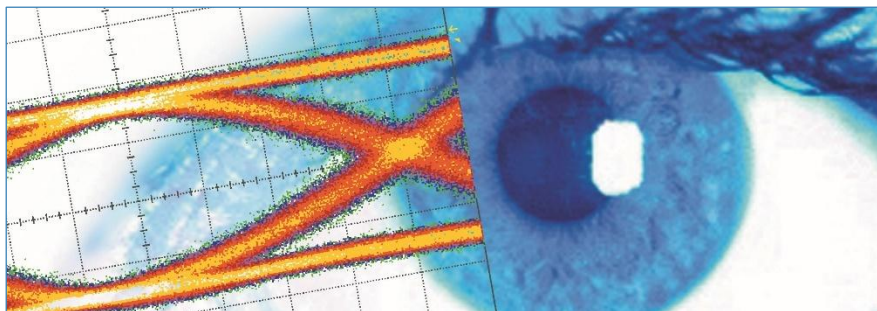




## Data Sheet

# SHF C684 A



## Analog FIR Filter

## Description

The SHF C684 A is a tunable analog 5-tap finite impulse response (FIR) filter. The differential input signal is amplified and filtered by a 5-stage FIR filter structure with fixed tap delays of about 6 ps. The frequency response can be arbitrarily modified by adjusting the filter coefficients (i.e. the gain of the tap amplifiers in the GUI). Equalizing operation has been verified for heavily degraded signals up to 100 GBaud PAM4 and 100 Gbps NRZ signals (please be referred to the signals below). All RF in- and output ports are AC-coupled and internally terminated with 50 Ohm to GND. Unused in- or output ports should be terminated with 50 Ohm.

## Features

- Single ended or differential operation (either In or In! or both can be used)
- Compact module to be placed wherever adaptive equalization is required e.g. close to the DUT
- Complementary DSP software ("SHF Optimizer") to calculate optimum settings from s2p-files and captured traces from oscilloscopes

## Applications

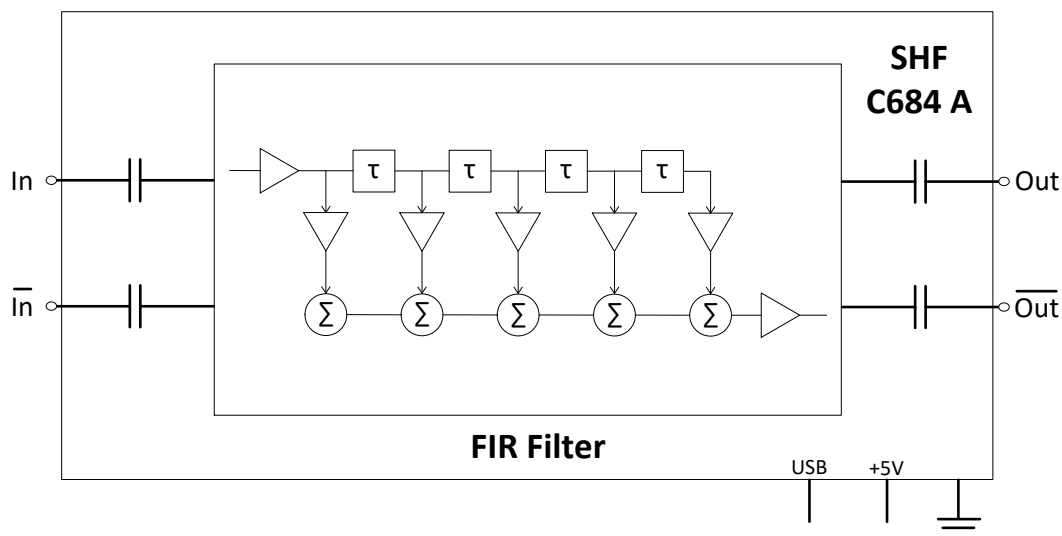
- Quality improvement of a degraded signal e.g. for BER measurements
- Equalization of transmission channels
- Emulation of various RF and microwave modules
- Signal predistortion to simulate various transmission channels
- 100GbE, 200GbE, 400GbE and 1TbE system evaluation & development
- Telecom transmission
- Broadband test and measurement equipment

## Accessories

- +5 V Power Supply Desktop Adapter
- Functional Earth Cable → Connection to test setup ground has to be set up first before any other connection to prevent instrument damage!
- Mini-USB cable



