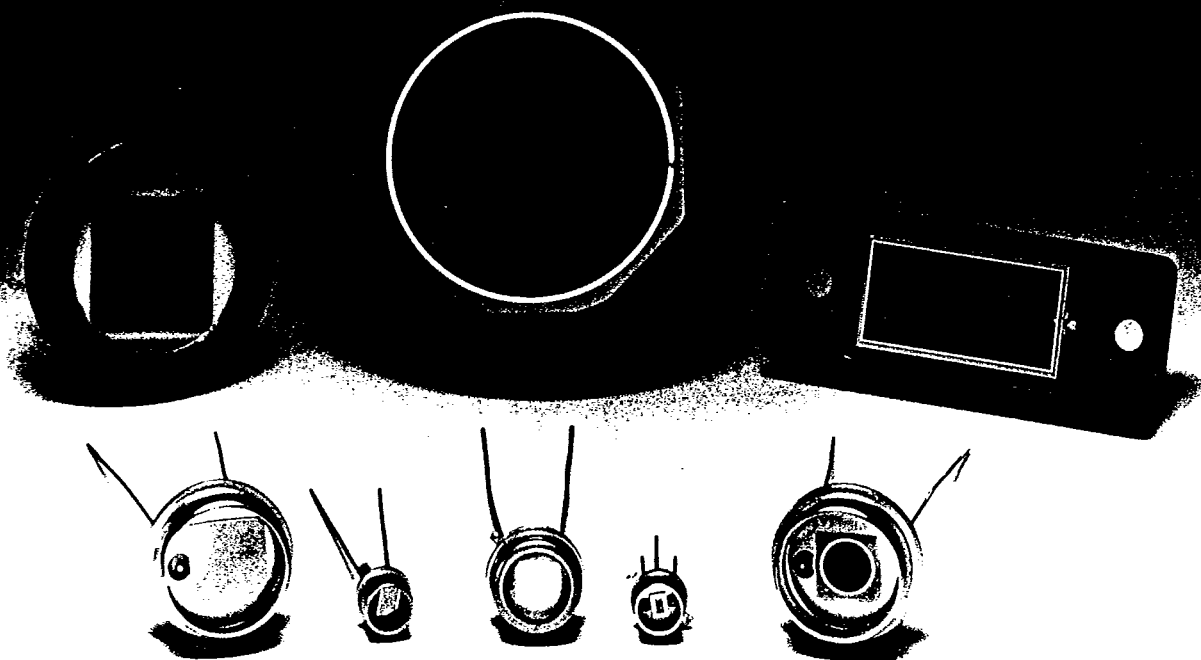


# PIN SERIES

## PLANAR-DIFFUSED SILICON PHOTODIODES



**U** UNITED DETECTOR TECHNOLOGY

# PIN SERIES PLANAR-DIFFUSED SILICON P

## D SERIES PIN PHOTODIODE SPECIFICATIONS

|                   | RESPONSIVITY | CAPACITANCE |      | DARK CURRENT | MINIMUM BREAKDOWN VOLTAGE | NEP                   | RISE TIME    | ACTIVE AREA     |
|-------------------|--------------|-------------|------|--------------|---------------------------|-----------------------|--------------|-----------------|
|                   | 850nm        | 10V         | 50V  | 10V          | Volts                     | 850nm/1kHz            | 50V/50Ω LOAD | mm <sup>2</sup> |
|                   | A/W          | pF          | pF   | nA           |                           | W/√Hz                 | nsec         |                 |
| PIN-2DI           | 0.50         | 40          | N/A  | 10           | 25                        | $1 \times 10^{-13}$   | 50           | 1.5             |
| PIN-3CD           | 0.50         | 10          | 6    | 20           | 50                        | $2 \times 10^{-13}$   | 15           | 3.2             |
| PIN-5D            | 0.50         | 15          | 7    | 100          | 50                        | $5 \times 10^{-13}$   | 15           | 5.1             |
| PIN-6D<br>PIN-6DI | 0.50         | 60          | 30   | 300          | 50                        | $8 \times 10^{-13}$   | 15           | 20.3            |
| PIN-10D           | 0.45         | 350         | 190  | 500          | 50                        | $1 \times 10^{-12}$   | 25           | 100             |
| PIN-10DI          | 0.45         | 350         | 190  | 500          | 50                        | $1 \times 10^{-12}$   | 25           | 100             |
| PIN-25D           | 0.45         | 2500        | 1000 | 4000         | 50 @ 50μA                 | $5 \times 10^{-12}$   | 100          | 613             |
| PIN-44D           | 0.50         | 190         | 100  | 400          | 50                        | $9 \times 10^{-13}$   | 20           | 44              |
| PIN-220D          | 0.45         | 600         | 300  | 1500         | 50 @ 50μA                 | $1.4 \times 10^{-12}$ | 100          | 200             |

Note: Typical specifications represent approximately 50% of yield. Photodiodes can be selected at extra charge.

