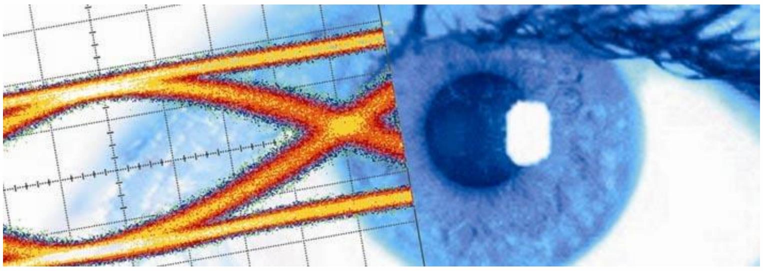
SHF Communication Technologies AG

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

Phone +49 30 772 051-0 • Fax +49 30 753 10 78

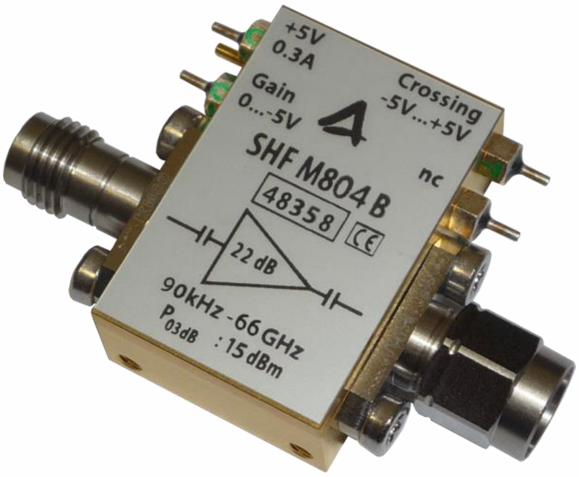
E-Mail: sales@shf.de • Web: http://www.shf.de



Datasheet

SHF M804 B

Broadband Amplifier



Description

The SHF M804 B broadband amplifier is the RoHS compliant successor of the popular SHF 804 M. A bandwidth of more than 66 GHz offers the capability to amplify binary signals up to 100 Gbps.
The M804 B is a two-stage amplifier design, using proprietary monolithic microwave integrated circuits (MMICs) inside special carriers to achieve ultra-wide bandwidth and low noise performance. An internal voltage regulation protects the amplifier against accidental reverse voltage connection and makes it robust against line voltage ripple.

Ease of Use

Only a single 5 V supply is needed for operation.

Upon delivery, the amplifier is already set to deliver maximum gain and 50% crossing. For operation under these conditions the appropriate pins can be left floating. However, in case gain and crossing shall be modified, this can be done just by applying another bias. For more detailed information see page 9.

Available Options

MP: Matches the phase of two amplifiers

Specifications - SHF M804 B

Parameter	Unit	Symbol	Min	Typ	Max	Conditions
Absolute Maximum Ratings						
Maximum RF Input Power in Operation	dBm V	$P_{in\ max}$			4 1	 peak to peak voltage
Maximum RF Input Power without Power Supply	dBm V	$P_{in\ max}$			10 2	 peak to peak voltage
DC Voltage at RF Input	V				±9	AC coupled input
DC Voltage at RF Output	V				±8	AC coupled output
Positive Supply Voltage	V		4.5	5	5.5	max. 0.3 A reverse voltage protected
Gain Control Voltage	V		-6	-5…0	+6	will not exceed 0.02 A
Crossing Control Voltage	V		-6	-5…+5	+6	will not exceed 0.02 A
Case Temperature[1]	T_{case}	°C	10	35	45	

