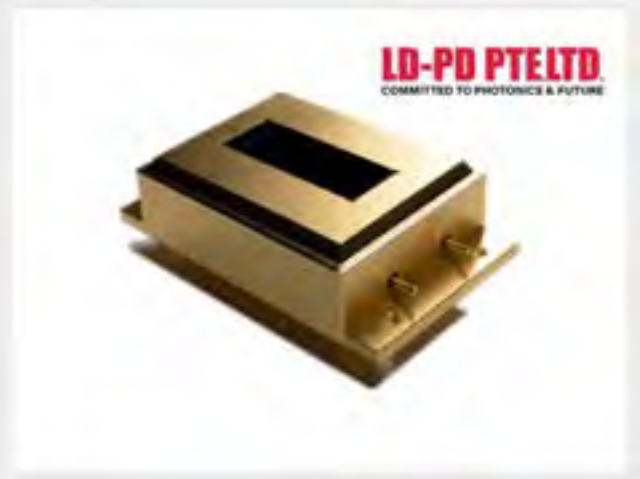
512 InGaAs Linear Detector

User Manual

L055125M2-A, 512x1, 25x250 μ m^2, 2.5 μ m



62 Highland Ave., Bethlehem, PA 18017, USA
Sales: contact@cybel-llc.com | Web: www.cybel-llc.com | Tel: +1 (610) 691-7012

Version Notes

Date	Version	Update Content Description
2025.6.5	2025.6	First version output

Overview

The L055125M2-A InGaAs linear detector is mainly composed of a 512×1 scale InGaAs photosensitive chip, a readout circuit (ROIC) and a two-stage thermoelectric cooler (TEC), and adopts a metal package. It has the characteristics of wavelength extension and multi-level gain selection, and can be used in short-wave infrared imaging, industrial detection, color sorting and other fields.

Main Parameters of Detector

Photoelectric Properties

Index	Typical value	
Response spectrum range(μ m)*1	$1.30_{\pm 0.05}$~$2.50_{\pm 0.05}$	
Peak quantum efficiency(%)	≥60	
Dark current density (μ A/cm^2)*1	< 5	
Effective pixel rate (%)*2,3	≥98	
Response inconsistency (%)*3	<8	
Readout method	IWR, ITR, optional	
Readout rate (MHz)	Single channel 10	
Maximum frame rate (fps)	20k	
Gain level	8	
Saturation voltage (V)	1.6	
Conversion gain (nV/e$^-$)	Gain level 1: 16000	Gain level 5: 1775
	Gain level 2: 8000	Gain level 6: 840
	Gain level 3: 4000	Gain level 7: 325
	Gain level 4: 2665	Gain level 8: 160

*1 Focal plane temperature = -20℃

*2 The deviation between the pixel response signal and the average value is less than the percentage of pixels within a certain range

*3 Test conditions: focal plane temperature = -20℃, 8th gain, integration time 0.5ms

Mechanical Property

Index	Typical value
L x W x H (mm^3)	55 x 32.6 x 13
Weight (g)	~78
Focal plane scale	512 x 1
Pixel center distance (μ m)	25
Pixel size (μ m^2)	25 x 250
Photosensitive area (mm^2)	12.8 x 0.25

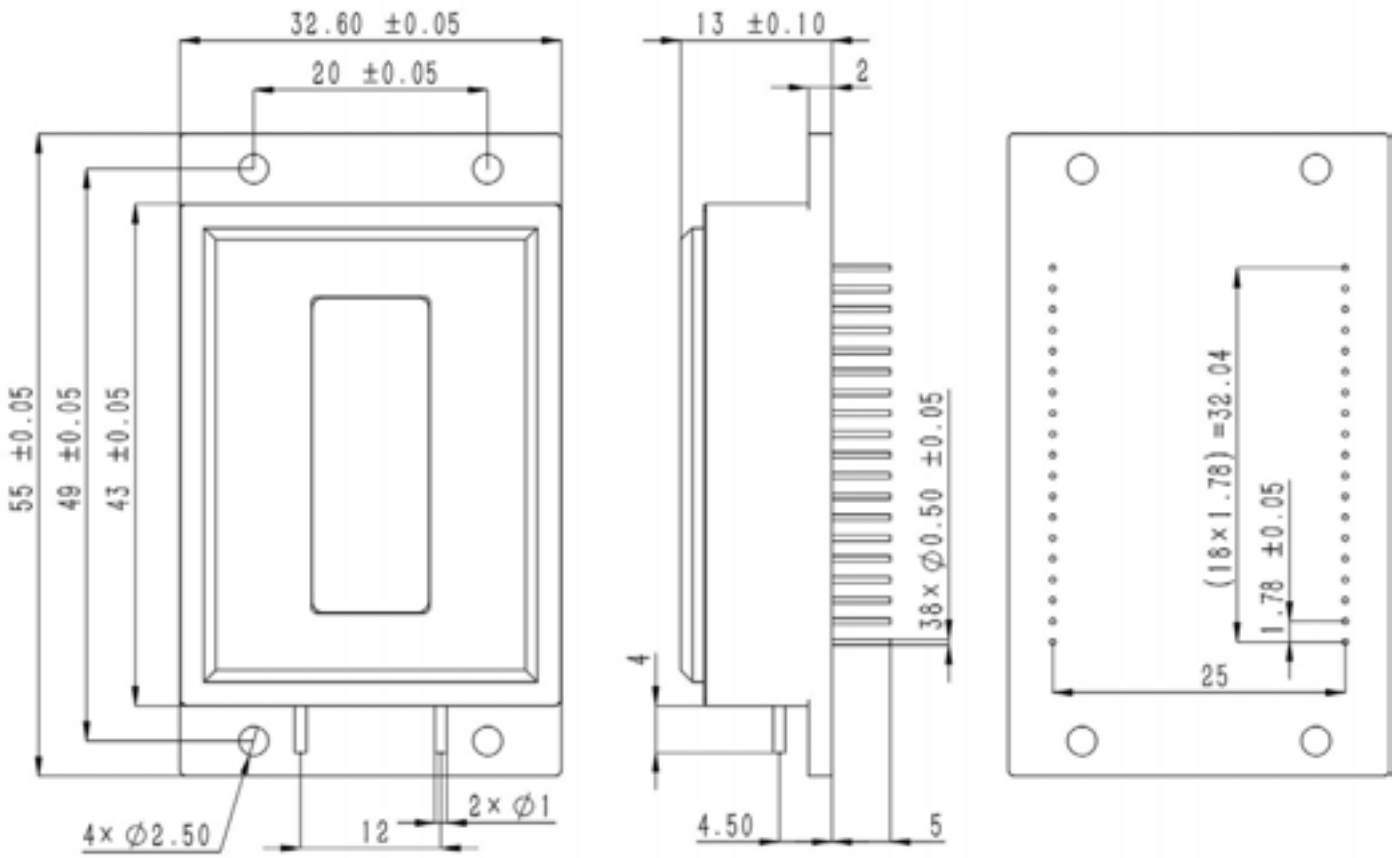
Operating Environment and Power Consumption Parameters

