

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

Contents	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Test conditions	1
5 Test location	2
6 Test instrumentation	2
6.1 General	2
6.2 Simulated portable transmitters	2
6.2.1 General	2
6.2.2 ● Dual directional coupler	3
6.2.3 Power monitoring	3
6.2.4 ● Low loss coaxial cable	4
6.2.5 Vector network analyser (VNA)	4
6.2.6 ● Transmit antenna	4
6.2.7 Stimulation and monitoring of the DUT	5
7 Test set-up	5
7.1 Ground plane	5
7.2 LV power supply system	5
7.3 HV power supply system	6
7.4 Location of the DUT	6
7.5 Location of the test harness	7
7.6 Location of the load simulator	7
7.7 Location of the simulated portable transmitter equipment	7
8 Test procedure	17
8.1 General	17
8.2 Test plan	17
8.3 Test procedure	17
8.3.1 General	17
8.3.2 DUT test	18
8.3.3 Antenna positioning for coupling to the DUT/connectors	21
8.3.4 Antenna positioning for coupling to harness	26
8.4 Test report	36
Annex A (normative) Net power characterization procedure	37
Annex B (informative) Typical characteristics and use of portable transmitters	48
Annex C (informative) Characteristics of simulated portable transmitter antenna	51
Annex D (informative) Function performance status classification (FPSC)	73
Annex E (informative) Remote/local grounding	74
● Annex F (informative) Broadband noise source by AWG (arbitrary waveform generator)	76

Which "phenomenon" is being simulated?



Requirement according standard

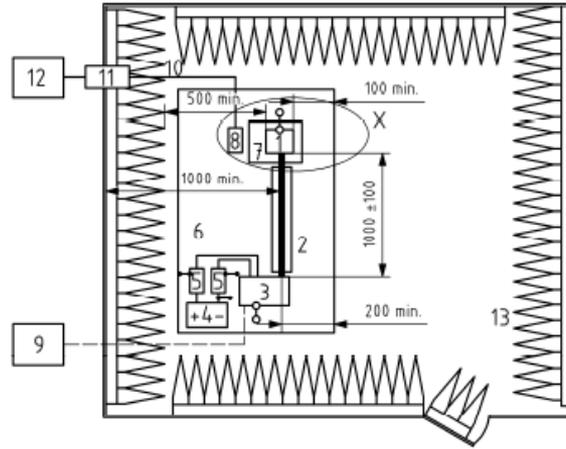
- Type of Test: Radiated Immunity
- Frequency Range: (26) 142 MHz – 6 GHz
- Test Level (following slide)
- **! Directional Coupler, Antenna and Cable as described in the standard !**

Test Set-Up

ISO/DIS 11452-9

Dimensions in millimetres

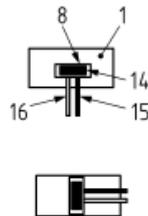
Upper View



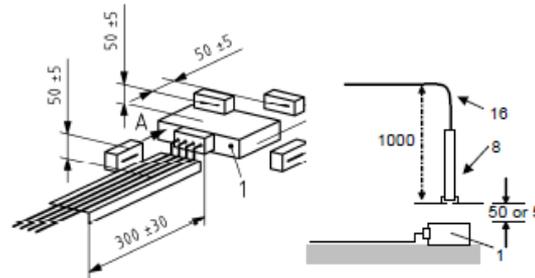
Key

- 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 (50Ω)
- 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	Nettleistung 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
BLWA 0260-15	25 ... 6000 MHz	15 / 20	42 / 46 ±4	12 / 12	260	2 HE, 430 mm	14
BLWA 0260-20D	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
BLWA 0260-25D	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
BLWA 0260-30/10D	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
BLWA 0260-30/20/10D	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

