



## EpiRAS<sup>®</sup> TT

The EpiRAS<sup>®</sup> TT is a multi-purpose in-situ monitor for epitaxial growth of cubic semiconductors based on two spectroscopic optical techniques: Reflectance Anisotropy Spectroscopy (RAS) and reflectance spectroscopy (R). It can be combined with an internal temperature module for emissivity corrected pyrometry measurements (TT option).

### Features

#### Reflectance

- Full spectroscopic wafer selective RAS and reflectance measurements at the wavelength between 280 nm ... 800 nm
- Spectroscopic and time resolved pseudo 3D colour plot
- True reflectance measurements using reflectance calibration on substrate
- Wafer selective growth rate fits using virtual layer approach or alternatively oscillator fits
- Additional reflectance measurements at 950 nm (with TT option)

#### Temperature

- Wafer selective true temperature measurements, pyrometer calibrated against a black body radiation source
- Temperature line scans across the wafers for uniformity evaluation in multi wafer configurations
- Patented optical wobble compensation included
- Measurements on single and multiple wafers supporting planetary susceptor

#### Communication / Integration

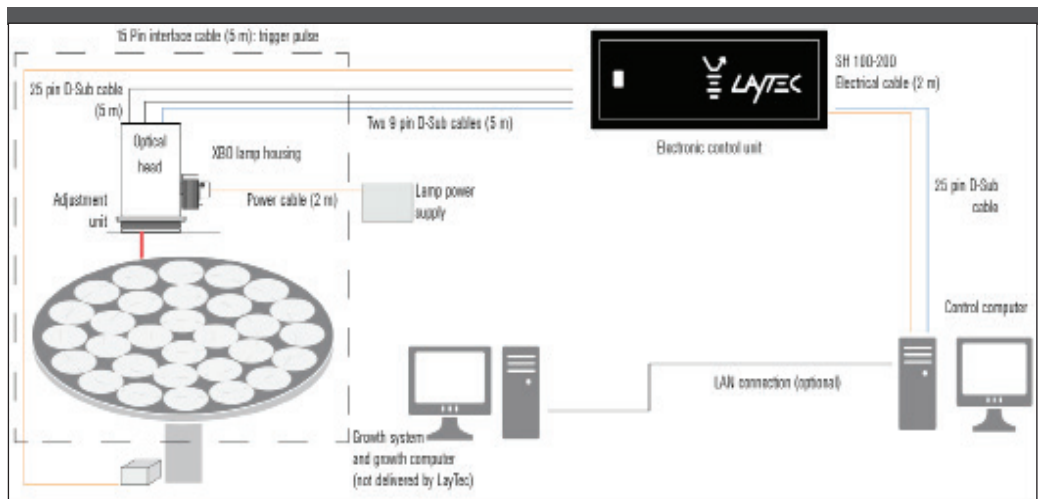
- Direct communication with AIXTRON CACE and AIXact software
- Data exchange with growth system control computer via hardware interface and/or TCP/IP protocol based software interface
- Remote controllable from growth recipe

## Features

### Measurable growth parameters

- RAS signal: the wafer must be visible at least one complete revolution for each data point
- Growth rate: typical accuracy  $\pm 1\%$
- Ternary composition: typical accuracy  $\pm 1\%$  (e.g. for AlGaAs)
- Doping carrier concentration: range  $10^{17} \dots 5 \times 10^{18} \text{ cm}^{-3}$  (accuracy material depends and temperature)
- Reflectance: noise typically better than  $\pm 1\%$
- Growth rate: typical accuracy better than  $\pm 1\%$  (down to 0.001 nm/s)
- Wafer temperature: typical accuracy better than  $\pm 1\text{K}$ ; temperature range: 450–1300°C for AIX Planetary® and single-wafer systems
- Fingerprinting of surface stoichiometry and surface reconstruction

## System components



### Optical head incl. light source and monochromator / single detector unit

EpiRAS® TT systems are designed for the VIS/UV spectral range. Special UV-enhanced configuration is available on request.

