

# TIL189-1 THRU TIL189-4 TIL190-1 THRU TIL190-4 OPTOCOUPLEDERS/OPTOISOLATORS

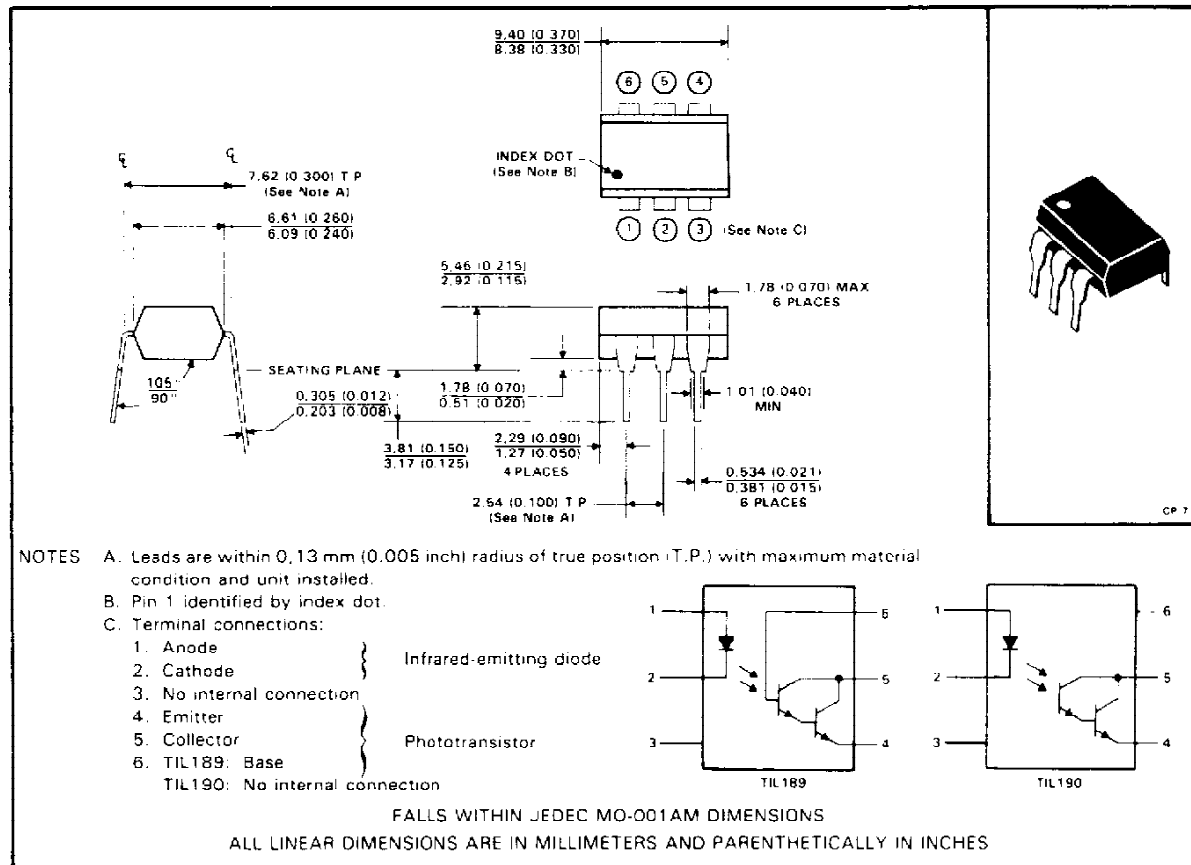
SOOS038A D2987, JANUARY 1987—REVISED JULY 1989

- High Direct-Current Transfer Ratios, 500% Minimum at  $I_F = 10$  mA and Up to 1500% at  $I_F = 2$  mA with Choice of Four Categories
- Plastic Dual-In-Line Package
- High-Voltage Electrical Isolation, 3.535 kV Peak (2.5 kV rms)
- Gallium Arsenide Diode Infrared Source Optically Coupled to a Silicon N-P-N Darlington Phototransistor
- No Base Lead Connection on TIL190 for High-EMI Environment
- UL Recognized — File # E65085

