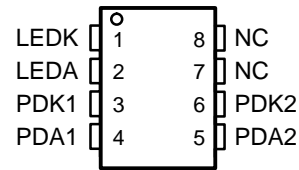


- ac or dc Signal Coupling
- Wide Bandwidth . . . >200 kHz
- High Transfer-Gain Stability . . .  $\pm 0.005\%/^{\circ}\text{C}$
- 3500 V Peak Isolation
- Typical Applications
  - Power-Supply Feedback
  - Medical-Sensor Isolation
  - Opto Direct-Access Arrangement (DAA)
  - Isolated Process-Control Transducers

DCS OR P PACKAGE  
(TOP VIEW)

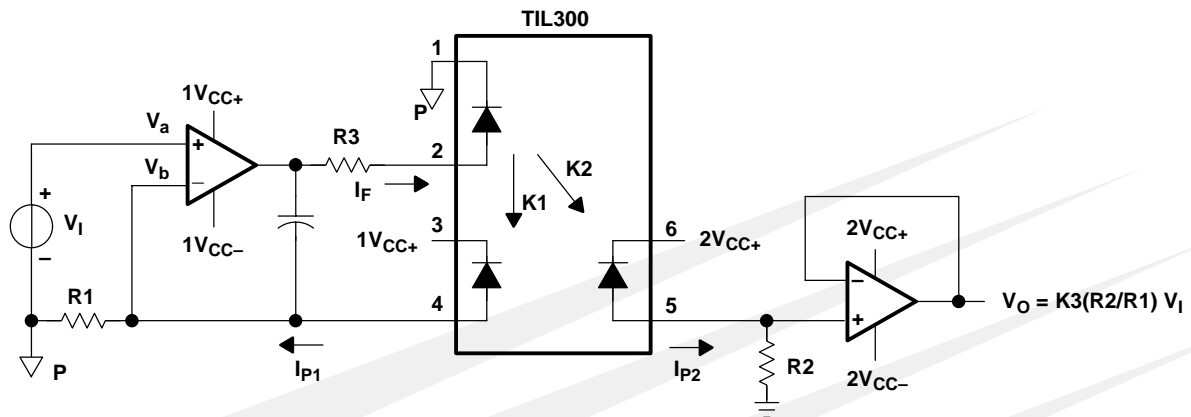


NC – No internal connection

## Description

The TIL300 precision linear optocoupler consists of an infrared LED irradiating an isolated feedback photodiode and an output photodiode in a bifurcated arrangement. The feedback photodiode captures a percentage of the flux of the LED that can be used to generate a control signal to regulate the LED drive current. This technique is used to compensate for the nonlinear time and temperature characteristics of the LED. The output-side photodiode then produces an output signal that is linearly proportional to the servo-optical flux emitted from the LED.

A typical application circuit (shown in Figure 1) uses an operational amplifier as the input to drive the LED. The feedback photodiode sources current through R1, which is connected to the inverting input of the input operational amplifier. The photocurrent  $I_{P1}$  assumes a magnitude that satisfies the relationship  $I_{P1} = V_i/R1$ . The magnitude of the current is directly proportional to the LED current through the feedback transfer gain  $K1$  ( $V_i/R1 = K1 \times I_F$ ). The operational amplifier supplies LED current to produce sufficient photocurrent to keep the node voltage  $V_b$  equal to node voltage  $V_a$ .



- NOTES: A.  $K1$  is servo current gain, the ratio of the feedback servo photodiode current ( $I_{P1}$ ) to the input LED current ( $I_F$ ), i.e.  $K1 = I_{P1}/I_F$ .  
 B.  $K2$  is forward gain, the ratio of the output photodiode current ( $I_{P2}$ ) to the input LED current ( $I_F$ ), i.e.  $K2 = I_{P2}/I_F$ .  
 C.  $K3$  is transfer gain, the ratio of the forward gain to the servo gain, i.e.  $K3 = K2/K1$ .

