Rosenberger

Calibration Services

Application Note AN 001

The Rosenberger calibration laboratory offers two types of calibration services, the **Factory Calibration** and the **Accredited Calibration**.

Products

- Calibration Kit
- Calibration Standard
- Verification Kit
- Verification Standard
- Traceability Kit
- Traceability Standard
- Attenuator
- Connector Gauge
- Torque Wrench (Calibration Kit type)

Each of the above mentioned products comes with a Factory Calibration Certificate when explicitly mentioned in the specific datasheet. Measurement results and uncertainties are included.

Optional delivery is the Accredited Calibration. In this case the product is calibrated in the Rosenberger calibration laboratory that is accredited by the German accreditation body DAkkS (Deutsche Akkreditierungsstelle) according to DIN EN ISO 17025. Calibration Certificates issued by an accredited calibration laboratory are worldwide accepted to demonstrate that measurement results are traceable to national / international standards.

Dimensional- and mechanical measurements and the calibration of Sliding Loads are not available under the Rosenberger DAkkS accreditation. If these devices are delivered as part of a calibration kit and an accredited calibration was ordered a separate Factory Calibration Certificate is issued.

The following tables show in detail the standard technical services and the documents that are included if a Factory Calibration or the optional Accredited Calibration is ordered. Other services and documents are available on request.

For some products a Testing can be offered if a calibration is not needed.

Calibration Services

Application Note AN 001

Connector	Accredited Calibration (optional)	Factory Calibration (standard)	Traceable to national/international standards	Traceable to Rosenberger standards
RPC-N 50 Ohm (N 50 Ohm)	+	+	+	
RPC-N 75 Ohm (N 75 Ohm)	+	+	+	
RPC-3.50 (3.5 mm)	+	+	+	
RPC-2.92 (2.92 mm)	+	+	+	
7-16	+	+	+	
RPC-2.40 (2.4 mm)	(+)	+	+	
RPC-1.85 (1.85 mm)	(+)	+	+	
7 mm	(+)	+	+	
RPC-1.35 (1.35 mm)	-	+	+	
SMP	-	+		+
Mini SMP	-	+		+
PSMP	-	+		+
RPC-TNC (TNC) [IEC 61169-26]	-	+		+
BNC 50 Ohm	-	+		+
BNC 75 Ohm	-	+		+
4.3-10	-	+		+
4.1-9.5	-	+		+
RPC-SP (BMA)	-	+		+
QMA	-	+		+
F	-	+		+

(+) : subcontracted to another DAkkS accredited calibration laboratory:

Calibration Kits and single Calibration Standards
Kalibrier Kits und einzelne Kalibrierstandards

Services performed on new devices
Leistungen bei Neuteilen

	Factory Calibration *Werkskalibrierung*	Accredited Calibration *Akkreditierte Kalibrierung*	Testing
Visual Inspection *Optische Kontrolle*	X	X	X
Gauging No documented values *Prüfung der Anschlußmaße* *Keine Messwertdokumentation*	X	X	X
Electrical measurements *Elektrische Messungen* Open, Short Load, Thru, Adapter, Mismatch Coaxial orientation	**Measurands** Phase Return Loss 1	**Measurands** Phase and Return Loss Phase and Return Loss 4	**Measurands** Phase Return Loss 1
Electrical measurements *Elektrische Messungen* Sliding Load	**Measurand** Effective Return Loss *2	Not available *1	Not available
Dimensional measurements *Mechanische Messungen* Air Line:	**Measurands** Length and Diameter of inner and outer conductor	Not available *1	Not available
Dimensional measurements *Mechanische Messungen* Gauge	**Measurand** Gauge error (at two significant recessions)	Not available *1	Not available
Mechanical measurements *Mechanische Messungen* Torque Wrench	**Measurand** Torque	Not available *1	Not available
Measurement frequencies *3 Messfrequenzen	100 MHz steps *4	100 MHz steps *4	100 MHz steps *4
Model Based Standard Definitions	Individual optimized	Individual optimized	General values
Data Based Standard Definitions	X *5	X	Not available

