Phototransistor Optocoupler

FEATURES

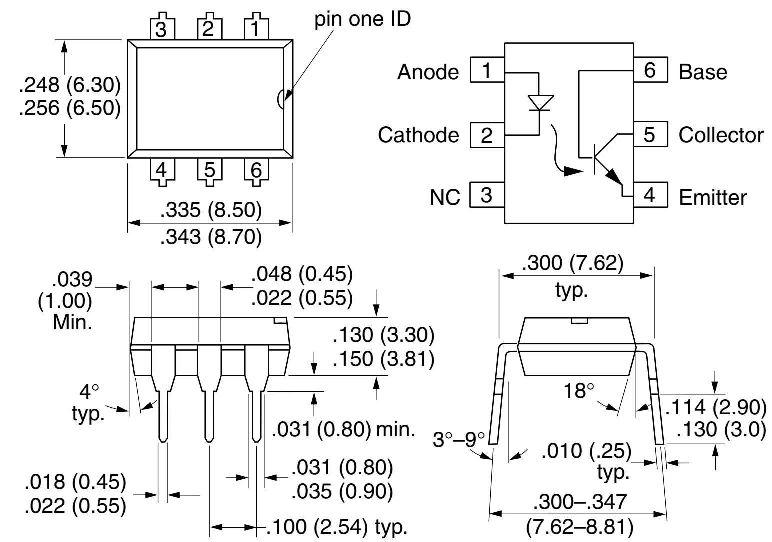
- **Current Transfer Ratio at I_F=10 mA**
  IL1, 20% Min.
  IL2, 100% Min.
  IL5, 50% Min.
- **High Collector-Emitter Voltage**
  IL1 – BV_{CEO}=50 V
  IL2, IL5 – BV_{CEO}=70 V
- **Field-Effect Stable by TRansparent IOn Shield (TRIOS)**
- **Double Molded Package Offers Isolation Test Voltage 5300 V_{RMS}**
- **Underwriters Lab File #E52744**
- **VDE Approval #0884**
  (Available with Option 1)

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”.

Dimensions in inches (mm)



Maximum Ratings

Emitter

Reverse Voltage	6.0 V
Forward Current	60 mA
Surge Current	2.5 A
Power Dissipation	100 mW
Derate Linearly from 25°C	1.33 mW/°C

Detector

Collector-Emitter Reverse Voltage	
IL1	50 V
IL2, IL5	70 V
Emitter-Base Reverse Voltage	7.0 V
Collector-Base Reverse Voltage	70 V
Collector Current	50 mA
Collector Current (t<1.0 ms)	400 mA
Power Dissipation	200 mW
Derate Linearly from 25°C	2.6 mW/°C

Package

Package Power Dissipation	250 mW
Derate Linearly from 25°C	3.3 mW/°C
Isolation Test Voltage (between emitter and detector referred to standard climate 23°C/50%RH, DIN 50014)	5300 V_{RMS}
Creepage	≥7.0 mm
Clearance	≥7.0 mm
Comparative Tracking Index per DIN IEC 112/VDE 0303, part 1	175
Isolation Resistance	
V_{IO}=500 V, T_A=25°C	$\geq 10^{12}\ \Omega$
V_{IO}=500 V, T_A=100°C	$\geq 10^{11}\ \Omega$
Storage Temperature	–40°C to +150°C
Operating Temperature	–40°C to +100°C
Junction Temperature	100°C
Soldering Temperature (2.0 mm from case bottom)	260°C

