

EpiTT

EpiTT is a production-line optical in-situ sensor for monitoring of epitaxial growth. EpiTT 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, 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
- measurements on single and multiple wafers, supporting planetary susceptor even with multiple wafers per satellite (such as 24x2" and 42x2")
- optical wobble compensation included
- optimized for 24 h/7day operation in production environment

Communication / integration

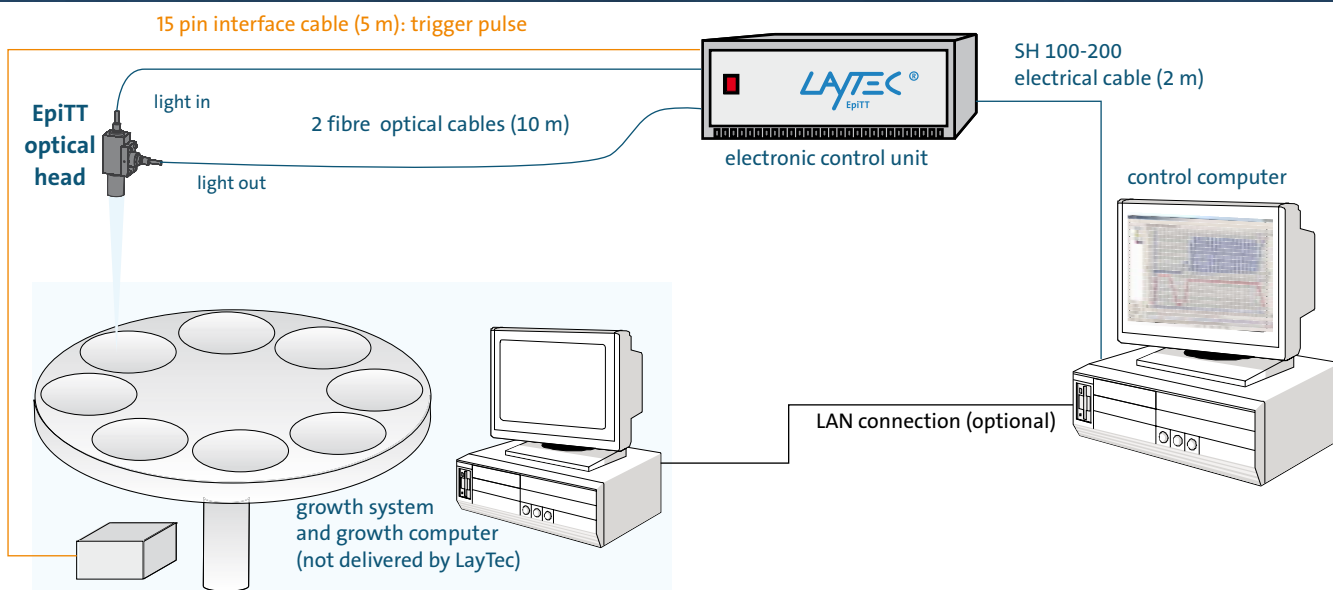
- direct communication with AIXTRON CACE and AIXact software
- data exchange with growth system control computer via hardware interface and/or TCP/IP protocol based software interface
- remote controllable from growth recipe
- heartbeat/watchdog signals for SPS integration

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)



EpiTT standard package



Optical head

Depending on the reactor configuration and the rotation speed, two different measurement modes can be used:

	rotation 1 ... 20 rpm	rotation 20 ... 200 rpm (higher on request)
light source	combination of ultra high brightness LEDs	combination of ultra high brightness LEDs
typical life-time according to manufacturer	20.000 h	20.000 h
reflectance measurement wavelength and bandwidth	633 nm ± 1.5 nm or 488 nm ± 5 nm or 405 nm ± 5 nm or 950 nm ± 1 nm	633 nm ± 1.5 nm 488 nm ± 5 nm or 405 nm ± 5 nm or 950 nm ± 1 nm
pyrometry wavelength and bandwidth	950 nm ± 5 nm	950 nm ± 5 nm
typical sampling rate	100 Hz	2...5 kHz
data repetition rate	1 revolution of main susceptor	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

- 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 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)

EpiTT standard package

Cables

- 2 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; 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. 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	–
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 head	50 x 100 x 150	0.5
control unit (19" case 4 HE, 84 TE)	450 x 300 x 180	8.0
control computer, desktop housing	430 x 500 x 180	13.0
optional 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

EpiTT requirements

Requirements to the growth system

- standard normal-incidence optical view port; customized solutions with two optical heads for other angles of incidence available on request
- optical access to the sample
 - AIX 2400/2600, AIX 2800: 6 mm hole in reactor ceiling, plus AIXTRON quartz inlay
 - AIX 200, AIX 200/4: 6 mm hole in liner tube
 - AIXTRON CCS®: standard viewport equipped with quartz window
 - MBE: heated viewport, required size depends on chamber geometry and wafer wobble
- purged or heated window highly recommended to avoid window coating
- for multiple wafer systems or motor driven single wafer systems: 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 two optical fibers (feed-through plate for KF40 is available)

Operating conditions

Component	Allowed temperature range	
	operation	storage
optical head	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 head have to be avoided during the measurement
- optical head is 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	20	69
sum	5.3	180	609

Availability

EpiTT can be adapted to virtually any growth system. We have special mounts for AIXTRON Planetary® 2400/2600G3 and 2800G4 systems, AIXTRON CCS® reactors, for many MBE systems by Riber, Veeco / Applied Epi, VG, DCA and various custom built MOCVD, MBE or Sputter systems.

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

Version 5, August 2009

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