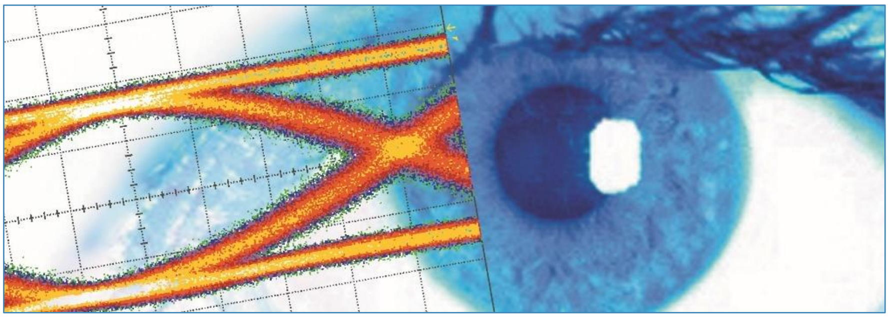


Data Sheet

SHF T850 C

Broadband Amplifier

Description

The SHF T850 C is a RoHS compliant ultra-broadband RF amplifier with a small footprint and a bandwidth of more than 100 GHz.

A distributed amplifier design is employed using our monolithic microwave integrated circuit (MMIC) inside special carriers to achieve the ultra-wide bandwidth.

This extreme bandwidth offers the capability to amplify binary signals of more than 100 GBaud while its good linearity enables this amplifier to drive modulators and lasers for PAM, optical QAM, OFDM and analog signals.

Ease of Use

Only a single 5 V supply is needed for operation.

Upon delivery the amplifier is assembled with a heat sink and a junction box. The junction box adapts the supply pins to a screw-type terminal. By this the power and bias tee[1] supply cables do not need to be soldered or clipped. They can easily be connected and tightened with a screw driver. Further information can be found in the mechanical drawing section of this document.

For system applications or permanent set ups, the heat sink as well as the junction box, can be removed. In that case, other adequate cooling measures have to be provided.

Individual Inspection

Each amplifier will be furnished with an individual inspection report showing the compliance to the data sheet as well as the time- and frequency domain performance. This data (including the touchstone® s2p-file) is accessible on-line. The specific link dedicated to each serial number will be provided with the delivery and is printed as a QR code on the heat-sink.

Options

04: Built-in bias tee on output (max. ±5 V, max. 150 mA)[2]

MP: Matched Pair of two amplifiers

QHS: Quad Heat Sink, four amplifiers on one heatsink

[1] Only if the optional output bias-tee (option 04) is included.

[2] If this option is chosen, the maximum gain and the maximum output power might be reduced by up to 1 dB. The output reflection might be increased by 1 dB. The DC resistance of a bias tee is about 7 Ω.

Specifications

Absolute Maximum Ratings

Parameter	Unit	Symbol	Min	Typ	Max	Comment
Maximum RF Input	dBm V	$P_{in\ max}$			4 1	 peak to peak voltage
DC Voltage at RF Input	V				±5	
DC Voltage at RF Output	V				±5	
Positive Supply Voltage	V		4.7		6.0	current depends on voltage typ. 0.4 A @ 5.0 V, allow 1 A
Case Temperature	°C	T_{case}	10	45	55	

Electrical Characteristics (At 45°C case temperature, unless otherwise specified)

Parameter	Unit	Symbol	Min	Typ	Max	Comment
High Frequency 3 dB Point	GHz	f_{High}	100			At P_{in}=-20 dBm
Low Frequency 3 dB Point	kHz	f_{Low}			100	At P_{in}=-20 dBm
Gain	dB	S_{21}	10			At P_{in}=-20 dBm and 500 MHz
Input Reflection	dB	S_{11}			-12 -9 -7	0.5 MHz < f ≤ 50 GHz 50 GHz < f ≤ 80 GHz 80 GHz < f ≤ 100 GHz
Output Reflection	dB	S_{22}			-12 -9 -7	0.5 MHz < f ≤ 50 GHz 50 GHz < f ≤ 80 GHz 80 GHz < f ≤ 100 GHz
Output Eye Amplitude	V				2	
Phase Delay Difference[3]	deg	Δ PD			±5 ±10 ±15	1 GHz < f ≤ 30 GHz 30 GHz < f ≤ 60 GHz 60 GHz < f ≤ 80 GHz If option MP is chosen
Gain Difference[4]	dB	Δ S_{21}			±1	1 to 80 GHz If option MP is chosen
Power Consumption	W			2		

[3] The phase delay difference is defined as the phase difference in degrees of the output signals of both amplifiers. It is calculated as: $\vartheta_{Amp1} - \vartheta_{Amp2}$, where ϑ_{Amp1} and ϑ_{Amp2} indicate the unwrapped phase of $S_{21\ Amp1}$ and $S_{21\ Amp2}$, respectively.