## description

The TIL189 and TIL190 Optocouplers are designed for use in applications that require high current transfer ratio and high voltage isolation between the input and output. The TIL189 has the base connected for applications where a base signal or resistor is required. The TIL190 is designed with no internal base connection for applications where high base-noise immunity is desired. Users can select from four different current gains (TIL189-1 through TIL189-4 and TIL190-1 through TIL190-4).

## mechanical data



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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**TIL189-1 THRU TIL189-4  
TIL190-1 THRU TIL190-4  
OPTOCOUPERS/OPTOISOLATORS**

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

|                                                                       |                                    |
|-----------------------------------------------------------------------|------------------------------------|
| Input-to-output voltage                                               | ±3.535 kV peak or dc (±2.5 kV rms) |
| Collector-base voltage (TIL189)                                       | 100 V                              |
| Collector-emitter voltage (see Note 1)                                | 55 V                               |
| Emitter-collector voltage                                             | 7 V                                |
| Emitter-base voltage (TIL189)                                         | 14 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 3)                                          | 150 mW                             |
| Total, infrared-emitting diode plus phototransistor (see Note 4)      | 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 mA/°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 3.33 mW/°C.

**TIL189-1 THRU TIL189-4  
TIL190-1 THRU TIL190-4  
OPTOCOUPERS/OPTOISOLATORS**

electrical characteristics at 25°C free-air temperature (unless otherwise noted)

| PARAMETER     |                                                  |                      | TEST CONDITIONS                                         | TIL189    |     |     | TIL190    |     |     | UNIT     |
|---------------|--------------------------------------------------|----------------------|---------------------------------------------------------|-----------|-----|-----|-----------|-----|-----|----------|
|               |                                                  |                      |                                                         | MIN       | TYP | MAX | MIN       | TYP | MAX |          |
| $V_{(BR)CBO}$ | Collector-base breakdown voltage                 |                      | $I_C = 10 \mu A, I_E = 0, I_F = 0$                      | 100       |     |     |           |     |     | V        |
| $V_{(BR)CEO}$ | Collector-emitter breakdown voltage              |                      | $I_C = 1 mA, I_B = 0, I_F = 0$                          | 55        |     |     | 65        |     |     | V        |
| $V_{(BR)EBO}$ | Emitter-base breakdown voltage                   |                      | $I_E = 10 \mu A, I_C = 0, I_F = 0$                      | 14        |     |     |           |     |     | V        |
| $V_{(BR)ECO}$ | Emitter-collector breakdown voltage              |                      | $I_E = 100 \mu A, I_F = 0$                              |           |     |     | 7         |     |     | V        |
| $I_R$         | Input diode static reverse current               |                      | $V_R = 3 V$                                             | 10        |     |     | 10        |     |     | $\mu A$  |
| $I_{C(on)}$   | On-state collector current                       | TIL189-1, TIL190-1   | $V_{CE} = 1 V, I_F = 2 mA, I_B = 0$                     | 5         |     |     | 5         |     |     | mA       |
|               |                                                  | TIL189-2, TIL190-2   |                                                         | 10        |     |     | 10        |     |     |          |
|               |                                                  | TIL189-3, TIL190-3   |                                                         | 20        |     |     | 20        |     |     |          |
|               |                                                  | TIL189-4, TIL190-4   |                                                         | 30        |     |     | 30        |     |     |          |
|               |                                                  |                      | $V_{CE} = 1 V, I_F = 10 mA, I_B = 0$                    | 50        |     |     | 50        |     |     |          |
|               |                                                  | Photodiode operation | $V_{CB} = 1 V, I_F = 10 mA, I_E = 0$                    | 5         | 15  |     |           |     |     | $\mu A$  |
| $I_{C(off)}$  | Off-state collector current                      |                      | $V_{CE} = 10 V, I_F = 0, I_B = 0$                       | 1 100     |     |     | 1 100     |     |     | nA       |
| $h_{FE}$      | Transistor static forward current transfer ratio |                      | $V_{CE} = 1 V, I_C = 10 mA, I_F = 0$                    | 25000     |     |     |           |     |     |          |
| $V_F$         | Input diode static forward voltage               |                      | $I_F = 10 mA$                                           | 1.2 1.5   |     |     | 1.2 1.5   |     |     | V        |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage             |                      | $I_C = 50 mA, I_F = 10 mA, I_B = 0$                     | 0.87 1    |     |     | 0.87 1    |     |     | V        |
| $r_{iD}$      | Input-to-output internal resistance              |                      | $V_{in-out} = \pm 500 V, \text{ See Note 5}$            | $10^{11}$ |     |     | $10^{11}$ |     |     | $\Omega$ |
| $C_{iD}$      | Input-to-output capacitance                      |                      | $V_{in-out} = 0, f = 1 \text{ MHz}, \text{ See Note 5}$ | 1 1.3     |     |     | 1 1.3     |     |     | pF       |

