

# PbS Photoconductive Detectors

## Easy-to-use photoconductive detectors with high responsivity over 3 $\mu\text{m}$

### ● Operates at room temperature

Since PbS cells operate stably at room temperature, they are used in a wide range of applications such as radiation thermometers and flame monitors. (Cooled types are also available for precision photometry.)

### ● High responsivity

### ● Lower temperature detection limit: Approx. 100 °C

PbS cells make use of the photoconductive effect by which the electrical resistance decreases with application of infrared radiation

### Noncooled Types

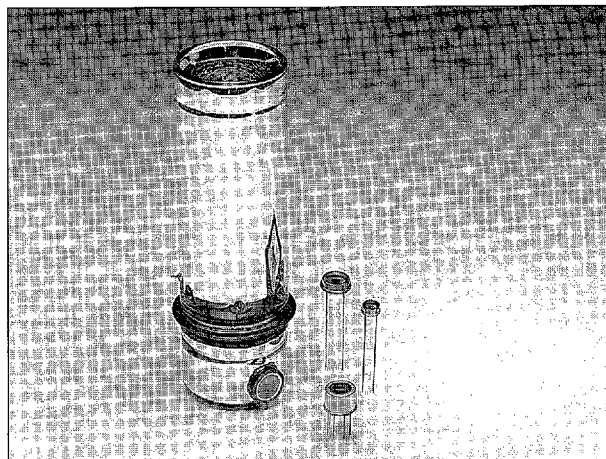
These devices can stably operate at room temperature, making them easy to use in diverse fields.

### Multielement Types

Multielement types are provided as standard items.

### ● SPECIFICATIONS (Common)

|                                   |                                                                        |
|-----------------------------------|------------------------------------------------------------------------|
| Peak wavelength                   | 2.2 $\mu\text{m}$ (element temperature 25 °C)                          |
| Cutoff Wavelength                 | 2.9 $\mu\text{m}$ (element temperature 25 °C)                          |
| Window Material                   | Borosilicate glass<br>Sapphire glass (P2682 series, P5168)             |
| Thermistor Allowable Dissipation  | 0.2 mW                                                                 |
| Peltier Element Allowable Current | 1.5 A (one-stage TE-cooled types)<br>1.0 A (two-stage TE-cooled types) |
| Maximum Supply Voltage            | 100 V                                                                  |



### Cooled Types

Thermoelectrically-cooled devices and glass dewar devices are available. Cooling a PbS cells enhances the responsivity and improves the S/N ratio, thus cooled types are widely used in precision photometry for applications such as in analytical instruments.

|                       |               |
|-----------------------|---------------|
| Operating Temperature | -30 to +50 °C |
| Storage Temperature   | -55 to +50 °C |

### ● ACCESSORIES (Optional)

Heatsink for one-stage TE-cooled types : A3179  
Heatsink for two-stage TE-cooled types : A3179-01  
Temperature controller for TE-cooled types : C1103-04  
Preamplifier for PbS/PbSe cells : C3757-02  
Housing for glass dewar devices : A3262-02  
(Dewar devices are available potted in the housing upon request.)

(Typical data unless otherwise specified)

| Type No. | Outline No.<br>(P.34-36) | Package | Active Area<br>(mm) | Element Temperature<br>(°C) | Photo Sensitivity S<br>$\lambda = \lambda_p$<br>$V_s = 15 \text{ V}$<br>(V/W) | Signal<br>A       |                   | Noise B N D* (500, 600, 1) |                   |                                                  |                                                  | D*<br>( $\lambda_p, 600, 1$ )<br>( $\text{cm} \cdot \text{Hz}^{1/2} / \text{W}$ ) | Rise Time<br>$t_r$<br>0 to 63 %<br>( $\mu\text{s}$ ) | Dark Resistance<br>$R_d$<br>(M $\Omega$ ) |
|----------|--------------------------|---------|---------------------|-----------------------------|-------------------------------------------------------------------------------|-------------------|-------------------|----------------------------|-------------------|--------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------|
|          |                          |         |                     |                             |                                                                               | Min.              | Typ.              | Typ.                       | Max.              | Min.                                             | Typ.                                             |                                                                                   |                                                      |                                           |
|          |                          |         |                     |                             |                                                                               | ( $\mu\text{V}$ ) | ( $\mu\text{V}$ ) | ( $\mu\text{V}$ )          | ( $\mu\text{V}$ ) | ( $\text{cm} \cdot \text{Hz}^{1/2} / \text{W}$ ) | ( $\text{cm} \cdot \text{Hz}^{1/2} / \text{W}$ ) |                                                                                   |                                                      |                                           |

