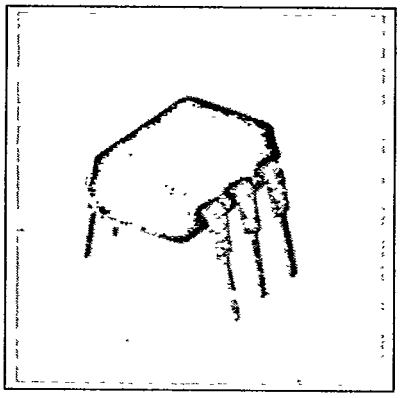
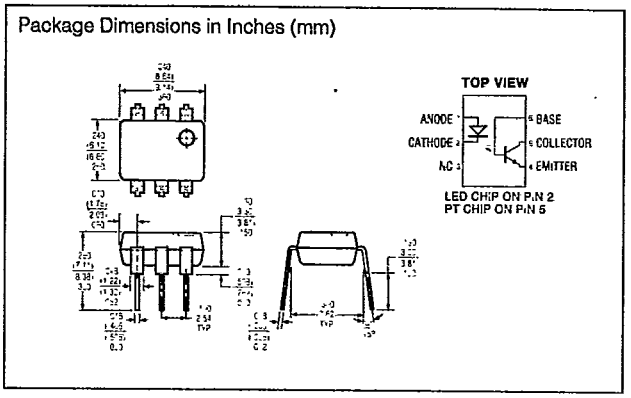
SIEMENS

# IL1/2/5

## PHOTOTRANSISTOR OPTOCOUPLER

T-41-83






### FEATURES

- **Current Transfer Ratio @ $I_F$ = 10 mA**
  **IL1 – 20% Min.**
  **IL2 – 100% Min.**
  **IL5 – 50% Min.**
- **High Collector-Emitter Voltage**
  **IL1 – $BV_{CEO}$ = 50 V**
  **IL2, IL5 – $BV_{CEO}$ = 70 V**
- **Field-Effect Stable by TRansparent IOn Shield (TRIOS)***
- **Double Molded Package Offers Withstand Test Voltage**
  **7500 $VAC_{PEAK}$, 1 sec.**
  **4420 $VAC_{RMS}$, 1 min.**
- **UL Approval #E52744**
- **VDE Approvals 0883/6.80, 0804/1.83**

### DESCRIPTION

The IL1/2/5 are optically coupled isolated pairs employing GaAs infrared LEDs and silicon NPN phototransistor. Signal information, including a DC level, can be transmitted by the drive while maintaining a high degree of electrical isolation between input and output. The IL1/2/5 are especially designed for driving medium-speed logic and can be used to eliminate troublesome ground loop and noise problems. These couplers can be used also to replace relays and transformers in many digital interface applications such as CRT modulation.

*See Appnote 45, "How to Use Optocoupler Normalized Curves."*

TRansparent IOn Shield.

### Maximum Ratings

**Emitter**

| | |
|---|---|
| Reverse Voltage | 6 V |
| Forward Current | 100 mA |
| Surge Current | 2.5 A |
| Power Dissipation | 200 mW |
| Derate Linearly from 25°C | 2.6 mW/°C |

**Detector**

| | |
|---|---|
| Collector-Emitter Reverse Voltage | |
| IL1 | 50 V |
| IL2, IL5 | 70 V |
| Emitter-Base Reverse Voltage | 7 V |
| Collector-Base Reverse Voltage | 70 V |
| Collector Current | 50 mA |
| Collector Current (t<1 ms) | 400 mA |
| Power Dissipation | 200 mW |
| Derate Linearly from 25°C | 2.6 mW/°C |

