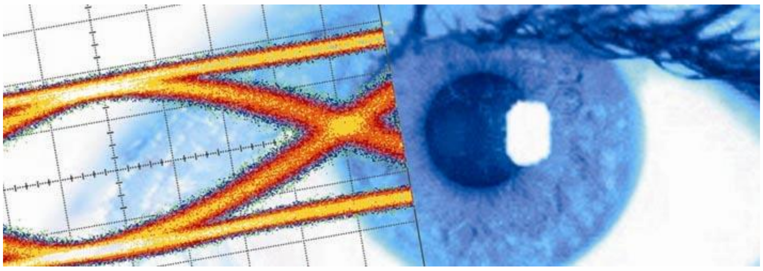
SHF Communication Technologies AG

Wilhelm-von-Siemens-Str. 23D • 12277 Berlin • Germany

Phone +49 30 772051-0 • Fax +49 30 7531078

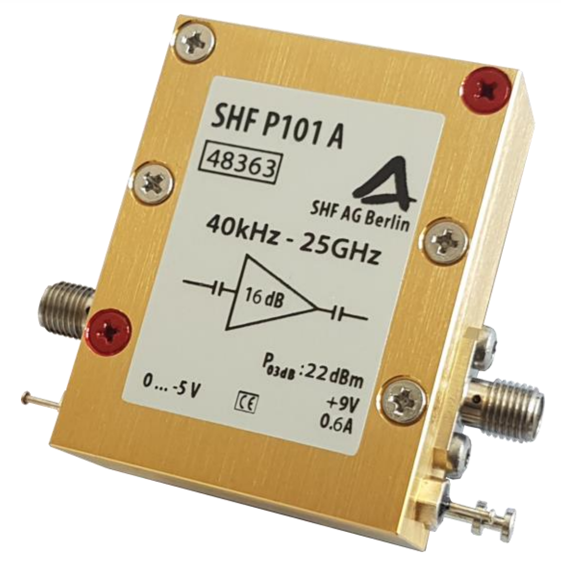
E-Mail: sales@shf-communication.com **• Web:** www.shf-communication.com



Datasheet

SHF P101 A

Broadband Amplifier



Description

The SHF P101 A broadband amplifier is the RoHS compliant successor of the popular SHF 100 BP. The SHF P101 A is a two stage, wideband RF amplifier featuring flat gain and low group delay variation. By use of proprietary monolithic microwave integrated circuits (MMICs) a 1 dB compression point of 18 dBm and low noise figure are achieved.

In addition the amplifier is characterized by a single power supply requirement and a gain control input for up to 3 dB gain reduction. Optionally an optimized tuning for improved pulse performance is available making this amplifier an excellent choice for muli-level (PAM) or analogue applications (OFDM or RF over fiber).

Applications

- Optical Communications, Modulator Driver
- High-Speed Pulse Experiments
- Satellite Communications
- Research and Development
- Antenna Measurements
- RF over fiber

Available Options

01: DC return on input (max. ±1.75 V, max. 35 mA)[1]

02: Built-in bias tee on input (max. ±12 V, max. 220 mA)[1]

03: DC return on output (max. ±1.75 V, max. 35 mA)[1]

04: Built-in bias tee on output (max. ±12 V, max. 220 mA)[1]

MP: Matches the phase of two amplifiers

MT: Special tuning available to optimize performance with E/O modulators[2]

ML: Special tuning optimised for multi-level applications up to 12.5 Gbaud[3]

[1] The options 01 & 02 or 03 & 04 cannot be combined.
If an option is chosen, the maximum gain and the maximum output power might be reduced by up to 1 dB. The low frequency 3 dB Point might be increased up to 50 kHz.

[2] If this option is chosen, the maximum gain might be reduced by up to 3 dB.

[3] If this option is chosen, the high frequency 3 dB Point might be decreased down to 14 GHz. The limits for output power are valid until 14 GHz.
The output return loss might be increased up to -8 dB < 20 GHz.

Specifications - SHF P101 A

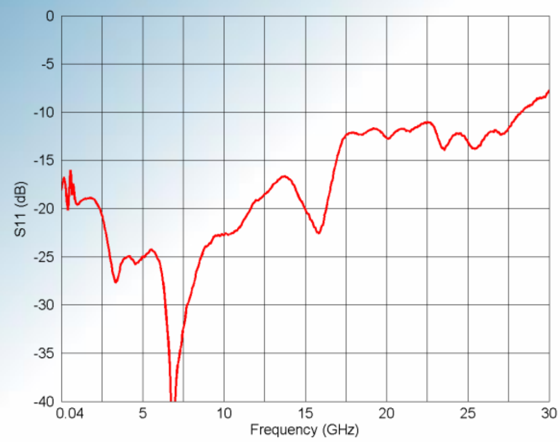
Parameter	Unit	Symbol	Min.	Typ.	Max.	Comment
Absolute Max Ratings						
Maximum RF Input	dBm V	P_{in} max			10 2	 peak to peak voltage
DC Voltage at RF Input	V				±12	AC coupled input
DC Voltage at RF Output	V				±12	AC coupled output
Positive Supply Voltage	V		8.5	9	12	reverse voltage protected
Positive Supply Current	A	I_{DD}		0.5	0.6	
Gain Control Voltage	V	U_{GC}	-5		0	Reduction by approx. 3dB I_{GC} <= 10 mA pin open: max gain is achieved.
Case Temperature[4]	T_{case}	°C	10	40	50	

