Smart Manager User Manual

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1   PIP Detection Module Settings Window

All buttons marked „Edit" allow to fine tune parameter values.

1.1 Detector Bias Voltage
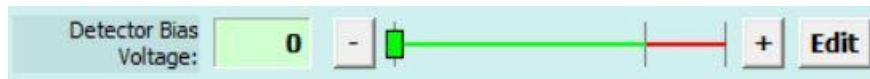
Setup for reverse voltage of photodiode. It can be changed from zero to maximum value for your photodiode. Real bias voltage on the detector could be observed on monitor section at the bottom of the window
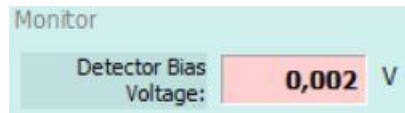
Zero bias voltage
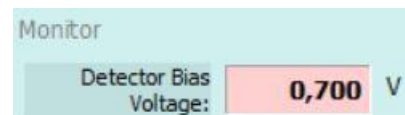
Exemplary -700mV bias voltage

1.2 Detector Bias Current Compensation

1.3 Preamplifier Gain

Setup of 2nd stage voltage gain.

1.4 Output DC Offset
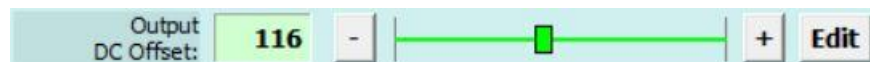
For proper detection module operation output DC offset voltage value should be set for max. ±25mVDC, and having full dynamic range.

1.5 Preamp 1st Stage Frequency Compensation
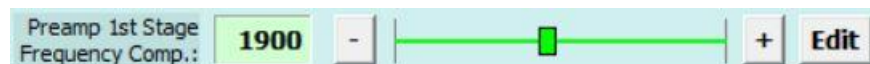
This feature is used to adjust capacitance at transimpedance preamplifier to compensate gain peak. It is negative regulation - Max. value means zero capacitance. Min. value means max. capacitance.

1.6 Signal Coupling
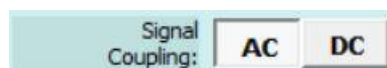
DC – operation at 0Hz, AC- operation at low cut-off frequency 10Hz.

Important Note!

- **Strong DC component at the 1st stage output is acceptable for normal operation, however the 1st stage cannot be saturated, and AC coupling should be activated (to prevent amplification of the signal DC component)**

- **Preamplifier 2nd stage, if DC coupled with the 1st stage, amplifies AC and DC signal component. Cannot, however, distinguish if the DC part is caused by improper offset cancelation or the photocurrent.**

- **It is not recommended to combine DC coupling and detector biasing due to the detection module DC instability. The output voltage offset would change along with the time leading to preamp saturation. If the operator is aware of the instability, the PIP may work as DC coupled with the biased detector, but the signal offset should be monitored and compensated.**

1.7 Preamplifier Bandwidth

Preamplifier bandwidth can be switched between following values:

HIGH - maximum preamplifier bandwidth – **20MHz** for DC-20M/**150MHz** for DC-200M.

MID – medium preamplifier bandwidth - **1.5MHz** for DC-20MHz/**15MHz** for DC-200M.

LOW – low preamplifier bandwidth – **150kHz** for DC-20MHz/**1.5MHz** for DC-200M.
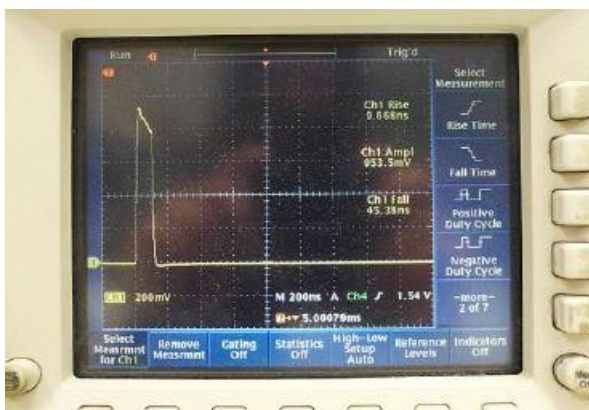
Figure 1 Preamp bandwidth HIGH (not limited): basing on the rise time ~ 35 MHz

