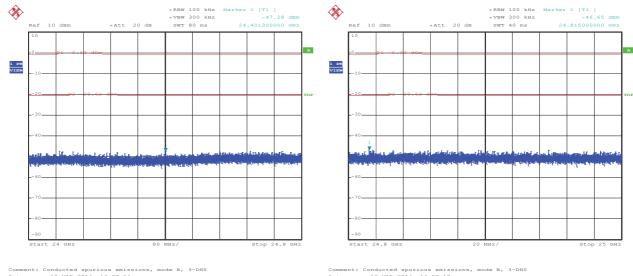


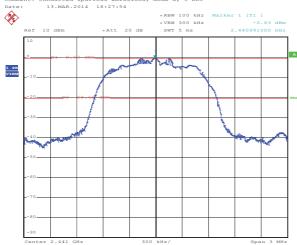


Produkte Products

> Prüfbericht - Nr.: 50001232 001 Seite 49 von 71 Page 49 of 71 Test Report No.:

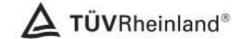
Figure 31: Conducted Spurious Emissions, 24.0-25.0GHz and carrier, Mode B (2441MHz)

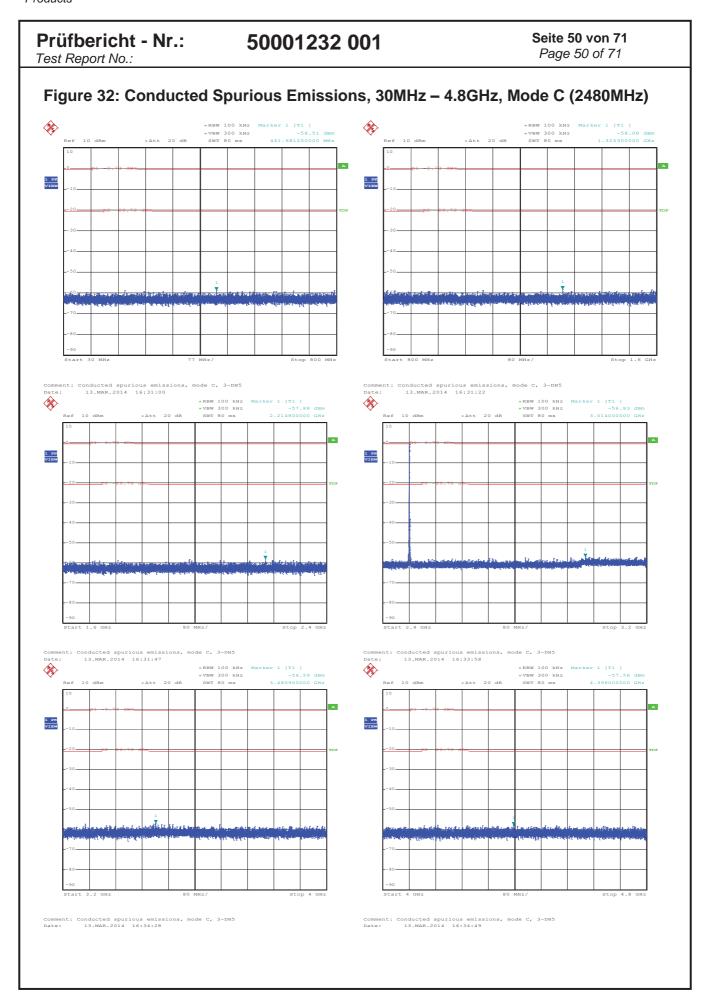




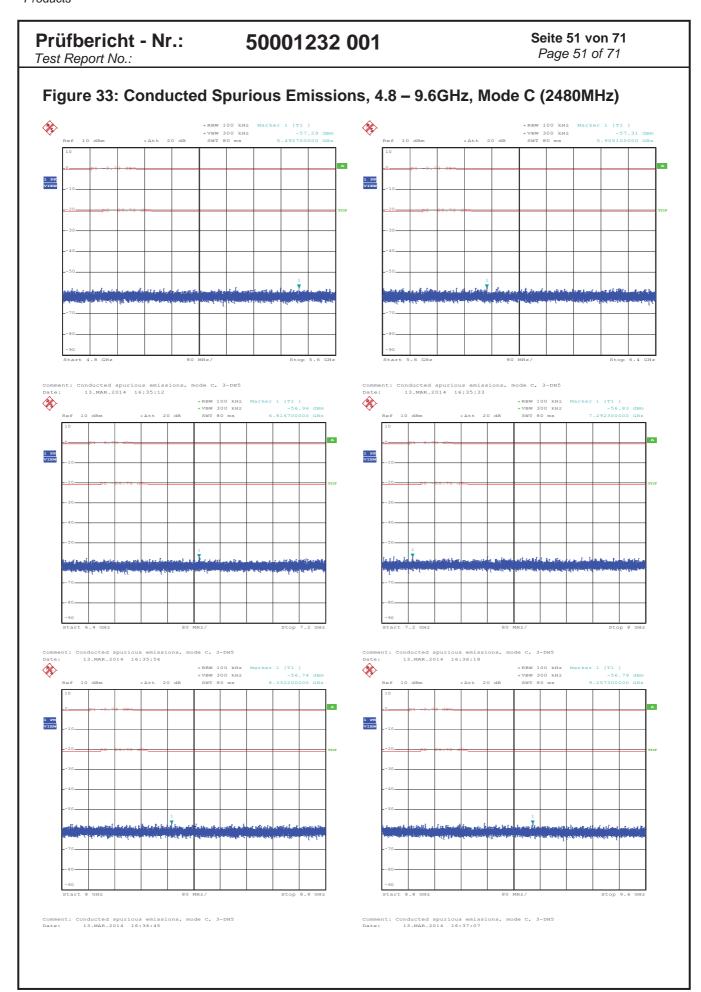
Comment: Conducted spurious emissions, mode B, 3-DH5 Date: 13.MAR.2014 16:14:13

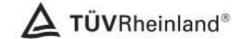
Comment: Conducted spurious emissions, mode B, 3-DH5 Date: 13.MAR.2014 16:28:17

