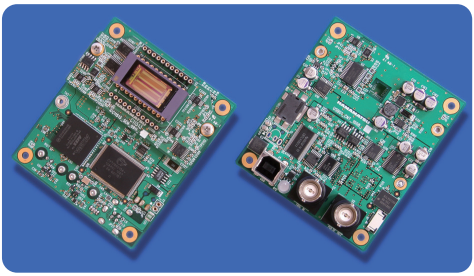
# Driver Circuit for InGaAs Linear Image Sensor C11513

**Version 1.00**

## 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.

Please observe the following safety precautions when you use 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 use in contradiction to these precaution notes.

**1) Avoid using or storing this production in the following locations:**

a) where ambient temperature drops below 0°C or rises above 50°C
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

**2) 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.

## 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 use in contradiction to these precaution notes.
In this manual, the following symbols are used.

| | |
|---|---|
| **Danger** | If you do wrong handling ignoring this mark, it indicates danger that the user owes the death or the serious injury. |
| **Warning** | If you do wrong handling ignoring this mark, it indicates that there is a possibility that the user owes the death or the serious injury. |
| **Note** | If you do wrong handling ignoring this mark, it indicates that user owes injury or damage to the product. |

# Table of contents

# 1 Overview

The C11513 driver circuit for InGaAs linear image sensor can be used for the applications such as spectroscope in the signal processing circuit for InGaAs image sensor (G11612-512DA).

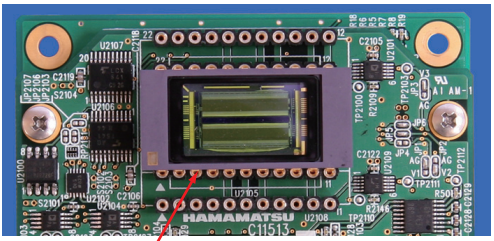
This driver circuit which is composed of InGaAs image sensor driver unit, the analog video signal processor (16bit ADC), digital control unit and power supply, outputs the analog video signals as digital signals from the InGaAs sensor. This driver circuit and PC (personal computer) are connected with the USB connector of the main unit (Base USB2.0), and various settings, the controls of the driver circuit and acquisition of data can be done from PC. Moreover, as the power supply to main unit of driver circuit can be done from USB connector of PC, the external source is not necessary. Additionally, the BNC connector is installed in the main unit for external trigger input and pulse output, and system configuration is easy by the connection with the external unit. Main unit has become very easy to handle because it is compact and lightweight design.

There are internal synchronous mode in which data is acquired in software timing from application software and external sync mode in which data is acquired synchronizing with external signal. In this circuit, data acquisition can use either of these modes according to the usage. Moreover, data acquisition conditions like the operation condition etc. can be optimized as the gain adjustment function and offset adjustment functions etc. are installed. Additionally, operating status of this driver circuit easily confirms the current operating state to separate color display by main unit LED. It is operated in the same state from next time to save operation condition, setting value during data acquisition in the internal memory of circuit.

Application software (DCam-USB) that works on the Windows2000/XP is attached to this product, and it is possible to operate it more easily on PC. Moreover, function library (DCamUSB.DLL) of this product is attached in the application software and software can be developed on the user side.

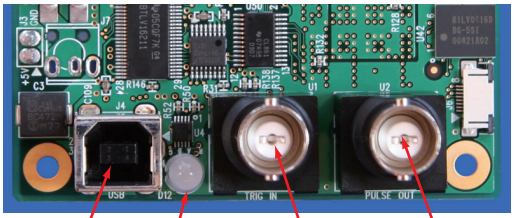
# 2 Setup

## 2.1 Parts description




(1)

Sensor Side




(2) (3) (4) (5)

Component Side

**(1) Image Sensor**

InGaAs Linear image sensor (G11612-512DA) is installed.

