User Manual

PSD Reader

Manual Version 1.7

TEM Messtechnik GmbH
Grosser Hillen 38
D-30559 Hannover
Germany

Tel: +49 (0)511 51 08 96 -30
Fax: +49 (0)511 51 08 96 -38
E-mail: info@TEM-Messtechnik.de
URL: http://www.TEM-Messtechnik.de

Table of Contents

1 Introduction

The *PSD Reader* from TEM Messtechnik is a multi-purpose device for measuring physical values (optical power, voltage, current) and display them on a PC. In standard application the sensor is a *PSD4Dc* (or derivatives like *PSD2D* or *PSDe*) and the device displays the four degrees of freedom of a laser´s beam pointing (angle phi and theta, position x and y, or just two degrees of freedom in case of using a *PSD2D*).
In customized applications the device is able to act as a digital regulator which measures a value, compares it to a setpoint and provides an output to feed it to an actuator.

Since the signal processing is exclusively done by a microcontroller, the *PSD Reader* device shows great flexibility. All important parameters and settings are accessible by interfacing the device with a PC, either using the dedicated program *Kangoo* or user-supplied software

2 Block Diagram *PSD Reader*

At the heart of the *PSD Reader* device lies a microcontroller, which handles all communications over the USB interface and over the I2C or SPI bus. For reading input signals or acquiring data, the *PSD Reader* is equipped with an 8-channel, 16-bit ADC with an input range of +/-10V.

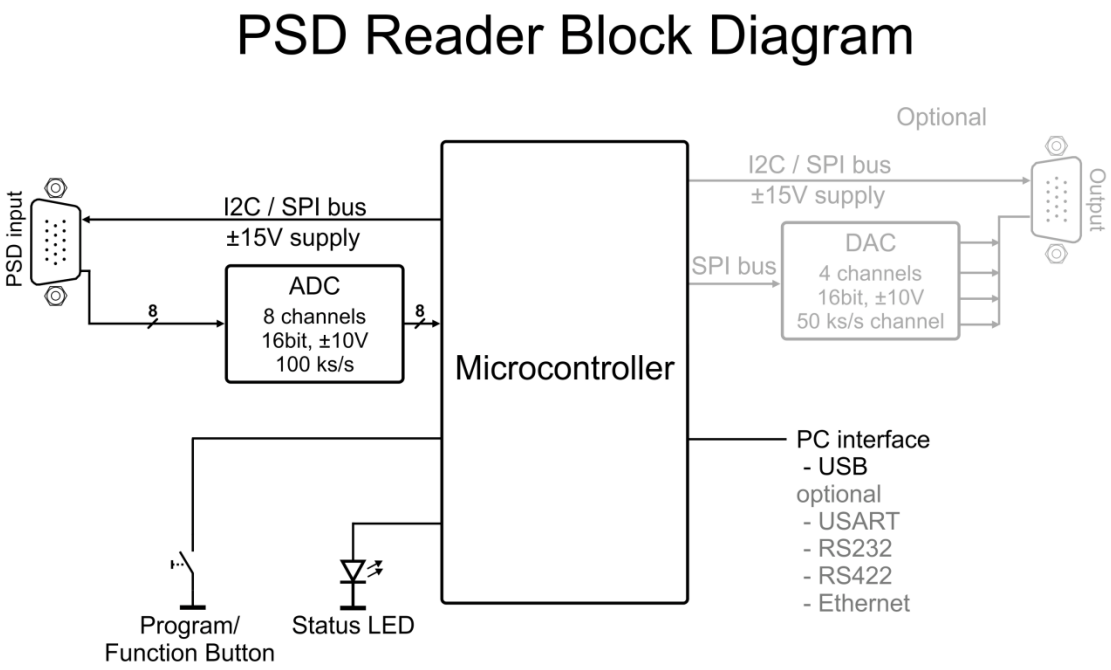


Figure 1 Block diagram, optional components shown semi-transparent

The standard configuration of the *PSD Reader* electronics features one 8-channel input connector for feeding in PSD- or photodiode-signals.
Optionally the controller can do signal processing, such as the implementation of PID-regulators, the generation of control signals for micro-stepper motors or digital filtering.
Optional signal output is provided by a 4-channel, 16-bit digital-to-analog converter (DAC). The output range of this DAC is +/-10V.

3 Description of the Front Panel Elements

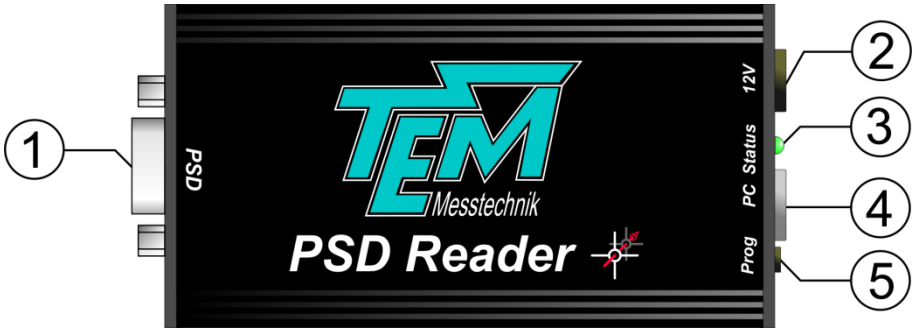


Figure 2 Top view of the *PSD Reader*

Table 1 Function of the front panel elements

1	PSD input	HD-15 connector: PSD input, I2C, SPI, supply voltages
2	Power plug	Input for coaxial power connector (5,5/2,5 mm)
3	Status LED	LED indicator for intensity status: Slow “breathing”: intensity OK Fast “breathing”: intensity too high or too low
4	USB port	USB port for the connection to a PC and the *Kangoo* software
5	Prog Key	Hold key and switching on power supply: Enter program mode In normal use: Perform Autogain

3.1 RS232 Version (optional)

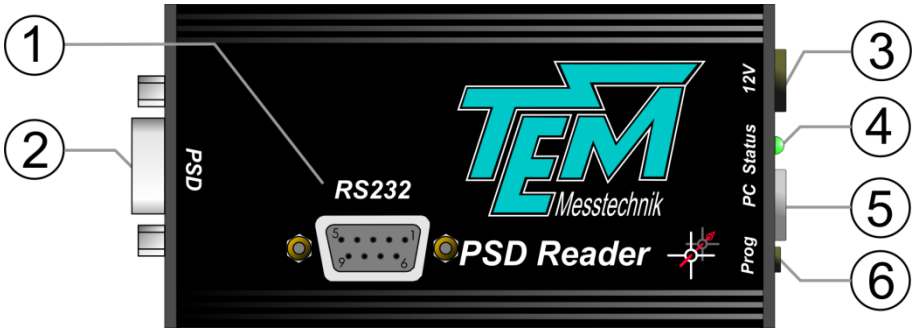


Figure 3 Top view of the *PSD Reader*

Table 2 Function of the front panel elements

1	RS232 port	SUB-D 9 Connector for the communication via RS232 to a PC and the *Kangoo* software
2	PSD input	HD-15 connector: PSD input, I2C, SPI, supply voltages
3	Power plug	Input for coaxial power connector (5,5/2,5 mm)
4	Status LED	LED indicator for microcontroller activity
5	USB port	USB port for flashing the microcontroller
6	Prog Key	Hold key and switching on power supply: Enter program mode In normal use: Perform Autogain

