Accredited Bluetooth Test Facility (BQTF)

TTI-P-G166/98

Test report no.: 2_2941-01-01/02
FCC Part 15.245
RAD 255 / RAD 256
FCC ID: QKRRAD255-256

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1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 1.5. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

1.2 Testing laboratory

CETECOM ICT Services GmbH
Untertürkheimer Straße 6 - 10
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Telefax : + 49 681 598 - 9075
E-mail : info@ict.cetecom.de
Internet : www.cetecom.de

Accredited testing laboratory
The Test laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025.
DAR registration number: TTI-P-G-166/98
Accredited Bluetooth™ Test Facility (BQTF)
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1.3 Details of applicant

Name : **Agtatec AG**
Street : **Allmendstrasse 24**
City : **8320 Fehraltorf**
Country : **Switzerland**
Telephone: **+41 1 954 92 50**
Telefax : **+41 1 995 60 14**
Contact : **Mr. Beat Kuster**
Telephone: **+41 1 954 92 50**

1.4 Application details

Date of receipt of application : 2002-08-08
Date of receipt of test item : 2002-08-08
Date of test : 2002-08-08

1.5 Test item

Type of equipment	:	**Field disturbance sensor for door opening**
Type designation	:	**Model : RAD 255 / RAD 256**
Manufacturer	:	- applicant -
Street	:	
City	:	
Country	:	
Serial number	:	88128 (RAD 256)
Additional informations: :		
Frequency	:	24.160 GHz
Type of modulation	:	200kN0NN
Number of channels	:	1
Antenna	:	integral dielectrical antenna
Power supply	:	24V DC external
Output power cond.	:	13.04 dBm / 20.14mW or 109.7 dBµV/m / 305.5 mV/m at 3m
Type of equipment	:	Class B
Temperature range	:	0°C - +35°C
FCC ID		QKRRAD255-256

1.6 Test standards: FCC Part 15 §15.245

2 Technical test

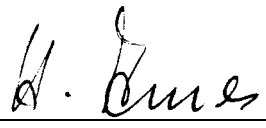
2.1 Summary of test results

There are two different type of equipment: RAD255 and RAD 256.
The only difference is in the receiver part. RAD 255 has 1 RX-diode, RAD 256 has two.
We tested the higher equiped RAD 256.
The radiated measurements were performed vertical and horizontal over the whole frequency range. We start at 1 m high with vertical receiving antenna and rotate the dish continuously. During rotation we use the antenna lift system to vary the high from 1 to 4 m. So we find maximum radiation output. At this points we do manual re-measurements. After this we repeat measurements in horizontal position of the receiving antenna. This (horizontal and vertical) is made for all the three planes of the test sample. We use the maximum received results.
The detector function and selection of bandwidth are according ANSI C63.2-1996 item 8.2.1 and ANSI C63.4-1992 Item 4.2. Antennas are conform with ANSI C63.2-1996 item 15.
30 MHz - 200 MHz: Quasi Peak measurement, 120 kHz Bandwidth, biconical antenna
200 MHz – 1 GHz: Quasi Peak measurement, 120 kHz Bandwidth, log periodic antenna
>1 GHz: Average, RBW / VBW ≥ 1 MHz, waveguide horn and standard gain horns. In order to show evidence it can be necessary to reduce the resolution bandwidth and /or measuring distance and/or to use a low-noise microwave amplifier.
Spurious emissions and output power above 12 GHz are measured with calibrated standard gain horns at distances of 0.5 m / 1 m and recalculated to 3 m by reducing the levels by 15.6 dB / 9.5 dB. All measurement settings are according to FCC 15.35, 15.205, 15.209 and 15.245.

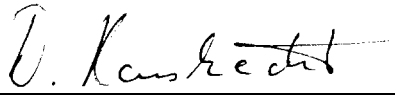
Test result: No deviations from the technical specification(s) were ascertained in the course of the tests performed.

Final verdict : PASS

Technical responsibility for area of testing :

2002-08-09	**RSC 8414**	**Ames H.**	
Date	**Section**	**Name**	**Signature**

Technical responsibility for area of testing :

2002-08-09	**RSC 8412**	**Hausknecht D.**	
Date	**Section**	**Name**	**Signature**

2.2 Test report

TEST REPORT

Test report no. : 2_2941-01-01/02

TEST REPORT REFERENCE

LIST OF MEASUREMENTS

Field strength of fundamental frequency (wanted carrier) §15.245(b)

radiated

TEST CONDITIONS		Field strength		
Frequency (MHz)		24160		
T_{nom}(23.4)°C	V_{nom}(24.0)V	305.5 mV/m 109.7 dBµV/m (= 102 dBpW)		
Measurement uncertainty		± 4 dB		

Measuring distance calculated to 3m

RBW / VBW : ≥ 1 MHz / 1 MHz

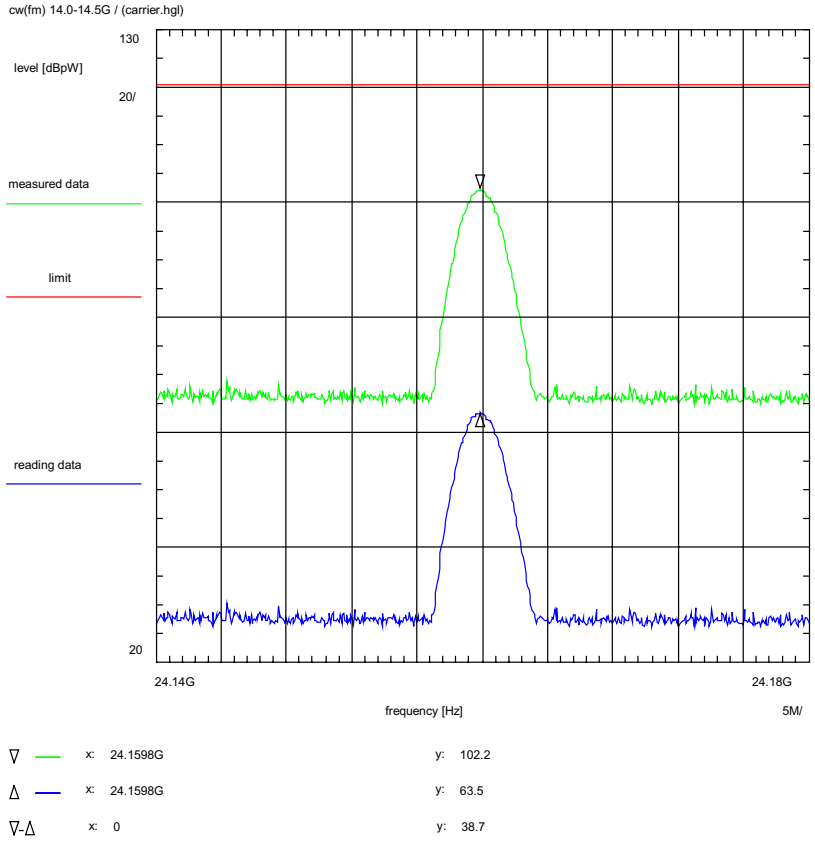
LIMIT SUBCLAUSE §15.245 (b)

24075 – 24175 MHz 2500 mV/m or 127.96 dBµV/m at 3 m distance (120.5 dBpW)

Field strength of fundamental frequency (wanted carrier) §15.245(b)

The green trace shows the real calculated value in dBpW. The correction factor into field strength at 3m distance is 7.5 dB (e[dBµV/m] = 17 + p[dBpW] – 20*log d[m] @ 3m).

