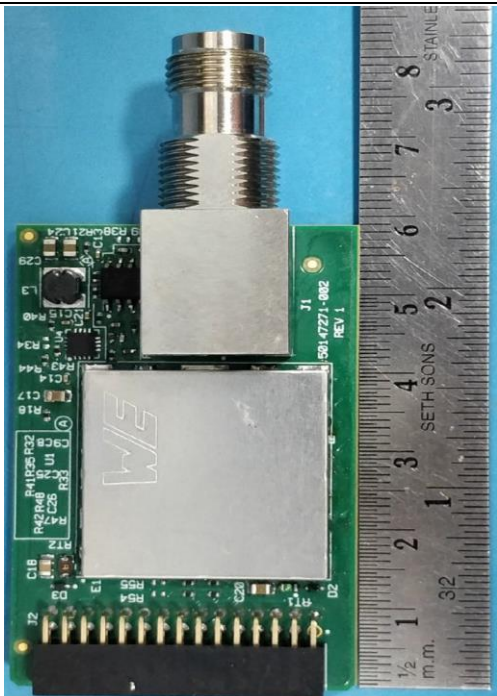


Prüfbericht – Produkte
Test Report - Products

Prüfbericht-Nr.: Test report no.:	ULR-TC568821300000033F	Auftrags-Nr.: Order no.:	166554137 0010	Seite 1 von 199 Page 1 of 199
Kunden-Referenz-Nr.: Client reference no.:	NA	Auftragsdatum: Order date:	2021-05-18	
Auftraggeber: Client:	1. HONEYWELL INTERNATIONAL INC, Honeywell Safety and Productivity Solutions 9680 OLD BAILES RD, FORT MILL, SC 29707, USA 2. M/S Venture Corporation Limited 4, Jalan Kempas 5/2 (Block D) Tampoi, 81200 Johor Bahru DID +60 7231 2391 Main +60 7237 7201 Fax +60 7236 4146			
Prüfgegenstand: Test item:	HWB11AC-PRTM	Product Type	Wi-Fi BT Module	
Bezeichnung: Identification.:	HWB11AC-PRT			
Auftrags-Inhalt: Order content:	Testing and issue of Test Report and Grant Certificate			
Prüfgrundlage: Test specification:	FCC Part 15 Subpart C 15.247, 15.207 RSS 247 Issue 2 and RSS GEN Issue 5			
Wareneingangsdatum: Date of sample receipt:	2021-05-20			
Prüfmuster-Nr & Serien-Nr.: Test sample no & serial no.:	A003068621-001 2021061001			
Prüfzeitraum: Testing period:	2021-05-21 - 2021-06-08			
Ort der Prüfung: Place of testing:	Wireless laboratory, Bangalore			
Prüflaboratorium: Testing laboratory:	TÜV Rheinland (India) Pvt.Ltd., 27/B, 2nd Cross, Electronic City Phase1 Bangalore -560 100, India FCC Test site registration number: 496599 ISED Test site registration number: 3466E-1			
Prüfergebnis*: Test result*:	Pass			
geprüft von: tested by:	genehmigt von: authorized by:			
Datum: Date: 2021-06-11	Ausstellatum: Issue date: 2021-07-14			
Stellung / Position:	Likhithesh M D Engineer	Stellung / Position:	Mahammadgouse Kaladagi Assistant Manager	
Sonstiges / Other:	FCC ID: HD5-HWB11 IC: 1693B-HWB11			
Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery:	Prüfmuster vollständig und unbeschädigt Test item complete and undamaged			
* Legende:	1 = sehr gut P(ass) = entspricht o.g. Prüfgrundlage(n)	2 = gut F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	3 = befriedigend F(ail) = entspricht nicht o.g. Prüfgrundlage(n)	4 = ausreichend N/A = nicht anwendbar
* Legend:	1 = very good P(ass) = passed a.m. test specification(s)	2 = good F(ail) = failed a.m. test specification(s)	3 = satisfactory F(ail) = failed a.m. test specification(s)	4 = sufficient N/A = not applicable
Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. This test report only relates to the a. m. test sample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This test report does not entitle to carry any test mark.				

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 2 von 199
Page 2 of 199

TEST SUMMARY

Test Item	Applicable Standard		Result
	FCC	ISED	
Maximum conducted (average) output power	FCC 15.247(b)(3)	RSS 247 Issue 2, Section 5.4 (d)	Pass
Maximum Power Spectral Density	FCC 15.247(e)	RSS 247 Issue 2, Section 5.2 (b)	Pass
DTS Bandwidth	FCC 15.247(a)(2)	RSS 247 Issue 2, Section 5.2 (a)	Pass
Emissions in non-restricted frequency bands	FCC 15.247(d)	RSS 247 Issue 2, Section 5.5	Pass
Spurious Radiated Emissions and Restricted Bands of Operation	FCC 15.209 / FCC 15.205	RSS-Gen Issue 5, Section 8.9 /8.10	Pass
Conducted Emissions on a.c Power Lines	FCC 15.207	RSS-Gen Issue 5, Section 8.8	Pass

Product Category: Electronics Testing
Test Discipline: EMC Test Facility

Compliance statement for Part 15.203:

"THE ANTENNA WITH A SPECIAL CONNECTOR (RP-TNC) USED, WITH NO POSSIBILITY OF REPLACEMENT WITH A NON-APPROVED ANTENNA BY THE END-USER. THEREFORE, THE EUT IS CONSIDERED TO COMPLY WITH THIS PROVISION."

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 3 von 199
Page 3 of 199

REVISION HISTORY OF THIS REPORT

Report Number	Version	Description	Issue date
ULR-TC568821300000033F	01	Initial issue of report	2021-07-01
ULR-TC568821300000033F	02	Reviewer comments updated	2021-07-09
ULR-TC568821300000033F	03	Reviewer comments updated	2021-07-14

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 4 von 199
Page 4 of 199

Table of Contents

1	GENERAL REMARKS	6
1.1	Attachments	6
2	TEST SITES	7
2.1	Testing Facilities.....	7
2.2	List of Test and Measurement Instruments.....	7
3	GENERAL PRODUCT INFORMATION.....	8
3.1	Product Function and Intended Use.....	8
3.2	Ratings and System Details of Equipment under Test	8
3.3	Measurement Uncertainty:	9
4	TEST SET-UP AND OPERATION MODE.....	10
4.1	Principle of Configuration Selection	10
4.2	UUT Operation and Software	10
4.3	Special Accessories and Auxiliary Equipment	10
4.4	Simultaneous Transmission	10
4.5	Countermeasures to achieve EMC Compliance	10
4.6	List of frequencies	10
4.7	Report references.....	11
5	Operational Description	12
6	Block Diagram.....	12
7	TEST METHODOLOGY	13
7.1	Conducted Spurious Emission Test on AC Power Line.....	13
7.1.1	Test Setup Configuration	13
7.2	Radiated Emission Test	14
7.2.1	Test Setup Configuration	14
8	TEST RESULTS FOR Wi-Fi.....	16
8.1	Maximum Average Conducted Output Power.....	16
8.2	Maximum Power Spectral Density	31
8.3	DTS Bandwidth & 99% Bandwidth.....	46
8.4	Emissions in non-restricted frequency bands and Conducted Spurious Emission.....	73
8.4.1	Band edge and reference plots	74
8.4.2	Out-Of-Band Emissions.....	92
8.5	Spurious Radiated Emissions & Restricted Bands of Operation	140
9	TEST RESULTS FOR BLUETOOTH LOW ENERGY	165
9.1	Maximum Peak Conducted Output Power.....	165
9.2	Maximum Power Spectral Density	168
9.3	DTS Bandwidth & 99% Bandwidth.....	171
9.4	Emissions in non-restricted frequency bands and Conducted Spurious Emission.....	176
9.4.1	Band edge and reference plots	177
9.4.2	Out-Of-Band Emissions.....	179
9.5	Spurious Radiated Emissions & Restricted Bands of Operation	186

Prüfbericht - Nr.:

Test Report No.:

ULR-TC568821300000033F

Seite 5 von 199

Page 5 of 199

10	Conducted Spurious Emission Test on AC Power Line	195
11	LIST OF TABLES	199
12	Power level used for testing	199

1 GENERAL REMARKS

1.1 Attachments

All attachments are part of this test report and are issued in separate document

1. TEST SETUP PHOTOS
- 2: EUT EXTERNAL PHOTOS
- 3: EUT INTERNAL PHOTOS
- 4: FCC LABEL AND LABEL LOCATION
- 5: BLOCK DIAGRAM
- 6: SPECIFICATION OF EUT
- 7: SCHEMATIC DIAGRAM
- 8: BILL OF MATERIAL
- 9: USER MANUAL
- 10: MAXIMUM PERMISSIBLE EXPOSURE INFORMATION

2 TEST SITES

2.1 Testing Facilities

1. TÜV Rheinland (India) Pvt.Ltd.,
27/B, 2nd Cross,
ElectronicCityPhase1
Bangalore – 560 100,
India

2. TUV Rheinland (India) Pvt.Ltd.,
108 , Beside ISBR Business School,
Electronic city Phase I
Bangalore - 560 100.
India

Radiated Measurement site type :
Fully anechoic chamber (used for above 1 GHz
measurements)

Radiated Measurement site type :
Semi anechoic chamber (used for below 1 GHz
measurements)

2.2 List of Test and Measurement Instruments

Table 1: List of test and measurement instruments

Equipment	Manufacturer	Model Name	Serial Number	Firmware Versions	Calibration Due Date	Periodicity	Test Facility
EMI Receiver	Rohde & Schwarz	ESW 44	101732	4.73 SP5	27.01.2022	Yearly	Radiated Spurious Emission
Active loop antenna	Frankonia	FMZB 1519 B	1519B-00111	-	28.02.2022	Yearly	
Balloon and Biconical Antenna	Schwarzbeck mess-elektronik	VHBB-9124 / BBA-9106	01028	-	02.09.2021	Yearly	
Log - Periodical Antenna	Schwarzbeck mess-elektronik	VUSLP-9111B	9111B-111	-	31.08.2021	Yearly	
Horn Antenna	Frankonia	HAX-18	802	-	01.03.2022	Yearly	
Semi Anechoic Chamber	Frankonia	-	-	-	-	-	
Fully Anechoic Chamber	Albatross	-	-	-	-	-	Antenna-Port Conducted test
Spectrum Analyser	Agilent Technologies	E4407B	US41192 772	A.14.06	10.08.2021	Yearly	
Pulse Limiter	Rohde & Schwarz	ESH3-Z2	100811	-	04.08.2021	Yearly	
LISN	Rohde & Schwarz	ENV216	100022	-	04.09.2021	Yearly	Conducted AC Power line Test

Table 2: Instrument application Software versions

SL. No.	Test Type	Application software	Version
1	Radiated spurious emission measurement in SAC	EMC 32	10.60.00
2	Radiated spurious emission measurement in FAC	EMC 32	10.60.00

3 GENERAL PRODUCT INFORMATION

3.1 Product Function and Intended Use

HWB11AC-PRTM is a carrier board with System on Module. The module to be used inside the Honeywell Products. The Module has Dual Band WIFI (2.4GHz & 5GHz) and BLUETOOTH radio interface. This module communicates with external host using SDIO interface for WIFI and UART for BLUETOOTH.

This Module supports 802.11a/b/g/n/ac for WIFI and Supports BT (Basic , EDR & BLE) The module will act as Access Point / Master only in NON - DFS bands. In the DFS band, the Module acts as Slave /Station device which do not have Radar detection functionality.

Powered with QCA6174A, **HWB11AC-PRTM** achieve the best possible connectivity and performance in RF Environment.

This Module will be used to provide the WIFI & BLUETOOTH wireless connectivity for Honeywell Products

3.2 Ratings and System Details of Equipment under Test

Table 3: Ratings and System Details as declared by Client*

Radio Protocol		Wi-Fi	BLE
Operating Frequency Range		2412MHz to 2462MHz	2402MHz to 2480MHz
No. of Channels		11 (Refer Table 5)	40 (Refer Table 6)
Channel Spacing		5MHz	2MHz
Transmitting Power Level		Refer clause 12	
Maximum Measured Power (e.i.r.p)		18.82 dBm (1Mbps 2437MHz)	1.58 dBm(1Mbps 2480MHz)
Modulation		802.11b: DSSS (1Mbps,11Mbps) 802.11g: OFDM (6Mbps, 54Mbps) 802.11n: OFDM (20MHz: MCS0, MCS7 40MHz: MCS0, MCS7)	GFSK
Number of antennas		1	
Antenna Gain		2.35 dBi	
Antenna Type		Omni-directional Dipole Antenna	
Supply Voltage to Product		5.0V, 0.5A	
Environmental conditions	Storage	-20degC to +70degC Relative Humidity <95%	
	Operating	-20degC to +60degC Relative Humidity <95%	
EUT Dimension		80 x 37 x 18 mm (L x W x H)	

***Disclaimer:** The information/data is supplied by the client and the same is considered to arrive at the final value. Any changes made apart from the specified specification, can directly impact on the tests results. Refer the products user manual for more details.

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 9 von 199
Page 9 of 199

Note: Product HWB11AC-PRTM has multiple protocols. All the supported wireless protocols and their respective test results are issued in separate test reports, refer clause 4.7 Report references

3.3 Measurement Uncertainty:

Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k = 2$

Table 4: Measurement Uncertainty

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

Note: The Listed Measurement Uncertainties are the worst-case uncertainty, for the respective test cases. Above Table is for reporting purpose only and not used in determining Final Pass/Fail verdict.

4 TEST SET-UP AND OPERATION MODE

4.1 Principle of Configuration Selection

Transmission was enabled with highest possible duty cycle on low, mid and high channels

4.2 UUT Operation and Software

Hardware Version Identification number (HVIN) : 50180228-001
Software version : 10.17.98.0257

4.3 Special Accessories and Auxiliary Equipment

Test laptop (QRCT tool with Software Version : 3.0.296.0),
LAN cable

4.4 Simultaneous Transmission

This product does not supports Simultaneous transmission

4.5 Countermeasures to achieve EMC Compliance

- None

4.6 List of frequencies

Frequency Band (MHz)	Channel No.	Channel Frequency (MHz)
2412 – 2462	1	2412
	2	2417
	3	2422
	4	2427
	5	2432
	6	2437
	7	2442
	8	2447
	9	2452
	10	2457
	11	2462

Table 5: List of Wi-Fi center Frequencies

Channel used for Wi-Fi 2.4GHz testing

Protocol: WLAN 802.11b

Channel Low : 2412 MHz
Channel Mid : 2437 MHz
Channel High : 2462 MHz

Protocol: WLAN 802.11g

Channel Low : 2412 MHz
Channel Mid : 2437 MHz
Channel High : 2462 MHz

Protocol: WLAN 802.11n_20MHz

Channel Low : 2412 MHz
Channel Mid : 2437 MHz
Channel High : 2462 MHz

Protocol: WLAN 802.11n_40MHz

Channel Low : 2422 MHz Channel Mid : 2437 MHz Channel High : 2452 MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 11 von 199
Page 11 of 199

Frequency Band (GHz)	Channel No.	Frequency (MHz)
BLE (2.4-2.4835)	0	2402
	1	2404
	2	2406
	3	2408
	:	:
	:	:
	18	2438
	19	2440
	20	2437
	:	:
	:	:
	36	2474
	37	2476
	38	2478
	39	2480

Table 6: List of BLE Center frequencies

Channel used for BLE testing

Channel low : 2402MHz

Channel mid : 2440MHz

Channel High : 2480MHz

Note:

TUV Sample Identification number : A003068621-001– Radiated test Sample
A003068621-001– Conducted test Sample

4.7 Report references

Note: Product HWB11AC-PRTM has multiple protocols. All the supported wireless protocols and their respective test results are issued in separate test reports, following table lists the report numbers.

Radio Protocol	Report Number
RF test report for Wi-Fi (2.4GHz) & BLE (2.4GHz) – (This report)	ULR-TC568821300000033F
RF test report for Wi-Fi (5GHz)	ULR-TC568821300000034F
RF test report for Bluetooth (2.4GHz)	ULR-TC568821300000035F

5 Operational Description

This HWB11AC-PRTM is a WiFi/BT system on module which will be placed inside the Honeywell products like printers, barcode scanners, RFID readers etc. to enable wireless connectivity. This module includes MAC & physical layer of 802.11a/b/g/n/ac and the Bluetooth modem.

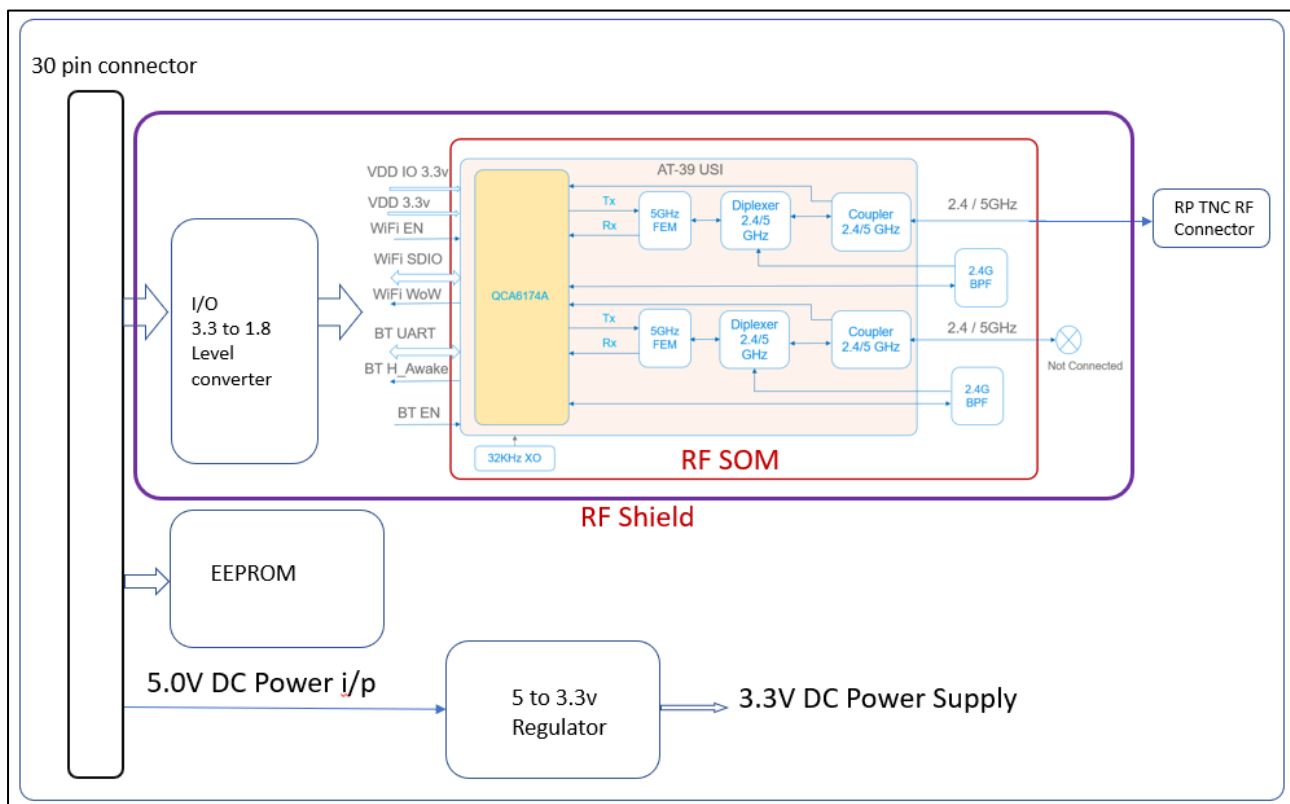
This module operates on 5.0V DC Power supply with internal on board regulation to generate 3.3v for powering ON all the circuits. The entire RF circuits is enclosed in RF shield of dimension 25mm X 25mm.

The module uses internal power amplifier and LNA for 2.4GHz frequency band and an external front end chip for 5GHz frequency band. All filters and diplexers are included in the module to ensure maximum power flatness and optimum VSWR. The module has one antenna chain for 1X1 output.

The module supports range of data rates from 1Mbps in 802.11b mode to MCS9 in 802.11ac mode. This chipset also supports concurrent operation of Bluetooth (Version 5.0) for wireless connectivity during browsing or other device applications. Along with both standard and high speed (HS) Bluetooth data rates, Bluetooth low energy modes are also supported. Hardware WAPI acceleration engine, AES, TKIP, WPA and WPA2 are supported to provide the latest security requirement on your network.

The Device communicates with HOST using SDIO interface for WIFI and UART interface for BLUETOOTH.

6 Block Diagram



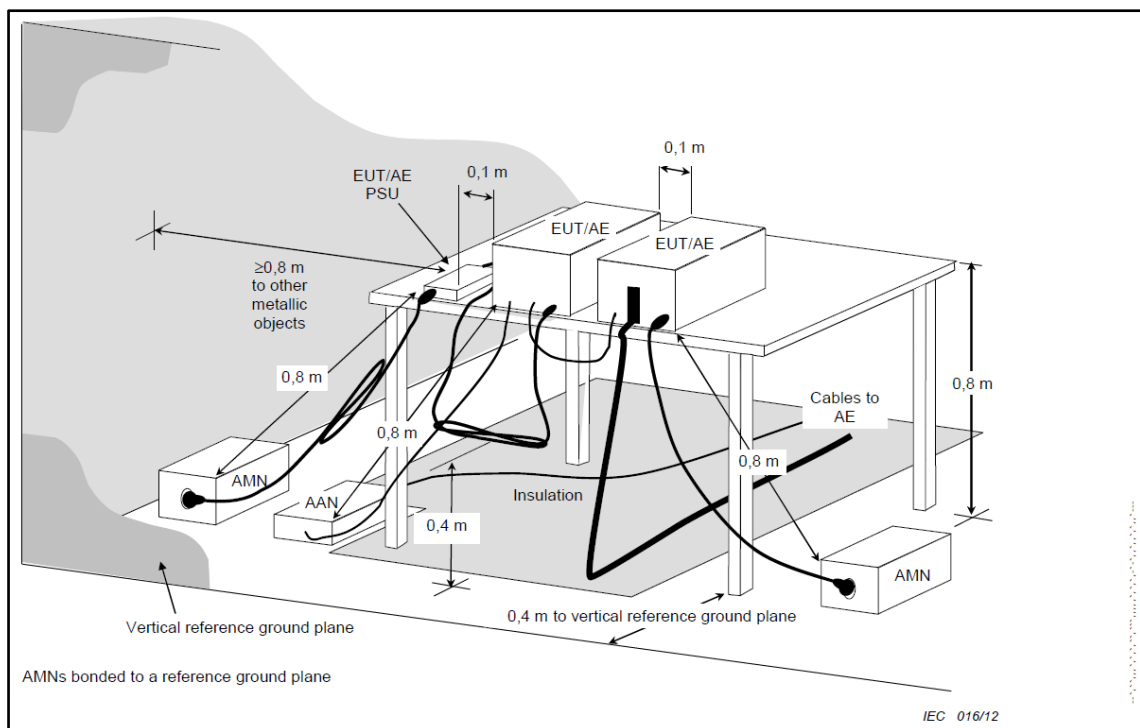
7 TEST METHODOLOGY

7.1 Conducted Spurious Emission Test on AC Power Line

Measured levels of ac power-line conducted emission across the 50Ω LISN port (to which the EUT is connected). All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer.

The device is placed on the test table, raised 80cm above the reference ground plane. The vertical conducting plane is located 40cm to the rear of the device. AC Conducted emission measurement is made over frequency range from 150kHz to 30MHz, this measurement was performed with EUT powered by 2 methods and both methods are tested individually, one with an AC adaptor with 110V AC 60Hz supply and second with Wireless charger with supply 110V AC 60Hz.

7.1.1 Test Setup Configuration



7.2 Radiated Emission Test

The radiated emission measurement was performed according to the procedures in ANSI C63.10-2013. The equipment under test (EUT) was placed at the middle of the 80 cm high turntable for below 1 GHz & 1.5 m height for above 1 GHz measurement, and the EUT is 3 meters far from the measuring antenna. The turntable was rotated 360° for obtaining the maximum emission. The height of the measuring antennas was scanned between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained. The measurement above 1000 MHz was performed by horn antenna, The measurement below 30 MHz was performed by loop antenna, Measurement from 30 MHz to 200 MHz was performed by Baloon and Biconical Antenna, and measurement from 200 MHz to 1 GHz was performed by Log-Periodic Antenna.

The EUT was rotated around the X-, Y-, and Z-Axis and the results from worst case axis are recorded

7.2.1 Test Setup Configuration

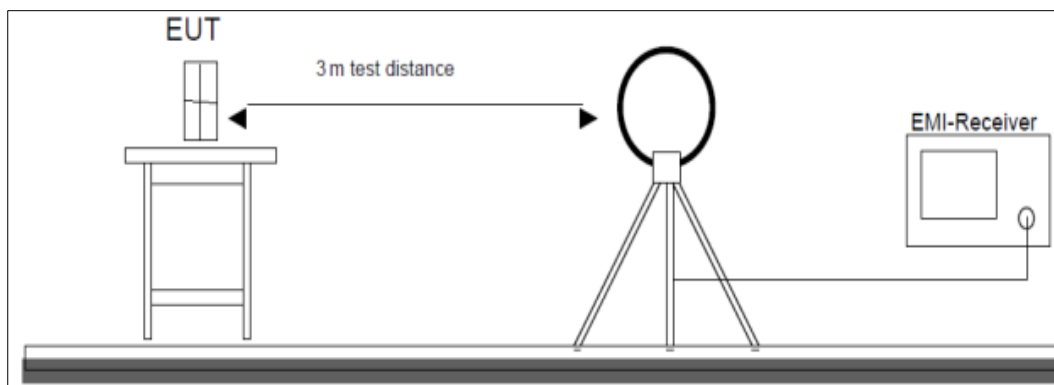


Figure 1: Frequency Range 9 kHz- 30 MHz

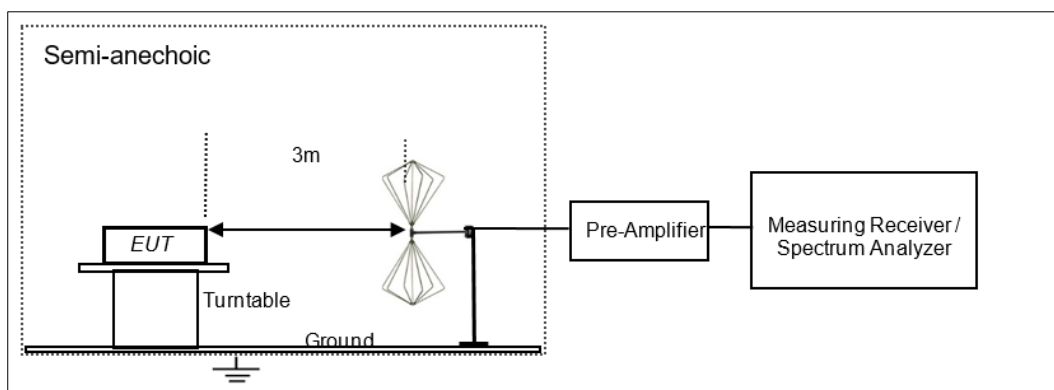


Figure 2: Frequency Range 30 MHz – 200 MHz

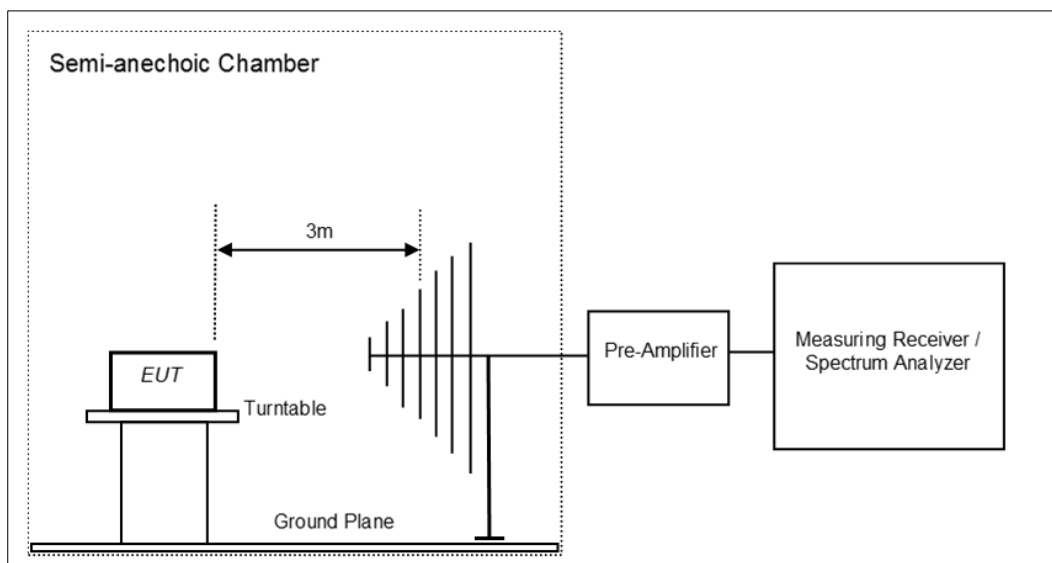


Figure 3: Frequency Range 200 MHz - 1GHz

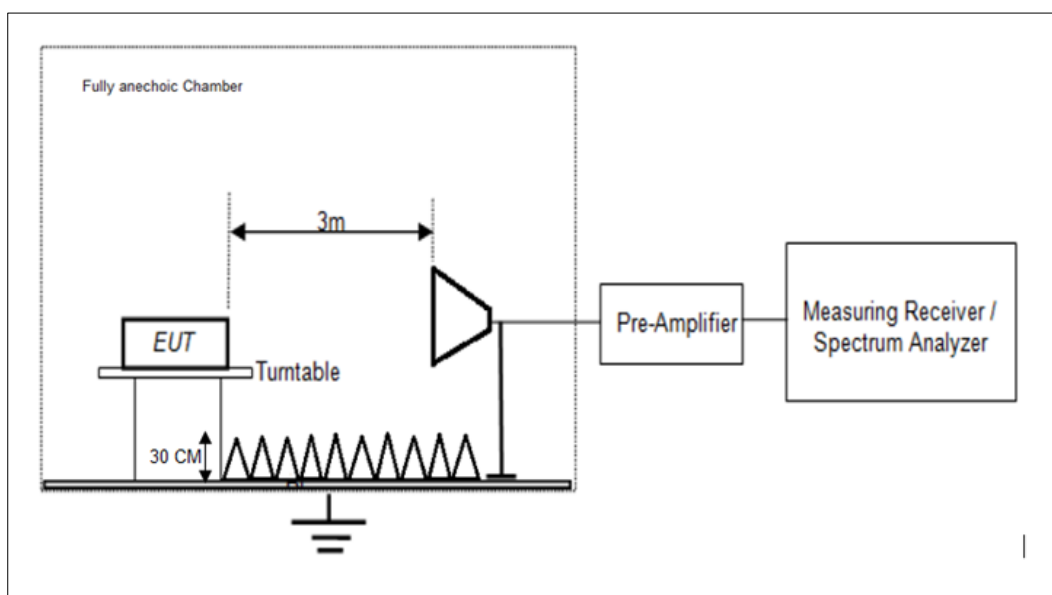


Figure 4: Frequency Range above 1 GHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 16 von 199
Page 16 of 199

8 TEST RESULTS FOR Wi-Fi

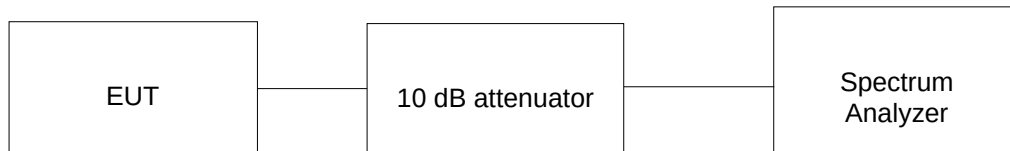
8.1 Maximum Average Conducted Output Power

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (b)(3) / RSS 247 Issue 2, Section 5.4 (d)
Test Method	Subclause 11.9.2.2.2 of ANSI C63.10
Measurement Bandwidth	1 MHz
Detector	Average sample detector mode
Port of testing	Antenna port
Requirement	Power ≤ 1 W (30 dBm) & e.i.r.p ≤ 4 W (36 dBm)

Test Method



Test Condition

Normal Test Condition:

Temperature (Norm) = + 25 °C Voltage = 5.0V AC to DC Adaptor Relative humidity: 62%

KDB Guidelines applied:

Measurements were made as per section 8.3.2.2 in KDB 558074 D01 15.247 Measurement Guidance v05r02.