### Noncooled Types

|          |    |            |                      |    |                     |      |      |   |   |                   |                   |                    |           |            |
|----------|----|------------|----------------------|----|---------------------|------|------|---|---|-------------------|-------------------|--------------------|-----------|------------|
| P394     | 15 | 2-pin TO-5 | 1×5                  | 25 | 1×10 <sup>5</sup>   | 100  | 250  | 2 | 4 | 5×10 <sup>8</sup> | 1×10 <sup>9</sup> | 1×10 <sup>11</sup> | 50 to 200 | 0.1 to 1   |
| P394A    |    | 2-pin TO-5 | 2×5                  | 25 | 5×10 <sup>4</sup>   | 100  | 250  | 2 | 4 | 5×10 <sup>8</sup> | 1×10 <sup>9</sup> | 1×10 <sup>11</sup> | 50 to 200 | 0.1 to 1.5 |
| P3258-02 | 16 | 2-pin TO-5 | 2×2                  | 25 | 1×10 <sup>5</sup>   | 100  | 250  | 2 | 4 | 5×10 <sup>8</sup> | 1×10 <sup>9</sup> | 1×10 <sup>11</sup> | 50 to 200 | 0.5 to 2.5 |
| P3258-03 |    | 2-pin TO-5 | 3×3                  | 25 | 5×10 <sup>4</sup>   | 100  | 250  | 2 | 4 | 5×10 <sup>8</sup> | 1×10 <sup>9</sup> | 1×10 <sup>11</sup> | 50 to 200 | 0.5 to 2.5 |
| P3226-02 | 17 | 2-pin TO-5 | 1.5×1.5 <sup>Ⓒ</sup> | 25 | 1.5×10 <sup>5</sup> | 1500 | 2000 | 2 | 4 | 5×10 <sup>8</sup> | 1×10 <sup>9</sup> | 1×10 <sup>11</sup> | 50 to 200 | 0.3 to 2   |
| P397     | 18 | 2-pin TO-8 | 4×5                  | 25 | 3×10 <sup>4</sup>   | 100  | 250  | 2 | 4 | 2×10 <sup>8</sup> | 5×10 <sup>8</sup> | 5×10 <sup>10</sup> | 50 to 200 | 0.3 to 2   |

### One-stage Thermoelectrically-cooled Types

|          |   |            |     |     |                   |     |     |   |   |                   |                   |                    |            |           |
|----------|---|------------|-----|-----|-------------------|-----|-----|---|---|-------------------|-------------------|--------------------|------------|-----------|
| P2532    | 4 | 6-pin TO-8 | 1×3 | -10 | 6×10 <sup>5</sup> | 300 | 750 | 4 | 8 | 1×10 <sup>9</sup> | 2×10 <sup>9</sup> | 2×10 <sup>11</sup> | 200 to 600 | 0.3 to 5  |
| P2532-01 |   | 6-pin TO-8 | 4×5 | -10 | 9×10 <sup>4</sup> | 300 | 750 | 4 | 8 | 5×10 <sup>8</sup> | 1×10 <sup>9</sup> | 1×10 <sup>11</sup> | 200 to 600 | 0.5 to 10 |

### Two-stage Thermoelectrically-cooled Types

|          |   |            |     |     |                   |     |      |   |    |                   |                   |                    |            |         |
|----------|---|------------|-----|-----|-------------------|-----|------|---|----|-------------------|-------------------|--------------------|------------|---------|
| P2682    | 5 | 6-pin TO-8 | 1×3 | -20 | 1×10 <sup>6</sup> | 600 | 1500 | 5 | 10 | 2×10 <sup>9</sup> | 4×10 <sup>9</sup> | 4×10 <sup>11</sup> | 200 to 600 | 1 to 10 |
| P2682-01 |   | 6-pin TO-8 | 4×5 | -20 | 2×10 <sup>5</sup> | 600 | 1500 | 5 | 10 | 8×10 <sup>8</sup> | 2×10 <sup>9</sup> | 2×10 <sup>11</sup> | 200 to 600 | 1 to 10 |

