Radome tester
QAR50-R

Löhnert Elektronik GmbH

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Table of contents

1 Description of appliance

The QAR50-R is for measuring automotive radomes and bumpers.

The technology is based on the Rohde & Schwarz QAR 50, but has a lighter design and a shorter antenna distance.

Measurements:

- Precise reflection measurements from both sides for two frequency bands.
- Frequency-resolved reflection and transmission loss measurement.
- Measurement of the transmission phase (additional software required!).
- High-resolution reflection image (additional software required!).

2 General information

2.1 About this description

These operating instructions are for instruction purposes and are intended for persons who work on or with the product described here

Improper operation can lead to injuries or damage to property.

Make sure that you do not install and commission product until you have fully read and understood the descriptions in these operating instructions.

The operating instructions must be stored in such a way that they are always accessible to the operating company and the user. If the product is relocated, the operating instructions must also be provided.

Note!

The operating instructions must be stored in such a way that they are available at all times.

2.2 Explanation of signal words and the danger sign

This operating instructions contains specific signal words (Danger, Warning, Caution or Note) and, if necessary, a danger sign.

The signal words are intended to draw attention to the safety instructions and indicate the severity of the danger.

The danger sign (a triangle with an exclamation mark) indicates a possible danger of bodily harm.

⚠ Danger!

indicates an **actual** imminent danger.
Failure to avoid this will result
in death or serious injuries.

⚠ Warning!

indicates **possible** imminent danger.
Failure to avoid this may result
in death or serious injuries.

⚠ Caution!

indicates possible imminent danger.
Failure to avoid this may result in slight or minor injuries.

Note!

Non-observance of the instructions can cause **damage to the machine or modules.**
Also gives information about special procedures or workflows.

2.3 Version number, Amendment status

Date	Version	Name	Amendment
17/12/2024	V1.0	Schober, Hölzl, Singer, Kast	First draft
27/12/2025	V1.1	Schober	switch off supplemented

2.4 Limitation of liability

This operating instructions was created with great care. However, Löhnert Elektronik GmbH does not accept liability for any errors in these operating instructions or for the consequences thereof. Moreover, the company does not accept liability for direct or consequential damages resulting from the improper operation or from any usage other than its intended use.

The operating company is responsible for implementing the specifications, conditions, risk assessment and inspecting the implementation on the product (validation).

2.5 Warranty

The warranty is based on the conditions defined in the contract.

2.6 CE

An EU declaration of conformity in accordance with EMC and ROHS is available. This is included in the scope of delivery.

Note!

Changes are not permitted.

This invalidates the manufacturer's warranty, the manufacturer's liability and the validity of the EU Declaration of Conformity.

2.7 Intended use

The QAR50-R is designed to measure automotive radomes and bumpers using an industrial robot.

The QAR50-R is intended solely for operation on a power supply unit equipped with the control and protection devices required for the power circuit against direct and indirect contact with voltage-carrying parts.

This product is designed for industrial applications only and is intended solely for operation in non-flammable/non-explosive atmospheres.

Note!

Any other or additional use is not permitted and is therefore not in accordance with the intended use. The manufacturer is not liable for any resulting damage. All risks shall be borne by the operating company.

Using the system as intended includes observing the operating instructions and safety measures.

2.8 Non-intended use

Non-intended use includes, but is not limited to:

- Any structural, technical or electrical modifications
- Non-intended use outside the areas described in these operating instructions.
- Use that deviates from the technical data.

2.9 Copyright protection

This manual is protected by copyright and is intended for internal use only.

This operating manual may not be passed on to third parties, reproduced in any form or by any means - even in extracts - or used and/or communicated to third parties without the written consent of the manufacturer, except for internal purposes.

Infringements are subject to compensation for damages. We reserve the right to assert further claims.

Note!

The content, texts, drawings, pictures and other representations are protected by copyright and are subject to industrial property rights.

Any improper use is punishable by law.

3 Explanation of terms

3.1 Qualified electrician

"A qualified electrician is a person who, on the basis of their technical training, knowledge and experience as well as knowledge of the relevant standards, is able to assess the work assigned to them and recognise possible danger.

Several years of activity in the relevant field of work, documented with an examination in theory and practice, can also be used to assess the technical training." (DGUV Regulation 3 or DIN VDE 0105-100)

The professional qualification as a skilled electrician is usually proven by the successful completion of training, e.g. as an electrical engineer, electrical technician, master electrician, journeyman electrician.

It can also be demonstrated by several years of activity with training in theory and practice after verification by a qualified electrician. This proof must be documented. (From DGUV regulation 3).

3.2 Persons trained in electrotechnology

An person trained in electrotechnology is a person who has been instructed by a qualified electrician about the tasks assigned to him/her and the possible dangers of improper behaviour and, if necessary, has been trained and instructed about the necessary protective devices and protective measures (DGUV Regulation 3 or DIN VDE 0105-100). This proof must be documented.

