

Test-System for Automotive Components acc. ISO 11452-9:2021

Raditeq Reseller Meeting 2024

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Content

- Requirements (according to standard)
- What needs to be considered?
- Selection of the correct components (according to standard)
- How does **a** solution look like?

ISO 11452-9:2021

Road vehicles

Component test methods for electrical disturbances from
narrowband radiated electromagnetic energy

Part 9: Portable transmitters

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Which "phenomenon" is being simulated?



Requirement according standard

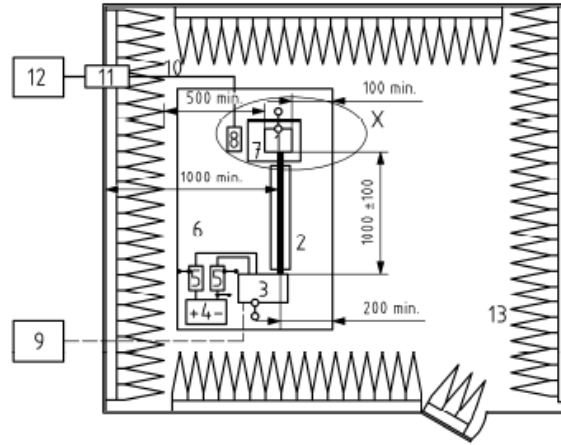
- Type of Test: Radiated Immunity
- Frequency Range: (26) 142 MHz – 6 GHz
- Test Level (following slide)
- ! Directional Coupler, Antenna and Cable as described in the standard !

Test Set-Up

ISO/DIS 11452-9

Dimensions in millimetres

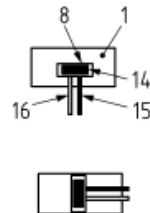
Upper View



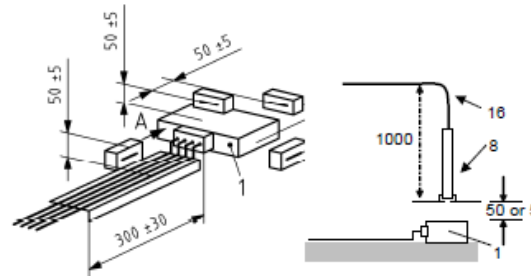
Key

- 1 DUT (grounded locally if required in test plan)
- 2 Test harness
- 3 Load simulator (placement and ground connection according to 7.5)
- 4 Power supply (location optional)
- 5 Artificial network (AN)
- 6 Ground plane (bonded to shielded enclosure)
- 7 Low relative permittivity support ($\epsilon_r \leq 1,4$)
- 8 Simulated portable transmitter
- 9 Stimulation and monitoring system
- 10 High quality double-shielded coaxial cable (50 Ω)
- 11 Bulkhead connector
- 12 RF signal generator, amplifier, coupler and power meter
- 13 RF absorber material

A^b



X^a



Test Level:

- *Net !!*

Prfg. Nr.	Dienst oder Band	Frequenzbereich MHz	Maximale Frequenzschrittweite kHz	Nettoleistung W	Modulation
MT_1	2 m	144 bis 148	100	10 (RMS)	CW
MT_2	70 cm	420 bis 450	1 000	7,5 (RMS)	CW
MT_3	TETRA /TETRAPOL	380 bis 390 410 bis 420 450 bis 460 806 bis 825 870 bis 876	400	7,5 (Peak)	PM 18 Hz 50 % duty cycle
MT_4	GSM 850 GSM 900 (Mobiltelefon)	824 bis 849 876 bis 915	500	3 (Peak)	PM 217 Hz 50 % duty cycle
MT_5	GSM 1800/1900 (Mobiltelefon)	1 710 bis 1 785 1 850 bis 1 910	1 000	1,5 (Peak)	PM 217 Hz 50 % duty cycle
MT_6	UMTS (Mobiltelefon)	824 bis 849 880 bis 915 1 850 bis 1 980 1 885 bis 2 025 1 920 bis 1 980	2 000	1 (Peak)	PM 1 600 Hz 50 % duty cycle
MT_7	Bluetooth, WIFI	2 400 bis 2 500	4 000	1 (Peak)	PM 1 600 Hz 50 % duty cycle
MT_8	LTE und 5G (Mobiltelefon)	452 bis 458 698 bis 803 807 bis 862 880 bis 915 1 427 bis 1 463 1 625 bis 1 661 1 710 bis 1 785 1 850 bis 2 025 2 300 bis 2 400 2 496 bis 2 690 3 400 bis 3 800	2 000	1 (Peak)	PM 1 000 Hz 10 % duty cycle
MT_9	IEEE 802.11a (WIFI)	5 150 bis 5 850	4 000	1 (Peak)	PM 1 600 Hz 50 % duty cycle
MT_10	IEEE 802.11p (DSRC)	5 850 bis 5 925	4 000	2 (Peak)	PM 1 600 Hz 50 % duty cycle