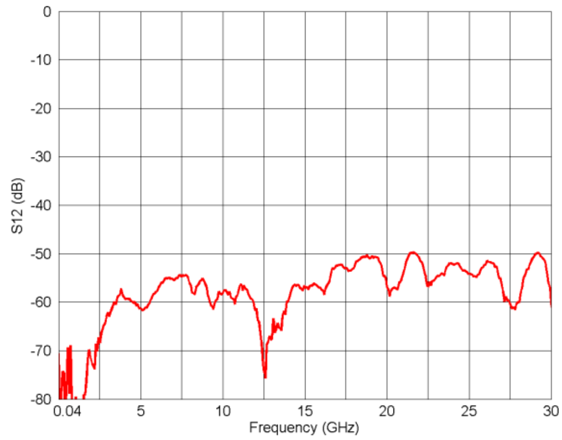
[4] If operated with heat sink (part of the delivery) at room temperature there is no need for additional cooling.

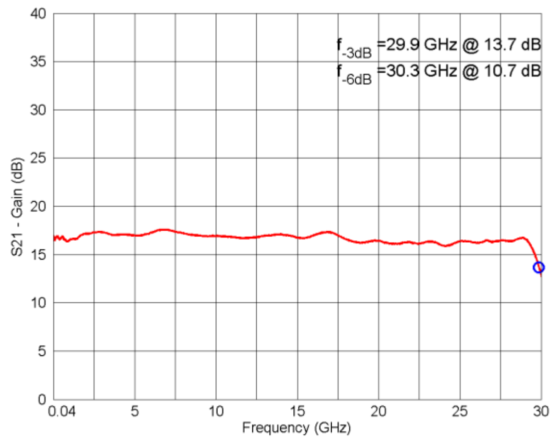
Parameter	Unit	Symbol	Min.	Typ.	Max.	Comment
Electrical Characteristics (At 40°C case temperature, unless otherwise specified)						
High frequency 3 dB point	GHz	f_{HIGH}	25			without option ML
Low frequency 3 dB point	kHz	f_{LOW}		30	40	
Gain	dB	S_{21}	15	16		non-inverting
Output Power at 1 dB Compression	dBm V	P_{01dB}	18 5			10 MHz...17 GHz peak to peak voltage
Output Power at 2 dB Compression	dBm V	P_{02dB}	21 7.1			10 MHz...17 GHz peak to peak voltage
Output Power at 3 dB Compression	dBm V	P_{03dB}	22 8			10 MHz...17 GHz
Input Return Loss	dB	S_{11}		-12	-10	< 20 GHz
Output Return Loss	dB	S_{22}		-10	-9	< 20 GHz
Rise Time/Fall Time	ps	t_r/t_f			20	Full Setup [5] 20%...80%, 7 V ≤ Vout ≤ 8 V
Jitter	ps	J_{RMS}			1.5	Full Setup [5] 7 V ≤ Vout ≤ 8 V
Group Delay Ripple	ps				±50	2…20 GHz, 100 MHz aperture
Power Consumption	W			4.5		9 V supply voltage
Mechanical Characteristics						
Input Connector						SMA female
Output Connector						SMA female
Dimensions	mm					51x40x16 excluding connectors

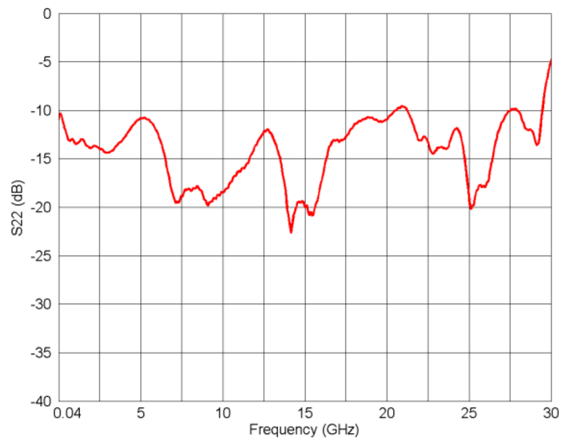
[3] Measured with the following setup: SHF BPG 40 A -> DUT (SHF P101 A) -> Agilent 86100C with 50 GHz sampling head and precision timebase.

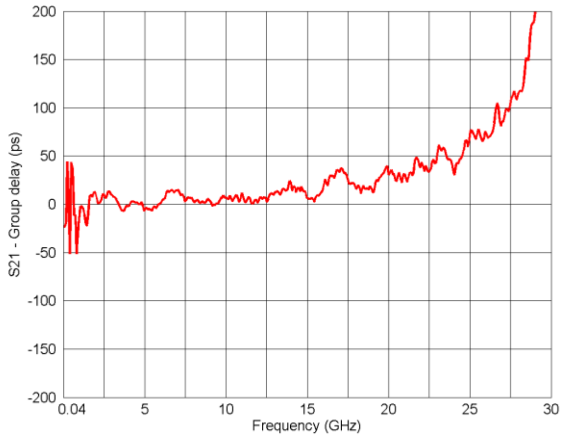
Typical S-Parameters, Group Delay and Phase Response (without option ML)

