



Diode Array  
Technology

UV-NIR

Electronics

Spectrometers

High Speed  
and Dynamics

Embedded  
Spectroscopy

Color  
Accessories

Software  
Customization

Raman

Film Thickness

Sorting

Quality and  
Process Control

Concentration



## Learning from Light

It's amazing!

Analyzing the composition of optical radiation provides valuable information about the interaction of light and matter. Optical parallel spectroscopy measures the intensity of light for a range of wavelengths.

Matter influences the spectral composition of light. Using a spectrometer, even minute changes can be measured, revealing the characteristics of the studied material.

### [Partnership]

▮ We strive for sustainable business relationships with a long-term vision.

### [Custom Developments]

▮ We bring your ideas to work  
– by adapting optical measurement devices to your requirements.

**Spec|tro|sco|py {f},**

*Studying the interaction between light and matter.*

### [Applications]

- ▮ Emission
- ▮ Color
- ▮ Concentration
- ▮ Reflection
- ▮ Transmission
- ▮ Film thickness

- ▮ Process control of liquid, solid and gaseous samples
- ▮ Reaction monitoring
- ▮ Quality inspection
- ▮ Precision farming
- ▮ Environmental monitoring
- ▮ Research and development

# Your Partner for Spectroscopy.

## With a vision ...

... to provide high quality spectroscopic solutions for a multitude of applications, our five founders established the company in 1993. Today, tec5 together with its US subsidiary operate worldwide, and representatives are positioned in many countries to provide optimum services to local markets.

As an industry leading company in UV-VIS, NIR and Raman spectroscopy with an established focus on market needs and customer requirements, tec5 specializes in research, development and manufacturing of 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 combines many years of experience of utilizing the highest performance development tools. The array of products is complemented by consulting, 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. 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 providing cutting-edge solutions.