Index	Typical value
Operating environment temperature (℃)	0~+35
Storage environment temperature (℃)	-5~+40
Typical power (W)*	<0.15

*TEC is not turned on, ambient temperature = 25℃, clock frequency = 1MHz, VDDD = VDDA = 3.3V, VBOP = 2.4V, VBOUT = VREF = VNDET = 2.3V

Mechanical Parameters

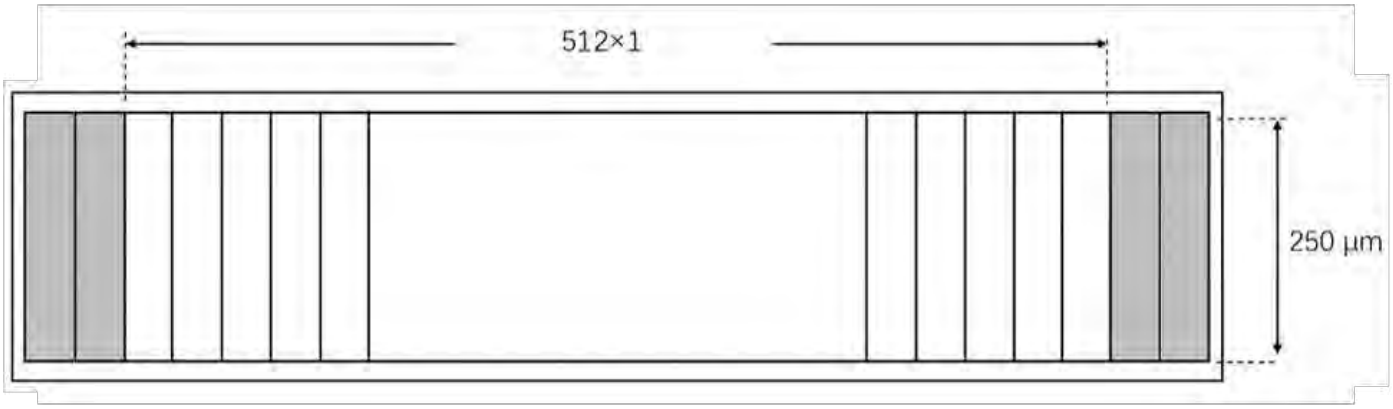
This detector adopts metal packaging, filled with high-purity nitrogen at normal pressure, the metal shell is made of FeNiCoSi alloy, the surface is electroplated with Ni/Au layer, the window welding method is bonding, and the cover is resistance welding. The detector size is 55mm (L) × 32.6mm (W) × 13mm (H). There are thirty-eight Φ0.5mm pins on the shell leading out from the back, with a pin spacing of 1.78mm, which are used for the input of focal plane power supply and command, focal plane detection signal and electrical lead-out of temperature sensor; two Φ1.0mm pins on the side are used for the connection of thermoelectric cooler. There are four Φ2.5mm through holes on both sides of the tube shell for fixing the detector.



