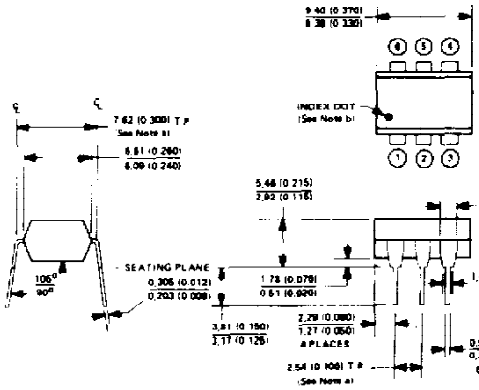
SOOS047A D2492, SEPTEMBER 1978—REVISED JUNE 1989

UL LISTED – FILE #E65085

- **GaAs-Diode Light Source Optically Coupled to a Silicon N-P-N Darlington-Connected Phototransistor**
- **High Direct-Current Transfer Ratio . . . 300% Minimum at 10 mA**
- **Plug-In Replacement for TIL113 and TIL119A**
- **High-Voltage Electrical Isolation . . . 2500 V RMS (3535 V Peak)**
- **No Base Connection on TIL157A for Environments with High Electromagnetic Interference**

mechanical data

The package consists of a gallium arsenide infrared-emitting diode and an n-p-n silicon darlington-connected phototransistor mounted on a 6-lead frame encapsulated within an electrically nonconductive plastic compound. The case will withstand soldering temperature with no deformation and device performance characteristics remain stable when operated in high humidity conditions. Unit weight is approximately 0.52 grams.



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.

Terminal connections:
1. Anode
2. Cathode
3. No internal connection
4. Emitter
5. Collector
6. TIL156 base
   TIL157A no internal connection

Infrared-emitting diode

Photo-transistor

FALLS WITHIN JEDEC MO-001AM DIMENSIONS
ALL LINEAR DIMENSIONS ARE IN MILLIMETERS AND PARENTHETICALLY IN INCHES.

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

Input-to-Output RMS Voltage (See Note 1)	2500 V
Collector-Base Voltage (TIL156)	30 V
Collector-Emitter Voltage (See Note 2)	30 V
Emitter-Collector Voltage	7 V
Emitter-Base Voltage (TIL156)	7 V
Input-Diode Reverse Voltage	3 V
Input-Diode Continuous Forward Current at (or below) 25°C Free-Air Temperature (See Note 3)	100 mA
Continuous Phototransistor Power Dissipation at (or below) 25°C Free-Air Temperature (See Note 4)	150 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 rating applies for sine-wave operation at 50 or 60 Hz. Service capability is verified by testing in accordance with UL requirements.
2. This value applies when the base emitter diode is open-circuited.
3. Derate linearly to 100°C free-air temperature at the rate of 1.33 mA/°C.
4. Derate linearly to 100°C free-air temperature at the rate of 2 mW/°C.

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electrical characteristics at 25°C free-air temperature

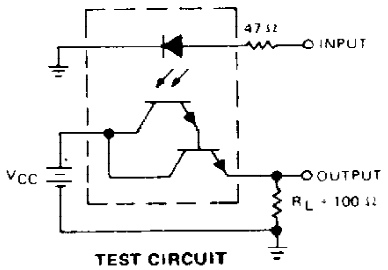
PARAMETER		TEST CONDITIONS†			TIL156			TIL157A			UNIT
					MIN	TYP	MAX	MIN	TYP	MAX	
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	I_C = 10 μA,	I_E = 0,	I_F = 0	30						V
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	I_C = 1 mA,	I_B = 0,	I_F = 0	30			30			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	I_E = 10 μA,	I_C = 0,	I_F = 0	7						V
$V_{(BR)ECO}$	Emitter-Collector Breakdown Voltage	I_E = 10 μA,	I_F = 0					7			V
I_R	Input Diode Static Reverse Current	V_R = 3 V					10			10	μA
$I_{C(on)}$	On-State Collector Current	V_{CE} = 1 V,	I_B = 0,	I_F = 10 mA	30	100					mA
		V_{CE} = 1 V,	I_F = 10 mA					30	160		
$I_{C(off)}$	Off-State Collector Current	V_{CE} = 10 V,	I_B = 0,	I_F = 0			100			100	nA
h_{FE}	Transistor Static Forward Current Transfer Ratio	V_{CE} = 1 V,	I_C = 10 mA,	I_F = 0		15 000					
V_F	Input Diode Static Forward Voltage	I_F = 10 mA					1.5			1.5	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C = 125 mA,	I_B = 0,	I_F = 50 mA			1.2				V
		I_C = 30 mA,	I_F = 10 mA							1	
r_{IO}	Input-to-Output Internal Resistance	V_{in-out} = 500 V,	See Note 5		10^{11}			10^{11}			Ω
C_{io}	Input-to-Output Capacitance	V_{in-out} = 0,	f = 1 MHz,	See Note 5		1	1.3		1	1.3	pF

Note 5: These parameters are measured between both input-diode leads shorted together and all the phototransistor leads shorted together.
†References to the base are not applicable to the TIL157A.

