

## OP411D InGaAs SPAD Detector

### Product Features

- Working wavelength: 0.95 $\mu\text{m}$ ~1.65 $\mu\text{m}$ ;
- High detection sensitivity (single photon level detection capability);
- Internal integrated three-stage cooler;
- Free Space Optical/FC Pluggable Optical Interface/Multimode Fiber (62.5 $\mu\text{m}$ ) optional.



### Main photoelectric indicators

#### Linear mode parameters

Characteristic parameters	Test conditions (TC=25 $\pm$ 5 $^{\circ}$ C unless otherwise specified)	Minimal	Greatest	Unit
Effective detection surface diameter $d$	-	25	-	$\mu\text{m}$
Spectral Response Range	-	950	1650	nm
Reverse breakdown voltage $V_{BR}$	$I_D = 10 \mu\text{A}$ , $T_c = 22^{\circ}\text{C}$	60	85	V
Responsiveness $R_e$	$\lambda = 1.55 \mu\text{m}$ , $V_R = V_{BR} - 1\text{V}$ , $\phi_e = 1 \mu\text{W}$	8	-	A / W
Dark Current $I_D$	$V_R = V_{BR} - 1\text{V}$ , $\phi_e = 0$	-	1	nA
Capacitance $C_{tot}$	$V_R = V_{BR} - 1\text{V}$ , $f = 1\text{MHz}$	-	0.6	pF
Temperature coefficient of breakdown voltage $\eta$	$T_c = -45 \sim +30^{\circ}\text{C}$ , $I_R = 10 \mu\text{A}$ , $\phi_e = 0$	0.10	0.15	V / $^{\circ}\text{C}$

#### Geiger mode parameters

parameters	Test conditions	Min	Max	Unit
Single Photon Detection Efficiency $PDE$	$T_A = -40 \pm 5^{\circ}\text{C}$ , $\mu = 1$ , $f_g = 1.25 \text{ kHz}$ , $f_g = 625 \text{ kHz}$ , $\text{DCR} \leq 3.0 \text{ kcps}$ , $\lambda = 1.55 \mu\text{m}$	20	—	%
Dark Count Rate $DCR$	$T_A = -40 \pm 5^{\circ}\text{C}$ , $\mu = 1$ , $f_g = 1.25 \text{ kHz}$ , $\text{SPDE} \geq 20\%$ , $\lambda = 1.55 \mu\text{m}$	—	3	kcps
Post-Pulse Probability $APP$ (500 ns)	$T_A = -40 \pm 5^{\circ}\text{C}$ , $\mu = 1$ , $f_g = 1.25 \text{ GHz}$ , $f_g = 625 \text{ kHz}$ , $\text{DCR} \leq 3.0 \text{ kHz}$ , $\text{SPDE} \geq 20\%$ , $\lambda = 1.55 \mu\text{m}$	—	4	%
Time Jitter $T_J$	$\text{SPDE} = 20\%$	—	200	ps

Note :  $\lambda$ : Spectral response;  $T_A$ : device temperature;  $\mu$ : under a certain average photon number per pulse;  $f_p$ : versus the photon trigger repetition rate.

### Absolute maximum ratings & Optical values

Serial Number	Parameters	Rated Value	
Parameter setting range	1	Storage temperature $T_{STG}$	-50 $^{\circ}\text{C}$ ~+85 $^{\circ}\text{C}$
	2	Operating ambient temperature $T_c$	-50 $^{\circ}\text{C}$ ~60 $^{\circ}\text{C}$
	3	Welding temperature $T_{sld}$ (time)	260 $^{\circ}\text{C}$ (10s)
	4	Reverse DC bias voltage $V_{DC}$	$V_{BR} + 5\text{V}$
	5	Input optical power $\phi_e$ (continuous)	1mW
	6	Forward current $I_F$ (continuous)	200 $\mu\text{A}$
	7	Electrostatic Discharge Sensitivity $ESD$	$\geq 300\text{V}$
	8	TEC Voltage	6.8 V
	9	TEC Current	1.0 A