3.3 Operating personnel / user

The person or persons responsible for installing, operating, setting up, maintaining, cleaning, repairing or transporting machinery.

Operating personnel refers to personnel instructed by the operating company of the MAE.

4 Personnel qualification

4.1 Installation, assembly and commissioning

Installation, assembly and commissioning may only be carried out by a qualified electrician.

4.2 Normal operation

During normal operation, only operating personnel may work on the MAE.

4.3 Repair, measuring or adjustment tasks

Repair, measuring or adjustment tasks may only be carried out by a qualified electrician.

4.4 Maintenance tasks

Maintenance tasks may only be carried out by a qualified electrician.

4.5 Cleaning tasks

Cleaning work may only be carried out by operating personnel.

4.6 Dismantling tasks

Dismantling tasks may only be carried out by a qualified electrician.

⚠ Warning!

Ensure that only authorised personnel can operate the QAR50-R through suitable operational organisation.

5 Safety information

⚠Danger!

Opening is not permitted throughout the service life.

⚠Danger!

Danger of electric shock.

All work should only be carried out when switched off.

Check that there is no voltage before starting work.

⚠Danger!

Risk of fatal electric shock.

The QAR50-R does not provide protection against contact with live parts if as fault occurs.

This protection must be provided by the power supply unit.

⚠Danger!

Danger of electric shock.

All work may only be carried out by a qualified electrician who has sufficient experience in working on low-voltage systems.

6 Safety measures

⚠Danger!

The safety and health of employees can only be guaranteed if the safety measures described are observed during the entire service life (construction, transport, assembly, installation, operation, etc.).

Never attempt to install and operate the QAR50-R without first reading the entire operating instructions. All safety instructions must be read and understood before starting work. If they are not available, contact your supplier and request that the missing documents be sent to you or the persons responsible for safe operation of the equipment without delay.

The operating instructions must be read carefully before using the equipment for the first time in order to eliminate the risk of injury or damage to property. The safety instructions must be strictly adhered to.

All safety regulations and requirements of the country in which the QAR50-R is operated must be observed.

The ambient and operating conditions specified in these operating instructions must be observed.

These instructions for use are only examples or suggestions. The operating company must ensure that the QAR50-R complies with the applicable safety regulations and standards and must take the necessary measures or make additions. Furthermore, the operating company must ensure that the QAR50-R is also suitable for its application.

The QAR50-R may only be put into operation if the machine or system in which the QAR50-R is installed complies with national regulations, safety regulations and application standards.

The operating company is responsible for compliance with the EMC regulations and for compliance with the limit values specified in the national regulations.

Any work may only be carried out when the machine or system in which the QAR50-R is installed is de-energised and only if the main switch has been switched off and secured against being switched on again.

All electrical connection points must never be touched when the device is switched on.

Never plug in or remove plug connectors or wires while the QAR50-R is in operation. The plug connectors or wires may only be plugged in or removed by a qualified electrician and without exception when switched on.

If one of the plug connectors or wires has been removed, operation is prohibited.

The information in these operating instructions must be observed during the entire service life of the device. Read the relevant sections of the operating instructions carefully before starting work.

You must always check that the system is safe to use before starting work.

The operating company and user must ensure that these operating instructions are readily available with the QAR50-R.

The operating company is obliged to only use the QAR50-R when it is in perfect working order. The operator must check the condition of the system prior to use and make sure that any defects are rectified before placing the system into operation.

Access to the QAR50-R by unauthorised persons must be prevented by the operating company.

6.1 Power supply unit for control voltage

An external control voltage must be connected to operate the QAR50-R. The operating company must ensure that the QAR50-R is only operated with a operational extra-low voltage with safe electrical isolation (SELV, PELV) in accordance with IEC 60364-4-41 (VDE 0100, Part 410).

The operating company is responsible for ensuring that the design of the power supply unit provides adequate protection against overcurrent.

⚠ Warning!

Power supply 12V DC.

6.2 Protection through automatic switch-off if a fault occurs

The overcurrent protection and, if necessary, the residual current protection circuit must be guaranteed by the power supply unit and/or UPS.

⚠Danger!

Risk of fatal electric shock.

The QAR50-R does not provide protection against contact with live parts if as fault occurs.

This protection must be provided by the power supply unit.

6.3 EMC influence

The QAR50-R may cause radio interference under certain circumstances. The operating company is responsible for taking measures to comply with the EMC regulations and the limit values specified in the national regulations.

7 Delivery, storage and disposal

7.1 Inspection on delivery

The QAR50-R must be checked for completeness and transport damage immediately after delivery. If the delivery is not complete or if a claim is to be made, the manufacturer and supplier must be notified without delay.