**Package**

| | |
|---|---|
| Storage Temperature | -40°C to +150°C |
| Operating Temperature | -40°C to +100°C |
| Junction Temperature | 100°C |
| Soldering Temperature (in a 2 mm distance from case bottom) | 260°C |
| Package Power Dissipation | 250 mW |
| Derate Linearly from 25°C | 3.3 mW/°C |
| UL Withstand Test Voltage (PK) (t=1 sec.) | 7500 VDC/5300 $VAC_{RMS}$ |
| VDE Isolation Test Voltage in Accordance with DIN 57883/6 80 | 5300 VDC/3750 $VAC_{RMS}$ |
| Creepage Path | 8 min mm |
| Clearance Path | 7 min mm |
| Tracking Index According to VDE 0303 | KB100/A |
| Working Voltage | 1700 $VAC_{RMS}$ |
| Insulation Resistance | $10^{11}$ Ω |

## Characteristics

| | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| **Emitter** | | | | | |
| Forward Voltage ($I_F$=60 mA) | $V_F$ | | 1.25 | 1.65 | V |
| Breakdown Voltage ($I_R$=10 µA) | $V_{BR}$ | 6 | 30 | | V |
| Reverse Current ($V_R$=6 V) | $I_R$ | | 0.01 | 10 | µA |
| Capacitance ($V_R$=0 V, f=1 MHz) | $C_0$ | | 40 | | pF |
| Thermal Resistance Junction to Lead | $R_{th\,JL}$ | | 750 | | °C/W |
| **Detector** | | | | | |
| Capacitance | | | | | |
| ($V_{CE}$=5 V, f=1 MHz) | $C_{CE}$ | | 6.8 | | pF |
| ($V_{CB}$=5 V, f=1 MHz) | $C_{CB}$ | | 8.5 | | pF |
| ($V_{EB}$=5 V, f=1 MHz) | $C_{EB}$ | | 11 | | pF |
| Collector-Emitter Leakage Current ($V_{CE}$=10 V) | $I_{CEO}$ | | 5 | 50 | nA |
| Collector-Emitter Saturation Voltage ($I_{CE}$=1 mA, $I_B$=20 µA) | $V_{CE(SAT)}$ | | 0.25 | 0.4 | |
| Base-Emitter Voltage ($V_{CE}$=10 V, $I_B$=20 µA) | $V_{BE}$ | | 0.65 | | V |
| DC Forward Current Gain ($V_{CE}$= 10 V, $I_B$=20 µA) | HFE | 200 | 650 | 1800 | |
| Saturated DC Forward Current Gain ($V_{CE}$= 0.4 V, $I_B$=20 µA) | $HFE_{SAT}$ | 120 | 400 | 600 | |
| Thermal Resistance Junction to Lead | $R_{th\,JL}$ | | 500 | | C°/W |
| **Package Transfer Characteristics** | | | | | |
| **IL1** | | | | | |
| Saturated Current Transfer Ratio (Collector-Emitter) ($I_F$=10 mA, $V_{CE}$=0.4 V) | $CTR_{CESAT}$ | | 75 | | % |
| Current Transfer Ratio (Collector-Emitter) ($I_F$=10 mA, $V_{CE}$=10 V) | $CTR_{CE}$ | 20 | 80 | 300 | % |
| Current Transfer Ratio (Collector-Base) ($I_F$=10 mA, $V_{CB}$=9.3 V) | $CTR_{CB}$ | | 0.25 | | % |