3.2 RS422 Version (optional)

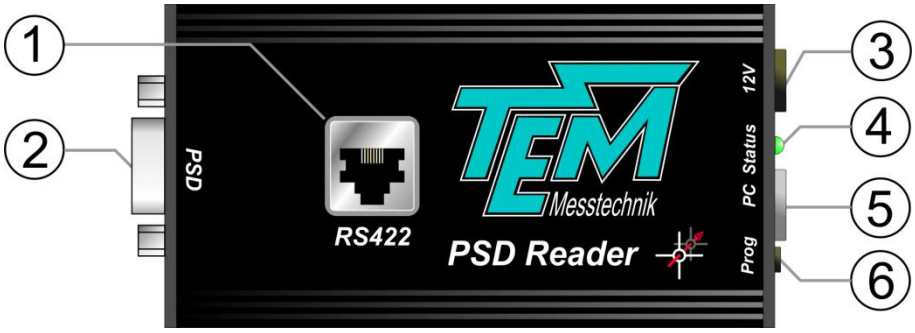


Figure 4 Top view of the *PSD Reader*

Table 3 Function of the front panel elements

1	RS422 port	RJ45 Connector for the communication via RS422 to a PC and the *Kangoo* software
2	PSD input	HD-15 connector: PSD input, I2C, SPI, supply voltages
3	Power plug	Input for coaxial power connector (5,5/2,5 mm)
4	Status LED	LED indicator for microcontroller activity
5	USB port	USB port for flashing the microcontroller
6	Prog Key	Hold key and switching on power supply: Enter program mode In normal use: Perform Autogain

3.3 Version with DAC output (optional)

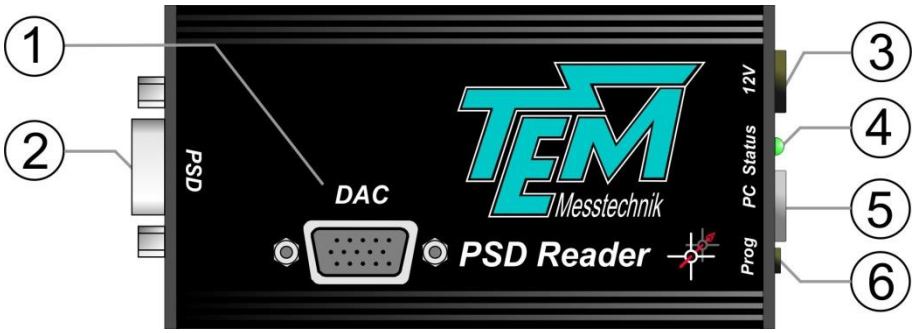


Figure 5 Top view of the *PSD Reader*

Table 4 Function of the front panel elements

1	DAC output	HD-15 connector: Pointing and trigger signals output Pin1: DacA, Pin2, DacB, Pin 3: DacC, Pin 4: DacD, Pin 8: SG, Pin11: Trigger out, Pin 12: DAC update, Pin 13: Sampling (Pulsed Mode)
2	PSD input	HD-15 connector: PSD input, I2C, SPI, supply voltages
3	Power plug	Input for coaxial power connector (5,5/2,5 mm)
4	Status LED	LED indicator for microcontroller activity
5	USB port	USB port for flashing the microcontroller
6	Prog Key	Hold key and switching on power supply: Enter program mode In normal use: Perform Autogain

4 Connection of the *PSD Reader*

The *PSD Reader* is commonly used to set the gain of the PSD detectors and read out the position and angle data. For this purpose the PSD detector is connected via Sub-D 15 HD cable (1:1 Pin connection) to the *PSD Reader*. This configuration is shown in Figure 6. The 12 Volt power supply of the *PSD Reader* is used to supply the electronics and the PSD detector. For the communication to the PC a UBS cable is included.

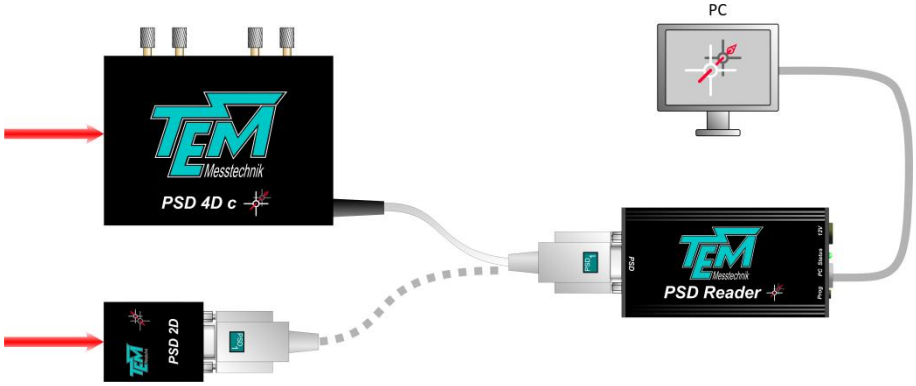


Figure 6 Connection of the *PSD Reader*

4.1 *Aligna Con* (optional)

TEM Messtechnik GmbH offers an *Aligna Con* module to get access to the raw signals of the PSD via BNC connector. This allows a monitoring of the signal with e.g. an oscilloscope without limitation of the bandwidths. The *Aligna Con* is either inserted into the connection between the PSD and the *PSD Reader* or connected to the *PSD reader* with a y-adapter cable (see Figure 7 and Figure 8).

