OEM Electronics for InGaAs Arrays

Modular Components for NIR Spectroscopy

tec5 five
Technology for Spectroscopy

Key Features

- high precision and high dynamic range
- fast readout with
  15 or 16 bit A/D conversion
- various PC interfaces supported

Application Areas for InGaAs Technology

- humidity
- protein content
- layer thickness
- organics concentration

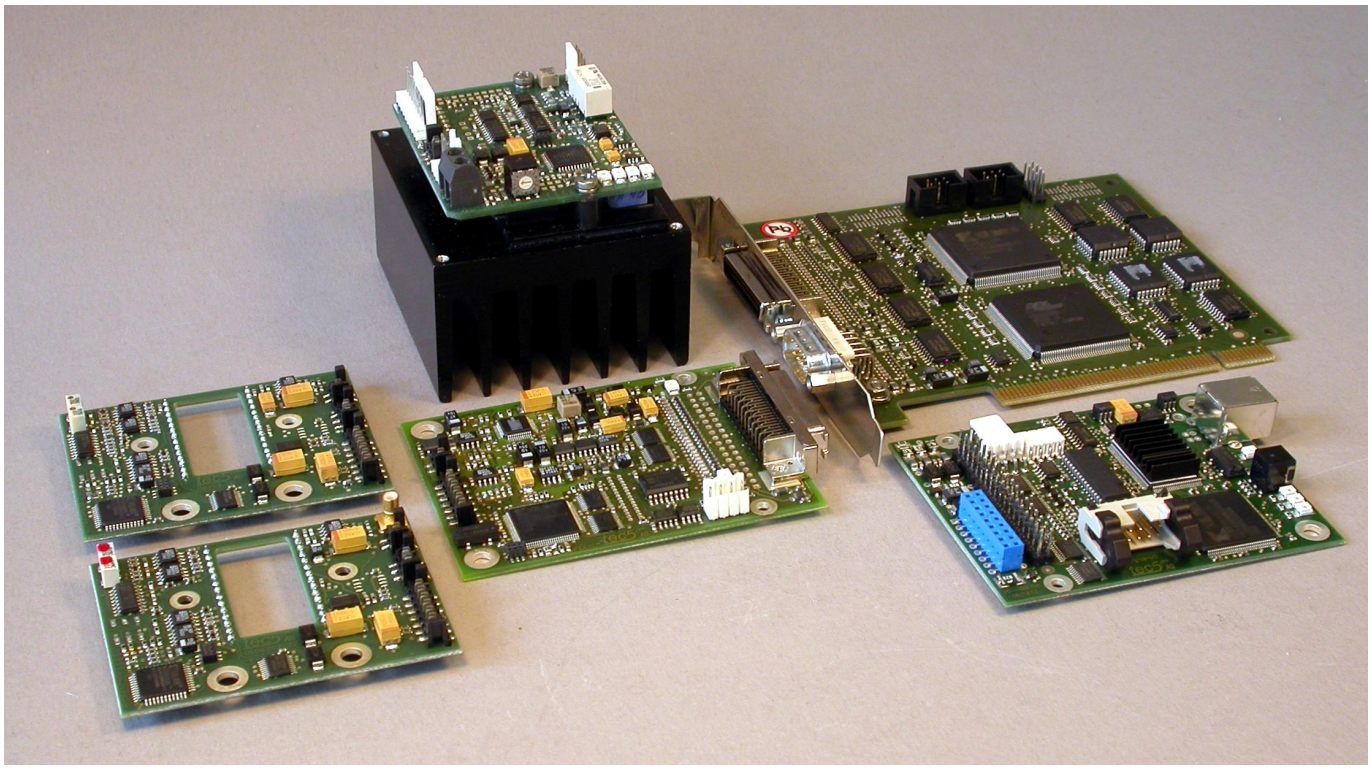

Figure 1: Electronics modules for InGaAs arrays

General

A number of modules is available supporting linear multiplexed InGaAs arrays from several manufacturers. These include standard InGaAs sensitive in the wavelength range between 900 nm and 1700 nm and extended InGaAs sensitive up to 2500 nm maximum.

