

EMC & RF Test Report
As per
RSS-247 Issue 1
&
FCC Part 15 Subpart 15.247

Unlicensed Intentional Radiators

on the

Zigbee Module
ZBM1501



Issued by:

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A handwritten signature in black ink, appearing to read 'Abderrahmane Ferhat', is written over a horizontal line.

Testing produced for

sinopé

See Appendix A for full client &
EUT details.





Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

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Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Report Scope

This report addresses the EMC verification testing and test results of the **Zigbee Module: ZBM1501**, and is herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:


RSS-247 Issue 1:2015

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.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc, unless otherwise stated.


Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Summary

The results contained in this report relate only to the item(s) tested.

EUT:	ZBM1501
FCC Certification #, FCC ID:	2AK2T-ZBM1501
Industry Canada Certification #, IC:	22394-ZBM1501
EUT passed all tests performed	Yes
Tests conducted by	Abderrahmane Ferhat


For testing dates, see "Testing Environmental Conditions and Dates".

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS-GEN (Table 6)	Restricted Bands for Intentional Operation	QuasiPeak Average	Pass See Justification
FCC 15.209 RSS-GEN (Table 4)	Spurious Radiated Emissions	QuasiPeak Average	Pass
FCC 15.247(a)2 RSS-247 5.2(1)	6 dB Bandwidth	> 500 kHz	Pass
FCC 15.247(b)2 RSS-247 5.4(4)	Max Output Power	< 1 Watt	Pass
FCC 15.247(b)4 RSS-247 5.4(4)	Antenna Gain	< 6 dBi	Pass See Justifications
FCC 15.247(d) RSS-247 5.5	Antenna Conducted Spurious	< 20 dBc	Pass
FCC 15.247(e) RSS-247 5.2(2)	Spectral Density	< 8 dBm (3 kHz BW)	Pass
FCC 15.247(i) RSS-102	RF Exposure	> 20 cm separation.	Pass See justification and Calculations
Overall Result			Pass

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '*'.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
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Notes, Justifications, or Deviations

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, (2.1 dBi gain) with less than 6 dBi gain.

For the Restricted Bands of operation, the EUT is designed to only operate 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 axis to maximize emissions. Worst case results are presented.

For maximum permissible exposure, this device operates at less than 1 Watt at 2400 – 2483.5 MHz and is designed to operate greater than 20 cm from personnel during normal operation. No testing is required, however worst case calculated exposure compliance follows later in this report.


Sample Calculation(s)

Radiated Emission Test

Margin = Limit – (Received Signal + Antenna Factor + Cable Loss – Pre-Amp Gain)


Margin = 50.5dB μ V/m – (50dB μ V + 10dB + 2.5dB – 20dB)

Margin = 8.0 dB (pass)

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Applicable Standards, Specifications and Methods

- ANSI C63.4:2014 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
- ANSI C63.10:2013 American National Standard For Testing Unlicensed Wireless Devices
- CFR 47 FCC 15 Subpart C:2016 Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
- CISPR 22:2008 Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement
- FCC KDB 558074: 2016 FCC KDB 558074 Digital Transmission Systems, measurements and procedures
- ICES-003 Issue 6 2016 Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
- RSS-GEN Issue 4 2014 General Requirements and Information for the Certification of Radio Apparatus
- RSS-247 Issue 1:2015 Issue 1: Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
- ISO 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Document Revision Status

Revision 1 - April 21, 2017. Initial Release.
Revision 2 - May 15, 2017. Added RF Exposure section. Corrected antenna gain.
Removed Appendix B.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Definitions and Acronyms

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

AE – Auxiliary Equipment. A digital accessory that feeds data into or receives data from another device (host) that in turn, controls its operation.

BW – Bandwidth. Unless otherwise stated, this refers to the 6 dB bandwidth.

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMI – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.


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

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line Impedance Stabilization Network

NCR – No Calibration Required

RF – Radio Frequency


Client	Sinope Technologies Inc.	
Product	ZBM1501	
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Testing Facility

Testing for EMC on the EUT was carried out at TÜV SÜD Canada testing lab in Laval, near Montréal, Québec, Canada. The testing lab has a calibrated 3m semi-anechoic chamber which allows measurements on an EUT that has a maximum width or length of up to 2m and a height of up to 3m. The chamber is equipped with a turntable that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120Vac and 240Vac single phase, or devices that are rated for a 208Vac 3 phase input. DC capability is also available for testing. The chamber is equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. Radiated emission measurements are performed using a BiLog antenna and a Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN and using the Vertical Ground plane if applicable. For ESD testing, the HCP is 1.6m x 0.8m and the VCP is 0.5m x 0.5m. The reference ground plane, when applicable, is 1.6m x 1.6m.

Calibrations and Accreditations


The 3m semi-anechoic chamber is registered with Federal Communications Commission (FCC, 382292) and Industry Canada (IC, 6844B-1). This chamber was calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at TÜV SÜD Canada. For radiated susceptibility testing, a 16 point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc is accredited to ISO 17025 by A2LA with Testing Certificate #2955.02. The laboratory's current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

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Testing Environmental Conditions and Dates

Following environmental conditions were recorded in the facility during time of testing

Date	Test	Initials	Temperature (°C)	Humidity (%)	Pressure (kPa)
09-Feb-2017 to 24-Feb-2017	Radiated Emissions	AF	20 – 24	40 – 51	98.0 – 102.0
09-Mar-2017	Antenna Conducted Emissions	AF	20 – 24	40 – 51	98.0 – 102.0

Client	Sinope Technologies Inc.	
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Detailed Test Results Section

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

6dB Bandwidth of Digitally Modulated Systems

Purpose

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.

Limits and Method

The limit is as specified in FCC Part 15.247(a)2 and RSS-247.

Systems using digital modulation techniques may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz, and 5725 - 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz. This should be measured with a 100 kHz RBW and a 300 kHz VBW.


The method is given in Section 8.1 of FCC KDB 558074 and ANSI C63.10.

Results

The EUT passed.

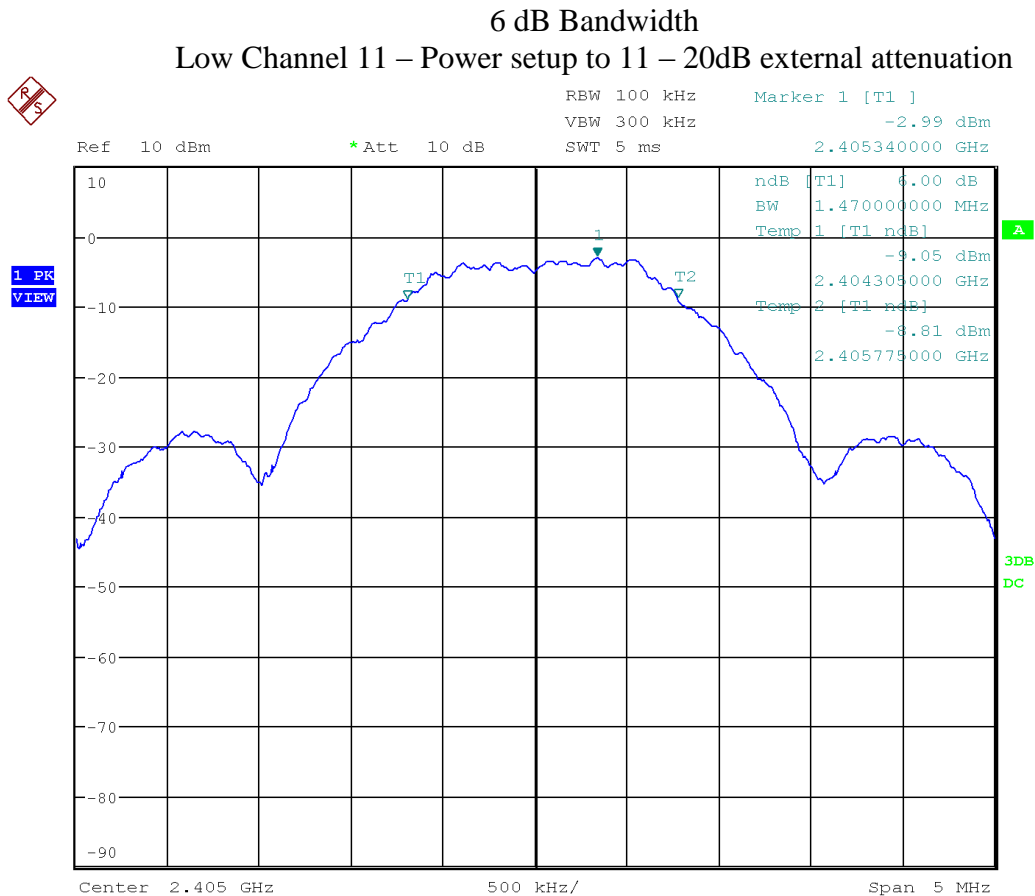
The minimum 6 dB BW measured was 1.260 MHz, and the maximum 99% BW was 2.335MHz (channel 26) .

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Lo Channel 11	2405	1.470	2.240
Mid Channel 18	2440	1.420	2.280
Hi Channel 24	2470	1.467	2.270
Hi Channel 25	2475	1.260	2.305
Hi Channel 26	2480	1.310	2.335


Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Graphs

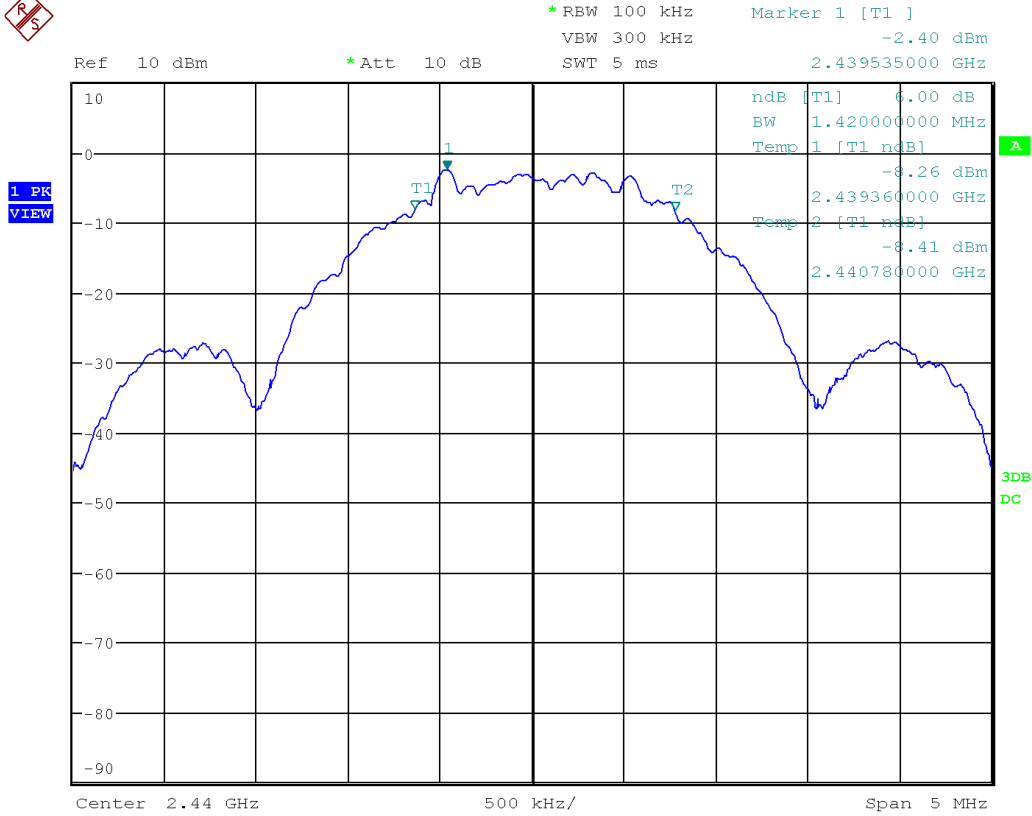
The graphs showed below show the OBW during the operation of the device. This is measured by a max hold on the spectrum analyzer and the highest resolution bandwidth that is sufficiently low to exhibit the 6 dB bandwidth of a channel during operation of the EUT. Max hold is performed for a duration of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




Date: 9.MAR.2017 16:04:21

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

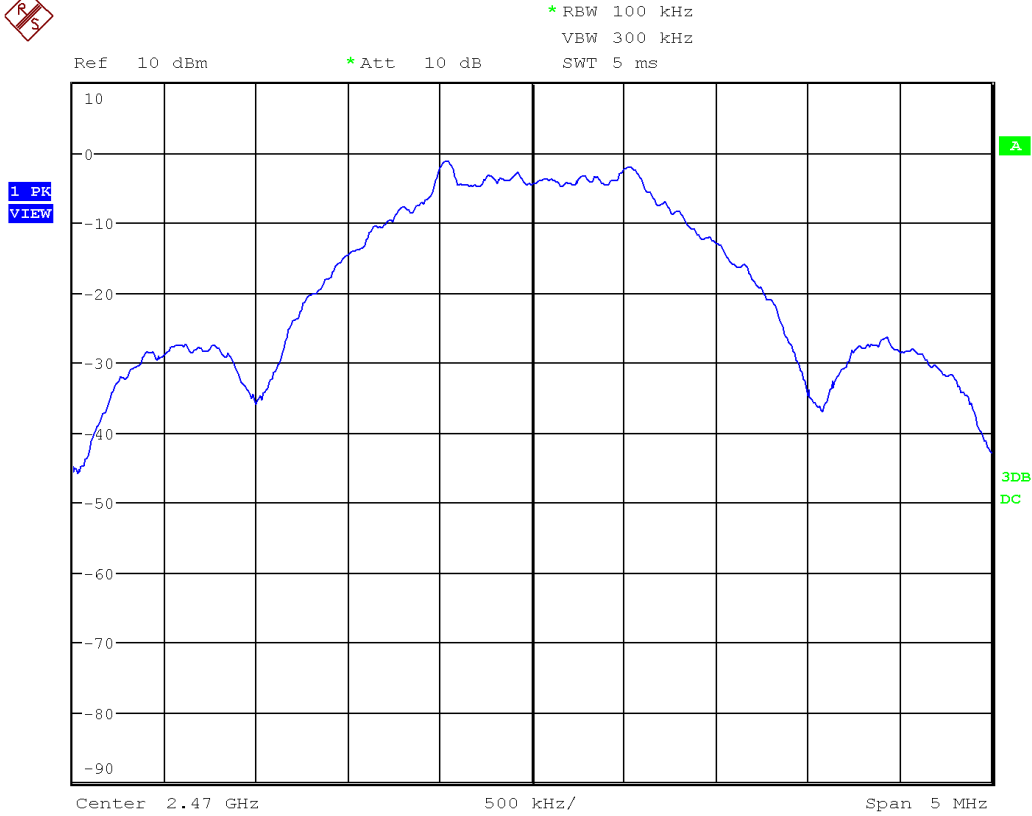
6 dB Bandwidth
Mid Channel 18 – Power setup to 11 – 20dB external attenuation




Date: 9.MAR.2017 16:27:43

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

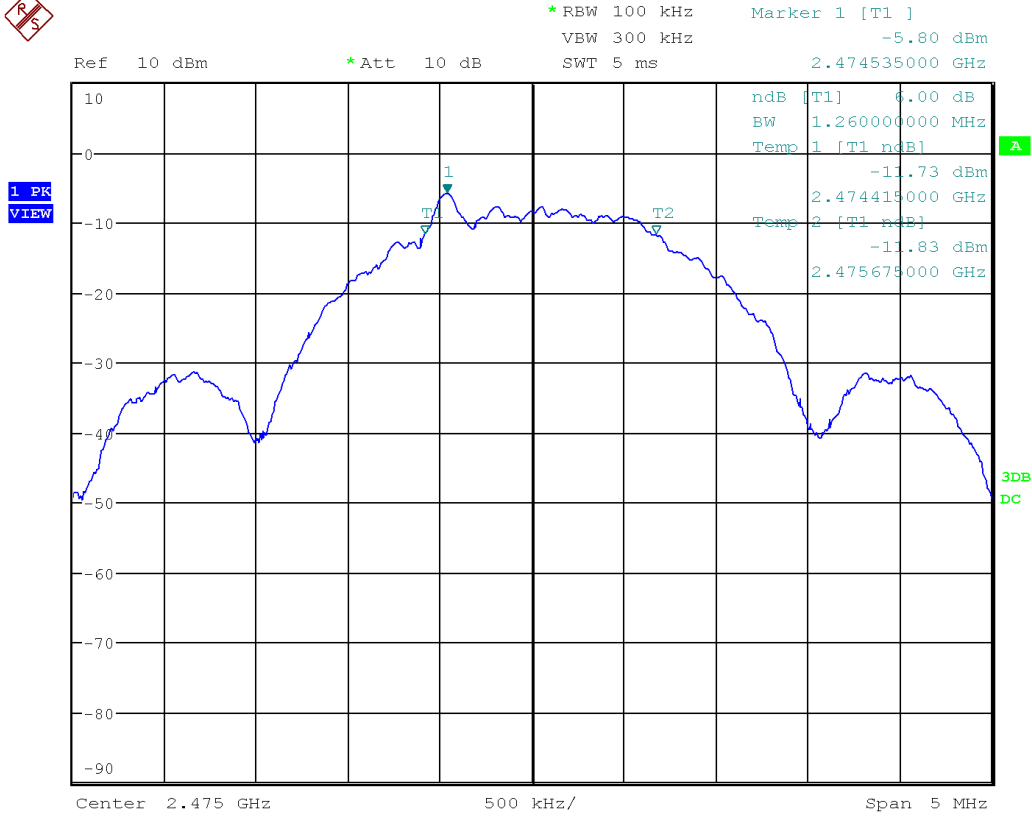
6 dB Bandwidth
Hi Channel 24 – Power setup to 11 – 20dB external attenuation




Date: 9.MAR.2017 16:45:29

Client	Sinope Technologies Inc.	 Canada
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

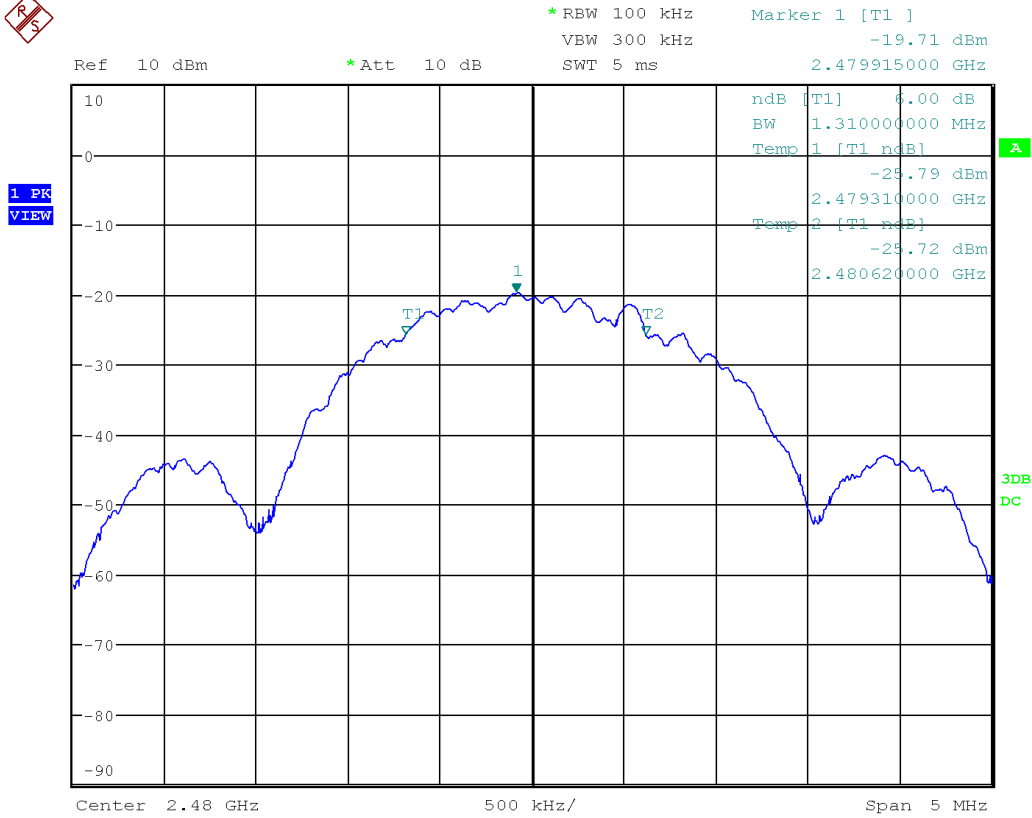
6 dB Bandwidth
Hi Channel 25 – Power setup to 13 – 20dB external attenuation