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

Specifications – SHF M804 B

Parameter	Unit	Symbol	Min	Typ	Max	Conditions
Electrical Characteristics (At 35°C case temperature, unless otherwise specified)						
High Frequency 3 dB Point	GHz	f_{HIGH}	66			
Low Frequency 3 dB Point	kHz	f_{LOW}			90	
Gain	dB	S_{21}	21	22		non-inverting measured at P_{in}=-20 dBm
Max. Gain Reduction	dB		2.5	3	4	< 2.5 Vpp
Output Power at 1 dB Compression	dBm V	P_{01dB}	11 2.2			10 MHz…28 GHz peak to peak voltage
Output Power at 2 dB Compression	dBm V	P_{02dB}	13 2.8			10 MHz…28GHz peak to peak voltage
Output Power at 3 dB Compression	dBm V	P_{03dB}	15 3.5			10 MHz…28 GHz peak to peak voltage
Max. RF Input for Linear Operation	dBm V	$P_{in\ lin}$			-11 0.18	I.e. $P_{out} \le P_{01dB}$ peak to peak voltage
Crossing Control Range	%		-4		4	> 2.5 Vpp
Input Reflection	dB	S_{11}			-9 -3	< 30 GHz < 65 GHz
Output Reflection	dB	S_{22}			-9 -5	< 50 GHz < 65 GHz
Rise Time/Fall Time	ps	tr/tf			 6 10	20%...80%, 3 V ≤ V_{out} ≤ 4 V Deconvoluted[2,3] Full Setup[2]
Jitter	fs	JRMS		 350 500	 500 600	3 V ≤ Vout ≤ 4 V @ 80 Gbps Deconvoluted[2,3] Full Setup[2]
Group Delay Ripple	ps				±50	40 MHz…40 GHz, 160 MHz aperture
Power Consumption	W			1.2		5 V supply voltage

[2] Measured with the following setup: SHF 603 A MUX -> DUT (SHF M804 B) -> Agilent 86100C with 70 GHz sampling head and precision time base.

[3] Calculation based on typical results of setup without DUT :

$$t_r/t_{f\ deconvoluted} = \sqrt{(t_r/t_{f\ full\ setup})^2 - (t_r/t_{f\ setup\ w/o\ DUT})^2} = \sqrt{(t_r/t_{f\ full\ setup})^2 - 8\ ps^2}$$

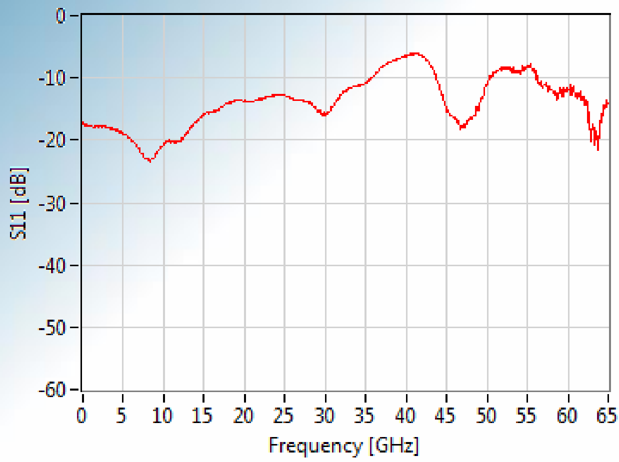
$$J_{RMS\ deconvoluted} = \sqrt{(J_{RMS\ full\ setup})^2 - (J_{RMS\ setup\ w/o\ DUT})^2} = \sqrt{(J_{RMS\ full\ setup})^2 - 300\ fs^2}$$

