EMC Technologies Pty Ltd
ABN 82 057 105 549
176 Harrick Road, Keilor Park
Victoria 3042, Australia

Ph: + 613 9365 1000
Fax: + 613 9331 7455
Email: sales@emctech.com.au

RADIO TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.247)

Test Sample:	Off the ear sound processor
Model:	CP950
FCC ID:	WTO-CP950
Report Number:	M150933-1 Rev 1.0
Tested for:	Cochlear Limited
Issue Date:	23 November 2015

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EMC Technologies Report No.: M150933-1 Rev 1.0

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Contents

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Report Number:	M150933-1 REV 1.0
Test Sample:	Off the ear sound processor
Model:	CP950
FCC ID:	WTO-CP950
Equipment Type:	Intentional Radiator (Transceiver)
Manufacturer:	Cochlear Limited
Address:	1 University Avenue , Macquarie University, NSW 2109, Australia
Phone:	+61 (0)2 9428 6555
Contact:	Sanjay Boppini
Email:	sboppini@cochlear.com
Standards:	**FCC Part 15** – Radio Frequency Devices **FCC Part 15 Subpart C** – Intentional Radiators **Section 15.247** – Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz **ANSI C63.10 – 2009** *American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices* **KDB 558074 D01 v03r03** *Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247*
Test Date:	12th and 17th October 2015
Test Engineer:	**Mahan Ghassempouri** **EMC/EMR/SAR/Wireless Engineer** **M.Sc. in Telecommunication**
Attestation:	*I hereby certify that the device(s) described herein were tested as described in this report and that the data included is that which was obtained during such testing.*
Authorised Signatory:	**Chris Zombolas** **Technical Director** **EMC Technologies Pty Ltd**

RADIO TEST REPORT FOR CERTIFICATION
to
FCC PART 15 Subpart C (Section 15.247)

1.0 INTRODUCTION

Radio testing was performed on the Hearing Assistance Device Model: CP950.

Test results and procedures were performed in accordance with the following Federal Communications Commission (FCC) standards/regulations:

47 CFR, Part 15, Subpart C	**Rules for intentional radiators (particularly section 15.247)**
Section 15.203:	Antenna requirements
Section 15.205:	Restricted bands of operation
Section 15.207:	Conducted Emission Limits
Section 15.209:	Radiated Emission Limits (General requirements)
Section 15.247:	Operation in the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz

The test sample **complied** with the requirements of 47 CFR, Part 15 Subpart C - Section 15.247.

The measurement procedure used was in accordance with ANSI C63.10-2013. The instrumentation conformed to the requirements of ANSI C63.2-2009.

1.1 Summary of Results

FCC Part 15 Subpart C	Test Performed	Results
15.203	Antenna requirement	Complied
15.205	Operation in restricted Band	Complied
15.207	Conducted emissions limits	N/A as the EUT is battery powered
15.209	Radiated emissions limits	Complied
15.247 (a)(2)	Minimum 6 dB Bandwidth	Complied
15.247 (b)(3)	Peak Output Power	Complied
15.247 (c)	Antenna Gain > 6 dBi	N/A as the EUT uses integral antenna with less than 6 dBi gain and no external antenna connector
15.247 (d)	Out of Band Emissions	Complied
15.247 (e)	Peak Power Spectral Density	Complied
15.247 (f)	Hybrid Systems	N/A, assessed to digital modulation requirements
15.247 (g)	Hopping channel application	N/A, assessed to digital modulation requirements
15.247 (h)	Incorporation of intelligence within FHSS	N/A, assessed to digital modulation requirements
15.247 (i)	Radio Frequency Hazard	Complied

N/A: Not Applicable

1.2 Modifications by EMC Technologies

No modifications were required to achieve compliance.

2.0 GENERAL INFORMATION

(Information supplied by the Client)

The device is an off the ear sound processor. The device processes the audio input and provides the data to the implant enabling the recipient to hear. The transceiver allowed programing of the sound processor.

2.1 EUT (Transmitter) Details

The RF transmitter was operating in the 2.4 GHz band. It used an integral antenna. A temporary SMA connector was mounted on the device to provide a means for measuring conducted output power. Transmitter specifications are shown in below table.

Test Sample:	Hearing Assistance Device
Model Number:	CP950
Input Power Supply:	Battery operated 3 VDC
Modulation type:	GFSK
Operating Frequency Range:	2400 MHz to 2483.5 MHz Low Channel: 2402 MHz Middle Channel: 2442 MHz High Channel: 2482 MHz
Nominal Conducted Power:	0 dBm
Nominal Channel Bandwidth:	2 MHz
99% Bandwidth:	1.7 MHz
Maximum Gain of Antenna Assembly:	4 dBi

2.2 EUT (Host) Details

The product was housed in a plastic enclosure approximately 40.9mm(L) x 35.7mm(W) x 11.2mm(H).

2.3 Test Procedure

Radio measurements were performed in accordance with the procedures of ANSI C63.10-2013. KDB 558074 D01 v03r03 - Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247 was used to demonstrate compliance with FCC part 47CFR15.247.

2.4 Test Facility

2.4.1 General

Measurements were performed at EMC Technologies' laboratory in Keilor Park, Victoria Australia. EMC Technologies Pty Ltd is listed by the FCC as a test laboratory able to perform compliance testing for the public. EMC Technologies is listed as an FCC part 47CFR2.948 test lab and may perform the testing required under Parts 15 and 18 – **FCC Registration Number 90560**

EMC Technologies Pty Ltd has also been accredited as a Conformity Assessment Body (CAB) by Australian Communications and Media Authority (ACMA) under the APECTEL MRA and is designated to perform compliance testing on equipment subject to Declaration of Conformity (DoC) and Certification under Parts 15 & 18 of the FCC Commission's rules – **Registration Number 494713 & Designation number AU0001.**

EMC Technologies' indoor open are test site (iOATS) has been accepted by Industry Canada for the performance of radiated measurements in accordance with RSS-Gen Issue 8 - **Industry Canada iOATS number - IC 3569B**

2.4.2 NATA Accreditation

NATA is the Australian National laboratory accreditation body and has accredited EMC Technologies to operate to the IEC/ISO17025 requirements. A major requirement for accreditation is the assessment of the company and its personnel as being technically competent in testing to the standards. This requires fully documented test procedures, continued calibration of all equipment to the National Standard at the National Measurements Institute (NMI), NPL (UK), NIST (USA) and an internal quality system to ISO 9002. NATA has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP) and the American Association for Laboratory Accreditation (A^2LA).

EMC Technologies is accredited in Australia by the National Association of Testing Authorities (NATA). All testing in this report has been conducted in accordance with EMC Technologies' scope of NATA accreditation.

The current full scope of accreditation can be found on the NATA website: www.nata.asn.au

It also includes a large number of emissions, immunity, SAR, EMR and Safety standards.

2.5 Test Equipment Calibration

Measurement instrumentation and transducers were calibrated in accordance with the applicable standards by an independent NATA registered laboratory such as Agilent Technologies (Australia) Pty Ltd, Rohde and Schwarz, NMI, NPL or NIST. All equipment calibration is traceable to Australia national standards at the National Measurements Institute. The reference antenna calibration was performed by NPL and the working antennas (BiLog and horn) calibrated by EMC Technologies. The complete list of test equipment used for the measurements, including calibration dates and traceability is contained in Appendix A

FCC PART 15 Subpart C (Section 15.247)

3.0 ANTENNA REQUIREMENT (§15.203)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

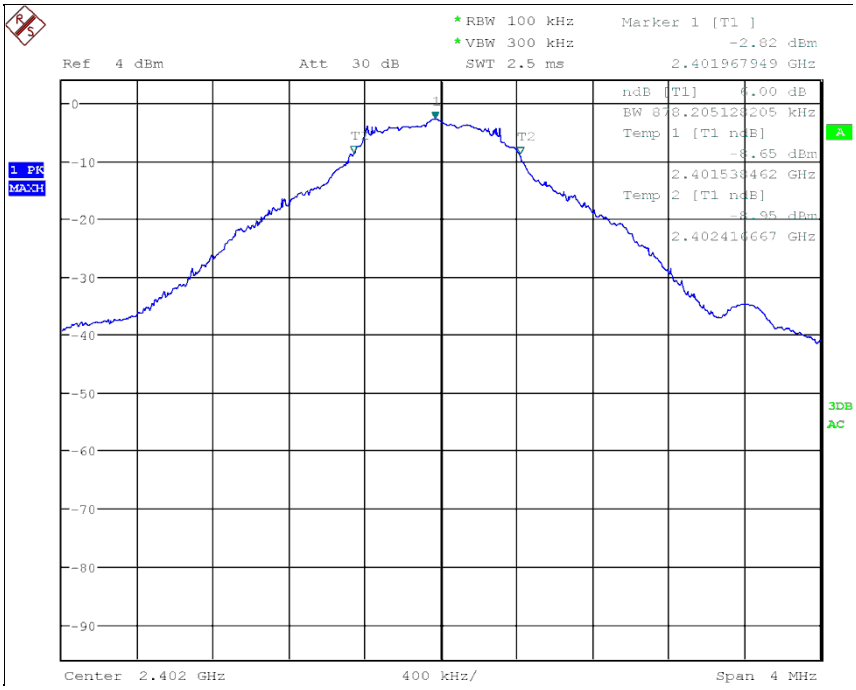
EUT used a permanently attached integral antenna therefore considered sufficient to comply with the provisions of this section. There was no external antenna connector available to the user.

