

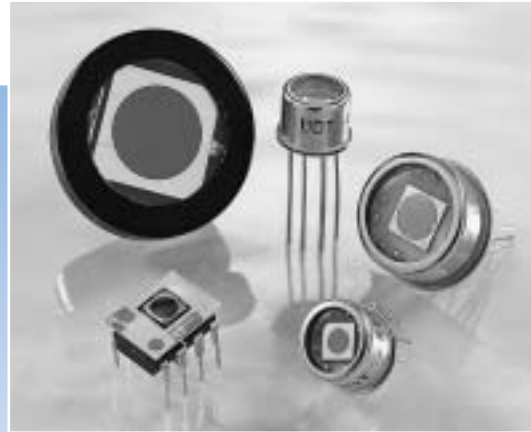
# Photops™

## Photodiode-Amplifier Hybrids

The Photop™ Series, combines a photodiode with an operational amplifier in the same package. Photops™ general-purpose detectors have a spectral range from either 350 nm to 1100 nm or 200 nm to 1100nm. They have an integrated package ensuring low noise output under a variety of operating conditions. These op-amps are specifically selected by UDT Sensors engineers for compatibility to our photodiodes.

Among many of these specific parameters are low noise, low drift and capability of supporting a variety of gains and bandwidths determined by the external feedback components. Operation from DC level to several MHz is possible in an either unbiased configuration for low speed, low drift applications or biased for faster response time. LN-Series Photops™ are to be used with OV-bias.

Any modification of the above devices is possible. The modifications can be simply adding a bandpass optical filter, integration of additional chip (hybrid) components inside the same package, utilizing a different op-amp, photodetector replacement, modified package design and / or mount on PCB or ceramic. For your specific requirements, contact one of our Applications Engineers.



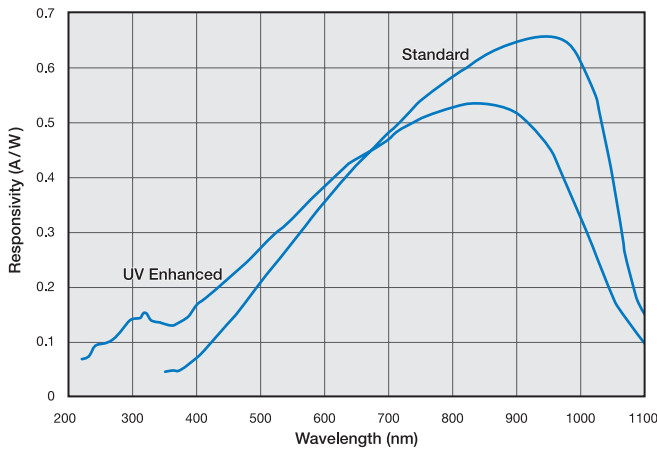
### ■ APPLICATIONS

- General Purpose Light Detection
- Laser Power Monitoring
- Medical Analysis
- Laser Communications
- Bar Code Readers
- Industrial Control Sensors
- Pollution Monitoring
- Guidance Systems
- Colorimeter

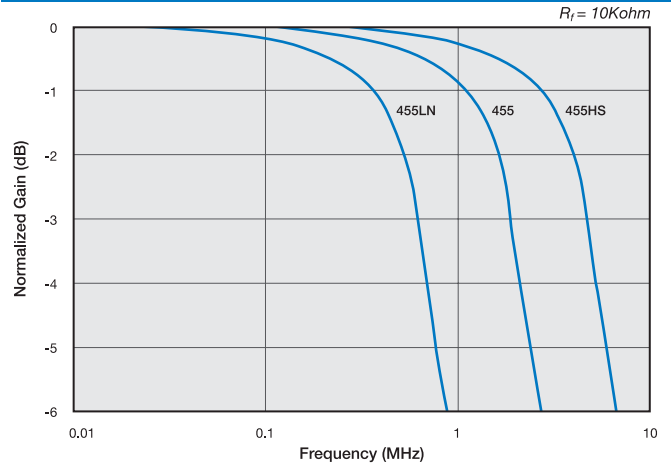
### ■ FEATURES

- Detector/Amplifier Combined
- Adjustable Gain/Bandwidth
- Low Noise
- Wide Bandwidth
- DIP Package
- Large Active Area

