



Becker & Hickl GmbH June 2007
Technology Leader in
Photon Counting

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GVD-120

Galvano Controller

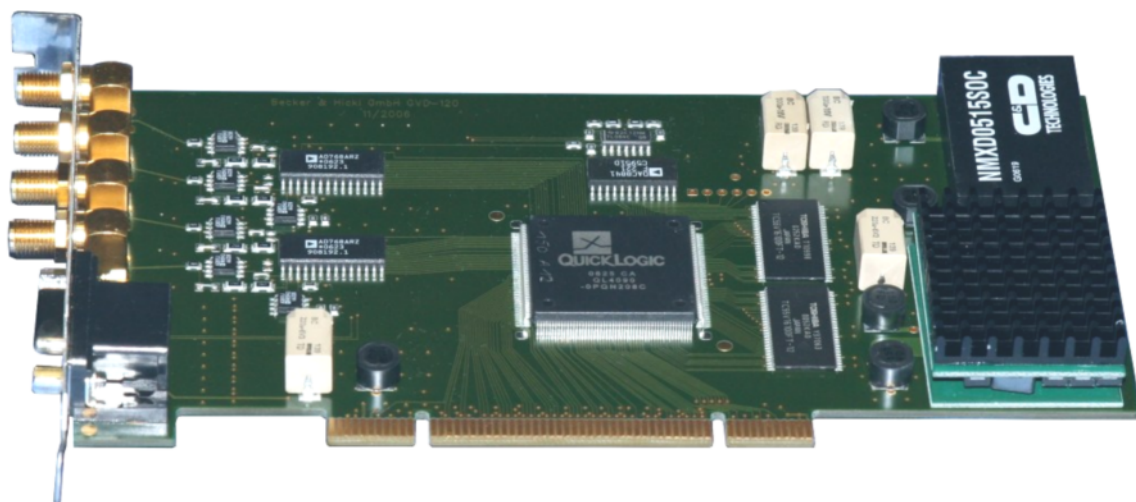
Waveform generator for X and Y galvano mirrors

Scan signal generation for SPC modules

Compatible with bh SPC-830, SPC-140, or SPC-150 TCSPC modules

Laser Control:

- Beam blanking during flyback
- Multiplexing of 2 lasers
- Power Control for two diode lasers



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Introduction

The GVD-120 generates the ramp signals for the x and y deflection. The signals are generated exclusively by the hardware of the GVD module. The waveforms are therefore independent of the computer speed and of any software reaction times. For the flyback portion of the signals a cycloid waveform is generated. This minimises mechanical resonances and thus results in extremely high scan rates (see Table 1 and Table 2, page 10).

The GVD also generates the scan synchronisation pulses for bh TCSPC modules, the beam blanking, multiplexing, and intensity control signals for the diode lasers. The GVD-120 card is shown in Fig. 1.

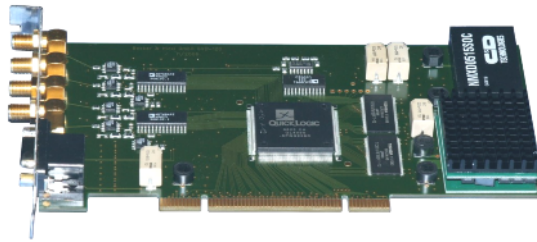


Fig. 1: GVD-120 galvo controller card

Software

The GVD-120 was intended to be only available as part of the bh DCS-120 system. Therefore the only available control software is contained in the SPCM software which mainly controls bh SPC modules. SPCM is contained in the TCSPC package which contains all software components commonly used for bh TCSPC systems. It is delivered on CD-ROM with the module. Updates can be downloaded from our website www.becker-hickl.com.

SPCM Application

The SPC-6xx, SPC-7xx, SPC-830, SPC-134 and SPC-144 modules come with the 'Multi SPC' or 'SPCM Software', a comfortable software package that contains all components to operate up to four SPC-6xx, four SPC-7xx, four SPC-830, or one SPC-134 or SPC-144 package. The SPCM software is described under 'Software' in this manual. The SPCM software is free. Updates are available from www.becker-hickl.com.

