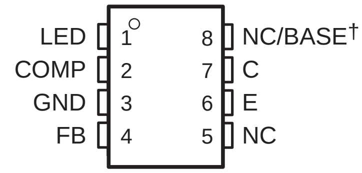
SOES030B – MAY 1997 – REVISED JANUARY 1998

- **TLV431 Precision Programmable Reference (1.24 V) and an Optocoupler in a Single Package**
- **1% Voltage-Reference Tolerance**
- **Controlled Optocoupler CTRs:**
  TPS5908, TPS5910 100% to 400%
  TPS5908A, TPS5910A 150% to 300%
- **High Withstand Voltage (WTV), 7500 V Peak for 1 Minute**
- **Safety Regulatory Approvals**
  - **UL . . . File Number E65085**
  - **FIMKO, SEMKO, NEMKO, DEMKO**
    - **EN60065/IEC 65**
    - **EN60950/IEC 950**
  - **VDE 0884, Level 4 (6000-V Insulation)**

DCS OR P PACKAGE
(TOP VIEW)



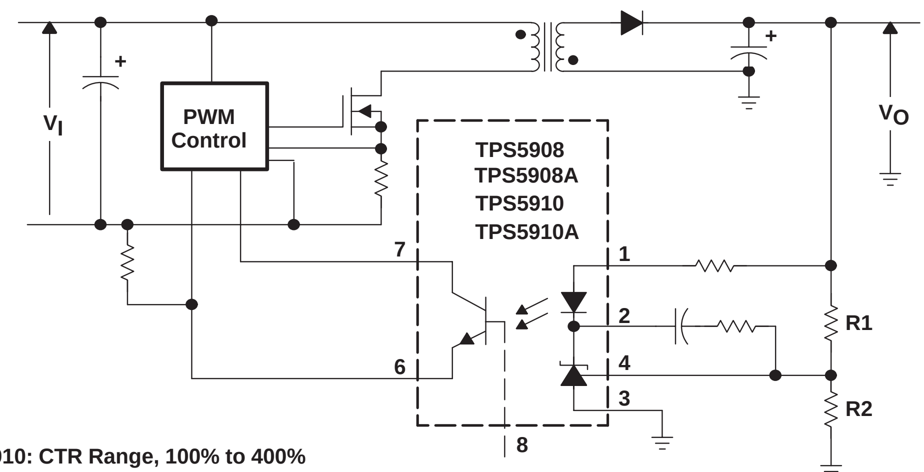
NC – No internal connection
†BASE – TPS5910, TPS5910A only

description

These optoisolated feedback amplifiers consist of the industry standard TLV431 precision programmable reference with a 1% reference voltage tolerance, and an optocoupler. The devices are primarily intended for use as the error-amplifier/reference/isolation-amplifier element in isolated ac-to-dc power supplies and dc-to-dc converters. The optocoupler is a gallium-arsenide (GaAs) light-emitting diode that emits at a wavelength of 940 nm, combined with a silicon phototransistor. The current transfer ratio (CTR) ranges from 100% to 400% in the standard version. The TPS5908A and TPS5910A versions with 150%-to-300% CTR are available for higher-performance applications. All versions enable power-supply designers to reduce component count and save space in tightly packaged designs. The tight-tolerance reference eliminates the need for adjustments in many applications.

These devices are characterized for operation from –40°C to 100°C. Each amplifier is supplied in an 8-pin DIP or in an 8-pin gull-wing surface-mount package (DCS).

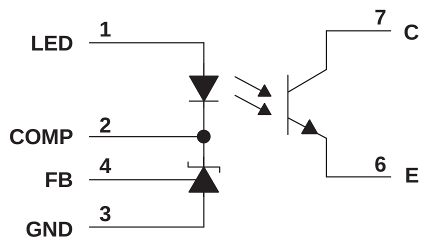
typical application



TPS5908, TPS5910: CTR Range, 100% to 400%
TPS5908A, TPS5910A: CTR Range, 150% to 300%
(TPS5910, TPS5910A Only)

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

schematic



Terminal Functions

TERMINAL NAME	TERMINAL NO.	I/O	DESCRIPTION
C	7		Phototransistor collector
COMP	2	O	Light-emitting diode and TLV431 cathodes
E	6		Phototransistor emitter
FB	4	I	Feedback
GND	3		Ground
LED	1	I	Light-emitting diode anode
NC	5, 8		No connection

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

Input power dissipation at (or below) T_A = 25°C (see Note 1) . . . . 250 mW
Input LED current, $I_{I(LED)}$ . . . . 50 mA
Input LED voltage, $V_{I(LED)}$ . . . . 8 V
Input diode reverse voltage . . . . 6 V
Output power dissipation at (or below) T_A = 25°C (see Note 2) . . . . 150 mW
Output collector-to-emitter voltage . . . . 35 V
Output emitter-to-collector voltage . . . . 7 V
Output collector current . . . . 50 mA
Total continuous power dissipation at (or below) T_A = 25°C (see Note 3) . . . . 350 mW
Operating free-air temperature range, T_A . . . . –40°C to 100°C
Storage temperature range, T_{stg} . . . . –55°C to 150°C
Total input-to-output voltage . . . . 7.5 kV peak or dc (5.3 kVrms)
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . 260°C
Flammability . . . . (see Note 4)

† 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 or any other conditions beyond those indicated under “recommended operating 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 2.95 mW/°C.
2. Derate linearly from 25°C at a rate of 1.76 mW/°C.
3. Derate linearly from 25°C at a rate of 4.12 mW/°C.
4. Optocoupler total-package flame retardancy is tested to IEC695-2-2 using a flame application time of 30 seconds. Outer mold compound is verified to meet UL 94 V-0.

