

# TIL111, TIL114, TIL116, TIL117 OPTOCOUPLED

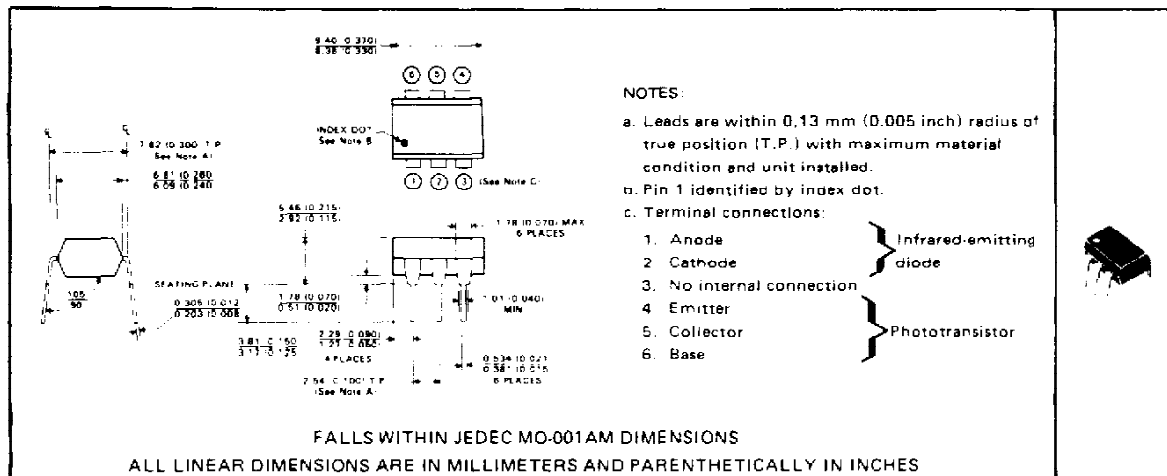
SOOS040 D1607, NOVEMBER 1973—REVISED FEBRUARY 1983

## COMPATIBLE WITH STANDARD TTL INTEGRATED CIRCUITS

- Gallium Arsenide Diode Infrared Source Optically Coupled to a Silicon N-P-N Phototransistor
- High Direct-Current Transfer Ratio
- High-Voltage Electrical Isolation . . . 1.5-kV or 2.5-kV Rating
- Plastic Dual-In-Line Package
- High-Speed Switching:  $t_r = 5 \mu s$ ,  $t_f = 5 \mu s$  Typical

### 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.



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

Input-to-Output Voltage: TIL111	±1.5 kV
TIL114, TIL116, TIL117	±2.5 kV
Collector-Base Voltage	70 V
Collector-Emitter Voltage (See Note 1)	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 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 4)	150 mW
Total, Infrared-Emitting Diode plus Phototransistor (See Note 5)	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:
- This value applies when the base-emitter diode is open circuited.
  - Derate linearly to 100°C free-air temperature at the rate of 1.33 mW/°C.
  - Derate linearly to 100°C free air temperature at the rate of 2 mW/°C.
  - Derate linearly to 100°C free air temperature at the rate of 2 mW/°C.
  - Derate linearly to 100°C free air temperature at the rate of 3.33 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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# TIL111, TIL114, TIL116, TIL117 OPTOCOUPERS

