

TL7702B, TL7702BY, TL7705B, TL7705BY SUPPLY VOLTAGE SUPERVISORS

SLVS037G – SEPTEMBER 1989 – REVISED OCTOBER 1998

- Power-On Reset Generator
- Automatic Reset Generation After Voltage Drop
- $\overline{\text{RESET}}$ Output Defined From $V_{\text{CC}} \geq 1 \text{ V}$
- Precision Voltage Sensor
- Temperature-Compensated Voltage Reference
- True and Complement Reset Outputs
- Externally Adjustable Pulse Duration

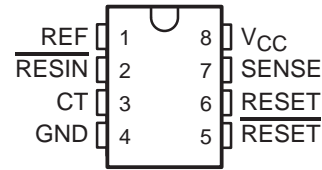
description

The TL7702B and TL7705B are monolithic integrated-circuit supply-voltage supervisors designed 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 1 V. As V_{CC} approaches 3 V (assuming that SENSE is above $V_{\text{T}+}$), 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, outputs $\overline{\text{RESET}}$ 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} : $t_{\text{d}} \approx 2.6 \times 10^4 \times C_{\text{T}}$, where C_{T} is in farads (F) and t_{d} is in seconds (s).

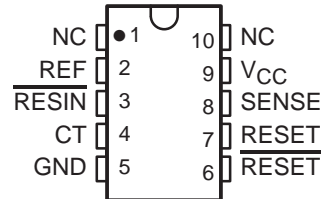
An external capacitor (typically 0.1 μF) must be connected to REF to reduce the influence of fast transients in the supply voltage.

The TL7702BC and TL7705BC are characterized for operation from 0°C to 70°C. The TL7702BI and TL7705BI are characterized for operation from -40°C to 85°C. The TL7702BQ and TL7705BQ are characterized for operation from -40°C to 125°C. The TL7702BM and TL7705BM are characterized for operation from -55°C to 125°C.

TL77xxBC . . . D OR P PACKAGE
TL77xxBM . . . JG PACKAGE
(TOP VIEW)

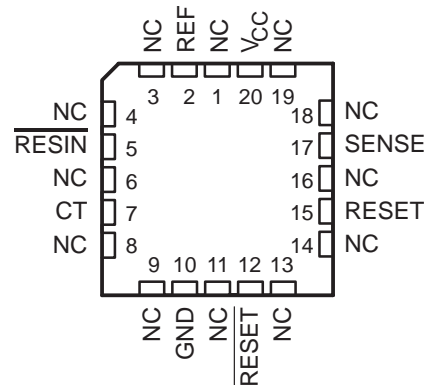


TL77xxBM . . . U PACKAGE
(TOP VIEW)



NC – No internal connection

TL77xxBM . . . FK PACKAGE
(TOP VIEW)



NC – No internal connection



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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
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On products compliant to MIL-PRF-38535, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

