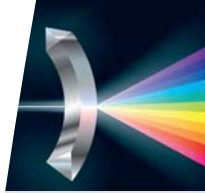


**High Speed
Diode Array Spectroscopy**

Components for OEM Solutions



Learning from Light

It is amazing! Analyzing the composition of optical radiation provides valuable information about light and matter. Optical parallel spectroscopy measures the intensity of light for each wavelength. The process is contactless, non-destructive and fast.

Interaction with matter influences the spectral composition of light entering the spectrometer. These minute changes are recorded by the measuring instrument and reveal the characteristics of the studied material.



Colour



Film Thickness



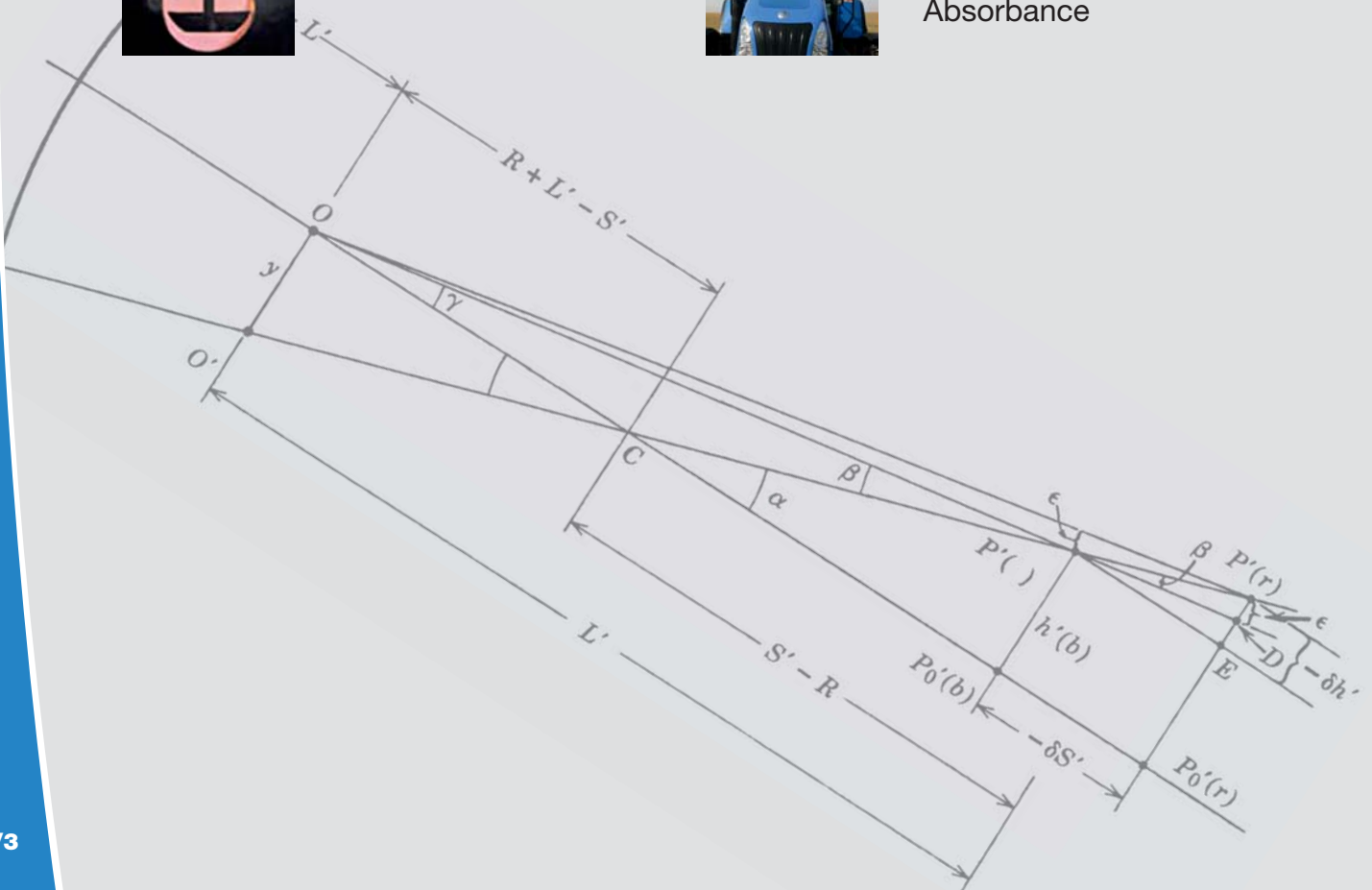
Emission



Concentration



Transmission, Reflection, Absorbance



With a vision...



tec5 has been certified according to ISO 9001 since 2000.



