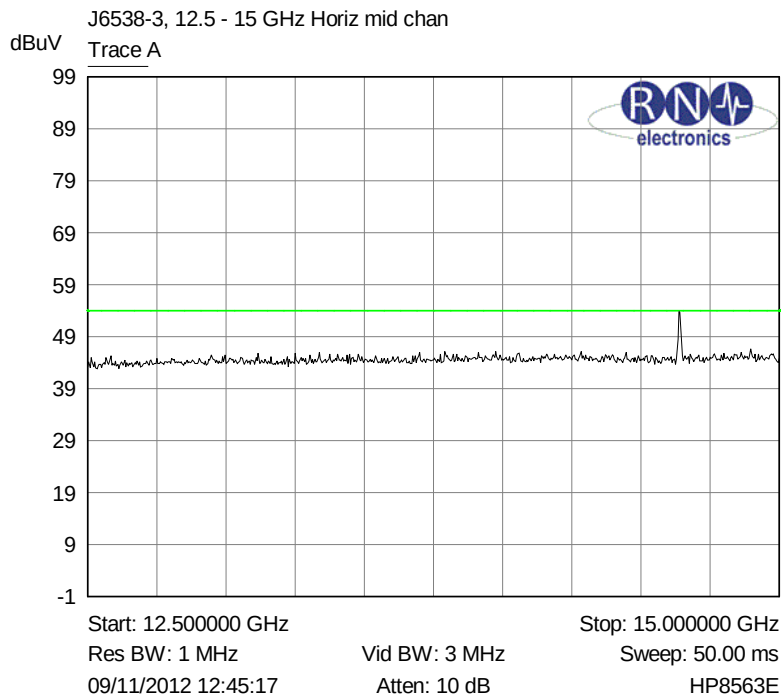


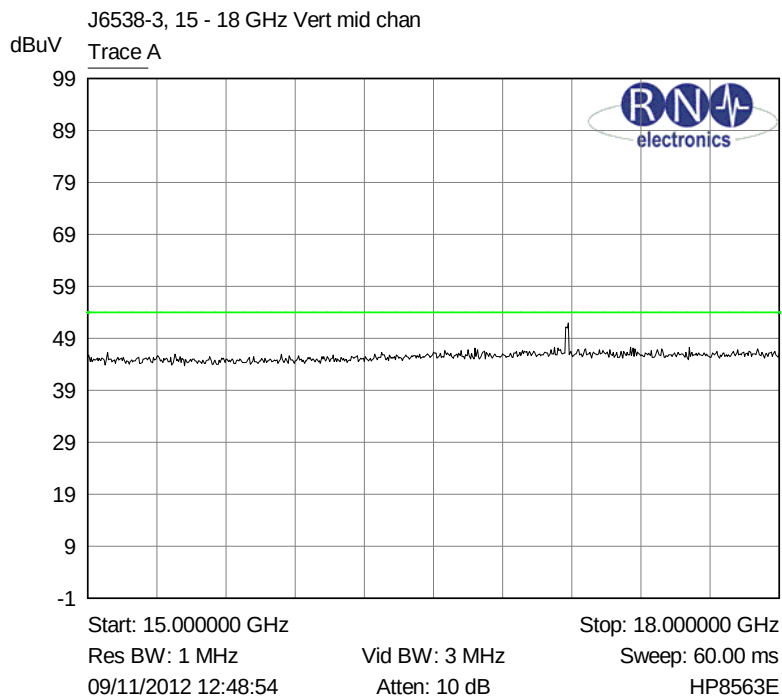
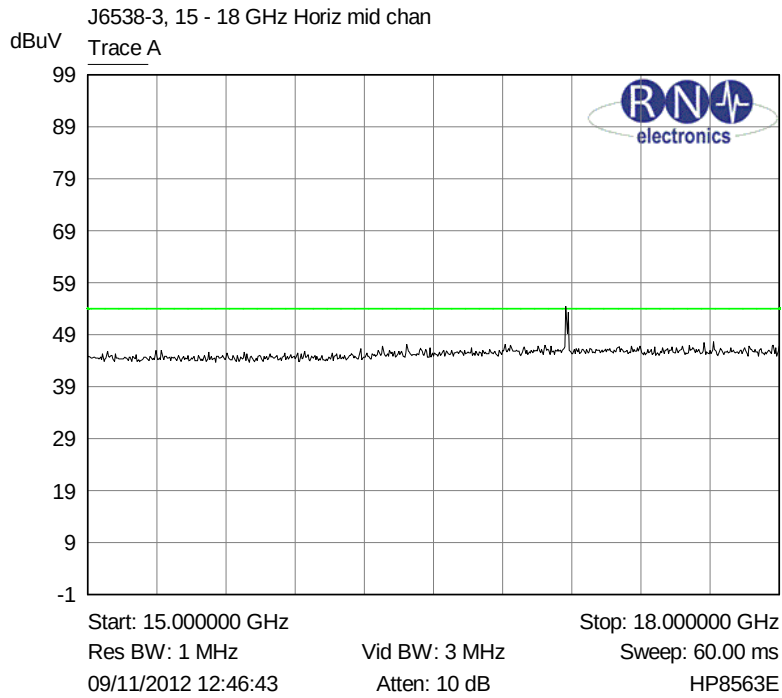


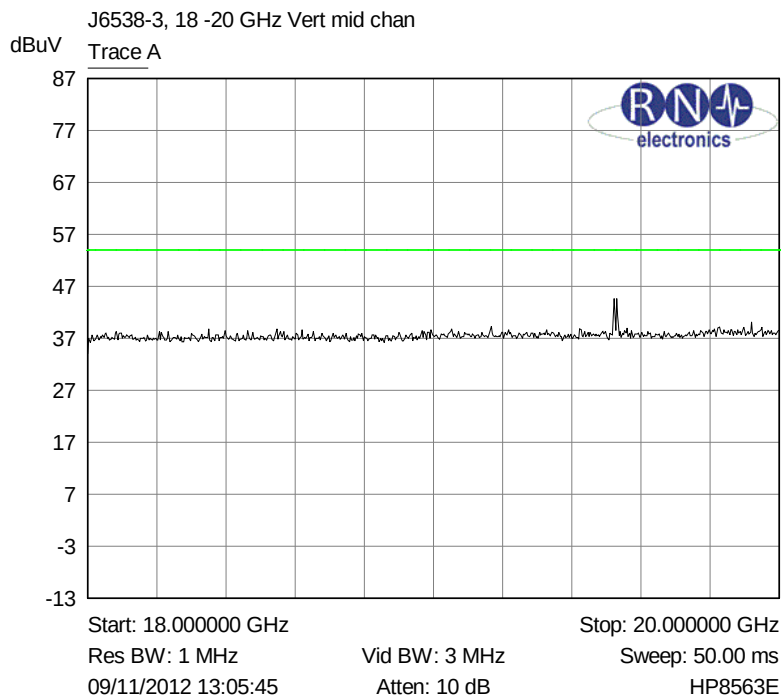
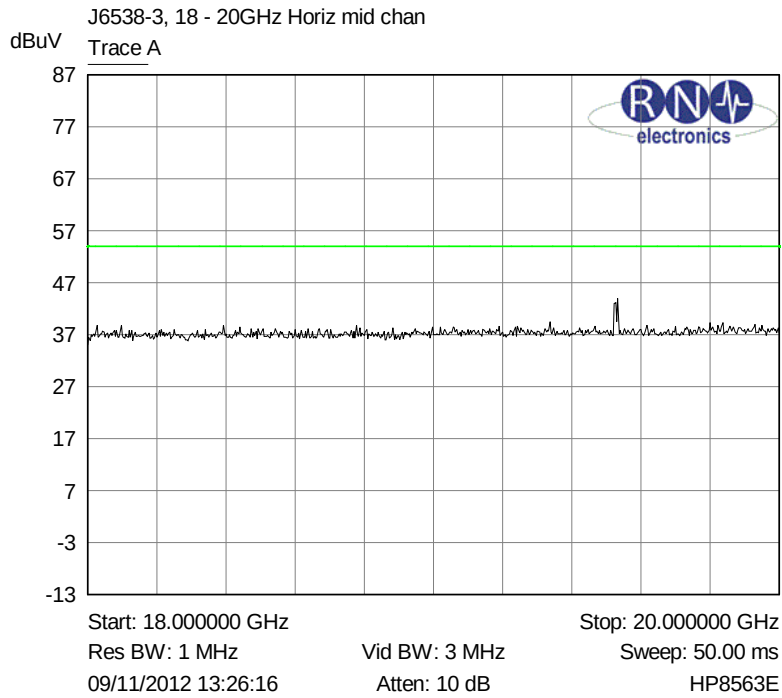


