The C11165-02 is a driver circuit designed for Hamamatsu CCD image sensor S11155/S11156-2048-02. The C11165-02 can be used in spectrometers when combined with the S11155/S11156-2048-02. The C11165-02 holds a CCD driver circuit, analog video signal processing circuit (16-bit A/D converter), timing generator, control circuit and power supply. The C11165-02 converts analog video signals from a CCD into digital signals and outputs them. The USB connector (USB 2.0) provided as a standard feature easily connects to a PC for the C11165-02 control and data acquisition. The C11165-02 also has a BNC connector for external trigger input and pulse output. The C11165-02 is compact, lightweight and very easy to handle.

Application software (DCam-USB) that comes with the C11165-02 allows easy operation from a PC running on Microsoft® Windows® 7 (32-bit, 64-bit)/10 (32-bit, 64-bit). A function library (DCamUSB.DLL) included with the application software helps you to develop your own software. This software is available with DLL to help you develop your own software programs under various developmental environments.

### Features
- **Built-in 16-bit A/D converter**
- **Adjustable offset**
- **Adjustable gain**
- **Interface of computer: USB 2.0**
- **Power supply: DC+5 V**

Note) Microsoft and Windows are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries.

### Applications
- **Spectrometer**
- **Control and data acquisition of CCD image sensor (S11155/S11156-2048-02)**

The table below shows CCD linear image sensors applicable for the C11165-02. Since the C11165-02 does not include CCD image sensors, so select the desired sensor and order it separately.

<table>
<thead>
<tr>
<th>Type no.</th>
<th>Number of pixels</th>
<th>Number of effective pixels</th>
<th>Pixel size (μm)</th>
<th>Image size [mm (H) × mm (V)]</th>
</tr>
</thead>
<tbody>
<tr>
<td>S11155-2048-02</td>
<td>2128 × 1</td>
<td>2048 × 1</td>
<td>14 × 500</td>
<td>28.672 × 0.500</td>
</tr>
<tr>
<td>S11156-2048-02</td>
<td></td>
<td></td>
<td>14 × 1000</td>
<td>28.672 × 1.000</td>
</tr>
</tbody>
</table>

### Structure

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output type</td>
<td>Digital</td>
<td></td>
</tr>
<tr>
<td>A/D conversion resolution</td>
<td>16</td>
<td>bit</td>
</tr>
<tr>
<td>Interface</td>
<td>USB 2.0</td>
<td></td>
</tr>
</tbody>
</table>
### Absolute maximum ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>-</td>
<td>$Ta=25,^\circ C$</td>
<td>0 to +6.0</td>
<td>V</td>
</tr>
<tr>
<td>Input signal voltage</td>
<td>Vi</td>
<td>$Ta=25,^\circ C$</td>
<td>0 to $Vdd$</td>
<td>V</td>
</tr>
<tr>
<td>Operating temperature*2</td>
<td>Topr</td>
<td></td>
<td>0 to +50</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature*2</td>
<td>Tstg</td>
<td></td>
<td>-20 to +70</td>
<td>°C</td>
</tr>
</tbody>
</table>

*1: Trigger input
*2: No condensation

When there is a temperature difference between a product and the surrounding area in high humidity environment, dew condensation may occur on the product surface. Dew condensation on the product may cause deterioration in characteristics and reliability.

Note: Exceeding the absolute maximum ratings even momentarily may cause a drop in product quality. Always be sure to use the product within the absolute maximum ratings.

### Electrical characteristics ($Ta=25\,^\circ C$)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Condition</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readout frequency*3</td>
<td>fop</td>
<td></td>
<td>-</td>
<td>6</td>
<td>-</td>
<td>MHz</td>
</tr>
<tr>
<td>Line rate*4</td>
<td>-</td>
<td></td>
<td>-</td>
<td>-</td>
<td>2.78</td>
<td>kHz</td>
</tr>
<tr>
<td>Conversion gain</td>
<td>Gc</td>
<td>Gain 1</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>e/ADU</td>
</tr>
<tr>
<td>Trigger output voltage</td>
<td>High level</td>
<td>$Vp=+5,V$</td>
<td>3.8</td>
<td>-</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Low level</td>
<td></td>
<td></td>
<td>0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trigger input voltage</td>
<td>High level</td>
<td>$Vp=+5,V$</td>
<td>-</td>
<td>3.5</td>
<td>5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Low level</td>
<td></td>
<td>-</td>
<td>-</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Current consumption</td>
<td>Ic</td>
<td>$fop=6,MHz$</td>
<td>-</td>
<td>940</td>
<td>1110</td>
<td>mA</td>
</tr>
<tr>
<td>Integration time*5</td>
<td>Tinteg</td>
<td></td>
<td>12</td>
<td>-</td>
<td>16 777 215</td>
<td>clock</td>
</tr>
</tbody>
</table>

*3: Fixed
*4: This is the theoretical value of the line rate that is determined by the internal operation timing of the driver circuit and is different from the line rate defined by the sensor specifications. This value differs from the line rate in a series of processes that acquire data from the circuit to a PC via the USB 2.0 port on the PC.
*5: 1 clock = 1/6 MHz ≈ 0.167 μs

### Electrical and optical characteristics ($Ta=25\,^\circ C$)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readout noise</td>
<td>Nr</td>
<td>-</td>
<td>12</td>
<td>-</td>
<td>ADU</td>
</tr>
<tr>
<td>Dynamic range</td>
<td>DR</td>
<td>-</td>
<td>4000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Operating voltage*6</td>
<td>-</td>
<td>4.5</td>
<td>5</td>
<td>5.5</td>
<td>V</td>
</tr>
</tbody>
</table>