## Block Diagram



## Specifications

### Absolute Maximum Ratings

| Parameter                                 | Unit | Symbol         | Min | Typ | Max | Comment                      |
|-------------------------------------------|------|----------------|-----|-----|-----|------------------------------|
| Data Input Voltage                        | mV   | $V_{data\ in}$ |     |     | 900 | Peak-to-Peak<br>Single-ended |
| External DC Voltage on<br>RF Input Ports  | V    | $V_{DCin}$     | -6  |     | +6  | AC coupled input             |
| External DC Voltage on<br>RF Output Ports | V    | $V_{DCout}$    | -6  |     | +6  | AC coupled output            |
| DC Supply Voltage                         | V    | $V_{cc}$       | 0   |     | +6  |                              |

### Input Parameters

| Parameter                   | Unit | Symbol         | Min             | Typ        | Max | Comment                                                                     |
|-----------------------------|------|----------------|-----------------|------------|-----|-----------------------------------------------------------------------------|
| Maximum Analog<br>Bandwidth | GHz  | $f_{-3dB}$     | 70 <sup>1</sup> |            |     |                                                                             |
| Data Input Voltage          | mV   | $V_{data\ in}$ |                 |            | 500 | Eye Amplitude<br>Single-ended                                               |
| 1 dB Compression            | mV   | $V_{1dB}$      |                 | 350<br>175 |     | Eye Amplitude<br>Single ended drive<br>Differential drive (each input port) |

<sup>1</sup> Analog Bandwidth depends on the set filter characteristic



## Output Parameters

| Parameter        | Unit | Symbol    | Min | Typ | Max  | Comment                                                                           |
|------------------|------|-----------|-----|-----|------|-----------------------------------------------------------------------------------|
| Output Amplitude | mV   | $V_{out}$ |     |     | 1000 | Eye Amplitude<br>Single-ended<br>Depending on tap settings and<br>input amplitude |

## Power Requirements

| Parameter         | Unit | Symbol   | Min  | Typ  | Max  | Comment                    |
|-------------------|------|----------|------|------|------|----------------------------|
| Supply Voltage    | V    | $V_{CC}$ | +4.8 |      | +5.2 | 2.5 x 0.7 mm DC Power Jack |
| Supply Current    | mA   | $I_{CC}$ |      | 1400 | 1500 |                            |
| Power Dissipation | W    | $P_d$    |      |      | 7.5  | @ $V_{CC} = +5V$           |

## Mechanical Characteristics

| Parameter         | Unit     | Symbol | Min | Typ       | Max | Comment                      |
|-------------------|----------|--------|-----|-----------|-----|------------------------------|
| Input Connectors  | $\Omega$ |        |     | 50        |     | 1.85 mm (V) female           |
| Output Connectors | $\Omega$ |        |     | 50        |     | 1.85 mm (V) female           |
| Dimensions        | mm       |        |     |           |     | See pages 10-12              |
| Weight            | g<br>g   |        |     | 90<br>420 |     | module<br>module + heat sink |

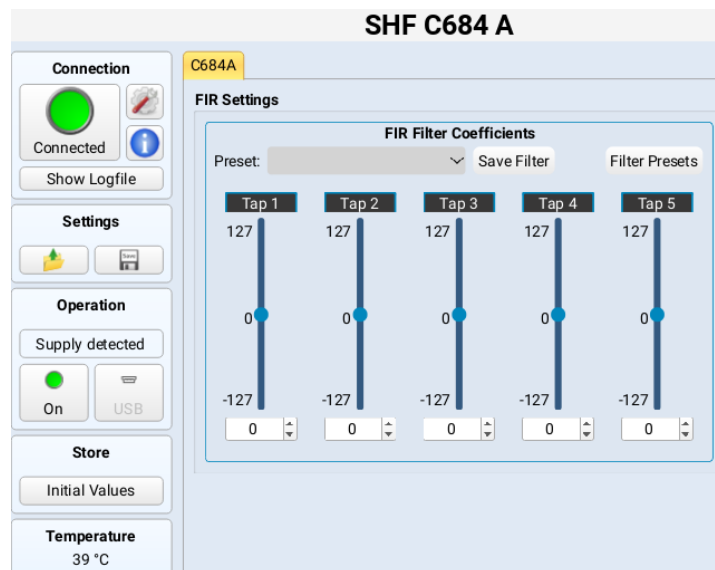
## Conditions

| Parameter             | Unit | Symbol        | Min | Typ | Max | Comment |
|-----------------------|------|---------------|-----|-----|-----|---------|
| Operating Temperature | °C   | $T_{ambient}$ | 15  |     | 35  |         |

