

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**

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 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

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

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, biomedicine, 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

Features

- High-sensitivity linear CCD sensor array with 3648 active pixels (8 x 200 μm 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 μs - 1 min in precise 1 μs 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
- Supported by many programming languages & development platforms for unlimited post-processing possibilities
- Multi-OS support: Windows, Linux, Mac OS X, etc. (32 & 64 bit)
- Free & ready-to-use USB drivers & libraries, LabVIEW drivers, GUI applications & C++ examples, all available for Windows, Linux and Mac OS X

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



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

Parameters	Specifications	Notes
Sensor Type	High-Sensitivity Linear CCD Array	Large number of highly sensitive pixels, high optical resolution and wide spectral ranges.
Active Sensor Pixels	3648 pixels	
Total Sensor Pixels	3694 pixels	Include optical black (light shielded) pixels and dummy pixels.
Size of Sensor Pixels (W x H)	8 μm x 200 μm	The sensor features vertically elongated pixels for high sensitivity.
Active Length of Sensor	3648 x 8 μm = 29.184 mm	
Spectral Range (typ.)	<ul style="list-style-type: none"> • 200 nm - 1100 nm with UV option • 320 nm - 1100 nm without UV option 	The UV option must be ordered explicitly.
Dynamic Range (typ.)	1000 : 1	
Signal-to-Noise Ratio without Averaging (typ.)	300 : 1	Can be greatly increased by signal averaging.
Sensitivity (V/(lx*s)) (typ.)	160	High sensitivity CCD sensor.
Integration Time (T_{int})	10 μs – 1 minute, programmable in precise 1 μs (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.
Frame Rate	Max. 269.5 Hz (frames/s) constant frame rate, corresponds to a minimum frame duration of 3710 μs (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).
Sensor Readout Time	3710 μs (3.71 ms)	This time is specified by the CCD sensor.
Sensor Modes	<ul style="list-style-type: none"> • Shutter Mode for T_{int} < 3710 μs • Non-Shutter Mode for T_{int} \geq 3710 μs 	The CCD camera automatically uses the correct sensor mode.
Trigger Input	Yes	External devices can trigger the CCD.
Trigger Output	Yes	The CCD can trigger external devices.
Analog-to-Digital Converter (ADC)	16-bit ADC	Industry-leading ADC, high-speed, high-precision, low-noise, low-power.
Bits per Pixel	16 bits / pixel	
Saturation Levels per Pixel	65536	
Pixel Output Speed	1 MHz (1 μs / pixel)	
Readout Data Rate from Sensor to Internal RAM	2 MBytes / s	
On-Board Memory	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.
Data Acquisition Modes	<ul style="list-style-type: none"> • Onboard data storage mode (PC can fetch data later when free) • Data Streaming Mode (PC fetches data immediately, number of frames is not limited by the onboard RAM) 	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).
Onboard Data Storage	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.
Data Streaming	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.
Continuous Frame Capture at Highest Frame Rate without Any Missing Frames	<ul style="list-style-type: none"> • UNLIMITED number of frames & capture time in data streaming mode • 4599 frames in onboard storage mode 	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.
Trigger Types	Internal & External Triggering	See main operating modes.

Note: All specifications are typical at 25 °C unless otherwise stated.

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

Parameters	Specifications	Notes
Main Operating Modes	Five main operating modes: 1. Internally synchronized, continuously running, with software capture start 2. Internally synchronized, continuously running, with hardware capture start 3. Internally synchronized, continuously running, with hardware capture enable 4. Single-shot with external hardware trigger (sensor is kept clean & ready), usable for T_{int} up to 500 μ s 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
External Trigger Input	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 \sim 50 ns. The minimum trigger pulse width is \sim 8 ns.
External Trigger Output	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 μ s when triggering on the rising or falling edge.
User-Definable Offset for Trigger Output Before Integration Starts	Yes, for short integration times when the sensor is in shutter mode. Programmable at runtime in the range from 0 μ s to 1849 μ s.	
Main CCD Controller Hardware	Industry-leading Xilinx FPGA for precise concurrent hardware control.	
Full Programmability	Yes, all parameters are fully programmable at runtime through software commands.	
Onboard Signal Conditioning	Yes	
Onboard Dark Correction in Hardware	Yes, with temperature adaptability.	Can be activated by the user at any time.
PC Interface	High-Speed USB 2.0 (480 Mb/s)	USB Type B Connector on device side.
Onboard USB 2.0 Hardware	Industry-leading FTDI dual-channel high-speed USB 2.0 controller with FIFO buffers.	
USB Bus Powered	Yes, no external power supply required.	Ideal for mobile & notebook applications.
Package Features	Very compact, no moving parts.	Ideal for mobile & notebook applications.
Plug & Play	Yes, plug & play operation.	Ideal for mobile & notebook applications.
OEM	Yes, ideal for OEM applications.	Very compact. Uses standard FTDI drivers & libraries. Multi-OS support. Unlimited post-processing with the customer's software.
USB Drivers & Libraries Included	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.
LabVIEW Drivers, GUI Applications & Examples Included	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.
C++ Examples	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.
Post-Processing Possibilities with Additional Software Packages	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.
Programming Languages for Programming and Controlling the CCD	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 (www.ftdichip.com) for more information.

