

Prüfbericht - Nr.: **ULR-TC568819300000028F** **Seite 1 von 45**
Page 1 of 45
Test Report No.:

Auftraggeber: **ABB AB, Machines**
Client: **Elmotorgatan 2,
Vasteras
Sweden - 72136**

Gegenstand der Prüfung: **MACHsense-R**
Test item:

Bezeichnung: **MSR1600** **Serien-Nr.:** **B1807033**
Identification: **Serial No.**

Wareneingangs-Nr.: **166120185** **Eingangsdatum:** **05-04-2019**
Receipt No.: **Date of receipt:**

Prüfart: **Refer Page 5 of 45 for Test site details**
Testing location:

Prüfgrundlage: **FCC Part 15 Subpart C - 15.247 & ANSI C63.10-2013 &
RSS 247 Issue 2 ,RSS Gen Issue 5**
Test specification:

Prüfresultat: **Der Prüfgegenstand entspricht oben genannter Prüfgrundlage(n).**
Test Result: **The test items passed the test specification(s).**

Prüflaboratorium: TÜV Rheinland (India) Pvt. Ltd.
Testing Laboratory: 27/B, 2nd Cross,
Electronic City , Phase 1
Bangalore – 560 100,
Karnataka
FCC Test Site Registration no.: 496599 & ISED Test Site number.: 3466E-1

geprüft / tested by:			kontrolliert / reviewed by:		
12.04.2019	Srinivasa B R Engineer		03.04.2020	Mahammadgouse kaladagi AsisstantManager	
Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>	Datum <i>Date</i>	Name/Stellung <i>Name/Position</i>	Unterschrift <i>Signature</i>

Sonstiges / Other Aspects: **FCC ID: 2AUVY-DSG1C4V1**
IC ID: 25660-DSG1C4V1

Abkürzungen: P(ass) = entspricht Prüfgrundlage F(ail) = entspricht nicht Prüfgrundlage N/A = nicht anwendbar N/T = nicht getestet	Abbreviations: P(ass) = passed F(ail) = failed N/A = not applicable N/T = not tested
---	--

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 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 safety mark on this or similar products.

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568819300000028F

Seite 2 von 45
Page 2 of 45

TEST SUMMARY

Test Item	FCC Clause	ISED Clause	Result	Remarks
Maximum Peak Conducted Output	Section 15.247(b) (3)	RSS 247 Issue 2, section 5.4 (d)	Pass	-
6 dB Bandwidth/DTS Bandwidth	Section 15.247(a) (2)	RSS-247 Issue 2 Section 5.2(a)	Pass	-
Maximum Power Spectral Density	Section 15.247(e)	RSS 247 Issue 2, section 5.2(b)	Pass	-
Emissions in non-restricted frequency bands	Section 15.247(d)	RSS 247 Issue 2, section 5.5	Pass	-
Spurious Radiated Emissions and Restricted Bands of Operation	Section 15.209 / 15.205	RSS- Gen Issue 5 Section 8.9/8.10	Pass	-
Conducted Emissions on A.C. Power Lines	15.207	ICES-003 Issue 6 section 6.1	Pass	

Note:

1. MACHsense-R has integrated with following certified RF modules.this is a partial scope test report based on full scope testing as reported in test report numbers mentioned below.
2. Conducted RF output power verification is performed and maximum output power is within the module test results authorized under below listed FCCID, hence validity of the test results reported are verified and only Radiated spurious emission and band edge test are performed to confirm that the product MACHsense-R meets RF exposure condition when all modules are integrated and Co-located with multiple transmitters. Simultaneous operation is not supported by MACHsense-R, hence not addressed in this test report.
3. Manufacture has provided declaration in the user manual of the product (MACHsense-R) that the modules are integrated in the host product as per the module intergration rule.

SI No.	Radio Protocol	FCC ID	IC ID	Report number	Report Issued by
1	GSM (GPRS & EGPRS)	RI7HE910	5131A-HE910	1112FR12-02	A Test lab Techno Corp
2	WCDMA Band 2 & Band 4	RI7HE910	5131A-HE910	1112FR12-02	A Test lab Techno Corp
3	WCDMA Band 4	RI7HE910	5131A-HE910	1201FR11-02	A Test lab Techno Corp
4	Wi-Fi 2.4GHz	QOQWF111	5123A-BGTWF111	266892-1	SGS Fimko Ltd

Product Category: Electronics Testing
Test Discipline: EMC Test Facility

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568819300000028F

Seite 3 von 45
Page 3 of 45

Table of Contents

1	GENERAL REMARKS	4
1.1	Complimentary Materials	4
2	TEST SITES	5
2.1	Testing Facilities.....	5
2.2	List of Test and Measurement Instruments.....	5
3	GENERAL PRODUCT INFORMATION.....	6
3.1	Product Function and Intended Use.....	6
3.2	Ratings and System Details declared by client*	6
3.3	Measurement Uncertainty:	7
4	TEST SET-UP AND OPERATION MODE.....	8
4.1	Principle of Configuration Selection	8
4.2	Test Operation and Test Software	8
4.3	Special Accessories and Auxiliary Equipment	8
4.4	Countermeasures to achieve EMC Compliance	8
4.5	Test modes – data rates and modulations	8
4.6	List of Wi-Fi Centre frequencies.....	8
5	TEST METHODOLOGY	9
5.1	Radiated Emission Test	9
5.1.1	Test Setup Configuration	9
6	TEST RESULTS	11
6.1	Maximum Peak Conducted Output Power	11
6.2	Maximum Power Spectral Density	17
6.3	Emissions in non-restricted frequency bands and Conducted spurious Emission	23
6.4	Spurious Radiated Emissions & Restricted Bands of Operation	27
6.5	Conducted Emission Test on A.C. Power Line	42
7	LIST OF TABLES.....	45

Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

Seite 4 von 45

Page 4 of 45

1 GENERAL REMARKS

1.1 Complimentary Materials

All attachments are integral part of this test report. This applies especially to the following items.

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

Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

Seite 5 von 45

Page 5 of 45

2 TEST SITES

2.1 Testing Facilities

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

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

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	Used for Test Items
Spectrum Analyser	Agilent Technologies	E4407B	US4119 2772	A.14.06	15.11.2019	Yearly	Antenna - Port Measurements
USB Peak power sensor	AIMIL Ltd	55006	10231		22.12.2019	Yearly	
EMI Test Receiver	Rohde & Schwarz	ESU 40	100288	4.43 SP3	11.10.2019	Yearly	Radiated Spurious Emission
Active loop antenna	Frankonia	LAX-10	LAX-10-800		15.01.2020	Yearly	
Biconical Antenna	Schwarzbeck mess-elektronik	VHBB-9124 / BBA-9106	9124-656		16.01.2020	Yearly	
Log-Periodic Antenna	Schwarzbeck mess-elektronik	VUSLP-9111B	9111B-111		17.01.2020	Yearly	
Broadband Horn Antenna	Frankonia	HAX-18	HAX18-802		17.05.2019	Yearly	
Emission Horn Antenna	ETS Lindgren	116706	00107323		02.11.2019	Yearly	
10m Semi Anechoic Chamber	Frankonia	-	-		-	-	

3 GENERAL PRODUCT INFORMATION

3.1 Product Function and Intended Use

MACHsense-R is a data acquisition unit (DAU) has 16 high speed analog channels, 16 low speed analog channels, 4 GPI channels, 4 GPO channels, 1 RS485 port and 1 Ethernet port. EUT is powered by either 230V AC in AC power mode or +48V DC in POE mode. It also supports 2G/3G and Wi-Fi. EUT is intended to use for condition monitoring of industrial motors

Operational description:

16 High speed channels of EUT can sense +/-10V AC/DC or IEPE Accelerometer signals

16 Low speed channels can read RTD sensor

4 GPI channels can sense High or Low level of input signal

4 GPO channels can drive four HIGH/LOW outputs

The EUT supports communication facilities such as RS485, Ethernet, Wi-Fi & 2G/3G

3.2 Ratings and System Details declared by client*

Table 2: Ratings and System Details

Radio Protocol	GSM	WCDMA	Wi-Fi 2.4GHz
Operating Frequency band	GSM- 850 MHz & 1900 MHz	WCDMA Band2,Band 4 & Band 5	2412MHz – 2462MHz
Channel spacing	200 kHz	5 MHz	5MHz
Maximum transmitted power (Measured conducted power)	GSM 850: 30.47 dBm GSM 1900: 26.07 dBm	WCDMA Band2: 22.27 dBm WCDMA Band 4: 18.79 dBm WCDMA Band 5: 23.65 dBm	18.54 dBm
Modulation	GSM- GMSK/8PSK	WCDMA-QPSK	802.11b: CCK and DSSS
			802.11g: OFDM
			802.11n: OFDM
Data rates	-	-	1 to 72.2 Mbps
Number of antennas	One		One
Maximum Antenna gain	GSM 850: 1 dBi		3 dBi
	GSM 1900: 2.8 dBi		
	WCDMA band 2: 2.8 dBi		
	WCDMA band4: 2.8dBi		
	WCDMA band5: 1 dBi		
Antenna type	Penta-band cellular Hinged SMA male monopole		Screw mount dipole antenna
Supply Voltage to Product	1. Universal AC mains mode : 110 VAC/ 60Hz		
	2. Power over Ethernet(POE): +48 VDC in POE mode		
Environmental conditions	-20 to +70 °C		
Dimensions (LxWxH)	313mm X 240mm X 159mm		

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568819300000028F

Seite 7 von 45
Page 7 of 45

Note: The product does not support simultaneous transmission. Conducted output power measured with respect to each protocol with single transmission chain

***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.

Table 3: Report No. References

SL. No.	RF Protocol / Frequency Bands	Report No.
1	GSM / WCDMA	ULR-TC568819300000027F
2	WLAN 2.4GHz	ULR-TC568819300000028F

Note: This product contains multiple radio operation, test report reference is provided in the above table

Table 4: Power level setting used in Wi-Fi testing

Mode	Power level (dBm)
802.11b	16
802.11g	14
802.11n	14

3.3 Measurement Uncertainty:

Table 5: Measurement Uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±1.5 dB
Power Spectral Density, conducted	±3 dB
Unwanted Emissions, conducted	±3 dB
SAC, radiated measurement	±6 dB
FAC, radiated measurement	±6 dB
Temperature	±3 °C
Supply Voltages	±3 %
Time	±5 %

Note: The listed uncertainties are the worst case uncertainty for the entire range of measurements and are for the reporting purpose only and are not used in determining the PASS/FAIL of the results.

4 TEST SET-UP AND OPERATION MODE

4.1 Principle of Configuration Selection

Transmission enabled with the highest possible duty cycle on low, middle and highest operating channels to obtain maximum emissions.

4.2 Test Operation and Test Software

Test Software name: UniTest, Version V7.4.1.17
Firmware version: WF111_profile_7_4_1_17
Hardware version: Rev B.1

4.3 Special Accessories and Auxiliary Equipment

Test laptop and POE supply.

4.4 Countermeasures to achieve EMC Compliance

None

4.5 Test modes – data rates and modulations

EUT has been tested for worst-case modes only as per the module test report.

4.6 List of Wi-Fi Centre frequencies

Table 6: List of center frequencies

Frequency Band (MHz)	Channel No.	Channel Frequency (MHz)
2400 – 2483.5	1	2412
	2	2417
	3	2422
	4	2427
	5	2432
	6	2437
	7	2437
	8	2447
	9	2452
	10	2457
	11	2462

5 TEST METHODOLOGY

5.1 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.

5.1.1 Test Setup Configuration

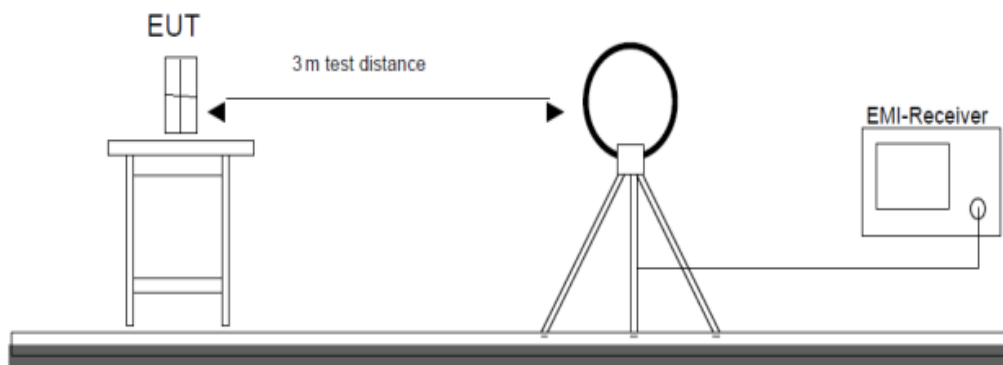


Figure 1: Frequency Range for 9 kHz- 30 MHz

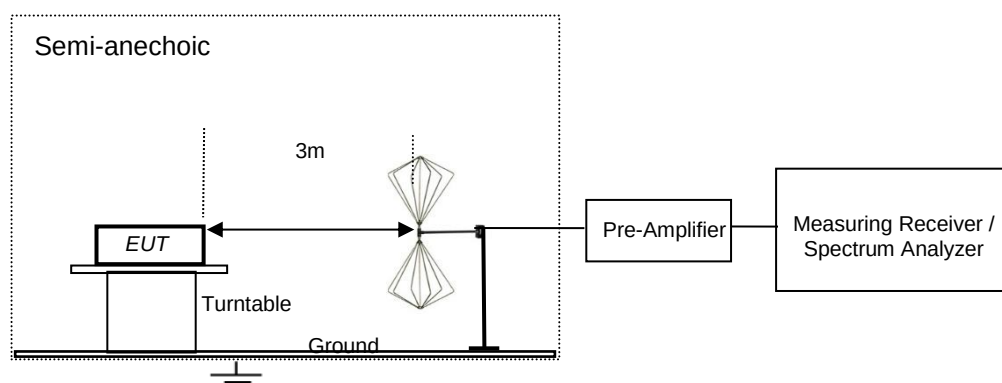


Figure 2: Frequency Range for 30 MHz – 200 MHz

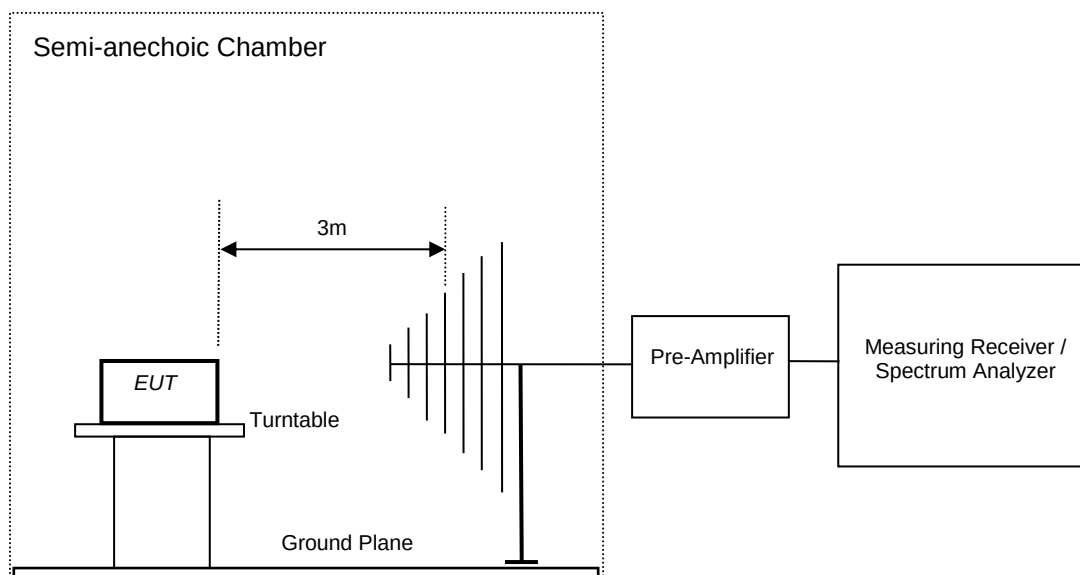


Figure 3: Frequency Range for 200 MHz - 1GHz

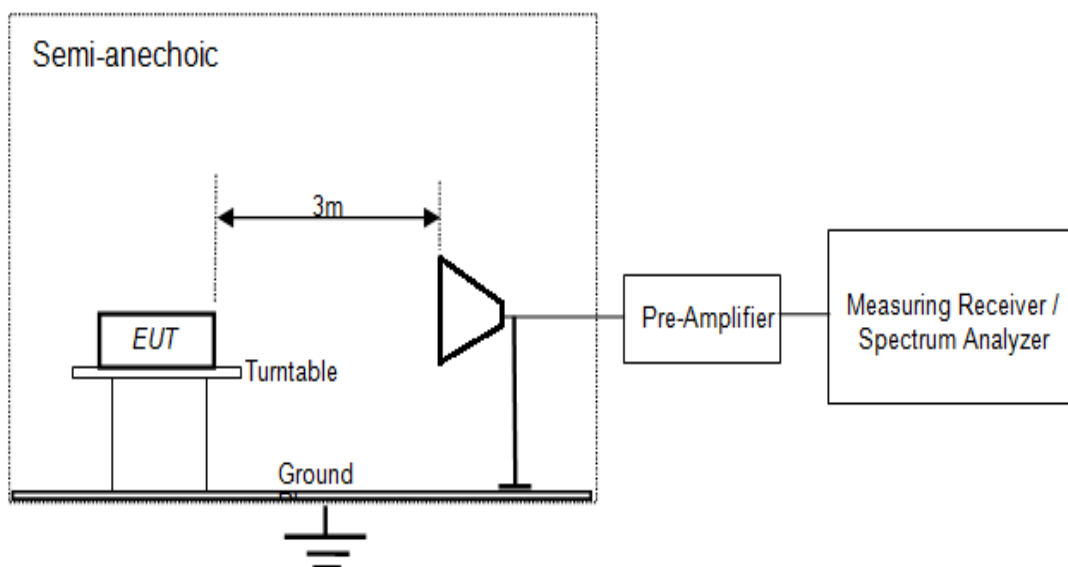


Figure 4: Frequency Range for above 1 GHz

6 TEST RESULTS

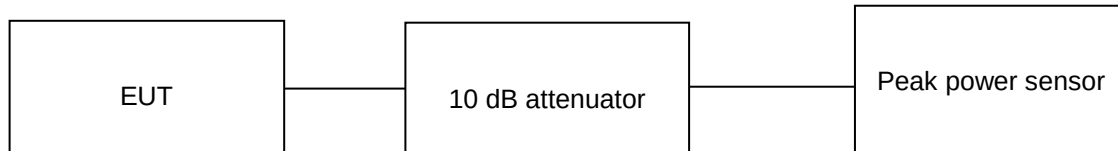
6.1 Maximum Peak Conducted Output Power

Result

Pass

Test Specification FCC part 15 Subpart C 15.247 (b)(3) and
RSS 247 Issue 2, section 5.4 (d).
Measurement Bandwidth 1 MHz
Detector Peak
Requirement ≤ 1 W (30 dBm)

Test setup:



Environmental conditions:

Temperature (Norm) = + 22.3 °C

RH= 62 %

Supply voltage: 110 VAC, 60Hz

Test results:

Note:

Measurements were made as per KDB 558074 D01 section 8.3.1.2 DTS Measurement Guidance v05r02.

