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RSC-Laboratory

Accredited testing-laboratory

DAR registration number: DAT-P-176/94-D1

Federal Motor Transport Authority (KBA)
DAR registration number: KBA-P 00070-97

Recognized by the Federal Communications Commission
Anechoic chamber registration no.: 90462 (FCC)
Anechoic chamber registration no.: 3463C-1 (IC)
Certification ID: DE 0001
Accreditation ID: DE 0002

Accredited Bluetooth® Test Facility (BQTF)

Test report no.	**:**	**1-0794-01-04/08-A**
Type identification	**:**	**Wireless Ethernet Bridge SL60-6004 (DPR-00112589)**
Applicant	**:**	**Huber + Suhner AG**
FCC ID	**:**	**TTD-SL606004**
IC Certification No	**:**	**6318A-SL606004**
Test standards	**:**	**FCC CFR 47 Part 15.255**

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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 3.1.1. 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.

Test laboratory manager:

2009-03-19	**Karsten Geraldy**	Geraldy Karsten
Date	Name	Signature

Technical responsibility for area of testing:

2009-03-19	**Nicolas Stamber**	N. Stamber
Date	Name	Signature

Cetecom ICT Services
Accredited Test Laboratory
Untertürkheimer Str. 6-10
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1.2 Testing laboratory

CETECOM ICT Services GmbH

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State of accreditation: **The test laboratory (area of testing) is accredited according to DIN EN ISO/IEC 17025**
DAR registration number: DAT-P-176/94-D1

Accredited by: **Federal Motor Transport Authority (KBA)**
DAR registration number: KBA-P 00070-97

Testing location, if different from CETECOM ICT Services GmbH:

Name :
Street :
Town :
Country :
Phone :
Fax :

1.3 Details of applicant

Name:	**Huber + Suhner AG**
Street:	**Degersheimer Str. 14**
Town:	**9100 Herisau**
Country:	**Switzerland**
Telephone:	**+41 (0) 71 353 41 11**
Fax:	**+41 (0) 71 353 47 80**
Contact:	**Mr. Dieter Merk**
E-mail:	**dmerk@hubersuhner.com**
Telephone:	**+41 (0) 71 353 41 11**

1.4 Application details

Date of receipt of order:	**2008-09-09**
Date of receipt of test item:	**2008-10-27**
Date of start test:	**2008-12-17**
Date of end test	**2009-03-18**
Persons(s) who have been present during the test:	**-/-**

2 Test standard/s

FCC 47 CFR Part 15.255	**2008-07**	**Radio Frequency Devices, Subpart C - Intentional Radiators, Operation within the band 57 - 64 GHz**
RSS-210	**2007-06**	**Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment**

3 Technical tests

3.1 Details of manufacturer

Name:	**Huber + Suhner AG**
Street:	**Degersheimer Str. 14**
Town:	**9100 Herisau**
Country:	**Switzerland**

3.1.1 Test item

Kind of test item:	**Point to point, Digital Microwave Fixed Link**
Type identification:	**Wireless Ethernet Bridge SL60-6004 (DPR-00112589)**
Model / S/N serial number:	**Terminal A: 84069633 / 84069633A000456**
	Terminal B: 84069644 / 84069644A000461
Frequency:	**Terminal A: Tx: 59.375 GHz, Rx: 62.225 GHz**
	Terminal B: Tx: 62.225 GHz, Rx: 59.375 GHz
Type of Modulation:	**QPSK**
Number of channels:	**1**
Antenna :	**4 field patch antenna** **59.375 GHz: 41.0 dBi** **62.225 GHz: 42.5 dBi**
Power Supply:	**100 - 250 Vac, 50 - 60 Hz, 500 mA**
Temperature Range:	**-45 °C to +55 °C**

FCC ID: TTD-SL606004
IC: 6318A-SL606004

Not more than two units of the transceiver type SL60-6004 provides a wireless link. The transceivers are designed for outdoor operation only (FCC rules Part 15.255(i)).

Transceiver A (Terminal A) and transceiver B (Terminal B) operate on two different fix frequencies: f1 = 59.375 GHz and f2 = 62.225 GHz. Whereas transceiver A transmits on f1 and receives on f2, transceiver B transmits on f2 and receives on f1. The hardware of both transceivers is absolutely identical except a slight variation in size of the hole in the resonator assembled in the microwave unit.

As soon as the equipment is powered up, TX and RX start operation simultaneously. There is no receive-only mode applicable.

The transceivers are not equipped with an interface for external control of TX/RX signals in frequency, amplitude or phase. The transceivers do not provide any feature allowing beam-forming arrays.
(FCC rules Part 15.255(h))

The microwave unit is realized on a Low Temperature Cofired Ceramics (LTCC), which is connected by a waveguide transition structure with the diplexer. The diplexer and the microwave unit are stuck together. The interface between diplexer and the four antenna arrays is a unique waveguide dividing structure which is not suitable to connect commercially available antennas. (FCC rules Part 15.203)

Modification: For AC-line conducted emissions the EUT has been modified by using several ferrites in the main lead.

3.1.2 EUT operating modes

EUT operating mode no.*)	Description of operating modes	Additional information
Op. 0	Normal mode	Normal temperature and power source conditions
Op. 1		low temperature, nominal power source conditions
Op. 2		high temperature, nominal power source conditions

*) EUT operating mode no. is used to simplify the test plan

3.1.3 Nominal conditions for testing

Description	Shortcut	Unit	Value
Nominal Temperature	T_{nom}	°C	**23**
Nominal Humidity	H_{nom}	%	**45**
Nominal Power Source	V_{nom}	Vac	**110**

Type of power source: 100 - 250 V AC adaptor to 48 V DC power over Ethernet

Extreme conditions are reported in chapter 5.7.

4 Summary of Measurement Results and list of all performed test cases

☒ **No deviations from the technical specifications were ascertained**

☐ There were deviations from the technical specifications ascertained

TC identifier	Description	verdict	date	Remark
RF-Testing	FCC CFR 47 Part 15 §15.255 RSS-210, Annex 13	PASS	2009-03-19	

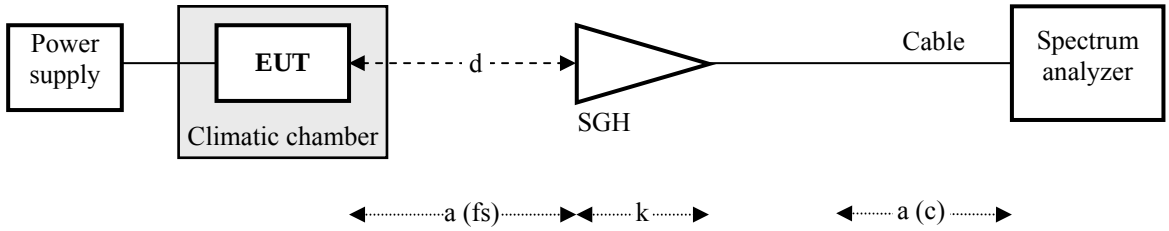
Test Specification Clause	Test Case	Pass	Fail	Not applicable	Not performed
§ 15.255 (b)(1)	Power Density	X			
§ 15.207	Conducted Spurious Emissions < 30 MHz	X			
§ 15.255 (e)	Total Peak Transmitter Output Power	X			
§ 15.255 (e)	Total Peak Transmitter Output Power	X			
§ 15.255 (f)	Fundamental Emissions Unter Extreme Conditions	X			

5 RF measurement testing

5.1 Description of test set-up

5.1.1 Radiated measurements

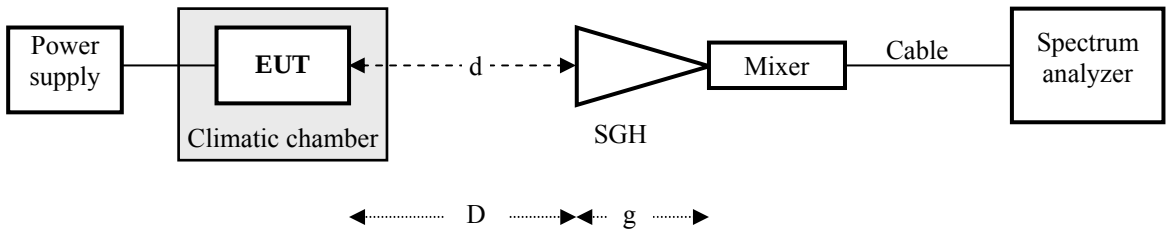
Field strength of spurious radiation in the frequency range 12 GHz to 40 GHz
Frequency stability of wanted signals



Frequency f [GHz]	Distance d [m]	Standard gain Horn ant. (SGH)	Dist. correction. dc (3m/Xm) [dB]	Antenna factor k [dB 1/m]	Cable loss a [dB]	Amplifier gain g(amp)[dB]
12 ... 18	0.125	narda 639	-27.6	34.0	3.1	35.0
18 ... 26	0.125	narda 638	-27.6	40.2	3.3	33.0
26 ... 40	0.125	narda V637	-27.6	44.0	4.2	19.0

Calculation: Field strength = Analyser reading + Cable loss + Antenna factor + Distance correction – Amp. gain
E = u + a + k + dc – g(amp)

Frequency stability and power density of wanted signal
and spurious radiation in the frequency range 40 to 240 GHz



Frequency f [GHz]	Distance d [m]	Free space attenuation D [dB]	Antenna gain g [dBi] or antenna factor k [dB/m]	System Attenuation [dB]
40 ... 60	0.125	46.5 … 50.0	20.0 (50 GHz)	28.4
50 … 75	3	76.0 … 79.5	25.3 (62.5 GHz)	52.6
59.375	3		k = 40.67	
62.225	3		k = 40.67	
60 ... 90	0.125	50.0 … 53.5	25.7 (75 GHz)	26.3
90 ... 140	0.125	53.5 … 57.4	25.5 (115 GHz)	30.1
140 ... 170	0.125	57.4 … 59.0	22.0 (155 GHz)	36.2
170 ... 240	0.125	59.0 … 62.0	20.0 (205 GHz)	40.7

A minimum test distance of 0.125 m was used for detecting of spurious radiations. 3.0 m was adjusted to measure wanted signal levels in field strength or EIRP.

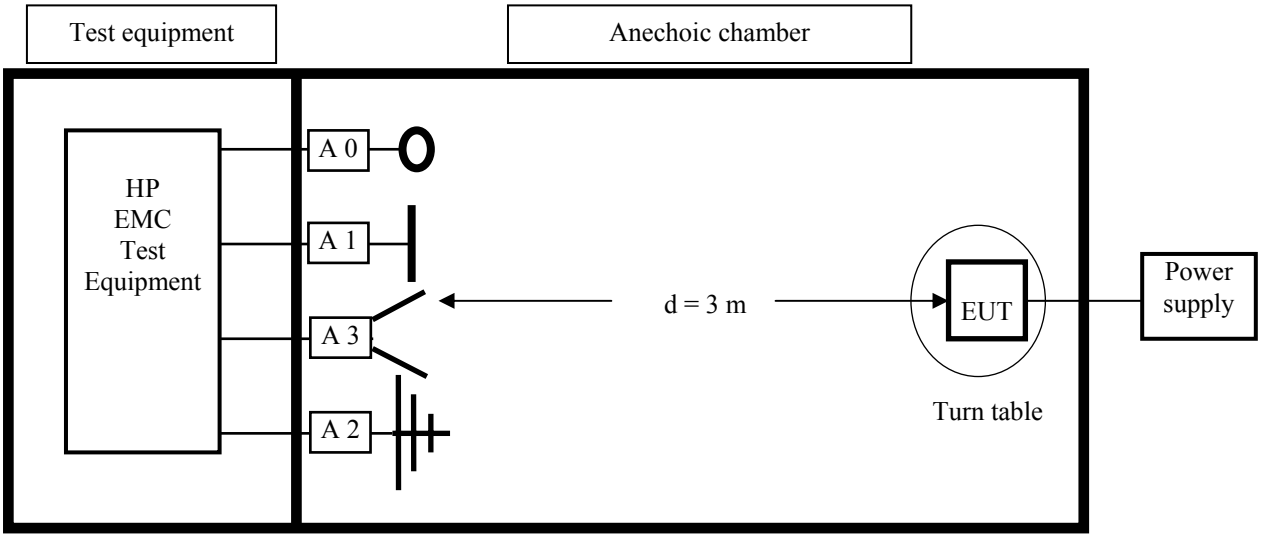
Calculation : Power density = EIRP /($4\pi d^2$) = EIRP / 1130973.4 cm^2 (for 3 m evaluation distance)

No	Equipment/Type	Manuf.	Serial Nr.	Inv. No. Cetecom	Last Calibration	Frequency (months)	Next Calibration
1	Climatic box VUK 04/500	Heraeus Vötsch	32678	300000297	29.07.2008	24	27.07.2010
2	Spectrum Analyser 8565E	HP	3738A00773	300001665	08.01.2008	24	08.01.2010
3	Spectrum Analyser FSU 50	R&S	200012	300003443	05.06.2008	24	05.06.2010
4	Spectrum Analyzer 2782	Tektronix		300001665	28.08.2008	24	28.08.2010
5	Power Supply 6032A			300002115	15.05.2007		
6	SGH 12 ... 18 GHz	narda	01005	300000787	cyclic verification		
7	SGH 18 ... 27 GHz	narda	01005	300000487	cyclic verification		
8	SGH 27 ... 40 GHz	narda	82016	300000510	cyclic verification		
9	SGH 33 ....50 GHz	Thomson		300000812	visual inspection		
10	Adapter WG/SMA	narda	64088	-/-	cyclic verification		
11	Adapter WG/SMA	flann	213	-/-	cyclic verification		
12	Adapter WG/SMA	HP	00231	-/-	cyclic verification		
13	SGH 50 ... 75GHz	Thomson	-/-	300000813	visual inspection		
14	Mixer 50 ... 75 GHz	HP	-/-	30000781m	07.08.2007	24	07.08.2009
15	SGH 75 ... 110 GHz	Thomson	-/-	30000798b	visual inspection		
16	Mixer 75 ... 110 GHz	HP	-/-	30000781c	07.08.2007	24	07.08.2009
17	SGH 110 … 170 GHz	Flann	-/-	300001999	visual inspection		
18	Mixer 110 … 170 GHz	Tektronix	B010186	300001685d	n.a.		
19	SGH 170 … 325 GHz	Flann	-/-	300002000	visual inspection		
20	Mixer 170 … 325 GHz	Tektronix	B010241	300001685j	n.a.		

Measurement uncertainties

Test parameter	Measurement uncertainty
Power supply	±0.1 VDC
Temperature	±0.2 °C
Frequency	±0.01 ppm
eirp	±2.0 dB (up to 50 GHz)
eirp	±3.0 dB (above 50 GHz)

Field strength of spurious radiation in the frequency ranges 9 kHz to 30 MHz and 1 to 12 GHz
Set-up for radiated measurements (FAC "Chamber C")

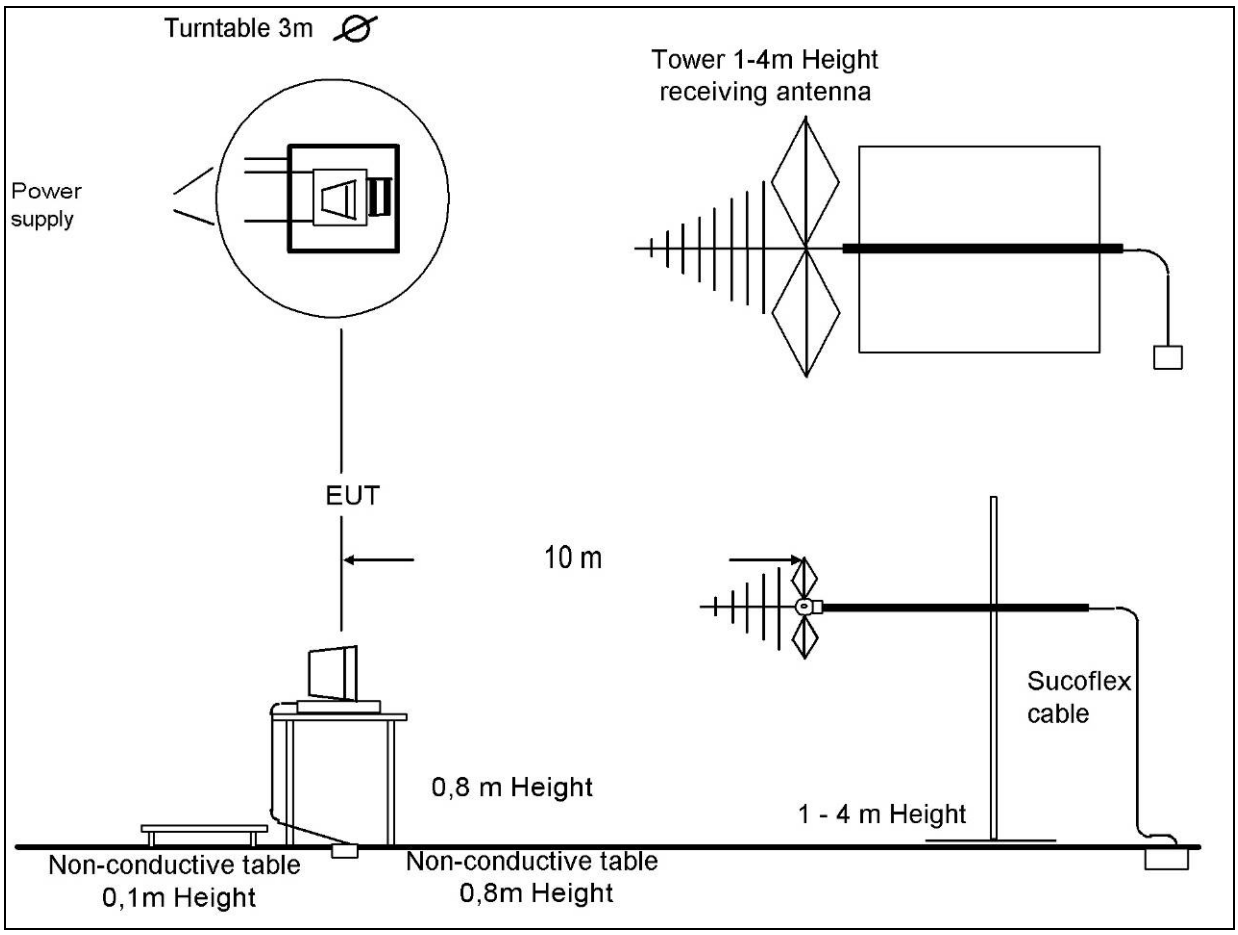


No	Equipment/Type	Manuf.	Serial Nr.	Inv. No. Cetecom	Last Calibration	Frequency (months)	Next Calibration
1	Anechoic chamber	MWB	87400/02	300000996	Monthly verification		
2	System-Rack 85900	HP I.V.	*	300000222	n.a.		
3	Measurement System 1						
4	Spektrum Analyzer 8566B	HP	3138A07614	300001207	13.12.2007	24	13.12.2009
5	Spektrum Analyzer Display 85662A	HP	3144A28627	300001208	13.12.2007	24	13.12.2009
6	Quasi-Peak-Adapter 85650A	HP	2811A01204	300002308	13.12.2007	24	13.12.2009
7	RF-Preselector 85685A	HP	2837A00778	300002448	13.12.2007	24	13.12.2009
8	PC Vectra VL	HP		300001688	n.a.		
9	Software EMI	HP		300000983	n.a.		
10	Measurement System 2						
11	FSP 30	R&S	100886	300003575	25.08.2008	24	25.08.2010
12	PC	F+W			n.a.		
13	TILE	TILE			n.a.		
14	Biconical antenna	EMCO	S/N: 860 942/003		Monthly verification (System cal.)		
15	Log. Period. Antenna 3146	EMCO	2130	300001603	Monthly verification (System cal.)		
16	Double Ridged Antenna HP 3115P	EMCO	3088	300001032	Monthly verification (System cal.)		
17	Active Loop Antenna 6502	EMCO	2210	300001015	Monthly verification (System cal.)		
18	Power Supply 6032A	HP	2818A03450	300001040	12.05.2007	36	12.05.2010
19	Busisolator	Kontron		300001056	n.a.		
20	Leitungsteiler 11850C	HP		300000997	Monthly verification (System cal.)		
21	Power attenuator 8325	Byrd	1530	300001595	Monthly verification (System cal.)		
22	Band reject filter WRCG1855/1910	Wainwright	7	300003350	Monthly verification (System cal.)		
23	Band reject filter WRCG2400/2483	Wainwright	11	300003351	Monthly verification (System cal.)		

