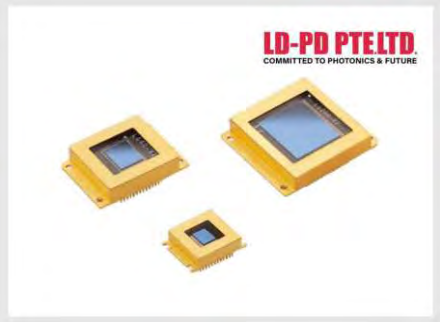
1024×512 InGaAs area array detector



Description

The A97A530M1-A InGaAs area array detector is mainly composed of a 1024×512 InGaAs photosensitive chip, a readout circuit (ROIC) and a first-stage thermoelectric cooler (TEC), and is packaged in metal form. It can be used in short-wave infrared imaging, hyperspectral imaging and other fields.

Key Parameter

Main Parameters of Detector

Indicator Name	Typical Value
Response spectrum range (μm)*1	0.95 ±0.05 ~ 1.65±0.05
Pixel filling rate (%)	100
Effective pixel rate (%)*2, 3	≤99.5
Noise electron number (e-)*3	≤240
Dark current (nA/cm2)*1	
Dynamic range (dB) *1	
Voltage conversion gain(μV/e-)	≤10
Saturation output voltage(V)	≥55
Response non-uniformity (%)*3	≤5%
Peak quantum efficiency (%)	≥70%
Readout mode	IWR、ITR
Number of output channels	8
Maximum readout rate (MHz)	20
Maximum full frame rate (Hz)	250
Output mode	Support row selection

*1 Focal plane chip temperature = 25°C

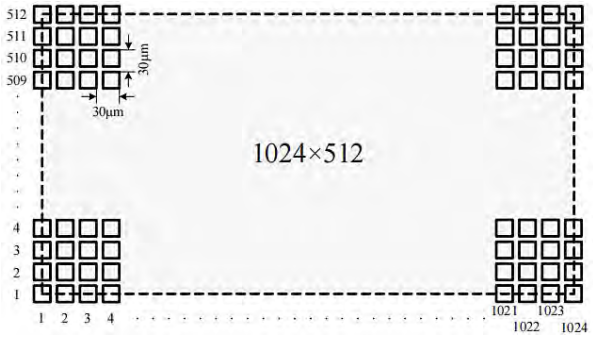
*2 Percentage of pixels whose response signal deviates less than 50% from the mean value under conditions near the optical signal half-trap

*3 Test conditions: chip temperature = 25°C, high gain, integration time 11.2ms, ITR mode

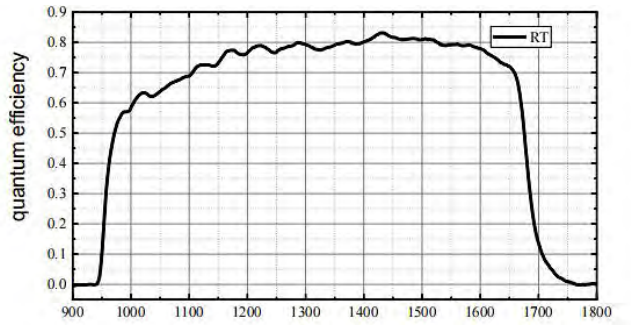
Optical Parameters

1.Optical structure

The detector uses a 1024×512-element InGaAs focal plane with 8 circles of redundant elements on the periphery, that is, the total number of pixels is 1040×528. The pixel shape is square, the photosensitive size is 30μm×30μm, and the pixel center distance is 30μm.