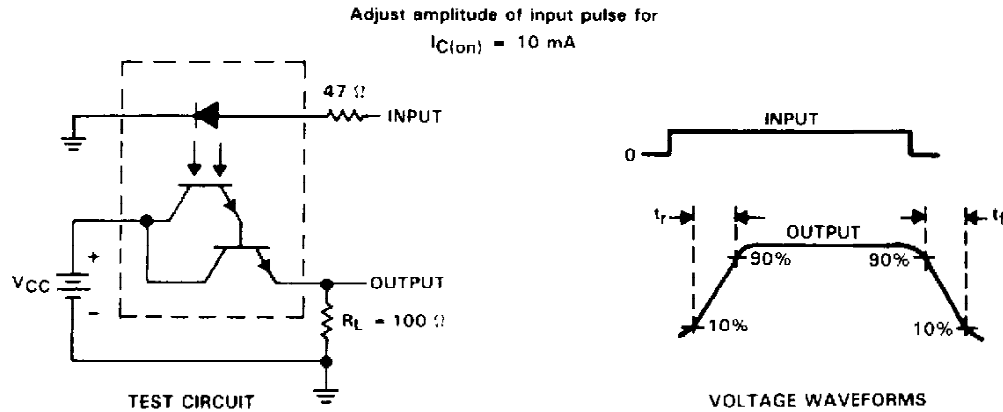
NOTE 5: These parameters are measured between both input-diode leads shorted together and all the phototransistor leads shorted together.

switching characteristics at 25°C free-air temperature

| PARAMETER       | TEST CONDITIONS                          | TIL189 |     |     | TIL190 |     |     | UNIT    |
|-----------------|------------------------------------------|--------|-----|-----|--------|-----|-----|---------|
|                 |                                          | MIN    | TYP | MAX | MIN    | TYP | MAX |         |
| $t_r$ Rise time | $V_{CC} = 10 V, I_{C(on)} = 10 mA,$      | 100    |     |     | 100    |     |     | $\mu s$ |
| $t_f$ Fall time | $R_L = 100 \Omega, \text{ see Figure 1}$ | 100    |     |     | 100    |     |     | $\mu s$ |

