

## 1.5A Dual High-Speed Power MOSFET Drivers

### Features:

- High-Speed Switching ( $C_L = 1000$  pF): 30 nsec
- High Peak Output Current: 1.5A
- High Output Voltage Swing:
  - $V_{DD} - 25$  mV
  - $GND + 25$  mV
- Low Input Current (Logic '0' or '1'): 1  $\mu$ A
- TTL/CMOS Input Compatible
- Available in Inverting and Noninverting Configurations
- Wide Operating Supply Voltage:
  - 4.5V to 18V
- Current Consumption:
  - Inputs Low – 0.4 mA
  - Inputs High – 8 mA
- Single Supply Operation
- Low Output Impedance: 6 $\Omega$
- Pinout Equivalent of DS0026 and MMH0026
- Latch-Up Resistant: Withstands > 500 mA Reverse Current
- ESD Protected: 2 kV

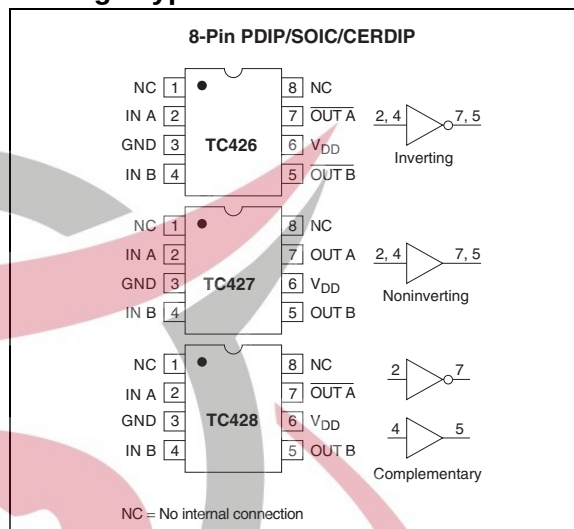
### Applications:

- Switch Mode Power Supplies
- Pulse Transformer Drive
- Clock Line Driver
- Coax Cable Driver

### Device Selection Table

| Part Number | Package      | Configuration | Temp. Range     |
|-------------|--------------|---------------|-----------------|
| TC426COA    | 8-Pin SOIC   | Inverting     | 0°C to +70°C    |
| TC426CPA    | 8-Pin PDIP   | Inverting     | 0°C to +70°C    |
| TC426EOA    | 8-Pin SOIC   | Inverting     | -40°C to +85°C  |
| TC426EPA    | 8-Pin PDIP   | Inverting     | -40°C to +85°C  |
| TC426IJA    | 8-Pin CERDIP | Inverting     | -25°C to +85°C  |
| TC426MJA    | 8-Pin CERDIP | Inverting     | -55°C to +125°C |
| TC427COA    | 8-Pin SOIC   | Noninverting  | 0°C to +70°C    |
| TC427CPA    | 8-Pin PDIP   | Noninverting  | 0°C to +70°C    |
| TC427EOA    | 8-Pin SOIC   | Noninverting  | -40°C to +85°C  |
| TC427EPA    | 8-Pin PDIP   | Noninverting  | -40°C to +85°C  |
| TC427IJA    | 8-Pin CERDIP | Noninverting  | -25°C to +85°C  |
| TC427MJA    | 8-Pin CERDIP | Noninverting  | -55°C to +125°C |
| TC428COA    | 8-Pin SOIC   | Complementary | 0°C to +70°C    |
| TC428CPA    | 8-Pin PDIP   | Complementary | 0°C to +70°C    |
| TC428EOA    | 8-Pin SOIC   | Complementary | -40°C to +85°C  |
| TC428EPA    | 8-Pin PDIP   | Complementary | -40°C to +85°C  |
| TC428IJA    | 8-Pin CERDIP | Complementary | -25°C to +85°C  |
| TC428MJA    | 8-Pin CERDIP | Complementary | -55°C to +125°C |

### Package Type



### General Description:

The TC426/TC427/TC428 are dual CMOS high-speed drivers. A TTL/CMOS input voltage level is translated into a rail-to-rail output voltage level swing. The CMOS output is within 25 mV of ground or positive supply.

The low-impedance, high-current driver outputs swing a 1000 pF load 18V in 30 nsec. The unique current and voltage drive qualities make the TC426/TC427/TC428 ideal power MOSFET drivers, line drivers, and DC-to-DC converter building blocks.

Input logic signals may equal the power supply voltage. Input current is a low 1  $\mu$ A, making direct interface to CMOS/bipolar switch-mode power supply control ICs possible, as well as open-collector analog comparators.

