Preamplifier Electronics for Hamamatsu Back-thinned / Back-illuminated CCD Sensors series S703x and S717x

DZA-S7030-4

DZA-S7030-4-S Version 1.3

Product-IDs: 06230.13(-S), 06231.13 (-L), 06232.13(-P); 06233.10(-tc)
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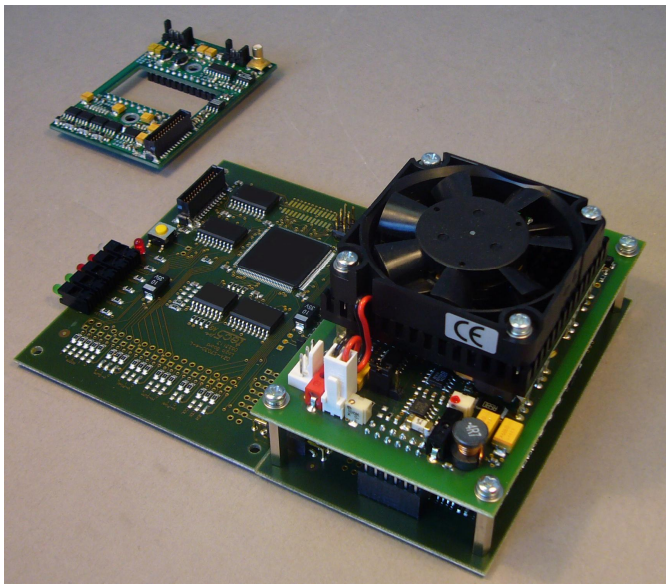
tec5 five
Technology for Spectroscopy

In der Au 27
61440 Oberursel / Germany

Phone: +49 (0) 6171 / 9758 – 0
Fax: +49 (0) 6171 / 9758 – 50
E-Mail: sales@tec5.com
Internet: www.tec5.com



Short Description

§ Preamplifier board set for Hamamatsu back-thinned / back-illuminated CCD Sensors series S7030, S7031, S7033, S7034 and series S7170, S7171
§ Optional Peltier cooling controller
§ Single supply +12 V operation
§ Input from device: CCD sensor
§ Output to device: Front End Electronics with sensor interface *‚Sensor_U2'*

General

The Preamplifier Electronics DZA-S7030-4 serves as an adaptation subassembly matching the Hamamatsu back-thinned / back illuminated CCDs series S703x and S717x to a Front End Electronics unit of a tec5 Operating Electronics (i.e. FEE-1M).

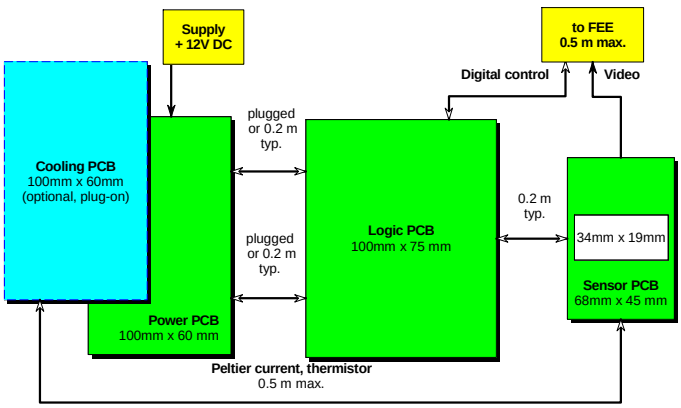


Fig. 1: Configuration of DZA-S7030-4

The unit consists of the following printed circuit boards:

- a Sensor PCB (DZA-S7030-4-S)
- a Logic PCB (DZA-S7030-4-L)
- a Power Supply PCB (DZA-S7030-4-P)
- an optional Cooling Controller PCB (DZA-S7030-4-tc)

The Logic and Power Supply PCBs may be combined mechanically to a board format of 135 mm x 100 mm for easier mounting into standard housings or frames. In most applications, the CCD array is directly plugged into the 24 pin DIL socket mounted to the soldering side of the Sensor PCB.
The interface for the Front End Electronics complies to tec5 specification *‚Sensor_U2'* (14 pin header connector for PDA control signals and SMB flange socket with pin contact or 4 pin MICS-4 connector for differential video signal) for direct interconnection to FEE-1M.

