

FOTOMETER 2008 COOL
(Light attenuation meter users guide)



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Device description

Light attenuation meter FOTOMETER 2008 consists of modulated light source, lock-in type light detector and control unit. Device measures intensity of light traveling from the light source to the light detector. It makes the device suitable for measurement changes of attenuation of light in the area between the light source and the light detector. Due to synchronization between light source modulation and the light detector the device is, to some extent, immune to ambient light and could be operated on normal day light conditions.

The readout of intensity value is in linear arbitrary units (AU) and is not directly related to any engineering units. The device is intended only for measurement of relative changes in light intensity.

Device has four decadic ranges and could be operated in two different modes. In **manual mode** the ranges must be switched manually by user. In **automatic mode** the device itself changes mode when intensity readout goes out of actual range.

The light detector is equipped with two input filters. **Fast filter** provides quick response but slightly higher noise and is intended for measurement of unstable, changing light intensity. For measurement in stable, balanced conditions might be done using **slow filter** which reduces noise but has very long settling time (up to one minute).

Safety rules

The control unit is powered by 230V AC which might be dangerous to life. Never remove the cover of control unit when the mains electricity is connected. Mains plug **MUST** be always removed before unscrewing the cover. Any service must be provided by a qualified electrician only.

Device may be operated only in room environment between 15 and 40 C with non condensing humidity. When moving device from cold environment to room temperature always allow the device temperature to accommodate to room environment to avoid moisture to condensate on the device before switching the device on.

Setting up the device

Cable connections

Mount control device to its place, preferably a 19 inch rack case. Connect cable with female connector between the control unit and the detector and cable with male connector between the control unit and the light source. Double check that cables are connected properly according to labels on control unit. Connect mains electricity and switch the device on.

The light source and light detector must be mounted in such position that light source outlet is facing the light detector inlet directly. The light beam must go through the area where the light attenuation should be measured. Make sure that axes of light source outlet and light detector inlet are perfectly parallel. Using small piece of paper make sure that the light beam is aimed directly to the center of light detector inlet.

Water cooling connections

Detector and light source are equipped by water cooling which allows their usage in ambient temperatures as high as 150 °C. Both detector and light source have water inlet and water outlet on the rear cover of device. Inlet is situated on the bottom side, outlet on the top. The topmost tube is the air purge inlet (DO NOT connect water supply into the air purge inlet).

Connect a silicone hose with 6mm internal diameter to the water inlets of both devices. Attach the other sides of hoses to the water supply. Water supply must be equipped

with two regulation valves so the flow rate to each device could be easily controlled. The maximum water flow rate is 5 liters per minute.

The water outlets must be connected to the water drain using same silicone hose with internal diameter 6mm.

Hoses must be secured to inlet / outlet and to the water supply by appropriate hose clamp.

Air purge connection

Detector and light source are also equipped by air purge unit. It provides a constant air flow along the front window, preventing the dust from burning chamber from sticking on the window.

Air purge inlet is located on the rear cover. It is the topmost inlet on this side of unit. The inlet must be connected to the compressed air source using appropriate pressure reduction valve and the regulation valve so the pressure and flow rate could be easily adjusted. Maximum allowed pressure connected to the inlet is 1 BAR.

Connect the inlet to the compressed pressure source by silicone hose with internal diameter 6mm. Make sure the hose is rated at least to 1 BAR pressure. Use appropriate hose clamp to secure both sides of hose.

Display content

Display on control unit shows measured light intensity value as well as other related information like actual range, measurement mode, selected input filter and so on. The layout of the display is described in the table below.

Switching status			Mode
Overflow status			Range number
Intensity value	Reference 1	Reference 2	Diagnostic mode
Range	[dB]	[dB]	Filter

Meaning of display messages is described bellow.

Display field	Possible values	Description
Switching status	SWITCHING	Device is switching between ranges. Intensity value is not valid at the moment.
	<blank>	Device is not switching range.
Overflow status	OVERFLOW	Light detector is saturated by ambient light or too strong signal from light source. . Intensity value is not valid at the moment.
	<blank>	Light detector is not in overflow condition.
Intensity value	<value in AU>	Actual value of intensity in AU. Selected range is already taken into account.
Range	Range 100	Selected range 0..100 AU (most sensitive)
	Range 1000	Selected range 0..1000 AU
	Range 10000	Selected range 0..10000 AU
	Range 100000	Selected range 0..100000 AU (less sensitive)
Reference 1	<value in dB>	Relative change in intensity since the reference 1 was set expressed in dB.
Reference 2	<value in dB>	Relative change in intensity since the reference 2 was set expressed in dB.
Mode	AUTO	Device is in automatic mode.
	MANUAL	Device is in manual mode.
Range number (according to codes used when operating device from remote computer)	RANGE 0	Selected range 0 (0..100 AU)
	RANGE 1	Selected range 1 (0..1000 AU)
	RANGE 2	Selected range 2 (0..10000 AU)
	RANGE 3	Selected range 3 (0..100000 AU)
Diagnostic mode	<blank>	Device is in standard measurement mode.
	DIAG ZERO	Device is in diagnostic mode ZERO.
	DIAG FULL	Device is in diagnostic mode FULL SCALE.
	DIAG NEG	Device is in diagnostic mode NEGATIVE FULL SCALE.
	DIAG CMR	Device is in diagnostic mode COMMON MODE REJECTION.
Filter	FILTER SLOW	Slow input filter selected.
	FILTER FAST	Fast input filter selected.