*6: Accessory AC adapter for external power supply
Functions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operation mode display</strong></td>
<td></td>
</tr>
<tr>
<td>Suspend mode (LED-off)</td>
<td>The power supply is turned off.</td>
</tr>
<tr>
<td>Standby mode (LED-white)</td>
<td>It is a standby state, in which the data acquisition is possible.</td>
</tr>
<tr>
<td>Data transfer mode (LED-green, aqua, blue)</td>
<td>In this mode, the driver circuit sends the data to PC.</td>
</tr>
<tr>
<td><strong>Synchronous mode</strong></td>
<td></td>
</tr>
<tr>
<td>Internal synchronous mode</td>
<td>Data is acquired on the basis of the trigger timing generated by application software.</td>
</tr>
<tr>
<td>External synchronous mode 1</td>
<td>(“INT” mode) In synchronization with the external trigger signal input from the BNC connector. In synchronization with an edge of the external trigger signal, data is accumulated for the set integration time and is then output.</td>
</tr>
<tr>
<td>External synchronous mode 2</td>
<td>(“EXT.LEVEL” mode) Data is acquired in synchronization with the external trigger signal input from the BNC connector. Data is accumulated for a period equal to the pulse width of the external trigger signal and is then output.</td>
</tr>
<tr>
<td><strong>Gain adjustment</strong></td>
<td>The gain value can be varied in the range of “1 to 3” with the step of 1. Default value is “1”.</td>
</tr>
<tr>
<td><strong>Offset adjustment</strong></td>
<td>The offset value can be varied in the range of “-255 to 255” with the step of 1. Default value is “10”.</td>
</tr>
<tr>
<td><strong>External signal</strong></td>
<td></td>
</tr>
<tr>
<td>Input</td>
<td>Acquires data in synchronization with trigger pulse input to the BNC connector</td>
</tr>
<tr>
<td>Output</td>
<td>Sets the timing for the pulse signal output from the pulse output BNC connector of the driver circuit</td>
</tr>
<tr>
<td><strong>MPP operation</strong></td>
<td></td>
</tr>
<tr>
<td>MPP mode</td>
<td>The REGH/REGL signal goes Low during integration.</td>
</tr>
<tr>
<td>Non-MPP mode</td>
<td>The REGH/REGL signal is constantly fixed to High.</td>
</tr>
<tr>
<td><strong>Electronic shutter ON/ OFF function</strong></td>
<td></td>
</tr>
<tr>
<td>ON mode</td>
<td>Performs integration only during the set period in one line period</td>
</tr>
<tr>
<td>OFF mode</td>
<td>Constantly performs integration in one line period</td>
</tr>
</tbody>
</table>

*7: External synchronous mode 2 (“EXT. LEVEL” mode) cannot be used when the electronic shutter is OFF.

Block diagram

- Bias circuit
- Power supply circuit
- +5 V
- Trigger IN
- Trigger OUT
- Clock driver
- Clock timing control circuit
- Buffer
- AFE (A/D converter)
- CPU
- USB controller
- USB

CCD linear image sensor
S11155-2048-02
S11156-2048-02
Timing chart

Internal synchronous mode ("INT" mode)

**Non-MPP operation**

- Trigger in (software)
- Exposure signal*
- REGH/REGL
- ARG
- TG
- P1H/P2H
- A/D conversion
- Data transfer

* Internal signal

**MPP operation**

- Trigger in (software)
- Exposure signal*
- REGH/REGL
- ARG
- TG
- P1H/P2H
- A/D conversion
- Data transfer

* Internal signal
External synchronous mode 1 ("EXT.EDGE" mode)

- Non-MPP operation

  Trigger in (from BNC)  
  Exposure time
  Exposure signal*
  REGH/REGL
  ARG
  TG
  P1H/P2H
  A/D conversion
  Data acquisition time
  Line readout time
  Data transfer
  Data transfer time
  Total transfer time

  * Internal signal

- MPP operation

  Trigger in (from BNC)  
  Exposure time
  Exposure signal*
  REGH/REGL
  ARG
  TG
  P1H/P2H
  A/D conversion
  Data acquisition time
  Line readout time
  Data transfer
  Data transfer time
  Total transfer time

  * Internal signal
External synchronous mode 2 ("EXT.LEVEL" mode)

= Non-MPP operation

1. Trigger in (from BNC)
2. Exposure signal*
3. REGH/REGL
4. ARG
5. TG
6. P1H/P2H
7. A/D conversion
8. Data transfer

* Internal signal

= MPP operation

1. Trigger in (from BNC)
2. Exposure signal*
3. REGH/REGL
4. ARG
5. TG
6. P1H/P2H
7. A/D conversion
8. Data transfer

* Internal signal
**Driver circuit for CCD linear image sensor**

**Dimensional outline (unit: mm)**

![Dimensional outline diagram](image)

- **BNC connector for pulse output**
- **BNC connector for external trigger input**
- **USB connector**
- **DC jack** (conforms to EIAJ RC-5320A voltage classification 2)
- **Component side**
  - 5.0 ± 0.2
  - 80 ± 0.3
- **Mount position of CCD image sensor**
- **Sensor mounting side**
  - (29.5)
  - (45)
  - 80 ± 0.3
- **Values in parentheses indicate reference value.**
- **Weight:** 65 g approx. (excluding sensor)

**Connection examples**

Refer to the following diagram to connect hardware peripherals.

![Connection example diagram](image)
Driver circuit for CCD linear image sensor

C11165-02

**Accessories**
- CD-ROM (includes C11165-02 instruction manual, application software, SDK)
- USB cable
- AC adapter

**Related information**
www.hamamatsu.com/sp/ssid/doc_en.html

- Precautions
- Disclaimer
- Technical information
- Resistive gate type CCD linear image sensors with electronic shutter

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