DZA-S7030-4 for Carl Zeiss MCS Spectral Sensors

For use with MCS spectral sensors from Carl Zeiss, equipped with a compatible CCD sensor, the Sensor PCB can be plugged directly onto the CCD array integrated in the spectrometer and is fastened to the spectrometer housing by means of two screws.

Features

Modes of operation

- Standard mode “line binning” (summing the vertical pixels), reading the array like a linear array
- Various alternative modes are supported by the DZA-S7030-4 (binning and imaging), depending on system configuration.
  Please contact tec5 for details.

Signal processing

- Operation in MPP-mode defined by Hamamatsu, optimizing dynamic range
- Correlated Double Sampling
- Differential video output

Cooling (optional)

- Four quadrant PI cooling possible with optional cooling board
- Automatic detection of excess detector temperature and disabling of cooling
- Analog setpoint input and monitor output

Configuration and monitoring

- Configuration and mode selection alternatively via I^2C bus or solder gaps
- Error monitoring via I^2C bus or LED’s
- Fast hardware error signal available

Technical Specifications

Supported CCD sensors

Hamamatsu back thinned / back illuminated CCDs series S7030, S7031, S7033, S7034, 7170 and 7171 (see table below). Front illuminated types S-7010 and S-7011 may be operated by tec5 preamplifier electronics type DZA-S7010-1-S. For other 2-phase, FFT-CCD sensors, please contact tec5.

Type	Cooling	Pixel count
S7030-0906	Non-cooled	532 × 64
S7031-0906	One-stage TE-cooled	532 × 64
S7030-0907	Non-cooled	532 × 128
S7031-0907	One-stage TE-cooled	532 × 128
S7033-0907	Non-cooled	532 × 128
S7034-0907	One-stage TE-cooled	532 × 128
S7030-0908	Non-cooled	532 × 256
S7031-0908	One-stage TE-cooled	532 × 256
S7170-0909	Non-cooled	532 × 520
S7171-0909	One-stage TE-cooled	532 × 520
S7030-1006	Non-cooled	1044 × 64
S7031-1006	One-stage TE-cooled	1044 × 64
S7030-1007	Non-cooled	1044 × 128
S7031-1007	One-stage TE-cooled	1044 × 128
S7033-1007	Non-cooled	1044 × 128
S7034-1007	One-stage TE-cooled	1044 × 128
S7030-1008	Non-cooled	1044 × 256
S7031-1008	One-stage TE-cooled	1044 × 256

Table 1: List of supported CCD's

Master clock (f_m): 200 kHz … 2 MHz (two preselected ranges)

Resulting readout time: see diagram

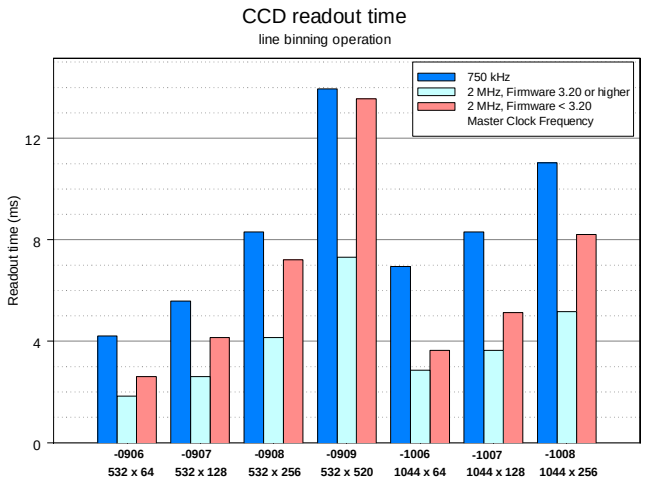


Fig. 2: Readout time calculated for two selected master clock frequencies f_m in standard line binning operation (preliminary).

Analog output:

Output range: 0 .. 20 V (differential)

Maximum load: 600 Ohm / 1 nF

Pixel readout clock: f_m / 4

Digital control inputs (TTL level):

START: Initiates a read-out cycle for the CCD (active high, minimum length: one MCLOCK period).

MCLOCK: Master clock for CCD readout (f_m), should be applied continuously. Used to derive all internal clocking and the output pixel rate.

