

FCC RF Test Report
as per

RSS-247 Issue 2
&
FCC Part 15 Subpart 15.247
on the

Zigbee Module - ZBM1502

Prepared to:

Sinope Technologies Inc.

705 montrichard St-Jean-sur-richelieu
J2X5K8 Quebec, Canada



Product Service

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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Test Specialist	Jose Martinez-Ortega	11-09-2019	
Test Specialist	Abdoulaye Ndiaye	11-09-2019	
Authorised Signatory	Scott Drysdale	11-09-2019	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

EXECUTIVE SUMMARY

A sample of this product was tested and found to be in compliance with FCC Part 15 Subpart 15.247 and RSS-247 Issue 2.

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2972 Joseph-A-Bombardier
Laval, QC H7P 6E3 Canada

TÜV SÜD Ltd is a
TÜV SÜD Group Company

Phone: +450-687-4976
www.tuv-sud.ca



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1 Report Summary

1.1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	September 11 th , 2019
2	Revision 1	October 15 th , 2019

Table 1 – Modification Records

1.1.2 Acronyms & Definitions

The following definitions and acronyms are applicable in this report. See also ANSI C63.14.

Acronyms

AM	Amplitude Modulation
ASCE	Antenna Spurious Conducted Emissions
EIRP	Equivalent Isotropical Radiated Power
ETSI	European Telecommunications Standards Institute
EUT	Equipment Under Test
N/A	Not Applicable
OOB	Out of Band
OQPSK	Offset Quadrature Phase-Shift Keying
OSDI	Open Smart Device Interface
PKPSD	Peak Power Spectrum Density
QP	Quasi-Peak
RBW	Reading Bandwidth
RF	Radio Frequency of oscillation rate of electromagnetic fields (e.g. radio waves: 9kHz to 300GHz)
RMS	Root mean square, i.e., $V_p / \sqrt{2}$
Rx	Referred as antennae for receiving RF signals
SD	Spurious Domain
TR	Technical Report
Tx	Referred as antennae for transmitting RF signals
VBW	Visual Bandwidth
Vp	Peak Voltage



EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.



2 Introduction

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations Section 15.247 and Innovation Science and Economic Development Canada's Radio Standards Specification RSS-247 for the test documented herein.

Manufacturer:	Sinope Technologies Inc.
Name:	Zigbee Module: ZBM1502
Number of Samples Tested:	2
Test Specification/Issue/Date:	RSS-247 Issue 2 : February 2017 FCC Part 15 Subpart 15.247
Test Plan/Issue/Date:	N/A
Order Number:	7169006203
Date:	2019-06-27
Date of Receipt of EUT:	2019-05-27
Start of Test:	2019-08-01
Finish of Test:	2019-08-09
Name of Tester(s):	Jose Martinez-Ortega Abdoulaye Ndiaye
Related Documents:	ANSI C63.10:2013 ISO/IEC 17025:2005



2.1.1 Brief Summary of Results

A brief summary of the tests carried out in accordance with RSS-247 Issue 1 & FCC Part 15 Subpart 15.247 is summarized in Table 2.

Report Section	FCC 47 CFR Rule Part	ISED Canada's Rule	Description	Class/Limit/ Detector	Result	Remark
-	§15.203 & §15.204	-----	Antenna Requirement	N/A	N/A	See Note 1
-	§15.207	RSS-GEN 8.8	AC- Power Conducted Emissions	N/A	N/A	See Note 2
6	§ 15.205. § 15 209(a)	§RSS-GEN 8.9,8.10	Radiated Spurious Emission	QP	Pass	Worst-case scenario
7	§15.247(a)(2)	§RSS-247 5.2(a)	6dB Bandwidth	>500kHz	Pass	-
8	§15.247(b)(3)	§RSS-247 5.4(d)	Peak Output Power	< 1W	Pass	-
9	15.247(e)	§RSS-247 5.2(2)	Power Spectral Density	< 8 dBm (3 kHz BW)	Pass	-
10	§15.247(d)	§RSS-247 5.5	Band-Edge Compliance of RF Conducted Emissions	≤ 20dBc	Pass	-

Note 1: Manufacture uses a permanently attached antenna for unique coupling to the intentional radiator.
Note 2: EUT contains no means for connection directly or indirectly to AC mains and it is powered by battery only.

Table 2 – Test Summary Table



2.1.2 Declaration of Build Status

This report addresses the EMC verification testing and test results of the Zigbee Module: ZBM1502, and is herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:

RSS-247 Issue 2:2017
FCC Part 15 Subpart C 15.247:2016

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

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For a more detailed list of the standards and the revision used, see the "Applicable Standards, Specifications and Methods" section of this report.

2.1.3 Notes, Justification

The following justifications for tests not performed or deviations from the above listed specifications apply:

The following notes, justifications for tests not performed or deviations from the above listed specifications apply:

For the Antenna requirement specified in FCC 15.203 (RSS-247 section 5.5), the unit uses a PCB trace antenna, with a 2.3dBi gain.

For the Restricted Bands of operation, the EUT is designed to operate only between: 2400 – 2483.5 MHz.

The EUT is not a hybrid system and FCC 15.247 (f) does not apply to it. However, the 15.247 (d) requirement of power density were met and are detailed later in this test report.

For the scope of this test report, the EUT was mounted in three orthogonal axes to maximize emissions. Worst case results are presented.



3 Click or tap here to enter text. **EUT: Zigbee Module: ZBM1502**

3.1.1 Specifications:

PRODUCT NAME:	Zigbee Module: ZBM1502
MANUFACT URER:	Sinope Technologies Inc.
Model	ZBM1502
TUV NUMBER:	437710
PART NUMBER:	N/A
Frequency Range (MHz)	2405-2480
Channel Numbers	11-26 [16]
Data Rate	25kB/s
Modulation Type	OQPSK
VOLTAGE RATING:	3.3Vdc
Gain	2.3dBi

Table 3 – EUT – Zigbee Module – Specifications

Level	Channel	Frequency
Lower	11	2.405
	12	2.410
	13	2.415
	14	2.420
	15	2.425
	16	2.430
	17	2.435
Middle	18	2.440
	19	2.445
	20	2.450
	21	2.455
	22	2.460
	23	2.465
	24	2.470
High	25	2.475
	26	2.480

Table 4 – EUT – Zigbee Module – Frequency of Operations



3.1.2 Modes of Operation

The Zigbee Module: ZBM1502 Module is a Zigbee card operating in the 2.4 GHz bands with frequencies as depicted in Table 4. For operation it uses the IEEE 802.15.4 Zigbee wideband modulation.

The worst case of Tx / Rx – emissions were guaranteed by parsing the command of SetPower 20, which set all channels to 20dBm power level.

4 Deviations from the Standard

No deviations from the applicable test standard were made during testing.

5 Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2. For instance, for the range of 30MHz – 1GHz and 1GHz – 18GHz is $\pm 4.25\text{dB}$ and $\pm 4.93\text{dB}$, respectively with a 'k=2' coverage factor and a 95% confidence level.

Uncertainties on quantities measured shall be according to Table 5

Parameter	Uncertainty
Occupied channel Bandwidth	$\pm 5\%$
RF output power, conducted	$\pm 1.5\text{dB}$
Power Spectral Density, conducted	$\pm 3\text{dB}$
Unwanted Emission, conducted	$\pm 3\text{dB}$
All emission, radiated	$\pm 6\text{dB}$
Temperature	$\pm 3^{\circ}\text{C}$
Supply Voltages	$\pm 3\%$
Time	$\pm 3\%$

Table 5 Acceptable Uncertainties



6 Radiated Spurious Emission

6.1.1 Purpose & Method

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference. The method is as defined in Section 12.2 of FCC KDB 558074 and ANSI C63.10.

The limits, as defined in 15.247(d) for unintentional radiated emissions, apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

All unintentional emissions must also meet the 'Spurious Conducted Emissions' requirements of -20 dBc or greater. See also '[Antenna Spurious Conducted Emissions](#)' for further details.

Frequency	Limit
0.009 MHz – 0.490 MHz	2400/F(kHz) uV/m at 300m ¹
0.490 MHz – 1.705 MHz	24000/F(kHz) uV/m at 30m ¹
1.705 MHz – 30 MHz	30 uV/m at 30m ¹
30 MHz – 88 MHz	100 uV/m (40.0 dBuV/m) at 3m (¹)
88 MHz – 216 MHz	150 uV/m (43.5 dBuV/m) at 3m (¹)
216 MHz – 960 MHz	200 uV/m (46.0 dBuV/m) at 3m (¹)
Above 960 MHz	500 uV/m (54.0 dBuV/m) at 3m (¹)
Above 1000 MHz	500 uV/m (54 dBuV/m) at 3m (²)
Above 1000 MHz	500 uV/m (74 dBuV/m) at 3m (³)
¹ Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1	
² Limit is with 1 MHz measurement bandwidth and using an Average detector	
³ Limit is with 1 MHz measurement bandwidth and using a Peak detector	

Table 6 Limits – Radiated Spurious Emission

Based on ANSI C63.10, clause 11.11, if the Peak detector measurements do not exceed the Quasi-Peak limits, where defined, then the EUT is deemed to have passed the requirements.



6.1.2 Test Specifications

REFERENCE	FCC Section : §15.205
STANDARD	FCC Section : §15.209
	ISED Canada : RSS-GEN 8.9. 8.10
	ANSI C63.10 Clause 5.5, 5.6 and 11.11

SPECIFICATIONS

Limit (dB) <20

Frequencies (MHz) 2405
2440
2470

RBW (kHz): 120

VBW (kHz) 300

EUT

Identification Zigbee Module: ZBM1502

Voltage Input 3.3Vdc

ENVIROMENTAL & TEST INFO

Test Date
(YYYY-MM-DD) 2019-08-06

Temperature (°C) 22 ± 2

Humidity (%) 61 ± 5

Atmospheric Pressure
kPa (For Info Only) 99.9

Tester Jose Martinez-Ortega

Client Witness No witness



6.1.3 Test Setup

The EUT was configured to transmit at 100% duty cycle during testing. No duty cycle correction was applied to the average measurements for the correct average results.

As per ANSI C63.10 Clause 6.3.1, below 1GHz, the height of the EUT was set to 80cm. Above 1GHz, the height was raised to 1.5m.

6.1.4 Results

The EUT passed. Low, medium, and high bands were tested. The worst-case are only presented. Final measurements are given in [Appendix A](#).

Channel	Frequency Range (MHz)	Frequency (MHz)	Polarization	Detector	Limit	Margin	Results
#11	0.009 – 0.015	-	-	-	See Table 6	Note 1	Pass
	30 – 1000	47.96	Vertical	Peak		7.5	Pass
	>1000	-	-	-		Note 1	Pass
#18	0.009 – 0.015	-	-	-		Note 1	Pass
	30 – 2000	-	-	-		Note 1	Pass
	2000-3000	-	-	-		Note 1	Pass
	3000-26000	5182.28	Vertical	Peak		2.3	Pass
#25	0.009 – 0.015	-	-	-		Note 1	Pass
	30 – 2000	-	--			Note 1	Pass
	2000-3000	-	Vertical	Average		1.9	Pass
	>3000	-	-	-		Note 1	Pass
Note 1: No significant emission, i.e., 10dB below the limit was noted							

Table 7 – Test Results for Radiated Spurious Emission – Worst Cases

6.1.4.1 Graphs

The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector over a full 0-360°. This peaking process is done as a worst-case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, please refer to the tables under Final Measurements.

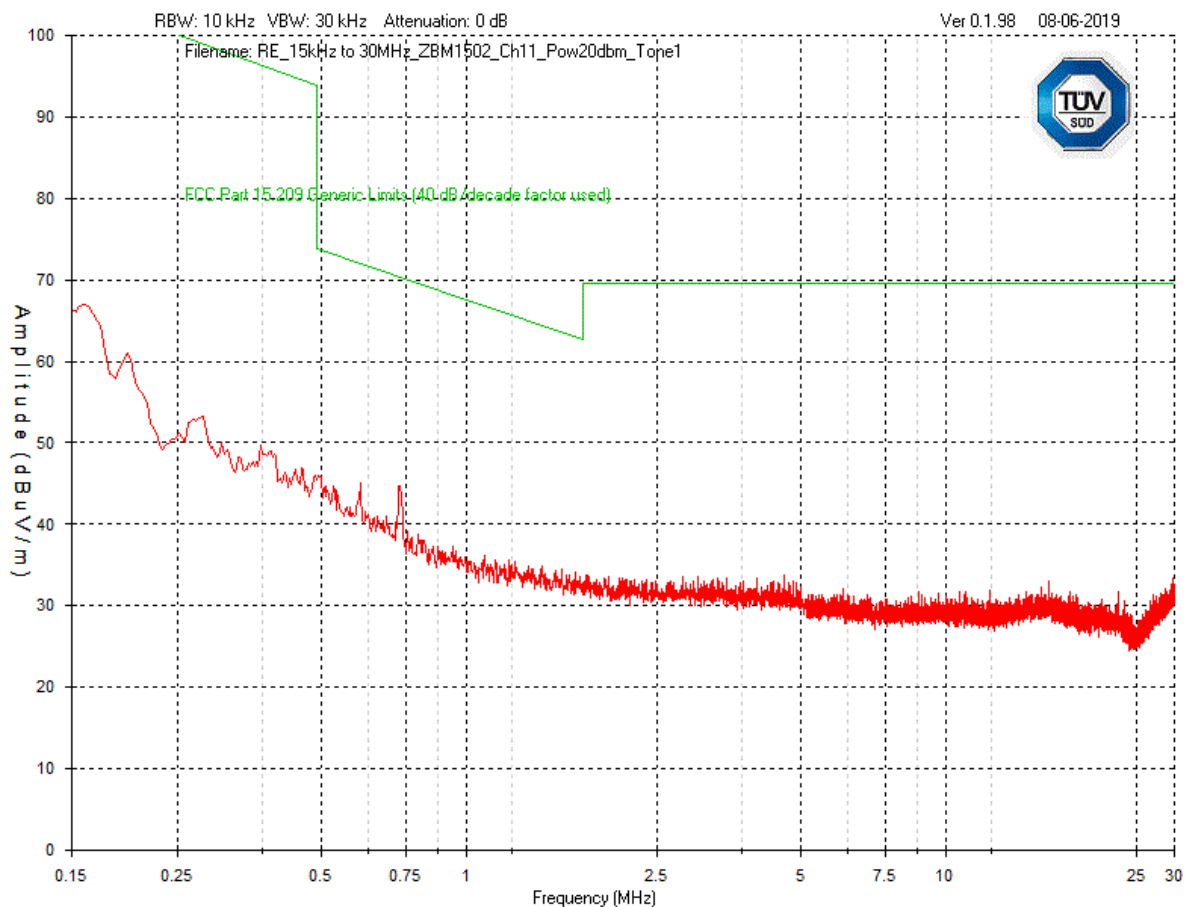


In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic (a minimum of 24.835 GHz).

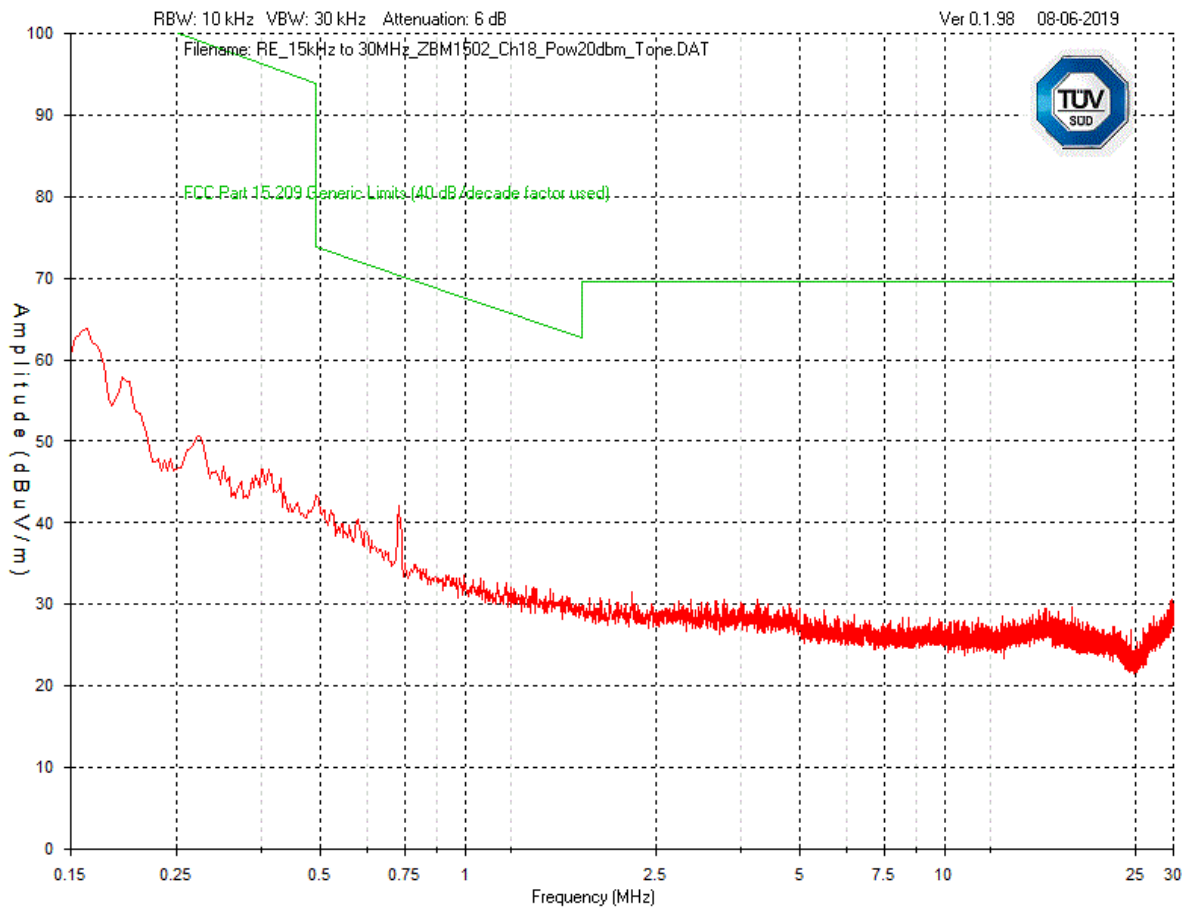
Devices scanned may be scanned at alternate test distances and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example, for 1-meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m / 3m) is applied.