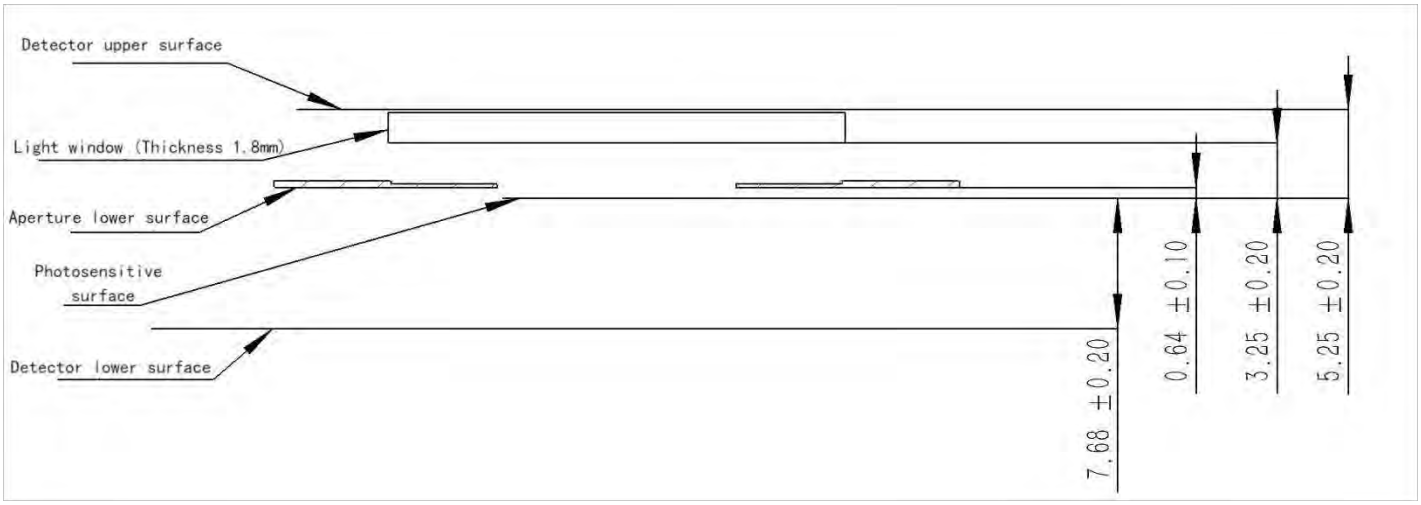
Optical Parameters

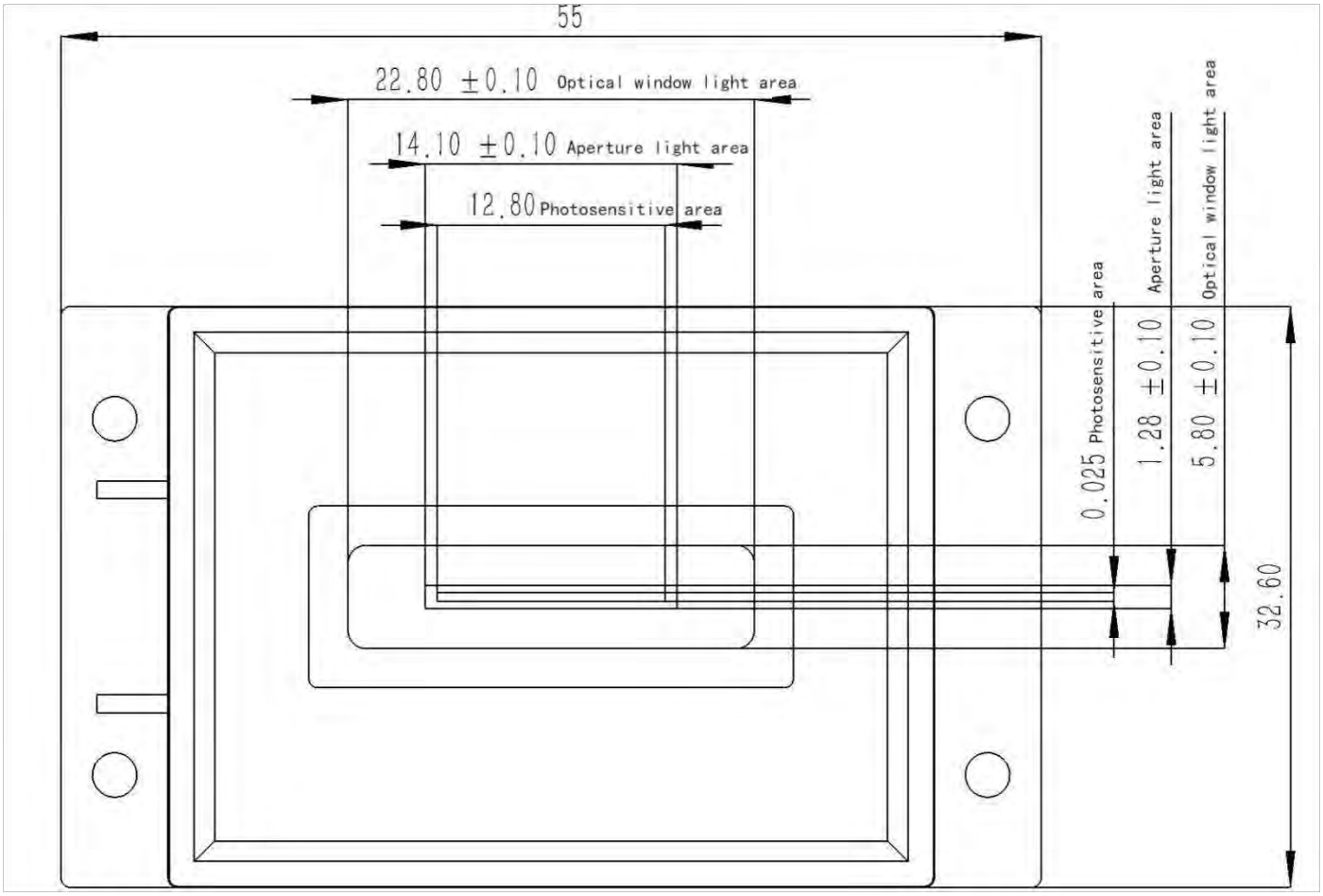
Optical Structure

This product uses a 512×1 element InGaAs focal plane, with 2 redundant elements on each end, that is, the total number of pixels is 516×1. In actual use, it is recommended to use the 3rd to 514th columns. The pixel shape is rectangular, the photosensitive size is 25μm×250μm, and the structure is arranged in a "one" shape, as shown in the figure below.

