



# MICROCHIP TC4423M/TC4424M/TC4425M

## 3A Dual High-Speed Power MOSFET Drivers

### Features

- High Peak Output Current: 3A
- Wide Input Supply Voltage Operating Range:
  - 4.5V to 18V
- High Capacitive Load Drive Capability:
  - 1800 pF in 25 ns
- Short Delay Times: <40 ns (typ)
- Matched Rise/Fall Times
- Low Supply Current:
  - With Logic '1' Input – 3.5 mA (Max)
  - With Logic '0' Input – 350  $\mu$ A (Max)
- Low Output Impedance: 3.5 $\Omega$  (typ)
- Latch-Up Protected: Will Withstand 1.5A Reverse Current
- Logic Input: Will Withstand Negative Swing Up To 5V
- ESD Protected: 4 kV
- Pin-compatible with the TC4426M/TC4427M/TC4428M and TC4426AM/TC4427AM/TC4428AM devices
- Wide Operating Temperature Range:
  - -55°C to +125°C
- See TC4423/TC4424/TC4425 Data Sheet (DS21421) for additional temperature range and packaging offerings

### Applications

- Switch-mode Power Supplies
- Pulse Transformer Drive
- Line Drivers

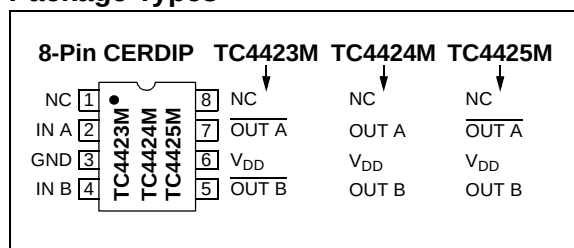
### General Description

The TC4423M/TC4424M/TC4425M devices are a family of 3A, dual output buffers/MOSFET drivers. Pin-compatible with both the TC4426M/TC4427M/TC4428M and TC4426AM/4427AM/4428AM families (dual 1.5A drivers), the TC4423M/TC4424M/TC4425M family has an increased latch-up current rating of 1.5A, making them even more robust for operation in harsh electrical environments.

As MOSFET drivers, the TC4423M/TC4424M/TC4425M can easily charge 1800 pF gate capacitance in under 35 nsec, while providing low enough impedances in both the on and off states to ensure the MOSFET's intended state will not be affected, even by large transients.

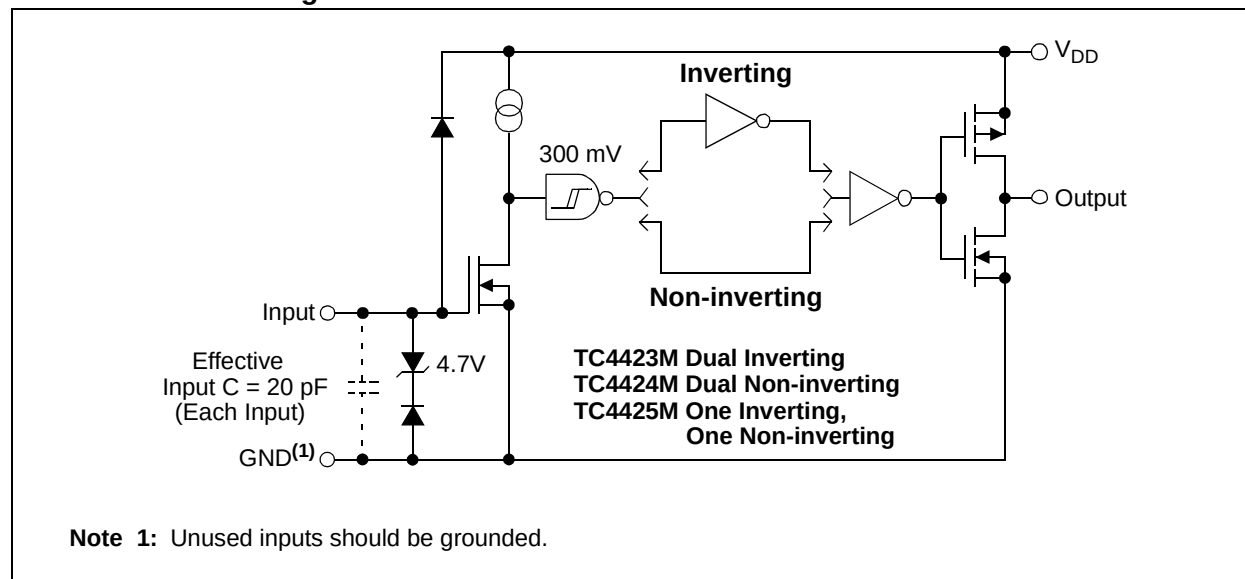
The TC4423M/TC4424M/TC4425M inputs may be driven directly from either TTL or CMOS (2.4V to 18V). In addition, 300 mV of hysteresis is built-in to provide noise immunity and to allow the device to be driven from slowly rising or falling waveforms.