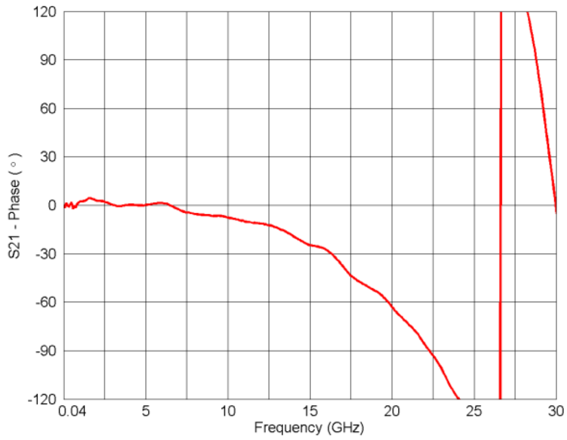








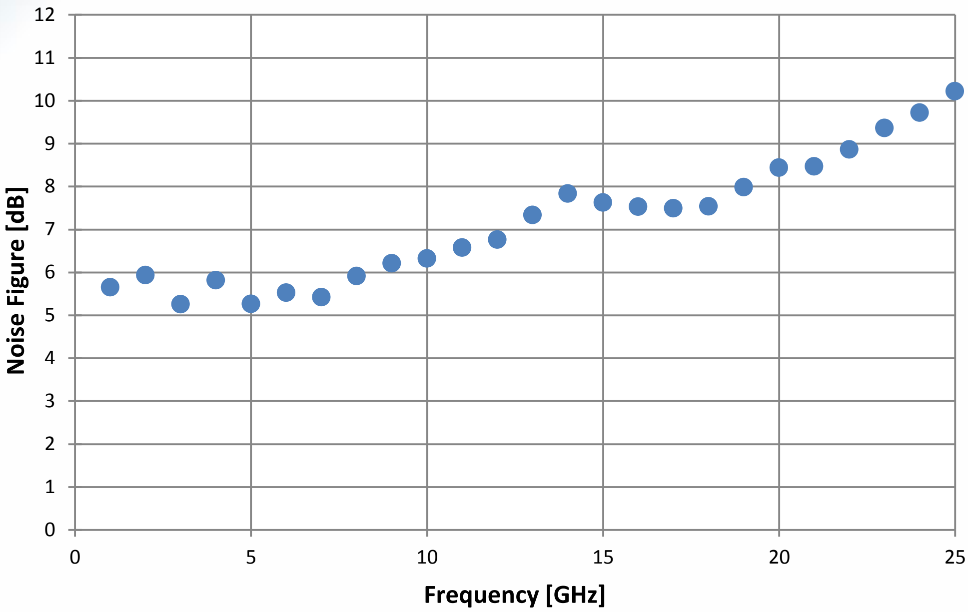




Aperture of group delay measurement: 100 MHz

Typical Noise Figure

The measurement had been performed using a FSW85 Spectrum Analyzer by Rhode & Schwarz. The noise figure defines the degradation of the signal-to-noise ratio when the signal passes the amplifier. An ideal amplifier would amplify the noise at its input along with the signal. However, a real amplifier adds some extra noise from its own components and degrades the signal-to-noise ratio. Please note that this applies to small signals only. When the amplifier is used close to or in its saturation region additional non-linear effects will impact the signal-to-noise ratio and the signal waveform.

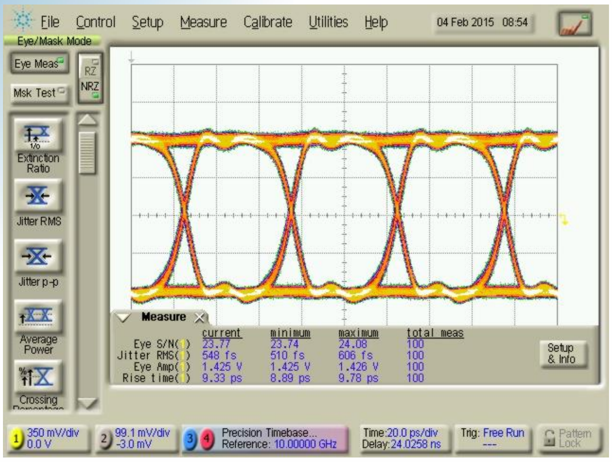


SHF Communication Technologies AG the bandwidth company

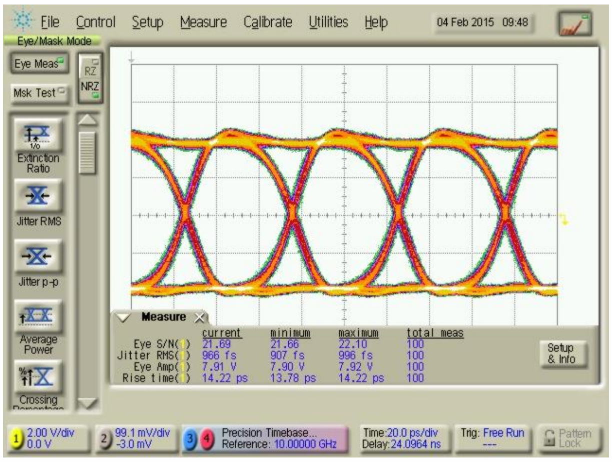
Typical Binary Waveforms (without option ML)

Measurements at 20 and 2.5 Gbps (PRBS 2^{23}-1) had been performed using a SHF BPG 40 A and an Agilent 86100C DCA with Precision Time Base Module (86107A) and 50 GHz Sampling Head (83484A).

