# NPN Silicon Phototransistor

## OP505, OP505W, OP506, OP506W OP535

## Obsolete (OP505D, OP506C, OP705A)


### Features:

- T-1 package style
- Variety of sensitivity ranges
- Choice of narrow or wide receiving angle
- Small package size ideal for space-limited applications
- 0.050” [1.27 mm] or 0.100” [2.54 mm] Lead spacing

### Description:

Each OP505 and OP506 devices consist of an NPN silicon phototransistor, the OP535 device consist of an NPN silicon photodarlington transistor. All of the devices are molded in a blue-tinted T-1 (3 mm) epoxy package.

The OP505 and OP535 devices have a narrow receiving angle that provides excellent on-axis coupling while the OP506 device has a wider receiving angle for those applications where a narrow receiving angle of the OP505 and OP535 is not required. The OP505W and OP506W device have the widest receiving angle and provides relatively even reception over a large area.

Devices are 100% production tested, using infrared light for close correlation with Optek’s GaAs and GaAlAs emitters.

*Please refer to Application Bulletins 208 and 210 for additional design information and reliability (degradation) data.*

Please see your OPTEK representative for custom versions of these devices.

### Applications:

- Space-limited applications
- Interruptive applications to detect media which is semi-transparent to infrared light

**Ordering Information**

| Part Number | Sensor | Viewing Angle | Lead Spacing | Lead Length |
|---|---|---|---|---|
| OP505A | Transistor | 20° | 0.050” [1.27 mm] | 0.50" [12.7 mm] |
| OP505B | | | | |
| OP505C | | | | |
| OP505D (Obsolete) | | | | |
| OP505W | | 90° | | |
| OP506A | | 20° | 0.100” [2.54 mm] | |
| OP506B | | | | |
| OP506C (Obsolete) | | | | |
| OP506W | | 90° | | |
| OP535A | Darlington | 20° | 0.050” [1.27 mm] | |
| OP535B | | | | |
| OP705A (Obsolete) | $R_{BE}$ Transistor | | | |

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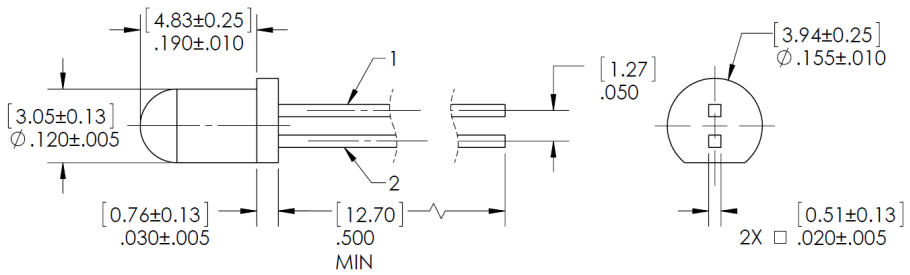
# NPN Silicon Phototransistor

## OP505, OP505W, OP506, OP506W
## OP535

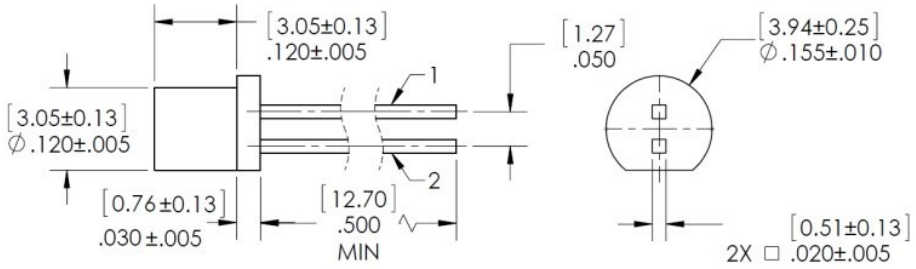
Obsolete (OP505D, OP506C, OP705A)

