AIE-4X4LR

4X4 Channel Air Interface Emulator, 500…9000 MHz

Features

- wideband
- 2 watts power capability
- 63.5 dB attenuation range
- LAN and USB Remote Interface
- trigger interface
- compact 19", 1 U device

Applications

- Air Interface Emulation
- MIMO emulation
- GSM, UMTS, LTE, 5G
- Handover testing
- Fading simulation

At a Glance

The AIE-4X4LR air interface emulator enables real emulation of RF levels for radio communication between mobile devices and wireless networks. It has 4 RF Ports for base stations and 4 ports for DUTs like cellular phones. All signal paths are bidirectional. Every of the 4 DUT ports can be fed with a composite RF signal that is individually composed of a programmable mix of the 4 signals coming from the base station ports. The variation of levels can be done in a wide dynamic range with internal precision attenuators. The AIE-4X4LR allows to recreate a realistic air interface, whereby the DUTs receives multiple cellular stations simultaneously with varying propagation loss. In particular it allows the simulation of handovers between cellular base stations and cellular phones. The reproducible emulation of air interface scenarios in laboratory environment saves time and cost in product development and verification.

Matrix Function

The AIE-4X4LR can also be used as non-blocking matrix. Every output has free access to each input. Attenuators between the signal paths allow also the emulation of fading effects. With a fast attenuator response time, the device is an efficient and fast solution for automatic testing systems.

Wideband

The operating frequency range covers more than 500 MHz to 9000 MHz. Therefore, the AIE-4X4LR is useable for all cellular standards and Wi-Fi standards including 5G (FR1).
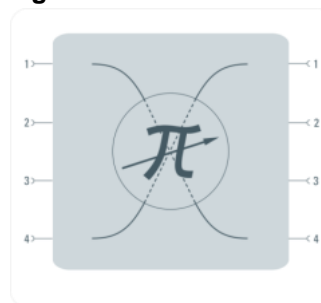
High Dynamic

The setting range of the digitally controlled attenuators covers 63.5 dB and is adjustable in 0.25 dB steps. This allows test scenarios with highest requirements for dynamics and accuracy. All RF ports of the air emulation system allow signals levels of up to 2 Watts.

Synchronous Operation

For remote control the AIE-4X4LR offers LAN and USB interfaces. AIE-4X4LR offers additional a TRIGGER IO port. This Interface provides a precise trigger pulse which complies with the physical execution of the applied switching command. On the other hand, external pulses can be applied to this port in order to trigger the execution of queued switching commands synchronously. The attenuator configuration of the emulator can be preloaded with SCPI oriented ASCII strings via LAN interface without execution. After a positive TTL pulse slope at the trigger input, the preloaded attenuator configuration will be executed only by hardware in micro seconds.

Principle Diagram

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Quality Made in Germany

Subject to change in specification and design without notice.
released version 1.01 - January 2025

RoHS compliant in accordance with
EU Directive 2015/863

RF Specification

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
impedance	Z_{IN}/Z_{OUT}		50		Ω	
low frequency	f_{min}		400	500	MHz	
high frequency	f_{max}	8500	9000		MHz	
number of RF inputs	n_{IN}		4			bi-directional
number of RF outputs	n_{OUT}		4			bi-directional
return loss[2]	S_{11}, S_{22}		-17	-10	dB	f ≤ 4 GHz
	S_{11}, S_{22}		-15	-9	dB	f > 4 GHz
insertion loss[1]	S_{21}	-22	-20		dB	f = 1 GHz
	S_{21}	-24	-21		dB	f = 2 GHz
	S_{21}	-31	-27		dB	f = 5 GHz
	S_{21}	-36	-32		dB	f = 7 GHz
	S_{21}	-39	-34		dB	f = 8 GHz
attenuation dynamic[3]	dATT		-30		dB	f < 1.7 GHz
	dATT		-50		dB	f ≥ 1.7 GHz
attenuation range	ΔS_{21}	0.00		63.50	dB	
attenuation resolution	dS_{21}		0.25		dB	
attenuation accuracy	ATT_{ERR}		± 0.50		dB	@ 3 GHz, ATT = 31.25 dB
attenuator settling time	t_{ASET}		1		µs	
atten. response time	t_{ARSP}		1		ms	
DC voltage	U_{DC}			20	V	all RF ports
ESD discharge resistor	R_{ESD}		4.7		kΩ	all RF ports
input power	P_{RF}			+33	dBm	CW
RF connector	X_{RF}		N female			rear side