**TIL189-1 THRU TIL189-4  
TIL190-1 THRU TIL190-4  
OPTOCOUPERS/OPTOISOLATORS**

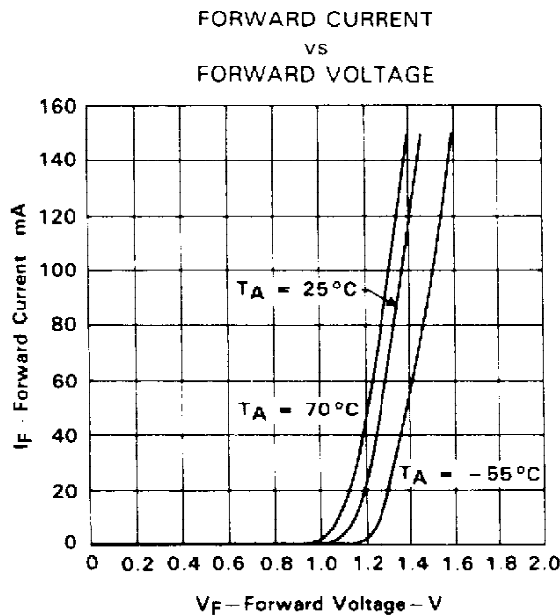
**PARAMETER MEASUREMENT INFORMATION**



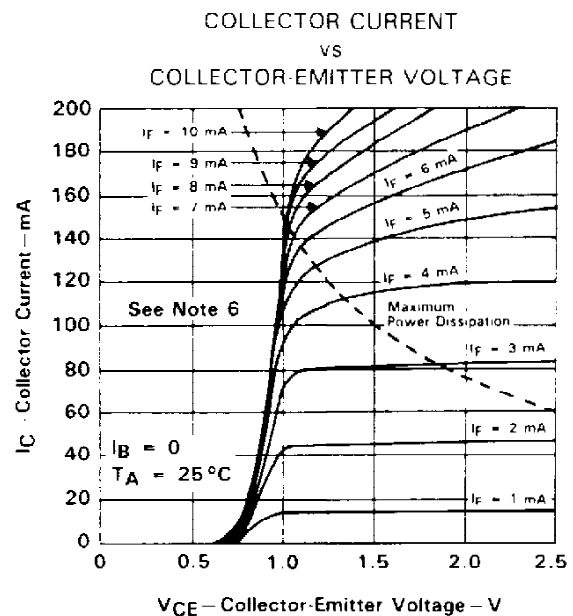
NOTES: A The input waveform is supplied by a generator with the following characteristics:  $Z_0 = 50 \Omega$ ,  $t_r \leq 15 \text{ ns}$ , duty cycle = 1%.  
B The output waveform is monitored on an oscilloscope with the following characteristics:  $t_f \leq 12 \text{ ns}$ ,  $R_I \geq 1 \text{ M}\Omega$ ,  $C_{IN} \leq 20 \text{ pF}$ .