Measurement uncertainties

Test Parameter	Measurement uncertainty
Input power (DC)	±0.1 V
Temperature	±0.2 °C
Frequency	±0.01 ppm
RF-power	±2.0 dB

Field strength of spurious radiation in the frequency ranges 30 to 1000 MHz
Set-up for radiated measurements at test distances 3m and 10m (SAC "Chamber F")



No	Equipment/Type	Manuf.	Serial Nr.	Inv. No. Cetecom	Last Calibration	Frequency (months)	Next Calibration
1	Control Computer	F+W	FW0502032	300003303	-/-	-/-	-/-
2	Trilog Antenna VULB 9163	Schwarzbeck	9163-295	300003787	30.04.2008	24	30.04.2010
3	Amplifier - 0518C-138	Veritech Micro-wave Inc.	-/-	-/-	-/-	-/-	-/-
4	Switch - 3488A	HP		300000368	-/-	-/-	-/-
5	EMI Test receiver - ESCI	R&S	100083	300003312	31.01.2007	24	31.01.2009
6	Turntable Controller - 1061 3M	EMCO	1218	300000661	-/-	-/-	-/-
7	Tower Controller 1051 Controller	EMCO	1262	300000625	-/-	-/-	-/-
8	Tower - 1051	EMCO	1262	300000625	-/-	-/-	-/-
10	Ultra Notch-Filter Rejected band Ch. 62	WRCD	9	-/-	-/-	-/-	-/-

Measurement uncertainties:
The uncertainty of the measurement equipment fulfils CISPR 16 and the related European and international standards.
The semi anechoic chamber fulfils the requirements of CISPR 16-1 (ANSI C63.4) for a test volume of 1.5m ∅.

Remarks on methods of measurements

1. General

The device under test is positioned on a non-conductive fixture and can be rotated and tilted relative to the measurement antenna.
The measurements of radiated emissions in the frequency range from 30 MHz to 1 GHz are performed in vertical and horizontal plane in a semi-anechoic chamber, compliant to CISPR 16-1 for test distances of 3m and 10m. The EUT is positioned on a non-conductive support at a height of 0.80 m above the conductive ground plane covering the whole chamber. The measuring antennas can be moved over a height range from 1.0 m to 4.0 m in order to detect the maximum field strength emitted from the EUT. These antennas are compliant with specifications ANSI C63.2-1996 clause 15 and ANSI C63.4-2003 clause 4.1.5.

Radiated emissions measurements in the frequency ranges from 9 kHz to 30 MHz and 1 GHz to 18 GHz are carried out in a fully-anechoic chamber, compliant to CISPR 16-1, providing test distances up to 5 m. EUT and receiving antennas are positioned 1.5 m above the tips of the absorbers.
Measurements between 18 GHz and 240 GHz are performed in certain test laboratory environments, where analyzers up to 50 GHz, without using mixers, and harmonic mixer modules and standard gain horns are available up to 320 GHz.

The measurement distances between EUT and receiving antennas are indicated in the test set–ups for the various frequency ranges. For each measurement, the EUT is three-dimensional rotated until the maximum field strength is received for both polarisations of the measuring antennas.

The wanted and unwanted emissions are received by spectrum analysers where the detector modes and resolution bandwidths (RBW) over various frequency ranges are set according to requirement ANSI C63-4-2003 clause 4.2.

Test equipment and ancillaries used for tests
Calibrations occur according to the EN/ISO/IEC 17025 standard. Calibrations are performed by an accredited external calibration laboratory. Additional to these calibrations, the laboratory performs comparison measurements with other calibrated systems and regular chamber inspections. All used devices are connected to a 10 MHz external reference.

2. Measurements of the EIRP and power density (PD) at fundamental frequency

The measurements are conducted according to FCC rules and, if appropriate to the guideline "Millimeter Wave Test Procedure" with a spectrum analyser (SA), harmonic mixer covering appropriate frequency range and a rectangular standard gain horn antenna (SGH) with matching wave guide dimensions. The conversion loss of the external mixer is taken into account in the SA power level reading automatically.

The radiated power measurements are performed with resolution bandwidth filter (RBW) of 1.0 MHz and a video filter of 1 MHz. Tests are repeated with different RBW, eg. 2.0 MHz and Video bandwidth filter (VBW) 3.0 MHz in order to evaluate whether a calculated bandwidth correction may be performed.

The evaluation distance for fundamental power measurement is 3.0 m. If the far field condition is met, a test distance of 2 m is usually used and compliance with the 3 m requirement is proved by corresponding calculation. The SA level scale is set to the dimension dBm. With the appropriate antenna aperture area the power density can be calculated from the equation:

Power Density	=	EIRP	/	Antenna aperture area [mW/cm ^{2}]
pd	=	eirp	–	a [dB(mW/cm ^{2})]

Field strength measurements in 3m distance are performed in the case of too large far field distances ($R=2*L^2/\lambda$, R = far field distance in meters, L = largest dimension of either measuring horn or transmitting EUT antenna).

3. Measurements of frequency stability

The frequency stability of the EUT under normal and extreme test conditions is measured in CW-mode (unmodulated).

Frequency measurements are performed under normal test conditions (normal power supply voltage and normal temperature).

Then the test is repeated with extreme test conditions. For extreme test conditions the EUT is placed in a climatic chamber where the front door is made of stable polystyrene. The EUT can radiate through the front door without any additional path losses. The climatic chamber together with the EUT is cooled down to -20 ºC for 1 hour. Then frequency and power density measurements are carried out with power supply set to minimum and maximum values.
The climatic chamber together with the EUT is warmed up at a rate of + 1ºC/minute. During warming-up time the frequency stability and the eirp is monitored constantly. After 2 hours the temperature stability at 50 ºC is reached. Then frequency and power density measurements are carried out with minimum and maximum power supply.

4. Measurements of field strength and power density at spurious frequencies

Spurious frequencies are produced by transmitter and receiver when the EUT is active. The radar unit under test provides different operation modes:
- in motion: medium range mode, long range mode, medium and long range mode
- not in motion: medium range mode, transmission suppressed (transceiver disabled).
In order to avoid measuring errors in power levels caused by very short sweep times, the sweep of the EUT is stopped as certain frequencies.
According to FCC requirements 15.209 and 15.255, spurious emissions have to be investigated as maximum field strength values in the frequency range from 9 kHz to 40 GHz, and as maximum power density in the frequency range above 40 GHz up to 240 GHz. Where possible, the measurement distance shall be 3 m.

In the low frequency range (9 kHz to 30 MHz), the receiving antenna is an active loop antenna which is positioned at 3 m distance in a shielded, anechoic chamber. In case of required measuring distances greater than 3 m, a distance correction factor is used to calculate the received field strength.

Spurious field strength measurements in the frequency range 1 to 12(18) GHz are carried out in shielded semi-anechoic test chambers. The measurement distance is 3 m.

In the frequency range 18 to 240 GHz, spurious field strength measurements are performed in a certain test laboratory environments with rectangular SGH´s. The test distance is 3 m for tests up to 40 GHz.

In the frequency range 40 to 240 GHz, spurious frequencies are measured as power densities. The EUT is operating with its specified modulation. The RBW and VBW are set to such a value that spurious power levels are clearly readable above the fundamental noise level of spectrum analyzer. The measurement distance is chosen up to 0.125 m, depending on the test system noise floor for detecting spurious emission signals.

5. Measurements of maximum safe level for radiated power density

According to FCC § 1.1307, § 1.1310, § 2.1091 and § 2.1093 measurements are carried out in order to evaluate the impact of human exposure to RF radiation. For this test the EUT is in normal operation mode: QPSK modulated.

There is a safety distance of 2m given in the manufacturer's document: "Installation and user manual SL60-100-57/64-38-E-O".

The maximum peak power density PD in r = 3 m distance is determined as

1.02 [µW/cm^2] (see plot 1e, Chapter 5.4 Power Density §15.255(b)(1))

Peak Power (EIRP) $EIRP = PD * 4\pi * r^2 = PD * 1130973.4\ cm^2$
$EIRP = 1.154\ W$

Limit of maximum ERP (EIRP) for frequencies above 1.5 GHz is 3 W (4.9W). See FCC § 2.1091
(eirp = erp + 2.15 dB, EIRP = ERP x 1.64).

RF Exposure at 2 m distance from EUT

$PD = EIRP / (4\pi * r^2)$
$PD = 0.0023\ mW/cm^2 = 0.023\ W/m^2$

Limit of maximum permissible exposure (MPE) for uncontrolled environment:1.0 mW/cm². See FCC § 1.1310.

5.2 Referenced Documents

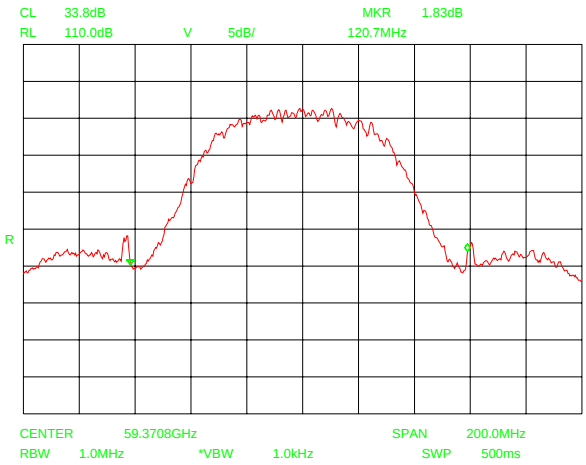
none

5.3 Additional comments

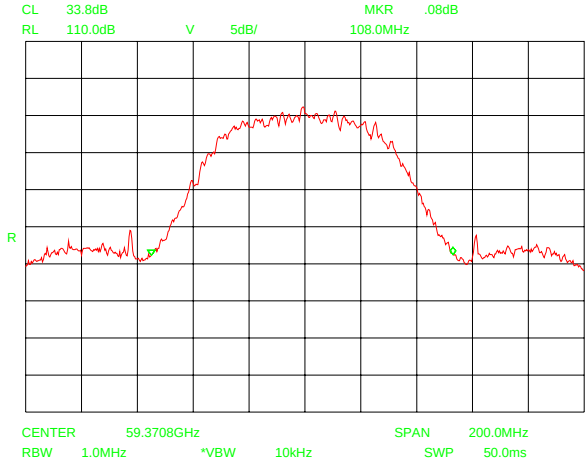
none

5.4 Power Density §15.255(b)(1)

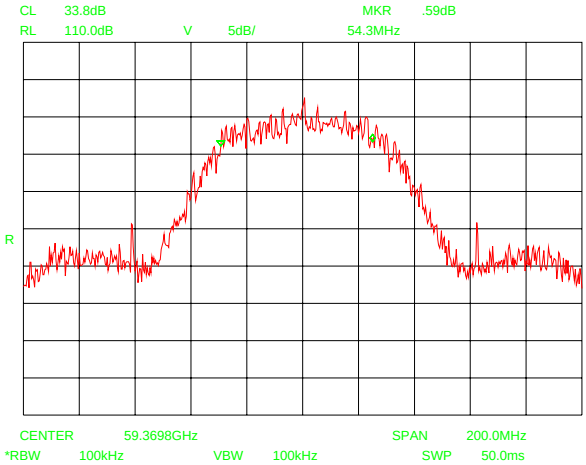
Plot 1a-d (Terminal A) Signal bandwidth



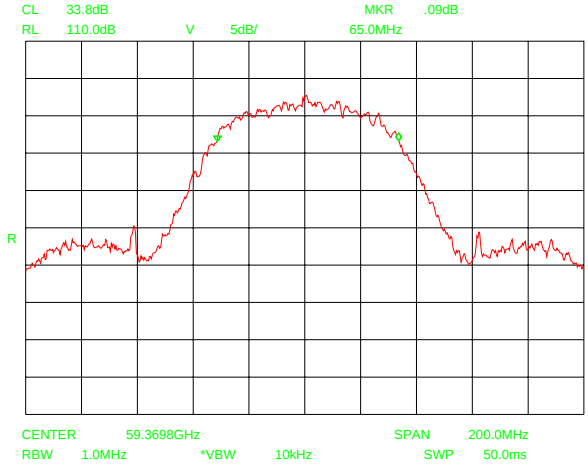
Occupied bandwidth 99% (analyzer function)



20dB bandwidth 1MHz RBW
Noise average by VBW reduced

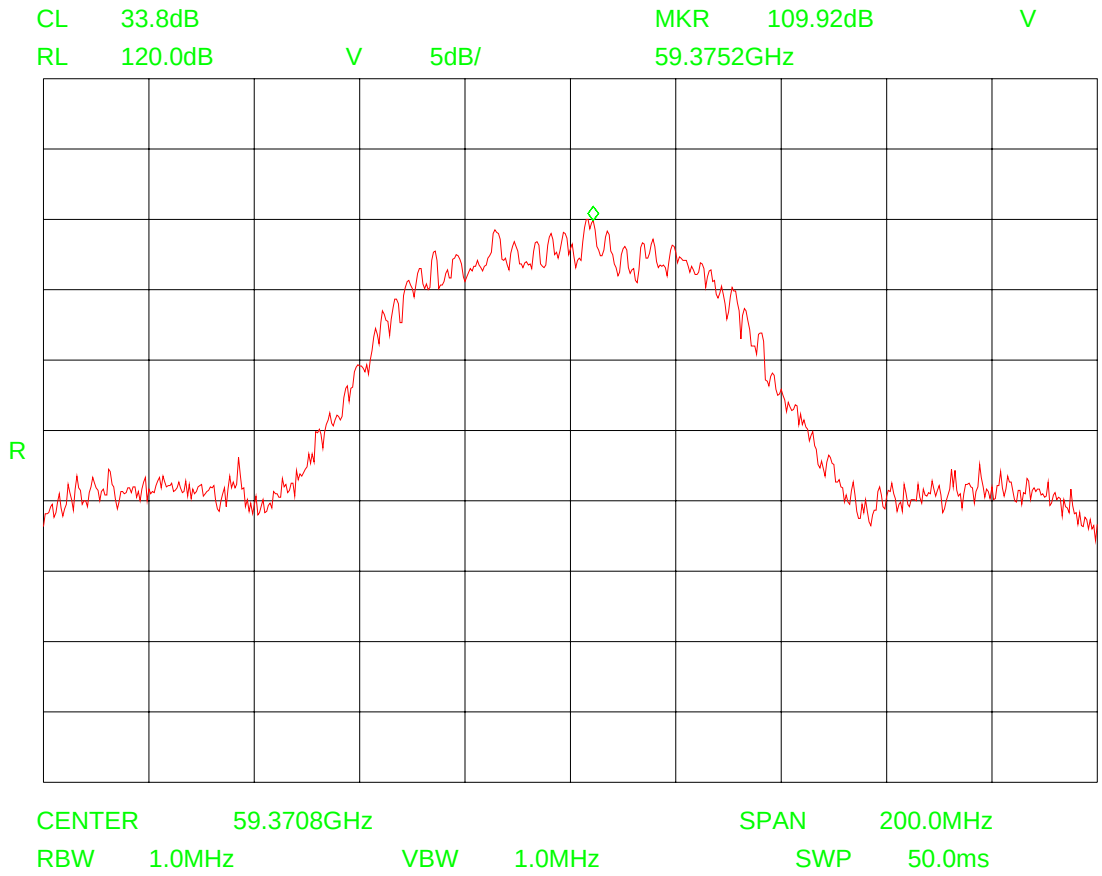


6dB bandwidth 100kHz RBW / 100kHz VBW



6dB bandwidth 1MHz RBW = 65MHz
Noise average by VBW reduced

Plot 1e (Terminal A) Field strength at 3m distance

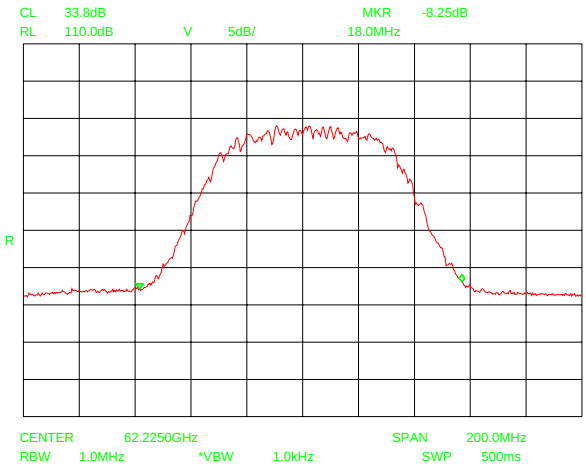


The mark "R" in the measurement plot indicates a reference level offset adjusted. This offset equates to the measurement antenna factor and is considered in the test.

