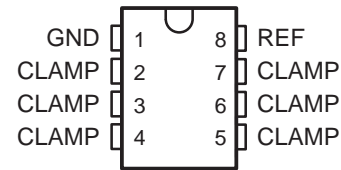


- Protects Against Latch-Up
- 25-mA Current Sink in Active State
- Less Than 1-mW Dissipation in Standby Condition
- Ideal for Applications in Environments Where Large Transient Spikes Occur
- Stable Operation for All Values of Capacitive Load
- No Output Overshoot

D OR P PACKAGE
(TOP VIEW)



description

The TL7726 consists of six identical clamping circuits that monitor an input voltage with respect to a reference value, REF. For an input voltage (V_I) in the range of GND to $< REF$, the clamping circuits present a very high impedance to ground, drawing current of less than 10 μA . The clamping circuits are active for $V_I < GND$ or $V_I > REF$ when they have a very low impedance and can sink up to 25 mA.

These characteristics make the TL7726 ideal as protection devices for CMOS semiconductor devices in environments where there are large positive or negative transients to protect analog-to-digital converters in automotive or industrial systems. The use of clamping circuits provides a safeguard against potential latch-up.

The TL7726C is characterized for operation over the temperature range of 0°C to 70°C. The TL7726I is characterized for operation over the temperature range of -40°C to 85°C. The TL7726Q is characterized for operation over the temperature range of -40°C to 125°C.

AVAILABLE OPTIONS

| T_A | SOIC (D) | PLASTIC DIP (P) |
|----------------|----------|-----------------|
| 0°C to 70°C | TL7726CD | TL7726CP |
| -40°C to 85°C | TL7726ID | TL7726IP |
| -40°C to 125°C | TL7726QD | TL7726QP |

The D package is available taped and reeled. Add the suffix R to the device type (i.e., TL7726CDR).



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.

TL7726

HEX CLAMPING CIRCUITS

SLAS078C – SEPTEMBER 1993 – REVISED JULY 1999

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

| | |
|---|----------------|
| Reference voltage, V_{ref} | 6 V |
| Clamping current, I_{IK} | ±50 mA |
| Junction temperature, T_J | 150°C |
| Package thermal impedance, θ_{JA} (see Notes 1 and 2): D package | 97°C/W |
| P package | 127°C/W |
| 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. Maximum power dissipation is a function of $T_{J(max)}$, θ_{JA} , and T_A . The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} - T_A)/\theta_{JA}$. Operating at the absolute maximum T_J of 150°C can impact reliability.
2. The package thermal impedance is calculated in accordance with JEDEC 51, except for through-hole packages, which use a trace length of zero.

recommended operating conditions

| | | MIN | MAX | UNIT |
|---|--------------------|-----|-----|------|
| Reference voltage, V_{ref} | | 4.5 | 5.5 | V |
| Input clamping current, I_{IK} | $V_I \geq V_{ref}$ | 25 | | mA |
| | $V_I \leq GND$ | –25 | | |
| Operating free-air temperature range, T_A | TL7726C | 0 | 70 | °C |
| | TL7726I | –40 | 85 | |
| | TL7726Q | –40 | 125 | |

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

| PARAMETER | | TEST CONDITIONS | MIN | TYP‡ | MAX | UNIT |
|-----------|------------------------|---|-----------|------|-----------------|------|
| V_{IK+} | Positive clamp voltage | $I_I = 20$ mA | V_{ref} | | $V_{ref} + 200$ | mV |
| V_{IK-} | Negative clamp voltage | $I_I = 20$ mA | –200 | | 0 | mV |
| I_Z | Reference current | $V_{ref} = 5$ V | | 25 | 60 | µA |
| I_I | Input current | $V_{ref} - 50$ mV $\leq V_I \leq V_{ref}$ | | | 10 | µA |
| | | $GND \leq V_I \leq 50$ mV | –10 | | | |
| | | 50 mV $\leq V_I \leq V_{ref} - 50$ mV | –1 | | 1 | |

‡ All typical values are at $T_A = 25^\circ\text{C}$.

