- 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) LED [ 1 8 NC/BASE† COMP [ 2 7 C GND [ 3 6 ] E FB [ 4 5 NC NC – No internal connection

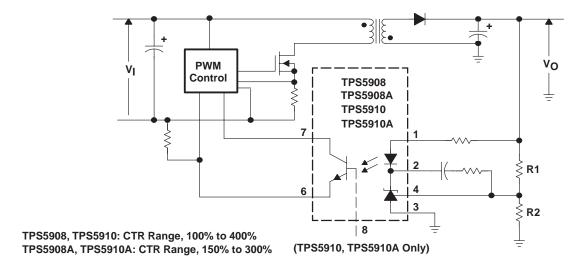
†BASE – TPS5910, TPS5910A only

# 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

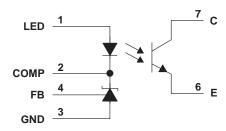




Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



### schematic



# **Terminal Functions**

TERMINAL		1/0	DESCRIPTION					
NAME	NO.	1/0	DESCRIPTION					
С	7		Phototransistor collector					
COMP	2	0	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 <sub>A</sub> = 25°C (see Note 1)	250 mW
Input LED current, I <sub>I(LED)</sub>	50 mA
Input LED voltage, $\hat{V}_{I(LED)}$	
Input diode reverse voltage	
Output power dissipation at (or below) T <sub>A</sub> = 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) $T_A = 25^{\circ}C$ (see Note 3)	350 mW
Operating free-air temperature range, T <sub>A</sub>	–40°C to 100°C
Storage temperature range, T <sub>stq</sub>	–55°C to 150°C
Total input-to-output voltage	
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Flammability	(see Note 4)

<sup>†</sup> 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, $T_A = 25^{\circ}C$ (unless otherwise noted)

# input

	PARAMETER	TEST CONDITI	MIN	TYP	MAX	UNIT	
VF	Light-emitting diode forward voltage	VO(COMP) = VI(FB), See Figure 1	$I_{I(LED)} = 10 \text{ mA},$		1.2	1.4	V
I <sub>R</sub>	Light-emitting diode reverse current	V <sub>R</sub> = 6 V				10	μΑ
V <sub>ref</sub>	Reference voltage	VO(COMP) = VI(FB), See Figure 1	$I_{I(LED)} = 10 \text{ mA},$	1.228	1.24	1.252	V
V <sub>ref(dev)</sub>	Deviation of reference voltage over temperature	VO(COMP) = VI(FB), T <sub>A</sub> = 25°C to 100°C,	I <sub>I(LED)</sub> = 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	$\Delta V_{I(LED)} = 3 \text{ V to 7 V},$ See Figure 2	$I_{I(LED)} = 10 \text{ mA},$		-1.5	-2.7	mV/V
I <sub>I</sub> (FB)	Feedback input current	I <sub>I(LED)</sub> = 10 mA, See Figure 3	$R3 = 10 \text{ k}\Omega$ ,		0.15	0.5	μΑ
I <sub>ref(dev)</sub>	Deviation of reference input current over temperature	I <sub>I</sub> (LED) = 10 mA, T <sub>A</sub> = 25°C to 100°C,	R3 = 10 kΩ, See Figure 3		0.05		μΑ
I <sub>DRV(min)</sub>	Minimum drive current	VO(COMP) = VI(FB),	See Figure 1		55	80	μΑ
I <sub>I(off)</sub>	Off-state input light-emitting-diode current	V <sub>I(LED)</sub> = 7 V, See Figure 4	$V_{I(FB)} = 0$ ,		0.001	0.1	μΑ
Z <sub>ka</sub>  †	Regulator output impedance	VO(COMP) = VI(FB), IO(COMP) = 1 mA to 50 mA	$f \le 1 \text{ kHz},$		0.25	·	Ω