Digital control outputs (TTL level)

EOS: EndOfScan, returns a pulse (active low, duration: one MCLOCK pulse) to indicate the end of the array.

TRIGGER: Pulse chain, indicating the sampling instant (the value is valid throughout the duration of the pulse) for the video signal per pixel during readout (active high, duration: one MCLOCK pulse).

I^2C Interface

The DZA-S7030-4 is equipped with an I^2C interface addressing on-board EEPROM and digital I/O circuitry. This interface is used by new-generation tec5 Interface Electronics for retrieval of characteristic data, automatic detection and setting of configuration details and error determination purposes.

Cooling Controller (optional)

Function: Four quadrant PI-controller

Power supply: From +12V supply input

Max. current: 1.5 A (optional: 3 A)

Temperature sensor supported: Thermistor (NTC)

Setpoint range: 5 kOhm ... 100 kOhm

Power consumption

+12 V: typically < 300 mA (no cooling)

Environmental conditions

Temperature range operating: 0 °C ... 30 °C[1]

Temperature range storage: -40 °C... +50 °C[1]

Humidity (@25°C, non condensing): 10 % ... 90 %

[1]: *limited by operating / storage temperature ratings of the CCD sensor*

System Operational Specifications

Example data obtained using the tec5 PC Operating Electronics, 'CCD' version, and a Hamamatsu CCD Sensor type S-7031-0907 (cooled operation):

Pixel clock rate: 500 kHz

Intensity resolution: 16 bits

Dynamic range: typically 15 bits (line binning)

Electronics thermal drift: typically < 2 counts/°C

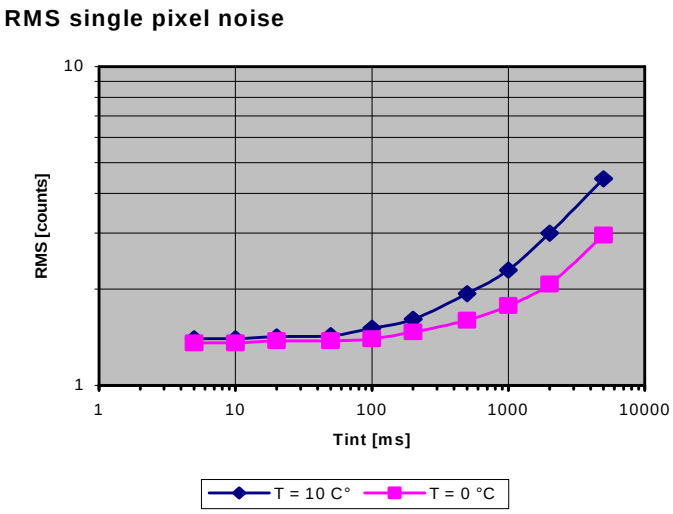


Fig. 3: RMS single pixel noise data obtained with S-7031-0907 sensor in cooled line binning operation with tec5 16-bit CCD operating electronics at 0 °C and 10 °C detector temperatures.

Views of the circuit boards

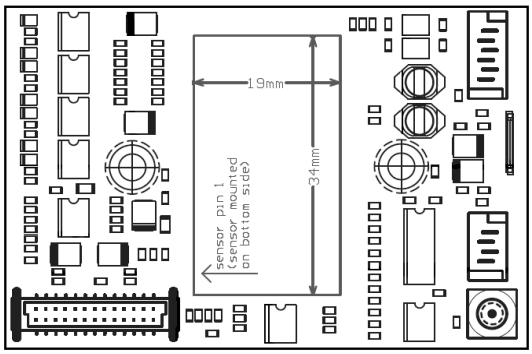


Fig. 4: Sensor Board (Version 1.3)

