Radio Test Report

Audio Ltd

Digital Radio Microphone Pocket Transmitter

TX1010

47 CFR Part 74H
Effective Date 1st October 2014

Test Date: 27th August 2015 to 9th September 2015
Report Number: 09-8242-3-15 Issue 02

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Certificate of Test 8242-3

The equipment noted below has been fully tested by R.N. Electronics Limited and, where appropriate, conforms to the relevant subpart of 47CFR part 74H. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

Equipment:	Digital Radio Microphone Pocket Transmitter
Model Number:	TX1010
Unique Serial Number:	D064900-11 (470.2 – 547.8 MHz, Unit A) D064900-13 (518.2 – 607.4 MHz, Unit B)
Manufacturer:	Audio Ltd Audio House, Progress Road High Wycombe Buckinghamshire HP12 4JD
Full measurement results are detailed in Report Number:	09-8242-3-15 Issue 02
Test Standards:	47 CFR Part 74H Effective Date 1st October 2014 Licensed Broadcast transmitter worn on Body; class TBT

DEVIATIONS:
No deviations from the standard have been applied.

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 Federal Regulations, 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 the FCC 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: 27th August 2015 to 9th September 2015

Test Engineer: Digitally signed by: Graham Blake
DN: CN = Graham Blake C = GB O = RN Electronics Ltd
Date: 2016.09.09 11:22:03 +01'00'

Approved By:
Radio Approvals Manager: Digitally signed by: Daniel Sims
DN: CN = Daniel Sims C = GB O = RN Electronics Ltd
Date: 2016.09.09 09:09:30 Z

Customer Representative:

1 Contents

2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Audio Ltd Audio House Progress Road High Wycombe Buckinghamshire HP12 4JD	
Manufacturer of EUT	Audio Ltd	
Brand name of EUT	Digital Radio Microphone Pocket Transmitter	
Model Number of EUT	TX1010	
Serial Number of EUT	D064900-11 (470.2 – 547.8 MHz, Unit A) D064900-13 (518.2 – 607.4 MHz, Unit B)	
Date Received	20th August 2015	
Date of Test:	27th August 2015 to 9th September 2015	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Created	4th November 2015	
Visual Description	The TX1010 transmitter is enclosed within a milled aluminium body and the units' power is provided by two 1.5V AA batteries housed in a hinged, lockable compartment. There's a built-in SD card reader which can be used to update the system's firmware and capture the live audio stream. The unit is controlled using the three push-buttons; this allows the user to navigate the menu system. The power switch is situated under the lockable flap. The whip antenna is connected via the units' SMA antenna port and a lapel microphone is connected via a 3-pin Lemo connector.	
Main Function	Pocket microphone radio transmitter with Bluetooth (low energy) functionality.	
Information Specification	Height	124 mm
	Width	68 mm
	Depth	18 mm
	Weight	0.18 kg
	Voltage	2 - 3 VDC
	Current	0.5 Amp @ 2.5 VDC

2.2 Configurations for testing

General Parameters	
EUT Normal use position	Pocket (Body-worn)
Choice of model(s) for type tests	Production prototypes
Antenna details	UHF SMA whip antenna, Integral antenna Bluetooth
Antenna port	Yes
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	2480 MHz (Bluetooth)
Lowest Signal generated in EUT	10 MHz
TX Parameters	
Alignment range – transmitter	470.2 MHz - 547.8 MHz (Unit A) 518.2 MHz - 607.4 MHz (Unit B)
EUT Declared Modulation Parameters	OFDM
EUT Declared Power level	50 mW
EUT Declared Signal Bandwidths	200 kHz
EUT Declared Channel Spacing's	400 kHz (in steps of 25 kHz)
EUT Declared Duty Cycle	100%
Unmodulated carrier available?	No
Declared frequency stability	+/-2.5 ppm
Audio Parameters – TX	
Max Audio input level	10 dBV
Audio input limiting threshold	-35 dBV
Lowest audio mod frequency	20 Hz
Pre-Emphasis used	N/A

2.3 Functional description

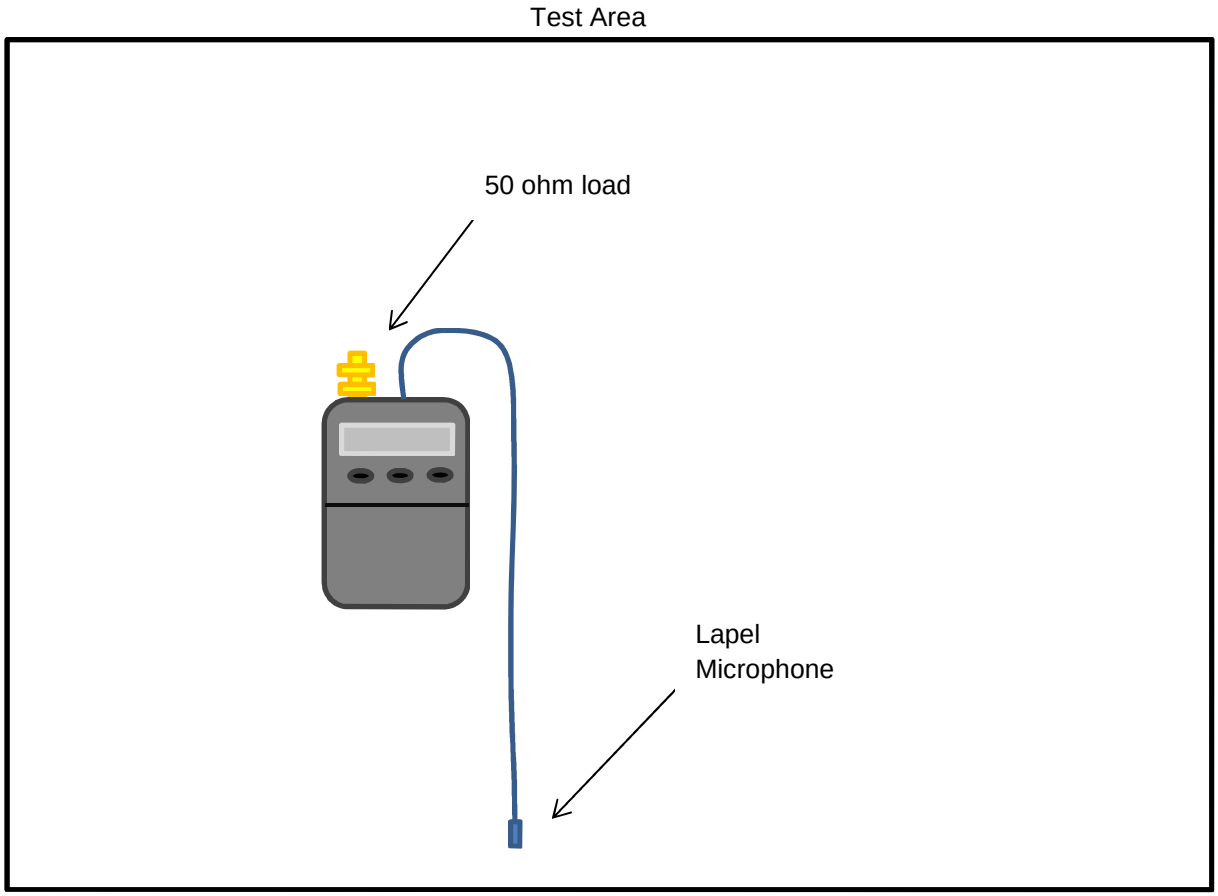
The EUT is a UHF digital radio transmitter which transmits audio over the frequency range of 470.2 MHz - 693.8 MHz (top channel of 607.4MHz within USA). Within the product range are different production builds, each covering a segment of the overall switching-range. For the purposes of testing to 47 CFR Part 74H, the manufacturer supplied different test units covering the frequencies 470.2 to 547.8 MHz and 518.2 to 607.4 MHz. The EUT uses OFDM digital modulation and transmits at a maximum of 50 mW. The EUT also incorporates a Bluetooth (Low energy) transceiver module which allows remote control of the equipment using a Smartphone or Tablet PC and a dedicated application (App).

2.4 Modes of operation

Mode Reference	Description	Used for testing
TX 470.2	Transmitting at 470.2 MHz without applied audio modulation	Yes
TX 509	Transmitting at 509 MHz without applied audio modulation	Yes
TX 547.8	Transmitting at 547.8 MHz without applied audio modulation	Yes
TX 518.2	Transmitting at 518.2 MHz without applied audio modulation	Yes
TX 563	Transmitting at 563 MHz without applied audio modulation	Yes
TX 607.4	Transmitting at 607.4 MHz without applied audio modulation	Yes
TX 470.2 MOD	Transmitting at 470.2 MHz with applied audio modulation	Yes (see note 2)
TX 509 MOD	Transmitting at 509 MHz with applied audio modulation	Yes (see note 2)
TX 547.8 MOD	Transmitting at 547.8 MHz with applied audio modulation	Yes (see note 2)
TX 518.2 MOD	Transmitting at 518.2 MHz with applied audio modulation	Yes (see note 2)
TX 563 MOD	Transmitting at 563 MHz with applied audio modulation	Yes (see note 2)
TX 607.4 MOD	Transmitting at 607.4 MHz with applied audio modulation	Yes (see note 2)
STANDBY	The unit is powered but the UHF transmitter is disabled	No
BT 2402 TX	The Bluetooth module is transmitting on 2402 MHz	No
BT 2442 TX	The Bluetooth module is transmitting on 2442 MHz	No
BT 2480 TX	The Bluetooth module is transmitting on 2480 MHz	No
BT HOP	The Bluetooth module is hopping on 2402, 2426 and 2480 MHz	Yes (see note 1)
BT 2402 RX	The Bluetooth module is receiving on 2402 MHz	No
BT 2442 RX	The Bluetooth module is receiving on 2442 MHz	No
BT 2480 RX	The Bluetooth module receiving on 2480 MHz	No

Note 1: In normal use the Bluetooth radio and UHF transmitter operate simultaneously, therefore during the test covered in this test report, the EUTs' Bluetooth module was active and set to 'hopping mode'.
Note 2: Where "MOD" is used in the mode reference name this refers to either a 1kHz audio tone at 0dBV being applied to the audio input of the device (modulation Bandwidth / Mask test), or in the case of radiated emissions tests a lapel microphone was attached as worst case for radiated emissions test which then picked up ambient audio noise from within the test chamber. In both cases the audio input signals are converted to digital modulation by the device.

2.5 Emissions configuration



The unit was powered from a new set of batteries. Battery voltage was checked and maintained within +-5% of nominal throughout tests. A lapel microphone was connected to the EUTs' microphone port. The EUTs' whip antenna was removed and a 50 ohm termination was fitted to the antenna port. The transmit mode was sending continuous data packets with modulation and the power settings for each channel were as stated below:-

Low Channel (470.2 MHz) = level 50 mW	Product Band 'A'
Mid Channel (509 MHz) = level 50 mW	Product Band 'A'
High Channel (547.8 MHz) = level 50 mW	Product Band 'A'
Low Channel (518.2 MHz) = level 50 mW	Product Band 'B'
Mid Channel (563 MHz) = level 50 mW	Product Band 'B'
High Channel (607.4 MHz) = level 50 mW	Product Band 'B'

For tests performed at extremes of temperature and voltage, the batteries were removed and wires were soldered directly to the battery terminals. This allowed the EUT to be connected to an external power supply so that the supply voltage could be varied to the end-points as stated in section 4.3. For conducted tests the whip antenna was removed and the analyser was connected directly to the SMA antenna port. For the purposes of testing, the manufacturer supplied units of different builds, to cover switching-range of the product family. The units were configured with menus in software to allow permanent transmit modes of the device on the top, middle and bottom channels as stated within section 2.4 of this report. In normal use the Bluetooth radio and UHF transmitter operate simultaneously, therefore during the test covered in this test report, the EUTs' Bluetooth module was active and set to 'hopping mode'.

2.5.1 Signal leads

Port Name	Cable Type	Connected
Antenna	SMA	Yes
Microphone	Custom	Yes

3 Summary of test results

The Digital Radio Microphone Pocket Transmitter, TX1010 was tested for compliance to the following standards

47 CFR Part 74H
Effective Date 1st October 2014
Licensed Broadcast transmitter worn on Body; class TBT

Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to the FCC 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. 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 or the essential requirements of the directive, particularly under different conditions to those during testing. 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%.

Title	References	Results
Transmitter Tests		
1. Antenna power conducted emissions	47CFR part 74H Clause 74.861 (e) (6) (iii)	PASSED
2. Maximum Average conducted output power	47CFR part 74H Clause 74.861 (e) (1) (ii)	PASSED
3. Frequency stability	47CFR part 74H Clause 74.861 (e) (4)	PASSED
4. Occupied bandwidth	47CFR part 74H Clause 74.861 (e) (5)	PASSED
5. Radiated emissions	47CFR part 74H Clause 74.861 (e) (6) (iii)	PASSED
6. Audio frequency response	47CFR part 2J Clause 2.1047	NOT APPLICABLE[1]
7. Modulation limiting	47CFR part 74H Clause 74.861 (e) (3)	NOT APPLICABLE[1]

[1] Not applicable to digitally modulated EUTs.

4 Specifications

The tests were performed and operated in accordance with R.N. Electronics Ltd procedures and the relevant standards listed below.

4.1 Relevant standards

Ref.	Standard Number	Version	Description
4.1.1	47CFR part 74H	2014	PART 74—EXPERIMENTAL RADIO, AUXILIARY, SPECIAL BROADCAST AND OTHER PROGRAM DISTRIBUTIONAL SERVICES Subpart H - Low Power Auxiliary Stations
4.1.2	47CFR part 2J	2014	Part 2 – Frequency Allocations and radio treaty matters; General rules and regulations
4.1.3	TIA-603-D	2010	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

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

4.2 Deviations

No deviations to the standards have been applied.

4.3 Tests at extremes of temperature & voltage

The following test conditions were used to simulate testing at nominal or extremes.

Temperature Test Conditions		Voltage Test Conditions	
T nominal	20 °C	V nominal	2.5V DC
T minimum	-30 °C	V minimum	2V DC
T maximum	50 °C	V maximum	3V DC

Extremes of voltage are based on nominal manufacturers' declaration.

Extremes of temperature are based upon the requirements of FCC subpart J, 47CFR §2.1055.

The ambient test conditions of humidity and pressure in the laboratory were as follows:

47 %; 101 kPa.

4.4 Test fixtures

In order to measure RF parameters at temperature extremes, the EUT was tested in a temperature controlled chamber as follows:

The equipment external RF port was used for testing.

5 Tests, methods and results

5.1 Antenna power conducted emissions

5.1.1 Test methods

Test Requirements:	47CFR part 74H Clause (e) (6) (iii) [Reference 4.1.1 of this report]
Test Method:	47CFR part 2J Clause 2.1053 [Reference 4.1.2 of this report]
	TIA-603-D Clause 2.2.13 [Reference 4.1.3 of this report]
Limits:	47CFR part 74H Clause (e) (6) (iii) [Reference 4.1.1 of this report]

5.1.2 Configuration of EUT

The EUT was operated on a test bench. Measurements were made at the 50 ohm coaxial transmit port. The EUT was operated in **TX 470.2**, **TX 509**, **TX 547.8**, **TX 518.2**, **TX 563** and **TX 607.4** modes for this test.

5.1.3 Test procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' section at Site A. A complete scan of emissions from the lowest frequency generated or used within the equipment, up to 10 times the highest frequency generated or used was made, to identify any signals within 20dB of the limits. Any identified spurious signals were measured in the required bandwidths.

5.1.4 Test equipment

E533, E624, E250, E251

See Section 8 for more details

5.1.5 Test results

Temperature of test environment	20°C
Humidity of test environment	55%
Pressure of test environment	100kPa

Setup Table

Band	470.2-547.8 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
Low channel	470.2 MHz

Frequency Range	Plots
3 MHz – 30 MHz	J8242-3 TX Conducted Emissions 470.2 MHz, 3 MHz - 30 MHz
30 MHz – 469.7 MHz	J8242-3 TX Conducted Emissions 470.2 MHz, 30 MHz - 469.7 MHz
470.7 – 1 GHz	J8242-3 TX Conducted Emissions 470.2 MHz, 470.7 MHz - 1 GHz
1 GHz – 4 GHz	J8242-3 TX Conducted Emissions 470.2 MHz, 1 GHz - 4 GHz
4 GHz – 6.1 GHz	J8242-3 TX Conducted Emissions 470.2 MHz, 4 GHz - 6.1 GHz

No emissions within 20 dB of the limit were observed.

Setup Table

Band	470.2-547.8 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
Mid channel	509 MHz

Frequency Range	Plots
3 MHz – 30 MHz	J8242-3 TX Conducted Emissions 509 MHz, 3 MHz - 30 MHz
30 MHz – 508.5 MHz	J8242-3 TX Conducted Emissions 509 MHz, 30 MHz - 508.5 MHz
509.5 MHz – 1 GHz	J8242-3 TX Conducted Emissions 509 MHz, 509.5 MHz - 1 GHz
1 GHz – 4 GHz	J8242-3 TX Conducted Emissions 509 MHz, 1 GHz - 4 GHz
4 GHz – 6.1 GHz	J8242-3 TX Conducted Emissions 509 MHz, 4 GHz - 6.1 GHz

No emissions within 20 dB of the limit were observed.

Setup Table

Band	470.2-547.8 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
High channel	547.8 MHz

Frequency Range	Plots
3 MHz – 30 MHz	J8242-3 TX Conducted Emissions 547.8 MHz, 3 MHz - 30 MHz
30 MHz – 547.3 MHz	J8242-3 TX Conducted Emissions 547.8 MHz, 30 MHz - 547.3 MHz
547.8 MHz – 1 GHz	J8242-3 TX Conducted Emissions 547.8 MHz, 548.3 MHz - 1 GHz
1 GHz – 4 GHz	J8242-3 TX Conducted Emissions 547.8 MHz, 1 GHz - 4 GHz
4 GHz – 6.1 GHz	J8242-3 TX Conducted Emissions 547.8 MHz, 4 GHz - 6.1 GHz

No emissions within 20 dB of the limit were observed.

