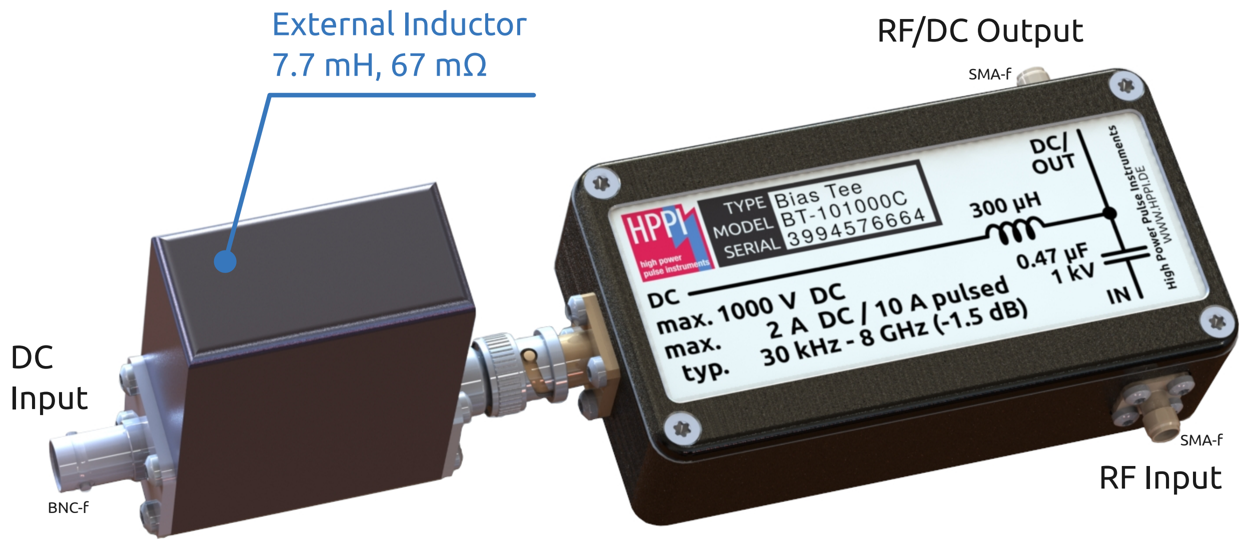
1 kV, 2 A, 7 kHz – 8 GHz High Voltage Bias Tee BT-101000C

Advanced TLP/HMM/HBM Solutions



1 Features

- High voltage 7 kHz to 8 GHz (−1.5 dB S21) bias tee
- 1 kV DC bias voltage[1]
- DC input bias current: max. 2 A DC and max. 10 A pulsed at 100 ms pulse width and 1 % duty cycle
- Typ. 0.5 Ω DC resistance (port 3 to port 2)
- **SMA** 50 Ω pulse input and DC/pulse output
- Optional: **TNC** 50 Ω pulse input and DC/pulse output
- **BNC** DC input
- Size: 130.6 mm x 77.6 mm x 31 mm
- Lab safety requirement: interlock operation above an operation voltage of 40 V needed to avoid life-endangerment risks.

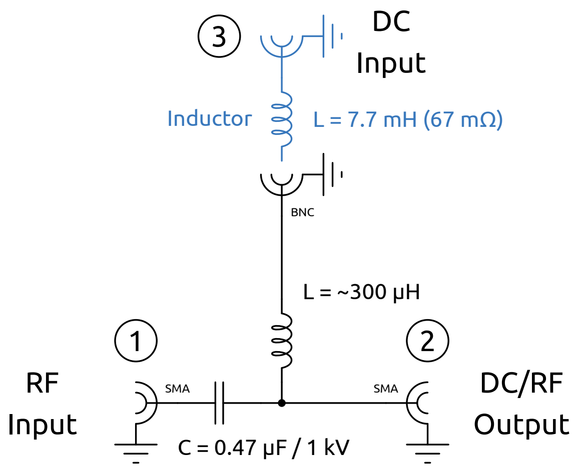


Figure 1: Simplified schematic diagram

2 Description

The BT-101000C is used for DC-biased RF measurements at high voltages in both the time and frequency domains. It provides a lower cutoff frequency of 7 kHz while maintaining a high bandwidth of 8 GHz. The core bias tee has a lower cutoff frequency of 30 kHz. The overall lower cutoff frequency of 7 kHz is achieved by adding an external 7.7 mH inductor.
Fig. 1 shows the simplified schematic diagram.

