

FCC/ISED RF Test Report
As per

RSS-247 Issue 2

FCC Part 15.247 Subpart C
&
ICES 003 Issue 6
on the

ZX WIRELESS Thermostat

IC:8410A-ZXWU; FCC ID: XEY-ZX-WU

Prepared to:

Verdant. Environmental Technologies, Inc.

1850 – 55th Avenue, Lachine, Quebec, H8T 3J5
CANADA



Product Service

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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 15.247 Subpart C/ ICES 003 Issue 6 and RSS-247 Issue 2.

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Contents

1	Report Summary	7
2	Introduction	8
3	EUT: ZX WIRELESS THERMOSTAT	13
3.1	Specifications:	13
3.2	Modes of Operation	16
3.3	Setup Diagram	16
4	Deviations from the Standard	17
5	Measurement Uncertainty	17
6	99% Bandwidth	18
6.1	Purpose & Methods	18
6.2	Test Specifications	18
6.3	Test Results	19
6.4	Graphs	20
6.5	Test Instruments	26
7	6dB Bandwidth of Digitally Modulated Systems	27
7.1	Purpose & Methods	27
7.2	Test Specifications	27
7.3	Test Results	28
7.4	Graphs	29
7.5	Test Instruments	32
8	Hopping Channel	33
8.1	Purpose & Methods	33
8.2	Test Specifications	33
8.3	Limits	34
8.4	Test Results	34
8.5	Graphs	35
8.6	Test Instruments	38
9	Channel Separation	39
9.1	Purpose & Methods	39
9.2	Test Specifications	39
9.3	Limits	40
9.4	Test Results	40
9.5	Graphs	41
9.6	Test Instruments	42
10	Time of Occupancy	43
10.1	Purpose & Methods	43
10.2	Test Specifications	43
10.3	Limits	44
10.4	Test Results	44
10.5	Graphs	45
10.6	Test Instruments	46



11	Maximum Peak Envelope Conducted Power – Digital Modulated	47
11.1	Purpose & Methods.....	47
11.2	Test Specifications	47
11.3	Limits	48
11.4	Tests Results	48
11.5	Graphs.....	49
11.6	Test Instruments	56
12	Power Spectral Density.....	57
12.1	Purpose & Methods.....	57
12.2	Test Specifications	57
12.3	Limits	58
12.4	Test Results.....	58
12.5	Graphs.....	59
12.6	Test Instruments	62
13	Band Edge Spurious Emission (-20 dBc Requirement).....	63
13.1	Purpose & Methods.....	63
13.2	Test Specifications	63
13.3	Limits	64
13.4	Test Setup	64
13.5	Test Results.....	64
13.6	Graphs.....	65
13.7	Test Instruments	78
14	Tx Spurious Radiated Emissions	79
14.1	Purpose & Methods.....	79
14.2	Test Specifications	80
14.3	Limits	81
14.4	Results.....	81
14.5	Graphs.....	83
14.6	Test Instruments	105

TABLE OF APPENDICES

APPENDIX A	Tx Spurious Emissions – Worst Cases.....	106
-------------------	---	------------



LIST OF TABLES

Table 1 – Modification Records	7
Table 2 – Test Summary Table	10
Table 3 – EUT – ZX WIRELESS THERMOSTAT– Specifications for 2.4GHz	13
Table 4 – EUT – ZX WIRELESS THERMOSTAT– Specifications for 900MHz	13
Table 5 List of Channels for ZX Wireless Thermostat2.4 GHz	14
Table 6 List of Channels for ZX Wireless Thermostat900 MHz	15
Table 7 Acceptable Uncertainties	17
Table 8 – 99% Bandwidth Results.....	19
Table 9 – 99% Bandwidth Results.....	19
Table 10: 99%BW Test Equipment.....	26
Table 11 – 6dB Bandwidth Results.....	28
Table 12: 6 dB OBW Test Equipment.....	32
Table 13 – Hopping Channel Results	34
Table 14: Hopping Channel Test Equipment	38
Table 15 – Channel Separation Results	40
Table 16: Channel Separation Test Equipment	42
Table 17 – Time Occupancy Results.....	44
Table 18: Time of Occupancy Test Equipment	46
Table 19 – Test Results Peak-Power Measurements ZX Wireless Thermostat(2.4GHz)	48
Table 20 – Test Results Peak-Power Measurements ZX Wireless Thermostat(900MHz)	49
Table 21: Conducted Peak Power Test Equipment.....	56
Table 22- Results – PKPSD	58
Table 23 – Test Instrumentation – PKPS.....	62
Table 24- Results Band Edge – 2.4GHz Band.....	64
Table 25- Results – Band Edge – 900GHz Band	65
Table 26 – Test Instrumentation – Band Edge.....	78
Table 27 Limits – Tx Spurious.....	79
Table 28 – Test Results for Tx Spurious Emission – Worst Cases (900MHz).....	81
Table 29 – Test Results for Tx Spurious Emission – Worst Cases (2.4GHz).....	82
Table 30 – Test Instrumentation – Tx Spurious Emission	105

LIST OF FIGURES

Figure 1: EUT Setup Diagram – ZX WIRELESS THERMOSTAT– Spurious Emissions.....	16
---	----

**LIST OF GRAPHS**

Graph 1 Test Results – 99% Bandwidth Results – Lower Channel (#0) ZX WIRELESS Thermostat(2.4GHz)	20
Graph 2 Test Results – 99% Bandwidth Results – Middle Channel (#19) ZX WIRELESS Thermostat(2.4GHz)...	21
Graph 3 Test Results – 99% Bandwidth Results – Highest Channel (#39) ZX WIRELESS Thermostat(2.4GHz) .	22
Graph 4 Test Results – 99% Bandwidth Results – Low Channel ZX Wireless Thermostat(900MHz)	23
Graph 5 Test Results – 99% Bandwidth Results – Mid Channel ZX Wireless Thermostat(900MHz).....	24
Graph 6 Test Results – 99% Bandwidth Results – High Channel ZX WIRELESS Thermostat(900MHz).....	25
Graph 7 Test Results – 6dB Bandwidth Results – Low Channel ZX WIRELESS Thermostat(2.4GHz)	29
Graph 8 Test Results – 6dB Bandwidth Results – Mid Channel ZX WIRELESS Thermostat(2.4GHz)	30
Graph 9 Test Results – 6dB Bandwidth Results – High Channel ZX WIRELESS Thermostat(2.4GHz).....	31
Graph 10: Hopping Channel – ZX Wireless Thermostat(900MHz) – 902MHz – 912.1MHz	35
Graph 11: Hopping Channel – ZX Wireless Thermostat(900MHz) – 912.1MHz – 920.1MHz	36
Graph 12: Hopping Channel – ZX Wireless Thermostat(900MHz) – 920.1MHz – 928MHz	37
Graph 13: Channel Separation – ZX Wireless Thermostat(900MHz)	41
Graph 14: Time of Occupancy – ZX Wireless Thermostat(900MHz)	45
Graph 15 Test Results – Conducted Peak Power Measurements – Low Channel.....	50
Graph 16 Test Results – Conducted Peak Power Measurements – Mid Channel.....	51
Graph 17 Test Results – Conducted Peak Power Measurements – High Channel	52
Graph 18 Test Results – Conducted Peak Power Measurements – Low Channel.....	53
Graph 19 Test Results – Conducted Peak Power Measurements – Mid Channel.....	54
Graph 20 Test Results – Conducted Peak Power Measurements – High Channel	55
Graph 21 Test Results – PKPSD – Low Channel	59
Graph 22 Test Results – PKPSD – Mid Channel	60
Graph 23 Test Results – PKPSD – High Channel.....	61
Graph 24 Test Results – Low Band Edge – 9kHz to 150kHz – Low Channel	66
Graph 25 Test Results – Band Edge –150kHz to 30MHz – Low Channel.....	67
Graph 26 Test Results – Band Edge –30MHz to 2.4GHz– Low Channel	68
Graph 27 Test Results – Band Edge –2.4GHz to 2.402GHz– Mid Channel.....	69
Graph 28 Test Results – Band Edge –2.402GHz to 2.4835GHz– Mid Channel.....	70
Graph 29 Test Results – Band Edge –2.4835GHz to 26GHz– High Channel	71
Graph 30 Test Results – Band Edge – 9kHz to 150kHz – Low Channel.....	72
Graph 31 Test Results – Band Edge –150kHz to 30MHz – Low Channel.....	73
Graph 32 Test Results – Band Edge –30MHz to 1GHz – Low Channel	74
Graph 33 Test Results – Band Edge – 900MHz to 902.46 MHz– Mid Channel	75
Graph 34 Test Results – Band Edge – 902 to 928MHz– Mid Channel	76
Graph 35 Test Results – Band Edge –1GHz to 10 GHz – High Channel	77
Graph 36 Test Results – Tx Spurious emission 9kHz – 150kHz: Mid Channel ZX Wireless Thermostat (900MHz)	84
Graph 37 Test Results – Tx Spurious emission 9kHz – 150kHz: Mid Channel ZX Wireless Thermostat (2.4GHz)	85
Graph 38 Test Results – Tx Spurious emission 150kHz – 30MHz: Mid Channel ZX Wireless Thermostat (900MHz).....	86



ZX Wireless Thermostat

Graph 39 Test Results – Tx Spurious emission 150kHz – 30MHz: Mid Channel ZX Wireless Thermostat (2.4GHz)	87
Graph 40 Test Results – Tx Spurious emission 30MHz – 1GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Horizontal Polarization	88
Graph 41 Test Results – Tx Spurious emission 30MHz – 1GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Vertical Polarization	89
Graph 42 Test Results – Tx Spurious emission 30MHz – 1GHz: Mid Channel ZX Wireless Thermostat(2.4GHz) – Vertical Polarization	90
Graph 43 Test Results – Tx Spurious emission 30MHz – 1GHz: Mid Channel ZX Wireless Thermostat(2.4GHz) – Horizontal Polarization	91
Graph 44 Test Results – Tx Spurious emission 1GHz – 3GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Horizontal Polarization	92
Graph 45 Test Results – Tx Spurious emission 1GHz – 3GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Vertical Polarization	93
Graph 45 Test Results – Tx Spurious emission 1GHz – 3GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Horizontal Polarization	94
Graph 46 Test Results – Tx Spurious emission 1GHz – 3GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Horizontal Polarization	95
Graph 47 Test Results – Tx Spurious emission 1GHz – 3GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Vertical Polarization	96
Graph 48 Test Results – Tx Spurious emission 3GHz – 10GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Horizontal Polarization	97
Graph 49 Test Results – Tx Spurious emission 3GHz – 10GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Vertical Polarization	98
Graph 50 Test Results – Tx Spurious emission 3GHz – 10GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Horizontal Polarization	99
Graph 51 Test Results – Tx Spurious emission 3GHz – 10GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Vertical Polarization	100
Graph 52 Test Results – Tx Spurious emission 10GHz – 18GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Horizontal Polarization	101
Graph 53 Test Results – Tx Spurious emission 10GHz – 18GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Vertical Polarization	102
Graph 54 Test Results – Tx Spurious emission 18GHz – 26GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Horizontal Polarization	103
Graph 55 Test Results – Tx Spurious emission 18GHz – 26GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Vertical Polarization	104



1 Report Summary

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	April 27 th , 2020

Table 1 – Modification Records

Acronyms & Definitions

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

Acronyms

AM	Amplitude Modulation
DTS	Digital Transmission System
EIRP	Equivalent Isotropic Radiated Power
ETSI	European Telecommunications Standards Institute
EUT	Equipment Under Test
FVIN	Firmware Version Identification Number
HVIN	Hardware Version Identification Number(s)
OOB	Out of Band
PKPSD	Peak Power Spectrum Density
RBW	Resolution 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 antenna for transmitting RF signals
VBW	Video Bandwidth
Vp	Peak Voltage



2 Introduction

Applicant:	Verdant Environmental Technologies, Inc.
Manufacturer:	Verdant Environmental Technologies, Inc.
Number of Samples Tested:	1
Test Specification/Issue/Date:	RSS-247 Issue 2 : February 2017 FCC Part 15 Subpart C.247 2016 ICES 003 Issue 6:2019
Test Plan/Issue/Date:	N/A
Project Number:	7169005571
Date:	2019-02-26
Date of Receipt of EUT:	2019-02-10
Start of Test:	2019-02-26
Finish of Test:	2019-04-09
Name of Tester(s):	Abderrahmane Ferhat
Related Documents:	ANSI C63.10:2013 FCC 15. Subpart 15 Subpart C/RSS-247



Brief Summary of Results

A brief summary of the tests carried out in accordance with RSS-247 Issue 2, FCC Part 15 Subpart 15.247, FCC Part 15 Subpart 15.207 & FCC Part 15 Subpart 15.209 is summarized in Table 2.

Report Section	FCC Rule	IC Rule	Description	Class/Limit	Result
6	15.247(a)(1)	RSS-GEN.6.7	99% Bandwidth DTS+FHSS	Refer to RSS GEN.6.7	Pass
	15.247(a)(1)(i)	RSS-247.5.1	99% Bandwidth Hopping System	≤500kHz	Pass
7	15.247(a)(2)	RSS-247.5.2(a)	6 dB Bandwidth	>500kHz	Pass
8	15.247(a)(1)(i)	RSS 247 5.1 (c)	Hopping Channels	≥50	Pass
9	15.247(a)(1)	RSS 247 5.1 (2)	Channel Separation	> 25 kHz or 20 dB BW	Pass
10	15.247(a)(1)(i)	RSS 247 5.1 (c)	Time of occupancy	<0.4 s in 20s period	Pass
11	§15.247(b)(3)	RSS-247.5.4(d)	Maximum Peak Output Power (DTS)	< 1W	Pass
	15.247(b)(2)	RSS-247.5.4(a)	Maximum Peak Output Power (FHSS)	< 1W	
12	15.247(f)	RSS-247 5.2(b)	Power Spectral Density	<8dBm in any 3kHz Band	Pass
13	§15.247(d)	RSS-247 5.5	Band-Edge Spurious Conducted Emission	≤ 20dBc	Pass



ZX Wireless Thermostat

<u>14</u>	§15.209(a)	RSS-247 5.5	Tx Spurious Radiated Emission	Quasi-Peak Average	Pass
<u>15</u>	15.207(a)	RSS GEN 8.8	Conducted Emission	Quasi-Peak Average	Pass
-	15.247(h)	RSS 247 5.1	FHSS Intelligence	Note 3	Pass
-	15.247 (i)	RSS-102	RF Exposure	Note 4	Pass
-	15.247(b)(4)	RSS 247 5.4 (3)	Antenna Gain	<6dBi <Note 2>	Pass
-	15.203 & 15.247(b)	RSS-210	Antenna Requirement	Note 1	Not Applicable
Note 1: Manufacture uses a SMA antenna connector for unique coupling to the intentional radiator Note 2: For the Antenna requirement specified in FCC 15.203 (RSS-247 section 5.5), the unit uses a trace antenna with a gain of 1.2dBi. Note 3: The EUT does not coordinate transmission with any other FHSS to avoid simultaneous occupation of hopping frequencies Note 4: For maximum permissible exposure, this device operates at less than 1 Watt at 902 - 928MHz and at 2.4GHz – 2.48GHz. It is designed to operate less than 20 cm from any personnel during normal operation. No testing is required; however, it complies with SAR exemption evaluation as determined the RF Exposure exhibits					

Table 2 – Test Summary Table



Declaration of Build Status

This report addresses the EMC verification testing and test results of the ZX WIRELESS Thermostat as 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

ICES 003 Issue 6: 2019

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

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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.

Notes, Justification

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 trace antenna with a gain of 0dBi.

For the Restricted Bands of operation, the EUT is designed to only operate between 902 – 907.6 MHz and 2.402 – 2.48GHz.



ZX Wireless Thermostat

The EUT does not coordinate transmission with any other FHSS to avoid simultaneous occupation of hopping frequencies.

For maximum permissible exposure, this device operates at less than 1 Watt at 902 - 928MHz and 2.4GHz – 2.48GHz. It is designed to operate less than 20 cm from any personnel during normal operation. No testing is required; however, it complies with SAR exemption evaluation as determined the RF Exposure exhibits.

For antenna requirements, the antenna is permanently glue with epoxy to a standard connector. See for instance external photos. Thus, complies with section 15.203 2a (ii).

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



3 EUT: ZX WIRELESS THERMOSTAT

3.1 Specifications:

PRODUCT NAME:	ZX WIRELESS THERMOSTAT
MANUFACTURER:	Verdant Environmental Technologies, Inc
MODEL	2.4G
FREQUENCY RANGE (MHz)	2402-2480
VOLTAGE RATING:	5Vdc
HVIN	WU
FVIN	V1.00

Table 3 – EUT – ZX WIRELESS THERMOSTAT– Specifications for 2.4GHz

PRODUCT NAME:	ZX WIRELESS THERMOSTAT
MANUFACTURER:	Verdant Environmental Technologies, Inc
MODEL	900 MHz
FREQUENCY RANGE (MHz)	902-928
VOLTAGE RATING:	5Vdc
HVIN	WU
FVIN	V1.00

Table 4 – EUT – ZX WIRELESS THERMOSTAT– Specifications for 900MHz



ZX Wireless Thermostat

Channels	Frequency (GHz)	Channels	Frequency (GHz)
Channel #0	2.402	Channel #20	2.442
Channel #1	2.404	Channel #21	2.444
Channel #2	2.406	Channel #22	2.446
Channel #3	2.408	Channel #23	2.448
Channel #4	2.410	Channel #24	2.450
Channel #5	2.412	Channel #25	2.452
Channel #6	2.414	Channel #26	2.454
Channel #7	2.416	Channel #27	2.456
Channel #8	2.418	Channel #28	2.458
Channel #9	2.420	Channel #29	2.460
Channel #10	2.422	Channel #30	2.462
Channel #11	2.424	Channel #31	2.464
Channel #12	2.426	Channel #32	2.466
Channel #13	2.428	Channel #33	2.468
Channel #14	2.430	Channel #34	2.470
Channel #15	2.432	Channel #35	2.472
Channel #16	2.434	Channel #36	2.474
Channel #17	2.436	Channel #37	2.476
Channel #18	2.438	Channel #38	2.478
Channel #19	2.440	Channel #39	2.480

Table 5 List of Channels for ZX Wireless Thermostat 2.4 GHz



Channels	Frequency (MHz)	Channels	Frequency (MHz)	Channels	Frequency (MHz)
#0	902.46	#33	915	#66	927.54
#1	902.84	#34	915.38	#67	927.92
#2	903.22	#35	915.76		
#3	903.6	#36	916.14		
#4	903.98	#37	916.52		
#5	904.36	#38	916.90		
#6	904.74	#39	917.28		
#7	905.12	#40	917.66		
#8	905.5	#41	918.04		
#9	905.88	#42	918.42		
#10	906.26	#43	918.8		
#11	906.64	#44	919.18		
#12	907.02	#45	919.56		
#13	907.4	#46	919.94		
#14	907.78	#47	920.32		
#15	908.16	#48	920.7		
#16	908.54	#49	921.08		
#17	908.92	#50	921.46		
#18	909.3	#51	921.84		
#19	909.68	#52	922.22		
#20	910.06	#53	922.6		
#21	910.44	#54	922.98		
#22	910.82	#55	923.36		
#23	911.2	#56	923.74		
#24	911.58	#57	924.12		
#25	911.96	#58	924.5		
#26	912.34	#59	924.88		
#27	912.72	#60	925.26		
#28	913.1	#61	925.64		
#29	913.48	#62	926.02		
#30	913.86	#63	926.4		
#31	914.24	#64	926.78		
#32	914.62	#65	927.16		

Table 6 List of Channels for ZX Wireless Thermostat 900 MHz**COMMERCIAL-IN-CONFIDENCE**

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3.2 Modes of Operation

The ZX WIRELESS THERMOSTAT is operating in the 2.4 GHz and 915 MHz bands. For operation, wireless was configured to transmit at maximum possible duty cycle

The transmitter was provided in 2 different settings:

- A configuration with special test firmware was installed on the EUT to control hopping through its pseudo random sequence and single channel
- A configuration with low, medium and high channels transmitting continuously at a 100% duty cycle.

3.3 Setup Diagram

During the EUT was exercised by powering to the rated voltage and connecting according to Figure 1.

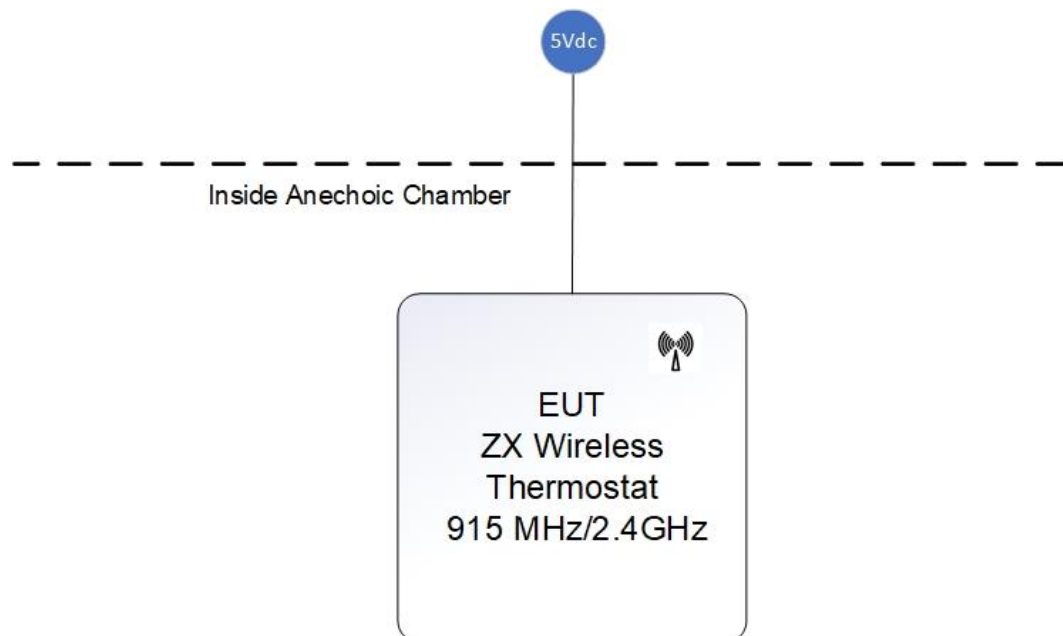


Figure 1: EUT Setup Diagram – ZX WIRELESS THERMOSTAT– Spurious Emissions



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 0.15MHz-30MHz, 30MHz – 1GHz and 1GHz – 18GHz is ± 3.3 dB, ± 4.25 dB and ± 4.93 dB, respectively with a 'k=2' coverage factor and a 95% confidence level.

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

Table 7 Acceptable Uncertainties



6 99% Bandwidth

6.1 Purpose & Methods

The Purpose & Methods 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 test method is defined in ANSI C63.10.

6.2 Test Specifications

REFERENCE STANDARD	FCC 15.247(a)(1) ANSI C63.10-2013 Clause 6.9 RSS-247.5.1	
SPECIFICATIONS		
Limit – Bandwidth (kHz)	≤500	
Frequency range (MHz)	2402	902.46
	2442	915
	2480	927.52
RBW (kHz):	Set to 1% to 3% of the 99% bandwidth	
VBW (kHz)	3xRBW	
EUT		
Identification	ZX Wireless Thermostat(2.4GHz) ZX Wireless Thermostat(915MHz)	
Voltage Input	5Vdc	
ENVIRONMENTAL & TEST INFO		
Test Date (YYYY-MM-DD)	2019-04-08	
Temperature (°C)	23.4± 2	
Humidity (%)	36.3 ± 5	
Atmospheric Pressure kPa (For Info Only)	109.7	
Tester	Abderrahmane Ferhat	
Client Witness	No Witness	



6.3 Test Results

ZX Wireless Thermostat(2.4GHz)

All the Channels gave a maximum of 1.193MHz for 99% BW. Details are depicted in Table 8.

Channel	Frequency (MHz)	99% Bandwidth (MHz)	Results
Low channel	2402	1.193	Pass
Middle Channel	2442	1.046	Pass
Highest Channel	2480	1.050	Pass
Note 1: No Limit is applicable, but according to RSS GEN 5 the RBW has to be set to 1% to 3% of the 99% bandwidth			

Table 8 – 99% Bandwidth Results

ZX Wireless Thermostat(900MHz)

The Channel #0 gave a maximum of 182.7 kHz for 99% BW. Details are depicted in Table 9.

