

## Electronics for CMOS Arrays for Use in UV-VIS Spectroscopy

With the advent of new photodiode arrays, designed for spectral sensors in CMOS technology, many applications take advantage of the powerful, versatile and cost-effective detector technology. The range of CMOS linear image sensors for spectroscopy, supported by modular tec5 electronics technology, comprises high-resolution, high sensitivity types S11639 and S13496 as well as high dynamic range types S12198 and S11637, all manufactured by Hamamatsu. In addition, the

electronics modules can be used to operate Spectral Sensors or spectrometers based on these CMOS array types.

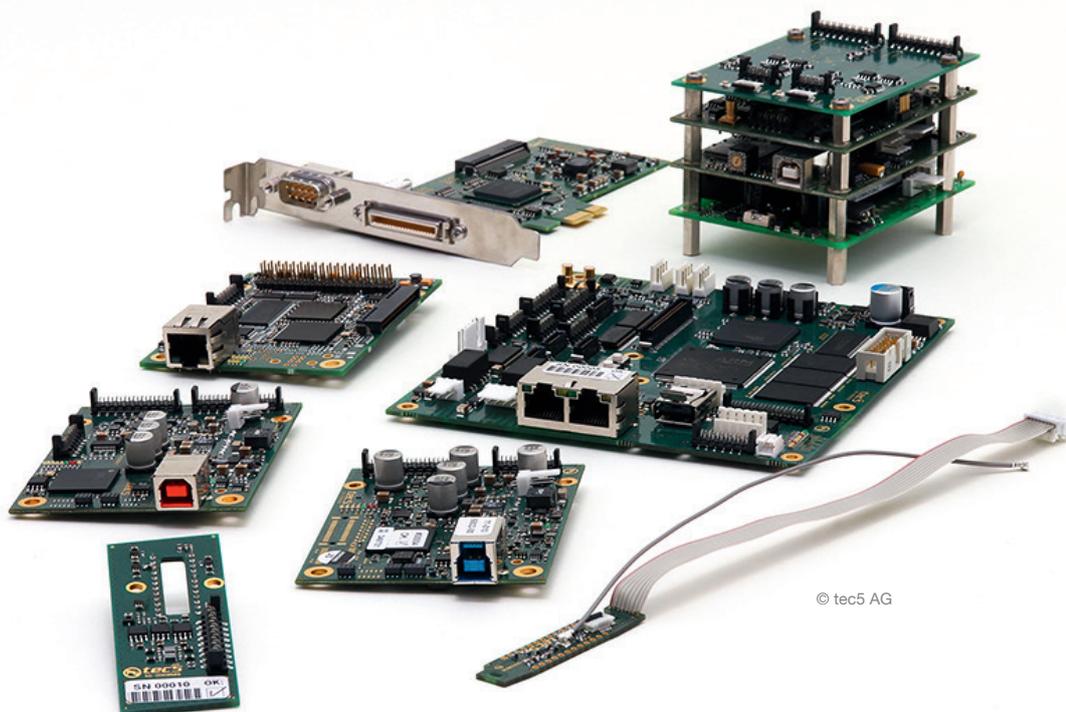
In PC-based systems, data are passed to follow-on processing by various interfaces, e.g. PCIe, USB or Ethernet for a standard PC or by a parallel interface to a customer microcomputer's digital I/O. Embedded spectroscopy systems based on the tec5 tecSaaS® platform also support CMOS diode array based sensors.

### [ Key Features ]

- High sensitivity and high dynamic range
- Ultrafast readout [up to 19,000 spectra / second]
- Precise illumination control
- Various PC interfaces and embedded configurations

### [ Application Areas ]

- Ultrafast spectral monitoring
- Short pulse laser monitoring or control
- Laser-induced spectroscopy



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[ Figure 1: Electronics modules for CMOS arrays ]

### [ Characteristics ]

- Pixel counts: 512, 1024, 2048 and 4096
- A/D conversion: 16 bit, 1 - 10 MPixel /s
- Acquisition rates of up to 19,000 spectra per second
- PC-based systems with USB, Ethernet or PCIe interface
- Embedded spectrometers with tecSaaS® platform
- Customization, e.g. real-time data processing, available

