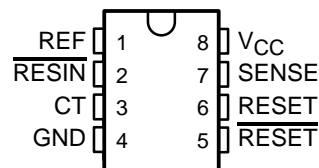


TL7702A, TL7705A, TL7709A, TL7712A, TL7715A SUPPLY-VOLTAGE SUPERVISORS

SLVS028H – APRIL 1983 – REVISED MAY 2003

- Power-On Reset Generator
- Automatic Reset Generation After Voltage Drop
- Wide Supply-Voltage Range
- Precision Voltage Sensor
- Temperature-Compensated Voltage Reference
- True and Complement Reset Outputs
- Externally Adjustable Pulse Duration

TL7702A, TL7709A, TL7712A, TL7715A . . . D OR P PACKAGE
TL7705A . . . D, P, OR PS PACKAGE,
(TOP VIEW)



description/ordering information

ORDERING INFORMATION

TA	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
0°C to 70°C	PDIP (P)	Tube of 50	TL7702ACP	TL7702ACP
	SOIC (D)	Tube of 75	TL7702ACD	7702AC
		Reel of 2500	TL7702ACDR	
	PDIP (P)	Tube of 50	TL7705ACP	TL7705ACP
	SOIC (D)	Tube of 75	TL7705ACD	7705AC
		Reel of 2500	TL7705ACDR	
	SOP (PS)	Reel of 2000	TL7705ACPSR	T7705A
	PDIP (P)	Tube of 50	TL7709ACP	TL7709ACP
	SOIC (D)	Tube of 75	TL7709ACD	7709AC
		Reel of 2500	TL7709ACDR	
	PDIP (P)	Tube of 50	TL7712ACP	TL7709ACP
	SOIC (D)	Tube of 75	TL7712ACD	7712AC
Reel of 2500		TL7712ACDR		
PDIP (P)	Tube of 50	TL7715ACP	TL7715ACP	
SOIC (D)	Tube of 75	TL7715ACD	7715AC	
-40°C to 85°C	PDIP (P)	Tube of 50	TL7702AIP	TL7702AIP
	SOIC (D)	Tube of 75	TL7702AID	7702AI
		Reel of 2500	TL7702AIDR	
	PDIP (P)	Tube of 50	TL7705AIP	TL7705AIP
SOIC (D)	Tube of 75	TL7705AID	7705AI	
	Reel of 2500	TL7705AIDR		

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.



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.

PRODUCTION DATA information is 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.

 **TEXAS
INSTRUMENTS**

POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2003, Texas Instruments Incorporated

TL7702A, TL7705A, TL7709A, TL7712A, TL7715A SUPPLY-VOLTAGE SUPERVISORS

SLVS028H – APRIL 1983 – REVISED MAY 2003

description/ordering information (continued)

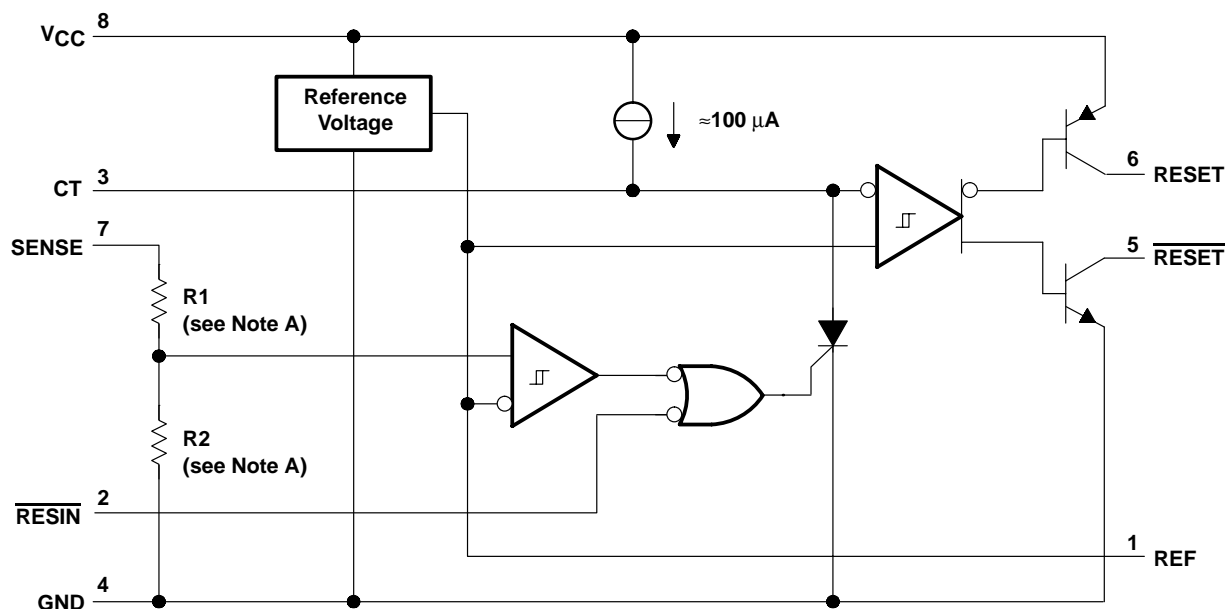
The TL77xxA family of integrated-circuit supply-voltage supervisors is designed specifically for use as reset controllers in microcomputer and microprocessor systems. The supply-voltage supervisor monitors the supply for undervoltage conditions at the SENSE input. During power up, the $\overline{\text{RESET}}$ output becomes active (low) when V_{CC} attains a value approaching 3.6 V. At this point (assuming that SENSE is above V_{IT+}), the delay timer function activates a time delay, after which outputs $\overline{\text{RESET}}$ and RESET go inactive (high and low, respectively). When an undervoltage condition occurs during normal operation, $\overline{\text{RESET}}$ and RESET go active. To ensure that a complete reset occurs, the reset outputs remain active for a time delay after the voltage at the SENSE input exceeds the positive-going threshold value. The time delay is determined by the value of the external capacitor C_T : $t_d = 1.3 \times 10^4 \times C_T$, where C_T is in farads (F) and t_d is in seconds (s).