10 dB attenuator + 0.6 dB Cable loss = 10.6 dB offset is considered in below results

Table 7: Maximum peak conducted output power test results

Data rate (Mbps)	Channel Frequency (MHz)	Peak power (dBm)	Limit (dBm)	Margin (dB)
1	2412	18.02	30	-11.98
	2437	17.93	30	-12.07
	2462	18.01	30	-11.99
6	2412	18.39	30	-11.61
	2437	18.28	30	-11.72
	2462	17.82	30	-12.18
7.2	2412	18.54	30	-11.46
	2437	18.41	30	-11.59
	2462	17.97	30	-12.03

Prüfbericht - Nr.:

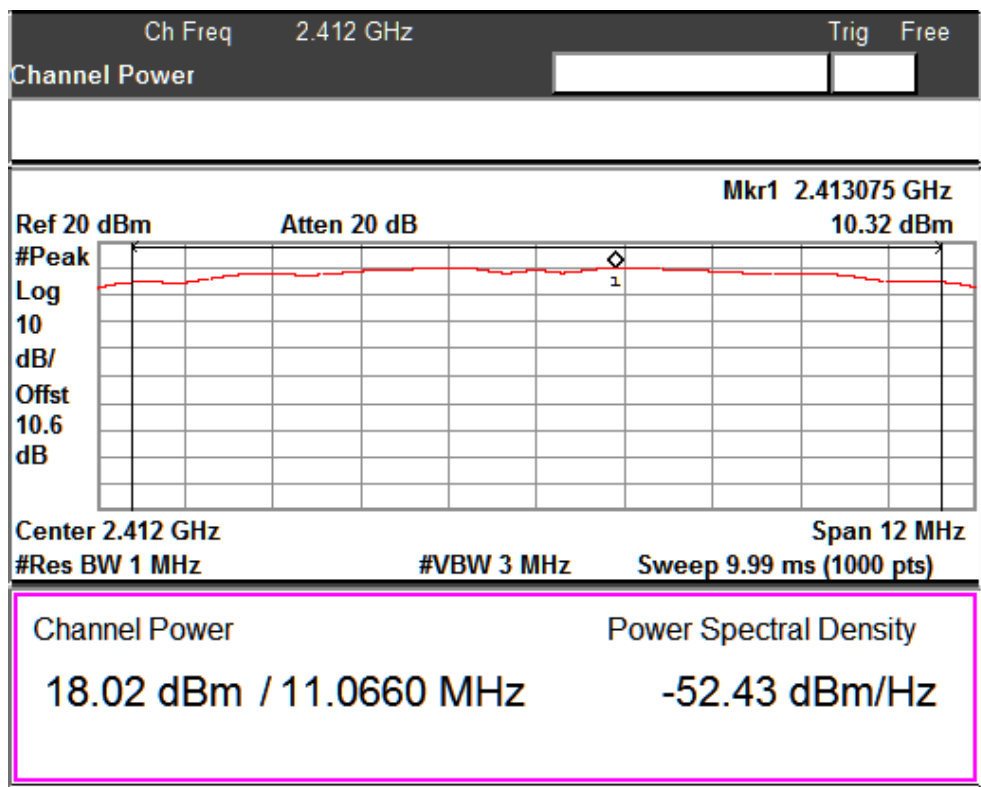
Test Report No.:

ULR-TC568819300000028F

Seite 12 von 45

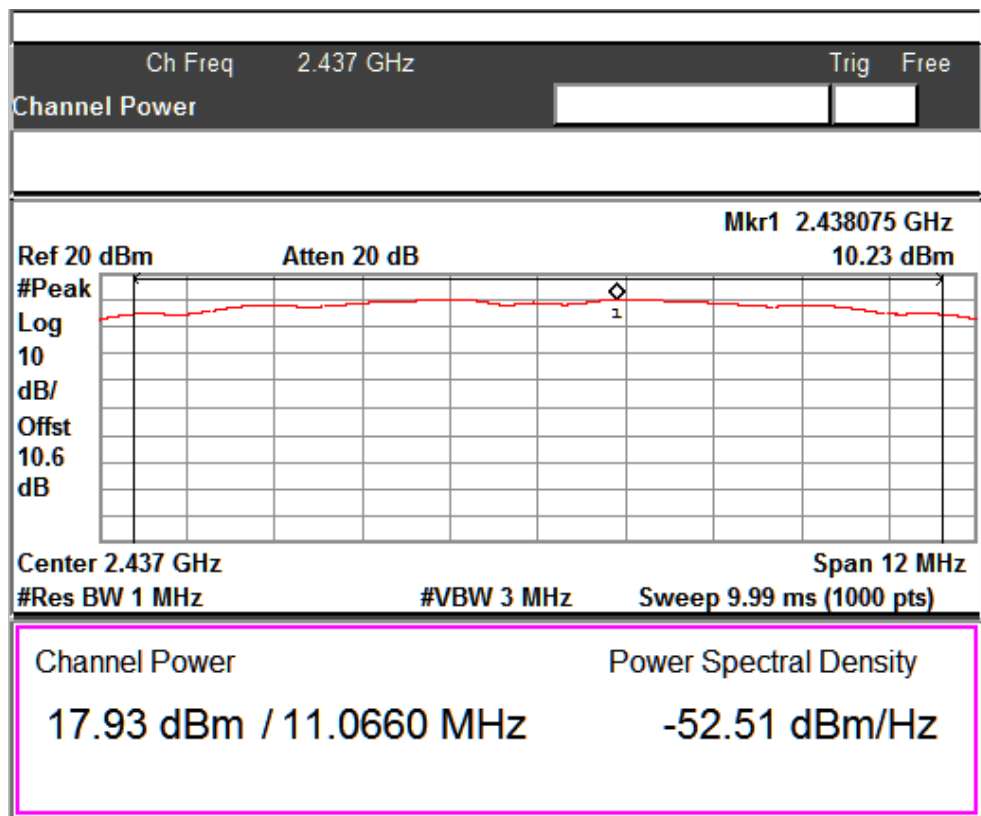
Page 12 of 45

Test plots 1: Conducted power measurement plots



Data rate: 1 Mbps

Channel Low :2412MHz



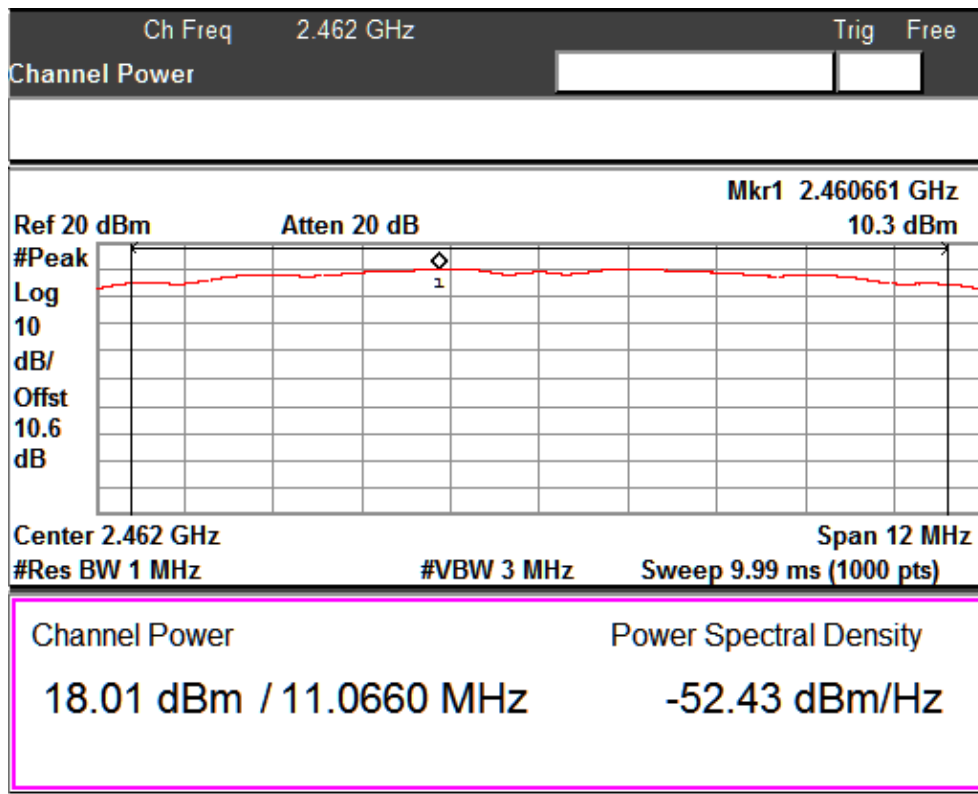
Data rate: 1 Mbps

Channel Mid:2437MHz

Prüfbericht - Nr.:
Test Report No.:

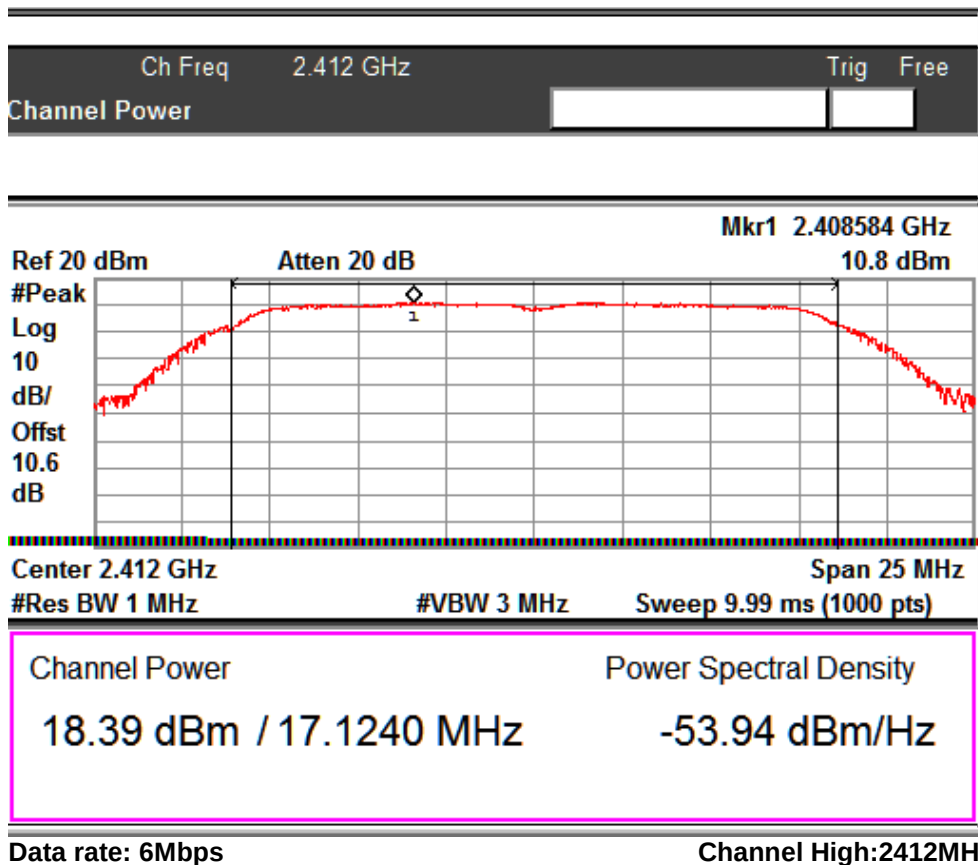
ULR-TC568819300000028F

Seite 13 von 45
Page 13 of 45



Data rate: 1 Mbps

Channel High : 2462 MHz



Data rate: 6Mbps

Channel High:2412MHz

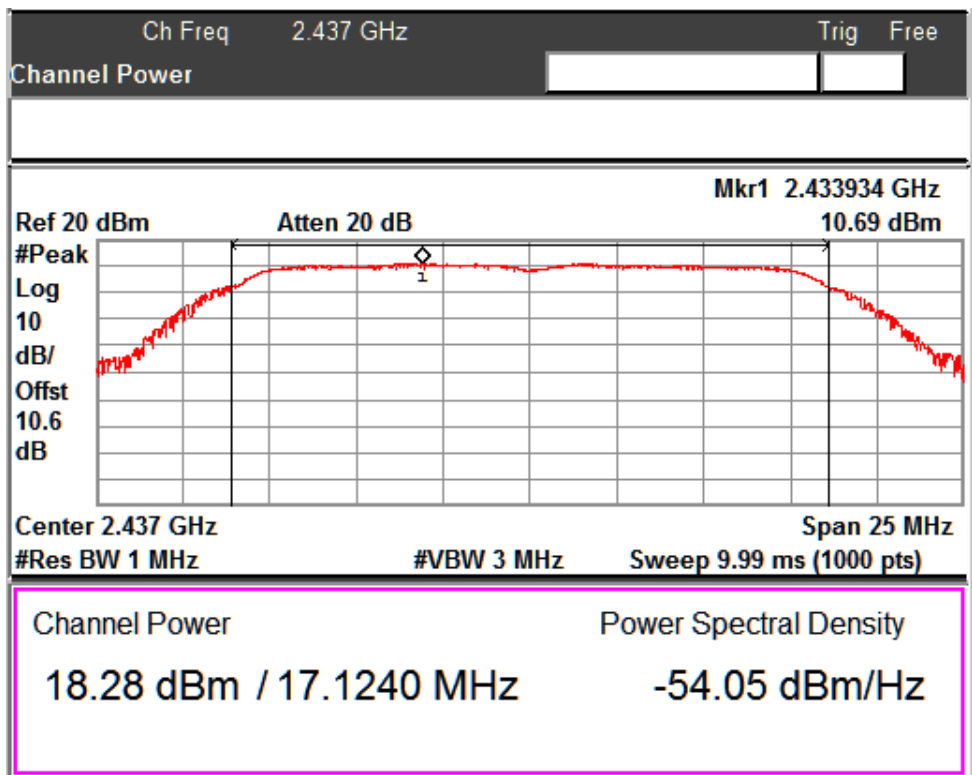
Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

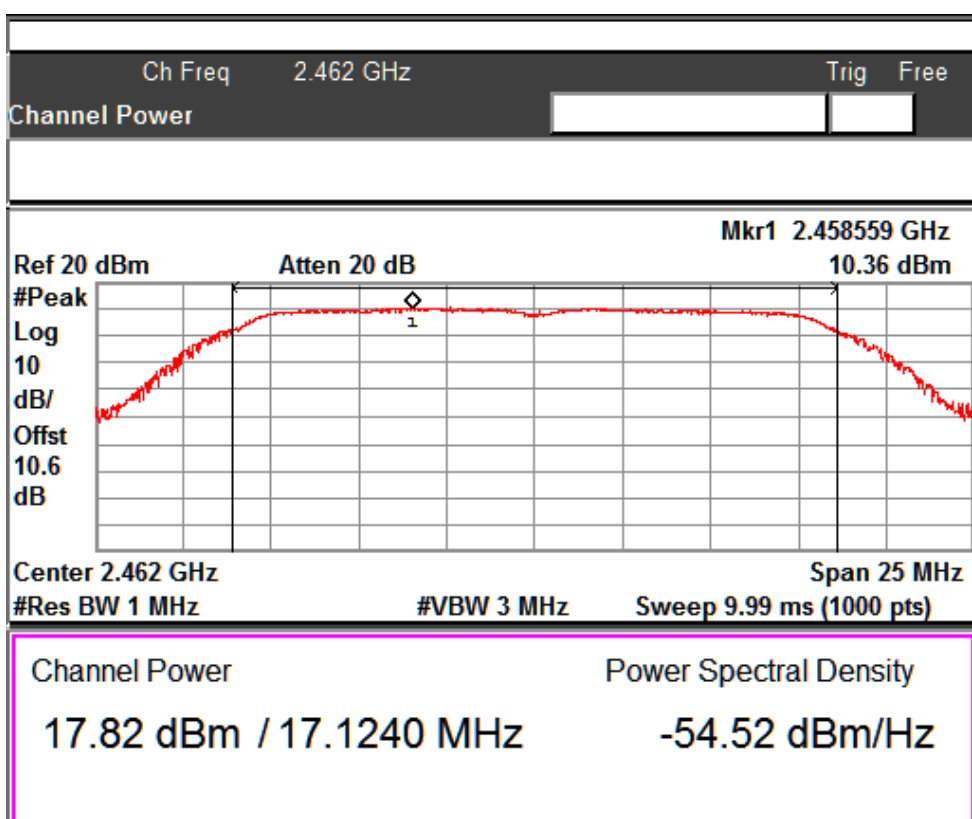
Seite 14 von 45

Page 14 of 45



Data rate: 6Mbps

Channel mid:2437MHz



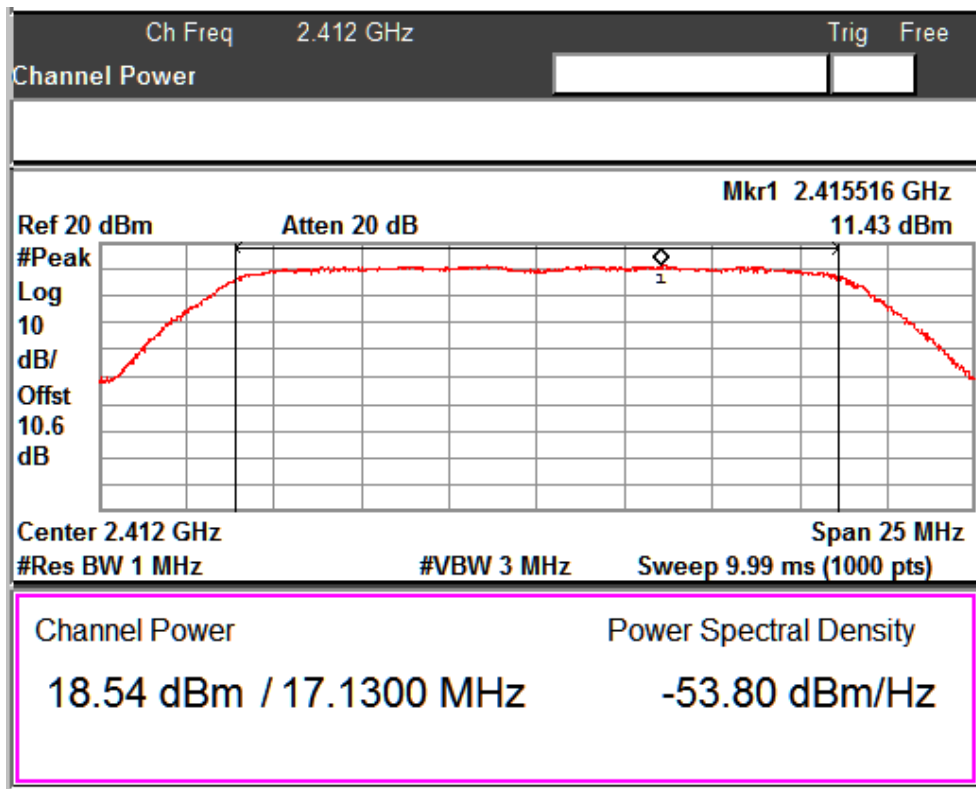
Data rate: 6Mbps

Channel high:2462MHz

Prüfbericht - Nr.:
Test Report No.:

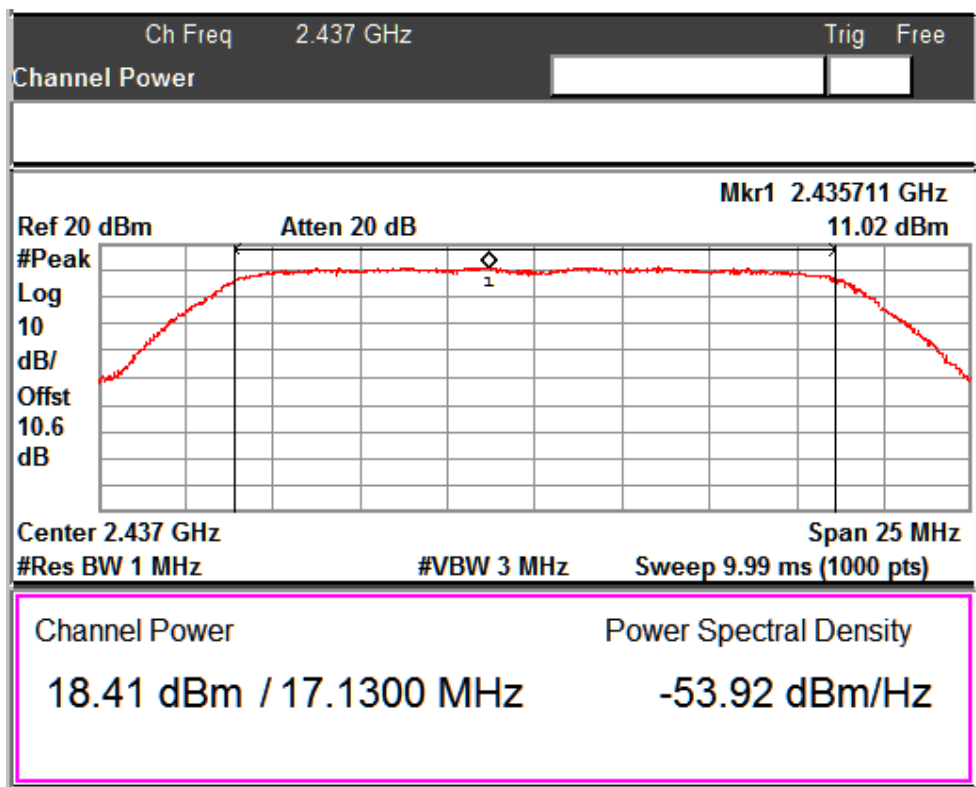
ULR-TC568819300000028F

Seite 15 von 45
Page 15 of 45



Data rate:7.2Mbps

Channel low:2412MHz



Data rate:7.2Mbps

Channel mid:2437MHz

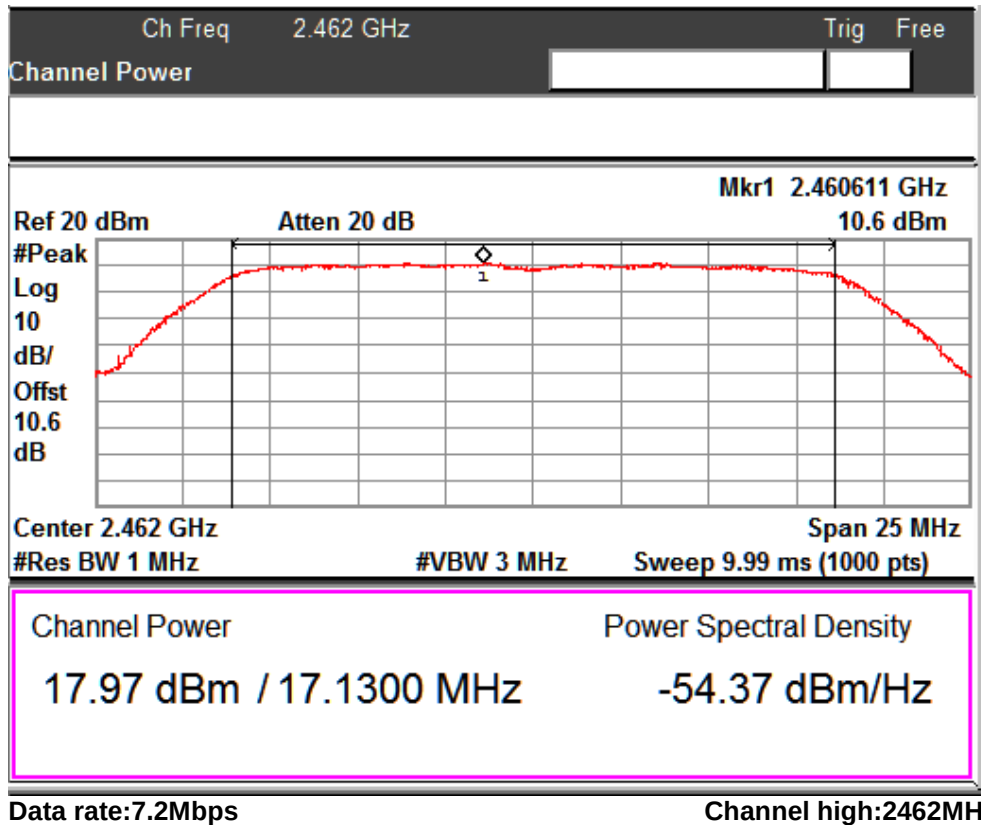
Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

Seite 16 von 45

Page 16 of 45



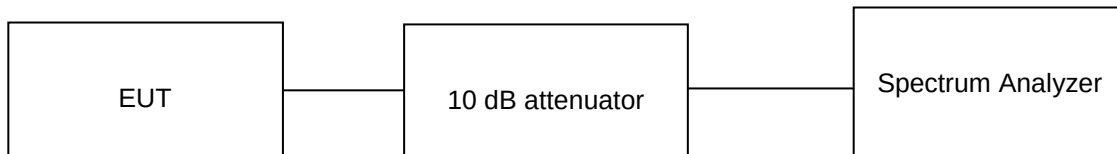
6.2 Maximum Power Spectral Density

Result

Pass

Test Specification	FCC Part 15 Subpart C Section 15.247 (e) and RSS 247 Issue 2, section 5.2(b)
Detector Function	Peak
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 Setup:



Environmental conditions:

Temperature (Norm) = + 22.3 °C

RH= 62 %

Supply voltage: 110 VAC, 60Hz

Test results:

Note: Measurements were made as per KDB 558074 D01 section 8.4 DTS Measurement Guidance v05r02.

10 dB attenuator + 0.6 dB Cable loss = 10.6dB offset is considered in below results

Table 8: Maximum power spectral density test results

Data rate (Mbps)	Channel Frequency (MHz)	Measured PSD	PSD at 3KHz Bandwidth	Limit (dBm)	Margin (dB)
1	2412	6.55	-8.67	8	-16.67
	2437	6.34	-8.89	8	-16.89
	2462	5.96	-9.26	8	-17.26
6	2412	2.34	-12.90	8	-20.90
	2437	2.32	-12.88	8	-20.88
	2462	1.82	-13.40	8	-21.40
7.2	2412	2.43	-12.79	8	-20.79
	2437	2.18	-13.04	8	-21.04
	2462	1.81	-12.85	8	-20.85

Prüfbericht - Nr.:

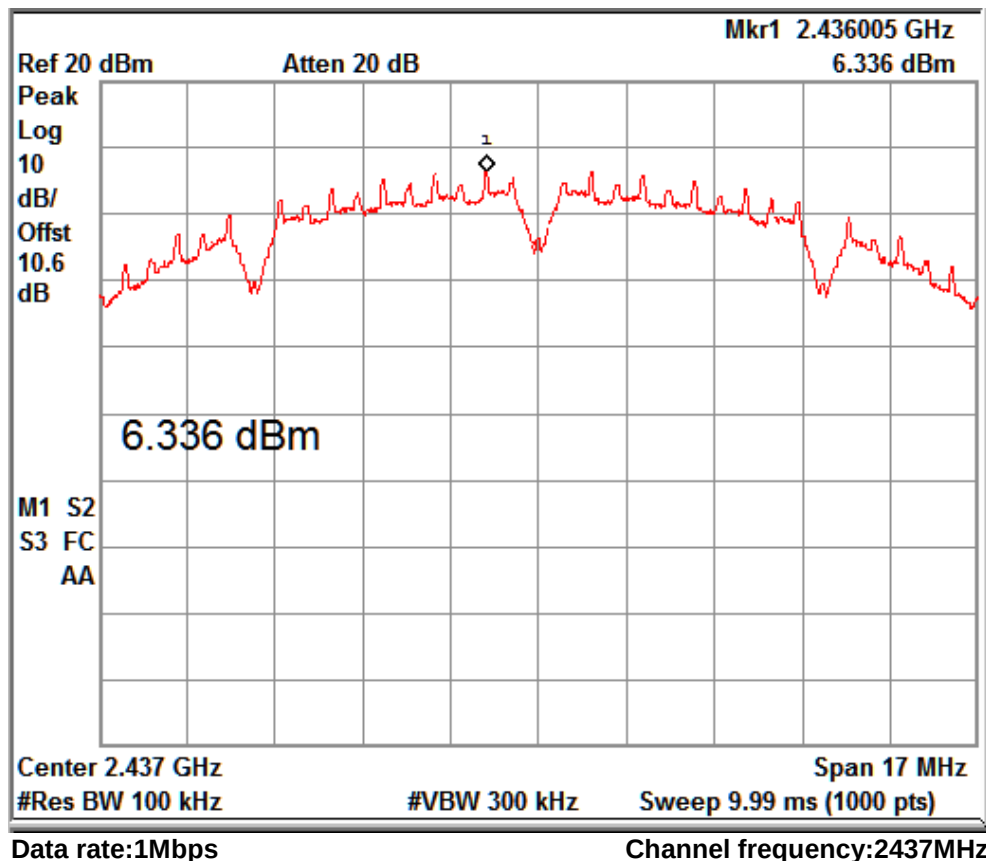
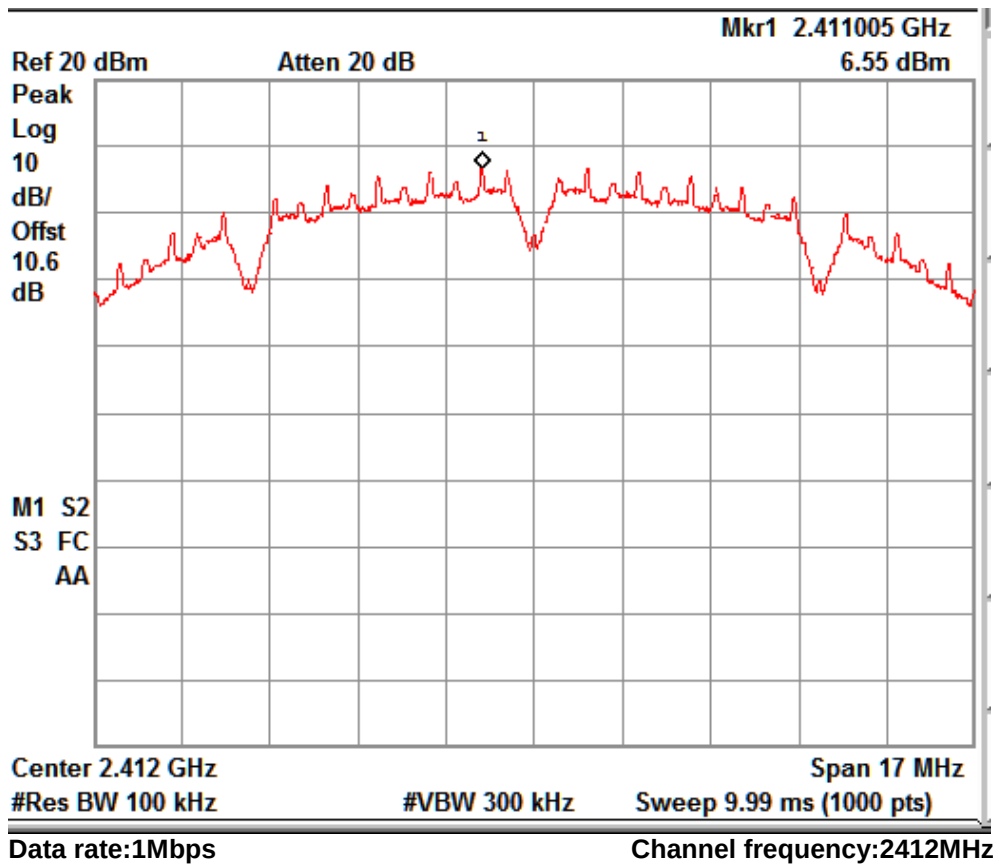
Test Report No.:

ULR-TC568819300000028F

Seite 18 von 45

Page 18 of 45

Test plots 2: PSD Measurements plots



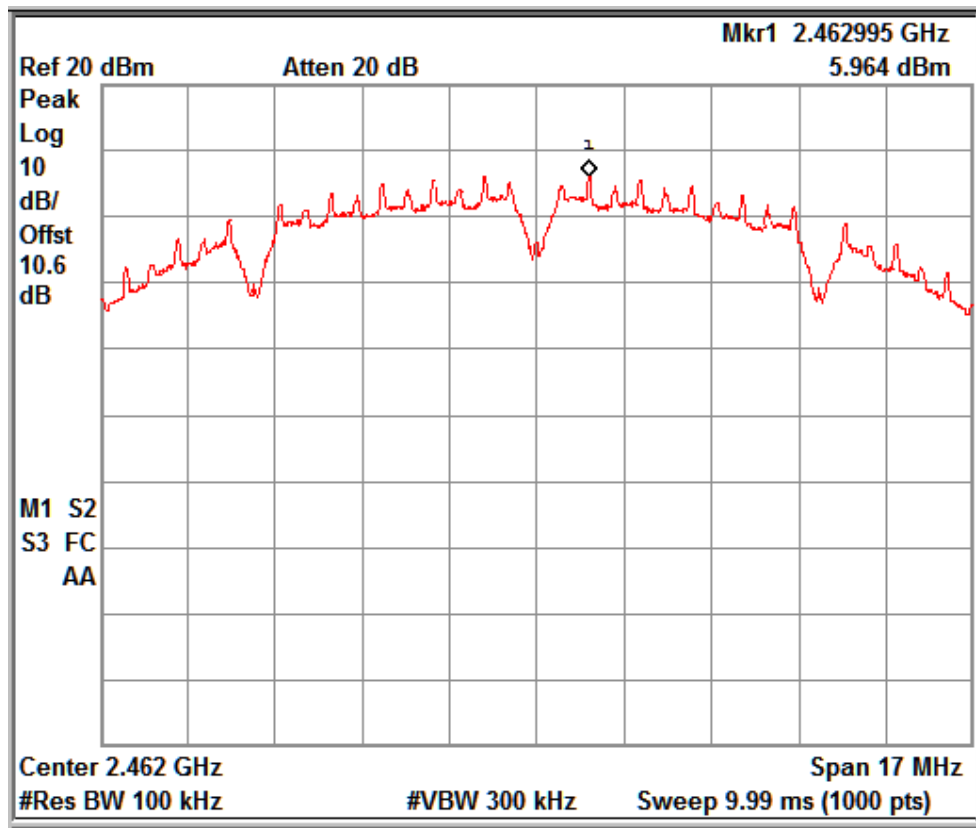
Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

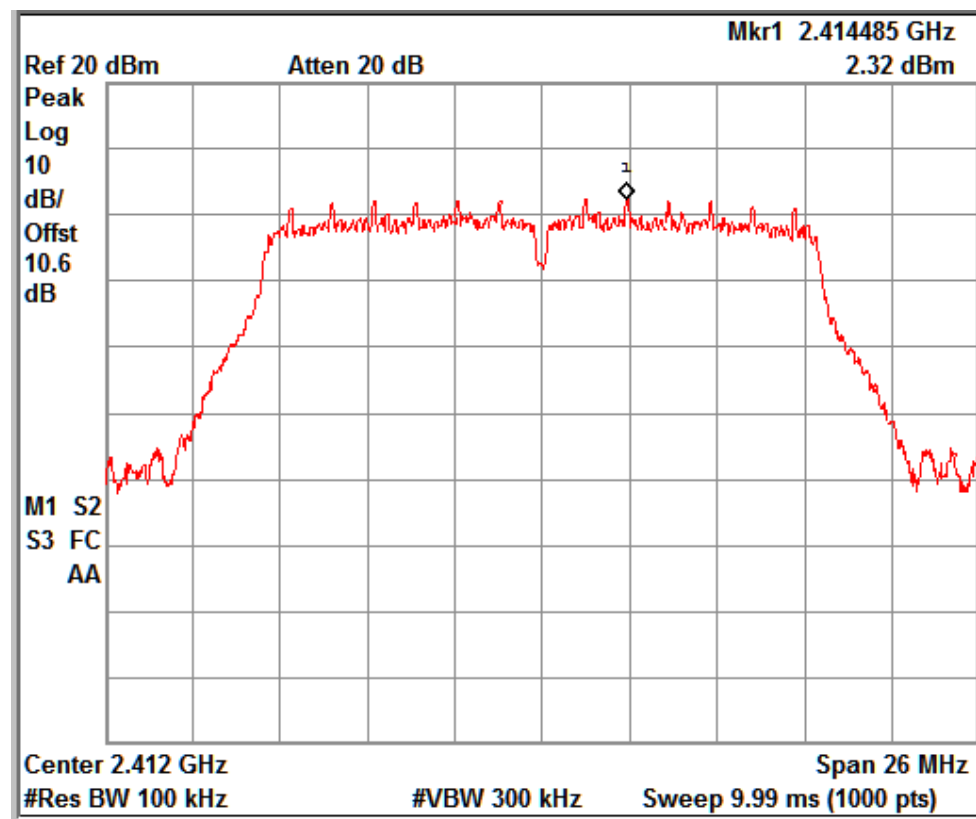
Seite 19 von 45

Page 19 of 45



Data rate:1Mbps

Channel frequency:2462MHz



Data rate:6Mbps

Channel frequency: 2412MHz

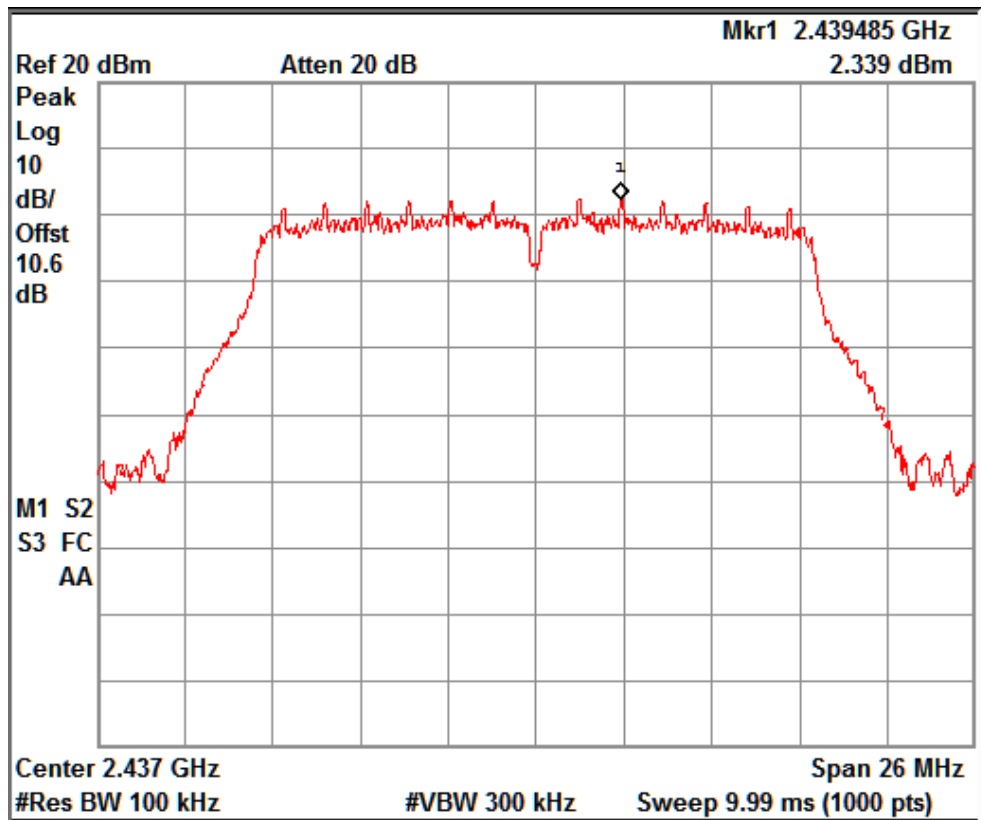
Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