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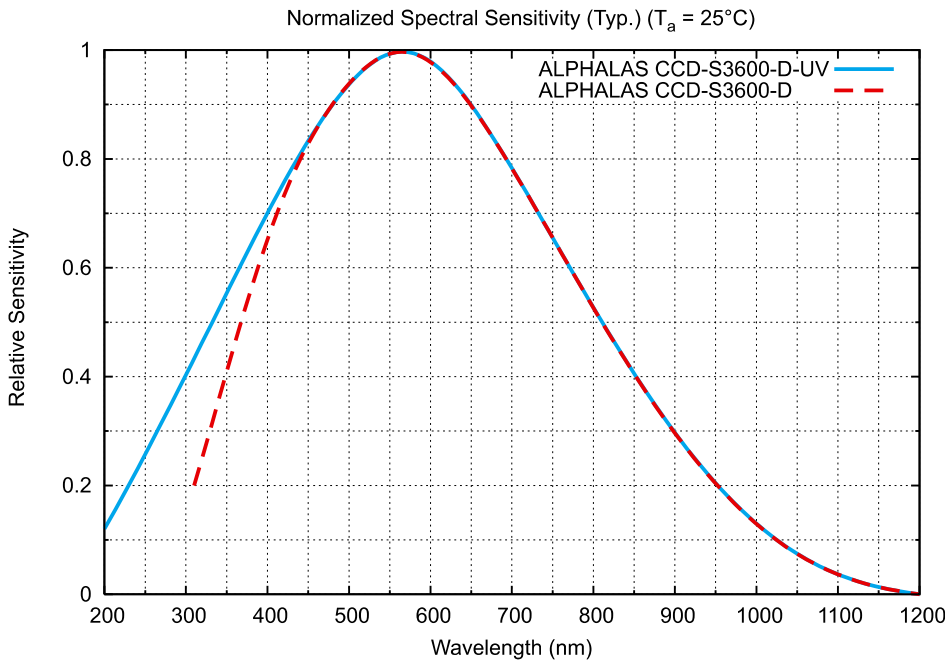
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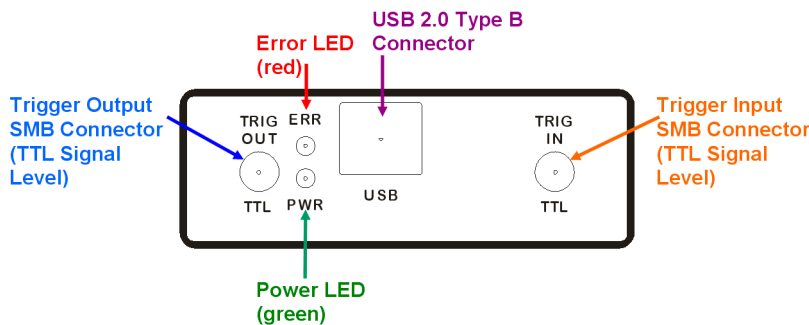
CCD-S3600-D(-UV) • Detailed Specifications for the CCD Line Camera (3/3)

Parameters	Specifications	Notes
Operating Systems Supported by the FTDI Device Driver	Microsoft Windows (XP, Vista, 7, Server, etc.) 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. For an updated list of new operating systems compatible with the FTDI drivers, please see the FTDI web site (www.ftdichip.com).
Multi-Camera Support	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.
Visual Indicators	Power LED, Error LED	The Error LED will signal an internal buffer overflow in data streaming mode.
Host PC Hardware Requirements	Modern PC or Notebook (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 device should also run without problems on slower hardware.
Power-Up Time (Typ.)	< 1 s	
Operating Temperature	0°C to 40 °C	
Storage Temperature	-20°C to 60 °C	
Relative Humidity	0% to 80%, non-condensing	
Physical Dimensions (W x H x D)	~ 90 x 25 x 105 mm See mechanical drawing.	Very compact size.
Weight	~ 165 g	Very lightweight.