*1 Not under DAkkS accreditation. Separate Factory Calibration Certificate.
Nicht unter DAkkS Akkreditierung. Getrennter Werkskalibrierschein.
*2 Acc. EURAMET cg-12, Version 2.0 (03/2011), chapter 6.2.1. Sliding Load specific frequency range.
Gem. EURAMET cg-12, Version 2.0 (03/2011), Kapitel 6.2.1. Sliding Load spezifischer Frequenzbereich.
*3 Other frequencies on request. Lowest available frequency is 9 kHz.
Andere Frequenzen auf Anfrage. Die niedrigste mögliche Frequenz beträgt 9 kHz.
*4 Maximum Kit frequency:
Up to 4 GHz: 25 MHz to max Kit frequency in 25 MHz steps, e.g. BNC
Up to 12 GHz: 50 MHz to max Kit frequency in 50 MHz steps, e.g. 4.3-10
Bis 4 GHz: 25 MHz bis zur maximalen Kit Frequenz in 25 MHz Schritten, z.B. BNC
Bis 12 GHz: 50 MHz bis zur maximalen Kit Frequenz in 50 MHz Schritten, e.g. 4.3-10
*5 Only for series RPC-1.35 Open, Short and Load standards.
Nur für Serie RPC-1.35 Open, Short und Load Standards.

Documentation
Dokumentation

	Factory Calibration *Werkskalibrierung*	Accredited Calibration *AkkreditierteKalibrierung*	Testing
Document Title *Bezeichnung*	„Kalibrierschein / Calibration Certificate“	“Kalibrierschein / Calibration Certificate”	“Certificate of Testing”
Printed Measurement Values incl. filing *Ausgedruckte Messwerte inkl. Archivierung*	X	X	Not available
TabularMeasurementValues Measurement Uncertainties Data Sheet Specification Limits Compliance Statements *6, *7 *Tabellarische Messergebnisse* *Messunsicherheiten* *Datenblatt Spezifikationsgrenzen* *Konformitätsaussage* *6, *7	Open, Short (Phase) Load, Thru, Adapter, Mismatch (Return Loss) In 1 GHz steps	Open, Short (Phase) Load, Thru, Adapter, Mismatch (Return Loss) In 1 GHz steps	Not available
Graphical Measurement Values *Grafische Messergebnisse*	Open, Short (Phase Error) Load, Thru, Adapter, Mismatch (Return Loss) All Measurement frequencies	Open, Short (Phase Error) Load, Thru, Adapter, Mismatch (Return Loss) All Measurement frequencies	Not available
Tabular Measurement Values and Measurement Uncertainties *Tabellarische Messergebnisse und Messunsicherheiten*		Open, Short, Load, Thru, Adapter, Mismatch (Return Loss + Phase) All Measurement frequencies	Not available
Graphical Measurement Values *Grafische Messergebnisse*	Sliding Load (Effective Return Loss *2)	Not available *1	Not available
Tabular Measurement Values Measurement Uncertainties *Tabellarische Messergebnisse* *Messunsicherheiten*	Air Line, Gauge (Dimensional measurands) Torque Wrench (Mechanical measurands)	Not available *1	Not available
Specification Limits *Spezifikationsgrenzen*	See above	See above	General information

*6 Factory Calibration: Details are described in chapter „Decision Rule“
Werkskalibrierung: Details sind im Kapitel „Entscheidungsregel” beschrieben
*7 Accredited Calibration: Details are described in chapter „Decision Rule“
Akkreditierte Kalibrierung: Details sind im Kapitel „Entscheidungsregel” beschrieben

	Factory Calibration Werkskalibrierung	Accredited Calibration AkkreditierteKalibrierung	Testing
Description of the measurement method *Beschreibung des Messverfahrens*	X	X	Not available
Traceability Information Angabe der Rückführbarkeit	X	X	X
List of Working Standards used *Liste der Gebrauchsnormale*	X	*8	X
Service Report *Servicebericht*	X	X	Not available
Calibration Label *Kalibrieraufkleber*	„Calibrated“	DAkkS specific *7	Not available
Actual Standard Definition Cards with optimized Model Based Standard Definitions Aktuelle Standard Definition Cards mit optimierten Model Based Standard Definitions	X	X	Not available
USB stick with Standard Definitions *9 USB Stick mit Standard Definitions *9	Model based *10 + Data based *5	Model based + Data based	Not available

*8 According to the sample Calibration Certificate structure in DAkkS Guideline 71 SD 0 025 no List of Working Standards is used
Gemäß der Struktur des Musterkalibrierscheins in der DAkkS-Richtlinie 71 SD 0 025 wird keine Liste der Gebrauchsnormale verwendet

*9 Keysight/ Agilent PNA family and R&S ZVA, ZNB family. Other VNAs on request.
Keysight/ Agilent/ PNA Familie und R&S ZVA, ZNB Familie. Andere VNAs auf Anfrage.

