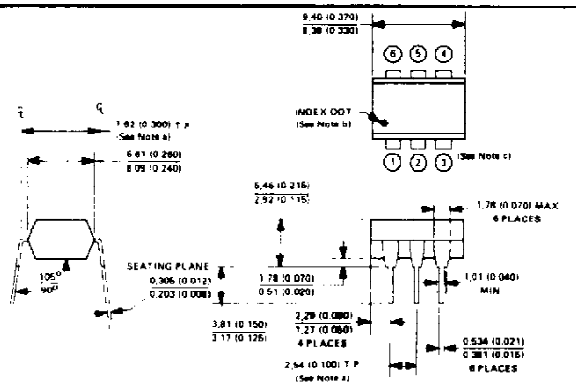
SOOS050 D2491, SEPTEMBER–REVISED DECEMBER 1982

UL LISTED – FILE # E65085

- **GaAs-Diode Infrared Source Optically Coupled to a Silicon N-P-N Phototransistor**
- **Direct-Current Transfer Ratio . . . 10% to 50%**
- **Plug-In Replacements for TIL111 Series**
- **High-Voltage Electrical Isolation . . . 2500 V RMS (3535 V Peak)**

mechanical data

The package consists of a gallium arsenide infrared-emitting diode and an n-p-n silicon 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

} Infrared-emitting diode

4. Emitter
5. Collector
6. Base

} Phototransistor

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	70 V
Collector-Emitter Voltage (See Note 2)	30 V
Emitter-Collector Voltage	7 V
Emitter-Base Voltage	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.

electrical characteristics at 25°C free-air temperature

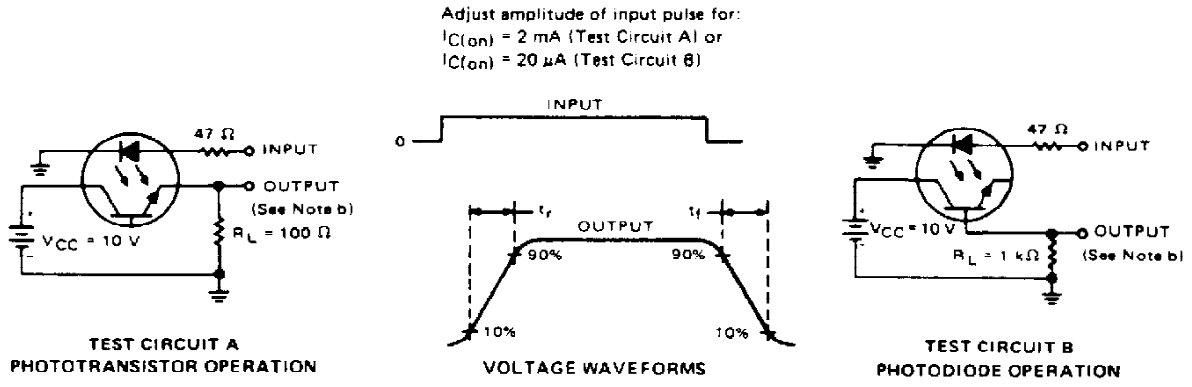
PARAMETER			TEST CONDITIONS	TIL153			TIL154			TIL155			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage		I_C = 10 µA, I_E = 0, I_F = 0	70			70			70			V
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage		I_C = 1 mA, I_B = 0, I_F = 0	30			30			30			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage		I_E = 10 µA, I_C = 0, I_F = 0	7			7			7			V
I_R	Input Diode Static Reverse Current		V_R = 3 V			10			10			10	µA
$I_{C(on)}$	On-State Collector Current	Phototransistor Operation	V_{CE} = 10 V, I_F = 10 mA, I_B = 0	1	3		2	5		5	9		mA
		Photodiode Operation	V_{CB} = 10 V, I_F = 10 mA, I_E = 0		10			10			10		µA
$I_{C(off)}$	Off-State Collector Current	Phototransistor Operation	V_{CE} = 10 V, I_F = 0, I_B = 0		1	50		1	50		1	50	nA
		Photodiode Operation	V_{CB} = 10 V, I_F = 0, I_E = 0		0.1	20		0.1	20		0.1	20	
h_{FE}	Transistor Static Forward Current Transfer Ratio		V_{CE} = 5 V, I_C = 10 mA, I_F = 0	50	100		100	200		100	550		
V_F	Input Diode Static Forward Voltage		I_F = 10 mA		1.2	1.4		1.2	1.4		1.2	1.4	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage		I_C = 1 mA, I_F = 10 mA, I_B = 0		0.25	0.4		0.25	0.4		0.25	0.4	V
r_{IO}	Input-to-Output Internal Resistance		V_{in-out} = 500 V, See Note 5	10^{11}			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		1	1.3	pF