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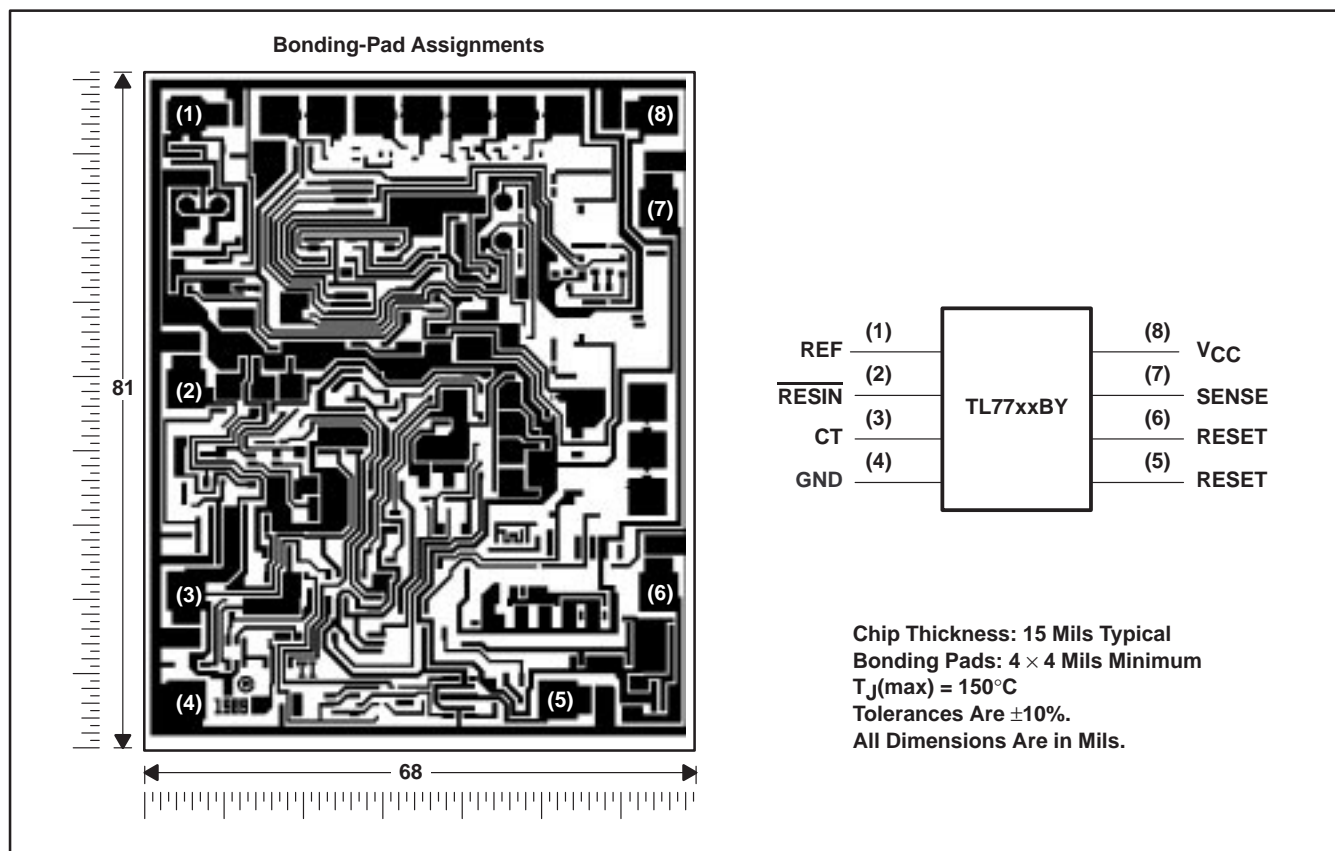
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AVAILABLE OPTIONS

T _A	PACKAGED DEVICES					CHIP FORM (Y)
	SMALL OUTLINE (D)	CHIP CARRIER (FK)	CERAMIC DIP (JG)	PLASTIC DIP (P)	CERAMIC FLATPACK (U)	
0°C to 70°C	TL7702BCD	—	—	TL7702BCP	—	TL7702BY TL7705BY
	TL7705BCD	—	—	TL7705BCP	—	
-40°C to 85°C	TL7702BID	—	—	TL7702BIP	—	
	TL7705BID	—	—	TL7705BIP	—	
-40°C to 125°C	TL7702BQD	—	—	TL7702BQP	—	
	TL7705BQD	—	—	TL7705BQP	—	
-55°C to 125°C	—	TL7702BMFK	TL7702BMJG	—	TL7702BMU	
	—	TL7705BMFK	TL7705BMJG	—	TL7705BMU	