## Characteristics (Cont.)

| | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| **Package Transfer Characteristics (Cont.)** | | | | | |
| **IL2** | | | | | |
| Saturated Current Transfer Ratio (Collector-Emitter) ($I_F$=10 mA, $V_{CE}$=0.4 V) | $CTR_{CESAT}$ | | 170 | | % |
| Current Transfer Ratio (Collector-Emitter) ($I_F$=10 mA, $V_{CE}$=10 V) | $CTR_{CE}$ | 100 | 200 | 500 | % |
| Current Transfer Ratio ($I_F$=10 mA, $V_{CB}$=9.3 V) | $CTR_{CB}$ | | 0.35 | | % |
| **IL5** | | | | | |
| Saturated Current Transfer Ratio (Collector-Emitter) ($I_F$=10 mA, $V_{CE}$=0.4 V) | $CTR_{CESAT}$ | | 100 | | % |
| Current Transfer Ratio (Collector-Emitter) ($I_F$=10 mA, $V_{CE}$=10 V) | $CTR_{CE}$ | 50 | 130 | 400 | % |
| Current Transfer Ratio ($I_F$=10 mA, $V_{CB}$=9.3 V) | $CTR_{CB}$ | | 0.3 | | % |
| **Isolation and Insulation** | | | | | |
| Common Mode Rejection Output High ($V_{CM}$=50 $V_{P-P}$, $R_L$=1 kΩ, $I_F$=0 mA) | CMH | | 5000 | | V/µs |
| Common Mode Rejection Output Low ($V_{CM}$=50 $V_{P-P}$, $R_L$=1 kΩ, $I_F$=10 mA) | CML | | 5000 | | V/µs |
| Common Mode Coupling Capacitance | $C_{CM}$ | | 0.01 | | pF |
| Package Capacitance ($V_{I-O}$=0 V, f=1 MHz.) | $C_{I-O}$ | 0.8 | | | pF |
| Insulation Resistance ($V_{I-O}$=500 V) | $R_S$ | $5^{+10}$ | $10^{+14}$ | | Ω |
| Dielectric Leakage Current ($V_{IO}$=4420 $AC_{(RMS)}$, 1 min., 60 Hz) | $I_{I-O}$ | | 3.3 | 10 | µA |
| ($V_{IO}$=6250 VDC, 1 min.) | | | 0.5 | 10 | µA |
| ($V_{IO}$=5304 $AC_{(RMS)}$, 1 sec., 60 Hz) | | | 4 | 10 | µA |
| ($V_{IO}$=7500 VDC, 1 sec.) | | | 0.6 | 12 | µA |

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Optocouplers (Optoisolators)

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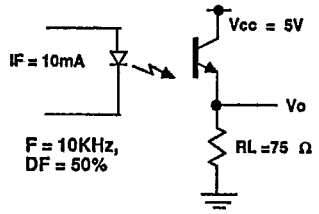
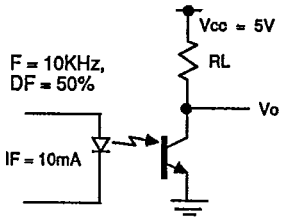
## SWITCHING TIMES

