

TIL111, TIL114, TIL116, TIL117 OPTOCOUPLED

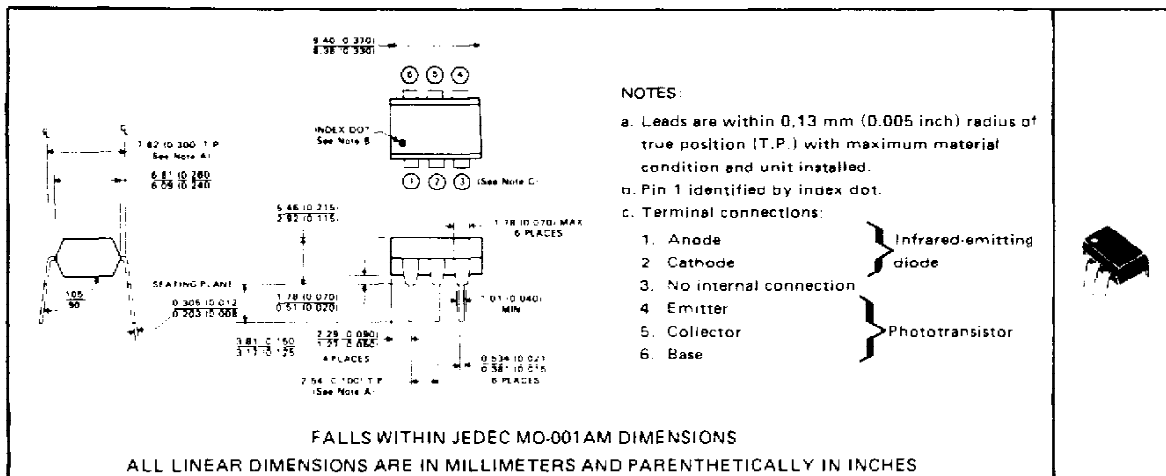
SOOS040 D1607, NOVEMBER 1973—REVISED FEBRUARY 1983

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 _{(BR)ICBO} | Collector-Base Breakdown Voltage | I _C = 10 μA, I _E = 0, I _F = 0 | 70 | | | 70 | | | 70 | | | V |
| V _{(BR)ICEO} | Collector-Emitter Breakdown Voltage | I _C = 1 mA, I _B = 0, I _F = 0 | 30 | | | 30 | | | 30 | | | V |
| V _{(BR)IEBO} | 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} = 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 μA, 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 = 50 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} = ±1.5 kV for TIL111, ±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 |

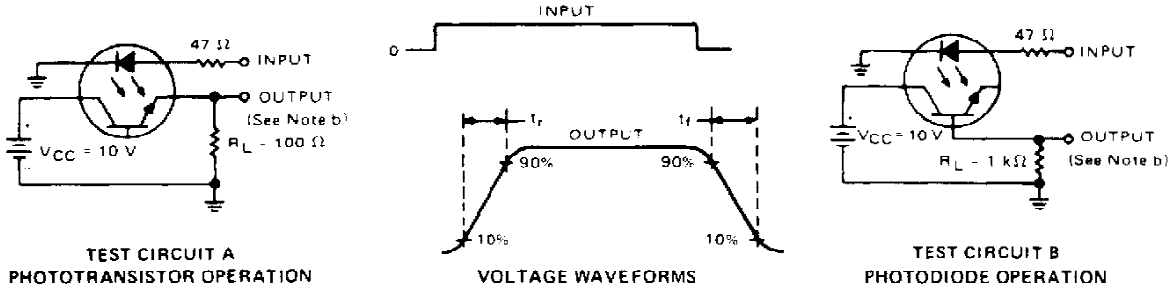
NOTE 6 These parameters are measured between both input diode leads shorted together and all the phototransistor leads shorted together.