**NOTE**

**Please do the installation, as per the orientation of the package and pin number. If incorrectly installed, operation may cause sensor damage.**

**(2) USB**

Industry Standard USB Connector is used for the connection with PC. The interface applies to the standard of USB2.0. Each setting is done through this interface and data that is converted into the digital signal is also transmitted. In addition, the power supply from this connector to the main body is supplied.

**NOTE**

**Please confirm maximum current value (500mA typ.) supplied by PC.**

### (3) LED

LED display colors a present state of this drive circuit.

### (4) EXT.TRIGGER_IN

It is BNC connector for the external signal input when the drive circuit is used in an external trigger mode.

### (5) PULSE_OUT

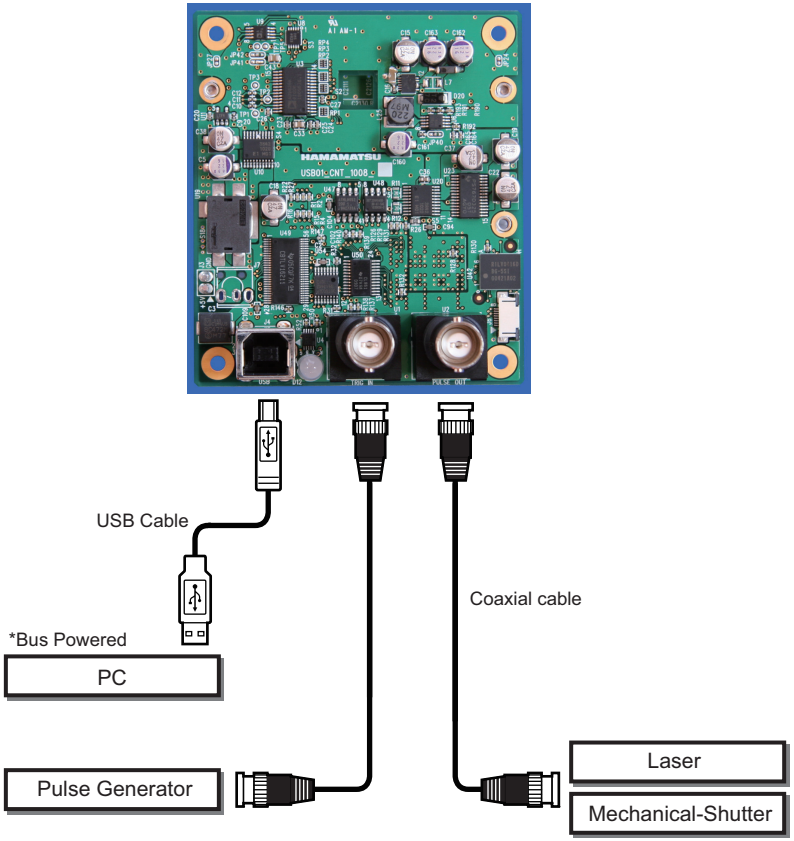
BNC connector is used to give pulse output from the drive circuit.
Power Signal is the H-CMOS-level pulse. InGaAs image sensor outputs the pulse synchronized with the storage time.

## 2.2 Hardware setup

Use these drawings to connecting the every hardwares 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 Functions

The functions of this driver circuit are as below.

## ■ Display the operational modes

It is function to display operational mode of this driver circuit by the LED color. Below describe LED colors in relation to operational mode.

| LED color | Operational Mode |
|---|---|
| Lights off | This drive circuit can be safely detached from PC when power supply OFF or USB suspended. Or, initialization/setup state, after the power supply is turned on. |
| Red | Error |
| Green | Data Acquisition or Transfer (INT Mode) |
| Cyan | Data Acquisition or Transfer (Ext.Edge Mode) |
| Blue | Data Acquisition or Transfer (Ext.Level Mode) |
| Purple | Data Acquisition or Transfer (Ext.Gated Mode) |
| White | Standby data acquisition state (Standby/Idle). At this time, the InGaAs image sensor does so-called dummy scanning operation that expels the dark current. Usually, when the power supply is turned on, operation mode will be this mode. |

Note : LED can be an off mode (always turn off).