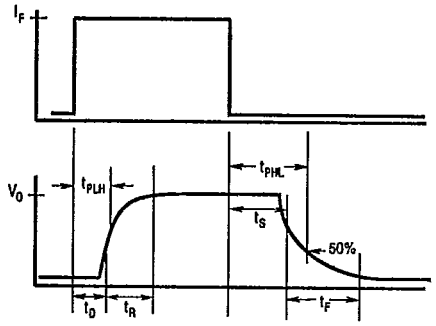
### Non-Saturated Switching



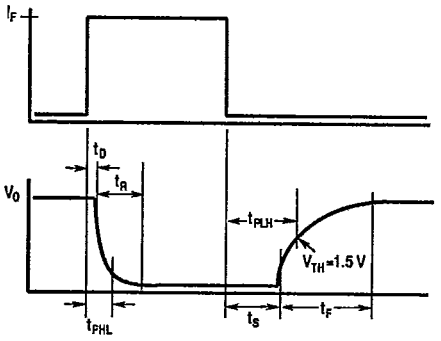

### Saturated Switching




### Non-Saturated Switching Timing



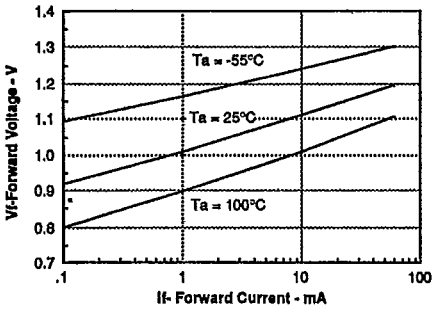

### Saturated Switching Timing



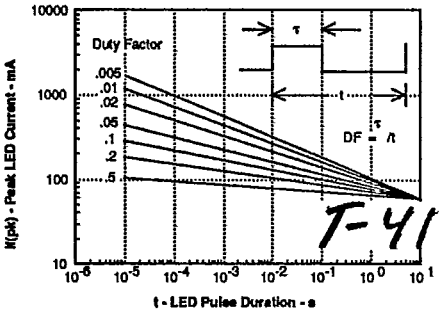

| Characteristic | | IL1 $I_F$=20 mA | IL2 $I_F$=5 mA | IL5 $I_F$=10 mA | Unit |
|---|---|---|---|---|---|
| Delay | $T_D$ | 0.8 | 1.7 | 1.7 | µs |
| Rise Time ($V_{CC}$=5 V) | $t_R$ | 1.9 | 2.6 | 2.6 | µs |
| Storage ($R_L$=75 Ω) | $t_S$ | 0.2 | 0.4 | 0.4 | µs |
| Fall Time | $t_F$ | 1.4 | 2.2 | 2.2 | µs |
| Propagation H-L (50% of $V_{PP}$) | $t_{PHL}$ | 0.7 | 1.2 | 1.1 | µs |
| Propagation L-H | $t_{PLH}$ | 1.4 | 2.3 | 2.5 | µs |

| Characteristic | | IL1 $I_F$=20 mA | IL2 $I_F$=5 mA | IL5 $I_F$=10 mA | Unit |
|---|---|---|---|---|---|
| Delay | $T_D$ | 0.8 | 1 | 1.7 | µs |
| Rise Time ($V_{CE}$=0.4 V) | $t_R$ | 1.2 | 2 | 7 | µs |
| Storage ($R_L$=1 kΩ) | $t_S$ | 7.4 | 5.4 | 4.6 | µs |
| Fall Time ($V_{CC}$=5 V) | $t_F$ | 7.6 | 13.5 | 20 | µs |
| Propagation H-L ($V_{TH}$=1.5 V) | $t_{PHL}$ | 1.6 | 5.4 | 2.6 | µs |
| Propagation L-H | $t_{PLH}$ | 8.6 | 7.4 | 7.2 | µs |

Forward voltage versus forward current




Peak LED current versus duty factor, Tau

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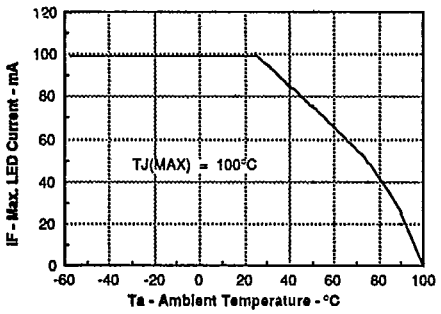
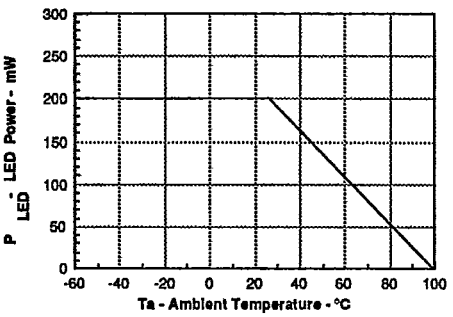
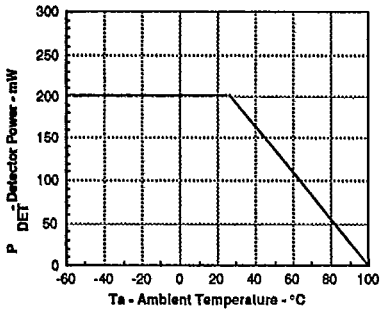
Maximum LED current versus ambient temperature



