

# Advanced Digital High-Speed CCD Line Camera

CCD-S3600-D(-UV)

High-Sensitivity Linear  
CCD Array with 3648 Pixels,  
16-bit ADC, 32 MB DDR2 RAM,  
USB 2.0, Trigger Input & Output

Acquisition & Viewer  
Software for Windows  
Included

USB 2.0  
Plug & Play



Includes  
Drivers & Applica-  
tions for LabVIEW &  
C++

The CCD-S3600-D(-UV) is a complete and ready to use high-speed digital CCD line scan camera. The device includes many advanced and unique features. At the same time it is easy to use, very compact, lightweight and does not require an external power supply.

The high-sensitivity linear CCD sensor array contains 3648 active pixels and covers a wide spectral range. The sensor is controlled by complex FPGA-based state-of-the-art hardware. Other high-end components like 16-bit ADC, 32 MB DDR2 RAM & USB 2.0 assure high precision, large data storage & high speed. Highlights include high frame rates with no missing frames, precise control over parameters (e.g. integration), trigger in & out, multiple operating modes and a unique data streaming mode.

The CCD-S3600-D(-UV) is suitable for novice users who need to simply acquire light intensity data with the included standalone software as well as advanced users and experts who want to "squeeze out" each of the advanced capabilities of the device.

The CCD camera supports all major OS and can be interfaced from many programming languages, allowing unlimited post-processing possibilities. Constantly updated USB drivers,

interfacing libraries and well-commented applications for LabVIEW and C++ are included free of charge.

The CCD line camera represents an ideal cost-effective solution for numerous applications in science, research, education and OEM.

## Applications

- Ideal for science, research, education as well as OEM applications
- Ideal for mobile / notebook / laptop as well as desktop use
- Physics, chemistry, biology, bio-medicine, medicine (but not for use on human beings)
- Lasers, optics, photonics, spectroscopy
- Measurements: light, fluorescence,  $M^2$ , beam profile, single-shot autocorrelators
- Imaging (1-D or 2-D by parallel moving), data acquisition, machine vision, monitoring, process control, industrial OEM applications

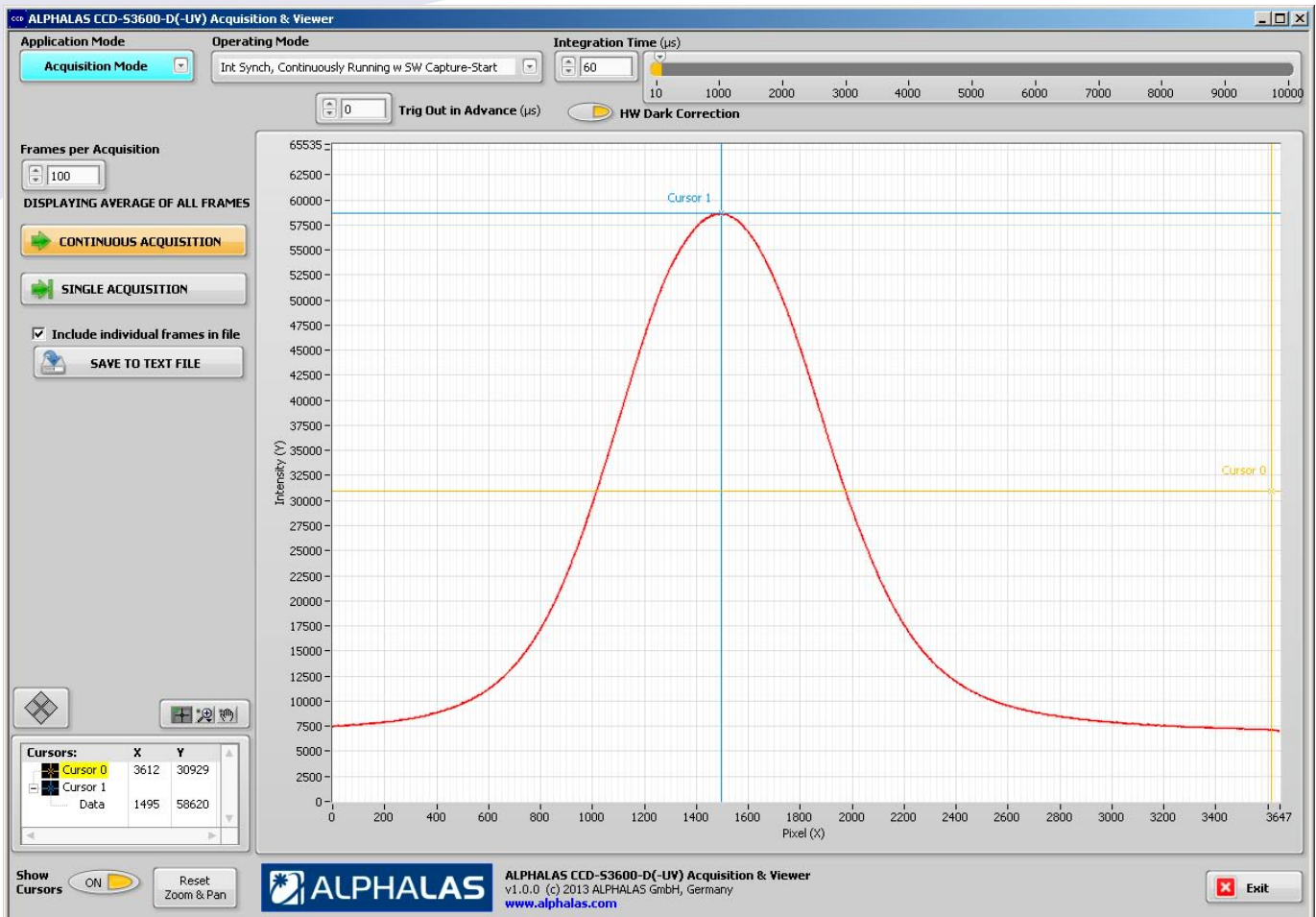
Supports Windows (WHQL Certified), Linux, Mac OS X & Other OS