Date: 9.MAR.2017 16:43:51

Client	Sinope Technologies Inc.	 Canada
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

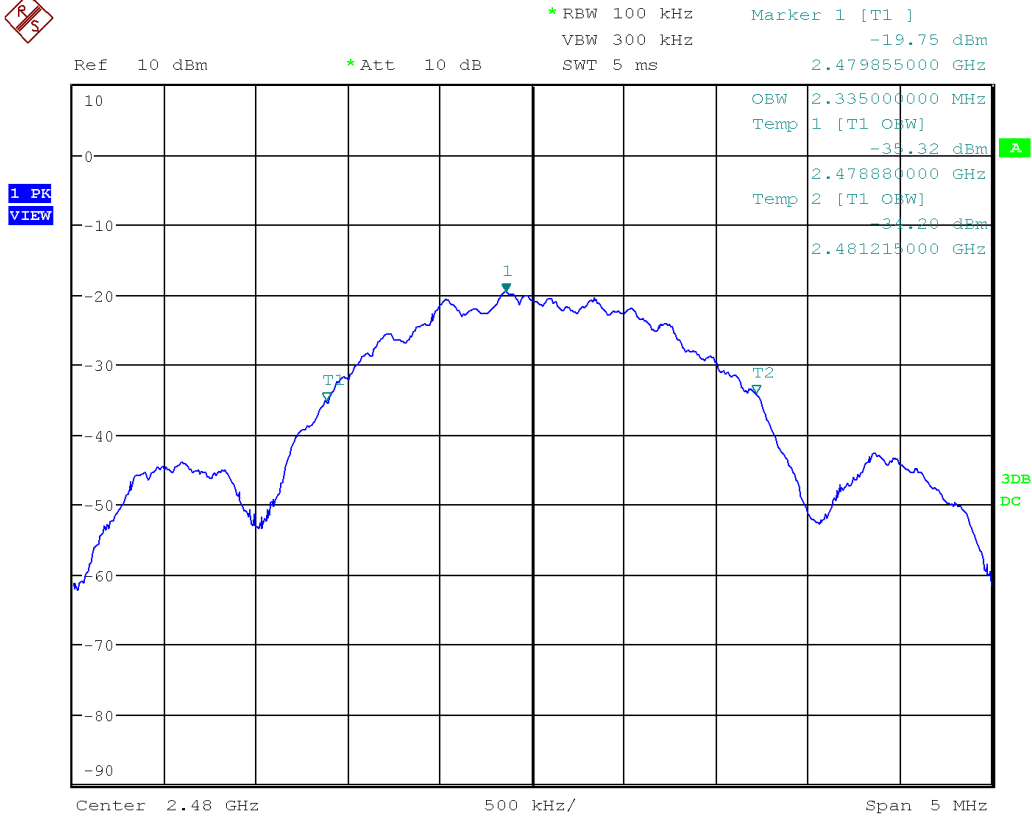
6 dB Bandwidth
Hi Channel 26 – Power setup to 15 – 20dB external attenuation



Date: 9.MAR.2017 16:41:42


Client	Sinope Technologies Inc.	 Canada
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

99% Bandwidth
Hi Channel 26 – Power setup to 15 – 20dB external attenuation




Date: 9.MAR.2017 16:52:11

Note: See ‘Appendix B – EUT & Test Setup Photos’ for photos showing the test set-up.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU-40	Rohde & Schwarz	Jan 28, 2016	Jan 28, 2018	4092
Attenuator 10 dB	4779-10	narda	NCR	NCR	4096

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Maximum Peak Envelope Conducted Power - DM

Purpose

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.

Limits and Method

The limits are defined in FCC Part 15.247(b) and RSS-247.


For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, the peak limit is 1 watt (30 dBm).

The method is given in Section 9.1.2 of FCC KDB 558074 and ANSI C63.10.

Results

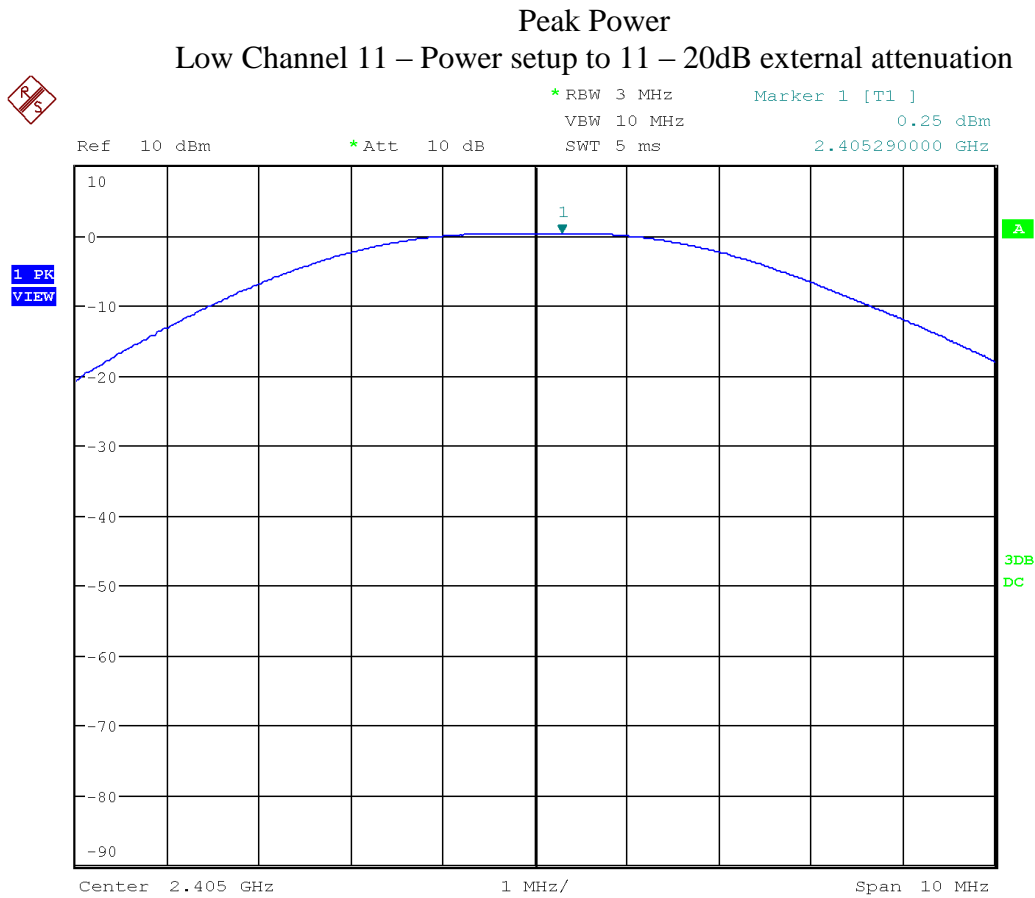
The EUT passed. The EUT was set to transmit at maximum power up to channel 24 (PWR = 128.8 mW). Channels 25 and 26 were set to lower power to comply with the bandedge limits. The following table shows the peak power:

Channel	Frequency (MHz)	Measured Peak Power dBm	External & Cable Attenuation dB	Corrected Peak Power dBm	Peak Power (mW)
Lo Channel 11	2405	0.3	20.5	20.8	120.2
Mid Channel 18	2440	0.5	20.5	21.0	125.9
Hi Channel 24	2470	0.6	20.5	21.1	128.8
Hi Channel 25	2475	-4.3	20.5	16.2	41.7
Hi Channel 26	2480	-16.8	20.5	3.7	2.3


Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Graphs

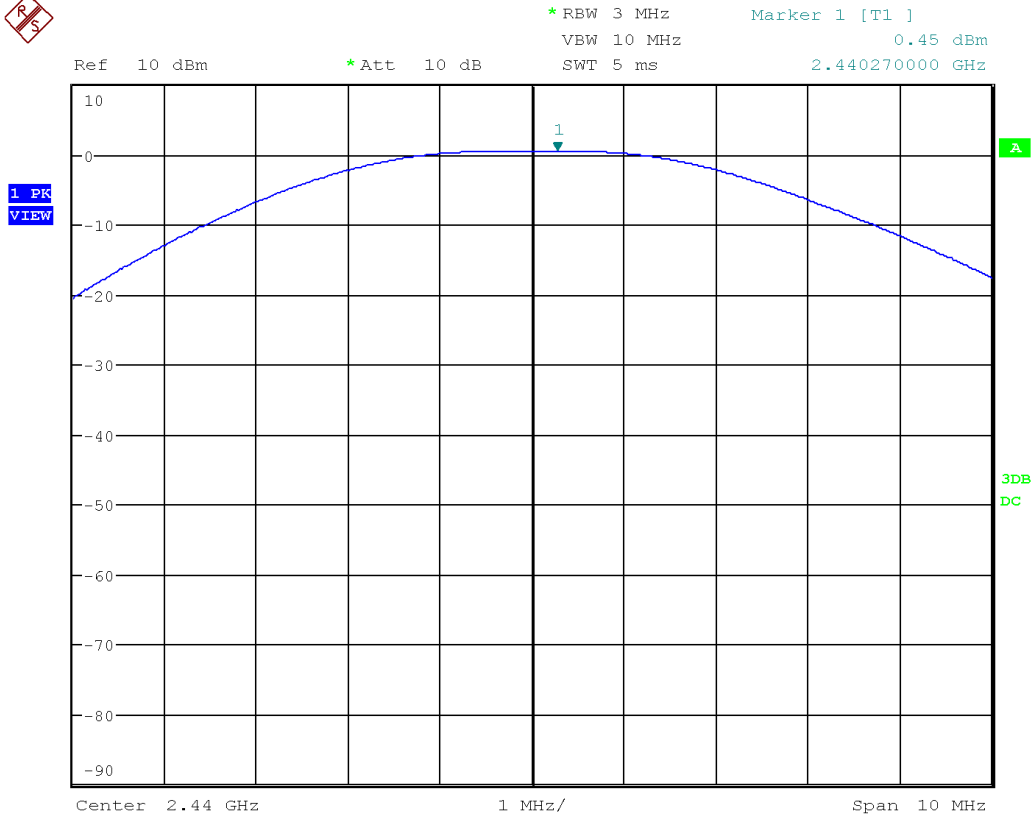
The plots shown below show the peak power output of the device during the antenna conducted measurements during transmit operation of the EUT.




Date: 9.MAR.2017 16:15:40

Client	Sinope Technologies Inc.	 Canada
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

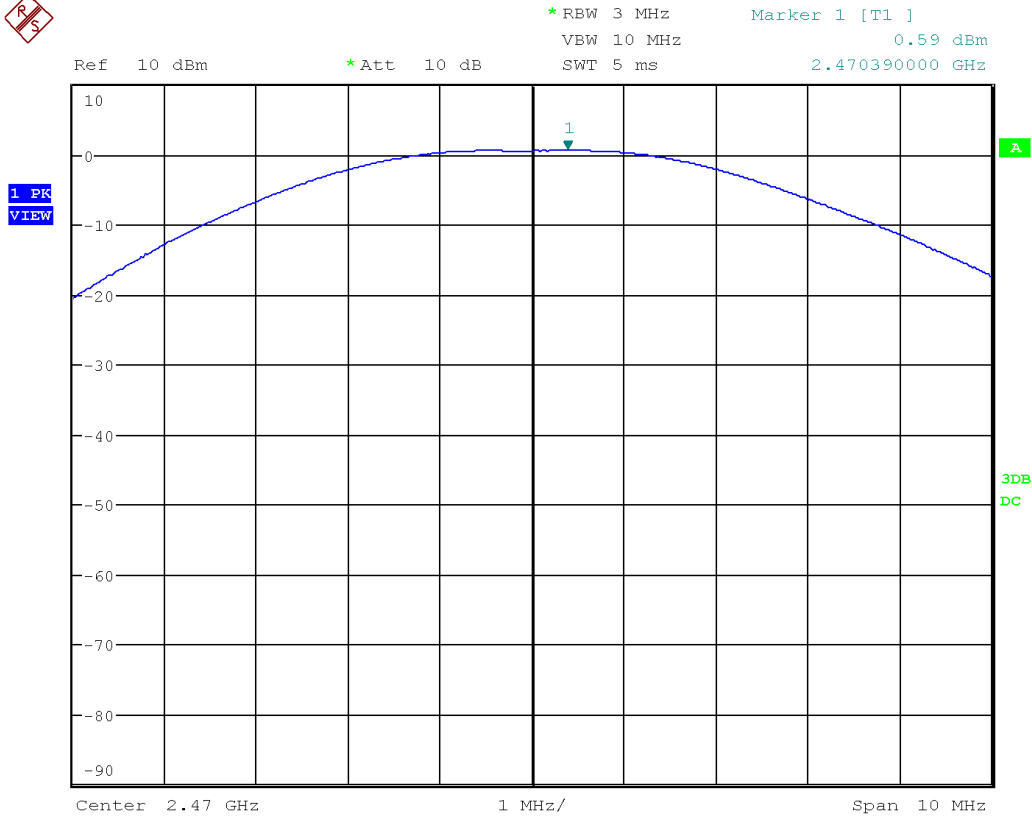
Peak Power
Mid Channel 18 – Power setup to 11 – 20dB external attenuation




Date: 9.MAR.2017 16:33:04

Client	Sinope Technologies Inc.	 Canada
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Peak Power
Hi Channel 24 – Power setup to 11 – 20dB external attenuation



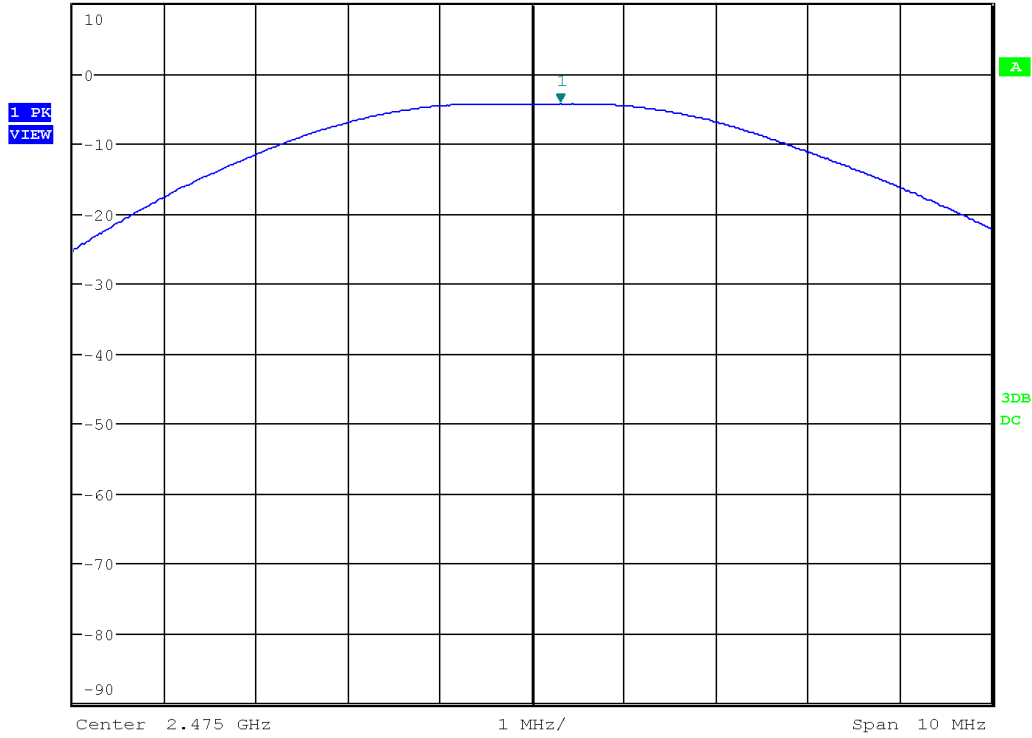
Date: 9.MAR.2017 16:36:02

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


Peak Power
Hi Channel 25 – Power setup to 13 – 20dB external attenuation



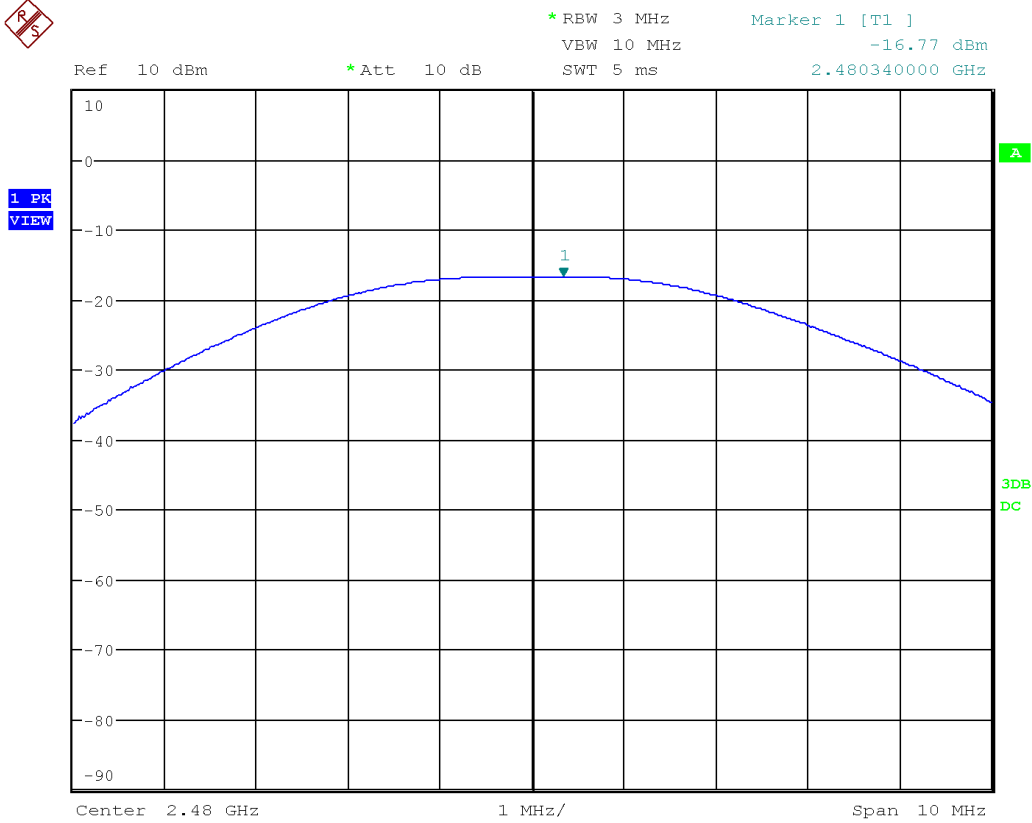
*RBW 3 MHz Marker 1 [T1]
 VEW 10 MHz -4.28 dBm
 Ref 10 dBm *Att 10 dB SWT 5 ms 2.475310000 GHz



Date: 9.MAR.2017 16:37:25


Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Peak Power
Hi Channel 26 – Power setup to 15 – 20dB external attenuation




Date: 9.MAR.2017 16:38:39

See 'Appendix B – EUT and Test Setup Photos' for photos showing the test set-up.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU-40	Rohde & Schwarz	Jan 28, 2016	Jan 28, 2018	4092
Attenuator 10 dB	4779-10	narda	NCR	NCR	4096

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Antenna Spurious Conducted Emissions (-20 dBc Requirement)

Purpose

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.


Limits and Method

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.

