

AIE-4X4LR

4X4 Channel Air Interface Emulator, 500...9000 MHz

Features

- 127 dB attenuation range
- High power capability
- LAN and USB Remote Interface
- Trigger interface
- Compact 19", 1 U device

Applications

- Air interface emulation
- Full fan-out matrix
- Multipoint radio fading simulation
- Mesh network testing
- Wi-Fi (802.11 a/h, ac, b, g, n, p)
- LTE 5G, 6G
- V2X, V2V



At a Glance

The AIE-4X4LR radio field emulator enables the realistic simulation of RF levels for wireless communication between mobile devices and wireless networks such as Wi-Fi or LTE. The device features 4 RF ports for base stations and 4 ports for DUTs (Devices Under Test), such as mobile phones. All signal paths are bidirectional. Each of the 4 DUT ports can be fed with an individually composed RF signal from the 4 base station ports. Likewise, the base stations can receive individually composed signals from the 4 DUT ports. The signal levels can be adjusted for each signal path using internal attenuators over an extended dynamic range.

Due to the device's wide frequency bandwidth, it can be used flexibly for almost all common wireless transmission standards, including GSM900, GSM1800, UMTS, LTE 4G, LTE 5G FR1, LTE6G, IEEE 802.11a/b/g/n/ac/ax (Wi-Fi 6E), and 802.11be (Wi-Fi 7). The reproducible emulation of air interface scenarios in a laboratory environment saves time and costs 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).

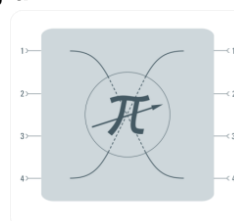
High Dynamic

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



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	$f \leq 4$ 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	$f \geq 1.7$ GHz
attenuation range	ΔS_{21}	0.00		63.50	dB	
attenuation resolution	d S_{21}		0.25		dB	
attenuation accuracy	ATT _{ERR}		± 0.50		dB	@ 3 GHz, ATT = 31.25 dB
attenuator settling time	t _{ASET}		1		μ s	
atten. response time	t _{ARSP}		1		ms	
DC voltage	U _{DC}			20	V	all RF ports
ESD discharge resistor	R _{ESD}		4.7		k Ω	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		k Ω		
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		μ s		
rise time	T _R		0.1 ¹	0.5 ²	μ s		
sinking current	I _S			60	mA		
trigger offset	t _o		0.5		μ s	50% trigger signal to 50% RF-switching (trigger mode "OUT")	
attenuator settling time	t _{RISE}		0.3		μ s	10% → 90% RF	