## Features

- High-sensitivity linear CCD sensor array with 3648 active pixels (8 x 200  $\mu\text{m}$  each), high optical resolution & wide dynamic range
- Wide spectral range: 320 - 1100 nm, 200 - 1100 with UV Option
- Precise 16-bit high-speed ADC
- Plug & play, full software control
- Integration time can be set from 10  $\mu\text{s}$  - 1 min in precise 1  $\mu\text{s}$  steps
- High frame rates up to 269.5 fps
- Onboard data storage mode & unique direct data streaming mode: Capture an unlimited number of subsequent frames with no missing frames at the highest frame rate (the only constraint is your storage device)
- Large 32 MB high-speed DDR2 RAM for onboard data storage of 4599 frames & data buffering
- High-speed USB 2.0 (480 Mbit/s)
- State-of-the-art FPGA HW controller & high-speed electronics
- Trigger input & output for synchronization from & to external devices
- Multiple operating modes & multiple trigger modes
- Hardware dark correction
- USB-powered, no external supply required, very compact design
- Acquisition & Viewer Software; free & ready-to-use LabVIEW drivers & applications, C++ examples
- Supported by many programming languages & development platforms for unlimited post-processing possibilities
- Multi-OS support: Windows, Linux, Mac OS X, etc. (32 & 64 bit)

LASERS, OPTICS, ELECTRONICS.  
MADE IN GERMANY.  
WWW.ALPHALAS.COM





## Acquisition & Viewer Software for Microsoft Windows

- Included free of charge
- Very easy to use but controls many advanced features of the CCD camera
- Standalone software, no LabVIEW license required
- Compatible with Microsoft Windows 8.x, 7, Vista, XP (64-bit and 32-bit versions)

### Acquisition Mode

- Easily control the CCD camera and all settings: operating modes (incl. all trigger modes), integration times, frames per acquisition, HW dark correction, trig out in advance
- Easily acquire CCD data: continuous acquisition mode & single acquisition mode
- Easily save CCD data: average of all frames + all individual frames, all acquisition parameters and device settings are also saved in the versatile text file format for easy access from any other software (e.g. Microsoft Excel, text editors, mathematical software, etc.)

### Viewer Mode

- Easily load & view saved data
- View average & individual frames from any acquisition; saved acquisition parameters are also displayed

### Tools Included in the Software

- Zoom & panning, cursors (free & snapping)
- Direct export of acquired data as image files, to clipboard or to Microsoft Excel