United Detector Technology's commitment to state-of-the-art light detection and measurement is exemplified by its PIN series planar-diffused silicon photodiodes. These devices exhibit long-term stability, very low noise, and high impedance, as well as high speed. They work over a wide spectral range, from 350 nm to 1100 nm, making them ideal for instrument use.

The D series photodiodes, optimized for voltage-biased (photoconductive) operation, provide response times under 500 nanoseconds, long term reliability, and the ability to tolerate high light levels. In addition, their high speed makes them the best choice for AC light measurements.

The DP series photodiodes, optimized for unbiased (photovoltaic) operation, offer high zero-bias impedance. Thus they are ideal for coupling to an opamp in the current mode. In the detector/opamp configuration, DC light level changes up to ten decades can be linearly detected and converted to an output voltage. Because of their very low noise and excellent NEP, the DP series photodiodes are a good choice for very low light level detection.

The features of each detector family are summarized below.

### D SERIES

- ☐ Voltage-biased (photoconductive)
- ☐ Fast response time
- ☐ Low capacity

- ☐ Low dark current
- ☐ Excellent linearity

### DP SERIES

- ☐ Unbiased (photovoltaic)
- ☐ Optimized for opamps
- ☐ Ultra-high impedance
- ☐ Ultra-low noise
- ☐ Ten decades of output linearity with DC light source

### D SERIES APPLICATIONS.

D series photodiodes are ideal for use in laser rangefinders, OCR scanners, pulse detectors, production line sorters, and as opto-isolators. Also in video disc recorders, star trackers and spectrometers.

# PHOTODIODES



TYPICAL SPECIFICATIONS AT 22°C

|  | ACTIVE DIAMETER | TEMPERATURE RANGE |             | PACKAGE TYPE    |
|--|-----------------|-------------------|-------------|-----------------|
|  | INCHES          | OPERATING         | STORAGE     |                 |
|  |                 | °C                | °C          |                 |
|  | 0.04 x 0.061    | -55 to +125       | -65 to +150 | TO-18           |
|  | 0.05 x 0.10     | -55 to +125       | -65 to +150 | TO-18           |
|  | 0.10            | -55 to +125       | -65 to +150 | TO-5            |
|  | 0.20            | -55 to +125       | -65 to +150 | TO-8            |
|  | 0.444           | 0 to +70          | -25 to +85  | BNC SPECIAL     |
|  | 0.444           | 0 to +70          | -25 to +85  | ISOLATED HEADER |
|  | 1.10            | 0 to +70          | -25 to +85  | BNC SPECIAL     |
|  | 0.261 x 0.261   | -55 to +125       | -65 to +150 | TO-8            |
|  | 0.39 x 0.79     | 0 to +70          | -25 to +85  | SPECIAL         |

DP SERIES PIN PHOTODIODE SP

|                     | RESPONSIVITY | CAPACITANCE | R |
|---------------------|--------------|-------------|---|
|                     | 850nm        | OV          |   |
|                     | A/W          | pF          |   |
| PIN-2DPI            | 0.45         | 160         |   |
| PIN-3CDP<br>PIN-3DP | 0.55         | 300         |   |
| PIN-5DP             | 0.55         | 500         |   |
| PIN-6DP<br>PIN-6DPI | 0.55         | 1800        |   |
| PIN-10DP            | 0.50         | 2400        |   |
| PIN-10DPI           | 0.50         | 2400        |   |
| PIN-25DP            | 0.45         | 9000        |   |
| PIN-44DP            | 0.55         | 700         |   |
| PIN-125DPL          | 0.50         | 30          |   |
| PIN-220DP           | 0.45         | 3000        |   |

## DP SERIES APPLICATIONS.

DP series photodiodes are a good choice for colorimeters, photometers and radiometers, and densitometers. Also for intrusion alarms, electro-optical blood analyzers and particle detectors. They have been used as a replacement for photo-transistors, as opto-couplers, and in the food processing industry.