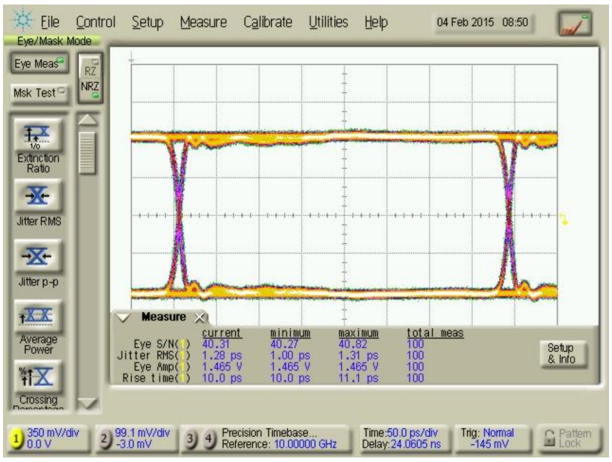
The measurements will be part of the inspection report delivered with each particular device.



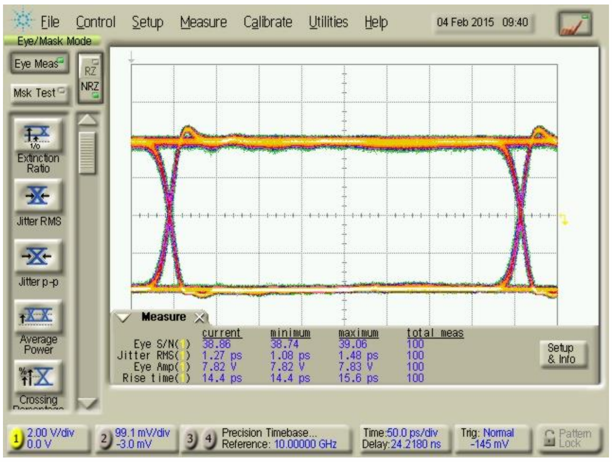
Input Signal @ 20 Gbps



Output Signal @ 20 Gbps

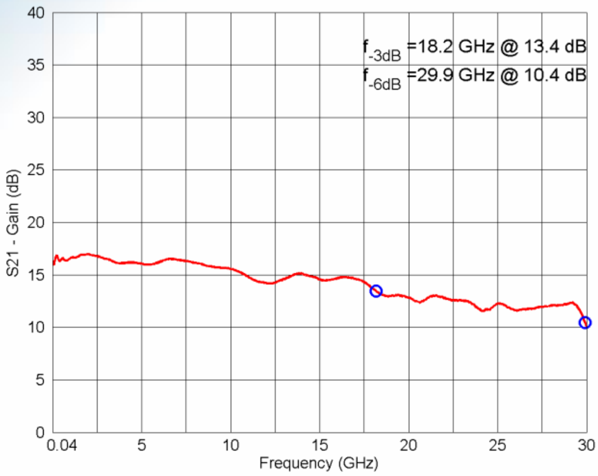


Input Signal @ 2.5 Gbps



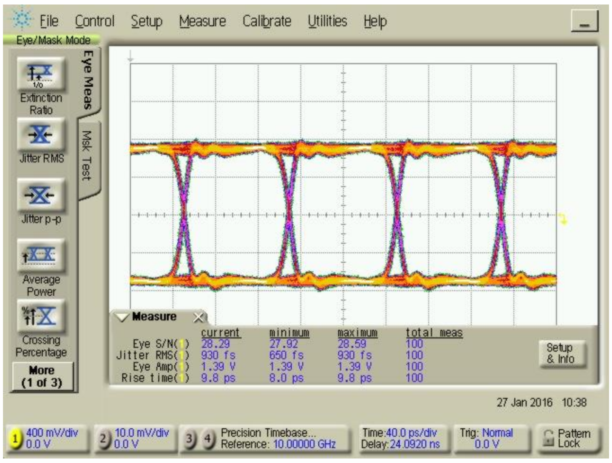
Output Signal @ 2.5 Gbps

Typical Frequency Response (with option ML)

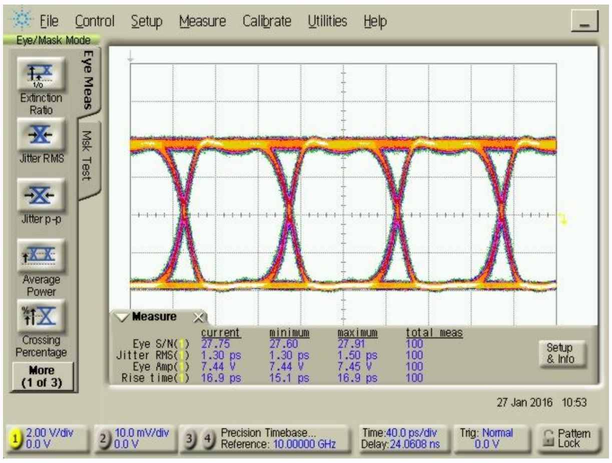


Typical Binary Waveforms (with option ML)

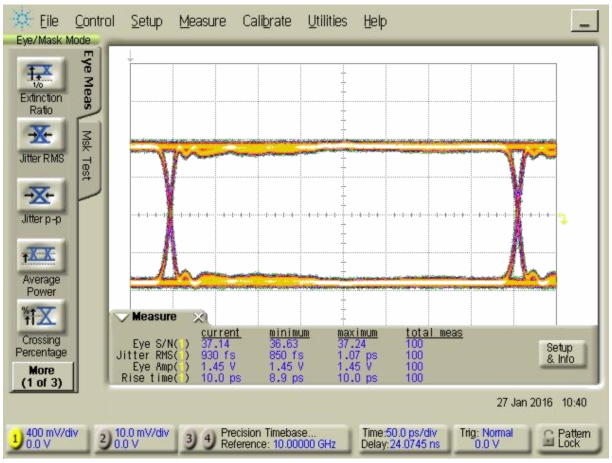
Measurements at 10 and 2.5 Gbps had been performed using a SHF BPG 40 A and an Agilent 86100C DCA with 50 GHz Sampling Head (83484A).