## CCD-S3600-D(-UV) • Detailed Specifications for the CCD Line Camera (1/3)

| Parameters   | Specifications   | Notes  |
|--|--|--|
| <b>Sensor Type</b>   | High-Sensitivity Linear CCD Array  | Large number of highly sensitive pixels, high optical resolution and wide spectral ranges.   |
| <b>Active Sensor Pixels</b>  | 3648 pixels  |  |
| <b>Total Sensor Pixels</b>   | 3694 pixels  | Include optical black (light shielded) pixels and dummy pixels.  |
| <b>Size of Sensor Pixels (W x H)</b>   | 8 $\mu\text{m}$ x 200 $\mu\text{m}$  | The sensor features vertically elongated pixels for high sensitivity.  |
| <b>Active Length of Sensor</b>   | 3648 x 8 $\mu\text{m}$ = 29.184 mm   |  |
| <b>Spectral Range (typ.)</b>   | <ul style="list-style-type: none"> <li>• 200 nm - 1100 nm with UV option</li> <li>• 320 nm - 1100 nm without UV option</li> </ul>  | The UV option must be ordered explicitly.  |
| <b>Dynamic Range (typ.)</b>  | 1000 : 1   |  |
| <b>Signal-to-Noise Ratio without Averaging (typ.)</b>                            | 300 : 1  | Can be greatly increased by signal averaging.  |
| <b>Sensitivity ( V/(lx*s) ) (typ.)</b>   | 160  | High sensitivity CCD sensor.   |
| <b>Integration Time (T<sub>int</sub>)</b>  | 10 $\mu\text{s}$ – 1 minute, programmable in precise 1 $\mu\text{s}$ (0.001 ms) steps  | The integration time is controllable in an extremely wide range and in very precise steps. The same wide range is also usable with external synchronization triggering.  |
| <b>Frame Rate</b>  | Max. 269.5 Hz (frames/s) constant frame rate, corresponds to a minimum frame duration of 3710 $\mu\text{s}$ (3.71 ms)  | The frame rate depends on the set integration time. In streaming mode a constant frame rate without any missing frames can be achieved for an unlimited time (only constrained by the storage device).                   |
| <b>Sensor Readout Time</b>   | 3710 $\mu\text{s}$ (3.71 ms)   | This time is specified by the CCD sensor.  |
| <b>Sensor Modes</b>  | <ul style="list-style-type: none"> <li>• Shutter Mode for T<sub>int</sub> &lt; 3710 <math>\mu\text{s}</math></li> <li>• Non-Shutter Mode for T<sub>int</sub> <math>\geq</math> 3710 <math>\mu\text{s}</math></li> </ul>            | The CCD camera automatically uses the correct sensor mode.   |
| <b>Trigger Input</b>   | Yes  | External devices can trigger the CCD.  |
| <b>Trigger Output</b>  | Yes  | The CCD can trigger external devices.  |
| <b>Analog-to-Digital Converter (ADC)</b>   | 16-bit ADC   | Industry-leading ADC, high-speed, high-precision, low-noise, low-power.  |
| <b>Bits per Pixel</b>  | 16 bits / pixel  |  |
| <b>Saturation Levels per Pixel</b>   | 65536  |  |
| <b>Pixel Output Speed</b>  | 1 MHz (1 $\mu\text{s}$ / pixel)  |  |
| <b>Readout Data Rate from Sensor to Internal RAM</b>                             | 2 MBytes / s   |  |
| <b>On-Board Memory</b>   | 32 Mbytes (256 Mbits) High-Speed DDR2 RAM @ 266 MHz  | The extremely large high-end DDR2 RAM runs at 266 MHz and is used for onboard data storage as well as for buffering in data streaming mode.  |
| <b>Data Acquisition Modes</b>  | <ul style="list-style-type: none"> <li>• Onboard data storage mode (PC can fetch data later when free)</li> <li>• Data Streaming Mode (PC fetches data immediately, number of frames is not limited by the onboard RAM)</li> </ul> | The unique data streaming mode allows the user to stream an unlimited amount of data to the PC at the highest frame rate without any missed frames. The only constraint is the data storage device (e.g. PC hard drive). |
| <b>Onboard Data Storage</b>  | Up to 4599 frames can be captured, before fetching any of them.  | The CCD can store up to 4599 frames onboard (approx. 17 s at the highest frame rate), before the PC fetches them. For unlimited number of captured frames see data streaming mode.                                       |
| <b>Data Streaming</b>  | Unlimited number of frames can be streamed to the PC in this mode. The large RAM is used as a FIFO frame buffer.   | This mode allows capturing of an unlimited number of frames in real-time and streaming them directly to the PC's hard drive. The onboard RAM is used as a big buffer in this mode.                                       |
| <b>Continuous Frame Capture at Highest Frame Rate without Any Missing Frames</b> | <ul style="list-style-type: none"> <li>• UNLIMITED number of frames &amp; capture time in data streaming mode</li> <li>• 4599 frames in onboard storage mode</li> </ul>  | Unique streaming technology with 32 MB RAM can buffer up to 17 s at the highest frame rate. This allows the PC to fetch the data on time.  |
| <b>Trigger Types</b>   | Internal & External Triggering   | See main operating modes.  |

**Note:** All specifications are typical at 25 °C unless otherwise stated.  
 All specifications are subject to change without notice. No responsibility for typing or printing errors.  
 All trademarks are the property of their respective owners.

