

Compact High-Speed USB Operating Electronics for Spectral Sensors and Detector Arrays

tecSpeed[®]

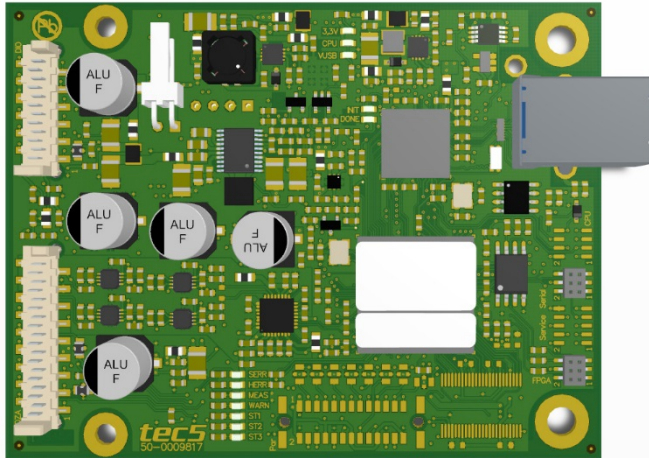
CFE-USB11

Product-ID: 06801.10

Document: tec5_2007_DS_CFE-USB11_e_201902.docx

tec5^{five}
Technology for Spectroscopy

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Short Description

- Compact, high-speed spectral data acquisition electronics with USB 3.0 interface
- Suited for **CMOS** detector arrays
- USB Super-Speed and Hi-Speed data transfer
- **Integrated Frontend Electronics**
- **16 bit A/D conversion** of the sensors' analog video signal
- **10 MSPS** spectral sensor readout rate
- Power supply with wide input voltage range of **7 V_{DC} – 24 V_{DC}**
- Dynamic range: up to > 15 bits (depending on detector array)
- Digitally adjustable sensor offset compensation
- Input from device:
Preamplifier with image sensor/PDA or Spectral Sensor
- Output to device:
PC with USB 2.0 / 3.0 port and Windows 7, 10 (32-bit / 64-bit)
- External I/O:
 - illumination control
 - scan synchronization
 - I²C
 - general purpose digital I/O (3 outputs and 3 inputs)
- PCB dimensions 87.5 mm x 67.0 mm (PD-USB or FEE standard size)

General

A member of the tecSpeed technology for high speed spectrometers of tec5, the CFE-USB11 is a new generation of spectral data acquisition electronics with an integrated analog frontend and a Super-Speed USB interface. It features a fast A/D converter with 10 MSPS readout rate for spectral sensors or preamplifiers with PDAs.

Using the CFE-USB11, the PC is able to control the Spectral Sensor connected and to read measurement data. Once parameterized and started by the PC, the onboard FPGA-powered spectral data acquisition controller provides a fully autonomous management of the selected readout cycle. It generates the control signals for the image sensor, preprocesses the analog video signal and performs analog / digital conversion. During spectral data acquisition the PC is able to perform other tasks.

All configuration data is stored in an onboard non-volatile memory. An integrated I²C bus allows additional information exchange between connected electronics (e.g. preamplifier or external electronics).

The sensor interface corresponds to specification ,Sensor_Ux'. The interconnection to the sensors modules is done via one (18-pin) flat ribbon cable.

PC and Power Requirements

For operation, a PC with a free USB 3.0 / 2.0 port and Windows 7..10 (32-bit or 64-bit). Recommended: USB3.0 with 64 bit Windows 10. The CFE-USB11 Operating Electronics is a ,self powered USB device' powered by a supply voltage of **+7 V_{DC} to +24 V_{DC}** ($\pm 10\%$, typically < 5 W).

Standard Version for CMOS

The CFE-USB11 is available in one standard version:

- **CFE-USB11 /CMOS-10**
for CMOS-type linear arrays Hamamatsu S11637, S11639, S12198 and S13496 with tec5 preamplifier DAZ-S11639 or DZA-S12198 or C-MOS based Spectral Sensors with integrated tec5 preamplifier. An additional adapter is required in certain configurations. Refer to the preamplifiers data sheets for configuration details.