electrical characteristics, T_A = 25°C (unless otherwise noted)

input

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_F	Light-emitting diode forward voltage	$V_{O(COMP)} = V_{I(FB)}$, See Figure 1	$I_{I(LED)}$ = 10 mA,		1.2	1.4	V
I_R	Light-emitting diode reverse current	V_R = 6 V				10	µA
V_{ref}	Reference voltage	$V_{O(COMP)} = V_{I(FB)}$, See Figure 1	$I_{I(LED)}$ = 10 mA,	1.228	1.24	1.252	V
$V_{ref(dev)}$	Deviation of reference voltage over temperature	$V_{O(COMP)} = V_{I(FB)}$, T_A = 25°C to 100°C,	$I_{I(LED)}$ = 10 mA, See Figure 1		4		mV
$\frac{\Delta V_{ref}}{\Delta V_{I(LED)}}$	Ratio of reference voltage change-to-change in input light-emitting-diode voltage	$\Delta V_{I(LED)}$ = 3 V to 7 V, See Figure 2	$I_{I(LED)}$ = 10 mA,		–1.5	–2.7	mV/V
$I_{I(FB)}$	Feedback input current	$I_{I(LED)}$ = 10 mA, See Figure 3	R3 = 10 kΩ ,		0.15	0.5	µA
$I_{ref(dev)}$	Deviation of reference input current over temperature	$I_{I(LED)}$ = 10 mA, T_A = 25°C to 100°C,	R3 = 10 kΩ, See Figure 3		0.05		µA
$I_{DRV(min)}$	Minimum drive current	$V_{O(COMP)} = V_{I(FB)}$,	See Figure 1		55	80	µA
$I_{I(off)}$	Off-state input light-emitting-diode current	$V_{I(LED)}$ = 7 V, See Figure 4	$V_{I(FB)}$ = 0,		0.001	0.1	µA
$\|Z_{kal}\|$†	Regulator output impedance	$V_{O(COMP)} = V_{I(FB)}$, $I_{O(COMP)}$ = 1 mA to 50 mA	f ≤ 1 kHz,		0.25		Ω

† This symbol is not currently listed within EIA or JEDEC standards for semiconductor symbology.

output

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_{CEO}	Collect dark current		V_{CE} = 35 V,	See Figure 5			100	nA
$V_{(BR)ECO}$	Breakdown voltage, emitter-to-collector, base open		I_E = 100 µA		7			V
$V_{(BR)CBO}$	Breakdown voltage, collector-to-base, emitter open	TPS5910, TPS5910A	I_C = 10 µA, See Figure 7	I_F = 0,	70			V
h_{FE}	Static forward current transfer ratio, common collector	TPS5910, TPS5910A	I_C = 10 mA, I_F = 0,	V_{CE} = 5 V, See Figure 8	200			
$V_{(BR)EBO}$	Breakdown voltage, emitter-to-base, collector open	TPS5910, TPS5910A	I_E = 10 µA, See Figure 9	I_F = 0,	7			V

coupler

PARAMETER			TEST CONDITIONS		MIN	TYP	MAX	UNIT
CTR	Current transfer ratio	TPS5908, TPS5910	$V_{O(COMP)} = V_{I(FB)}$, V_{CE} = 5 V,	$I_{I(LED)}$ = 5 mA, See Figure 6	100%		400%	
CTR	Current transfer ratio	TPS5908A, TPS5910A	$V_{O(COMP)} = V_{I(FB)}$, V_{CE} = 5 V,	$I_{I(LED)}$ = 5 mA, See Figure 6	150%		300%	
$V_{CE(sat)}$	Collector-emitter saturation voltage		$V_{O(COMP)} = V_{I(FB)}$, I_C = 1 mA,	$I_{I(LED)}$ = 10 mA, See Figure 6		0.1	0.2	V
V_{iso}†	Isolation voltage		I_{IO} = 10 µA,	f = 60 Hz	7500			V
C_{io}	Input to output capacitance		V_{IO} = 0,	f = 1 kHz		0.6		pF

† This symbol is not currently listed within EIA or JEDEC standards for semiconductor symbology.

