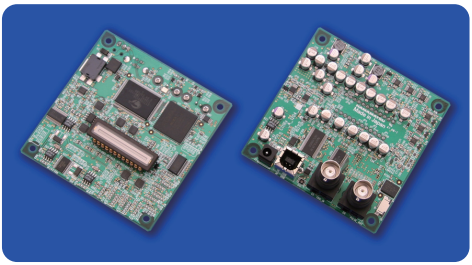
C11160/C11165-01
Driver Circuit for
CCD Linear Image Sensor

Instruction Manual

- Be sure to read the operation manual carefully before the product is used.
- If operated differently from the standard procedure in the manual, a serious accident may occur.
- Keep this manual for future reference.



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HAMAMATSU

Handling Precautions

Please observe following precautions fully precautions for safety.

Please observe the following safety precautions when you operate this product to use this product correctly and safely. However, please note that our company cannot assume the responsibility and the guarantee beforehand about the failure caused by wrong usage mentioned in the precaution notes.

1) Please look after the next precaution by all means on using this product. When you are used against these attention, it might affect the human body.

a) Because there are the some ICs that this products temperature rises at the time of movement, which may cause burn if it is touched. Please touch it after you switch it off, and temperature drops.

b) Please do not give a power supply with reverse polarity. It causes the damage of the part and the fire.

c) Please do not remodel this product. It causes the damage of the part and the fire.

d) Please do not use it at a place condensing dew. There is the risk of the damage of the electric shocks due to leakage of electricity and damage of the part by the short circuit and the outbreak of the fire.

e) Please do not use this product out of a movement security temperature range. It causes the damage of the part.

2) This product is a high precision device. Avoid using or storing this production in the following locations:

a) wwhere ambient temperature is out of Operating temperature, or out of Storage temperature

b) subject to large changes in temperature

c) exposed to direct sunlight or near heaters

d) subject to condensation

e) near strong magnetic sources or radio frequency generator

f) subject to vibration

g) where corrosive gases are present (such as chlorine or fluorine)

h) exposed to excessive dust

3) This product is a high precision device. Handle it with extreme care.

a) Do not disassemble or modify any part of this product. Malfunctions might otherwise occur.

b) Be careful not to drop, bump or apply excessive impacts to this product. Drop impacts or bumps may damage the product.

c) The InGaAs image sensor is at risk for destruction or deterioration by static electricity or surge. Be careful when installing the sensor in the product.

4) To improve the performance of the product, please note the following points.

a) When use the external power supply, please use an attached AC adapter without fail.

b) Please use included accessories (USB cables, etc.) for operate normally.

Handling Precautions

In this manual, the following symbols are used.

Danger	This mark indicates the danger that if you do wrong handling ignoring this mark, it causes death or serious injury to the user.
Warning	This mark indicates the warning that if you do wrong handling ignoring this mark, there is possibility of death or serious injury to the user.
Note	This mark indicates that if you do wrong handling ignoring this mark, it may cause injury or damage to the product.

Table of contents

1 Overview

The C11160/C11165-01 CCD Driver Circuit is signal processing circuit for Hamamatsu CCD Linear Image Sensor. Combining the Driver Circuit with those CCD image sensors creates the ideal tool for the application that used a spectroscope.

The Driver Circuit consists of a CCD driver, analog video processor (16bit ADC), timing pulse generator, control circuit and power supply circuit. When an analog signal is input from the CCD Linear image sensor, the Driver Circuit converts that analog signal to a digital signal and outputs it to an external device such as a PC (personal computer). The Driver Circuit easily connects to the PC through a USB connector (conforming to USB2.0) provided on the rear panel of the Driver Circuit, allowing control and data acquisition by the PC.
The BNC connector for the external trigger input, the connector for the pulse output, and DC Jack for the power supply are installed in the Driver Circuit. Even with all these functions, the Driver Circuit still offers compact size, light weight, and easy use.

The Driver Circuit has three data acquisition modes. One is an internal sync mode (Internal mode) that acquires data with a trigger signal generated by the application software. The other two are external sync modes (External Trigger modes) in which data is acquired while synchronized with a trigger signal generated from an external device. Select the data acquisition mode that best suits your application.

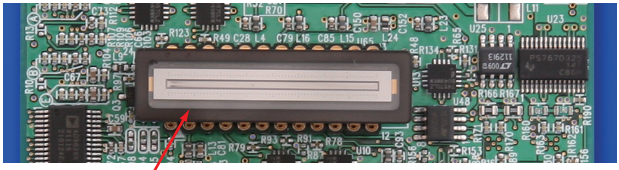
Besides external trigger modes, the Driver Circuit has versatile functions like gain and offset adjustment.

To make the Driver Circuit easier to use, it has "Standby" and "Data Transfer" operating modes.
The LED display on the Driver Circuit lets you know which operating mode is currently selected.