Setup Table

Band	518.2-607.4 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
Low channel	518.2 MHz

Frequency Range	Plots
3 MHz – 30 MHz	J8242-3 TX Conducted Emissions 518.2 MHz, 3 MHz - 30 MHz
30 MHz – 517.7 MHz	J8242-3 TX Conducted Emissions 518.2 MHz, 30 MHz - 517.7 MHz
518.7 MHz – 1 GHz	J8242-3 TX Conducted Emissions 518.2 MHz, 518.7 MHz - 1 GHz
1 GHz – 4 GHz	J8242-3 TX Conducted Emissions 518.2 MHz, 1 GHz - 4 GHz
4 GHz – 6.1 GHz	J8242-3 TX Conducted Emissions 518.2 MHz, 4 GHz - 6.1 GHz

Spurious Frequency (MHz)	Measured Spurious Level (dBm)	Difference to Limit (dB)
1554.6	-27.9	-14.9

Setup Table

Band	518.2-607.4 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
Mid channel	563 MHz

Frequency Range	Plots
3 MHz – 30 MHz	J8242-3 TX Conducted Emissions 563 MHz, 3 MHz - 30 MHz
30 MHz – 562.5 MHz	J8242-3 TX Conducted Emissions 563 MHz, 30 MHz - 562.5 MHz
563 MHz – 1 GHz	J8242-3 TX Conducted Emissions 563 MHz, 563.5 MHz - 1 GHz
1 GHz – 4 GHz	J8242-3 TX Conducted Emissions 563 MHz, 1 GHz - 4 GHz
4 GHz – 6.1 GHz	J8242-3 TX Conducted Emissions 563 MHz, 4 GHz - 6.1 GHz

No emissions within 20 dB of the limit were observed.

Setup Table

Band	518.2-607.4 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
High channel	607.4 MHz

Frequency Range	Plots
3 MHz – 30 MHz	J8242-3 TX Conducted Emissions 607.4 MHz, 3 MHz - 30 MHz
30 MHz – 607.3 MHz	J8242-3 TX Conducted Emissions 607.4 MHz, 30 MHz - 607.3 MHz
608.3 MHz – 1 GHz	J8242-3 TX Conducted Emissions 607.4 MHz, 608.3 MHz - 1 GHz
1 GHz – 4 GHz	J8242-3 TX Conducted Emissions 607.4 MHz, 1 GHz - 4 GHz
4 GHz – 6.1 GHz	J8242-3 TX Conducted Emissions 607.4 MHz, 4 GHz - 6.1 GHz

No emissions within 20 dB of the limit were observed.

The plots referred to in the above table may be found in section 6

LIMITS:
On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least 43+10log10 (mean output) = -13 dBm.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows: <± 2.8 dB

5.2 Maximum Average conducted output power

5.2.1 Test methods

Test Requirements:	47CFR part 74H Clause (e) (1) (ii) [Reference 4.1.1 of this report]
Test Method:	47CFR part 2J Clause 2.1046 [Reference 4.1.2 of this report]
Limits:	47CFR part 74H Clause (e) (1) (ii) [Reference 4.1.1 of this report]

5.2.2 Configuration of EUT

The EUT was powered using an external power supply, and was measured on a bench using a power meter connected to the external RF port.

The EUT was operated in **TX 470.2**, **TX 509**, **TX 547.8**, **TX 518.2**, **TX 563** and **TX 607.4** modes for this test.

The EUT was set to each mode in turn (see section 2.4) and highest power levels recorded.

5.2.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.
Power meter reading stated is maximum power observed using an average power head. Measurements were made on a test bench in site A.

5.2.4 Test equipment

E291-2, E312, E624, E266, E227, L264, TMS38, P266, E434, E313, E252, P233

See Section 8 for more details

5.2.5 Test results

Temperature of test environment	20°C
Humidity of test environment	55%
Pressure of test environment	101kPa

Band	470.2-547.8 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
Low channel	470.2 MHz
Mid channel	509 MHz
High channel	547.8 MHz

Test conditions		Carrier Power (mW) Low	Carrier Power (mW) Mid	Carrier Power (mW) High
Temp Ambient	Volts Nominal	31.48	40.74	39.90

Band	518.2-607.4 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
Low channel	518.2 MHz
Mid channel	563 MHz
High channel	607.4 MHz

Test conditions		Carrier Power (mW) Low	Carrier Power (mW) Mid	Carrier Power (mW) High
Temp Ambient	Volts Nominal	44.46	43.45	36.31

The maximum average conducted output power was 44.46 mW

LIMITS:
47CFR part 74H Clause 74.861 (e) (1) (ii)
For low power auxiliary stations operating in the bands allocated for TV broadcasting in the frequency ranges of 470–608 and 614–698 MHz bands: 250 mW

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 1.0 dB

5.3 Frequency stability

5.3.1 Test methods

Test Requirements: 47CFR part 74H Clause 74.861 (e) (4) [Reference 4.1.1 of this report]
Test Method: 47CFR part 2J Clause 2.1055 [Reference 4.1.2 of this report]
Limits: 47CFR part 74H Clause 74.861 (e) (4) [Reference 4.1.1 of this report]

5.3.2 Configuration of EUT

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. The EUT was placed in a temperature controlled chamber. The EUTs' internal batteries were removed and a bench top supply was connected directly to the battery terminals. This allowed the battery end points to be set as declared by the manufacturer.

The EUT was operated in **TX 470.2**, **TX 509**, **TX 547.8**, **TX 518.2**, **TX 563** and **TX 607.4** modes.

5.3.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. Temperature stability was achieved at each test level before taking measurements. No CW carrier was available for measurement since the EUT was digitally modulated, and therefore the mean frequency was calculated by measuring two points (at the same level) on the upper & lower sides of the modulation envelope summing them together and dividing the answer by two.

Tests were performed using Test Site A.

5.3.4 Test equipment

L264, TMS36, E367, E252, P240, E434, P266, E227

See Section 8 for more details

5.3.5 Test results

Temperature of test environment 20°C
Humidity of test environment 47%
Pressure of test environment 101kPa

Band	470.2-547.8
Power Level	50 mW
Channel	400 kHz
Mod Scheme	OFDM
Low channel	470.2 MHz
Mid channel	509 MHz
High channel	547.8 MHz

Test conditions		Frequency Reading (MHz) Low	Frequency Reading (MHz) Mid	Frequency Reading (MHz) High
-30°C	Volts Nominal	-0.000137	-0.000582	0.000356
-20°C	Volts Nominal	-0.000492	-0.000455	-0.000747
-10°C	Volts Nominal	0.000354	0.000415	-0.000596
0°C	Volts Nominal	0.000275	0.000006	-0.000358
10°C	Volts Nominal	0.000426	0.000073	0.000196
20°C	Volts Minimum	0.000241	0.000054	0.000146
	Volts Nominal	0.000000	0.000000	0.000000
	Volts Maximum	-0.000176	0.000151	-0.000130
30°C	Volts Nominal	0.000031	-0.000016	-0.000179
40°C	Volts Nominal	0.000312	0.000187	-0.000228
50°C	Volts Nominal	0.000368	0.000271	-0.000335
Max Frequency Error per chan		+425.5 / -492	+415 / -581.5	+356 / -747
Max Frequency Error observed		-0.000492	-0.000582	-0.000747

Band	518.2-607.4
Power Level	50 mW
Channel	400 kHz
Mod Scheme	OFDM
Low channel	518.2 MHz
Mid channel	563 MHz
High channel	607.4 MHz

Test conditions		Frequency Reading (MHz) Low	Frequency Reading (MHz) Mid	Frequency Reading (MHz) High
-30°C	Volts Nominal	-0.000084	0.000264	-0.000164
-20°C	Volts Nominal	-0.000950	-0.000090	-0.000385
-10°C	Volts Nominal	-0.000743	0.000162	-0.000306
0°C	Volts Nominal	-0.001001	-0.000139	0.000049
10°C	Volts Nominal	-0.000594	0.000355	0.000264
20°C	Volts Minimum	-0.000972	-0.000109	-0.000347
	Volts Nominal	0.000000	0.000000	0.000000
	Volts Maximum	-0.000943	-0.000235	-0.000652
30°C	Volts Nominal	-0.001167	-0.000056	-0.000677
40°C	Volts Nominal	-0.001090	-0.000402	-0.000232
50°C	Volts Nominal	-0.001023	-0.000321	-0.000452
Max Frequency Error per chan		+0 / -1167	+354.5 / -402	+263.5 / -677.5
Max Frequency Error observed		-0.001167	-0.000402	-0.000677

Maximum variation observed was 1167 Hz at 518.2 MHz (0.00045%)

LIMITS:
47CFR part 74H Clause 74.861 (e)(4) +/-0.005%

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 0.7 ppm

5.4 Occupied bandwidth and bandwidth mask

5.4.1 Test methods

Test Requirements: 47CFR part 74H Clause 74.861 (e)(5) [Reference 4.1.1 of this report]
Test Method: 47CFR part 2J Clause 2.1049 [Reference 4.1.2 of this report]
Limits: 47CFR part 74H Clause 74.861 (e)(5) [Reference 4.1.1 of this report]
47CFR part 74H Clause 74.861 (e)(6) i & ii [Reference 4.1.1 of this report]

5.4.2 Configuration of EUT

The EUT was operated on a bench and an audio analyser was connected to the EUTs' microphone port. Measurements were made at the EUTs transmit port. The EUT was modulated by an appropriate audio signal to be representative of the type of service in which used i.e. 1 kHz tone at a level of 0dBV. The EUT was operated in **TX 470.2 MOD**, **TX 509 MOD**, **TX 547.8 MOD, TX 518.2 MOD**, **TX 563 MOD** and **TX 607.4 MOD** modes.

5.4.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. A 3kHz RBW, 3x VBW, auto sweep time and max hold settings were used along with the 99% bandwidth measurement function of the spectrum analyser.
Tests were performed in Test Site A.

5.4.4 Test equipment

E624, E227, E367, E255, TMS55

See Section 8 for more details

5.4.5 Test results

Temperature of test environment 20°C
Humidity of test environment 45%
Pressure of test environment 102kPa

Band	470.2-547.8 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
Low channel	470.2 MHz
Mid channel	509 MHz
High channel	547.8 MHz

	Low	Mid	High
99% Bandwidth (MHz)	0.1918	0.191	0.191
Plot reference	J8242-3 Occupied Bandwidth 470.2 MHz	J8242-3 Occupied Bandwidth 509 MHz	J8242-3 Occupied Bandwidth 547.8 MHz

Band	518.2-607.4 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
Low channel	518.2 MHz
Mid channel	563 MHz
High channel	607.4 MHz

	Low	Mid	High
99% Bandwidth (MHz)	0.191	0.1906	0.1906
Plot reference	J8242-3 Occupied Bandwidth 518.2 MHz	J8242-3 Occupied Bandwidth 563 MHz	J8242-3 Occupied Bandwidth 607.4 MHz

Analyser plots for the 99% bandwidth can be found in Section 6 of this report.

A second plot was taken, in which the analyser was referenced to the conducted power measurement. The analyser employed the use of an RMS detector and 3kHz RBW, 3x VBW, auto sweep time and max hold settings were used. Using a mask, the plot was assessed to ensure the emission remained within the limits.

LIMITS:
47CFR part 74H Clause 74.861 (e) (5) - The operating bandwidth shall not exceed 200 kHz.

47CFR part 74H Clause 74.861 (e)(6) i & ii – mean power of emissions to be attenuated below mean output power of transmitter, according to the following:-
50% up to 100% of authorised BW at least 25dB.
100% up to 250% of authorised BW at least 35dB.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 1.9 %

5.5 Radiated emissions

5.5.1 Test methods

Test Requirements:	47CFR part 74H Clause 74.861 (e) (6) (iii) [Reference 4.1.1 of this report]
Test Method:	47CFR part 2J Clause 2.1053 [Reference 4.1.2 of this report]
	TIA-603-D Clause 2.2.12 [Reference 4.1.3 of this report]
Limits:	47CFR part 74H Clause 74.861 (e) (6) (iii) [Reference 4.1.1 of this report]

5.5.2 Configuration of EUT

The EUT was tested in an ALSE and ambient conditions were monitored. Three orthogonal planes were examined. The EUT was operated in **TX 470.2 MOD**, **TX 509 MOD**, **TX 547.8 MOD, TX 518.2 MOD**, **TX 563 MOD** and **TX 607.4 MOD** modes for this test.

5.5.3 Test procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment noted in the 'Test Equipment' Section at Site B. Peak field strength from the EUT was maximised by rotating it 360 degrees.

25MHz - 1GHz.
The measuring antenna was scanned 1 - 4m in both Horizontal and Vertical polarisations. Substitution method was performed using tuned dipoles and a calibrated bi-conical antenna.

1GHz – 6.1GHz.
The measuring antenna was used in both Horizontal and Vertical polarisations. Substitution method was performed using standard gain horn antennas.

5.5.4 Test equipment

E327, E428, E624, E268, TMS814, E268, E007-2

See Section 8 for more details

5.5.5 Test results

Temperature of test environment	20°C
Humidity of test environment	55%
Pressure of test environment	100kPa

Setup Table

Band	470.2-547.8 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
Low channel	470.2 MHz
Mid channel	509 MHz
High channel	547.8 MHz

Spurious Frequency (MHz)
No spurious emissions were found within 20dB of the limits.

Setup Table

Band	518.2-607.4 MHz
Power Level	50 mW
Channel Spacing	400 kHz
Mod Scheme	OFDM
Low channel	518.2 MHz
Mid channel	563 MHz
High channel	607.4 MHz

Spurious Frequency (MHz)
No spurious emissions were found within 20dB of the limits.

LIMITS:

On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth:

at least 43+10log10 (mean output power in watts) dB = -13dBm.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:

30MHz – 1 GHz ±3.9dB
1 – 18 GHz ±3.5dB

5.6 Audio frequency response

NOT APPLICABLE: Not applicable to digitally modulated EUTs.

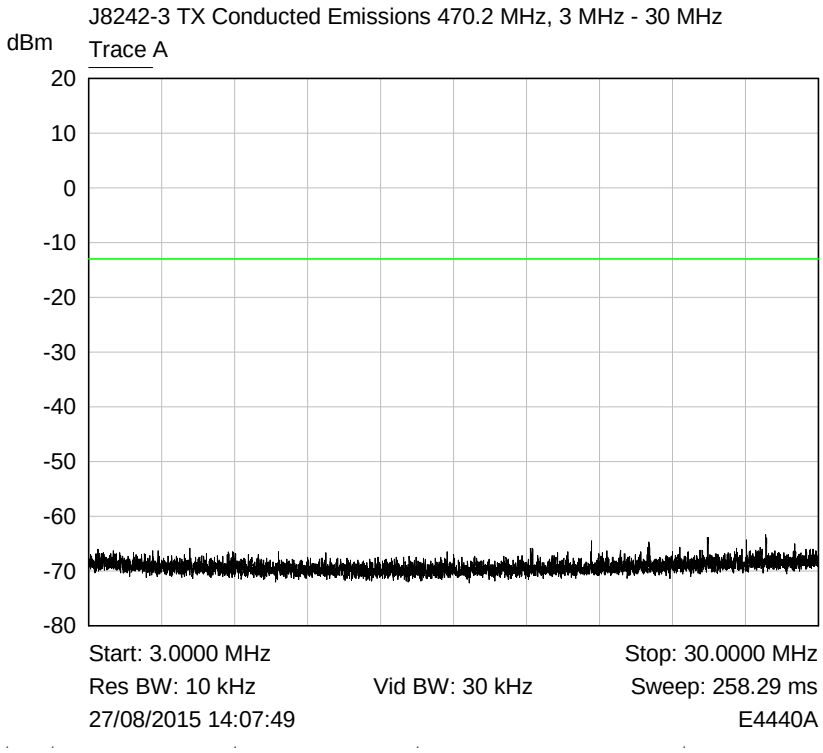
5.7 Modulation limiting

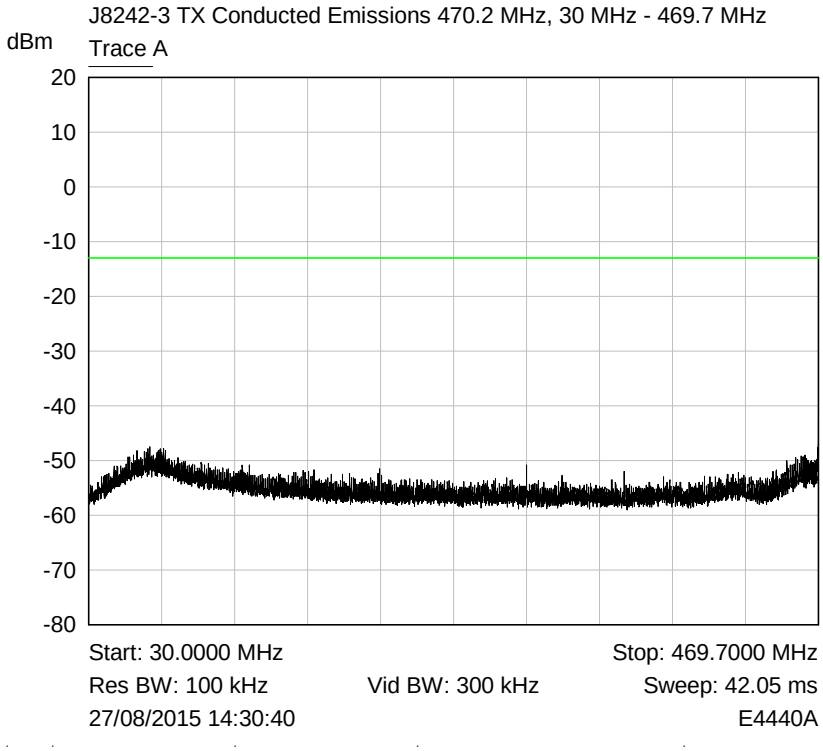
NOT APPLICABLE: Not applicable to digitally modulated EUTs.