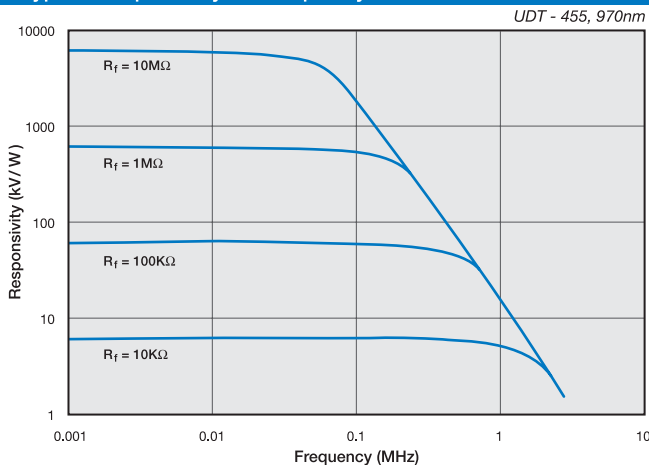
### ■ Typical Spectral Response



### ■ Typical Gain vs. Frequency



### ■ Typical Responsivity vs. Frequency



## ■ Photops™ (Photodiode Specifications)

Typical Electro-Optical Specifications at T<sub>A</sub>=23°C

Model Number	Active Area		Responsivity (A/W)				Capacitance (pF)		Dark Current (nA)		Shunt Resistance (MΩ)	NEP (W/√Hz)		Reverse Voltage	Temp.* Range (°C)		Package Style †			
	Area (mm <sup>2</sup> )	Dimension (mm)	254 nm		970 nm		0 V	-10 V	-10 V		-10 mV	0 V 254 nm	-10V 970 nm	V	Operating	Storage				
			min.	typ.	min.	typ.	typ.	typ.	typ.	max.	typ.	typ.	max.							
<b>350-1100 nm Spectral Range</b>																				
UDT-451	5.1	2.54 φ	---	0.60	0.65	85	15	0.25	3	---	---	1.4 e- 14	30**	0 ~ +70	-30 ~ +100	29 / DIP				
UDT-455																30 / TO-5				
UDT-455LN**																31 / TO-8				
UDT-455HS																				
UDT-020D	16	4.57 φ	0.10	0.14	---	330	60	0.5	10	---	---	1.9 e- 14	5**	32 / Special						
UDT-555D	100	11.3 φ				1500	300	2	25			3.9 e- 14								
<b>200-1100 nm Spectral Range</b>																				
UDT-455UV	5.1	2.54 φ	0.10	0.14	---	300	---	---	---	100	9.2 e- 14	---	5**	0 ~ +70	-30 ~ +100	30 / TO-5				
UDT-455UV/LN**																31 / TO-8				
UDT-020UV																	16	4.57 φ	1000	50
UDT-055UV																50	7.98 φ	2500	20	2.1 e- 13
UDT-555UV	100	11.3 φ	0.10	0.14	---	4500	---	---	---	10	2.9 e- 13	---	5**	0 ~ +70	-30 ~ +100	32 / Special				
UDT-555UV/LN**																32 / Special				

## Operational Amplifier Specifications Typical Electro-Optical Specifications at T<sub>A</sub>=23 °C

Model Number	Supply Voltage (V)			Quiescent Supply Current (mA)		Input Offset Voltage		Temp. Coefficient Input Offset Voltage		Input Bias Current		Gain Bandwidth Product		Slew Rate		Open Loop Gain, DC		Input Noise Voltage		Input Noise Current
	min.	typ.	max.	typ.	max.	typ.	max.	typ.	max.	typ.	max.	min.	typ.	min.	typ.	min.	typ.	100 Hz	1 kHz	1 kHz
																		± 15 V	mV	µV / °C
UDT-451	---	±15	±18	1.4	2.5	3.0	6.0	10	---	30	200	---	4.0	---	13	50	150	---	18	10
UDT-455	---	±15	±18	2.8	5.0	0.5	3	4	30	±80	±400	3.0	5.4	5	9	50	200	20	15	10
UDT-455UV																				
UDT-020D																				
UDT-020UV																				
UDT-455HS	---	±15	±18	4.8	8.0	0.5	3	4	30	±80	±500	11	26	25	40	50	200	20	15	10
UDT-455LN**	±5	±15	±18	0.9	1.8	0.26	1	---	20	0.15	0.3	0.5	1	0.5	3	50	2500	78	27	0.22
UDT-455UV/LN**																				
UDT-055UV	---	±15	±22	2.7	4.0	0.4	1	3	10	±40	±200	3.5	5.7	7.5	11	75	220	20	15	10
UDT-555D																				
UDT-555UV																				

