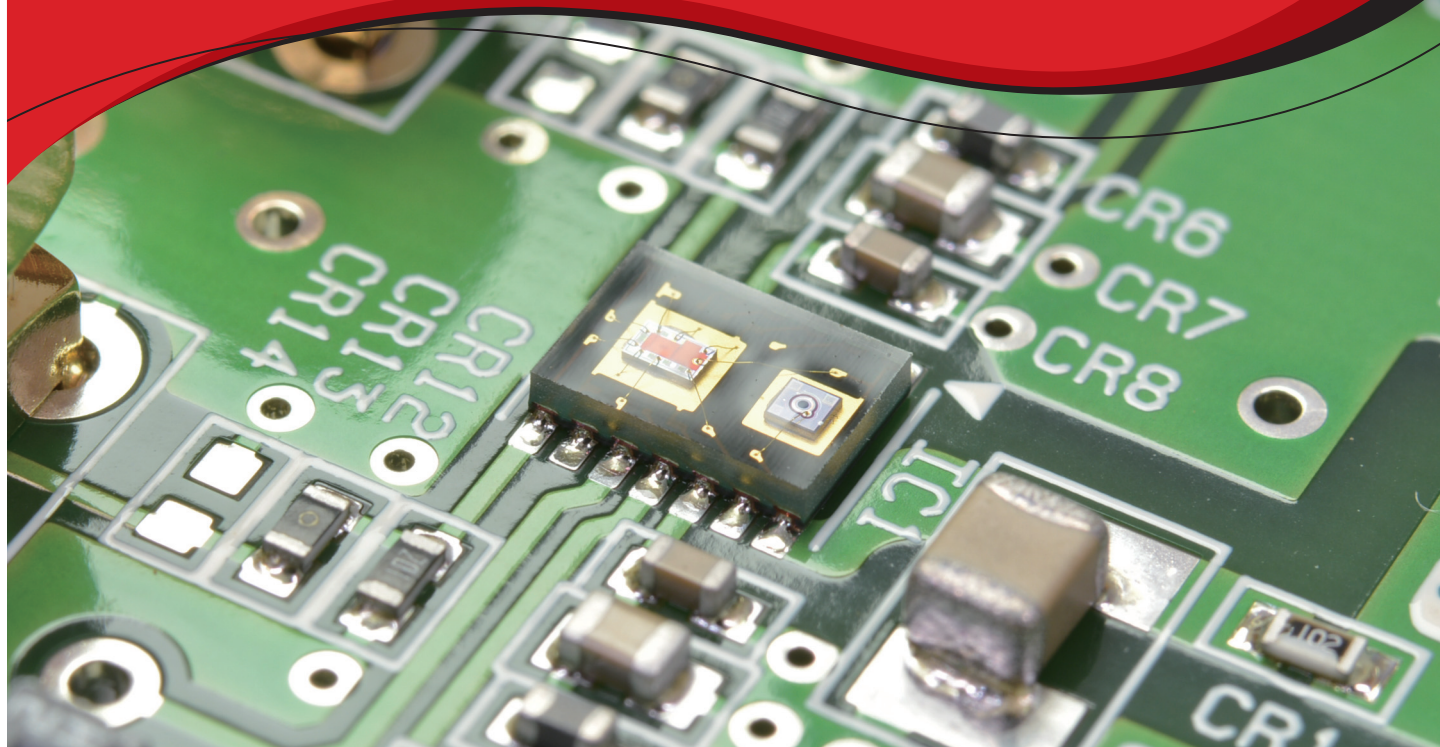


# Opto-semiconductor hybrid devices



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### ● What is hybrid device ?

Hybrid device is integration of HAMAMATSU photosensor - such as Si photodiode and InGaAs APD - and front-end IC that reads the signals from the photosensor.

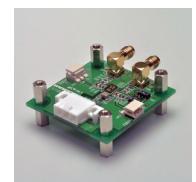
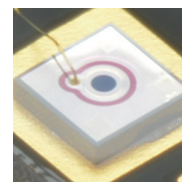
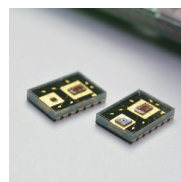
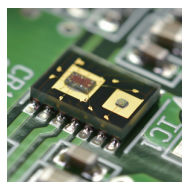
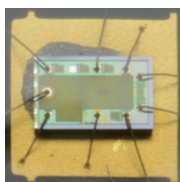
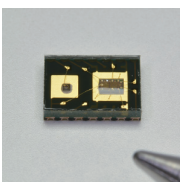
When compared with discrete circuits, hybrid device has the following advantages.