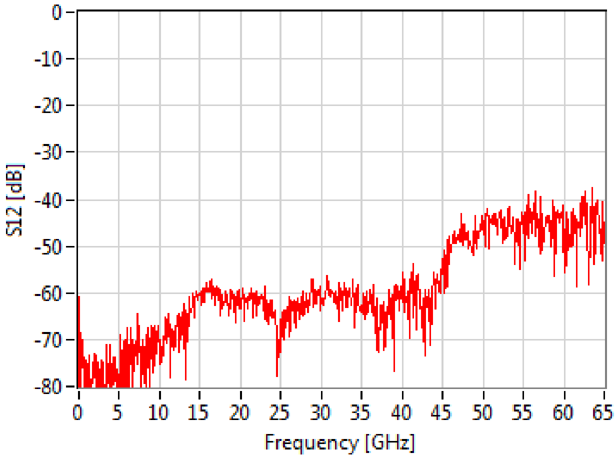
Parameter	Unit	Symbol	Min	Typ	Max	Conditions
Mechanical Characteristics						
Input Connector						1.85 mm (V) female[4]
Output Connector						1.85 mm (V) male[4]

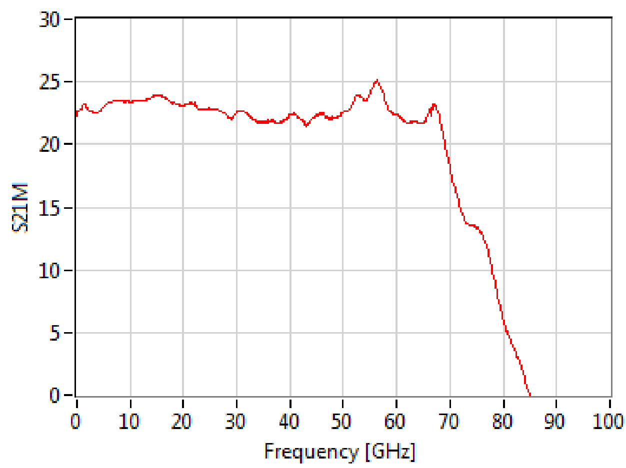
[4] Other gender configurations are available on request.

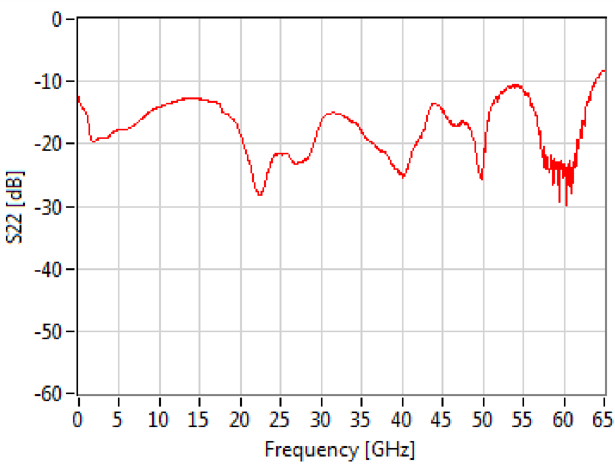
Other connector types, e.g. 2.92mm (K) or Mini-SMP (GPPO®) connectors, are also available but may impact the bandwidth and reflection characteristic.

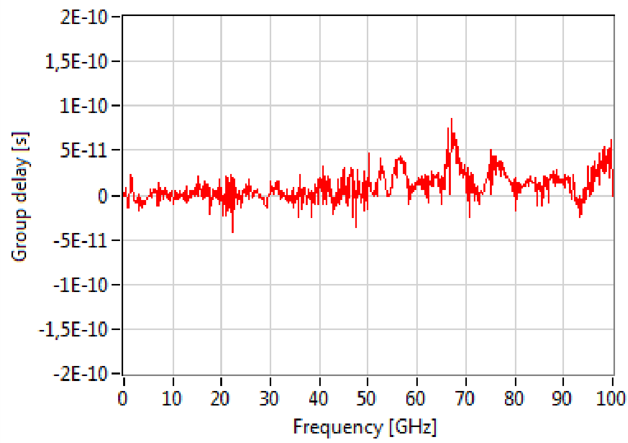
Typical S-Parameters, Group Delay and Phase Response