...of providing high quality spectroscopic solutions for a multitude of applications, our five founders established the company in 1993. Today, tec5 is operating worldwide with subsidiaries in the USA and UK; global representatives are positioned to better serve local markets.

As an industry leading company in UV/VIS and NIR spectroscopy with an established focus on market needs and customer requirements, tec5 specializes in research, development and manufacturing of suitable components and systems. Our high quality products range from standard OEM electronics modules to complete application specific solutions.

At tec5 we pair our core competencies in high speed diode array readout technology, optical, mechanical, electronic and software engineering with excellent customer service and support. Our engineering team leverages many years of experience utilizing the highest performance development tools. The array of products is complemented by service of initial conception, project planning, hardware design, software creation, system implementation, user training and after-sales support.

Close cooperation with professional component manufacturers provides direct access to all key technologies for optical process spectroscopy.

Our technology extends into many application areas. Industrial optical spectroscopy is instrumental in helping industry maintain optimal quality in the production process and reduce cost. The environment benefits from faster and more accurate measurement methods. Moreover, research and development labs use the technology to create new materials, streamline processes and ensure product efficiency.

tec5 is proud to be at the forefront in the field of optical spectroscopy and to provide cutting edge solutions - today and in the future.

tec5 AG

Products

- Spectrometer systems
- Electronics modules
- Spectral Sensors
- Custom solutions
- Software

Examples of Applications

- Process control
- Quality inspection
- Environmental monitoring
- Precision farming
- Research and development

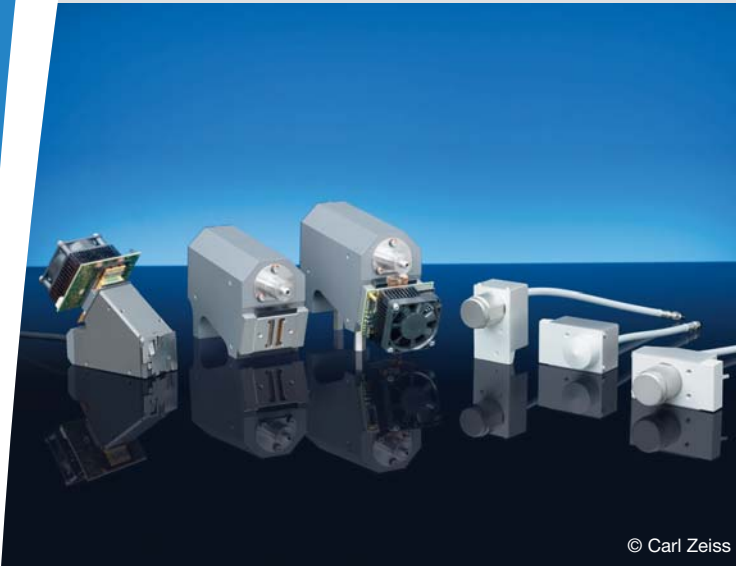
Industries

Chemical	Semiconductor
Pharma	Glass
Food	Agriculture
Printing	Solar

- Optical
- Lighting

Diode Array Technology

Simultaneous Readout Spectrometers



© Carl Zeiss

Spectral Sensors

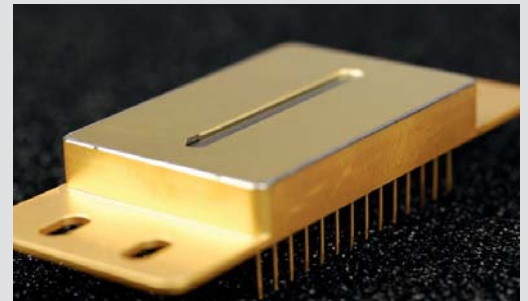
High performance instruments for spectroscopy are composed of high quality subunits around first-class Spectral Sensors. Their rugged design allows reliable and accurate data acquisition in rough environments. With these features they are ideal devices for process and production control.

tec5 has been developing electronics for detector arrays for years in close cooperation with manufacturers of arrays and Spectral Sensors.

