

# TL7702A, TL7705A, TL7709A, TL7712A, TL7715A TL7702AY, TL7705AY, TL7709AY, TL7712AY, TL7715AY SUPPLY VOLTAGE SUPERVISORS

SLVS028C – APRIL 1983 – REVISED AUGUST 1995

- 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

## description

The TL77xxA family of monolithic integrated circuit supply voltage supervisors are specifically designed for use as reset controllers in micro-computer 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, 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  $C_T$ :  $t_d = 1.3 \times 10^4 \times C_T$ , where  $C_T$  is in farads (F) and  $t_d$  is in seconds (s).

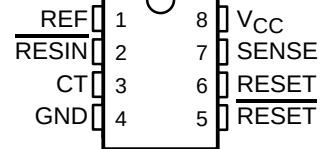
During power down (assuming that SENSE is below  $V_{IT-}$ ), the outputs remain active until the  $V_{CC}$  falls below a maximum of 2 V. After this, the outputs are undefined.

An external capacitor (typically 0.1  $\mu\text{F}$  for the TL77xxAC and TL77xxAI and typically 0.02  $\mu\text{F}$  for the TL77xxAM) must be connected to REF to reduce the influence of fast transients in the supply voltage.

The TL77xxAC series are characterized for operation from 0°C to 70°C. The TL77xxAI series are characterized for operation from –40°C to 85°C. The TL7702AM and TL7705AM are characterized for operation over the full military range of –55°C to 125°C.

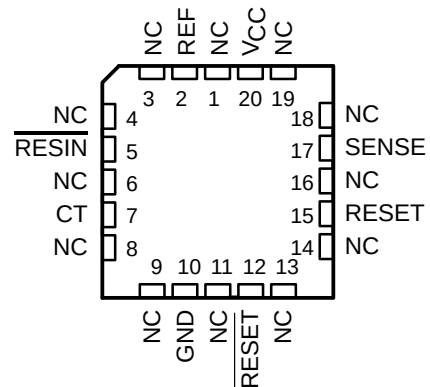
D, JG, OR P PACKAGE

(TOP VIEW)



FK PACKAGE

(TOP VIEW)



NC – No internal connection

## AVAILABLE OPTIONS

| T <sub>A</sub> | PACKAGED DEVICES      |                          |                          |                       | CHIP FORM (Y)         |
|----------------|-----------------------|--------------------------|--------------------------|-----------------------|-----------------------|
|                | SMALL OUTLINE (D)     | CHIP CARRIER (FK)        | CERAMIC DIP (JG)         | PLASTIC DIP (P)       |                       |
| 0°C to 70°C    | TL7702ACD – TL7715ACD |                          |                          | TL7702ACP – TL7715ACP | TL7702ACY – TL7715ACY |
| –40°C to 85°C  | TL7702AID – TL7715AID |                          |                          | TL7702AIP – TL7715AIP |                       |
| –55°C to 125°C |                       | TL7702AMFK<br>TL7705AMFK | TL7702AMJG<br>TL7705AMJG |                       |                       |

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.



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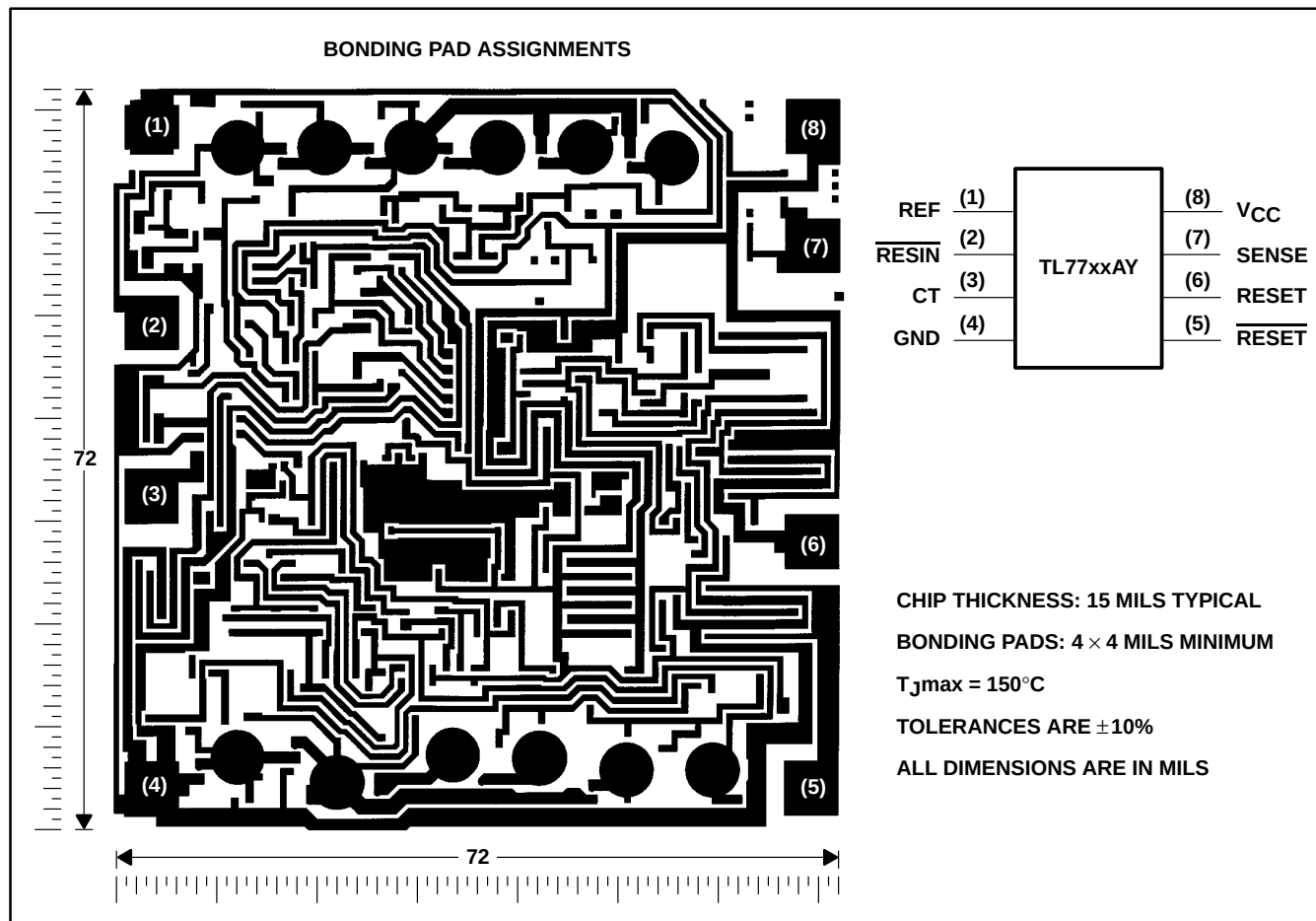
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On products compliant to MIL-STD-883, Class B, all parameters are tested unless otherwise noted. On all other products, production processing does not necessarily include testing of all parameters.

