

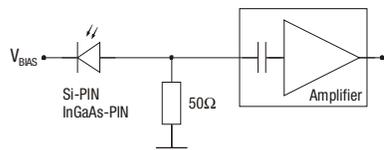
## Application Note

## DC-Path (BIAS-T) for fast Photodetectors

### What is a DC-path required for?

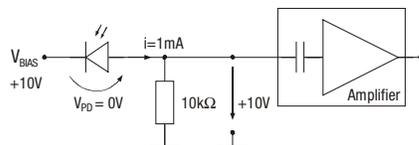
In many applications – e. g. shot-noise-limited spectroscopy, heterodyne measurements etc. – the detector is subject to relatively high cw-power. As a result of this, a high level DC current is generated in the detector. This DC current must have an electrical path to flow off to ground. Unfortunately, common high-speed amplifiers do not have a DC path, they are ac-coupled.

### Is the integration of a 50 Ohm resistor to ground not the simple and rapid solution?



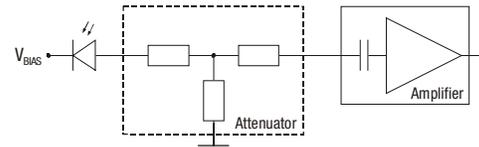
An integrated 50 Ohm resistor has two disadvantages:  
 1) At high frequencies, mismatching may occur, because the amplifier's 50 Ohm input resistance and 50 Ohm to ground result in 25 Ohm.  
 2) The signal amplitude is halved, as the photocurrent over 25 Ohms only generates half of the signal voltage in comparison with the 50 Ohm amplifier input resistance. The signal-to-noise ratio decreases.

### Would a higher resistance of, e.g. 10 kOhm, solve this problem?



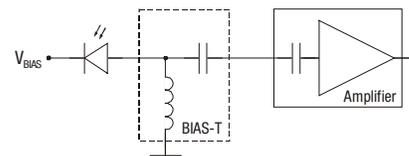
The BIAS voltage over the photodiode then becomes dependent on the signal current. As the illustration shows, a DC-photocurrent of, e. g., 1 mA then generates a voltage of 10 Volts over the 10 kOhm resistor. The BIAS voltage over the photodiode is therefore 0 Volts! If an Avalanche Photodiode is used, the voltage over the 10 kOhm resistor shifts the operating point of the APD. The amplification of the APD is instable.

### Would an attenuator provide a solution?



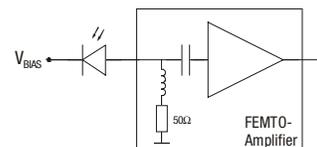
As the name suggests, an attenuator attenuates the signal. The signal-to-noise ratio decreases.

### What is the optimum solution in this case?



A so-called BIAS-T solves all of the problems described above: The special coil permits high DC-photocurrents without any considerable voltage drop. At the same time, the coil ensures that the RF-measurement signals cannot flow off to ground, but they can flow completely into the amplifier input. This guarantees an optimum signal-to-noise-ratio with very good 50 Ohm matching.

### The FEMTO solution:



We have given consideration to this problem, and have developed the optimum solution for our High-Speed Amplifiers: The BIAS-T is already integrated in our amplifiers.

Please do not hesitate to contact us for further information.