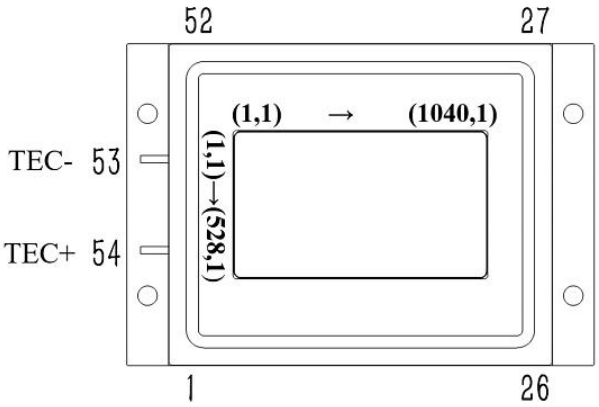


2. Quantum efficiency (typical value)



Electrical Properties

1.Detector pin diagram



2. Detector Pin Description

Pin Number	Pin Name	Input/ Output	Pin Function	Reference Value
1	VDDD	Input	Digital circuit power supply, providing voltage for the digital circuit in the detector	DC 3.3V, working current <30mA
2	CLKCOL	Input	Detector column clock	Digital voltage: high level 3.3V, low level 0V
3	STCOL	Input	Detector column triggering	
4	STCOLOP	Input	Detector Column Op Amp Trigger	
5	STROWCOL	Input	Detector row trigger	
6	GND	-	Public Land	-
7	VDDA	Input	Analog circuit power supply, providing voltage for the analog circuit in the detector	DC 3.3V, working current <150mA
8/9	VOUT1R/S	Output	The eight channels have corresponding reference/ output signals. The actual detector response signal value is obtained by subtracting the output signal value is obtained by subtracting the output signal from the reference signal of the same channel.	Reference signal 2.2~2.4V Output signal 0.4~2.4V
10/11	VOUT2R/S	Output		
12/13	VOUT3R/S	Output		
14/15	VOUT4R/S	Output		
16/17	VOUT5R/S	Output		
18/19	VOUT6R/S	Output		
20/21	VOUT7R/S	Output		
22/23	VOUT8R/S	Output		

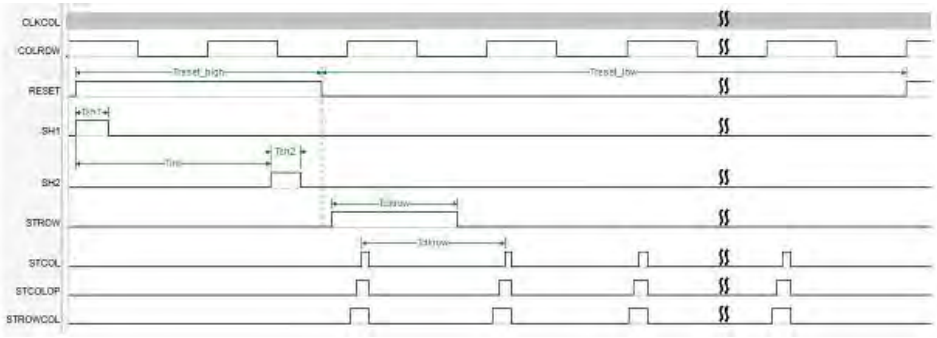
Pin Number	Pin Name	Input/ Output	Pin Function	Reference Value
24	VDDA	Input	Same as 7	Same as 7
25	GND	-	Same as 6	Same as 6
26	CASE	-	Grounded together with the entire detector housing	-
27/28	NTC	-	Temperature sensor, which measures the resistance value through two pins to feedback the working temperature of the focal plane	-
29	GND	-	Same as 6	Same as 6
30	VDDA	Input	Same as 7	Same as 7
31	VNDET	Input	Chip Public N	DC 2.5V
32	VREF	Input	CTIA Op Amp Reference	DC 2.5V
33	VBOUT	Input	Buffer bias, providing bias voltage for the circuit's total buffer	DC 2.2V
34	VBCOLBUF	Input	Column op amp bias, providing bias voltage for column op amp	DC 2.2V
35	VBCOLSF	Input	Unit Output Bias	DC 1.0V
36	VBOPN	Input	CTIA Op Amp N Bias	DC 1.0V
37	VBOPP	Input	CTIA Op Amp P Bias	DC 2.0V
38	VBOP	Input	CTIA op amp bias, providing bias voltage for signal amplifier	DC 2.5V
39	EOSCOL		Column output monitoring pulse	
40	EOSROW		Line output monitoring pulse	
41/42	SH2/1	Input	Signal/reference sampling pulse	Digital voltage: high level 3.3V, low level 0V
43	RESET	Input	Reset signal, controls the length of the circuit acquisition cycle. The control method is shown in the timing section.	
44	CLKROW	Input	Detector row clock	
45	STROW	Input	Detector line trigger pulse	
46	SELCAP	Input	Detector gain selection	
47	SEL128	Input	Detector subwindow selection	
48	VDDA	Input	Same as 7	Same as 7
49	GND	-	Same as 6	Same as 6
50	VDDD	Input	Same as 1	Same as 1
51/52	NTC	-	Temperature sensor, which measures the resistance value through two pins to feedback the working temperature of the focal plane	-
53/54	TEC-/TEC+	-	Thermoelectric cooler input voltage, when the + pin is connected to a high potential, it is cooling, and when it is connected to a low potential, it is heating	Do not exceed the rated voltage and current of the TEC

