

PIER-ELECTRONIC

Transmission Photometer
UV / VIS / NIR / IR

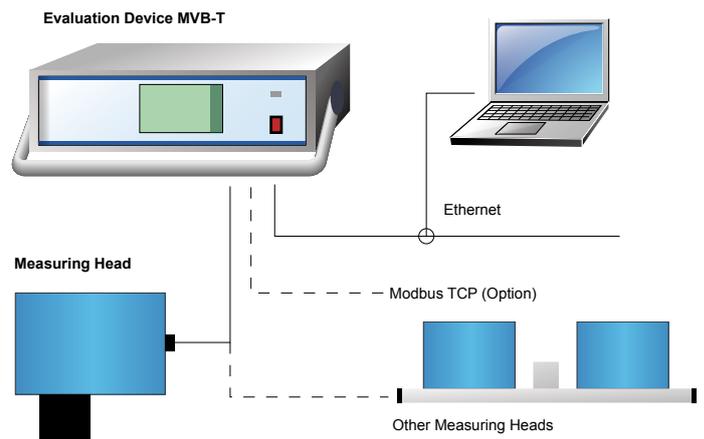
Reflection Photometer
VIS / NIR / IR



Photometer from PIER-ELECTRONIC

PIER-ELECTRONIC has been developing and manufacturing easy-to-use, reliable optical measuring equipment for more than 50 years. Detailed user consultancy and the finding of optimum solutions in combination with good service are a matter of fact. More than 4000 worldwide installed measuring systems prove their quality and underline their diverse application possibilities. PIER-ELECTRONIC can offer suitable optical measuring techniques for the specific measuring tasks. Whereas transmission photometers use light transmission as the measuring quantity, reflection measuring systems evaluate the reflection of the emitted light beam.

Transmission and reflection measuring systems consist of a measuring head, the evaluation device and connecting cables. A higher-level archiving system or a maintenance PC can be connected via a network link.



Application information and photometer measuring techniques in detail:

Measurements can be made in the ppm, vpm and percentage (%) ranges. The achievable measuring ranges are dependent on the flow cell window thickness in the case of a transmission measurement, or the reflection properties of the material in the case of a reflection measurement, and the selected wavelengths. The applications are only limited in that the degree of transmission/reflection may not be below a certain level because the usable light yield would then be too low.

The achievable accuracy of the measurement is given as a percentage value for each calibrated measurement range. A calibration of each measuring system is indispensable. Reproducible absolute adjustments are not possible because the different measuring media have different spectral curves.

The filter wheel used in the photometer has at least two interference filters. One filter determines the measuring wavelength and the other filter determines the reference wavelength. The rotation of the filter wheel causes light with the reference wavelength and light with the measuring wavelength to be filtered alternately out of the measuring light beam.

The filter is selected according to the absorption behaviour of the component to be measured. It should produce a high absorption at the measuring wavelength and a low absorption at the reference wavelength. An electronic switch isolates the measuring and reference signals. The level of both signals corresponds to the beam intensities of the measuring and reference wavelengths detected by the detector. Their ratio is displayed and is a measurement value for the substance to be measured. The displayed value is dependent on influences that equally affect the measuring wavelength and the reference wavelength. In principle, a normal flow cell dirtiness in the case of a transmission measurement or an external light in the case of a reflection measurement, and in general the age of the filament bulb and the light detector do not affect, or only insignificantly affect, the measurement accuracy. The effect: PIER-ELECTRONIC photometers are long-life measuring devices with very simple maintenance.

Typical examples

- Food, milk powder, flour, starch ..
- Semi-luxury food, coffee, cocoa, potato chips ..
- Wood shavings, wood products, chipboard, MDF ..
- Construction material, cement, clay, sand, sandlime bricks ..
- Chemical powder, washing powder, soap, fertilizer ..
- Paints, pigments, polymers, cellulose ..
- Fibres, textiles, paper, coatings ..
- Plastics, granulates, films, rubber ..
- Water-based paints and emulsions ..
- Fertilizers, seeds, soil ..