## CUSTOM DEVICES.

A major portion of our capability is devoted to fabricating special devices used in a variety of applications such as OCR, optical alignment, medical instruments, and infrared detection.

For harsh environments, we can supply hermetically-sealed, hi-rel devices.

Multielement PIN arrays, with from 4 to 128 elements, have already been built, and are available as standard parts. If one does not fit your needs, we can fabricate one that will.

Our capability extends to making single-element or multielement array hybrids. Hybrids, which combine a photodiode and opamp in one package, offer unique advantages in certain applications.

In addition to the planar-diffused devices covered in this data sheet, UDT also offers strong capability in Schottky barrier-junction and inversion-layer technology.

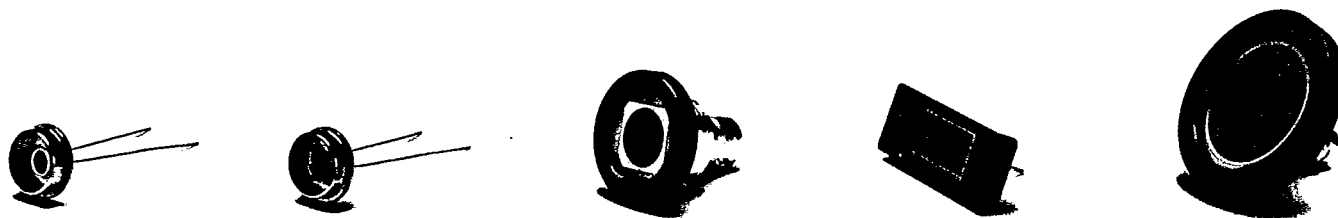
Whatever your needs in light detection and measurement, chances are good that UDT can help. Just send us your requirements. We'll give you our recommendations and a quote.

## CONSTRUCTION.

Planar-diffused PIN photodiodes are produced by introducing a heavily doped P region and a heavily doped N region into silicon, separated by a lightly doped I region. The I region resistivity can range from 10 ohm-cm to 100,000 ohm-cm, while the P and N region resistivities are less than 0.1 ohm-cm.

A top surface oxide layer serves as a diffusion mask to define the shape of the active area as well as to form a stable, passivated construction.

The metalized layer on the bottom of the silicon chip provides a low resistance ohmic contact to the outside world. The metalized layer also acts as an optical reflector, which improves sensi-

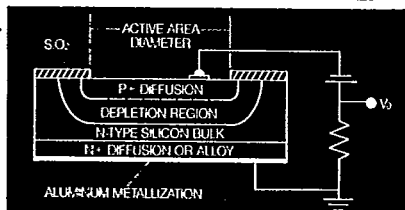


## SPECIFICATIONS

TYPICAL SPECIFICATIONS AT 22°C

| SOURCE RESISTANCE | NEP                   | RISE TIME           | ACTIVE AREA | ACTIVE DIAMETER | TEMPERATURE RANGE |               | PACKAGE TYPE    |
|-------------------|-----------------------|---------------------|-------------|-----------------|-------------------|---------------|-----------------|
| MΩ                | 850nm/1kHz<br>W/√Hz   | OV/50Ω LOAD<br>nsec | mm²         | INCHES          | OPERATING<br>°C   | STORAGE<br>°C |                 |
| 50                | $4 \times 10^{-14}$   | 500                 | 1.5         | 0.04 x 0.061    | -55 to +125       | -65 to +150   | TO-18           |
| 300               | $5 \times 10^{-14}$   | 500                 | 3.2         | 0.05 x 0.10     | -55 to +125       | -65 to +150   | TO-18           |
| 50                | $6 \times 10^{-14}$   | 500                 | 5.1         | 0.10            | -55 to +125       | -65 to +150   | TO-5            |
| 30                | $8 \times 10^{-14}$   | 1000                | 20.3        | 0.20            | -55 to +125       | -65 to +150   | TO-8            |
| 2                 | $3 \times 10^{-13}$   | 2000                | 100         | 0.444           | 0 to +70          | -25 to +85    | BNC SPECIAL     |
| 2                 | $3 \times 10^{-13}$   | 2000                | 100         | 0.444           | 0 to +70          | -25 to +85    | ISOLATED HEADER |
| 0.4               | $5 \times 10^{-13}$   | 5000                | 613         | 1.10            | 0 to +70          | -25 to +85    | BNC SPECIAL     |
| 10                | $1 \times 10^{-13}$   | 1000                | 44          | 0.261 x 0.261   | -55 to +125       | -65 to +150   | TO-8            |
| 20                | $1 \times 10^{-13}$   | 1000                | 1.6         | 0.05 x 0.05     | -55 to +75        | -65 to +100   | TO-18           |
| 5                 | $1.4 \times 10^{-13}$ | 3000                | 200         | 0.39 x 0.79     | 0 to +70          | -25 to +85    | SPECIAL         |

