All new SHF 12106 A BPG
- Reduced size & weight
- Sync. of multiple units

SHF
Signal Generation & Analysis

SHF has always pioneered the market for high-speed bit pattern generators (BPGs) or pulse pattern generators (PPGs). Now that PAM4 is the mainstream, SHF's remote head architecture provides the most flexible approach for 400G, 800G and 1.6T applications.

SHF 12106 A BPG with remote head

Remote Head Concept

The base instrument for data generation is the BPG. Simply by extending the BPG with a small, lightweight and field replaceable remote head, different line rates and modulation schemes can be achieved. This renders this approach most flexible and future proof as new remote heads released by SHF will continue to be a fitting extension.

An SHF BPG and an SHF remote head are not just two discrete modules connected together. The complementary software package unifies them to virtually one instrument.

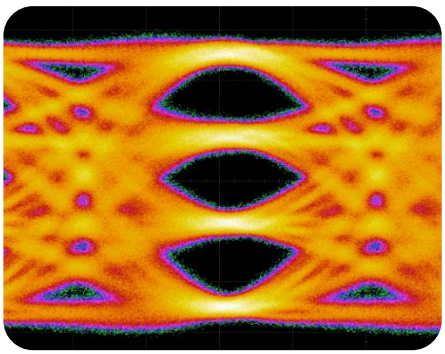
A few example configurations are outlined in the table below.

Basis Model	Remote Head	Available Options
SHF 12106 A **Pattern Generator**	---	Up to 4 NRZ channels per unit[1] (SHF 12106 A) Up to 64 Gbps per channel Built-in PRBS patterns and 8 Gbit user pattern per channel High voltage options
	SHF C603 B **2:1 MUX**	Up to 128 Gbps per channel Built-in PRBS patterns and 16 Gbit user pattern per channel
	SHF C911 A **4-Bit DAC**	PAM4, PAM8 or PAM16 Up to 64 GBaud Built-in PRBS and PAM patterns (e.g., PRBS31Q) plus 8 GSamples/s user pattern per channel
	SHF 616 C **PAM-MUX**	Up to 128 GBaud PAM4 (256 Gbps) Built-in PRBS and PAM patterns (e.g., PRBS31Q) plus 8 GSamples/s user pattern per channel

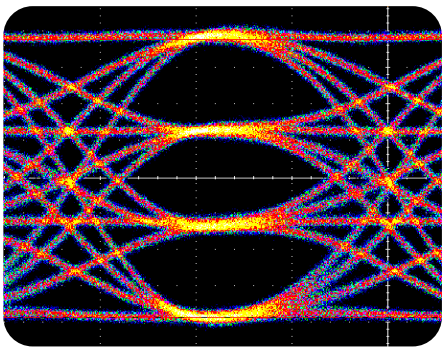
[1] Synchronization of multiple SHF 12106 A BPGs possible

BPG vs. AWG

High-speed signals are often generated by AWGs, but for NRZ or PAM data our BPG approach has significant advantages because parameters can be adjusted on the fly without waiting for the memory to be loaded. Very long patterns (e.g., PRBS 2^{31}-1 or PRBS31Q) can be generated instantly. Further, the remote heads can be placed very close to the DUT. The low weight even allows them to be placed on a wafer prober.



100 GBaud (200 Gbps)
from a *SHF 616 C* PAM-MUX



50 GBaud (100 Gbps)
from a *SHF C911 A* DAC

Clocked vs. Clock-Less Pre-Emphasis

The “classic” approach for pre-emphasis is to use a DAC or an AWG with a higher vertical resolution than required for the signal payload. Such a “clocked” approach would be, for example, our SHF BPG extended with a SHF DAC.

While this remains a viable option, SHF adds a “clock-less” pre-emphasis method. This technique utilizes analog filters instead of individually weighted bits. The frequency response of these FIR filters can be automatically adjusted for optimal channel compensation.

The clock-less pre-emphasis concept was initially introduced with the SHF C681 A and SHF C683 A filter modules. SHF will be significantly expanding its filter portfolio, even to speeds beyond the 100 GBaud (200 Gbps) limit. New and integrated filters in the remote heads will be available soon.

The left image shows a 64 GBaud (128 Gbps) PAM4 signal degraded by a DUT while the right image shows the same signal improved by equalization through clock-less pre-emphasis (by the SHF C683 A FIR-Filter).

NRZ & PAM Error Analysis

The SHF 11104 A Error Analyzer (EA) or Error Detector (ED) is capable not only to perform BER measurements at binary but also at PAM4 signals. Via a 3-pass approach, the instrument performs an auto-search to determine the optimum timing and threshold of the three individual PAM4 eyes. During the actual measurement it successively samples all three eye openings, one at a time, and measures the three individual bit error ratios. In parallel to this 3-pass measurement the software calculates the total Bit Error Ratio (BER).

SHF 11104 A EA extended with a SHF 11220 A PAM-Sampler

The SHF 11104 A Error Analyzer as a single instrument is capable to perform such BER measurement. Extended with a remote head, the upper baud rate limit is raised.

Base Model	Remote Head	Available Options
SHF 11104 A **Error Analyzer**	---	Up to 64 Gbps NRZ per channel Up to 32 GBaud PAM4 (64 Gbps) per channel
	SHF 11221 A **1:2 DEMUX**	Up to 128 Gbps NRZ per channel
	SHF 11220 A **PAM-Sampler**	Up to 58 GBaud PAM4 (116 Gbps) per channel

Find out more about our pattern generation and error analysis instruments by scanning the QR Code below.

Bit Error Test & Arbitrary Waveform Generation

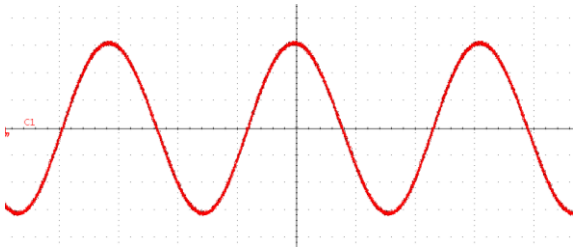
Synthesized Signal Generation

New SHF 78125 A
- Excellent harmonics suppression & phase noise
- Improved frequency stability

In digital high-speed test and measurement set ups with or without afore outlined SHF BPGs and EAs, a perfect clock signal is crucial for the generation of low jitter reference test signals. An SHF Synthesized Signal Generator (Synthesizer) used as a clock source can operate over several decades of frequency.

P/N	Description
SHF 78124 A | 32 Synthesizer	Output signals from 1… 32.8 GHz
SHF 78124 A | 64 Synthesizer	Output signals from 1… 64.0 GHz
SHF 78125 A | 64 Synthesizer	Output signals from 1… 64.0 GHz

In contrast to other high-speed signal generators SHF synthesizers focus on the generation of CW signals only which enables us to offer the most cost-effective solutions in this frequency range. The high purity and fidelity could be achieved by waiving potentially not required components and capabilities (like e.g., signal modulation or complex signal sweeps).



32 GHz from a SHF 78124 A

If other frequencies, more outputs or phase shifts are required, there is a wide variety of matching clock distributions, phase shifters, frequency dividers & multipliers to provide the signal exactly as needed in the setup. Find out more about these modules and our synthesizers by scanning the QR Code below.

RF & Microwave
Modules and Instruments