Transmission Photometers

The PIER-ELECTRONIC transmission photometers have a broad field of application:

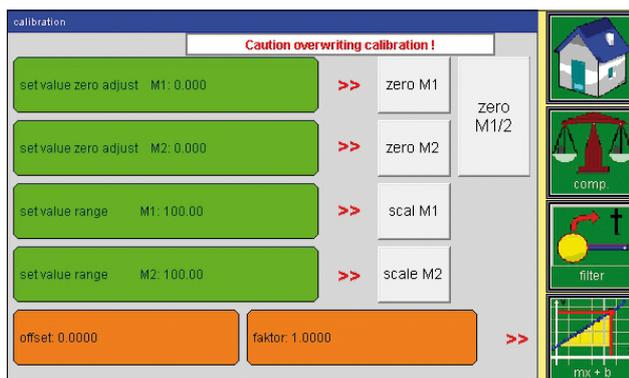
- Measurement of the amount of a specific constituent in liquid or gaseous substances
- Water measurement in various substances
- Measurement of the intensity of colourations in solutions and colour changes and determination of red, blue or yellow shades in the visible range
- Measurement of organic substance residues in water or other liquids in the ultraviolet range

These photometers work without affecting the substance/material to be measured. They deliver the measurement result after only a few seconds in the case of a single measurement and in a fraction of a second in the case of a continuous measurement. The quick display or registration of the measurement values is not the only advantage. A direct control of the production process in automated systems is also possible and this measuring method is also suitable in production support laboratories for both sample testing and series measurements. In the production process, the measuring system contributes to significant quality improvements and substantial production cost savings.

The Measuring Principle

The transmission photometers work in the wavelength range of 200 – 4700 nm and with a special alternating light method, which distinguishes itself by a very high time constancy. The result is that many interference effects have only a negligible effect on the measurement result.

The transmission measurement is excellently suitable for the analysis of liquids and gases, in both in-process and laboratory applications. As individual components of a substance



Easy calibration

mixture absorb light differently at different wavelengths, the determination of a component only requires exact knowledge of the absorption of a single substance in order to select suitable measuring and reference wavelengths. The measurement of gases is also possible in all wavelength ranges. However,



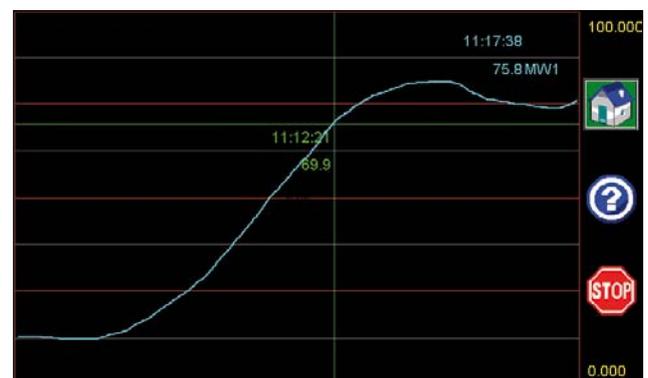
larger layer depths are necessary because of the lower density that may exist depending on pressure and temperature. If pressure and temperature cannot be kept constant, a compensation for the resulting measured value differences can be performed.

Four wavelength ranges are possible:

Ultraviolet (UV)	200 – 400 nm
Visible (VIS)	400 – 700 nm
Near Infrared (NIR)	700 – 2500 nm
Infrared (IR)	2500 – 4700 nm

In the case of the transmission measurement, the measuring light beam goes through a flow cell containing the material to be measured, then through a filter wheel and is then received by a light detector. The measurement result is displayed or registered after signal preamplification and processing in the evaluation device. Other light beam paths can also be supplied on request, for example, measuring heads with periscope arms or flow cells coupled via optical fibres.