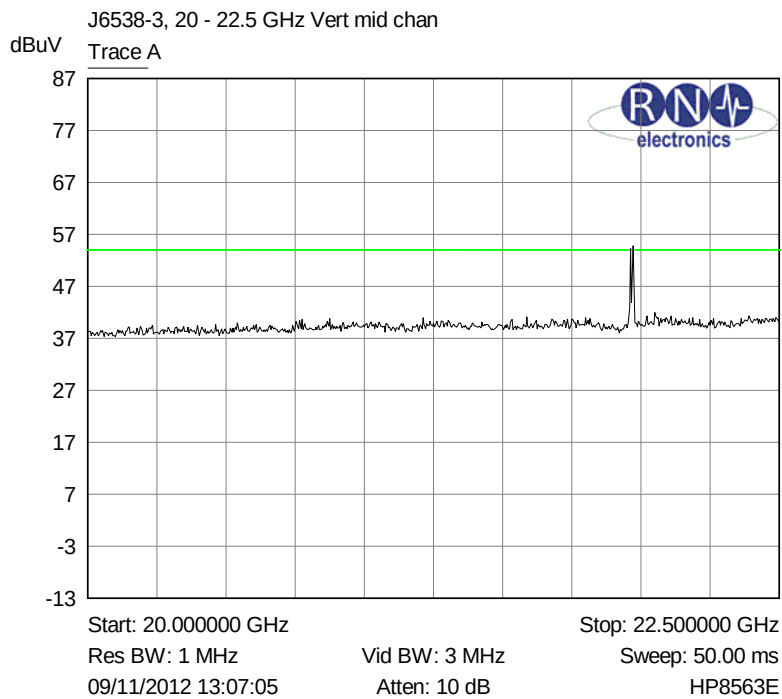
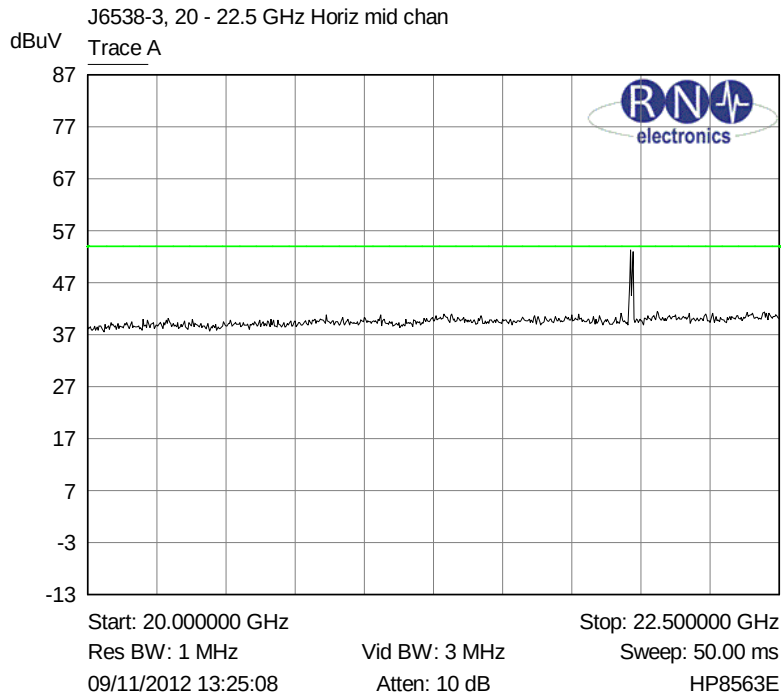




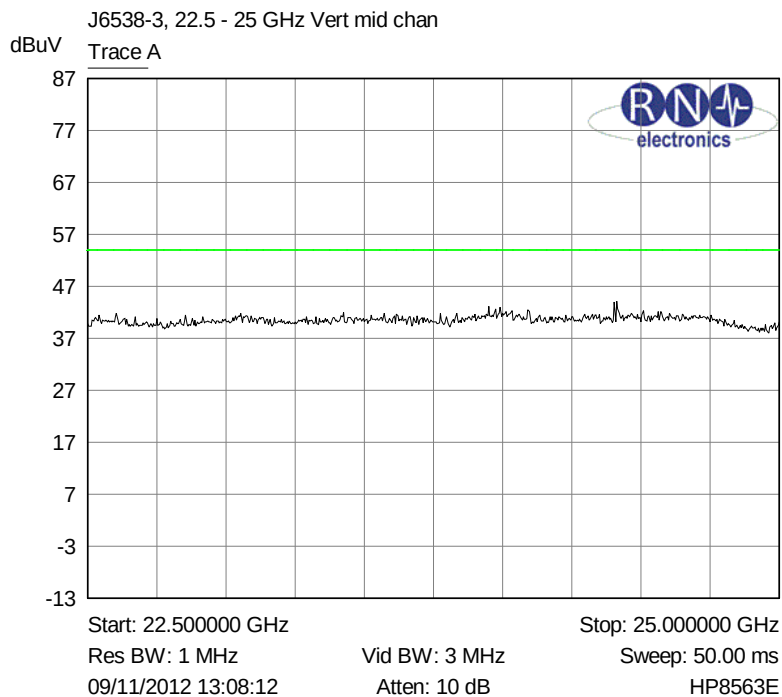
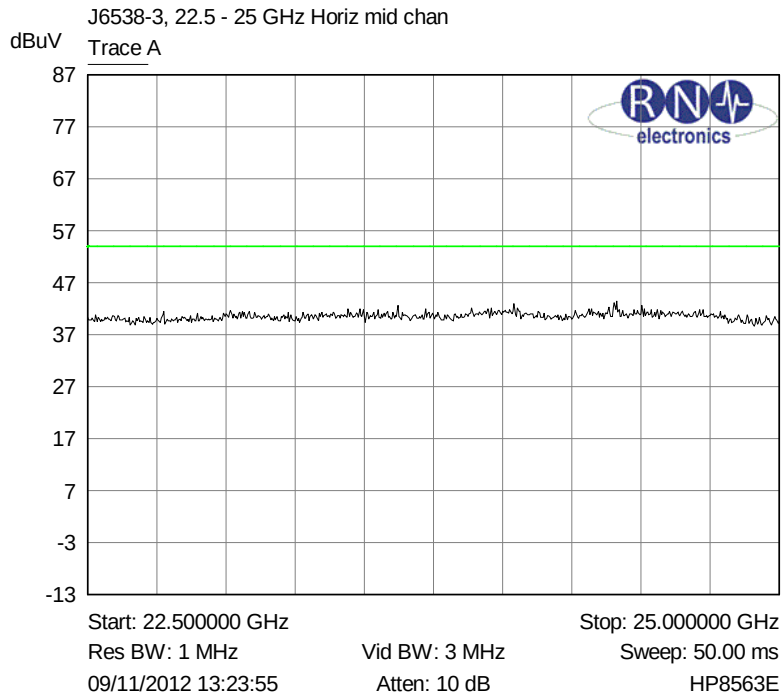




