

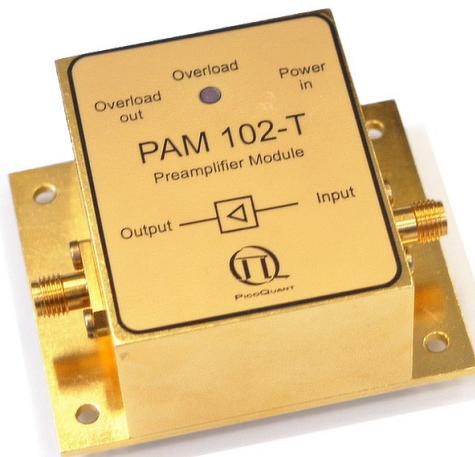
# PAM 102

Wide Bandwidth  
Preamplifier Module



User's Manual and Technical Data

Version 2.0





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# 1. Introduction

The PAM 102 preamplifier is specially targeted at timing sensitive applications such as Time-Correlated Single Photon Counting (TCSPC) with fast photon detectors like Microchannel plate PMTs (MCP) or standard PMTs. Such detectors produce very small output pulses with extremely short pulse widths, usually too weak for direct interfacing with TCSPC electronics or other counters. The pulse rise times (or fall times) are typically 150 to 500 ps, and the pulse widths (FWHM) are correspondingly small. Therefore, an amplifier with an appropriately fast rise time is needed between the detector and the timing discriminator of the TCSPC system. The rise time of an amplifier is directly related to its bandwidth. A fast rise time corresponds to a wide bandwidth. On the other hand, the wider the bandwidth, a pre-amplifier contributes more electronic noise to the signal. All amplitude noise on the signal adds to the timing jitter, when the signal is processed by a timing discriminator of the TCSPC electronics. This is because the signal is not infinitely steep and any fluctuation in amplitude will be translated to a timing uncertainty inversely proportional to the steepness  $dV/dt$  of the timing edge of the signal. There are, therefore, contradicting demands for the selection of the appropriate amplifier bandwidth. Best timing resolution is usually achieved when the amplifier rise time is comparable to the detector rise time. For common modern MCP detectors this corresponds to an optimum amplifier bandwidth of 1 to 2 GHz. This is why the PAM 102 is designed for bandwidths in this range.

The PAM 102 is available in two different versions: Inverting, 25 dB Gain version for PMTs (T-version) and inverting MCP-PMTs (Mi-version). Those two versions differ in the threshold level for the overload protection signal and amplification gain. If a non-inverting amplification is needed, a SI-100 inverter (PicoQuant) can be added to the output. All PAM 102 come with a wide range input (110-240V AC) power supply unit. Signal input and output are standard 50 Ohms SMA connectors. The housing is gold plated for maximum RF immunity.

## 2. Controls

Fig. 1 shows the top view of the PAM102.

The external power supply must be connected at socket (1). The SMA connector (2) acts as signal input, the SMA connector (3) is for signal output.

The socket (4) allows to connect a 5.5 x 2.1 mm plug to control an optical shutter to protect a connected PMT or MCP-PMT from heavy light. A blinking red LED (5) signals an overloaded state.

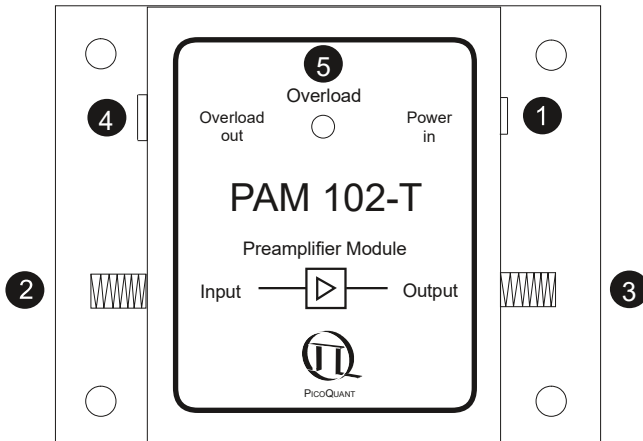


Figure 1

### 3. Use Instructions



**Attention:** Connecting a PMT with active high voltage supply may damage the amplifier.

In either case, before you connect the PMT to the input, switch off the high voltage supply of the PMT.

Connect the PMT to the input and the TCSPC electronics to the output of the PAM 102. The PAM 102 is delivered as a complete stand-alone device with an external power supply. Connect the power supply with the amplifier module. Thereafter switch on the high voltage supply of the PMT.

#### 3.1. Overload Signal

The PAM 102 contains an input current comparator to monitor the average current flows through the PMT or MCP-PMT detector. It depends on the PAM 102 option witch current threshold is set. See table 1 for more details.

