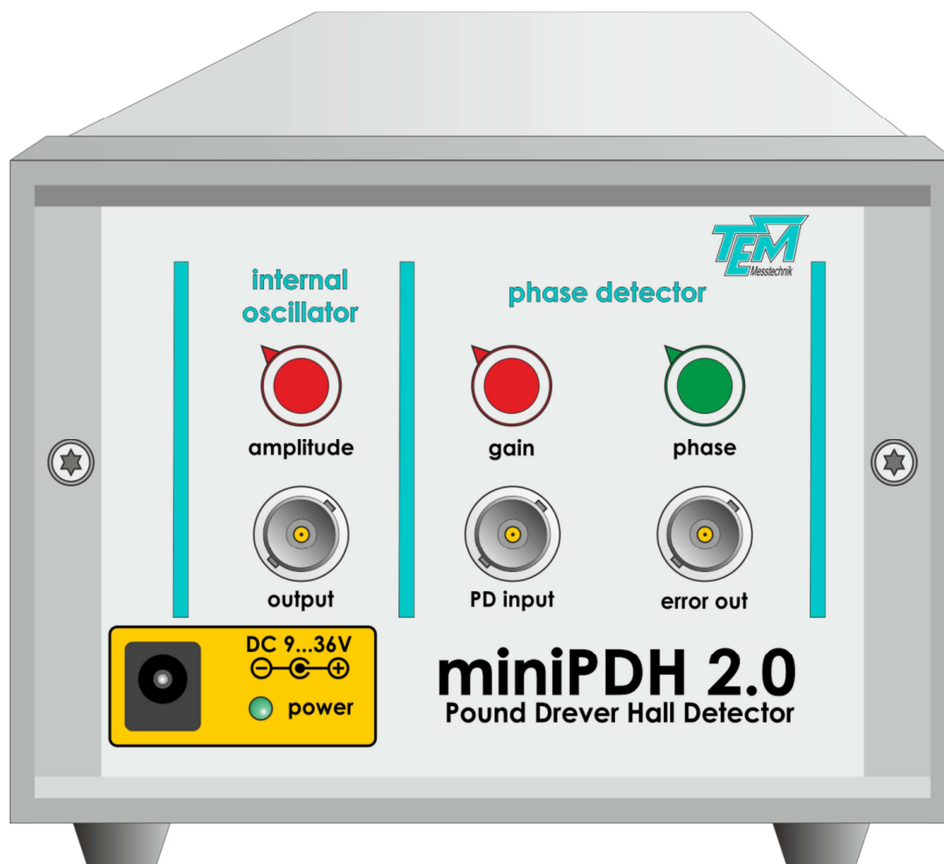




miniPDH 2.0

user guide



miniPDH 2.0

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1 Product description

1.1 General

miniPDH is a stand-alone phase-sensitive RF receiver with built-in oscillator for use in a Pound-Drever-Hall laser regulation set-up.

1.2 Principle of operation

The Pound-Drever-Hall stabilization is a method of regulating the frequency of a laser to the resonance of a passive optical resonator (cavity), or vice versa. The optical set-up couples the laser beam into the cavity, and a photo diode detects the optical power of the light reflected from the cavity. The aim is to regulate the laser frequency (or the cavity length, resp.) in a way that the reflection power approaches a local minimum. This state corresponds to maximum transmission of the cavity (i.e. resonance). The regulation principle is similar to the lock-in technique: The laser frequency is modulated, and the photo diode signal is demodulated by means of a phase-sensitive rectifier. Spoken in terms of the frequency domain, side bands are impressed to the optical carrier frequency, and the photo diode signal is mixed with the modulation signal. However, in contrast to conventional lock-in technique, such a large modulation frequency is chosen that the sidebands lie outside the cavity resonance when the carrier is centered to the resonance. This means that the sidebands are completely reflected. (For this reason, the Pound-Drever-Hall scheme never works in a transmission set-up. Another difference to conventional lock-in technique is the fact that the demodulation happens 90° out of phase compared to the optical modulation. But this is of no concern in practice, as the demodulation phase is adjusted empirically.)

2 Safety instructions

Before operating any part of the *miniPDH*, please carefully read this user guide in order to avoid any damage of the device or connected equipment as well as any injury to persons.

- CAUTION!** The *miniPDH* device is used with lasers emitting visible or invisible radiation. Make sure the safety regulations are fulfilled.
- CAUTION!** 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.
- CAUTION!** The device is intended for indoor operation with a temperature range from +5 °C to +45 °C. Do not subject to heat, direct sunlight or the influence of other electric devices. Protect from humidity, dust, aggressive liquids and vapors.
- CAUTION!** *miniPDH* 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 *miniPDH* to third parties only with this manual.

