ROHDE&SCHWARZ

akkreditiert durch die / *accredited by the*

Deutsche Akkreditierungsstelle GmbH

als Kalibrierlaboratorium im / *as calibration laboratory in the*

Deutschen Kalibrierdienst

DAkkS Deutsche Akkreditierungsstelle D-K-15195-01-00

Kalibrierschein *Calibration certificate*	Kalibrierzeichen *Calibration mark*
	606113
	D-K-15195-01-00
	2021-08

Gegenstand *Object*	**ZNB40 VECT.NETW.ANALYZER 2 PORT**
Hersteller *Manufacturer*	**ROHDE & SCHWARZ**
Typ *Type*	**ZNB40**
Fabrikat/Serien-Nr. *Serial number*	**101544**
Auftraggeber *Customer*	**RISE Research Institutes of Sweden AB** **Brinellgatan 4** **504 62 Borås** **SE**
Auftragsnummer *Order No.*	**8800006610 10, X1004157**
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	**3 Certificate** **18 Outgoing Results** **18 Incoming Results**
Datum der Kalibrierung *Date of calibration*	**2021-08-04**

Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Die DAkkS ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.
This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DAkkS is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
The user is obliged to have the object recalibrated at appropriate intervals.

Datum der Ausstellung *Date of issue*	Freigabe des Kalibrierscheins durch *Approval of the calibration certificate by*	
2021-08-04	Dr. Gerhard Rösel Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Philipp Bartsch Bearbeiter *Person in charge*

Place of Calibration

87700 Memmingen, Rohde-und-Schwarz-Str. 1

Calibration Procedure

The calibration of the object can be classified as a direct measurement. Frequency was compared using a GPS synchronized rubidium oscillator. RF power was measured with a power sensor. Linearity was measured with a spectrum analyzer.

The traceability is represented in the table Working Standards used.

Calibration Method **See first page of Outgoing Results**

Statement of Compliance

Incoming: Defective

Outgoing: All measured values are within the data sheet specifications.

Working Standards used

Item	Type	Serial Number	Calibration Certificate Number	Cal. Due
Spectrum Analyzer 20Hz...67GHz	FSU67	100056	576320 D-K-15195-01-00 2020-11	2022-05-31
Therm.Power Sensor DC-40GHz	NRP-Z55	100030	576360 D-K-15195-01-00 2020-11	2022-05-31
Therm.Power Sensor DC-40GHz	NRP-Z55	100031	576363 D-K-15195-01-00 2020-11	2022-05-31
Therm.Power Sensor DC-44GHz	NRP-Z55	140160	549276 D-K-15195-01-01 2020-04	2021-10-31
Therm.Power Sensor DC-40GHz	NRP-Z55	100271	576370 D-K-15195-01-00 2020-11	2022-05-31
Standardfrequency unit 1X1	SYSTEM2000	808	100029 D-K-15195-01-01 2020-06	2023-06-30
RMS Peak-Voltmeter DC-30 MHz	URE3	100183	598563 D-K-15195-01-00 2021-05	2022-11-30
Vect. Netw. Analyzer 4PORT	ZVA67	101347	892929 D-K-15195-01-01 2020-05	2021-11-30
2,92mm Fixed Match Cal. Kit	ZV-Z34	100123	606917 D-K-15195-01-00 2021-07	2022-07-31

Custom Data

Asset Number: BX50051

Measurement Uncertainty

The expanded measurement uncertainty corresponds to the measurement results from the standard measurement uncertainty multiplied by the coverage factor k = 2.
It was determined in accordance with EA-4/02 M:2013. The true value is located in the corresponding interval with a probability of 95 %.

Environmental Conditions

Ambient Temperature	(23 ± 3) °C	Relative Humidity	20%-70%

Ancillary Functional Measurements

In addition to the calibration results, the calibration certficate includes functional measurements that might have an influence on the measurement uncertainty of the calibration results. The functional measurement results are marked and are not intended to be used to support the further dissemination of metrological traceability. They are intended to verify the requirements on the measurement object according to manufacturer specifications and technical standards.

Comments on Measurement Results

The measurement results in the test report stated below have been tested for compliance with the given specifications and marked if necessary. The associated uncertainty of measurement has been taken into account. Measurement results that are not covered by the DAkkS accreditation are marked with [1].

Ref.: ILAC G8:09/2019 'Guidelines on Decision Rules and Statements of Conformity'.

Outgoing Results

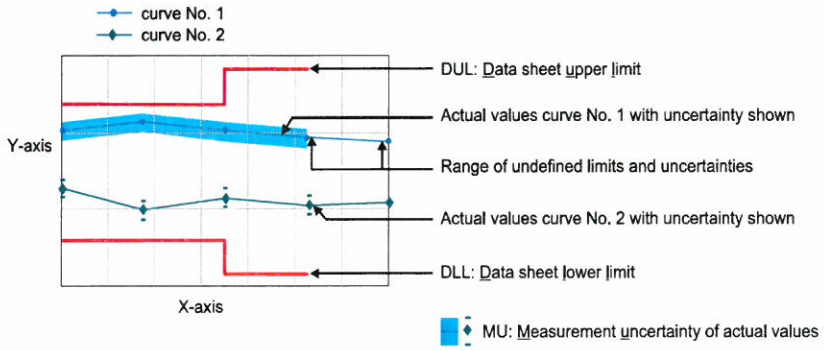
Designation:		**Network Analyzer**
Type:		**ZNB40-2Port**
Material No.:		**1311.6010K72**
Serial No.:		**101544**
Certificate No.:	**606113 D-K-15195-01-00**	**2021-08**
Referring to Test Documentation:		**1311.6010.01-PB-10.03**

Test Department:	**3MES2**
Name:	**see certificate**
Date:	**2021-08-04**

The following abbreviations may be used in this document

{a}	No measurement uncertainty stated because the errors always add together. So it is sure that a measurement result evaluated as "PASS" is pass.
{b}	The measurement uncertainty depends on the measurement result. The stated measurement uncertainty is valid for the close area around the specification. Measurement results outside the close area have a higher measurement uncertainty but are within the specification.
{c}	Functional test, therefore no measurement uncertainty is stated.
{d}	Typical value, refer to performance test.
{e}	The measurement uncertainty is taken into account when setting the measuring system.
{f}	Verification of specified requirements. Technical operation that consist of the determination of one or more characteristics to a specified procedure.
DL or DT	Data Limit for symmetrical tolerance limits
DLL	Datasheet Lower Limit
DUL	Datasheet Upper Limit
MU	Symmetrical Measurement Uncertainty
MLL or MLV	Measurement Uncertainty Lower Value
MUL or MUV	Measurement Uncertainty Upper Value
Nom.	Nominal Value
Dev.	Deviation
Act.	Actual Value
UGB	Uncertainty Guard Band: Measuring uncertainty violates the data (spec.) limit.
UGB1	A compliance statement may be possible where a confidence level of less than 95 % is acceptable.
UGB2	A non-compliance statement may be possible where a confidence level of less than 95 % is acceptable.
DU	Datasheet Uncertainty

Explanation of charts



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Software used for measurement			
Item	**Type**	**Version**	**Remark**
7010.9063.00_.G5LIM	Limit File	2019-12-04 12:15	
Suite	Setup	V12.16	Test Management Software G5
Test Program (7010.9063.00_)	Component	V04.96	

1. Connector gauge

Connector	Port	DLL	DUL	Actual	MU
2.92 mm (male)	1	-40 µm	0 µm	-2 µm	1 µm
2.92 mm (male)	2	-40 µm	0 µm	-4 µm	1 µm