7.2 Scope of delivery

- QAR50-R
- Operating instructions
- EU Declaration of Conformity
- Accessories depending on the order quantity

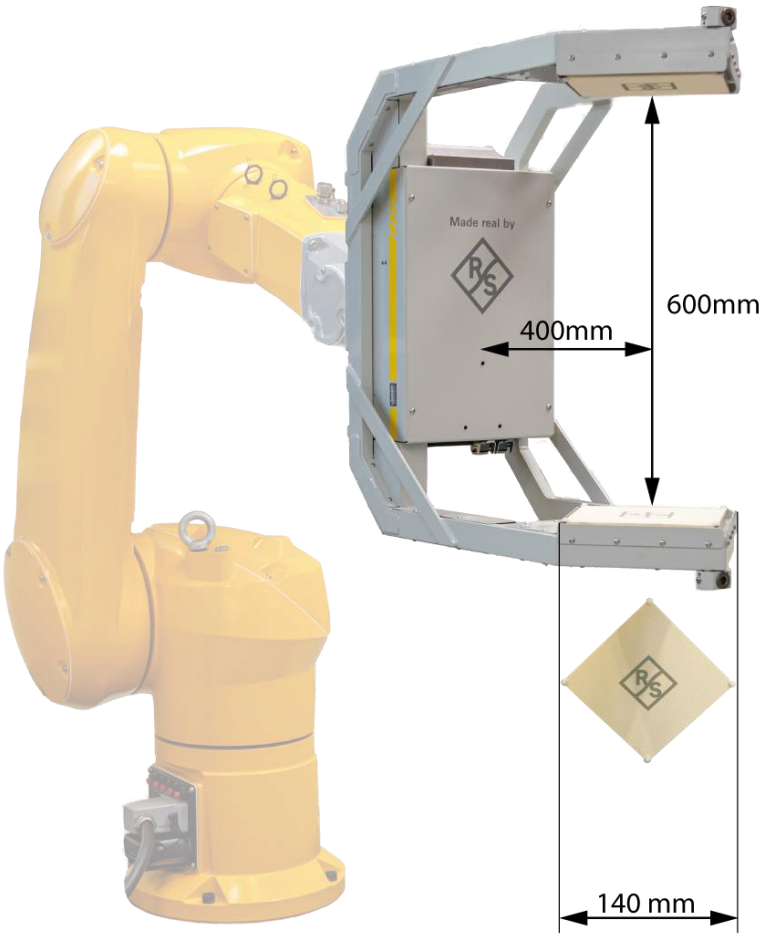
7.3 Storage

The place of storage should be dry, clean, and heated. The product must be protected from dust and water by means of a suitable cover.

7.4 Disposal

When disposing of the device, ensure that the local laws on the disposal of electronic devices are observed.

8 Overview



9 Definitions

9.1 General information

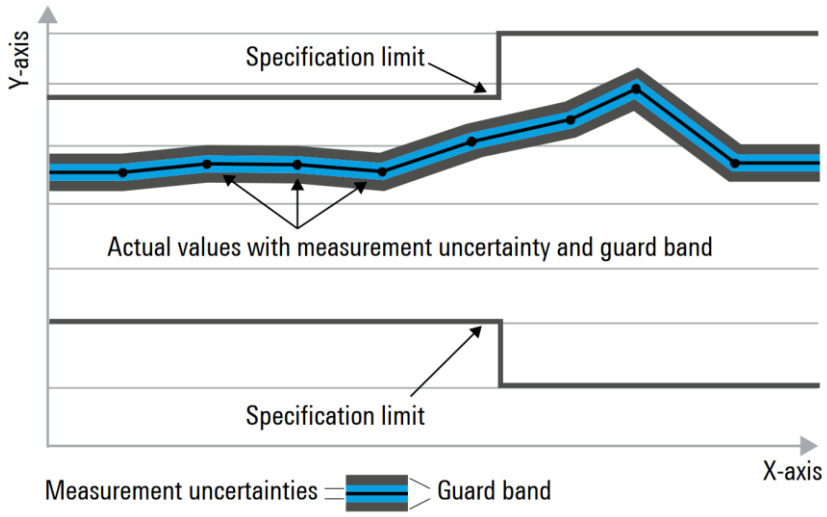
The product data apply under the following conditions:

- Three hours storage at ambient temperature, followed by 90 minutes warm-up time
- Compliance with the specified ambient conditions
- Compliance with the recommended calibration interval
- All internal automatic adjustments made, if applicable

9.2 Specifications with limit values

The guaranteed product performance is represented by a range of values for the specified parameter. This information is labelled with limit value symbols such as <, ≤, >, ≥, ±, or designations such as maximum, limit value, minimum.

Compliance is ensured by means of checks or results from the design. The test limits are delimited by guard bands to allow for measurement uncertainties, drift and ageing, if applicable.



9.3 Non-traceable specifications with limit values (n. trc.)

They represent the product performance that has been specified and tested as described under "Specifications with limit values" above. However, the product performance cannot
be guaranteed in this case, as no measuring equipment is available that is traceable to national measurement standards. In this case, the measurements refer to the standards used in the Rohde & Schwarz laboratories.