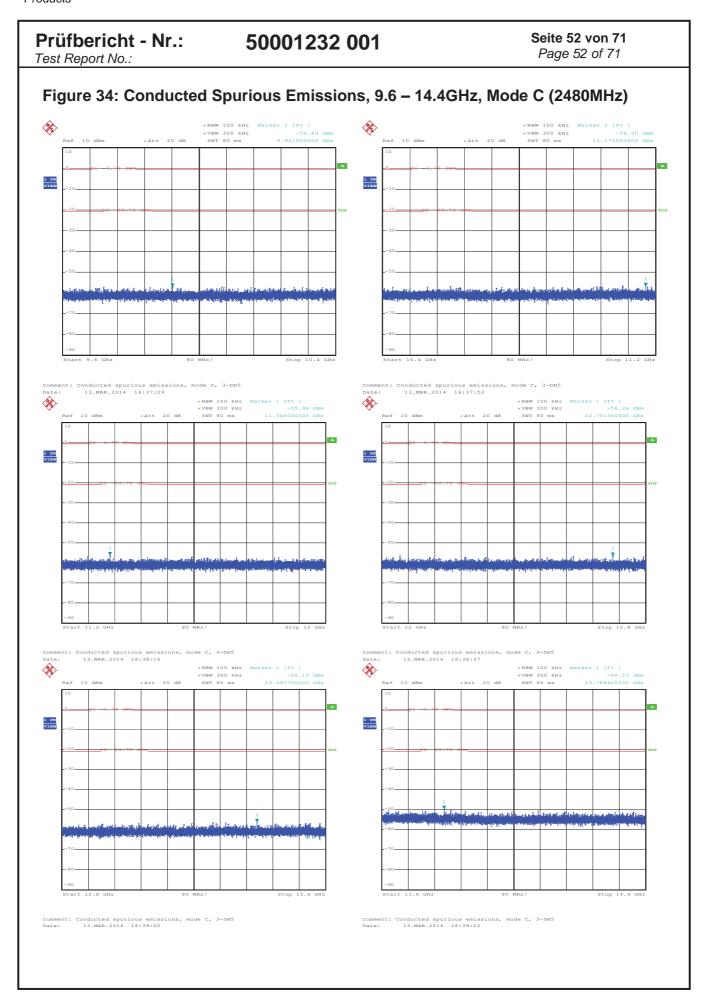


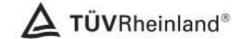


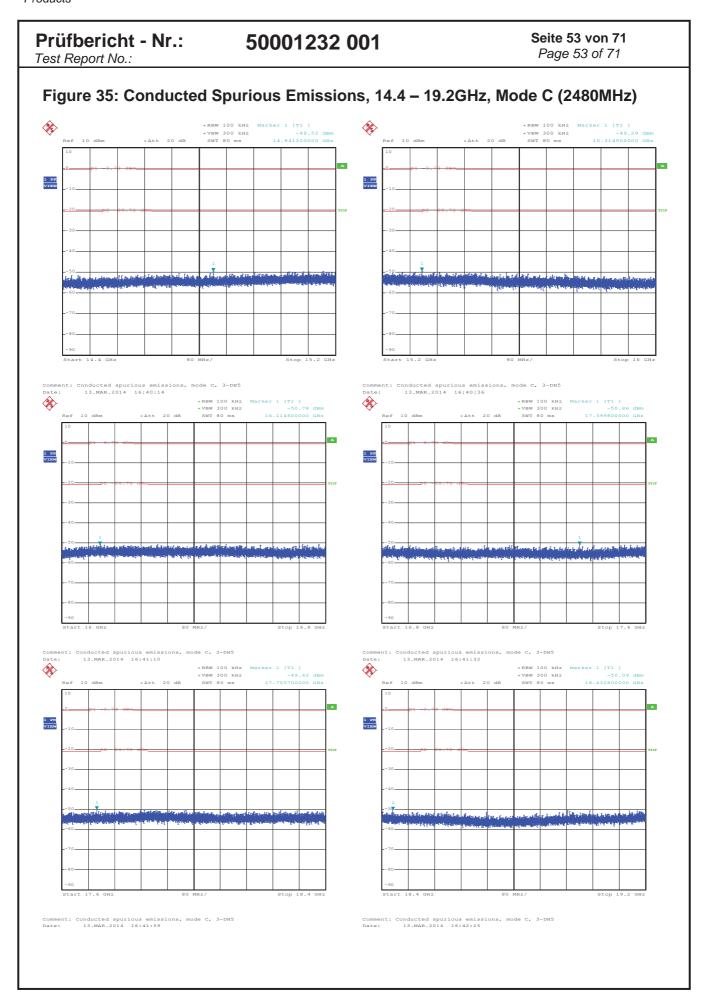




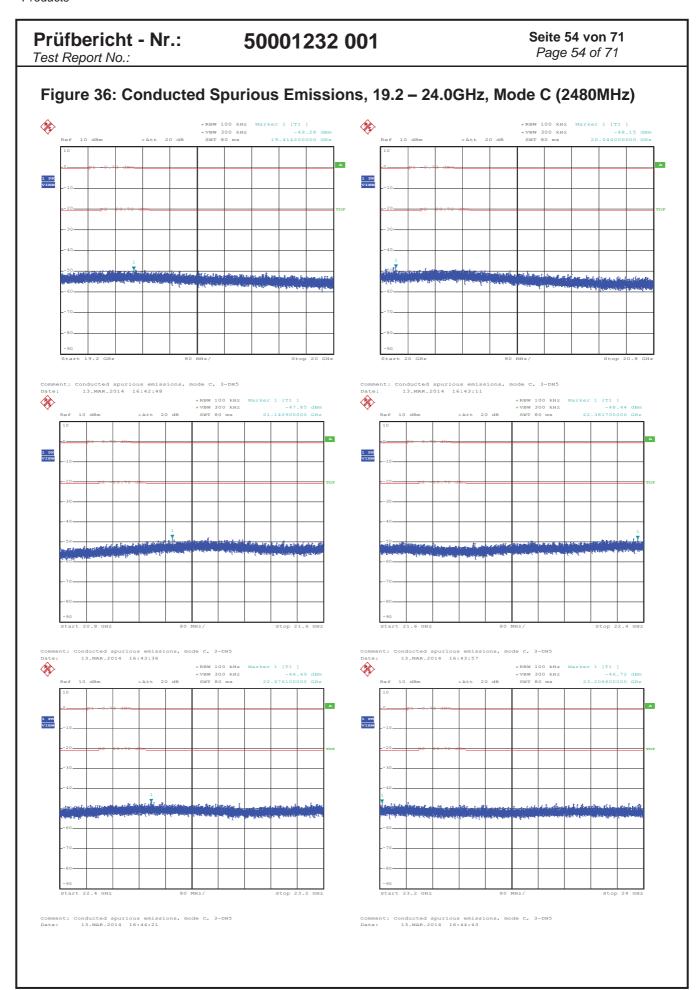












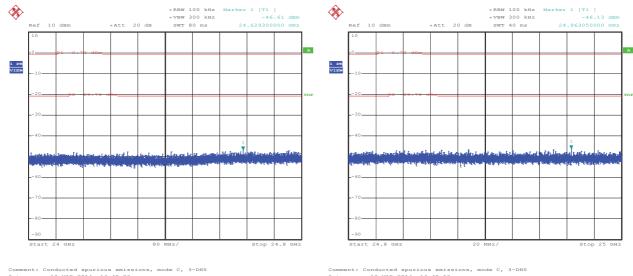


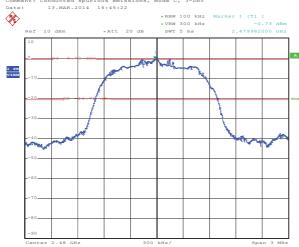
Produkte Products

 Prüfbericht - Nr.:
 50001232 001
 Seite 55 von 71

 Test Report No.:
 Page 55 of 71

Figure 37: Conducted Spurious Emissions, 24.0– 25.0GHz and carrier, Mode C (2480MHz)