So the calculated field strength at 3 m distance is 109.7 dBµV/m or 305.5 mV/m.



Setup of measurement equipment:

Start frequency:	24.135	GHz
Stop frequency:	24.185	GHz
Center frequency:	24.16	GHz
Frequency span:	50	MHz
Input attenuation:	10	dB
Resolution-BW:	2	MHz
Video-BW:	3	MHz
Video-Average:	100	sweep(s) (>1)
Detector-Mode:	1	Sample (VidAvg / VidBW<300Hz)

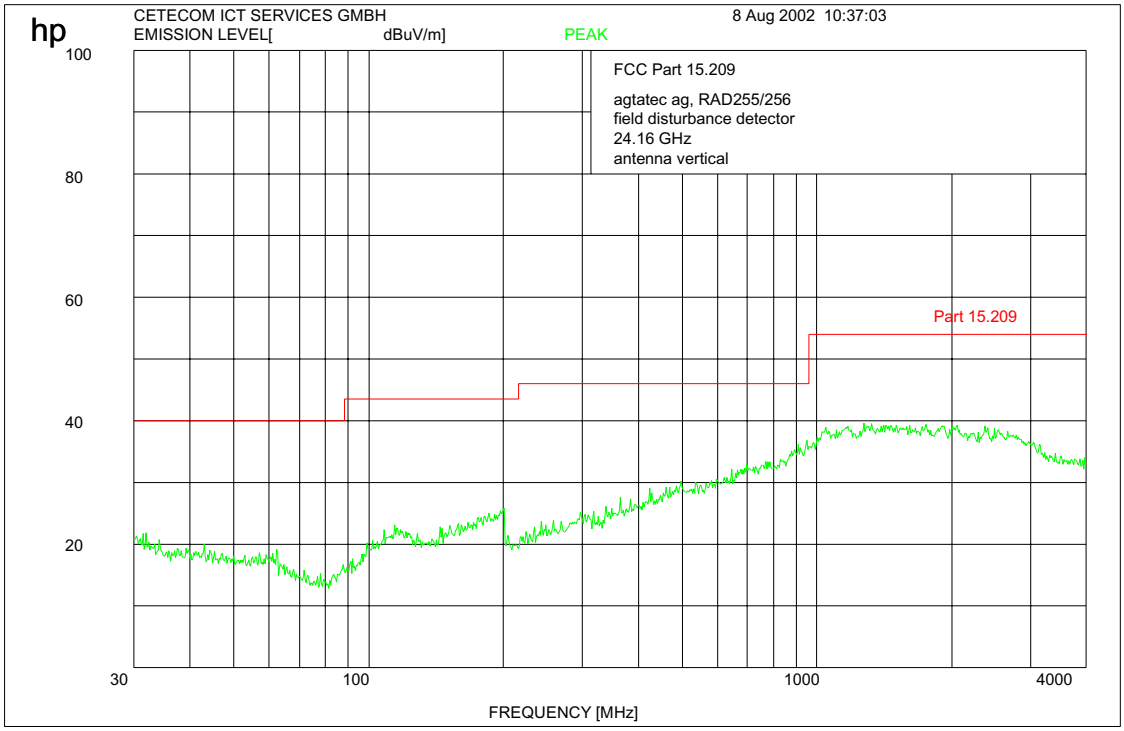
Correction (average):

Coaxial cable (C027)	+	4.6	dB
Test antenna (A019)	-	20.0	dB
Free space attenuation (24.16GHz, 0.5m)	+	54.1	dB
TOTAL CORRECTION:	+	38.7	dB
Measurement uncertainty:	±	4.0	dB

Spurious emissions outside band **§15.245 (b) (3)**

Measurements were made from 30 MHz to 50 GHz.
There were no peaks found, only the first overtone was detected, but far below limit.

30 – 4000 MHz

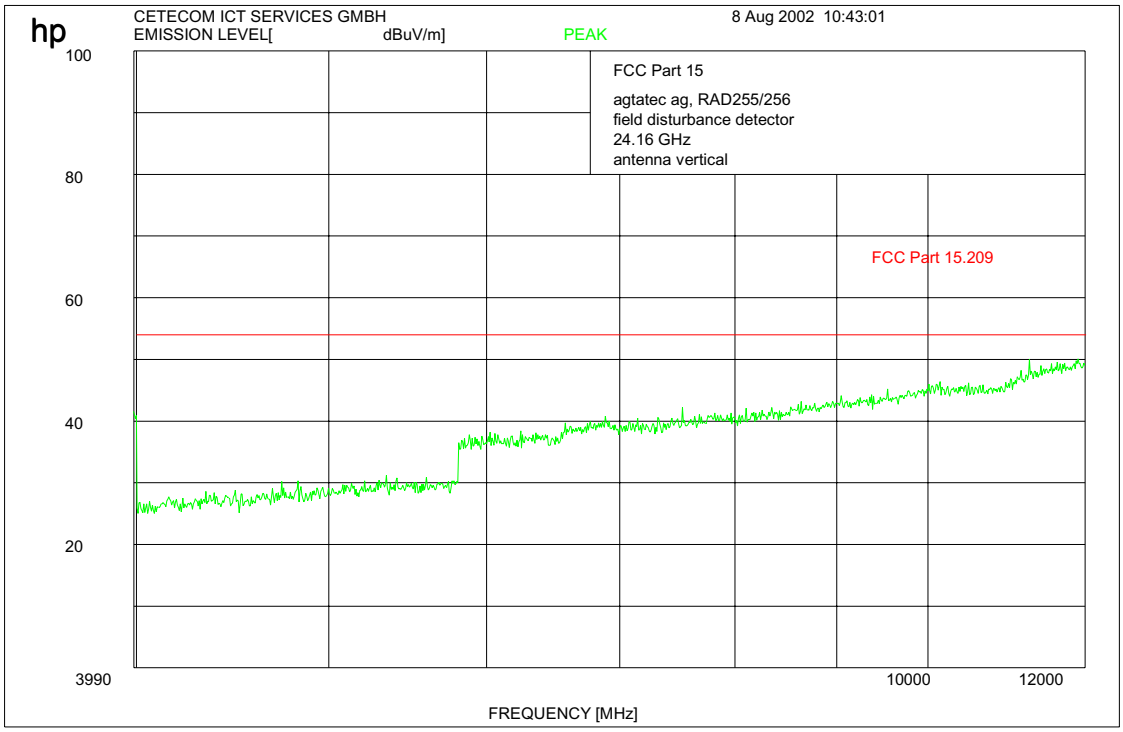


There were no peaks found.