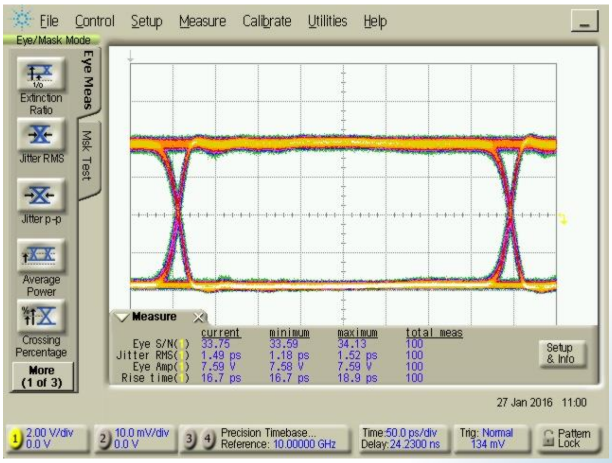
Input Signal @ 10 Gbps



Output Signal @ 10 Gbps



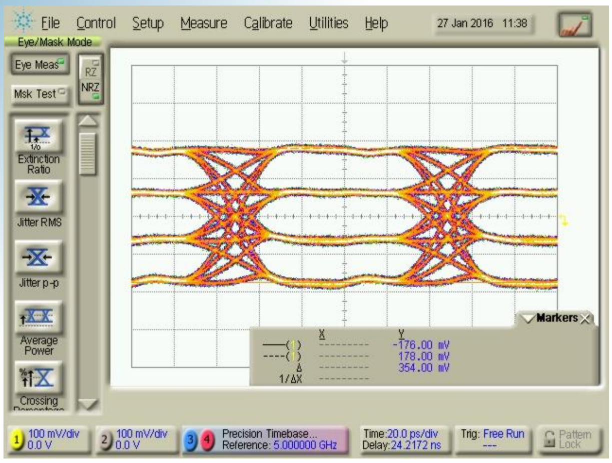
Input Signal @ 2.5 Gbps



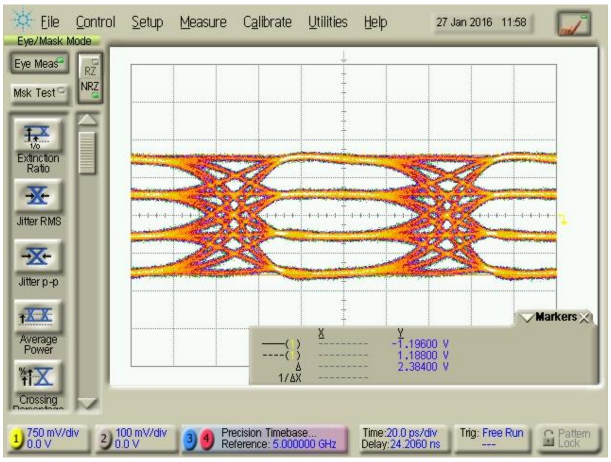
Output Signal @ 2.5 Gbps

Typical 4-Level Waveforms (with option ML)

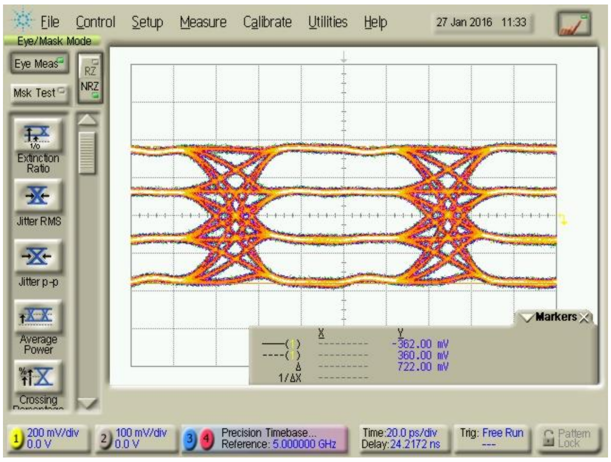
Measurements at 10 GBaud had been performed using a SHF 611 C DAC with 15 GHz low pass filter and an Agilent 86100C DCA with Precision Time Base Module (86107A) and 70 GHz Sampling Head (86118A).