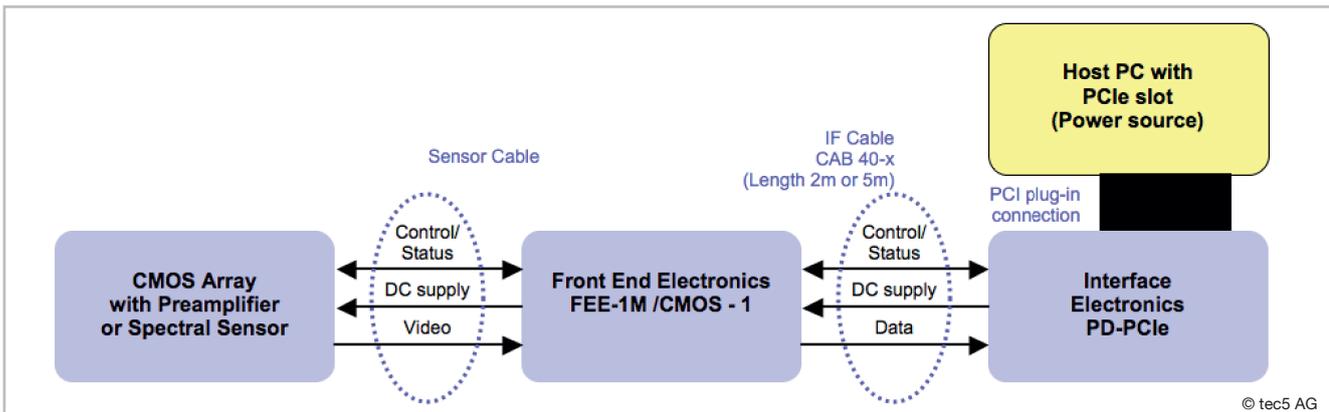
[ **Electronics Configurations** ]

**Modular PC Based Operation**

These configurations are based on a Frontend Electronics FEE-1M /CMOS-1, allowing a 1 MPixel/s A/D conversion with 16 bit resolution. The raw data is streamed to the PC. Software support is provided for Windows operating systems Windows 7 through 10 in 32 and 64 bit versions.

**PCI-based Configuration**

A tec5 PD-PCIe interface board is plugged into a PC with a free PCIe slot [minimum 1x]. The remaining boards are connected to the PC by an interface cable [CAB-40]. The system requires no additional power supply.