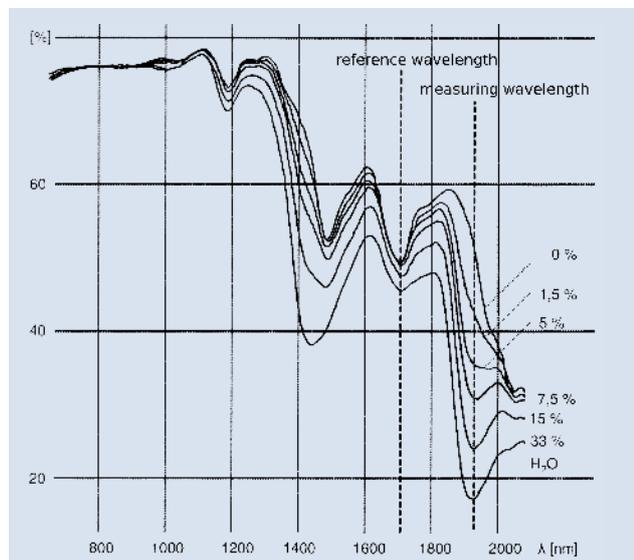
The open measuring head design offers great advantages. Flow cells containing dangerous liquids or gases are located in the space between the light source and light detector housing. Neither liquid nor gaseous media can penetrate the photometer housing in the case of a leak. And the flow cell is easily accessible for maintenance work.



Good process tracking

Application Example: Water

A common application is the measurement of water in various substances/products. According to the spectrum shown in Fig. 2, a distinct 'water range' exists at a wavelength of 1940nm. A relatively low level of moisture can be measured if



this wavelength is selected. The smallest achievable measuring range for determining the amount of water is dependent on the maximum possible flow cell window thickness and thus on the material to be measured.

A further range, which is not so distinct, exists at 1450nm. This can be used for measuring a medium level of water content. The reference wavelength should be selected outside of these two ranges. The following list includes some examples of water determination.

Water determination in:

Acetic acid	Hydrochloric acid
Acetone	Methanol
Ammonia	Methylene chloride
Aniline	Nitric acid
Brake fluid	Phenol
Butanol	Propanol
Butyl acetate	Propylene oxide
Carbon tetrachloride	Silicone
Chlorobenzene	Sulphuric acid
Cyanogen chloride	Tetrahydrofuran
Cyclohexane	Toluene
Dichlorobenzene	Vinyl acetate
Dimethyl formamide	Vinyl chloride
Ethanol	
Ether	
Ethylene dichloride	
Ethylene glycol	

Special Applications

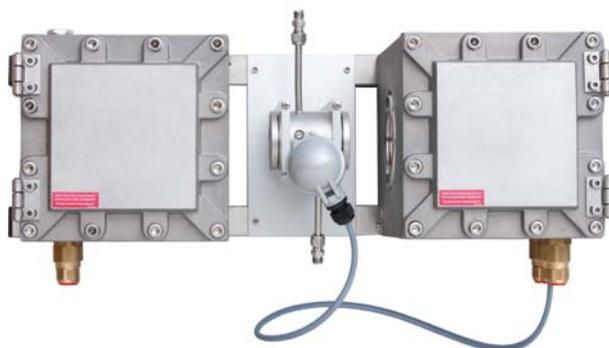
The intensity of colourations in solutions can be determined in the visible light range. This also includes the recognition of colour changes, for example in a titration process, or the determination of red, blue or yellow shades.

Residues of organic substances in water or other liquids or gases can be measured in the ultraviolet range. For example, the determination of the chlorine content in phosgene is possible. Further application examples can be found at www.pier-electronic.de.

Also Suitable for Explosion Hazard Use

A pressure encapsulated variant and an over-pressure encapsulated case variant with separate control are available for the use of measuring heads in explosion hazard areas.

Measuring heads for Ex-Zone 1 and 2 in accordance with the ATEX standards are available.



Sample Measurements and Calibration Guarantee Precise Measuring

PIER-ELECTRONIC ensures correct measuring with a suitable design of the measuring equipment in accordance with the specifications of the user or a sample measurement. A questionnaire, which can be requested as a form or downloaded from www.pier-electronic.de, is available as an aid for providing us with the necessary information.

The feasibility of a measuring task can often be assessed in a very short time by means of our application database. However, in cases of doubt, only a sample measurement or a defined product composition is decisive for the success determination. Sample measurements and calibrations can be done in the PIER-ELECTRONIC laboratory. On request and in accordance with the customer's specifications, both an automatic calibration device and the conditioning of the material to be measured, e.g. gas measurements, are possible. This usually involves the supply and commissioning of complete analyser cabinets. These can be tested under operating conditions at our factory for acceptance purposes.