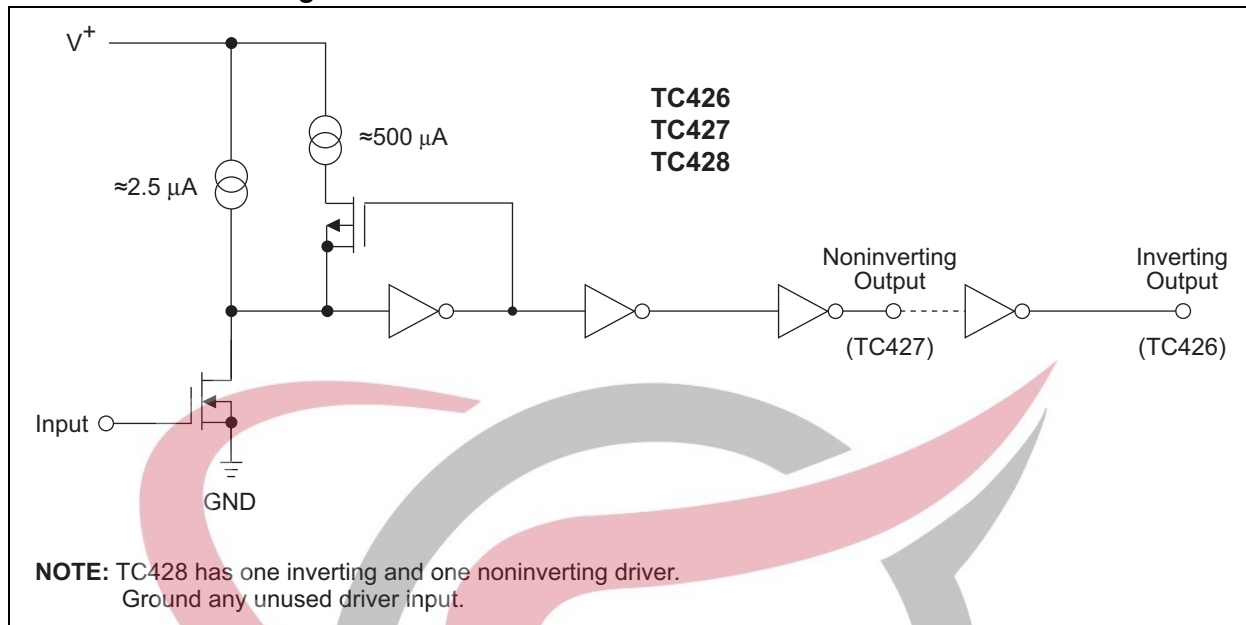
Quiescent power supply current is 8 mA maximum. The TC426 requires 1/5 the current of the pin-compatible bipolar DS0026 device. This is important in DC-to-DC converter applications with power efficiency constraints and high-frequency switch-mode power supply applications. Quiescent current is typically 6 mA when driving a 1000 pF load 18V at 100 kHz.

The inverting TC426 driver is pin-compatible with the bipolar DS0026 and MMH0026 devices. The TC427 is noninverting; the TC428 contains an inverting and non-inverting driver.

Other pin compatible driver families are the TC1426/TC1427/TC1428, TC4426/TC4427/TC4428 and TC4426A/TC4427A/TC4428A.

# TC426/TC427/TC428

## Functional Block Diagram



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## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings\*

|                                             |                                 |
|---------------------------------------------|---------------------------------|
| Supply Voltage .....                        | +20V                            |
| Input Voltage, Any Terminal<br>.....        | $V_{DD} + 0.3V$ to $GND - 0.3V$ |
| Power Dissipation ( $T_A \leq 70^\circ C$ ) |                                 |
| PDIP .....                                  | 730 mW                          |
| CERDIP .....                                | 800 mW                          |
| SOIC .....                                  | 470 mW                          |
| Derating Factor                             |                                 |
| PDIP .....                                  | 8 mW/ $^\circ C$                |
| CERDIP .....                                | 6.4 mW/ $^\circ C$              |
| SOIC .....                                  | 4 mW/ $^\circ C$                |
| Operating Temperature Range                 |                                 |
| C Version .....                             | $0^\circ C$ to $+70^\circ C$    |
| I Version .....                             | $-25^\circ C$ to $+85^\circ C$  |
| E Version .....                             | $-40^\circ C$ to $+85^\circ C$  |
| M Version .....                             | $-55^\circ C$ to $+125^\circ C$ |
| Storage Temperature Range .....             | $-65^\circ C$ to $+150^\circ C$ |

\*Stresses above 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 above those indicated in the operation sections of the specifications is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

### TC426/TC427/TC428 ELECTRICAL SPECIFICATIONS

| Electrical Characteristics: $T_A = +25^\circ C$ with $4.5V \leq V_{DD} \leq 18V$ , unless otherwise noted. |                             |                  |     |       |          |                                           |
|------------------------------------------------------------------------------------------------------------|-----------------------------|------------------|-----|-------|----------|-------------------------------------------|
| Symbol                                                                                                     | Parameter                   | Min              | Typ | Max   | Units    | Test Conditions                           |
| <b>Input</b>                                                                                               |                             |                  |     |       |          |                                           |
| $V_{IH}$                                                                                                   | Logic 1, High Input Voltage | 2.4              | —   | —     | V        |                                           |
| $V_{IL}$                                                                                                   | Logic 0, Low Input Voltage  | —                | —   | 0.8   | V        |                                           |
| $I_{IN}$                                                                                                   | Input Current               | -1               | —   | 1     | $\mu A$  | $0V \leq V_{IN} \leq V_{DD}$              |
| <b>Output</b>                                                                                              |                             |                  |     |       |          |                                           |
| $V_{OH}$                                                                                                   | High Output Voltage         | $V_{DD} - 0.025$ | —   | —     | V        |                                           |
| $V_{OL}$                                                                                                   | Low Output Voltage          | —                | —   | 0.025 | V        |                                           |
| $R_{OH}$                                                                                                   | High Output Resistance      | —                | 10  | 15    | $\Omega$ | $I_{OUT} = 10\text{ mA}$ , $V_{DD} = 18V$ |
| $R_{OL}$                                                                                                   | Low Output Resistance       | —                | 6   | 10    | $\Omega$ | $I_{OUT} = 10\text{ mA}$ , $V_{DD} = 18V$ |
| $I_{PK}$                                                                                                   | Peak Output Current         | —                | 1.5 | —     | A        |                                           |
| <b>Switching Time (Note 1)</b>                                                                             |                             |                  |     |       |          |                                           |
| $t_R$                                                                                                      | Rise Time                   | —                | —   | 30    | nsec     | Figure 3-1, Figure 3-2                    |
| $t_F$                                                                                                      | Fall Time                   | —                | —   | 30    | nsec     | Figure 3-1, Figure 3-2                    |
| $t_{D1}$                                                                                                   | Delay Time                  | —                | —   | 50    | nsec     | Figure 3-1, Figure 3-2                    |
| $t_{D2}$                                                                                                   | Delay Time                  | —                | —   | 75    | nsec     | Figure 3-1, Figure 3-2                    |
| <b>Power Supply</b>                                                                                        |                             |                  |     |       |          |                                           |
| $I_S$                                                                                                      | Power Supply Current        | —                | —   | 8     | mA       | $V_{IN} = 3V$ (Both Inputs)               |
|                                                                                                            |                             | —                | —   | 0.4   |          | $V_{IN} = 0V$ (Both Inputs)               |