DCC Application

This application controls the DCC-100 detector controller card that is often used in conjunction with bh SPC modules. For details, please see individual DCC-100 manual.

SPCImage Application

SPCImage is the data analysis program for image files obtained in the imaging modes of the SPC-730, SPC-830 and SPC-144. For details, please see SPCImage manual. SPCImage is available on extra order. Installing SPCImage requires a licence keyword.

DLL Libraries and SPC Lab View Drivers

To facilitate the development of user-specific software DLL libraries for the SPC modules, the DCC-100, and the STP-340 Step motor controller are available on extra order. Moreover, Lab View drivers for the SPC modules are available. Installing the DLLs and Lab View drivers requires a licence keyword.

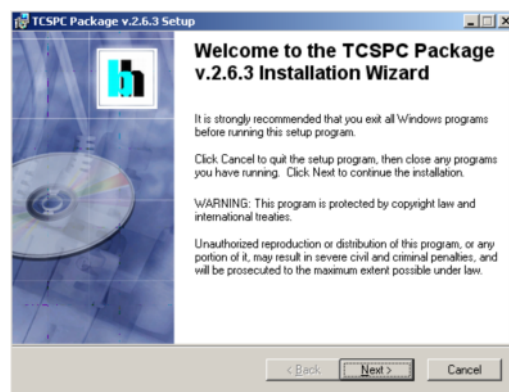
Important note: Before you start into the laborious work of developing your own programs please check whether the problem can be solved by the functions of the Multi-SPC software or by the multi-dimensional recording features of the SPC module. Please do not hesitate to discuss the control problem with bh.

Manuals

The pdf files of the SPC, DCC and SPCImage manuals and the manuals of the DLL libraries are in a 'manuals' folder on the CD. The latest versions of the manuals are also available from www.becker-hickl.com.

Installation

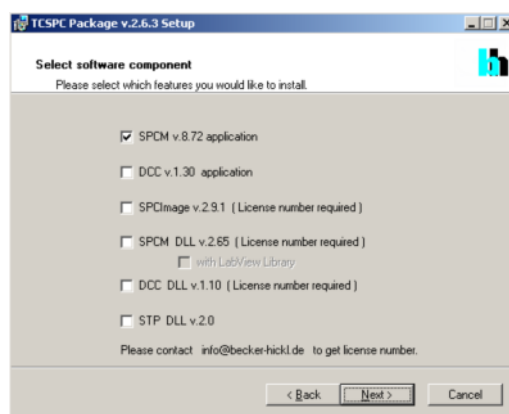
When you put the installation disk into the CD drive the installation procedure starts automatically. If you want to start the procedure on command for whatever reason, start TCSPC_setup_cd.exe from the CD. If the installation is run the first time it comes up with the following window.



The installation wizard bores you with the usual copyright warnings. We explicitly note that you are allowed

- to install all software features that are not licence-number protected on any computer and in any place you like to.
- to install the key-protected features on several computers within your workgroup for use with all SPC modules you purchased.

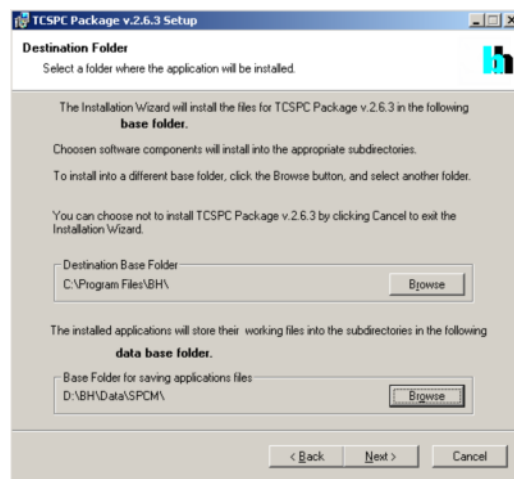
The next window allows you to select the software components you want to install. If you only have the GVD-120 alone or in combination with an SPC module installing the SPCM



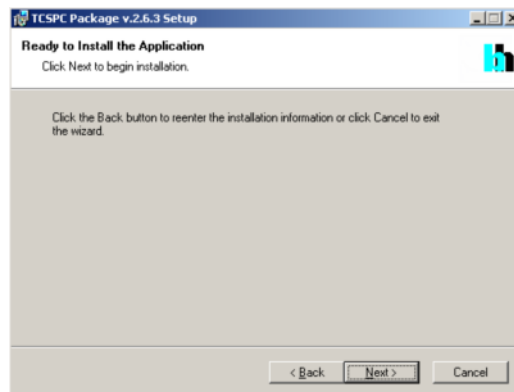
application is enough. If a DCC-100 is present, the respective software may be installed too.

