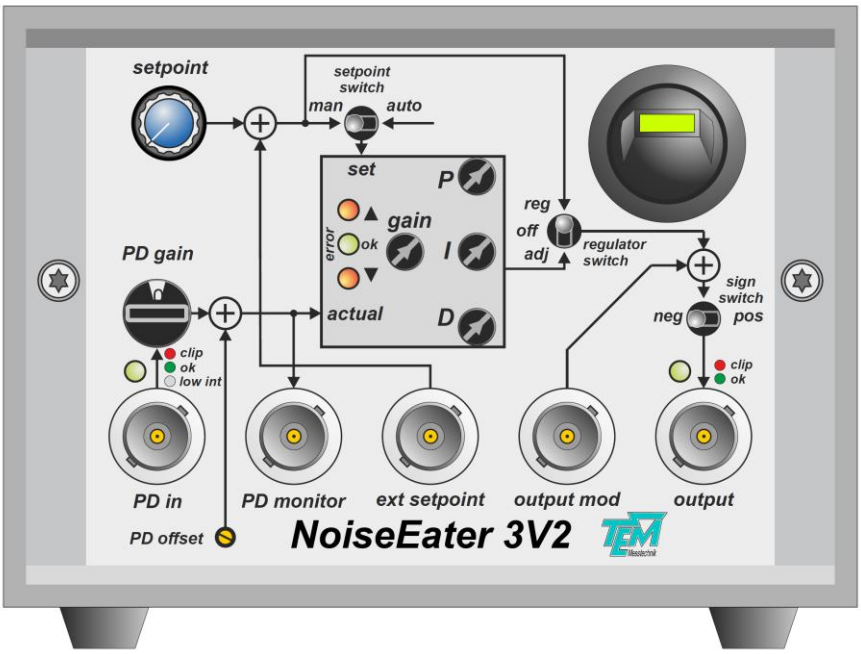
NoiseEater 3.2

Laser Intensity Stabilization

User Guide



NoiseEater 3.2

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Contents

1 Product Description

1.1 Principle of Operation

The technology of acousto-optic and electro-optic modulation allows the modulation of the laser intensity. This can be used for a precise stabilization of the laser power.

For this purpose the laser beam is led into an acousto-optical modulator (AOM) or an electro-optical modulator (EOM). One part of the laser power will be diffracted (AOM), or rotated in direction of polarization and separated by a polarizer (EOM). The laser power regulation takes place by measuring the intensity of the diffracted (first order) or undiffracted beam (zeroth order) (fig. 1.1).

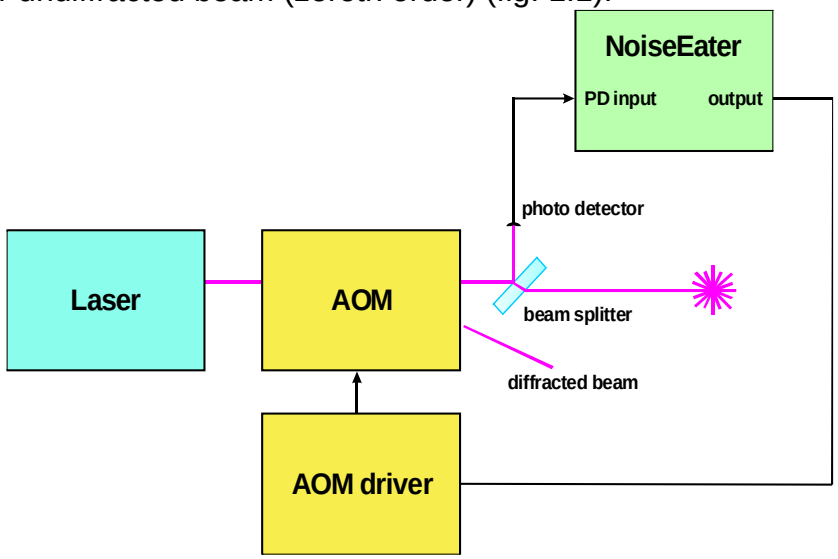


fig. 1.1: setup for intensity stabilization with AOM

The input amplifier of the *NoiseEater* PDin is a voltage amplifier and provided with a stepwise selectable amplification (position 0 corresponds to amplification **1**, position 1 corresponds to amplification **3**, pos. 2: **10**, Pos. 3: **30**). Furthermore there is a PID-regulator with manually or automatically selectable setpoint and a AOM- or EOM-driver adapted output amplifier (fig. 1.2).