### Glass Dewar Types

|                    |    |             |      |     |                   |       |       |   |   |                    |                    |                    |              |           |
|--------------------|----|-------------|------|-----|-------------------|-------|-------|---|---|--------------------|--------------------|--------------------|--------------|-----------|
| P5168 <sup>Ⓓ</sup> | 14 | Glass dewar | 2×10 | -77 | 1×10 <sup>6</sup> | 10000 | 20000 | 3 | 6 | 1×10 <sup>10</sup> | 2×10 <sup>10</sup> | 1×10 <sup>12</sup> | 2 to 10 (ms) | 0.5 to 10 |
|--------------------|----|-------------|------|-----|-------------------|-------|-------|---|---|--------------------|--------------------|--------------------|--------------|-----------|

Ⓐ Light source : 500 K blackbody

Chopping frequency : 600 Hz

Supply Voltage : 15 V

Load resistance : Nearly equal to the element dark resistance.

Incident energy : 4.8  $\mu\text{W}/\text{cm}^2$

Ⓑ Chopping frequency : 600 Hz

Noise bandwidth : 60 Hz

Load resistance : Nearly equal to the element dark resistance.

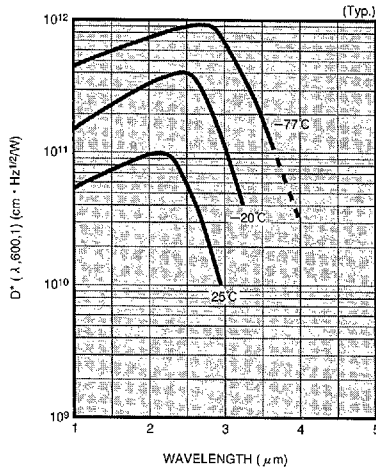
Ⓒ Lens window

Ⓓ Chopping frequency : 100 Hz

Noise bandwidth : 10 Hz

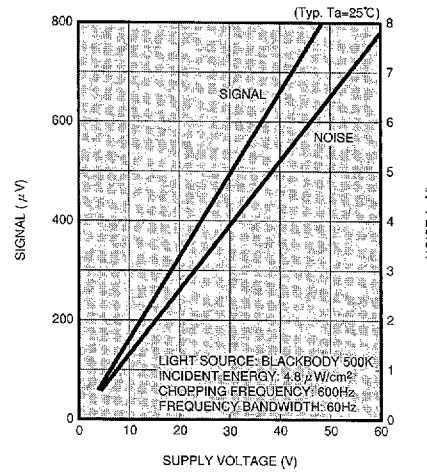
# Spectral Response 1.0 to 3.6 $\mu\text{m}$

## • Spectral Response



KIRDB0045EA

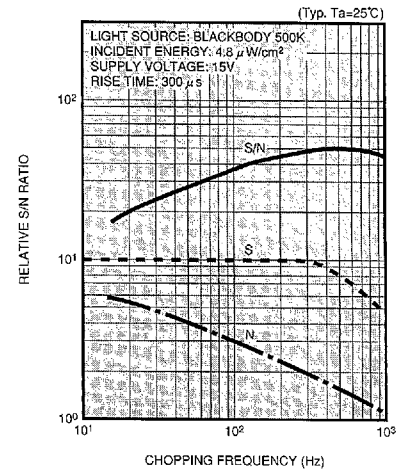
## • S/N Ratio vs. Supply Voltage



KIRDB0046EA

If a voltage higher than 60 V is applied, the noise increases exponentially, degrading the S/N ratio. The device should be operated at 60 V or less.

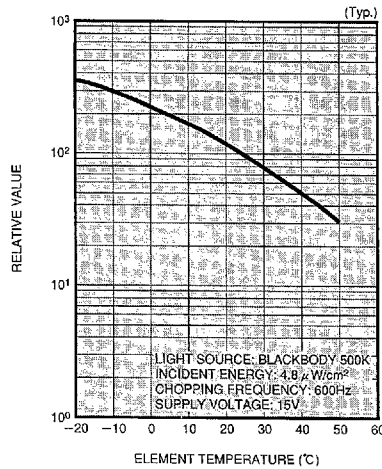
## • S/N Ratio vs. Chopping Frequency



KIRDB0047EA

Increasing the chopping frequency reduces the  $1/f$  noise and results in an improved S/N ratio. The S/N ratio can also be improved by narrowing the noise bandwidth using a lock-in amplifier.