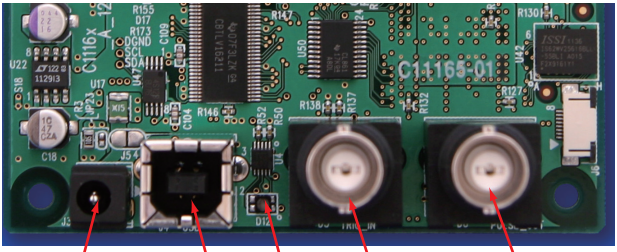
The Driver Circuit comes with application software that runs on Windows7(64bit), Windows7(32bit) and is specifically programmed to operate the Driver Circuit from the PC. The application software also includes a function library exclusively for the Driver Circuit, allowing you to develop your own software more efficiently.

2 Setup

2.1 Parts description



Sensor Side



Component Side

(1) CCD Image Sensor

CCD Driver Circuit	Accept Image Sensor
C11160	S11151-2048
C11165-01	S11155-2048-01, S11156-2048-01

(2) USB

This is an industrial standard USB connector for connecting to a PC. This connector interface conforms to USB2.0. Various Driver Circuit settings can be made from the PC through this interface. Data converted to digital signals are sent to the PC.
The "C11160" is supplied power by this connector. (Bus powered)
However, "C11165-01" is supplied power by AC adapter. (Self powered)

(3) LED display

Indicates the current status of the Driver Circuit. The LED display indicates the following status modes.

LED display	Mode
White	Standby mode
Green	Internal Operation mode
Cyan	External Edge Operation mode
Blue	External Level Operation mode
Red	Device Error

NOTE

It is possible to set this LED to OFF Mode (Always turned Off) by controlling from the PC.

(4) EXT.TRIG_IN connector

An industrial standard BNC connector used to input external trigger signals when the Driver Circuit is operated in the External Trigger mode. The input signal should be an H-CMOS level pulse. The internal circuits are not optically isolated.

(5) PULSE_OUT connector

It is an industry standard BNC Connector, which outputs the Pulse from the Driver Circuit. The output signal is H-CMOS level pulse and it is possible to output the pulse, which is synchronized with the accumulation time of the CCD image sensor and can be used as timing signal for UV-Lazer or Mechanical-Shutter. It is not insulated from an internal circuit.

(6) DC5V

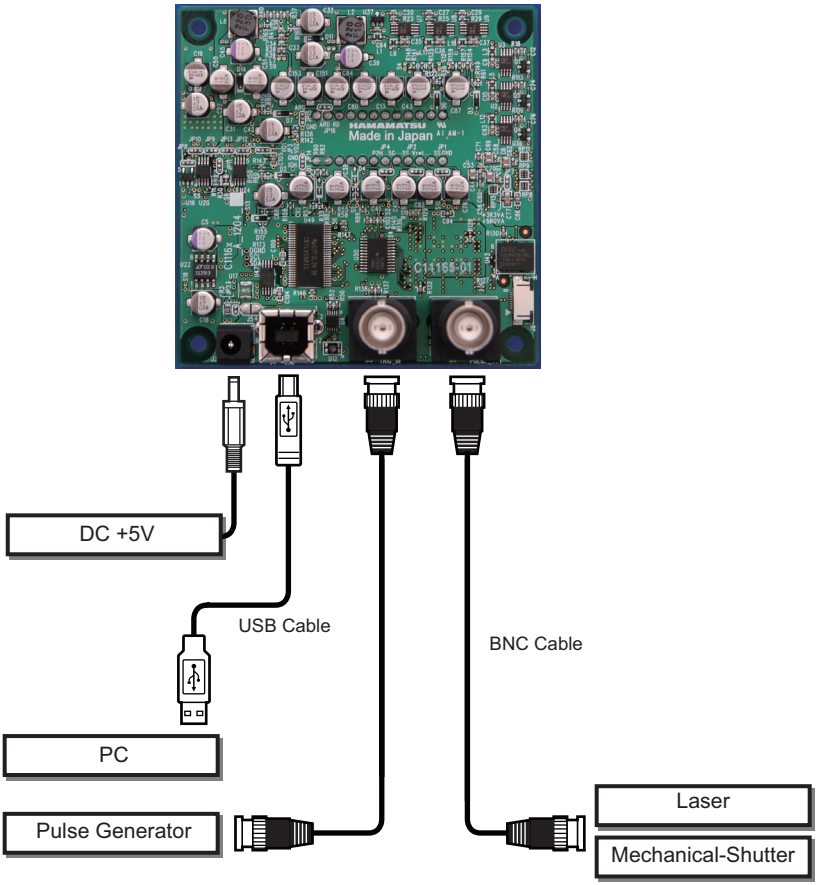
It is a power supply connector from the external source to the module. This is implemented on C11165-01 only. It is DC power supply Jack of the industry-wide standard (the EIAJ RC5320A standard, the voltage division "2"). Please use a AC adapter (+5V, more than 1A) for power supply. When use a DC power supply, please use with the +5.0V power supply. The center of the terminal of the connector is positive terminal and the surroundings is the negative terminal.