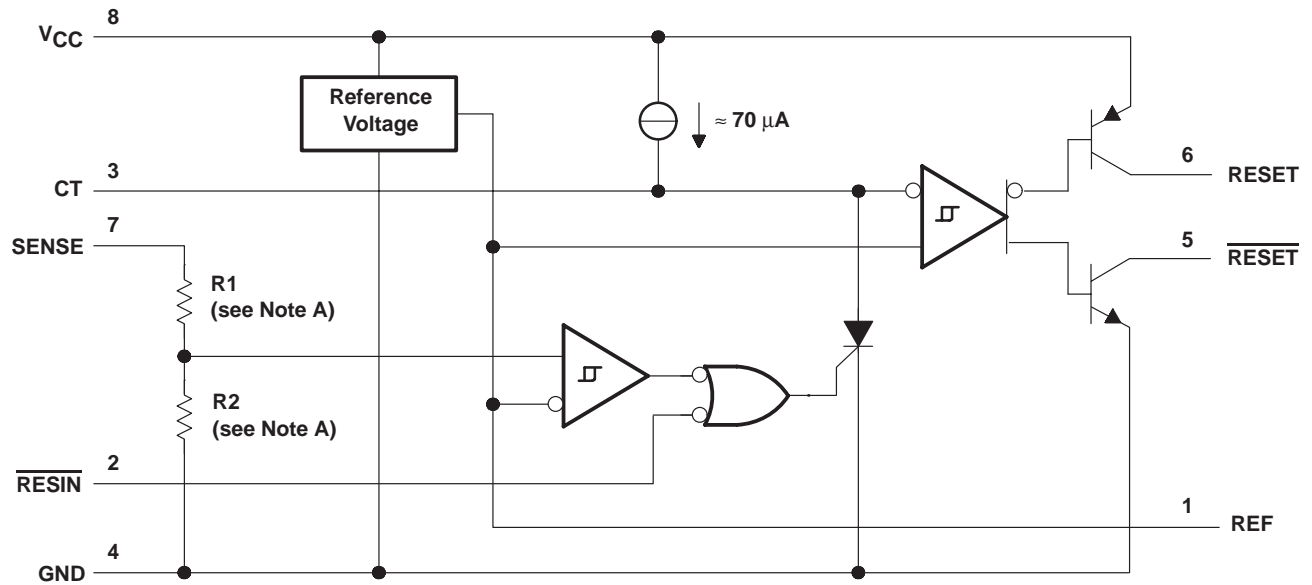
TL7702BY and TL7705BY chip information

These chips, when properly assembled, have characteristics similar to the TL7702BC and the TL7705BC. Thermal compression or ultrasonic bonding can be used on the doped-aluminum bonding pads. The chips can be mounted with conductive epoxy or a gold-silicon preform.



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.

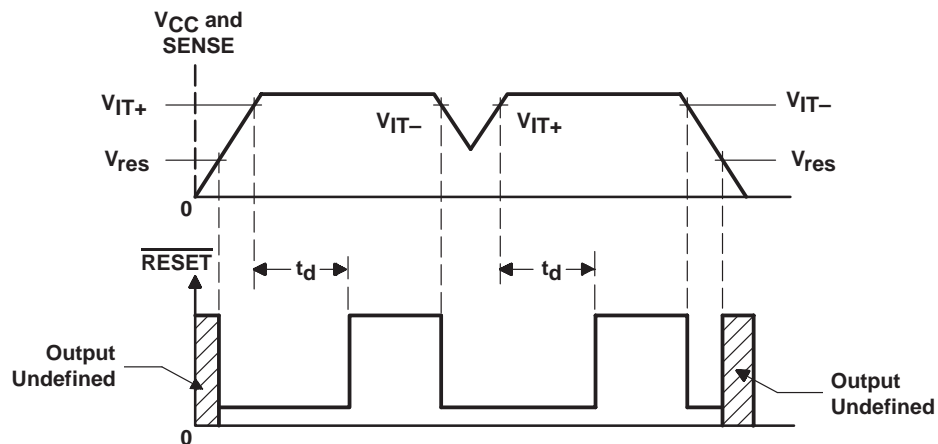


Pin numbers shown are for the D, JG, and P packages.

NOTE A: TL7702B: R1 = 0 Ω, R2 = open

TL7705B: R1 = 23 kΩ, R2 = 10 kΩ, nominal

typical timing diagram



TL7702B, TL7702BY, TL7705B, TL7705BY SUPPLY VOLTAGE SUPERVISORS

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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 : $\overline{\text{RESIN}}$	-0.3 V to 20 V
SENSE	-0.3 V to 20 V
High-level output current, I_{OH} (RESET)	-30 mA
Low-level output current, I_{OL} ($\overline{\text{RESET}}$)	30 mA
Continuous total power dissipation	See Dissipation Rating Table
Storage temperature range, T_{stg}	-65°C to 150°C
Case temperature for 60 seconds, T_C : FK package	260°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG or U packages	300°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or P packages	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 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.