During power down and when SENSE is below V_{IT-} , the outputs remain active until V_{CC} falls below 2 V. After this, the outputs are undefined.

An external capacitor (typically 0.1 μF) must be connected to REF to reduce the influence of fast transients in the supply voltage.

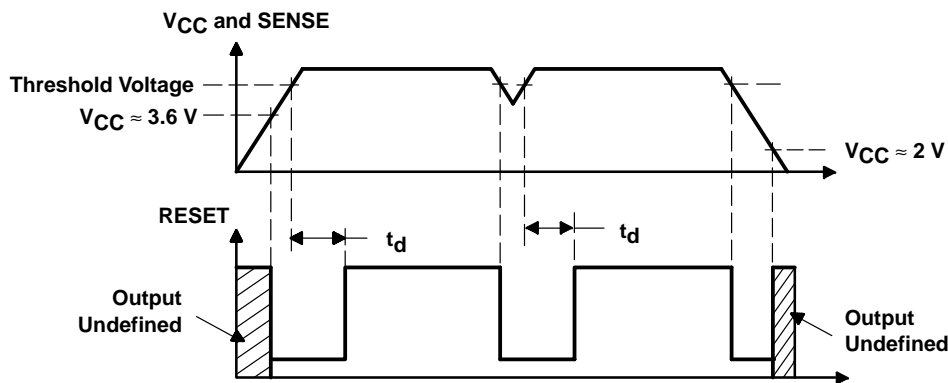
functional block diagram

The functional block diagram is shown for illustrative purposes only; the actual circuit includes a trimming network to adjust the reference voltage and sense-comparator trip point.



- NOTES: A. TL7702A: R1 = 0 Ω , R2 = open
 TL7705A: R1 = 7.8 k Ω , R2 = 10 k Ω
 TL7709A: R1 = 19.7 k Ω , R2 = 10 k Ω
 TL7712A: R1 = 32.7 k Ω , R2 = 10 k Ω
 TL7715A: R1 = 43.4 k Ω , R2 = 10 k Ω
 B. Resistor values shown are nominal.

timing diagram



absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Supply voltage, V_{CC} (see Note 1)	20 V
Input voltage range, V_I , \overline{RESIN}	-0.3 V to 20 V
Input voltage range, V_I , SENSE: TL7702A (see Note 2)	-0.3 V to 6 V
TL7705A	-0.3 V to 20 V
TL7709A	-0.3 V to 20 V
TL7712A, TL7715A	-0.3 V to 20 V
High-level output current, I_{OH} , \overline{RESET}	-30 mA
Low-level output current, I_{OL} , \overline{RESET}	30 mA
Package thermal impedance, θ_{JA} (see Notes 3 and 4): D package	97°C/W
P package	85°C/W
PS package	95°C/W
Operating virtual junction temperature, T_J	150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Storage temperature range, T_{Stg}	-65°C to 150°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 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. All voltage values are with respect to GND.

2. For proper operation of the TL7702A, the voltage applied to the SENSE terminal should not exceed $V_{CC} - 1\text{ V}$ or 6 V, whichever is less.
3. Maximum power dissipation is a function of $T_J(\text{max})$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can affect reliability.
4. The package thermal impedance is calculated in accordance with JESD 51-7.

