User Manual for iAMP-700 (Preliminary)

Contents

Germany & Other Countries
Laser Components GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

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Laser Components GmbH
Tel: +49 8142 2864 – 0
Fax: +49 8142 2864 – 11
info@lasercomponents.com
www.lasercomponents.com

1. Important remarks

The iAMP-700 is a transimpedance ampflifier and can therefore only amplify currents but no voltages.

It is necessary to check if the bandwidth is sufficient for a sensible use of the iAMP-700. It is important to note that the bandwidth of the amplifier decreases with increasing amplification (see section 2.5). With amplifications from 10^2 to 10^3 the bandwidth of the iAMP-700 is 720kHz.

The iAMP-700 has the possibility for the output to be grounded (GND) with a resistor which means that the amplified input signal will not be given out (inactive output). This is part of the basic settings of the iAMP-700 when being switched on. In order to perform measurements the output needs to be activated with the button "OUT" (button 6, see section 4.1).

2. Technical Data

2.1 General

Supply voltage		±15	V
		+5	V
Temperature	Operation	0…+60	°C
	Storage	-40…+100	°C

Table 1: General technical data

It is recommended to use the i-AMP-PSU.

2.2 Absolute maximum ratings

Signal input current	±40	mA
Transient input voltae	±3	kV
Power supply voltage	±25	V

Table 2: Absolute maximum ratings

2.3 Connectors

Signal input	BNC
Singnal output	BNC
Power supply	LEMO ERA.2S.305.CLL
RS232	D-Sub 9-pin male

Table 3: Connectors

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2.4 Test conditions

Test conditions		V_S= ±15 V and +5 V, T_a= 25°C	
Gain	Transimpedance	10^2 - 10^{11}	V/A
	Gain accuracy	± 1	%
	Gain drift	see table below	
Frequency response	Lower cut-off frequency	DC / 1 Hz	
	Upper cut-off frequency	Up to 720 kHz (see table below), switchable to 10 Hz	
	Gain flatness	±0.1	dB
Input	Equivalent input noise current	see table below (value per √Hz, @ 500 Hz)	
	Equivalent input noise voltage	4 nV/√Hz (@ 100 Hz)	
	Input offset current drift	see table below	
	Input bias current	1 pA typ. (max. 3 pA)	
	Max. input current	see table below (value for linear amplification)	
	Input offset compensation	adjustable by control	
Output	Output voltage	± 10 V (@>10 kΩ load)	
	Output impedance	50 Ω (terminate with > 10 kW load for best performance)	
	Max. output current	± 100 mA	
Detector bias	Bias voltage range	10 V, max. ± 100 mA	
Offsett control	Control voltage range	± 10 V	

Table 4: Test conditions

2.5 Gain settings

Table Gain Setting: "Low Noise"

	10^2	10^3	10^4	10^5	10^6	10^7	10^8	10^9	V/A
Upper cut-off frequency	720	720	480	480	72	72	1.6	1.6	kHz
Rise/Fall Time (10%-90%)	0.5	0.5	0.7	0.7	5	5	200	200	µs
Equivalent input noise current	26	24	2.6	2.2	0.28	0.26	0.009	0.009	pA
Max. input current	100000	10000	1000	100	10	1	0.1	0.01	µA
Input offset compensation range	1000000	100000	10000	1000	100	10	1	0.1	nA
DC input impedance (//5pF)	50	50	50	50	150	150	10000	10000	Ω

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Table Gain Setting: "High Speed"

	10^4	10^5	10^6	10^7	10^8	10^9	10^{10}	10^{11}	V/A
Upper cut-off frequency	720	720	480	480	72	72	1.6	1.6	kHz
Rise/Fall Time (10%-90%)	0.5	0.5	0.7	0.7	5	5	200	200	µs
Equivalent input noise current	26	24	2.6	2.2	0.28	0.26	0.009	0.009	pA
Max. input current	1000000	100000	10000	1000	100	10	1	0.1	nA
Input offset compensation range	1000000	100000	10000	1000	100	10	1	0.1	nA
DC input impedance (//5pF)	50	50	50	50	150	150	10000	10000	Ω

2.6 Connector Configuration

2.6.1 Power supply

PIN	Connection
1	-15 V
2	GND
3	+15 V
4	+5 V
5	GND

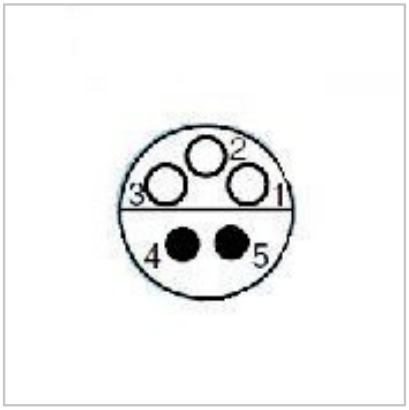

Fig. 1: Pinning LEMO connector

2.6.2 RS232

PIN	Bezeichnung
1	NC
2	RXD
3	TXD
4	NC
5	GND
6	NC
7	NC
8	NC
9	NC

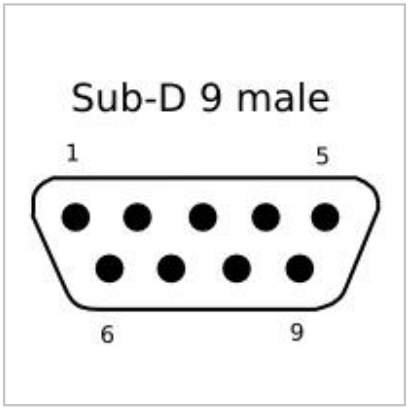

Fig. 2: RS232 Pinning of Sub-D connector

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2.7 Dimensions

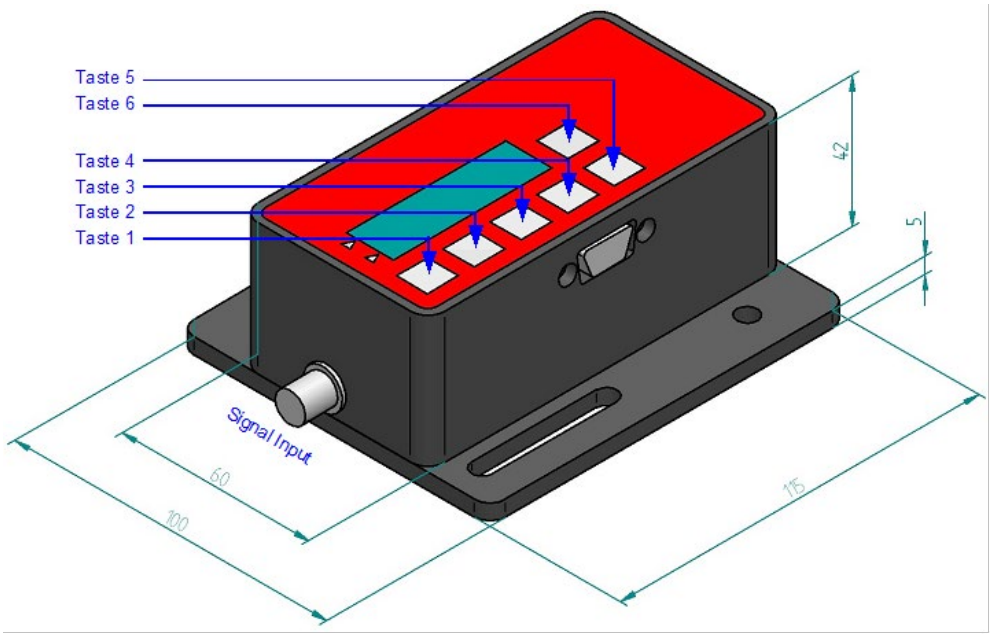

Fig. 3: Dimensions, keyboard and signal input

2.8. Connecting the iAMP-700

- 2x BNC (current input, voltage output)
- 1x D-Sub 9-pin male (for RS232)
- 1x LEMO ERA.2S.305.CLL (power supply)