The method is given in Section 11 of FCC KDB 558074 and ANSI C63.10

Results

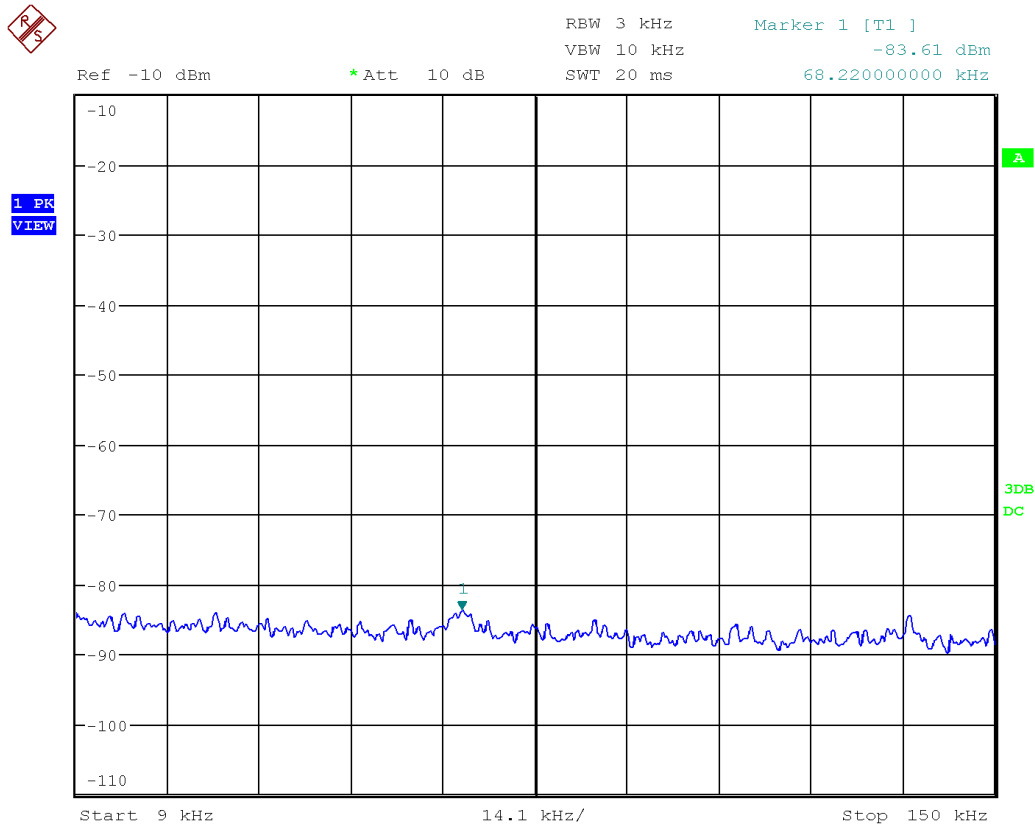
The EUT passed. Low, middle and high bands were measured. The worst case is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band and also for the higher band edge at 2.4835 GHz in the high band.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


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. Note there was 20 dB of external attenuation during this measurement.

9 kHz to 150 kHz (Low channel 11)



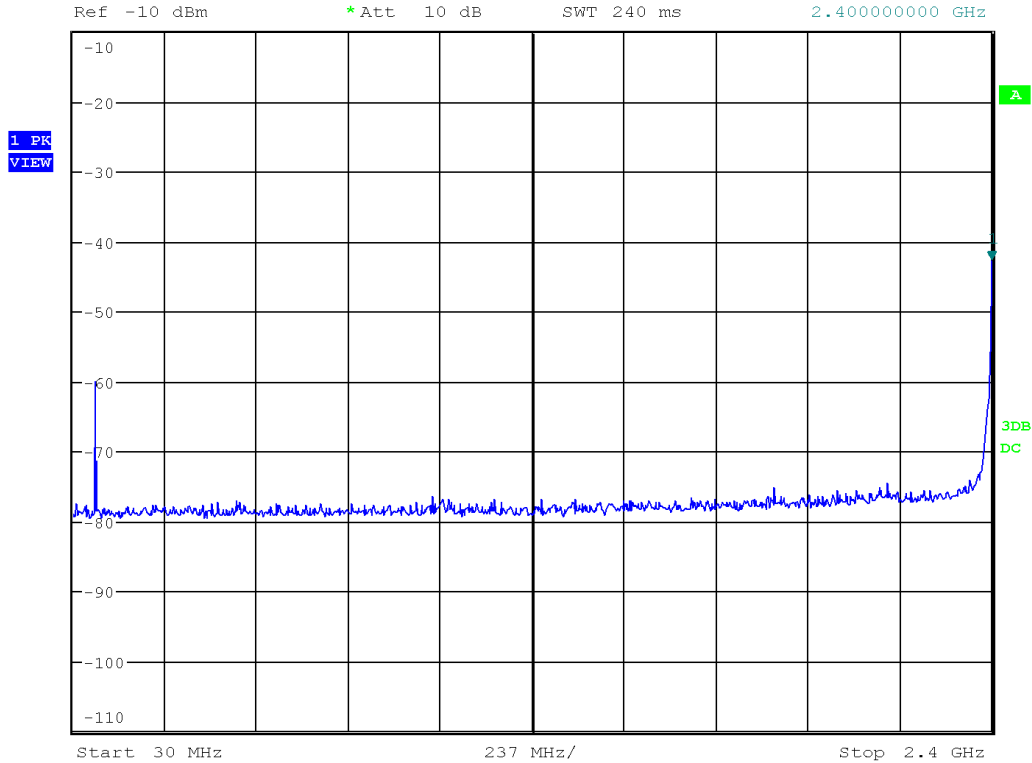
Date: 9.MAR.2017 08:50:21

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


30 MHz to 2.4 GHz (Low channel 11)



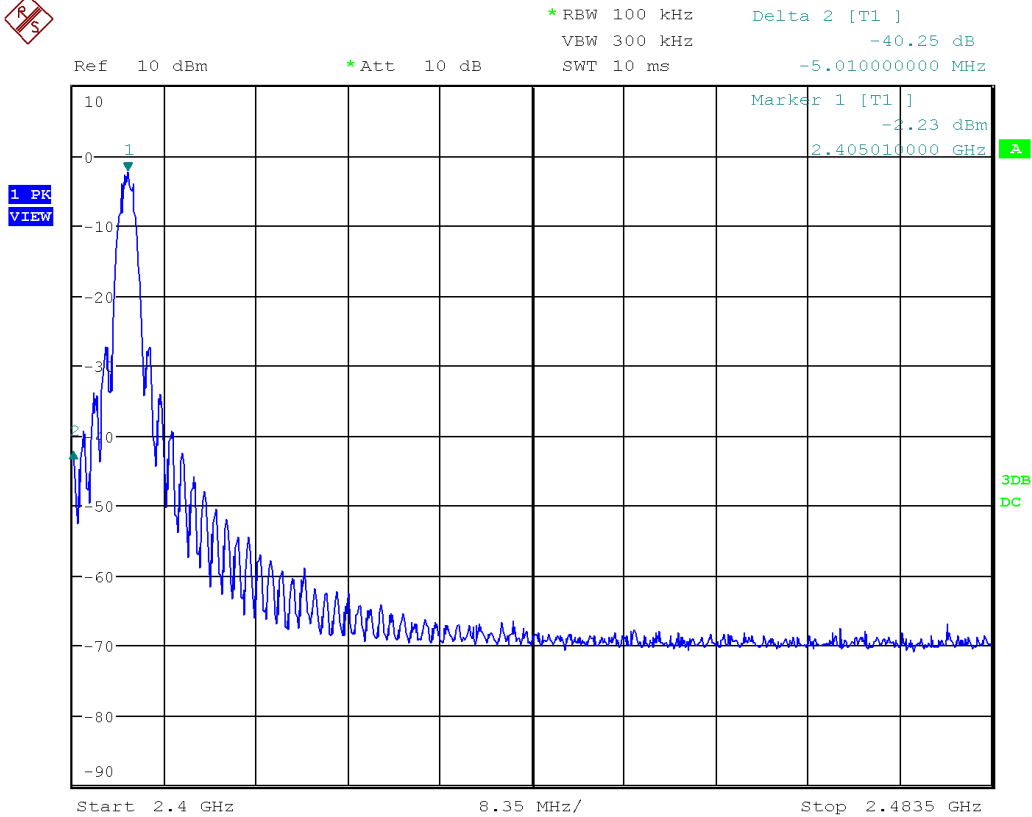
*RBW 100 kHz Marker 1 [T1]
 VBW 300 kHz -42.67 dBm
 SWT 240 ms 2.400000000 GHz




Date: 9.MAR.2017 08:58:36

Client	Sinope Technologies Inc.	 Canada
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

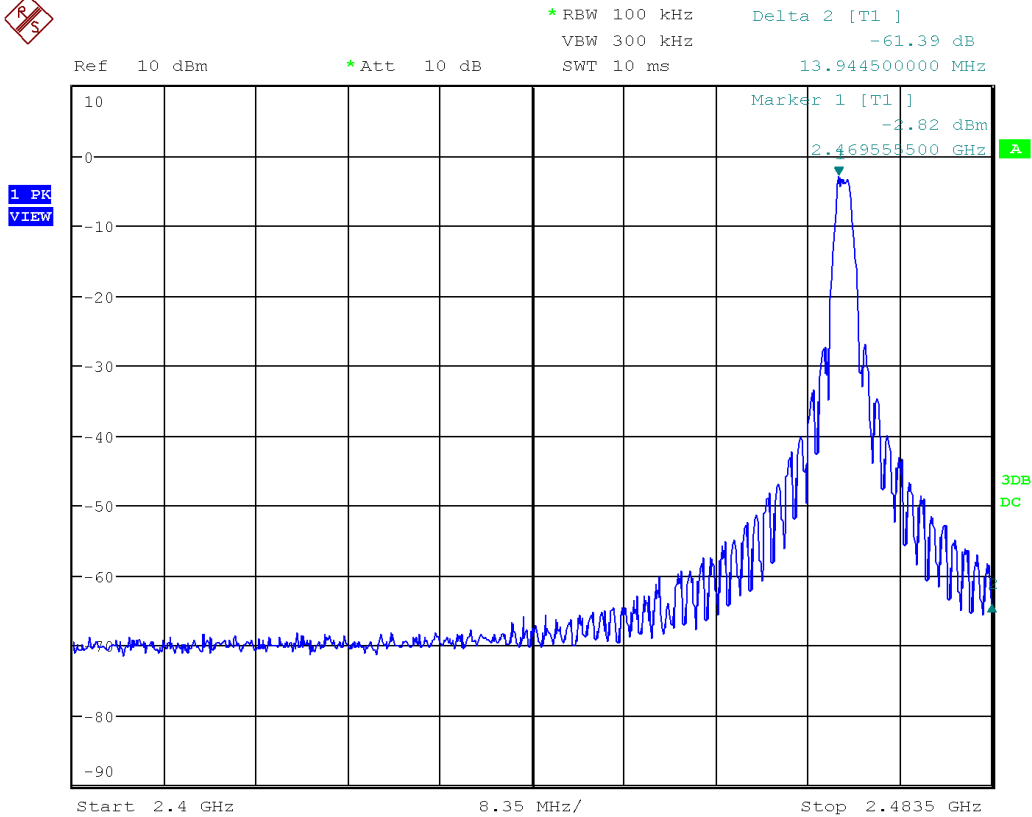
2.4 GHz to 2.4835 GHz (Low channel 11 – band edge)




Date: 9.MAR.2017 09:03:05

Client	Sinope Technologies Inc.	 Canada
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

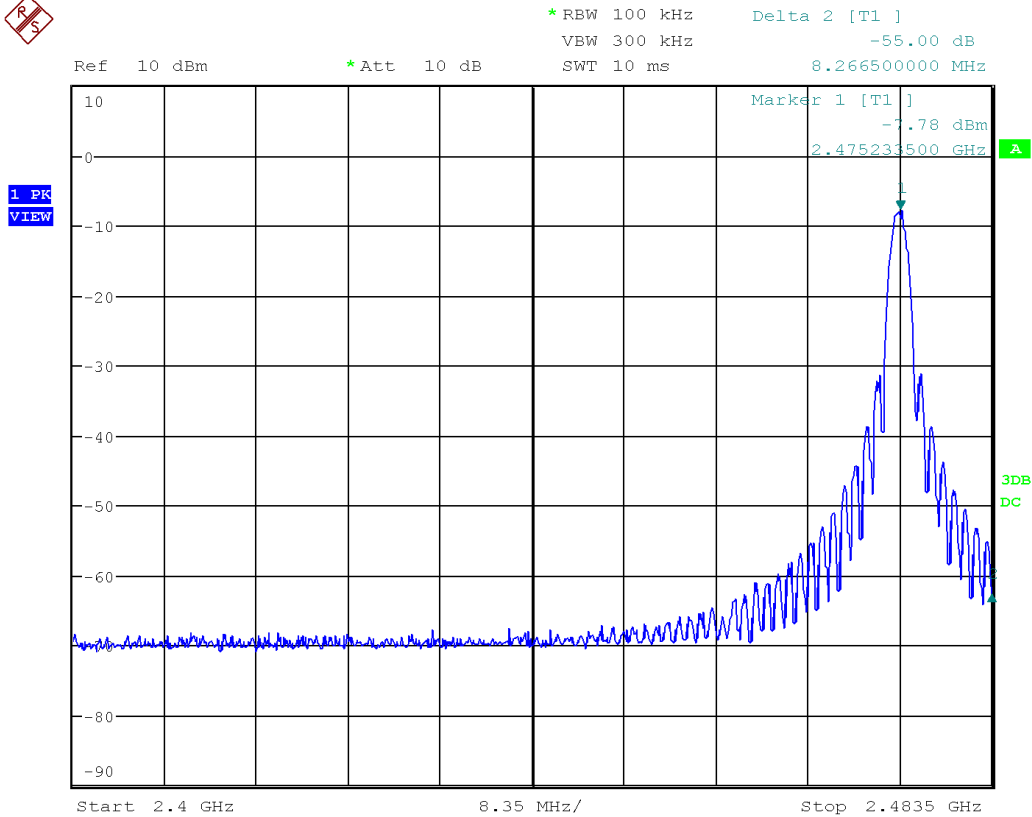
2.4 GHz to 2.4835 GHz (high channel 24 – band edge)




Date: 9.MAR.2017 09:49:04

Client	Sinope Technologies Inc.	 Canada
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

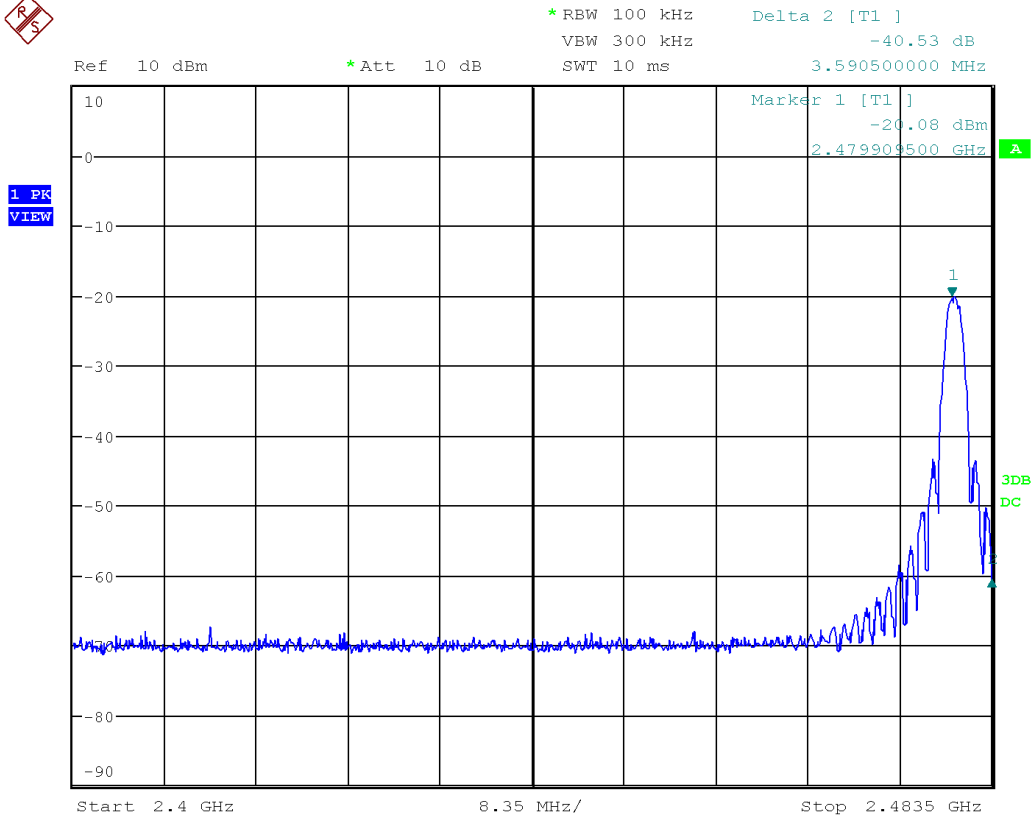
2.4 GHz to 2.4835 GHz (high channel 25 – band edge)




Date: 9.MAR.2017 09:57:27

Client	Sinope Technologies Inc.	 Canada
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

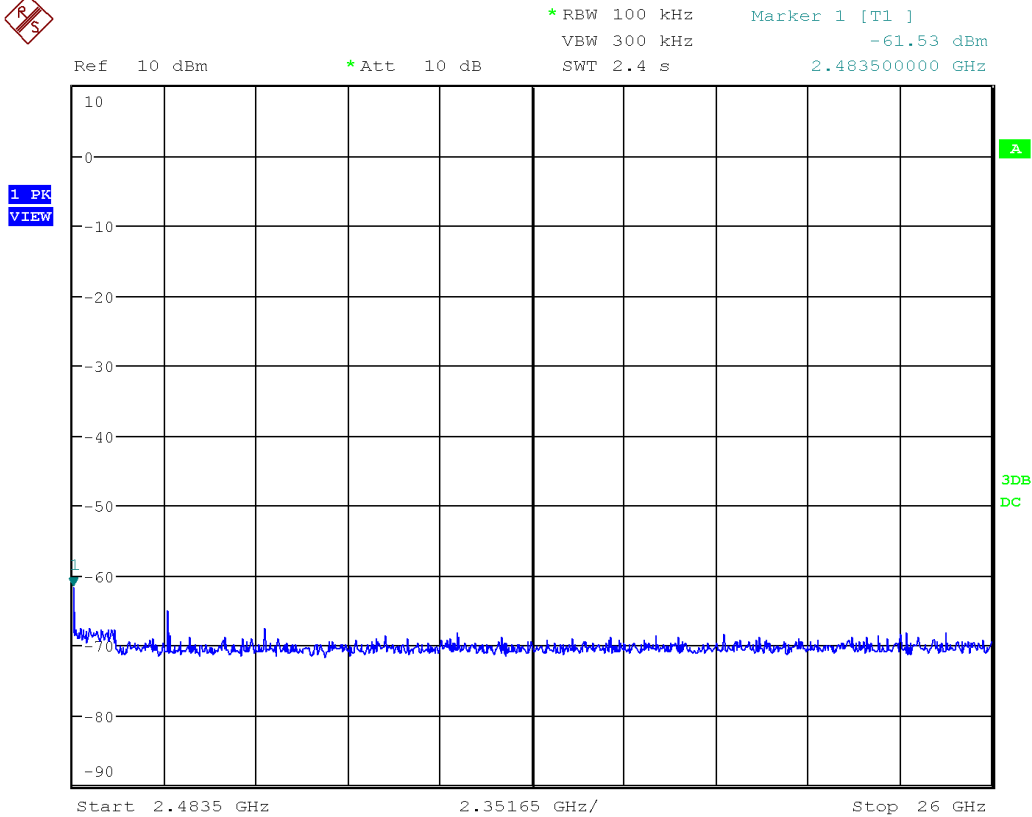
2.4 GHz to 2.4835 GHz (high channel 26 – band edge)



Date: 9.MAR.2017 09:37:27


Client	Sinope Technologies Inc.	 Canada
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

2.4835 GHz to 26 GHz (High channel 24)




Date: 9.MAR.2017 09:44:12

See 'Appendix B – EUT and Test Setup Photos' for photos showing the test set-up.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
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Client	Sinope Technologies Inc.	
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Transmitter Spurious Radiated Emissions

Purpose

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.