If you select features protected by a licence number the next window asks you for the licence number. Type in your licence number, or, if you cannot find it, please call bh under +49 30 787 56 32 or mail to info@becker-hickl.com. If possible keep the purchase number handy - this simplifies reproducing your licence number.

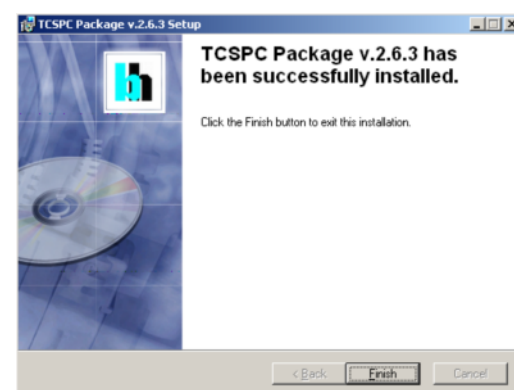
In the next window you can - but need not - change the directory ('base folder') in which the selected software features will be installed. The installation procedure will create individual sub-directories for the selected software components in the selected folder. Moreover, you can define a 'data base folder'. This folder is used as a working directory, as a default directory for loading and saving data and setup files, and as a source directory for predefined setups.



After you confirmed the base directory the installation wizard is ready to install the selected components. You have a last chance to cancel the installation or to go back to the previous step. After clicking on 'Next' the installation goes ahead.



Copying the files will take some 10 seconds for each selected feature. It is not required to re-boot the computer after installation. At the end you get the message 'TCSPC package has been successfully installed'.



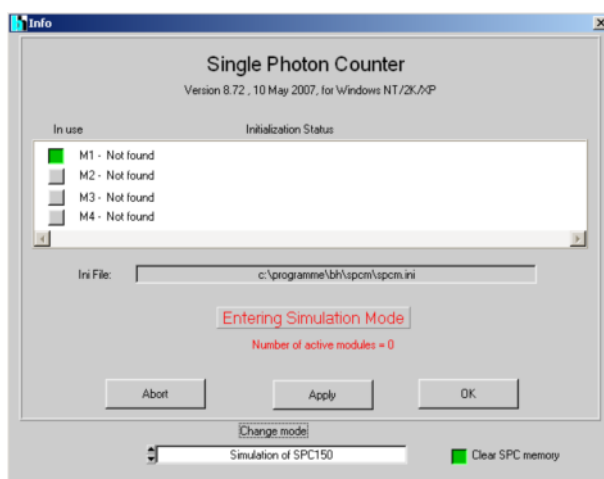
If you are using the SPCM and DCC software frequently we recommend to create a shortcut on the desk top.

Note: If software components of the TCSPC package are already installed the next installation of the same version of the package comes up with a different start window. To install additional components or repair a damaged installation please see 'Installing New Features' or 'Software Repair'.

When you have installed the SPC software, please send us an email with your name, address and telephone number. This will help us to provide you with information about new software releases and about new features of your module which may become available in future. We won't use your address to spam you with advertising.