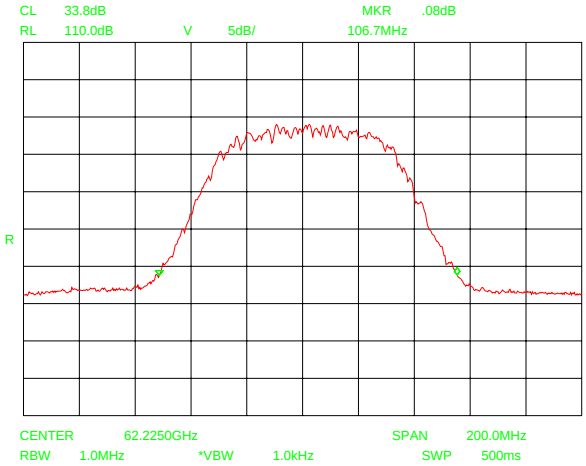
Antenna factor	a	=	40.67 dB/m
Measurement distance	d	=	3.0 m
Evaluation distance	R	=	3.0 m

Power [dBpW]	=	E [dBuV/m]	+	10 log (signal BW/RBW)	-	17	+	20 log (d)
	=	109.9[dBuV/m]	+	10 log (65 MHz / 1 MHz)	-	17	+	20 log (3m)
	=	109.9[dBuV/m]	+	18.1 dB	-	7.5		
	=	120.6 [dBpW]						
	=	60.6 [dBµW]						
Power density [µW/cm^2]	=	1148154 [µW]	/	4 π 300 [cm^2]				
	=	1.02 [µW/cm^2]						

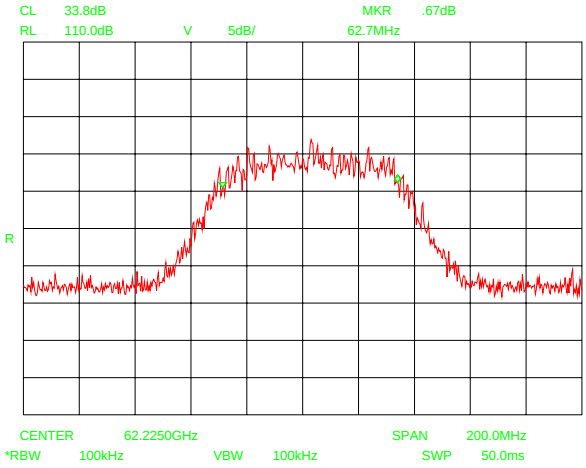
Plot 2a-d (Terminal B) Signal bandwidth



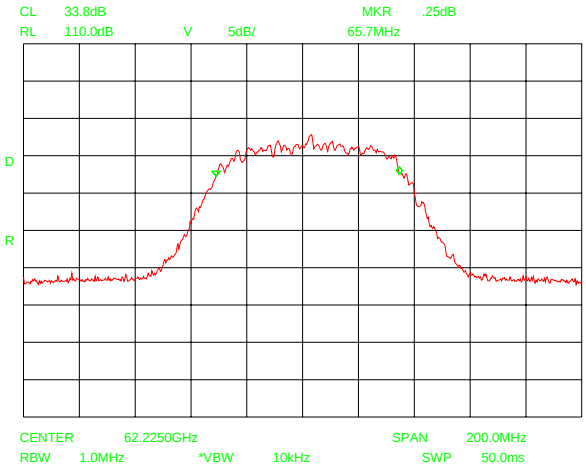
Occupied bandwidth 99% (analyzer function)



20dB bandwidth 1MHz RBW
Noise average by VBW reduced

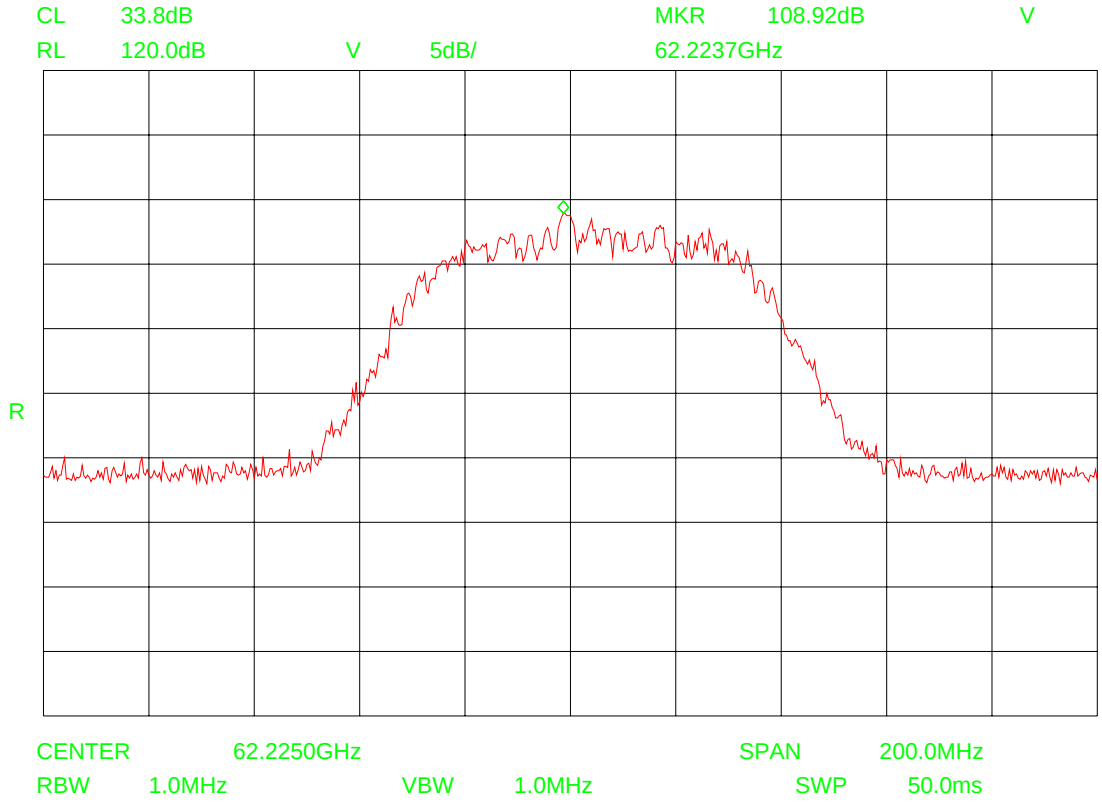


6dB bandwidth 100kHz RBW / 100kHz VBW



6dB bandwidth 1MHz RBW = 66MHz
Noise average by VBW reduced

Plot 2e (Terminal B) Field strength at 3m test distance



The mark "R" in the measurement plot indicates a reference level offset adjusted. This offset equates to the measurement antenna factor and is considered in the test.

Antenna factor	a	=	40.67 dB/m
Measurement distance	d	=	3.0 m
Evaluation distance	R	=	3.0 m

Power [dBpW]	=	E [dBuV/m]	+	10 log (signal BW/RBW)	-	17	+	20 log (d)
	=	108.9[dBuV/m]	+	10 log (66 MHz / 1 MHz)	-	17	+	20 log (3m)
	=	108.9[dBuV/m]	+	18.2 dB	-	7.5		
	=	119.6 [dBpW]						
	=	59.6 [dBµW]						
Power density [µW/cm^2]	=	912011 [µW]	/	4 π 300 [cm^2]				
	=	0.81 [µW/cm^2]						

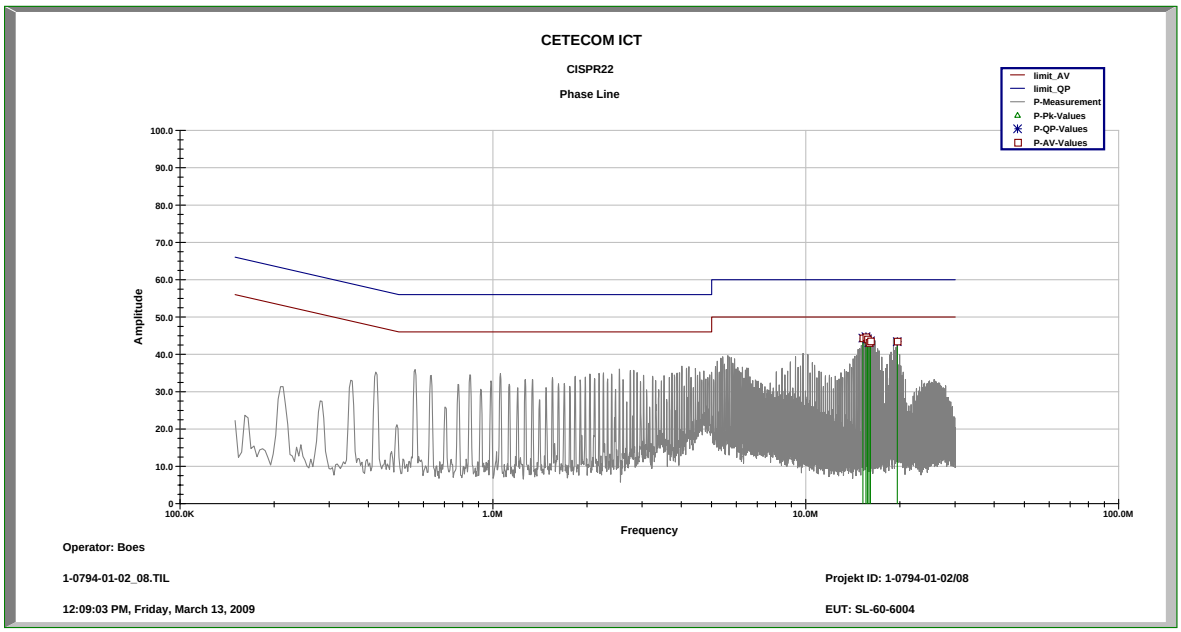
Limits :

Under normal test conditions only	For products other than fixed field disturbance sensors, the average power density of any emission, measured during the transmit interval, shall not exceed 9 µW/cm^2, as measured 3 meters from the radiating structure, and the peak power density of any emission shall not exceed 18 µW/cm^2, as measured 3 meters from the radiating structure.

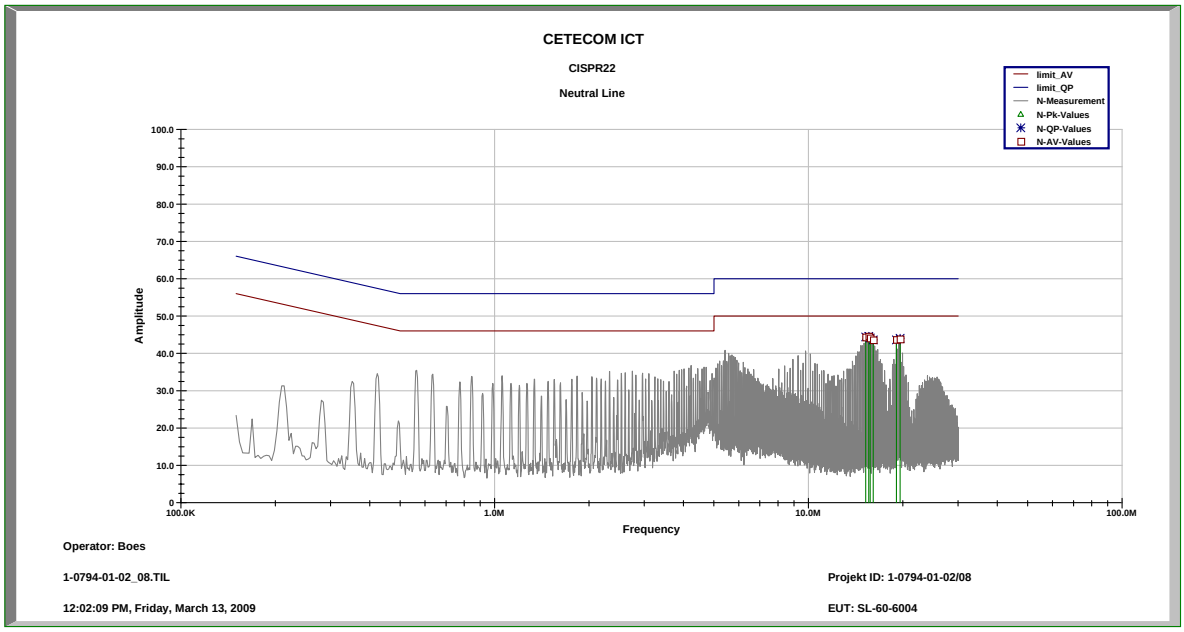
Test Result: pass

5.5 Conducted Spurious Emissions §15.207

Plot 1: 150 kHz - 30 MHz (Terminal A)



Plot 2: 150 kHz - 30 GHz (Terminal A)



Frequency (MHz)	Line	Average AV (dBµV)	Margin AV (dBµV)	Quasi Peak QP (dBµV)	Margin QP (dBµV)
15.211	Phase	44.4	-5.6	44.3	-15.7
15.560	Phase	44.7	-5.3	44.7	-15.3
15.735	Phase	44.1	-5.9	44.1	-15.9
15.910	Phase	43.2	-6.8	43.1	-16.9
16.084	Phase	43.6	-6.4	43.6	-16.4
19.582	Phase	43.6	-6.4	43.4	-16.6

Remark: no differences in test results of Terminal A and B; the plots show the test results after modification on the main-lead (ferrites, see photo no. 6, chapter 7).

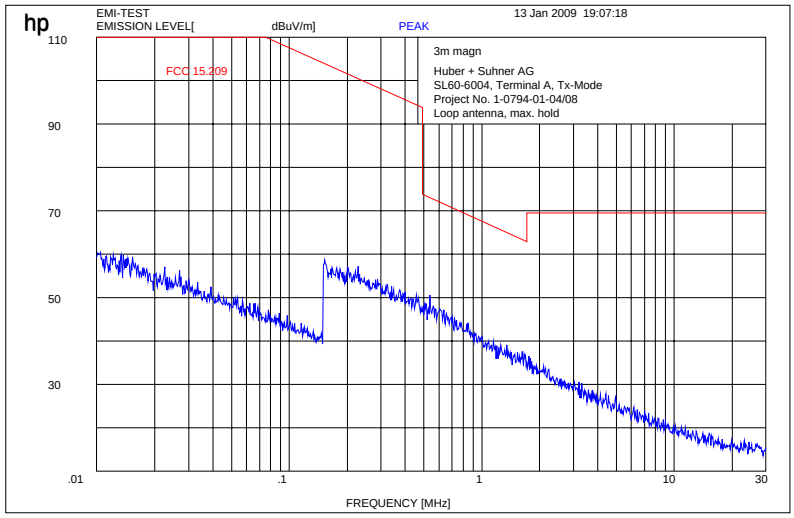
Limits: § 15.207

Frequency (MHz)	Conducted Emission (dBµV) Quasi-Peak	Conducted Emission (dBµV) Average
0.15 -0.5	66 to 56	56 to 46
0.5 - 5	56	46
5 - 30	60	50

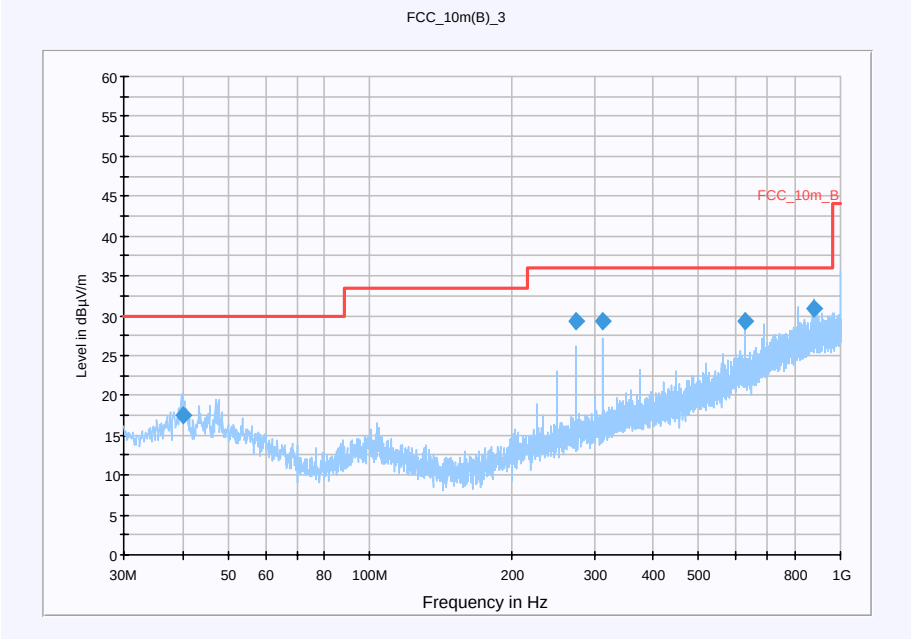
Test Result: pass

5.6 Radiated Spurious Emissions §15.255 (c)

Plot 3: 9 kHz - 30 MHz (Terminal A)

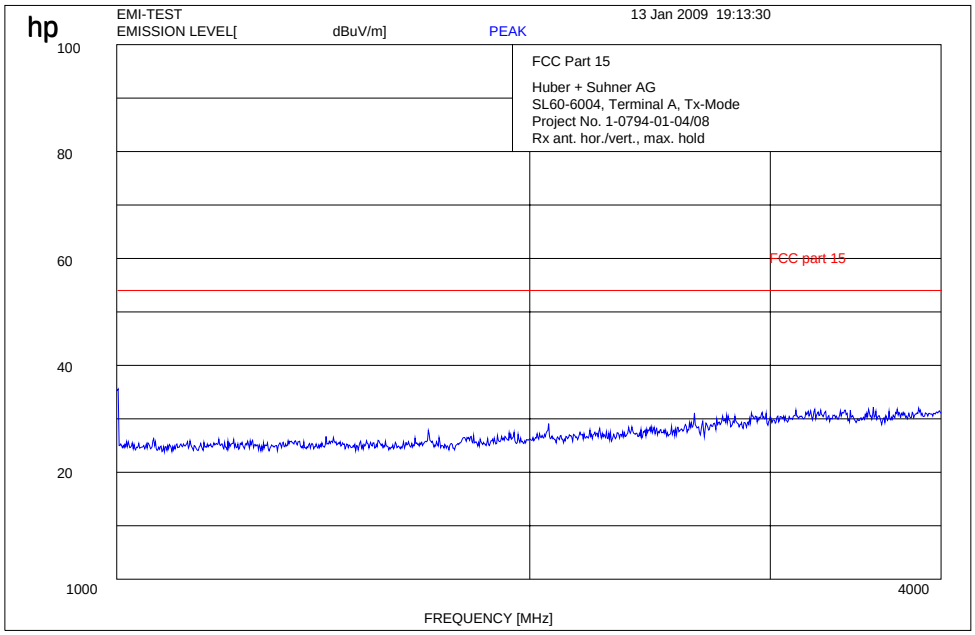


Plot 4: 30 MHz - 1 GHz (Terminal A)