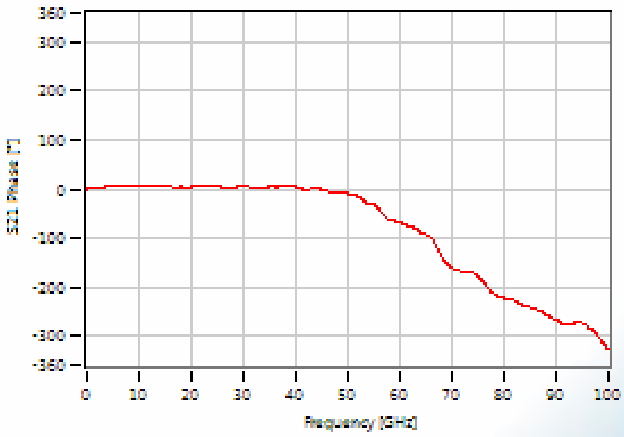








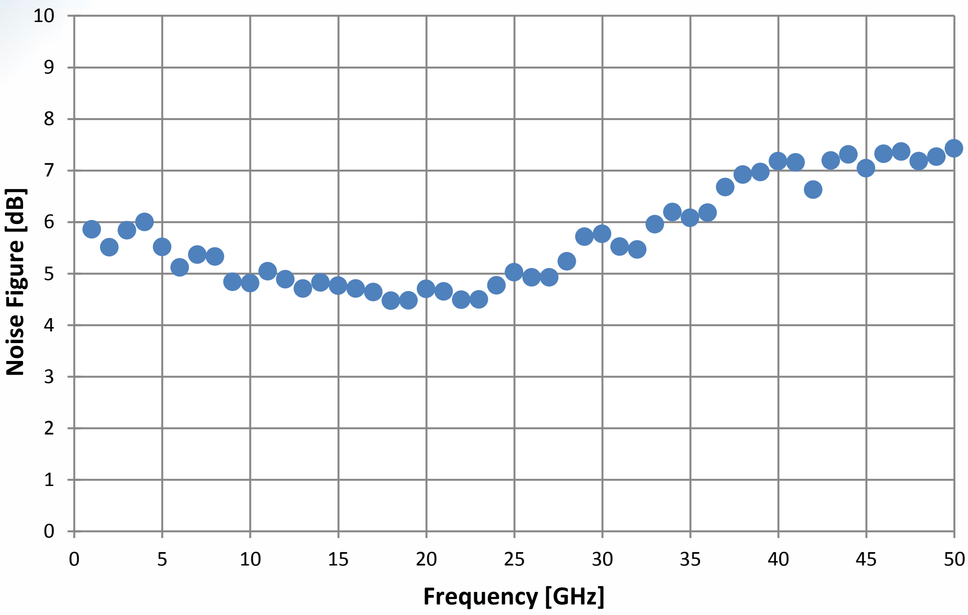




Aperture of group delay measurement: 160 MHz

Typical Noise Figure

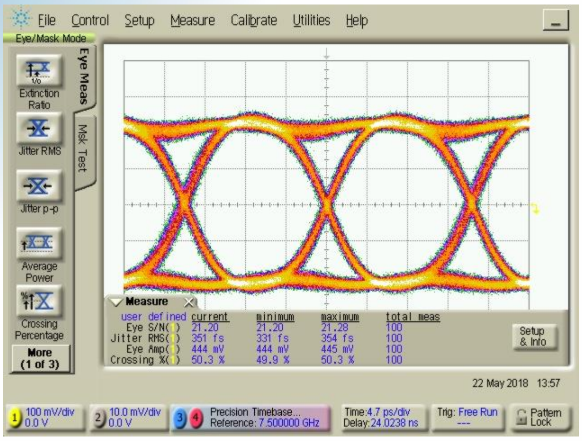
The measurement had been performed using a FSW85 Spectrum Analyzer by Rhode & Schwarz. The noise figure defines the degradation of the signal-to-noise ratio when the signal passes the amplifier. An ideal amplifier would amplify the noise at its input along with the signal. However, a real amplifier adds 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.



