TELEDYNE COMPONENTS

TC426
TC427
TC428

DUAL HIGH-SPEED POWER MOSFET DRIVERS

FEATURES

- **High-Speed Switching (C_L = 1000 pF) .... 30 ns**
- **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 µA**
- **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 6Ω**
- **Pinout Equivalent of DS0026 and MMH0026**
- **Latch-Up Resistant: Withstands >500 mA Reverse Current**
- **ESD Protected .... 2 kV**

GENERAL DESCRIPTION

The TC426/TC427/TC428 are dual CMOS high-speed drivers. A TTL/CMOS input voltage level is translated into an output voltage level swing equaling the supply. The CMOS output will be within 25 mV of ground or positive supply. Bipolar designs are capable of swinging only within 1V of the supply.

The low impedance, high-current driver outputs will swing a 1000 pF load 18V in 30 ns. 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 µA, 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 noninverting driver.

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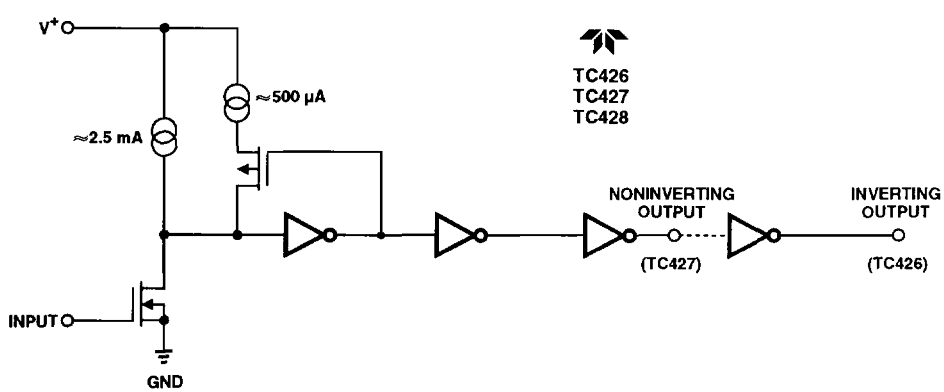
FUNCTIONAL DIAGRAM

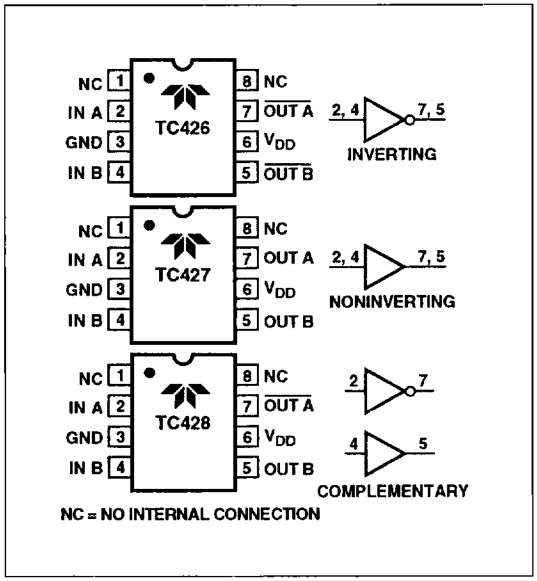


NOTE: TC428 has one inverting and one noninverting driver. Ground any unused driver input.

ORDERING INFORMATION

Part No.	Package	Configuration	Temperature Range
TC426CPA	8-Pin PDIP	Inverting	0°C to +70°C
TC427CPA	8-Pin PDIP	Noninverting	0°C to +70°C
TC428CPA	8-Pin PDIP	Complementary	0°C to +70°C
TC426COA	8-Pin SOIC	Inverting	0°C to +70°C
TC427COA	8-Pin SOIC	Noninverting	0°C to +70°C
TC428COA	8-Pin SOIC	Complementary	0°C to +70°C
TC426IJA	8-Pin CerDIP	Inverting	–25°C to +85°C
TC427IJA	8-Pin CerDIP	Noninverting	–25°C to +85°C
TC428IJA	8-Pin CerDIP	Complementary	–25°C to +85°C
TC426EOA	8-Pin SOIC	Inverting	–40°C to +85°C
TC427EOA	8-Pin SOIC	Noninverting	–40°C to +85°C
TC428EOA	8-Pin SOIC	Complementary	–40°C to +85°C
TC426MJA	8-Pin CerDIP	Inverting	–55°C to +125°C
TC427MJA	8-Pin CerDIP	Noninverting	–55°C to +125°C
TC428MJA	8-Pin CerDIP	Complementary	–55°C to +125°C

PIN CONFIGURATIONS (DIP and SO)