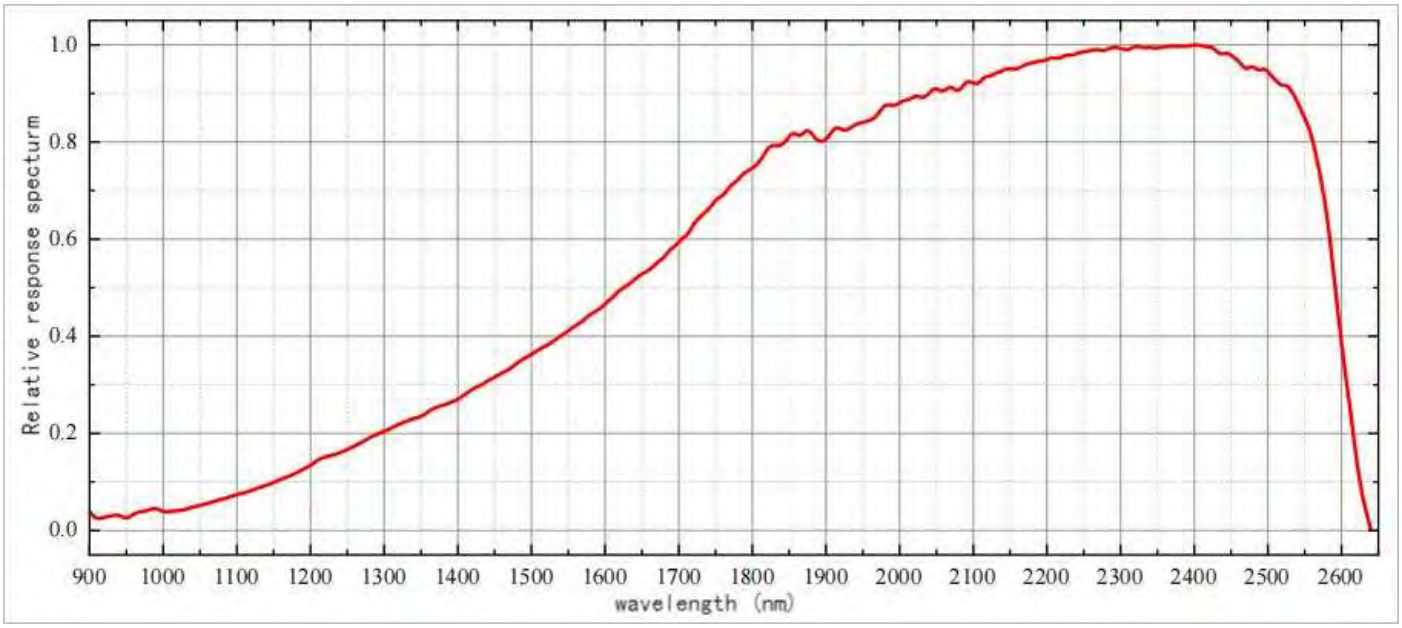


The optical window material is K9 glass with a thickness of 1.8mm and a transmittance of >90% in the response band. The center of the photosensitive surface is located at the center of the detector, with a relative position offset of ≤0.05mm and a relative rotation displacement of ≤0.02mm. The optical interface dimensions are shown in the figure below.



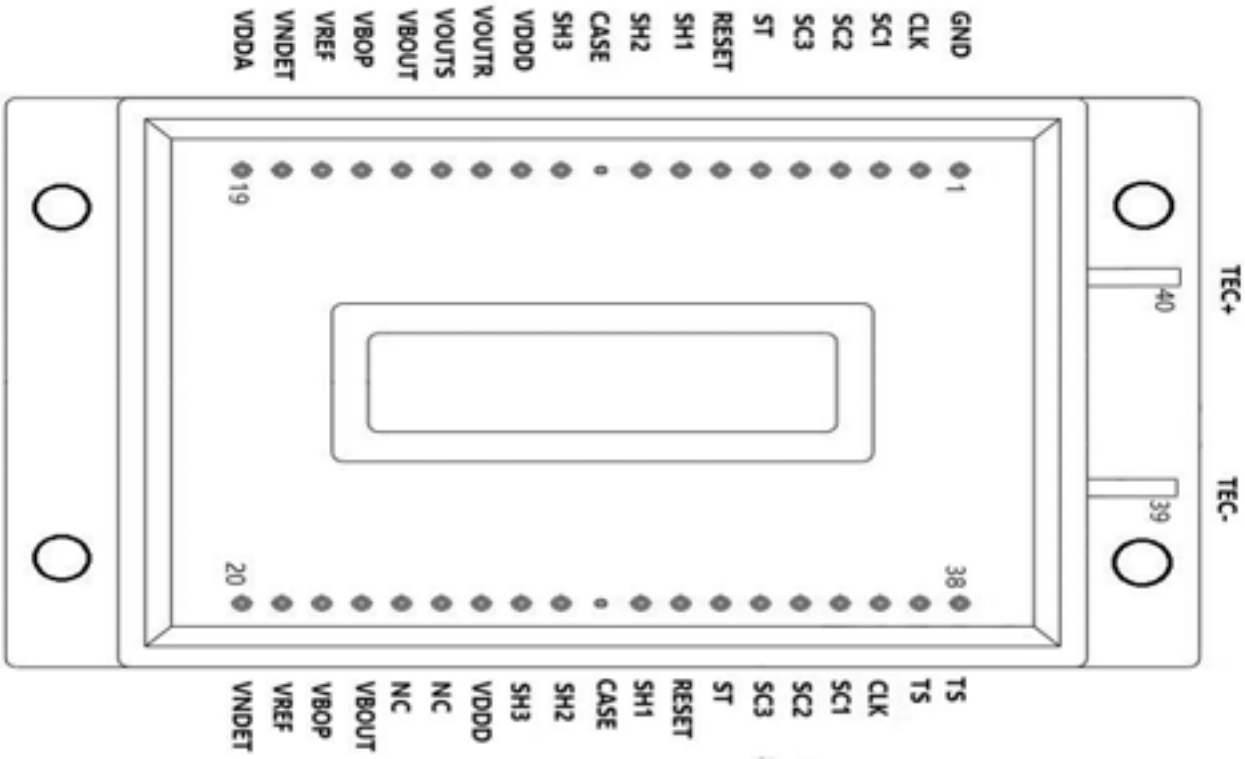


Relative Response Spectrum (Typical Value at Room Temperature)



Electrical properties

Detector pin diagram



Detector Pin Description

PIN	Input / Output	Pin Function	Reference Value
GND	Input	Ground wire	Current <10mA during operation
CLK	Input	CLK Input Clock, providing time reference for circuit drive timing	Digital voltage; High level 3.3V, low level 0V
VDDD	Input	Digital circuit power supply, providing voltage for the digital circuit in the detector	DC 3.3V, current during operation needs <5mA
VDDA	Input	Analog circuit power supply, providing voltage for the analog circuit in the detector	DC 3.3V, current during operation needs <25mA

