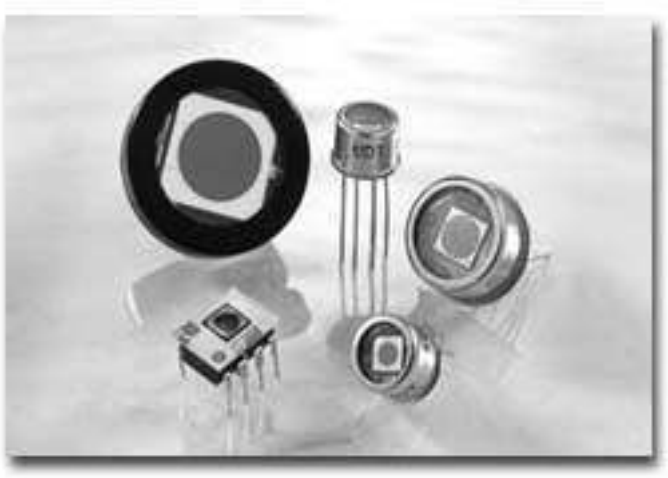
## PHOTODIODE-AMPLIFIER HYBRIDS



### APPLICATIONS

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

### FEATURES

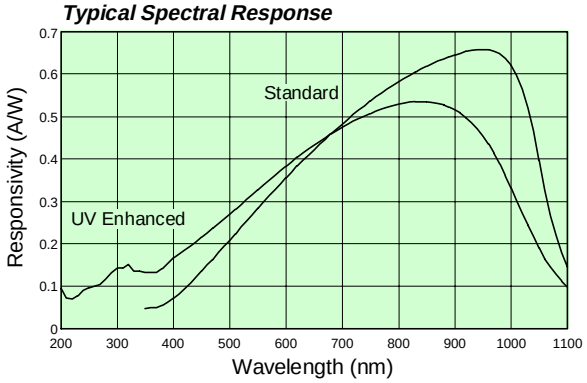
- Detector/Amplifier Combined
- Adjustable Gain/Bandwidth
- Low Noise
- Wide Bandwidth
- DIP Package
- Large Active Area

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.

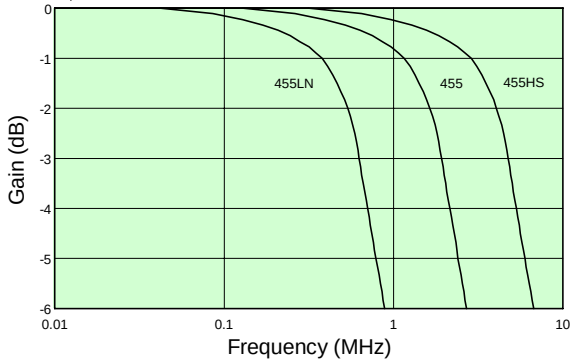
**Any modification of the above devices is possible. The modifications can be simply adding a bandpass optical filter, integration of additional chip (hybrid) components inside the same package, utilizing a different op-amp, photodetector replacement, modified package design and / or mount on PCB or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

***Typical Spectral Response***



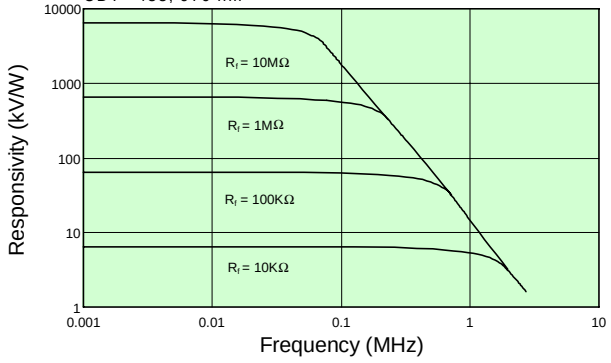

***Typical Gain vs Frequency***

$R_f$ = 10 kΩ




***Typical Responsivity vs Frequency***

UDT - 455, 970 nm



| Model No. | Active Area | | Responsivity (A/W) | | | | Capacitance (pF) | | Dark Current (nA) | | Shunt Resistance (MΩ) | NEP (W/√Hz) | | Reverse Voltage (V) | Temp Range (°C) | | Package Style ¶ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Area (mm²) | Dimension (mm) | 200 nm | | 970 nm | | 0 V | -10 V | -10 V | | -10 mV | 0 V 200 nm | -10V 970 nm | | Operating | Storage | |
| | | | Min | typ | min | typ | typ | typ | typ | max | typ | typ | typ | max | | | |
| **350-1100 nm Spectral Range** | | | | | | | | | | | | | | | | | |
| UDT-451 | 5.1 | 2.54 ϕ | | | .60 | .65 | 85 | 15 | .25 | 3 | | | 1.4 e- 14 | 30 | 0 ~ +70 | -30 ~ +100 | 28/ DIP |
| UDT-455 | | | | | | | | | | | | | | | | | 29 / TO-5 |
| UDT-455LN | | | | | | | | | | | | | | | | | |
| UDT-455HS | | | | | | | | | | | | | | | | | |
| UDT-020D | 16 | 4.57 ϕ | | | | | 330 | 60 | .5 | 10 | | | 1.9 e- 14 | | | | 30 / TO-8 |
| UDT-555D | 100 | 11.3 ϕ | | | | | 1500 | 300 | 2 | 25 | | | 3.9 e -14 | | | | 31 / Special |
| **200-1100 nm Spectral Range** | | | | | | | | | | | | | | | | | |
| UDT-455UV | 5.1 | 2.54 ϕ | .10 | .14 | | | 300 | | | | 100 | 9.2 e -14 | | 5 | | | 29 / TO-5 |
| UDT-455UV/LN | | | | | | | | | | | | | | | | | |
| UDT-020UV | 16 | 4.57 ϕ | | | | | 1000 | | | | 50 | 1.3 e -13 | | | | | 30 / TO-8 |
| UDT-055UV | 50 | 7.98 ϕ | | | | | 2500 | | | | 20 | 2.1 e -13 | | | | | 31 / Special |
| UDT-555UV | 100 | 11.3 ϕ | | | | | 4500 | | | | 10 | 2.9 e -13 | | | | | 31 / Special |
| UDT-555UV/LN | | | | | | | | | | | | | | | | | |