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

# output

	PARAMETER	TEST CO	MIN	TYP	MAX	UNIT		
ICEO	Collect dark current	$V_{CE} = 35 \text{ V},$	See Figure 5			100	nA	
V(BR)ECO	Breakdown voltage, emitter-to-collector, base or	I <sub>E</sub> = 100 μA		7			V	
V <sub>(BR)</sub> CBO	Breakdown voltage, collector-to-base, emitter open		$I_C = 10 \mu A$ , See Figure 7	I <sub>F</sub> = 0,	70			V
h <sub>FE</sub>	Static forward current transfer ratio, common collector	TPS5910, TPS5910A	$I_C = 10 \text{ mA},$ $I_F = 0,$	V <sub>CE</sub> = 5 V, See Figure 8	200			
V <sub>(BR)EBO</sub>	Breakdown voltage, emitter-to-base, collector open		I <sub>E</sub> = 10 μA, See Figure 9	IF = 0,	7			V

# coupler

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

<sup>&</sup>lt;sup>†</sup> This symbol is not currently listed within EIA or JEDEC standards for semiconductor symbology.



# PARAMETER MEASUREMENT INFORMATION

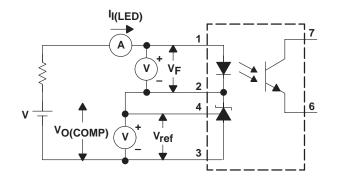


Figure 1.  $V_{ref}$ ,  $V_{F}$ ,  $I_{min}$  Test Circuit

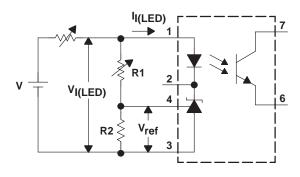


Figure 2.  $\Delta V_{ref}/\Delta V_{I(LED)}$  Test Circuit

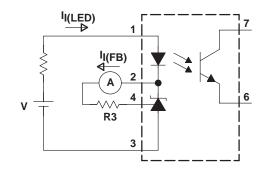


Figure 3. I<sub>I(FB)</sub> Test Circuit

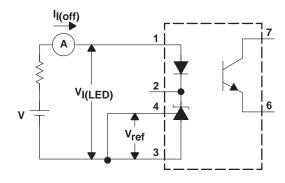


Figure 4. I<sub>I(off)</sub> Test Circuit

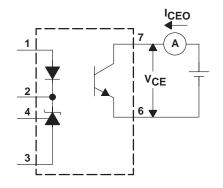


Figure 5. I<sub>CEO</sub> Test Circuit

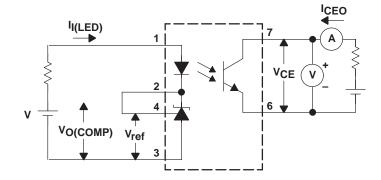
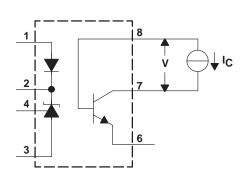


Figure 6. CTR, V<sub>CE(sat)</sub> Test Circuit

# PARAMETER MEASUREMENT INFORMATION



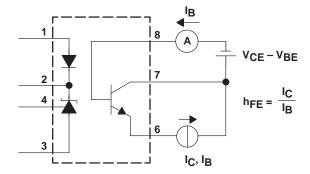


Figure 7. V<sub>(BR)CBO</sub> Test Circuit

Figure 8. hFE Test Circuit

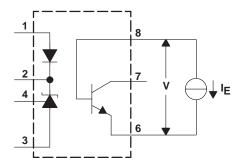


Figure 9. V<sub>(BR)EBO</sub> Test Circuit

# TYPICAL CHARACTERISTICS

# INPUT LIGHT-EMITTING-DIODE CURRENT VS REFERENCE VOLTAGE VO(COMP) = VI(FB) TA = 25°C 150 0 0 0.5 1 1.5 V<sub>ref</sub> - Reference Voltage - V