Reflection Photometer

The most important task of reflection photometers is quality control in numerous, very different industries.

- Moisture measurements (e.g. in powders, granulates or fibres)
- Thickness measurements of films and foils
- Component determination in mixtures
- Degree of whiteness and colour determination
- Coating thickness determination

Reflection photometers are not only suitable for sample measuring and laboratory use but also for continuous measurement, for example over a conveyor belt.

PIER-ELECTRONIC photometers are widely used for measuring on the following materials:

- Minerals, construction materials, ceramic masses
- Chemicals, powders, granulates
- Films and foils
- Food and animal feed material
- Filter cake
- Fibres, textiles and paper

See www.pier-electronic.de for further applications

The Measuring Principle

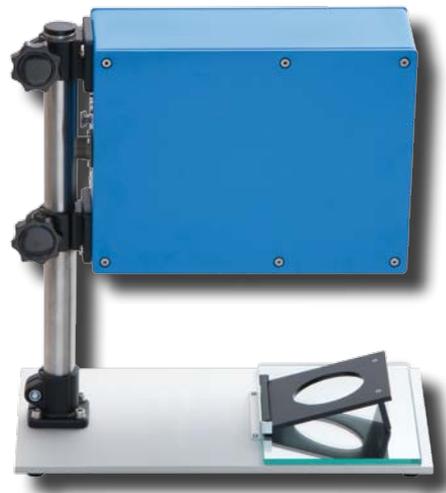
The reflection measuring equipment works in the wavelength range of 400 – 4700nm using a special alternating light technique, which distinguishes itself by a very high time constancy. The result is that many interference effects have only a negligible, small effect on the measurement result.

A feature exploited for the measurements is that the individual components of a substance mixture reflect incident light differently at different wavelengths. To measure a component, we therefore only need to know the exact degree of reflection of the individual substances of a mixture in order to select suitable measuring and reference wavelengths from three possible ranges:

- | | |
|-----------------------|---------------|
| • Visible (VIS) | 400 – 700nm |
| • Near Infrared (NIR) | 700 – 2500nm |
| • Infrared (IR) | 2500 – 4700nm |

Moisture Measurement

A common application is the measurement of moisture in different substances. A distinct, so-called 'water range' exists, according to the spectral curves, at a wavelength of 1940nm. The reflected light quantity at this wavelength is very dependent on the water content and relatively small levels of moisture can therefore be measured at this measuring wavelength. A further range, which is not so distinct, exists at 1450nm. This can be used for measuring a medium level of water content. The reference wavelength should be selected outside of these two ranges.



Checking of Colour Intensity, Degree of Whiteness, Colour Changes

(Application examples for visible light)

The intensity of colours can be determined in the (wavelength) range visible to the human eye. The checking of the degree of whiteness in the manufacture of salt or sugar are typical examples. Many chemical reaction processes can also be evaluated by measuring colour changes. The determination of red, blue or yellow shades plays an important role in the colouring of textiles and plastics.



Reflection measuring head with integrated evaluation

Tailored Accessories

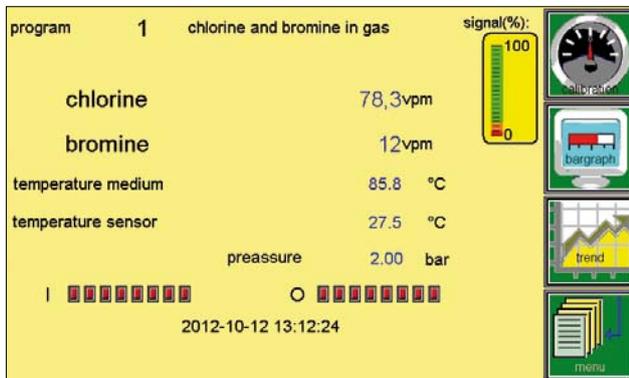
A comprehensive range of equipment variants and accessories suitable for numerous application possibilities of the reflection measuring heads is available. We fulfil special customer wishes in terms of design and tailored modifications with the help of our design department and an excellently equipped production department.