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

switching characteristics at 25°C free-air temperature

PARAMETER			TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_r	Rise Time	Phototransistor Operation	V_{CC} = 10 V, $I_{C(on)}$ = 2 mA, R_L = 100 Ω, See Test Circuit A of Figure 1		5	10	µs
t_f	Fall Time				5	10	
t_r	Rise Time	Photodiode Operation	V_{CC} = 10 V, $I_{C(on)}$ 20 µA, R_L 1 kΩ, See Test Circuit B of Figure 1		1		µs
t_f	Fall Time				1		

PARAMETER MEASUREMENT INFORMATION



TEST CIRCUIT A
PHOTOTRANSISTOR OPERATION

VOLTAGE WAVEFORMS

TEST CIRCUIT B
PHOTODIODE OPERATION

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 = 100 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

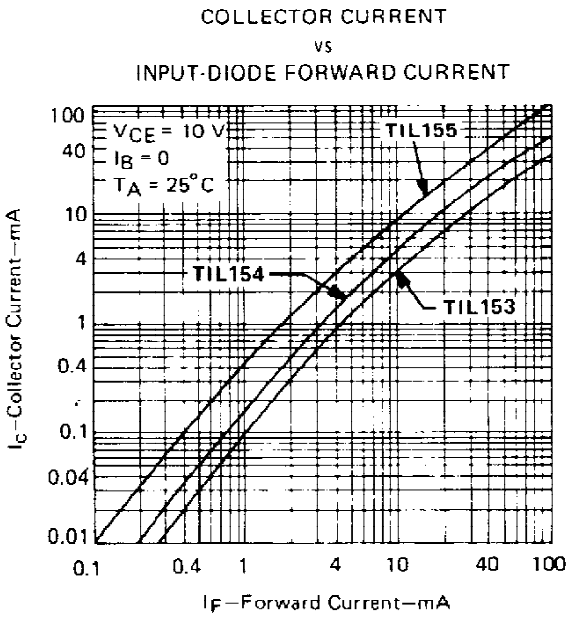


FIGURE 2

TYPICAL CHARACTERISTICS

TIL153

COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

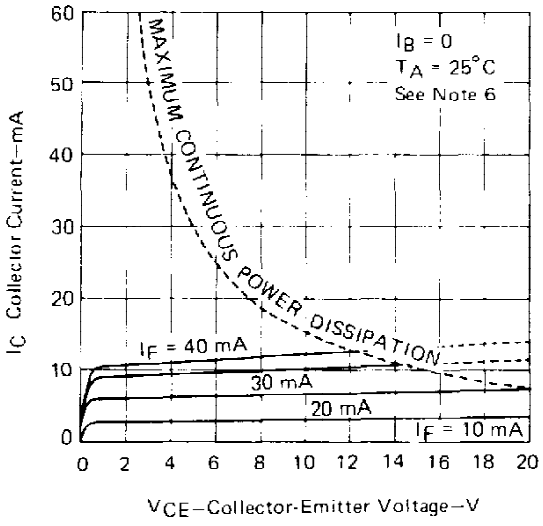


FIGURE 3

TIL154

COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

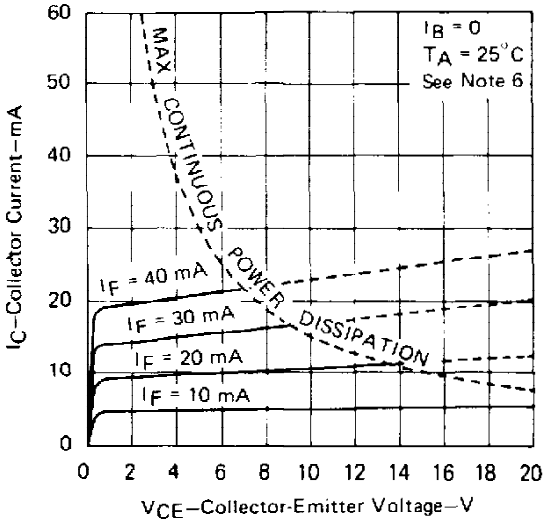


FIGURE 4

TIL155

COLLECTOR CURRENT
vs
COLLECTOR-EMITTER VOLTAGE

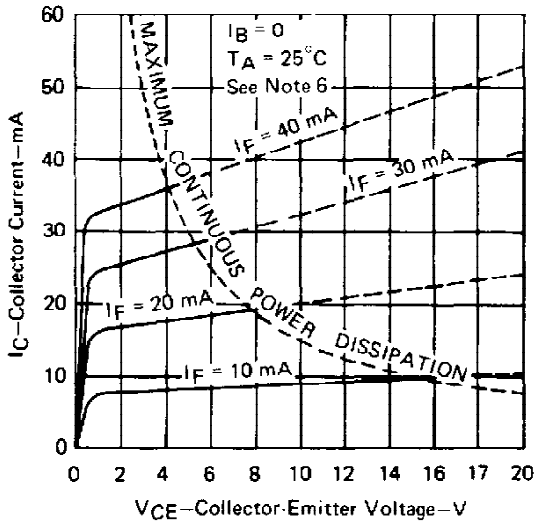


FIGURE 5

RELATIVE ON-STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

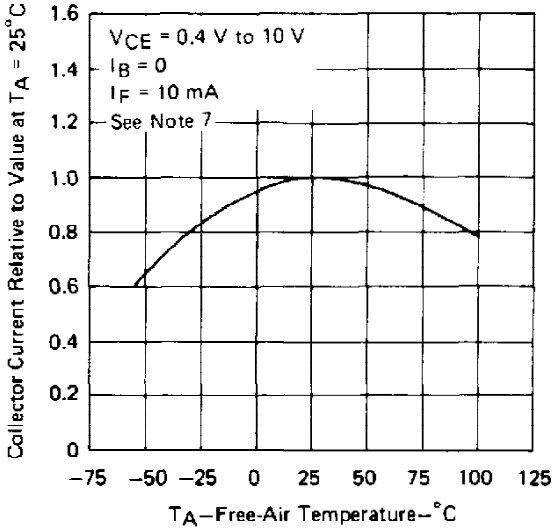


FIGURE 6

NOTES: 6. Pulse operation of input diode is required for operation beyond limits shown by dotted lines.
7. These parameters were measured using pulse techniques. t_w = 1 ms, duty cycle ≤ 2%.

