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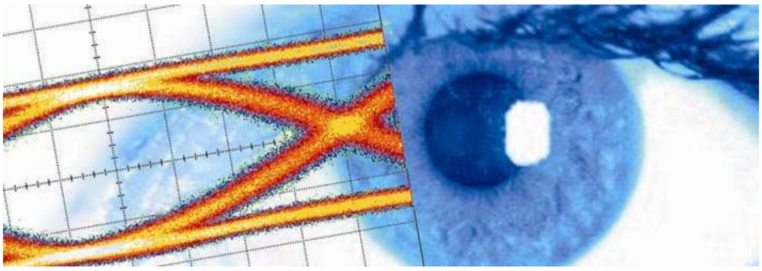
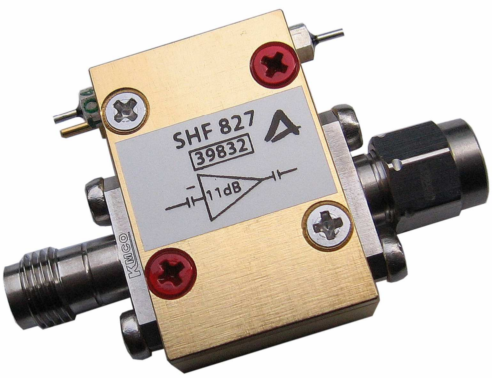


Datasheet

SHF 827

Ultra-Broadband Amplifier



Description

The SHF 827 is an ultra-broadband RF amplifier with an extremely small footprint and more than 65 GHz bandwidth.

A single stage amplifier design is employed using our special monolithic microwave integrated circuits (MMICs) inside special carriers to achieve the ultra-wide bandwidth and the low noise performance.

This extreme bandwidth offers the capability to amplify binary signals of more than 60 Gbps. The high linearity also enables this amplifier to optimally drive modulators and lasers for PAM, optical QAM, OFDM or even analog signals.

Applications

- Optical Communications
- High-Speed Pulse Experiments
- Satellite Communications
- Research and Development
- Antenna Measurements
- Data Transmission

Available Options

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

02: Built-in bias tee on input (max. ±9 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. ±7 V, max. 220 mA)[1]

MP: Matches the phase of two amplifiers

1 Only one option out of 01 – 04 is available at the same time.
S parameters may be slightly different from above stated specifications if option 01, 02, 03 or 04 is chosen.

Specifications

Parameter	Unit	Symbol	Min	Typ	Max	Conditions
Absolute Maximum Ratings						
Maximum RF Input Power in Operation	dBm V	$P_{in\ max}$			10 2	 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				±7	AC coupled output
Positive Supply Voltage	V	V_{DD}	3	5	6	reverse voltage protected
Positive Supply Current	A	I_{DD}		0.14	0.2	
Bias Control Voltage	V	V_{G1}	-5	+1	+5	will not exceed 0.02 A
Case Temperature	T_{case}	°C	10	30	50	

Electrical Characteristics (At 30°C case temperature, unless otherwise specified)						
High Frequency 3 dB Point	GHz	f_{HIGH}	65			
Low Frequency 3 dB Point	kHz	f_{LOW}			70	
Gain	dB	S_{21}	10	11		inverting measured at P_{in}=-20 dBm @ 40 MHz
Gain Ripple	dB	ΔS_{21}		±0,5	±1	40 MHz…40 GHz
Output Power at 1 dB Compression	dBm V	P_{01dB}	11 2.2	12 2.5		10 MHz…35 GHz peak to peak voltage
Output Power at 2 dB Compression	dBm V	P_{02dB}	14 3.2	15 3.6		10 MHz…35 GHz peak to peak voltage
Output Power at 3 dB Compression	dBm V	P_{03dB}	15.5 3.8	16 4		10 MHz…35 GHz peak to peak voltage
Input Return Loss	dB	S_{11}			-10 -5	< 12 GHz < 40 GHz
Output Return Loss	dB	S_{22}			-10 -5	< 30 GHz < 45 GHz
Rise Time/Fall Time	ps	t_r/t_f			6 10	20%...80%, 2 V ≤ Vout ≤ 3 V Deconvoluted [2, 3] Full Setup [2]
Jitter	fs	J_{RMS}		350 450	500 600	2 V ≤ Vout ≤ 3 V Deconvoluted [2, 3] Full Setup [2]
Group Delay Ripple	ps				±50	40 MHz…40 GHz, 100 MHz aperture
Power Consumption	W			0.7		V_{DD} = 5 V / I_{DD} = 0.14A
Mechanical Characteristics						
Input Connector						1.85mm (V) female[4]
Output Connector						1.85mm (V) male[3]