9.4 Specifications without limit values

They represent the guaranteed product performance for the specified parameter. This information is not specially labelled and represents values that show no or negligible deviations from the specified value (e.g. dimensions or resolution of a setting parameter). Compliance is ensured by the design.

9.5 Typical data (typ.)

Characterises the product performance based on representative data for the respective parameter. If they are labelled with <, > or as a range, they represent the performance that is met by around 80 % of the devices at the time of production. Otherwise it is the mean value.

9.6 Nominal values (nom.)

Characterisation of the product performance by a representative value for the given parameter (e.g. nominal impedance). In contrast to typical data, there is no statistical analysis and the parameter is not tested during production.

9.7 Measured values (meas.)

Characterise the expected product performance based on measurement results obtained from individual samples.

9.8 Measurement uncertainties

Represent the limits of measurement uncertainty for a specific measurand. The measurement uncertainty is defined with a coverage factor of 2 and was calculated according to the rules of the Guide to the Expression of Measurement Uncertainty (GUM), taking into account ambient conditions, ageing, wear and tear.

Device settings and GUI parameters are specified as follows: "Parameter: Value".

Non-traceable data with limit values, typical data and nominal and measured values are not guaranteed by Rohde & Schwarz.

10 Specifications

The specifications apply under the following conditions:

90 minutes warm-up time under specified ambient conditions and after successfully verified calibration.

10.1 System

Measurement time		< 3ms
Measurement cycle	From measurement start to results display (data saving time excluded)	< 4s
Operating system		Windows 10 IoT

10.2 Specifications for imaging

Frequency range	start frequency	
	band 1	76 GHz
	band 2	76 GHz
	stop frequency	
	band 1	77 GHz
	band 2	81 GHz
Image size	W x H	200 mm × 200 mm (7.87 in × 7.87 in)
Image pixel size	W x H	1.56 mm × 1.56 mm (0.06 in × 0.06 in)

10.2.1 Reflectance measurements

Image dynamic range	of mean reflection value	> 20 dB
Maximum evaluation area	for the calculation of the mean reflection	100 mm x 100 mm (3.93 in x 3.93 in)
Reproducibility [1] of mean reflection [2]	with 0 dB mean reflection	< 0.2 dB

[1] The reproducibility values apply after proper standardisation and for temperature changes of less than 4k. The DUT must be positioned in the test bench.

[2] The mean reflection value is defined as the arithmetic mean of the individually measured reflection values within the range [maxVal - 3 dB; maxVal]. maxVal is the maximum reflection value within the evaluation range.

10.2.2 Transmission loss measurements

Image dynamic range	of mean transmission attenuation value	> 30 dB
Maximum evaluation area	for the calculation of the mean attenuation	100 mm x 100 mm (3.93 in x 3.93 in)
Reproducibility [1] of mean attenuation [3]	with 0 dB mean attenuation	< 0.1dB

10.2.3 Transmit phase measurements (with R&S®QAR50-K20 option)

Image lateral resolution 4		≤ 8 mm (0.31 in)
Phase resolution 5	with 0 dB mean attenuation	±5°

10.2.4 High-resolution reflection measurements (with R&S®QAR50-K30 option)

Image lateral resolution		≤ 8 mm (0.31 in)
Frequency range	band 2	
	start frequency	76 GHz
	stop frequency	81 GHz
	center frequency	78.5 GHz
	frequency span	5 GHz
Number of frequency steps	band 2	128

10.3 Frequency-resolved measurements (with R&S®QAR50-K10 option)

Frequency range (measurement range)	start frequency	72 GHz
	stop frequency	82 GHz
	center frequency	77 GHz
	frequency span	10 GHz
Number of frequency steps		256
Frequency accuracy		1 MHz
Frequency range (analysis range after time gating)	start frequency	73 GHz
	stop frequency	81 GHz
	center frequency	77 GHz
	frequency span	8 GHz

[3] The mean transmission attenuation value is defined as the arithmetic mean of the individually measured transmission attenuation values within the range [minVal; minVal + 3 dB]. minVal is the minimum transmission attenuation value within the assessment range.

[4] The lateral image resolution defines the minimum distance between two phase steps to be resolved.

[5] The phase resolution defines the minimum phase difference in a DUT that can be resolved within the calculated image.