In addition, the electronics modules can be used to operate Spectral Sensors types PGS-NIR manufactured by Carl Zeiss, based on InGaAs arrays supported. In most cases, the detector arrays are Peltier-cooled for operation, with cooling control electronics used to stabilize the detector temperature.

Data are passed to follow-on processing by various interfaces, e.g. PCI, USB or Ethernet for a standard PC or by a parallel interface to a customer microcomputer's digital I/O.

Charcteristics

- 128, 256 and 512 pixel arrays supported
- Carl Zeiss PGS-NIR sensors supported
- 15 or 16 bit A/D conversion
- Fast readout operation
  allowing acquisition rates of
  up to 1000 spectra per second
- Cooling module available
  for 1..3 stage Peltier elements
- Available PC interfaces:
  - USB
  - PCI
  - Ethernet
  - other (contact tec5)
- Customization available

Electronics Block Diagrams

Several electronics modules are used with the arrays or Spectral Sensors according to the block diagrams shown in figures 2 and 3. The function of each of the blocks is described in detail below.

PCI-based Configuration

A dedicated interface electronics board is plugged into a PC with PCI slot. The other boards and the sensor are designed for being included into a customer's housing, connected to the PC by a 40-pin interface cable available in standard lengths of 2 m or 5 m.

All signal electronics, drawn in blue in figure 2, are supplied from the PC's internal power supply. Only the DC supply voltage required for Peltier cooling has to be provided externally.

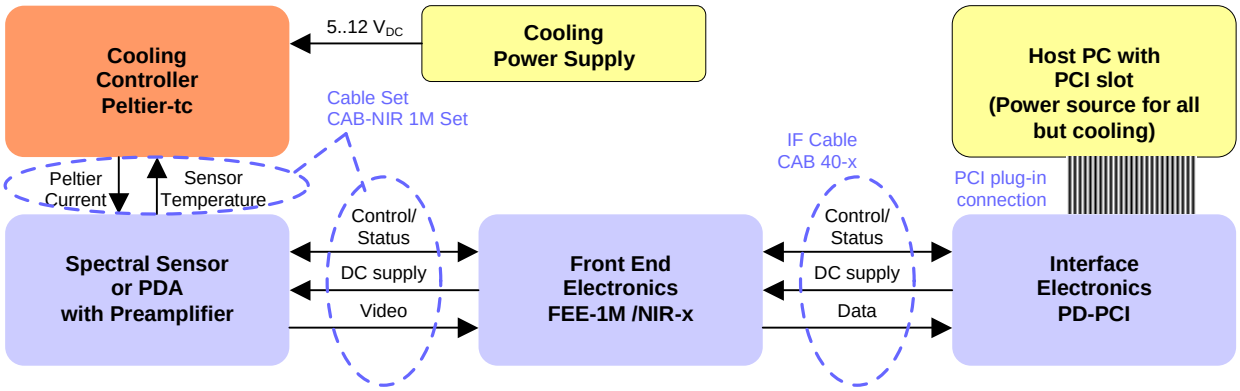

Figure 2: Block diagram of PCI-based electronics

USB- / Ethernet based Configuration

The USB- / Ethernet- based interface electronics with the Front End Electronics are supplied externally by an additional power supply (self-powered USB device). The electronics is connected to the PC by a standard USB or Ethernet interconnection cable according to the block diagram shown in figure 3. Although the electronics are compatible to the older standards USB 1.1 or Ethernet 802.3 10Base-T, we recommend to use a Hi-Speed USB 2.0 port or an Ethernet 802.3 100Base-T interconnection for best performance.
For high speed versions FEE-1M, Hi-Speed USB communication 100Base-T Ethernet is mandatory.
All electronics boards are designed for integration into a customer's housing.