6 Plots/Graphical results

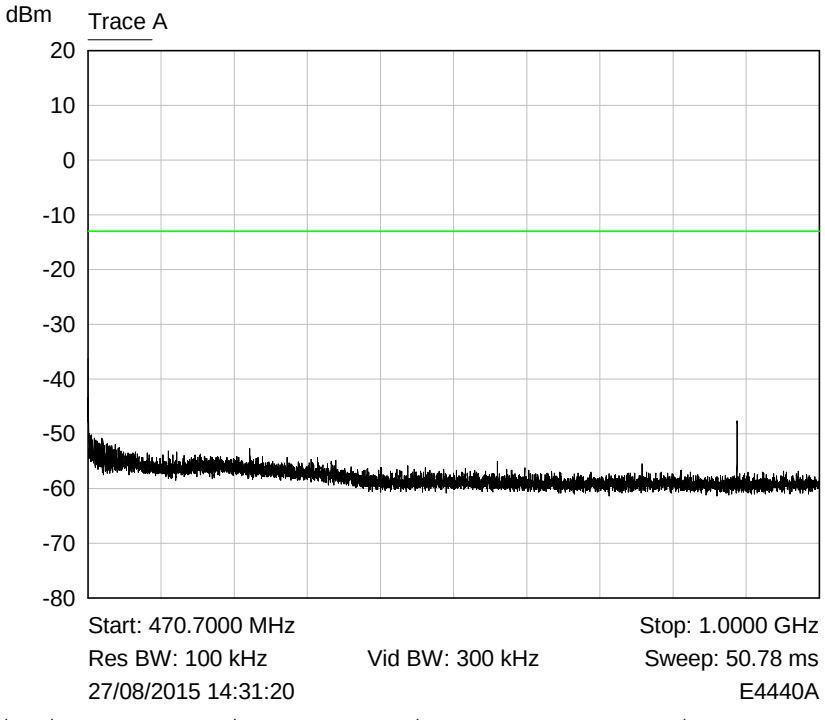
6.1 Antenna power conducted emissions

RF Parameters: Band 470.2-547.8 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 470.2 MHz

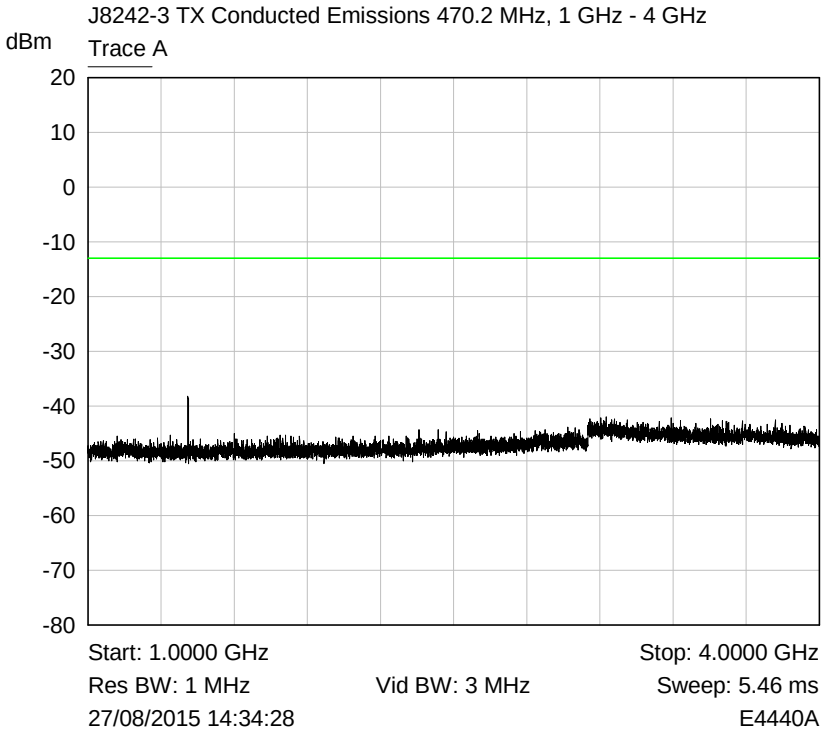


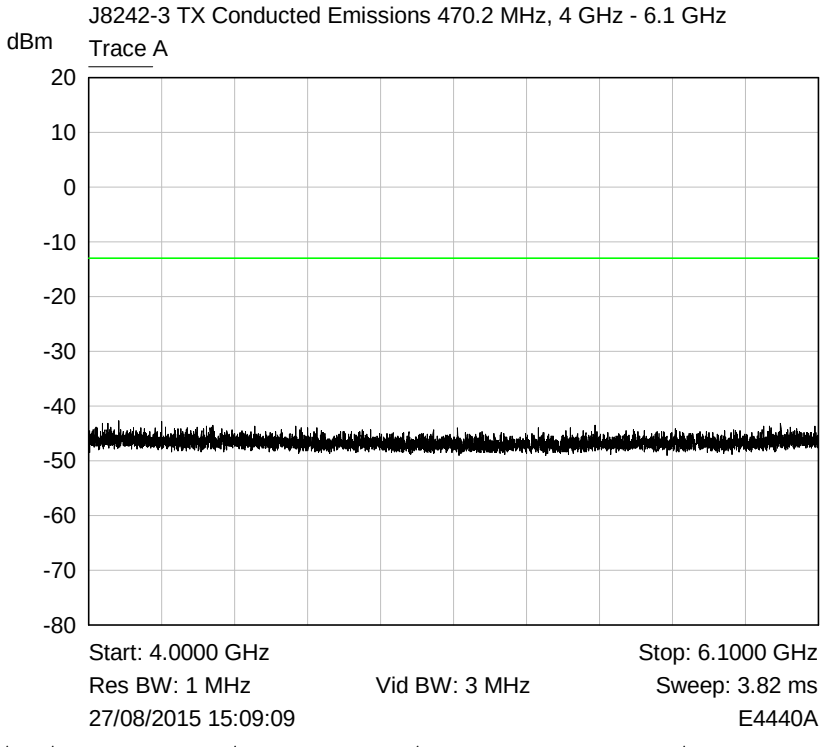


J8242-3 TX Conducted Emissions 470.2 MHz, 470.7 MHz - 1 GHz

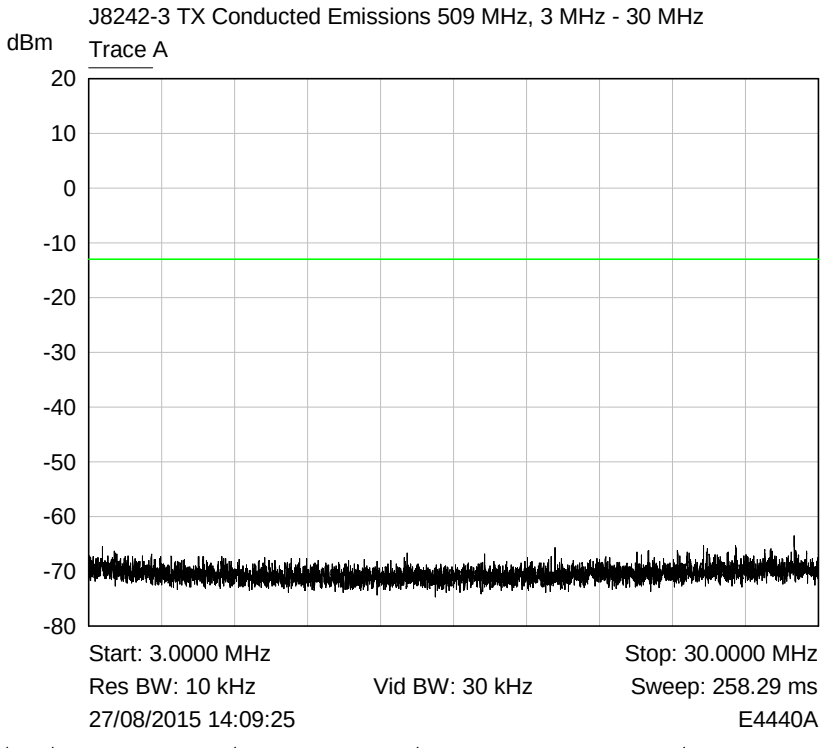


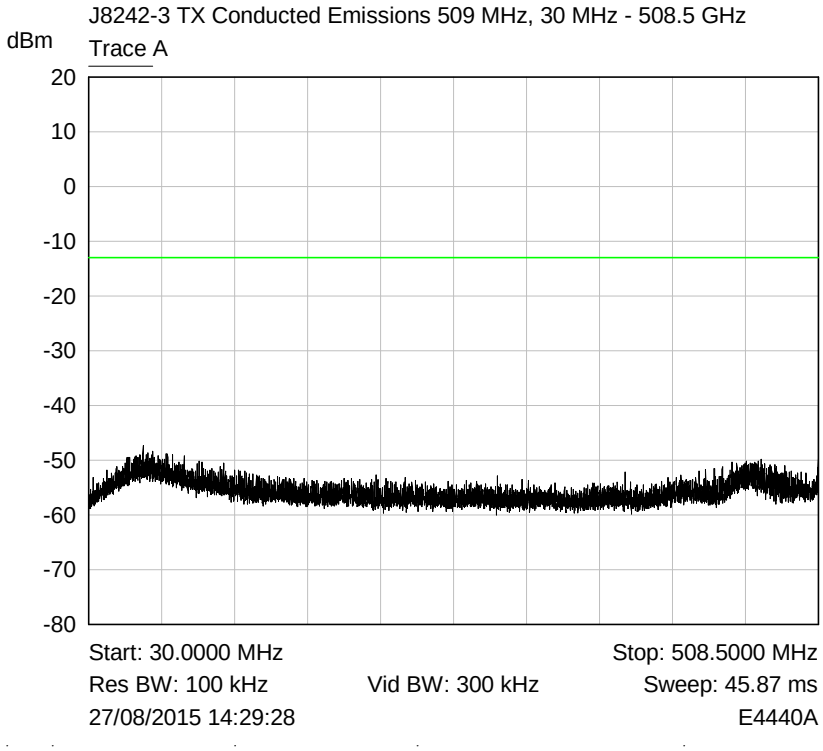
J8242-3 TX Conducted Emissions 470.2 MHz, 1 GHz - 4 GHz



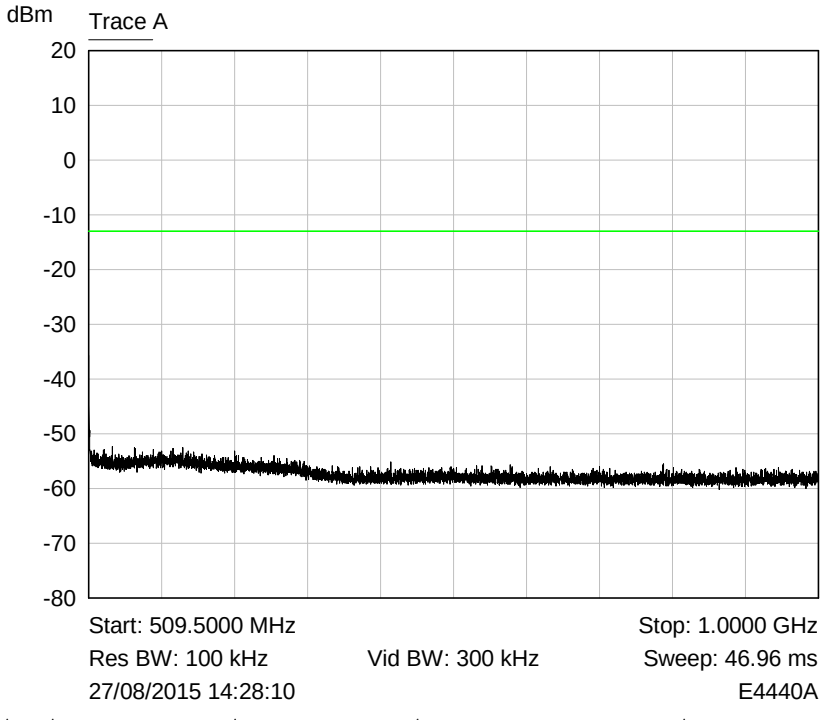


RF Parameters: Band 470.2-547.8 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 509 MHz

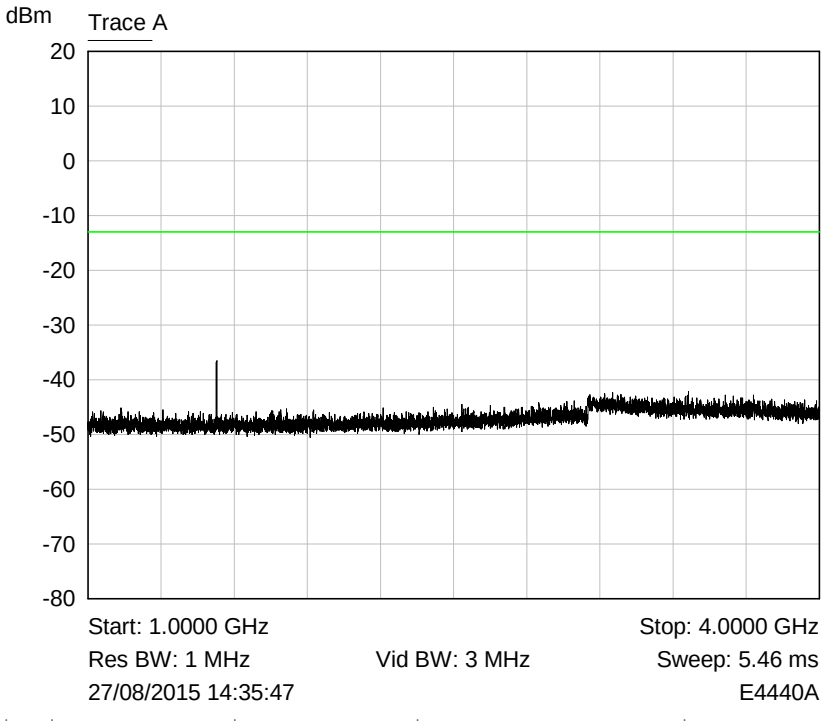


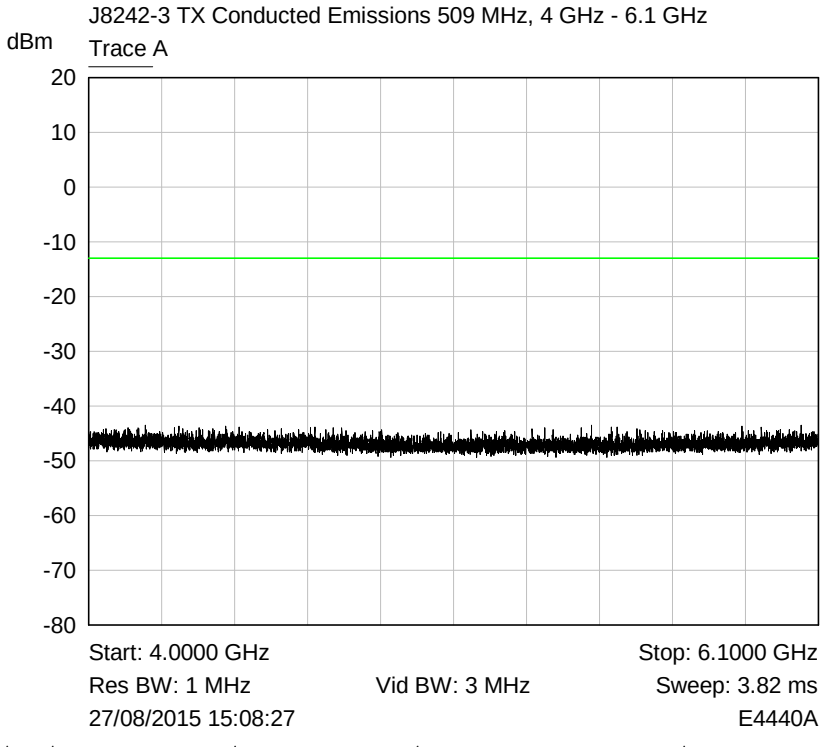


J8242-3 TX Conducted Emissions 509 MHz, 509.5 MHz - 1 GHz

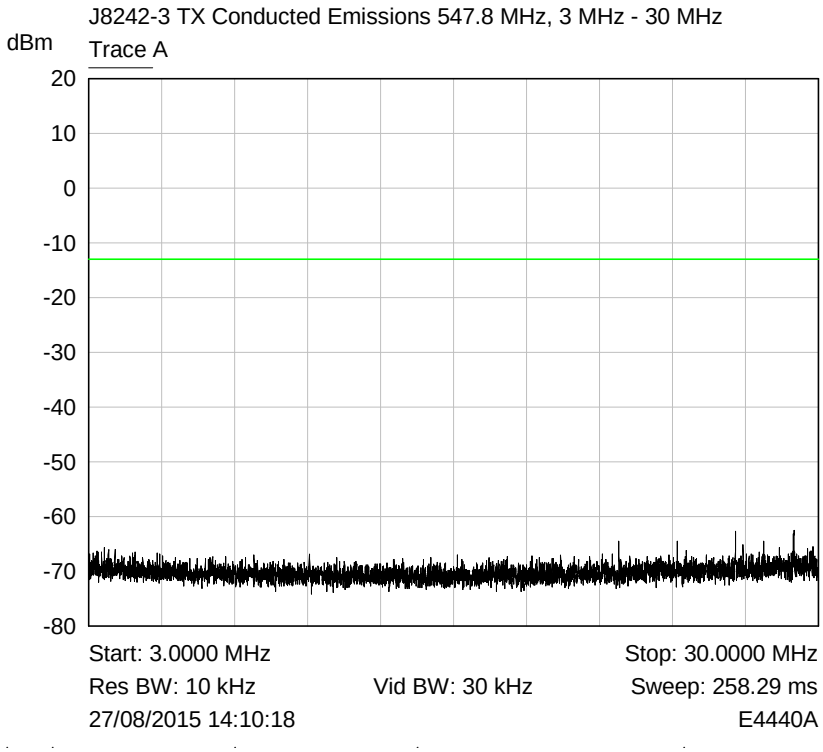


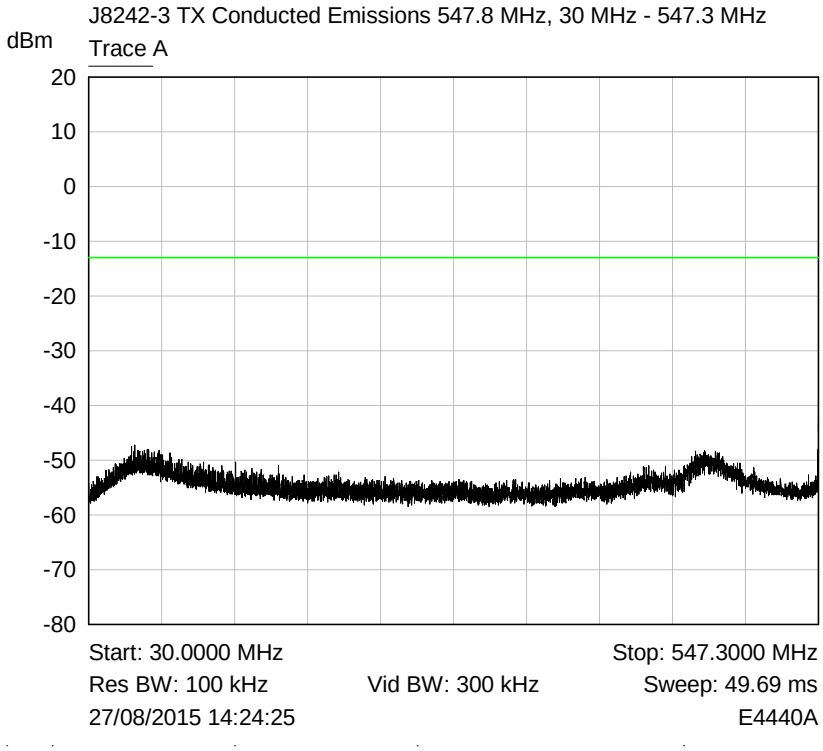
J8242-3 TX Conducted Emissions 509 MHz, 1 GHz - 4 GHz