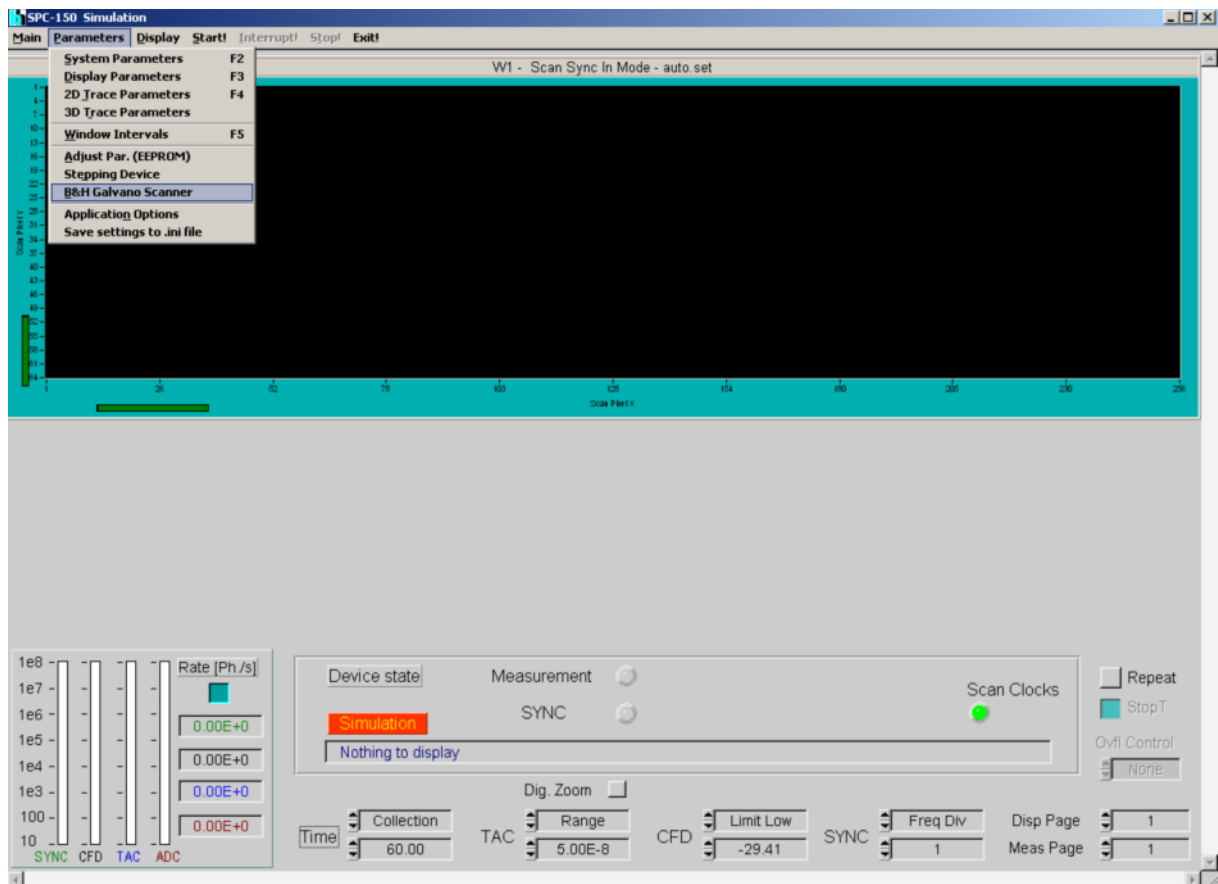
Using the Scanner Control without SPC Module

Start the SPCM-software by clicking Start/Programs/BH/SPCM/SPCM. The opening panel will show up:



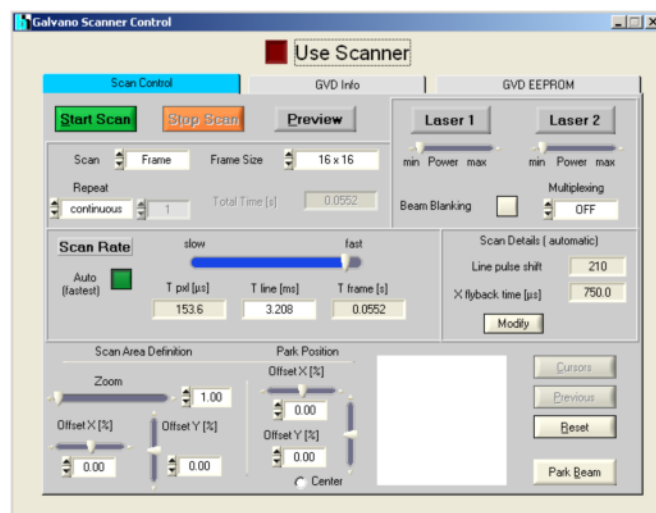
Select from the mode list under "Change mode" "Simulation of SPC-150. Then click "OK".

