



# EpiTwin TT for multiple-wafer ring reactors

EpiTwin TT is a production-line double-head optical in-situ sensor for monitoring of epitaxial growth. EpiTwin TT features emissivity corrected wafer temperature measurements and a two wavelength reflectance measurement for optimized on-line growth analysis.

## EpiTT features:

### Temperature measurements

- wafer selective true temperature measurements at two positions simultaneously
- pyrometer calibrated against a black body radiation source

### Reflectance measurements

- wafer selective reflectance measurements at two wavelengths: 950 nm and a customized second wavelength (405 nm or 488 nm or 633 nm or 950 nm)
- multiple position reflectance and temperature measurements in multi-wafer configurations (e.g. for comparison center to edge on the wafer)
- line scan measurements across the wafers for uniformity evaluation
- on-line wafer selective growth rate fits using virtual layer approach or alternatively oscillator fits
- recipe controlled automated growth rate fit for multi-layer structures
- optical wobble compensation included
- measurements on single and multiple wafers, supporting planetary susceptor even with multiple wafers per satellite (such as 24x2" and 42x2")
- optimized for 24 h/7day operation in production environment

### Communication / integration

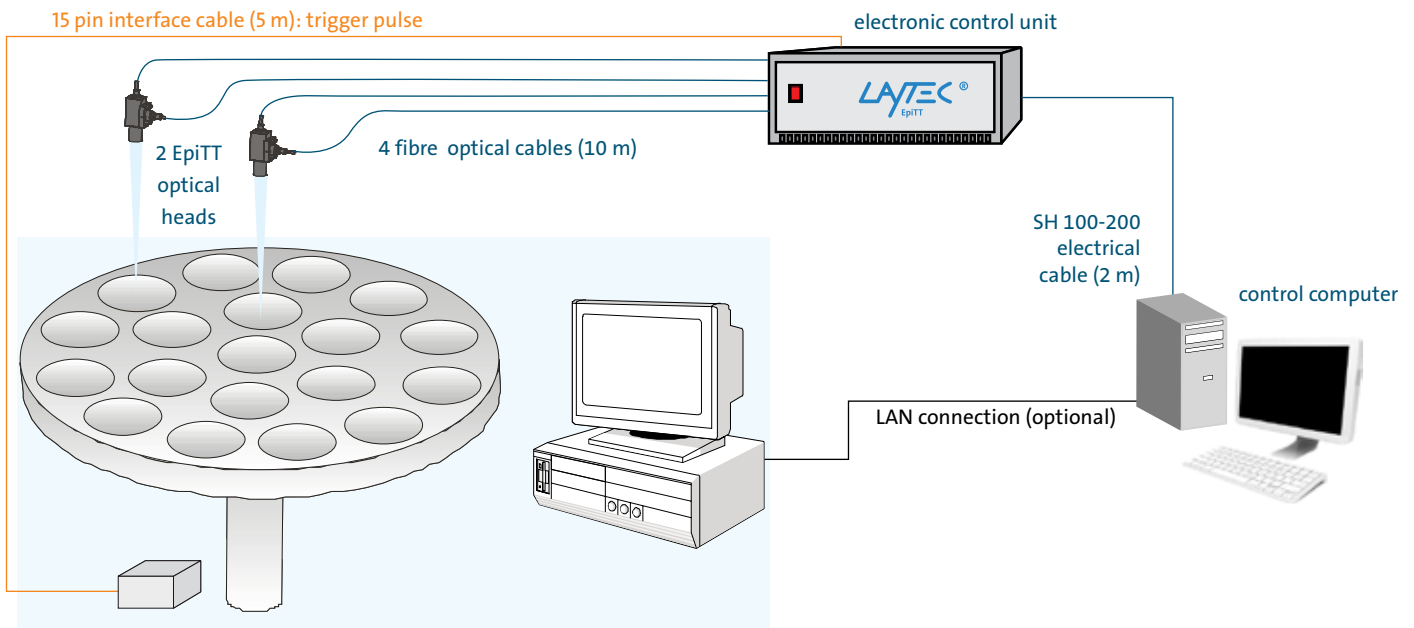
- direct communication with AIXTRON CACE and AIXact software
- data exchange with growth system control computer via hardware interface and/or TCP/IP protocol based software interface
- remote controllable from growth recipe
- heartbeat/watchdog signals for SPS integration

### Measurable growth parameters

- reflectance: typical noise better than  $\pm 0.5\%$
- growth rate: typical accuracy better than  $\pm 1\%$  (down to 0.001 nm/s)
- wafer temperature: typical accuracy better than  $\pm 1K^*$ : temperature range: 450–1300°C for AIX Planetary® and single-wafer systems; 500–1400 °C for AIX CCS® (others on request)



