Wasatch Photonics
Ultimate Spectrometers

Cobra Spectrometer with 2048 array
User's Manual

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About Wasatch Photonics

Wasatch Photonics specializes in high performance Volume Phase Holographic Gratings (VPHGs), Volume Phase Holographic Optical Elements (VHOEs), and systems based on these components. Systems include spectrometers and engines for applications ranging from Raman spectroscopy to optical coherence tomography to hyper-spectral imaging for users including researchers, end users, and OEM's.

At Wasatch Photonics, we are committed to quality, innovation, and meeting the needs of our customers. With 130+ years of combined experience and 80+ patents in the design and manufacture of Volume Phase Holography and instruments, our skilled staff is unmatched in quality and know-how.

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1 Introduction

1.1 Description of product

The Cobra spectrometer is intended for use in OEM systems or laboratory research settings for OCT imaging when used in conjunction with a light source, interferometer sample scanner and appropriate computer hardware and software. Users are corporate OEM's and researchers who need a high performance OCT spectrometer. The Cobra spectrometer consists of a Wasatch Photonics Volume Phase Holographic Grating, high performance optics and an internal line scan array with Camera Link or USB 3.0 output.

1.2 Definitions, Acronyms, and Abbreviations

A	Amps
APC	angled physical connector
C	Celsius
°C	degrees Celsius
cm	centimeters
dB	decibels
I/O	input/output
mm	millimeter
nm	nanometer
µm	micron or micrometer
MSamp	Megasamples (10^6 samples)
OCT	Optical Coherence Tomography
PC	physical connector
RoHS	Restriction of Hazardous Substances
QE	Quantum Efficiency
sec	seconds
SLD	superluminescent diode
SM	single mode
V	Volts

1.3 Specifications

Cobra with integrated 2048 pixel array

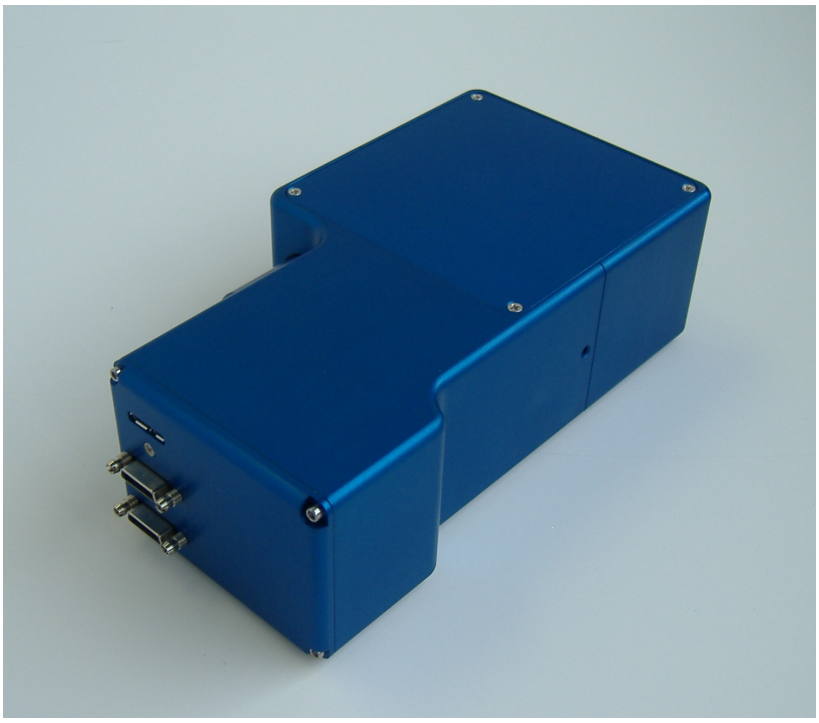


Table 1: Specifications

Feature	***Cobra SRC***	***Cobra HRC***
Spectral range (nm)	800 to 880	770 to 930
Center wavelength (nm)	840	850
Resolution (nm/pixel)	0.04	0.078
Spectrometer Pixels	2048	2048
A-Scan Rate (lines/second)	Up to 45,000	Up to 45,000
Bit depth	12 (up to 12,000 lines/sec) 11 (up to 24,000 lines/sec) 10 (up to 45,000 lines/sec)	12 (up to 12,000 lines/sec) 11 (up to 24,000 lines/sec) 10 (up to 45,000 lines/sec)