NOTE 1: All voltage values are with respect to the network ground terminal.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING	$T_A = 125^\circ\text{C}$ POWER RATING
D	725 mW	5.8 mW/°C	464 mW	377 mW	145 mW
FK	1375 mW	11.0 mW/°C	880 mW	715 mW	275 mW
JG	1050 mW	8.4 mW/°C	672 mW	546 mW	210 mW
P	1000 mW	8.0 mW/°C	640 mW	520 mW	200 mW
U	700 mW	5.5 mW/°C	453 mW	370 mW	150 mW

recommended operating conditions

		MIN	MAX	UNIT
Supply voltage, V_{CC}		3.6	18	V
High-level input voltage, V_{IH}	$\overline{\text{RESIN}}$	2	18	V
Low-level input voltage, V_{IL}	$\overline{\text{RESIN}}$	0	0.8	V
Input voltage, V_I	SENSE	0	18	V
High-level output current, I_{OH}	RESET		-16	mA
Low-level output current, I_{OL}	$\overline{\text{RESET}}$		16	mA
Operating free-air temperature range, T_A	TL770xBC	0	70	°C
	TL770xBI	-40	85	
	TL770xBQ	-40	125	
	TL770xBM	-55	125	



TL7702B, TL7702BY, TL7705B, TL7705BY SUPPLY VOLTAGE SUPERVISORS

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electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TL77xxBC TL77xxBI TL77xxBQ			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	I _{ref} = 500 μA, T _A = 25°C		2.48	2.53	2.58	V
V _{IT-}	Negative-going input threshold voltage at SENSE input	TL7702B	T _A = 25°C	2.505	2.53	2.555	V
		TL7705B		4.5	4.55	4.6	
		TL7702B	T _A = full range‡	2.48	2.53	2.58	
		TL7705B		4.45	4.55	4.65	
V _{hys}	Hysteresis, SENSE (V _{IT+} - V _{IT-})	TL7702B	V _{CC} = 3.6 V to 18 V, T _A = 25°C	10			mV
		TL7705B		30			
V _{res} §	Power-up reset voltage	I _{OL} at $\overline{\text{RESET}}$ = 2 mA, T _A = 25°C		1			V
I _I	Input current	$\overline{\text{RESIN}}$	V _I = 0.4 V to V _{CC}	-10			μA
		SENSE	TL7702B V _I = V _{ref} to 18 V	-0.1	-2		
I _{OH}	High-level output current, $\overline{\text{RESET}}$	V _O = 18 V, See Figure 1		50			μA
I _{OL}	Low-level output current, $\overline{\text{RESET}}$	V _O = 0 V, See Figure 1		-50			μA
I _{CC}	Supply current	V _{SENSE} = 15 V, $\overline{\text{RESIN}} \geq 2$ V		1.8	3		mA
		V _{CC} = 18 V, T _A = full range‡		3.5			mA

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

‡ Full range for the C-suffix device is 0°C to 70°C, full range for the I-suffix device is -40°C to 85°C, and full range for the Q-suffix device is -40°C to 125°C.

§ This is the lowest voltage at which $\overline{\text{RESET}}$ becomes active.

switching characteristics, V_{CC} = 5 V, CT open, T_A = 25°C

PARAMETER		FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	TL77xxBC TL77xxBI TL77xxBQ			UNIT
					MIN	TYP	MAX	
t _{PLH}	Propagation delay time from low- to high-level output	$\overline{\text{RESIN}}$	RESET	See Figures 1, 2, and 3	270	500	ns	
t _{PHL}	Propagation delay time from high- to low-level output	$\overline{\text{RESIN}}$	$\overline{\text{RESET}}$		270	500		
t _w	Effective pulse duration	$\overline{\text{RESIN}}$		See Figure 2	150		ns	
		SENSE			100			
t _r	Rise time		RESET	See Figures 1 and 3	75		ns	
t _f	Fall time				150 200			
t _r	Rise time		$\overline{\text{RESET}}$		75	150	ns	
t _f	Fall time				50			



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electrical characteristics over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS†		TL7702BM TL7705BM			UNIT
				MIN	TYP	MAX	
V _{OH}	High-level output voltage, RESET	I _{OH} = -16 mA		V _{CC} -1.5			V
V _{OL}	Low-level output voltage, RESET	I _{OL} = 16 mA		0.4			V
V _{ref}	Reference voltage	I _{ref} = 500 μA,	T _A = 25°C	2.48	2.53	2.58	V
V _{IT-}	Negative-going input threshold voltage at SENSE input	TL7702B	T _A = 25°C	2.505	2.53	2.555	V
		TL7705B		4.5	4.55	4.6	
		TL7702B	T _A = full range‡	2.48	2.53	2.58	
		TL7705B		4.45	4.55	4.65	
V _{hys}	Hysteresis, SENSE (V _{IT+} - V _{IT-})	TL7702B	V _{CC} = 3.6 V to 18 V, T _A = 25°C	10			mV
		TL7705B		30			
V _{res} §	Power-up reset voltage	I _{OL} at RESET = 2 mA, T _A = 25°C		1			V
I _I	Input current	RESIN	V _I = 0.4 V to V _{CC}		-10		μA
		SENSE	TL7702B	V _I = V _{ref} to V _{CC} - 1.5 V		-0.1	
I _{OH}	High-level output current, RESET	V _O = 18 V		50			μA
I _{OL}	Low-level output current, RESET	V _O = 0		-50			μA
I _{CC}	Supply current	V _{SENSE} = 15 V, RESIN ≥ 2 V		1.8		3	mA
		V _{CC} = 18 V, T _A = full range‡				4	