Low, middle and high channels, each in three orthogonal axes were tested. However, the worst-case graphs are presented.

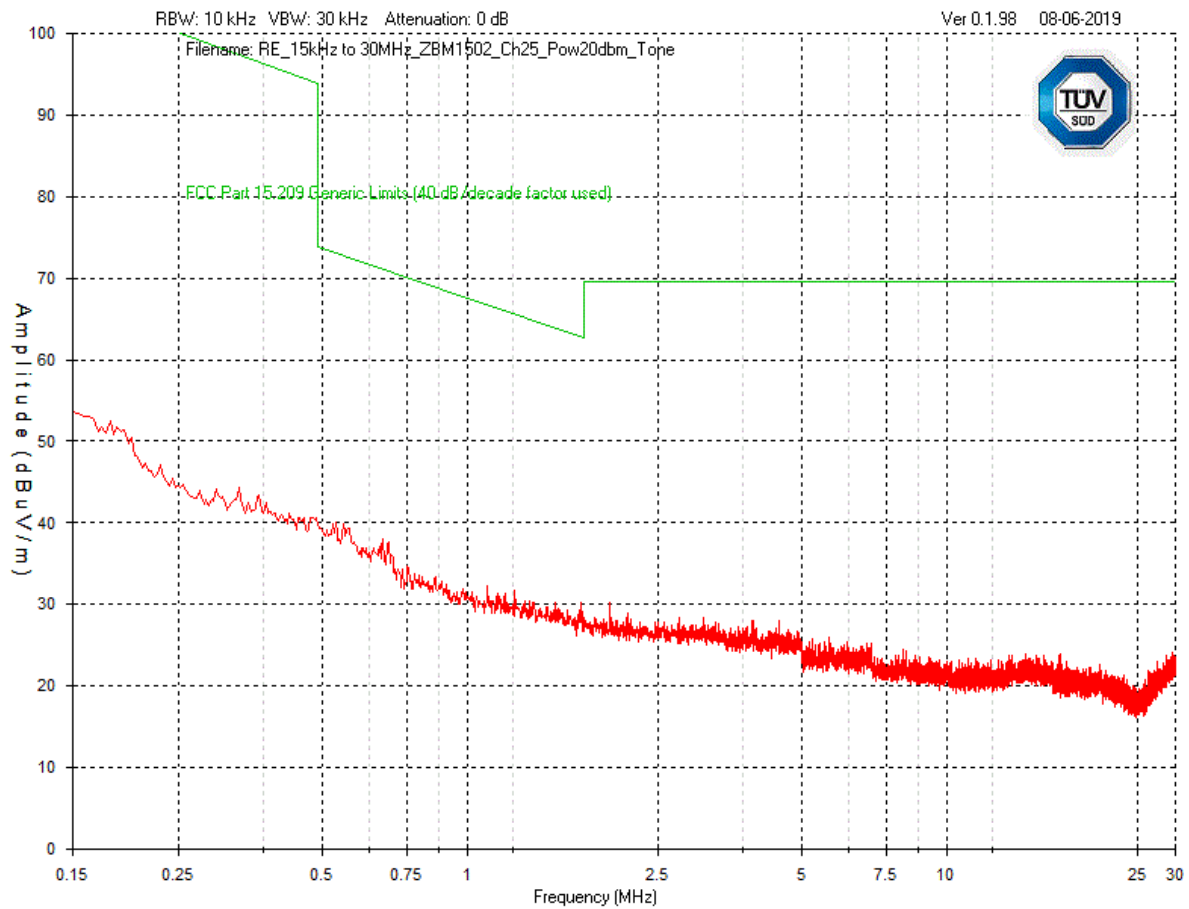
6.1.4.1.1 Frequency range from 15kHz to 30MHz



Graphs 1: Tx Spurious emission 15kHz – 30MHz: Channel 11



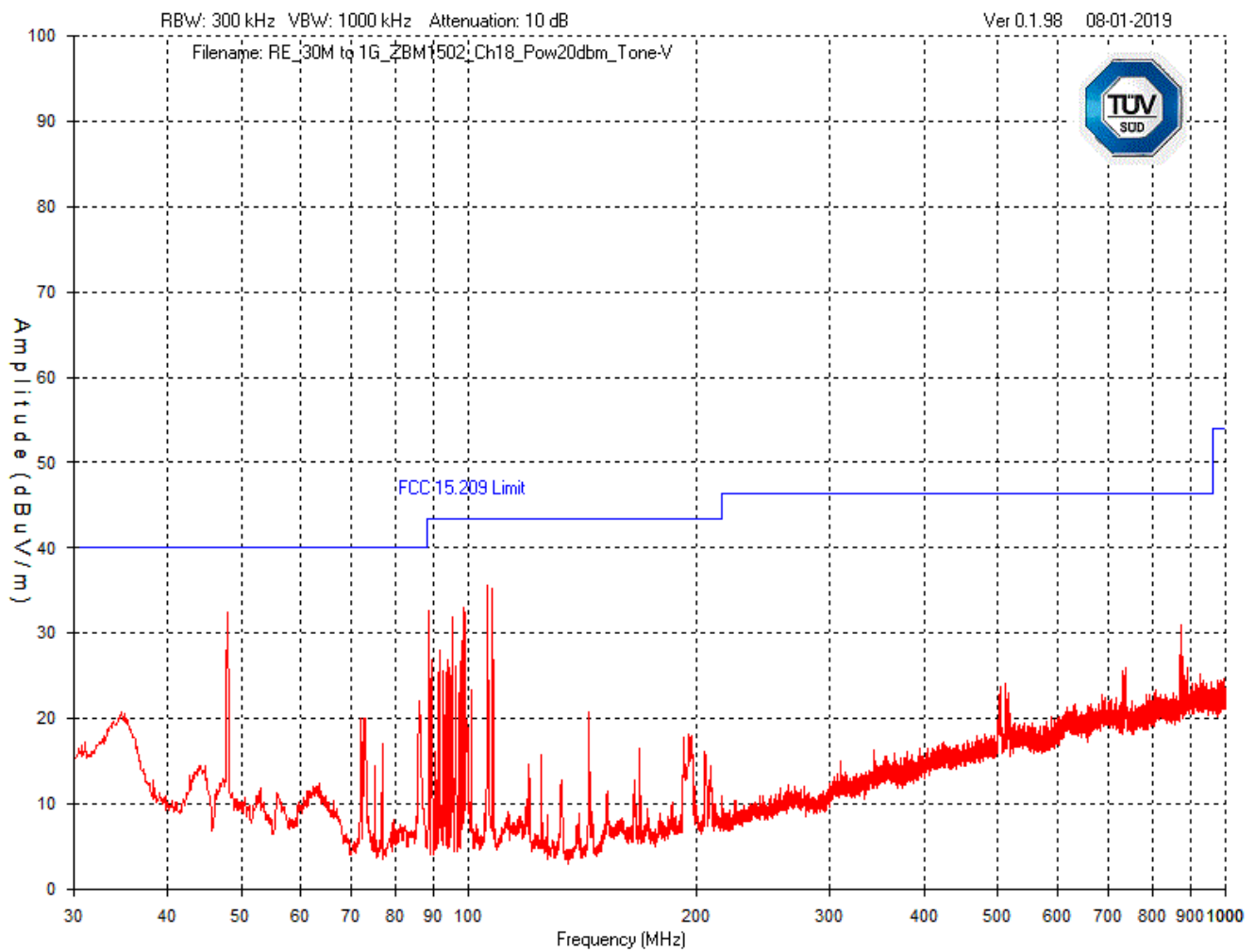
Graphs 2: Tx Spurious emission 15kHz – 30MHz: Channel 18



Graphs 3: Tx Spurious emission 15kHz – 30MHz: Channel 25



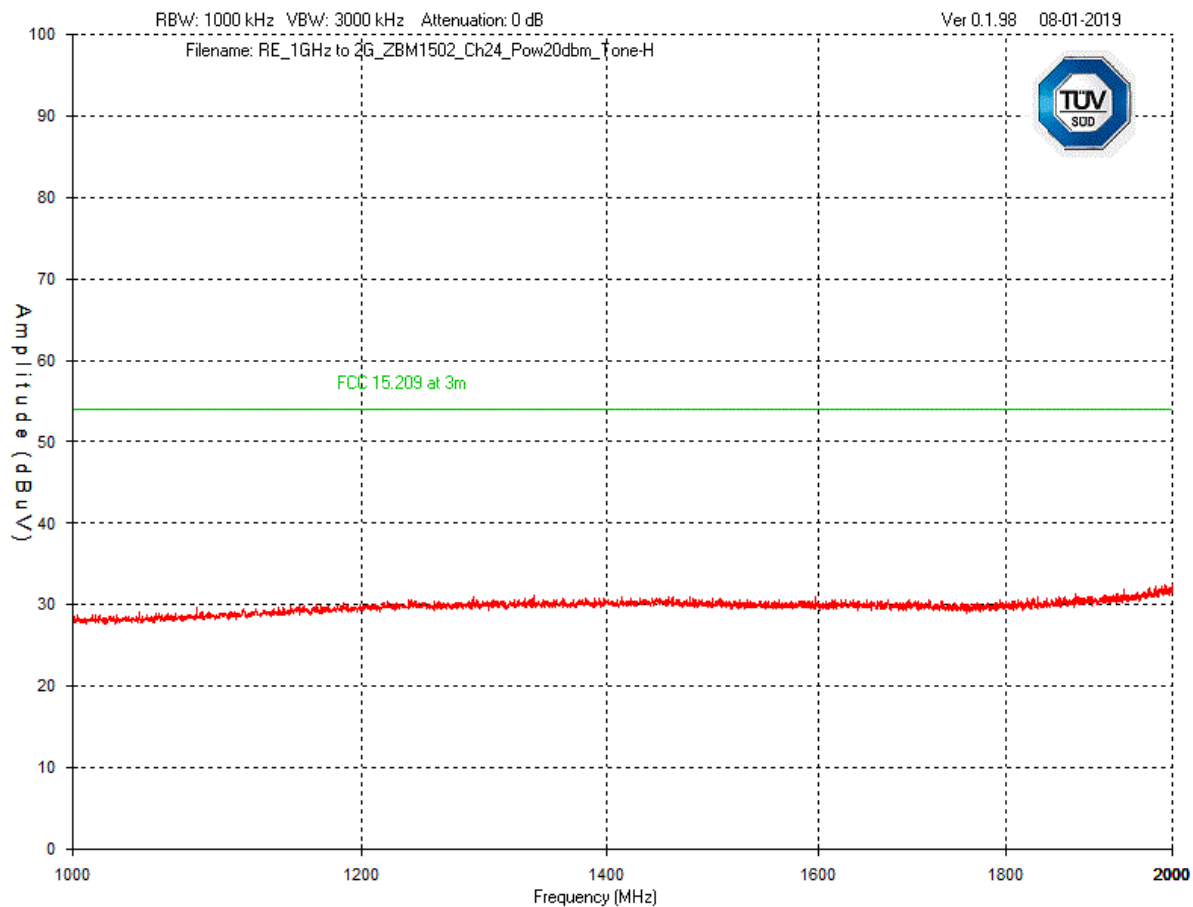
6.1.4.1.2 Frequency Range from 30MHz to 1GHz – Worst case – Channel 18



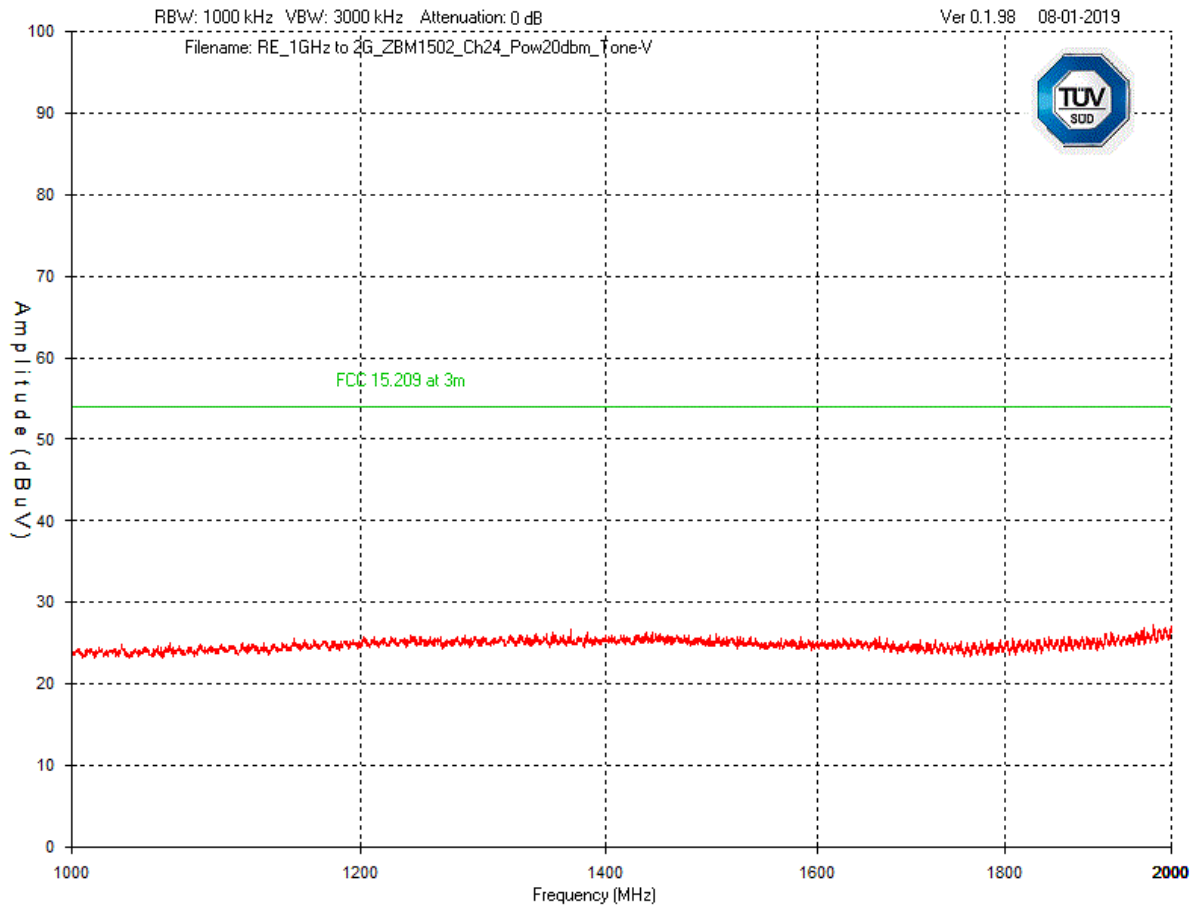
Graphs 4: Tx Spurious Emission 30MHz – 1GHz (Vertical Polarization): Channel 18



