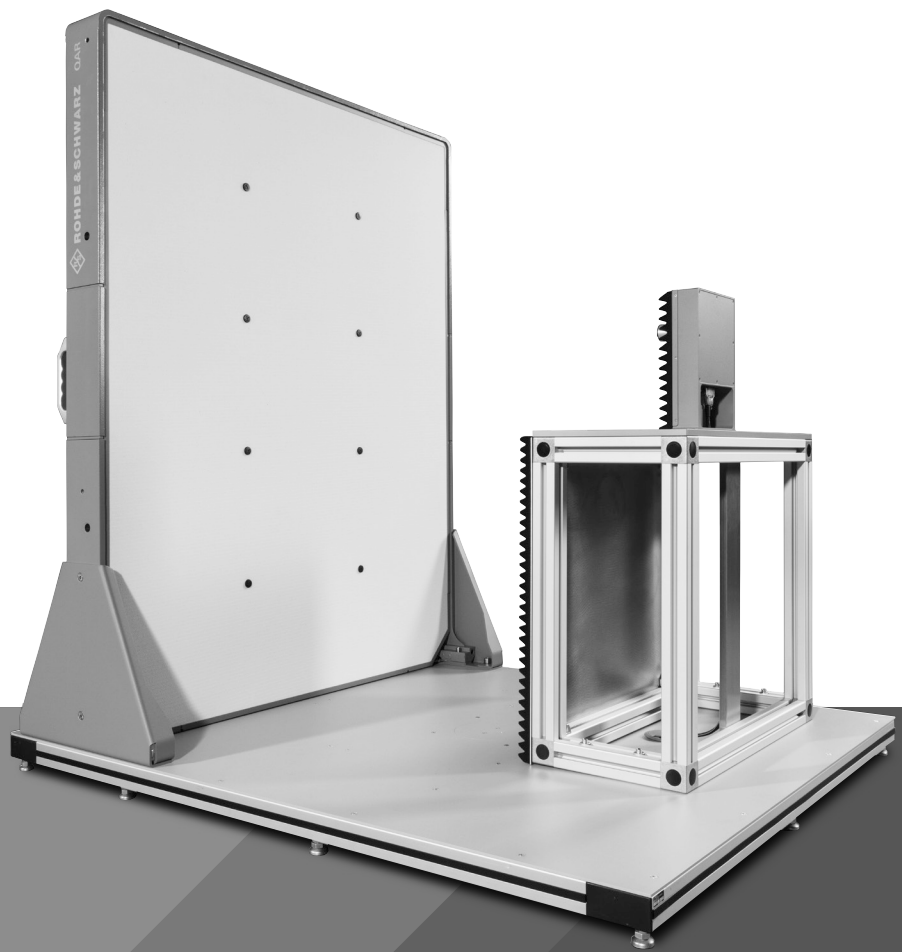


R&S® QAR QUALITY AUTOMOTIVE RADOME TESTER

Specifications



Data Sheet
Version 05.00

ROHDE & SCHWARZ

Make ideas real



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Definitions

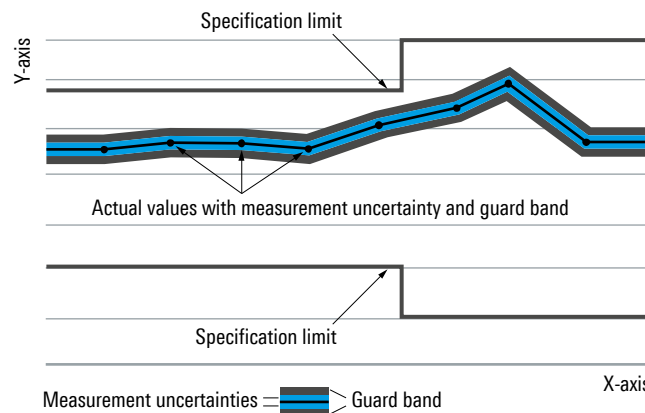
General

Product data applies under the following conditions:

- Three hours storage at ambient temperature followed by 90 minutes warm-up operation
- Specified environmental conditions met
- Recommended calibration interval adhered to
- All internal automatic adjustments performed, if applicable

Specifications with limits

Represent warranted product performance by means of a range of values for the specified parameter. These specifications are marked with limiting symbols such as $<$, \leq , $>$, \geq , \pm , or descriptions such as maximum, limit of, minimum. Compliance is ensured by testing or is derived from the design. Test limits are narrowed by guard bands to take into account measurement uncertainties, drift and aging, if applicable.



Non-traceable specifications with limits (n. trc.)

Represent product performance that is specified and tested as described under "Specifications with limits" above. However, product performance in this case cannot be warranted due to the lack of measuring equipment traceable to national metrology standards. In this case, measurements are referenced to standards used in the Rohde & Schwarz laboratories.

Specifications without limits

Represent warranted product performance for the specified parameter. These specifications are not specially marked and represent values with no or negligible deviations from the given value (e.g. dimensions or resolution of a setting parameter). Compliance is ensured by design.

Typical data (typ.)

Characterizes product performance by means of representative information for the given parameter. When marked with $<$, $>$ or as a range, it represents the performance met by approximately 80 % of the instruments at production time. Otherwise, it represents the mean value.

Nominal values (nom.)

Characterize product performance by means of a representative value for the given parameter (e.g. nominal impedance). In contrast to typical data, a statistical evaluation does not take place and the parameter is not tested during production.

Measured values (meas.)

Characterize expected product performance by means of measurement results gained from individual samples.

Uncertainties

Represent limits of measurement uncertainty for a given measurand. Uncertainty is defined with a coverage factor of 2 and has been calculated in line with the rules of the Guide to the Expression of Uncertainty in Measurement (GUM), taking into account environmental conditions, aging, wear and tear.

Device settings and GUI parameters are indicated as follows: "parameter: value".

Non-traceable specifications with limits, typical data as well as nominal and measured values are not warranted by Rohde & Schwarz.