**FIGURE 1. SWITCHING TIMES**

**TYPICAL CHARACTERISTICS**



**FIGURE 2**

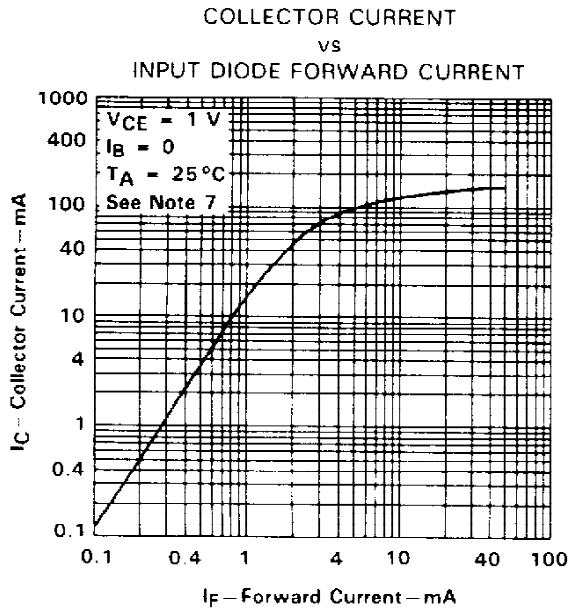


**FIGURE 3**

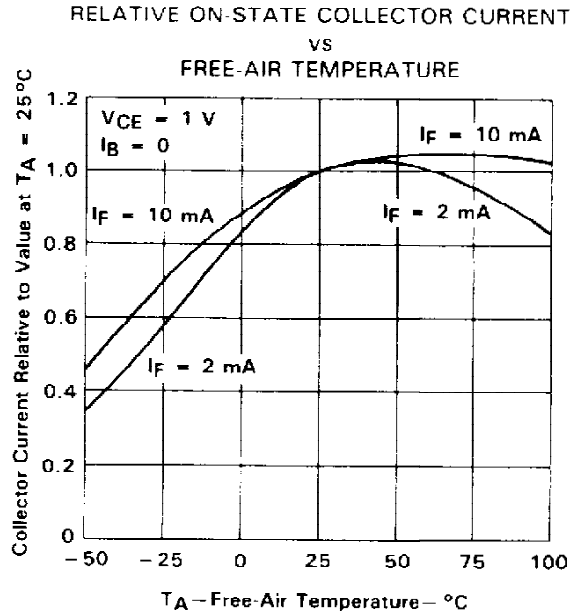
NOTE 6 Pulse operation is required for operation beyond limits shown by the dashed line.