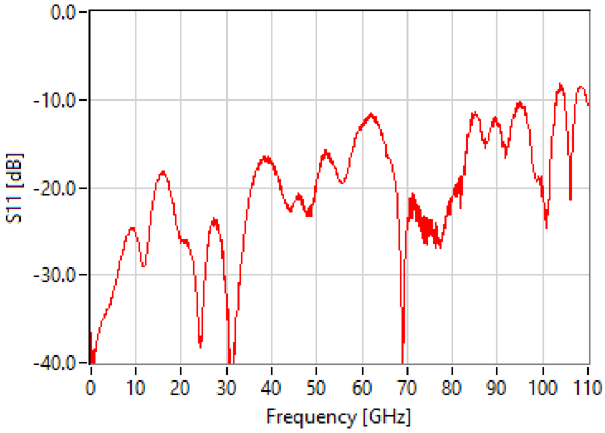
[4] The gain difference is defined as the gain difference in dB of the output signals of both amplifiers. It is calculated as: $|S_{21\ Amp1}|_{dB} - |S_{21\ Amp2}|_{dB}$.

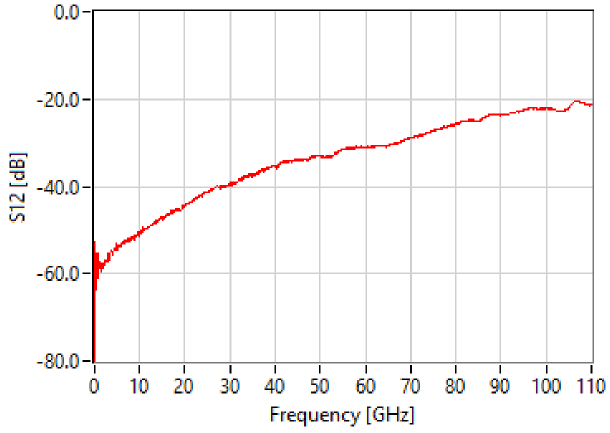
Mechanical Characteristics

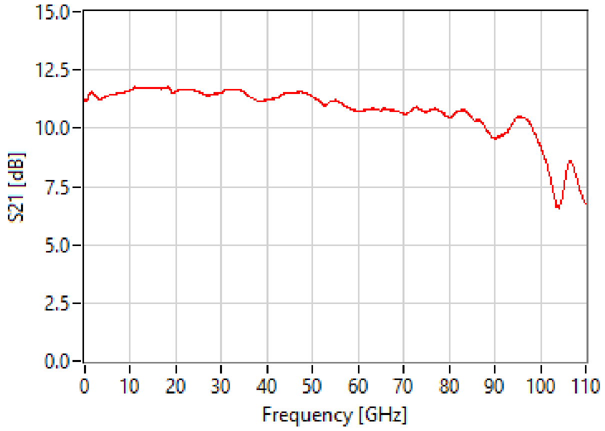
Parameter	Unit	Symbol	Min	Typ	Max	Conditions
Input Connector	Ω			50		1.0 mm female[5]
Output Connector	Ω			50		1.0 mm male[5]
Dimensions	mm					see page 10 to 12
Weight	g			35 10 40		Amplifier only Junction box only Heat Sink only

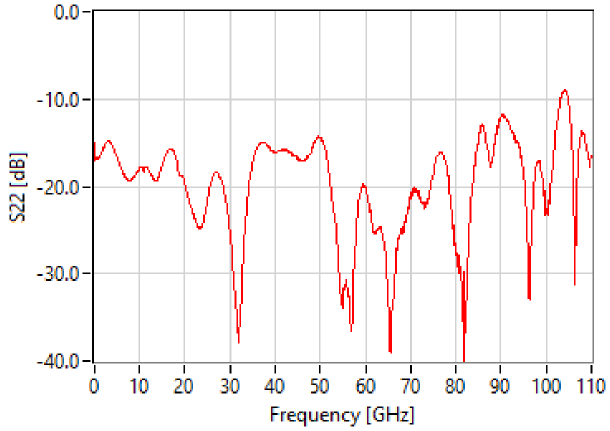
[5] Other gender configurations are available on request.