Note 1: capacitive load < 100 pF

Note 2: capacitive load ≤ 2 nF

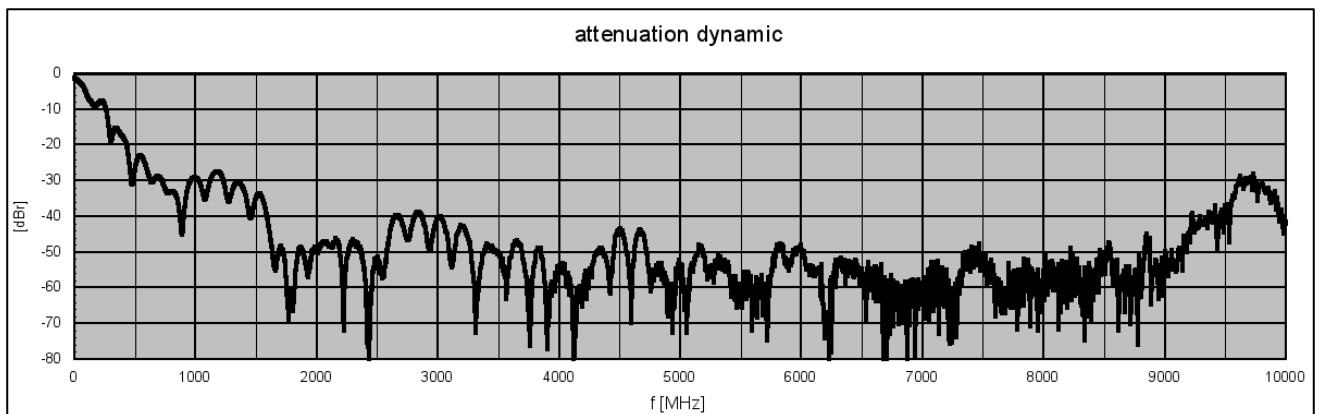
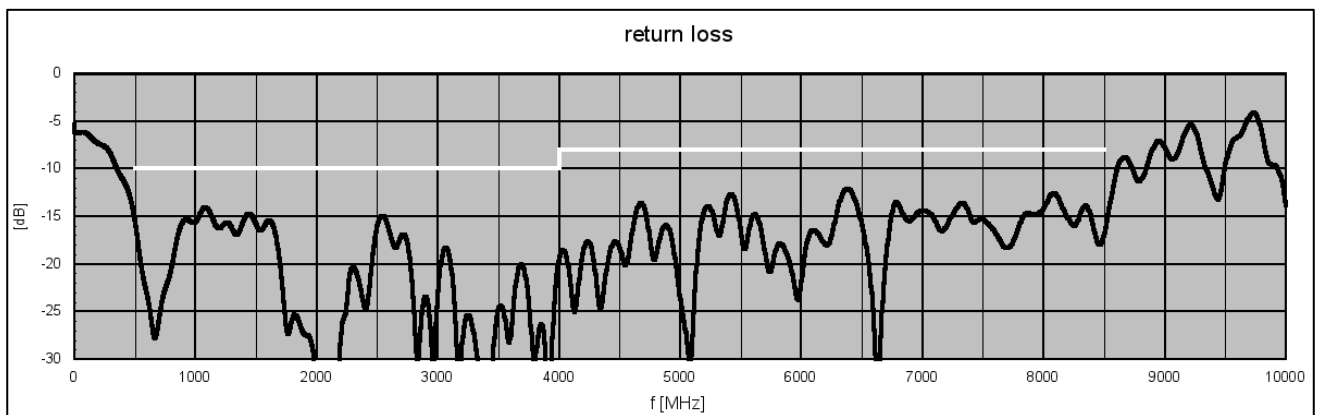
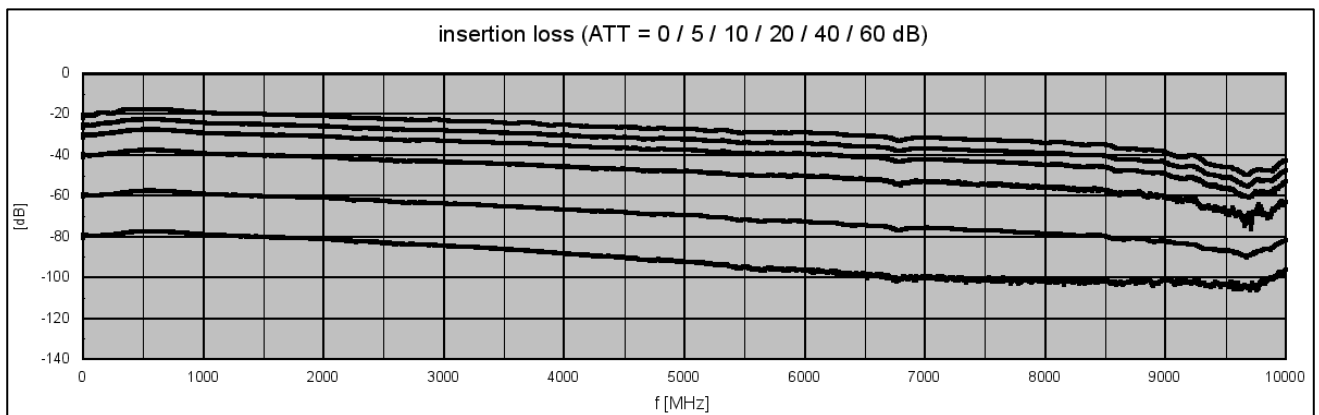
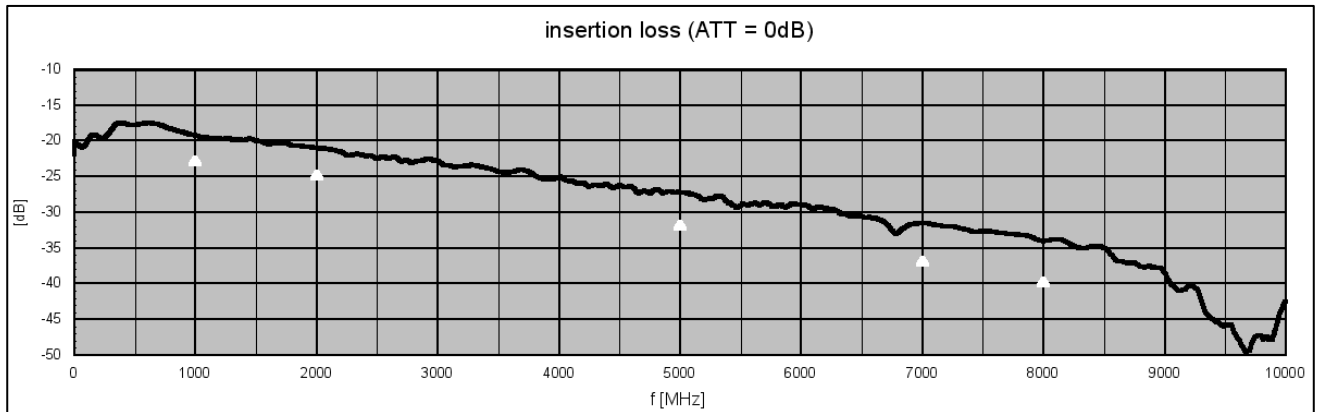