2.2 Hardware setup

Use these drawings to connecting the hardware for use with the Driver Circuit.
Please use pan head screw of M3, when you install the Driver Circuit to device etc.

NOTE

Please use the flat washer of less or equal 6mm diameter, when you install the Driver Circuit to device etc.



3 Operation

The Driver Circuit comes with dedicated application software (DCam-USB). Use this software for control of the Driver Circuit and data acquisition.

For information on how to use the DCam-USB software, refer to the separate "DCam-USB_APL_InstructionManual" that also comes with the Driver Circuit.

4 Functions

The Driver Circuit has the following functions operable from the C10785DCamAPL software.

■ Operating mode display

The Driver Circuit can be set 3 operating mode. And LED indicate the current mode.

(1) "Standby mode" (LED-White)

This is Standby state, in which the data acquisition is possible. At this moment, the sensor is Operating state not outputing data from this circuit, and performing dummy scan operation. This mode is set at the time of power-up.

(2) "Data Transfer Mode"(LED-Green, Aqua, Blue)

In this mode the Driver Circuit sends the data to PC. Colour of LED changes depending upon the trigger mode.

■ Selectable data acquisition modes

"Line Time" is settable in C11160.
It is settable individually in Exposure Time and Line Time in C11165-01.
Furthermore, in C11165-01, there are ON/OFF change function of the electronic shutter and Non-MPP/MPP movement change function.
Electronic shutter function at the time of ON, the exposure time of the sensor becomes same as a setting value of Exposure Time.
When you turn it OFF, sensor always become the exposure state, and Line Time is exposure time.MPP is motion to reduce the dark current of CCD image sensor.
But when you use this MPP motion in C11165-01, it is necessary to set Line Time only for 2071[Clock] (=345us) for a long time to set exposure time same as Non-MPP.

Setting [Line Time]

Circuit	Electronic Shutter	Mode (Non-MPP / MPP)	Line Time [Clock]*1	
			Min.	Max.
C11160	-	-	2071	16777215
C11165-01	ON	Non-MPP	2097	16777215
		MPP	2097	16777215
	OFF	Non-MPP	2097	16777215
		MPP	2097	16777215

Setting [Exposure Time]

Circuit	Electronic Shutter	Mode (Non-MPP / MPP)	Exposure Time*2 [Clock]*3		Actual Exposure time*4 [Clock]
			Min.	Max.	
C11160		-	-	-	Line Time
C11165-01	ON	Non-MPP	12	Line Time - 9	Exposure Time
		MPP	12	Line Time - 2080	Exposure Time
	OFF	Non-MPP	12	Line Time - 9	Line Time
		MPP	12	Line Time - 2080	Line Time

*1 Range of [Line Time].
*2 Range of [Exposure Time].
*3 C11160 : 1(Clock) = 1(μs)
C11165-01 : 1(Clock) = 167(ns)
C11160 :
Actual Exposure Time is as Linetime.
*4 C11165-01 :
Electronic shutter is ON, actual Exposure Time is same as setting value.
Electronic shutter is OFF, actual Exposure Time is same as Line Time.

(1) Internal synchronous mode("INT" Mode)

Data is acquired on the basis of the trigger timing generated by application software. The CCD Image Sensor operates repeatedly after each specific interval of Accumulation time, which is set inside the driver circuit beforehand.

(2) External synchronous mode1 ("EXT.EDGE" Mode)

Data is acquired in synchronization with the external trigger signal input from the built in BNC Connector. CCD Image Sensor performs dummy scan until external trigger signal is received. In Synchronization with the Edge of the external trigger signal, it accoumulates the data for the definite Accumulation time and then outputs it after that. In this case, similar to the Internal synchronous mode("INT" Mode), the accumulation time is set to the Driver Circuit beforehand. Input Signal Level is H-CMOS compatible. Polarity of the External trigger signal edge can be selected through the software to either Positive(+ve) or Negative(-ve) polarity.

(3) External synchronous mode2 ("EXT.LEVEL" Mode)

Data is acquired in synchronization with the external trigger signal input from the built in BNC Connector. In this Mode also, CCD Image Sensor performs dummy scan until external trigger signal is received. Immediately after receiving the input external trigger, CCD Image sensor accumulates the data in the time interval that is same as the external signal pulse width and then outputs it after that. Input Signal Level is H-CMOS compatible. Polarity of trigger signal can be selected through the software o either Positive(+ve) or Negative(-ve) polarity.

MPP mode

MPP(Multi Pinned Phase) is also called inversion operation because it reduces the dark current. It is possible to implement MPP operation if it makes the inverse state of all the gates of MOS structure, which composes the electrode of CCD.
This mode is exclusive for C11165-01.