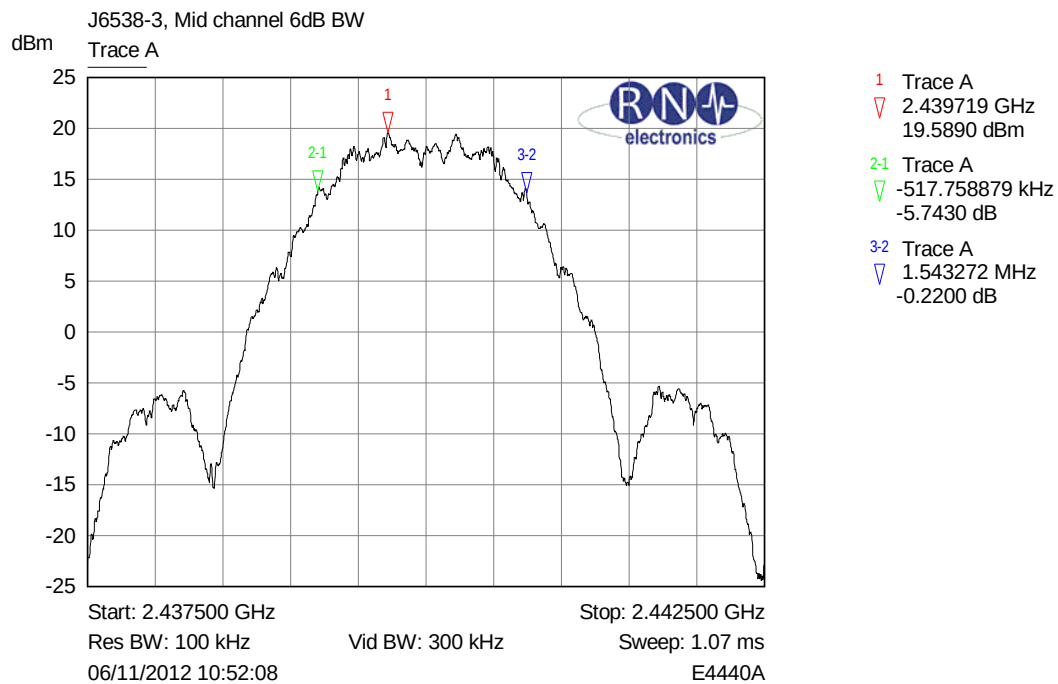
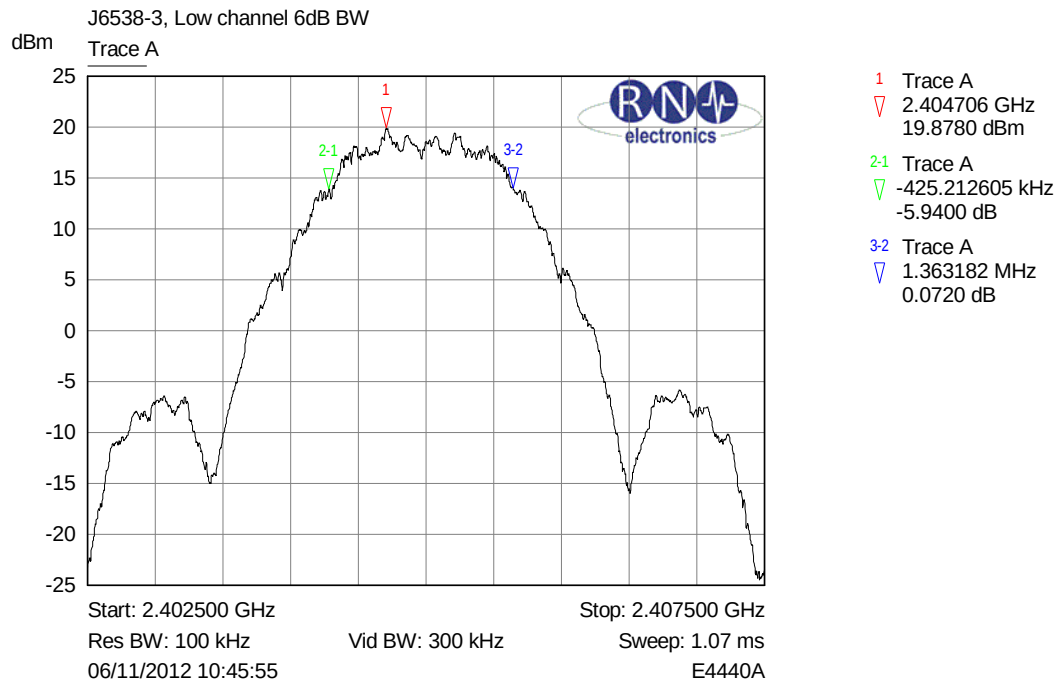








