

### **Rochester Electronics Manufactured Components**

Rochester branded components are manufactured using either die/wafers purchased from the original suppliers or Rochester wafers recreated from the original IP. All recreations are done with the approval of the OCM.

Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceed the OCM data sheet.

### **Quality Overview**

- ISO-9001
- AS9120 certification
- Qualified Manufacturers List (QML) MIL-PRF-35835
  - Class Q Military
  - Class V Space Level
- Qualified Suppliers List of Distributors (QSLD)
  - Rochester is a critical supplier to DLA and meets all industry and DLA standards.

Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

The original manufacturer's datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OEM specifications. 'Typical' values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.

# TIL111, TIL114, TIL116, TIL117 OPTOCOUPLED

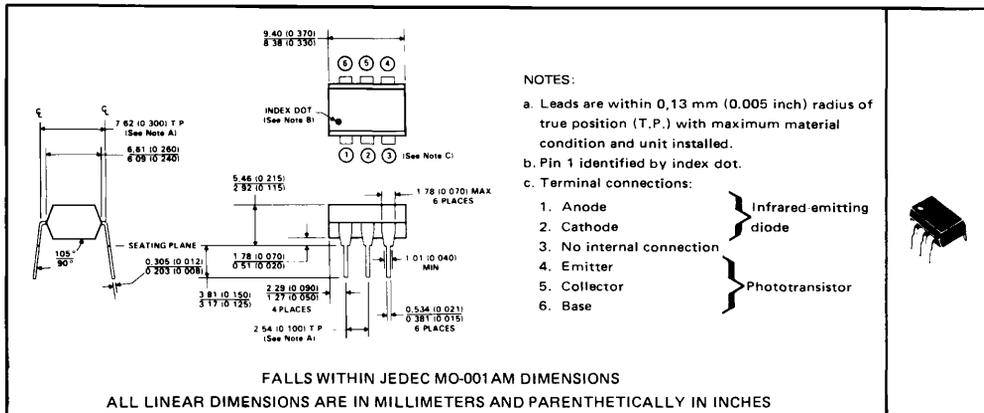
D1607, NOVEMBER 1973—REVISED FEBRUARY 1983

## 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.



3  
Optocouplers (Isolators)

### 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 mA/°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<br>TIL114 |     |     | TIL116           |     |     | TIL117           |     |     | UNIT |
|----------------------|--|--|------------------|-----|-----|------------------|-----|-----|------------------|-----|-----|------|
|                      |  |  | MIN              | TYP | MAX | MIN              | TYP | MAX | MIN              | TYP | MAX |      |
| V(BR)CBO             | 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(BR)CEO             | 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(BR)EBO             | 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<br>V <sub>CE</sub> = 0.4 V, I <sub>B</sub> = 0, I <sub>F</sub> = 16 mA | 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<br>V <sub>CE</sub> = 10 V, I <sub>B</sub> = 0, I <sub>F</sub> = 0      |                  | 1   | 50  |                  | 1   | 50  |                  | 1   | 50  | nA   |
|                      |  | Photodiode Operation<br>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> = 60 mA   |                  |     |     |                  |     |     | 1.25             | 1.5 |     |      |
| V <sub>CE(sat)</sub> | Collector-Emitter Saturation Voltage             | I <sub>C</sub> = 2 mA, I <sub>B</sub> = 0, I <sub>F</sub> = 16 mA                                | 0.25             | 0.4 |     |                  |     |     |                  |     |     | V    |
|                      |  | I <sub>C</sub> = 2.2 mA, I <sub>B</sub> = 0, I <sub>F</sub> = 15 mA                              |                  |     |     | 0.25             | 0.4 |     |                  |     |     |      |
|                      |  | I <sub>C</sub> = 0.5 mA, I <sub>B</sub> = 0, I <sub>F</sub> = 10 mA                              |                  |     |     |                  |     |     | 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   |

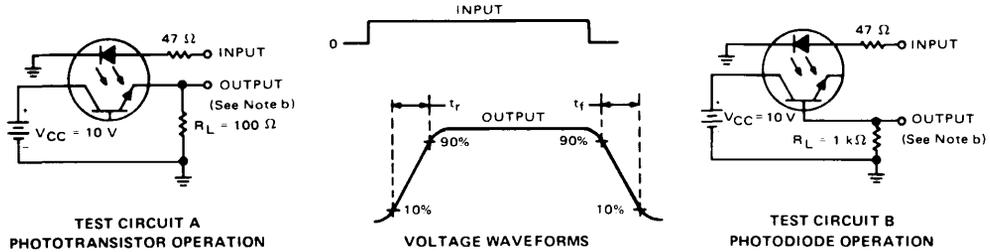
NOTE 6: These parameters are measured between both input-diode leads shorted together and all the phototransistor leads shorted together.