Characteristics

	Symbol	Min	Typ	Max	Unit	Condition
Emitter						
Forward Voltage	V_F	—	1.25	1.65	V	I_F=60 mA
Breakdown Voltage	V_{BR}	6.0	30	—		I_R=10 µA
Reverse Current	I_R	—	0.01	10	µA	V_R=6.0 V
Capacitance	C_O	—	40	—	pF	V_R=0 V, f=1.0 MHz
Thermal Resistance Junction to Lead	R_{THJL}	—	750	—	K/W	—
Detector						
Capacitance	C_{CE} C_{CB} C_{EB}	—	6.8 8.5 11	—	pF	V_{CE}=5.0 V, f=1.0 MHz V_{CB}=5.0 V, f=1.0 MHz V_{EB}=5.0 V, f=1.0 MHz
Collector-Emitter Leakage Current	I_{CEO}	—	5.0	50	nA	V_{CE}=10 V
Collector-Emitter Saturation Voltage	V_{CESAT}	—	0.25	—	V	I_{CE}=1.0 mA, I_B=20 µA
Base-Emitter Voltage	V_{BE}	—	0.65	—	V	V_{CE}=10 V, I_B=20 µA
DC Forward Current Gain	HFE	200	650	1800	—	V_{CE}=10 V, I_B=20 µA
Saturated DC Forward Current Gain	HFE_{SAT}	120	400	600	—	V_{CE}=0.4 V, I_B=20 µA
Thermal Resistance Junction to Lead	R_{THJL}	—	500	—	K/W	—
Package Transfer Characteristics						
IL1						
Saturated Current Transfer Ratio (Collector-Emitter)	CTR_{CESAT}	—	75	—	%	I_F=10 mA, V_{CE}=0.4 V
Current Transfer Ratio (Collector-Emitter)	CTR_{CE}	20	80	300		I_F=10 mA, V_{CE}=10 V
Current Transfer Ratio (Collector-Base)	CTR_{CB}	—	0.25	—		I_F=10 mA, V_{CB}=9.3 V
IL2						
Saturated Current Transfer Ratio (Collector-Emitter)	CTR_{CESAT}	—	170	—	%	I_F=10 mA, V_{CE}=0.4 V
Current Transfer Ratio (Collector-Emitter)	CTR_{CE}	100	200	500		I_F=10 mA, V_{CE}=10 V
Current Transfer Ratio	CTR_{CB}	—	0.25	—		I_F=10 mA, V_{CB}=9.3 V
IL5						
Saturated Current Transfer Ratio (Collector-Emitter)	CTR_{CESAT}	—	100	—	%	I_F=10 mA, V_{CE}=0.4 V
Current Transfer Ratio (Collector-Emitter)	CTR_{CE}	50	130	400		I_F=10 mA, V_{CE}=10 V
Current Transfer Ratio	CTR_{CB}	—	0.25	—		I_F=10 mA, V_{CB}=9.3 V
Isolation and Insulation						
Common Mode Rejection Output High	CMH	—	5000	—	V/µs	V_{CM}=50 V_{P-P}, R_L=1 kΩ, I_F=10 mA
Common Mode Rejection Output Low	CML	—		—		
Common Mode Coupling Capacitance	C_{CM}	—	0.01	—	pF	—
Package Capacitance	C_{I-O}	—	0.6	—		V_{I-O}=0 V, f=1.0 MHz
Insulation Resistance	R_S	—	10^{14}	—	Ω	V_{I-O}=500 V