PARAMETER MEASUREMENT INFORMATION

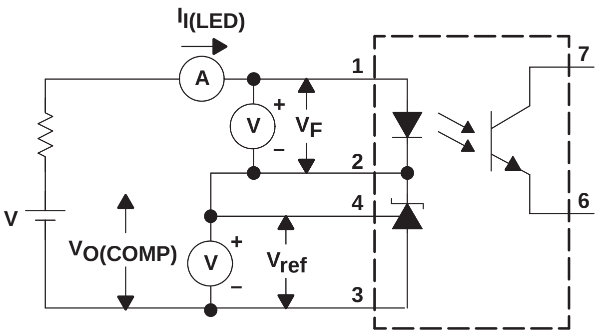


Figure 1. V_{ref}, V_F, I_{min} Test Circuit

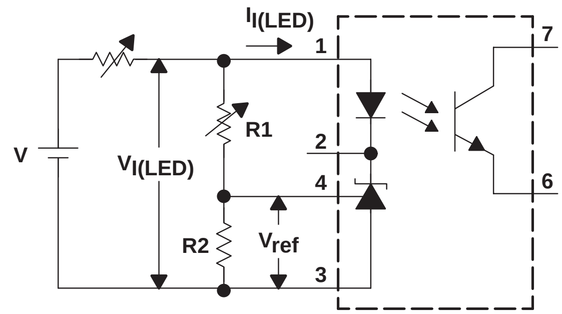


Figure 2. $\Delta V_{ref}/\Delta V_{I(LED)}$ Test Circuit

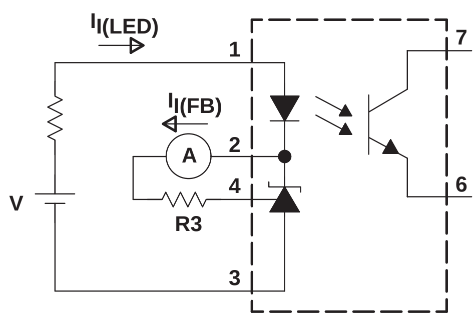


Figure 3. $I_{I(FB)}$ Test Circuit

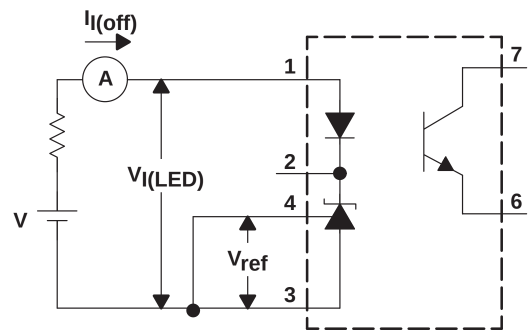


Figure 4. $I_{I(off)}$ Test Circuit