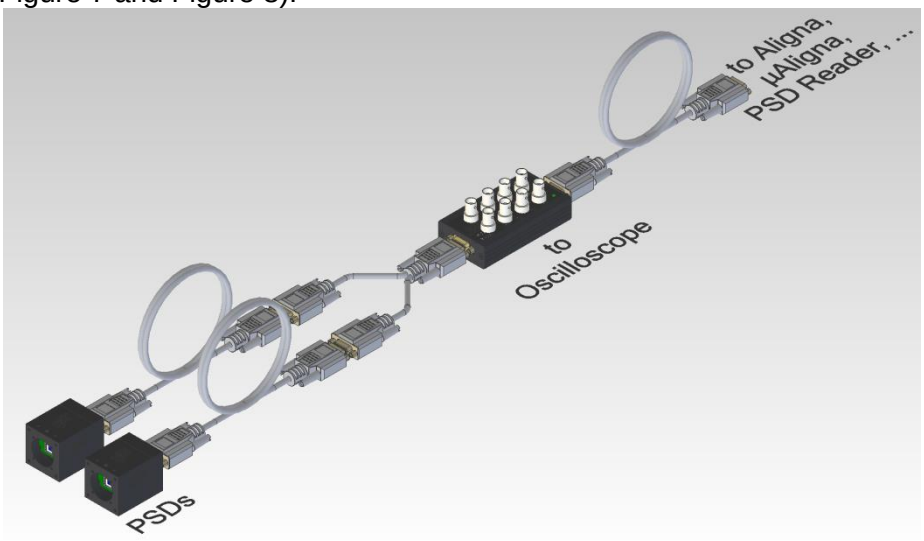


Figure 7 In-Line configuration

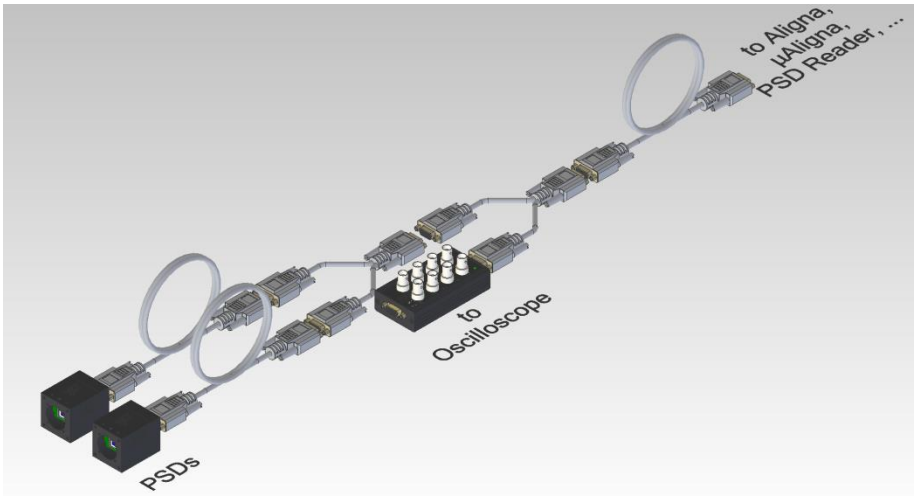
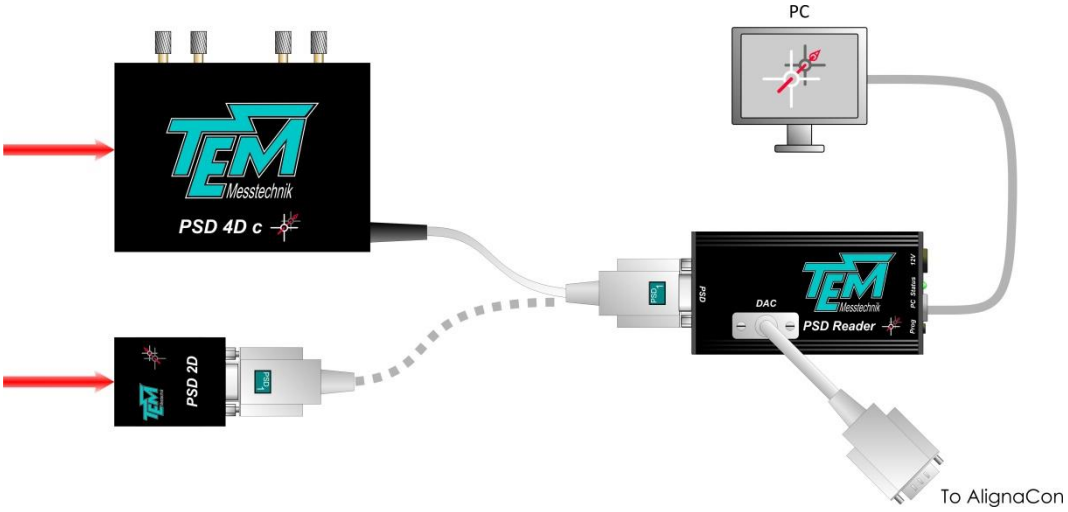


Figure 8 Y-configuration

4.2 PSD Reader with DAC (optional)

If ordered the PSD Reader can equip with a 4 channel digital-to-analog converter, providing +/-10 volts per channel. The output voltages can be controlled via Kangoo Software or coupled to the measured pointing data. As pointing output the voltages correspond to the measured position in mrad or mm (mrad or mm / Volt). The four pointing signals can be connected at the DAC output via AlignaCon module to an oscilloscope.



5 Software Installation

5.1 Installing the *Kangoo* Software

To install the *Kangoo* software, start the program “Install.exe” in the root directory of the installation CD. The installer will show a welcome screen with several options.

Figure 9 Kangoo installation: Welcome screen

"Details" informs you about the installation procedure.
"Source path" indicates the source path of the installation.
"Destination Path": Here, you can choose the desired destination path. The standard directory is "TEM" in the "ProgramFiles" folder. On Windows Visa or Windows 7 systems, please avoid the "Program Files" folder and choose the path "C:/TEM"!
The button "OK, install now!" starts copying all required files from the source path to the destination path.
During the installation procedure, the installation program checks all required files.

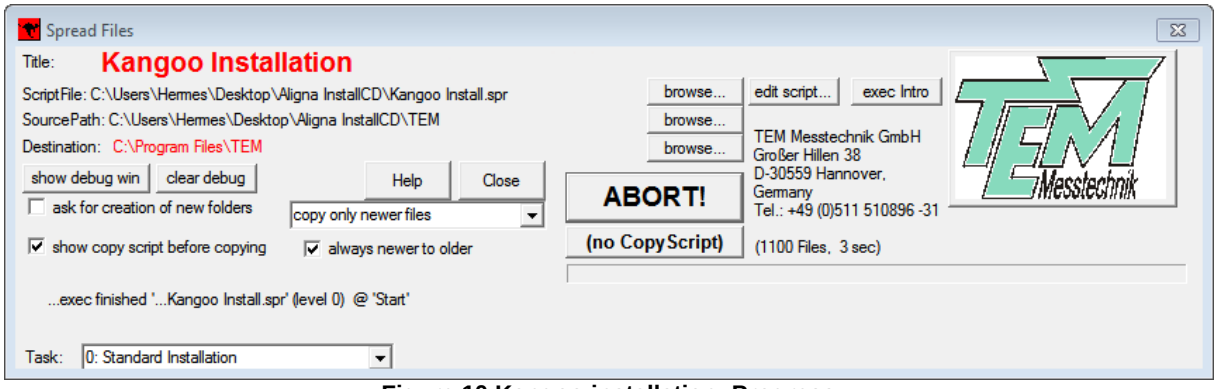


Figure 10 Kangoo installation: Progress

The program then creates a list of file copy commands. When this list is complete, you can check the list and start the copy procedure.