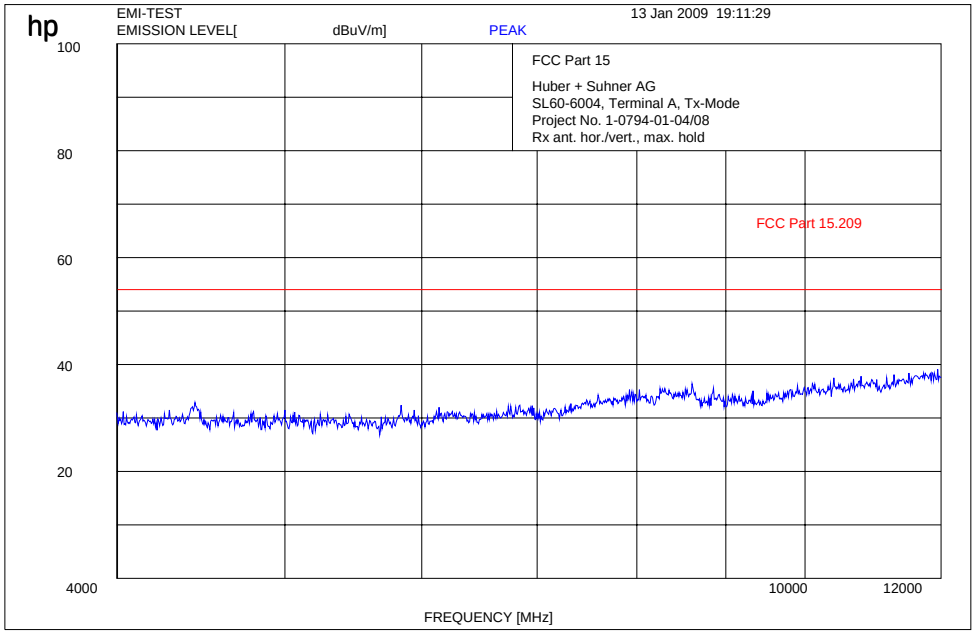


Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
40.045900	17.5	15000.000	120.000	136.0	V	138.0	13.6	12.5	30.0
274.993750	29.3	15000.000	120.000	220.0	H	9.0	14.1	6.7	36.0
312.478600	29.3	15000.000	120.000	220.0	H	0.0	15.1	6.7	36.0
624.954700	29.4	15000.000	120.000	130.0	H	267.0	21.1	6.6	36.0
874.911750	31.0	15000.000	120.000	107.0	H	96.0	25.5	5.0	36.0

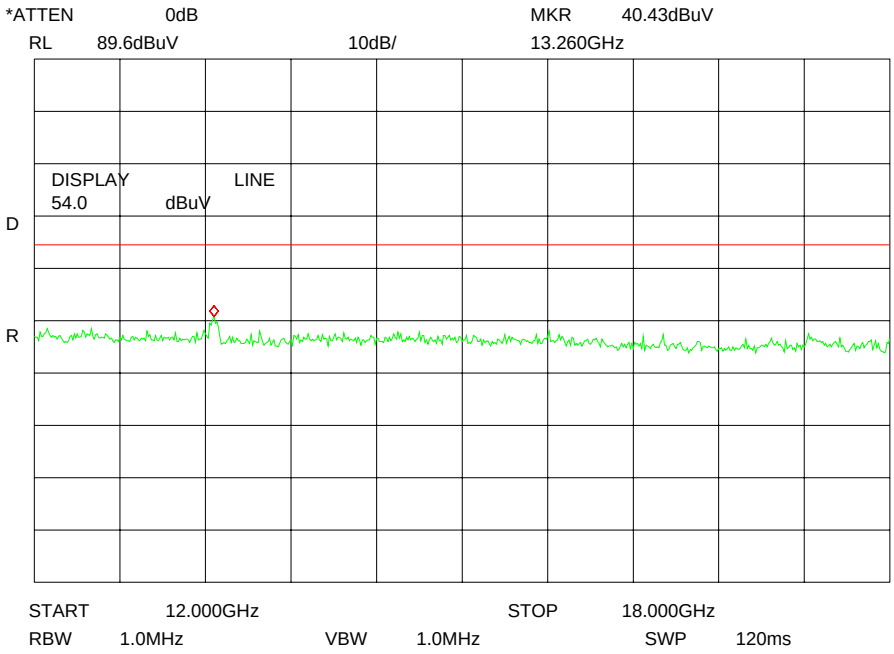
Plot 5: 1 - 4 GHz (Terminal A)



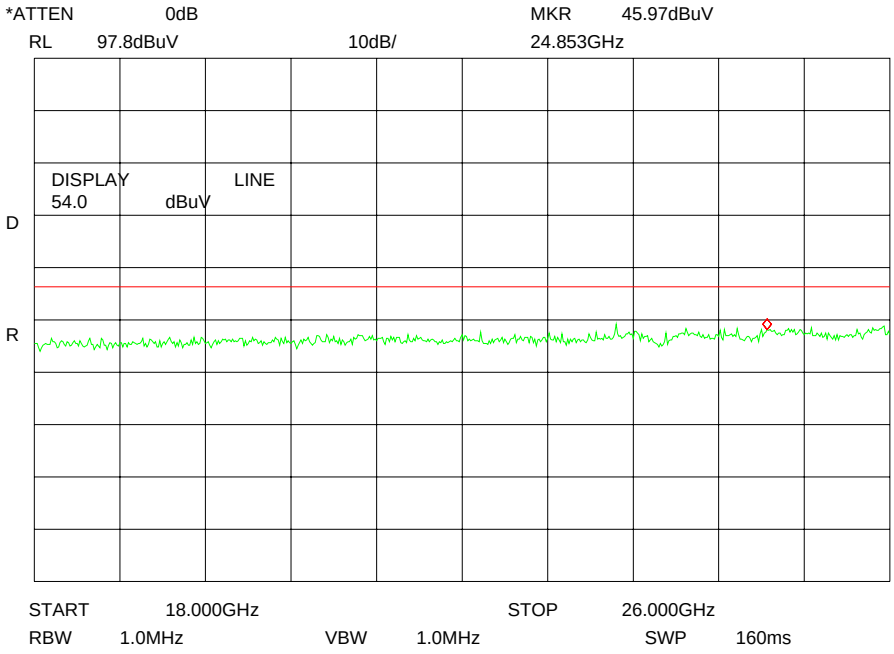
Plot 6: 4 - 12 GHz (Terminal A)



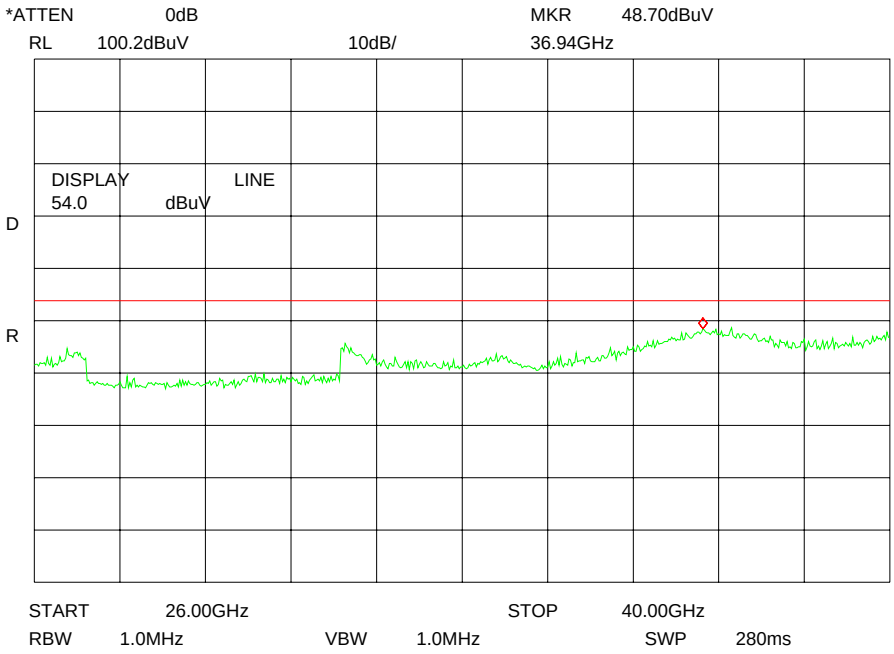
Plot 7: 12 - 18 GHz (Terminal A)



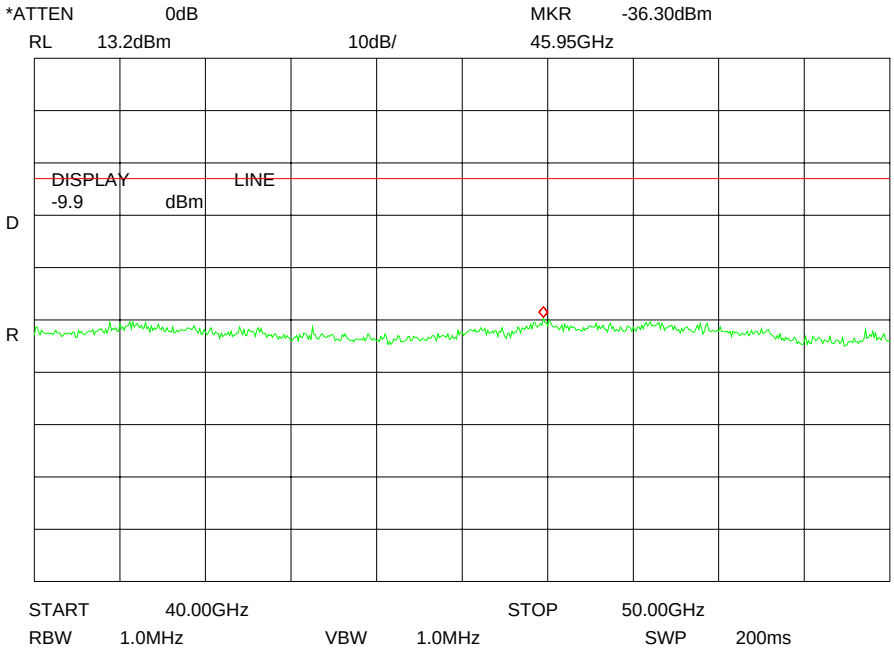
Plot 8: 18 - 26 GHz (Terminal A)



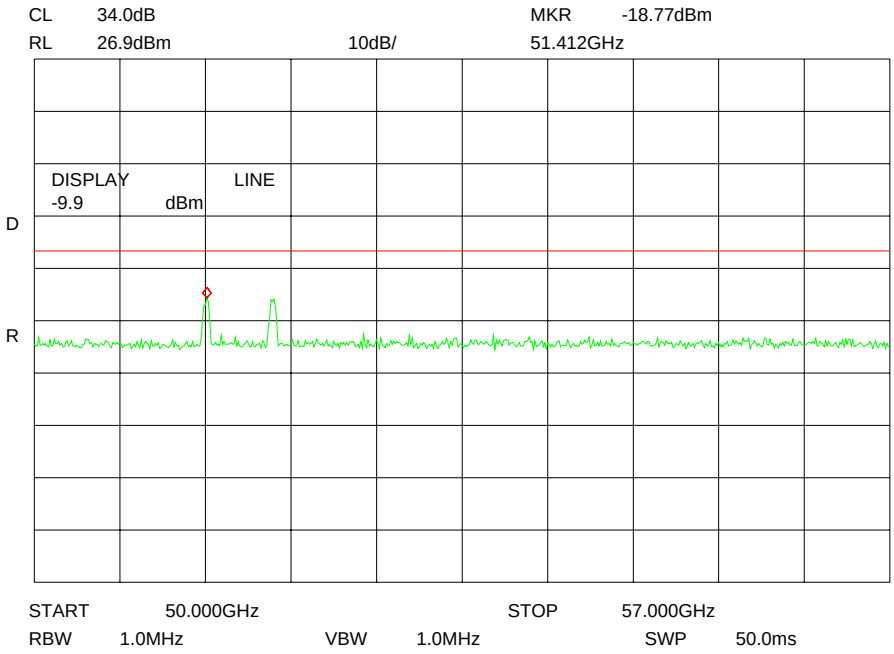
Plot 9: 26 - 40 GHz (Terminal A)



Plot 10: 40 - 50 GHz (Terminal A)

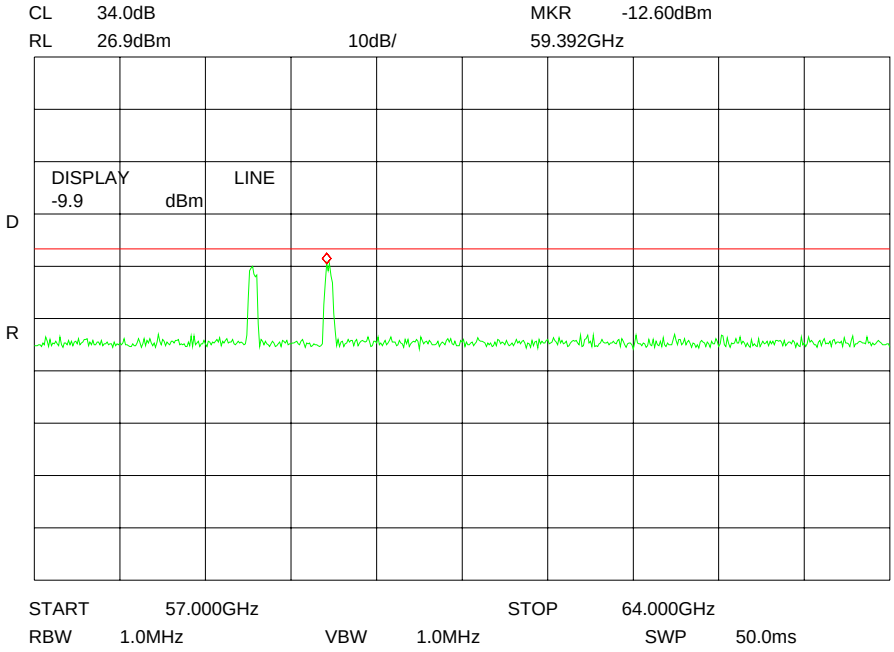


Plot 11: 50 - 57 GHz (Terminal A)



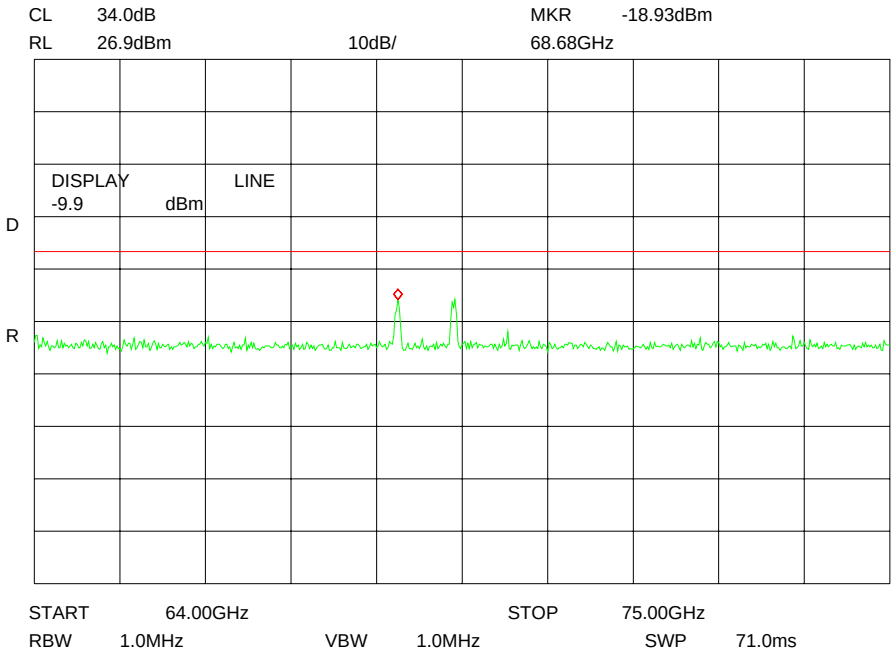
The plot shows peaks caused by the harmonic mixer.

Plot 12: 57 - 64 GHz (Terminal A)



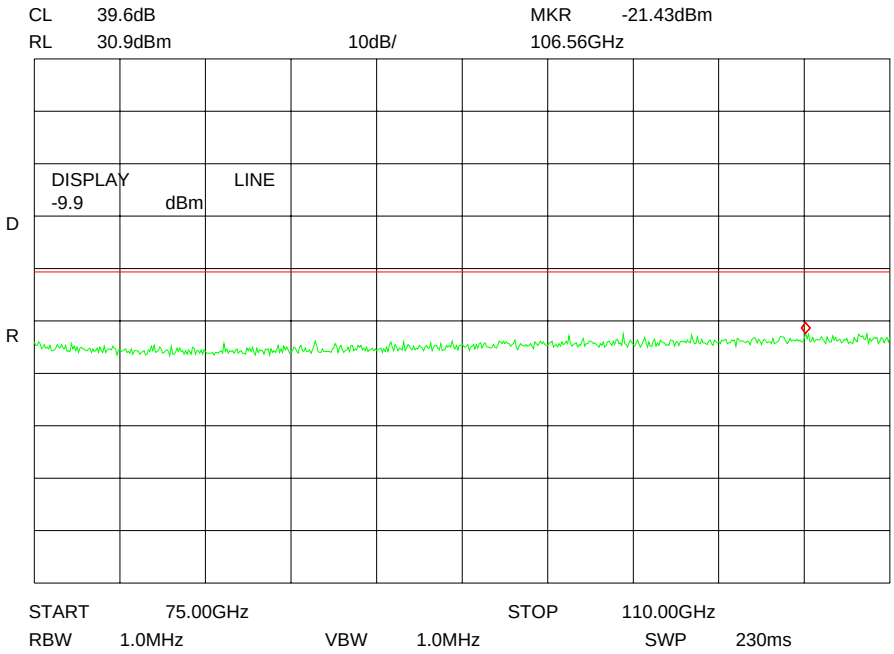
The left peak is caused by the harmonic mixer. The right peak is the wanted signal at 59.375 GHz.