Limits and Method

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 (-20dBc)’ 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 ¹) at 3m
88 MHz – 216 MHz	150 uV/m (43.5 dBuV/m ¹) at 3m
216 MHz – 960 MHz	200 uV/m (46.0 dBuV/m ¹) at 3m
Above 960 MHz	500 uV/m (54.0 dBuV/m ¹) at 3m
Above 1000 MHz	500 uV/m (54 dBuV/m ²) at 3m
Above 1000 MHz	500 uV/m (74 dBuV/m ³) at 3m

¹Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1

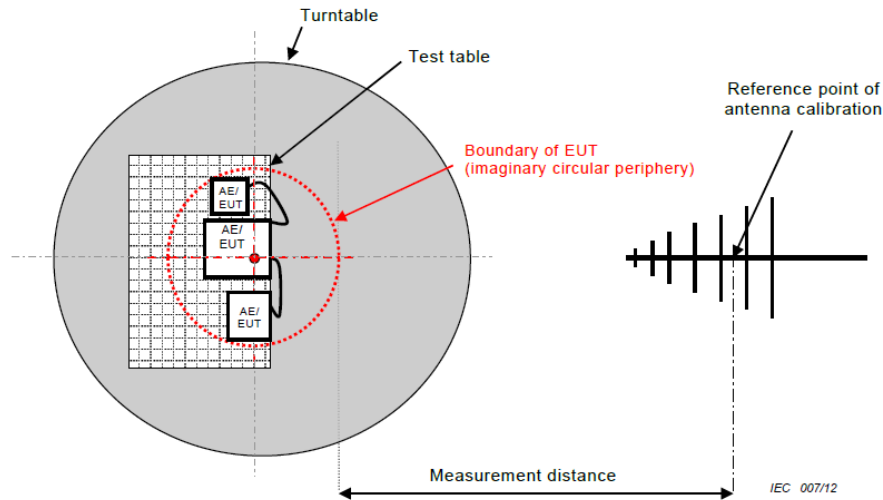
²Limit is with 1 MHz measurement bandwidth and using an Average detector

³Limit is with 1 MHz measurement bandwidth and using a Peak detector

Based on ANSI C63.4 Section 4.2, if the Peak detector measurements do not exceed the Quasi-Peak limits, where defined, then the EUT is deemed to have passed the requirements.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Typical Radiated Emissions Setup



Measurement Uncertainty

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


Preliminary 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).

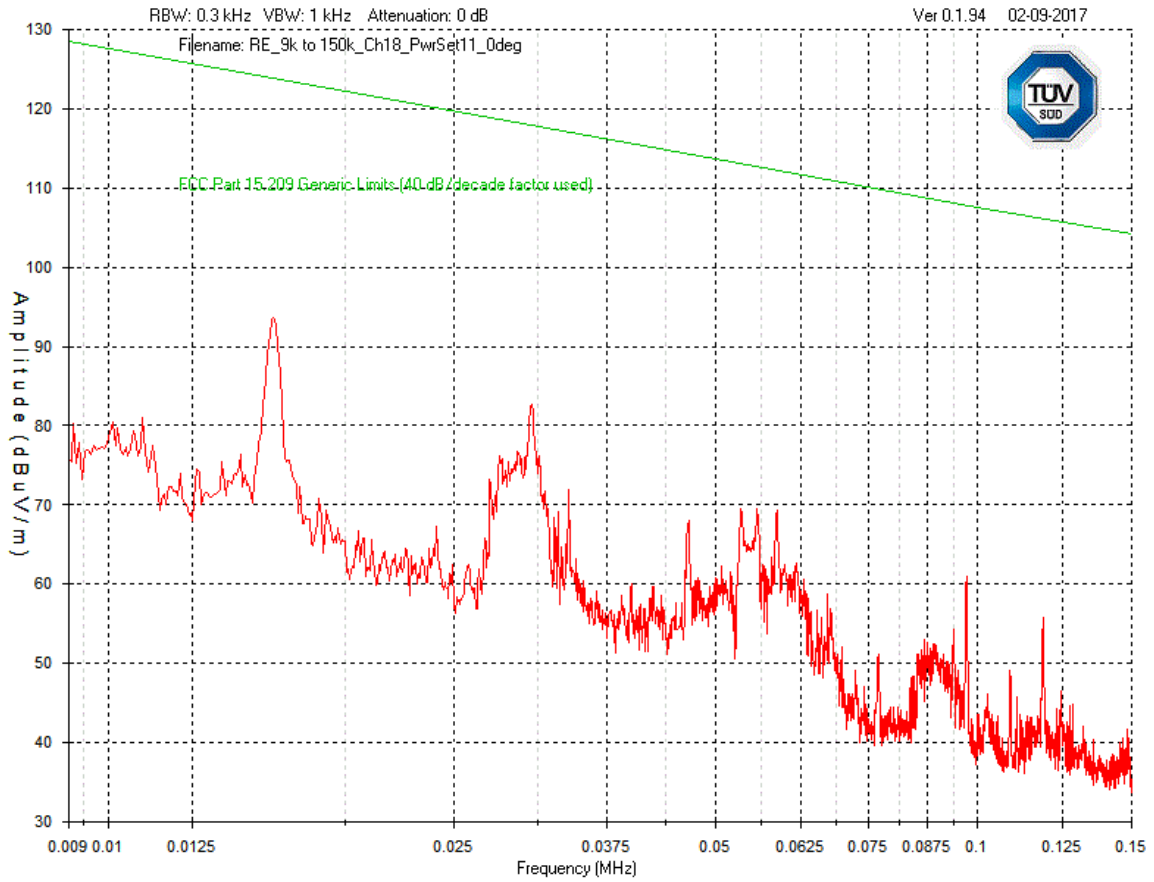
Devices scanned may be scanned at alternate test distances and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m /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


Low, middle and high channels, each in three orthogonal axis were checked. However, the worst case graphs are presented.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

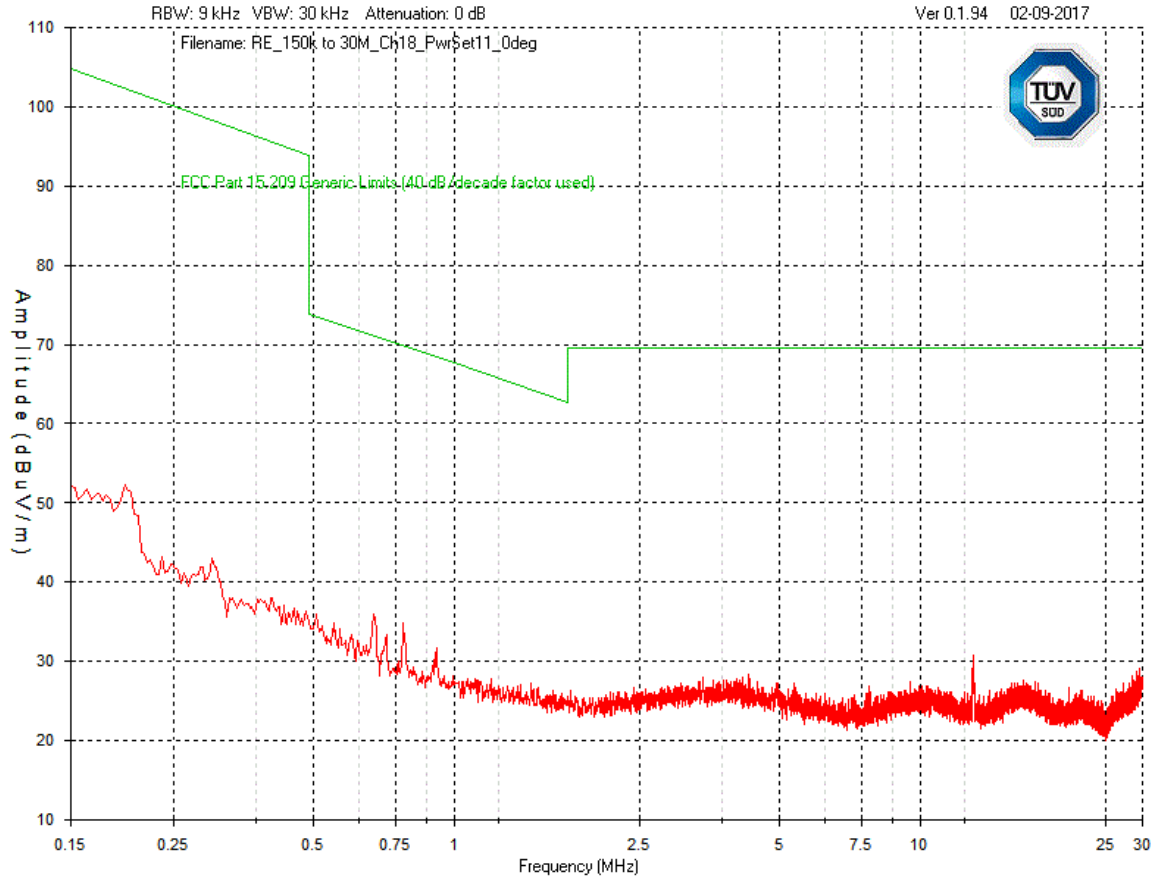
Band-edge measurement graphs are shown for illustration purposes. See final measurement section for all measurements.


Mid Channel 18
9 kHz – 150 kHz
Peak Emission Graph



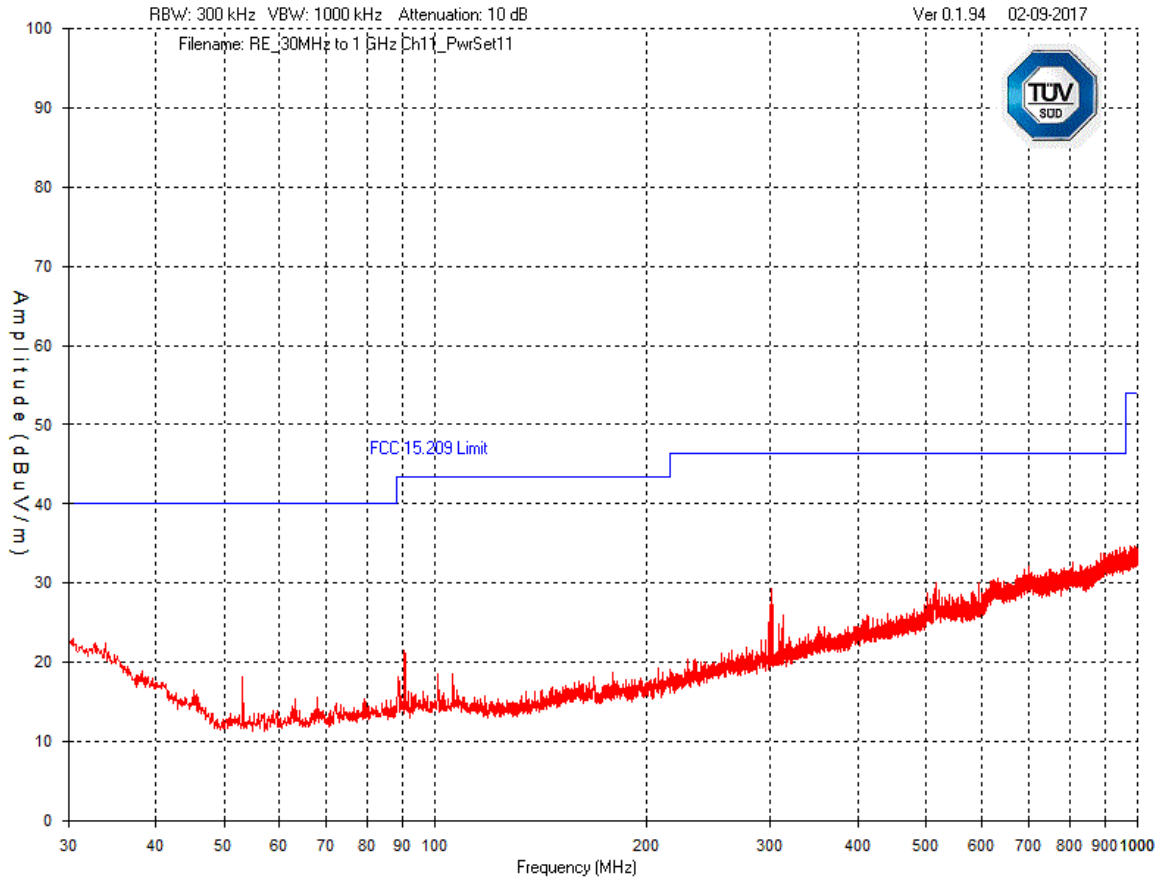
Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


Mid Channel 18
150 kHz – 30 MHz
Peak Emission Graph



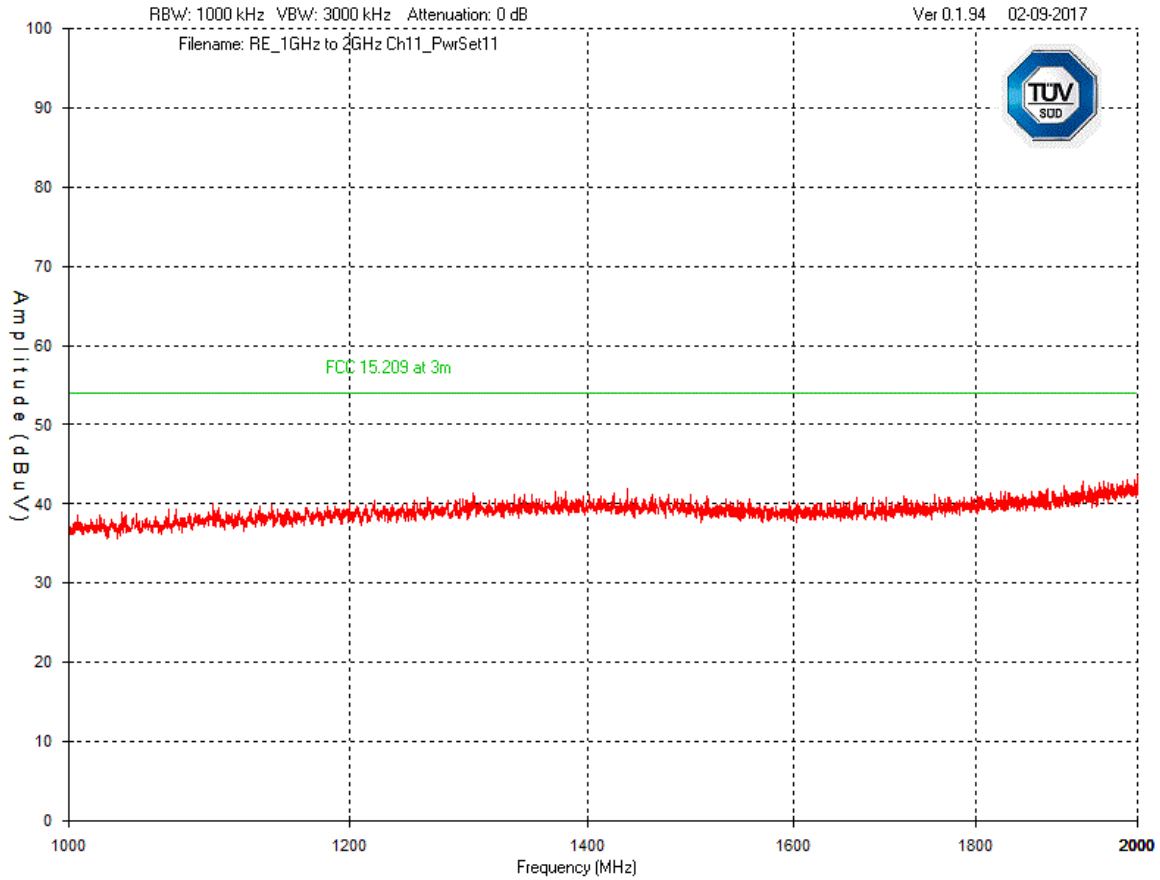
Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


**Low Channel 11 – 30 MHz – 1 GHz
Horizontal - Peak Emission Graph**



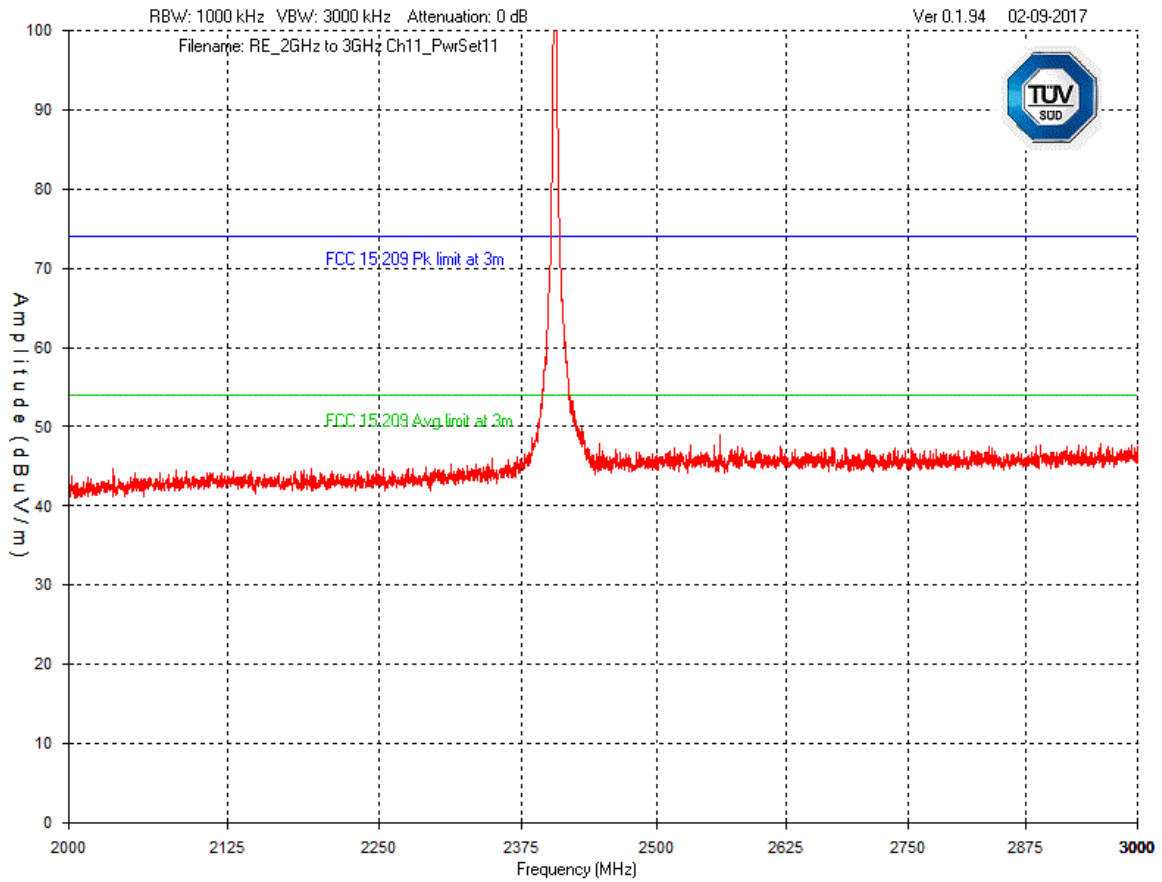
Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


