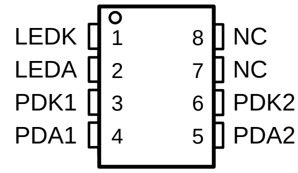
- **ac or dc Signal Coupling**
- **Wide Bandwidth . . . >200 kHz**
- **High Transfer-Gain Stability . . . ±0.005%/°C**
- **3500 V Peak Isolation**
- **Typical Applications**
  - **Power-Supply Feedback**
  - **Medical-Sensor Isolation**
  - **Opto Direct-Access Arrangement (DAA)**
  - **Isolated Process-Control Transducers**

DCS OR P PACKAGE
(TOP VIEW)

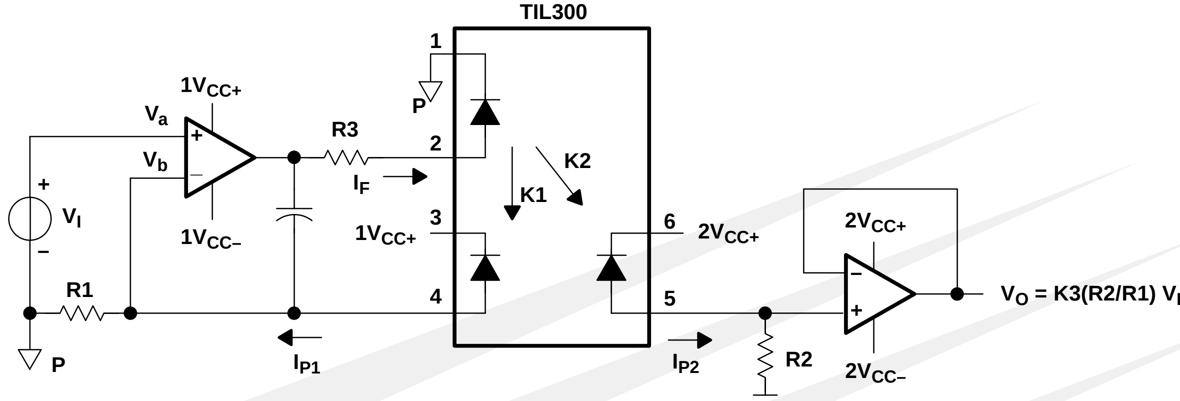


NC – No internal connection

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 $V_O = K2I_FR2$. Overall transfer gain V_O/V_I becomes $V_O/V_I = (K2I_FR2/K1I_FR1)$. 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.

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Terminal Functions

TERMINAL NAME	TERMINAL NO.	DESCRIPTION
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 µs . . . . 250 mA
Reverse voltage, V_R . . . . 5 V
Reverse current, I_R . . . . 10 µA

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 Vpeak
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 $T_A = 25°C$ (unless otherwise noted)

Emitter

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_F	LED forward voltage	I_F = 10 mA			1.25	1.50	V
	Temperature coefficient of V_F				–2.2		mV/°C
I_R	Reverse current	V_R = 5 V				10	µA
t_r	Rise time	I_F = 10 mA,	ΔI_F = 2 mA		1		µs
t_f	Fall time	I_F = 10 mA,	ΔI_F = 2 mA		1		µs
C_j	Junction capacitance	V_F = 0,	f = 1 MHz		15		pF

Detector

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

Coupler, detector bias voltage, V_R = –15 V

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
K1†	Servo-current gain		I_F = 1 mA		0.3%	0.7%	1.5%	
			I_F = 10 mA		0.5%	1.25%	2%	
K2‡	Forward current gain		I_F = 1 mA		0.3%	0.7%	1.5%	
			I_F = 10 mA		0.5%	1.25%	2%	
K3§	Transfer gain	TIL300	I_F = 1 mA		0.75	1	1.25	
			I_F = 10 mA		0.75	1	1.25	
		TIL300A	I_F = 1 mA		0.9	1	1.10	
			I_F = 10 mA		0.9	1	1.10	
	Gain temperature coefficient	K1/K2	I_F = 10 mA			–0.5		%/°C
		K3				±0.005		
ΔK3¶	Transfer gain linearity		I_F = 1 to 10 mA			±0.25%		
			I_F = 1 to 10 mA,	T_A = 0 to 75°C		±0.5%		
BW	Bandwidth		I_F = 10 mA, $I_{F(MODULATION)}$ = ±2 mA	R_L = 1 kΩ,		200		kHz
t_r	Rise time		I_F = 10 mA, $I_{F(MODULATION)}$ = ±2 mA	R_L = 1 kΩ,		1.75		µs
t_f	Fall time		I_F = 10 mA, $I_{F(MODULATION)}$ = ±2 mA	R_L = 1 kΩ,		1.75		µs
V_{iso}#	Peak isolation voltage		I_{IO} = 10 µA, time = 1 minute	f = 60 Hz,	3535			V