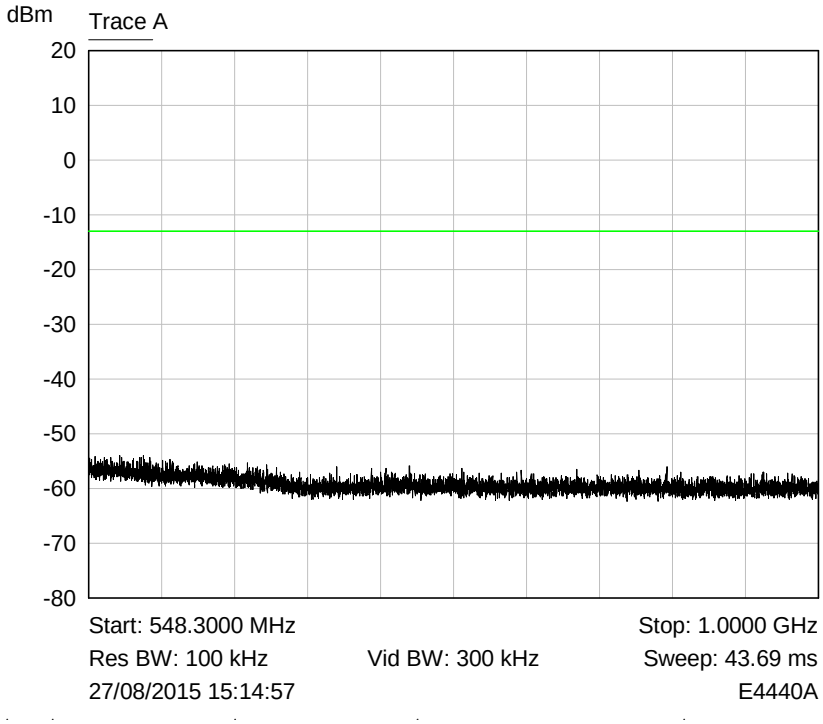


RF Parameters: Band 470.2-547.8 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 547.8 MHz

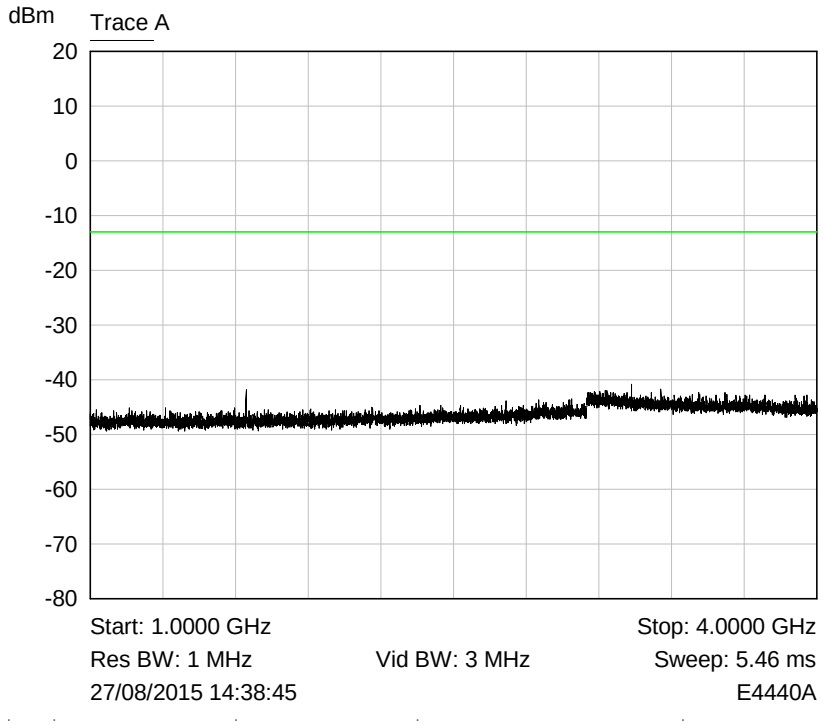


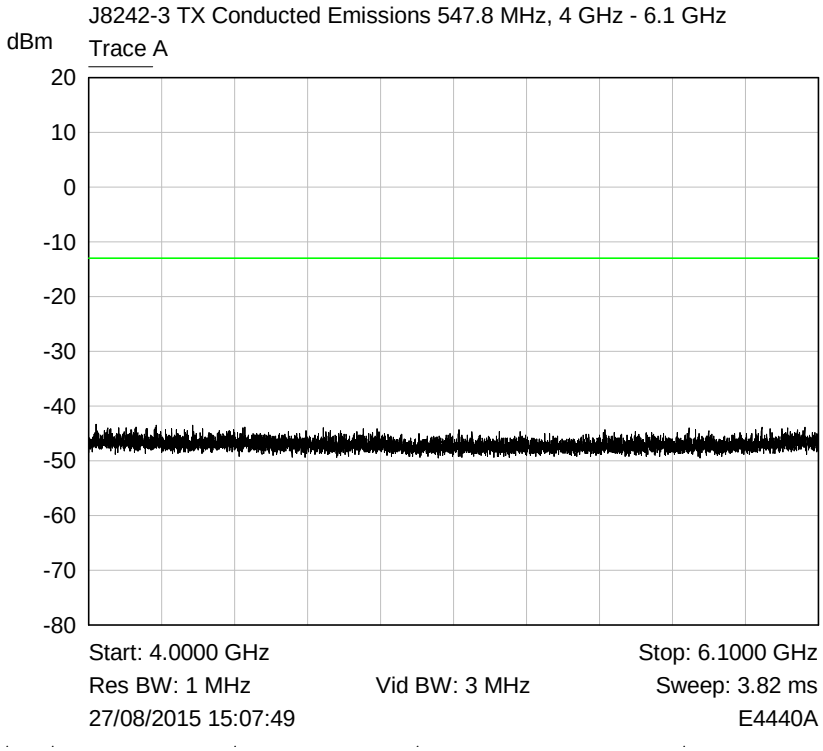


J8242-3 TX Conducted Emissions 547.8 MHz, 548.3 MHz - 1 GHz

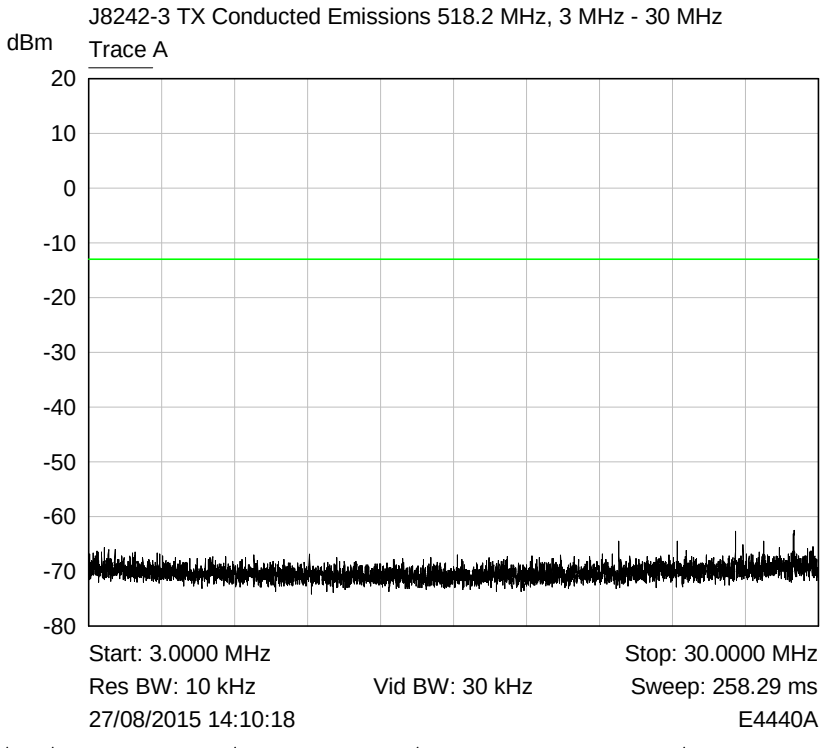


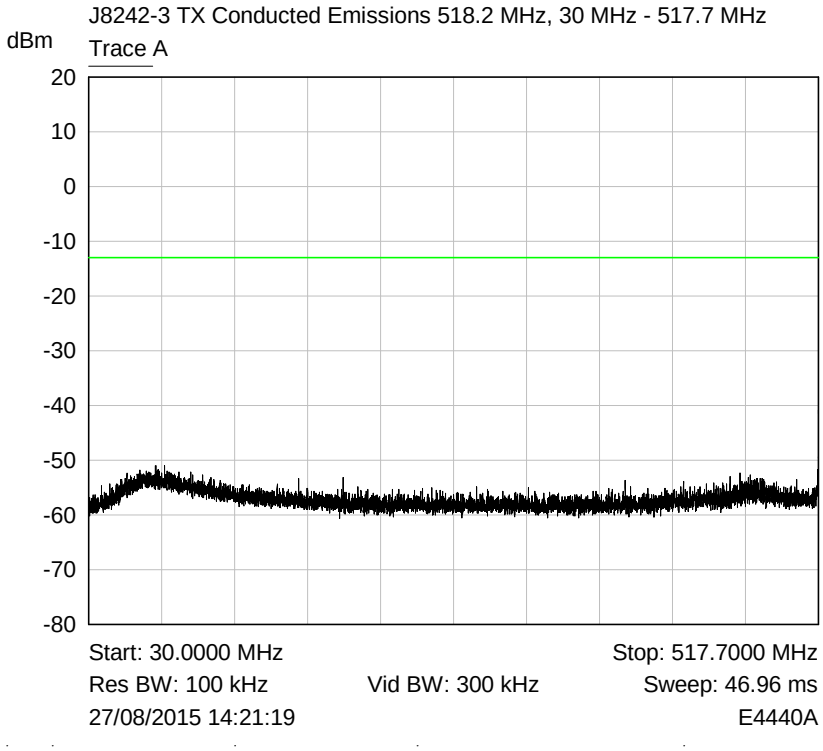
J8242-3 TX Conducted Emissions 547.8 MHz, 1 GHz - 4 GHz

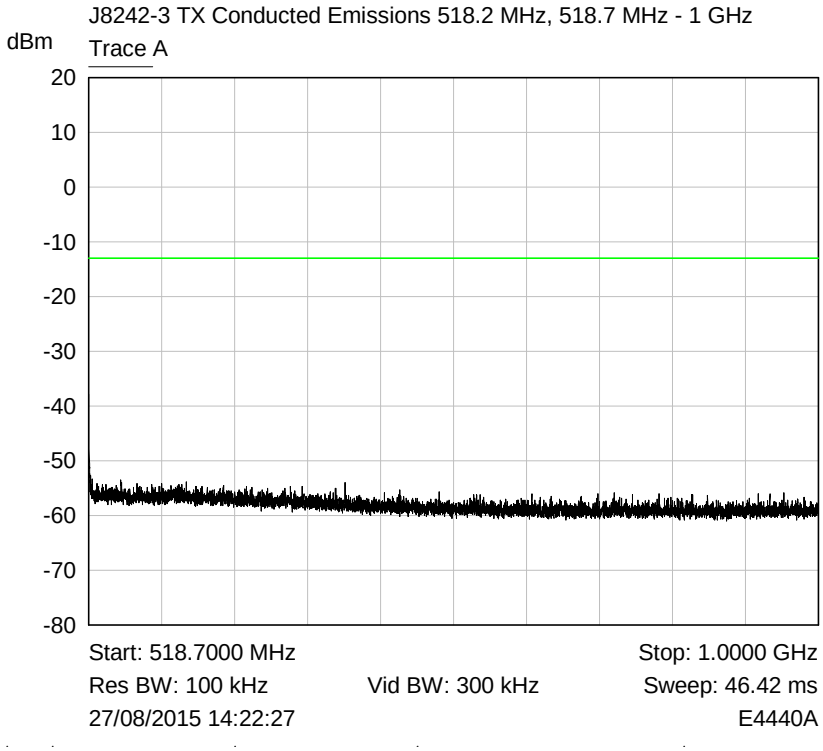


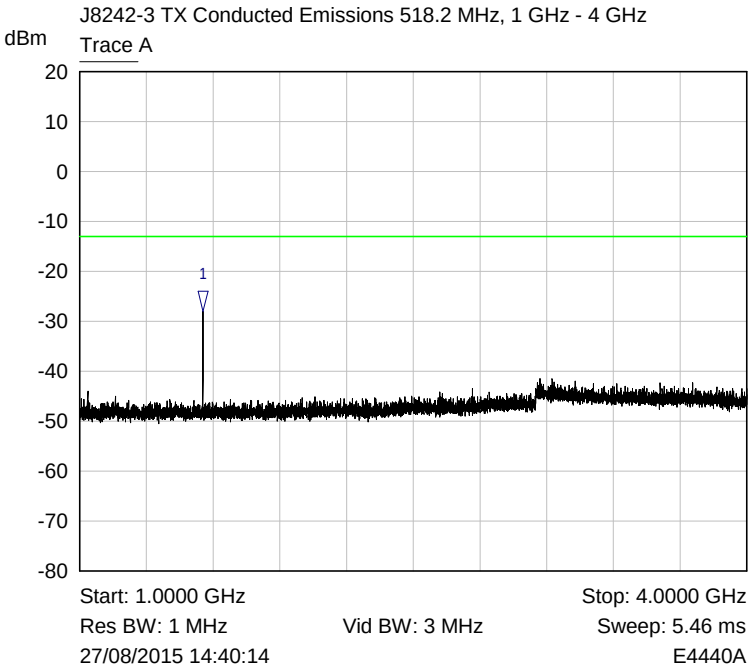


RF Parameters: Band 518.2-607.4 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 518.2 MHz