[2] Measured with the following setup: SHF 12103A -> DUT (SHF 827) -> Agilent 86100A with 70 GHz sampling head and precision time base.

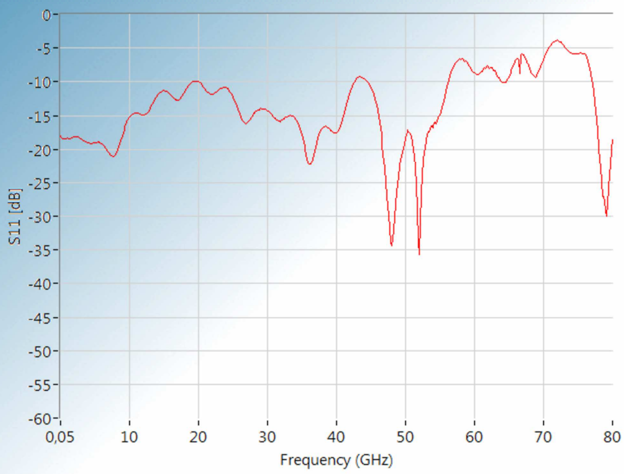
[3] Calculation based on typical results of setup without DUT :

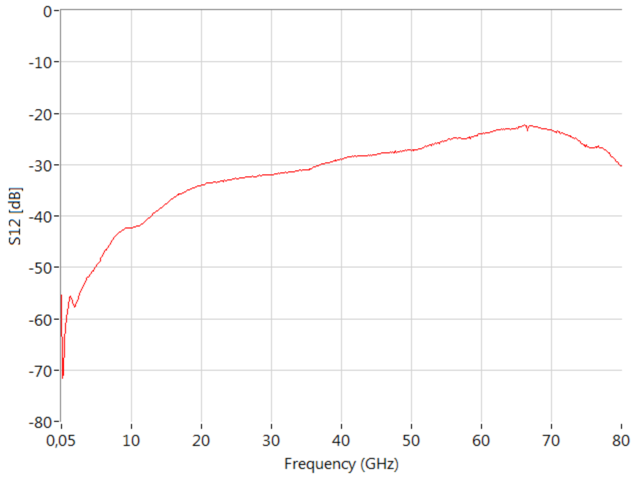
$$t_r/t_{f\ deconvoluted} = \sqrt{(t_r/t_{f\ full\ setup})^2 - (t_r/t_{f\ setup\ w/o\ DUT})^2} = \sqrt{(t_r/t_{f\ full\ setup})^2 - 8\ ps^2}$$

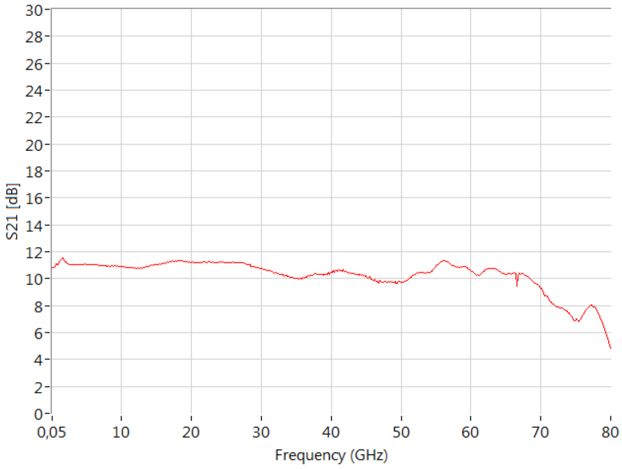
$$J_{RMS\ deconvoluted} = \sqrt{(J_{RMS\ full\ setup})^2 - \left(J_{RMS\ setup\ w/o\ DUT}\right)^2} = \sqrt{(J_{RMS\ full\ setup})^2 - 300\ fs^2}$$