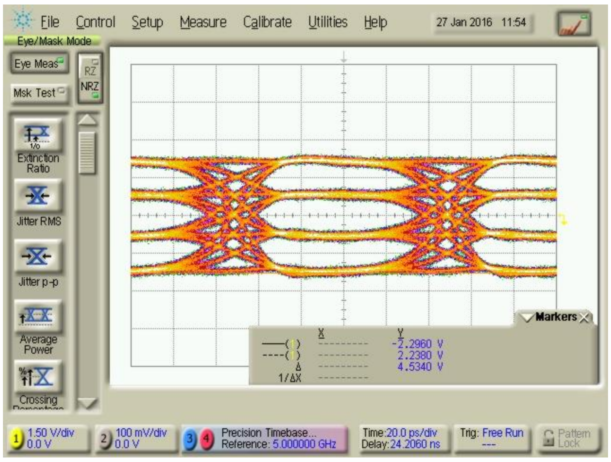
Input Signal @ 10 Gbaud, ~0.35 Vpp



Output Signal @ 10 GBaud, ~2.4 Vpp



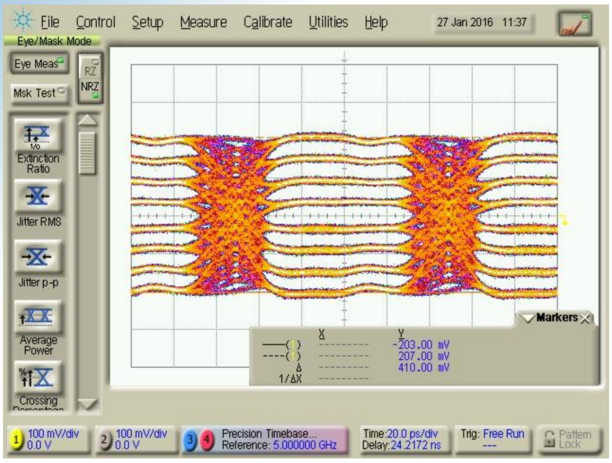
Input Signal @ 10 Gbaud, ~0.7 Vpp



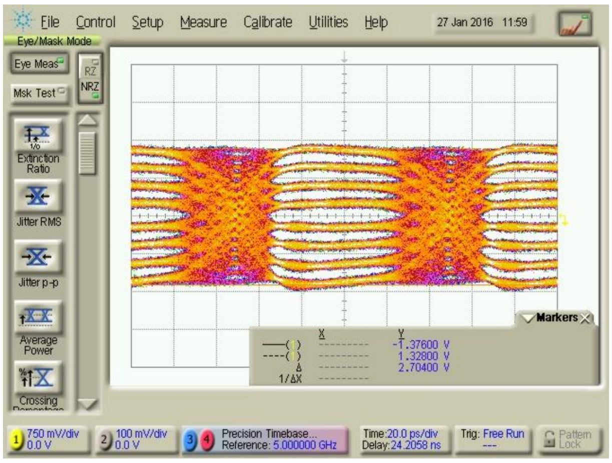
Output Signal @ 10 GBaud, ~4.5 Vpp

Typical 8-Level Waveforms (with option ML)

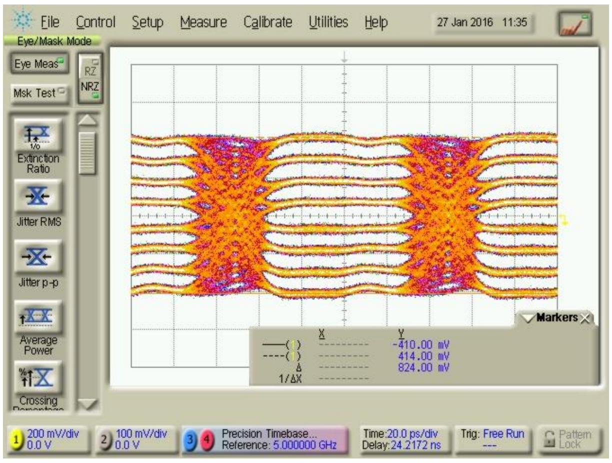
Measurements at 10 GBaud had been performed using a SHF 611 C DAC with 15 GHz low pass filter and an Agilent 86100C DCA with Precision Time Base Module (86107A) and 70 GHz Sampling Head (86118A).