**Low Channel 11 – 1 GHz – 2 GHz
Horizontal - Peak Emission Graph**



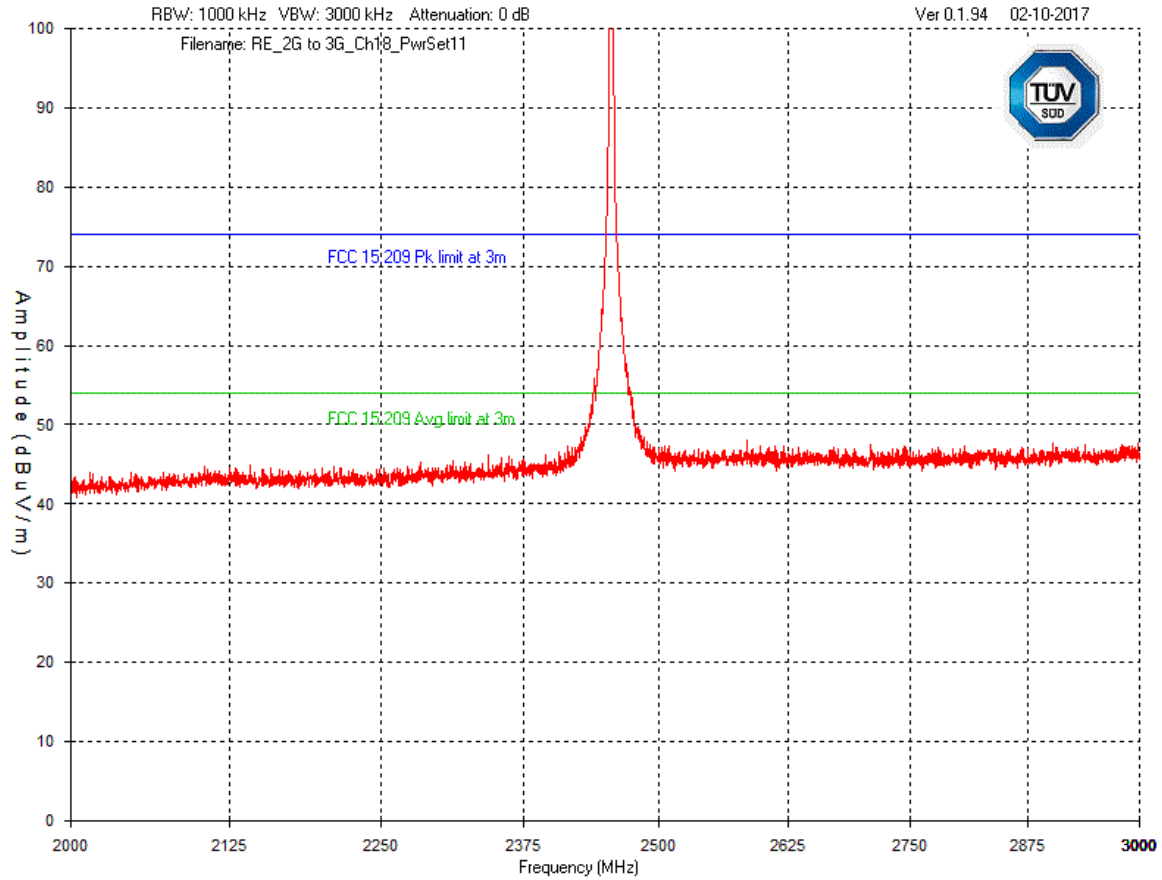
Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


**Low Channel 11 – 2 GHz – 3 GHz
Horizontal - Peak Emission Graph**



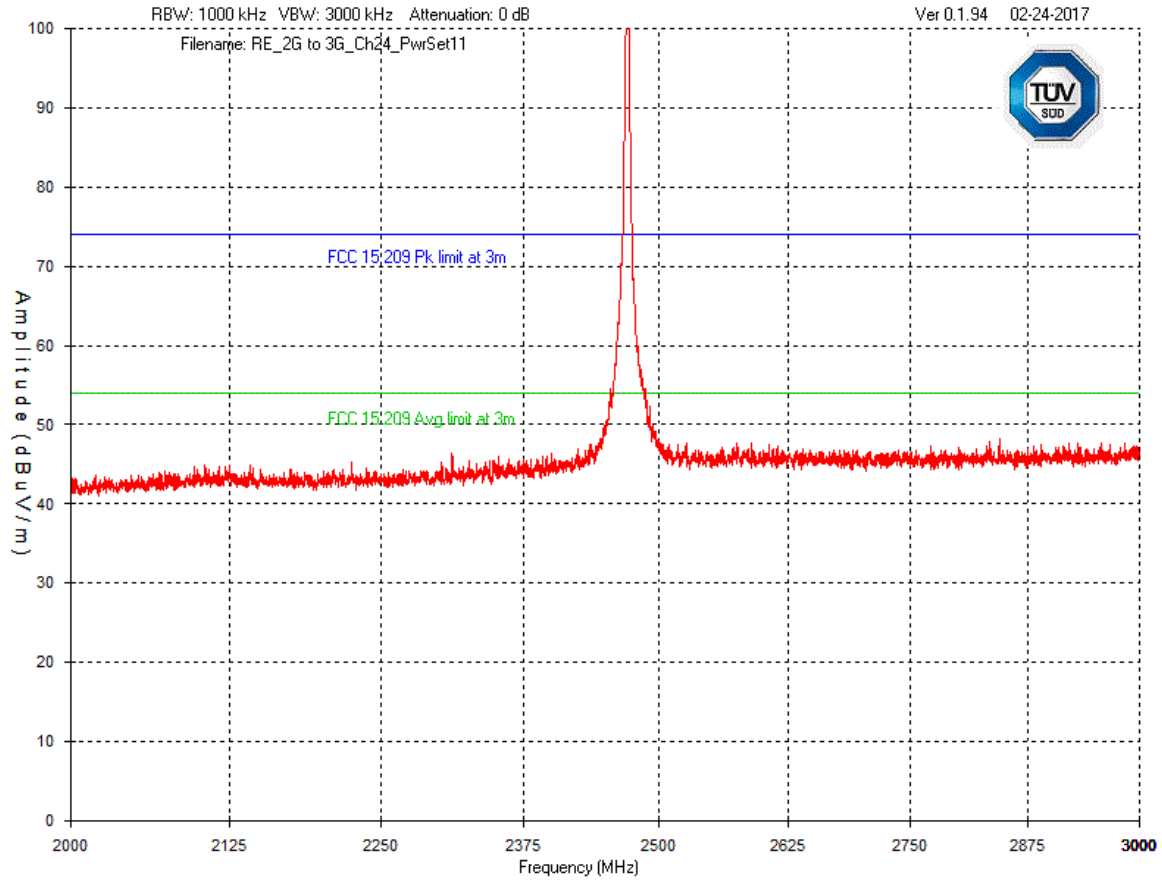
Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


**Mid Channel 18 – 2 GHz – 3 GHz
Horizontal - Peak Emission Graph**



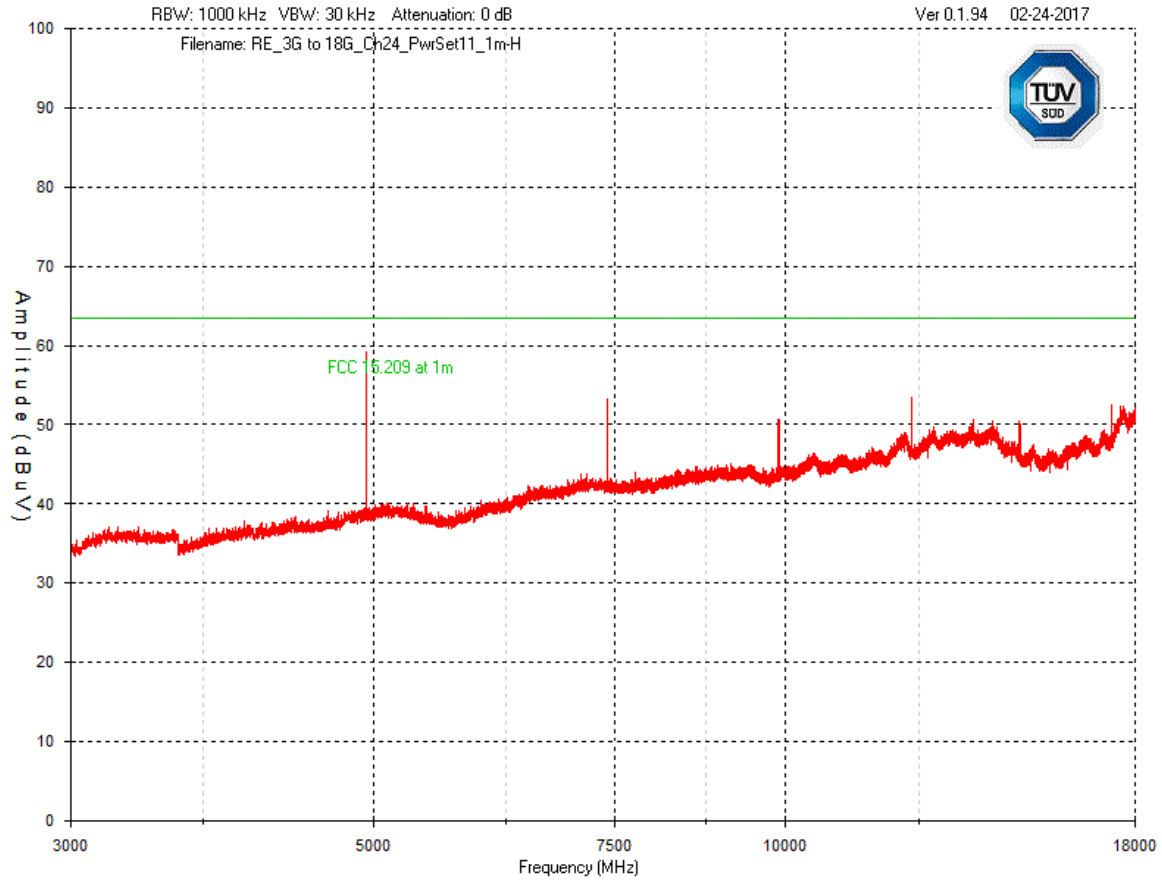
Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

High Channel 24 – 2 GHz – 3 GHz Horizontal - Peak Emission Graph




Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

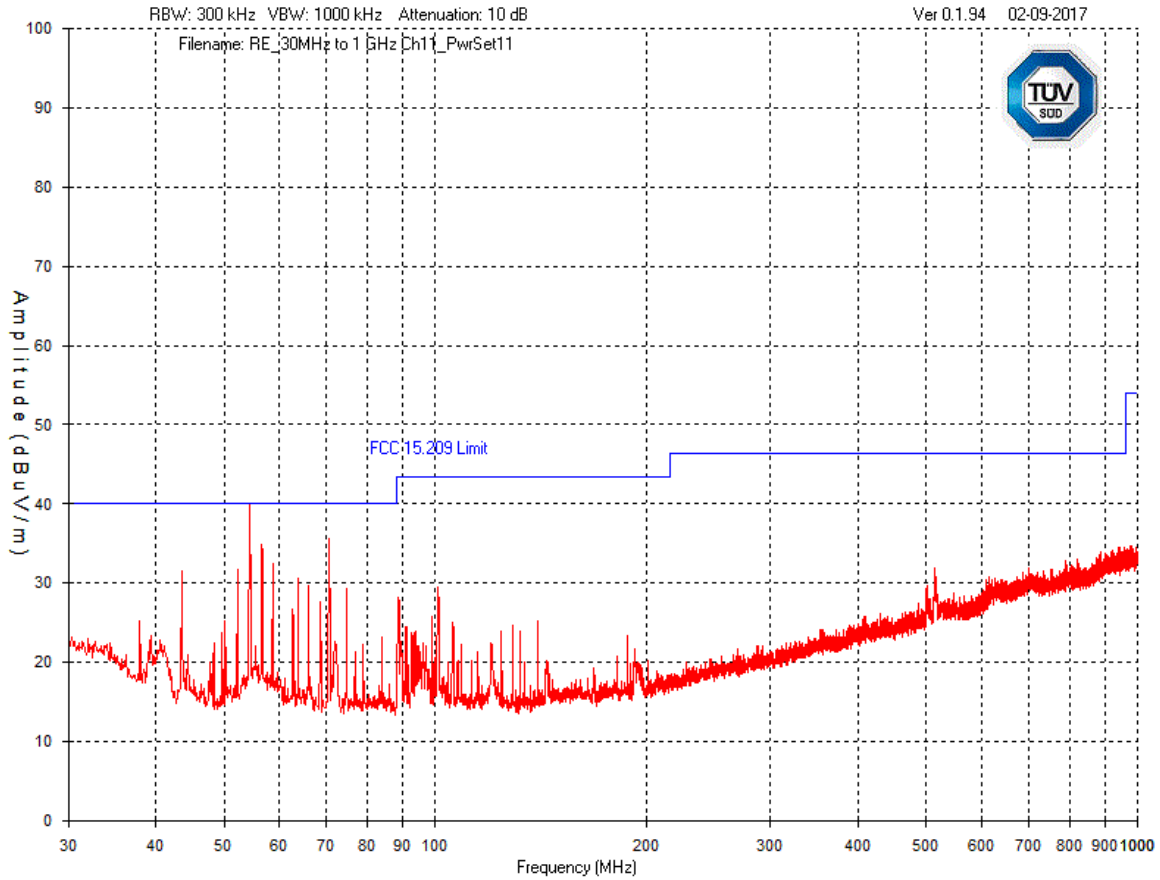
Hi Channel 24 – 3 GHz – 18 GHz
Horizontal - Peak Emission Graph




Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

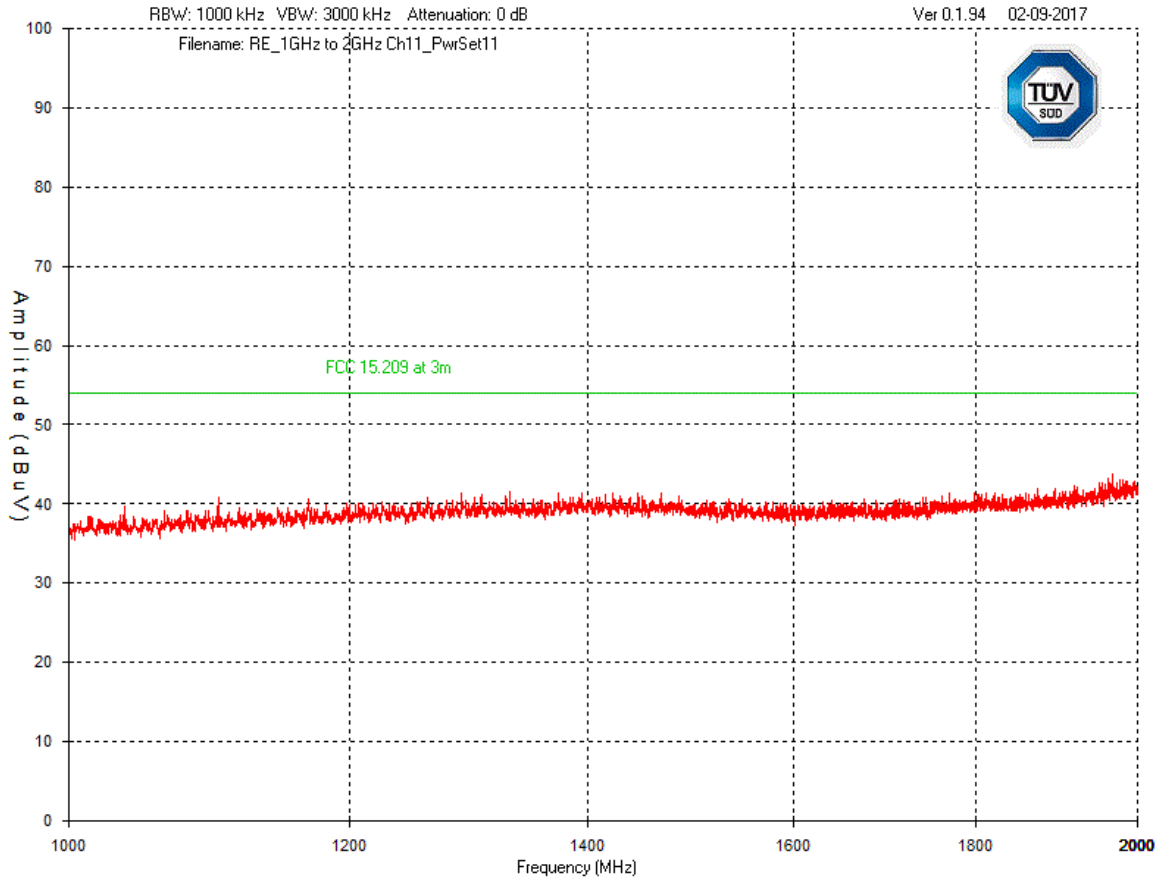
Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


**Low Channel 11 – 30 MHz – 1 GHz
Vertical - Peak Emission Graph**



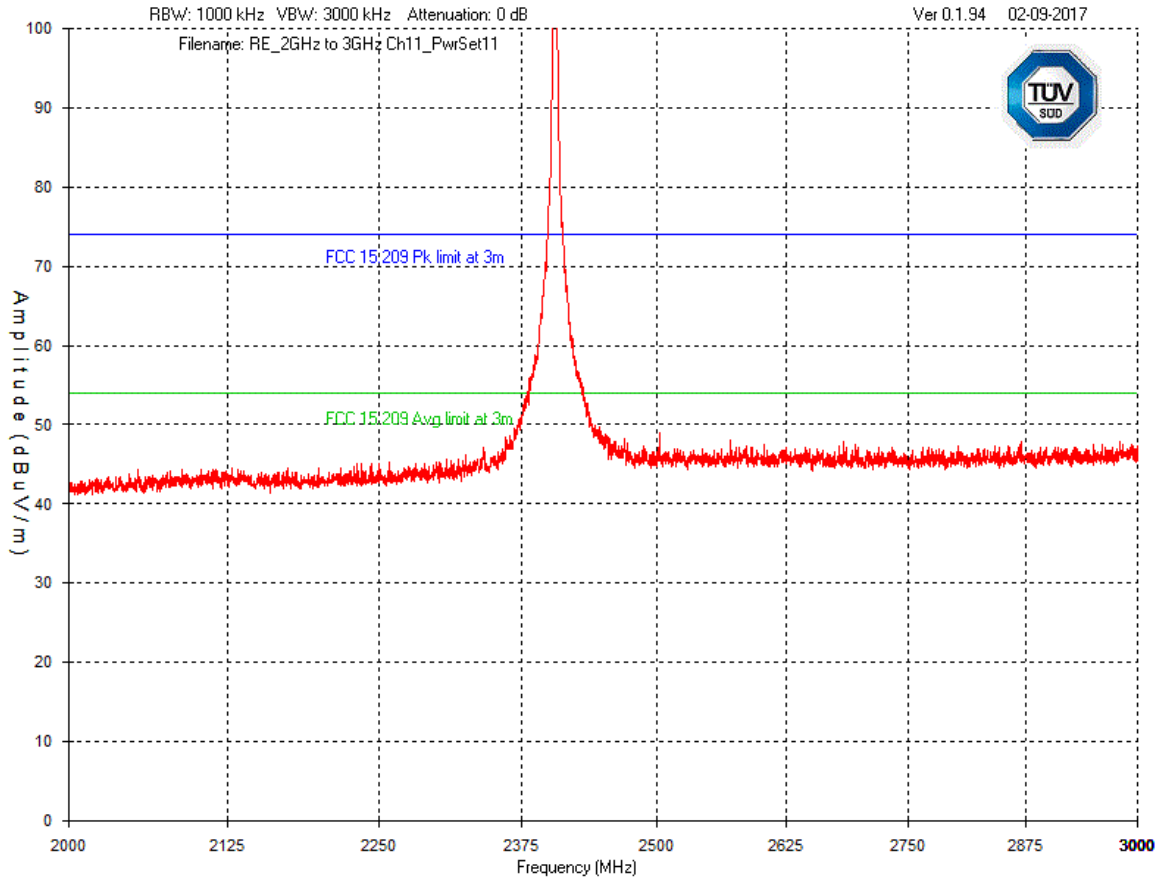
Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


Low Channel 11 – 1 GHz – 2 GHz
Vertical - Peak Emission Graph



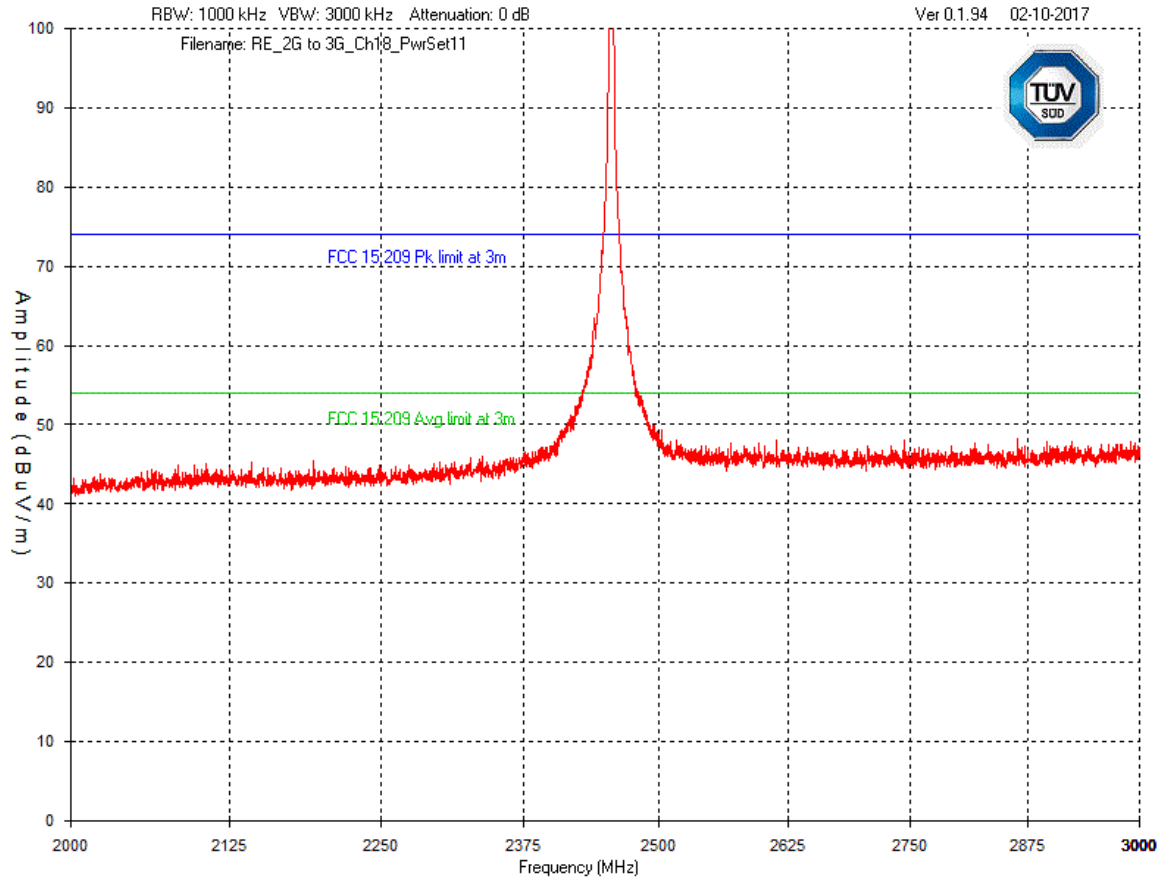
Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