Gain Adjustment

This is Hardware Gain Adjustment Function using which the gain value can be varied in the range of [1 to 3] with the step of 1.Default value is "1".

Offset Adjustment

This is Hardware Offset Adjustment Function using which the offset value can be varied in the range of [-255 to 255] with the step of 1.Default value is "0".

Pulse Output Signal Setting

It is possible to set the timing of the "Pulse Output Signal (PULSE-OUT)" generated from the PULSE_OUT of the Driver Circuit. Independent of the Data acquisition mode of CCD Image sensor, this Signal can be generated in synchronization with the accumulation start time of CCD Image sensor and It is possible to set Pulse polarity, Output start time Delay and Pulse Width.

Electronic Shutter Setting

This is Electronic Shutter Setting Function. It switch the ON and OFF. When Electronic Shutter is OFF, the driver circuit keep the charge accumulation during the one line cycle. This function is exclusive for C11165-01.

5 Specifications

5.1 Specifications

C11160

Parameter	Specifications
CCD	S11151-2048
Total number of pixels	2056(H) x 1(V)
Effective number of pixels	2048(H) x 1(V)
Pixel size	14 (H) x 200 (V) μm
Effective active area	28.672 (H) x 0.200 (V) mm
Line scanning rate	1MHz
Line readout time	2.071msec(@TG=8usec)
Data transfer time	344.67usec
Total cycle time	2.415msec
AD conversion resolution	16bit (65,535ADU)
Conversion gain	3e-/ADU
Readout noise	15ADU
Dynamic range	4,000
Interface	USB2.0
Supply voltage	DC+4.5 to 5.5V (360mA typ@5.0V)
Operating temperature	0°C to +50°C (no condensation)
Storage temperature	-20°C to +70°C (no condensation)
Dimensions(only PC board)	80 mm (H) x 80 mm (V)
Weight	Approx. 65 g

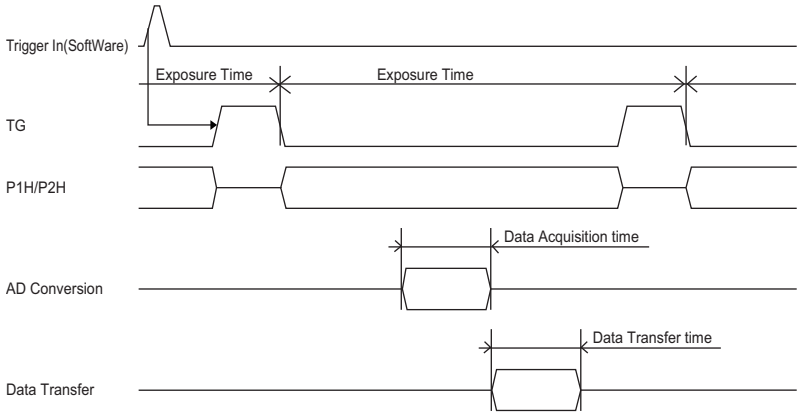
C11165-01

Parameter	Specifications	
CCD	S11155-2048-01	S11156-2048-01
Total number of pixels	2068(H) x 1(V)	
Effective number of pixels	2048(H) x 1(V)	
Pixel size	14 (H) x 500 (V) μm	14 (H) x 100 (V) μm
Effective active area	28.672(H) x 0.500(V) mm	28.672(H) x 1.000(V) mm
Line scanning rate	6MHz	
Line readout time	349.5usec(@TG=2usec)	
Data transfer time	344.67usec	
Total cycle time	694.17usec	
AD conversion resolution	16bit (65,535ADU)	
Conversion gain (Theoretical value)	3e-/ADU	
Readout noise	20ADU	
Dynamic range	3,000	
Interface	USB2.0	
Supply voltage	DC+4.5 to 5.5V(900mA typ@5.0V)	
Operating temperature	0°C to +50°C (no condensation)	
Storage temperature	-20°C to +70°C (no condensation)	
Dimensions (only PC board)	80 mm (H) x 80 mm (V)	
Weight (only PC board)	Approx. 65 g	

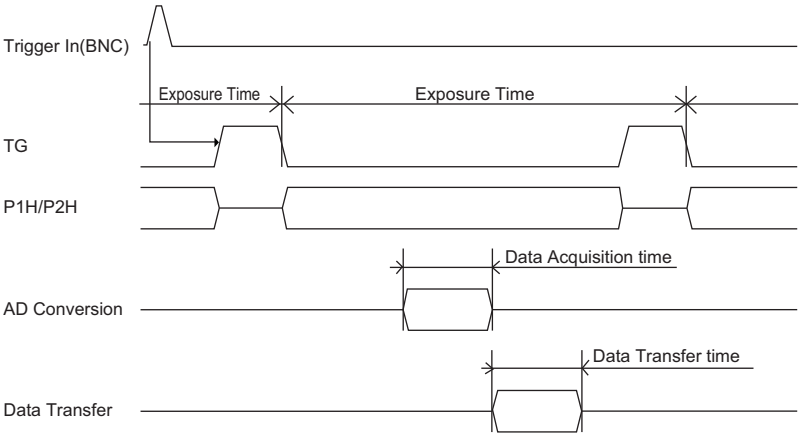
5.2 Data acquisition timing charts

5.2.1 C11160

■ Internal synchronous mode("INT" Mode)