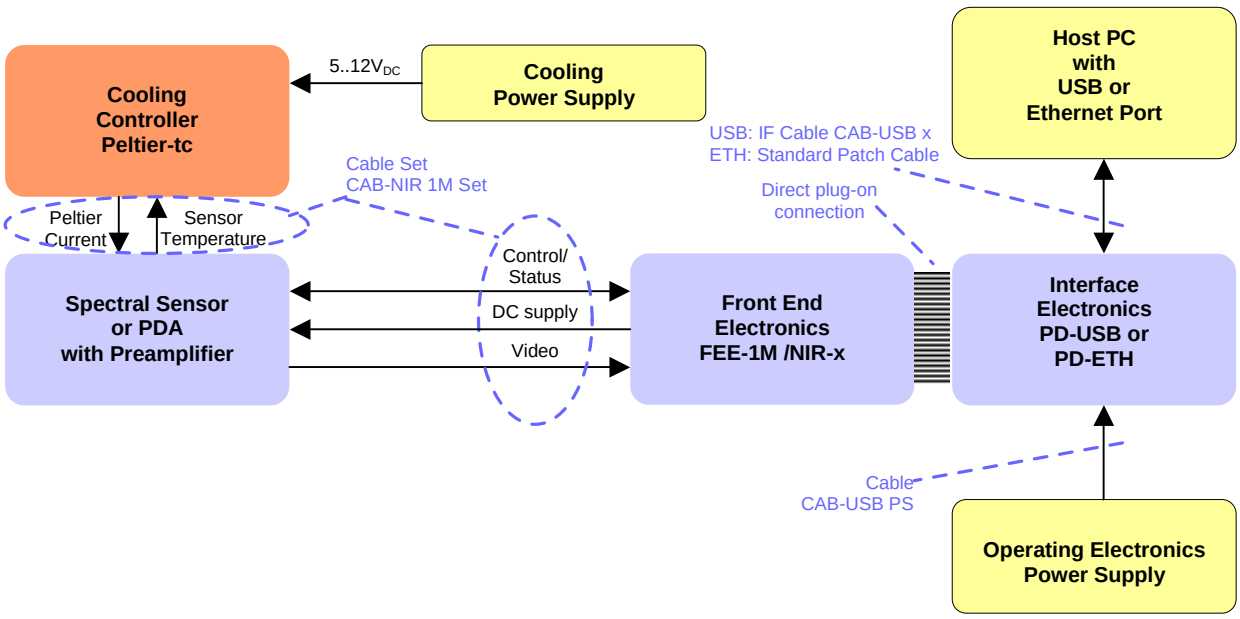

Figure 3: Block diagram of USB- / Ethernet based electronics

Sensor Preamplifier Modules

For each array type supported, a dedicated preamplifier module is available, where the sensor array can be directly plugged onto this board. The electronics contains circuitry which should be located in close proximity to the detector array.

Available sensor preamplifier modules

- **DZA-VVIR-LD** for Sensors Unlimited InGaAs array types SUxxx-LD and SUxxx-LX with RT or T1 pinout.
- **DZA-VVIR-HM** for Hamamatsu InGaAs array types G9211-G9214 and G9205-G9208.

For each of the arrays mentioned, compatible types may be available and can be possibly operated with one of the preamplifiers. Additional arrays can be supported by modifications of the sensor board. In case of any uncertainty, please contact tec5 to assure compatibiliy.

For cooled operation of the InGaAs array, appropriate heatsinking has to be considered to remove thermal power dissipated by the detector array and by the Peltier element. A rectangular clearance in the sensor circuit board allows to attach a heat conductor to the bottom of the photodetector array for this purpose.

If a Carl Zeiss spectral sensor type PGS is used, heat-sinking is provided with the module.