4.0 DTS 6 dB BANDWIDTH (§15.247 (a)(2))

Minimum 6 dB bandwidth shall be at least 500 kHz. Measurements were performed on low, middle and high channel. Care was taken so that the bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

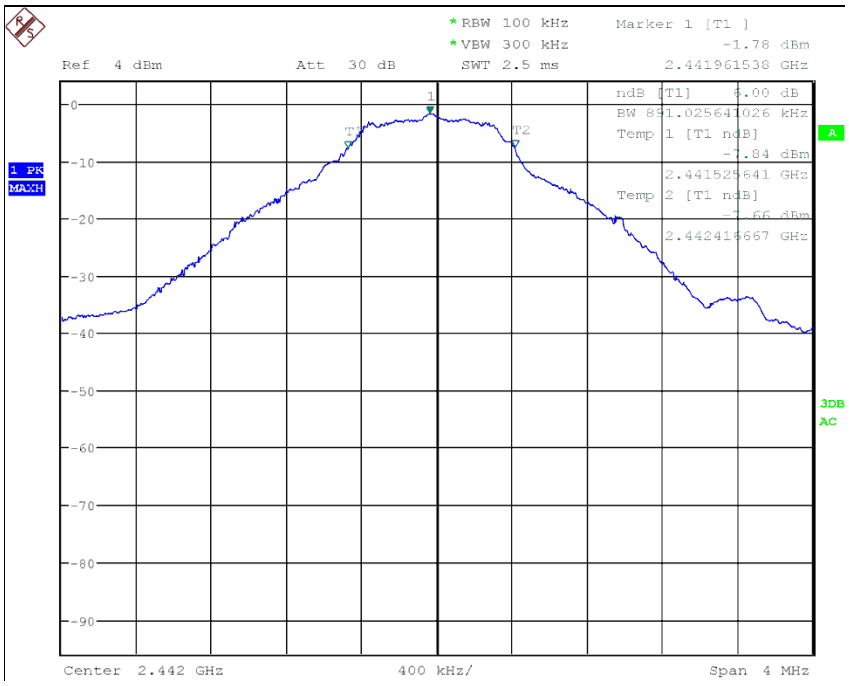
4.1. Results

Measurement results are shown in the following graphs.



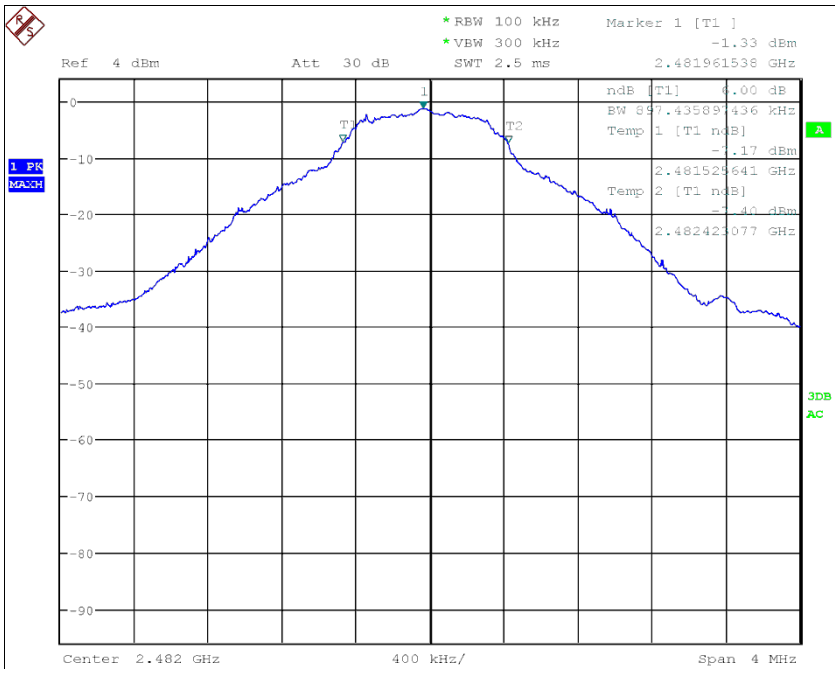
Channel	6 dB Bandwidth (kHz)	Limit (kHz)	Result
Low	878.2	> 500	Pass

Graph 1: 6 dB bandwidth, low channel



Channel	6 dB Bandwidth (MHz)	Limit (kHz)	Result
Middle	891.0	> 500	Pass

Graph 2: 6 dB bandwidth, middle channel



Channel	6 dB Bandwidth (MHz)	Limit (kHz)	Result
High	897.4	>500	Pass

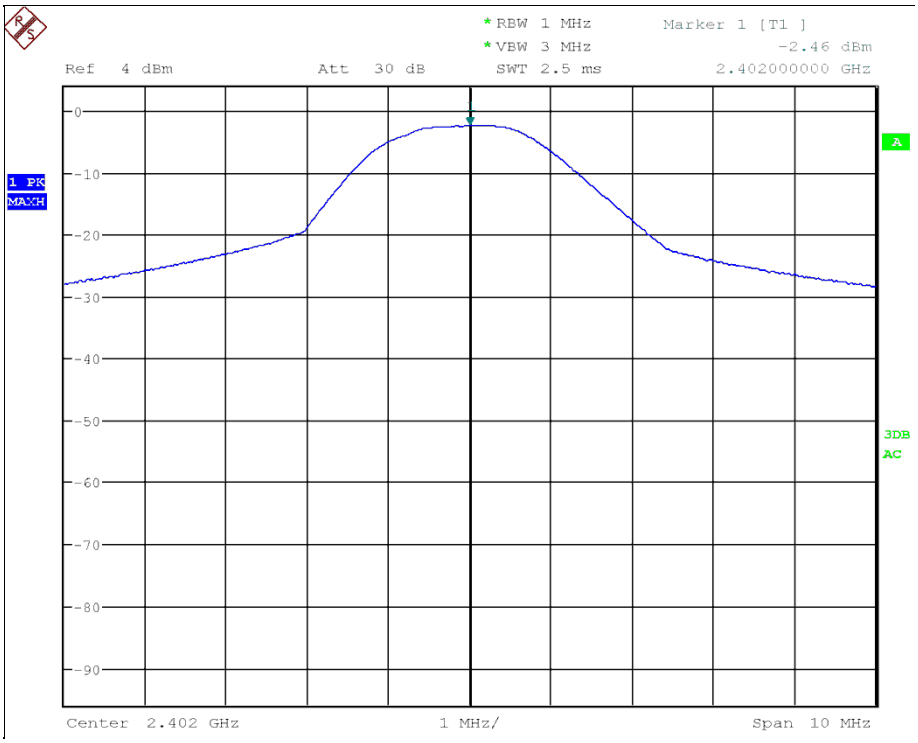
Graph 3: 6 dB bandwidth, high channel

5.0 PEAK OUTPUT POWER (§15.247 (b)(3))

As there was a temporary antenna connector available on the PCB the test was performed using conducted measurement. Maximum peak conducted power method (clause 9.1.1 of KDB 558074 D01 v03r03) was applied. The cable loss between connector and spectrum analyser were accounted for in reading.

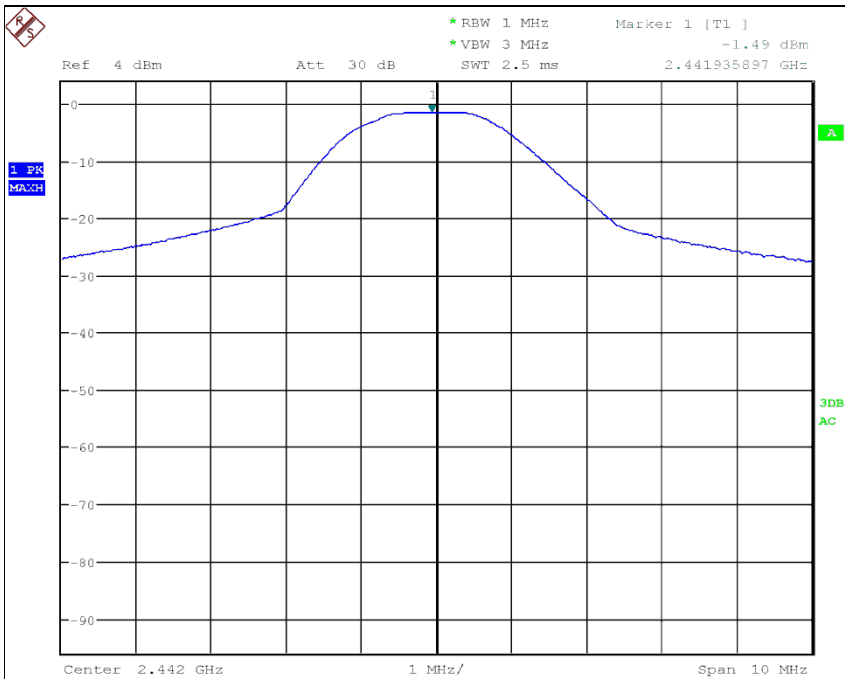
5.1. Results

Measurement results are shown in the following graphs.