**Low Channel 11 – 2 GHz – 3 GHz
Vertical - Peak Emission Graph**



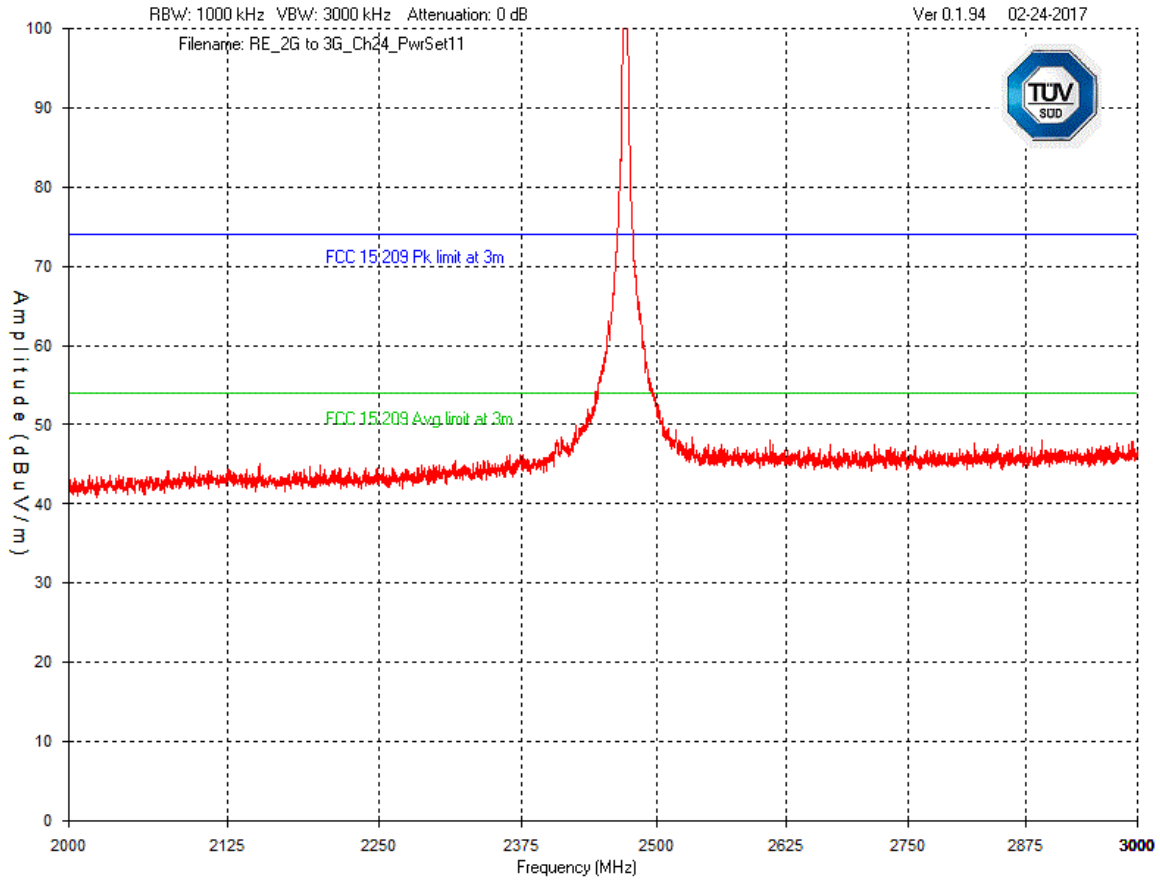
Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


**Mid Channel 18 – 2 GHz – 3 GHz
Vertical - Peak Emission Graph**



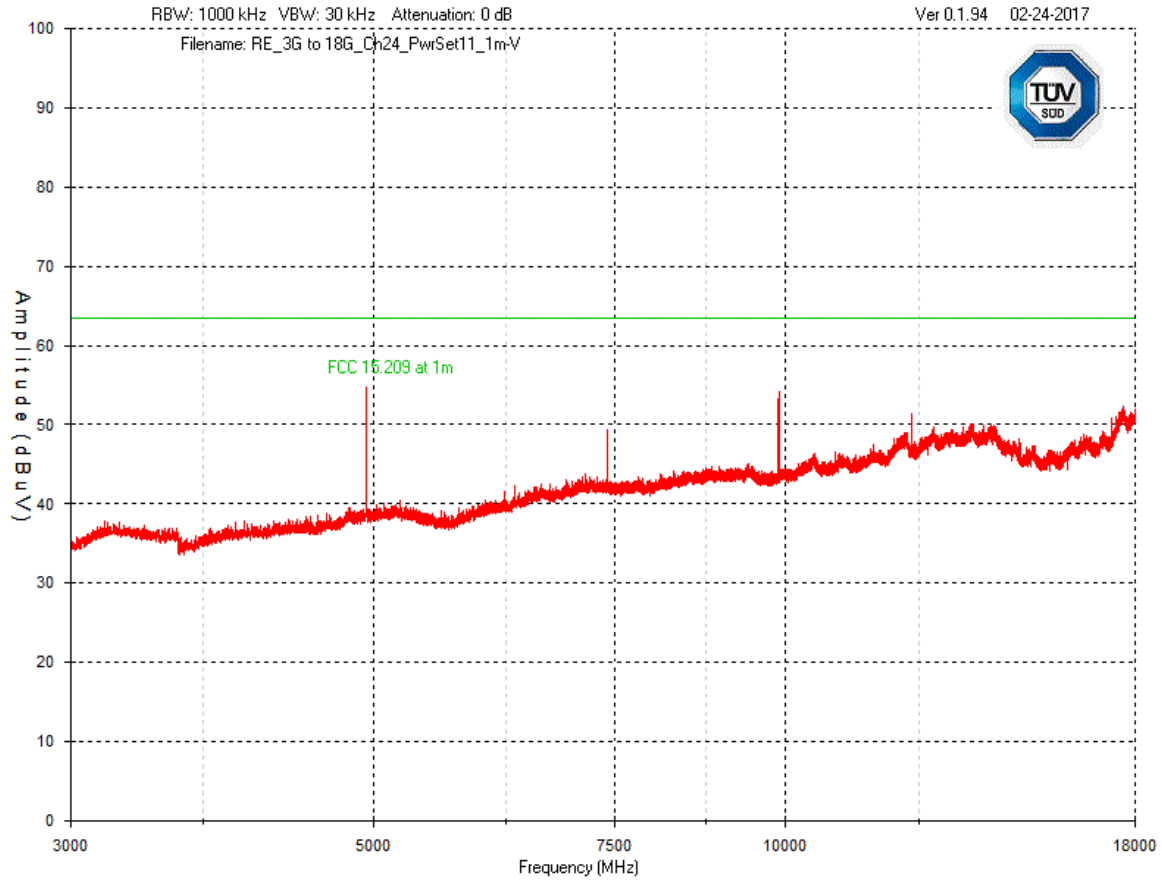
Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

**High Channel 24 – 2 GHz – 3 GHz
Vertical - Peak Emission Graph**




Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

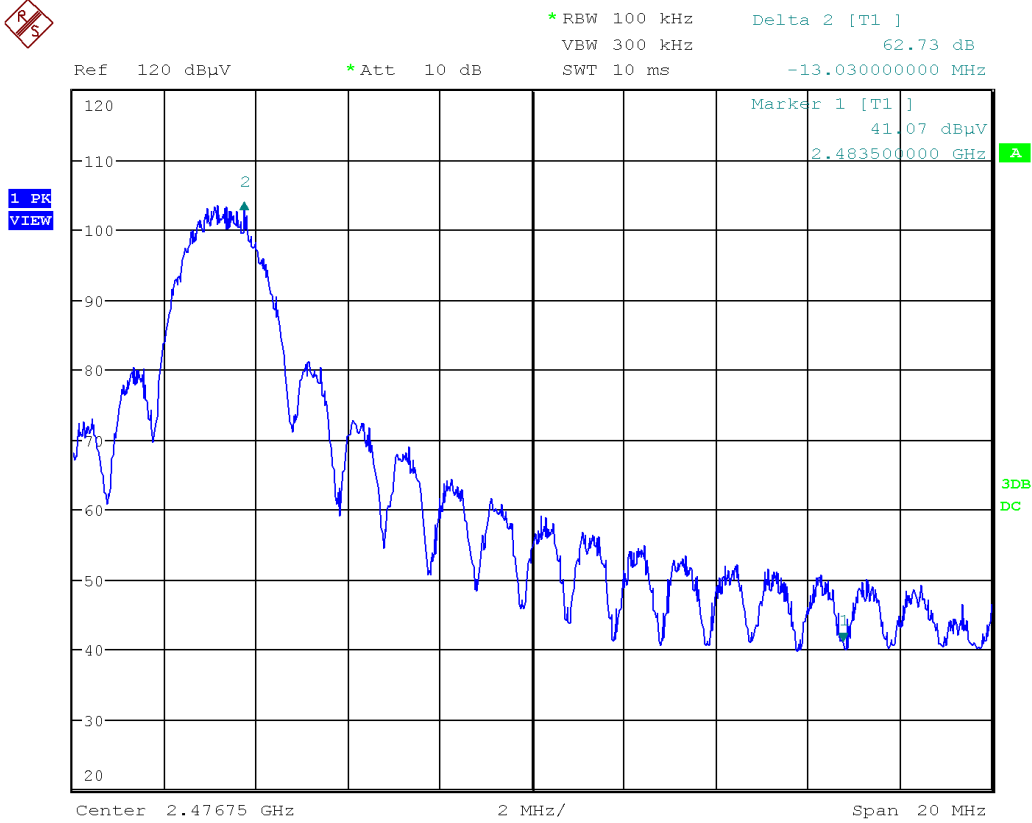
**Hi Channel 24 – 3 GHz – 18 GHz
Vertical - Peak Emission Graph**




Plot was taken at a 1 meter distance. All emissions were noise floor of measurement instrument. No emissions were found in this frequency range.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

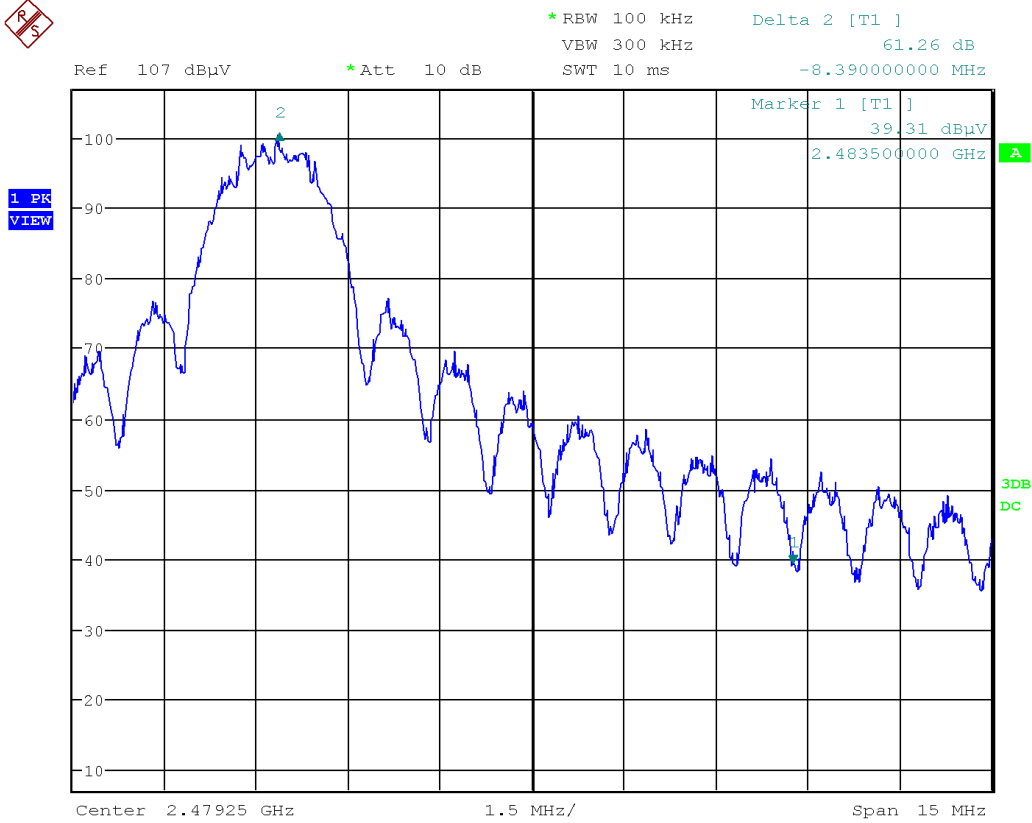
**Band Edge – Hi Channel 24 – Power set to 11
Horizontal - Peak Emission**




Date: 7.MAR.2017 14:56:20

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

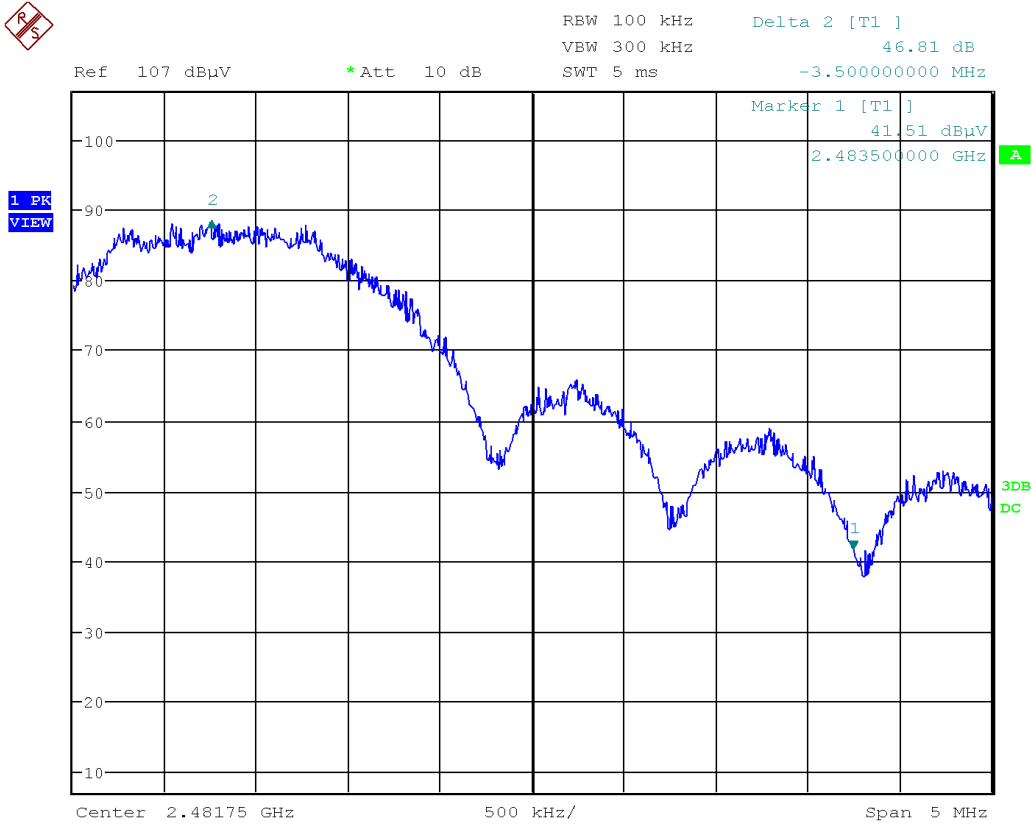
**Band Edge – Hi Channel 25 – Power set to 13
Horizontal - Peak Emission**



Date: 7.MAR.2017 14:52:01


Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

**Band Edge – Hi Channel 26 – Power set to 15
Horizontal - Peak Emission**

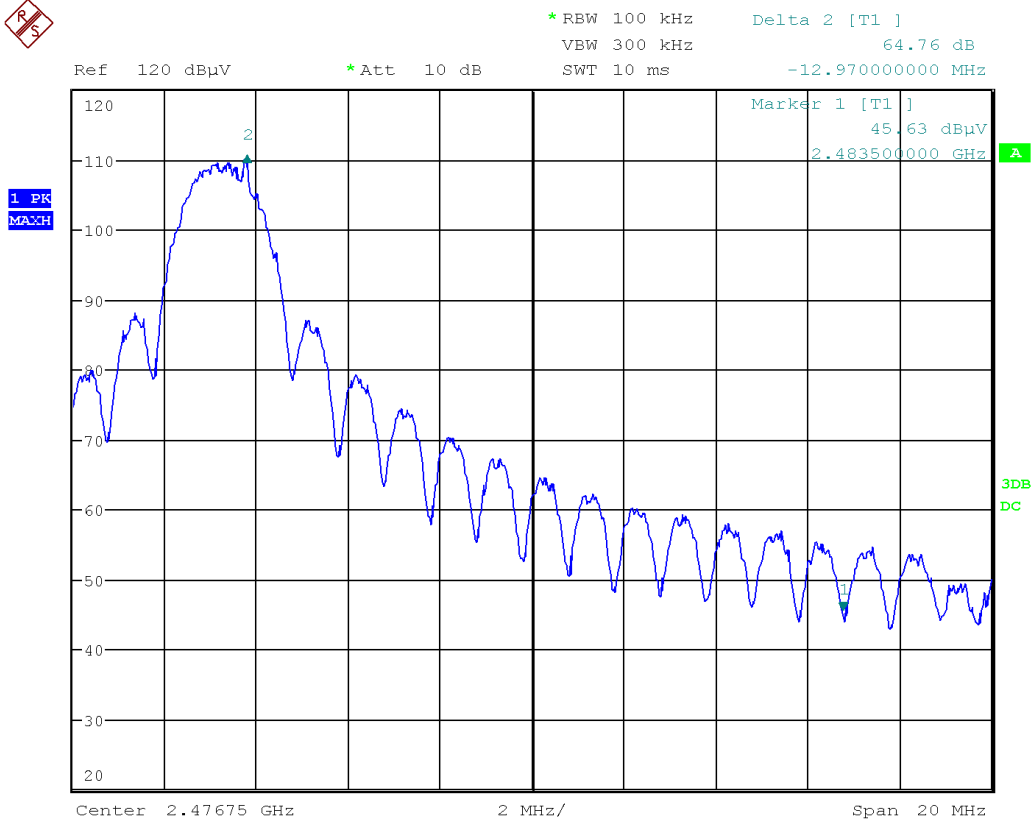


Date: 7.MAR.2017 12:36:14


Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The marker shows the raw value. See the Final Measurements and Results section below for correct values.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