3 Shipping materials and system preconditions

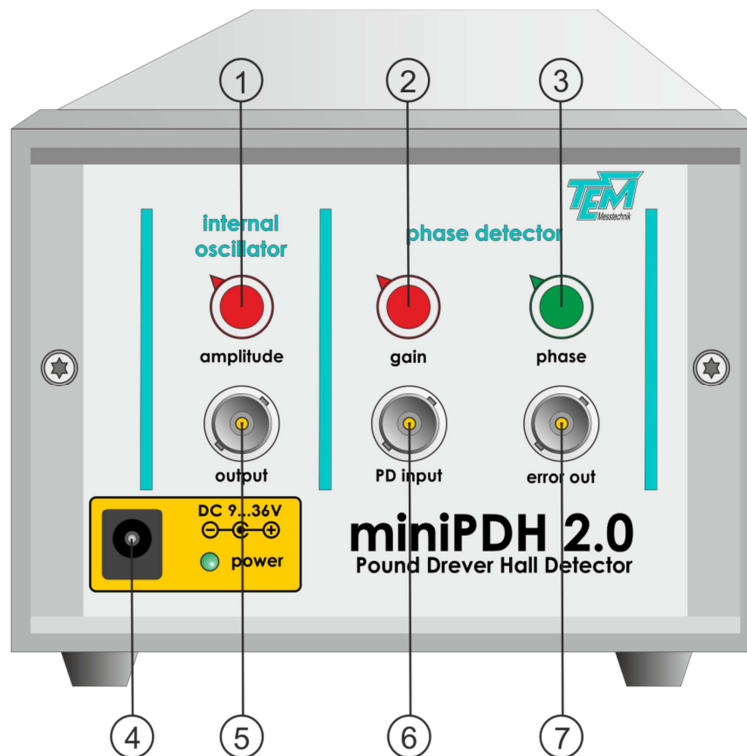
3.1 Shipping materials

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 *miniPDH* system consists of the following parts:

- One *miniPDH* unit in 2 height units housing
- One power cord
- One 12V AD/DC adapter
- This manual

4 Brief description of control elements



- 1 Adjustment of the output amplitude of the built-in oscillator
- 2 Adjustment of input sensitivity
- 3 Adjustment of demodulation phase
- 4 DC power inlet
- 5 Modulation output
- 6 Photo diode input
- 7 Mixer output (error output)

4.1.1 Block diagram

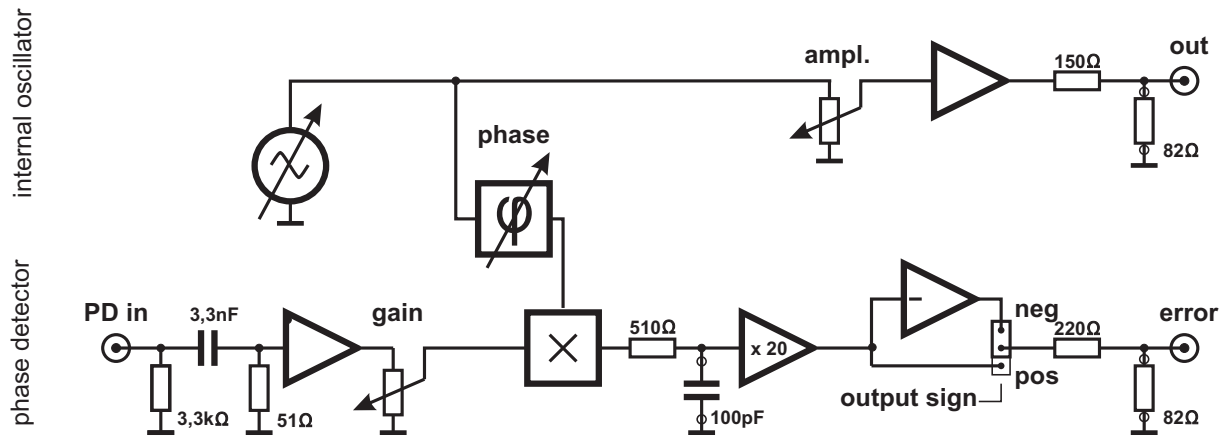


Fig. 4.1: miniPDH block diagram

5 Mechanical setup and electrical connections

5.1 Setup

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

5.2 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 BNC outlet „output“ to the FM input of your laser. If you are using a TOPTICA DL100, use the SMA connector of the bias-T as input.

Connect the BNC outlet „PD input“ to the photodetector.

