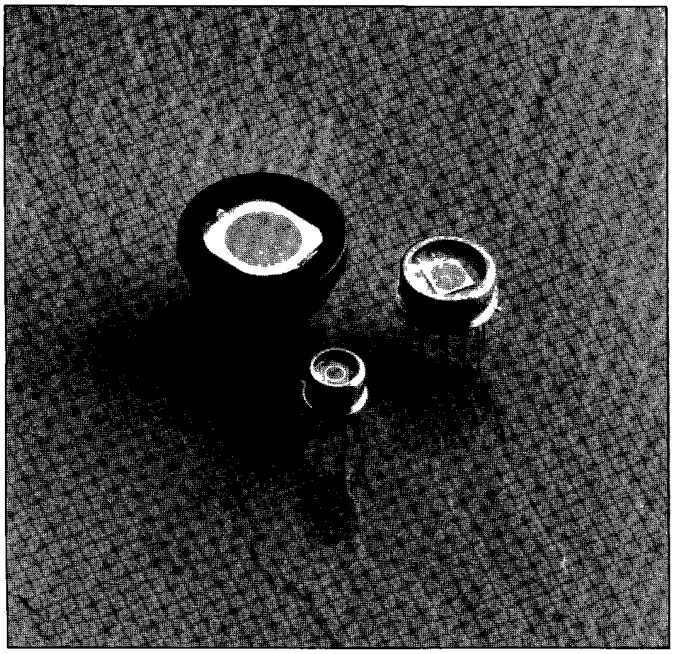
PHOTOPS™ SERIES

Hybrid Photodetector/Amplifier Combinations



PHOTOPS are high-speed, solid-state photodetectors with integral electronics. Their ultrasensitive silicon photodiodes detect light over a wide range of intensities. Built-in monolithic JFET operational amplifiers allow low-level measurements and ensure low-noise output under a variety of operating conditions.

UDT PHOTOPS are used in many different applications ranging from medical diagnostic instrumentation to bar code readers for business and industrial use.

STANDARD PHOTOPS.

Numerous detector and packaging configurations are available to assist design engineers in selecting system components.

UDT-451 is a low-cost PHOTOP in an 8-pin mini-DIP package.
UDT-455 is a general purpose PHOTOP with a 5.1mm² active area, packaged in a TO-5 housing.
UDT-455HS is a very high speed version of the UDT-455. Its amplifier is decompensated, for high speed use.
UDT-455UHS is used for applications requiring megahertz bandwidth and high sensitivity.
UDT-455UV is a UV-enhanced version of the UDT-455.
UDT-020D is a general purpose PHOTOP with a 20mm² active area, packaged in a TO-8 housing.
UDT-020UV is a UV-enhanced version of the UDT-020D.
UDT-055UV is a UV-enhanced detector with a 50mm² active area.
UDT-555D is a general purpose PHOTOP with a 100mm² active area, packaged in a UDT metal case.
UDT-555UV is a UV-enhanced version of the UDT-555D.

LOW-NOISE DETECTORS.

UDT photodiodes employ state-of-the-art technology to provide rugged detectors with high-speed and low-noise for low level measurements. PHOTOP general purpose sensors have a spectral range of 350 to 1100 nm. UV-enhanced models incorporate recent technological advancements which extend their capability down to 200 nm. High frequency response permits use of PHOTOP sensors for pulse operation and for rapid scanning requirements. And choice can be made between photovoltaic and photoconductive modes of detector operation.

VERSATILE AMPLIFIERS.

The PHOTOPS series utilizes amplifiers with very low voltage and current errors. In addition, PHOTOPS provide design engineers with the flexibility they need for circuit design. Since the customer usually provides his own feedback components, gain can be adjusted in accordance with system needs. And the low-impedance output of the built-in operational amplifier protects against noise pickup from the environment

FEATURES

- UV Enhanced Optional
- Variable Voltage Output
- Ultra Low Noise
- Low Temperature Dependence
- High Gain
- High Speed

APPLICATIONS

- Laser Power Measurements
- Colorimeter
- Medical Analytical Instrumentation
- Laser Communications
- Industrial Processing Equipment
- Pollution Monitoring Instrumentation
- Optical Measurements Instrumentation
- Spectroradiometers
- Densitometers

PACKAGE SELECTION.