Serial Number	Parameters	Rated Value	
Optical values	1	APD chip operating temperature $T_{th}$	-50 $^{\circ}\text{C}$ ~-30 $^{\circ}\text{C}$
	2	Reverse DC bias voltage $V_{DC}$	$V_{BR} + 1\text{V}$ to $V_{BR} + 5\text{V}$

### Typical Characteristic Curve

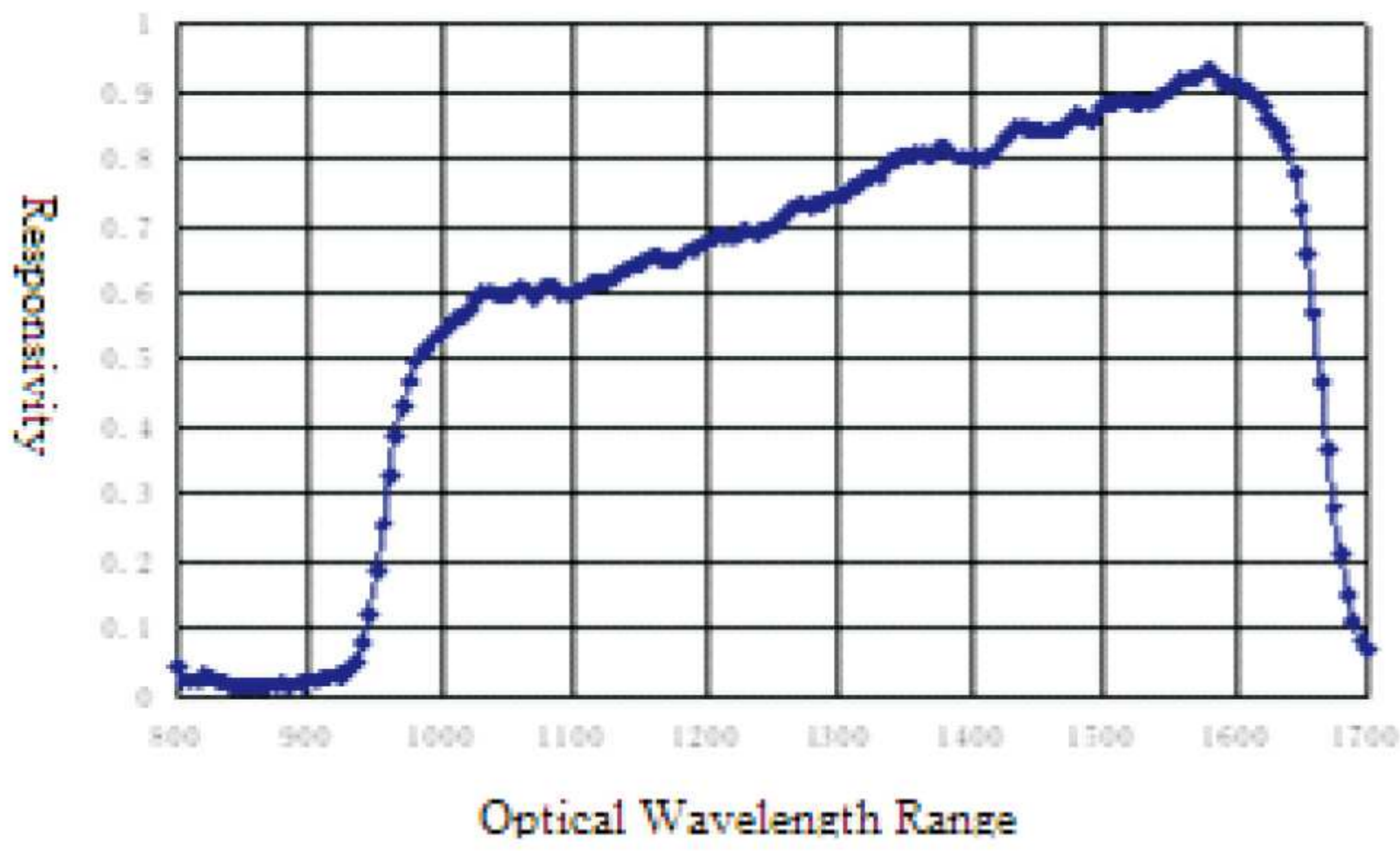