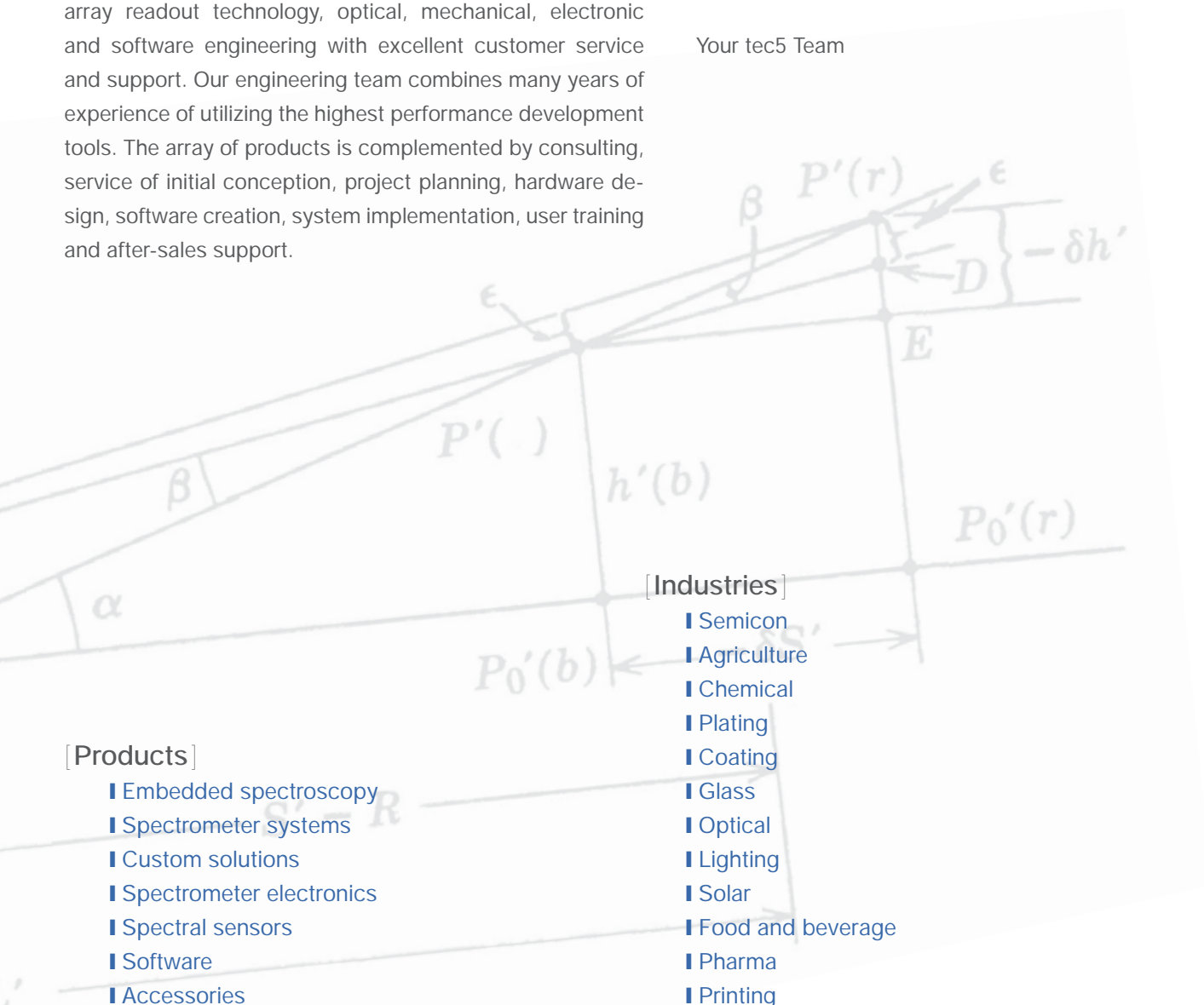
Your tec5 Team

### [Products]

- Embedded spectroscopy
- Spectrometer systems
- Custom solutions
- Spectrometer electronics
- Spectral sensors
- Software
- Accessories

### [Industries]

- Semicon
- Agriculture
- Chemical
- Plating
- Coating
- Glass
- Optical
- Lighting
- Solar
- Food and beverage
- Pharma
- Printing





## Detector Technology

### Optical Engines for Industrial Spectroscopy

The light entering the spectrometer module is dispersed into its spectral components by an imaging grating. When a linear array of discrete detectors is placed in the image plane, a range of wavelengths can be measured simultaneously. The most common detector types are silicon photodiode arrays [NMOS or CMOS technology], InGaAs arrays, and silicon charged-couple device [CCD] arrays. Since these sensors have no moving parts, a full spectrum can be acquired within milliseconds or even faster. The rugged

design of monolithic spectral sensors allows reliable, accurate data acquisition without any need for recalibration. InGaAs and CCD devices with significant dark current are thermoelectrically cooled or stabilized for drift-free operation. Thus, diode-array based spectrometers are especially useful in an industrial environment where samples are rapidly passing. Application examples include quality inspection of wafers, LED production, and chemical monitoring.



[ Carl Zeiss MMS Optical Scheme ]



[ Carl Zeiss Sensors ]

### Single Element Detectors

Spectral photometry may be implemented using single- or multi-element photodiodes combined with optical filters or alternative dispersive techniques. This allows for more flexibility in the optics and electronics design so that additional applications for spectral measurement technologies can be realized. Especially in the NIR, e.g. in food or agri applications, specific photometer instruments have the potential for lower cost compared to full-range diode array spectroscopy systems.

### Active Illumination

tec5 spectroscopy hardware can control various active illumination setups including flash lamps, LEDs, and lasers. This allows for active measurement systems for use in labs, manufacturing and in the field.

#### [Advantages]

- Precise design using high-grade components
- Robust
- No moving parts
- Permanent alignment using advanced cementing techniques
- Thermally matched components
- High versatility in mechanical setup and in optical arrangements
- UV-improved versions with solarization-stabilized fibers
- Compact

# Spectrometer Electronics

## Building Blocks for Spectroscopic Instruments

tec5 specializes in developing operating electronics for detector arrays and spectral sensors in close cooperation with their manufacturers.

We offer high-quality components for state-of-the-art spectroscopic devices.

### [Electronics Functionality]

- Supports NMOS, CMOS, InGaAs and CCD type detector arrays
- Accurate integration timing and array readout control
- Analog-to-digital conversion with high dynamic range and low noise
- Buffer memory for digitized data
- High-speed data transfer to host computer
- Software control of hardware settings and operation parameters
- Control of peripheral devices [shutters, flash lamp sources, ...]
- Process synchronization modes
- Peltier cooling control



[OEM Components]

### [Advantages]

- Fast time-to-market using proven high-end technology
- Modular, PC-based technology for high flexibility
- Designed for high stability, reliability and data security
- Optional on-board data preprocessing
- Ready-to-use software interfaces for C/C++, C#.Net and LabVIEW
- Direct support for system integrators
- Customization possible
- Continuing development for future requirements

## Compact Electronics for Diode Array Spectrometers

These electronics modules offer all required functions for operating a spectral sensor with a PC – from the electronic interface of the sensor to the PC interface – in a compact size. When combined with the suitable sensor, an easy-to-use spectrometer unit is created, that can be powered via a single operating voltage.