- Reduced external noise effects.
- Reduced parasitic elements (inductance and stray capacitance). Improved performance characteristics such as noise characteristics and frequency characteristics.
- Original opto-semiconductor process contributes the characteristics of photosensors that are retained outstanding performance and high efficiency.

### Features

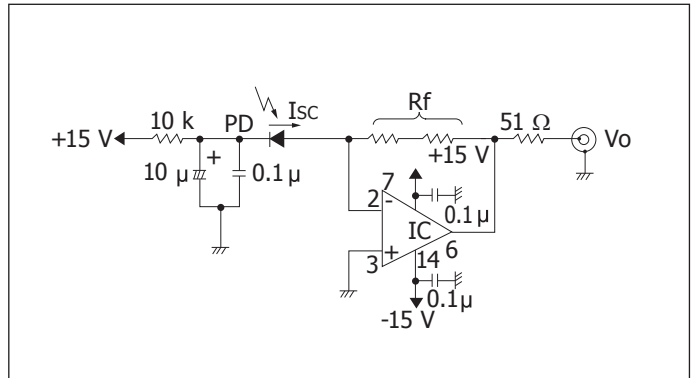
Hybrid device that consists of APD and trans-impedance amplifier (TIA) have the following features.

- The integration of an APD (Si APD or InGaAs APD) and TIA into a single chip reduces parasitic elements (capacitance and inductance) and improves noise and frequency characteristics.
- In distance measurement, the power of the reflected light varies greatly depending on the reflectance of the target object and the distance. So the sensor must be able to handle light ranging from low-level to extremely incident light. Hybrid devices feature 5 figures dynamic range of incident light levels.
- The hybrid device employs an extraneous light elimination circuit. When extraneous light is received, the extraneous light elimination amplifier (DCFB Amp) is activated to prevent the saturation of output, even when current of several milli-amperes generated.



● Front-end IC (TIA)

The TIA (trans-impedance amplifier) is a circuit that converts output current from detectors such as a PIN photodiode or an APD into voltage output. The TIA is widely used as a preamp for photodiodes since it usually maintains a good input-to-output relationship in real-time. Applications include distance measurement, optical communication devices, analytical instruments, scientific measurement devices, as well as many others.



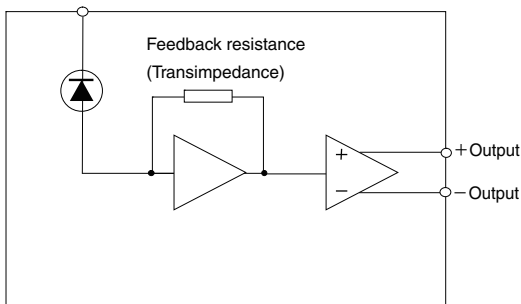
**Feature 1**

Designed to provide high-speed response and low noise when combined with a HAMAMATSU photodiode (Si PIN photodiode, Si APD, InGaAs PIN photodiode, InGaAs APD).

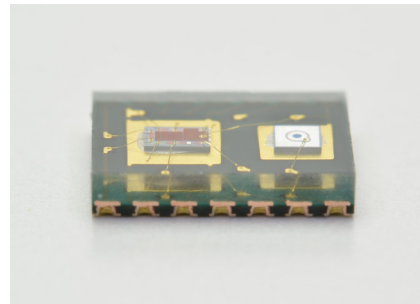
**Feature 2**

In distance measurement applications, there is a wide range of optical power incident on the detector depending on the reflectivity of the target as well as the distance. This requires the front-end IC has a wide dynamic range up to several orders of magnitude. The TIA we developed offers a dynamic range up to 5 figures for good timing detection. We also provide different types with background light countermeasures, so they can be used outdoors.

> Photodiode + TIA

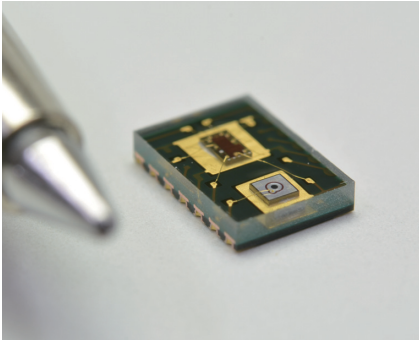


> Device example



# Hybrid device

## S13282-01CR



These devices integrate an APD chip and TIA to strengthen light detection capability. The TIA is incorporated in the readout circuit, which converts the current generated by the photodiode into voltage at high speed. The output shows the instantaneous value of incident light.