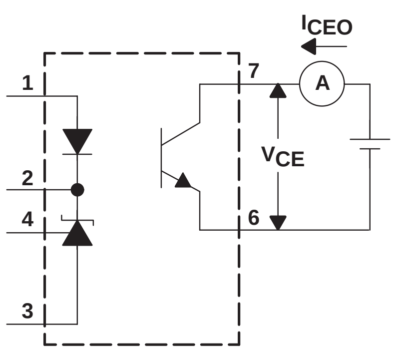


Figure 5. I_{CEO} Test Circuit

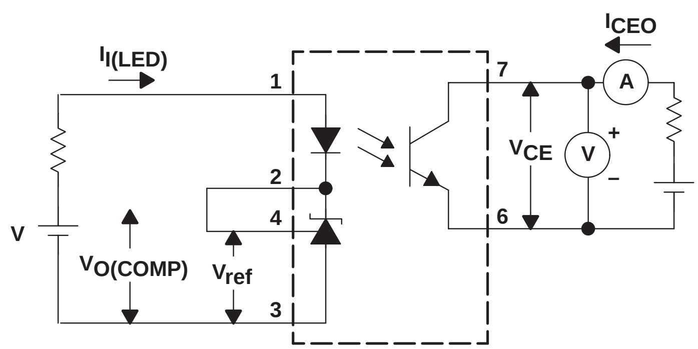


Figure 6. CTR, $V_{CE(sat)}$ Test Circuit

PARAMETER MEASUREMENT INFORMATION

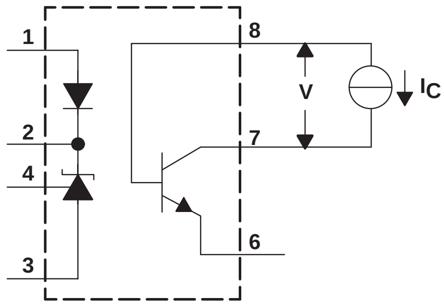


Figure 7. $V_{(BR)CBO}$ Test Circuit

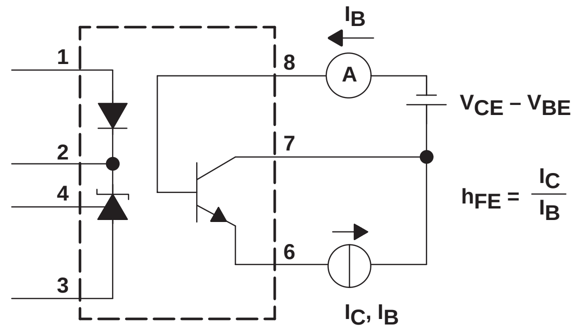


Figure 8. h_{FE} Test Circuit

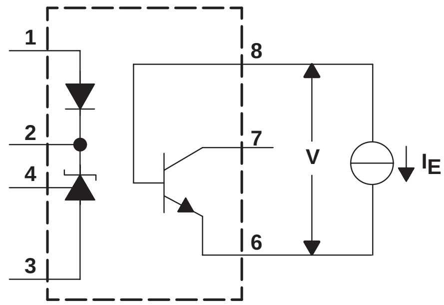