### Package Types



# TC4423M/TC4424M/TC4425M

## Functional Block Diagram



# TC4423M/TC4424M/TC4425M

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings †

Supply Voltage .....+22V

Input Voltage, IN A or IN B ..... ( $V_{DD} + 0.3V$ ) to (GND – 5V)

† **Notice:** Stresses above those listed under "Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

### DC CHARACTERISTICS

| <b>Electrical Specifications:</b> Unless otherwise indicated, $T_A = +25^\circ\text{C}$ , with $4.5V \leq V_{DD} \leq 18V$ . |           |                  |             |             |               |                                                             |
|------------------------------------------------------------------------------------------------------------------------------|-----------|------------------|-------------|-------------|---------------|-------------------------------------------------------------|
| Parameters                                                                                                                   | Sym       | Min              | Typ         | Max         | Units         | Conditions                                                  |
| <b>Input</b>                                                                                                                 |           |                  |             |             |               |                                                             |
| Logic '1', High Input Voltage                                                                                                | $V_{IH}$  | 2.4              | —           | —           | V             |                                                             |
| Logic '0', Low Input Voltage                                                                                                 | $V_{IL}$  | —                | —           | 0.8         | V             |                                                             |
| Input Current                                                                                                                | $I_{IN}$  | -1               | —           | 1           | $\mu\text{A}$ | $0V \leq V_{IN} \leq V_{DD}$                                |
| <b>Output</b>                                                                                                                |           |                  |             |             |               |                                                             |
| High Output Voltage                                                                                                          | $V_{OH}$  | $V_{DD} - 0.025$ | —           | —           | V             |                                                             |
| Low Output Voltage                                                                                                           | $V_{OL}$  | —                | —           | 0.025       | V             |                                                             |
| Output Resistance, High                                                                                                      | $R_{OH}$  | —                | 2.8         | 5           | $\Omega$      | $I_{OUT} = 10\text{ mA}$ , $V_{DD} = 18V$                   |
| Output Resistance, Low                                                                                                       | $R_{OL}$  | —                | 3.5         | 5           | $\Omega$      | $I_{OUT} = 10\text{ mA}$ , $V_{DD} = 18V$                   |
| Peak Output Current                                                                                                          | $I_{PK}$  | —                | 3           | —           | A             |                                                             |
| Latch-Up Protection Withstand Reverse Current                                                                                | $I_{REV}$ | —                | >1.5        | —           | A             | Duty cycle $\leq 2\%$ , $t \leq 300\text{ }\mu\text{sec}$ . |
| <b>Switching Time (Note 1)</b>                                                                                               |           |                  |             |             |               |                                                             |
| Rise Time                                                                                                                    | $t_R$     | —                | 23          | 35          | ns            | Figure 4-1, Figure 4-2, $C_L = 1800\text{ pF}$              |
| Fall Time                                                                                                                    | $t_F$     | —                | 25          | 35          | ns            | Figure 4-1, Figure 4-2, $C_L = 1800\text{ pF}$              |
| Delay Time                                                                                                                   | $t_{D1}$  | —                | 33          | 75          | ns            | Figure 4-1, Figure 4-2, $C_L = 1800\text{ pF}$              |
| Delay Time                                                                                                                   | $t_{D2}$  | —                | 38          | 75          | ns            | Figure 4-1, Figure 4-2, $C_L = 1800\text{ pF}$              |
| <b>Power Supply</b>                                                                                                          |           |                  |             |             |               |                                                             |
| Power Supply Current                                                                                                         | $I_S$     | —                | 1.5<br>0.15 | 2.5<br>0.25 | mA            | $V_{IN} = 3V$ (Both inputs)<br>$V_{IN} = 0V$ (Both inputs)  |