## ■ Selectable data acquisition modes

It is a function to set the method of data acquisition. In the data acquisition mode, there is an internal synchronous mode operating basically with the software trigger and an external synchronous mode that operates synchronizing with an external signal. In addition, the external synchronous mode is divided into six operational modes depending on the method of inputting the external synchronizing signal. The external synchronizing signal is input in BNC connector "TRIGGER_IN" on the driver circuit. Input signal level is, H-CMOS compatible, and the polarity can be selected either of positive or negative. Moreover, accumulation time and data acquisition count of image sensors are set at this time.
Data acquisition in this drive circuit is done in the attached application software. However according to the interface specification, when the line rate is high, consecutive line data cannot be acquired. Therefore 4MB memory is mounted on this drive circuit for the continuous line data acquisition. As a result, the continuous data of maximum 512 lines can be acquired. When the continuous data is not required, data till upper bound limited in the application software can be acquired.

### (1) Internal synchronous mode ("Internal" mode)

Data is acquired in the software timing from the application software. The InGaAs image sensor works repeatedly at the accumulation time was set in advance in driver circuit. It is acquired rom the newest data in the timing of the application software.

**(2) External synchronous mode 1 ("External Edge1" mode)**

Data is acquired synchronizing with the edge of the external trigger signal. However, only one line data of one external trigger is acquired. The InGaAs image sensor scans the dummy until the external trigger signal is entered. When the external trigger signal edge is detected, data is accumulated in accumulation time was set in advance in the driver circuit and then outputs the data. However, if an external trigger signal is entered in the middle of the dummy scan, accumulation doesn't begin until the scanning ends. Therefore, external synchronous mode 1 becomes an asynchronous mode.

**(3) External synchronous mode 2 ("External Edge2" mode)**

As soon as the external trigger signal is entered; InGaAs image sensor starts to accumulate and outputs data though it is similar to external synchronous mode 1.This mode of operation operates as an external trigger signal to synchronize the driver circuit. Therefore, 2 or more external trigger signals are required to acquire the data of one line. External synchronous mode 2 becomes a synchronous mode.

**(4) External synchronous mode 3 ("External Edge3" mode)**

Multiple line data can be acquired for one external trigger signal though it is similar to external synchronous mode 1. The number of lines can be set from software. When the setting of the number of lines is "1", external synchronous mode 1 and external synchronous mode 3 operation become exactly same.

**(5) External synchronous mode 4 ("External Level1" mode)**

Data is acquired synchronizing with the level of the external trigger signal. However, only the data of one line of one external trigger is acquired. The InGaAs image sensor scans the dummy until the external trigger signal is entered. After detecting the end of the level period of the external trigger signal, data is accumulated in the accumulation time was set in advance in the driver circuit, and then outputs the data. However, if an external trigger signal is entered in the middle of the dummy scan, accumulation doesn't begin until the scanning ends. Therefore, external synchronous mode 4 becomes an asynchronous mode.

**(6) External synchronous mode 5 ("External Level2" mode)**

Data is acquired synchronizing with the level of the external trigger signal. The InGaAs image sensor scans the dummy until the external trigger signal is entered. InGaAs image sensor starts to accumulate and outputs data as soon as external trigger signal is entered. At this time, the level period of an external trigger becomes the accumulation time of the InGaAs image sensor. This mode of operation operates as an external trigger signal to synchronize the driver circuit. Therefore, 2 or more external trigger signals are required to acquire the data of one line. External synchronous mode 5 becomes a synchronous mode.