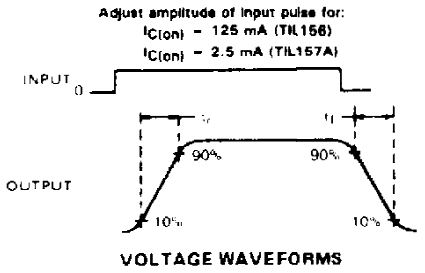
switching characteristics at 25°C free-air temperature

PARAMETER		TEST CONDITIONS†		TIL156			TIL157A			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
t_r	Rise Time	V_{CC} = 15 V,	$I_{C(on)}$ = 125 mA,		300					μs
t_f	Fall Time	R_L = 100 Ω,	See Figure 1		300					
t_r	Rise Time	V_{CC} = 10 V,	$I_{C(on)}$ = 2.5 mA,					300		μs
t_f	Fall Time	R_L = 100 Ω,	See Figure 1					300		

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT



VOLTAGE WAVEFORMS

NOTES: a. The input waveform is supplied by a generator with the following characteristics: Z_{out} = 50 Ω, t_r ≤ 15 ns, duty cycle ≈ 1%, t_w = 500 μs.
b. The output waveform is monitored on an oscilloscope with the following characteristics: t_r ≤ 12 ns, R_{in} ≥ 1 MΩ, C_{in} ≤ 20 pF.