PIN	Input / Output	Pin Function	Reference Value
SC1、SC2、SC3	Input	Detector gain selection, controlling the output signal size of the detector, for details on the control method, see the timing section	Digital voltage High level 3.3V, low level 0V
ST	Input	Trigger pulse, the sign that the circuit starts to collect signals	Digital voltage High level 3.3V, low level 0V
RESET	Input	Reset signal, controls the length of the circuit collection cycle, Control method see timing section	Digital voltage High level 3.3V, low level 0V
SH1、SH2、SH3	Input	Sampling control signal, sets pixel integration time, Change readout mode, control method see timing section	Digital voltage High level 3.3V, low level 0V
VBOUT	Input	Buffer bias, provides bias for the circuit total buffer	Voltage DC 2.3V
VBOP	Input	Amplifier bias, provides bias for the signal amplifier	Voltage DC 2.3V~2.5V, recommended 2.4V
VREF	Input	Reference voltage, provides reference value	output signal DC 2.3V
VNDET	Input	Chip common N	DC 2.3V
VOUTR	Output	Reference signal	0.5V~2.5V
VOUTS	Output	Output signal, the actual detector response signal value is obtained by subtracting the output signal from the reference signal	0.5V~2.5V
TS	-	Temperature measuring	

		resistor, the resistance value is measured through two pins to feedback the working temperature of the focal plane	
TEC+、TEC-	-	Thermoelectric cooler input voltage, + pin connected to high potential, - pin connected to high potential	Don't exceed the rated voltage and current of TEC
CASE	-	Grounded together with the entire detector tube shell	
ST	Input	Trigger pulse, the sign that the circuit starts to collect signals Digital voltage	High level 3.3V, low level 0V
RESET	Input	Reset signal, control circuit collection cycle length, control method see timing section	Digital voltage High level 3.3V, low level 0V
NC	-	No pin	

Notes:

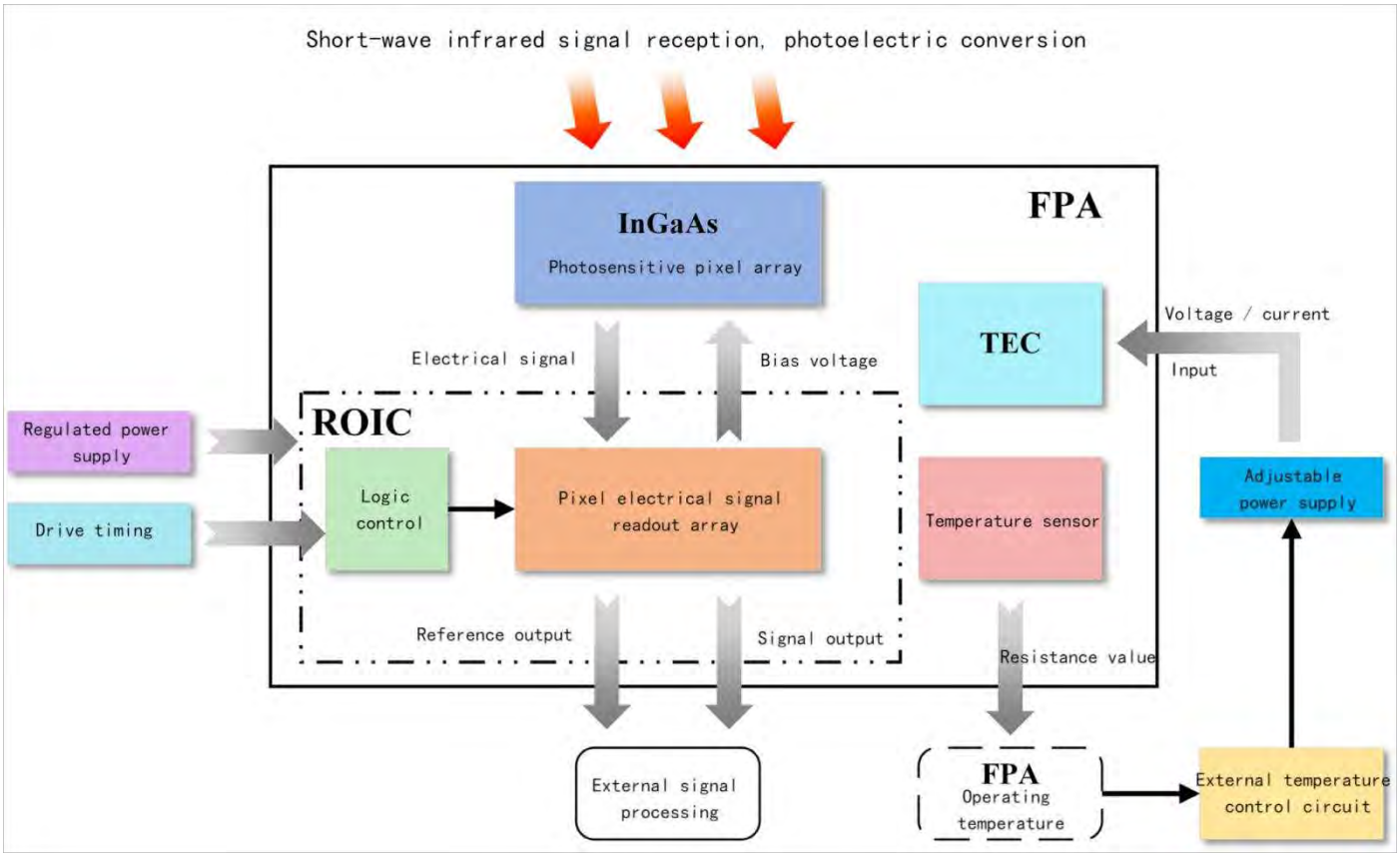
1) Anti-static measures should be taken during the delivery and use of the detector;