electrical characteristics at 25°C free-air temperature

PARAMETER		TEST CONDITIONS	TIL111 TIL114			TIL116			TIL117			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
V <sub>(BR)ICBO</sub>	Collector-Base Breakdown Voltage	I <sub>C</sub> = 10 μA, I <sub>E</sub> = 0, I <sub>F</sub> = 0	70			70			70			V
V <sub>(BR)ICEO</sub>	Collector-Emitter Breakdown Voltage	I <sub>C</sub> = 1 mA, I <sub>B</sub> = 0, I <sub>F</sub> = 0	30			30			30			V
V <sub>(BR)IEBO</sub>	Emitter-Base Breakdown Voltage	I <sub>E</sub> = 10 μA, I <sub>C</sub> = 0, I <sub>F</sub> = 0	7			7			7			V
I <sub>R</sub>	Input Diode Static Reverse Current	V <sub>R</sub> = 3 V			10			10			10	μA
I <sub>C(on)</sub>	On-State Collector Current	Phototransistor Operation V <sub>CE</sub> = 0.4 V, I <sub>F</sub> = 16 mA, I <sub>B</sub> = 0	2	7								mA
		V <sub>CE</sub> = 10 V, I <sub>F</sub> = 10 mA, I <sub>B</sub> = 0				2	5		5	9		
	Photodiode Operation	V <sub>CB</sub> = 0.4 V, I <sub>F</sub> = 16 mA, I <sub>E</sub> = 0	7	20		7	20		7	20		μA
I <sub>C(off)</sub>	Off-State Collector Current	Phototransistor Operation V <sub>CE</sub> = 10 V, I <sub>F</sub> = 0, I <sub>B</sub> = 0		1	50		1	50		1	50	nA
		Photodiode Operation V <sub>CB</sub> = 10 V, I <sub>F</sub> = 0, I <sub>E</sub> = 0		0.1	20		0.1	20		0.1	20	
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	100	300					200	550		
		V <sub>CE</sub> = 5 V, I <sub>C</sub> = 100 μA, I <sub>F</sub> = 0				100	300					
V <sub>F</sub>	Input Diode Static Forward Voltage	I <sub>F</sub> = 16 mA		1.2	1.4					1.2	1.4	V
		I <sub>F</sub> = 50 mA					1.25	1.5				
V <sub>CE(sat)</sub>	Collector-Emitter Saturation Voltage	I <sub>C</sub> = 2 mA, I <sub>F</sub> = 16 mA, I <sub>B</sub> = 0		0.25	0.4							V
		I <sub>C</sub> = 2.2 mA, I <sub>F</sub> = 15 mA, I <sub>B</sub> = 0					0.25	0.4				
		I <sub>C</sub> = 0.5 mA, I <sub>F</sub> = 10 mA, I <sub>B</sub> = 0								0.25	0.4	
r <sub>IO</sub>	Input-to-Output Internal Resistance	V <sub>in-out</sub> = ±1.5 kV for TIL111, ±2.5 kV for all others, See Note 6	10 <sup>11</sup>			10 <sup>11</sup>			10 <sup>11</sup>			Ω
C <sub>io</sub>	Input-to-Output Capacitance	V <sub>in-out</sub> = 0, f = 1 MHz, See Note 6		1	1.3		1	1.3		1	1.3	pF

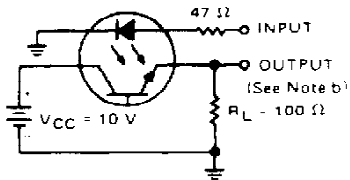
NOTE 6 These parameters are measured between both input diode leads shorted together and all the phototransistor leads shorted together.

switching characteristics at 25°C free-air temperature

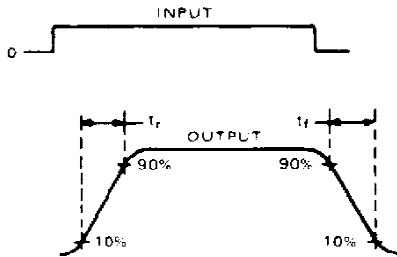
PARAMETER		TEST CONDITIONS	TIL111 TIL114			TIL116			TIL117			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
t <sub>r</sub>	Rise Time	Phototransistor Operation V <sub>CC</sub> = 10 V, I <sub>C(on)</sub> = 2 mA, R <sub>L</sub> = 100 Ω, See Test Circuit A of Figure 1	5	10		5	10		5	10	μs	
t <sub>f</sub>	Fall Time		5	10		5	10		5	10		
t <sub>r</sub>	Rise Time	Photodiode Operation V <sub>CC</sub> = 10 V, I <sub>C(on)</sub> = 20 μA, R <sub>L</sub> = 1 kΩ, See Test Circuit B of Figure 1	1			1			1		μs	
t <sub>f</sub>	Fall Time		1			1			1			

PARAMETER MEASUREMENT INFORMATION

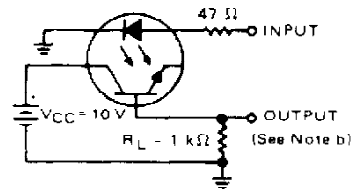
Adjust amplitude of input pulse for:  
 $I_{C(on)} = 2 \text{ mA}$  (Test Circuit A) or  
 $I_{C(on)} = 20 \mu\text{A}$  (Test Circuit B)