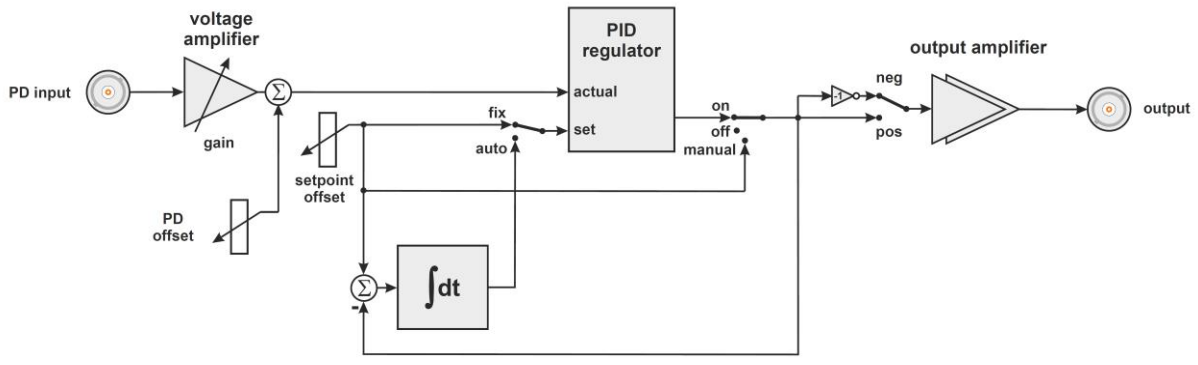


fig. 1.2: block diagram of the NoiseEater

2 safety instructions

Please read this manual carefully before operating any part of your *NoiseEater* system to avoid any damage to objects or persons.

Warning!

The *NoiseEater*-system is being used in Laser systems with partially invisible laser radiation. Do not look into the laser beam! Take precautions to avoid any direct or reflected laser radiation outside the experiment.

Warning!

The users are responsible for following the legal rules concerning laser safety that apply in their country. In germany this is the Unfallverhütungsvorschrift BGV B2 of the Berufs-genossenschaft der Feinmechanik und Elektrotechnik.

Warning!

Use only the supplied power cord and plugs or the corresponding ones for your country, as only this guarantees safe operation and grounding of the devices.

Warning!

Please ensure before operation that the proper supply voltage is chosen on the *NoiseEater* unit (see section7.1 for details).

Warning!

The device *NoiseEater* is intended for indoor operation with a temperature range from +5 °C to +45 °C (please take into account that the spectroscopy cell has to have the right optical density and therefore the right temperature for proper operation.) Do not subject the device to heat, direct sunlight or the influence of other electric devices. Protect from humidity, dust, agressive liquids and vapors.

Warning!

The *NoiseEater* should be opened only by trained technical personnel. Before opening the housing, the device must under all circumstances be disconnected from the supply voltage, for example by pulling the power plug.
Please keep this manual within easy reach to refer to if needed.

Give your *NoiseEater*-system to third parties only with this manual.

3 Shipping Materials and System Preconditions

3.1 Shipping Materials

Please check first of all if you obtained all the parts listed below. If not please check your ordering form and refer to the manufacturer or distributor.

