

PHOTOTRANSISTOR OPTOCOUPLER

FEATURES

- High Current Transfer Ratio—4N35/6/7, 100% Min.
- Coupling Capacitance, 0.5 pF
- Standard Dual-In-Line
- Underwriters Lab File #E52744
- VDE Approval #0884 (Optional with Option 1, add -X001 Suffix)

DESCRIPTION

The 4N35, 4N36, 4N37, and 4N38 are optically coupled pairs with a Gallium Arsenide infrared LED and a silicon NPN phototransistor.

Maximum Ratings

Emitter

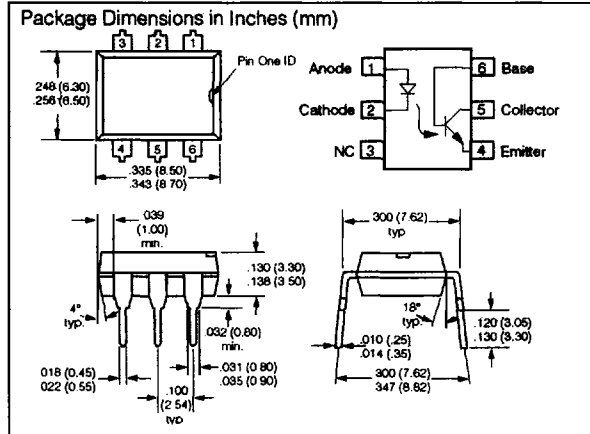
Peak Reverse Voltage	6.0 V
Continuous Forward Current	60 mA
Power Dissipation at 25°C	100 mW
Derate Linearly from 25°C	1.33 mW/°C

Detector

Collector-Emitter Breakdown Voltage, BV_{CEO}	
4N35/6/7	30 V
4N38	80 V
Emitter-Collector Breakdown Voltage BV_{ECO}	7 V
Collector-Base Breakdown Voltage, BV_{CBO}	
4N35/6/7	70 V
4N38	80 V
Power Dissipation at 25°C	300 mW
Derate Linearly from 25°C	4.0 mW/°C

Package

Withstand Test Voltage	$V_{IO}=5300Vdc$
Between Emitter and Detector	
Referred to Standard Climate	
23°C/50%RH, DIN 50014	
Leakage Path	min. 8.2 mm
Air Path	min. 7.3 mm
Storage Temperature	-55°C to +150°C
Operating Temperature	-55°C to +100°C
Lead Soldering Time at 260°C	10 sec.
Relative Humidity at 85°C	85%



Electrical Characteristics ($T_A=25^\circ C$)

	Sym	Min.	Typ.	Max.	Unit	Condition
Emitter						
Forward Voltage*	V_F	0.9	1.3	1.5	V	$I_F=10\text{ mA}$
				1.7	V	$I_F=10\text{ mA}, T_A=-55^\circ C$
Reverse Current	I_R	0.1	10		μA	$V_R=6.0\text{ V}$
Capacitance	C_O	25			pF	$V_R=0, f=1\text{ MHz}$
Detector						
BV_{ECO}^*		7			V	$I_E=100\text{ }\mu A$
BV_{CEO}^*					V	
4N35/6/7		30			V	$I_C=1\text{ mA}$
4N38		80			V	$I_C=1\text{ mA}$
I_{CEO}					nA	$V_{CE}=10\text{ V}, I_F=0$
4N35/6/7			5	50	nA	$V_{CE}=60\text{ V}, T_A=25^\circ C$
4N38				50	nA	
I_{CEO}					μA	$V_{CE}=30\text{ V}, I_F=0$
4N35/6/7				500	μA	$V_{CE}=60\text{ V}, T_A=100^\circ C$
4N38				6	μA	
BV_{CBO}^*					V	
4N35/6/7		70			V	$I_C=100\text{ }\mu A$
4N38		80			V	$I_B=1\text{ }\mu A$
Capacitance						
Collector-Emitter	C_{CE}	6			pF	$V_{CE}=0$
Package						
DC Current Transfer Ratio*						
4N35/6/7	CTR	100			%	$I_F=10\text{ mA}, V_{CE}=10\text{ V}$ $T_A=25^\circ C$
4N38	CTR	10			%	$V_{CE}=10\text{ V}, I_F=10\text{ mA}$
DC Current Transfer Ratio—4N35/6/7						
	CTR	40			%	$I_F=10\text{ mA}, V_{CE}=10\text{ V}$ $T_A=-55^\circ C\text{ to }100^\circ C$
Saturation Voltage						
Collector-Emitter					V	
4N35/6/7	$V_{CE(SAT)}$		0.3		V	$I_F=10\text{ mA}, I_C=0.5\text{ mA}$
4N38	$V_{CE(SAT)}$		1		V	$I_F=20\text{ mA}, I_C=4\text{ mA}$