Remark:
Within the frequency range 9 kHz to 30 MHz measurements of orientation were performed.
For doing this a loop antenne was used at a distance of 3 m from the DUT.
There were no emissions detected.

Spurious emissions outside band **§15.245 (b) (3)**

4000 - 12000 MHz



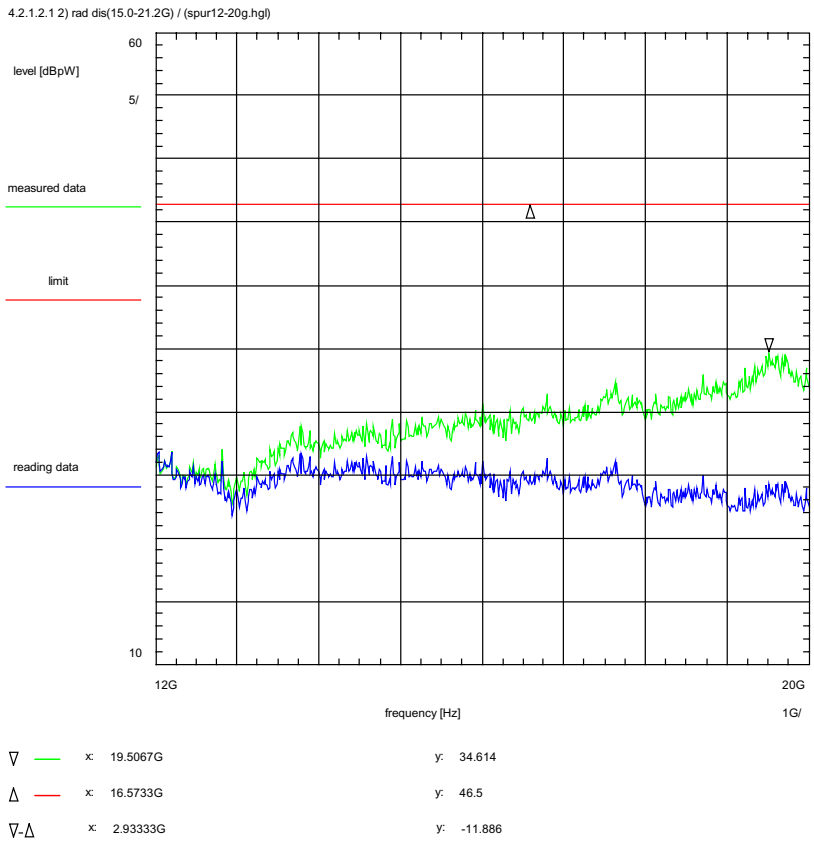
There were no peaks found.

LIMIT **SUBCLAUSE §15.209**

> 960 MHz 500 µV/m or 54 dBµV/m at 3m distance

Spurious emissions outside band §15.245 (b) (3)

12 – 20 GHz



Setup of measurement equipment:		
Start frequency:	12	GHz
Stop frequency:	20	GHz
Center frequency:	16	GHz
Frequency span:	8	GHz
Input attenuation:	0	dB
Resolution-BW:	1	MHz
Video-BW:	1	MHz
Video-Average:	1	sweep(s) (>1)
Detector-Mode:	2	Pos Peak (Maximum-Hold)

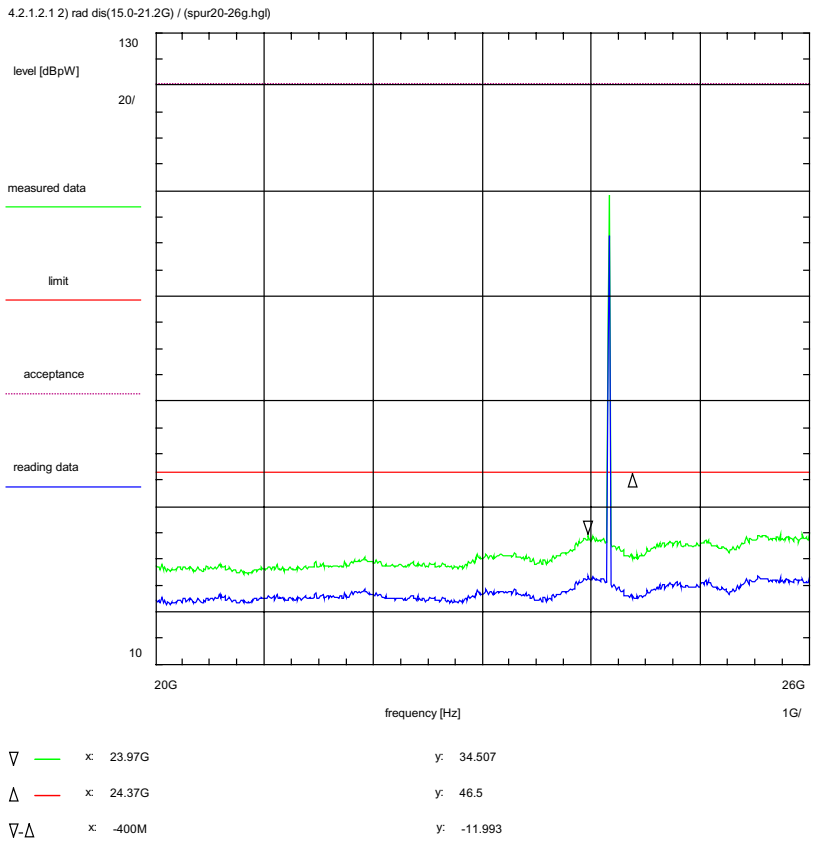
Correction (average):			
Coaxial cable (C027)	+	3.8	dB
Test antenna (A037)	-	16.0	dB
Free space attenuation (16.00GHz, 0.5m)	+	50.5	dB
Microwave amplifier (11b)	-	33.7	dB
TOTAL CORRECTION:	+	4.6	dB
Measurement uncertainty:	±	4.0	dB