The influence of exogenous noise is decreased because the light detecting element and readout IC are closely connected which makes it possible to decrease the noise property and improve the cut-off frequency characteristics.

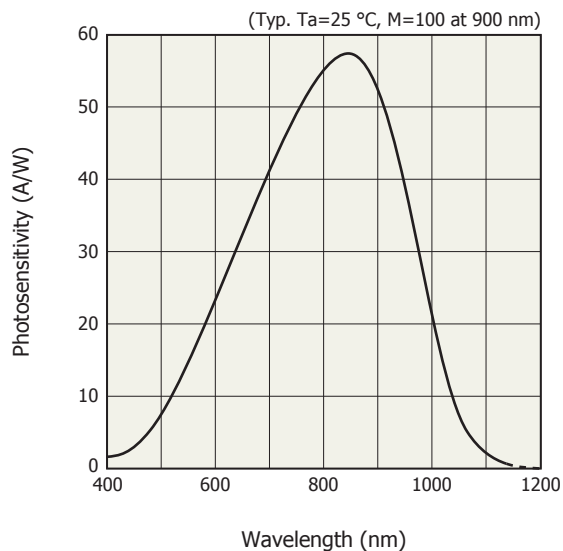
### ▼ Specifications

(Typ, Ta=25 °C)

Parameter		S13282-01CR	Units
Product type		<b>Si APD +TIA</b>	-
Photosensitive area		φ 0.2	mm
Peak sensitivity wavelength		840	nm
Feedback resistance		5	kΩ
Cutoff frequency	High gain	180	MHz
	Low gain	200	
Noise equivalent power	High gain	75	fW/Hz <sup>1/2</sup>
	Low gain	50	
Gain	High	4	MV/W
	Low	0.2	

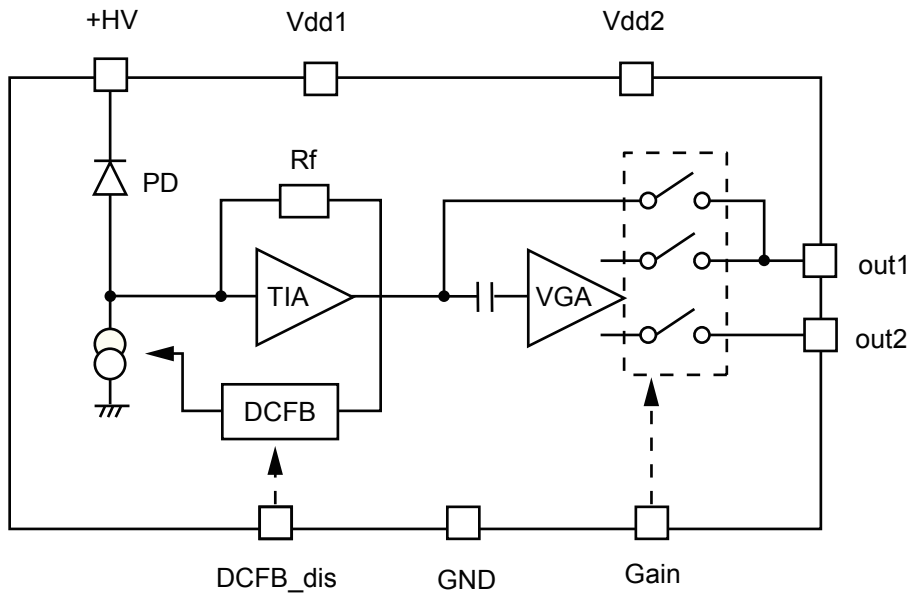
\* S13282-01CR: λ=840nm M=100 at 10 MHz

### ▼ Spectral response



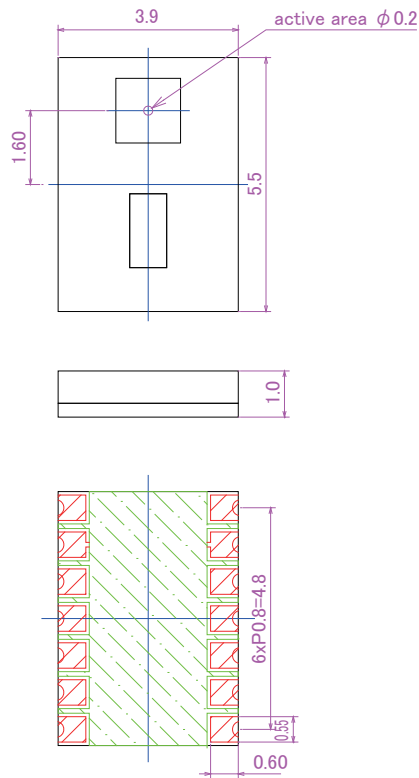
KAPDB0269EA

▼ Block diagram



\* DCFB circuit detects and subtracts DC (low frequency) component of photo current.