**Note 1:** Switching times ensured by design.

# TC426/TC427/TC428

## TC426/TC427/TC428 ELECTRICAL SPECIFICATIONS (CONTINUED)

**Electrical Characteristics:** Over operating temperature range with  $4.5V \leq V_{DD} \leq 18V$ , unless otherwise noted.

### Input

|          |                             |     |   |     |         |                              |
|----------|-----------------------------|-----|---|-----|---------|------------------------------|
| $V_{IH}$ | Logic 1, High Input Voltage | 2.4 | — | —   | V       |                              |
| $V_{IL}$ | Logic 0, Low Input Voltage  | —   | — | 0.8 | V       |                              |
| $I_{IN}$ | Input Current               | -10 | — | 10  | $\mu A$ | $0V \leq V_{IN} \leq V_{DD}$ |

### Output

|          |                        |                  |    |       |          |                                            |
|----------|------------------------|------------------|----|-------|----------|--------------------------------------------|
| $V_{OH}$ | High Output Voltage    | $V_{DD} - 0.025$ | —  | —     | V        |                                            |
| $V_{OL}$ | Low Output Voltage     | —                | —  | 0.025 | V        |                                            |
| $R_{OH}$ | High Output Resistance | —                | 13 | 20    | $\Omega$ | $I_{OUT} = 10 \text{ mA}$ , $V_{DD} = 18V$ |
| $R_{OL}$ | Low Output Resistance  | —                | 8  | 15    | $\Omega$ | $I_{OUT} = 10 \text{ mA}$ , $V_{DD} = 18V$ |

### Switching Time (Note 1)

|          |            |   |   |     |      |                        |
|----------|------------|---|---|-----|------|------------------------|
| $t_R$    | Rise Time  | — | — | 60  | nsec | Figure 3-1, Figure 3-2 |
| $t_F$    | Fall Time  | — | — | 60  | nsec | Figure 3-1, Figure 3-2 |
| $t_{D1}$ | Delay Time | — | — | 75  | nsec | Figure 3-1, Figure 3-2 |
| $t_{D2}$ | Delay Time | — | — | 120 | nsec | Figure 3-1, Figure 3-2 |

### Power Supply

|       |                      |   |   |           |    |                                                            |
|-------|----------------------|---|---|-----------|----|------------------------------------------------------------|
| $I_S$ | Power Supply Current | — | — | 12<br>0.6 | mA | $V_{IN} = 3V$ (Both Inputs)<br>$V_{IN} = 0V$ (Both Inputs) |
|-------|----------------------|---|---|-----------|----|------------------------------------------------------------|

**Note 1:** Switching times ensured by design.

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## 2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

**TABLE 2-1: PIN FUNCTION TABLE**

| Pin No.<br>(8-Pin PDIP,<br>SOIC, CERDIP) | Symbol          | Description                                       |
|------------------------------------------|-----------------|---------------------------------------------------|
| 1                                        | NC              | No Internal Connection.                           |
| 2                                        | IN A            | Control Input A, TTL/CMOS compatible logic input. |
| 3                                        | GND             | Ground.                                           |
| 4                                        | IN B            | Control Input B, TTL/CMOS compatible logic input. |
| 5                                        | OUT B           | CMOS totem-pole output.                           |
| 6                                        | V <sub>DD</sub> | Supply input, 4.5V to 18V.                        |
| 7                                        | OUT A           | CMOS totem-pole output.                           |
| 8                                        | NC              | No internal Connection.                           |



# TC426/TC427/TC428

## 3.0 APPLICATIONS INFORMATION

### 3.1 Supply Bypassing

Charging and discharging large capacitive loads quickly requires large currents. For example, charging a 1000 pF load to 18V in 25 nsec requires an 0.72A current from the device power supply.

To ensure low supply impedance over a wide frequency range, a parallel capacitor combination is recommended for supply bypassing. Low-inductance ceramic disk capacitors with short lead lengths (< 0.5 in.) should be used. A 1  $\mu$ F film capacitor in parallel with one or two 0.1  $\mu$ F ceramic disk capacitors normally provides adequate bypassing.