Figure 9. $V_{(BR)EBO}$ Test Circuit

TYPICAL CHARACTERISTICS

INPUT LIGHT-EMITTING-DIODE CURRENT vs REFERENCE VOLTAGE

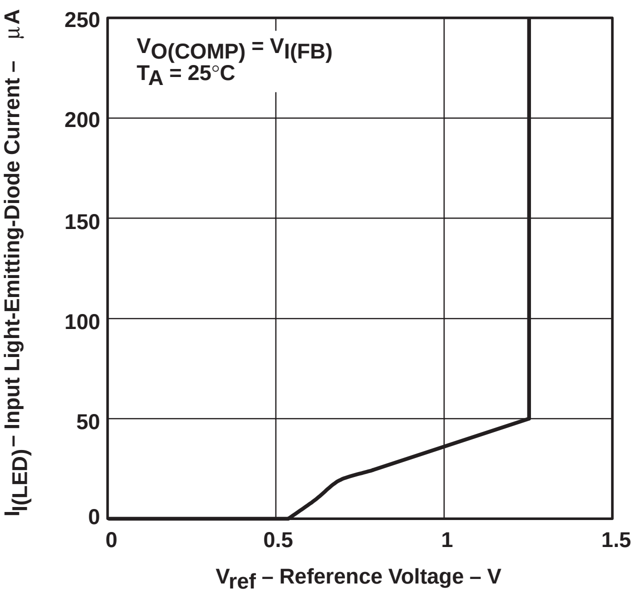


Figure 10

INPUT LIGHT-EMITTING-DIODE CURRENT vs REFERENCE VOLTAGE

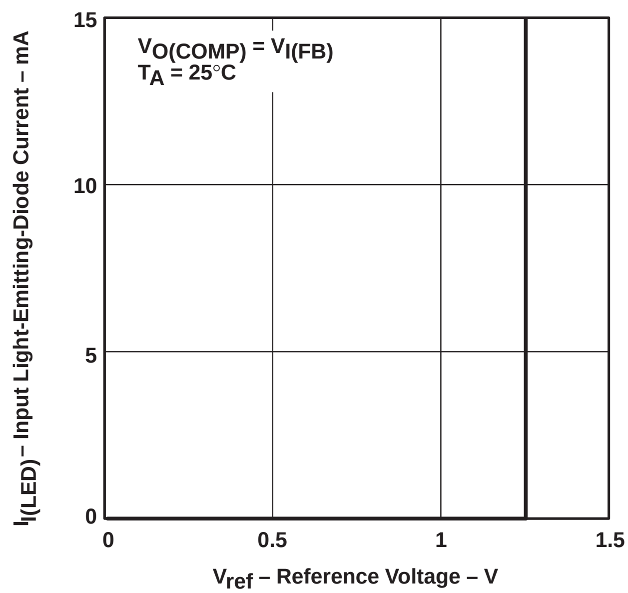


Figure 11

REFERENCE VOLTAGE vs FREE-AIR TEMPERATURE

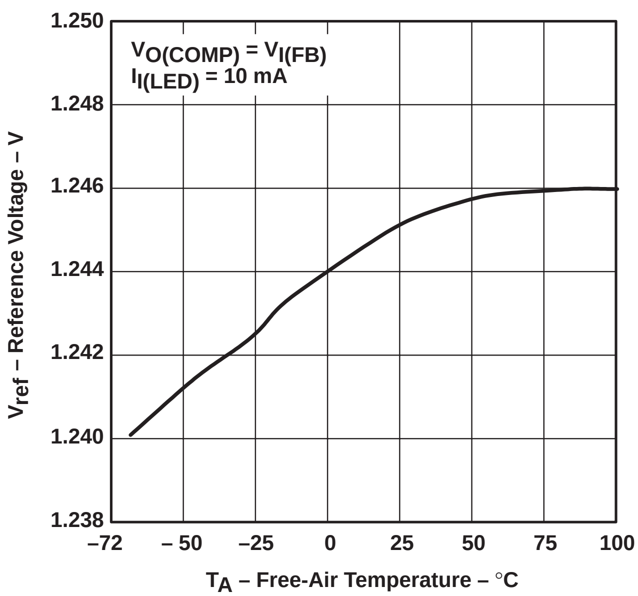


Figure 12