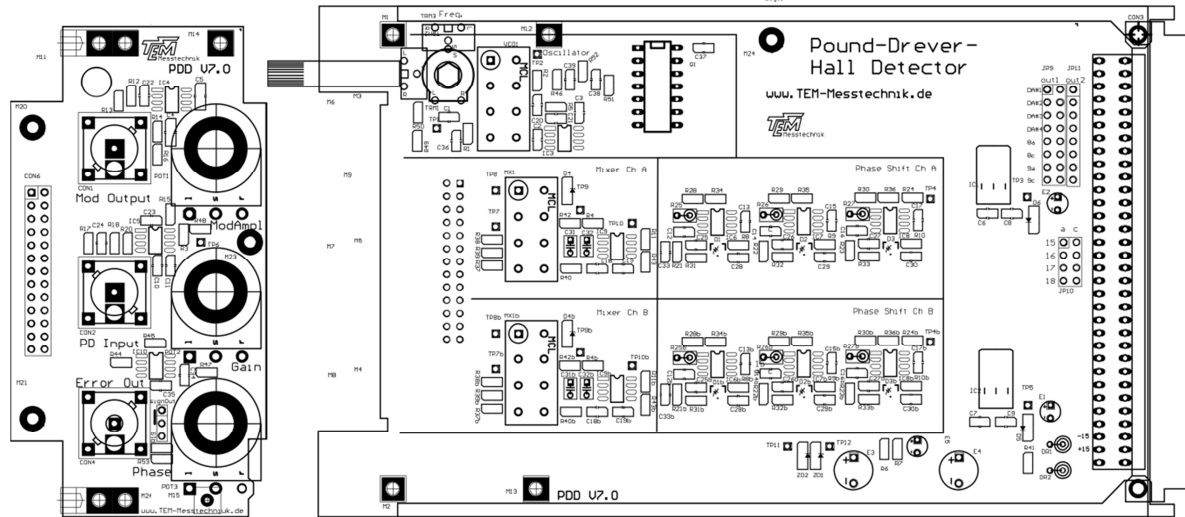
Connect the BNC outlet „error output“ to the vertical-coordinate (Y-) input of an oscilloscope and adjust the sensitivity to 2V/cm.

Provide a means to scan the laser frequency across the cavity resonance (or vice versa). Synchronise the trigger for the oscilloscope's horizontal coordinate with the scan ramp.

If you are using TEM Messtechnik's *LaseLock digital*, connect the outlet “error out” to the BNC “input A” on the PreAmp Box, and connect the oscilloscope to the monitor BNCs. It is often advantageous to use the scan ramp signal as horizontal (X-) coordinate of the oscilloscope.

6 Internal user changeable components

The following internal components can be changed.



designator	function	default value	new value
Q1	Crystal oscillator	20MHz	
TRM1 / 2 / 3	osc. Frequency (VCO version only)	20MHz	
C32	IF bandwidth	100pF -> 3MHz	
C31	optional, provides steeper lowpass filtering of IF	omitted	
signOut	output sign	positive	
R16	max. modulation amplitude	82 Ohm	
R25/26/27	working frequency range for phase shifter	1k Ohm	

7 Troubleshooting

Problem	Possible cause	Possible solution
No function / power-LED is off	a) <i>miniPDH</i> is not connected to power supply	a) Connect <i>miniPDH</i> to the mains using the AD/DC adaptor delivered with the <i>miniPDH</i>
No error signal	a) Optical adjustment is wrong b) Laser is out of resonance c) modulation is too small	a) Adjust cavity set-up. b) increase scan range until you find a resonance c) increase modulation amplitude

7.1 Self test

- 1) Connect the BNC "output" in the oscillator section to an oscilloscope with 50 ohms termination. Set the "amplitude" knob to maximum. Check that the amplitude of the oscillation is 1Vpp.
- 2) Connect the oscillator output with the PD input.
Set "amplitude" and "gain" to the middle of the range.
Connect the "error out" BNC to the oscilloscope.
Rotate the the phase knob: The signal on the oscilloscope should move vertically by +/-300mV

8 Appendix

8.1 Technical specifications

8.1.1 Oscillator Output

Frequency: 20MHz crystal stabilized, other frequencies or variable frequency on request

Amplitude: up to 1 Vpp (+4 dBm) @ 50 Ω load.

2nd harmonic suppression: better than 30 dB.

8.1.2 Phase detector

Photo detector input sensitivity: 10 mVpp (max. gain) ... 1 Vpp (min. gain). (Higher levels will distort the error signal and will not result in bigger error signals.)

Phase adjustment range: >180°, sign adjustable by internal jumper

8.1.3 Error signal output

Output voltage range: $\pm 4V$

IF bandwidth: DC...3MHz

8.1.4 Supply and Housing

Supply voltage for *MiniPDH*: DC 9...36V; 5.5x2.5mm plug; positive polarity

Power consumption: $\approx 5W$

Housing dimensions: 87.2 mm x 125 mm x 209 mm (2 height units)

8.2 Connectors and cables

8.2.1 Power plug and cord

The power cord delivered with the system serves to connect *MiniPDH* to the mains. It has a three-pole outlet matching the corresponding plug at the back of *MiniPDH*. On the other end is a Schutzkontakt plug to go into a grounded wall socket. Use the corresponding cable for your country if you have different mains power wall sockets.

8.3 Maintenance and care

No maintenance is needed.

Caution!

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

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

In case of contact with liquids the devices may by no means be switched on. Instead, keep them in a dry, warm place for at least 72 hours. In many cases the systems work again after such treatment.

8.4 Customer service

In case of questions, necessary repairs or warranty claims you will obtain fast and reliable help under the address given on page 2.

9 Revision history

2021-08-06 New: 7.1 Self test
 8.1.1. Changed to 20MHz fixed frequency

Notes

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