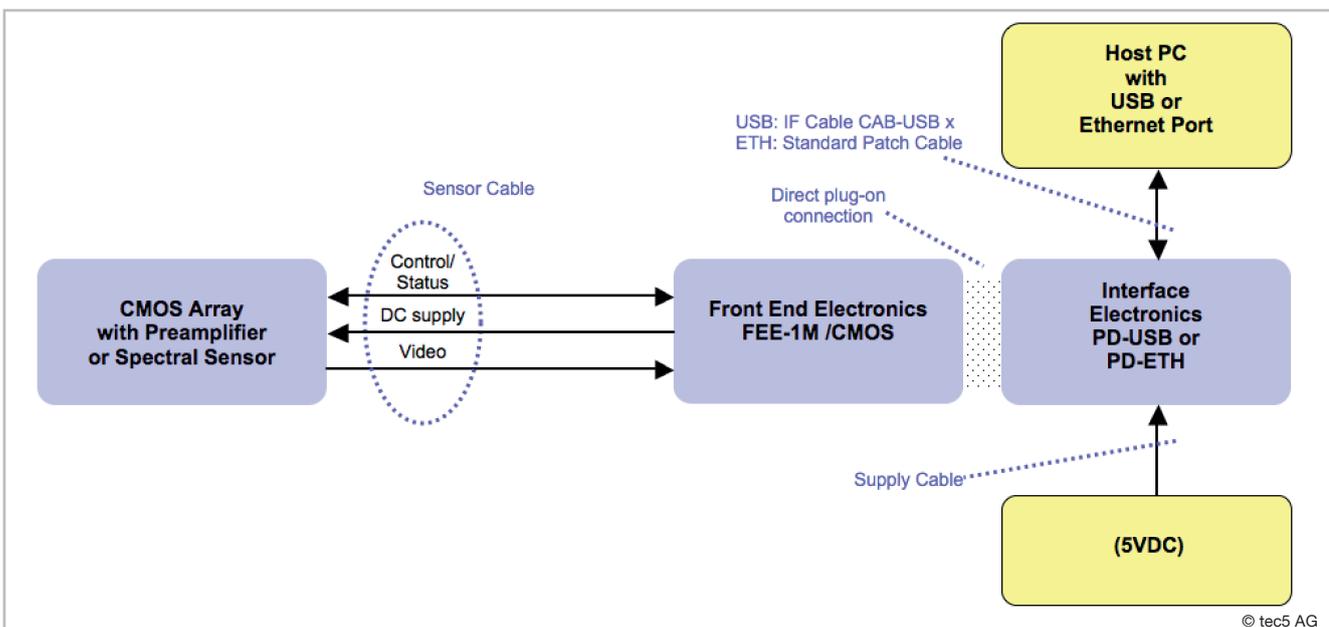


[ Figure 2: Block diagram of PCI-based electronics ]

**USB- / Ethernet based Configuration**

The interface and frontend electronics are operated by an additional power supply [self-powered]. An standard USB or Ethernet cable is used for connecting the electronics

to the PC. A Hi-speed USB or 100base-T Ethernet connection is required for operation in this configuration.



[ Figure 3: Block diagram of USB- or Ethernet based electronics ]

## [ Electronics Modules ]

**Sensor Preamplifiers**

The photodiode array is plugged into the socket on the pre-amplifier printed circuit board, containing circuitry which should be located in close proximity to the detector array.

**Available Preamplifier Modules**

- **DZA-S11639** for Hamamatsu S11639 and S13496 type photodiode arrays
- **DAA-S11639** for Hamamatsu S11639 and S13496 type photodiode arrays for connection with ADAP-AVB
- **DAA-S12198** for Hamamatsu S12198 and S11637 type photodiode arrays for connection with ADAP-AVB

**Front End Electronics**

Featuring 16 bit A/D conversion, the FEE-1M supports all tec5 1M-type sensor preamplifier modules for CMOS photodiode arrays. Sensor readout is performed at a rate of 1000 kpixels per second. Depending on the sensor pixel count and mode of operation, up to 1900 full spectra per second can be acquired.

**Available Front End Electronics**

- **FEE-1M /CMOS-1** for for all supported configurations, 16 bit, 1 MPixel / s

**Interface Electronics**

Depending on the preferred type of connection to the host PC, a PCIe plug-in interface, a USB- or an Ethernet interface may be used. Other alternatives for interfacing are available, please contact tec5 for details. The Interface Electronics modules retrieve digitized data from the Front End and forward the data to a host PC. The 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 modules offer peripheral control and synchro-

nization with digital I/O lines, e.g. flash trigger output, external trigger input and general purpose digital I/O lines.

**Available Interface Electronics**

- **PD-ETH01** for Ethernet networks
- **PD-USB01** for USB connection
- **PD-PCIe01** for PCI bus connection

