CCD Line Detectors
Larry-USB Series

Key Features
- Scientific grade, no bad pixels, no fringing
- Industrial grade, no bad pixels
- 2048, 3000 & 3648 element linear CCD arrays
- Spectral range: UV/VIS/NIR
- Built-In USB interface
- External trigger for single shot operation and synchronisation to pulsed sources
- Advanced spectroscopic software for Windows
- LabView drivers with VI’s

Overview
Larry-USB detectors are linear CCD detectors with a built-in USB interface. They come in three different versions with different characteristics:

Larry-USB 2048
The Larry-USB 2048 linear array CCD sensor has 2048 sensitive high-aspect ratio (14 µm x 200 µm) pixels. The array has a total length of 29 mm, the dynamic range has a maximum of 1150 for single shot operation. The Larry-USB 2048 can be supplied with TCDC technology to achieve low noise performance.

Larry-USB 3000
The Larry-USB 3000 linear CCD sensor has 3000 sensitive high aspect ratio (7 µm x 200 µm) pixels. The smaller pixels result in a total length of 21 mm, the dynamic range still being >800. The Larry-USB 3000 can be supplied with TCDC technology to achieve low noise performance.

Larry-USB 3648
The Larry-USB 3648 linear CCD sensor has 3648 sensitive high aspect ratio (7 µm x 200 µm) pixels. With a total length of 25.5 mm and a dynamic range >800 it is ideally suited for high resolution spectroscopy over a broad spectral range.

Applications
- Upgrade spectrometers/spectrographs
- Recording spectra of short pulse events
- Plasma monitoring and end point detection
- Radiometry, photometry and colorimetry
- Spectroscopic measurements
- Fringe analysis, beam profiling/monitoring
- Line scan imaging

Software
SpectraArray
SpectraArray is a software package for data acquisition and control of Larry linear detectors under Windows. It supports real-time single acquisition and averaging modes, spectral measurements, background subtraction and normalization. SpectraArray provides interactive control, a fully featured display and reporting functions. Absorption, transmission, reflectance, irradiance and emission measurements are supported. Allows import of reference data in ASCII format for irradiance measurements and instrument function calculation. Data can be exported to ASCII files for more detailed analysis or reporting in other applications. Generates blackbody curve for instrument function calculation. Supports wavelength calibration of spectrometers using spectral lamp references. Supports TCDC “clean spectra” noise reduction technology. Supports SEF signal/noise enhancement feature via horizontal binning with smoothing, 2x, 4x and 8x.

SpectraNet
SpectraNet has all the operational features of SpectraArray but supports local as well as remote operation. It can be loaded onto any number of PC’s operated by the one user institution.

OEM developers kit
This software provides compiled driver functions for the control of Larry-USB detectors and includes examples in C++ and VisualBasic.

Labview Drivers
Labview drivers for Larry-USB linear array detectors with VI’s for Labview 7.1 or later.
**CCD Line Detectors**

**Larry-USB Series**

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**Larry-USB Series Technical Specifications**

<table>
<thead>
<tr>
<th>Head type</th>
<th>Larry-USB 2048</th>
<th>Larry-USB 3000</th>
<th>Larry-USB 3648</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of active pixels</td>
<td>2048</td>
<td>3000</td>
<td>3648</td>
</tr>
<tr>
<td>Wavelength range, scientific grade</td>
<td>200 - 1100 nm</td>
<td>200 - 1100 nm</td>
<td>200 - 1100 nm</td>
</tr>
<tr>
<td>Wavelength range, industrial grade</td>
<td>360 - 1100 nm</td>
<td>360 - 1100 nm</td>
<td>360 - 1100 nm</td>
</tr>
<tr>
<td>Pixel size [µm]</td>
<td>14 x 200</td>
<td>7 x 200</td>
<td>7 x 200</td>
</tr>
<tr>
<td>Array length [mm]</td>
<td>29</td>
<td>21</td>
<td>25.5</td>
</tr>
<tr>
<td>Well capacity electrons (typical)</td>
<td>140000</td>
<td>70000</td>
<td>94000</td>
</tr>
<tr>
<td>Dark noise in one second (electrons, RMS)</td>
<td>26</td>
<td>29</td>
<td>11</td>
</tr>
<tr>
<td>Readout noise (electrons, RMS)</td>
<td>122</td>
<td>85</td>
<td>115</td>
</tr>
<tr>
<td>Gain (electrons/ADC count)</td>
<td>34</td>
<td>17</td>
<td>23</td>
</tr>
<tr>
<td>Max S/N single measurement</td>
<td>374</td>
<td>265</td>
<td>307</td>
</tr>
<tr>
<td>Dynamic range (well capacity/readout noise)</td>
<td>1150</td>
<td>823</td>
<td>818</td>
</tr>
<tr>
<td>Integration time (minimum)</td>
<td>8 ms</td>
<td>0.01 ms</td>
<td>0.01 ms</td>
</tr>
<tr>
<td>Accuracy</td>
<td>300 ns</td>
<td>450 ns</td>
<td>400 ns</td>
</tr>
<tr>
<td>Readout clock</td>
<td>1 MHz</td>
<td>1 MHz</td>
<td>1 MHz</td>
</tr>
<tr>
<td>External trigger</td>
<td>yes</td>
<td>yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Interface</td>
<td>Built-In USB</td>
<td>Built-In USB</td>
<td>Built-In USB</td>
</tr>
</tbody>
</table>

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**SAM-4X-1M4K and D-SAM**

**Simultaneous Acquisition Module for linear CCD array detectors**

The **SAM module** provides full control for simultaneous and synchronous data acquisition from up to four linear CCD detectors (LARRY and GARRY series) under identical exposure times. The module is connected to a PC via an USB interface.

