AC-INPUT OPTOCOUPLERS/OPTOISOLATORS

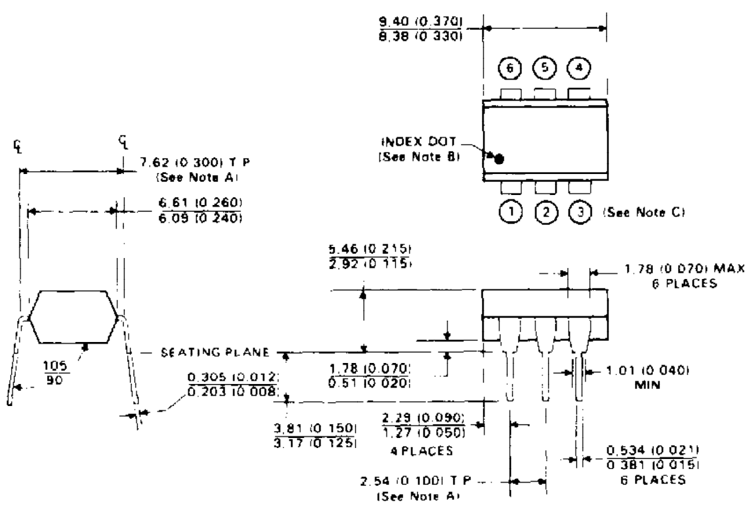
SOOS012A D2980, JANUARY 1987—REVISED JULY 1989

- AC Signal Input
- Gallium Arsenide Dual-Diode Infrared Source Optically Coupled to a Silicon N-P-N Darlington Phototransistor
- Plastic Dual-In-Line Package
- High-Voltage Electrical Isolation, 3.535 kV Peak (2.5 kV rms)
- High Current Transfer Ratio, 500% Minimum at I_F = 10 mA, Up to 1500% Minimum at I_F = 2 mA with Four Categories
- High $V_{(BR)CEO}$, 55 V Min
- UL Recognized — File #E65085
- No Base Lead Connection on TIL188 for High-EMI Environment

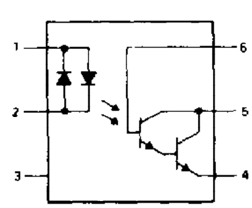
description

The TIL187 and TIL188 Optocouplers are designed for use in AC applications that require very high current transfer ratio and high voltage isolation between input and output. These optocouplers consist of two GaAs light-emitting diodes connected in a reverse-parallel configuration and a silicon n-p-n Darlington phototransistor. The TIL187 has the base connected for applications where a base signal or base resistor is required. The TIL188 is designed with no base connected for applications where high base-noise immunity is desired. Users can select from four different current gains (TIL187-1 through TIL187-4 and TIL188-1 through TIL188-4).

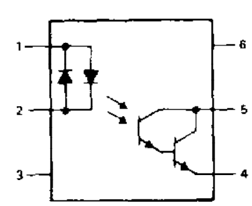
mechanical data



NOTES. A Leads are within 0.13 mm (0.005 inch) radius of true position (T.P.) with maximum material condition and unit installed.
B Pin 1 identified by index dot.
C Terminal connections:
1. Input } Infrared-emitting diode
2. Input
3. No internal connection
4. Emitter } Phototransistor
5. Collector
6. TIL187: Base
TIL188: No internal connection



TIL187



TIL188

FALLS WITHIN JEDEC MO 001AM DIMENSIONS

ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES

TEXAS INSTRUMENTS
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absolute maximum ratings at 25°C free-air temperature (unless otherwise noted)

Input-to-output voltage	±3.535 kV peak or dc (±2.5 kV rms)
Collector-base voltage (TIL187)	100 V
Collector-emitter voltage (see Note 1)	55 V
Emitter-collector voltage	7 V
Emitter-base voltage (TIL187)	14 V
Input diode continuous forward current at (or below) 25°C free-air temperature (see Note 2)	100 mA
Continuous power dissipation at (or below) 25°C free-air temperature:	
Infrared-emitting diode (see Note 3)	150 mW
Phototransistor (see Note 3)	150 mW
Total, infrared-emitting diode plus phototransistor (see Note 4)	250 mW
Storage temperature range	−55°C to 150°C
Lead temperature 1,6 mm (1/16-inch) from case for 10 seconds	260°C