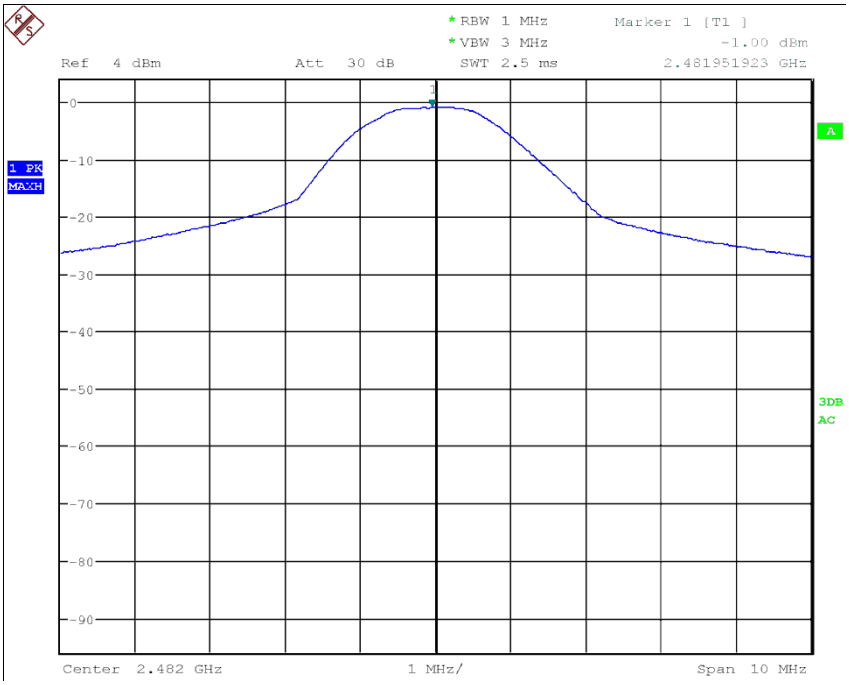
Channel	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Low	-2.46	30	-32.46	Pass

Graph 4: Conducted power, low channel



Channel	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
Middle	-1.49	30	-31.49	Pass

Graph 5: Conducted power, middle channel



Channel	Conducted Power (dBm)	Limit (dBm)	Margin (dB)	Result
High	-1.00	30	-31.00	Pass

Graph 6: Conducted power, high channel

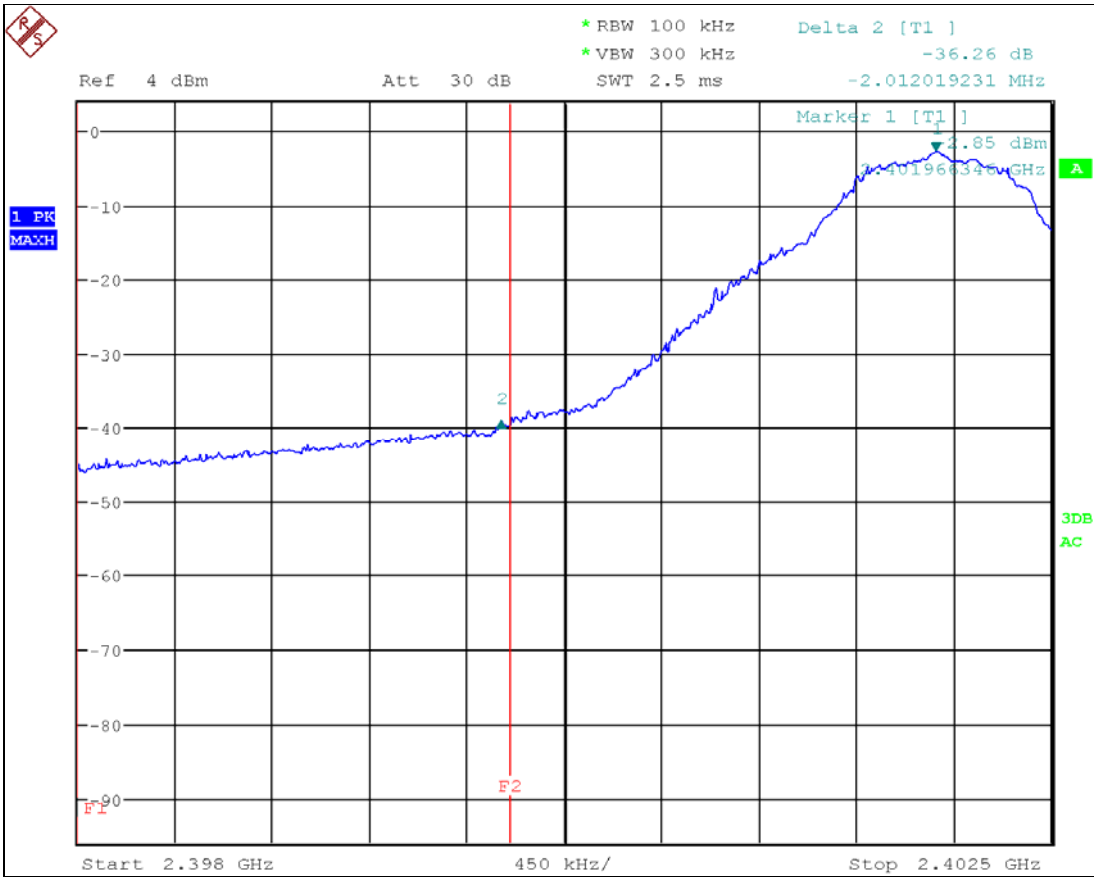
6.0 BAND-EDGE EMISSION MEASUREMENTS

Band edge emission were investigated according to KDB 558074 D01 v03r02 clause 13. Emissions within 2 MHz of an authorized band edge were measured using the marker-delta method (KDB 558074 D01 v03r02 clause 13.2). Results from section 6 of this report were used for in band emission values.

6.1. Results

All emissions above and below the edge of the authorised band were more than 20 dB below the in band intentional emission.

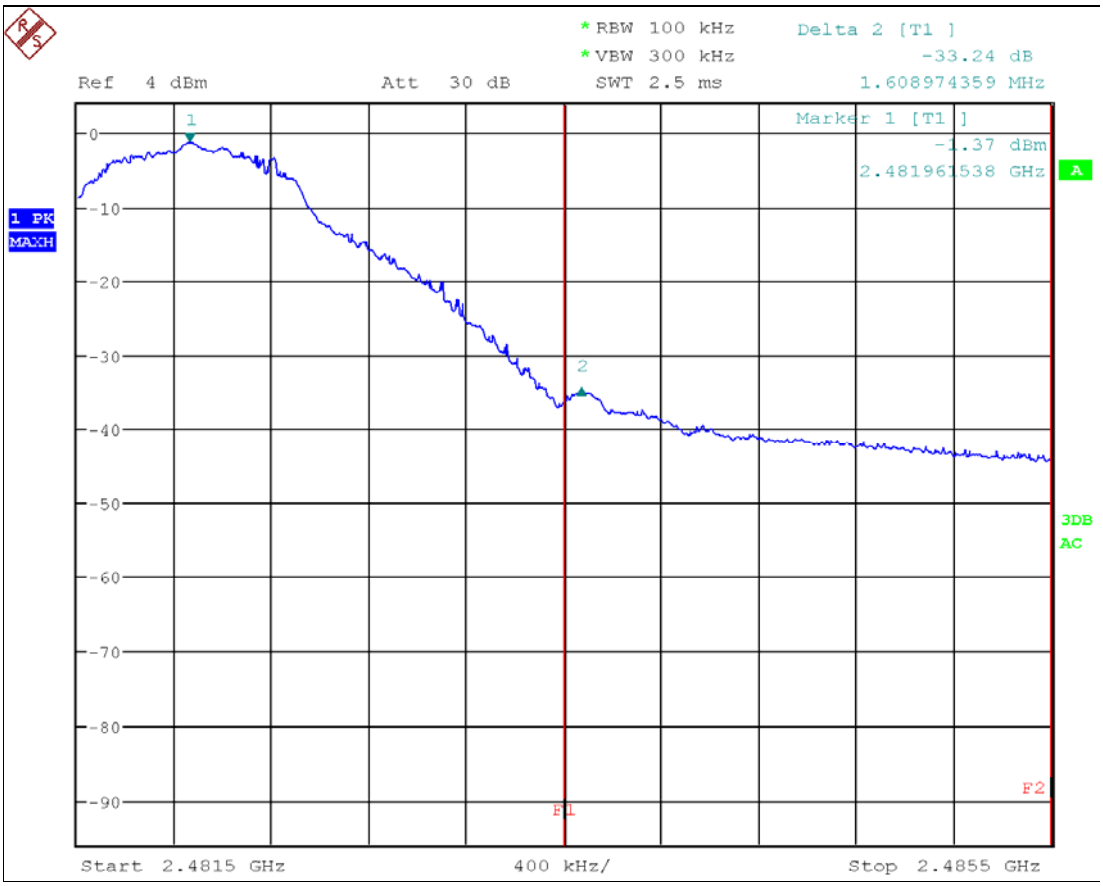
Measurement results are shown in the following graphs.



Vertical marker F1 and F2 were positioned at 2398 MHz and 2400 MHz respectively.

In Band Emission (A) (dBm)	Delta (B) (dB)	Band Edge Emission (A-B) (dBm)	Limit (dBm)	Margin (dB)	Result
-2.46	36.26	-38.72	-22.46	-16.26	Pass

Graph 7: Lower band-edge emissions



Vertical marker F1 and F2 were positioned at 2483.5 MHz and 2485.5 MHz respectively.