Comment: Conducted spurious emissions, mode C, 3-DH5 Date: 13.MAR.2014 16:30:39

Produkte Products



 Prüfbericht - Nr.:
 50001232 001
 Seite 56 von 71

 Test Report No.:
 Page 56 of 71

5.3 Radiated Measurements

5.3.1 Radiated Spurious Emissions of Transmitter

RESULT: PASS

Date of testing: 2014-03-17, 2014-03-18, 2014-03-19

2014-03-24

Ambient temperature: 22, 23, 24, 24°C Relative humidity: 42, 43, 42, 40%

Atmospheric pressure: 1021, 1010, 1014, 1019hPa

Frequency range: 9kHz - 25GHz

Measurement distance: 3m

Kind of test site: Semi Anechoic Chamber

Requirements:

FCC 15.205, FCC 15.209, FCC 15.247(d), RSS-Gen 7.2.2 and 7.2.5 and RSS-210 2.1, 2.2, 2.5 and A8.5

Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a) and RSS-Gen 7.2.2 (table 3), must comply with the radiated emission limits specified in FCC 15.209(a) and RSS-Gen 7.2.5 (tables 5 and 6).

Radiated emissions which fall outside the operation frequency band and outside restricted bands shall either meet the limit specified in FCC 15.209(a) and RSS-Gen 7.2.5 or be attenuated at least 20dB below the power level in the 100kHz bandwidth within the band that contains the highest level of the desired power (the less severe limit applies).

Test procedure:

ANSI C63.10-2009, RSS-Gen 4.9 and 7.2 and Public Notice DA 00-705.

The EUT was placed on a nonconductive turntable 0.8m above the ground plane. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 9kHz to the 10th harmonic of the highest fundamental transmitter frequency (25GHz). Final radiated emission measurements were made at 3m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

TÜVRheinland®

Products

Products

 Prüfbericht - Nr.:
 50001232 001
 Seite 57 von 71

 Test Report No.:
 Page 57 of 71

For emissions between 30MHz and 1GHz, measurements were performed with a test receiver operating in the CISPR quasi-peak detection mode. The receiver's 6dB bandwidth was set to 120kHz. For emissions above 1GHz, measurements were performed with a spectrum analyzer using the following settings: for peak field strength: RBW = 1MHz & VBW ≥ 1MHz; for average field strength: RBW = 1MHz & VBW = 10Hz.

Absorbers have been placed on the floor between the EUT and the measuring antenna for testing above 1GHz.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Emissions other than those mentioned are small or not detectable.

The worst case was found at the data rate of DH5 in 8DPSK (3-DH5) Therefore, the final measurement was reported accordingly.

No spurious emission was found in the range from 9kHz to 30MHz.

Products



 Prüfbericht - Nr.:
 50001232 001
 Seite 58 von 71

 Test Report No.:
 Page 58 of 71

Table 12: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode A (2402MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
31.843	Z/V	40.9	-17.3	23.6	40.0	16.4	105	53
54.510	Z/V	47.2	-16.2	31.0	40.0	9.0	106	85
126.684	Z/H	32.3	-16.7	15.6	43.5	27.9	262	257
294.232	Z/H	54.8	-13.6	41.2	46.0	4.8	116	131
535.542	Z/H	39.9	-7.2	32.7	46.0	13.3	120	44
901.884	Z/H	30.8	-2.2	28.6	46.0	17.4	163	57

Note: Level QP = Reading QP + Factor

Table 13: Radiated Emissions, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode A (2402MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading AV [dBµV]	Factor [dB(1/m)]	Level AV [dBµV/m]	Limit [dBµV/m]	Margin AV [dB]	Height [cm]	Angle [°]
1920.219	X/H	49.4	-16.4	33.0	54.0	21.0	100	149
7994.967	X/V	37.1	1.5	38.6	54.0	15.4	107	252
10735.180	X/H	36.4	-4.8	31.6	54.0	22.4	127	77
17239.300	X/H	42.1	-4.6	37.5	54.0	16.5	125	316

Note: Level AV = Reading AV + Factor

Table 14: Radiated Emissions, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode A (2402MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading PK [dBµV]	Factor [dB(1/m)]	Level PK [dBµV/m]	Limit [dBµV/m]	Margin PK [dB]	Height [cm]	Angle [°]
1920.219	X/H	56.3	-16.4	39.9	74.0	34.1	100	149
7994.967	X/V	50.9	1.5	52.4	74.0	21.6	107	252
10735.180	X/H	50.0	-4.8	45.2	74.0	28.8	127	77
17239.300	X/H	55.7	-4.6	51.1	74.0	22.9	125	316