NOTES: 1. This value applies when the base-emitter diode is open circuited.
2. Derate linearly to 100°C free-air temperature at the rate of 1.33 mA/°C.
3. Derate linearly to 100°C free-air temperature at the rate of 2 mW/°C
4. Derate linearly to 100°C free-air temperature at the rate of 3.33 mW/°C.

electrical characteristics at 25°C free-air temperature (unless otherwise noted)

PARAMETER			TEST CONDITIONS	TIL187 MIN	TIL187 TYP	TIL187 MAX	TIL188 MIN	TIL188 TYP	TIL188 MAX	UNIT
$V_{(BR)CBO}$	Collector-base breakdown voltage		I_C = 10 μA, I_E = 0, I_F = 0	100						V
$V_{(BR)CEO}$	Collector-emitter breakdown voltage		I_C = 1 mA, I_B = 0, I_F = 0	55			55			V
$V_{(BR)EBO}$	Emitter-base breakdown voltage		I_E = 10 μA, I_C = 0, I_F = 0	14						V
$V_{(BR)ECO}$	Emitter-collector breakdown voltage		I_E = 10 μA, I_F = 0				7			V
$I_{C(on)}$ On-state collector current	Photo-transistor operation	TIL187-1, TIL188-1	V_{CE} = 1 V, I_F = 2 mA, I_B = 0	5			5			mA
		TIL187-2, TIL188-2		10			10			mA
		TIL187-3, TIL188-3		20			20			mA
		TIL187-4, TIL188-4		30			30			mA
			V_{CE} = 1 V, I_F = 10 mA, I_B = 0	50			50			mA
	Photodiode operation		V_{CB} = 1 V, I_F = 10 mA, I_E = 0		12					μA
$I_{C(off)}$	Off-state collector current		V_{CE} = 10 V, I_F = 0, I_B = 0			100			100	nA
h_{FE}	Transistor static forward current transfer ratio		V_{CE} = 1 V, I_C = 10 mA, I_F = 0		25000					
V_F†	Input diode static forward voltage		I_F = 10 mA	1	1.2	1.5	1	1.2	1.5	V
$V_{CE(sat)}$†	Collector-emitter saturation voltage		I_C = 50 mA, I_F = 10 mA, I_B = 0		0.87	1		0.87	1	V
r_{IO}	Input-to-output internal resistance		$V_{in\text{-}out}$ = ±500 V, See Note 5	10^{11}			10^{11}			Ω
C_{io}	Input-to-output capacitance		$V_{in\text{-}out}$ = 0, f = 1 mHz, See Note 5		1	1.3		1	1.3	pF
$\frac{I_{C(on)1}}{I_{C(on)2}}$	On-state collector current symmetry ratio (see Note 6)		V_{CE} = 1 V, I_F = 2 mA	1		3	1		3	

†These parameters apply for either direction of the input current.

NOTES: 5. These parameters are measured between both input-diode leads shorted together and all the phototransistor leads shorted together.

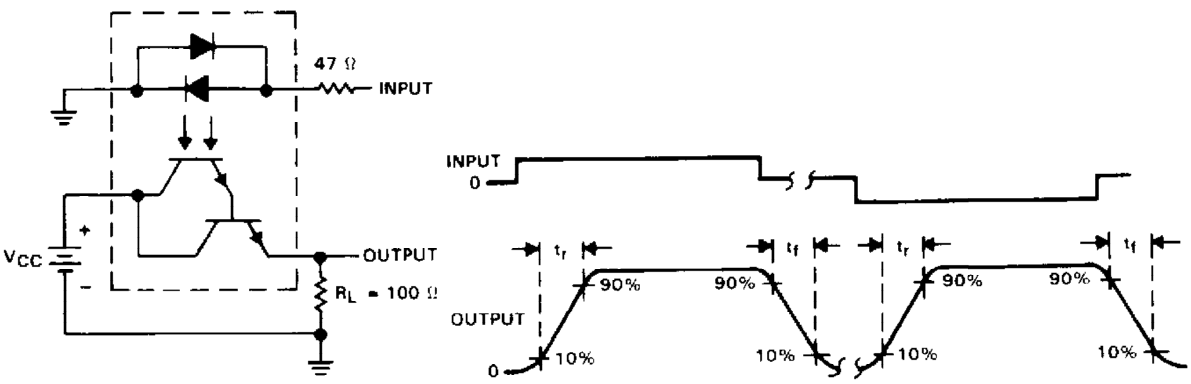
6. The higher of the two $I_{C(on)}$ values generated by the two diodes is taken as $I_{C(on)1}$.