In Band Emission (A) (dBm)	Delta (B) (dB)	Band Edge Emission (A-B) (dBm)	Limit (dBm)	Margin (dB)	Result
-1.00	33.24	-34.24	-21.00	-13.24	Pass

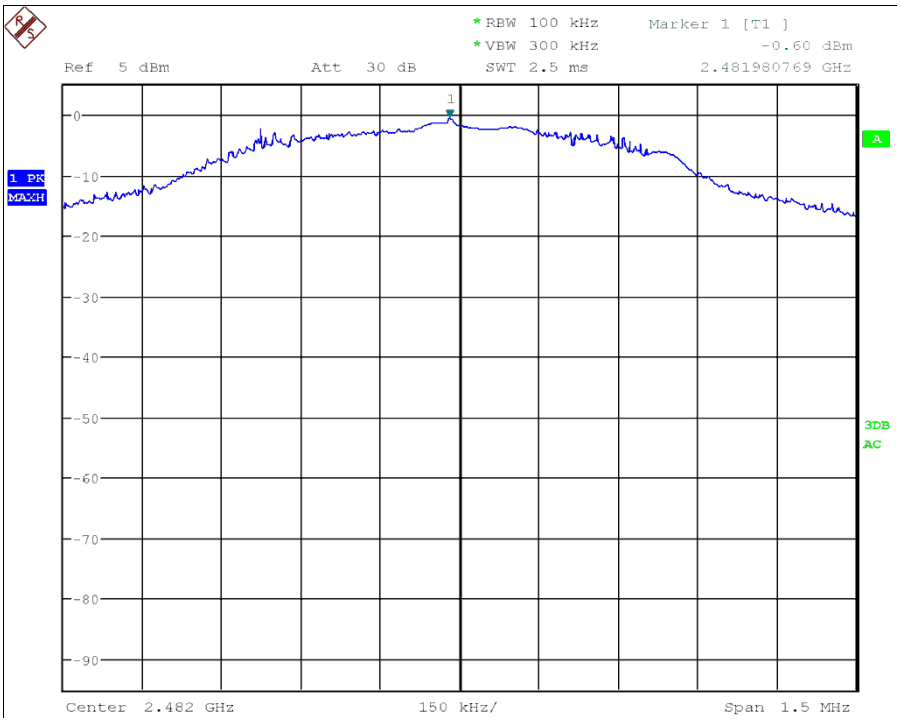
Graph 8: Upper band-edge emissions

7.0 SPURIOUS EMISSION MEASUREMENTS (§15.247 (d))

7.1. Emission in non-restricted bands

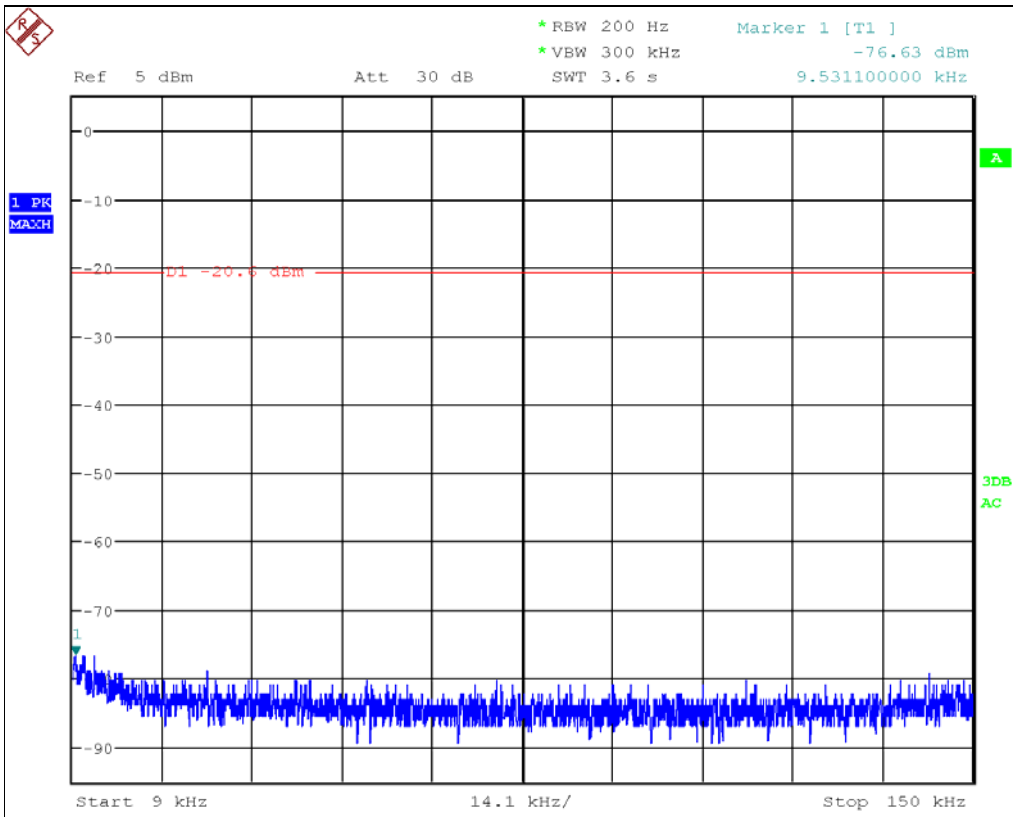
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. Conducted method was used according to clause 11 of KDB 558074 D01 v03r03.

7.1.1. Results

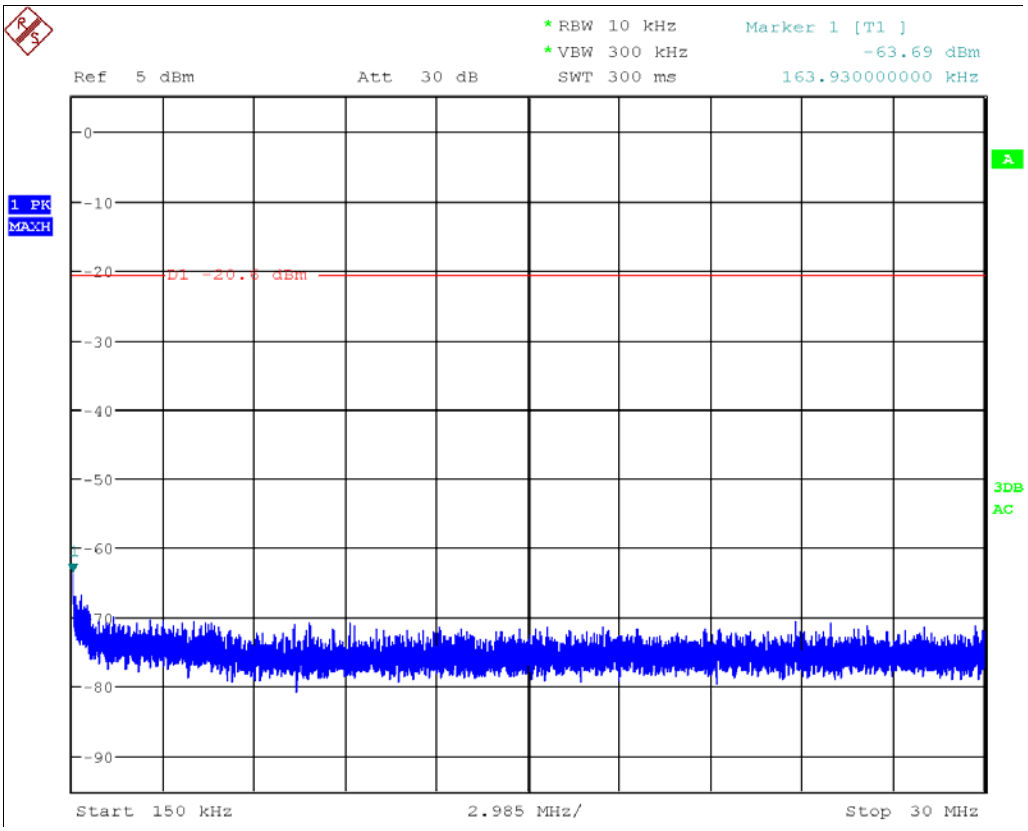


Peak	Frequency (MHz)	SA Reading (dBm)	Spurious Limit (dBm)
1	2481.98	-0.60	-20.60