TEST CIRCUIT A  
PHOTOTRANSISTOR OPERATION



VOLTAGE WAVEFORMS



TEST CIRCUIT B  
PHOTODIODE OPERATION

- NOTES
- The input waveform is supplied by a generator with the following characteristics:  $Z_{out} = 50 \Omega$ ,  $t_r = 15 \text{ ns}$ , duty cycle  $\approx 1\%$ ,  $t_w = 100 \mu\text{s}$ .
  - The output waveform is monitored on an oscilloscope with the following characteristics:  $t_r = 12 \text{ ns}$ ,  $R_{in} = 1 \text{ M}\Omega$ ,  $C_{in} = 20 \text{ pF}$ .

FIGURE 1—SWITCHING TIMES

TYPICAL CHARACTERISTICS

TIL111, TIL114

COLLECTOR CURRENT

vs

INPUT-DIODE FORWARD CURRENT

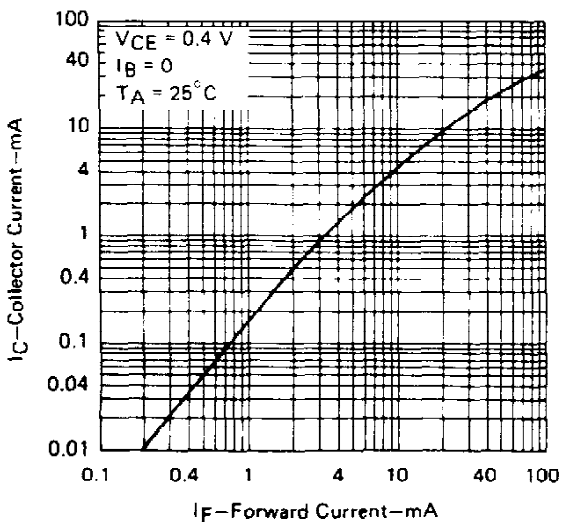


FIGURE 2

TIL116, TIL117

COLLECTOR CURRENT

vs

INPUT-DIODE FORWARD CURRENT

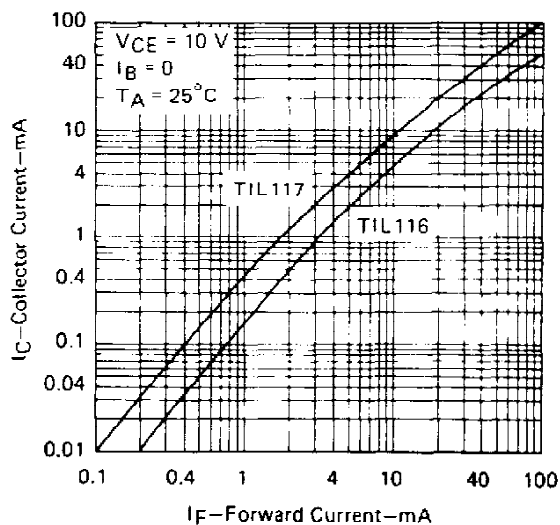


FIGURE 3

**TIL111, TIL114, TIL116, TIL117**  
**OPTOCOUPERS**

**TYPICAL CHARACTERISTICS**

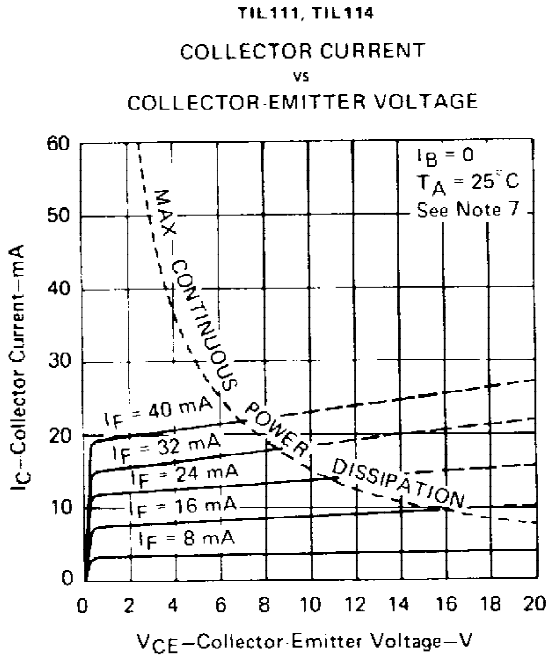


FIGURE 4

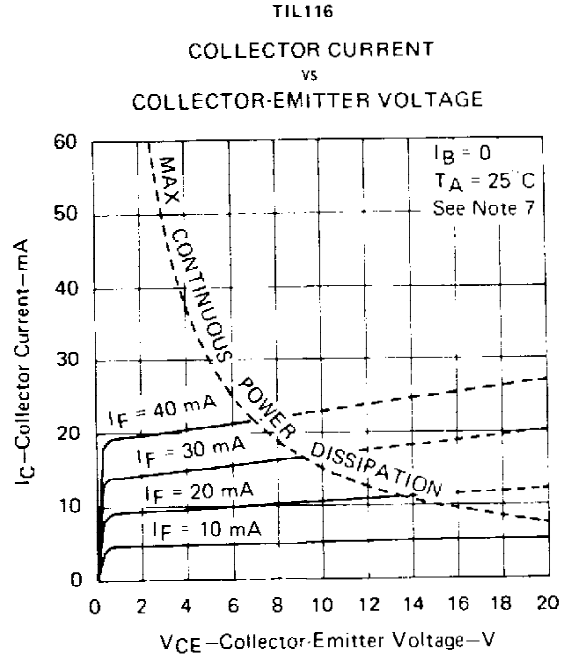


FIGURE 5

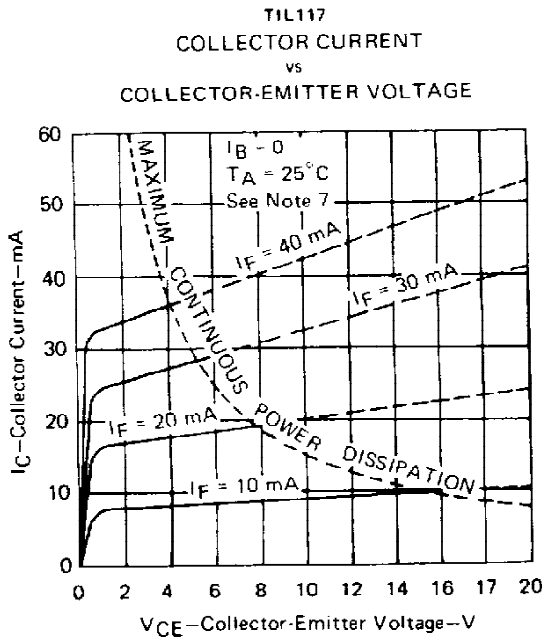


FIGURE 6

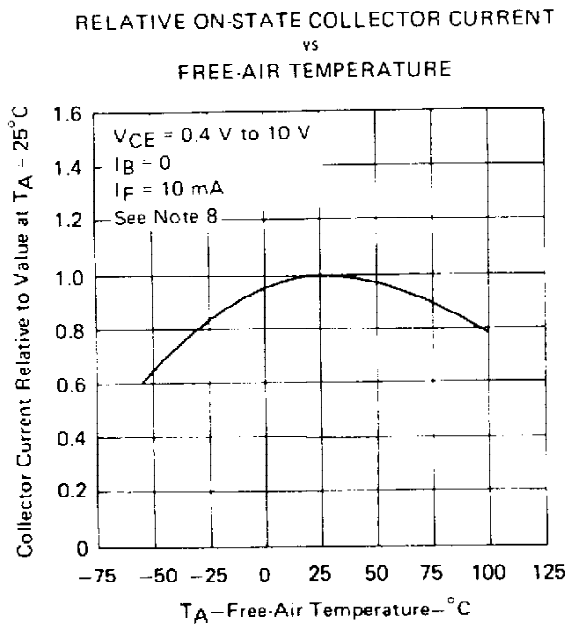


FIGURE 7

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

TIL111, TIL114, TIL116, TIL117  
OPTOCOUPERS

TYPICAL CHARACTERISTICS