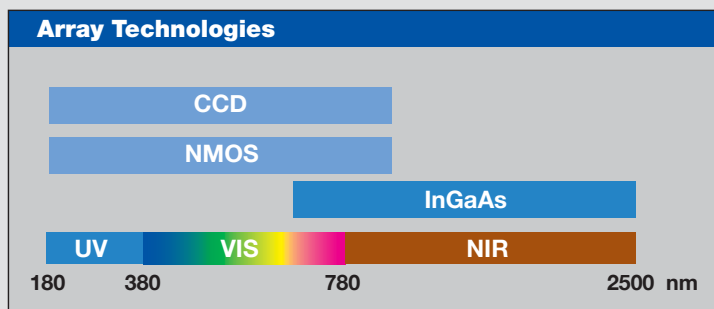
As a result, our customers benefit from high performance technology by including OEM components in their state-of-the-art spectroscopy devices.

Operation of Detector Arrays

tec5 OEM components for spectral data acquisition are designed to read photodiode arrays with high precision through various PC interfaces. Software drivers and function libraries provide access to the Operating Electronics for setting measurement parameters and acquiring information.



InGaAs multiplexed photodiode array



Electronics functionality

- Accurate integration timing and array readout control
- Preamplification and preprocessing of the sensor signal
- Analog-to-digital conversion
- Buffer memory for digitized data
- Data transfer to host computer
- Software control of hardware settings and operation parameters
- Control of peripheral devices (shutters, flash lamp sources,...)
- Process synchronization modes

Operating Electronics

Product Philosophy

tec5 OEM electronics are based on PC oriented interface technology for operation with standard computer equipment. Customers take advantage of high-quality OEM electronics subunits for spectral data acquisition with an outstanding performance/cost ratio.

- Si NMOS, CCD and InGaAs photodiode arrays supported
- Standard PC interfaces: Ethernet, USB Hi-Speed and PCI, more IF-types available
- Windows 7, Vista, XP and 2000 support, plug-and-play with configuration detection
- Ready-to-use programmer interfaces for C#.net, C++, Visual Basic, Delphi and LabVIEW®



tec5 inside

OEM components are used in many high-end UV/VIS/NIR spectrometer systems for lab and process

Building Blocks

The hardware and software follow a modular architecture with space-saving mechanics for compact product design. Even multichannel, multi wavelength configurations are realized easily in customer instruments.

Design for Speed

Fast readout with high dynamics

Process synchronization (flash control, trigger input, digital I/O)

High throughput PC interfaces

Short Time-to-Market with *tec5* Technology

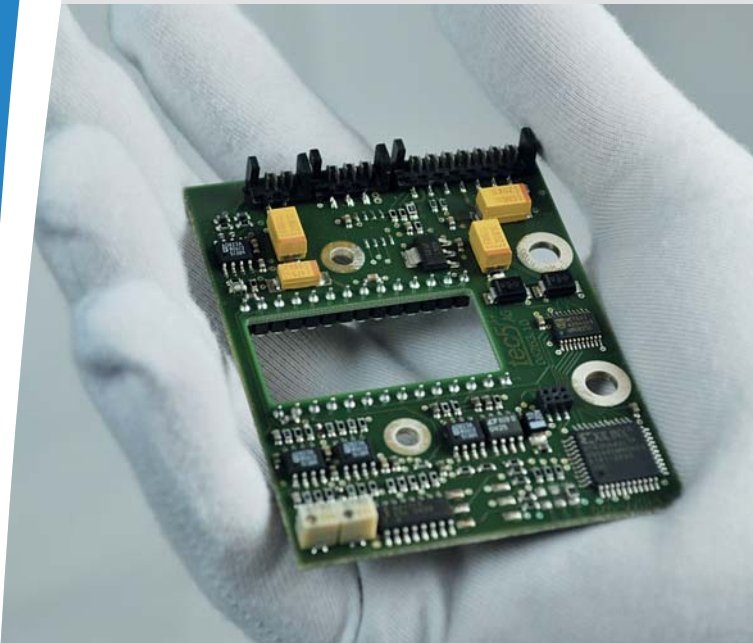
- Proven high-end components
- Software development kits
- Direct support for system integrators
- Continuing development
- Customization available



Compact and modular assembly

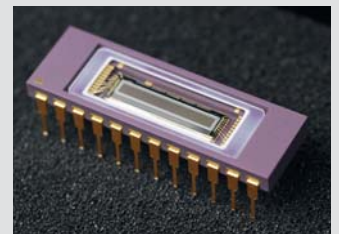
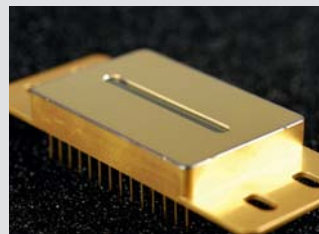
PDA an CCD Array Preamplifier

Sensor Electronics



Supporting the most popular photodiode array types in simultaneous spectroscopy, a number of preamplifier boards is available for use with tec5 Front End and Interface Electronics. Each of them contains a sensor plug-in socket and the electronics required in proximity to the array.