LIMIT **SUBCLAUSE §15.209**

> 960 MHz 500 µV/m or 54 dBµV/m at 3m distance (46.5 dBpW)
= 3000 µV/m or 69.5 dBµV/m at 0.5m distance (46.5 dBpW)

Spurious emissions outside band §15.245 (b) (3)

20 – 26 GHz



Setup of measurement equipment:		
Start frequency:	20	GHz
Stop frequency:	26	GHz
Center frequency:	23	GHz
Frequency span:	6	GHz
Input attenuation:	10	dB
Resolution-BW:	1	MHz
Video-BW:	30	kHz
Video-Average:	1	sweep(s) (>1)
Detector-Mode:	2	Pos Peak (Maximum-Hold)

Correction (average):			
Coaxial cable (C027)	+	4.4	dB
Test antenna (A019)	-	19.6	dB
Free space attenuation (23.00GHz, 0.5m)	+	53.7	dB
Microwave amplifier (11b)	-	31.4	dB
TOTAL CORRECTION:	+	7.1	dB
Measurement uncertainty:	±	4.5	dB

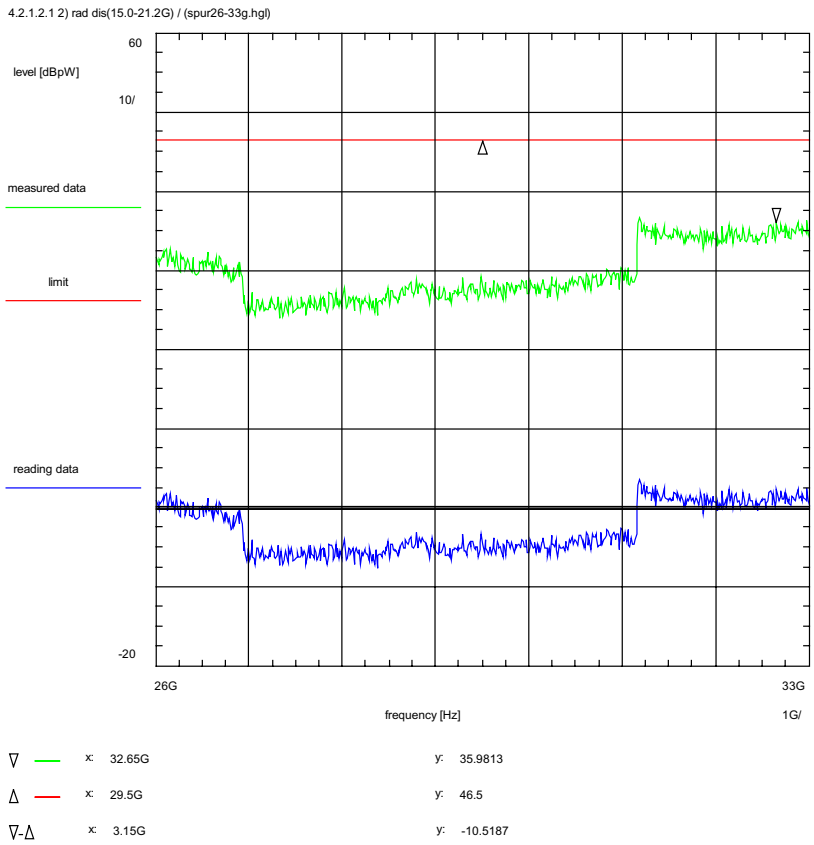
LIMIT **SUBCLAUSE §15.209**

> 960 MHz 500 µV/m or 54 dBµV/m at 3m distance (46.5 dBpW)
= 3000 µV/m or 69.5 dBµV/m at 0.5m distance (46.5 dBpW)
harmonics 25 mV/m or 87.96 dBµV/m at 3m distance (80.5 dBpW)
24075 – 24175 MHz max. 2500 mV/m or 127.96 dBµV/m at 3m distance (120.5 dBpW)

There were no peaks found.

Spurious emissions outside band **§15.245 (b) (3)**

26 – 33 GHz



Setup of measurement equipment:			Correction (average):			
Start frequency:	26	GHz	Coaxial cable (C027)	+	5.2	dB
Stop frequency:	33	GHz	Test antenna (A017)	-	22.6	dB
Center frequency:	29.5	GHz	Free space attenuation (29.50GHz, 0.25m)+		49.8	dB
Frequency span:	7	GHz	TOTAL CORRECTION:	+	32.4	dB
Input attenuation:	0	dB				
Resolution-BW:	100	kHz	Measurement uncertainty:	±	4.5	dB
Video-BW:	100	kHz				
Video-Average:	100	sweep(s) (>1)				
Detector-Mode:	1	Sample (VidAvg / VidBW<300Hz)				

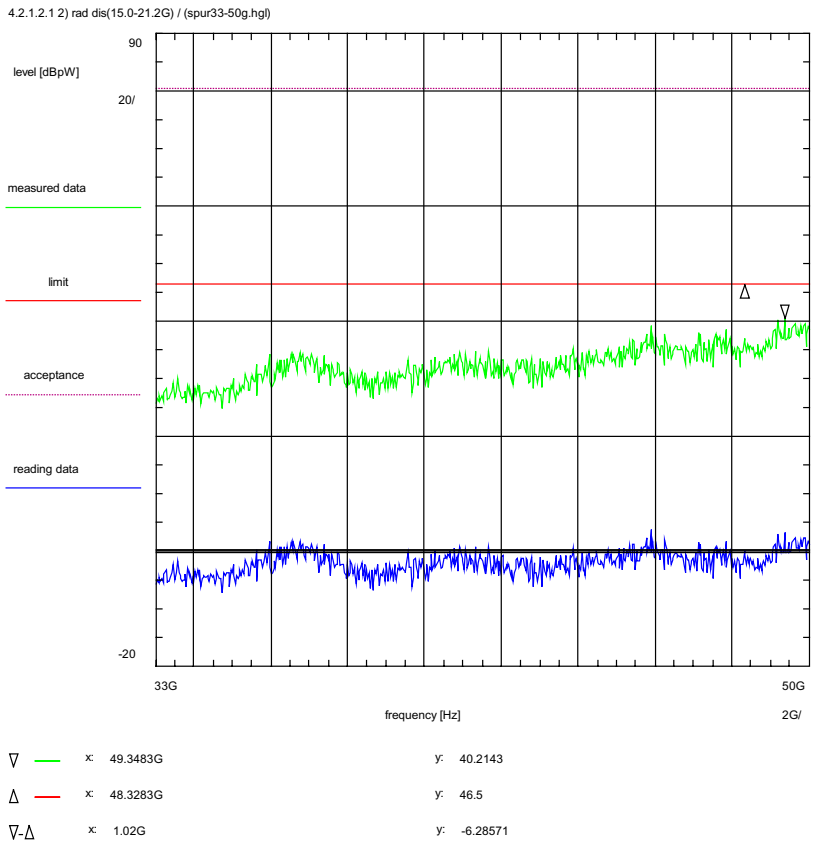
LIMIT **SUBCLAUSE §15.209**

> 960 MHz 500 µV/m or 54 dBµV/m at 3m distance (46.5 dBpW)
= 6000 µV/m or 75.6 dBµV/m at 0.5m distance (46.5 dBpW)

There were no peaks found.

