

# TIL102, TIL103 OPTOCOUPERS

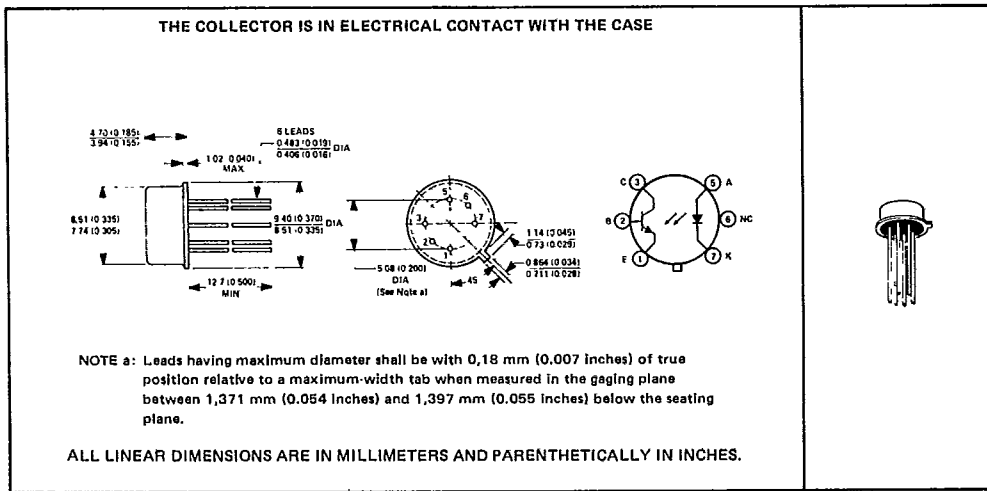
D910, SEPTEMBER 1970—REVISED NOVEMBER 1974

T-41-83

## GALLIUM ARSENIDE DIODE INFRARED SOURCE OPTICALLY COUPLED TO A HIGH-GAIN N-P-N SILICON PHOTOTRANSISTOR

- Photon Coupling for Isolator Applications
- Base Lead Provided for Conventional Transistor Biasing
- High Overall Current Gain . . . 1.5 Typ (TIL103)
- High-Voltage Transistor . . .  $V_{(BR)CEO} = 35\text{ V Min}$
- High-Voltage Electrical Isolation . . . 1-kV Rating
- Stable over Wide Temperature Range

### mechanical data



3  
Optocouplers (Isolators)

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

Input-to-Output Voltage . . . . .	±1 kV
Collector-Emitter Voltage . . . . .	35 V
Collector-Base Voltage . . . . .	35 V
Emitter-Base Voltage . . . . .	4 V
Input Diode Reverse Voltage . . . . .	2 V
Input Diode Continuous Forward Current at (or below) 65°C Free-Air Temperature (See Note 1) . . . . .	40 mA
Continuous Collector Current . . . . .	50 mA
Continuous Transistor Power Dissipation at (or below) 25°C Free-Air Temperature (See Note 2) . . . . .	300 mW
Storage Temperature Range . . . . .	-55°C to 125°C
Lead Temperature 1,6 mm (1/16 Inch) from Case for 10 Seconds . . . . .	240°C

NOTES: 1. Derate linearly to 125°C free air temperature at the rate of 0.67 mA/°C.  
2. Derate linearly to 125°C free air temperature at the rate of 3 mW/°C.

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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