Electrical Characteristics (T_A=25°C)—continued

	Sym	Min.	Typ.	Max.	Unit	Condition
Isolation, Input to Output Current*						Pulse Width=8 msec.
4N35/4N38				100	μA	V _{IO} =2500 VRMS
4N36				100	μA	V _{IO} =1750 VRMS
4N37				100	μA	V _{IO} =1050 VRMS
Resistance, Input to Output*		10 ¹¹			Ω	V _{IO} =500 V
Coupling Capacitance*			0.5		pF	f=1.0 MHz
Switching Time*	T _{on} , T _{off}		10		μs	I _C =2 mA, R _E =100 Ω, V _{CC} =10 V
						RH≤50%
Dielectric Leakage Current						
V _{IO} = 4420 V _{AC(RMS)} , 1 min., 60 Hz	I _{IO}	3.3	10.0		μA _{AC(RMS)}	
V _{IO} = 6250 V _{AC(PK)} , 1 min., 60 Hz	I _{IO}	4.7	14.2		μA _{AC(PK)}	
V _{IO} = 5304 V _{AC(RMS)} , 1 sec., 60 Hz	I _{IO}	4.0	12.0		μA _{AC(RMS)}	
V _{IO} = 7500 V _{AC(PK)} , 1 sec., 60 Hz	I _{IO}	5.7	17.0		μA _{AC(PK)}	

* Indicates JEDEC registered values

Figure 1. Forward voltage versus forward current

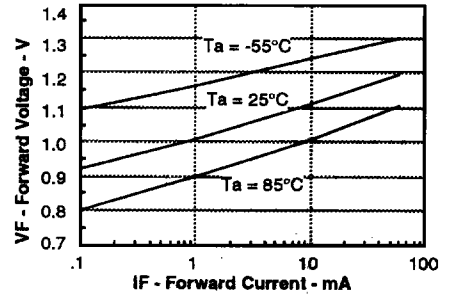


Figure 2. Normalized non-saturated and saturated CTR at T_A=25°C versus LED current

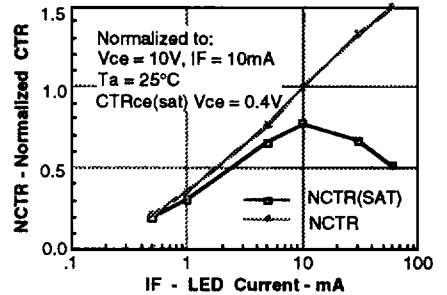


Figure 4. Normalized non-saturated and saturated CTR at T_A=70°C versus LED current

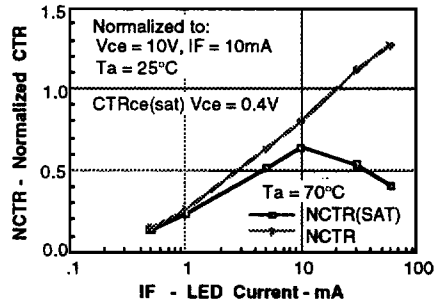


Figure 3. Normalized non-saturated and saturated CTR at T_A=50°C versus LED current

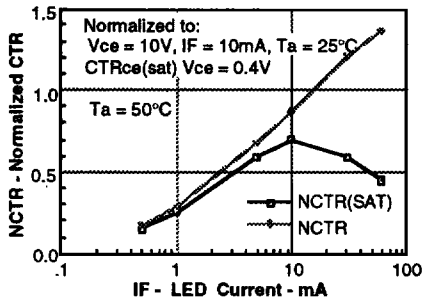


Figure 5. Normalized non-saturated and saturated CTR at T_A=85°C versus LED current