## 6.4 6dB Bandwidth

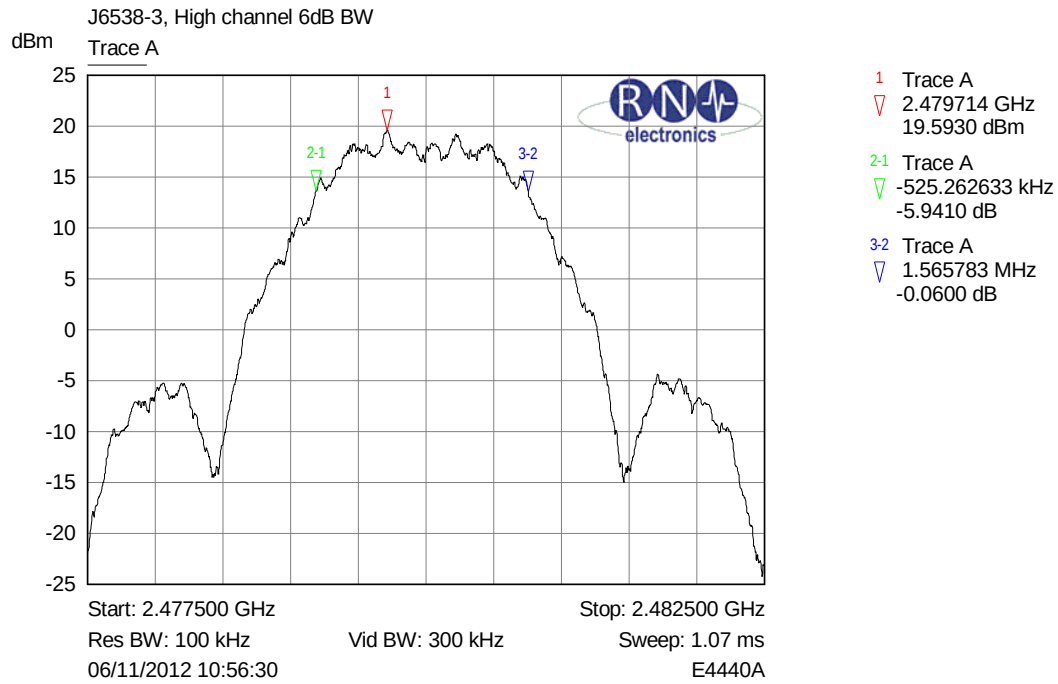


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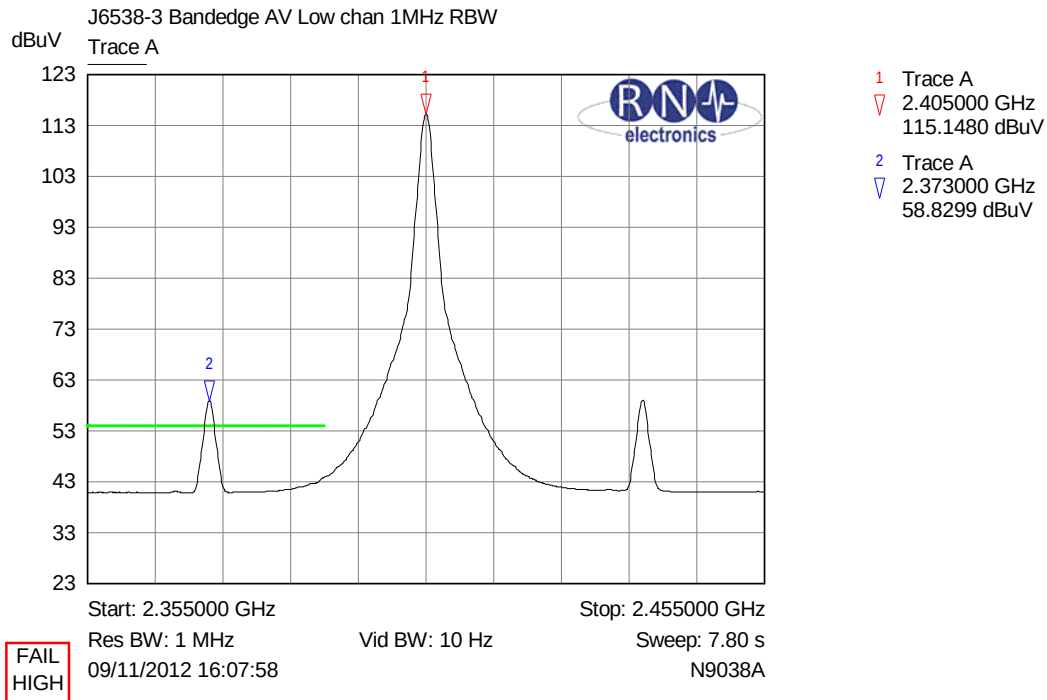
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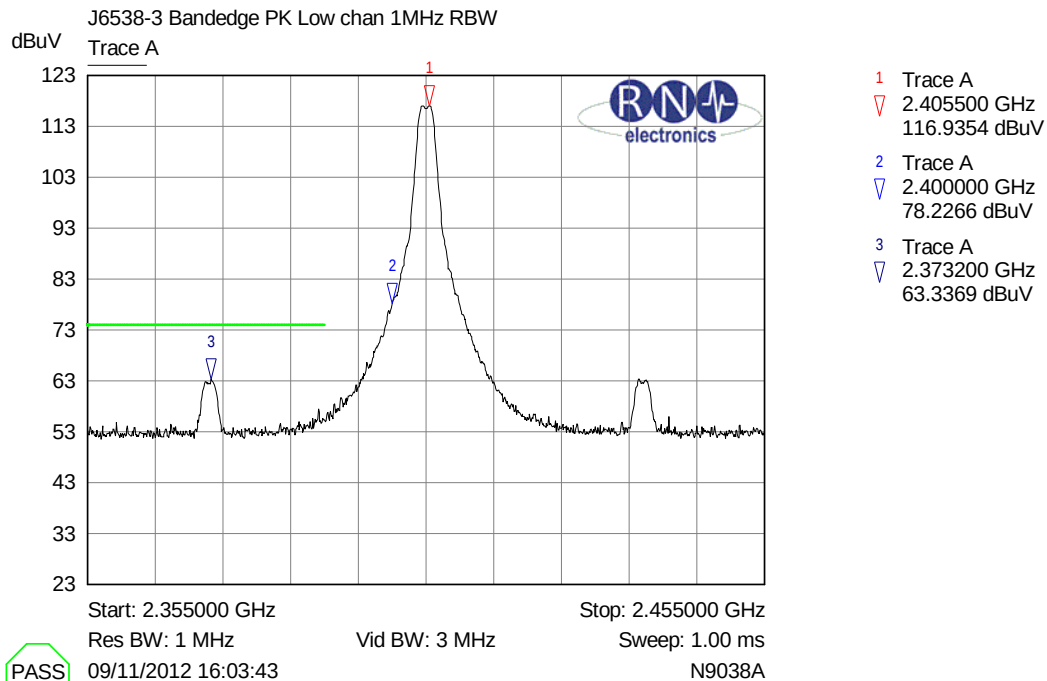


## 6.5 Band Edge Compliance

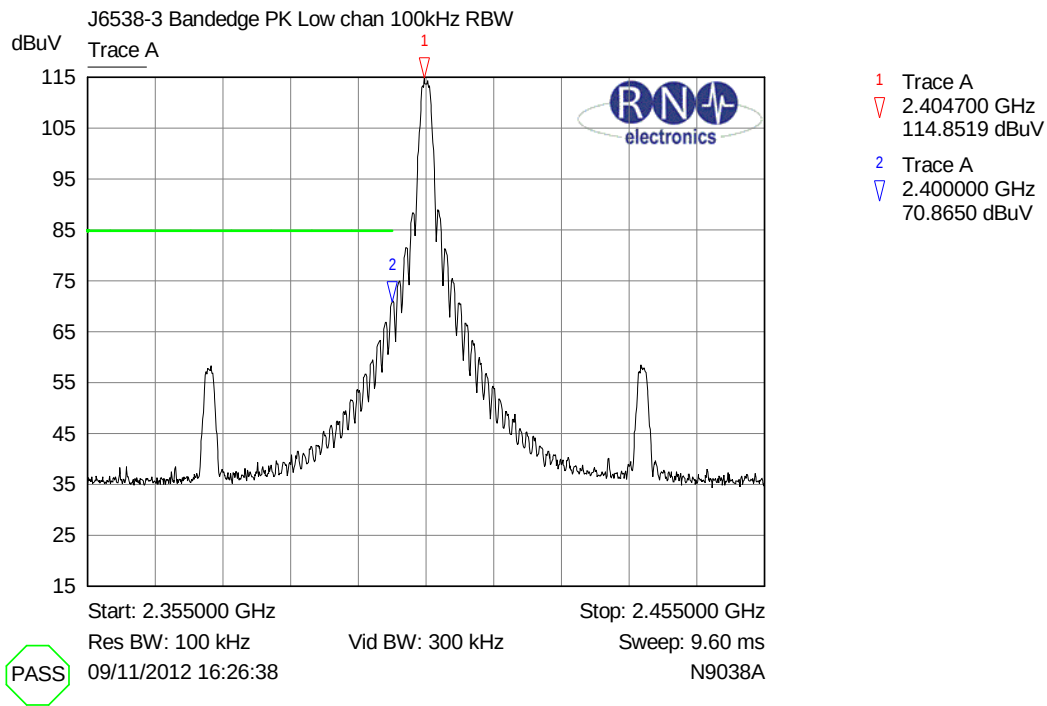
### Lower Band Edge.