switching characteristics at 25°C free-air temperature

PARAMETER		TEST CONDITIONS		TIL187 MIN	TIL187 TYP	TIL187 MAX	TIL188 MIN	TIL188 TYP	TIL188 MAX	UNIT
t_r	Rise time	V_{CC} = 10 V,	$I_{C(on)}$ = 10 mA,		100			100		μs
t_f	Fall time	R_L = 100 Ω,	see Figure 1		100			100		μs

PARAMETER MEASUREMENT INFORMATION

Adjust amplitude of input pulse is for $I_{C(on)} = 10$ mA



TEST CIRCUIT

VOLTAGE WAVEFORMS

NOTES: A. The input waveform is supplied by a generator with the following characteristics: $Z_O = 50\ Ω$, $t_r \le 15$ ns, duty cycle $\approx 1\%$.
B. The output waveform is monitored on an oscilloscope with the following characteristics: $t_r \le 12$ ns, $R_I \ge 1\ MΩ$, $C_I \le 20$ pF.

FIGURE 1. SWITCHING TIMES

TYPICAL CHARACTERISTICS

INPUT CURRENT
vs
INPUT VOLTAGE

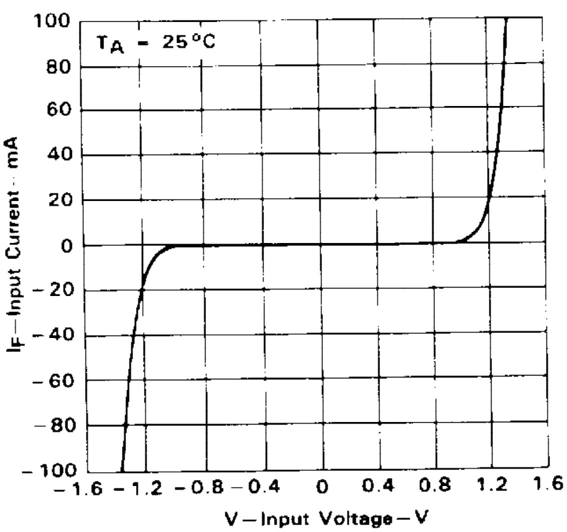


FIGURE 2

COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

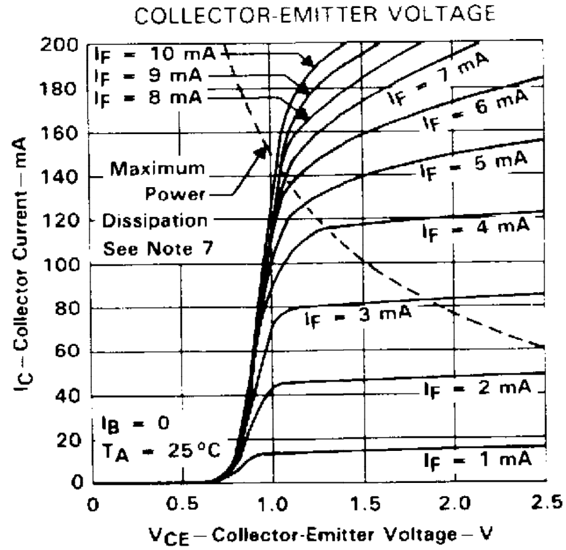


FIGURE 3

Note 7: Pulse operation is required for operation beyond limits shown by the dashed line.