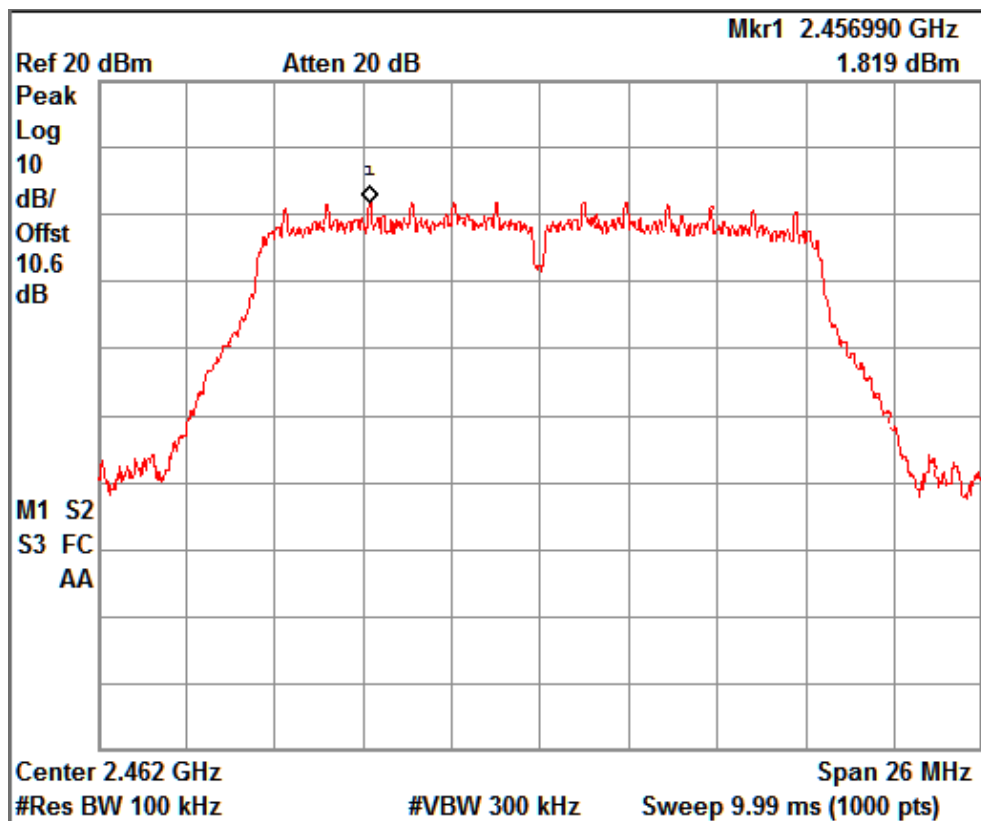
Seite 20 von 45

Page 20 of 45



Data rate:6Mbps

Channel frequency: 2437MHz



Data rate:6Mbps

Channel frequency: 2462MHz

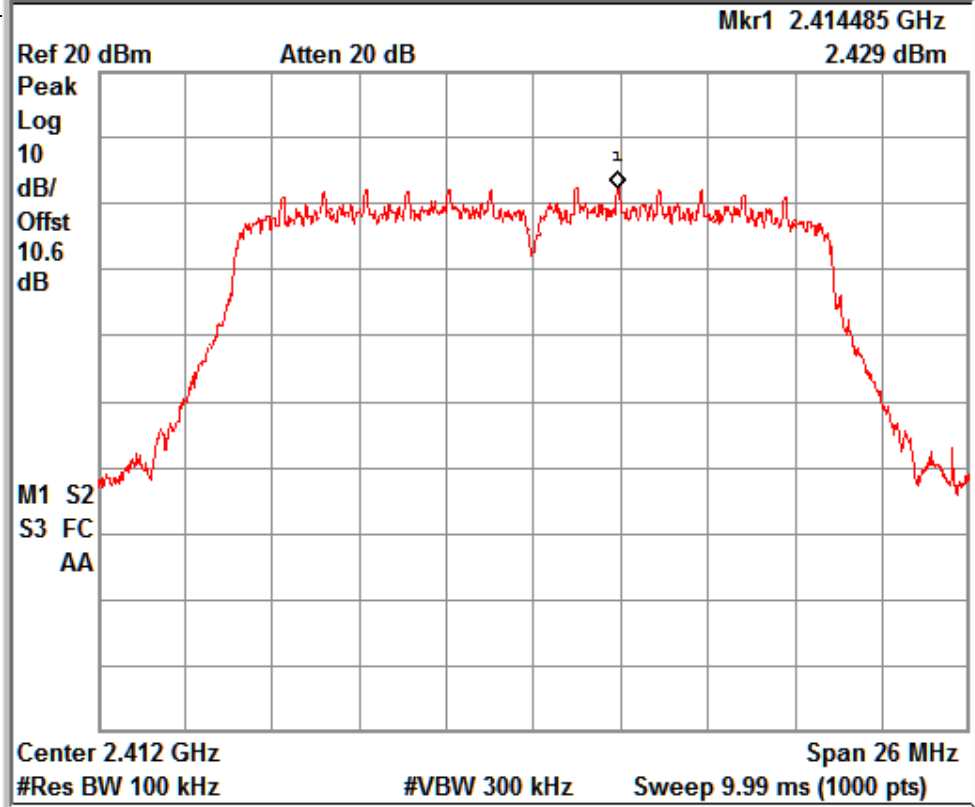
Prüfbericht - Nr.:

ULR-TC568819300000028F

Seite 21 von 45

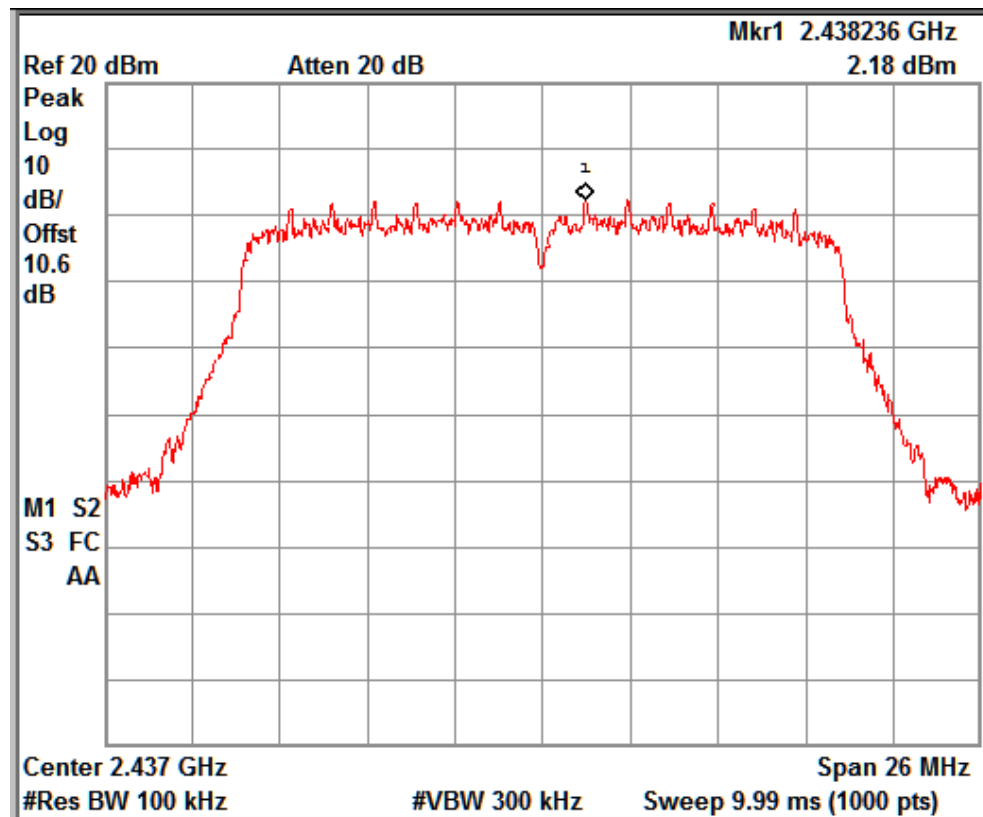
Test Report No.:

Page 21 of 45



Data rate:7.2Mbps

Channel frequency:2412MHz



Data rate:7.2Mbps

Channel frequency:2437MHz

Prüfbericht

Test Report No.

Ref 20 dBm

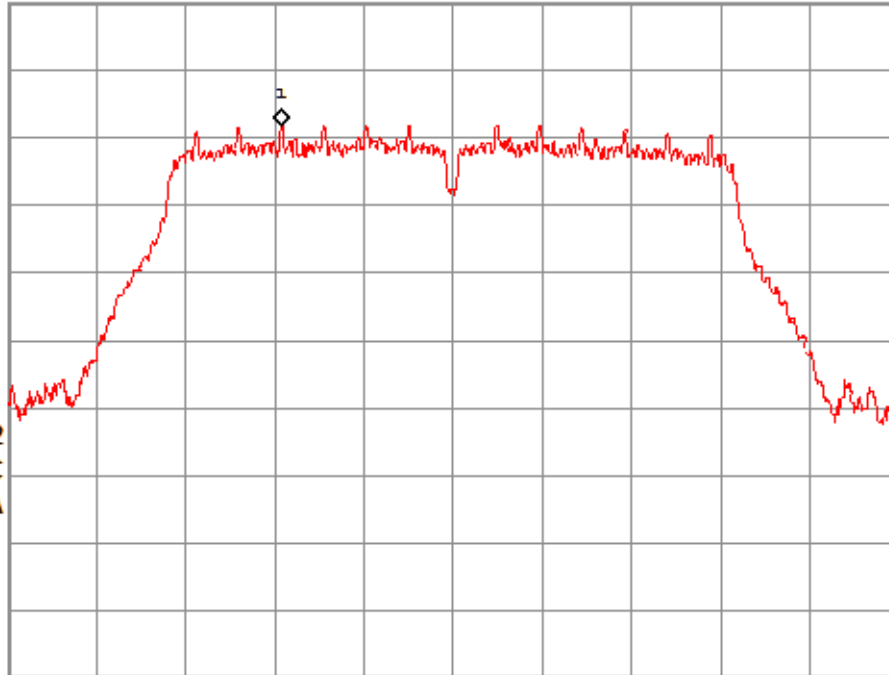
Atten 20 dB

Mkr1 2.456990 GHz
1.819 dBm

Seite 22 von 45
Page 22 of 45

Peak
Log
10
dB/
Offst
10.6
dB

M1 S2
S3 FC
AA



Center 2.462 GHz

Span 26 MHz

#Res BW 100 kHz

#VBW 300 kHz

Sweep 9.99 ms (1000 pts)

Data rate:7.2Mbps

Channel frequency:2462MHz

Note: Bandwidth Correction factor of -15.22dB is added to obtain the PSD for 3KHz bandwidth.

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568819300000028F

Seite 23 von 45
Page 23 of 45

6.3 Emissions in non-restricted frequency bands and Conducted spurious Emission

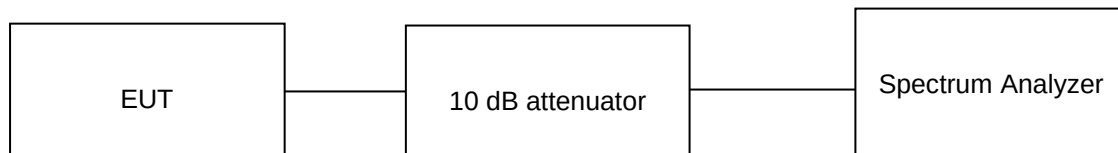
Result

Pass

Test Specification FCC Part 15 Subpart C Section 15.247 (d) and and RSS 247, section 5.5
Detector Function Peak
Port of testing Antenna port

Requirement In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

Test Setup:



Environmental conditions:

Temperature (Norm) = + 22.3 °C

RH= 62 %

Supply voltage: 110 VAC, 60Hz

Test results:

Note:

Note: Measurements were made as per KDB 558074 D01 Section 8.5 DTS Measurement Guidance v05r02.

10 dB attenuator + 0.6 dB Cable loss = 10.6 dB offset is considered in below result.

Table 9:Emissions in non-restricted frequency bands test results

Data rate (Mbps)	Channel Frequency (MHz)	Value at Band Edge		Reference PSD Value B (dBm)	Band Edge Value A~B (dBc)	Limit (dBc)
		Frequency (MHz)	Value A (dBm)			
1	2412	2398.16	-36.27	6.55	42.82	>=20
	2462	2483.50	-42.83	5.96	48.79	>=20
6	2412	2399.60	-37.15	2.32	39.47	>=20
	2462	2483.50	-45.66	1.82	47.48	>=20
7.2	2412	2400.00	-37.67	2.43	40.10	>=20
	2462	2483.50	-44.49	2.37	46.86	>=20

Prüfbericht - Nr.:

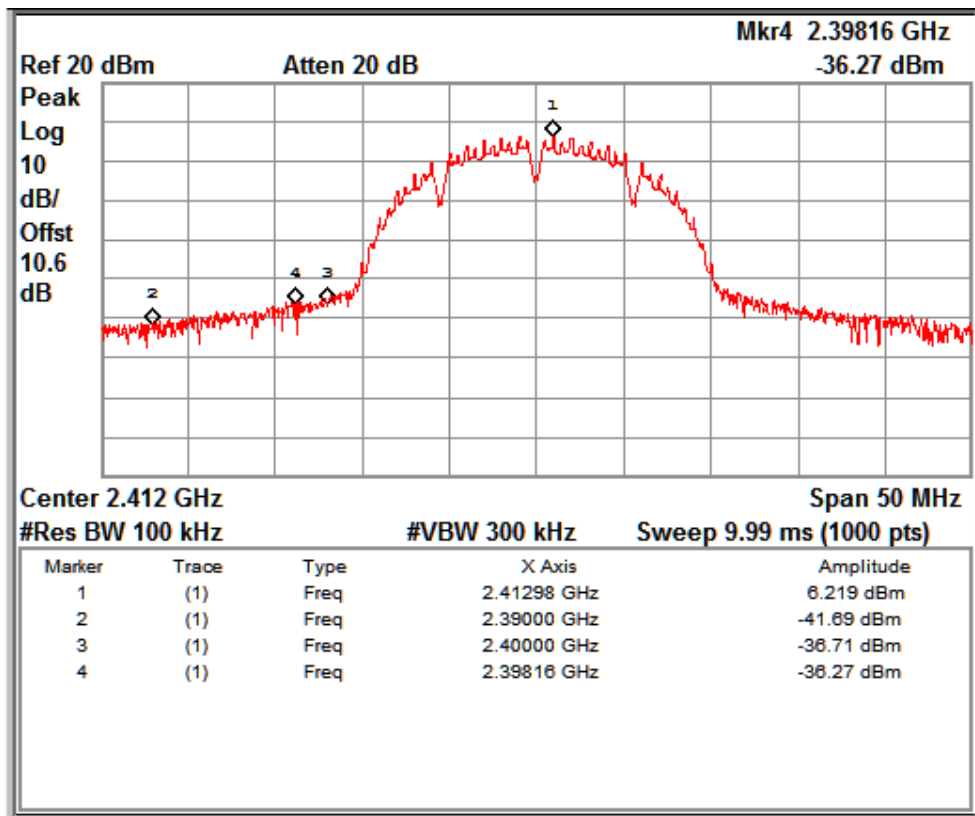
Test Report No.:

ULR-TC568819300000028F

Seite 24 von 45

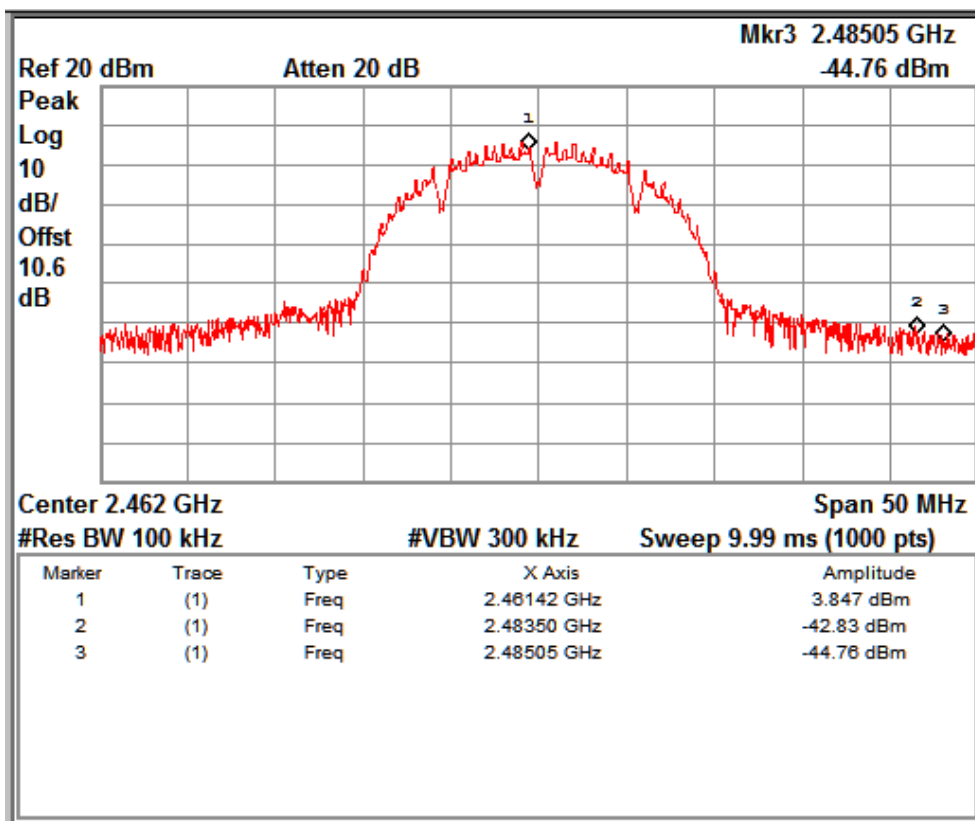
Page 24 of 45

Test plots 3:Emission in non restricted bands measurements plots



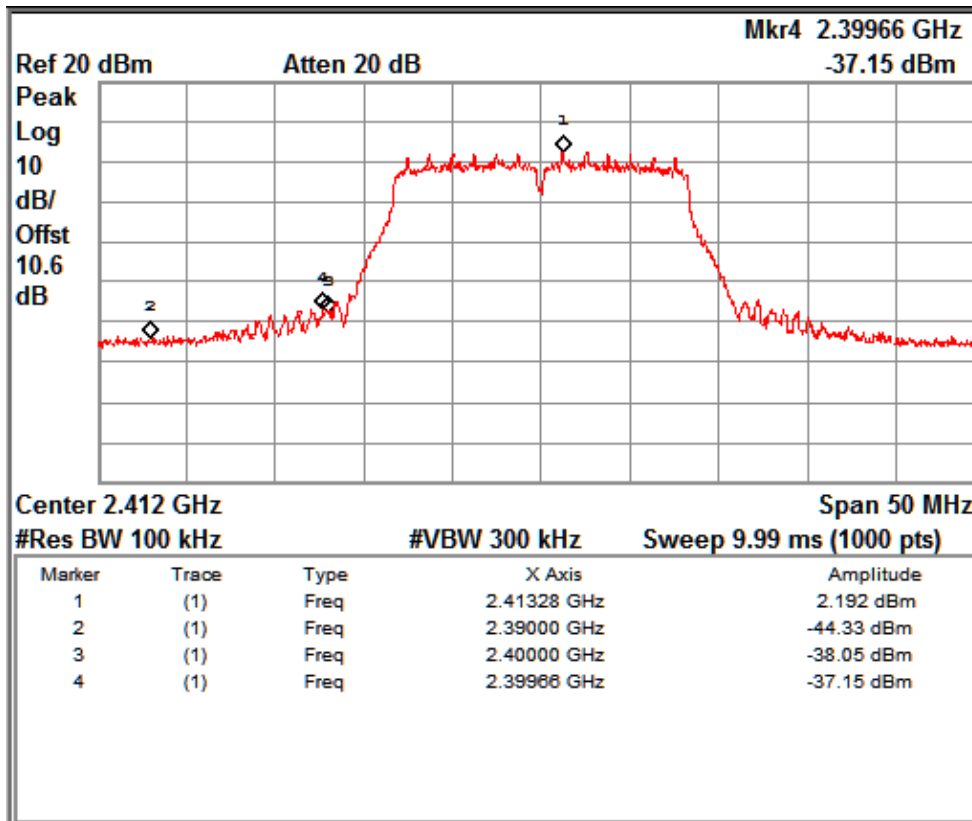
Data rate:1Mbps

Channel frequency:2412MHz



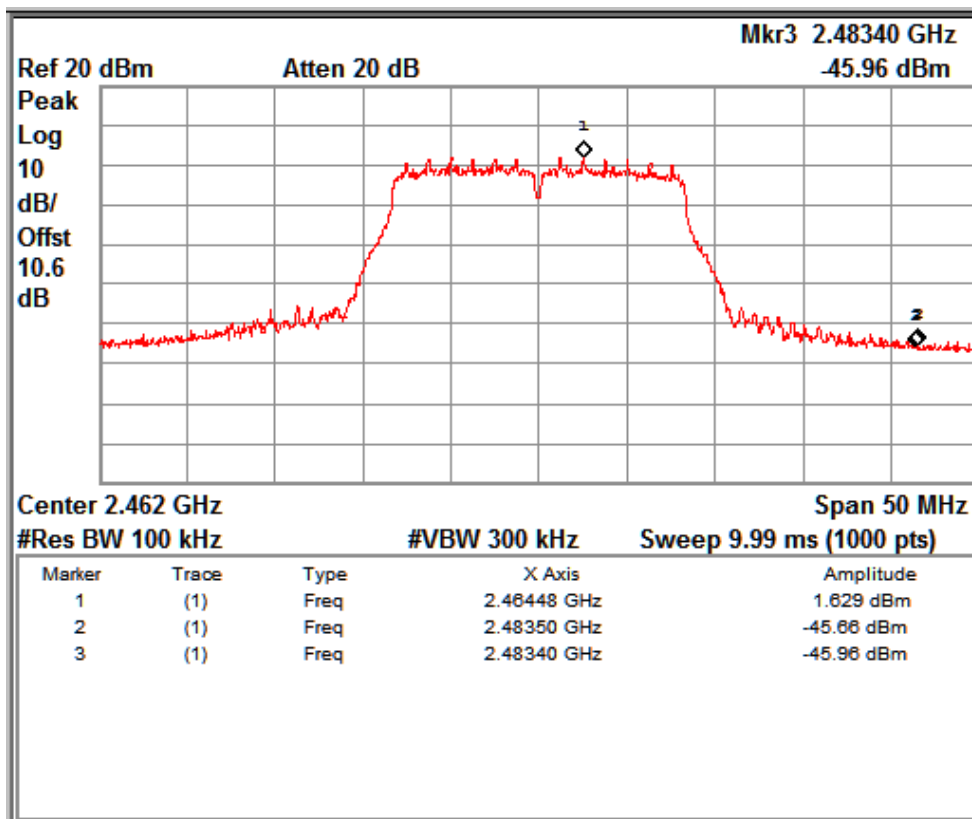
Data rate:1Mbps

Channel frequency: 2462MHz



Data rate:6Mbps

Channel frequency:2412MHz



Data rate:6Mbps

Channel frequency:2462MHz

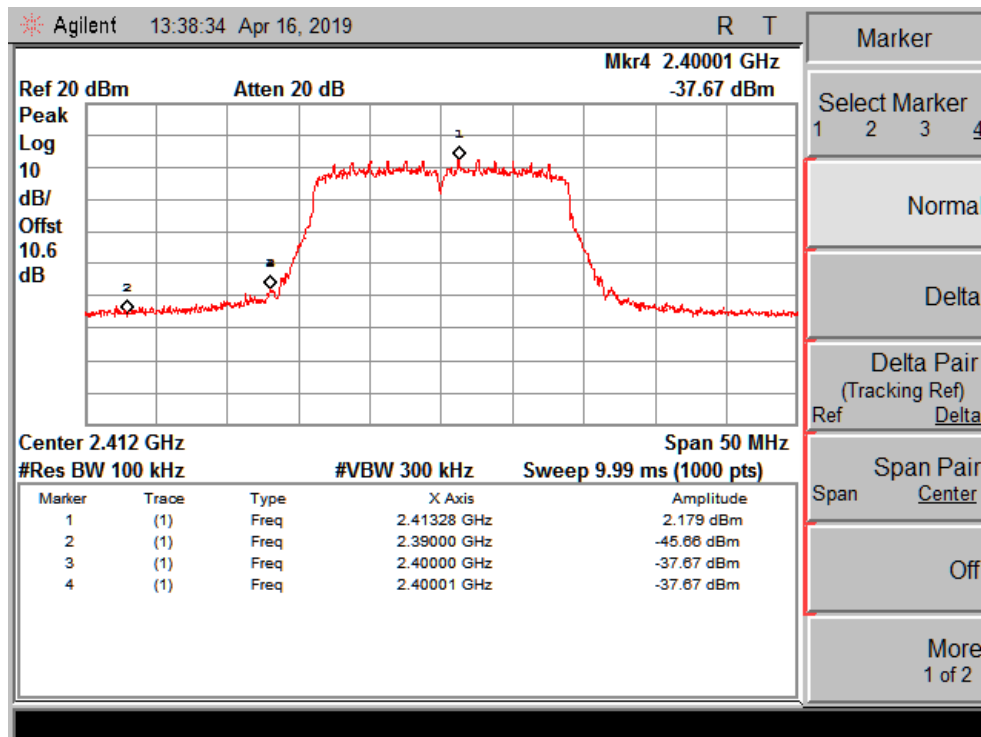
Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

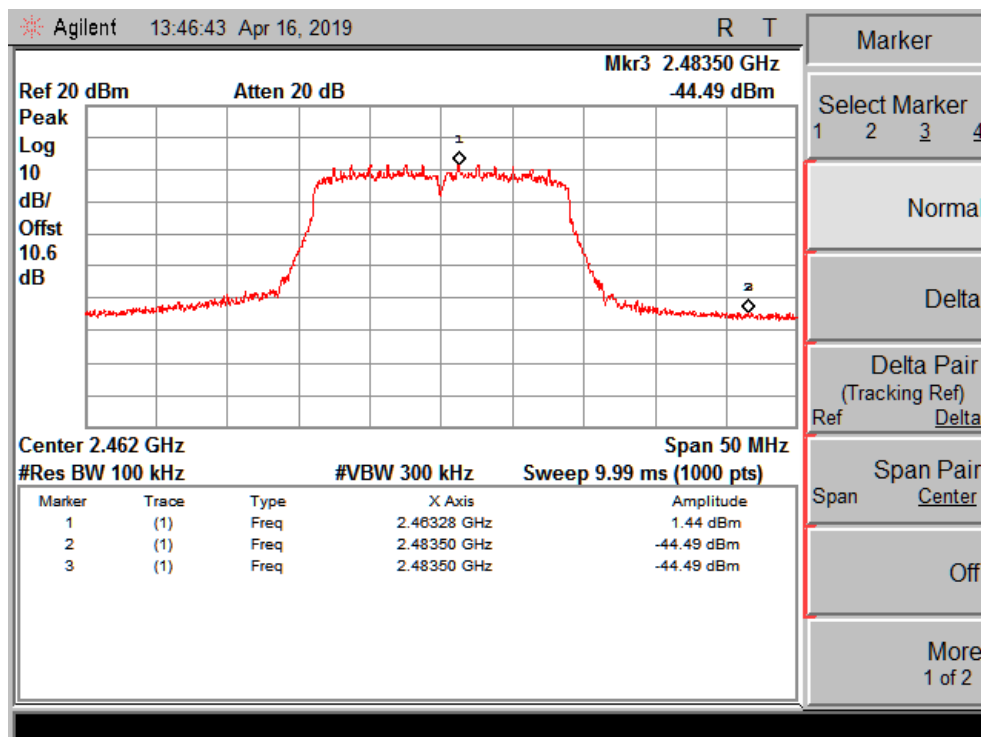
Seite 26 von 45

Page 26 of 45



Data rate:7.2Mbps

channel frequency:2412MHz



Data rate:7.2Mbps

Channel frequency:2462MHz

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568819300000028F

Seite 27 von 45
Page 27 of 45

6.4 Spurious Radiated Emissions & Restricted Bands of Operation

Result

Pass

Test Specification	FCC part 15 Subpart C Section 15.247 (d)/(15.209 & 15.205) and RSS- Gen Issue 5 Section 8.9/8.10
Test Method	ANSI C 63.10 - 2013
Measurement Location	Semi Anechoic Chamber
Measuring Distance	3 m
Detector	QP for frequency below 1 GHz, average for frequency above 1 GHz
Requirement	As per the limits mentioned in the below table

Table 10: Transmitter limits for Radiated emission

Frequency (MHz)	Field strength ($\mu\text{V/m}$)	Field strength (dB $\mu\text{V/m}$)	Distance of Measurement (m)
0.009 – 0.490	2400/F(kHz)	48.50 – 13.80	300*
0.490 – 1.705	24000/F(kHz)	33.80 – 23.00	30*
1.705 -30	30	29.54	30*
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Remark: * The limit shows in the table above of frequency range 0.009 – 0.490, 0.490 – 1.705 MHz and 1.705-30MHz is at 300 meter and 30meter range respectively, which corresponds to 128.51 – 93.80, 73.80 – 62.96 and 69.54 dB $\mu\text{V/m}$ at 3m range by extrapolation calculation and the measurement of loop antenna.

The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz Radiated emission limits in these three bands are based on measurements employing an average detector.

Test Conditions:

Supply Voltage: Voltage =110 VAC, 60Hz and PoE

Environmental conditions:

Temperature: +23.5 °C RH: 54 %

Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

Seite 28 von 45

Page 28 of 45

Test results:

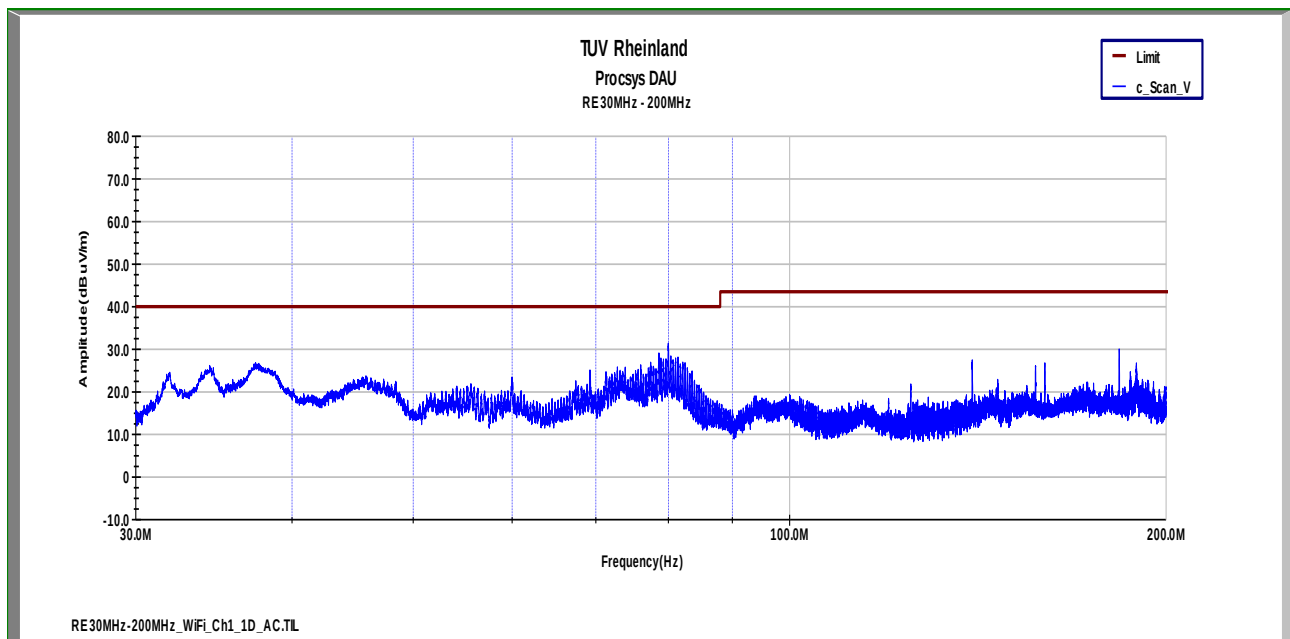
Test results for frequency range 9KHz to 30MHz

No emissions found in frequency range 9 kHz to 1 GHz.