**OP505, OP535**



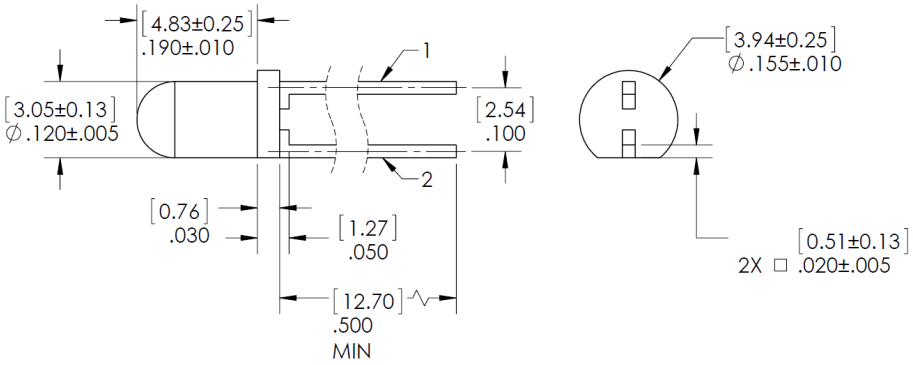

| Pin # | Transistor |
|---|---|
| 1 | Emitter |
| 2 | Collector |

**OP505W**

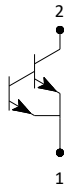



**OP505, OP506**
**OP505W, OP506W**

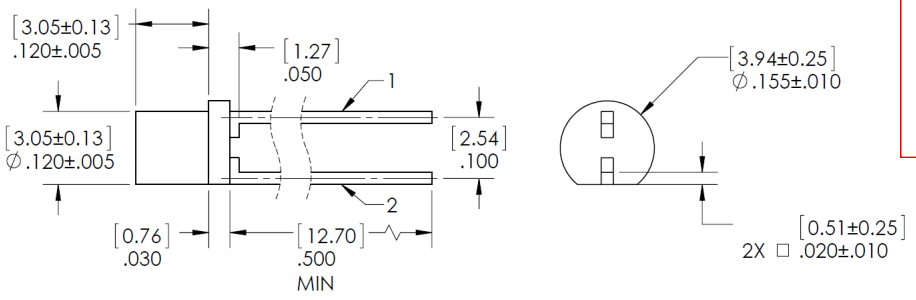

**OP506**




**OP535**




**OP506W**




**CONTAINS POLYSULFONE**

Methanol and isopropanol alcohols
are recommended cleaning agents.
Housings are soluble in chlorinated hydrocarbons and keytones.
Highly activated or water soluble fluxes may damage body.
Testing reagents before use is recommended prior to use.

**TOLERANCES ARE ± .010" [.25] UNLESS OTHERWISE STATED**
**DIMENSIONS ARE IN INCHES [MILLIMETERS]**



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## Electrical Specifications

**Absolute Maximum Ratings** ($T_A$ = 25° C unless otherwise noted)

| | |
|---|---|
| Storage & Operating Temperature Range | -40° C to +100° C |
| Collector-Emitter Voltage (OP505, OP506, OP505W, OP506W) | 30 V |
| Collector-Emitter Voltage (OP535) | 15 V |
| Emitter-Collector Voltage (OP505 and OP506 series only) | 5.0 V |
| Lead Soldering Temperature (1/16 inch (1.6 mm) from case for 5 seconds with soldering iron) | 260° C |
| Power Dissipation | 100 mW (2) |

**Electrical Characteristics** ($T_A$ = 25° C unless otherwise noted)

**OP505, OP506, OP505W, OP506W**

| SYMBOL | PARAMETER | MIN | TYP | MAX | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $I_{C(ON)}$ | On-State Collector Current<br>OP505A, OP506A<br>OP505B, OP506B<br>OP505C | <br>4.30<br>2.15<br>1.10 | <br>-<br>-<br>- | <br>-<br>5.95<br>3.00 | mA | $V_{CE}$ = 5 V, $E_E$ = 0.50 mW/cm$^2$, Note 3 |
| | OP505W, OP506W | 0.10 | - | - | mA | $V_{CE}$ = 5 V, $E_E$ = 0.75 mW/cm$^2$, Note 3 |
| $V_{CE(SAT)}$ | Collector-Emitter Saturation Voltage<br>OP505, OP506 | - | - | 0.40 | V | $I_C$ = 250 µA, $E_E$ = 0.5 mW/cm$^2$, Note 3 |
| | OP505W, OP506W | - | - | 0.40 | V | $I_C$ = 50 µA, $E_E$ = 0.75 mW/cm$^2$, Note 3 |
| $I_{CEO}$ | Collector-Dark Current | - | - | 100 | nA | $V_{CE}$ = 10 V, $E_E$ = 0 |
| $V_{(BR)CEO}$ | Collector-Emitter Breakdown Voltage | 30 | - | - | V | $I_C$ = 100 µA, $E_E$ = 0 |
| $V_{(BR)ECO}$ | Emitter-Collector Breakdown Voltage<br>OP505, OP506 | 5 | - | - | V | $I_E$ = 100 µA, $E_E$ = 0 |
| $\Delta I_C/\Delta T$ | Relative $I_C$ Changes with Temperature | - | 1.00 | - | % / ° C | $V_{CE}$ = 5 V, $E_E$ = 1.0 mW/cm$^2$ |