### 3.2 Grounding

The TC426 and TC428 contain inverting drivers. Ground potential drops developed in common ground impedances from input to output will appear as negative feedback and degrade switching speed characteristics.

Individual ground returns for the input and output circuits or a ground plane should be used.

### 3.3 Input Stage

The input voltage level changes the no-load or quiescent supply current. The N-channel MOSFET input stage transistor drives a 2.5 mA current source load. With a logic '1' input, the maximum quiescent supply current is 8 mA. Logic '0' input level signals reduce quiescent current to 0.4 mA maximum. Minimum power dissipation occurs for logic '0' inputs for the TC426/TC427/TC428. **Unused driver inputs must be connected to  $V_{DD}$  or GND.**

The drivers are designed with 100 mV of hysteresis. This provides clean transitions and minimizes output stage current spiking when changing states. Input voltage thresholds are approximately 1.5V, making the device TTL compatible over the 4.5V to 18V supply operating range. Input current is less than 1  $\mu$ A over this range.

The TC426/TC427/TC428 may be directly driven by the TL494, SG1526/1527, SG1524, SE5560, and similar switch-mode power supply integrated circuits.

## 3.4 Power Dissipation

The supply current vs frequency and supply current vs capacitive load characteristic curves will aid in determining power dissipation calculations.

The TC426/TC427/TC428 CMOS drivers have greatly reduced quiescent DC power consumption. Maximum quiescent current is 8 mA compared to the DS0026 40 mA specification. For a 15V supply, power dissipation is typically 40 mW.

Two other power dissipation components are:

- Output stage AC and DC load power.
- Transition state power.

Output stage power is:

$$P_o = P_{DC} + P_{AC} \\ = V_o (I_{DC}) + f C_L V_S^2$$

Where:

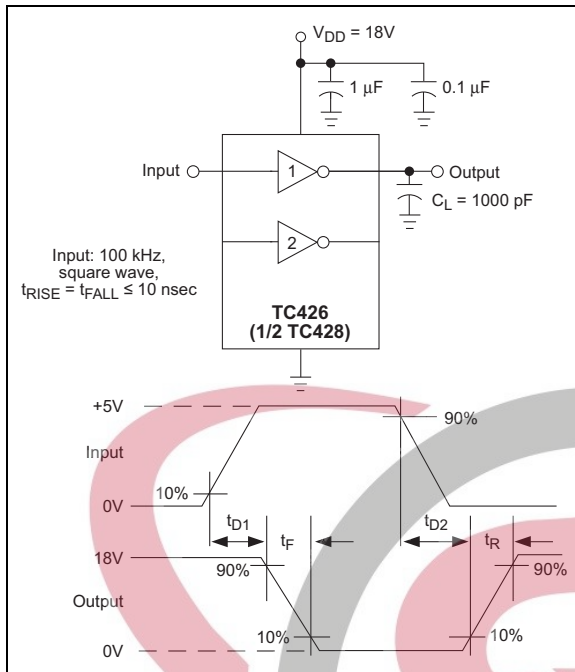
- $V_o$  = DC output voltage
- $I_{DC}$  = DC output load current
- $f$  = Switching frequency
- $V_s$  = Supply voltage

In power MOSFET drive applications the  $P_{DC}$  term is negligible. MOSFET power transistors are high-impedance, capacitive input devices. In applications where resistive loads or relays are driven, the  $P_{DC}$  component will normally dominate.

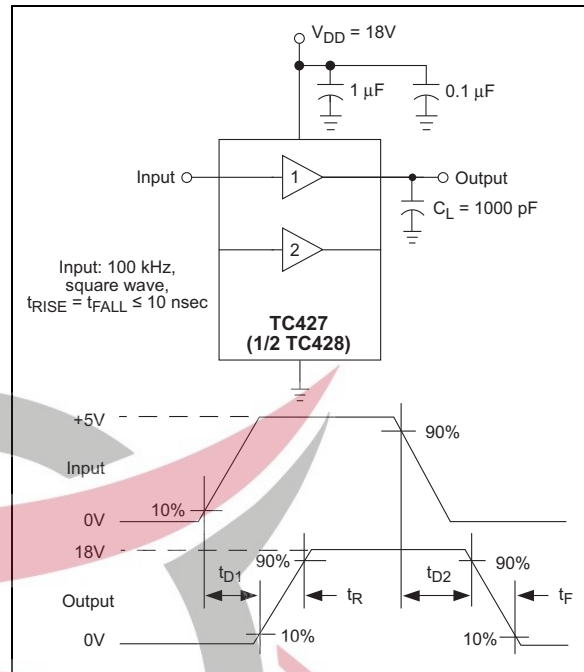
The magnitude of  $P_{AC}$  is readily estimated for several cases:

- | A.                  | B.                  |
|---------------------|---------------------|
| 1. $f = 200$ kHz    | 1. $f = 200$ kHz    |
| 2. $C_L = 1000$ pf  | 2. $C_L = 1000$ pf  |
| 3. $V_s = 18$ V     | 3. $V_s = 15$ V     |
| 4. $P_{AC} = 65$ mW | 4. $P_{AC} = 45$ mW |