COLLECTOR CURRENT
vs
INPUT DIODE FORWARD CURRENT

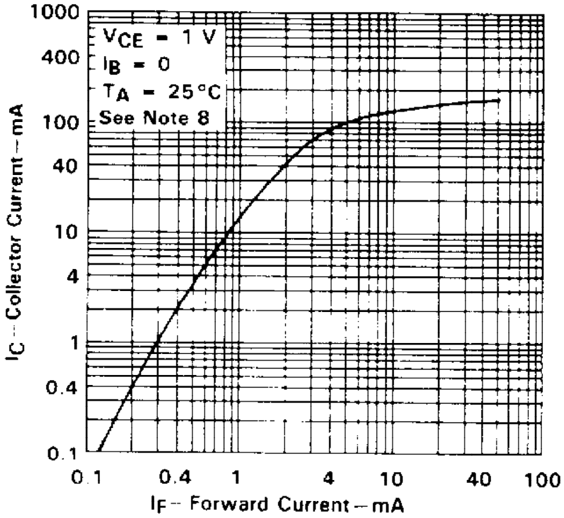


FIGURE 4

NORMALIZED ON STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

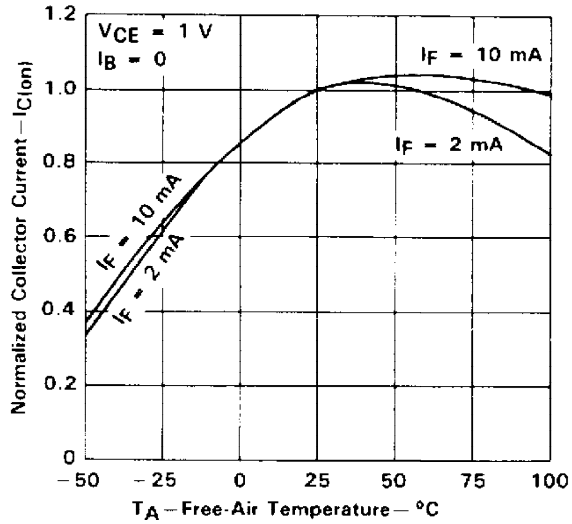


FIGURE 5

TIL187
NORMALIZED TRANSISTOR STATIC
FORWARD CURRENT TRANSFER RATIO
vs
COLLECTOR CURRENT

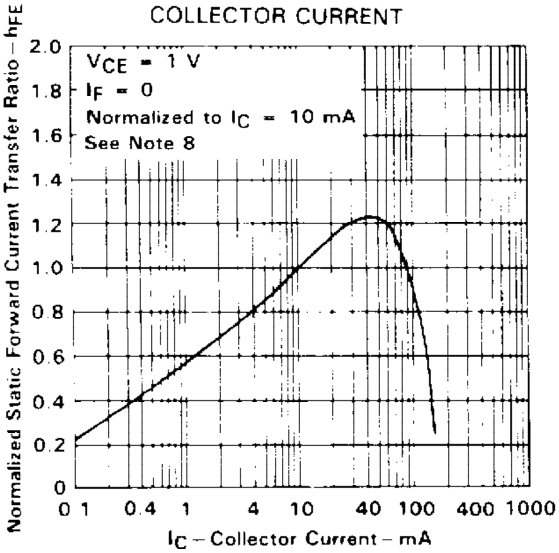


FIGURE 6

TIL187
NORMALIZED TRANSISTOR STATIC
FORWARD CURRENT TRANSFER RATIO
vs
FREE-AIR TEMPERATURE

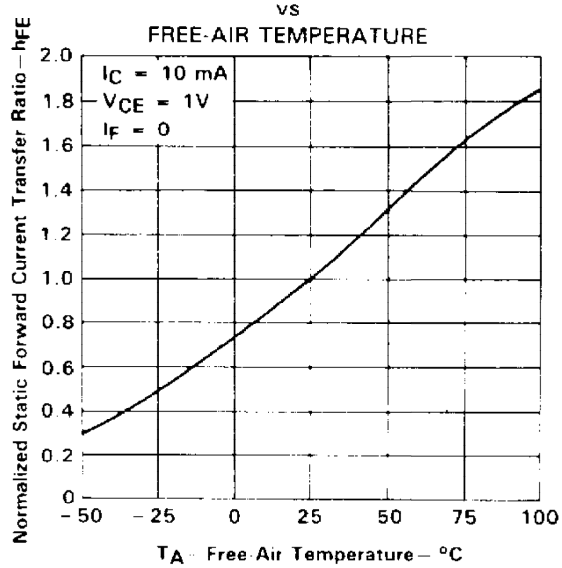


FIGURE 7

NOTE 8: These parameters were measured using pulse techniques t_w = 1 ms, duty cycle ≤ 2%.