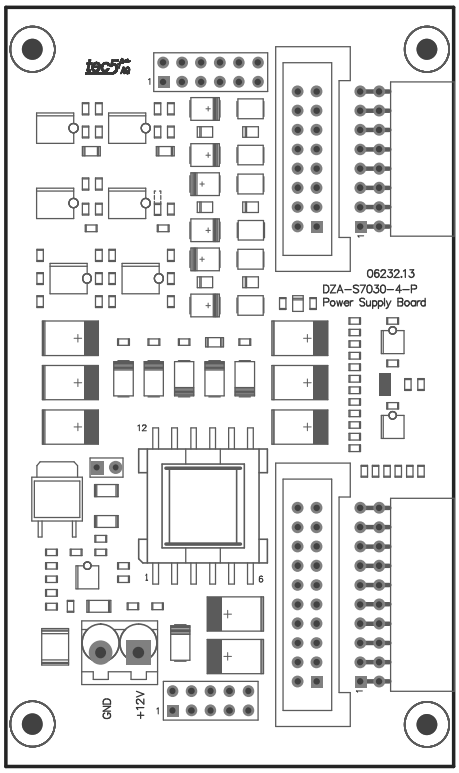


Fig. 5: Power Supply Board

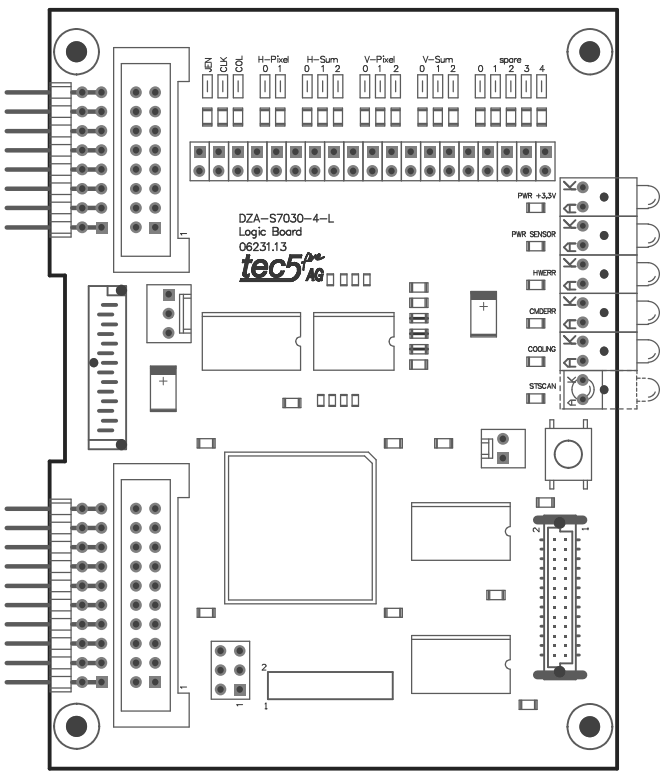


Fig. 6: Logic Board

Interfaces

PCB dimensions:

- Power Supply PCB: 60 mm x 100 mm
- Sensor PCB: 68 mm x 45 mm
- Logic PCB: 75 mm x 100 mm

CCD sensor socket:
24-pin DIL-socket, mounted to bottom of Sensor PCB

Interface Connections

1) Cooling connector:
Format: MICS 6 connector, on Sensor PCB
to connect peltier power and thermistor output

Pin	Signal designation	Explanatory remarks
1	Peltier+	Peltier power +
2	Peltier+	
3	Peltier-	Peltier power -
4	Peltier-	
5	Thermistor2	Thermistor pin 2
6	Thermistor1	Thermistor pin 1

2) Digital Control connector to FEE (14 pin):
Format: MICS 14, on Logic PCB

Pin	Signal designation	Explanatory remarks
1	C1_TRIGG	A/D trigger
2	C1_START	Start-Scan
3	DIN1	Digital Input 1
4	C1_PHI1	Master clock
5	DIN2	Digital Input 2
6	C1_EOS	End-Of-Scan
7	GND	Ground
8	Reserved	
9	GND	Ground
10	Reserved	
11	DOUT1	Digital Output 1
12	DOUT2	Digital Output 2
13	I2C_SDA	I²C Data
14	I2C_SCL	I²C Clock

3) Analog Coax connector to FEE:
Format: SMB flange socket, on Sensor PCB

Pin	Signal designation	Explanatory remarks
Center contact	ANALOG_OUT-	Video- output
Shield	ANALOG_OUT+	Video+ output

4) Analog MICS-4 connector to FEE:
Format: MICS-4, on Sensor PCB

Pin	Signal designation	Explanatory remarks
1	GND	Ground
2	ANALOG_OUT-	Video- output
3	ANALOG_OUT+	Video+ output
4	GND	Ground