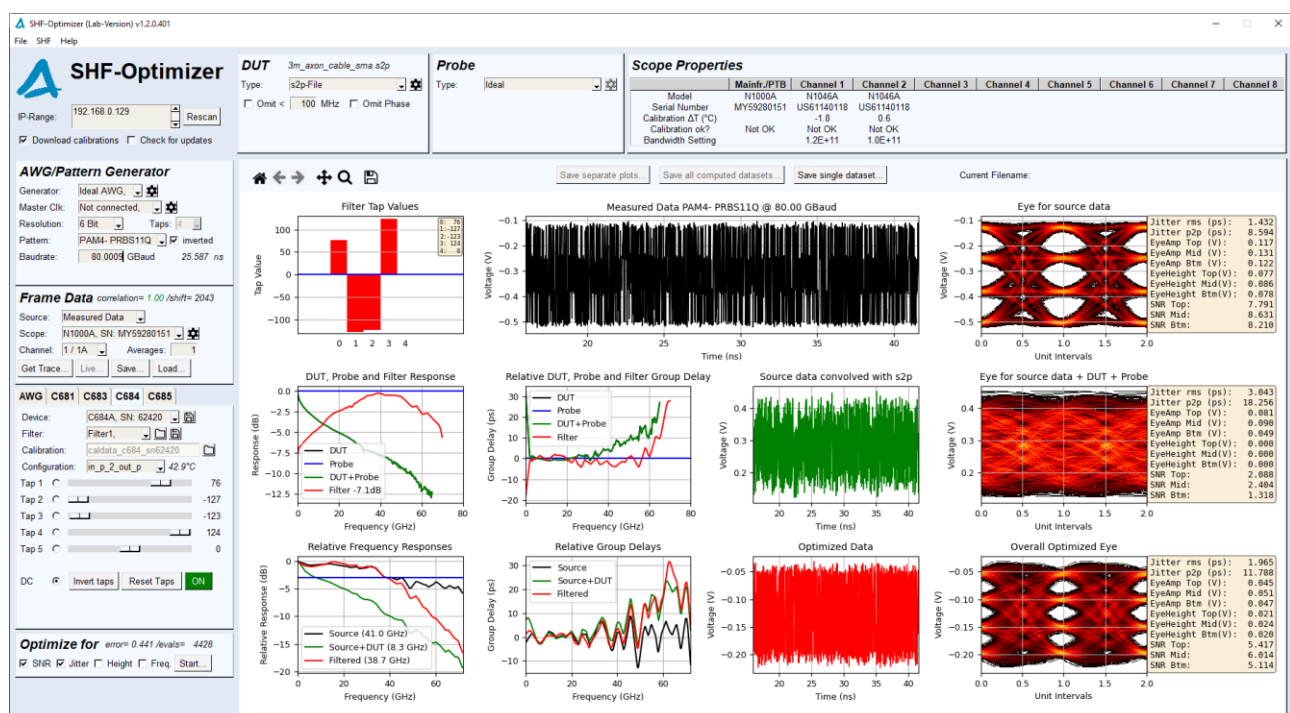


## Remote Interface & Software

The filter is controlled either by the SHF Control Center (SCC) software or by the dedicated DSP program SHF-Optimizer. The SCC is an easy to use tool for setting the filter coefficient. The SHF-Optimizer can do the same, but is much more powerful as it provides various algorithms to calculate the optimum settings (e.g. based on signal traces from supported oscilloscopes or s-parameters). In addition, the SHF Optimizer provides accurate prediction of the output eye, frequency response and group delay at any stage of the signal chain. Both software packages are a complementary part of the SHF C684 A.