*10 For Calibration Kits and single Attenuators, other single Calibration Standards are without USB-stick.
Für Kalibrier Kits und einzelne Dämpfungsglieder, andere einzelne Kalibrier-Elemente sind ohne USB-Stick.

Re-Calibrations
Re-Kalibrierungen

The Calibration Services described are not only available for new Rosenberger products but also as Re-Calibrations of products from Rosenberger and other manufacturers.

Additional Services at a Re-Calibration
Weitere Leistungen einer Re-Kalibrierung

	Factory Calibration Werkskalibrierung	Accredited Calibration Akkreditierte Kalibrierung	Testing
Cleaning *Reinigung*	X	X	X
Visual inspection: mating planes, connector pins, contact fingers Optische Kontrolle: Kontaktflächen, Stecker Pins, Kontaktlamellen	X	X	X
Incoming status: measurements before adjustment, repair or replacement, if possible. *Anlieferzustand: Messungen vor Justierung, Reparatur oder Austausch, falls möglich.*	X	X	Not available

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Statements of Conformity
Konformitätsbewertung

The new ISO/IEC 17025:2017 standard [1] includes some noteworthy changes regarding reporting statements of conformity (chapter 7.8.6). In comparison to the previous version, the laboratory shall document the decision rule employed, taking into account the level of risk (such as false accept and false reject and statistical assumptions). The following paragraphs provide detailed information about the decision rule and conformance probability.

Decision Rule
Entscheidungsregel

Factory Calibration:

Measurement results and their corresponding uncertainties are reported in the calibration certificate. In addition, compliance with specification is also stated. However, measurement uncertainties are not taken into account. If the measured value is at or within specification limits the status of compliance is reported as “Pass”, otherwise the compliance status is reported as “Fail”.

Accredited Calibration:

Measurement results and their corresponding uncertainties are reported in the calibration certificate. Additionally, compliance with specification is also stated according to ILAC-G8:03/2009 [3].
The statement of compliance is based on a 95 % coverage probability for the expanded uncertainty and reported as follows:

Pass	Case 1 (ILAC-G8:03/2009)	Compliance
*	Case 2 (ILAC-G8:03/2009)	It is not possible to state compliance using a 95 % coverage probability for the expanded uncertainty although the measurement result is below the limit.
**	Case 3 (ILAC-G8:03/2009)	It is not possible to state non-compliance using a 95 % coverage probability for the expanded uncertainty although the measurement result is above the limit.
Fail	Case 4 (ILAC-G8:03/2009)	Non-Compliance

Conformance Probability
Konformitätswahrscheinlichkeit

The following comments and formulas on conformance probability were taken from the BIPM document JCGM 106:2012 “Evaluation of measurement data – The role of measurement uncertainty in conformity assessment” [2].

Assume that a quantity of interest Y is measured, yielding a best estimate y and an associated standard uncertainty $u(y) = u$. Then, the probability p_c that Y lies in the interval $[T_L, T_U]$, given a normal probability density function (PDF), is

$$p_c = \Phi\left(\frac{T_U - y}{u}\right) - \Phi\left(\frac{T_L - y}{u}\right) \quad (1)$$

where $y = y(\eta_{m)}$ and

$$\Phi(z) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{z} e^{\frac{-t^2}{2}} dt \quad (2)$$

is the standard normal distribution function. For a one-sided tolerance interval with a single upper tolerance limit T_U, equation (1) reduces to

$$p_c = \Phi\left(\frac{T_U - y}{u}\right). \quad (3)$$

Similarly, the conformance probability for a one-sided tolerance interval with a single lower tolerance limit T_L, is

$$p_c = 1 - \Phi\left(\frac{T_L - y}{u}\right). \quad (4)$$

In computing coverage probabilities and conformance probabilities, one often has to evaluate integrals of normal PDFs between finite or semi-infinite limits. Such integrals as in equation (2) cannot be evaluated in closed form and are therefore evaluated numerically and tabulated. The normal distribution is also known as Gaussian distribution.