Specifications

Specifications apply under the following conditions: 90 minutes warm-up time at specified environmental conditions and after successfully verified calibration.

System

Measurement time	for reflection only	< 1 s
	for reflection and transmission	< 2 s
Measurement cycle (R&S®QAR-K10 and R&S®QAR-K60)	from measurement start to results display (data saving time excluded)	< 7 s
Operating system		Windows 10 IoT

Reflection measurements (using R&S®QAR-K10 software)

Frequency range	start frequency	74 GHz
	stop frequency	79 GHz
	center frequency	76.5 GHz
	frequency span	5 GHz
Frequency accuracy		1 MHz
Number of frequency steps		64
Scan volume	W x H x D	352 mm x 512 mm x 550 mm (14 in x 20 in x 22 in)
Image dynamic range	of mean reflection value ¹	> 25 dB
RF output power		5 mW (nom.)
Polarization angle	see Fig. 4	45°
Image lateral resolution		≤ 3 mm
Image pixel size		0.5 mm x 0.5 mm
Normalization interval	for retaining reproducibility	< 2 h
Reproducibility ² of mean reflection ¹	with 0 dB mean reflection	< 0.5 dB
	with -20 dB mean reflection	< 0.7 dB

Transmission measurements (using R&S®QAR-Z10 option with R&S®QAR-K10 software)

Frequency range ³		72 GHz to 82 GHz
Frequency accuracy		1 MHz
Number of frequency steps	max. frequency range	64
Dynamic range		> 30 dB
TX ⁴ antenna gain	at 76.5 GHz	22 dB
	at 79.0 GHz	23 dB
TX antenna HPBW ⁵ in E plane	at 76.5 GHz	17°
TX antenna HPBW in H plane	at 76.5 GHz	12°
TX antenna HPBW in E plane	at 79.0 GHz	15°
TX antenna HPBW in H plane	at 79.0 GHz	11°
TX RF output power		5 mW (nom.)
Polarization angle	R&S®QAR-Z10, model .02, copolar	identical to panel polarization
	R&S®QAR-Z10, model .03, horizontal	horizontally polarized
Normalization interval	for retaining reproducibility	< 2 h
Reproducibility ⁶ of mean attenuation	for DUT with transmission attenuation of 0 dB	< 0.25 dB
	for DUT with transmission attenuation of 4 dB	< 0.35 dB

¹ The mean reflection value is defined as the arithmetic mean of the individually measured reflection values of 100 x 100 pixel within the evaluation area of default size 50 mm x 50 mm at the center of the imaging zone.

² Reproducibility values are valid for stationary DUT, after proper normalization and for temperature changes less than 4° K. The device under test (DUT) has to be positioned within the test fixture, see Fig. 2.

³ In verification mode, time gating is applied to reduce standing waves. As a result, the analysis range is from 73 GHz to 81 GHz.

⁴ TX: transmitter.

⁵ HPBW: half-power beamwidth.

⁶ Reproducibility values are valid for stationary DUT, utilizing the verification mode (time gating), after proper normalization and for temperature changes less than 4° K. It is specified for one-way mean attenuation over the two frequency bands, i.e. 76 GHz to 77 GHz and 76 GHz to 81 GHz.

Reflection measurements (single cluster) (using R&S®QAR-K10 software with R&S®QAR-K50 option)

Frequency range	start frequency	75.98 GHz
	stop frequency	77.02 GHz
	center frequency	76.5 GHz
	frequency span	1 GHz
Frequency accuracy		1 MHz
Number of frequency steps		14
Scan volume	W × H × D	257 mm × 257 mm × 187.1 mm (10.1 in × 10.1 in × 7.4 in)
Image dynamic range	of mean reflection value ⁷	> 30 dB
RF output power		5 mW (nom.)
Polarization angle	see Fig. 4	45°
Image lateral resolution		≤ 15 mm
Image pixel size		1 mm × 1 mm
Normalization interval	for retaining reproducibility	< 2 h
Reproducibility ⁸ of mean reflection ⁷ (static)	with 0 dB mean reflection	< 0.5 dB
	plate A (with typ. -25 dB mean reflection)	< 0.8 dB
	plate B (with typ. -8 dB mean reflection)	< 0.6 dB
	plate C (with typ. -6.5 dB mean reflection)	< 0.6 dB
Reproducibility ⁹ of mean reflection ⁷ (dynamic)	with 0 dB mean reflection	< 0.5 dB
	plate A (with typ. -25 dB mean reflection)	< 3 dB
	plate B (with typ. -8 dB mean reflection)	< 1.2 dB
	plate C (with typ. -6.5 dB mean reflection)	< 1.2 dB
Measurement cycle time	from measurement start to results display (data saving time excluded)	< 3 s

Transmission measurements (using R&S®QAR-Z60 option with R&S®QAR-K60 software)

Frequency range	start frequency	76 GHz
	stop frequency	81 GHz
	center frequency	78.5 GHz
	frequency span	5 GHz
Frequency accuracy		1 MHz
Number of frequency steps		64
Scan volume	W × H × D	352 mm × 512 mm × 550 mm (14 in × 20 in × 22 in)
Dynamic range		> 25 dB
RF output power		5 mW (nom.)
Polarization angle	see Fig. 4	45°
Normalization interval	for retaining reproducibility	< 1 h
Reproducibility ¹⁰ of mean attenuation ¹¹		< 0.4 dB

⁷ 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 area of default size 100 mm × 100 mm at the center of the imaging zone.

⁸ Reproducibility values are valid for stationary DUT, after proper normalization and for temperature changes less than 4° K. The device under test (DUT) has to be positioned within the test fixture, see Fig. 3.

⁹ Reproducibility values are evaluated with repositioning of the DUT, after proper normalization and for temperature changes less than 4° K. The device under test (DUT) has to be positioned within the test fixture, see Fig. 3.