### (7) External synchronous mode 6 ("External Gated" mode)

Data is acquired for the level period of the external trigger signal. Multiple line data can be acquired for one external trigger signal. After detecting the level of the external trigger signal, data is accumulated in the accumulation time was set in advance in the driver circuit, and then outputs the data. However, if an external trigger signal is entered in the middle of the dummy scan, accumulation doesn't begin until the scanning ends. Also, if the level is ended in the middle of the data output, data acquisition is ended after all data is outputted.

| Data acquisition mode | Synchronous or Asynchronous | Exposure period | Acquisition data count per input one external signal. (N ≥ 1,M ≥ 1) |
|---|---|---|---|
| Internal | Asynchronous | Internal time base | - |
| External Edge1 | Asynchronous | Internal time base | N : N |
| External Edge2 | Synchronous | Internal time base | N+1 : N |
| External Edge3 | Asynchronous | Internal time base | N : N |
| External Level1 | Asynchronous | Internal time base | N : N |
| External Level2 | Synchronous | External trigger signal pulse width | N+1 : N |
| External Gated | Asynchronous | Internal time base | N : M (N ≤ M) |

| Setting argument | Setting range |
|---|---|
| Exposure time | 6 to 16777215 : clock count<br>Default value is "10". |
| External trigger polarity | Positive / Negative or Rising edge / Down edge<br>Default value is "Positive" or "Rising edge". |
| Acquisition data count | 1 to 512 (transfer by RAM)<br>Default value "1". |

## ■ Gain Adjustment

The gain adjustment of hardware can be varied in the range of 1 to 5, 1 step at a time. The default value is "1".

## ■ Offset Adjustment

It is possible to set every one step within the range of -255 to 255 in the offset adjustment function by the hardware. For this value "factor of about 19.3 count" is the actual value multiplied by the offset. However, this factor is for gain '1', this factor varies for other gain value. Default value is "10" (About 193 counts).

| OFFSET value | Offset Count value |
|---|---|
| -255 | -4921.5 |
| -254 | -4902.2 |
| -1 | -19.3 |
| 0 | 0 |
| 1 | 19.3 |
| 254 | 4902.2 |
| 255 | 4921.5 |

| GAIN | Offset count calculation factor |
|---|---|
| 1 | 19.3 |
| 2 | 38.6 |
| 3 | 57.9 |
| 4 | 77.2 |
| 5 | 96.5 |

## ■ Pulse Output Signal Setting

The pulse signal output from BNC connector "PULSE_OUT" on driver circuit is set. This signal outputs synchronizing with at the beginning of the accumulation time of the InGaAs image sensor without depend on the data acquisition mode of the InGaAs image sensor. The pulse output signal level is compatible H-CMOS, and can set the output control, the signal polarity, delay time, and the pulse width.
The following is the table showing values to be set in parameters.

| Set item | Set value |
|---|---|
| Output control | Output ON/OFF default value is "OFF" |
| Signal polarity | Positive / negative or rise / fall default is "positive" or "rise" |
| Delay | 0 to 16777215 Clock count Default value is "0". |
| Pulse width | 0 to 16777215 Clock count Default value is "0". |

## ■ Integration Capacity Selecting

The capacity of the integration amplifier in the InGaAs image sensor is changed. The integration capacity "1pF" or "10pF" can be changed. The smaller the value of the integral capacity increases the sensitivity of InGaAs image sensor. Default value is "1pF".

## ■ Save Settings

A setting value etc. at data acquisition can be saved in the memory of the circuit. It can work in the same state when power is turned ON next time.

# 4 Operation

Special application software (DCam-USB) is attached to this drive circuit. The control and data acquisition in the drive circuit can be done with this software.

Please refer to attached "Multi Channel Detector Head and Driver Circuit for Image Sensor Control Software" Instruction Manual for the method of handling application software (DCam-USB) to be attached.