Channel	Frequency (MHz)	20 dB Bandwidth (kHz)	Limits (kHz)	Results
Low channel	902.46	182.692	≤500	Pass
Middle Channel	915	181.891	≤500	Pass
Highest Channel	927.52	182.692	≤500	Pass

Table 9 – 99% Bandwidth Results

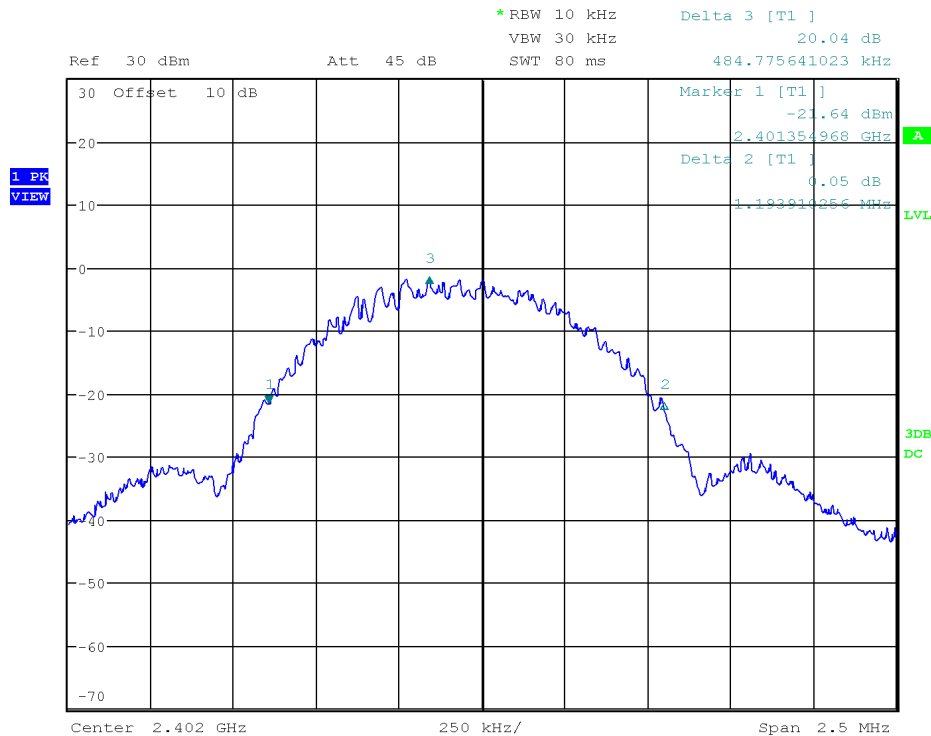


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6.4 Graphs

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 99% bandwidth of a channel during operation of the EUT. Max hold is performed for a duration of not less than 1 minute. No attenuator was used between the EUT and the Spectrum Analyzer.

ZX Wireless Thermostat(2.4GHz)



Date: 9.APR.2019 01:29:08

Graph 1 Test Results – 99% Bandwidth Results – Lower Channel (#0) ZX WIRELESS Thermostat(2.4GHz)

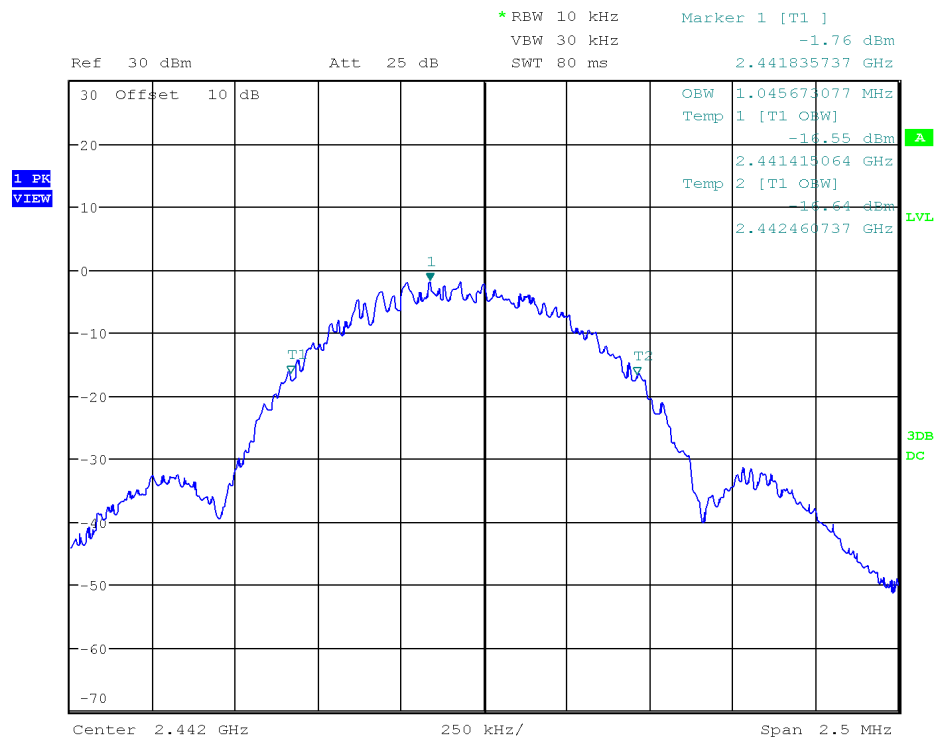
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ZX Wireless Thermostat



Date: 9.APR.2019 01:56:51

**Graph 2 Test Results – 99% Bandwidth Results – Middle Channel (#19) ZX
WIRELESS Thermostat(2.4GHz)**

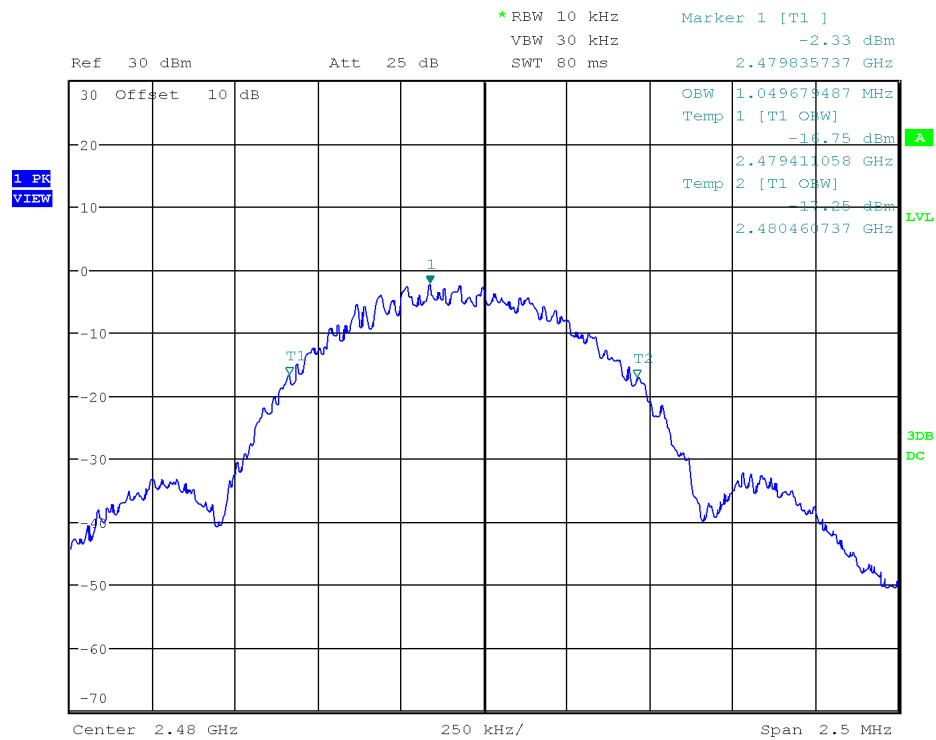
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ZX Wireless Thermostat



Date: 9.APR.2019 02:06:15

Graph 3 Test Results – 99% Bandwidth Results – Highest Channel (#39) ZX WIRELESS Thermostat(2.4GHz)

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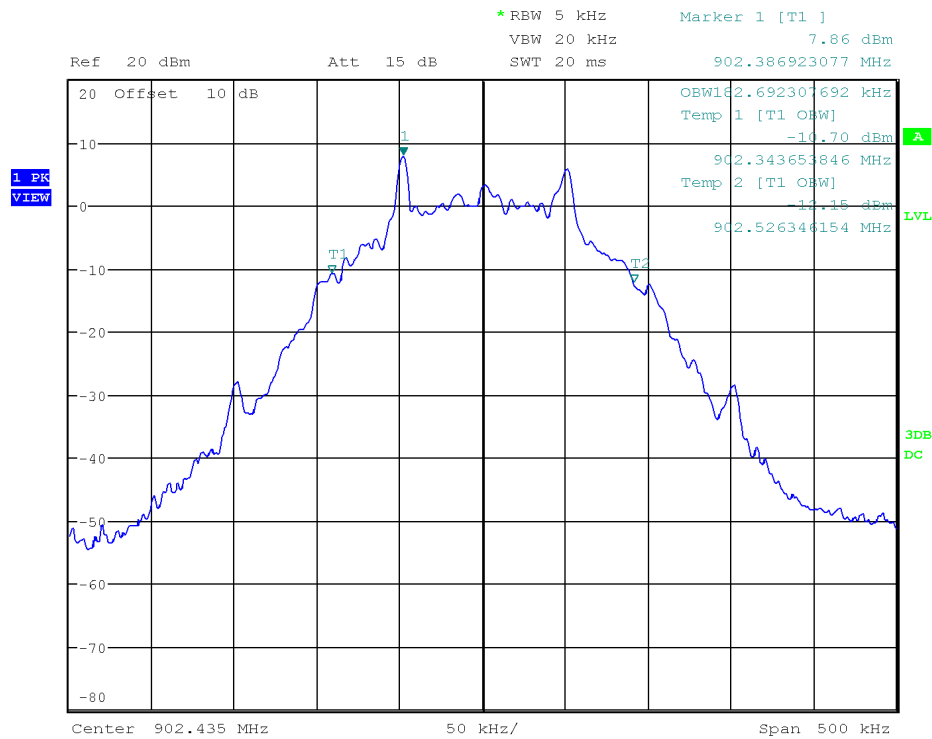
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ZX Wireless Thermostat

ZX Wireless Thermostat(900MHz)



Date: 8.APR.2019 02:53:57

Graph 4 Test Results – 99% Bandwidth Results – Low Channel ZX Wireless Thermostat(900MHz)

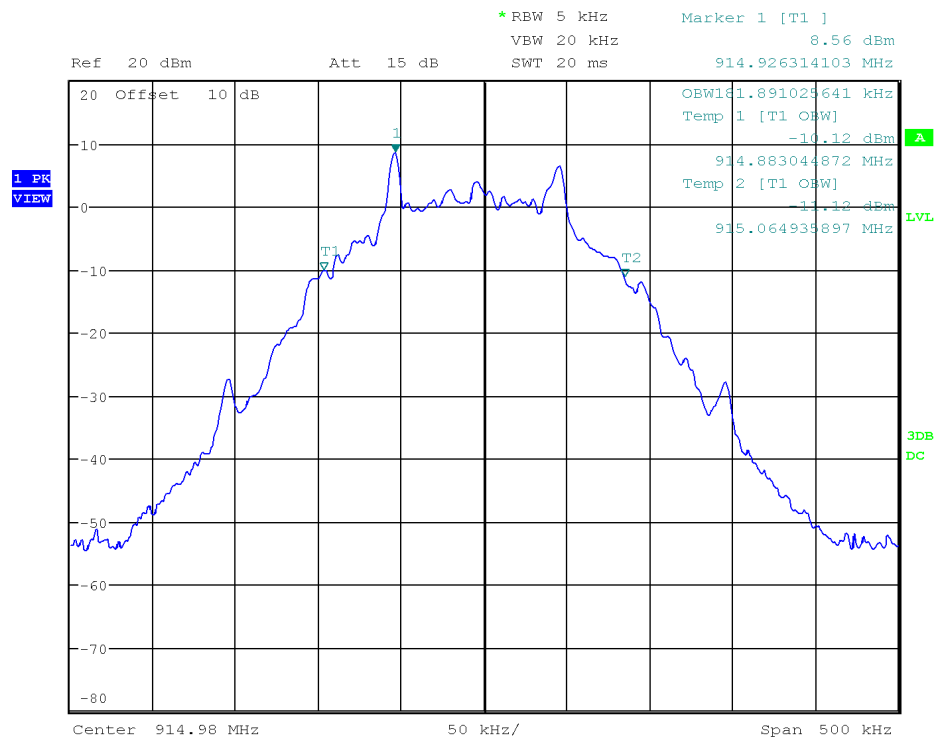
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Graph 5 Test Results – 99% Bandwidth Results – Mid Channel ZX Wireless Thermostat(900MHz)

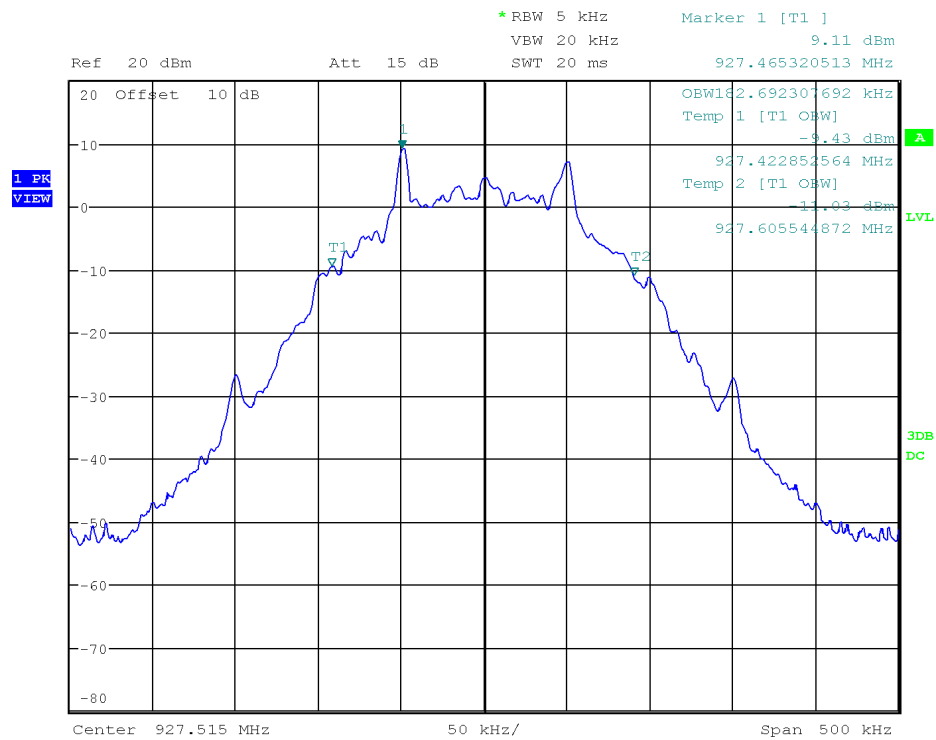
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Graph 6 Test Results – 99% Bandwidth Results – High Channel ZX WIRELESS Thermostat(900MHz)

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6.5 Test Instruments

This test was carried out in Laval test location. Instrumentation used is depicted in Table 10.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2019-04-20	4092
Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096

Table 10: 99%BW Test Equipment



7 6dB Bandwidth of Digitally Modulated Systems

7.1 Purpose & Methods

The Purpose & Methods 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 test method is defined in ANSI C63.10.

7.2 Test Specifications

REFERENCE STANDARD	FCC Part 15.247(a)2 RSS-247 5.2(a)
SPECIFICATIONS	
Limit – 6dB Bandwidth(kHz)	≥500kHz
Test Frequency (MHz):	2402 2442 2480
RBW (kHz)	10
VBW (kHz)	30
EUT	
Identification	ZX Wireless Thermostat(2.4GHz)
Voltage Input	5Vdc
Environmental	Normal Conditions
Test Date (YYYY-MM-DD)	2019-04-09
Temperature (°C)	23.4 ± 1
Humidity (%)	36.3 ± 5
Atmospheric Pressure kPa (For Info Only)	109.7
Tester(s)	Abderrahmane Ferhat
Client Witness	No witness



7.3 Test Results

ZX Wireless Thermostat(2.4GHz)

The Channel #0 and Channel #19 gave a maximum of 596.955kHz for 6dB BW. Details are depicted in Table 11

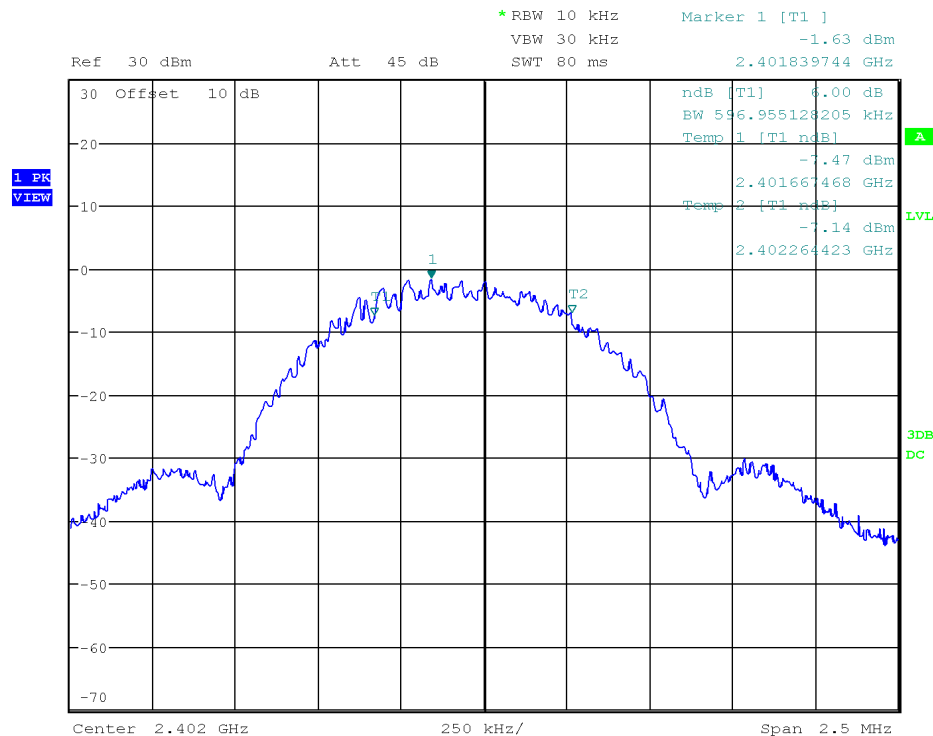
Channel	Frequency (MHz)	6dB Bandwidth (kHz)	Limit (kHz)	Results
Low channel:	2402	596.955	≥500	Pass
Middle Channel	2442	596.955	≥500	Pass
Highest Channel	2480	560.897	≥500	Pass

Table 11 – 6dB Bandwidth Results



7.4 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 99% bandwidth of a channel during operation of the EUT. Max hold is performed for a duration of not less than 1 minute. No attenuator was used between the EUT and the Spectrum Analyzer.



Date: 9.APR.2019 01:30:37

Graph 7 Test Results – 6dB Bandwidth Results – Low Channel ZX WIRELESS Thermostat(2.4GHz)

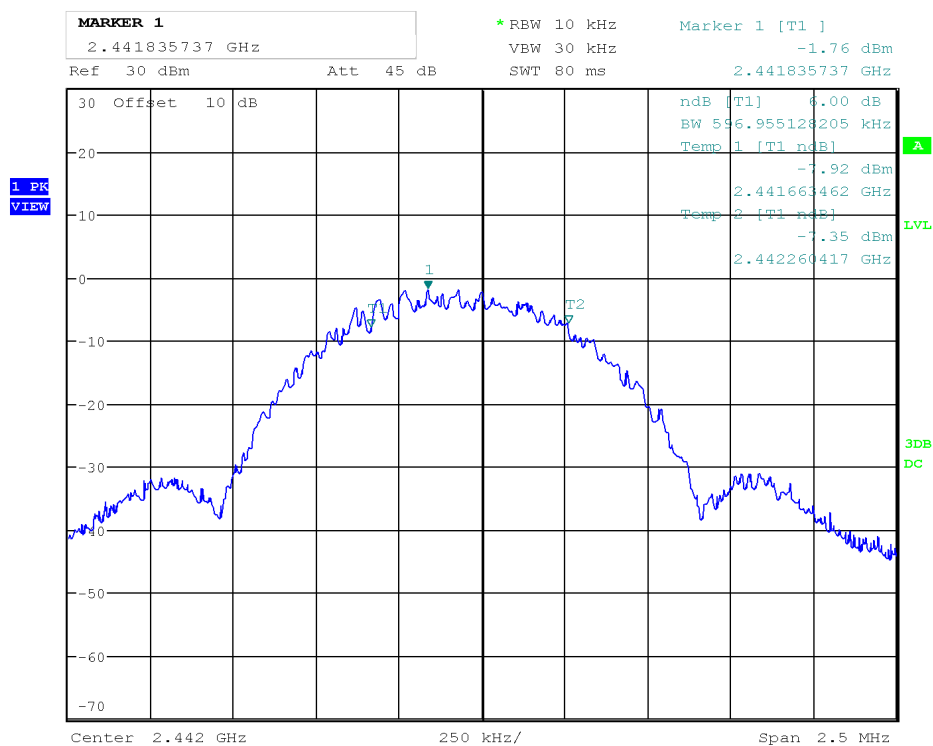
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ZX Wireless Thermostat



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**Graph 8 Test Results – 6dB Bandwidth Results – Mid Channel ZX WIRELESS
Thermostat(2.4GHz)**

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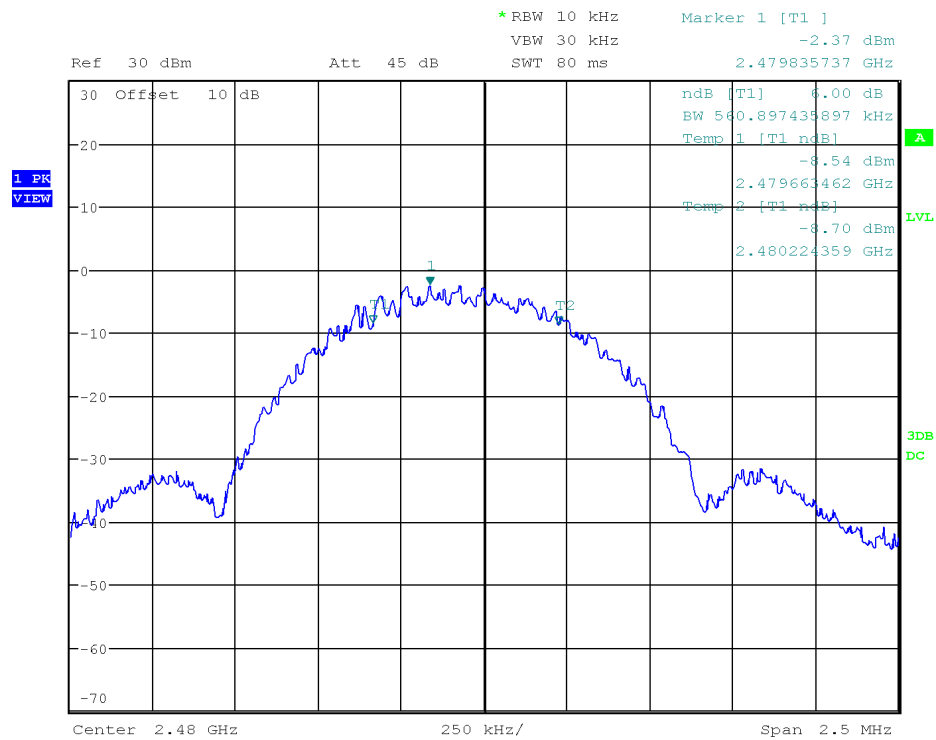
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Page 30 of 109



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**Graph 9 Test Results – 6dB Bandwidth Results – High Channel ZX WIRELESS
Thermostat(2.4GHz)**

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7.5 Test Instruments

This test was carried out in Laval test location. Instrumentation used are depicted in Table 12.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2019-04-20	4092
Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096

Table 12: 6 dB OBW Test Equipment



8 Hopping Channel

8.1 Purpose & Methods

The Purpose & Methods of this test is to ensure that the RF energy of frequency hopping systems is sufficiently spread over a spectrum and that the radio energy is not overly dense. This limit helps allow for other spread spectrum devices to co-exist in the same frequency spectrum. This also helps prevent corruption of data by ensuring adequate channel separation to distinguish the reception of the intended information. The test method is a defined in ANSI C63.10.