GUI – SHF Control Center SCC

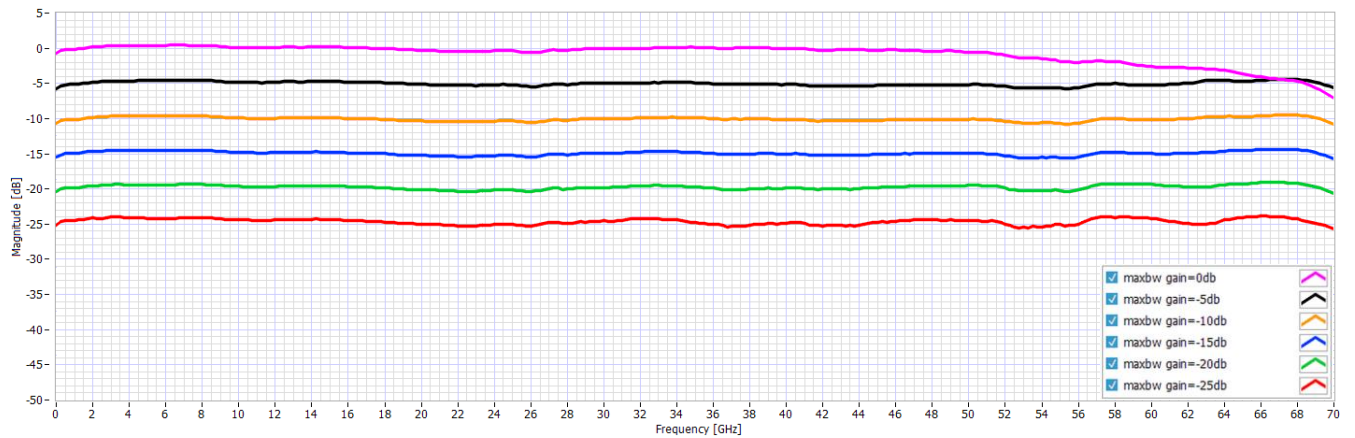


GUI – SHF-Optimizer

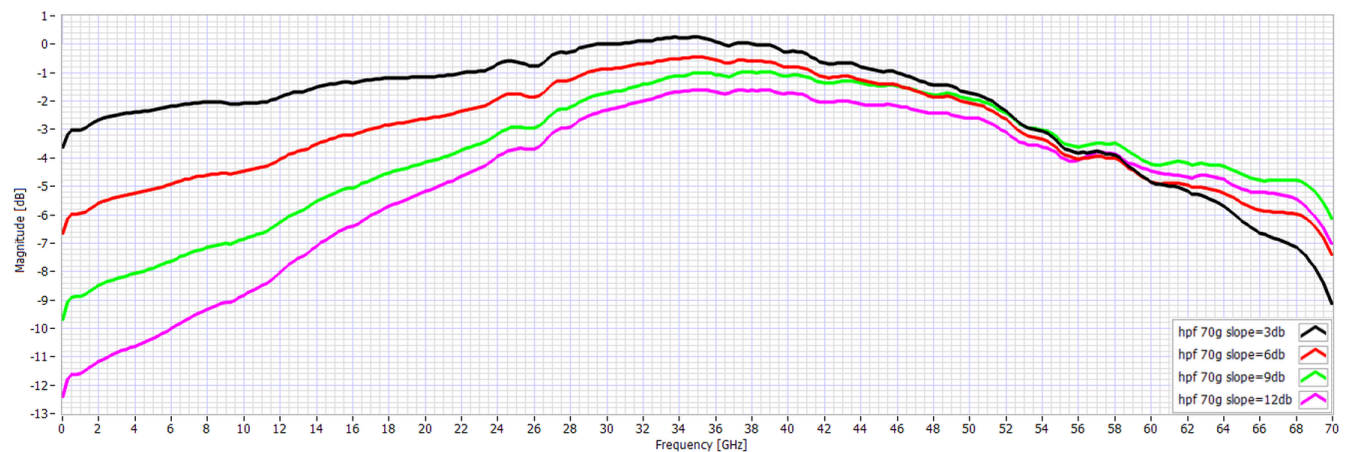


## Typical FIR Filter Presets

Flat frequency responses for maximum bandwidth at various gain levels. Increasing the gain above -5 dBm reduces the maximum filter bandwidth.



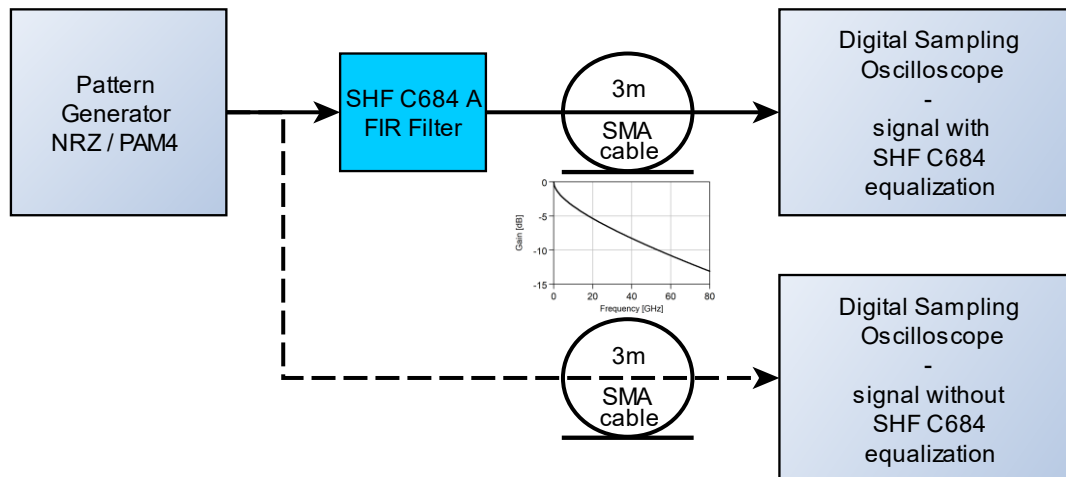
Frequency responses for a 3, 6, 9 and 12 dB slope @ 35 GHz.