† Servo-current gain (K1) is the ratio of the feedback photodiode current (I_{P1}) to the input LED current (I_F) current (I_F), i.e. K1 = I_{P1}/I_F.
‡ 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.
§ Transfer gain (K3) is the ratio of the forward gain to the servo-current gain, i.e. K3 = K2/K1.
¶ Transfer gain linearity (ΔK3) 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.

TYPICAL CHARACTERISTICS

Table of Graphs

			FIGURE
I_F	LED Forward Current	vs LED Forward Voltage	2
		vs LED Forward Voltage	3
I_{p1}	Servo Photodiode Current	vs LED Forward Current and Temperature	4
		vs LED Forward Current and Temperature	5
I_{p1}	Normalized Servo Photodiode Current	vs LED Forward Current and Temperature	6
			7
K1	Normalized Servo Current Gain	vs LED Forward Current and Temperature	8
K3	Normalized Transfer Gain	vs LED Forward Current	9
A_O	Output Current Amplitude	vs Frequency	10

TYPICAL CHARACTERISTICS

LED FORWARD CURRENT vs LED FORWARD VOLTAGE

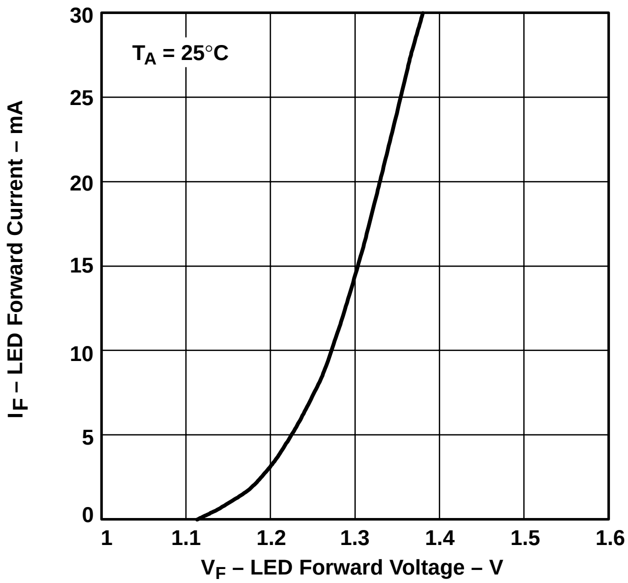


Figure 2

LED FORWARD CURRENT vs LED FORWARD VOLTAGE

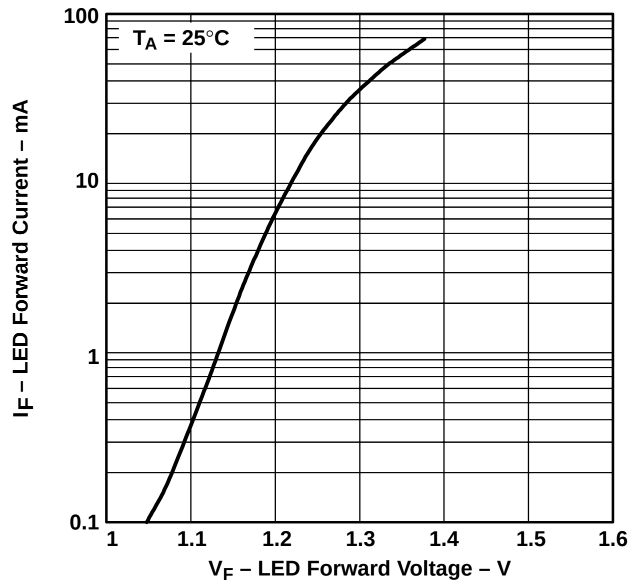


Figure 3

SERVO PHOTODIODE CURRENT vs LED FORWARD CURRENT AND TEMPERATURE

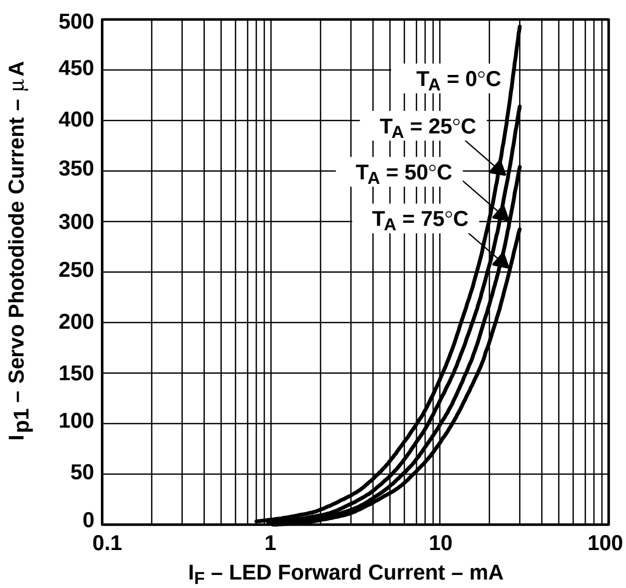


Figure 4

SERVO PHOTODIODE CURRENT vs LED FORWARD CURRENT AND TEMPERATURE