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 17 von 199
Page 17 of 199

Test results:

Note:

1. All the losses are included during measurement and final values are mentioned in the test report.
2. Total Average Output power (dBm) = Measured Average power (dBm) + Attenuator factor (10dB) + Cable loss (0.5dB)
3. This product do not support additional beamforming gain / directional gain, it uses signal antenna and hence directional gain of the single antenna is 2.35 dBi
4. Maximum (e.i.r.p) = Maximum Average output power (dBm) + antenna gain (2.35 dBi)

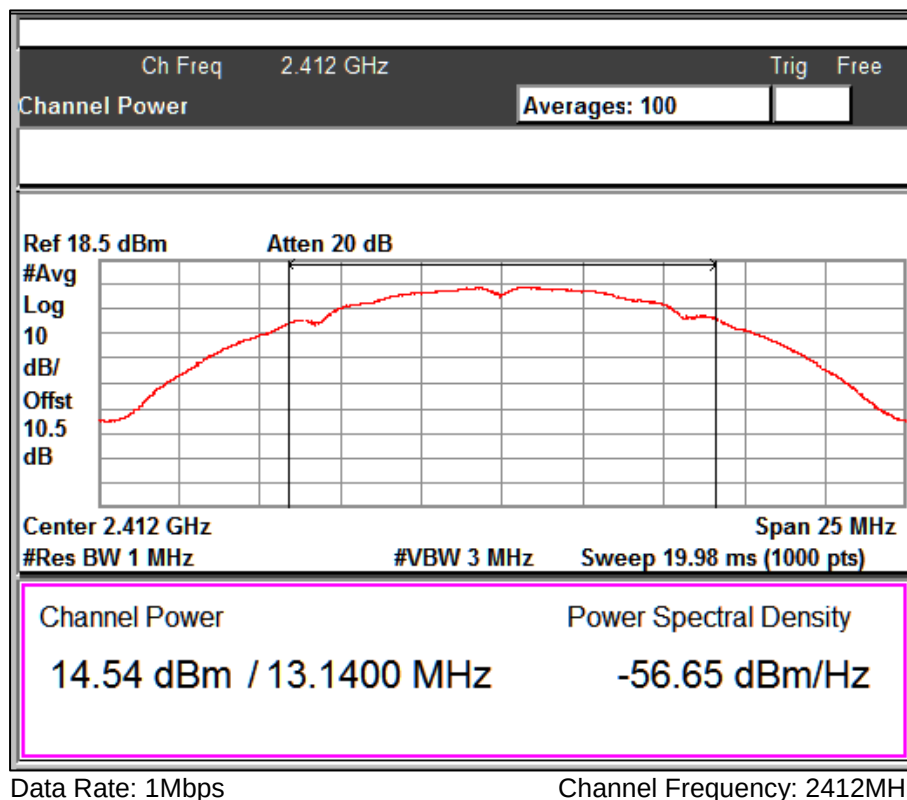
Modulation: 802.11b

Data rate (Mbps)	Channel Frequency (MHz)	Measured Average Power (dBm)	Duty cycle %	Duty cycle correction factor (dB)	Maximum Average output power (dBm)	Maximum (e.i.r.p) (dBm)	Power Limit (dBm)	e.i.r.p Limit (dBm)
1	2412	14.54	98.88	0.05	14.59	16.94	30	36
	2437	18.82	98.88	0.05	18.87	21.22	30	36
	2462	16.65	98.88	0.05	16.70	19.05	30	36
11	2412	14.29	98.88	0.05	14.34	16.69	30	36
	2442	18.72	98.88	0.05	18.77	21.12	30	36
	2462	16.17	98.88	0.05	16.22	18.57	30	36

*Note: Duty Cycle Correction Factor Calculation

$10 \cdot \log(1/X)$ Where X is Duty Cycle is considered in below results

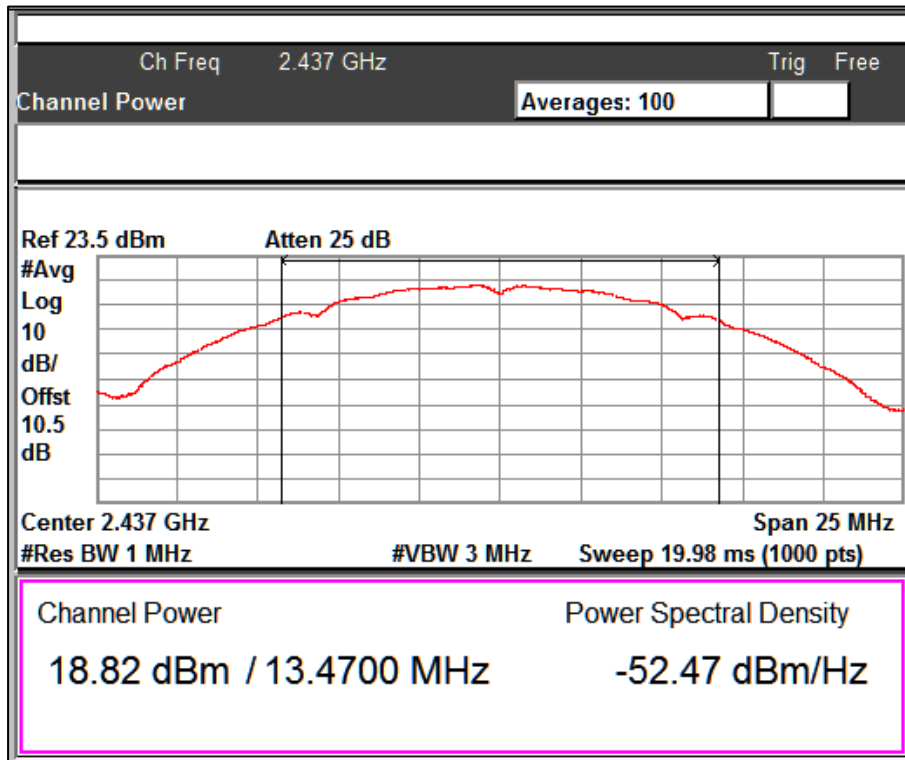
Duty cycle correction Factor is considered in Final Average Power



Prüfbericht - Nr.:
Test Report No.:

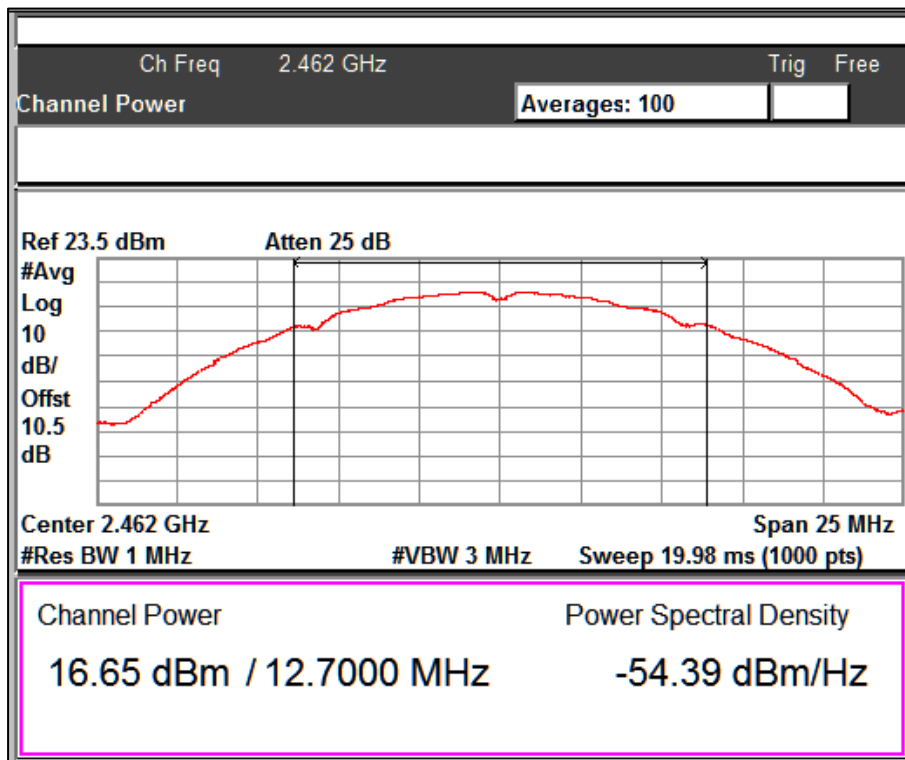
ULR-TC568821300000033F

Seite 18 von 199
Page 18 of 199



Data Rate: 1Mbps

Channel Frequency: 2437MHz



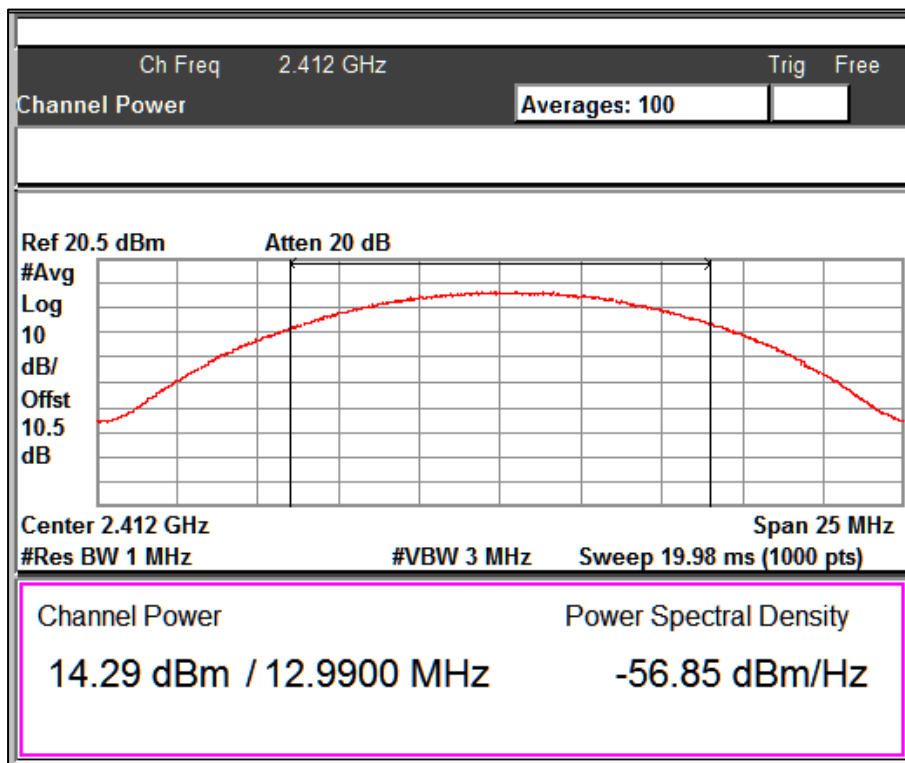
Data Rate: 1Mbps

Channel Frequency: 2462MHz

Prüfbericht - Nr.:
Test Report No.:

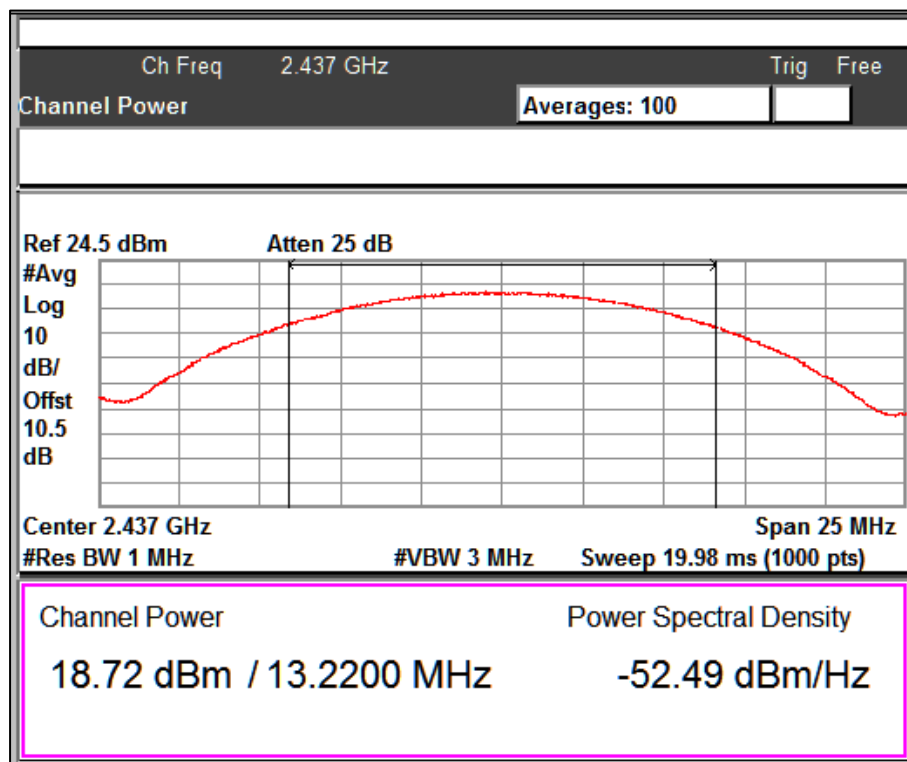
ULR-TC568821300000033F

Seite 19 von 199
Page 19 of 199



Data Rate: 11Mbps

Channel Frequency: 2412MHz



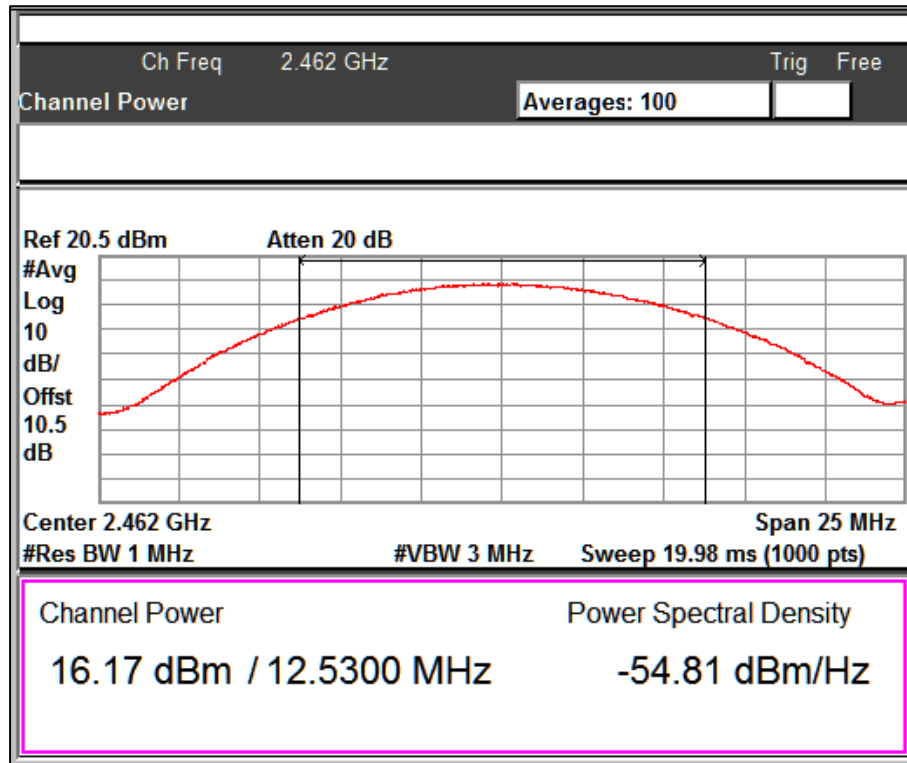
Data Rate: 11Mbps

Channel Frequency: 2437MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 20 von 199
Page 20 of 199



Data Rate: 11Mbps

Channel Frequency: 2462MHz

Modulation: 802.11g

Data rate (Mbps)	Channel Frequency (MHz)	Measured Average Power (dBm)	Duty cycle %	Duty cycle correction factor (dB)	Final Average power (dBm)	Maximum (e.i.r.p) (dBm)	Power Limit (dBm)	e.i.r.p Limit (dBm)
6	2412	10.42	98.88	0.05	10.47	12.82	30	36
	2437	16.24	98.88	0.05	16.29	18.64	30	36
	2462	10.58	98.88	0.05	10.63	12.98	30	36
54	2412	8.60	98.88	0.05	8.65	11.00	30	36
	2437	13.87	98.88	0.05	13.92	16.27	30	36
	2462	9.06	98.88	0.05	9.11	11.46	30	36

*Note: Duty Cycle Correction Factor Calculation

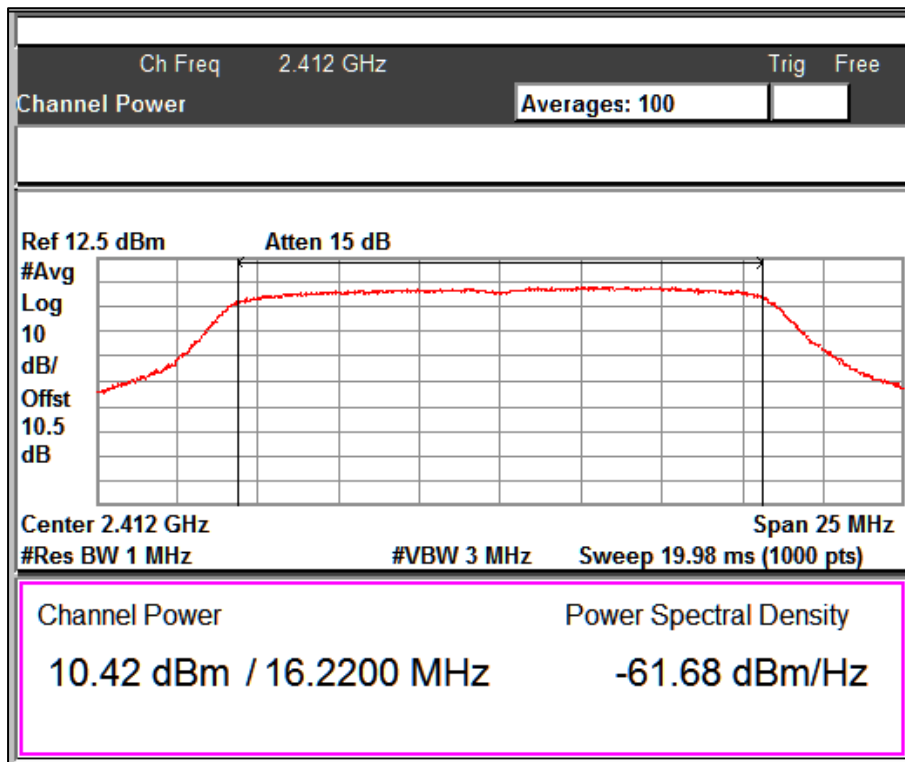
10*LOG (1/X) Where X is Duty Cycle is considered in below results

Duty cycle correction Factor is considered in Final Average Power

Prüfbericht - Nr.:
Test Report No.:

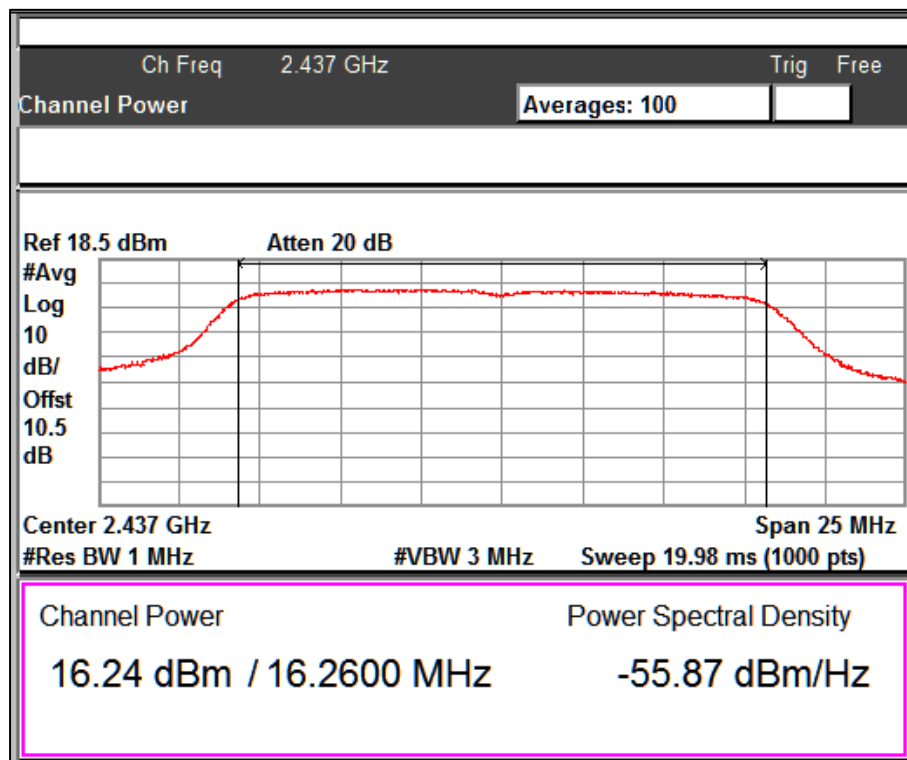
ULR-TC568821300000033F

Seite 21 von 199
Page 21 of 199



Data Rate: 6Mbps

Channel Frequency: 2412MHz



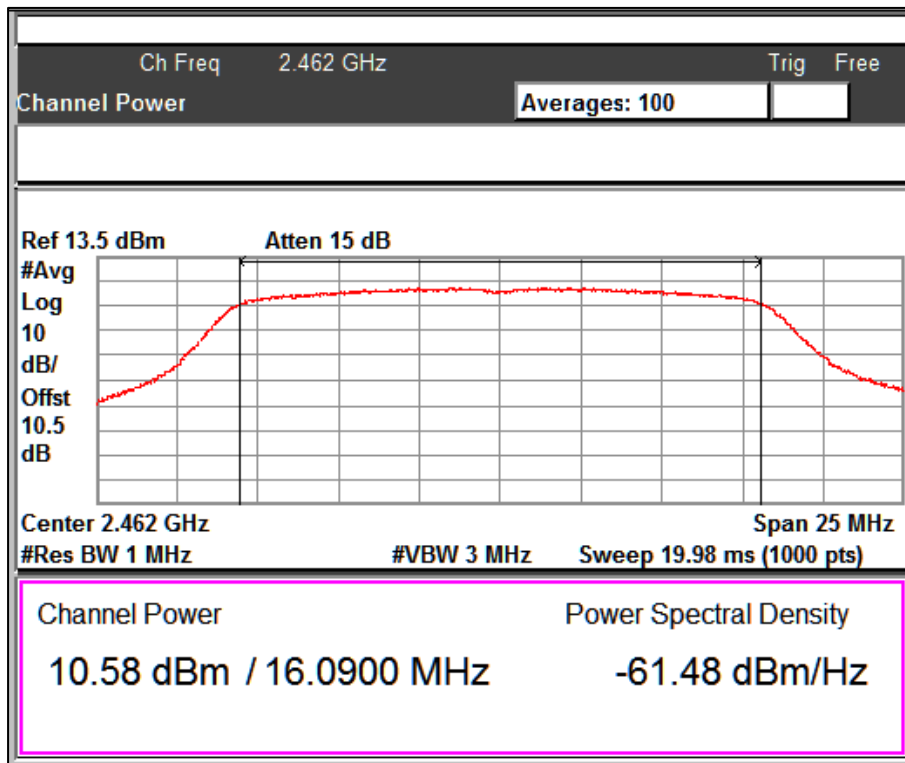
Data Rate: 6Mbps

Channel Frequency: 2437MHz

Prüfbericht - Nr.:
Test Report No.:

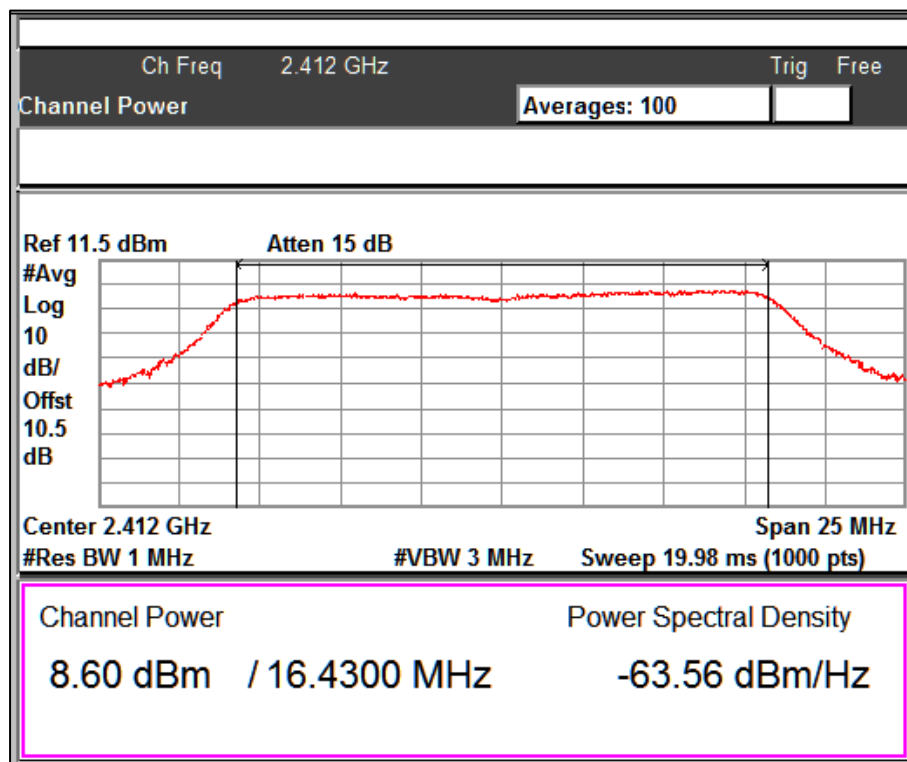
ULR-TC568821300000033F

Seite 22 von 199
Page 22 of 199



Data Rate: 6Mbps

Channel Frequency: 2462MHz



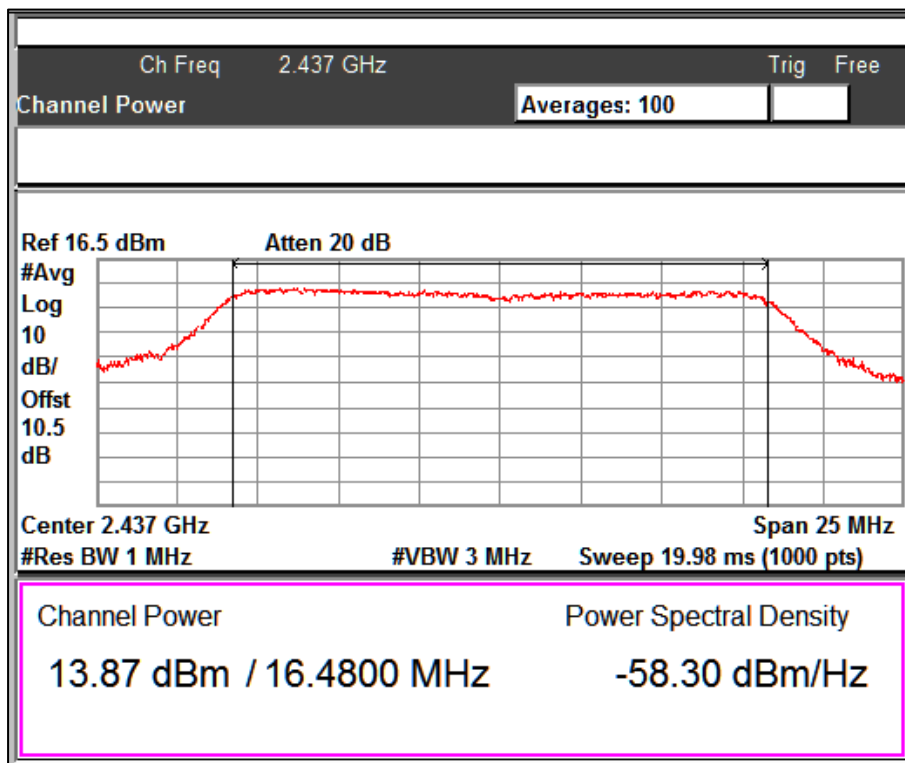
Data Rate: 54Mbps

Channel Frequency: 2412MHz

Prüfbericht - Nr.:
Test Report No.:

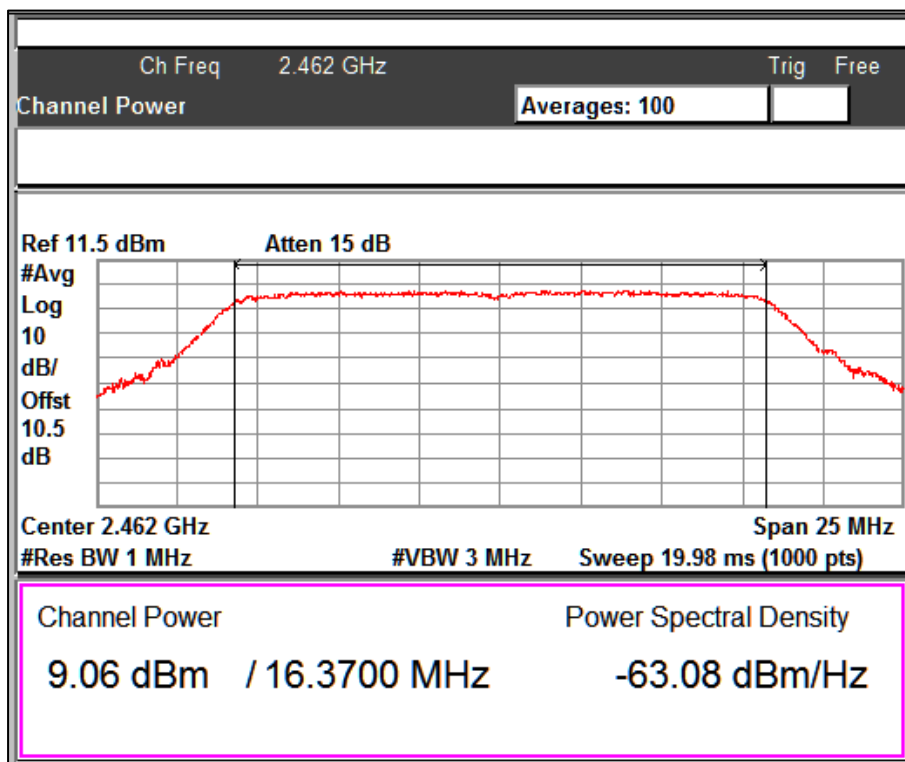
ULR-TC568821300000033F

Seite 23 von 199
Page 23 of 199



Data Rate: 54Mbps

Channel Frequency: 2437MHz



Data Rate: 54Mbps

Channel Frequency: 2462MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 24 von 199
Page 24 of 199

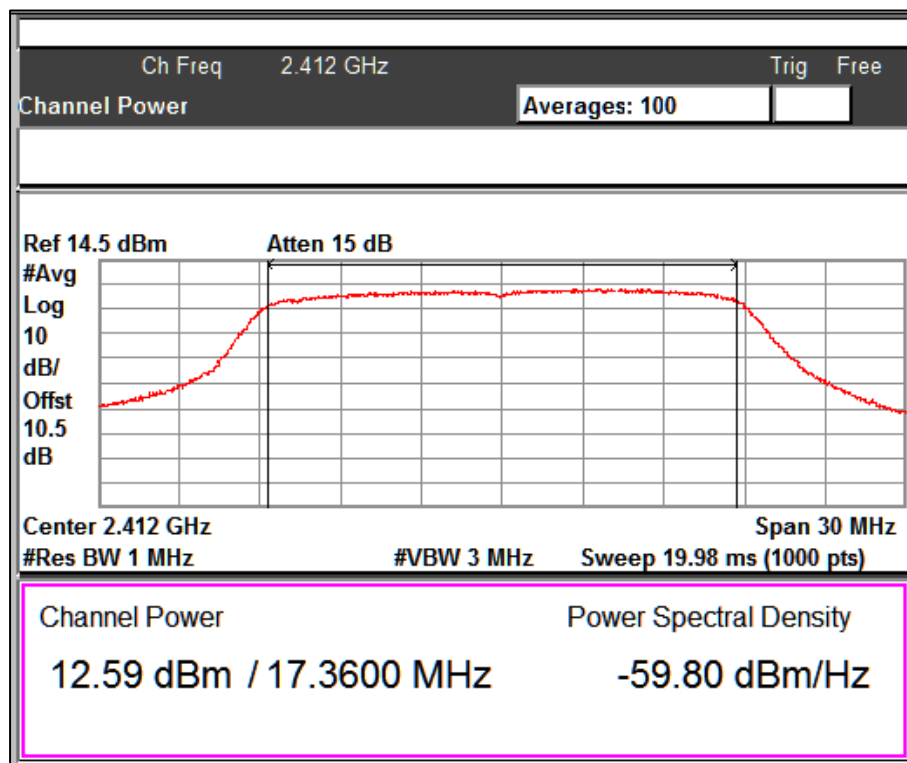
Modulation: 802.11n_20MHz

Data rate (Mbps)	Channel Frequency (MHz)	Measured Average Power (dBm)	Duty cycle %	Duty cycle correction factor (dB)	Final Average power (dBm)	Maximum (e.i.r.p) (dBm)	Power Limit (dBm)	e.i.r.p Limit (dBm)
MCS0	2412	12.59	98.88	0.05	12.64	14.99	30	36
	2437	14.89	98.88	0.05	14.94	17.29	30	36
	2462	12.10	98.88	0.05	12.15	14.50	30	36
MCS7	2412	11.25	98.88	0.05	11.30	13.65	30	36
	2437	13.48	98.88	0.05	13.53	15.88	30	36
	2462	10.44	98.88	0.05	10.49	12.84	30	36

*Note: Duty Cycle Correction Factor Calculation

$10 \cdot \log(1/X)$ Where X is Duty Cycle is considered in below results

Duty cycle correction Factor is considered in Final Average Power



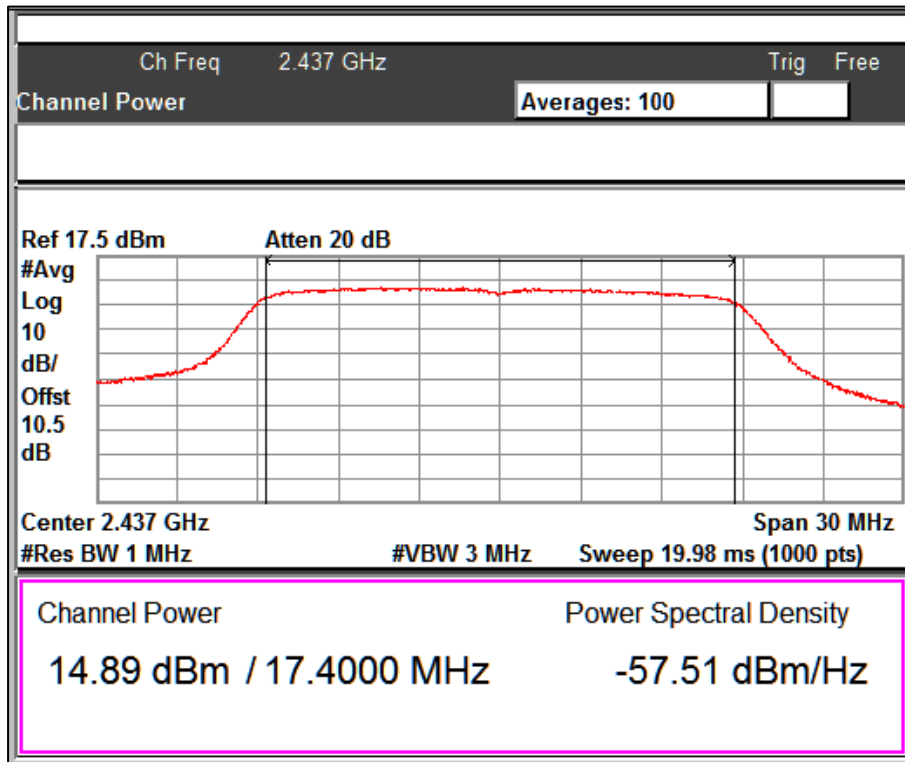
Data Rate: MCS0

Channel Frequency: 2412MHz

Prüfbericht - Nr.:
Test Report No.:

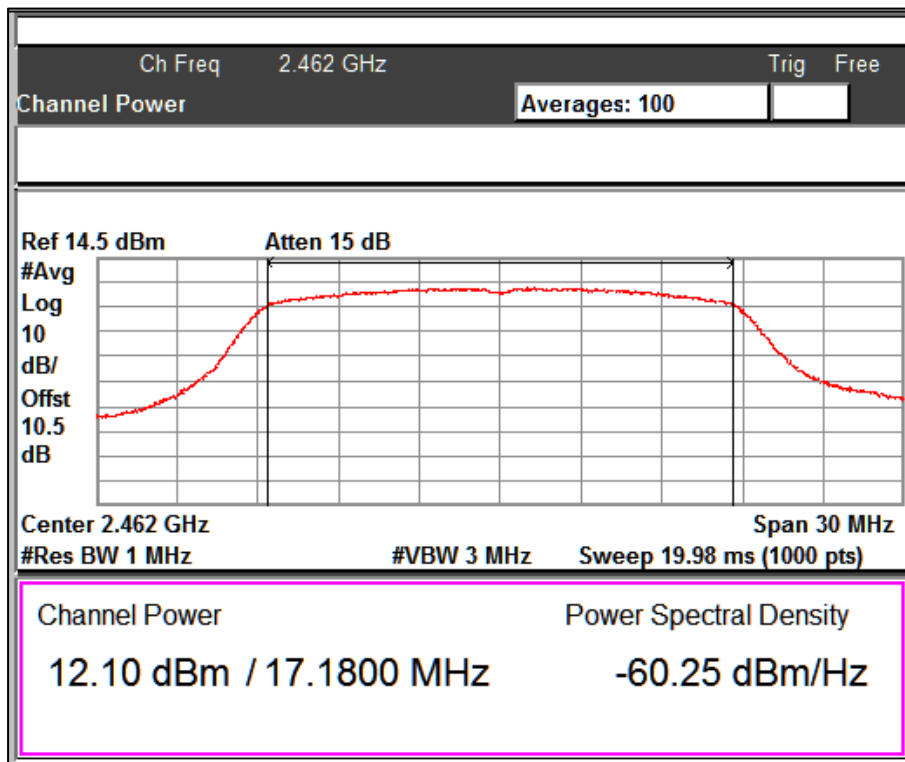
ULR-TC568821300000033F

Seite 25 von 199
Page 25 of 199



Data Rate: MCS0

Channel Frequency: 2437MHz



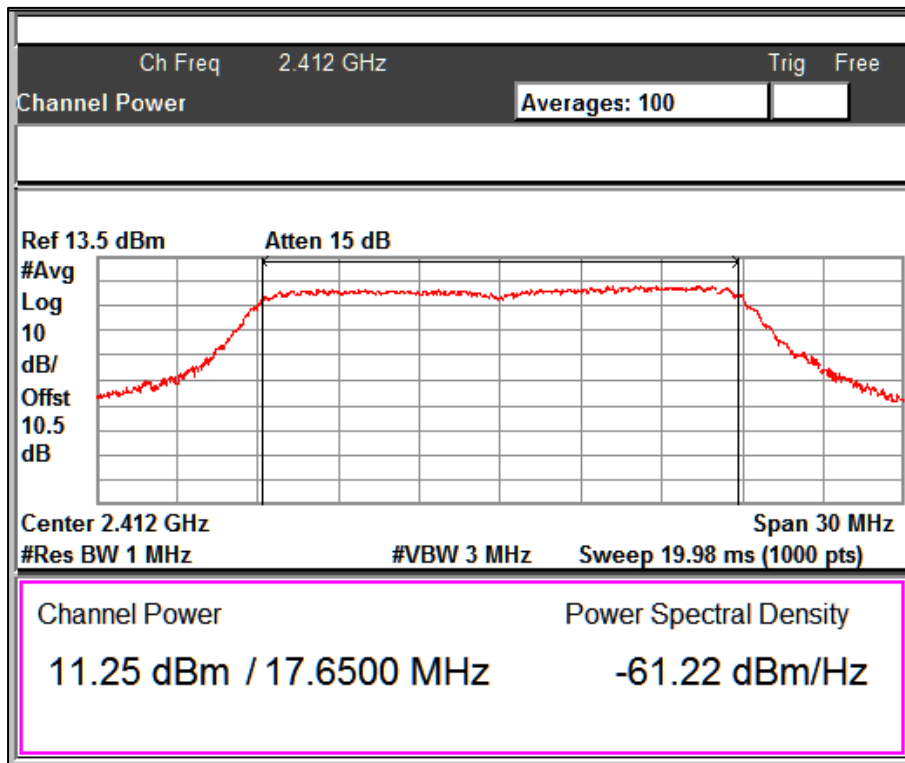
Data Rate: MCS0

Channel Frequency: 2462MHz

Prüfbericht - Nr.:
Test Report No.:

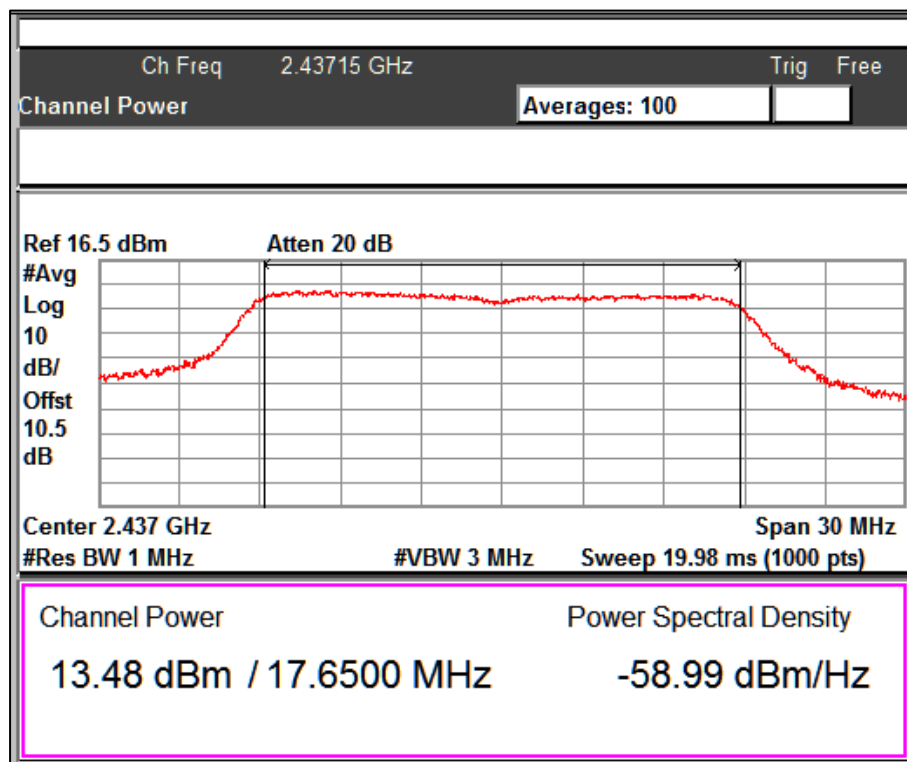
ULR-TC568821300000033F

Seite 26 von 199
Page 26 of 199



Data Rate: MCS7

Channel Frequency: 2412MHz



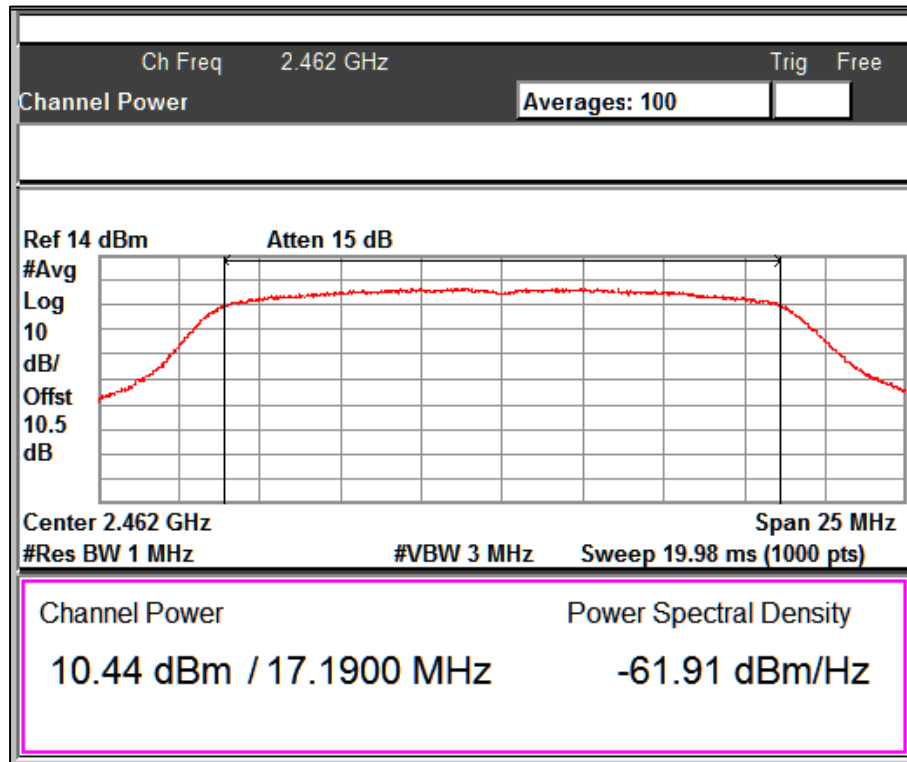
Data Rate: MCS7

Channel Frequency: 2437MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 27 von 199
Page 27 of 199



Data Rate: MCS7

Channel Frequency: 2462MHz

Modulation: 802.11n_40MHz

Data rate (Mbps)	Channel Frequency (MHz)	Measured Average Power (dBm)	Duty cycle %	Duty cycle correction factor (dB)	Final Average power (dBm)	Maximum (e.i.r.p) (dBm)	Power Limit (dBm)	e.i.r.p Limit (dBm)
MCS0	2422	12.14	98.88	0.05	12.19	14.54	30	36
	2437	13.35	98.88	0.05	13.40	15.75	30	36
	2452	12.14	98.88	0.05	12.19	14.54	30	36
MCS7	2422	9.40	98.88	0.05	9.45	11.80	30	36
	2437	10.51	98.88	0.05	10.56	12.91	30	36
	2452	7.44	98.88	0.05	7.49	9.84	30	36

*Note: Duty Cycle Correction Factor Calculation

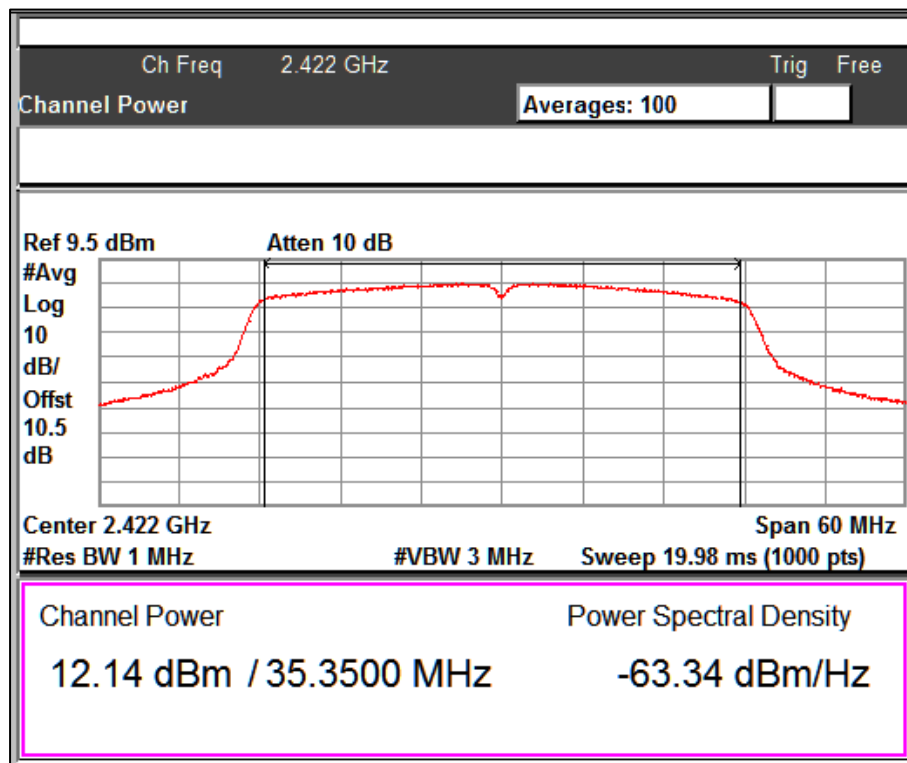
10*LOG (1/X) Where X is Duty Cycle is considered in below results

Duty cycle correction Factor is considered in Final Average Power

Prüfbericht - Nr.:
Test Report No.:

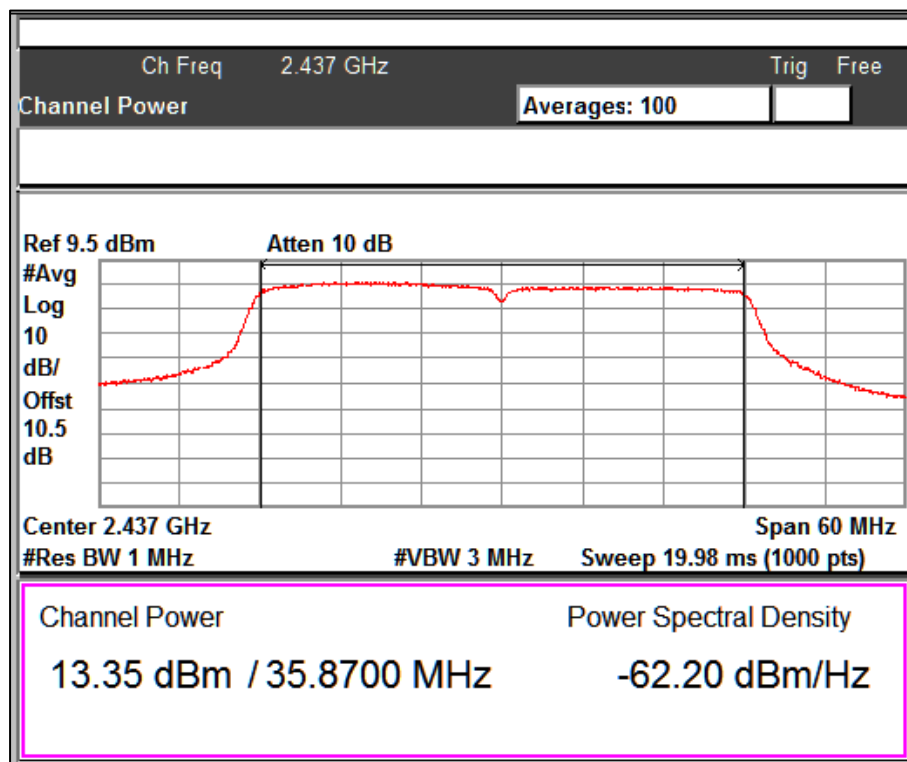
ULR-TC568821300000033F

Seite 28 von 199
Page 28 of 199



Data Rate: MCS0

Channel Frequency: 2422MHz



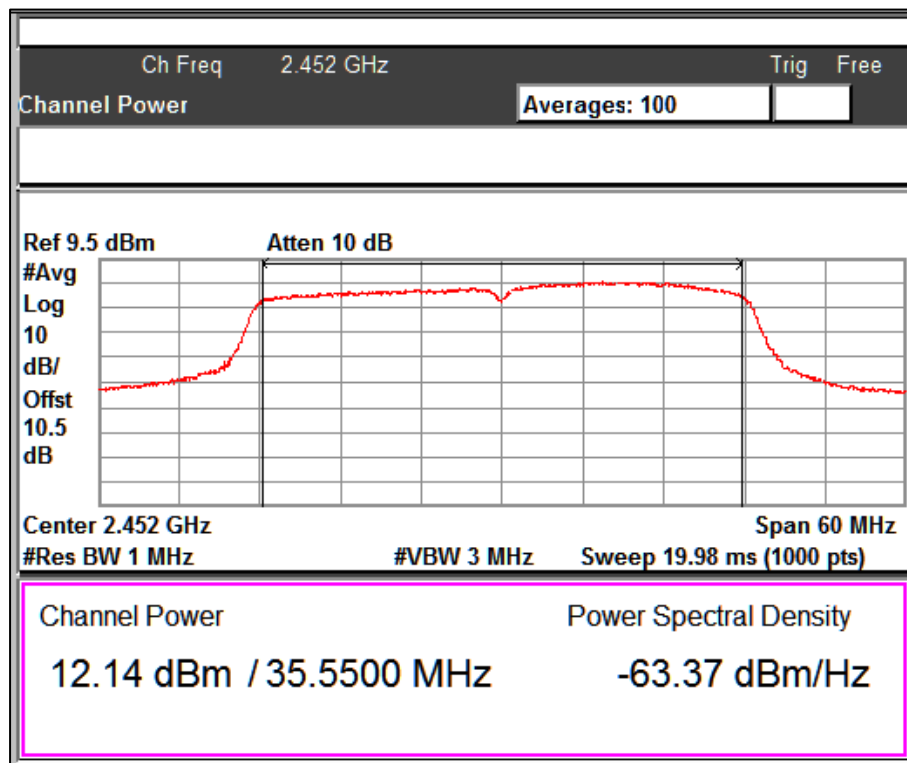
Data Rate: MCS0

Channel Frequency: 2437MHz

Prüfbericht - Nr.:
Test Report No.:

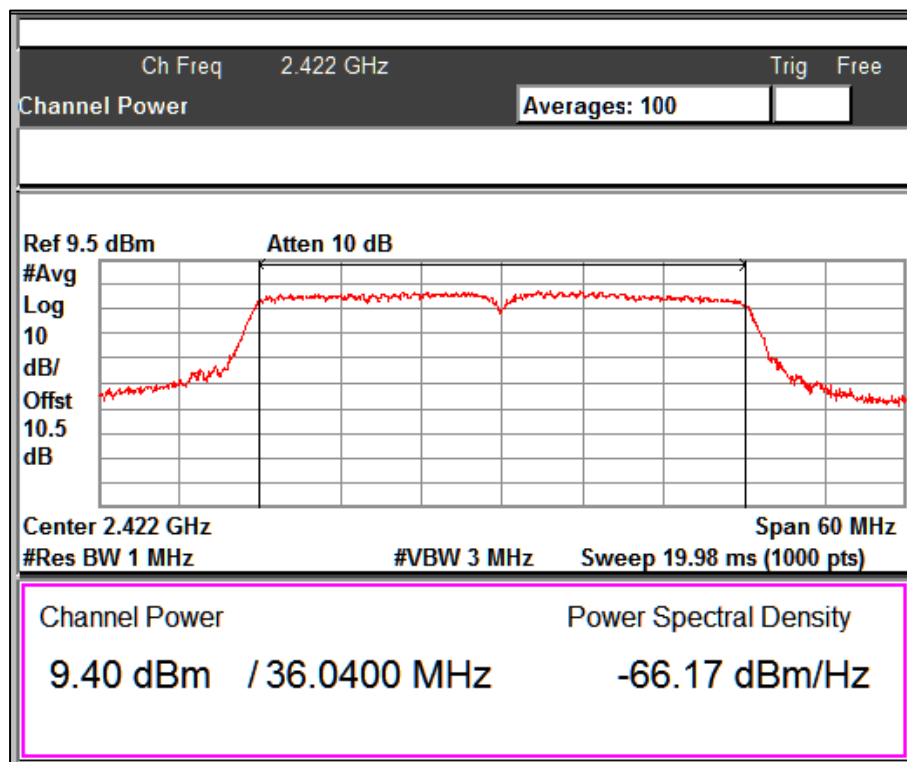
ULR-TC568821300000033F

Seite 29 von 199
Page 29 of 199



Data Rate: MCS0

Channel Frequency: 2452MHz



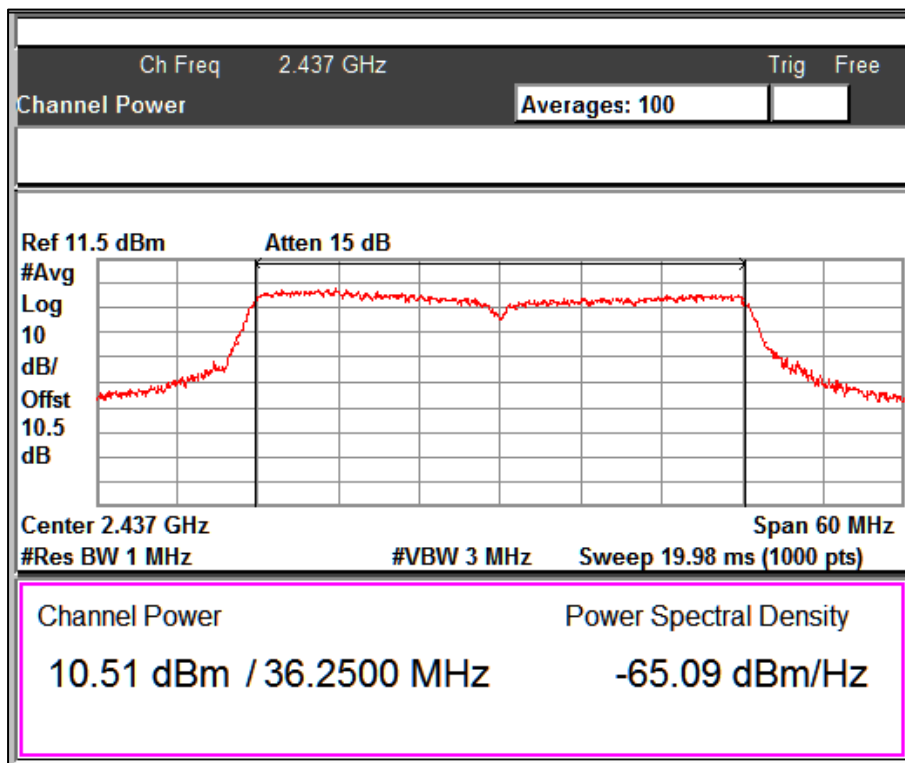
Data Rate: MCS7

Channel Frequency: 2422MHz

Prüfbericht - Nr.:
Test Report No.:

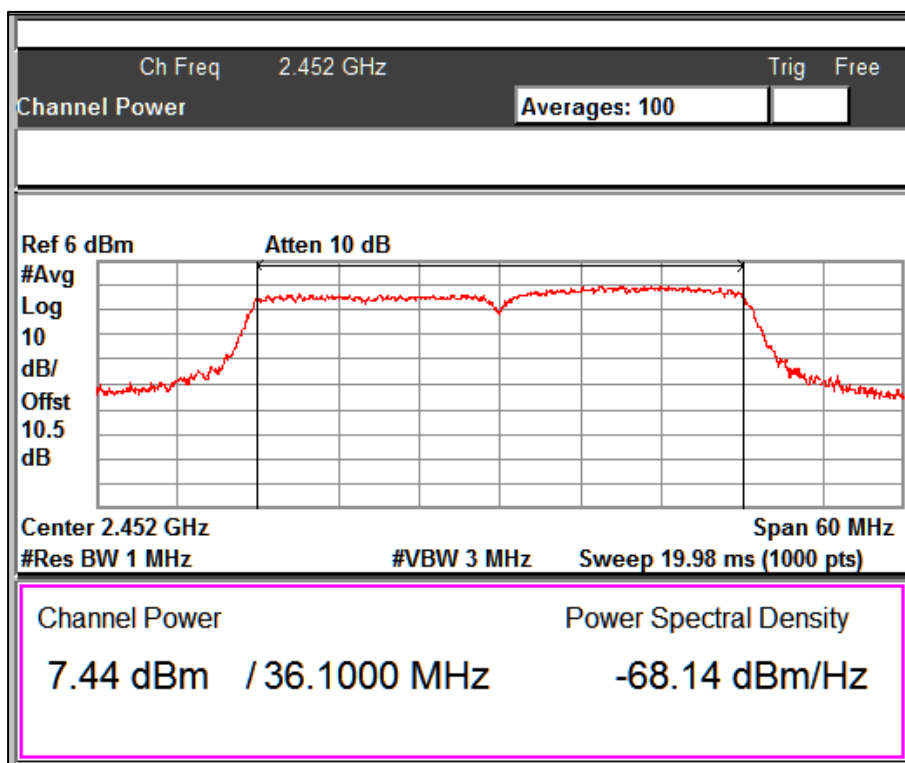
ULR-TC568821300000033F

Seite 30 von 199
Page 30 of 199



Data Rate: MCS7

Channel Frequency: 2437MHz



Data Rate: MCS7

Channel Frequency: 2452MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 31 von 199
Page 31 of 199

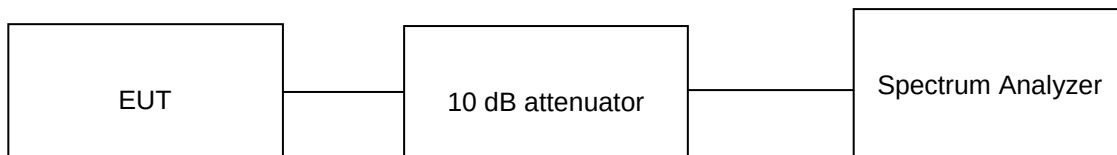
8.2 Maximum Power Spectral Density

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (e) / RSS 247 Issue 2, Section 5.2 (b)
Test Method	Subclause 11.10.3 of ANSI C63.10
Measurement Bandwidth	100 kHz
Detector	Average sample detector mode
Port of testing	Antenna port
Requirement	For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 25°C Voltage = 5.0V AC to DC Adaptor Relative humidity: 62 %

KDB Guidelines applied:

Measurements were made as per section 8.4 in KDB 558074 D01 15.247 Measurement Guidance v05r02.