2.1 Electrical Characteristics

Fig. 2 shows the step response[2] from port 1 to port 2. The output signal exhibits a delay of approximately 0.4 ns. Fig. 3 shows the typical insertion loss between port 1 and port 2.

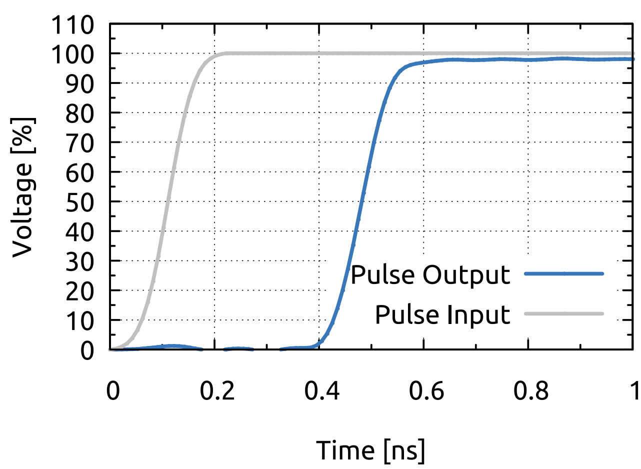


Figure 2: Step response of the bias tee at the pulse output (port 2) with input pulse rise time of 100 ps at the pulse input (port 1).

[1] SMA connectors with a clean dielectric interface, tightened to 1 Nm torque.

[2] Calculated from the measured S-parameters over the range 300 kHz to 9 GHz, using an input pulse with a 100 ps rise time.

High Power Pulse Instruments GmbH
Internet: https://www.hppi.de/
E-mail: info@hppi.de

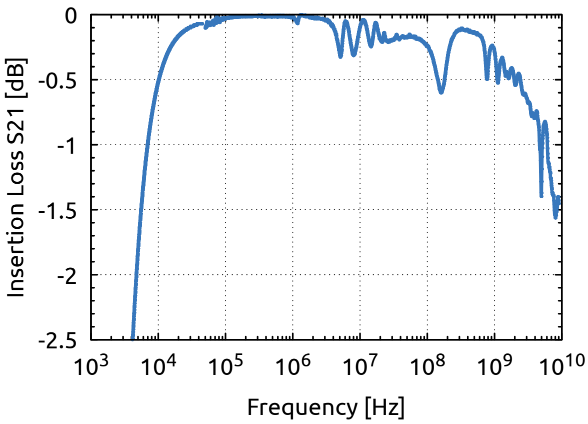


Figure 3: Measured insertion loss S21: pulse input to DC/pulse output in [dB]. Measurement condition: DC input port 3 terminated with 50 Ω.

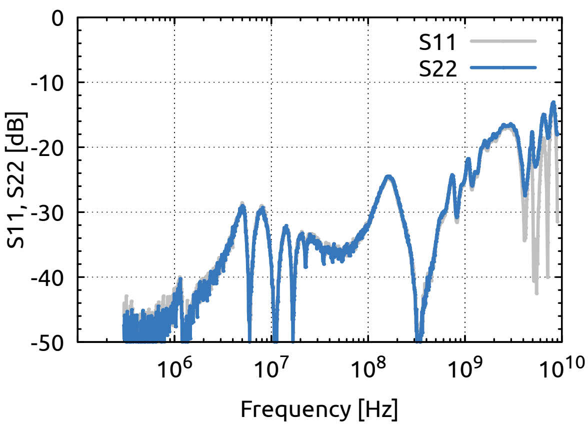


Figure 4: Measured reflection coefficients S11, S22: pulse input, DC/pulse output in [dB]. Measurement condition: DC input port 3 terminated with 50 Ω.

