

## TIL111, TIL114, TIL116, TIL117 OPTOCOUPERS

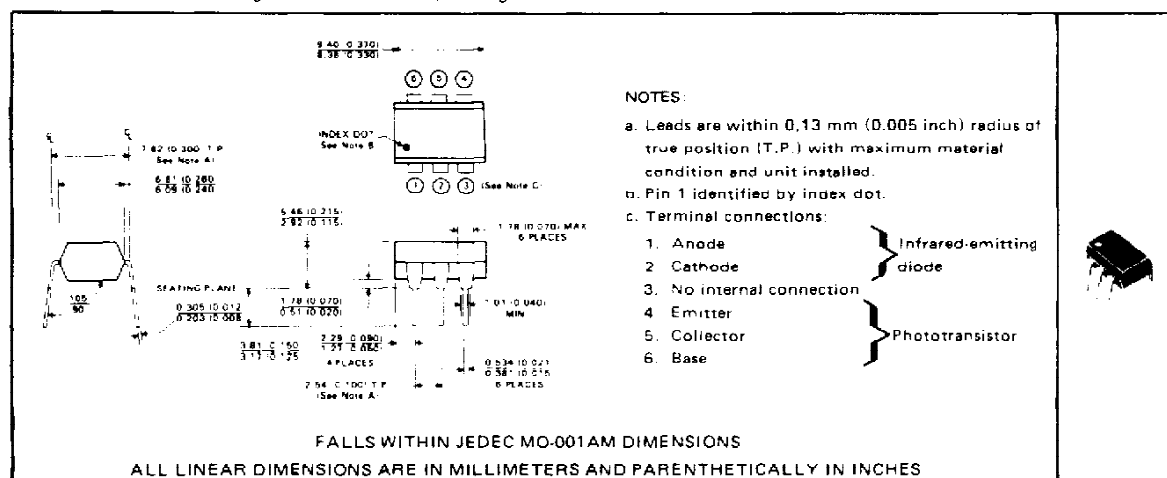
SDOS040 D1607, NOVEMBER 1973-REVISED FEBRUARY 1983

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: 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 mW/°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 2 mW/°C.  
5. 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	
$V_{(BR)CBO}$	Collector-Base Breakdown Voltage	$I_C = 10 \mu A$ , $I_E = 0$	70			70			70			V
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	$I_C = 1 mA$ , $I_E = 0$	30			30			30			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10 \mu A$ , $I_C = 0$	7			7			7			V
$I_R$	Input Diode Static Reverse Current	$V_R = 3 V$		10			10			10		$\mu A$
$I_{C(on)}$	On-State Collector Current	Phototransistor Operation $V_{CE} = 0.4 V$ , $I_B = 0$	2	7								mA
		$V_{CE} = 10 V$ , $I_B = 0$				2	5		5	9		
	Photodiode Operation	$V_{CB} = 0.4 V$ , $I_E = 0$	7	20		7	20		7	20		$\mu A$
$I_{C(off)}$	Off-State Collector Current	Phototransistor Operation $V_{CE} = 10 V$ , $I_B = 0$		1	50		1	50		1	50	nA
		Photodiode Operation $V_{CB} = 10 V$ , $I_E = 0$		0.1	20		0.1	20		0.1	20	
$h_{FE}$	Transistor Static Forward Current Transfer Ratio	$V_{CE} = 5 V$ , $I_F = 0$	100	300					200	550		
		$V_{CE} = 5 V$ , $I_C = 100 \mu A$ , $I_F = 0$				100	300					
$V_F$	Input Diode Static Forward Voltage	$I_F = 16 mA$		1.2	1.4					1.2	1.4	V
		$I_F = 60 mA$					1.25	1.5				
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$I_C = 2 mA$ , $I_B = 0$		0.25	0.4							V
		$I_C = 2.2 mA$ , $I_B = 0$					0.25	0.4				
		$I_C = 0.5 mA$ , $I_B = 0$								0.25	0.4	
$r_{iO}$	Input-to-Output Internal Resistance	$V_{in-out} = \pm 1.5 kV$ for TIL111, $\pm 2.5 kV$ for all others, See Note 6	$10^{11}$			$10^{11}$			$10^{11}$			$\Omega$
$C_{iO}$	Input to-Output Capacitance	$V_{in-out} = 0$ , 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.

