

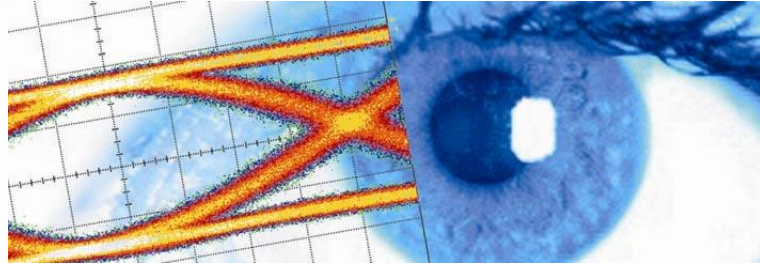


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
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Datasheet

SHF 78210 B

Synthesized Signal Generator

 **SHF 78210 B** Synthesized Signal Generator Power 

Input	Output
Modulation In 1 Vpp Max	Trigger Out < 0.65 Vpp
 	 
50 Ω / SMA Female	
	RF Out < +6 dBm 
	 
	50 Ω / 1.85 mm Male



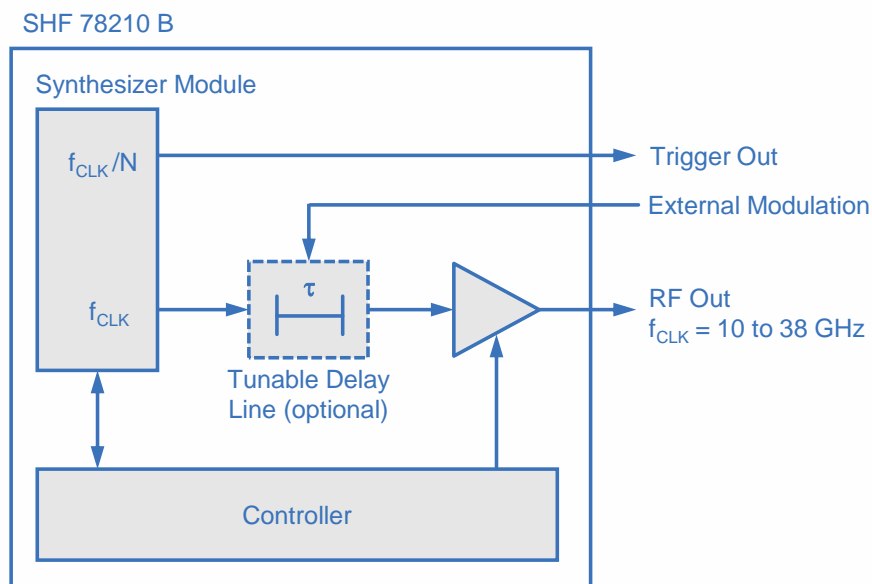
Description

The Synthesized Signal Generator SHF 78210 B was developed to provide our BERT system customers with a suitable internal clock source for their 100G Ethernet test applications, at reasonable cost. With a frequency range from 10 GHz to 38 GHz all bit rates of interest are covered. The output power can be varied between -3 dBm and +4 dBm in 0.1 dB steps.

For trigger purposes, the SHF 78210 B provides a trigger signal at a quarter or half of the RF output frequency.

Optionally, jitter injection functionality can be added to the signal generator module. Arbitrary jitter types may be applied to the clock signal using an external signal source, enabling various test scenarios such as serial data protocol compliance testing.

Block Diagram



Features

- Output clock frequency ranges from $f_{CLK} = 10$ to 38 GHz
- Output power adjustable from -3 to +4 dBm in 0.1 dB steps with an accuracy better than 0.1 dB
- Computer controlled
- Integrates seamlessly in the SHF BERT system hardware and software environment
- Operated using the BERT Control Center GUI running on a PC



Options

- Option J1: Jitter Injection

Enables injection of arbitrary jitter types by applying an external modulation signal up to 1 GHz bandwidth with a maximum jitter amplitude of 90 ps peak-to-peak. A jitter-free trigger signal is available for measurement and calibration purposes.

- Option T2 or T4: Trigger Frequency, refer to Table 1

The trigger signal is derived from the clock signal whose frequency is divided by an integer N depending on the chosen trigger option and the frequency range. Refer to Table 1 to determine the value of N.