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 32 von 199
Page 32 of 199

Test results:

Note:

1. All the losses are included during measurement and final values are mentioned in the test report.
2. Total Average PSD (dBm) = Measured Average PSD (dBm) + Attenuator factor (10dB) + Cable loss (0.5dB)
3. This product do not support additional beamforming gain / directional gain, it uses signal antenna and hence directional gain of the single antenna is 2.35 dBi

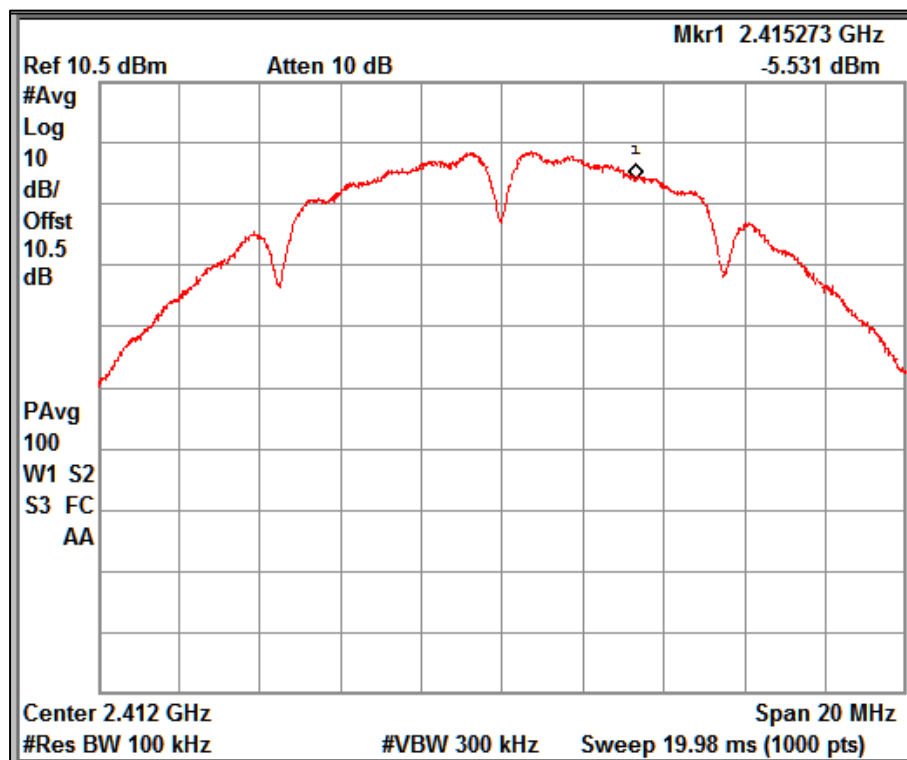
Modulation: 802.11b

Data rate (Mbps)	Channel Frequency (MHz)	Measured average PSD (dBm/100kHz)	Duty cycle %	Duty cycle correction factor (dB)	Maximum average PSD (dBm/100kHz)	PSD Limit (dBm/100kHz)
1	2412	-5.53	98.88	0.05	-5.48	8
	2437	3.20	98.88	0.05	3.25	8
	2462	1.83	98.88	0.05	1.88	8
11	2412	-1.23	98.88	0.05	-1.18	8
	2442	3.30	98.88	0.05	3.35	8
	2462	0.65	98.88	0.05	0.70	8

*Note: Duty Cycle Correction Factor Calculation

$10 \cdot \log(1/X)$ Where X is Duty Cycle is considered in below results

Duty cycle correction Factor is considered in Final Average PSD



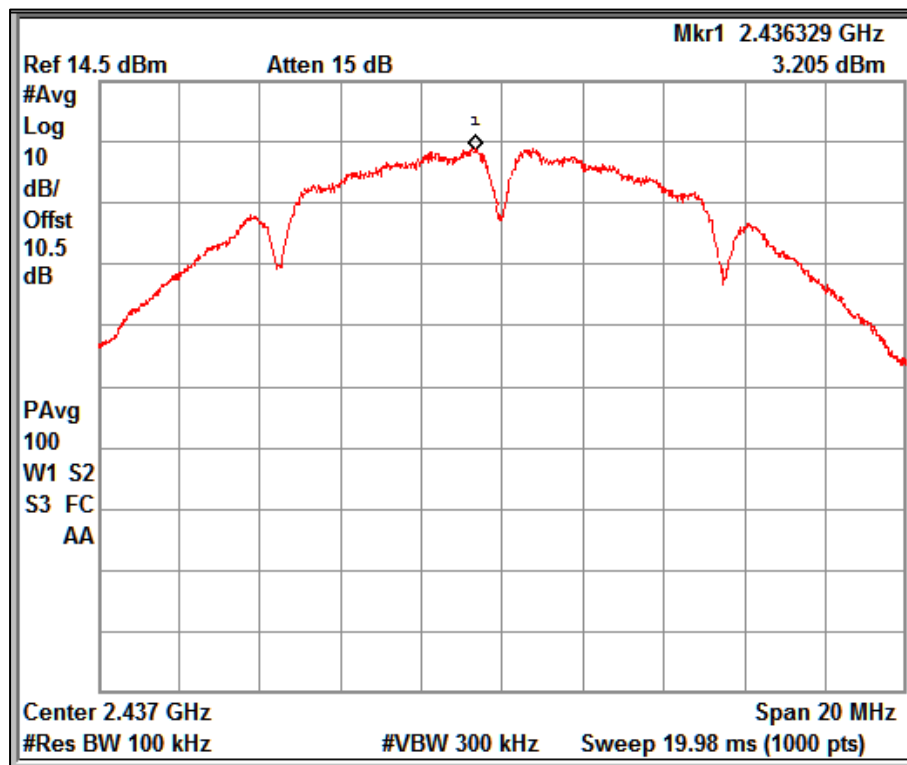
Data Rate: 1Mbps

Channel Frequency: 2412MHz

Prüfbericht - Nr.:
Test Report No.:

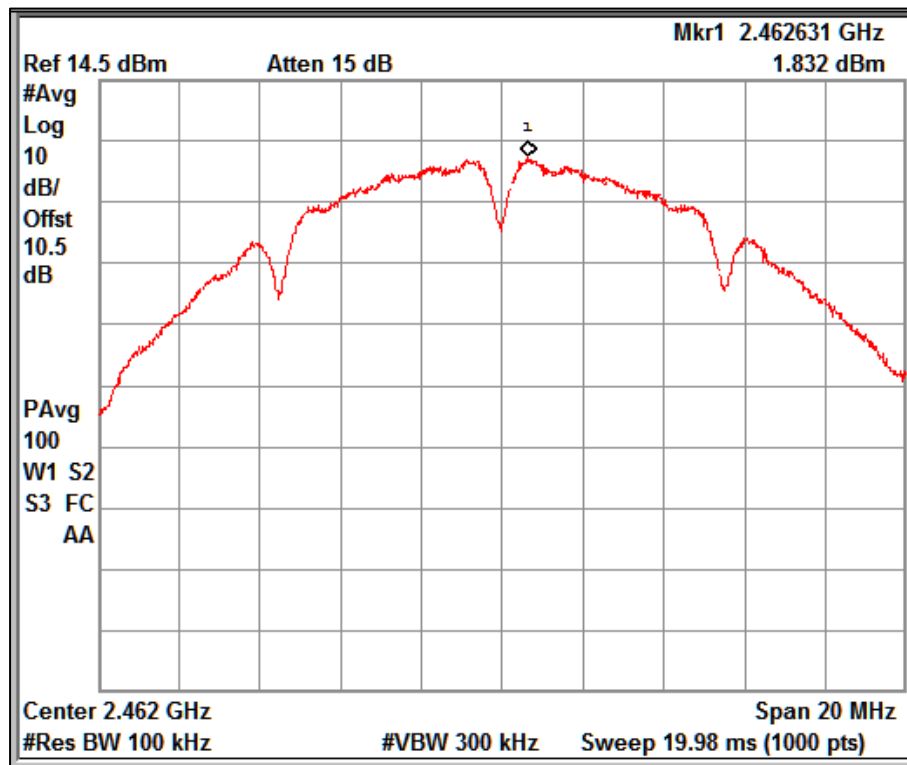
ULR-TC568821300000033F

Seite 33 von 199
Page 33 of 199



Data Rate: 1Mbps

Channel Frequency: 2437MHz



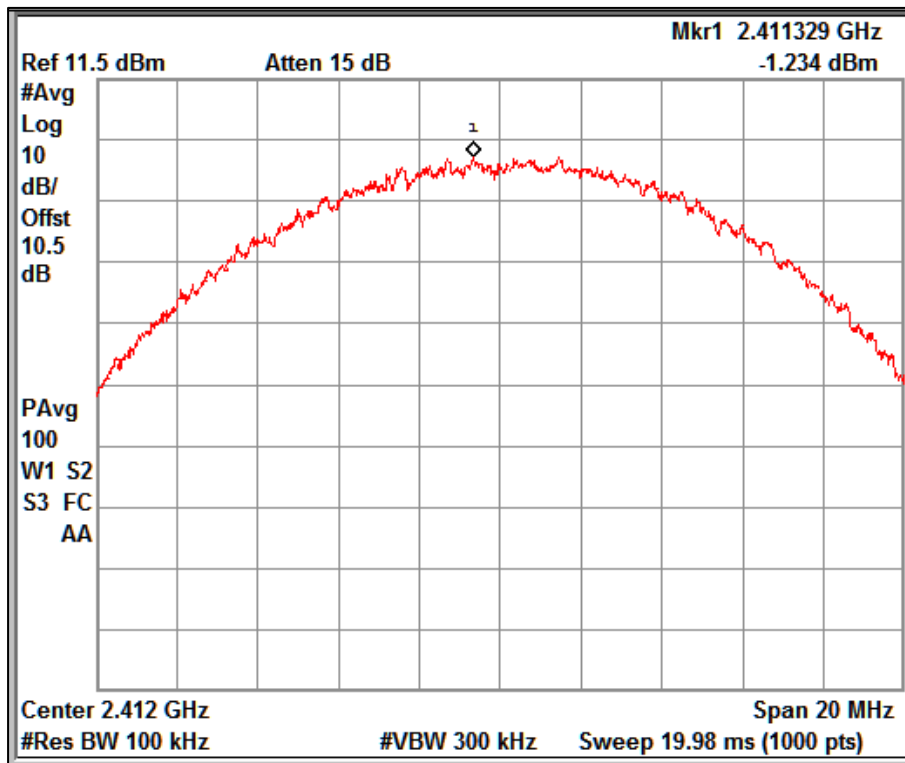
Data Rate: 1Mbps

Channel Frequency: 2462MHz

Prüfbericht - Nr.:
Test Report No.:

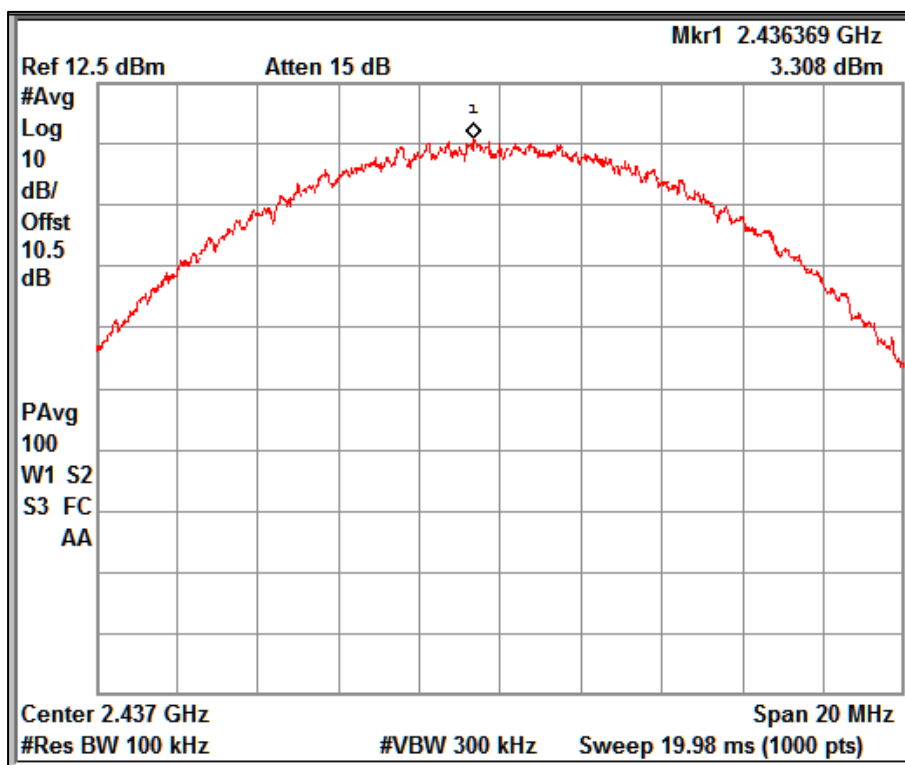
ULR-TC568821300000033F

Seite 34 von 199
Page 34 of 199



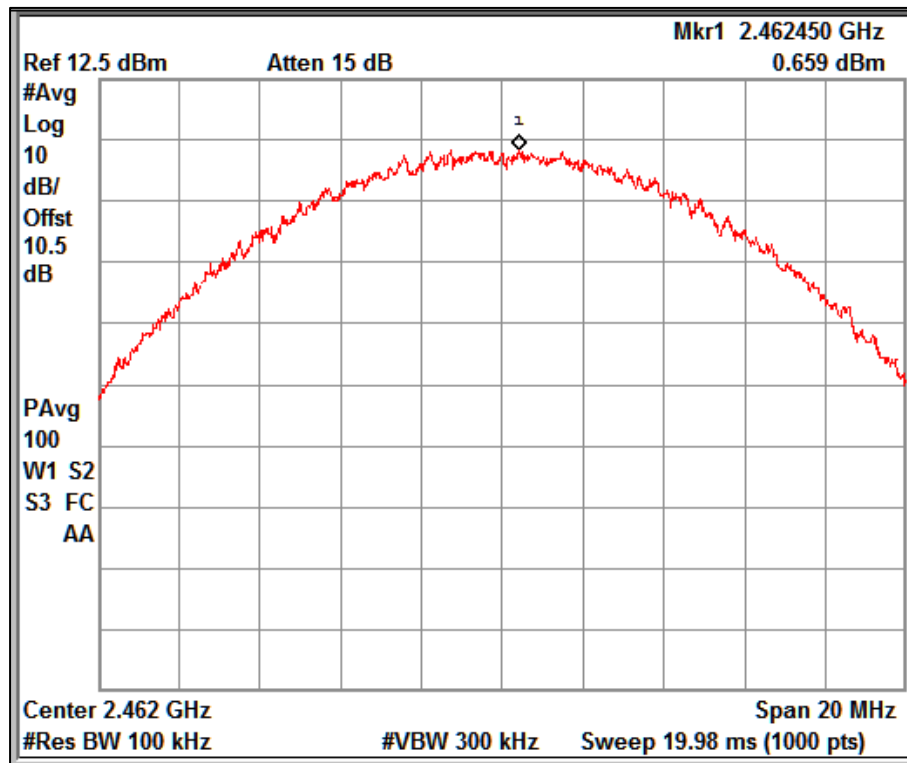
Data Rate: 11Mbps

Channel Frequency: 2412MHz



Data Rate: 11Mbps

Channel Frequency: 2437MHz



Data Rate: 11Mbps

Channel Frequency: 2462MHz

Modulation: 802.11g

Data rate (Mbps)	Channel Frequency (MHz)	Measured average PSD (dBm/100kHz)	Duty cycle %	Duty cycle correction factor (dB)	Maximum average PSD (dBm/100kHz)	PSD Limit (dBm/100kHz)
6	2412	-8.08	98.88	0.05	-8.03	8
	2437	-2.42	98.88	0.05	-2.37	8
	2462	-7.35	98.88	0.05	-7.30	8
54	2412	-8.77	98.88	0.05	-8.72	8
	2437	-3.80	98.88	0.05	-3.75	8
	2462	-8.98	98.88	0.05	-8.93	8

*Note: Duty Cycle Correction Factor Calculation

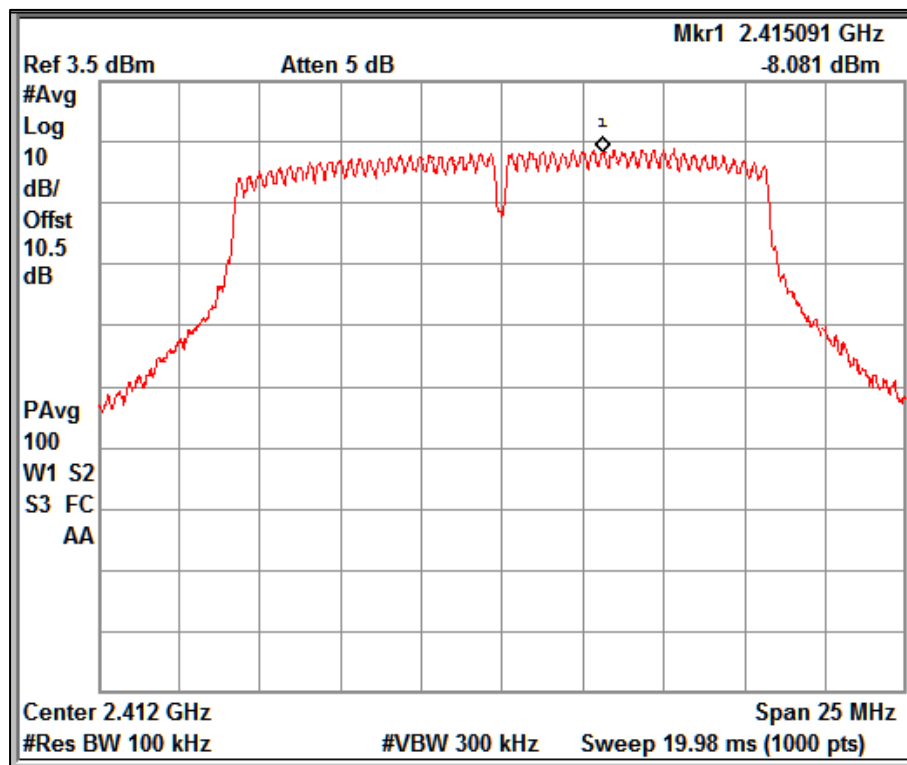
10*LOG (1/X) Where X is Duty Cycle is considered in below results

Duty cycle correction Factor is considered in Final Average PSD

Prüfbericht - Nr.:
Test Report No.:

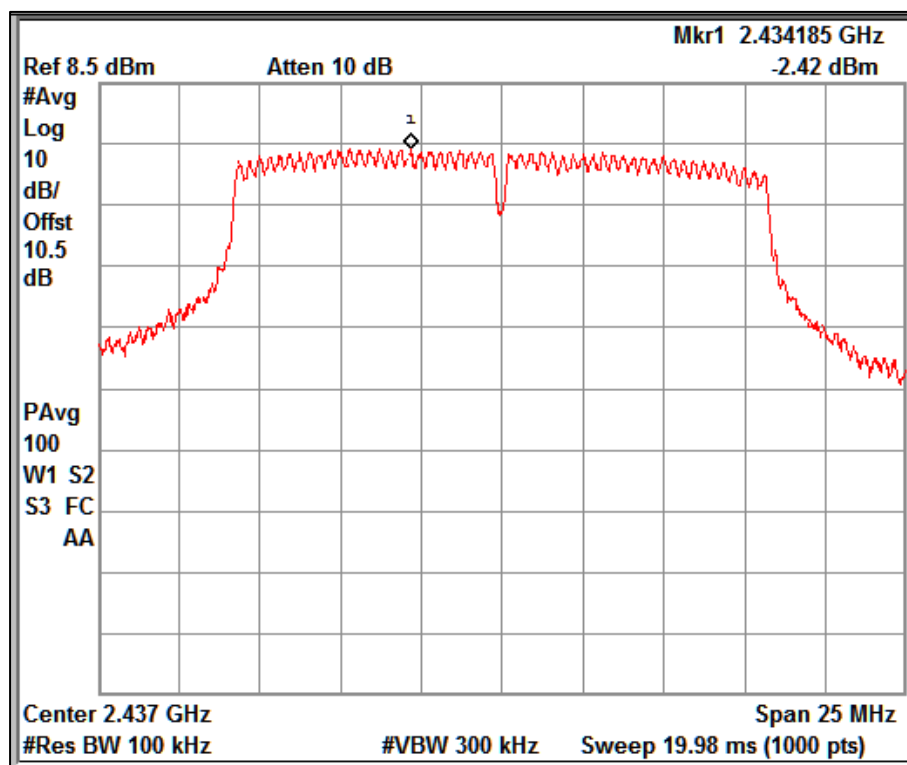
ULR-TC568821300000033F

Seite 36 von 199
Page 36 of 199



Data Rate: 6Mbps

Channel Frequency: 2412MHz



Data Rate: 6Mbps

Channel Frequency: 2437MHz

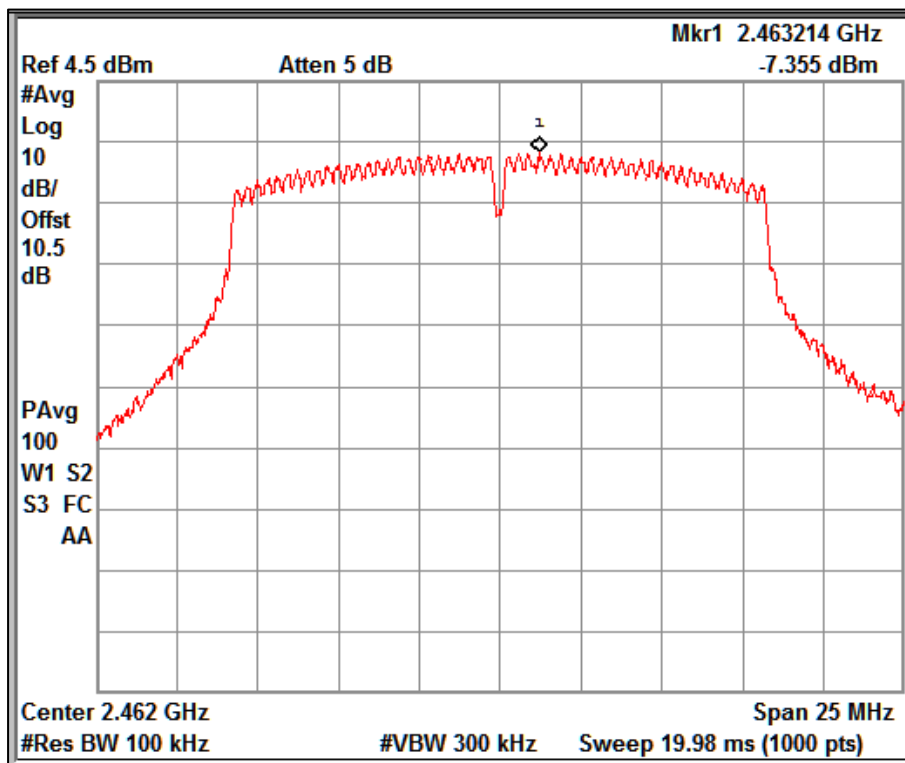
Prüfbericht - Nr.:

Test Report No.:

ULR-TC568821300000033F

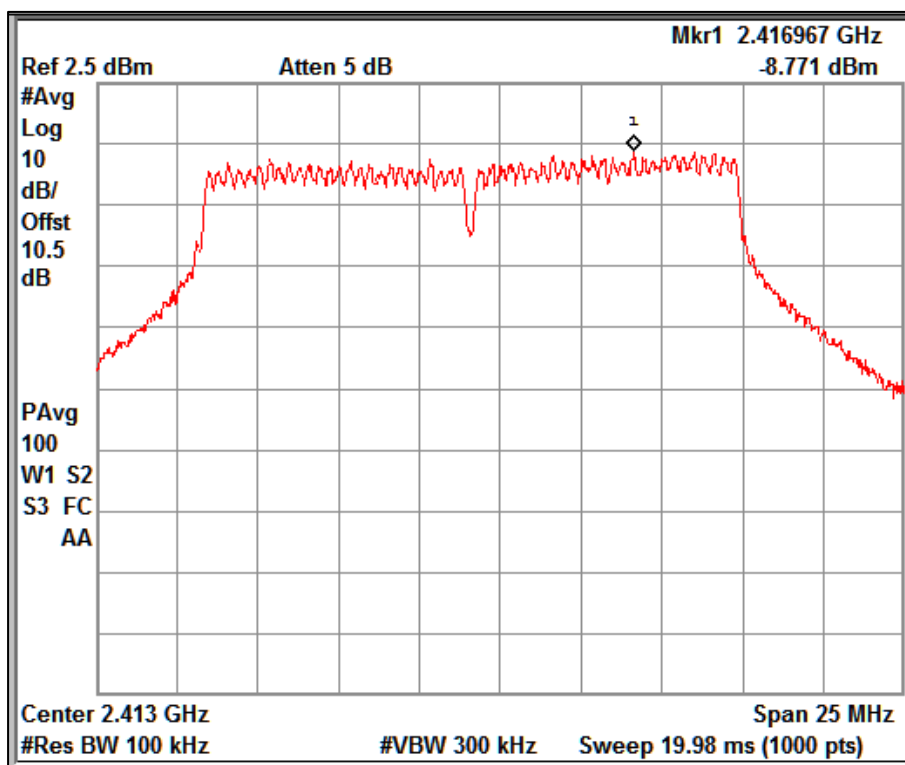
Seite 37 von 199

Page 37 of 199



Data Rate: 6Mbps

Channel Frequency: 2462MHz



Data Rate: 54Mbps

Channel Frequency: 2412MHz

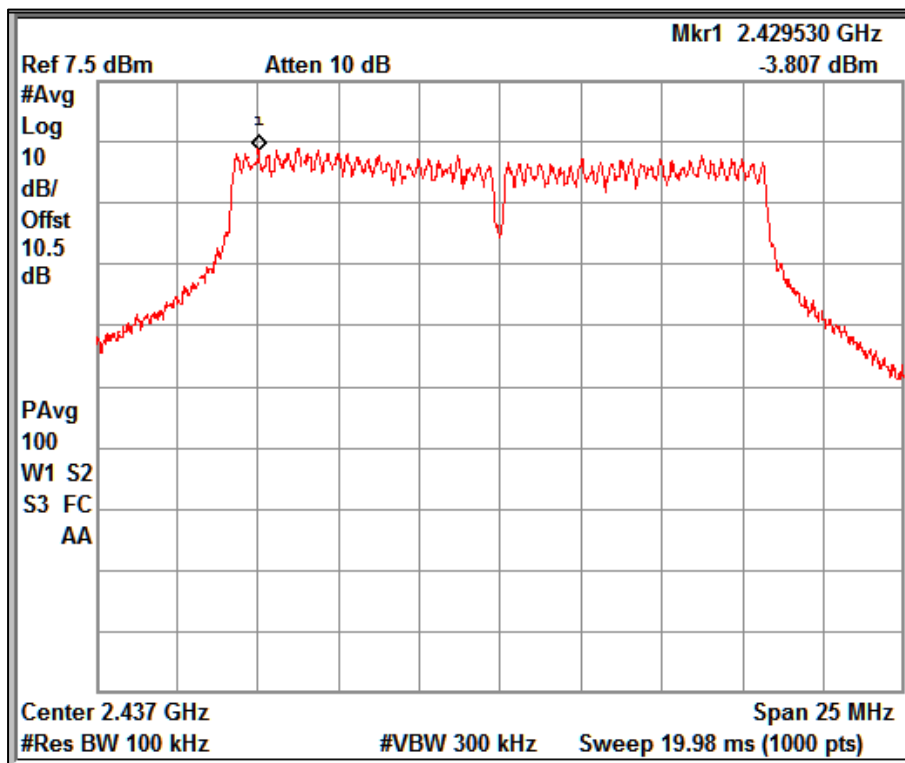
Prüfbericht - Nr.:

Test Report No.:

ULR-TC568821300000033F

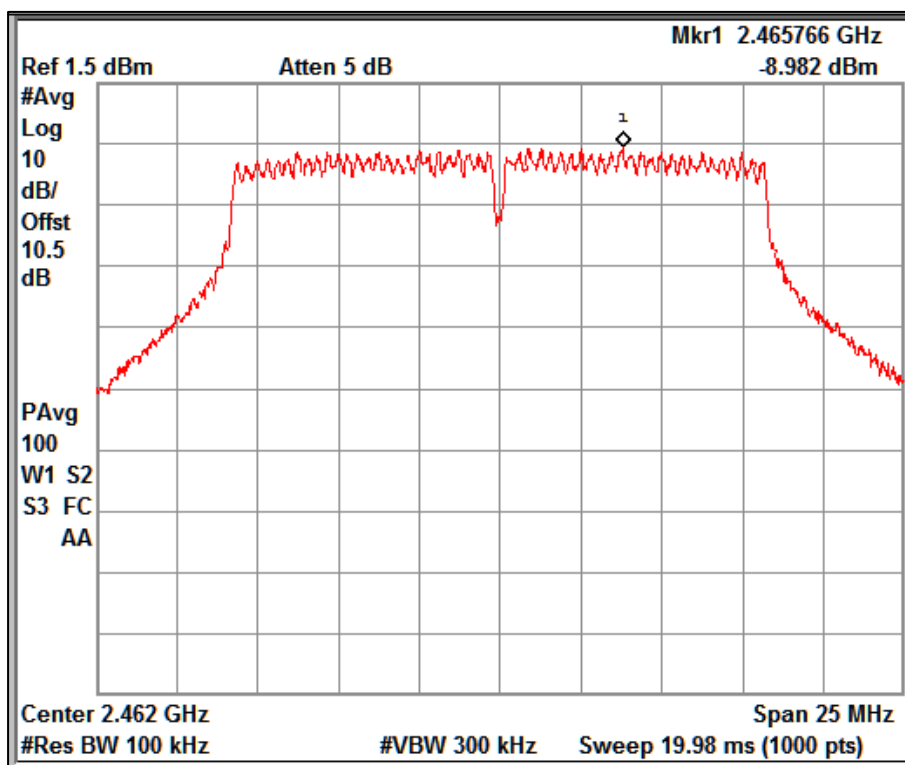
Seite 38 von 199

Page 38 of 199



Data Rate: 54Mbps

Channel Frequency: 2437MHz



Data Rate: 24Mbps

Channel Frequency: 2462MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 39 von 199
Page 39 of 199

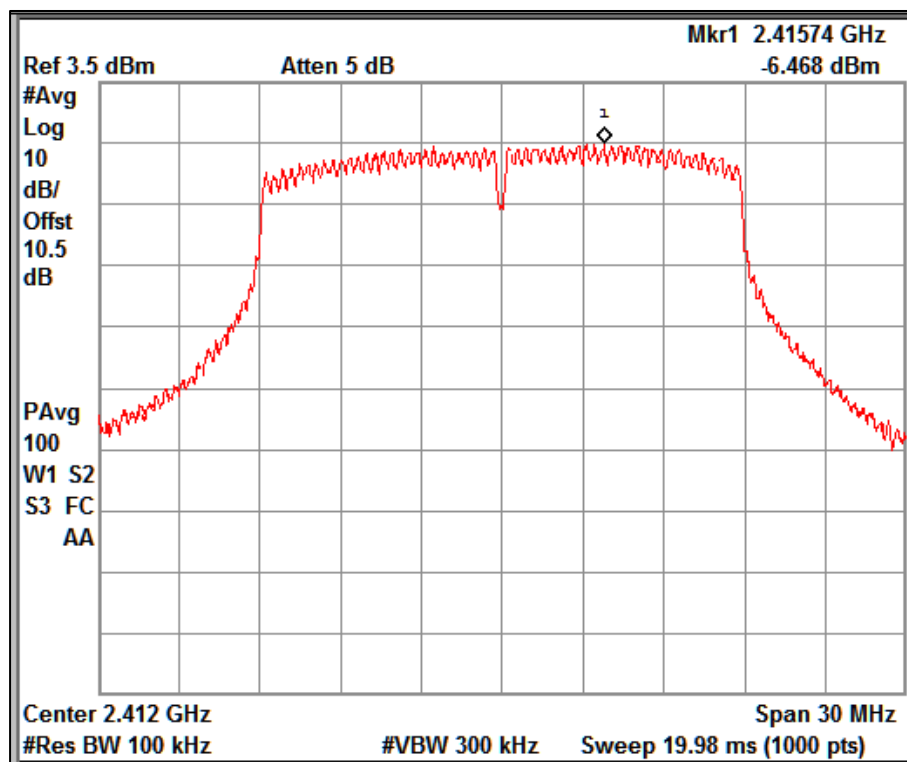
Modulation: 802.11n_20MHz

Data rate (Mbps)	Channel Frequency (MHz)	Measured average PSD (dBm/100kHz)	Duty cycle %	Duty cycle correction factor (dB)	Maximum average PSD (dBm/100kHz)	PSD Limit (dBm/100kHz)
MCS0	2412	-6.46	98.88	0.05	-6.41	8
	2437	-4.87	98.88	0.05	-4.82	8
	2462	-7.36	98.88	0.05	-7.31	8
MCS7	2412	-6.60	98.88	0.05	-6.55	8
	2437	-4.07	98.88	0.05	-4.02	8
	2462	-8.40	98.88	0.05	-8.35	8

*Note: Duty Cycle Correction Factor Calculation

$10 \cdot \log(1/X)$ Where X is Duty Cycle is considered in below results

Duty cycle correction Factor is considered in Final Average PSD



Data Rate: MCS0

Channel Frequency: 2412MHz

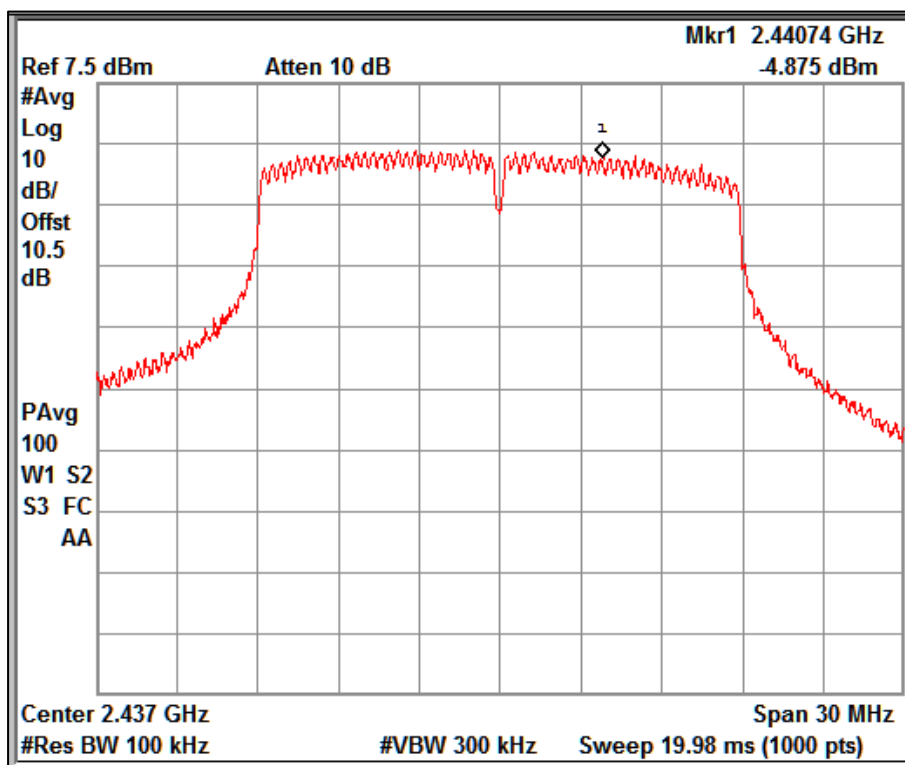
Prüfbericht - Nr.:

Test Report No.:

ULR-TC568821300000033F

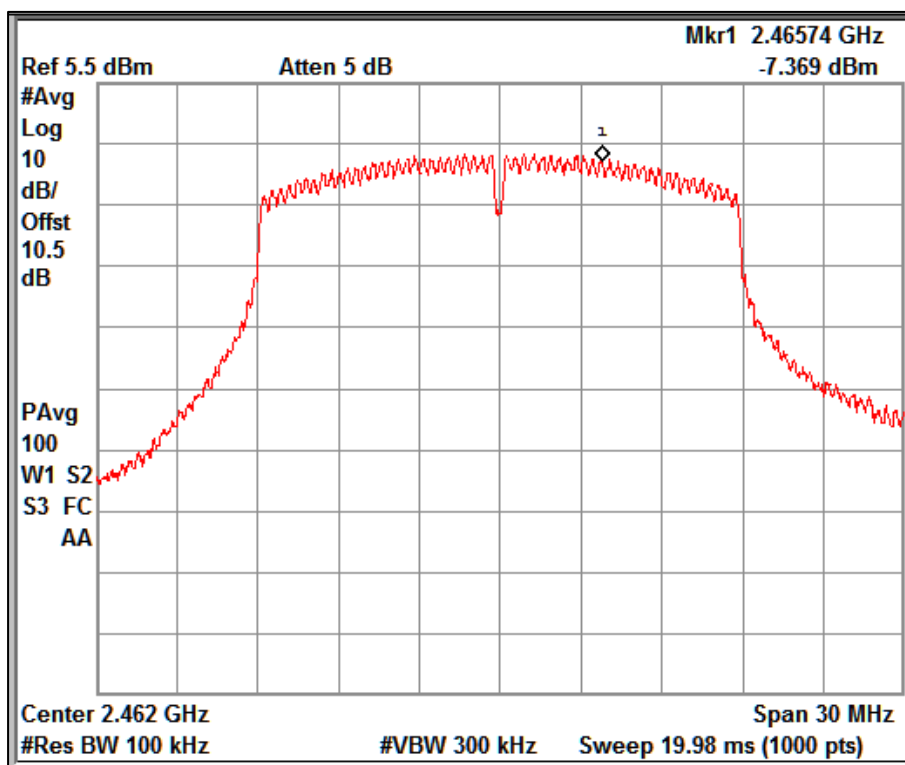
Seite 40 von 199

Page 40 of 199



Data Rate: MCS0

Channel Frequency: 2437MHz



Data Rate: MCS0

Channel Frequency: 2462MHz

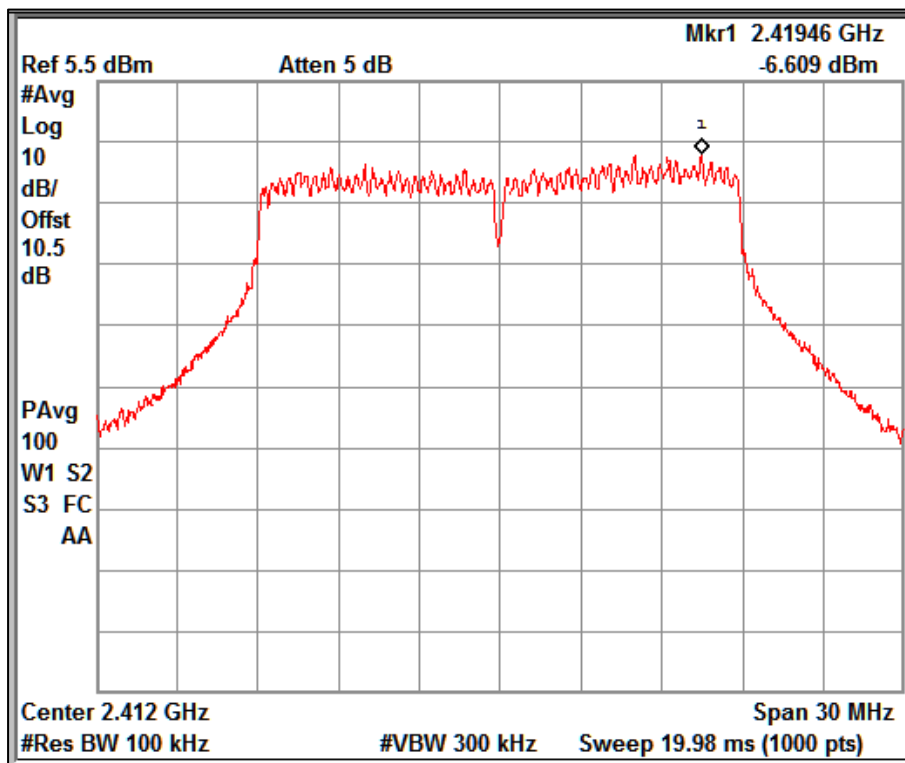
Prüfbericht - Nr.:

Test Report No.:

ULR-TC568821300000033F

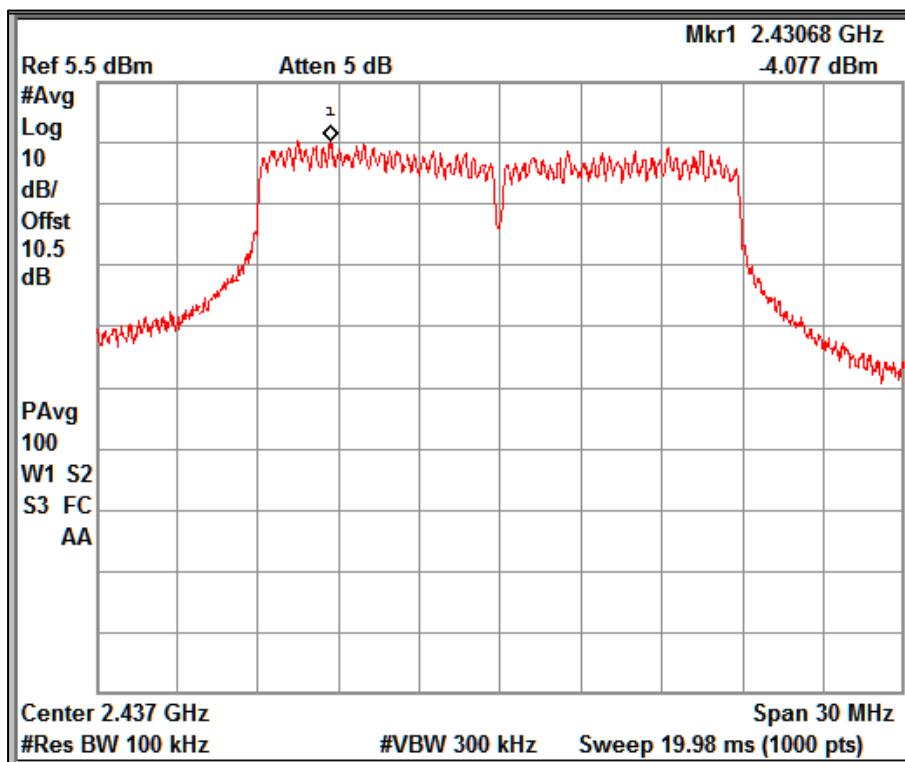
Seite 41 von 199

Page 41 of 199



Data Rate: MCS7

Channel Frequency: 2412MHz



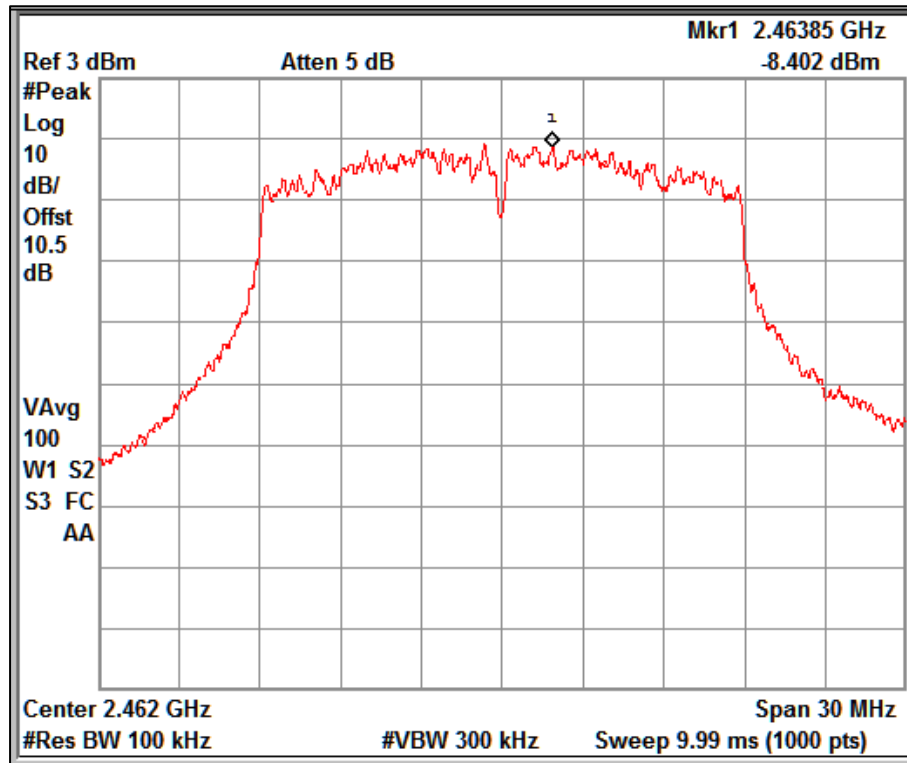
Data Rate: MCS7

Channel Frequency: 2437MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 42 von 199
Page 42 of 199



Data Rate: MCS7

Channel Frequency: 2462MHz

Modulation: 802.11n_40MHz

Data rate (Mbps)	Channel Frequency (MHz)	Measured average PSD (dBm/100kHz)	Duty cycle %	Duty cycle correction factor (dB)	Maximum average PSD (dBm/100kHz)	PSD Limit (dBm/100kHz)
MCS0	2422	-8.71	98.88	0.05	-8.66	8
	2437	-7.43	98.88	0.05	-7.38	8
	2452	-9.12	98.88	0.05	-9.07	8
MCS7	2422	-14.35	98.88	0.05	-14.30	8
	2437	-8.41	98.88	0.05	-8.36	8
	2452	-11.48	98.88	0.05	-11.43	8

*Note: Duty Cycle Correction Factor Calculation

10*LOG (1/X) Where X is Duty Cycle is considered in below results

Duty cycle correction Factor is considered in Final Average PSD

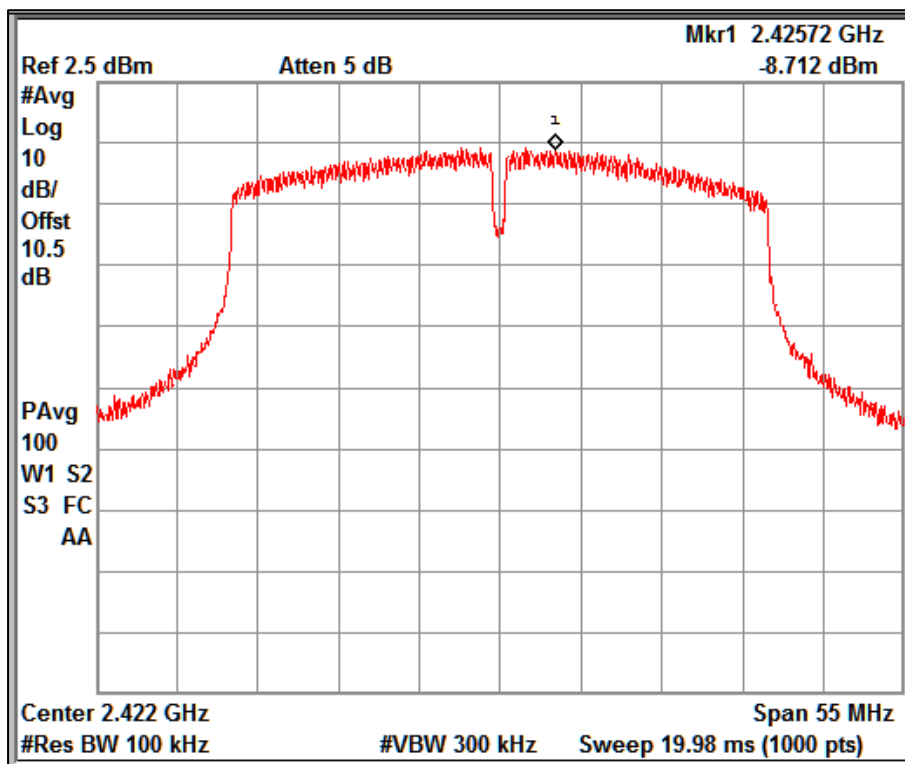
Prüfbericht - Nr.:

Test Report No.:

ULR-TC568821300000033F

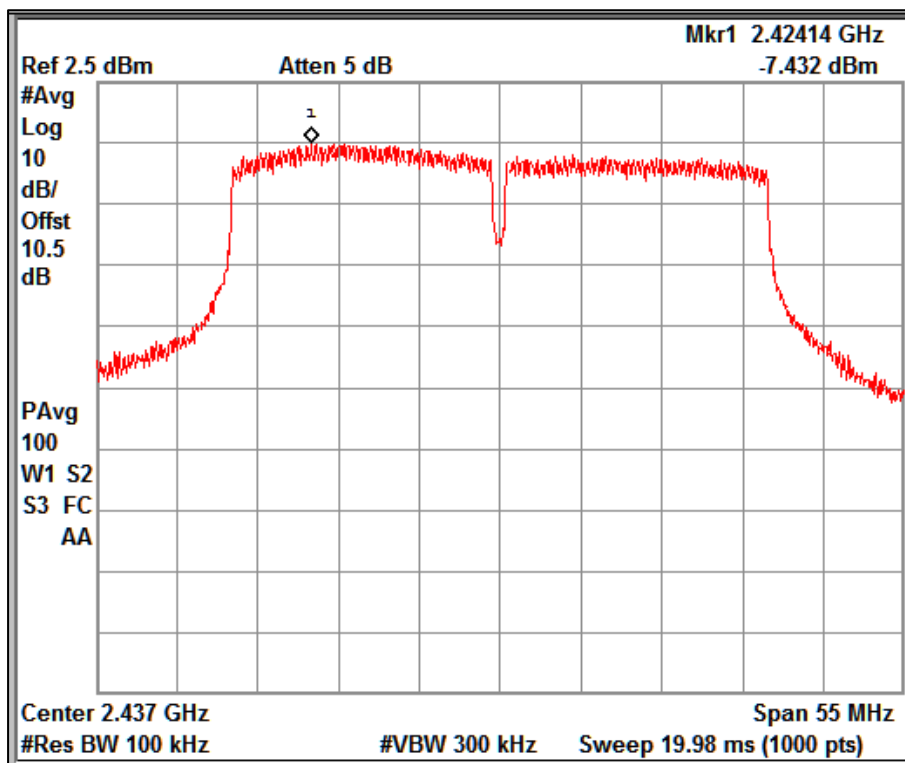
Seite 43 von 199

Page 43 of 199



Data Rate: MCS0

Channel Frequency: 2422MHz



Data Rate: MCS0

Channel Frequency: 2437MHz

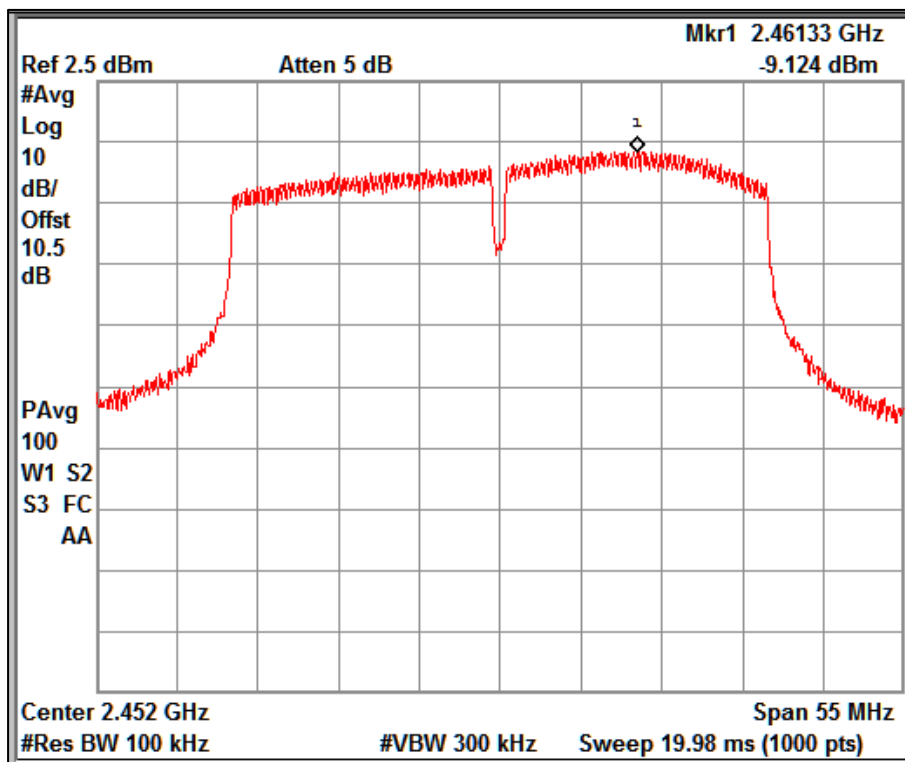
Prüfbericht - Nr.:

Test Report No.:

ULR-TC568821300000033F

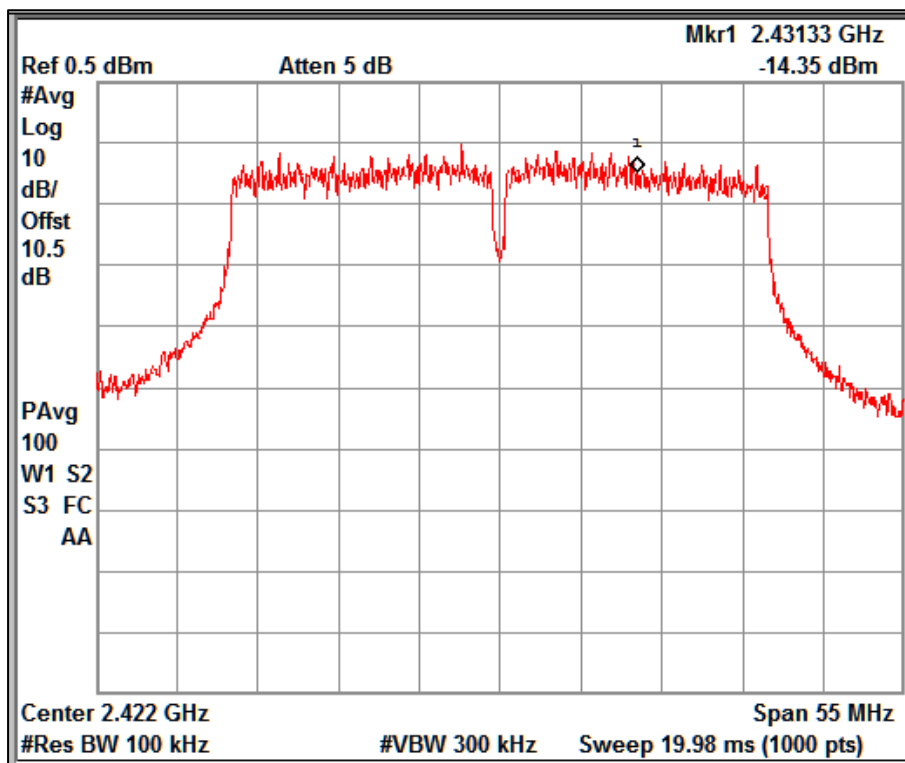
Seite 44 von 199

Page 44 of 199



Data Rate: MCS0

Channel Frequency: 2452MHz



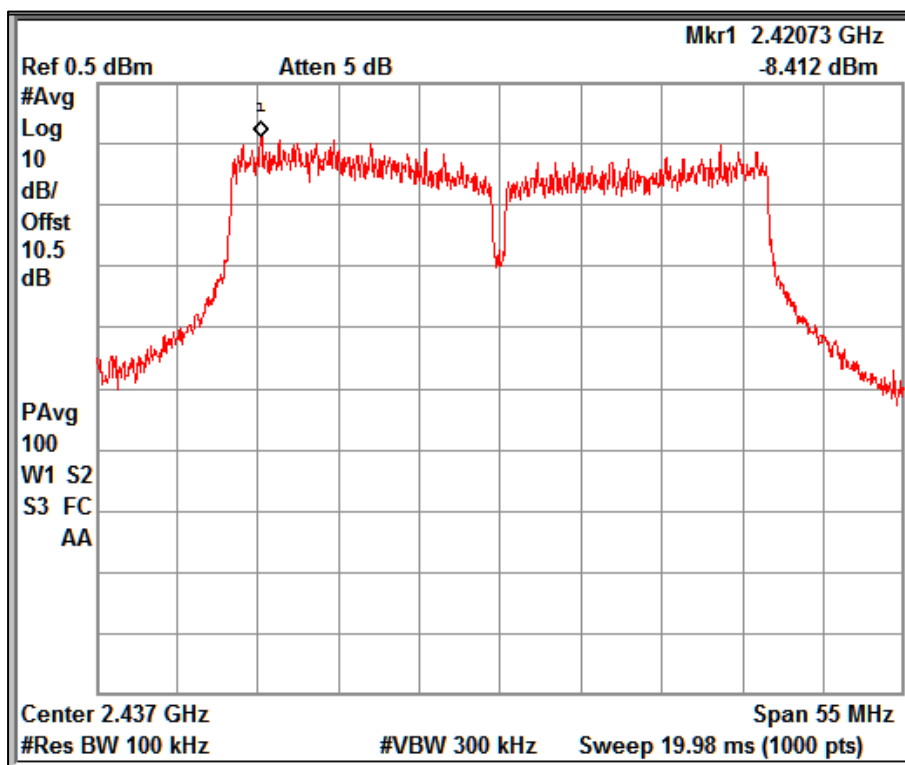
Data Rate: MCS7

Channel Frequency: 2422MHz

Prüfbericht - Nr.:
Test Report No.:

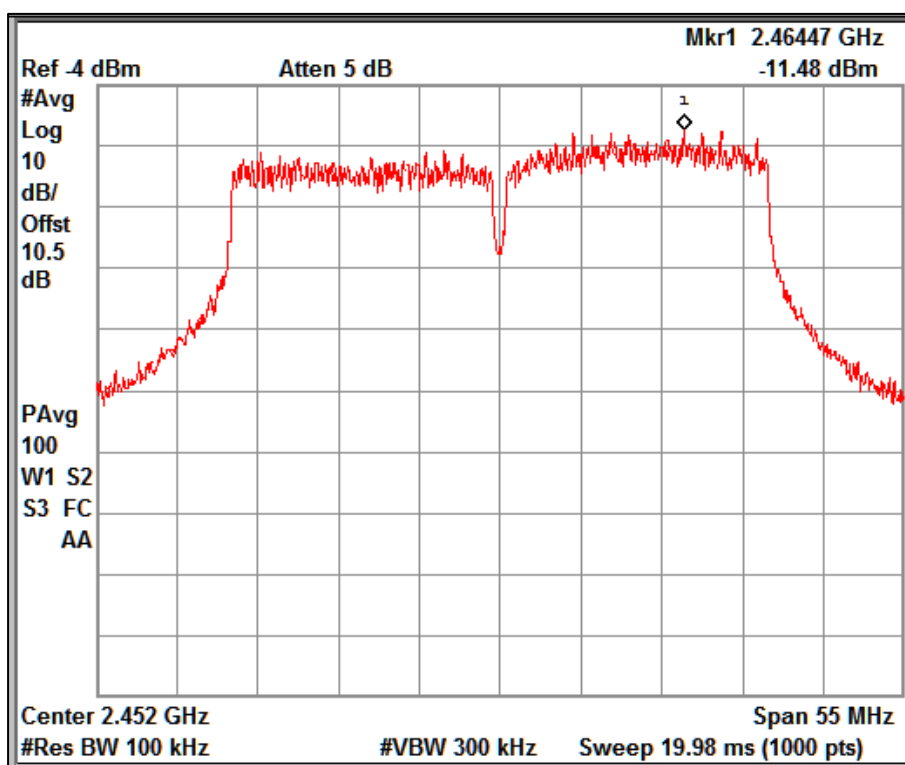
ULR-TC568821300000033F

Seite 45 von 199
Page 45 of 199



Data Rate: MCS7

Channel Frequency: 2437MHz



Data Rate: MCS7

Channel Frequency: 2452MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 46 von 199
Page 46 of 199

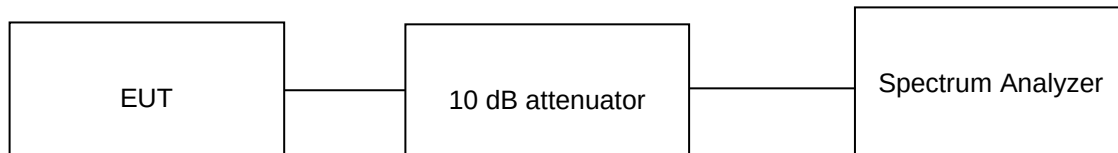
8.3 DTS Bandwidth & 99% Bandwidth

Result

Pass

Test Specification	FCC part 15 Subpart C 15.247 (a) (2) / RSS 247 Issue 2, Section 5.2 (a)
Test Method	Subclause 11.8.1 of ANSI C63.10
Measurement Bandwidth	100 kHz for x dB bandwidth 1 to 5% of OCB for 99% bandwidth
Detector	Peak
Port of testing	Antenna port
Requirement	The minimum 6 dB bandwidth shall be at least 500 kHz

Test Method:



Test Condition

Normal Test Condition:

Temperature (Norm) = + 25 °C Voltage 5.0V AC to DC Adaptor Relative humidity: 62 %

KDB Guidelines applied:

Measurements were made as per section 8.2 in KDB 558074 D01 15.247 Measurement Guidance v05r02.

