

Radio Test report

20082433300

based on:
Radio Equipment Regulations for Japan

802.11 abg compact flash module
Summit Data Communications
SDC-CF10AG

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This report comprises of four modules. The total number of pages is: 64

Main module

1 Introduction

This report contains the result of tests performed by:

Telefication B.V.
Edisonstraat 12a
6902 PK Zevenaar
The Netherlands

Telefication complies with the accreditation criteria for test laboratories as laid down in ISO/IEC 17025:2005. The accreditation covers the quality system of the laboratory as well as the specific activities described in the authorized annex bearing the accreditation number L021 and is granted on 30 November 1990 by the Dutch Council For Accreditation (RvA: Raad voor Accreditatie). The contents of this test report, if reproduced, shall be copied in full, unless special consent in writing for reproduction in part is granted by Telefication. Copyright of this test report is reserved to Telefication.

Ordering party:

Company name : Elliott Labs, Inc.
Address : 684 West Maude Avenue
Zip code : 94085-3518
City/town : Sunnyvale
Country : United States of America
Date of order : 15 April 2008

2 Product

A sample of the following product was submitted for testing:

Product name	: 802.11 abg compact flash module
Manufacturer	: Gemtek Technology Co., Ltd.
Trade mark	: Summit Data Communications
Type designation	: SDC-CF10AG
Identification no.	: --
Hardware version	: V04
Software release	: --
Serial number	: CF10AG0802011493

3 Test schedule

Tests are carried out in accordance with the specification detailed in chapter 6 "Summary" of this report.

Tests are carried out at the following location:

- Telefication; Zevenaar

The sample of the product was received on:

- 4 June 2008

Tests are carried out between:

- 30 June and 11 July 2008

4 Product documentation

For production of this report the following product documentation has been used:

Description:	Date:	Identification:
Summit Manufacturing Utility Guide	20/3/08	Summit Data Communications, Inc.
Electrical diagram, sht. 2 of 6, rev.04	6 Dec. 2007	Dwg no. WCFB-108AG_V02_S2
Electrical diagram, sht. 5 of 6, rev.04	6 Dec. 2007	Dwg no. WCFB-108AG_V02_S4
Block diagram	Not dated	WCFB-108AG
Operational description	Not dated	SDC-CF10AG
Summit operating instructions	Not dated	--

The above-mentioned documentation will be filed at Telefication for a period of 10 years following the issue of this report.

5 Observations and comments

For the purpose of testing a PDA, type iPAQ, served as a host.

All measurements are carried out as conducted tests on the antenna connector.

6 Summary

The product is intended for use in the following application area:

- Wireless Local Area Network (WLAN)

The sample is tested according to the following specification:

- Radio Equipment Regulations for Japan

7 Conclusions

The sample of the product showed **NO NON-COMPLIANCES** to the specification stated in chapter 6 of this report.

The results of the tests as stated in this report, are exclusively applicable to the product items as identified in this report. Telefication accepts no responsibility for any stated properties of product items in this test report, which are not supported by the tests as specified in chapter 6 “*Summary*”.

All tests are performed by:

name : ing. P.A. Suringa

function : Senior Engineer Radio/EMC

signature :



Review of test methods and report by:

name : ing. K.A. Roes

function : Senior Engineer

signature :



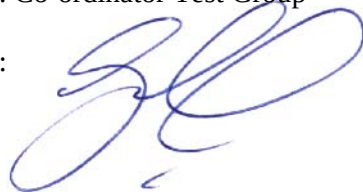
The above conclusions have been verified by the following signatory:

date : 8 August 2008

name : J.P. van de Poll

function : Co-ordinator Test Group

signature :



Test results module

1 Summary of tests 802.11a W52 & W53 bands

Article reference	Report reference	Requirement	Status (note 1)
General provisions			
5	5.1	Frequency tolerance	C
6	5.2	Occupied bandwidth	C
7	5.3	Spurious emissions	C
Transmitting equipment			
14	5.6	Antenna power tolerance	C
Transmitting antenna			
20	4.5	Type, configuration, etc. of transmitting antenna	C
22	4.6	Directional pattern of transmitting antenna	C
Receiving equipment			
24	5.7	Spurious emission of receiver	C
26	4.5, 4.6	Refer to all articles for transmitting antenna	C
Operating frequencies 5180, 5200, 5220, 5240, 5260, 5280, 5300 & 5320 MHz			
49.20 (3) (a)	4.4	High Frequency/modulation section cannot be opened easily	C
49.20 (3) (b)	4.1	Communication method	C
49.20 (3) (c)	4.1	Modulation method	C
49.20 (3) (d)	4.1	Signal transmission rate	C
49.20 (3) (e)	5.8	Burst Length	C
49.20 (3) (f)	5.6	Antenna power tolerance	C
49.20 (3) (g)	5.6	Isotropically radiated power	C
49.20 (3) (h)	5.2	Number of carriers within 1 MHz bandwidth in OFDM	C
49.20 (3) (i)	--	Spreading factor	NA
	5.4	Out-band emission power	C
49.20 (3) (j)	5.5	Adjacent channel power tolerance	C
MIC notice 157	5.9	Carrier sense capability	C
Note 1: C = Conform NC = Not Conform NT = Not Tested NA = Not Applicable			

2 Summary of tests 802.11b

Article reference	Report reference	Parameter	Status (note 1)
General provisions			
5	6.1	Frequency tolerance	C
6	6.2	Occupied bandwidth	C
7	6.4	Spurious emissions	C
Transmitting equipment			
14	6.5	Antenna power	C
14.2	--	SAR	NA
15	6.1	Frequency stabilization	C
Transmitting antenna			
20	4.5	Type, configuration, etc. of transmitting antenna	C
22	6.6	Directional pattern of transmitting antenna	C
Receiving equipment			
24	6.7	Spurious emission of receiver	C
26	4.5, 4.6	Refer to all articles for transmitting antenna	C
Operating frequency 2400 – 2483 MHz			
49.20(1); a	4.4	High Frequency/modulation section cannot be opened easily	C
49.20(1); b	4.1	Communication method	C
49.20(1); c	4.1	Modulation method	C
49.20(1); d	4.1	Spread spectrum method	C
49.20(1); e	6.5	Antenna power	C
49.20(1);f(1)	4.5	Absolute gain of transmitting antenna	C
49.20(1);f(2)	6.6	Angular width of principal radiation (AWPR)	C
49.20(1); g	--	Number of carriers within 1 MHz bandwidth in OFDM	NA
49.20(1); h	6.3	Diffusion bandwidth	C
49.20(1); i	6.3	Spreading factor	C
49.20(1); j	--	Frequency retention time (FH employed)	NA
Operating frequency 2471 – 2497 MHz			
49.20(2); a	4.1	High Frequency/modulation section cannot be opened easily	C
49.20(2); b	4.1	Communication method	C
49.20(2); c	4.1	Spread Spectrum method	C
49.20(2); d	6.5	Antenna power	C
49.20(2); e	4.5	Absolute gain of transmitting antenna	C
49.20(2); f	6.3	Diffusion bandwidth	C
49.20(2); g	6.3	Spreading factor	C
49.20(2); h	--	Interference immunity function	NA
Note 1: C = Conform NC = Not Conform NT = Not Tested NA = Not Applicable			

3 Summary of tests 802.11g

Article reference	Report reference	Parameter	Status (note 1)
General provisions			
5	7.1	Frequency tolerance	C
6	6.2	Occupied bandwidth	C
7	7.4	Spurious emissions	C
Transmitting equipment			
14	7.5	Antenna power	C
14.2	--	SAR	NA
15	7.1	Frequency stabilization	C
Transmitting antenna			
20	4.5	Type, configuration, etc. of transmitting antenna	C
22	4.5	Directional pattern of transmitting antenna	C
Receiving equipment			
24	7.7	Spurious emission of receiver	C
26	3.4 & 3.5	Refer to all articles for transmitting antenna	C
Operating frequency 2400 – 2483 MHz			
49.20(1); a	4.4	High Frequency/modulation section cannot be opened easily	C
49.20(1); b	4.1	Communication method	C
49.20(1); c	4.1	Modulation method	C
49.20(1); d	4.1	Spread spectrum method	C
49.20(1); e	7.5	Antenna power	C
49.20(1);f(1)	3.4 & 3.5	Absolute gain of transmitting antenna	C
49.20(1);f(2)	7.6	Angular width of principal radiation (AWPR)	C
49.20(1); g	7.2	Number of carriers within 1 MHz bandwidth in OFDM	C
49.20(1); h	7.3	Diffusion bandwidth	C
49.20(1); i	7.3	Spreading factor	C
49.20(1); j	--	Frequency retention time (FH employed)	NA
Operating frequency 2471 – 2497 MHz			
49.20(2); a	--	High Frequency/modulation section cannot be opened easily	NA
49.20(2); b	--	Communication method	NA
49.20(2); c	--	Spread Spectrum method	NA
49.20(2); d	--	Antenna power	NA
49.20(2); e	--	Absolute gain of transmitting antenna	NA
49.20(2); f	--	Diffusion bandwidth	NA
49.20(2); g	--	Spreading factor	NA
49.20(2); h	--	Interference immunity function	NA
Note 1: C = Conform NC = Not Conform NT = Not Tested NA = Not Applicable			

4 General information

4.1 Equipment information

Equipment type designation	SDC-CF10AG
Type of equipment	Data transmission equipment operating in the 2.4 & 5 GHz bands using spread spectrum techniques
Modulation	802.11a: Orthogonal Frequency Division (OFDM) 802.11b: CCK 802.11g: Orthogonal Frequency Division (OFDM)
Operating frequency ranges	5180 – 5320 MHz (W52 & W53 bands); 2400 – 2483.5 MHz
Rated conducted RF power IEEE 802.11a	1.5 mW/MHz
Rated conducted RF power IEEE 802.11b	2.5 mW/MHz
Rated conducted RF power IEEE 802.11g	2.5 mW/MHz
Signal transmission rate (max.)	802.11a: 54 Mbps; 802.11b: 11 Mbps; 802.11g: 54 Mbps

4.2 Frequency test channels

802.11a W52 & W53 bands	TX	RX
Channel 36	5180 MHz	5180 MHz
Channel 48	5240 MHz	5240 MHz
Channel 52	5260 MHz	5260 MHz
Channel 64	5320 MHz	5320 MHz
802.11b	TX	RX
Channel 1	2412 MHz	2412 MHz
Channel 7	2442 MHz	2442 MHz
Channel 14	2484 MHz	2484 MHz
802.11g	TX	RX
Channel 1	2412 MHz	2412 MHz
Channel 7	2442 MHz	2442 MHz
Channel 13	2472 MHz	2472 MHz

4.3 Test conditions

Test Conditions	Voltage (Vdc)
Normal	3.3

The nominal voltage of the SDC-CF10AG is 3.3 V_{DC}. This voltage is the input voltage to the voltage regulator (type LP2985, manufacturer National Semiconductor) of the radio module. The line regulation error is specified as 0.014 %/V. This means that in the worst case of a variation of 0.33 V (10 %) at the input, the output varies with 0.0046 %, which is less than the required 1%. Therefore all measurements for the SDC-CF10AG are performed with a (nominal) supply voltage of 3.3 V_{DC}.

4.4 Assembly

The RF part is contained in a miniature shielded metal housing.
The housing cannot be opened easily, see photographs 3 up to 6 in the Photographs module.

4.5 Antenna specifications

The device has been designed to operate with the antennas listed below:

Larson dual band swivel mount dipole	Type	Dipole
	Freq. range (MHz)	2400 –2500/4900 - 5900
	Gain max.	1.6 dBi/ 5 dBi
	VSWR	2:1
	Impedance	50 Ohms
	Polarization	Linear vertical
	Radiation pattern	E plane: 85° low band 30 ° high band H plane: omni-directional

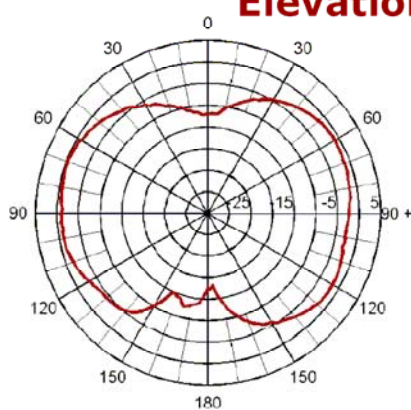
Laird Centurion NanoBlade	Type	PCB
	Freq. range (GHz)	2.4 - 2.5/4.9 – 6.0
	Gain max.	3.8 dBi (2.45 GHz); 4.7 dBi (4.9 GHz); 5.1 dBi (5.25 GHz); 4.5 dBi (5.875 GHz)
	VSWR	< 2:1
	Impedance	50 Ohms
	Polarization	Vertical , omni-directional
	Radiation pattern	See section 4.6 ' <i>radiation patterns</i> '
Volex VLX-51004-A	Type	Dipole
	Freq. range (GHz)	2.4 – 2.5/4.9 – 5.825
	Gain max.	2.3 dBi (2.4 - 2.5 GHz); 1.9 dBi (4.9 – 5.825 GHz)
	VSWR	1.92:1 Max.
	Impedance	50 Ohms
	Polarization	Linear, vertical
	Radiation pattern	Omni-directional