Then the SPCM main window appears. Select from the menu bar "Parameters" and then



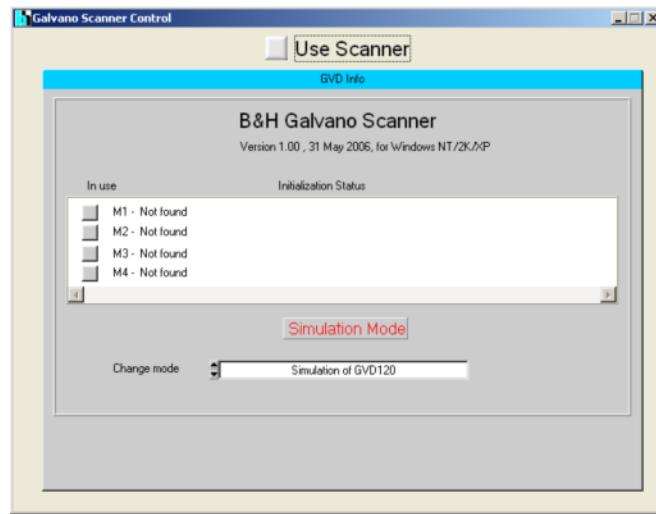
"B&H Galvano Scanner".

Now the Scanner Control pop-up window appears. But because SPCM is running in



simulation mode the SPCM software assumes also not to have a real GVD-120. The following steps enable the hardware mode of GVD-120.

Press the red button next to "Use Scanner" to switch off the (simulated) GVD-120.



Now select from the mode list next to "Change Mode" "hardware mode" and press the grey "Use Scanner" button again.

Now the Scanner Control pop-up window appears again, but this time it is connected to the GVD-120.

Scanner Control

To open the scanner control panel, click on 'Parameters' and 'B&H Galvano Scanner'. The panel allows you to define the number of pixels of the scan, the scan rate, the size and location of a zoom area, or the location to park the laser beam. Moreover, you can start and stop the scan, run a fast preview, turn on and off the lasers, and define how two lasers are multiplexed. The scanner control panel is shown in Fig. 2.

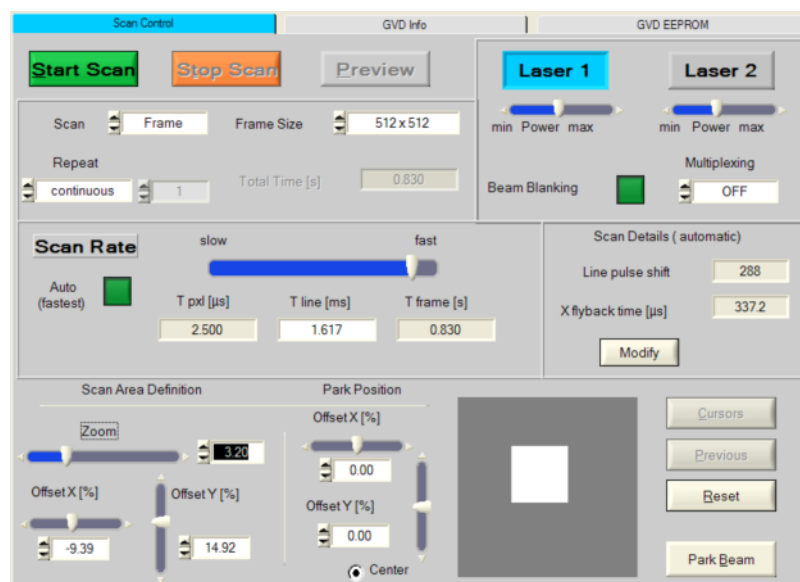


Fig. 2: Scanner control panel of the SPCM software

General Scan Parameters

The frame size can be defined from 16 x 16 pixels up to 2048 x 2048 pixels. Please note that the 'Scan Pixels X' and 'Scan Pixels Y' in the TCSPC System Parameters should correspond to the selected image size.