6.1.4.1.3 Frequency Range from 1GHz to 2GHz – Worst case – Channel 24



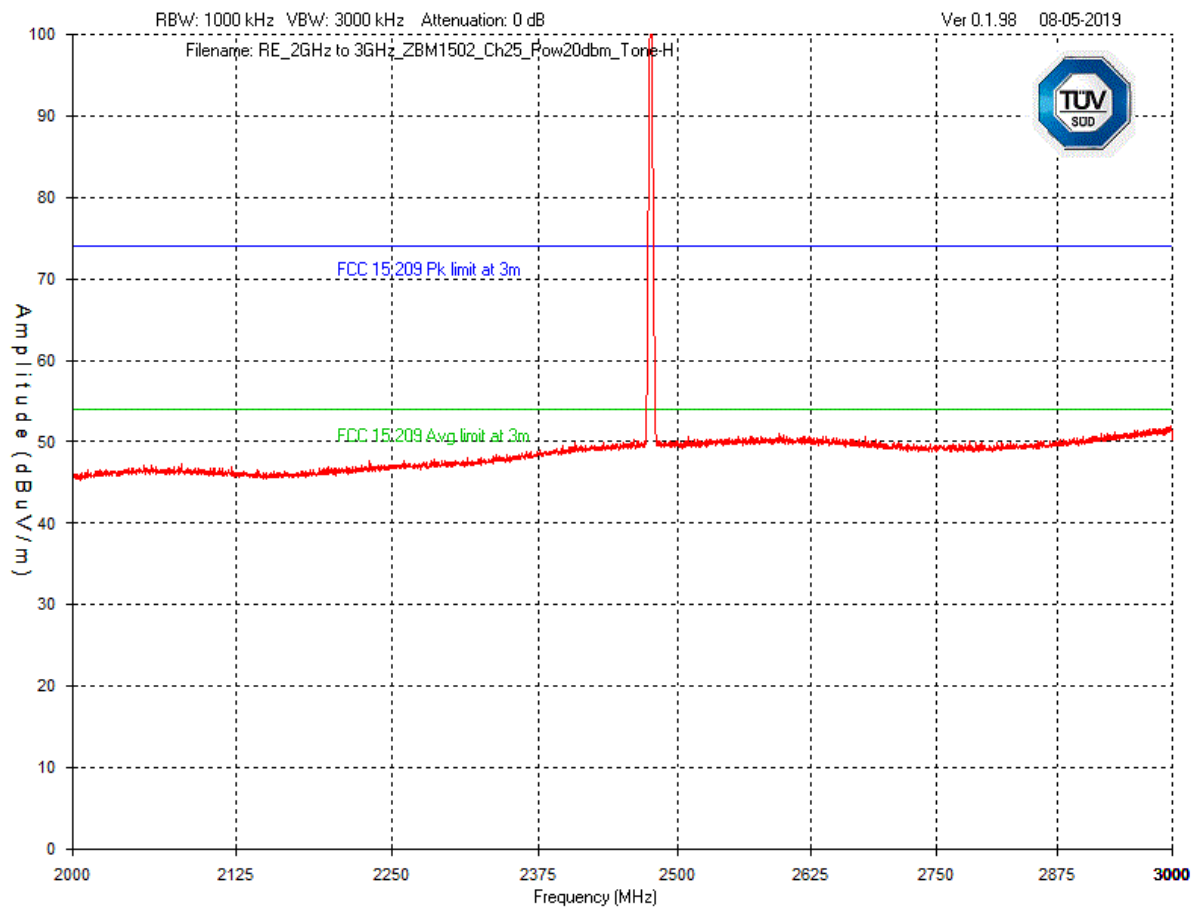
Graphs 5: Tx Spurious Emission 1GHz – 2GHz (Horizontal Polarization): Channel 24



Graphs 6: Tx Spurious Emission 1GHz – 2GHz (Vertical Polarization): Channel 24



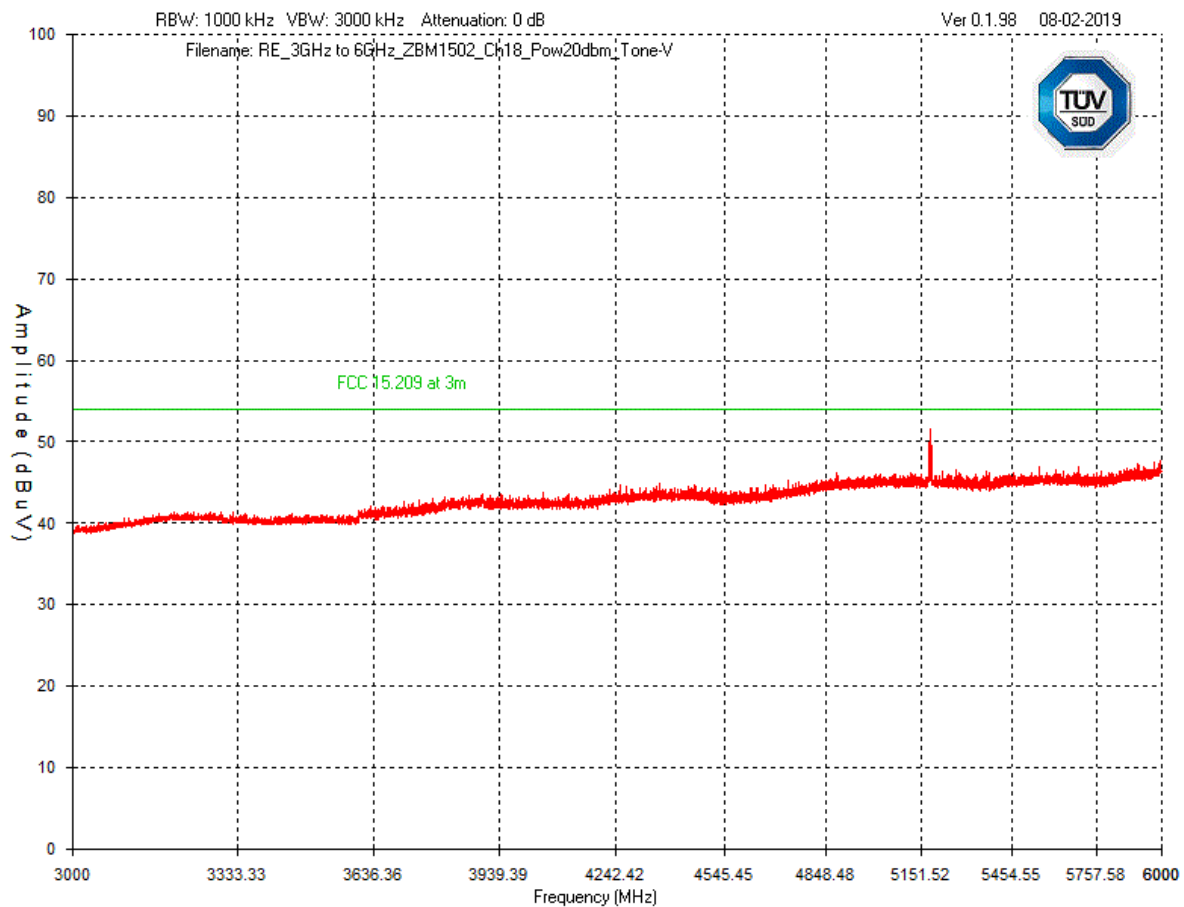
6.1.4.1.4 Frequency Range from 2GHz to 3GHz – Worst case – Channel 25



Graphs 7: Tx Spurious Emission 2GHz – 3GHz (Horizontal Polarization): Channel 25



6.1.4.1.5 Frequency Range 3GHz – 6GHz – Worst case – Channel 18



Graphs 8: Tx Spurious Emission 3GHz – 6GHz (Vertical Polarization): Channel 18



6.1.5 Test Instruments

This test was carried out in Laval test location.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No LAV0
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2021-04-20	4092
BiLog Antenna	3142-E	ETS	24	2021-11-29	4002
Attenuator 4 dB	20181128A	KLP	24	2021-11-29	4300
Horn Antenna	ATH1G18G	AR	24	2021-04-25	4005
Attenuator 6 dB	FP-50-3	Trilithic	NCR	NCR	4125
LNA pre-amp	LNA-1450	RF Bay Inc.	24	2020-12-22	4089
1-26.5GHz preamp	8449B	Agilent	24	2019-09-09	6351
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	NCR	NCR	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	4026
Emission software	0.1.94	Global EMC	NCR	NCR	4058

Table 8 – Test Instrumentation – Tx Spurious Emission



7 6dB Bandwidth of Digitally Modulated Systems

7.1.1 Purpose & Method

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. This ensures that if the end-user replaces the antenna, the maximum power does not exceed an amount which may create an excessive power level.
The method is given in Section 8.1 of FCC KDB 558074 and ANSI C63.10.

7.1.2 Test Specifications

REFERENCE FCC Section : §15.247(a)2
STANDARD ISED Canada : §247 5.2(a)

SPECIFICATIONS

Limit – 6dB Bandwidth ≥500kHz

Frequency range (GHz) 2405
2440
2480

RBW (kHz): 100

VBW (kHz) 300

EUT

Identification Zigbee Module: ZBM1502

Voltage Input 3.3Vdc

ENVIROMENTAL & TEST INFO

Test Date
(YYYY-MM-DD) 2019-08-08

Temperature (°C) 22 ± 2

Humidity (%) 32 ± 5

Atmospheric Pressure
kPa (For Info Only) 102.3

Tester Jose Martinez-Ortega

Client Witness No witness



7.1.3 Results

The minimum 6 dB BW measured was 1.67 MHz from channel #11, and all channels gave a maximum of 2.27 MHz for 99% BW. Details are depicted in Table 6

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	99% Bandwidth (MHz)	Results
#11	2405	1.67	2.27	Pass
#18	2440	1.69	2.27	Pass
#26	2480	1.99	2.27	Pass

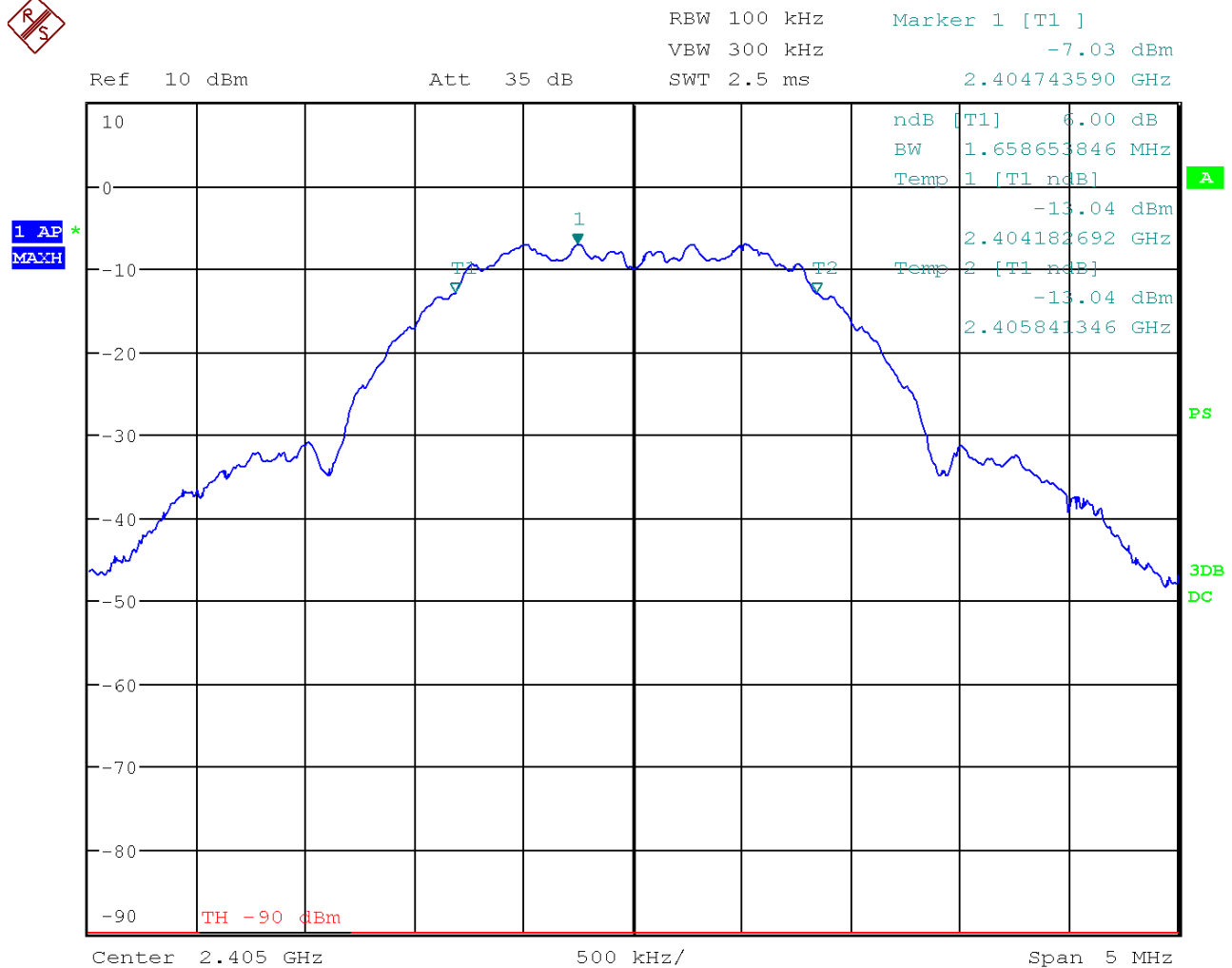
Table 9 – 6dB Bandwidth Results

7.1.3.1 Graphs

The graphs showed below show the OBW during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the 6 dB bandwidth of a channel during operation of the EUT. Max hold is performed for a duration of not less than 1 minute. Note that a 20dB attenuator was used between the EUT and the Spectrum Analyzer.



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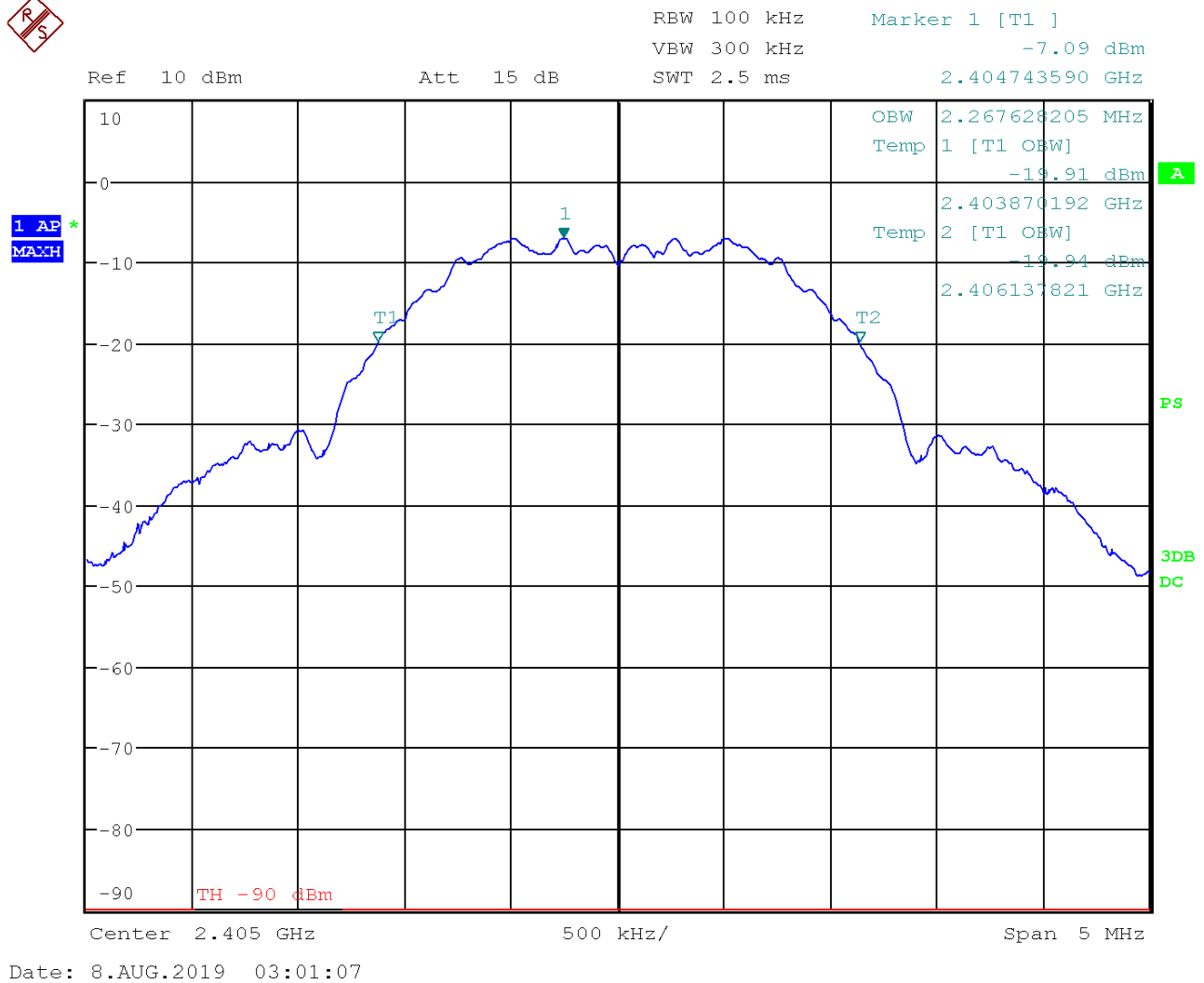
Graphs 9: 6dB Results – Channel 11

