

## tec5 Software Modules for Diode Array Spectrometers for Windows Operating Systems

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### [ Architecture ]

The tec5 Software components for spectral data acquisition and processing have a modular design. In this way, they comply to a variety of requirements and allow flexible adaption to diverse hardware configurations.

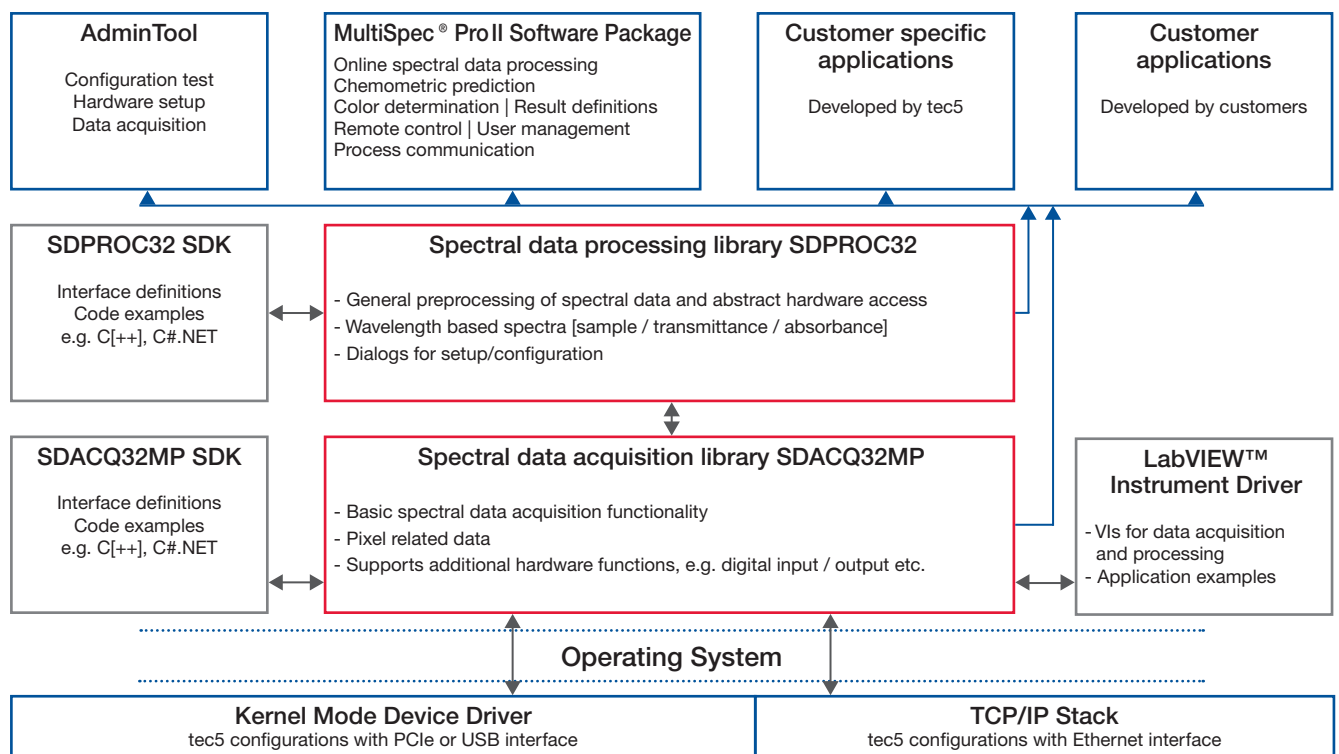
For the range of spectrometer components and systems offered by tec5, device drivers are available for supported Windows OS. The library SDACQ32MP directly accesses these device drivers providing functions allowing to configure the operating electronics and to acquire spectral data. All tec5 software products are

based on this function library. The test application AdminTool and the required device drivers are available free for download from the tec5 website to operate the spectrometer systems and hardware components from tec5.

The software application MultiSpec® Pro II is offered as a comprehensive, modern program package for near process laboratory and in-process applications. It is characterized by simple, intuitive operation with high modularity and flexibility.