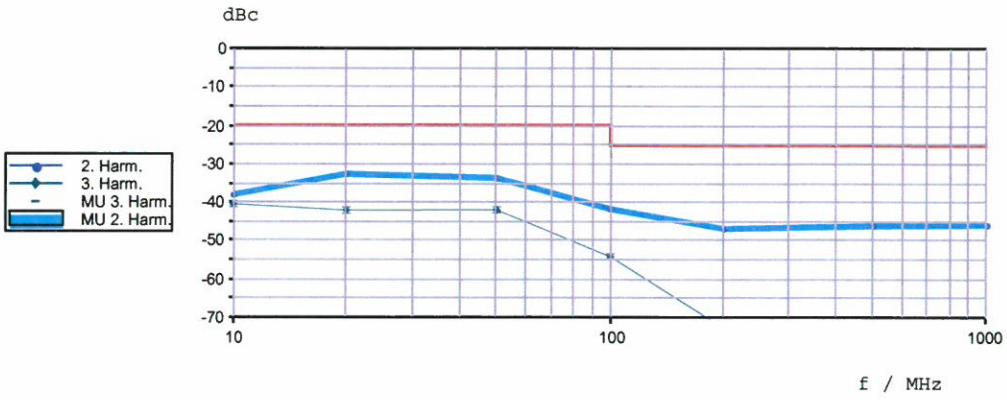
2. Static frequency accuracy

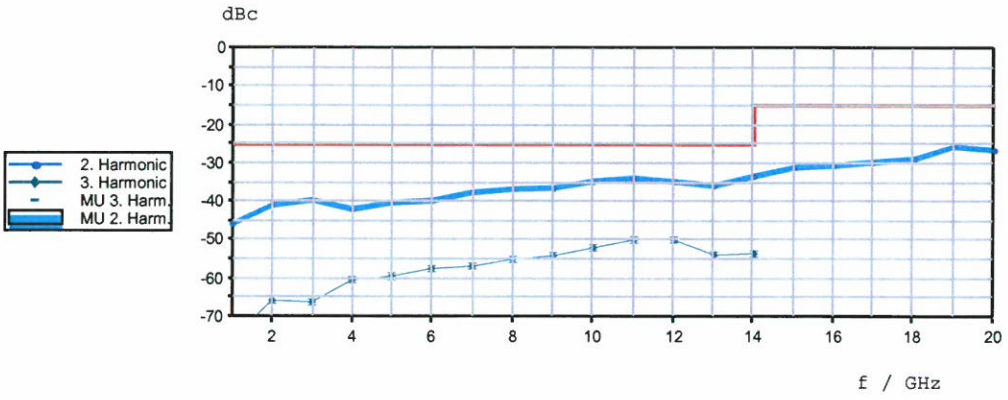
Frequency	Max. Deviation	Actual Deviation	MU
1 GHz	+/- 500 Hz	-394 Hz	1 Hz

3. Output harmonics

3.1 Harmonics PORT1

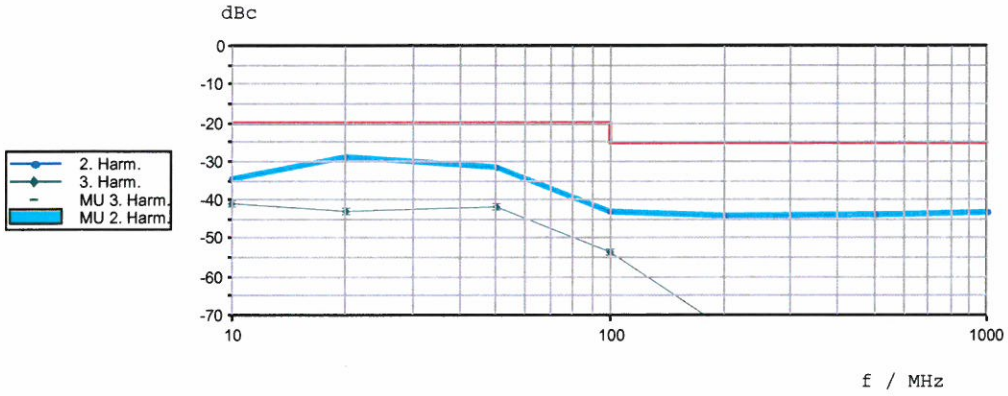
Source power level = 0 dBm, measurement uncertainty: {b}