TL7702A, TL7705A, TL7709A, TL7712A, TL7715A  
 TL7702AY, TL7705AY, TL7709AY, TL7712AY, TL7715AY  
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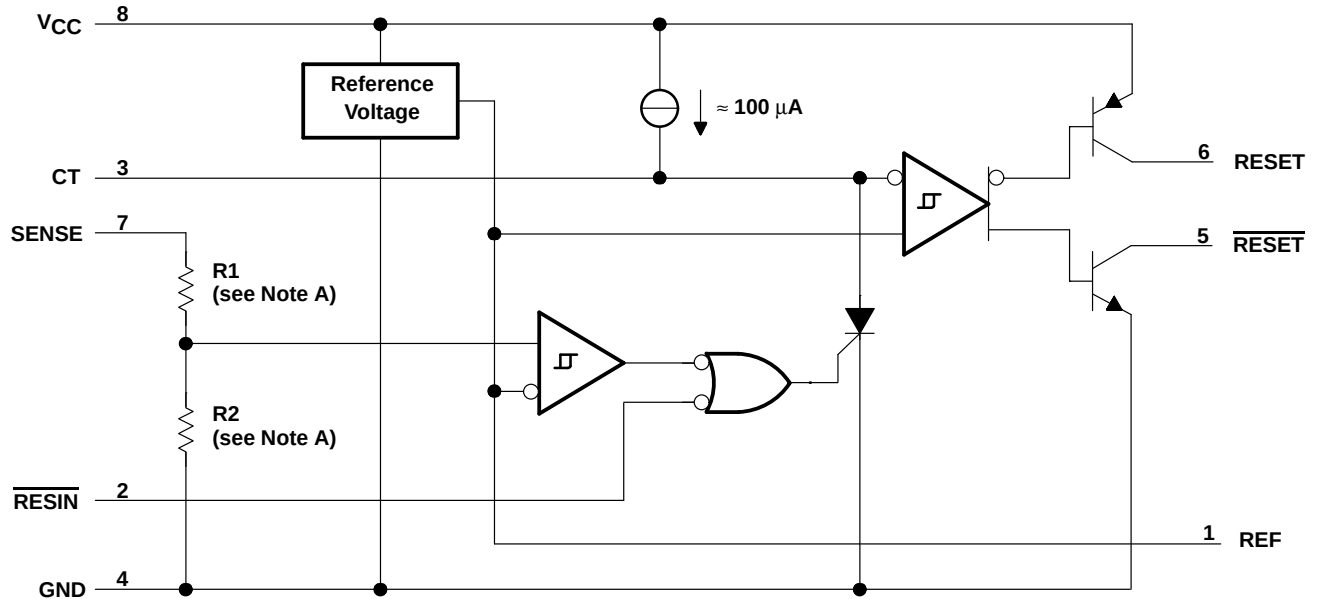
**TL77xxAY chip information**

This chip, when properly assembled, displays characteristics similar to the TL77xxAC. Thermal compression or ultrasonic bonding may be used on the doped aluminum bonding pads. The chips may be mounted with conductive epoxy or a gold-silicon preform.



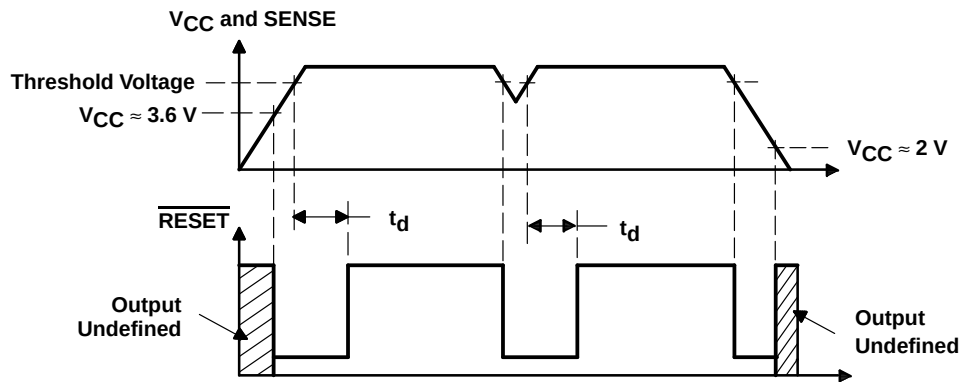
## functional block diagram

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.