*1: ch. attenuator setting: 0.00 dB

*2: ch. attenuator setting: 63.50 dB

*3: ch.. attenuator setting 63.50, all other ch. attenuator setting 0.00 dB, referred to insertion loss

TRIGGER IO Specification

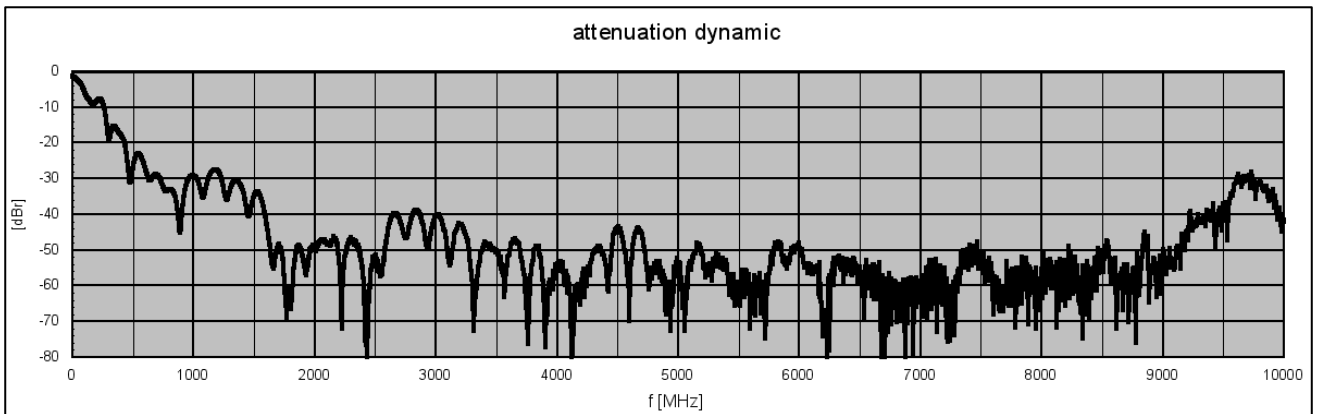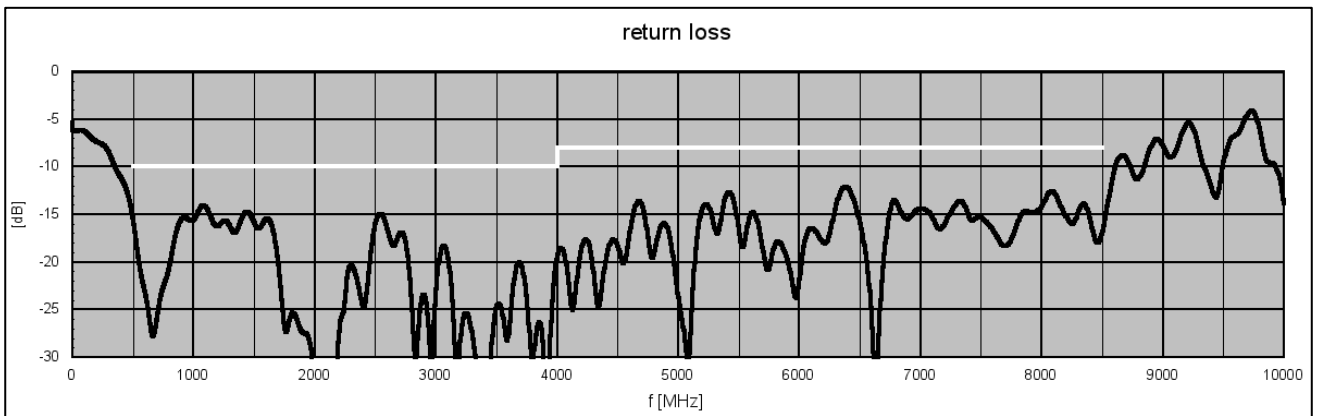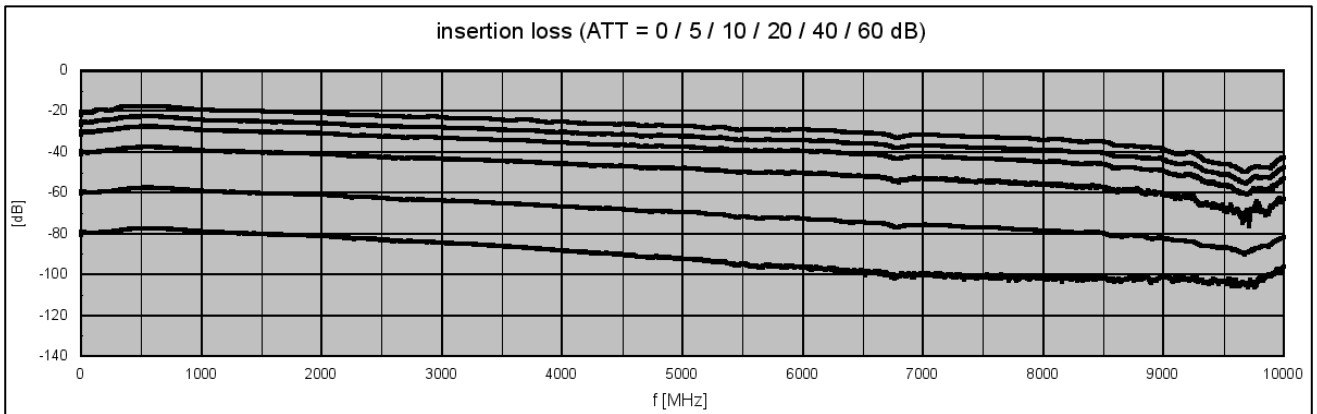| Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
connector type	X_{TRIG}		BNC female			
function type			open collector, wired AND			positive edge = trigger
			low state = BUSY			SLAVE mode
passive pull up	R_{PU}		1		kΩ	
active pull up	I_{PU}		10		mA	MASTER & OUT mode
drivable capacitance	C_D			2	nF	
port capacitance	C_L		110		pF	mode SLAVE
logic high level	U_H	2.0	5.0	5.5	V	
logic low level	U_L	-0.5	0.0	1.2	V	
pulse width	T_W		50		µs	
rise time	T_R		0.1[1]	0.5[2]	µs	
sinking current	I_S			60	mA	
trigger offset	t_o		0.5		µs	50% trigger signal to 50% RF-switching (trigger mode "OUT")
attenuator settling time	t_{RISE}		0.3		µs	10% → 90% RF