10.3.1 Frequency-resolved reflection measurements (with R&S®QAR50-K10 option)

Dynamic range		> 20 dB
Minimum DUT size [6]	W × H	60 mm × 60 mm (2.36 in × 2.36in)
Reproducibility of reflection [7] per frequency point [8]	reproducibility of reflection values in linear scale	
	static	< 7%
	dynamic	< 12%
	with 0 dB reflection	
	static	< 0.4 dB
	dynamic	< 0.4 dB
	with -8 dB reflection	
	static	< 1.6 dB
	dynamic	< 3.0 dB
	with -15 dB reflection	
	static	< 3.0 dB
	dynamic	< 6.0 dB

10.3.2 Frequency-resolved attenuation measurements (with R&S®QAR50-K10 option)

Dynamic range		> 30 dB
Minimum DUT size [6]	W × H	60 mm × 60 mm (2.36 in × 2.36in)
Reproducibility of attenuation [9] per frequency point [8]	reproducibility of transmission attenuation values in linear scale	
	static	< 3%
	dynamic	< 5%
	with 0 dB mean attenuation	
	static	< 0.2 dB
	dynamic	< 0.2 dB
	with 1 dB mean attenuation	
	static	< 0.2 dB
	dynamic	< 0.4 dB

[6] Provided that the evaluation range is set according to the size of the DUT. The evaluation window should be at least 10 mm away from the edge of the DUT. The normalisation measurement must be carried out with the same window size.

[7] The automatic processing recognises the pixel with the highest reflectance in the restored image and calculates the frequency response of this specific point of the DUT.

[8] A time gate is used to reduce standing waves. The measured values apply to frequencies between 73 and 81 GHz.

[9] The automatic processing recognises the pixel with the lowest transmission loss within the restored image and calculates the frequency response of this specific point of the DUT.

11 Installation

All work should only be carried out when switched off. Therefore, check that there is no voltage before starting work.

The QAR50-R is mounted on an industrial robot using an adapter plate.

Ensure that the QAR50-R is only operated with a operational extra-low voltage with safe electrical isolation (SELV, PELV) in accordance with IEC 60364-4-41 (VDE 0100, Part 410).

Flexible cables suitable for the intended use must be used for the wiring and must always be visible at all points where they could be exposed to mechanical stress.

Operation is only permitted in a temperate, dry and low-dust environment.

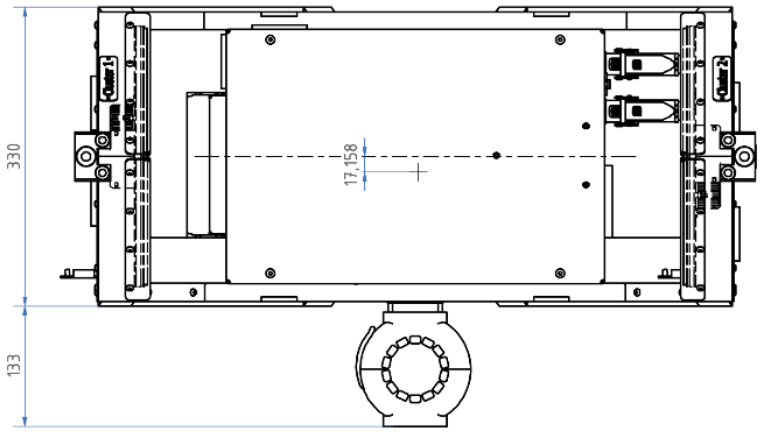
⚠ Danger!

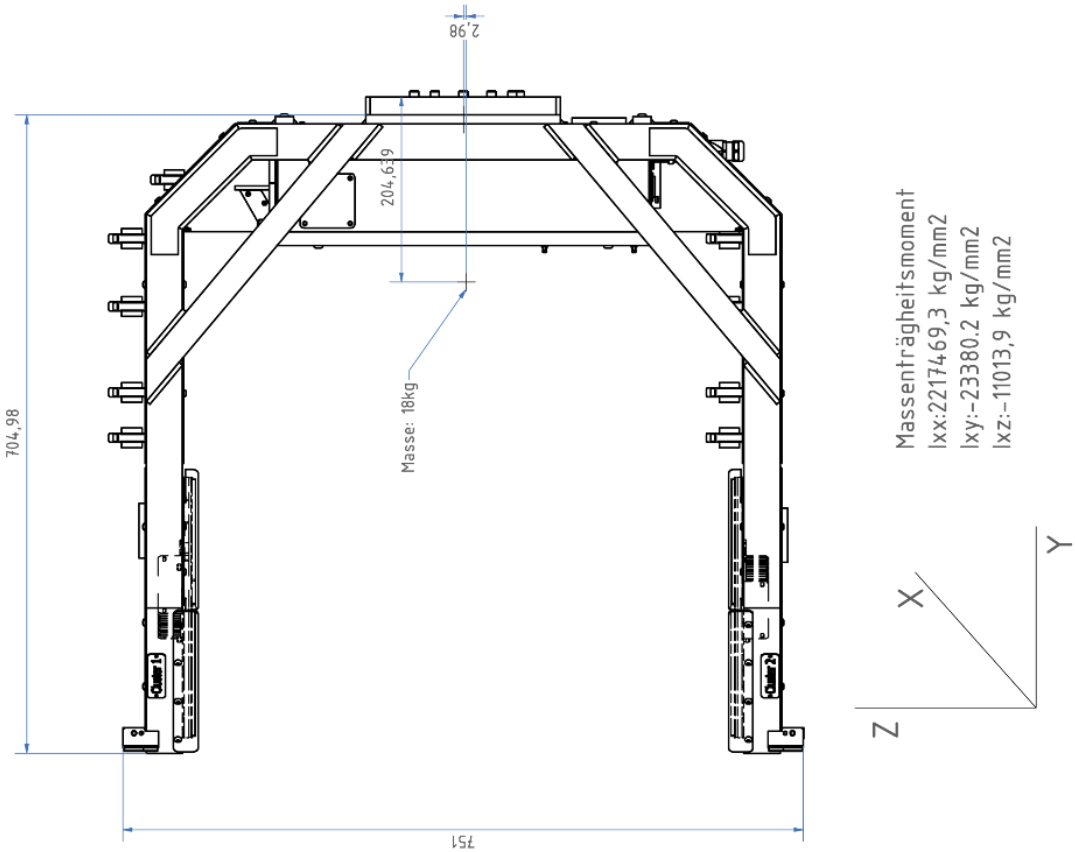
Opening the QAR50-R is not permitted during its entire service life.