Note: Level PK = Reading PK + Factor

Products



 Prüfbericht - Nr.:
 50001232 001
 Seite 59 von 71

 Test Report No.:
 Page 59 of 71

Table 15: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode B (2441MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
32.070	Z/V	40.2	-17.3	22.9	40.0	17.1	100	359
52.926	Z/V	47.4	-16.1	31.3	40.0	8.7	100	41
75.103	Z/V	43.4	-18.5	24.9	40.0	15.1	100	89
294.390	Z/H	53.6	-13.6	40.0	46.0	6.0	116	135
480.047	Z/V	38.5	-8.2	30.3	46.0	15.7	100	178
534.794	Z/H	38.5	-7.2	31.3	46.0	14.7	121	48

Note: Level QP = Reading QP + Factor

Table 16: Radiated Emissions, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode B (2441MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading AV [dBµV]	Factor [dB(1/m)]	Level AV [dBµV/m]	Limit [dBµV/m]	Margin AV [dB]	Height [cm]	Angle [°]
1920.204	Z/H	50.2	-16.4	33.8	54.0	20.2	101	150
7683.736	Z/H	38.5	0.8	39.3	54.0	14.7	199	353
11897.420	X/H	37.6	-5.8	31.8	54.0	22.2	183	328
16153.400	X/V	42.3	-4.9	37.4	54.0	16.6	164	215

Note: Level AV = Reading AV + Factor

Table 17: Radiated Emissions, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode B (2441MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading PK [dBµV]	Factor [dB(1/m)]	Level PK [dBµV/m]	Limit [dBµV/m]	Margin PK [dB]	Height [cm]	Angle [°]
1920.204	Z/H	56.9	-16.4	40.5	74.0	33.5	101	150
7683.736	Z/H	52.8	0.8	53.6	74.0	20.4	199	353
11897.420	X/H	52.0	-5.8	46.2	74.0	27.8	183	328
16153.400	X/V	56.5	-4.9	51.6	74.0	22.4	164	215

Note: Level PK = Reading PK + Factor

Products



 Prüfbericht - Nr.:
 50001232 001
 Seite 60 von 71

 Test Report No.:
 Page 60 of 71

Table 18: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna Orientations, Mode C (2480MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading QP [dBµV]	Factor [dB(1/m)]	Level QP [dBµV/m]	Limit [dBµV/m]	Margin QP [dB]	Height [cm]	Angle [°]
32.047	Z/V	41.1	-17.3	23.8	40.0	16.2	101	68
36.402	Z/V	36.6	-16.5	20.1	40.0	19.9	101	64
55.580	Z/V	46.3	-16.3	30.0	40.0	10.0	117	355
294.235	Z/H	55.1	-13.6	41.5	46.0	4.5 (*)	123	131
480.049	Z/H	39.0	-8.2	30.8	46.0	15.2	100	139
534.980	Z/H	39.0	-7.2	31.8	46.0	14.2	101	44

Note: Level QP = Reading QP + Factor

(*) The measured result is below the specification limit by a margin less than the measurement uncertainty; it is therefore not possible to determine compliance at a level of confidence of 95%. However, the measured result indicates a high probability that the tested product complies with the specification limit.

Table 19: Radiated Emissions, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode C (2480MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading AV [dBµV]	Factor [dB(1/m)]	Level AV [dBµV/m]	Limit [dBµV/m]	Margin AV [dB]	Height [cm]	Angle [°]
1920.201	Z/H	49.5	-16.4	33.1	54.0	20.9	101	257
7998.539	Z/H	37.2	1.5	38.7	54.0	15.3	195	12
11913.040	X/H	37.8	-5.7	32.1	54.0	21.9	126	102
16364.520	X/V	42.1	-5.1	37.0	54.0	17.0	177	42

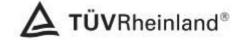
Note: Level AV = Reading AV + Factor

Table 20: Radiated Emissions, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations, Mode C (2480MHz)

Freq. [MHz]	EUT / Antenna Orientation	Reading PK [dBµV]	Factor [dB(1/m)]	Level PK [dBµV/m]	Limit [dBµV/m]	Margin PK [dB]	Height [cm]	Angle [°]
1920.201	Z/H	56.2	-16.4	39.8	74.0	34.2	101	257
7998.539	Z/H	51.1	1.5	52.6	74.0	21.4	195	12
11913.040	X/H	51.2	-5.7	45.5	74.0	28.5	126	102
16364.520	X/V	55.7	-5.1	50.6	74.0	23.4	177	42