Remarks:

- Bias voltage is available from the outer sleeve of the BNC input.
  The bias voltage can be set in the range -10 V to +10 V. At 0 V bias, the sleeve is connected to ground via an internal relay.
- The bias voltage allows straightforward operation of the iAMP with a PIN photodiode.
- The outer sleeve of the BNC output is at GND.
- The inner contact of the output BNC is connected to ground via 10 kOhm when inactive (no output signal).
- RS232 operation is described in section 5.

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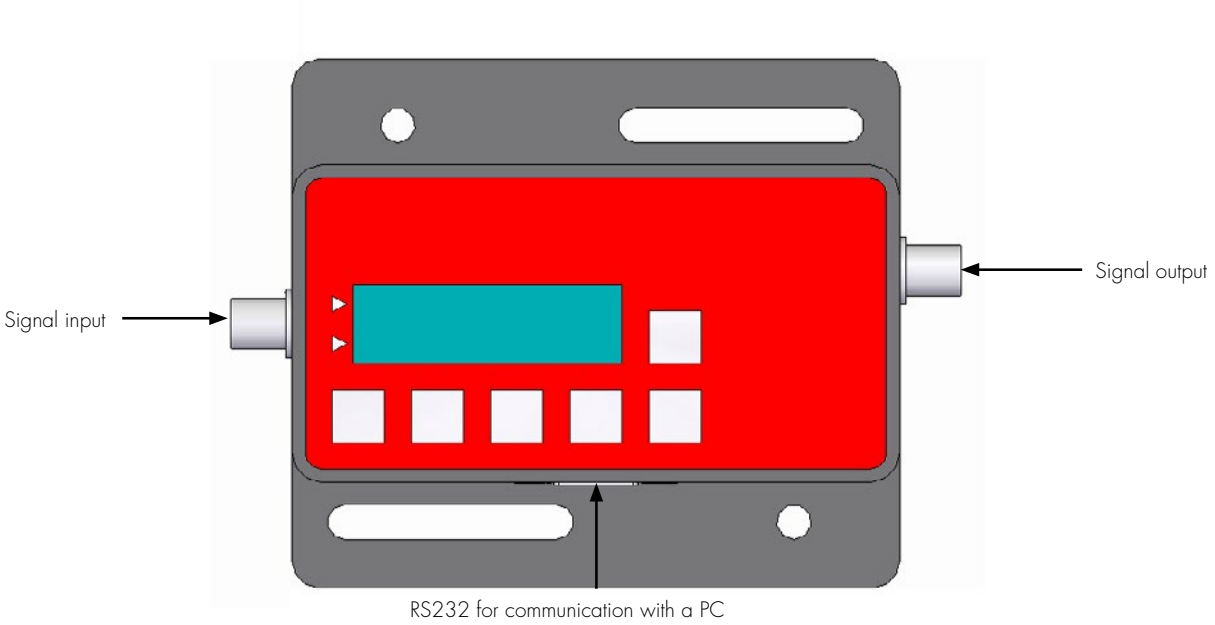

Fig. 4: Connecting th iAMP-700

2.9 Signal input

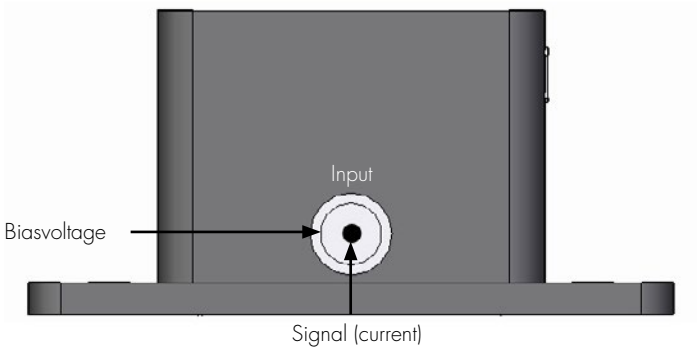

Fig. 5: Signal input

The bias voltage can be set between -10V and +10V with reference to GND.

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2.10 Signal output and PSU connection

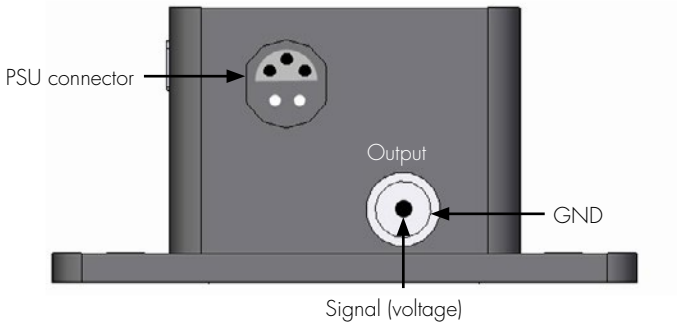

Fig. 6: Signal output

2.11 RS232 port

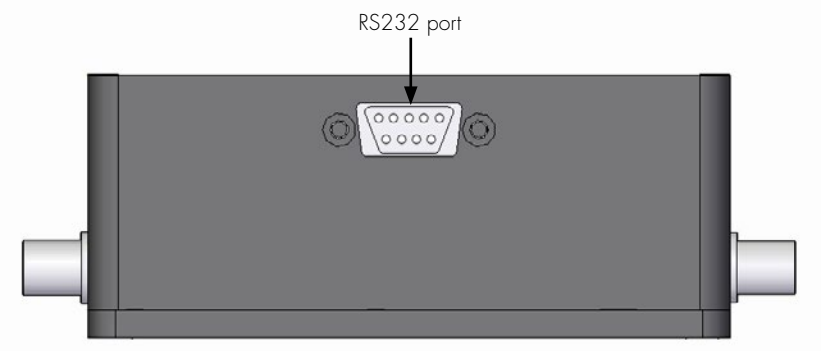

Fig. 7: RS232 port

3. Starting up the iAMP-700

3.1 Important remark

Before starting up the iAMP-700 read this manual carefully. With this, many operating errors can be prevented.

3.2 Step 1: Connecting the iAMP-700 correctly

The iAMP-700 is to be connected in the following way:

1. Connect the PSU with the PSU connector
2. Connect the signal source with the signal input
3. Connect the signal output with the read-out device (for example oscilloscope, voltmeter, etc.).
4. If digital control is requested connect the iAMP-700 via RS232 port to the PC

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3.3 Step 2: Operation via keypad

In most cases it is recommended to activate the signal output with pressing button 6. This should be done before altering any of the settings of the iAMP-700.