The **D-SAM controller** was developed for simultaneous acquisition from DUAL GARRY 3000 linear CCD array detector heads. It was evolved from the SAM module. The D-SAM controller has the appropriate connectors and input/output signals to control a DUAL-GARRY 3000 detector head with two 3000 element linear CCDs mounted 13mm apart. In addition, one can add 1 or 2 single GARRY 3000 linear CCD array detector heads to configure 3 and 4 linear CCD detector systems.

**Principle of operation**

The light collection (integration) cycle can be initiated by external TTL trigger applied to the LARRY/GARRY detectors trigger connector or in software. When the selected integration time is completed the output analog signals from the detector heads are converted by individual A/D converters in the SAM or D-SAM unit and stored in the FIFO buffers, one per linear CCD array.

The control logic of the module then sequentially transfers the results from FIFO to PC via USB interface. The module also provides synchronization for the detectors and allows control of the integration time, which has to be the same for all detectors. Two BNCs on SAM and D-SAM units, provide digital outputs for additional control of peripheral equipment (spectrometer shutter, for instance), that can be initiated from software.
**CCD Line Detectors**

**Larry-USB Series**

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**Ordering information**

### Larry detector head product matrix/selection

<table>
<thead>
<tr>
<th>CCD grade</th>
<th>Industrial 360 - 1100 nm</th>
<th>Scientific 200 - 1100 nm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard</td>
<td>TCDC</td>
</tr>
<tr>
<td>Larry-USB 2048 series</td>
<td>AP-D7221</td>
<td>AP-D7521</td>
</tr>
<tr>
<td>Larry-USB 3000 series</td>
<td>AP-D7224</td>
<td>AP-D7524</td>
</tr>
<tr>
<td>Larry-USB 3648 series</td>
<td>AP-D7265</td>
<td>AP-D7266</td>
</tr>
</tbody>
</table>

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**Ordering information**

### Simultaneous Acquisition Module

- **AP-D7315**
  - **SAM-4X-1M4K controller**
    - Four channel simultaneous acquisition module for LARRY and GARRY series linear CCD array detectors with external USB interface

- **AP-D7320**
  - **D-SAM controller**
    - For DUAL-GARRY 3000 detector head and up to 2 single GARRY 3000 detector heads

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**Software options**

- **AP-D7402**
  - SpectraArray SL acquisition, control and analysis software for basic spectroscopic applications for Windows

- **AP-D7404**
  - SpectraNet multiple detector/server/client PC license (for single institution/customer)

- **AP-D7403**
  - SpectraSolve advanced spectroscopic applications software for Windows

- **AP-D7421**
  - OEM developers kit with C++ and VisualBasic examples

- **AP-D7422**
  - LabView drivers with VI’s (virtual instruments) for LabView 7.1 or later

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**Face plate options**

- **AP-D7604**
  - Mounting flange with 42.5, through hole, ¼-20 mounting hole for rod mounting with C-Mount lens adapter

- **AP-D7630**
  - T-mount face plate, with female thread 42 mm, dia. 0.75 mm pitch. For t-mount 35 mm camera lenses, image plane diagonal 35 mm

- **AP-D7635**
  - Nikon 35 mm lens bayonet mount face plate, image plane diagonal 35 mm

- **AP-D7650**
  - Adapter plate for mounting Ames Photonics array detectors to Oriel spectrographs (has same mounting hole pattern and focal position as Oriel/Andor CCD detectors)

Adapters for other spectrometers are available on request.
Detector arrays such as the Larry-USB 3000 & 3648 series with 7 µm wide pixels offer very high resolution measurements for spectroscopic applications, but the narrow pixel size means that they capture less light in a dispersed field than a 14 µm wide pixel with the same height in the Larry-USB 2048 series.

By combining the signal from two adjacent pixels, the same signal is achieved as with a 14 µm pixel. Combining 4 pixels gives 4 times the signal and the detector acts almost as though it had 28 micron wide pixels. A 3648 element array with 4x pixel binning performs like a 912 element array with 28 micron wide pixels and typically captures 4x the signal per the 912 array points.

The signal increases in a linear fashion with this technique, together with a smoothing function, increases the signal to noise almost linearly. This can be seen in the examples shown below.

SEF is available in software, allowing 2x, 4x and 8x horizontal binning and is ideal for measuring broad, weak spectral features. Using SEF to improve sensitivity is often more convenient to implement than changing the dispersive element in the spectrograph. SEF is supported by SpectraArray and the OEM drivers.

Temperature Compensated Dark Correction (TCDC™)

TCDC™ technology was developed to achieve low noise performance with uncooled CCD detectors.

An example of the performance TCDC can achieve is shown immediately below. On the left hand side a dark signal dominated spectrum is shown without TCDC technology. On the right hand side is the TCDC corrected spectrum which is quite clean and has excellent signal to noise by comparison.