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 Ω, 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 μA, R _L = 1 kΩ, See Test Circuit B of Figure 1 | 1 | | | 1 | | | 1 | | μs | |
| t _f | 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)



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

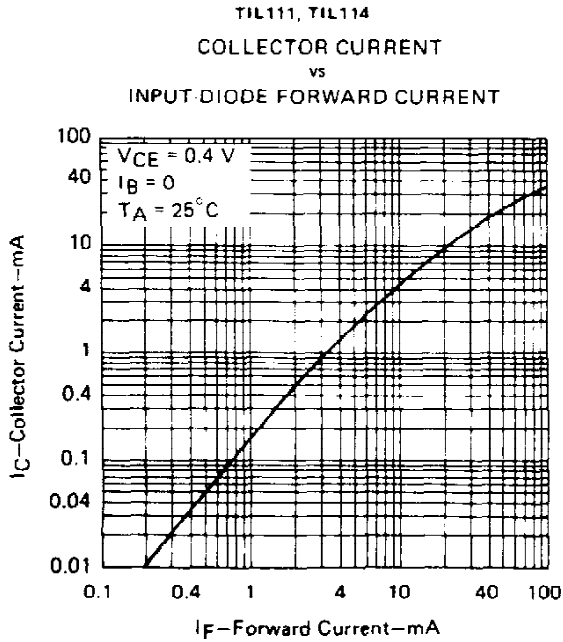


FIGURE 2

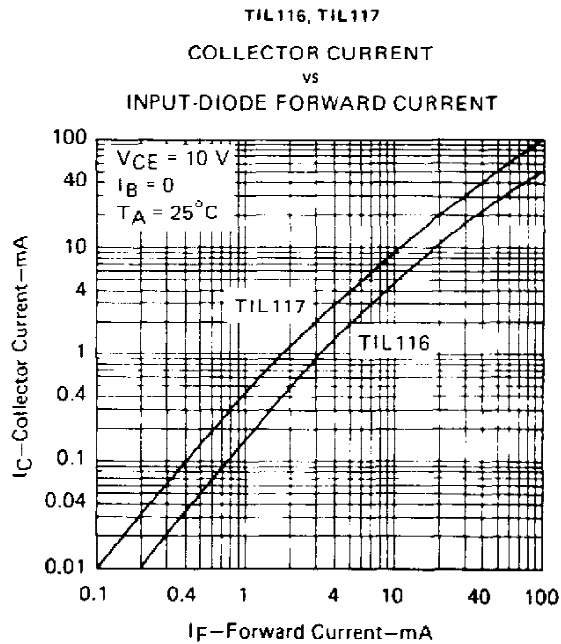


FIGURE 3