1.4 Setting up the Cobra spectrometer

The following steps should be taken to unpack and set up the spectrometer for operation. This setup assumes the user has a computer with a Camera Link card and associated software.

1. Unpack all items from box.
2. Connect FC/PC end of optical fiber patchcord to spectrometer.
3. Connect FC/APC end of patchcord to OCT setup (or light source).
4. Connect MDR end of Camera Link cable (the larger connector) to Camera Link card.
5. Connect SDR end of Camera Link cable (the smaller connector) to spectrometer (top Camera Link connection).
6. Connect USB Micro Type B connector to spectrometer.
7. Connect USB Type A connector to power supply.
8. Insert power supply into wall outlet (120V 60 Hz).
9. Establish serial port connection to spectrometer. If <enter> is sent, the spectrometer should return 'Cobra SRC'.
10. The following command sequence can be used to start generating lines from the camera. This sequence uses internal triggering and generates A-scans at a rate of 10,000/ second.

    init

    gain 187

    offset 255

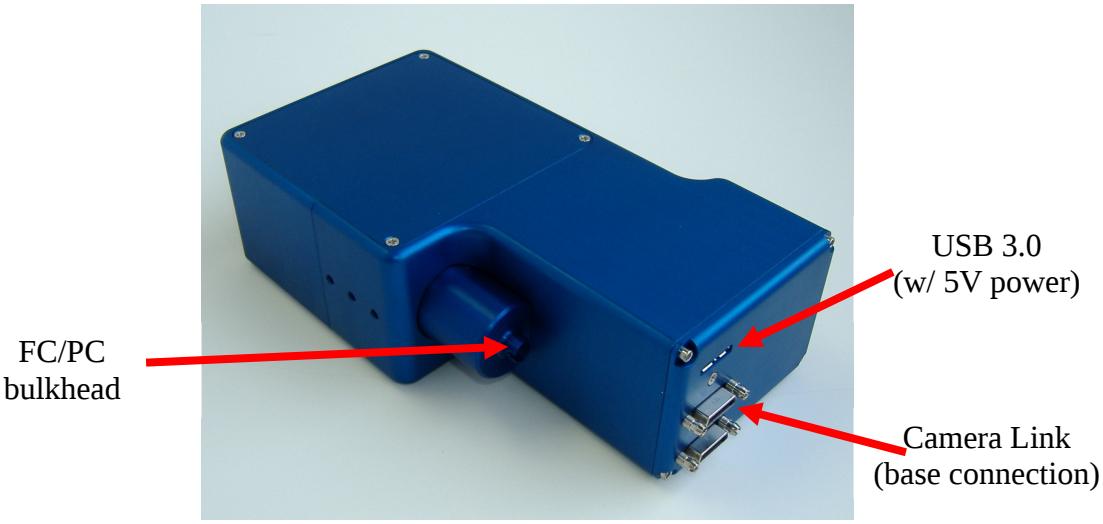
    int 90

    ltm 100

    lsc 1

    To stop generating lines, use *lsc 0*. Be sure to issue an *lsc 0* command BEFORE changing *int*, *gain*, or *offset*.

1.5 Input / Output Connections



FC/PC bulkhead

Fiber bulkhead connector for FC/PC connector.

Camera Link connection

The spectrometer has two Camera Link connectors. The top connector is the base Camera Link connector; insert Camera Link cable in this location. The bottom Camera Link connector is not used for the 2048 array. Control of the spectrometer happens via the serial connection in the Camera Link interface.