Notes:

(1) RMA flux is recommended. Duration can be extended to 10 seconds maximum when flow soldering. A maximum of 20 grams force may be applied to the leads when soldering.

(2) Derate linearly 1.33 mW/° C above 25° C.

(3) Light source is an unfiltered GaAs LED with a peak emission wavelength of 935 nm and a radiometric intensity level, which varies less than 10 % over the entire lens surface of the phototransistor being tested.

(4) The knee point irradiance is defined as the irradiance required to increase $I_{C(ON)}$ to 50 µA.




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## Electrical Specifications

**Electrical Characteristics** ($T_A$ = 25° C unless otherwise noted)

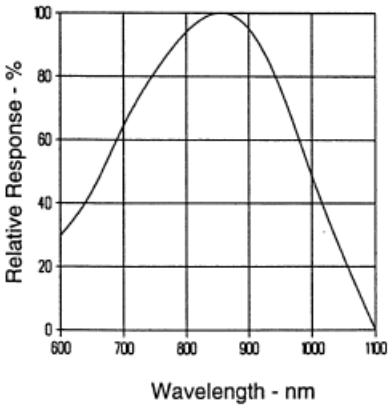
**OP535**

| SYMBOL | PARAMETER | MIN | TYP | MAX | UNITS | TEST CONDITIONS |
|---|---|---|---|---|---|---|
| $I_{C(ON)}$ | On-State Collector Current<br>OP535A<br>OP535B | <br>10.5<br>3.5 | <br>-<br>- | <br>-<br>32.0 | mA | $V_{CE}$ = 5 V, $E_E$ = 0.13 mW/cm$^2$, Note 3 |
| $V_{CE(SAT)}$ | Collector-Emitter Saturation Voltage | - | - | 1.10 | V | $I_C$ = 400 µA, $E_E$ = 0.13 mW/cm$^2$, Note 3 |
| $I_{CEO}$ | Collector-Dark Current | - | - | 100 | nA | $V_{CE}$ = 10 V, $E_E$ = 0 |
| $V_{(BR)CEO}$ | Collector-Emitter Breakdown Voltage | 15.0 | - | - | V | $I_C$ = 1.0 mA, $E_E$ = 0 |
| $V_{(BR)ECO}$ | Emitter-Collector Breakdown Voltage | 5.0 | - | - | V | $I_E$ = 100 µA, $E_E$ = 0 |