OFF-STATE COLLECTOR CURRENT  
vs  
FREE-AIR TEMPERATURE

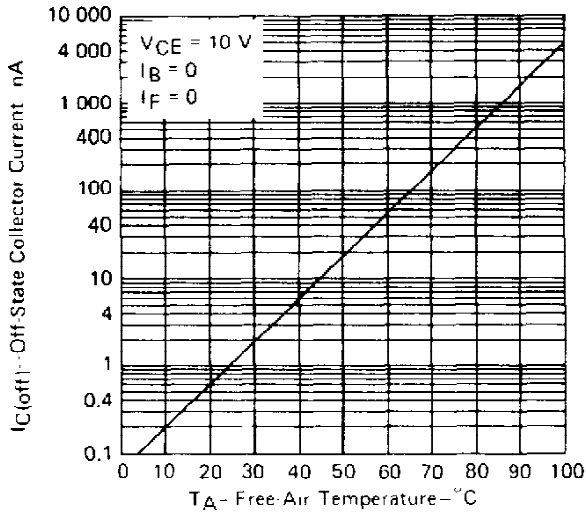


FIGURE 8

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

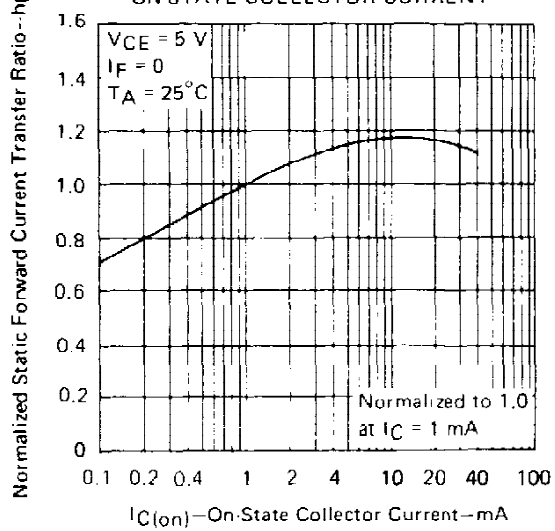


FIGURE 9

INPUT DIODE FORWARD  
CONDUCTION CHARACTERISTICS

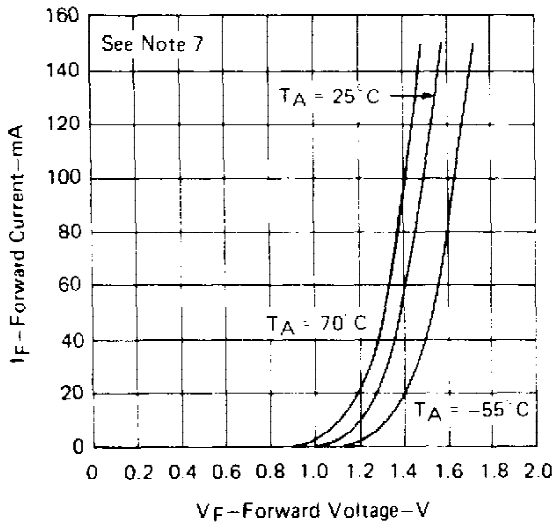


FIGURE 10

COLLECTOR CURRENT  
vs  
MODULATION FREQUENCY

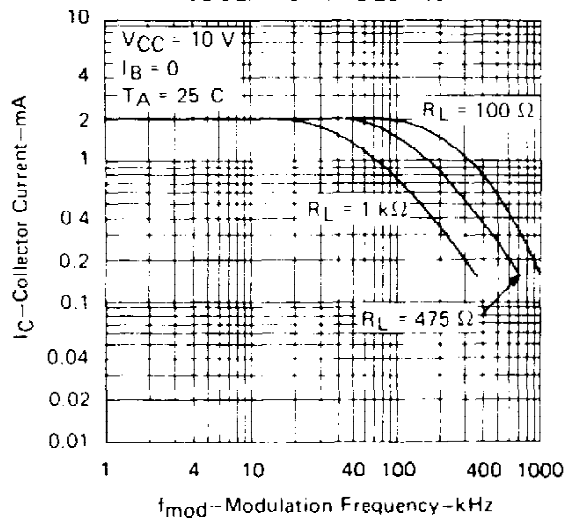


FIGURE 11

NOTE 7: These parameters were measured using pulse techniques.  $t_w = 1$  ms, duty cycle  $\leq 2\%$

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