2) Before the detector is powered on, the power supply connection status and drive setting value must be checked to strictly ensure that the working current of each circuit does not exceed 60mA during the power supply process. Short circuit of the signal output terminal is prohibited, and it is recommended to supply power first and then supply timing;

3) DC input directly affects the overall noise of the detector, so the ripple noise of the DC input power supply has the following requirements:

a) VDDA＜2mV
b) VDDD＜10mV
c) VREF、VNDET＜0.3mV
d) VBOP、VBOUT＜1mV

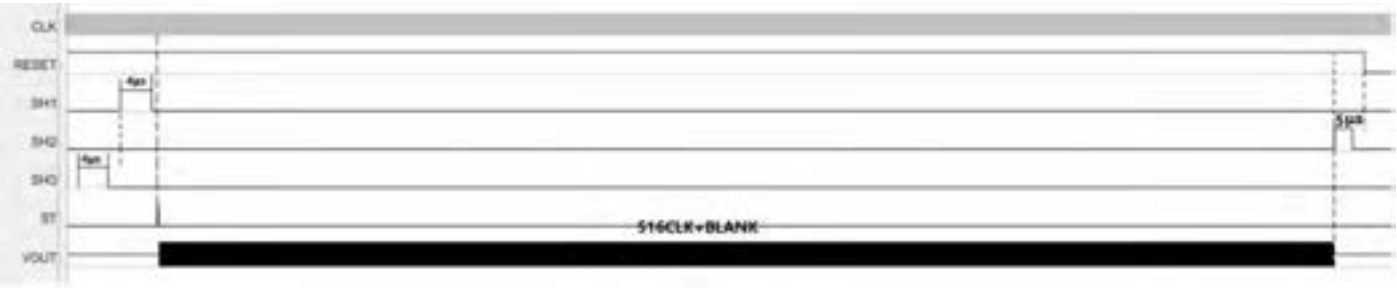
Detector working principle and connection diagram



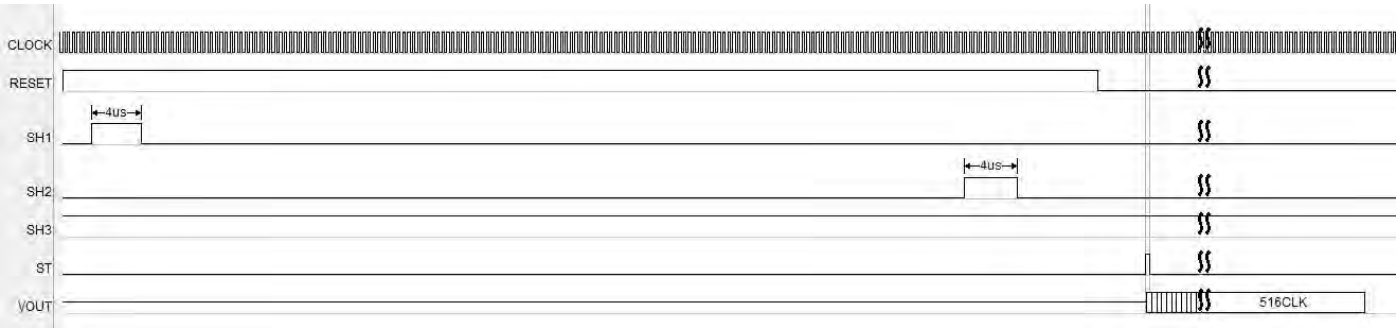
Detector Timing Description

The overall readout circuit driving timing pulse is shown in the following figure:

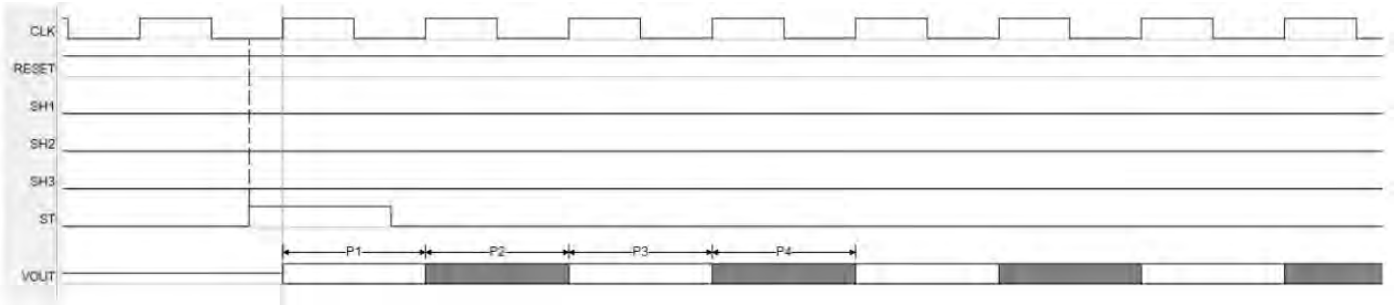
IWR mode:



ITR mode:



After zooming in, the timing details at the trigger level ST are as follows:



The overall timing requirements are as follows:

Name	High level width	Initial level	Rising edge time
CLK	0.5 CLK cycle	Low	.5 CLK cycle
RESET	Adjust according to the integration time	High	
SH1		Low	6 μ s
SH2	4 μ s	Low	5 μ s before RESET falling edge
SH3	4 μ s	Low	1 μ s
ST	1 CLK cycle	Low	15 μ s

Notes:

1) The CLK cycle and RESET high level width can be set according to the needs. The recommended CLK frequency range is 1~10MHz, and the RESET low level width cannot be less than 2μs;