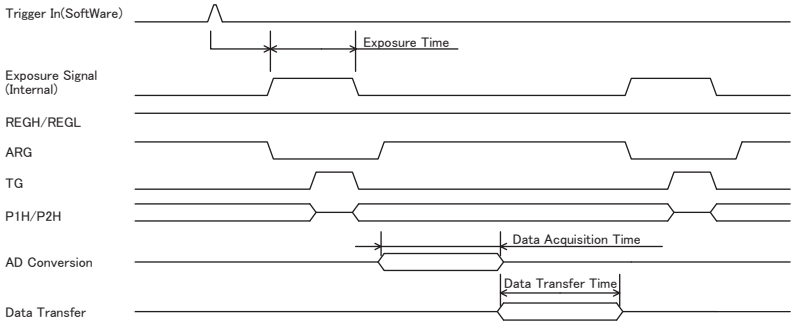


■ External synchronous mode 1("EXT.EDGE" Mode)

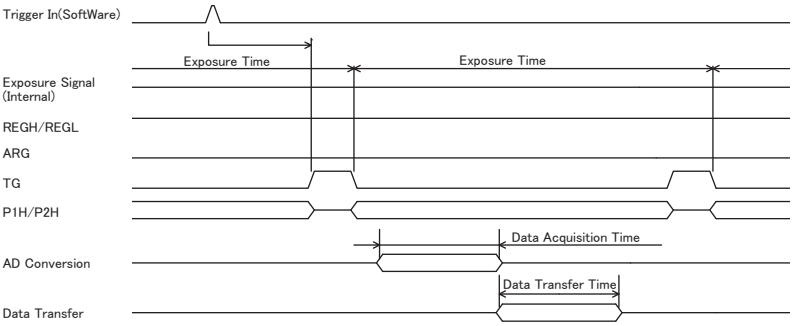


5.2.2 C11165-01

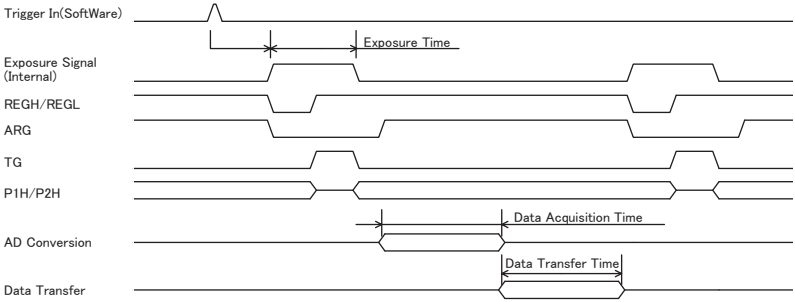
■ Internal synchronous mode (“INT” MODE) [Non-MPP / Electronic shutter ON]



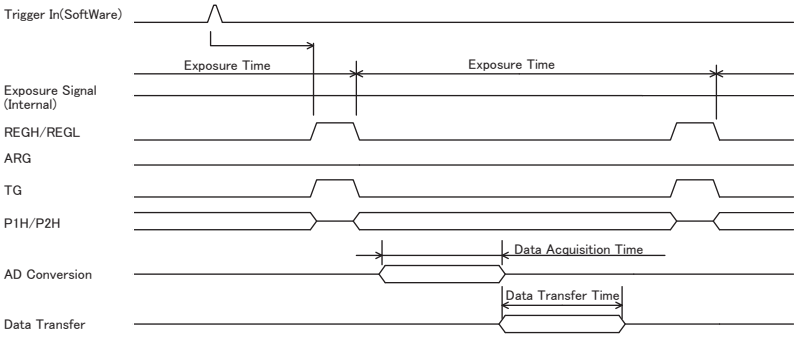
■ Internal synchronous mode ("INT" MODE) [Non-MPP / Electronic shutter OFF]



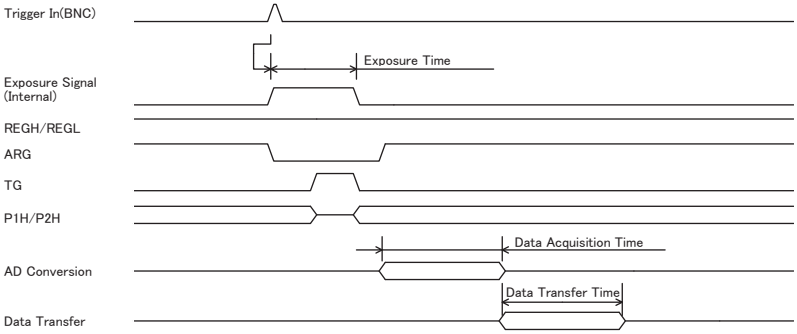
■ Internal synchronous mode ("INT" MODE) [MPP / Electronic shutter ON]