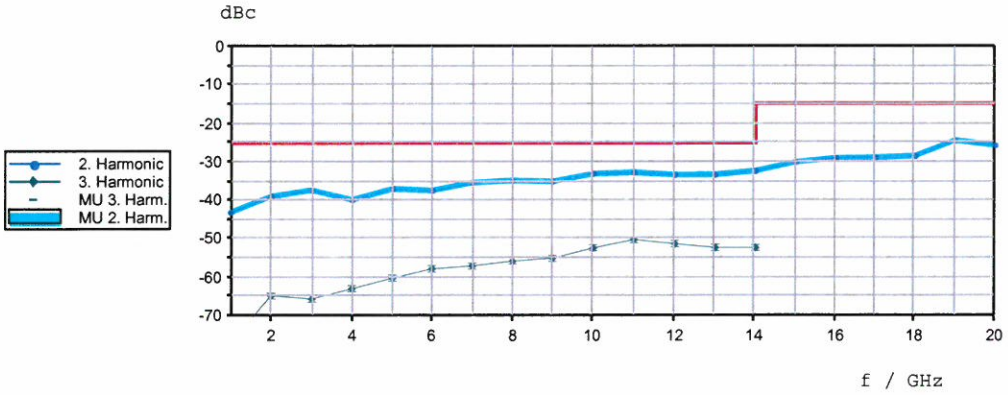




3.2 Harmonics PORT2

Source power level = 0 dBm, measurement uncertainty: {b}

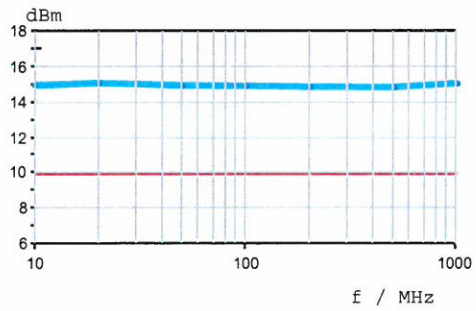


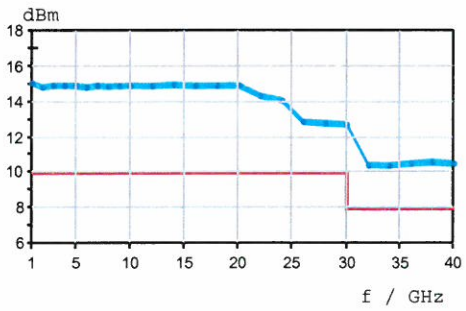


4. Maximum output power

4.1 Maximum output power PORT1

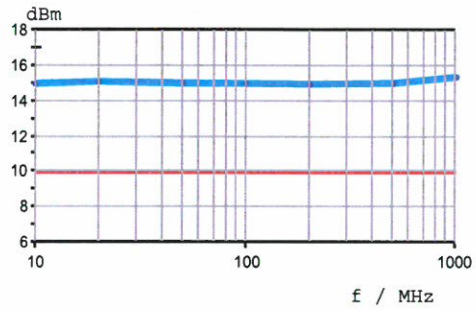
Power setting: +15 dBm

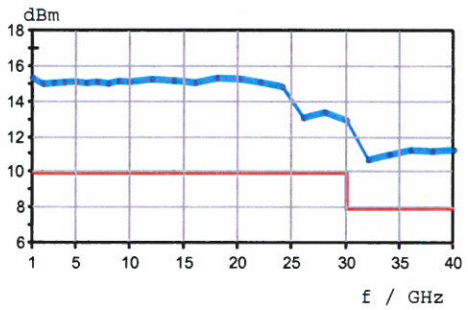




4.2 Maximum output power PORT2

Power setting: +15 dBm

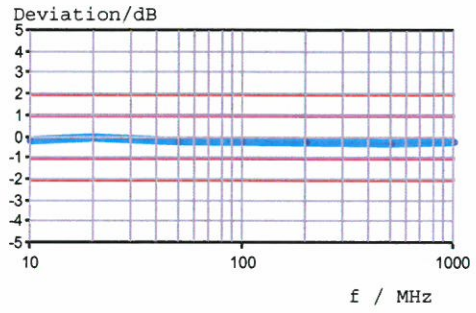


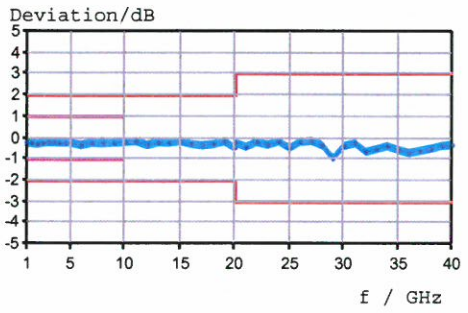


5. Accuracy of output power

5.1 Accuracy of output power PORT1

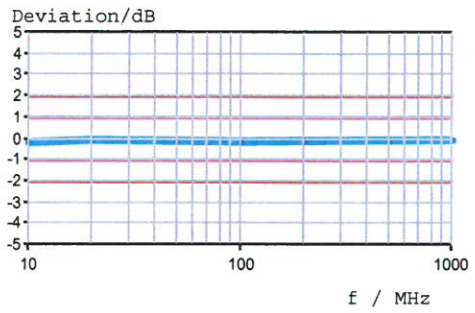
Source power = -10 dBm

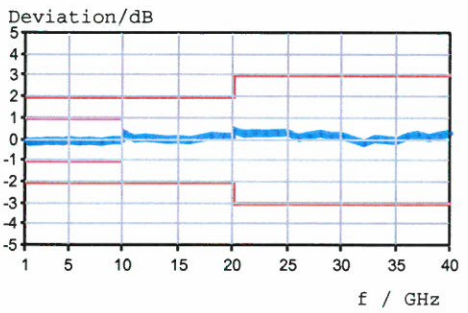




5.2 Accuracy of output power PORT2

Source power = -10 dBm

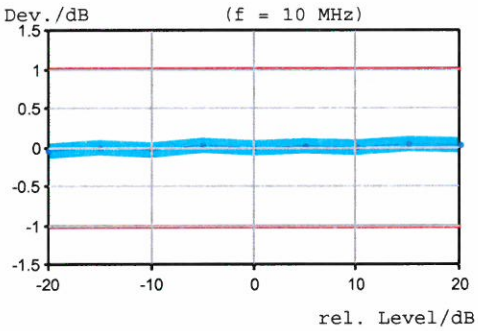


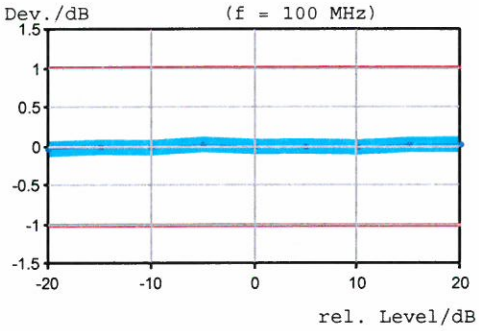


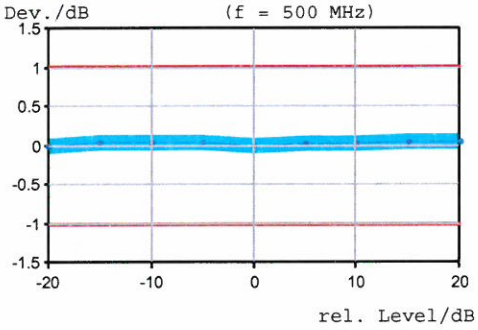
6. Output level linearity

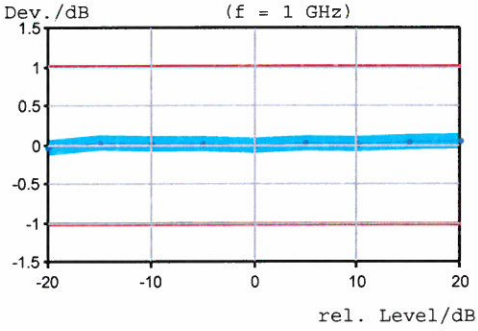
6.1 Output level linearity PORT1

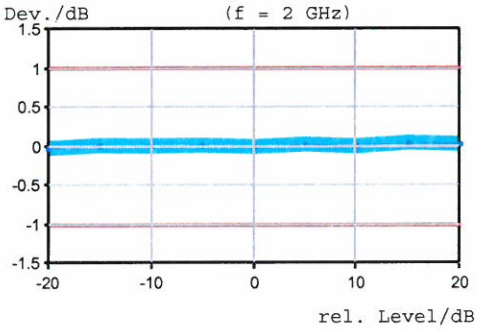
Reference level = -10 dBm

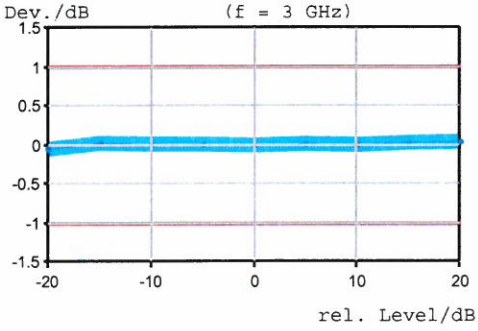


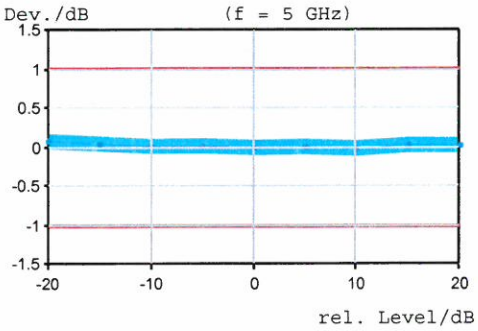


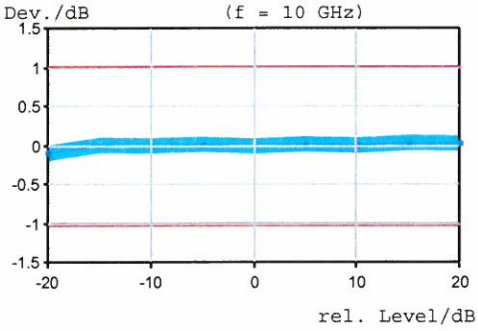