BONN Amplifier Range

BLWA 20 ... 6000 MHz
Halbleiterverstärker

BONN Elektronik 
YOUR ULTIMATE RF POWER SOURCE

STANDARDMODELLE

Modell	Frequenzbereich	Ausgangsleistung P _N min / typ W	Verstärkung min / typ dB	Harmonische 2te / 3te dBc	Netzleistung VA	Abmessungen (H, T) 19"-System	Gewicht kg
<u>BLWA 0260-15</u>	25 ... 6000 MHz	15 / 20	42 / 46 ±4	12 / 12	260	2 HE, 430 mm	14
<u>BLWA 0260-20D</u>	20 ... 6000 MHz 20 ... 1000 MHz 1000 ... 6000 MHz	20 / 25 20 / 25	43 / 45 ±2 43 / 45 ±2	20 / 20 15 / 20	450	3 HE, 430 mm	19
<u>BLWA 0260-25D</u>	20 ... 6000 MHz 20 ... 1000 MHz 1000 ... 6000 MHz	25 / 30 25 / 30	44 / 46 ±2 44 / 46 ±2	20 / 20 15 / 20	500	3 HE, 430 mm	19
<u>BLWA 0260-30/10D</u>	20 ... 6000 MHz 20 ... 1000 MHz 1000 ... 6000 MHz	30 / 35 10 / 13	44,8 / 47 ±2 40 / 43 ±3	20 / 20 15 / 20	320	2 HE, 430 mm	17
<u>BLWA 0260-30/20/10D</u>	20 ... 6000 MHz 20 ... 1000 MHz 1 ... 2,5 GHz 2,5 ... 6 GHz	30 / 35 20 / 25 10 / 13	44,8 / 47 ±2 43 / 46 ±3 40 / 43 ±3	25 / 20 15 / 20 15 / 20	320	2 HE, 430 mm	14

BONN Amplifier Range

BLWA 80 ... 6000 MHz
Halbleiterverstärker

BONN Elektronik 
YOUR ULTIMATE RF POWER SOURCE

STANDARDMODELLE

Modell	Frequenzbereich	Ausgangsleistung P_N min / typ W	Verstärkung min / typ dB	Harmonische 2te / 3te dBc	Netzleistung VA	Abmessungen (H, T) 19"-System	Gewicht kg
BLWA 0860-10D	80 ... 6000 MHz 80 ... 1000 MHz 1000 ... 6000 MHz	10 / 12 10 / 12	40 / 42 ±2 40 / 42 ±2	20 / 20 15 / 20	270	2 HE, 430 mm	15
BLWA 0860-30D	80 ... 6000 MHz 80 ... 1000 MHz 1000 ... 6000 MHz	30 / 35 30 / 35	44,8 / 47 ±2 44,8 / 47 ±2	20 / 20 15 / 20	500	3 HE, 430 mm	15
BLWA 0860-50/20D	80 ... 6000 MHz 80 ... 1000 MHz 1000 ... 6000 MHz	50 / 60 20 / 30	47 / 49 ±2 43 / 46 ±3	20 / 20 15 / 20	700	3 HE, 430 mm	18

Directional Coupler

6.2.2 Dual directional coupler

The coupler shall exhibit the following characteristics:

- coupling factor: >20 dB (40 dB recommended),
- mainline port VSWR: <1,3,
- coupling port VSWR: <1,5,
- mainline transmission loss: <0,5 dB,
- directivity: >18 dB.

Selection of coupling factor (20 – 40 dB) shall be compatible with the sensitivity of the measurement equipment used to measure forward and reflected power (see [6.2.3](#) for details).