RATIO OF DELTA REFERENCE VOLTAGE TO DELTA LED VOLTAGE vs FREE-AIR TEMPERATURE

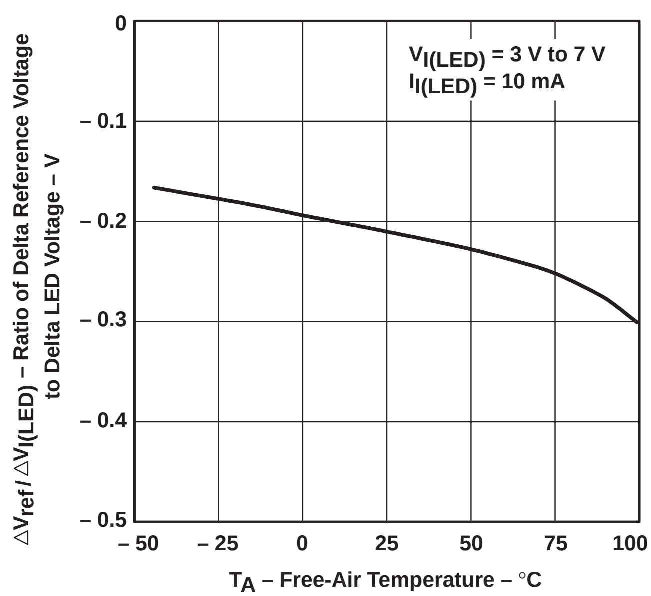


Figure 13

TYPICAL CHARACTERISTICS

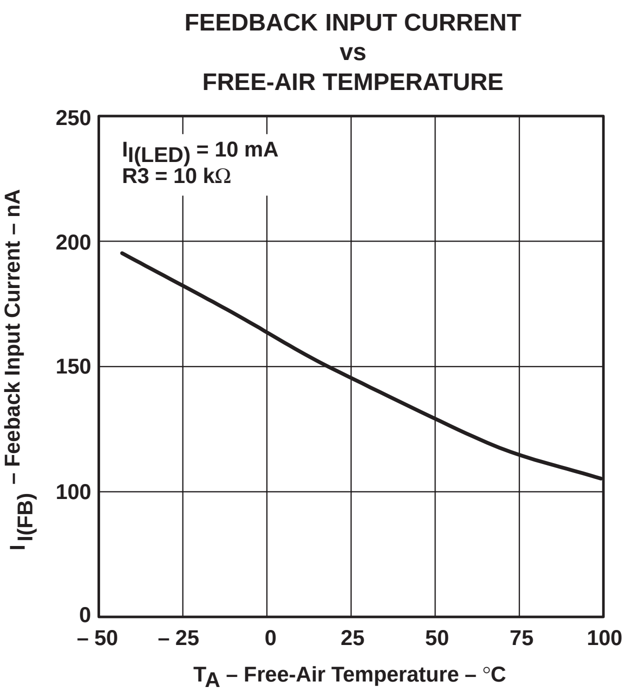


Figure 14

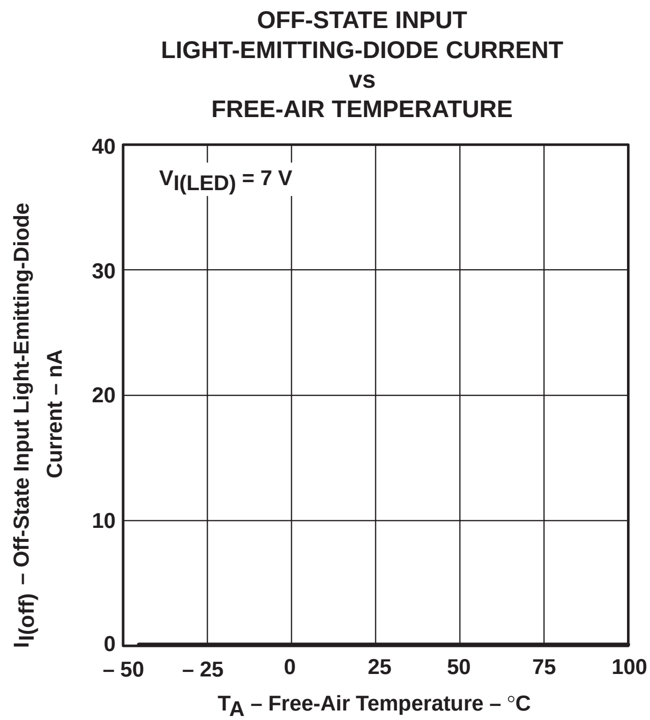


Figure 15

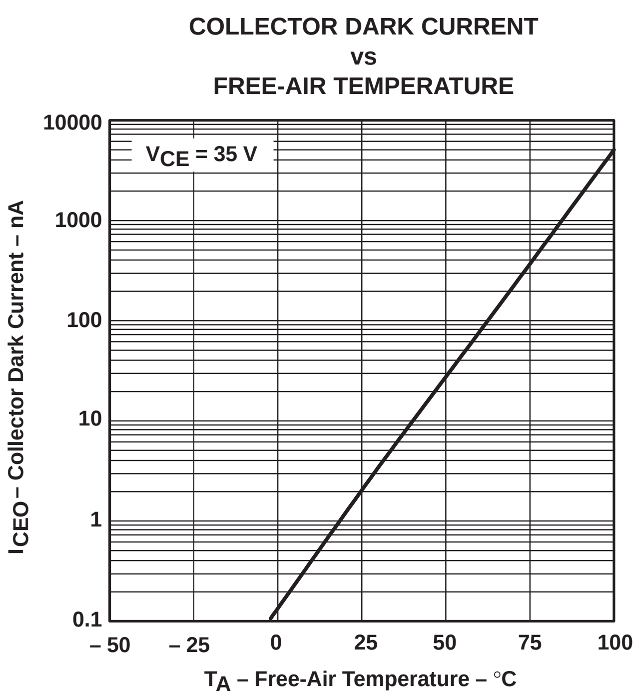


Figure 16

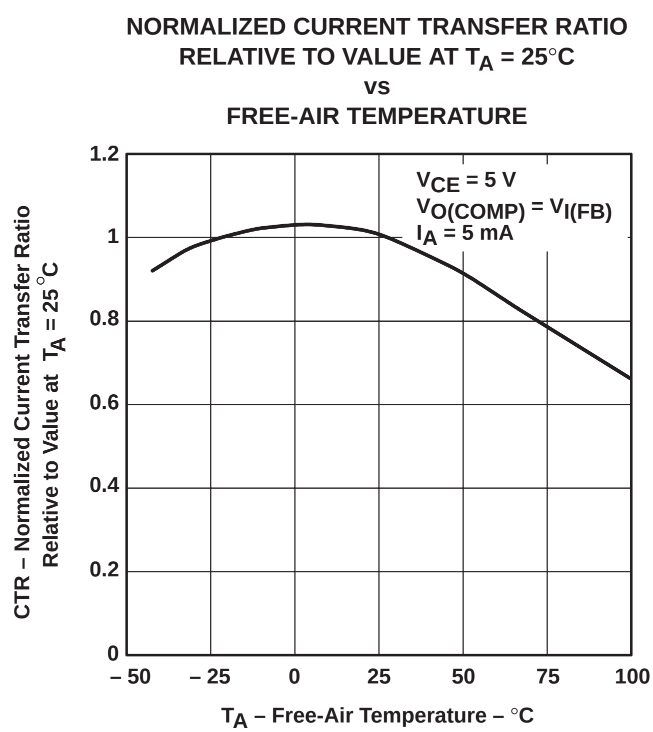


Figure 17

TYPICAL CHARACTERISTICS