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

TYPICAL CHARACTERISTICS

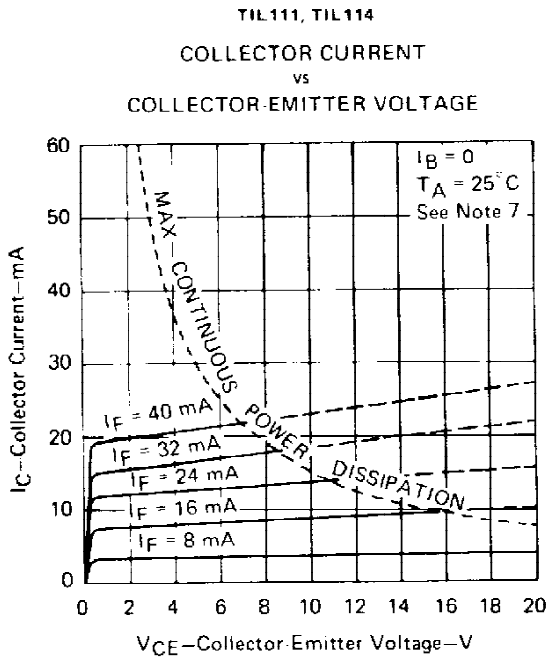


FIGURE 4

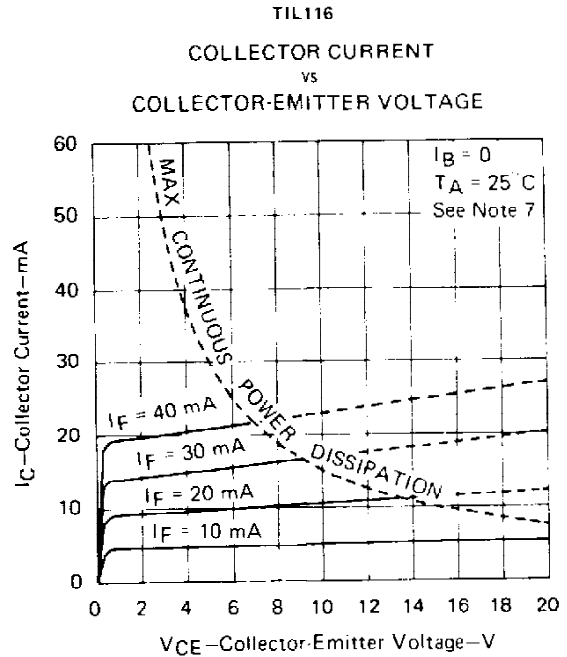


FIGURE 5

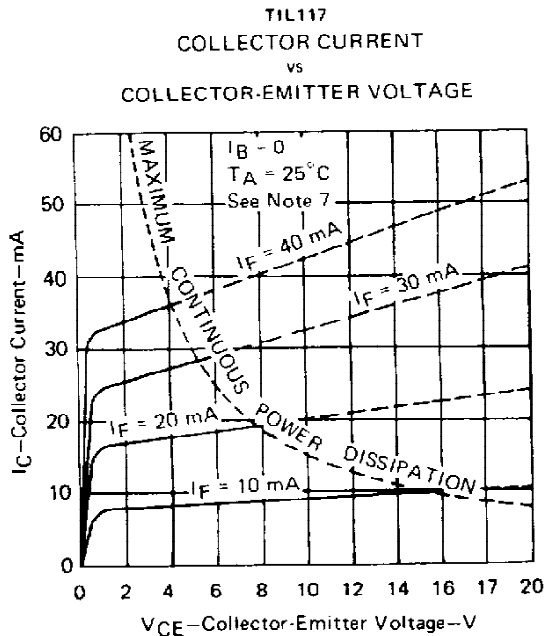


FIGURE 6

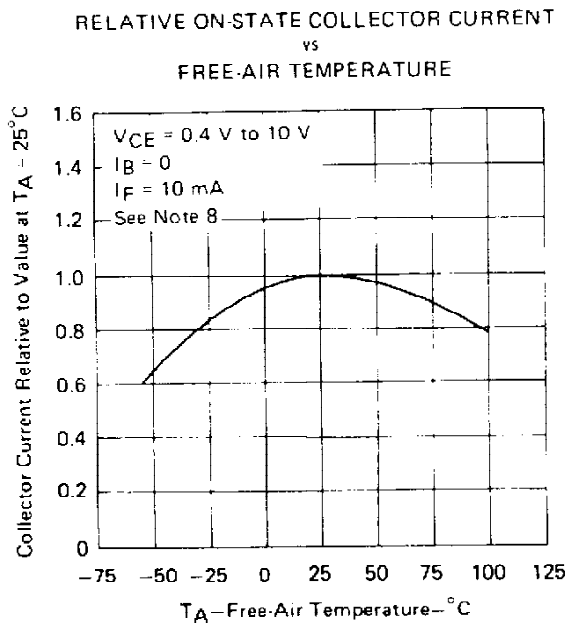


FIGURE 7

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 $\leq 2\%$

TYPICAL CHARACTERISTICS

OFF-STATE COLLECTOR CURRENT
vs
FREE-AIR TEMPERATURE

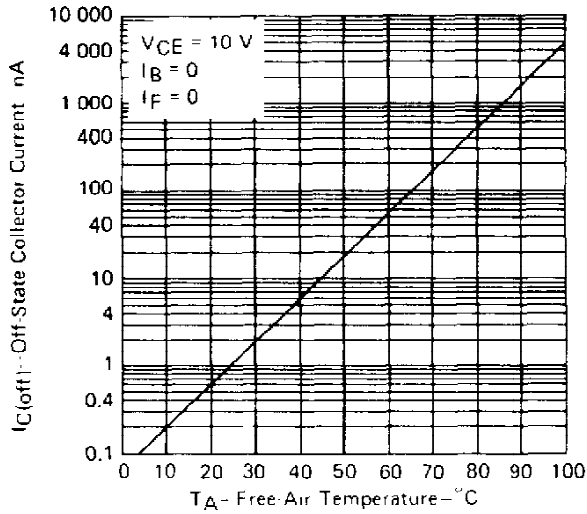