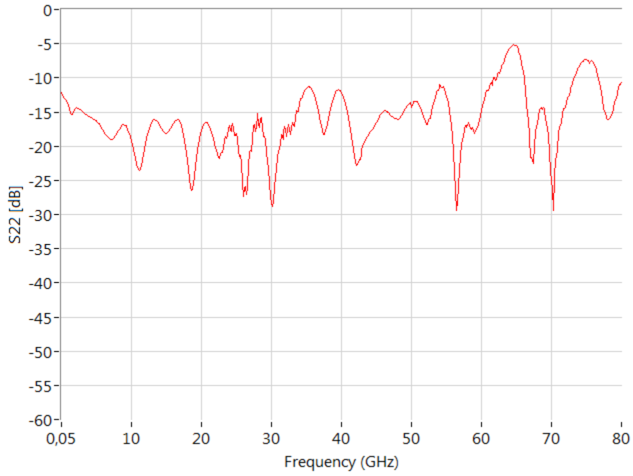
[4] Other gender configurations are available on request.

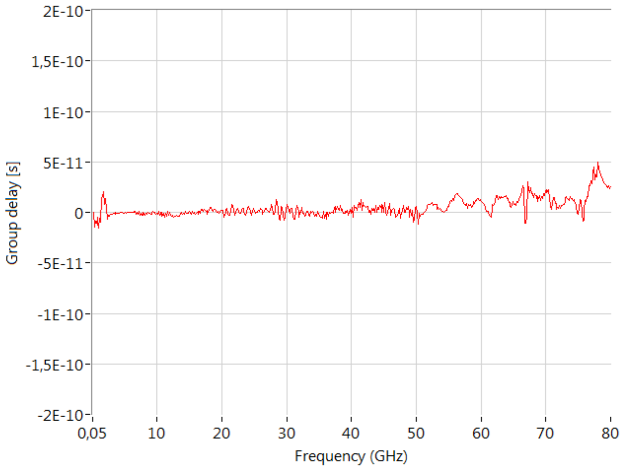
Typical S-Parameters, Group Delay and Phase Response