CCD-S3600-D(-UV) • Detailed Specifications for the CCD Line Camera (2/3)

| Parameters  | Specifications  | Notes   |
|---|---|---|
| <b>Main Operating Modes</b>   | Five main operating modes:<br>1. Internally synchronized, continuously running, with software capture start<br>2. Internally synchronized, continuously running, with hardware capture start<br>3. Internally synchronized, continuously running, with hardware capture enable<br>4. Single-shot with external hardware trigger (sensor is kept clean & ready), usable for $T_{int}$ up to 500 $\mu$ s<br>5. Externally synchronized, continuously running, with software capture start | Each operating mode is usable in onboard data storage mode as well as data streaming mode   |
| <b>External Trigger Input</b>   | Yes, gold-plated SMB connector. Used in the different operating modes as capture start, capture enable, single-shot trigger or synchronization trigger.   | TTL, max. + 5 V (rising edge). Note: To be able to also capture short signals, the input signals are stretched by ~ 50 ns. The minimum trigger pulse width is ~ 8 ns.   |
| <b>External Trigger Output</b>  | Yes, gold-plated SMB connector. Used for synchronization of external devices. In most operating modes this signal indicates when the integration in a frame actually begins. In external synchronization mode this signal indicates when the integration in a frame ends.   | TTL, + 5 V (rising edge). This signal is high for 500 ns. This means that external devices can be triggered with a resolution of 0.5 $\mu$ s when triggering on the rising or falling edge.   |
| <b>User-Definable Offset for Trigger Output Before Integration Starts</b> | Yes, for short integration times when the sensor is in shutter mode. Programmable at runtime in the range from 0 $\mu$ s to 1849 $\mu$ s.   |   |
| <b>Main CCD Controller Hardware</b>                                       | Industry-leading Xilinx FPGA for precise concurrent hardware control.   |   |
| <b>Full Programmability</b>   | Yes, all parameters are fully programmable at runtime through software commands.  |   |
| <b>Onboard Signal Conditioning</b>  | Yes   |   |
| <b>Onboard Dark Correction in Hardware</b>                                | Yes, with temperature adaptability.   | Can be activated by the user at any time.   |
| <b>PC Interface</b>   | High-Speed USB 2.0 (480 Mb/s)   | USB Type B Connector on device side.  |
| <b>Onboard USB 2.0 Hardware</b>   | Industry-leading FTDI dual-channel high-speed USB 2.0 controller with FIFO buffers.   |   |
| <b>USB Bus Powered</b>  | Yes, no external power supply required.   | Ideal for mobile & notebook applications.   |
| <b>Package Features</b>   | Very compact, no moving parts.  | Ideal for mobile & notebook applications.   |
| <b>Plug &amp; Play</b>  | Yes, plug & play operation.   | Ideal for mobile & notebook applications.   |
| <b>OEM</b>  | Yes, ideal for OEM applications.  | Very compact. Uses standard FTDI drivers & libraries. Multi-OS support. Unlimited post-processing with the customer's software.   |
| <b>USB Drivers &amp; Libraries Included</b>                               | Yes, FREE! Original FTDI drivers & libraries for high-level USB interfacing from multiple programming languages for Windows (.dll), Linux (.so) and Mac OS X (.dylib).  | FTDI D2XX drivers for all major operating systems are constantly updated. WHQL certified. Application software can access the USB device through well-documented simple high-level library function calls, no need to understand the low-level details of USB operation.            |
| <b>LabVIEW Drivers, GUI Applications &amp; Examples Included</b>          | Yes, FREE! For LabVIEW 8.6 and later. Support LabVIEW for Windows, Linux and Mac OS. Compliant with NI LabVIEW driver guidelines.   | Drivers, GUI applications and examples for data acquisition, data streaming, Gaussian fit, FWHM, 3D graph visualization, etc. Well-commented block diagrams & front panels and context help.  |
| <b>C++ Examples</b>   | Yes, FREE! Visual C++ project & GCC C++ files. Source code can be compiled under Windows, Linux and Mac OS X.   | Console application demonstrates cross-platform access to the CCD device. The Express edition of Visual C++ is also supported. Well-commented source code.  |
| <b>Post-Processing Possibilities with Additional Software Packages</b>    | Unlimited, using your favorite software package, e.g. LabVIEW, MATLAB, Origin, Mathcad, etc.  | The captured data can be further processed using floating point accuracy (averaging, binning, accumulation, reference subtraction), noise can be removed, data can be reviewed, printed, exported, etc. This functionality is defined by the capabilities of your software package. |
| <b>Programming Languages for Programming and Controlling the CCD</b>      | LabVIEW, Visual C++, GCC C++, C++ Builder, C#, Delphi, Visual Basic, Java, LabWindows/CVI, Perl, Python, etc.   | The large variety of languages is not directly supported by ALPHALAS. Please refer to the programming examples on the FTDI web site ( <a href="http://www.ftdichip.com">www.ftdichip.com</a> ) for more information.  |