Note that the trigger remains jitter-free even if jitter injection is enabled.

Table 1: Value of the trigger frequency divider N

Clock Frequency Range	Option T2	Option T4
10 – 18.75 GHz	N=1	N=2
18.75 – 38 GHz	N=2	N=4

Specifications – SHF 78210 B

Parameter	Unit	Min.	Typ.	Max.	Comment
Clock Output (RF Out)					
Operating Frequency	GHz	10		38	f _{CLK}
Frequency Resolution	MHz		1		
Output Power Level	dBm	-3		+4	1.85 mm (V) male
Spurious Signals	dBc			-20	
SSB Phase Noise	dBc/Hz		tbd		
Intrinsic Jitter (RMS)	fs			400	Scope measurement not deconvoluted

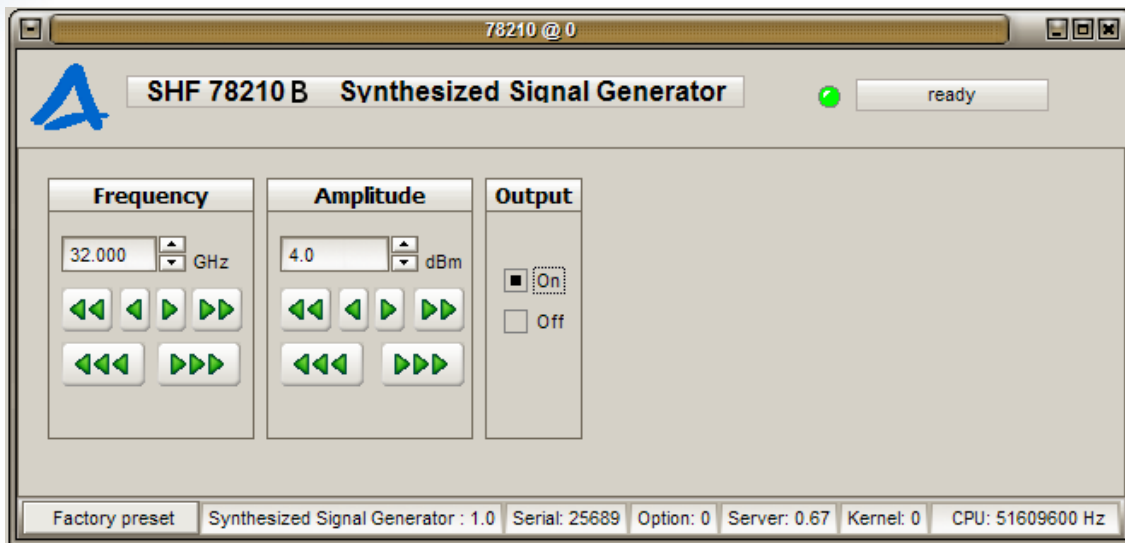
Trigger Out					
Frequency (Option T2)	GHz	10		16	Refer to Table 1
Frequency (Option T4)	GHz	5		8	Refer to Table 1
Output Amplitude	mVpp	300		650	SMA female

Jitter Injection (Option J1)					
Modulation Bandwidth	MHz	0.1		1000	
External Modulation Amplitude	mVpp	0		1000	SMA female
Jitter Amplitude	ps	0		90	Peak-to-peak