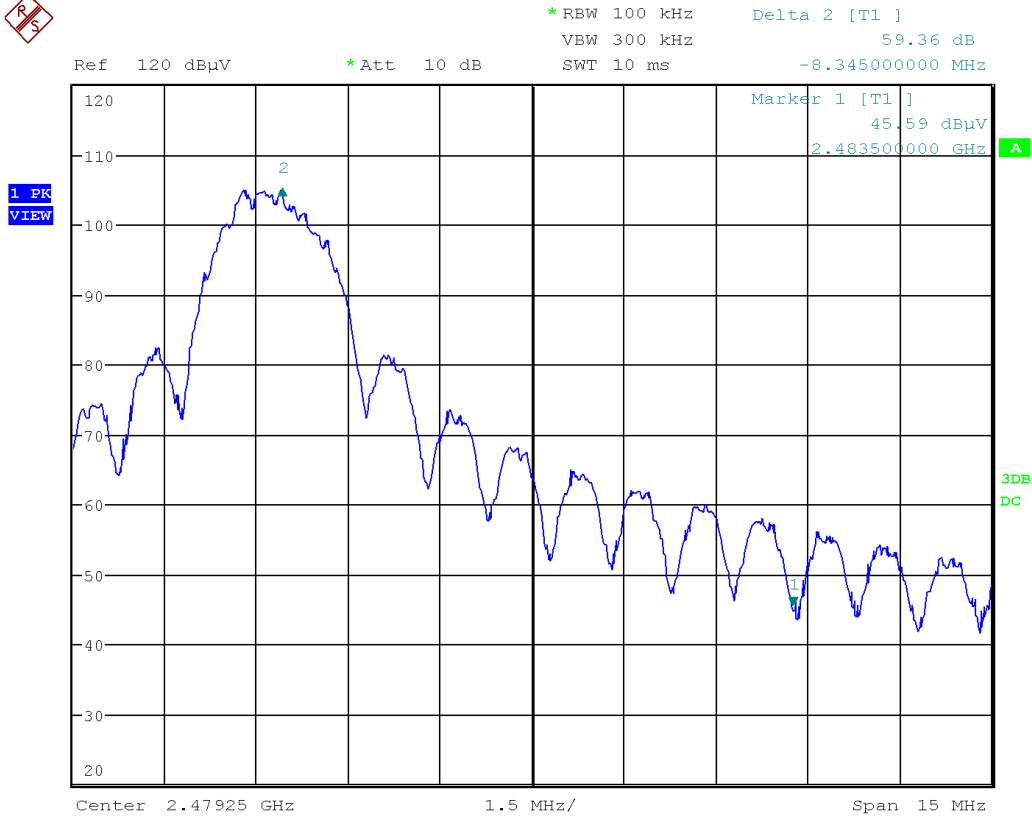
**Band Edge – Hi Channel 24 – Power set to 11
Vertical - Peak Emission**




Date: 7.MAR.2017 14:57:41

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

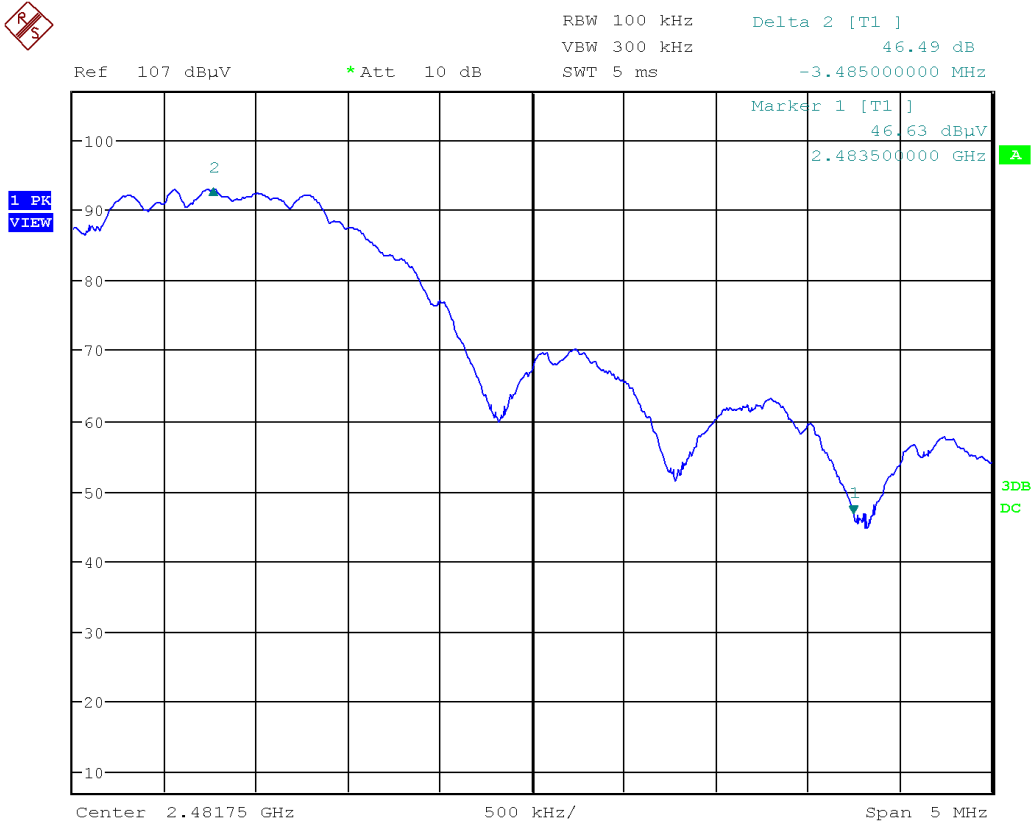
**Band Edge – Hi Channel 25 – Power set to 13
Vertical - Peak Emission**



Date: 6.MAR.2017 18:47:21


Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

**Band Edge – Hi Channel 26 – Power set to 15
Vertical - Peak Emission**



Date: 7.MAR.2017 12:39:29

Note: Restricted band Band Edge plot was taken at a 3m measurement distance. The marker shows the raw value. See the Final Measurements and Results section below for correct values.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


Final Measurements and Results

The EUT passed. Low, middle, and high bands were measured.


In accordance with 15.247(d), only frequencies exceeding the 15.209 limit that occur within the bands listed in 15.205 need to be verified with a final detector. Emissions outside the restricted bands were measured for informational purposes.

The measurements were maximized by rotating the turn table over a full 0-360 rotation and the antenna height was varied from 1 m to 4 m.


Product Category			Class B							
Product			Zigbee module model: ZBM1501							
Supply			3.3Vdc							
Frequency (MHz)	Detector Peak/QP	Received Signal (dBµV)	Antenna Factor (dB/m)	Atten Factor (dB)	Cable Factor (dB)	Pre-Amp (dB)	Level (dBµV/m)	QP Limit (dB)	QP Margin (dB)	Pass/Fail
Horizontal Antenna Polarization										
30.4855	Peak	34.7	17.2	3	0.5	-32.4	23	40	17	Pass
300.901	Peak	44.2	13.7	3	1.7	-33.3	29.3	46.4	17.1	Pass
302.94	Peak	42	13.8	3	1.7	-33.3	27.2	46.4	19.2	Pass
299.444	Peak	42.1	13.7	3	1.7	-33.3	27.2	46.4	19.2	Pass
312.941	Peak	40.5	14.1	3	1.7	-33.3	26	46.4	20.4	Pass
53.2062	Peak	41	6.9	3	0.7	-33.3	18.3	40	21.7	Pass
Vertical Antenna Polarization										
54.2743	QP	36.3	6.9	3	0.7	-33.3	13.6	40	26.4	Pass
70.5866	QP	32.9	7.6	3	0.8	-33.4	10.9	40	29.1	Pass
56.6046	QP	38.7	6.8	3	0.8	-33.3	16	40	24	Pass
58.6436	QP	38.9	6.8	3	0.8	-33.3	16.2	40	23.8	Pass
52.2352	QP	34.1	6.9	3	0.7	-33.3	11.4	40	28.6	Pass
43.4965	QP	31.1	9.8	3	0.7	-33	11.6	40	28.4	Pass

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


Test Freq. (MHz)	Detect. mode (Q-Peak)	Ant. polarity (Horz/Vert)	Raw signal dB(µV)	Ant. factor dB	Cable loss dB + Preselector	Atten. dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
Low Channel											
2405	Peak	Horz	95.9	30.6	5.2	10.0	33.0	108.7			PASS
2405	Avg	Horz	94.6	30.6	5.2	10.0	33.0	107.4			PASS
2405	Peak	Vert	105.3	30.6	5.2	10.0	33.0	118.1			PASS
2405	Avg	Vert	104.1	30.6	5.2	10.0	33.0	116.9			PASS
2390	Peak	Horz	47.7	28.8	5.0	10.0	33.1	58.4	74.0	15.6	PASS
2390	Avg	Horz	35.3	28.8	5.0	10.0	33.1	46.0	54.0	8.0	PASS
2390	Peak	Vert	52.5	28.8	5.0	10.0	33.1	63.2	74.0	10.8	PASS
2390	Avg	Vert	42.2	28.8	5.0	10.0	33.1	52.9	54.0	1.1	PASS
2400	Peak	Horz	60.5	30.6	5.2	10.0	33.0	73.3			PASS
2400	Avg	Horz	52.2	30.6	5.2	10.0	33.0	65.0			PASS
2400	Peak	Vert	69.5	30.6	5.2	10.0	33.0	82.3			PASS
2400	Avg	Vert	61.5	30.6	5.2	10.0	33.0	74.3			PASS
4810	Peak	Horz	49.7	33.7	2.9	0.0	35.7	50.6	74.0	23.4	PASS
4810	Avg	Horz	41.6	33.7	2.9	0.0	35.7	42.5	54.0	11.5	PASS
4810	Peak	Vert	48.4	33.7	2.9	0.0	35.7	49.3	74.0	24.7	PASS
4810	Avg	Vert	39.4	33.7	2.9	0.0	35.7	40.3	54.0	13.7	PASS
7215	Peak	Vert	46.3	37.9	4.3	0.0	35.9	52.6	74.0	21.4	PASS
7215	Avg	Vert	32.9	37.9	4.3	0.0	35.9	39.2	54.0	14.8	PASS
7215	Peak	Horz	47.1	37.9	4.3	0.0	35.9	53.4	74.0	20.6	PASS
7215	Avg	Horz	34.6	37.9	4.3	0.0	35.9	40.9	54.0	13.1	PASS
9620	Peak	Horz	45.6	39.2	5.8	0.0	35.9	54.7	74.0	19.3	PASS
9620	Avg	Horz	31.5	39.2	5.8	0.0	35.9	40.6	74.0	33.4	PASS
9620	Peak	Vert	45.5	39.2	5.8	0.0	35.9	54.6	74.0	19.4	PASS
9620	Avg	Vert	31.5	39.2	5.8	0.0	35.9	40.6	54.0	13.4	PASS
Mid channel 18											
2440	Peak	Horz	95.9	30.6	5.2	10.0	33.0	108.7			PASS
2440	Avg	Horz	94.5	30.6	5.2	10.0	33.0	107.3			PASS
2440	Peak	Vert	104.4	30.6	5.2	10.0	33.0	117.2			PASS
2440	Avg	Vert	103.1	30.6	5.2	10.0	33.0	115.9			PASS
4880	Peak	Horz	48.6	33.7	2.9	0.0	35.7	49.5	74.0	24.5	PASS
4880	Avg	Horz	39.7	33.7	2.9	0.0	35.7	40.6	54.0	13.4	PASS
4880	Peak	Vert	48.1	33.7	2.9	0.0	35.7	49.0	74.0	25.0	PASS
4880	Avg	Vert	39.2	33.7	2.9	0.0	35.7	40.1	54.0	13.9	PASS
7320	Peak	Vert	44.9	37.9	4.3	0.0	35.9	51.2	74.0	22.8	PASS
7320	Avg	Vert	31.1	37.9	4.3	0.0	35.9	37.4	54.0	16.6	PASS
7320	Peak	Horz	45.5	37.9	4.3	0.0	35.9	51.8	74.0	22.2	PASS

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


Test Freq. (MHz)	Detect. mode (Q-Peak)	Ant. polarity (Horz/Vert)	Raw signal dB(μV)	Ant. factor dB	Cable loss dB + Preselector	Atten. dB	Pre-Amp Gain dB	Received signal dB(μV/m)	Emission limit dB(μV/m)	Margin dB(μV)	Result
7320	Avg	Horz	31.9	37.9	4.3	0.0	35.9	38.2	54.0	15.8	PASS
High channel 24											
2470	Peak	Horz	106.6	29.3	5.1	0.0	33.1	107.9			PASS
2470	Avg	Horz	105.1	29.3	5.1	0.0	33.1	106.4			PASS
2470	Peak	Vert	114.1	29.3	5.1	0.0	33.1	115.4			PASS
2470	Avg	Vert	112.8	29.3	5.1	0.0	33.1	114.1			PASS
2483.5	Peak	Horz	56.0	29.4	5.1	0.0	33.1	57.4	74.0	16.6	PASS
2483.5	Avg	Horz	45.6	29.4	5.1	0.0	33.1	47.0	54.0	7.0	PASS
2483.5	Peak	Vert	48.2	29.4	5.1	0.0	33.1	49.6	74.0	24.4	PASS
2483.5	Avg	Vert	46.9	29.4	5.1	0.0	33.1	48.3	54.0	5.7	PASS
2485.5	Peak	Horz	54.6	29.4	5.1	0.0	33.1	56.0	74.0	18.0	PASS
2485.5	Avg	Horz	44.8	29.4	5.1	0.0	33.1	46.2	54.0	7.8	PASS
2485.5	Peak	Vert	61.1	29.4	5.1	0.0	33.1	62.5	74.0	11.5	PASS
2485.5	Avg	Vert	51.6	29.4	5.1	0.0	33.1	53.0	54.0	1.0	PASS
4940	Peak	Horz	48.1	33.7	2.9	0.0	35.7	49.0	74.0	25.0	PASS
4940	Avg	Horz	38.8	33.7	2.9	0.0	35.7	39.7	54.0	14.3	PASS
4940	Peak	Vert	46.8	33.7	2.9	0.0	35.7	47.7	74.0	26.3	PASS
4940	Avg	Vert	35.8	33.7	2.9	0.0	35.7	36.7	54.0	17.3	PASS
7410	Peak	Vert	44.5	37.9	4.3	0.0	35.9	50.8	74.0	23.2	PASS
7410	Avg	Vert	30.7	37.9	4.3	0.0	35.9	37.0	54.0	17.0	PASS
7410	Peak	Horz	44.7	37.9	4.3	0.0	35.9	51.0	74.0	23.0	PASS
7410	Avg	Horz	30.9	37.9	4.3	0.0	35.9	37.2	54.0	16.8	PASS
9880	Peak	Horz	45.7	39.2	5.8	0.0	35.9	54.8	74.0	19.2	PASS
9880	Avg	Horz	31.3	39.2	5.8	0.0	35.9	40.4	74.0	33.6	PASS
9880	Peak	Vert	45.5	39.2	5.8	0.0	35.9	54.6	74.0	19.4	PASS
9880	Avg	Vert	31.3	39.2	5.8	0.0	35.9	40.4	54.0	13.6	PASS
High channel 25 (Power set up to 13)											
2475	Peak	Horz	100.1	29.4	5.2	0.0	33.1	101.6			PASS
2475	Avg	Horz	98.6	29.4	5.2	0.0	33.1	100.1			PASS
2475	Peak	Vert	108.2	29.4	5.2	0.0	33.1	109.7			PASS
2475	Avg	Vert	106.9	29.4	5.2	0.0	33.1	108.4			PASS
2483.5	Peak	Horz	60.7	29.4	5.2	0.0	33.1	62.2	74.0	11.8	PASS
2483.5	Avg	Horz	50.9	29.4	5.2	0.0	33.1	52.4	54.0	1.6	PASS
2483.5	Peak	Vert	48.8	29.4	5.2	0.0	33.1	50.3	74.0	23.7	PASS
2483.5	Avg	Vert	47.5	29.4	5.2	0.0	33.1	49.0	54.0	5.0	PASS
2485.5	Peak	Horz	58.1	29.4	5.2	0.0	33.1	59.6	74.0	14.4	PASS

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Test Freq. (MHz)	Detect. mode (Q-Peak)	Ant. polarity (Horz/Vert)	Raw signal dB(µV)	Ant. factor dB	Cable loss dB + Preselector	Atten. dB	Pre-Amp Gain dB	Received signal dB(µV/m)	Emission limit dB(µV/m)	Margin dB(µV)	Result
2485.5	Avg	Horz	48.1	29.4	5.2	0.0	33.1	49.6	54.0	4.4	PASS
2485.5	Peak	Vert	61.7	29.4	5.2	0.0	33.1	63.2	74.0	10.8	PASS
2485.5	Avg	Vert	51.7	29.4	5.2	0.0	33.1	53.2	54.0	0.8	PASS
4950	Peak	Horz	46.3	34.2	4.0	0.0	32.8	51.7	83.5	31.8	PASS
4950	Avg	Horz	33.3	34.2	4.0	0.0	32.8	38.7	63.5	24.8	PASS
4950	Peak	Vert	46.7	34.2	4.0	0.0	32.8	52.1	83.5	31.4	PASS
4950	Avg	Vert	33.7	34.2	4.0	0.0	32.8	39.1	63.5	24.4	PASS
7425	Peak	Horz	44.7	37.9	4.0	0.0	33.0	53.6	83.5	29.9	PASS
7425	Avg	Horz	30.7	37.9	4.0	0.0	33.0	39.6	63.5	23.9	PASS
7425	Peak	Vert	45.1	37.9	4.0	0.0	33.0	54.0	83.5	29.5	PASS
7425	Avg	Vert	30.6	37.9	4.0	0.0	33.0	39.5	63.5	24.0	PASS
9900	Peak	Horz	46.1	39.2	4.0	0.0	33.6	55.7	83.5	27.8	PASS
9900	Avg	Horz	31.7	39.2	4.0	0.0	33.6	41.3	63.5	22.2	PASS
9900	Peak	Vert	46.4	39.2	4.0	0.0	33.6	56.0	83.5	27.5	PASS
9900	Avg	Vert	31.7	39.2	4.0	0.0	33.6	41.3	63.5	22.2	PASS
High channel 26 (Power set up to 15)											
2480	Peak	Horz	89.1	29.4	5.2	0.0	33.1	90.6			PASS
2480	Avg	Horz	87.7	29.4	5.2	0.0	33.1	89.2			PASS
2480	Peak	Vert	95.7	29.4	5.2	0.0	33.1	97.2			PASS
2480	Avg	Vert	94.4	29.4	5.2	0.0	33.1	95.9			PASS
2483.5	Peak	Horz	62.6	30.6	5.2	0.0	33.1	65.3	74.0	8.7	PASS
2483.5	Avg	Horz	40.9	30.6	5.2	0.0	33.1	43.6	54.0	10.4	PASS
2483.5	Peak	Vert	69.1	30.6	5.2	0.0	33.1	71.8	74.0	2.2	PASS
2483.5	Avg	Vert	47.9	30.6	5.2	0.0	33.1	50.6	54.0	3.4	PASS
2485.5	Peak	Horz	56.6	29.4	5.2	0.0	33.1	58.1	74.0	15.9	PASS
2485.5	Avg	Horz	46.7	29.4	5.2	0.0	33.1	48.2	54.0	5.8	PASS
2485.5	Peak	Vert	60.2	29.4	5.2	0.0	33.1	61.7	74.0	12.3	PASS
2485.5	Avg	Vert	50.2	29.4	5.2	0.0	33.1	51.7	54.0	2.3	PASS
4960	Peak	Horz	46.2	34.2	4.0	0.0	32.8	51.6	83.5	31.9	PASS
4960	Avg	Horz	30.8	34.2	4.0	0.0	32.8	36.2	63.5	27.3	PASS
4960	Peak	Vert	45.2	34.2	4.0	0.0	32.8	50.6	83.5	32.9	PASS
4960	Avg	Vert	31.1	34.2	4.0	0.0	32.8	36.5	63.5	27.0	PASS
7440	Peak	Horz	44.5	37.9	4.0	0.0	33.0	53.4	83.5	30.1	PASS
7440	Avg	Horz	30.6	37.9	4.0	0.0	33.0	39.5	63.5	24.0	PASS
7440	Peak	Vert	45.4	37.9	4.0	0.0	33.0	54.3	83.5	29.2	PASS
7440	Avg	Vert	30.6	37.9	4.0	0.0	33.0	39.5	63.5	24.0	PASS
9920	Peak	Horz	45.3	39.2	4.0	0.0	33.6	54.9	83.5	28.6	PASS

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


Test Freq. (MHz)	Detect. mode (Q-Peak)	Ant. polarity (Horz/Vert)	Raw signal dB(μ V)	Ant. factor dB	Cable loss dB + Preselector	Atten. dB	Pre-Amp Gain dB	Received signal dB(μ V/m)	Emission limit dB(μ V/m)	Margin dB(μ V)	Result
9920	Avg	Horz	31.5	39.2	4.0	0.0	33.6	41.1	63.5	22.4	PASS
9920	Peak	Vert	45.5	39.2	4.0	0.0	33.6	55.1	83.5	28.4	PASS
9920	Avg	Vert	31.5	39.2	4.0	0.0	33.6	41.1	63.5	22.4	PASS

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration / Verification Date	Next Calibration / Verification Date	Asset #
Spectrum Analyzer	ESU-40	Rohde & Schwarz	1-28-2016	1-28-2018	4092
Spectrum Analyzer	FSL6	Rohde & Schwarz	1-28-2016	1-28-2018	4095
Attenuator 10 dB	4779-10	narda	NCR	NCR	4096
BiLog Antenna	3142-C	ETS	9-8-15	9-8-17	4002
Horn Antenna	ATH1G18G	AR	4-23-15	4-23-17	4003
Biconical Antenna	EM-6913	Electro-Metrics	4-28-15	4-28-17	4060
Log Periodic Antenna	LPA-25	Electro-Metrics	4-14-15	4-14-17	4087
Attenuator 3 dB	FP-50-3	Trilithic	N/A	N/A	4028
LNA pre-amp	LNA-1450	RF Bay Inc.	7-22-15	7-22-17	4089
1-26.5GHz preamp	8449B	Agilent	9-9-15	9-9-17	6351
RF Cable 10m	LMR-400-10M-50OHM-MN-MN	LexTec	N/A	N/A	4025
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	N/A	N/A	4026
Emission software	0.1.93	Global EMC	N/A	N/A	58

FCC - 15.209 - Radiated Emissions_Rev1

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Power Spectral Density - DM

Purpose

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.