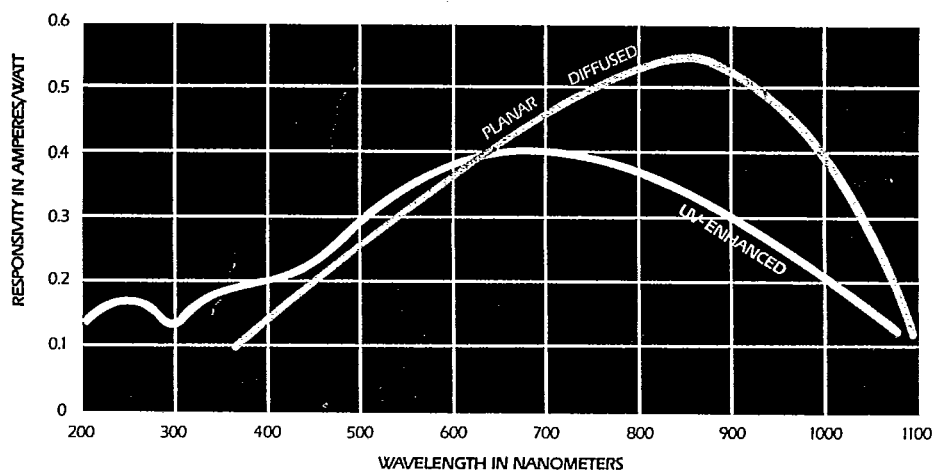
### PLANAR-DIFFUSED PHOTODIODE.



tivity at longer wavelengths, where the incident light would normally penetrate the silicon.

The D series is constructed with high breakdown voltage and low capacitance, ideal for photoconductive operation.

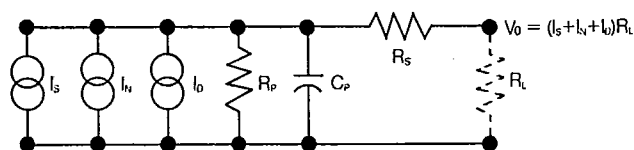
The DP series is optimized for high impedance and excellent NEP for photo-voltaic operation and opamp coupling.



Typical spectral response.

4

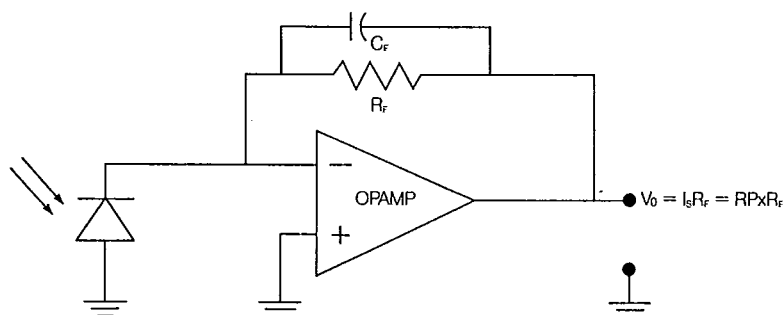
EQUIVALENT CIRCUIT FOR ALL MODELS.



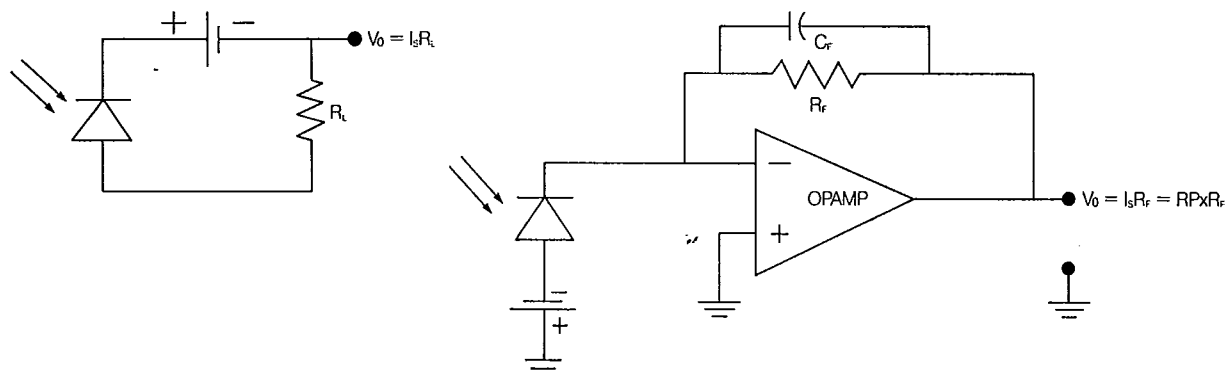
DEFINITION OF TERMS.

