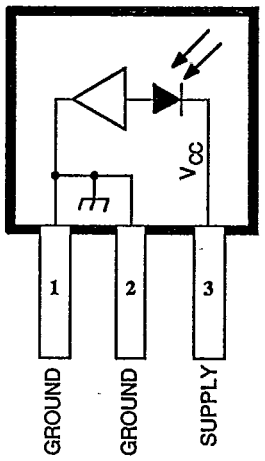
3311 AND 3312

T-41-67

PRECISION LIGHT SENSORS with calibrated Current Amplifiers



Dwg. PH-008

Direct replacements for photocells and phototransistors, the ULN3311T and ULN3312T precision light sensors are two-terminal monolithic integrated circuits that linearly convert light level into electrical current. The light-controlled current sources are linear over a wide range of supply voltages and light levels and require no external calibration.

Each precision light sensor (PLS) consists of a photodiode and a calibrated current amplifier. The design of the amplifier allows derivation of its supply current from the same terminal as the photodiode cathode and amplifier output. Since this supply current is a linear function of the photodiode current, it acts as part of the signal current. On-chip resistor-trimming techniques are used during manufacture to adjust each PLS to specified sensitivity. A 100 μW/cm² GaAlAs LED emission provides the light source for this calibration.

The ULN3311T and ULN3312T are supplied in an inexpensive clear plastic package. Both devices are rated for operation over the temperature range of -40°C to +70°C.

FEATURES

- Two-Terminal Operation
- Linear Over a Wide Range
- Precalibrated
- Wide Operating Voltage Range
- High Output

ABSOLUTE MAXIMUM RATINGS

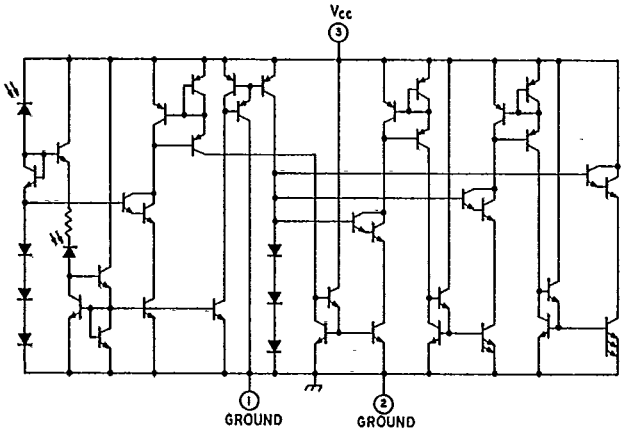
Supply Voltage, V_{CC} ..... 24 V
Operating Temperature Range,
T_A ..... -40°C to +70°C
Storage Temperature Range,
T_S ..... -55°C to +110°C

Always order by complete part number, e.g., **ULN3311T**.
See Characteristics table for differences between devices.

3311 AND 3312
PRECISION LIGHT SENSORS

T-41-67

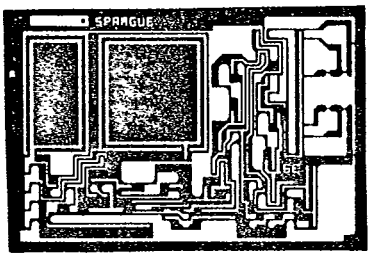
SCHEMATIC



Dwg. No. A-11,996

UNPACKAGED CHIP

0.053" x 0.077" (1.35 mm x 1.96 mm)



ELECTRICAL CHARACTERISTICS at T_A = +25°C, V_{CC} = 12 V

Characteristics	Device Type	Limits			
		Min.	Typ.	Max.	Units
Initial Accuracy at 100 µW/cm²	Both	—	—	±7.2	%
Sensitivity	ULN3311T	280	—	350	nA/µW/cm²
	ULN3312T	350	—	420	nA/µW/cm²
Operating Voltage Range	Both	2.7	12	24	V
Output Linearity, 10 to 10k µW/cm²	Both	—	—	±7.2	%
Dark Current	Both	—	—	100	nA
Power Supply Rejection, $(\Delta I_0/I_0)\Delta V$	Both	40	50	—	dB
Temperature Coefficient of Sensitivity	Both	—	3500	—	ppM/°C