5) Power Supply connector (+ 12V):
Format: Screw/socket connector Weco Connecta 2 pin,
on Power Supply PCB

Pin	Signal designation	Explanatory remarks
1	+ 12V	Stabilized power input
2	GND	System ground

Cooling PCB (Option)

Specifications

- Linear P-I type controller electronics
- Peltier power/thermistor connector:
  6 pin MICA connector (Lumberg MICS/SMD 6)
- Board dimensions: 100 mm x 60 mm
- For direct mount on top of the Power Supply PCB
- Height 30 mm (with heatsink and fan)
- Screw holes: for M2.5 (diameter 2.8 mm)
- Thermistor current: 10 µA
- Peltier current limit: 1.5 A
  (3 A in high-current option)
- Temperature setpoint range: 5 k .. 100 kOhm
  thermistor resistance

View of the circuit board

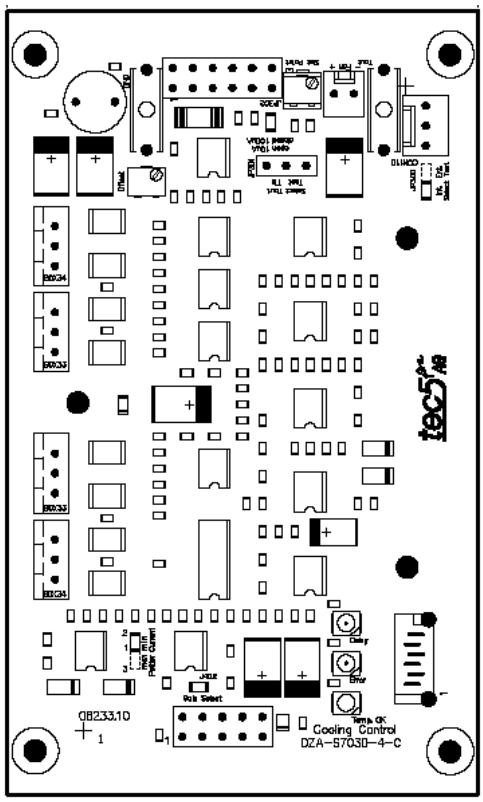


Fig. 7: Cooling Board

Connector Pin Assignment

Peltier Power and Thermistor Connector
This connector is used to connect to the sensors Peltier cooler and thermistor.
Connector type: 6 pin MICA (Lumberg MICS/SMD 6)

Pin	Signal Designation	Input / Output	Comment
1, 2	CCD_P+	Input	Peltier cooler current input
3, 4	CCD_P-	Output	Peltier cooler current return
5	CCD_TH2	Passive	Thermistor pin 2
6	CCD_TH1	Passive	Thermistor pin 1

Select Tout Jumper
This three-pin header connector is used to select the Tout voltage. To select, shortcut one pair of pads with a jumper bridge.

Connected	Description	Comment
1 and 2	Tout is actual temperature	
2 and 3	Tout is Set Point temp.	Default setting

Set Point Connector
This connector is used to connect to external Set Point voltages or to measure the Tout temperature.
Connector type: 3 pin socket (MOLEX KK-6410-3)

Pin	Signal Desig-nation	Description	Comment
1	Tset_in	External Set Point voltage input	External input of the Set Point has to be chosen via JP300
2	Tout	Set Point or actual tempera-ture voltage output	Output has to be chosen via JP301
3	GND	Ground	

Tout / GND Connectors
This set of connectors is used for a handy connection to a measuring instrument to measure the Tout temperature.
Connector type: 2mm banana jack

Signal Designation	Description	Comment
Tout	Set Point or actual temperature volt-age output	Output has to be chosen via JP301
GND	Ground	

Heatsink Fan Power Connector
This connector is used to connect to a heatsink fan.
Connector type: 2pin socket (MOLEX KK-6410-2)

Pin	Signal Designation	Description	Comment
1	+12V	Power	Connected directly to input voltage.
2	GND	Ground	

Select Set Point Jumper
This double 0805 sized pair of pads is used to select the use of an internal or external source for the Set Point voltage. To select, shortcut one pair of pads with a 0R resistor (0805 size).

Connected	Description	Comment
1 and 2	Use external Tset voltage	
2 and 3	Use internal Tset voltage	Default

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.