Limits and Method

The limits are defined in 15.247(e).

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

The method is given in Section 10.2 of FCC KDB 558074.


Results

The EUT passed. Low, medium, and high bands were tested. The worst case value is 4.0 dBm as measured with a 3 kHz resolution bandwidth (peak power).

Channel	Frequency (MHz)	Measured PSD (dBm)	External & Cable Attenuation (dB)	Corrected PSD (dBm)	Limit (dBm)	Pass/Fail
Lo Channel 11	2405	-18.2	20.5	2.3	8	Pass
Mid Channel 18	2440	-16.9	20.5	3.6	8	Pass
Hi Channel 24	2470	-16.5	20.5	4.0	8	Pass
Hi Channel 25	2475	-20.8	20.5	-0.3	8	Pass
Hi Channel 26	2480	-33.3	20.5	-12.8	8	Pass

Graphs

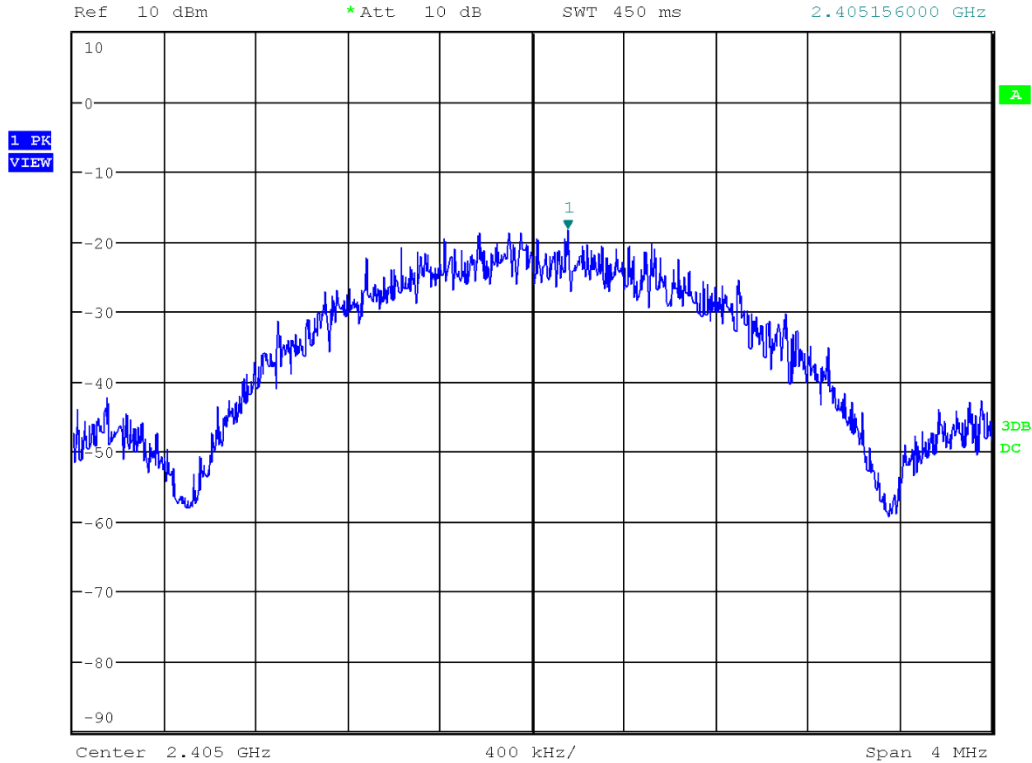
The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. Low, middle, and high channel was investigated.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


PSD - Low Channel 11



*RBW 3 kHz Marker 1 [T1]
 VBW 10 kHz -18.23 dBm
 SWT 450 ms 2.405156000 GHz



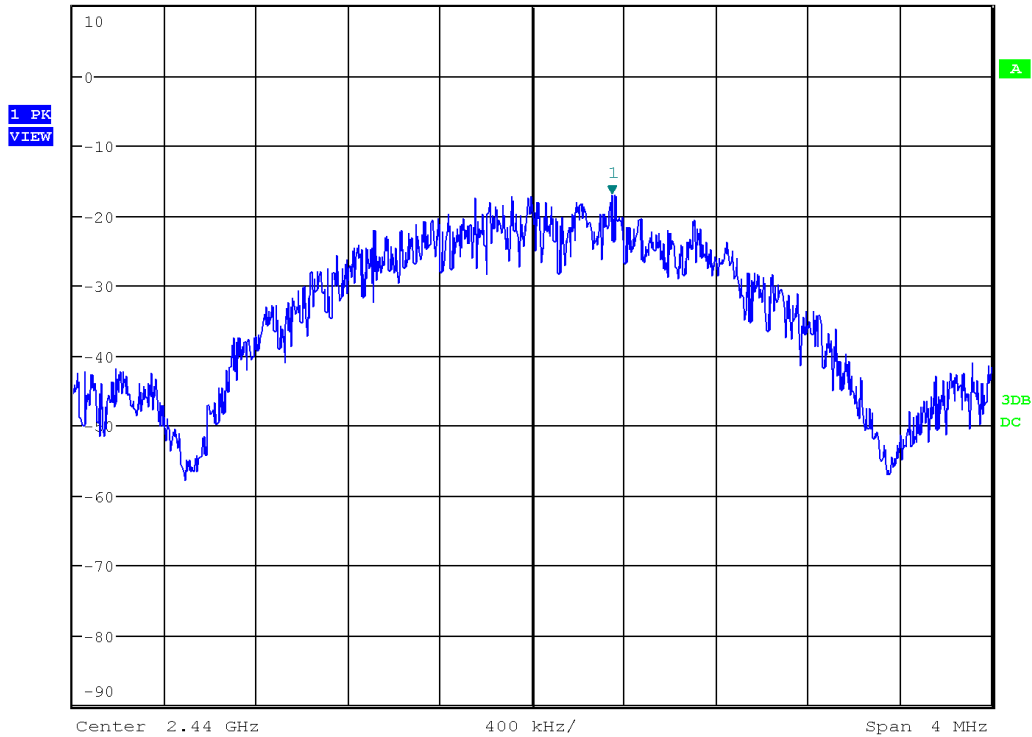
Date: 9.MAR.2017 17:06:54

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


PSD - Mid Channel 18



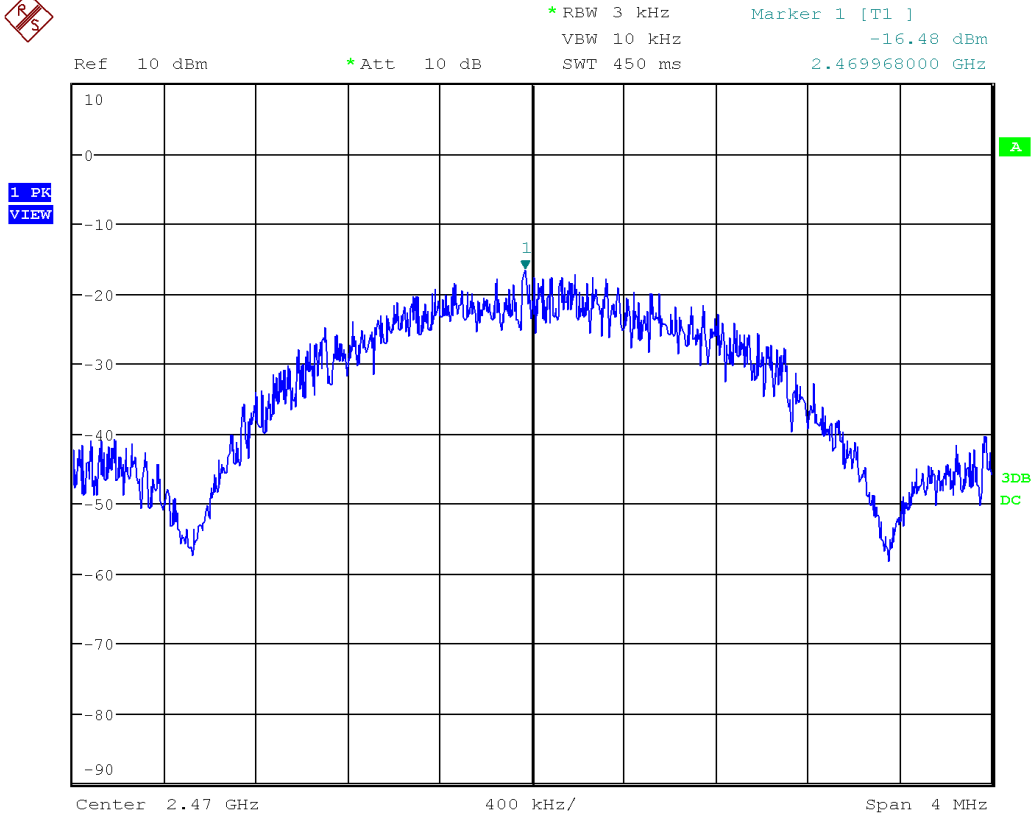
* RBW 3 kHz Marker 1 [T1]
 VBW 10 kHz -16.96 dBm
 Ref 10 dBm * Att 10 dB SWT 450 ms 2.440344000 GHz




Date: 9.MAR.2017 16:30:51

Client	Sinope Technologies Inc.	 Canada
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

PSD – Hi Channel 24



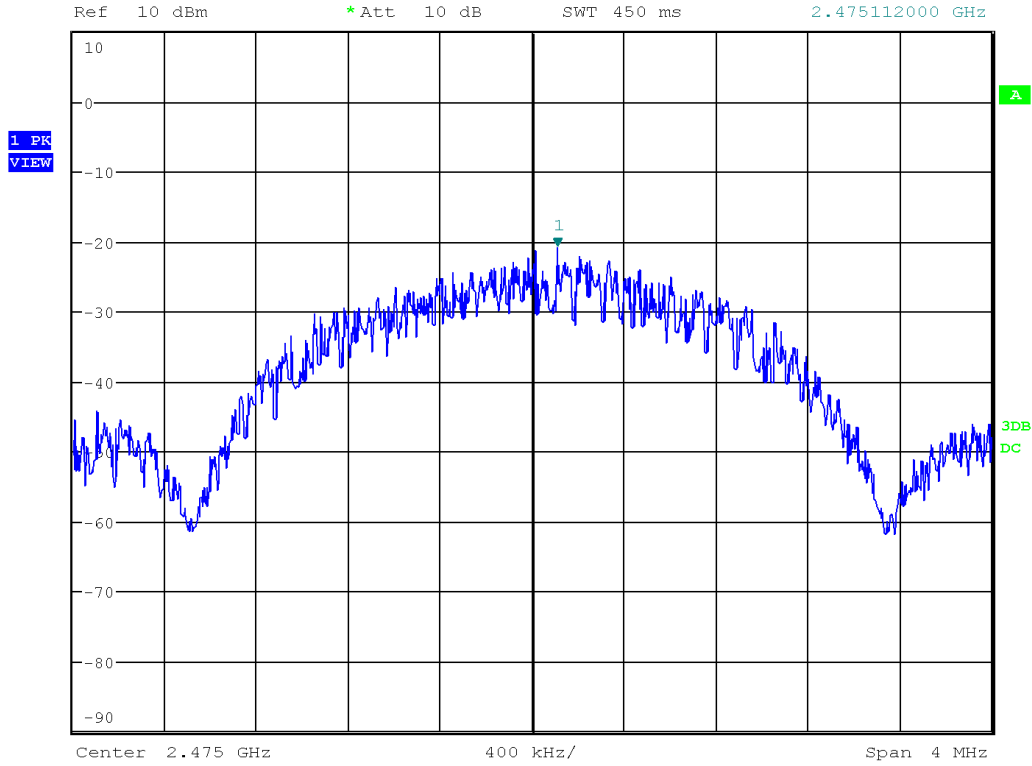
Date: 9.MAR.2017 17:46:12

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	


PSD - Hi Channel 25



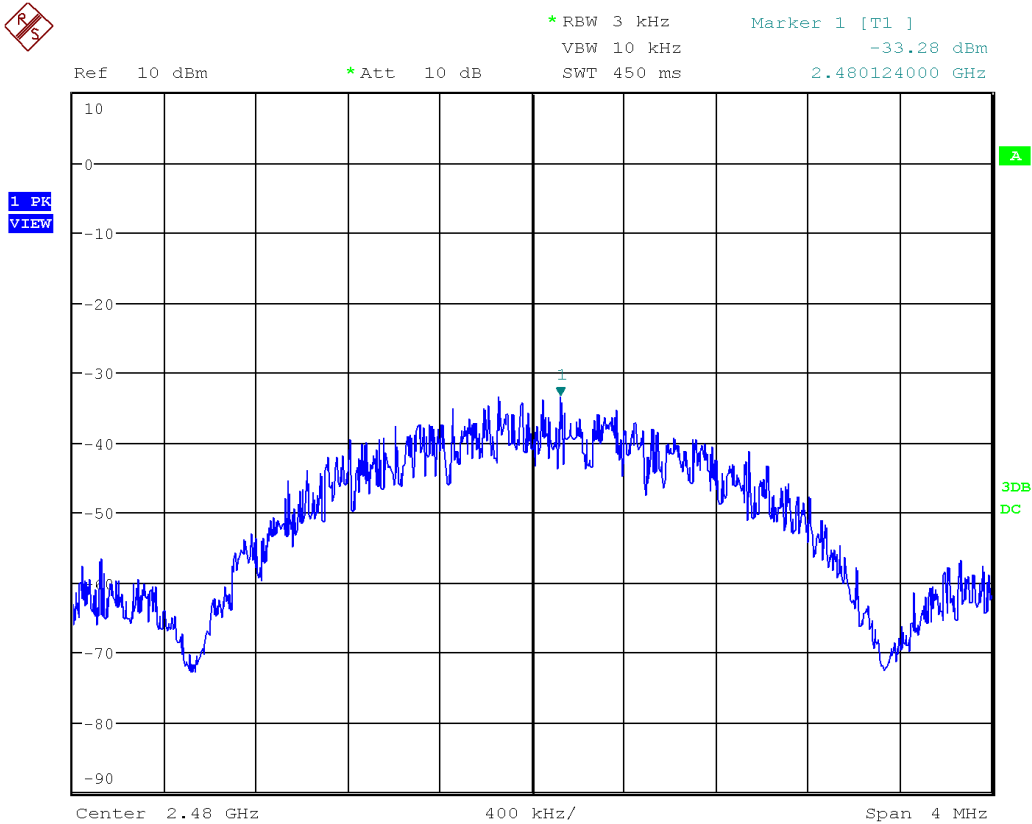
*RBW 3 kHz Marker 1 [T1]
 VBW 10 kHz -20.84 dBm
 SWT 450 ms 2.475112000 GHz



Date: 9.MAR.2017 17:04:20


Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

PSD - Hi Channel 26




Date: 9.MAR.2017 17:00:05

See 'Appendix B – EUT and Test Setup Photos' for photos showing the test set-up.

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Test Equipment List

Equipment	Model No.	Manufacturer	Last Calibration Date	Next Calibration Date	Asset #
Spectrum Analyzer	ESU-40	Rohde & Schwarz	Jan 28, 2016	Jan 28, 2018	4092
Attenuator 10 dB	4779-10	narda	NCR	NCR	4096

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

RF Exposure

Purpose

The purpose of this test is to ensure that the RF energy intentionally transmitted, in terms of power density emitted from the EUT at a stated operating distance does not exceed the limits listed below as defined in the applicable test standard, as calculated based upon readings obtained during testing. This helps protect human exposure to excessive RF fields.

Limits and Method

The limits, as defined in RSS-102, Section 2.5.2 and FCC 15.247(i) and FCC 1.1310 Table 1 (B), limits for general public exposure were applied. The limit for the frequency range of 1.5 GHz to 100 GHz was applied. This is a limit of 1.0 mW/cm². The distance used for calculations was 20cm, as this is the minimum distance an operator will be from the EUT during normal operation, as stated by the manufacturer.

Results

The EUT passed the requirements. For FCC requirement, the worst case calculated power density was 0.04 mW/cm², this is significantly under the 1.0 mW/cm² requirement. For IC requirement the max measured EIRP (0.195W) is significantly under, 2.679W, the value calculated with the formula given in RSS-102, section 2.5.2.

Calculations

FCC:

Method 1 (conducted power): Internal antenna

$$P_d = (P_t * G) / (4 * \pi * R^2)$$

Where P_t = 128.8 mW as per Peak power conducted output

Where G = 2.1 dBi, or numerically 1.6

Where R = 20 cm

$$P_d = (128.8 \text{ mW} * 1.6) / (4 * \pi * 20\text{cm}^2) = 206.1 \text{ mW} / 5026.5 \text{ cm}^2$$

$$P_d = 0.04 \text{ mW/cm}^2$$


IC:

As per RSS-102, section 2.5.2, for devices above 300MHz and below 6GHz:


Maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} \times f^{0.6834}$ W (adjusted for tune-up tolerance), where *f* is in MHz.

Max EIRP is 0.195W measured at 2405MHz:

$$1.31 \times 10^{-2} \times (2405)^{0.6834} = 2.679\text{W} \text{ which is more than } 0.195\text{W}$$

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

Appendix A – EUT Summary

Client	Sinope Technologies Inc.	
Product	ZBM1501	
Standard(s)	RSS 247 Issue 1 FCC Part 15 Subpart 15.247	

For further details for filing purposes, refer to filing package.

General EUT Description

Client	
Organization / Address	Sinope technologies Inc 705 Montrichard, St-jean-sur-richelieu, J2X5K8, QC, Canada
Contact	Sylvain Mayer
Phone	450-741-7700
Email	sylvain.mayer@sinopetech.com
EUT Details	
EUT Name	ZBM1501
FCC ID	2AK2T-ZBM1501
Industry Canada #	22394-ZBM1501
Equipment Category	Zigbee module
Basic EUT Functionality	802.15.4/Zigbee radio module
Input Voltage and Frequency	2.9 Vdc to 3.3 Vdc
Rated Input Current	RX: 19 mA, Tx: 140 mA
Connectors available on EUT	None
Peripherals Required for Test	None
Release type	
Intentional Radiator Frequency	2400 – 2483.5 MHz
EUT Configuration	Wireless configured to transmit continuously.

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see ‘Appendix B – EUT and Test Setup Photos’.