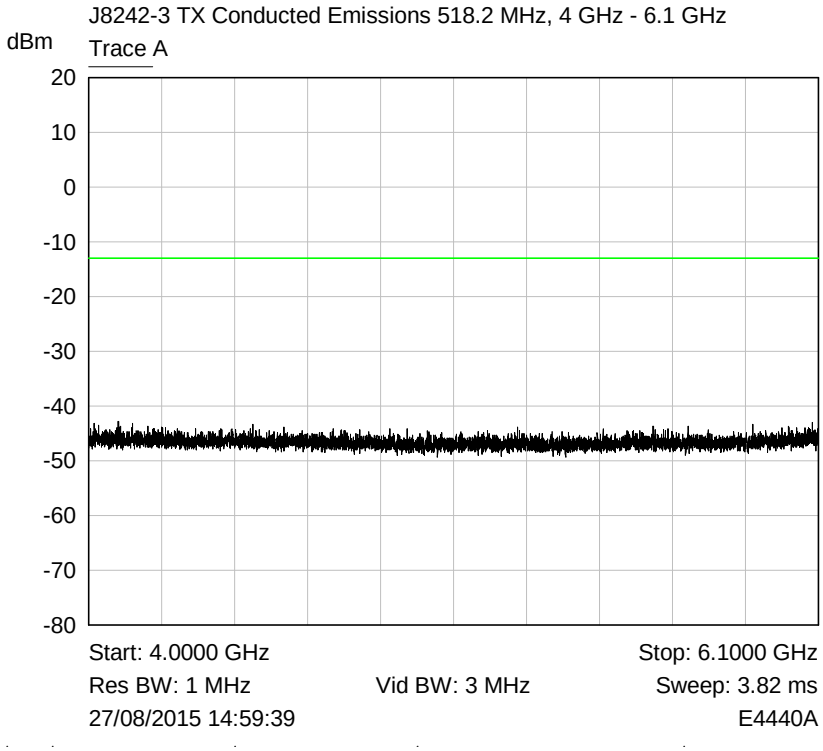




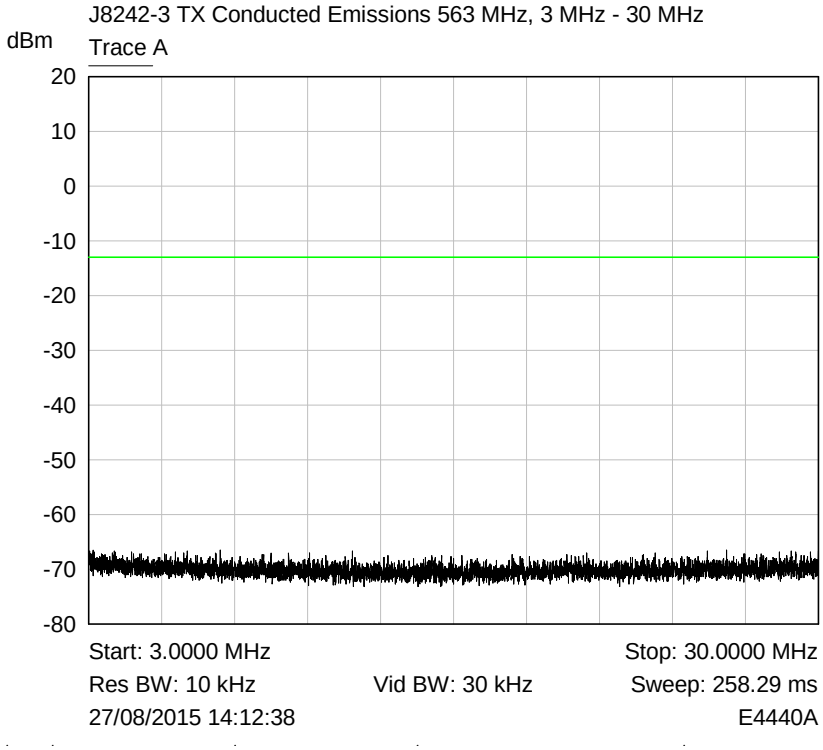


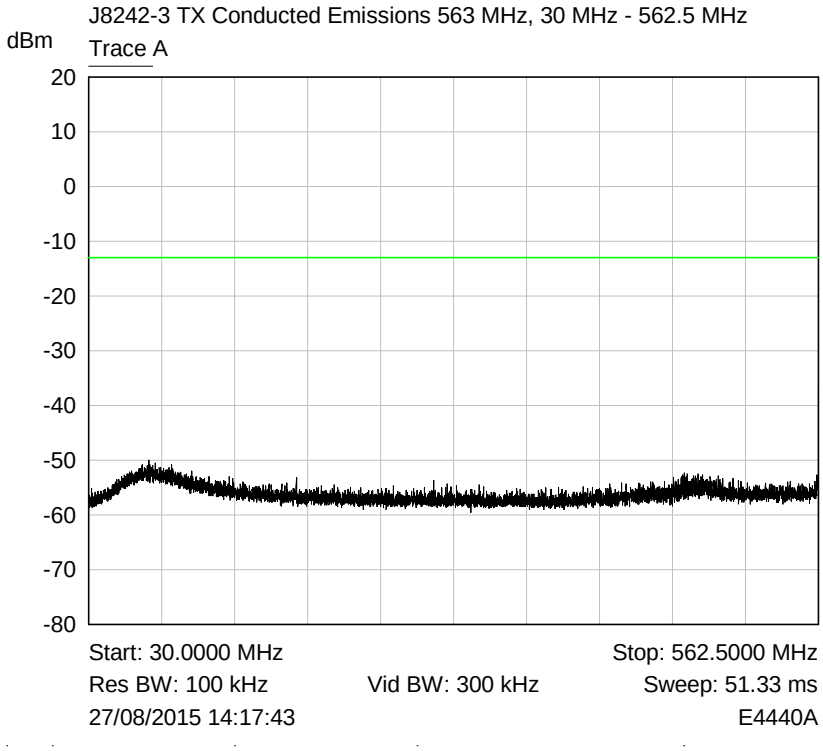


Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	1.5549 GHz	-27.93 dBm	

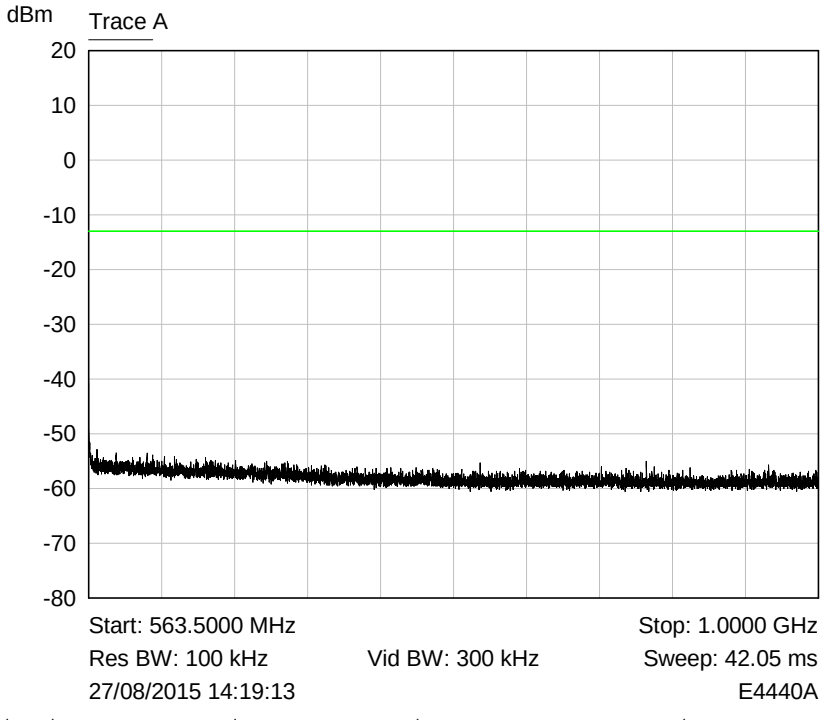


RF Parameters: Band 518.2-607.4 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 563 MHz

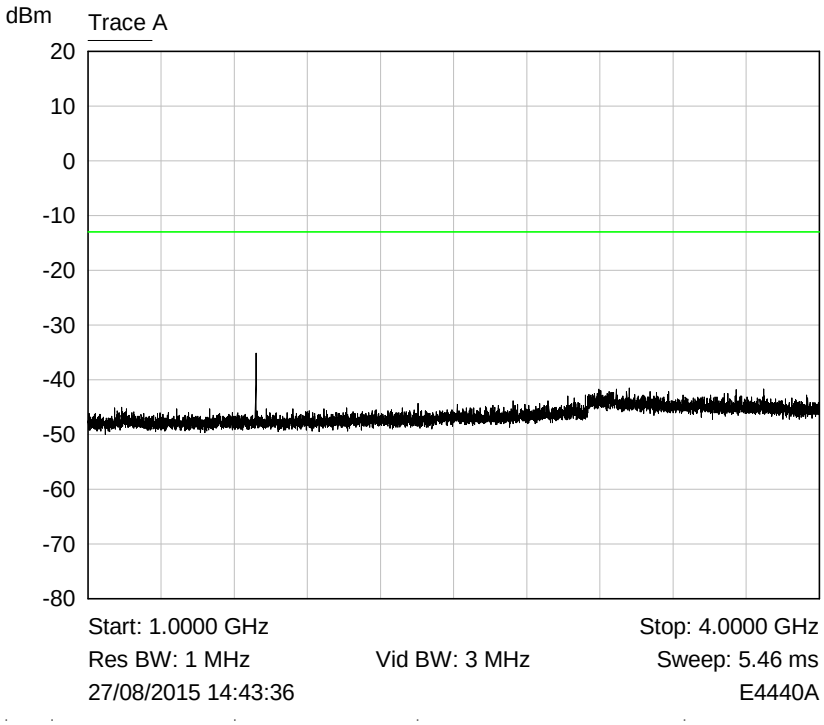


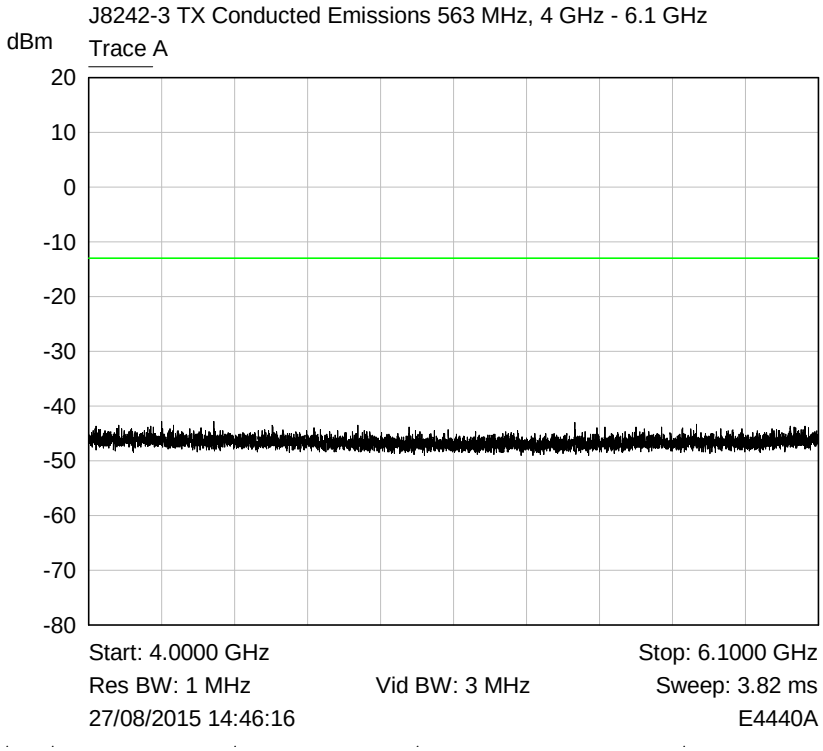


J8242-3 TX Conducted Emissions 563 MHz, 563.5 MHz - 1 GHz

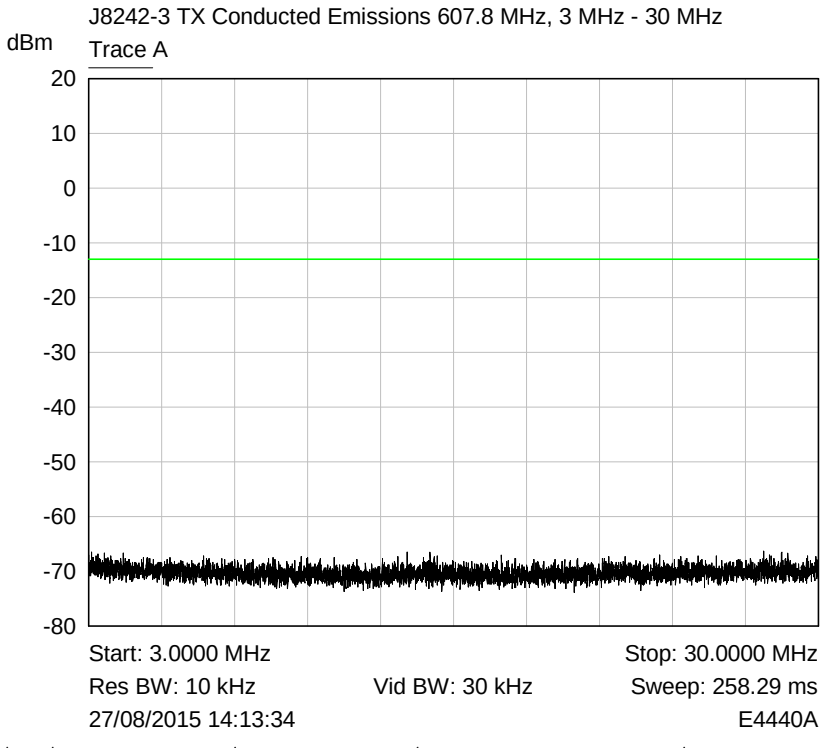


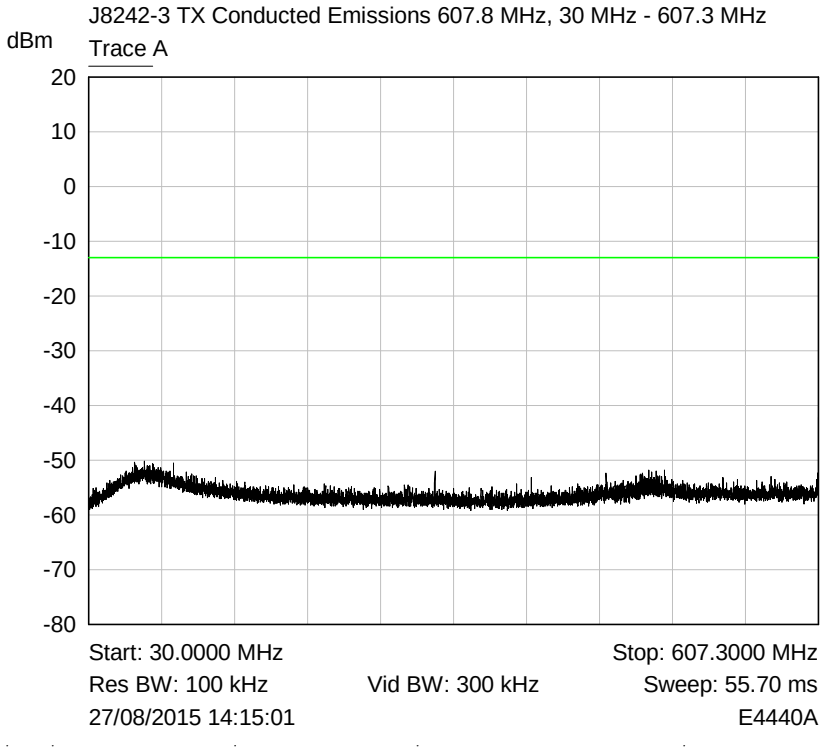
J8242-3 TX Conducted Emissions 563 MHz, 1 GHz - 4 GHz



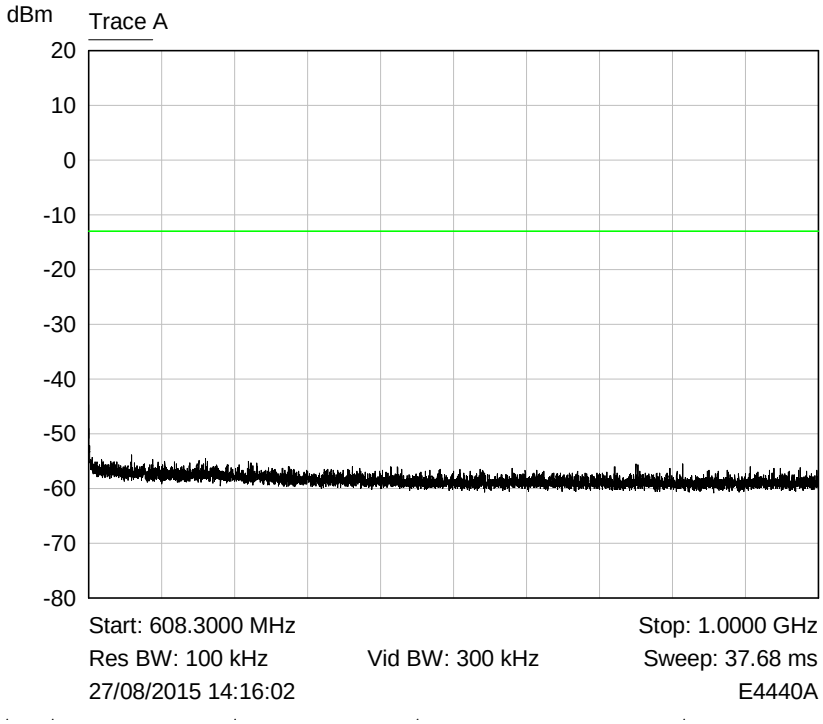


RF Parameters: Band 518.2-607.4 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 607.4 MHz