4.6 Radiation patterns

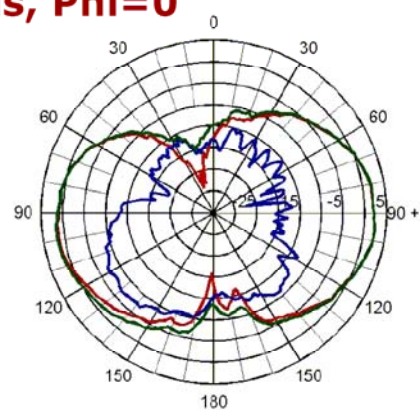
Laird Centurion NanoBlade

Elevation Patterns, Phi=0

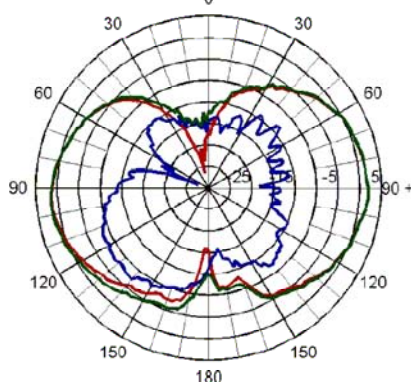
**2.45
GHz**



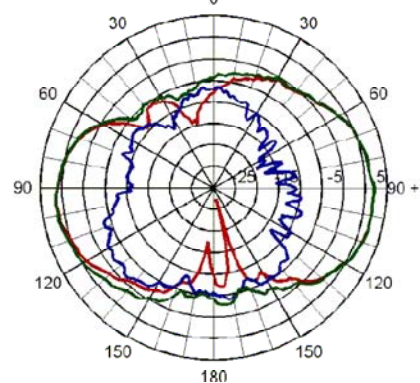
**5.192
GHz**



**4.9
GHz**



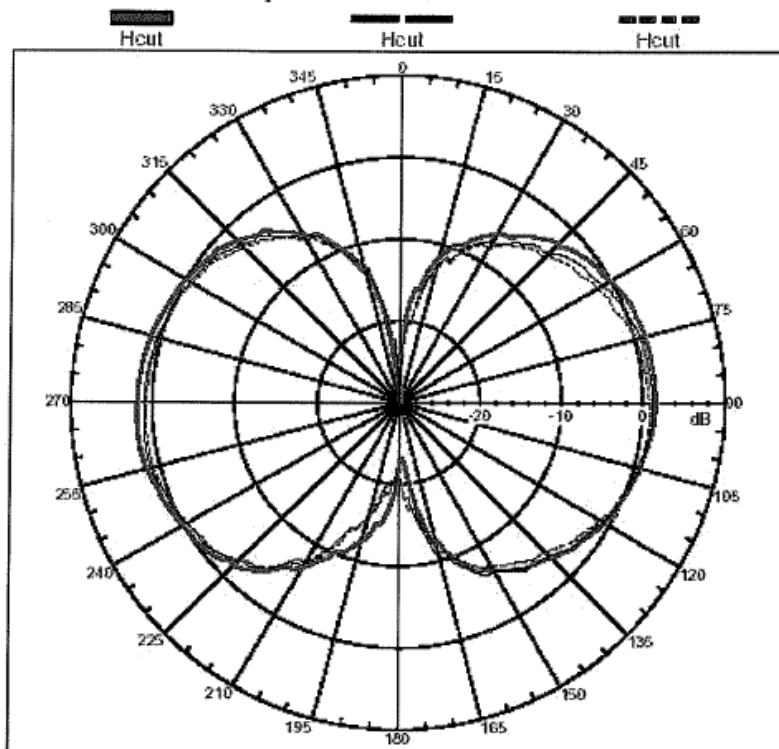
**5.875
GHz**



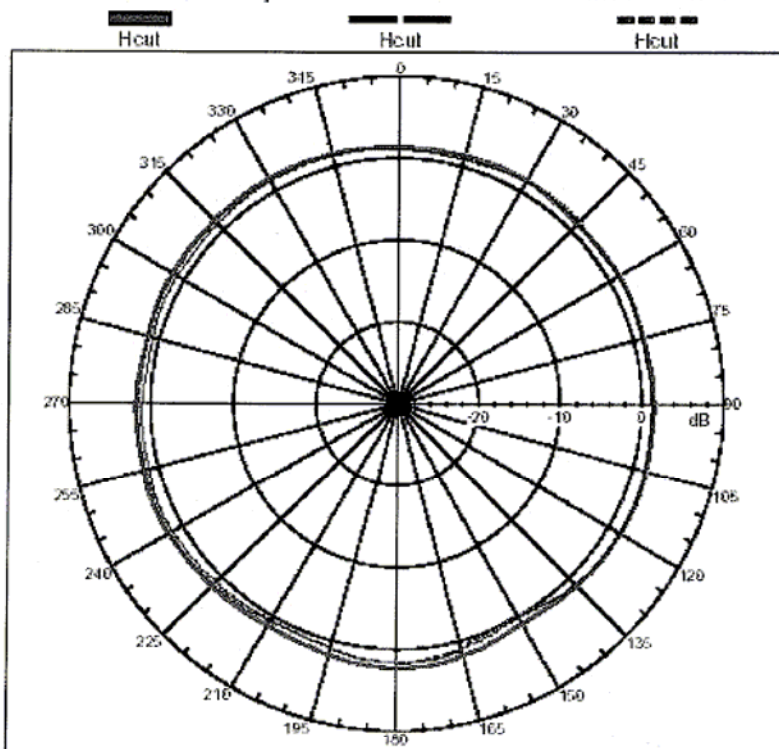
Volex VLX-51004-A

2.4 GHz band

Far-field amplitude of TNC Dual Band -H.nsi

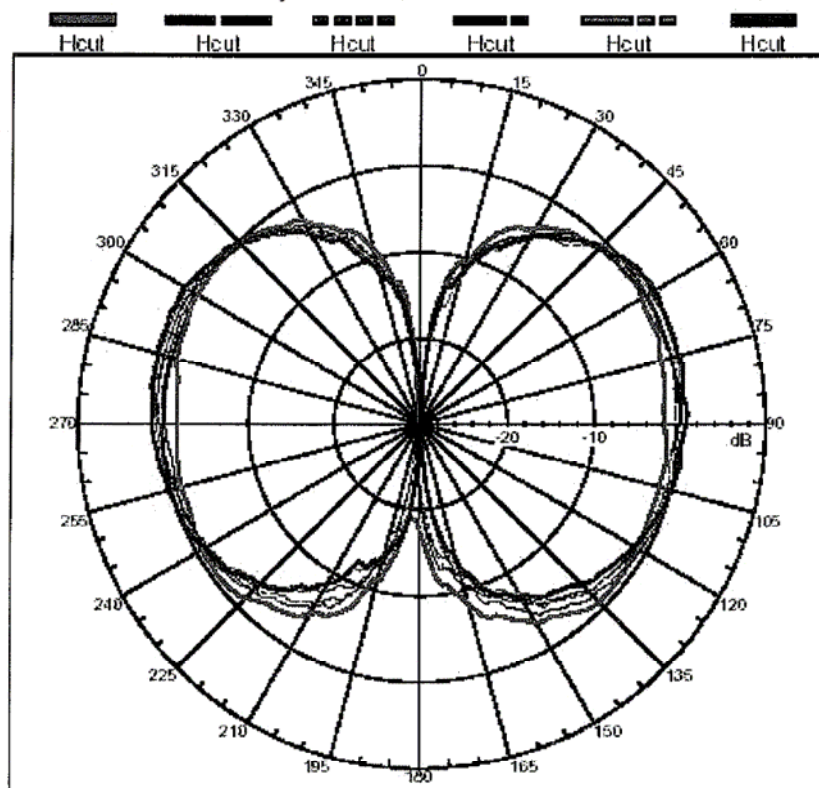


Far-field amplitude of TNC Dual Band -V.nsi

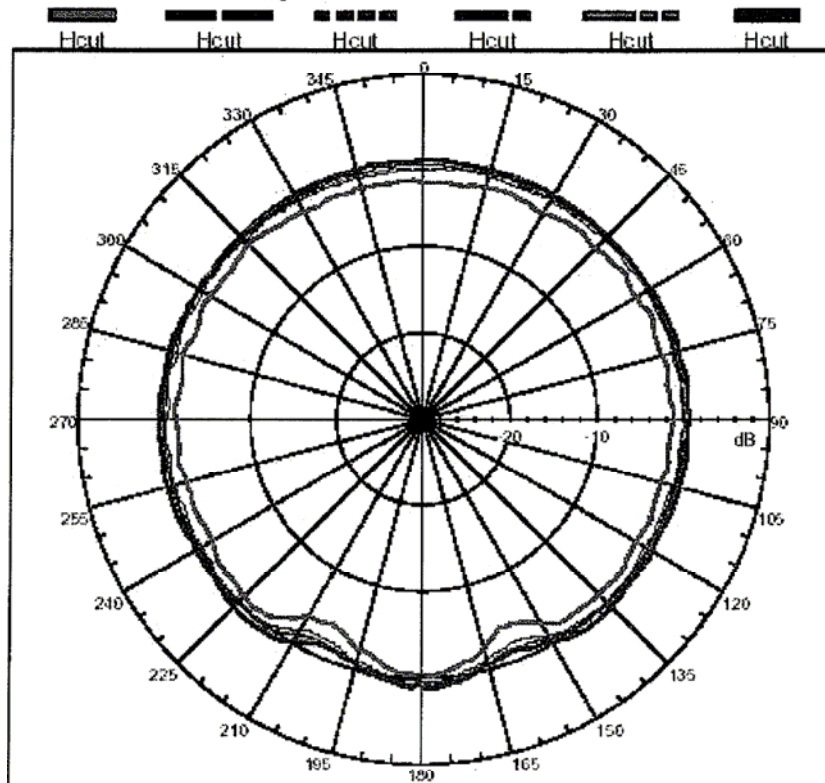


5 GHz band

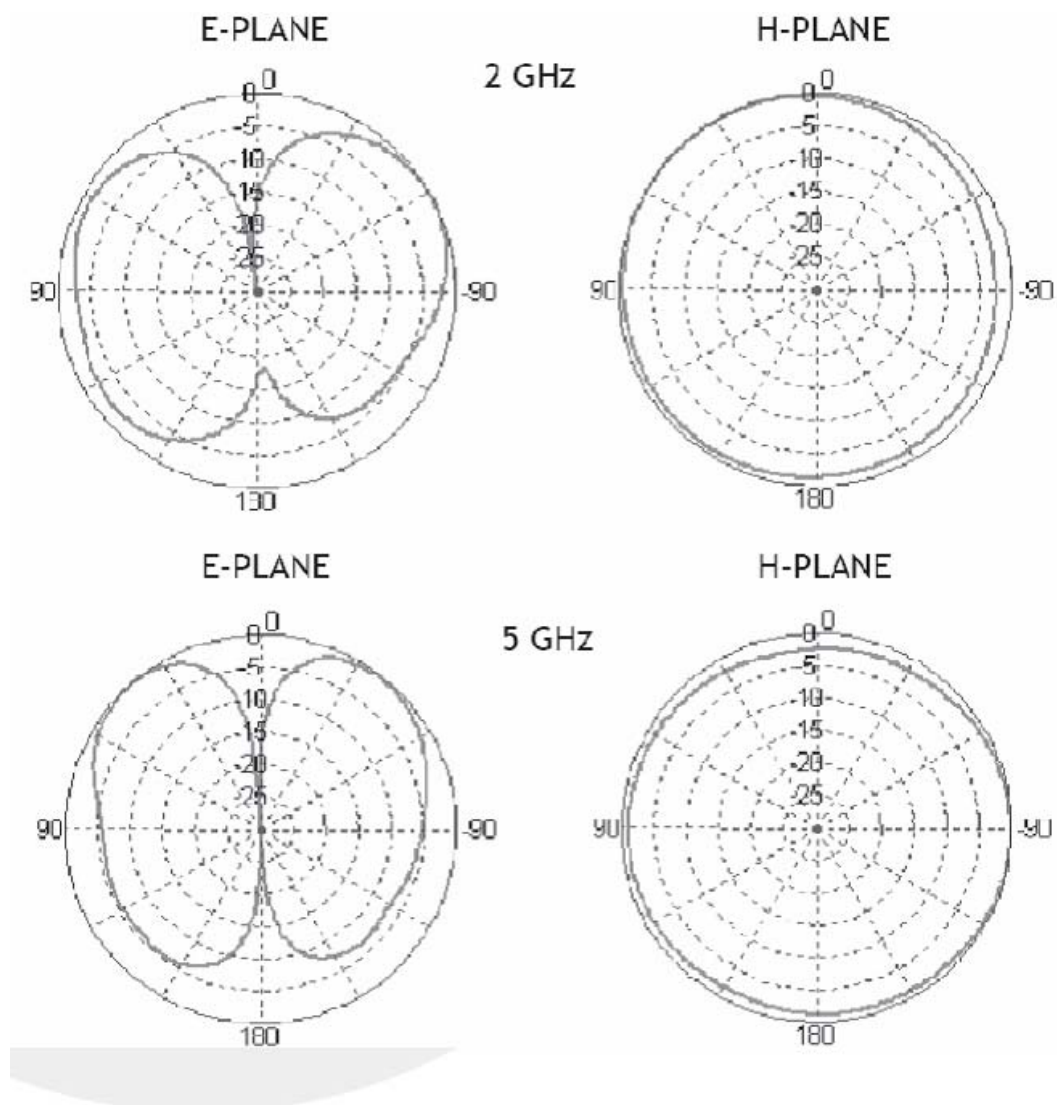
Far-field amplitude of TNC Dual Band -H.nsi



Far-field amplitude of TNC Dual Band -V.nsi



Larson dual band swivel mount dipole



5 Test results 802.11a W52 & W53 bands

5.1 Frequency Tolerance

Result values:

Tolerance from nominal frequency:

T _{amb} : 27 °C RH: 45 % U _{nom} : 3.3 Vdc				
Voltage		Ch 36	Ch 48	Ch 64
U _{nom}	Carrier frequency (MHz)	5179.967	5239.984	5320.009
	Frequency tolerance (ppm)	-6	-3	+2
U _{-10%}	Carrier frequency (MHz)	n.t.*	n.t.*	n.t.*
	Frequency tolerance (ppm)	n.t.*	n.t.*	n.t.*
U _{+10%}	Carrier frequency (MHz)	n.t.*	n.t.*	n.t.*
	Frequency tolerance (ppm)	n.t.*	n.t.*	n.t.*
Measurement uncertainty		+/- 2 kHz		

* See remark in section 4.3 “test conditions”.

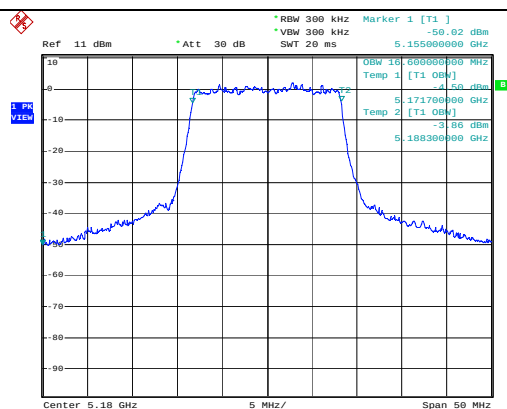
Limit values:

Under all test conditions	20 ppm
---------------------------	--------

5.2 Occupied Bandwidth (99 % channel power bandwidth)

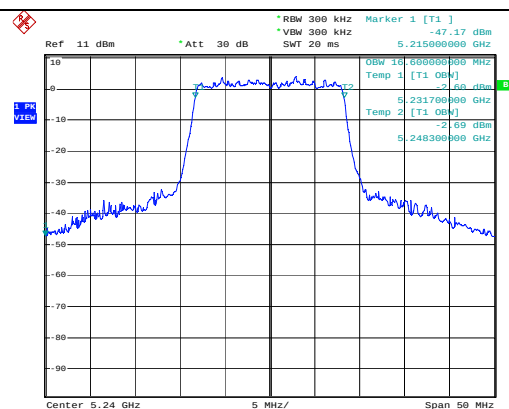
Result values:

T_{amb}: 27 °C
RH: 45 %
U_{nom}: 3.3 Vdc



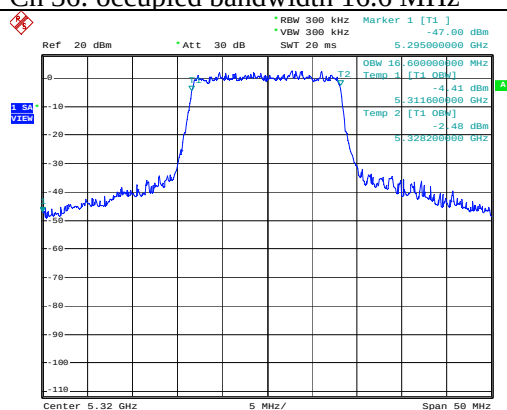
Date: 4.JUL.2008 15:34:02

Ch 36: occupied bandwidth 16.6 MHz



Date: 4.JUL.2008 16:26:41

Ch 48: occupied bandwidth 16.6 MHz



Date: 1.JUL.2008 15:56:31

Ch 64: occupied bandwidth 16.6 MHz

Measurement uncertainty

± 196 kHz

Limit values:

Under all test conditions

Occupied bandwidth: ≤ 18 MHz

Number of carriers:

The total number of subcarriers in one channel OFDM is 52. There is no subcarrier at the channel center frequency (therefore there are 53 subcarrier frequencies but only 52 are used in a given channel).

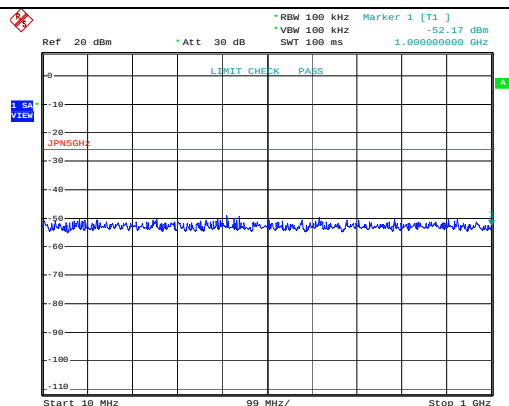
The measured occupied bandwidth varies is 16.6 MHz. $16.6 \text{ MHz} / 53 = 0.31$

Within a bandwidth of 1 MHz there are at least 3 subcarriers. This complies with the requirement of at least 1 subcarrier.