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

# TC4423M/TC4424M/TC4425M

## DC CHARACTERISTICS (OVER OPERATING TEMPERATURE RANGE)

| <b>Electrical Specifications:</b> Unless otherwise indicated, operating temperature range with $4.5V \leq V_{DD} \leq 18V$ . |           |                  |            |            |          |                                                            |
|------------------------------------------------------------------------------------------------------------------------------|-----------|------------------|------------|------------|----------|------------------------------------------------------------|
| Parameters                                                                                                                   | Sym       | Min              | Typ        | Max        | Units    | Conditions                                                 |
| <b>Input</b>                                                                                                                 |           |                  |            |            |          |                                                            |
| Logic '1', High Input Voltage                                                                                                | $V_{IH}$  | 2.4              | —          | —          | V        |                                                            |
| Logic '0', Low Input Voltage                                                                                                 | $V_{IL}$  | —                | —          | 0.8        | V        |                                                            |
| Input Current                                                                                                                | $I_{IN}$  | -10              | —          | +10        | $\mu A$  | $0V \leq V_{IN} \leq V_{DD}$                               |
| <b>Output</b>                                                                                                                |           |                  |            |            |          |                                                            |
| High Output Voltage                                                                                                          | $V_{OH}$  | $V_{DD} - 0.025$ | —          | —          | V        |                                                            |
| Low Output Voltage                                                                                                           | $V_{OL}$  | —                | —          | 0.025      | V        |                                                            |
| Output Resistance, High                                                                                                      | $R_{OH}$  | —                | 3.7        | 8          | $\Omega$ | $I_{OUT} = 10 \text{ mA}$ , $V_{DD} = 18V$                 |
| Output Resistance, Low                                                                                                       | $R_{OL}$  | —                | 4.3        | 8          | $\Omega$ | $I_{OUT} = 10 \text{ mA}$ , $V_{DD} = 18V$                 |
| Peak Output Current                                                                                                          | $I_{PK}$  | —                | 3.0        | —          | A        |                                                            |
| Latch-Up Protection Withstand Reverse Current                                                                                | $I_{REV}$ | —                | >1.5       | —          | A        | Duty cycle $\leq 2\%$ , $t \leq 300 \mu\text{sec}$         |
| <b>Switching Time (Note 1)</b>                                                                                               |           |                  |            |            |          |                                                            |
| Rise Time                                                                                                                    | $t_R$     | —                | 28         | 60         | ns       | Figure 4-1, Figure 4-2, $C_L = 1800 \text{ pF}$            |
| Fall Time                                                                                                                    | $t_F$     | —                | 32         | 60         | ns       | Figure 4-1, Figure 4-2, $C_L = 1800 \text{ pF}$            |
| Delay Time                                                                                                                   | $t_{D1}$  | —                | 32         | 100        | ns       | Figure 4-1, Figure 4-2, $C_L = 1800 \text{ pF}$            |
| Delay Time                                                                                                                   | $t_{D2}$  | —                | 38         | 100        | ns       | Figure 4-1, Figure 4-2, $C_L = 1800 \text{ pF}$            |
| <b>Power Supply</b>                                                                                                          |           |                  |            |            |          |                                                            |
| Power Supply Current                                                                                                         | $I_S$     | —<br>—           | 2.0<br>0.2 | 3.5<br>0.3 | mA       | $V_{IN} = 3V$ (Both inputs)<br>$V_{IN} = 0V$ (Both inputs) |