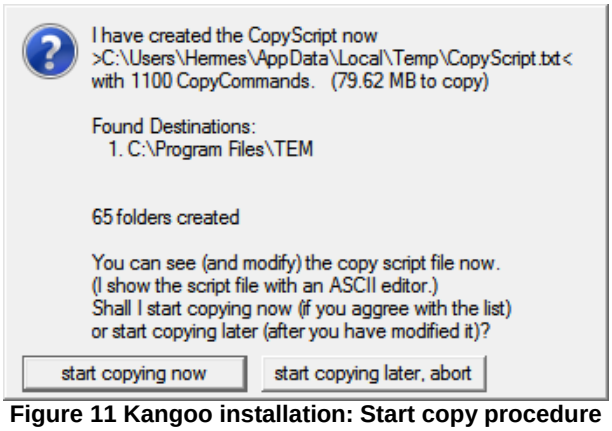


Figure 11 Kangoo installation: Start copy procedure

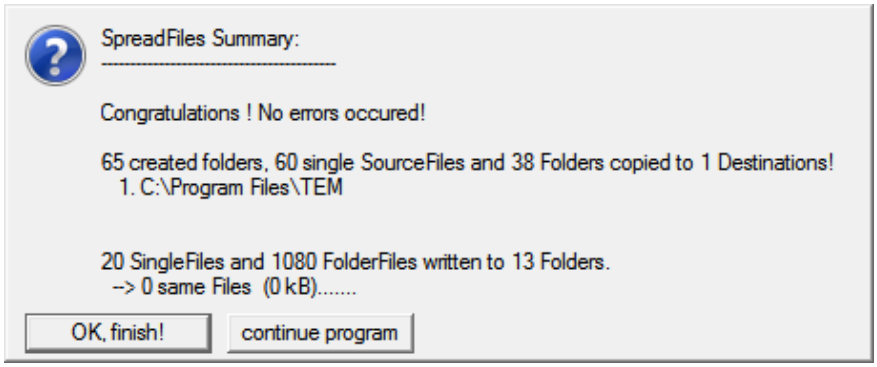


Figure 12 Kangoo installation: Summary

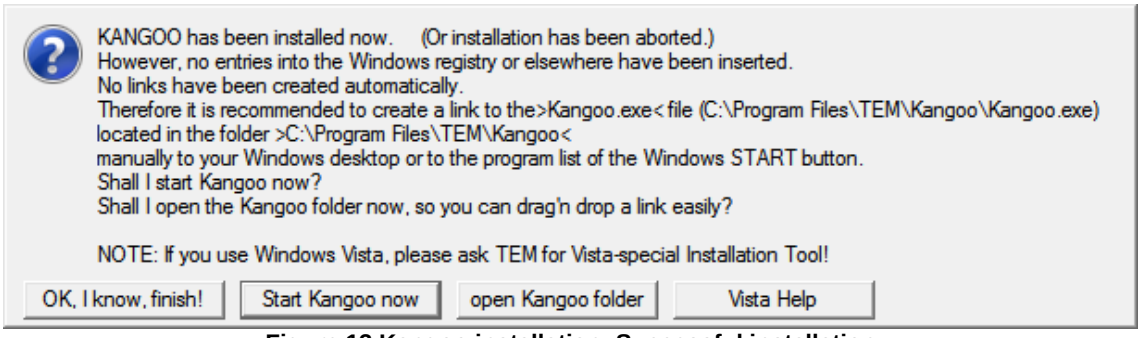


Figure 13 Kangoo installation: Successful installation

5.2 Installing USB driver

Typically, when the USB connection between the micro-controller and a PC is first made, Windows will open the Found New Hardware Wizard. Here, choose to install drivers from a user-specified location. The necessary driver file is located in the directory “TEM/Service/USB Driver” in the Kangoo installation directory (or on the USB Stick). The Hardware Wizard will now finish the installation and no further configuration will be necessary. Once the installation is complete, Windows will assign a COM-port. To find out which COM-port has been assigned, check for a new entry in the section “Ports (COM & LPT)” of the device manager.

6 Upgrading the Firmware

Please contact TEM Messtechnik for details about firmware upgrades.

7 Interfacing with a PC

The microcontroller of the *PSD Reader* is accessed via USB using ASCII-formatted text strings. Each string has to be terminated by a carriage return character (‘\r’ or ASCII 13). These strings separate into two general categories, namely *variables* and *commands*. A variable represents a user-accessible parameter which can be set, queried and stored. Examples of variables are the maximum speed of a motor, the regulator status and the serial number of the device. Commands execute single actions, such as an analog-to-digital conversion or the sending of output to the PC.

7.1 Variables

If the text string sent to the microcontroller contains an equal sign, it is interpreted as a variable. If this equal sign is followed by a space and an integer number, the text string is an assignment and the current value of the variable is updated. If the string ends after the equal sign (trailing spaces are irrelevant), the string represents a query and the microcontroller echoes the current value of the queried variable. Echoes can be suppressed by prefacing the variable name by a backslash.

Table 5 Examples of setting and requesting variables

Text string	Type	Answer from microcontroller
SerialNumber= 7012	Assignment	SerialNumber= 7012
SerialNumber=	Query	SerialNumber= 7012
\SerialNumber= 7012	Assignment, no echo	

Each variable has a maximum and a minimum value. If assignments lie outside this range, the assigned value is clipped and this clipped assignment is echoed back to the PC.
The following list shows all variables which are available in the *PSD Reader*.

Table 6 List of variables

Variable name	Values	Description
SerialNumber	0 to 100000000	the serial number of the device
Build		Actual Firmware version
uCApplication	0 to 1000	tells the PC which application program is active
PCBVersion		Actual Hardware version
DacA, Dacb, DacC, DacD	-10000 to 10000	optional: Voltage at the DacA/B/C/D output in mV
DacA_output, DacB_output, DacC_output, DacD_output	0 to 6	optional: 0: manual setting 1: Pointing Ax 2: Pointing Ay 3: Pointing Bx 4: Pointing By 5: Sum A 6: Sum B
PsdAgain	100 to 1000000	gain in percent for a *TEM* angle PSD
PsdAdx	-9999 to 9999	gain offset factor in x-direction for a *TEM* angle PSD
PsdAdy	-9999 to 9999	gain offset factor in y-direction for a *TEM* angle PSD
PsdBgain	100 to 1000000	gain in percent for a *TEM* position PSD
PsdBdx	-9999 to 9999	gain offset factor in x-direction for a *TEM* position PSD
PsdBdy	-9999 to 9999	gain offset factor in y-direction for a *TEM* position