The *NoiseEater* system consists of the following parts:

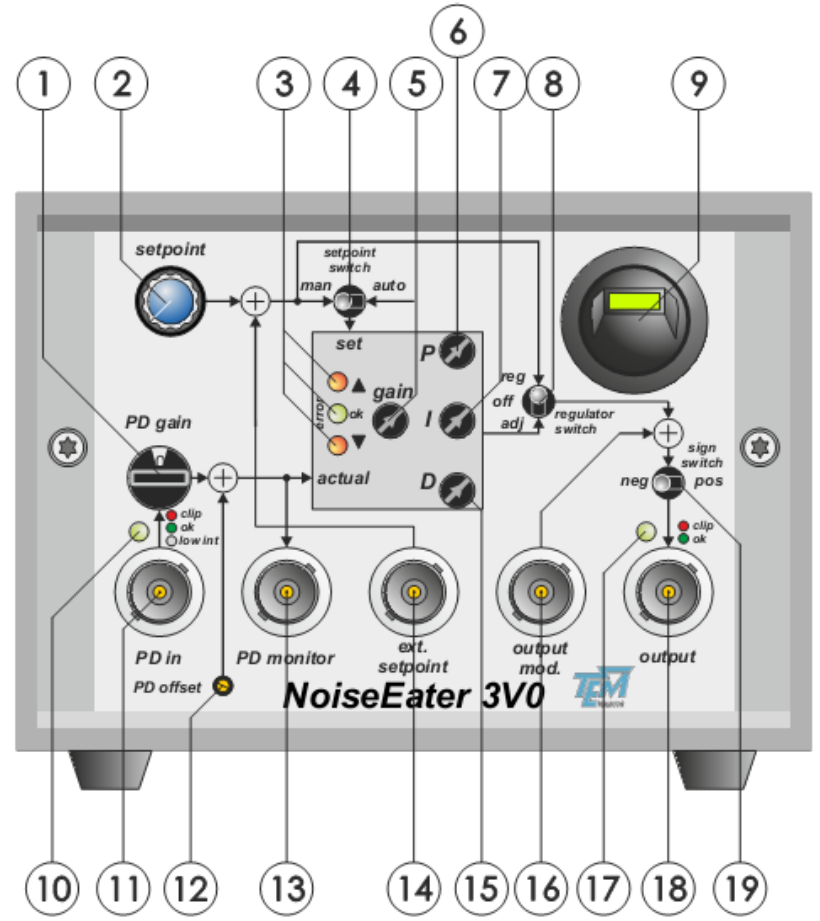
- One device *NoiseEater (*2HE-housing)
- One power cord

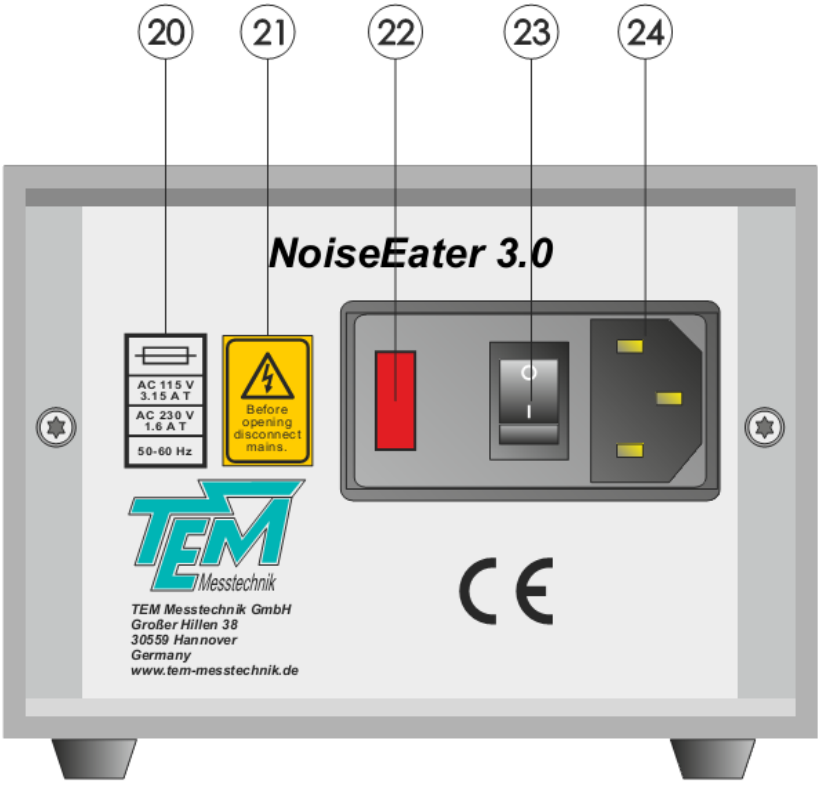
It is recommended to keep the original packaging for future transport or storage.