USB 3.0 (with power)

The spectrometer has a USB 3.0 connector for data transfer and to supply 5V power to the unit. If USB 3 communication is desired, the operator must use the provided PCI interface card to guarentee correct operation of the spectrometer. USB 2.0 communication is supported on a wide variety of motherboards and PCI connectors, but USB 3 communication is only supported on the provided PCI Interface card.

2 Firmware

2.1 Overview

The spectrometer camera board has an FPGA that provides control of the linescan array and sends out data via the Camera Link cable. Commands are sent via the serial port in the Camera Link board and cable.

2.2 Camera Link card requirements

The spectrometer is designed to conform to the Camera Link standards for pinouts and I/O. The spectrometer has been tested with Camera Link boards from Dalsa, but any board that conforms to the Camera Link standards should work.

For the 2048 pixel arrays, base Camera Link configuration is used. This requires one Camera Link cable connected to the top connector (closest to the USB connector). For base Camera Link, the bottom connector is not used. The Camera Link interface should be configured for 12-bits per port with interleaved pixels.

Control of the spectrometer happens via the serial port on the Camera Link card. The following parameter values should be used for the serial communications

Baud rate: 9600

No parity

Data bits: 8

Stop bits: 1

For external triggering the CC1 line on the base Camera Link connector is used. Triggering should use LVDS values compatible with the Camera Link interface, with trigger pulses that are at least 1 microsecond long.

2.3 Cobra Spectrometer Commands

Command: init
Response: '<ok>\n'
Remarks: Initializes sensor registers; must be done before any other commands.

Command: srst
Response: '<ok>\n' if value is accepted. '<err>\n' otherwise.
Remarks: Resets sensor.

Command: gain <gain in decimal>
Response: '<ok>\n'
Remarks: Sets the sensor gain. Gain range is 0 to 255. This command can be sent without a parameter to read the current value.

Command: offset <offset in decimal>
Response: '<ok>\n'
Remarks: Sets the sensor offset. Range is 0 to 255. This command can be sent without a parameter to read the current value.

Command: int <integration time in decimal microseconds>
Response: '<ok>\n'

Remarks: Sets the integration time in microseconds. Valid range is 1 to 32,767 us. This command can be sent without a parameter to read the current value. This should only be set with when the camera is NOT scanning (i.e. after an lsc 0 command). The integration time must be at least 2 microseconds less than the line time (ltm).

Command: ltm <line time in decimal microseconds>
Response: '<ok>\n'
Remarks: Sets the line time in microseconds. Valid range is 22 to 65,535 us. The ltm must be larger than the integration time. This command can be sent without a parameter to read the current value. This should only be set with when the camera is NOT scanning (i.e. after an lsc 0 command).

Command: ats <0 or 1>
Response: '<ok>\n'
Remarks: Sets the trigger source. 0 for internal trigger or 1 for external trigger. Default is internal trigger generated from the line time. This should only be set with when the camera is NOT scanning (i.e. after an lsc 0 command).

Command: lsc <0 or 1>
Response: '<ok>\n'
Remarks: Line scan control. Set to 1 to start linescan, set to 0 to stop linescan.

3 Mechanical and Environmental Specifications

Table 5: Physical Specifications

	Feature	***Detailed Specifications***
	Size	2" x 4" x 7" housing
	Weight	2 lbs 14oz

Table 6: Electrical Power Specifications

	Feature	***Detailed Specifications***
	Requirement	1A at + 5V DC
	Power up time	30 seconds
	Power consumption	<5W

Table 7: Environmental Specifications

	Feature	***Detailed Specifications***
	Operating Range	15 – 35 °C;
	Storage Temp Range	TBD
	Relative Humidity	0 – 90% noncondensing

4 Troubleshooting

Please contact Wasatch Photonics in Durham, North Carolina with any troubleshooting questions.

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