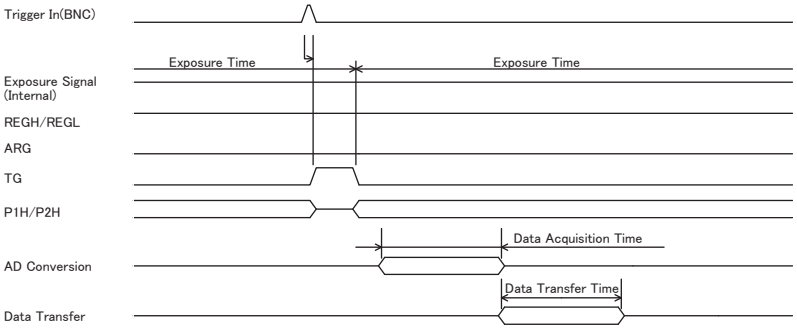
■ Internal synchronous mode ("INT" MODE) [MPP / Electronic shutter OFF]



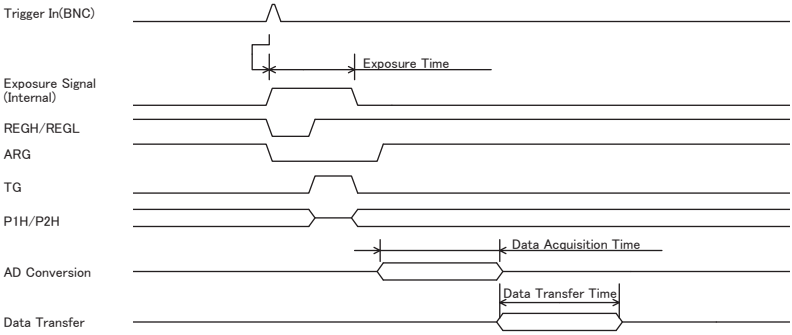
External synchronous mode 1 ("EXT.EDGE" Mode) [Non-MPP / Electronic shutter ON]



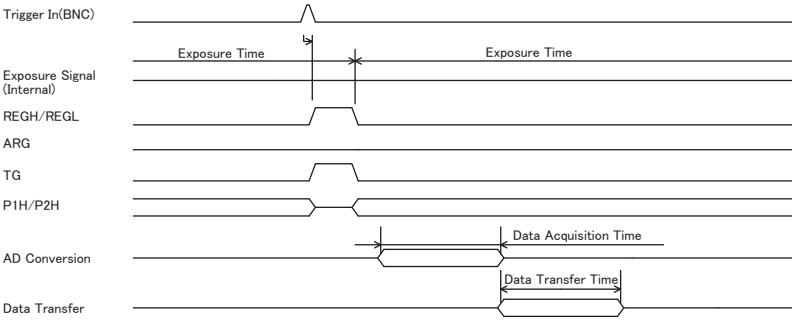
External synchronous mode 1 ("EXT.EDGE" Mode) [Non-MPP / Electronic shutter OFF]



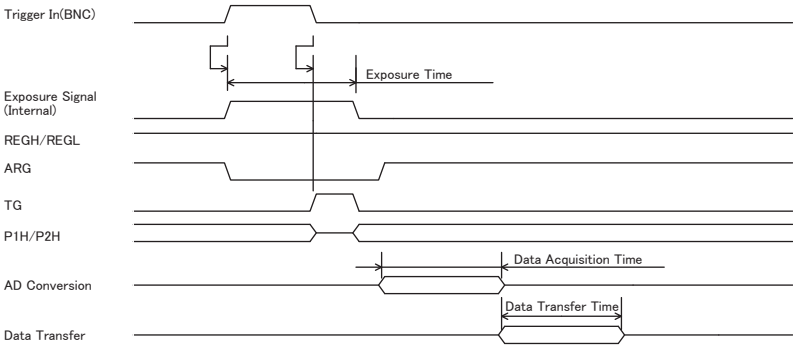
External synchronous mode 1 ("EXT.EDGE" Mode) [MPP / Electronic shutter ON]



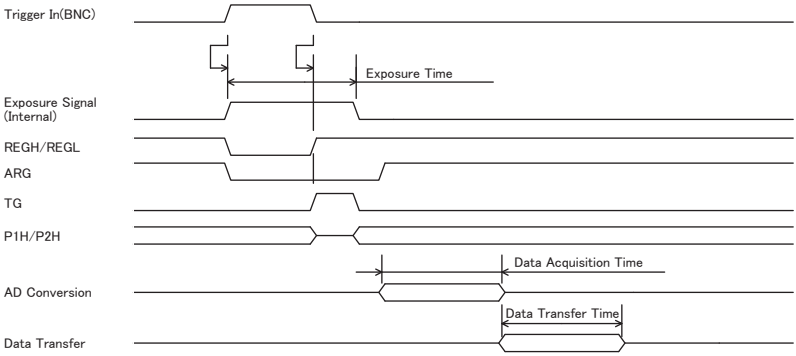
External synchronous mode 1 ("EXT.EDGE" Mode) [MPP / Electronic shutter OFF]