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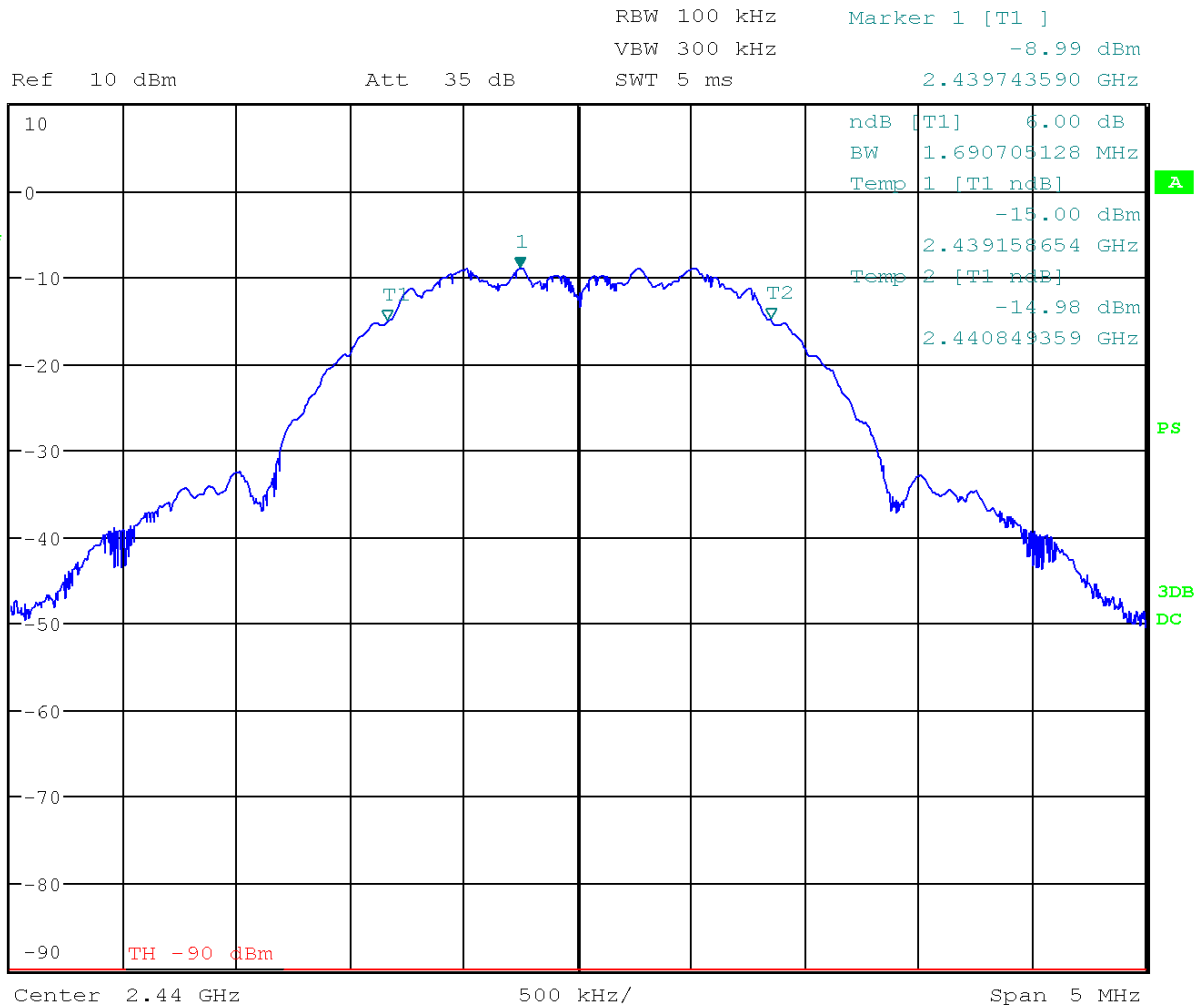
Graphs 10: OBW Results – Channel 11



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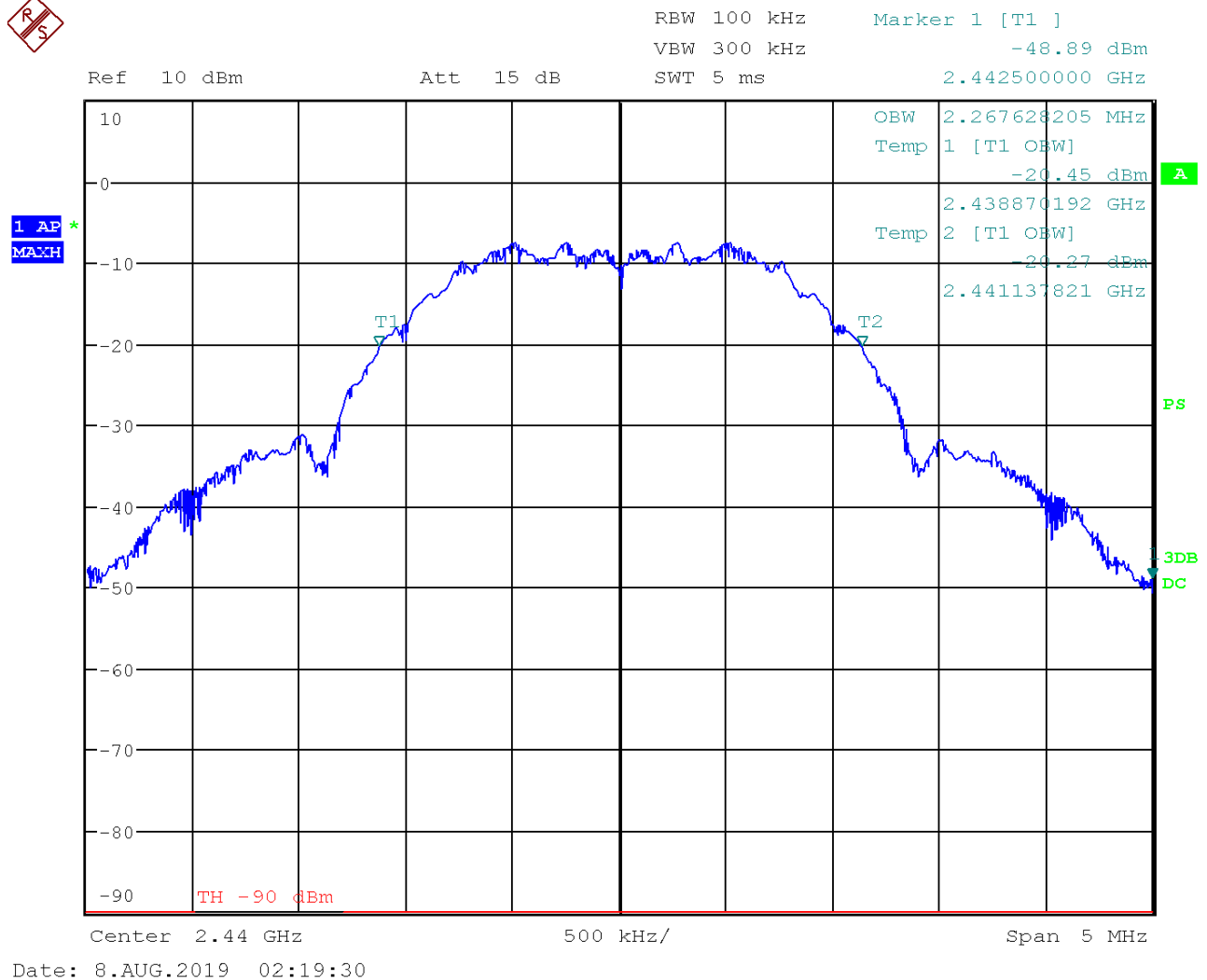
Graphs 11: Setting the SA – 6dB Results – Channel 18

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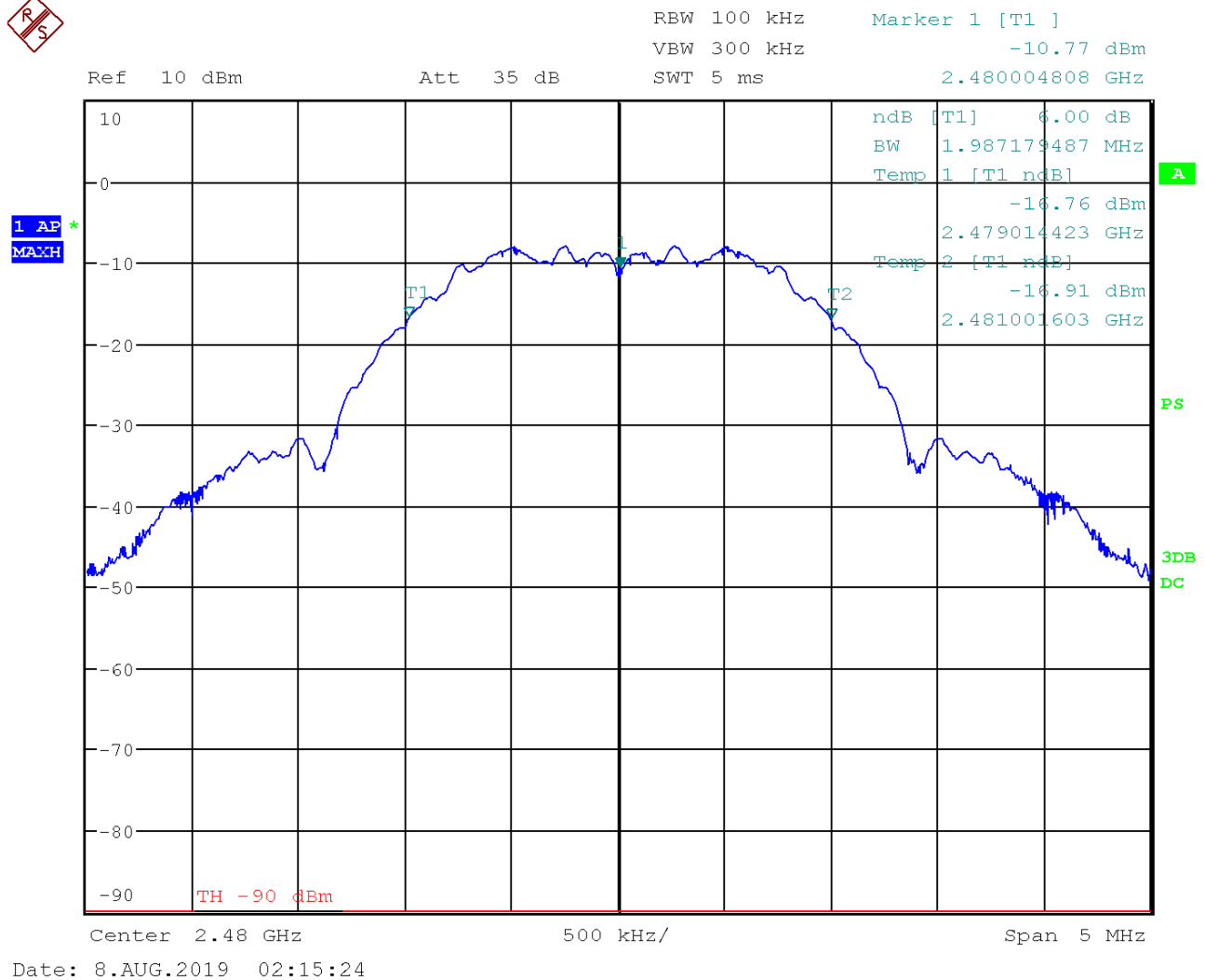
Graphs 12: Setting the SA – OBW Results – Channel 18

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Graphs 13: Setting the SA – 6dB Results – Channel 26

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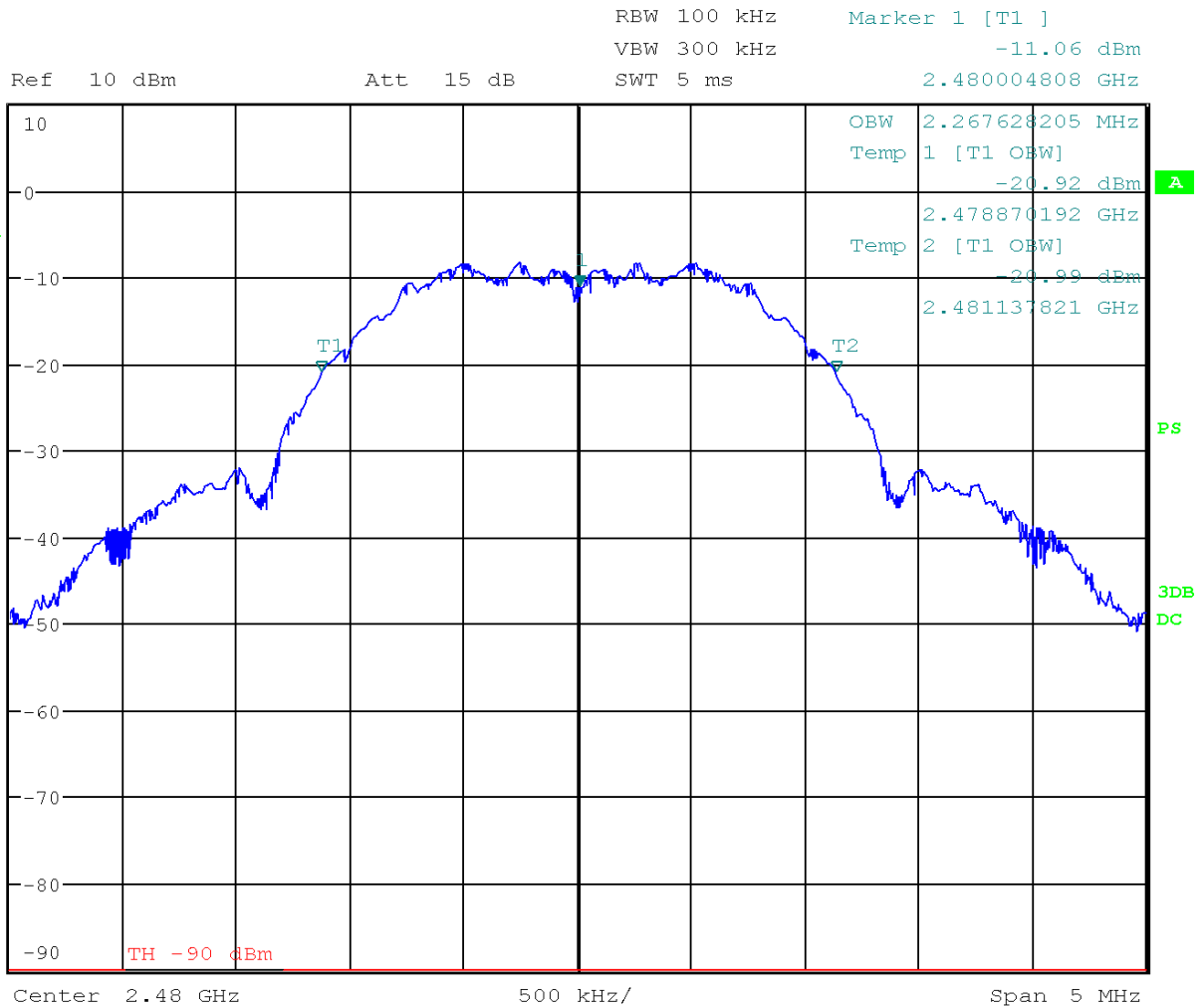
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Graphs 14: Setting the SA – OBW Results – Channel 26

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7.1.4 Test Instruments

This test was carried out in Laval test location.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2021-04-20	4092
Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096
Cable 254mm SMA	Minibend-10	Huber+ Suhner	NCR	NCR	4080
Signal generator	SMU100A	Rohde & Schwarz	24	2020-08-23	4135



8 Maximum Peak Envelope Conducted Power – Digital Modulated

8.1.1 Purpose & Method

The purpose of this test is to ensure that the bandwidth occupied exceeds a stated minimum. This helps ensure the utilization of the frequency allocation is sufficiently wide. This also helps prevent corruption of data by ensuring adequate data separation to distinguish the reception of the intended information. The method is given in Section 9.1.2 of FCC KDB 558074 and ANSI C63.10.