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 47 von 199
Page 47 of 199

Test results:

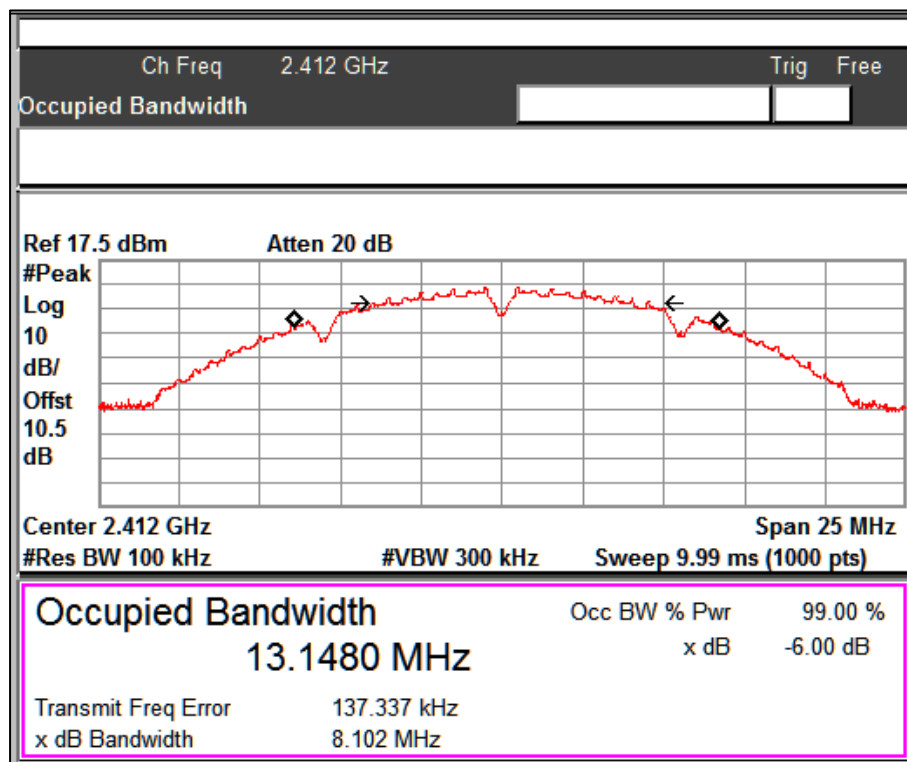
Note:

1. All the losses are included during measurement and final values are mentioned in the test report.
2. For 6 dB Bandwidth Measurements were made as per section 8.2 in KDB 558074 D01 15.247 Measurement Guidance v05r02.
3. For OCW 99 % Bandwidth measurements were made as per section 6.9.3 ANSI C63.10-2013 & 6.7 RSS GEN issue 5

Modulation: 802.11b

Data rate (Mbps)	Channel Frequency (MHz)	6 dB Bandwidth (MHz)	99% OBW (MHz)	Minimum Limit (MHz)
1	2412	8.10	13.18	0.5
	2437	7.56	13.56	0.5
	2462	8.05	12.76	0.5
11	2412	8.33	12.99	0.5
	2442	7.49	13.25	0.5
	2462	7.12	12.49	0.5

Graphs for 6 dB bandwidth measurement



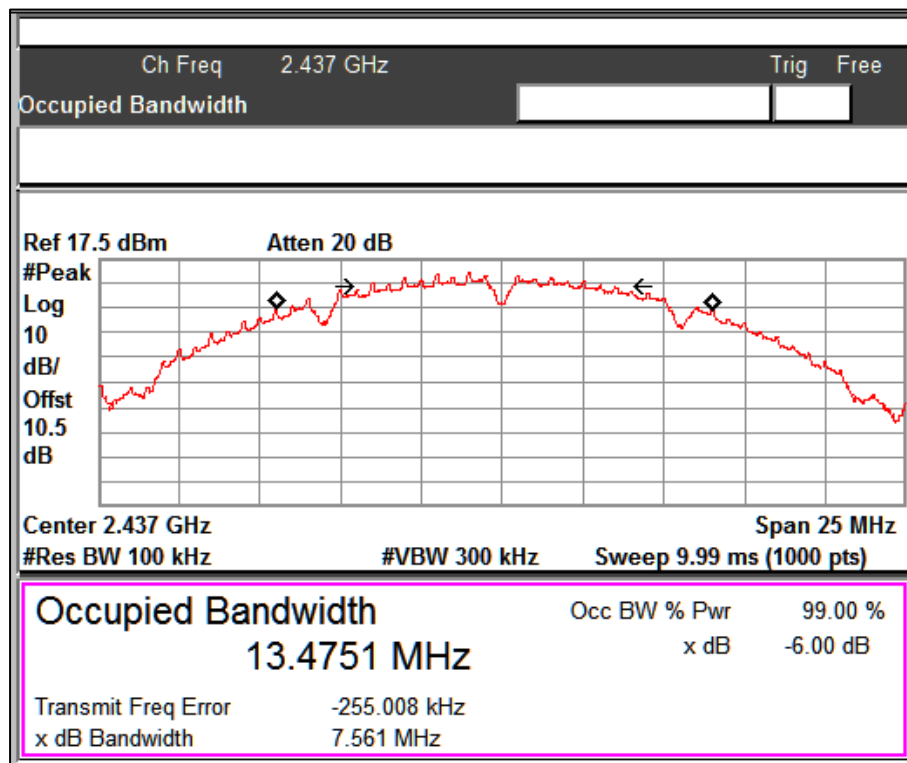
Data Rate: 1Mbps

Channel Frequency: 2412MHz

Prüfbericht - Nr.:
Test Report No.:

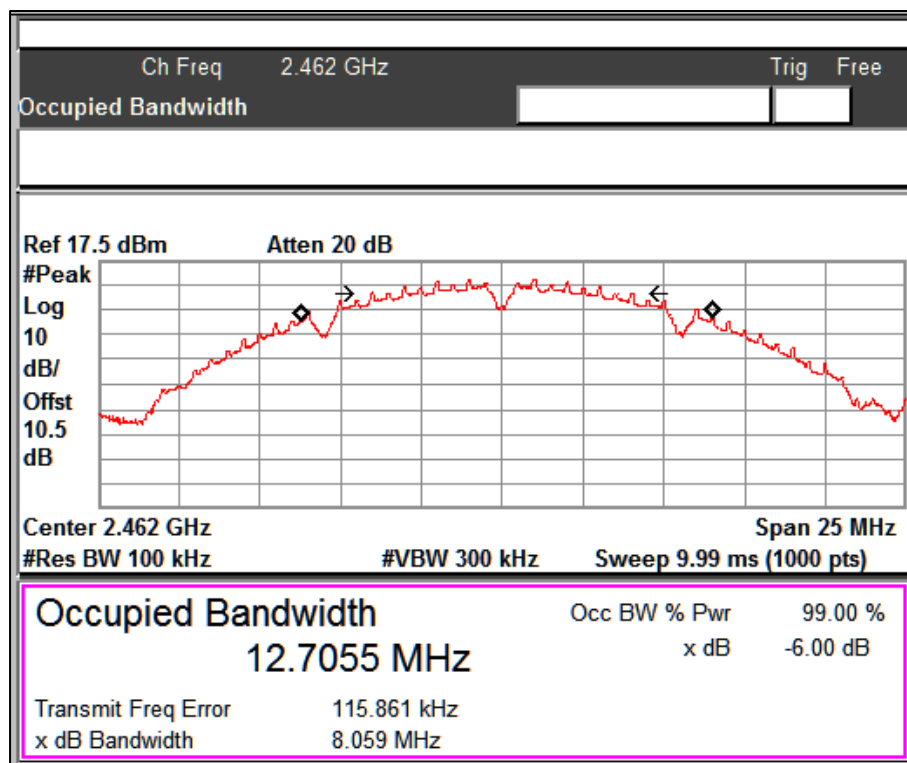
ULR-TC568821300000033F

Seite 48 von 199
Page 48 of 199



Data Rate: 1Mbps

Channel Frequency: 2437MHz



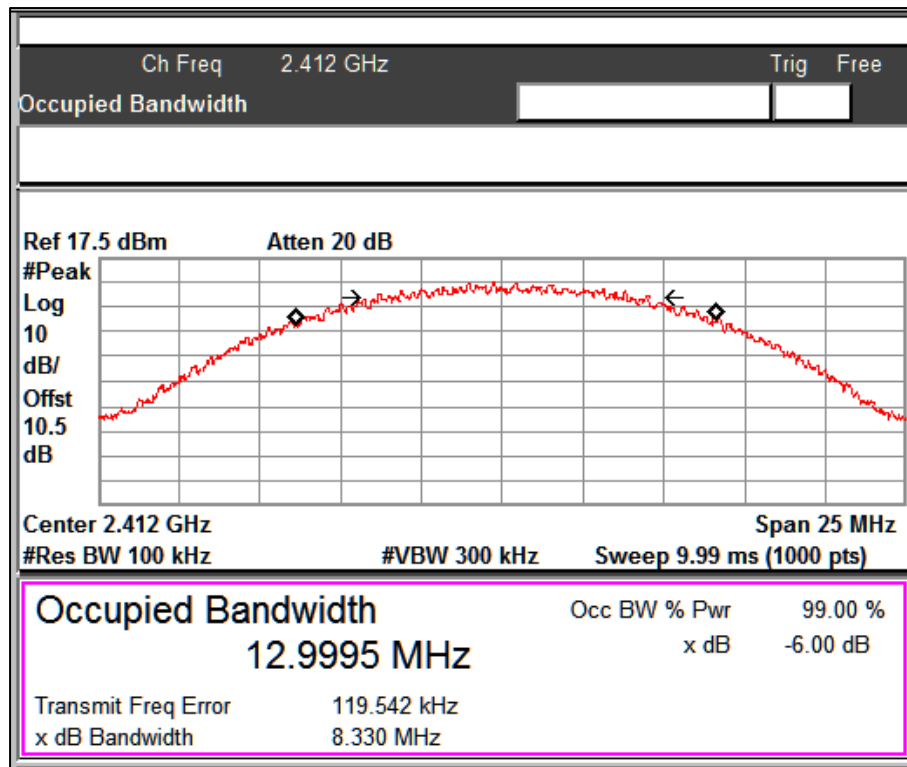
Data Rate: 1Mbps

Channel Frequency: 2462MHz

Prüfbericht - Nr.:
Test Report No.:

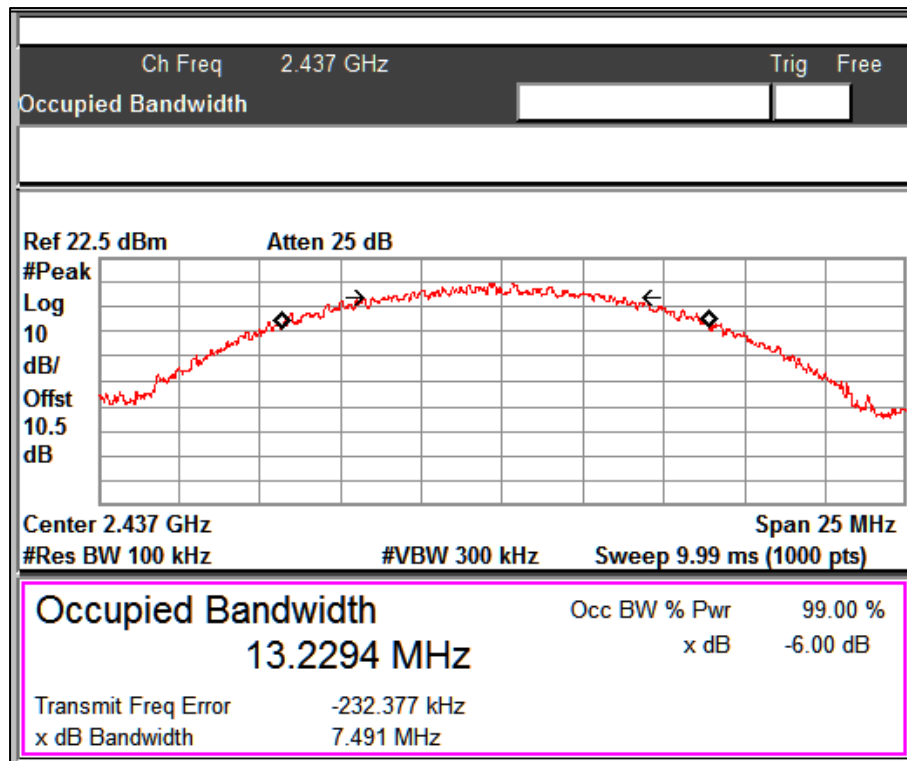
ULR-TC568821300000033F

Seite 49 von 199
Page 49 of 199



Data Rate: 11Mbps

Channel Frequency: 2412MHz



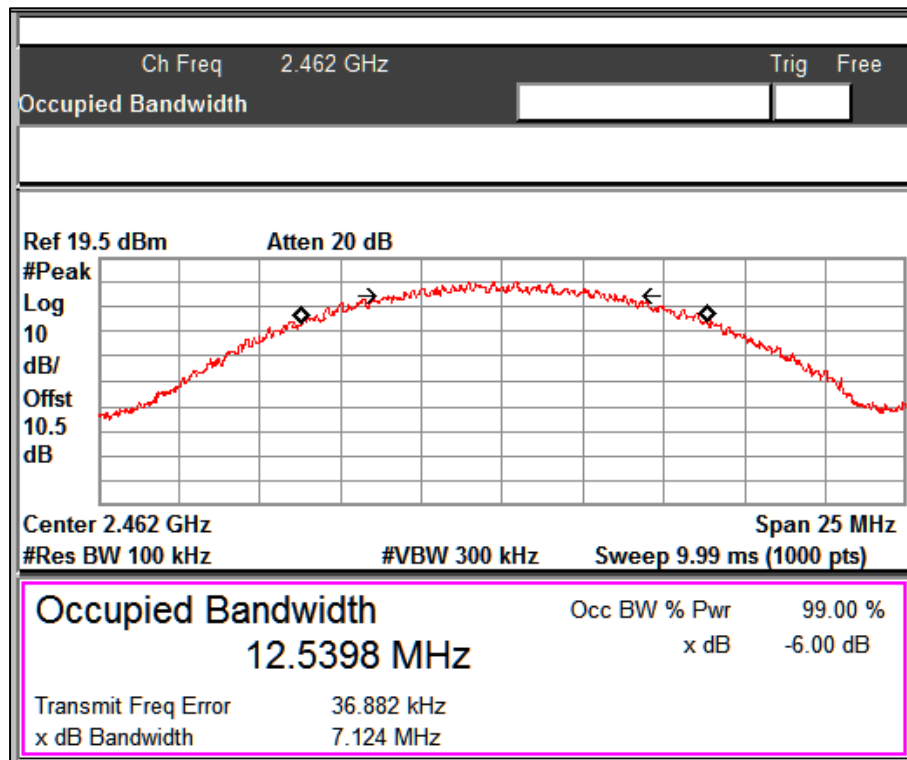
Data Rate: 11Mbps

Channel Frequency: 2437MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

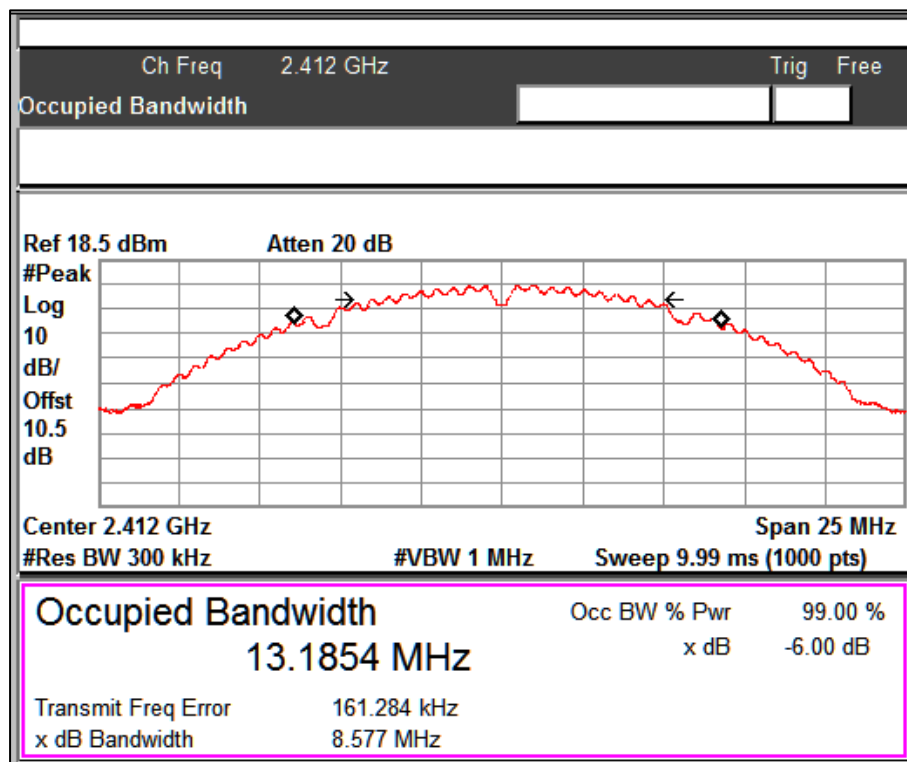
Seite 50 von 199
Page 50 of 199



Data Rate: 11Mbps

Channel Frequency: 2462MHz

Graphs for OCW 99 % bandwidth measurement



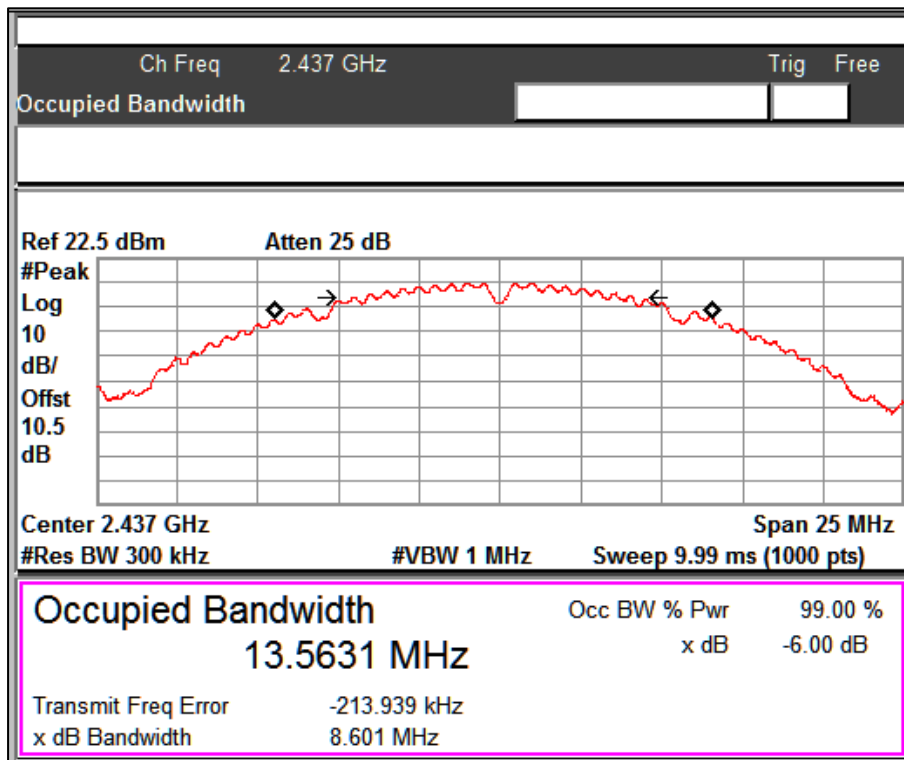
Data Rate: 1Mbps

Channel Frequency: 2412MHz

Prüfbericht - Nr.:
Test Report No.:

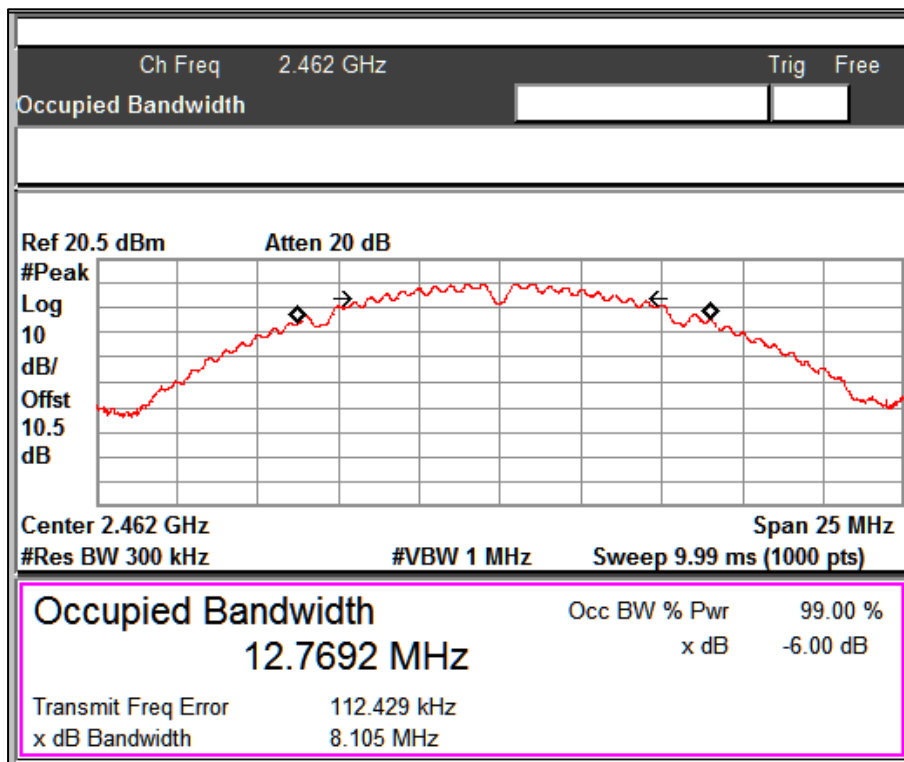
ULR-TC568821300000033F

Seite 51 von 199
Page 51 of 199



Data Rate: 1Mbps

Channel Frequency: 2437MHz



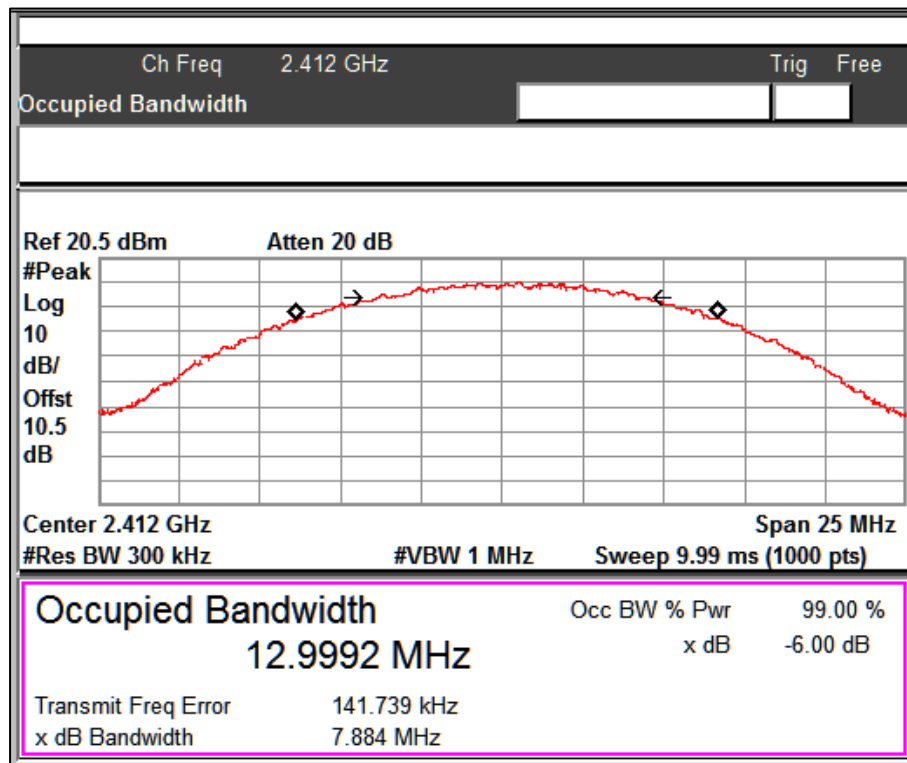
Data Rate: 1Mbps

Channel Frequency: 2462MHz

Prüfbericht - Nr.:
Test Report No.:

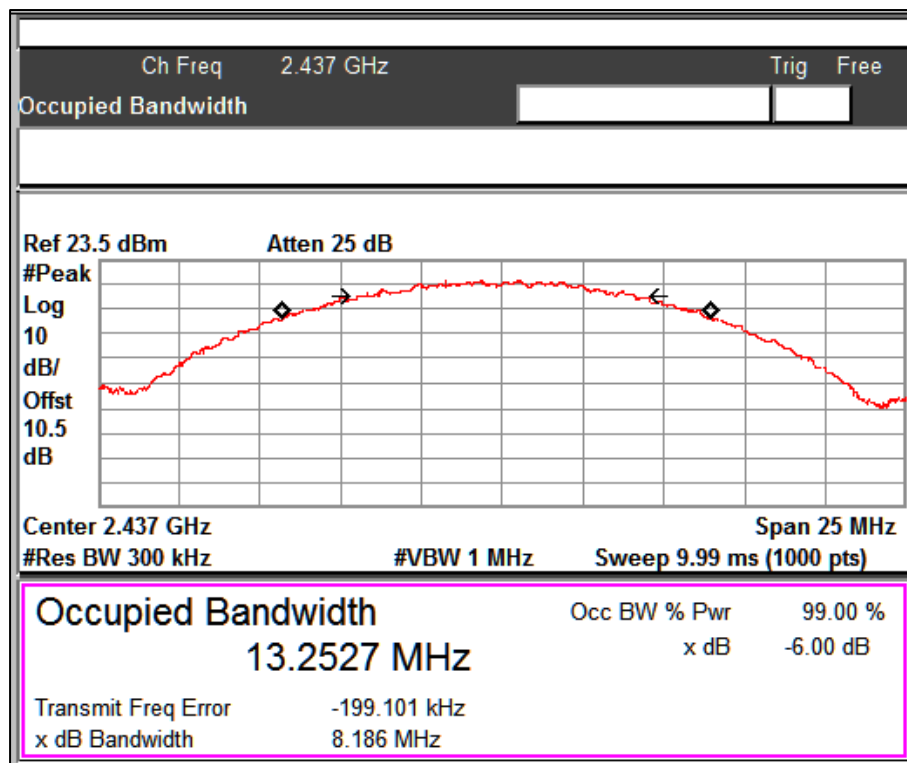
ULR-TC568821300000033F

Seite 52 von 199
Page 52 of 199



Data Rate: 11Mbps

Channel Frequency: 2412MHz



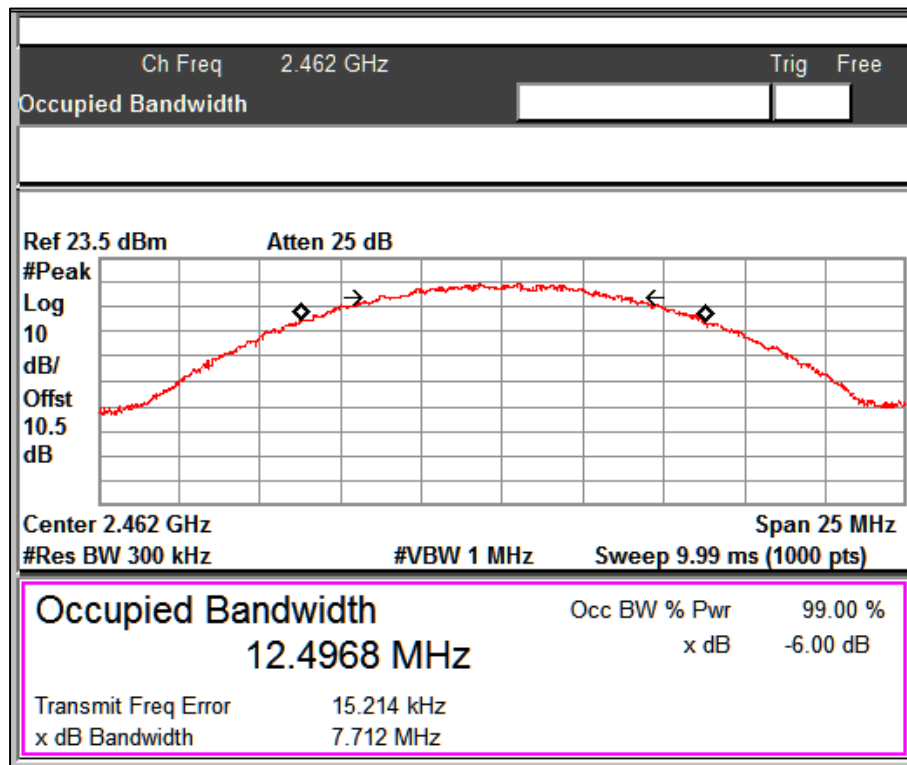
Data Rate: 11Mbps

Channel Frequency: 2437MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 53 von 199
Page 53 of 199



Data Rate: 11Mbps

Channel Frequency: 2462MHz

Modulation: 802.11g

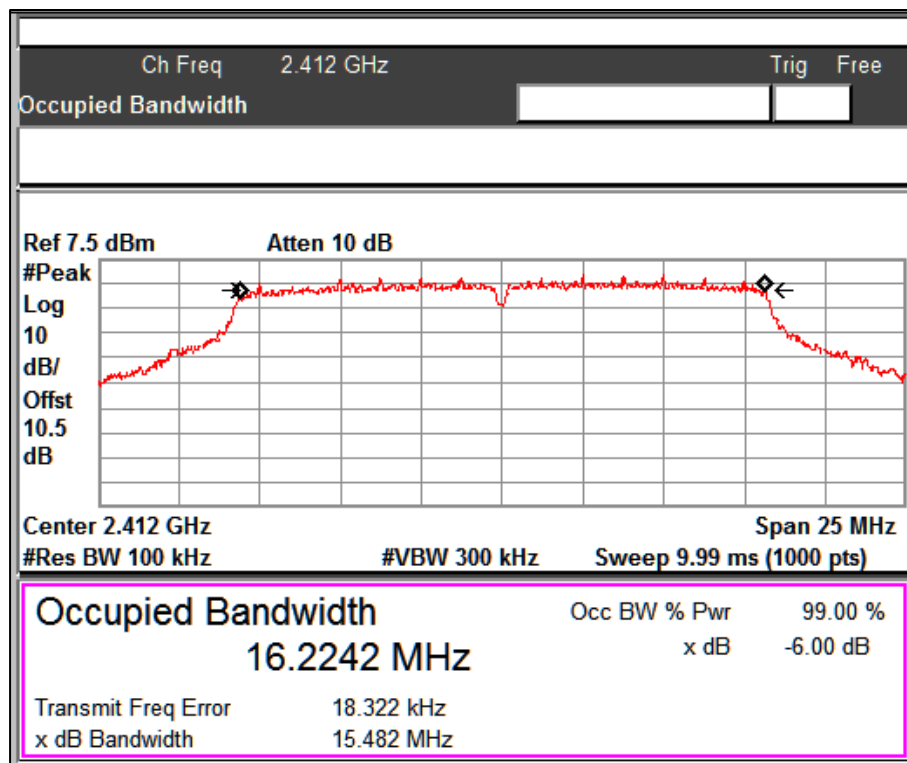
Data rate (Mbps)	Channel Frequency (MHz)	6 dB Bandwidth (MHz)	99% OBW (MHz)	Minimum Limit (MHz)
6	2412	15.48	16.32	0.5
	2437	15.42	16.40	0.5
	2462	14.02	16.16	0.5
54	2412	16.43	16.79	0.5
	2437	16.47	16.96	0.5
	2462	16.42	16.62	0.5

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

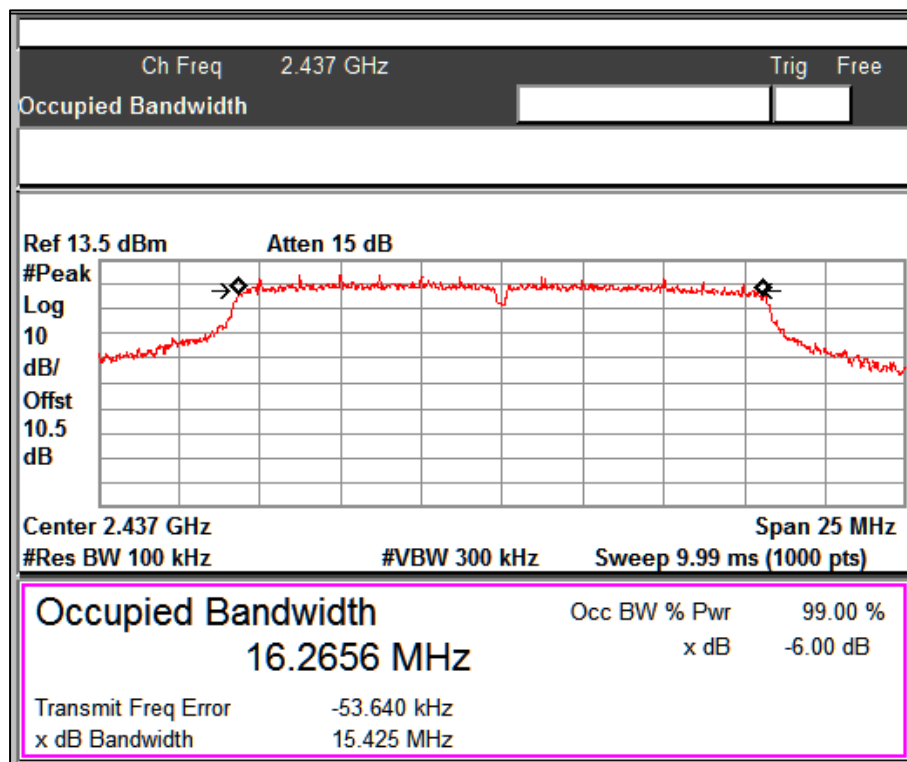
Seite 54 von 199
Page 54 of 199

Graphs for 6 dB bandwidth measurement



Data Rate: 6Mbps

Channel Frequency: 2412MHz



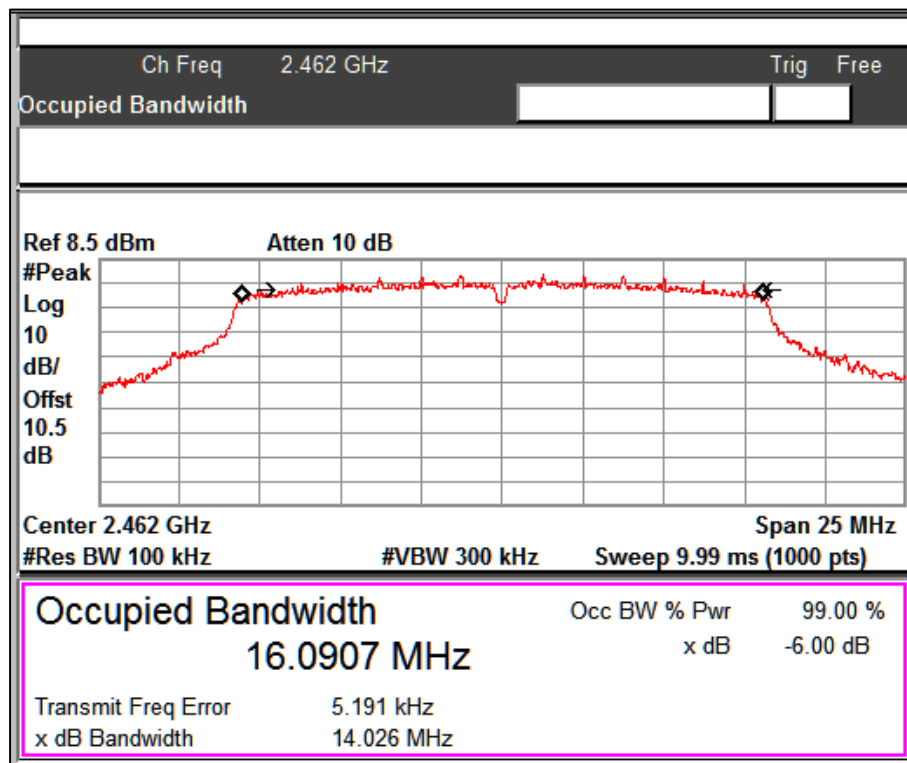
Data Rate: 6Mbps

Channel Frequency: 2437MHz

Prüfbericht - Nr.:
Test Report No.:

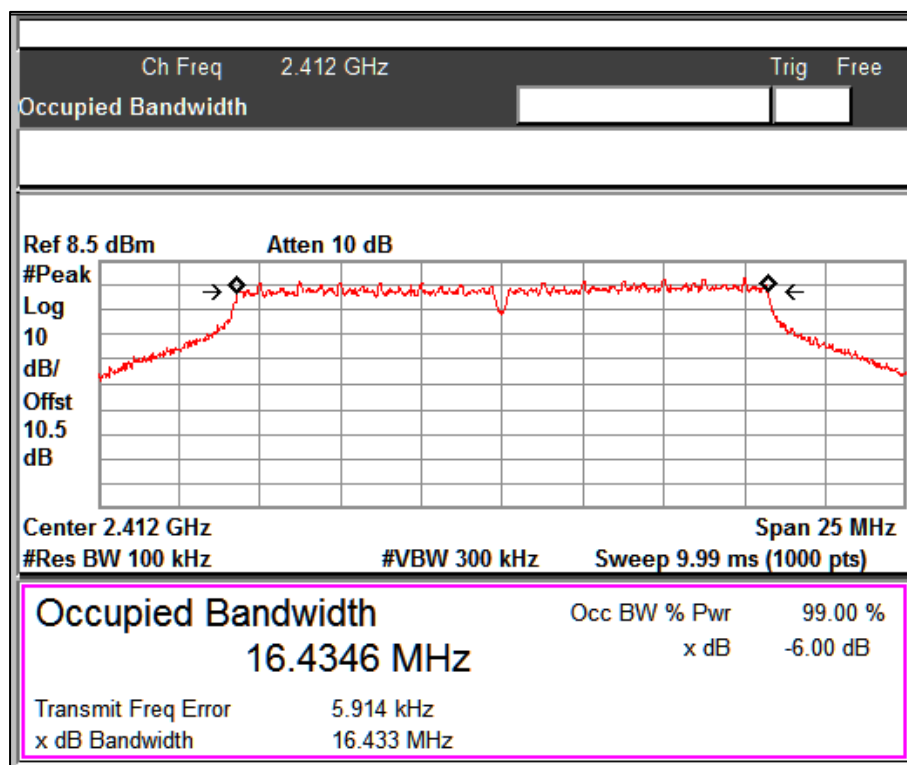
ULR-TC568821300000033F

Seite 55 von 199
Page 55 of 199



Data Rate: 6Mbps

Channel Frequency: 2462MHz



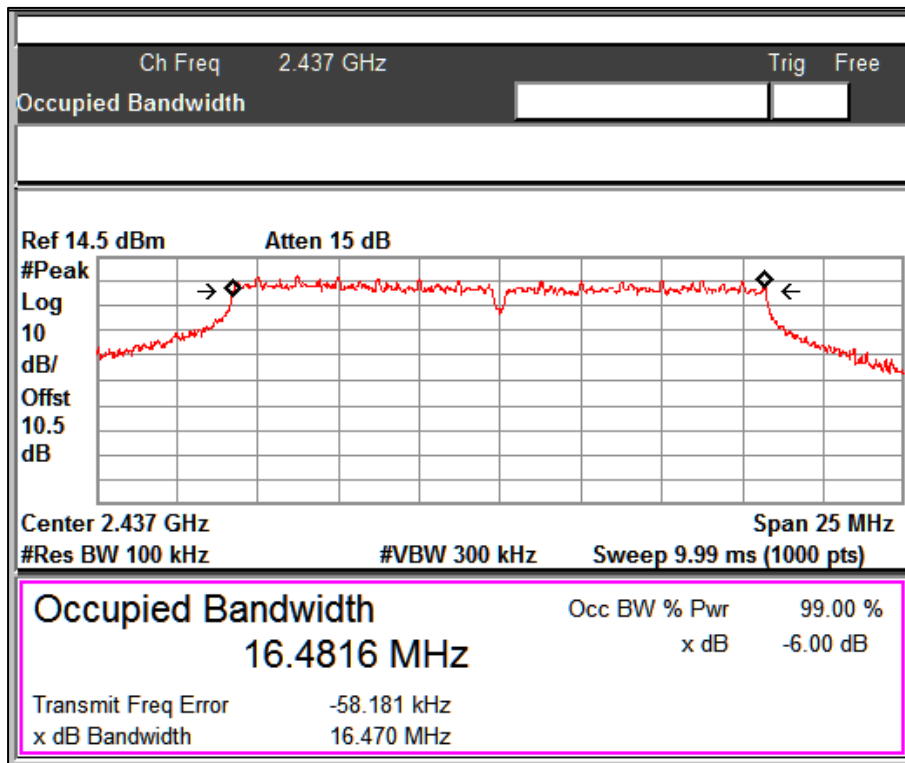
Data Rate: 54Mbps

Channel Frequency: 2412MHz

Prüfbericht - Nr.:
Test Report No.:

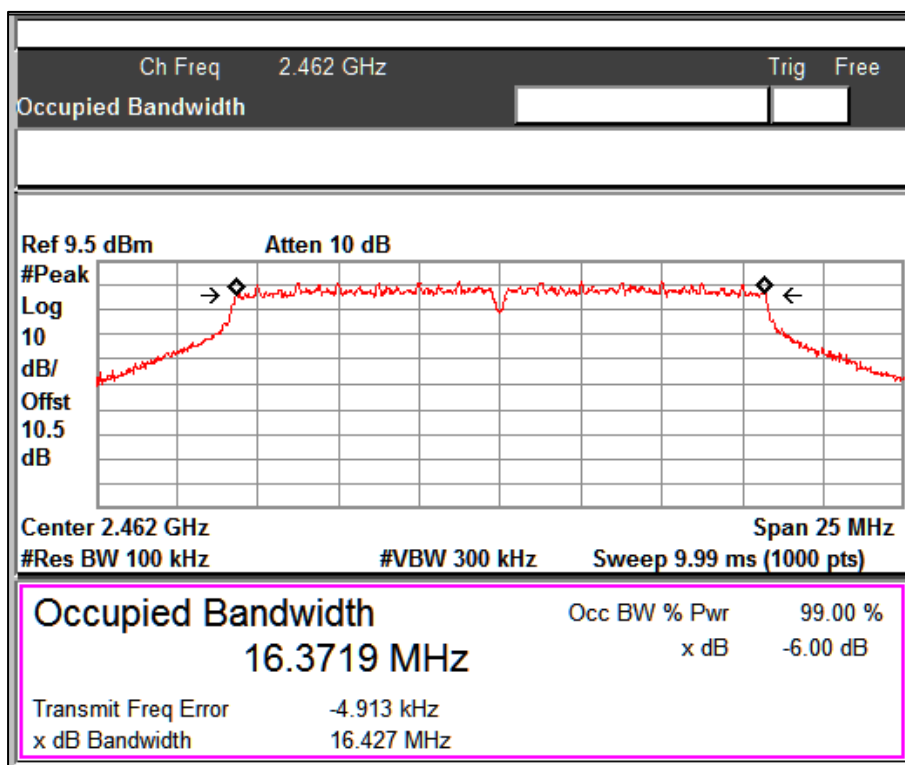
ULR-TC568821300000033F

Seite 56 von 199
Page 56 of 199



Data Rate: 54Mbps

Channel Frequency: 2437MHz



Data Rate: 54Mbps

Channel Frequency: 2462MHz

Prüfbericht - Nr.:

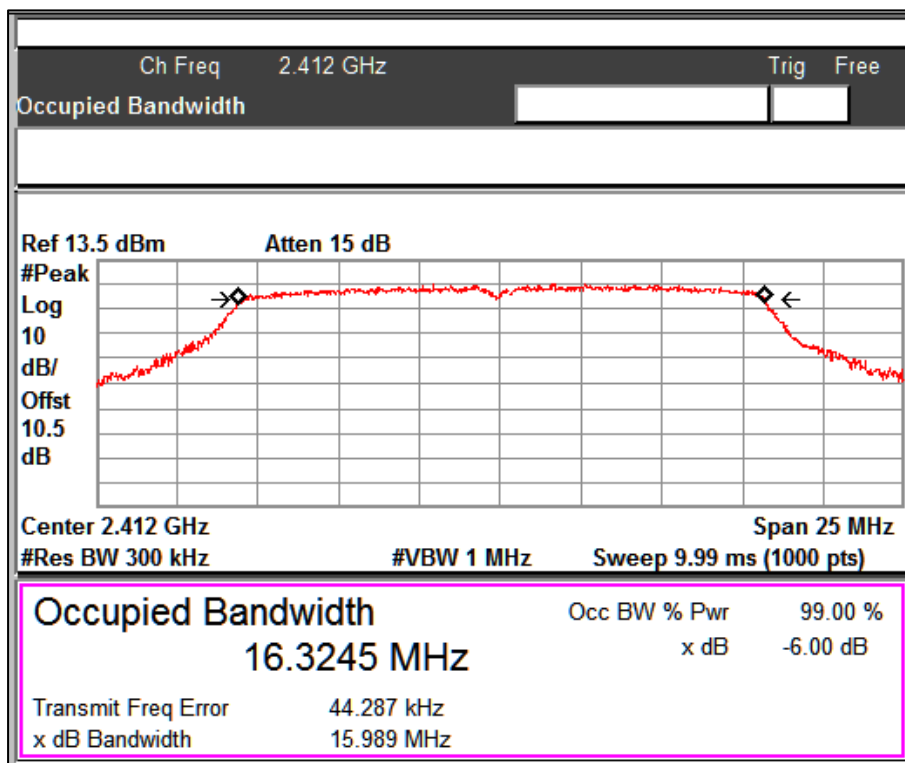
Test Report No.:

ULR-TC568821300000033F

Seite 57 von 199

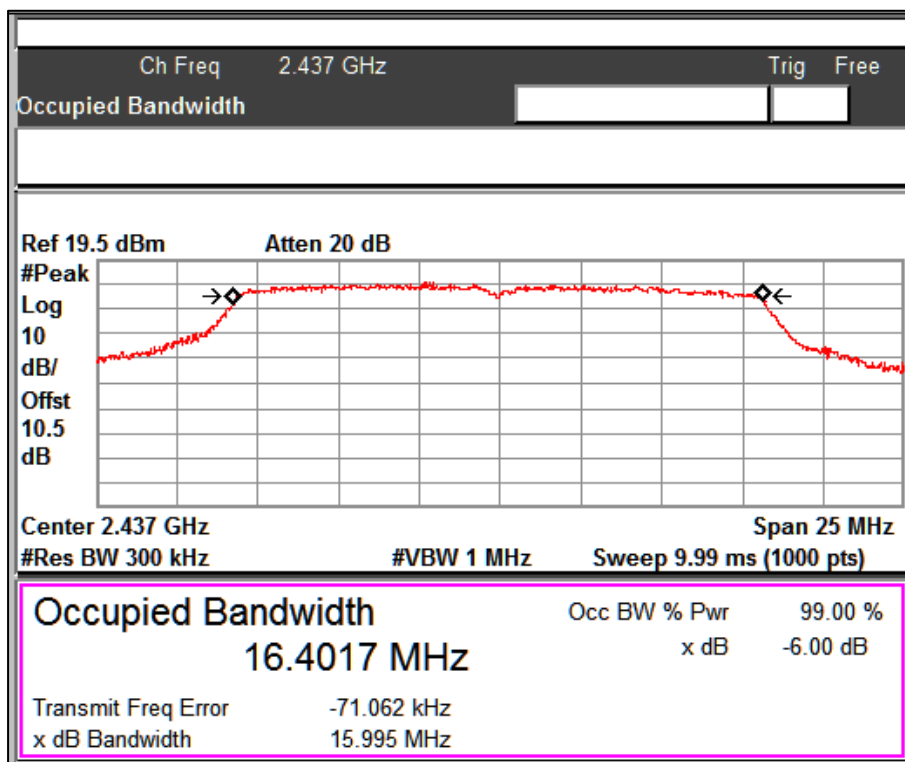
Page 57 of 199

Graphs for OCW 99 % bandwidth measurement



Data Rate: 6Mbps

Channel Frequency: 2412MHz



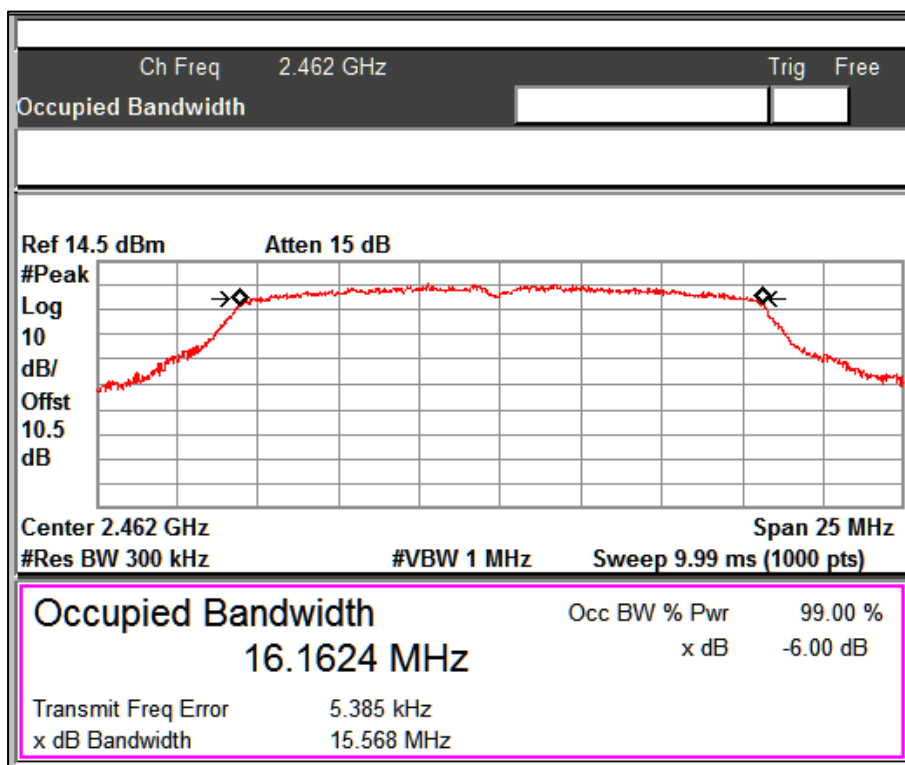
Data Rate: 6Mbps

Channel Frequency: 2437MHz

Prüfbericht - Nr.:
Test Report No.:

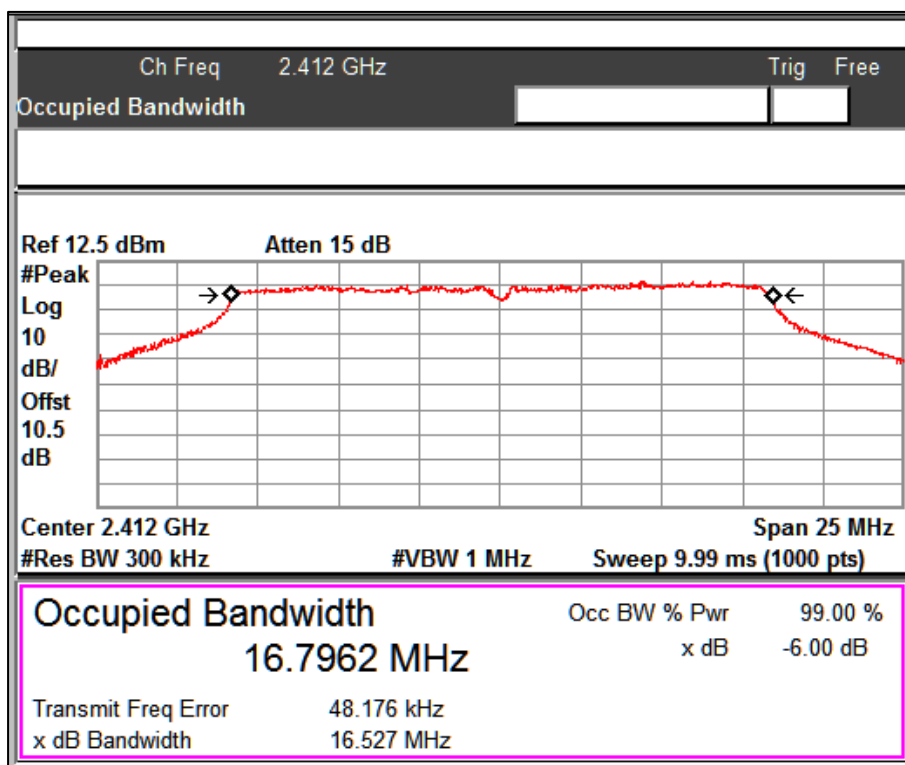
ULR-TC568821300000033F

Seite 58 von 199
Page 58 of 199



Data Rate: 6Mbps

Channel Frequency: 2462MHz



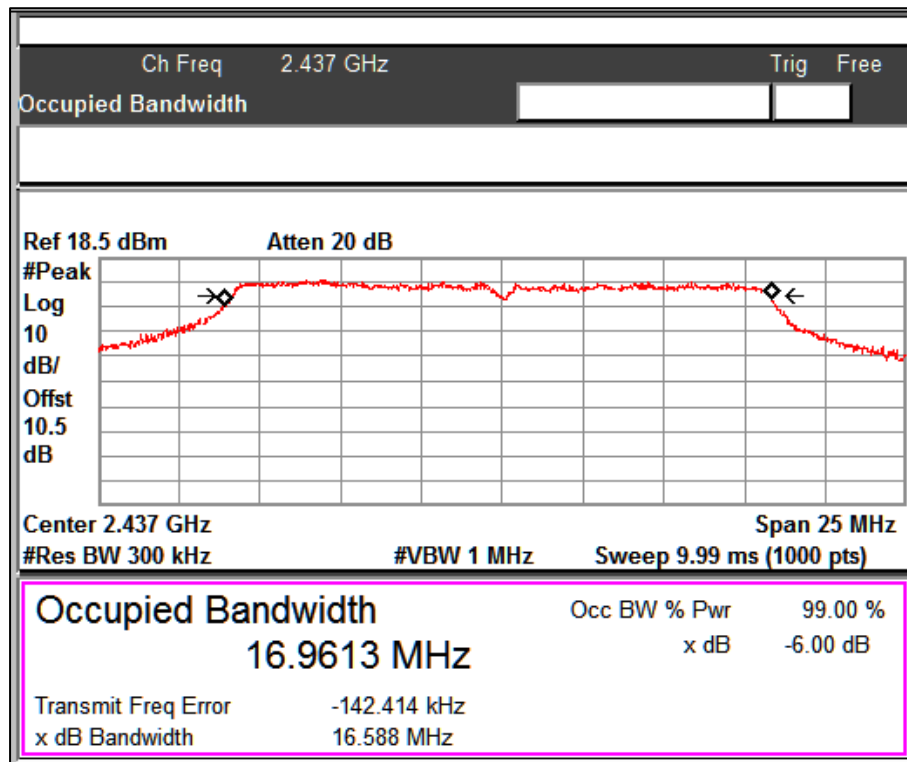
Data Rate: 54Mbps

Channel Frequency: 2412MHz

Prüfbericht - Nr.:
Test Report No.:

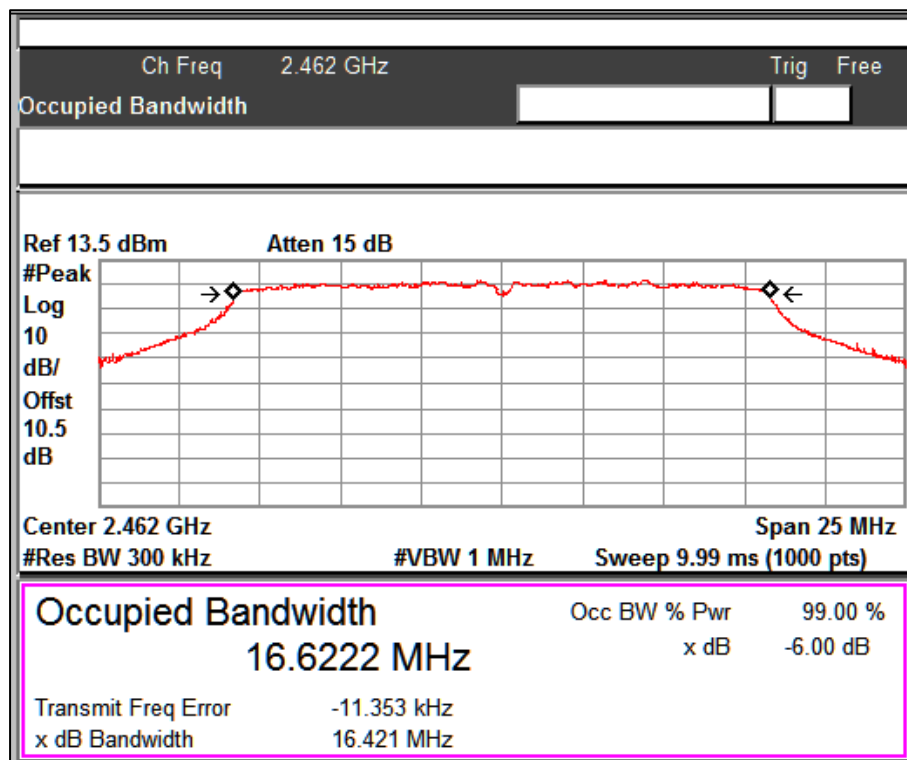
ULR-TC568821300000033F

Seite 59 von 199
Page 59 of 199



Data Rate: 54Mbps

Channel Frequency: 2437MHz



Data Rate: 54Mbps

Channel Frequency: 2462MHz

Prüfbericht - Nr.:
Test Report No.:

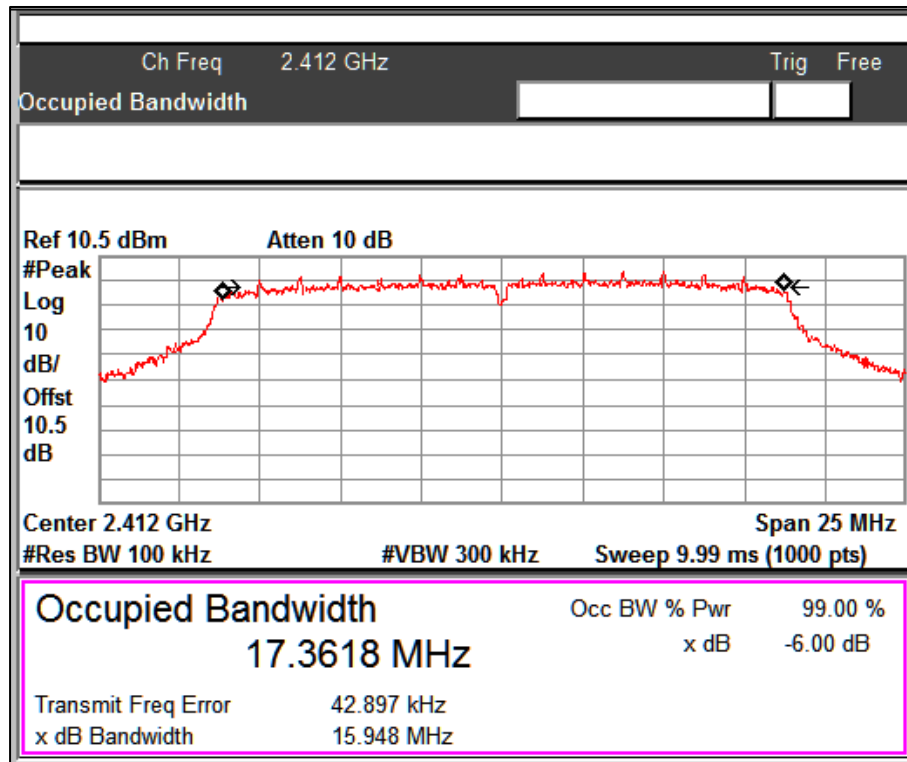
ULR-TC568821300000033F

Seite 60 von 199
Page 60 of 199

Modulation: 802.11n_20MHz

Data rate (Mbps)	Channel Frequency (MHz)	6 dB Bandwidth (MHz)	99% OBW (MHz)	Minimum Limit (MHz)
MCS0	2412	15.94	17.43	0.5
	2437	15.92	17.49	0.5
	2462	15.06	17.23	0.5
MCS7	2412	17.29	17.90	0.5
	2437	17.31	17.98	0.5
	2462	14.99	17.75	0.5

Graphs for 6 dB bandwidth measurement



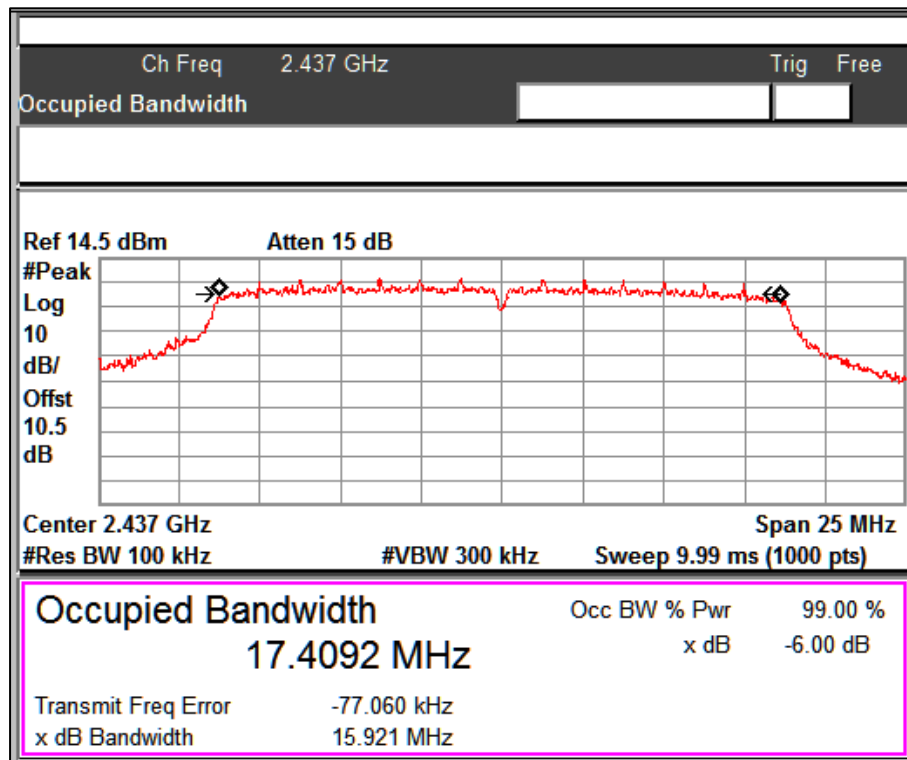
Data Rate: MCS0

Channel Frequency: 2412MHz

Prüfbericht - Nr.:
Test Report No.:

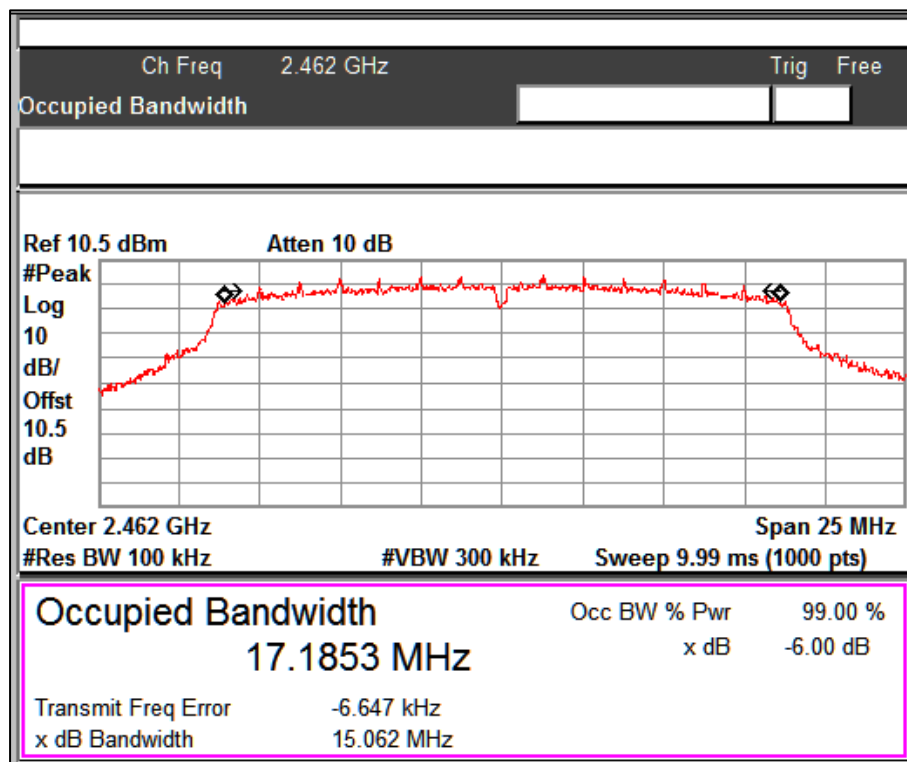
ULR-TC568821300000033F

Seite 61 von 199
Page 61 of 199



Data Rate: MCS0

Channel Frequency: 2437MHz



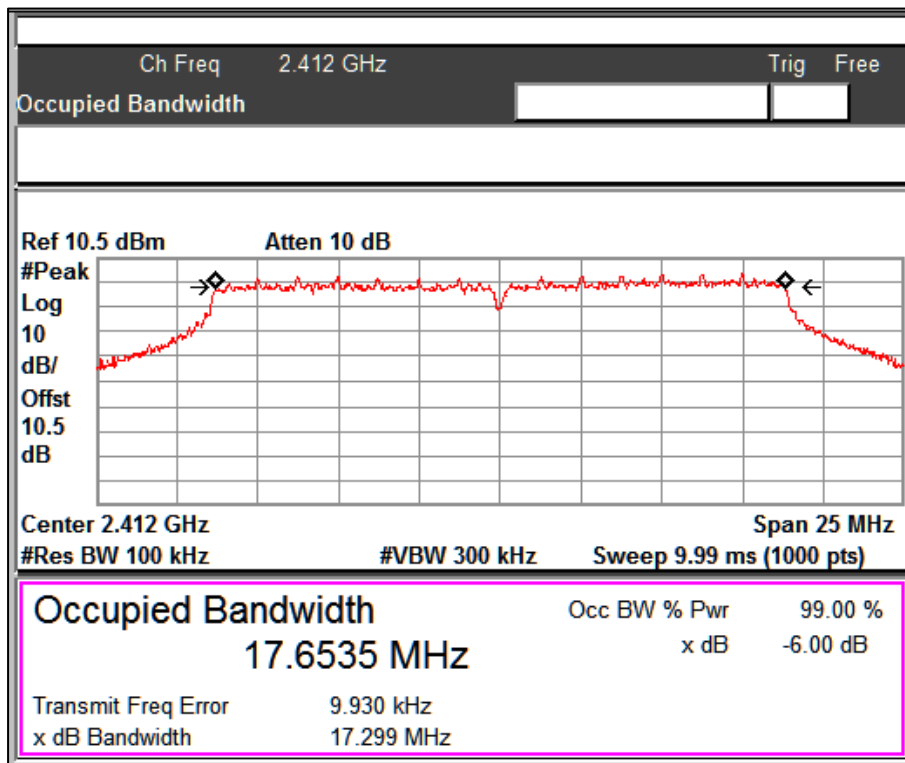
Data Rate: MCS0

Channel Frequency: 2462MHz

Prüfbericht - Nr.:
Test Report No.:

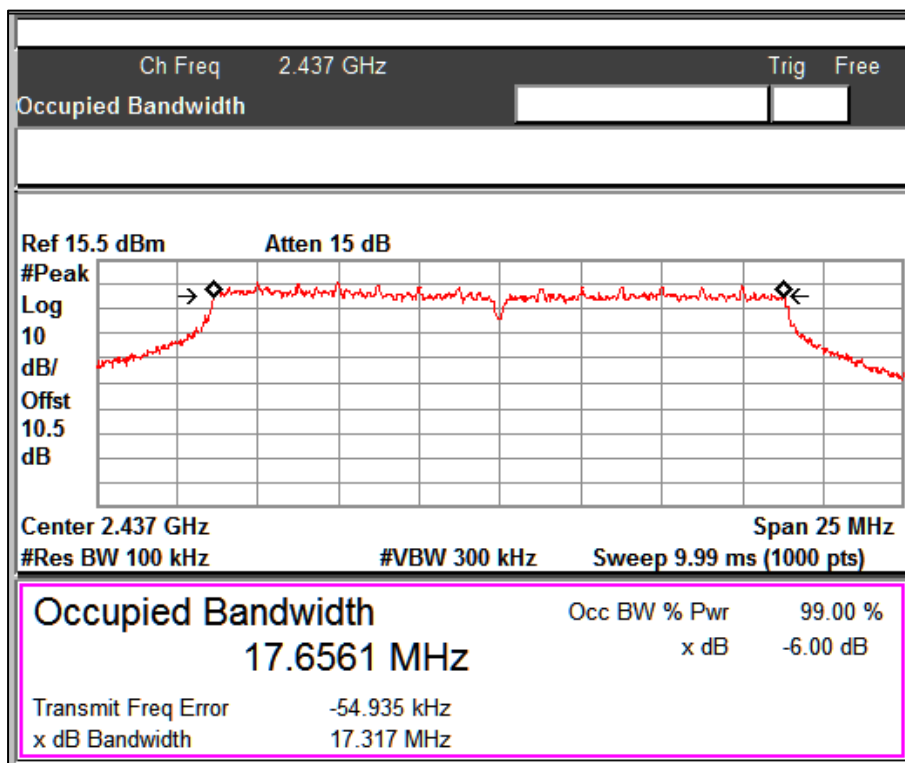
ULR-TC568821300000033F

Seite 62 von 199
Page 62 of 199



Data Rate: MCS7

Channel Frequency: 2412MHz



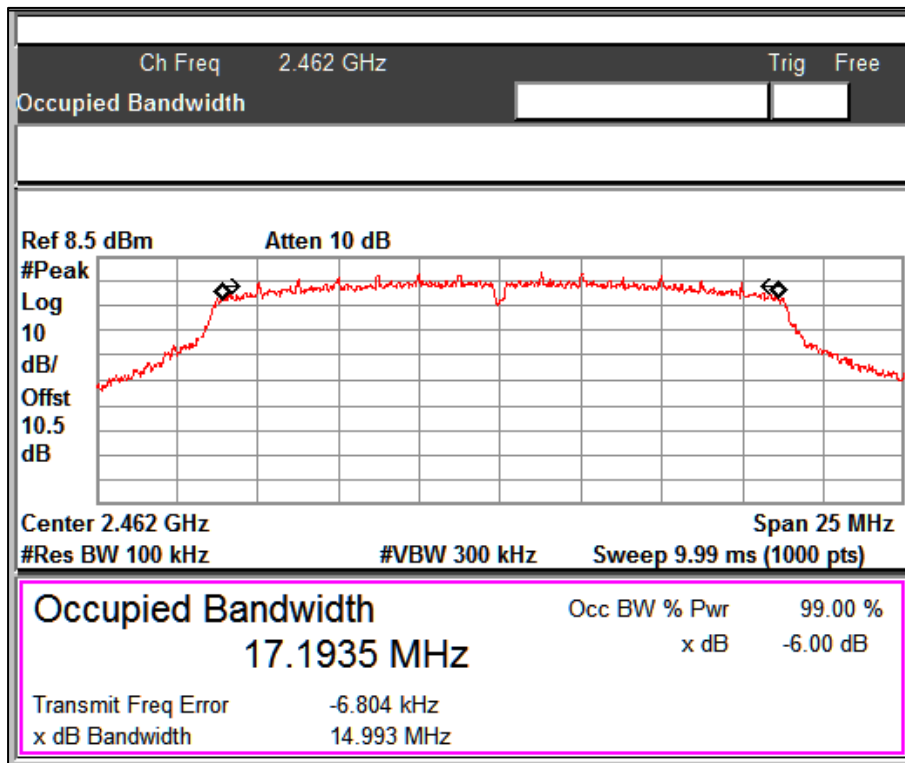
Data Rate: MCS7

Channel Frequency: 2437MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

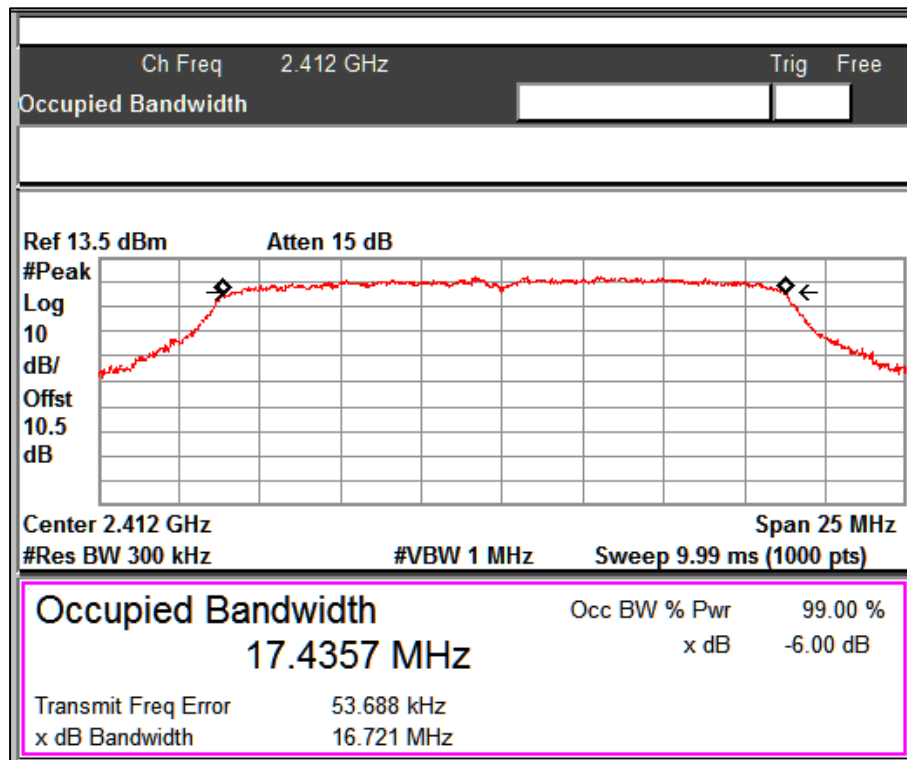
Seite 63 von 199
Page 63 of 199



Data Rate: MCS7

Channel Frequency: 2462MHz

Graphs for OCW 99 % bandwidth measurement



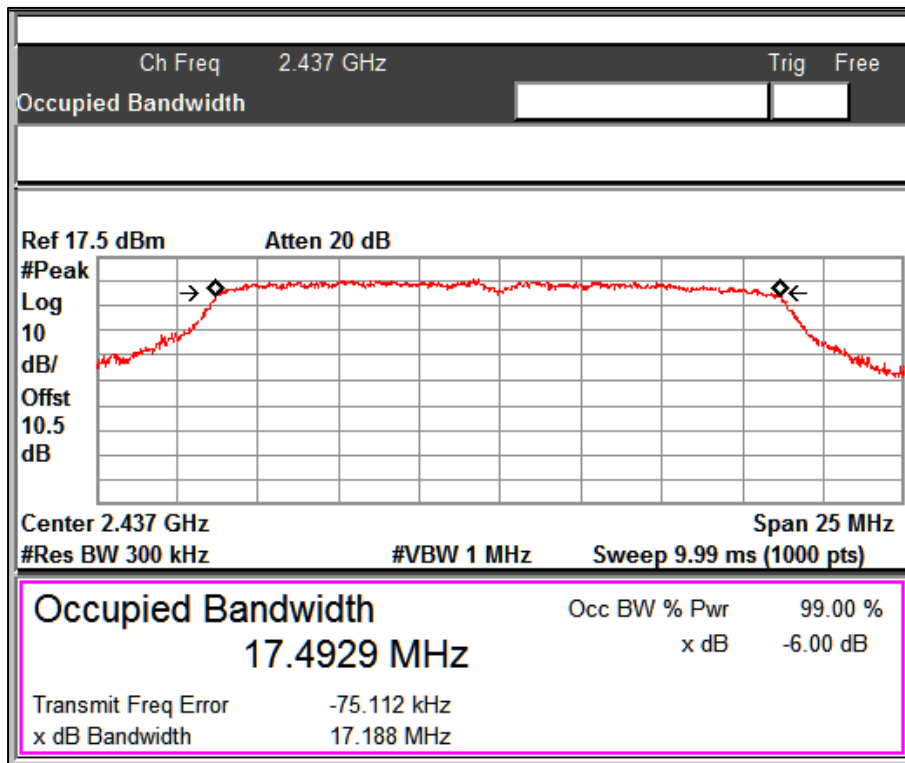
Data Rate: MCS0

Channel Frequency: 2412MHz

Prüfbericht - Nr.:
Test Report No.:

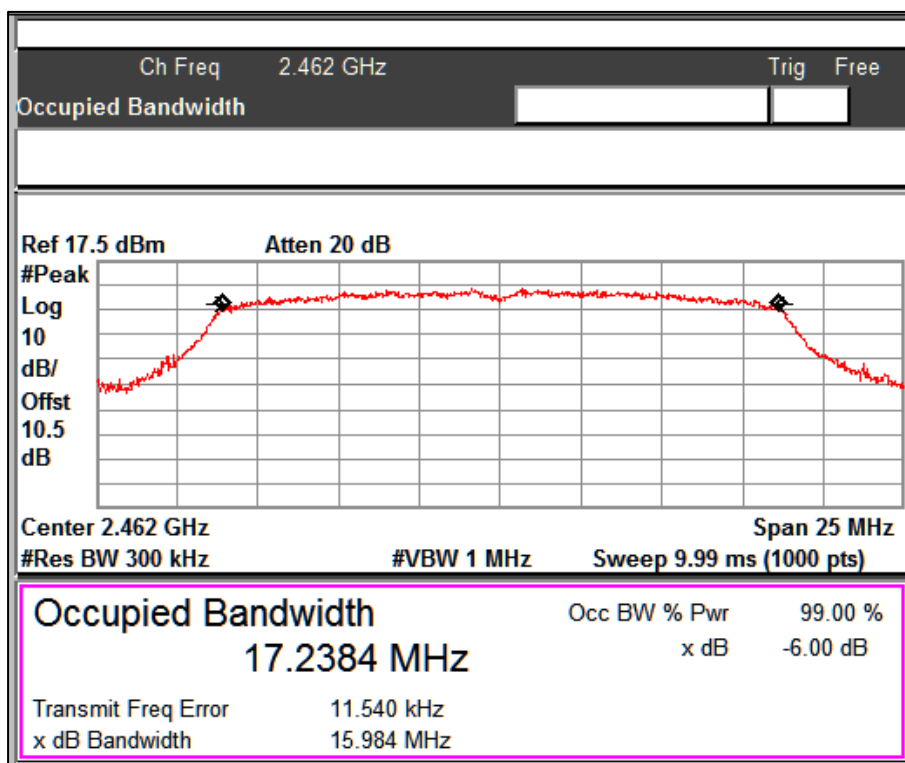
ULR-TC568821300000033F

Seite 64 von 199
Page 64 of 199



Data Rate: MCS0

Channel Frequency: 2437MHz



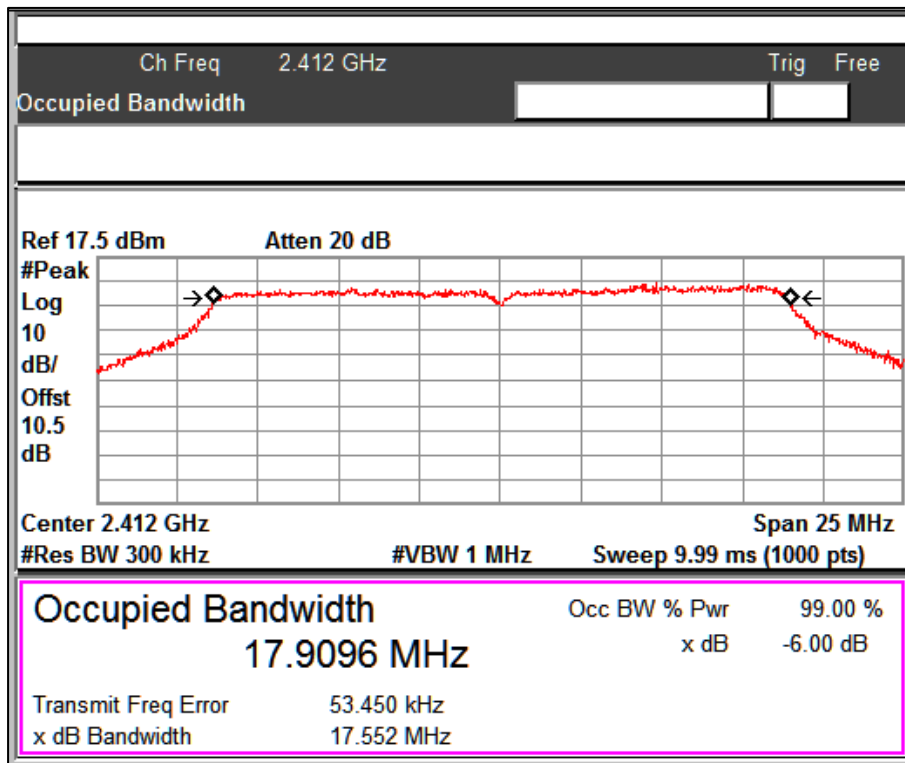
Data Rate: MCS0

Channel Frequency: 2462MHz

Prüfbericht - Nr.:
Test Report No.:

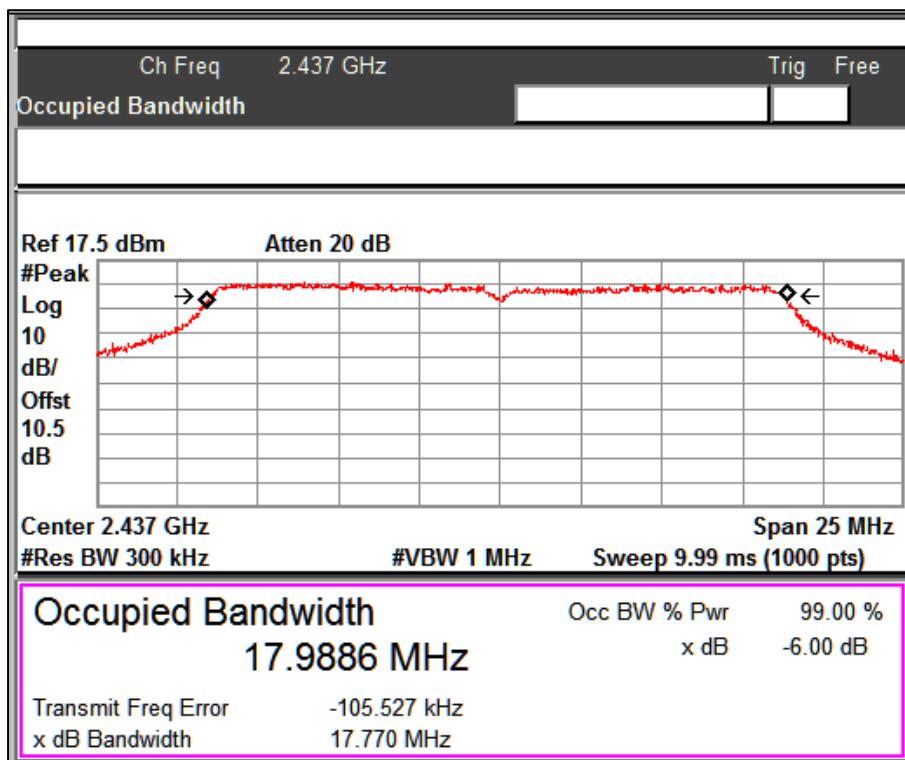
ULR-TC568821300000033F

Seite 65 von 199
Page 65 of 199



Data Rate: MCS7

Channel Frequency: 2412MHz



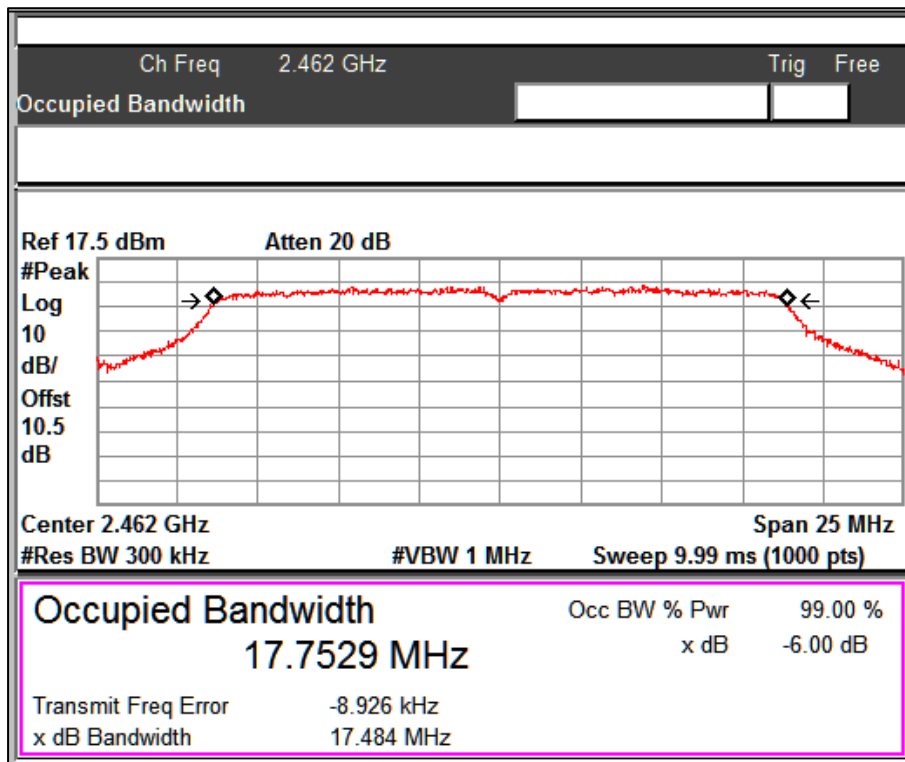
Data Rate: MCS7

Channel Frequency: 2437MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568821300000033F

Seite 66 von 199
Page 66 of 199



Data Rate: MCS7

Channel Frequency: 2462MHz

Modulation: 802.11n_40MHz

Data rate (Mbps)	Channel Frequency (MHz)	6 dB Bandwidth (MHz)	99% OBW (MHz)	Minimum Limit (MHz)
MCS0	2422	32.53	35.59	0.5
	2437	35.06	36.36	0.5
	2452	30.09	35.88	0.5
MCS7	2422	35.74	36.69	0.5
	2437	36.39	37.63	0.5
	2452	36.16	37.08	0.5