FIGURE 8

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

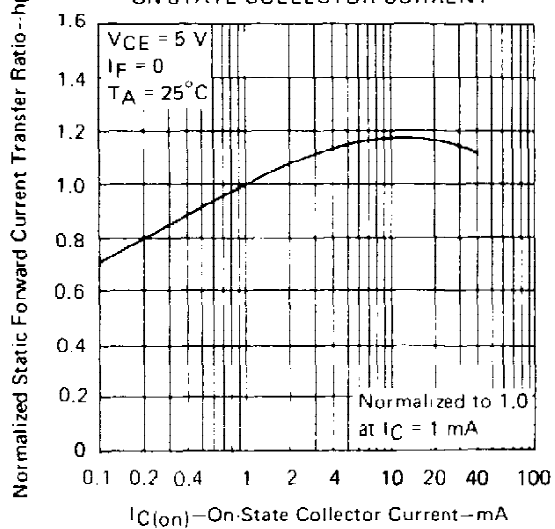


FIGURE 9

INPUT DIODE FORWARD
CONDUCTION CHARACTERISTICS

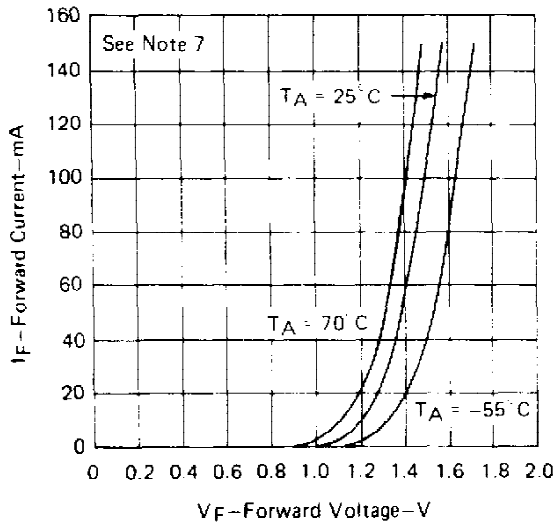


FIGURE 10

COLLECTOR CURRENT
vs
MODULATION FREQUENCY

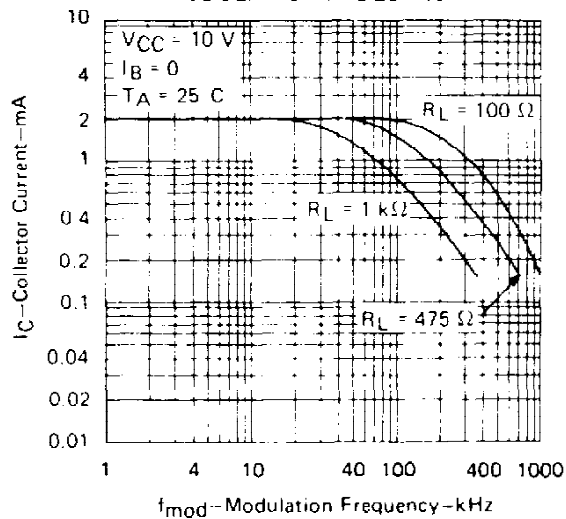


FIGURE 11

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

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