Note:

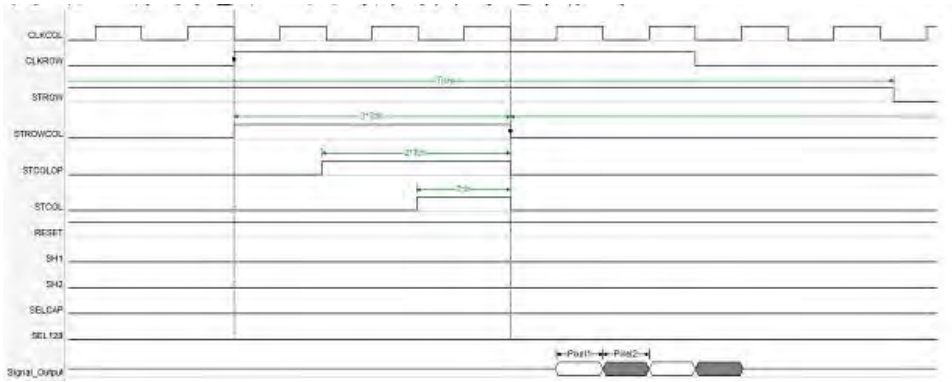
DC input directly affects the overall noise of the detector, so the ripple noise of the DC input power supply has the following requirements: VDDA<2mV; VDDD<10mV; VREF VNDET<0.3mV; VBOP, VBOUT<1mV

3.Detector timing description

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



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

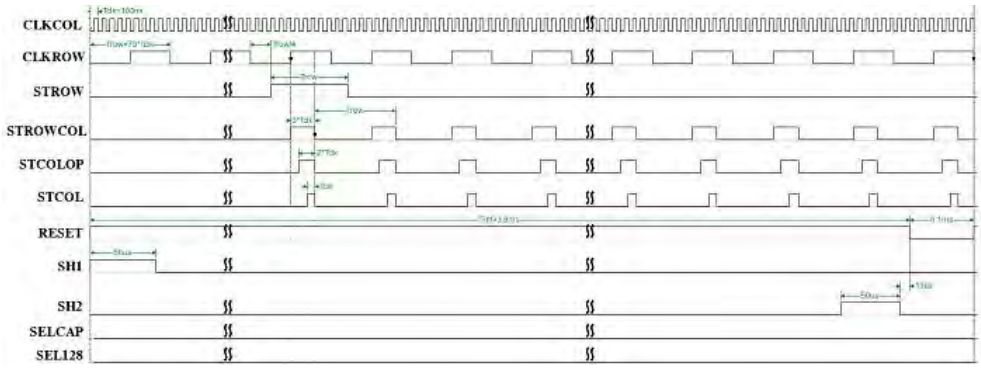


The overall timing requirements are as follows:

Name	Cycle	Pulse Width	High Level Start Position	High Level End Position
CLKROW	$T_{row}=70T_{col}$	/	/	/
CLKCOL	$T_{col}=0.1\mu s$	/	/	/
RESET	T_{frame}	$T_{int}=0.4\sim10+ms$	0	After SH2 falling edge
SH1	T_{frame}	$T_{sh1}=50\mu s$	0	$50\mu s$
SH2	T_{frame}	$T_{sh2}=50\mu s$	T_{int}	$T_{int}+50\mu s$
STROW	T_{frame}	T_{row}	After the RESET falling edge, CLK ROW low level	CLKROW low level middle
STCOL	T_{row}	T_{col}	After the falling edge of STROW	
STCOLOP	T_{row}	$2T_{col}$	After the falling edge of STROW	
STROWCOL	T_{row}	$3T_{col}$	After the falling edge of STROW	