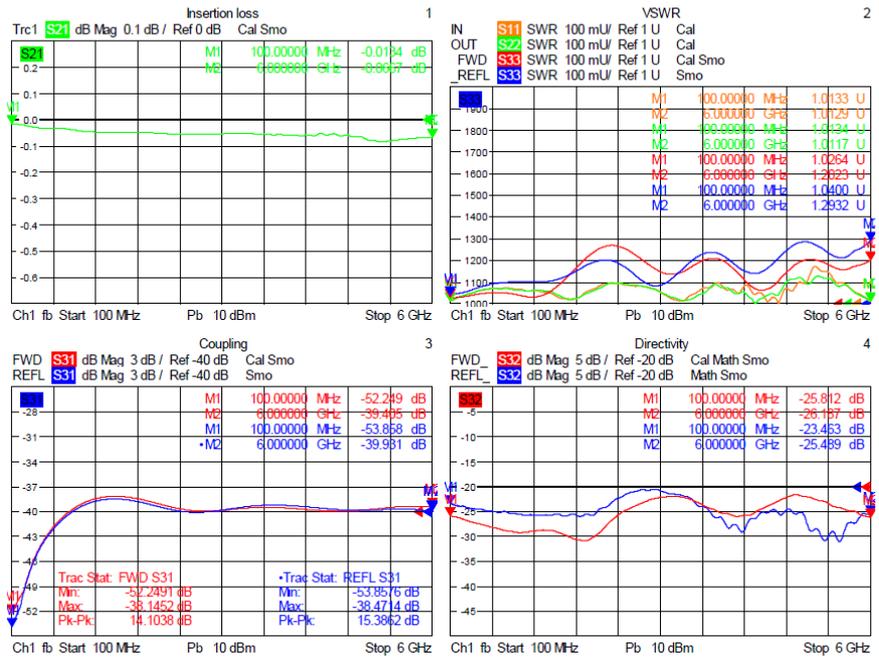
STANDARD MODELS

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 <input type="button" value="Add"/> <input type="button" value="info"/>

Antenna Types

Table 1 — Transmit antenna types

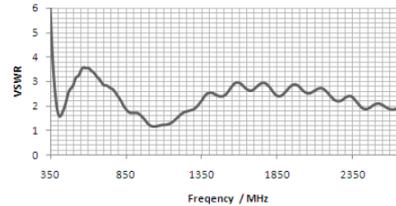
Antenna description	Frequency coverage
Folded dipole antennas	142 MHz – 246 MHz
Sleeve antennas	380 MHz – 460 MHz ^a
Broadband dipole antenna	360 MHz – 2 700 MHz
Broadband sleeve antenna	700 MHz – 3 200 MHz
Microwave broadband dipole antenna	2 000 MHz – 6 000 MHz
HF broadband sleeve antenna	2 400 MHz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

Miniature Broadband Antenna

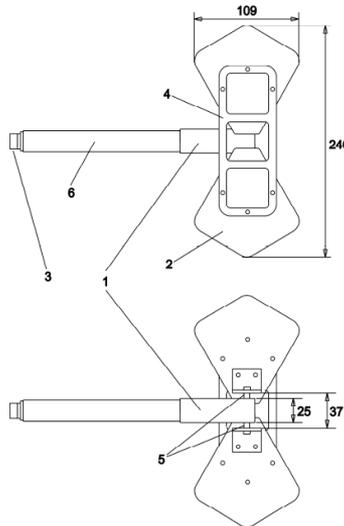
Typical characteristics

- 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 Antenna-Set

- ISO 11452-9
- OEM Standards

Toyota TSC 7006G
TL 82166:2009-05



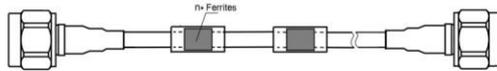
SWBC – Sheath Wave Blocking Cable



SWBC-A02 – Sheath Wave Blocking Cable

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

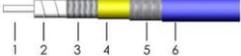
Sheath waves are a form of (mostly unwanted) electromagnetic waves on the outer conductor (or sheath) of a coaxial cable. Due to the unwanted emission of conducted and/or radiated electromagnetic signals, those interfere with EMC measurements. High-frequency sheath waves on coaxial cables can be suppressed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

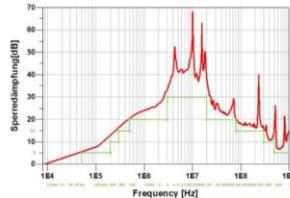
Frequency GHz	0,01	0,05	0,1	0,5	1	5	10	50	100	500	1000	2000	3000
Total Cable Assembly Attenuation dB	0,1	0,1	0,1	0,1	0,1	0,1	0,3	0,5	0,7	1,1	1,7	2,2	2,9
CW Power W	500	500	500	500	500	450	400	400	300	300	200	100	100