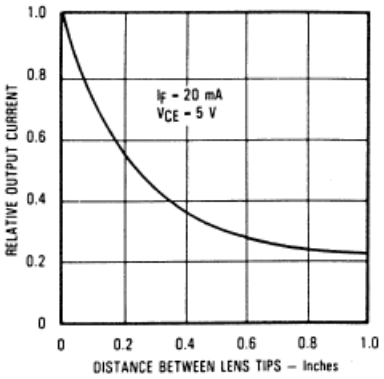
## Performance

**OP505A, OP505B, OP505C**

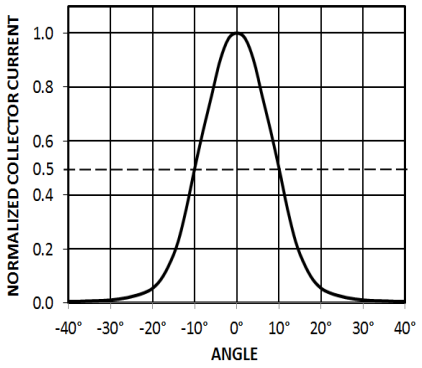
**Typical Spectral Response**



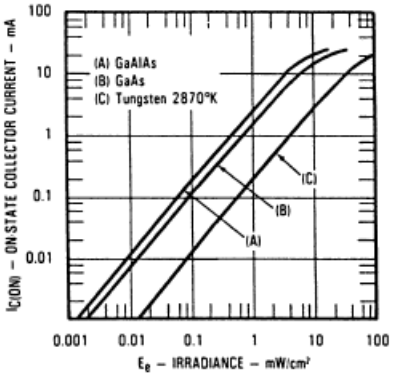

**Coupling Characteristics OP165 and OP505**



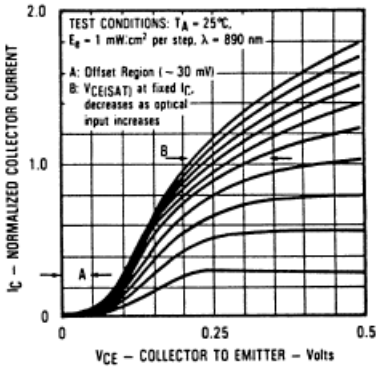

**Normalized Collector Current vs. Angular Displacement**



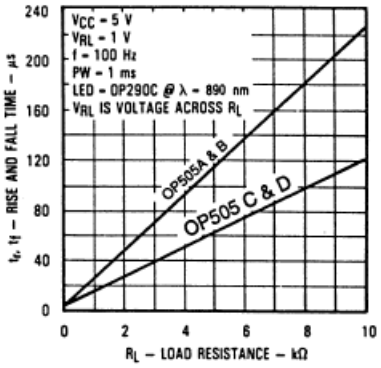

**On-State Collector Current vs. Irradiance**



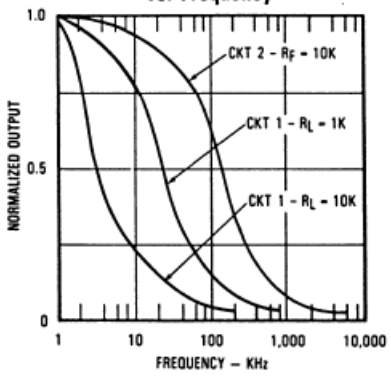

**Normalized Collector Current vs. Collector to Emitter Voltage**



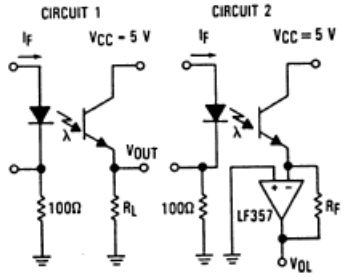

**Rise and Fall Time vs. Load Resistance**




**Normalized Output vs. Frequency**




**Switching Time Test Circuit**




Test Conditions:
Light source is pulsed LED with $t_r$ and $t_f \leq 500$ ns.
$I_F$ is adjusted for $V_{OUT}$ = 1 Volt.

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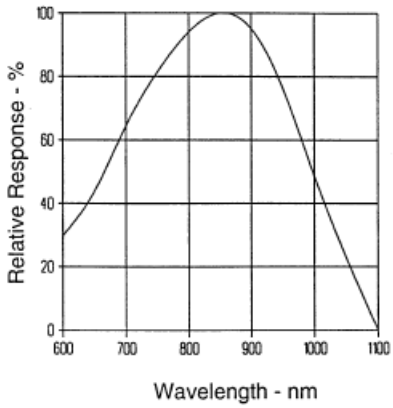
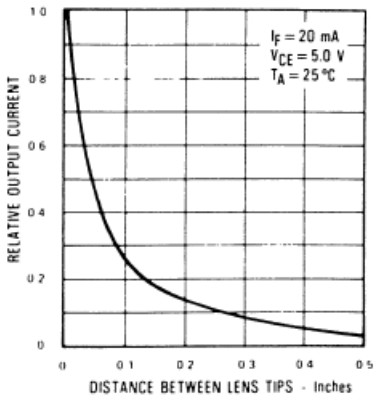
## Performance