		PSD
PsdUnitsA	0 t0 3	physical units for displaying the angle PSD 0: ADC units (-32768 to 32767) 1: Volts (-10 to 10) 2: mm @ PSD 3: mrad
PsdUnitsB	0 t0 3	physical units for displaying the position PSD 0: ADC units (-32768 to 32767) 1: Volts (-10 to 10) 2: mm @ PSD 3: mrad
AxScale, AyScale	0 to 10000	scaling factor, active when PsdUnitsA = 2
BxScale, ByScale	0 to 10000	scaling factor, active when PsdUnitsB = 2
BL_AdcScale(0)=	-1000000 to 1000000	Scaling of Pointing signal Ax
BL_AdcScale(1)=	-1000000 to 1000000	Scaling of Pointing signal Ay
BL_AdcScale(2)	-1000000 to 1000000	Scaling of Pointing signal Bx
BL_AdcScale(3)	-1000000 to 1000000	Scaling of Pointing signal By
BL_AdcScale(4)	-1000000 to 1000000	Scaling of SumA
BL_AdcScale(5)	-1000000 to 1000000	Scaling of SumB
AdcOffsetAx	-10000 to 10000	offsets
AdcOffsetAy	-10000 to 10000	
AdcOffsetBx	-10000 to 10000	
AdcOffsetBy	-10000 to 10000	
AdcOffsetSumA	-10000 to 10000	
AdcOffsetSumB	-10000 to 10000	
FocalLengthPsdA	100 to 10000000	
FocalLengthPsdB	100 to 10000000	
PsdDiffGainSwitchA	0 to 1	gain boost for the angle PSD
PsdDiffGainSwitchB	0 to 1	gain boost for the position PSD
PsdDiffGainAx	1 to 1000000	
PsdDiffGainAy	1 to 1000000	
PsdDiffGainBx	1 to 1000000	
PsdDiffGainBy	1 to 1000000	
MinIntens	-1000 to 12000	minimum intensity for the measured PSD signals (below this threshold, scope view wont´t work)
MaxIntens	-1000 to 12000	maximum intensity for the measured PSD sigals (over this threshold, scope view wont´t work)
AutoGainAset	1000 to 9000	set value for autogain procedure
BL_PowerPortion	0 to 100000000	Calibration factor for the power display
Psd_DiagonalA	0 to 1	switch for rotating angle PSD by 90°
Psd_DiagonalB	0 to 1	switch for rotating position PSD by 90°
BL_AvailableAB	0 to 3	0: no detector 1: Detector A only 2: Detector B only 3: Detector A + B
IclABx	-8192 to 8192	Crosslink matrix element
IclABy	-8192 to 8192	Crosslink matrix element
IclBAx	-8192 to 8192	Crosslink matrix element
IclBAy	-8192 to 8192	Crosslink matrix element
Norm	0 to 1	switch on/off the normalization of the differential

		signals
LaserCwPulsed	0 or 1	0: cw mode 1: activate Trigger for Pulsed mode
LaserRepRate	0 to 80000000	➔ sec. 8.3 for details below 4000: double sample above 4001; single sample
Delay1	1 to 65535	Delay in µs between trigger event and first sample
Delay2	1 to 65535	Delay in µs between first and second sample for "LaserPepRate" below 4000
UcUsartBaudrate		Default 57600. For the (optional) serial communication higher baud rates might be necessary like e.g. 921600
Datasendperiod	0 to 10000	Automatic Data output option (same format than the "BL_PrntVars 1" answer). Define the delay (ms) between two Datasets. 0: sending off < 8: sending data with maximum speed of 8ms ➢ 8: data output with defined speed For Pulsed mode the datasets are sending after each new trigger event but not faster than the defined delay.
BL_LowPassOn	0 to 1	activates a digital low-pass filter for PSD signals
BL_LowPassTime	1 to 5000	time constant for the low-pass filter

7.2 Commands

Text strings which do not contain equal signs are interpreted as commands. The possible formats are single words, a word followed by an argument or a word followed by an argument and a value. Examples are shown in the following table.

Table 7 Examples of using commands

Text string	Type	Microcontroller action
varDump	Single word command	Print all variable values
varLoad 1	Command with argument	Set variables to default
da 3 7888	Cmd with arg and value	Set DAC channel 3 to 7888 mV
ad 5	Cmd with arg	Print the value of ADC CH5 in mV

What follows is a comprehensive list of all commands which the *PSD Reader* can understand.

Table 8 List of commands

Command name	Arg	Values	Description
Com			
Hello			answers with "Hi there!"
Help			
VarSave			save all current variable values to the EEPROM
VarLoad	flag		load variable values from EEPROM (0) or from the program memory (1) and print all
varDefault			set all variables to default values
VarDump			print all variables with their current values
CmdDump			print all command names
uCtype			echo the µController type
AD	channel		ADC value of the desired channel
DA	channel	val	DAC output (if DAC-option)
AutoGain			automatically adjust the gains of *TEM* detectors
BL_PrntVars 1			Answers with the 4D laser pointing Ax, Ay, Bx, By, SumA, SumB
Reset			resets the controller

8 Using the *Kangoo* Software

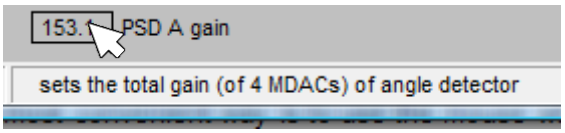
The alignment of the parameters of the system is most easily done with the supplied software package *Kangoo*.
Since the *PSD Reader* is controlled by plain-text commands, it can be configured with any control software like LabView, TestPoint, or other programs written in VisualBasic, VisualC, C++, C#, etc. However, to become familiar with the system it is highly recommended to use *Kangoo* and benefit from the built-in functions.

8.1 Basic *Kangoo* Features

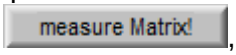
"Kangoo" is a comprehensive measurement and controlling software system, which can be adapted to control completely different applications. (Controlling a *PSD Reader* or *Aligna*® are just two systems of a long list). *Kangoo* will not be described in complete detail here; just the basic use and the configuration for use of the *PSD Reader* will be covered.
In this chapter we will describe very briefly some elementary features and the basic common usage of *Kangoo*. In a following chapter we will describe the usage of the standard configuration, related to the *PSD Reader*.

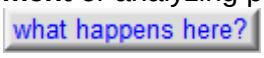
8.1.1 Buttons and Devices

The interaction between the user and the program is mainly realized by "buttons" and "devices" (with the exception of the menu bar). A short explanation ("ToolTip") of the meaning and sense of a button or device is displayed in the status line, when the mouse pointer is located over the button or device position.