- NOTES: A. TL7702A: R1 = 0 Ω, R2 = open  
 TL7705A: R1 = 7.8 kΩ, R2 = 10 kΩ  
 TL7709A: R1 = 19.7 kΩ, R2 = 10 kΩ  
 TL7712A: R1 = 32.7 kΩ, R2 = 10 kΩ  
 TL7715A: R1 = 43.4 kΩ, R2 = 10 kΩ  
 B. Terminal numbers shown are for the D, JG, or P package.  
 C. Resistor values shown are nominal.

## timing diagram



**TL7702A, TL7705A, TL7709A, TL7712A, TL7715A**  
**TL7702AY, TL7705AY, TL7709AY, TL7712AY, TL7715AY**  
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**absolute maximum ratings over operating free-air temperature (unless otherwise noted)<sup>†</sup>**

|                                                                              |                              |
|------------------------------------------------------------------------------|------------------------------|
| 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, $I_{OH}$ , RESET                                  | –30 mA                       |
| Low-level output current, $I_{OL}$ , RESET                                   | 30 mA                        |
| Continuous total power dissipation                                           | See Dissipation Rating Table |
| Operating free-air temperature range, $T_A$ : TL77xxAC                       | 0°C to 70°C                  |
| TL77xxAI                                                                     | –40°C to 85°C                |
| TL7702AM, TL7705AM                                                           | –55°C to 125°C               |
| 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 10 seconds: D or P package | 260°C                        |
| Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG package     | 300°C                        |

<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.

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

**DISSIPATION RATING TABLE**

| PACKAGE | $T_A \leq 25^\circ\text{C}$<br>POWER RATING | DERATING FACTOR<br>ABOVE $T_A = 25^\circ\text{C}$ | $T_A = 70^\circ\text{C}$<br>POWER RATING | $T_A = 85^\circ\text{C}$<br>POWER RATING | $T_A = 125^\circ\text{C}$<br>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                                    |

**recommended operating conditions**

|                                                           |                    | TL77xxAC, TL77xxAI |            | TL77xxAM |            | UNIT |
|-----------------------------------------------------------|--------------------|--------------------|------------|----------|------------|------|
|                                                           |                    | MIN                | MAX        | MIN      | MAX        |      |
| Supply voltage, $V_{CC}$                                  |                    | 3.5                | 18         | 3.6      | 10         | V    |
| High-level input voltage at $\overline{RESIN}$ , $V_{IH}$ |                    | 2                  |            | 2        |            | V    |
| Low-level input voltage at $\overline{RESIN}$ , $V_{IL}$  |                    |                    | 0.6        |          | 0.6        | V    |
| Input voltage, SENSE, $V_I$                               | TL7702A            | 0                  | See Note 2 | 0        | See Note 2 | V    |
|                                                           | TL7705A            | 0                  | 10         | 0        | 10         |      |
|                                                           | TL7709A            | 0                  | 15         |          |            |      |
|                                                           | TL7712A            | 0                  | 20         |          |            |      |
|                                                           | TL7715A            | 0                  | 20         |          |            |      |
| High-level output current, RESET, $I_{OH}$                |                    |                    | –16        |          | –16        | mA   |
| Low-level output current, $\overline{RESET}$ , $I_{OL}$   |                    |                    | 16         |          | 16         | mA   |
| Timing capacitor, $C_T$                                   |                    |                    | 10         |          | 10         | μF   |
| Operating free-air temperature range, $T_A$               | TL77xxAC           | 0                  | 70         |          |            | °C   |
|                                                           | TL77xxAI           | –40                | 85         |          |            |      |
|                                                           | TL7702AM, TL7705AM |                    |            | –55      | 125        |      |

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.



**TL7702A, TL7705A, TL7709A, TL7712A, TL7715A**  
**TL7702AY, TL7705AY, TL7709AY, TL7712AY, TL7715AY**  
**SUPPLY VOLTAGE SUPERVISORS**  
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**electrical characteristics over recommended operating conditions (unless otherwise noted)**

