

# PearL

PearL is an optical in-line monitoring system, measuring photoluminescence spectra. The system is designed for measuring on CIS and CIGS based production lines. Photoluminescence spectra allow a fast detection of the effective Ga and Cu content of the absorber during the production process. A product option for CdTe absorbers is also available.

## Features

### Measurement parameters

- In-line measurement of photoluminescence spectra of thin film modules in production lines
- Real-time data evaluation and visualization
- Characterization of the absorber composition during production time
- Measurements on moving substrates in a production line
- Can even be applied on hot substrates (> 200°C)

### Benefits

A spot with a size of approx. 1 mm<sup>2</sup> on the CIGS surface is excited by an IR laser beam. On recombination of the produced electron/hole pairs, the absorber material irradiates photoluminescence light. The luminescence light is analyzed by a spectrometer. Features of the spectrum are significant for the Gallium content of the absorber and V<sub>oc</sub> of the ready-made module.

With Pearl, this measurement can be performed in-line, immediately after the absorber deposition. The result can be fed back to the production machine.

PL peak position	± 0.001 eV
Ga-content sensitivity in CIGS	± 0.01 GGI (molar Gallium/(Gallium + Indium) ratio)

## Description of the parts

**Control computer  
(Subject to technical changes)**

- 19" rack mount control computer
- CPU: Pentium Core 2 Duo, min 1.66 GHz, RAM min. 1 GB
- HDD min. 160 GB, RAID 1
- VD-writer, card reader, mouse, keyboard
- 1 Gbit/s LAN interface or better
- Operating system: Windows XP pro MUI (multi language version)
- 19" TFT flat screen (monitor resolution of 1280 x 1024 or higher)

**Cables**

- Ethernet Cat5 + TP cable
- Metal shielded optical fiber between controller and optical heads
- Multi-Plug and power cables

**Miscellaneous items**

- Customized mounting and adjustment unit
- Manual and software CD
- Trigger units for detecting incoming glass substrates (available on request)
- Angle encoder for roll-to-roll set-ups

**Interfacing options offered by LayTec**

- Profibus
- DeviceNet
- OPC
- Straight Wiring: connecting analog or digital signals via wire pairs as the simplest way of interfacing. Available are 24 V current loops (4 - 20 mA) or voltages (0 - 10 V).
- Other options on request, e.g., LightBus, EtherCat, CANBus, ModBus, InterBus.

**Sizes and weights of the parts**

Parts	Size X x Y x Z mm	Weight in kg
Detection head	154 x 108 x 152.5	2.0
Controller	450 x 600 x 180	17.0
Rack mount control computer (4 HE)	450 x 600 x 180	17.0
19" LCD display	410 x 20 x 420	5.5