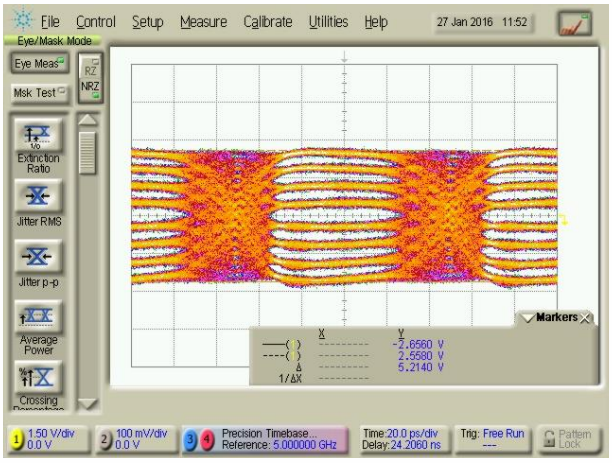
Input Signal @ 10 Gbaud, ~0.41 Vpp



Output Signal @ 10 GBaud, ~2.7 Vpp



Input Signal @ 10 Gbaud, ~0.82 Vpp

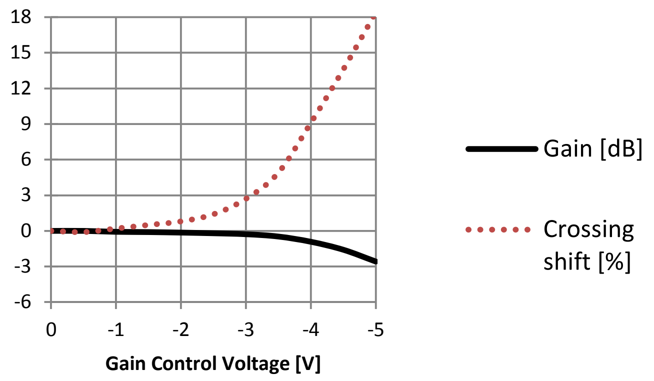


Output Signal @ 10 GBaud, ~5.2 Vpp

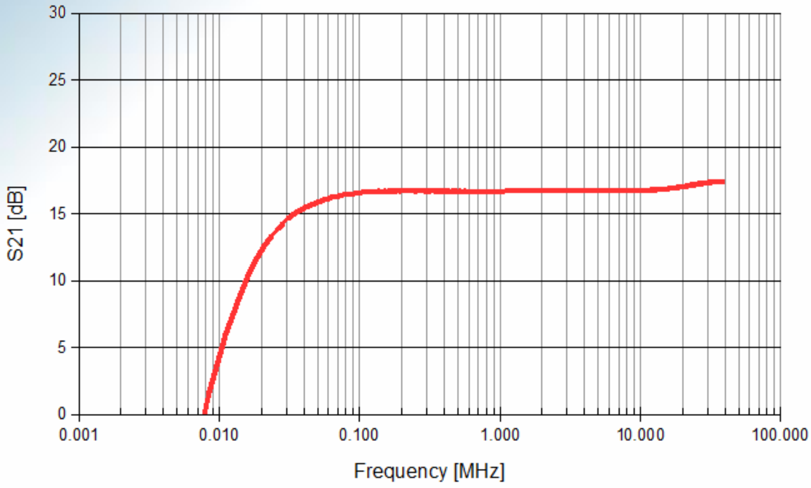
Handling Instructions

To operate the amplifier a positive supply voltage of approximately +9 V must be applied.

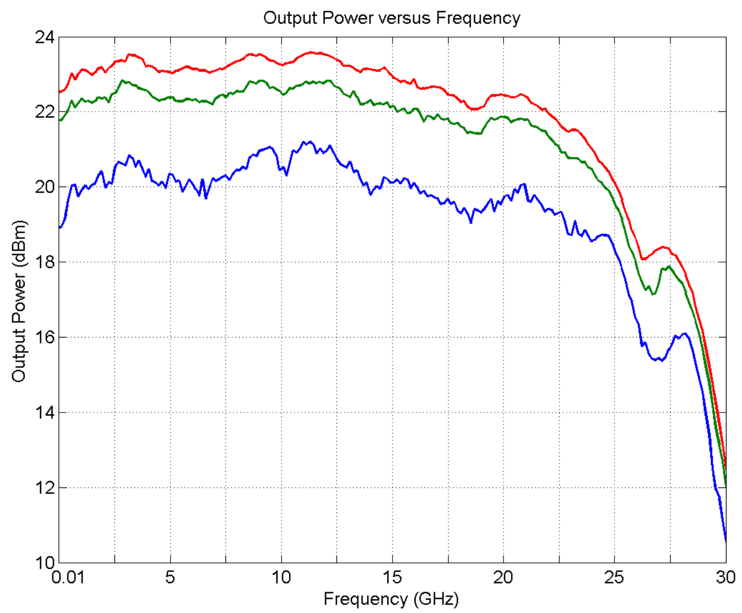
The gain can be adjusted by applying a voltage of 0 to -5 V. If this pin is left open, the amplifier will have maximum gain. By reducing the gain the crossing will shift. Typical characteristics are shown in the following diagram for an input voltage of 1.4 V with 50% crossing.