For normal FLIM acquisition the scan format is 'Frame'. Line scans can be performed by setting 'Scan' to 'Line'. After being started, scanning is normally continuously repeated (Repeat = 'continuous'. If necessary, the scan can be stopped after a defined number of frames.

'Total Time' is the time to scan one frame. It depends on the used frame size and scan rate. The times of the line and frame flyback are included in the total time.

Lasers

Two bh BDL-SMC diode lasers can be controlled from the scan control panel. The lasers can be switched on and of via the 'Laser 1' and Laser 2' buttons. The power can be controlled by the 'Power' sliders. Important: The power sliders control the electrical driving power of the laser diode. Therefore also the shape of the laser pulse changes. The power sliders should therefore not be changed within a series of comparable measurements.

The bh diode lasers can (and should be) used with beam blanking. That means, the lasers are turned of when the system is not scanning and during the line and frame flyback. Beam blanking thus helps to reduce photobleaching of the sample. Please note that beam blanking has to be turned off in the 'Park Beam' mode.

If two lasers are operated simultaneously they can be multiplexed on a pixel-by-pixel, line-by-line, or frame-by-frame basis. If only one laser is used 'multiplexing' must be 'off'.

Scan Rate

The scan rate is defined either by changing the line time or by moving the scan rate slider. Please note that the applicable scan rate depends on the image size and the zoom state. Therefore the scan rate may change if you change one of these parameters.

If you want to run a fast scan without taking care of these relationships you may activate the 'Auto' button. The software then automatically selects the fastest scan rate that can be used with the selected image size and zoom without compromising image linearity. Thus, the DCS-120 will scan fast, but not necessarily at the fastest rate possible. To obtain the absolutely fastest rate, turn of 'Auto', shift the rate slider to the right end, or type in a small line time. The shortest pixel times and frame times for different images sizes and zoom settings are shown in Table 1 and Table 2.

Image Size	Zoom = 1	Zoom = 2	Zoom = 4	Zoom = 8
128 x 128	12.8 μ s	6.4 μ s	4.8 μ s	3.2 μ s
256 x 256	6.4 μ s	3.2 μ s	2.4 μ s	1.6 μ s
512 x 512	3.2 μ s	1.6 μ s	1.2 μ s	0.8 μ s
1024 x 1024	1.6 μ s	1.2 μ s	0.8 μ s	0.6 μ s

Table 1: Minimum pixel time for different image size and zoom

Image Size	Zoom = 1	Zoom = 2	Zoom = 4	Zoom = 8
128 x 128	0.367 s	0.184 s	0.120 s	0.074 s
256 x 256	0.640 s	0.643 s	0.259 s	0.173 s
512 x 512	1.24 s	0.636 s	0.480 s	0.320 s
1024 x 1024	2.6 s	2.0 s	1.2 s	1.0 s

Table 2: Minimum frame time for different image size and zoom

Scan Details

The fastest line time and the optimum line flyback time depend on the zoom factor used. Moreover, at high scan rate the scanner lags behind the control voltage ramp. To avoid that a change in the scan rate results in large image shifts the lag is compensated by shifting the line sync pulse that the scan controller sends to the SPC card. All three parameters are calculated automatically from the current zoom factor and line time. The calculation parameters are accessible via the 'Modify' button. The button opens the following panel:

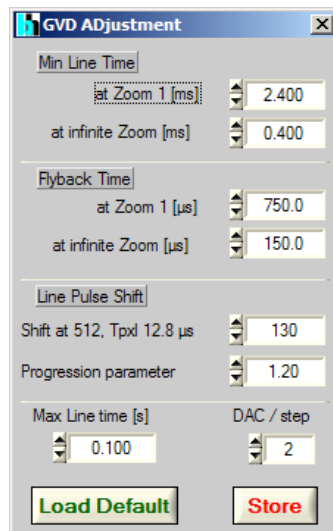


Fig. 3: Panel for adjusting the details of the scanner control

The parameters are mainly intended for adjusting the GVD-120 scan controller for different scanners. For the DCS-120 system we recommend not to change anything but the 'Max Line Time'. 'Max Line Time' determines the range of the scan rate slider. Changes may be required if the DCS-120 is to be used for extremely slow scans.