Directional Coupler

BDC 0.1 ... 6 GHz Directional Coupler

BONN Elektronik 
YOUR ULTIMATE RF POWER SOURCE

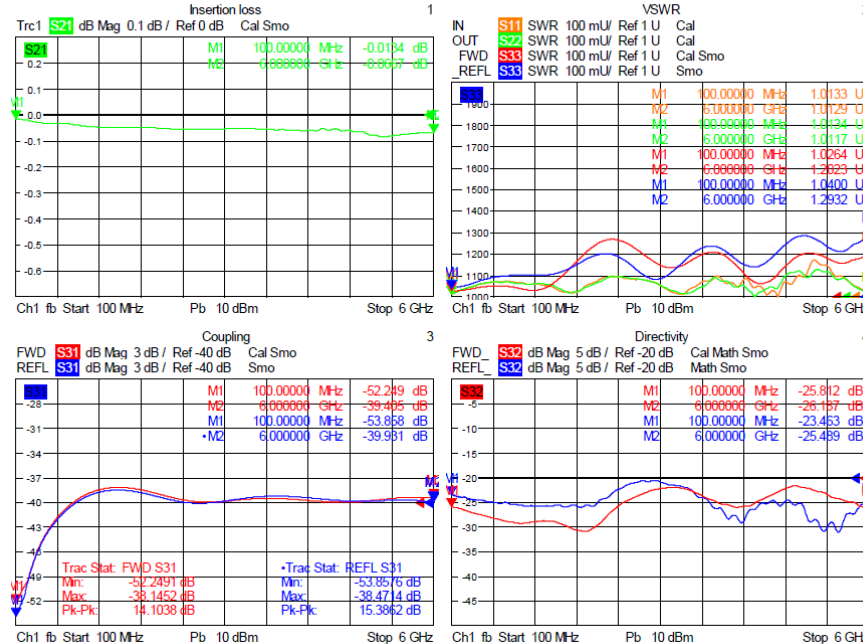
STANDARD MODELS

Model	Frequency Range X)	Coupling X) dB	Power P _{min} W	Insertion Loss max dB	Directivity min dB	VSWR max Main Line	Main Line Connector 1), 2)	Coupling Line Connector 3)
BDC 0160-30/500	0.1 ... 6 GHz					1.3:1	N-f	N-f
	144 ... 146 MHz	45 ±3	500	0.2	20			
	400 ... 450 MHz	36 ±3	500	0.2	20			
	0.7 ... 6 GHz	30 ±2	500	0.2	20			
BDC 0160-40/500	0.1 ... 6 GHz					1.3:1	N-f	N-f
	144 ... 146 MHz	55 ±3	500	0.2	20			
	400 ... 450 MHz	46 ±3	500	0.2	20			
	0.7 ... 6 GHz	40 ±2	500	0.2	20			
BDC 0160-50/500	0.1 ... 6 GHz					1.3:1	N-f	N-f
	144 ... 146 MHz	65 ±3	500	0.2	20			
	400 ... 450 MHz	56 ±3	500	0.2	20			
	0.7 ... 6 GHz	50 ±2	500	0.2	20			

For individual data sheets, please click on the above model name
S: Single directional coupler

Directional Coupler

Test Data BDC 0160-40/500 100 MHz ... 6 GHz :: SN 2230781



accredited calibration @ KIWA...

CPL004KT Dual Directional Coupler

Kiwa DARE B.V.
Calibrations lab.

100 MHz-6
GHz

EMC/RF RvA

990.00

695.00

Add info

Antenna Types

Table 1 — Transmit antenna types

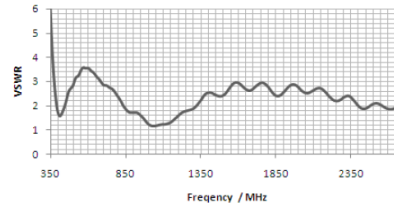
Antenna description	Frequency coverage
Folded dipole antennas	142 MHz – 246 MHz
Sleeve antennas	380 MHz – 460 MHz ^a
Broadband dipole antenna	360 MHz – 2 700 MHz
Broadband sleeve antenna	700 MHz – 3 200 MHz
Microwave broadband dipole antenna	2 000 MHz – 6 000 MHz
HF broadband sleeve antenna	2 400 MHz – 6 000 MHz
^a Requires antenna tuning for selected test frequencies (see Annex C).	