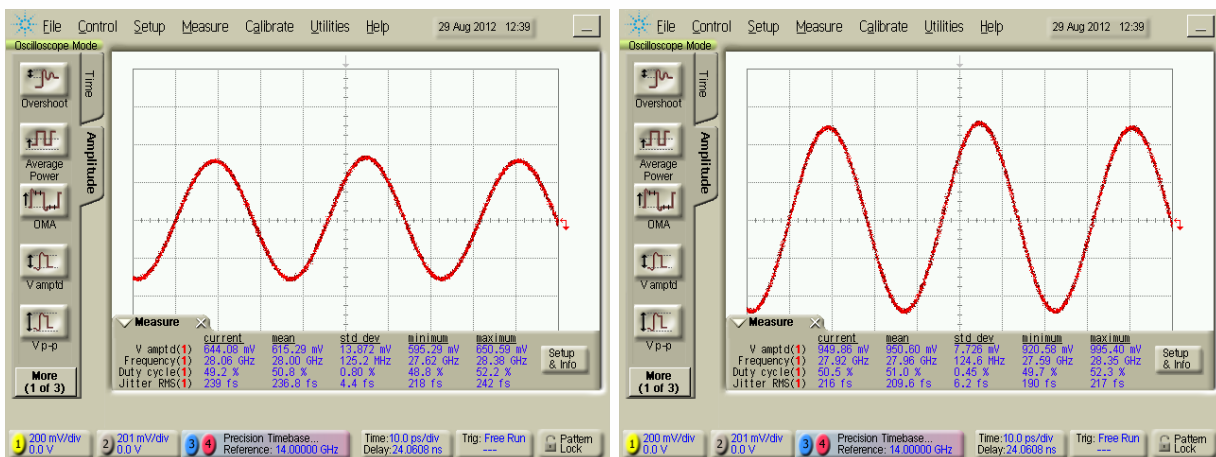
General					
Weight	kg		3.3		
Dimensions	mm		59x213x 450		w/o Front Panel Connector
Power Consumption	W		12		
Operating Temperature	°C	10		35	

Graphical User Interface



Typical Output Signal Waveforms

Clock Signal at $f_{CLK} = 28$ GHz

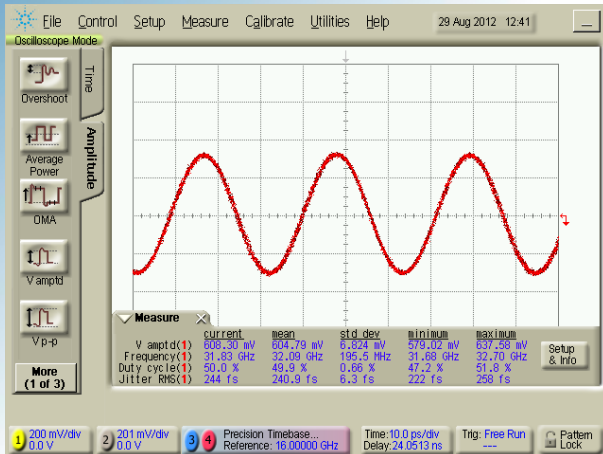


$P_{out} = 0$ dBm

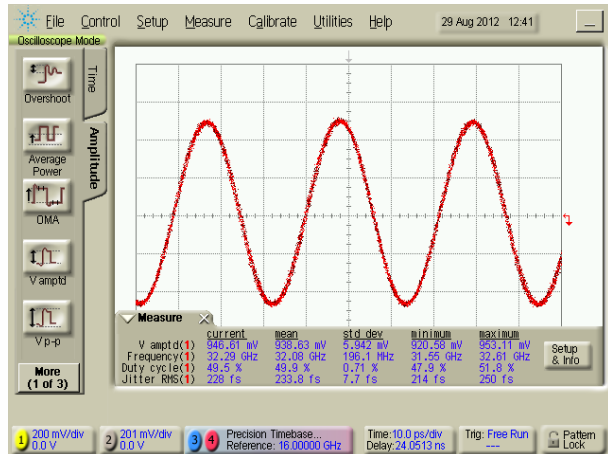
$P_{out} = +4$ dBm



Clock Signal at $f_{CLK} = 32$ GHz



$P_{out} = 0$ dBm



$P_{out} = +4$ dBm

Jitter Injection Option

The SHF 78210 B jitter injection feature is designed to apply arbitrary jitter modulation to the high-speed clock signal. Jitter is injected by connecting a signal source such as an arbitrary waveform generator to the external modulation input. Internally, the time delay of a tunable delay line is modulated. The maximum jitter amplitude is 90 ps peak-to-peak with a modulation bandwidth of up to 1 GHz. As an example, the jitter amplitude of 90 ps corresponds to a relative jitter amplitude of 2.5 unit intervals (UI) at a bitrate of 28 Gbit/s.