Features / Specifications

- Uses the ,tec5 Spectra Acquisition IP-Core'
- Software selectable Readout Operating Modes: StartNewScan, SyncToContScan, ExternalTrigger-Slope or -Pulse, with or without 'cleaning' and acquisition of a single spectrum or a burst acquisition.
- Quartz controlled integration time
- Continuous data stream via USB during measurement, therefore, uninterrupted continuous data acquisition is possible

Functional Properties

- Sensor readout timing
- Analog video signal preprocessing, A/D conversion
- Data transfer to the PC
- Local non-volatile configuration memory, (e.g. for identification data of the preamplifier or sensor, calibration coefficients or customer specific information)

Specifications

- ADC 16 bits, 10 MSPS
- Temperature drift $< \pm 5$ counts / °C
- Offset adj. range approx. ± 3000 counts

CFE-USB11 Version with sensor type	/CMOS-10 S13496
Input sensitivity [Photo e ⁻ / counts] approx.	1.2
Standard deviation [counts] typically	< 20 (typ. 17 *)
Pixel frequency [MHz]	10
Master clock frequency [MHz]	10
Readout time [ms]	< 0.5 ms
Sensor (example) [number pixels]	(4096)
External trigger delay	< 0.2 μ s
External trigger jitter	< 5 ns

(*) Sample measured in a configuration with a Hamamatsu S13496 Array and a tec5 DZA-S11639 preamplifier electronics.

Periphery I/O:

- Integrated illumination control: trigger output for triggering of light sources
- Trigger input for external synchronization of spectral data acquisition
- Universal digital I/O: 3 outputs, 3 (latched) inputs

Miscellaneous:

- Configuration by software
- On board I²C bus for configuration data exchange
- Non volatile memory for configuration data storage

Interfaces:

- USB 3.0 series 'B' receptacle interface
- External I/O interface for trigger and digital I/O
- Power connector
- I²C bus connector

Environmental conditions:

- Temp. range operating (@V_{IN}=7.0 V_{DC}): 0 ... +60 °C
- Temperature range storage: -40 °C ... +70 °C
- Humidity (@25°C, non condensing): 10 % ... 90 %

Interfaces

The interconnection to the sensor module is done via a 18-pin connector. By using an 18-pin cable, it is possible to connect to compatible tec5 sensor modules.

Sensor interface connector (type MICS 18)

Pin	In /Out	Description
1	Input	DI1 Sensor Trigger
2	Output	DO1 Sensor StartScan
3	Output	DO2 Sensor Master Clock 2 not used
4	Output	DO3 Sensor Master Clock
5	Output	DO4 Sensor Integrator Reset not used
6	Input	DI2 Sensor EndOfScan
7	Power	Ground
8	Power	-5V Power supply for sensor module
9	Power	Ground
10	Power	+5V Power supply for sensor module
11	Input	DI3 currently not used
12	Input	DI4 currently not used
13	Bidirect.	I2C_SDA, serial data currently not used
14	Bidirect.	I2C_SCL, serial clock currently not used
15	Power	Analog Ground
16	Input	Analog In+ (non inverted)
17	Input	Analog In- (inverted)
18	Power	Analog Ground

The external I/O connector provides control signals for lamp trigger output or readout synchronization input.

External I/O connector (type MICS 12)

Pin	In /Out	Description
1	Input	Digital Input 1, CMOS
2	Power	Supply voltage output +5 V _{DC} / <500 mA
3	Input	Illumination control voltage input (ICVI)
4	Output	Digital Output 1, CMOS
5	Input	External Scan Trigger Input (ESTI), CMOS
6	Output	Digital Output 2, CMOS
7	Input	Digital Input 2, CMOS
8	Power	Ground
9	Output	Illumination control output (ICO)
10	Power	Ground
11	Output	Digital Output 3, CMOS
12	Input	Digital Input 3, CMOS

Power connector type: Molex KK 7395-2 or KK 6410-2 (Plug type: KK 6471-2)

Pin	In /Out	Description
1	Power	+7 V _{DC} to +24 V _{DC} Supply Voltage Input V _{IN}
2	Power	Ground

I²C bus connector type: AMP Quick 0-828549-4 (90°) or AMP Quick 0-828548-4

Pin	In /Out	Description
1	Bidirect.	I2C_SDA, serial data
2	Power	Ground
3	Bidirect.	I2C_SCL, serial clock
4	Power	+ 5 V _{DC} / < 500 mA power output

An optional parallel 16-bit data interface can be used for customized interfacing. It is suitable for real-time applications where a deterministic and / or low latency data transfer is required. The interface can be configured to operate at either 3.3 V or 5 V CMOS logic levels.