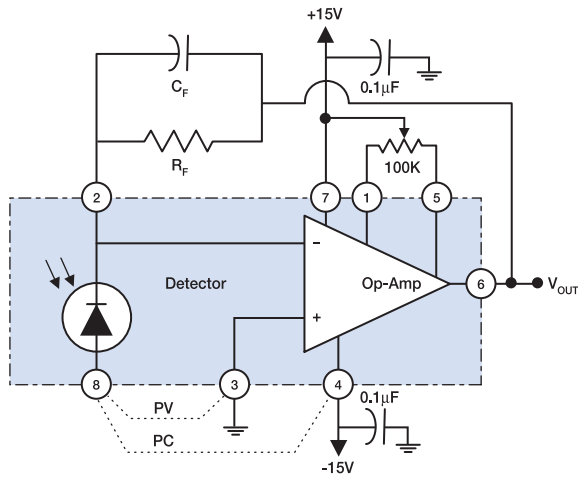
† For mechanical drawings please refer to pages 55 thru 66.

\*\* LN - Series Devices are to be used with a 0V Bias.

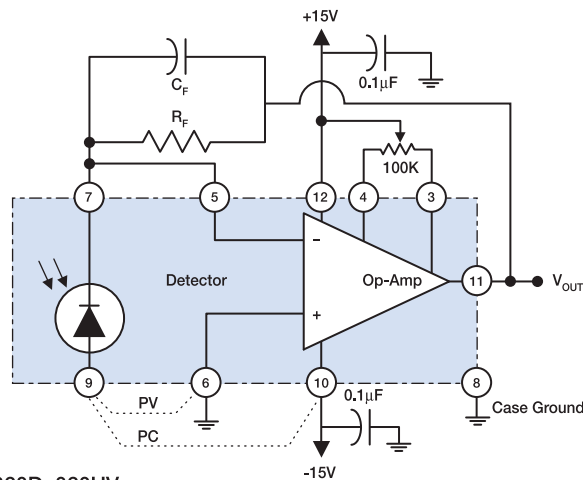
\* Non-Condensing temperature and Storage Range, Non-Condensing Environment.

## ■ Photop Series

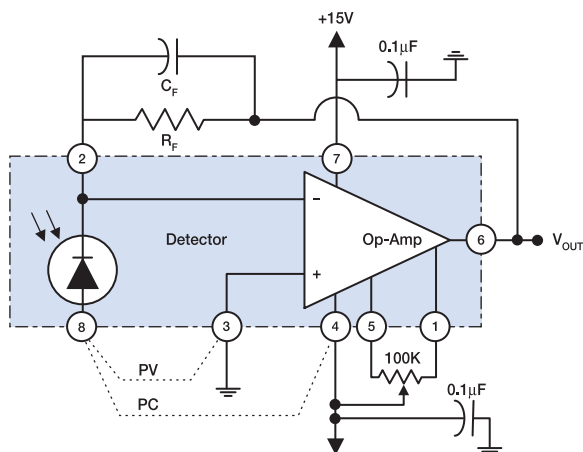
### Schematic Diagrams



UDT-455, 455HS  
UDT-555, 555UV, 055UV



UDT-020D, 020UV



UDT-451, 455LN, 455UV/LN  
UDT-555UV/LN

The output voltage is proportional to the light intensity of the light and is given by:

$$\begin{aligned} V_{OUT} &= I_P \times R_F \\ &= (P \times R_\lambda) \times R_F \end{aligned} \quad (1)$$

### Frequency Response (Photodiode/Amplifier Combination)

The frequency response of the photodiode / amplifier combination is determined by the characteristics of the photodiode, pre-amplifier as well as the feedback resistor ( $R_F$ ) and feedback capacitor ( $C_F$ ). For a known gain, ( $R_F$ ), the 3dB frequency response of the detector/pre-amp combination is given by:

$$f_{3dB} = \frac{1}{2\pi C_F R_F} \quad (2)$$

However, the desired frequency response is limited by the Gain Bandwidth Product (GBP) of the op-amp. In order to have a stable output, the values of the  $R_F$  and  $C_F$  must be chosen such that the 3dB frequency response of the detector / pre-amp combination, be less than the maximum frequency of the op-amp, i.e.  $f_{3dB} < f_{max}$ .

$$f_{max} = \sqrt{\frac{GBP}{2\pi R_F (C_F + C_J + C_A)}} \quad (3)$$

where  $C_A$  is the amplifier input capacitance.