Spurious emissions outside band §15.245 (b) (3)

33 - 50 GHz



Setup of measurement equipment:			Correction (average):			
Start frequency:	33	GHz	Coaxial cable (C027)	+	6.5	dB
Stop frequency:	50	GHz	Test antenna (A038)	-	17.0	dB
Center frequency:	41.5	GHz	Free space attenuation (41.50GHz, 0.1m)	+	44.8	dB
Frequency span:	17	GHz	TOTAL CORRECTION:	+	34.3	dB
Input attenuation:	0	dB				
Resolution-BW:	30	kHz	Measurement uncertainty:	±	4.5	dB
Video-BW:	30	kHz				
Video-Average:	100	sweep(s) (>1)				
Detector-Mode:	1	Sample (VidAvg / VidBW<300Hz)				

LIMIT **SUBCLAUSE §15.209**

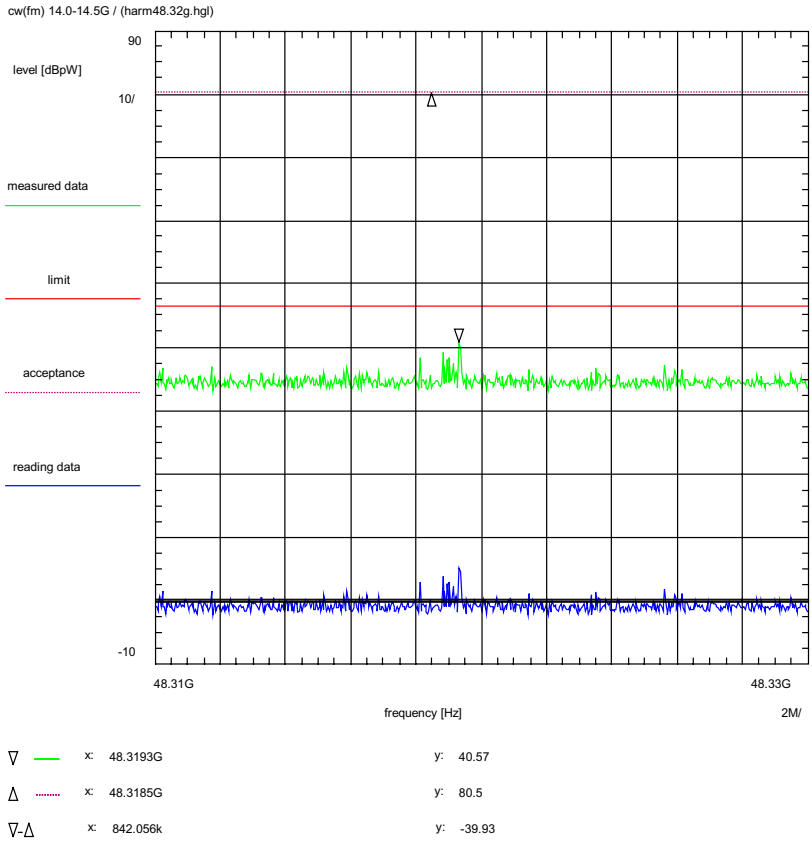
> 960 MHz 500 µV/m or 54 dBµV/m at 3m distance (46.5 dBpW)
harmonics 25 mV/m or 87.96 dBµV/m at 3m distance (80.5 dBpW)

There were no peaks found.

Spurious emissions outside band **§15.245 (b) (3)**

Special measurement very close to the test sample (5 cm) was performed to show that there are some spurs at the first overtone.

We recalculated the value to 3 m. It is 40.5 dBpW or 48 dBµV/m at 3m distance. This corresponds to 251 µV/m at 3 m.



Setup of measurement equipment:		
Start frequency:	48.31	GHz
Stop frequency:	48.33	GHz
Center frequency:	48.32	GHz
Frequency span:	20	MHz
Input attenuation:	0	dB
Resolution-BW:	3	kHz
Video-BW:	3	kHz
Video-Average:	1	sweep(s) (>1)
Detector-Mode:	2	Pos Peak (Maximum-Hold)

Correction (average):			
Coaxial cable (C030)	+	15.3	dB
Test antenna (A038)	-	20.0	dB
Free space attenuation (48.32GHz, 0.05m)+		40.1	dB
TOTAL CORRECTION:	+	35.4	dB
Measurement uncertainty:	±	4.5	dB

LIMIT **SUBCLAUSE §15.209**

harmonics 25 mV/m or 87.96 dBµV/m at 3m distance (80.5 dBpW)

Spurious emissions outside band **§15.245 (b) (3)**

50 - 100 GHz

Remark: Within the frequency ranges 50 to 75 GHz and 75 to 100 GHz measurements of orientation were performed. For doing this external harmonic mixers and appropriate standard gain horn antennas were used at distances very close to the DUT.
No emissions were detected.