TL7702A, TL7705A, TL7709A, TL7712A, TL7715A SUPPLY-VOLTAGE SUPERVISORS

SLVS028H – APRIL 1983 – REVISED MAY 2003

recommended operating conditions

		MIN	MAX	UNIT	
V _{CC}	Supply voltage	3.5	18	V	
V _{IH}	High-level input voltage at $\overline{\text{RESIN}}$	2		V	
V _{IL}	Low-level input voltage at $\overline{\text{RESIN}}$		0.6	V	
V _I	Input voltage, SENSE	TL7702A	0	See Note 2	V
		TL7705A	0	10	
		TL7709A	0	15	
		TL7712A	0	20	
		TL7715A	0	20	
I _{OH}	High-level output current, $\overline{\text{RESET}}$		-16	mA	
I _{OL}	Low-level output current, $\overline{\text{RESET}}$		16	mA	
T _A	Operating free-air temperature range	TL77xxAC	0	70	°C
		TL77xxAI	-40	85	

NOTE 2: For proper operation of the TL7702A, the voltage applied to the SENSE terminal should not exceed V_{CC} - 1 V or 6 V, whichever is less.

electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITION [†]	TL77xxAC TL77xxAI			UNIT	
			MIN	TYP	MAX		
V _{OH}	High-level output voltage, $\overline{\text{RESET}}$	I _{OH} = -16 mA	V _{CC} -1.5			V	
V _{OL}	Low-level output voltage, $\overline{\text{RESET}}$	I _{OL} = 16 mA	0.4			V	
V _{ref}	Reference voltage	T _A = 25°C	2.48	2.53	2.58	V	
V _{IT-}	Negative-going input threshold voltage, SENSE	T _A = 25°C	TL7702A	2.48	2.53	2.58	V
			TL7705A	4.5	4.55	4.6	
			TL7709A	7.5	7.6	7.7	
			TL7712A	10.6	10.8	11	
			TL7715A	13.2	13.5	13.8	
V _{hys}	Hysteresis, SENSE (V _{IT+} - V _{IT-})	T _A = 25°C	TL7702A	10		mV	
			TL7705A	15			
			TL7709A	20			
			TL7712A	35			
			TL7715A	45			
I _I	Input current	RESIN	V _I = 2.4 V to V _{CC}		μA		
		SENSE	V _I = 0.4 V				
I _{OH}	High-level output current, $\overline{\text{RESET}}$	V _O = 18 V	0.5		2		
I _{OL}	Low-level output current, $\overline{\text{RESET}}$	V _O = 0	-100		50		
I _{CC}	Supply current	All inputs and outputs open	1.8	3		mA	

[†] All electrical characteristics are measured with 0.1-μF capacitors connected at REF, CT, and V_{CC} to GND.



switching characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	TL77xxAC TL77xxAI			UNIT
		MIN	TYP	MAX	
Output pulse duration	$C_T = 0.1 \mu\text{F}$	0.65	1.2	2.6	msec
Input pulse duration at $\overline{\text{RESIN}}$		0.4			μs
$t_w(\text{S})$ Pulse duration at SENSE input to switch outputs	$V_{IH} = V_{IT-} + 200 \text{ mV}, V_{IL} = V_{IT-} - 200 \text{ mV}$	2			μs
t_{pd} Propagation delay time, $\overline{\text{RESIN}}$ to $\overline{\text{RESET}}$	$V_{CC} = 5 \text{ V}$			1	μs
t_r Rise time	$\overline{\text{RESET}}$	$V_{CC} = 5 \text{ V},$	See Note 5	0.2	μs
	$\overline{\text{RESET}}$			3.5	
t_f Fall time	$\overline{\text{RESET}}$	$V_{CC} = 5 \text{ V},$	See Note 5	3.5	μs
	$\overline{\text{RESET}}$			0.2	

† All switching characteristics are measured with 0.1- μF capacitors connected at REF and V_{CC} to GND.

NOTE 5: The rise and fall times are measured with a 4.7-k Ω load resistor at RESET and $\overline{\text{RESET}}$.