| PARAMETER        |                                                          |         | TEST CONDITIONS†                                            | TL77xxAC, TL77xxAI   |      |      | UNIT |
|------------------|----------------------------------------------------------|---------|-------------------------------------------------------------|----------------------|------|------|------|
|                  |                                                          |         |                                                             | MIN                  | TYP  | MAX  |      |
| V <sub>OH</sub>  | High-level output voltage, $\overline{\text{RESET}}$     |         | I <sub>OH</sub> = –16 mA                                    | V <sub>CC</sub> –1.5 |      |      | V    |
| V <sub>OL</sub>  | Low-level output voltage, $\overline{\text{RESET}}$      |         | I <sub>OL</sub> = 16 mA                                     | 0.4                  |      |      | V    |
| V <sub>ref</sub> | Reference voltage                                        |         | T <sub>A</sub> = 25°C                                       | 2.48                 | 2.53 | 2.58 | V    |
| V <sub>IT–</sub> | Negative-going input threshold voltage, SENSE            | TL7702A | T <sub>A</sub> = 25°C                                       | 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 <sub>hys</sub> | Hysteresis, SENSE (V <sub>IT+</sub> – V <sub>IT–</sub> ) | TL7702A | T <sub>A</sub> = 25°C                                       | 10                   |      |      | mV   |
|                  |                                                          | TL7705A |                                                             | 15                   |      |      |      |
|                  |                                                          | TL7709A |                                                             | 20                   |      |      |      |
|                  |                                                          | TL7712A |                                                             | 35                   |      |      |      |
|                  |                                                          | TL7715A |                                                             | 45                   |      |      |      |
| I <sub>I</sub>   | Input current, $\overline{\text{RESIN}}$                 |         | V <sub>I</sub> = 2.4 V to V <sub>CC</sub>                   | 20                   |      |      | μA   |
|                  |                                                          |         | V <sub>I</sub> = 0.4 V                                      | –100                 |      |      |      |
| I <sub>I</sub>   | Input current, SENSE                                     | TL7702A | V <sub>ref</sub> < V <sub>I</sub> < V <sub>CC</sub> – 1.5 V | 0.5      2           |      |      | μA   |
| I <sub>OH</sub>  | High-level output current, $\overline{\text{RESET}}$     |         | V <sub>O</sub> = 18 V                                       | 50                   |      |      | μA   |
| I <sub>OL</sub>  | Low-level output current, RESET                          |         | V <sub>O</sub> = 0                                          | –50                  |      |      | μA   |
| I <sub>CC</sub>  | 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<sub>CC</sub> to GND.

**switching characteristics over recommended operating conditions (unless otherwise noted)**

| PARAMETER                                         |                                                                                    | TEST CONDITIONS‡                                                                            | TL77xxAC, TL77xxAI |     |     | UNIT |    |
|---------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------|-----|-----|------|----|
|                                                   |                                                                                    |                                                                                             | MIN                | TYP | MAX |      |    |
| Output pulse duration                             |                                                                                    | C <sub>T</sub> = 0.1 μF                                                                     | 0.65               | 1.2 | 2.6 | μs   |    |
| Input pulse duration at $\overline{\text{RESIN}}$ |                                                                                    |                                                                                             | 0.4                |     |     | μs   |    |
| t <sub>w(S)</sub>                                 | Pulse duration at SENSE input to switch outputs                                    | V <sub>IH</sub> = V <sub>IT−</sub> + 200 mV,<br>V <sub>IL</sub> = V <sub>IT−</sub> − 200 mV | 2                  |     |     | μs   |    |
| t <sub>pd</sub>                                   | Propagation delay time from $\overline{\text{RESIN}}$ to $\overline{\text{RESET}}$ | V <sub>CC</sub> = 5 V                                                                       | 1                  |     |     | μs   |    |
| t <sub>r</sub>                                    | RESET                                                                              | V <sub>CC</sub> = 5 V, See Note 3                                                           | 0.2                |     |     | μs   |    |
|                                                   | $\overline{\text{RESET}}$                                                          |                                                                                             | 3.5                |     |     |      |    |
| t <sub>f</sub>                                    | RESET                                                                              |                                                                                             |                    | 3.5 |     |      | μs |
|                                                   | $\overline{\text{RESET}}$                                                          |                                                                                             |                    | 0.2 |     |      |    |

‡ All switching characteristics are measured with 0.1-μF capacitors connected at REF and V<sub>CC</sub> to GND.

NOTE 3: The rise and fall times are measured with a 4.7-kΩ load resistor at RESET and RESET.

**TL7702A, TL7705A, TL7709A, TL7712A, TL7715A**  
**TL7702AY, TL7705AY, TL7709AY, TL7712AY, TL7715AY**  
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**electrical characteristics over recommended operating conditions (unless otherwise noted)**

| PARAMETER        |                                                         |          | TEST CONDITIONS†                                            | TL7702AM, TL7705AM   |      |      | UNIT |
|------------------|---------------------------------------------------------|----------|-------------------------------------------------------------|----------------------|------|------|------|
|                  |                                                         |          |                                                             | MIN                  | TYP  | MAX  |      |
| V <sub>OH</sub>  | High-level output voltage, <u>RESET</u>                 |          | I <sub>OH</sub> = −16 mA                                    | V <sub>CC</sub> −1.5 |      |      | V    |
| V <sub>OL</sub>  | Low-level output voltage, <u>RESET</u>                  |          | I <sub>OL</sub> = 16 mA                                     | 0.4                  |      |      | V    |
| V <sub>ref</sub> | Reference voltage                                       |          |                                                             | 2.38                 | 2.53 | 2.63 | V    |
| V <sub>IT−</sub> | Negative-going input threshold voltage, SENSE           | TL7702AM | V <sub>CC</sub> = 3.6 V to 10 V                             | 2.38                 | 2.53 | 2.63 | V    |
|                  |                                                         | TL7705AM |                                                             | 4.25                 | 4.55 | 4.7  |      |
| V <sub>hys</sub> | Hysteresis SENSE (V <sub>IT+</sub> − V <sub>IT−</sub> ) | TL7702AM | V <sub>CC</sub> = 3.6 V to 10 V                             | 10                   |      |      | mV   |
|                  |                                                         | TL7705AM |                                                             | 15                   |      |      |      |
| I <sub>I</sub>   | Input current, <u>RESIN</u>                             |          | V <sub>I</sub> = 2.4 V to V <sub>CC</sub>                   | 20                   |      |      | μA   |
|                  |                                                         |          | V <sub>I</sub> = 0.4 V                                      | −100                 |      |      |      |
| I <sub>I</sub>   | Input current, SENSE                                    | TL7702AM | V <sub>ref</sub> < V <sub>I</sub> < V <sub>CC</sub> − 1.5 V | 0.5                  |      | 2    | μA   |
| I <sub>OH</sub>  | High-level output current, <u>RESET</u>                 |          | V <sub>O</sub> = 10 V                                       | 50                   |      |      | μA   |
| I <sub>OL</sub>  | Low-level output current, <u>RESET</u>                  |          | V <sub>O</sub> = 0                                          | −50                  |      |      | μA   |
| I <sub>CC</sub>  | Supply current                                          |          | All inputs and outputs open                                 | 1.8                  |      | 3    | mA   |

† All electrical characteristics are measured with 0.02-μF capacitors connected at REF, CT, and V<sub>CC</sub> to GND.