A variety of standard packaging is available. The low-cost mini-DIP package permits photodetectors to be inserted into standard sockets on printed circuit boards. Other detectors are available in standard TO-5 and TO-8 housings. The UDT-020D and UDT-020UV feature electrical case isolation.

CUSTOM SENSORS.

UDT Sensors welcomes inquiries for custom PHOTOP detectors. All design and manufacturing is performed in our modern facility in California. Typical requests include changes in detector size, spectral characteristics and speed of response.

Also, custom feedback components can be encapsulated to provide fixed gain, so that all detectors can be delivered with a standard sensitivity range.

T-41-67

PHOTOPS SERIES DETECTOR SPECIFICATIONS

Typical at 22°C.

MODEL #	ACTIVE SURFACE		SPECTRAL RANGE		RESPONSIVITY		CAPACITANCE			SHUNT RESISTANCE	DARK CURRENT (V_R = 10V)	NEP (AT 254nm FOR UV DEVICES) (AT 850nm FOR ALL OTHERS)		BREAKDOWN VOLTAGE (I_R = 10μA)	TEMP. RANGE	
	AREA	DIA.	MIN.	MAX.	254nm	850nm	0V	10V	50V	MΩ	nA	0V	10V	V	OPERATING	STORAGE
	mm²	in.	nm	nm	A/W	A/W	pF	pF	pF			W/√Hz	W/√Hz		°C	°C
UDT-020D	20	0.197	350	1100	—	0.5	50	15	7	100	20	2.5×10^{-14}	1.6×10^{-13}	50	0 to +70	−65 to +125
UDT-020UV	20	0.197	200	1100	0.15	—	1000	250	—	50	60	1.2×10^{-13}	9.2×10^{-13}	25	0 to +70	−65 to +125
UDT-055UV	50	0.314	200	1100	0.15	—	2500	650	—	20	100	1.9×10^{-13}	1.2×10^{-12}	25	0 to +70	−65 to +125
UDT-451*	5.1	0.100	350	1100	—	0.5	50	15	7	50	100	3.5×10^{-14}	3.6×10^{-13}	50	0 to +70	−65 to +125
UDT-455**	5.1	0.100	350	1100	—	0.5	50	15	7	100	20	2.5×10^{-14}	1.6×10^{-13}	50	0 to +70	−65 to +125
UDT-455UV	5.1	0.100	350	1100	0.15	0.5	300	—	—	100	20	2.5×10^{-14}	1.6×10^{-13}	50	0 to +70	−65 to +125
UDT-455UV/LN	5.1	0.100	200	1100	0.1	0.4	300	N/A	N/A	500	—	2.5×10^{-14}	N/A	10	−55 to +125	−65 to +150
UDT-555D	100	0.444	350	1100	—	0.5	1100	350	190	20	200	5.7×10^{-14}	5.0×10^{-13}	50	0 to +70	−65 to +125
UDT-555UV	100	0.444	200	1100	0.15	—	4500	1200	—	10	200	2.7×10^{-13}	1.7×10^{-12}	25	0 to +70	−65 to +125
UDT-555UV/LN	100	0.444	200	1100	0.07	0.5	6000	N/A	N/A	100	—	1×10^{-13}	N/A	15	−55 to +125	−65 to +150

*The UDT-451 is also available in a UV-enhanced version of a custom device, on special order

**The UDT-455 is available with high-speed amplifier, UDT-455HS, UDT-455 UHS-1, UDT-455 UHS-2 (see below)

"LN" suffix on model number indicates low noise.

PHOTOPS SERIES AMPLIFIER SPECIFICATIONS

Typical at 22°C.