4. The keypad

4.1 General information

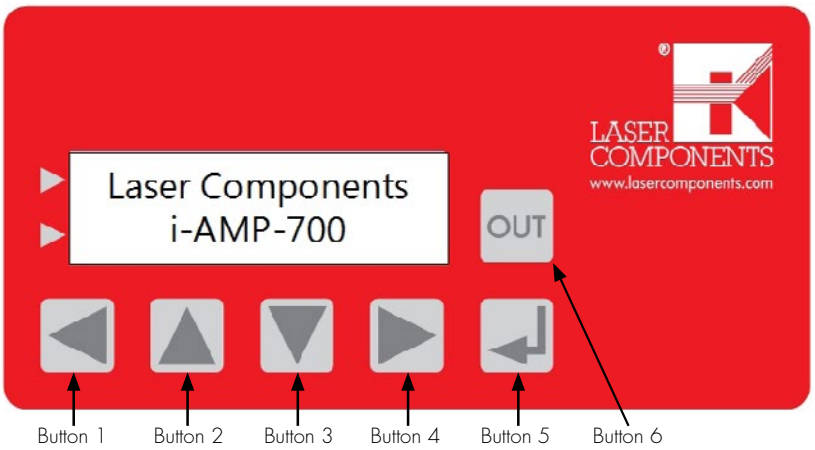

Fig. 8: Keypad of the iAMP-700

The buttons 1 to 4 allow to navigate through the different menu items.

Buttons 2 and 3 allow setting of different values for bias voltage, offset voltage and amplification. Moreover, button 2 and 3 allow to choose between different functions like high speed/ low noise, AC/DC coupling and lowpass filter.

With button 5 settings can be confirmed or a reset can be carried out with holding down the button for a few seconds.

Button 6 activates or deactivates the signal output. Only when the signal output is activated an output signal can be measured.

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4.2 Operation via keypad

4.2.1 Display 1

When starting up the iAMP-700 the device runs through a starting routine which activates the basic settings and deactivates the output port. The starting display can be seen in Fig. 9.

Navigation through the different menu items is done with buttons 1 to 4.

Fig. 9: Starting display; Display 1

4.2.2 Display 2

After pressing button 4 the following display appears (Fig. 10). Here prior settings that were saved can be chosen.

Fig. 10: Display 2

4.2.3 Displays 3 and 4: Overview of current settings of the i-AMP

After pressing button 4 again displays 3 and 4 are shown.

These two displays show an overview of the current settings of the i-AMP. Here, these settings cannot be changed. In display 3 the gain is shown with "G:1E+02" which means that the gain is:

$G=1E + 2 = 1 \cdot 10^2 = 100$

The combination of letters (here: „LNDCFBW") gives information about the status of three different functions of the amplifier:

Fig. 11: Display 3

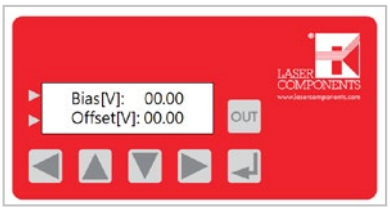

Fig. 12: Display 4

Display	Explanation		
LNDCFBW	Low Noise	DC-coupled	Full bandwidth, low pass filter disabled
HSDCFBW	High Speed	DC-coupled	Full bandwidth, low pass filter disabled
LNACFBW	Low Noise	AC-coupled	Full bandwidth, low pass filter disabled
HSACFBW	High Speed	AC-coupled	Full bandwidth, low pass filter disabled
LNDC10Hz	Low Noise	DC-coupled	Bandwidth limited to 10 Hz, low pass filter enabled
HSDC10Hz	High Speed	DC-coupled	Bandwidth limited to 10 Hz, low pass filter enabled
LNAC10Hz	Low Noise	AC-coupled	Bandwidth limited to 10 Hz, low pass filter enabled
HSAC10Hz	High Speed	AC-coupled	Bandwidth limited to 10 Hz, low pass filter enabled

Table 6: Display explanation

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4.2.4 Display 5: Setting the bias voltage

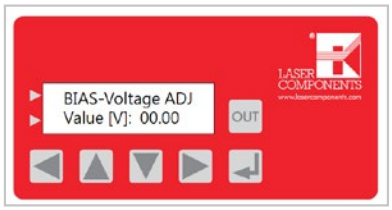

Fig. 13: Displyay 5

Display 5 shows the index value of the bias voltage. Here, the value of the bias voltage can be changed. In the case displayed in Fig. 13 the index value is 0.00 V.

The setting of the bias voltage is done by pushing buttons 2 and 3. Holding down these buttons increases the velocity of setting these values.

The index value of the bias voltage can be set from -10V to + 10V.

Once the desired value is chosen pressing button 4 changes the menu to display 6.

4.2.5 Display 6: Setting the offset voltage

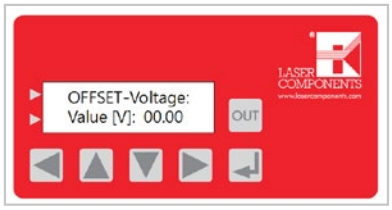

Fig. 14: Display 6

Analogous to the bias voltage the offset voltage can be set to an index value. It is important to note that the value of the offset voltage is a relative parameter and not absolute. This means that when setting the value to +5V not really 5V are set but 50% of the possible positive offset voltage value. How to use the offset voltage appropriately is shown in the detailed example in section 6.3.4.

4.2.6 Display 7: Setting the gain

Fig. 15: Display 7

Displayed here is the current gain which can be set using the buttons 2 and 3. If the amplifier is run in low-noise-mode gains in the range from 10^2 V/A to 10^9 V/A can be set. If changed into the high-speed-mode the gain region changes from 10^4 V/A to 10^{11} V/A.

4.2.7 Display 8: High-speed-mode or Low-speed-mode

Fig. 16: Display 8

When this menu is selected the user can choose between low-noise-mode and high-speed-mode. The high-speed-mode offers a higher bandwidth than the low-speed-mode when the gain is identical which can be helpful when working with fast signals. However, the signal-to-noise ratio deteriorates in this case. Very small signals can be illustrated very well with a frequency < 10 Hz in high-speed-mode with a gain of 10^11 along with a low pass filter. The customer can change between the low-noise and high-speed-mode with buttons 2 and 3.

4.2.8 Display 9: AC or DC

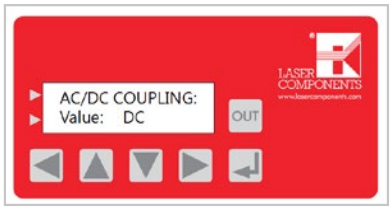

Fig. 17: Display 9

In the basic settings the i-AMP-700 is DC coupled, without high pass filter. If necessary a high pass filter can be activated (AC-coupling). This selection between DC and AC coupling can be made with buttons 2 and 3.

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4.2.9 Display 10: Full bandwidth or low pass filter

With the help of low pass filters (Tschebyscheff 8th order) the bandwidth can be reduced to 10Hz. The achievement is better signal illustration.