**Figure 1. Typical Application Circuit**

The output photodiode is connected to a noninverting voltage follower; R2 is used to develop a voltage from the photodiode current. The output of the amplifier is  $V_O = K2I_F R2$ . Overall transfer gain  $V_O/V_i$  becomes  $V_O/V_i = (K2I_F R2/K1I_F R1)$ . Factoring out the LED forward current  $I_F$  and remembering that  $K2/K1 = K3$ , the overall transfer gain becomes  $V_O/V_i = K3R2/R1$ . The overall transfer gain, therefore, is shown to be independent of the LED current.

# TIL300, TIL300A PRECISION LINEAR OPTOCOUPLER

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## Terminal Functions

TERMINAL		DESCRIPTION
NAME	NO.	
LEDK	1	LED cathode
LEDA	2	LED anode
PDK1	3	Photodiode 1 cathode
PDA1	4	Photodiode 1 anode
PDA2	5	Photodiode 2 anode
PDK2	6	Photodiode 2 cathode
NC	7	No internal connection
NC	8	No internal connection

## Absolute Maximum Ratings over operating free-air temperature range (unless otherwise noted)†

### Emitter

Continuous total power dissipation (see Note 1) ..... 160 mW  
 Input LED forward current,  $I_F$  ..... 60 mA  
 Surge current with pulse duration < 10  $\mu$ s ..... 250 mA  
 Reverse voltage,  $V_R$  ..... 5 V  
 Reverse current,  $I_R$  ..... 10  $\mu$ A

### Detector

Continuous total power dissipation (see Note 2) ..... 50 mW  
 Reverse voltage,  $V_R$  ..... 50 V

### Coupler

Continuous total power dissipation (see Note 3) ..... 210 mW  
 Storage temperature range,  $T_{stg}$  ..... -55°C to 150°C  
 Operating free-air temperature range,  $T_A$  ..... -55°C to 100°C  
 Input-to-output voltage ..... 3535  $V_{peak}$   
 Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds ..... 260°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES: 1. Derate linearly from 25°C at a rate of 2.66 mW/°C.  
 2. Derate linearly from 25°C at a rate of 0.66 mW/°C.  
 3. Derate linearly from 25°C at a rate of 3.33 mW/°C.

**Electrical Characteristics at  $T_A = 25^\circ\text{C}$  (unless otherwise noted)**

**Emitter**

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_F$	LED forward voltage	$I_F = 10\text{ mA}$		1.25	1.50	V
	Temperature coefficient of $V_F$			-2.2		mV/ $^\circ\text{C}$
$I_R$	Reverse current	$V_R = 5\text{ V}$			10	$\mu\text{A}$
$t_r$	Rise time	$I_F = 10\text{ mA}$ , $\Delta I_F = 2\text{ mA}$		1		$\mu\text{s}$
$t_f$	Fall time	$I_F = 10\text{ mA}$ , $\Delta I_F = 2\text{ mA}$		1		$\mu\text{s}$
$C_j$	Junction capacitance	$V_F = 0$ , $f = 1\text{ MHz}$		15		pF

**Detector**

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$I_{DK}^\dagger$	Dark current	$V_R = -15\text{ V}$ , $I_F = 0$			25	nA
	Open-circuit voltage	$I_F = 10\text{ mA}$		0.5		V
$I_{OS}$	Short-circuit current limit	$I_F = 10\text{ mA}$		80		$\mu\text{A}$
$C_j$	Junction capacitance	$V_F = 0$ , $f = 1\text{ MHz}$		12		pF