MODEL #	SUPPLY VOLTAGE			QUIESCENT SUPPLY CURRENT (±15 VDC)		INPUT OFFSET VOLTAGE		TEMPERATURE COEFFICIENT OF 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	100 Hz
	V	V	V	mA	mA	mV	mV	μV/°C	μV/°C	pA	pA	MHz	MHz	V/μS	V/μS	V/mV	V/mV	nV/√Hz	nV/√Hz	fA/√Hz
UDT-020D UDT-020UV	±5	±15	±18	2.7	5.0	0.5	3	4	15	15	200	3.3	5.4	5	15	50	200	20	15	10
UDT-451	±5	±15	±18	1.4	2.5	3	6	10	—	30	200	—	3	—	13	50	200	25	18	10
UDT-455 UDT-455UV	±5	±15	±18	2.7	5.0	0.5	3	4	15	15	200	3.3	5.4	5	15	50	200	20	15	10
UDT-455UV/LN	±5	±15	±18	0.9	1.8	0.3	1	15	20	0.15	0.3	—	3.0	0.5	3	50	2500	78	27	2
UDT-455HS	±5	±15	±18	4.8	8.0	0.5	3	4	15	15	200	11	26	25	62	50	200	20	15	10
UDT-455UHS-1*	—	±5	—	14	—	0.25	—	2	—	2.5×10^{6}	—	—	1000	—	200	—	105	8.9	2.7	25
UDT-455UHS-2*	—	±15	—	7.5	—	0.6	—	20	—	6×10^{6}	—	—	470	—	340	—	25	—	11	6
UDT-055UV UDT-555D UDT-555UV	±5	±15	±18	2.7	4.0	0.4	1	3	10	40	200	3.5	5.6	7.5	16	50	200	20	15	10
UDT-555UV/LN	±5	±15	±18	2.5	3.5	0.1	0.5	2	5	0.8	2	—	3.0	1	2	320	1770	15	8	5

"HS" suffix on model number indicates high speed

"LN" suffix on model number indicates low noise.

"UHS" suffix on model number indicates ultra-high speed

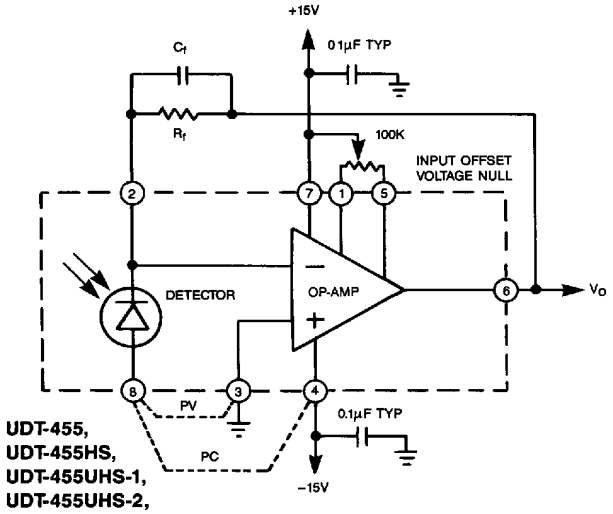
*R_L Load Resistance is 5kΩ for UDT-455UHS-1 and 1kΩ for UDT-455UHS-2

T-41-67

Electrical Schematics

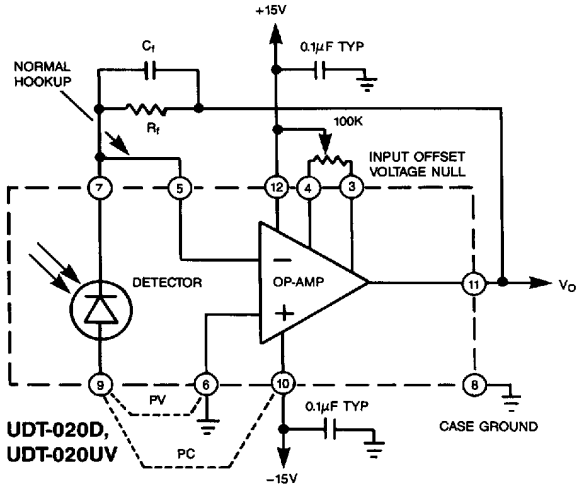
With typical external connections shown.