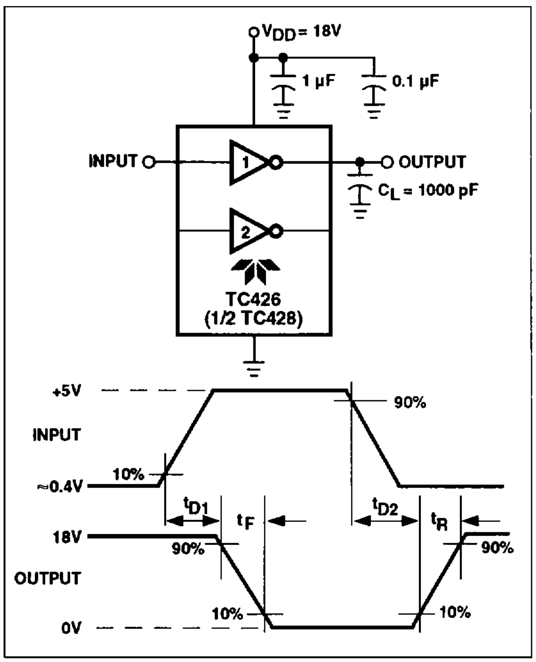


Figure 1. Inverting Driver Switching Time Test Circuit

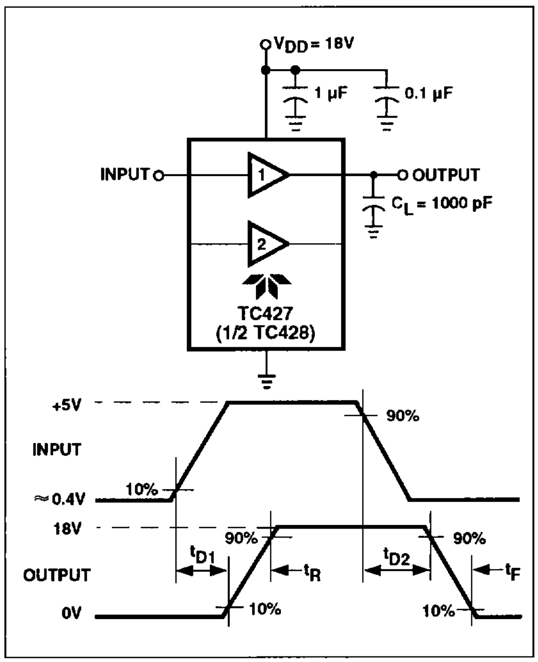


Figure 2. Noninverting Driver Switching Time Test Circuit

DUAL HIGH-SPEED POWER MOSFET DRIVERS

TC426
TC427
TC428

ABSOLUTE MAXIMUM RATINGS

Supply Voltage .... +20V
Input Voltage, Any Terminal .... V_{DD}+0.3V to GND –0.3V
Power Dissipation
- Plastic .... 1000 mW
- CerDIP .... 800 mW
- SOIC .... 500 mW

Derating Factor
- Plastic .... 8 mW/°C
- CerDIP .... 6.4 mW/°C
- SOIC .... 4 mW/°C

Operating Temperature Range
- C Version .... 0°C to +70°C
- I Version .... –25°C to +85°C
- E Version .... –40°C to +85°C
- M Version .... –55°C to +125°C

Maximum Chip Temperature .... +150°C
Storage Temperature Range .... –65°C to +150°C
Lead Temperature (Soldering, 10 sec) .... +300°C

Static-sensitive device. Unused devices must be stored in conductive material. Protect devices from static discharge and static fields. 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 operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may effect device reliability.

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ELECTRICAL CHARACTERISTICS: T_A = +25°C with 4.5V ≤ V_{DD} ≤ 18V, unless otherwise specified.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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	0V ≤ V_{IN} ≤ V_{DD}	–1	—	1	µA
Output						
V_{OH}	High Output Voltage		V_{DD}–0.025	—	—	V
V_{OL}	Low Output Voltage		—	—	0.025	V
R_{OH}	High Output Resistance	I_{OUT} = 10 mA, V_{DD} = 18V	—	10	15	Ω
R_{OL}	Low Output Resistance	I_{OUT} = 10 mA, V_{DD} = 18V	—	6	10	Ω
I_{PK}	Peak Output Current		—	1.5	—	A
Switching Time (Note 1)						
t_R	Rise Time	Test Figure 1	—	—	30	ns
t_F	Fall Time	Test Figure 1	—	—	20	ns
t_{D1}	Delay Time	Test Figure 1	—	—	50	ns
t_{D2}	Delay Time	Test Figure 1	—	—	75	ns
Power Supply						
I_S	Power Supply Current	V_{IN} = 3V (Both Inputs)	—	—	8	mA
		V_{IN} = 0V (Both Inputs)	—	—	0.4	mA