**Note:** All specifications are typical at 25 °C unless otherwise stated.  
All specifications are subject to change without notice. No responsibility for typing or printing errors.  
All trademarks are the property of their respective owners.

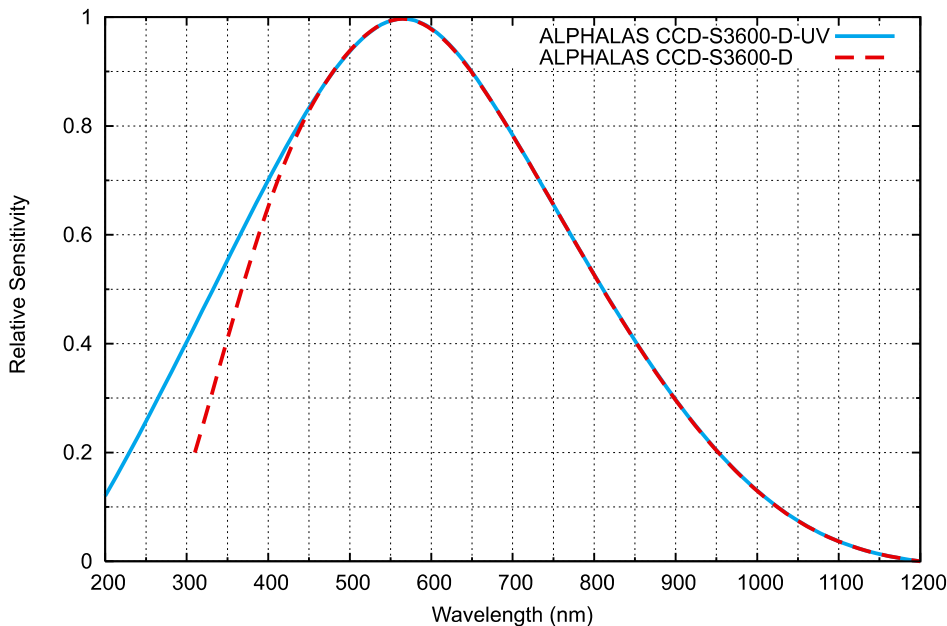


## CCD-S3600-D(-UV) • Detailed Specifications for the CCD Line Camera (3/3)

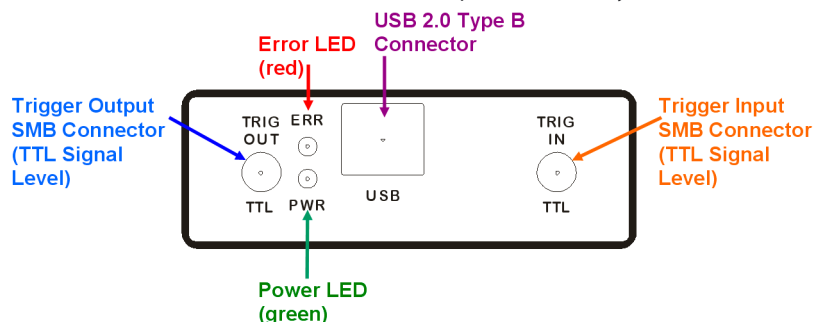
| Parameters   | Specifications   | Notes   |
|--|--|---|
| <b>Acquisition &amp; Viewer Software Included</b>            | Yes, FREE! Supports Microsoft Windows. Standalone, does <b>not</b> require a LabVIEW license.  | Easily control the CCD camera and all settings, acquire & save CCD data. Easily load & view saved data, incl. average & individual frames. Tools include zoom, panning, cursors and data export.  |
| <b>Operating Systems Supported by the FTDI Device Driver</b> | Microsoft Windows 8.x, 7, Vista, XP, Server Linux (e.g. Ubuntu, openSUSE, Debian, etc.), Apple Mac OS X, Microsoft Windows CE 4.2-5.2 & CE 6.0. Both 32-bit & 64-bit OS are supported. | Windows Hardware Quality Labs (WHQL) certification. Fully automatic driver installation on plug-in through Windows Update.<br><br>For an updated list of new operating systems compatible with the FTDI drivers, please see the FTDI web site ( <a href="http://www.ftdichip.com">www.ftdichip.com</a> ). |
| <b>Multi-Camera Support</b>                                  | Yes, multiple CCD line cameras are supported on the same host computer.  | This allows the user to connect more than one CCD line camera and acquire data from all devices simultaneously. A LabVIEW example is provided.  |