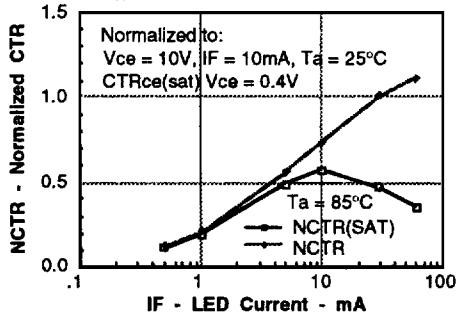


Figure 6. Collector-emitter current versus temperature and LED current

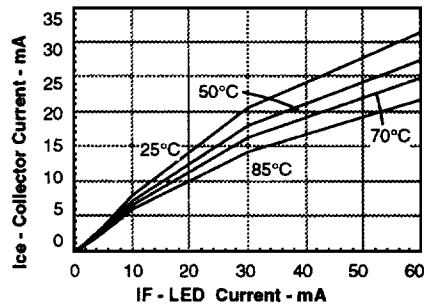


Figure 7. Collector-emitter leakage current versus temperature

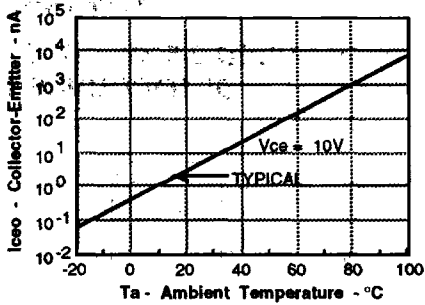


Figure 9. Collector base photocurrent versus LED current

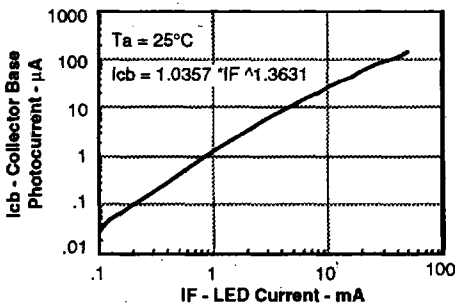


Figure 11. Normalized non-saturated HFE versus base current and temperature

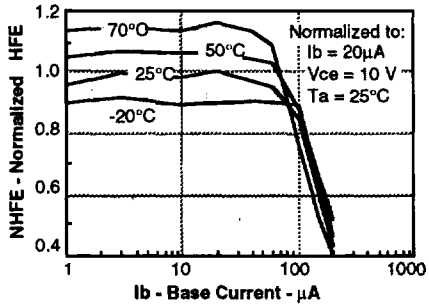


Figure 13. Propagation delay versus collector load resistor

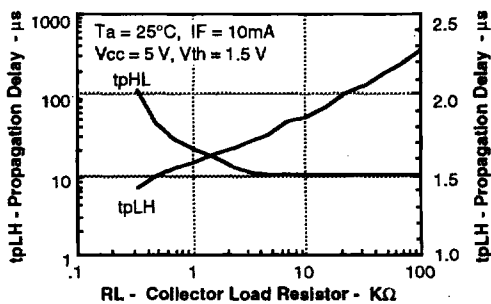


Figure 8. Normalized CTRcb versus LED current and temperature

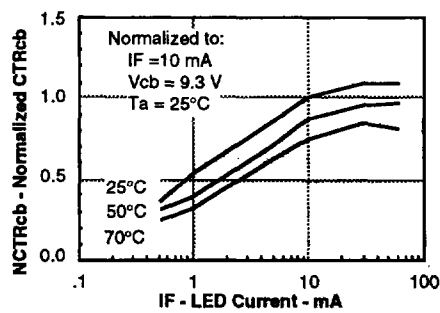


Figure 10. Normalized photocurrent versus I_f and temperature

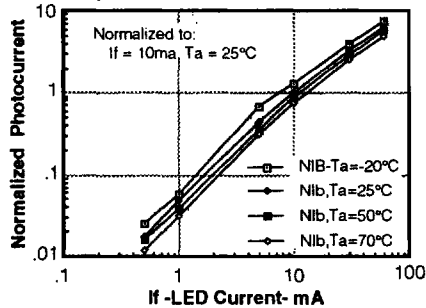


Figure 12. Normalized saturated HFE versus base current and temperature

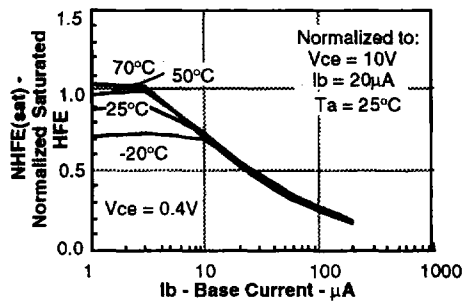
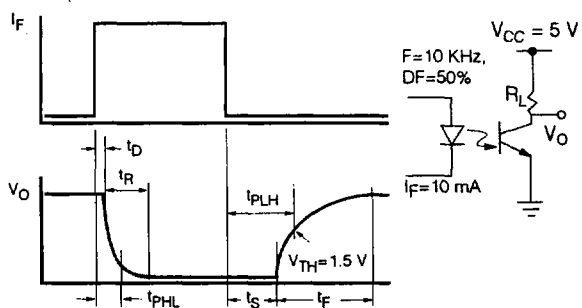


Figure 14. Switching waveform and switching schematic



Optocouplers (Optoisolators)