**OP505W**

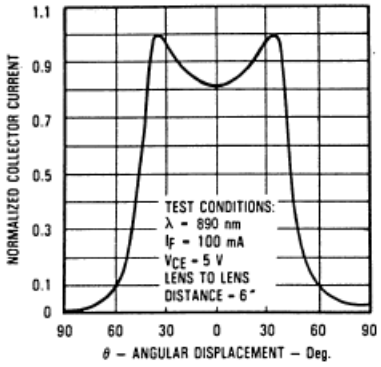
Typical Spectral Response



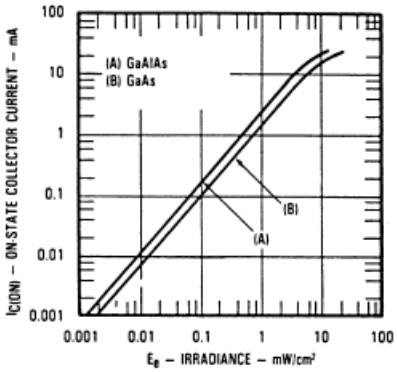

Coupling Characteristics of OP165W and OP505W



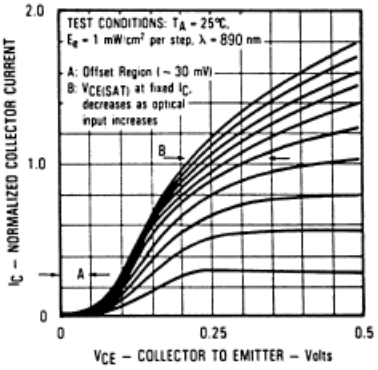

Normalized Collector Current vs. Angular Displacement



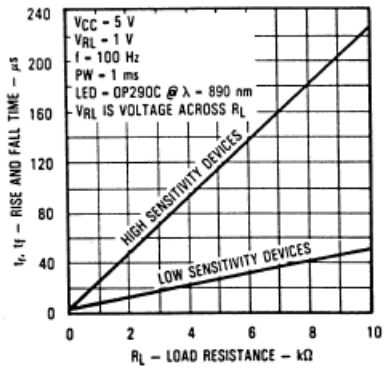

On-State Collector Current vs Irradiance



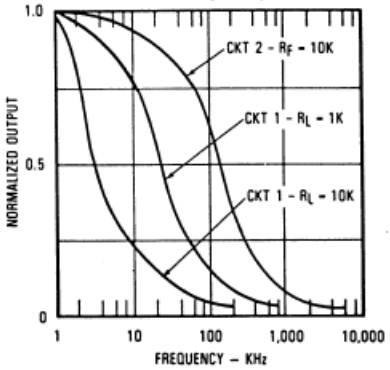

Normalized Collector Current vs. Collector to Emitter Voltage



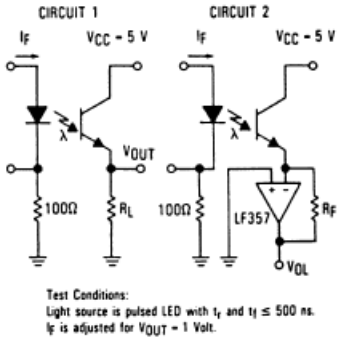

Rise and Fall Time vs. Load Resistance




Normalized Output vs. Frequency




Switching Time Test Circuit




Test Conditions:
Light source is pulsed LED with $t_r$ and $t_f \leq$ 500 ns.
$I_F$ is adjusted for $V_{OUT}$ = 1 Volt.

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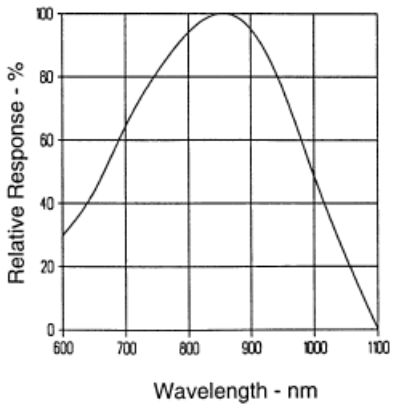
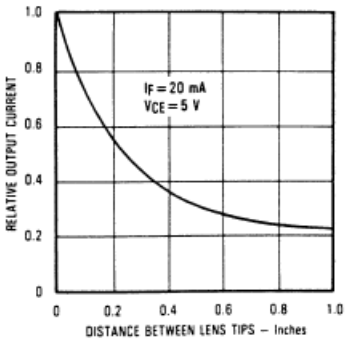
## Performance