| <b>Visual Indicators</b>                                     | Power LED, Error LED   | The Error LED will signal an internal buffer overflow in data streaming mode.   |
| <b>Host PC Hardware Requirements</b>                         | Modern PC, notebook or tablet (e.g. Intel Core CPU), 2 GB of RAM or more, USB 2.0  | Enough hard drive space if data streaming will be used. The software should also run without problems on slower hardware.   |
| <b>Power-Up Time (Typ.)</b>                                  | < 1 s  |   |
| <b>Operating Temperature</b>                                 | 0°C to 40 °C   |   |
| <b>Storage Temperature</b>                                   | -20°C to 60 °C   |   |
| <b>Relative Humidity</b>                                     | 0% to 80%, non-condensing  |   |
| <b>Physical Dimensions (W x H x D)</b>                       | ~ 90 x 25 x 105 mm<br>See mechanical drawing.  | Very compact size.  |
| <b>Weight</b>  | ~ 165 g  | Very lightweight.   |

**Note:** All specifications are typical at 25 °C unless otherwise stated.  
All specifications are subject to change without notice. No responsibility for typing or printing errors.  
All trademarks are the property of their respective owners.

Normalized Spectral Sensitivity (Typ.) ( $T_a = 25^\circ\text{C}$ )

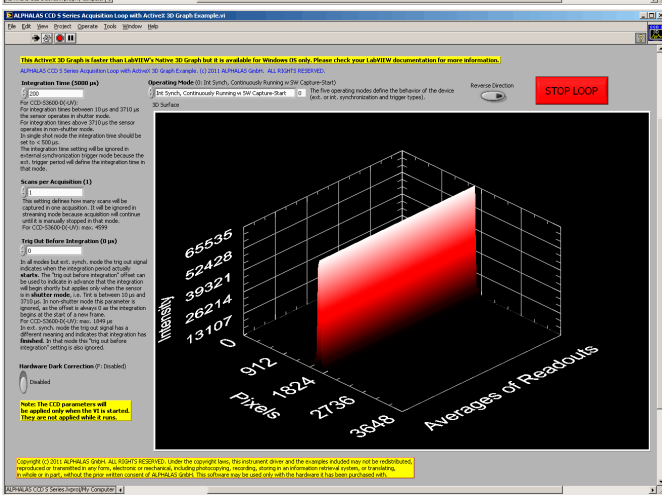
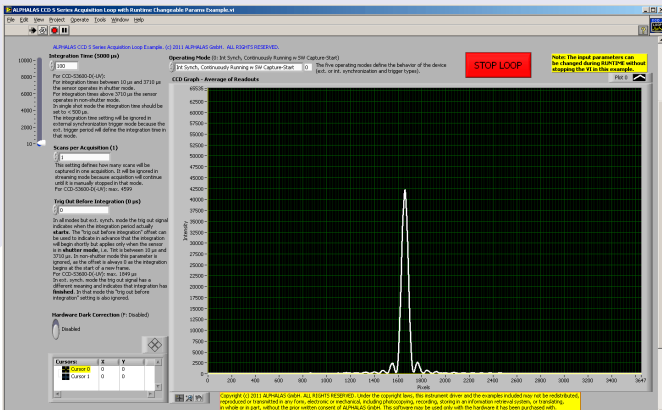