8.2 Test Specifications

REFERENCE STANDARD	FCC Part 15.247(a)(1)(i) RSS 247 5.1 (c)
SPECIFICATIONS	
Limits	See Section 15.247(a)(1)
Test Frequency (MHz):	902.46 915 927.52
RBW (kHz)	200
VBW (kHz)	500
EUT	
Identification	ZX Wireless Thermostat(900MHz)
Voltage Input	5Vdc
Environmental	Normal Conditions
Test Date (YYYY-MM-DD)	2019-04-08
Temperature (°C)	23.4 ± 1
Humidity (%)	36.3 ± 5
Atmospheric Pressure kPa (For Info Only)	109.7
Tester(s)	Abderrahmane Ferhat
Client Witness	No witness



8.3 Limits

The limits are as defined in 47 CFR FCC Part 15 Section 15.247(a)(1). The test method is defined in ANSI C63.10.

Frequency Band	20 dB Bandwidth of the hopping channel	Hopping Number
902 - 928	$\leq 250\text{kHz}$	≥ 50 channels
	$\geq 250\text{ kHz}$	≥ 25 channels
2400 - 2483.5	$\leq 250\text{kHz}$	≥ 15 channels
	$\geq 250\text{ kHz}$	≥ 15 channels
	$\geq 250\text{ kHz}$	≥ 75 channels

8.4 Test Results

The EUT passed the requirements of the number of channels. The number of channels occupied by the EUT and 64 channels in the allocation band of 902 MHz to 928 MHz. The results are depicted in Table 13.

Channel	Range (MHz)	Number of Hopping Measured	Limits	Results
Middle Channel:	902 - 928	64	≥ 50 channels	Pass

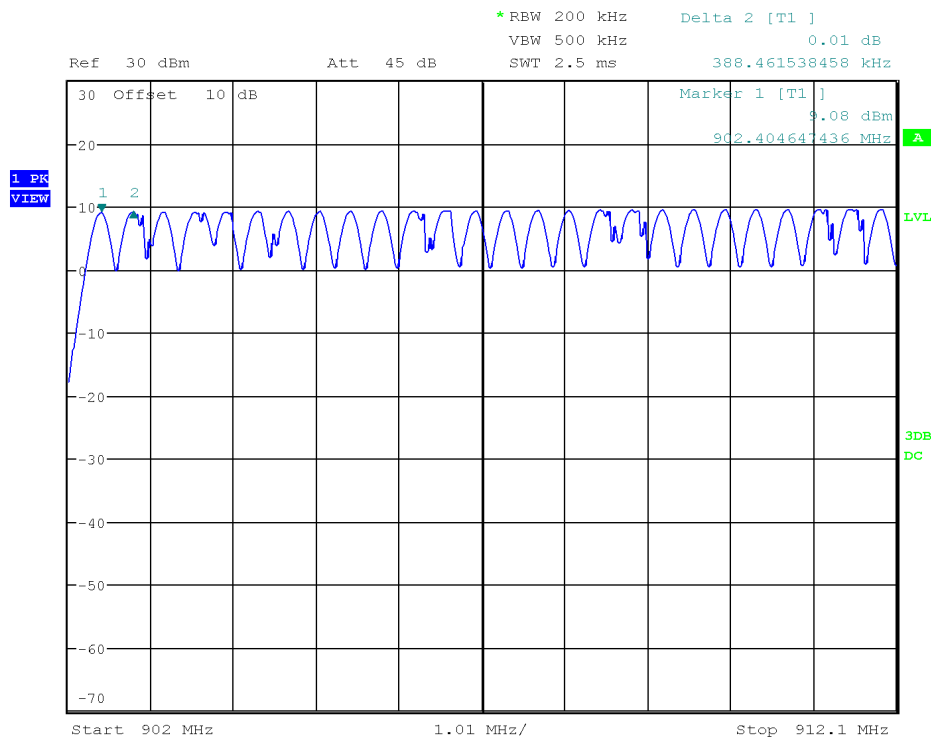
Table 13 – Hopping Channel Results



ZX Wireless Thermostat

8.5 Graphs

The graphs below show the number of occupied channels during the operation of the device. This is measured by a max hold on the spectrum analyser and the highest resolution bandwidth that is sufficiently low to exhibit the channel spacing of the signal being measured. This measurement is a peak measurement. Max hold is performed for a duration of not less than 10 minutes, or as sufficient to capture the channels occupied.



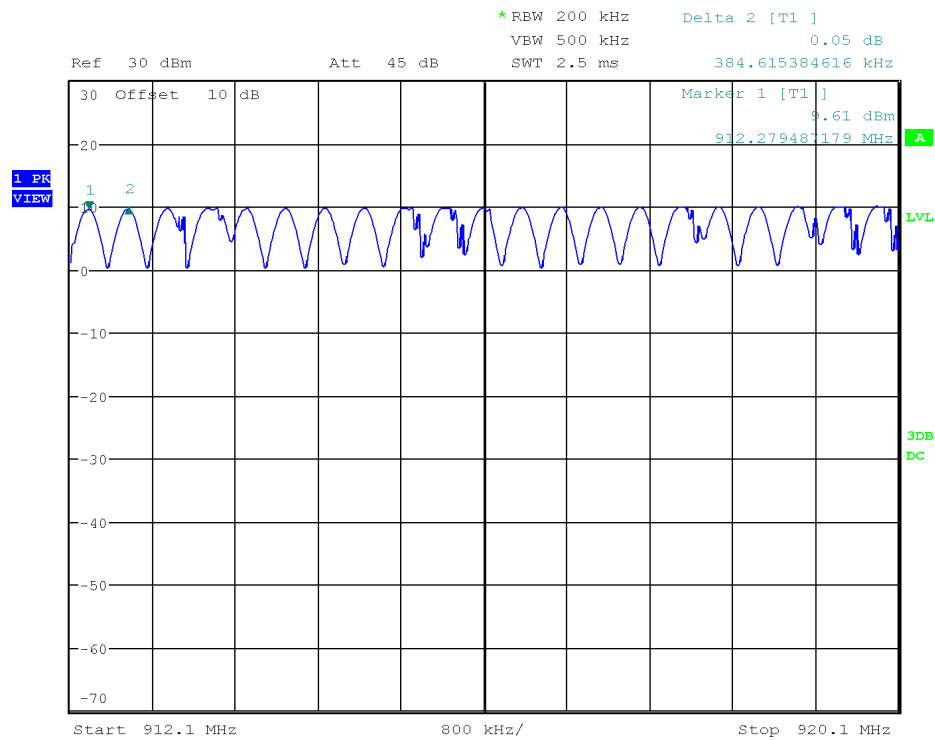
Date: 8.APR.2019 03:12:57

Graph 10: Hopping Channel – ZX Wireless Thermostat(900MHz) – 902MHz – 912.1MHz



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ZX Wireless Thermostat



Date: 8.APR.2019 03:18:31

Graph 11: Hopping Channel – ZX Wireless Thermostat(900MHz) – 912.1MHz – 920.1MHz

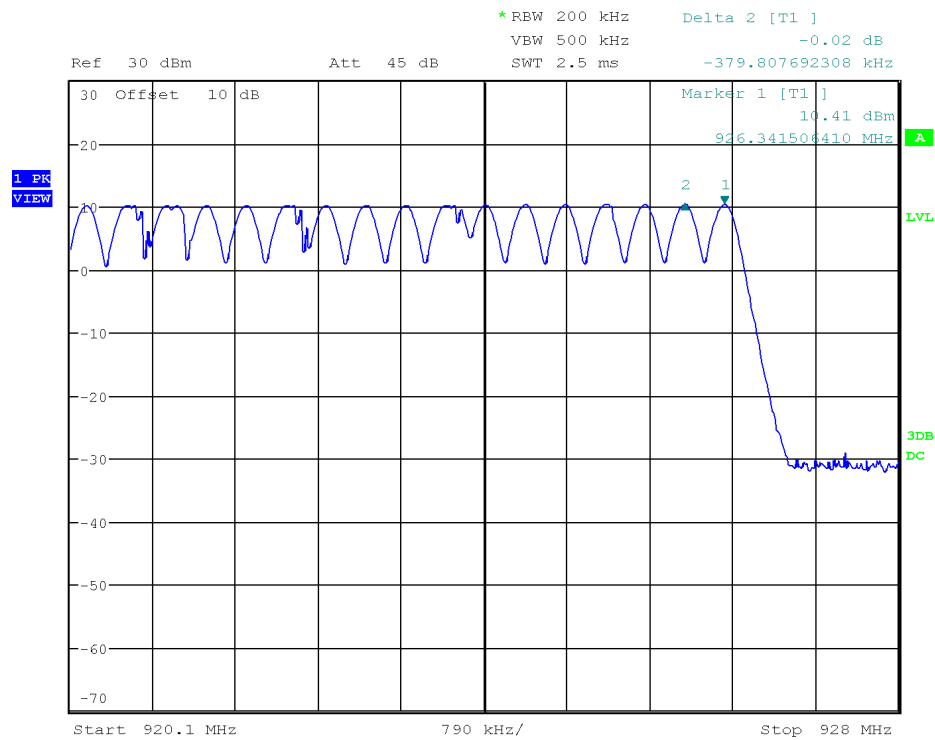
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Graph 12: Hopping Channel – ZX Wireless Thermostat(900MHz) – 920.1MHz – 928MHz

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8.6 Test Instruments

This test was carried out in Laval test location. Instrumentation used is depicted in Table 14.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2019-04-20	4092
Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096

Table 14: Hopping Channel Test Equipment



9 Channel Separation

9.1 Purpose & Methods

The Purpose & Methods of this test is to ensure that the RF energy of frequency hopping systems is sufficiently spread over a spectrum and that the radio energy is not overly dense. This limit helps allow for other spread spectrum devices to co-exist in the same frequency spectrum. This also helps prevent corruption of data by ensuring adequate channel separation to distinguish the reception of the intended information. The test method is defined in ANSI C63.10.

9.2 Test Specifications

REFERENCE STANDARD	FCC Part 15.247(a)(1). RSS 247 5.1 (2)
SPECIFICATIONS	
Limit	≥20 dB Bandwidth
Frequency range (MHz)	902.46 915 927.52
RBW (kHz):	100
VBW (kHz)	300
EUT	
Identification	ZX WIRELESS THERMOSTAT (900MHz)
Voltage Input	5Vdc
ENVIROMENTAL & TEST INFO	
Test Date (YYYY-MM-DD)	2019-04-08
Temperature (°C)	23.4 ± 1
Humidity (%)	36.3 ± 5
Atmospheric Pressure kPa (For Info Only)	109.7
Tester	Abderrahmane Ferhat
Client Witness	No Witness



ZX Wireless Thermostat

9.3 Limits

The limits are as defined in 47 CFR FCC Part 15 Section 15.247(a)(1). The test method is defined in ANSI C63.10 as shown in the Table below

Frequency Band	20 dB Bandwidth of the hopping channel	Limits <Note 1>
902 - 928	≤250kHz	25kHz or 20dB BW
2400 - 2483.5	≤250kHz	25kHz or 20dB BW
	≤125mW	25 kHz or 2/3 of 20 dB BW ¹
Note 1: The minimum channel separation is given by the greater of 25 kHz or 20 dB BW for unconditional operation. The 20 dB BW of the system was measured to be 184.63 kHz. Thus, a channel separation limit of 182.7kHz applies.		

9.4 Test Results

The results of the EUT are detailed in Table 15. Results are depicted in Table 15.

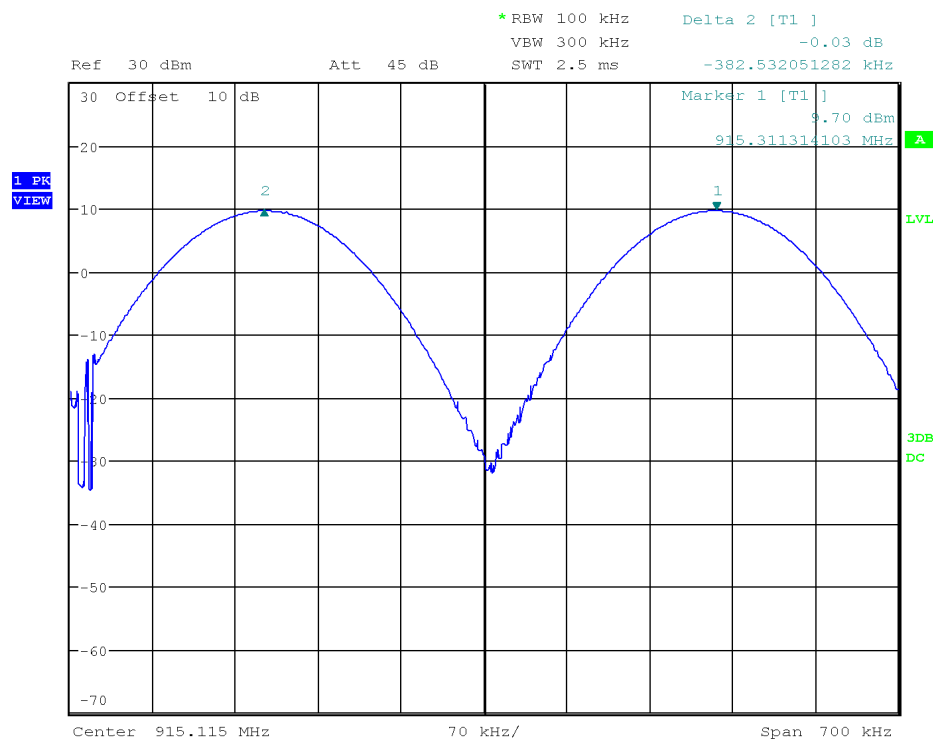
Channel	Range (MHz)	Channel Separation Measured <kHz>	Limits < kHz>	Results
Middle Channel:	902 - 915	382.53	≥182.7	Pass

Table 15 – Channel Separation Results



9.5 Graphs

The graphs shown below shows the channel spacing during the operation of the device. This is measured by a max hold on the spectrum analyser and the highest resolution bandwidth that is sufficiently low to exhibit the channel spacing of the signal being measured. This measurement is a peak measurement. Max hold is performed for a duration of not less than 1 minute, as the device is stepping through its hopping table.



Date: 8.APR.2019 03:30:22

Graph 13: Channel Separation – ZX Wireless Thermostat(900MHz)



9.6 Test Instruments

This test was carried out in Laval test location. Instrumentation used is depicted in Table 16.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2019-04-20	4092
Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096

Table 16: Channel Separation Test Equipment



10 Time of Occupancy

10.1 Purpose & Methods

The purpose of this test is to ensure that the RF energy of frequency hopping systems is hopping at a minimum defined rate. This helps ensure sufficient time off to enable other frequency hopping devices to co-operate within this allocated band.

10.2 Test Specifications

REFERENCE STANDARD	FCC Part 15.247(a)(1). RSS 247 5.1 (2)
SPECIFICATIONS	
Limit	See FCC 15.247(a)(1)(i).
Frequency range (MHz)	902.46 915 927.52
RBW (kHz):	200
VBW (kHz)	500
EUT	
Identification	ZX WIRELESS THERMOSTAT (900MHz)
Voltage Input	5Vdc
ENVIROMENTAL & TEST INFO	
Test Date (YYYY-MM-DD)	2019-04-08
Temperature (°C)	23.4 ± 1
Humidity (%)	36.3 ± 5
Atmospheric Pressure kPa (For Info Only)	109.7
Tester	Abderrahmane Ferhat
Client Witness	No Witness



10.3 Limits

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

10.4 Test Results

The EUT cycles through its pseudo-random generated list of hopping frequencies. There are 64 channels occupied in total. The average transmit time is 4.5ms per channel and each channel is repeated approximately every 1s. Results are depicted in Table 17.

Channel	Range (MHz)	Average Transmit Time/ Channel (ms)	Number of Hops in 20s	Average Time of Occupancy (ms)	Limit (ms)	Results
Middle Channel: #34	902 - 915	4.5	20	90	≤400	Pass

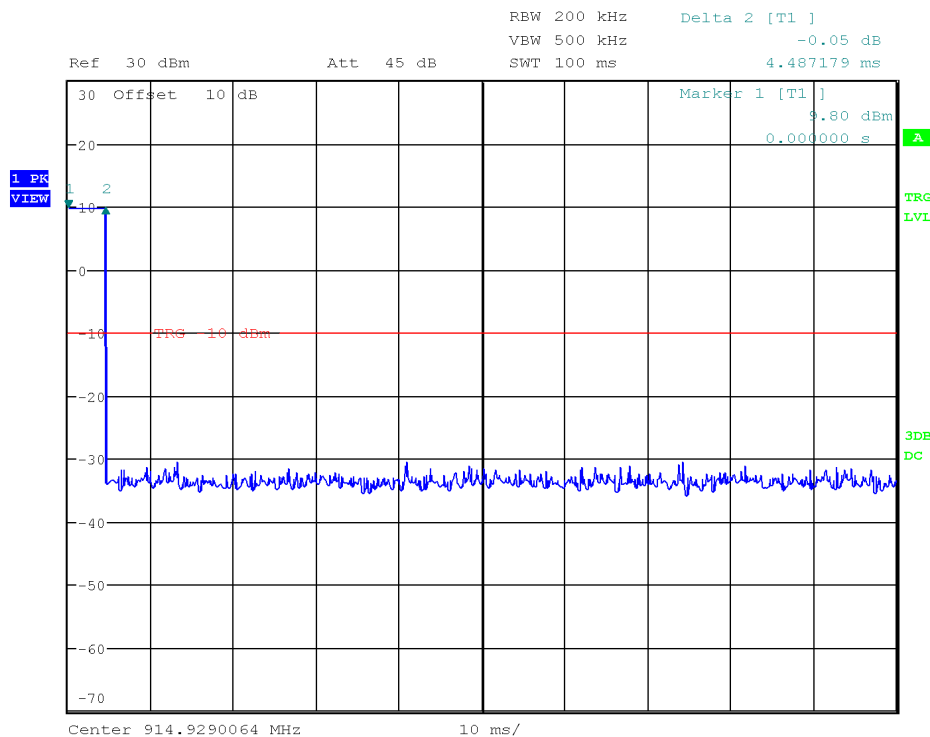
Table 17 – Time Occupancy Results



ZX Wireless Thermostat

10.5 Graphs

The graphs shown below shows the Time of Occupancy during the operation of the device. This is measured by a max hold on the spectrum analyser and the highest resolution bandwidth that is sufficiently low to exhibit the Time of Occupancy of the signal being measured. This measurement is a peak measurement.



Date: 8.APR.2019 03:36:54

Graph 14: Time of Occupancy – ZX Wireless Thermostat(900MHz)



10.6 Test Instruments

This test was carried out in Laval test location. Instrumentation used is depicted in Table 18.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2019-04-20	4092
Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096

Table 18: Time of Occupancy Test Equipment



11 Maximum Peak Envelope Conducted Power – Digital Modulated

11.1 Purpose & Methods

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. The test method is defined in ANSI C63.10.

11.2 Test Specifications

REFERENCE STANDARD	FCC Part 15.247(b)(3) FCC Part 15.247(b)(2) RSS-247.5.4(d) ANSI C63.10. Clause 11.9.1	
SPECIFICATIONS		
Limit – Power (W)	<1	
Frequencies (MHz)	2402	902.46
	2442	915
	2480	927.52
RBW (MHz):	2	0.2
VBW (MHz)	10	0.5
Span (MHz)	10	1.5
EUT		
Identification	ZX WIRELESS THERMOSTAT	
Voltage Input	5Vdc	
ENVIRONMENTAL	Normal Conditions	
Test Date (YYYY-MM-DD)	2019-04-09	
Temperature (°C)	23.4 ± 2	
Humidity (%)	36.3 ± 5	
Atmospheric Pressure kPa (For Info Only)	109.7	
Tester	Abderrahmane Ferhat	
Client Witness	No Witness	



11.3 Limits

The limits are defined in 15.247(b)(2) and 15.247(b)(3). For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt.

11.4 Tests Results

ZX Wireless Thermostat(2.4GHz)

The Low Channel gave a maximum Peak Power of 8.8 dBm(7.6mW). Results of the peak power measurements of channels tested are depicted in Table 19.

Channel	Frequency (MHz)	Measured Peak Power (dBm)	Peak Power (mW)	Limit (W)	Result
Low	2402	8.71	7.43	1	Pass
Middle	2442	8.49	7.10	1	Pass
High	2480	7.88	6.13	1	Pass

Table 19 – Test Results Peak-Power Measurements ZX Wireless Thermostat(2.4GHz)

**ZX Wireless Thermostat(900MHz)**

The High Channel gave a maximum Peak Power of 10.78dBm (12mW). The peak power measurements of channels tested are depicted in Table 20.

Channel	Frequency (MHz)	Measured Peak Power (dBm)	Peak Power (mW)	Limit (mW)	Result
Low	902.46	9.54	8.99	1000	Pass
Middle	915	10.14	10.33	1000	Pass
High	927.52	10.78	11.97	1000	Pass

Table 20 – Test Results Peak-Power Measurements ZX Wireless Thermostat(900MHz)

11.5 Graphs

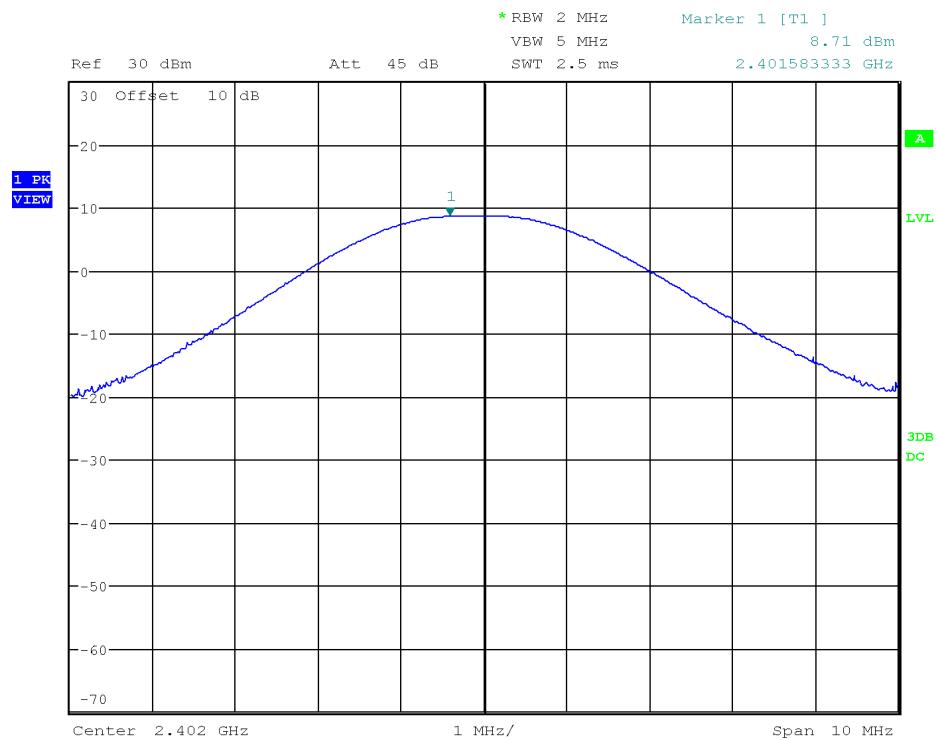
The plots shown below show the Peak Power Output of the device during the antenna conducted measurements during transmit operation of the EUT. Note that no attenuator was used between the EUT and the Spectrum Analyzer.