In conclusion, an example for frequency response calculations, is given below. For a gain of  $10^8$ , an operating frequency of 100 Hz, and an op-amp with GBP of 5 MHz:

$$C_F = \frac{1}{2\pi f_{3dB} R_F} = 15.9pF \quad (4)$$

Thus, for  $C_F = 15.9$  pF,  $C_J = 15$  pF and  $C_A = 7$  pF,  $f_{max}$  is about 14.5 kHz. Hence, the circuit is stable since  $f_{3dB} < f_{max}$ .

For more detailed application specific discussions and further reading, refer to the APPLICATION NOTES INDEX in the catalog.

Note: The shaded boxes represent the Photop™ components and their connections. The components outside the boxes are typical recommended connections and components.

## ■ Photodiode Care and Handling Instructions

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### AVOID DIRECT LIGHT

Since the spectral response of silicon photodiode includes the visible light region, care must be taken to avoid photodiode exposure to high ambient light levels, particularly from tungsten sources or sunlight. During shipment from UDT Sensors, your photodiodes are packaged in opaque, padded containers to avoid ambient light exposure and damage due to shock from dropping or jarring.

### AVOID SHARP PHYSICAL SHOCK

Photodiodes can be rendered inoperable if dropped or sharply jarred. The wire bonds are delicate and can become separated from the photodiode's bonding pads when the detector is dropped or otherwise receives a sharp physical blow.

### CLEAN WINDOWS WITH OPTICAL GRADE CLOTH / TISSUE

Most windows on UDT Sensors photodiodes are either silicon or quartz. They should be cleaned with isopropyl alcohol and a soft (optical grade) pad.

### OBSERVE STORAGE TEMPERATURES AND HUMIDITY LEVELS

Photodiode exposure to extreme high or low storage temperatures can affect the subsequent performance of a silicon photodiode. Storage temperature guidelines are presented in the photodiode performance specifications of this catalog. Please maintain a non-condensing environment for optimum performance and lifetime.

### OBSERVE ELECTROSTATIC DISCHARGE (ESD) PRECAUTIONS

UDT Sensors photodiodes, especially with IC devices (e.g. Photops) are considered ESD sensitive. The photodiodes are shipped in ESD protective packaging. When unpacking and using these products, anti-ESD precautions should be observed.

### DO NOT EXPOSE PHOTODIODES TO HARSH CHEMICALS

Photodiode packages and/or operation may be impaired if exposed to CHLOROTHENE, THINNER, ACETONE, or TRICHLOROETHYLENE.

### INSTALL WITH CARE

Most photodiodes in this catalog are provided with wire or pin leads for installation in circuit boards or sockets. Observe the soldering temperatures and conditions specified below:

Soldering Iron:	Soldering 30 W or less Temperature at tip of iron 300°C or lower.
Dip Soldering:	Bath Temperature: 260±5°C. Immersion Time: within 5 Sec. Soldering Time: within 3 Sec.
Vapor Phase Soldering:	DO NOT USE
Reflow Soldering:	DO NOT USE

Photodiodes in plastic packages should be given special care. Clear plastic packages are more sensitive to environmental stress than those of black plastic. Storing devices in high humidity can present problems when soldering. Since the rapid heating during soldering stresses the wire bonds and can cause wire to bonding pad separation, it is recommended that devices in plastic packages to be baked for 24 hours at 85°C.

The leads on the photodiode **SHOULD NOT BE FORMED**. If your application requires lead spacing modification, please contact UDT Sensors Applications group at (310)978-0516 before forming a product's leads. Product warranties could be voided.

**1. Parameter Definitions:**

- A = Distance from top of chip to top of glass.
- a = Photodiode Anode.
- B = Distance from top of glass to bottom of case.
- c = Photodiode Cathode  
(Note: cathode is common to case in metal package products unless otherwise noted).
- W = Window Diameter.
- F.O.V. = Filed of View (see definition below).

**2. Dimensions are in inches (1 inch = 25.4 mm).**

**3. Pin diameters are 0.018 ± 0.002" unless otherwise specified.**

**4. Tolerances** (unless otherwise noted)

- General: 0.XX ±0.01"  
0.XXX ±0.005"
- Chip Centering: ±0.010"
- Dimension 'A': ±0.015"

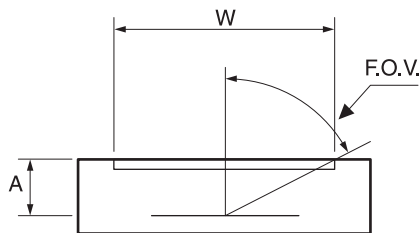
**5. Windows**

All 'UV' Enhanced products are provided with QUARTZ glass windows, 0.027 ± 0.002" thick.