Plot 13: 64 - 75 GHz (Terminal A)

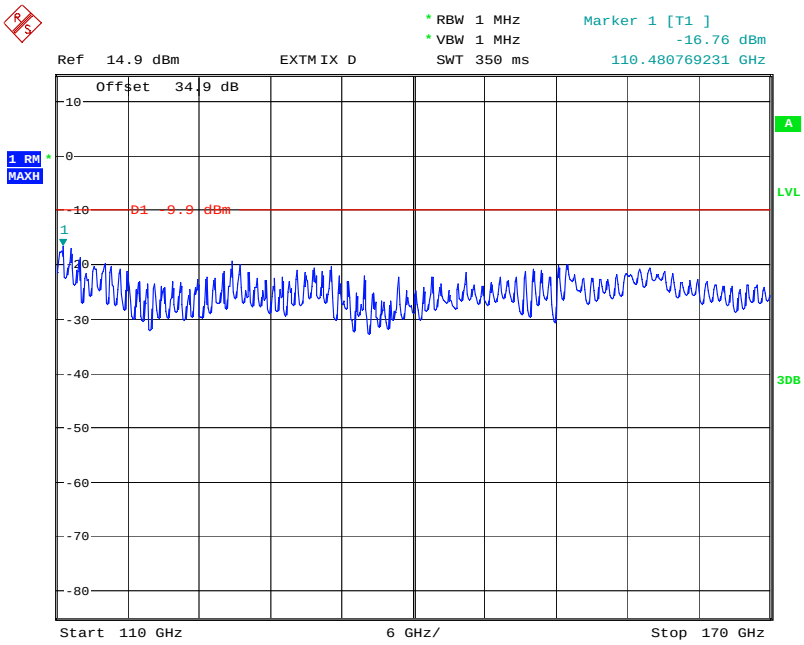


The plot shows peaks caused by the harmonic mixer.

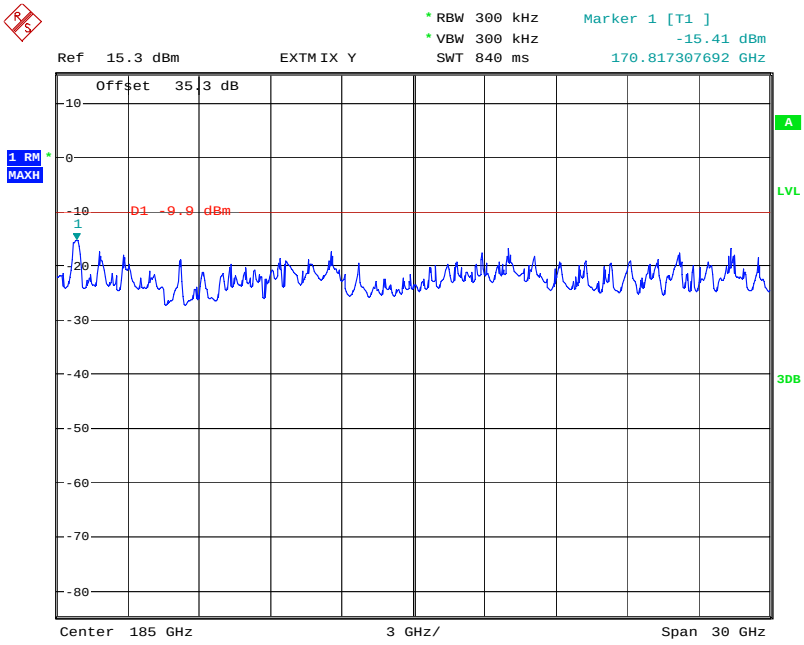
Plot 14: 75 - 110 GHz (Terminal A)



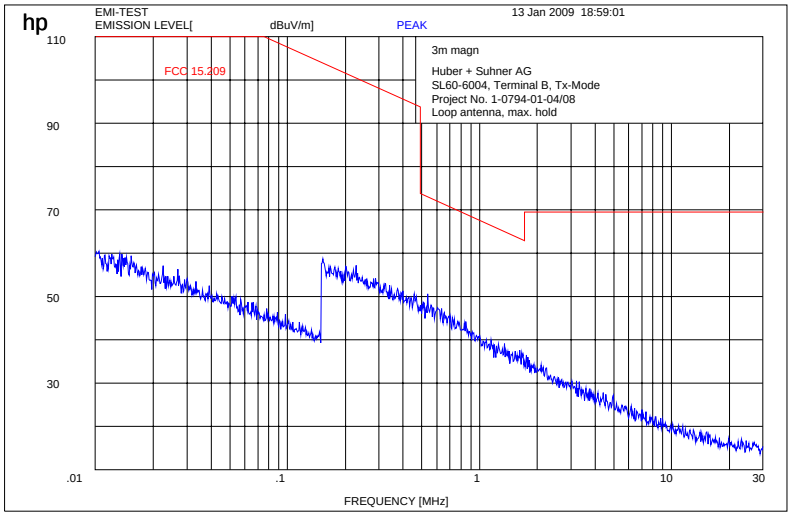
Plot 15: 110 - 170 GHz (Terminal A)



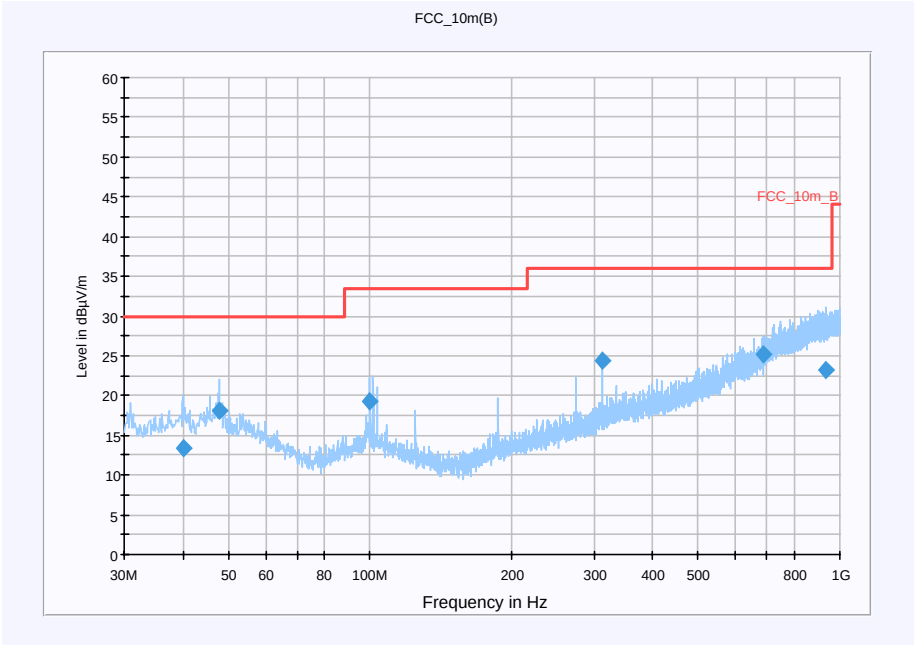
Plot 16: 170 - 200 GHz (Terminal A)



Plot 17: 9 kHz - 30 MHz (Terminal B)

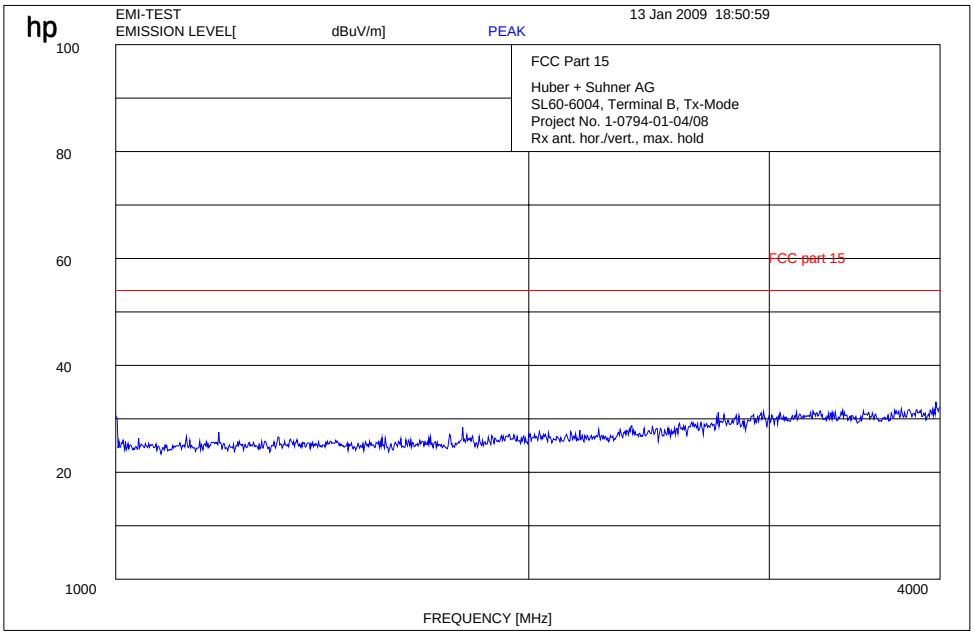


Plot 18: 30 MHz - 1 GHz (Terminal B)

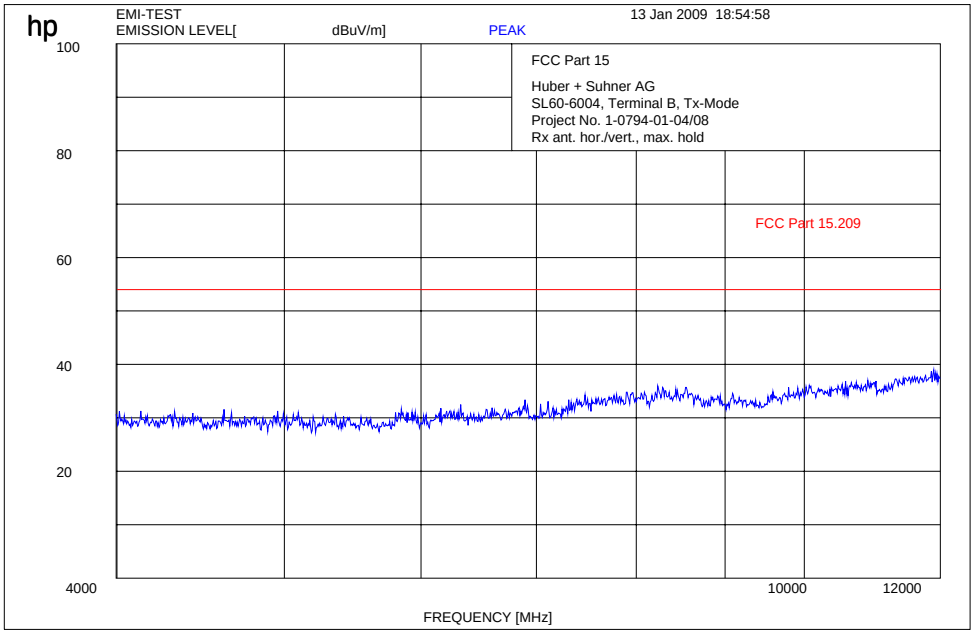


Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
40.059100	13.3	15000.000	120.000	143.0	V	288.0	13.6	16.7	30.0
47.808000	18.2	15000.000	120.000	100.0	V	341.0	13.5	11.8	30.0
100.001450	19.3	15000.000	120.000	100.0	V	349.0	12.3	14.2	33.5
312.472600	24.5	15000.000	120.000	100.0	V	0.0	15.1	11.5	36.0
687.491650	25.1	15000.000	120.000	400.0	V	341.0	22.3	10.9	36.0
932.875250	23.1	15000.000	120.000	200.0	H	143.0	25.9	12.9	36.0

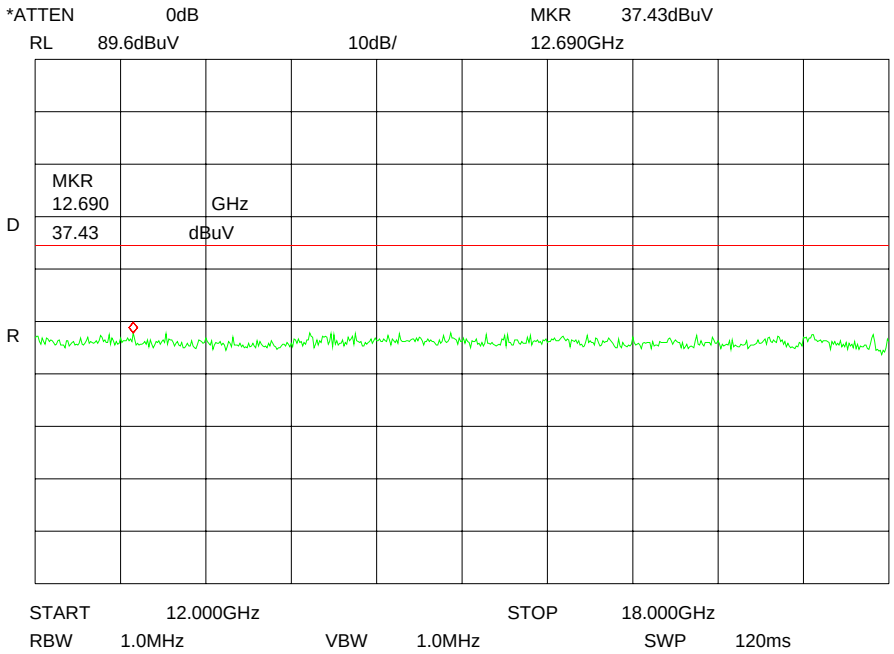
Plot 19: 1 - 4 GHz (Terminal B)



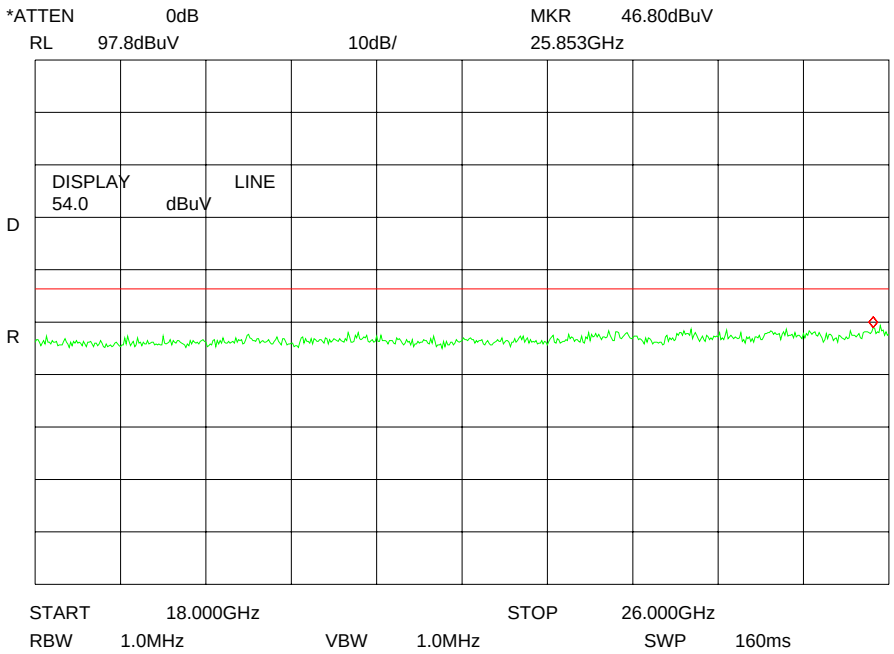
Plot 20: 4 - 12 GHz (Terminal B)



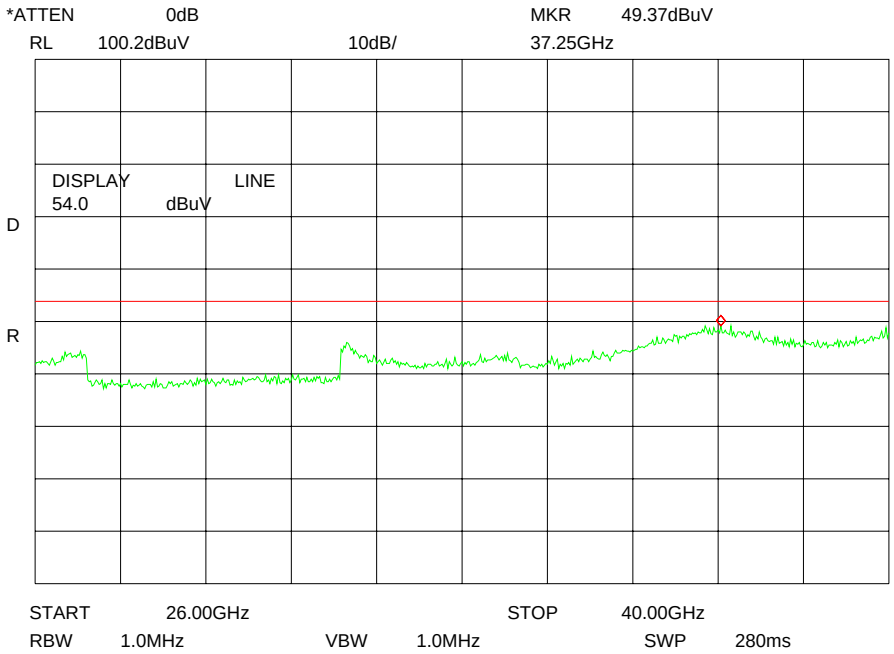
Plot 21: 12 - 18 GHz (Terminal B)



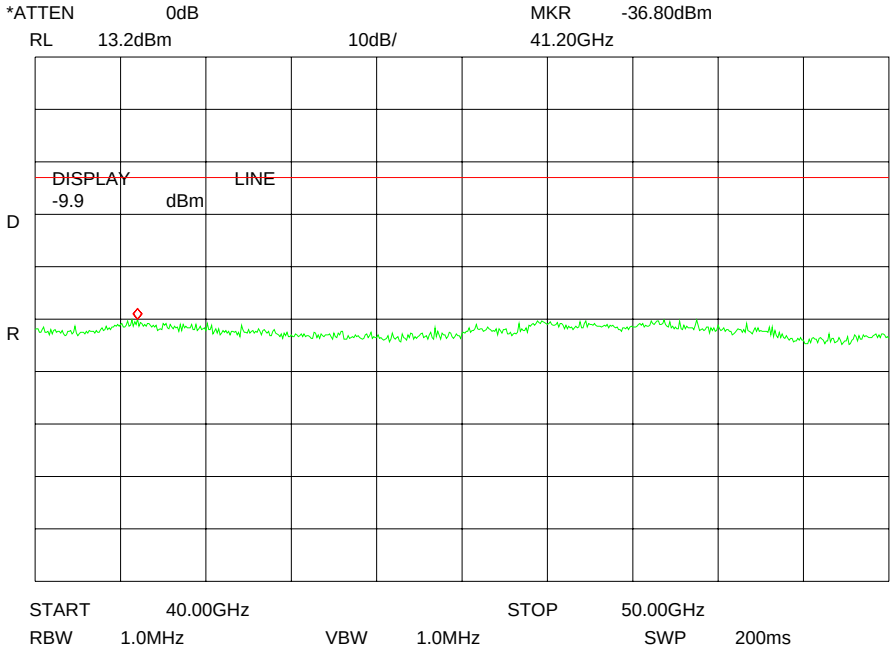
Plot 22: 18 - 26 GHz (Terminal B)