Si NMOS photodiode arrays are used under standard illumination conditions for applications requiring high dynamics in the wavelength range from 190-1100 nm. At lower light levels, back-illuminated CCD detector arrays are recommended. InGaAs photodiode arrays are applied for detection of near-infrared light in the wavelength range between 900 and 2500 nm.



Preamplifier Modules

Si NMOS

Superior dynamic range, up to > 5000 spectra per second*

- **DZA-S3901-4 1M** for Hamamatsu PDA, 16 bit readout with FEE-1M /NMOS-1, high speed and high dynamic range versions
- **DZA-S3901-4** for Hamamatsu high dynamic range PDA, 15 bit readout with FEE-HS, allows electronic multiplexing
- **DZA-MMS 1M** for Carl Zeiss MMS Spectral Sensors, 16 bit readout with FEE-1M/NMOS-1

Si CCD

High sensitivity including UV range with back-thinned, back-illuminated CCD sensor types, up to > 400 spectra per second*

- **DZA-S7030-4** for Hamamatsu CCD types S7030, S7031 (Peltier cooled), 16 bit readout with FEE-1M /CCD-2
- **DZA-S9840** for Hamamatsu CCD type S9840, 16 bit readout with FEE-1M /CCD-8
- **DZA-S11071** for Hamamatsu CCD type S11071, 16 bit readout with FEE-1M /CCD-8

InGaAs

Multiplexed InGaAs arrays for NIR, up to > 1000 spectra per second*

- **DZA-VVIR-LD** for Sensors Unlimited LX and LD series with RT or T1 pinout configuration, 15/16 bit readout with FEE-1M /NIR-2
- **DZA-VVIR-HM** for Hamamatsu G9205 - G9208 and G9211 - G9214 series: 15/16 bit readout with FEE-1M /NIR-4

* in burst operation, depending on system configuration

For more details please visit our website at www.tec5.com or contact our sales team: sales@tec5.com. Alternative array types may be supported or can be added upon customer request, please contact us for other sensor types.

Front End Electronics /Interface Electronics

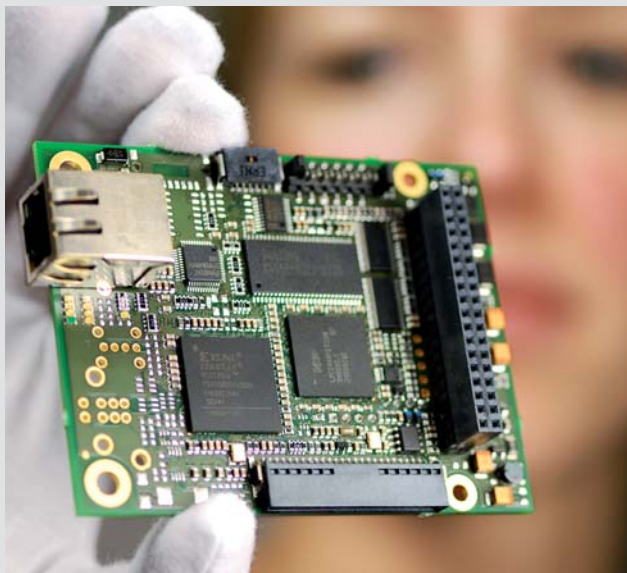
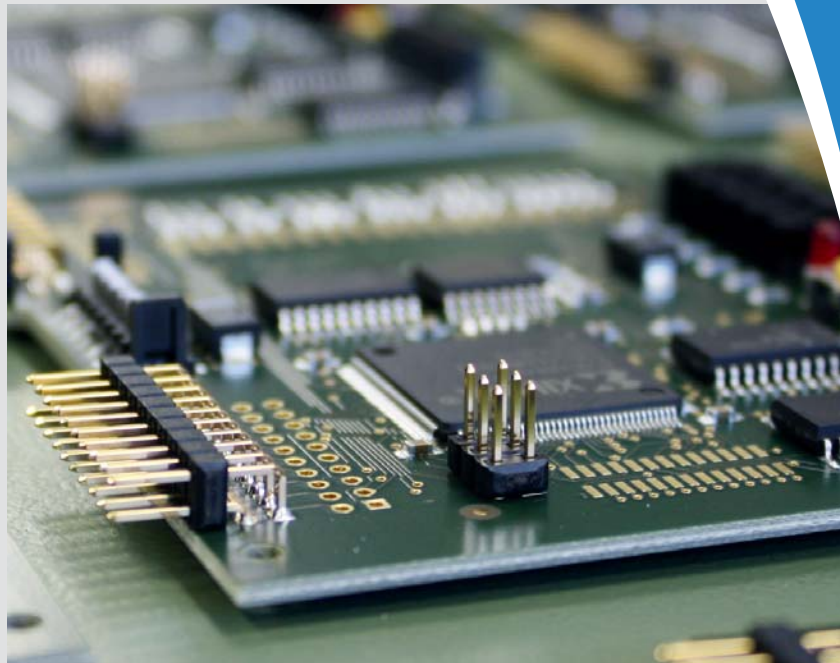
Front End Electronics