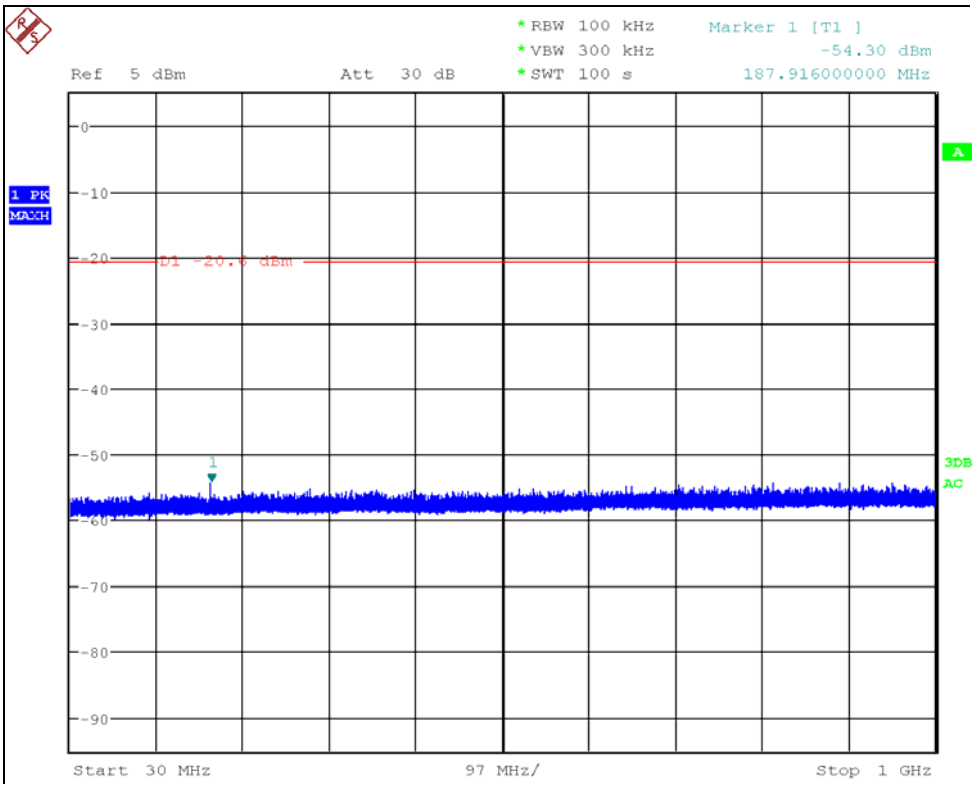
Graph 9: Reference level measurement (in band emission)



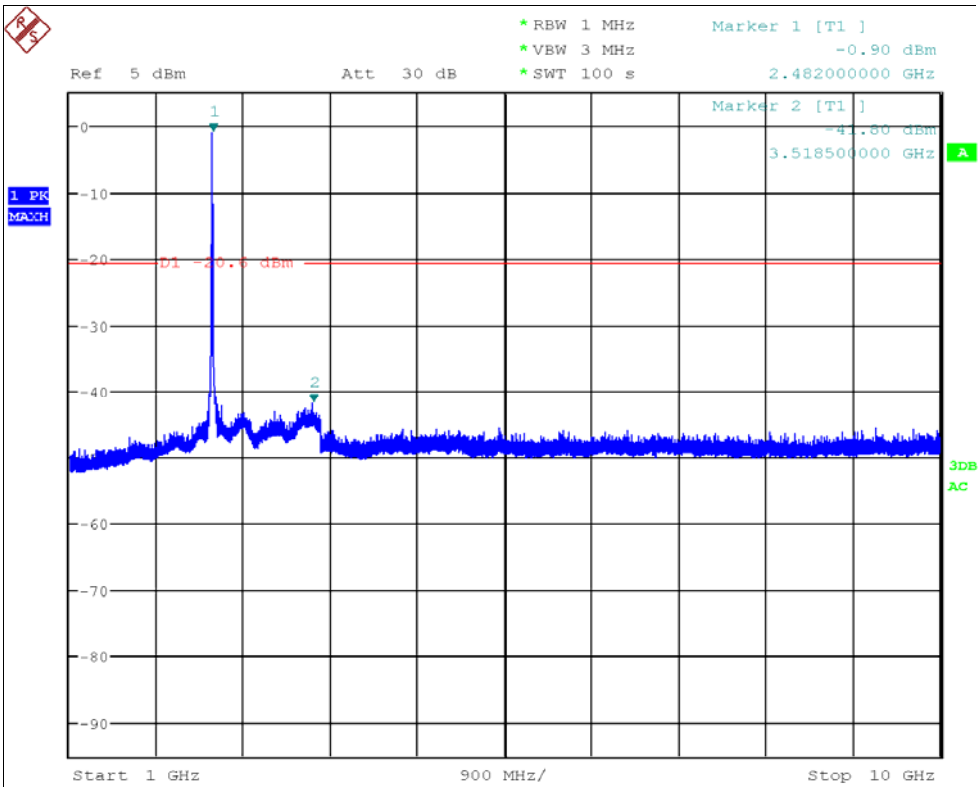
Graph 10: Conducted spurious emissions (non-restricted band), 9 kHz-150 kHz



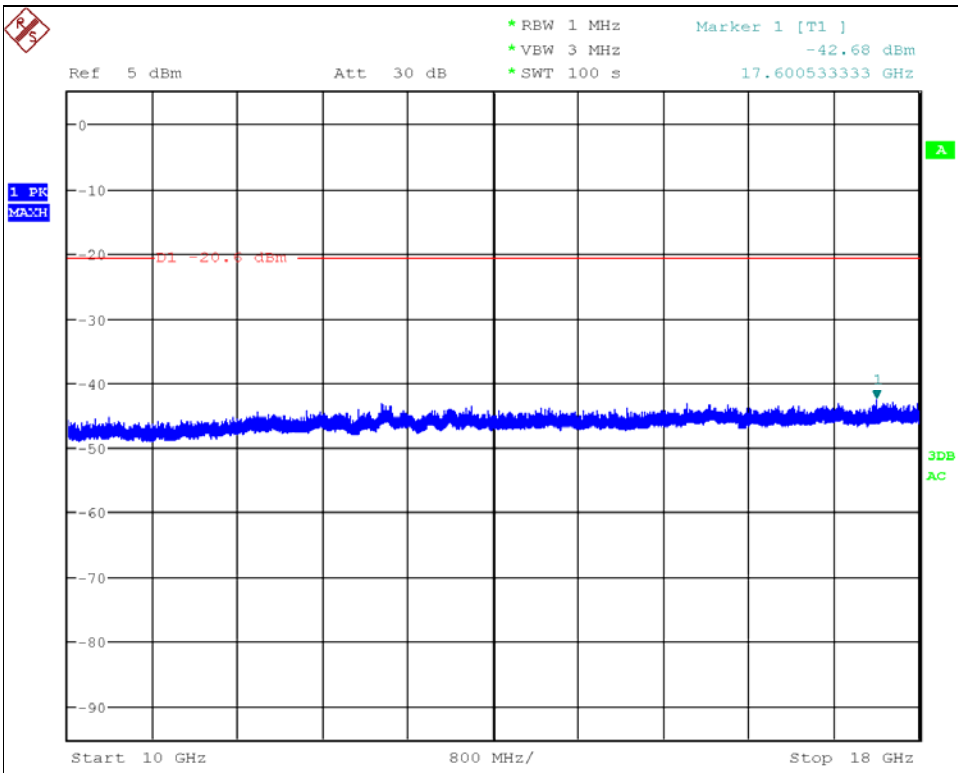
Graph 11: Conducted spurious emissions (non-restricted band), 150 kHz-30 MHz



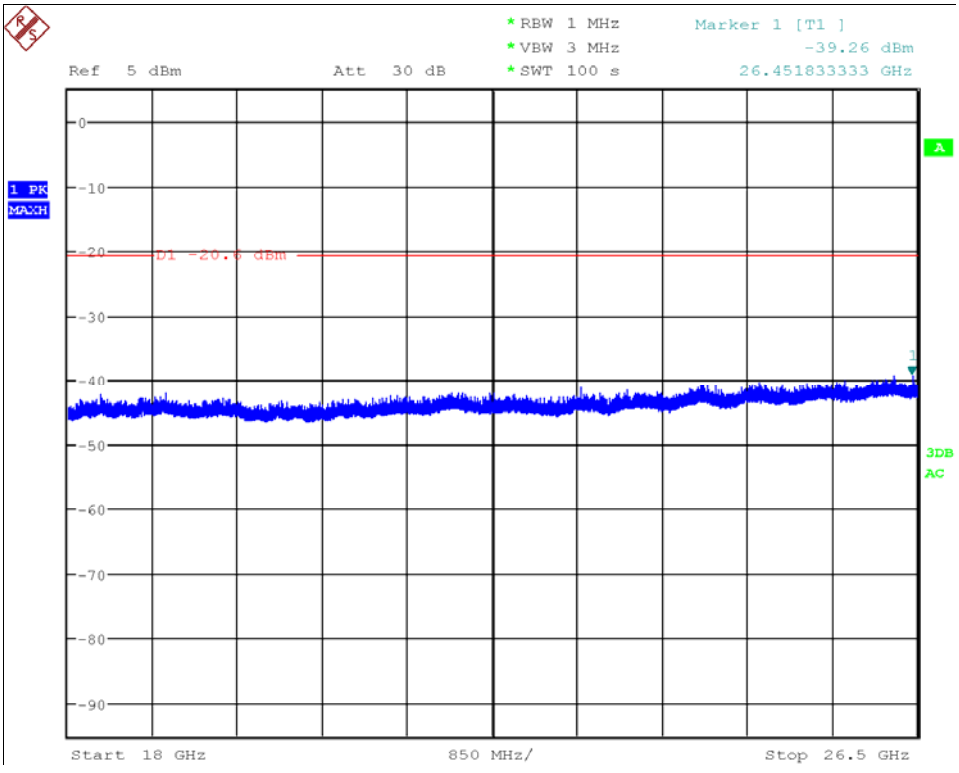
Graph 12: Conducted spurious emissions (non-restricted band), 30 MHz-1 GHz



Graph 13: Conducted spurious emissions (non-restricted band), 1 GHz-10 GHz



Graph 14: Conducted spurious emissions (non-restricted band), 10 GHz-18 GHz



Graph 15: Conducted spurious emissions (non-restricted band), 18 GHz-26.5 GHz

Horizontal line D1 was set to the level 20 dB lower than in band emission (figure 9).