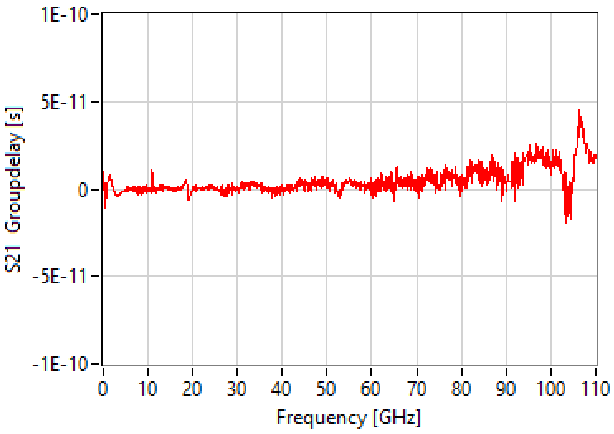
Typical S-Parameters

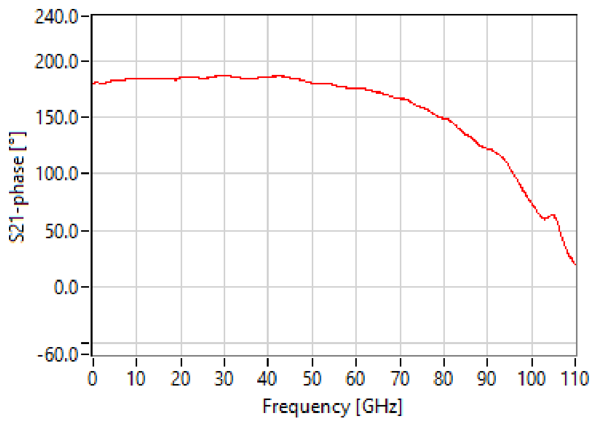












Aperture of group delay measurement: 160 MHz

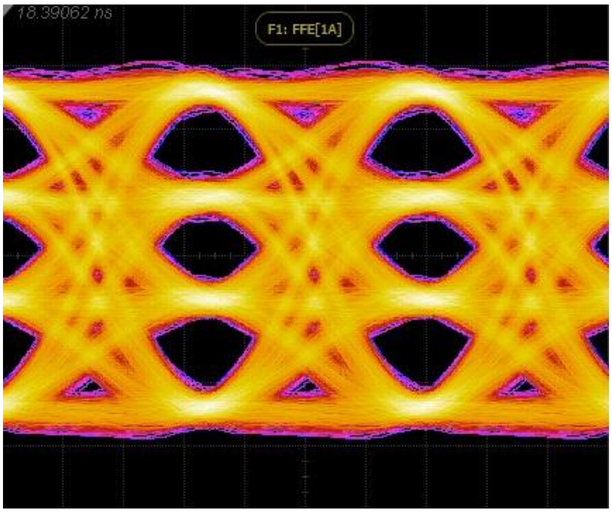
Typical Waveforms

The following measurements had been performed using the hardware mentioned below. The output of the amplifier had been connected with an attenuator (SHF ATT110 A) to the scope's sampling module.

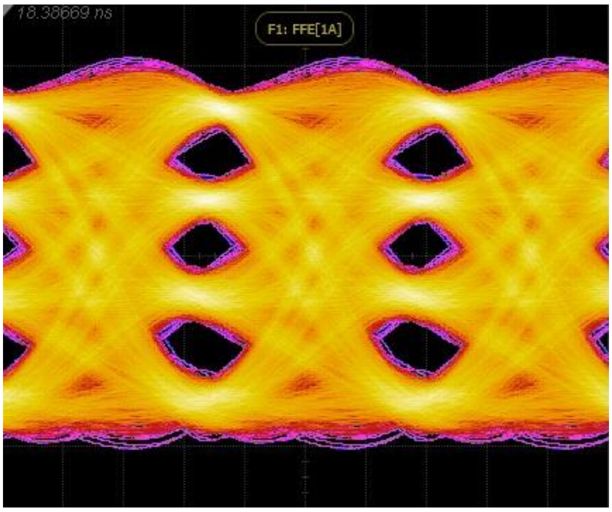
Please note that only the measurements taken with the Tektronix DCA DSA8300 will be part of the inspection report.

Measurements with:

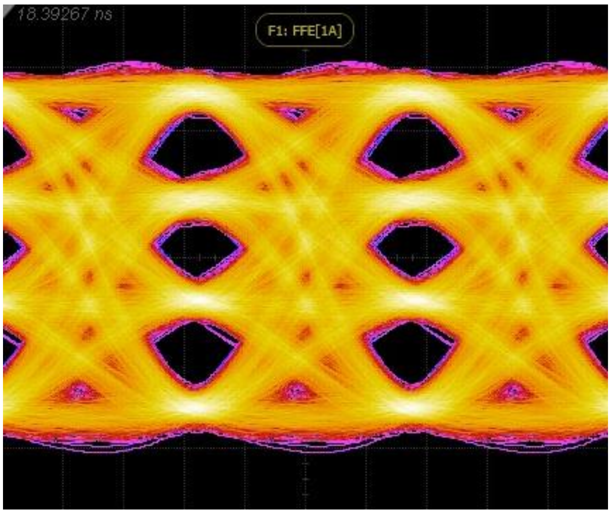
- **SHF 616 C PAM-MUX generating PAM4 signals (PRBS13Q)**
- **Keysight DCA N1000A, Precision Timebase & 122 GHz Sampling Module (N1046A)**
- **Linear FFE (7-Tap with 2 pre cursors) applied**