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 Strig	
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-tubus	SPC: silver plated copper	

Sheath Wave Attenuation (typical)

Sheath Wave Attenuation	from	to
5 dB	50 kHz	3 GHz
10 dB	200 kHz	500 MHz
15 dB	300 kHz	300 MHz
20 dB	500 kHz	80 MHz
30 dB	3 MHz	20 MHz



6.2.4 Low loss coaxial cable

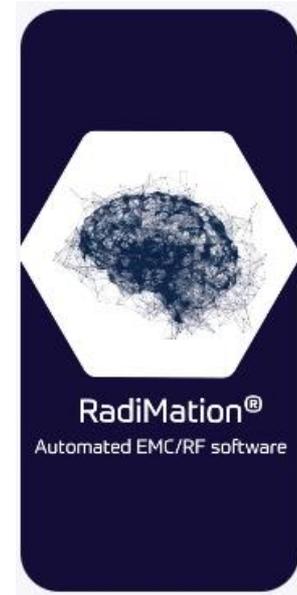
The 50 Ω coaxial cable assembly (including all adaptors, switches, etc.) connecting the dual directional coupler to the transmit antenna shall exhibit a VSWR <1,1 and transmission loss <4 dB. Verification shall be performed in accordance with [Annex A](#).



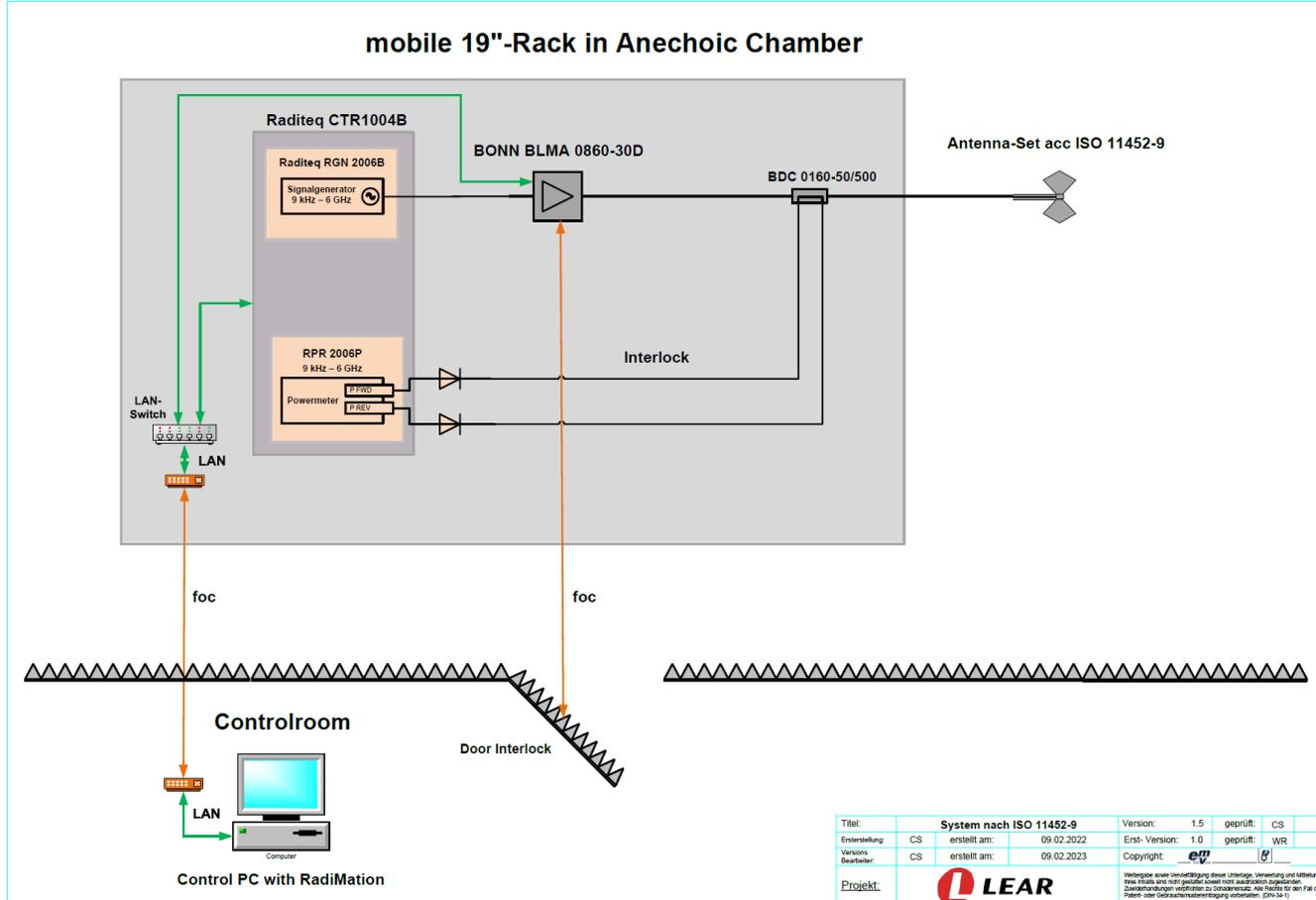
Signalgenerator / Powermeter / Software



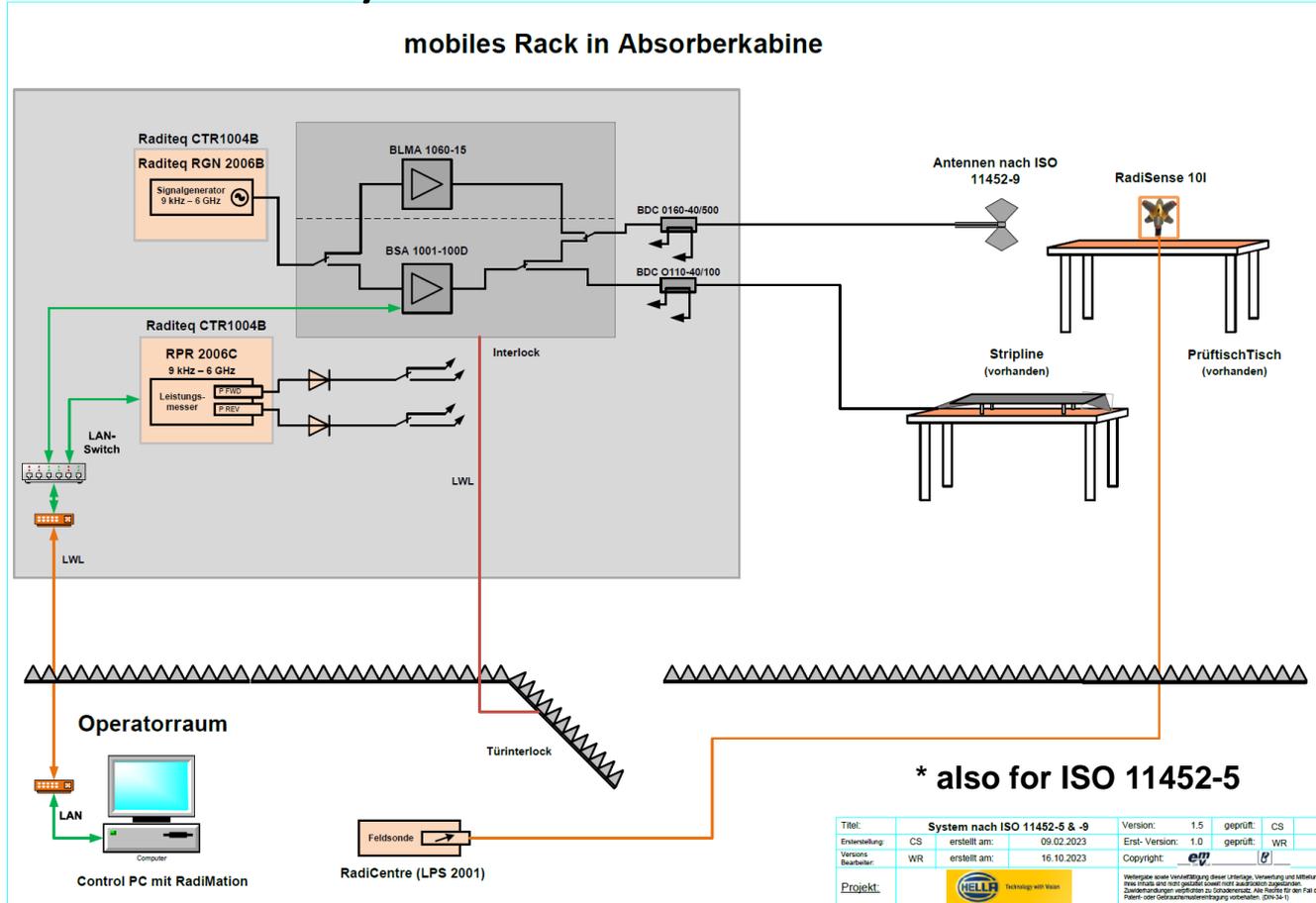
RadiPower RPR2006P