**Coupler, detector bias voltage,  $V_R = -15\text{ V}$**

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$K1^\dagger$	Servo-current gain	$I_F = 1\text{ mA}$	0.3%	0.7%	1.5%	
		$I_F = 10\text{ mA}$	0.5%	1.25%	2%	
$K2^\ddagger$	Forward current gain	$I_F = 1\text{ mA}$	0.3%	0.7%	1.5%	
		$I_F = 10\text{ mA}$	0.5%	1.25%	2%	
$K3^\S$	Transfer gain	TIL300 $I_F = 1\text{ mA}$	0.75	1	1.25	
		TIL300 $I_F = 10\text{ mA}$	0.75	1	1.25	
		TIL300A $I_F = 1\text{ mA}$	0.9	1	1.10	
		TIL300A $I_F = 10\text{ mA}$	0.9	1	1.10	
Gain temperature coefficient	K1/K2	$I_F = 10\text{ mA}$		-0.5		%/ $^\circ\text{C}$
	K3			$\pm 0.005$		
$\Delta K3^\P$	Transfer gain linearity	$I_F = 1\text{ to }10\text{ mA}$		$\pm 0.25\%$		
		$I_F = 1\text{ to }10\text{ mA}$ , $T_A = 0\text{ to }75^\circ\text{C}$		$\pm 0.5\%$		
BW	Bandwidth	$I_F = 10\text{ mA}$ , $I_{F(\text{MODULATION})} = \pm 2\text{ mA}$		200		kHz
$t_r$	Rise time	$I_F = 10\text{ mA}$ , $I_{F(\text{MODULATION})} = \pm 2\text{ mA}$		1.75		$\mu\text{s}$
$t_f$	Fall time	$I_F = 10\text{ mA}$ , $I_{F(\text{MODULATION})} = \pm 2\text{ mA}$		1.75		$\mu\text{s}$
$V_{iso}^\#$	Peak isolation voltage	$I_O = 10\text{ }\mu\text{A}$ , time = 1 minute		3535		V

$^\dagger$  Servo-current gain ( $K1$ ) is the ratio of the feedback photodiode current ( $I_{P1}$ ) to the input LED current ( $I_F$ ), i.e.  $K1 = I_{P1}/I_F$ .

$^\ddagger$  Forward gain ( $K2$ ) is the ratio of the output photodiode current ( $I_{P2}$ ) to the input LED current ( $I_F$ ), i.e.  $K2 = I_{P2}/I_F$ .

$^\S$  Transfer gain ( $K3$ ) is the ratio of the forward gain to the servo-current gain, i.e.  $K3 = K2/K1$ .

$^\P$  Transfer gain linearity ( $\Delta K3$ ) is the percent deviation of the transfer gain  $K3$  as a function of LED input current ( $I_F$ ) or the package temperature.

$^\#$  This symbol is not currently listed within EIA or JEDEC standards for semiconductor symbology.

# TIL300, TIL300A PRECISION LINEAR OPTOCOUPLER

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## TYPICAL CHARACTERISTICS

Table of Graphs

		FIGURE
I <sub>F</sub>	LED Forward Current	vs LED Forward Voltage
		vs LED Forward Voltage
I <sub>p1</sub>	Servo Photodiode Current	vs LED Forward Current and Temperature
		vs LED Forward Current and Temperature
I <sub>p1</sub>	Normalized Servo Photodiode Current	vs LED Forward Current and Temperature
K1	Normalized Servo Current Gain	vs LED Forward Current and Temperature
K3	Normalized Transfer Gain	vs LED Forward Current
A <sub>O</sub>	Output Current Amplitude	vs Frequency