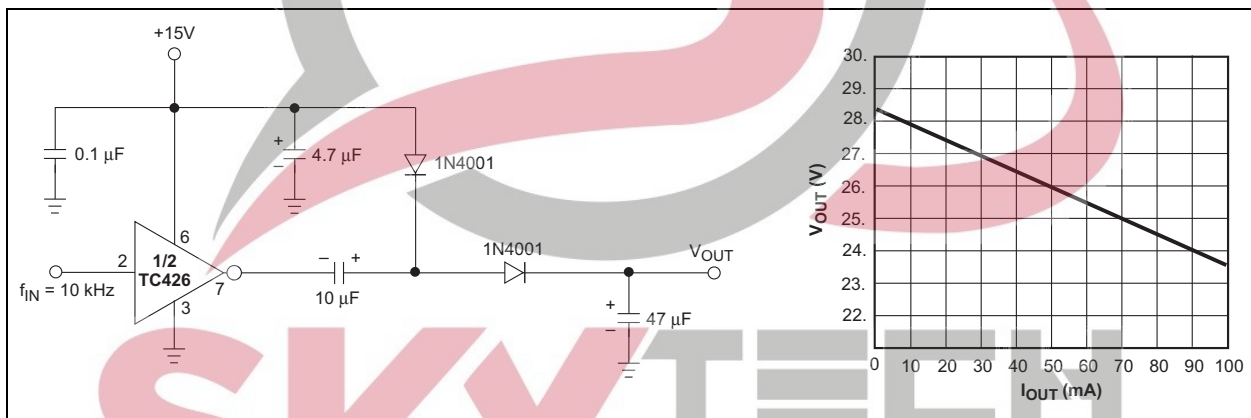
During output level state changes, a current surge will flow through the series connected N and P channel output MOSFETS as one device is turning "ON" while the other is turning "OFF". The current spike flows only during output transitions. The input levels should not be maintained between the logic '0' and logic '1' levels. **Unused driver inputs must be tied to ground and not be allowed to float.** Average power dissipation will be reduced by minimizing input rise times. As shown in the characteristic curves, average supply current is frequency dependent.



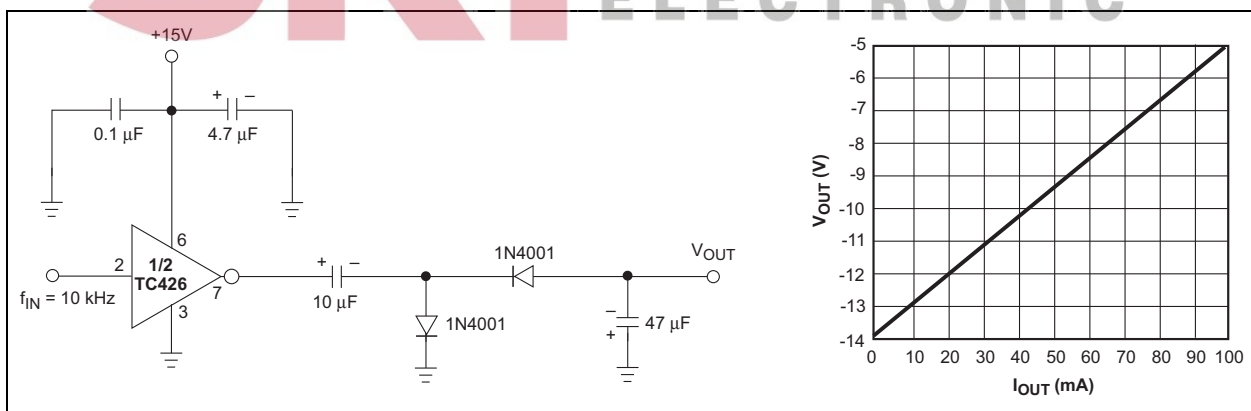
**FIGURE 3-1:** Inverting Driver Switching Time Test Circuit