Note: Level PK = Reading PK + Factor

Products



 Prüfbericht - Nr.:
 50001232 001
 Seite 61 von 71

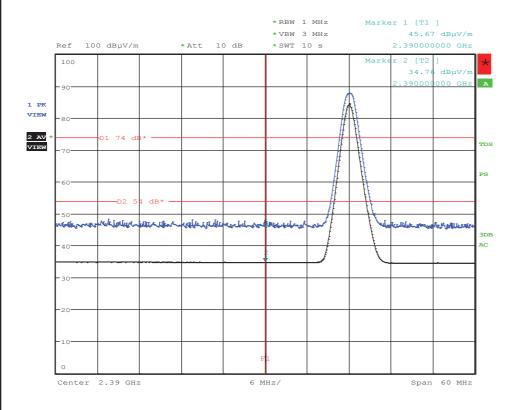
 Test Report No.:
 Page 61 of 71

Table 21: Radiated Emissions at Band Edge, Modes A (2402MHz) and C (2480MHz), GFSK

Operating Frequency [MHz]	EUT / Antenna Orientation	Level AV [dBµV/m]	Level PK [dBµV/m]	Limit AV [dBµV/m]	Limit PK [dBµV/m]	Margin AV [dB]	Margin PK [dB]
2402.00	Y/V	34.76	45.67	54.0	74.0	19.24	28.33
2480.00	Y/V	44.62	51.78	54.0	74.0	9.38	22.22

Notes: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values. Average limit in dB μ V/m is calculated as follows: Average limit = 20 x log(500 μ V/m). Peak limit in dB μ V/m is calculated as follows: Peak limit = Average limit + 20dB.

Figure 38: Radiated Emissions at Band Edge, Spectral Diagram, Mode A (2402MHz), GFSK



Band Edge, Mode A, DH5
Date: 19.MAR.2014 15:22:17

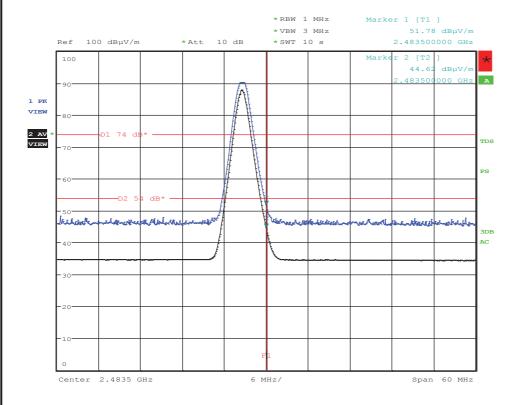


Produkte Products

 Prüfbericht - Nr.:
 50001232 001
 Seite 62 von 71

 Test Report No.:
 Page 62 of 71

Figure 39: Radiated Emissions at Band Edge, Spectral Diagram, Mode C (2480MHz), GFSK



Band Edge, Mode C, DH5
Date: 19.MAR.2014 16:20:35

Products



 Prüfbericht - Nr.:
 50001232 001
 Seite 63 von 71

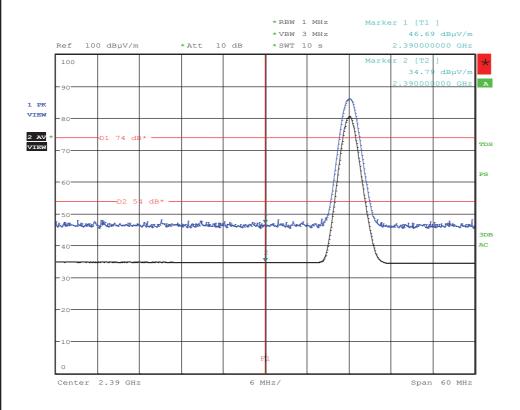
 Test Report No.:
 Page 63 of 71

Table 22: Radiated Emissions at Band Edge, Modes A (2402MHz) and C (2480MHz), 8DPSK

Operating Frequency [MHz]	EUT / Antenna Orientation	Level AV [dBµV/m]	Level PK [dBµV/m]	Limit AV [dBµV/m]	Limit PK [dBµV/m]	Margin AV [dB]	Margin PK [dB]
2402.00	Y/V	34.79	46.69	54.0	74.0	19.21	27.31
2480.00	Y/V	45.14	54.00	54.0	74.0	8.86	20.00

Notes: All correction factors (antenna, cable, pre-amplifier) are included in the measurement values. Average limit in dB μ V/m is calculated as follows: Average limit = 20 x log(500 μ V/m). Peak limit in dB μ V/m is calculated as follows: Peak limit = Average limit + 20dB.