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



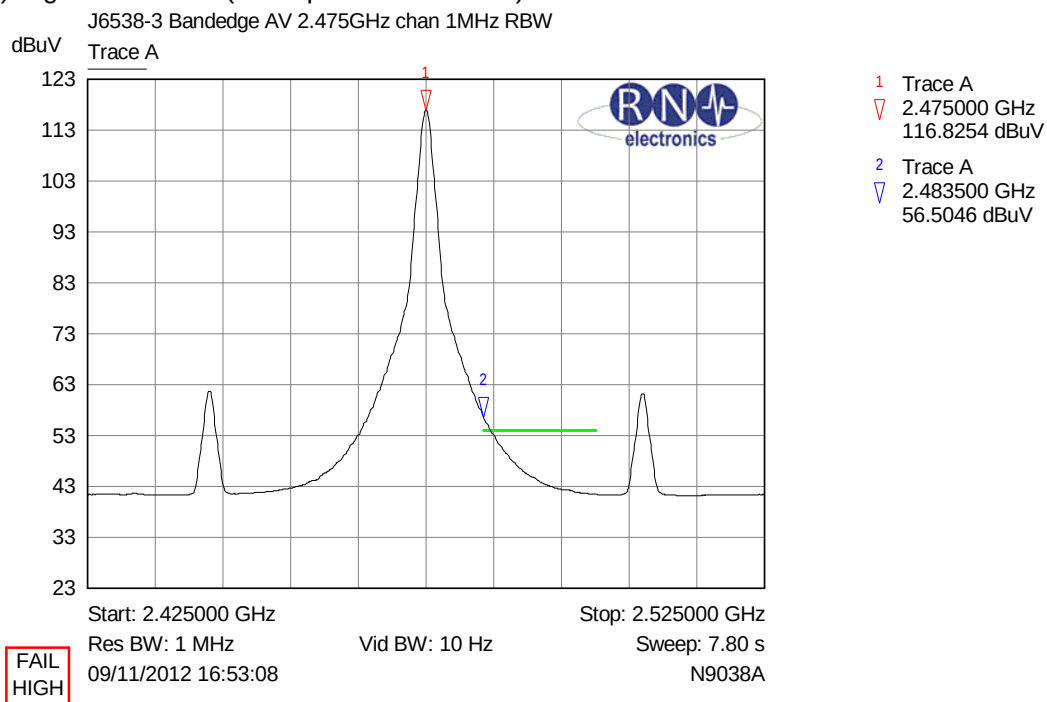
The above peak plot shows compliance with the peak restricted band limits at the adjacent lower restricted band (2310 – 2390 MHz). Also, the peak of the signal at 2373MHz will, after duty cycle correction, comply with the average 54dBuV/m limit.



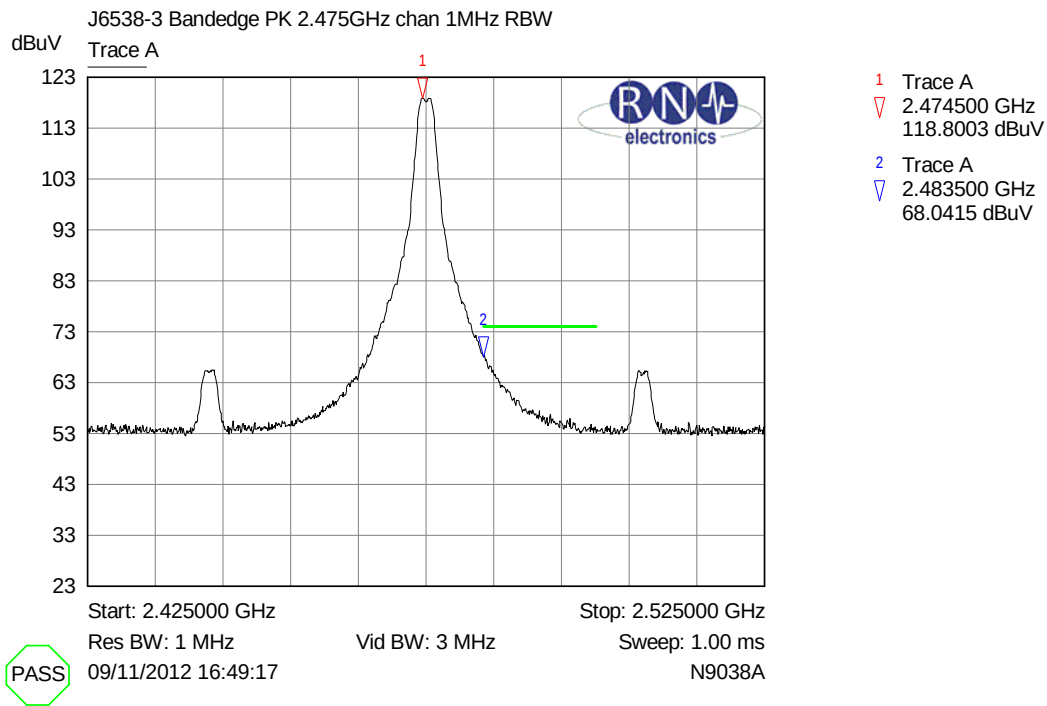
The above peak plot shows compliance with the out of band (spurious emission) 30dBc in 100kHz RBW limit.

#### Upper Band Edge

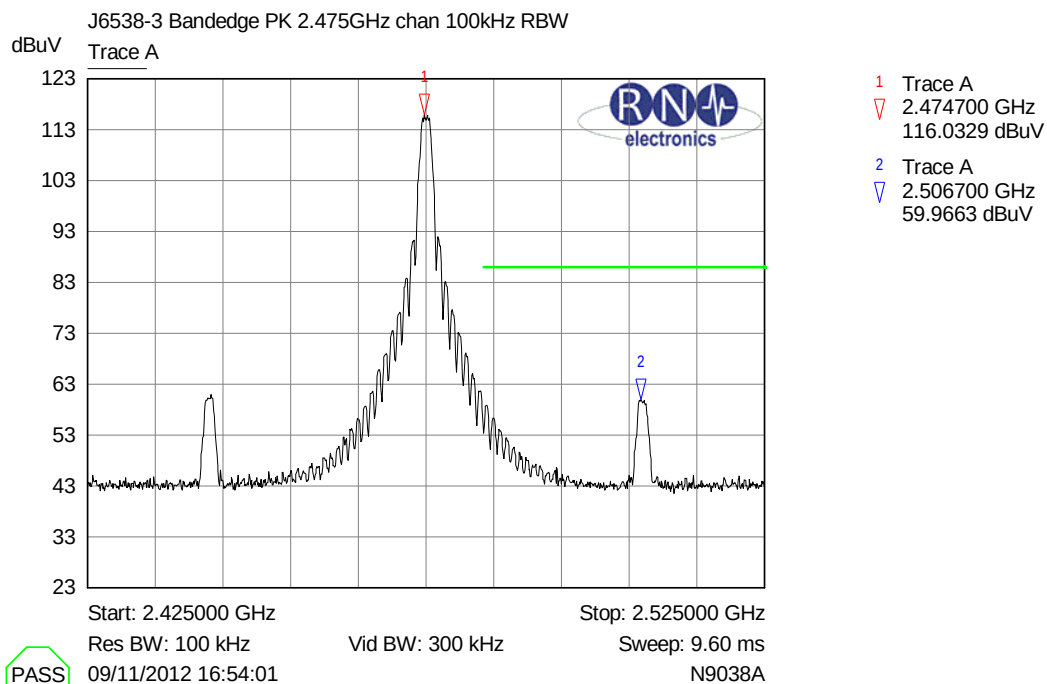
1) High – 1 channel (set at power level 3 of 3).



The above avg plot shows a possible problem against the average restricted band limits at the adjacent upper restricted band (2483.5 – 2500 MHz).