### [ Functions ]

- Data acquisition and parameter setting for diode array spectrometers
- Supports spectral sensors and photo diode arrays based on different technologies in the UV-VIS-NIR spectral range
- Instrument control, including tec5 light source cassettes and multiplexers
- Supports multichannel spectrometer systems
- Selection of sensor modes of operation [synchronous/asynchronous, triggered, sensor cleaning, etc.]
- Data preprocessing: offset/dark correction, averaging, linearization, interpolation, etc.
- Storage and loading configuration data to/from instruments [for automatic configuration detection]
- For supported Windows operating systems
- Kernel-Mode drivers for USB and PCIe based configurations
- Software development kits [SDKs]
- Standard software: AdminTool and MultiSpec® Pro II
- Custom programming and adoptions



[ Figure 1: Simplified structure of the Software Components ]

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### [ Windows Kernel Mode Device Drivers ]

PD-USB01 device driver, PD-PCIe01 device driver

The tec5 interface electronics with PC-Bus Interface [PCIe, USB] are supported by proprietary device drivers developed by tec5. As an extension to the operating system, they manage the direct communication with the corresponding electronics hardware. The drivers are accessed by the programmer interface

[API] of the function library SDACQ32MP. This library is used for configuring and parameter setting of the operating electronics. In addition, it provides a set of readout modes, data acquisition functions and several additional control functions [e.g. for digital I/O].

### [ Software Development Kits [SDKs] ]

With the intention to enable customers programming their own application software, the SDKs contain files and documentation for the suitable function library. The declaration files for functions and constants primarily support the programming languages C, C++ and C# for direct implementation. In principle, program development is possible with any development environment and

programming language capable of using standard Windows DLLs. The SDKs also contain a number of programming examples. The libraries **SDACQ32MP** and **SDPROC32** are provided as 32 and 64 bit modules. The SDK types contain different control and processing capabilities in terms of hardware abstraction and included functionality.

### [ Software Development Kit for SDACQ32MP ]

Product-ID: 11-2010022-00 | SDACQ32MP SDK

This SDK is used to directly access the SDACQ32MP.DLL, the common baseline of all tec5 software products. It provides a large number of functions allowing to set hardware parameters, spectral data acquisition and supporting additional functions [e.g. digital-I/O].

The device drivers of the operating electronics in use are accessed directly by the library, taking into account their specific hardware properties. In this way, as far as possible, hardware independent spectral data acquisition is possible, i.e. a number of different hardware architectures can be accessed by a single software interface. In turn, this enables programmers to design application software which operates independent of the operating electronics type.

The function library allows to access several operating electronics of the same type concurrently, making quasi-simultaneous acquisition of spectral data from different sensors possible.

The modules of the tec5 operating electronics contain EEPROM memories, to which identification information is stored. After reading and processing this information, the function library uses it for automatic parameter setting. The SDACQ32MP forwards the inquired spectral data as pixel-related sample data. In addition to optional averaging and dark correction, no further data processing is done in this library.

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### [ Software Development Kit for SDPROC32 ]

Product-ID: 11-2010029-00 | SDPROC32 SDK

The SDK is used to directly access the function library SDPROC32.DLL. Based on the SDACQ32MP, the library SDPROC32 provides a software interface with further hardware abstraction and basic spectral data processing functions generally used in spectroscopy applications.

It provides standard functions like interpolation, calculation of transmission and absorbance, joining of two sensor channels as well as a set of data preprocessing functions [e.g. baseline correction].

This SDK contains functionality at a higher abstraction level, passing conditioned data to the application software [wavelength oriented, interpolated]. Spectral data and calculated

transmission / reflection /absorbance spectra are accessed via logical channels. For this purpose, integrated dialogs for parameter setting and a configuration wizard are provided. The wizard generates and administrates an INI-file containing the configuration and parameter details for the hardware in use. The hardware independent interface allows to add and use future operating electronics to existing application software, in most cases without program modifications.

The SDPROC32 library is used by most spectrsopcopy application programs developed by tec5 [e.g. MultiSpec® Pro II].