Miniature Broadband Antenna

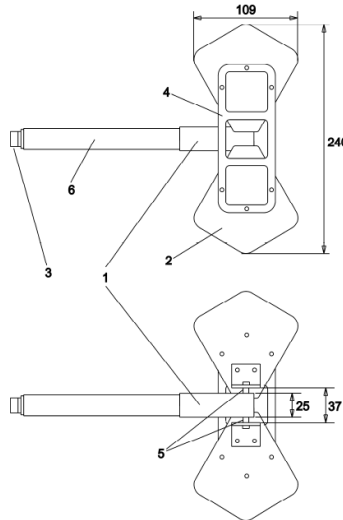
Typical characteristics

- Input impedance: 50 Ohms
- Balun transformation ratio: 1:1
- Frequency range: 360 - 2700 MHz
- Radiating element dimensions: 240 x 109 mm
- Maximum Power input 20 W
- Connector: Type N-female

Typical VSWR Characteristics

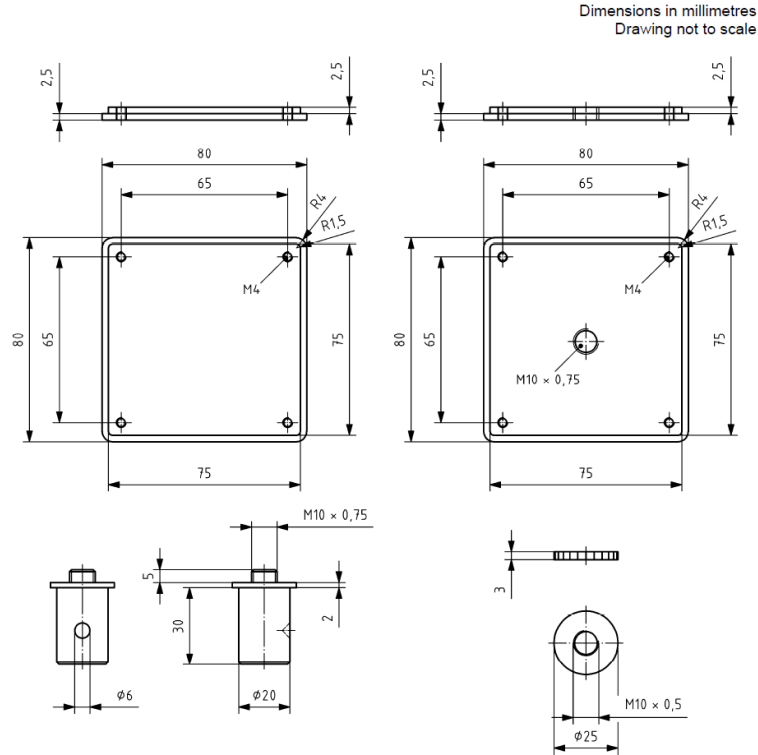


Below drawing to scale



Schwarzbeck 420 NJ





Schwarzbeck HLC 27



Schwarzbeck Antenna-Set

- ISO 11452-9
- OEM Standards

Toyota TSC 7006G
TL 82166:2009-05



SWBC – Sheath Wave Blocking Cable

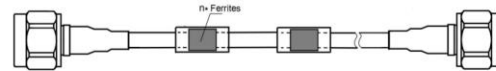


SWBC-A02 – Sheath Wave Blocking Cable

Model: SWBC-A02-07-07-5M/CH RF Connectors: N-m (optional -f) Length: 5 m

Sheath waves are a form of (mostly unwanted) electromagnetic waves on the outer conductor (or sheath) of a coaxial cable. Due to the unwanted emission of conducted and/or radiated electromagnetic signals, those interfere with EMC measurements. High-frequency sheath waves on coaxial cables can be suppressed e.g. with our special sheath wave blocking cable using ferrite cores.

Typical application: e.g. mobile testing ISO 11451-3 and ISO 11452-9



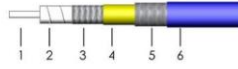
Attenuation & RF Power

Frequency GHz	0,01	0,05	0,1	0,5	1	5	10	50	100	500	1000	2000	3000
Total Cable Assembly Attenuation dB	0,1	0,1	0,1	0,1	0,1	0,1	0,3	0,5	0,7	1,1	1,7	2,2	2,9
CW Power W	500	500	500	500	500	450	400	400	300	300	200	100	100