¹⁰ Reproducibility values are valid for a stationary DUT after proper normalization and for temperature changes less than 4° K. It is specified for the arithmetic mean of the 6 × 17 individually measured two-way attenuation values at the rods of the R&S®QAR-Z60 reference reflector in the frequency band from 76 GHz to 81 GHz.
The reproducibility is specified for flat samples with a maximum thickness of 5 mm and a maximum two-way attenuation of 3 dB.

¹¹ The mean attenuation value is defined as the arithmetic mean of the individually measured two-way attenuation values at the rods of the reference reflector R&S®QAR-Z60 in the frequency band from 76 GHz to 81 GHz.

Radar sensor positioning measurement (using R&S®QAR-Z42 option with R&S®QAR-K100 software)

Frequency range	start frequency	71 GHz
	stop frequency	81 GHz
	center frequency	76 GHz
	frequency span	10 GHz
Frequency accuracy		1 MHz
Number of frequency steps		128
Scan volume	W × H × D (When mounted on R&S®QAR-Z21 platform)	512 mm × 352 mm × 250 mm (20 in × 14 in × 10 in)
Dynamic range		> 25 dB
RF output power		5 mW (nom.)
Polarization angle	see Fig. 4	45°
Accuracy of clearance calculation ¹²		< ±3 mm (typ.)
Measurement cycle time	from measurement start to results display (data saving time excluded)	< 22 s

¹² The typical accuracy values of the clearance calculation are valid for the stationary R&S®QAR-Z42 verification set positioned as shown in Fig. 8. The positioning tolerance for the verification set is 5 mm of lateral displacement in X/Y/Z direction and 0.5° of rotation around the X/Y/Z axis. The distance calculation is performed as explained in Figs. 9 and 10.

Connectors and switches

AC inlet and mains power switch	(1) see Fig. 1	for mains power supply
Ground terminal	(2) see Fig. 1	for additional protective earthing
External transmitter control and RF out	(3) see Fig. 1	for R&S®QAR-Z10
Monitor power	(4) see Fig. 1	AC output for monitor supply
LAN	(5) see Fig. 1	1 Gbit
Digital visual interface (DVI)	(6) see Fig. 1	display connector for monitor
2 × USB 2.0 and 2 × USB 3.0	(7) see Fig. 1	for keyboard, mouse and general use
Power button	(8) see Fig. 1	for switching on and off

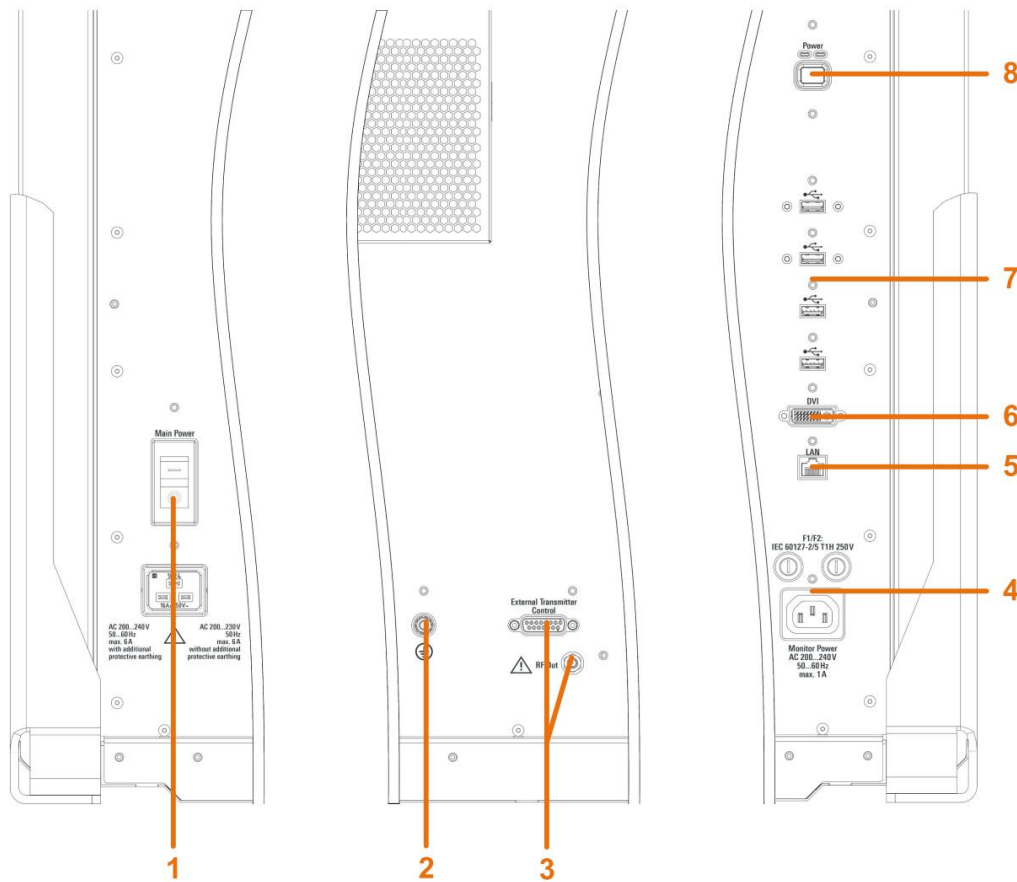


Fig. 1: Connectors of the R&S®QAR

The drawing shows three sections of the R&S®QAR back panel, namely left-hand, middle and right-hand sections.