Additional: Customized adjustable mounts

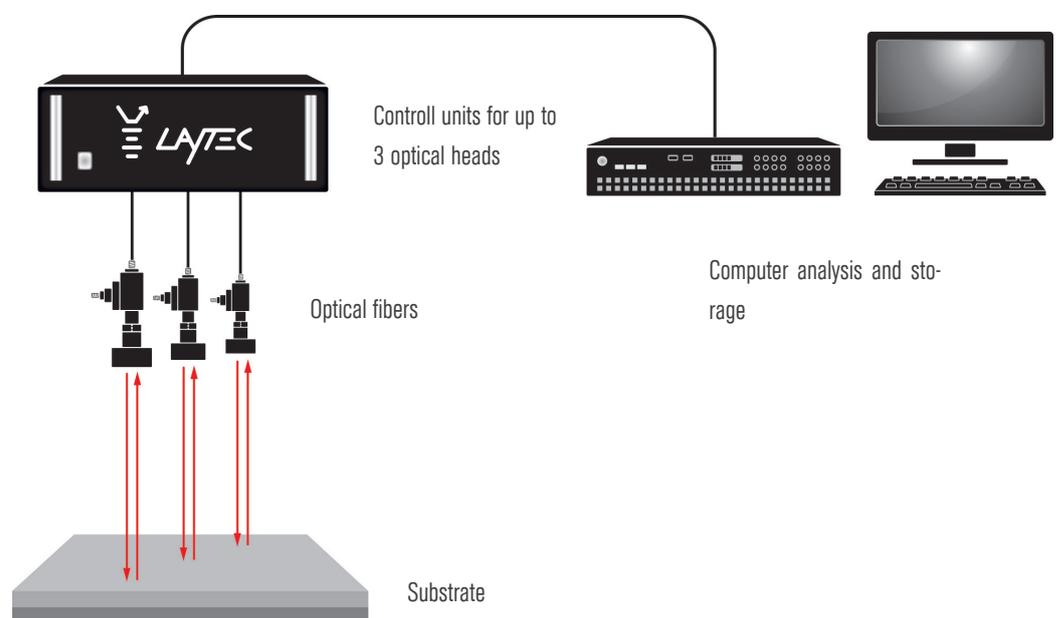
**Components**

Light source	Laser (laser class 3b)
Laser wavelength	808 nm (others on request)
Typical measurement interval	0.2 s

## The process

Pearl is based on LayTec's proven modular platform for optical in-line set-ups. A controller unit contains all optical and electronical components including a real-time embedded controller for highest reliability. Optical fibers guide the measurement light between the controller unit and the measurement positions. Compact measurement heads provide optimum optical performance with low foot-print. Measurements are usually performed on moving substrates. Sophisticated automated analysis, monitoring, and storage of the data are provided by a metrology PC connected to the controller unit. Optionally, Pearl integrates into production machines and software systems by a large variety of protocols like OPC, Ethernet, ProfiBus, and others. Mounting and adjustment units are customized to fit to the requirements of the specific production line. The device needs to be calibrated only once, which is typically done during the installation.

## Details of the set-up



### Requirements to the production line

- Free optical access to the substrate at the measurement position
- Distance between detection head and substrate: 190 mm. Others on request.
- Distance between controller and detection head: Typ. < 10 m
- Laser light beam must be shielded according to local regulations

### Communication / Integration

The system can interface to production machines using a variety of interface protocols: TCP / IP, Profibus, DeviceNet, RS232, RS 485, SECS II / GEM, OPC and others on request. Customer specific adaptations are possible. Specific software / hardware interfaces can be implemented based on 5 V TTL or 24 V voltage / current on request.

## Requirements

- Direct optical access “through the air” between deposition steps  
or
- Depending on the deposition system, feed-throughs for two optical fibers, if necessary (feed-through plate for KF40 is available)
- Standard normal-incidence optical view ports; customized solutions with two optical heads for other angles of incidence available on request

## Operating conditions

Component	Temperature range (°C)	
	Operation	Storage
Electronic control unit	10 – 40	10 – 60
Control computer	10 – 35	10 – 60

- Device contains a class 3b laser source
- Optical head and controller are fragile, avoid shock-treatment
- Optical fibers must not be kinked. Minimum bending radius: 150 mm
- Vacuum proof design is available on request

## Electrical connections / Power

- The main connection (100 - 240 V) including extension cables to the control unit has to be provided by the customer
- Input voltage: 100 - 240 V AC wide range
- The power supply must be equipped with grounding wire
- Power consumption (typical values for 230 V operation):

Component	Current / A	Power / W typical
Control computer	0.5	115
Monitor	0.3	60
Controller	0.5	120
Total	1.3	295

Specifications are subject to further technical development and may differ from those given in the data sheet. In certain cases, performance may be limited by reactor type and/or growth conditions. Please consult our technical sales team to see how LayTec metrology can best serve your specific application.

For further information please contact:

**LayTec AG**  
Seesener Str. 10-13  
10709 Berlin, Germany

Tel.: +49 (0)30 89 00 55-0  
Fax: +49 (0)30 89 00 55-180  
Email: [info@laytec.de](mailto:info@laytec.de)  
Web: [laytec.de](http://laytec.de)



Developed,  
manufactured,  
qualified in Germany.