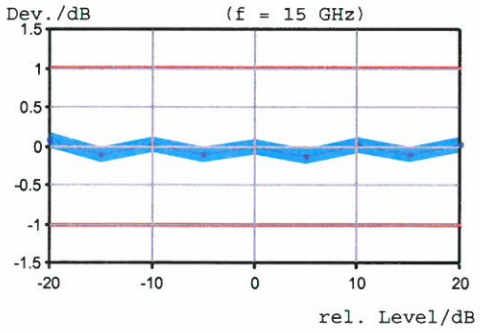


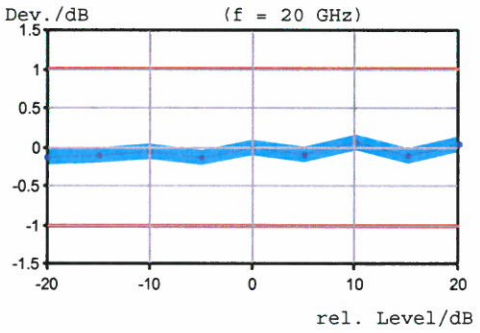


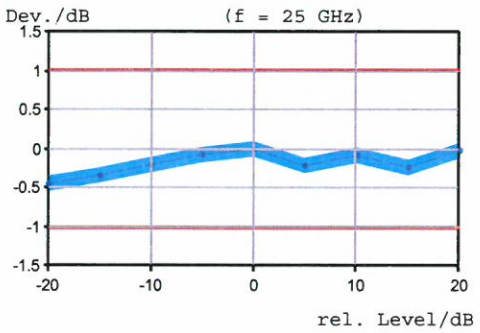


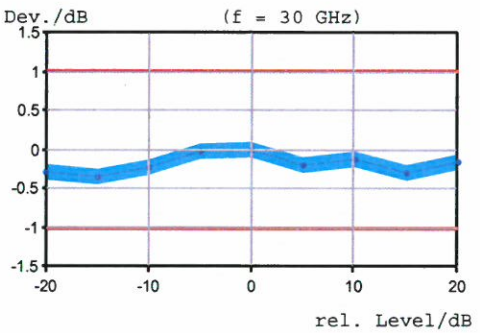


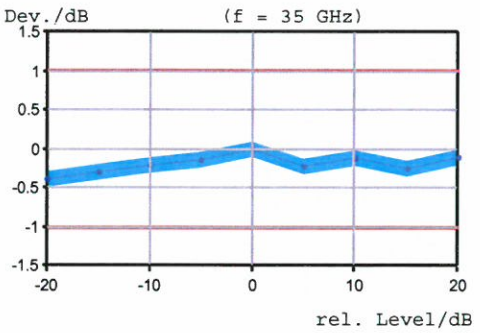


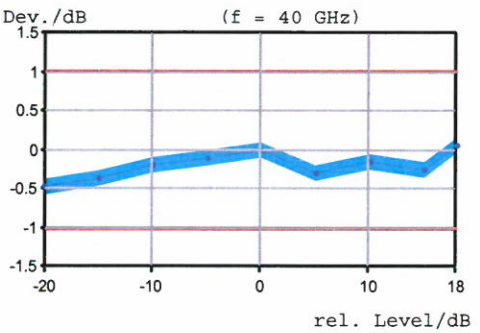






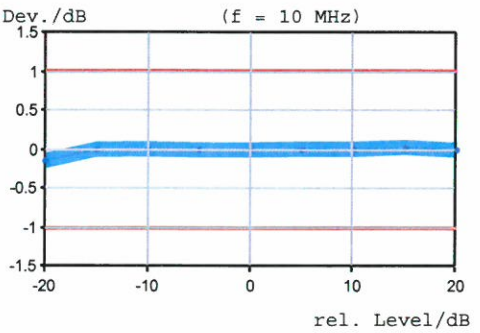


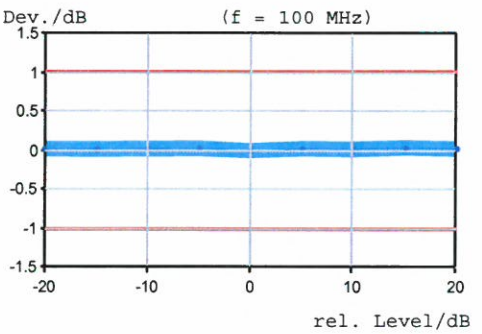


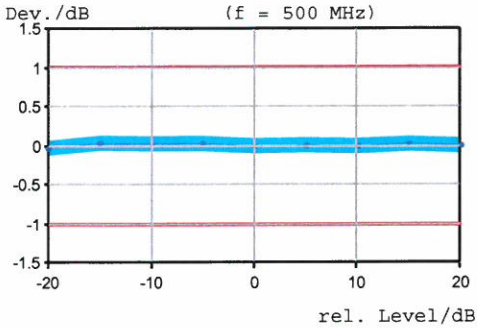


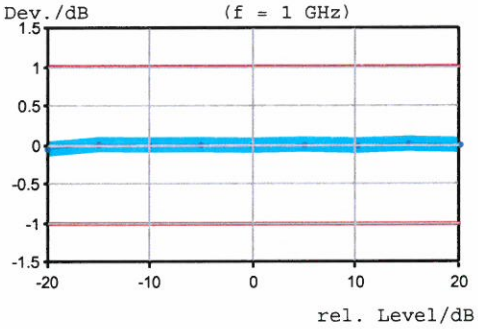
6.2 Output level linearity PORT2

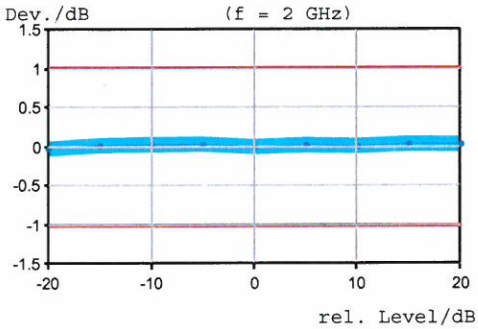
Reference level = -10 dBm

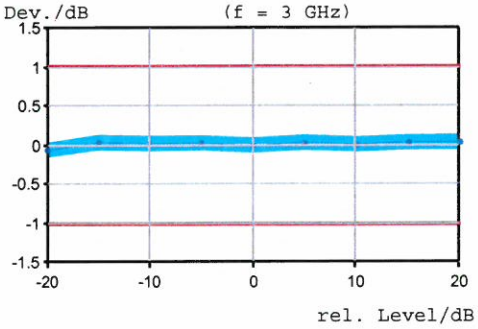


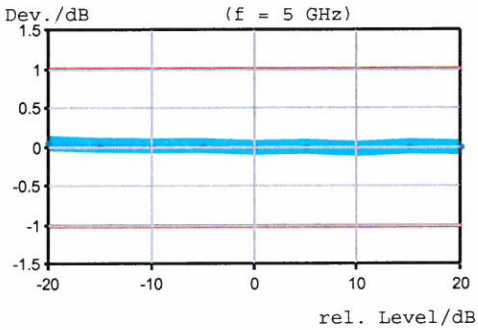


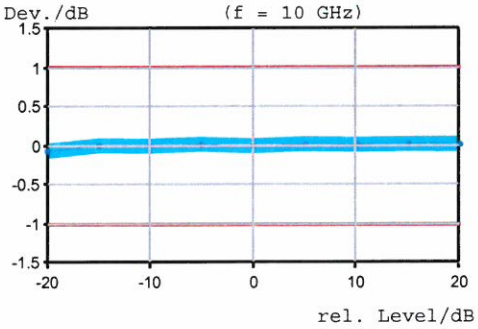

Dev./dB
(f = 500 MHz)
1.5
1
0.5
0
-0.5
-1
-1.5
-20
-10
0
10
20
rel. Level/dB

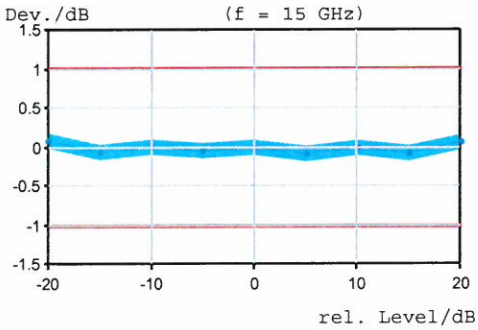

Dev./dB
(f = 1 GHz)
1.5
1
0.5
0
-0.5
-1
-1.5
-20
-10
0
10
20
rel. Level/dB

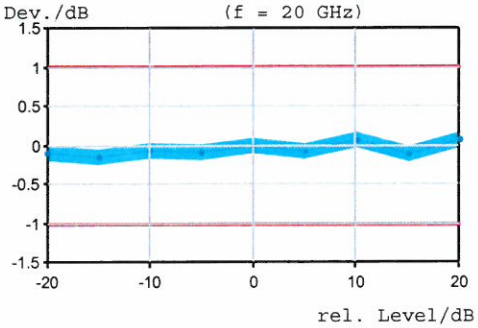

Dev./dB
(f = 2 GHz)
1.5
1
0.5
0
-0.5
-1
-1.5
-20
-10
0
10
20
rel. Level/dB

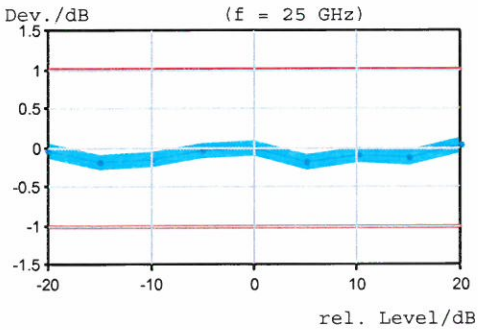

Dev./dB
(f = 3 GHz)
1.5
1
0.5
0
-0.5
-1
-1.5
-20
-10
0
10
20
rel. Level/dB

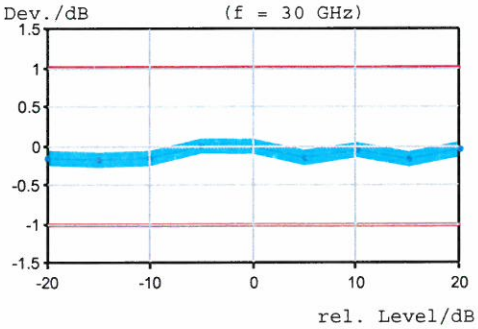

Dev./dB
(f = 5 GHz)
1.5
1
0.5
0
-0.5
-1
-1.5
-20
-10
0
10
20