All emissions were more than 20 dB below the maximum in-band emission.

7.2. Emission in restricted bands (radiated)

In order to ensure the compliance to the requirements of emission in restricted bands, radiated measurements were performed. Frequency range of 9 kHz to 26.5 GHz was investigated for any emissions falling in restricted frequency bands. Limits of FCC 15.209 were applied.

For below 1 GHz the EUT was placed 0.8 metres above the floor during the test. For above 1 GHz measurement the EUT was placed 1.5 metres above the floor during the test. The EUT was checked in three orthogonal planes to determine maximum emission, only the worst case is reproduced for the report.

Radiated EMI tests were performed inside a compliant CISPR16-1-4 semi-anechoic chamber for a 2m x 2m x 2m test volume up to 18 GHz, at a test distance of 10, 3 and 1 metres. The EUT was set up on the table top (placed on turntable) of total height 150 cm above the ground plane. The test frequency range was sub-divided into smaller bands with sufficient frequency resolution to permit reliable display and identification of possible EMI peaks while also permitting fast frequency scan times. A calibrated loop antenna was used for measurements between 9 kHz and 30 MHz. A calibrated Biconilog antenna was used for measurements between 30 MHz and 1000 MHz. Calibrated EMCO 3160 and EMCO 3160 standard gain horn antennas were used for measurements between 1 to 26.5 GHz.

The measurement of emissions between 30 - 1000 MHz was measured with the resolution bandwidth of 120 kHz and the video bandwidth of 300 kHz.

The measurement of emissions above 1000 MHz was measured using a following setting:
Peak measurements setting: RBW = VBW = 1 MHz
Average measurements setting: RBW = 1 MHz and VBW = 10 Hz

The receiver bandwidth was set to 6 dB.

The EUT was slowly rotated with the Peak Detector set to Max-Hold. This was performed for two antenna heights. When an emission was located, it was positively identified and its maximum level found by rotating the automated turntable and by varying the antenna height. The procedure was repeated with the device orientated in three orthogonal axis to further maximise the emission.

Each significant peak was investigated with the Quasi-peak, Peak or Average Detectors as appropriate. The measurement data for each frequency range was corrected for cable losses, antenna factors and preamplifier gain. This process was performed for both horizontal and vertical antenna polarisations.

The field strength was calculated automatically by the software using all the pre-stored calibration data. The method of calculation is shown below:

E = V + AF - G + L
Where:

E	=	Radiated Field Strength in dBµV/m.
V	=	EMI Receiver Voltage in dBµV. (measured value)
AF	=	Antenna Factor in dB. (stored as a data array)
G	=	Preamplifier Gain in dB. (stored as a data array)
L	=	Cable loss in dB. (stored as a data array of Insertion Loss versus frequency)

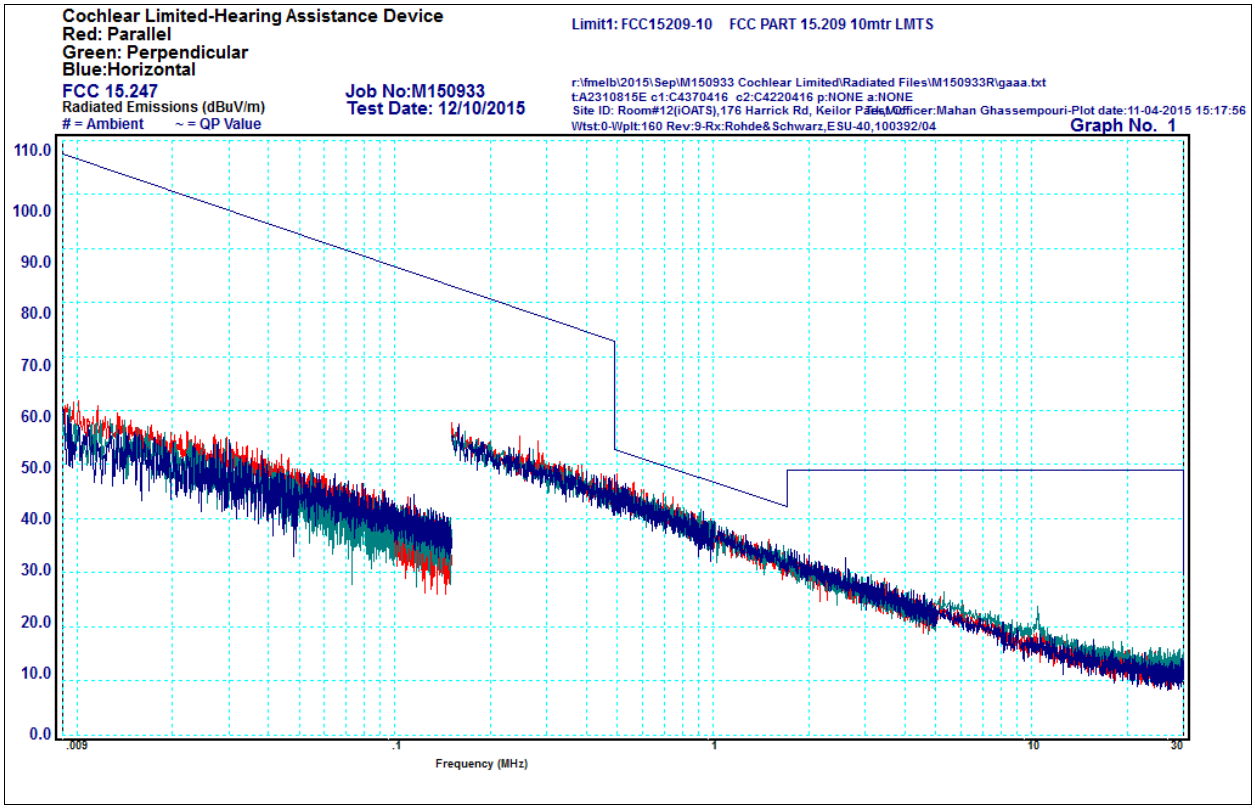
- **Example Field Strength Calculation**

Assuming a receiver reading of 34.0 dBµV is obtained at 90 MHz, the Antenna Factor at that frequency is 9.2 dB. The cable loss is 1.9 dB while the preamplifier gain is 20 dB. The resulting Field Strength is therefore as follows:

34.0 + 9.2 + 1.9 - 20 = 25.1 dBµV/m

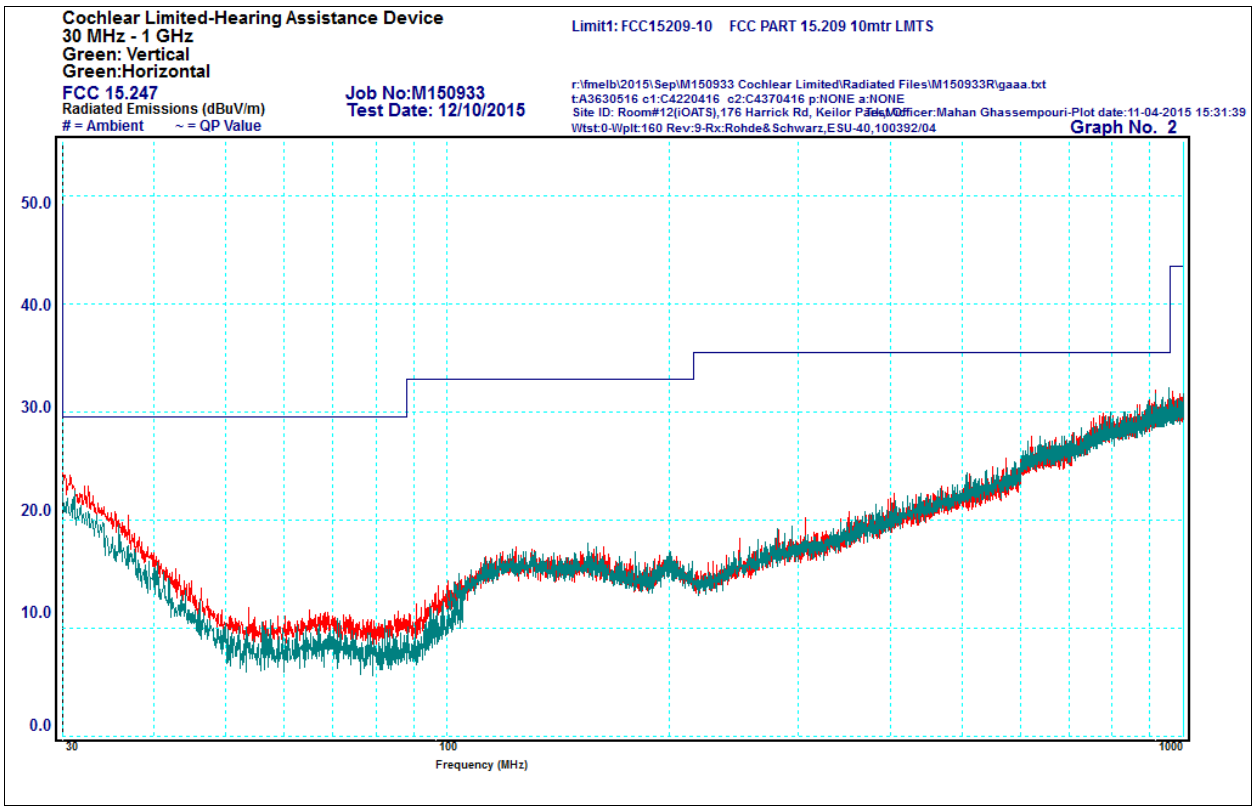
7.2.1. Results

The §15.209 limits were applied across the frequency range 9 kHz to 26.5 GHz. As no emissions exceeded the general requirements the relaxed limits of §15.247 (d) outside the bands were complied with.