# EpiTwin TT standard package



## Two EpiTT optical heads

The two optical heads measure wafer temperature and reflectance on the wafers on two wafer rings of the susceptor. The heads are supplied with mounting and adjustment units.

|  |  |
|--|--|
| light source for reflectance measurement         | combination of ultra high brightness LEDs  |
| typical life-time according to manufacturer      | 20.000 h   |
| reflectance measurement wavelength and bandwidth | 633 nm $\pm$ 1.5 nm or 488 nm $\pm$ 5 nm or 405 nm $\pm$ 5 nm or 950 nm $\pm$ 1 nm |
| pyrometry wavelength and bandwidth               | 950 nm $\pm$ 5 nm  |
| typical sampling rate                            | 2...5 kHz  |
| data repetition rate                             | 4 revolutions of main susceptor  |

## Electronic control unit

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 drawing above.

## Control computer

- 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 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
- manual and software 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)

# EpiTwin TT standard package

## Cables

- 4 optical fibres (optical head <-> electronic unit): 10 m, core diameter - 600 µm, special vis-IR transparent material, minimum bending radius 36 cm
- SH 100-200 electrical cable (2 m, electronic unit <-> computer).
- optionally, a KVM extension set (cable or ethernet based extender) is available
- 15 pin interface cable (5 m, electronic unit <-> growth system): transfers the trigger and marker signals as well as exports analog voltages proportional to the measured temperature and reflectance (see “communication with growth system” below)
- multi-plug and power cables

## 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. This 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 | –                                    |
| 2 digital signals to growth system indicating heartbeat and busy/error status                                 | 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                           | 5V TTL or open collector signal | via TCP/IP                           |
| up to 3 marker signals to indicate different growth steps and for data synchronization with the growth recipe | 5V TTL or open collector signal | 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)          | analog voltage** (0-10 V)       | via TCP/IP (all wafers individually) |
| reflectance signal to growth system for export of the measured reflectance                                    | analog voltage** (0-10 V)       | via TCP/IP (all wafers individually) |

## Sizes and weights of the parts

| Parts                               | Size X x Y x Z mm | Weight, kg |
|-------------------------------------|-------------------|------------|
| EpiTT optical heads (each)          | 50 x 100 x 150    | 0.5        |
| control unit (19" case 4 HE, 84 TE) | 450 x 300 x 180   | 8.0        |
| rack mount control computer (4 HE)  | 450 x 600 x 180   | 17.0       |
| 19" LCD display                     | 410 x 20 x 420    | 5,5        |
| mounting and adjustment unit        | reactor specific  | 2.0        |

\* 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

# EpiTwin TT requirements

## Requirements to the growth system

- optical access to the sample: 2 standard AIXTRON CCS® viewports equipped with quartz window
- purged or heated windows are highly recommended to avoid window coating
- rotation synchronous trigger pulse from rotation axis: one pulse per revolution
- for multiple wafer systems: maximum rotation frequency 200 rpm (higher on request)
- for remote control hardware and LAN connection to MOCVD system PC (to be arranged with growth system manufacturer)
- feed-throughs for further optical fibers (feed-through plate for KF40 is available)

## Operating conditions

| Component               | Allowed temperature range |             |
|-------------------------|---------------------------|-------------|
|                         | operation                 | storage     |
| optical heads           | 10°C – 40°C               | 10°C – 60°C |
| electronic control unit | 10°C – 35°C               | 10°C – 60°C |
| control computer        | 10°C – 35°C               | 10°C – 60°C |

## Please note:

- vibrations of optical heads have to be avoided during the measurement
- optical heads are fragile, avoid shock-treatment
- warm-up time: <15 min

## Electrical connections / power consumption

- 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 | power / W |
|-------------------|-------------|-----------|-----------|
|                   |             | typical   | max.      |
| control computer  | 3.5         | 134       | 500       |
| monitor           | 1.5         | 26        | 40        |
| control unit rack | 0.3         | 50        | 69        |
| total             | 5.3         | 210       | 609       |

## Availability

EpiTwin TT is available:

- for AIXTRON Close Coupled Showerhead® (CCS) systems CRIUS and recommended for the following configurations: 19x2", 30x2", 31x2", 12x3"
- for multiple-ring MBE systems with a wafer in the center
- as an on-site upgrade to existing EpiTTs

The two optical heads provide a complete control of every wafer in configurations with two rings of wafers and offer the possibility for uniformity comparison between inner and outer rings.

Specifications are subject to further technical development and may differ from those given in the datasheet.

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