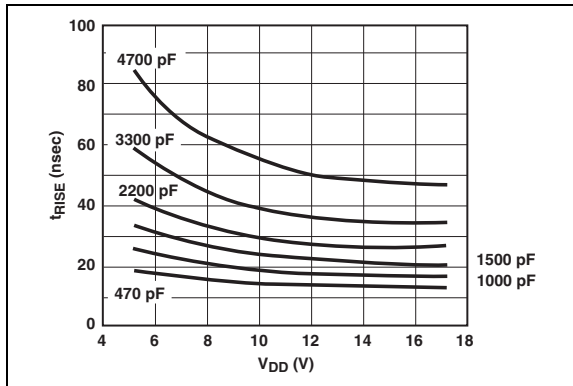
**Note 1:** Switching times ensured by design.

## TEMPERATURE CHARACTERISTICS

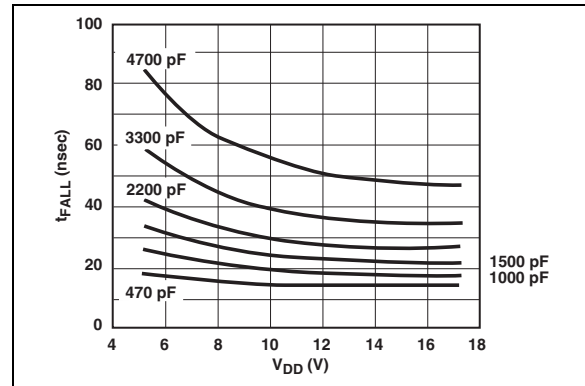
| <b>Electrical Specifications:</b> Unless otherwise noted, all parameters apply with $4.5V \leq V_{DD} \leq 18V$ . |               |     |     |      |               |            |
|-------------------------------------------------------------------------------------------------------------------|---------------|-----|-----|------|---------------|------------|
| Parameters                                                                                                        | Sym           | Min | Typ | Max  | Units         | Conditions |
| <b>Temperature Ranges</b>                                                                                         |               |     |     |      |               |            |
| Specified Temperature Range (M)                                                                                   | $T_A$         | -55 | —   | +125 | $^{\circ}C$   |            |
| Maximum Junction Temperature                                                                                      | $T_J$         | —   | —   | +150 | $^{\circ}C$   |            |
| Storage Temperature Range                                                                                         | $T_A$         | -65 | —   | +150 | $^{\circ}C$   |            |
| <b>Package Thermal Resistances</b>                                                                                |               |     |     |      |               |            |
| Thermal Resistance, 8L-CERDIP                                                                                     | $\theta_{JA}$ | —   | 150 | —    | $^{\circ}C/W$ |            |

## 2.0 TYPICAL PERFORMANCE CURVES

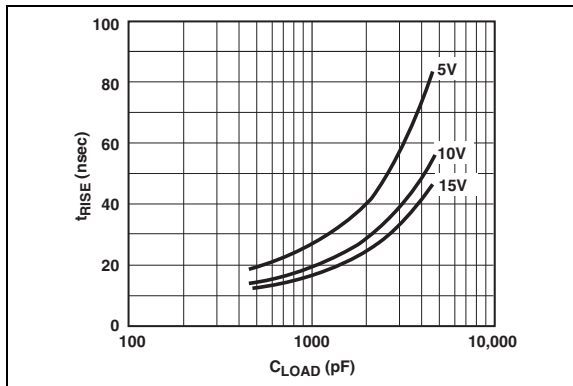
**Note:** The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only. The performance characteristics listed herein are not tested or guaranteed. In some graphs or tables, the data presented may be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



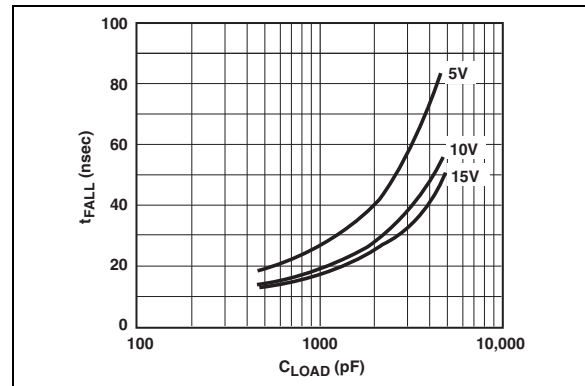
**FIGURE 2-1:** Rise Time vs. Supply Voltage.