PARAMETER MEASUREMENT INFORMATION

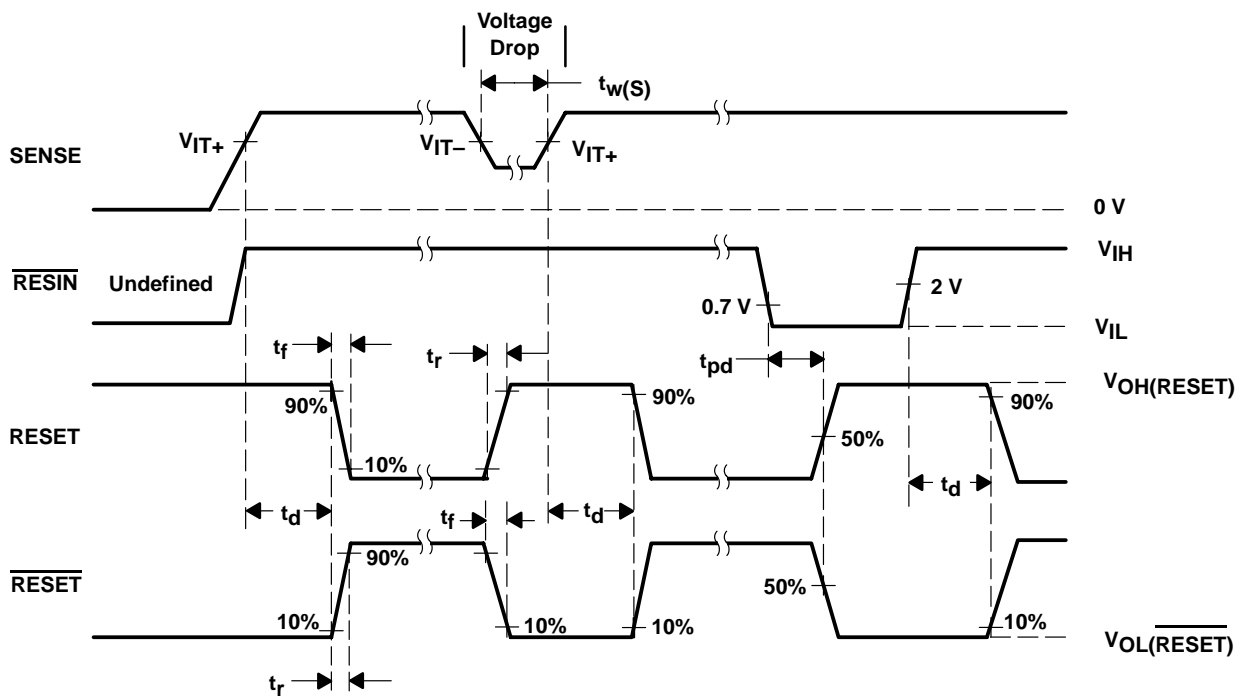


Figure 1. Voltage Waveforms

TL7702A, TL7705A, TL7709A, TL7712A, TL7715A SUPPLY-VOLTAGE SUPERVISORS

SLVS028H – APRIL 1983 – REVISED MAY 2003

TYPICAL CHARACTERISTICS†

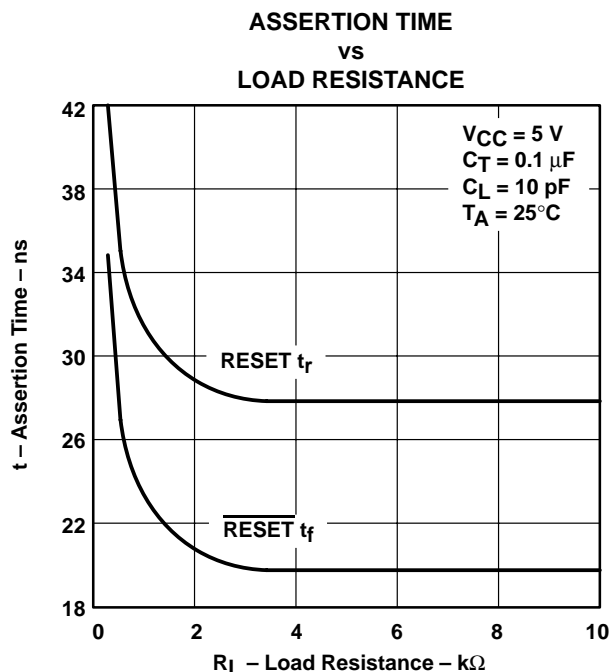


Figure 2

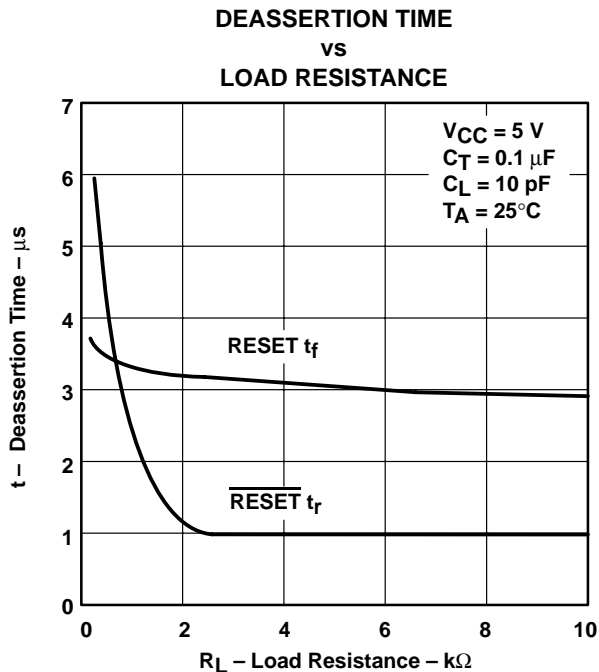