The specifications of the external signal source are given in the table below for sinusoidal jitter injection. Depending on the user's jitter injection requirements, an arbitrary waveform generator may be used for maximum flexibility of the available jitter types. Several examples of jittered clock waveforms using an arbitrary waveform generator are shown in the next section.

Recommended Minimum Specifications of the External Signal Source Required for Injection of Sinusoidal Jitter

Parameter	Unit	Min.	Typ.	Max.
Frequency Range	MHz	0.1		1000
Amplitude	mVpp	0		1000
Connector Type			SMA	

For jitter calibration purposes, the trigger signal of the SHF 78210 B remains jitter-free even if jitter injection is applied to the RF out signal.

In combination with the SHF bit pattern generator series 1210X A, the SHF 78210 B including the jitter injection feature enables a complete test solution for jitter tolerance tests as required by many telecommunication standards such as 100G Ethernet and 40 GBit/s OTN, FibreChannel, InfiniBand®, PCI Express®, and Serial ATA. For further details please refer to the SHF application note „Jitter Injection using the Multi- Channel BPG“, available online at www.shf.de.

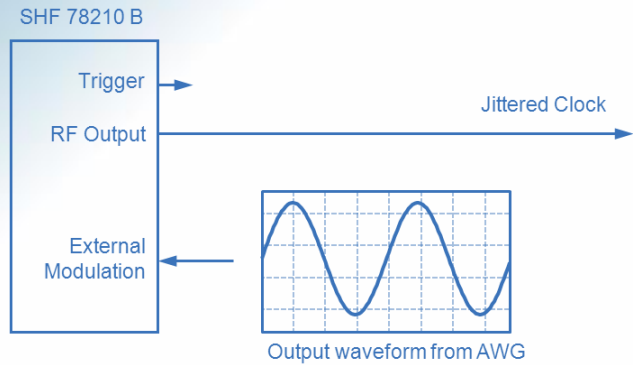
® *InfiniBand* is a registered trademark of the InfiniBand Trade Association. *PCI Express* is a registered trademark of Peripheral Component Interconnect Special Interest Group (PCI-SIG).



Typical Jittered Signal Waveforms

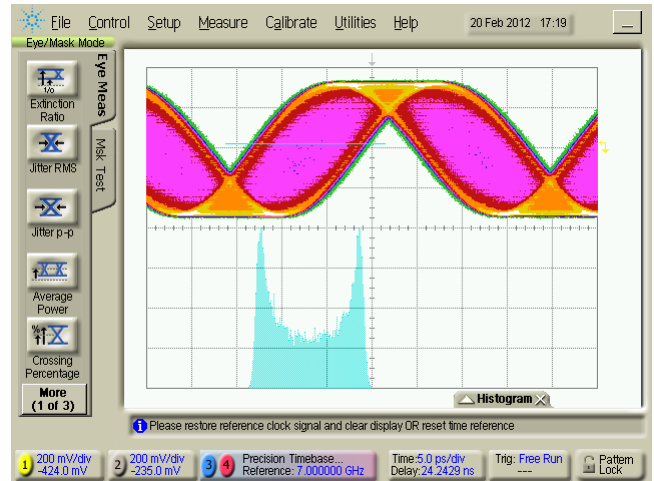
The external modulation input can be driven by a function generator such as the Agilent 332XX family of function / arbitrary waveform generators (AWG). The waveform characteristics of the AWG determine the jitter type of the SHF 78210 B.