CURRENT TRANSFER RATIO vs INPUT LIGHT-EMITTING-DIODE CURRENT

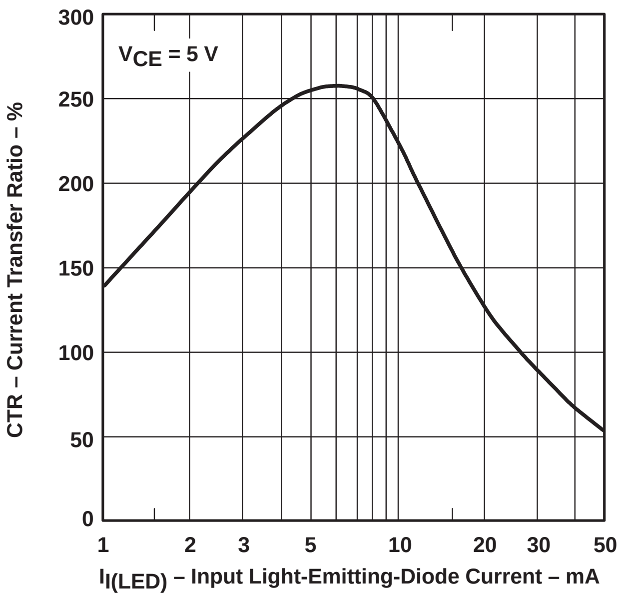


Figure 18

COLLECTOR-TO-EMITTER SATURATION VOLTAGE vs FREE-AIR TEMPERATURE

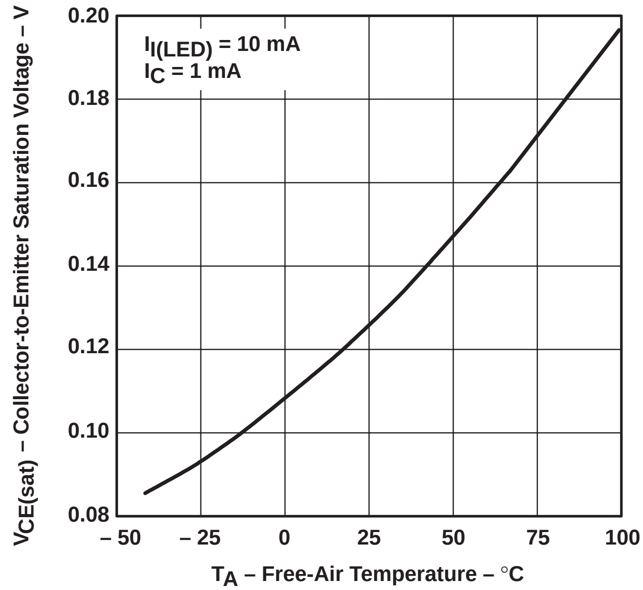


Figure 19

INPUT LIGHT-EMITTING-DIODE FORWARD CURRENT vs LIGHT-EMITTING-DIODE FORWARD VOLTAGE

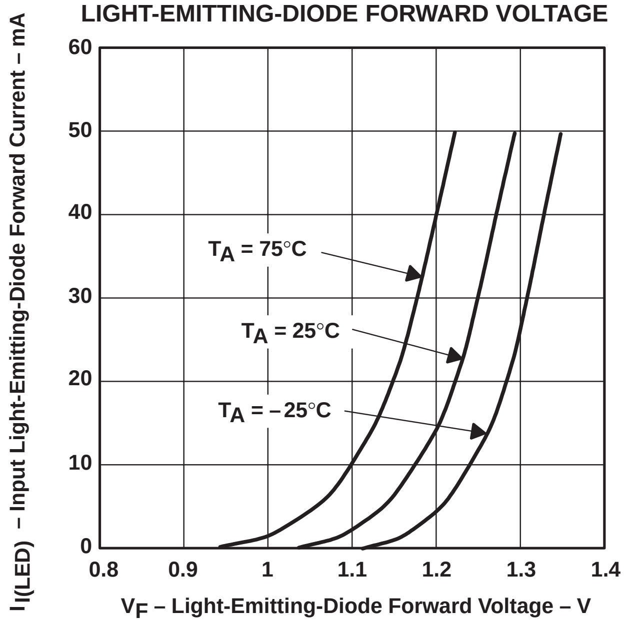
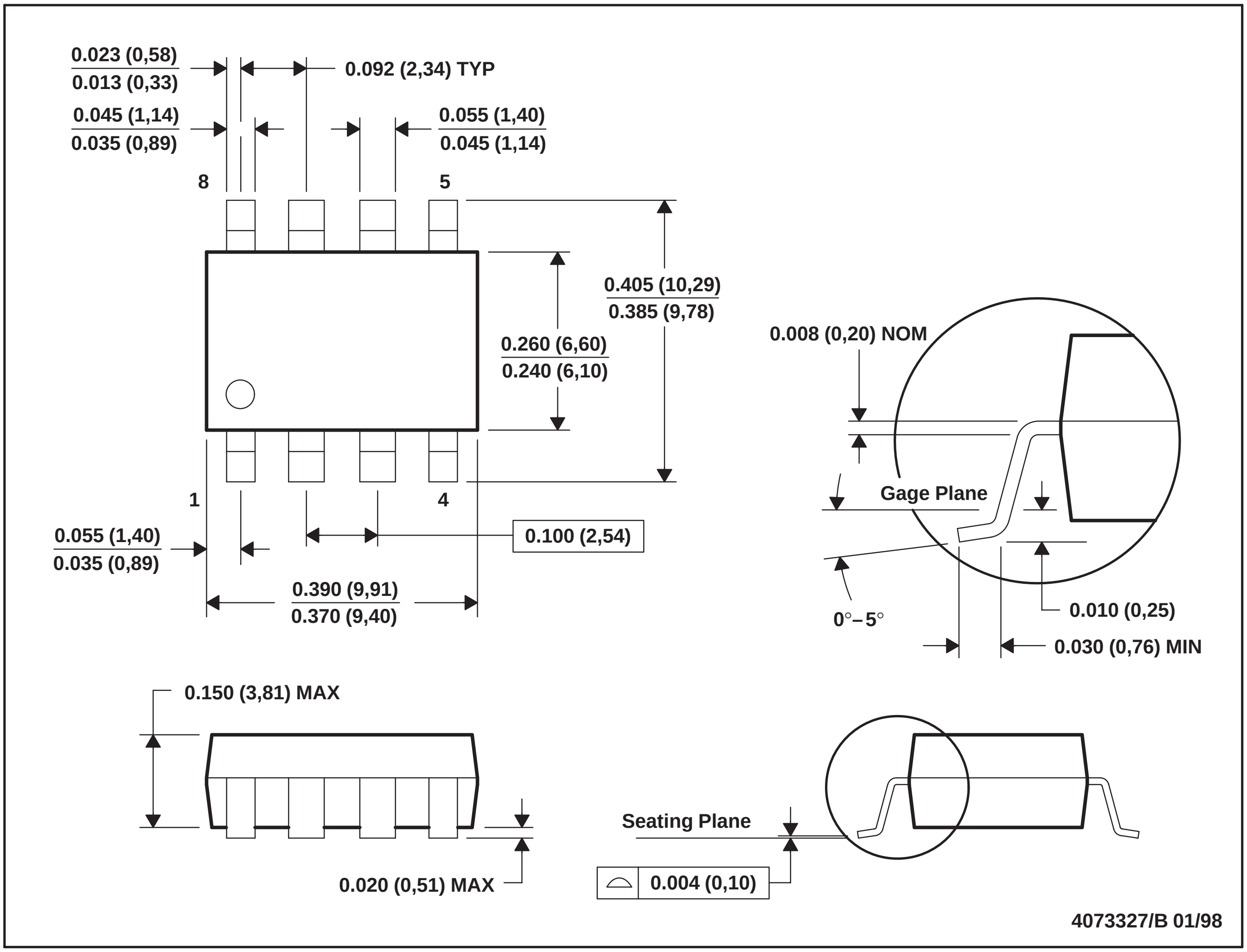