Figure 3

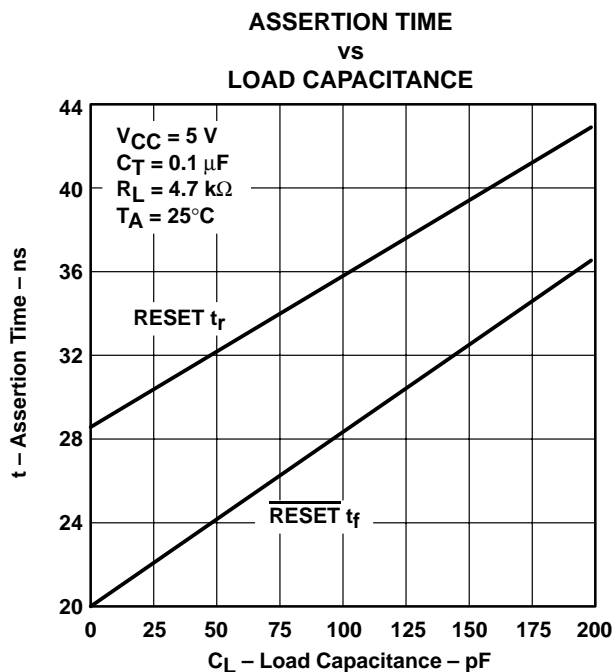


Figure 4

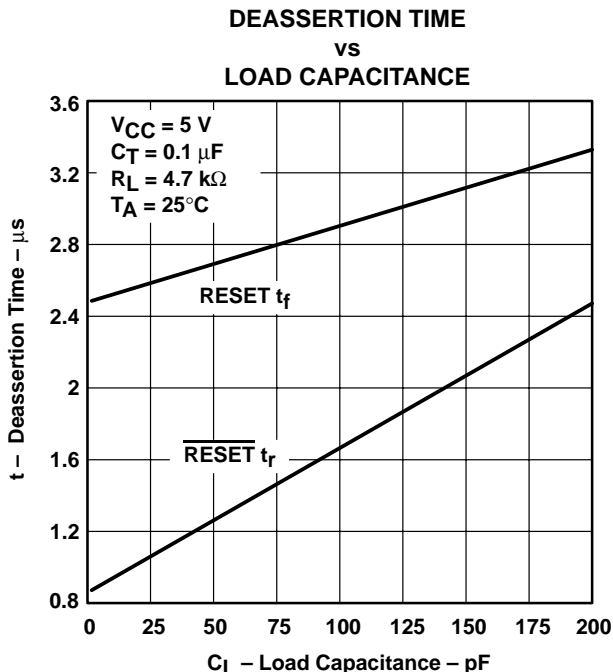


Figure 5

† For proper operation, both RESET and $\overline{\text{RESET}}$ should be terminated with resistors of similar value. Failure to do so may cause unwanted plateauing in either output waveform during switching.