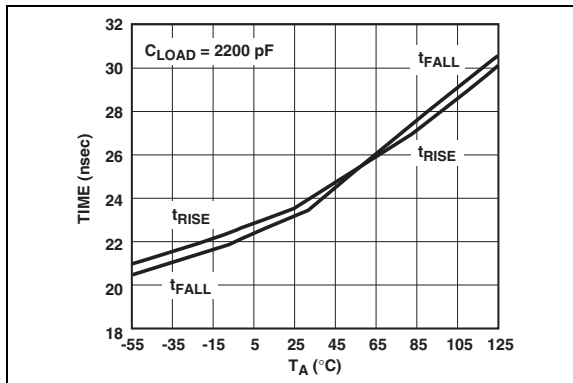
**FIGURE 2-4:** Fall Time vs. Supply Voltage.



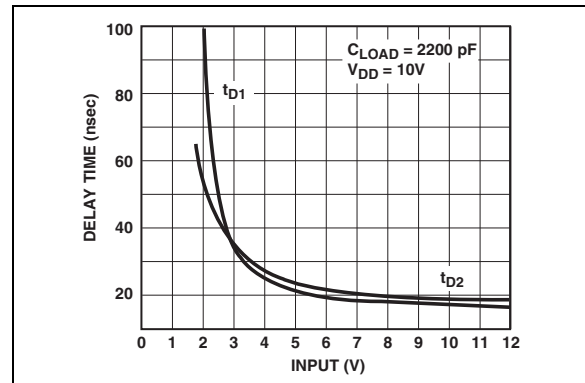
**FIGURE 2-2:** Rise Time vs. Capacitive Load.



**FIGURE 2-5:** Fall Time vs. Capacitive Load.



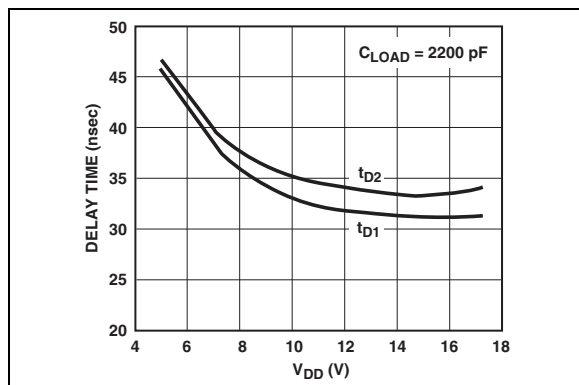
**FIGURE 2-3:** Rise and Fall Times vs. Temperature.



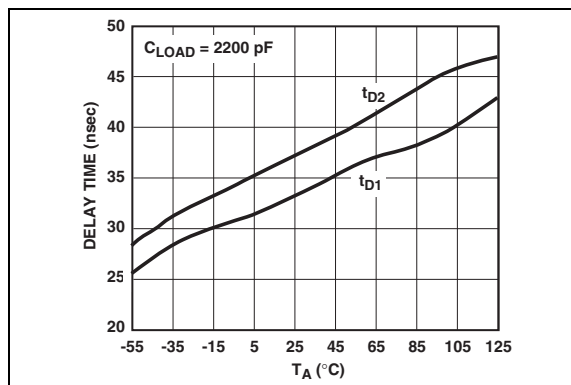
**FIGURE 2-6:** Propagation Delay vs. Input Amplitude.