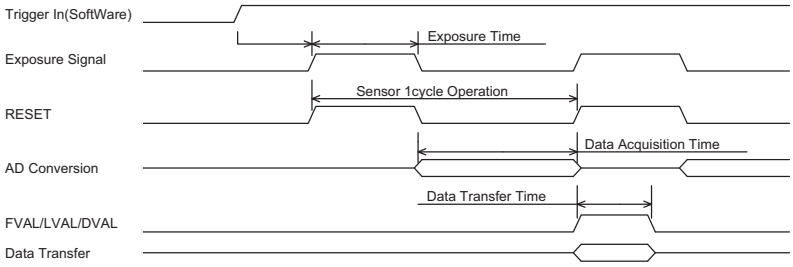
# 5 Specifications

## 5.1 Specifications

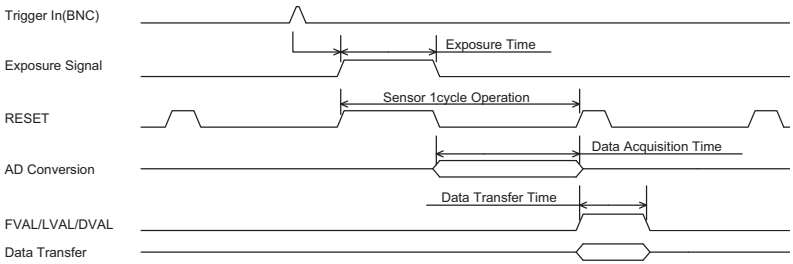
| Parameter | Specifications |
|---|---|
| InGaAs Sensor | G11612-512DA |
| Total number of pixels | 512 |
| Pixel size | 25um (H) x 500um (V) |
| Pixel pitch | 25um |
| Image size | 12.8mm (H) x 0.5mm (V) |
| Scanning rate | 1MHz |
| Line rate | 1.8 k lps max. |
| Data transfer time | 0.1 mSec |
| Total cycle time | 0.66 mSec |
| AD conversion resolution | 16bit (65,535ADU) |
| Conversion gain | 18.3 uV/ADU typ. |
| Readout noise | 7.2 ADU typ. |
| Dynamic range | 1 : 9,000 typ. |
| Interface | USB2.0 |
| Supply voltage | DC+5.0V (480mA max.) *USB bus powered |
| Operating temperature | 0 to +50°C (no condensation) |
| Storage temperature | -20 to +70°C (no condensation) |
| Dimensions | 80mm (H) x 70mm (W) |
| Weight | 70g |