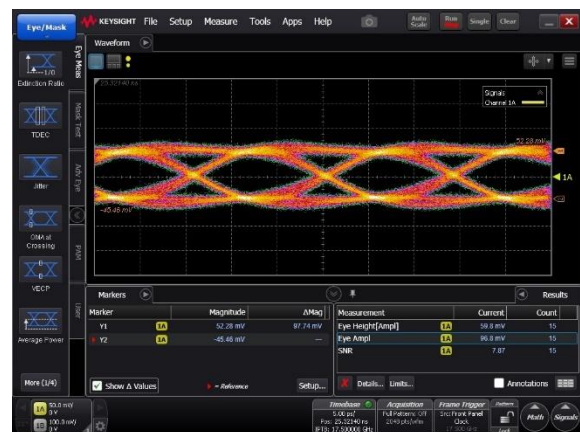


## Example Application

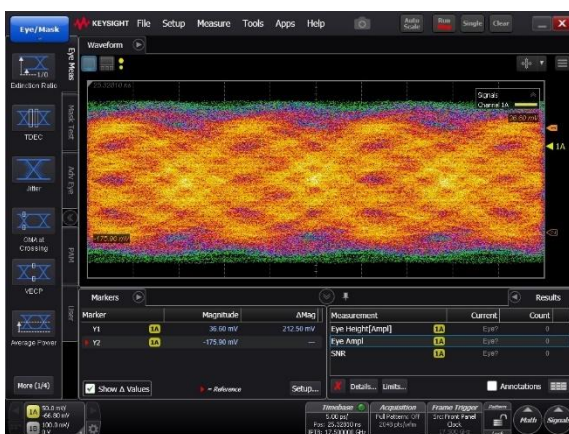
Compensation of a 3m SMA cable



NRZ @ 70 Gbps without equalization



NRZ @ 70 Gbps with equalization



PAM4 @ 70 GBaud without equalization

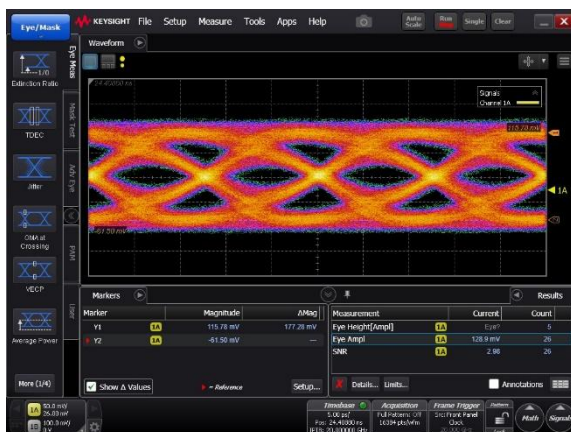
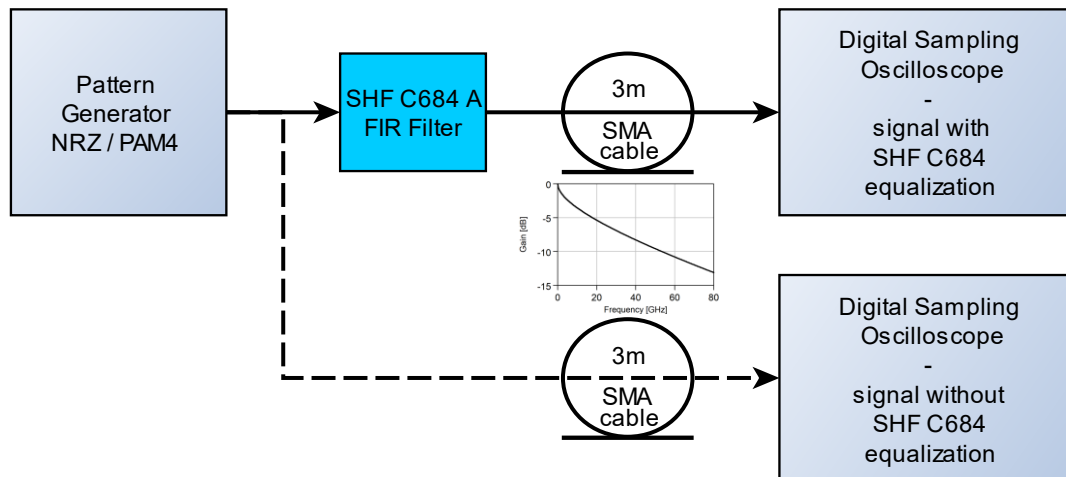