[SEU-CGS – Compact Electronics for Carl Zeiss CGS-CCD Spectral Sensor]



## Integrated Subsystems

### Compact Spectrometer Units

The tecSpec® product family contains a number of spectrometer units covering the complete UV-VIS and NIR wavelength range. Compact and competitively priced, they are the ideal spectrometer solution for measurement tasks in research, development and industry. Based on high-grade spectral sensors and electronic components, the units are well-suited for fast, precise spectral data acquisition. The compact design allows easy integration into inspection and production machinery. Each tecSpec® is shipped with a universal AC-input power supply, but may be operated directly via a DC supply. Acquired spectral data are transferred to a PC via a USB or Ethernet interface. A compact broadband, visible light source [halogen] is also available, covering the whole spectral range from 380–2500 nm. Easy connection of light guides and fiber-optic probes is possible using standard SMA connectors on the front panel.



[tecSpec® Family]

### [Short Time-to-Market with tec5 Technology]

- Proven high-end components
- Various software development kits
- Direct support for system integrators
- Continuous enhancements

### Customized Integrated Subsystems

These customized spectrometer units contain all the necessary components to be used in manufacturing and quality inspection systems. Functionality, housing design and special test parameters are implemented according to the specific requirements of the customer's particular application. The subsystems may be combined with additional components such as light sources, fiber-optics, mechanics and options for data preprocessing and process interfacing. The housing can be adapted to the requirements on dimensions or environmental conditions.

### [Advantages]

- Reduces customer's engineering/development cost and time-to-market
- Easy integration by custom-tailored external interfaces
- Lower complexity and improved subsystem reliability
- Designed to meet EMV/ESD requirements
- Production, testing, stock and logistics provided by tec5



[CAD Design]



# Embedded Spectroscopy

## Industrial Smart Sensors

In the development process of our new embedded platform tecSaaS® [tec5 [Spectrometer as a Sensor]] we had one goal in mind: To realize intelligent, highly available and autonomous spectrometer systems, which can be integrated directly into machines or production plants.

Thanks to the complete integration of the processing and readout functions into the tecSaaS® spectrometer device, measurement results can be transferred directly to the processing unit using various process interfaces [e.g. Modbus/TCP]. A separate [Win] PC is not needed anymore. The tecSaaS® technology platform consists of a predefined electronic architecture [tecSaaS® CB], as well as comprehensive firmware and embedded software.

This extends the tec5 product portfolio with various embedded systems, which can be customized to project-specific requirements. tecSaaS® is also used as generic platform for the realization of specific OEM projects. It is compatible to all detectors, spectral sensors, light sources and optical accessories, which are offered within the traditional

PC-based system series of tec5. This ready-to-use embedded infrastructure ensures the fast realization even of small instrument series.

Systems based on our new tecSaaS® platform can be a big step towards the goal of smart, networked process sensors. This matches today's most frequently demanded requirements of our customers and of the Industry 4.0 initiative.

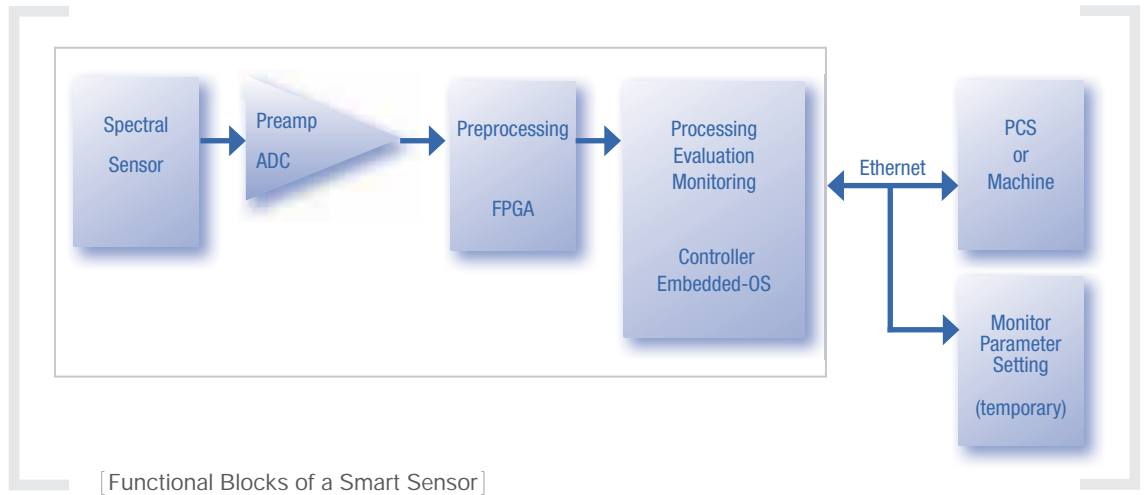


[tecSaaS® CB Core Electronics]