**switching characteristics over recommended operating conditions (unless otherwise noted)**

| PARAMETER          |                                                                                | TEST CONDITIONS‡                                                                            | TL7702AM, TL7705AM |     |     | UNIT |
|--------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------|-----|-----|------|
|                    |                                                                                |                                                                                             | MIN                | TYP | MAX |      |
| t <sub>w</sub> (S) | Pulse duration at SENSE input to switch outputs                                | V <sub>IH</sub> = V <sub>IT–</sub> + 200 mV,<br>V <sub>IL</sub> = V <sub>IT–</sub> – 200 mV | 2*                 |     |     | μs   |
| t <sub>pd</sub>    | Propagation delay time, $\overline{\text{RESIN}}$ to $\overline{\text{RESET}}$ | V <sub>CC</sub> = 5 V                                                                       | 1.5                |     |     | μs   |
| t <sub>r</sub>     | RESET                                                                          | V <sub>CC</sub> = 5 V,            See Note 3                                                | 0.2*               |     |     | μs   |
|                    | $\overline{\text{RESET}}$                                                      |                                                                                             | 3.5*               |     |     |      |
| t <sub>f</sub>     | RESET                                                                          |                                                                                             | 3.5*               |     |     | μs   |
|                    | $\overline{\text{RESET}}$                                                      |                                                                                             | 0.2*               |     |     |      |

\* On products compliant to MIL-STD-883, Class B, this parameter is not production tested.

‡ All switching characteristics are measured with 0.02-μF capacitors connected at REF and V<sub>CC</sub> to GND.

NOTE 3: The rise and fall times are measured with a 4.7-kΩ load resistor at RESET and RESET.

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

| PARAMETER        |                                                         | TEST CONDITIONS <sup>†</sup> | TL77xxAY                                                       |      |     | UNIT          |
|------------------|---------------------------------------------------------|------------------------------|----------------------------------------------------------------|------|-----|---------------|
|                  |                                                         |                              | MIN                                                            | TYP  | MAX |               |
| $V_{\text{ref}}$ | Reference voltage                                       |                              |                                                                | 2.53 |     | V             |
| $V_{\text{IT-}}$ | Negative-going input threshold voltage, SENSE           | TL7702A                      |                                                                | 2.53 |     | V             |
|                  |                                                         | TL7705A                      |                                                                | 4.55 |     |               |
|                  |                                                         | TL7709A                      |                                                                | 7.6  |     |               |
|                  |                                                         | TL7712A                      |                                                                | 10.8 |     |               |
|                  |                                                         | TL7715A                      |                                                                | 13.5 |     |               |
| $V_{\text{hys}}$ | Hysteresis, SENSE ( $V_{\text{IT+}} - V_{\text{IT-}}$ ) | TL7702A                      |                                                                | 10   |     | mV            |
|                  |                                                         | TL7705A                      |                                                                | 15   |     |               |
|                  |                                                         | TL7709A                      |                                                                | 20   |     |               |
|                  |                                                         | TL7712A                      |                                                                | 35   |     |               |
|                  |                                                         | TL7715A                      |                                                                | 45   |     |               |
| $I_{\text{I}}$   | Input current, SENSE                                    | TL7702A                      | $V_{\text{ref}} < V_{\text{I}} < V_{\text{CC}} - 1.5\text{ V}$ |      |     | $\mu\text{A}$ |
| $I_{\text{CC}}$  | Supply current                                          | All inputs and outputs open  |                                                                |      | 1.8 | mA            |

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

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

| PARAMETER             | TEST CONDITIONS <sup>‡</sup> | TL77xxAY |     |     | UNIT          |
|-----------------------|------------------------------|----------|-----|-----|---------------|
|                       |                              | MIN      | TYP | MAX |               |
| Output pulse duration | $C_T = 0.1\ \mu\text{F}$     |          | 1.2 |     | $\mu\text{s}$ |

<sup>‡</sup> All switching characteristics are measured with 0.1- $\mu\text{F}$  capacitors connected at REF and  $V_{\text{CC}}$  to GND.