PAM 102 Option	Input Current Threshold
-T	-100 $\mu$ A
-Mi	-0.1 $\mu$ A

*Table 1*

In case of exceeding the respective input current threshold, the red LED (4) is blinking. This state is locked until the external power supply is switched off. Note that the overload signal is only an indicator. It does not automatically shut off or protect the amplifier or the detector. Detector protection may be achieved as outlined in the next section.

### 3.2. Overload Output

The built-in overload logic puts the external power through to the overload output male connector. In this case the output provides +12V with maximum of 1A. You need a 2.1 x 5.5mm female connector for using the overload output. See the Fig.2 below for block diagram and interconnections.

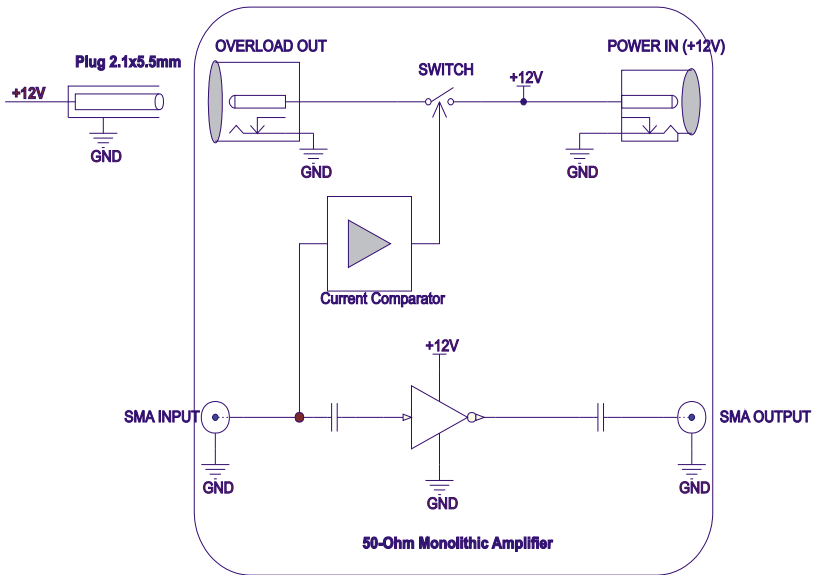


Fig. 2: Block Diagram



**Note:** The overload circuit alone does not represent a protection mechanism against destroying the MCP/PMTs.

# 4. Application Example

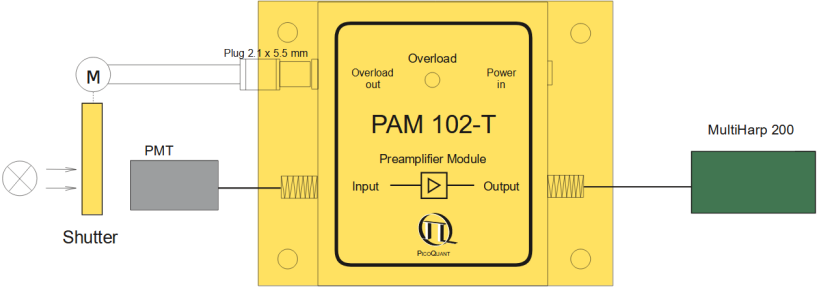


Fig. 3: Photon Counting Example



## 5. Technical Data

### 5.1. Overall Specifications

**Ext. Power Supply:**

Line voltage ..... 110 - 240 VAC, 50/60 Hz  
Power consumption ..... max. 15 Watts

**Module Dimensions:**

w x d x h (mm)..... 62 x 51 x 27

**Max. Input Voltage:**

@ 50 Ohm..... +/-100mV

**Operating Environment:**

Operating temperature ..... 0 to 50°C

### 5.2. PAM 102 Options

**-T:**

Phase .....inverting  
Bandwith ..... 2 GHz  
Gain .....20 dB  
P<sub>1dB</sub> ..... +3.7 dBm  
Overload threshold .....-100 µA

**-Mi:**

Phase .....inverting  
Bandwith .....1.0 GHz  
Gain .....25 dB  
P<sub>1dB</sub> ..... +12.5 dB  
Overload threshold .....-0.1 µA

## **6. Support and Warranty**

The PAM 102 has gone through thorough testing at PicoQuant. It is stable and reliable. Nevertheless we will continually make improvements and in-corporate these into upcoming versions.

In any case, we would like to offer you our complete support. Please do not hesitate to contact PicoQuant if you would like assistance with any of our products.

If you observe any errors e-mail a detailed description of the problem and relevant circumstances to [support@picoquant.com](mailto:support@picoquant.com). Your feedback will help us to improve the product and documentation.

Of course we also appreciate good news: If you have obtained exciting results with one of our systems, we would like to know!

## 7. Appendix

### Retraction Of Old Devices

Waste electrical products must not be disposed of with household waste. This equipment should be taken to your local recycling centre for safe treatment.



WEEE-Reg.-No. DE 96457402



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