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ZX Wireless Thermostat

ZX Wireless Thermostat(2.4GHz)



Date: 9.APR.2019 01:26:03

Graph 15 Test Results – Conducted Peak Power Measurements – Low Channel

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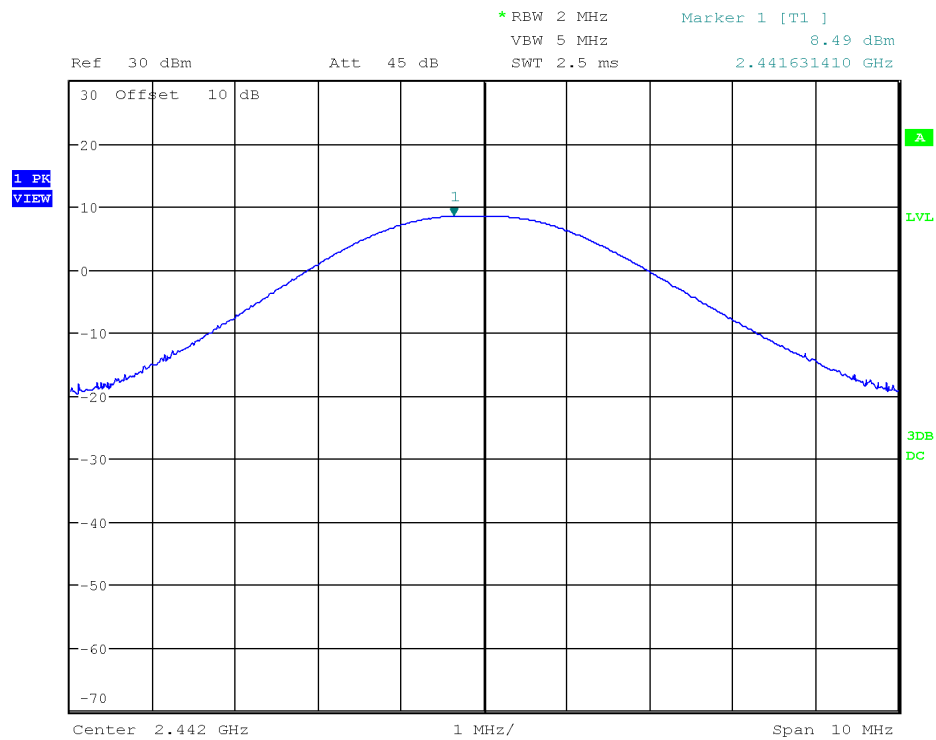
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Page 50 of 109



Product Service

ZX Wireless Thermostat



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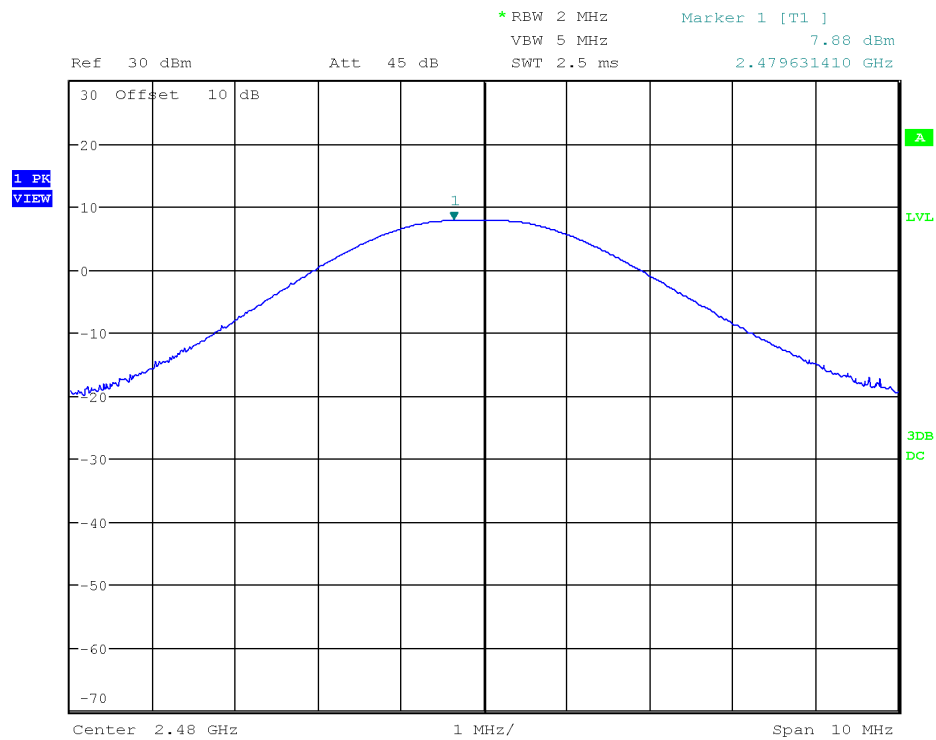
Graph 16 Test Results – Conducted Peak Power Measurements – Mid Channel**COMMERCIAL-IN-CONFIDENCE**

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Graph 17 Test Results – Conducted Peak Power Measurements – High Channel

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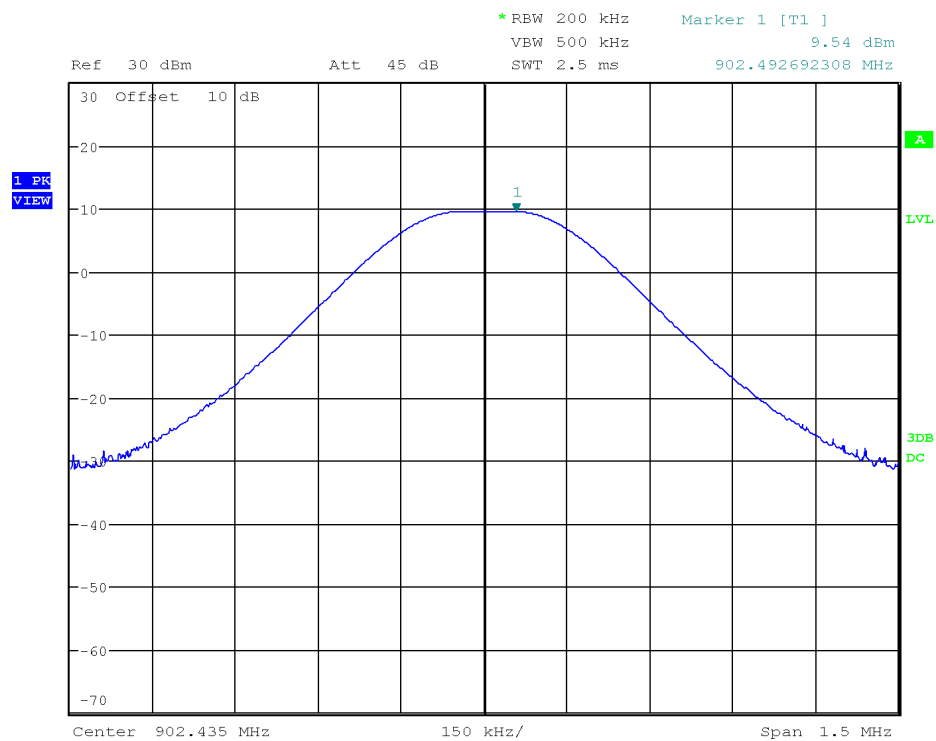
Page 52 of 109



Product Service

ZX Wireless Thermostat

ZX Wireless Thermostat(900MHz)



Date: 8.APR.2019 02:57:44

Graph 18 Test Results – Conducted Peak Power Measurements – Low Channel

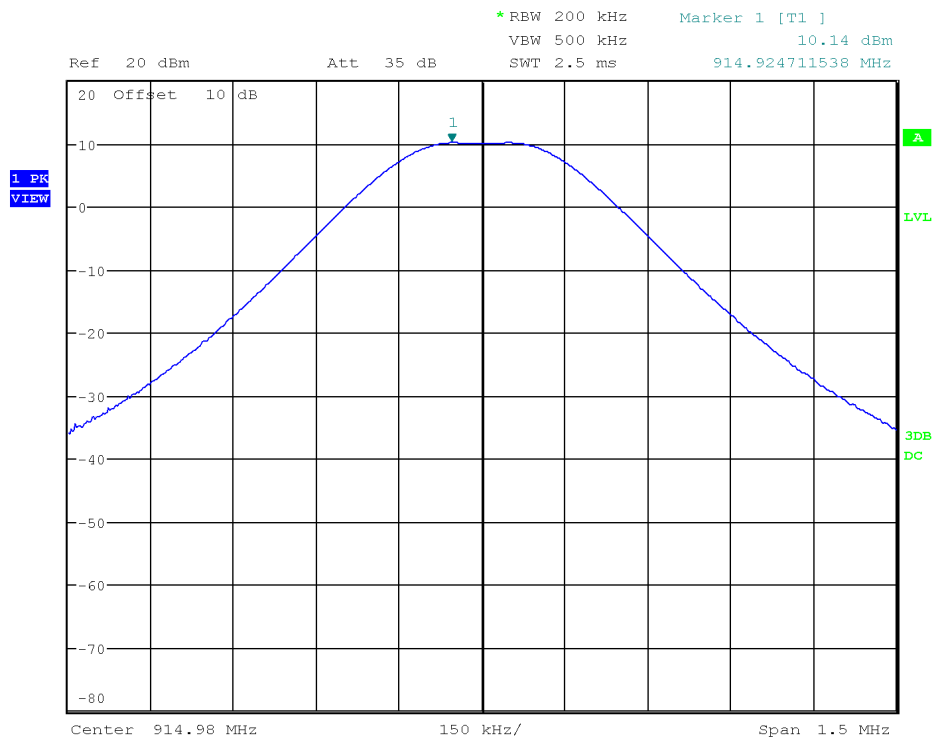
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Date: 8.APR.2019 02:47:37

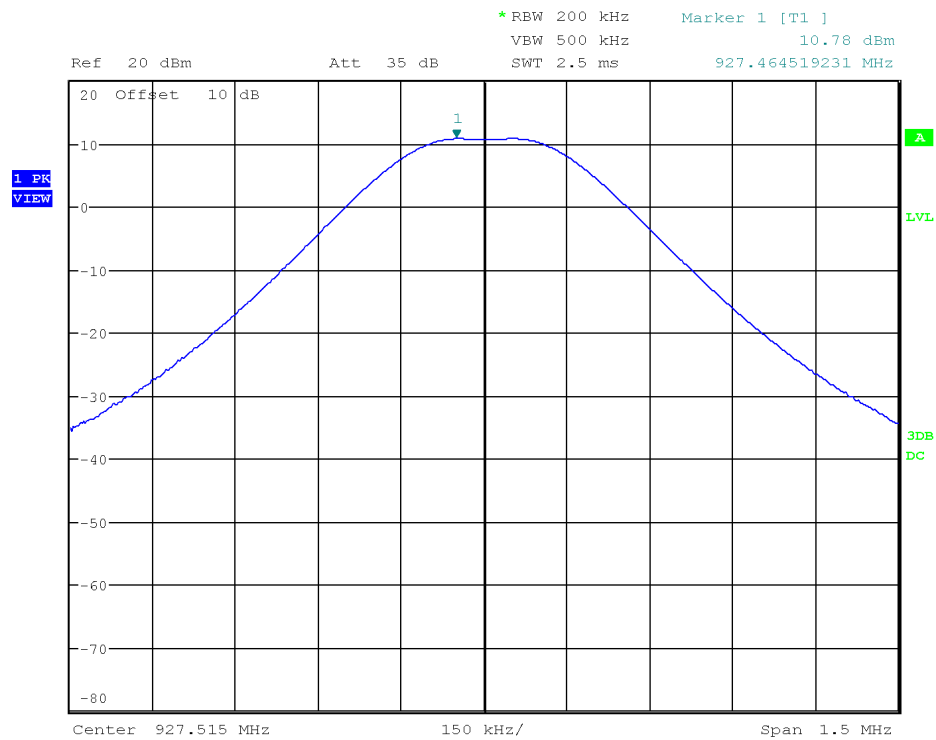
Graph 19 Test Results – Conducted Peak Power Measurements – Mid Channel**COMMERCIAL-IN-CONFIDENCE**

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Graph 20 Test Results – Conducted Peak Power Measurements – High Channel**COMMERCIAL-IN-CONFIDENCE**

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11.6 Test Instruments

This test was carried out in Laval test location. Instrumentation used is depicted in Table 21.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2019-04-20	4092
Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096

Table 21: Conducted Peak Power Test Equipment



12 Power Spectral Density

12.1 Purpose & Methods

The Purpose & Methods 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 11.10.

12.2 Test Specifications

REFERENCE STANDARD	FCC Part 15.247(F) RSS-247 5.2(b) ANSI C63.10. Clause 11.10
SPECIFICATIONS	
Limit (dBm)	<8
Frequencies (MHz)	2402 2442 2480
RBW (kHz):	3
VBW (kHz)	10
Span (MHz)	2
EUT	
Identification	ZX WIRELESS Thermostat
Voltage Input	5Vdc
ENVIRONMENTAL & TEST INFO	
Test Date (YYYY-MM-DD)	2019-04-09
Temperature (°C)	23.4 ± 2
Humidity (%)	36.3 ± 5
Atmospheric Pressure kPa (For Info Only)	109.7
Tester	Abderrahmane Ferhat
Client Witness	No Witness



12.3 Limits

The limits are defined in 15.247(f)

The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

12.4 Test Results

ZX Wireless Thermostat(2.4GHz)

The EUT was tested on: Low, medium, and high bands. The worst-case value is the High Channel with -8.18dBm as measured with a 3 kHz resolution bandwidth (peak power) on the higher channel #39. The results of the peak power of channels tested are depicted in Table 22.

Channel	Frequency (MHz)	Measured PSD (dBm)	Limit (dBm)	Results
Low	2402	-7.47	<8	Pass
Middle	2442	-7.65	<8	Pass
High	2480	-8.18	<8	Pass

Table 22- Results – PKPSD

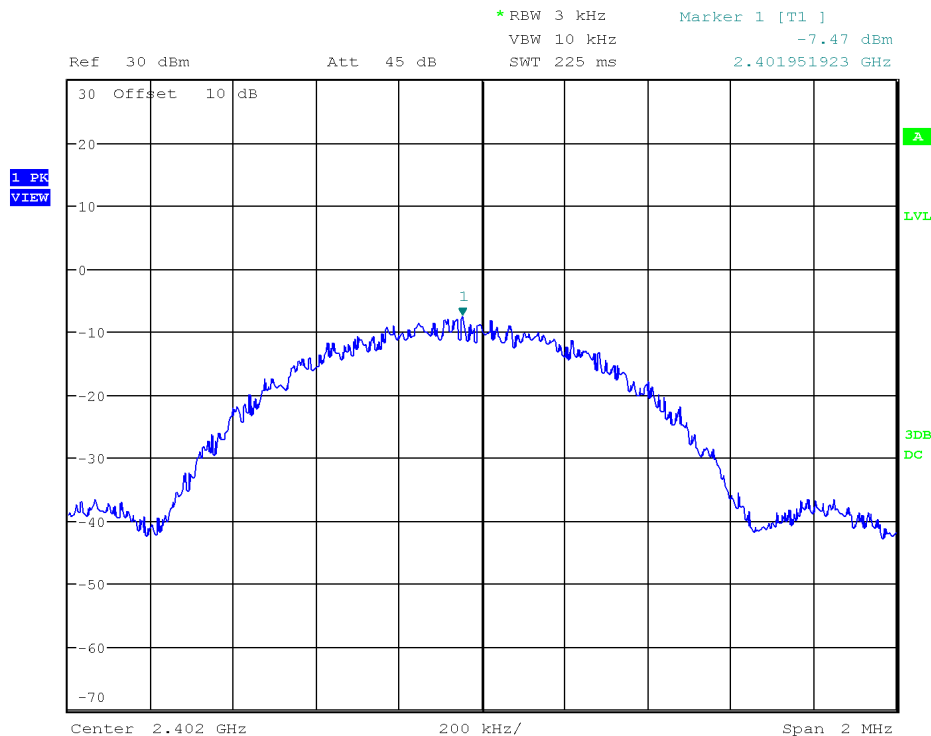


ZX Wireless Thermostat

12.5 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. No attenuator was used between the EUT and the Spectrum Analyzer.

ZX Wireless Thermostat(2.4GHz)



Date: 9.APR.2019 01:24:38

Graph 21 Test Results – PKPSD – Low Channel

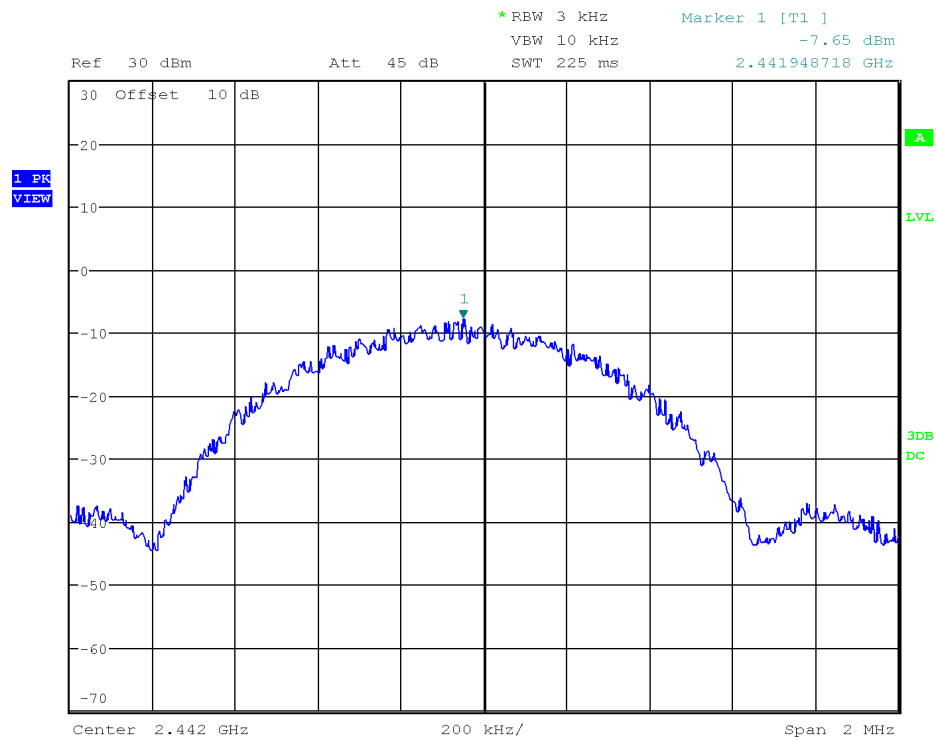
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ZX Wireless Thermostat



Date: 9.APR.2019 02:00:28

Graph 22 Test Results – PKPSD – Mid Channel**COMMERCIAL-IN-CONFIDENCE**

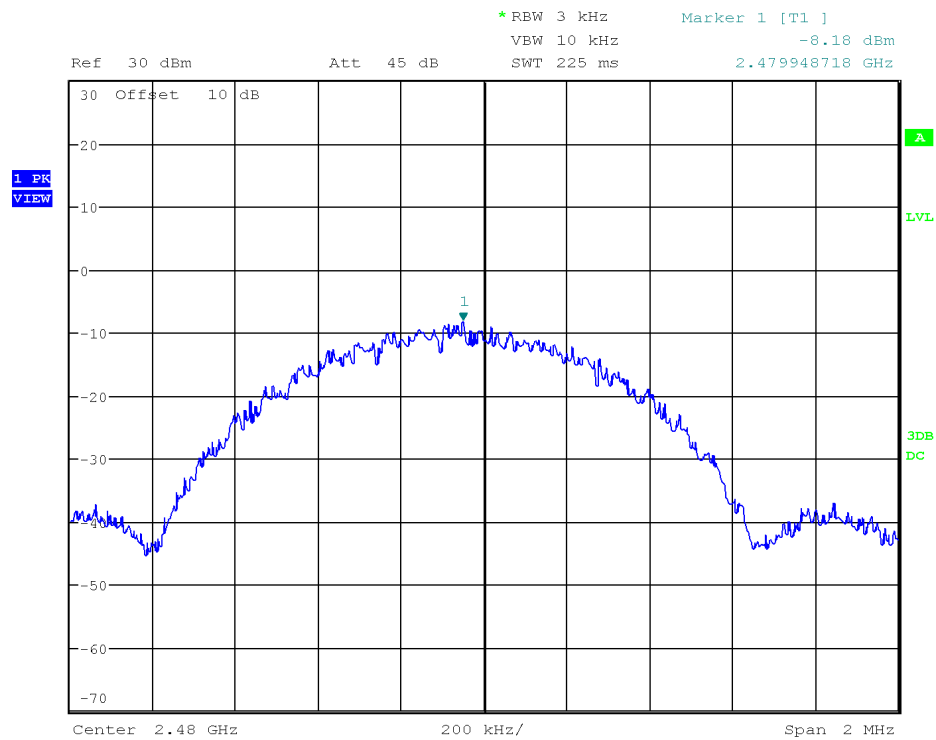
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Page 60 of 109



Product Service

ZX Wireless Thermostat



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Graph 23 Test Results – PKPSD – High Channel**COMMERCIAL-IN-CONFIDENCE**

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12.6 Test Instruments

This test was carried out in Laval test location. Instrumentation used is depicted in Table 23.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2019-04-20	4092
Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096

Table 23 – Test Instrumentation – PKPS



13 Band Edge Spurious Emission (-20 dBc Requirement)

13.1 Purpose & Methods

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 method applied is described in ANSI C63.10-2013 in Clause 11.11.1.

13.2 Test Specifications

REFERENCE STANDARD	FCC Part 15.247(d) RSS-247 5.5 ANSI C63.10 Clause 11.11.1	
SPECIFICATIONS		
Limit (dBc)	<20	
Frequencies (MHz)	2402 2442 2483.5	902.46 915 927.52
EUT		
Identification	ZX WIRELESS THERMOSTAT	
Voltage Input	24 Vdc	
ENVIROMENTAL & TEST INFO		
Test Date (YYYY-MM-DD)	2019-04-08	2019-04-09
Temperature (°C)	23.4 ± 2	21 ± 2
Humidity (%)	36.3 ± 5	18 ± 5
Atmospheric Pressure kPa (For Info Only)	109.7	101.2
Tester	Abderrahmane Ferhat	
Client Witness	No Witness	



13.3 Limits

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. Band Edge is to be evaluated up to the 10th harmonic. This -20 dBc requirement also applies at the 'band edge' of 2.4 GHz and 2.4835 GHz.

13.4 Test Setup

The Setup for the Maximum Peak Power testing is identical to the 99% Bandwidth setup.

13.5 Test Results

ZX Wireless Thermostat(2.4GHz)

The EUT was tested on: Low, medium, and high bands. The worst-case value is -28.88 dBm and on High Channel. The peak power of channels tested are depicted in Table 24.

Frequency Band (MHz)	Channel	Frequency (MHz)	Measured Spurious Conducted (dBm)	Results <Note 1>
2402 – 2480	Low	0.009-0.15	-39.5	Pass
	Low	0.15-30	-39.38	Pass
	Low	30-2400	-30.34	Pass
	Low	2400-2402	-40.39	Pass
	Middle	2402-2483.5	-30.0	Pass
	High	2483.5-26000	-28.58	Pass
Note 1. The highest level of the fundamental is 8.71dBm based on RF output Power results (see Table 19).				

Table 24- Results Band Edge – 2.4GHz Band

**ZX WIRELESS THERMOSTAT(900MHz)**

The EUT was tested on: Low, medium, and high bands. The worst-case value is -34.65 dBm on Middle channel. The peak power of channels tested are depicted in Table 25.

Frequency Band (MHz)	Channel	Frequency (MHz)	Measured Spurious Conducted (dBm)	Results <Note 1>
902 – 907.6	Low	0.009-0.15	-39.54	Pass
	Low	0.15-30	-39.38	Pass
	Low	30-1000	-42.5	Pass
	Low	900-902.46	-39.11	Pass
	Middle	902 - 928	-45.07	Pass
	Hight	1000 - 10000	-32.0	Pass
Note 1. The highest level of the fundamental is 10.78dBm based on RF output Power results (see Table 20)				

Table 25- Results – Band Edge – 900GHz Band**13.6 Graphs**

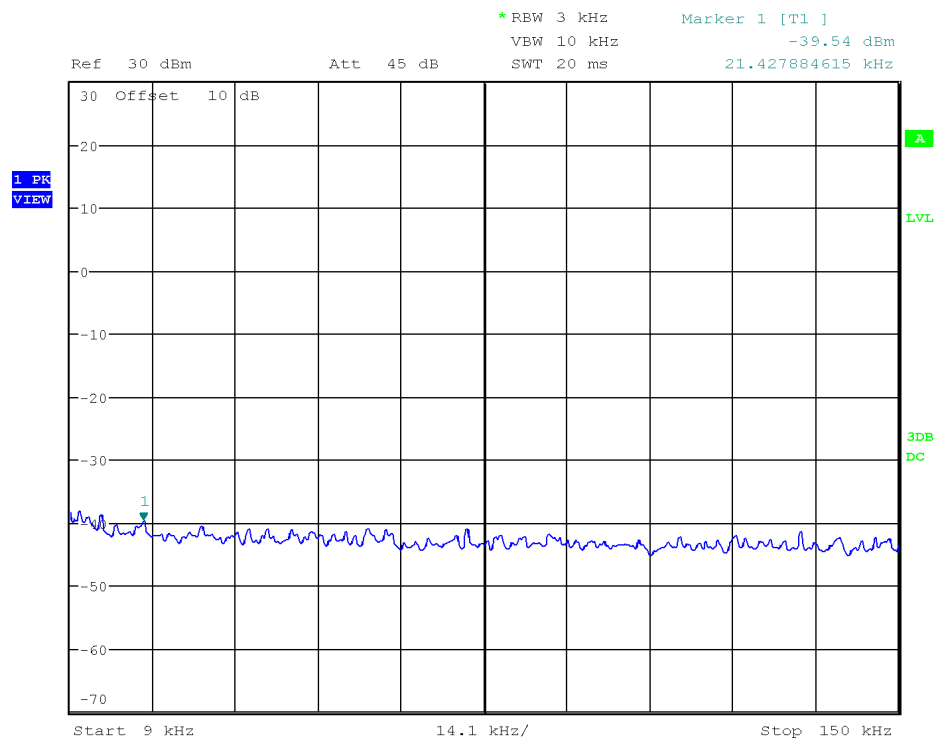
The graphs shown below show the worst-case peak power output of the device during the antenna conducted measurement during transmit operation of the EUT. No attenuator was used between the EUT and the Spectrum Analyzer.