8.1.2 Test Specifications

REFERENCE	FCC Section : §15.247(b)3
STANDARD	ISED Canada : RSS-247 §5.4(d)
	ANSI C63.10. Clause 10.3.7

SPECIFICATIONS

Limit – Power (W)	<1
Frequencies (MHz)	2405
	2440
	2470
	2475
	2480

RBW (MHz): 3

VBW (MHz) 10

Span (MHz) 10

EUT

Identification Zigbee Module: ZBM1502

Voltage Input 3.3Vdc

ENVIROMENTAL & TEST INFO

Test Date
(YYYY-MM-DD) 2019-08-08

Temperature (°C) 23 ± 2

Humidity (%) 30 ± 5

Atmospheric Pressure
kPa (For Info Only) 102.3

Tester Jose Martinez-Ortega

Client Witness No witness



8.1.3 Results

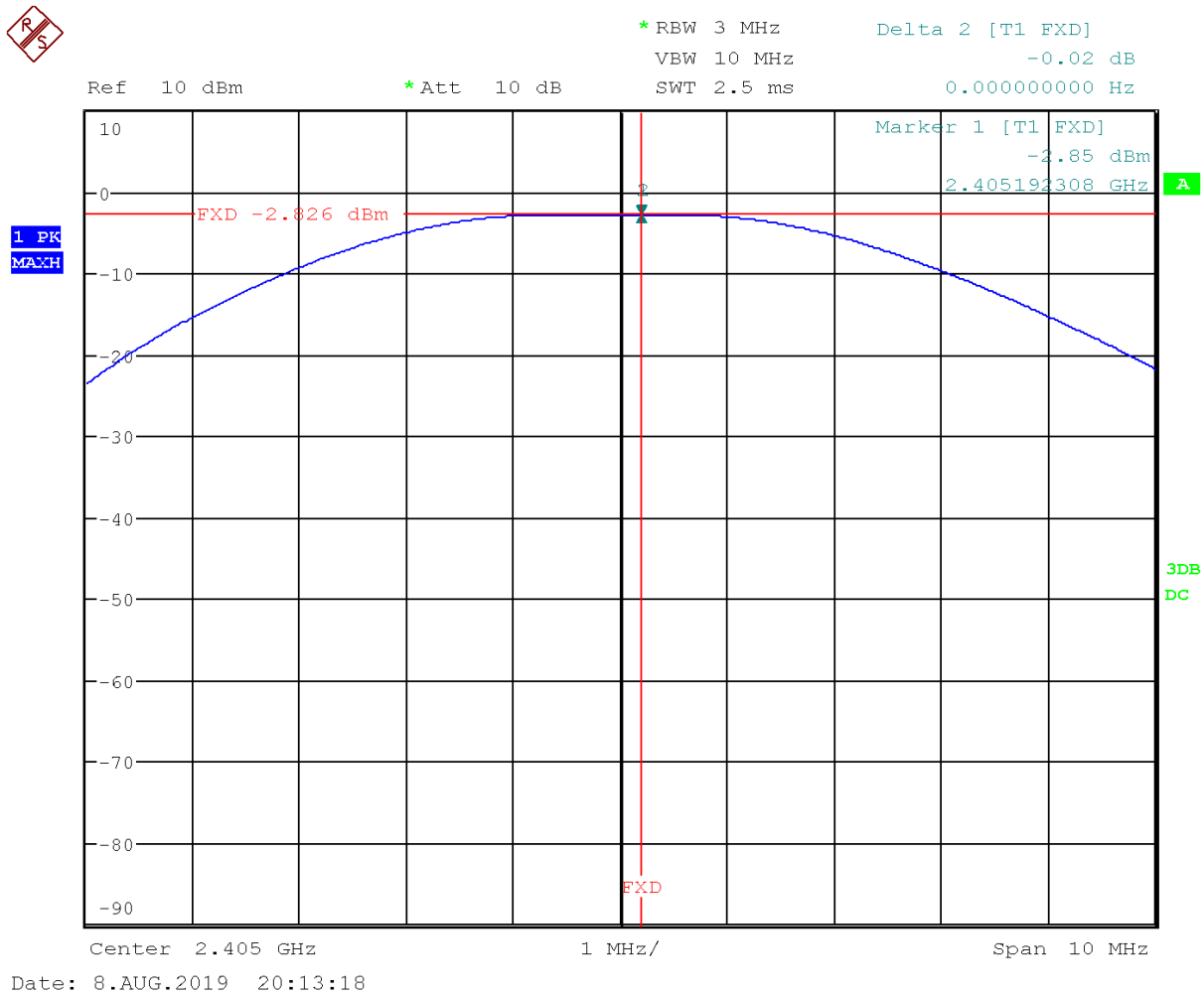
The EUT was set to transmit at maximum power (20dBm) up to channel 24. Both channels 25 and 26 were set to lower power to comply with the band-edge limits. The peak power of channels tested are depicted in Table 10

Channel	Frequency (MHz)	EUT Power Setting (dBm)	Measured Peak Power (dBm)	External Attenuation +Cable (dB)	Corrected Peak Power (dBm)	Peak Power (mW)	Result
Low: #11	2405	20	-2.826	20.5	17.71	59.0	Pass
Middle: #18	2440	20	-3.258	20.5	17.242	53.0	Pass
High: #24	2470	20	-3.144	20.5	17.356	54.4	Pass
High: #25	2475	20	-3.129	20.5	17.371	54.58	Pass
High: #26	2480	20	-3.182	20.5	17.318	53.92	Pass

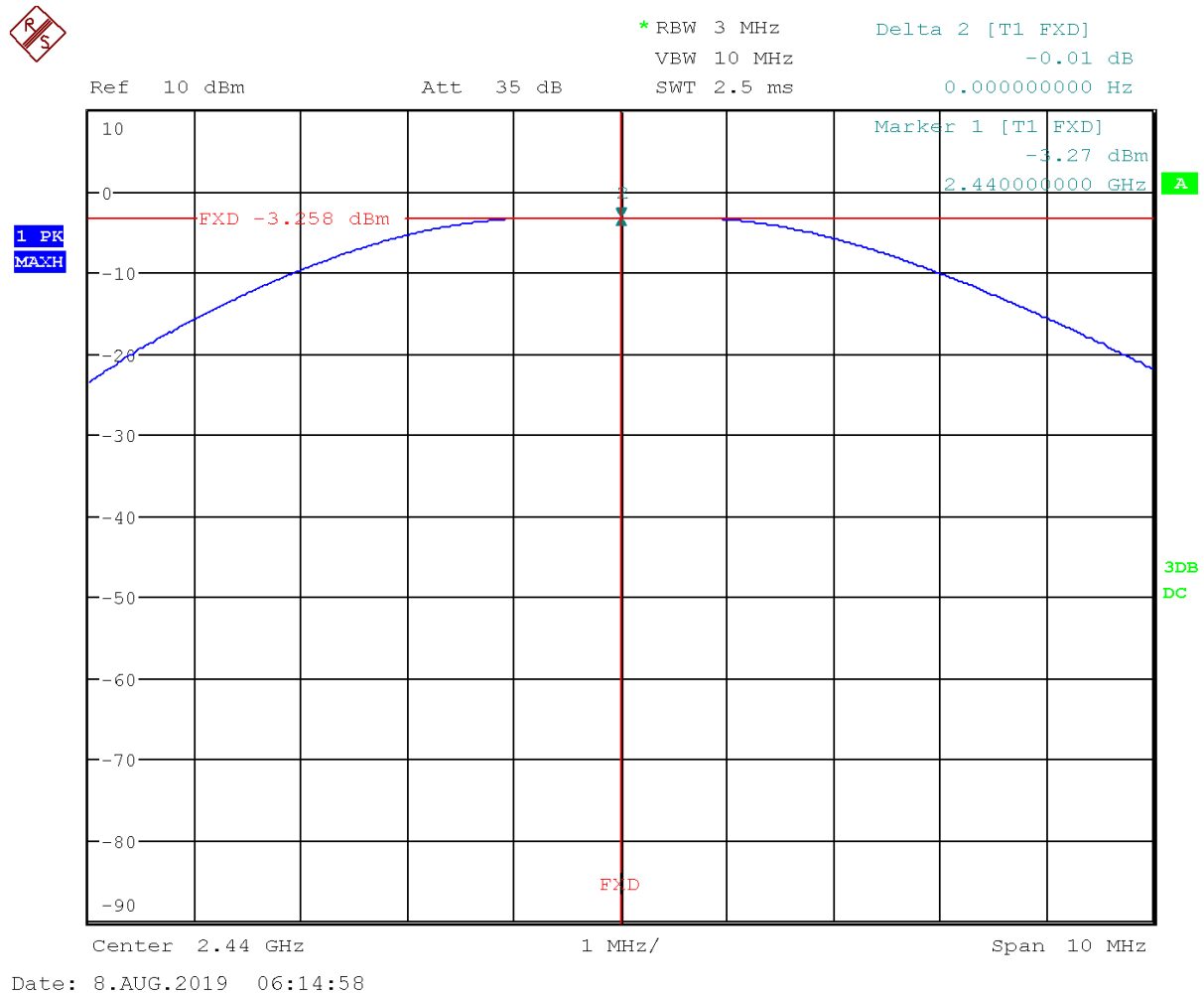
Table 10 – Maximum Peak Power

8.1.3.1 Graphs

The plots shown below show the peak power output of the device during the antenna conducted measurements during transmit operation of the EUT. Note that a 20 dB attenuator was used between the EUT and the Spectrum Analyzer.



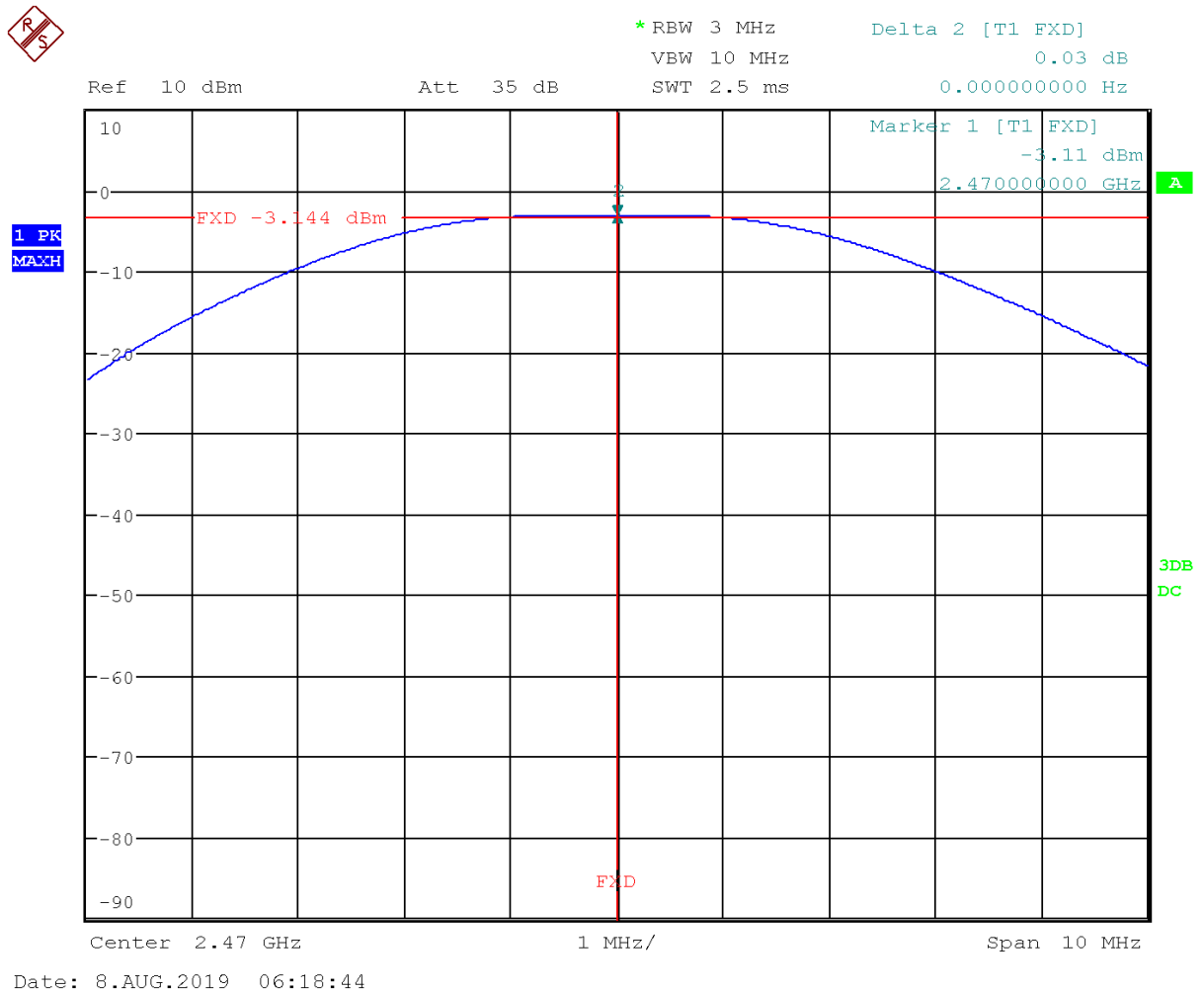
Graphs 15: Conducted Peak Power Measurements – Channel 11



