

TIL111, TIL114, TIL116, TIL117 OPTOCOUPERS

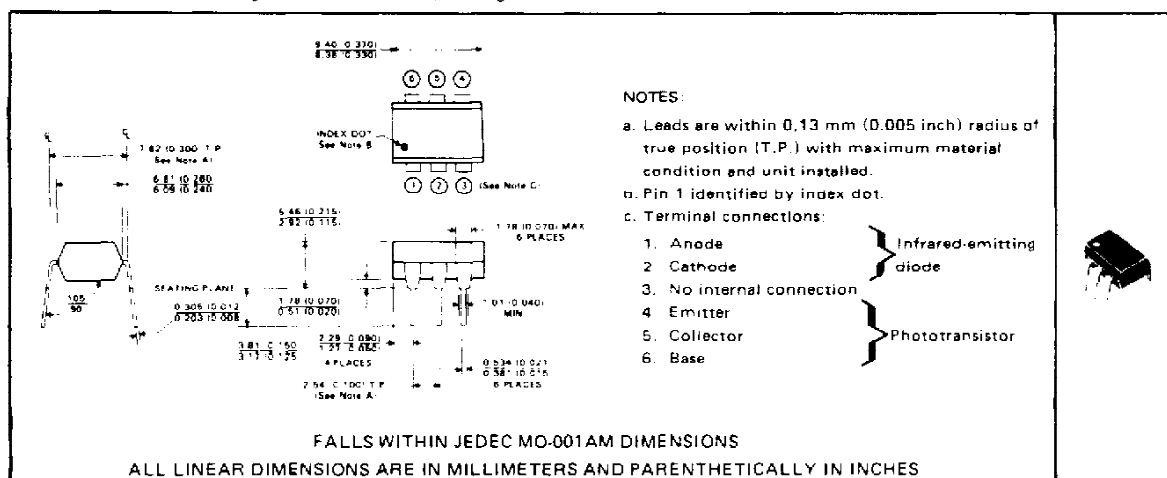
SOOSM0 D1607, NOVEMBER 1973-REVISED FEBRUARY 1983

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	$I_C = 10 \mu A$, $I_E = 0$, $I_F = 0$	70			70			70			V
$V_{(BR)CEO}$	Collector-Emitter Breakdown Voltage	$I_C = 1 mA$, $I_E = 0$, $I_F = 0$	30			30			30			V
$V_{(BR)EBO}$	Emitter-Base Breakdown Voltage	$I_E = 10 \mu A$, $I_C = 0$, $I_F = 0$	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 $V_{CE} = 0.4 V$, $I_F = 16 mA$, $I_B = 0$	2	7								mA
		$V_{CE} = 10 V$, $I_F = 10 mA$, $I_B = 0$				2	5		5	9		
	Photodiode Operation	$V_{CB} = 0.4 V$, $I_F = 16 mA$, $I_E = 0$	7	20		7	20		7	20		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	$V_{CE} = 5 V$, $I_C = 10 mA$, $I_F = 0$	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	$I_C = 2 mA$, $I_F = 16 mA$, $I_B = 0$		0.25	0.4							V
		$I_C = 2.2 mA$, $I_F = 15 mA$, $I_B = 0$					0.25	0.4				
		$I_C = 0.5 mA$, $I_F = 10 mA$, $I_B = 0$								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}			Ω
C_{iO}	Input to-Output Capacitance	$V_{in-out} = 0$, $f = 1 MHz$, 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.

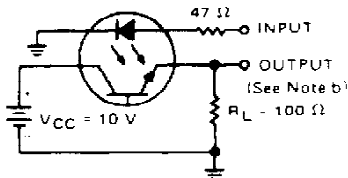
switching characteristics at 25°C free-air temperature

PARAMETER		TEST CONDITIONS	TIL111 TIL114			TIL116			TIL117			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
t_r	Rise Time	Phototransistor Operation $V_{CC} = 10 V$, $I_{C(on)} = 2 mA$, $R_L = 100 \Omega$, See Test Circuit A of Figure 1	5	10		5	10		5	10		μs
t_f	Fall Time		5	10		5	10		5	10		
t_r	Rise Time	Photodiode Operation $V_{CC} = 10 V$, $I_{C(on)} = 20 \mu A$, $R_L = 1 k\Omega$, See Test Circuit B of Figure 1	1			1			1			μs
t_f	Fall Time		1			1			1			