Product Service

ZX Wireless Thermostat

ZX Wireless Thermostat(2.4GHz)



Date: 8.APR.2019 03:01:44

Graph 24 Test Results – Low Band Edge – 9kHz to 150kHz – Low Channel

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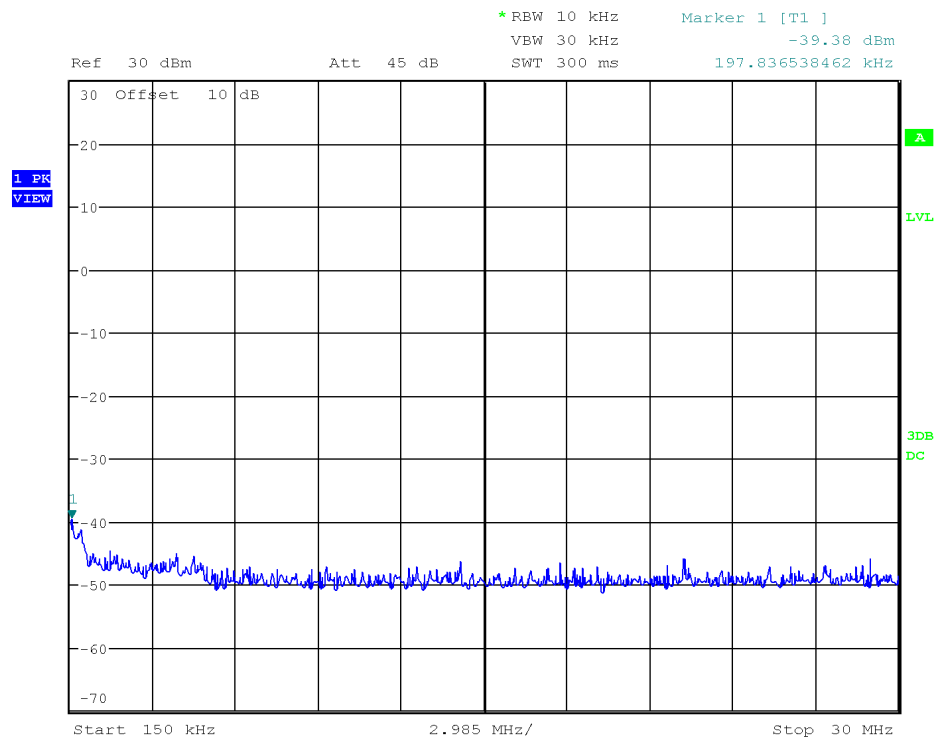
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Page 66 of 109



Product Service

ZX Wireless Thermostat



Date: 8.APR.2019 03:02:54

Graph 25 Test Results – Band Edge –150kHz to 30MHz – Low Channel

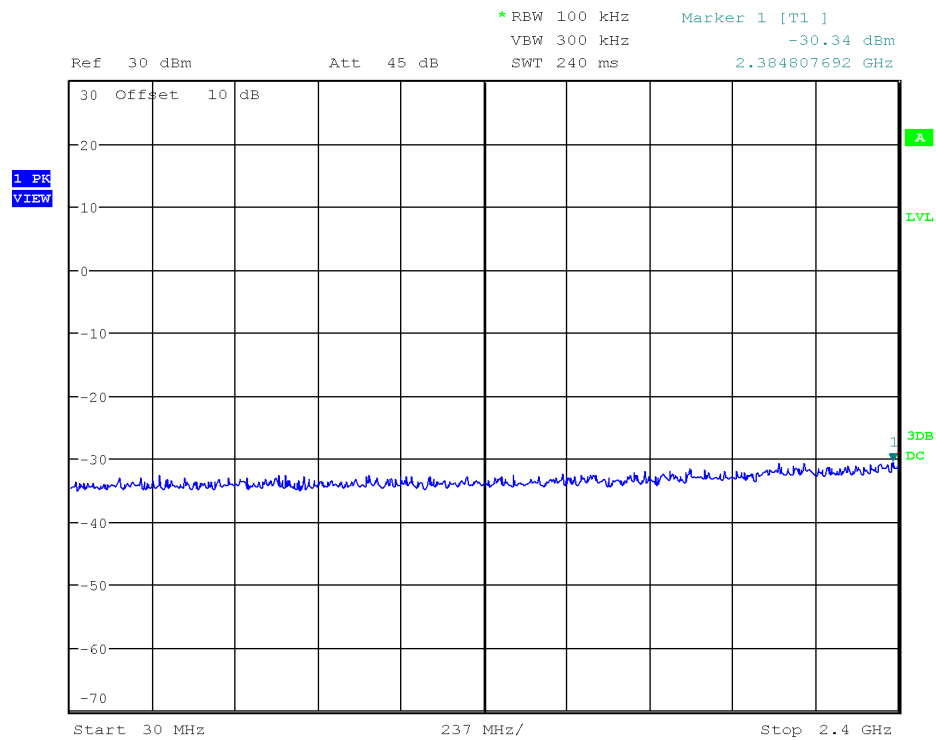
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Graph 26 Test Results – Band Edge –30MHz to 2.4GHz– Low Channel

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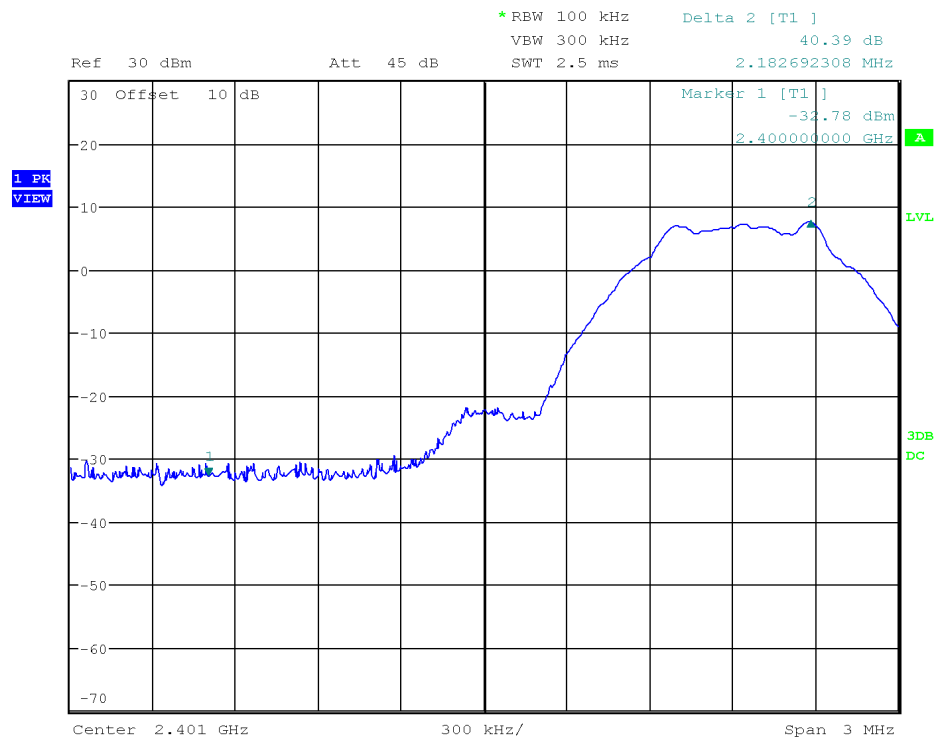
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Page 68 of 109



Product Service

ZX Wireless Thermostat



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Graph 27 Test Results – Band Edge –2.4GHz to 2.402GHz– Mid Channel**COMMERCIAL-IN-CONFIDENCE**

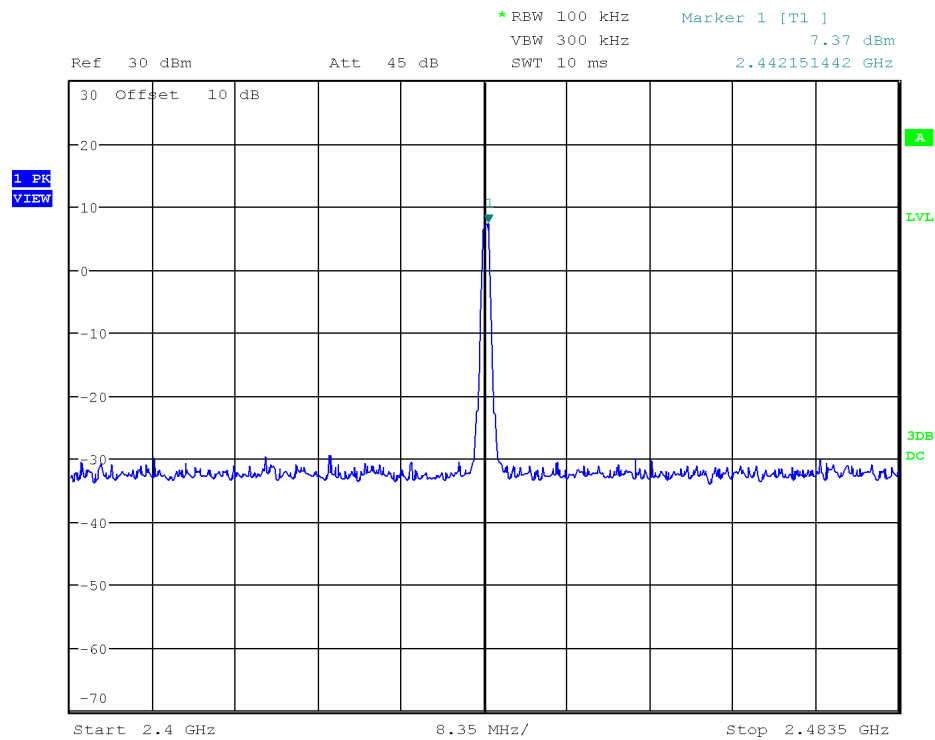
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Page 69 of 109



Product Service

ZX Wireless Thermostat



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Graph 28 Test Results – Band Edge –2.402GHz to 2.4835GHz– Mid Channel

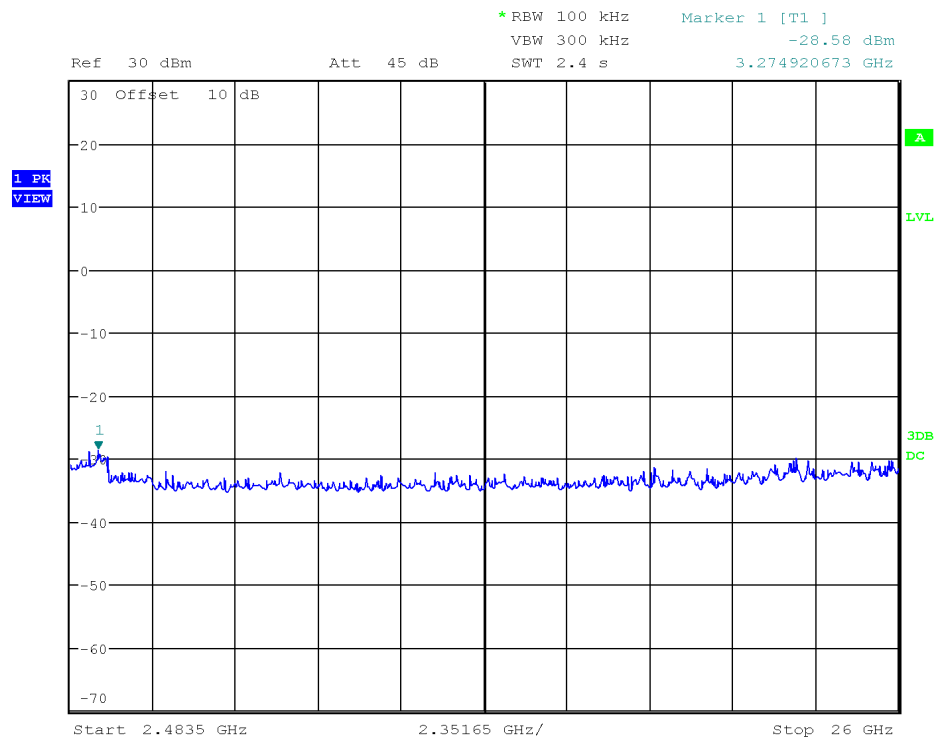
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Graph 29 Test Results – Band Edge –2.4835GHz to 26GHz– High Channel**COMMERCIAL-IN-CONFIDENCE**

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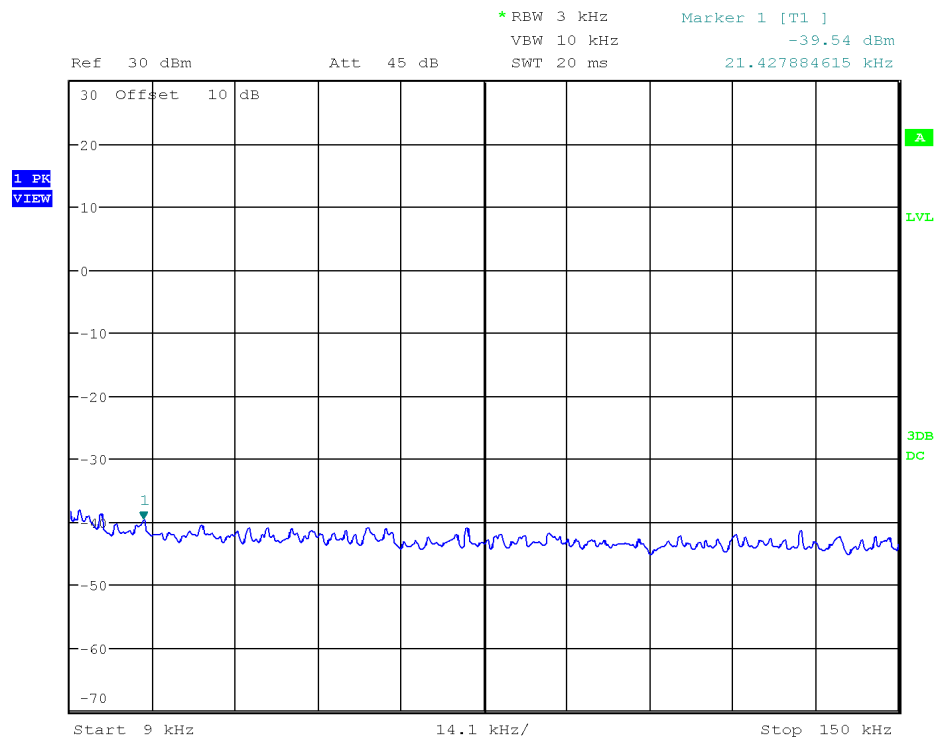
Page 71 of 109



Product Service

ZX Wireless Thermostat

ZX Wireless Thermostat(900MHz)



Date: 8.APR.2019 03:01:44

Graph 30 Test Results – Band Edge – 9kHz to 150kHz – Low Channel

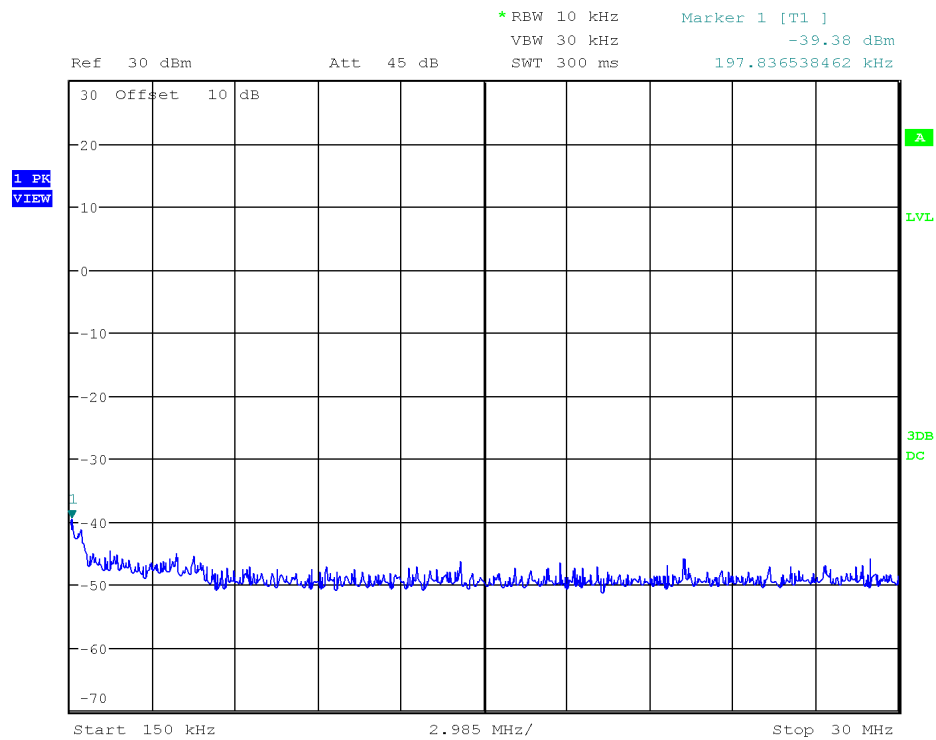
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ZX Wireless Thermostat



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Graph 31 Test Results – Band Edge –150kHz to 30MHz – Low Channel

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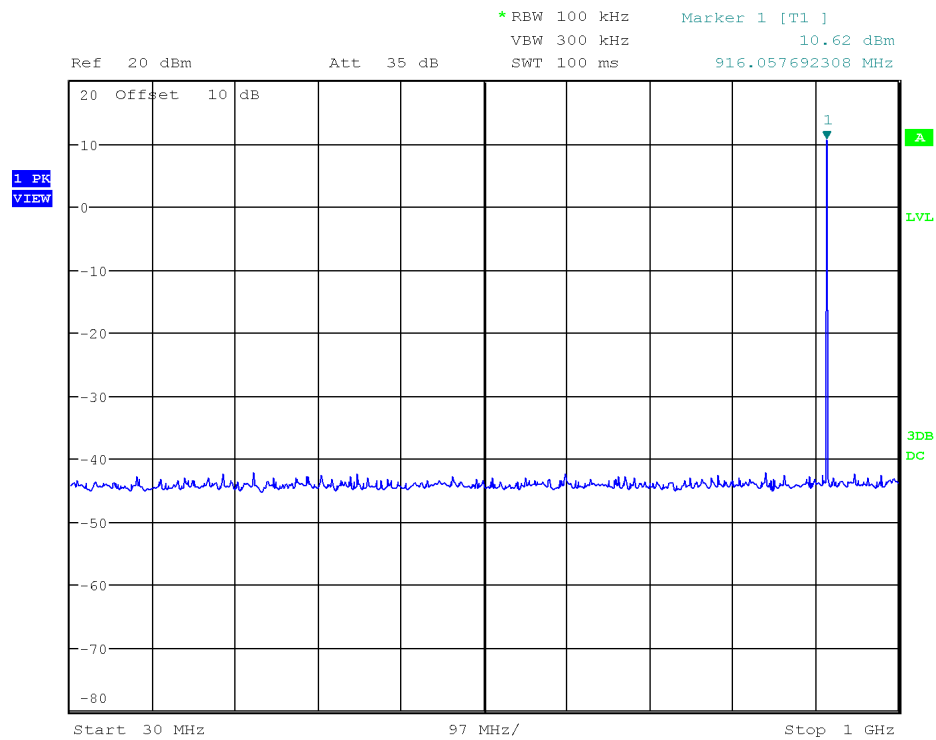
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Page 73 of 109



Product Service

ZX Wireless Thermostat



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Graph 32 Test Results – Band Edge –30MHz to 1GHz – Low Channel

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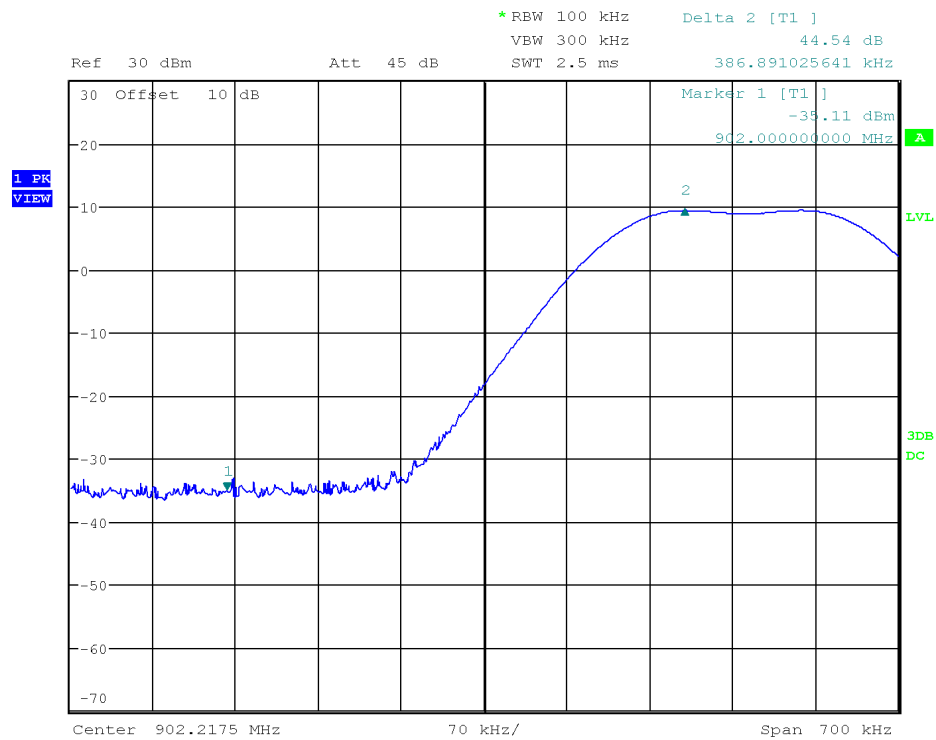
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Page 74 of 109



Product Service

ZX Wireless Thermostat



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Graph 33 Test Results – Band Edge – 900MHz to 902.46 MHz– Mid Channel**COMMERCIAL-IN-CONFIDENCE**

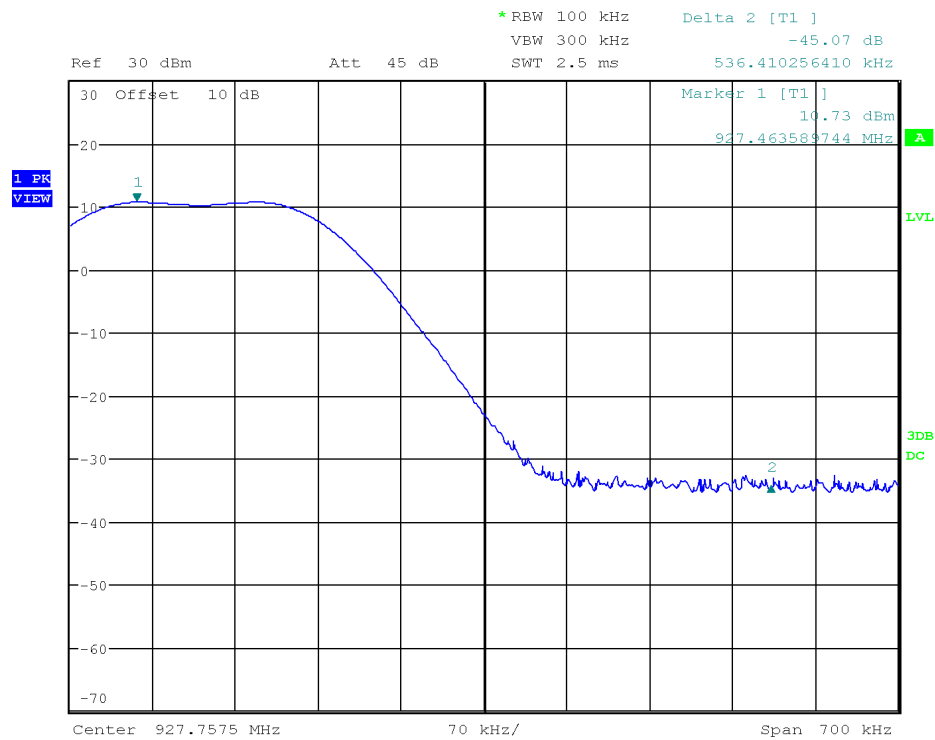
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Page 75 of 109



Product Service

ZX Wireless Thermostat



Date: 8.APR.2019 02:36:04

Graph 34 Test Results – Band Edge – 902 to 928MHz– Mid Channel**COMMERCIAL-IN-CONFIDENCE**

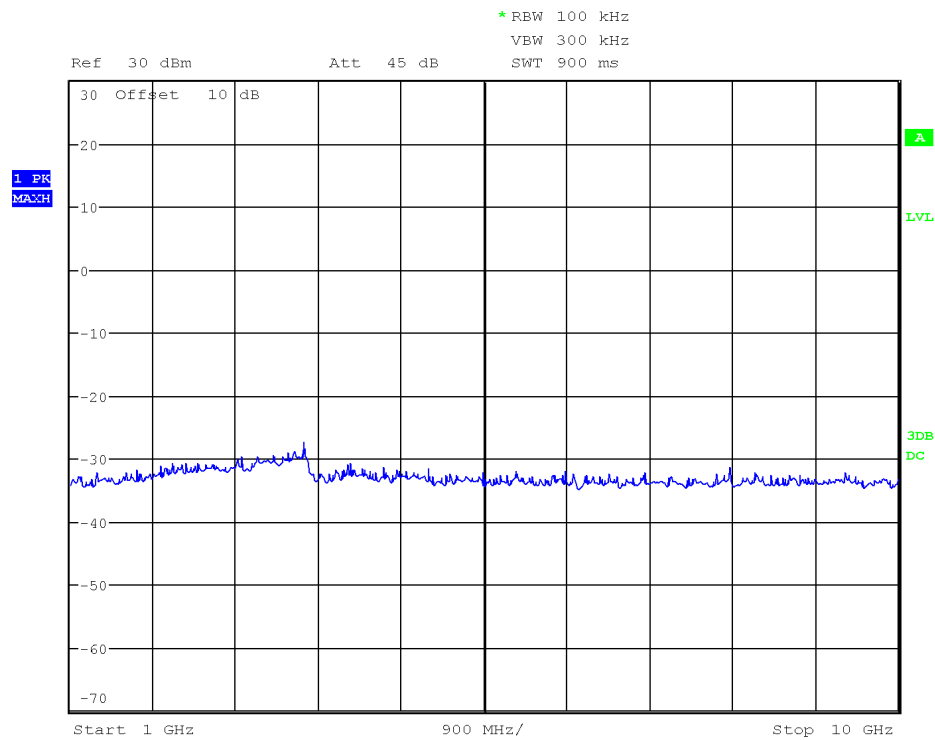
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Page 76 of 109



Product Service

ZX Wireless Thermostat



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Graph 35 Test Results – Band Edge –1GHz to 10 GHz – High Channel**COMMERCIAL-IN-CONFIDENCE**

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Page 77 of 109



13.7 Test Instruments

This test was carried out in Laval test location. Instrumentation used is depicted in Table 26.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No: LAVE
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2019-04-20	4092
Attenuator 10 dB	4779-10	Narda	NCR	NCR	4096

Table 26 – Test Instrumentation – Band Edge



14 Tx Spurious Radiated Emissions

14.1 Purpose & Methods

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 12.1 of FCC KDB 558074 and ANSI C63.10.