rel. Level/dB

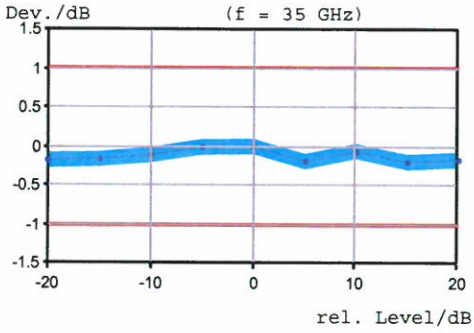

Dev./dB
(f = 10 GHz)
1.5
1
0.5
0
-0.5
-1
-1.5
-20
-10
0
10
20
rel. Level/dB

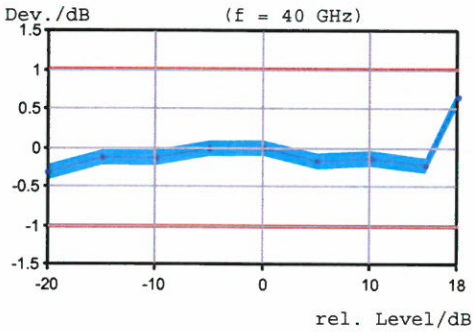

Dev./dB
(f = 15 GHz)
1.5
1
0.5
0
-0.5
-1
-1.5
-20
-10
0
10
20
rel. Level/dB


Dev./dB
(f = 20 GHz)
1.5
1
0.5
0
-0.5
-1
-1.5
-20
-10
0
10
20
rel. Level/dB


Dev./dB
(f = 25 GHz)
1.5
1
0.5
0
-0.5
-1
-1.5
-20
-10
0
10
20
rel. Level/dB


Dev./dB
(f = 30 GHz)
1.5
1
0.5
0
-0.5
-1
-1.5
-20
-10
0
10
20
rel. Level/dB

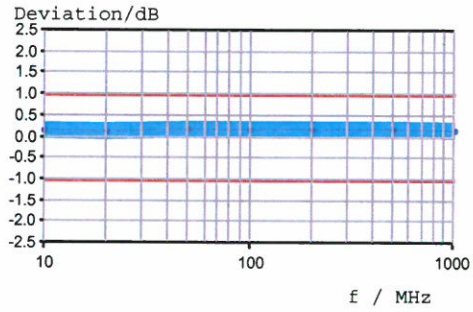


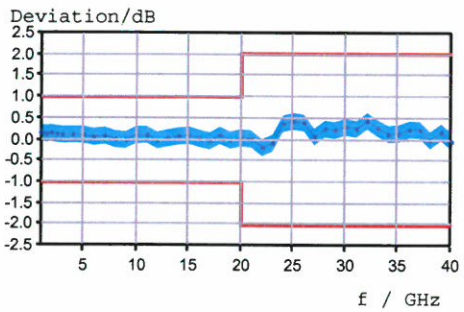


7. Input power measurement accuracy

7.1 Input power measurement accuracy PORT1

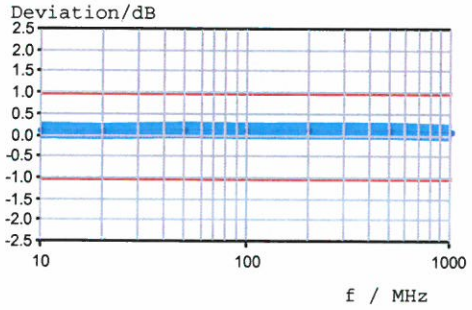
Test level = -10 dBm

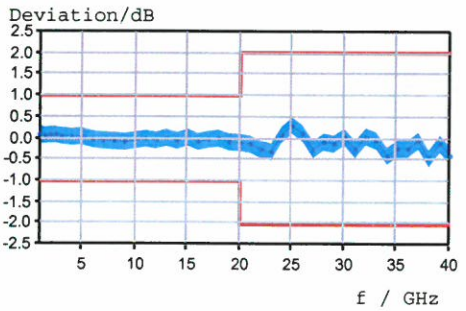




7.2 Input power measurement accuracy PORT2

Test level = -10 dBm

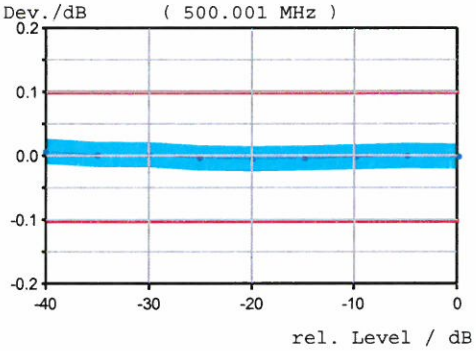




8. Input power linearity (low level)

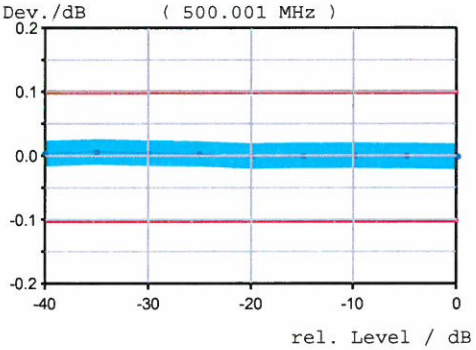
8.1 Input power linearity (low level) PORT1

Refered to a nominal input power level of -10 dBm



8.2 Input power linearity (low level) PORT2

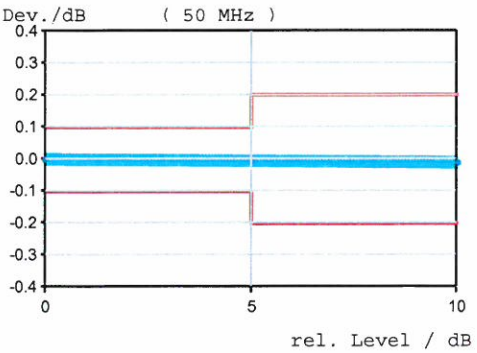
Refered to a nominal input power level of -10 dBm