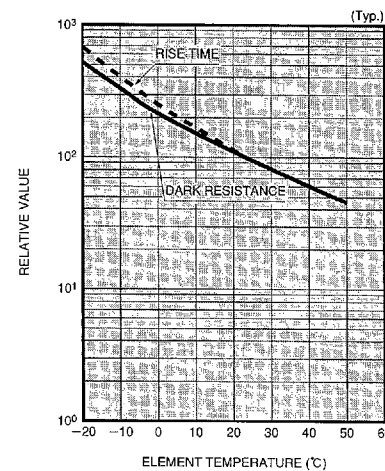
## • Responsivity vs. Temperature



KIRDB0048EA

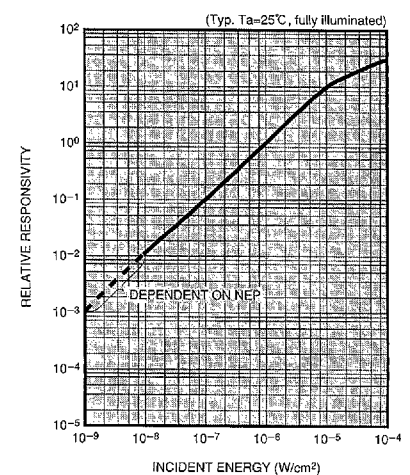
Cooling the device enhances its responsivity. But the responsivity also depends on the load resistance in the circuit.

## • Dark Resistance, Rise Time vs. Temperature



KIRDB0049EA

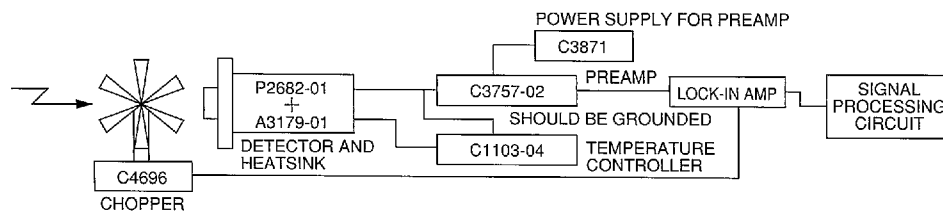
## • Linearity



KIRDB0050EA

When making the incident light spot is smaller than the active area, the upper limit of the linearity becomes lower.

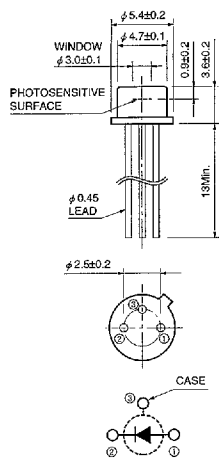
## • Connection Example



KIRDB0050EA

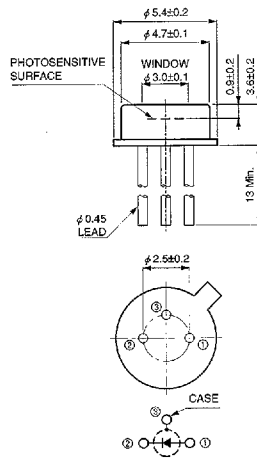
# Dimensional Outlines (Unit: mm)

## ① G3476-01, etc.



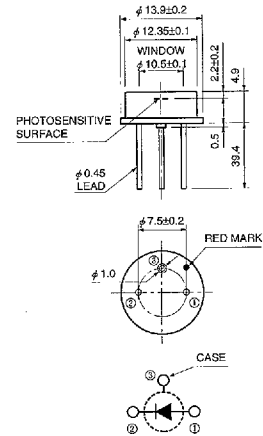
KIRDA0034EA

## ② G5832-02, -03



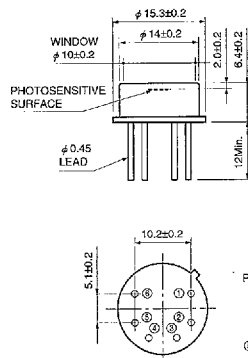
KIRDA0002EB

## ③ G5832-05, etc.



KIRDA00052EA

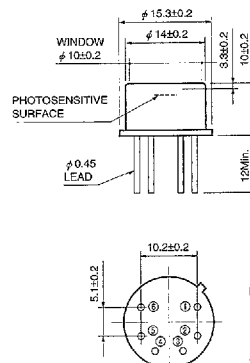
## ④ G5832-11, etc.