Cooling Controller

The electronics module Peltier-tc is a universal cooling controller unit, which has been specifically designed to operate cooled photodiode arrays. Containing a linear PI-type control circuit, possible interactions and cross-talk to the weak optical signal are minimized. Depending on the system configuration, a temperature stability of less than 0.1 K can be achieved.

All important parameters for control loop operation are selectable on the board. For known temperature sensor and Peltier element parameters, factory preconfiguration of the module is possible. In addition, the electronics board allows to connect heatsink thermistors or remote switches to shut down cooling in cases of failure. Relay contacts are available allowing to disrupt the power supply of attached electronics (e.g. the sensor preamplifier) if the sensor temperature is out of its control limit.

The module offers a maximum cooling current of 3 A with adjustable current limit. It is supplied by a DC voltage in the range between 5 V and 12 V. For specifications and configuration details please refer to the technical data sheet of the module.

Front End Electronics

Featuring 16 bit A/D conversion, the **FEE-1M** supports all tec5 sensor preamplifier modules for InGaAs arrays. Sensor readout is performed at a rate of 500 or 1000 kpixels per second, allowing to read up to more than a thousand full spectra per second.

Matching different types of interface electronics and diode arrays or sensors, various board versions of the FEE-1M are available from tec5. Please refer to the configuration details below or to the FEE-1M technical data sheet for additional information concerning the FEE-1M board versions.

Interface Electronics

Depending on the preferred type of connection to the host PC, a PCI plug-in Interface Electronics, a USB-type or an Ethernet-type Interface Electronics may be used. Other alternatives for interfacing are available, please contact tec5 for details.
The interface electronics modules retrieve digitized data from the Frontend Electronics and forward the data to a host PC. The electronics circuitry contains the readout scan cycle control logic with precise integration timing and hardware sequencing of all functions with real-time requirements. A FIFO buffer memory is used to assure consistent data transfer to the computer's main memory.
The Interface Electronics modules offer peripheral control and synchronisation with digital I/O lines, e.g. flash trigger output, external trigger input and general purpose digital I/O lines.

Operating Carl Zeiss PGS Spectral Sensors

If ordered as OEM spectral sensor modules, the PGS-NIR series manufactured by Carl Zeiss is supplied with sensor preamplifier electronics manufactured by tec5. For operation, a tec5 Front End and Interface Electronics and a cooling controller are required.

Software Support

For configurations based on Interface Electronics manufactured by tec5, Windows 2000, XP and Vista drivers and the AdminTool program can be used for verifying hardware operation and simple data acquisition. In addition, various application programs and programming libraries are available from tec5. Please contact us for alternative operating systems or custom software development.

Configuration Details

For each sensor supported, the basic hardware configuration is shown in figure 4. The tables below contain detailed ordering information for the most popular sensors and interfaces.