5.3 Spurious emissions transmitter

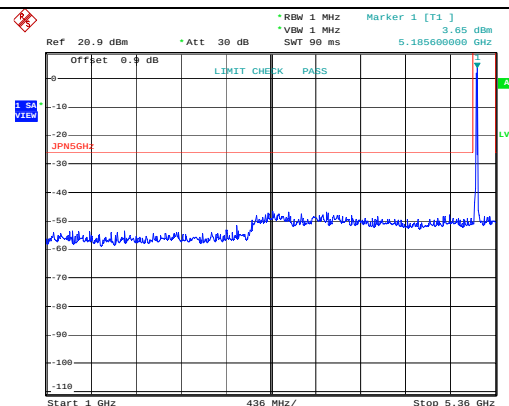
Result values:

T_{amb} : 27 °C
 RH : 45 %
 U_{nom} : 3.3 Vdc



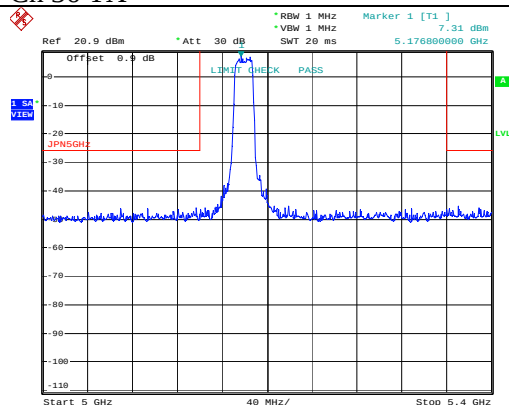
Date: 3.JUL.2008 17:19:11

Ch 36 TX



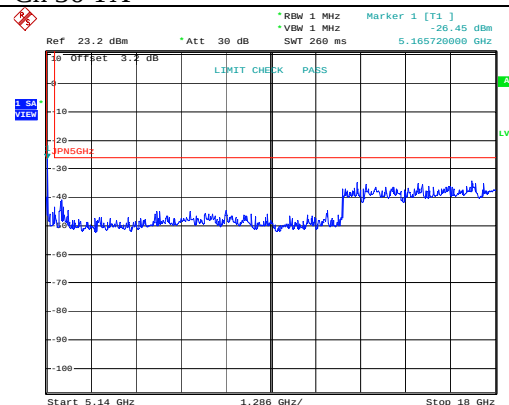
Date: 3.JUL.2008 17:13:41

Ch 36 TX



Date: 3.JUL.2008 17:15:22

Ch 36 TX



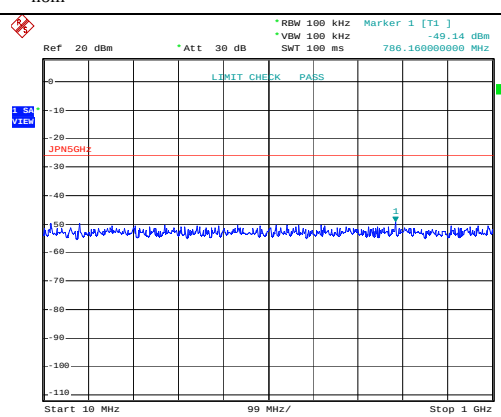
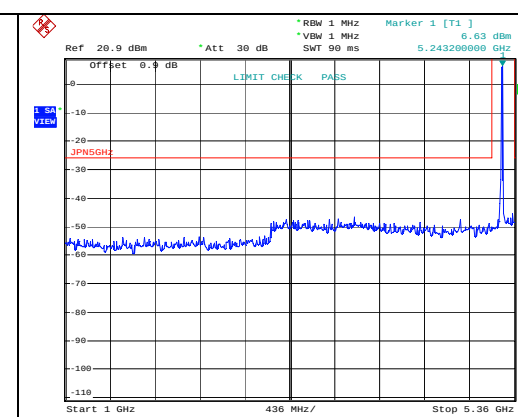
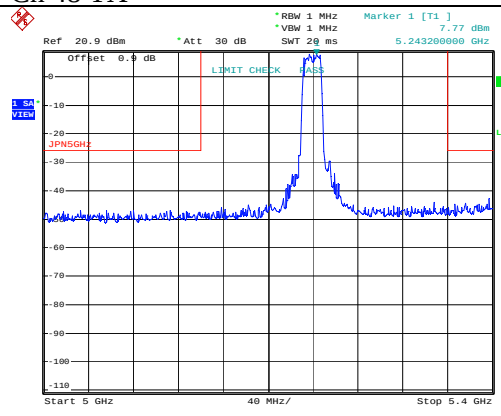
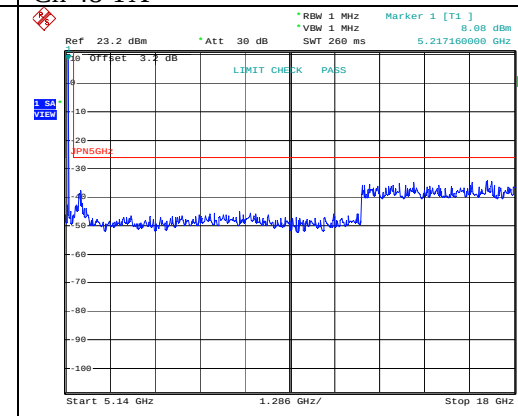
Date: 3.JUL.2008 17:17:24

Ch 36 TX

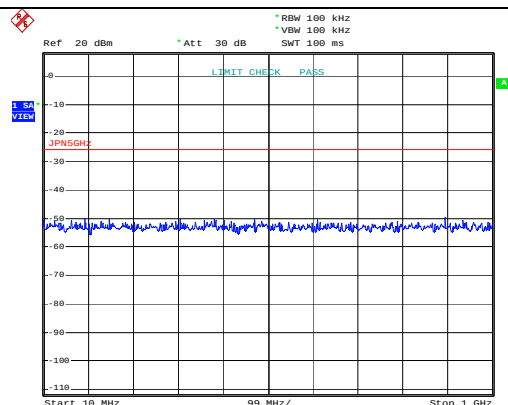
Measurement uncertainty

+2.4/-2.7 dB

Result values:

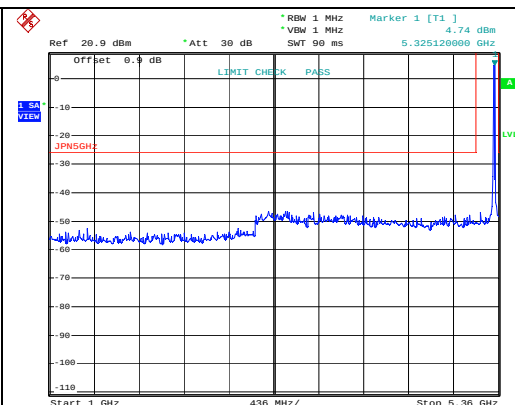
T_{amb}: 27 °C RH: 45 % U_{nom}: 3.3 Vdc	
 Ref: 20.9 dBm, Att: 30 dB, RBW: 100 kHz, VBW: 100 kHz, SWT: 100 ms, Marker 1 [T1]: -49.14 dBm, 786.16000000 MHz. Date: 3.JUL.2008 16:59:40	 Ref: 20.9 dBm, Att: 30 dB, RBW: 1 MHz, VBW: 1 MHz, SWT: 90 ms, Marker 1 [T1]: 6.63 dBm, 5.243200000 GHz. Date: 3.JUL.2008 16:53:17
Ch 48 TX  Ref: 20.9 dBm, Att: 30 dB, RBW: 1 MHz, VBW: 1 MHz, SWT: 20 ms, Marker 1 [T1]: 7.77 dBm, 5.243200000 GHz. Date: 3.JUL.2008 16:51:15	Ch 48 TX  Ref: 23.2 dBm, Att: 30 dB, RBW: 1 MHz, VBW: 1 MHz, SWT: 200 ms, Marker 1 [T1]: 8.08 dBm, 5.217100000 GHz. Date: 3.JUL.2008 16:55:50
Ch 48 TX	Ch 48 TX
Measurement uncertainty	+2.4/-2.7 dB

T_{amb} : 27 °C
 RH : 45 %
 U_{nom} : 3.3 Vdc



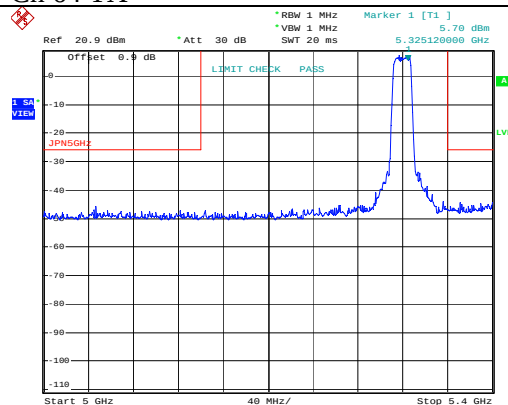
Date: 3.JUL.2008 15:22:37

Ch 64 TX



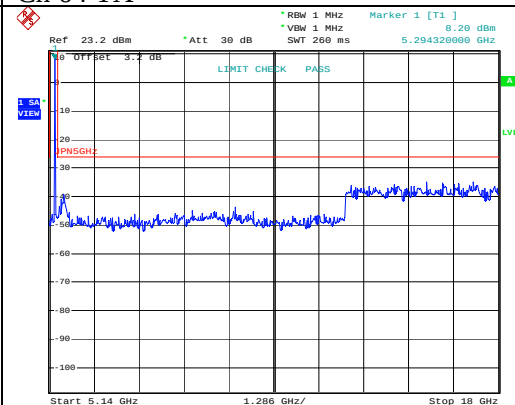
Date: 3.JUL.2008 15:13:02

Ch 64 TX



Date: 3.JUL.2008 15:16:43

Ch 64 TX



Date: 3.JUL.2008 15:20:39

CH 64 TX

Measurement uncertainty

+2.4/-2.7 dB

Limit values:

Transmitter operating

< 5140 MHz:

≤ - 26 dBm/MHz

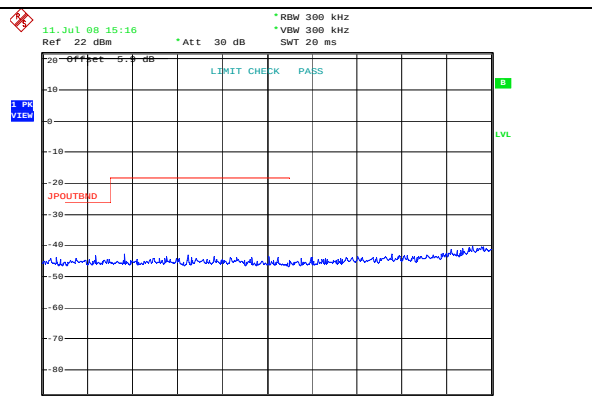
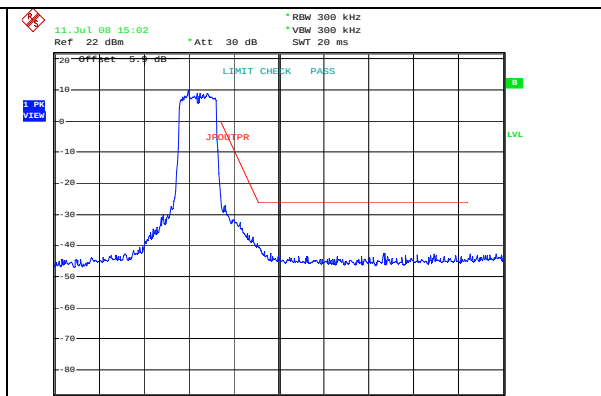
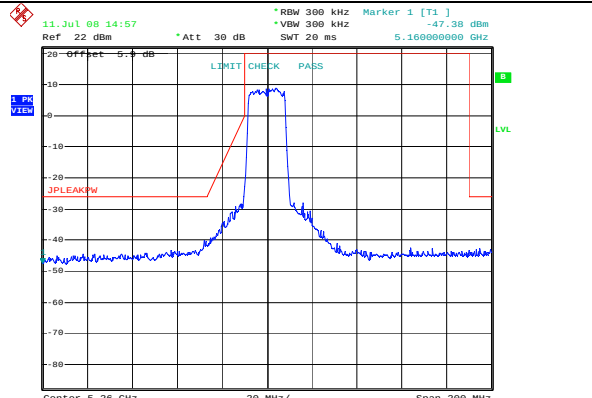
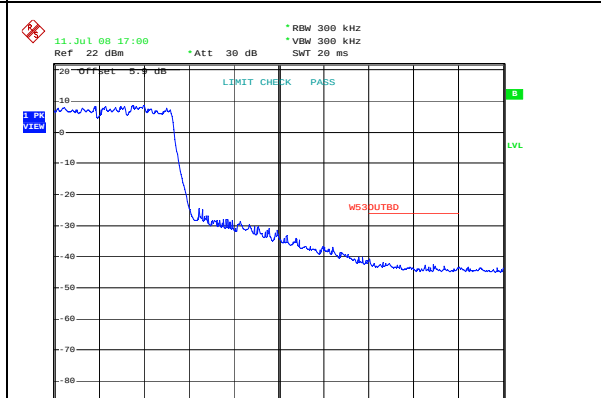
> 5280 MHz:

≤ - 26 dBm/MHz

5.4 Out-band emission power

Result values:

T_{amb}: 27 °C
RH: 45 %
U_{nom}: 3.3 Vdc

 11.Jul.08 15:16 Ref: 22 dBm Att: 30 dB RBW: 300 kHz VBW: 300 kHz SWT: 20 ms Center: 5.149 GHz 2 MHz/ Span: 20 MHz SUBSTITUTED VALUE: 2412.000 MHz Date: 11.JUL.2008 15:16:55 Ch 36 TX	 11.Jul.08 15:02 Ref: 22 dBm Att: 30 dB RBW: 300 kHz VBW: 300 kHz SWT: 20 ms Center: 5.276 GHz 20 MHz/ Span: 200 MHz SUBSTITUTED VALUE: 2412.000 MHz Date: 11.JUL.2008 15:02:46 Ch 48TX
 11.Jul.08 14:57 Ref: 22 dBm Att: 30 dB RBW: 300 kHz VBW: 300 kHz SWT: 20 ms Center: 5.26 GHz 20 MHz/ Span: 200 MHz SUBSTITUTED VALUE: 2412.000 MHz Date: 11.JUL.2008 14:57:36 Ch 52 TX	 11.Jul.08 17:00 Ref: 22 dBm Att: 30 dB RBW: 300 kHz VBW: 300 kHz SWT: 20 ms Center: 5.34 GHz 5 MHz/ Span: 50 MHz Date: 11.JUL.2008 17:00:43 Ch 64 TX
Measurement uncertainty	+2.4/-2.7 dB

Limit values W52 band:

Frequency band	Deviation frequency (f) from 5240MHz	EIRP
5140 - 5142MHz	98- 100MHz	2.5µW/MHz or less
5142 - 5150MHz	90 - 98MHz	15µW/MHz or less
5250 - 5251MHz	10 - 11MHz	$10^{1-(f-9)}$ mW/MHz or less
5251 - 5260MHz	11 - 20MHz	$10^{-1-(8/90)(f-20)}$ mW/MHz or less
5260 - 5266.7MHz	20 - 26.7MHz	$10^{-1.8-(6/50)(f-20)}$ mW/MHz or less
5266.7 - 5360MHz	26.7 - 120MHz	2.5µW/MHz or less

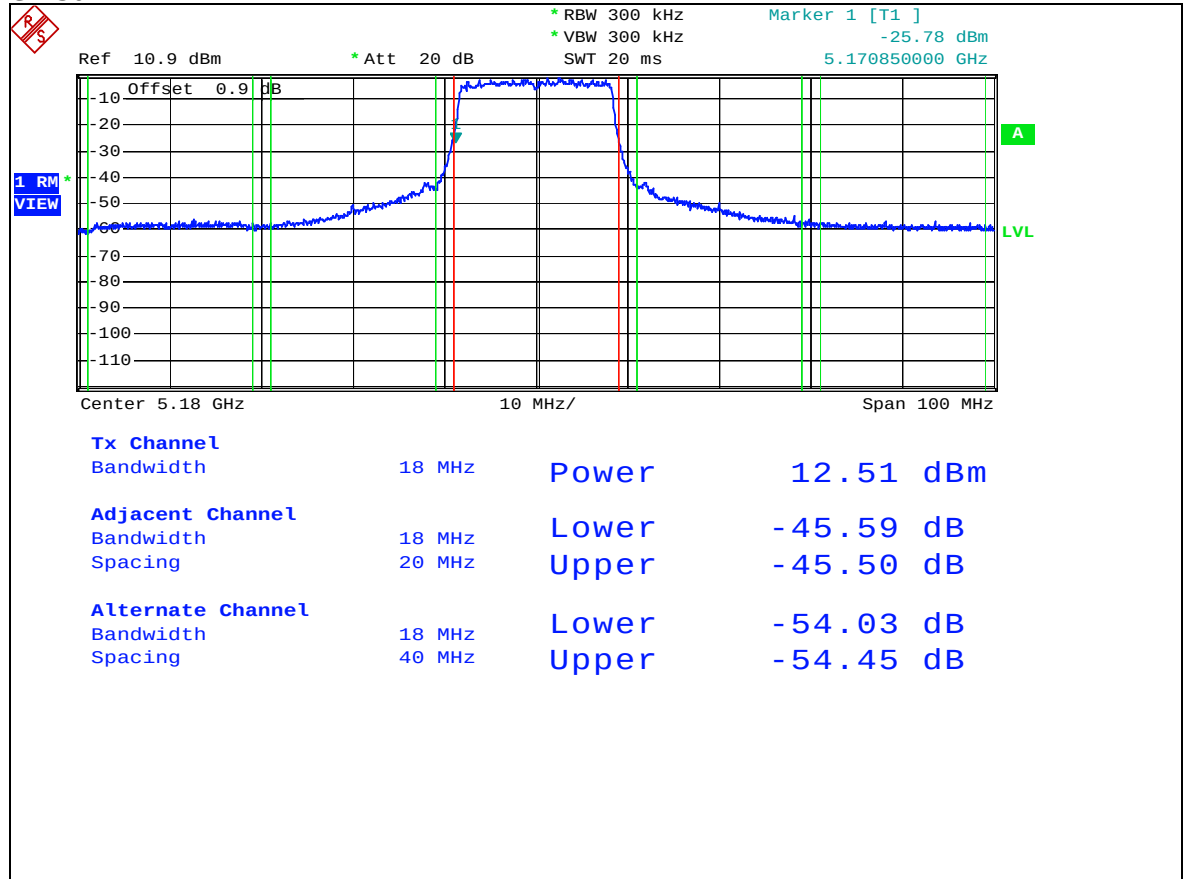
Limit values W53 band:

Frequency band	Deviation frequency (f) from 5260MHz	EIRP
5140 - 5233.3MHz	26.7 - 120MHz	2.5µW/MHz or less
5233.3 - 5240MHz	20 - 26.7MHz	$10^{-1.8-(6/50)(f-20)}$ mW/MHz or less
5240 - 5249MHz	11 - 20MHz	$10^{-1-(8/90)(f-11)}$ mW/MHz or less
5249 - 5250MHz	10 - 11MHz	$10^{1-(f-9)}$ mW/MHz or less
5350 - 5360MHz	90 - 100MHz	2.5µW/MHz or less

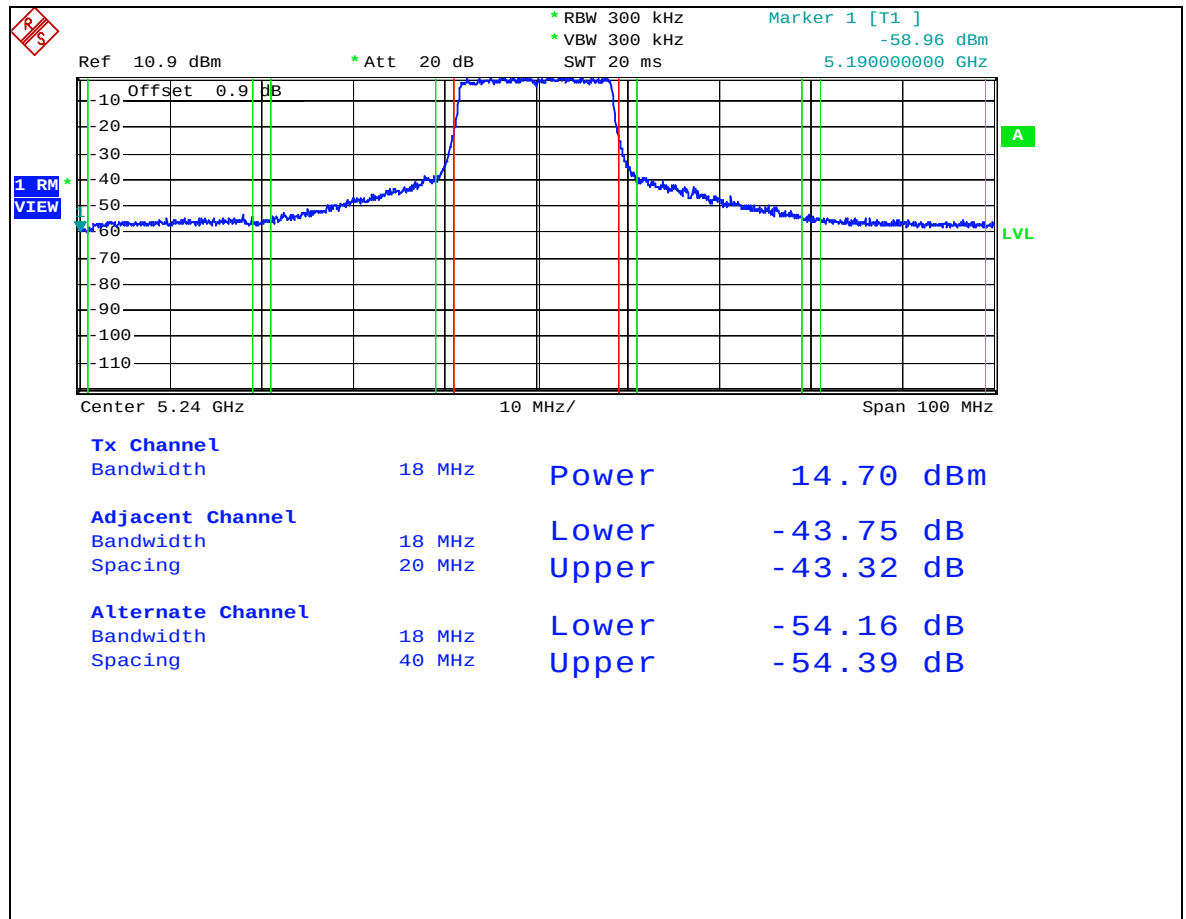
5.5 Adjacent channel power tolerance

Result values:

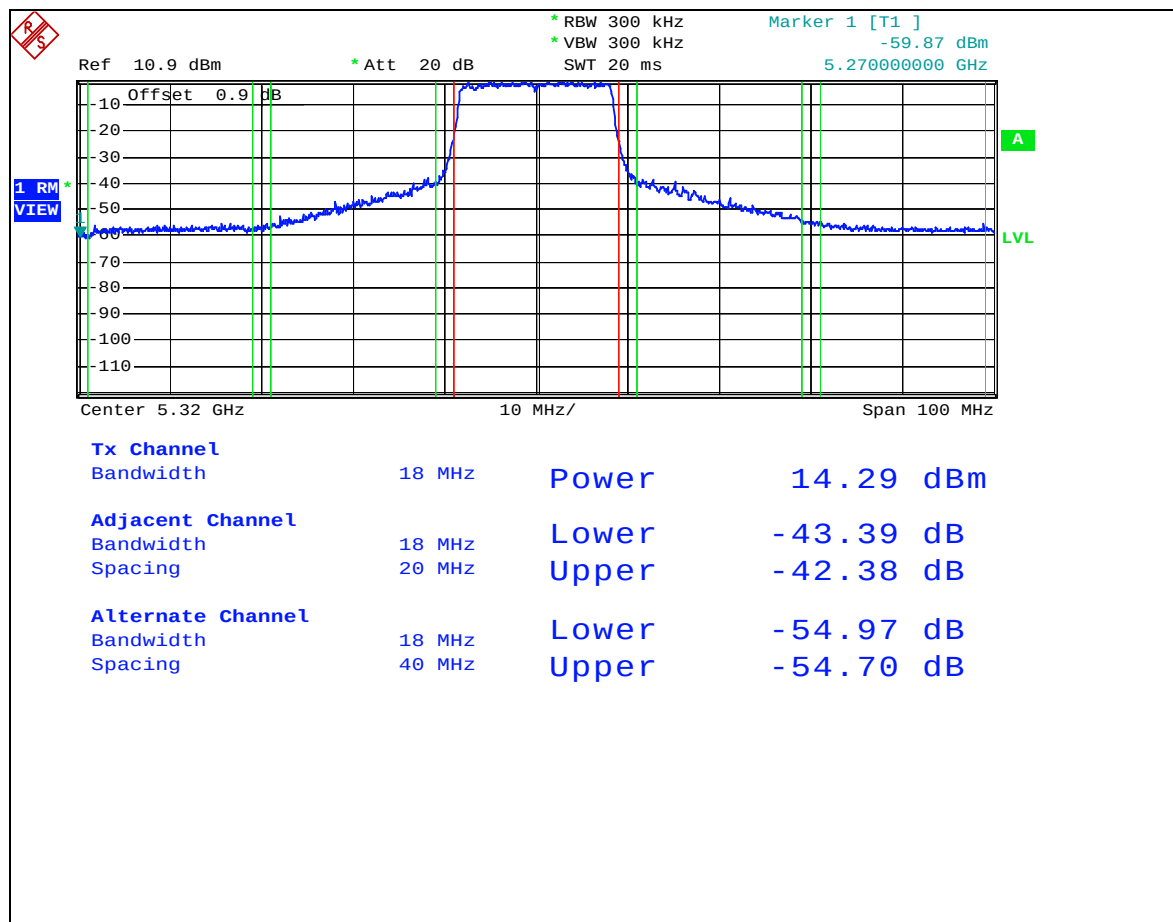
CH 36



CH 48



CH 64



** These test results are conducted measurements. Antenna gain is not related to this measurement.

Limit values:

Under all test conditions	Mean Power 20 MHz distance of carrier:	≥ -25 dBc
	Mean Power 40 MHz distance of carrier:	≥ -40 dBc

5.6 Antenna Power

Result values:

T _{amb} : 27 °C RH: 45 % U _{nom} : 3.3 Vdc				
Voltage		ch 36	ch 48	ch 64
U _{nom}	Conducted power (dBm/MHz)	0.15	1.15	0.05
	Deviation from rated power (%)	-31	-13.1	-32.6
	Radiated power (mW/MHz) **	3.35	4.22	3.27
U _{-10%}	Conducted power (dBm)	n.t.*	n.t.*	n.t.*
	Radiated power (mW/MHz)	n.t.*	n.t.*	n.t.*
U _{+10%}	Conducted power (dBm)	n.t.*	n.t.*	n.t.*
	Radiated power (mW/MHz)	n.t.*	n.t.*	n.t.*
Measurement uncertainty		< 3.3 dB		

* See remark in section 4.3 “test conditions”.

** The test results are valid for the 5.1 dBi gain antenna as specified in section 3.5 “Antenna specifications”.

Note: the rated conducted power is 1.5 mW/MHz

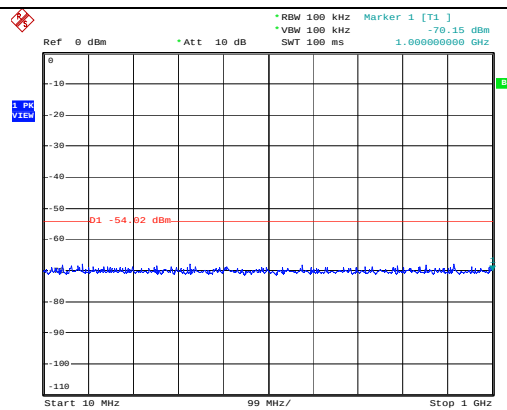
Limit values :

Under all test conditions	OFDM: ≤ 10 mW/MHz (radiated) (tolerance +50% to - 50% from rated conducted power)
---------------------------	--

5.7 Spurious emissions receiver

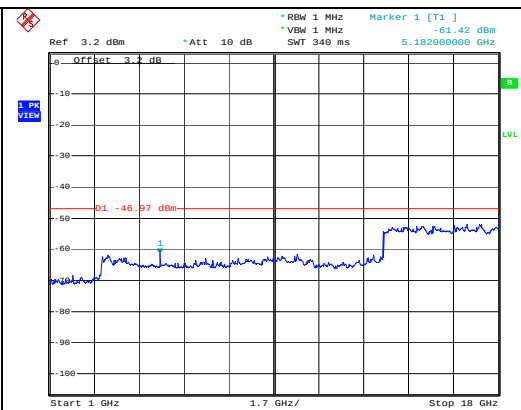
Result values:

T_{amb}: 27 °C
RH: 45 %
U_{nom}: 3.3 Vdc



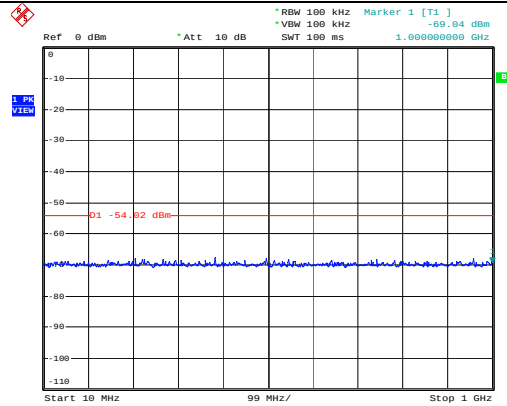
Date: 4.JUL.2008 17:06:19

Ch 36 RX



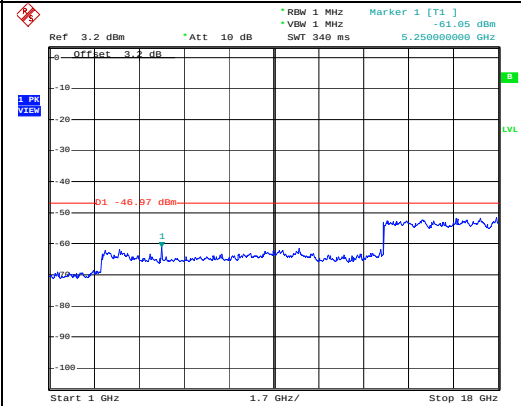
Date: 4.JUL.2008 17:12:09

Ch 36 RX



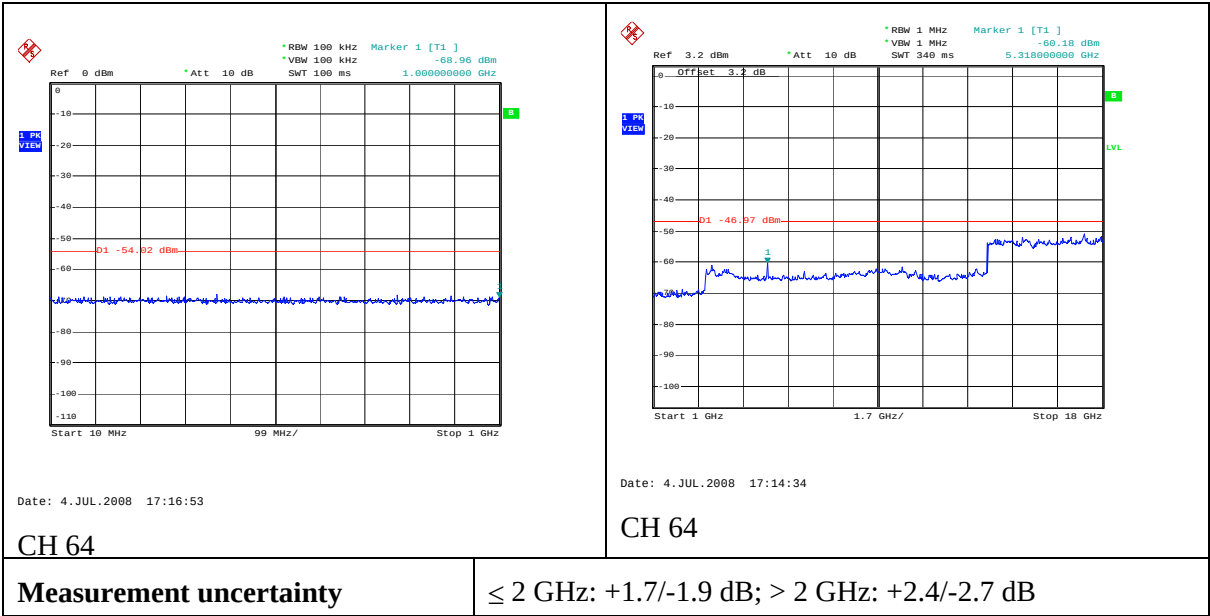
Date: 4.JUL.2008 16:56:47

Ch 48 RX



Date: 4.JUL.2008 16:54:14

Ch 48 RX



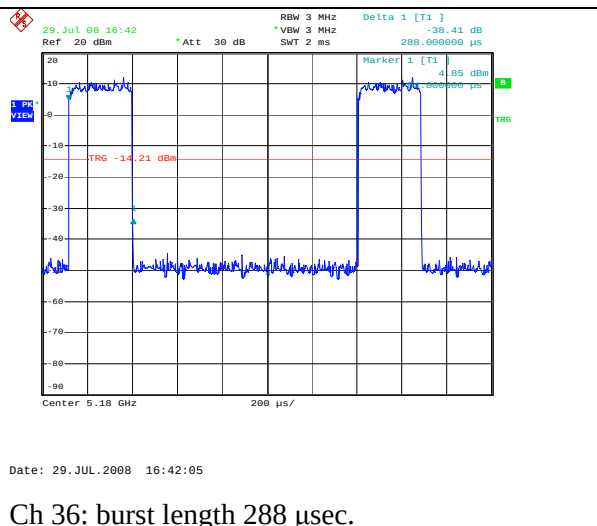
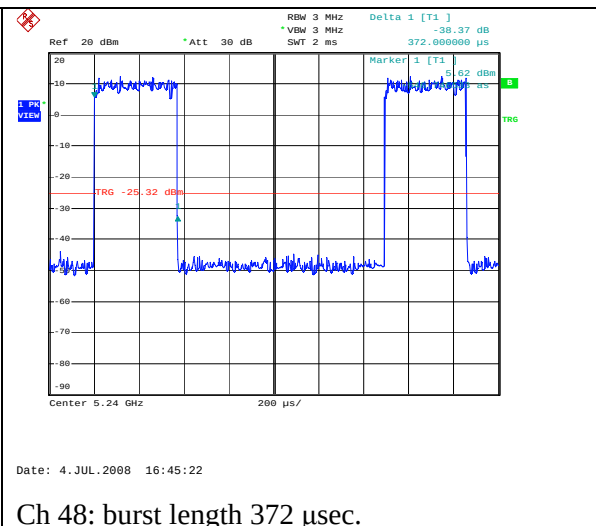
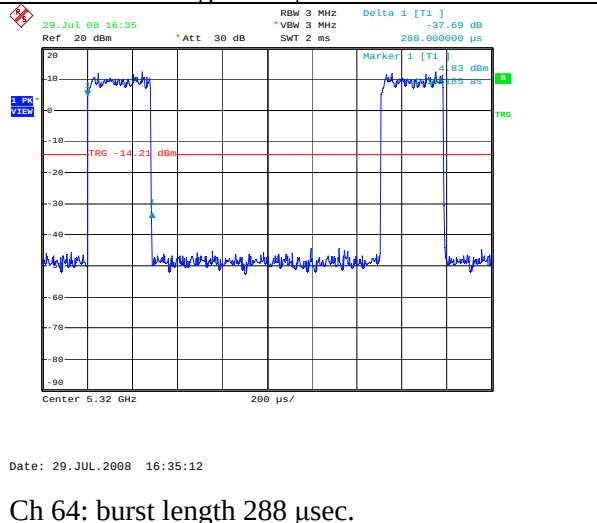
Limit values:

Receiver operating	≤ 1000 MHz: ≤ 4 nW (-54 dBm) ≥ 1000 MHz: ≤ 20 nW (-47 dBm)
--------------------	--

5.8 Burst Length

Result values:

T_{amb}: 27 °C
RH: 45 %
U_{nom}: 3.3 Vdc

 Date: 29.JUL.2008 16:42:05 Ch 36: burst length 288 μsec.	 Date: 4.JUL.2008 16:45:22 Ch 48: burst length 372 μsec.
 Date: 29.JUL.2008 16:35:12 Ch 64: burst length 288 μsec.	
Measurement uncertainty	4.5%

Limit values:

Transmitter operating	≤ 4 ms
-----------------------	--------

5.9 Carrier sense capability

Automatic cessation of transmitting is required when the electric field strength is exceeding E (mV/m):

$$E = 100 \sqrt{\frac{1}{G}} \times \sqrt{\frac{0.16}{P_t \times \frac{20}{n}}} \quad (\text{mV/m})$$

where:

P_t = antenna power in W;

G = gain (numeric);

$n = 20, 10$, and 5 for 20 MHz , 10 MHz and 5 MHz systems respectively

Substituting the formula into the expression: $P_{cs} = \frac{E^2}{120\pi} \times \frac{\lambda^2}{4\pi} \times G \quad (\text{W})$

converts to the expression:

$$P_{cs} = 44.83 - 20 \log F - P_{tm} + 10 \log \frac{n}{20} \quad (\text{dBm})$$

where:

P_{cs} = carrier sense power in dBm;

P_{tm} = total antenna power in dBm;

F = frequency in MHz;

$n = 20, 10$, and 5 for 20 MHz , 10 MHz and 5 MHz systems respectively

For example, for channel 36 (5180 MHz) this yields:

$$P_{cs} = 44.83 - 20 \log 5180 - 14 + 10 \log (20/20) = -43.5 \text{ dBm}$$

Results:

Channel	Limit (dBm)	Result (dBm)	Margin w.r.t. to limit (dB)
5180 MHz	-43.5	-83.4	33.9
5240 MHz	-43.6	-84.5	40.9
5320 MHz	-43.7	-83.5	39.8

6 Test results 802.11b

6.1 Frequency Tolerance

Result values:

Tolerance from nominal frequency:

T _{amb} : 27 °C RH: 45 % U _{nom} : 3.3 Vdc				
Voltage		Ch 1	Ch 7	Ch 14
U _{nom}	Carrier frequency (MHz)	2412.010	2442.000	2484.092
	Frequency tolerance (ppm)	+4	0	+37
U _{-10%}	Carrier frequency (MHz)	n.t.*	n.t.*	n.t.*
	Frequency tolerance (ppm)	n.t.*	n.t.*	n.t.*
U _{+10%}	Carrier frequency (MHz)	n.t.*	n.t.*	n.t.*
	Frequency tolerance (ppm)	n.t.*	n.t.*	n.t.*
Measurement uncertainty		+/- 2 kHz		

* See remark in section 4.3 “test conditions”.

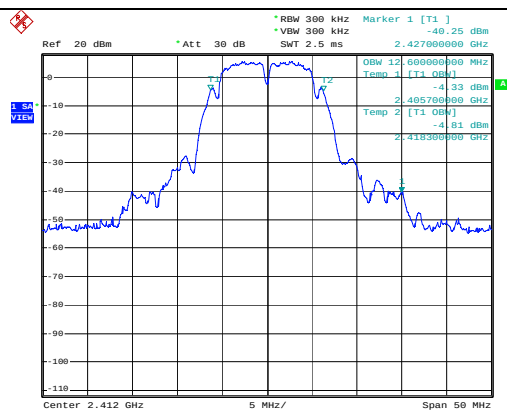
Limit values:

Under all test conditions	50 ppm
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6.2 Occupied Bandwidth (99 % channel power bandwidth)

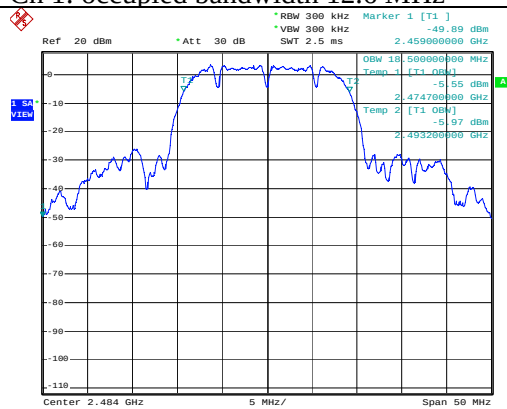
Result values:

T_{amb}: 27 °C
RH: 45 %
U_{nom}: 3.3 Vdc



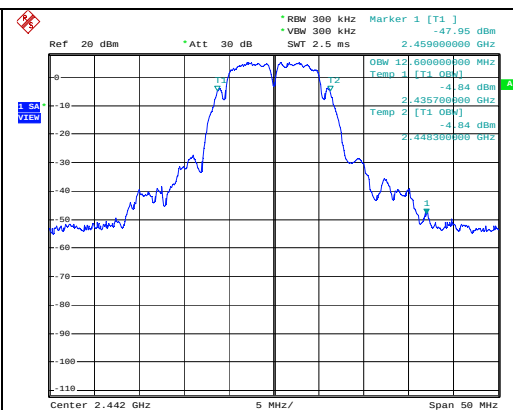
Date: 30. JUN.2008 13:37:40

Ch 1: occupied bandwidth 12.6 MHz



Date: 30. JUN.2008 13:40:42

Ch 14: occupied bandwidth 18.5 MHz



Date: 30. JUN.2008 13:35:31

Ch 7: occupied bandwidth 12.6 MHz

Measurement uncertainty

± 196 kHz

Limit values:

Under all test conditions

Occupied bandwidth: ≤ 18 MHz

Number of carriers:

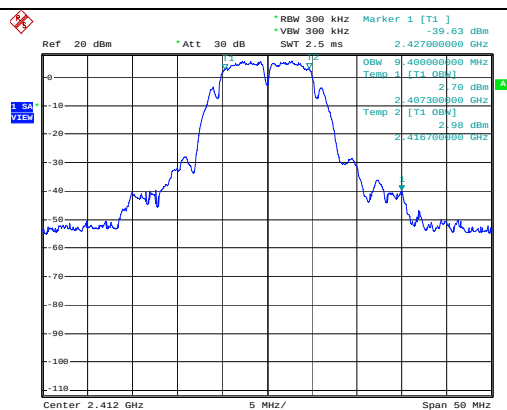
The total number of subcarriers in one channel OFDM is 52. There is no subcarrier at the channel center frequency (therefore there are 53 subcarrier frequencies but only 52 are used in a given channel).

The measured occupied bandwidth varies between 17.08 MHz and 17.92 MHz. $17.08 \text{ MHz} / 53 = 0.32$, $17.88 \text{ MHz} / 53 = 0.34$. Within a bandwidth of 1 MHz there are at least 3 subcarriers. This complies with the requirement of at least 1 subcarrier.

6.3 Occupied Bandwidth (90 % channel power bandwidth)

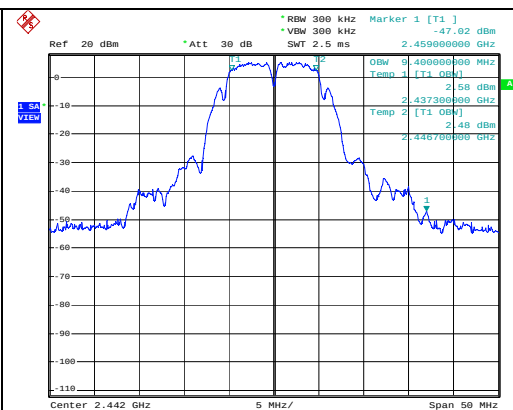
Result values:

T_{amb}: 27 °C
RH: 45 %
U_{nom}: 3.3 Vdc



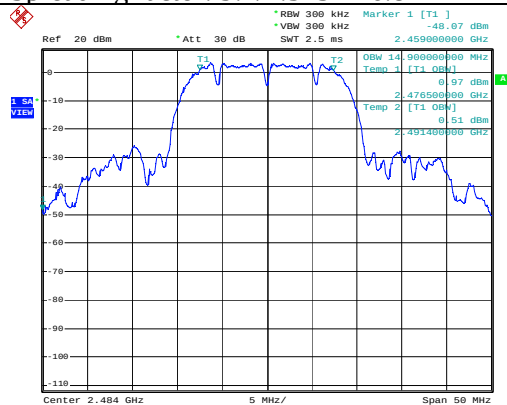
Date: 30. JUN.2008 13:38:59

Ch 1: occupied bandwidth 9.4 MHz
Spreading factor: $9.4/1.375 = 6.8$



Date: 30. JUN.2008 13:34:11

Ch 7: occupied bandwidth 9.4 MHz
Spreading factor: $9.4/1.375 = 6.8$



Date: 30. JUN.2008 13:32:22

Ch 14: occupied bandwidth 14.9 MHz
Spreading factor: $14.9/1.375 = 10.8$

Measurement uncertainty ± 196 kHz

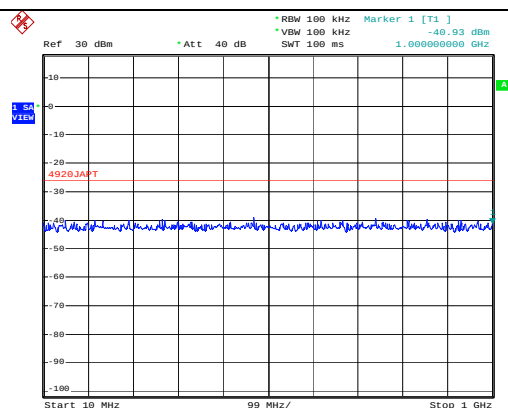
Limit values:

Under all test conditions	Spreading factor: ≥ 5 (2400 – 2483.5 MHz); ≥ 10 (2471 – 2497 MHz)
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6.4 Spurious emissions transmitter

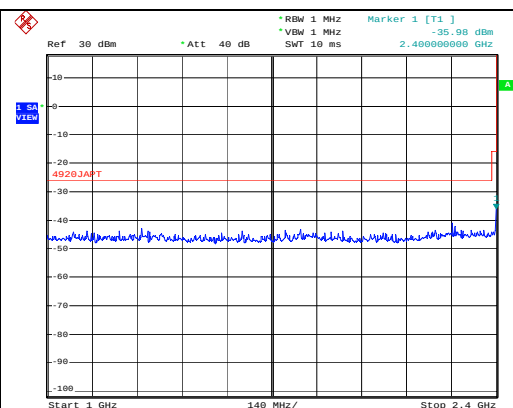
Result values:

T_{amb} : 27 °C
 RH : 45 %
 U_{nom} : 3.3 Vdc



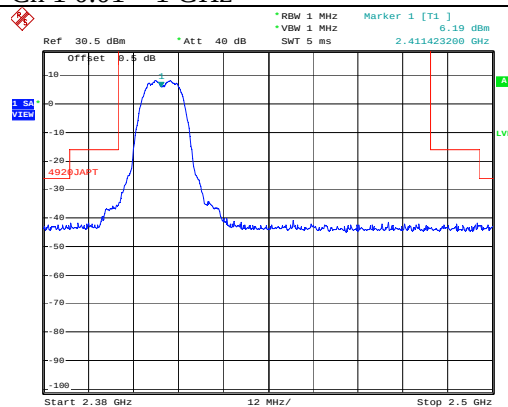
Date: 30.JUN.2008 12:04:40

Ch 1 0.01 – 1 GHz



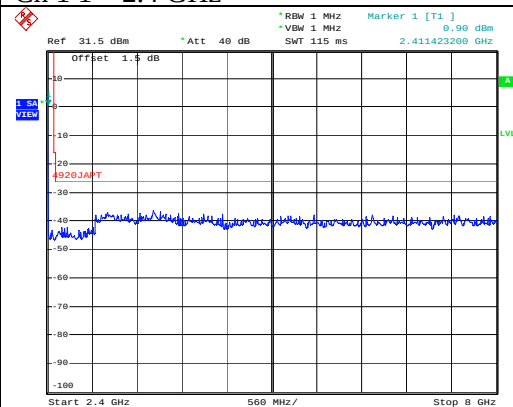
Date: 30.JUN.2008 12:02:20

Ch 1 1 – 2.4 GHz



Date: 30.JUN.2008 11:57:28

Ch 1 2.38 – 2.5 GHz



Date: 30.JUN.2008 12:00:05

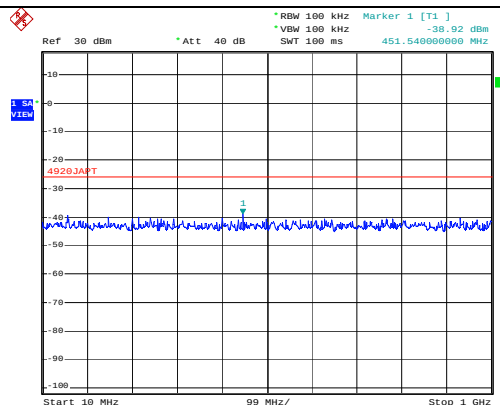
Ch 1 2.4 – 8 GHz

Measurement uncertainty

+2.4/-2.7 dB

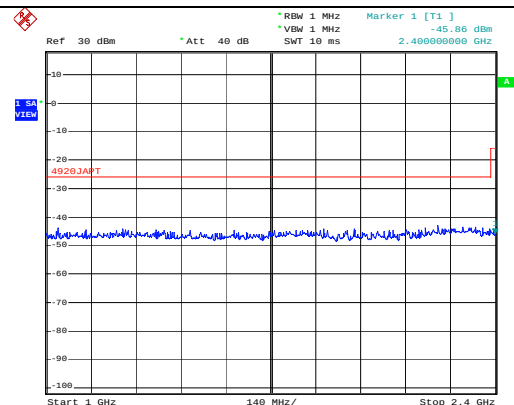
Result values:

T_{amb} : 27 °C
 RH : 45 %
 U_{nom} : 3.3 Vdc



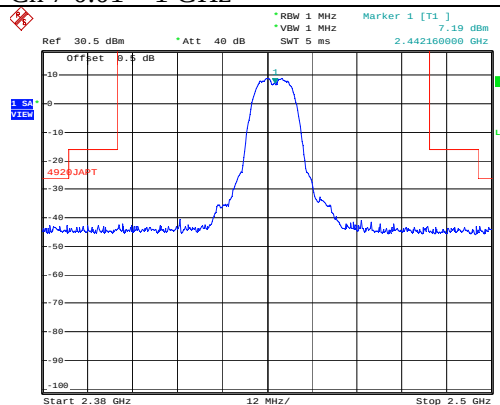
Date: 30.JUN.2008 12:13:17

Ch 7 0.01 – 1 GHz



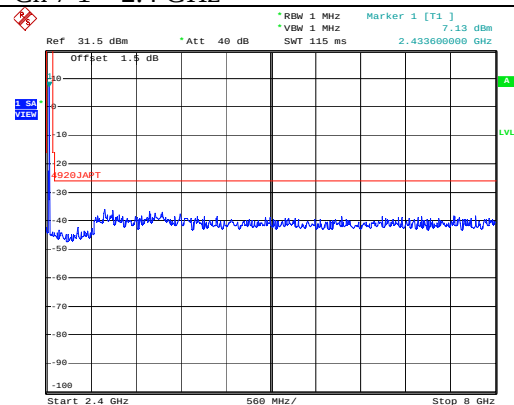
Date: 30.JUN.2008 12:11:31

Ch 7 1 – 2.4 GHz



Date: 30.JUN.2008 12:07:27

Ch 7 2.38 - 2.5 GHz



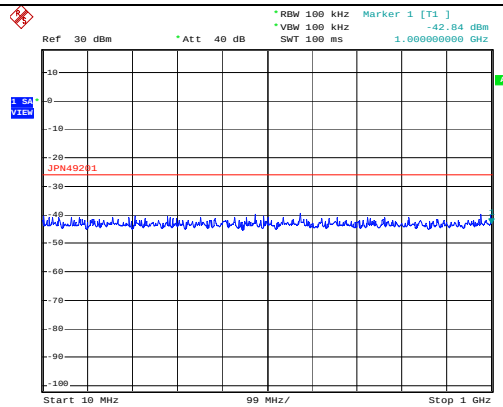
Date: 30.JUN.2008 12:09:42

Ch 7 2.4 – 8 GHz

Measurement uncertainty

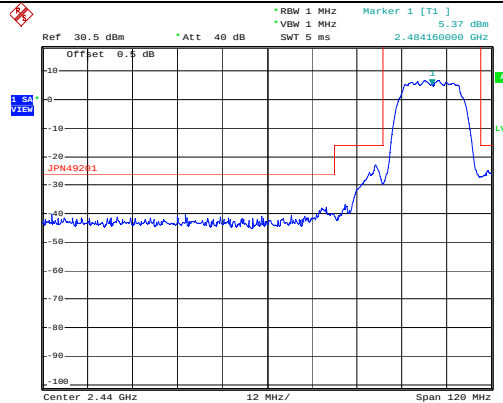
+2.4/-2.7 dB

T_{amb}: 27 °C
RH: 45 %
U_{nom}: 3.3 Vdc



Date: 30.JUN.2008 13:28:59

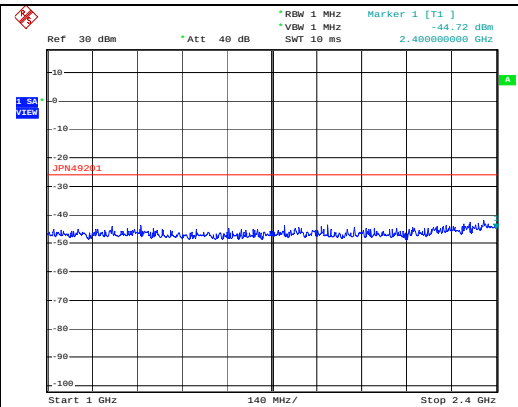
Ch 14 0.01 – 1 GHz



Date: 30.JUN.2008 13:23:49

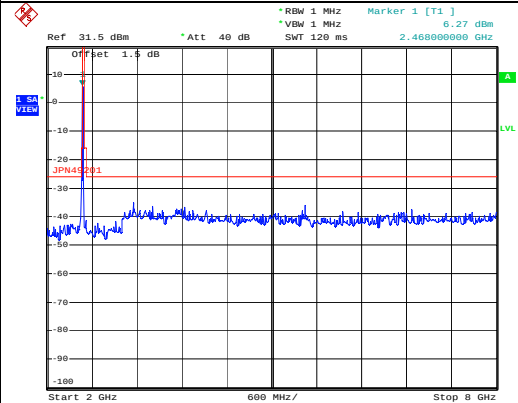
Ch 14 2.38 - 2.5 GHz

Measurement uncertainty



Date: 30.JUN.2008 13:27:26

Ch 14 1 – 2.4 GHz



Date: 30.JUN.2008 13:25:52

Ch 14 2.4 – 8 GHz

+2.4/-2.7 dB

Limit values:

Transmitter operating	CH 1- 13	Below 2387MHz : 2.5μW/MHz 2387 to 2400MHz : 25μW/MHz 2483.5 through 2496.5MHz : 25μW/MHz Over 2496.5MHz : 2.5μW/MHz
	CH 14	Below 2458MHz : 2.5μW 2458 to 2471MHz : 25μW 2497 through 2510MHz : 25μW Over 2510MHz : 2.5μW

6.5 Antenna Power

Result values:

T _{amb} : 22 °C RH: 43 %				
Voltage		ch 1	ch 7	ch 14
U _{nom}	Conducted power (dBm/MHz)	3.14	4.35	-0.35
	Deviation from rated power (%)	-17.6	+8.9	-63.1
	Radiated power (dBm/MHz) **	6.94	8.15	3.45
U _{-10%}	Conducted power (dBm) *	n.t.*	n.t.*	n.t.*
	Radiated power (mW/MHz) *	n.t.*	n.t.*	n.t.*
U _{+10%}	Conducted power (dBm) *	n.t.*	n.t.*	n.t.*
	Radiated power (mW/MHz) *	n.t.*	n.t.*	n.t.*
Measurement uncertainty		< 3.3 dB		

* See remark in section 4.3 “test conditions”.

** The test results are valid for + 3.8 dBi gain.

Note: the rated conducted power is 2.5 mW/MHz

Limit values :

Under all test conditions	DS: ≤ 10 mW/MHz (tolerance +20 % to - 80 %)
---------------------------	--

6.6 Angular width of principal radiation (AWPR)

The angular width of principal radiation (AWPR), which follows from the antenna pattern specifications, shall satisfy the expression $360/A$ degrees.

To be assessed:

$$\text{AWPR} < 360/A \quad (\text{degrees})$$

A represents the value determined by dividing the equivalent isotropic radiated power by the value obtained by applying an antenna power with the mean power of 10 mW to the transmitting antenna with its absolute gain being 2.14 dBi.

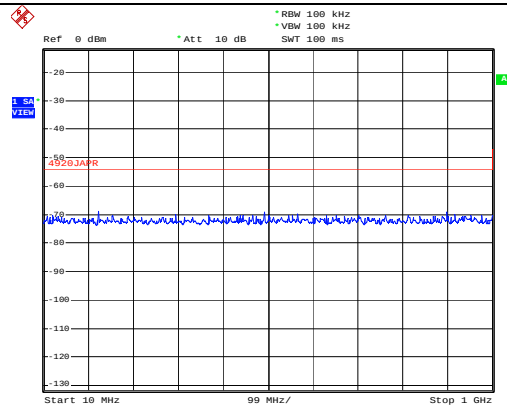
Results:

	ch 1	ch 7	ch 14
Radiated power (mW/MHz)	4.94	6.53	2.21
Constant A	$4.94/16.4 < 1$	$6.53/16.4 < 1$	$2.21/16.4 < 1$
$360/A$ (degrees)	360	360	360

6.7 Spurious emissions receiver

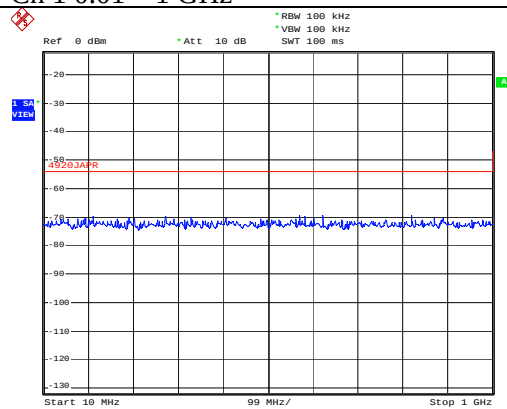
Result values:

T_{amb} : 27 °C
 RH: 45 %
 U_{nom} : 3.3 Vdc



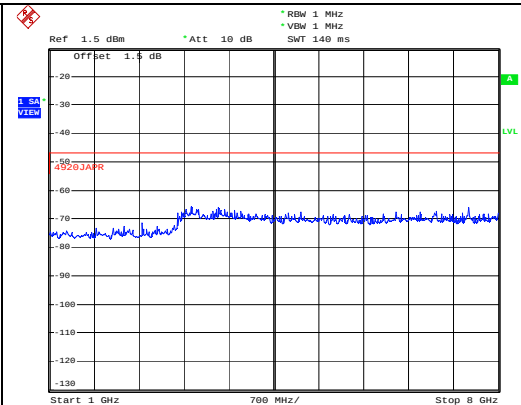
Date: 1.JUL.2008 10:55:03

Ch 1 0.01 - 1 GHz



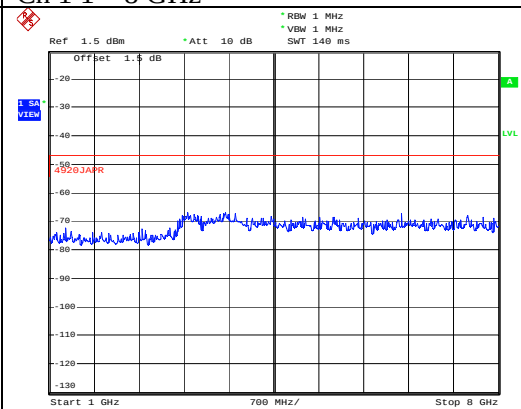
Date: 1.JUL.2008 10:51:57

Ch 7 0.01 - 1 GHz



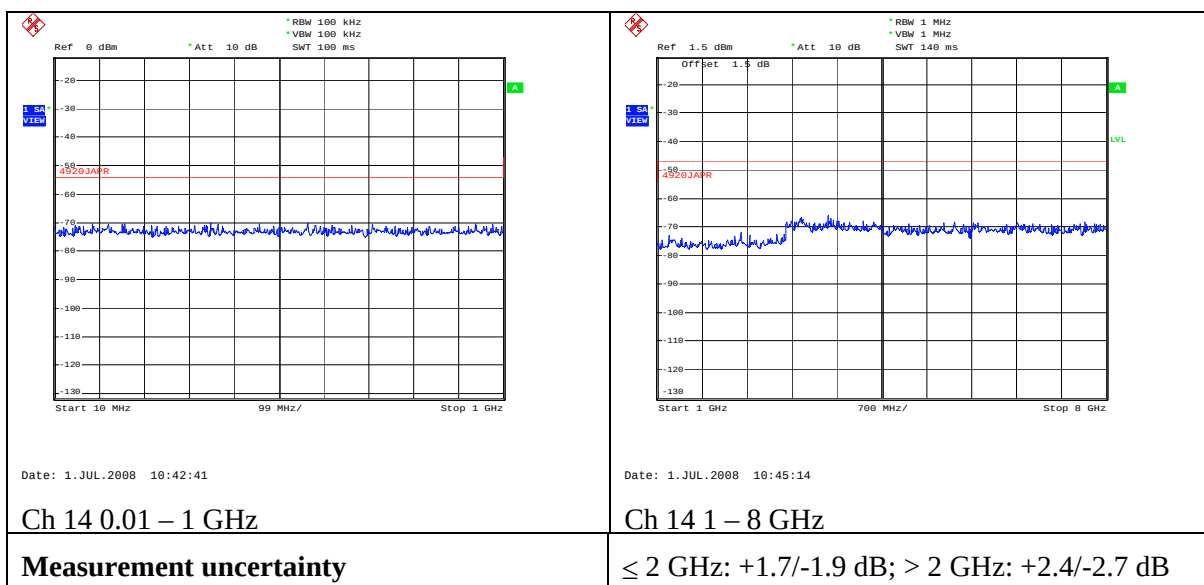
Date: 1.JUL.2008 10:59:46

Ch 1 1 - 8 GHz



Date: 1.JUL.2008 10:49:14

Ch 7 1 - 8 GHz


Limit values:

Receiver operating	$\leq 1000 \text{ MHz:}$	$\leq 4 \text{ nW } (-54 \text{ dBm})$
	$\geq 1000 \text{ MHz:}$	$\leq 20 \text{ nW } (-47 \text{ dBm})$

7 Test results 802.11g

7.1 Frequency Tolerance

Result values:

Tolerance from nominal frequency:

T _{amb} : 27 °C RH: 45 % U _{nom} : 3.3 Vdc				
Voltage		Ch 1	Ch 7	Ch 13
U _{nom}	Carrier frequency (MHz)	2412.000	2442.008	2472.000
	Frequency tolerance (ppm)	0	+3	0
U _{-10%}	Carrier frequency (MHz)	n.t.*	n.t.*	n.t.*
	Frequency tolerance (ppm)	n.t.*	n.t.*	n.t.*
U _{+10%}	Carrier frequency (MHz)	n.t.*	n.t.*	n.t.*
	Frequency tolerance (ppm)	n.t.*	n.t.*	n.t.*
Measurement uncertainty		+/- 2 kHz		

* See remark in section 4.3 “test conditions”.

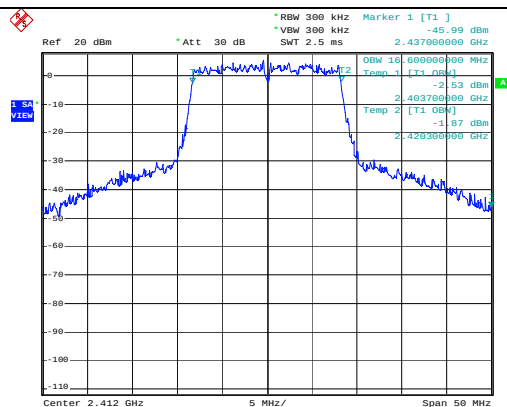
Limit values:

Under all test conditions	50 ppm
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7.2 Occupied Bandwidth (99 % channel power bandwidth)

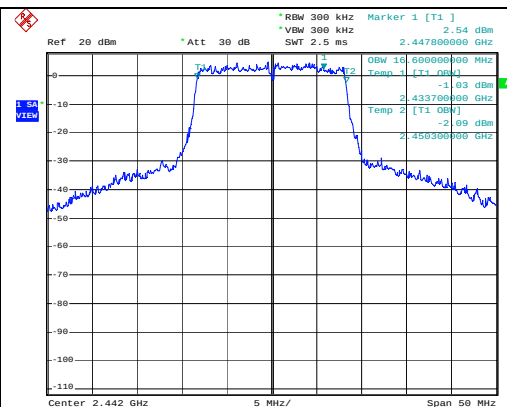
Result values:

T_{amb} : 27 °C
 RH: 45 %
 U_{nom} : 3.3 Vdc



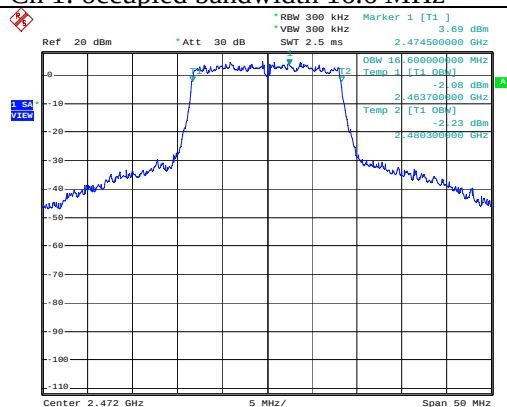
Date: 30.JUN.2008 14:08:07

Ch 1: occupied bandwidth 16.6 MHz



Date: 30.JUN.2008 14:28:33

Ch 7: occupied bandwidth 16.6 MHz



Date: 30.JUN.2008 15:33:24

Ch 13: occupied bandwidth 16.6 MHz

Measurement uncertainty
 ± 196 kHz

Limit values:

Under all test conditions

Occupied bandwidth: ≤ 18 MHz

Number of carriers:

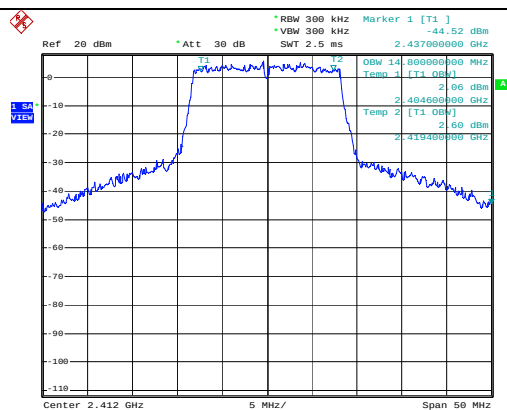
The total number of subcarriers in one channel OFDM is 52. There is no subcarrier at the channel center frequency (therefore there are 53 subcarrier frequencies but only 52 are used in a given channel).