## PARAMETER MEASUREMENT INFORMATION

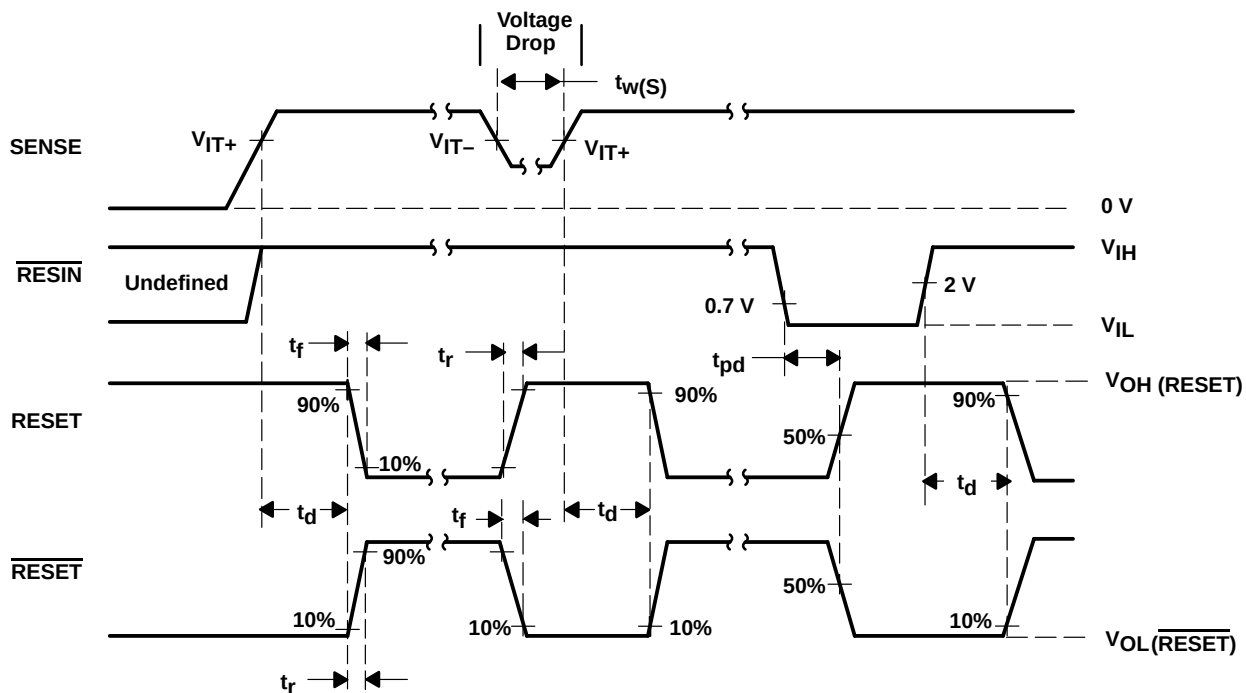
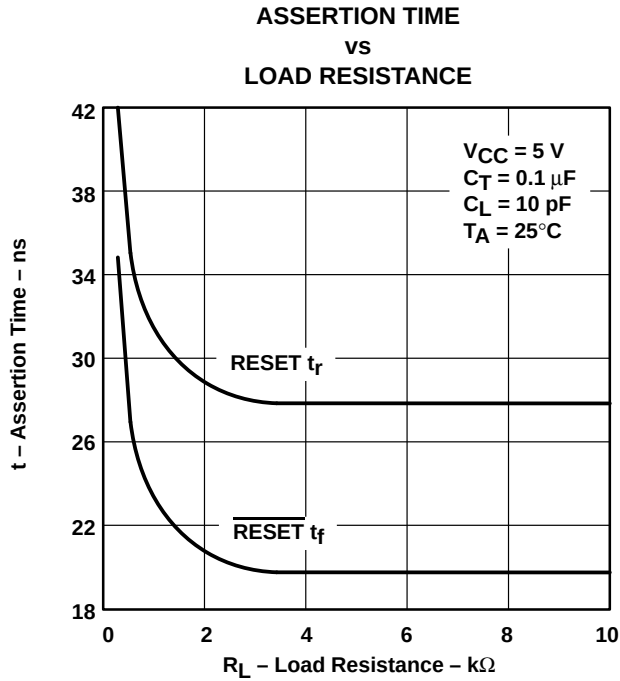