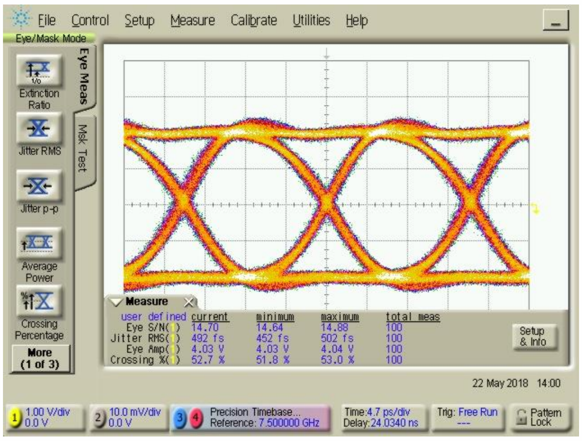
Typical Binary Waveforms

Measurements had been performed using a SHF 603 A MUX and an Agilent 86100C DCA with Precision Time Base Module (86107A) and 70 GHz Sampling Head (86118A).

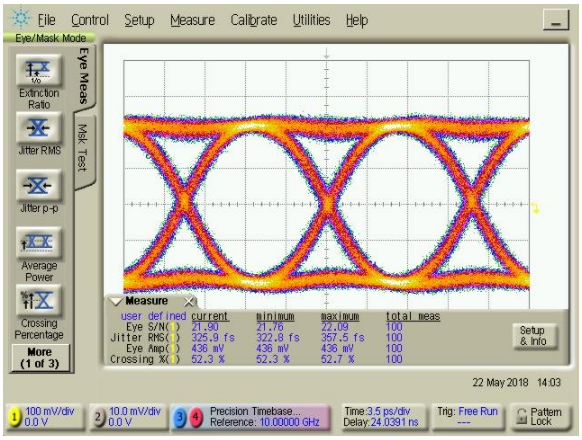
Eye Amplitude: Input ~440 mV ⇒ Output ~3.7 V