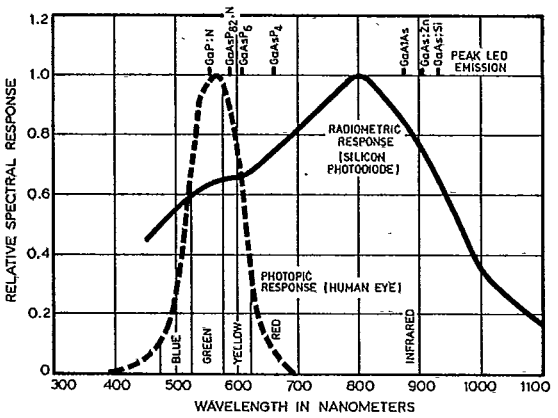
NOTE: Light source is an infrared LED with a peak output wavelength of 880 nm.

3311 AND 3312 PRECISION LIGHT SENSORS

T-41-67

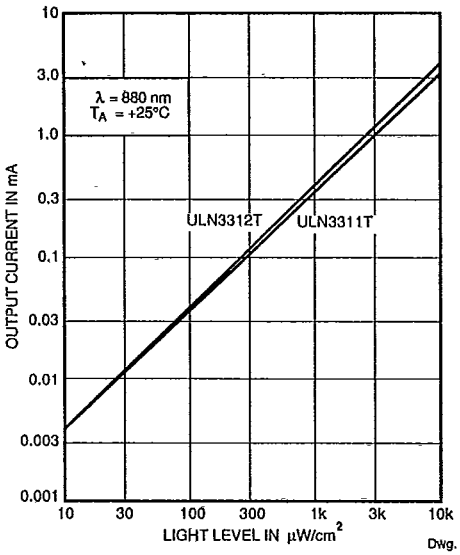
TYPICAL CHARACTERISTICS

RELATIVE SPECTRAL RESPONSE AS A FUNCTION OF WAVELENGTH OF LIGHT



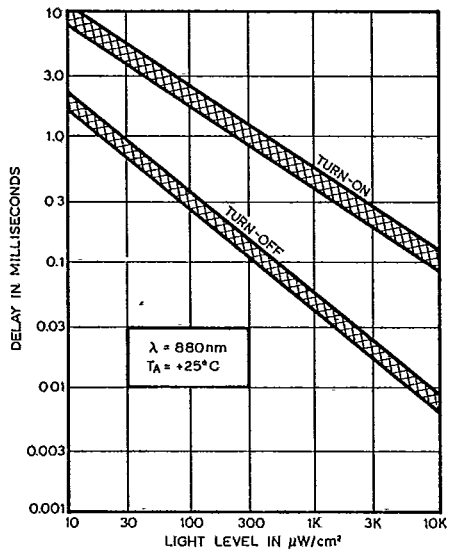
Dwg. No. A-12,135A

OUTPUT CURRENT AS A FUNCTION OF ILLUMINANCE



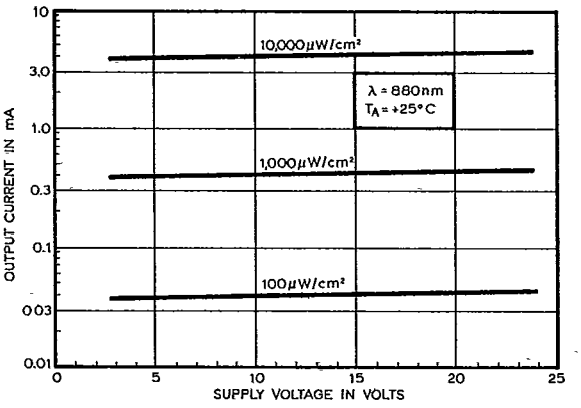
Dwg. GH-019

PROPABATION DELAY AS A FUNCTION OF ILLUMINANCE



Dwg. No. A-12,138A

OUTPUT CURRENT AS A FUNCTION OF SUPPLY VOLTAGE

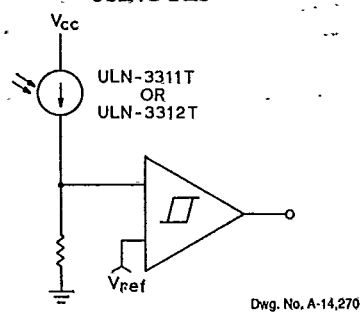


Dwg. No. A-12,137A

3311 AND 3312 PRECISION LIGHT SENSORS

T-41-67

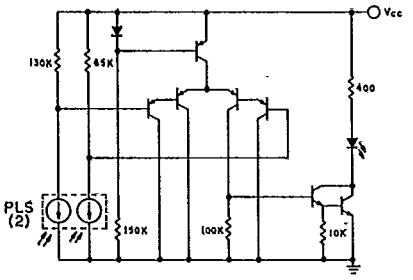
LIGHT-LEVEL DETECTOR USING PLS



Dwg. No. A-14,270

FIGURE 1

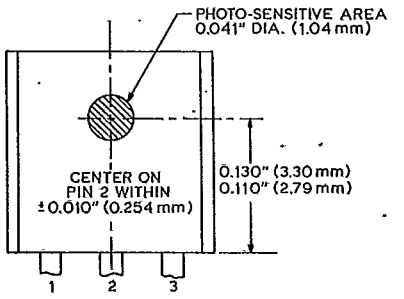
DIFFERENTIAL EDGE DETECTOR



Dwg. No. A-11,995

FIGURE 2

SENSOR-CENTER LOCATION



Dwg. No. A-14,275

APPLICATIONS INFORMATION

Photocells exhibit a change in resistance proportional to light intensity. However, they are highly inaccurate. They exhibit light memory, which makes their response dependent on the previous light level.

Phototransistors exhibit no light memory, but show as much as 50% variation in sensitivity among parts of the same type due to process and beta variations. Output current as a function of light level is linear only over a very small range.