Note 1: capacitive load < 100 pF

Note 2: capacitive load ≤ 2 nF

Common Specification

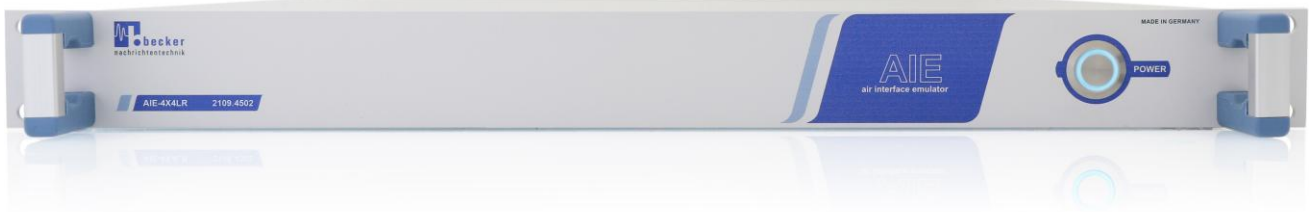| Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
voltage supply range	U_{AC}	90	230	260	V	50 / 60 Hz AC
power consumption	P_{AC}		4		W	
power socket	X_{AC}	IEC-60320 C14				country specific mains cable
Dimensions and weight						
dimensions	W x H x D	approx. 482 x 44 x 460			mm	19" 1 U, without connectors and handles
weight	m		7		kg	
Environment conditions						
operating temp. range	T_o	+5		+45	°C	
storage temp. range	T_s	-40		+70	°C	
Remote interfaces						
remote ports	LAN	10/100BaseT		TCP/IP		RJ45
	USB	2.0 (high speed)				USB type B
Product conformity						
Electromagnetic compatibility	EU: in line with EMC directive (2014/30/EC)					applied harmonized standards: EN 61326-1 (for use in industrial environment), EN 61326-2-1, EN 55011 (class B), EN 61000-3-2, EN 61000-3-3
Electrical safety	EU: in line with low voltage directive (2014/35/EC)					applied harmonized standard: EN 61010-1
Ordering information	AIE-4X4LR		P/N: 2109.4502.2			

S-Parameters (typical responses)

insertion loss (ATT = 0dB)

insertion loss (ATT = 0 / 5 / 10 / 20 / 40 / 60 dB)