Output variation versus voltage

Volt	21.6	22.0	22.5	23.0	23.5	24.0	24.5	25.0	25.5	26.0	26.5	27.0
output relativ	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	100 %	102 %	101 %	102 %

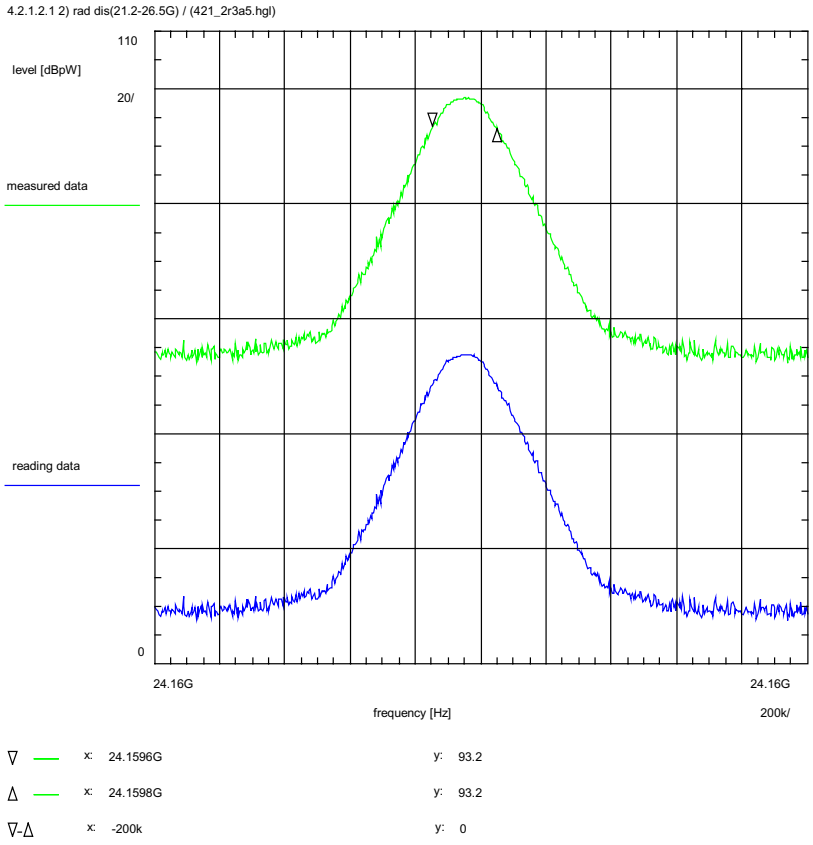
During the variation of voltage the output power changed between:
21.6 V and 27.0 V is 2% or 6.7 mV/m

Band edge compliance

As the DUT transmits a single carrier without any modulation, the signal is narrow.

We used 100 kHz RBW to determine the -6dB points.

The occupied bandwidth is 200 kHz.



TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

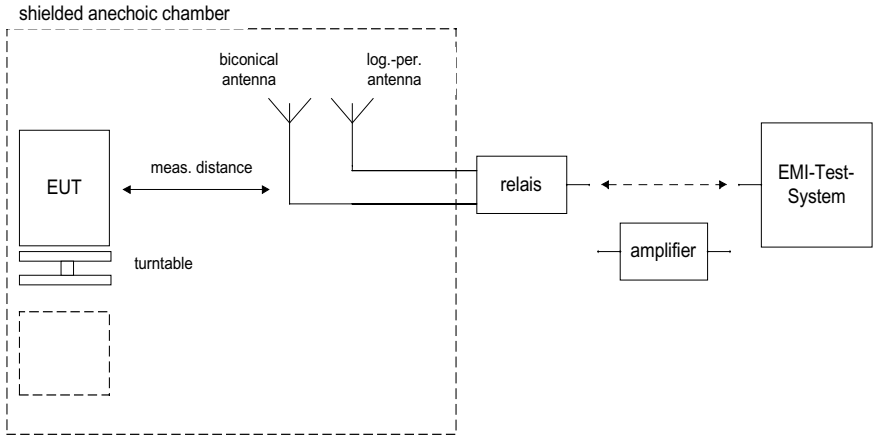
To simplify the identification on each page of the test equipment used, on each page of the test report, each item of test equipment and ancillaries such as cables are identified (numbered) by the Test Laboratory, below.

No	Instrument/Ancillary	Type	Manufacturer	Serial No.
01	Spectrum Analyzer	8566 A	Hewlett-Packard	1925A00257
02	Analyzer Display	8566 A	Hewlett-Packard	1925A00860
03	Oscilloscope	7633	Tektronix	230054
04	Radio Analyzer	CMTA 54	Rohde & Schwarz	894 043/010
05	System Power Supply	6038 A	Hewlett-Packard	2848A07027
06	Signal Generator	8111 A	Hewlett-Packard	2215G00867
07	Signal Generator	8662 A	Hewlett-Packard	2224A01012
08	Funktionsgenerator	AFGU	Rohde & Schwarz	862 480/032
09	Regeltrenntrafo	MPL	Erfi	91350
10	Netznachbildung	NNLA 8120	Schwarzbeck	8120331
11	Relais-Matrix	PSU	Rohde & Schwarz	893 285/020
12	Power-Meter	436 A	Hewlett-Packard	2101A12378
13	Power-Sensor	8484 A	Hewlett-Packard	2237A10156
14	Power-Sensor	8482 A	Hewlett-Packard	2237A00616
15	Modulationsmeter	9008	Racal-Dana	2647
16	Frequenzzähler	5340 A	Hewlett-Packard	1532A03899
17	Absorber Schirmkabine	---	MWB	87400/002
18	Spectrum Analyzer	85660 B	Hewlett-Packard	2747A05306
19	Analyzer Display	85662 A	Hewlett-Packard	2816A16541
20	Quasi Peak Adapter	85650 A	Hewlett-Packard	2811A01131
21	RF-Preselector	85685 A	Hewlett-Packard	2833A00768
22	Biconical Antenne	3104	Emco	3758
23	Log. Per. Antenne	3146	Emco	2130
24	Double Ridge Horn	3115	Emco	3088
25	EMI-Testreceiver	ESAI	Rohde & Schwarz	863 180/013
26	EMI-Analyzer-Display	ESAI-D	Rohde & Schwarz	862 771/008
27	Biconical Antenne	HK 116	Rohde & Schwarz	888 945/013
28	Log. Per. Antenne	HL 223	Rohde & Schwarz	825 584/002
29	Relais-Switch-Unit	RSU	Rohde & Schwarz	375 339/002
30	Highpass	HM985955	FSY Microwave	001
31	Amplifier	P42-GA29	Tron-Tech	B 23602
32	Absorber Schirmkabine		Frankonia	
33	Steuerrechner	PSM 7	Rohde & Schwarz	834 621/004
34	EMI Test Reciever	ESMI	Rohde & Schwarz	827 063/010
35	EMI Test Receiver	Display	Rohde & Schwarz	829 808/010