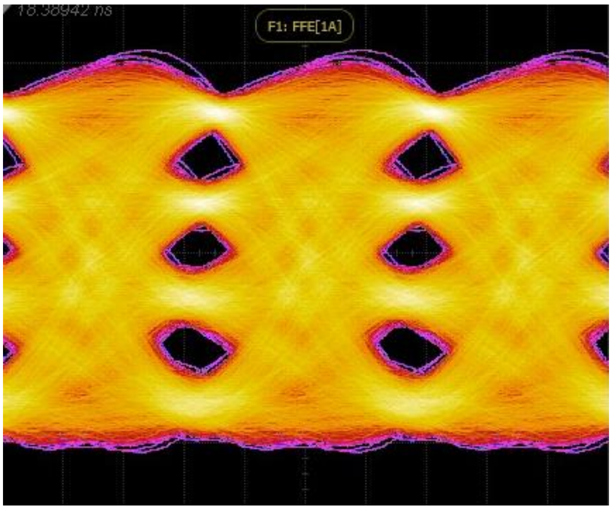
100 GBaud (200 Gbps) 470 mV Input Signal



100 GBaud (200 Gbps) 1.65 V Output Signal



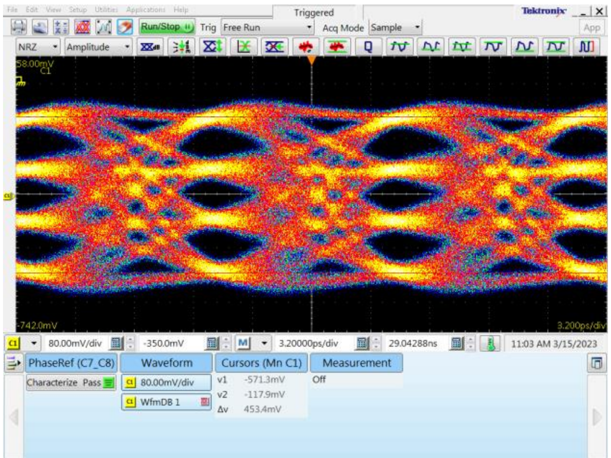
112 GBaud (224 Gbps) 470 mV Input Signal



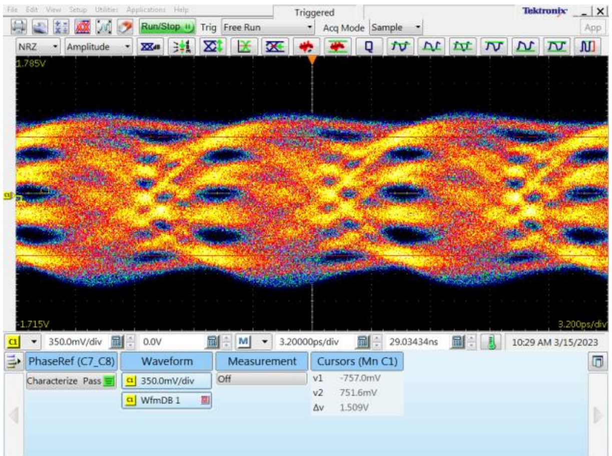
112 GBaud (224 Gbps) 1.65 V Output Signal

Measurements with:

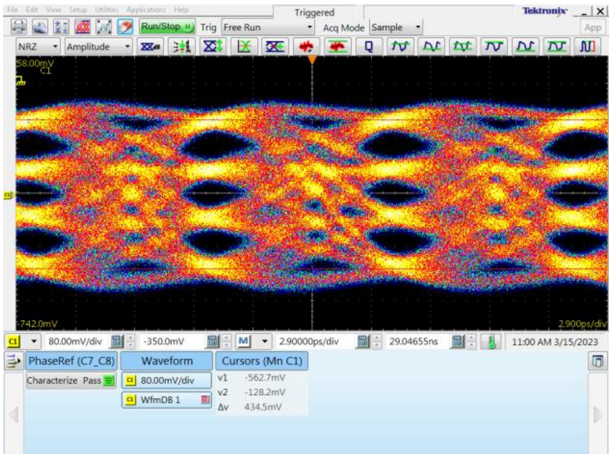
- **SHF 616 C PAM-MUX generating PAM4 signals (PRBS13Q)**
- **Tektronix DCA DSA8300 with Phase Reference 82A04B and Sampling Head 80E11**
- **No Filter applied**



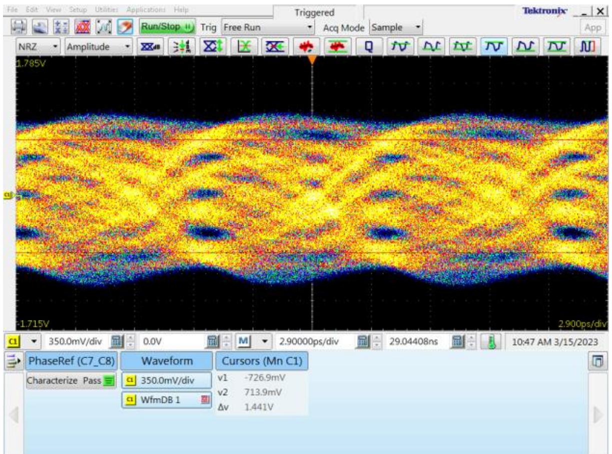
100 GBaud (200 Gbps) 450 mV Input Signal