The board contains the array readout control logic and the ADC to digitize the sensor's analog video signal. It serves as a coupling unit for a detector array (with tec5 preamplifier) or a Spectral Sensor to a PC Interface Electronics.

Product Versions

- **FEE-HS** for NMOS PDAs, 15 bit A/D conversion, optional input multiplexing
- **FEE-1M** for fast data acquisition, NMOS, CCD and InGaAs arrays, 16 bit A/D conversion

For customers who prefer to use their own digital signal processing electronics, we offer to disclose the interface between the FEE and the Interface Electronics.



Interface Electronics

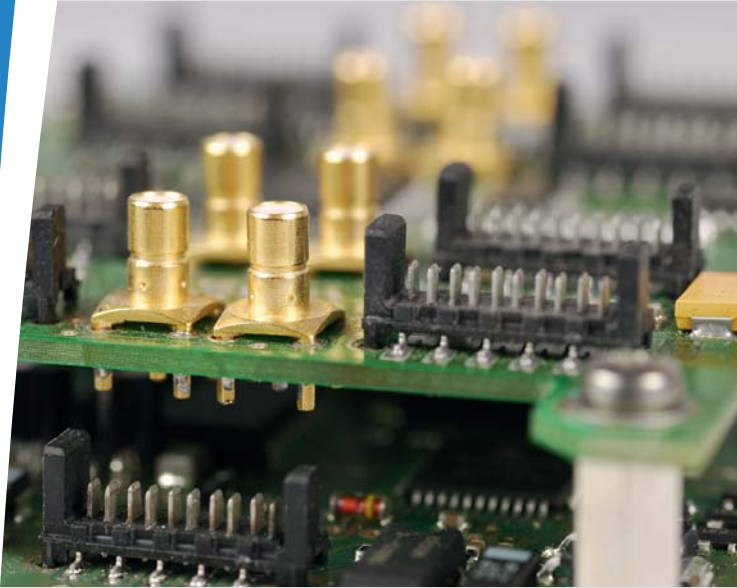
In addition to the bus interface, a scan cycle control logic with precise exposure timing for the sensor is contained. It also controls several I/O lines for peripheral devices like shutters or light sources which may be attached to an on-board I/O connector. A FIFO memory is used as a temporary data buffer assuring consistent data transfer to the computer's main memory.

tec5 Interface Solutions

- **PD-USB** for connection to a USB 2.0 interface
- **PD-PCI** plug-in board for PCs with PCI interface slot
- **PD-ETH01** for Ethernet 10baseT/100baseT connectivity
- **PD-ETH01 /DP** with added on-board real time data processing capabilities

Interface type	Cable length max (m)	Data rate	Timing	Industrial Application
USB	5	+++	++	++
PCI	15	+	+++	++
Ethernet	100	++	++	+++
+ good ++ better +++ best choice Interface selection guide				

Additional Components



Temperature Sensor

Monitoring air or component temperature within an instrument allows to issue warnings in case of overheating conditions due to e.g. excess ambient temperature or system fan failure. Alternatively, thermal compensation algorithms may benefit from the temperature sensor data.