APPLICATION INFORMATION

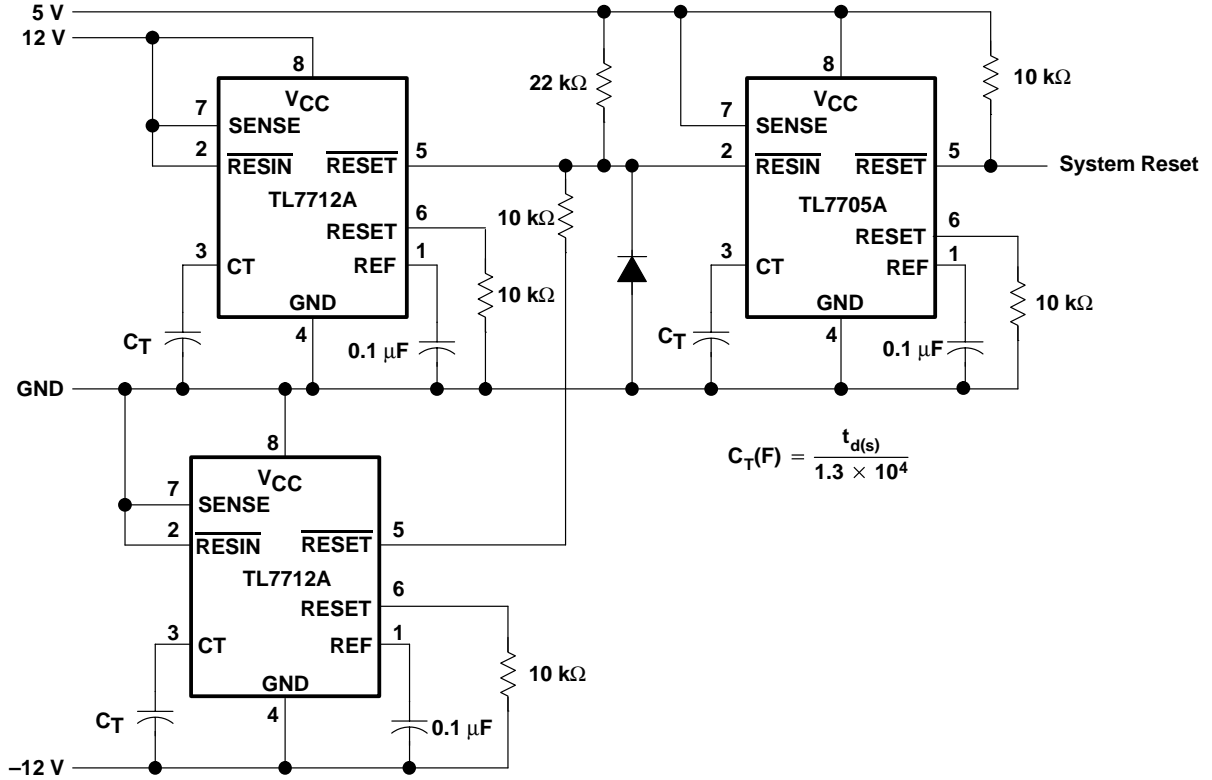


Figure 6. Multiple Power-Supply System Reset Generation

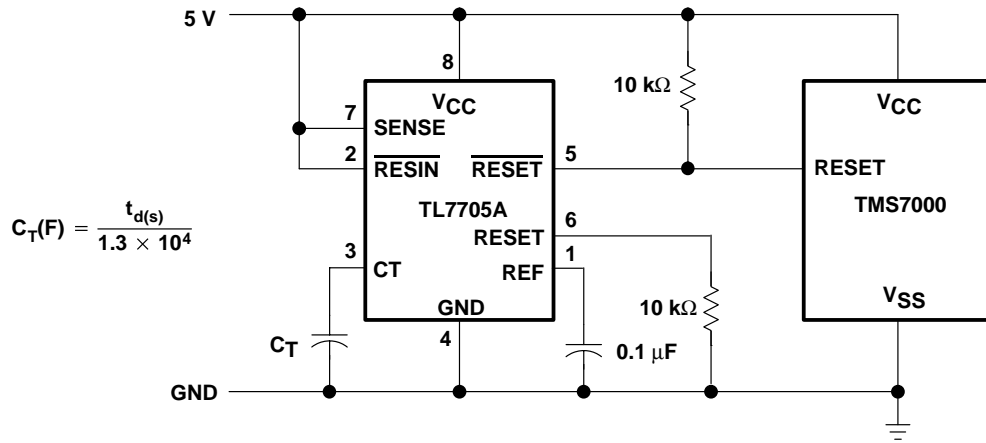


Figure 7. Reset Controller for TMS7000 System

TL7702A, TL7705A, TL7709A, TL7712A, TL7715A SUPPLY-VOLTAGE SUPERVISORS

SLVS028H – APRIL 1983 – REVISED MAY 2003

APPLICATION INFORMATION

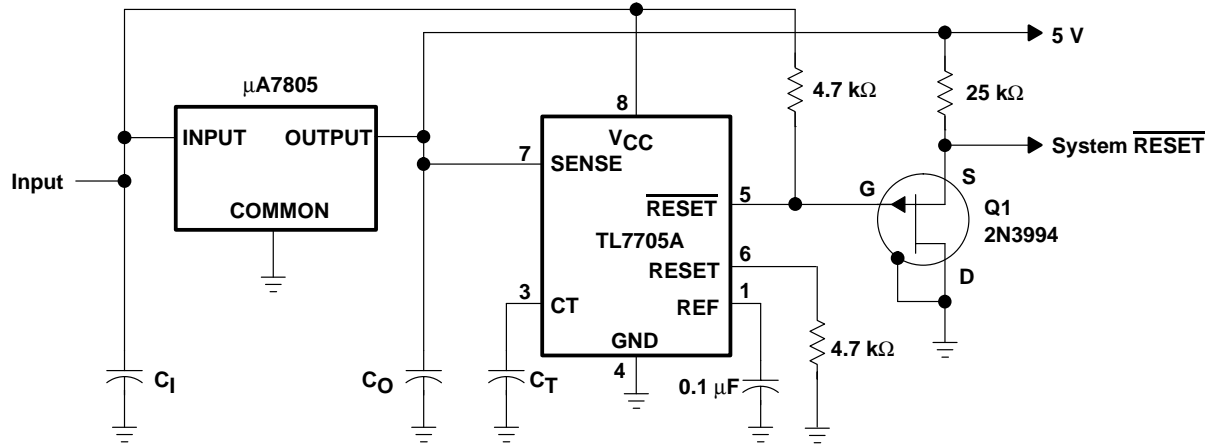


Figure 8. Eliminating Undefined States Using a P-Channel JFET

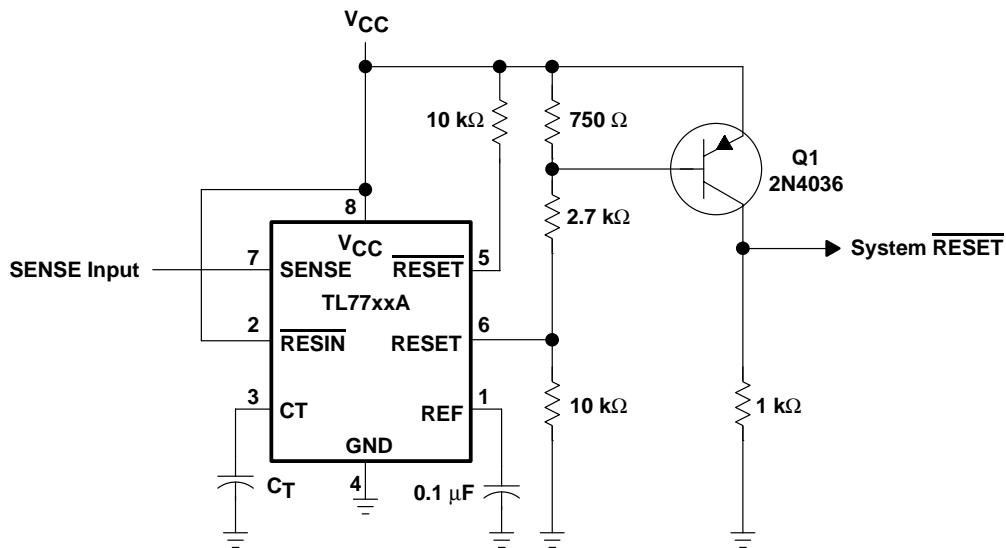


Figure 9. Eliminating Undefined States Using a pnp Transistor

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
5962-88685012A	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI
TL7702ACD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7702ACDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7702ACDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
TL7702ACDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7702ACDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7702ACDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
TL7702ACP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL7702ACPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL7702AID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7702AIDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
TL7702AIDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7702AIDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
TL7702AIP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL7702AMFKB	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI
TL7702AMJG	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TL7702AMJGB	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TL7705ACD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7705ACDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7705ACDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
TL7705ACDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7705ACDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7705ACDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