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

‡ Full range for the M-suffix device is -55°C to 125°C.

§ This is the lowest value at which RESET becomes active.

switching characteristics, V_{CC} = 5 V, CT open, T_A = 25°C

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	TL7702BM TL7705BM			UNIT
				MIN	TYP	MAX	
t _{PLH}	RESIN	RESET	See Figures 1, 2, and 3	270	500*	ns	
t _{PHL}	RESIN	RESET		270	500*		
t _w	RESIN		See Figure 2	150		ns	
	SENSE			100			
t _r		RESET	See Figures 1 and 3	75*		ns	
t _f				150			200*
t _r		RESET		75		150*	ns
t _f						50*	

* On products compliant to MIL-PRF-38535, these parameters are not production tested.



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electrical characteristics over recommended operating conditions, $T_A = 25^\circ\text{C}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS†	TL7702BY TL7705BY			UNIT
			MIN	TYP	MAX	
V_{OH}	High-level output voltage, $\overline{\text{RESET}}$	$I_{OH} = -16\text{ mA}$	$V_{CC} - 1.5$			V
V_{OL}	Low-level output voltage, $\overline{\text{RESET}}$	$I_{OL} = 16\text{ mA}$	0.4			V
V_{ref}	Reference voltage	$I_{ref} = 500\ \mu\text{A}$	2.48	2.53	2.58	V
V_{IT-}	Negative-going input threshold voltage at SENSE input	TL7702BY	2.505	2.53	2.555	V
		TL7705BY	4.5	4.55	4.6	
V_{hys}	Hysteresis, SENSE ($V_{IT+} - V_{IT-}$)	TL7702BY	10			mV
		TL7705BY	30			
V_{res}^\ddagger	Power-up reset voltage	I_{OL} at $\overline{\text{RESET}} = 2\text{ mA}$	1			V
I_I	Input current	$\overline{\text{RESIN}}$	$V_I = 0.4\text{ V to }V_{CC}$			μA
		SENSE	TL7702BY	$V_I = V_{ref}$ to 18 V		
I_{OH}	High-level output current, $\overline{\text{RESET}}$	$V_O = 18\text{ V}$, See Figure 1	50			μA
I_{OL}	Low-level output current, $\overline{\text{RESET}}$	$V_O = 0\text{ V}$, See Figure 1	-50			μA
I_{CC}	Supply current	$V_{SENSE} = 15\text{ V}$, $\overline{\text{RESIN}} \geq 2\text{ V}$	1.8	3		mA

† All electrical characteristics are measured with $0.1\text{-}\mu\text{F}$ capacitors connected at REF, CT, and V_{CC} to GND.

‡ This is the lowest voltage at which $\overline{\text{RESET}}$ becomes active.

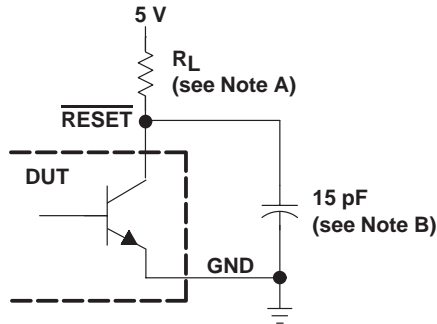
switching characteristics, $V_{CC} = 5\text{ V}$, CT open, $T_A = 25^\circ\text{C}$