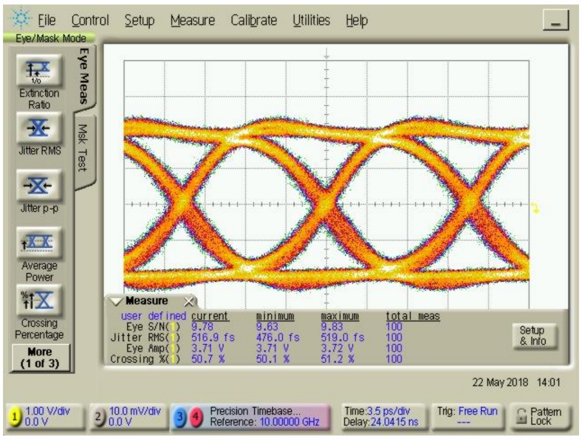
Input Signal @ 60 Gbps



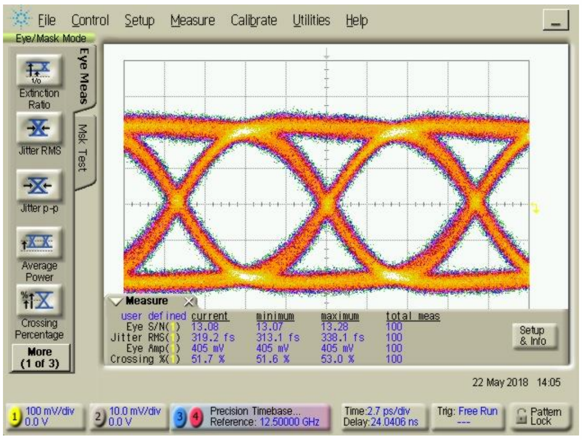
Output Signal @ 60 Gbps



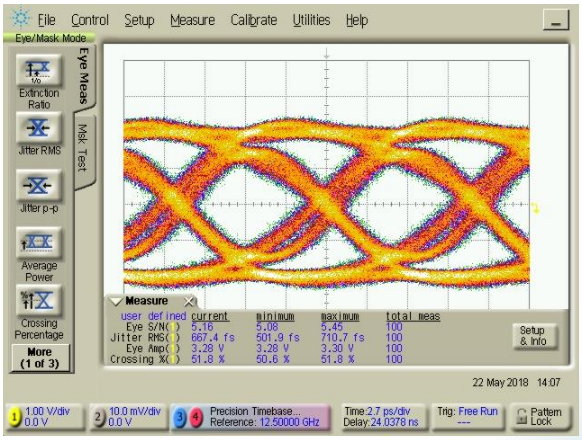
Input Signal @ 80 Gbps



Output Signal @ 80 Gbps



Input Signal @ 100 Gbps

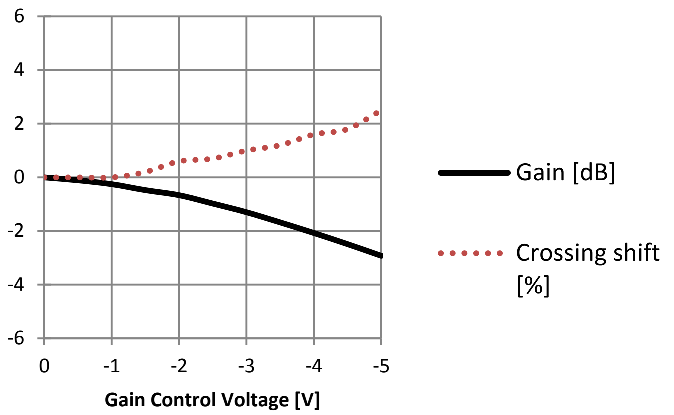


Output Signal @ 100 Gbps

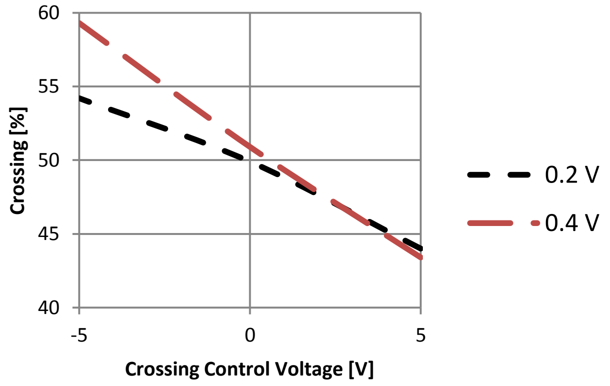
Handling Instructions

To operate the amplifier a positive supply voltage of approximately +5 V must be applied.

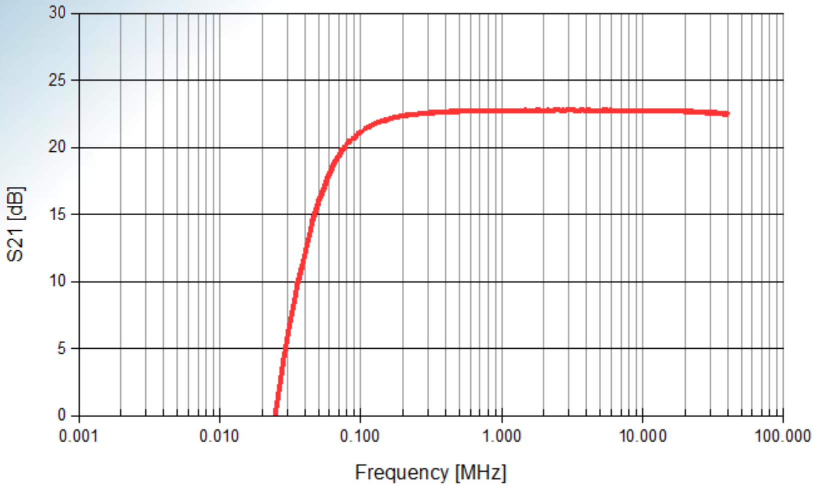
The gain can be adjusted by applying a voltage of 0 to -5 V. If this pin is left open, the amplifier will have maximum gain. By reducing the gain the crossing will shift. Typical characteristics are shown in the following diagram for an input voltage of 0.2 V with 50% crossing.