With buttons 2 and 3 the filter can be activated or deactivated. After the choice is made pressing the button 4 changes the menu to display 11.

Fig.18: Display 10

4.2.10 Display 11: Saving the current gain settings

With the i-AMP-700 up to 5 complete gain settings can be saved. Each one of these settings can be reactivated after the start-up of the device. These settings can be reactivated using display 2.

To save the current settings of the i-AMP-700 the customer needs to choose either "No!" or "Yes!" with buttons 2 and 3. Afterwards the selection is confirmed with the ENTER-button (button 5) which shows display 11.

With buttons 2 and 3 the customer can choose the memory location. The preferred location is selected with the ENTER-button and display 2 is shown.

If the customer does not want to choose a setting pressing button 4 leads to the next display which is display 1 in this case.

With button 1 the prior display can be set.

Fig. 19: Display 11

Fig. 10: Display 12

5. Operation via RS232 Interface

5.1 General information

The information provided here are of a very general kind. Special information about the usage of the digital interface and the LabView- driver with interface will be given in a separate manual.

Important:

To control the i-AMP-700 via RS232 a D-Sub cable, 9-pin, female/female with 1:1 connection is necessary. A "Null-modem-cable" does not work. Operation with a "USB to Serial Converter" is possible.

5.2 Default Interface

RS232 (RxD, TxD)

Baud rate: 9600

8 bits

No parity

No flow control

Remote operation of the iAMP via RS232 requires a 9-pin D-sub cable. USB operation using a USB to serial converter is also possible.

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5.3 Table of Functions

Function	RS232 command	Description
U_{Bias} (-10 V bis +10 V)	b␣xxxx	Bias voltage
U_{Offset}	o␣xxxx	Offset voltage
Gain	g␣xx	Gain 10^{xx} A/V xx ∈ {3;4;…;11}
AC/DC	a␣0 a␣1	AC/DC: high pass DC on AC on
High Speed	h␣0 h␣1	Low Noise / High Speed Low Noise (gain setting range 10^2 to 10^9) High Speed (gain setting range 10^4 bis 10^{11})
TTPF	t␣0 t␣1	Tschebyschow low pass filter (10 Hz) off on
OUT	x␣0 x␣1	Output switching Output connected to ground via resistive load Output active
Save State	s␣xx	Saves current setup xx: 01…05 (memory location number)
Recall State	r␣xx	Recalls saved setup xx: 01…05 (memory location number)
Riegel	R␣0 R␣1	Disables keypad deactivated (keypad operation is also permitted) activated (keypad disabled; operation via RS232 only)
Help	H	Lists all commands
State	H	Display the current setup

Table 7: RS232 Commands

RS232-commands: „ ␣ “ = „space“;
If a command's numerical appendix is replaced by a „?“ the current parameter value is returned as the reply (does not apply to commands in described in red above). Space does not need to be set if a value is written after a command.

- Example:
  g␣? Command
  GAIN: 1E+02 Reply

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5.4 Direct control

In order to directly control the i-AMP-700 via RS232 a simple terminal program is recommended.

As soon as the connection is established and the i-AMP-700 is up and running a welcome screen appears. This is to show the customer that the connection between PC and i-AMP-700 is established and functioning.

The commands mentioned in table 7 can be entered here. Consequently, the state of the changed parameter is displayed if the command was entered correctly and was processed by the i-AMP-700.

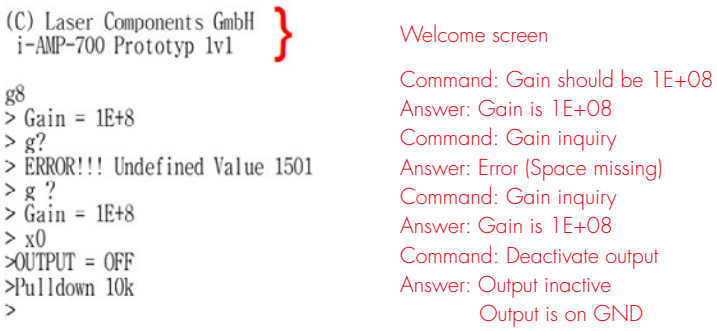

Fig. 21: Terminal program

6. Applications: Current measurement

6.1 Task

Different currents are to be measured from a current source (here: Keithley 220) with the i-AMP-700 and an oscilloscope (here: Agilent MSO7104A) to show the voltage signal.

The signals are of rectangular pulse shape with a duty cycle of 50%. The values of the different currents with repetition frequency are listed in the table below:

Measurement	High	Low	Frequency
1	+10 mA	-10 mA	100 Hz
2	+1 mA	-1 mA	100 Hz
3	+100 µA	-100 µA	100 Hz
4	+10 µA	-10 µA	100 Hz
5	+1 µA	-1 µA	100 Hz
6	+100 nA	-100 nA	100 Hz
7	+10 nA	-10 nA	100 Hz
8	+2 nA	-2 nA	100 Hz
9	+500 pA	-500 pA	1 Hz
10	+50 pA	-50 pA	1 Hz

Table 8: List of current and repetition frequencies

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6.2 Setup

- Current source: Keithley 220
- Oscilloscope: Agilent MSO7104A
- Current-voltage-amplifier: i-AMP-700
- Power supply unit: i-AMP-PSU

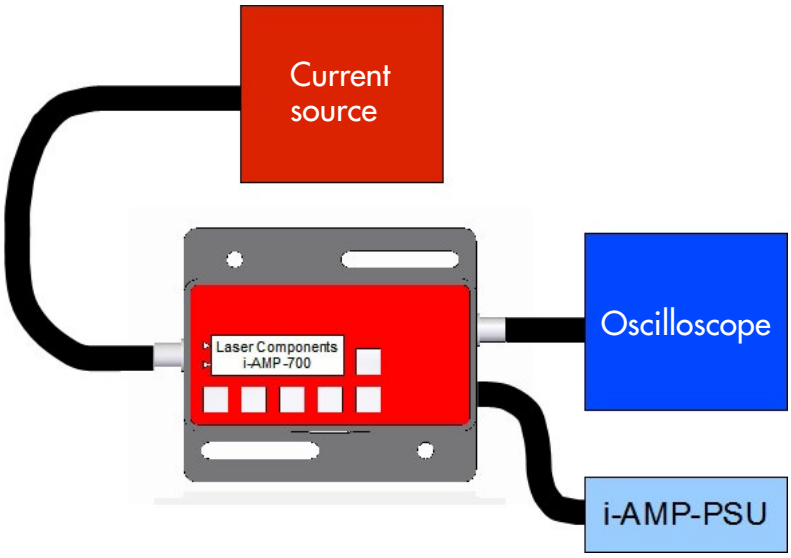

Fig. 22: Setup

6.3 Carrying out the measurments

6.3.1 Measurement 1

Step 1: Starting up the measurement. Display 1 (see section 4.2.1) is shown on the i-AMP-700. Output must be activated by pushing button 6.

Step 2: Button 4 needs to be pushed 5 times to get to display 6 (see section 4.2.6) . Here the offset voltage is set. It is set to -0.39V and like this fits nicely to the gain which is 1E+02.