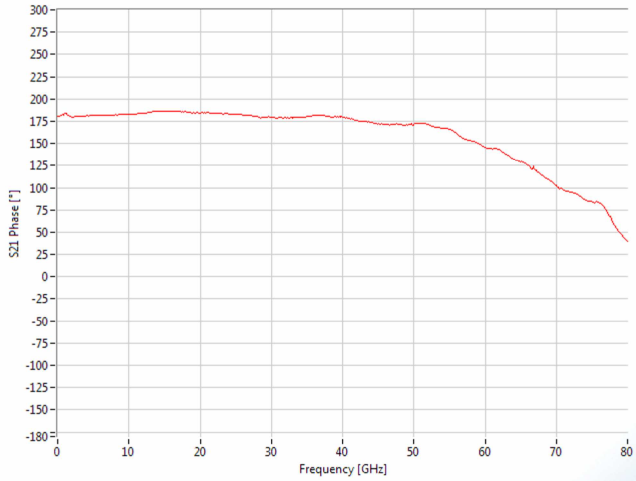








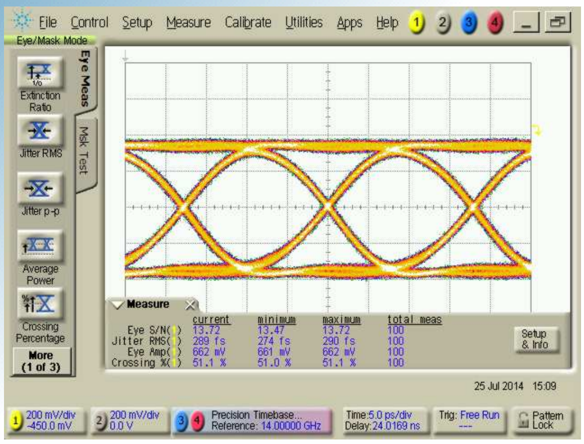




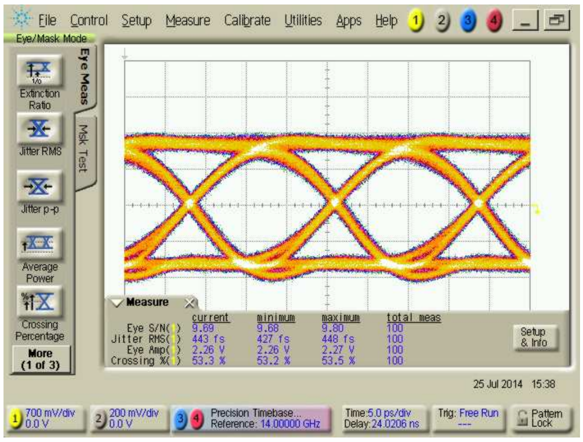
Aperture of group delay measurement: 100 MHz

Typical Binary Eye diagram

The measurements below had been performed using a SHF 12103 A and an Agilent 86100D DCA with Precision Time Base Module (86107A) and 70 GHz Sampling Head (86118A).



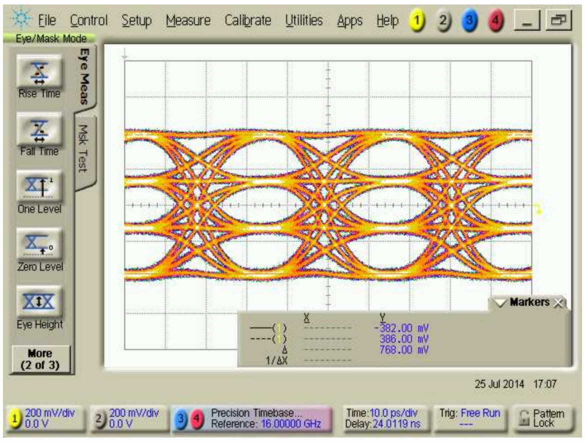
Input Signal @ 56 Gbps, Eye amplitude: 662 mV



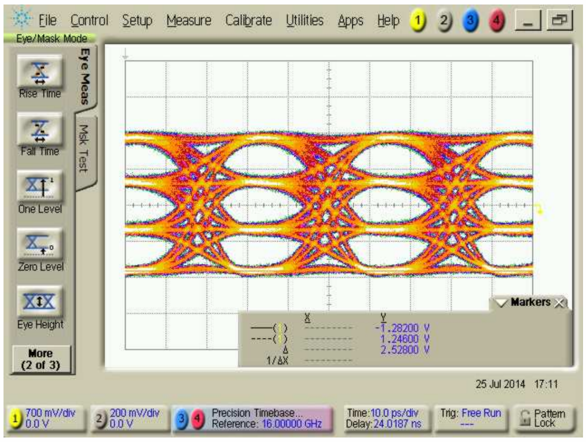
Output Signal @ 56 Gbps, Eye amplitude: 2.26 V

Typical 4-Level Eye diagram

The measurements below had been performed using a SHF 611C DAC and an Agilent 86100D DCA with Precision Time Base Module (86107A) and 70 GHz Sampling Head (86118A).