**FIGURE 3-2:** Noninverting Driver Switching Time Test Circuit



**FIGURE 3-3:** Voltage Doubler

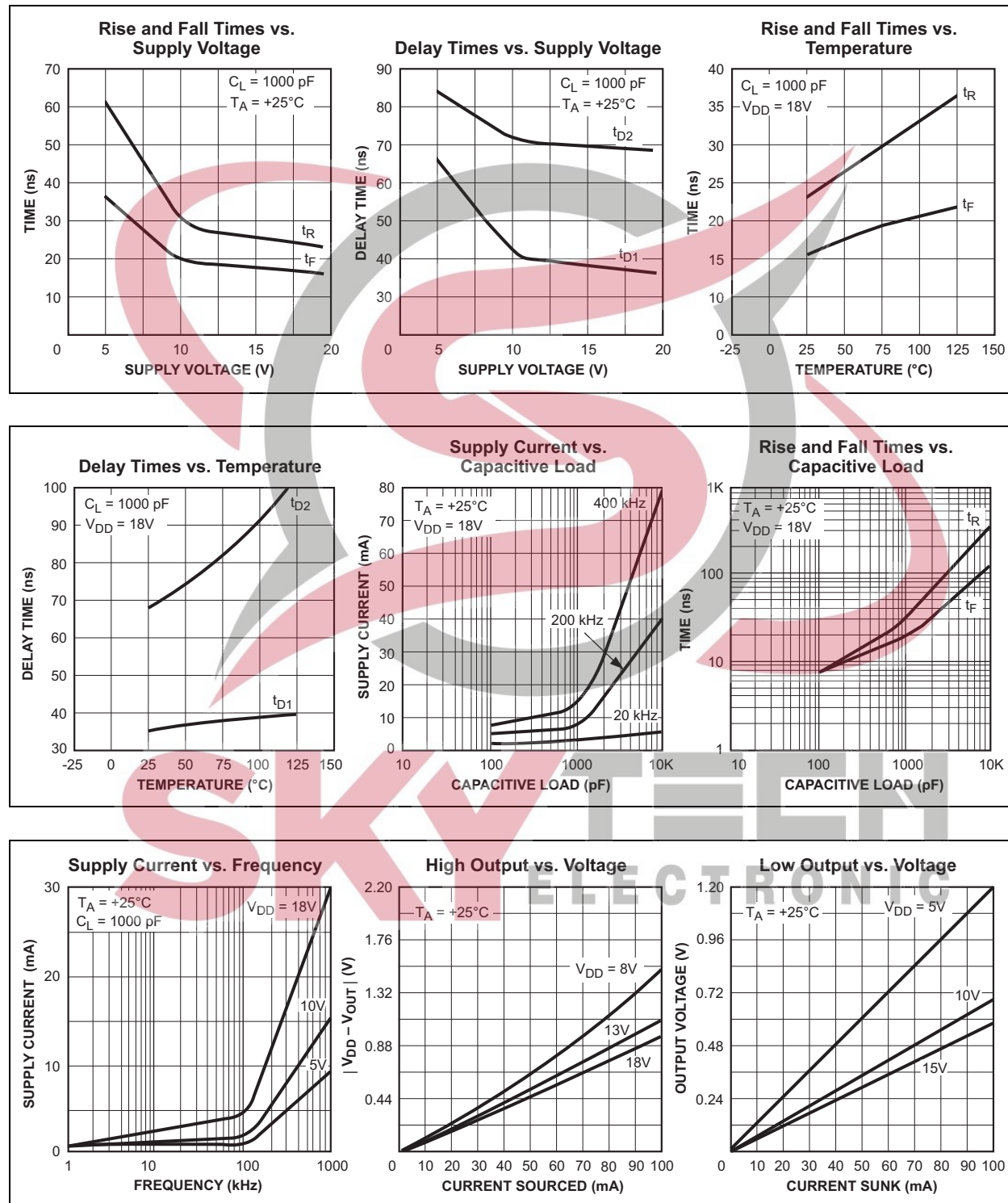


**FIGURE 3-4:** Voltage Inverter

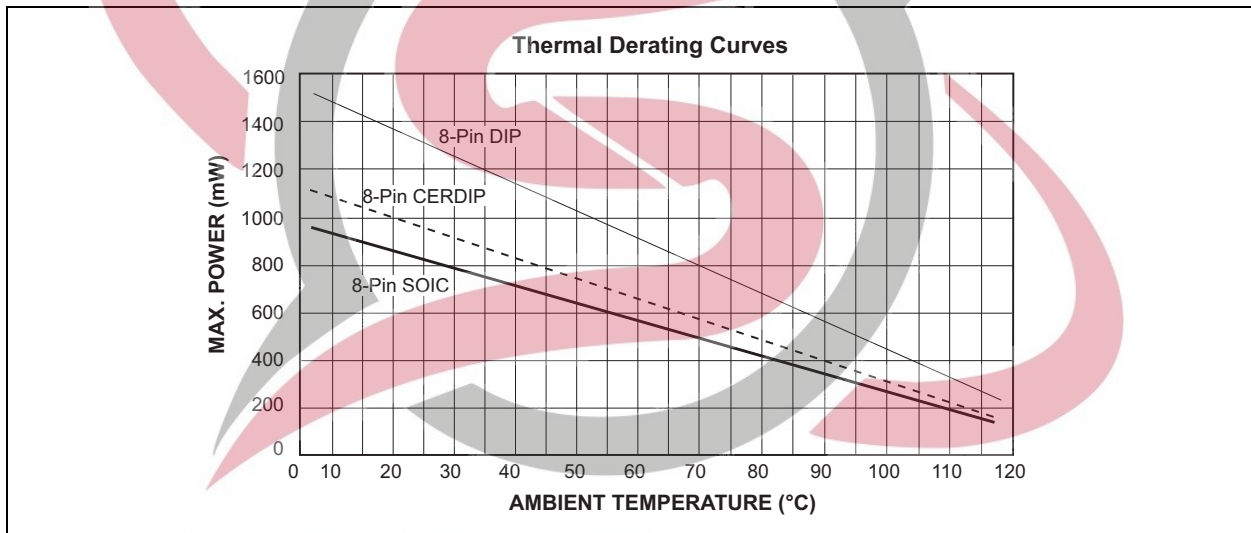
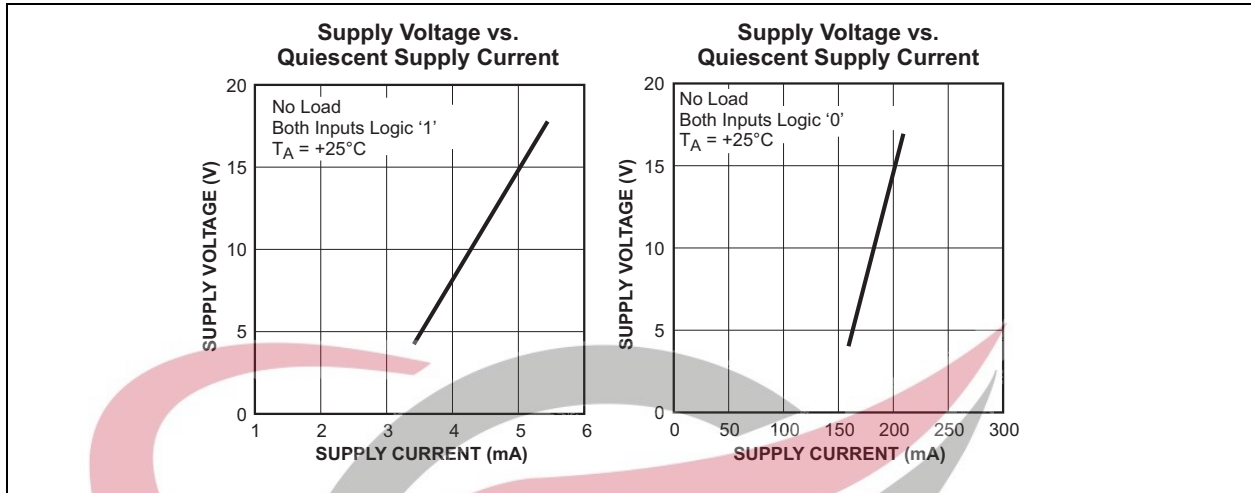
# TC426/TC427/TC428