General data

Environmental conditions		
Temperature	operating temperature range	+10 °C to +38 °C
	storage temperature range	−10 °C to +60 °C
Humidity		+38 °C at 95 % rel. humidity, in line with IEC 60068-2-78
Protection class		IP20
Installation altitude		max. 2000 m above sea level
Vibration		in line with IEC 60068-2-6
Shock		in line with IEC 60068-2-27
Transport		in line with IEC 60068-2-31 and IEC 60068-2-64
Adjustment interval		6 months
Surroundings	<ul style="list-style-type: none"> • installation to be maintained in low-reflection environment • metal walls or strong reflectors in the proximity of the imaging zone to be avoided 	

Power rating		
Rated voltage	without additional protective earthing	200 V to 230 V AC (± 10 %)
	with additional protective earthing ¹³	200 V to 240 V AC (± 10 %)
Rated current		max. 6 A
Power consumption	average	800 W
	standby	11 W
Rated frequency	without additional protective earthing	50 Hz (± 5 %)
	with additional protective earthing ¹³	50 Hz to 60 Hz (± 5 %)

Product conformity		
Electromagnetic compatibility	EU: EMC Directive 2014/30/EU	applied standards: IEC/EN 61326-1 immunity for industrial environment table 2, CISPR 11/EN 55011 class A
Electrical safety	EU: in line with Low Voltage Directive 2014/35/EU	applied standards: EN 61010-1, IEC 61010-1, UL 61010-1, CSA C22.2 61010-1
Hazardous substances	restriction of the use of hazardous substances in electrical and electronic equipment (RoHS) in line with 2011/65/EU	applied standard: EN 50581

Dimensions		
Panel and options		see Figs. 4, 6 and 8
Absorber wall	W x H x D	1875 mm x 1860 mm x 136 mm (74 in x 74 in x 5 in)

Weight		
Panel	R&S®QAR	86 kg (190 lb)
Transmitter module	R&S®QAR-Z10	3 kg (7 lb)
Platform	R&S®QAR-Z20	44 kg (97 lb)
Platform Horizontal	R&S®QAR-Z21	40 kg (89 lb)
Calibration set	R&S®QAR-Z30	15 kg (33 lb)
Verification set	R&S®QAR-Z40	5 kg (11 lb)
Verification set	R&S®QAR-Z41	5 kg (11 lb)
Verification set	R&S®QAR-Z42	17 kg (38 lb)
Verification set	R&S®QAR-Z43	4 kg (9 lb)
Mounting table	R&S®QAR-Z50	17 kg (37 lb)
Reference reflector	R&S®QAR-Z60	1.5 kg (3.3 lb)
Fixture for reference reflector	R&S®QAR-Z61	12 kg (27 lb)
Absorber wall	R&S®QAR-Z70	18 kg (40 lb)

¹³ For additional protective earthing (grounding), a green/yellow earth wire with a cross section of at least 4 mm² is to be used.

Shipping dimensions (W × H × D)		
Panel	R&S®QAR	1530 mm × 1320 mm × 820 mm (60 in × 52 in × 32 in)
Transmitter module	R&S®QAR-Z10	360 mm × 340 mm × 190 mm (14 in × 14 in × 8 in)
Platform	R&S®QAR-Z20	1530 mm × 330 mm × 1250 mm (60 in × 13 in × 50 in)
Platform horizontal	R&S®QAR-Z21	1510 mm × 300 mm × 800 mm (60 in × 12 in × 32 in)
Calibration set	R&S®QAR-Z30	1020 mm × 760 mm × 350 mm (40 in × 30 in × 14 in)
Verification set	R&S®QAR-Z40	580 mm × 380 mm × 380 mm (23 in × 15 in × 15 in)
Verification set	R&S®QAR-Z41	530 mm × 460 mm × 370 mm (21 in × 19 in × 15 in)
Verification set	R&S®QAR-Z42	735 mm × 665 mm × 380 mm (29 in × 27 in × 15 in)
Verification set	R&S®QAR-Z43	600 mm × 450 mm × 340 mm (24 in × 18 in × 14 in)
Mounting table	R&S®QAR-Z50	830 mm × 500 mm × 700 mm (33 in × 20 in × 28 in)
Reference reflector	R&S®QAR-Z60	330 mm × 320 mm × 80 mm (13 in × 13 in × 4 in)
Fixture for reference reflector	R&S®QAR-Z61	1200 mm × 800 mm × 500 mm (48 in × 32 in × 20 in)
Absorber wall	R&S®QAR-Z70	1020 mm × 750 mm × 350 mm (42 in × 30 in × 14 in)

Shipping weight		
Panel	R&S®QAR	176 kg (390 lb)
Transmitter module	R&S®QAR-Z10	6 kg (13 lb)
Platform	R&S®QAR-Z20	102 kg (225 lb)
Platform horizontal	R&S®QAR-Z21	90 kg (199 lb)
Calibration set	R&S®QAR-Z30	20 kg (44 lb)
Verification set	R&S®QAR-Z40	6 kg (13 lb)
Verification set	R&S®QAR-Z41	10 kg (22 lb)
Verification set	R&S®QAR-Z42	21 kg (47 lb)
Verification set	R&S®QAR-Z43	7 kg (16 lb)
Mounting table	R&S®QAR-Z50	40 kg (90 lb)
Reference reflector	R&S®QAR-Z60	2 kg (4.5 lb)
Fixture for reference reflector	R&S®QAR-Z61	15 kg (33 lb)
Absorber wall	R&S®QAR-Z70	22 kg (49 lb)