Typical Low Frequency Response

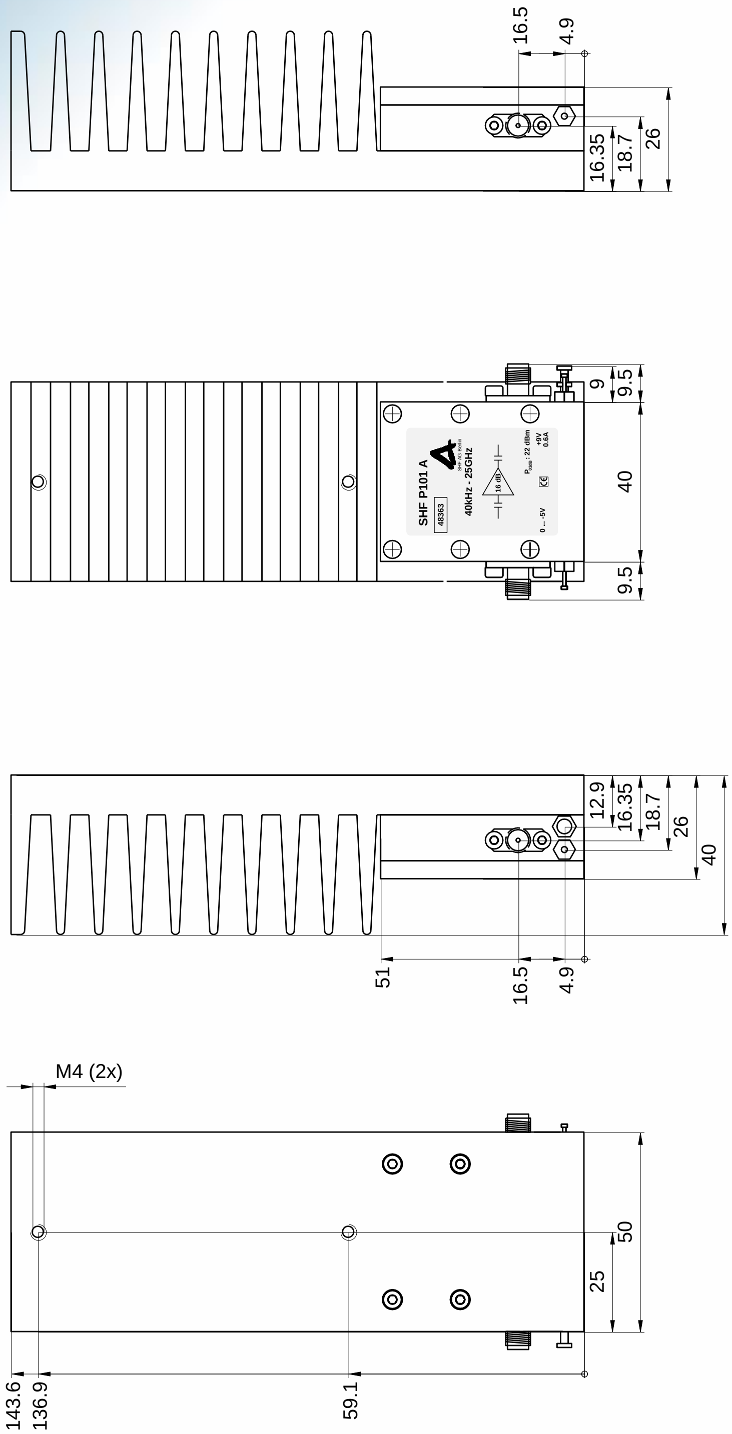


Typical Saturation power



Top (red): 3 dB compression;
Middle (green): 2 dB compression;
Bottom (blue): 1 dB compression

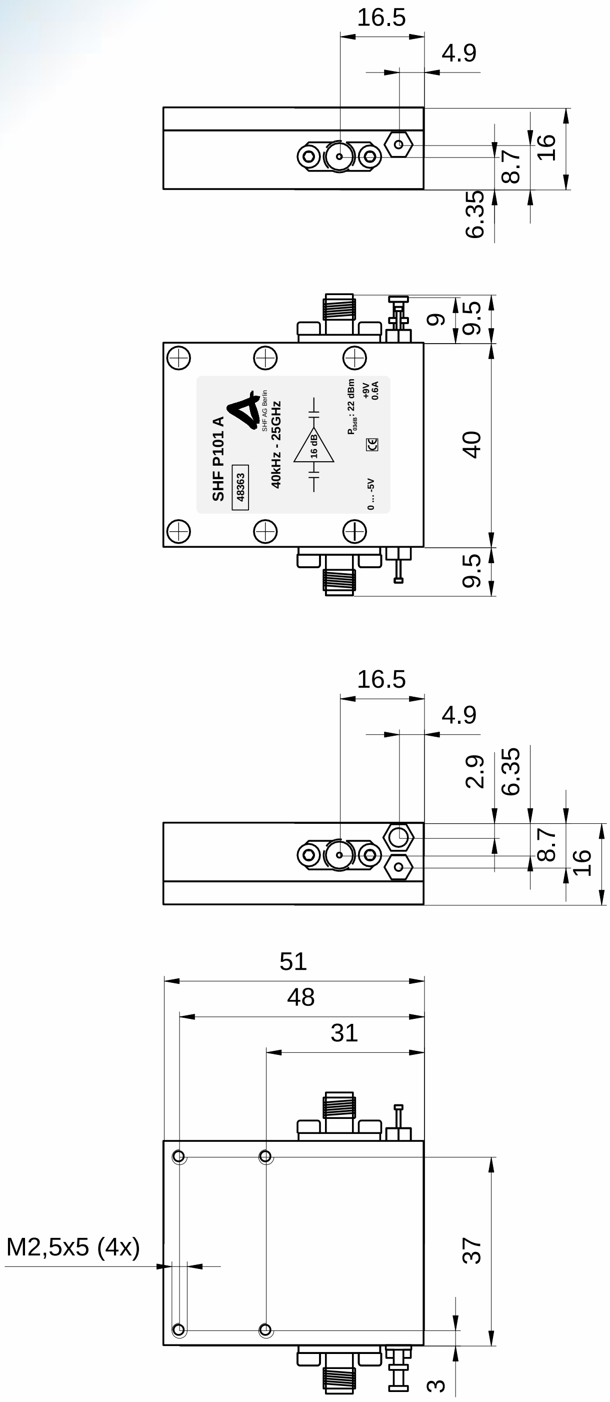
Mechanical Drawing with Heat Sink



all dimensions in mm

For permanent mounting remove the heat sink from the amplifier. In that case please ensure that adequate cooling of the amplifier is guaranteed. It is recommended to use thermal paste or a thermal gap pad for the mounting. In order to separate the heat sink from the amplifier, remove the four screws on the heat sink. Please note, thermal paste is used between the heat sink and the amplifier housing.

Mechanical Drawing without Heat Sink



all dimensions in mm

Please ensure that adequate cooling of the amplifier is guaranteed.

User Instructions

ATTENTION!

Electrostatic sensitive GaAs FET amplifier

1. To prevent damage through static charge build up, cables should be always discharged before connecting them to the amplifier!
2. Attach a 50 Ohm output load **before** supplying DC power to the amplifier!
3. The supply voltage can be taken from any regular power supply and can be connected to the supply feed-through filter via an ON / OFF switch.
4. It make sense to use the minimum supply voltage. A higher one increases the power dissipation of the internal voltage stabilizer.
5. Using a 3 dB or 6 dB input attenuator will result in a 6 dB or 12 dB increase of the input return loss. For minimal degradation of amplifier rise time, these attenuators should have a bandwidth specification of more than the amplifier bandwith.
6. High input voltages will drive the amplifier’s output stage into saturation, leading to waveform peak clipping.
7. Saturated output voltages can only be used without damage while the amplifier is connected to a 50 Ohm precision load with a VSWR of less than 1.2 or better than 20 dB return loss.
8. While using a reflective load the output voltage has to be reduced to a safe operating level according to the magnitudes of the reflections.

   ATTENTION: At radio frequencies a capacitive load can be transformed to an inductive one through transmission lines! With an output stage driven into saturation this may lead to the immediate destruction of the amplifier (within a few ps)!