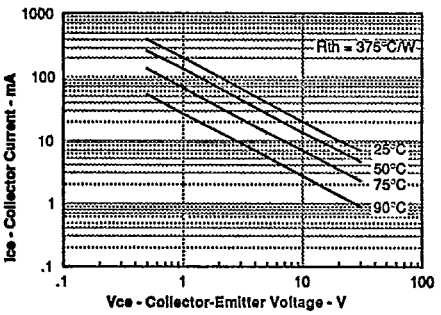

Maximum LED power dissipation



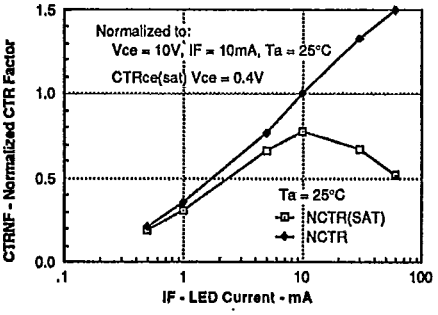

Maximum detector power dissipation



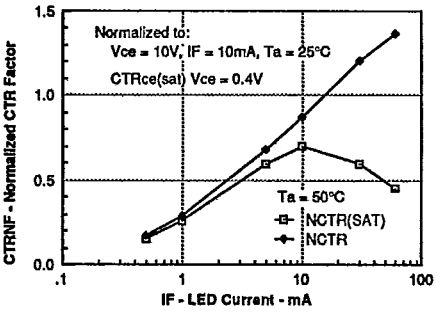

IL1 Maximum collector current versus collector voltage




Normalization factor for non-saturated and saturated CTR
$T_{amb}$=25°C versus $I_F$



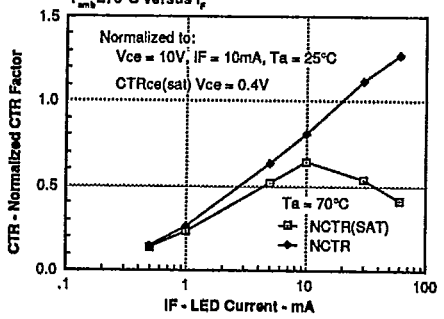

Normalization factor for non-saturated and saturated CTR
$T_{amb}$=50°C versus $I_F$



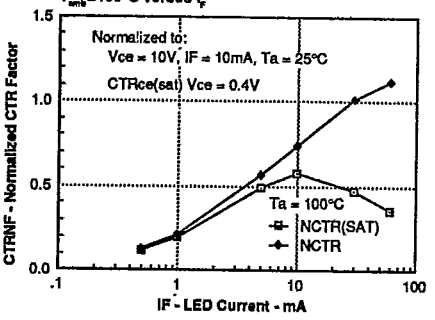

Optocouplers (Optoisolators)

IL1/2/5

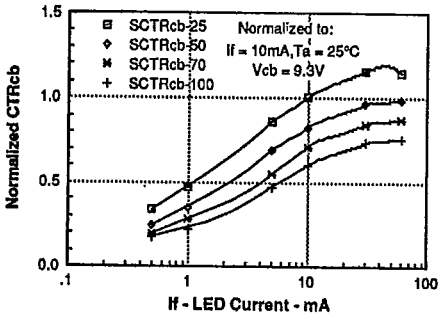
Normalization factor for non-saturated and saturated CTR $T_{amb}$=70°C versus $I_F$



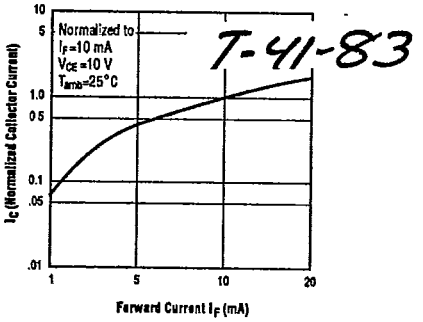

Normalization factor for non-saturated and saturated CTR $T_{amb}$=100°C versus $I_F$