Construction

Description	Diameter	Material
1 Center Conductor	1,29 mm	Solid SPC
2 Dielectric	3,68 mm	Expanded PTFE Tape
3 Outer Conductor	3,86 mm	SPC Strip
4 Interlayer	4,03 mm	Aluminum Polyester
5 Outer Shield	4,42 mm	SPC Braid
6 Jacket	4,95 mm	FEP
Ferrite Cover	10,00 mm	Shrink Tubing

PTFE: FEP before SPC: silver plated copper



Bend Radius: installation 75 mm

Bend Radius: repeated 150 mm

Weight approx. 5 kg

Temperature Range -55 ... +85 °C

Sheath Wave Attenuation (typical)



6.2.4 Low loss coaxial cable

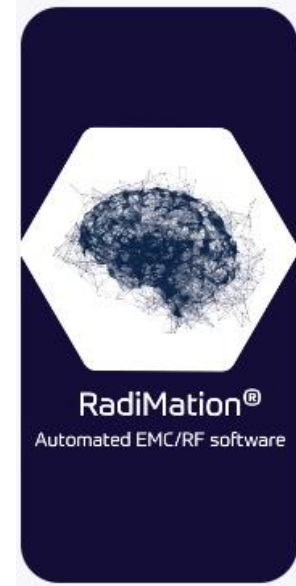
The 50 Ω coaxial cable assembly (including all adaptors, switches, etc.) connecting the dual directional coupler to the transmit antenna shall exhibit a VSWR <1,1 and transmission loss <4 dB. Verification shall be performed in accordance with [Annex A](#).