$I_s$  = signal current in amps =  $RP$   
 $P$  = incident optical power in watts  
 $R$  = responsivity in amps/watt  
 $I_N$  = noise current in amps  
 $I_o$  = dc dark current in amps  
 $R_L$  = load resistance in ohms  
 $C_p$  = barrier capacitance in farads  
 $R_p$  = barrier resistance in ohms  
 $R_s$  = series resistance in ohms

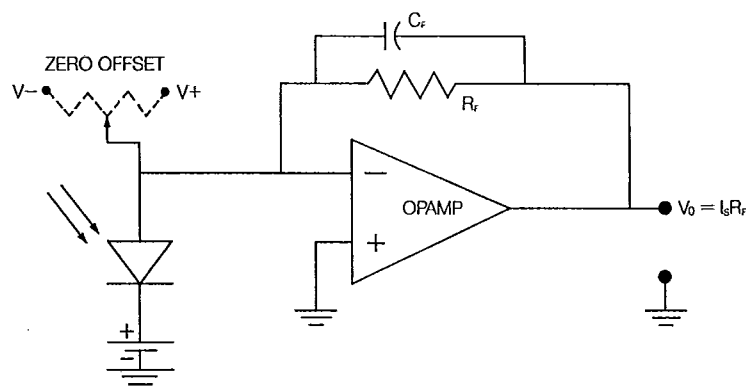
PHOTOVOLTAIC MODE OF OPERATION.

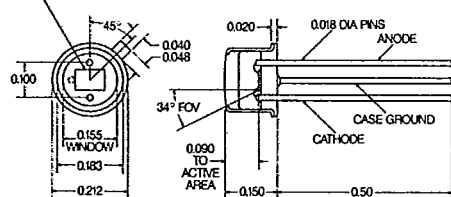
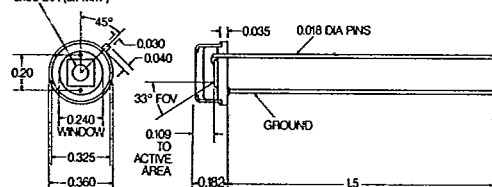
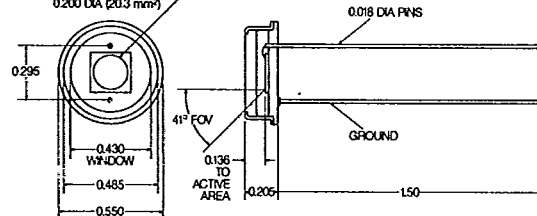
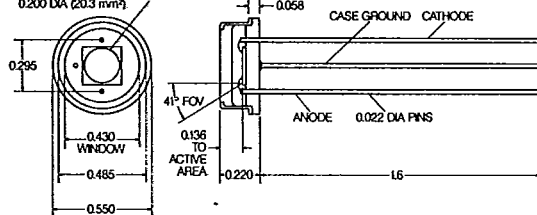
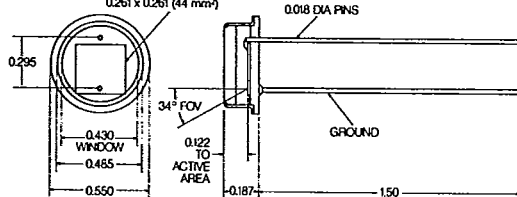
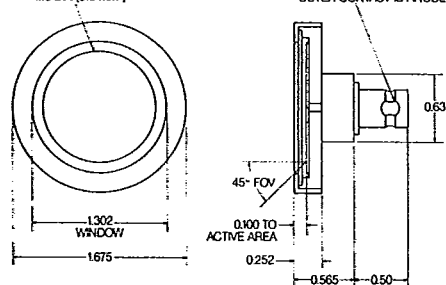


PHOTOCONDUCTIVE MODE OF OPERATION.