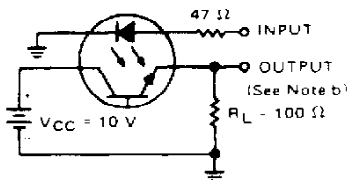
switching characteristics at 25°C free-air temperature

PARAMETER		TEST CONDITIONS	TIL111 TIL114			TIL116			TIL117			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
$t_r$	Rise Time	Phototransistor Operation $V_{CC} = 10 V$ , $R_L = 100 \Omega$ , See Test Circuit A of Figure 1	5	10		5	10		5	10		$\mu s$
$t_f$	Fall Time		5	10		5	10		5	10		
$t_r$	Rise Time	Photodiode Operation $V_{CC} = 10 V$ , $R_L = 1 k\Omega$ , See Test Circuit B of Figure 1	1			1			1			$\mu s$
$t_f$	Fall Time		1			1			1			

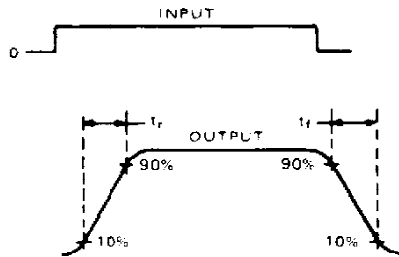
# TIL111, TIL114, TIL116, TIL117 OPTOCOUPERS

## PARAMETER MEASUREMENT INFORMATION

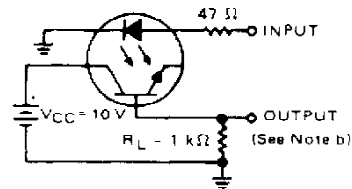
Adjust amplitude of input pulse for:  
 $I_{C(on)} = 2 \text{ mA}$  (Test Circuit A) or  
 $I_{C(on)} = 20 \mu\text{A}$  (Test Circuit B)



**TEST CIRCUIT A**  
PHOTOTRANSISTOR OPERATION



**VOLTAGE WAVEFORMS**



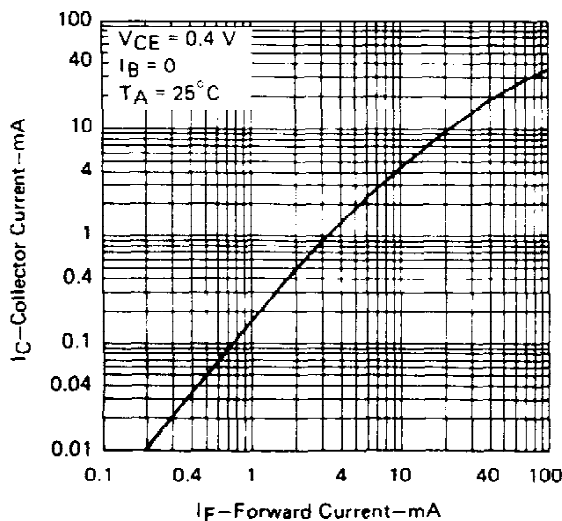
**TEST CIRCUIT B**  
PHOTODIODE OPERATION

- NOTES**
- The input waveform is supplied by a generator with the following characteristics:  $Z_{out} = 50 \Omega$ ,  $t_r \leq 15 \text{ ns}$ , duty cycle  $\leq 1\%$ ,  $I_w = 100 \mu\text{s}$ .
  - The output waveform is 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**