# REFERENCE VOLTAGE 15 VO(COMP) = VI(FB) TA = 25°C 10 0 0 0.5 1.5 Vref - Reference Voltage - V

INPUT LIGHT-EMITTING-DIODE CURRENT

Figure 11

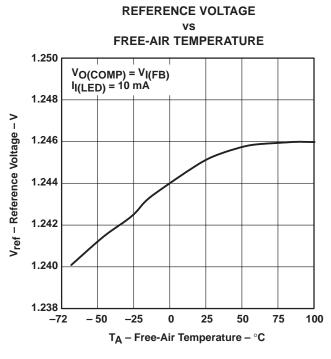


Figure 12

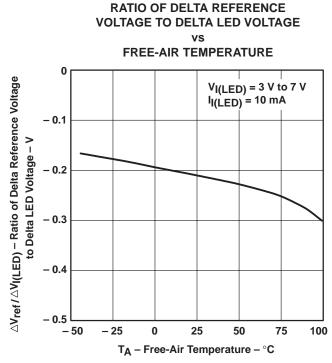


Figure 13

# TYPICAL CHARACTERISTICS

# 

Figure 14

# 

Figure 16

# OFF-STATE INPUT LIGHT-EMITTING-DIODE CURRENT vs FREE-AIR TEMPERATURE

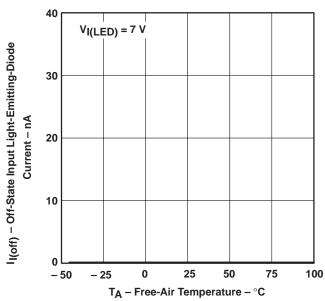


Figure 15

# NORMALIZED CURRENT TRANSFER RATIO RELATIVE TO VALUE AT $T_A = 25^{\circ}C$

vs FREE-AIR TEMPERATURE

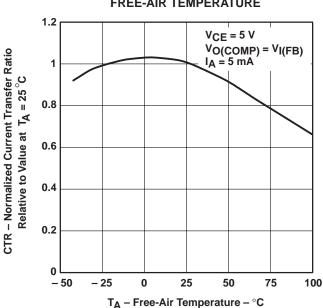


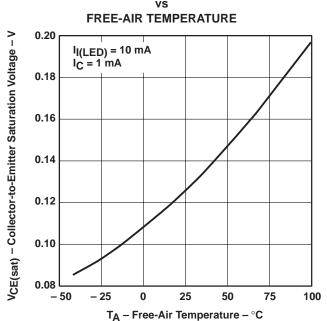
Figure 17



# TYPICAL CHARACTERISTICS

# CURRENT TRANSFER RATIO VS INPUT LIGHT-EMITTING-DIODE CURRENT 300 VCE = 5 V 250 250 100 1 2 3 5 10 20 30 50 Il(LED) - Input Light-Emitting-Diode Current - mA

# COLLECTOR-TO-EMITTER SATURATION VOLTAGE



# Figure 18 Figure 19

# INPUT LIGHT-EMITTING-DIODE FORWARD CURRENT

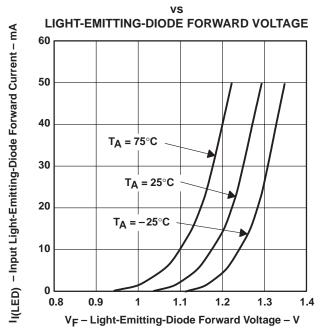
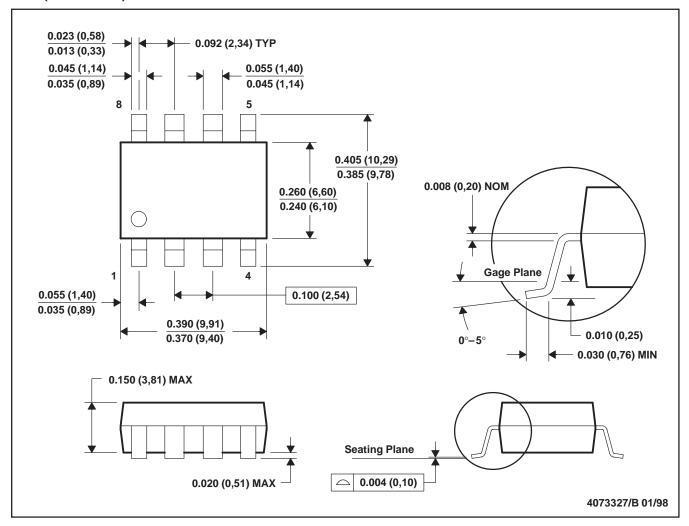