Common Specification

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			

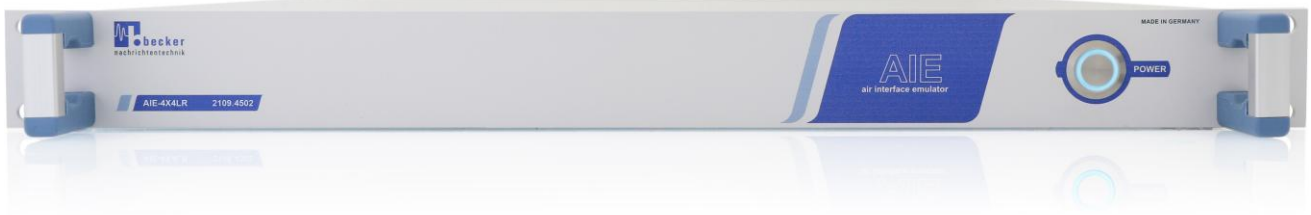


S-Parameters (typical responses)



Appearances

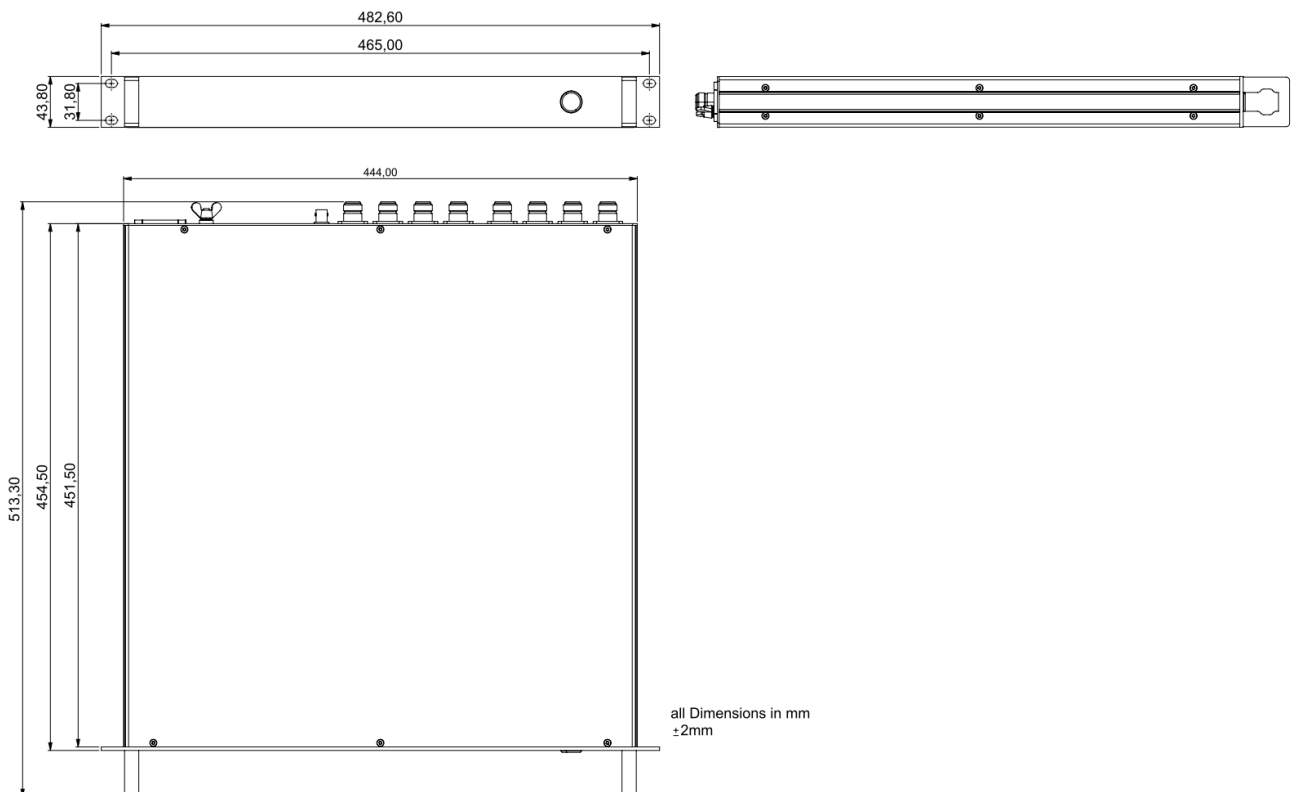
Front View



Rear View



Dimensions



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