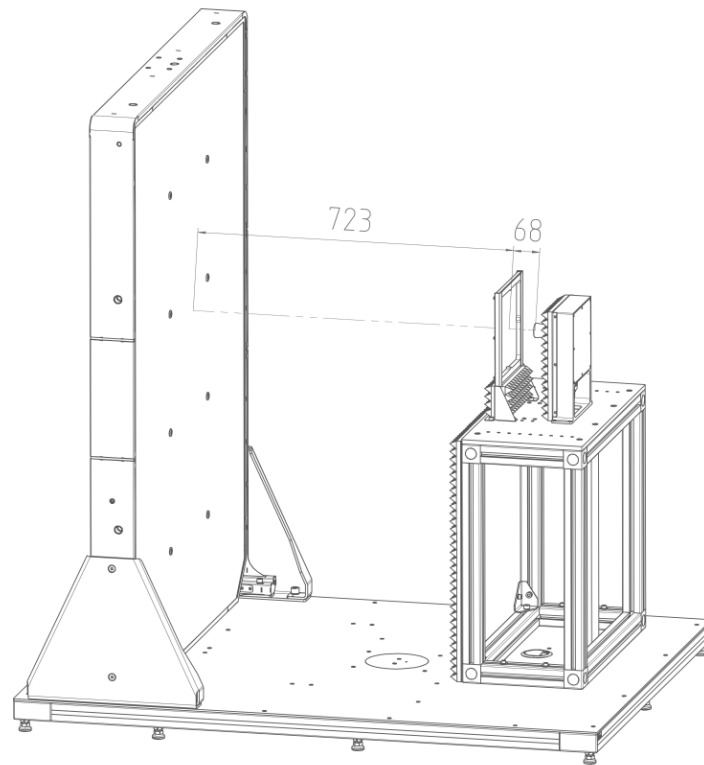


Fig. 2: R&S®QAR and test setup incl. R&S®QAR-Z10 transmitter module, R&S®QAR-Z20 platform, R&S®QAR-Z40 verification set and R&S®QAR-Z50 mounting table.

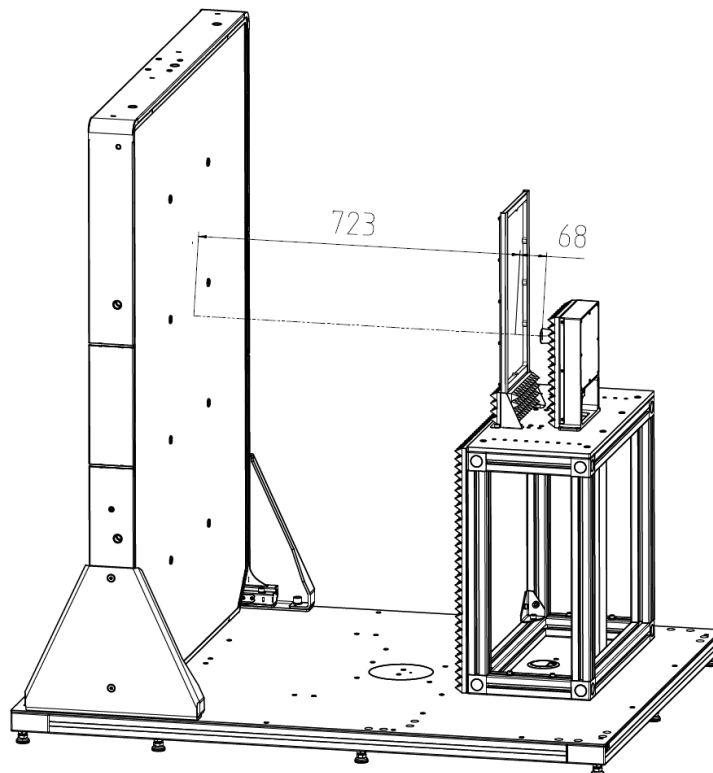
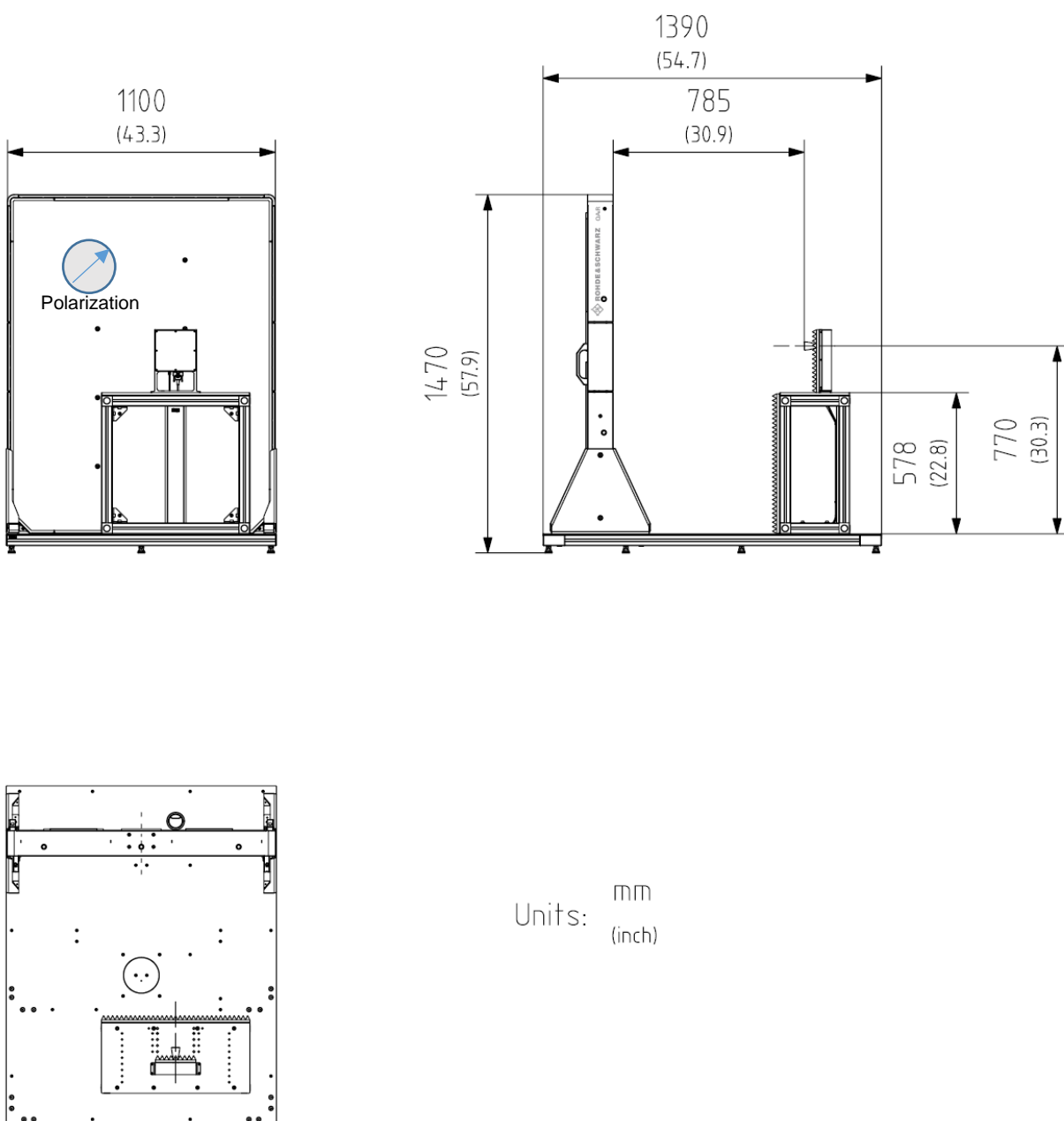