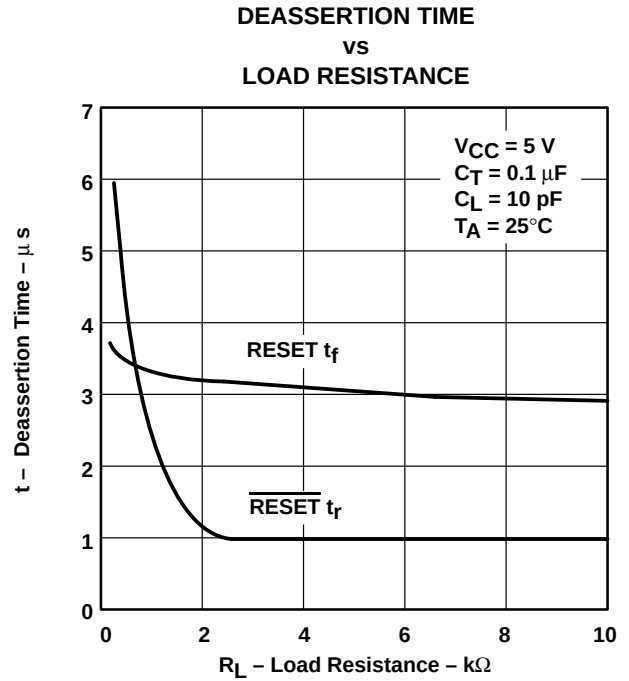
Figure 1. Voltage Waveforms



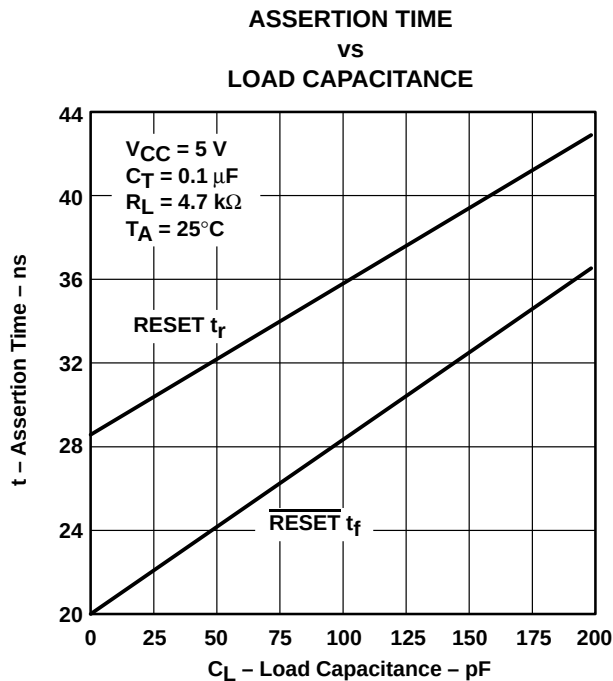
**TYPICAL CHARACTERISTICS†**



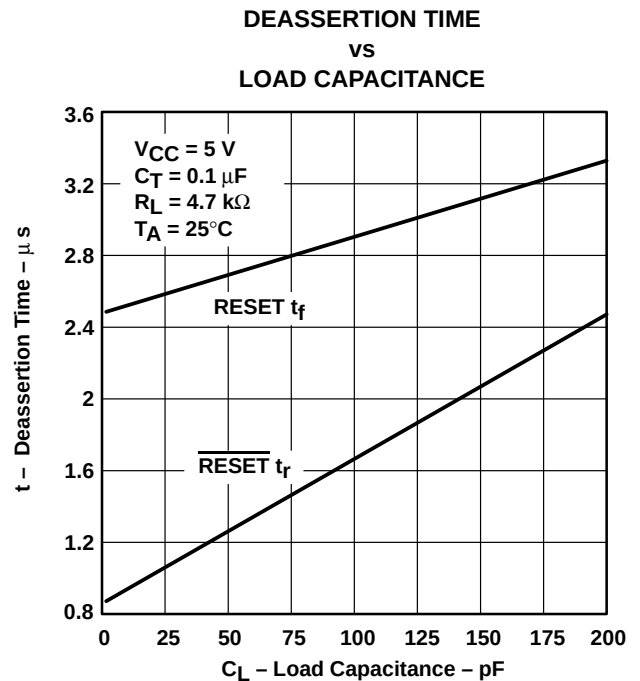
**Figure 2**



**Figure 3**



**Figure 4**



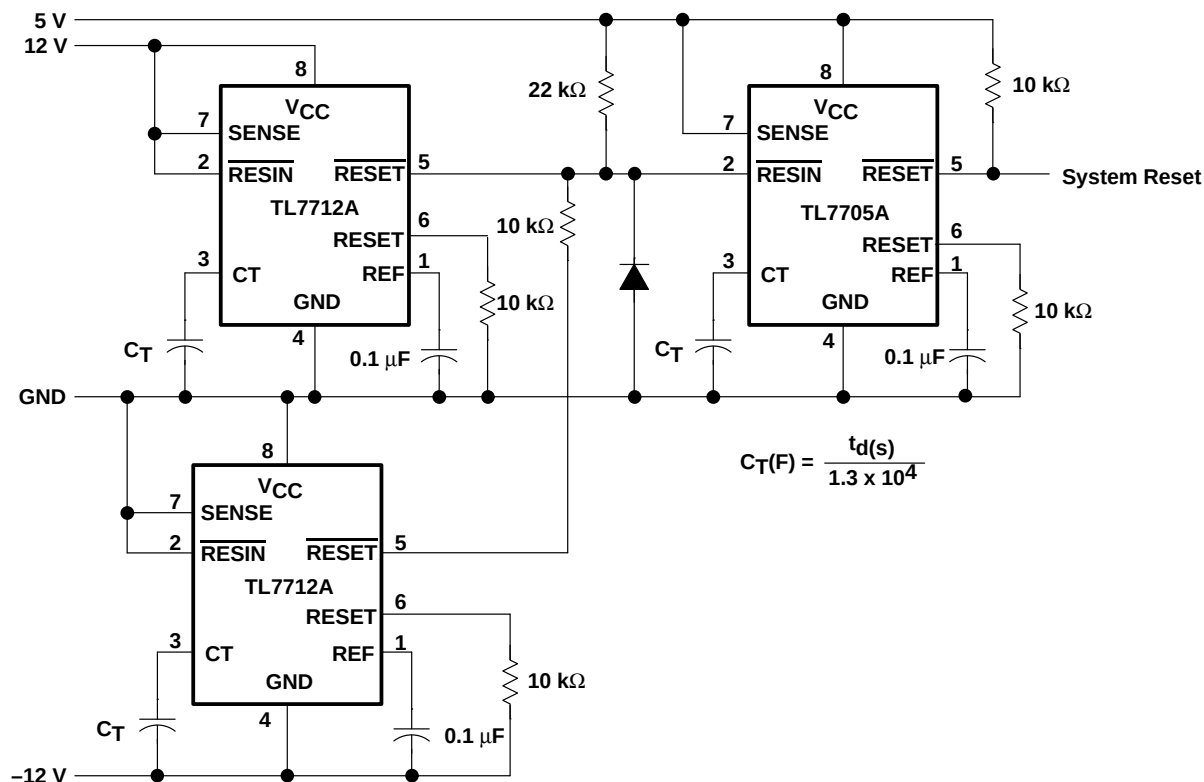
**Figure 5**

† 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.