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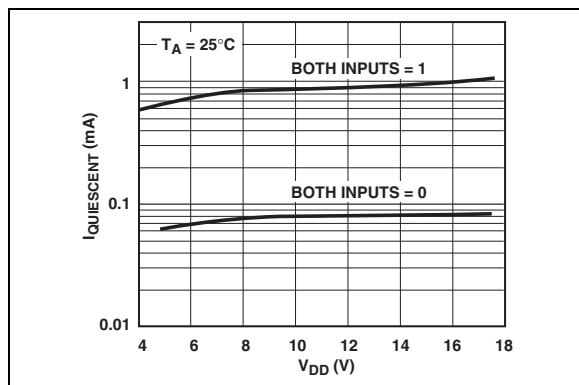
## Typical Performance Curves (Continued)



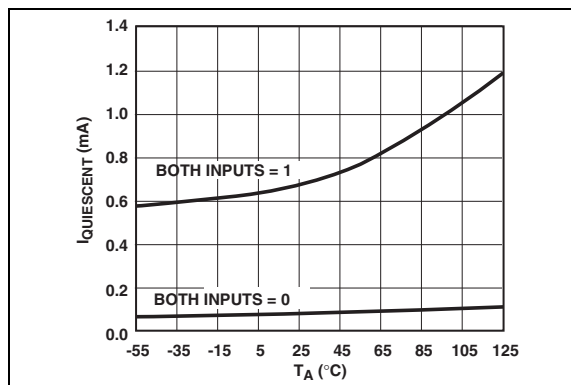
**FIGURE 2-7:** Propagation Delay Time vs. Supply Voltage.



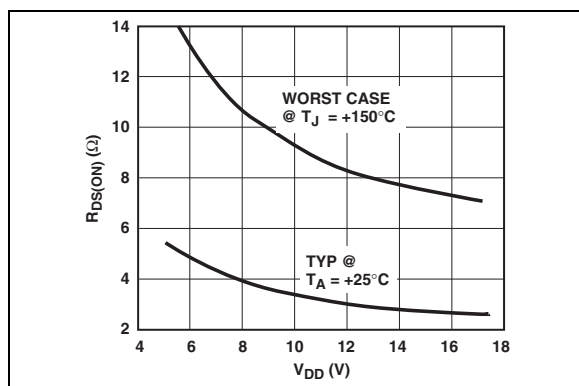
**FIGURE 2-10:** Propagation Delay Time vs. Temperature.



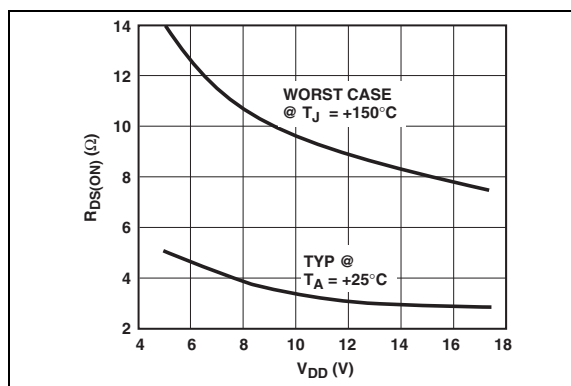
**FIGURE 2-8:** Quiescent Current vs. Supply Voltage.