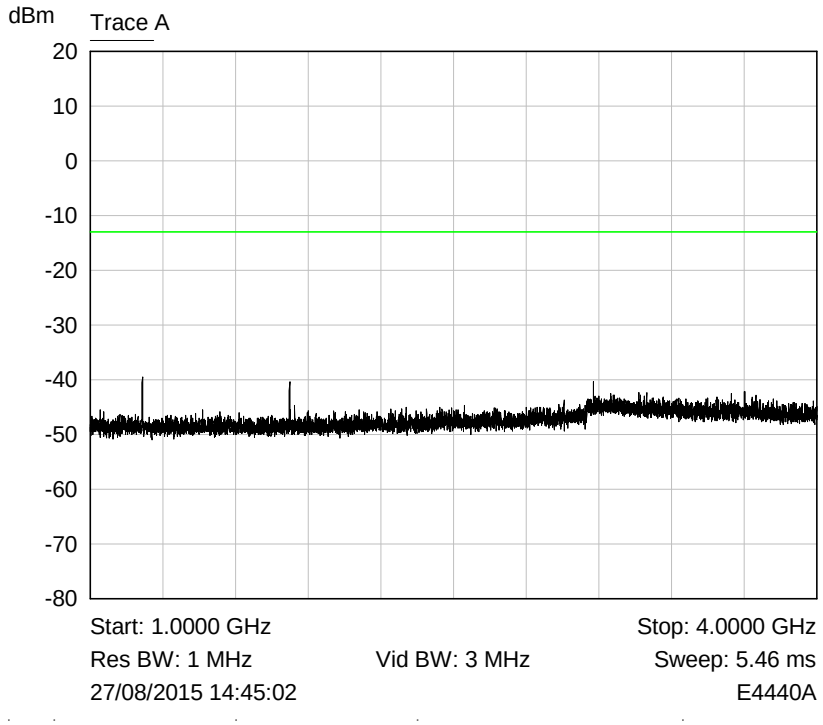


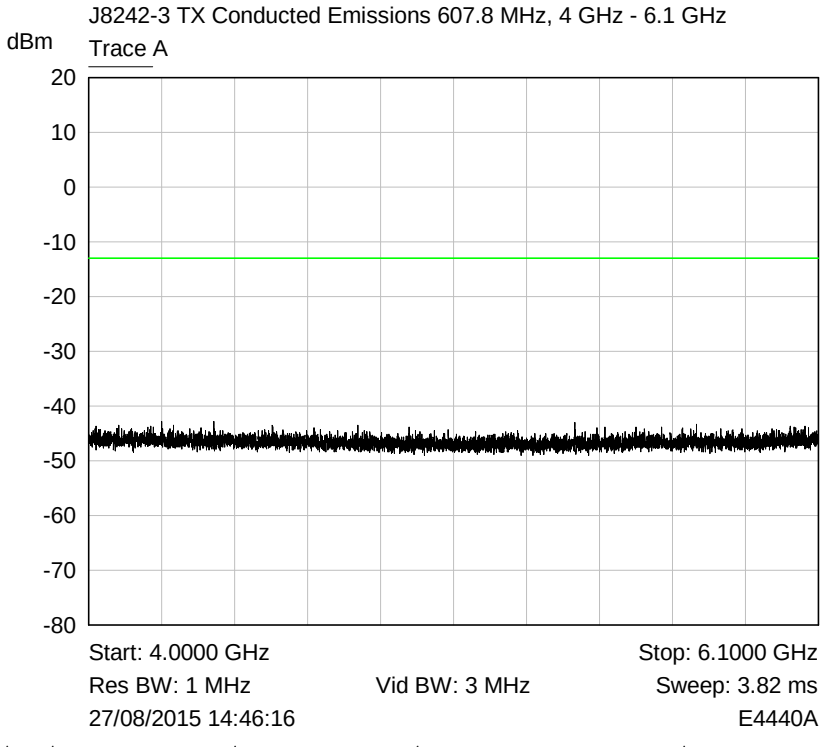


J8242-3 TX Conducted Emissions 607.8 MHz, 608.3 MHz - 1 GHz

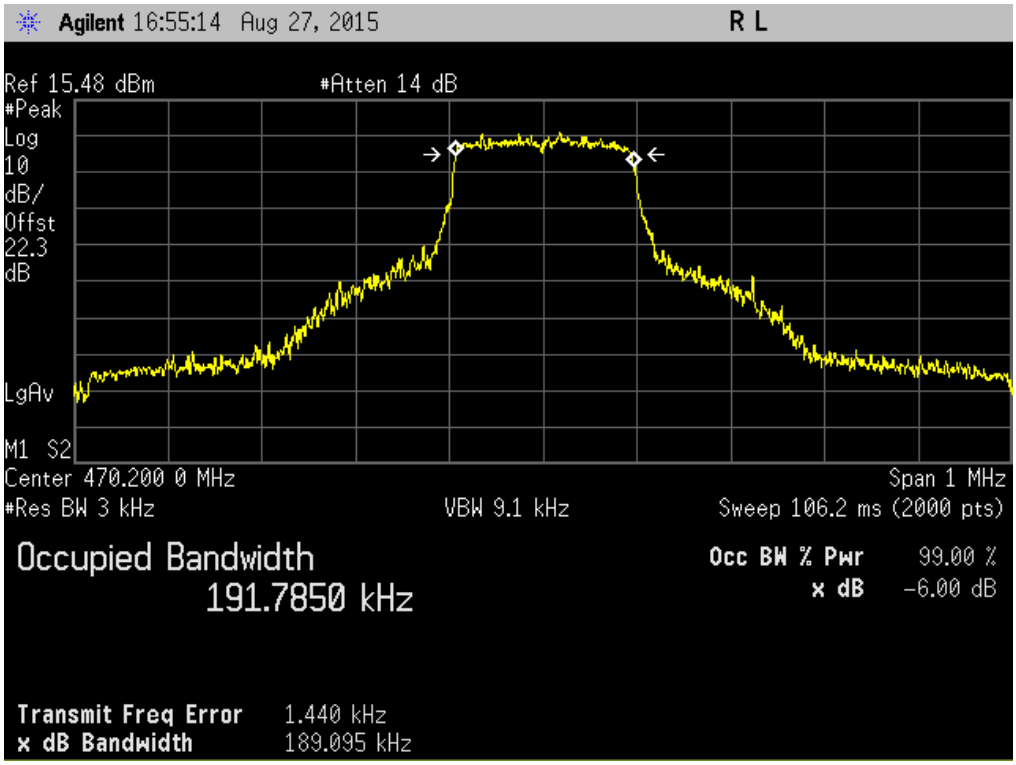


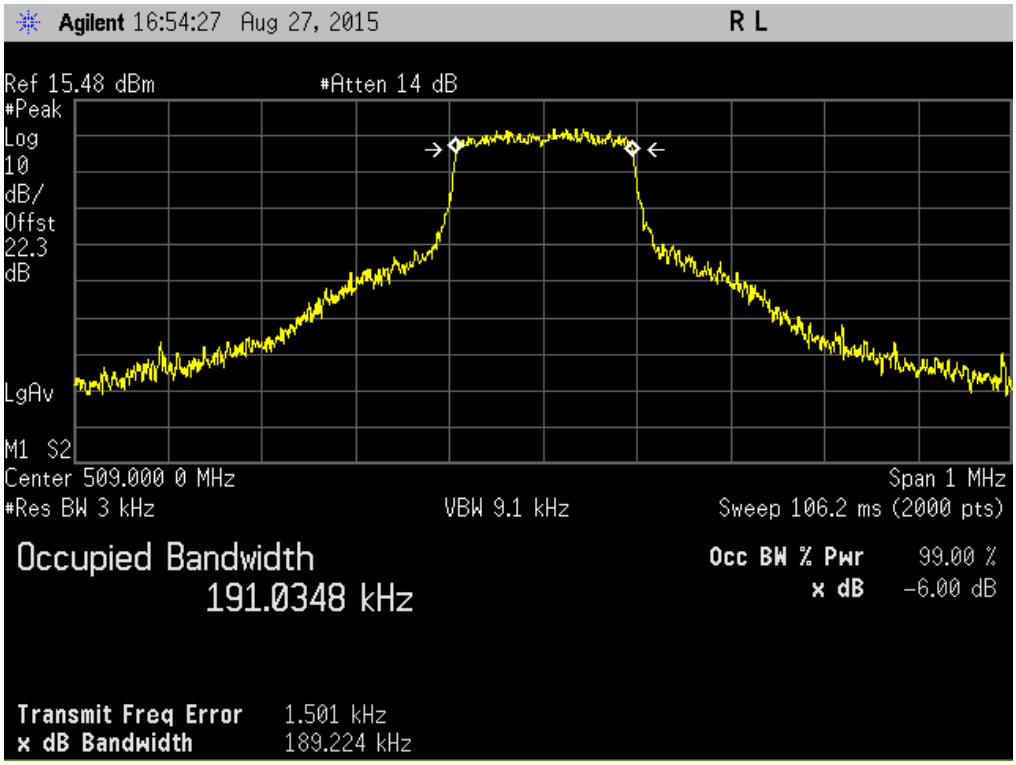
J8242-3 TX Conducted Emissions 607.8 MHz, 1 GHz - 4 GHz

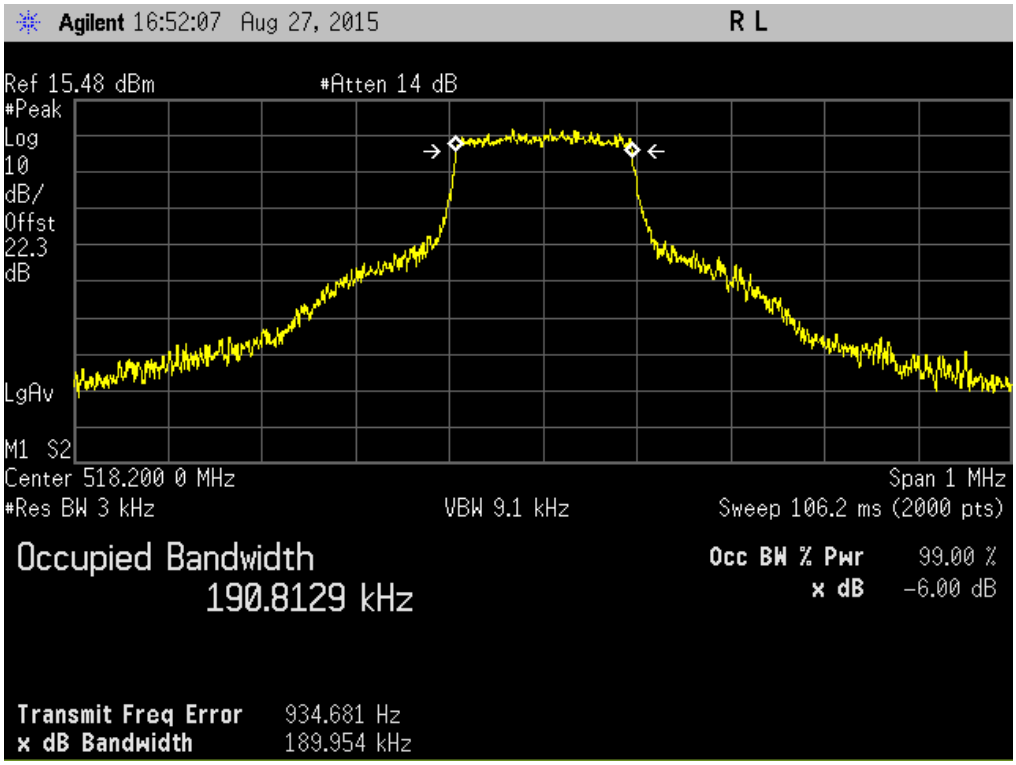


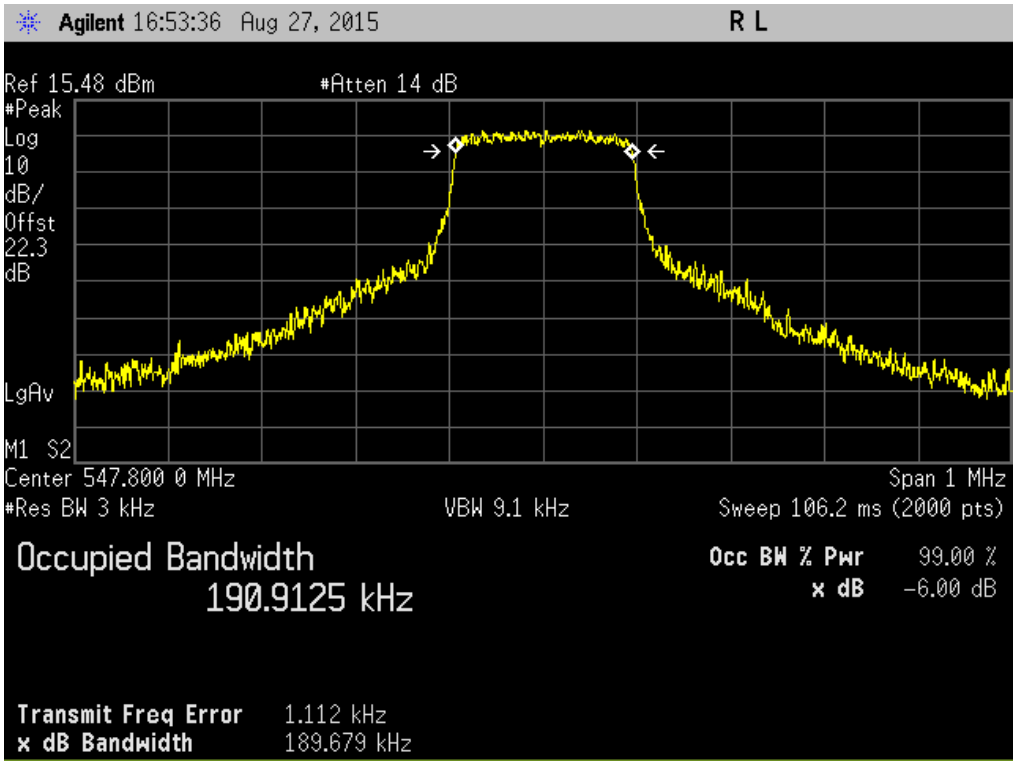


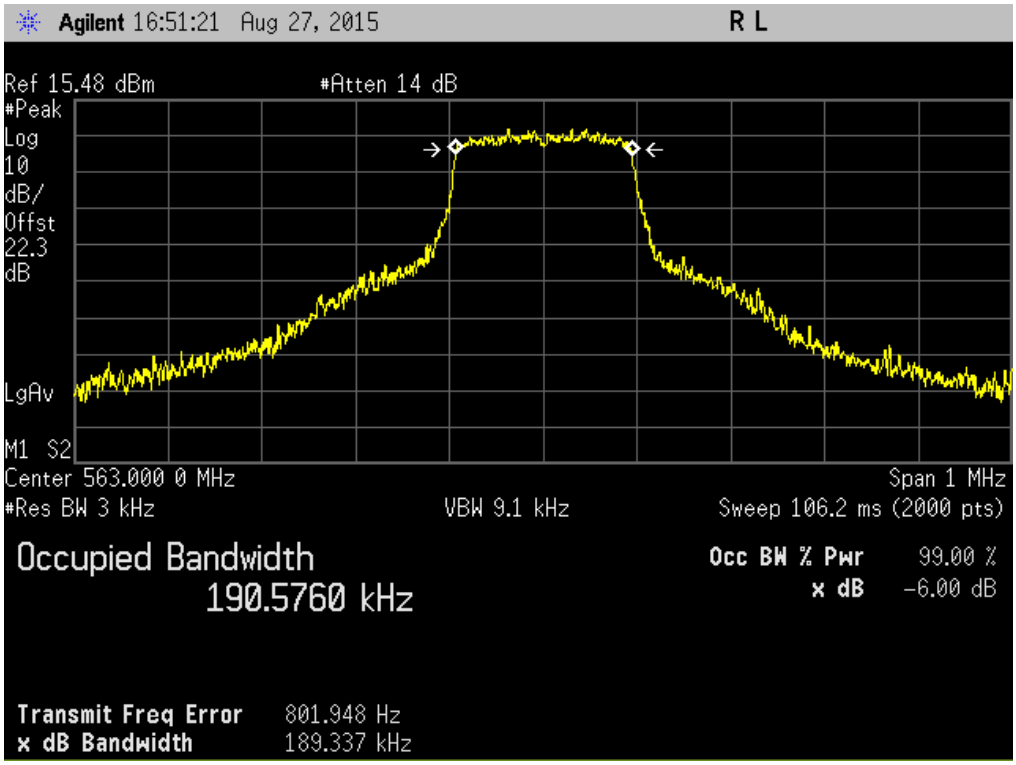
6.2 99% Occupied bandwidth and bandwidth mask

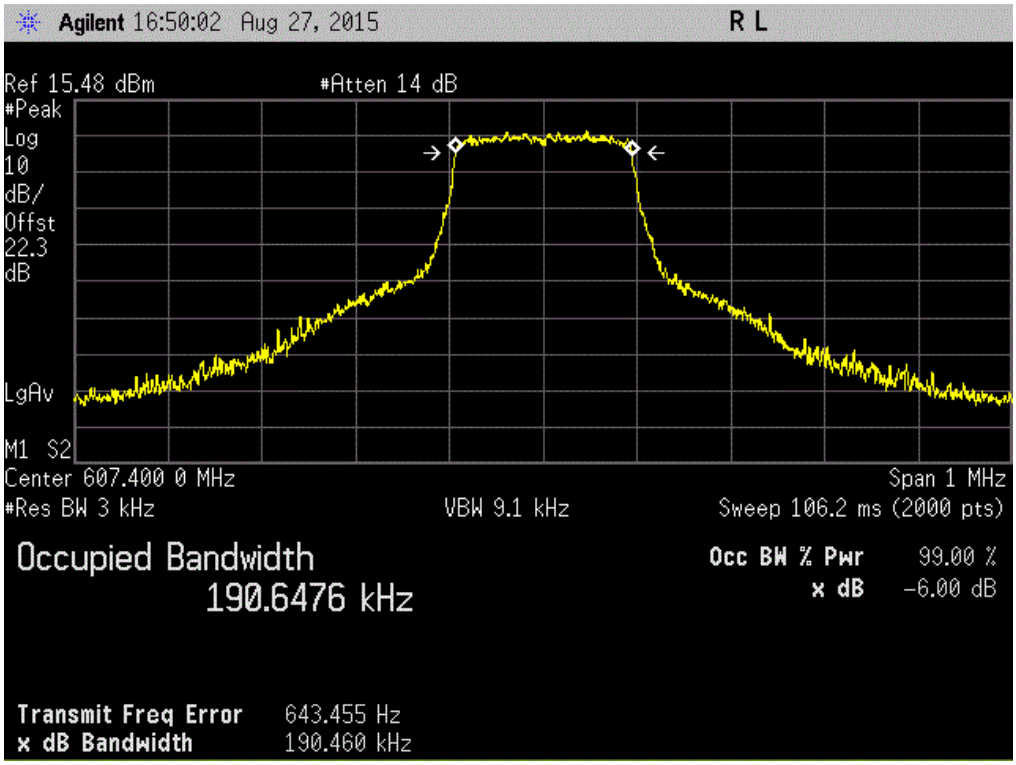





Agilent 16:52:07 Aug 27, 2015
R L
Ref 15.48 dBm
#Atten 14 dB
#Peak
Log
10
dB/
Offst
22.3
dB
LgAv
M1 S2
Center 518.200 0 MHz
Span 1 MHz
#Res BW 3 kHz
VBW 9.1 kHz
Sweep 106.2 ms (2000 pts)
Occupied Bandwidth
190.8129 kHz
Occ BW % Pwr 99.00 %
x dB -6.00 dB
Transmit Freq Error 934.681 Hz
x dB Bandwidth 189.954 kHz

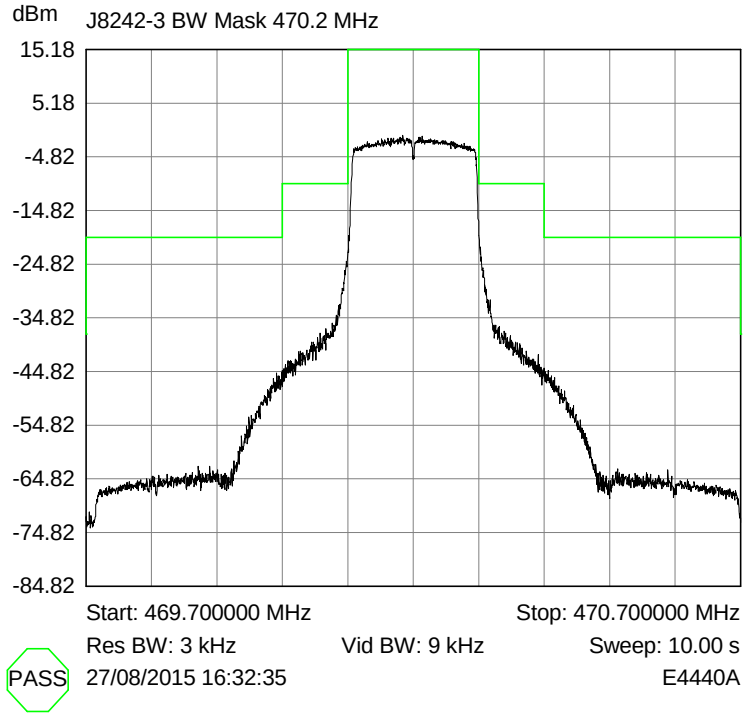

Agilent 16:53:36 Aug 27, 2015
R L
Ref 15.48 dBm
#Atten 14 dB
#Peak
Log
10
dB/
Offst
22.3
dB
LgAv
M1 S2
Center 547.800 0 MHz
Span 1 MHz
#Res BW 3 kHz
VBW 9.1 kHz
Sweep 106.2 ms (2000 pts)
Occupied Bandwidth
190.9125 kHz
Occ BW % Pwr 99.00 %
x dB -6.00 dB
Transmit Freq Error 1.112 kHz
x dB Bandwidth 189.679 kHz