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	TL7702BY TL7705BY			UNIT
				MIN	TYP	MAX	
t_{PLH}	$\overline{\text{RESIN}}$	RESET	See Figures 1, 2, and 3	270	500	ns	
t_{PHL}	$\overline{\text{RESIN}}$	$\overline{\text{RESET}}$		270	500		
t_w	$\overline{\text{RESIN}}$		See Figure 2	150		ns	
	SENSE			100			
t_r		RESET	See Figures 1 and 3	75		ns	
t_f				150	200		
t_r		$\overline{\text{RESET}}$		75	150	ns	
t_f				50			

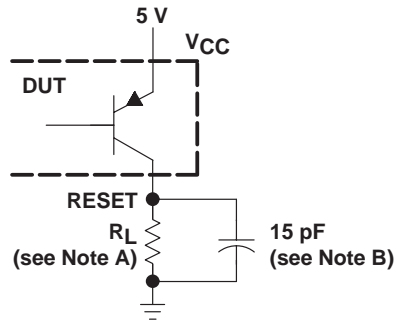
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PARAMETER MEASUREMENT INFORMATION



$\overline{\text{RESET}}$ OUTPUT CONFIGURATION



RESET OUTPUT CONFIGURATION

NOTES: A. For I_{OL} and I_{OH} , $R_L = 10 \text{ k}\Omega$. For all switching characteristics, $R_L = 511 \Omega$.
B. This figure includes jig and probe capacitance.