PIN No.  
① DETECTOR (ANODE)  
② DETECTOR (CATHODE)  
③ COOLER (-)  
④ COOLER (+)  
⑤ THERMISTOR

KIRDA0028EB

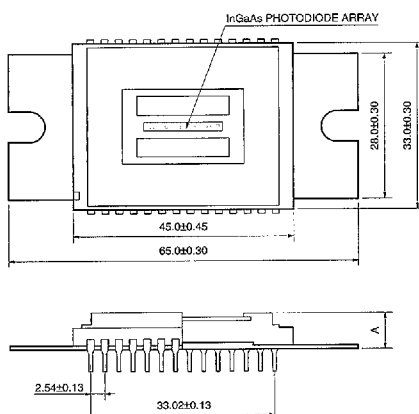
## ⑤ G5832-21, etc.



PIN No.  
① DETECTOR (ANODE)  
② DETECTOR (CATHODE)  
③ COOLER (-)  
④ COOLER (+)  
⑤ THERMISTOR

KIRDA0031EB

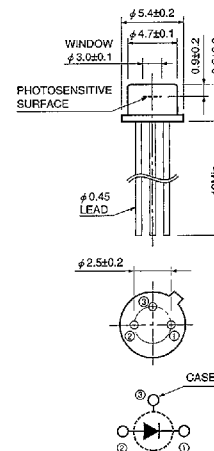
## ⑥ G6890-128, etc.



G6890 SERIES A=7.06±0.70  
G6891 SERIES A=11.05±1.10 (2-stage TE-cooled)  
G6893 SERIES A=11.05±1.10 (2-stage TE-cooled)  
A=17.15±1.70 (3-stage TE-cooled)