**TIL189-1 THRU TIL189-4  
TIL190-1 THRU TIL190-4  
OPTOCOUPERS/OPTOISOLATORS**

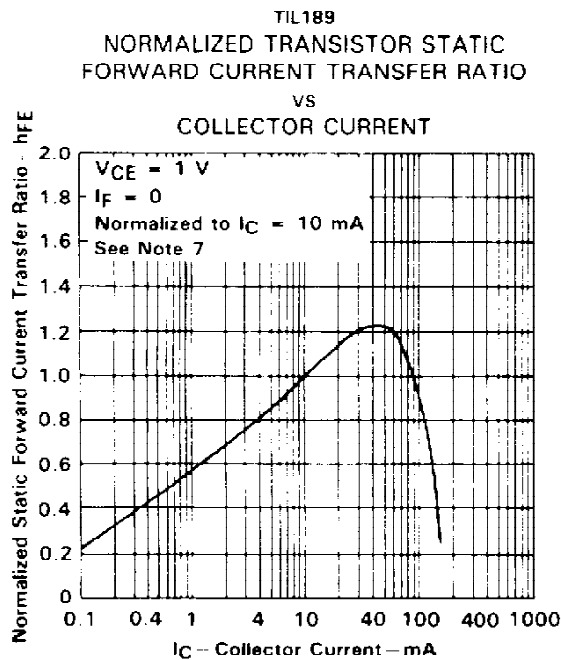
**TYPICAL CHARACTERISTICS**



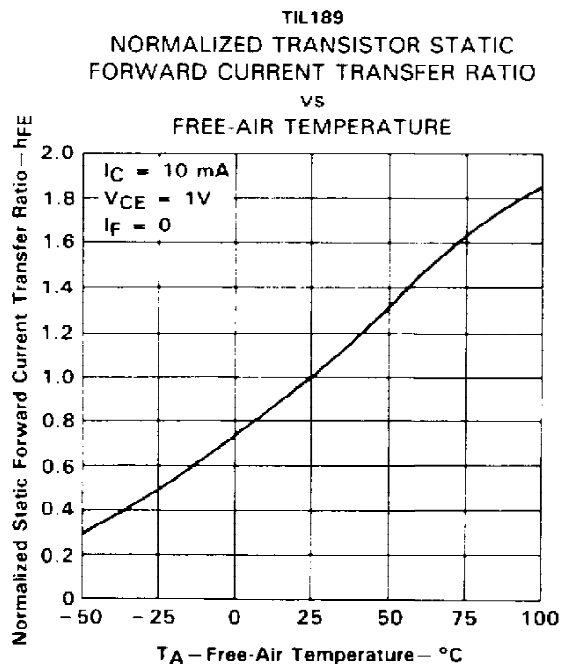
**FIGURE 4**



**FIGURE 5**



**FIGURE 6**

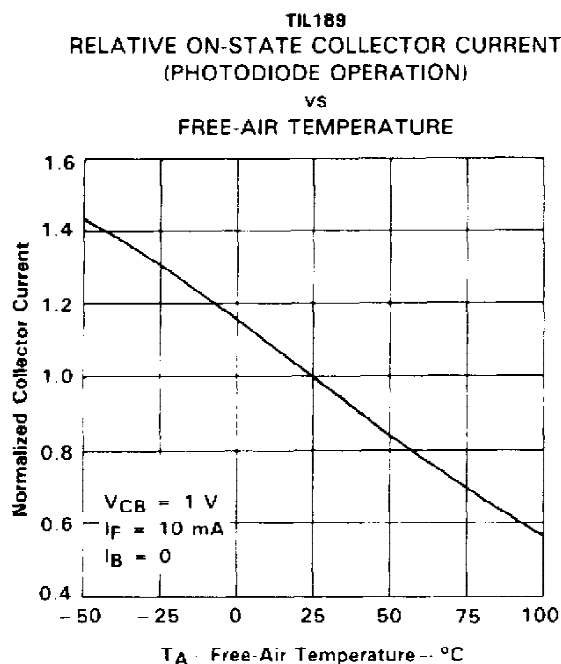


**FIGURE 7**

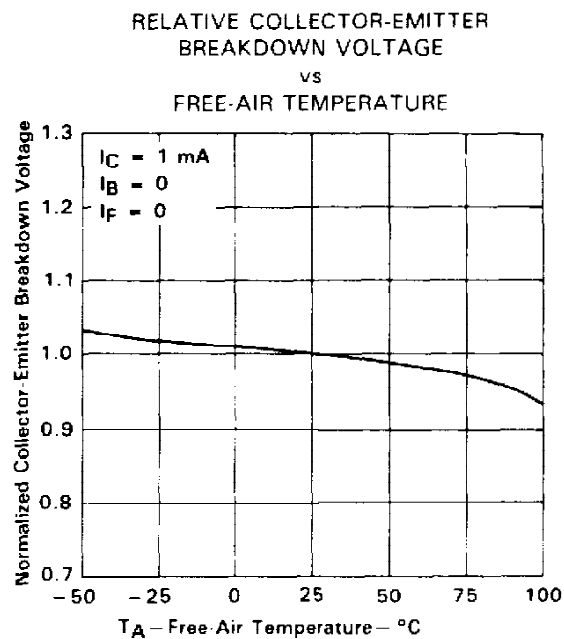
NOTE 7: These parameters were measured using pulse techniques  $t_w = 1\text{ ms}$ , duty cycle  $\leq 2\%$ .

**TIL189-1 THRU TIL189-4**  
**TIL190-1 THRU TIL190-4**  
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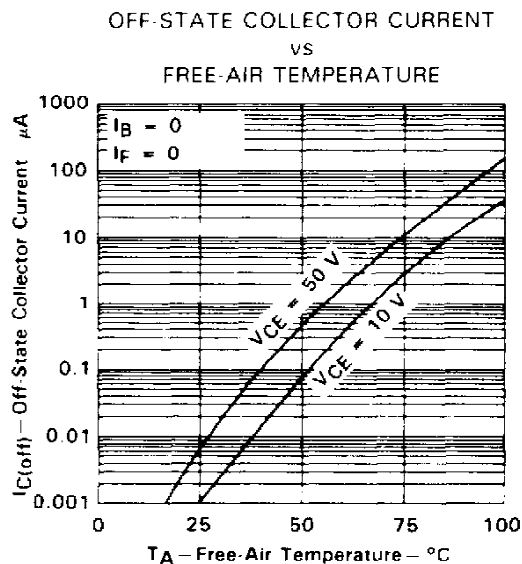
**TYPICAL CHARACTERISTICS**



**FIGURE 8**



**FIGURE 9**



**FIGURE 10**

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