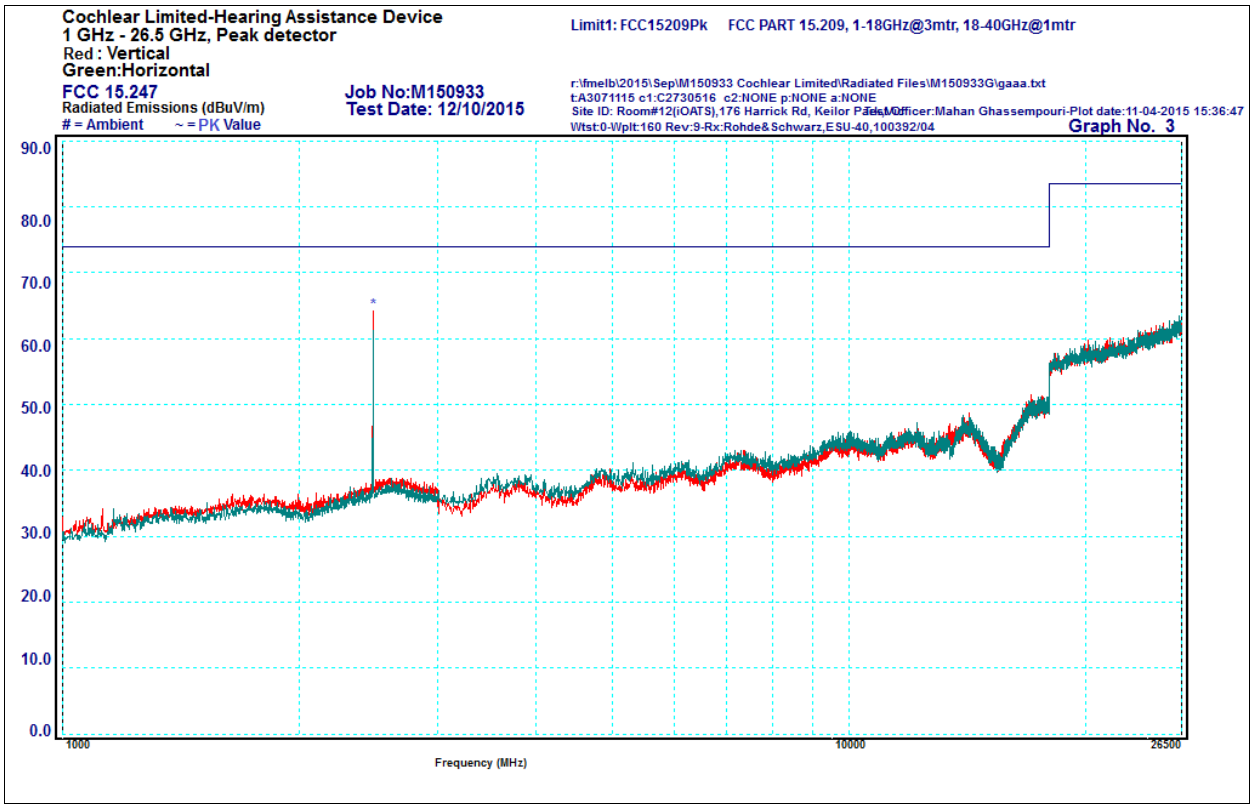
No emissions from the EUT were detected above the system noise floor.

Graph 16: Radiated emission, 9 kHz-30 MHz, loop antenna



No emissions from the EUT were detected above the system noise floor.

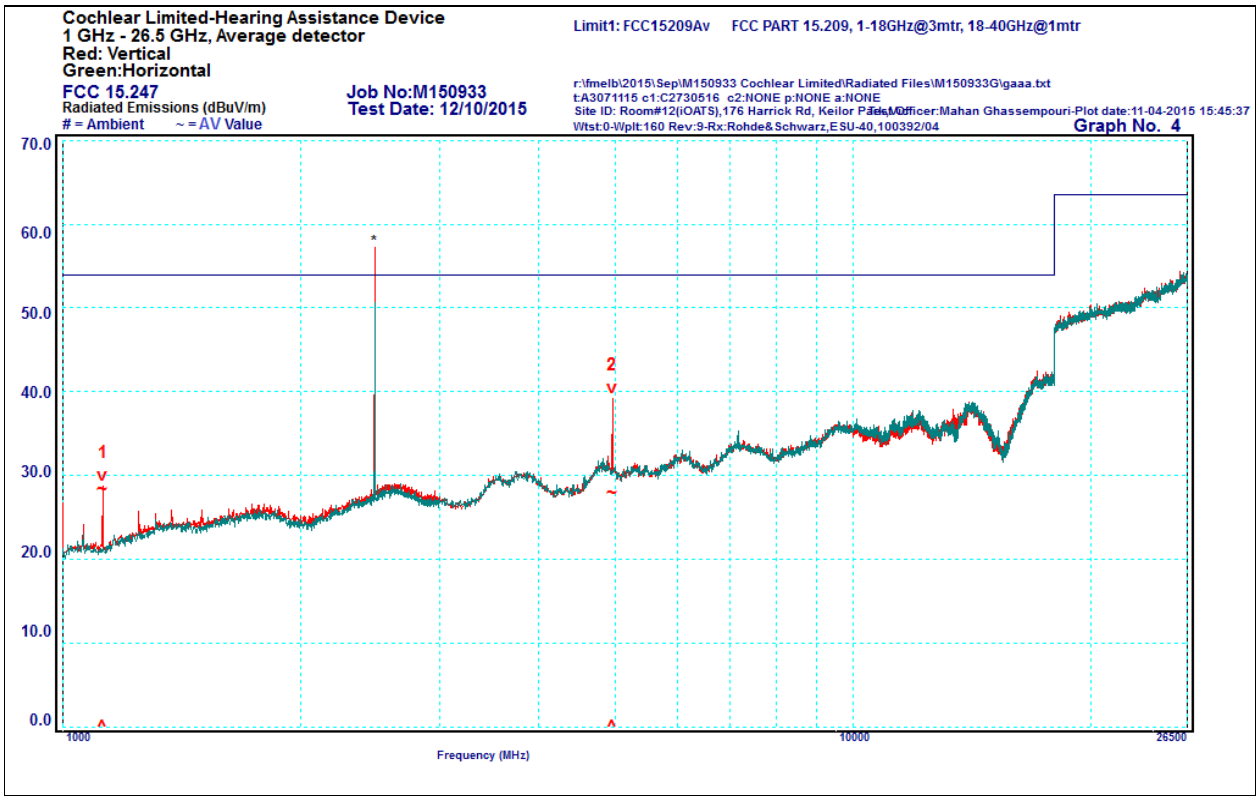
Graph 17: 30 MHz – 1 GHz, radiated emissions in restricted bands



No emissions from the EUT were detected above the system noise floor.

Note: Intentional radiation is excluded from measurement

Graph 18: 1 GHz – 26.5 GHz, radiated emissions in restricted bands, peak detector



Peak	Frequency MHz	Measured AV Level dBµV/m	AV Limit dBµV/m	ΔAV ±dB
1	1125.07	28.3	54.0	-25.7
2	4956.61	27.9	54.0	-26.1

Graph 19: 1 GHz – 26.5 GHz, radiated emissions in restricted bands, average detector

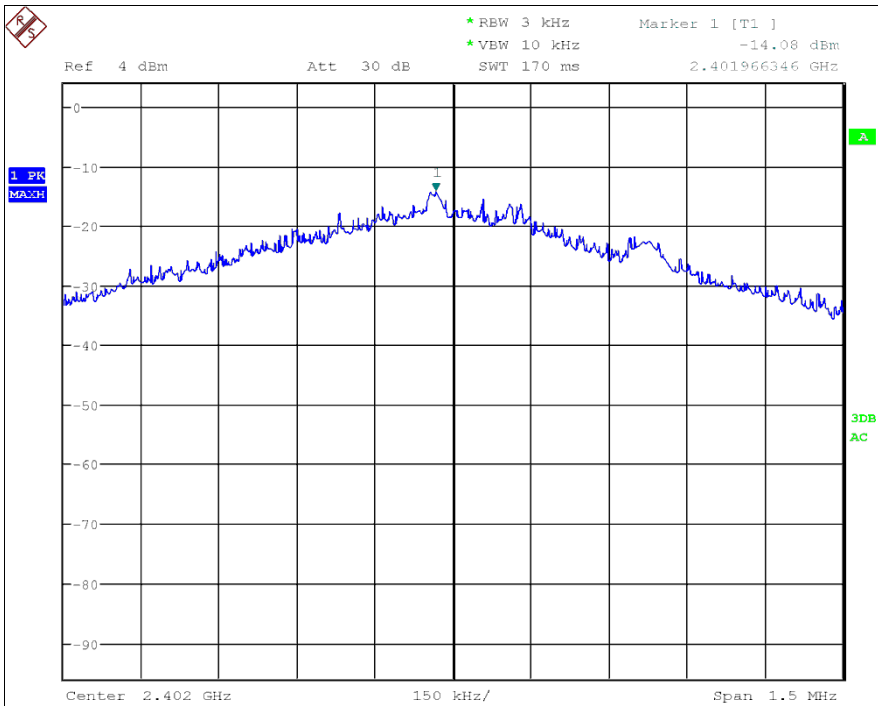
Note: Intentional radiation is excluded from measurement

8.0 POWER SPECTRAL DENSITY (§15.247 (d))

The PKPSD method according to KDB 558074 D01 v03r03 was used to demonstrate compliance.