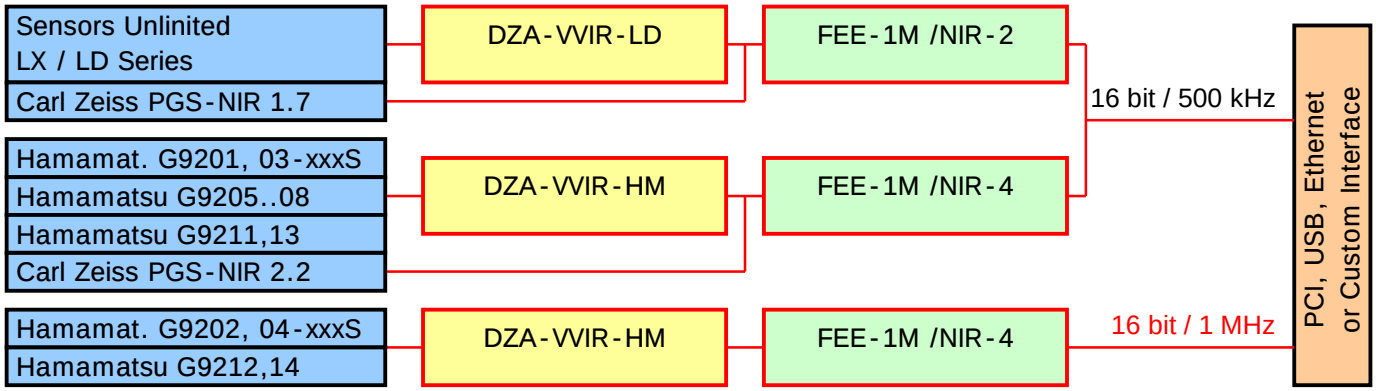

Figure 4: Configurations overview

USB / Ethernet Configurations

Sensor Type	Preamplifier	Front End	Interface	Cooling	Cable Assy
SU LX or LD Sensors Unlimited	DZA-VVIR-LD 11-0106253-00	FEE-1M /NIR-2 EMB 11-0106107-31	PD-USB01V2 /STD 11-0106015-00 or PD-ETH01V1 /STD 11-0106020-00	PELTIER-tc 11-0106550-01 one stage types* PELTIER-tc 11-0106550-02 two-stage types* or customized*	CAB-NIR 1M Set 11-1501004-13
G9201, G9203-xxxS G9205…G9208 G9211, G9213 Hamamatsu	DZA-VVIR-HM /256 11-0106252-00	FEE-1M /NIR-4 EMB 11-0106107-41			
G9202, G9204-xxxS G9212, G9214 Hamamatsu	DZA-VVIR-HM /512 11-0106252-01	FEE-1M /NIR-4 EMB 11-0106107-41			
PGS-NIR 1.7 Carl Zeiss	Included in sensor	FEE-1M /NIR-2 EMB 11-0106107-31		PELTIER-tc 11-0106550-01	
PGS-NIR 2.2 Carl Zeiss	Included in sensor	FEE-1M /NIR-4 EMB 11-0106107-41		PELTIER-tc 11-0106550-02	

Optional for all USB configurations: USB cable CAB-USB 2, 11-1501007-00 or CAB-USB 5, 11-1501007-01.
DC power supply for signal chain NT-USB, 11-0302001-01 / Additional DC power supply required for cooling.
*Cooling of sensors: compatibility must be checked with the Peltier element and thermistor specifications of the detector array.

PCI Configurations

Sensor Type	Preamplifier	Front End	Interface	Cooling	Cable Assy
SU LX or LD Sensors Unlimited	DZA-VVIR-LD 11-0106253-00	FEE-1M /NIR-2 STD 11-0106107-30	PD-PCI01V1 /52 11-0106012-30	PELTIER-tc 11-0106550-01 one stage types* PELTIER-tc 11-0106550-02 two-stage types* or customized*	CAB-NIR 1M Set 11-1501004-13
G9201, G9203-xxxS G9205…G9208 G9211, G9213 Hamamatsu	DZA-VVIR-HM /256 11-0106252-00	FEE-1M /NIR-4 STD 11-0106107-40			
G9202, G9204-xxxS G9212, G9214 Hamamatsu	DZA-VVIR-HM /512 11-0106252-01	FEE-1M /NIR-4 STD 11-0106107-40			
PGS-NIR 1.7 Carl Zeiss	Included in sensor	FEE-1M /NIR-2 STD 11-0106107-31		PELTIER-tc 11-0106550-01	
PGS-NIR 2.2 Carl Zeiss	Included in sensor	FEE-1M /NIR-4 STD 11-0106107-40		PELTIER-tc 11-0106550-02	

For all PCI configurations: PCI interconnection cable CAB40-2, 11-1501005-00 or CAB40-5, 11-1501005-01.
Additional DC power supply required for cooling.
*Cooling of sensors: compatibility must be checked with the Peltier element and thermistor specifications of the detector array.

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