▼ Dimensional outline (unit: mm)

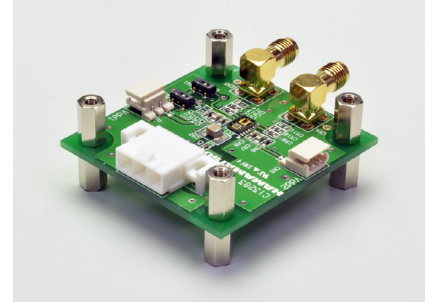


\* At the phase of mass-production, it will be changed. Please do not use for the design this drawing above.

▼ Driver circuit for hybrid device

C13283-03

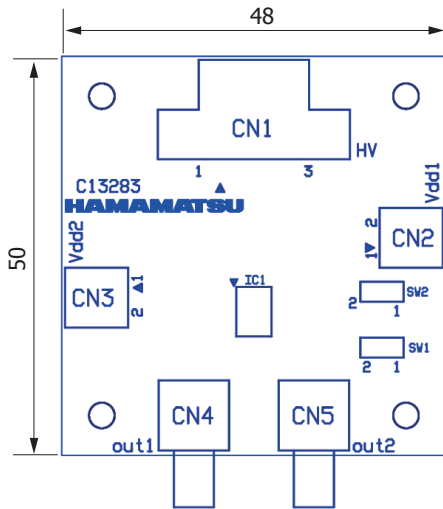
We also offer a hybrid device evaluation board ideal for customers who want to speed up device development. This driver circuit is an experimental kit designed to allow customers to easily make preliminary hybrid device evaluations. We also fabricate modules to meet mass-production assembly needs, so feel free to consult us as needed.



Suitable device

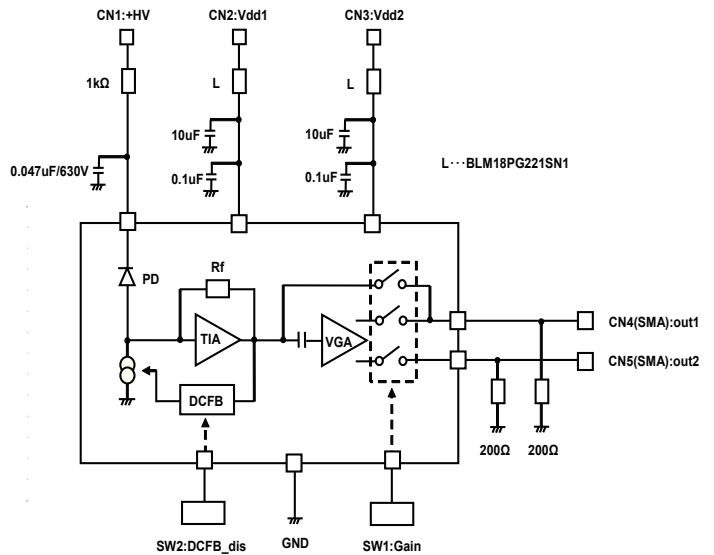
- C13283-01AR: S13282-01CR (Si APD+TIA)

■ Dimensional outline (unit: mm)



Connector No.	Pin No.	Function	Connector No.	Pin No.	Function
CN1	1	+High voltage	CN4	-	out1
	2	NC		CN5	-
	3	GND	SW1		1
CN2	1	Vdd (3.3 V)		SW2	1
	2	GND	2		DCFB on
CN3	1	Vdd (3.3 V)			
	2	GND			

■ Block diagram



\* At the phase of mass-production, it will be changed. Please do not use for the design this drawing above.



Information described in this material is current as of May, 2015.  
 Product specifications are subject to change without prior notice due to improvements or other reasons. Before assembly into final products, please contact us for the delivery specification sheet to check the latest information.  
 The product warranty is valid for one year after delivery and is limited to product repair or replacement for defects discovered and reported to us within that one year period. However, even if within the warranty period we accept absolutely no liability for any loss caused by natural disasters or improper product use. Copying or reprinting the contents described in this material in whole or in part is prohibited without our prior permission.

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