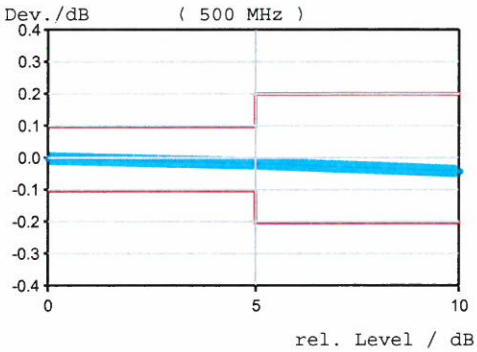


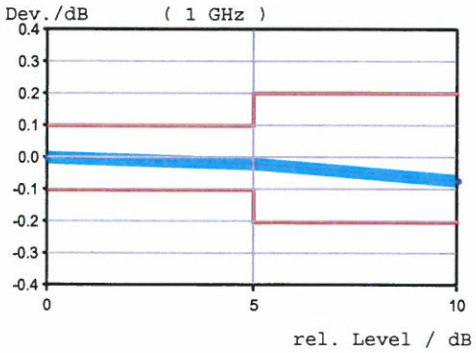
9. Input power linearity (high level)

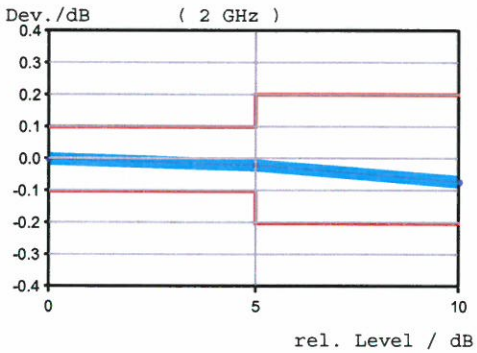
9.1 Input power linearity PORT1 (high level)

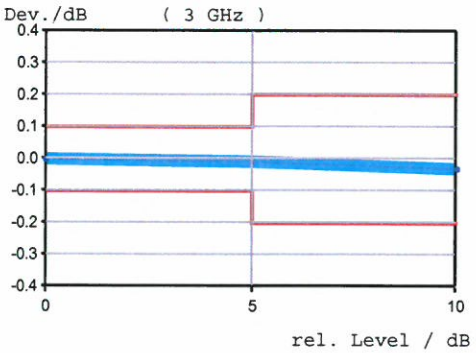
Refered to a nominal input power level of -10 dBm