PAM4 @ 70 GBaud with equalization



## Example Application

Compensation of a 3m SMA cable



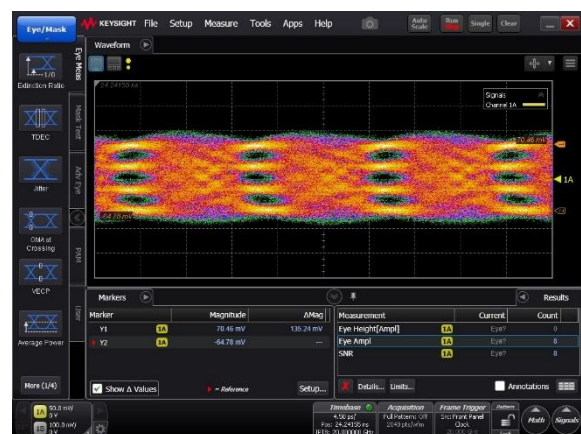
NRZ @ 80 Gbps without equalization



NRZ @ 80 Gbps with equalization



PAM4 @ 80 GBaud without equalization

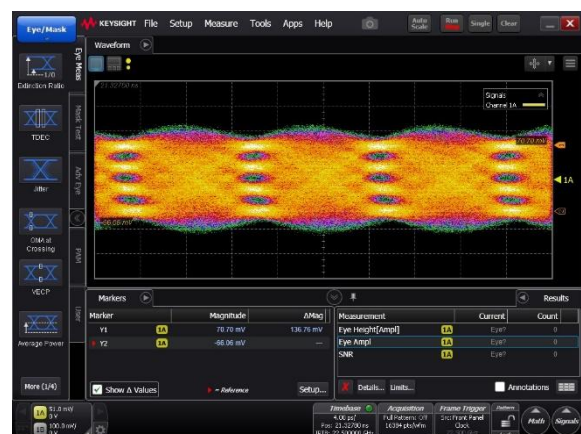
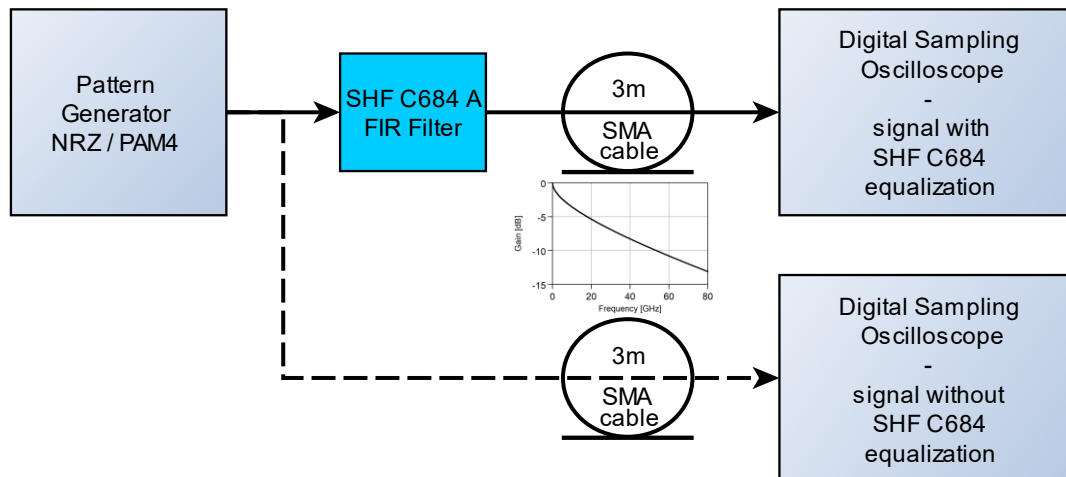