**OP506A, OP506B**

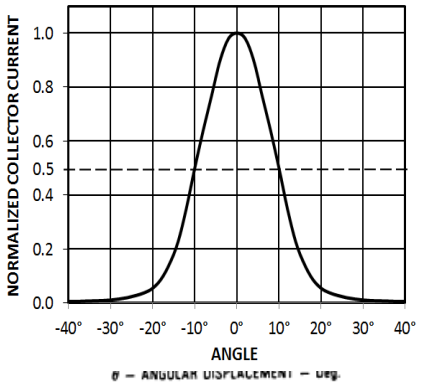
Typical Spectral Response



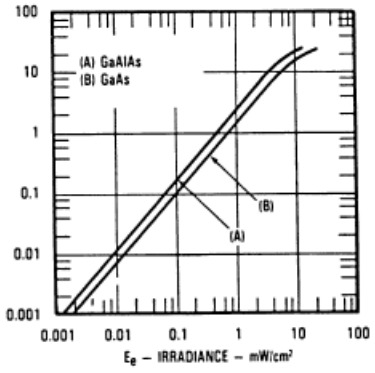

Coupling Characteristics of OP166 and OP506



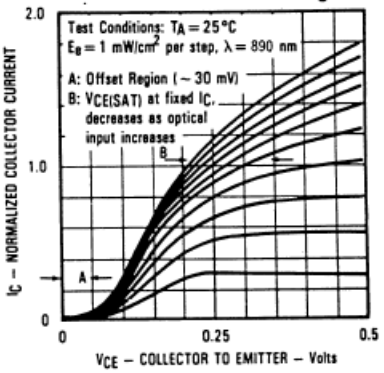

Normalized Collector Current vs. Angular Displacement



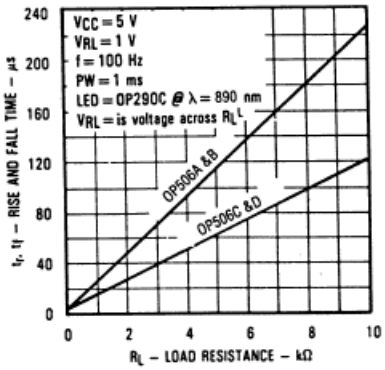

On-State Collector Current vs Irradiance



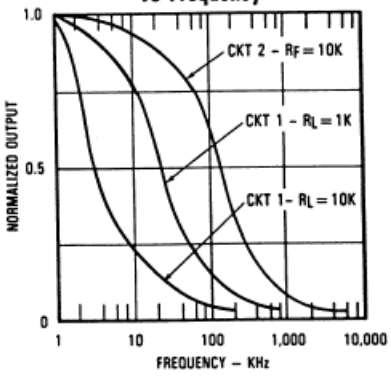

Normalized Collector Current vs Collector-to-Emitter Voltage



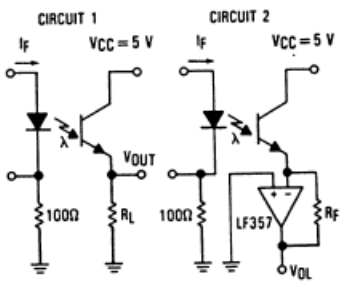

Rise and Fall Time vs Load Resistance




Normalized Output vs Frequency




Switching Time Test Circuit




Test Conditions:
Light source is pulsed LED with $t_r$ and $t_f \leq 500$ ns.
$I_F$ is adjusted for $V_{OUT} = 1$ Volt.