All unintentional emissions must also meet the 'Spurious Conducted Emissions' requirements of -20 dBc or greater. See also '[Band Edge](#)' for further details. Limits are depicted in Table 27.

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 27 Limits – Tx Spurious

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.



ZX Wireless Thermostat

14.2 Test Specifications

REFERENCE STANDARD	FCC Part 15.209(a) RSS-247 5.5 ANSI C63.10 Clause 5.5				
SPECIFICATIONS					
Limit (dBuV/m)	See table 28				
Frequencies (MHz)	2402		902.46		
	2442		915		
	2480		927.52		
EUT					
Identification	ZX WIRELESS THERMOSTAT				
Voltage Input	5Vdc				
ENVIROMENTAL & TEST INFO					
Test Date (YYYY-MM-DD)	2019-02-26	2019-03-15	2019-03-19	2019-04-04	2019-04-08
Temperature (°C)	24 ± 2	21 ± 2	23 ± 2	21 ± 2	23 ± 2
Humidity (%)	15 ± 5	18 ± 5	20 ± 5	19 ± 5	20 ± 5
Atmospheric Pressure kPa (For Info Only)	102.6	101	101	100.6	101.2
Tester	Abderrahmane Ferhat				
Client Witness	No Witness				



ZX Wireless Thermostat

14.3 Limits

The limits, as defined in 15.247(d) for intentional 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).

14.4 Results

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

Channel	Frequency Range (MHz)	Frequency (MHz)	Polarization	Detector	Limit	Margin	Results <Note 2>	
Low	0.009 – 0.015	-	-	-	See Table 27	Note 1	Pass	
	0.015 – 30						Pass	
	30 – 1000						Pass	
	>1000						Pass	
Mid	0.009 – 0.015	-	-	-		Note 1	Pass	
	0.015 – 30						Pass	
	30 – 1000	194.441	Vertical	Quasi-Peak		6	Pass	
	>1000	-	-	-			Pass	
High	0.009 – 0.015					Note 1	Pass	
	0.015 – 30						Pass	
	30 – 1000			Quasi-Peak			Pass	
	>1000			Average			Pass	
Note 1: No significant emission, i.e., 10dB below the limit was noted								
Note 2: For Worst cases final measurements please refer to Appendix A : Table A5								

Table 28 – Test Results for Tx Spurious Emission – Worst Cases (900MHz)



ZX Wireless Thermostat

Channel	Frequency Range (MHz)	Frequency (MHz)	Polarization	Detector	Limit	Margin	Results <Note 2>	
Low	0.009 – 0.015	-	-	-	See Table 27	Note 1	Pass	
	0.015 – 30						Pass	
	30 – 1000						Pass	
	>1000						Pass	
Mid	0.009 – 0.015	-	-	-		Note 1	Pass	
	0.015 – 30						Pass	
	30 – 1000	194.58	Vertical	Quasi-Peak		5.5	Pass	
	>1000	2467.75	Vertical	Average		4.9	Pass	
High	0.009 – 0.015	-	-	-		Note 1	Pass	
	0.015 – 30			-			Pass	
	30 – 1000			Quasi-Peak			Pass	
	>1000			Average			Pass	
Note 1: No significant emission, i.e., 10dB below the limit was measured.								
Note 2: For Worst cases final measurements please refer to Appendix A : Table A1 to Table A4.								

Table 29 – Test Results for Tx Spurious Emission – Worst Cases (2.4GHz)



14.5 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.

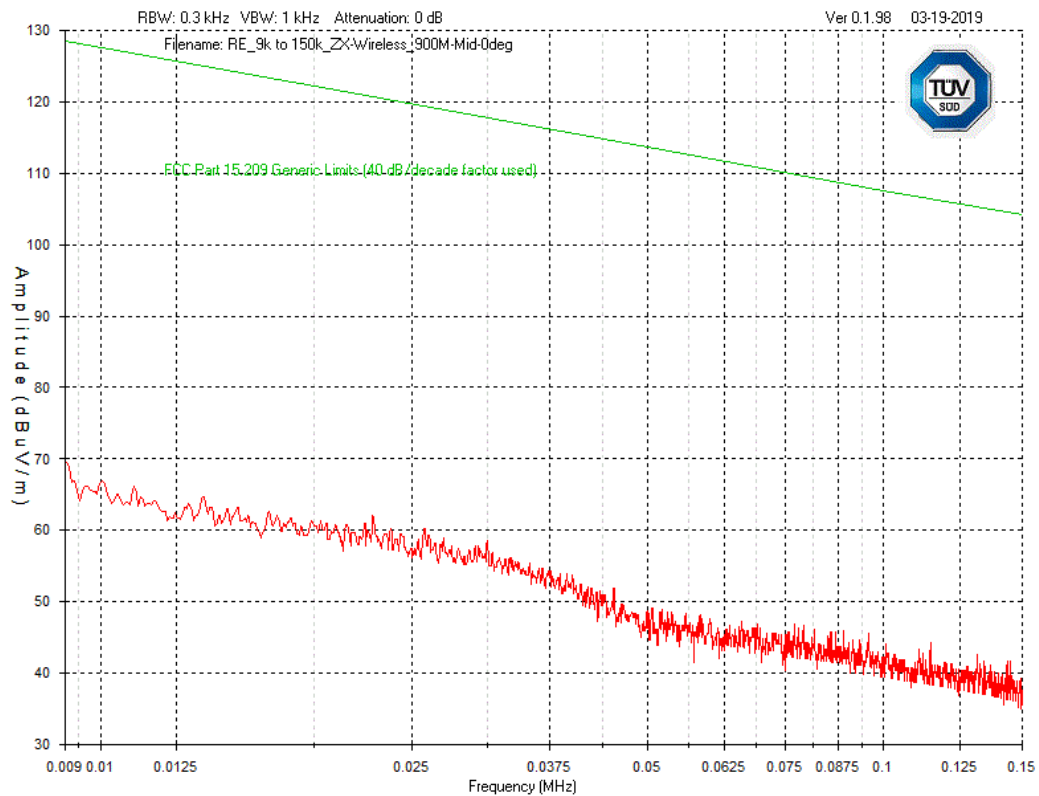
Low, middle and high channels. However, the worst-case graphs are presented.



Product Service

ZX Wireless Thermostat

Frequency range from 9kHz to 150kHz



Graph 36 Test Results – Tx Spurious emission 9kHz – 150kHz: Mid Channel ZX Wireless Thermostat (900MHz)

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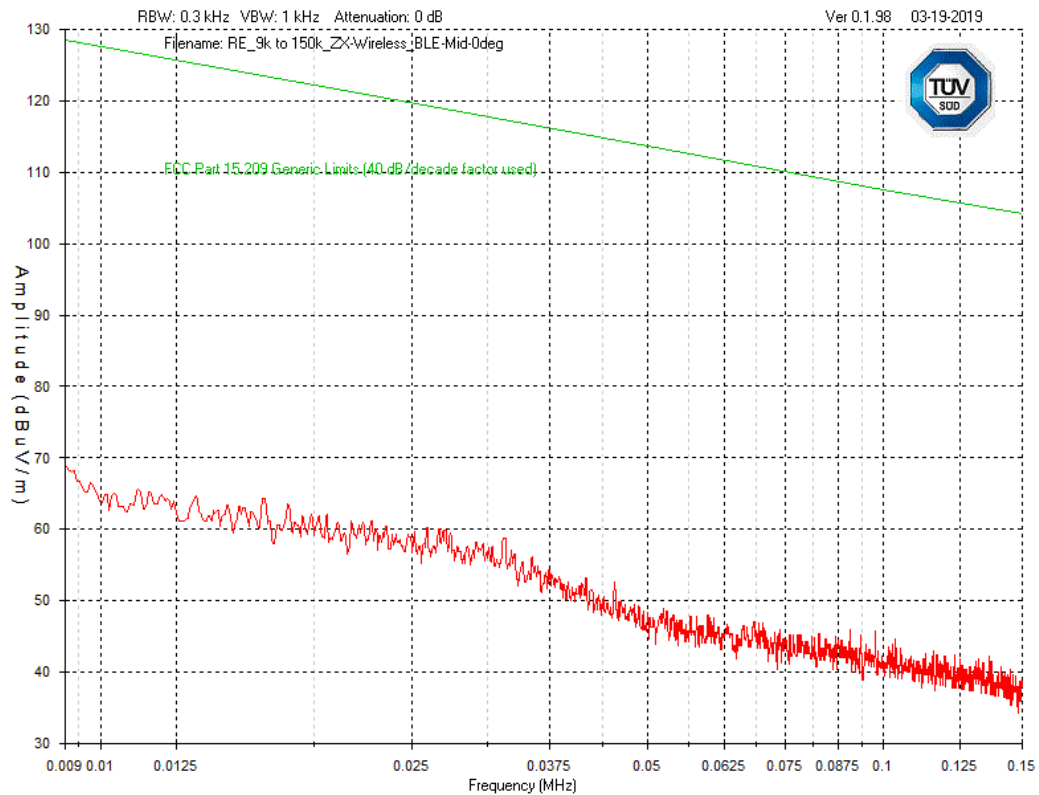
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Page 84 of 109



Product Service

ZX Wireless Thermostat



Graph 37 Test Results – Tx Spurious emission 9kHz – 150kHz: Mid Channel ZX Wireless Thermostat (2.4GHz)

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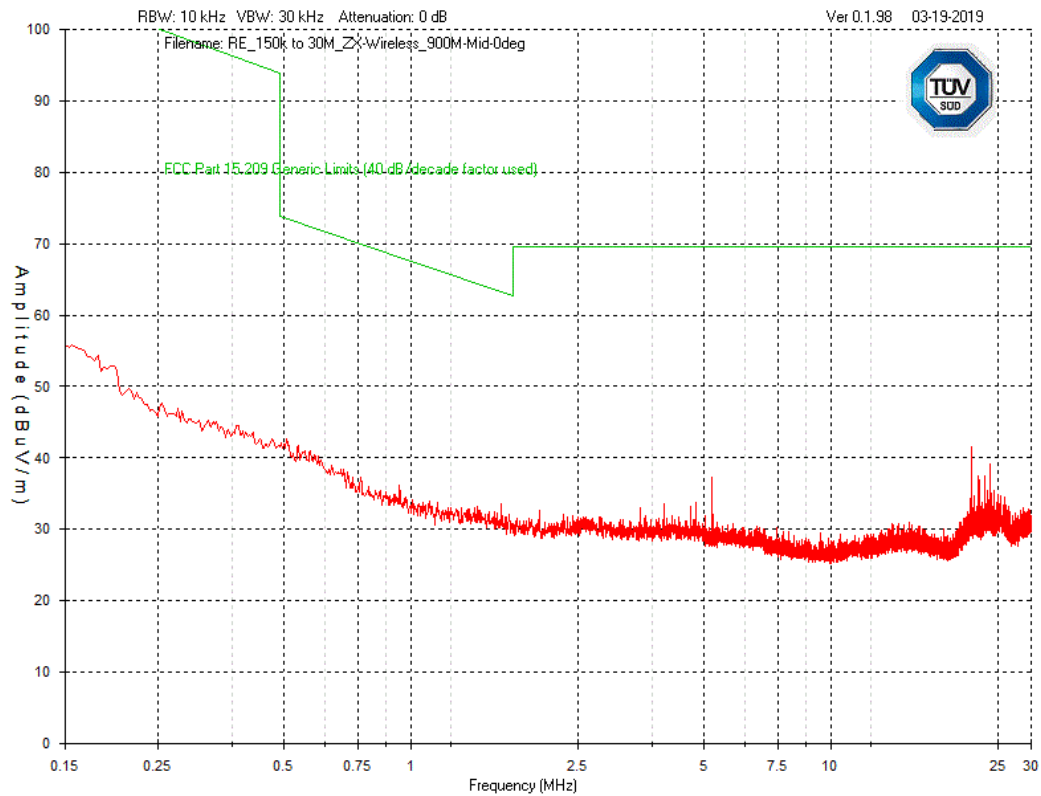
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Page 85 of 109



ZX Wireless Thermostat

Frequency range from 150kHz to 30MHz

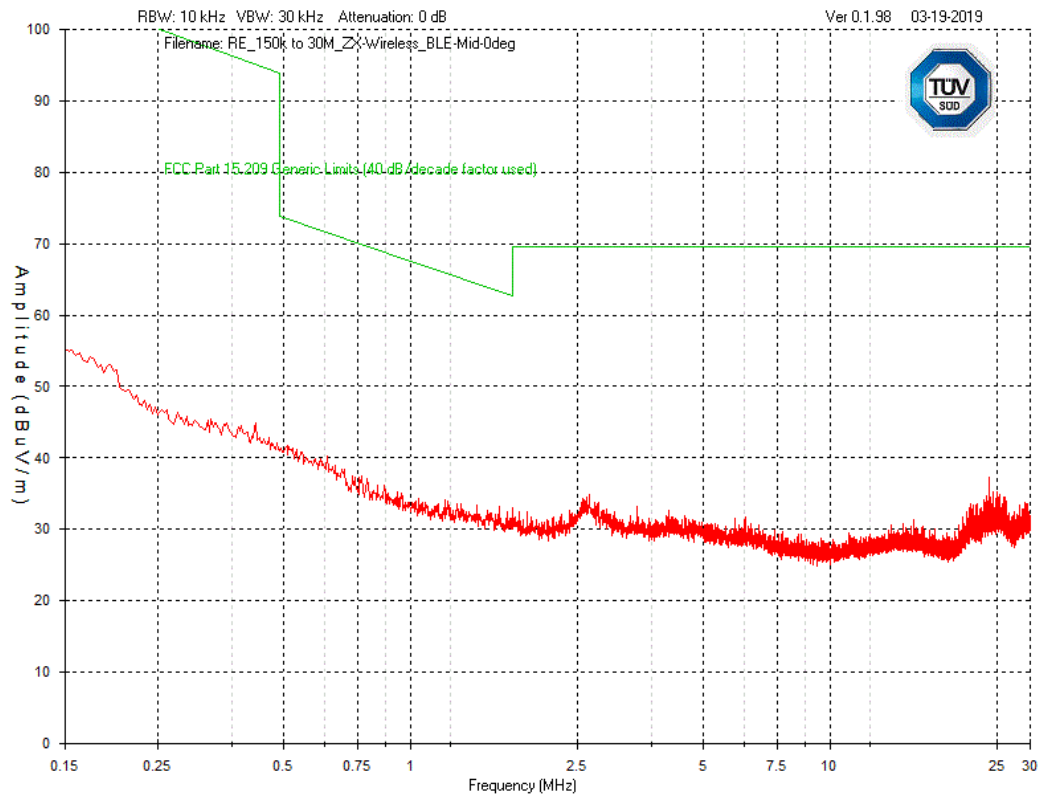


Graph 38 Test Results – Tx Spurious emission 150kHz – 30MHz: Mid Channel ZX Wireless Thermostat (900MHz)



Product Service

ZX Wireless Thermostat



Graph 39 Test Results – Tx Spurious emission 150kHz – 30MHz: Mid Channel ZX Wireless Thermostat (2.4GHz)

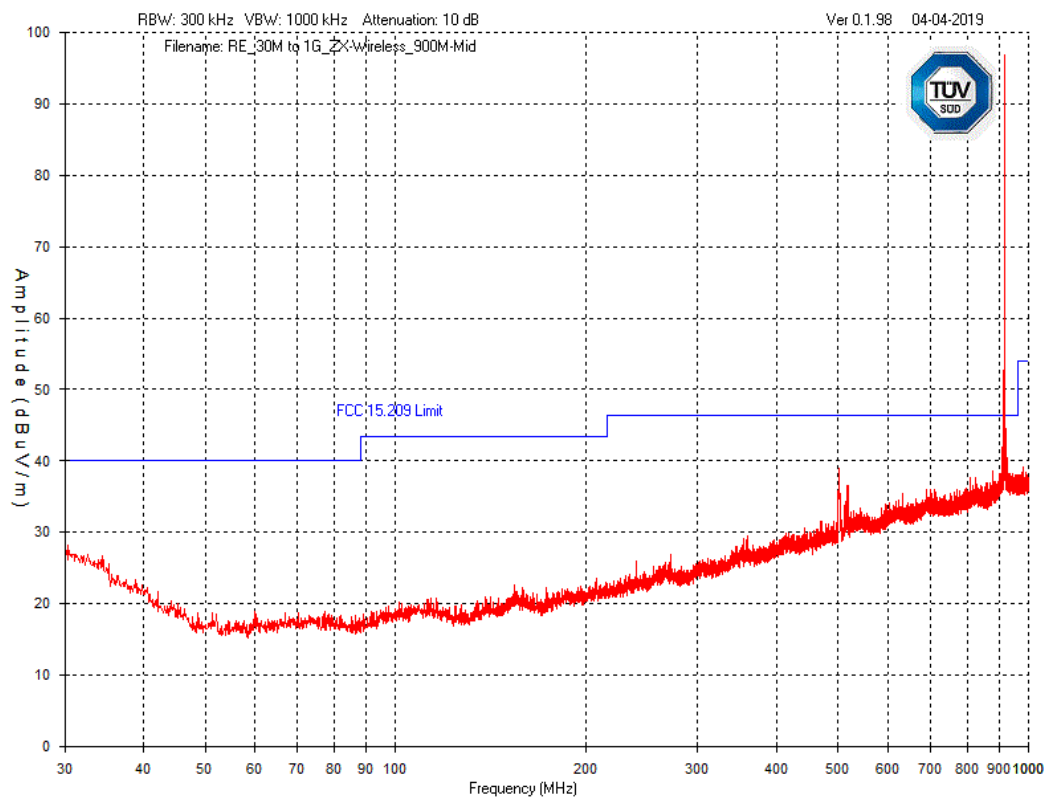
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Frequency Range from 30MHz to 1GHz – Worst case – Mid Channel



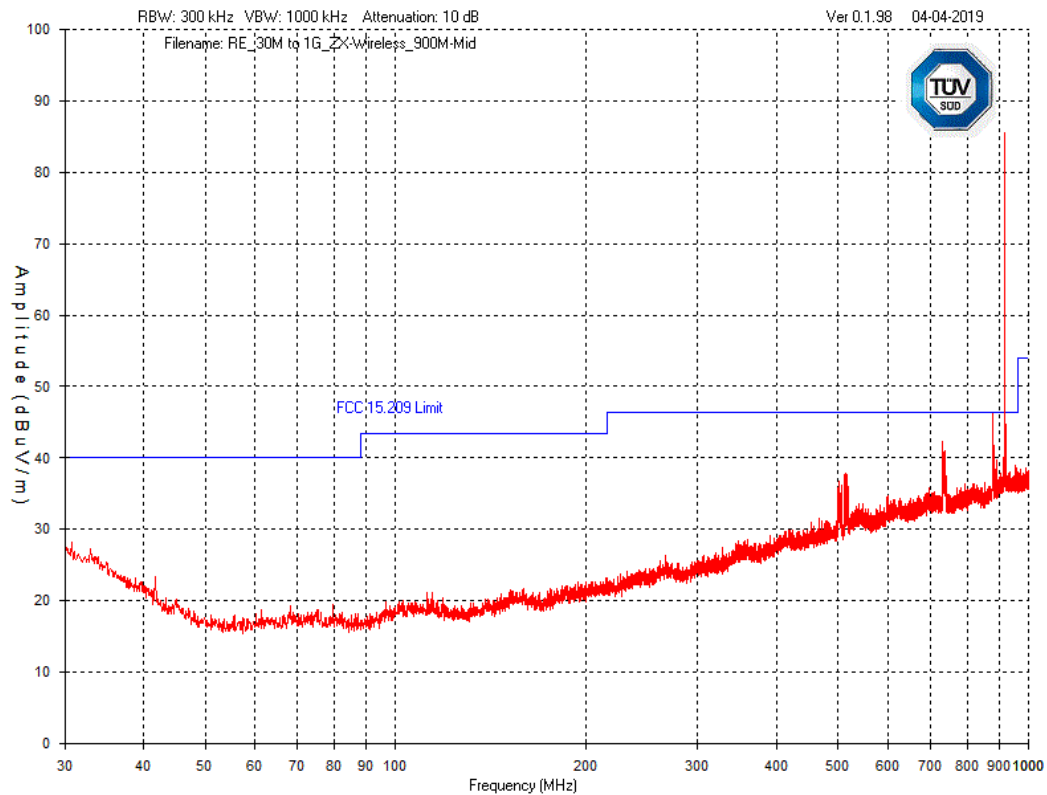
Graph 40 Test Results – Tx Spurious emission 30MHz – 1GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Horizontal Polarization

Note. The worst-case scenario (peak measurements) is given at 915MHz with peak value of 98 dBμV/m.