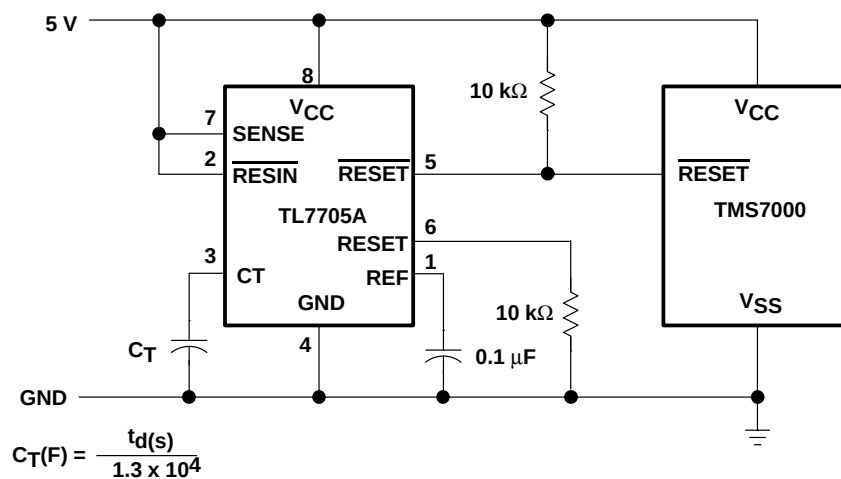
TL7702A, TL7705A, TL7709A, TL7712A, TL7715A  
 TL7702AY, TL7705AY, TL7709AY, TL7712AY, TL7715AY  
**SUPPLY VOLTAGE SUPERVISORS**

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**APPLICATION INFORMATION**



**Figure 6. Multiple Power Supply System Reset Generation**



**Figure 7. Reset Controller for TMS7000 System**

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

## APPLICATION INFORMATION

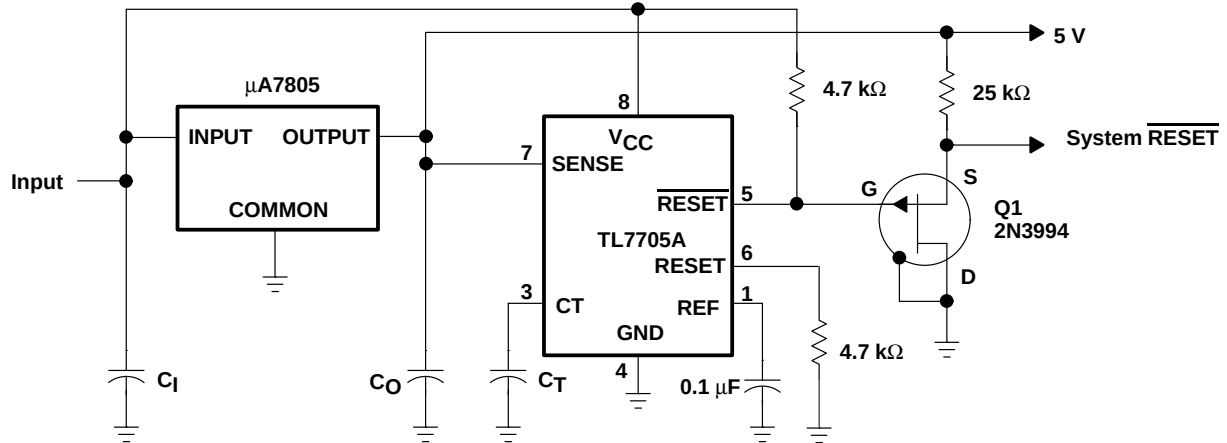


Figure 8. Eliminating Undefined States Using a P-Channel JFET

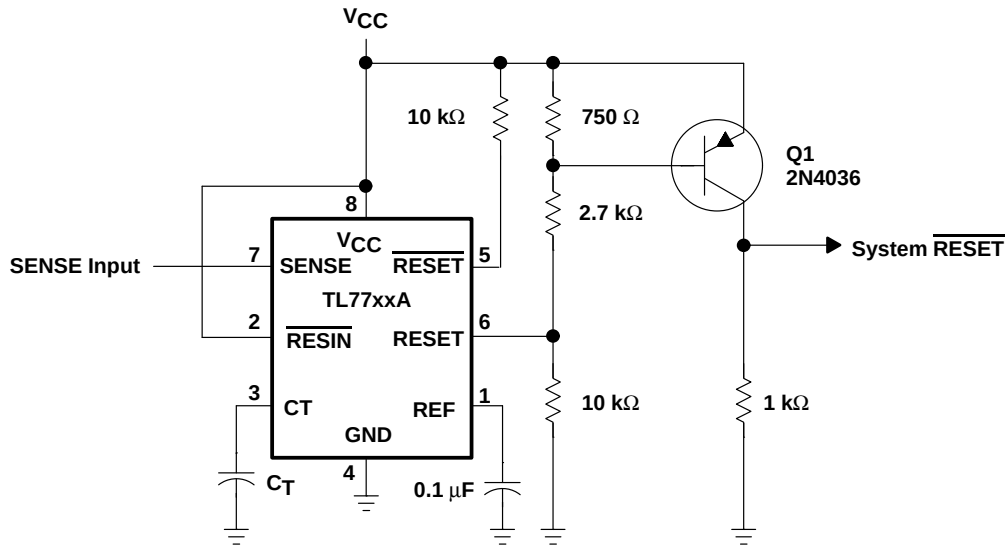


Figure 9. Eliminating Undefined States Using a pnp Transistor

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



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