The above equations require quantities and uncertainties to be expressed in linear units. S-parameter measurement quantities and associated uncertainties expressed in logarithmic units have to be converted to linear units in order to ensure the symmetry of the coverage interval.

Figure 1 shows a one-sided tolerance interval with a single upper tolerance limit T_U.

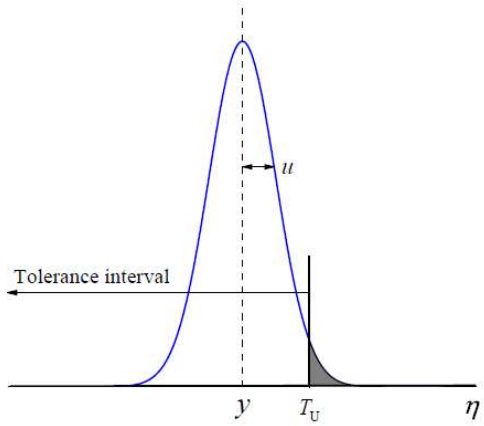

Figure 1: One-sided tolerance interval with a single upper tolerance limit T_U. Conforming values of Y lie in the interval $\eta \leq T_U$.

General considerations

Accepting or rejecting an item when the measured value of its property of interest is close to a tolerance limit may result in an incorrect decision and lead to undesirable consequences. Such incorrect decisions are generally of two kinds in the case of a single upper tolerance limit as illustrated in figure 2, outcomes (b) and (c).

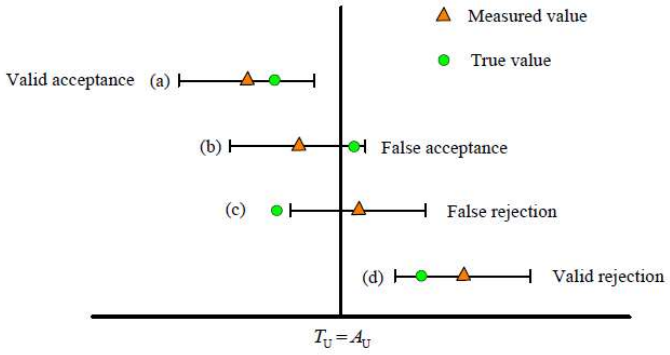

Figure 2: Simple acceptance decision rule near an upper tolerance limit T_U, with four 95 % coverage intervals.

Conformance Probability

For a given one-sided tolerance interval with a single upper tolerance limit T_U and a measurement value y with an associated standard uncertainty $u(y) = u$, the conformance probability p_c can be calculated using equation (3). The table below shows the conformance probability p_c for the four cases stated in figure 2 on the assumption that the measurand is characterized by a normal PDF.

(a)	Valid acceptance	Item accepted		$p_c \geq 97.5\ \%$
(b)	False acceptance	"Consumer's risk" R_C^*	$R_C^* = 1 - p_c$	$2.5\ \% < p_c < 97.5\ \%$
(c)	False rejection	"Producer's risk" R_P^*	$R_P^* = p_c$	$2.5\ \% < p_c < 97.5\ \%$
(d)	Valid rejection	Item rejected		$p_c \leq 2.5\ \%$

Example

The magnitude of the reflection coefficient Γ of a load is measured at the frequency of 1 GHz, yielding a best estimate $|\Gamma| = 0.033$ with associated standard uncertainty $u(|\Gamma|) = 0.005$. Specification requires $|\Gamma| \leq 0.04$. Then from equation (3), $p_c = \Phi\left(\frac{0.040-0.033}{0.005}\right) = \Phi(1.4) = 0.919$. There is a $91.9\ \%$ probability that the device conforms to specification.

References

[1] General requirements for the competence of testing and calibration laboratories (ISO/IEC 17025:2017); German and English version EN ISO/IEC 17025:2017.

[2] Joint Committee for Guides in Metrology, JCGM 106: 2012; Evaluation of measurement data – The role of measurement uncertainty in conformity assessment (BIPM, 2012), available in http://www.bipm.org/en/publications/guides/

[3] ILAC-G8:03/2009, "Guidelines on the Reporting of Compliance with Specification," International Laboratory Accreditation Cooperation (ILAC), 2009, available at http://ilac.org/publications-and-resources/ilac-guidance-series/