100 GBaud (200 Gbps) 1.5 V Output Signal



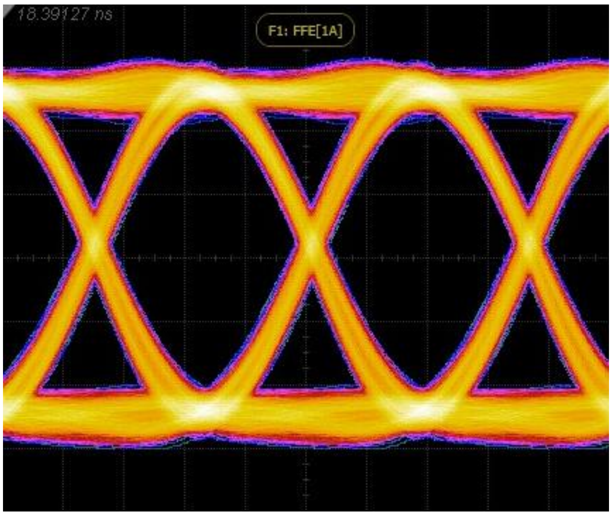
112 GBaud (224 Gbps) 430 mV Input Signal



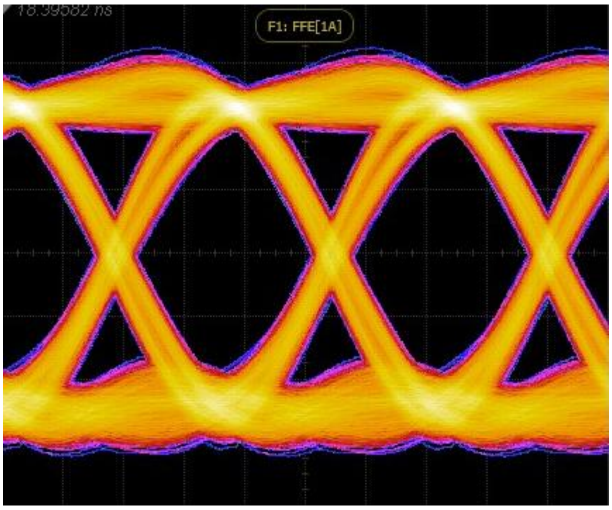
112 GBaud (224 Gbps) 1.44 V Output Signal

Measurements with:

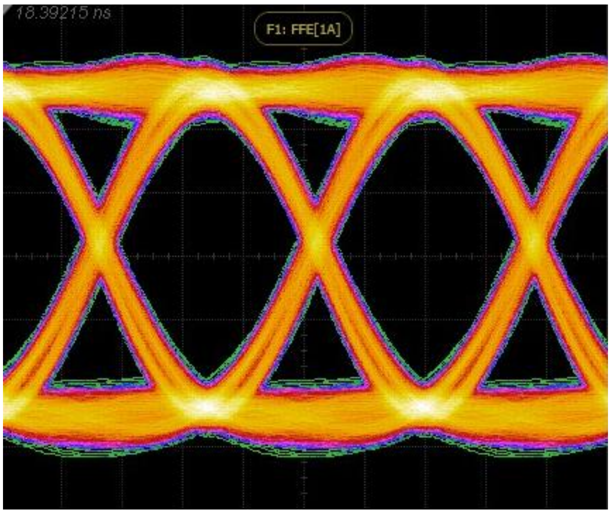
- **SHF 616 C PAM-MUX generating binary signals (PRBS13)**
- **Keysight DCA N1000A, Precision Timebase & 122 GHz Sampling Module (N1046A)**
- **Linear FFE (7-Tap with 2 pre cursors) applied**