PV = PHOTOVOLTAIC MODE
PC = PHOTOCONDUCTIVE MODE

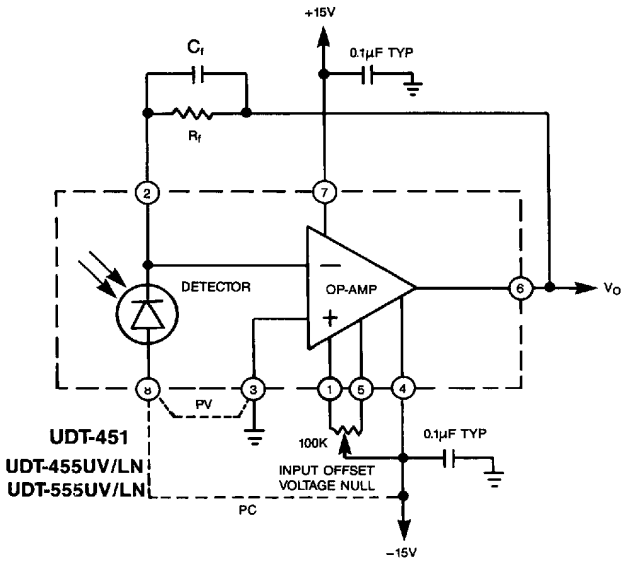


UDT-455,
UDT-455HS,
UDT-455UHS-1,
UDT-455UHS-2,
UDT-055UV, UDT-555D, UDT-555UV

Note: For UDT-455HS, minimum recommended feedback resistance is 100K.



UDT-020D,
UDT-020UV



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

Note: Do not solder leads for this device. Use a DIP socket.

EFFECTIVE LOAD SEEN BY DETECTOR:

$$R_L = \frac{R_f}{A_O}$$

Where A_O = open loop gain of op-amp
R_f = feedback resistance

OUTPUT VOLTAGE:

$$V_O = I_P R_f$$
$$= (P_{in} \times R) R_f$$

Where I_P = photodetector output current
P_{in} = optical power in watts
R = responsivity in amps/watt

ZERO SIGNAL OUTPUT ERROR:

$$V_O = R_f (I_B + I_D) + V_{OS} (1 + \frac{R_f}{R_{sh}})$$

Where I_B = amplifier bias current
I_D = detector dark current at operating bias voltage V_D (I_D = 0 at V_D = 0)
V_{OS} = amplifier input offset voltage
R_{sh} = detector shunt resistance (when V_D = 0)
$= \frac{V_D}{I_D}$ if biased

GAIN BANDWIDTH PRODUCT:

For desired gain R_f and maximum operating frequency f, the feedback capacitor value required is:

$$C_f = \frac{1}{2\pi f R_f}$$

For the Gain Bandwidth Product (GBP) required of the op-amp, the maximum stable 3 dB frequency is:

$$f_{max} = \sqrt{\frac{GBP}{2\pi R_f (C_j + C_f)}}$$

Where C_j = Diode capacitance

For example:
For a gain of $R_f \sim 10^8$, at operating frequency f~100 Hz, and with an op-amp GBP~5 MHz:

$$C_f \sim \frac{1}{2\pi f R_f} = 15.915 \text{ pF}$$

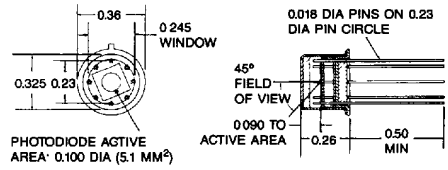
$$f_{max} \sim \sqrt{\frac{GBP}{2\pi R_f (C_j + C_f)}}$$

for C_j~15 pF and C_f~16pF. The circuit is stable since $f_{max} \gg f$.