Figure 40: Radiated Emissions at Band Edge, Spectral Diagram, Mode A (2402MHz), 8DPSK



Band Edge, Mode A, 3-DH5
Date: 19.MAR.2014 15:34:03

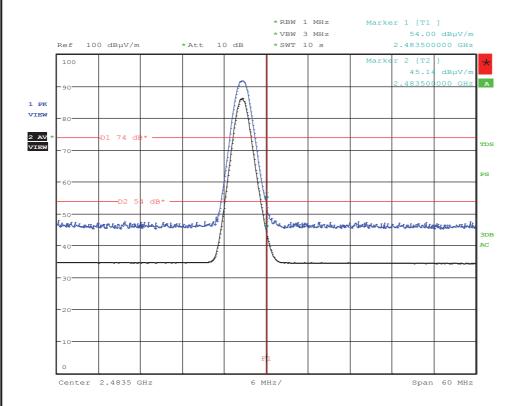


Produkte Products

 Prüfbericht - Nr.:
 50001232 001
 Seite 64 von 71

 Test Report No.:
 Page 64 of 71

Figure 41: Radiated Emissions at Band Edge, Spectral Diagram, Mode C (2480MHz), 8DPSK



Band Edge, Mode C, 3-DH5
Date: 19.MAR.2014 16:33:32



Produkte Products

 Prüfbericht - Nr.:
 50001232 001
 Seite 65 von 71

 Test Report No.:
 Page 65 of 71

5.4 AC Power Line Conducted Measurements

5.4.1 AC Power Line Conducted Emission of Transmitter

RESULT: N/A

Frequency range: 0.15 – 30MHz

Requirements:

FCC 15.207 and RSS-Gen 7.2.4.

Note: This test is not applicable, since the EUT is for vehicular use only.

Produkte Products

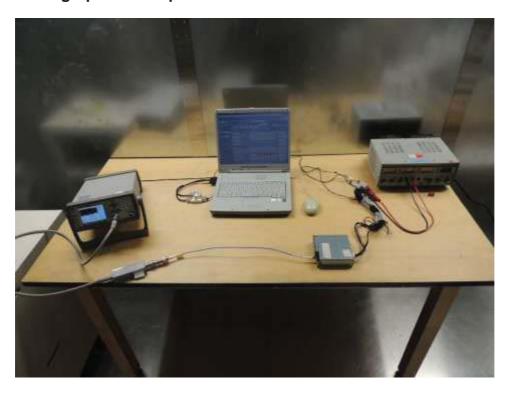


 Prüfbericht - Nr.:
 50001232 001
 Seite 66 von 71

 Test Report No.:
 Page 66 of 71

6. Photographs of the Test Setup

Photograph 1: Set-up for Conducted Power Measurement at Antenna Port



Photograph 2: Set-up for Conducted Spurious Emissions



Produkte Products



 Prüfbericht - Nr.:
 50001232 001
 Seite 67 von 71

 Test Report No.:
 Page 67 of 71

Photograph 3: Set-up for Radiated Emission of Transmitter, Front View



Photograph 4: Set-up for Radiated Emission of Transmitter, Rear View



Produkte Products



 Prüfbericht - Nr.:
 50001232 001
 Seite 68 von 71

 Test Report No.:
 Page 68 of 71

Photograph 5: Set-up for Radiated Emission, EUT Configuration X-Axis



Photograph 6: Set-up for Radiated Emission, EUT Configuration Y-Axis



Produkte Products



 Prüfbericht - Nr.:
 50001232 001
 Seite 69 von 71

 Test Report No.:
 Page 69 of 71

Photograph 7: Set-up for Radiated Emission, EUT Configuration Z-Axis



Produkte Products



Page 70 of 71

Prüfbericht - Nr.: 50001232 001 Seite 70 von 71 Test Report No.:

7. List of Tables

Table 1: List of Test and Measurement Equipment	6
Table 2: Emission Measurement Uncertainty	7
Table 3: Interfaces present on the EUT	
Table 4: Conducted Output Power, Mode A (2402MHz), all Data Rates	
Table 5: Conducted Output Power, Mode B (2441MHz), all Data Rates	16
Table 6: Conducted Output Power, Mode C (2480MHz), all Data Rates	17
Table 7: Carrier Frequency Separation	
Table 8: 20dB Bandwidth	
Table 9: 99% Bandwidth	
Table 10: Number of Hopping Frequencies	
Table 11: Average Time of Occupancy	35
Table 12: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna	
Orientations, Mode A (2402MHz)	
Table 13: Radiated Emissions, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations,	
Mode A (2402MHz)	58
Table 14: Radiated Emissions, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations,	
Mode A (2402MHz)	58
	ΕO
Orientations, Mode B (2441MHz)	59
Mode B (2441MHz)	
Table 17: Radiated Emissions, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations,	59
Mode B (2441MHz)	50
Table 18: Radiated Emissions, Quasi Peak Data, 30MHz - 1GHz, Horizontal and Vertical Antenna	59
Orientations, Mode C (2480MHz)	മെ
Table 19: Radiated Emissions, Average Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations,	
Mode C (2480MHz)	
Table 20: Radiated Emissions, Peak Data, 1 - 25GHz, Horizontal and Vertical Antenna Orientations,	00
Mode C (2480MHz)	60
Table 21: Radiated Emissions at Band Edge, Modes A (2402MHz) and C (2480MHz), GFSK	
Table 22: Radiated Emissions at Band Edge, Modes A (2402MHz) and C (2480MHz), 8DPSK	
	-
8. List of Figures	
0. <u>1.0.</u> 0. 1. 19 0.0	
Figure 1: Block Diagram	10
Figure 2: Carrier Frequency Separation, GFSK	
Figure 3: Carrier Frequency Separation, 8DPSK	20
Figure 4: 20dB Bandwidth, Mode A (2402MHz), GFSK	
Figure 5: 20dB Bandwidth, Mode B (2441MHz), GFSK	
Figure 6: 20dB Bandwidth, Mode C (2480MHz), GFSK	
Figure 7: 20dB Bandwidth, Mode A (2402MHz), 8DPSK	
Figure 8: 20dB Bandwidth, Mode B (2441MHz), 8DPSK	
Figure 9: 20dB Bandwidth, Mode C (2480MHz), 8DPSK	
Figure 10: 99% Bandwidth, Mode A (2402MHz), GFSK	
Figure 11: 99% Bandwidth, Mode B (2441MHz), GFSK	
Figure 12: 99% Bandwidth, Mode C (2480MHz), GFSK	
Figure 13: 99% Bandwidth, Mode A (2402MHz), 8DPSK	
Figure 14: 99% Bandwidth, Mode B (2441MHz), 8DPSK	
Figure 15: 99% Bandwidth, Mode C (2480MHz), 8DPSK	
Figure 16: Hopping Frequencies up to 2441MHz, Mode D (Hopping)	
	33



Prüfbericht - Nr.: Test Report No.:	50001232 001	Seite 71 von 71 Page 71 of 71
	rror! Reference source not found. (Hoppir	
	(Hopping), DH3	
	Emissions, 30MHz – 4.8GHz, Mode A (2	
	s Emissions, 4.8 – 9.6GHz, Mode A (2402	
	s Emissions, 9.6 – 14.4GHz, Mode A (240	
	s Emissions, 14.4 – 19.2GHz, Mode A (24	
	s Emissions, 19.2 – 24.0GHz, Mode A (24	
	Emissions, 24.0–25.0GHz and carrier, N	
	Emissions, 30MHz – 4.8GHz, Mode B (2	
	s Emissions, 4.8 – 9.6GHz, Mode B (2441	
	S Emissions, 9.6 – 14.4GHz, Mode B (244	
	s Emissions, 14.4 – 19.2GHz, Mode B (24 s Emissions, 19.2 – 24.0GHz, Mode B (24	
	s Emissions, 19.2 – 24.0GHz, Mode B (24 s Emissions, 24.0– 25.0GHz and carrier, N	
	s Emissions, 24.0–25.0012 and carrier, No s Emissions, 30MHz – 4.8GHz, Mode C (2	
	s Emissions, 300112 – 4.00112, Mode C (2	
	s Emissions, 4.6 – 9.00112, Mode C (2400	
	s Emissions, 9.0 - 14.4GHz, Mode C (246 s Emissions, 14.4 - 19.2GHz, Mode C (24	
	s Emissions, 19.2 – 24.0GHz, Mode C (24	
	Emissions, 19.2 – 24.00Hz, Mode C (24	
	at Band Edge, Spectral Diagram, Mode A	
	at Band Edge, Spectral Diagram, Mode C	
	at Band Edge, Spectral Diagram, Mode A	
	at Band Edge, Spectral Diagram, Mode C	
9. List of Photog	•	
	ucted Power Measurement at Antenna Poucted Spurious Emissions	
	ated Emission of Transmitter, Front View	
	ated Emission of Transmitter, Front View	
	ated Emission of Transmitter, Real view	
	ated Emission, EUT Configuration Y-Axis	
	ated Emission, EUT Configuration Z-Axis	