All 'XUV' products are provided with removable windows.

All 'DLS' PSD products are provided with A/R coated glass windows.

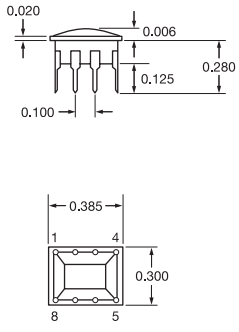
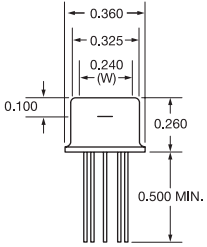
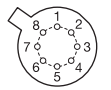
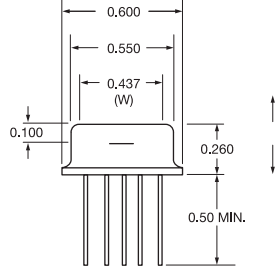
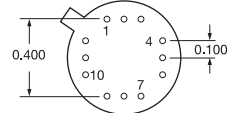
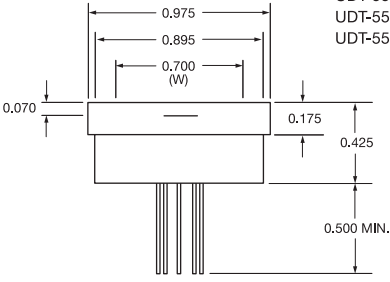
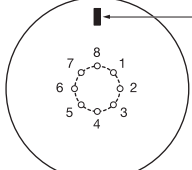
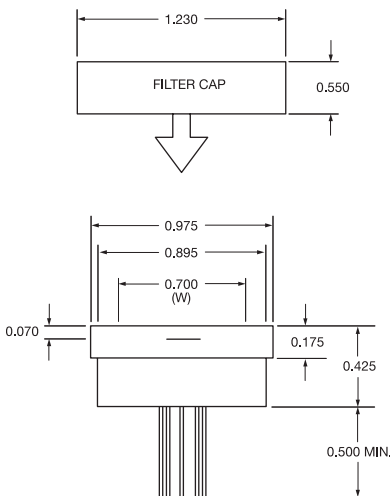
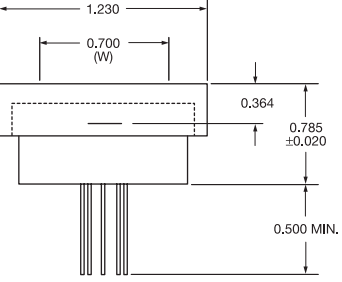
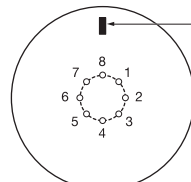
All 'FIL' photoconductive and photovoltaic products are epoxy filled instead of glass windows.



$$F.O.V. = \tan^{-1} \left( \frac{W}{2A} \right)$$

# Mechanical Specifications

All units in inches. Pinouts are bottom view.