PAM4 @ 80 GBaud with equalization



## Example Application

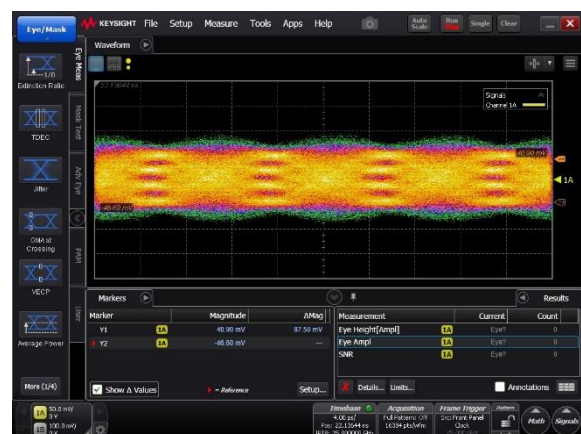
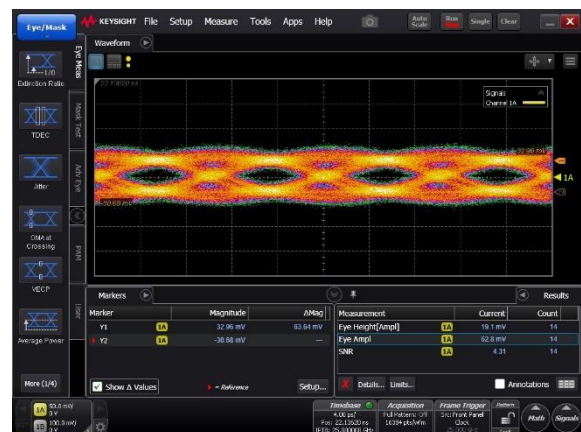
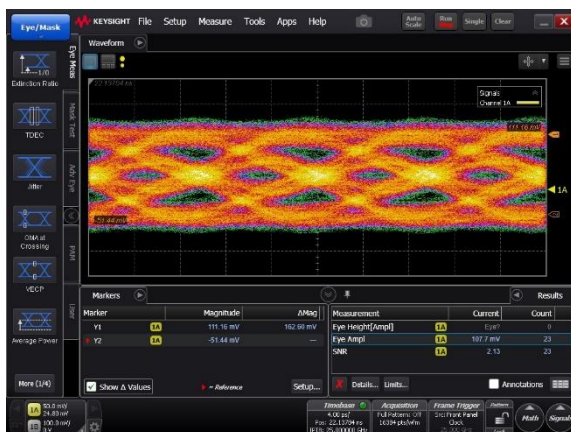
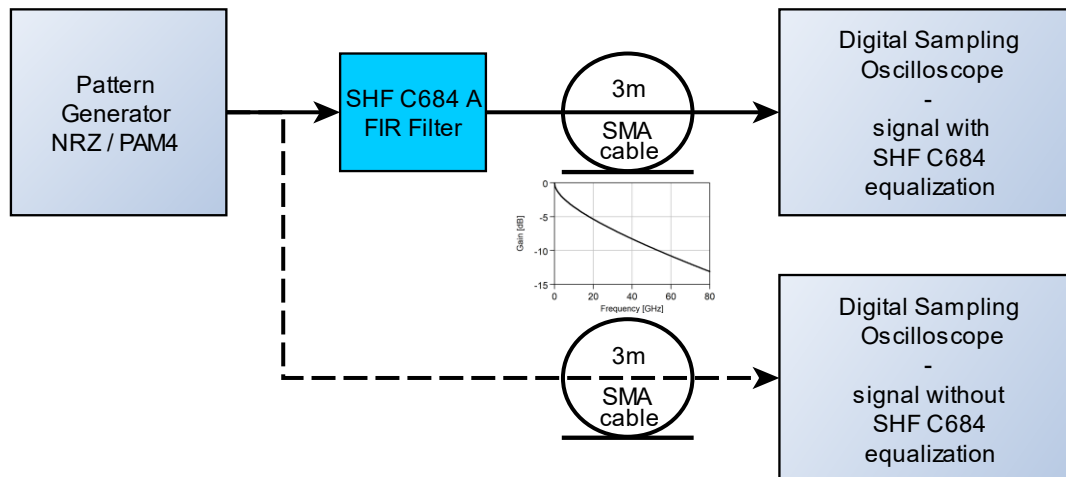
Compensation of a 3m SMA cable