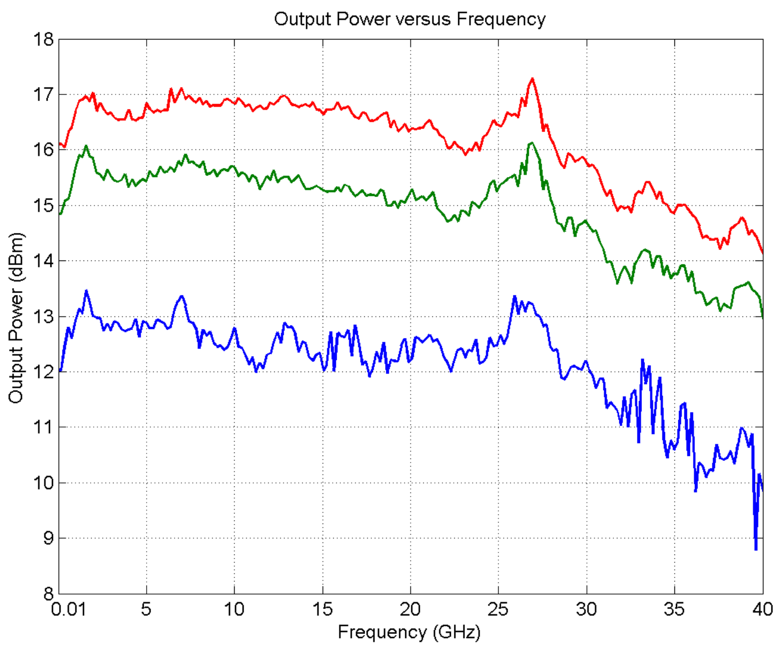
The crossing can be adjusted by applying a voltage of -5 to +5 V. If this pin is left open a crossing of approximately 50 % is achieved. The range depends on the input voltage. Typical characteristics are shown in the following diagram for input voltages of 0.2, and 0.4 V with 50% crossing.



Typical Low Frequency Response (<40 MHz)