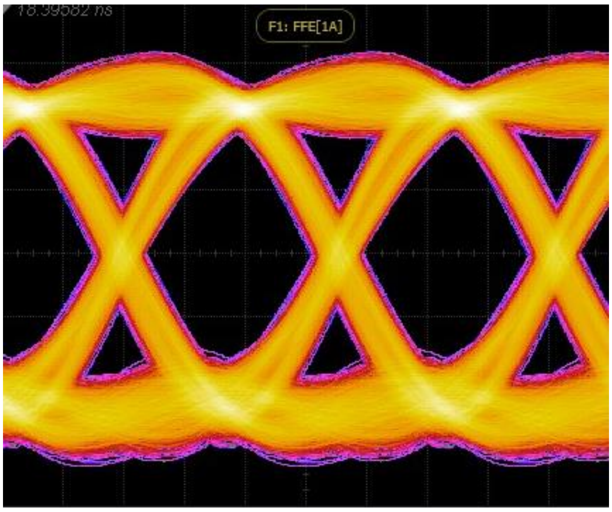
100 Gbps 450 mV Input Signal



100 Gbps 1.6 V Output Signal



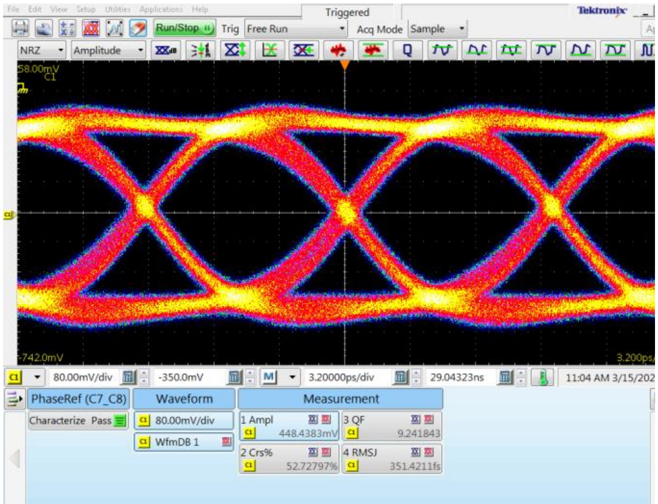
112 Gbps 430 mV Input Signal



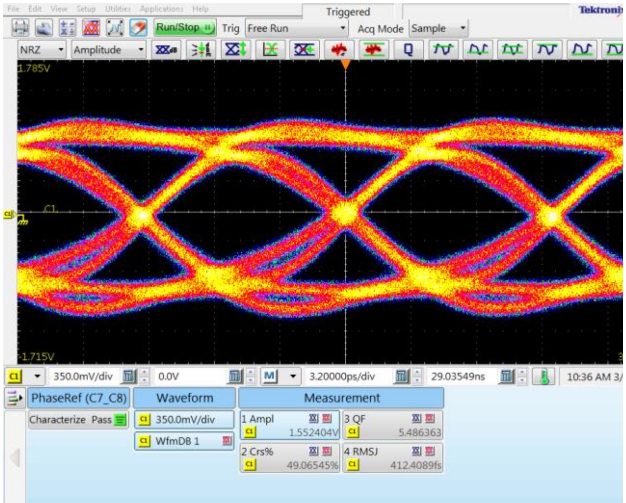
112 Gbps 1.5 V Output Signal

Measurements with:

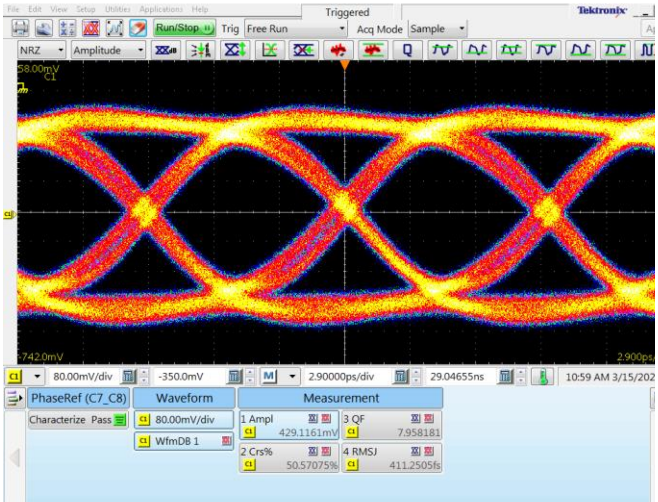
- **SHF 616 C PAM-MUX generating binary signals (PRBS13)**
- **Tektronix DCA DSA8300 with Phase Reference 82A04B and Sampling Head 80E11**
- **No Filter applied**