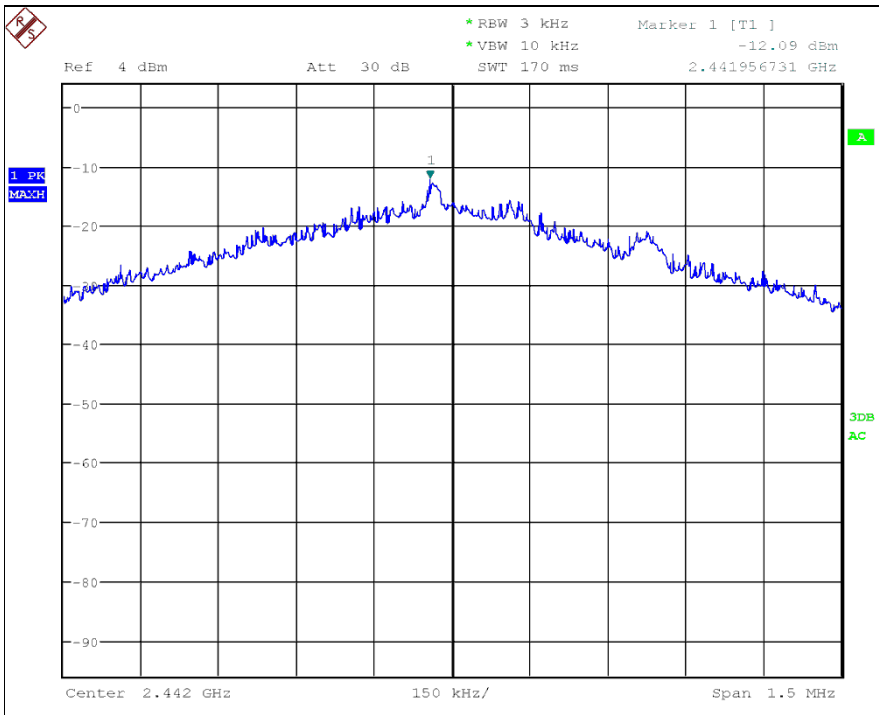
8.1. Results

Measurement results are shown in the following graphs.



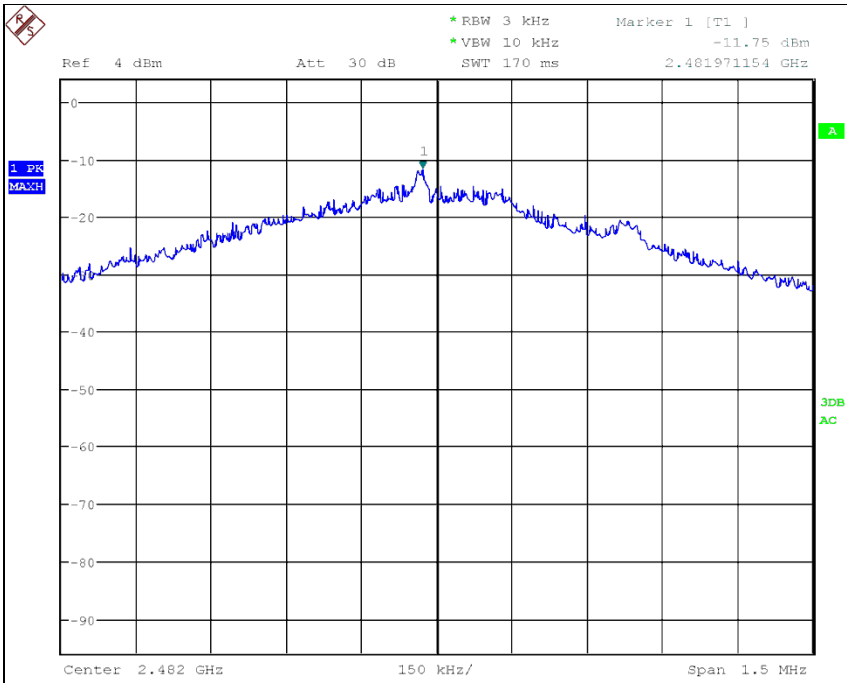
Channel	Peak PSD (dBm/3 kHz)	Limit (dBm)	Margin (dB)	Result
Low	-14.08	8	-22.08	Pass

Graph 18: Transmitter peak power spectral density, low channel



Channel	Peak PSD (dBm/3 kHz)	Limit (dBm)	Margin (dB)	Result
Middle	-12.09	8	-20.09	Pass

Graph 19: Transmitter peak power spectral density, middle channel



Channel	Peak PSD (dBm/3 kHz)	Limit (dBm)	Margin (dB)	Result
High	-11.75	8	-19.75	Pass

Graph 20: Transmitter peak power spectral density, high channel

9.0 RADIO FREQUENCY EXPOSURE (HAZARD) (§15.247 (i))

The EUT met the general public/uncontrolled exposure limits of §11310. Refer to EMC Technologies test report No. M150934-3.

10.0 COMPLIANCE STATEMENT

Off the ear sound processor, Model: CP950 tested on behalf of Cochlear Limited, **complied** with the requirements of 47 CFR, Part 15 Subpart C - Rules for Radio Frequency Devices (intentional radiators), Section 15.247 - Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

Summary of results are shown in below table:

FCC Part 15 Subpart C	Test Performed	Results
15.203	Antenna requirement	Complied
15.205	Operation in restricted Band	Complied
15.207	Conducted emissions limits	N/A as the EUT is battery powered
15.209	Radiated emissions limits	Complied
15.247 (a)(2)	Minimum 6 dB bandwidth	Complied
15.247 (b)(3)	Peak output power	Complied
15.247 (c)	Antenna gain > 6 dBi	N/A as the EUT uses integral antenna with less than 6 dBi gain and there is no external antenna connector
15.247 (d)	Out of band emissions	Complied
15.247 (e)	Peak power spectral density	Complied
15.247 (f)	Hybrid systems	N/A as the EUT uses digital modulation
15.247 (g)	Hopping channel application	N/A as the EUT uses digital modulation
15.247 (h)	Incorporation of intelligence within FHSS	N/A as the EUT uses digital modulation
15.247 (i)	Radio Frequency Hazard	Complied

11.0 MEASUREMENT UNCERTAINTY

EMC Technologies has evaluated the equipment and the methods used to perform the emissions testing. The estimated measurement uncertainty for emissions tests shown within this report are as follows:

Conducted Emissions:	9 kHz to 30 MHz	±3.2 dB
Radiated Emissions:	9 kHz to 30 MHz	±4.1 dB
	30 MHz to 300 MHz	±5.1 dB
	300 MHz to 1000 MHz	±4.7 dB
	1 GHz to 18 GHz	±4.6 dB
	18 GHz to 26 GHz	±5.1 dB
Peak Output Power:		±1.5 dB
Peak Power Spectral Density:		±1.5 dB

The above expanded uncertainties are based on standard uncertainties multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

APPENDIX A
MEASUREMENT INSTRUMENT DETAILS

Equipment Type	Make/Model/Serial Number	Last Cal. dd/mm/yy	Due Date dd/mm/yy	Cal. Interval
Chamber	Frankonia SAC-10-2 (R-139)	8/1/2015	8/1/2016	1 Year, *1
EMI Receiver	R&S ESU40 20 Hz – 40 GHz Sn: 100392 (R-140)	09/10/2014	09/10/2015	1 Year, *2
	R&S ESU40 20 Hz – 40 GHz Sn: 100182 (R-037)	12/02/2015	12/02/2016	1 Year, *2
	HP 8546A Sn: 3549A00290 (R-009)	02/10/2014	02/10/2015	1 Year, *2
Antennas	EMCO 6502 Active Loop A-231 9kHz-30MHz Sn. 9311-2801	20/07/2015	20/07/2018	3 Year, *2
	SUNOL JB6 BICONILOG 30 – 6000 MHz Sn. A012312 (A-363)	16/05/2014	16/05/2016	2 Year, *2
	EMCO 3115 Broadband Horn 1 – 18 GHz Sn. 8908-3282 (A-004)	09/05/2013	09/05/2016	3 Year, *1
	ETS-Lindgren Horn 3160-09 18-26.5 GHz Sn. 66032 (A-307)	12/11/2012	12/11/2015	3 Year, *1
	ETS-Lindgren Horn 3160-10 26.5-40 GHz Sn. 66032 (A-306)	12/11/2012	12/11/2015	3 Year, *1

Note *1. Internal NATA calibration.
Note *2. External NATA / A2LA calibration