- **IIO-T1** cascadable temperature sensor module for I²C connection in USB or Ethernet based configurations

Electronic Sensor Multiplexers

In many applications spectral data from several channels have to be acquired. Up to eight Spectral Sensors based on NMOS array technology can be controlled by a single Operating Electronics. For this purpose, an optional electronic multiplexer board is mounted on top of the Front End Electronics.

With sensors of the same type attached, concurrent exposure is possible e.g. for reference measurements in simultaneous readout mode. This allows to optimize measurement accuracy by eliminating error sources like light fluctuations or drifts. Alternatively, each channel may be selected individually in sequential operation.

- **MUX-4P** max. four NMOS-based sensors in sequential operation or two sensors in simultaneous mode
- **MUX-8A** max. eight NMOS-based sensors operated in sequential or simultaneous mode

Peltier Cooling Controllers

Cooled operation of the sensor reduces dark current and stabilizes the dark pattern for improved measurement accuracy. This is generally an advantage for InGaAs PDAs and CCD sensors, especially when long-term integration is required at low light levels. If detector arrays with built-in Peltier elements are used, control electronics cool the optical sensor element and stabilize the sensor temperature at an optimum setpoint.

All tec5 control electronics are linear PI control circuits for lowest possible contribution to detector noise. A temperature stability of better than 0.1 K can be achieved.

- **Peltier-tc** universal PI linear cooling controller, max. 3 A current limit



Advanced Instrumentation

Integrated Spectrometer Modules

The tecSpec units are well-established, ready-to-use subsystems for customer equipment or laboratory instruments for demonstration and evaluation purposes.

- **tecSpec** modules with PGS-NIR Spectral Sensors and high-speed USB Operating Electronics
- **tecSpec** modules with MCS (flex)-CCD or MCS (flex) Spectral Sensors and high-speed USB Operating Electronics
- **EVALine** USB Operating Electronics with built-in MMS-type Spectral Sensor
- **Customized** integrated spectrometer modules based on the tec5 range of modular electronics



tecSpec integrated spectrometer modules

Spectrometer Systems

Covering a wide range of applications and demands a series of standard spectrometer systems is offered for various ambient conditions. Hardware and software may be modified to suit individual requirements.

- **CompactSpec® II** process spectrometer system for harsh environment with integrated PC and touchscreen in IP 65 or EEx p housing



- **MultiSpec® Systems** modular instrument family in 19" chassis technology for lab and process, available with different detectors and light sources



MultiSpec®

- **HandySpec®** portable battery-driven spectrometer system, optimized for reflection measurements of plants and soils
- **LensColour Analyser TFM-1** dedicated instrument for the at-line colour measurement of ophthalmic lenses in the production area

CompactSpec® II

Custom-Designed Products / Software Support

Custom-Designed Products

Based on long-term experience in electronics design and operation of photodiode arrays and spectral sensors, tec5 offers efficient custom development of electronics and devices for spectroscopy. In this way, customers can take advantage of in-house know-how and capabilities, supported by a comprehensive co-operation network with leading manufacturers of related key technologies.

- Contract development
- Conception, design, prototyping
- Batch production



Tractor-based Operating Electronics for the YARA N-Sensor, including processing electronics and spectral sensors in IP65 housing.

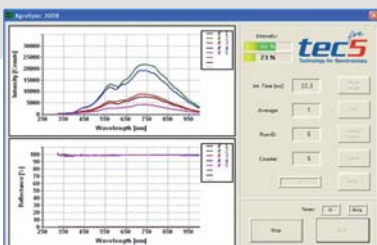


Software Support

tec5 electronics sets are supplied with drivers for Windows 7, Vista, XP and 2000 operating systems and the AdminTool program for testing the hardware configuration and data acquisition. In addition, programming libraries and application programs are available.

Please contact tec5 for details on support of alternative operating systems (Windows CE and LINUX) and for custom software development.

- Programmer interfaces for C#.net, C++, Visual Basic and Delphi
- LabVIEW® libraries
- My Instrument driver for GRAMS/AI®
- MultiSpecPro® modular spectroscopy software
- Various additional tools, drivers and software development kits



GRAMS/AI™ 7

Customer Advantages



- Far-reaching know-how in optical spectroscopy and many years of experience with applications
- Modular standard components, systems and customer specific instruments
- Complete solutions with high-quality products, competitively priced
- Prototyping, single unit and serial production
- Competent consulting and excellent technical support
- Close cooperation with technology leaders
- Outstanding know-how in operation of photodiode arrays and single detectors

Worldwide Distribution





Your local distributor

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