### [ Summary SDACQ32MP SDK compares to you SDPROC32 SDK ]

SDACQ32MP SDK	SDPROC32 SDK
Direct access to all hardware functions	Uses SDACQ32MP functionality
Provides pixel related raw data	Provides wavelength related, interpolated data
Physical channel assignment	Logical channel assignment
Direct digital I/O and Light Source Control	INI file management [hardware, parameters]
Generic I2C access functions	Hardware transparent to the application
Dark correction, Linearization	Configuration wizard and dialogues
	Spectroscopy processing functions

### [ Software Development Kit for LabVIEW™ ]

Product-ID: 11-2010023-00 | LabVIEW™ Instrument Driver

The programming environment LabVIEW™ from National Instruments is commonly used for graphical design of process software applications. LabVIEW™ instrument drivers are offered by tec5 for direct access to tec5 operating electronics. They contain a number of sub-VIs, reflecting most of the functionality available in the SDACQ32MP library. In addition to these functions, numerous sub-VIs for spectral data processing are contained.

- Calculation of the wavelength table from the sensor calibration coefficients
- Interpolation of spectral data
- Absorbance and transmission calculation
- Spectral data export to ASCII and JCAMP files

Example applications for the USB operating electronics are included, showing operating electronics configuration as well as spectral data acquisition and processing steps

### [ AdminTool ]

Product-ID: 11-2010026-00 | AdminTool

The AdminTool is an application software for use with tec5 operating electronics and spectrometer systems, for test and parameter setting purposes. It is used to acquire and display of pixel-related spectral data, to enter e.g. sensor parameters [sensor type, pixel count, sensor coefficients] and to permanently store these

parameters to the hardware. The acquired spectral data may be exported in ASCII format for further processing. The AdminTool exclusively uses the function library SDACQ32MP for spectral data acquisition.

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## [ MultiSpec® Pro II ]

Product-ID: 11-2010400-00 | MultiSpec® Pro II Process    11-2010402-00 | MultiSpec® Pro II Basic    11-2010404-00 | MultiSpec® Pro II Agro  
11-2010401-00 | MultiSpec® Pro II Standard    11-2010403-00 | MultiSpec® Pro II Raman

Based on up-to-date .NET technology with a new program structure and visualization, the application software MultiSpec® Pro II is the latest generation of process software for tec5 products offering outstanding usability. The modular program package offers extensive measurement and processing capabilities. With special focus on process applications, it boosts spectroscopy by versatile data acquisition, display,

processing and export functions. All tec5 operating electronics and spectrometer systems are supported. The Software is offered in five versions [MultiSpec® Pro II Basic, Standard, Process, Raman and Agro]. It may be upgraded by optional add-in modules e.g. for color evaluation, connection to GPS device or process communication.

## [ Customer Specific Solutions ]

If the desired software solution has special requirements, customized application programming may be designed and implemented by tec5. To this end, our programming experts have access to variety of existing software components available internally and to their experience from developing many standard and specific applications. For realization in Windows operating systems, e.g. technologies like C# with .NET & WPF or native C++ may be applied. Simple solutions sometimes may

be even implemented directly as an extension to an MS Excel application. In addition to a custom-developed application, extensions to our existing software products may be a good solution, depending on the application scenario and requirements. For example, MultiSpec® Pro II takes advantage of up-to-date technologies for efficient implementation of custom evaluation algorithms [as plug-in] or to generate customized user interfaces [using WPF].

## [ System Requirements ]

1. Drivers, SDACQ32MP/SDPROC32 SDKs and AdminTool
  - Operating system: 32 or 64 bit Windows 7 [SP1], 8 or 10
  - CPU: with SSE2-support [e.g. Pentium 4 or comparable or newer CPU]
2. LabVIEW™ Instrument Driver
  - In addition to 1.: LabVIEW™ development environment [32 bit version]

3. MultiSpec® Pro II
  - Operating system: 32 or 64 bit Windows 7 [SP1], 8 or 10
  - CPU: with SSE-2 support [e.g. Pentium 4 or comparable or newer CPU]



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