FIGURE 1–SWITCHING TIMES

TYPICAL CHARACTERISTICS

COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

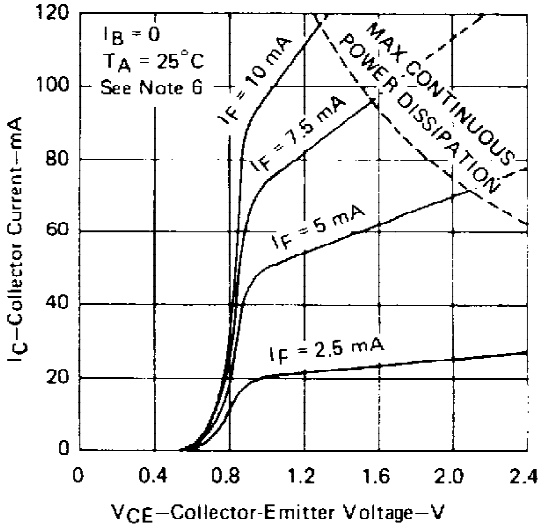


FIGURE 2

COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

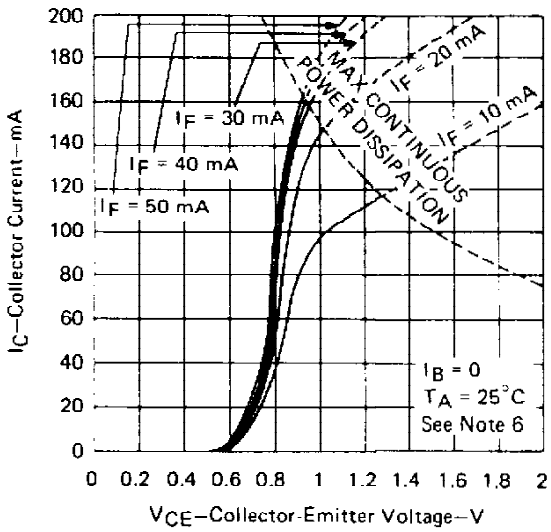


FIGURE 3

COLLECTOR CURRENT
vs
INPUT-DIODE FORWARD CURRENT

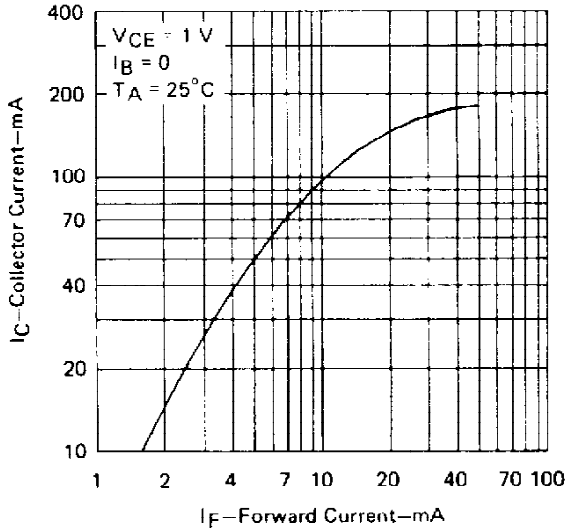


FIGURE 4

OFF-STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

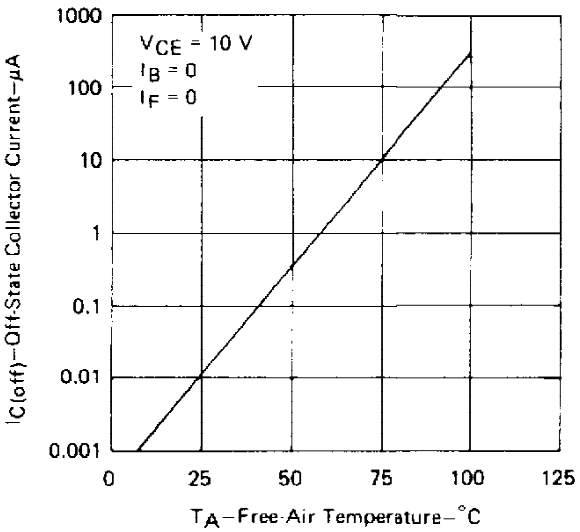


FIGURE 5

NOTE 6. Pulse operation of input diode is required for operation beyond limits shown by dotted line.

TYPICAL CHARACTERISTICS

RELATIVE COLLECTOR-EMITTER SATURATION VOLTAGE VS FREE-AIR TEMPERATURE

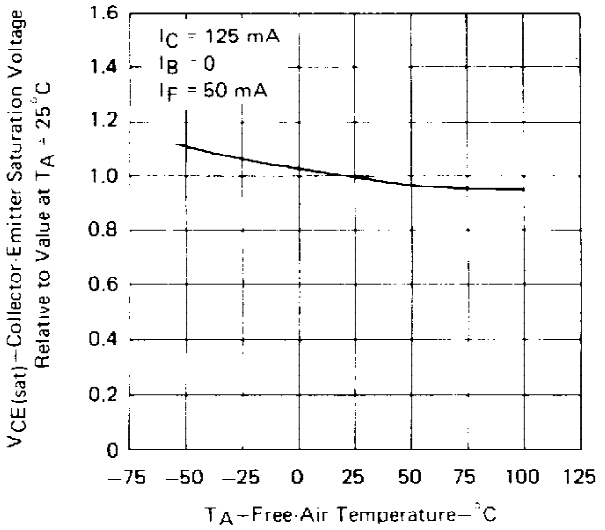


FIGURE 6

TIL156
TRANSISTOR STATIC FORWARD CURRENT TRANSFER RATIO VS COLLECTOR CURRENT

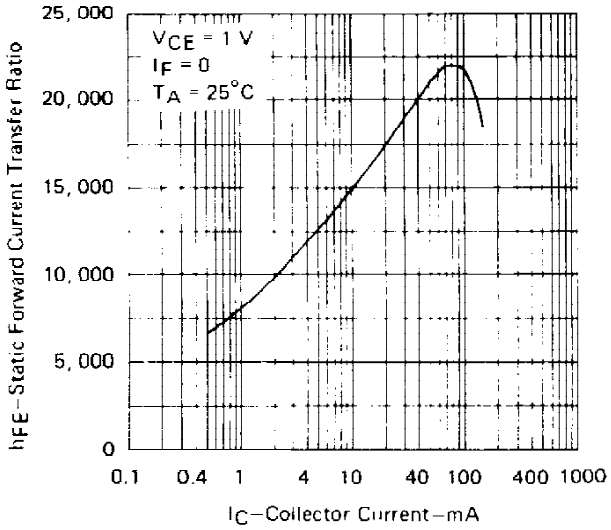


FIGURE 7

INPUT DIODE FORWARD CONDUCTION CHARACTERISTICS

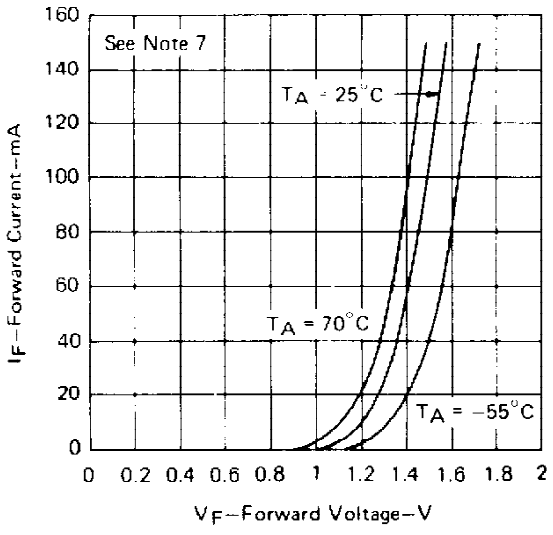


FIGURE 8

NOTE 7: This parameter was measured using pulse techniques, t_w = 1 ms, duty cycle ≤ 2%.

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