- Traversing equipment for measuring on webs, films/foils and panes, etc.
- Periscope arms for measuring thin material
- Dot-shaped measuring thanks to optical fibre connection

Practical Evaluation Devices

The evaluation devices MVB-T or MV 230-T process the signals from the measuring head and measurement values necessary for a pressure or temperature compensation. The device processes the measurement values digitally and can be used universally with the measuring heads from PIER-ELECTRONIC. It can also be retrofitted for use with already installed photometers. Both devices can be used in all typical cases of transmission and reflection measurements. Special functions are possible. Up to 100 selectable measuring programs can be stored in the standard version. The selection can be done automatically and by an external controller.

The integrated line recorder function allows measurement results to be recorded in real-time and displayed as a scalable curve. The data record and the application program can be stored on a USB stick. The calibration data is permanently stored in a separate read-write memory.



Possible measurement value display

Besides the measurement values, various other information can be displayed on the measurement value display, for example, the values for the additional sensors connected to the system, two temperature values and a pressure value. The names of the measuring programs and the measurement value can be freely selected. The signal strength at the detector can be monitored with the signal indication.

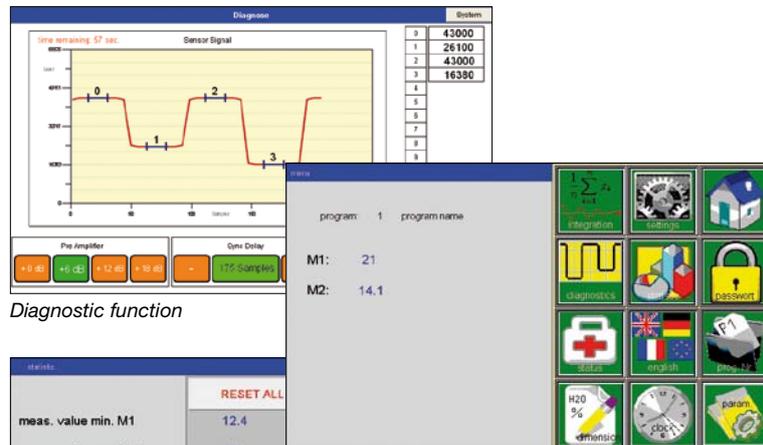


Screen saver / IP address

The external communication takes place via an ethernet interface. Any commercially available Internet browser can be used, additional software is therefore not necessary.

The programs and settings can be saved via an FTP server. This interface can also be used for remote display. The measured value display can be seen on the client after entry of the IP address as an http:// address. A device control from this location is not possible for safety reasons.

The simple and intuitive operation guarantees a quick familiarisation.



Diagnostic function

Statistics function



Main menu

Technical Data

	Transmission measuring head	Reflection measuring head
Light sources for the ultraviolet, visible, near infrared and infrared ranges:	Deuterium light bulb, tungsten light bulb, halogen light bulb, infrared emitter	Tungsten light bulb, halogen light bulb
Light detector:	Si photodiode, lead sulphide or lead selenide photoresistor, photomultiplier	Si photodiode, lead sulphide or lead selenide photoresistor, photomultiplier
Permitted ambient temperature:	-20 – +40°C, higher temperatures permitted with use of cooling equipment	-20 – +35°C, higher temperature permitted with use of cooling equipment
Connection cable from measuring head to evaluation device:	500 m max.	500 m max.
Weight:	Approx. 10 – 45 kg	Approx. 8 – 10 kg
Dimensions:	e.g. 550 x 200 x 160 mm	300 x 250 x 125 mm
Operating distance:		RMK 10 = 100 mm, ±10 mm / RMK 24 = 240 mm, ±60 mm
Case material:	Light metal	Light metal
Degree of protection:	IP54 / IP66	IP54 / IP66
EX approval (option):	Ex-Zone 1 and 2, PTB /ATEX, Ex (d), Ex (p)	Ex-Zone 1 and 2, PTB /ATEX, Ex (p)
Flow Cells:	Stainless steel as per DIN 1.4571, Monel, PTFE, PVDF, Hastelloy	
Flow cell windows:	Tempax, Saphir, CalciumFluorid, Suprasil	
Operating pressure:	1 – 50 bar depending on flow cell window thickness	
Options / accessories:	Flow cell heater, purgeable light beam cover, temperature sensor, pressure transducer	Purge air attachment (dust protection), user-defined sensor distance, enclosure cooling, light detector cooling, temperature compensation, laboratory stand, clamps, calibration standards, mounting flanges, optical fibre connector.