Photodiodes have an output current that is a linear function of illumination, but the output is very small. The output current is typically in the range of tens of nanoamperes. These devices also show wide unit-to-unit sensitivity variations.

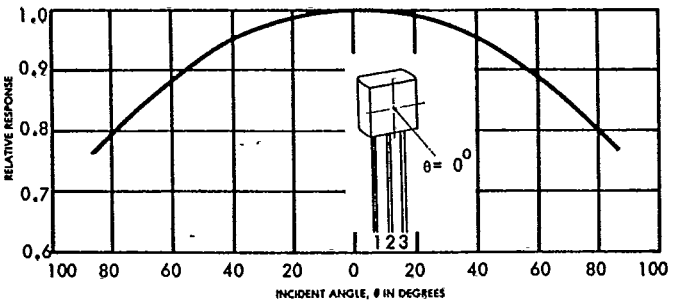
These precision light sensors are two-terminal replacements for photocells, phototransistors, and photodiodes. They are internally calibrated, have relatively high output currents, and are linear over a very wide range of light levels. Low-level amplifiers and adjustable controls can be eliminated. The precision light sensors are also ideal for use in arrays where matched characteristics are often required. Unpackaged chips are available on special order.

TYPICAL APPLICATIONS

Figure 1 shows a ULN3311T or ULN3312T integrated circuit replacing a photocell or phototransistor for the precise linear detection of a light level. Use of the precision light sensor eliminates the need for external calibration because it is calibrated to an initial accuracy of better than 7.2% during manufacture.

In Figure 2, two precision light sensors are used in a differential configuration to detect the edge of an object. When the light level on the first sensor is half of that on the second, the circuit switches. This circuit operates over a wide range of ambient light levels. No external calibration is required.

RELATIVE RESPONSE AS A FUNCTION OF THE ANGLE OF INCIDENCE



Dwg. No. A-12,134