

# ADU

**DEDICATED RESONANT EOM DRIVER**  
0.1 - 250 MHz



- DDS-based for precision frequency and phase control
- Automatic resonance frequency locking & tracking
- Heterodyne mixing circuit for laser frequency stabilisation (FM-/MT-Spectroscopy, PDH-Lock)
- Full phase control of the mixed signal with high resolution (< mrad)
- $3 \cdot f_0$  mixing for low RAM applications
- High power option for spectral broadening
- Free software for remote control and data acquisition

With the ADU model Qubig offers a dedicated driver for resonant EOMs from 100kHz - 250MHz.

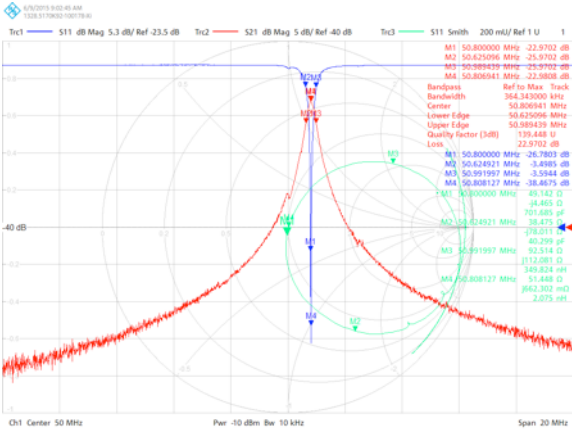
It is DDS-based for precision frequency and phase control and has an RF output level of 20dBm sufficient for the operation of most standard EOMs. With the high power option the output over the full frequency range can be increased to 2W. A sophisticated feedback control automatically finds and locks the EOMs resonance frequency and tracks it without any dither. This ensures always optimal RF coupling (typ. return loss better 20dB = VSWR < 1.2:1), modulation efficiency and phase stability.

Key feature is the built-in RF signal mixing circuit for heterodyne detection, like FM spectroscopy and PDH locking.

A phase detector generates a large level locking signal (~1V) for any external, separate PID controller (not included) and the phase of the mixed signal can be precisely optimized with high resolution (< mrad). The ADU is a stand-alone system with ultra-low noise linear power supplies, or configured as a 19" rack module and can be controlled and read-out via USB by a PC with supplied free software. Several options and customizations are available.

# Key Features / Main Applications

## Resonance Frequency Lock

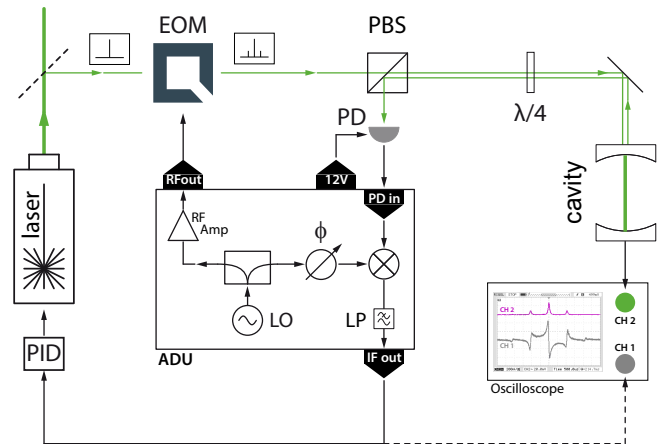


With a push-button control the ADU automatically detects and locks the EOMs resonance frequency and tracks it without any dither. This guarantees optimum coupling, modulation efficiency and phase stability through any environmental changes. No additional equipment like an optical spectrum analyzer to monitor the sidebands is required to find and ensure the best and most stable operating point.

(left) VNA trace of a high-Q, resonant EOM at 50MHz

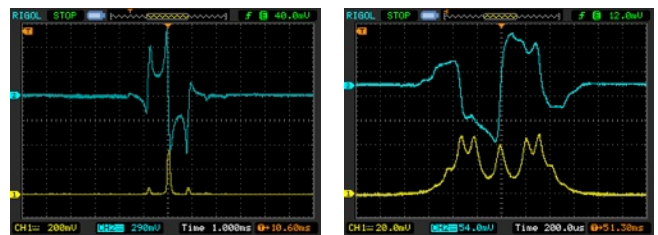
## PDH Mixing Module

Key feature is the built-in RF signal mixing circuit for heterodyne detection, like FM spectroscopy and PDH locking. A phase detector generates a large level locking signal (~1V) for any external, separate PID controller (not included) and the phase of the mixed signal can be precisely optimized with high resolution (360 degree phase control/ < mrad resolution).