A **"button"** forces an activity. This may be the
loading of another **configuration** (application-specific user surface) 

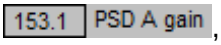
,
starting a **measurement** or analyzing process 

,
display a **help text** 

and many more.
A **"device"** may represent a parameter, either of the *Kangoo* program, or of the control software inside the *PSD Reader* device's microcontroller (µC) firmware.
The appearances of devices can be very different:

There are **keys or LEDs** 

,

numerical parameters, displayed as simple digital value 

,

digital and/or analog display 

, 

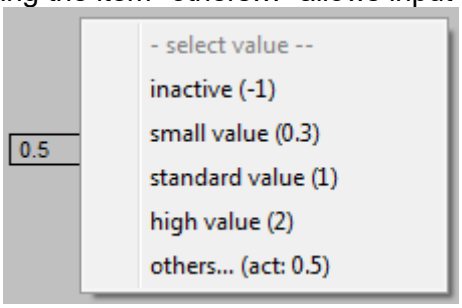
and many more.

To **change the value** of these parameters there are different options:

- The most convenient way is to use the **mouse wheel**, when the mouse is hovering over the device. Even very fine or coarse changes can be realized:
  The sensitivity of the mouse wheel can be controlled by pressing additional keyboard keys while moving the mouse wheel
  - pressing the "shift" key: factor of 10 higher resolution

- pressing the "ctrl" key: factor of 100 higher resolution
- pressing the "alt" key: factor of 10 stronger variation.

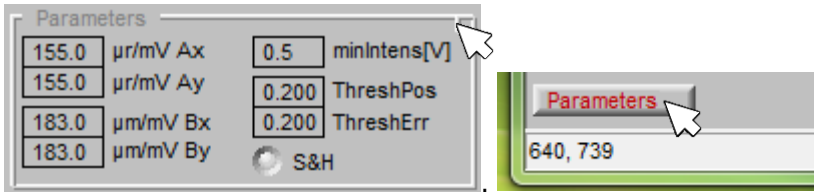
- In the absence of a mouse wheel you can click and hold the mouse at the device and move the pointer horizontally. Even here the "shift", "control" and "alt" keys will increase or decrease the sensitivity.
- Many devices have predefined values, which are displayed by a pop-up menu when left-clicking the device. Selecting the item "others…" allows input of any user-defined value.



- A right-click to the device opens a pop-up menu with the option "set value" (even if no "toggle" pull-up menu is defined with this device.)

8.1.2 Sections

The configurations are usually separated into sections for clarity and convenience. Some sections contain parameters which are used very infrequently. By clicking the upper right "close" button the section window will be shrunk to a small button at the bottom line or the left side of the user screen. The section window can be re-sized by clicking on the minimized button.



8.1.3 Further *Kangoo* Functions

There are reams of additional features of the *Kangoo* program, such as calculations, analyses of measured data sets, import and export of data or the creations of custom configurations. In this manual however we concentrate just on the description of those configurations needed for the use of the *PSD Reader.*
Many of the features are described in the help files, available in the menu items "Help / ...". (If you have questions regarding further use of Kangoo, please don't hesitate to ask TEM for additional information.)

8.2 *Kangoo* Configuration “CrossHair 4D”

The standard configuration for using the *PSD Reader* is the configuration “CrossHair 4D”. This configuration is located in the folder C:\TEM\Kangoo\Data\CrossHair. Figure 14 shows a screenshot of this configuration.

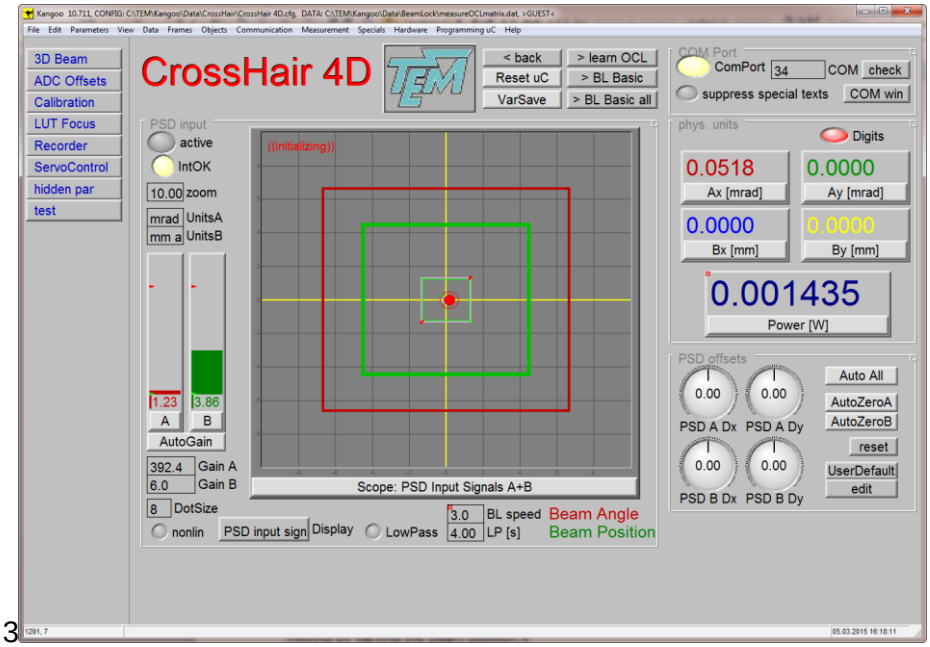


Figure 14 Kangoo Configuration Cross Hair 4D

First you have to connect to the microcontroller of the *PSD Reader*: Left-click on the “check”-button, then choose the matching COM-port (if you´re not sure which channel is correct, please have a look in the device manager). Open the COM-port by left-click on “ComPort”-Button. The Kangoo-LED should light up yellow.

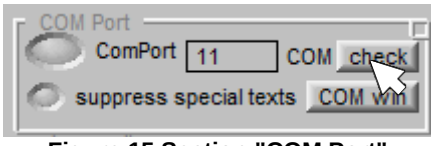
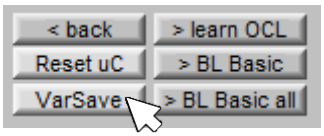


Figure 15 Section "COM Port"

If the *PSD Reader* and the PSD4Dc/PSD2D have just powered up, the photocurrent-amplifiers may have an incorrect gain. The effect would be a very high or low intensity level. To set the gains correctly, just change the devices “PSD A gain” or “PSD B gain” or do an “Auto gain” (The Auto gain procedure try to set the gains in a way that the sum-signals of A- and B-detector are the – “setintens” – e.g. 5V). Furthermore the gains have to be in the range between 5…10000.
If the beam hits the detector and the sum-signals are in the correct range, you can observe the beam movement on the Kangoo screen. The laser beam position is shown in the scope view. If you have a PSD4Dc the green dot stands for the laser beam position and the red dot stands for the laser beam angle. If the beam changes the position/angle this causes a movement of the green/red dot in Kangoo.
If you have a PSD2D then just one dot (the green or the red, depending on the detector) is moving by varying the beam position.