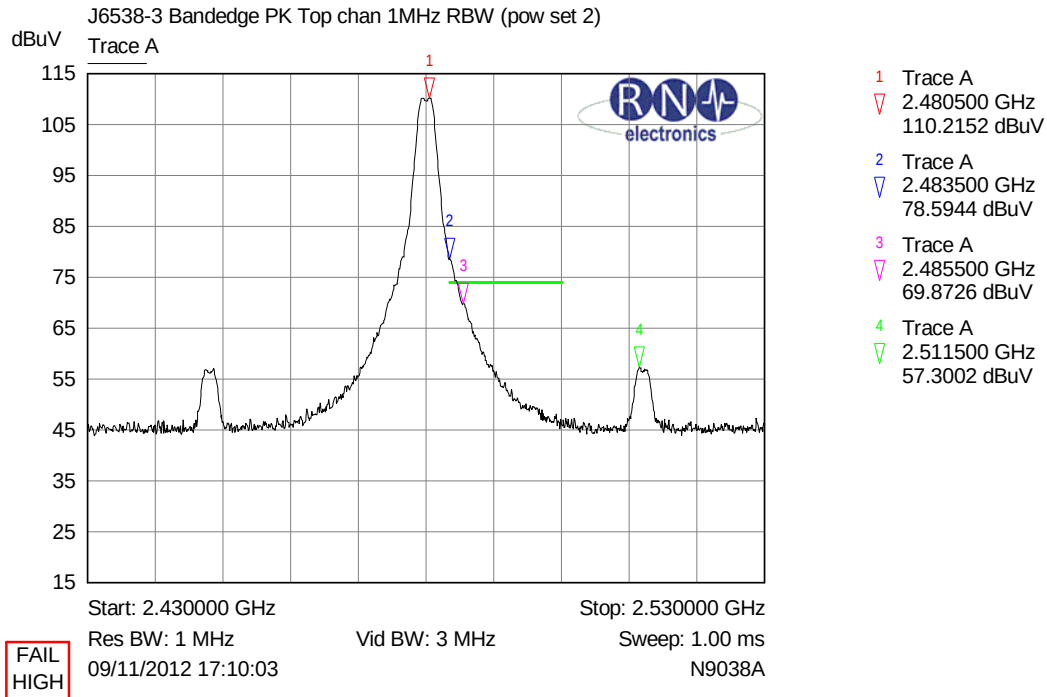


The above peak plot shows compliance with the peak restricted band limits at the adjacent upper restricted band (2483.5 – 2500 MHz). Also, the peak of the signal at 2483.5MHz will, after duty cycle correction, comply with the average 54dBuV/m limit.

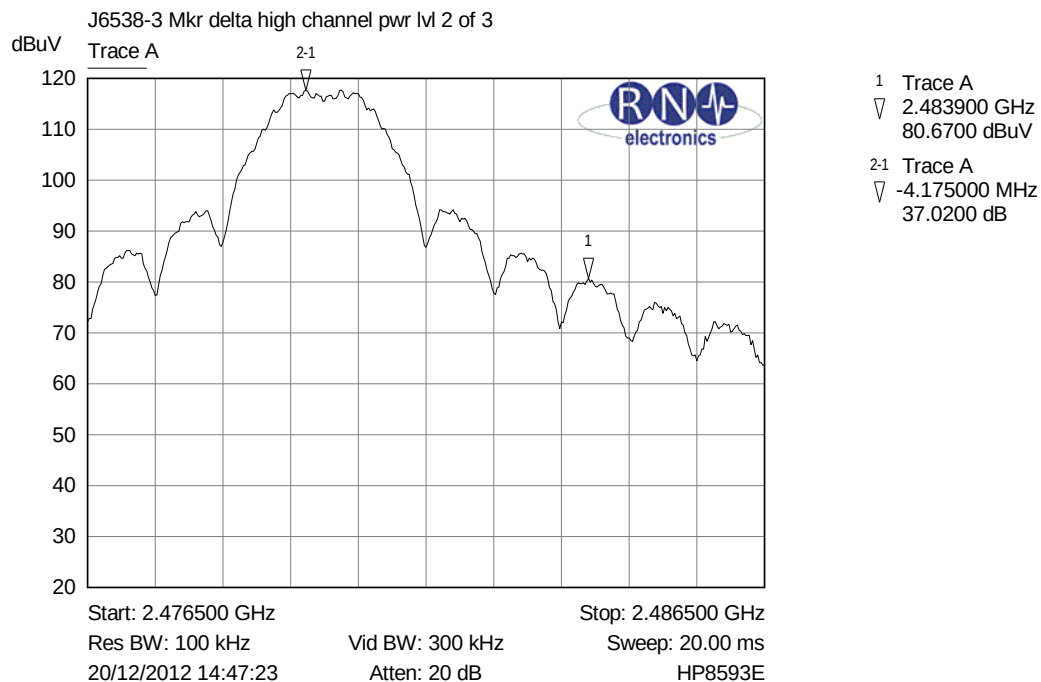


The above peak plot shows compliance with the out of band (spurious emission) 30dBc in 100kHz RBW limit.

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

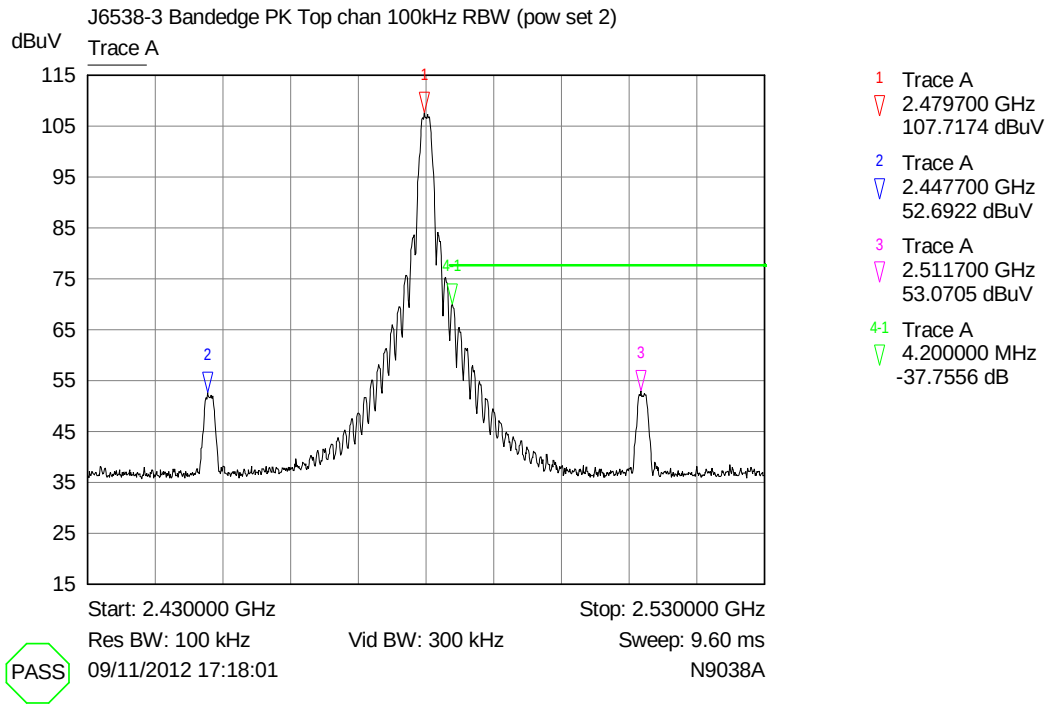


The above peak plot shows a possible problem at the upper restricted band (2483.5 – 2500MHz) against the peak limits, however it also shows compliance is achieved within 2 standard bandwidths (marker 3 is below the limit line), therefore the marker delta method is used for further analysis 2483.5 – 2485.5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



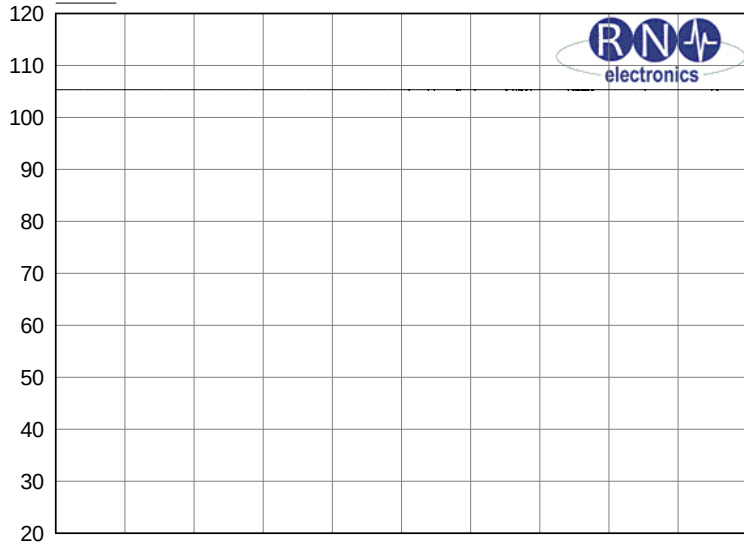
The above peak plot shows compliance with the out of band (spurious emission) 30dBc in 100kHz RBW limit.