**Compact Electronics and High-Speed Readout**

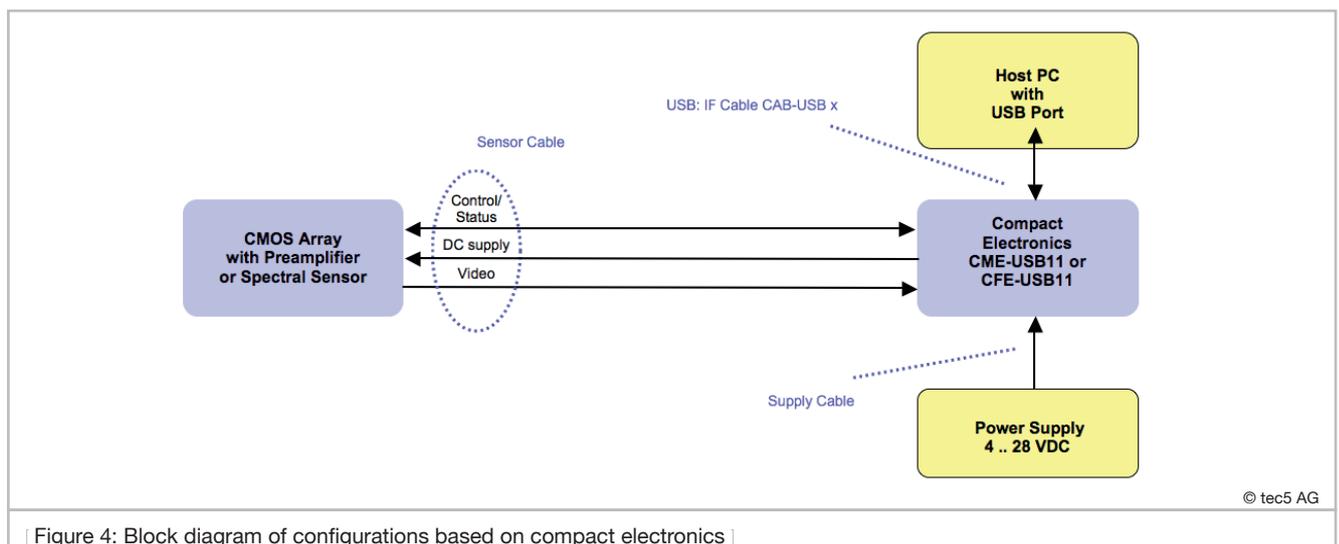
Integrated electronics boards which contain all functionality from A/D conversion to a USB interface are a good choice for use with CMOS detector arrays and their preamps to create compact, cost-effective spectroscopy instruments. The CME and CFE compact electronics are powered from a single DC voltage [wide range input] and thus do not need additional power supply components in many applications. The range of products includes the CME-USB11, a dual channel electronics with synchronous operation of two sensors, e.g. for referencing the light source intensity to achieve superior measurement accuracy. For very high-speed readout, the CFE-USB11 compact electronics has a ten times faster A/D conversion rate at 16 bit and USB Super Speed communication, allowing to acquire up to more than 19,000 spectra per second using a 512 pixel CMOS array – depending on the selected mode and sensor type.

**Available Compact Electronics**

- **CME-USB11**, 16 bit, 1 MPixel / s, dual channel, HiSpeed USB
- **CFE-USB11**, 16 bit, 10 MPixel/s, SuperSpeed USB

**Embedded Solutions**

The operation of CMOS type sensor arrays is also supported by the tecSaaS® platform for embedded spectroscopy. The spectral sensors with preamplifiers can be connected directly to the tecSaaS® CB controller base board, the firmware and software components are prepared for their operation.



[ Figure 4: Block diagram of configurations based on compact electronics ]

[ Software ]

For configurations based on Interface Electronics manufactured by tec5, drivers for current Windows operating systems are supplied. The free Admin-Tool program can be used for verifying hardware operation and simple data acquisition. In addition, various application programs and software development kits are available from tec5. Please contact us if you intend to use alternative operating systems or for custom software development.

**Software Development Kits**

- **SDK** for the function library SDACQ32MP.DLL supporting C/C++ und C#.net
- **SDK** for the function library SDPROC32.DLL with ready-to-use dialogs for data acquisition, configuration and parameter setting
- **LabVIEW** function library [Vis] for programming in a LabVIEW development environment