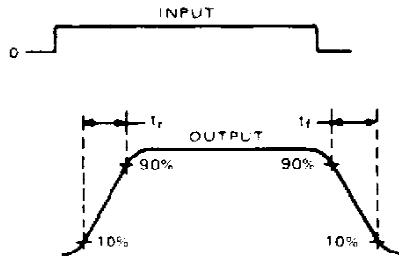
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PARAMETER MEASUREMENT INFORMATION

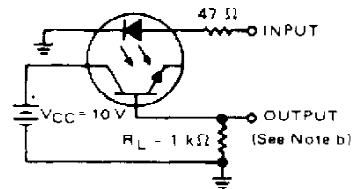
Adjust amplitude of input pulse for:
 $I_{C(on)} = 2 \text{ mA}$ (Test Circuit A) or
 $I_{C(on)} = 20 \mu\text{A}$ (Test Circuit B)



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

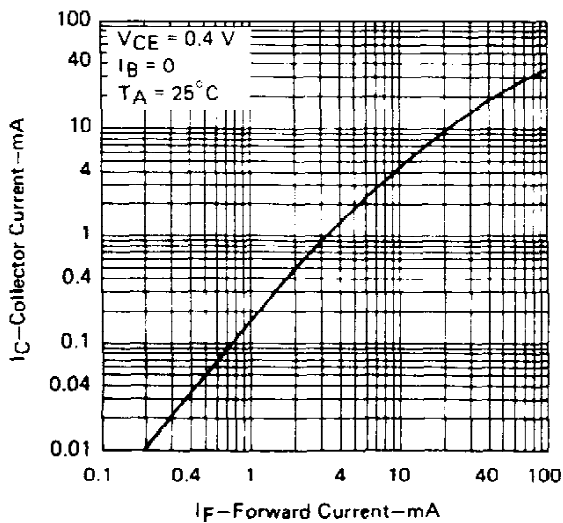


FIGURE 2

TIL116, TIL117