Figure 20

# **MECHANICAL DATA**

# DCS (R-PDSO-G8)

# PLASTIC DUAL SMALL-OUTLINE OPTO COUPLER



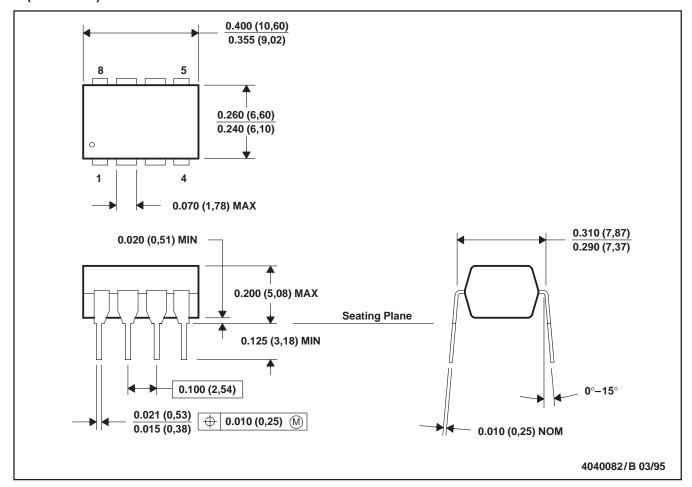
 $\label{eq:NOTES:A.All linear dimensions are in inches (millimeters).}$ 

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





ti.com 8-Apr-2005

# PACKAGING INFORMATION

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
TPS5908	OBSOLETE	PDIP	Р	8	TBD	Call TI	Call TI
TPS5908A	OBSOLETE	PDIP	Р	8	TBD	Call TI	Call TI
TPS5908DCS	OBSOLETE	OPTO	DCS	8	TBD	Call TI	Call TI
TPS5910	OBSOLETE	PDIP	Р	8	TBD	Call TI	Call TI
TPS5910A	OBSOLETE	PDIP	Р	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

<sup>&</sup>lt;sup>(1)</sup> 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.

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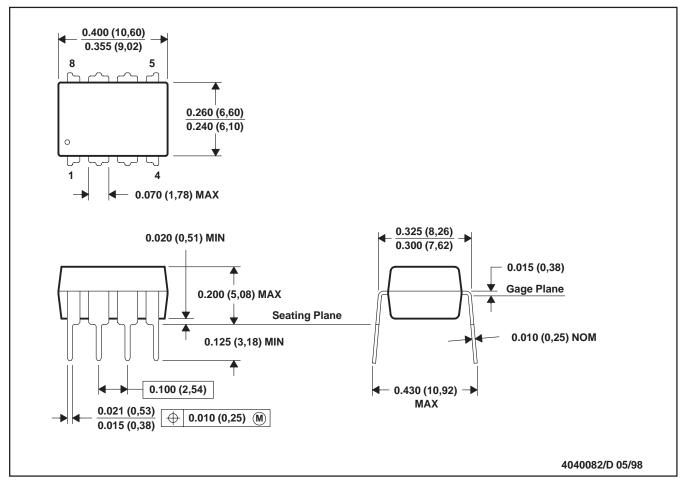
(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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# P (R-PDIP-T8)

# PLASTIC DUAL-IN-LINE



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- B. This drawing is subject to change without notice.
- C. Falls within JEDEC MS-001

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