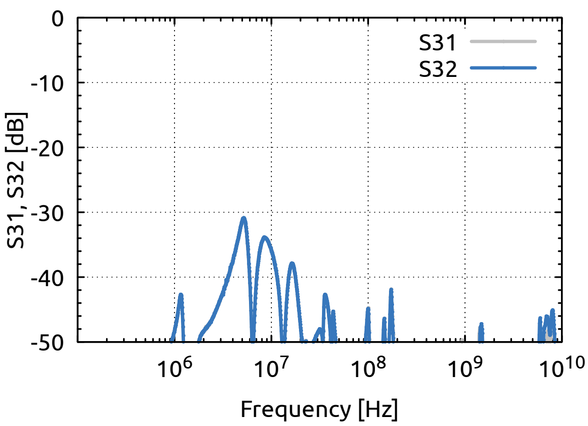


Figure 5: Measured isolation S31, S32: pulse input, DC/pulse output to DC input in [dB]. Measurement condition: DC input port 3 terminated with 50 Ω.

3 Application Note

3.1 SMU Control Loop Instabilities

A bias tee is sometimes included in the measurement setup to apply a DC bias voltage or current to the DUT using an SMU.

For pulsed measurements, the 50 Ω bias tee must have a lower cutoff frequency of around 10 kHz to accommodate large pulse widths, and an upper cutoff frequency in the gigahertz range to ensure fast pulse rise times. Meeting these requirements results in relatively large inductance and capacitance values within the bias tee.

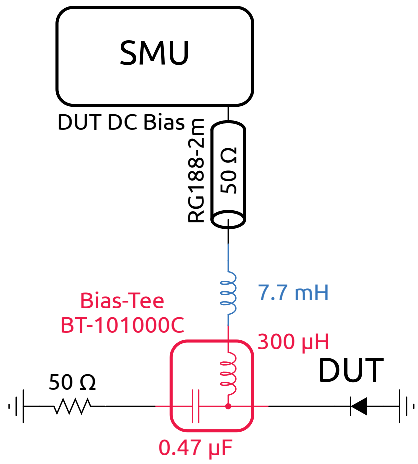


Figure 6: Typical bias tee application

Fig. 6 shows the equivalent model of a typical bias-tee application. The SMU must contend with an extremely challenging impedance condition at its output. First, the 2 m-long 50 Ω coaxial cable introduces a shunt capacitance of approximately 200 pF. This is followed by a large series inductance of 7.7 mH plus 300 µH, and a 0.47 µF capacitor in series with 50 Ω, all of which are shunted by the DUT.

Such an extreme load impedance at the SMU output can significantly affect the SMU's control loop. Depending on the phase margin of the SMU's open-loop gain, the output may become unstable. This can lead to unexpected DUT damage due to sudden SMU output runaway or high-voltage oscillations. If the DUT impedance varies widely—from a short circuit to high impedance, or if it exhibits nonlinear behavior—the stability of the SMU will depend strongly on the DUT impedance within the measurement setup. Note that the situation may change substantially when using a 4-wire (Kelvin) configuration.

To ensure safe operation, evaluate the SMU's stability using a dedicated test setup as shown in Fig. 6, review the SMU manual, and/or consult the SMU manufacturer.

3.2 Increase SMU Control Loop Stability

A simple yet highly effective way to improve the SMU's control-loop stability is to connect a resistor *R* directly at the SMU output, as shown in Fig. 7.

The resistor value should be made as large as practical; values of several hundred Ω to a few kΩ are often sufficient.

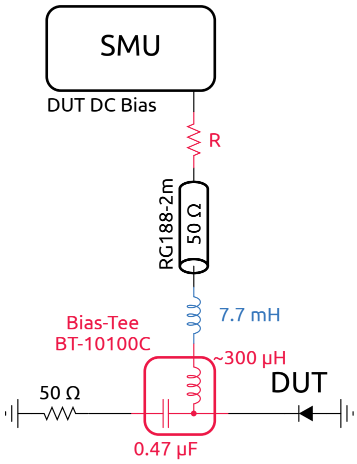


Figure 7: Increase SMU output stability with a resistor *R* connected in series

4 Laboratory Safety Requirement

Interlock operation is required above an operating voltage of 40 V to avoid life-endangering risks.