Graphs 16: Setting the SA – Conducted Peak Power Measurements – Channel 18



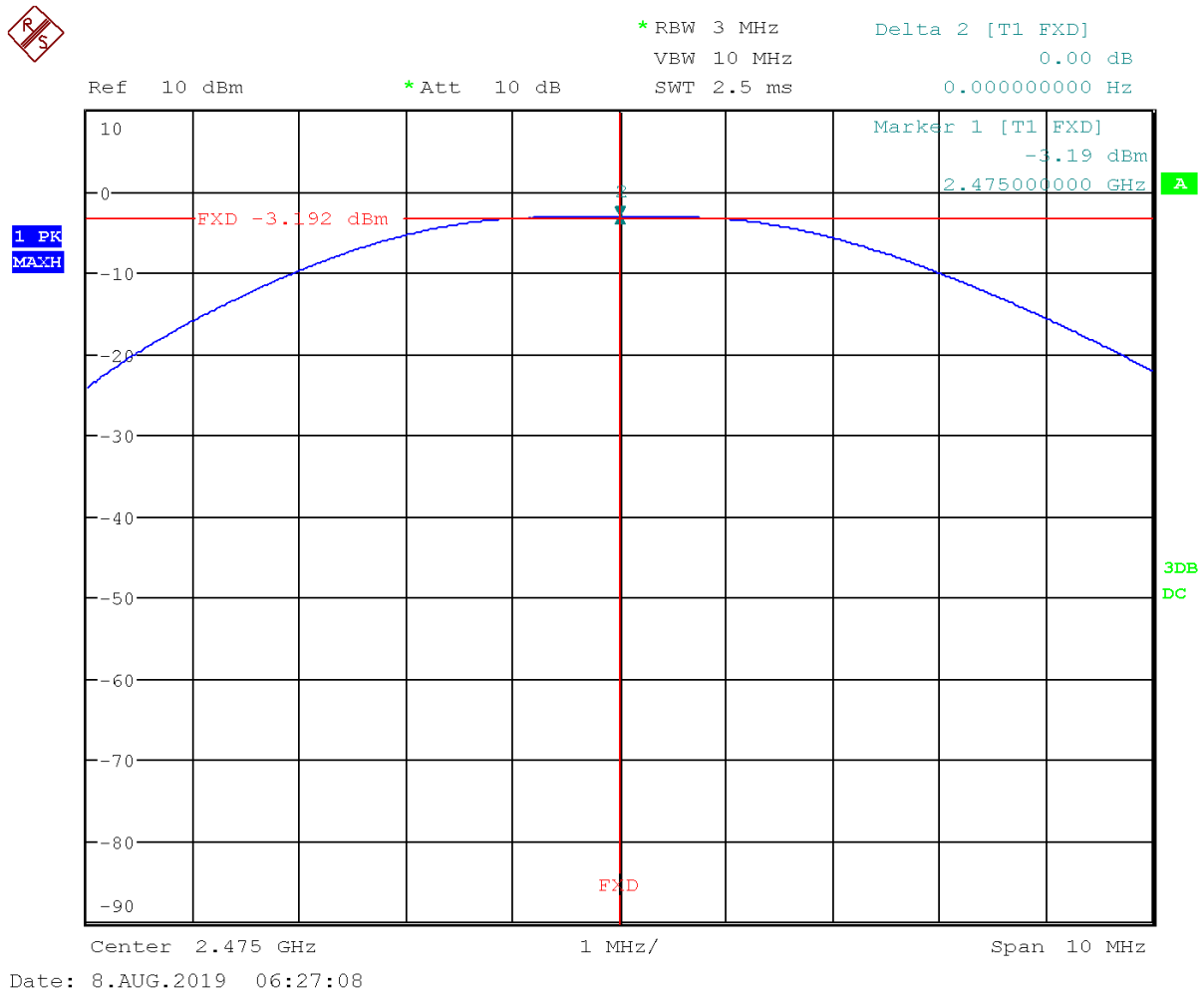
Product Service



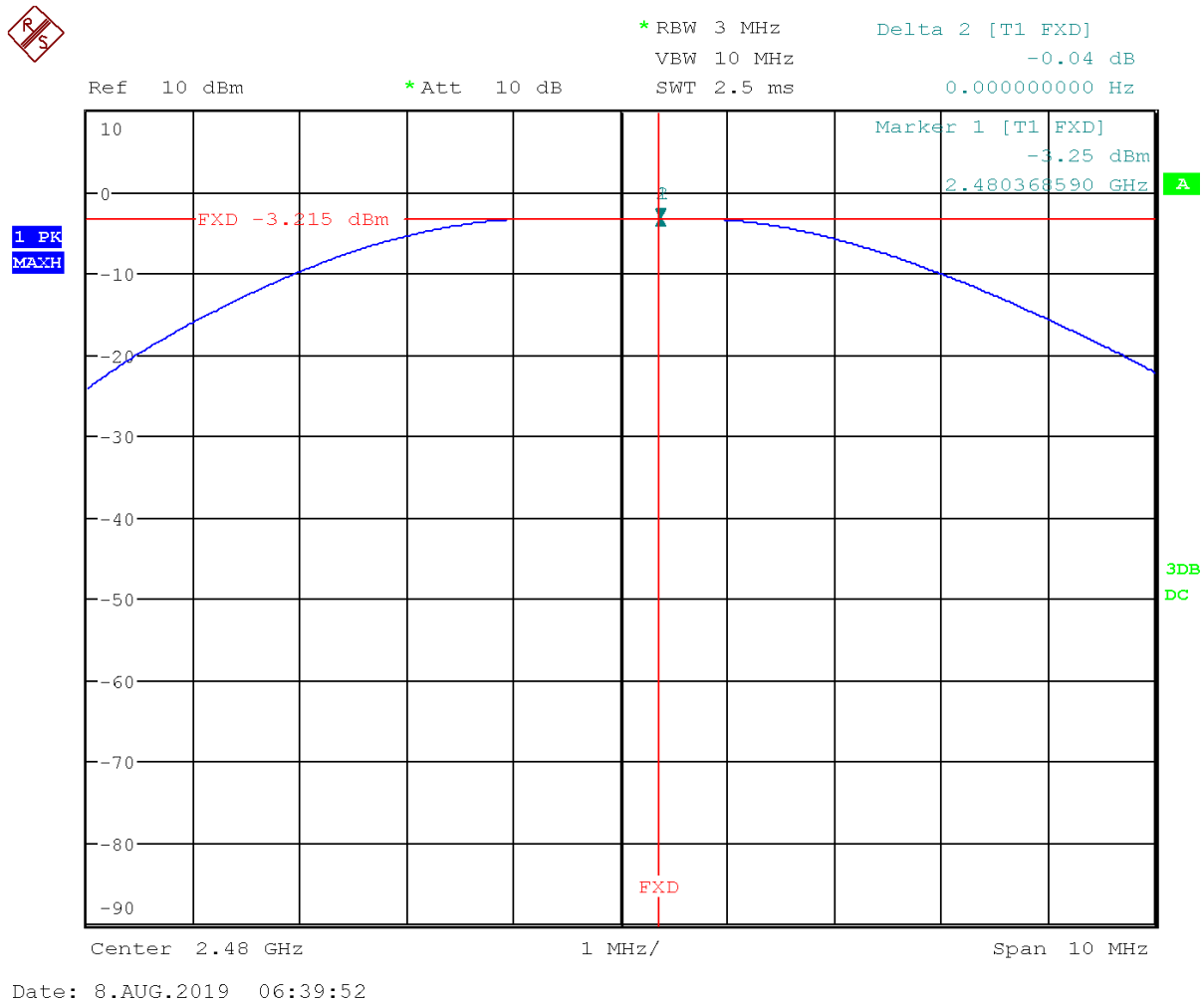
Graphs 17: Setting the SA – Conducted Peak Power Measurements – Channel 24

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Graphs 18: Setting the SA – Conducted Peak Power Measurements – Channel 25



Graphs 19: Setting the SA – Conducted Peak Power Measurements – Channel 26



8.1.4 Test Instruments

This test was carried out in Laval test location.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2021-04-20	4092
Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096
Cable 254mm SMA	Minibend-10	Huber+ Suhner	NCR	NCR	4080
Signal generator	SMU100A	Rohde & Schwarz	24	2020-08-23	4135

Table 11 – Test Instrumentation – Maximum Peak Output Power



9 Power Spectral Density

9.1.1 Purpose & Method

The purpose of this test is to ensure that the maximum power spectral density to the radiating element does not exceed the limits specified. This ensures that the modulation is significantly wide enough, or low enough in power that it will allow for co-operation of other wireless devices operating within this frequency allocation. The method applied is the PKPSD described in ANSI C63.10-2013 in Clause 10.2.

9.1.2 Test Specifications

REFERENCE	FCC Section : §5.247(e)
STANDARD	ISED Canada : RSS-247 §5.2 (b)
	ANSI C63.10. Clause 11.10

SPECIFICATIONS

Limit (dBm)	<8
--------------------	----

Frequencies (MHz)	2405
	2440
	2470
	2475
	2480

RBW (kHz):	3
-------------------	---

VBW (kHz)	10
------------------	----

Span (MHz)	4
-------------------	---

EUT

Identification	Zigbee Module: ZBM1502
-----------------------	------------------------

Voltage Input	3.3Vdc
----------------------	--------

ENVIRONMENTAL & TEST INFO

Test Date (YYYY-MM-DD)	2019-08-08
-----------------------------------------	------------

Temperature (°C)	22 ± 2
-------------------------	--------

Humidity (%)	61 ± 5
---------------------	--------

Atmospheric Pressure kPa (For Info Only)	99.9
-----------------------------------------------------------	------

Tester	Jose Martinez-Ortega
---------------	----------------------

Client Witness	No witness
-----------------------	------------



9.1.3 Results

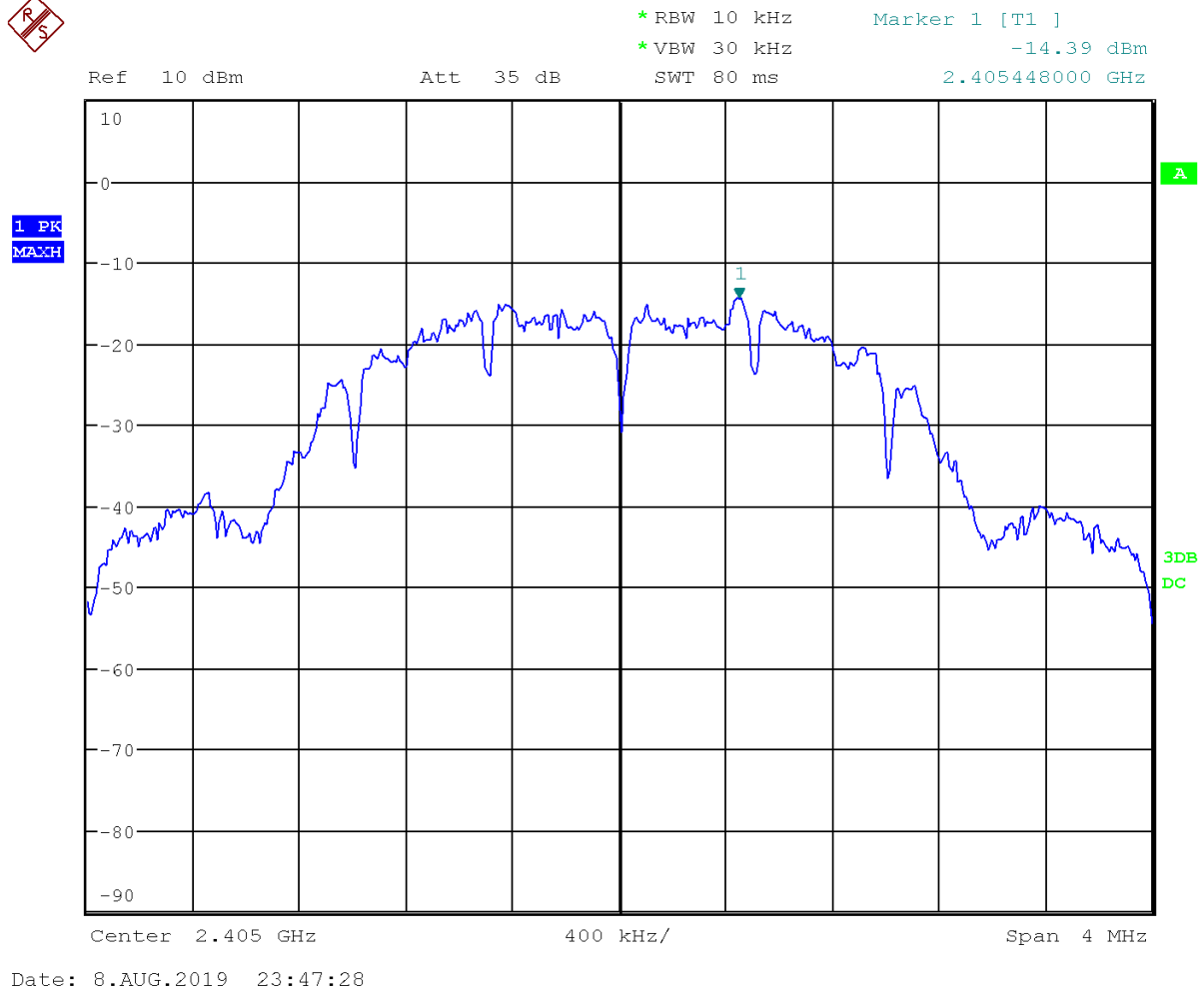
The EUT passed. Low, medium, and high bands were tested. The worst-case value is 6.1 dBm as measured with a 3 kHz resolution bandwidth (peak power) on channel 11. The peak power of channels tested are depicted in Table 8

Channel	Frequency (MHz)	EUT Power Setting (dBm)	Measured PSD (dBm)	External Attenuation +Cable (dB)	Corrected Peak Power (dBm)	Result
Low: #11	2405	20	-14.40	20.5	6.1	Pass
Middle: #18	2440	20	-14.69	20.5	5.81	Pass
High: #24	2470	20	-14.93	20.5	5.57	Pass
High: #25	2475	20	-14.64	20.5	5.86	Pass
High: #26	2480	20	-14.63	20.5	5.87	Pass

Table 12 – Results – PKPSD

9.1.3.1 Graphs

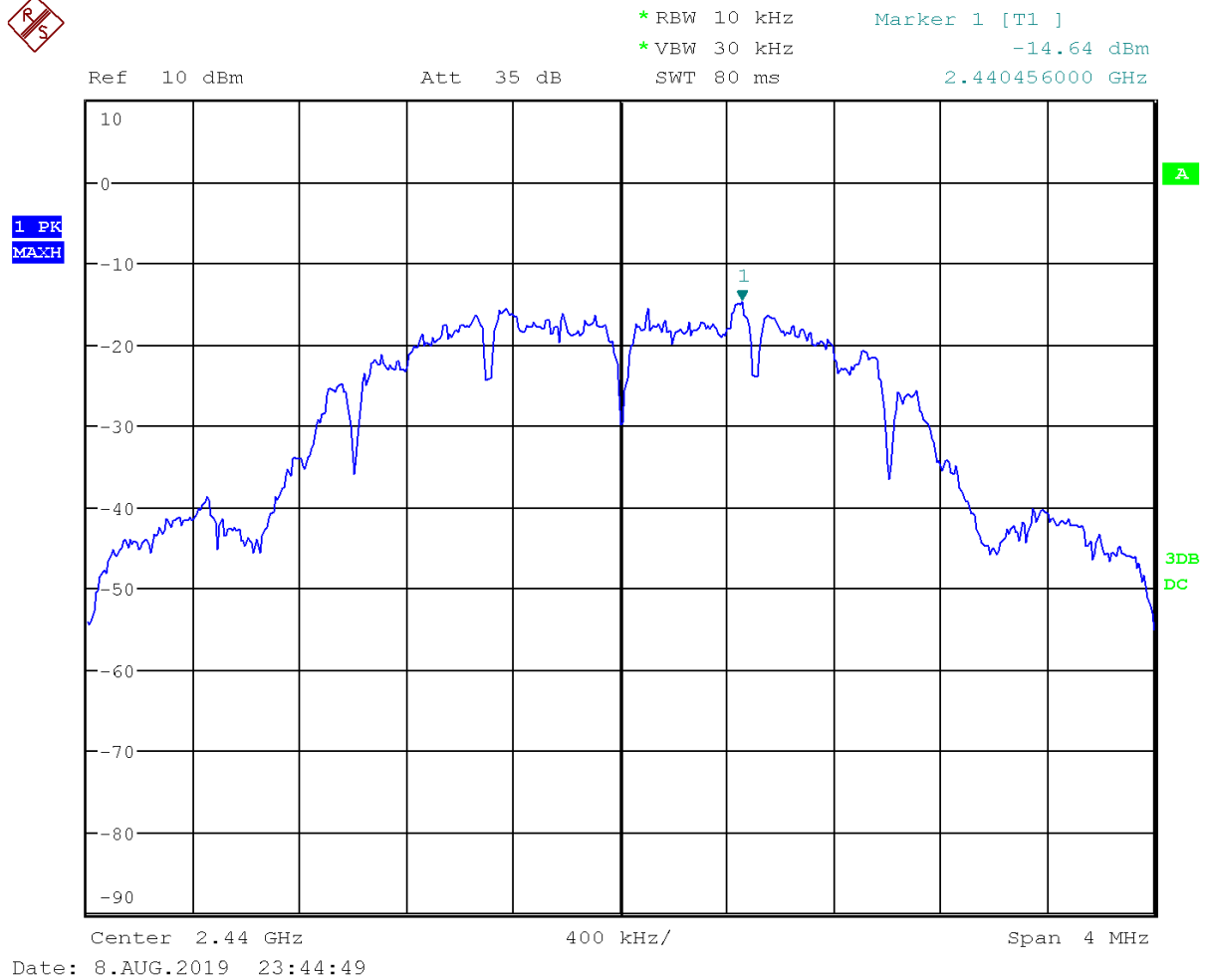
The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. Low, middle, and high channel was investigated. A 20 dB attenuator was used between the EUT and the Spectrum Analyzer



Graph 20: Results – PKPSD – Channel 11



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Graph 21: Results – PKPSD – Channel 18

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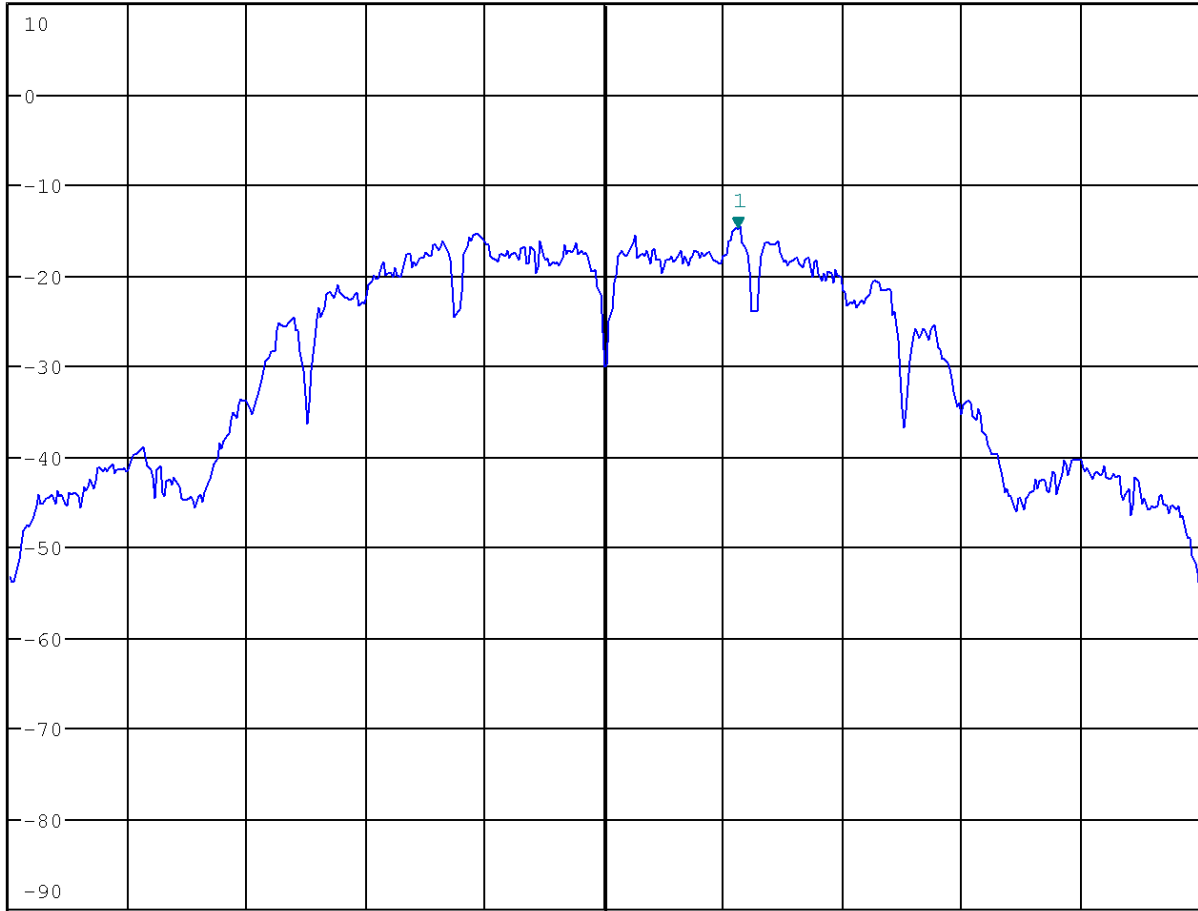