switching characteristics at 25°C free-air temperature

| PARAMETER      |           | TEST CONDITIONS   | TIL111<br>TIL114 |     |     | TIL116 |     |     | TIL117 |     |     | UNIT |
|----------------|-----------|---|------------------|-----|-----|--------|-----|-----|--------|-----|-----|------|
|                |           |   | MIN              | TYP | MAX | MIN    | TYP | MAX | MIN    | TYP | MAX |      |
| t <sub>r</sub> | Rise Time | Phototransistor Operation<br>V <sub>CC</sub> = 10 V, 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<br>V <sub>CC</sub> = 10 V, 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)



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  $\approx 1\%$ ,  $t_w = 100 \mu\text{s}$ .  
 b. 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

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Optocouplers (Isolators)

TYPICAL CHARACTERISTICS

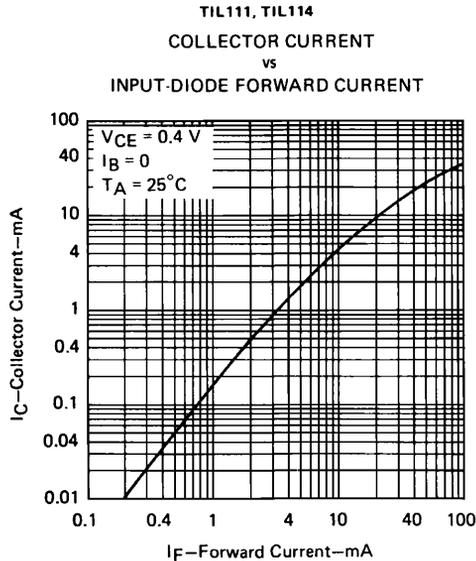


FIGURE 2

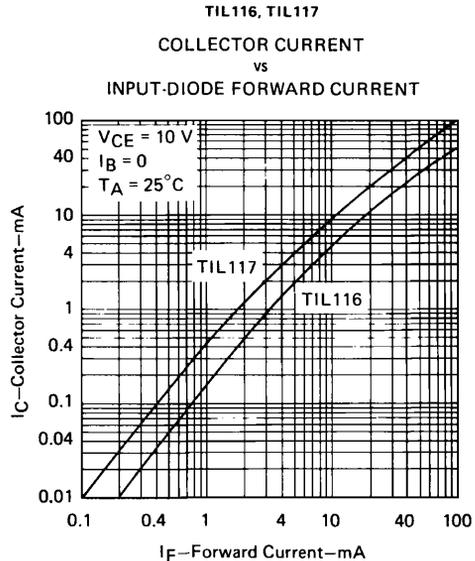


FIGURE 3