Parallel I/O connector type:
ERNI SMC-Q 234207

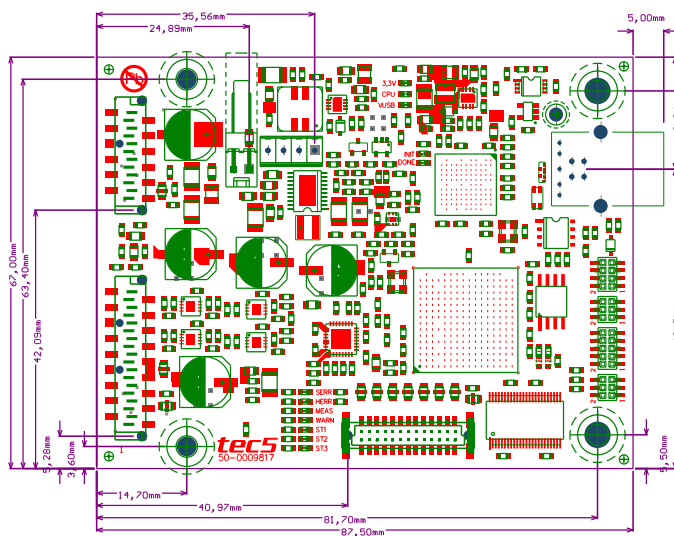
Pin	In /Out	Description
1	Power	Ground
2	Power	Ground
3	Input	Clock
4	Input	Enable
5	Output	Data Ready
6	Input	Reset
7	Output	Parallel Data Out 0
8	Power	Ground
9	Output	Parallel Data Out 1
10	Output	Parallel Data Out 2
11	Output	Parallel Data Out 3
12	Output	Parallel Data Out 4
13	Output	Parallel Data Out 5
14	Power	Ground
15	Output	Parallel Data Out 6
16	Output	Parallel Data Out 7
17	Output	Parallel Data Out 8
18	Output	Parallel Data Out 9
19	Output	Parallel Data Out 10
20	Power	Ground
21	Output	Parallel Data Out 11
22	Output	Parallel Data Out 12
23	Output	Parallel Data Out 13
24	Output	Parallel Data Out 14
25	Output	Parallel Data Out 15
26	Power	Ground

External Trigger Capabilities

In many applications, a sensor scan cycle is triggered by the PC. For synchronizing the sensor readout to an external event, the External Scan Trigger Input (ESTI) can be used. Two different modes are available: pulse (active low, falling edge) and slope mode (each slope). The external trigger functions can be controlled by software.

Design

The CFE-USB11 Compact High Speed USB Operating Electronics is a PCB with the dimensions 87.5 mm x 67 mm.



Trimming / Settings

For sensor signal offset compensation, the optical sensor

input has to be covered for dark operation. Use a spectral data acquisition software to display raw pixel data in continuous acquisition / live display mode (e.g. tec5 AdminTool) with the following settings:

- Shortest integration time, without dark correction
- View-Option Y-scale: ADC – counts
- View-Zoom Y-scale: approx. 0...200 [counts]
- Continuous acquisition

The offset compensation is done by adjusting a digital potentiometer via the I2C bus. The offset compensated baseline should be between 80 and 120 counts for CMOS sensors.

Driver and AdminTool Installation

The functionality is provided by a WDM driver for Windows 7 .. 10. The installation procedure starts automatically as soon as the Compact High-Speed USB Operating Electronics is connected to the PC for the first time.

Driver for Windows 7...10

After the first connection of the Compact High-Speed USB Operating Electronics, the user is asked for the location of the device driver. Please check our website www.tec5.com, service and support section, for the current software downloads. Select the correct driver for your operating system to start the installation the WDM driver. To allow identification of several devices connected to a single PC, the local non-volatile memory carries an identification parameter (factory preset 1).

AdminTool

In the software installation section of the tec5 website, you'll find the installation file for the AdminTool. Follow the instructions of the setup program to install the free AdminTool software.

Getting started with AdminTool

Start the test program AdminTool via Start / Programs / tec5 SDACQ function library / SDACQ32 Admin or click on the shortcut icon, if installed.

After the program start select the type of your operating electronics 'CFE-USB11' from the list. By clicking Search, the AdminTool searches for devices of that type attached to your system. If the search process was successful, the message „1 (or more) operating electronics found and opened“ appears. To display the hardware configuration, click the button ‚Show Config‘. Sensor parameters may be checked or modified in menu 'Sensors'.

The menu 'Measurement' is intended to verify that the spectral data acquisition works correctly:

- Set integration time (e.g. 30 ms)
- Set number of spectra to average (e.g. 1)
- Set mode (e.g. ‚continuously‘)
- Set delay time between two data acquisitions
- Select display type ‚Table‘ or ‚Chart‘
- Start acquisition via button ‚Get spectra‘
- Stop acquisition via button ‚Stop‘

More detailed information can be found in the 'Help' menu.

User Information

General

The information in this data sheet has been checked carefully. However, no responsibility is assumed for inaccuracies. tec5 reserves the right to make changes to any portion of this document without notice.

Each product is tested carefully before being shipped. If, however, problems should occur while initial operation or during later operation, please first check your specific settings and correct installation (connectors).

Warranty

The warranty period for this product is 12 months. The warranty begins on the day of delivery. Within the warranty period, tec5 will repair free of charge any faulty functioning of the product resulting from faulty design or defective material. All other claims are excluded, in particular consequential damage.

Handling

The electronics is partly constructed in CMOS technology and is thus sensitive against electrostatic discharge. Take appropriate precautions whenever handling the component. Please switch off the power before connecting or disconnecting the product.

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