Figure 1. RESET and $\overline{\text{RESET}}$ Output Configurations



WAVEFORMS

Figure 2. Input Pulse Definition

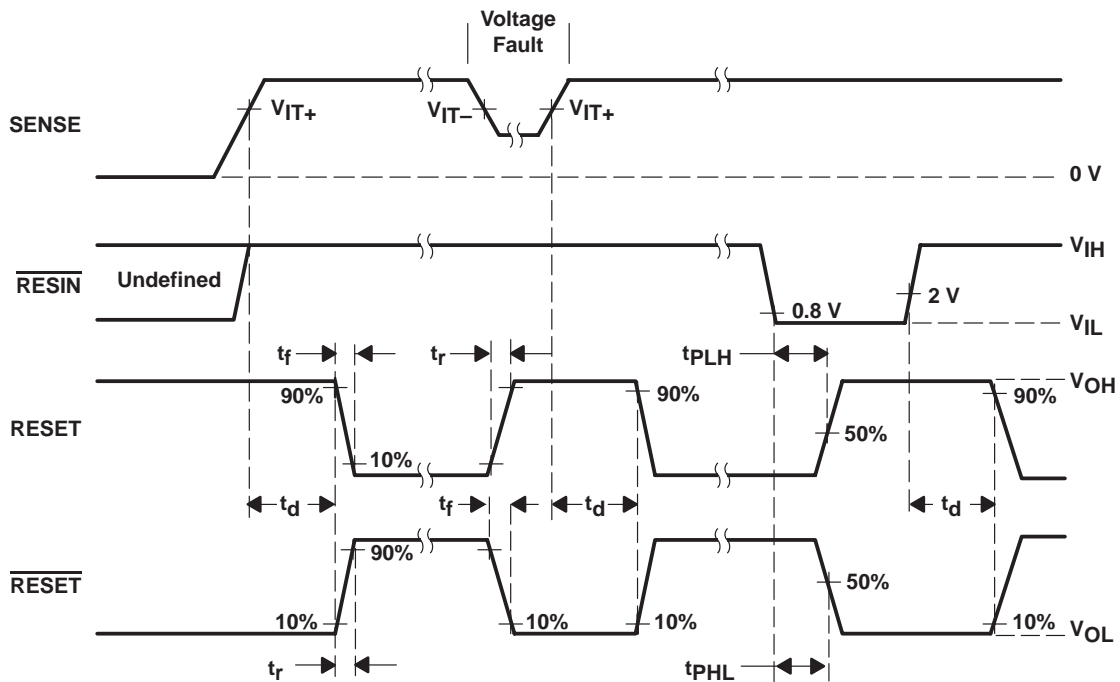
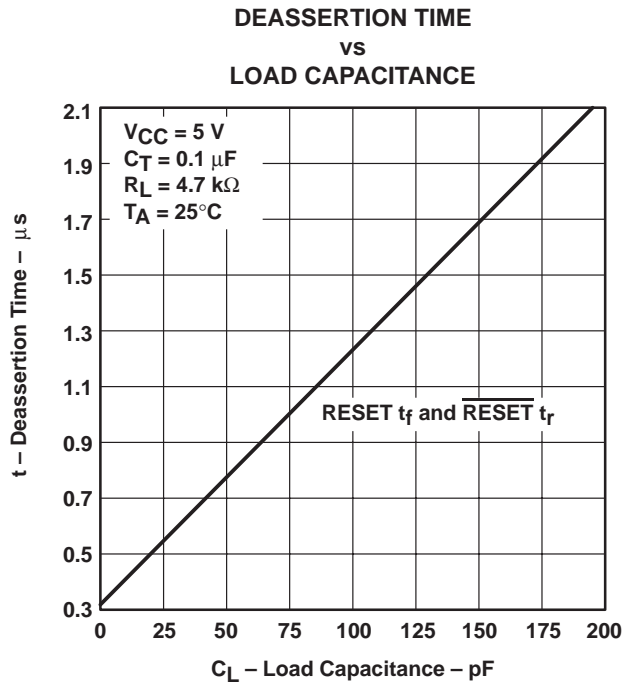
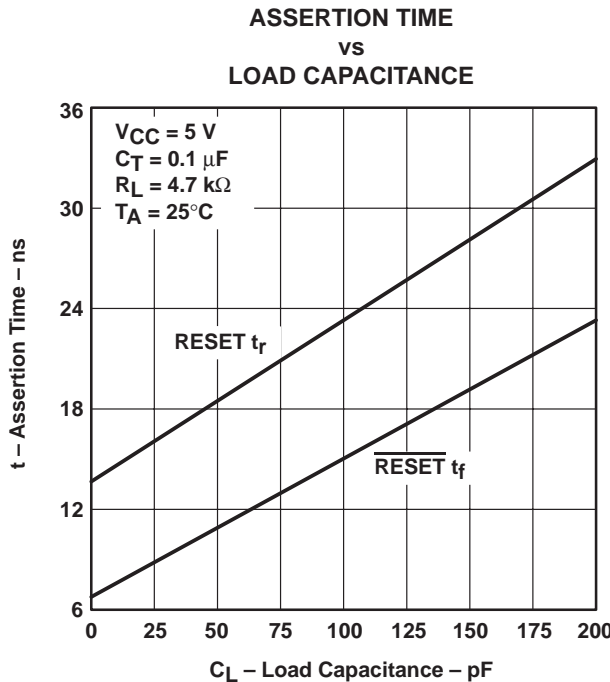
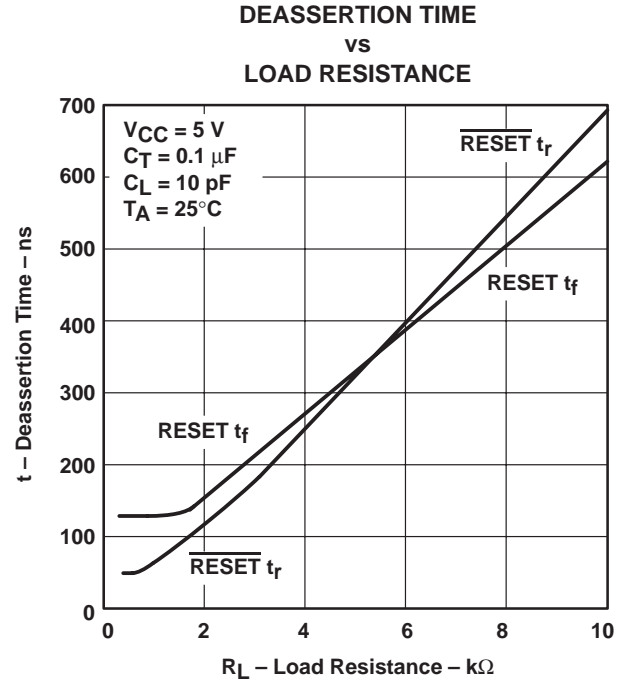
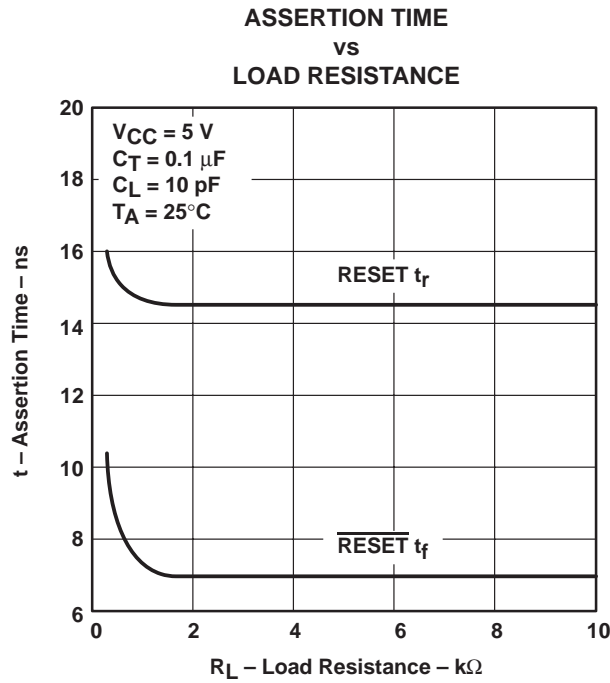