## 6.6 Duty cycle

J6538-3 TX Duty 100% selected On time

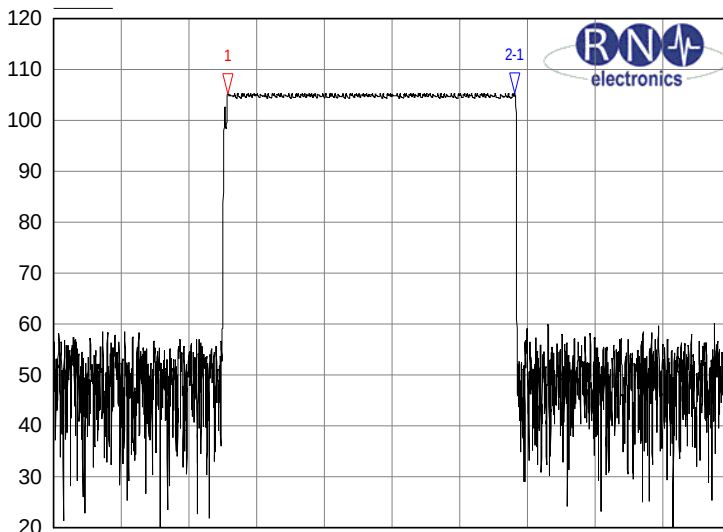
dBuV Trace A



Start: 0 s Stop: 100.000000 ms  
Res BW: 3 MHz Vid BW: 8 MHz Sweep: 100.00 ms  
06/11/2012 17:06:22 CF: 2.405000 GHz E4440A

J6538-3 TX Duty 1% selected On time

dBuV Trace A



Start: 0 s Stop: 400.000000 us  
Res BW: 3 MHz Vid BW: 8 MHz Sweep: 400.00 us  
06/11/2012 17:05:19 CF: 2.405000 GHz E4440A

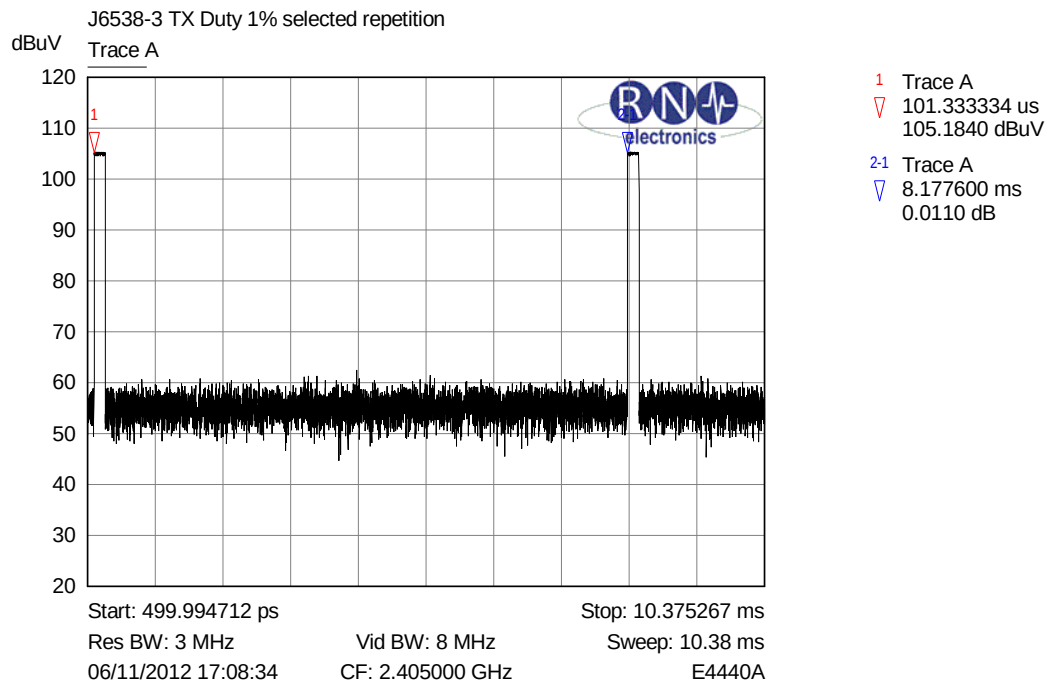
- 1 Trace A  
102.795751 us  
105.1230 dBuV
- 2:1 Trace A  
169.747284 us  
0.1620 dB

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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 (dBμV) | Pk – Lim 1 (dB) | QP Amp (dBμV) | QP - Lim1 (dB) | Av Amp (dBμV) | 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 (dBμV) is the level of received signal that was measured in dB above 1μV 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 (dBμV) is the level of received signal that was measured in dB above 1μV 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 (dBμV) is the level of received signal that was measured in dB above 1μV 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

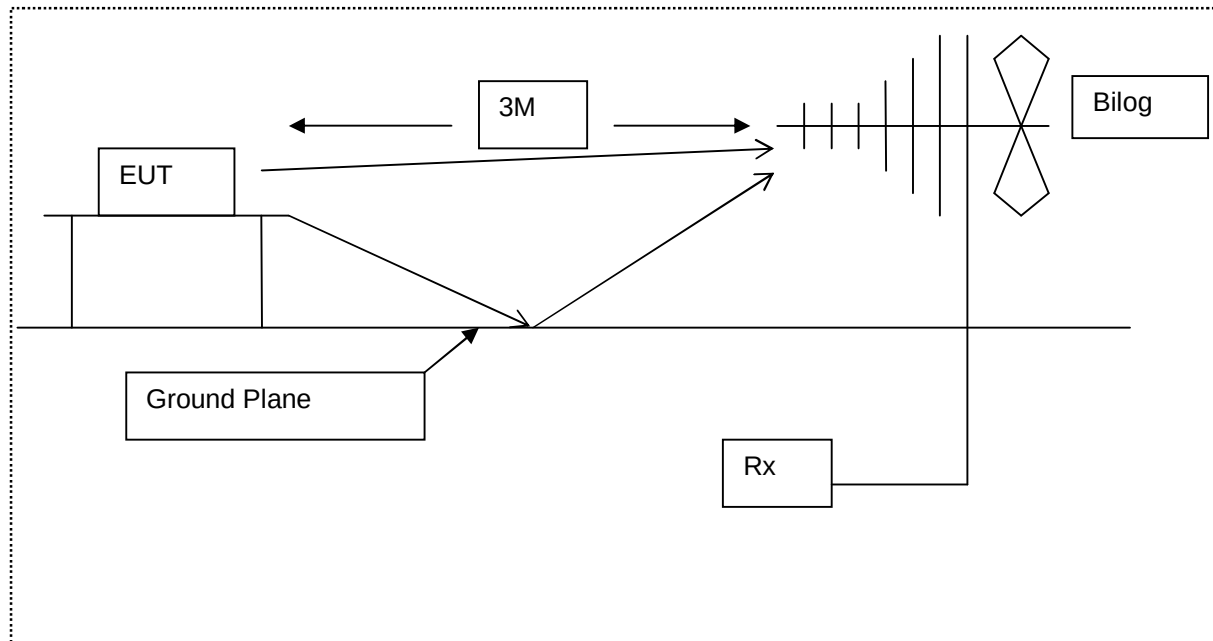
The limits given in the test standard are normally expressed as absolute values (e.g. in μV/m at a specified distance), whereas the measured values are expressed as peak, quasi peak or average values in dBμV/m referenced to the measuring instrument inputs. RN Electronics calibrate the test set-up to 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 μV/m equates to  $20.\log(500) = 54 \text{ dB } \mu\text{V/m}$ .
- (b) limit of 300 μV/m at 10m equates to  $20.\log(300 \cdot 10/3) = 60 \text{ dB } \mu\text{V/m at 3m}$