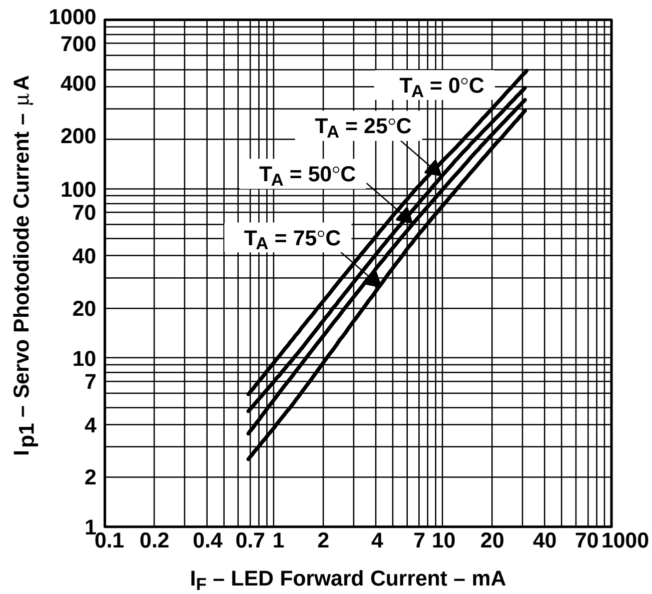


Figure 5

TYPICAL CHARACTERISTICS

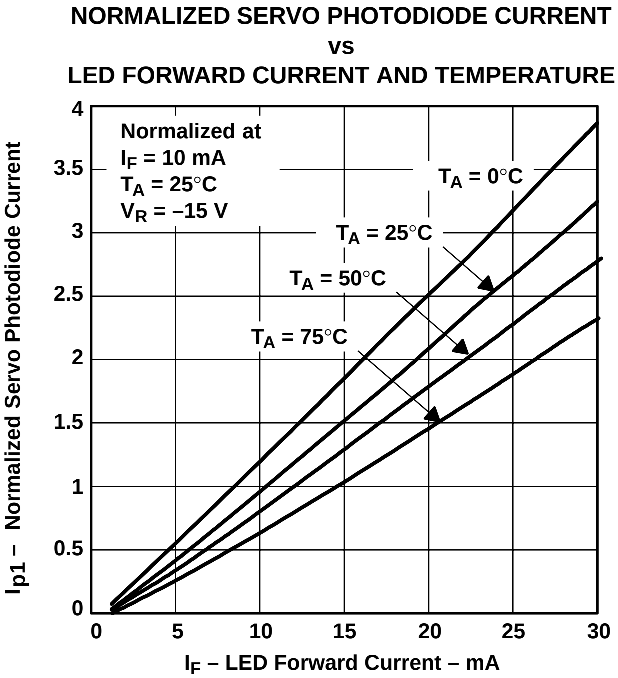


Figure 6

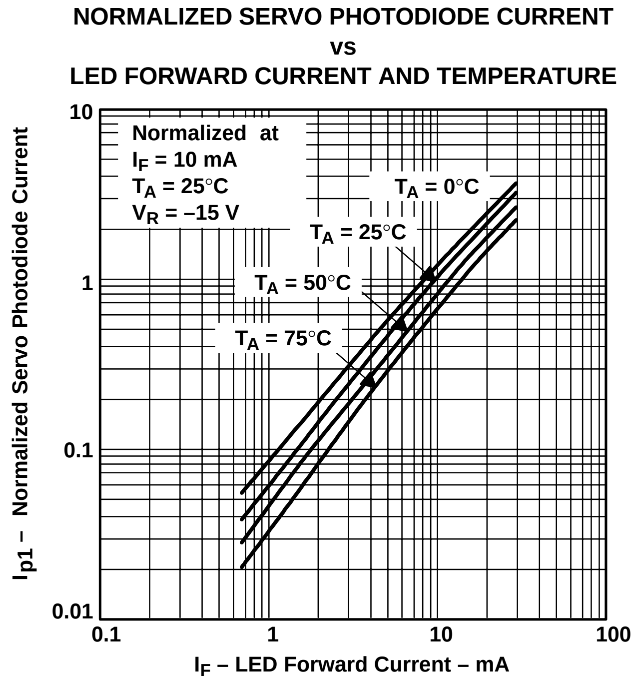


Figure 7

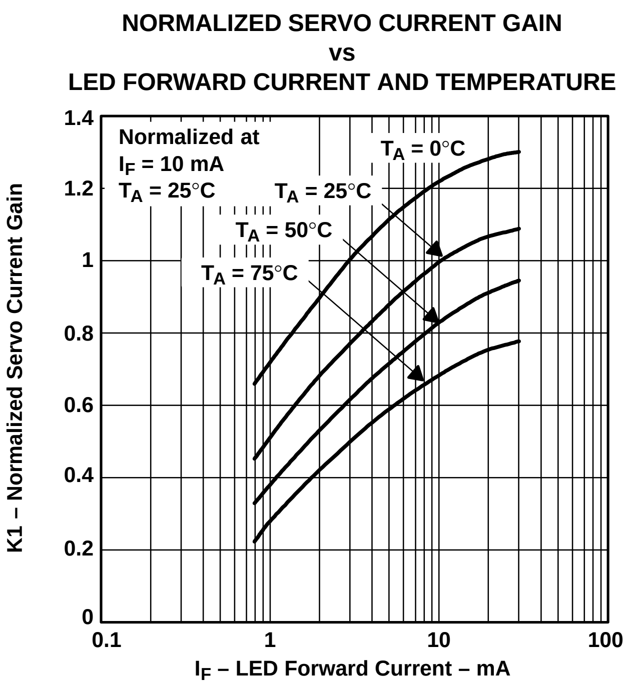


Figure 8

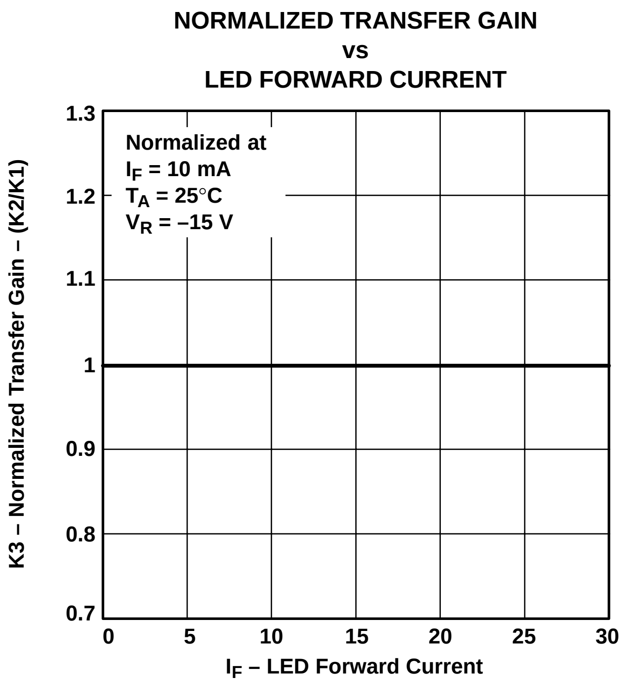


Figure 9

TYPICAL CHARACTERISTICS

**OUTPUT CURRENT AMPLITUDE
vs
FREQUENCY**

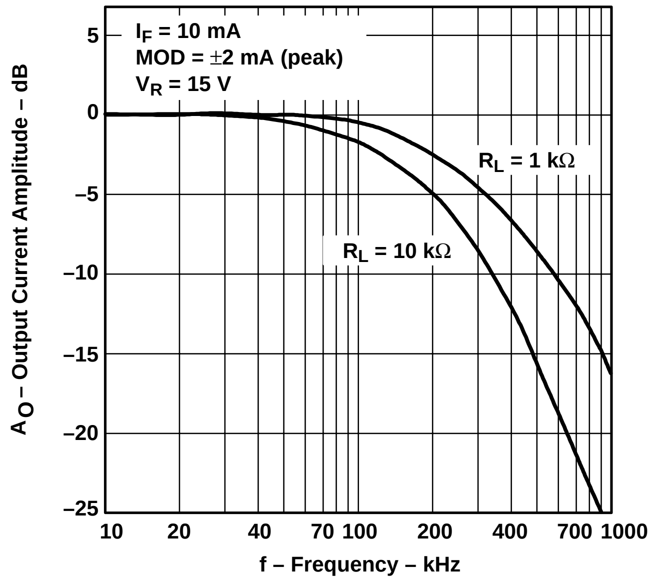
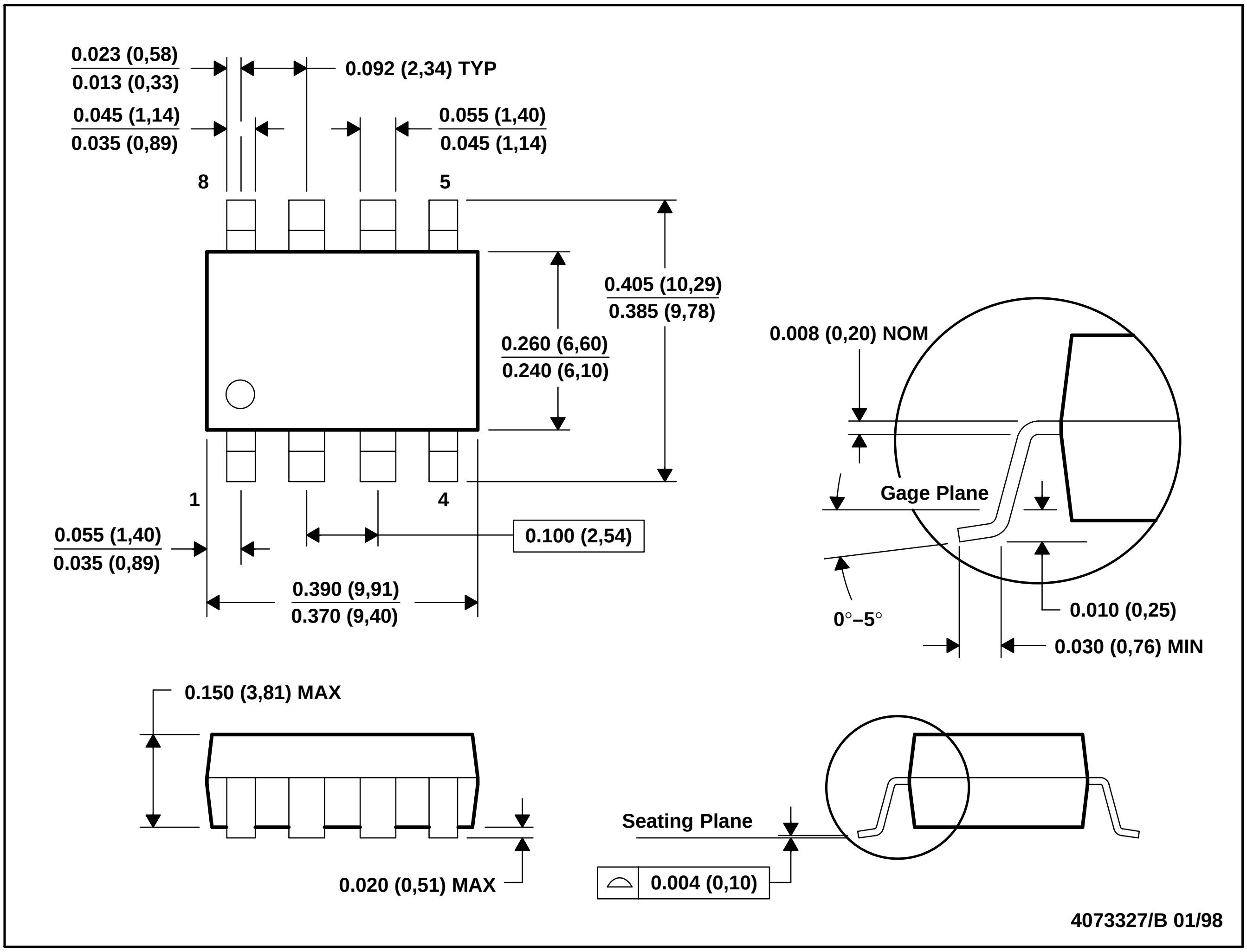