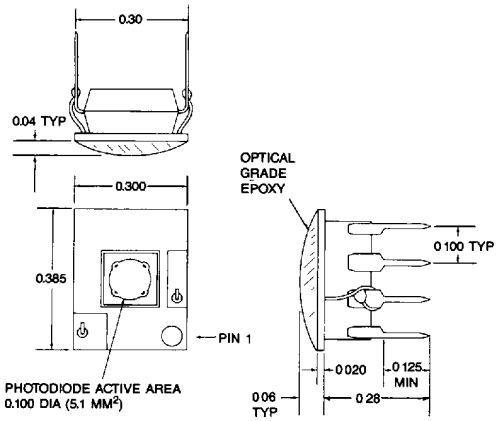
MECHANICAL DETAILS

T-41-67

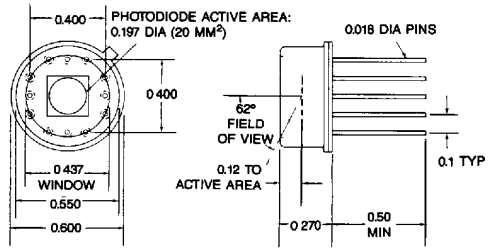
NOTES 1 DIMENSIONS IN INCHES, UNLESS OTHERWISE SPECIFIED
2 TYPICAL CENTERING OF DETECTOR CHIP IS ±0.010 INCH
3. UV-ENHANCED DETECTORS HAVE QUARTZ WINDOWS
4 TYPICAL TOLERANCE XX ± 01
XXX ± 005
ANGLES ±1°



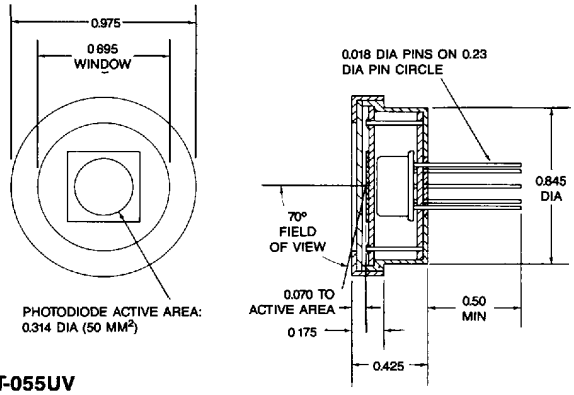
UDT-455, UDT-455HS, UDT-455UHS, UDT-455UV, UDT-455UV/LN



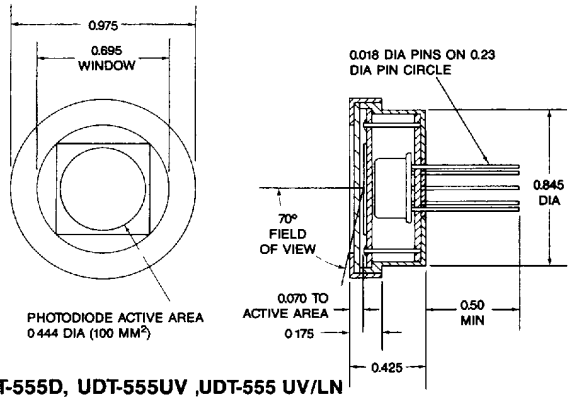
UDT-451



UDT-020D, UDT-020UV

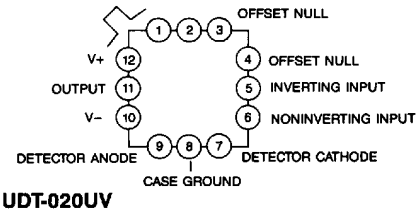


UDT-055UV

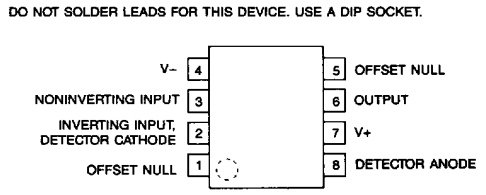


UDT-555D, UDT-555UV ,UDT-555 UV/LN

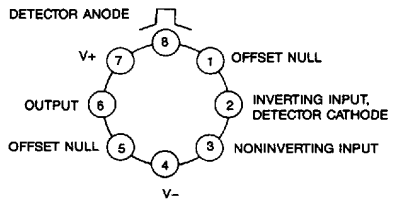
ELECTRICAL PINOUTS, BOTTOM VIEW



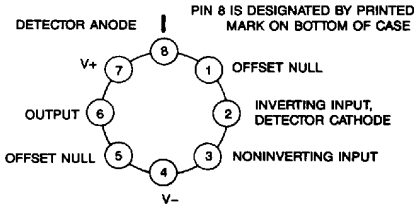
UDT-020D, UDT-020UV



UDT-451



UDT-455, UDT-455HS, UDT-455UHS, UDT-455UV, UDT-455UV/LN



UDT-055UV, UDT-555D, UDT-555UV, UDT-555UV/LN