External synchronous mode 2 ("EXT.LEVEL" Mode) [Non-MPP]

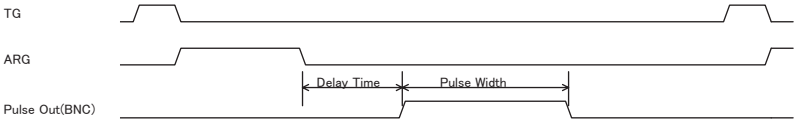


External synchronous mode 2 ("EXT.LEVEL" Mode) [MPP]

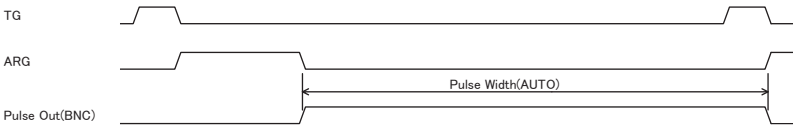


5.3 Pulse output timing chart

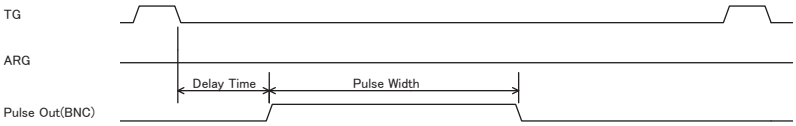
■ Pulse output ON [Electronic shutter ON]



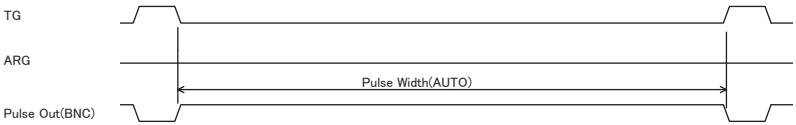
■ Pulse output AUTO [Electronic shutter ON]



■ Pulse output ON [Electronic shutter OFF]



■ Pulse output AUTO [Electronic shutter OFF]



5.4 Pin arrangement

■ C11160

Pin No.	Signal name	Voltage (amplitude)	Pin No.	Signal name	Voltage (amplitude)
1	OS	+12.5V	24	RG	0V/+9V
2	OD	+17V	23	TG	0V/+12V
3	OG	+7V	22	-	-
4	SG	0V/+9V	21	-	-
5	SS	+4V	20	-	-
6	RD	+15V	19	-	-
7	-	-	18	RD	+15V
8	-	-	17	SS	+4V
9	P2H	0V/+9V	16	-	-
10	P1H	0V/+9V	15	ISH	+15V
11	-	-	14	ISV	+15V
12	IGH	0V	13	IGV	0V

■ C11161-01

Pin No.	Signal name	Voltage (amplitude)	Pin No.	Signal name	Voltage (amplitude)
1	OS	+16V	24	RG	+3V/+16V
2	OD	+23V	23	TG	+1V/+17V
3	OG	+11V	22	-	-
4	SG	+1V/+13V	21	-	-
5	Vret	+9V	20	STG	+8V
6	RD	+23V	19	-	-
7	REGL	0V/+1.5V	18	RD	+23V
8	REGH	0V/+4V	17	SS	+8V
9	P2H	+1V/+13V	16	-	-
10	P1H	+1V/+13V	15	ISH	+23V
11	IG2H	0V	14	ARD	+23V
12	IG1H	0V	13	ARG	+6.5V/+16V