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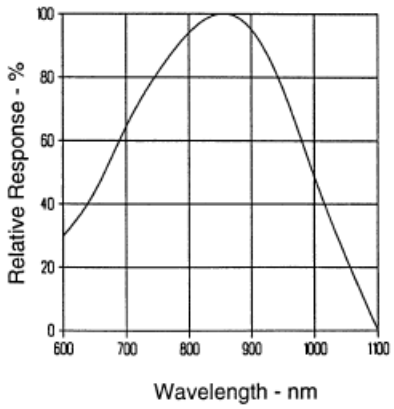
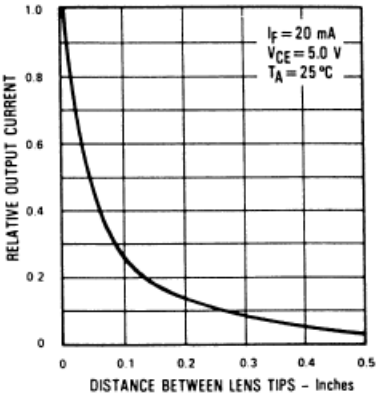
## Performance

**OP506W**

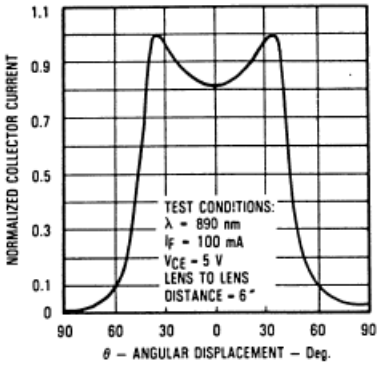
**Typical Spectral Response**



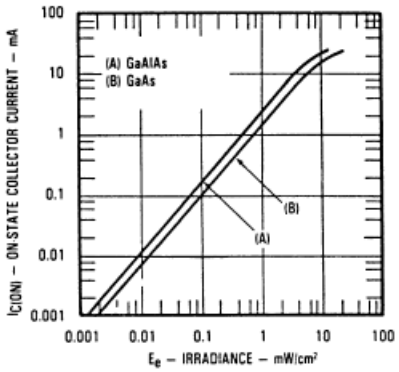

**Coupling Characteristics**



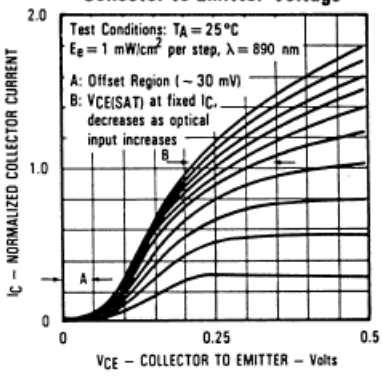

**Normalized Collector Current vs. Angular Displacement**



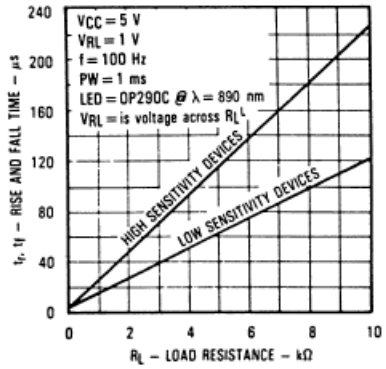

**On-State Collector Current vs Irradiance**



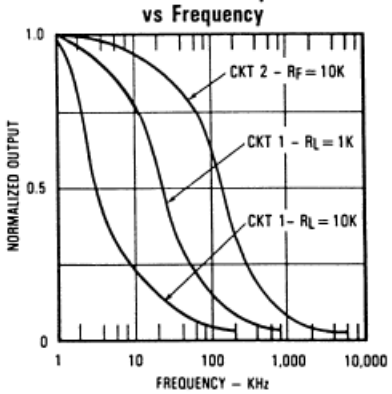

**Normalized Collector Current vs Collector-to-Emitter Voltage**



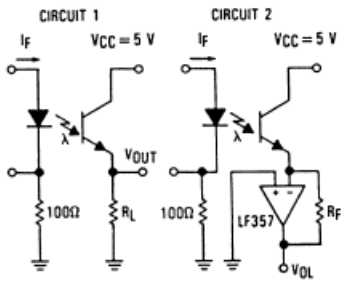

**Rise and Fall Time vs Load Resistance**




**Normalized Output vs Frequency**




**Switching Time Test Circuit**




Test Conditions:
Light source is pulsed LED with $t_r$ and $t_f$ ≤ 500 ns.
$I_F$ is adjusted for $V_{OUT}$ = 1 Volt.

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