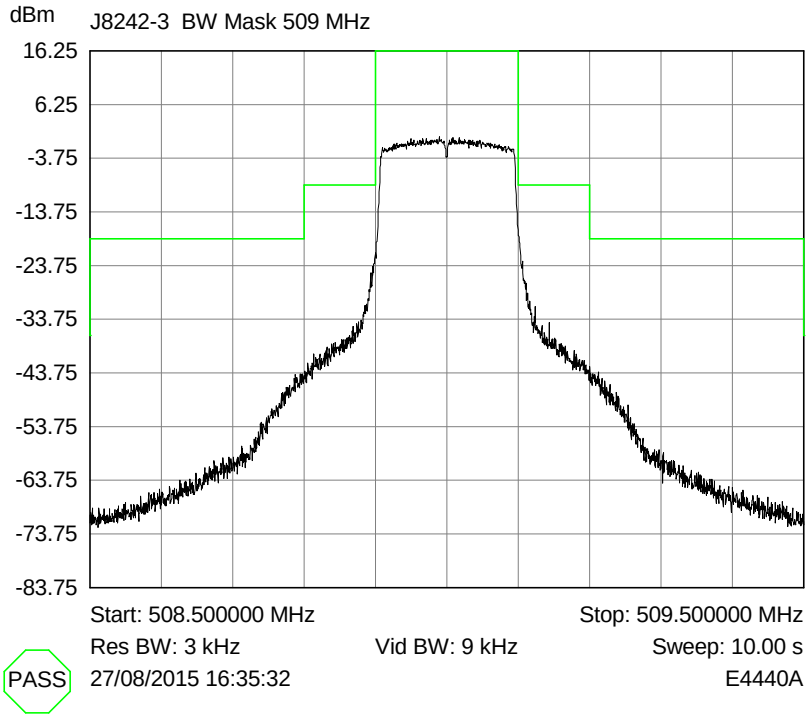


Bandwidth Mask

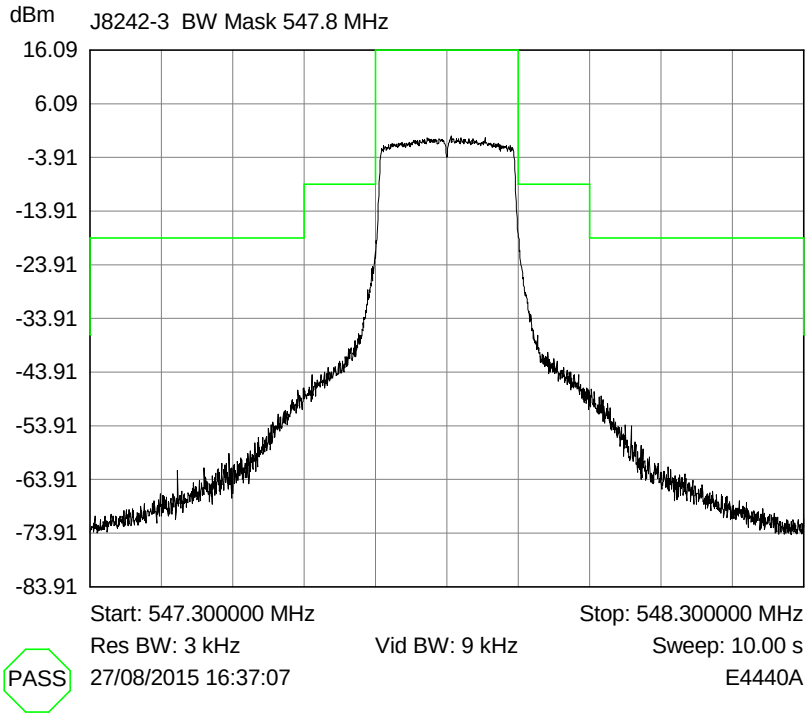
RF Parameters: Band 470.2-547.8 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 470.2 MHz



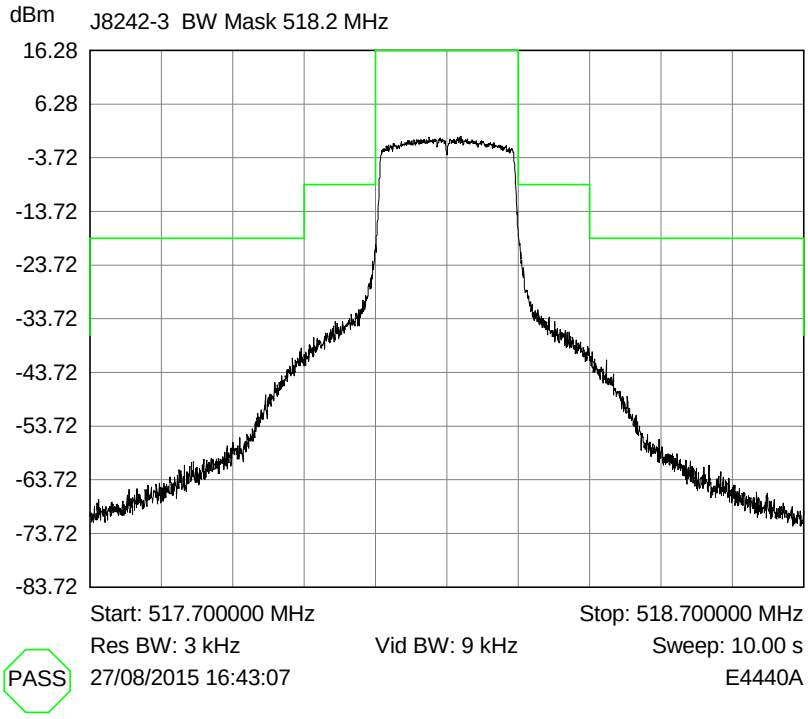
RF Parameters: Band 470.2-547.8 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 509 MHz



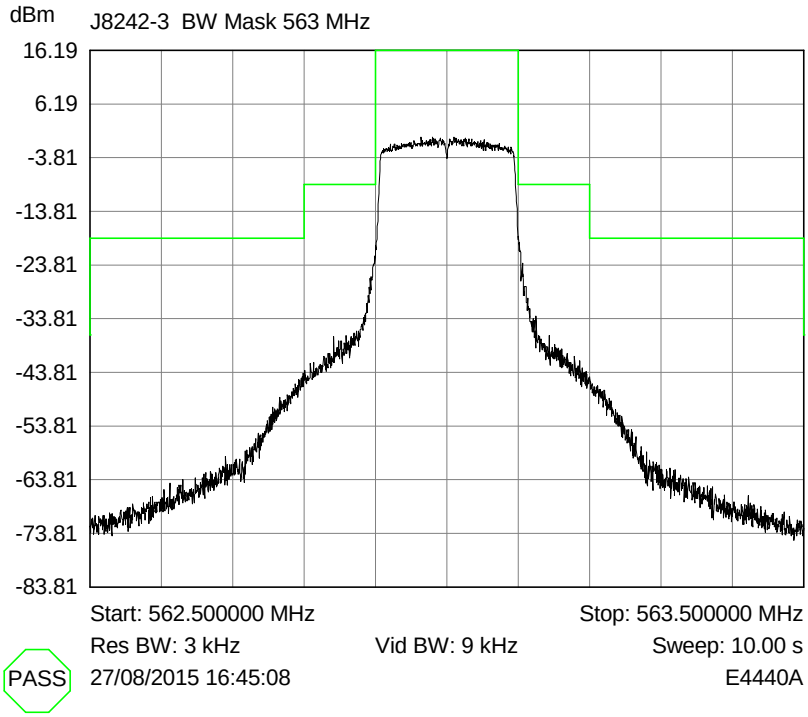
RF Parameters: Band 470.2-547.8 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 547.8 MHz



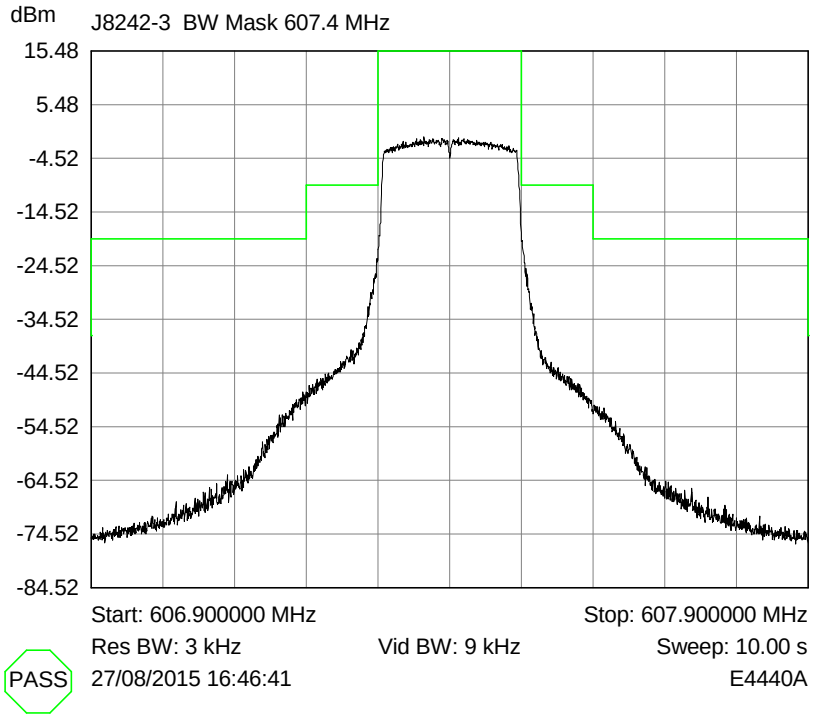
RF Parameters: Band 518.2-607.4 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 518.2 MHz



RF Parameters: Band 518.2-607.4 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 563 MHz



RF Parameters: Band 518.2-607.4 MHz, Power 50 mW, Channel Spacing 400 kHz, Modulation OFDM, Channel 607.4 MHz