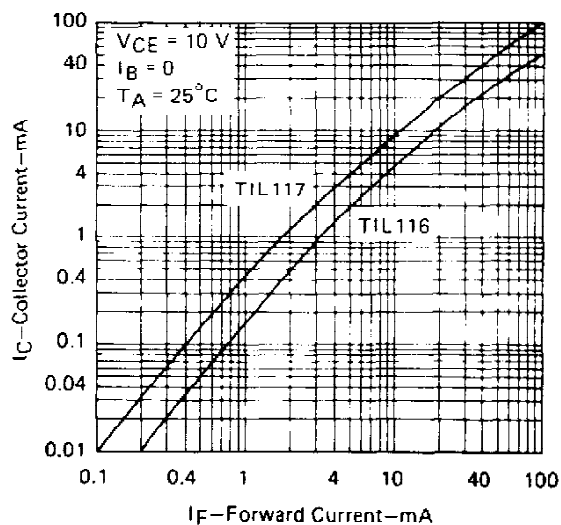
## TYPICAL CHARACTERISTICS

**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

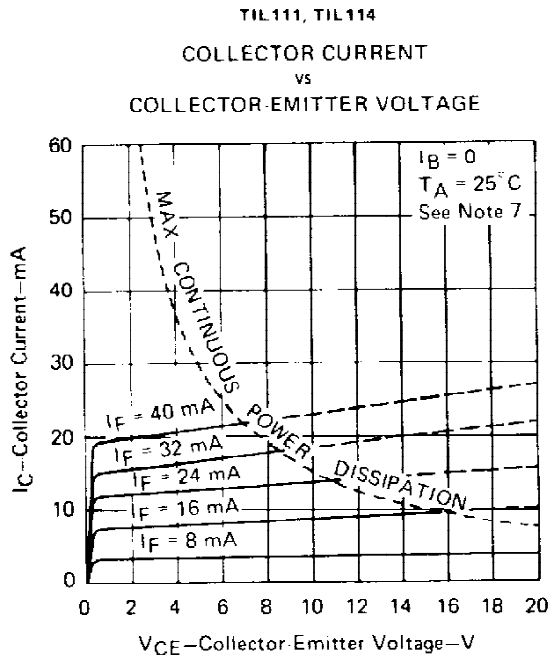


FIGURE 4

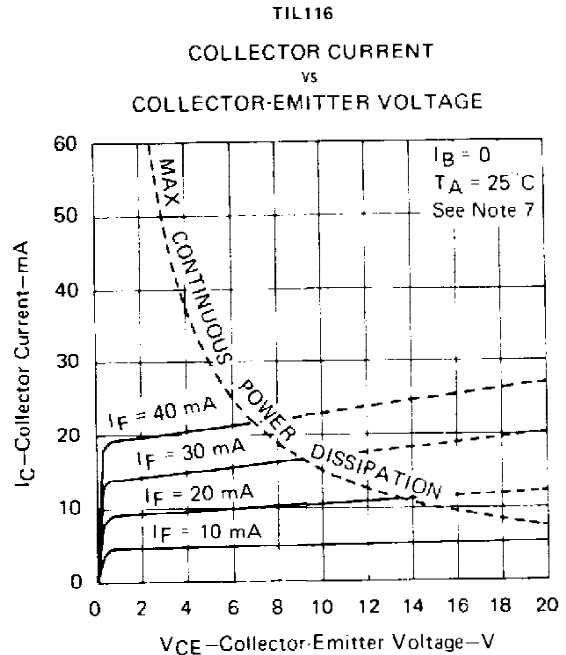


FIGURE 5

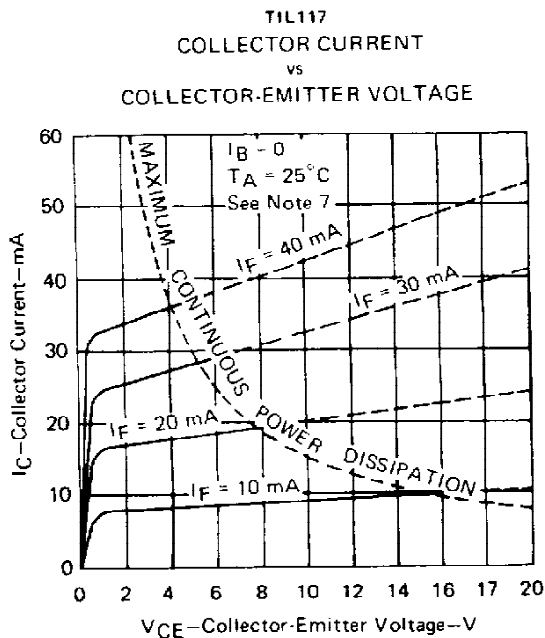


FIGURE 6

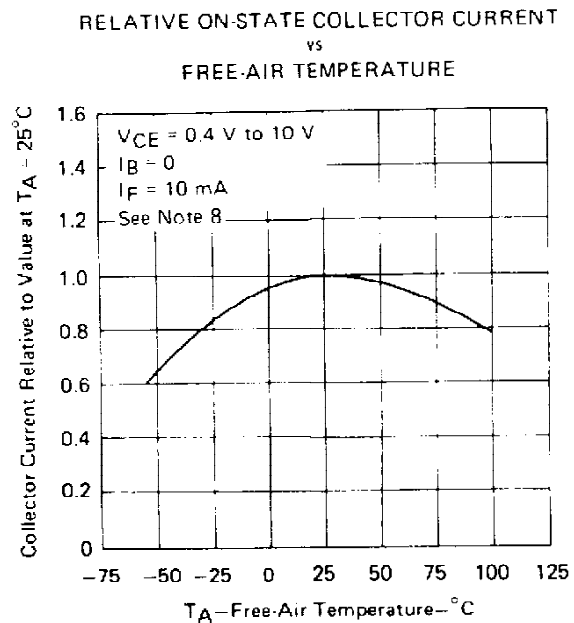


FIGURE 7

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:  $t_w = 1\text{ ms}$ , duty cycle  $\leq 2\%$ .