TYPICAL CHARACTERISTICS

LED FORWARD CURRENT  
vs  
LED FORWARD VOLTAGE

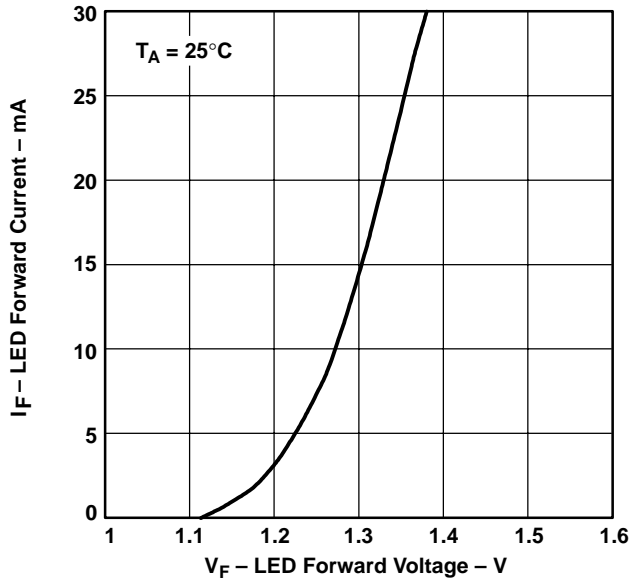


Figure 2

LED FORWARD CURRENT  
vs  
LED FORWARD VOLTAGE

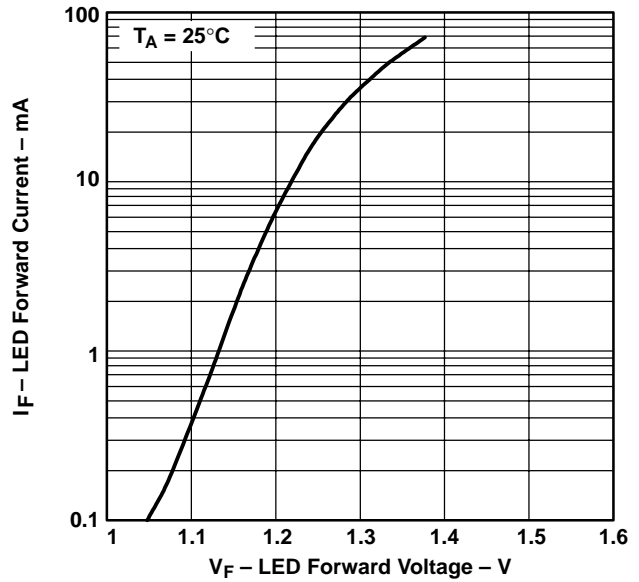


Figure 3

SERVO PHOTODIODE CURRENT  