switching characteristics specified at $T_A = 25^\circ\text{C}$

| PARAMETER | | TEST CONDITIONS | MIN | MAX | UNIT |
|-----------|---------------|---|-----|-----|------|
| t_s | Settling time | $V_I(\text{system}) = \pm 13$ V, $R_I = 600 \Omega$, $t_t < 1 \mu\text{s}$, Measured at 10% to 90%, See Figure 1 | | 30 | µs |



PARAMETER MEASUREMENT INFORMATION

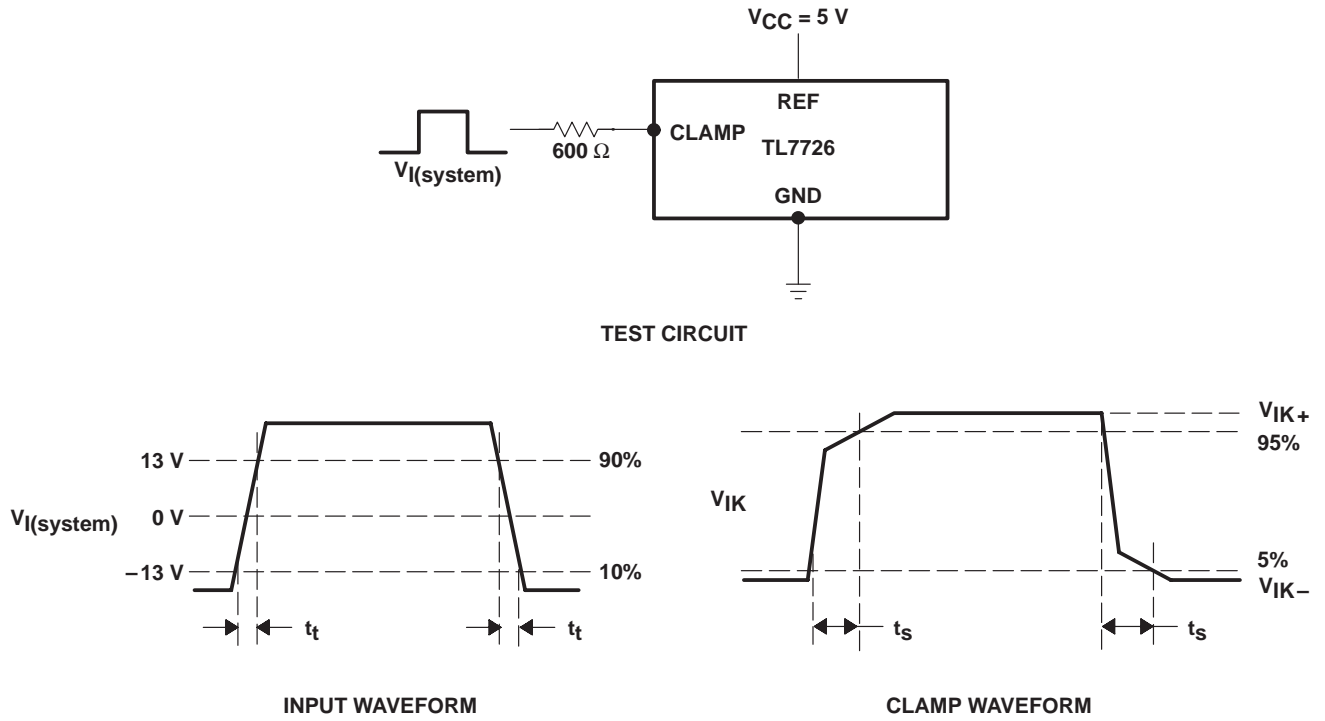