To save your new settings like gain of the PSD, click on the “VarSave”-Button.



The new values will be saved and at the next power cycle or reset, they will be load automatically.

To log the beam pointing, please open the section “Recorder”. In the window you can choose some different record options. By clicking “run” the chart recorder starts to record the beam-pointing.

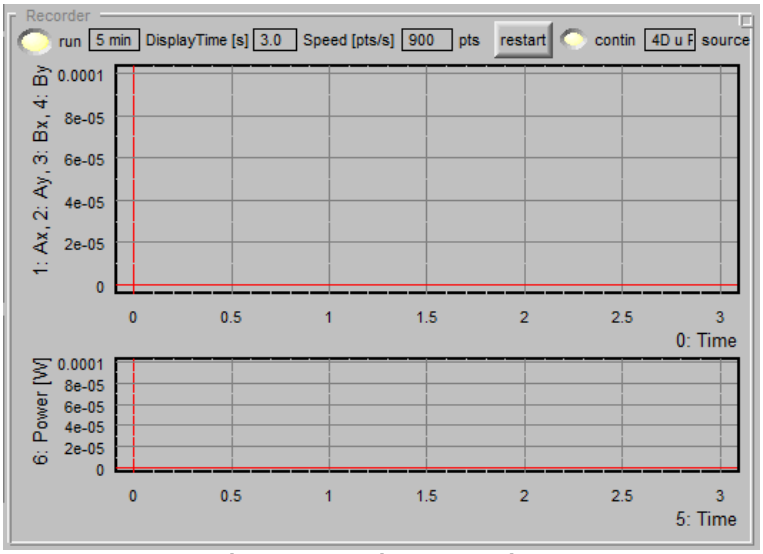


Figure 16 Section "Recorder"

To save these values to your computer choose in the menu bar: Data->Data export… Here you can choose several export options and save the recorded data to a *.txt file.

8.3 Pulsed Lasers

If you work with pulsed lasers, you have to choose the pulsed option in the section “Pulsed Laser Parameters” (Figure 17).

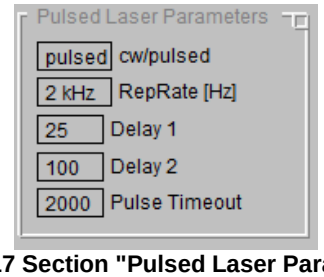


Figure 17 Section "Pulsed Laser Parameters"

Usually if a short pulse is applied to a photodiode (or the PSD), the photodiode will be saturated. Thus the electric signal of the photodiode is stretched by a low pass filter to spread the energy over a bigger time section. This stretched pulse is processed by the microcontroller.

In pulsed mode the rising edge of the sum of the PSD is detected and the signal is sampled. There are two different pulsed modes available depending on the repetition rate: If the repetition rate is below 4 kHz, the pulse is sampled twice: One sample at the peak and one sample at idle level. The difference is the resulting photodetector value. This way DC offsets like background light and also 50 Hz hum will be ignored. Figure 18 shows the principle. The time between detection and the first sample is set with the Kangoo device “Delay 1”. The time between the first and the second sample is set with the device “Delay 2”.

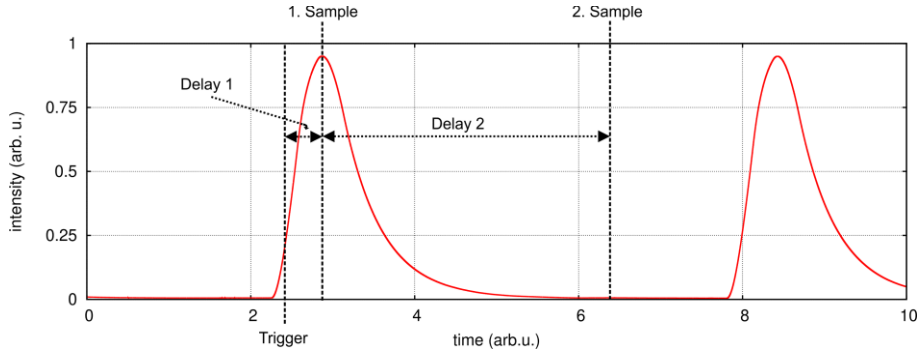


Figure 18 Pulsed mode <u>below</u> 4 kHz

At higher repetition rates, the pulses are getting closer to each other and a double sampling like in Figure 18 is not appropriate. If you choose a repetition rate above 4 kHz, the pulse is just sampled once, see Figure 19. The beam pointing may vary if you change between the two sampling modes.

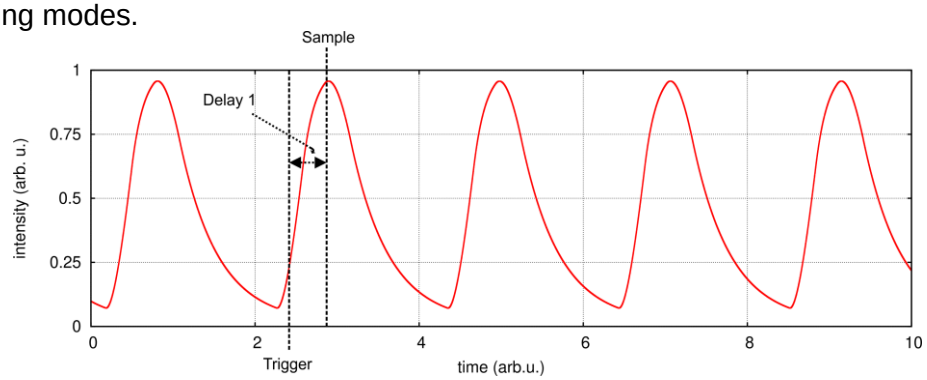


Figure 19 Pulsed mode <u>above</u> 4 kHz

Note: To set the correct delay, please set a repetition rate in Kangoo of 4 kHz or higher. (That means the controller just samples once. The laser may have another repetition rate). Set the device “Delay1” the way that the sum signal is at its maximum. The chart recorder may be a good help for that task (see Figure 20). For the time “Delay2” the standard time is 100 µs. In normal case you don´t have to change this value. To be on the save side, you can variate the “Delay 2” value and check, that the intensity signal of the PSDs don’t increase.