# TIL111, TIL114, TIL116, TIL117 OPTOCOUPERS

## TYPICAL CHARACTERISTICS

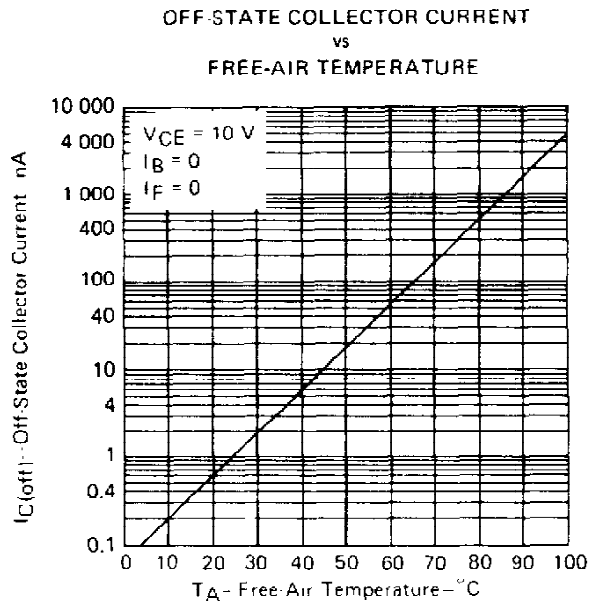


FIGURE 8

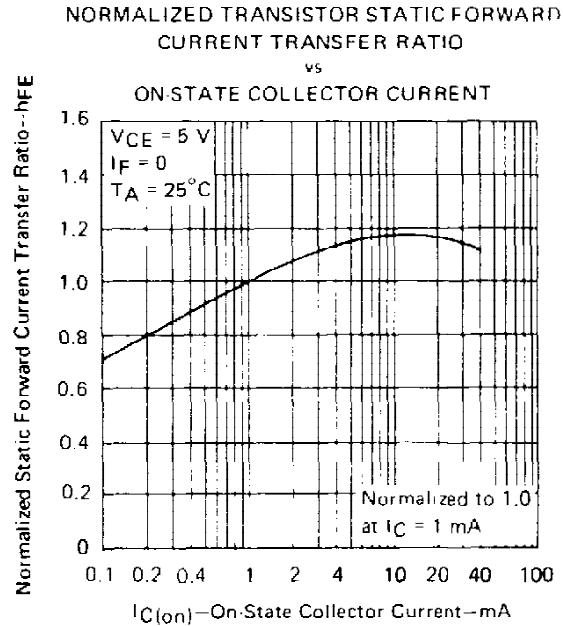


FIGURE 9

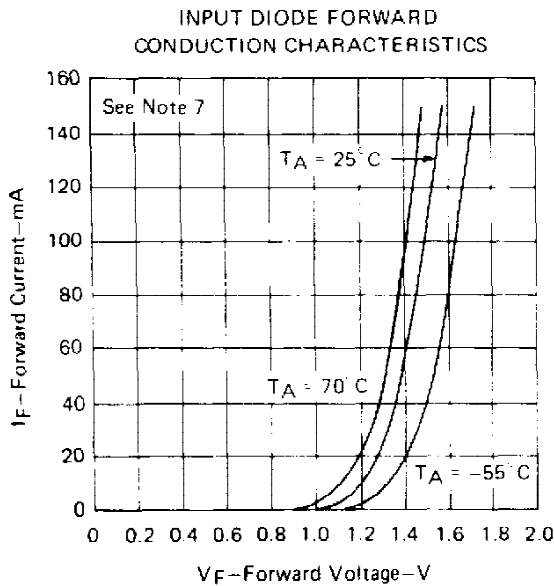


FIGURE 10

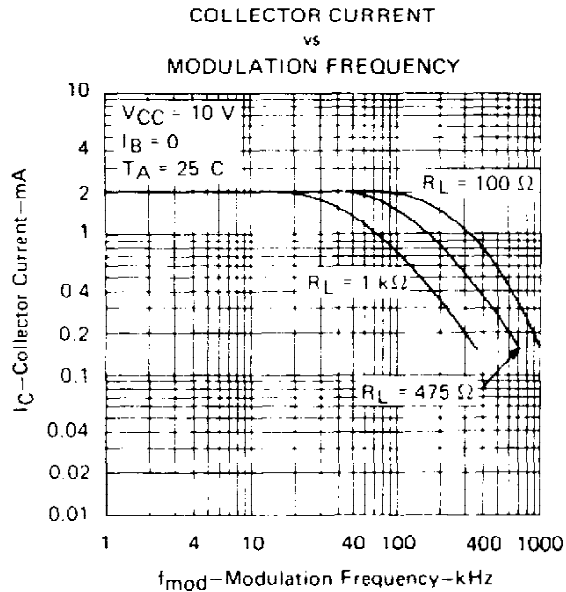


FIGURE 11

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

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