## 5.2 Data acquisition timing charts

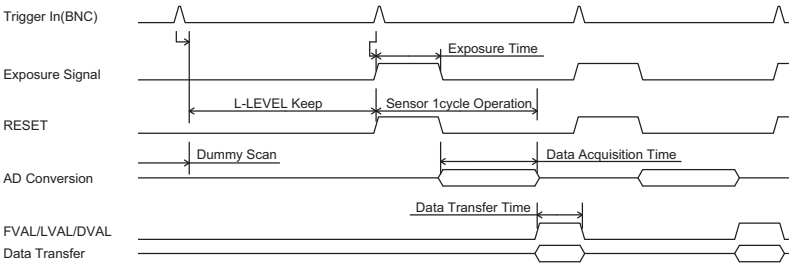
### "Internal" Mode



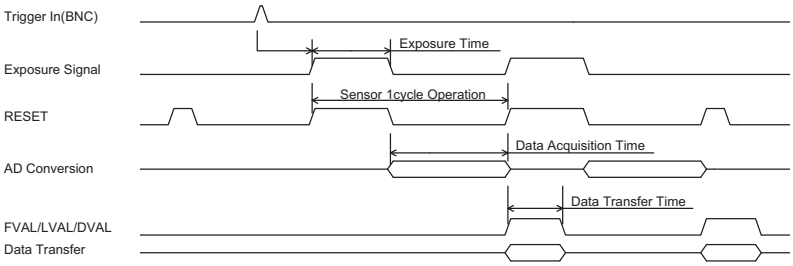

### "External Edge1" Mode




### "External Edge2" Mode

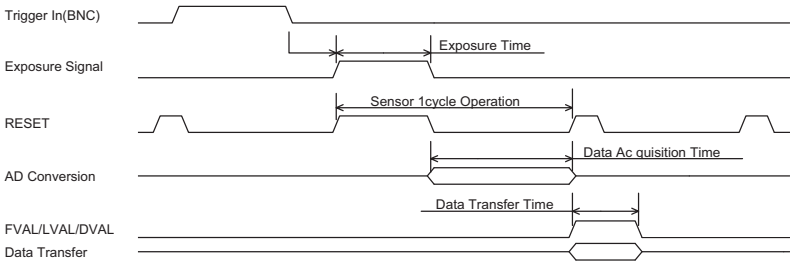


## ■ "External Edge3" Mode

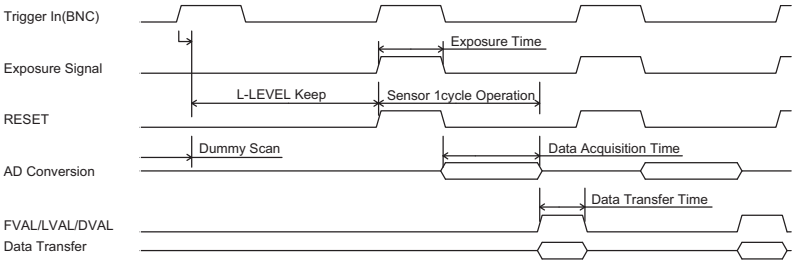



Note : This timing chart is case of acquiring two frames data.