TIL187
NORMALIZED ON-STATE COLLECTOR CURRENT
(PHOTODIODE OPERATION)
vs
FREE-AIR TEMPERATURE

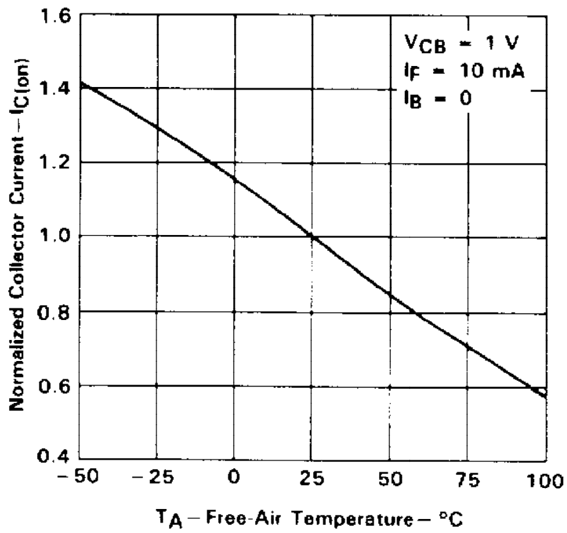


FIGURE 8

NORMALIZED COLLECTOR-EMITTER
BREAKDOWN VOLTAGE
vs
FREE-AIR TEMPERATURE

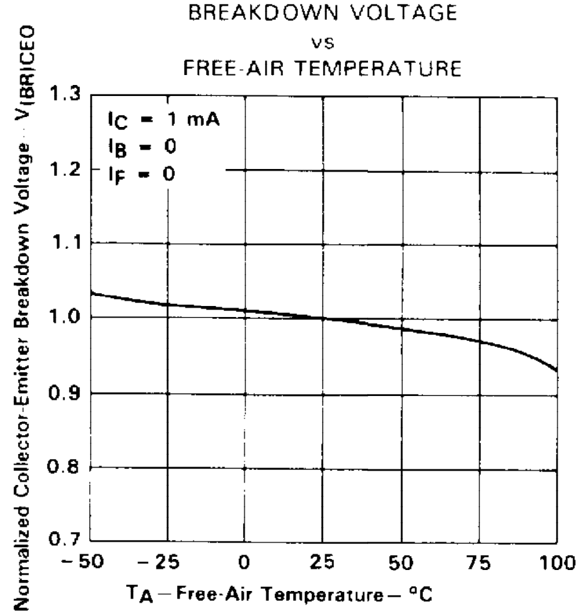


FIGURE 9

OFF-STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

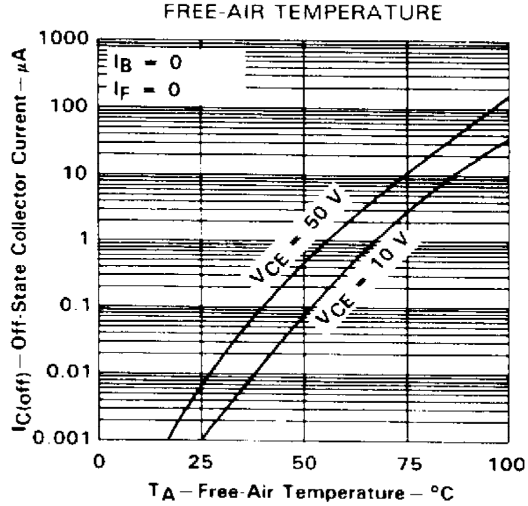


FIGURE 10

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