CCD-S3600-D & CCD-S3600-D-UV Spectral Sensitivity Chart

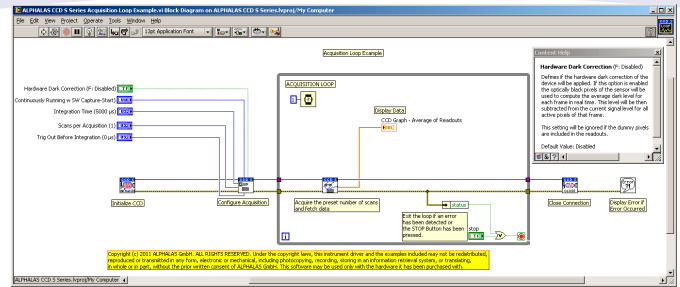


CCD-S3600-D(-UV) Connectors & Indicators on the Rear Panel

# Advanced Digital High-Speed CCD Line Camera: CCD-S3600-D-(UV)



Fully-Functional LabVIEW GUI Application VIs



Well-Commented Block Diagrams, Front Panels & Context Help

Project: ALPHALAS CCD 5 Series.lvproj

My Computer

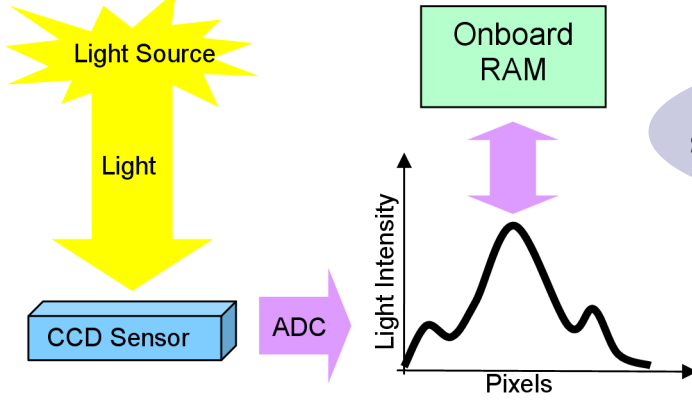
Examples

- ALPHALAS CCD 5 Series Single Acquisition Example.vi
- ALPHALAS CCD 5 Series Acquisition Loop Example.vi
- ALPHALAS CCD 5 Series Acquisition Loop with Runtime Changeable Params Example

| Initialize | Configuration | Data                        | Utility | Close |
|------------|---------------|-----------------------------|---------|-------|
|            |               |                             |         |       |
|            |               | <b>Low Level Data</b>       |         |       |
|            |               | Preset Number of Scans Mode |         |       |
|            |               |                             |         |       |
|            |               | Data Streaming Mode         |         |       |
|            |               |                             |         |       |

All LabVIEW Drivers & VIs are Modern Project-Style

C++ Examples with Well-Commented Source Code: Visual C++ Project & GCC C++ Files Demonstrating Cross-Platform Access to the CCD Line Camera



The CCD Line Camera: Collecting Light & Data Flow

**Easy-to-use plug & play design.**  
**Fully software-programmable parameters.**  
**State-of-the-art hardware & cross-platform support.**  
**Ideal for science, research, education & OEM.**