return loss

attenuation dynamic
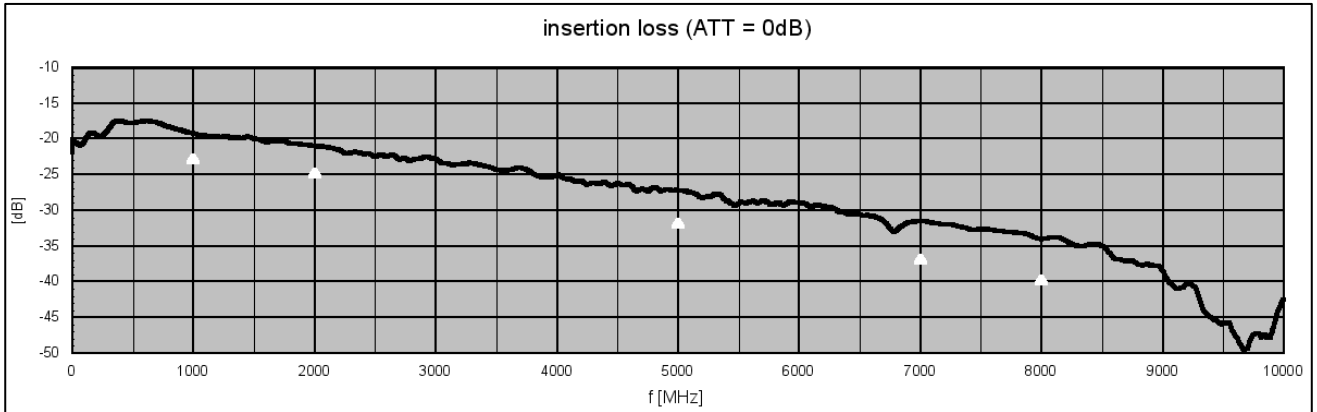
Appearances

Front View

Rear View

Dimensions

all Dimensions in mm
±2mm
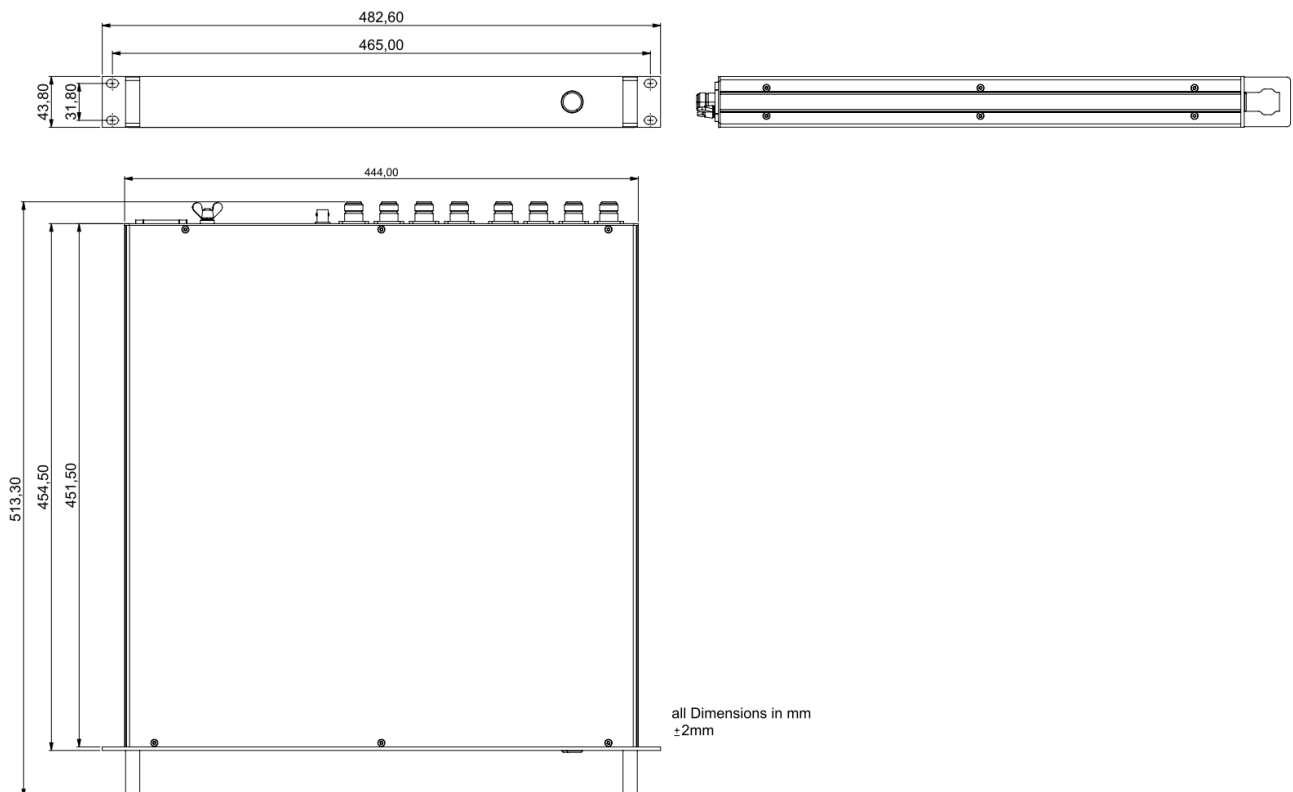
Related Products

Product	Description	P/N
AIE-W5LR	5 Port Air Interface Emulator, 500…9000 MHz, 1U 19" Device	2109.4002.1
AIE-W8LR	8 Port Air Interface Emulator, 500…8000 MHz, 2U 19" Device	2109.4102.1
AIE-4X4LR	4X4 Channel Air Interface Emulator, 500…9000 MHz, 127 dB attenuation range, 1U 19" Device	2109.4502.1
AIE-4X4LR	4X4 Channel Air Interface Emulator, 500…9000 MHz, 63.5 dB attenuation range, 1U 19" Device	2109.4502.2
AIE-4X8LR	4X8 Channel Air Interface Emulator, 500…9000 MHz, 63.5 dB attenuation range	2109.4602.2