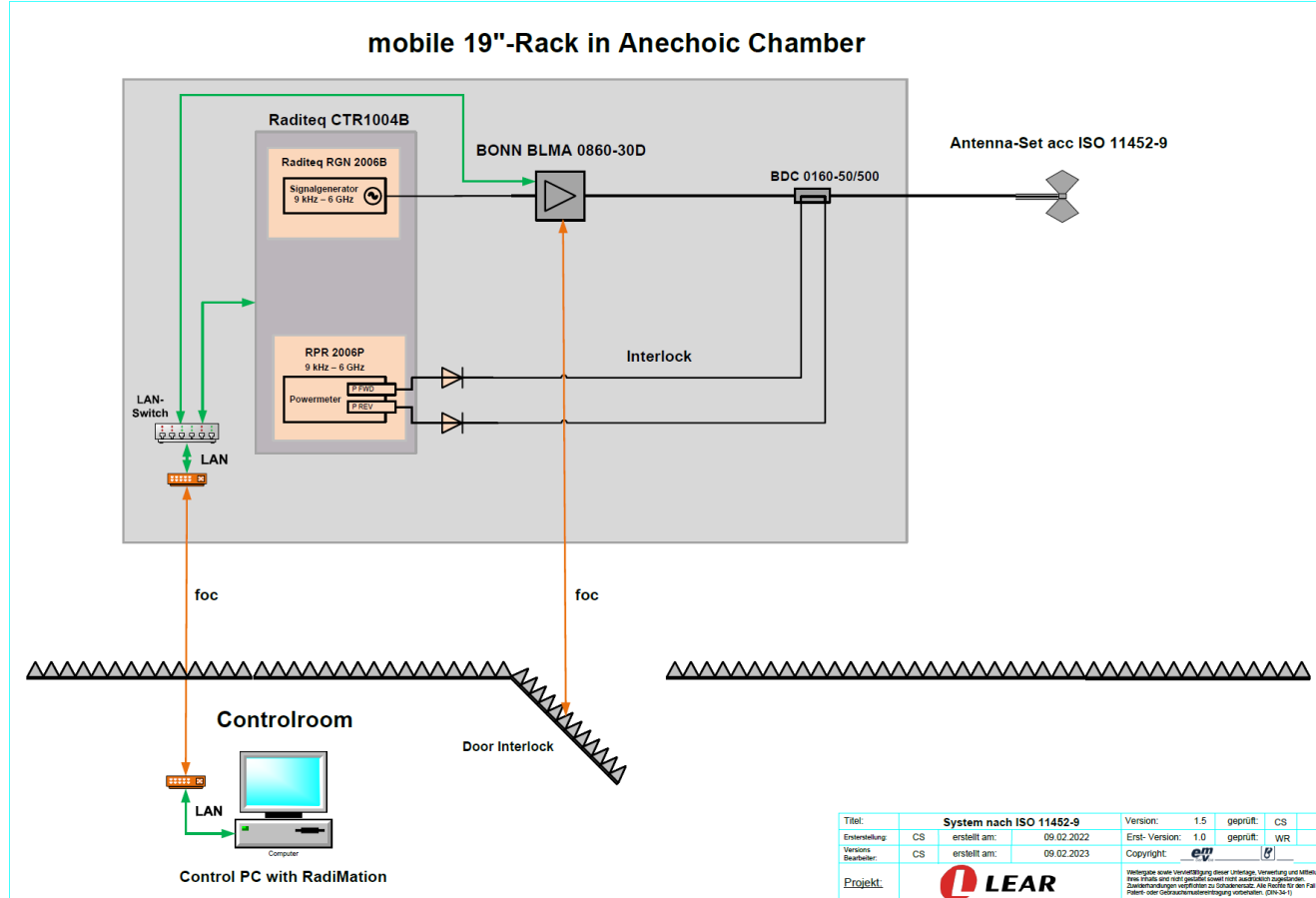
Signalgenerator / Powermeter / Software



RadiPower RPR2006P

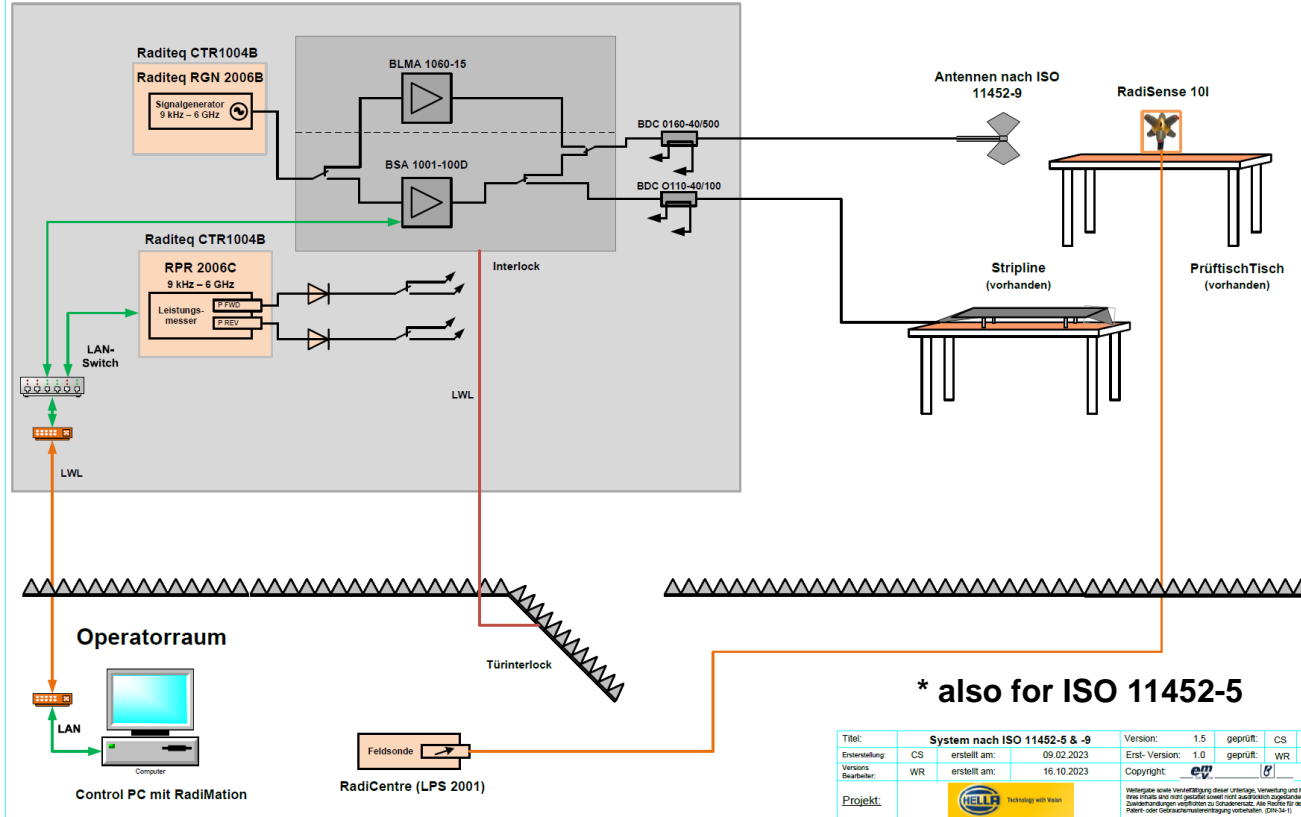


System Overview

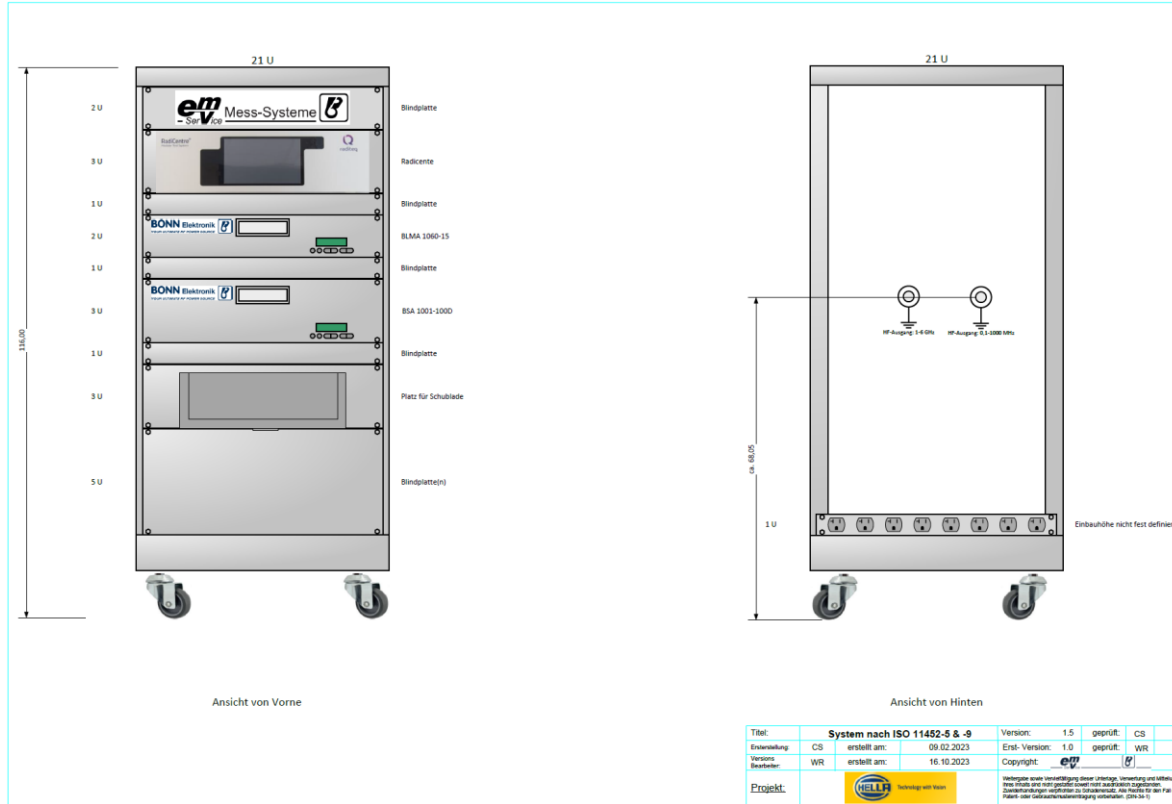


System Overview

mobiles Rack in Absorberkabine

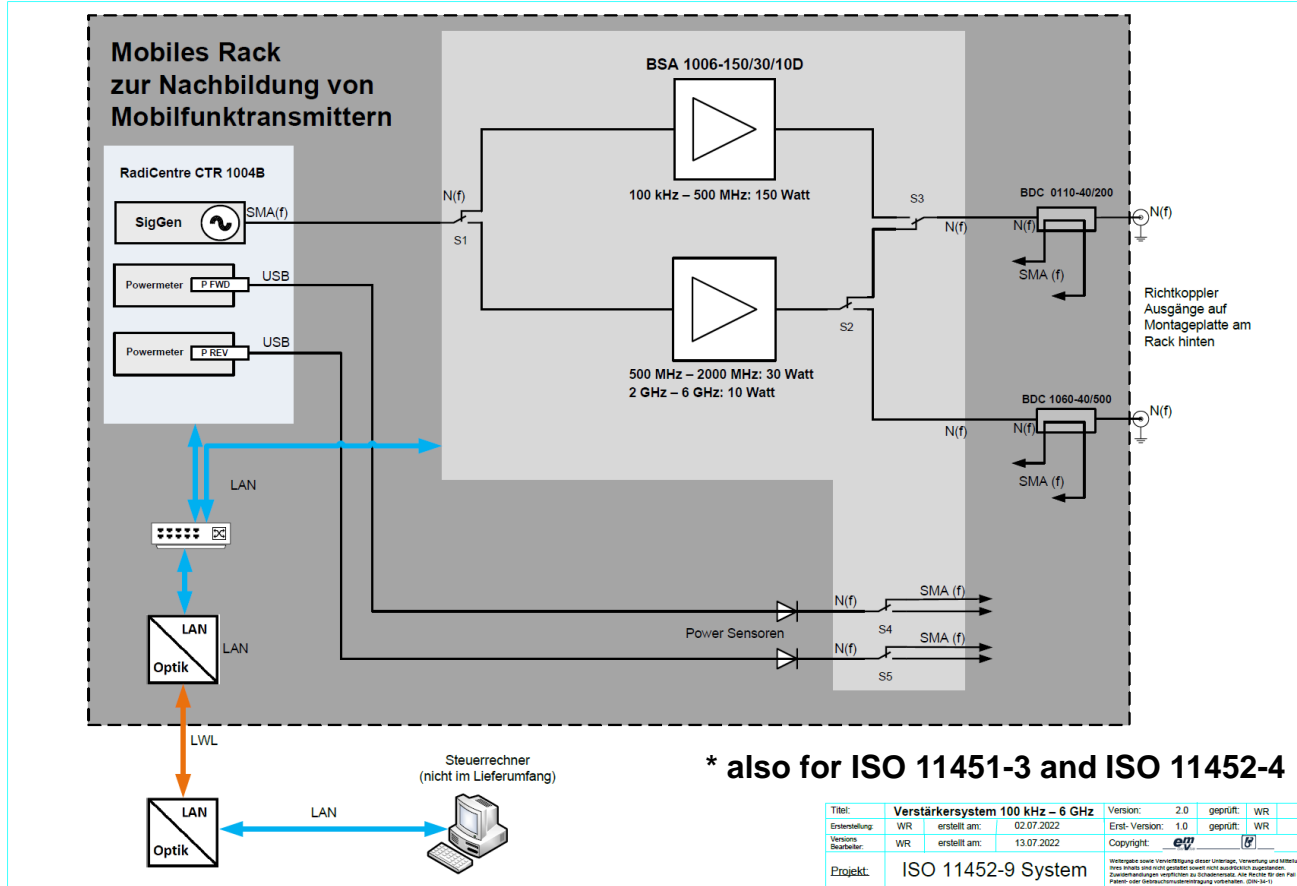


mobile Rack*



* also for ISO 11452-5

System Overview*



mobile Rack*



* also for ISO 11451-3 & ISO 11452-4

Future Requirements...

Table B.1 (continued)

Transmitter designation	Frequency [MHz]	Power ^a [W]	Typical transmitter modulation	Test modulation
Bluetooth, WLAN (data) WIFI	2 400 to 2 500	0,10(Peak)	QPSK	PM 1 600 Hz 50 % duty cycle Or broadband noise of 20MHz by AWG See Annex F
LTE (mobile phone OFDMA & SC-FDMA)	452 to 458 698 to 803 / 807 to 862 / 880 to 915 / 1 427 to 1 463 1 625 to 1 661 / 1 710 to 1 785 1 850 to 2 025 / 2 300 to 2 400 2 496 to 2 690 3 400 to 3 800	0,25(Peak)	OFDM - PSK	PM 1 000 Hz 10 % duty cycle Or broadband noise of 20MHz by AWG See Annex F
IEEE 802.11a (5G WIFI)	5 150 to 5 350 5 725 to 5 850	0,5(Peak)	OFDM - PSK	PM 1 600 Hz 50 % duty cycle Or broadband noise of 20MHz by AWG See Annex F

^a Power levels listed are typical of commercial equipment. However, power levels used during testing with simulated portable transmitters will be dependent on the test antenna used (see [Annex C](#)). Typically, the power levels using the simulated portable transmitter antenna will be higher (see [Annex D](#)).

... and also the extended Frequency Range up to 7.125 GHz

Questions?



Vielen Dank! Thanks!