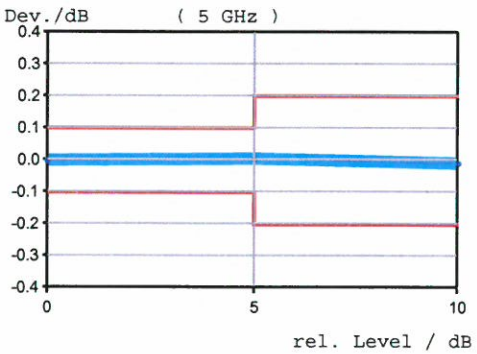


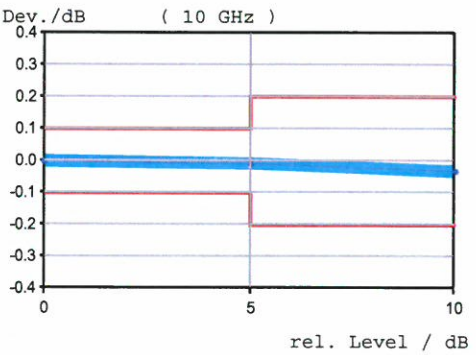


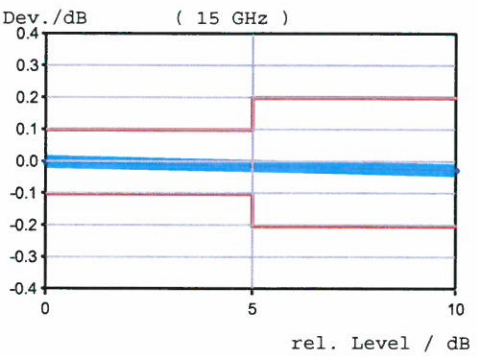

Dev./dB
(1 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB

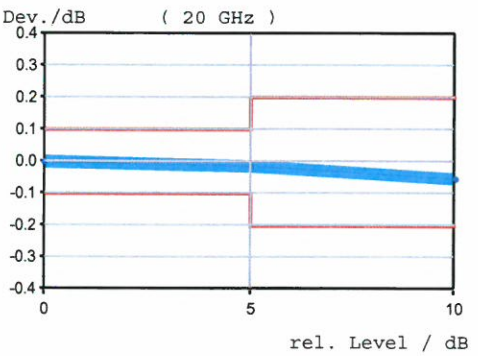

Dev./dB
(2 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB

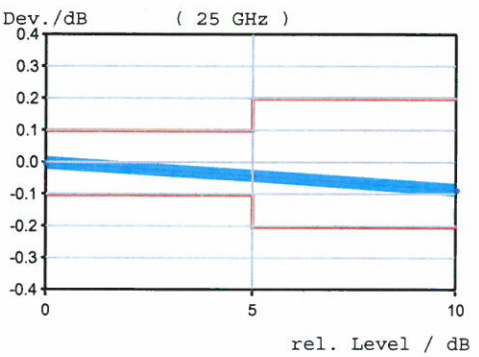

Dev./dB
(3 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB

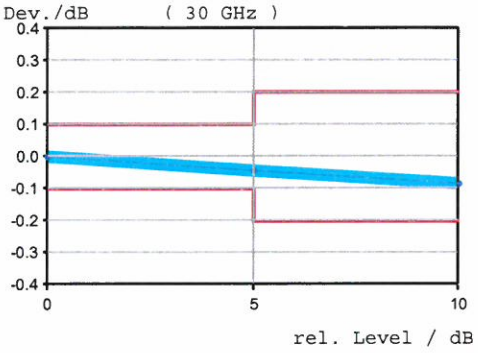

Dev./dB
(5 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB

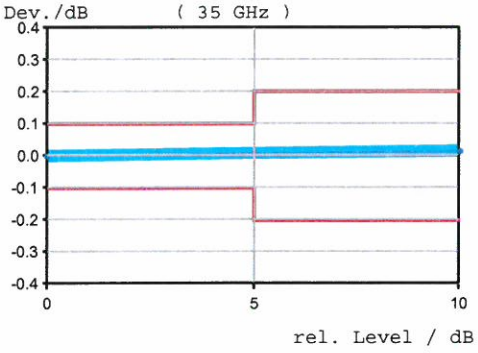

Dev./dB
(10 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB

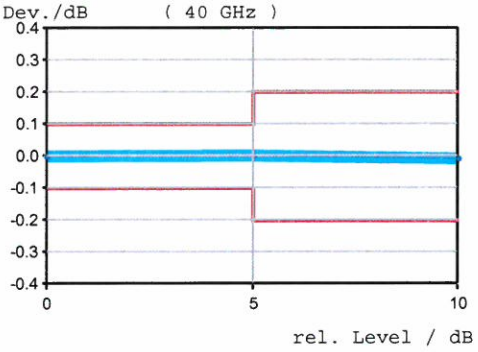

Dev./dB
(15 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB


Dev./dB
(20 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB


Dev./dB
(25 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB

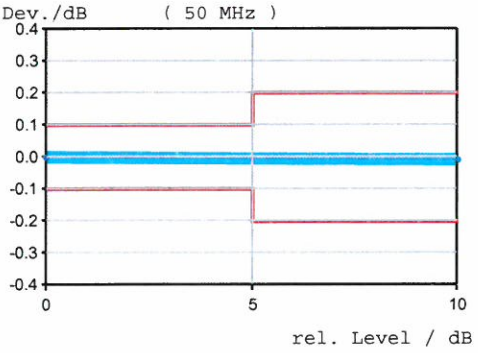


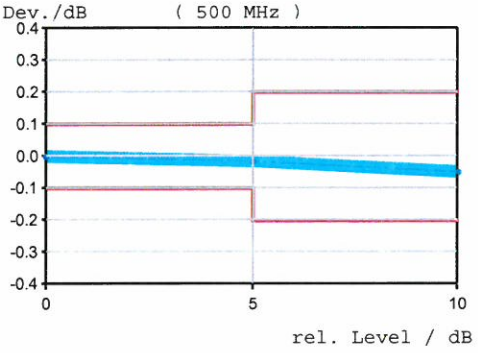


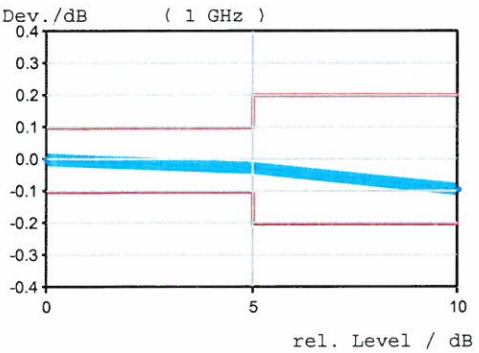


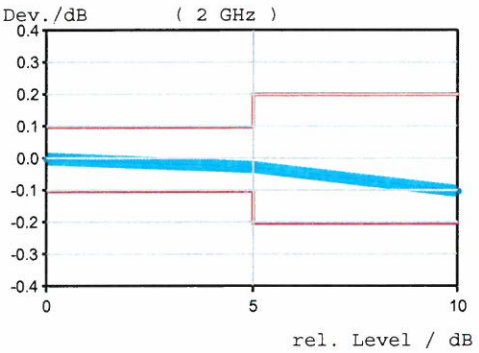
9.2 Input power linearity PORT2 (high level)

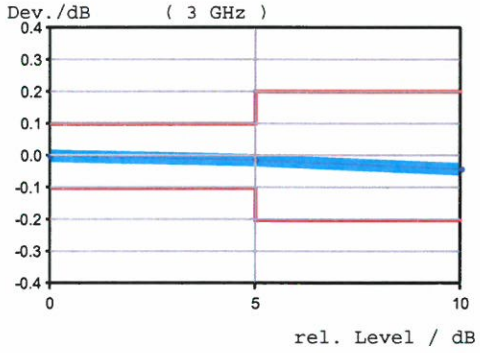
Refered to a nominal input power level of -10 dBm

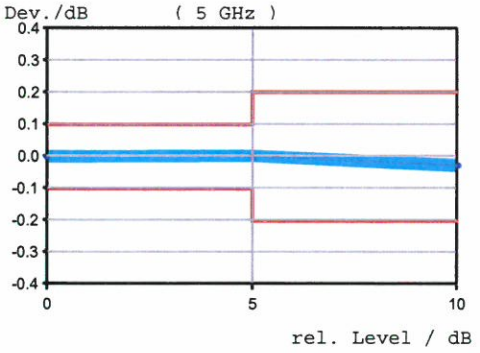


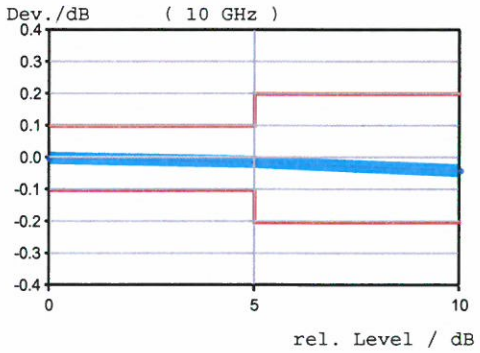


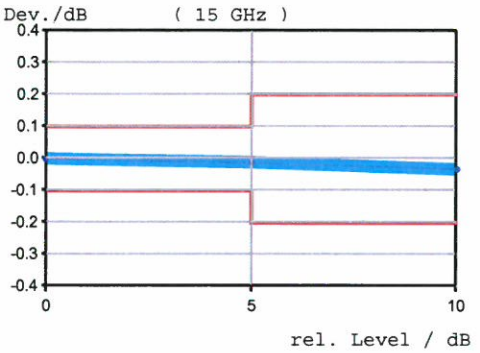


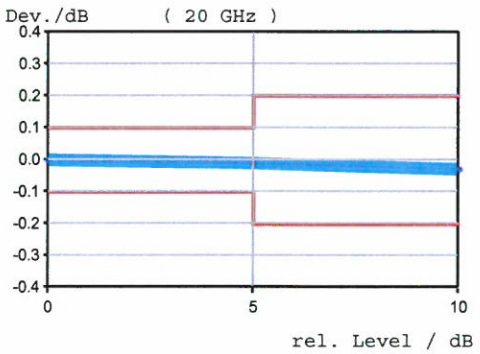


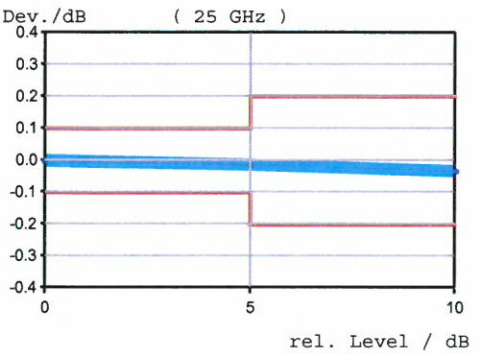

Dev./dB
(3 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB

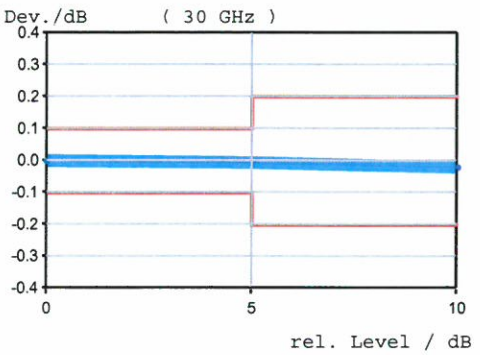

Dev./dB
(5 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB

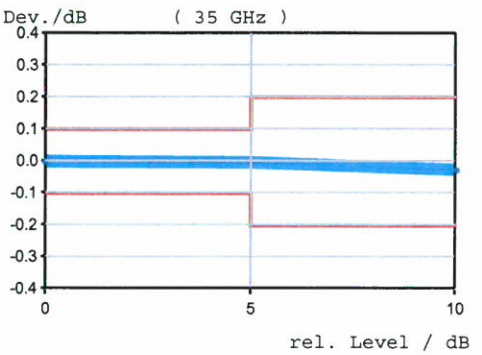

Dev./dB
(10 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB

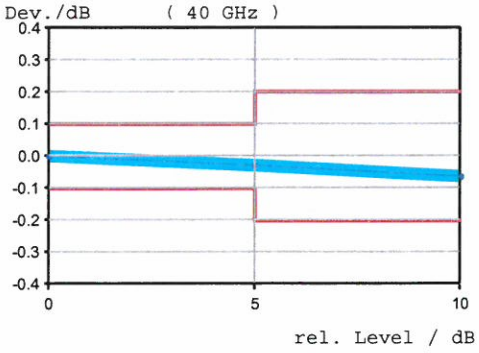

Dev./dB
(15 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB


Dev./dB
(20 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB


Dev./dB
(25 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB


Dev./dB
(30 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB

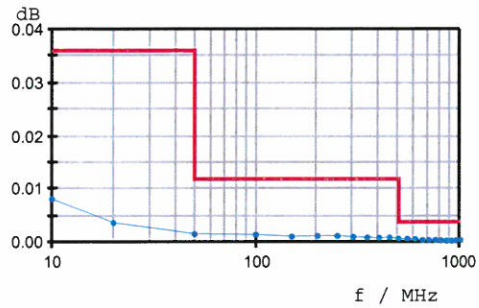

Dev./dB
(35 GHz)
0.4
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
0
5
10
rel. Level / dB