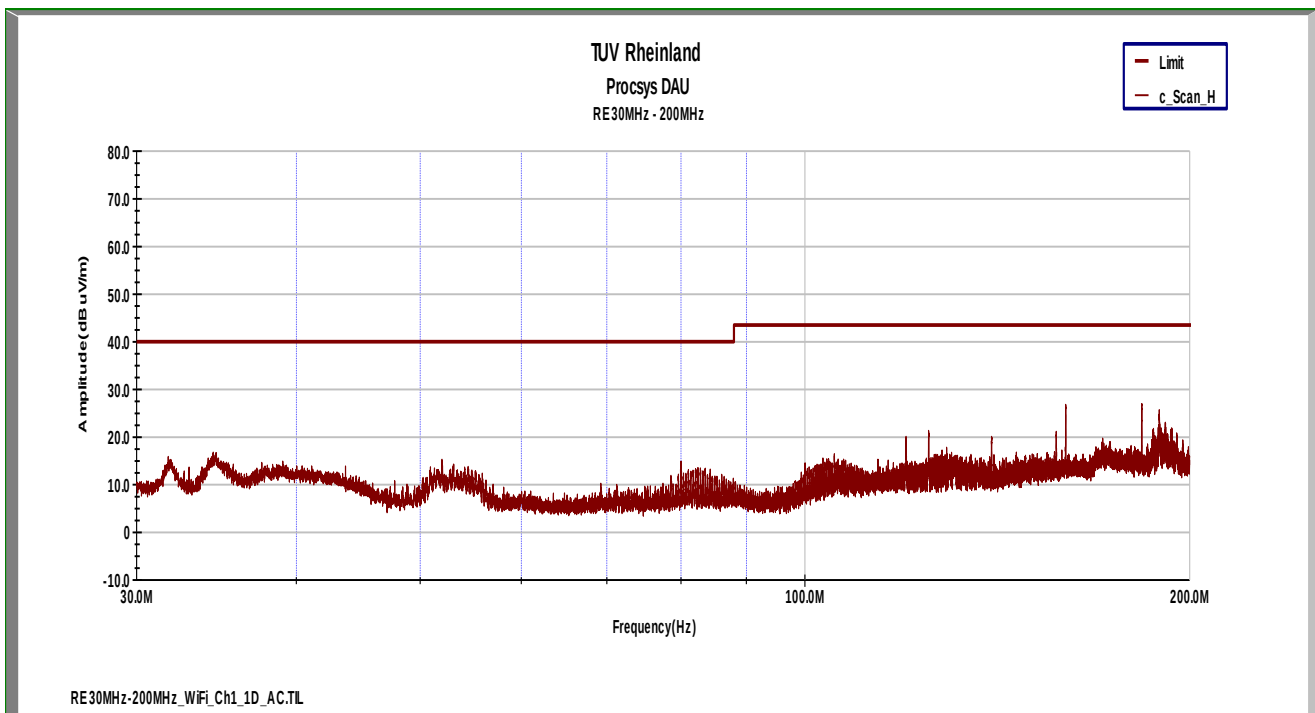
Test results for frequency range 30MHz – 1GHz

Antenna Polarization	Measured Frequency (MHz)	Field strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Vertical	37.40	23.59	40.00	-16.41
	79.98	31.39	40.00	-8.61
	140.00	27.47	43.50	-16.03
	183.49	30.05	43.50	-13.45
	209.73	26.03	43.50	-17.47
	874.98	37.55	46.00	-8.45
	899.81	20.89	46.00	-25.11
Horizontal	34.60	16.67	40.00	-23.33
	160.00	26.79	43.50	-16.71
	183.49	26.77	43.50	-16.73
	314.53	29.65	46.00	-16.35
	750.00	31.88	46.00	-14.12
	874.99	35.72	46.00	-10.28

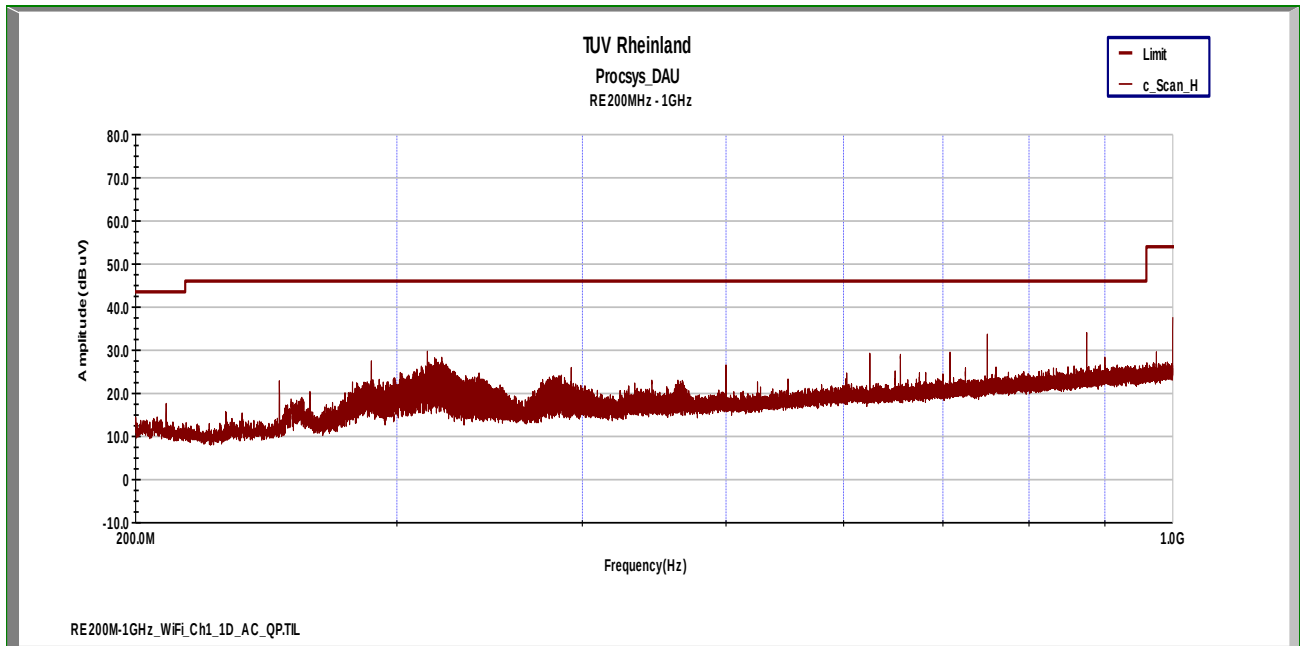
Test plots 4: Worst case spurious emissions plots in the frequency range 30MHz to 1GHz



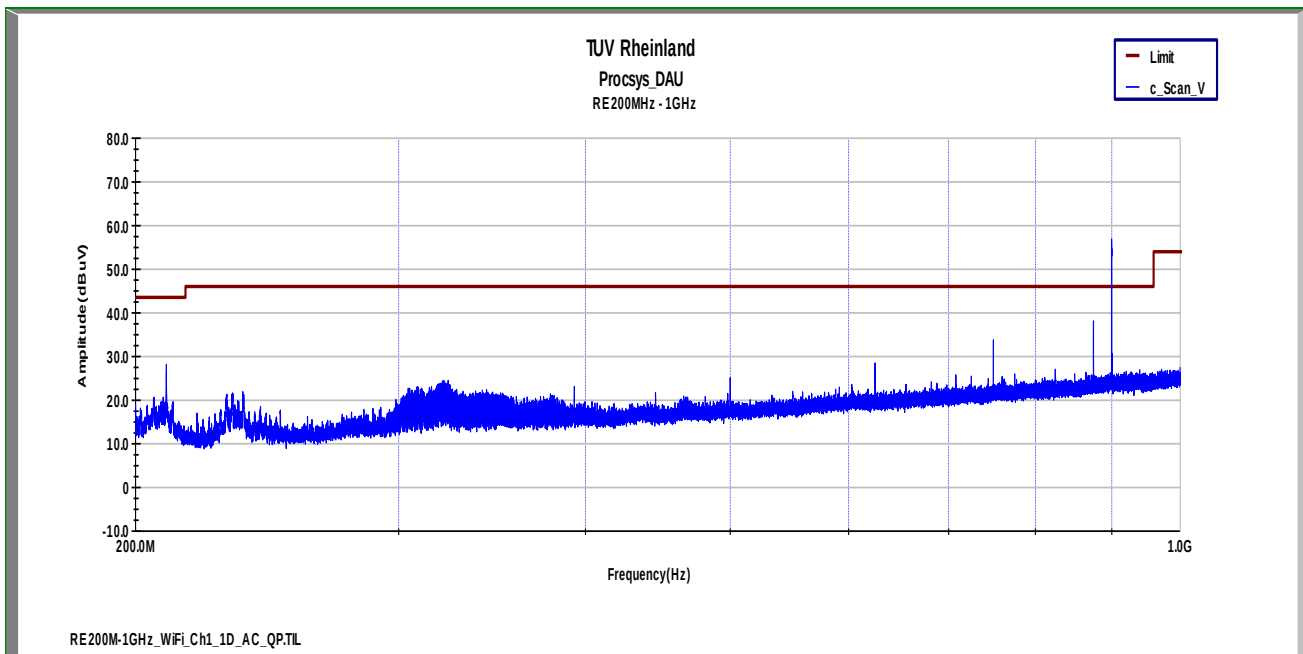
Vertical polarization



Horizontal polarization



Vertical polarization



Horizontal polarization

Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

Seite 31 von 45

Page 31 of 45

Test results for frequency range: 1GHz to 26GHz

Table 11: Spurious Radiated Emissions & Restricted Bands of Operation test results

Mode:802.11b

Data rates (Mbps)	Operating Frequency (MHz)	Antenna Polarization	Measured Frequency (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1	2412	Vertical	2390 (Pk)	64.18	74	-9.82
			2390 (Av)	37.78	54	-16.22
			2412 (Pk)	99.03	*	-
			2412 (Av)	96.41	*	-
			4824(Pk)	29.37	74	-44.63
			4824(Av)	17.15	54	-36.85
			7236(Pk)	32.21	74	-41.79
			7236(Av)	19.52	54	-34.48
		Horizontal	2390 (Pk)	56.94	74	-17.06
			2390 (Av)	30.46	54	-23.54
			2412 (Pk)	91.43	*	-
			2412 (Av)	87.80	*	-
			4824(Pk)	29.38	74	-44.62
			4824(Av)	16.69	54	-37.31
			7236(Pk)	32.45	74	-41.55
			7236(Av)	19.50	54	-34.50
	2437	Vertical	2437(Pk)	100.38	*	-
			2437(Av)	97.04	*	-
			4874(Pk)	29.70	74	-44.30
			4874(Av)	29.92	54	-24.08
			7311(Pk)	33.86	74	-40.14
			7311(Av)	19.81	54	-34.19
		Horizontal	2437(Pk)	91.59	*	-
			2437(Av)	88.82	*	-
			4874(Pk)	30.38	74	-43.62
			4874(Av)	16.81	54	-37.19
			7311(Pk)	33.24	74	-40.76
			7311(Av)	19.78	54	-34.22
	2462	Vertical	2483.5 (Pk)	67.15	74	-6.85
			2483.5 (Av)	38.47	54	-15.53
			2462 (Pk)	100.55	*	-
			2462 (Av)	97.56	*	-
			4924(Pk)	31.23	74	-42.77
			4924(Av)	17.93	54	-36.07
			7386(Pk)	33.84	74	-40.16
			7386(Av)	20.46	54	-33.54
		Horizontal	2483.5 (Pk)	56.17	74	-17.83
			2483.5 (Av)	29.16	54	-24.84
			2462 (Pk)	90.64	*	-
			2462 (Av)	88.04	*	-
			4924(Pk)	30.31	74	-43.69
			4924(Av)	17.13	54	-36.87
			7386(Pk)	34.80	74	-39.20
			7386(Av)	20.49	54	-33.51

Note: Measured Emissions (dBµV/m) = Received Emissions(dBµV) + Antenna Factor(dB/m)+ Cable Loss(dB) – Pre-amplifier Gain(dBi)

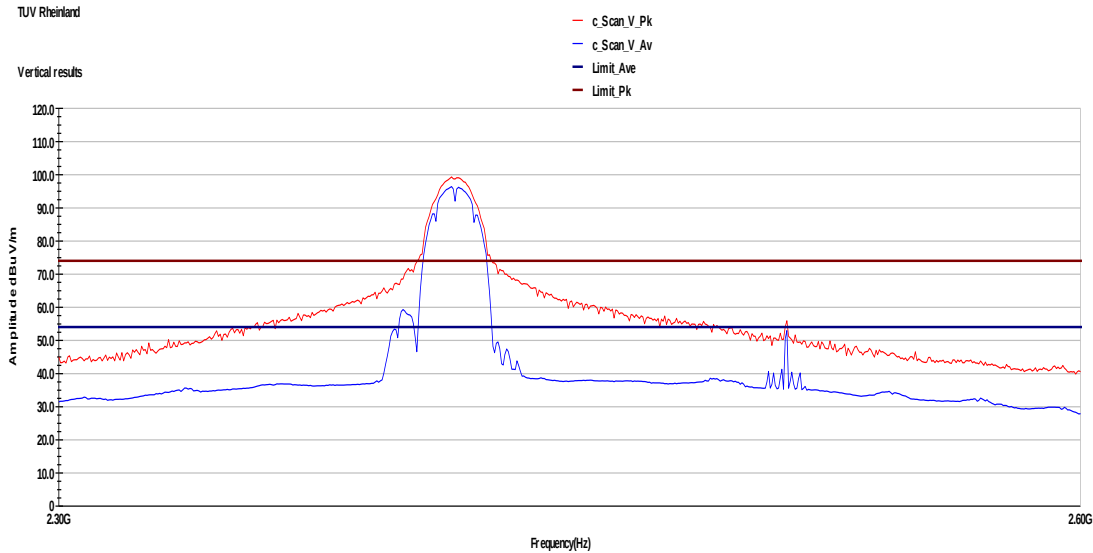
Note: *: Fundamental frequency

Pk: Peak Detector

Av: Average Detector

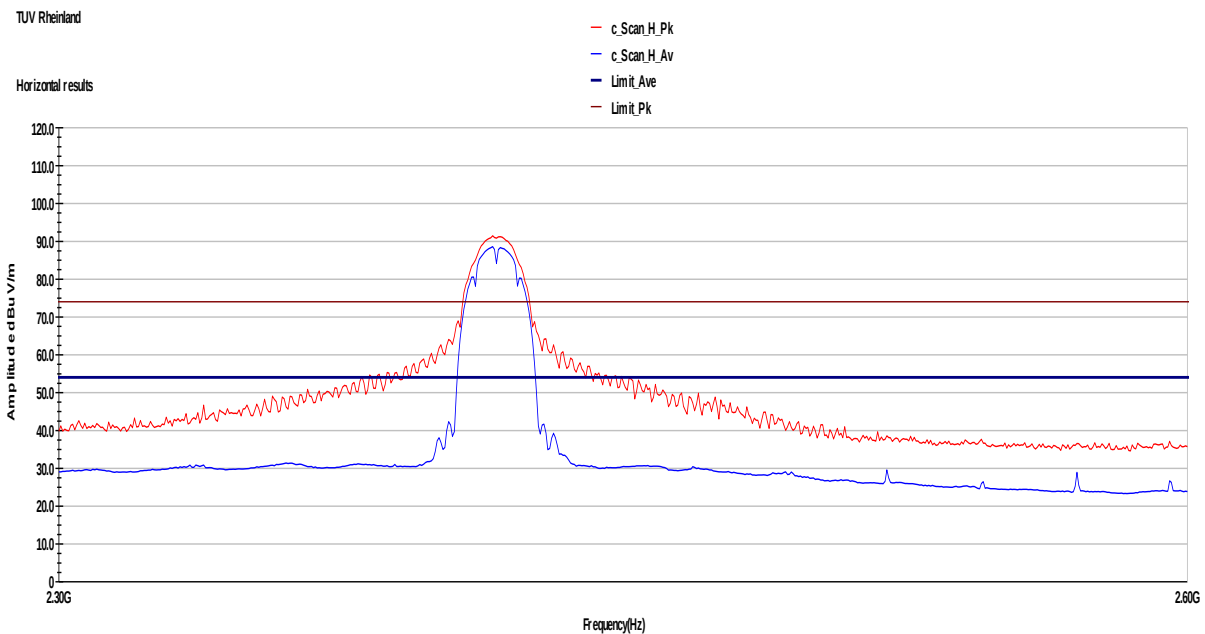
Test plots 5: Worst case Restricted bands/spurious emissions plots in the frequency range above 1GHz (Mode : 802.11b)

Restricted bands



Low_1Mbps.T1L

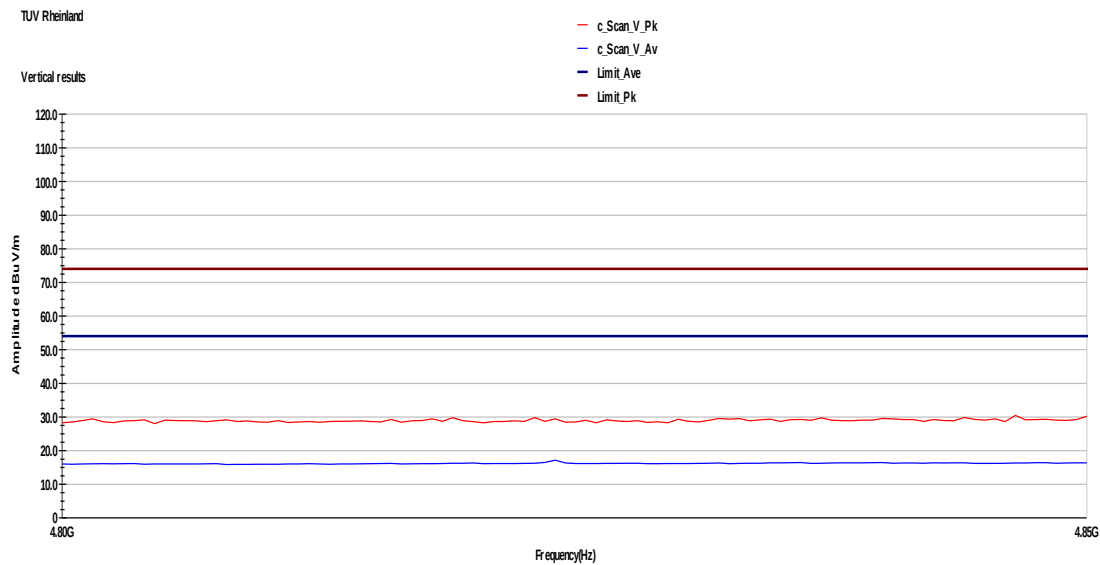
Vertical polarization



Low_1Mbps.T1L

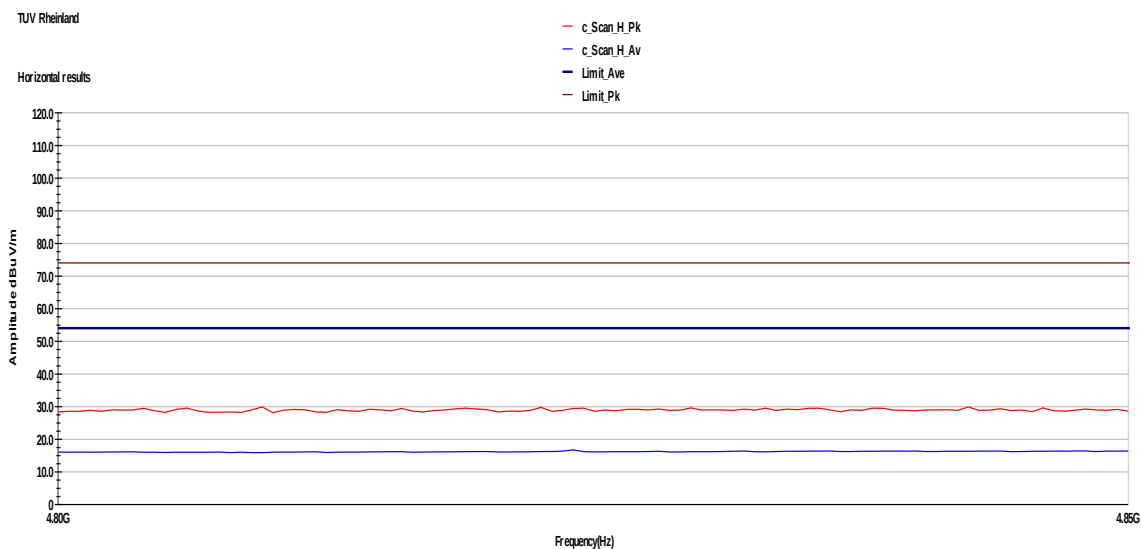
Horizontal polarization

Spurious emissions



ChLow_1Mbps_2nd Harmonic.TIL

Vertical polarization



ChLow_1Mbps_2nd Harmonic.TIL

Horizontal polarization

Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

Seite 34 von 45

Page 34 of 45

Mode:802.11g

Data rates (Mbps)	Operating Frequency (MHz)	Antenna Polarization	Measured Frequency (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
6	2412	Vertical	2390 (Pk)	58.49	74	-15.51
			2390 (Av)	42.83	54	-11.17
			2412 (Pk)	100.37	*	-
			2412 (Av)	91.32	*	-
			4824(Pk)	29.89	74	-44.11
			4824(Av)	16.53	54	-37.47
			7236(Pk)	32.89	74	-41.11
			7236(Av)	19.61	54	-34.39
		Horizontal	2390 (Pk)	47.41	74	-26.59
			2390 (Av)	32.93	54	-21.07
			2412 (Pk)	92.29	*	-
			2412 (Av)	82.61	*	-
			4824(Pk)	29.46	74	-44.54
			4824(Av)	16.51	54	-37.49
			7236(Pk)	32.82	74	-41.18
			7236(Av)	19.59	54	-34.41
	2437	Vertical	2437(Pk)	101.36	*	-
			2437(Av)	92.31	*	-
			4874(Pk)	29.75	74	-44.25
			4874(Av)	16.81	54	-37.19
			7311(Pk)	33.01	74	-40.99
			7311(Av)	19.84	54	-34.16
		Horizontal	2437(Pk)	93.32	*	-
			2437(Av)	83.71	*	-
			4874(Pk)	30.81	74	-43.19
			4874(Av)	16.75	54	-37.25
			7311(Pk)	32.86	74	-41.14
			7311(Av)	19.84	54	-34.16
	2462	Vertical	2483.5 (Pk)	57.14	74	-16.86
			2483.5 (Av)	41.57	54	-12.43
			2462 (Pk)	101.49	*	-
			2462 (Av)	92.42	*	-
			4924(Pk)	30.35	74	-43.65
			4924(Av)	17.03	54	-36.97
			7386(Pk)	35.19	74	-38.81
			7386(Av)	20.47	54	-33.53
		Horizontal	2483.5 (Pk)	46.75	74	-27.25
			2483.5 (Av)	31.41	54	-22.59
			2462 (Pk)	91.37	*	-
			2462 (Av)	82.44	*	-
			4924(Pk)	31.14	74	-42.86
			4924(Av)	17.01	54	-36.99
			7386(Pk)	33.57	74	-40.43
			7386(Av)	20.57	54	-33.43