*RBW 10 kHz Marker 1 [T1]
*VBW 30 kHz -14.93 dBm
SWT 80 ms 2.470448000 GHz

Ref 10 dBm

Att 35 dB

1 PK
MAXH



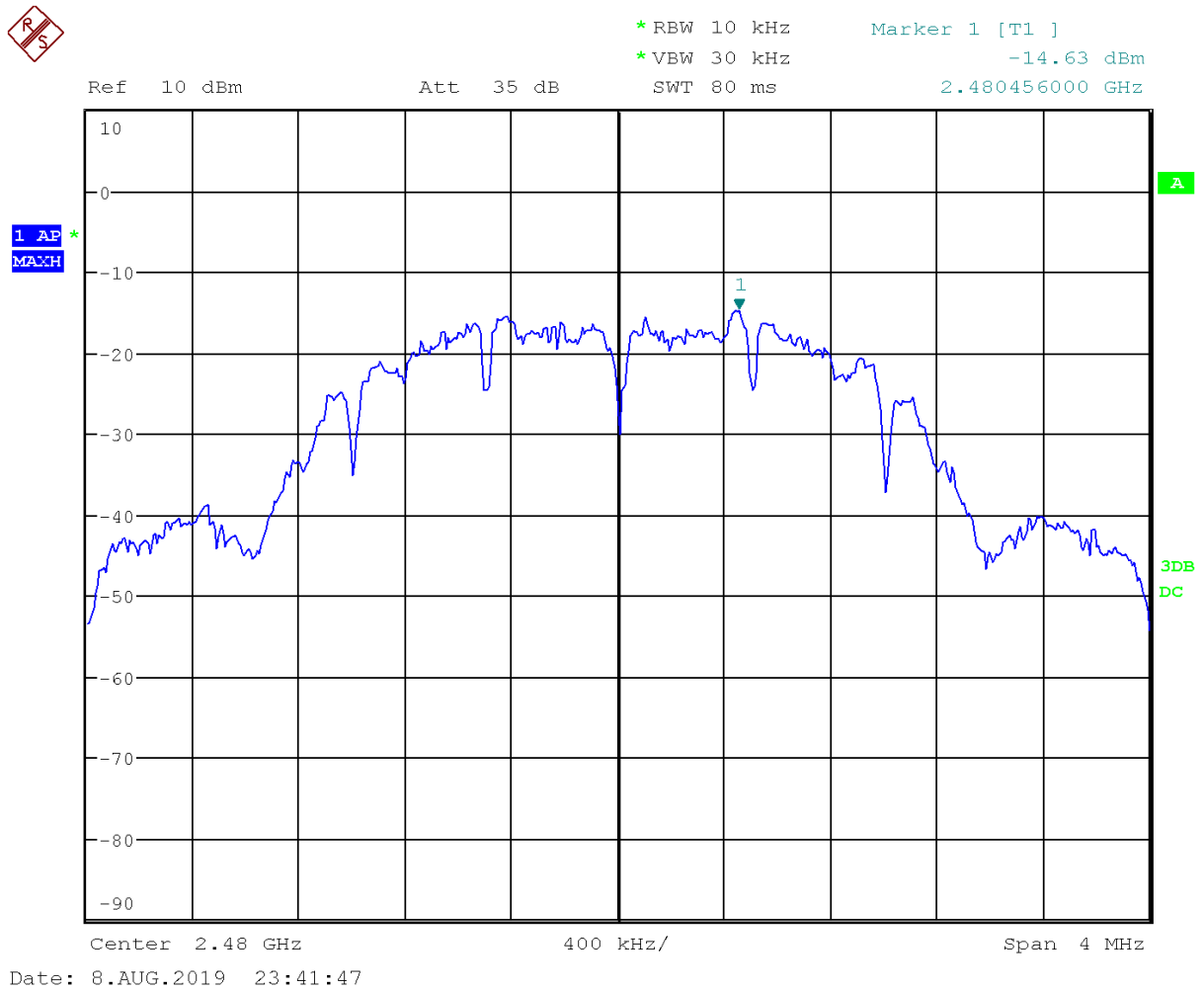
Center 2.47 GHz

400 kHz/

Span 4 MHz

Date: 8.AUG.2019 23:43:12

Graph 22: Results – PKPSD – Channel 24



Graph 23: Results – PKPSD – Channel 26



9.1.4 Test Instruments

This test was carried out in Laval test location.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2021-04-20	4092
Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096
Cable 254mm SMA	Minibend-10	Huber+ Suhner	NCR	NCR	4080
Signal generator	SMU100A	Rohde & Schwarz	24	2020-08-23	4135

Table 13 – Test Instrumentation –Peak Power Density



10 Band-Edge Compliance of RF Conducted Emissions

10.1.1 Purpose & Method

The purpose of this test is to ensure that the maximum power conducted to the radiating element at frequencies outside of the authorized spectrum does not exceed the limits specified. This ensures that the only the intended signal is delivered to the radiating element.

The limits are defined in 15.247(d). In any 100 kHz band, the peak spurious harmonics emissions must be at least 20 dB below the fundamental. Spurious Conducted emissions are to be evaluated up to the 10th harmonic. This -20 dBc requirement also applies at the 'band edge' or 2.4 GHz and 2.4835 GHz

10.1.2 Test Specifications

REFERENCE FCC Section : §15.247(d)
STANDARD ISED Canada : RSS-247 §5.5
ANSI C63.10 Clause 11.11

SPECIFICATIONS

Limit (dB) <20

Frequencies (MHz) 2405
2440
2470

RBW (kHz): 3

VBW (kHz) 10

EUT

Identification Zigbee Module: ZBM1502

Voltage Input 3.3Vdc

ENVIROMENTAL & TEST INFO

Test Date 2019-08-09
(YYYY-MM-DD)

Temperature (°C) 22 ± 2

Humidity (%) 61 ± 5

Atmospheric Pressure 99.9
kPa (For Info Only)

Tester Jose Martinez-Ortega

Client Witness No witness



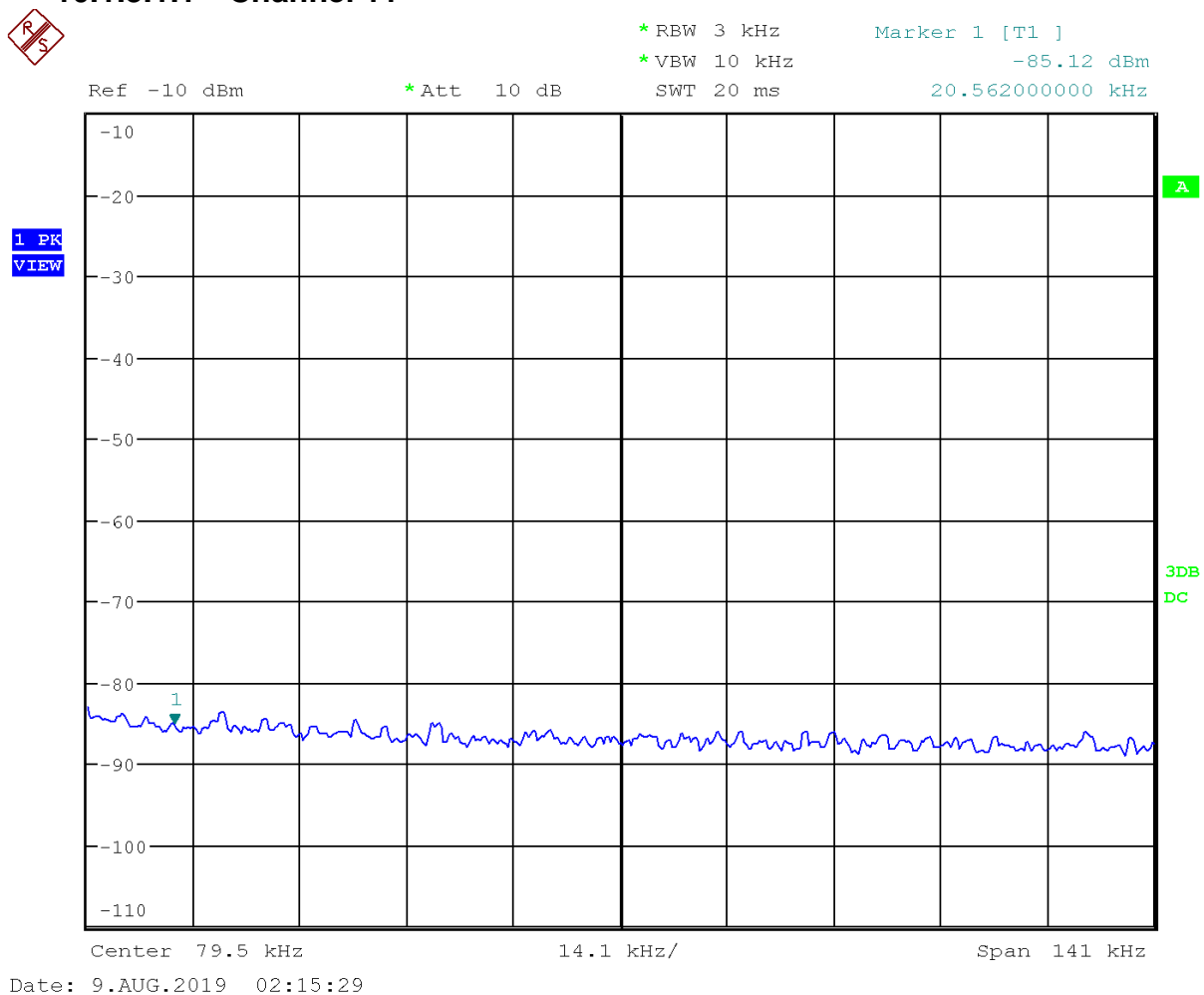
10.1.3 Results

The EUT passed. Low, medium, and high bands were tested. The worst-case value is 6.1 dBm as measured with a 3 kHz resolution bandwidth (peak power) on channel 11.

10.1.3.1 Graphs

The graphs shown below show the worst-case peak power output of the device during the antenna conducted measurement during transmit operation of the EUT. A 20-dB attenuator was used between the EUT and the Spectrum Analyzer

10.1.3.1.1 Channel 11



Graph 24: Results – 9kHz to 150kHz – Channel 11



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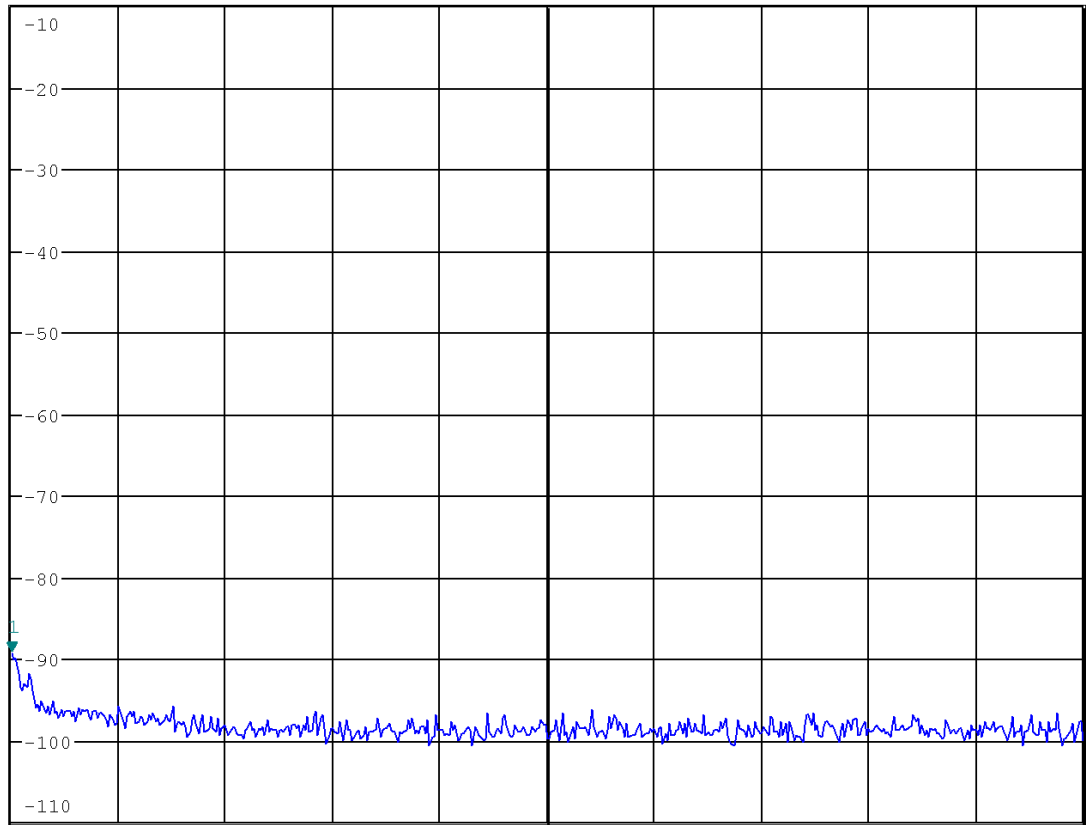