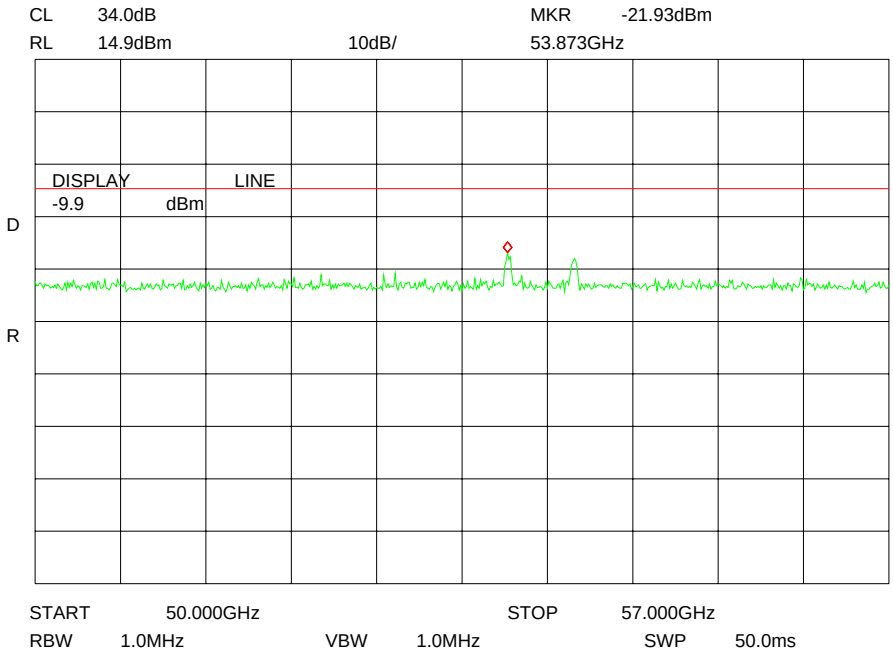
Plot 23: 26 - 40 GHz (Terminal B)



Plot 24: 40 - 50 GHz (Terminal B)

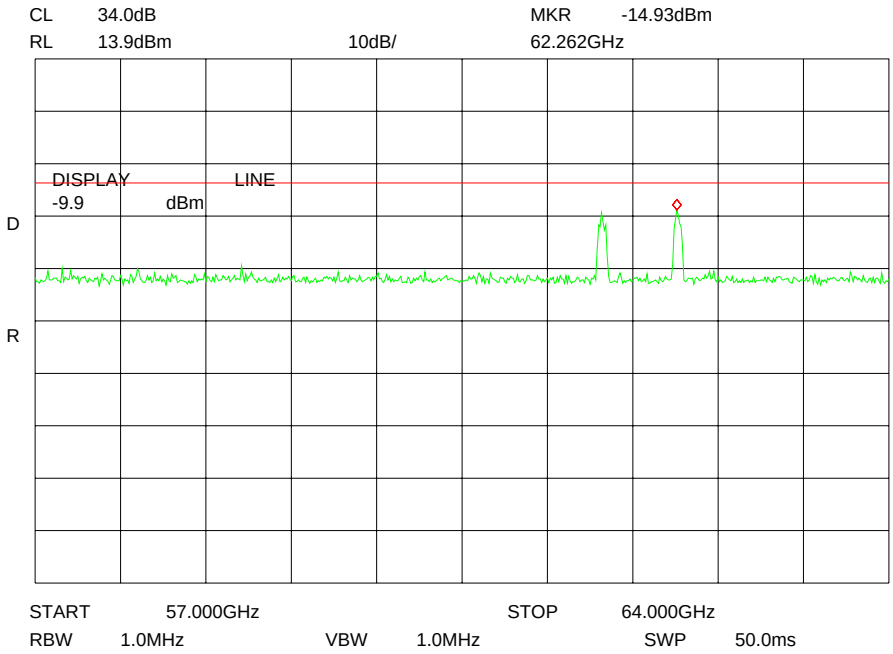


Plot 25: 50 - 57 GHz (Terminal B)



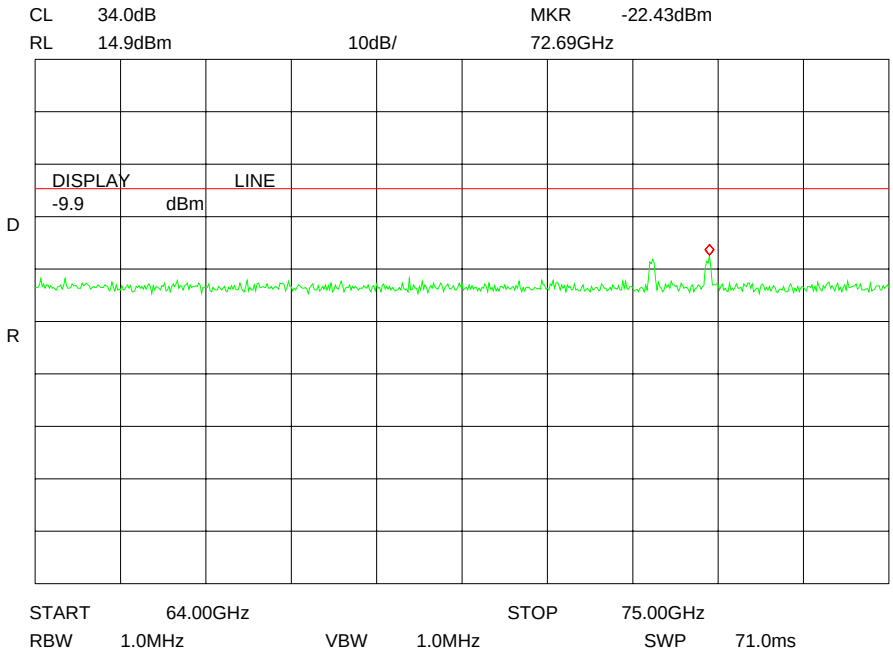
The plot shows peaks caused by the harmonic mixer.

Plot 26: 57 - 64 GHz (Terminal B)



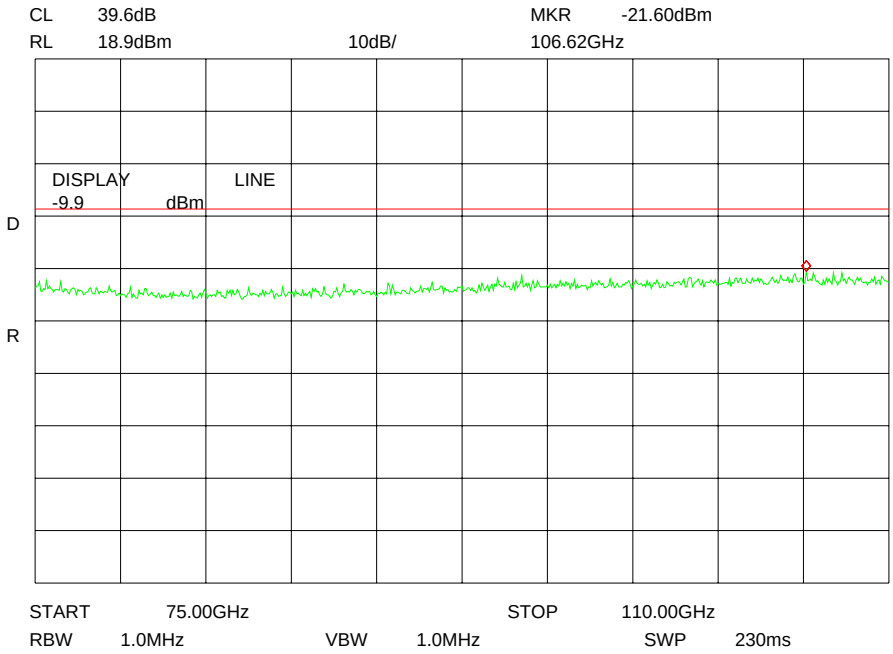
The left peak is caused by the harmonic mixer. The right peak is the wanted signal at 62.225 GHz.

Plot 27: 64 - 75 GHz (Terminal B)

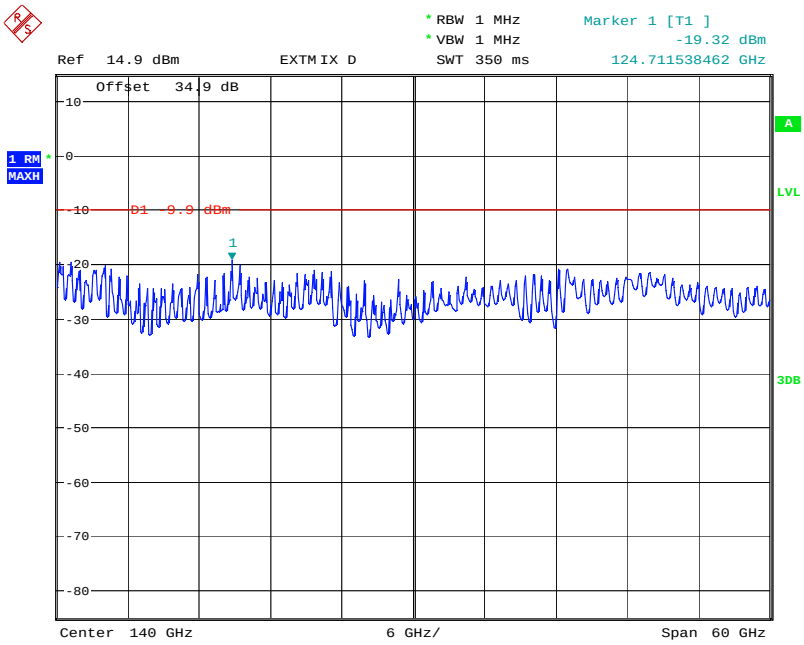


The plot shows peaks caused by the harmonic mixer.

Plot 28: 75 - 110 GHz (Terminal B)

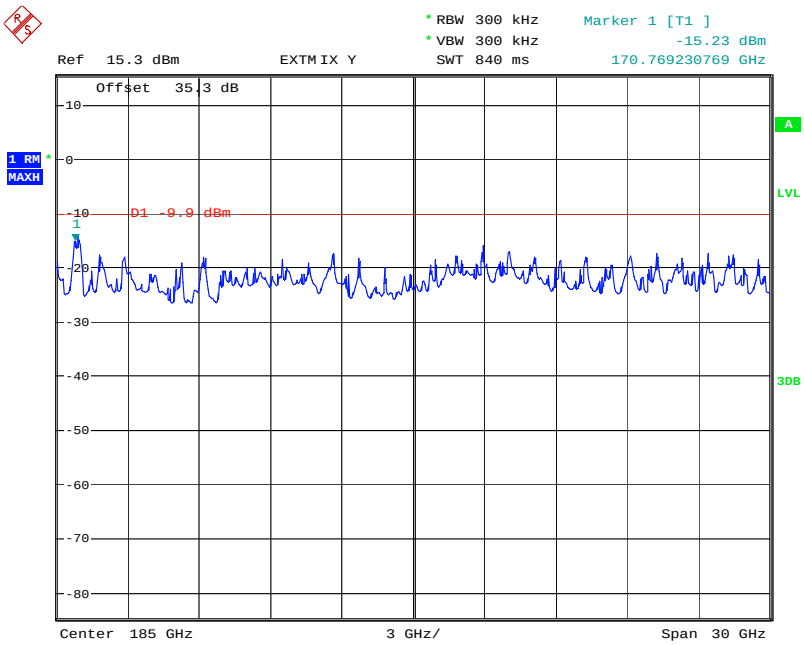


Plot 29: 110 - 170 GHz (Terminal B)



Date: 30.JAN.2009 14:36:54

Plot 30: 170 - 200 GHz (Terminal B)



Date: 30.JAN.2009 14:31:21

All spurious emissions detected are lower in level than the fundamental signal.

Limits: § 15.255 (c)

(c) Limits on spurious emissions:
(1) The power density of any emissions outside the 57-64 GHz band shall consist solely of spurious emissions.
(2) Radiated emissions below 40 GHz shall not exceed the general limits in Section 15.209 of this part.
(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters. [Equivalent to an EIRP of 102 µW.]
(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

Limit line:

Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30.0 µV/m / 29.5 dBµV/m	30
30 - 88	100 µV/m / 40.0 dBµV/m	3
88 - 216	150 µV/m / 43.5 dBµV/m	3
216 - 960	200 µV/m / 46.0 dBµV/m	3
above 960 up to 40 GHz	500 µV/m / 54.0 dBµV/m	3
40 GHz - 200 GHz	90 pW/cm^2	3

Remark:
90 pW/cm^2 measured at a distance of 3m corresponds to an EIRP of 102 µW / -9.9 dBm.

Test Result: pass

5.7 Total Peak Transmitter Output Power §15.255 (e)

Terminal A:

The maximum peak power density PD in r = 3 m distance is determined as

1.02 [µW/cm^2] (see plot 1e, Chapter 5.4 Power Density §15.255(b)(1))

Peak Power (EIRP)

EIRP = PD ∗ 4π ∗ r^2 = PD ∗1130973.4 cm^2
EIRP = 1.154 W
EIRP = 0.62 dBW
EIRP = 30.62 dBm

Terminal B:

The maximum peak power density PD in r = 3 m distance is determined as

0.81 [µW/cm^2] (see plot 2e, Chapter 5.4 Power Density §15.255(b)(1))

Peak Power (EIRP)

EIRP = PD ∗ 4π ∗ r^2 = PD ∗1130973.4 cm^2
EIRP = 0.92W
EIRP = -0.36 dBW
EIRP = 29.64 dBm

Results:

	radiated power [dBm]	antenna gain [dBi]	conducted power [dBm]	conducted power [mW]
Terminal A	30.6	41.0	-10.4	0.09
Terminal B	29.6	42.5	-12.9	0.05

Remark:
Antenna gain was specified by the manufacturer. Antenna patterns are available (see Annex 1).

Limits: § 15.255 (e)

(e) Except as specified below, the total peak transmitter output power shall not exceed 500 mW.
(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

Test Result: pass

5.8 Fundamental Emissions under Extreme Conditions §15.255 (f)

Terminal A:

U_{AC} [V]	Temperature [°C]	Carrier frequency [GHz]	Measured frequency [GHz]	Difference [MHz]	Difference [ppm]
110	-30.0	59.375	59.3680	-7.0	-117.9
110	-20.0	59.375	59.3686	-6.4	-107.8
110	-10.0	59.375	59.3691	-5.9	-99.4
110	0.0	59.375	59.3693	-5.7	-96.0
110	+10.0	59.375	59.3699	-5.1	-85.9
94	+20.0	59.375	59.3703	-4.7	-79.2
110	+20.0	59.375	59.3703	-4.7	-79.2
126	+20.0	59.375	59.3703	-4.7	-79.2
110	+30.0	59.375	59.3709	-4.1	-69.1
110	+40.0	59.375	59.3714	-3.6	-60.6
110	+50.0	59.375	59.3717	-3.3	-55.6

Terminal B:

U_{AC} [V]	Temperature [°C]	Carrier frequency [GHz]	Measured frequency [GHz]	Difference [MHz]	Difference [ppm]
110	-30.0	62.225	62.2339	8.9	143.0
110	-20.0	62.225	62.2325	7.5	120.5
110	-10.0	62.225	62.2309	5.9	94.8
110	0.0	62.225	62.2287	3.7	59.5
110	+10.0	62.225	62.2259	0.9	14.5
94	+20.0	62.225	62.2233	-1.7	-27.3
110	+20.0	62.225	62.2233	-1.7	-27.3
126	+20.0	62.225	62.2233	-1.7	-27.3
110	+30.0	62.225	62.2219	-3.1	-49.8
110	+40.0	62.225	62.2194	-5.6	-90.0
110	+50.0	62.225	62.2173	-7.7	-123.7

Limits: §15.255 (f)