3.2 System Preconditions

Construct your optical setup as shown in fig. 1.1. Use an EOM or AOM to modulate the laser beam. Use a photo diode detector and connect it as described in chapter 5.2.

4 *NoiseEater* Control Elements





Nb.	description
1	amplification selector switch for the photo diode input signal
2	setpoint trim-pot
3	indicator for error signal. green: regulator locked
4	setpoint switch (only active when regulator is on). left position: setpoint chosen manually by setpoint trim-pot (2). right position: automatically generated setpoint.
5	trim-pot for loop gain
6	trim-pot for the proportional amount of the regulator
7	trim-pot for the integral amount of the regulator
8	regulator switch. upper position: regulator on, middle: regulator off, lower position: diffraction ratio can be set manually by setpoint trim-pot (2)
9	power switch (secondary circuit)
10	indicator LED. dark: input signal too low, green: sufficient input level, red: input level too high
11	input jack for the photo diode input signal
12	offset adjustment for the photo detector
13	monitor output jack for the amplified photodiode signal
14	input jack for external setpoint
15	trim-pot for the differential amount of the regulator
16	input jack for output modulation
17	indicator LED for output level clip, green: output level okay, red: output level clipped.
18	regulator output jack (connect with the AOM-/EOM-driver input)
19	output sign switch (change in regulation sign)
20	instructions regarding the fuse
21	safety instructions
22	fuse holder
23	power switch (primary circuit)
24	input jack for power cord

5 Mechanical Setup and Electrical Connections

5.1 Setup

Place the *NoiseEater* suitably, taking into account the safety warnings in chapter 2.

The *NoiseEater* is equipped with an automatic line voltage switch.
You can operate the NoiseEater with a supply voltage of 230V or 115 Volt, 50 – 60 Hz.
Include the AOM or EOM suitably into the free laser beam of your experiment. Guide a part of the undiffracted or diffracted laser light to the photo diode (fig. 5.1).