Fig. 1 InGaAs spectral response characteristic curve

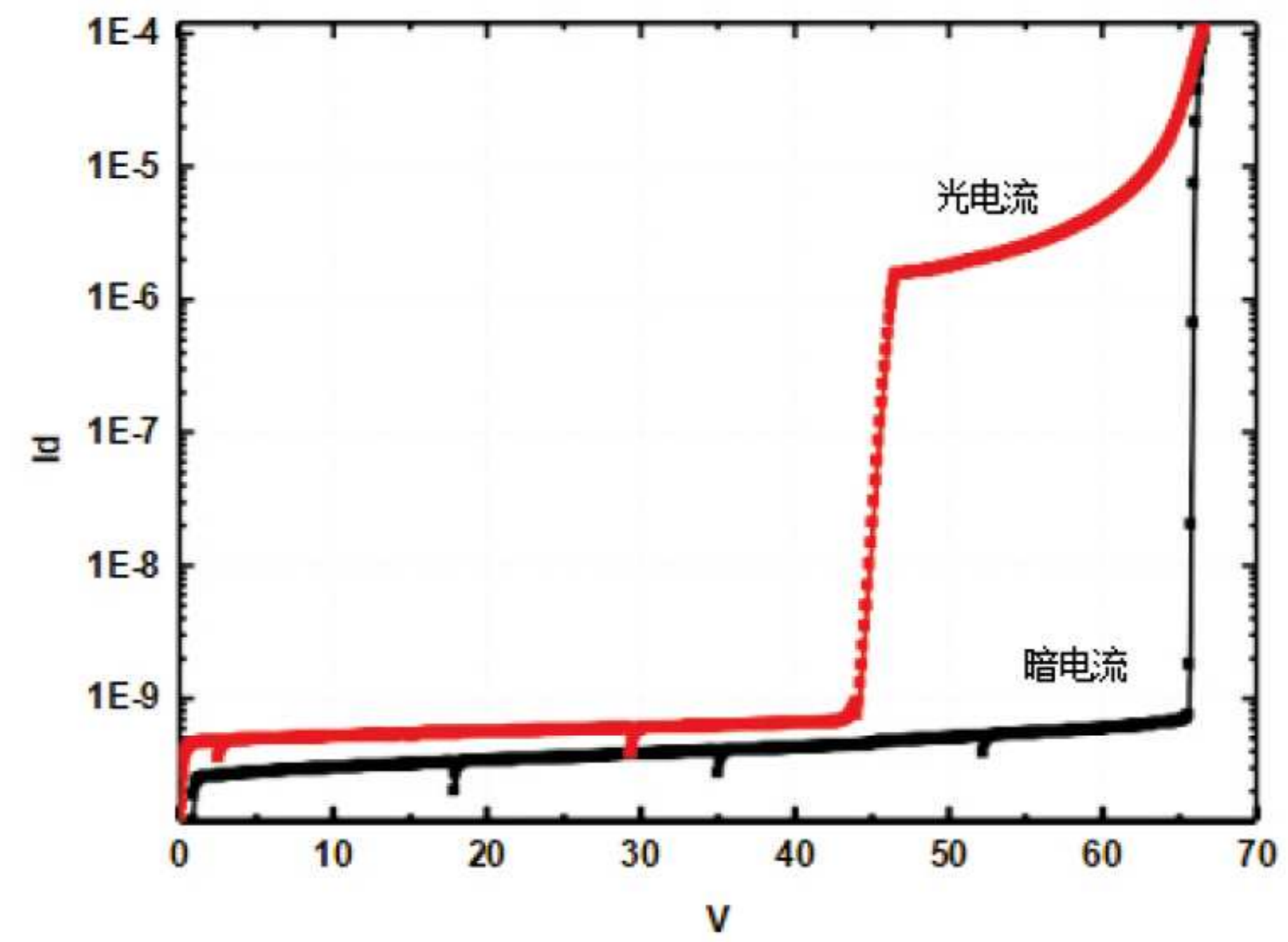


Fig. 2 Photocurrent/dark current curve