29 8 PIN DIP	30 TO-5	31 TO-8																																																								
<p><b>Products:</b> UDT-451</p>  <p><b>Pinout</b></p> <table border="1"> <tr><td>1</td><td>Offset Null</td></tr> <tr><td>2</td><td>Inverting Input Detector Cathode</td></tr> <tr><td>3</td><td>Noninverting Input</td></tr> <tr><td>4</td><td>V (-)</td></tr> <tr><td>5</td><td>Offset Null</td></tr> <tr><td>6</td><td>Output</td></tr> <tr><td>7</td><td>V (+)</td></tr> <tr><td>8</td><td>Detector Anode</td></tr> </table>	1	Offset Null	2	Inverting Input Detector Cathode	3	Noninverting Input	4	V (-)	5	Offset Null	6	Output	7	V (+)	8	Detector Anode	<p><b>Products:</b> UDT-455 UDT-455HS UDT-455LN UDT-455UV UDT-455UV/LN</p>   <p>Pin Circle Dia.=0.23</p> <p><b>Pinout</b></p> <table border="1"> <tr><td>1</td><td>Offset Null</td></tr> <tr><td>2</td><td>Inverting Input Detector Cathode</td></tr> <tr><td>3</td><td>Noninverting Input</td></tr> <tr><td>4</td><td>V (-)</td></tr> <tr><td>5</td><td>Offset Null</td></tr> <tr><td>6</td><td>Output</td></tr> <tr><td>7</td><td>V (+)</td></tr> <tr><td>8</td><td>Detector Anode</td></tr> </table>	1	Offset Null	2	Inverting Input Detector Cathode	3	Noninverting Input	4	V (-)	5	Offset Null	6	Output	7	V (+)	8	Detector Anode	<p><b>Products:</b> UDT-020D UDT-020UV</p>   <p>Pin Circle Dia.=0.295</p> <p><b>Pinout</b></p> <table border="1"> <tr><td>1</td><td>Not Used</td></tr> <tr><td>2</td><td>Not Used</td></tr> <tr><td>3</td><td>Offset Null</td></tr> <tr><td>4</td><td>Offset Null</td></tr> <tr><td>5</td><td>Inverting Input</td></tr> <tr><td>6</td><td>Noninverting Input</td></tr> <tr><td>7</td><td>Detector Cathode</td></tr> <tr><td>8</td><td>Case Ground</td></tr> <tr><td>9</td><td>Detector Anode</td></tr> <tr><td>10</td><td>V (-)</td></tr> <tr><td>11</td><td>Output</td></tr> <tr><td>12</td><td>V (+)</td></tr> </table>	1	Not Used	2	Not Used	3	Offset Null	4	Offset Null	5	Inverting Input	6	Noninverting Input	7	Detector Cathode	8	Case Ground	9	Detector Anode	10	V (-)	11	Output	12	V (+)
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<p><b>32 Special</b></p> <p><b>Products:</b> UDT-055UV UDT-555D UDT-555UV UDT-555UV/LN</p>   <p>Pin Circle Dia.=0.230</p> <p>Pin 8 is designated by a printed mark on the bottom of case</p> <p><b>Pinout</b></p> <table border="1"> <tr><td>1</td><td>Offset Null</td></tr> <tr><td>2</td><td>Inverting Input Detector Cathode</td></tr> <tr><td>3</td><td>Noninverting Input</td></tr> <tr><td>4</td><td>V (-)</td></tr> <tr><td>5</td><td>Offset Null</td></tr> <tr><td>6</td><td>Output</td></tr> <tr><td>7</td><td>V (+)</td></tr> <tr><td>8</td><td>Detector Anode and Case</td></tr> </table>	1	Offset Null	2	Inverting Input Detector Cathode	3	Noninverting Input	4	V (-)	5	Offset Null	6	Output	7	V (+)	8	Detector Anode and Case	<p><b>33 Special</b></p> <p><b>Products:</b> UDT-555D</p>  <p><b>Pinout</b></p> <table border="1"> <tr><td>1</td><td>Offset Null</td></tr> <tr><td>2</td><td>Inverting Input Detector Cathode</td></tr> <tr><td>3</td><td>Noninverting Input</td></tr> <tr><td>4</td><td>V (-)</td></tr> <tr><td>5</td><td>Offset Null</td></tr> <tr><td>6</td><td>Output</td></tr> <tr><td>7</td><td>V (+)</td></tr> <tr><td>8</td><td>Detector Anode and Case</td></tr> </table>	1	Offset Null	2	Inverting Input Detector Cathode	3	Noninverting Input	4	V (-)	5	Offset Null	6	Output	7	V (+)	8	Detector Anode and Case	<p><b>Products:</b> PIN-555AP</p>   <p>Pin Circle Dia.=0.230</p> <p>Pin 8 is designated by a printed mark on the bottom of case</p> <p><b>Pinout</b></p> <table border="1"> <tr><td>1</td><td>Offset Null</td></tr> <tr><td>2</td><td>Inverting Input Detector Cathode</td></tr> <tr><td>3</td><td>Noninverting Input</td></tr> <tr><td>4</td><td>V (-)</td></tr> <tr><td>5</td><td>Offset Null</td></tr> <tr><td>6</td><td>Output</td></tr> <tr><td>7</td><td>V (+)</td></tr> <tr><td>8</td><td>Detector Anode and Case</td></tr> </table>	1	Offset Null	2	Inverting Input Detector Cathode	3	Noninverting Input	4	V (-)	5	Offset Null	6	Output	7	V (+)	8	Detector Anode and Case								
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