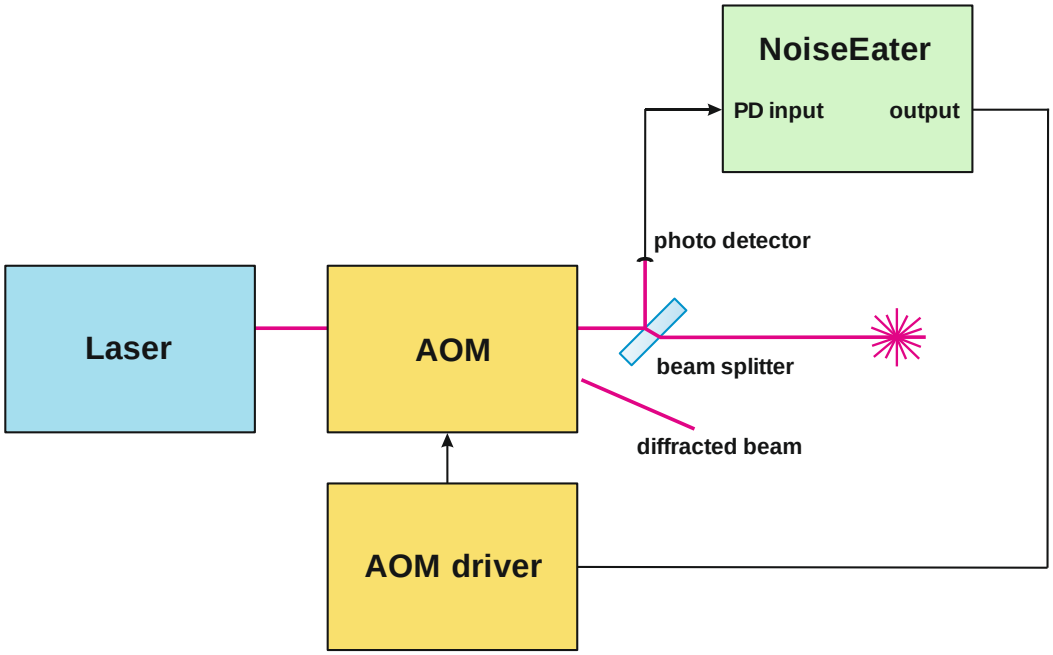


fig. 5.1: setup for power stabilization

5.2 electrical connections

Use the power cord and plugs delivered with your system if possible. If the power plug does not fit your country´s mains power socket, use the corresponding plug and cable of your country.

Connect the photo diode amplifier with the input jack „PD in“ of the NoiseEater. Please avoid unneccessarily long coaxial cables.

The BNC input-socket has the signal input at the core of the BNC-socket. The outer ring (or shield) is connected to ground.

Connect the output of the NoiseEater witch the AOM/EOM driver.
Make sure, that the output voltage range of the NoiseEater (0…10V @high impedance or 0...5 V@50Ohms) fits to your (AOM / EOM) -driver input.

Use 50 Ohms-BNC cables for all BNC connections.

6 Operating the NoiseEater System

6.1 Switching on

The *NoiseEater* should be turned off.

Turn the trim-pot “setpoint“ (2) anticlockwise to the left stop and the selector switch “PDgain“ (1) to zero. Turn the „setpoint” switch (4) to the left position (“man“) and the „regulator switch” (8) to the lower position („adj”). In this position the regulator is switched off.

Switch on the *NoiseEater* (23, 9). The integrated LED in the power switch (9) should glow.

6.2 Adjusting the Offset of the Photo Diode

Block the laser, or cover the photo diode. Turn the “PD gain” selector switch (1) to position “3”. Adjust the voltage at the “PD monitor”-jack (13) to zero by use of the “PD offset” trim-pot (12).

6.3 Adjusting the Sensitivity

Turn the trim-pot “setpoint“ (2) clockwise. The intensity at the photo diode should rise to its maximum. If the intensity decreases while turning the „setpoint” trim-pot clockwise, please change the state of the “sign switch” (19).
Turn the trim-pot “setpoint” to the right stop and watch the voltage at the “PDmonitor” jack (13). The maximum voltage should be between 0,15V ... 5V. In this case, the LED (10) above the “PDin“-jack glows green. Increase the input sensitivity by turning the selector switch “PDgain“ (1) clockwise as long as the LED (10) glows green. If the LED glows red, turn one step back.

6.4 Setting the Extinction-Ratio Manually

Set the “setpoint switch” (4) to the left position (“man“) and the “regulator switch” (8) to the lower position (“adj”). By turning the trim-pot “setpoint“ (2) the AOM/EOM-driver power and thus the extinction of the modulator can be manually adjusted. The indicator LED (17) signalizes the present value of the output voltage. Is the output voltage located in the permitted range, the LED glows green. Is the output voltage near the minimum or maximum value, the LED glows red.

6.5 Switching on the Regulator

Set the “regulator switch” (8) to the upper position (“reg“). The *NoiseEater* regulates the laser intensity to the value chosen by the trim-pot “setpoint” (2). The selected setpoint must be below the unregulated input signal (fig. 6.1).