## 4.0 TYPICAL CHARACTERISTICS

**Note:** The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be outside the specified operating range (e.g., outside specified power supply range) and therefore outside the warranted range.



## TYPICAL CHARACTERISTICS (CONTINUED)



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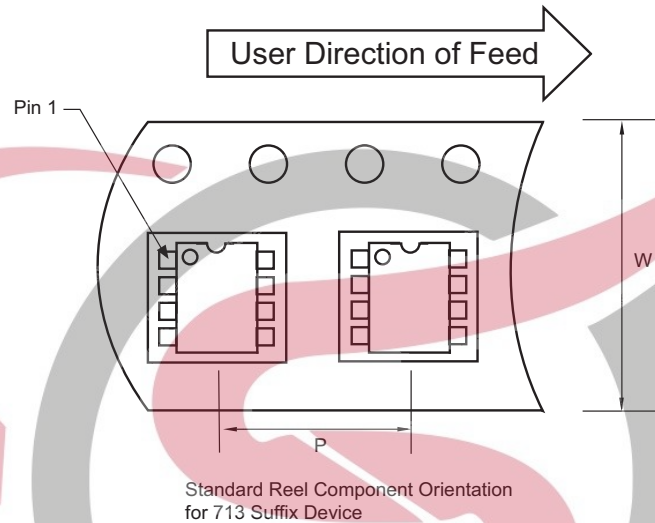
## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

Package marking data not available at this time.

### 5.2 Taping Form

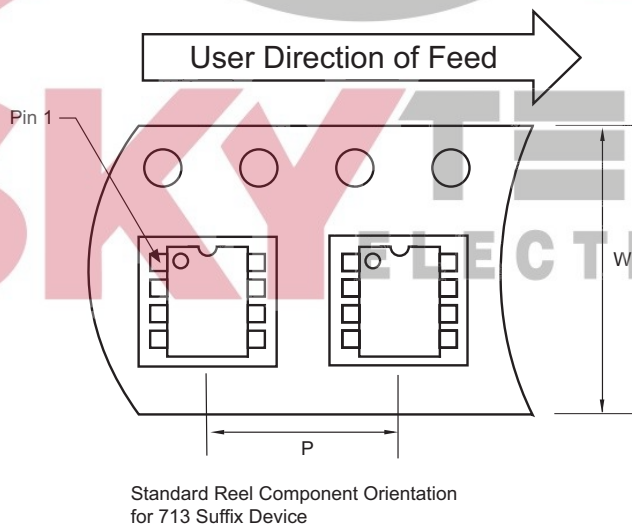
#### Component Taping Orientation for 8-Pin MSOP Devices



Carrier Tape, Number of Components Per Reel and Reel Size

| Package    | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|------------|-------------------|-----------|--------------------|-----------|
| 8-Pin MSOP | 12 mm             | 8 mm      | 2500               | 13 in     |

#### Component Taping Orientation for 8-Pin SOIC (Narrow) Devices



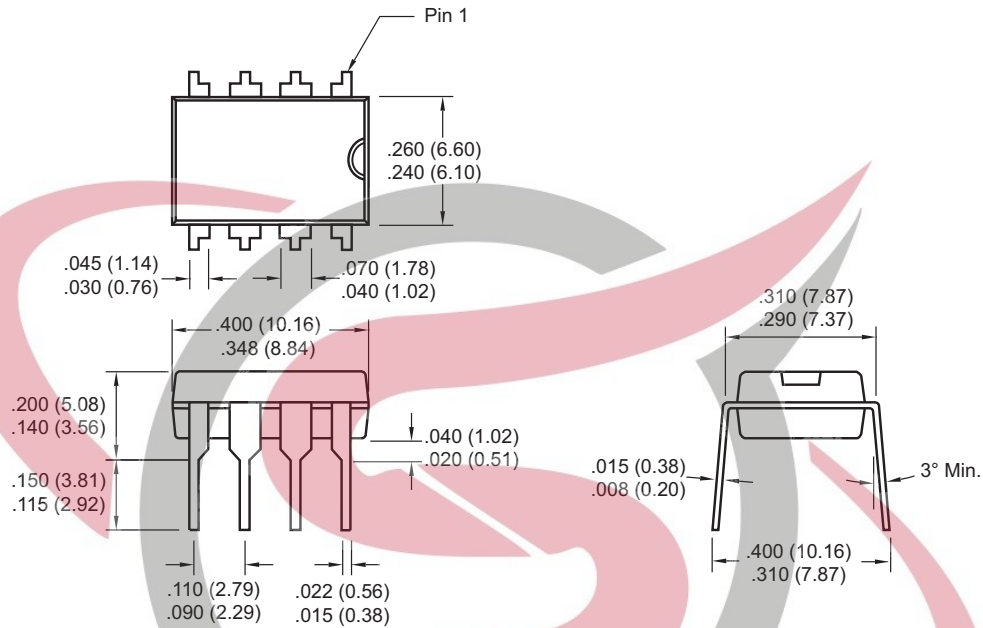
Carrier Tape, Number of Components Per Reel and Reel Size