PARAMETER		TEST CONDITIONS	TIL102			TIL103			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
V <sub>(BR)CBO</sub>	Collector-Base Breakdown Voltage	I <sub>C</sub> = 100 μA, I <sub>E</sub> = 0, I <sub>F</sub> = 0	35			35			V
V <sub>(BR)CEO</sub>	Collector-Emitter Breakdown Voltage	I <sub>C</sub> = 1 mA, I <sub>B</sub> = 0, I <sub>F</sub> = 0	35			35			V
V <sub>(BR)EBO</sub>	Emitter-Base Breakdown Voltage	I <sub>E</sub> = 100 μA, I <sub>C</sub> = 0, I <sub>F</sub> = 0	4			4			V
I <sub>R</sub>	Input Diode Static Reverse Current	V <sub>R</sub> = 2 V	100			100			μA
I <sub>C(on)</sub>	On-State Collector Current	Phototransistor Operation V <sub>CE</sub> = 5 V, I <sub>B</sub> = 0, I <sub>F</sub> = 10 mA	2.5	6		10	15		mA
		Photodiode Operation V <sub>CB</sub> = 5 V, I <sub>E</sub> = 0, I <sub>F</sub> = 10 mA	40			40			μA
I <sub>C(off)</sub>	Off-State Collector Current	Phototransistor Operation V <sub>CE</sub> = 20 V, I <sub>B</sub> = 0, I <sub>F</sub> = 0	6			100			nA
		Photodiode Operation V <sub>CB</sub> = 20 V, I <sub>E</sub> = 0, I <sub>F</sub> = 0, T <sub>A</sub> = 100 C	4			4			μA
		Photodiode Operation V <sub>CB</sub> = 20 V, I <sub>E</sub> = 0, I <sub>F</sub> = 0	0.1			0.1			nA
h <sub>FE</sub>	Transistor Static Forward Current Transfer Ratio	V <sub>CE</sub> = 5 V, I <sub>C</sub> = 10 mA, I <sub>F</sub> = 0	300			500			
V <sub>F</sub>	Input Diode Static Forward Voltage	I <sub>F</sub> = 10 mA	1.3			1.3			V
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	I <sub>C</sub> = 2.5 mA, I <sub>B</sub> = 0, I <sub>F</sub> = 20 mA	0.3						V
		I <sub>C</sub> = 10 mA, I <sub>B</sub> = 0, I <sub>F</sub> = 20 mA				0.3			
r <sub>IO</sub>	Input-to-Output Internal Resistance	V <sub>in-out</sub> = ±1 kV, See Note 3	10 <sup>11</sup>	10 <sup>12</sup>		10 <sup>11</sup>	10 <sup>12</sup>		Ω
C <sub>IO</sub>	Input-to-Output Capacitance	V <sub>in-out</sub> = 0, f = 1 MHz, See Note 3	2.5			2.5			pF

NOTE 3: 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	TIL102	TIL103	UNIT
			TYP	TYP	
t <sub>r</sub>	Rise Time	V <sub>CC</sub> = 20 V, I <sub>B</sub> = 0, I <sub>C(on)</sub> = 5 mA, R <sub>L</sub> = 100 Ω, See Test Circuit A of Figure 1	3	6	μs
t <sub>f</sub>	Fall Time		3	6	
t <sub>r</sub>	Rise Time	V <sub>CC</sub> = 20 V, I <sub>E</sub> = 0, I <sub>C(on)</sub> = 50 μA, R <sub>L</sub> = 100 Ω, See Test Circuit B of Figure 1	150	150	ns
t <sub>f</sub>	Fall Time		150	150	

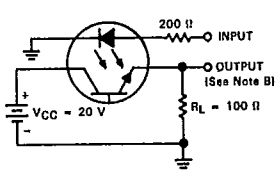
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Optocouplers (Isolators)

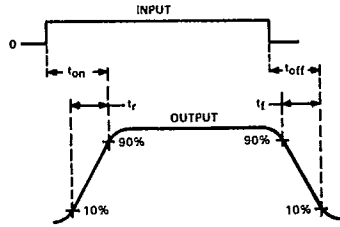
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PARAMETER MEASUREMENT INFORMATION

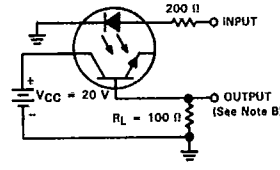
Adjust amplitude of input pulse for:  
 $I_{C(on)} = 5 \text{ mA}$  (Test Circuit A) or  
 $I_{C(on)} = 50 \mu\text{A}$  (Test Circuit B)



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:  $z_{out} = 50 \Omega$ ,  $t_r \leq 15 \text{ ns}$ , duty cycle  $\approx 1\%$ . For Test Circuit A,  $t_w = 100 \mu\text{s}$ . For Test Circuit B,  $t_w = 1 \mu\text{s}$ .  
 b. Waveforms are monitored on an oscilloscope with the following characteristics:  $t_r \leq 12 \text{ ns}$ ,  $R_{in} \geq 1 \text{ M}\Omega$ ,  $C_{in} \leq 20 \text{ pF}$ .