TL7705ACP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL7705ACPSLE	OBSOLETE	SO	PS	8		TBD	Call TI	Call TI
TL7705ACPSR	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7705ACPSRE4	ACTIVE	SO	PS	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
TL7705AID	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
TL7705AIDG4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
TL7705AIDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
TL7705AIDRG4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
TL7705AIP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL7705AIP E4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL7705AMFKB	OBSOLETE	LCCC	FK	20		TBD	Call TI	Call TI
TL7705AMJG	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TL7705AMJGB	OBSOLETE	CDIP	JG	8		TBD	Call TI	Call TI
TL7709ACD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7709ACDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7709ACDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7709ACDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7709ACP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL7709AID	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TL7709AIP	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI
TL7712ACD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7712ACDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7712ACDR	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7712ACDRE4	ACTIVE	SOIC	D	8	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7712ACP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL7712ACPE4	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL7712AID	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TL7712AIP	OBSOLETE	PDIP	P	8		TBD	Call TI	Call TI
TL7715ACD	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7715ACDE4	ACTIVE	SOIC	D	8	75	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
TL7715ACP	ACTIVE	PDIP	P	8	50	Pb-Free (RoHS)	CU NIPDAU	Level-NC-NC-NC
TL7715AID	OBSOLETE	SOIC	D	8		TBD	Call TI	Call TI
TL7715AIP	OBSOLETE	PDIP	P	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.