Figure 2 Preamp bandwidth MID: fall time – 220 ns, bandwidth ~ 1.5 MHz

Figure 3 Preamp bandwidth LOW: fall time 2 us, bandwidth ~ 170 kHz
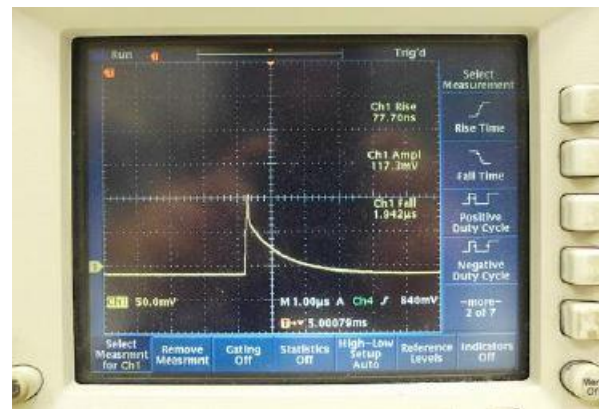
Figure 4 Preamp bandwidth LOW: fall time 2 us, bandwidth ~ 170 kHz

Important Note!

BW limit introduces slight distortion at the signal edges, therefore the limit is rather recommended only for preliminary measurements.

1.8 1st Stage Transimpedance

LOW - 1kΩ

HIGH - 5kΩ

Figure 5 Output noise and pulse response of not biased detector (no 1/f noise), 1st stage transimpedance LOW (1 kOhm), second stage gain 50 V/V, 50 kOhm entirely
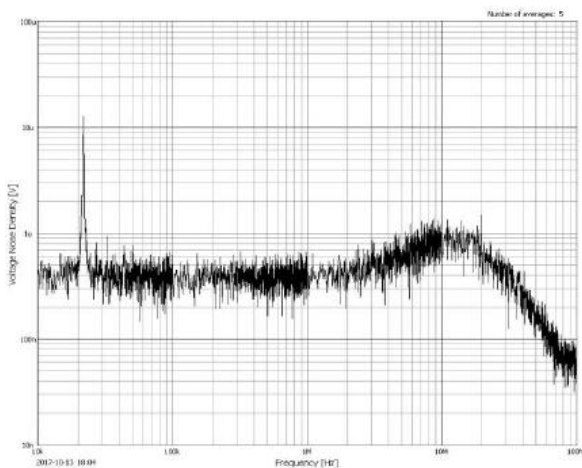
Figure 6 Output noise and pulse response of not biased detector (no 1/f noise), 1st stage transimpedance HIGH (5 kOhm), second stage gain 10 V/V, 50 kOhm entirely

Important Note!

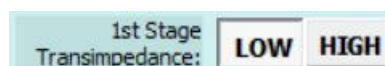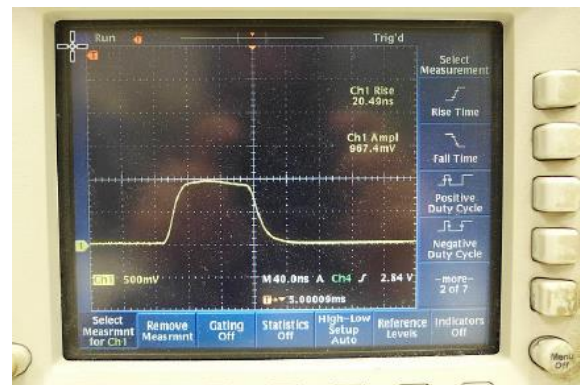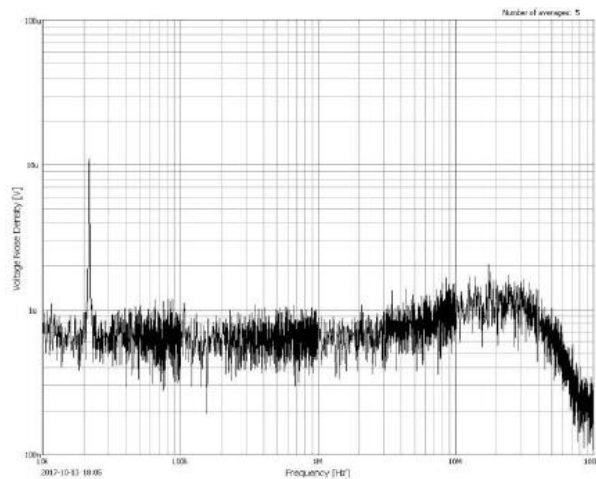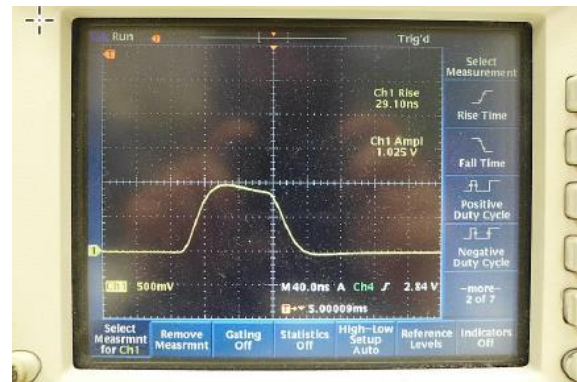- **Selecting HIGH 1st stage transimpedance results in lower noise level (in the flat region 10 kHz … 1 MHz) 400 nV/sqrt(Hz) vs 650 nV/sqrt(Hz)**