Fig. 3: R&S®QAR and test setup incl. R&S®QAR-Z10 transmitter module, R&S®QAR-Z20 platform, R&S®QAR-Z43 verification set and R&S®QAR-Z50 mounting table.



*Fig. 4: Mechanical dimensions of the R&S®QAR and options.
Additionally, the polarization of both, transmit and receive antennas of the panel of the R&S®QAR is indicated.*

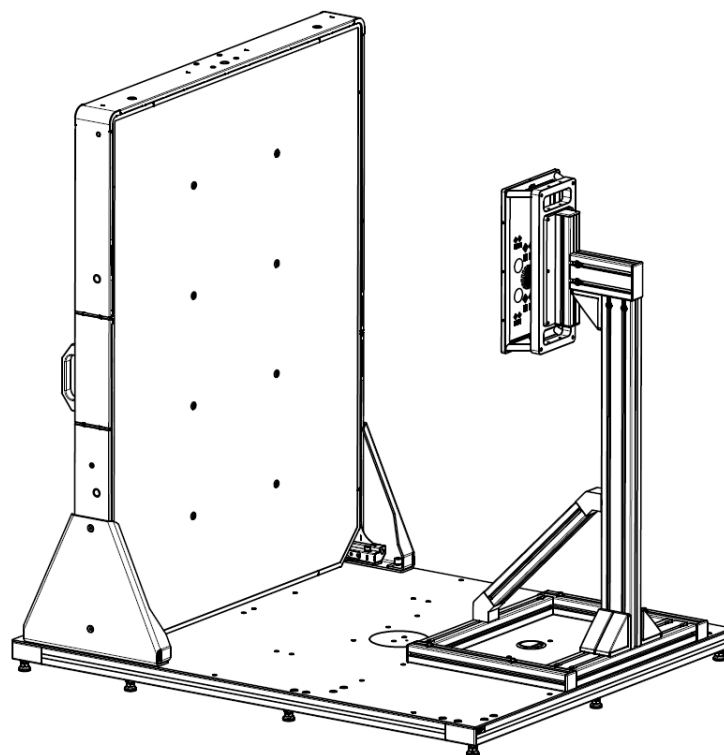


Fig. 5: R&S®QAR and test setup incl. R&S®QAR-Z60 reference reflector, R&S®QAR-Z61 fixture for reference reflector, R&S®QAR-Z20 platform, R&S®QAR-Z41 verification set.

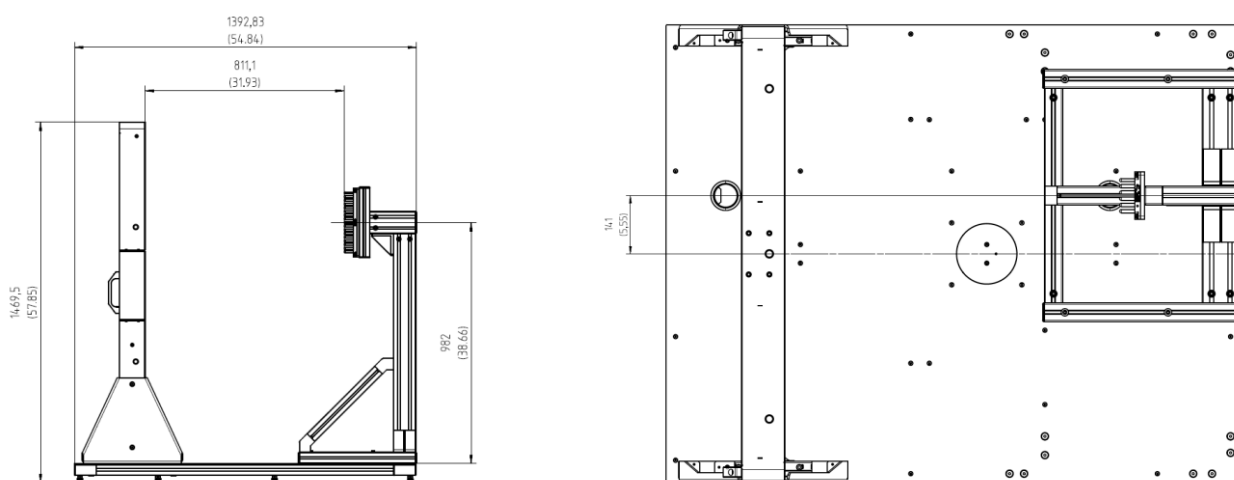


Fig. 6: Mechanical dimensions of the R&S®QAR and test setup incl. R&S®QAR-Z60 reference reflector, R&S®QAR-Z61 fixture for reference reflector, R&S®QAR-Z20 platform.