### Shape, Dimensions and Pinout Definitions (in mm)

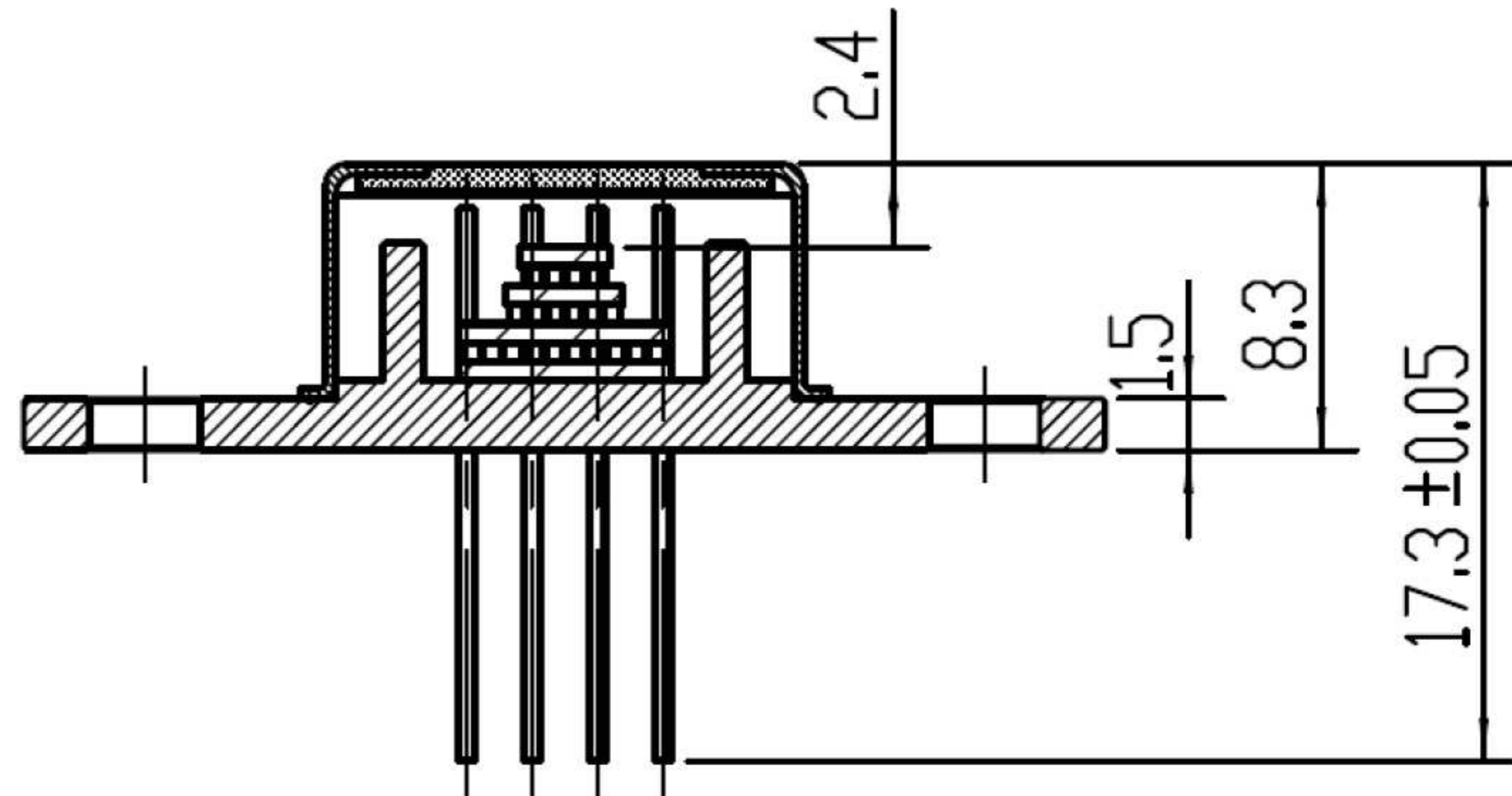
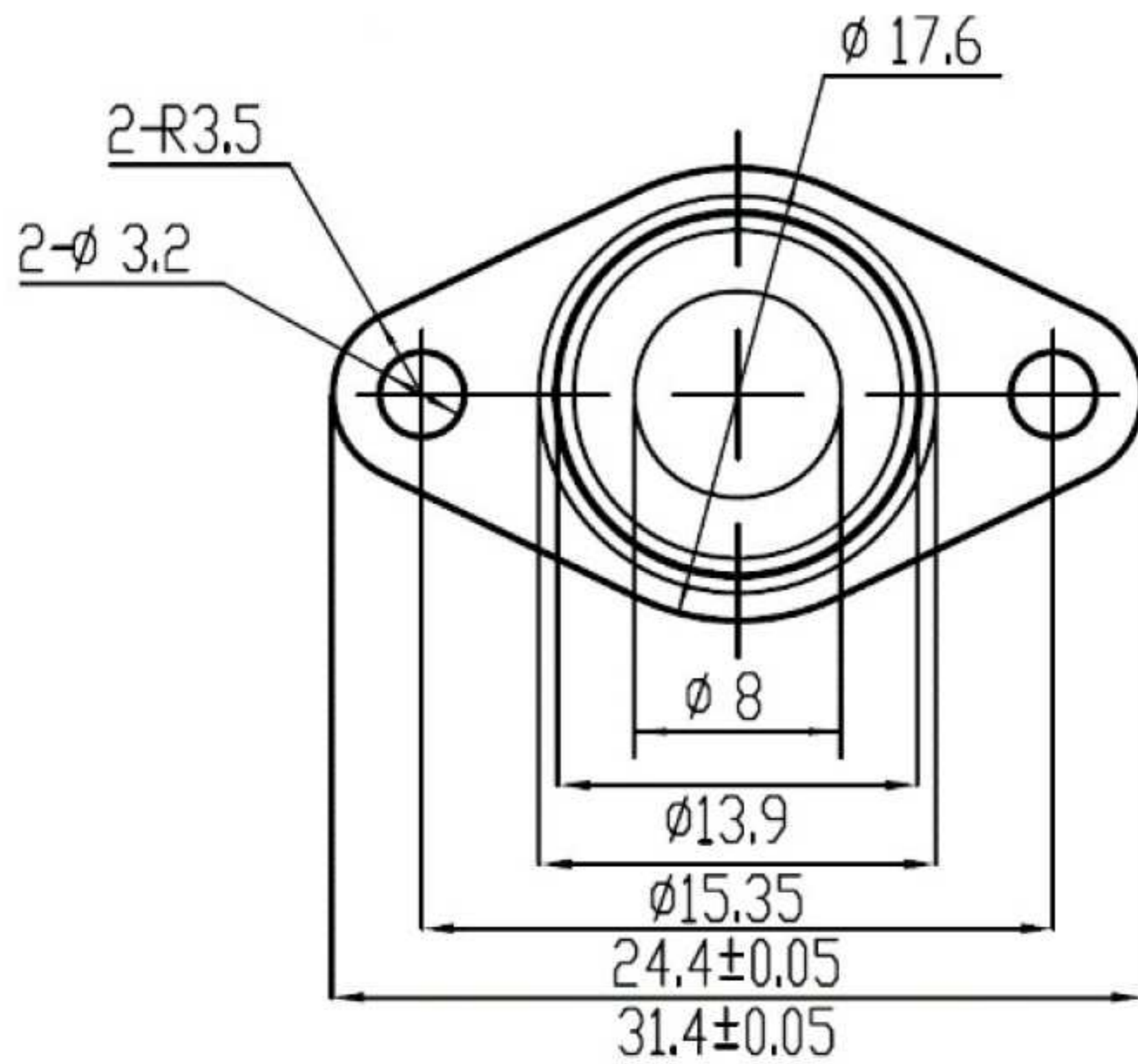