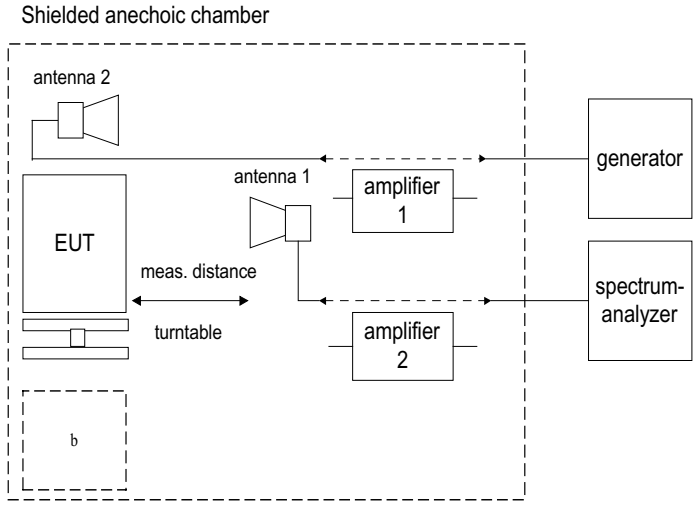
No	Instrument/Ancillary	Type	Manufacturer	Serial No.
36	Controler	HD 100	Deisel	100/322/93
37	Relais Matrix	PSN	Rohde & Schwarz	829 065/003
38	Control Unit	GB 016 A2	Rohde & Schwarz	344 122/008
39	Relais Switch Unit	RSU	Rohde & Schwarz	316 790/001
40	Power Supply	6032A	Hewlett Packard	2846A04063
41	Spektrum Monitor	EZM	Rohde & Schwarz	883 720/006
42	Meßempfänger	ESH 3	Rohde & Schwarz	890 174/002
43	Meßempfänger	ESVP	Rohde & Schwarz	891 752/005
44	Biconi Ant. 20-300MHz	HK 116	Rohde & Schwarz	833 162/011
45	Logper Ant. 0.3-1 GHz	HL 223	Rohde & Schwarz	832 914/010
46	Amplifier 0.1-4 GHz	AFS4	Miteq Inc.	206461
47	Logper Ant. 1-18 GHz	HL 024 A2	Rohde & Schwarz	342 662/002
48	Polarisationsnetzwerk	HL 024 Z1	Rohde & Schwarz	341 570/002
49	Double Ridge G Horn Antenne 1-26.5 GHz	3115	EMCO	9107-3696
50	Microw. Sys. Amplifier 0.5- 26.5 GHz	8317A	Hewlett Packard	3123A00105
51	Audio Analyzer	UPD	Rohde & Schwarz	1030.7500.04
52	Steuerrechner	PSM 7	Rohde & Schwarz	883 086/026
53	DC V-Netzwerk	ESH3-Z6	Rohde & Schwarz	861 406/005
54	DC V-Netzwerk	ESH3-Z6	Rohde & Schwarz	893 689/012
55	AC 2 Phasen V-Netzwerk	ESH3-Z5	Rohde & Schwarz	861 189/014
56	AC 2 Phasen V-Netzwerk	ESH3-Z5	Rohde & Schwarz	894 981/019
57	AC-3 Phasen V-Netzwerk	ESH2-Z5	Rohde & Schwarz	882 394/007
58	Stromversorgung	6032A	Rohde & Schwarz	2933A05441
59	HF-Test Empfänger	ESVP.52	Rohde & Schwarz	881 487/021
60	Spectrum Monitor	EZM	Rohde & Schwarz	883 086/026
61	HF-Test Empfänger	ESH3	Rohde & Schwarz	881 515/002
62	Relais Matrix	PSU	Rohde & Schwarz	882 943/029
63	Relais Matrix	PSU	Rohde & Schwarz	828 628/007
64	Spectrum Analyzer	FSIQ 26	Rohde & Schwarz	119.6001.27
65	Spectrum Analyzer	8565E	Hewlett Packard	3515A00283
66	Harmonic mixers	11970V / W	Hewlett Packard	2521A00375
67	Loop antenna	HMO 20	Rohde & Schwarz	832211/003
68	Set of Std. Gain Horns	1 – 300 GHz	Flann	see special list