Note!

The installation must be carried out in a low-reflection environment.
Avoid metal walls or strong reflectors near the imaging area

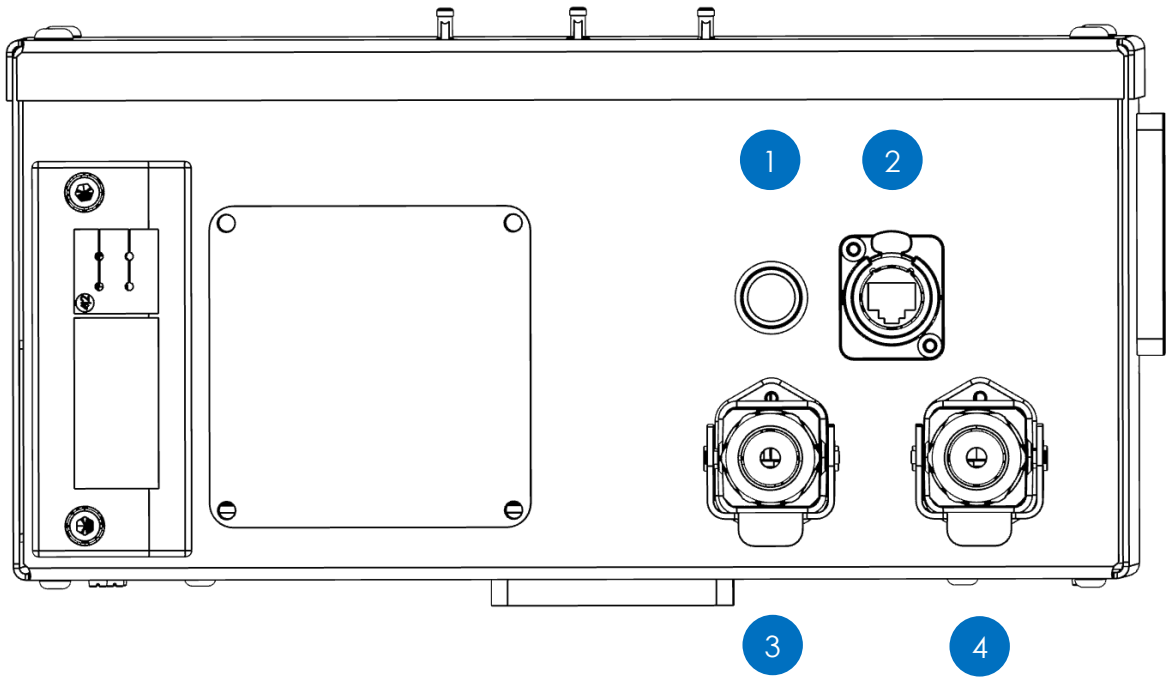
11.1 Dimensions / point of inertia



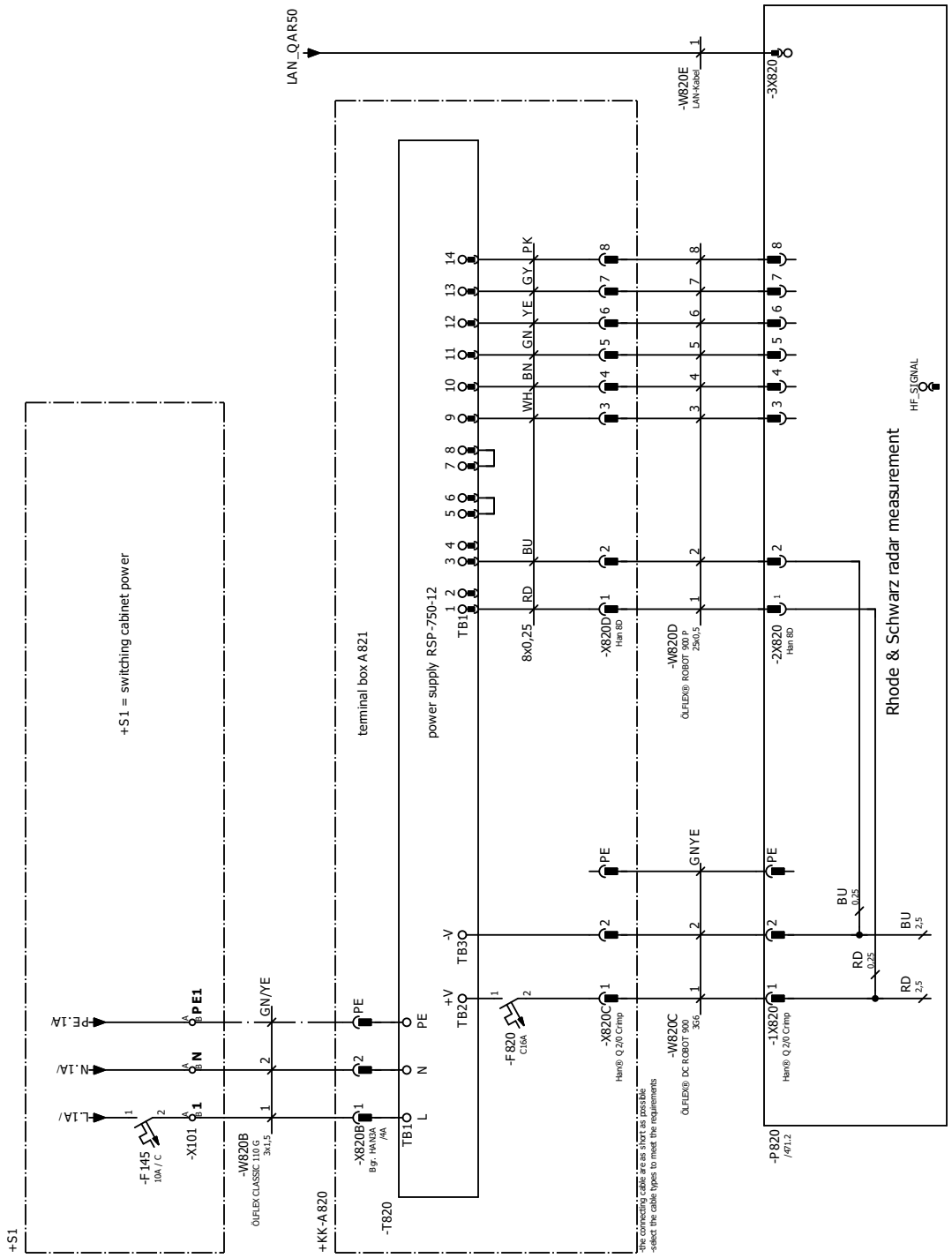


11.2 Connections

1. On/off switch
2. Network (1 Gbit)
3. Control
4. Supply +12V DC (± 0.5 V)



11.3 Wiring power supply unit (example)



12 Operation

A power supply unit (12V +/- 0.5V) is required to operate the QAR50-R.

For more information on the operating system and functions, please refer to the Rohde und Schwarz manual:

https://www.rohde-schwarz.com/de/handbuch/qar50/

Note: these manuals deal with the QAR50 from Rohde und Schwarz. However, the function is identical to the QAR50-R. Specifications differ in part!

This manual can also be found in the operating system of the QAR50-R (detailed description 13.3).

12.1 Switching on

Switch on:

1. Press the on/off switch
2. On/off switch lights up green

The QAR50-R starts up automatically when the power supply is switched on.

Wait for a warm-up time of 90 minutes.

Note!

If the hardware does not reach its operating temperature, the measurement results may be invalid.

12.2 Switching off

Switch off:

1. Briefly press the on/off switch or shut down the operating system
2. QAR50-R shuts down

Reset:

1. Press and hold the on/off switch
2. QAR50-R is switched off immediately (risk of data loss!)

The on/off switch lights up when the QAR50-R is switched on.

Note!

Switching off the QAR without first shutting it down can lead to loss of data. Under certain circumstances, the calibration may be lost.

A UPS is recommended.

12.3 Network setting (delivery status)

DHCP active

The computer name/IP is QAR50-04-<QAR-ID>, where "<QAR-ID>" is to be replaced with the ID of the QAR, e.g.: QAR50-04-101010. This can be found on the type plate under "R&S ID". The ID is the six-digit number between the hyphens.

12.4 Initial commissioning

Switch on the QAR50-R (see Switching on and off).

As soon as the QAR has started up, it can be accessed via a remote desktop connection.

Login data for the remote connection:

User name: Operator password: operator<QAR-ID> (e.g.: operator101010)

The QAR can now be set as required in the Windows interface.