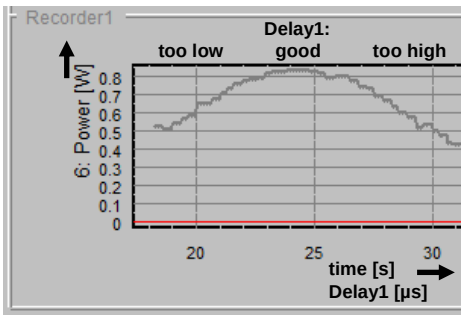


Figure 20 Power displayed in the chart recorder

8.4 Automatic Pointing data output

If needed the *PSD Reader* can send the actual pointing data to the PC. The data format is the same than the answer from the "`BL_PrntVars 1`" request. To activate this feature the variable "`Datasendperiod`" must be set to a value > 0. This defines the timeout (in ms) between two datasets. To avoid problems the minimum time between two dataset is limited to 8 ms. Values between 1 and 8 will cause a minimum delay of 8 ms. The variable can be found at the Crosshair 4D Configuration at the hidden parameter section. For CW mode the data output is time controlled. For Pulsed mode the data output is additional trigger by the optical pulse. In this mode a data set will be send after an trigger event and the given timeout. For repetition rates up to 100 Hz and the minimum timeout ("`Datasendperiod = 8`") the pointing data of each pulse can measured.
Notice!
The Auto gain function or high communication load might slow down the data output speed.

8.5 Optional: DAC output

The DAC output voltages can be controlled by the devices DacA…DacD via Kangoo Software. For manual setting of the voltages please set the corresponding "DAC Output" to Manual (value 0).

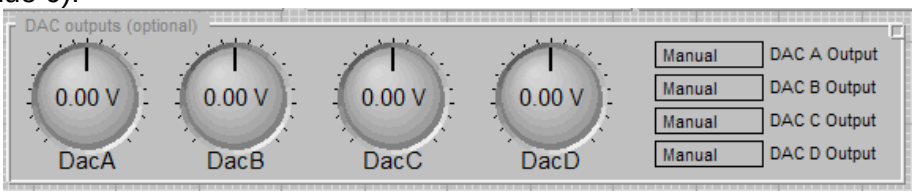


Figure 21 Menu of the DAC output

Alternatively the DAC voltages can be coupled the Pointing signals by Software

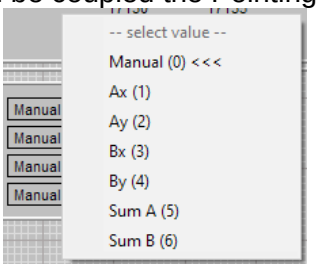


Figure 22 Option for the DAC outputs.

In this case the DAC values were updated with about 5 kHz for CW mode. The DAC update moment can be monitored via oscilloscope at DAC output pin 12. The rising signal edge is connected to the start of the DAC write while the falling edge is connected to the end of the DAC write process. For Pulsed mode the DAC values were updated after each optical pulse. The maximum repetition rate depends on the DAC write process time (about 25 µs per channel) and the delays. For repetition rates above a few kHz please monitor the electrical trigger signal (Pin 11 at the DAC output connector) and the update signal of the DAC (Pin 12 at the DAC output) to check that the DAC is updated after each pulse.

9 Delivery Content

Please check the device on delivery for damaged or missing items.
Delivery content:

- *PSD Reader*
- 12V Power supply
- HD15 and USB cable

It is recommended to keep the packaging material for future storage and transportation.

10 Pinout

Notice!
Only use the cables delivered with your system. Using standard cables like those used for personal computers can lead to malfunction or damage of electronic components. Many available cables have internal connections (common shielding of R, G, B) or some pins are not connected.

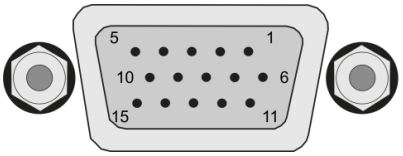


Figure 23 HD15 Female Socket

Table 9 HD15 Pinout (PSD)

Pin	output		Pin	Output
1	ADC channel 5		9	I2C clock
2	ADC channel 6		10	I2C/SPI data
3	ADC channel 7		11	ADC channel 1
4	ADC channel 8		12	ADC channel 2
5	Analog Ground		13	ADC channel 3
6	+15V		14	ADC channel 4
7	-15V		15	SPI clock
8	System Ground			

10.1 RJ45 for RS422 (optional)

Figure 24 RJ45 Socket

Table 10 RJ45 Pinout

Pin	output
1	TX+
2	TX-
3	RX+
4	SG
5	SG
6	RX-
7	NC
8	NC

10.2 SUB-D 9 for RS232 (optional)

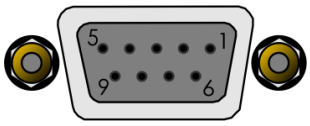


Figure 25 SUB-D 9 Socket

Table 11 SUB-D-9 Pinout

Pin	output
1	NC
2	Rx-
3	Tx
4	NC
5	SG
6	NC
7	NC
8	NC
9	NC

10.3 DAC output (optional)

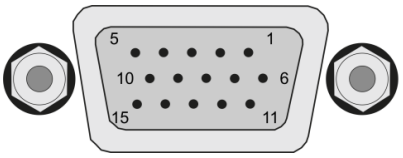


Figure 26 HD15 Female Socket

Table 12 HD15 Pinout (DAC output)

Pin	output		Pin	Output
1	DAC A		9	NC
2	DAC B		10	NC
3	DAC C		11	Trigger Signal
4	DAC D		12	ADC sampling moment
5	NC		13	DAC update
6	NC		14	NC
7	NC		15	NC
8	System Ground			

11 Electrical Specification

11.1 Environmental Conditions

The device has been designed for operation in laboratory environments with temperatures ranging between +15 °C and + 45 °C. The device is not to be operated in hazardous environments. Avoid exposure to heat or to emissions of other electric equipment. Protect the system against humidity, dust, aggressive fluids or vapors.

11.2 *PSD Reader* Device

Dimensions:	24 x 55 x 110 mm
Input Voltage	12 V
Power consumption:	typ. 3,1 W (PSD4Dc included)

11.3 USB COM Interface

Standard serial interface

Baud Rate:	Standard: 57.600 Baud
Data Bits:	8 Bit
Stop Bits:	1
Handshake:	Standard: No handshake
Command type:	simple ASCII commands

11.4 RS232 or RS422 Interface (optional)

Standard serial interface

Baud Rate:	Standard: 921.600 Baud
Data Bits:	8 Bit
Stop Bits:	1
Handshake:	Standard: No handshake
Command type:	simple ASCII commands

11.5 Mains Power Connection

Please use the included power supply. If an alternative mains adapter is preferred, use a device supplying 12V and at least 1.0A direct current.
(The system may be delivered with country-specific mains power adapters.)

12 Customer Service

In case of service needs, general questions need of repair, or warranty claims you will get quick and effective support at:

TEM Messtechnik GmbH

Grosser Hillen 38
D-30559 Hannover
Germany

Phone: +49 (0) 511 51 08 96 -30
Fax: +49 (0) 511 51 08 96 -38

E-mail: info@TEM-Messtechnik.de
Web: www.TEM-Messtechnik.de