Normalized $CTR_{cb}$ versus LED Current




Collector current versus diode forward current

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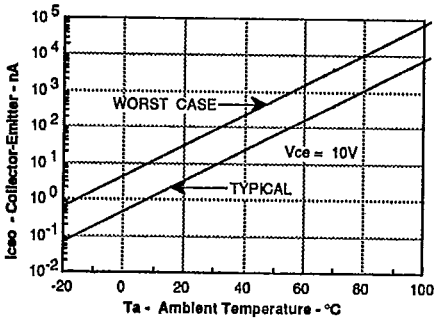
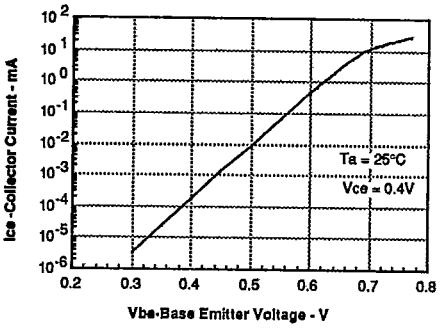
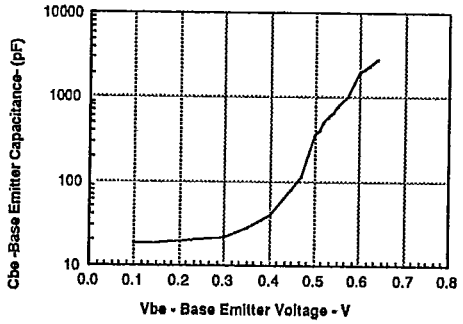
Collector-emitter leakage versus temperature



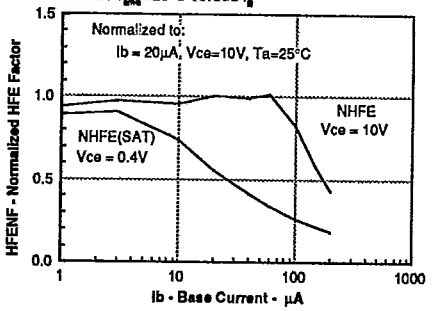

Collector current versus base voltage




$C_{be}$ versus $V_{be}$




Normalization factor for non-saturated and saturated HFE at $T_{amb}$=25°C versus $I_B$

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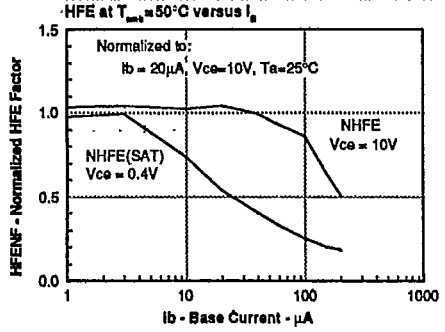
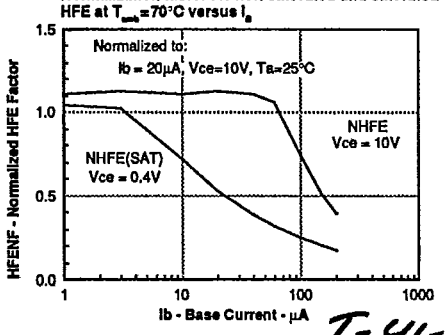
Normalization factor for non-saturated and saturated HFE at $T_{amb}$=50°C versus $I_b$




Normalization factor for non-saturated and saturated HFE at $T_{amb}$=70°C versus $I_b$

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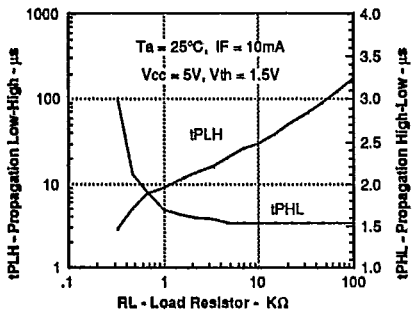
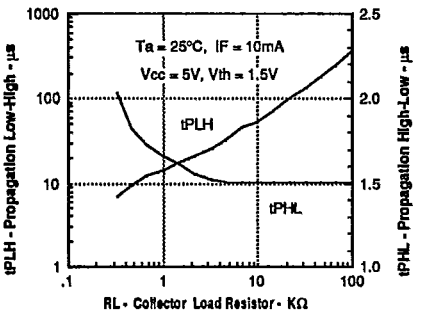
IL1 propagation delay versus collector load resistor




IL2 propagation delay versus collector load resistor




IL5 propagation delay versus collector load resistor