vs  
LED FORWARD CURRENT AND TEMPERATURE

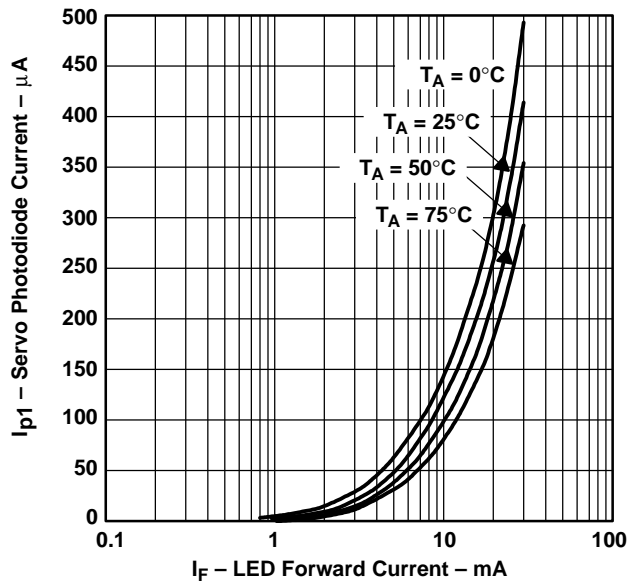


Figure 4

SERVO PHOTODIODE CURRENT  
vs  
LED FORWARD CURRENT AND TEMPERATURE

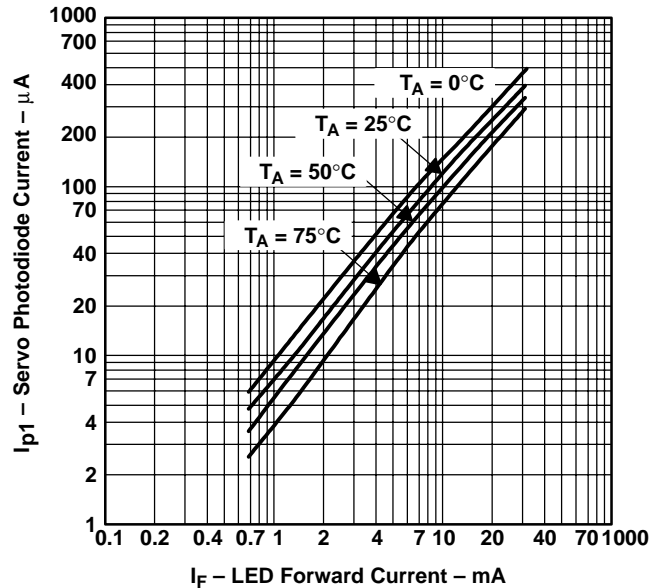
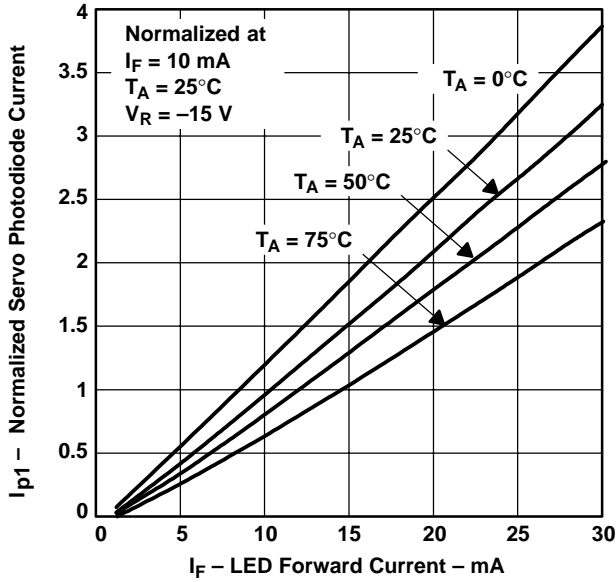