Scan Area

The scanned area can be changed by the parameters under 'Scan Area Definition'. 'Zoom' determines the size of the scan, 'Offset' the position. The location of the zoom area is shown at the right. You can shift the area with the mouse cursor. 'Reset' resets the scanner to the maximum scan area.

'Park Beam' places the laser beam in a defined spot of the scan area. The location can be set either by changing the Offset X and Offset Y of the park position, or by moving the yellow spot in the image area by the mouse cursor. Please see Fig. 4.

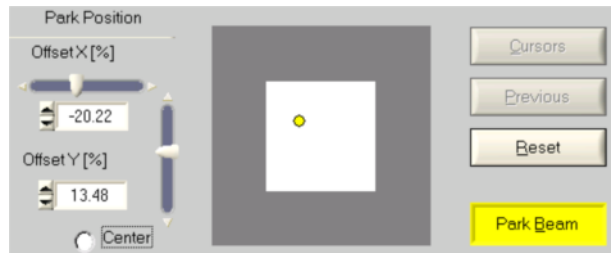


Fig. 4: Defining the beam position in the Beam Park mode

Please note that the beam blanking of the laser must be switched off to run a measurement in the beam park mode.

Connectors of the GVD-120

The GVD-120 is equipped with four SMA female connectors for the X- and Y- ramp signals and with one Sub-D-HD 15 pin female connector for Scan Control (and Laser Control) signals:

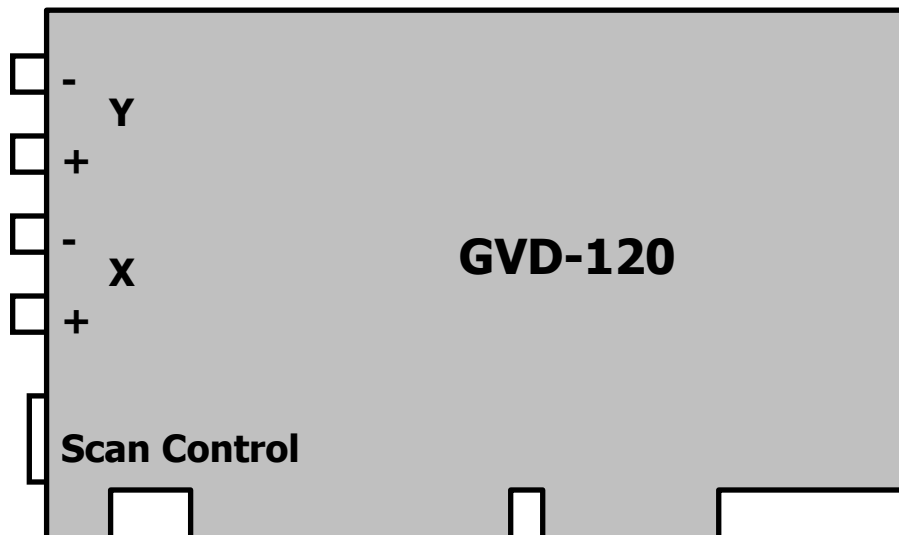


Fig. 5: Connectors at GVD-120

The following table shows the pin assignment of the Scan Control connector:

Pin	Description
1	+ 5 V
2	Laser-Routing
3	Laser 1 On
4	Laser 2 On
5	GND
6	- do not connect -
7	- do not connect -
8	Frame Clock (to SPC module)
9	Line Clock (to SPC module)
10	Laser 1 Power Control
11	Laser 2 Power Control
12	Pixel Clock (to SPC module)
13	- do not connect -
14	- do not connect -
15	GND

Table 3: Pin description of Scan Control Connector

Specifications

absolute max. Output Voltage Range at X+, X-, Y+, Y-	$\pm 10V$
Output Impedance X+, X-, Y+, Y-	50 Ω
absolute max. differential Output Voltage X+ - X- or Y+ - Y-	20 V
max. differential Output Voltage X+ - X- or Y+ - Y- by SPCM	10 V
Output Voltage Scan signals, Laser On, Laser Routing	TTL
min. pulse width Scan signals	100 ns
Output Voltage Range Laser Power	0V ...+10V