ZX Wireless Thermostat

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Graph 41 Test Results – Tx Spurious emission 30MHz – 1GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Vertical Polarization

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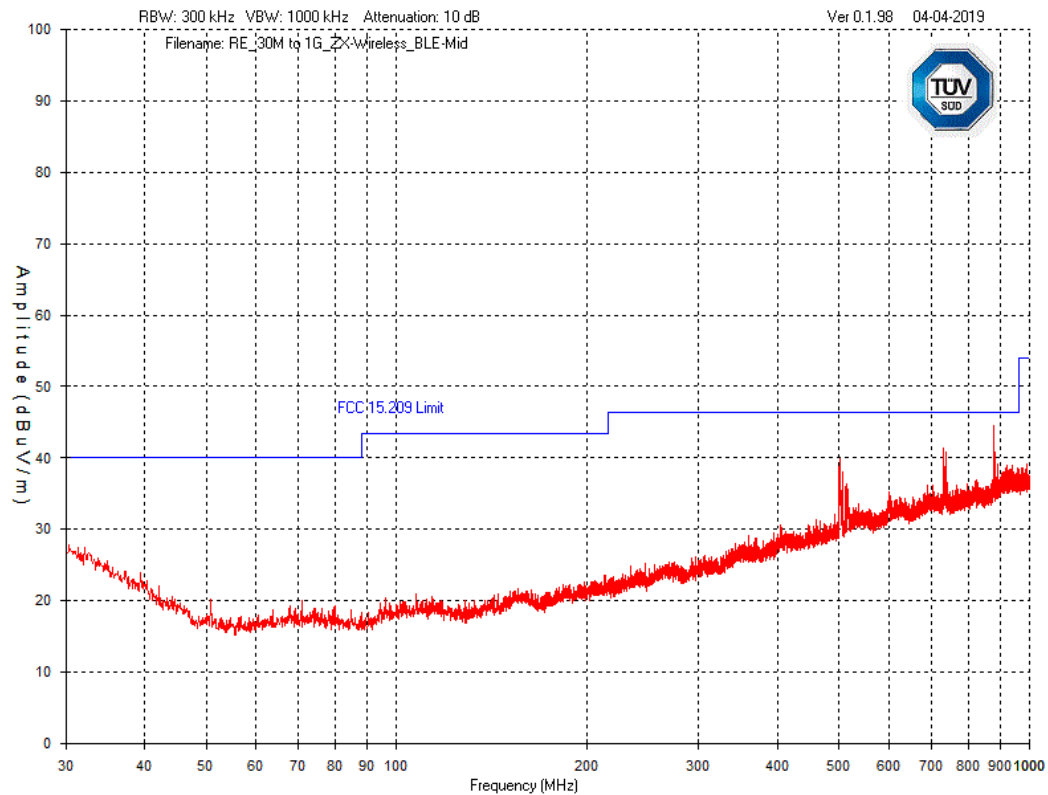
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Page 89 of 109



Product Service

ZX Wireless Thermostat



Graph 42 Test Results – Tx Spurious emission 30MHz – 1GHz: Mid Channel ZX Wireless Thermostat(2.4GHz) – Vertical Polarization

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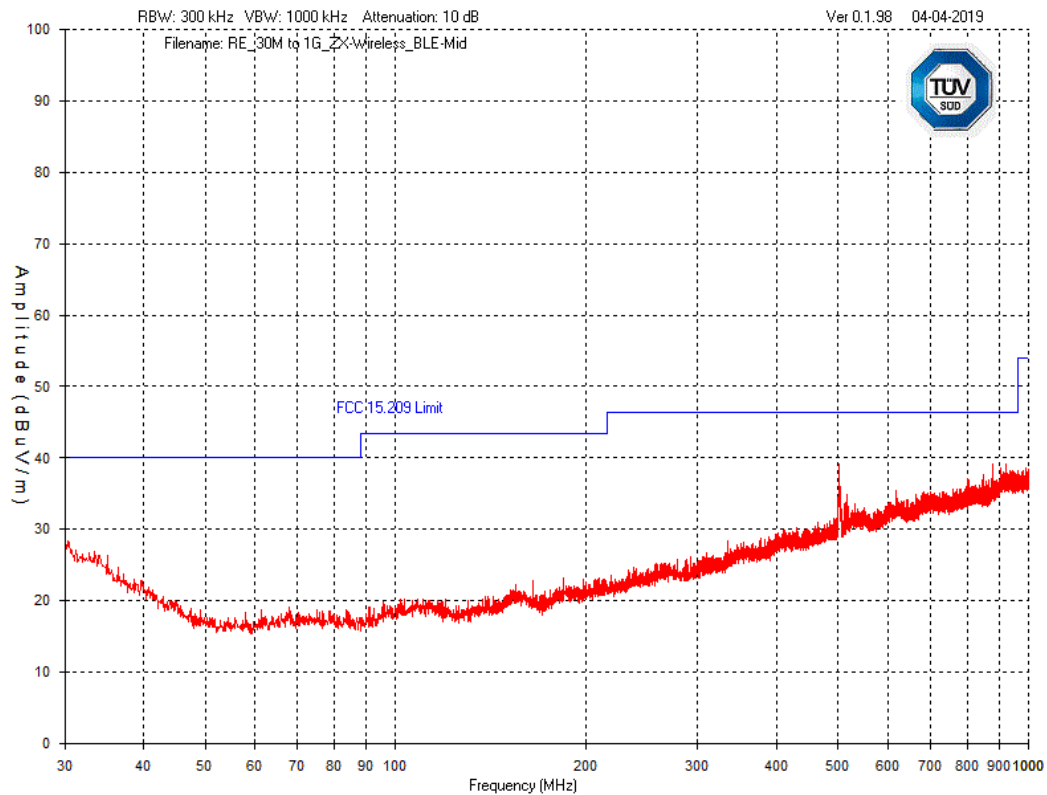
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Page 90 of 109



Product Service

ZX Wireless Thermostat



Graph 43 Test Results – Tx Spurious emission 30MHz – 1GHz: Mid Channel ZX Wireless Thermostat(2.4GHz) – Horizontal Polarization

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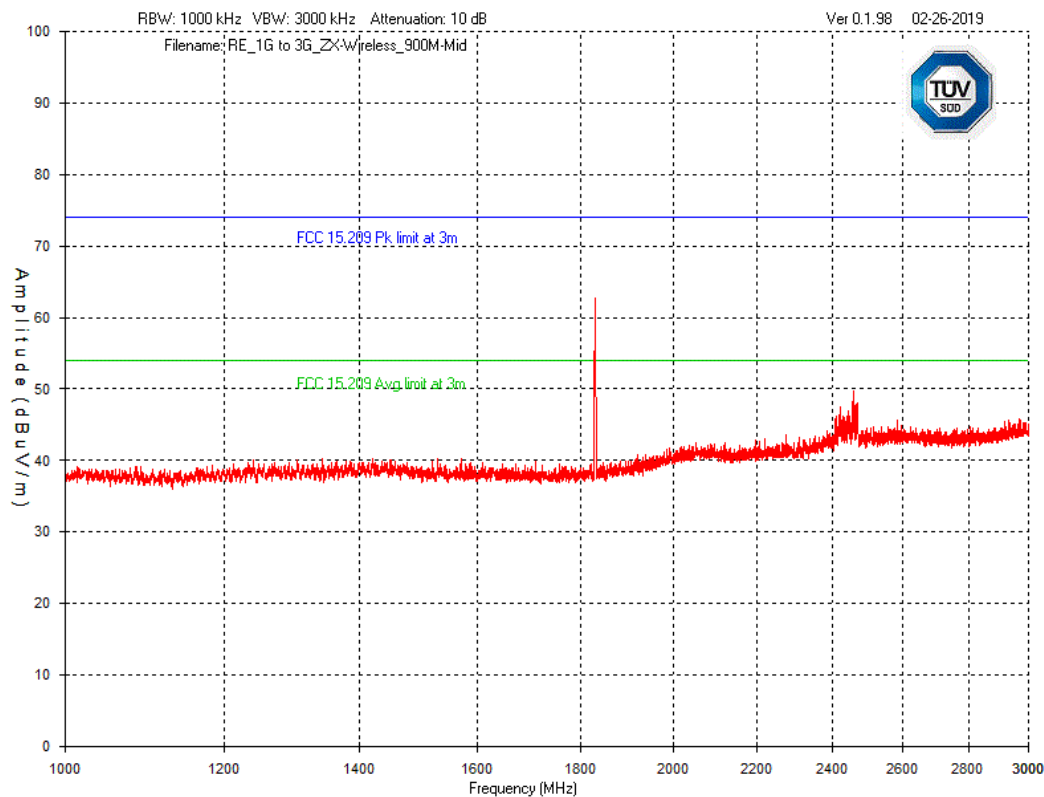
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Page 91 of 109



ZX Wireless Thermostat

Frequency Range from 1GHz to 3GHz – Worst case – Mid Channel

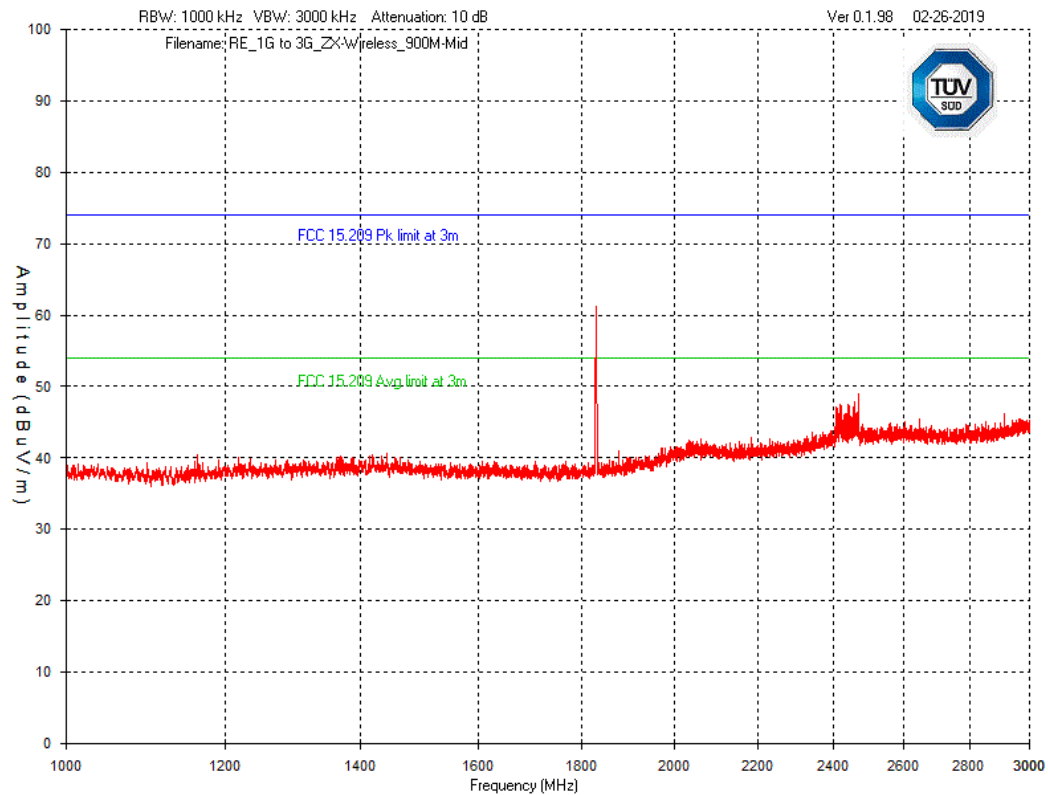


Graph 44 Test Results – Tx Spurious emission 1GHz – 3GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Horizontal Polarization



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ZX Wireless Thermostat



Graph 45 Test Results – Tx Spurious emission 1GHz – 3GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Vertical Polarization

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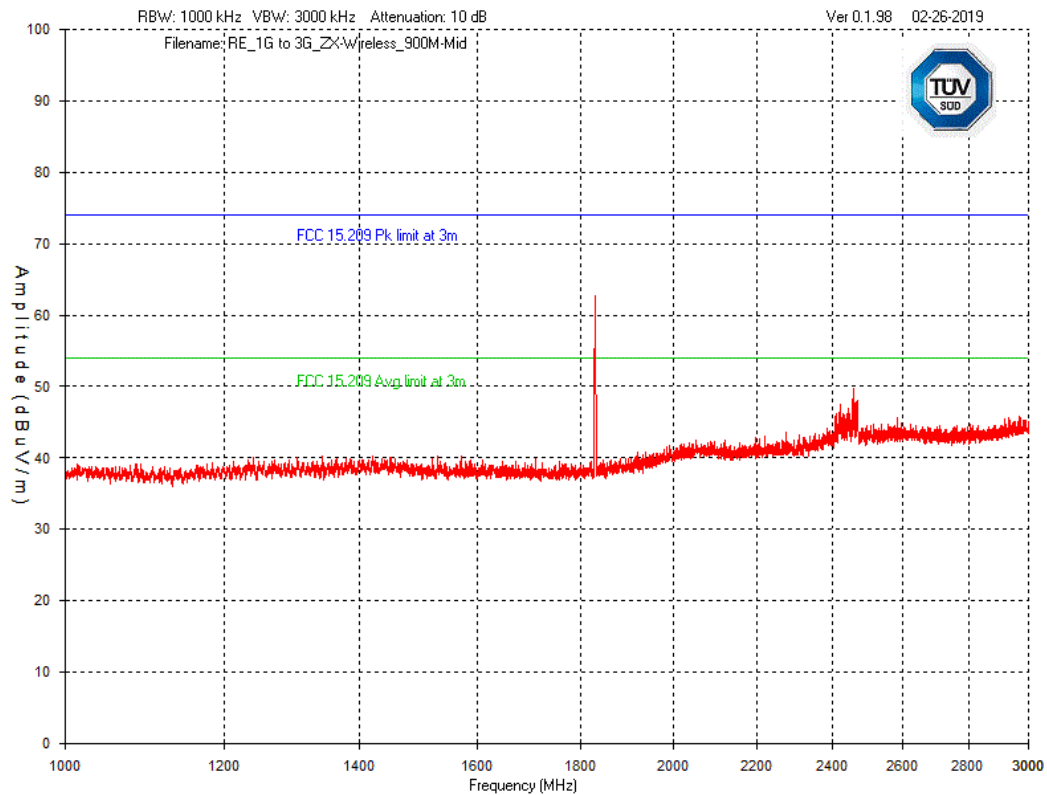
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Page 93 of 109



Product Service

ZX Wireless Thermostat



Graph 46 Test Results – Tx Spurious emission 1GHz – 3GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Horizontal Polarization

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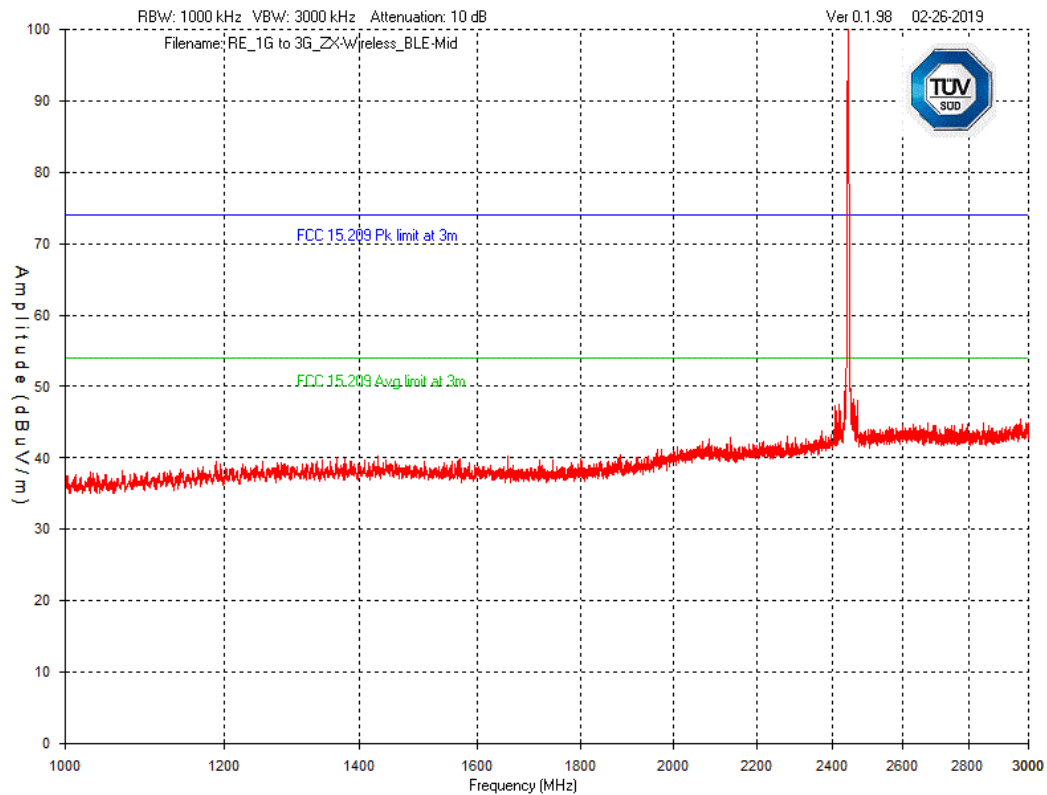
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Page 94 of 109



Product Service

ZX Wireless Thermostat



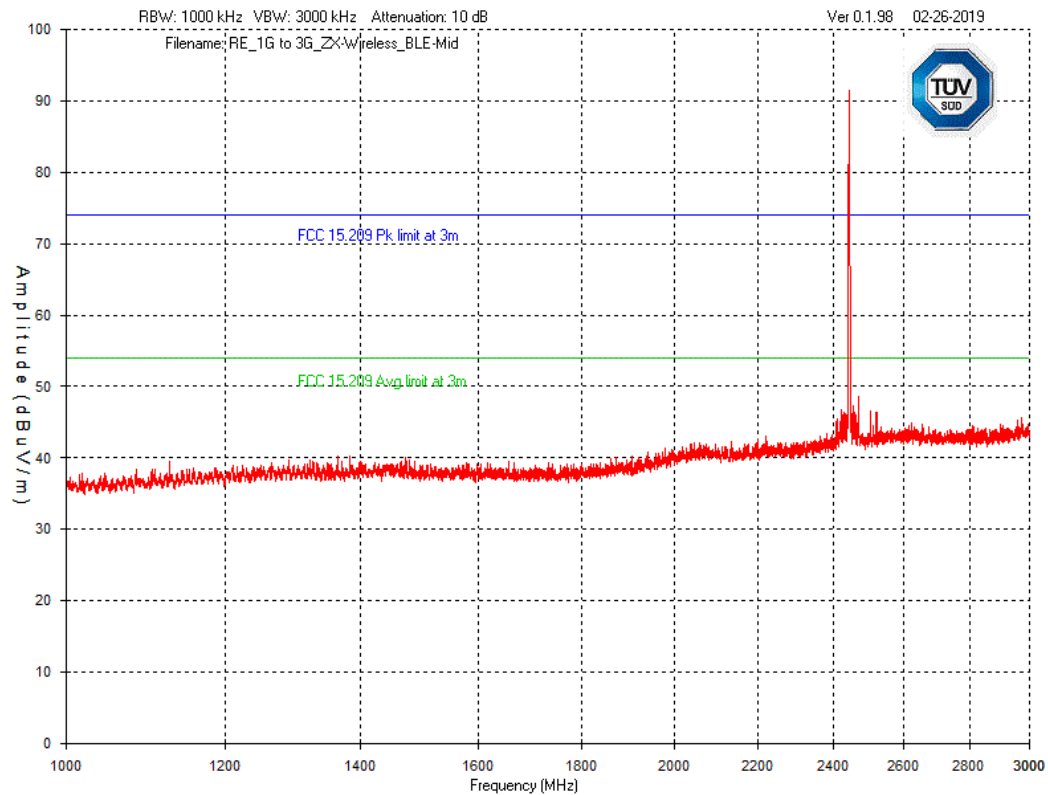
Graph 47 Test Results – Tx Spurious emission 1GHz – 3GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Horizontal Polarization

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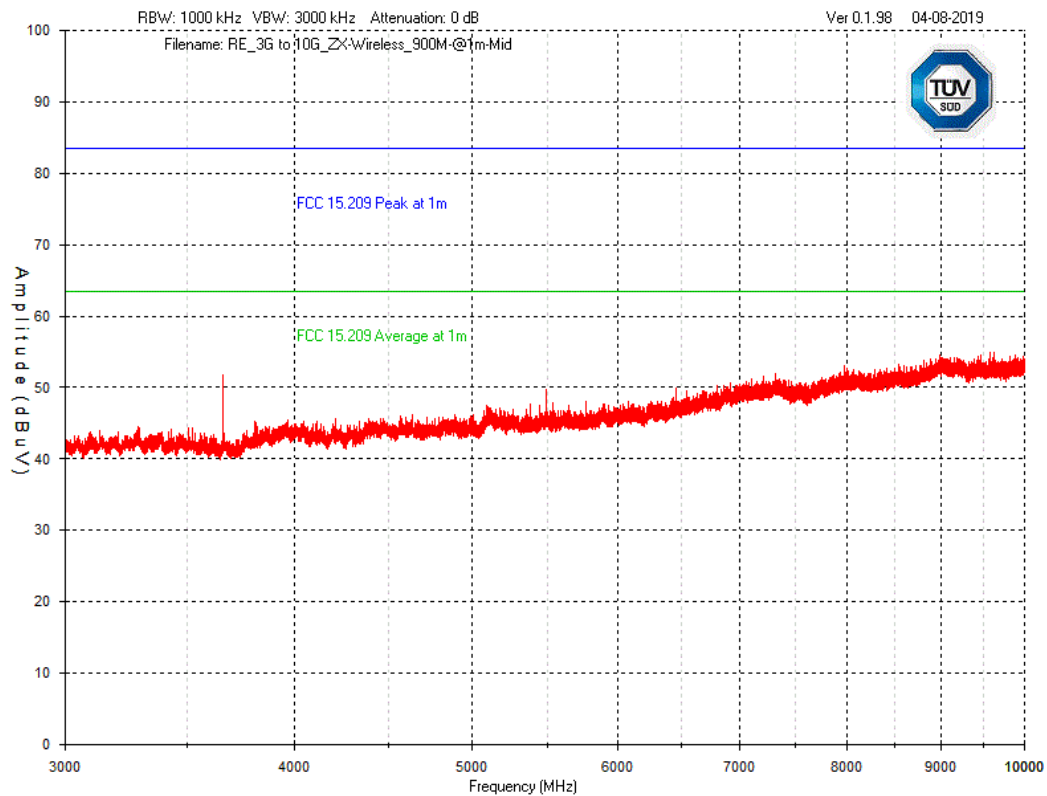
ZX Wireless Thermostat



Graph 48 Test Results – Tx Spurious emission 1GHz – 3GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Vertical Polarization



ZX Wireless Thermostat

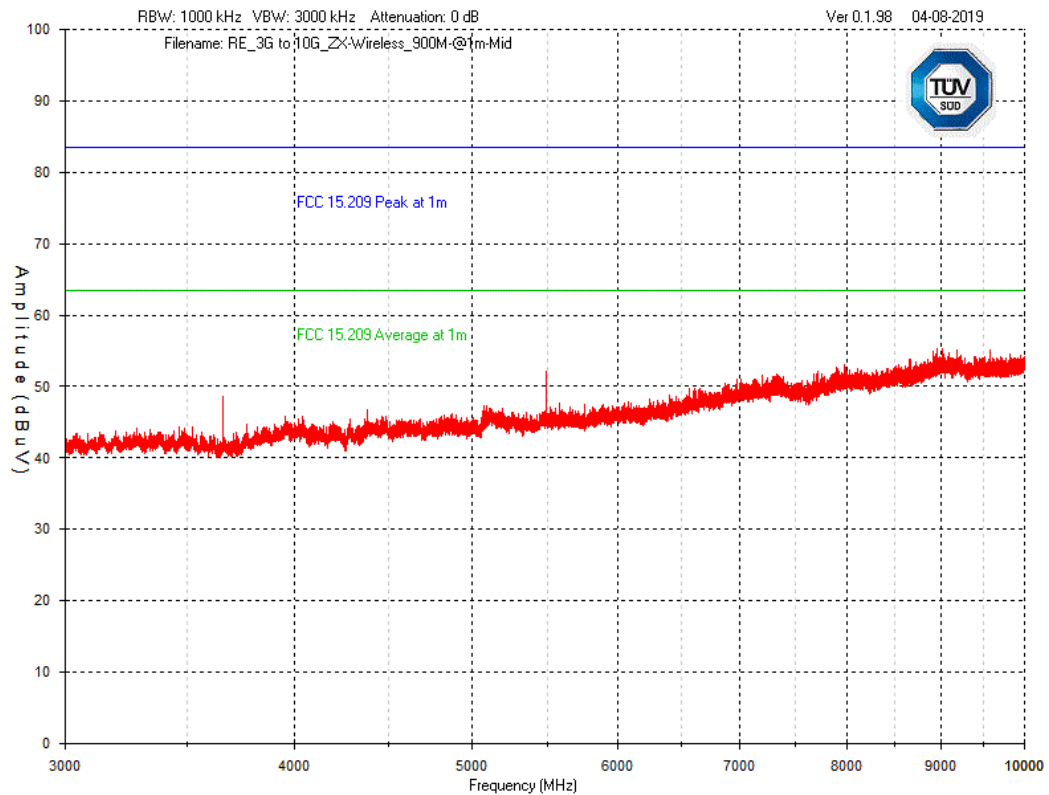
Frequency Range from 3GHz – 10GHz – Worst case – Mid Channel