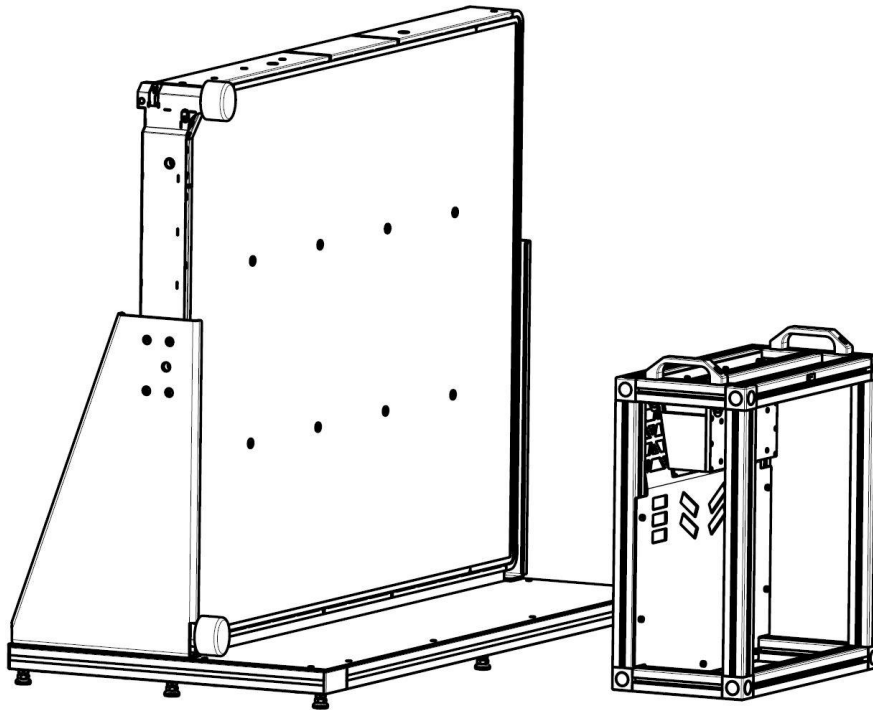


Fig. 7: R&S®QAR mounted on the R&S®QAR-Z21 platform incl. the R&S®QAR-Z42 verification set.

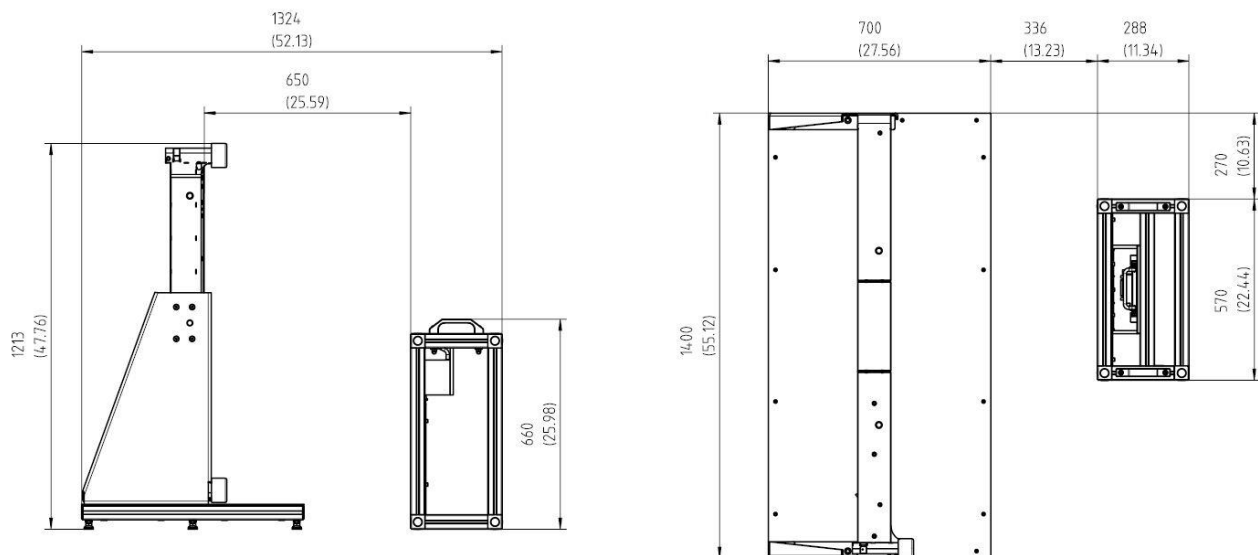


Fig. 8: Mechanical dimensions of the R&S®QAR mounted on the R&S®QAR-Z21 platform incl. the R&S®QAR-Z42 verification set.