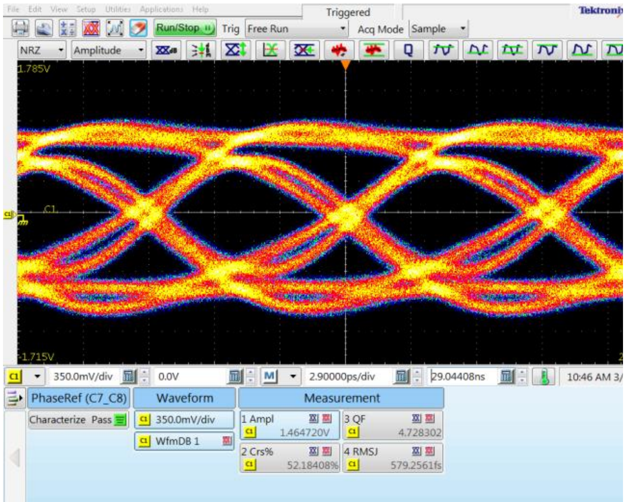
100 Gbps 450 mV Input Signal



100 Gbps 1.55 V Output Signal

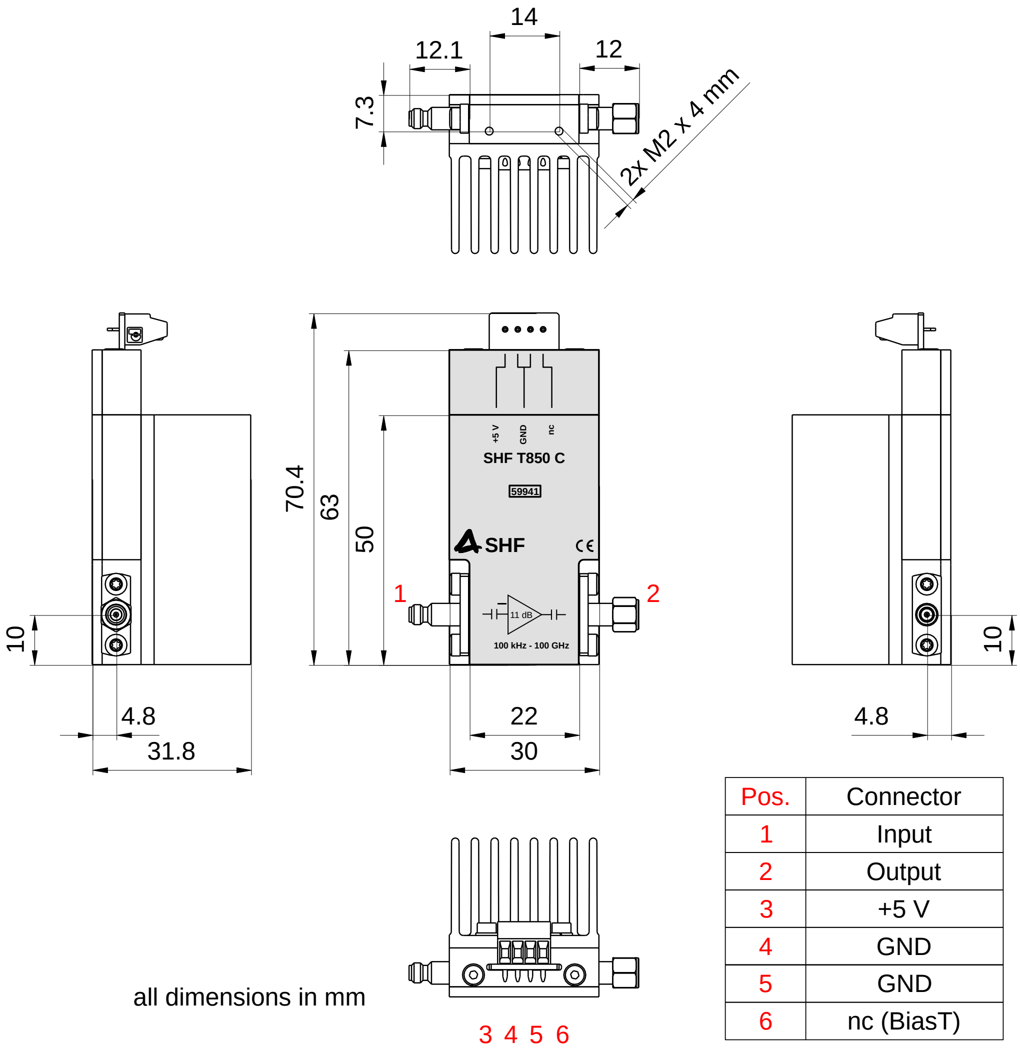


112 Gbps 430 mV Input Signal



112 Gbps 1.44 V Output Signal

Mechanical Drawing with Heat Sink

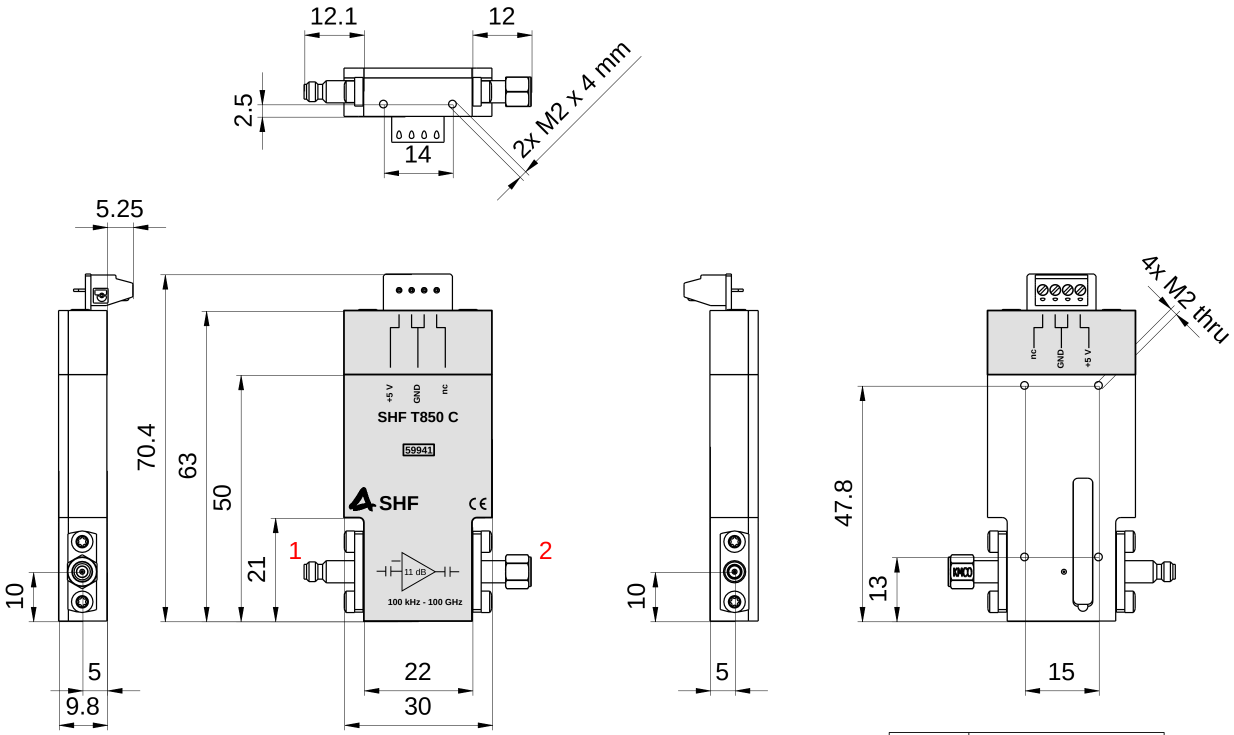


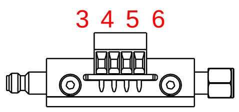
Pos.	Connector
1	Input
2	Output
3	+5 V
4	GND
5	GND
6	nc (BiasT)

In standard configuration pin 6 is not connected (nc). If an output bias-tee (option 04) is included the DC bias can be connected to pin 6 (BiasT).

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 a thermal gap pad is used between the heat sink and the amplifier housing.

Mechanical Drawing without Heat Sink





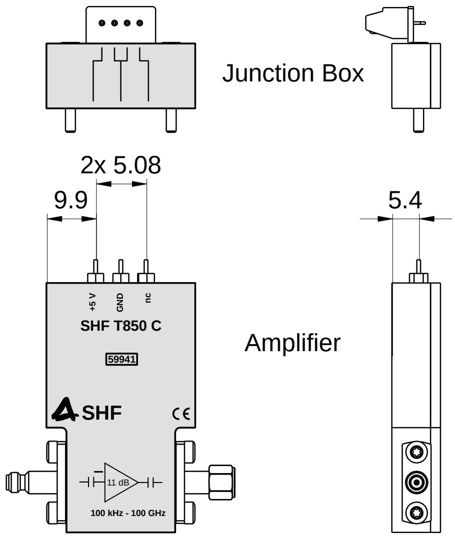
all dimensions in mm

Pos.	Connector
1	Input
2	Output
3	+5 V
4	GND
5	GND
6	nc (BiasT)

Please ensure that adequate cooling of the amplifier is guaranteed.

In standard configuration pin 6 is not connected (nc). If an output bias-tee (option 04) is included the DC bias can be connected to pin 6 (BiasT).

Mechanical Drawing with Removed Junction Box



The junction box can be removed on site by the customer. This connection, however, is not intended for frequent mating cycles. In case the amplifier is to be connected or disconnected from the power supply, please always use either the screw-type terminal or the connection directly at the power supply.

User Instructions

Electrostatic sensitive device

1. To prevent damage through static charge build up, cables should be always discharged before connecting them to the amplifier!