IWR mode

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

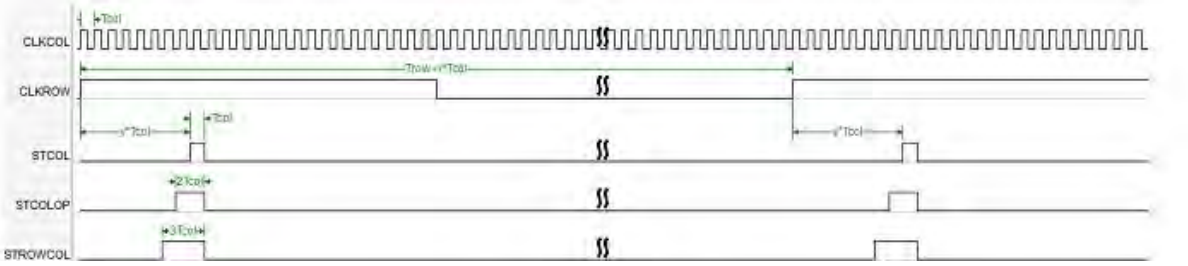


Note that the overall timing of the IWR mode is the same as that of the ITR. The main difference is that STROW, STROWCOL, STCOLOP and STCOL are moved as a whole to after the falling edge of SH1. In order to give the timing of STCOL, STCOLOP and STROWCOL in detail, as shown in the figure below,

Note that the STCOL rising edge is after the yth CLKCOL cycle after the CLKROW rising edge.

Note that the STCOL rising edge in the STCOL high-level pulse is the starting output position of the first pixel in each row.

The circuit driving timing pulse after local amplification is shown in the figure below:



The overall timing requirements are as follows:

Name	Cycle	Pulse Width	High Level Start Position	High Level End Position
CLKROW	$T_{row}=70T_{col}$	/	/	/
CLKCOL	$T_{col}=0.1\mu s$	/	/	/
RESET	T_{frame}	T_{int}	0	T_{int}
SH1	T_{frame}	$T_{sh1}=50\mu s$	0	$50\mu s$
SH2	T_{frame}	$T_{sh2}=50\mu s$	$T_{int}-60\mu s$	$T_{int}-10\mu s$
STROW	T_{frame}	T_{row}	After SH1 falling edge CLK ROW low level	CLKROW low level middle
STCOL	T_{row}	T_{col}	After the falling edge of STROW	
STCOLOP	T_{row}	$2T_{col}$	After the falling edge of STROW	
STROWCOL	T_{row}	$3T_{col}$	After the falling edge of STROW	

Notes:

1. RESET high level includes integration time, the length is adjustable, Tframe is the frame period, Tint is the integration time; SH1 high level is the reference level VOUTR sampling time; SH2 high level is the signal level VOUTS sampling time, the actual integration time is from the rising edge of SH1 to the rising edge of SH2;

2. The pixel data of the component is 528 rows and 1040 columns. Please pay attention to the starting position of the first column of pixels in each row (see the pulse details); the clock cycle of CLKROW is 70 times the clock cycle of CLKCOL, that is, in addition to reading out 130×8=1040 columns of data, there are 80 floating data. 80

floating data are concentrated at the end of the column (non-empty data), of which 16 data are one cycle, and the total cycle is 5 times;

3. When the row selection pulse SEL128 is low, 528 rows of full data are read out, and when it is high, only 144 rows are read out (128 rows are superimposed on top and bottom, and 8 rows are redundant);

4. If 528 rows are read out, 530 STCOLs are required (two rows are redundant). If 144 rows are read out, 146 STCOLs are required (two rows are redundant);

5. EOSROW is the row monitoring level of the signal output, and EOSCOL is the column monitoring level of the signal output;