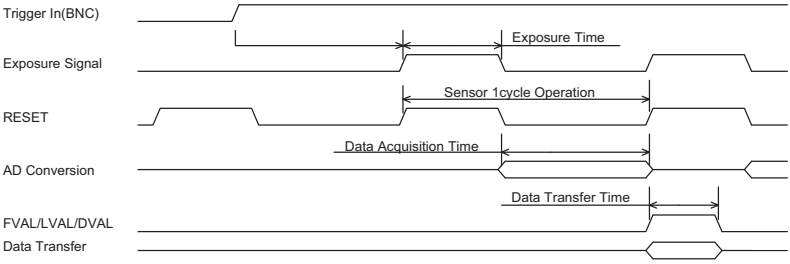
## ■ "External Level1" Mode



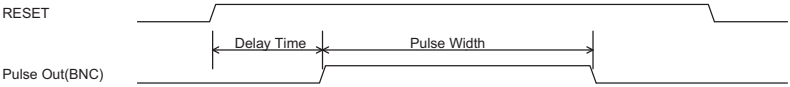

## ■ "External Level2" Mode



### ■ "External Gated" Mode

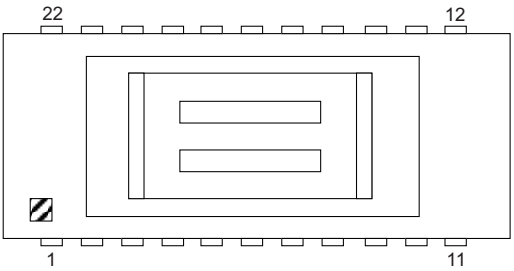



## 5.3 Pulse output timing chart



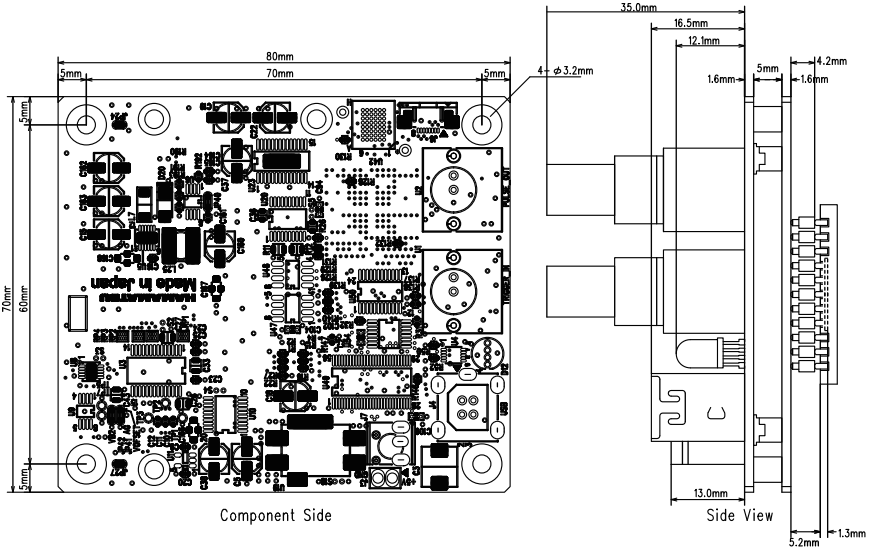
## 5.4 Pin arrangement

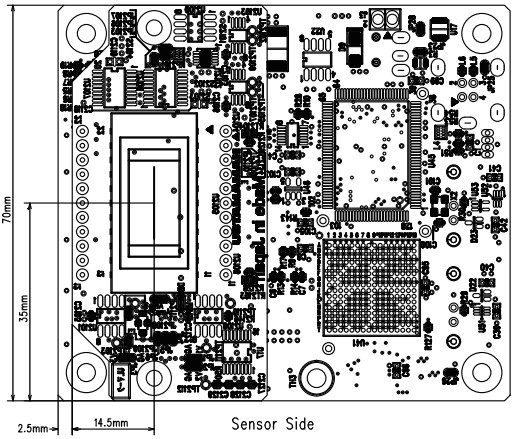
### ■ InGaAs Linear Image Sensor (G11612-512DA)




| Pin No. | Signal name | I/O | Account | Recital |
|---|---|---|---|---|
| 1 | NC | - | - | - |
| 2 | NC | - | - | - |
| 3 | NC | - | - | - |
| 4 | NC | - | - | - |
| 5 | Cf_select2 | Input | It is a signal that selects the feedback capacity (Conversion efficiency) on CMOS chip. Table 2-2 shows the selection logic. | 0V or +5V |
| 6 | Cf_select1 | Input | It is a signal that selects the feedback capacity (Conversion efficiency) on CMOS chip. Table 2-2 shows the selection logic. | 0V or +5V |
| 7 | Thermister | - | - | - |
| 8 | Thermister | - | - | - |
| 9 | NC | - | - | - |
| 10 | Fvref | Input | Delta amplifier reference voltage. It is a power supply to operate the signal processing circuit on CMOS chip. | +1.2V |
| 11 | NC | - | - | - |
| 12 | VIDEO | Output | Delta amplifier output. It is an analog video signal. | +1.2V to +2.4V |
| 13 | Vinp | Input | Video line reset voltage. It is a power supply to operate the signal processing circuit on CMOS chip. | +4.0V |
| 14 | CLK | Input | Clock pulse to make CMOS shift register work. | 0V to +5V |
| 15 | PDN | Input | InGaAs PD Cathode bias terminal | +4.0V |
| 16 | INP | Input | Input amplifier reference voltage. It is a power supply to operate the signal processing circuit on CMOS chip. | +4.0V |
| 17 | GND | - | Ground for the signal processing circuit on CMOS chip. | 0V |
| 18 | Vdd | Input | It is a power supply to operate the signal processing circuit on CMOS chip. | +5.0V |
| 19 | NC | - | - | - |
| 20 | AD_trig | Output | Sampling synchronous signal for AD conversion. | 0V to +5V |
| 21 | RESET | Input | Reset pulse to initialize the feedback capacity of the charge amplifier on CMOS chip. Accumulation time is decided by H period of the pulse. | 0V to +5V |
| 22 | AD_sp | Output | Digital start signal for AD conversion. | 0V to +5V |

## 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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- Please do not reprint or do not reproduce the content described in this material without our permission.

## 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 |
|---|---|---|
| 03.Dec.2010 | 1.00 | First Edition |
| 10.Mar.2011 | 1.01 | Modify the following<br>• Parts description<br>• Offset adjustment<br>• Pulse Output Signal Setting<br>• Specifications<br>• Pin arrangement |
| 22.Sep.2011 | 1.02 | Changed "Dimensional outlines" |

# Driver Circuit for InGaAs Linear Image Sensor C11513 Instruction Manual


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| --- |
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