Summary of settings:

- Output inactive
- Gain: 1E+02
- Bias: 0.0V
- Offset: -0.36V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

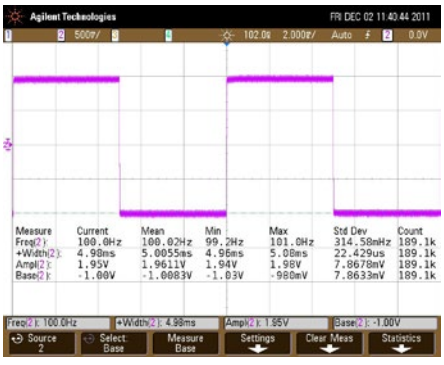

Fig. 23: Measurement 1; signal on oscilloscope for measurement 1

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6.3.2 Measurement 2

Step 1: Starting up the measurement. Display 1 (see section 4.2.1) is shown on the i-AMP-700. Output must be deactivated with pushing button 6.

Step 2: Button 4 needs to be pushed 6 times to get to display 7 (see section 4.2.7.). Here the gain is set. Optimum gain in this case is 10^3 V/A (1E+03). To be able to set this value, the customer needs to hold down button 2 for a few seconds. On the oscilloscope a small shift of the signal to the top is shown. This can be corrected with varying the offset voltage.

Step 3: Pushing button 1 changes the screen to display 6. Here the offset voltage is set. It is set to -0.10V and like this fits nicely to the gain which is 1E+03. With pushing button 3 several times the desired value can be set. The signal curve moves slowly to the bottom.

Summary of settings:

- Output active
- Gain: 1E+03
- Bias: 0.0V
- Offset: -0.10V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

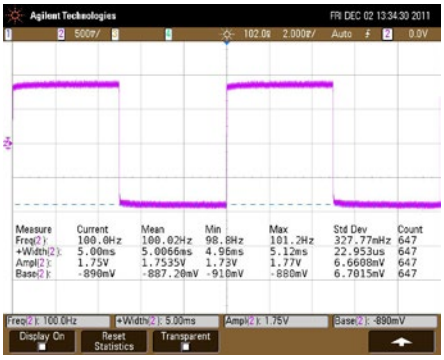

Fig. 24: Measurement 2; signal on oscilloscope for measurement 2

6.3.3 Measurements 3 to 7

Measurements 3 to 7 are similar to measurement 2 (see section 6.3.2). Only the gain values have to be chosen differently. This leads to a different setting of the offset voltage as well.

Regarding measurements 3 to 7 only the results as well as the summary of the settings will be mentioned in the following.

6.3.3.1 Measurement 3

Summary of settings:

- Output active
- Gain: 1E+04
- Bias: 0.0V
- Offset: -0.35V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

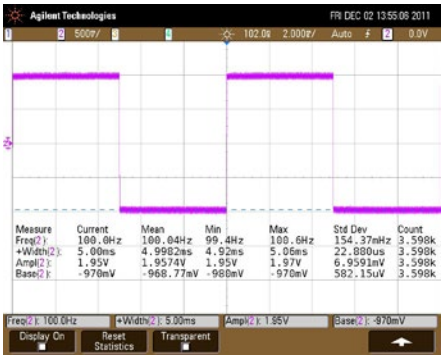

Fig. 25: Signal on oscilloscope for measurement 3

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6.3.3.2. Measurement 4

Summary of settings:

- Output active
- Gain: 1E+05
- Bias: 0.0V
- Offset: -0.10V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

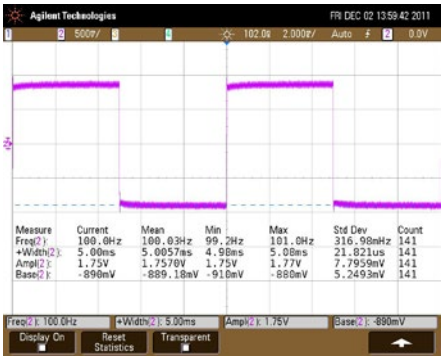

Fig. 26: Signal on oscilloscope for measurement 4

6.3.3.3 Measurement 5

Summary of settings:

- Output active
- Gain: 1E+06
- Bias: 0.0V
- Offset: -0.35V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

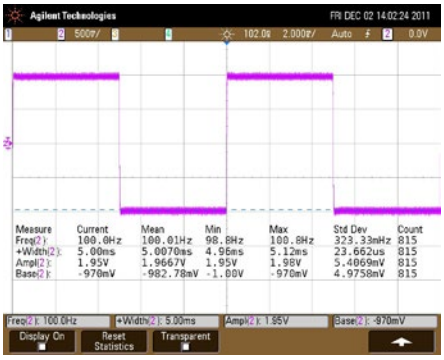

Fig. 27: Signal on oscilloscope for measurement 5

6.3.3.4 Measurement 6

Summary of settings:

- Output active
- Gain: 1E+07
- Bias: 0.0V
- Offset: -0.06V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

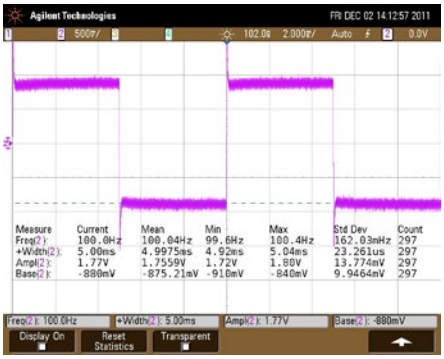

Fig. 28: Signal on oscilloscope for measurement 6

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6.3.3.5 Measurement 7

Summary of settings:

- Output active
- Gain: 1E+08
- Bias: 0.0V
- Offset: -1.34V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

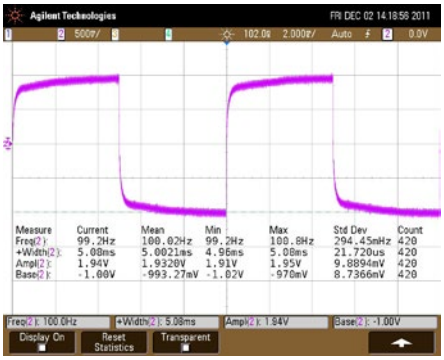

Fig. 29: Signal on oscilloscope for measurement 7

6.3.4 Measurement 8

The initial steps for this measurement are the same as for the prior measurements. After setting the gain to 10^9 V/A (1E+09) the oscilloscope shows the following picture:

The influence of the offset voltage is clearly visible. Without changing the offset voltage accordingly the measurement will not lead to any useful results. Therefore, the offset voltage needs to be changed. After switching to display 6 (see section 4.2.5) the offset voltage value can be set by pushing button 3. The offset voltage can now be set to -7.42 V.