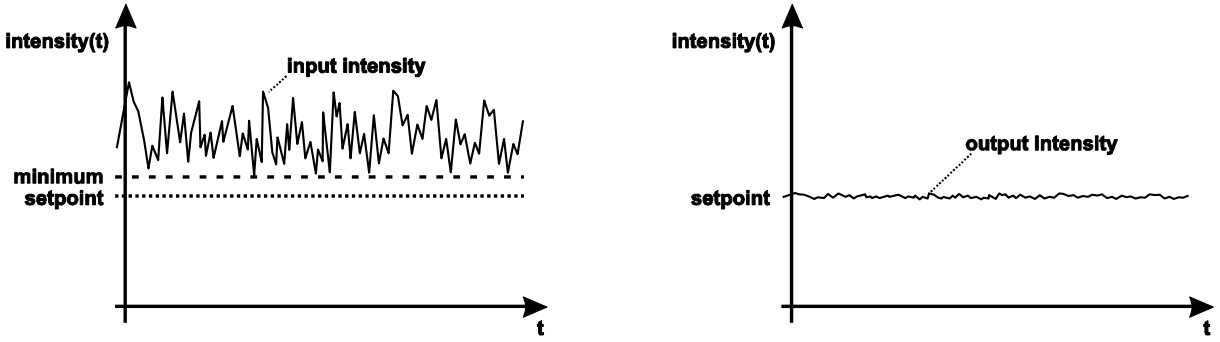


fig. 6.1: correct adjusted regulator-setpoint

The LED (17) signalizes the present value of the output voltage. Glowing red means the output voltage reached the maximum or minimum value. This represents less laser power provided or the modulators diffraction ratio is not sufficient for the chosen setpoint.

6.6 Adjusting the PID-Regulator

In order to appraise the regulation quality, a reproducible disturbance needs to be induced. In this case, we modulate the setpoint signal and optimize the PID-parameters for a fast and exact response.
Connect the input jack “ext. setpoint“ (14) to a function generator or similar. Set the waveform to rectangular: amplitude 200 mV, frequency 1 kHz.

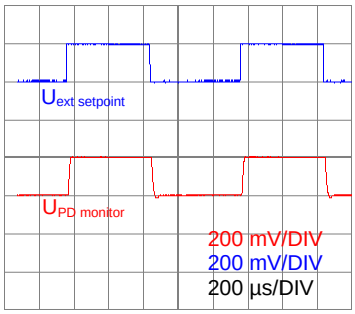


fig. 6.6.1

Turn the “setpoint” trim-pot to the middle position. Choose the “regulator switch” to the upper position (“reg”). Turn the trim-pot “P”(5), “I”(7) to appr. 30% and “D” (15) to the left stop. Increase the loop gain by turning trim-pot “gain”. Watch the voltage at the “PDmonitor“-jack. (fig.6.6.1)

Adjust trim-pot “P” to a small overshoot (10% of the step) of the PDmonitor signal.
Increase the “I” trim-pot until the PD monitor signal reaches the step-height as soon as possible after each step without additional overshooting.
The regulator is now adjusted very close to its optimum. You can improve the step response while varying the “P” and “D” trim-pots.

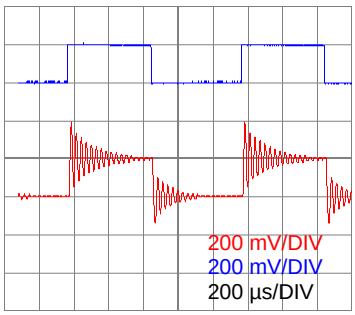


fig. 6.6.2

fig.6.6.2: “gain“ too high, closed loop oscillates.
fig.6.6.3: “gain“ ideally adjusted, fast response and small overshoot
fig.6.6.4: „gain“ too low, the regulator creeps very slowly to the setpoint step.

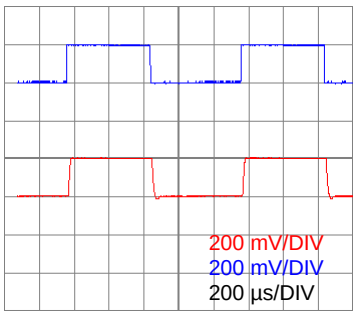


fig. 6.6.3

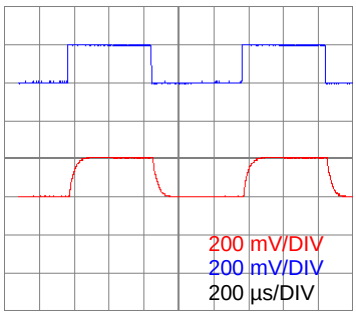


fig. 6.6.4

Keep in mind that an overshoot indicates potential instability. Do not allow more than a few percent overshoot.