Switching Times

Figure 1. Non-saturated switching timing

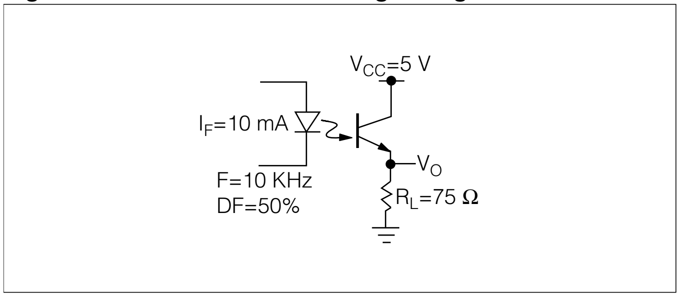


Figure 2. Saturated switching timing

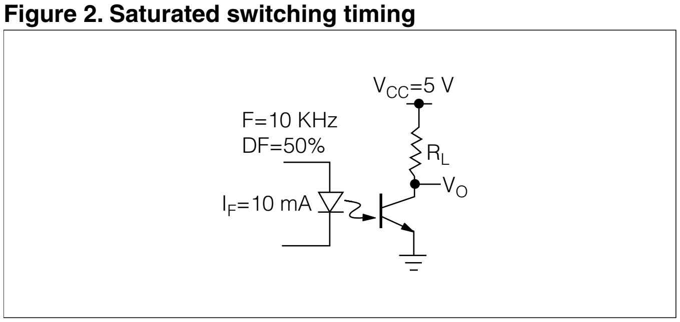


Figure 3. Non-saturated switching timing

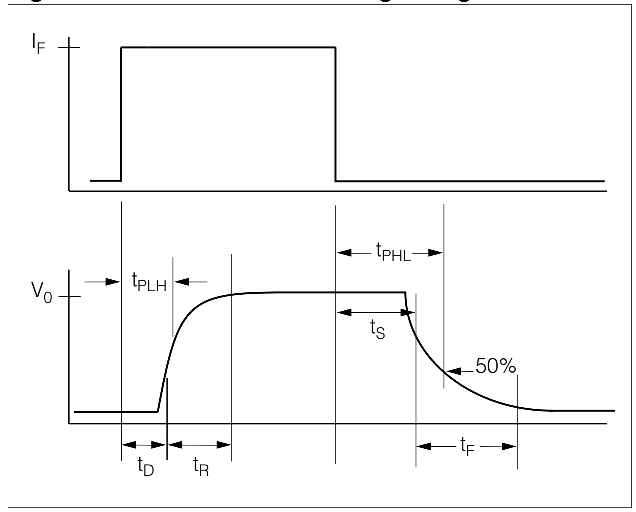
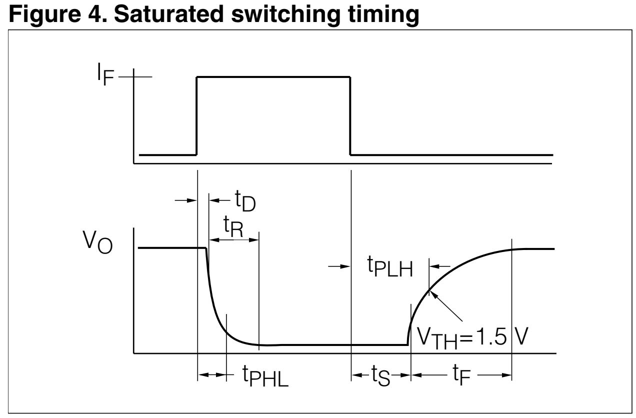


Figure 4. Saturated switching timing



Non-Saturated Switching Time Table—Typical

Characteristic	Sym	IL1 I_F=20 mA	IL2 I_F=5.0 mA	IL5 I_F=10 mA	Unit	Test Condition
Delay	T_D	0.8	1.7	1.7	µs	—
Rise Time	t_r	1.9	2.6	2.6		V_{CC}=5.0 V
Storage	t_S	0.2	0.4	0.4		R_L=75 Ω
Fall Time	t_f	1.4	2.2	2.2		—
Propagation H-L	t_{PHL}	0.7	1.2	1.1		t_p measured at 50% of output
Propagation L-H	t_{PLH}	1.4	2.3	2.5		—

Saturated Switching Time Table—Typical

Characteristic	Sym	IL1 I_F=20 mA	IL2 I_F=5.0 mA	IL5 I_F=10 mA	Unit	Test Condition
Delay	T_D	0.8	1.0	1.7	µs	—
Rise Time	t_r	1.2	2.0	7.0		V_{CL}=5.0 V
Storage	t_S	7.4	5.4	4.6		V_{CE}=0.4
Fall Time	t_f	7.6	13.5	20		R_L=1.0 K
Propagation H-L	t_{PHL}	1.6	5.4	2.6		V_{TH}=1.5 V
Propagation L-H	t_{PLH}	8.6	7.4	7.2		—

Figure 5. Forward voltage versus forward current

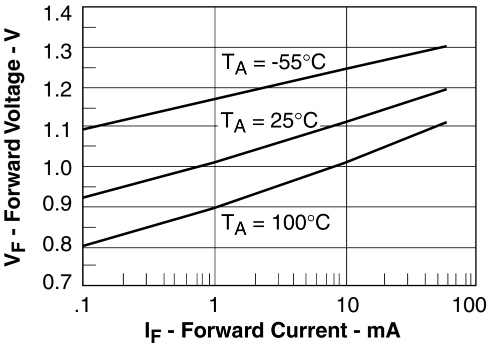


Figure 6. Normalized non-saturated and saturated CTR at T_A=25°C versus LED current