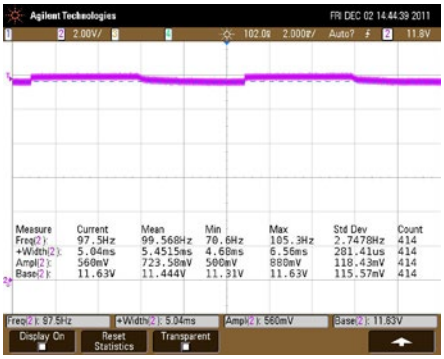

Fig. 30: Signal on oscilloscope for measurement 8 without adjustment of offset voltage

Summary of settings:

- Output active
- Gain: 1E+09
- Bias: 0.0V
- Offset: -7.42V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

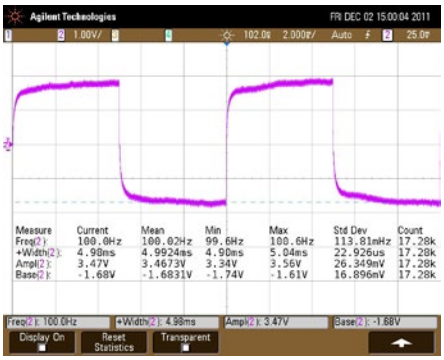

Fig. 31: Signal on oscilloscope after adjustment of offset voltage

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6.3.5 Measurement 9

For this measurement it is necessary to switch from low-noise-mode to high-speed-mode because in this mode gains of 10^{10} V/A and 10^{11} V/A are possible. For this, display 8 has to be activated (see section 4.2.7). One can change between low-noise-mode and high-speed-mode by pushing buttons 2 and 3.

In the next step, the gain has to be set to 10^{10} V/A in display 7 (see section 4.2.6), where the output of the amplifier reaches the upper limit (+12V), see fig, 32.

To be able to perform a measurement reasonably, the offset voltage has to be decreased. This is possible when activating display 6 (see section 4.2.5). After setting the offset voltage to -1.29 V the oscilloscope shows the following picture (Fig. 33):

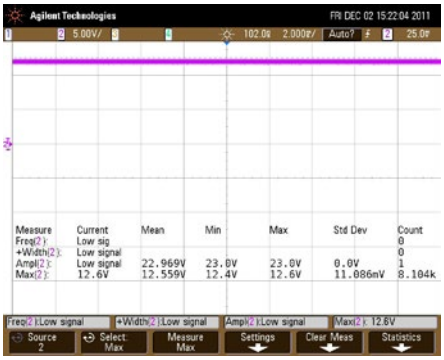

Fig. 32: Signal on oscilloscope for measurement 9 without adjustment of offset voltage

The picture shows the influence of the high gain on the signal noise without reduction of the bandwidth. At this point the low-pass filter needs to be activated since the signal frequency is 1 Hz which is significantly smaller than the 10 Hz the low-pass filter is limited to.

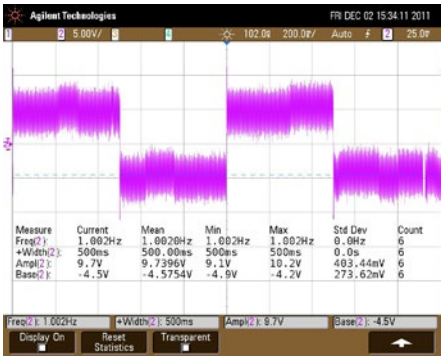

Fig. 33: Signal on oscilloscope for measurement 9 with adjustment of offset voltage but without low-pass-filter

To activate the low-pass filter display 10 needs to be chosen (see section 3.2.9). To activate or deactivate the low-pass filter push buttons 2 and 3. The signal on the oscilloscope changes as shown in fig. 34 when the low-pass filter is activated.

Summary of settings:

- Output active
- Gain: 1E+10
- Bias: 0.0V
- Offset: -1.29V
- High-speed-mode
- Coupling: DC
- Low pass filter: on

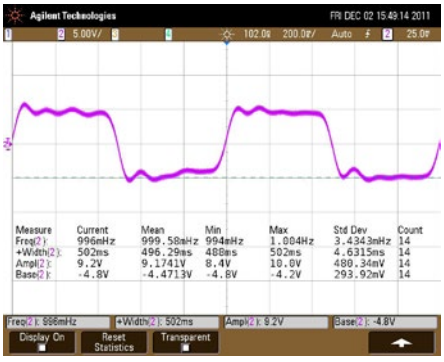

Fig. 34: Signal on oscilloscope for measurement 9 with adjusted offset and with low-pass-filter

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6.3.6 Measurement 10

Conducting this measurement is the same as with measurement 9. Therefore, we only mention the summary of the settings:

Summary of settings:

- Output active
- Gain: 1E+11
- Bias: 0.0V
- Offset: -7.48V
- High-speed-mode
- Coupling: DC
- Low pass filter: on

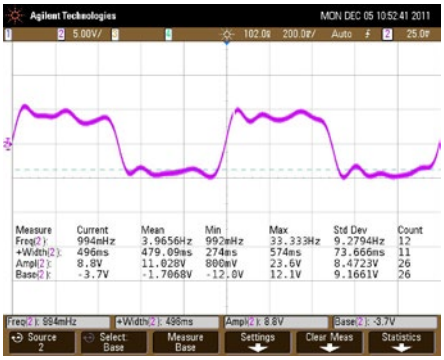

Fig. 35: Signal on oscilloscope for measurement 10

7. Example: Measurement of laser pulses with a photodiode

7.1 The task

The task is to detect laser pulses at a wavelength of 405nm with a photodiode. The output current of the photodiode is to be converted to amplified voltage pulses using the iAMP-700. The output voltage signal is then to be displayed on an oscilloscope. A filter is placed between the laser and the photodiode which allows for the transmittance to be varied. Detailed information about the transmittance of the filter can be seen in table 9.

Measurement	Transmittance of filter	Repetition frequency
1	100% (no filter)	100 Hz
2	32%	100 Hz
3	16%	100 Hz
4	10%	100 Hz
5	2%	100 Hz

Table 9: list of filters

The voltage supply of the photodiode is to be taken from the bias voltage of the iAMP-700. The laser pulse is of rectangular shape with a duty cycle of 50% and a repetition rate of 100 Hz.

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7.2 Experimental setup

- Laser: wavelength: 405nm, P_opt= 1.8mW;
- PSU for laser: GW Instek GPS 4303
- Trigger source: Agilent 3320A
- Photodiode: EPD-440-0-1.45
- Oscilloscope: Agilent MSO7104A

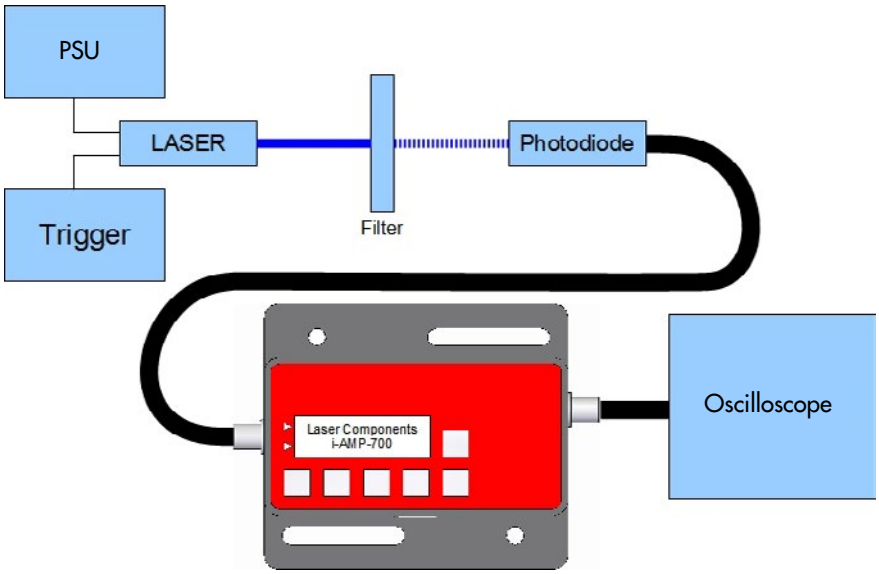

Fig. 36: Experimental setup

7.3 Measurement

7.3.1 Measurement 1

Step 1: Starting up the measurement. Display 1 (see section 4.2.1) is shown on the i-AMP-700. Output must be activated by pushing button 6.