Figure 1. Switching Characteristics

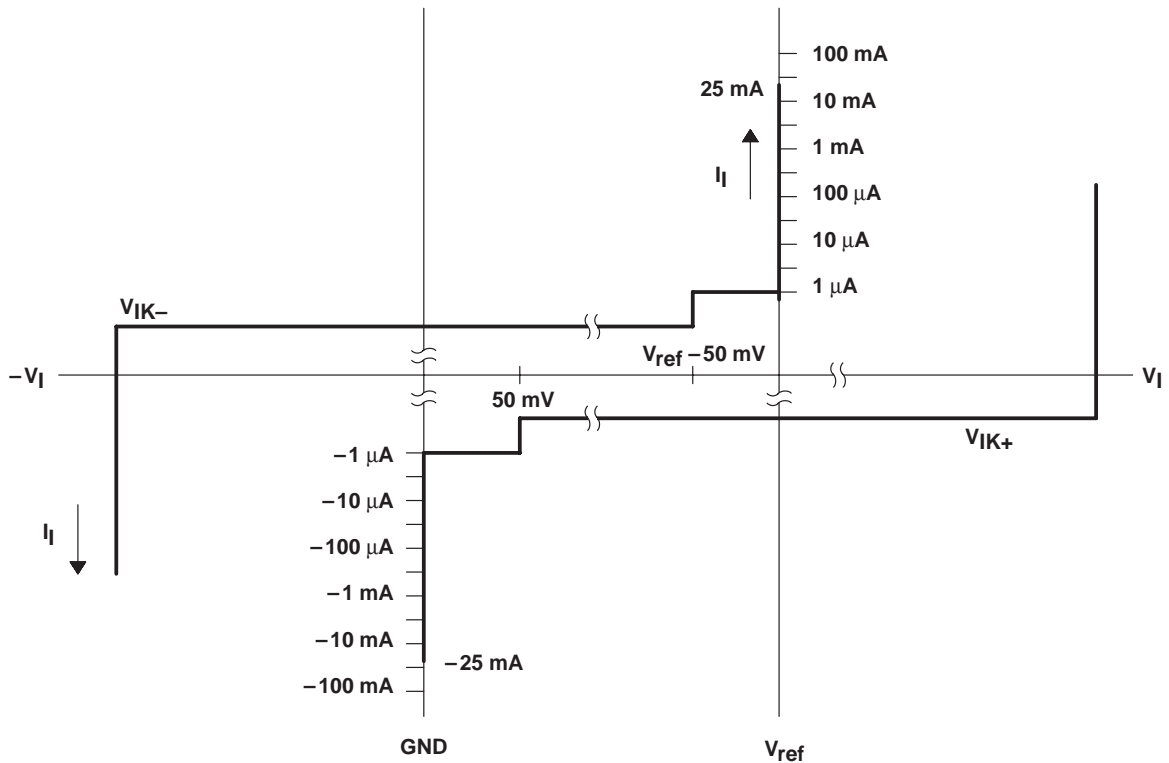
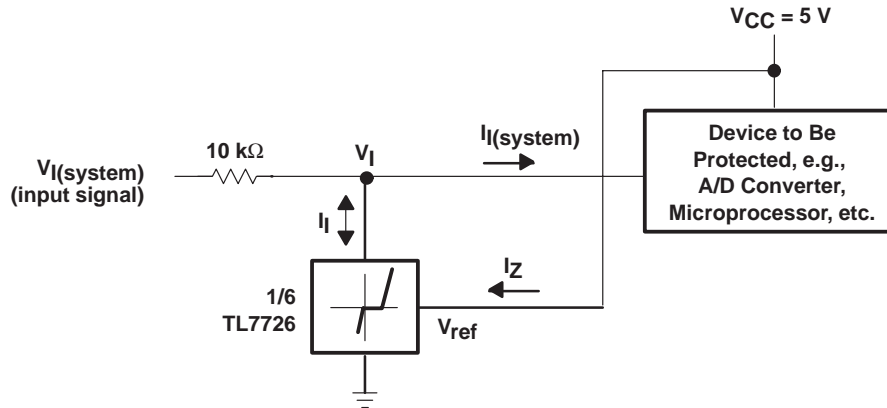


Figure 2. Tolerance Band for Clamping Circuit

TL7726 HEX CLAMPING CIRCUITS

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APPLICATION INFORMATION



Example: If $I_I \gg I_{I(\text{system})}$, i.e., $V_{I(\text{system})} > V_{\text{ref}} + 200\text{ mV}$
where:

$I_{I(\text{system})}$ = Input current to the device being protected

$V_{I(\text{system})}$ = Input voltage to the device being protected

then the maximum input voltage

$$\begin{aligned} V_{I(\text{system})\text{max}} &= V_{\text{ref}} + I_{I\text{max}}(10\text{ k}\Omega) \\ &= 5\text{ V} + 25\text{ mA}(10\text{ k}\Omega) \\ &= 5\text{ V} + 250\text{ V} \\ &= 255\text{ V} \end{aligned}$$

Figure 3. Typical Application

PACKAGING INFORMATION

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Top-Side Markings (4) | Samples |
|------------------|---------------|--------------|--------------------|------|-------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| TL7726CD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | 7726C | Samples |
| TL7726CDE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | 7726C | Samples |
| TL7726CDG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | 7726C | Samples |
| TL7726CDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | 7726C | Samples |
| TL7726CDRE4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | 7726C | Samples |
| TL7726CDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | 0 to 70 | 7726C | Samples |
| TL7726CP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | 0 to 70 | TL7726CP | Samples |
| TL7726CPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | 0 to 70 | TL7726CP | Samples |
| TL7726ID | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 7726I | Samples |
| TL7726IDE4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 7726I | Samples |
| TL7726IDG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 7726I | Samples |
| TL7726IDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 7726I | Samples |
| TL7726IDRE4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 7726I | Samples |
| TL7726IDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 85 | 7726I | Samples |
| TL7726IP | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -40 to 85 | TL7726IP | Samples |
| TL7726IPE4 | ACTIVE | PDIP | P | 8 | 50 | Pb-Free (RoHS) | CU NIPDAU | N / A for Pkg Type | -40 to 85 | TL7726IP | Samples |
| TL7726QD | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | -40 to 125 | 7726Q | Samples |

| Orderable Device | Status (1) | Package Type | Package Drawing | Pins | Package Qty | Eco Plan (2) | Lead/Ball Finish | MSL Peak Temp (3) | Op Temp (°C) | Top-Side Markings (4) | Samples |
|------------------|---------------|--------------|--------------------|------|-------------|----------------------------|------------------|----------------------|--------------|--------------------------|-------------------------|
| TL7726QDG4 | ACTIVE | SOIC | D | 8 | 75 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | 7726Q | Samples |
| TL7726QDR | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-3-260C-168 HR | -40 to 125 | 7726Q | Samples |
| TL7726QDRG4 | ACTIVE | SOIC | D | 8 | 2500 | Green (RoHS & no Sb/Br) | CU NIPDAU | Level-1-260C-UNLIM | | 7726Q | Samples |
| TL7726QP | OBSOLETE | PDIP | P | 8 | | TBD | Call TI | Call TI | -40 to 125 | TL7726QP | |

(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), Pb-Free (RoHS Exempt), 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.

Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

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.

(4) Only one of markings shown within the brackets will appear on the physical device.

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TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|-------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| TL7726CDR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| TL7726IDR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| TL7726QDR | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |
| TL7726QDRG4 | SOIC | D | 8 | 2500 | 330.0 | 12.4 | 6.4 | 5.2 | 2.1 | 8.0 | 12.0 | Q1 |

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

| Device | Package Type | Package Drawing | Pins | SPQ | Length (mm) | Width (mm) | Height (mm) |
|-------------|--------------|-----------------|------|------|-------------|------------|-------------|
| TL7726CDR | SOIC | D | 8 | 2500 | 340.5 | 338.1 | 20.6 |
| TL7726IDR | SOIC | D | 8 | 2500 | 340.5 | 338.1 | 20.6 |
| TL7726QDR | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |
| TL7726QDRG4 | SOIC | D | 8 | 2500 | 367.0 | 367.0 | 35.0 |

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 variation BA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
 - D. Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
 - E. Reference JEDEC MS-012 variation AA.

D (R-PDSO-G8)

PLASTIC SMALL OUTLINE



4211283-2/E 08/12

- NOTES:
- A. All linear dimensions are in millimeters.
 - B. This drawing is subject to change without notice.
 - C. Publication IPC-7351 is recommended for alternate designs.
 - D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
 - E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.

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