- **In case of fast version of PIP (BW = 200 MHz) entire bandwidth is available only when LOW 1st stage transimpedance is selected. Otherwise the reachable bandwidth is ~ 80 MHz, depending on the detector. In general, lower 1st stage transimpedance allows to achieve higher bandwidth.**

- **While selecting higher 1st stage transimpedance and lower 2st stage gain, the preamp saturation should be taken into account (+/- 1V @ 50 Ohm) is available only if at least 5 V/V is set. If the gain is lowet than 5 V/V, saturation voltage drops down accordingly. Choosing lower 1st stage transimpedance and higher 2nd stage gain may increase signal dynamic range (due to higher saturation voltage) the noise increases by a factor of 50 %.**

1.9 Real Time Parameter Monitoring

Real time parameter monitoring is used to show basic preamplifier parameters.

Detector Bias Voltage - real reverse voltage which is set on the DC coupled photodiode.

Preamplifier 1st Stage Voltage – output offset voltage on 1st transimpedance stage. Should be set near zero at all operation.

Preamplifier Output Voltage – output offset voltage on 2nd stage. Should be set within max ±20mV.

WARNING!

- **If 1st stage voltage or output voltage are high (e.g. 0.5÷1V), preamplifier could clip AC signal.**

Module Enclosure Temperature – real time temperature monitoring. Please keep module at maximum +30°C ambient temperature.

2 Non Biased Detector Operation Setup

Set detector bias voltage to zero.

Set detector bias current compensation to zero.

Compensate 1st stage output voltage and DC output voltage to ≤ ±20mV, using Output DC offset feature.
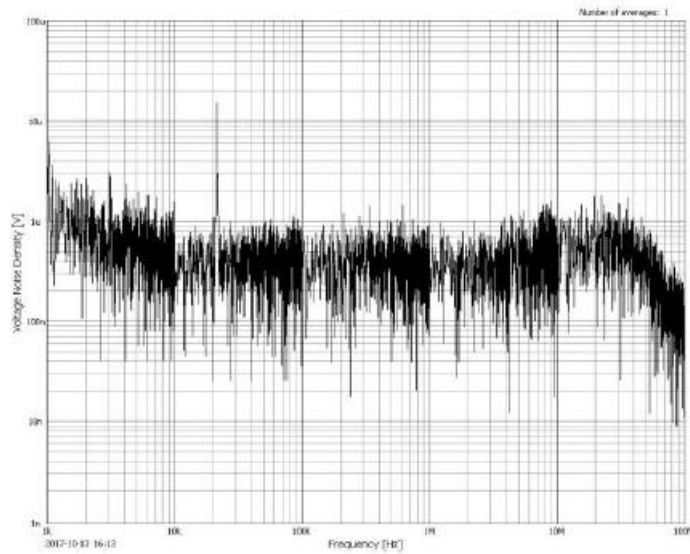
Figure 7 Pulse response and output noise of not biased detector (bias voltage 0 V)