Step 2: Bias voltage is to be set to +5.0V. To achieve this, display 5 needs to be activated by pressing button 4 (see section 4.2.4). Starting from display 1 button 4 needs to pressed 4 times. The index value of 0.0V is shown. By holding down button 2 this value needs to be changed to 5.0V.

Step 3: Gain is set to 10^4 (1E+04) by changing to display 7 (see section 4.2.6). To achieve this, button 4 needs to be pushed twice. The gain value shown is 10^2 (1E+02) and is changed to 10^4 by pushing button 2.

Step 4: Finally, the offset voltage is set in a way that the base of the signal is 0.0V. To achieve this, the customer needs to switch from display 7 to display 6 by pressing button 1 (see section 4.2.5). The necessary offset voltage is -0.36V and is set by pushing button 3.

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Summary of settings:

- Output active
- Gain: 1E+04
- Bias: +5.0V
- Offset: -0.36V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

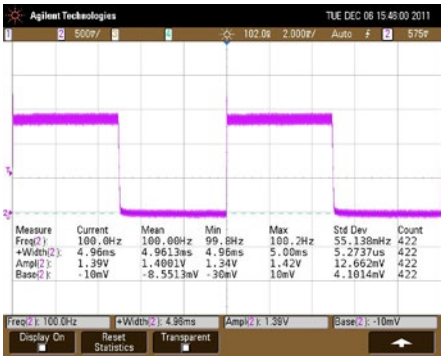


Fig. 37: Signal on oscilloscope for measurement 1

7.3.2 Measurements 2 to 5

Measurements 2 to 5 are similar to measurement 1.

Therefore, only the summary of the settings will be shown in the following. For measurements 3 and 4 the i-AMP 700 settings stay the same as with measurement 2, only the transmittance of the filter changes (see table 9).

7.3.2.1 Measurement 2

Summary of settings:

- Output active
- Gain: 1E+05
- Bias: +5.0V
- Offset: -0.09V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

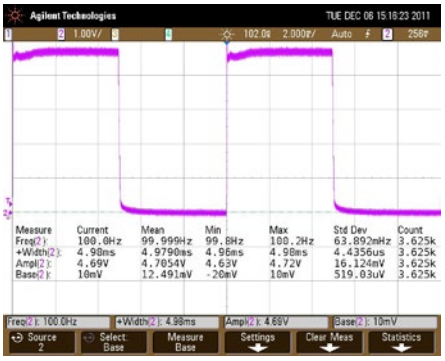
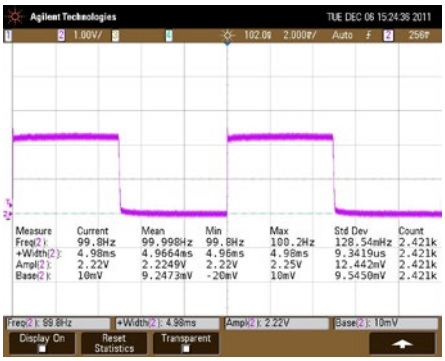


Fig. 38: Signal on oscilloscope for measurement 2

7.3.2.2 Measurement 3

- Output active
- Gain: 1E+05
- Bias: +5.0V
- Offset: -0.09V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off



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7.3.2.3 Measurement 4

Summary of settings:

- Output active
- Gain: 1E+05
- Bias: +5.0V
- Offset: -0.09V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

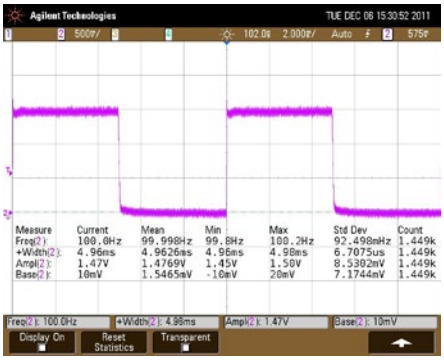

Fig. 40: Signal on oscilloscope for measurement 4

7.3.2.4 Measurement 5

Summary of settings:

- Output active
- Gain: 1E+06
- Bias: +5.0V
- Offset: -0.36V
- Low-noise-mode
- Coupling: DC
- Low pass filter: off

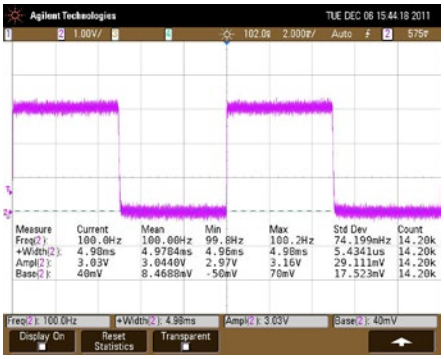

Fig. 41: Signal on oscilloscope

7.4 Analysis of measurement data

The results of the measurements are displayed in table 9.

	Sensitivity S [A/W]	Voltage amplitude U_{Ampl} [V]	Gain k_{iAMP} [V/A]	Transmittance T	Power P_{opt} [mW]
Measurement 1	0,1	1,410	10000	1,00	1,41
Measurement 2	0,1	4,710	100000	0,32	1,47
Measurement 3	0,1	2,257	100000	0,16	1,41
Measurement 4	0,1	1,478	100000	0,10	1,48
Measurement 5	0,1	3,044	1000000	0,02	1,52

Table 9: Measurement results

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According to the data sheet of EPD-440-0-1.4 the sensitivity of the photodiode is around 0.1 A/W. The voltage amplitude was measured with the oscilloscope. The gain of the iAMP-700 was set in each measurement and the transmittance of the filter is known. From these values one can calculate the laser power with using the following formula:

$$P_{opt} = \frac{U_{Ampl}}{k_{iAMP} \cdot S \cdot T}$$

Important:

In section 6.2 the optical power of the laser was said to be 1.8mW. This value cannot be fully achieved due to several reasons:

- The experimental setup does not feature any exact focusing of the laser onto the active area of the photodiode. The spot size of the laser beam is in fact larger than the active area, therefore the full power of the laser is not measured.
- The photodiode is a semiconductor. Therefore, the sensitivity mentioned in the data sheet can vary.
- The filters used are grey filters and their transmittance was not measured for 405nm but for 510nm.