Note: Measured Emissions (dBµV/m) = Received Emissions(dBµV) + Antenna Factor(dB/m)+ Cable Loss(dB) – Pre-amplifier Gain(dBi)

Note: *: Fundamental frequency

Pk: Peak Detector

Av: Average Detector

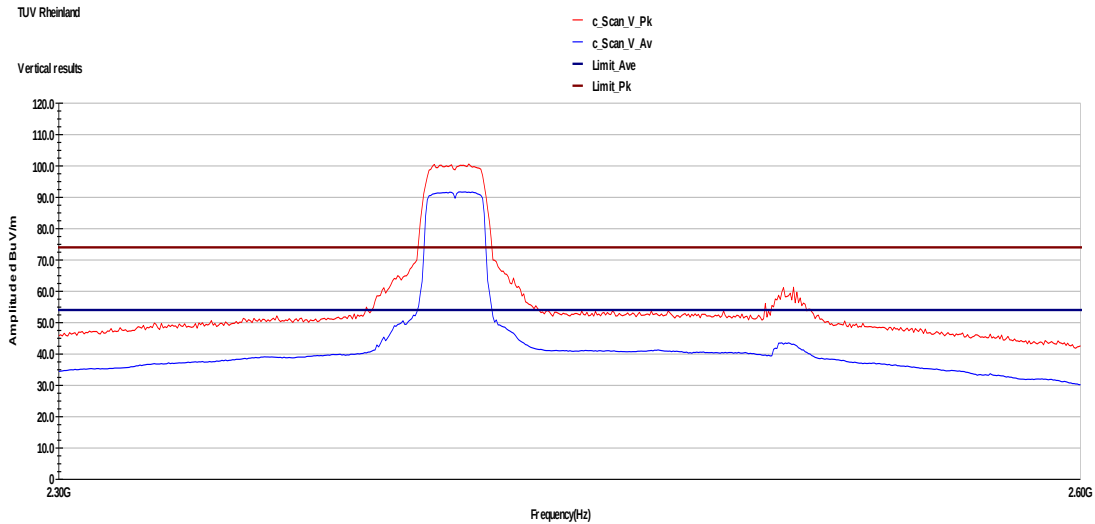
Prüfbericht - Nr.:
Test Report No.:

ULR-TC568819300000028F

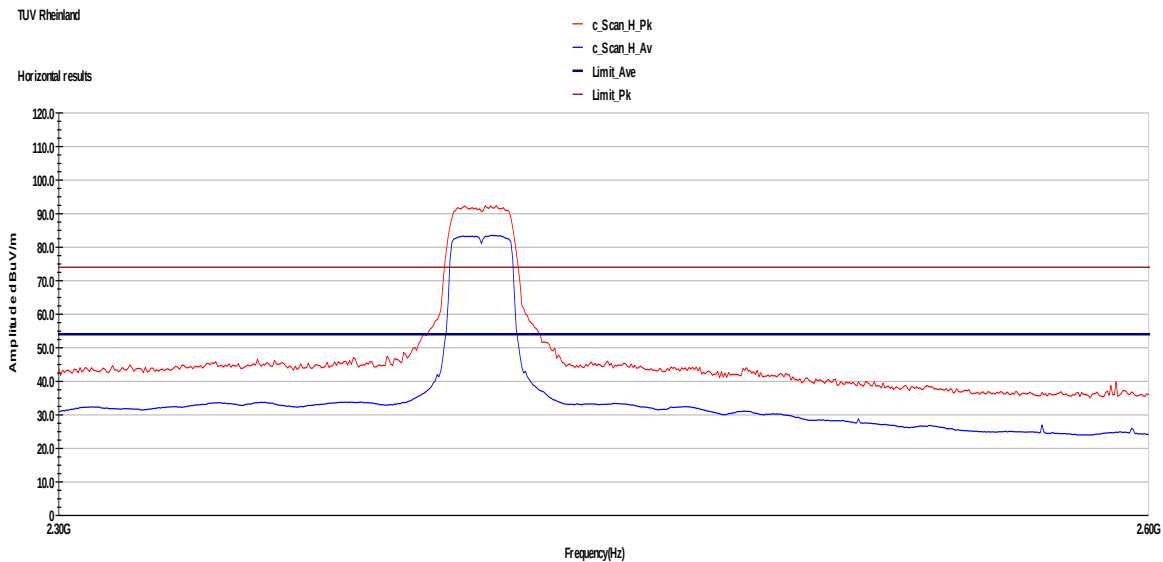
Seite 35 von 45
Page 35 of 45

Test plots 6: Worst case Restricted bands/spurious emissions plots in the frequency range above 1GHz (Mode : 802.11g)

Restricted bands

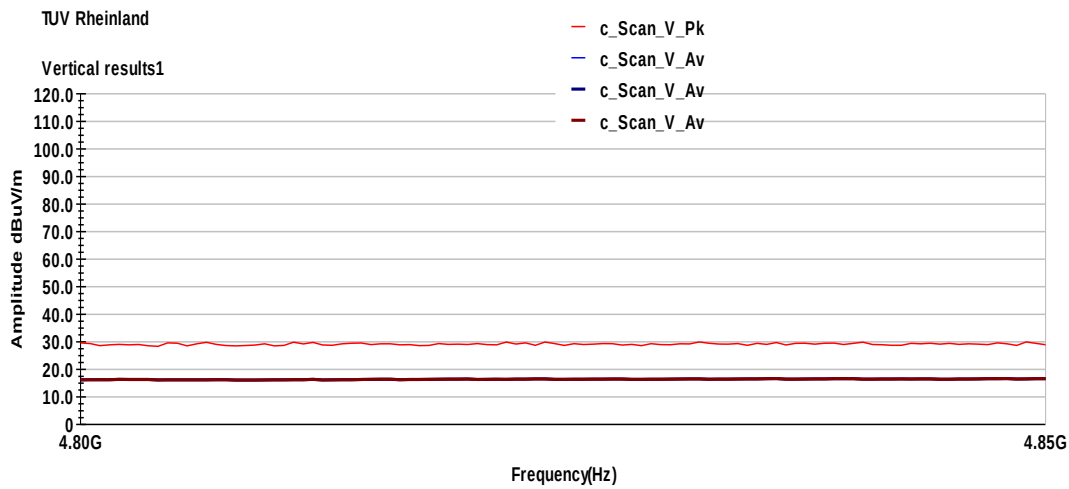


Vertical polarization



Horizontal polarization

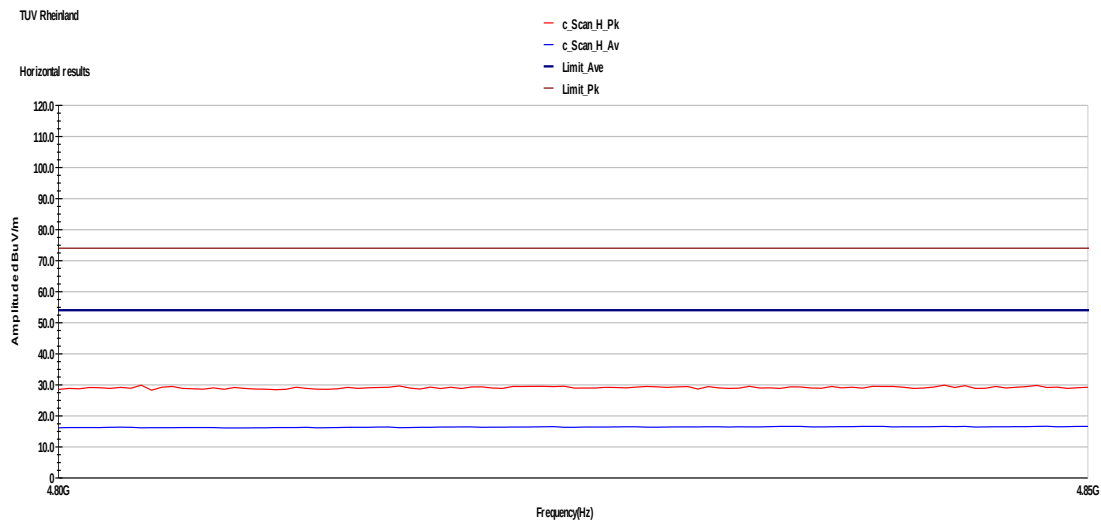
Spurious emissions



Ch-Low_6Mbps_2nd Harmonic.TIL

2nd harmonic

Vertical polarization



Ch-Low_6Mbps_2nd Harmonic.TIL

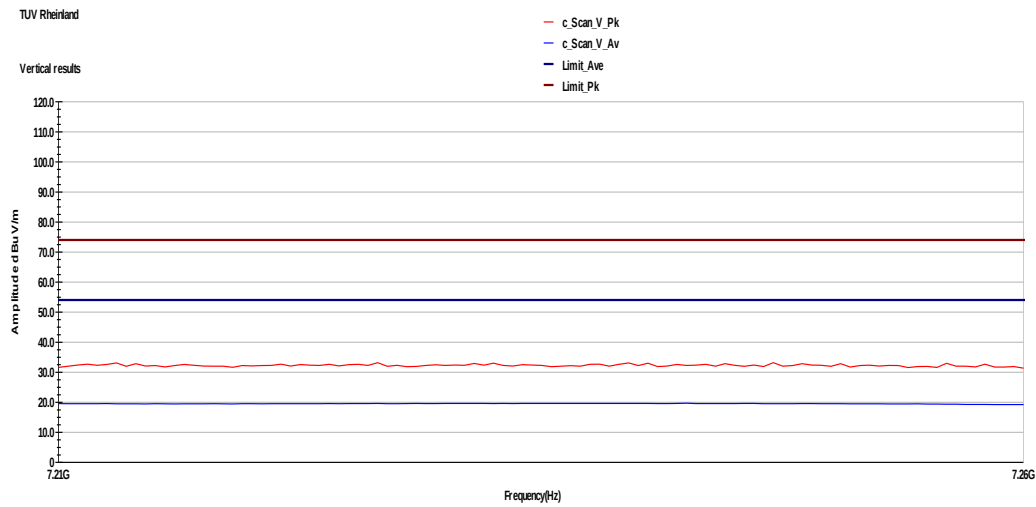
2nd harmonic

Horizontal polarization

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568819300000028F

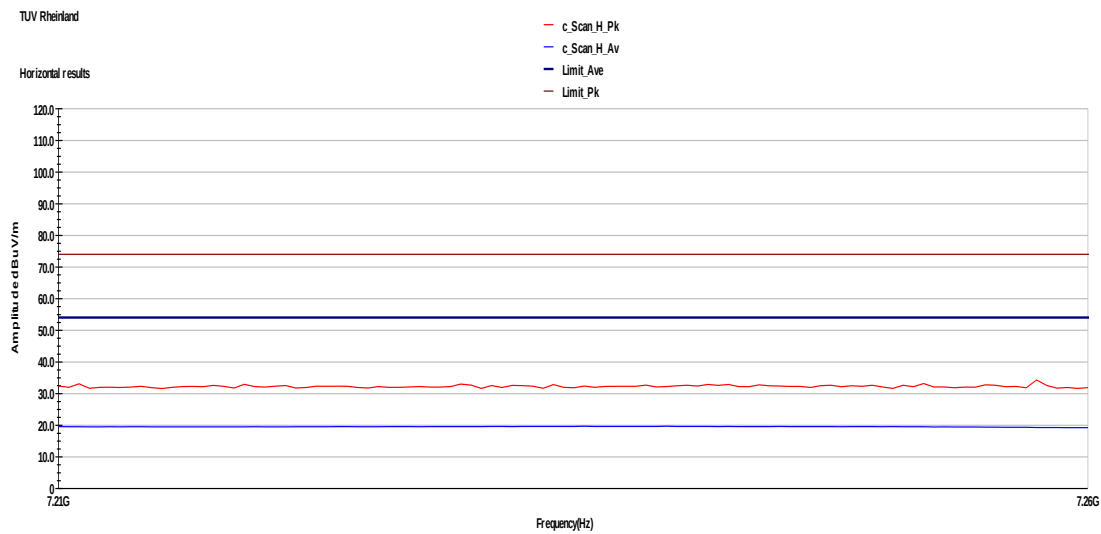
Seite 37 von 45
Page 37 of 45



ChLow_6Mbps_3rdHarmonic.TTL

3rd harmonic

Vertical polarization



ChLow_6Mbps_3rdHarmonic.TTL

3rd harmonic

Horizontal polarization

Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

Seite 38 von 45

Page 38 of 45

Mode:802.11n

Data rates (Mbps)	Operating Frequency (MHz)	Antenna Polarization	Measured Frequency (MHz)	Field Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)
7.2	2412	Vertical	2390 (Pk)	65.59	74	-8.41
			2390 (Av)	46.42	54	-7.58
			2412 (Pk)	102.71	*	-
			2412 (Av)	91.47	*	-
			4824(Pk)	29.07	74	-44.93
			4824(Av)	16.79	54	-37.21
			7236(Pk)	32.51	74	-41.49
			7236(Av)	19.61	54	-34.39
		Horizontal	2390 (Pk)	45.38	74	-28.62
			2390 (Av)	32.88	54	-21.12
			2412 (Pk)	94.08	*	-
			2412 (Av)	82.97	*	-
			4824(Pk)	30.06	74	-43.94
			4824(Av)	16.46	54	-37.54
			7236(Pk)	32.72	74	-41.28
			7236(Av)	19.57	54	-34.43
	2437	Vertical	2437(Pk)	103.03	*	-
			2437(Av)	92.09	*	-
			4874(Pk)	30.38	74	-43.62
			4874(Av)	16.44	54	-37.56
			7311(Pk)	32.88	74	-41.12
			7311(Av)	19.83	54	-34.17
		Horizontal	2437(Pk)	94.23	*	-
			2437(Av)	83.17	*	-
			4874(Pk)	29.07	74	-44.93
			4874(Av)	16.46	54	-37.54
			7311(Pk)	33.42	74	-40.58
			7311(Av)	19.80	54	-34.20
	2462	Vertical	2483.5 (Pk)	56.49	74	-17.51
			2483.5 (Av)	41.96	54	-12.04
			2462 (Pk)	103.24	*	-
			2462 (Av)	92.17	*	-
			4924(Pk)	31.23	74	-42.77
			4924(Av)	17.93	54	-36.07
		Horizontal	7386(Pk)	33.46	74	-40.54
			7386(Av)	20.44	54	-33.56
			2483.5 (Pk)	44.68	74	-29.32
			2483.5 (Av)	31.64	54	-22.36
			2462 (Pk)	92.89	*	-
			2462 (Av)	82.20	*	-
			4924(Pk)	30.54	74	-43.46
			4924(Av)	17.13	54	-36.87
			7386(Pk)	34.80	74	-39.20
			7386(Av)	20.48	54	-33.52

Note: Measured Emissions (dBµV/m) = Received Emissions(dBµV) + Antenna Factor(dB/m)+ Cable Loss(dB) – Pre-amplifier Gain(dBi)

Note: *: Fundamental frequency

Pk: Peak Detector

Av: Average Detector

Prüfbericht - Nr.:

Test Report No.:

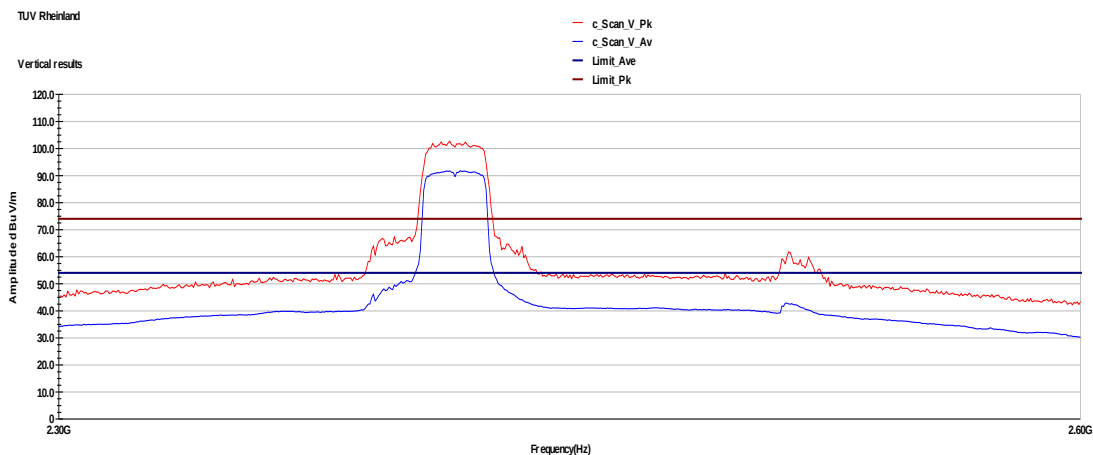
ULR-TC568819300000028F

Seite 39 von 45

Page 39 of 45

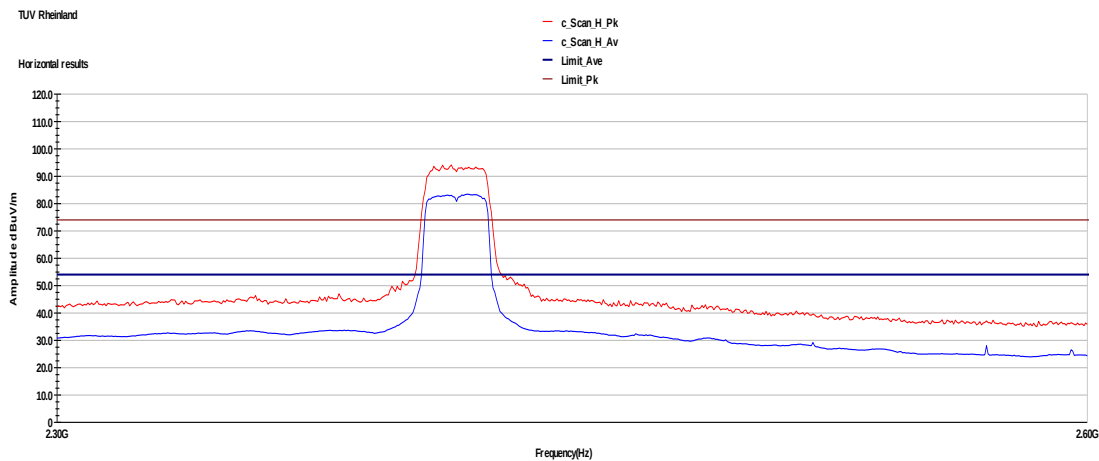
Test plots 7: Worst case Restricted bands/spurious emissions plots in the frequency range above 1GHz (Mode : 802.11n)

Restricted bands



Low_7.2Mbps.TIL

Vertical polarization



Low_7.2Mbps.TIL

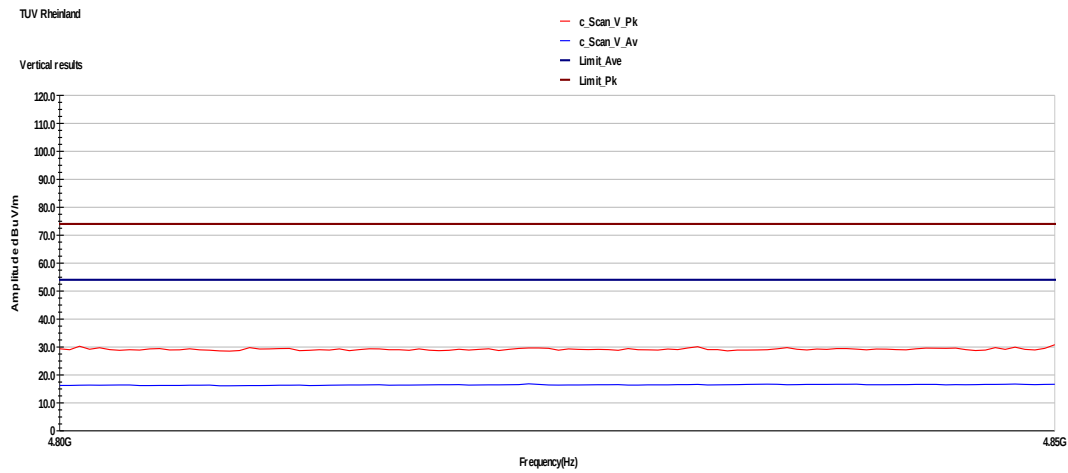
Horizontal polarization

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568819300000028F

Seite 40 von 45
Page 40 of 45

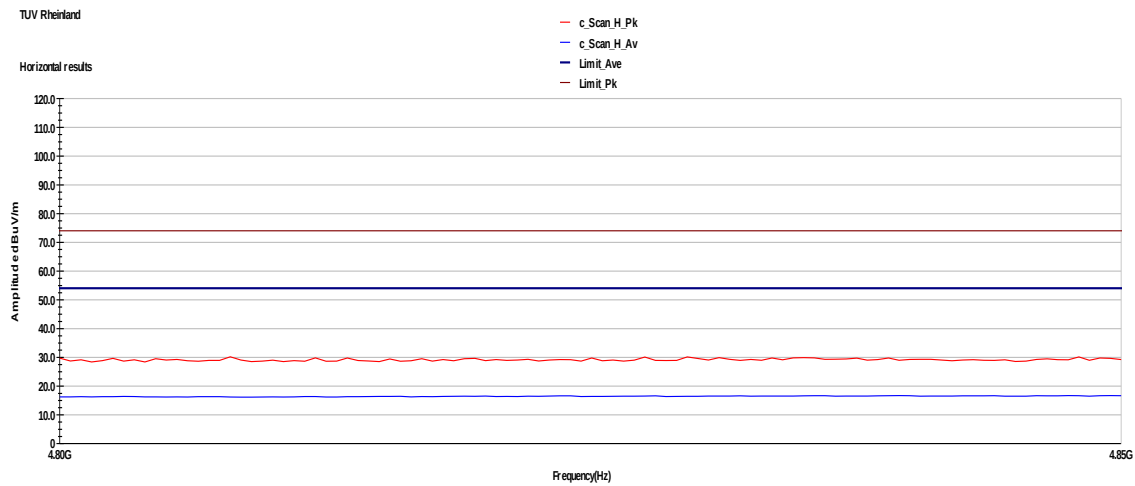
Spurious emissions



ChLow_7.2Mbps_2ndHarmonic.TIL

2nd Harmonic

Vertical polarization



ChLow_7.2Mbps_2ndHarmonic.TIL

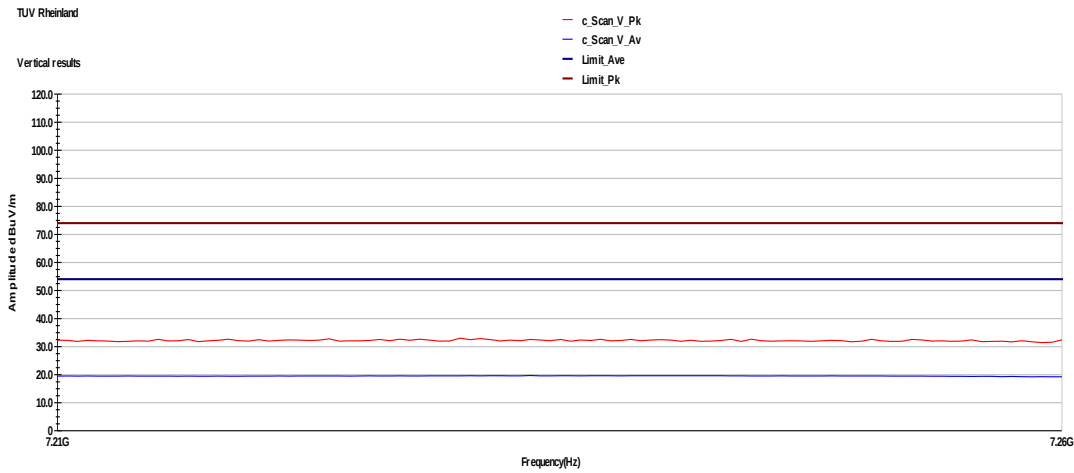
2nd Harmonic

Horizontal polarization

Prüfbericht - Nr.:
Test Report No.:

ULR-TC568819300000028F

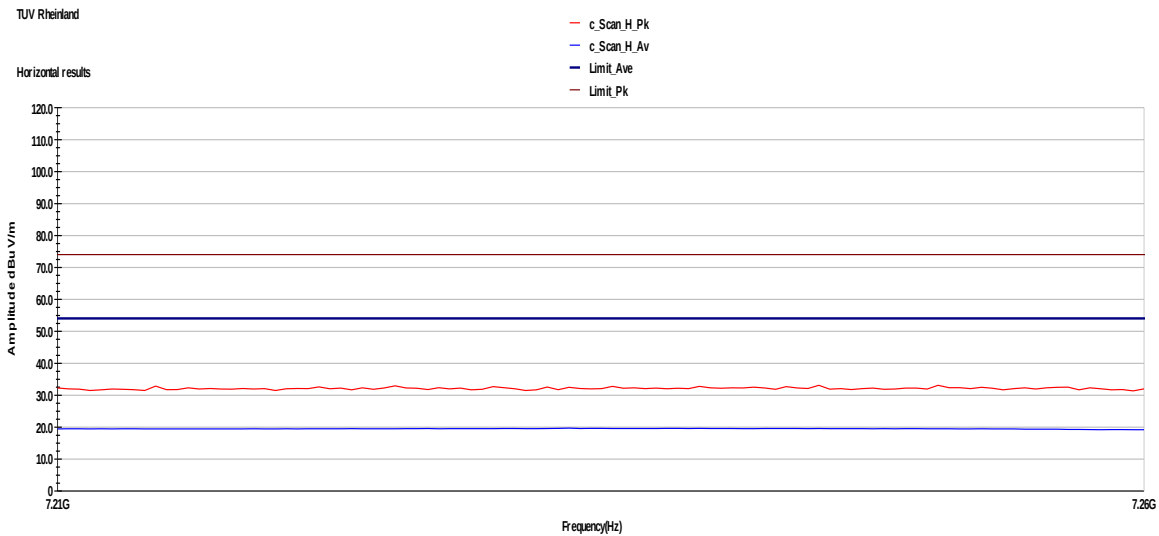
Seite 41 von 45
Page 41 of 45



ChLow_7.2Mbps_3rd Harmonic.TIL

3rd Hramonic

Vertical polarization



ChLow_7.2Mbps_3rd Harmonic.TIL

3rd Hramonic

Horizontal polarization

Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

Seite 42 von 45

Page 42 of 45

6.5 Conducted Emission Test on A.C. Power Line

Result

Pass

Test Specification : FCC Part 15 Section 15.207, ICES-003 Issue 6 section 6.1
 Test Method : ANSI C63.10-2013
 Testing Location : Screened room
 Measurement Bandwidth : 9kHz
 Frequency Range : 150kHz – 30MHz
 Supply Voltage : 120VAC,60Hz

Requirement : for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table

Limit of FCC Part 15 Section 15.207 and ICES-003 Issue 6 section 6.1

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15 to 0.5	66 to 56*	56 to 46*
0.5 to 5	56	46
5 to 30	60	50

Prüfbericht - Nr.:

Test Report No.:

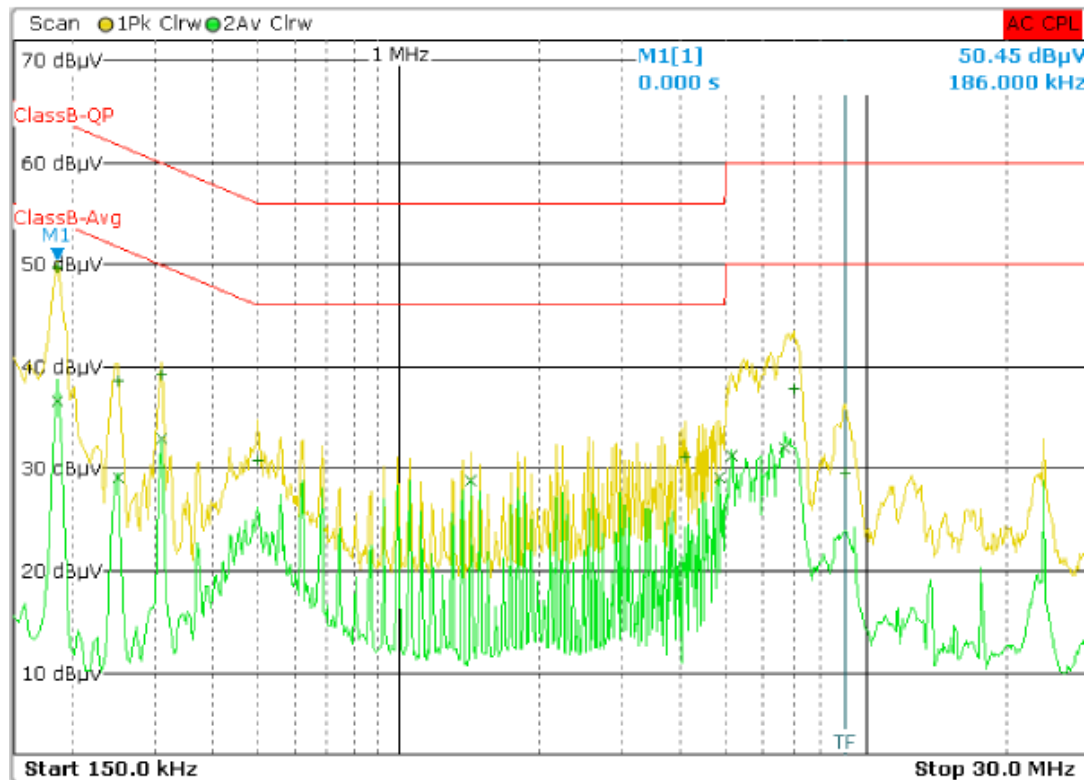
ULR-TC568819300000028F

Seite 43 von 45

Page 43 of 45

Test Results: LINE Graphs and Tables

110v AC , 60Hz



Line Graph

Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
1	186.000000000 kHz	49.67		Quasi Peak	-14.54
2	4.838000000 MHz	29.11		Average	-16.89
2	310.000000000 kHz	32.92		Average	-17.05
2	1.426000000 MHz	28.80		Average	-17.20
2	186.000000000 kHz	36.67		Average	-17.54
2	6.702000000 MHz	31.99		Average	-18.01
2	5.150000000 MHz	31.30		Average	-18.70
1	310.000000000 kHz	39.23		Quasi Peak	-20.74
1	7.006000000 MHz	37.91		Quasi Peak	-22.09
2	250.000000000 kHz	29.11		Average	-22.65
1	250.000000000 kHz	38.58		Quasi Peak	-23.18
1	4.094000000 MHz	31.08		Quasi Peak	-24.92
1	498.000000000 kHz	30.81		Quasi Peak	-25.22
1	9.002000000 MHz	29.63		Quasi Peak	-30.37

Line Table

Prüfbericht - Nr.:

Test Report No.:

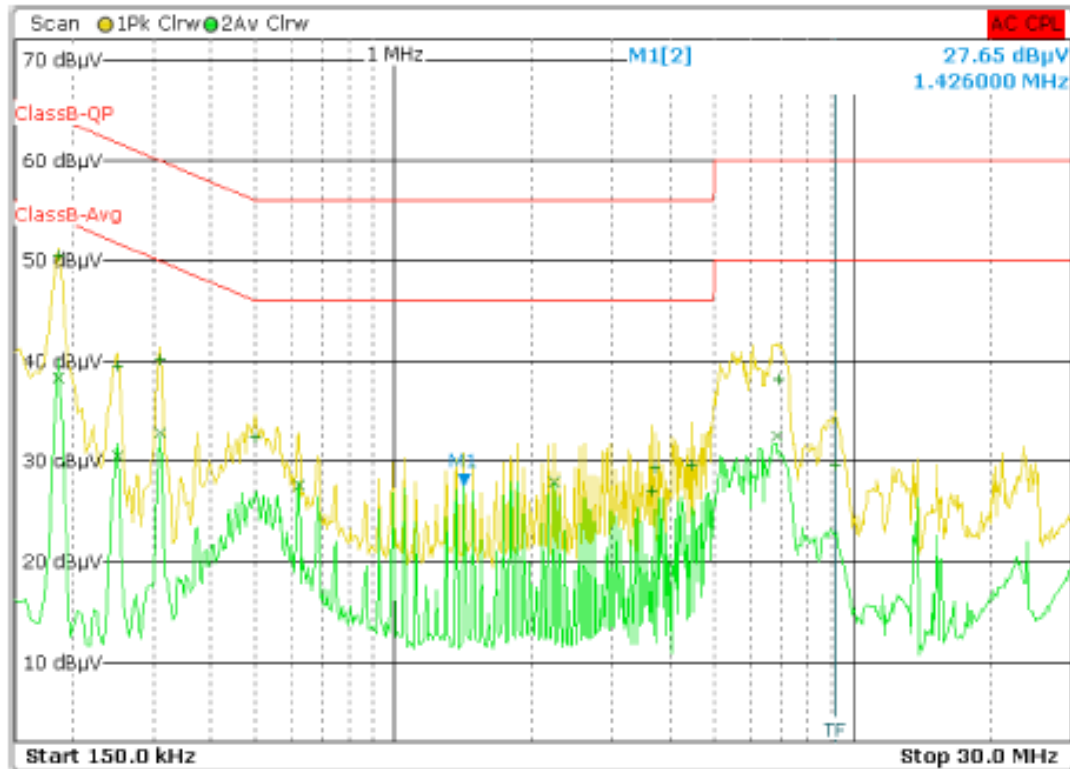
ULR-TC568819300000028F

Seite 44 von 45

Page 44 of 45

NEUTRAL Graphs and Tables

110v AC , 60Hz



Neutral Graph

Trace	Frequency	Level (dBμV)	Phase	Detector	Delta Limit/dB
1	186.000000000 kHz	50.50		Quasi Peak	-13.71
2	186.000000000 kHz	38.28		Average	-15.93
2	310.000000000 kHz	32.73		Average	-17.24
2	6.826000000 MHz	32.45		Average	-17.55
2	2.234000000 MHz	27.95		Average	-18.05
2	622.000000000 kHz	27.58		Average	-18.42
1	310.000000000 kHz	40.09		Quasi Peak	-19.88
2	250.000000000 kHz	30.58		Average	-21.18
1	6.898000000 MHz	38.12		Quasi Peak	-21.88
1	250.000000000 kHz	39.46		Quasi Peak	-22.30
1	498.000000000 kHz	32.30		Quasi Peak	-23.73
1	4.466000000 MHz	29.59		Quasi Peak	-26.41
1	3.722000000 MHz	29.28		Quasi Peak	-26.72
1	3.658000000 MHz	27.05		Quasi Peak	-28.95
1	9.122000000 MHz	29.59		Quasi Peak	-30.41

Neutral Table

Prüfbericht - Nr.:

Test Report No.:

ULR-TC568819300000028F

Seite 45 von 45

Page 45 of 45

7 LIST OF TABLES

Table 1: List of test and measurement instruments	5
Table 2: Ratings and System Details	6
Table 3: Report No. References	7
Table 3: Power level setting used in Wi-Fi testing	7
Table 5: Measurement Uncertainty	7
Table 5: List of center frequencies	8
Table 6: Maximum peak conducted output power test results	11
Table 7: Maximum power spectral density test results	17
Table 8: Emissions in non-restricted frequency bands test results	23
Table 9: Transmitter limits for Radiated emission	27
Table 10: Spurious Radiated Emissions & Restricted Bands of Operation test results	31

*****END OF TEST REPORT*****