(f) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

Test Result: pass

6 Photographs of the Test Set-up

Photo No. 1

Photo No. 2

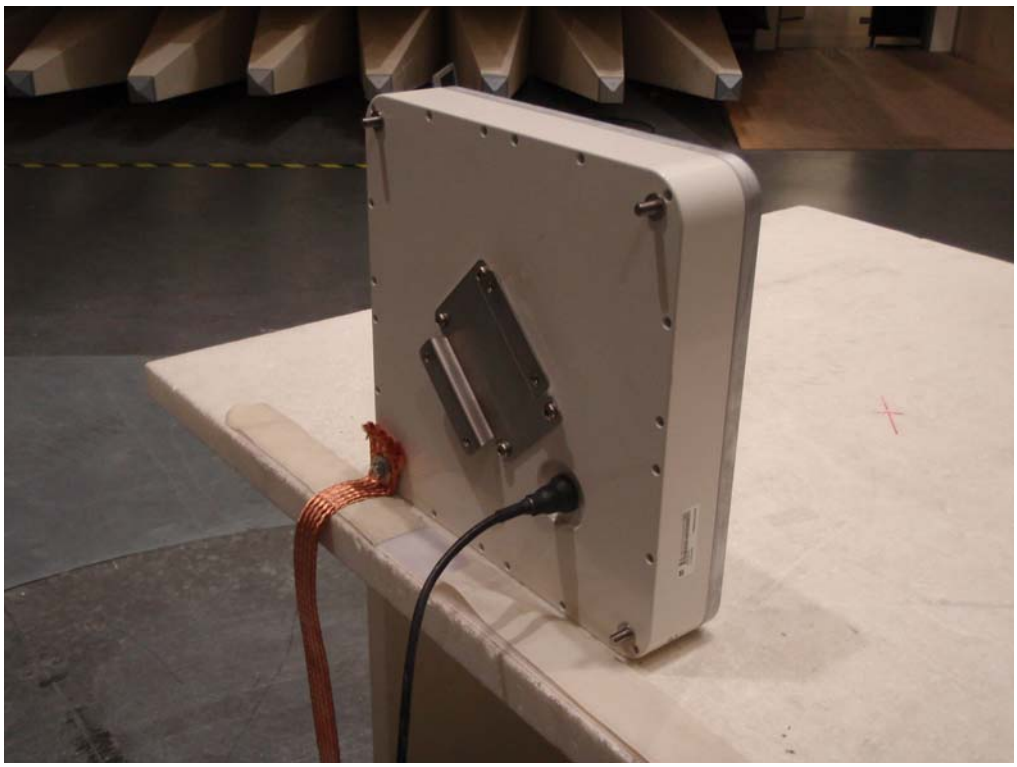


Photo No. 3

Photo No. 4

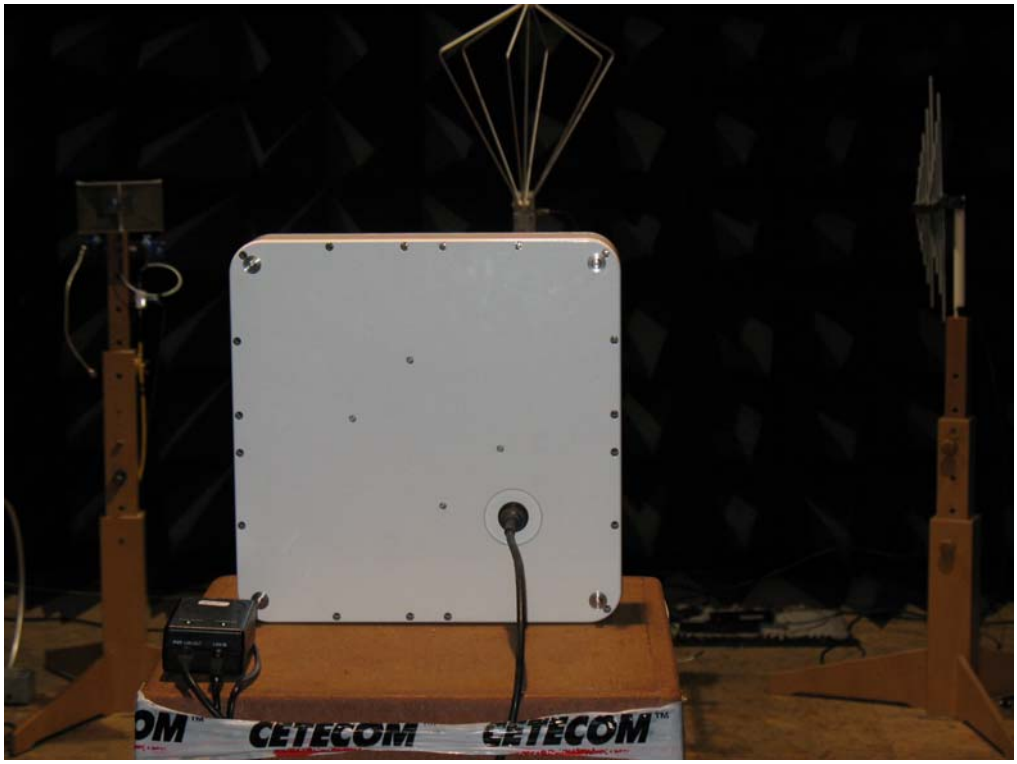


Photo No. 5

Photo No. 4

Remark: modification was done by means of using ferrites on the main-lead

7 Photographs of the EUT, interior view

Photo No. 1

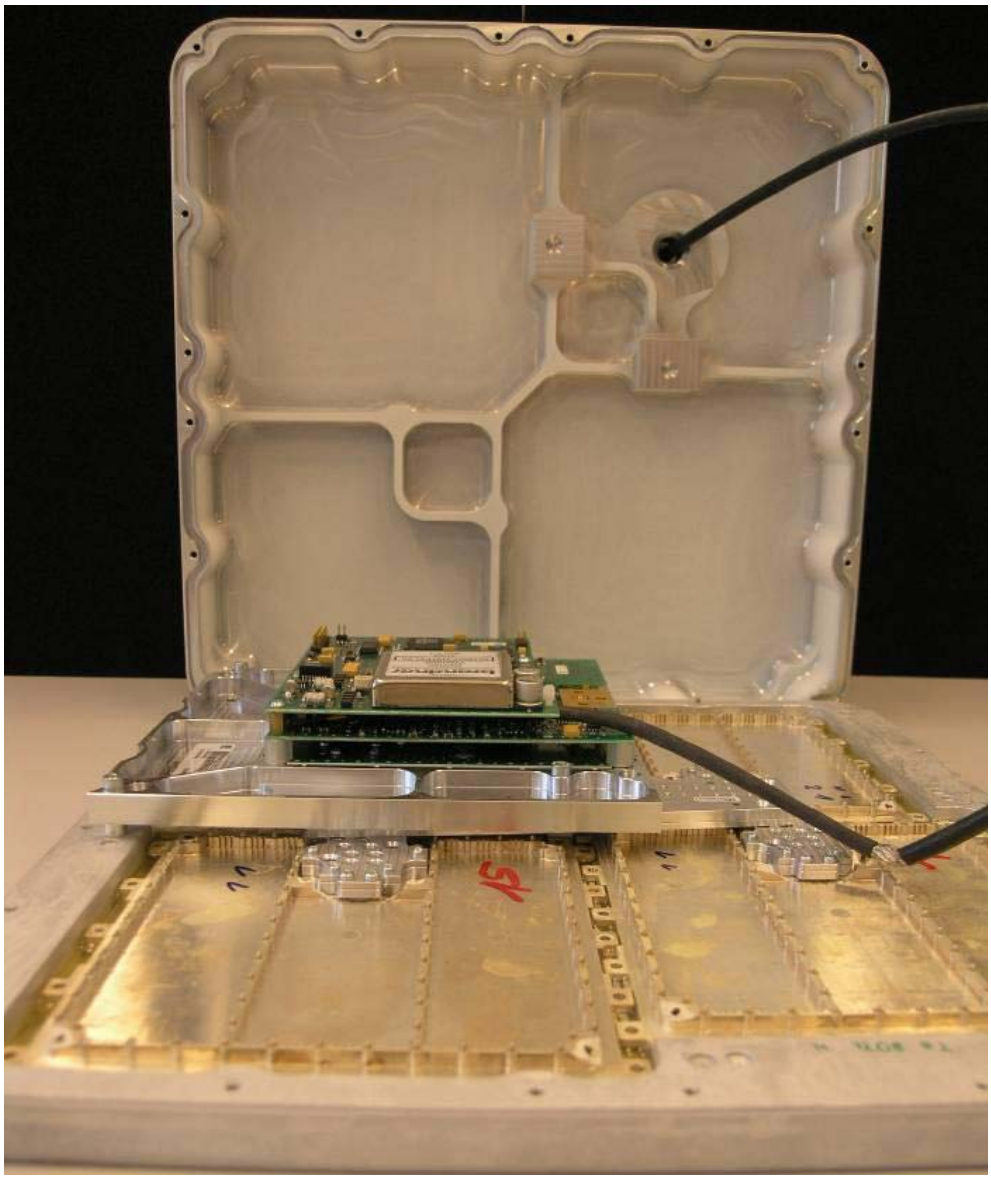


Photo No. 2

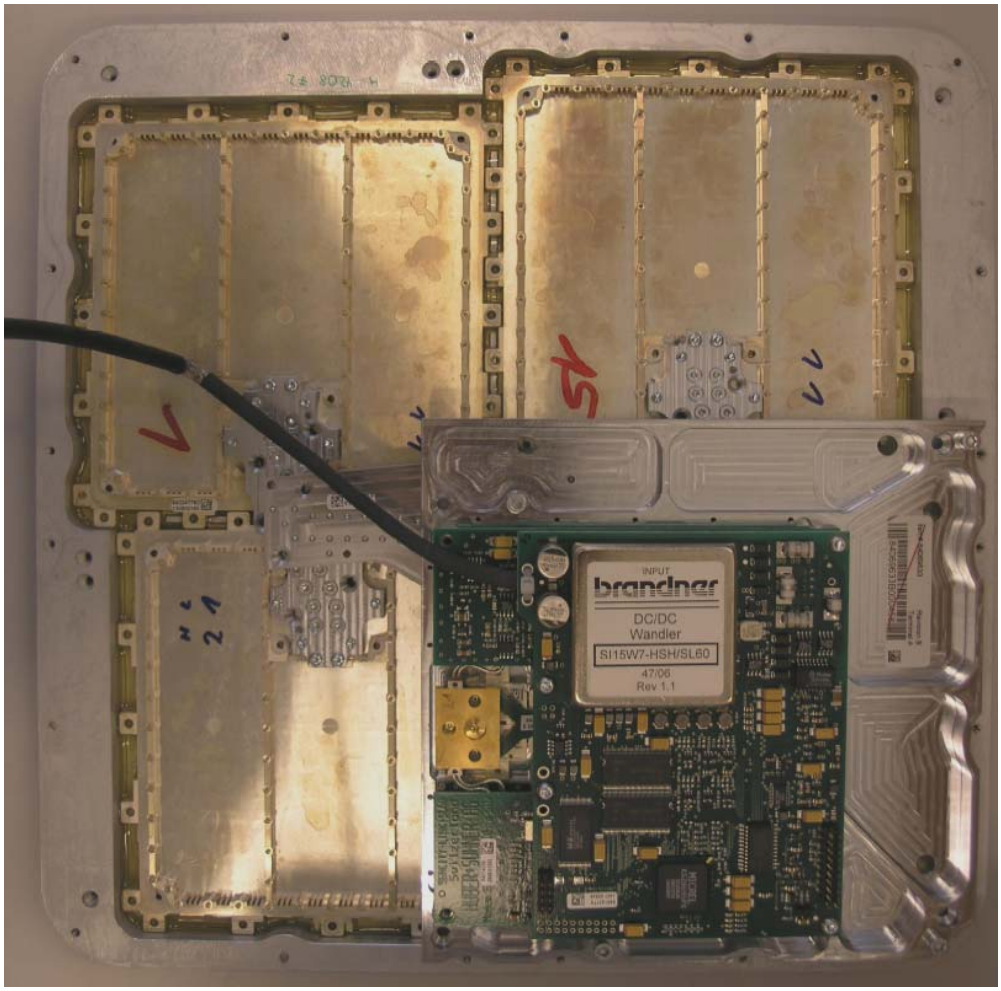


Photo No. 3

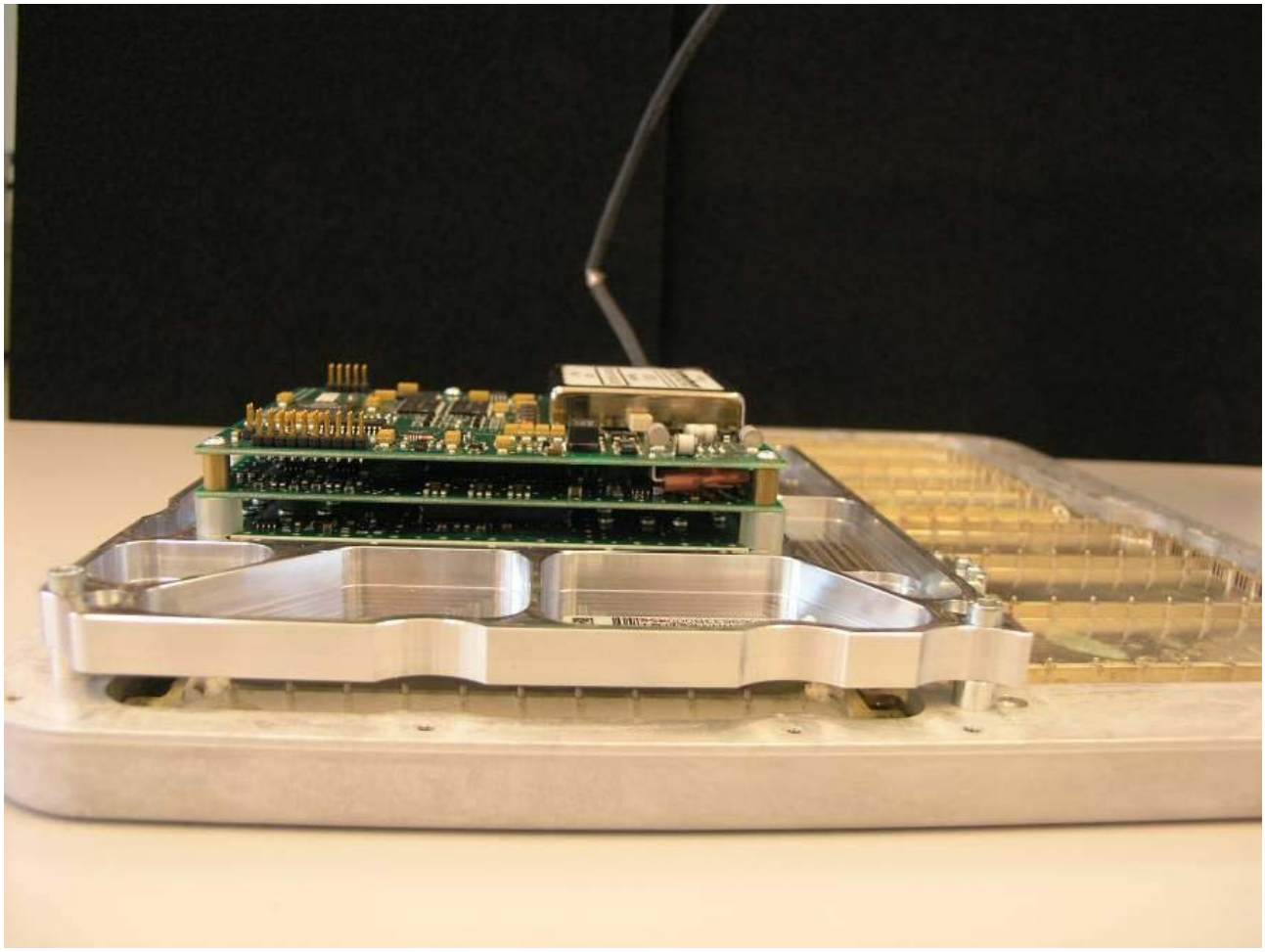


Photo No. 4

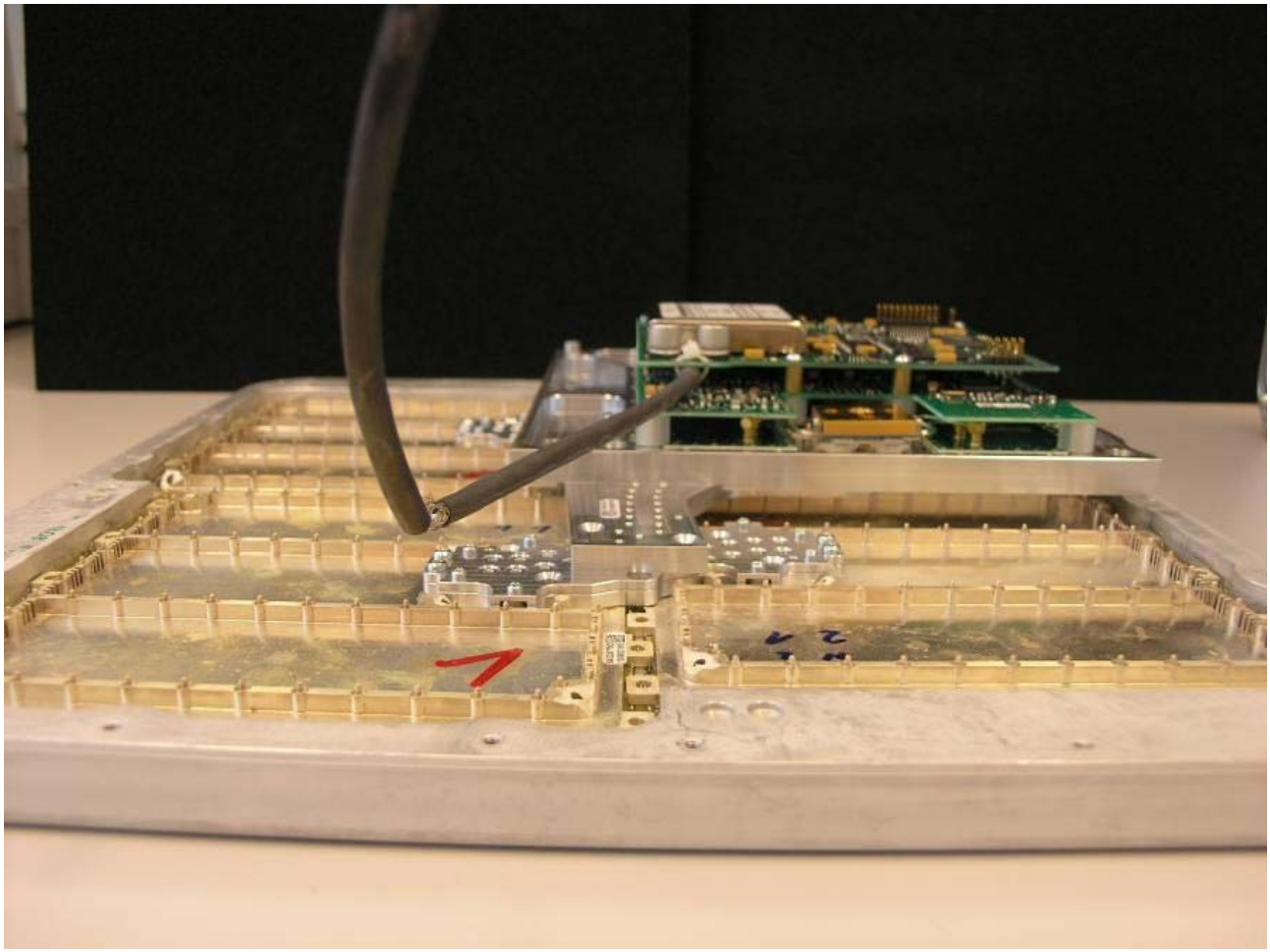
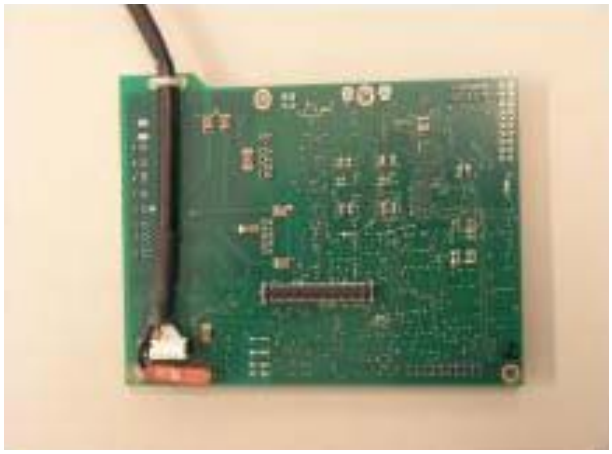