The measured occupied bandwidth varies between 17.08 MHz and 17.92 MHz. $17.08 \text{ MHz} / 53 = 0.32$, $17.88 \text{ MHz} / 53 = 0.34$. Within a bandwidth of 1 MHz there are at least 3 subcarriers. This complies with the requirement of at least 1 subcarrier.

7.3 Occupied Bandwidth (90 % channel power bandwidth)

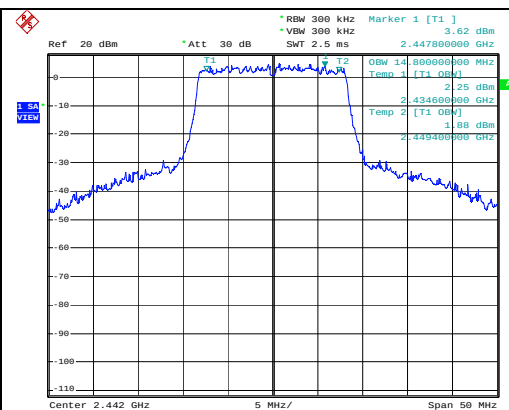
Result values:

T_{amb} : 27 °C
 RH : 45 %
 U_{nom} : 3.3 Vdc



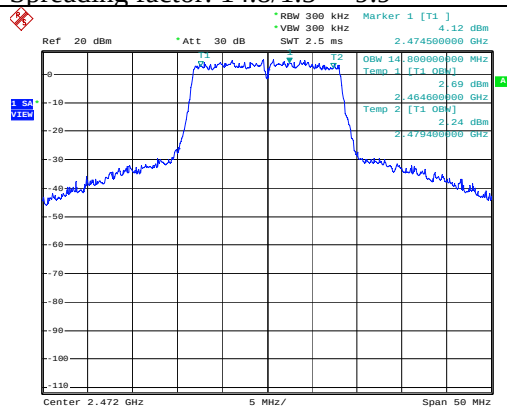
Date: 30. JUN.2008 14:15:56

Ch 1: occupied bandwidth 14.8 MHz
 Spreading factor: $14.8/1.5 = 9.9$



Date: 30. JUN.2008 14:27:16

Ch 7: occupied bandwidth 14.8 MHz
 Spreading factor: $14.8/1.5 = 9.9$



Date: 30. JUN.2008 15:37:11

Ch 13: occupied bandwidth 14.8 MHz
 Spreading factor: $14.8/1.5 = 9.9$

Measurement uncertainty

± 196 kHz

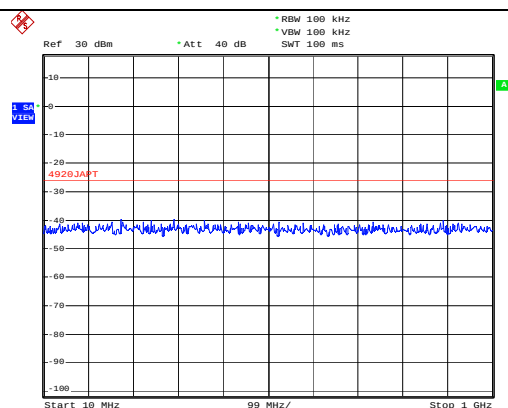
Limit values:

Under all test conditions	Spreading factor: ≥ 5 (2400 – 2483.5 MHz); ≥ 10 (2471 – 2497 MHz)
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7.4 Spurious emissions transmitter

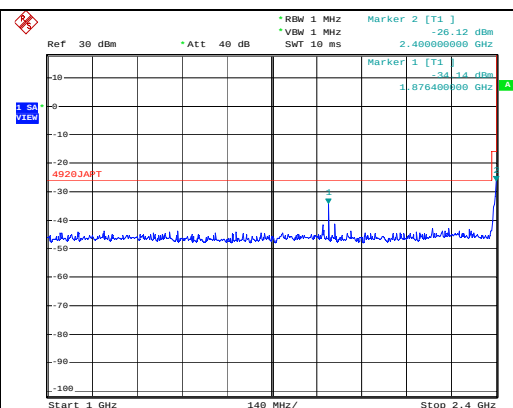
Result values:

T_{amb}: 27 °C
RH: 45 %
U_{nom}: 3.3 Vdc



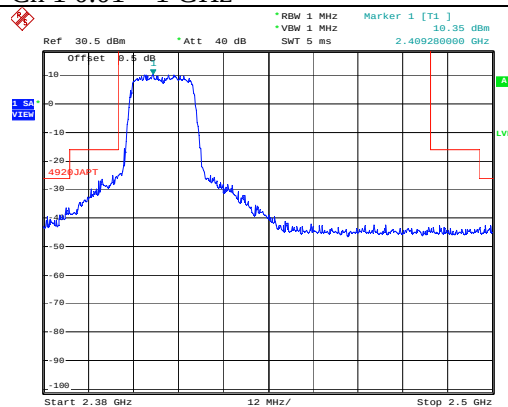
Date: 30.JUN.2008 15:00:54

Ch 1 0.01 – 1 GHz



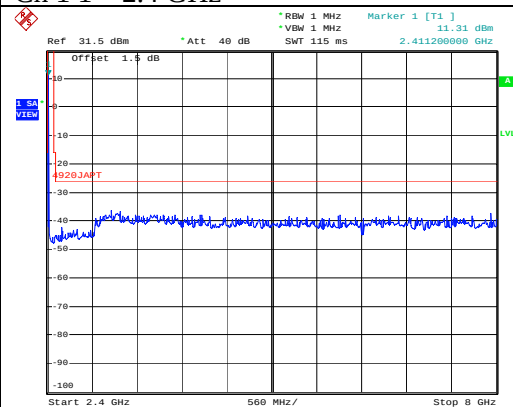
Date: 30.JUN.2008 14:59:16

Ch 1 1 – 2.4 GHz



Date: 30.JUN.2008 14:55:03

Ch 1 2.38 - 2.5 GHz



Date: 30.JUN.2008 14:57:03

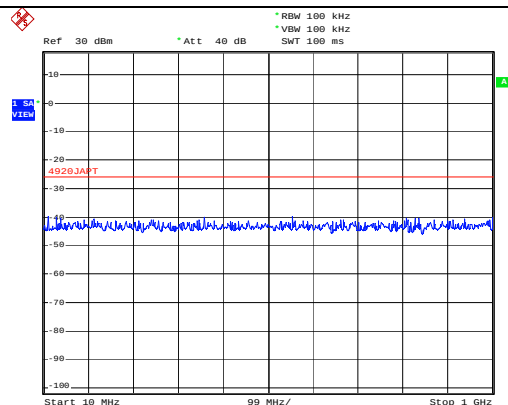
Ch 1 2.4 – 8 GHz

Measurement uncertainty

+2,4/-2,7 dB

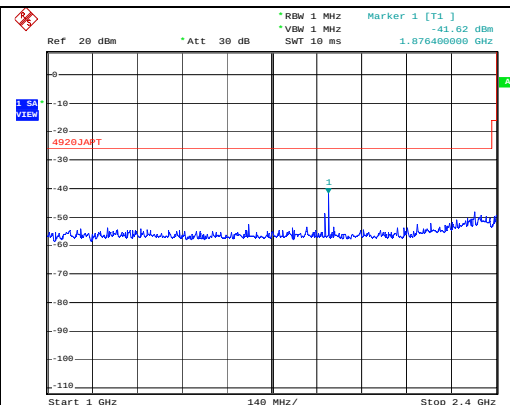
Result values:

T_{amb} : 27 °C
 RH : 45 %
 U_{nom} : 3.3 Vdc



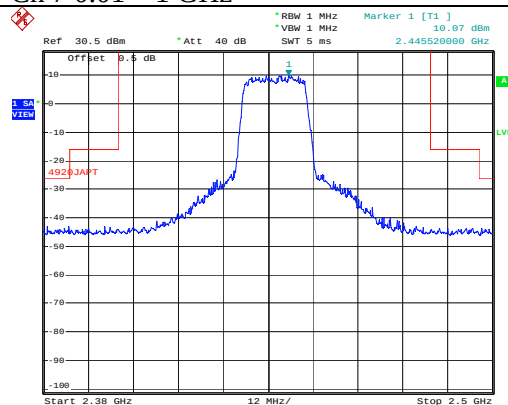
Date: 30.JUN.2008 14:38:29

Ch 7 0.01 – 1 GHz



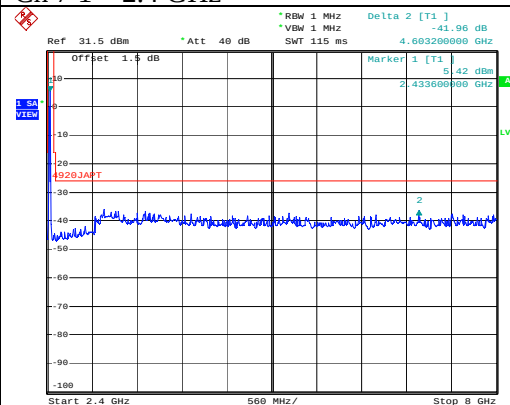
Date: 30.JUN.2008 14:31:16

Ch 7 1 – 2.4 GHz



Date: 30.JUN.2008 14:33:31

Ch 7 2.38 - 2.5 GHz



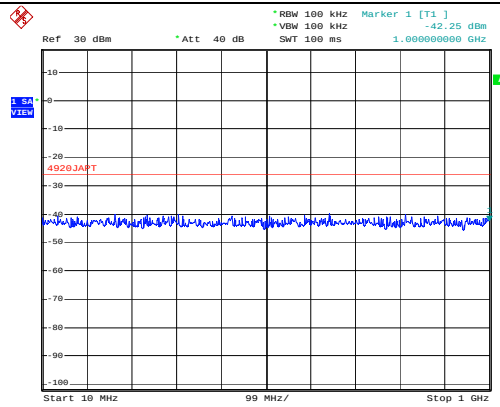
Date: 30.JUN.2008 14:36:44

Ch 7 2.4 – 8 GHz

Measurement uncertainty

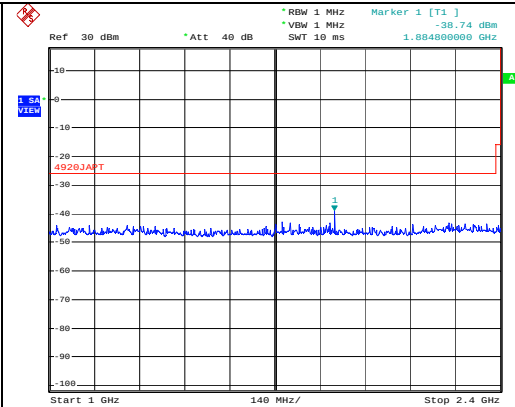
+2.4/-2.7 dB

T_{amb}: 27 °C
RH: 45 %
U_{nom}: 3.3 Vdc



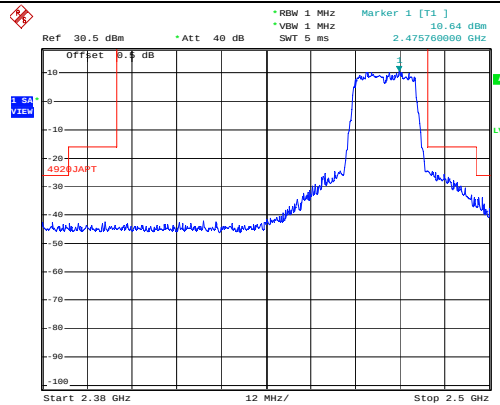
Date: 30. JUN.2008 15:47:36

Ch 13 0.01 – 1 GHz



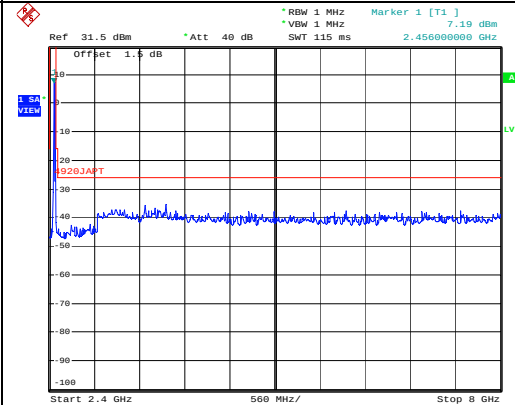
Date: 30. JUN.2008 15:39:50

Ch 13 1 – 2.4 GHz



Date: 30. JUN.2008 15:42:34

Ch 13 2.38 - 2.5 GHz



Date: 30. JUN.2008 15:45:26

Ch 13 2.4 – 8 GHz

Measurement uncertainty

+2.4/-2.7 dB

Limit values:

Transmitter operating	CH 1- 13	Below 2387MHz : 2.5µW/MHz 2387 to 2400MHz : 25µW/MHz 2483.5 through 2496.5MHz : 25µW/MHz Over 2496.5MHz : 2.5µW/MHz
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7.5 Antenna Power

Result values:

T _{amb} : 22 °C RH: 43 %				
Voltage		ch 1	ch 7	ch 13
U _{nom}	Conducted power (dBm/MHz)	3.5	3.4	3.3
	Deviation from rated power (%)	-10.5	-12.5	-14.5
	Radiated power (dBm/MHz) **	7.3	7.2	7.1
U _{-10%}	Conducted power (dBm) *	n.t.*	n.t.*	n.t.*
	Radiated power (mW/MHz) *	n.t.*	n.t.*	n.t.*
U _{+10%}	Conducted power (dBm) *	n.t.*	n.t.*	n.t.*
	Radiated power (mW/MHz) *	n.t.*	n.t.*	n.t.*
Measurement uncertainty		< 3.3 dB		

* See remark in section 4.3 “test conditions”.

** The test results are valid for + 3.8 dBi gain.

Note: the rated conducted power is 2.5 mW/MHz

Limit values :

Under all test conditions	DS: ≤ 10 mW/MHz (tolerance +20 % to - 80 %)
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7.6 Angular width of principal radiation (AWPR)

The angular width of principal radiation (AWPR), which follows from the antenna pattern specifications, shall satisfy the expression $360/A$ degrees.

To be assessed:

$$AWPR < 360/A \quad (\text{degrees})$$

A represents the value determined by dividing the equivalent isotropic radiated power by the value obtained by applying an antenna power with the mean power of 10 mW to the transmitting antenna with its absolute gain being 2.14 dBi.