ELECTRICAL CHARACTERISTICS:

Over operating temperature range with 4.5V ≤ V_{DD} ≤ 18V, unless otherwise specified.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
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	0V ≤ V_{IN} ≤ V_{DD}	−10	—	10	µA
Output						
V_{OH}	High Output Voltage		V_{DD}–0.025	—	—	V
V_{OL}	Low Output Voltage		—	—	0.025	V
R_{OH}	High Output Resistance	I_{OUT} = 10 mA, V_{DD} = 18V	—	13	20	Ω
R_{OL}	Low Output Resistance	I_{OUT} = 10 mA, V_{DD} = 18V	—	8	15	W
Switching Time (Note 1)						
t_R	Rise Time	Test Figure 1	—	—	60	ns
t_F	Fall Time	Test Figure 1	—	—	40	ns
t_{D1}	Delay Time	Test Figure 1	—	—	75	ns
t_{D2}	Delay Time	Test Figure 1	—	—	120	ns
Power Supply						
I_S	Power Supply Current	V_{IN} = 3V (Both Inputs) V_{IN} = 0V (Both Inputs)	— —	— —	12 0.6	mA mA

NOTE: 1. Switching times guaranteed by design.

SUPPLY BYPASSING

Charging and discharging large capacitive loads quickly requires large currents. For example, charging a 1000-pF load 18V in 25 ns requires an 0.8A current from the device power supply.

To guarantee 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 µF film capacitor in parallel with one or two 0.1 µF ceramic disk capacitors normally provides adequate bypassing.

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.

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 TC426/427/428. **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 µA over this range.

The TC426/427/428 may be directly driven by the TL494, SG1526/1527, SG1524, SE5560, and similar switch-mode power supply integrated circuits.

POWER DISSIPATION

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

The TC426/427/428 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:

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

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	= 20kHZ	1. f	= 200 kHz
2. C_L	=1000 pf	2. C_L	=1000 pf
3. Vs	= 18V	3. VS	=15V
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.

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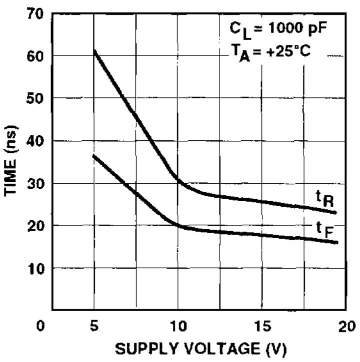
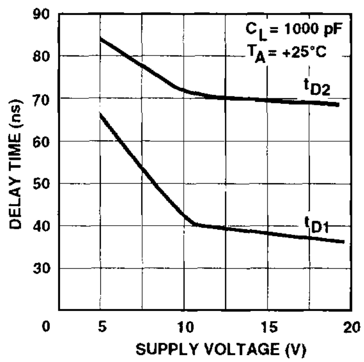
TYPICAL CHARACTERISTICS CURVES

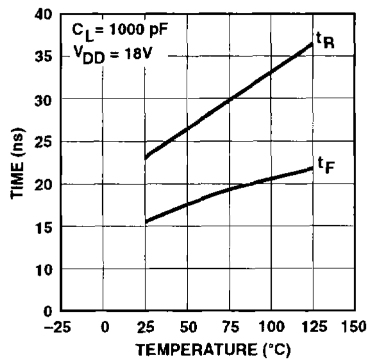
Rise and Fall Times vs Supply Voltage



Delay Times vs Supply Voltage

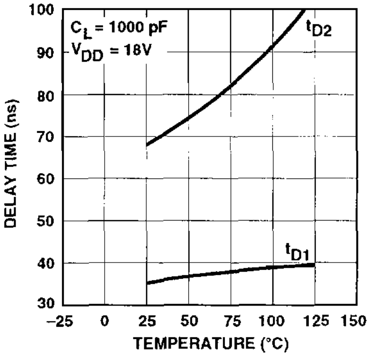


Rise and Fall Times vs Temperature

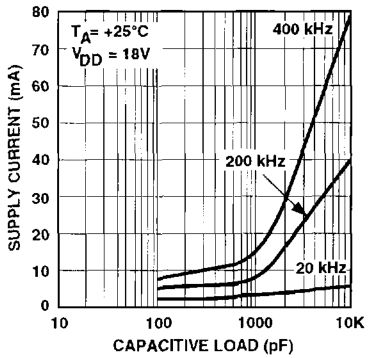


TYPICAL CHARACTERISTICS CURVES (Cont.)