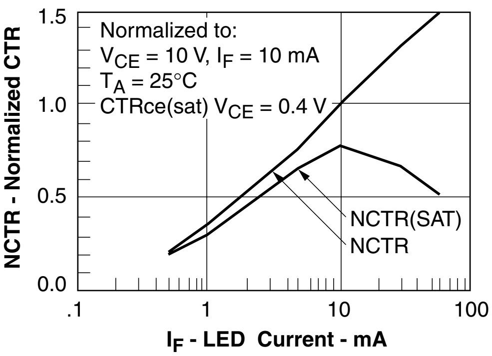


Figure 7. Normalized non-saturated and saturated CTR at T_A=50°C versus LED current

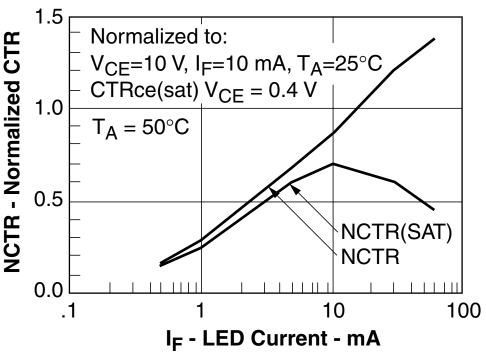


Figure 8. Normalized non-saturated and saturated CTR at T_A=70°C versus LED current

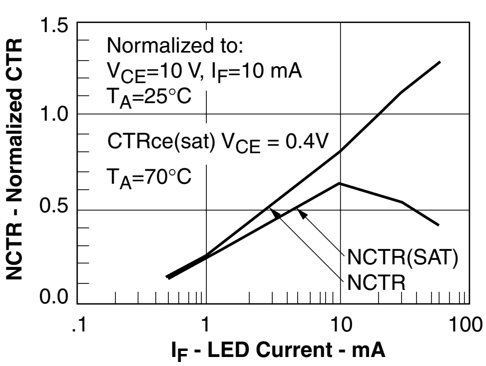


Figure 9. Normalized non-saturated and saturated CTR at T_A=100°C versus LED current