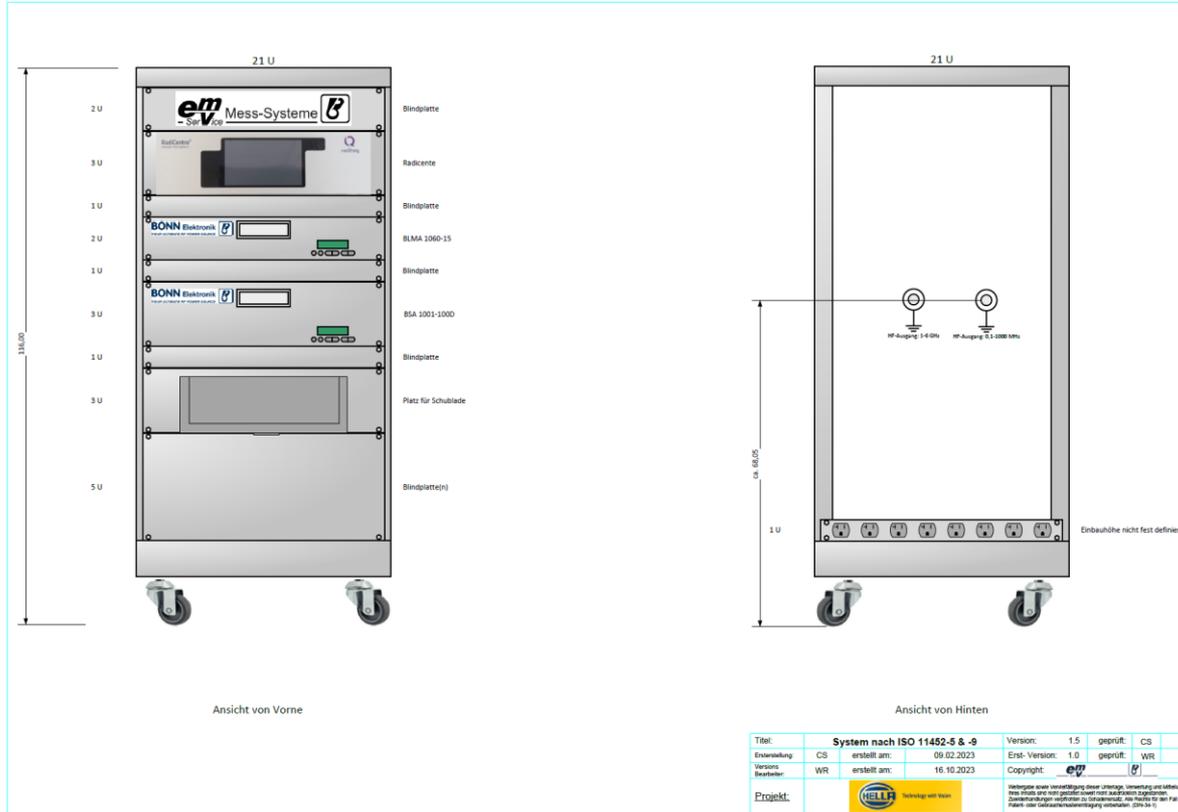
System Overview



System Overview

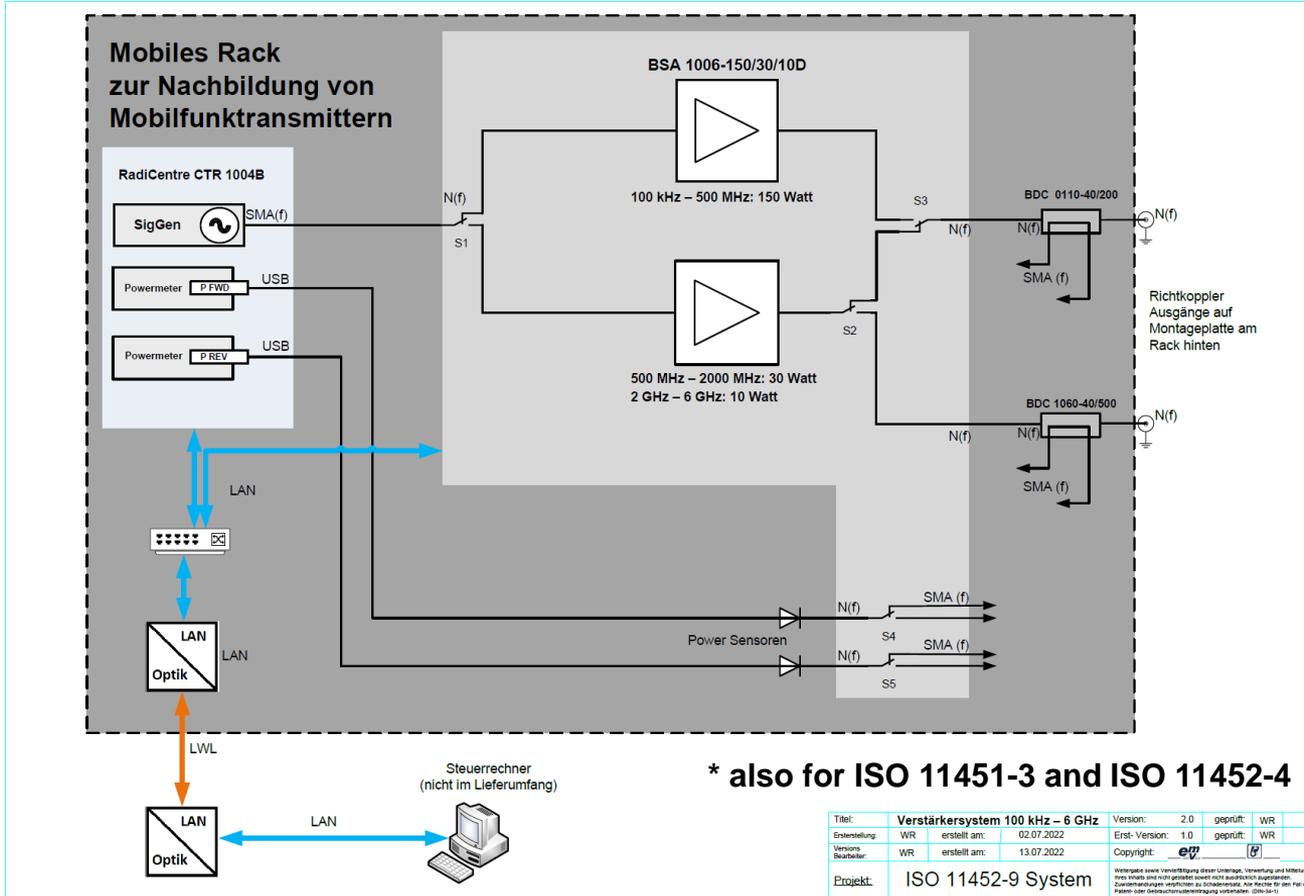


mobile Rack*



* also for ISO 11452-5

System Overview*



Titel: Verstärkersystem 100 kHz – 6 GHz		Version: 2.0	geprüft: WR
Erstellung: WR	erstellt am: 02.07.2022	Erst-Version: 1.0	geprüft: WR
Version: WR	erstellt am: 13.07.2022	Copyright:	
Projekt: ISO 11452-9 System		<small>Alle Rechte vorbehalten. Nachdruck, Vervielfältigung und Verbreitung, auch auszugsweise, ist ohne schriftliche Genehmigung der em Service GmbH. Für alle weiteren Informationen kontaktieren Sie bitte den Projektleiter.</small>	

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 E
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 E

^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!