**MultiSpec® Pro II Process Software**

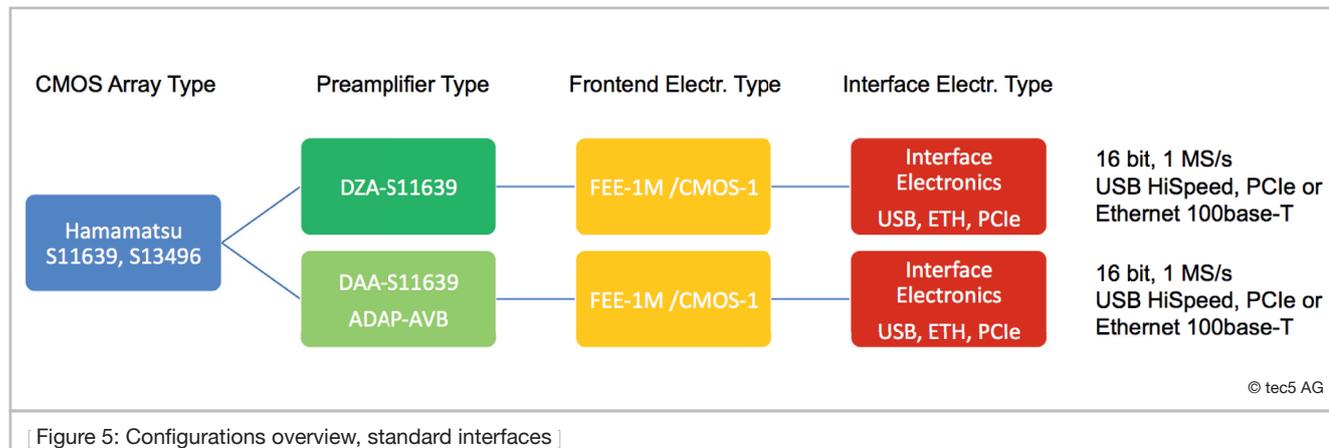
MultiSpec® Pro II is an improved new software package for laboratory and process applications. Incorporating current program environments and visualization schemes, a number of data acquisition modes, data processing and output options are provided. Five packages are offered, which range from basic data acquisition tool to application specific process software, including status information and user management. Optional modules, including prediction of chemometric models, acquiring GPS data and a number of process communication interfaces facilitate the adaption to required applications.

For minimum system requirements and operating systems compatibility please refer to the relevant software data sheets.

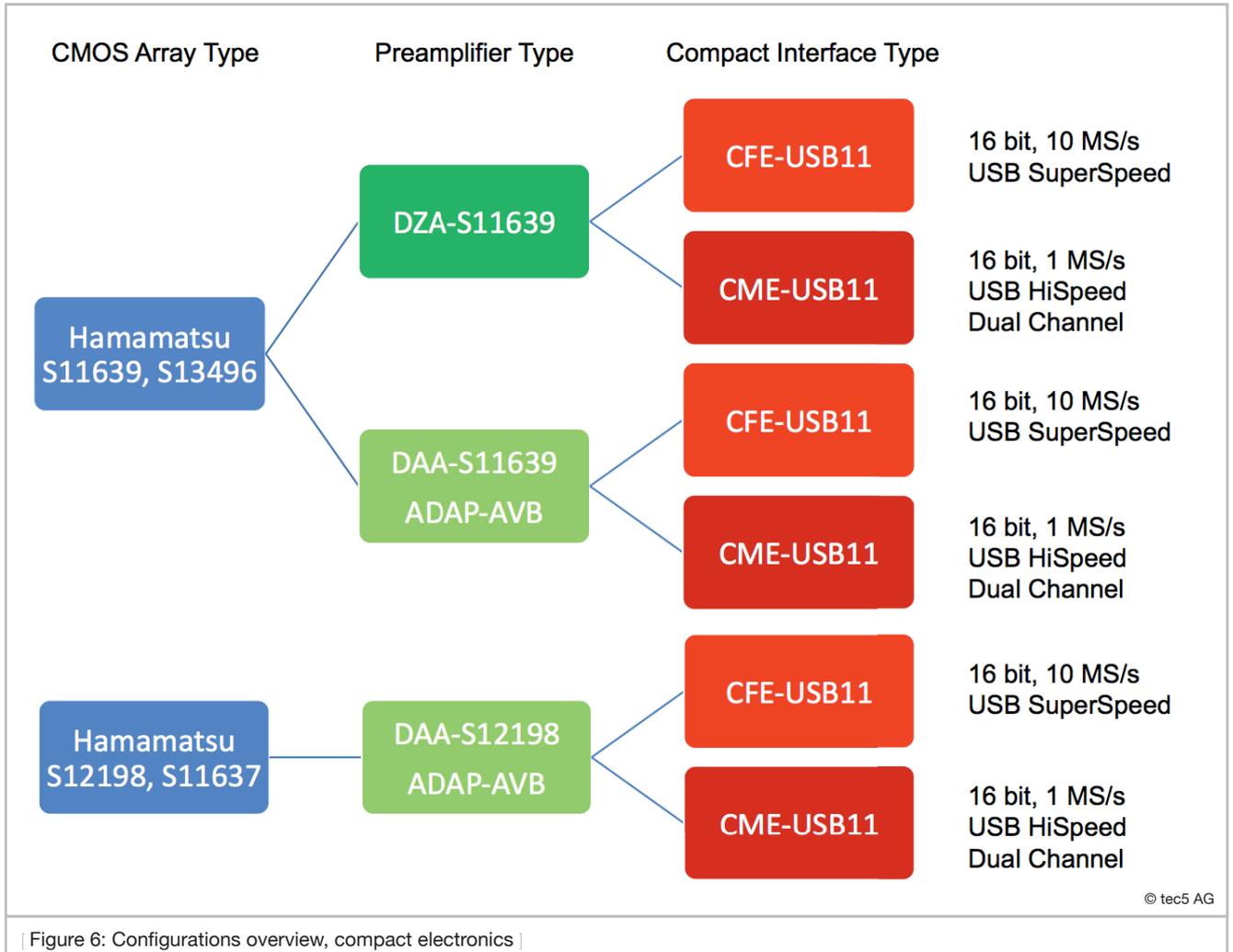
[ Configuration Details ]