Sine Wave on Modulation Input



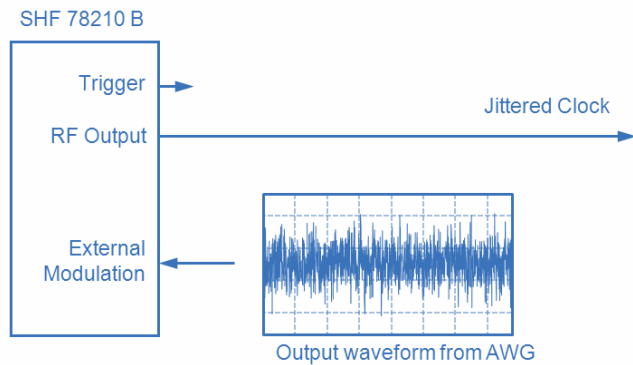
AWG Setting

Waveform Sine wave
Frequency 100 kHz
Amplitude 70 mVpp



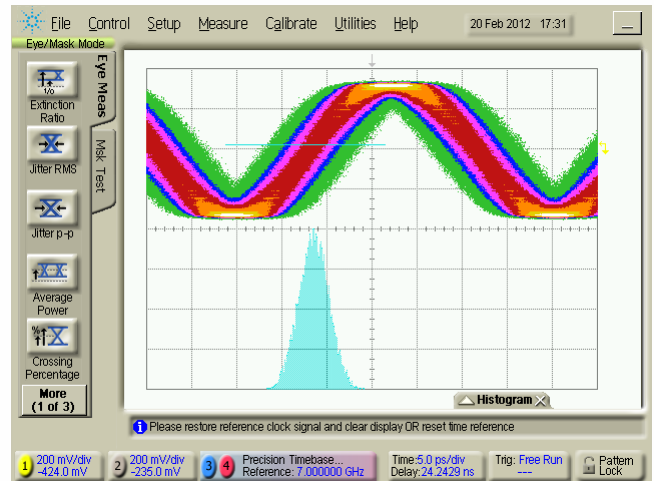
Sinusoidal jitter on 28 GHz clock,
jitter amplitude 11 ps peak-to-peak

Gaussian-Distributed Noise on Modulation Input



AWG Setting

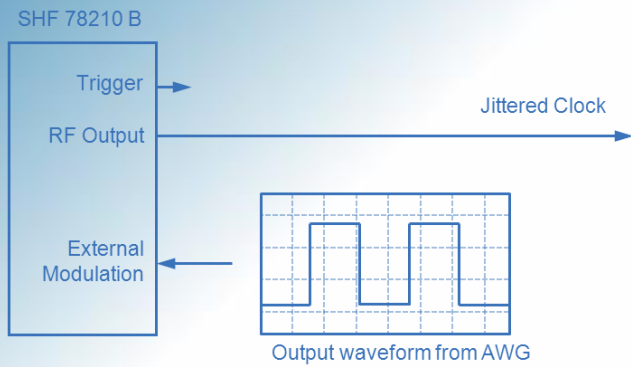
Waveform Noise
Amplitude 70 mVpp



Random jitter on 28 GHz clock,
jitter amplitude 1.7 ps rms

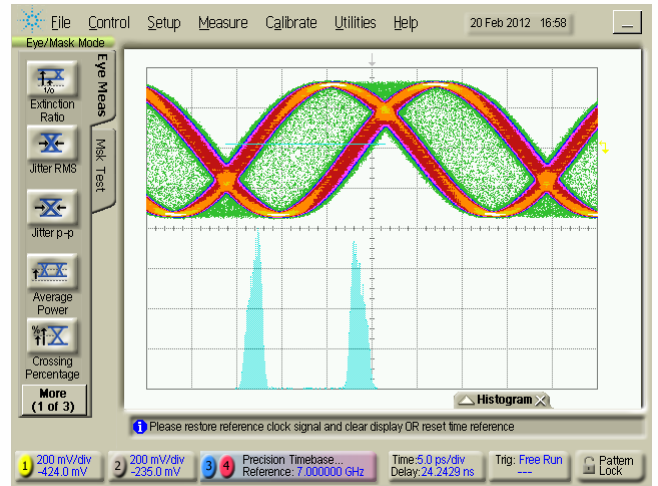


Square Waveform on Modulation Input



AWG Setting

Waveform	Square
Frequency	100 kHz
Amplitude	70 mVpp



Peak-to-peak jitter on 28 GHz clock,
jitter amplitude 11 ps peak-to-peak

As an example, the following diagram shows the peak-to-peak jitter amplitude in ps versus the modulation signal amplitude in mVpp for the special case of sinusoidal jitter of 100 kHz frequency modulated onto a 28 GHz clock using a function generator of the Agilent 332XX family. Note the hatched area which indicates a relative jitter amplitude of more than 1 UI (~36 ps). The jitter measurement in this case was limited by the sampling oscilloscope which shows a completely closed eye for jitter amplitudes larger than 1 UI.