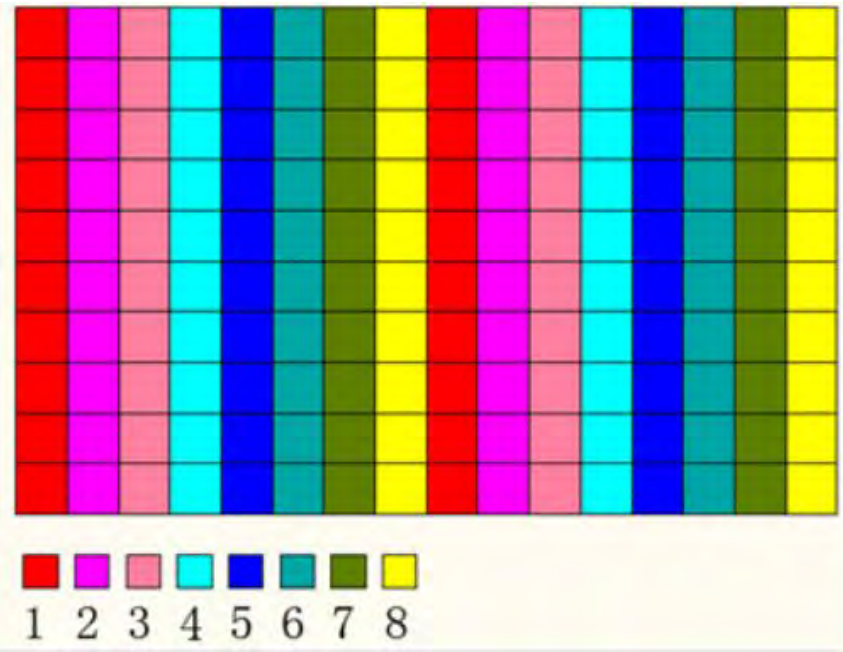
6. The readout cycle of a single data is Tcol/2, that is, two pixels are read out for each column clock;

7. Anti-static measures should be taken during the transmission and use of the detector;

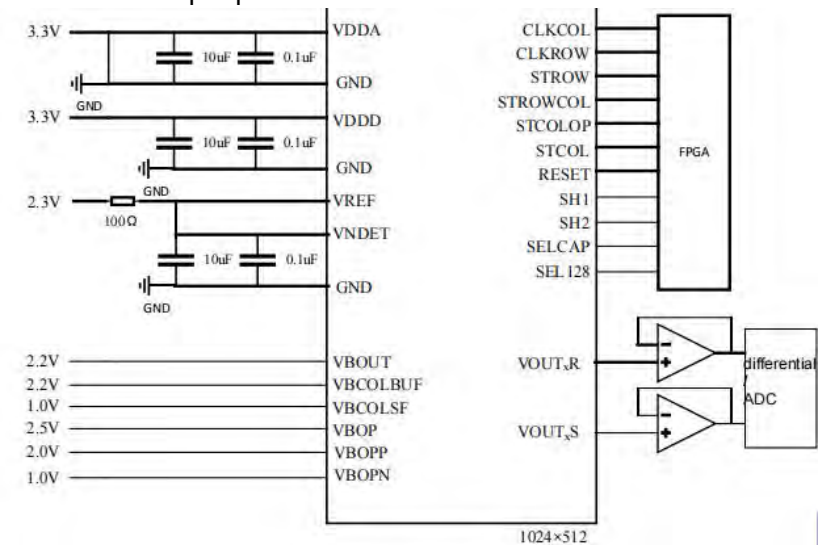
8. Before the detector is powered on, the power supply access status and set value must be checked to strictly ensure that the power consumption of each channel does not exceed 2W during the power supply process, and short circuit of the signal output terminal is strictly prohibited;

9. When the power supply is external, the analog power supply is powered synchronously, and then the digital circuit is powered, and there is no need to wait during the period;

10. 1040×528 pixels are read out row by row. After the first row is read out, the 1st, 2nd, 3rd, and 528th rows are read out in sequence. All columns of pixels are read out in parallel by 8 channels, with 8 columns as a cycle. The schematic diagram of the parallel output of the eight channels (VOUT1, VOUT2, VOUT3, VOUT4, VOUT5, VOUT6, VOUT7, VOUT8) is as follows:



4. Recommended diagram of detector peripheral circuit



Thermal Parameters

1. Thermoelectric cooler characteristics

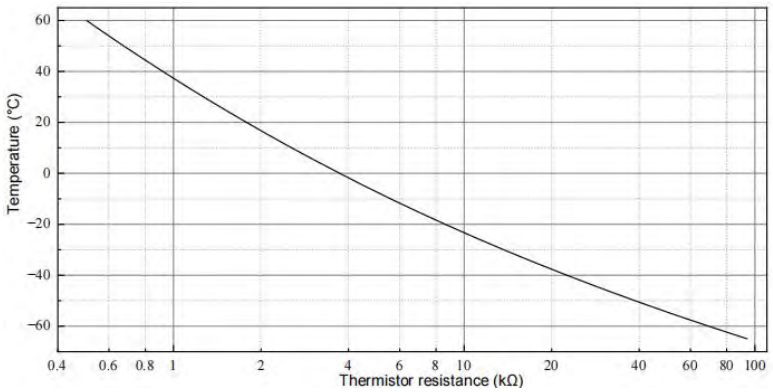
The detector integrates a first-stage thermoelectric cooler (TEC). The center of the heat dissipation surface is the center of the lower surface of the detector. The heat dissipation area is 40mm×33mm. Its performance parameters are shown in the following table:

Performance Indicators	Numeric
Maximum temperature difference between hot and cold surfaces (ΔT_{max}/°C) *	30
Maximum allowable loading current (ITEC-max/A)	2.4
Maximum allowable load voltage (VTEC-max/V)	10.5

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

1. Temperature sensor characteristics

This detector uses a thermistor as a temperature sensor. The relationship between the resistance value and temperature within the operating temperature range is shown in the following figure:



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)
-60	69.290	-30	13.690	0	3.729	30	1.268
-55	51.500	-25	10.810	5	3.075	35	1.077
-50	38.700	-20	8.608	10	2.55	40	0.918
-45	29.400	-15	6.909	15	2.126	45	0.786
-40	22.560	-10	5.587	20	1.782	50	0.674
-35	17.490	-5	4.549	25	1.5	55	0.581

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: ℃;

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

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

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

Notes:

a) 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;

b) It is recommended to connect the TEC in a way 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 and heating effects of the detector are 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.

Package Size

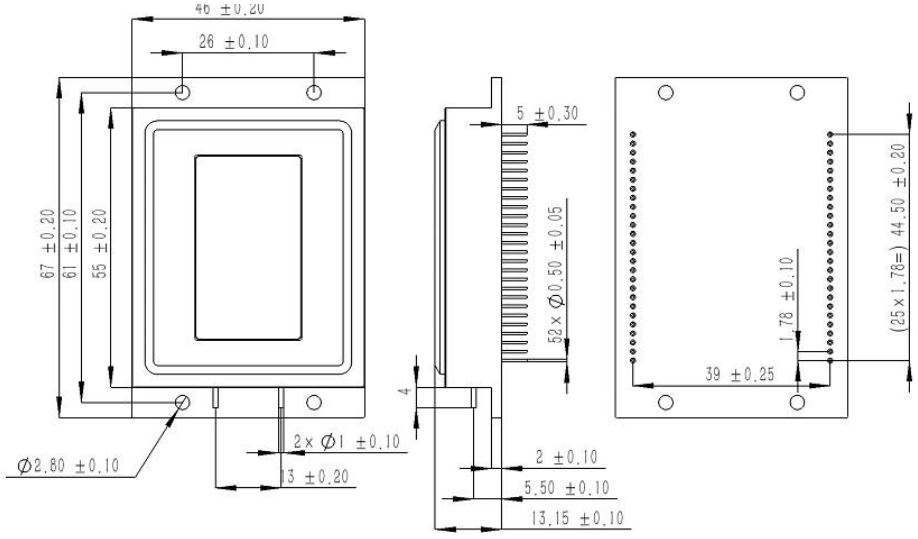
Mechanical Parameters

This detector adopts metal packaging, filled with high-purity gas at normal pressure, and the metal shell adopts Kovar alloy. The window welding method is airtight sealing welding, and the cover form is parallel seam welding.

The detector appearance

The size is 67mm (L) × 46mm (W) × 13.15mm (H). There are 52 Φ0.5mm pins on the shell leading out from the bottom, arranged in a double-sided single-row "I" shape, and the spacing between adjacent pins on one side is 1.78mm, which is used for the input of focal plane power supply and instructions, focal plane detection signal and electrical lead-out of temperature sensor;

The 2 Φ1.0mm pins on the side are used for the connection of thermoelectric cooler. There are 4 Φ2.8mm through holes on both sides of the tube shell, and M2.5 screws can be used to install and fix the detector. The appearance and size of the mechanical interface are shown in the figure below.



Indicator name	Typical value
LxWxH(mm)	67x46x13.15
Weight(g)	～165
Focal plane scale	1024x512
Pixel center distance (μm)	30
Pixel size (μm)	30x30
Photosensitive area(mm)	30.72x15.36

Operating environment and power consumption parameters

Indicator name	Typical value
Operating temperature(°C)	-45~+55
Storage temperature(°C)	-50~+60
Typical power (W)*	<0.25

* TEC off, room temperature, readout rate = 4MHz, ITR mode, number of readout channels = 8