Graph 49 Test Results – Tx Spurious emission 3GHz – 10GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Horizontal Polarization



ZX Wireless Thermostat

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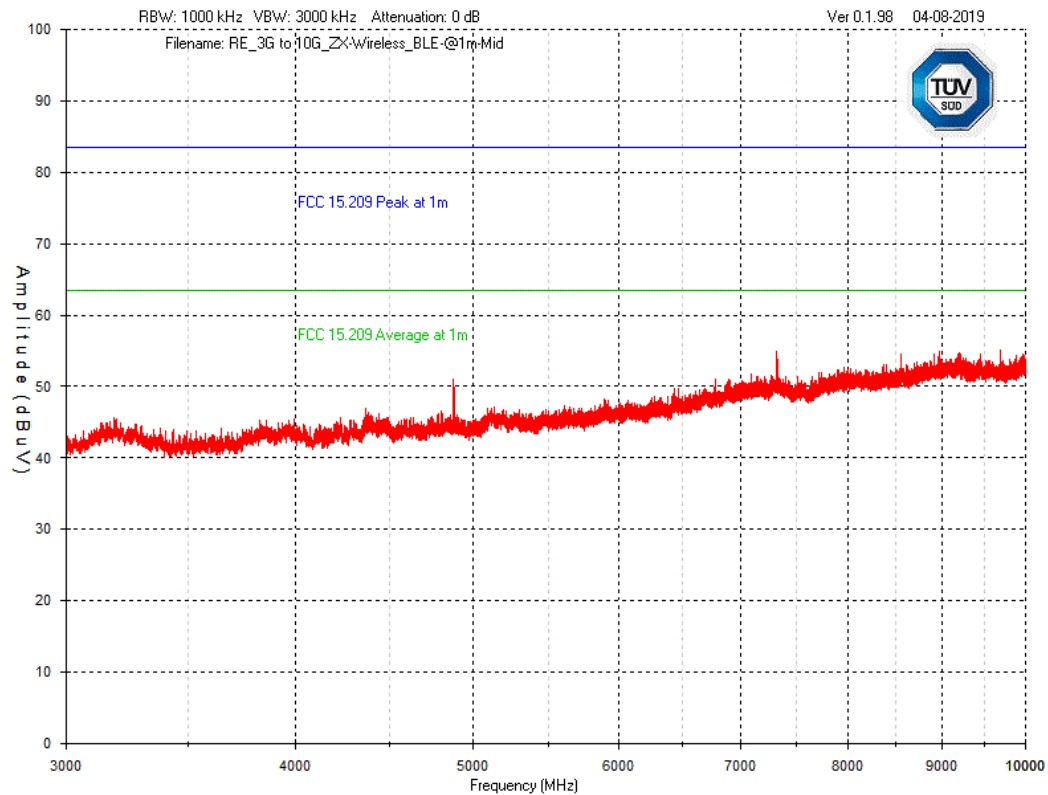
Graph 50 Test Results – Tx Spurious emission 3GHz – 10GHz: Mid Channel ZX Wireless Thermostat (900MHz) – Vertical Polarization

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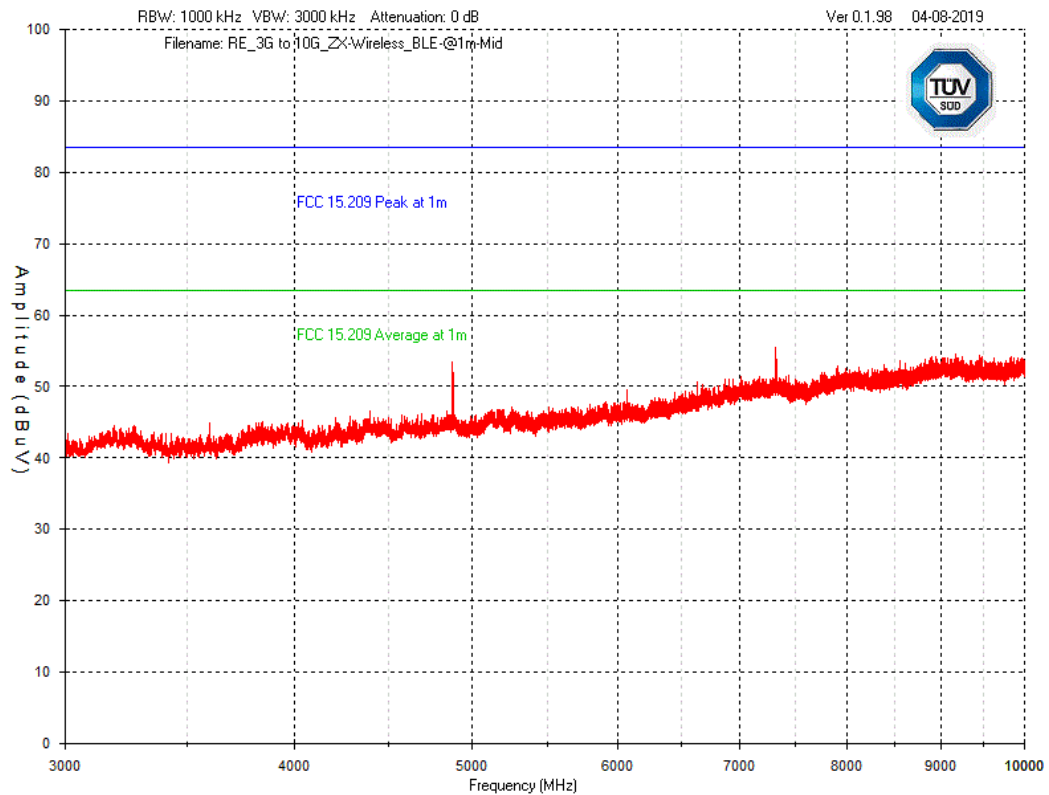


Graph 51 Test Results – Tx Spurious emission 3GHz – 10GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Horizontal Polarization



ZX Wireless Thermostat

Product Service



Graph 52 Test Results – Tx Spurious emission 3GHz – 10GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Vertical Polarization

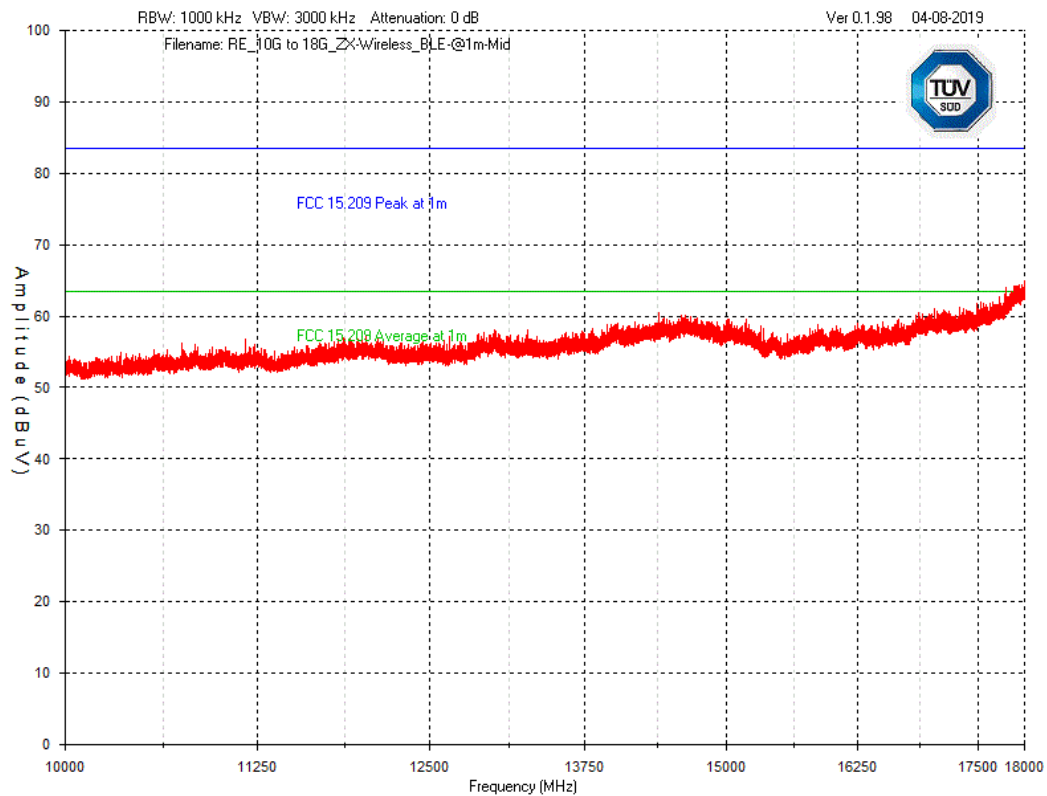
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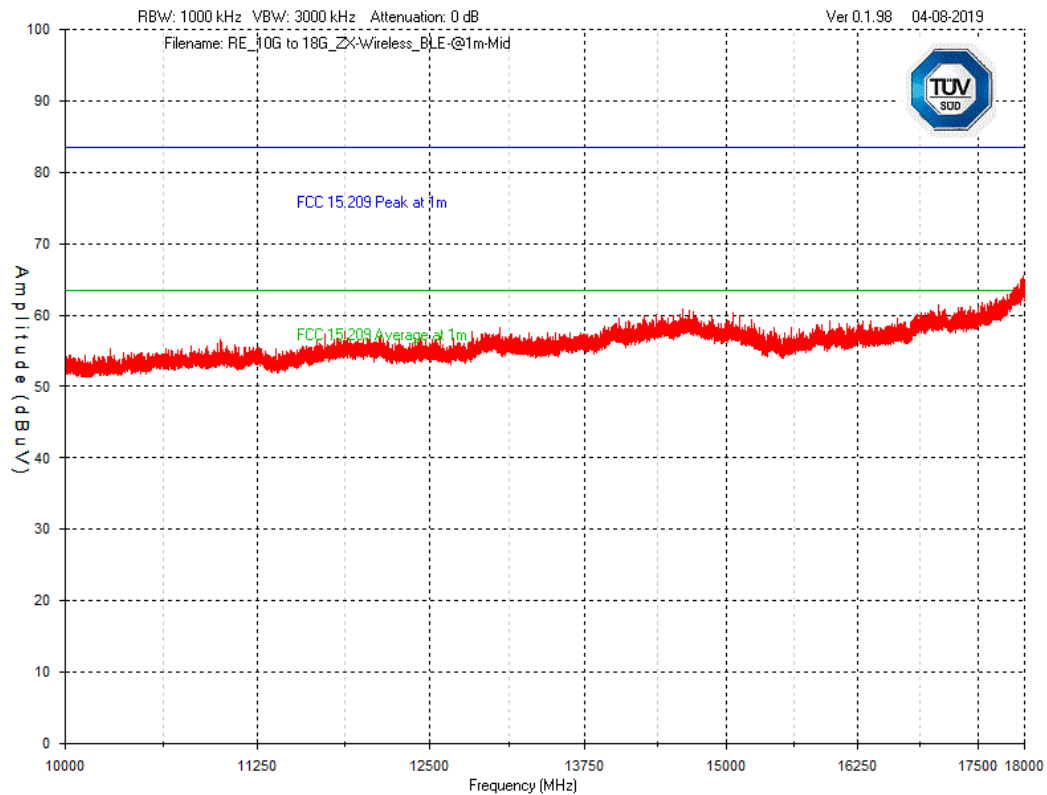
Page 100 of 109



ZX Wireless Thermostat

Frequency Range from 10GHz – 18GHz – Worst case – Mid Channel

Graph 53 Test Results – Tx Spurious emission 10GHz – 18GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Horizontal Polarization

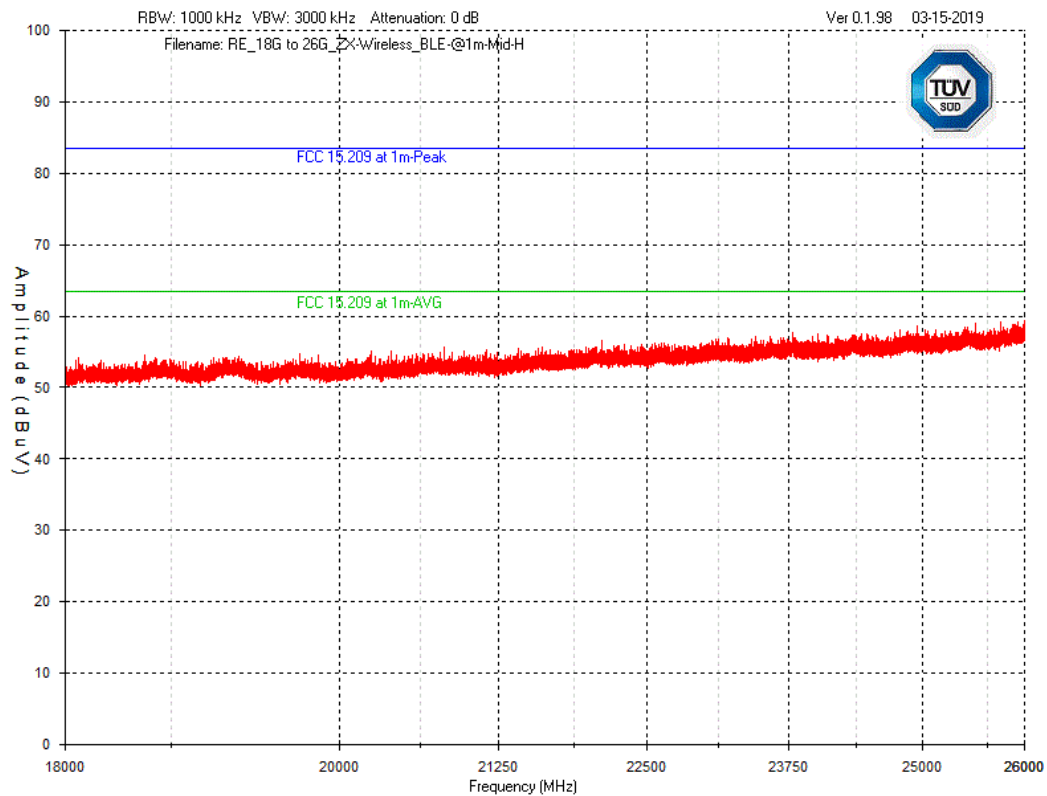


Graph 54 Test Results – Tx Spurious emission 10GHz – 18GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Vertical Polarization



Product Service

ZX Wireless Thermostat

Frequency Range from 18GHz – 26GHz – Worst case – Mid Channel

Graph 55 Test Results – Tx Spurious emission 18GHz – 26GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Horizontal Polarization

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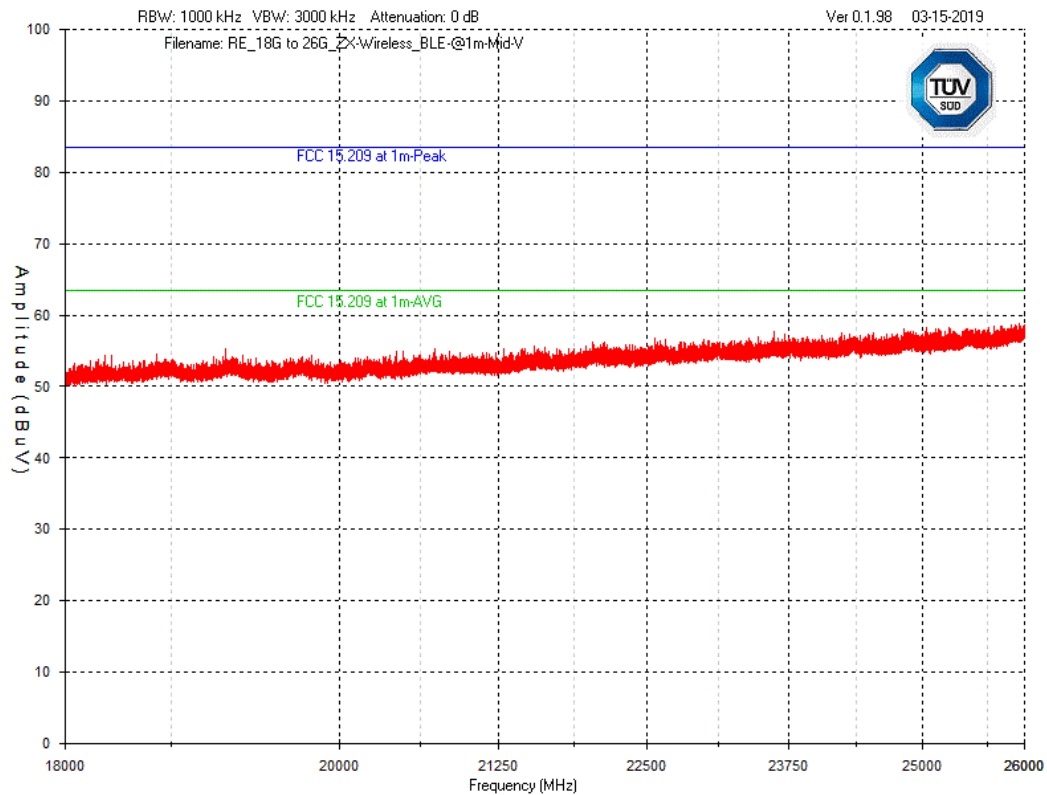
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Page 103 of 109



Product Service

ZX Wireless Thermostat



Graph 56 Test Results – Tx Spurious emission 18GHz – 26GHz: Mid Channel ZX Wireless Thermostat (2.4GHz) – Vertical Polarization

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14.6 Test Instruments

This test was carried out in Laval test location. Instrumentation used is depicted in Table 30.

Equipment	Model No.	Manufacturer	Calibration Period (months)	Calibration Due (YYY-MM-DD)	Asset No LAV0
Spectrum Analyzer	ESU-40	Rohde & Schwarz	24	2019-04-20	4092
BiLog Antenna	3142-E	ETS	24	2020-11-29	4002
Horn Antenna	ATH1G18G	AR	24	2019-04-25	4003
Biconical Antenna	EM-6913	Electro-Metrics	24	2019-05-02	4060
Log Periodic Antenna	LPA-25	Electro-Metrics	24	2019-04-20	4087
Loop Antenna	EM 6879	Electro-Metrics	24	2019-04-19	4040
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	4028
LNA pre-amp	LNA-1450	RF Bay Inc.	24	2019-07-22	4089
1-26.5GHz preamp	8449B	Agilent	24	2019-09-09	4006
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	0.1.97	Global EMC	NCR	NCR	58

Table 30 – Test Instrumentation – Tx Spurious Emission



APPENDIX A: Tx Spurious Emissions – Worst Cases



ZX WIRELESS THERMOSTAT

Frequency (MHz)	Detector	Raw Reading	Antenna Factor (dB/m)	Atten Factor (dB)	Cable Factor (dB)	Pre-Amp (dB)	Level	FCC 15.209 Limit	FCC 15.209 Limit Margin
914.943	PEAK	83.2	28.3	4	2.3	-32.3	85.5	46.4	-39.1 <Note 1>
878.823	QP	36	26.9	4	2.2	-32.5	36.6	46.4	9.8
920.769	QP	37.4	28.3	4	2.3	-32.2	39.8	46.4	6.6
731.138	QP	34.6	26	4	2	-33	33.6	46.4	12.8
737.255	PEAK	42	26	4	2	-33	41	46.4	5.4
512.573	PEAK	42	23.4	4	1.7	-33.2	37.9	46.4	8.5

Note 1. Transmitter Frequency excluded from FCC limits.

Table A.1 Tx Spurious Emission Mid Channel (900MHz) – 30MHz- 1GHz – Vertical Polarization-QP

Frequency (MHz)	Detector	Raw Reading	Antenna Factor (dB/m)	Atten Factor (dB)	Cable Factor (dB)	Pre-Amp (dB)	Level	FCC 15.209 Limit	FCC 15.209 Limit Margin
914.943	PEAK	94.5	28.3	4	2.3	-32.3	96.8	46.4	-50.4 <Note 1>
913.389	QP	37.3	28.3	4	2.3	-32.3	39.6	46.4	6.8
912.613	QP	40.2	28.3	4	2.3	-32.3	42.5	46.4	3.9
912.03	QP	35.4	28.3	4	2.3	-32.3	37.7	46.4	8.7
917.273	QP	32	28.3	4	2.3	-32.3	34.3	46.4	12.1
918.05	QP	38	28.3	4	2.3	-32.3	40.3	46.4	6.1

Note 1. Transmitter Frequency excluded from FCC limits.

Table A.2 Tx Spurious Emission Mid Channel (900MHz) – 30MHz – 1GHz – Horizontal Polarization- QP



ZX WIRELESS THERMOSTAT

Frequency (MHz)	Detector	Raw Reading	Antenna Factor (dB/m)	Atten Factor (dB)	Cable Factor (dB)	Pre-Amp (dB)	Level	FCC 15.209 Limit	FCC 15.209 Limit Margin
1830.26	AVG	58	24.9	3.3	0.2	-33.1	53.3	54	0.7
2457.17	AVG	43.4	28.3	4.1	0.3	-33.1	43	54	11
2467.18	AVG	40.5	28.4	4.2	0.3	-33.1	40.3	54	13.7
2419.71	AVG	39.2	28.2	4.1	0.3	-33.1	38.7	54	15.3
2442.59	AVG	40.5	28.3	4.1	0.3	-33.1	40.1	54	13.9
1830.26	AVG	58	24.9	3.3	0.2	-33.1	53.3	54	0.7

Table A.3 Tx Spurious Emission Mid Channel(900MHz) –1GHz –3GHz: Horizontal Polarization

Frequency (MHz)	Detector	Raw Reading	Antenna Factor (dB/m)	Atten Factor (dB)	Cable Factor (dB)	Pre-Amp (dB)	Level	FCC 15.209 Limit	FCC 15.209 Limit Margin
1830	AVG	55.2	24.9	3.3	0.2	-33.1	50.5	54	3.5
2467.75	PEAK	49.1	28.4	4.2	0.3	-33.1	48.9	54	5.1
2455.74	PEAK	48	28.3	4.1	0.3	-33.1	47.6	54	6.4
2417.7	PEAK	48	28.2	4.1	0.3	-33.1	47.5	54	6.5
2440.01	PEAK	47.7	28.3	4.1	0.3	-33.1	47.3	54	6.7
1830	AVG	55.2	24.9	3.3	0.2	-33.1	50.5	54	3.5

Table A.4 Tx Spurious Emission Mid Channel (900MHz) –1GHz – 3GHz: Vertical Polarization



Product Service

ZX WIRELESS THERMOSTAT

Frequency (MHz)	Detector	Raw Reading	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp (dB)	Level	FCC 15.209 Limit	FCC 15.209 Limit Margin
2442.01	PEAK	92	28.3	4.1	-33.1	91.3	54	-37.3 <Note 1>
2468.9	PEAK	49	28.4	4.2	-33.1	48.5	54	5.5
2454.6	PEAK	47.9	28.3	4.1	-33.1	47.2	54	6.8
2502.93	PEAK	46.8	28.6	4.2	-33.1	46.5	54	7.5
1737.31	PEAK	42.8	24.6	3.2	-33.2	37.4	54	16.6
Note 1. Transmitter Frequency excluded from FCC limits.								

Table A.5 Tx Spurious Emission Mid Channel (2.4GHz) –30MHz – 1GHz: Vertical Polarization

Frequency (MHz)	Detector	Raw Reading	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-Amp (dB)	Level	FCC 15.209 Limit	FCC 15.209 Limit Margin
2441.73	PEAK	103.4	28.3	4.1	-33.1	99.7	54	-45.7 <Note 1>
2456.03	PEAK	48.8	28.3	4.1	-33.1	48.1	54	5.9
2467.75	PEAK	48.6	28.4	4.2	-33.1	48.1	54	5.9
2416.56	PEAK	48.2	28.2	4.1	-33.1	47.4	54	6.6
2407.41	PEAK	48.2	28.2	4.1	-33.1	47.4	54	6.6
Note 1. Transmitter Frequency excluded from FCC limits.								

Table A.6 Tx Spurious Emission Mid Channel (2.4GHz) –30MHz – 1GHz: Horizontal Polarization