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

**TYPICAL CHARACTERISTICS**

3  
 Optocouplers (Isolators)

TIL111, TIL114  
 COLLECTOR CURRENT  
 vs  
 COLLECTOR-EMITTER VOLTAGE

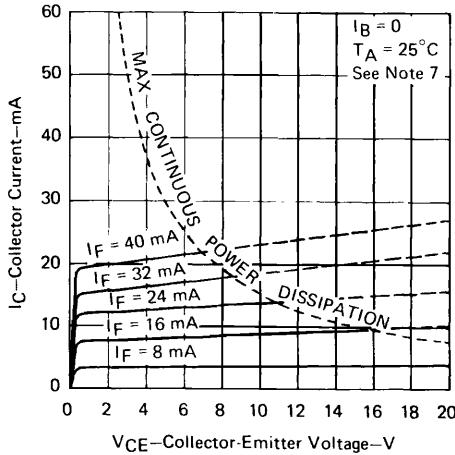


FIGURE 4

TIL116  
 COLLECTOR CURRENT  
 vs  
 COLLECTOR-EMITTER VOLTAGE

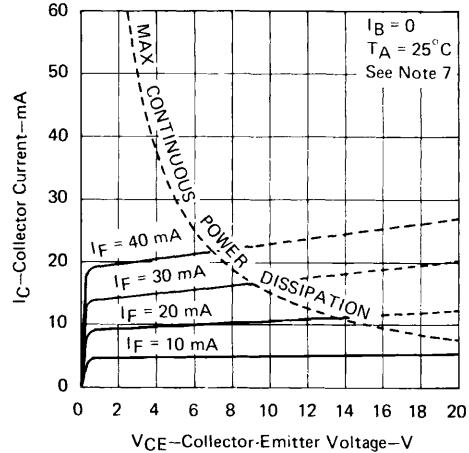


FIGURE 5

TIL117  
 COLLECTOR CURRENT  
 vs  
 COLLECTOR-EMITTER VOLTAGE

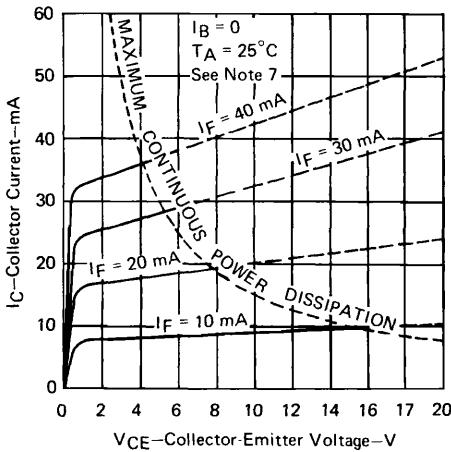


FIGURE 6

RELATIVE ON-STATE COLLECTOR CURRENT  
 vs  
 FREE-AIR TEMPERATURE

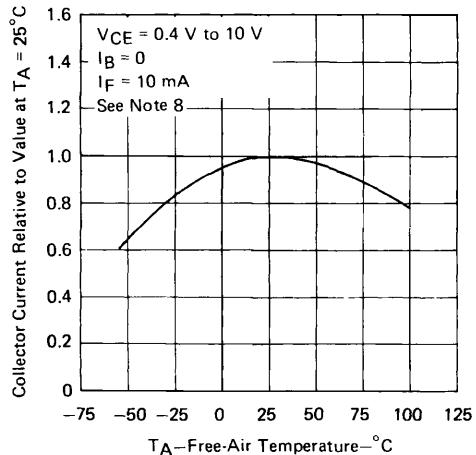


FIGURE 7

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

TYPICAL CHARACTERISTICS

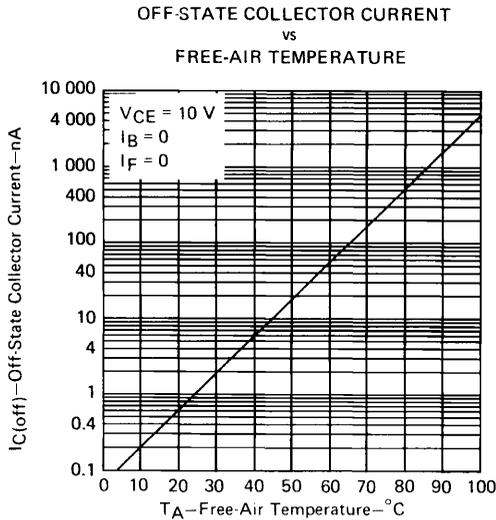


FIGURE 8

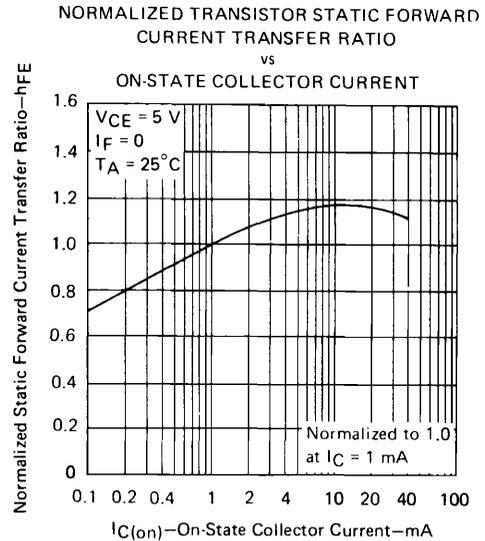


FIGURE 9

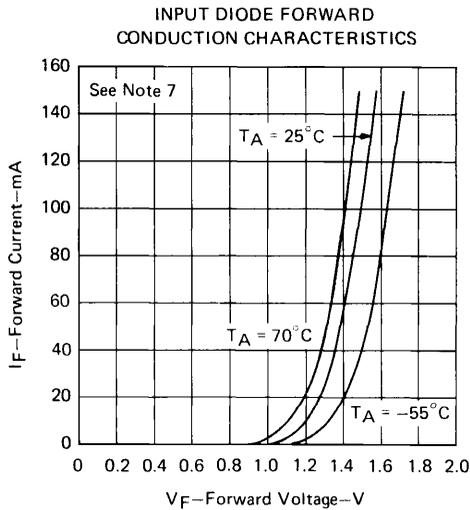


FIGURE 10

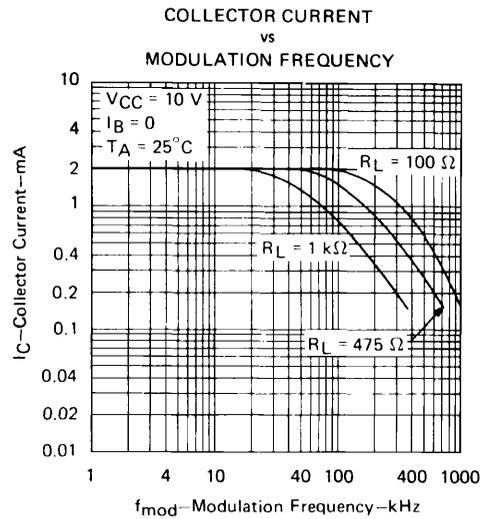


FIGURE 11

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

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Optocouplers (Isolators)