COLLECTOR CURRENT
vs
INPUT-DIODE FORWARD CURRENT

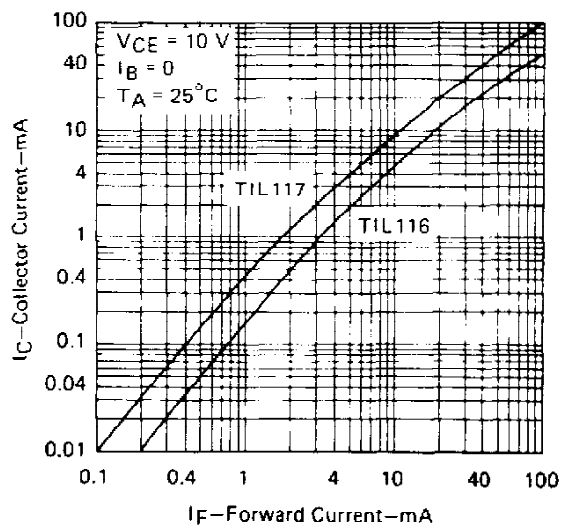


FIGURE 3

TIL111, TIL114, TIL116, TIL117 OPTOCOUPERS

TYPICAL CHARACTERISTICS

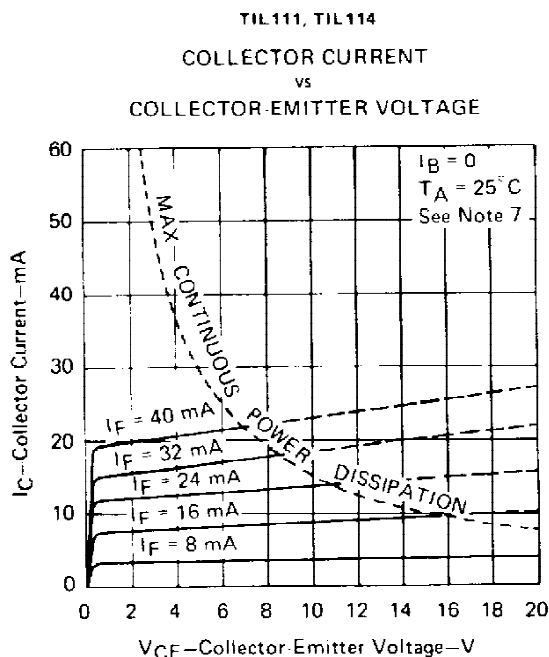


FIGURE 4

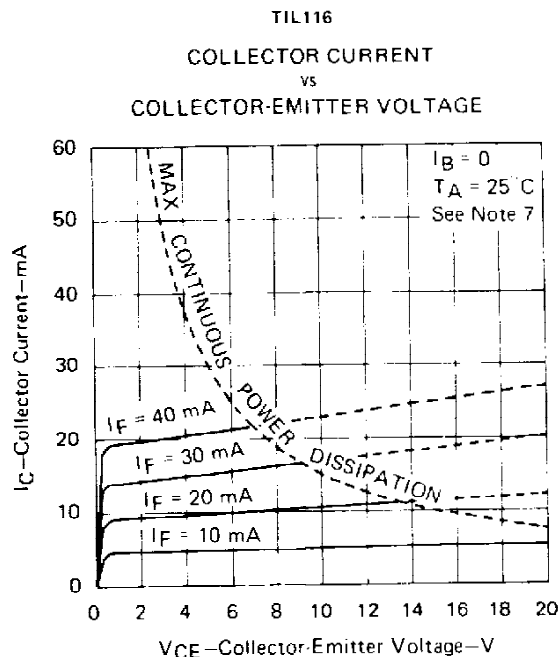


FIGURE 5

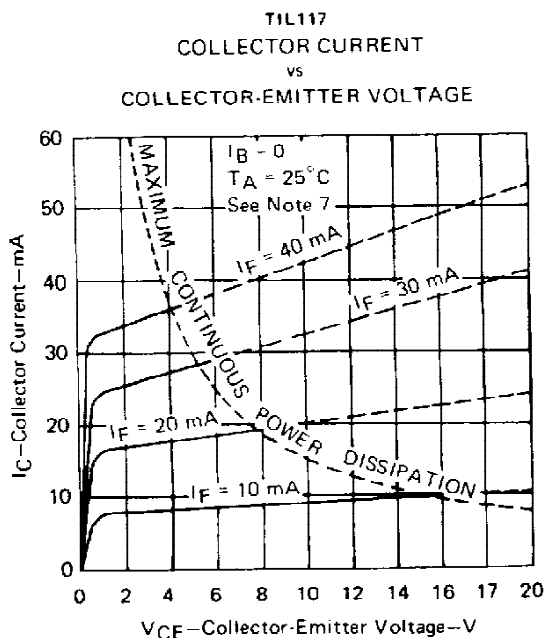


FIGURE 6

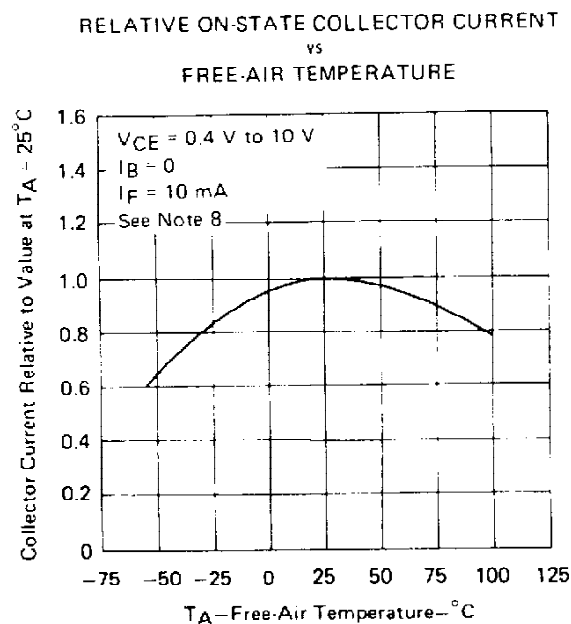


FIGURE 7

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