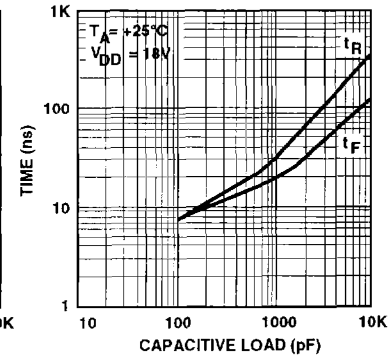
Delay Times vs Temperature



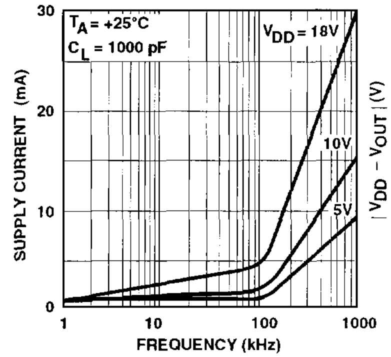
Supply Current vs Capacitive Load



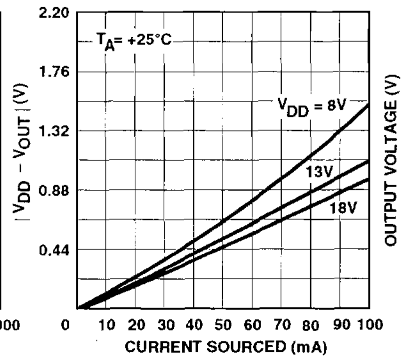
Rise and Fall Times vs Capacitive Load



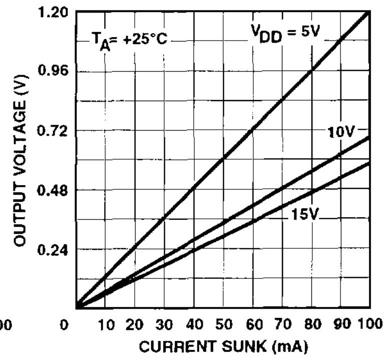
Supply Current vs Frequency



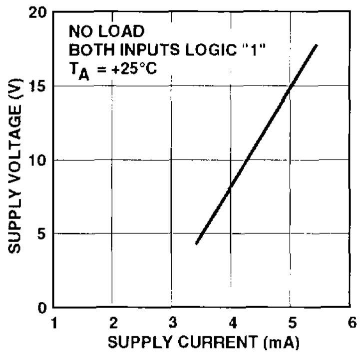
High Output vs Voltage



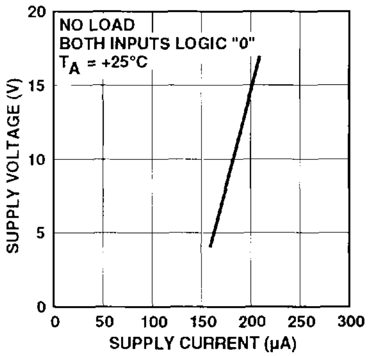
Low Output vs Voltage



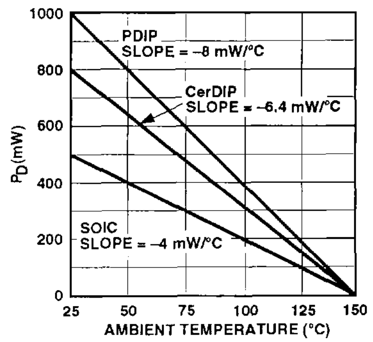
Supply Voltage vs Quiescent Supply Current



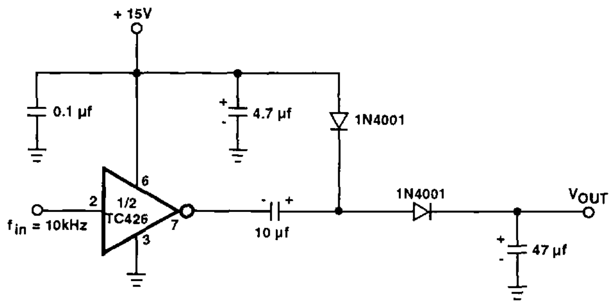
Supply Voltage vs Quiescent Supply Current

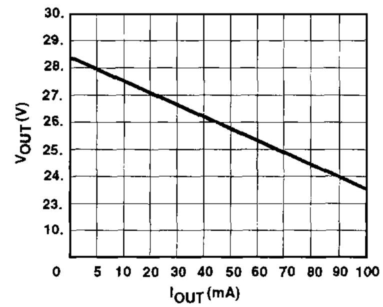


Package Power Dissipation



VOLTAGE DOUBLER





VOLTAGE INVERTER