For each sensor supported, the basic hardware configuration is shown in figure 5. The tables below contain detailed

ordering information for the most popular sensors and interfaces



[ Figure 5: Configurations overview, standard interfaces ]



[ Figure 6: Configurations overview, compact electronics ]

Configurations with Compact Electronics				
Sensor	Preamplifier   Adapter	Interface	Cable	Remark
S11639, S13496 Hamamatsu	DZA-S11639 /STD 11-0106238-00			
S11639, S13496 Hamamatsu	DAA-S11639 /STD 11-0106261-00 with ADAP-AVB /STD 11-0106293-00			
S12198, S11637 Hamamatsu	DAA-S12198 /STD 11-0106260-00 with ADAP-AVB /STD 11-0106293-00	CME-USB11 /STD 11-0106801-00 or CFE-USB11 /STD 11-0106802-00	CAB-MICA 18-18 11-1501026-00	Compact electronics configurations
Avabench ULS CMOS U2 or U3	ADAP-AVB /STD 11-0106293-00			
Avabench ULS CMOS yy [tec5 DAA based]	ADAP-AVB /STD 11-0106293-00			

USB   Ethernet Configurations					
Sensor Type	Preamplifier	Front End	Interface	Cable Assy	Remark
S11639, S13496 Hamamatsu	DZA-S11639 /STD 11-0106238-00	FEE-1M /CMOS-1 EMB 11-0106107-xx	PD-USB01V2 /STD 11-0106015-00 or PD-ETH01V1 /STD 11-0106020-00	CAB-MICA 18- 14-4 11-1501027-00	Standard IFE configuration
S11639, S13496 Hamamatsu	DAA-S11639 /STD 11-0106261-00 with ADAP-AVB /STD 11-0106293-00				
S12198, S11637 Hamamatsu	DAA-S12198 /STD 11-0106260-00 with ADAP-AVB /STD 11-0106293-00				
Avabench ULS CMOS U2 or U3	ADAP-AVB /STD 11-0106293-00				
Avabench ULS CMOS yy [tec5 DAA based]	ADAP-AVB /STD 11-0106293-00				
Power supply required: 4 .. 28 VDC, 300 mA approx. @ 12VDC					

PCIe Configurations					
Sensor Type	Preamplifier	Front End	Interface	Cable Assy	Remark
S11639, S13496 Hamamatsu	DZA-S11639 /STD 11-0106238-00	FEE-1M /CMOS-1 STD 11-0106107-xx	PD-PCIe01V2 /STD 11-0106015-00	CAB-MICA 18- 14-4 11-1501027-00	PCIe configuration
S11639, S13496 Hamamatsu	DAA-S11639 /STD 11-0106261-00 with ADAP-AVB /STD				
S12198, S11637 Hamamatsu	DAA-S12198 /STD 11-0106260-00 with ADAP-AVB /STD				
Avabench ULS CMOS U2 or U3	ADAP-AVB /STD 11-0106293-00				
Avabench ULS CMOS yy [tec5 DAA based]	ADAP-AVB /STD 11-0106293-00				
CAB40-* PCIe cable, 11-1501004-zz [various lengths]					