Evaluation devices	Evaluation device MVB-T	Evaluation device MV230-T
Case:	19" desk-case: 504 x 330 x 165 mm	Wall-mounting case: 256 x 270 x 139 mm
Degree of protection:		IP 65
Weight:	Approx. 6 kg	Approx. 5 kg
Operating voltage:	230 V ± 20 V, 50 Hz, Option: 11 5V, 60 Hz, 24 DC	230 V ± 20 V, 50 Hz, Option: 11 5V, 60 Hz, 24 DC
Power consumption:	Approx. 60 VA	Approx. 60 VA
Display:	Colour display TFT with screen saver; 800 x 480 dots, 7" WVGA Touchscreen, resistive 4-wire	Colour display TFT with screen saver; 480 x 272 dots, 7" WVGA Touchscreen, resistive 4-wire
Analogue input e.g. for pressure compensation:	0 / 4 - 20 mA	0 / 4 - 20 mA
Analogue inputs, e.g. for temperature compensation:	2 x Pt 100	2 x Pt 100
Analogue measured value	2 x 0 / 4 – 20 mA, max. 500 Ohm load, 1 x 0 / 4 – 20 mA, max. 500 Ohm outputs: elect. isolated, 0 – 1 / 10 V, termination resistance > 50 kOhm,	2 x 0 – 10 V, termination resistance > 50 kOhm
Digital I/O signals:	8 programmable inputs/outputs	
Relay outputs:	3 programmable outputs, e.g. for MIN/ MAX indication of the measured values or monitoring of the measuring signals	
Data interfaces:	1 x USB and 1 x Ethernet interfaces	1 x USB and 1 x Ethernet interfaces
Software:	<ul style="list-style-type: none"> • Software compliant with IEC 61131 • Selectable evaluation algorithms • Measuring program memory for up to 99 calibrations • Continuous line recorder function with 2880 measurements and cursor • Bar chart display • Statistics function, Min/Max/Average • Web server • Data logger • Scope diagnostics, etc. 	<ul style="list-style-type: none"> • Software compliant with IEC 61131 • Selectable evaluation algorithms • Measuring program memory for up to 20 calibrations • Continuous line recorder function with 1445 measurements and cursor • Bar chart display • Statistics function, Min/Max/Average • Data logger • Scope diagnostics, etc.
Options	IP55 wall-mounted case	Electrically isolated 0 – 20 mA

Subject to technical changes, different data available on request

Explosion-proof variants available for all measuring devices

Optical Measuring Devices

- **Transmission photometers**
for the UV, Visible and IR ranges
- **Reflection photometers**
for the Visible and IR ranges
- **Analysis Systems**
tailored to customer requirements
- **Evaluation systems**
with tailored functionality
- **Measuring cells and sample preparation**
for liquids and gases
- **Calibration standards and accessories**
in accordance with customer specifications
- **Measuring traverse**
for automatic area scanning
- **Electronic controllers**
for calibration and measuring operations

Explosion-proof variants are available for all photo-electric measuring devices.

Services

- **Application consultancy**
- **Test measuring**
- **Mechanical engineering**
- **Electrical engineering**
- **Case and cabinet integration**
- **Electronics development**
- **Application and system development**
- **Made to order and OEM manufacture**
- **Integration testing and Explosion-proof testing**
- **Test and rental devices**
- **Document production**
- **Acceptance support**
- **Commissioning and service worldwide**

About us.

PIER-ELECTRONIC has been developing and manufacturing easy-to-operate, reliable optical measuring devices for more than 50 years. A quality assurance system monitors the order processing and production of each device, from the feasibility analysis onwards, and documents the design data. Individual customer consultancy combined with convincing technical measuring solutions and good service have been our corporate culture from the beginning. Competent agents and partner companies support our customers worldwide.

PIER-ELECTRONIC

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