## Built-In Evaluation

The core of tec5's embedded spectrometer unit is its data processing capability, which implements all the important standard algorithms to perform calculations [incl. chemometrics] and evaluations of spectral data in the on-board controller. The tecSaaS® embedded platform is highly

modular and covers all necessary steps to obtain process-ready values without a PC. An application can be implemented quickly and easily without the need for programming. Parametrization and monitoring is done by temporarily using the software tool MPT via Ethernet.



[Functional Blocks of a Smart Sensor]



## UV-VIS-NIR and Raman Spectrometer Systems

### Spectrometer Systems for Process and Laboratory

tec5 offers high-quality diode-array spectrometer systems for UV-VIS-NIR and Raman spectroscopy to cover a wide range of applications and demands. You receive state-of-the-art products, with short lead times and a good cost/performance ratio. Based on diode-array technology, compact setups with high speed operation are possible.



[MultiSpec® Raman System with Fiber-optic Immersion Probe]

#### [Features]

- | Spectral ranges from 190–2150 nm [UV-VIS-NIR]; 300–3100  $\text{cm}^{-1}$  [Raman]
- | Fiber-coupled systems provide high flexibility
- | Communication interfaces to process control systems [PCS]
- | Simultaneous operation of up to 8 sample channels
- | Parallel operation of different spectrometer types
- | Long-life, high stability light sources
- | Drift-free operation thanks to internal referencing
- | SMA interface for the connection of fiber-optics and probes
- | Service and support – includes the offer of periodic maintenance contracts

[MultiSpec®] is a modular spectrometer system based on the flexible 19"-chassis design.

[CompactSpec® II] is a fast, robust UV-VIS-NIR spectrometer system in a stainless steel housing [IP54] with an integrated IPC.

[CompactSpec® II Ex] can directly be mounted in the production area with explosion-proof requirements to avoid long optical fibers.

[CompactSpec®] is a dust-protected and water-proof spectrometer system designed for the harsh conditions of process and field use.

[NIRON II] reflection head has an integrated light source and is optimized for reflectance measurements in contact mode.

### [Spectrometer Systems & Contact Measurement Head]



[CompactSpec® II Ex]



[CompactSpec®]



[NIRON II]



## Software Solutions and SDKs

### Process Software

MultiSpec® Pro II is the new generation of our process-proven spectrometer software package with improved usability and flexible display of spectra, results and trend charts. Incorporating a modern .NET design, MultiSpec® Pro II succeeds as a reliable, modular software package for laboratory and PAT applications. A step-by-step parameterization

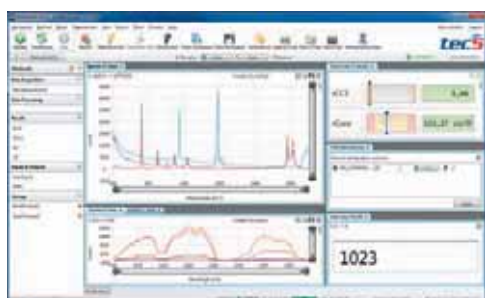
simplifies the operation. The software package can be tailored to customer requirements with regard to data analysis [chemometric predictors, colorimetric evaluation, peak fitting], user management and process communication [OPC DA, PROFIBUS, 4-20mA].

#### [Five packages are available]

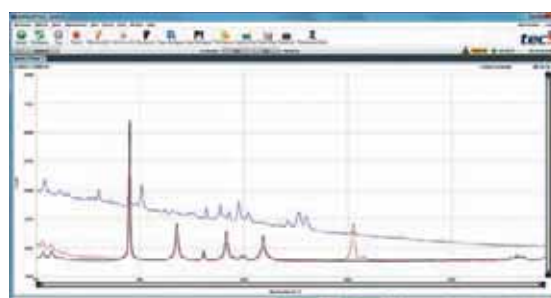
- MultiSpec® Pro II Basic
- MultiSpec® Pro II Standard
- MultiSpec® Pro II Process
- MultiSpec® Pro II Raman
- MultiSpec® Pro II Agro



[MultiSpec® Pro II Result View]



[MultiSpec® Pro II Flexible Window Layout]



[MultiSpec® Pro II Raman Package]

### Software Development Kits [SDKs]

Software Development Kits enable customers to program their own application by leveraging existing tec5 software components for simplified access to our electronics or spec-

trometer systems. These software products are offered for all current Windows platforms. Please contact tec5 for support of alternative operating systems.