Operating device in automatic mode

In automatic mode the device switch to more sensitive range, when intensity value decrease below 8 percent of current range. When intensity rise over 100 percent of current range, device automatically switches to less sensitive range.

During switching, the device displays SWITCHING message on the display. During this period the intensity readout is not valid. On some conditions (slow filter selected, large sudden change in intensity) the intensity might not be settled when SWITCHING message disappear and additional waiting for valid value might be necessary.

Switching to automatic mode

While in manual mode, press **AUTO/MANUAL** button to switch to automatic mode.

Switching back to manual mode

While in automatic mode you can press **AUTO/MANUAL** button to switch back to manual mode. By pressing **RANGE+**, **RANGE-** or **DIAG** while in automatic mode you switch back to manual mode as well.

Operating device in manual mode

In manual mode, ranges must be switched manually by the user. When range is manually switched, device displays SWITCHING message and goes through the switching procedure in same manner as in automatic mode.

Switching to manual mode

While in automatic mode you can press **AUTO/MANUAL** button to switch to manual mode. By pressing **RANGE+**, **RANGE-** or **DIAG** while in automatic mode you switch to manual mode as well.

Switching back to automatic mode

While in manual mode, press **AUTO/MANUAL** button to switch to automatic mode.

Switching to less sensitive range

To switch to less sensitive range press **RANGE-** button.

Switching to more sensitive range

To switch to more sensitive range press **RANGE+** button.

Using references

To compute light attenuation directly during measurement there are two user references available. When reference is set it displays the ratio between reference value and current value in a logarithmic scale in dB. The value in logarithmic scale is computed using following formula:

$$\text{Log value [dB]} = 10 \cdot \log \left(\frac{\text{Intensity value [AU]}}{\text{Reference value [AU]}} \right)$$

Setting reference

To set reference press SET button bellow the reference you want to set. Current intensity value is stored as reference value.

Using input filter

Light detector has two input filters. Fast filter is intended for measurement of values changeable in time. It provides fast response with slightly increased noise level. Slow filter suppress noise but has rather slow response time. Thus it is suitable for measurement of in stable conditions when light intensity does not change fast.

Setting input filter

To adjust input filter press the **FILTER** button. The filter will toggle from slow to fast and vice versa with every pres of the button.

Diagnostic modes

The device provides four diagnostic modes which are useful for troubleshooting. The diagnostic modes are: zero offset, full scale, negative full scale, common mode rejection.

Mode	Description
Zero offset	Both differential inputs of A/D converter are switched to ground.
Full scale	Negative input of A/D converter is grounded. Positive is switched to the voltage reference.
Negative full scale	Positive input of A/D converter is grounded. Negative is switched to the voltage reference.
Common mode rejection	Both differential inputs of A/D converter are switched to voltage reference.

Switching to diagnostic mode

To switch to diagnostic mode press **DIAG** button. First diagnostic mode is selected. With every consecutive press of **DIAG** button device will switch to next diagnostic mode. After last diagnostic mode the device switch back to normal measurement mode.

While in diagnostic mode you can switch to normal measurement mode anytime by pressing **RANGE+**, **RANGE-** or **AUTO/MANUAL** buttons.

Basic maintenance tasks

Replacing bulb in the light source

To replace the bulb in the light source follow the steps described bellow.

- Switch off the device.
- Disconnect cable between control unit and the light source.
- Remove six screws on the back cover of the light source using allen key number 3.
- Loosen the cable gland so the cable can move freely through the gland.
- Remove the metal sheet cover and slide it away on the cable.
- Carefully remove the teflon back cover and slide it away on the cable.
- Remove internal light source assembly off the cooling jacket.
- Remove two screws which hold the bulb at position. Remove old bulb.

- **WARNING:** never touch the bulb directly by hand. Use silicone gloves to avoid direct contact. When the bulb is spoiled by hand touch, its lifetime might be significantly reduced.
- Install new bulb in the same position as the original and tighten screws.
- Make sure that the bulb filament faces the hole in the printed circuit board on which the bulb is fixed.
- Insert light source assembly back to cooling jacket. Make sure it is properly positioned at the conical support flange at the front of cooling jacket. The conical flange is visible through the front window.
- Slide the teflon back cover on the cable to its place and press it firmly until the cover is aligned with the outer chassis.
- Slide the metal sheet cover back to the teflon cover.
- Fasten cover and metal sheet back by six screws using alen key number 3.