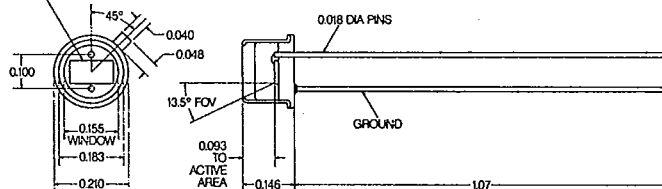
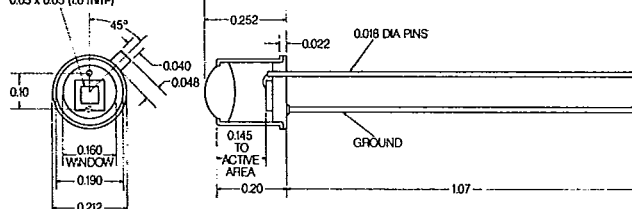
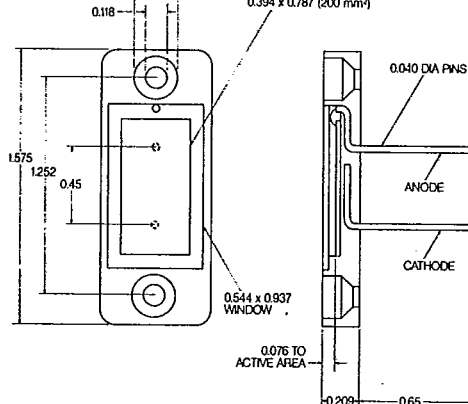
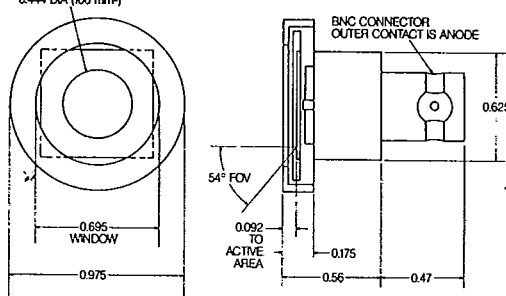
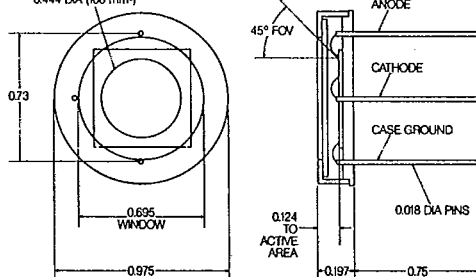


BACKGROUND LIGHT COMPENSATION.



**MECHANICAL DETAILS.****PIN-2DI, PIN-2DPI**PHOTOODE ACTIVE AREA:  
0.040 x 0.061 (1.5 mm<sup>2</sup>)**PIN-5D, PIN-5DP**PHOTOODE ACTIVE AREA:  
0.100 DIA (3.1 mm<sup>2</sup>)**PIN-6D, PIN-6DP**PHOTOODE ACTIVE AREA:  
0.200 DIA (20.3 mm<sup>2</sup>)**PIN-6DI, PIN-6DPI**PHOTOODE ACTIVE AREA:  
0.200 DIA (20.3 mm<sup>2</sup>)**PIN-44D, PIN-44DP**PHOTOODE ACTIVE AREA:  
0.261 x 0.261 (44 mm<sup>2</sup>)**PIN-25D, PIN-25DP**PHOTOODE ACTIVE AREA:  
1.0 DIA (813 mm<sup>2</sup>)

NOTES: 1. Dimensions in inches, unless otherwise specified.  
2. Typical centering of detector chip is  $\pm 0.010$  inch.

**PIN-3CD, PIN-3CDP, PIN-3DP**PHOTOODE ACTIVE AREA:  
0.050 x 0.100 (3.2 mm<sup>2</sup>)**PIN-12SDPL**PHOTOODE ACTIVE AREA:  
0.05 x 0.05 (1.6 mm<sup>2</sup>)**PIN-220D, PIN-220DP**PHOTOODE ACTIVE AREA:  
0.394 x 0.787 (200 mm<sup>2</sup>)**PIN-10D, PIN-10DP**PHOTOODE ACTIVE AREA:  
0.444 DIA (100 mm<sup>2</sup>)**PIN-10DI, PIN-10DPI**PHOTOODE ACTIVE AREA:  
0.444 DIA (100 mm<sup>2</sup>)**UNITED DETECTOR TECHNOLOGY**

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12525 Chadron Avenue, Hawthorne, CA 90250, (213) 978-0516, Telex 18-2458