### Project Specific Customization

tec5 offers consulting, conception and custom-tailored development for special requirements, specific software modification or complete application software. This covers a wide range of software technologies comprising Windows-based programming, alternative operating systems and embedded solutions.

Based on our existing products, additional data processing, analysis, storage options and customized GUIs and HMIs can be created efficiently.



## Custom Solutions

### Contract Development

tec5 offers efficient custom development of electronics and spectroscopic systems with a team of highly experienced engineers who have years of experience designing and operating optical measurement systems. Customers can take advantage of in-house knowledge and capabilities, supported by a comprehensive cooperation network with leading manufacturers of related key technologies.

#### [Capabilities]

- | Consulting and feasibility studies
- | Optical, electrical and mechanical design
- | From concept studies to series products
- | Light sources, light guides and optics adaption
- | PC-based and embedded software solutions
- | Conformity to regulatory requirements



© tec5 AG



© Atotech



© CLAAS



© YARA

[Custom Solutions | Designed and Manufactured by tec5]

### OEM Production

In close cooperation with our customers and taking advantage of their application specific experience, tec5 produces custom-designed components, spectrometer units or complete instrumentation for many different optical measurement tasks.

#### [Benefits]

- | Batch and series production [ISO 9001 certified]
- | Focused on small and medium quantities
- | Experienced and qualified production staff
- | Stocking and consignment
- | Spare part management and logistics
- | Contract service and repair
- | Certified QC system and data documentation

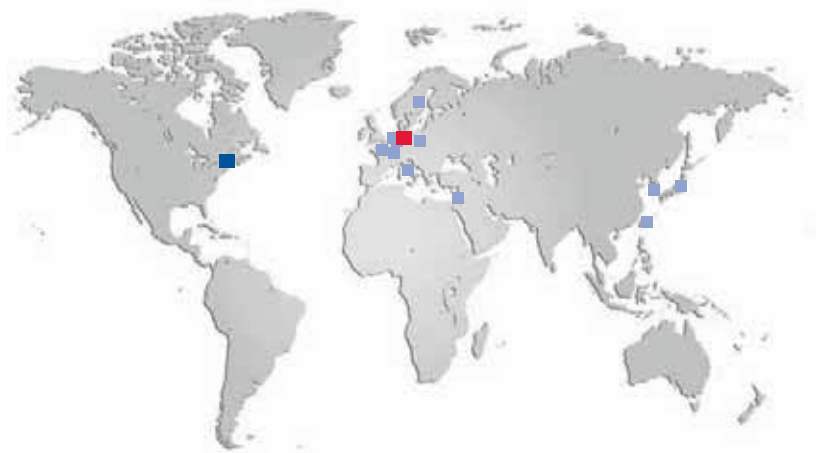


© Zunhammer

[VAN-CONTROL 2.0 | Designed and Manufactured by tec5]

# Customer Advantages

## Worldwide Distribution



■ Headquarters tec5 AG

■ tec5USA Inc.

■ Distributors

[Competent sales, engineering and service partners in Europe, America and Asia.]

## Core Competencies

- Far-reaching knowledge in optical spectroscopy and many years of experience in various applications
- Modular standard components, systems and customer specific instruments
- Complete solutions with high-quality products, competitively priced
- Prototyping, single unit and series production
- Consulting and excellent technical support
- Close cooperation with technology leaders
- Reliable partner with strong financial background



[tec5 has been certified according to ISO 9001 since 2000]

## Service & Support

Our service department guarantees a fast and professional handling of your queries and requests.

[Contact: [service@tec5.com](mailto:service@tec5.com)]

### [Our Services]

- Periodic maintenance of your spectrometer system
- Feasibility studies and application support
- Repair of all tec5 products, at tec5 and at customer site
- Delivery and installation of equipment with training for operators
- Individualized customer training
- Provision of replacement units

## Quality & Responsibility

tec5 AG is very conscious of its social responsibility and the influence of its business activities on both society and the environment. This particularly applies in preservation of the environment, as well as the safety, health and rights of people.

- Conflict Minerals
- REACh
- RoHS





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