Important Information and Disclaimer:The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

JG (R-GDIP-T8)

CERAMIC DUAL-IN-LINE



- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. This package can be hermetically sealed with a ceramic lid using glass frit.
 D. Index point is provided on cap for terminal identification.
 E. Falls within MIL STD 1835 GDIP1-T8

FK (S-CQCC-N**)

LEADLESS CERAMIC CHIP CARRIER

28 TERMINAL SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. This package can be hermetically sealed with a metal lid.
 - D. The terminals are gold plated.
 - E. Falls within JEDEC MS-004

P (R-PDIP-T8)

PLASTIC DUAL-IN-LINE



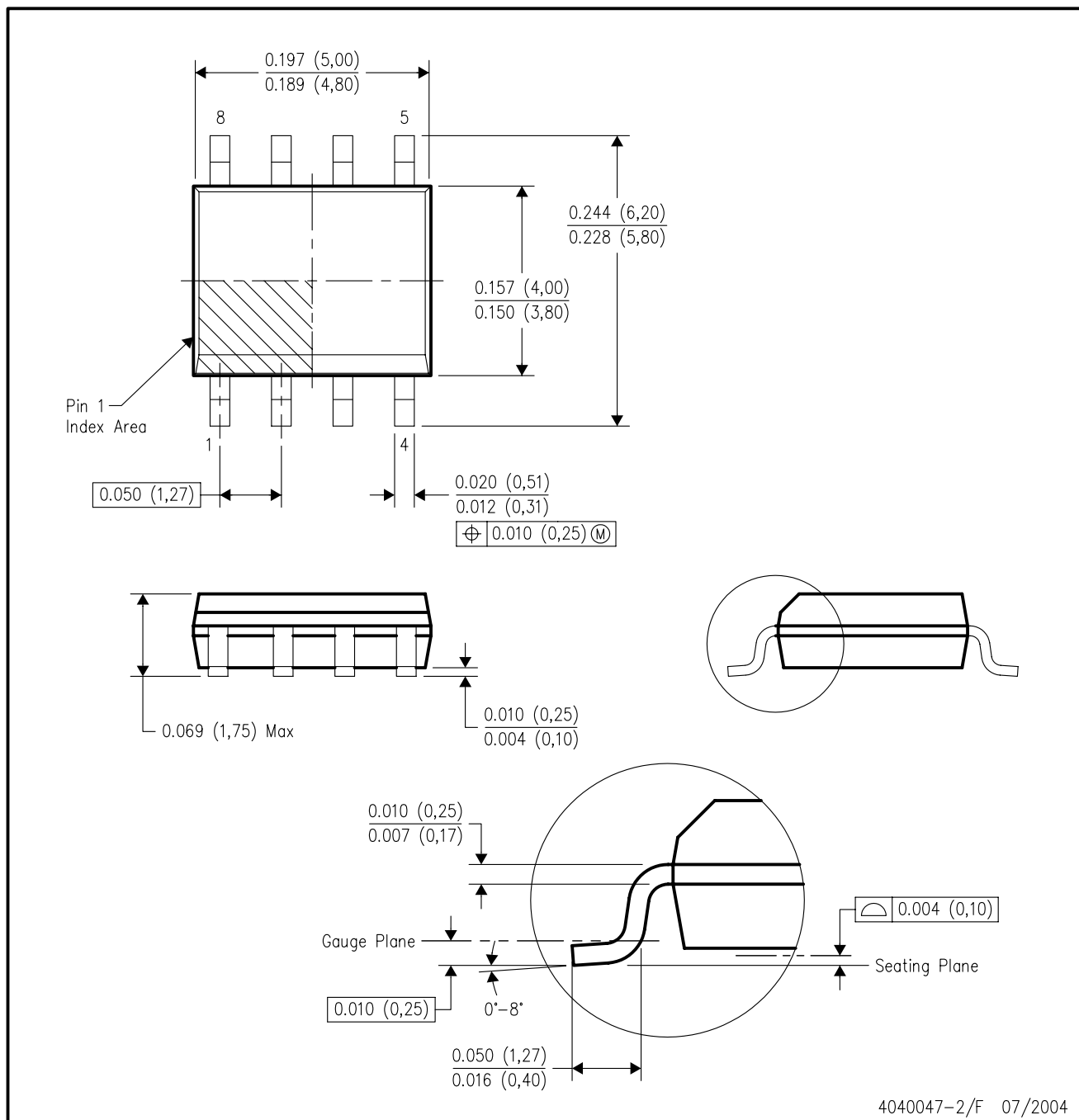
- NOTES: A. All linear dimensions are in inches (millimeters).
 B. This drawing is subject to change without notice.
 C. Falls within JEDEC MS-001

For the latest package information, go to http://www.ti.com/sc/docs/package/pkg_info.htm



D (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-012 variation AA.

MECHANICAL DATA

PS (R-PDSO-G8)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion, not to exceed 0,15.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		Applications	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265