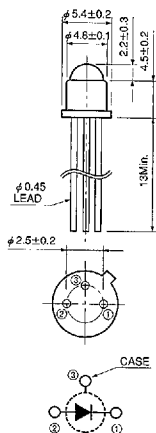
KMIFA0007EA

## ⑦ B1720-02, etc.



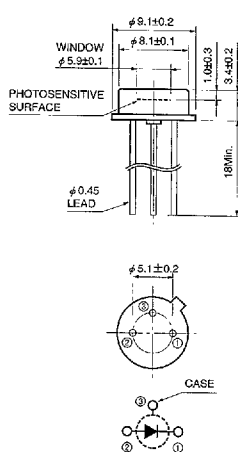
KIRDA0023EA

### 8 B1720-05



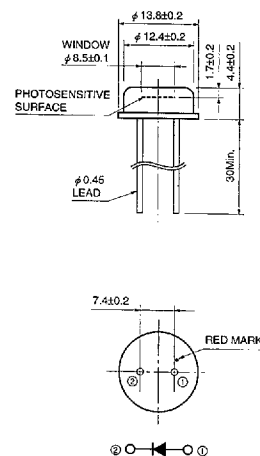
KIRDA0024EA

### 9 B2144-01, etc.



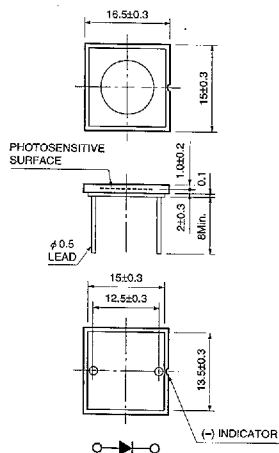
KIRDA0025EA

### 10 B1919-01



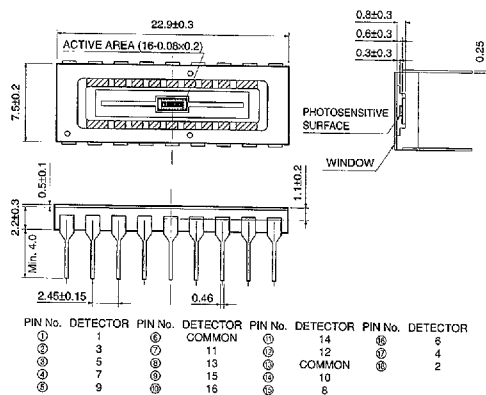
KIRDA0026EA

### 11 B1920-01



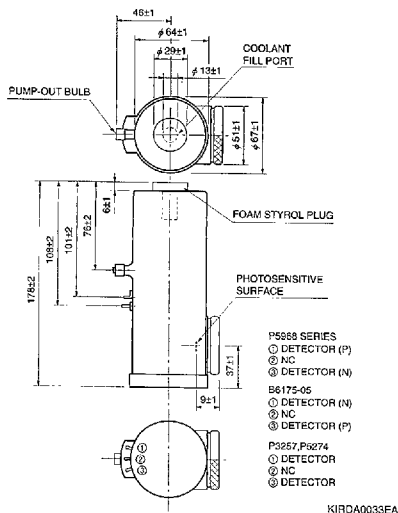
KIRDA0027EB

### 12 G7151-16



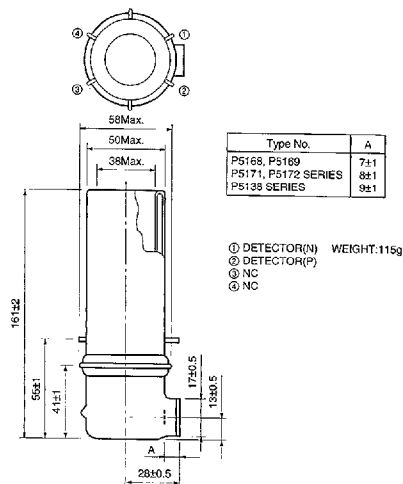
KIRDA0030EB

### 13 P5968 series, P7163, B6175-05, etc.



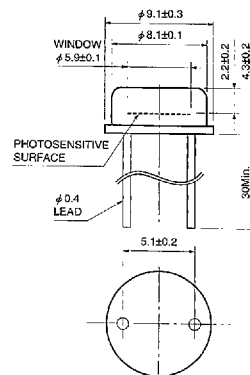
KIRDA0033EA

### 14 P5138, etc.



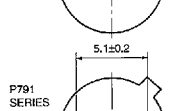
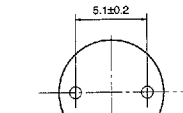
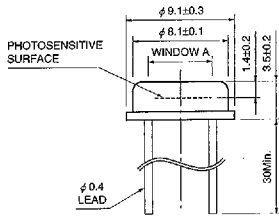
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### 15 P394



KIRDA0055EA

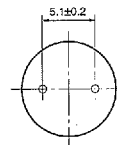
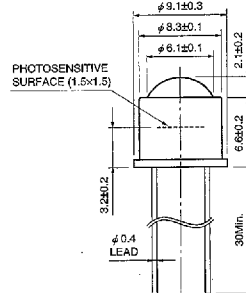
# 16 P394A, etc.



|   | P791 SERIES | OTHERS  |
|---|-------------|---------|
| A | 5.5±0.1     | 5.9±0.1 |

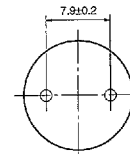
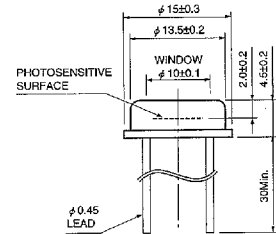
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# 17 P3226-02



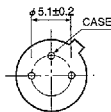
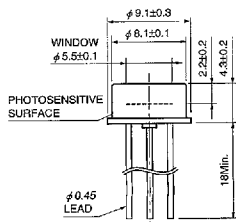
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# 18 P397



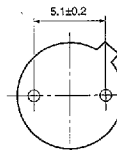
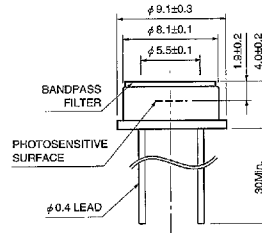
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# 19 P791-11



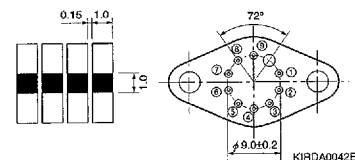
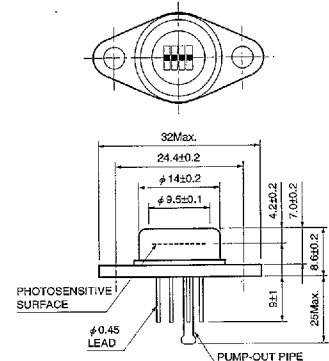
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# 20 P3207-04



KIRDA0054EA

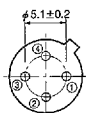
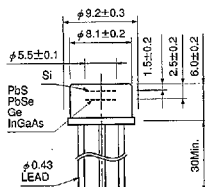
# 21 P4115



PIN No.  
① THERMISTOR  
② 1  
③ 2  
④ 3  
⑤ 4  
⑥ COMMON  
⑦ COOLER (-)  
⑧ COOLER (+)

KIRDA0042EC

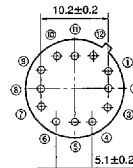
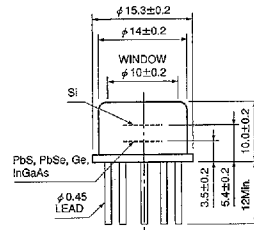
# 22 K1713-01, etc.