FIGURE 1—SWITCHING TIMES

TYPICAL CHARACTERISTICS

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Optocouplers (Isolators)

TIL102  
COLLECTOR CURRENT  
vs  
COLLECTOR-EMITTER VOLTAGE

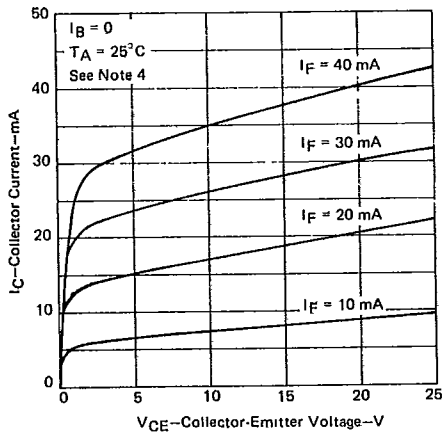


FIGURE 2

TIL103  
COLLECTOR CURRENT  
vs  
COLLECTOR-EMITTER VOLTAGE

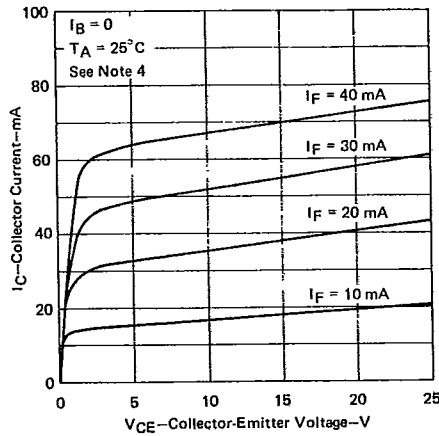


FIGURE 3

NOTE 4: This parameter was measured using pulse techniques.  $t_w = 100 \mu\text{s}$ , duty cycle = 1%.

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TYPICAL CHARACTERISTICS

INPUT DIODE FORWARD CONDUCTION CHARACTERISTICS

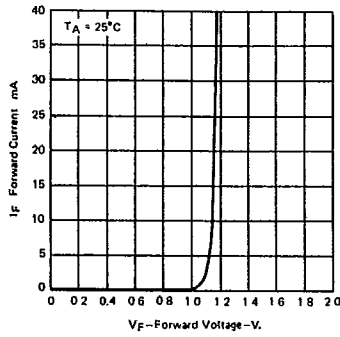


FIGURE 4

NORMALIZED ON-STATE COLLECTOR CURRENT<sup>1</sup>  
vs  
FREE-AIR TEMPERATURE

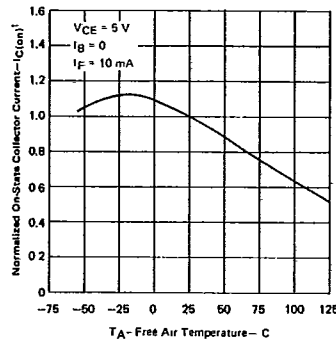


FIGURE 5

PHOTOTRANSISTOR COLLECTOR CURRENT  
vs  
INPUT-DIODE FORWARD CURRENT

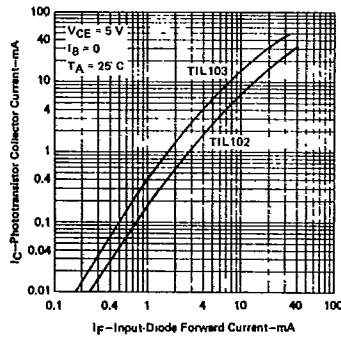


FIGURE 6

OFF-STATE COLLECTOR CURRENT  
vs  
FREE-AIR TEMPERATURE

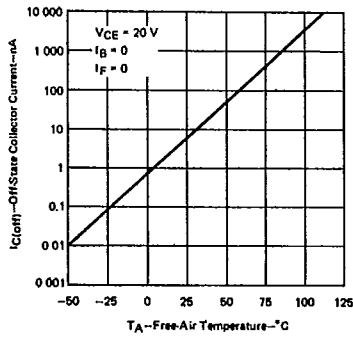


FIGURE 7

TIL102  
AVERAGE SWITCHING TIME  
vs  
LOAD RESISTANCE

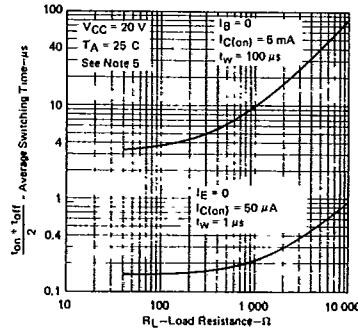


FIGURE 8

NOTE 5: These parameters were measured in Test Circuits A and B of Figure 1 with  $R_L$  varied between 40  $\Omega$  and 10 k $\Omega$ .

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Optocouplers (Isolators)