Figure 3. Voltage Waveforms

TYPICAL CHARACTERISTICS†



† 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.

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APPLICATION INFORMATION

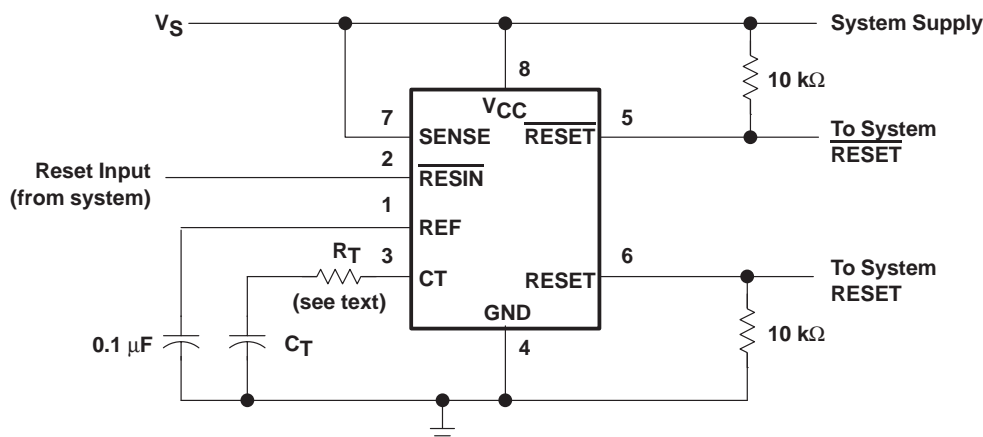


Figure 8. System Reset Controller With Undervoltage Sensing

When the TL770xB SENSE terminal is used to monitor V_{CC} , a current-limiting resistor in series with C_T is recommended. During normal operation, the timing capacitor is charged by the on-board current source to approximately V_{CC} or an internal voltage clamp (≈ 7.1 -V zener), whichever is less. When the circuit is then subjected to an undervoltage condition during which V_{CC} is rapidly slewed down, the voltage on CT exceeds that on V_{CC} . This forward biases a secondary path internally, which falsely activates the outputs. A fault is indicated when V_{CC} drops below $V_{(CT)}$, not when V_{SENSE} falls below V_{T-} .

Texas Instruments performs a 100% electrical screen to verify that the outputs do not switch with 1 mA forced into the CT terminal. Adding the external resistor, R_T , prevents false triggering. Its value is calculated as follows:

$$\frac{V_{(CT)} - V_{T-}}{R_T}$$

Where:

$$V_{(CT)} = V_{CC} \text{ or } 7.1 \text{ V, whichever is less}$$

$$V_{T-} = 4.55 \text{ V (nom)}$$

$$R_T = \text{value of series resistor required}$$

For $V_{CC} = 5 \text{ V}$:

$$\frac{5 - 4.55}{R_T} < 1 \text{ mA}$$

Therefore,

$$R_T > 450 \ \Omega$$

Using a 20% tolerance resistor, R_T should be greater than 560 Ω .

Adding this series resistor changes the duration of the reset pulse by no more than 10%. R_T extends the discharge of C_T , but also skews the $V_{(CT)}$ threshold. These effects tend to cancel one another. The precise percentage change can be derived theoretically, but the equation is complicated by this interaction and is dependent upon the duration of the supply-voltage fault condition.

Both outputs of the TL770xB should be terminated with similar value resistors, even when only one is being used. This prevents unwanted plateauing in either output waveform during switching, which may be interpreted as an undefined state or delay system reset.

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