8. Applications

8.1. iAMP-700 with PIN-Diode

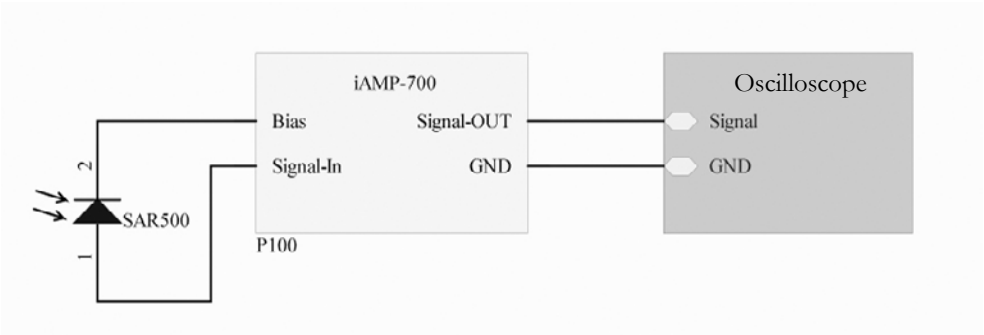

Fig. 43: i-AMP-700 with PIN-Diode

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8.2. iAMP-700 with dBC module and APD

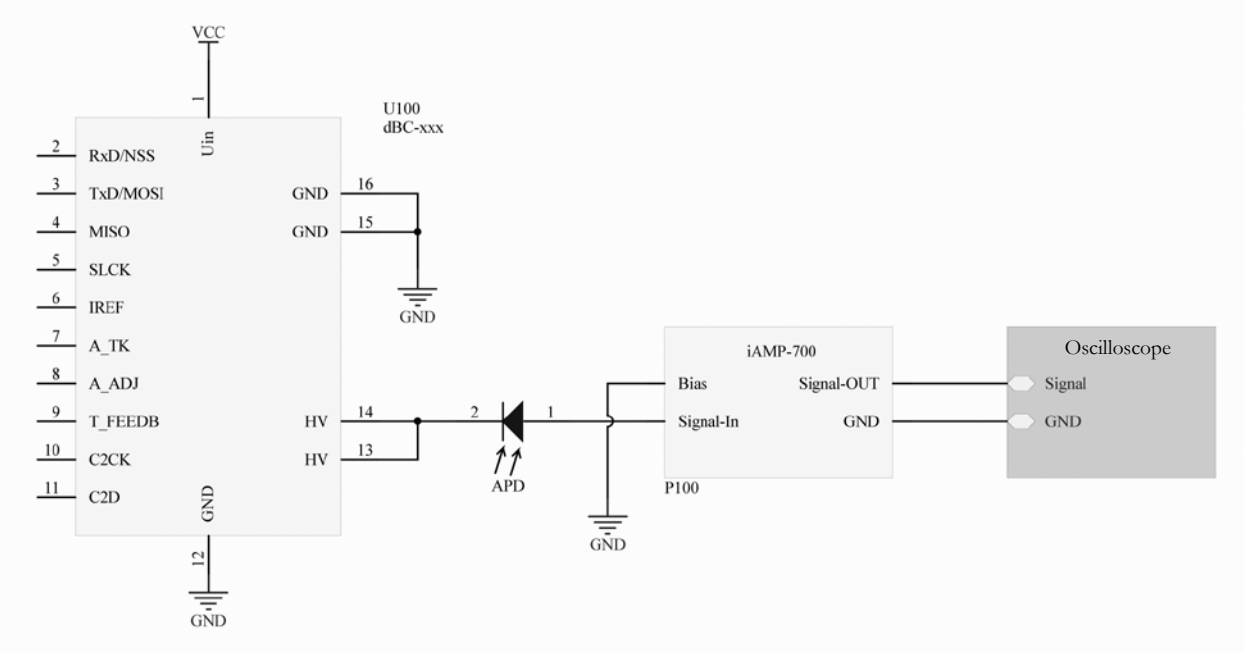

Fig. 44: iAMP-700 with dBC and APD

8.3. iAMP-700 with ABC-module and APD

The output voltage of the ABC-module is taken from the bias voltage of the iAMP-700.

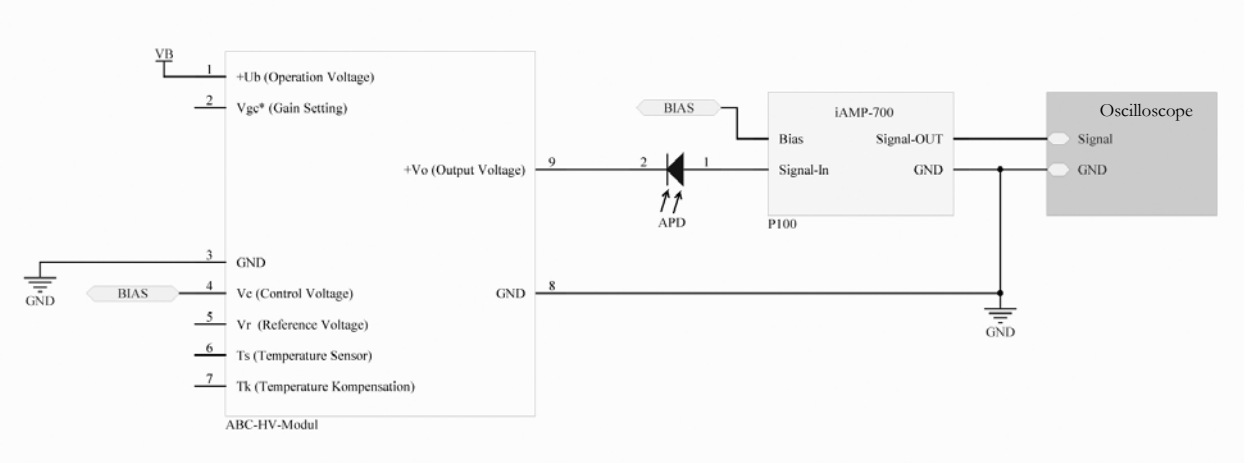

Fig. 45: iAMP-700 with ABC and SAR500

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9. Appendix

Display	Content	Explanation
1	LASER COMPONENTS iAMP-700	Device is ready
2	Recall State? YES! Press ENTER!	Activate saved setting
2a	Recall State: State 01	Choice of 5 saved settings
3	iAMP SETTINGS: G:1E+02 LNDCFBW	Overview of current settings (Part 1)
4	Bias[V]: 03.50 Offset[V]: 00.00	Overview of current settings (Part 2)
5	BIAS-Voltage ADJ VALUE [V]: 03.50	Setting the bias voltage
7	OFFSET-Voltage VALUE [V]: 00.00	Setting the offset voltage
8	GAIN-Adjustment: GAIN: 1E+02	Setting the gain
9	L.NOISE/H.SPEED: VALUE: Low Noise	Setting low-noise-mode or high-speed-mode
10	AC/DC COUPLING: VALUE: DC	Setting the coupling
11	Lowpass Filter: Filter OFF	Setting the low pass filter
12	Save Settings? NO! PRESS ENTER!	Save current settings
12a	Allocated Space: State 01 Enter?	choice between 5 saving spaces

Table 10: Overview of displays

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