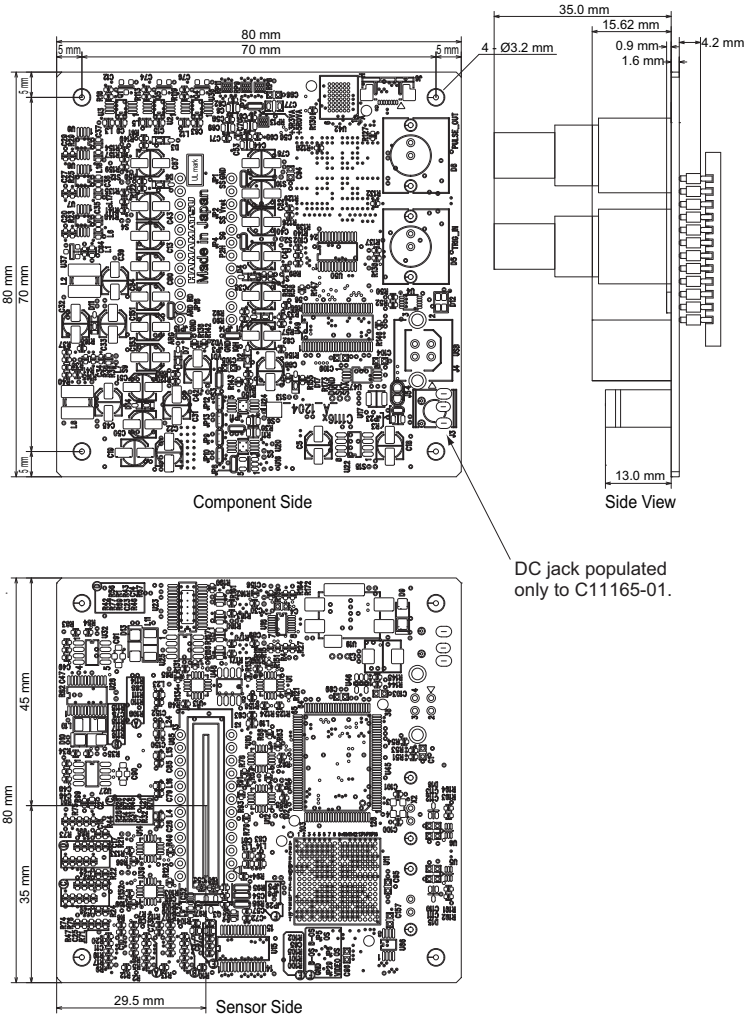
NOTE

With this Product, SS-Pin is biased to +4V in C11160, biased to +8V in C11165-01. For other terminals, setting is done as per the standard voltage corresponding to that SS-terminal.
When install a sensor that is not supported, there is a possible to damage the sensor or circuit.

Power supply connector (C11165-01)

DC power supply Jack, the EIAJ RC5320A standard, the voltage division "2"

5.5 Dimensional outlines



6 Warranty and Service

6.1 Warranty

- Please follow the maximum rating and notes etc, before the use of the product of this material. Our company does not give warranty the completeness of this product though have tried to improve the quality and reliability. Especially, if measures of an appropriate safe design etc. that consider the trouble that can usually occur are not followed then it is dangerous to use the equipment that might violate person's life, body or property.
  For such use, if not with our consent in writing of the specifications in advance, we hope that we assume no responsibility for the note.
- For ultimate user operation guidance, we would like you to consider it to explain the material used for this product, performance or handling, appropriate warnings and enough cautions for the display, etc.
- The warranty of this product, after delivery if the defects are discovered within one year, and if our company is notified of the same, will be limited to repair or substitute delivery of this product. However, even within the warranty period, the loss caused due to a natural disaster or an improper use (reconstruction, and environment, Application Area, Usage, storage, scrapping that contrary to the terms and conditions described in this document) we hope that our company assume no responsibility.
- Applications of this material is intended to illustrate typical examples of products used in this document, including the success or failure of commercial use and includes specific adaptability to use , and is not warranted. Moreover, it does not give warranty or give permission to do execution of the intellectual property. If you encounter problems with third parties concerning intellectual property rights for the use of this product, we do not take any responsibility for that.
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6.2 Service

If it is noticed abnormally, please contact our solid sales department and give the details of type name, the production number (serial no.) , and the symptom. The repair work will be completed as soon as possible, and please note that for following cases we may refuse to repair or you have to pay the cost of it.

- If long time has elapsed since the purchase
- If manufacturing of repair part is discontinued
- If the modifications have been made
- If it is found that significant damage
- When the anomalous phenomenon is not reproduced by our company
- By the influence of the equipment used at the same time

Document History

Date	Document Revision	Contents
02.Dec.2009	1.00	First Edition
19.Apl.2010	1.01	Add TG width setting
28.Jun.2012	2.00	End of support for Windows2000 and start of support for Windows7.
06.Jul.2012	2.01	Support for "C11165" is finish, and support for "C11165-01" is started.
02.Aug.2012	2.02	Edit "Handoing Precautions"
27.Aug.2012	2.03	P6) Append an explanation of the "Exposure Time". P7) Append an explanation of the "Electronic Shutter". P9) Edited the "Conversion Gain". P19)Edited the sensor position in drawing.
21.Jan.2013	2.04	P2)Appended description of USB-Connector P6)Appended the data chapturing P9)Edited data sheet P11)Edited timing chart P18)Edited Pin arrangement
2.Apr.2013	2.05	Edited the following contents. • Handling Precautions • 1.Overview • 3.Operation • 5.Specifications (data sheet) • 5.2. Timing chart (C11160) • 5.4. Pin arrangement
24.Sep.2013	2.06	Add list of offices on the back cover.
29.Jul.2014	2.07	Edited by the end of support of WindowsXP.

C11160/C11165-01 Driver Circuit for CCD Linear Image Sensor Instruction Manual

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