Figure 10

MECHANICAL DATA

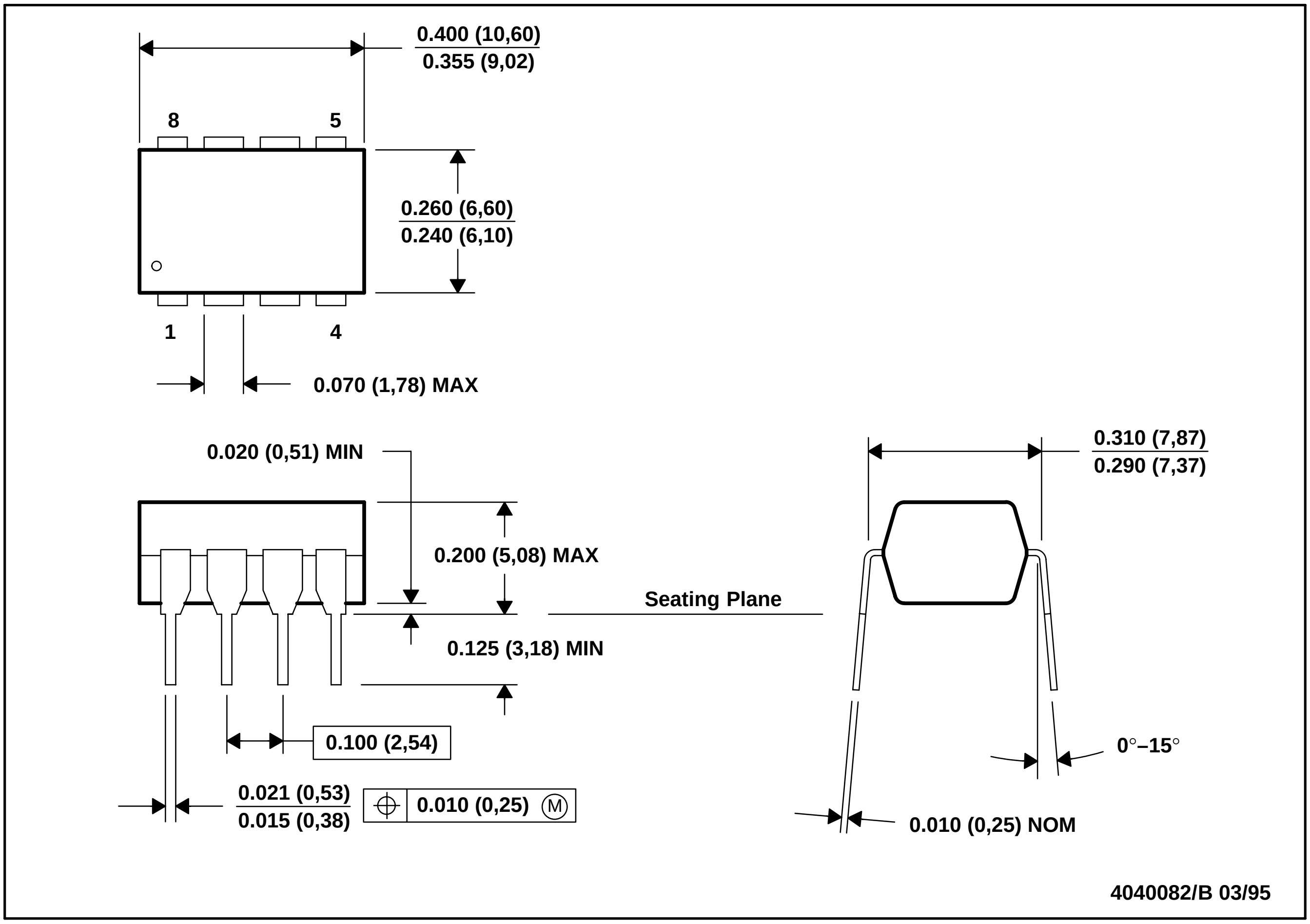
DCS (R-PDSO-G8) **PLASTIC DUAL SMALL-OUTLINE OPTO COUPLER**



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

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

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