2) In IWR mode, the order of SH1, SH2, and SH3 cannot be changed. The specific integration time of the detector is the time from the falling edge of SH1 to the falling edge of SH2 in the same RESET cycle;

3) The ST high level needs to cover a complete CLK high level, and the ST rising edge needs to be within the low level of CLK. It is recommended to set the rising edge at 1/2 of the CLK low level;

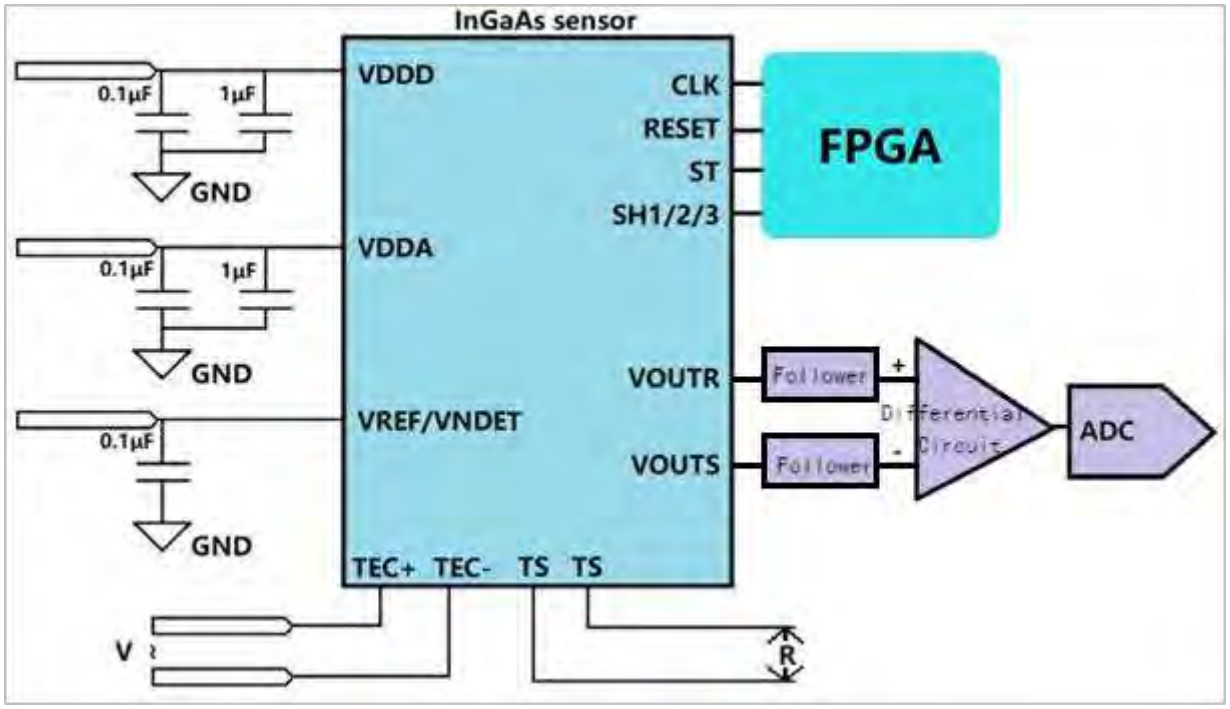
4) The actual signal is read from the first CLK rising edge after the ST rising edge. The reference signal R and the output signal S are read out in sequence until the last CLK cycle before the falling edge of SH2 is reached;

5) If the width of RESET high level is not enough to read out all 516 pixels, when the next RESET high level comes, it will still start reading from the first pixel, not from the pixel that has not been read; if the width of RESET high level is too large, it will continue to be empty after reading all 516 pixels of the channel, until the RESET low level comes to reset; 6) It is recommended to use digital input voltage for SC1, SC2, and SC3, that is, always maintain 3.3V high level/0V low level;

This detector has 8 levels of gain. It is recommended to use the lowest gain level (level 8). The specific relationship between the gain level and the input voltage is as follows:

Level	SC1	SC2	SC3	Gain
1	1	1	1	High
2	0	0	0	
3	0	0	1	
4	0	1	0	
5	0	1	1	
6	1	0	0	
7	1	0	1	
8	1	1	0	Low