3   Biased Detector Operation Setup

Set detector bias voltage to value from its test sheet. Usually this value is set by default, but it can be reduced if necessary.
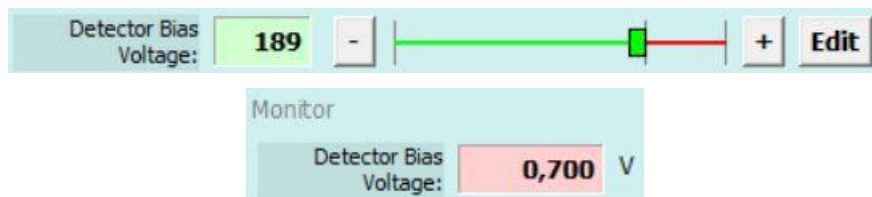
Compensate detector bias current to have near zero output 1st stage voltage.
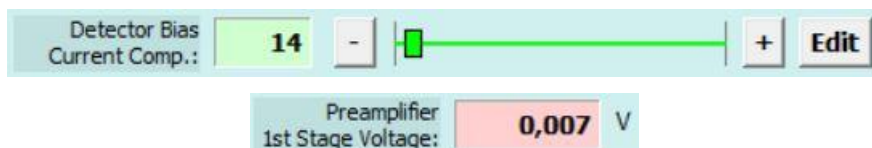
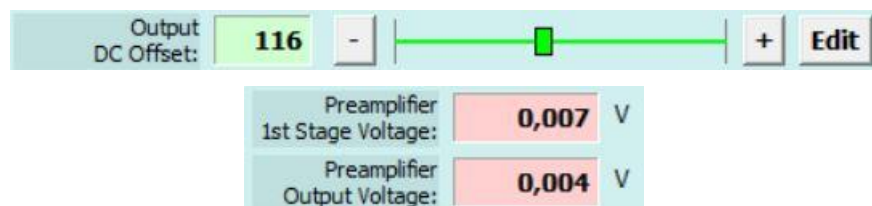Compensate 1st stage output voltage and DC output voltage to ≤ ±20mV, using Output DC offset feature
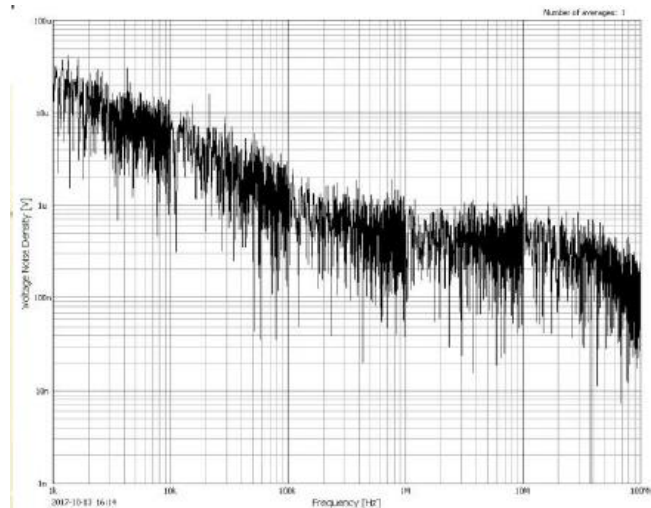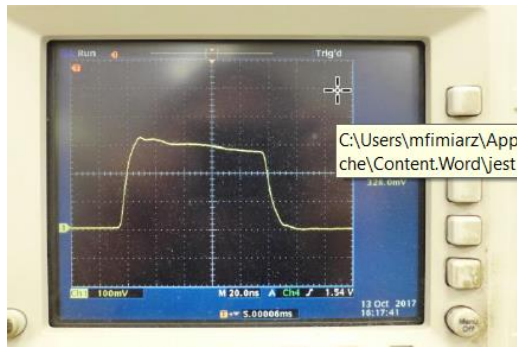
Figure 8 Pulse response and output noise of biased detector (bias voltage 0.7 V)

Important Note!

- **Not biased detector doesn't require bias current compensation.**

- **Optimal preamp 1st stage frequency compensation should be adjusted to achieve preamp stability and for the signal ringing reduction.**

- **If detector biasing is applied, and AC coupling is chosen, it is not needed to precisely cancel the voltage at the 1st stage output. Only requirement is to provide the 1st stage operation within linear region (-2V < 1st stage output voltage < 2 V).**

- **When biasing is applied to the detector, the detector becomes faster, but 1/f noise appears degrading the detectivity in low frequency region.**

4 Preamplifier Transimpedance and Gain Adjustment

4.1 Transimpedance Adjustment

Combination of LOW/HIGH transimpedance at 1st stage with 2nd stage gain.