Figure 20

MECHANICAL DATA

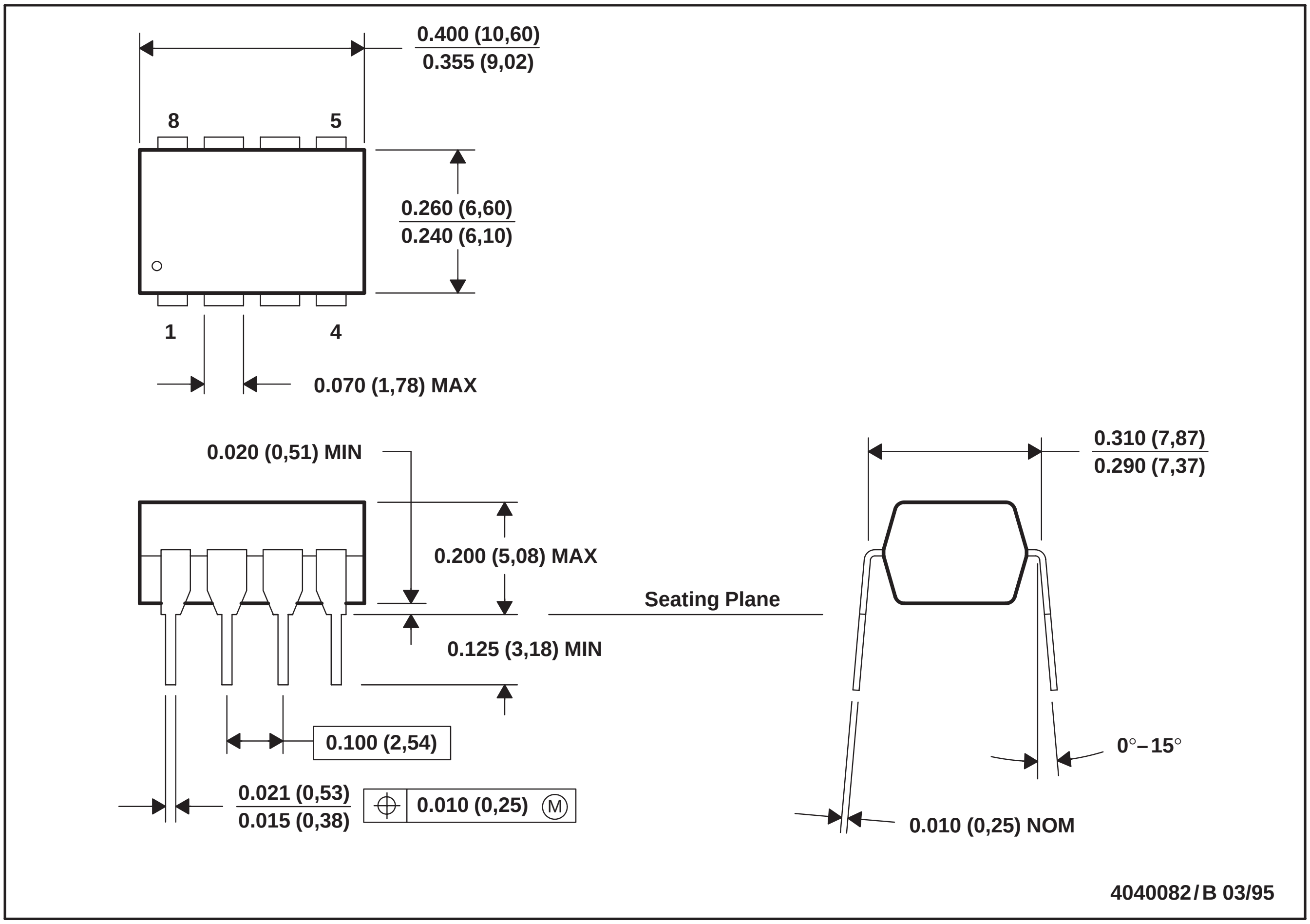
DCS (R-PDSO-G8) **PLASTIC DUAL SMALL-OUTLINE OPTO COUPLER**



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

PACKAGING INFORMATION

Orderable Device	Status [(1)]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [(2)]	Lead/Ball Finish	MSL Peak Temp [(3)]
TPS5908	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI
TPS5908A	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI
TPS5908DCS	OBSOLETE	OPTO	DCS	8		TBD	Call TI	Call TI
TPS5910	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI
TPS5910A	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI
TPS5910ADCS	OBSOLETE	OPTO	DCS	8		TBD	Call TI	Call TI
TPS5910DCS	OBSOLETE	OPTO	DCS	8		TBD	Call TI	Call TI

[(1)] The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

[(2)] Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

[(3)] MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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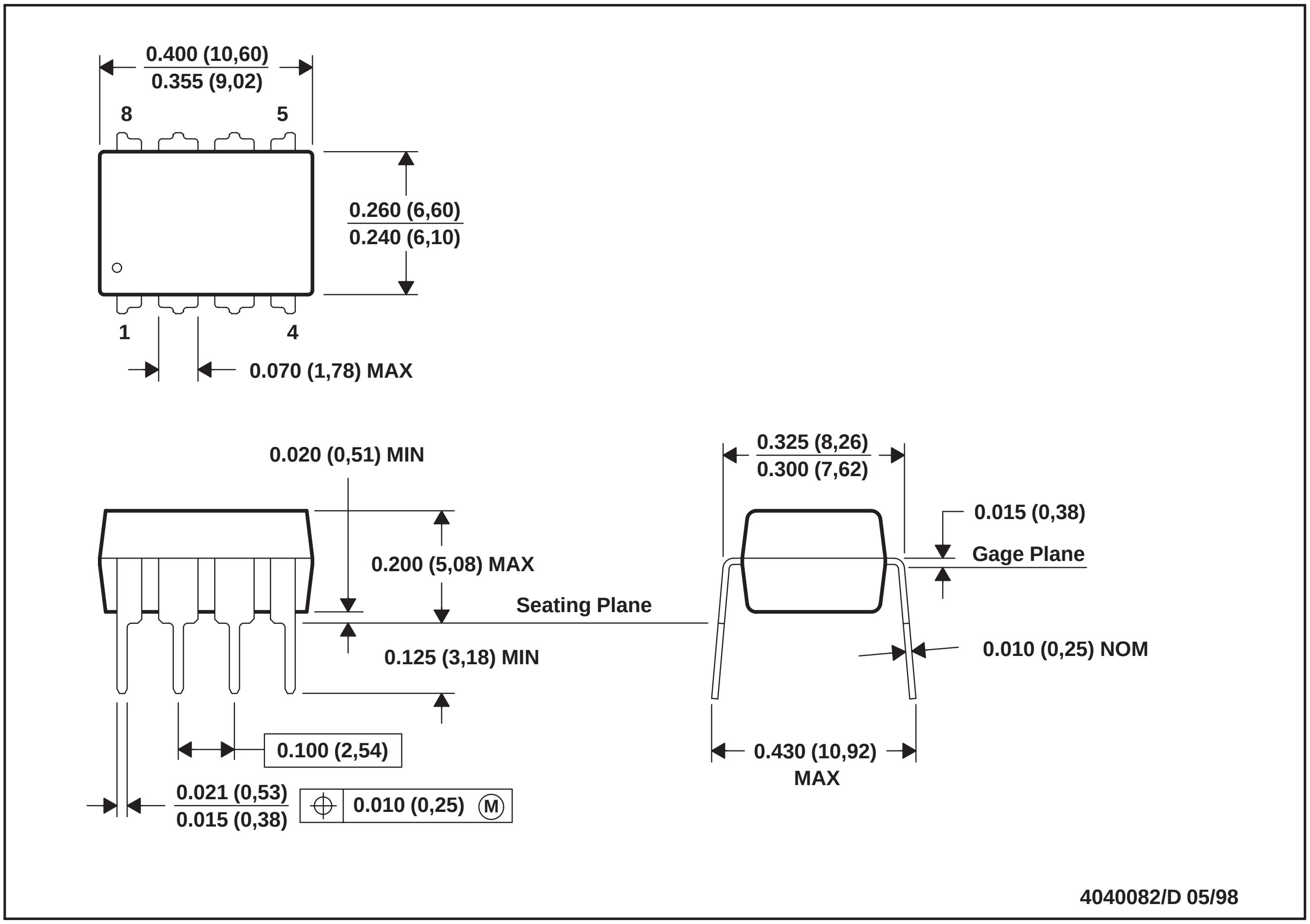
P (R-PDIP-T8) **PLASTIC DUAL-IN-LINE**



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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