5 Dimensions

Fig. 8 shows the enclosure dimensions of the BT-101000C core.

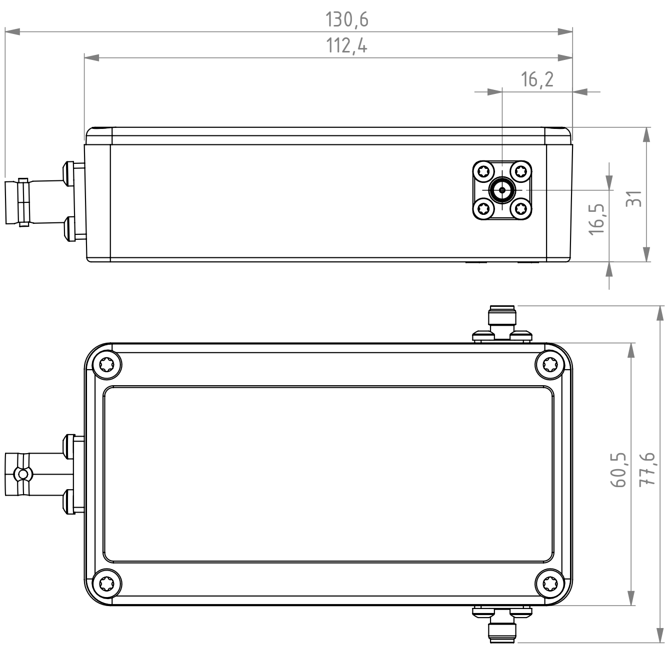


Figure 8: Physical dimensions of the BT-101000C in [mm]

On the bottom side the enclosure has two M4 threads and two Ø 4 mm dowel holes for fixation of the BT-101000C in the measurement setup (Fig. 9).

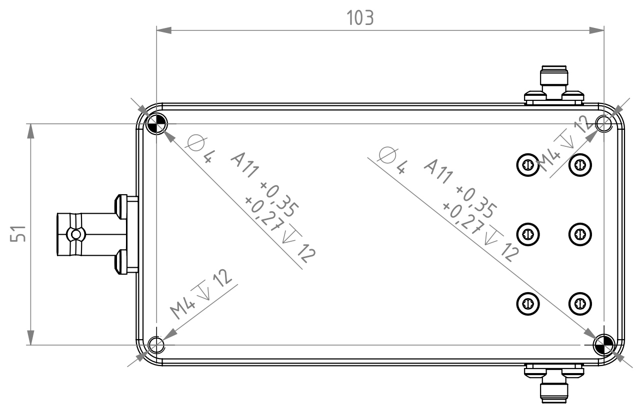


Figure 9: Bottom side fixation threads and dowel holes. All dimensions in [mm].

6 Ordering Information

The BT-101000C uses **SMA** connectors at the input and DC/output ports. The optional BT-101000C-TNC version is equipped with **TNC** connectors at these ports. Both versions have BNC connectors at the DC port.

Pos.	Description	Part No.
01	1 kV, 2 A, 7 kHz – 8 GHz High Voltage Bias Tee with **SMA** (female) connectors at Input and DC/Output, including external 7.7 mH inductor. DC port with **BNC** (female) .	BT-101000C
02	1 kV, 2 A, 7 kHz – 8 GHz High Voltage Bias Tee with **TNC** (female) connectors at Input and DC/Output, including external 7.7 mH inductor. DC port with **BNC** (female).	BT-101000C-TNC

General

High Power Pulse Instruments GmbH
Stadlerstrasse 6A
D-85540 Haar, Germany
Phone : +49 (0)89 8780698 - 440
Fax : +49 (0)89 8780698 - 444
E-Mail : info@hppi.de