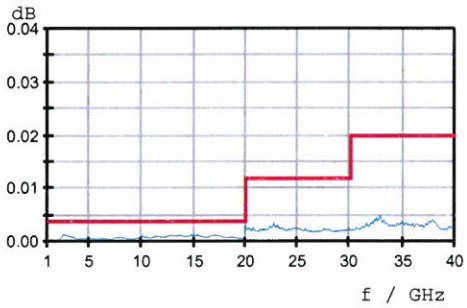


10. Trace noise magnitude

10.1 Trace noise magnitude PORT1

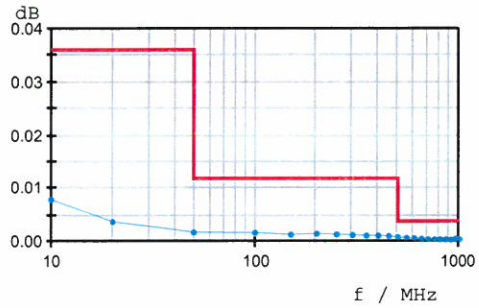
Measurement: S11 total reflection RMS StdDev, CW mode, source power = 0 dBm, points = 201, BW = 1 kHz (f < 100 kHz), BW = 10 kHz (f >= 100kHz), MU: {c}

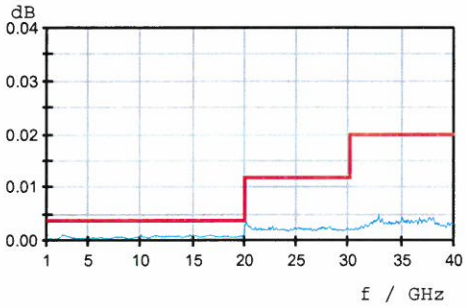




10.2 Trace noise magnitude PORT2

Measurement: S22 total reflection RMS StdDev, CW mode, source power = 0 dBm, points = 201, BW = 1 kHz (f < 100 kHz), BW = 10 kHz (f >= 100kHz), MU: {c}

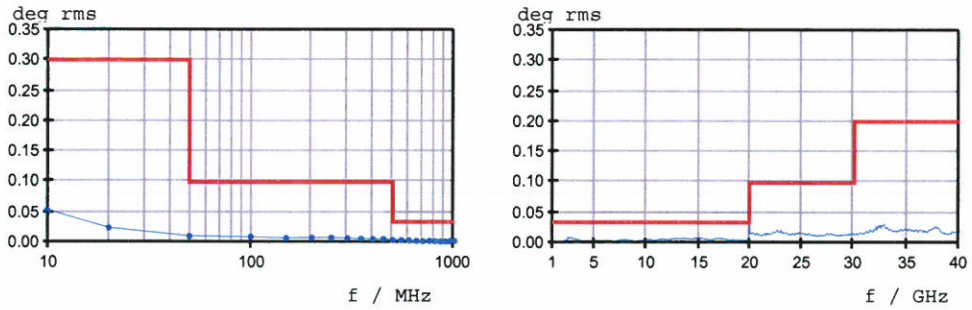




11. Trace noise phase

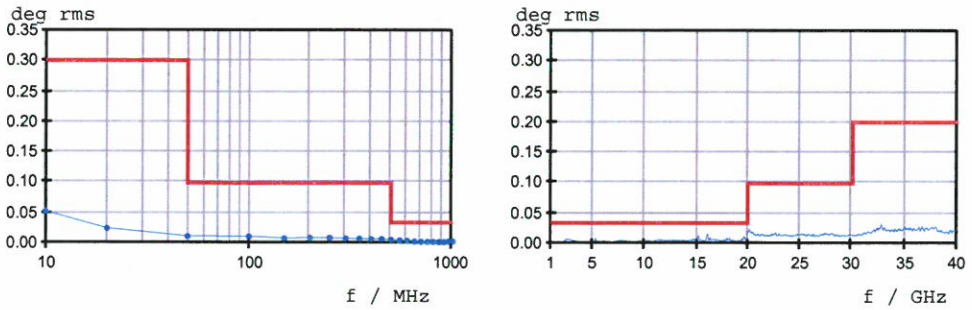
11.1 Trace noise phase PORT1

Measurement: S11 total reflection RMS StdDev, CW mode, source power = 0 dBm,
points = 201, BW = 1 kHz (f < 100 kHz), BW = 10 kHz (f >= 100kHz), MU: {c}



11.2 Trace noise phase PORT2

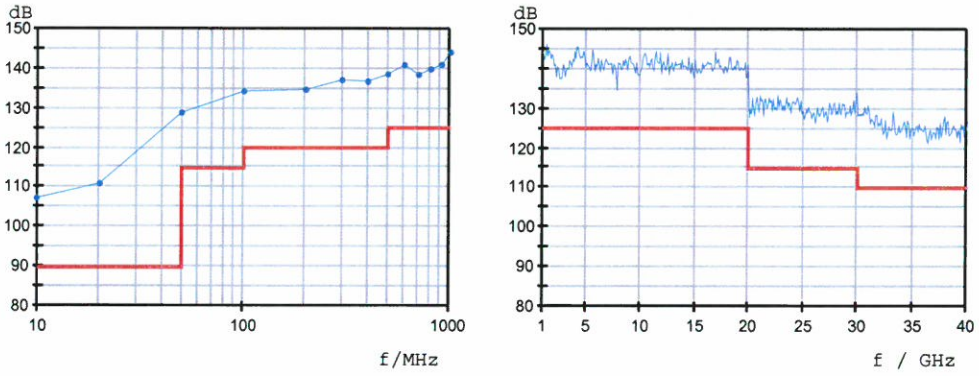
Measurement: S22 total reflection RMS StdDev, CW mode, source power = 0 dBm,
points = 201, BW = 1 kHz (f < 100 kHz), BW = 10 kHz (f >= 100kHz), MU: {c}



12. Dynamic range

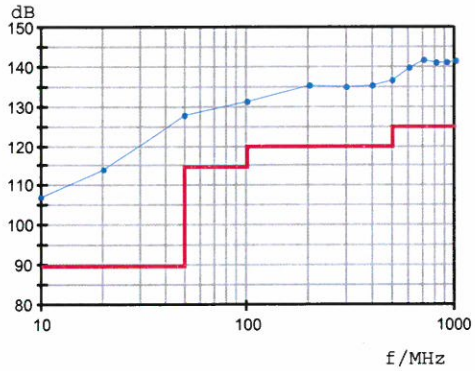
12.1 Dynamic range S21

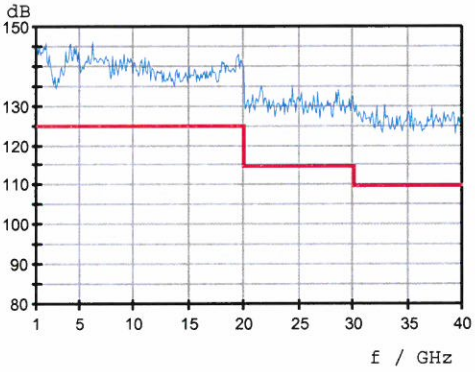
Measurement: S21, source power: 20 dBm, all ports are terminated by SHORTs, MU: {a}



12.2 Dynamic range S12

Measurement: S12, source power: 20 dBm, all ports are terminated by SHORTs, MU: {a}





13. Rear connectors and signals

13.1 Reference output

DLL	DUL	Actual	MU
+5 dBm	+13 dBm	7.7 dBm	0.3 dB

14. BIAS - functional test

DC input voltage = 10 V

Test point	Max. deviation	Actual	MU
Input (BNC) 1	+/-0.1 V	0.00 V	0.01 V
Output Port 1	+/-0.1 V	0.00 V	0.01 V
Input (BNC) 2	+/-0.1 V	0.00 V	0.01 V
Output Port 2	+/-0.1 V	0.00 V	0.01 V