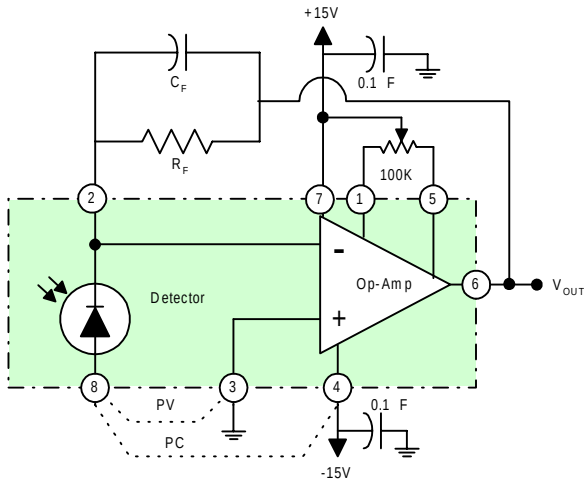
For MECHANICAL DRAWINGS Click Here

## *OPERATIONAL AMPLIFIER SPECIFICATIONS*

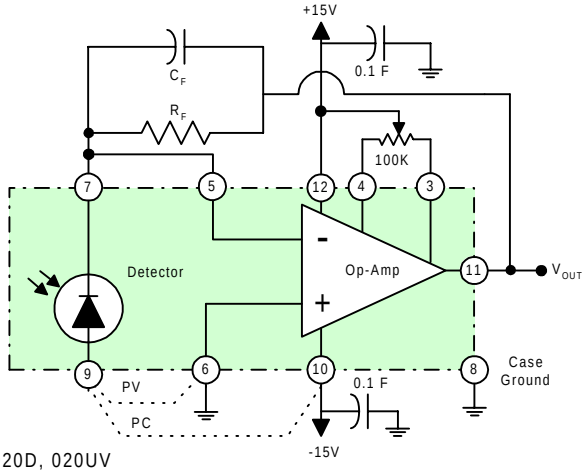
*TYPICAL ELECTRO-OPTICAL SPECIFICATIONS AT $T_A$=23 °C*

| Model No. | Supply Voltage (V) | | | Quiescent Supply Current (mA) | | Input Offset Voltage (mV) | | Temp Coefficient Input Offset Voltage (µV / °C) | | Input Bias Current (pA) | | Gain Bandwidth Product (MHz) | | Slew Rate (V / µs) | | Open Loop Gain, DC (V / mV) | | Input Noise Voltage (nV/√Hz) | | Input Noise Current (fA/√Hz) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ± 15 V | | | | | | | | | | | | | | 100 Hz | 1 kHz | 1 kHz |
| | min | typ | max | typ | max | typ | max | typ | max | typ | max | min | typ | min | typ | min | typ | typ | typ | typ |
| 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 | .26 | 1 | --- | 20 | .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 | | | | | | | | | | | | | | | | | | | | |
| UDT-555UV/LN | ±5 | ±15 | ±18 | 2.5 | 3.5 | .05 | 0.25 | 0.5 | 1 | 0.5 | 1 | --- | 2 | 1 | 2 | 1k | 1770 | 11 | 7 | 0.4 |

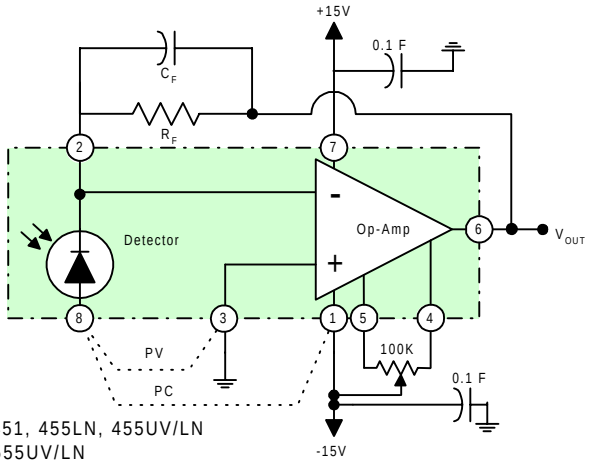
## SCHEMATIC DIAGRAMS




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:

$$V_{OUT} = I_P \times R_F$$
$$= (P \times R_\lambda) \times R_F$$

### FREQUENCY RESPONSE (PHOTODIODE /AMPLIFIER COMBINATION)

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

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

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 3 dB frequency response of the detector / pre-amp combination, be less than the maximum frequency of the op-amp, i.e. $f_{3dB} \le f_{max}$.

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

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:

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

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 $f_{3dB} \le f_{max}$.

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.***