## 8 Photographs



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



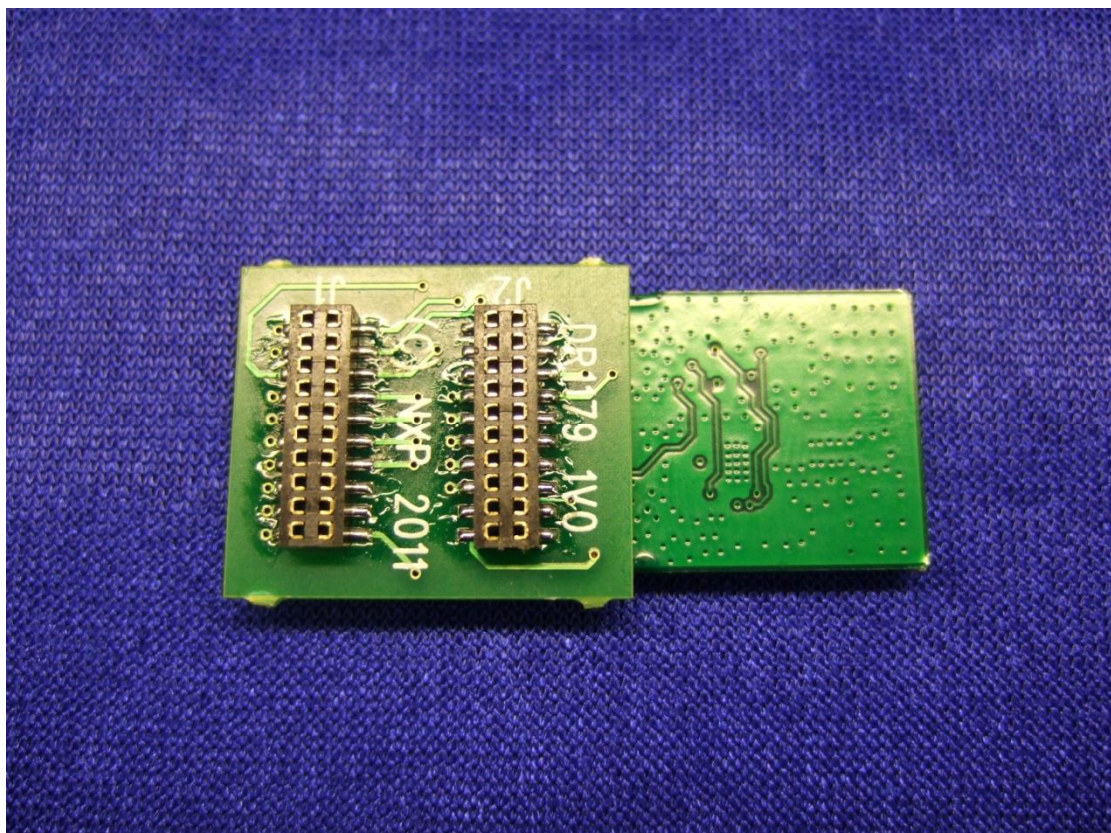
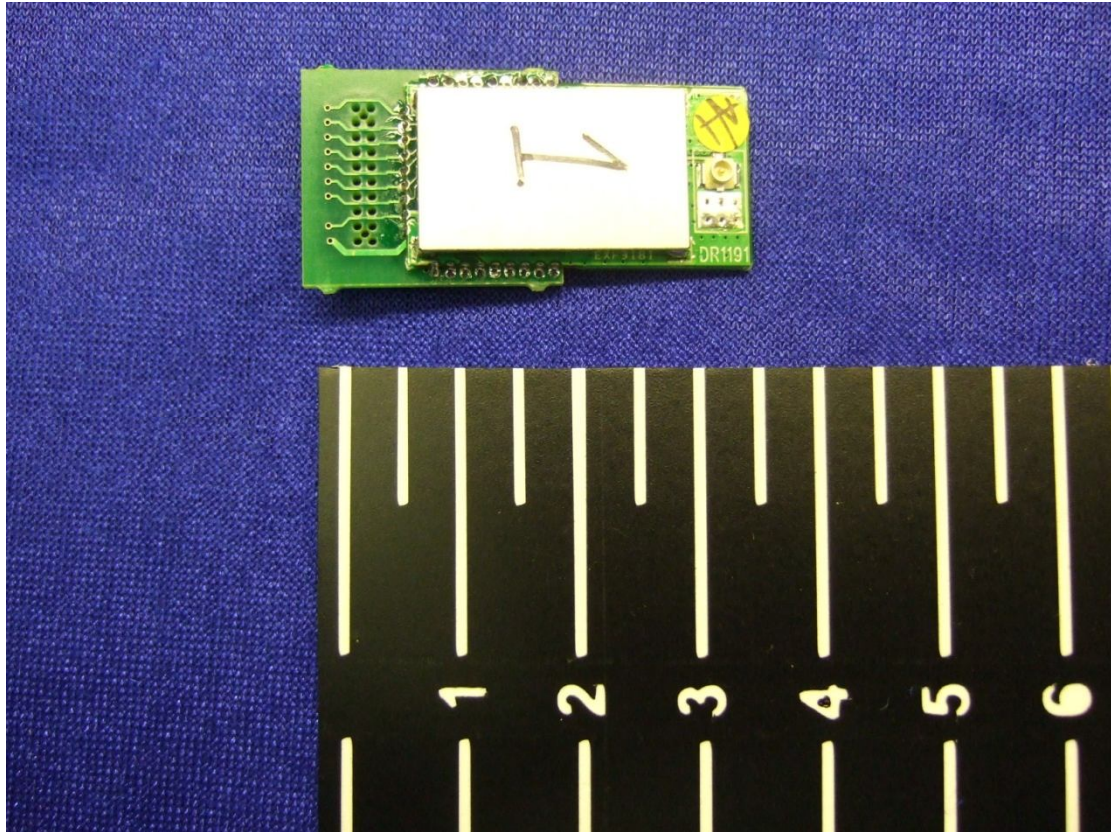
**Diagram of the radiated emissions test setup 30MHz-1GHz.**



**Photograph of radiated emissions set-up 18-26GHz**



## Identifying Photographs of the EUT



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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## 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)<br>VCCI Registration No. C-2823                                                          |
| Site K    | Screened Room (Control Room for Site M)                                                                                      |
| Site M    | 3m Semi-anechoic chamber (indoor OATS)<br>FCC Registration No. 293246                                                        |
| Site Q    | Fully-anechoic chamber                                                                                                       |
| Site OATS | 3m and 10m Open Area Test Site<br>FCC Registration No. 293246<br>IC Registration No. 5612A-1<br>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              | nom  | Nominal                                    |
| dBc  | decibels relative to Carrier          | nW   | nanoWatt                                   |
| dBm  | decibels relative to 1mW              | OATS | Open Area Test Site                        |
| DC   | Direct Current                        | OFDM | Orthogonal Frequency Division Multiplexing |
| EIRP | Equivalent Isotropic Radiated Power   | ppm  | Parts per million                          |
| ERP  | Effective Radiated Power              | QAM  | Quadrature Amplitude Modulation            |
| EUT  | Equipment Under Test                  | QPSK | Quadrature Phase Shift Keying              |
| FCC  | Federal Communications Commission     | Ref  | Reference                                  |
| FM   | Frequency Modulation                  | RF   | Radio Frequency                            |
| FSK  | Frequency Shift Keying                | RTP  | Room Temperature and Pressure              |
| g    | Grams                                 | s    | Seconds                                    |
| GHz  | GigaHertz                             | Tx   | Transmitter                                |
|      |                                       | V    | Volts                                      |