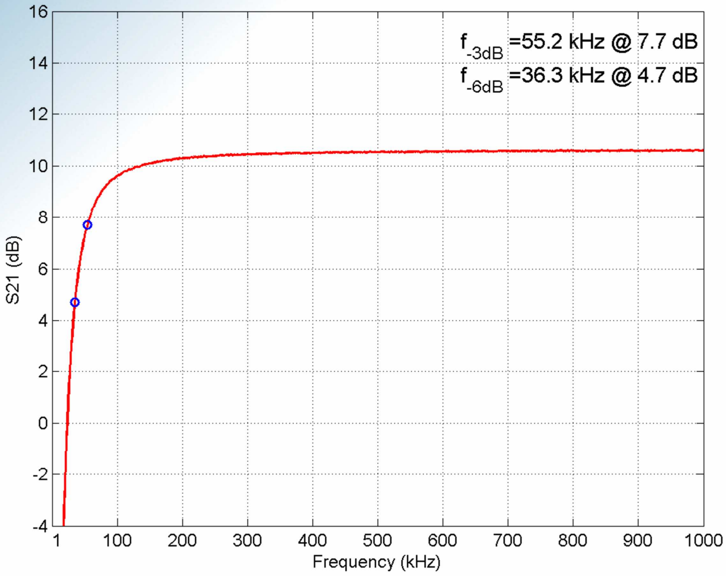


Input Signal @ 32 GBaud, ~768 mVpp

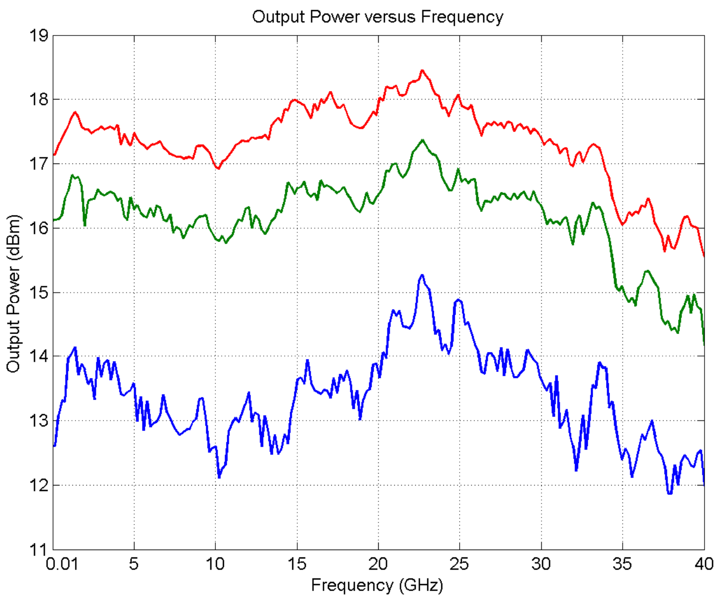


Output Signal @ 32 GBaud, ~2.53 Vpp

Typical Low Frequency Response (<1 MHz)



Typical Saturation power



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

Handling Instructions

To operate the amplifier the positive supply voltage V_{DD} of approximately +5 V must be applied to the designated pin shown below.

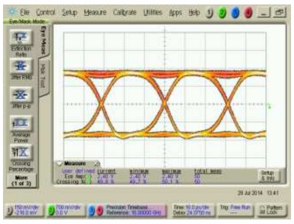
Please do never exceed the maximum values given in above table. This will severely damage the amplifier.

The amplifier does not contain a voltage regulator. It must be supplied by a well regulated power supply that does not generate transients.