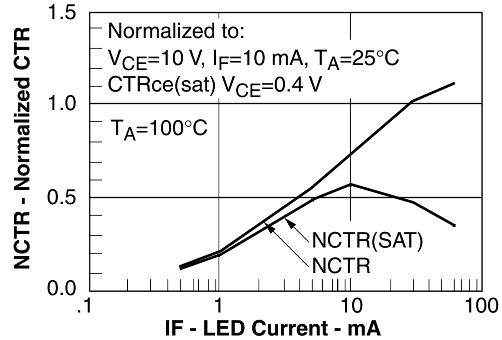


Figure 10. Collector-emitter current versus temperature and LED current

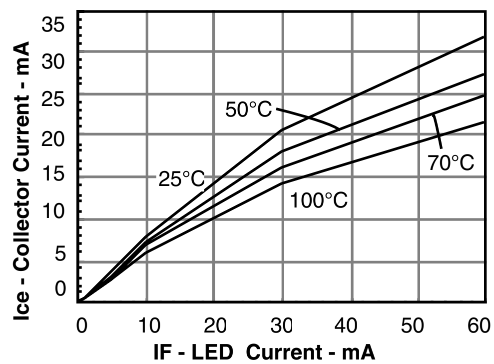


Figure 11. Collector-emitter leakage current versus temperature

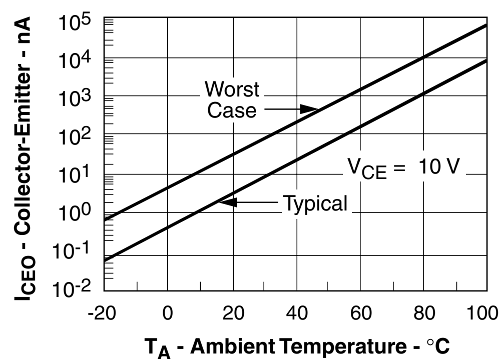


Figure 12. Normalized CTR_{cb} versus LED current and temperature

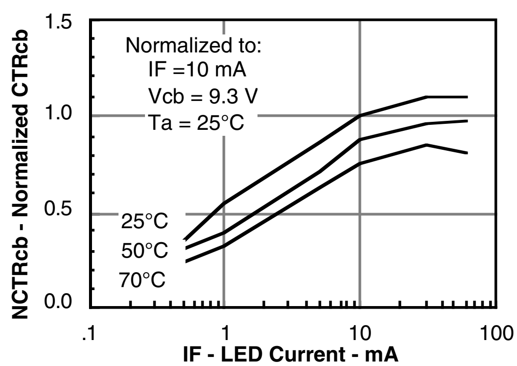


Figure 13. Collector base photocurrent versus LED current

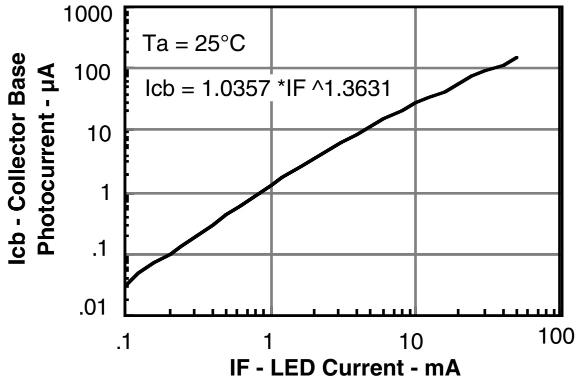


Figure 14. Normalized photocurrent versus I_F and temperature

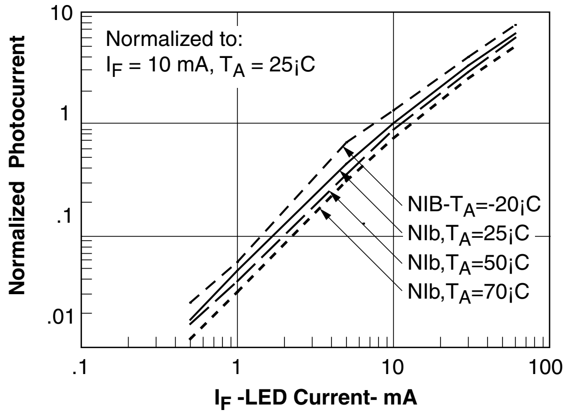


Figure 15. Normalized non-saturated HFE versus base current and temperature

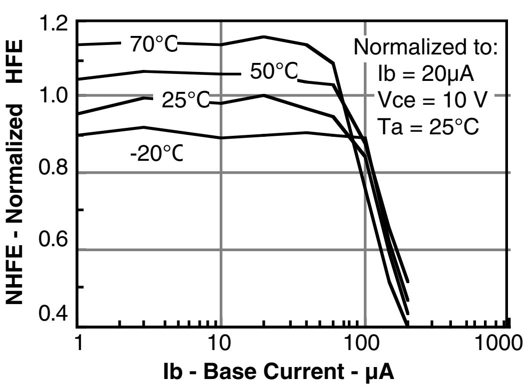


Figure 16. Normalized saturated HFE versus base current and temperature

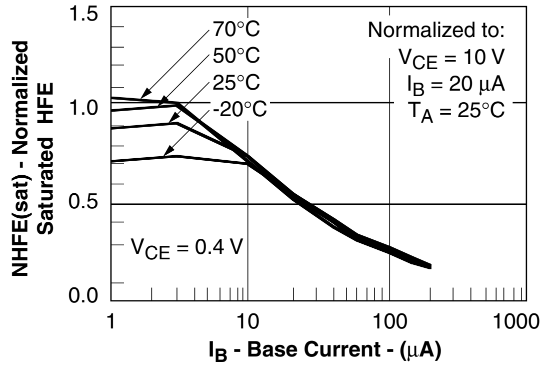


Figure 17. Propagation delay versus collector load resistor