Light source	XBO lamp	
- Manufacturer guaranteed lifetime	400 h	
- Typical life time	700 h	
RAS wavelength	275–840 nm	
Reflectance (R) wavelength	275–840 nm	
Spectroscopic resolution	$\pm 4 \text{ nm}$	
	RAS measurements	R measurements
Time resolution	Best 3 ms / Typical 30 ms	20 Points/sec 20 Sec for full spectrum*
Noise level	Best $\pm 1.5 \times 10^{-3}$ / typical $\pm 5 \times 10^{-3}$	Typical $\pm 5 \times 10^{-5}$

## Description of the parts

**Electronic control unit and PC** The control unit is a standard 19" case that can be easily mounted into existing 19" racks. It is connected with the control computer and the growth system as shown in the diagram.

**Control computer**

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

**Miscellaneous items**

- Reactor specific mounting and adjustment unit
- EpiSense control software preinstalled and on a CD
- Additional USB license dongle for growth rate analysis and growth rate fit on office computer
- Al-Si eutectic wafer for temperature calibration (special coated 2", 3" or 4" wafer) for TT option
- Manual

**Communication with growth system** The electronic control unit is connected with the growth system by a 15 pin interface cable (trigger pulse is mandatory). Optional LAN connection to growth control computer is available. Please note: for the LAN connection a special software interface on the growth system computer is necessary. The interface should be arranged by the customer with the manufacturer of the growth system.

Communication features	15 Pin interface cable	LAN connection
Rotation synchronous trigger pulse (once per susceptor revolution) from growth system*	5V TTL or open collector signal	-
Start/Stop signal from growth system for remote control from the recipe	5V TTL or open collector signal	Via TCP/IP
Reflectance calibration signal from growth system to indicate substrate reflectance	-	Via TCP/IP
1 Marker signal to indicate different growth steps and for data synchronization with the growth recipe	5V TTL or open collector signal	-
3 Marker signals to indicate different growth steps and for data synchronization with the growth recipe	-	Via TCP/IP
Process temperature from thermocouple or Eurotherm for advanced logging and calibration purpose	Analog voltage (0-10 V)	Via TCP/IP
Pyrometer temperature to growth system for export of measured temperature (uncorrected or corrected) and/or reflectance signal	Analog voltage** (0-10 V)	(All wafers individually)

\* This line is mandatory for multiple wafer systems and strongly recommended for motor driven single-wafer systems

\*\* In multi-wafer systems only averaged data or data from one specified wafer can be transferred

## Description of the requirements

### Sizes and weights of the parts

	Size X x Y x Z mm	Weight, kg
Overall size with cable plugs	390 x 160 x 470	-
Control unit 19" case 3/4 HE, 84 TE)	450 x 300x180	8.0
Rack mount control computer (4 HE)	450 x 600x180	Via TCP/IP

### Requirements to the growth system

- Normal-incidence strain reduced optical viewport (MBE: heatable; MOCVD: purged)
- Optical access to the sample
  - AIX 2400/2600/2800: 6mm hole in reactor ceiling
  - AIX 200/4: 6mm hole in liner tube
- Purged or heated window recommended to avoid window coating
- For multi-wafer reactors reset pulse from rotation axis, one pulse per revolution
- For AIXTRON Planetary® G2: measurement without reset pulse is possible, but not wafer-selective
- For remote control: hardware and LAN connection to MOCVD system PC (to be arranged with growth system manufacturer)

### Operating conditions

All components	Allowed temperature range	
	Operation	Storage
	10°C - 40°C	10°C - 40°C

### Electrical connections / Power consumption

- Optical head vibrations avoid during the measurement; optical head is fragile: avoid shock-treatment; warm-up time: 30 min
- 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 auto detect
- The power supply must be equipped with grounding wire
- Power consumption (typical values for 230 V operation):

Component	Current / A	Power / W Typical	Power / W Max
Total	5,9	367	747

### Availability

EpiRAS® TT can be adapted to virtually any growth system. We have special mounts for AIXTRON 200 and 200/4, AIXTRON Planetary® 2400/2600G3 (excluding 24x2" and other configurations with more than one wafer per pocket without a central wafer), 2800G4 systems, for many MBE systems by Riber, Veeco / Applied Epi, VG, DCA and various custom built systems.

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)