PIN No.  
① Si (N)  
② Si (P)  
③ PbS, PbSe, Ge, InGaAs (N)  
④ PbS, PbSe, Ge, InGaAs (P)

KIRDA0041EA

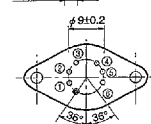
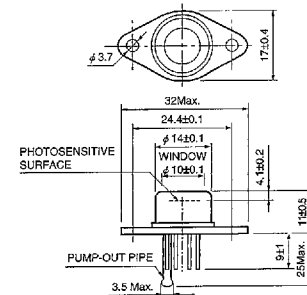
# 23 K3413-01, etc.



PIN No.  
① PbS, PbSe, Ge, InGaAs (P)  
② PbS, PbSe, Ge, InGaAs (N)  
③ COOLER (-)  
④ COOLER (+)  
⑤ THERMISTOR  
⑥ Si (N)  
⑦ Si (P)

KIRDA0043EA

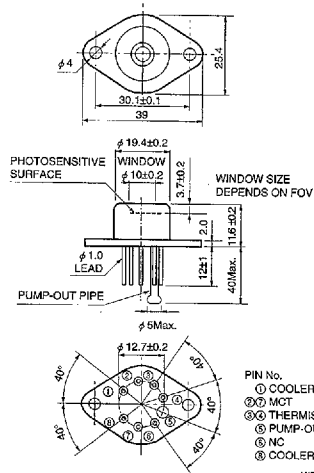
# 24 P3981-01, etc.



PIN No.  
① THERMISTOR  
② THERMISTOR  
③ DETECTOR  
④ DETECTOR  
⑤ COOLER (-)  
⑥ COOLER (+)

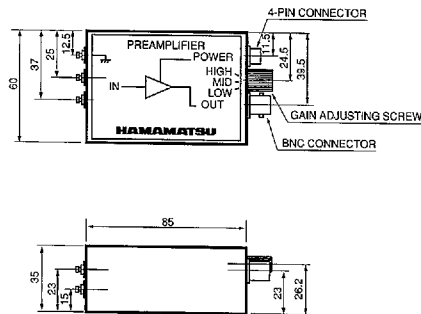
KIRDA0044EB

25 P2750, etc.



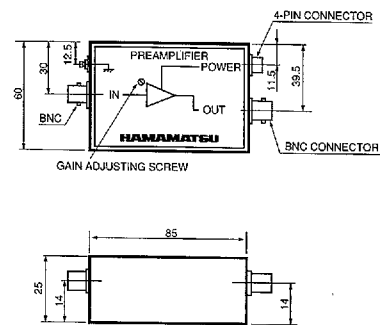
KIRDA0045EB

26 C4159, -01, -03



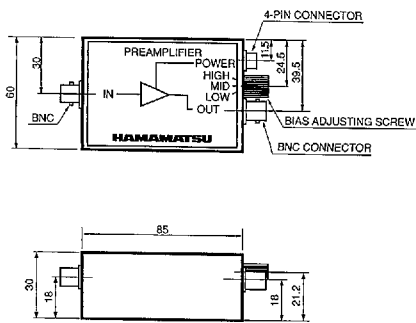
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27 C4159-02



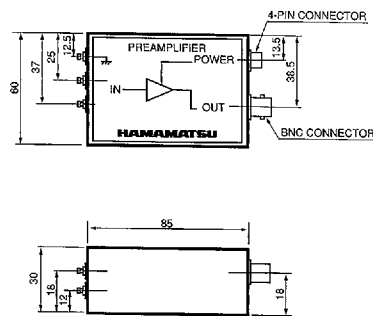
KIRDA0047EA

28 C5185, -01



KIRDA0048EB

29 C3757-02



KIRDA0049EA