Photo No. 5 - 10

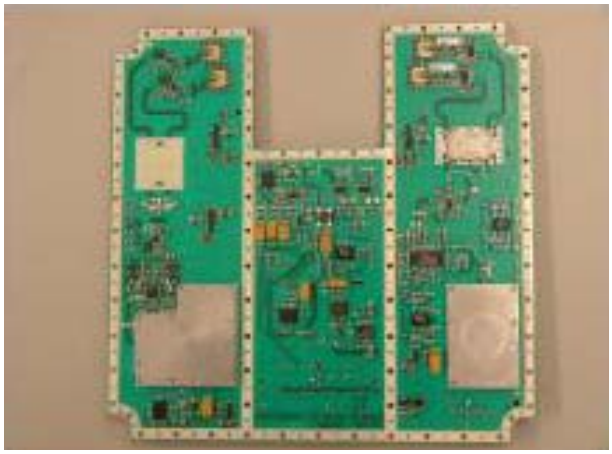

MAC-Board - Top


MAC-Board - Bottom


Modem-Board - Top


Modem-Board - Bottom


RF-Board - Top


RF-Board - Bottom

8 Photographs of the EUT, exterior view

Photo No. 1

Photo No. 2

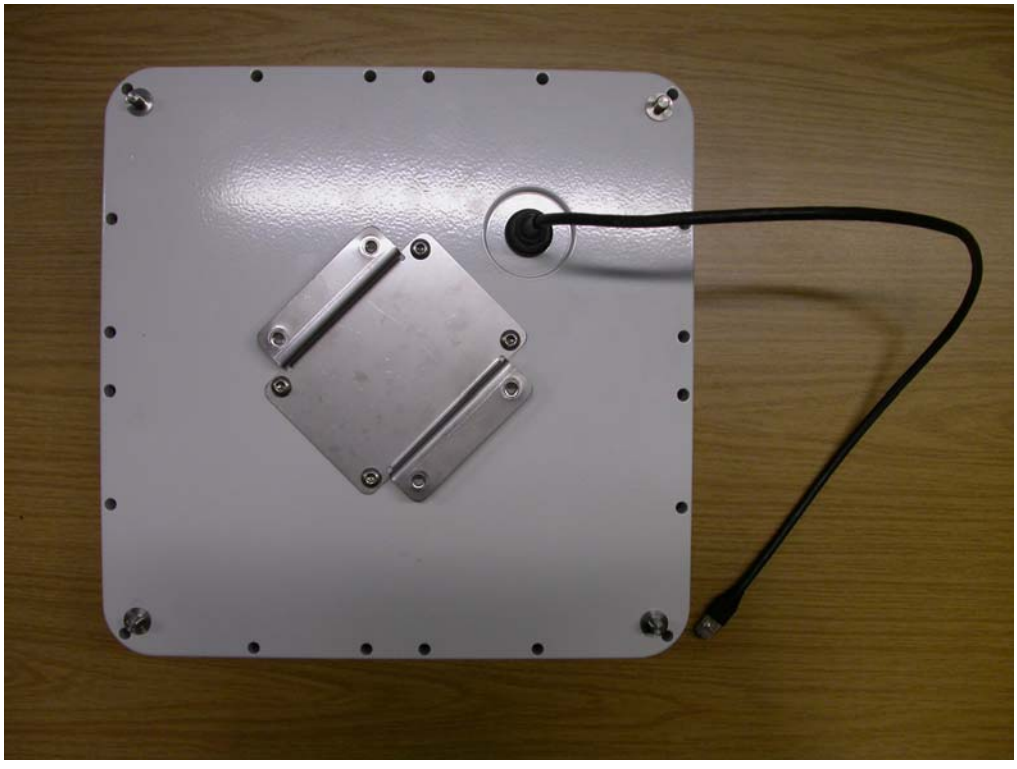


Photo No. 3

Photo No. 4

Photo No. 5

Photo No. 6

Photo No. 6


I. T. E. POWER SUPPLY
MODEL PW130
AULT INC., MADE IN CHINA
INPUT: 100-250 V~,50-60Hz,500mA
OUTPUT : 48 V⎓, 350mA
LISTED
2L85
E136791
EN 60950
IEC 60950
IEEE 802.3
INDOOR,DRY LOCATION USE ONLY
REFER TO INSTRUCTION
DOUBLE INSULATED
NO SERVICEABLE PARTS INSIDE
J1 PINS
J2 PINS
4 +POWER
5 +POWER
7 -POWER
8 -POWER
4 NO CONNECTION
5 NO CONNECTION
7 NO CONNECTION
8 NO CONNECTION
TYPE
RB4800N02

Annex 1 Antenna Compact Range Farfield Measurement Results

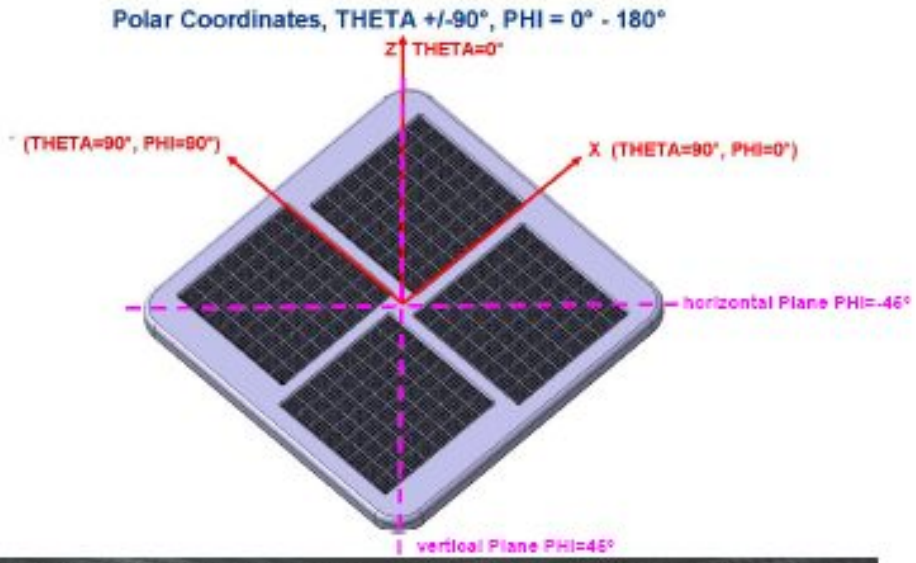
HUBER+SUHNER AG, CH-9100 Herisau
Radio Frequency Division
Development BWA

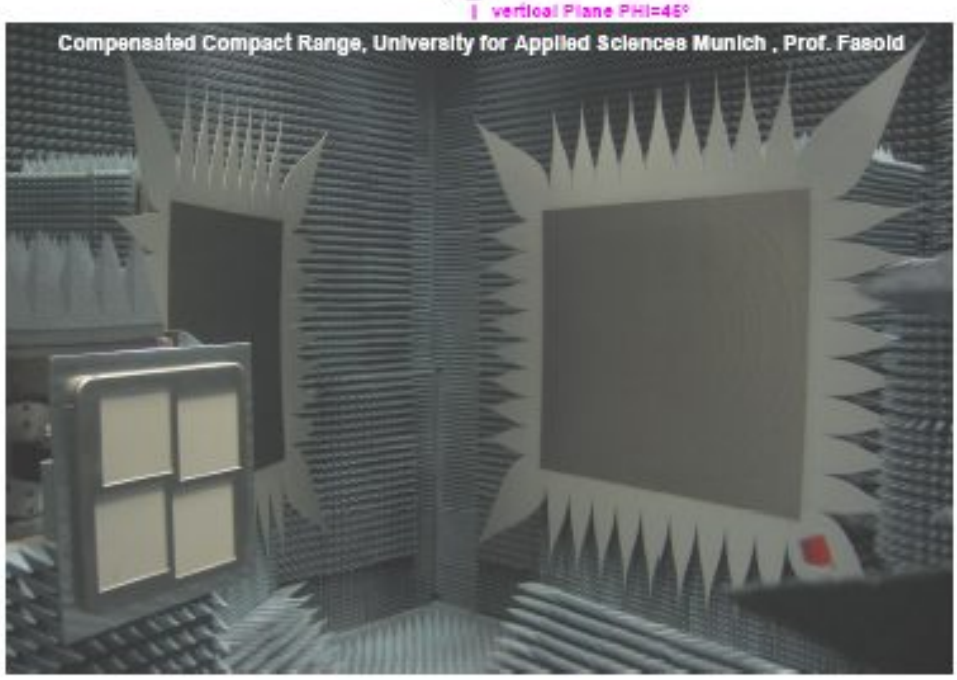
SL60-HGA Project Note

Subject: SL60-HGA Approval: Antenna Compact Range Farfield Measurement Results

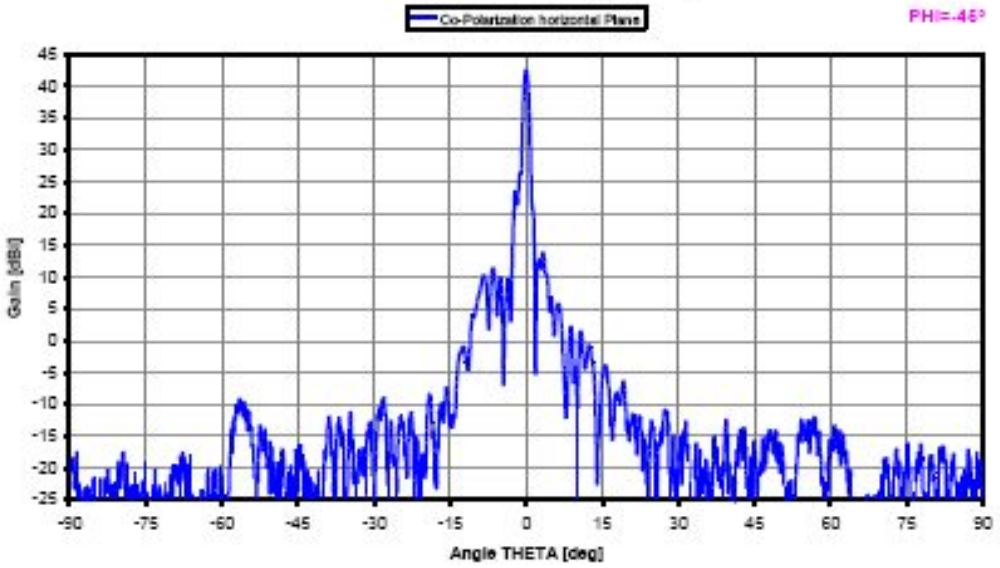
To: D. Stanelli, J. Richter, CETECOM-Testlab

For information: SL60-HGA Project Team

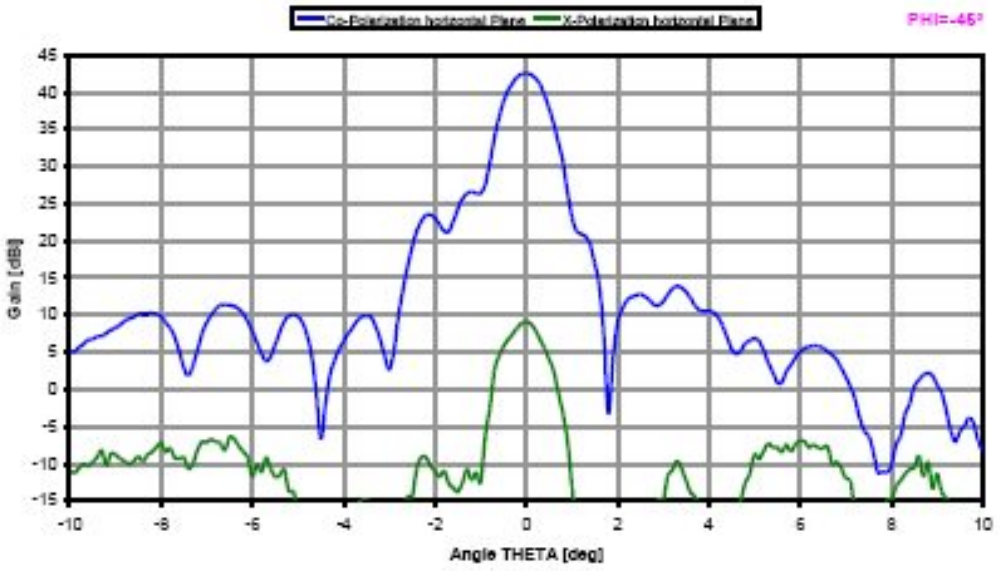




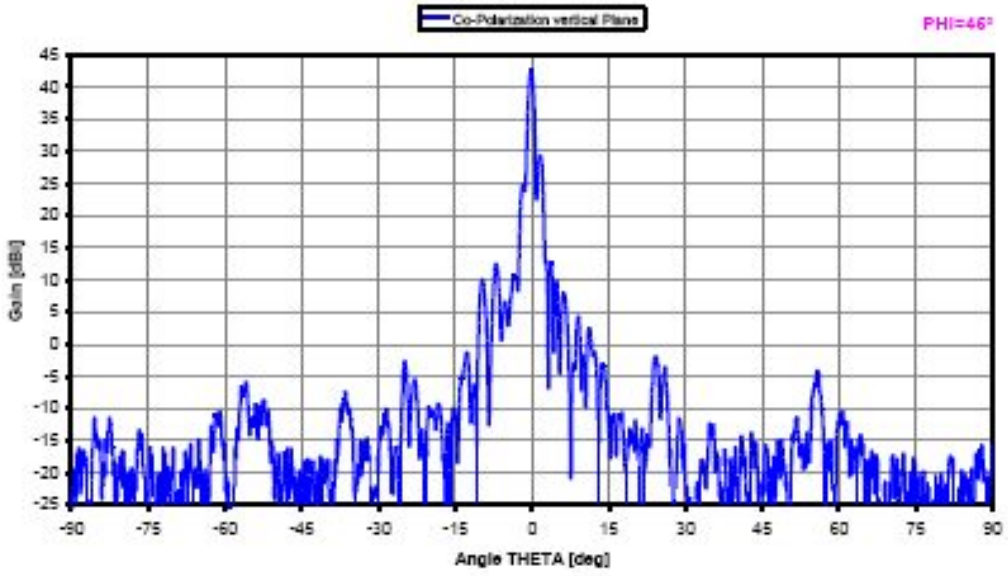
SL60-HGA Gain-Pattern Co-Polarization horizontal Plane @ 62.5GHz, Peak Gain = 42.6dBi



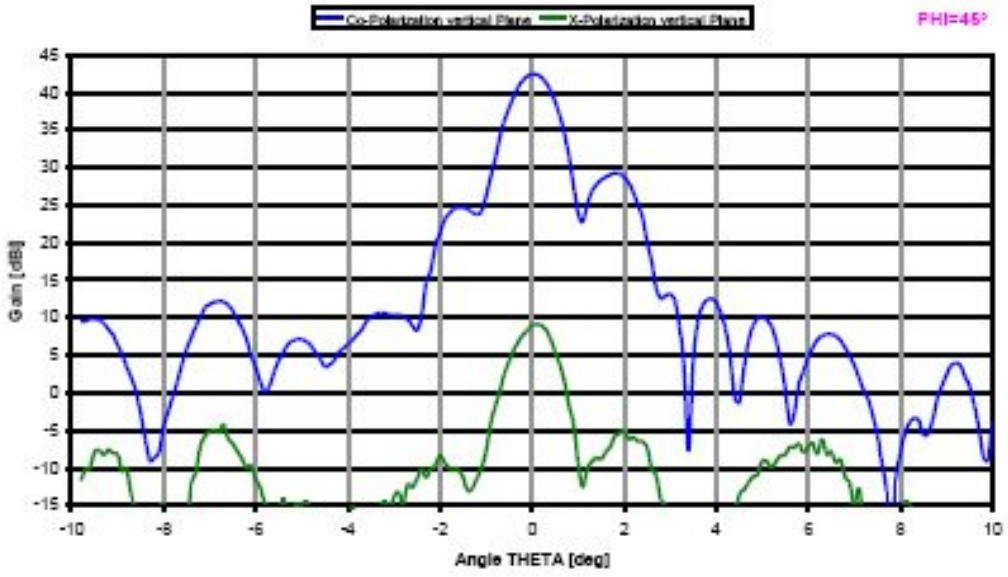
SL60-HGA Gain-Pattern Co/X--Polarization horizontal Plane @ 62.5GHz, Peak Gain = 42.6dBi



SL60-HGA Gain-Pattern Co-Polarization vertical Plane @ 62.5GHz, Peak Gain = 42.5dBi



SL60-HGA Gain-Pattern CO-/X-Polarization vertical Plane @ 62.5GHz, Peak Gain = 42.5dBi



Annex 2 Additional EUT information for Industry Canada

IC Registration Number:	**6318A-SL606004**
Model Name:	**Wireless Ethernet Bridge SL60-6004 (DPR-00112589)**
Manufacturer (complete Address):	**Huber + Suhner AG** **Degersheimer Str. 14** **9100 Herisau** **Switzerland**
Tested to Radio Standards Specification (RSS) No.:	**RSS-210 Issue 7**
Open Area Test Site Industry Canada Number:	**IC 3463A-1**
Frequency Range (or fixed frequency) [MHz]:	**Terminal A: Tx: 59.375 GHz, Rx: 62.225 GHz** **Terminal B: Tx: 62.225 GHz, Rx: 59.375 GHz**
RF: Power [W] (max):	**Rad. EIRP: 30.6 dBm / 1.15 W**
Antenna Type:	**4 field patch antenna**
Peak Power Density [µW/cm² in 3m]:	**1.02 µW/cm²**
Occupied Bandwidth (99% BW):	**66 MHz**
Type of Modulation:	**QPSK**
Emission Designator (TRC-43):	**66M0G1D**
Transmitter Spurious (worst case) [µV/m in 3m]:	**35.5 µV/m (845 MHz)**
Receiver Spurious (worst case) [µV/m in 3m]:	**receive-only not applicable** (TX+RX operate simultaneously)

ATTESTATION:

I attest that the testing was performed or supervised by me; that the test measurements were made in accordance with the above-mentioned departmental standard(s), and that the radio equipment identified in this application has been subject to all applicable test conditions specified in the departmental standards and all of the requirements of the standards have been met.

Signature:

Test engineer: Karsten Geraldy Date: 2009-03-19

Annex 3 RF Technical Brief Cover Sheet acc. to RSS-102

RF Technical Brief Cover Sheet acc. to RSS-102

All Fields must be completed with the requested information or the following codes: N/A for Not Applicable, N/P for Not Performed or N/V for Not Available. Where applicable, check appropriate box.

1. COMPANY NUMBER: 6318A

2. MODEL NUMBER: Wireless Ethernet Bridge SL60-6004 (DPR-00112589)

3. MANUFACTURER: Huber + Suhner AG

4. TYPE OF EVALUATION: **(c) RF Evaluation**

- Evaluated against exposure limits: General Public Use ☒ Controlled Use ☐
- Duty cycle used in evaluation: 100%
- Standard used for evaluation: RSS-102 Issue 2 (2005-11)
- Measurement distance: 2 m
- RF value: 0.023 W/m²

Measured ☒ Computed ☐ Calculated ☐

Declaration of RF Exposure Compliance

ATTESTATION:

I attest that the information provided in this test report are correct; that a Technical Brief was prepared and the information it contains is correct; that the device evaluation was performed or supervised by me; that applicable measurement methods and evaluation methodologies have been followed and that the device meets the SAR and/or RF exposure limits of RSS-102.

Name: Karsten Geraldy
Company: Cetecom ICT Services GmbH