Figure 5

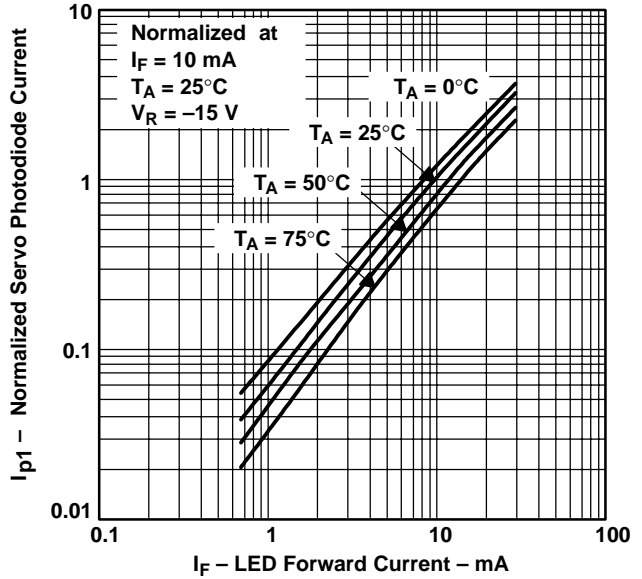
**TYPICAL CHARACTERISTICS**

**NORMALIZED SERVO PHOTODIODE CURRENT**  
**vs**  
**LED FORWARD CURRENT AND TEMPERATURE**



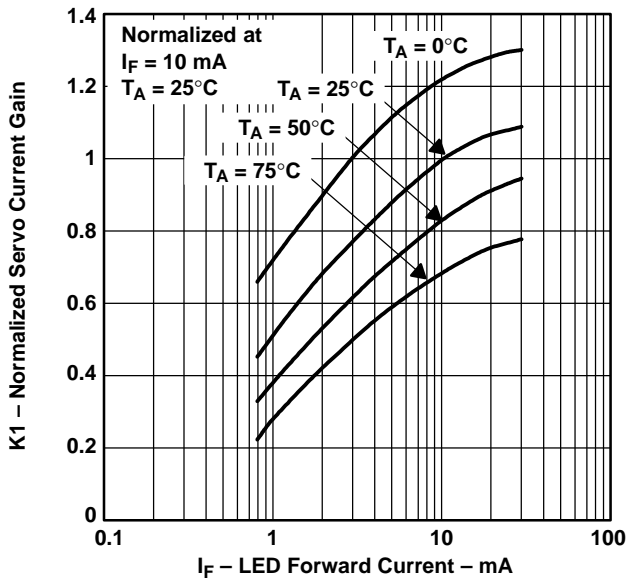
**Figure 6**

**NORMALIZED SERVO PHOTODIODE CURRENT**  
**vs**  
**LED FORWARD CURRENT AND TEMPERATURE**



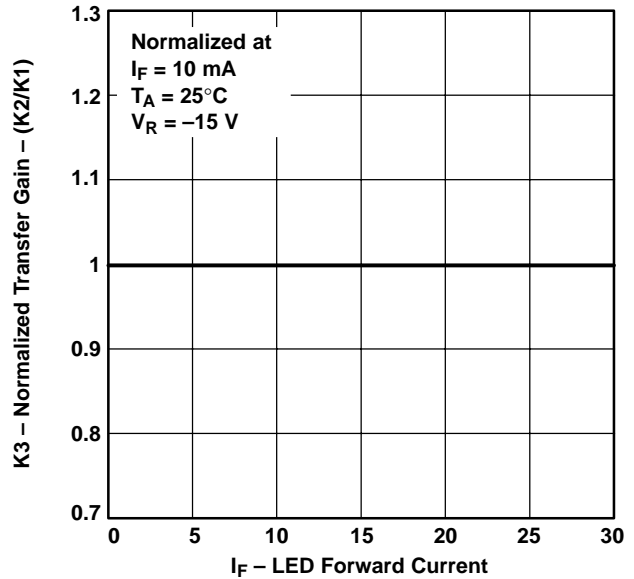
**Figure 7**

**NORMALIZED SERVO CURRENT GAIN**  
**vs**  
**LED FORWARD CURRENT AND TEMPERATURE**



**Figure 8**

**NORMALIZED TRANSFER GAIN**  
**vs**  
**LED FORWARD CURRENT**



**Figure 9**

TYPICAL CHARACTERISTICS