For instance, if you would like to set 100kV/A of transimpedance, you should set the gains as follows:

Please always try to keep as high as possible 1st stage transimpedance to have low system noise.

4.2 2nd Stage Gain Adjustment

Select predefined preamplifier gain from the list. All gains adjusted by „Edit", cause unknown resultant gain. It can be used only for situations when precise value of gain can be unknown.

Figure 9 2nd stage gain settings results at pulse response

5 Preamplifier 1ˢᵗ Stage Frequency Compensation

1ˢᵗ stage of preamplifier is compensated by default settings. It means that if you would like to change transimpedance on it, you should fine tune this parameter. Higher value of Preamp 1ˢᵗ stage frequency compensation means lowest feedback compensation capacitance. Lower – high capacitance.
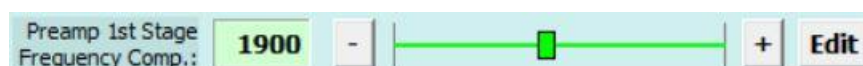
Important Note!

- **Optimal compensation strongly depends on the detector**

- **Compensation should be adjusted when the 1st stage transimpedance is changed.**

- **When gain, offset or bandwidth, are changed, compensation may not be adjusted (these setting doesn't affect the preamplifier 1st stage operation).**

- **Overcompensation use to result in preamp oscillations, while under compensation usually causes ringing (distortion on the edges), the preamp use to remain stable, however.**
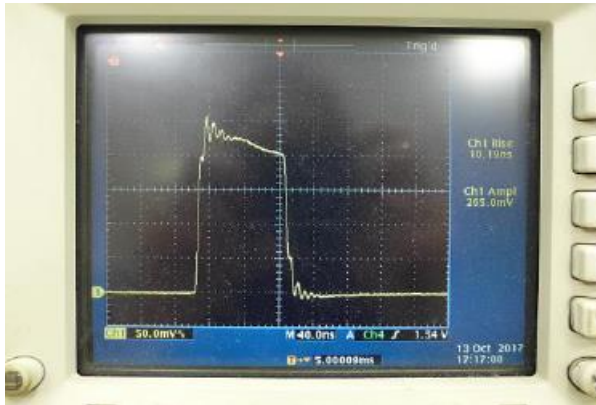

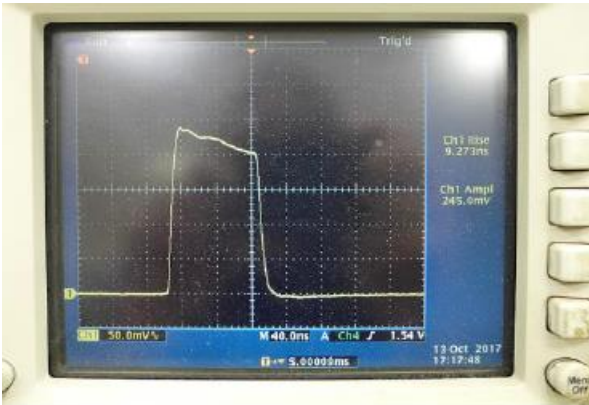
Figure 10 Preamplifier undercompensated

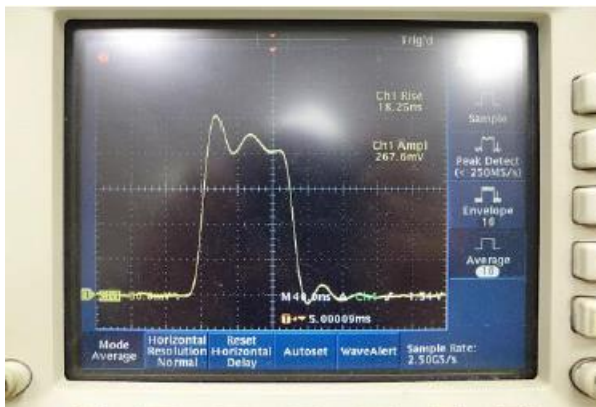*Figure 12 Preamplifier properly compensated*

Figure 11 Preamplifier overcompensated

Note! Above compensation is made with 1kΩ of first stage transimpedance – LOW button.

IMPORTANT! While doing adjustments please observe parameters on "Monitor" section.