TYPICAL CHARACTERISTICS

OFF-STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

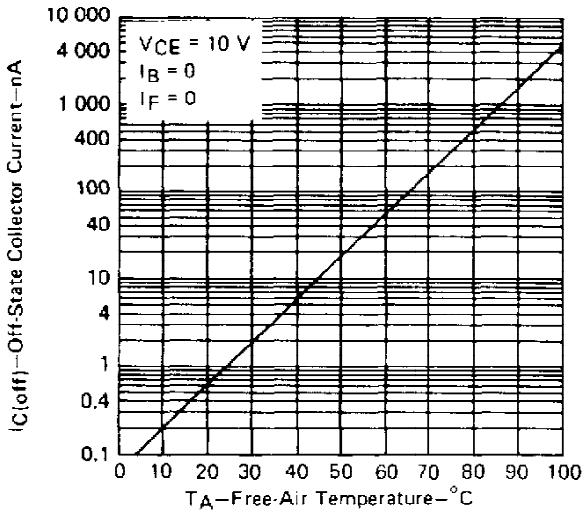


FIGURE 7

NORMALIZED TRANSISTOR STATIC FORWARD
CURRENT TRANSFER RATIO
vs
ON-STATE COLLECTOR CURRENT

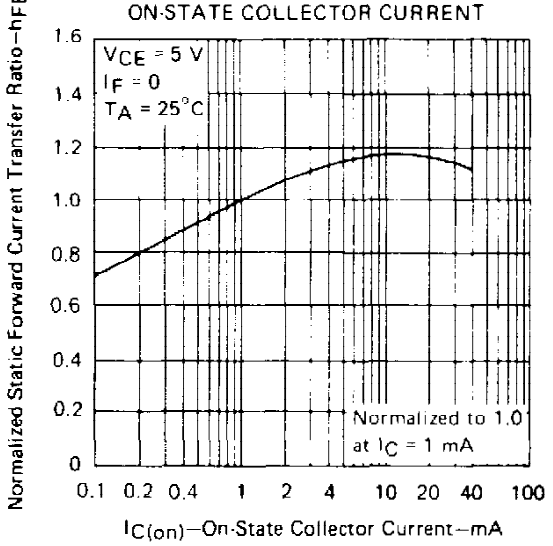


FIGURE 8

INPUT DIODE FORWARD
CONDUCTION CHARACTERISTICS

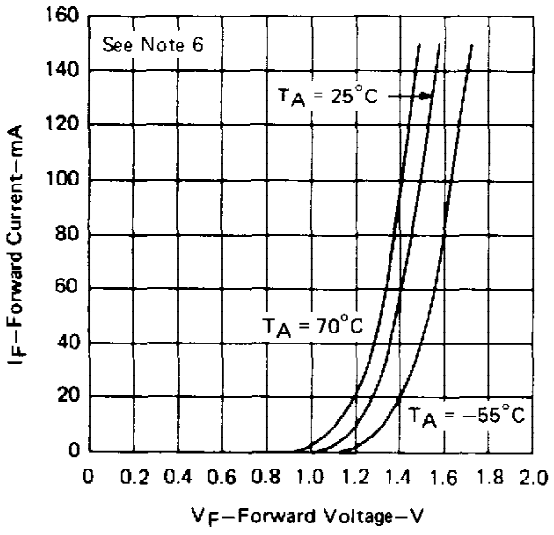


FIGURE 9

COLLECTOR CURRENT
vs
MODULATION FREQUENCY

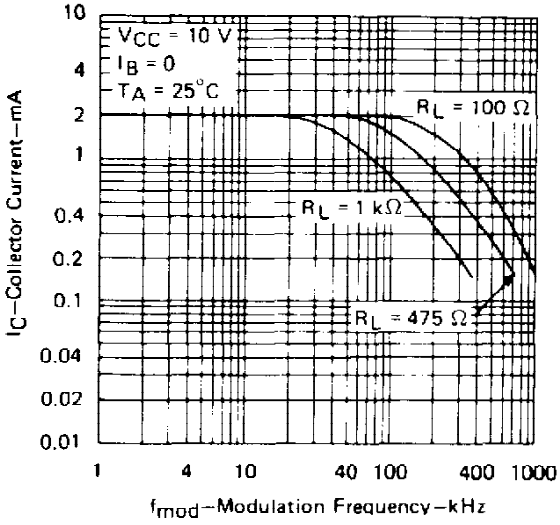


FIGURE 10

NOTE 6: These parameters were measured using pulse techniques, t_w = 1 ms, duty cycle ≤ 2%

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PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
TIL153	OBSOLETE	PDIP	N	6		TBD	Call TI	Call TI
TIL154	OBSOLETE	PDIP	N	6		TBD	Call TI	Call TI
TIL155	OBSOLETE	PDIP	N	6		TBD	Call TI	Call TI

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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