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TYPICAL CHARACTERISTICS

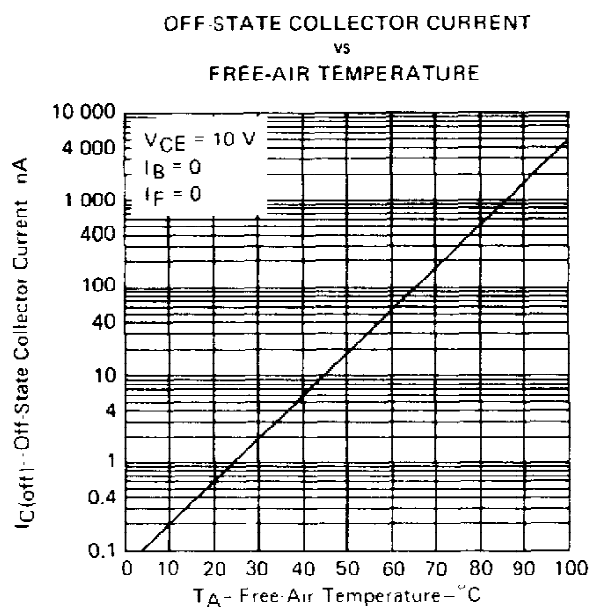


FIGURE 8

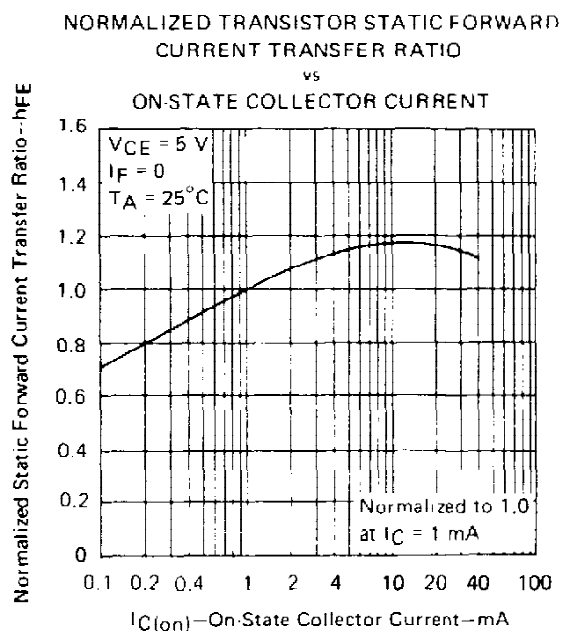


FIGURE 9

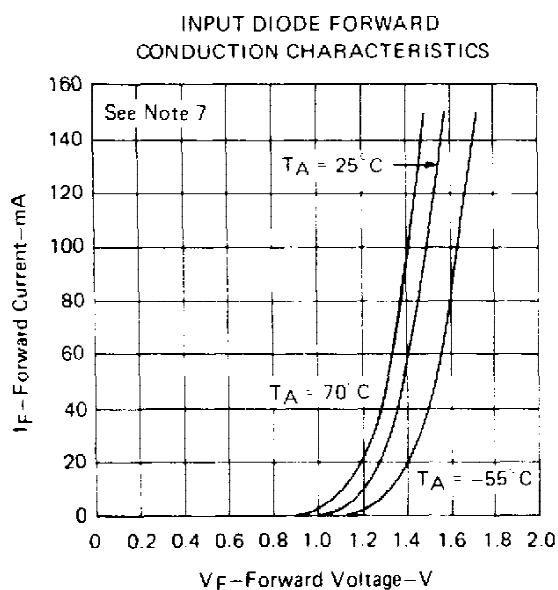


FIGURE 10

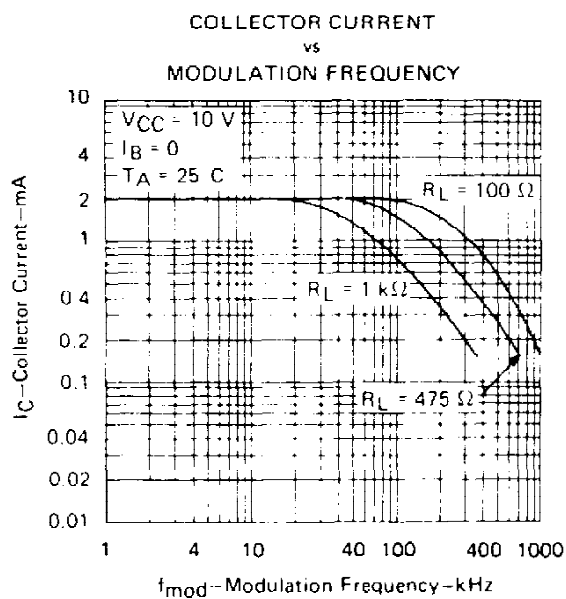


FIGURE 11

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

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