OUTPUT CURRENT AMPLITUDE  
VS  
FREQUENCY

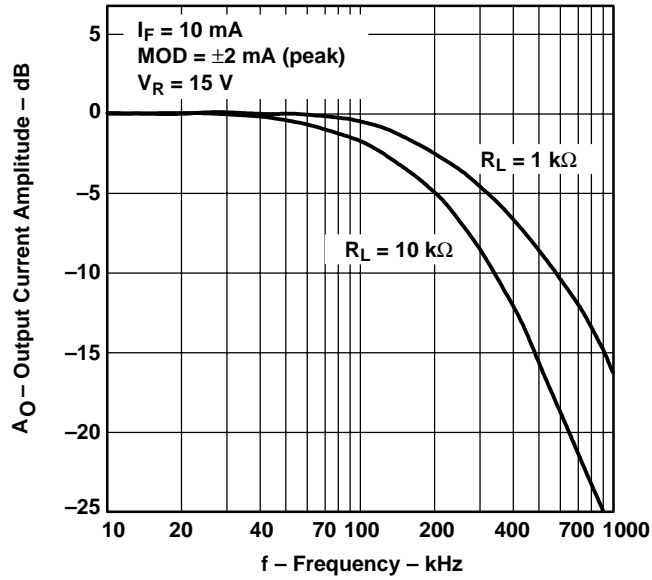


Figure 10

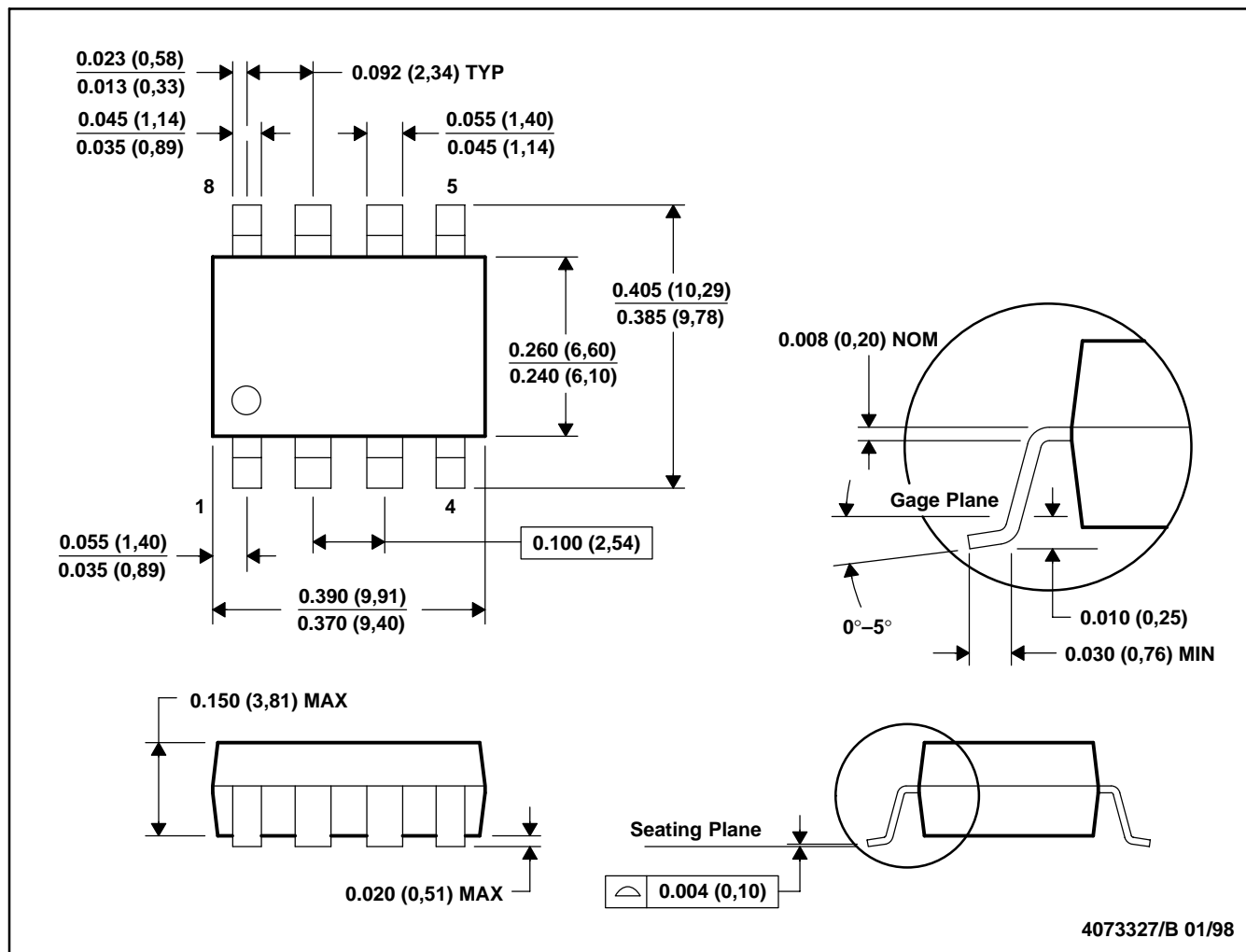
# TIL300, TIL300A PRECISION LINEAR OPTOCOUPLER

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## MECHANICAL DATA

DCS (R-PDSO-G8)

PLASTIC DUAL SMALL-OUTLINE OPTO COUPLER



NOTES: A. All linear dimensions are in inches(millimeters).  
B. This drawing is subject to change without notice.