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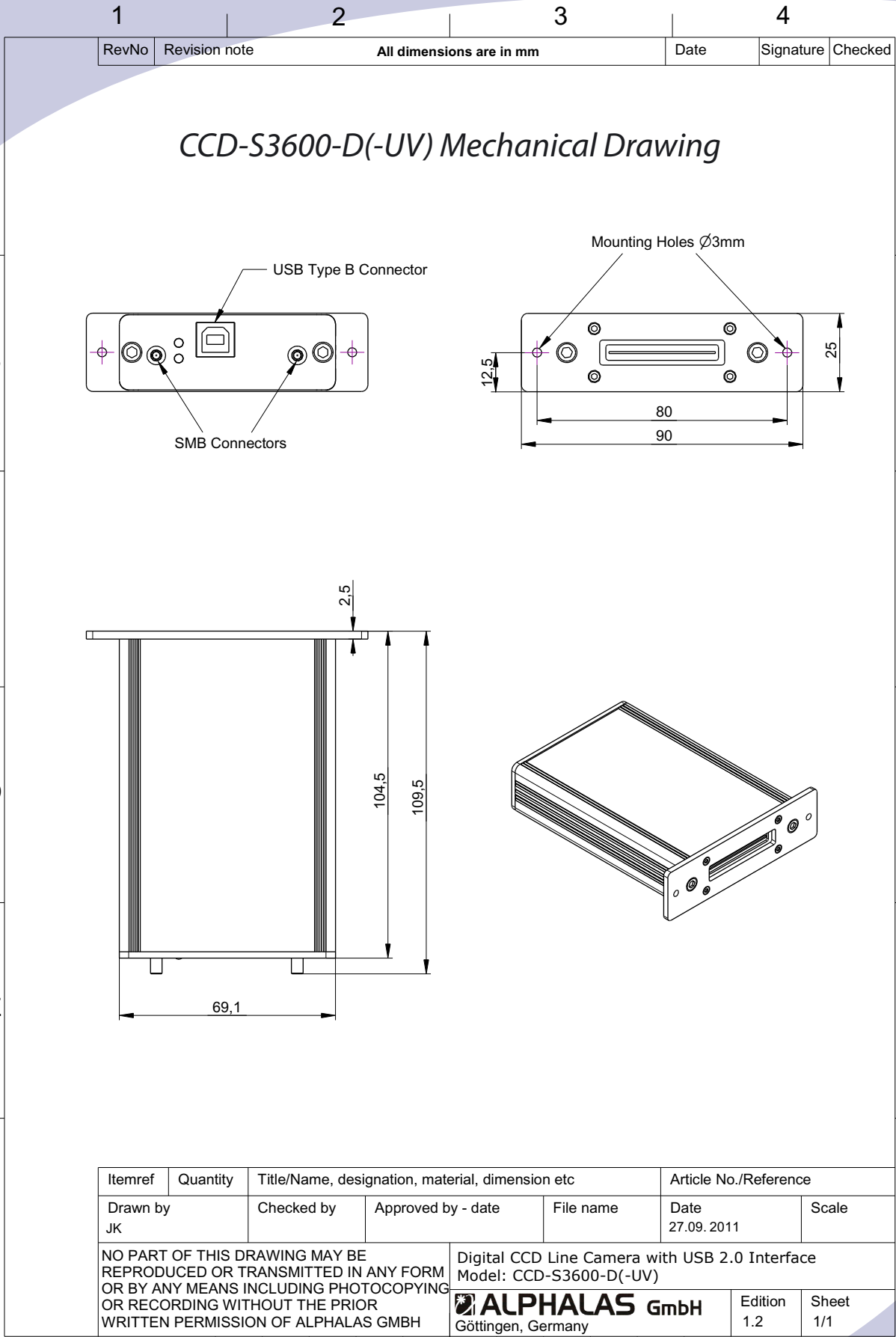


CCD-S3600-D & CCD-S3600-D-UV Spectral Sensitivity Chart



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

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



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