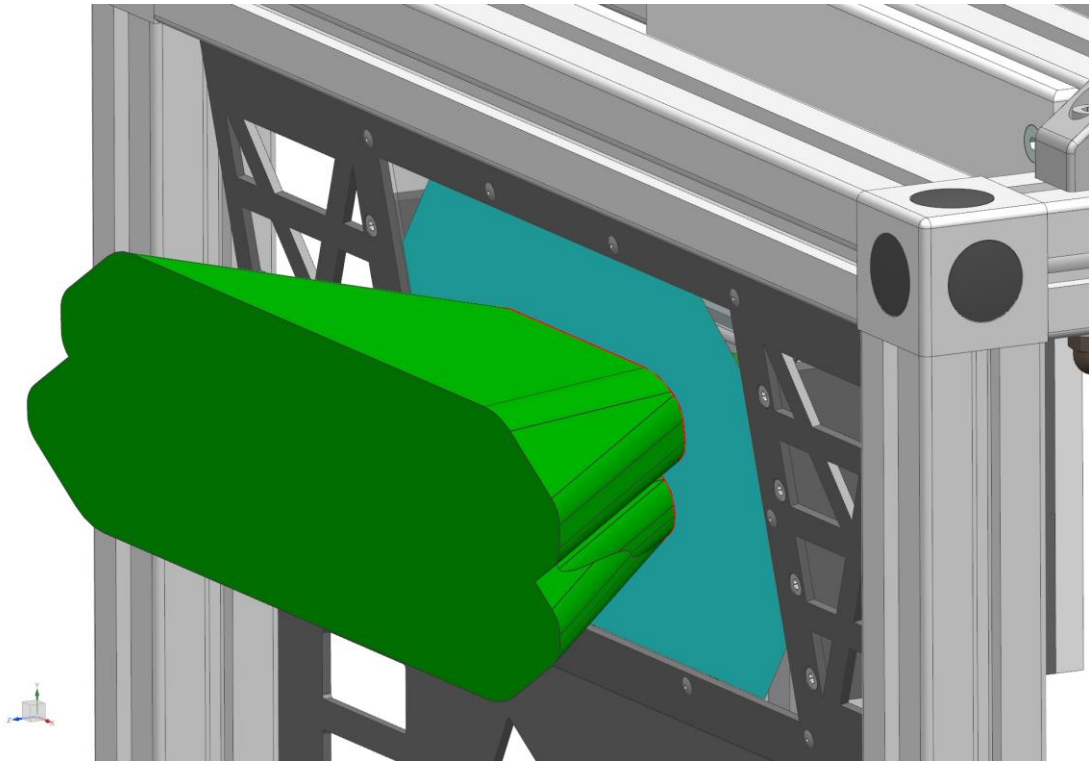


Fig. 9: Side view of the R&S®QAR-Z42 verification set with the virtual radar cone (green) cutting through the radome (cyan). The intersection area between the radar cone and the radome is marked in red.

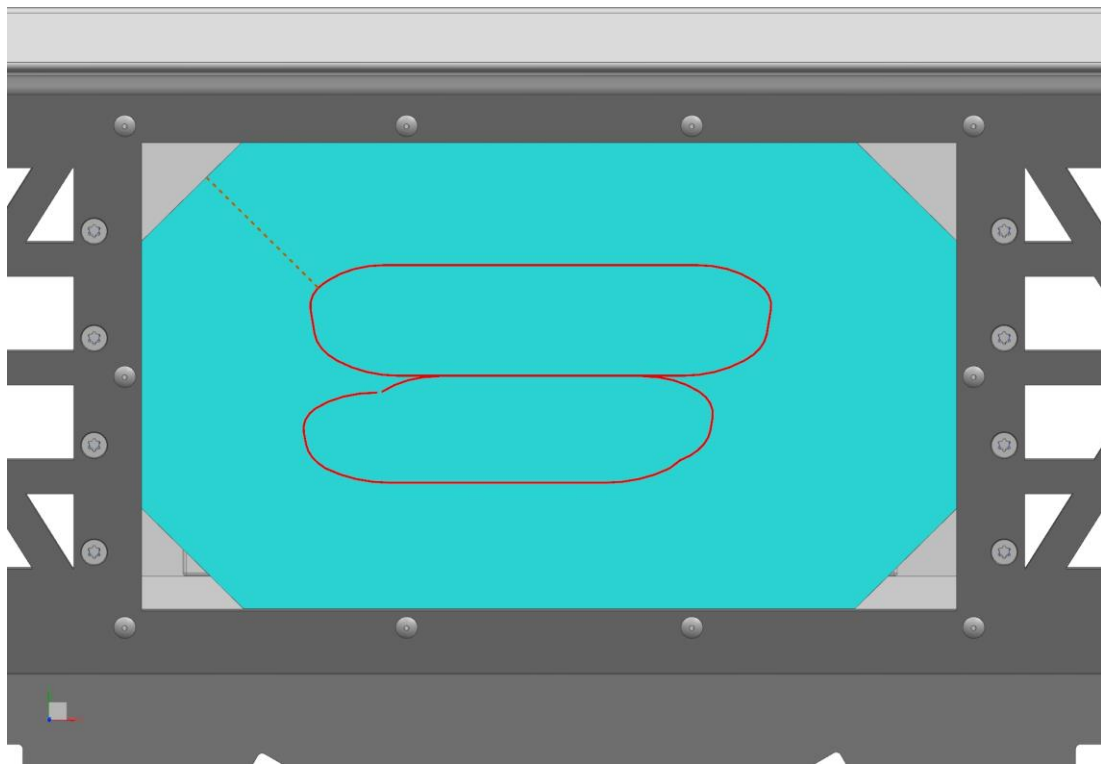


Fig. 10: Front view of the R&S®QAR-Z42 verification set. The intersection area between the radar cone and the radome is marked in red. The minimum distance is calculated as the shortest distance between the radome border (edges of the cyan colored surface) and the intersection polygon of the radar beam and the radome surface (red outline). One of the eight calculated minimum distances is shown as a dotted line on the top left edge.

Ordering information

Designation	Type	Order No.
Quality automotive radome tester	R&S®QAR	1336.6008.02
Options		
Transmitter module, copolar polarization	R&S®QAR-Z10	1336.5401.02
Transmitter module, horizontal polarization	R&S®QAR-Z10	1336.5401.03
Platform	R&S®QAR-Z20	1336.5418.02
Platform horizontal	R&S®QAR-Z21	1336.5524.02
Calibration set	R&S®QAR-Z30	1336.5430.02
Verification set for R&S®QAR-Z10	R&S®QAR-Z40	1336.5447.02
Verification set for R&S®QAR-Z60	R&S®QAR-Z41	1336.5499.02
Verification set for R&S®QAR-K100	R&S®QAR-Z42	1336.5530.02
Verification set for R&S®QAR-K50	R&S®QAR-Z43	1343.0230.02
Mounting table	R&S®QAR-Z50	1336.5424.02
Reference reflector	R&S®QAR-Z60	1336.5453.02
Fixture for reference reflector	R&S®QAR-Z61	1336.5476.02
Absorber wall	R&S®QAR-Z70	1336.5460.02
Software options		
Software for radome measurement	R&S®QAR-K10	1336.5501.02
OPC client for radome measurement	R&S®QAR-K11	1340.5219.02
Software option for grid evaluation (requires R&S®QAR-K10)	R&S®QAR-K20	1343.0030.02
Software option for 1-cluster measurement (requires R&S®QAR-K10)	R&S®QAR-K50	1343.0018.02
Software for bumper measurement	R&S®QAR-K60	1336.5482.02
OPC client for bumper measurement	R&S®QAR-K61	1340.5225.02
Software for radar positioning measurement	R&S®QAR-K100	1336.5518.02
Software update		
Upgrade of the R&S®QAR to Windows 10 IoT	R&S®QAR-U1	1343.0501.02

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