MEASUREMENT SETUPs

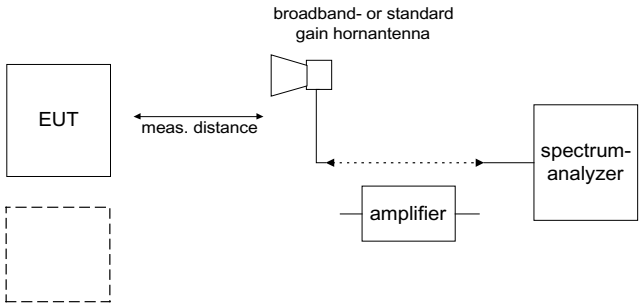
Radiated measurements



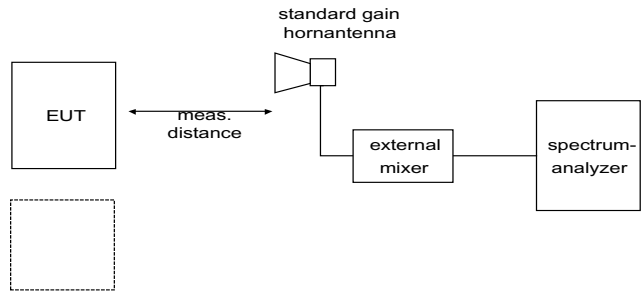
Setup 1



Setup 2



Setup 3



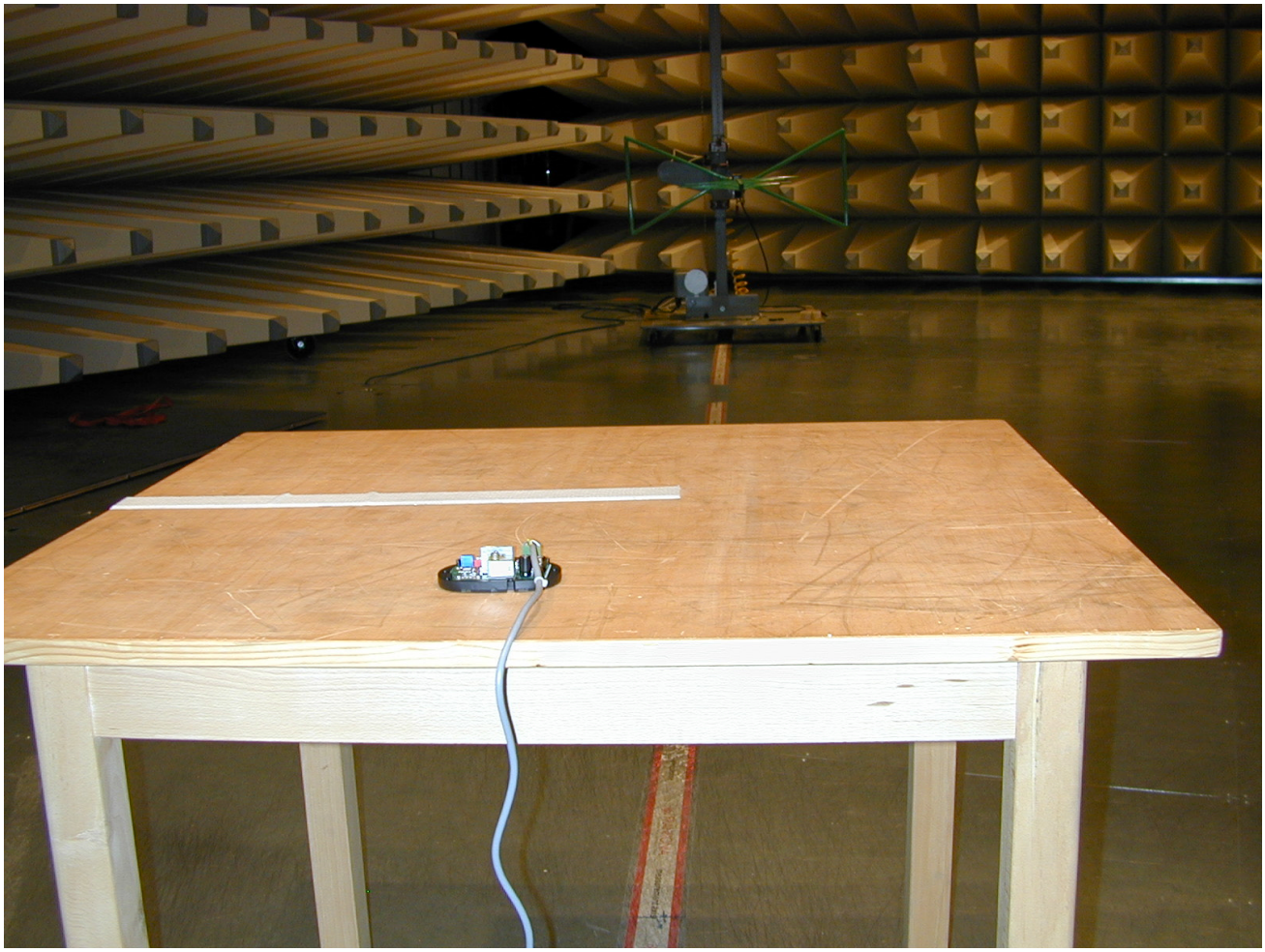
Setup 4

Test site

RADIATED EMISSIONS below 1 GHz

Test site

RADIATED EMISSIONS below 1 GHz (12 GHz – however horn antenna used)

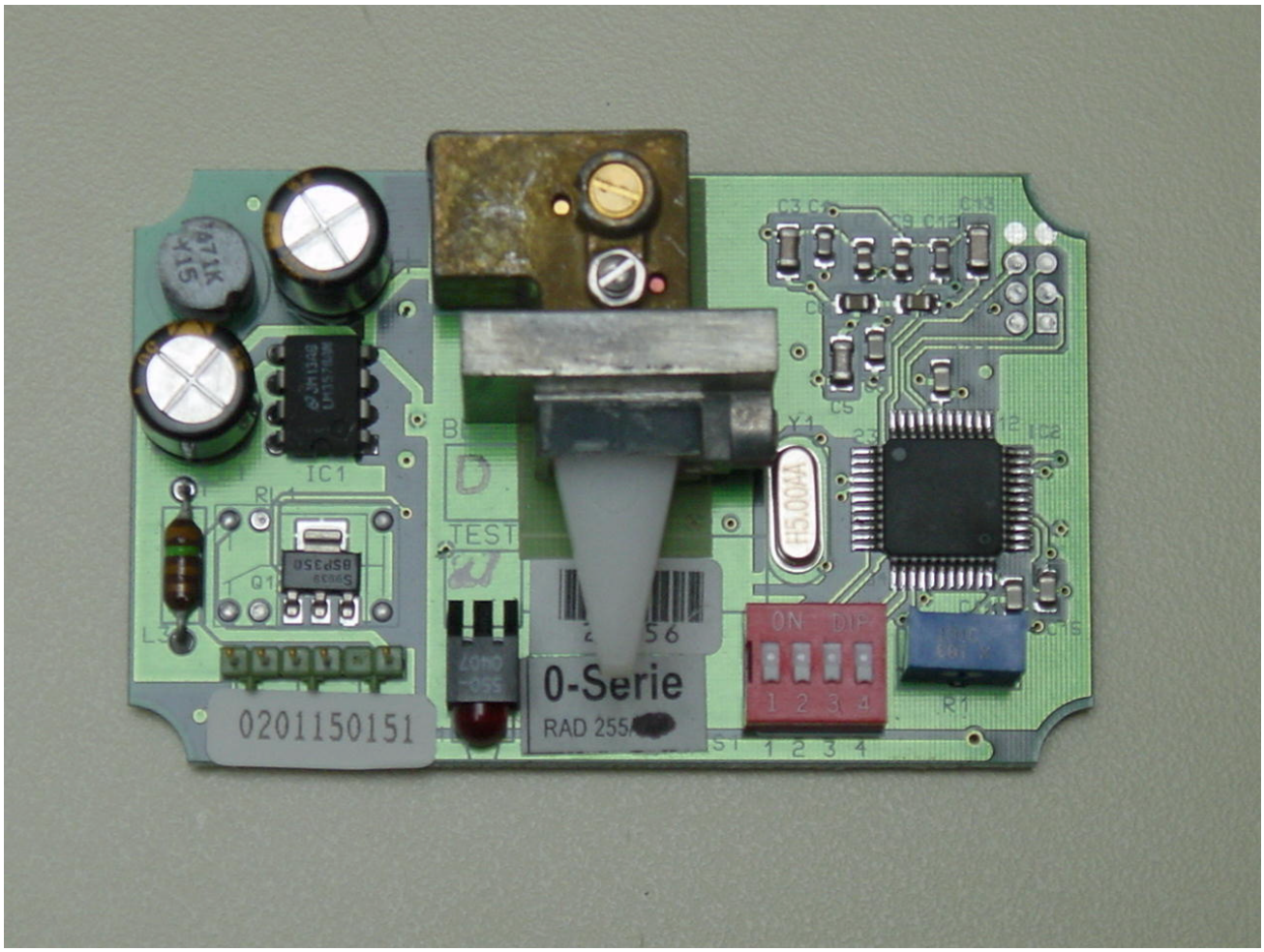


Photographs of the equipment under test

Photograph no.: 1

Photographs of the equipment under test

Photograph no.: 2



Photographs of the equipment under test

Photograph no.: 3