Fig. 3 External Dimensions 1 (Unmarked dimension tolerance  $\pm 0.1$  mm)

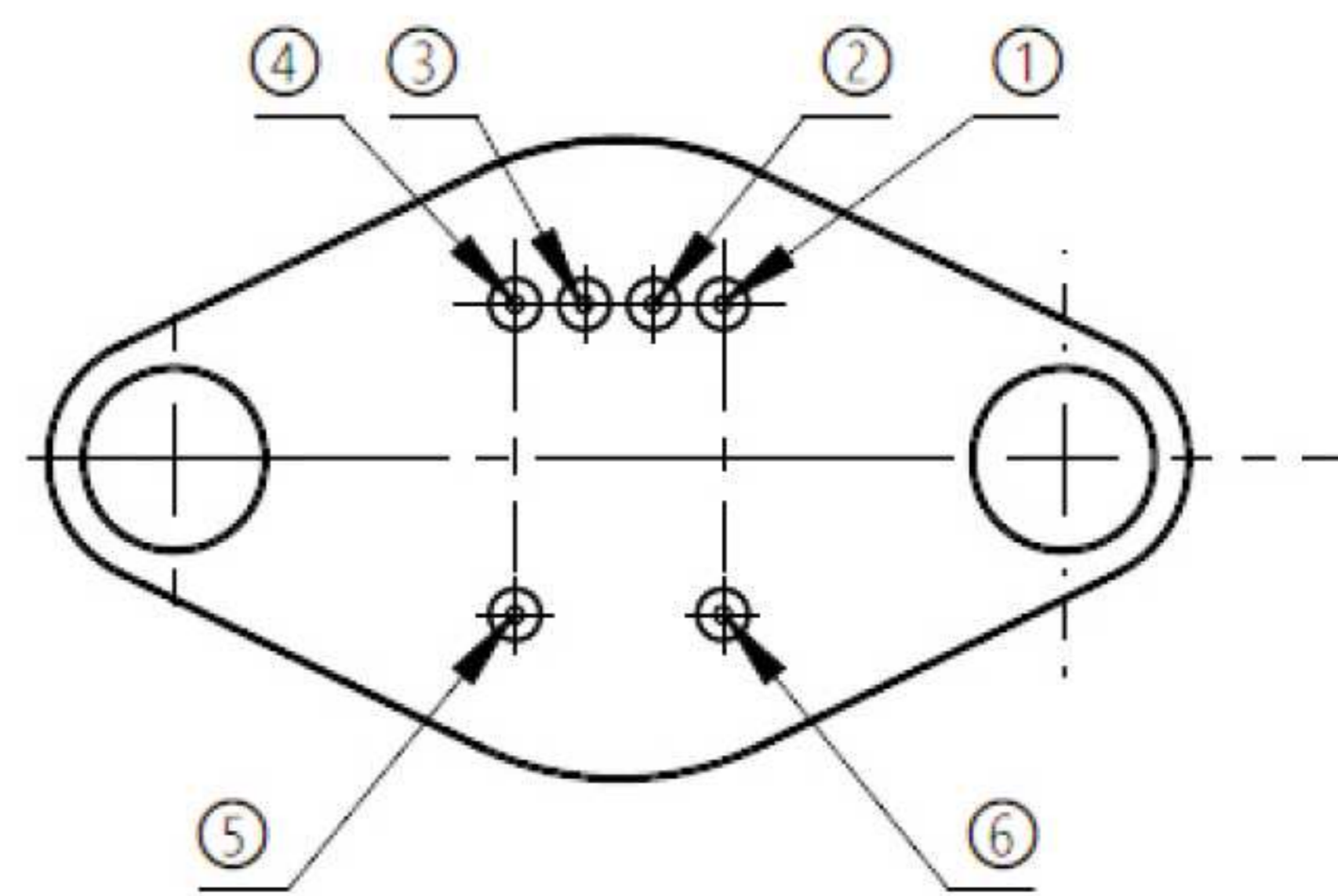
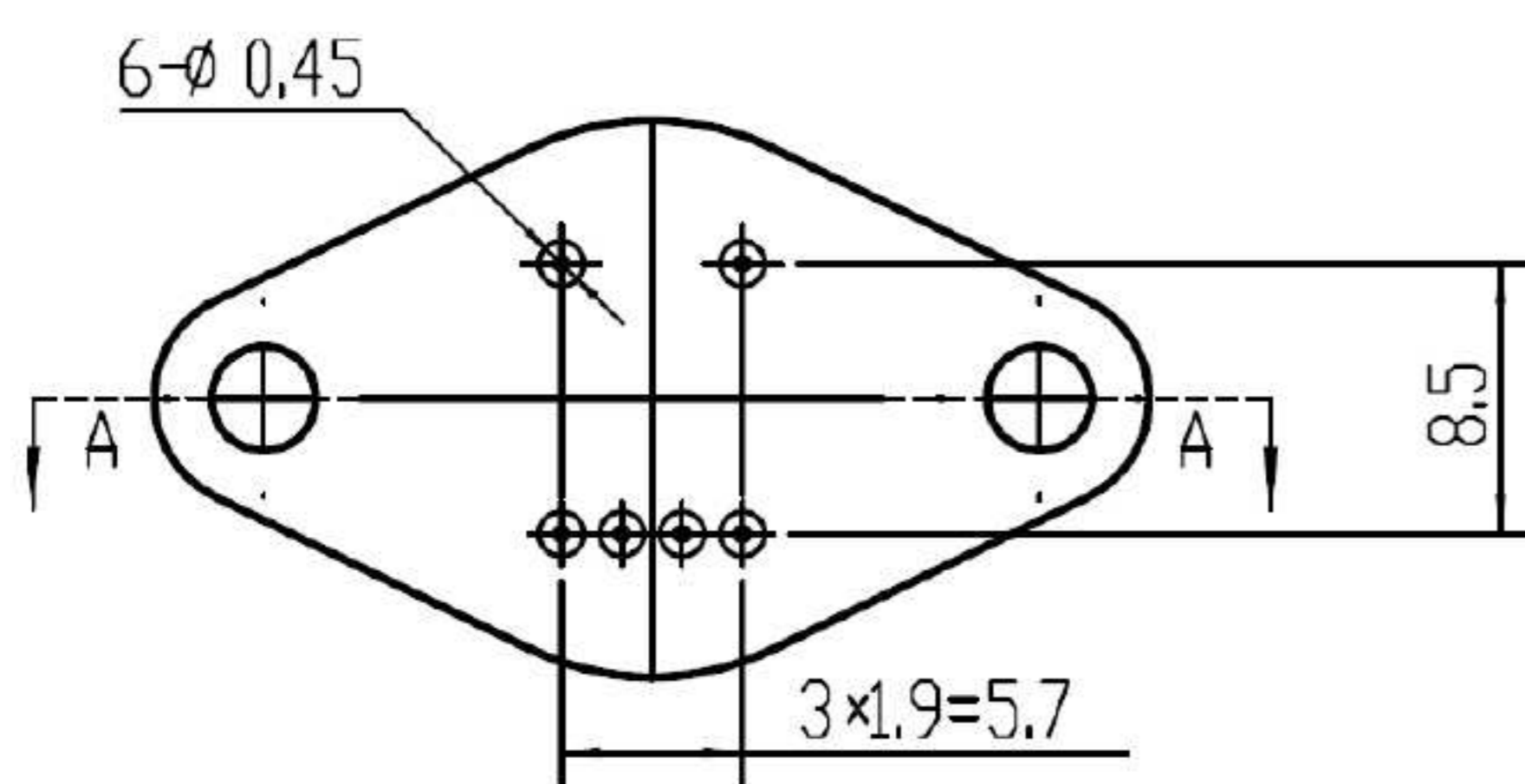
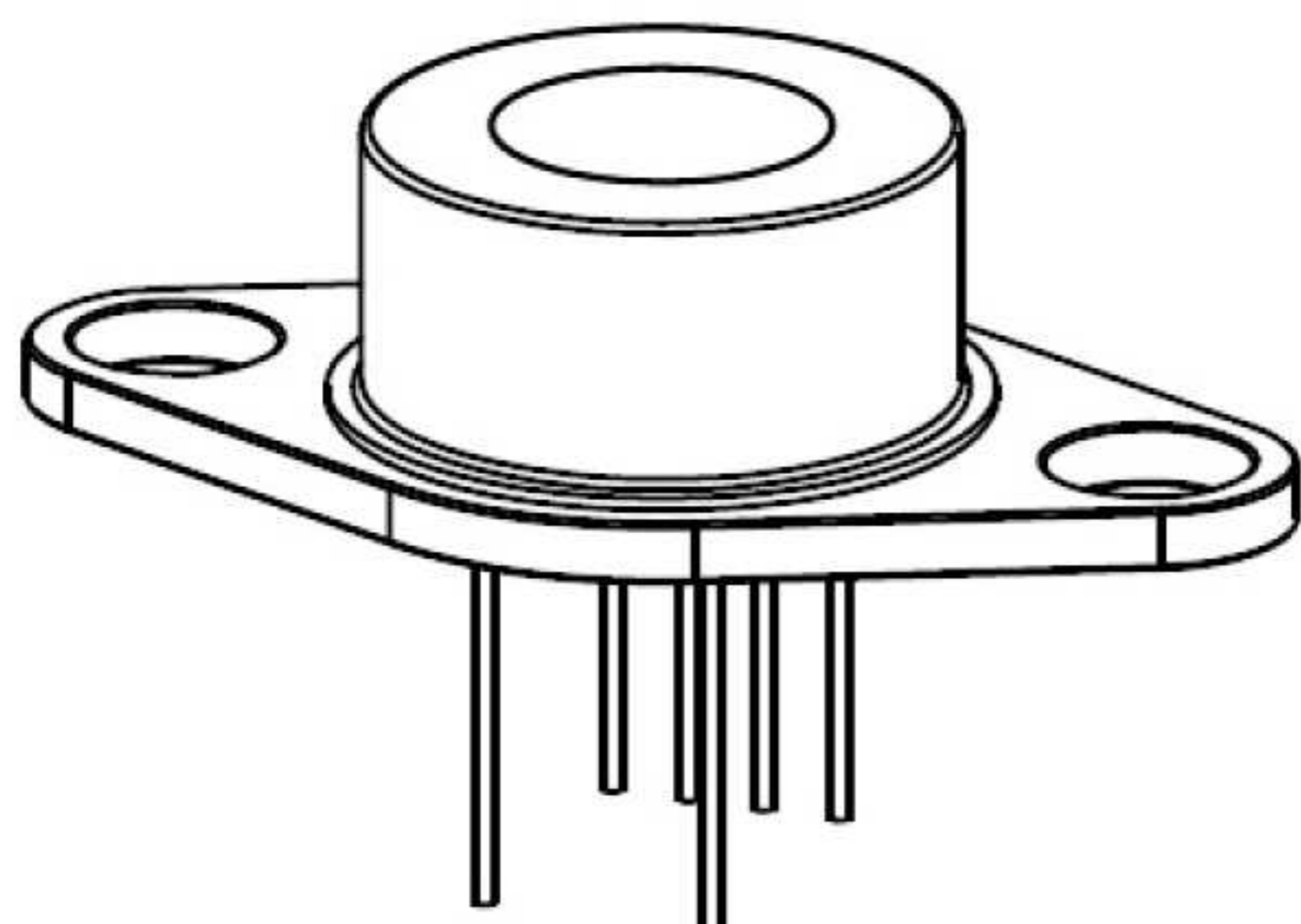


Fig. 4 External Dimensions 2 (Unmarked dimension tolerance  $\pm 0.1$  mm)



NO.	Pin Definitions	Pin Function
1	TEC-	TEC Negative
2	NTC	Temperature Sensitive Resistor Terminal
3	NTC	Temperature Sensitive Resistor Terminal
4	TEC+	TEC Positive
5	APD-N	Avalanche Photodiode Negative
6	APD-P	Avalanche Photodiode Positive

#### TEC\NTC Electrical Characteristics

NTC(Negative Temperature Coefficient) :  $R_T = 10k\Omega@25^\circ C$ ,  $\beta = 3450$ , 5%。

TEC(Thermoelectric cooler) :  $I_{MAX} = 1.0 A$ ,  $V_{MAX} = 6.8 V$ ,  $T_{HMAX} = 200^\circ C$ 。