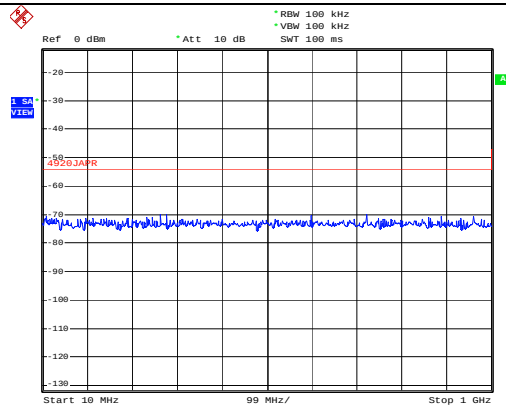
Results:

	ch 1	ch 7	ch 13
Radiated power (mW/MHz)	5.4	5.2	5.1
Constant A	$5.4/16.4 < 1$	$5.2/16.4 < 1$	$5.1/16.4 < 1$
$360/A$ (degrees)	360	360	360

7.7 Spurious emissions receiver

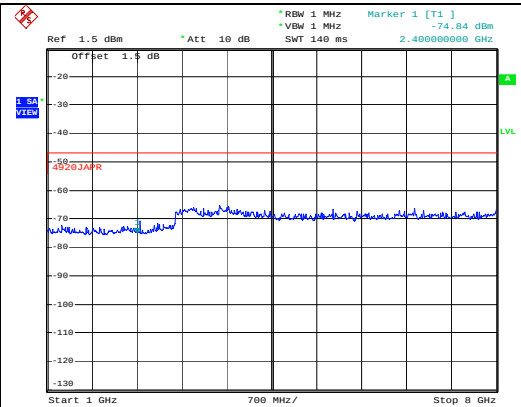
Result values:

T_{amb} : 27 °C
 RH: 45 %
 U_{nom} : 3.3 Vdc



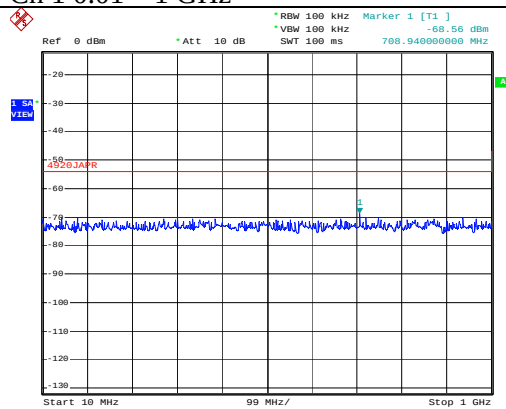
Date: 1.JUL.2008 11:21:32

Ch 1 0.01 – 1 GHz



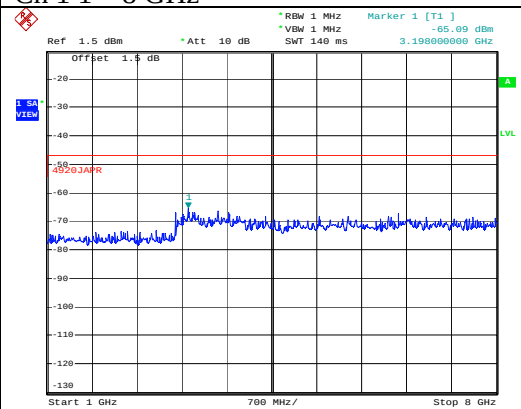
Date: 1.JUL.2008 11:18:03

Ch 1 1 – 8 GHz



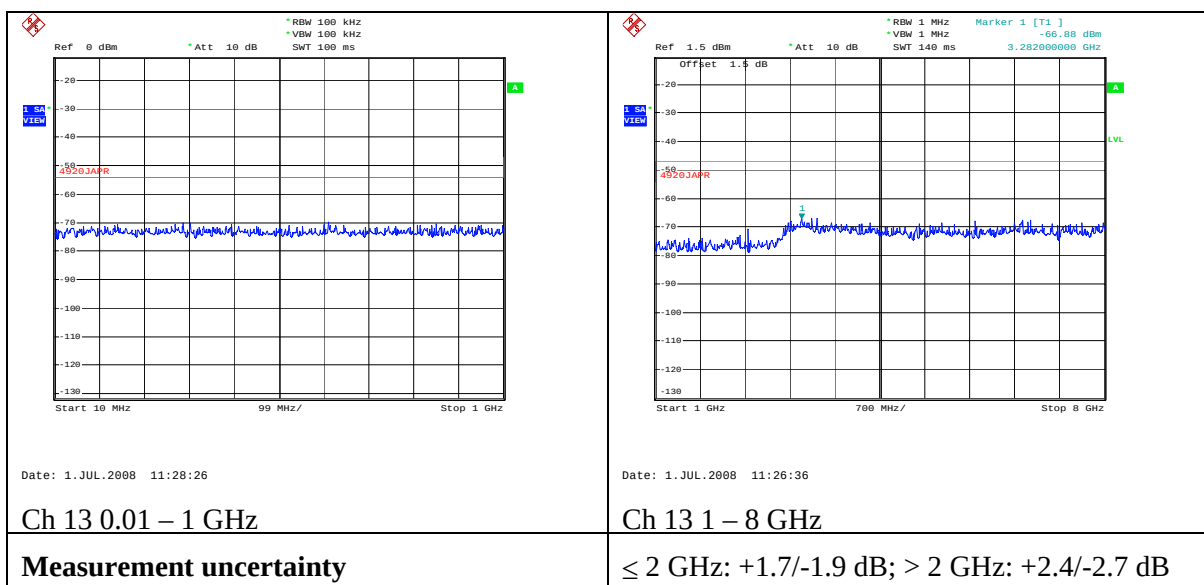
Date: 1.JUL.2008 11:23:07

Ch 7 0.01 – 1 GHz



Date: 1.JUL.2008 11:25:02

Ch 7 1 – 8 GHz



Limit values:

Receiver operating	$\leq 1000 \text{ MHz:}$	$\leq 4 \text{ nW } (-54 \text{ dBm})$
	$\geq 1000 \text{ MHz:}$	$\leq 20 \text{ nW } (-47 \text{ dBm})$

Used test equipment module

Item	Test equipment	Manufacturer	Type	Ident	Used at par.:
RF Measurement Equipment					
1	Spectrum Analyzer	Rohde & Schwarz	FSP	TE 11125	all
2	Signal Generator 10 kHz - 5.4 GHz	Marconi	2042	TE 00379	5.1, 5.6, 5.9, 6.1, 6.5, 7.1, 7.5
3	Power sensor	Hewlett Packard	8481A	TE 00485	5.6, 6.5, 7.5
4	Power meter	Hewlett Packard	437B	TE 00489	5.6, 6.5, 7.5
5	Directional coupler	Hewlett Packard	87300C	Te 00504	5.9

Photographs module

PHOTOGRAPH 1: SDC-CF10AG, TOP	56
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PHOTOGRAPH 7: SDC-CF10AG, LAIRD CENTURION ANTENNA.....	62
PHOTOGRAPH 8: SDC-CF10AG, DIPOLE ANTENNA (LARSON)	63
PHOTOGRAPH 9: SDC-CF10AG, DIPOLE ANTENNA (VOLEX)	64

Photograph 1: SDC-CF10AG, top



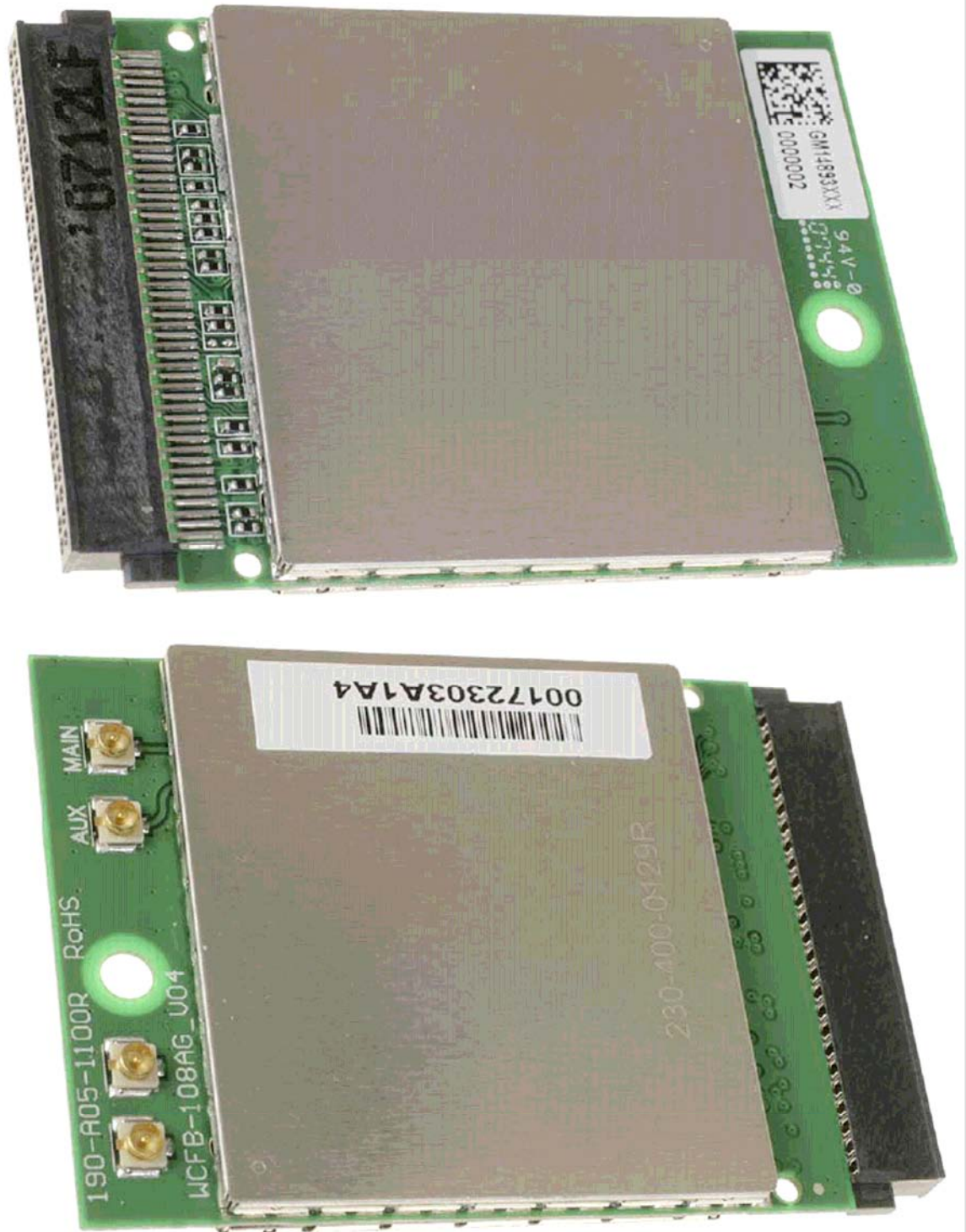
Photograph 2: SDC-CF10AG, bottom



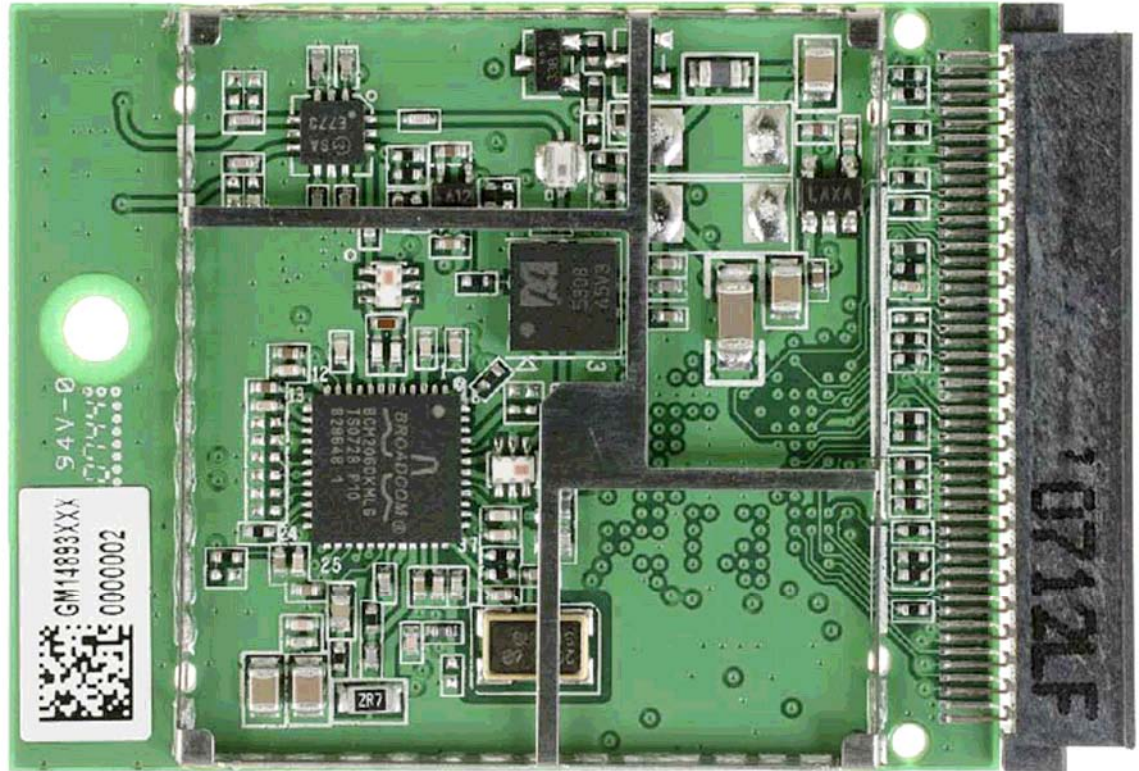
Photograph 3: SDC-CF10AG, disassembled view



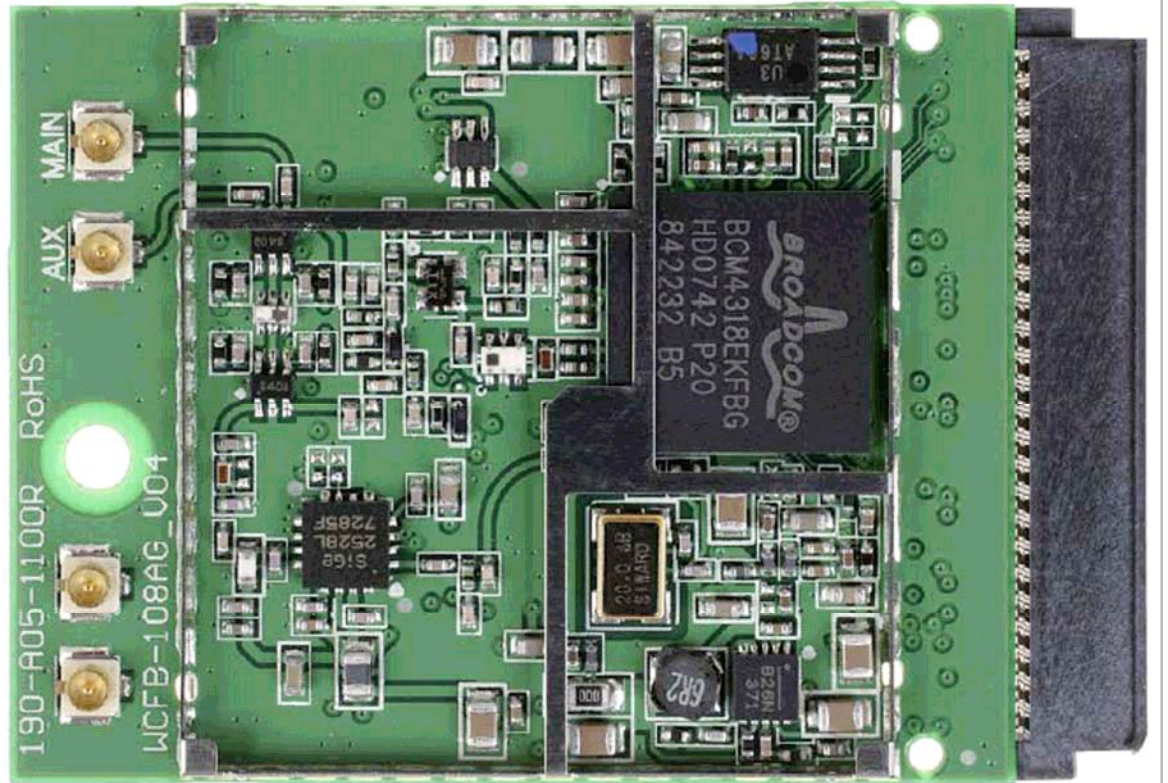
Photograph 4: SDC-CF10AG, PCB with top and bottom covers



Photograph 5: SDC-CF10AG, PCB side 1 with cover removed



Photograph 6: SDC-CF10AG, PCB side 2 with cover removed



Photograph 7: SDC-CF10AG, Laird centurion antenna



Photograph 8: SDC-CF10AG, dipole antenna (Larson)



Photograph 9: SDC-CF10AG, dipole antenna (Volex)