| Package        | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|----------------|-------------------|-----------|--------------------|-----------|
| 8-Pin SOIC (N) | 12 mm             | 8 mm      | 2500               | 13 in     |

## 5.3 Package Dimensions

**Note:** For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>

### 8-Pin Plastic DIP



Dimensions: inches (mm)

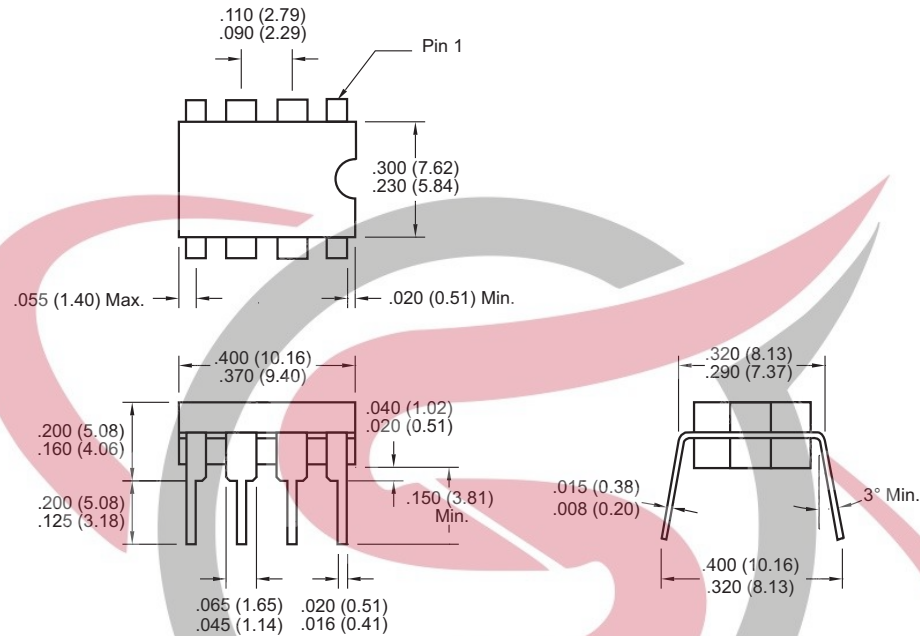
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## Package Dimensions (Continued)

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### 8-Pin Cerdip (Narrow)



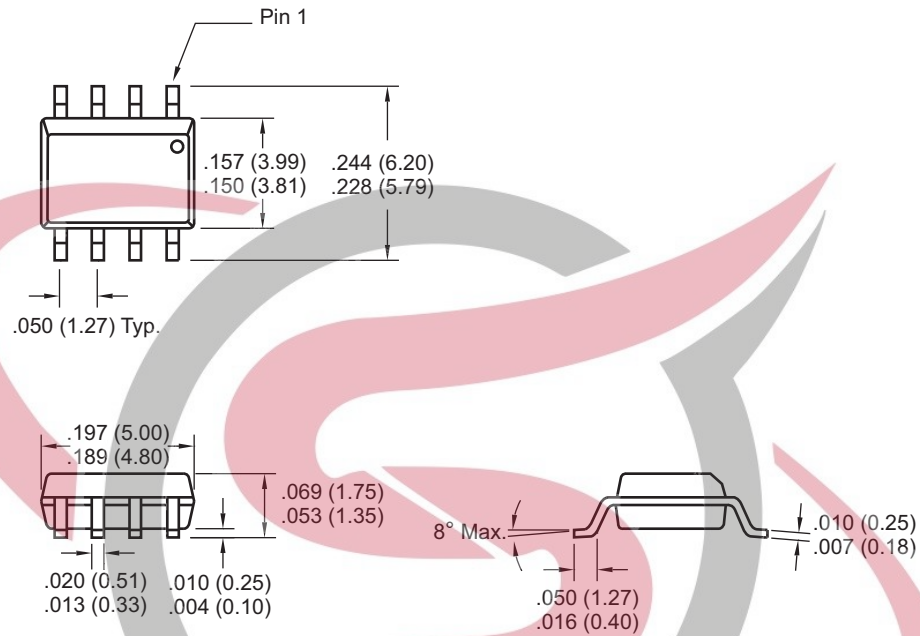
Dimensions: inches (mm)

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## Package Dimensions (Continued)

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### 8-Pin SOIC



Dimensions: inches (mm)

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## 6.0 REVISION HISTORY

### Revision D (December 2012)

Added a note to each package outline drawing.



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# TC426/TC427/TC428

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