Crossing

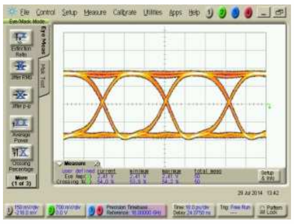
The crossing can be adjusted by applying a voltage to V_{G1}. If it is left open (only V_{DD} applied) the output signal will have an arbitrary crossing. In case this is considered to be accurate enough for the application V_{G1} can be left open. A crossing of 50% is achieved by applying the appropriate voltage for the individual amplifier. This value is provided in the inspection report of the amplifiers (typically + 1 V).[5]

Examples (values might be different for each individual device):



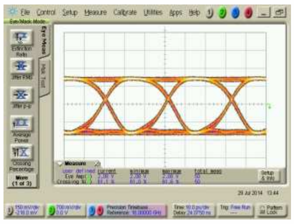
V_{G1} = optimized (typ. +1 V)

Crossing = 50 %



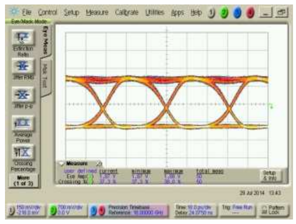
V_{G1} = open

Crossing = 54 %



V_{G1} = - 2 V

Crossing = 61 %



V_{G1} = +4 V

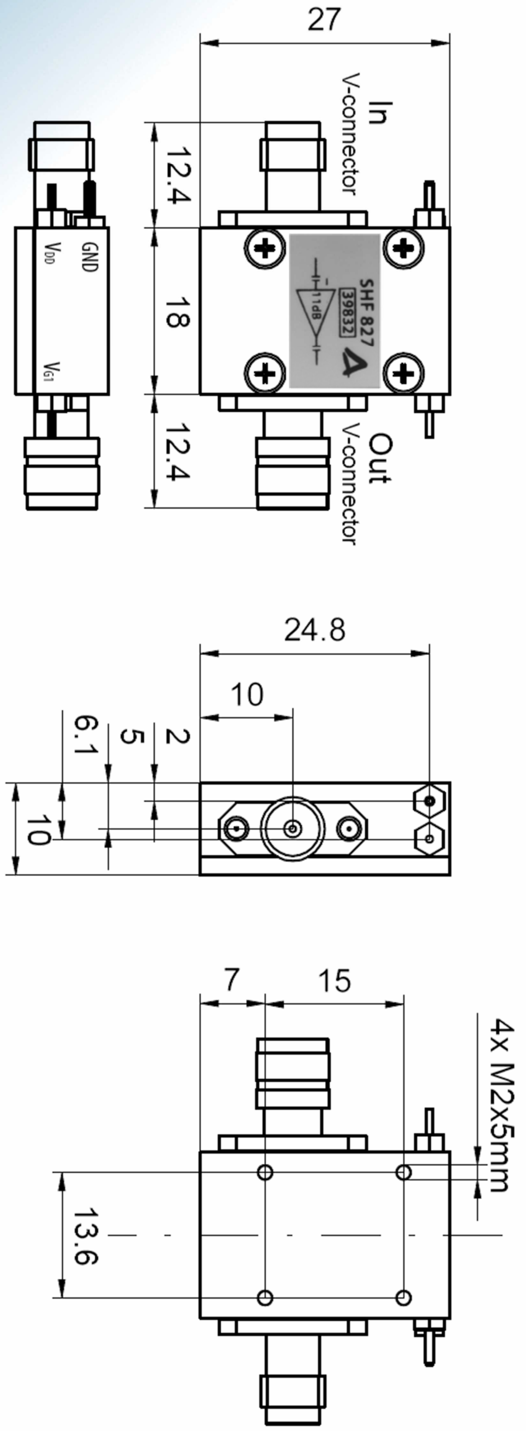
Crossing = 37 %

Output Power

For optimum performance and maximum output power we recommend applying +5 V to V_{DD}. The output swing can be reduced by applying a smaller voltage. V_{G1} must be readjusted to achieve maximum gain, output power and linearity.

[5] If the operating point shall be fixed it is possible to set V_{G1} via a simple voltage divider from V_{DD}. The input resistance of V_{G1} is 360 Ω.

Mechanical Drawing



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 a well regulated 3…5 V, 0.2 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 2 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 2 V_{pp} equivalent to 10 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.