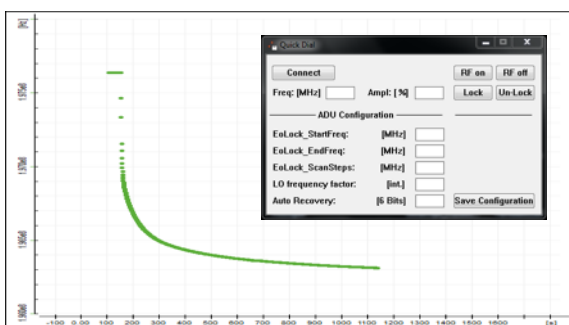
(right) PDH Laser Frequency Stabilization Scheme: typical Pound-Drever Hall (PDH) locking setup with a high-finesse optical cavity using an EOM, a fast photo-detector, and the RF mixing circuit integrated with the ADU. **(PID / servo controller is not provided !)**

For precision applications requiring ultra-low RAM (residual amplitude modulation) the RAM sensitivity can be suppressed by mixing with  $3 \cdot f_0$  (an idea by Holger Müller, UC Berkeley). This feature is integrated in the ADU and can be activated by software.



Pound-Drever Hall (PDH) error signals generated by the ADU left:  $f_0$ : 100MHz right:  $f_0$ : 10MHz mixed with  $3 \cdot f_0$

## Remote Control



The ADU can be controlled and read out via USB by a PC with supplied free software.

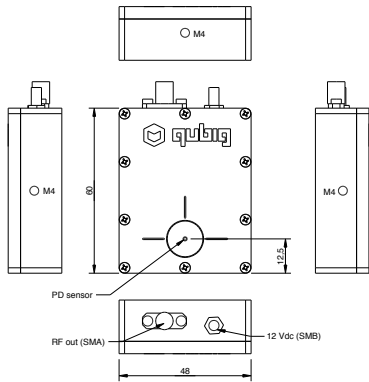
In addition, several features are provided for a secure implementation into large experimental setups, like digital and analog inputs and outputs as well as interlock features.

(left) Graphical user interface for remote control or lock monitoring and data acquisition tasks.

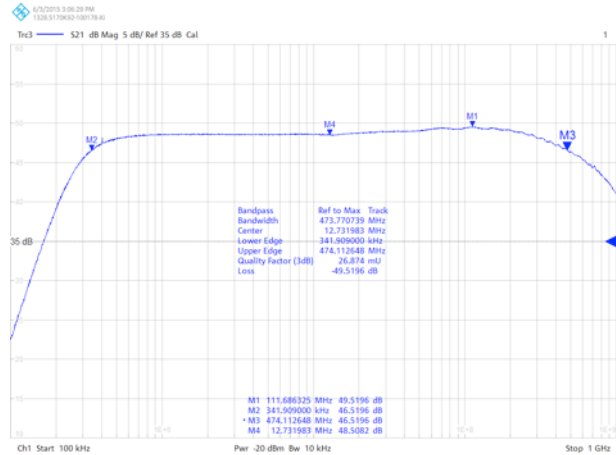
## Fast Photodetectors (optional)

These fast, trans-impedance amplified photodetectors are directly powered by the ADU and are provided with suitable cables (SMB + SMA, 2m). A selection of dedicated sensors is available for different wavelength ranges from UV to IR.

The high gain, low-noise trans-impedance amplifier circuit (ac-coupled, ca. 0.3 - 300MHz) is optimized for heterodyne detection and can be complemented with a convenient dc-coupled monitor (0 - 10 kHz).



Outline drawing of the Photo-Detector module



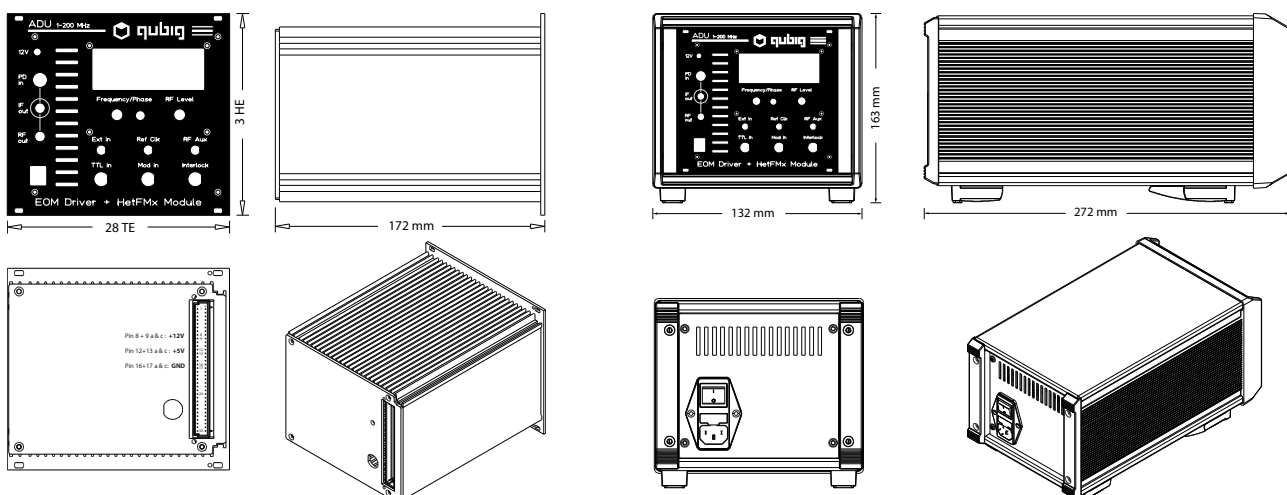
Measured gain bandwidth of the amplifier circuit