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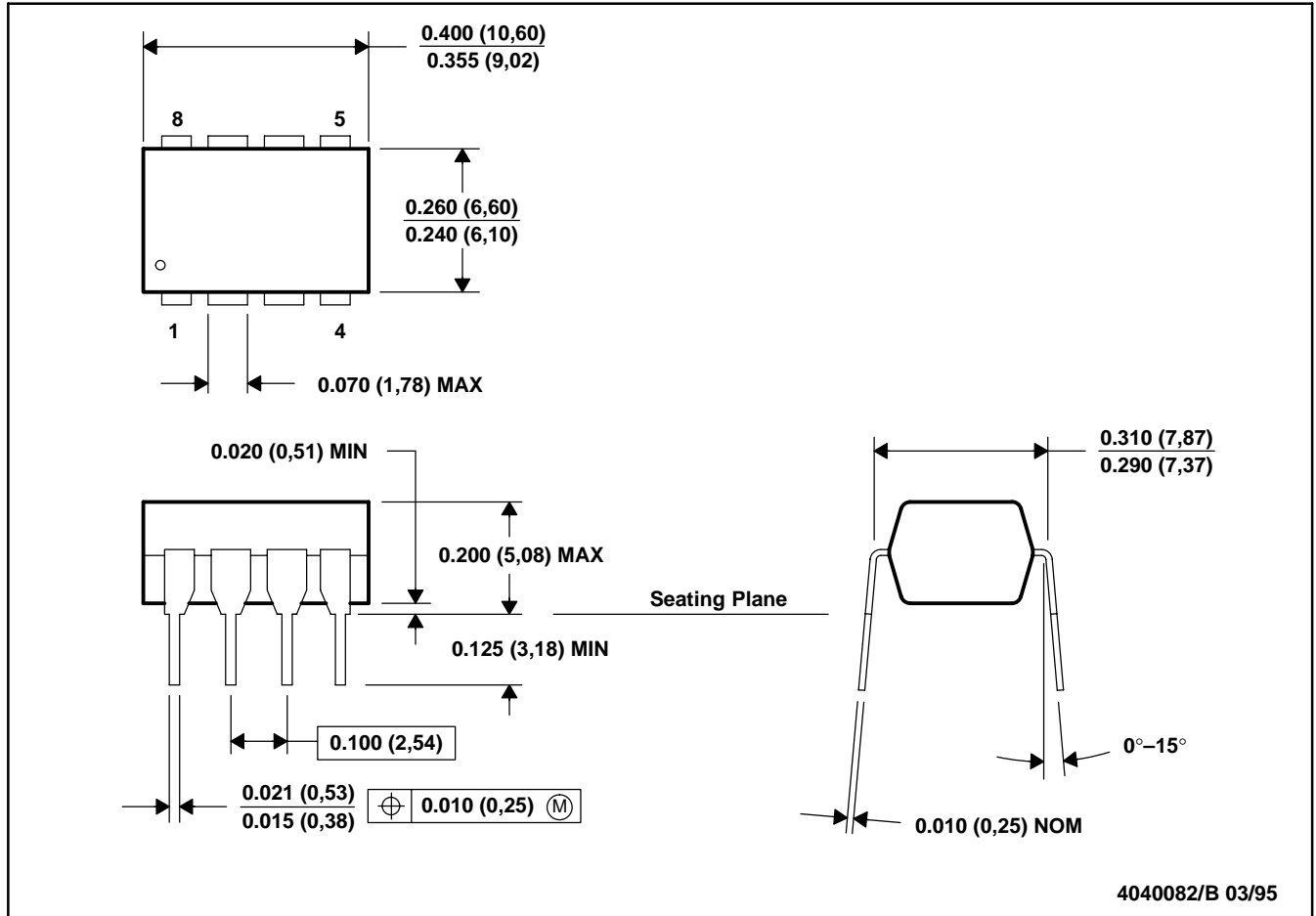




MECHANICAL DATA

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE PACKAGE



- NOTES: A. All linear dimensions are in inches (millimeters).  
B. This drawing is subject to change without notice.  
C. Falls within JEDEC MS-001

# TIL300, TIL300A PRECISION LINEAR OPTOCOUPLER

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