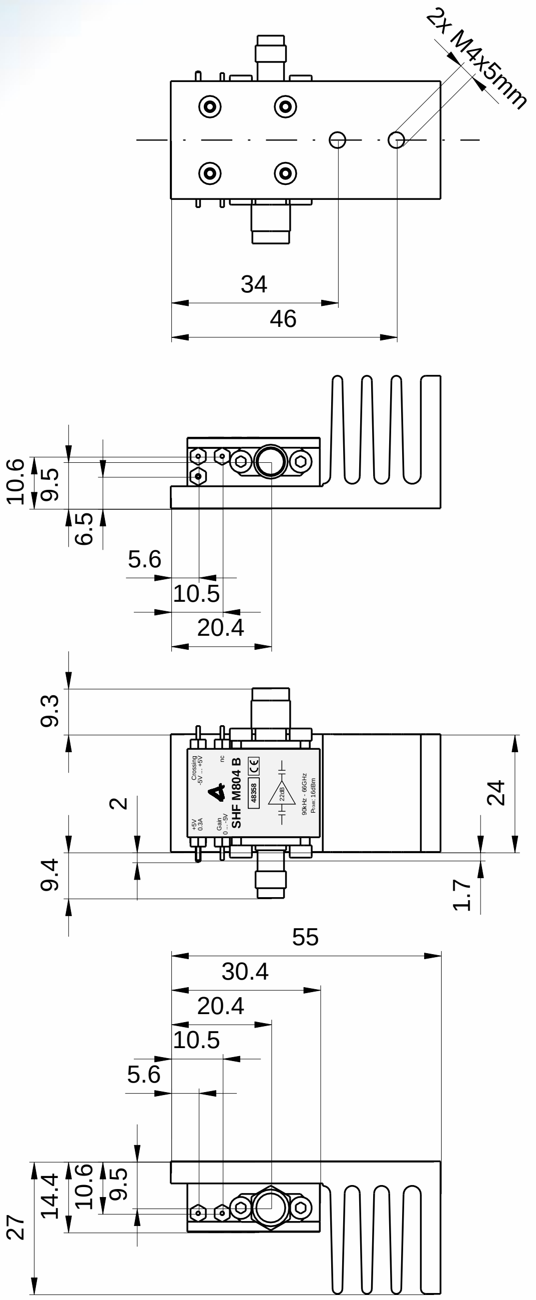


Typical Saturation power



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

Mechanical Drawing with Heat Sink

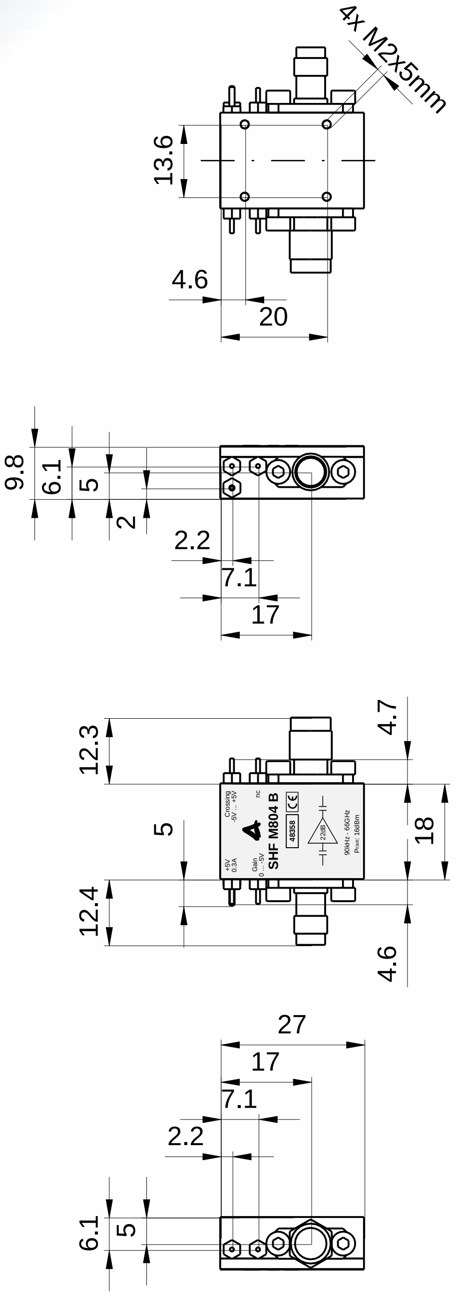


All dimensions in mm

Pin assignment might change if a bias tee option is chosen.

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 4.5…5.5 V, 0.3 A DC power supply and can be connected to the supply feed-through filter via an ON / OFF switch.
4. 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 greater 50 GHz (V/ 1.85mm attenuators)!
5. An input signal of about 0.45 V_{pp} will produce saturated output swing of about 4 V_{pp}.
6. Higher input voltages will drive the amplifier's output stage into saturation, leading to waveform peak clipping.
8. 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 up to 40 GHz.
9. 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)!
10. The input voltage should never be greater than 1 V_{pp} equivalent to 4 dBm input power.

    The input voltage without DC power supplied to the amplifier should never be greater than 2 V_{pp} equivalent to 10 dBm input power.