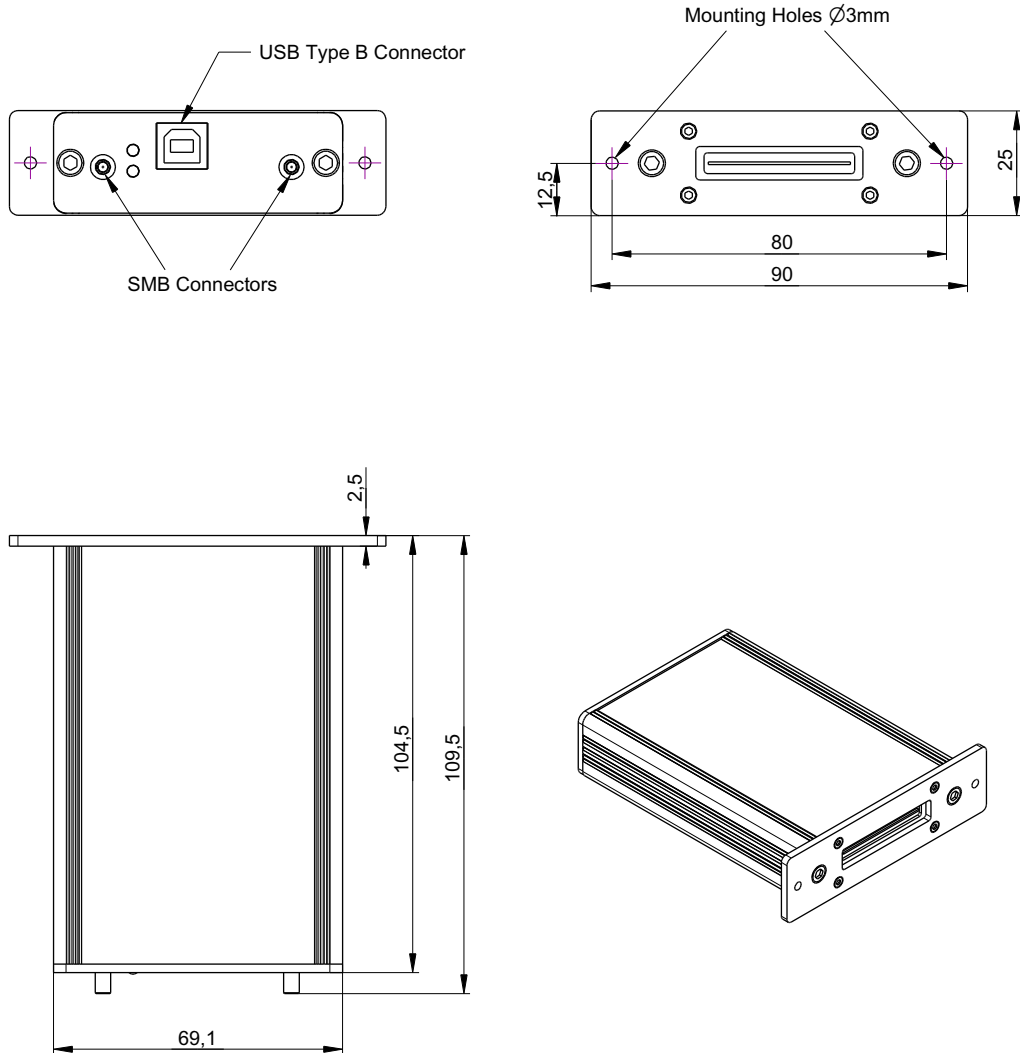
LASERS, OPTICS, ELECTRONICS.  
 MADE IN GERMANY.  
 WWW.ALPHALAS.COM



# Advanced Digital High-Speed CCD Line Camera: CCD-S3600-D(-UV)

|       |               |                          |           |
|-------|---------------|--------------------------|-----------|
| 1     | 2             | 3                        | 4         |
| RevNo | Revision note | All dimensions are in mm |           |
|       |               | Date                     | Signature |
|       |               |                          | Checked   |

## CCD-S3600-D(-UV) Mechanical Drawing



| Itemref  | Quantity   | Title/Name, designation, material, dimension etc |           |   | Article No./Reference |  |
|--|------------|--|-----------|---|-----------------------|--|
| Drawn by<br>JK   | Checked by | Approved by - date                               | File name | Date<br>27.09.2011  | Scale                 |  |
| NO PART OF THIS DRAWING MAY BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS INCLUDING PHOTOCOPYING OR RECORDING WITHOUT THE PRIOR WRITTEN PERMISSION OF ALPHALAS GMBH |            |  |           | Digital CCD Line Camera with USB 2.0 Interface<br>Model: CCD-S3600-D(-UV) |                       |  |
| <b>ALPHALAS GmbH</b><br>Göttingen, Germany   |            |  |           | Edition<br>1.2  | Sheet<br>1/1          |  |

**ALPHALAS GMBH**  
Bertha-von-Suttner-Str. 5  
D-37085 Goettingen  
Germany

TEL +49 - 551 - 77 06 147  
FAX +49 - 551 - 77 06 146  
E-MAIL sales@alphalas.com  
WEB www.alphalas.com

LASERS, OPTICS, ELECTRONICS.  
MADE IN GERMANY.  
WWW.ALPHALAS.COM



Options and further specifications are available upon request. Specifications in this data sheet are subject to change without notice. No responsibility for typing or printing errors. ALPHALAS GmbH reserves the right to make changes without further notice to any products herein. ALPHALAS GmbH makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ALPHALAS GmbH assume any liability arising out of the application or use of any product, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in ALPHALAS GmbH data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals", must be validated for each customer application by customer's technical experts. ALPHALAS GmbH products are intended for expert users only. ALPHALAS GmbH products are not designed, intended, or authorized for use in medical, surgical or any other human *in vivo* applications, or for any other application in which the failure of the ALPHALAS GmbH product could create a situation where personal injury or death may occur. Therefore, ALPHALAS GmbH products must not be used in such applications. Furthermore, ALPHALAS GmbH products must not be used in critical applications (e.g. in life support systems, in aviation, in nuclear facilities, in weapon systems, in safety or security systems, etc.). ALPHALAS GmbH products must not be used where damage to property may occur.