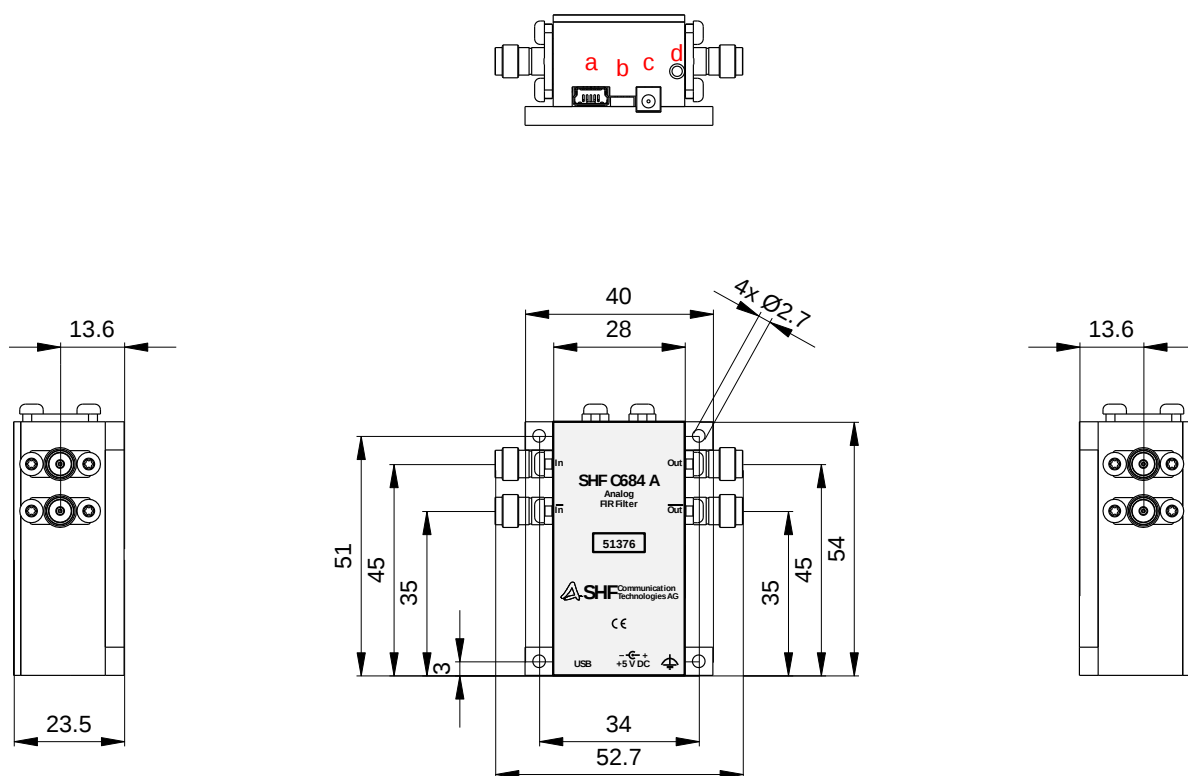
## Example Application

Compensation of a 3m SMA cable

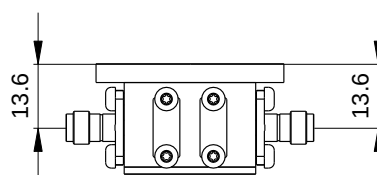




## Mechanical Drawing



| Port | Connector         |
|------|-------------------|
| In   | 1.85mm (V) female |
| In   | 1.85mm (V) female |
| Out  | 1.85mm (V) female |
| Out  | 1.85mm (V) female |

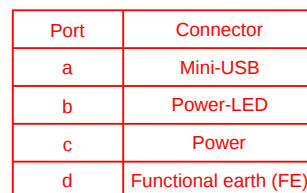
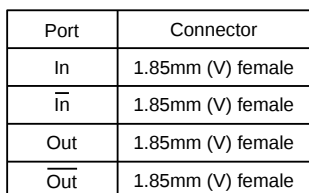


All dimensions are in mm

| Port | Connector             |
|------|-----------------------|
| a    | Mini-USB              |
| b    | Power-LED             |
| c    | Power                 |
| d    | Functional earth (FE) |



A schematic diagram of a four-terminal device. The device is represented by a central rectangular block with four ports labeled 'a', 'b', 'c', and 'd' in red. Port 'a' is on the left, 'b' is on the right, 'c' is on the top, and 'd' is on the bottom. The device is connected to a network of waveguides, represented by vertical lines with wavy patterns, which are connected to a horizontal line at the bottom.



SHF reserves the right to change specifications and design without notice  
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