PD Models	SiC	Si-PIN	InGaAs
Spectral Range	200 - 400 nm	320 - 1070 nm	0.9 - 1.7/2.5 $\mu$ m
Active Area	0.08 mm <sup>2</sup>	0.5-1 mm <sup>2</sup>	0.2 mm <sup>2</sup>
Gain	3 mV/uW	15 mV/uW	20 mV/uW
Bandwidth	0.3 - 50 MHz	0.3 - 500 MHz	0.3 - 200 MHz

## Power Supply Options

The ADU module is contained an EMV shielded cassette (plug-in unit 3HU, 28TE) with DIN 41612 type C (3x32) backplane connector. It requires +5V and +12V DC (0.5A ea.).

Typically it is boxed in convenient stand-alone benchtop version with ultra-low noise linear power supplies (please state your mains voltage), or configured as a 19" rack system.



The ADU plug-in unit for 19" systems (requires 5/12 VDC)

The ADU stand-alone benchtop version for mains voltage

# ADU - Specifications

## RF output

Frequency	1 - 250 MHz
Frequency increment	Front Panel: 1 kHz / Remote Ctrl: 0.1 Hz
RF power	-10 ... +20 dBm (5 - 175 MHz) / 2W (HP option)
RF power increments	< 0.1 dB steps
RF Leakage	-25 dBm typ.
Spurious	-10 dBm (1 - 200 MHz)
Frequency stability	100ppm (int. Quartz), phase-locked (ext. 10MHz)
Termination	50 Ω, GND on housing, (SMA, female)

## PDH Mixing Module

PD power supply out	+12V, (SMB, female)
PD input power	-10 dBm (damage threshold: 0 dBm )
PD input termination	50 Ω, SMA, GND decoupled, DC block required (!)
IF output bandwidth	DC - 2.5 MHz (other LP filters on request)
IF output termination	500 Ω, (SMA, female)
Phase Control	0 - 360 degree / mrad resolution

## TTL in/out **Digital in-/outputs (optional)**

Functions	RF on/off, frequency shifting, interlock
Logic level high/low	5V, 0V (typ.)
Switching time	< ms
Connector type	BNC / opto-decoupled

## Ext in/out **Custom Configured (optional)**

Connector type	50 Ω, SMA
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## Ref Clk **Reference clock input (optional)**

Frequency	10 MHz (sine or square-wave)
Power range	-6 to +10 dBm
Termination	50 Ω, GND decoupled, w/o DC blocking
Connector type	SMA, female

## RF aux **RF auxiliary output**

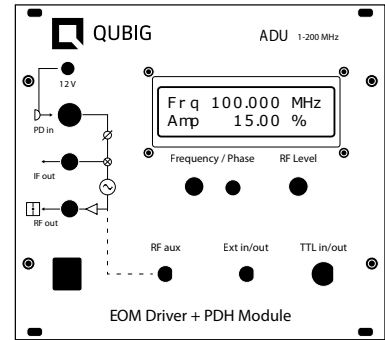
RF power	-10 dBm
Termination	50 Ω, GND decoupled, (SMA, female)

## User interface

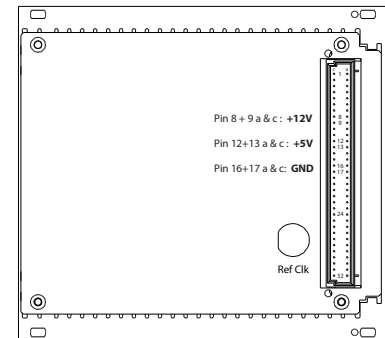
LCD display	2x 14 character, OLED
Rotary Push Button encoder	Frequency, Phase, mode select / RF-Power, on-off
Push button	Phase/Frequency select / firmware updates

## USB interface **used with free configuration software**

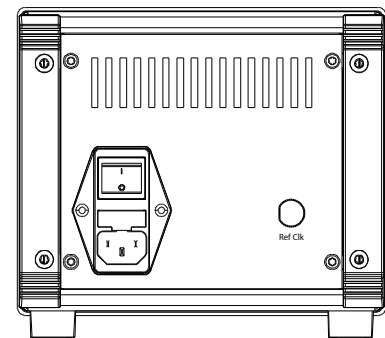
Compatibility	WinXP, Vista, Win7
Functions	Parameter settings, readout, firmware update



ADU front



ADU rear



ADU stand-alone rear

## Power supply Options

### ADU plug-in unit

### ADU stand-alone

Voltage	+5V/0.6A / +12V/0.4A (HP option: 1.5A)	230VAC <b>OR</b> 110VA (50/60Hz) - pls. specify!
Connector	DIN 41462 (back plane bus system)	power entry module, switched
Power consumption	< 10W	< 10W
Dimensions	142.2mm (28TE) x 133.4mm (3HU) x 172mm	170mm x 173 x 272mm
Weight	500g	2.3kg
Operating Temperature	0 to +65°C (ambient)	0 to +65°C (ambient)