2. First make the connections between amplifier, signal source and a 50 Ohm output load before supplying DC power to the amplifier!
3. The supply voltage can be taken from any regular 4.7…6 V, 1 A DC power supply and can be connected to the supply feed-through filter via an ON / OFF switch. Do not increase the supply voltage slowly from 0!
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 100 GHz (1.0 mm attenuators)!
5. While using a reflective load the output voltage has to be reduced to a safe operating level according to the magnitudes of the reflections.
6. 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)!
7. The input voltage should never be greater than 1 Vpp equivalent to 4 dBm input power.
8. In case a bias tee is connected to the amplifier, please note that abrupt connection or disconnection of the RF port of such bias tees may cause harmful transients. Therefore, it is always recommended not to connect or disconnect bias tees under bias voltage. For example, ramp down the bias to 0 V before lifting a waver prober. In case of a short circuit, first ramp down the bias to 0 V then open the short.
9. For the DC-connections flexible cables 0.2 … 0.5 mm^2 / AWG 24 … 20 are recommended. The maximum tightening torque for the screw-type terminal of the junction box is 0.15 Nm / 11 Ft.Lbs. .
10. If the junction box is removed both M2x3 mm threads could be used for GND connection. A maximum soldering temperature of 260 °C for 3 seconds is recommended for the feed-through.

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