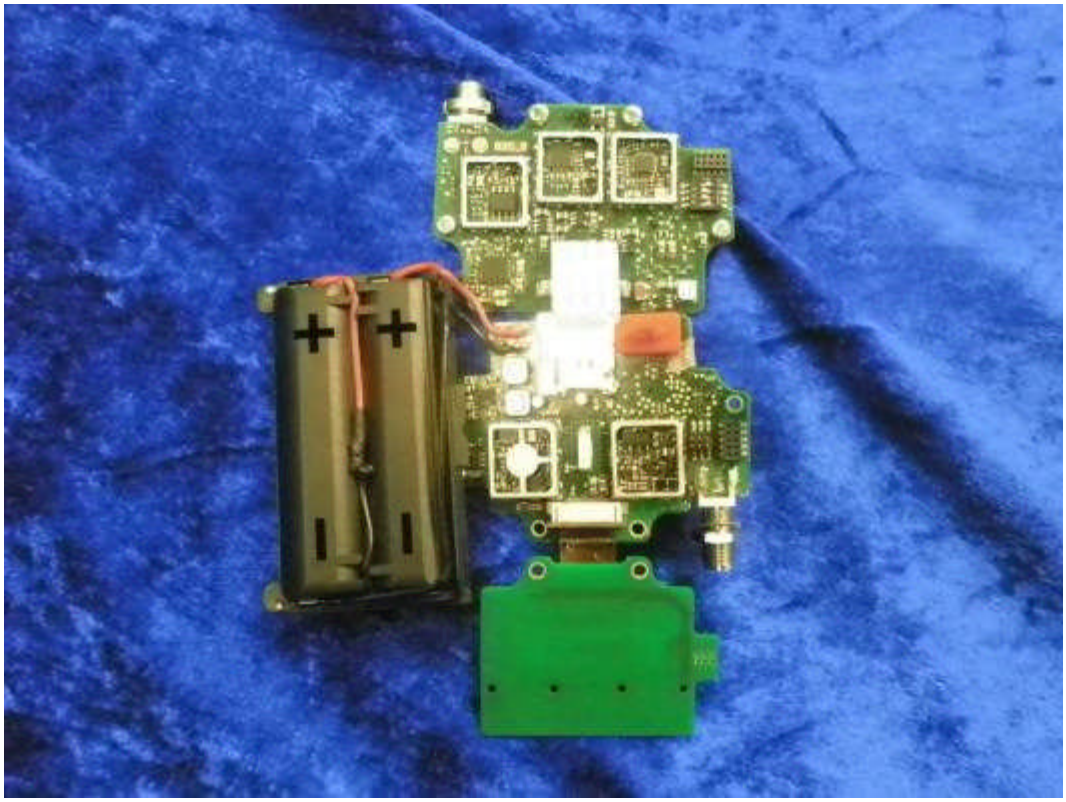
7 Photographs

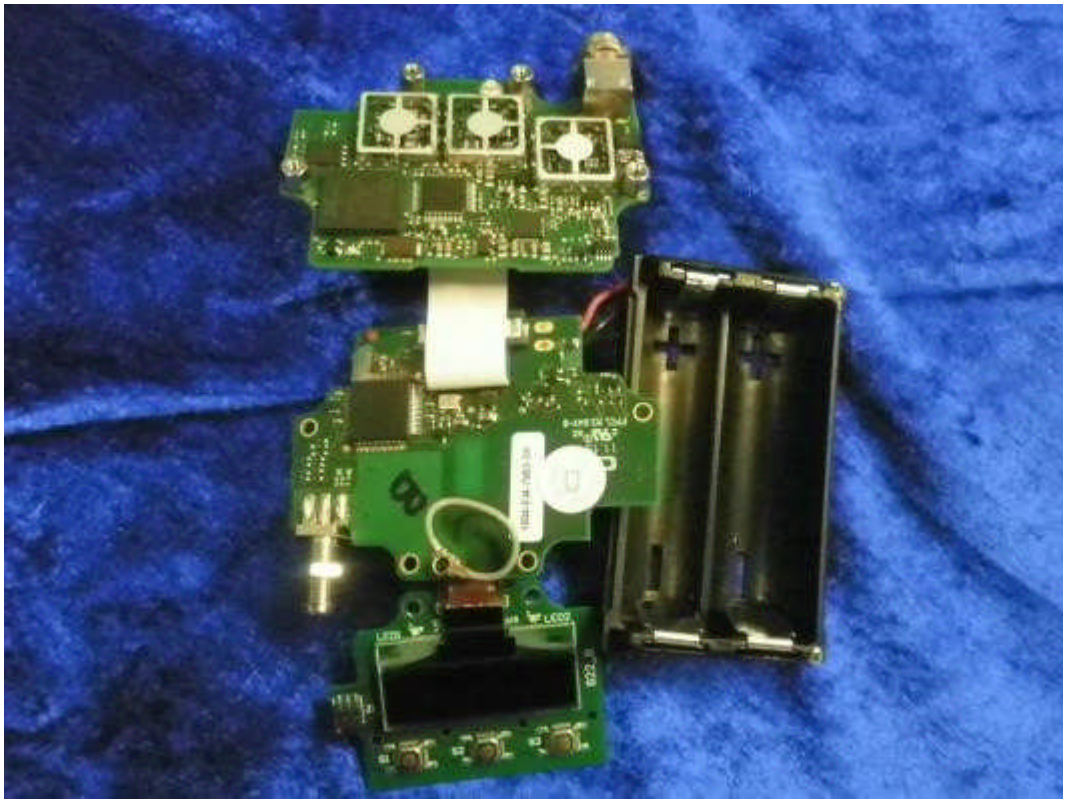
7.1 EUT Front View

7.2 EUT Reverse Angle

7.3 EUT Display & Controls

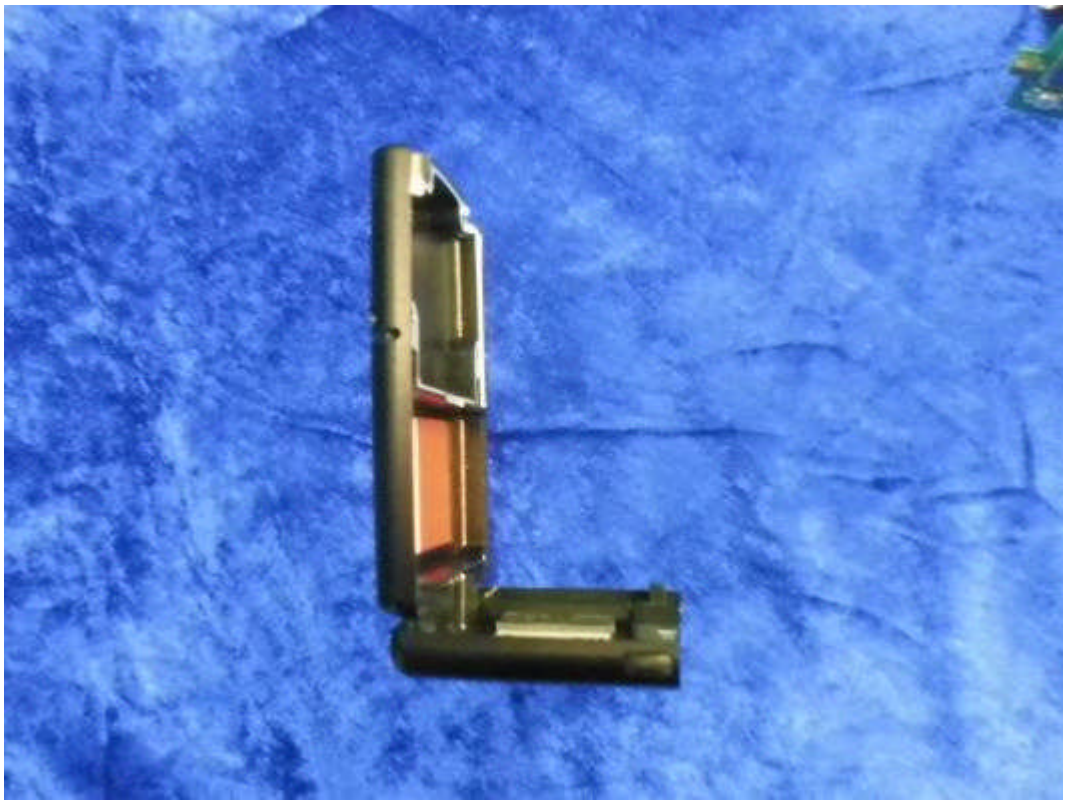
7.4 EUT Internal photos



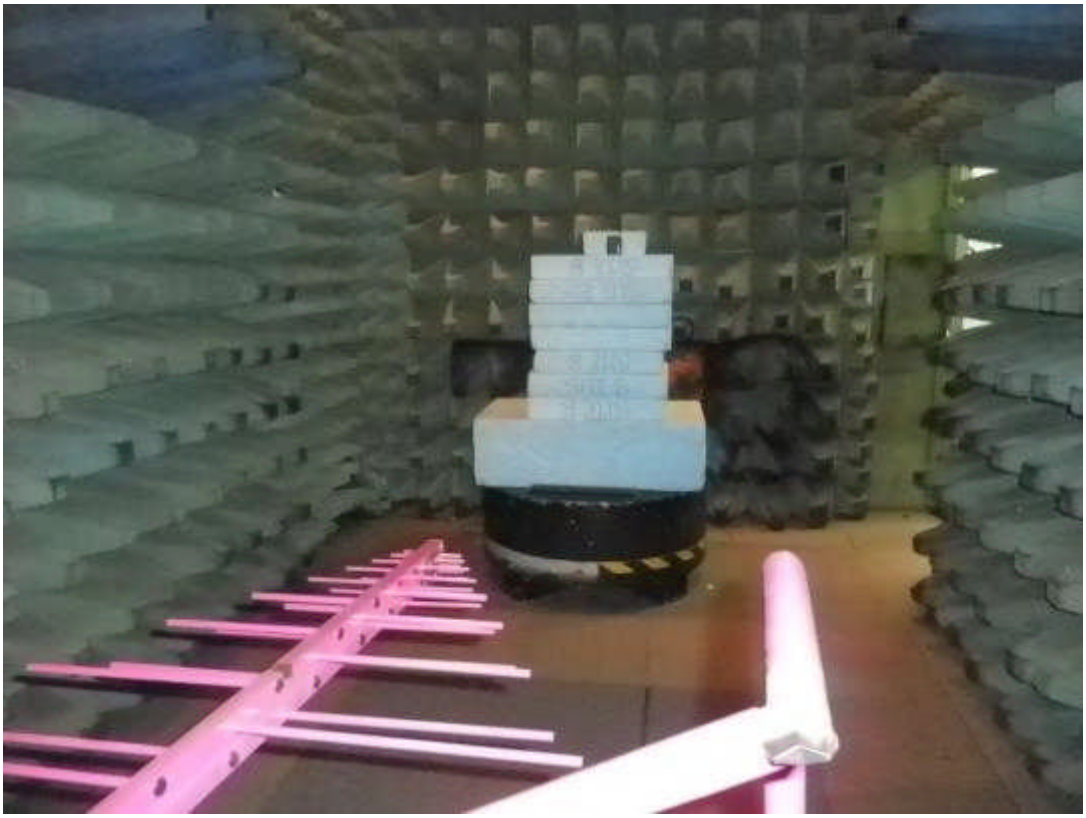


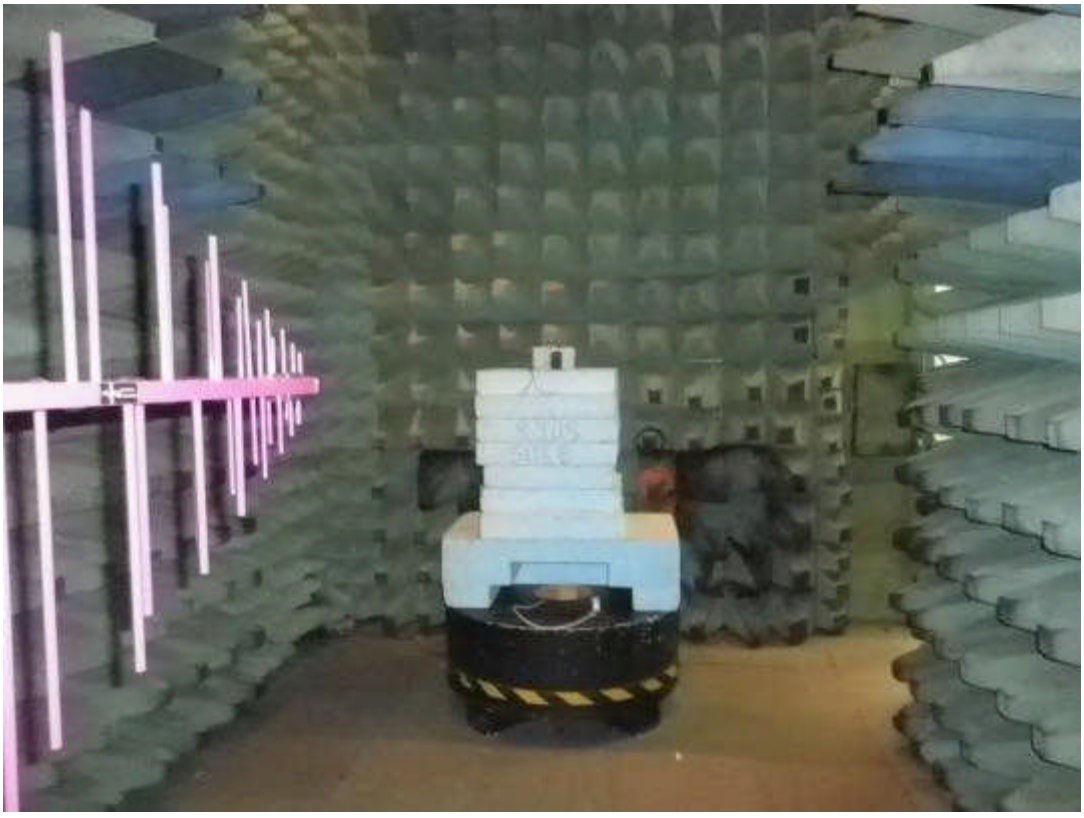
7.5 EUT ID Label

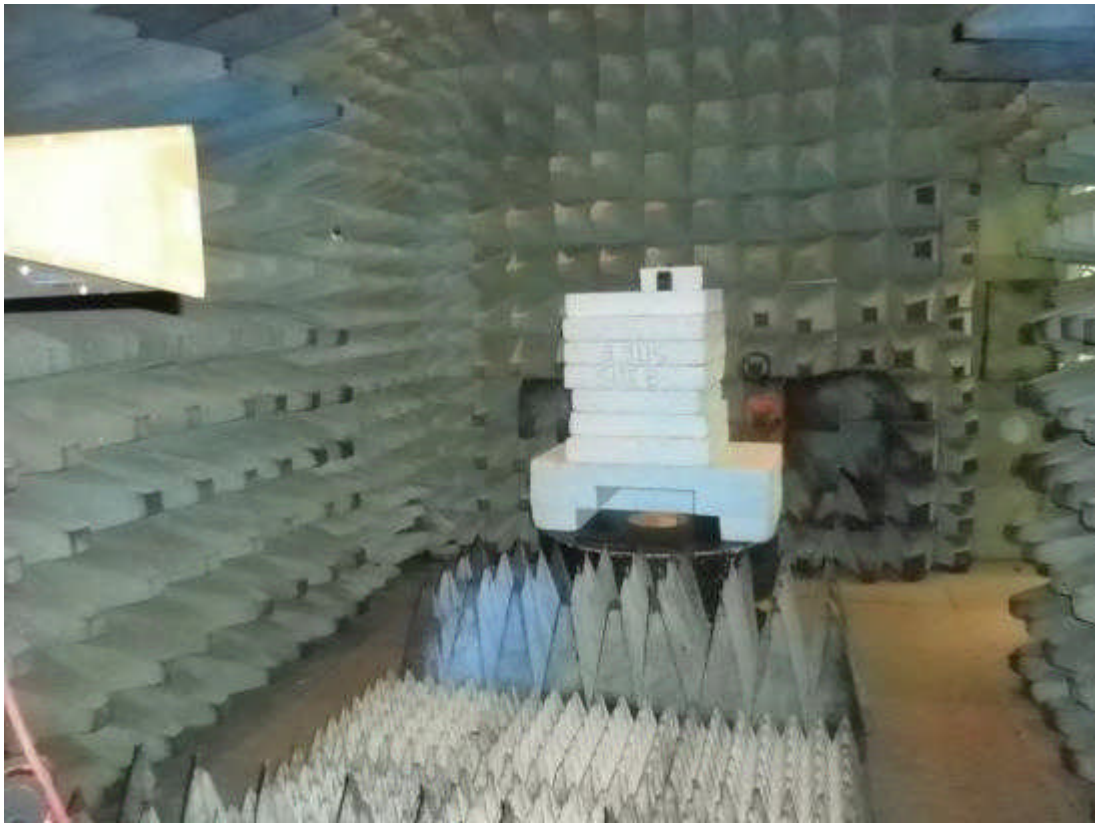
7.6 Chassis

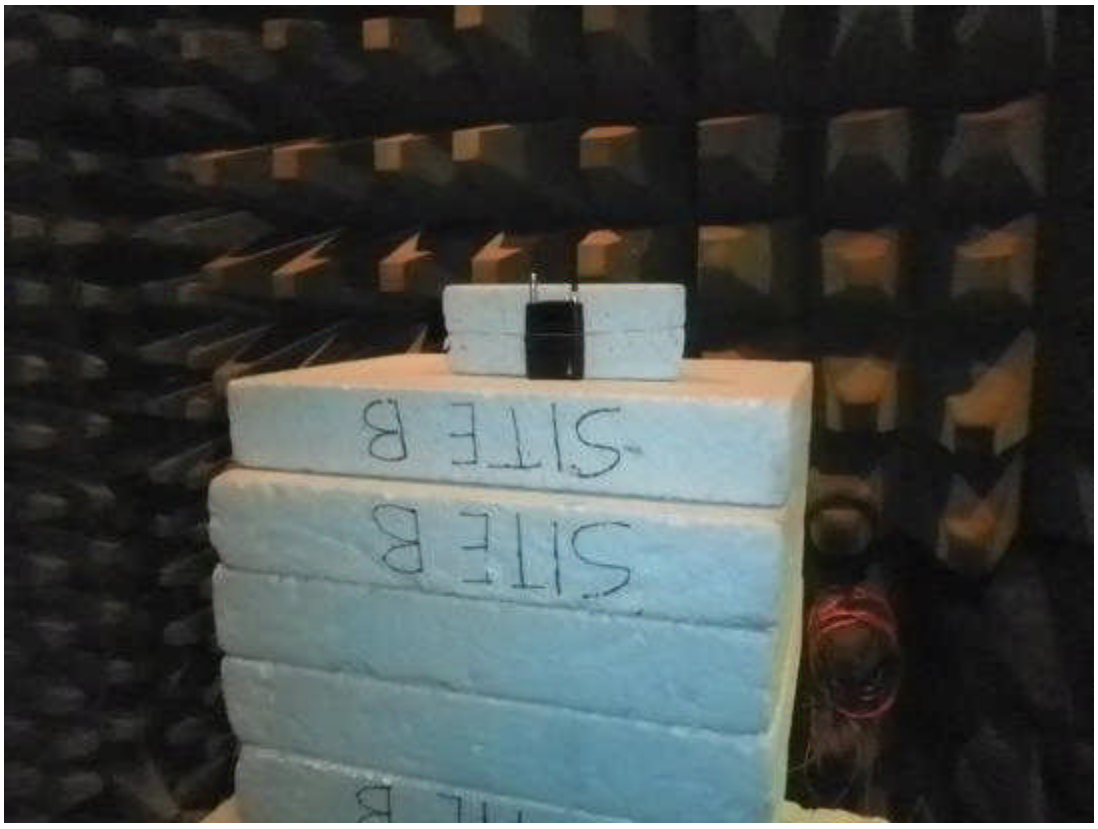


7.7 Radiated emissions photos









7.8 Radiated emission diagram

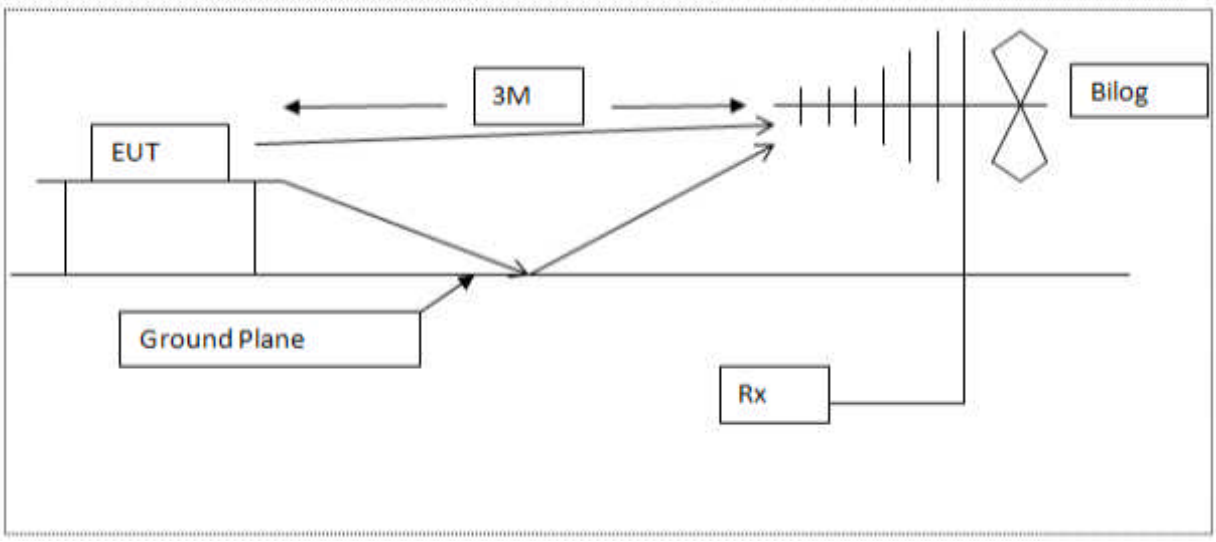


Diagram of the radiated emissions test setup 30 - 1000 MHz

8 Test equipment calibration list

The following is a list of the test equipment used by R.N. Electronics Ltd to test the unit detailed within this report. In line with our procedures, the equipment was within calibration for the period during which testing was carried out.

RN No.	Model No.	Description	Manufacturer	Calibration date	Cal period
E007-2	VHA9103	Bi-con Antenna	Schwarzbeck	14-Apr-2014	36 months
E227	6632A	System DC Power Supply	Hewlett Packard	19-Mar-2015	12 months
E250	6806.19.A	6dB Attenuator	Hewlett Packard	26-Nov-2014	12 months
E251	6806.19.A	6dB Attenuator	Suhner	07-Jan-2015	12 months
E252	6810.19.A	10 dB Attenuator	Suhner	19-May-2014	12 months
E255	779	6 dB Attenuator	Narda	13-Nov-2014	12 months
E266	2032	5.4GHz Signal Generator	Marconi Instruments	15-Jul-2014	24 months
E268	BHA 9118	1-18 GHz Horn Antenna	Schaffner	08-Apr-2015	24 months
E291-2	6960B	Power Meter	Marconi Instruments	01-Dec-2014	24 months
E312	6924	Power Sensor 10MHz - 40GHz	Marconi Instruments	18-Mar-2014	24 months
E313	777C	30dB Attenuator	Narda	19-Jun-2015	12 months
E327	CBL6141A	Bi-log Antenna	Schaffner	09-May-2014	24 months
E367	6534/4	20dB Attenuator	Marconi Instruments	19-May-2015	12 months
E428	HF906	1-18 GHz Horn Antenna	Rhode & Schwarz	28-Jan-2014	24 months
E434	G3RUH	10 MHz GPS Oscillator	James Miller	Not applicable	Not applicable
E533	N5182A	6 GHz MXG Signal Generator	Agilent Technologies	26-Feb-2013	36 months
E624	E4440A	3 Hz - 26.5 GHz PSA	Agilent Technologies	07-Oct-2015*	24 months
L264	DT75	Digital Thermometer	Instrotech Ltd	06-Dec-2013	24 months
P233	HP8491B	30dB Attenuator	Hewlett Packard	30-Jun-2014	12 months
E256	44	10dB Attenuator	Weinschel Engineering	06-Jan-2015	12 months
P266	9480	Distribution System	Racal Instruments Ltd	Not applicable	Not applicable
TMS36	VMT04/30	Environmental Oven	Heraeus Votsch	Not applicable	Not applicable
TMS55	8903B	Audio Analyser	Hewlett Packard	05-Mar-2014	24 months
TMS814	MP627A	Doublet Antenna 200-1700 MHz	Schaffner	29-Oct-2013	24 months
E007-2	VHA9103	Bi-con Antenna	Schwarzbeck	14-Apr-2014	36 months
E227	6632A	System DC Power Supply	Hewlett Packard	19-Mar-2015	12 months

* Equipment was within calibration dates for tests and has been re-calibrated since date of tests.

9 Auxiliary and peripheral equipment

9.1 Customer supplied equipment

No customer equipment was supplied.

9.2 RN Electronics supplied equipment

No RN Electronics Ltd supplied equipment was used.

10 Condition of the equipment tested

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

10.1 Modifications before test

Although the equipment under test was capable of operating over a wider switching range, at the request of the manufacturer, the highest test frequency used for tests covered in this test report was 607.4 MHz.

10.2 Modifications during test

No modifications were made during test by RN Electronics Ltd.

11 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:

Certified equipment - DoC not required.

12 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 G Screened Room (Control Room for Site H)

Site H 3m Semi-anechoic chamber (indoor OATS)
FCC Registration No. 293246
IC Registration No. 5612A-2

Site J Screened Room

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

13 Abbreviations and units

%	Percent	LBT	Listen Before Talk
µA/m	microAmps per metre	LO	Local Oscillator
µV	microVolts	mA	milliAmps
µW	microWatts	max	maximum
AC	Alternating Current	kPa	Kilopascal
ALSE	Absorber Lined Screened Enclosure	Mbit/s	MegaBits per second
AM	Amplitude Modulation	MHz	MegaHertz
Amb	Ambient	mic	Microphone
ATPC	Automatic Transmit Power Control	min	minimum
BER	Bit Error Rate	mm	milliMetres
ºC	Degrees Celsius	ms	milliSeconds
C/I	Carrier / Interferer	mW	milliWatts
CEPT	European Conference of Postal and Telecommunications Administrations	NA	Not Applicable
COFDM	Coherent OFDM	nom	Nominal
CS	Channel Spacing	nW	nanoWatt
CW	Continuous Wave	OATS	Open Area Test Site
dB	deciBels	OFDM	Orthogonal Frequency Division Multiplexing
dBµA/m	deciBels relative to 1µA/m	ppm	Parts per million
dBµV	deciBels relative to 1µV	PRBS	Pseudo Random Bit Sequence
dBc	deciBels relative to Carrier	QAM	Quadrature Amplitude Modulation
dBm	deciBels relative to 1mW	QPSK	Quadrature Phase Shift Keying
DC	Direct Current	R&TTE	Radio and Telecommunication Terminal Equipment
DTA	Digital Transmission Analyser	Ref	Reference
EIRP	Equivalent Isotropic Radiated Power	RF	Radio Frequency
ERP	Effective Radiated Power	RFC	Remote Frequency Control
EU	European Union	RSL	Received Signal Level
EUT	Equipment Under Test	RTP	Room Temperature and Pressure
FM	Frequency Modulation	RTPC	Remote Transmit Power Control
FSK	Frequency Shift Keying	Rx	Receiver
g	Grams	s	Seconds
GHz	GigaHertz	SINAD	Signal to Noise And Distortion
Hz	Hertz	Tx	Transmitter
IF	Intermediate Frequency	V	Volts
kHz	kiloHertz		