*RBW 3 kHz Marker 1 [T1]
*VBW 10 kHz -89.09 dBm
SWT 3.4 s 150.000000000 kHz

Ref -10 dBm

*Att 10 dB

1 PK
VIEW



Start 150 kHz

2.985 MHz/

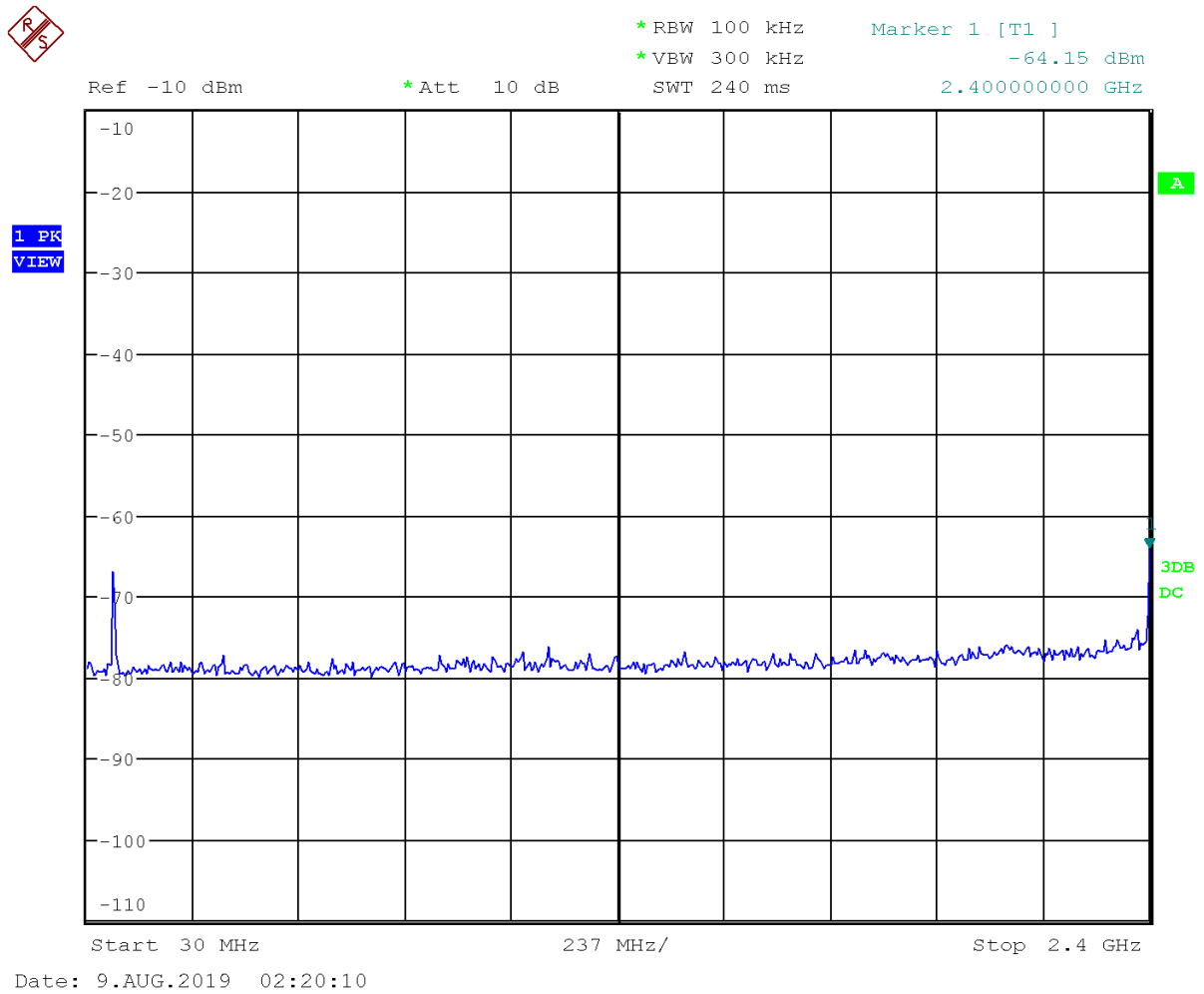
Stop 30 MHz

Date: 9.AUG.2019 02:16:47

Graph 25: Results – 150kHz to 30MHz – Channel 11



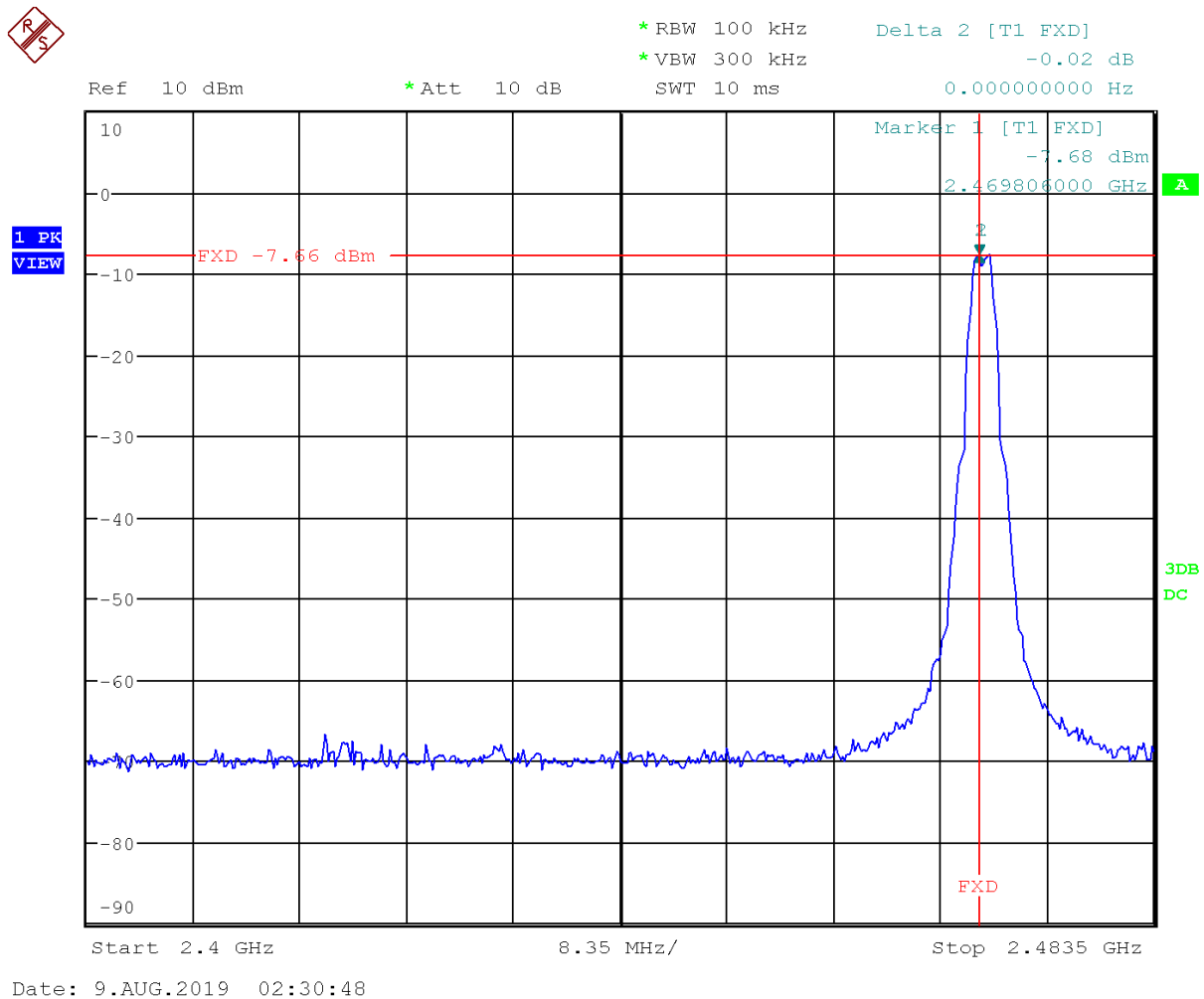
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Graph 26: Results – 30MHz to 2.4GHz – Channel 11



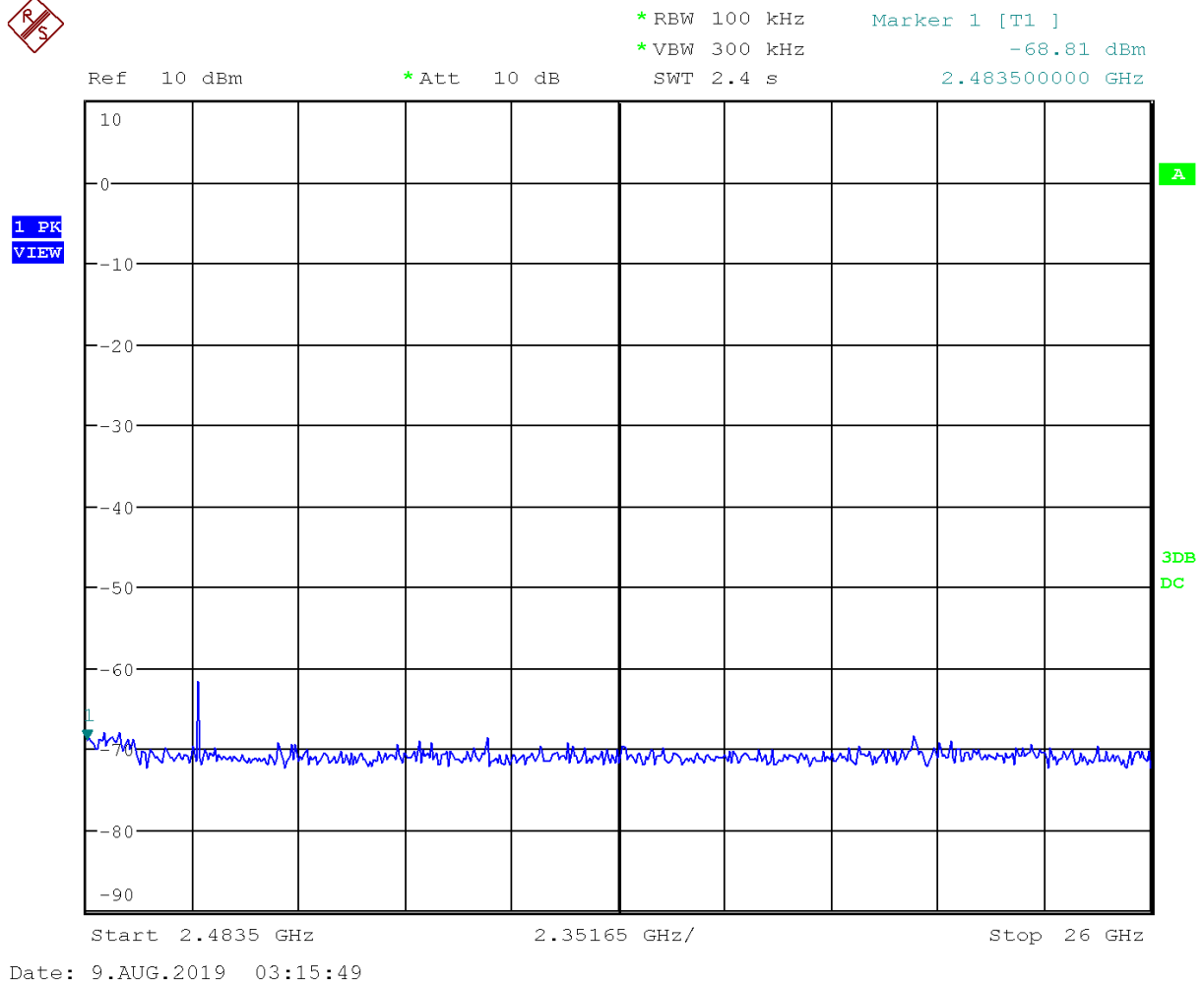
10.1.3.1.1 Channel 24



Graph 27: Results – 2.4GHz to 2.4835GHz – Channel 24



10.1.3.1.2 Channel 26



Graph 28: Results – 2.4GHz to 26GHz – Channel 26



10.1.4 Test Instruments

This test was carried out in Laval test location.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2021-04-20	4092
Bilog Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096
Cable 254mm SMA	Minibend-10	Huber+ Suhner	NCR	NCR	4080
Signal generator	SMU100A	Rohde & Schwarz	24	2020-08-23	4135

Table 14 – Test Instrumentation – Antenna Spurious Conducted Emission



Radiated Spurious Emissions – Worst Cases



Frequency (kHz)	Detector	Raw Reading	Atten 6dB Factor	Current to Voltage 51.5 Factor	Loop - EM6879 9k to 30M Factor	Preamp-LNA1450 Factor	Level	FCC Part 15.209 Generic Limits (40 dB/decade factor used) Limit	FCC Part 15.209 Generic Limits (40 dB/decade factor used) Margin
0.731	PEAK	26.4	6	51.5	-8.2	-31	44.7	70.3	25.6
16.4379	PEAK	21.2	6	51.5	-13.9	-31.7	33.1	69.5	36.4
0.16	PEAK	34.8	6	51.5	5.6	-30.9	67	104.2	37.2
22.8919	PEAK	21.9	6	51.5	-15.7	-32	31.7	69.5	37.8
23.7319	PEAK	21.2	6	51.5	-16.1	-32.1	30.5	69.5	39.0
16.491	PEAK	17.2	6	51.5	-13.9	-31.7	29.1	69.5	40.4

Table A.1 Tx Spurious Emission Channel #11 – 9kHz to 15kHz

Frequency (MHz)	Detector	Raw Reading	Antenna - Bilog3142E_H Factor	Atten 3dB Factor	Preamp-LNA1450 Factor	Level	FCC 15.209 Limit	FCC 15.209 Limit Margin
47.963	PEAK	51	11.7	3	-33.2	32.5	40	7.5
105.736	PEAK	53	13.1	3	-33.5	35.6	43.5	7.9
107.386	PEAK	52.5	13.2	3	-33.5	35.2	43.5	8.3
98.5506	PEAK	51.2	12.4	3	-33.5	33.1	43.5	10.4
88.5495	PEAK	52	11.1	3	-33.5	32.6	43.5	10.9
95.1522	PEAK	50.5	11.9	3	-33.5	31.9	43.5	11.6
97.7738	PEAK	47.2	12.3	3	-33.5	29	43.5	14.5

Table A.2 Tx Spurious Emission Channel #18 – 30MHz to 1GHz – Vertical Polarization



Frequency	Detector	Raw Reading	Ant DRG 1GHz to 18GHz Factor	Preamp - HP 8449B 4006 Factor	Level	FCC 15.209 Avg limit at 3m Limit	FCC 15.209 Pk limit at 3m Limit	FCC 15.209 Avg limit at 3m Margin	FCC 15.209 Pk limit at 3m Margin
2985.99	PEAK	55.7	29.5	-33.1	52.1	54	74	1.9	21.9
2605.61	PEAK	55.1	29	-33.1	51	54	74	3	23
2749.75	PEAK	53.5	28.7	-33.1	49.1	54	74	4.9	24.9
2067.82	PEAK	53	27.1	-33.1	47	54	74	7	27
2000	PEAK	52.2	26.6	-33.1	45.7	54	74	8.3	28.3

Table A.3 Tx Spurious Emission Channel #25 –2GHz – 3GHz: Vertical Polarization

Frequency (MHz)	Detector	Raw Reading	Ant DRG 1GHz to 18GHz Factor	Cable 27 - 10m LMR400 Factor	Cable 28 - 7m LMR400 Factor	Preamp - HP 8449B 4006 Factor	Level	FCC 15.209 at 3m Limit	FCC 15.209 at 3m Margin
5182.28	PEAK	44.9	33.4	3.6	2.5	-32.7	51.7	54	2.3
5176.58	PEAK	43.2	33.4	3.6	2.5	-32.7	50	54	4
5993.99	PEAK	39.6	34	4.1	2.7	-32.8	47.6	54	6.4
5365.77	PEAK	39.9	33	3.7	2.6	-32.7	46.5	54	7.5
4361.56	PEAK	40.1	32	3.2	2.4	-32.9	44.8	54	9.2
3000	PEAK	38.2	29.6	2.6	1.9	-33.1	39.2	54	14.8

Table A.4 Tx Spurious Emission Channel #18 –3GHz – 6GHz: Vertical Polarization



Client Documentation



Product Service



TUV SUD Canada



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Product Description Questionnaire

Hello,

Thank you for your interest in obtaining a quotation for your compliance requirements from TUV SUD Canada Inc.

To expedite our review and test reports, please fill out the attached questionnaire with as much as information as possible in order that we may best understand your product. When we receive your approval to commence work, this information will be utilized for our records, to generate a test plan for EMC compliance testing on your product, and for our report purposes. For every model of the device to be tested, please fill in one form and carefully label all the information.

For different products please use a new form. Please attach a soft copy of the user manual for the equipment if possible.

Thank you for your interest in TUV SUD labs, we appreciate the time to complete this form and appreciate the opportunity to serve you. If you have any questions while completing this form, please do not hesitate to contact our EMC compliance experts.

Many thanks from your "Trusted Certification and Compliance Advisors".

TUV SUD Canada Inc.
2972 Joseph-A-Bombardier
Laval, QC H7P 6E3

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Canada

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450-687-4976; www.tuv-sud.ca

Client Details	
Organization / Address	705 montrichard St-Jean-sur-richelieu J2X5K8 Qc, Canada
Contact	Sylvain Mayer
Phone	450-741-7700
Email	sylvain.mayer@sinopetech.com
Manufacturer Details (if not same as above)	
Organization / Address	
Contact	
Phone	
Email	
EUT (Equipment Under Test) Details	
EUT Name (for report title)	Zigbee module
EUT Model / SN (if known)	ZBM1502
EUT revision	New product
Software version	1.0
Equipment category	
EUT is powered using	DC
Input voltage range(s) (V)	3 to 3.3v
Frequency range(s) (Hz)	
Rated input current (A)	0.05
Nominal power consumption (W)	0.165
Number of power supplies in EUT	1
Transmits RF energy? (describe)	Yes
Testing is required for the following standards	<div><input type="checkbox"/> CISPR 11, EN 55011 Click here...</div> <div><input type="checkbox"/> CISPR 22, EN 55022 Click here...</div> <div><input type="checkbox"/> CISPR 24, EN 55024</div> <div><input type="checkbox"/> CISPR 32, EN 55032 (Please provide further information in the next row)</div> <div><input type="checkbox"/> FCC 15 Subpart B Click here...</div> <div><input checked="" type="checkbox"/> FCC 15 Subpart C</div> <div><input type="checkbox"/> ICES 001</div> <div><input type="checkbox"/> ICES 003</div> <div><input type="checkbox"/> IEC/EN 60601-1-2</div> <div><input type="checkbox"/> IEC/EN 61326-1</div> <div><input type="checkbox"/> Other</div>
CISPR 32 (all questions must be answered)	1) Does the unit have any FM receivers? Choose an item. If yes, are there any ports (ref. 3.1.8)? No

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	<p>2) Does the unit have a satellite receiving system? No</p> <p>3) Are there any TV/FM broadcast receiver tuner ports (ref. 3.1.8)? No With an accessible connector? No</p> <p>4) Are there any RF modulator output ports (ref. 3.1.29)? No</p> <p>5) Is the device a broadcast receiver equipment? No</p> <p>6) Are there any wired network ports (ref. 3.1.32)? No</p> <p>7) Are there any optical fibre ports (ref. 3.1.25) with metallic shield or tension members No</p> <p>8) Are there any antenna ports (ref. 3.1.3) No</p>
Reference definition	<p>3.1.3 antenna port port, other than a broadcast receiver tuner port (3.1.8), for connection of an antenna used for intentional transmission and/or reception of radiated RF energy</p> <p>3.1.8 broadcast receiver tuner port port intended for the reception of a modulated RF signal carrying terrestrial, satellite and/or cable transmissions of audio and/or video broadcast and similar services Note 1 to entry: This port may be connected to an antenna, a cable distribution system, a VCR or similar device.</p> <p>3.1.25 optical fibre port port at which an optical fibre is connected to an equipment</p> <p>3.1.29 RF modulator output port port intended to be connected to a broadcast receiver tuner port in order to transmit a signal to the broadcast receiver</p> <p>3.1.32 wired network port port for the connection of voice, data and signalling transfers intended to interconnect widelydispersed systems by direct connection to a single-user or multi-user communication network</p>



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	<p>Note 1 to entry: Examples of these include CATV, PSTN, ISDN, xDSL, LAN and similar networks. Note 2 to entry: These ports may support screened or unscreened cables and may also carry AC or DC power where this is an integral part of the telecommunication specification.</p>
Basic EUT functionality description	2.4GHz 802.15.4 Transceiver
High level block diagram of EUT (attachment)	
Modes of operation	
Step by step instructions for setup and operation	
Customer to setup EUT on site?	No
EUT response time (ms)	<= 0.5ms
EUT setup time (min)	10
Frequency of all clocks present in EUT	38.4MHz
I/O cable description Specify length and type	
Available connectors on EUT	None
Peripherals required to exercise EUT Ex. Signal generator	
Dimensions of product	L 100mm W 100mm H 2mm
Method of monitoring EUT and description of failure for immunity.	COmmunication feedback
Other notes to test lab (URL to product, etc).	

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