Detector peripheral recommended circuit diagram



Thermal parameters

Thermoelectric Cooler Characteristics

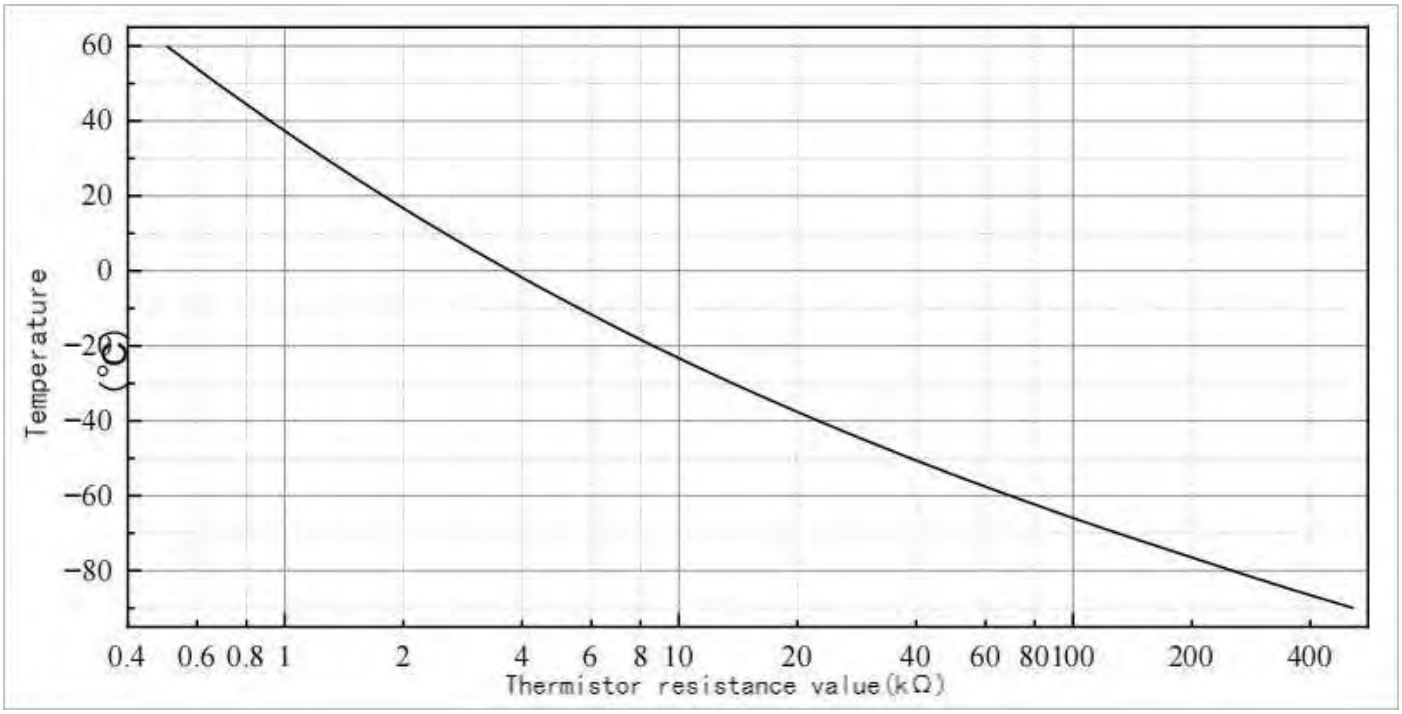
The detector integrates a secondary thermoelectric cooler (TEC). The center of the heat dissipation surface is the center of the lower surface of the detector. The heat dissipation area should be ≥ 20mm×20mm. Its performance parameters are shown in the following table:

Performance Indicators	Value
Maximum temperature difference between hot and cold surfaces (△Tmax/℃)*	45
Maximum allowable load current (ITEC-max/A)	2.72
Maximum allowable load voltage (VTEC-max/V)	13.5

* This performance index refers specifically to the temperature difference between the focal plane and the heat dissipation surface of the package structure

Temperature Sensor Characteristics

This detector uses a thermistor as a temperature sensor. The relationship between the resistance value and temperature within the working temperature is shown in the figure below.



The typical relationship between thermistor resistance and temperature is shown in the following table:

Temperature (℃)	Resistance(kΩ)	Temperature (℃)	Resistance(kΩ)	Temperature (℃)	Resistance(kΩ)	Temperature (℃)	Resistance(kΩ)	Temperature (℃)	Resistance(kΩ)
-50	38.70	-30	13.69	-10	5.587	10	2.550	30	1.268
-45	29.40	-25	10.81	-5	4.549	15	2.126	35	1.077
-40	22.56	-20	8.608	0	3.729	20	1.782	40	0.918
-35	17.49	-15	6.909	5	3.075	25	1.500	45	0.786

The corresponding relationship between thermistor resistance and temperature is as follows:

$$\frac{1}{(T_1+273.15)}=\frac{\ln\left(\frac{R_1}{R_2}\right)}{B}+\frac{1}{(T_2+273.15)}$$

T1: Test target temperature, unit: °C;

T2: Reference point temperature, unit: °C, the typical reference temperature in the range of -70~30°C is -40 or-10°C, and the reference temperature value close to the target temperature should be selected;

R1, R2: Thermistor resistance corresponding to T1 and T2, unit: kΩ;

B: Thermal coefficient, the typical value of B-40/-10 in the range of -70~30°C is 2854.43 (deviation ±2%), and the temperature deviation calculated by this typical value is ±0.5°C.

Notes:

i) During the installation of TEC, it is necessary to pay attention to the additional resistance introduced by the external electrical structure. If the additional resistance exceeds 10% of the TEC resistance, the I-V curve needs to be recalibrated;

j) It is recommended to connect the TEC with a smaller connection resistance. If welding is required, short-circuit grounding protection is required. The welding temperature should be ≤250℃ and the welding time should be <10s;

c) If higher measurement accuracy is required within a small temperature range, the B value can be calculated according to the requirements;

d) Before turning on the TEC, it is necessary to confirm that the temperature sensor is working properly, the heat dissipation surface is in full contact with the heat sink, the heat dissipation surface is not less than the required size area, and the heat sink is working properly. It is not recommended to turn on the TEC without installing the heat sink or the heat sink is not working;

e) When turning on the TEC for the first time, the current or voltage should be gradually loaded from 0A or 0V, and the temperature change should be monitored at the same time until the preset temperature is reached;

f) Since the performance of the detector is affected by temperature, the TEC should be turned on first until the temperature is stable before turning on the detector. It is not recommended that the detector work in an environment with temperature changes;

g) When the detector is not working, the power supply to TEC should be stopped to extend the service life of TEC;

h) The cooling effect of the detector is related to the ambient temperature, power performance, and heat dissipation status. It is recommended to reasonably match the heat dissipation system according to the use environment and the performance requirements of the detector.

Product Support

Problems	Possible causes	Solutions
Abnormal detector signal output	No power supply or abnormal power supply	Check whether each power supply meets the electrical requirements in the manual
	Abnormal timing	Modulate the detector timing pulse width as recommended in the manual
	Short integration time or no light intensity	Increase integration time and change gain gear
	Light intensity saturation	Shorten integration time and change gain gear
Detector output noise is too large	Power supply ripple noise is large	DC power supply ripple noise is supplied according to the electrical requirements in the manual
	Thermoelectric cooler pin is reversed	Detected by temperature sensor to determine whether there is reverse connection
	Noise is introduced in the back-end electronic circuit	Check the board-level circuit structure arrangement and circuit noise