6.7 Automatically generated Setpoint

The *NoiseEater* provides the option to adjust the setpoint automatically to the available laser power. Therefore set the “setpoint switch” (4) while regulating to the right position (“auto“). By turning the trim-pot “setpoint“ (2) you can choose the average laser intensity. If temporary intensity variations occur, the NoiseEater adjusts the setpoint below this variations. The average value of the intensity will be as the choosen value at the trim-pot “setpoint“. The average time constant is 1s. The optical arrangement behaves like an “opical low-pass“.

7 Further Hints

7.1 Adapting the NoiseEater to a given Supply

The *NoiseEater* is equipped with an automatic line voltage switch.
You can operate the NoiseEater witch a supply voltage of 230V or 115 Volt, 50 – 60 Hz.

7.2 Changing the *NoiseEater* Fuse

The power cord must be removed. The flap around the power switch opens by use of a small standard screwdriver. Now lift the fuse block from its anchoring with the screwdriver. Only fuses of the type 250 V/1.6 A, FLINK (for 110Volt: 250V/3.15A) are suitable.

7.3 Intensity Measurement with Beam Sampler and Photo Diode

The accuracy of the whole regulation is most often limited by the (long-term) accuracy of the intensity measurement with the beam splitter and the photo diode. The measurement of the laser intensity for the regulation has to be done very carefully.

Every measuring error will result directly in a wrong regulator signal.

Deviant measurements of the true laser intensity can occur because of interference effects, ambient light, thermal lenses, beam pointing, changes in polarization and so on.

8 Troubleshooting

Problem	Possible cause	Possible solution
no function, power LED is off	a) The NoiseEater is not connected to net supply power or is not switched on	a) Connect the NoiseEater to the net power socket by the power cord. Switch the NoiseEater on by the power switch on the rear side directly beside the supply outlet (primary circuit switch) and the power switch on the front panel (secondary circuit switch).
	b) fuse is defect	b) Check the fuse and replace it by a new fuse 250 V, 1,6 A, FLINK(for 110 V:250 V/3.15A).
regulation does not work, intensity flips to end of range while switching on	a) output sign is wrong	a) change state the state of the sign switch and try again.
	b) wrong PID-regulator parameters	b) review chapter 6 of this manual and try again.

9 Appendix

9.1 Technical Data

9.1.1 Amplification Range of the Input Transimpedance Amplifier:

switch setting	amplification
0	1
1	3
2	10
3	30

9.1.2 Supply Voltage

115 V or 230 V, 50 ... 60 Hz

9.1.3 Housing Dimensions

87.2 mm x 125 mm x 209 mm (2 HE)

9.1.4 Maximum electrical Ratings

connector (input/output)	regular range [no damage]
PD in (i)	0…5 V [±12 V]
PD monitor (o)	0…5 V
ext. setpoint (i)	± 2,5 V [±12 V]
output mod. (i)	± 2,5 V [±12 V]
output (o)	0…10 V (0…5 V @50 Ω)

9.1.5 input / output impediance

connector (input/output)	impedance
PD in (i)	10 kΩ
PD monitor (o)	50 Ω
ext. setpoint (i)	1 kΩ
output mod. (i)	1 kΩ
output (o)	50 Ω

9.2 Maintenance and Care

No maintenance is needed.

Caution!

Clean external surfaces with a damp cloth and then dry with a clean dry cloth. Do not clean the inside of the devices.

Never use cleaning agents such as solvents, petrol, sprays or mechanical cleaning agents as these may damage the surfaces.

In case of contact with liquids the devices may not be switched on under any circumstances. Instead, keep them in a dry, warm place for at least 72 hours. In many cases the systems work again after such treatment.

9.3 Customer Service

In case of necessary repairs or warranty claims you will obtain fast and reliable help at the adress below:

TEM Messtechnik GmbH
Großer Hillen 38
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Tel.: 0511-510896 -30, Fax: 0511-510896 -38
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