Note: The firmware starts automatically when the QAR is started, but it can also be started manually using the shortcut on the desktop.

For further information, a user manual is included with the QAR software, which can be opened via the "Info"-> "User Manual" tab.

13 Maintenance

The following maintenance work must be carried out on this device:

Activities	Dead-line/cycle/ rotation	Material	Execution notes / Description
Visual inspection, cleaning	Weekly, if nec-essary	damp, soft cleaning cloth	The device can be cleaned with a damp, soft cleaning cloth. Do not use any corrosive cleaning agents, thin-ners, abrasive cleaners or hard objects that could cause scratches. CAUTION: Do not clean the cluster covers (with R&S logo)
Visual inspection	monthly		- Check connections for damage and correct fit. - Check frame and weld seams for cracks and damage
Clean the air filter	monthly		- Determine the degree of contamination of the filter grids and vacuum if necessary - Check fan(s) (noise, function)
Service	annually		To ensure the functionality of the QAR50-R, it must be serviced annually by the manufacturer

14 Technical data

Supply voltage	+12V DC (± 0.5 V)
Power	< 300W (QAR50)
Operating temperature range	+5°C to +40°C
Storage	-10°C to +50°C
Humidity	90 %
Moisture condensation	not permitted
Icing	not permitted
Vibration	not permitted
Aggressive environmental influences	not permitted
Flammable atmosphere	not permitted
Explosive atmosphere	not permitted
Installation height	max. 2000 m above sea level
Protection class	Housing IP20
Dimensions	751 x 705 x 330mm (W x H x D)
Weight:	Approx. 20 kg
Housing material	Aluminium, sheet steel
Colour (RAL)	Light grey (7035)

LÖHNERT ELEKTRONIK

AUTOMATISIERUNGSLÖSUNGEN
PRÜFSTANDSBAU
ELEKTRONIKENTWICKLUNG
SOFTWAREENTWICKLUNG

LÖHNERT ELEKTRONIK GMBH · Oskar-Sembach-Ring 18 · 91207 Lauf a.d. Pegnitz

- Original -

EU-Konformitätserklärung
EC Declaration of Conformity

Im Sinne der EU-Richtlinie 2014/30/EU über elektromagnetische Verträglichkeit
according to EC directive 2014/30/EU on electromagnetic compatibility

Name und Anschrift des Herstellers:
Name and address of the manufacturer

Löhnert Elektronik GmbH
Oskar-Sembach-Ring 18
91207 Lauf an der Pegnitz

Diese Erklärung bezieht sich nur auf das Produkt in dem Zustand, in dem es in Verkehr gebracht wurde; vom Endnutzer nachträglich angebrachte Teile und/oder nachträglich vorgenommene Eingriffe bleiben unberücksichtigt. Die Erklärung verliert ihre Gültigkeit, wenn das Produkt ohne Zustimmung umgebaut, verändert oder nicht fachgerecht und bestimmungsgemäß eingesetzt wird.

This declaration relates exclusively to the product in the state it was placed on the market and excludes components which are added and/or modifications carried out subsequently by the final user. The declaration is no more valid if the product is modified without agreement or is not used according to its professional and intended use.

Hiermit erklären wir, dass nachfolgendes Produkt
Herewith we declare *that the product described below*

Produktbezeichnung / *product denomination*: Radom-Tester QAR50-R
Teilenummer / part number: L2204024.53.03

den Bestimmungen folgender EU-Richtlinien entspricht /
corresponds to the provisions of the following EC directives:

2014/30/EU	Elektromagnetische Verträglichkeit / *electromagnetic compatibility*

Folgende harmonisierten Normen wurden angewendet /
***The following harmonised standards were applied*:**

DIN EN 61000-4-2 VDE 0847-4-2:2009-12
DIN EN 61000-4-3 VDE 0847-4-3:2021-11
DIN EN 61000-4-4 VDE 0847-4-4:2013-04
DIN EN 61000-4-5 VDE 0847-4-5:2019-03, B1: 2021-04
DIN EN 61000-4-6 VDE 0847-4-6:2014-08

Die Konformität des Radom-Tester QAR50-R in der Endanwendung muss vom Kunden neu bewertet werden.
Conformity of the Radom-Tester QAR50-R in the end-use application has to be re-assessed by the customer.

Bevollmächtigter für die Zusammenstellung der relevanten technischen Unterlagen (EU-Adresse)
The person authorised to compile the relevant technical documentation *(must be established within EU):*

Löhnert Elektronik GmbH
Herr Dipl. Ing. (Univ.) Stephan Horváth
Oskar-Sembach-Ring 18
91207 Lauf an der Pegnitz

Lauf, 19.12.2024	Michael Möller, Geschäftsführer	
.....	.....	.....
(Ort, Datum) *(Place, Date)*	(Unterzeichner und Funktion des Unterzeichners) *(Surname, first name and function of signatory)*	(Unterschrift) *(Signature)*