**FIGURE 2-11:** Quiescent Current vs. Temperature.



**FIGURE 2-9:** Output Resistance (Output High) vs. Supply Voltage.

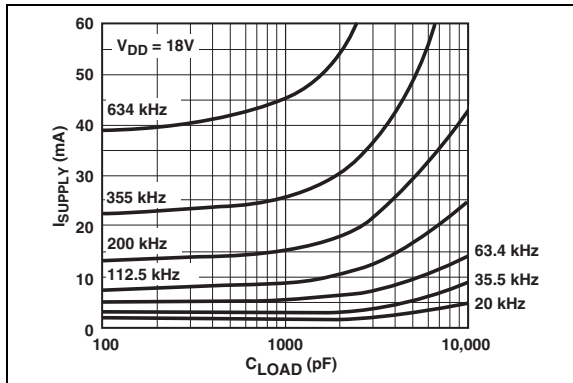


**FIGURE 2-12:** Output Resistance (Output Low) vs. Supply Voltage.

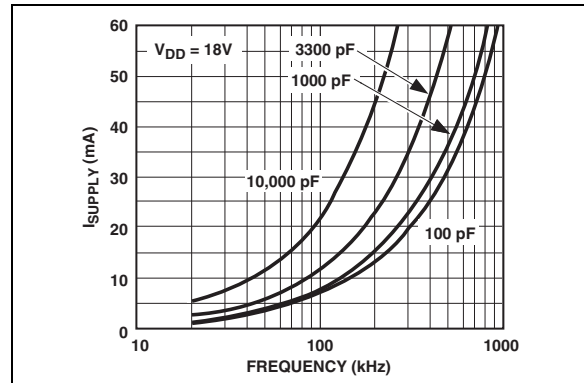
# TC4423M/TC4424M/TC4425M

## Typical Performance Curves (Continued)

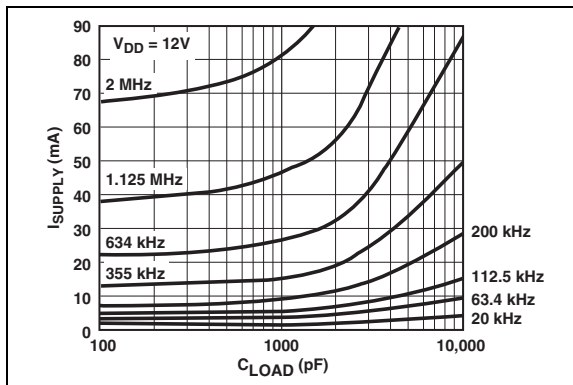
Note: Load on single output only



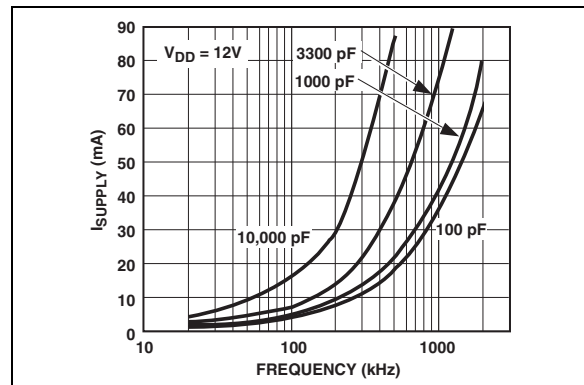
**FIGURE 2-13:** Supply Current vs. Capacitive Load.



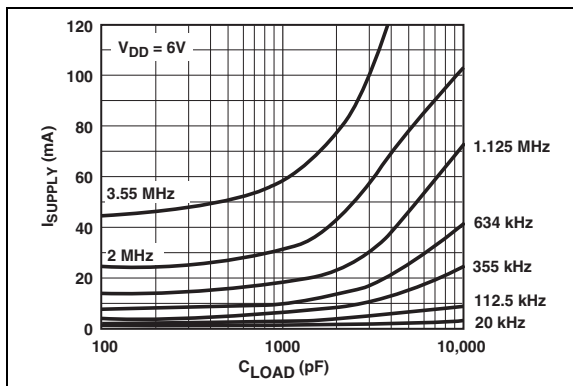
**FIGURE 2-16:** Supply Current vs. Frequency.



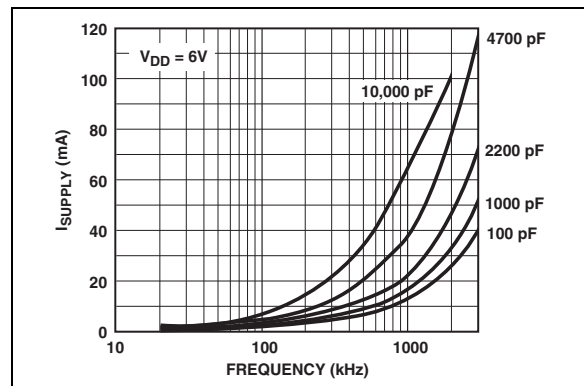
**FIGURE 2-14:** Supply Current vs. Capacitive Load.



**FIGURE 2-17:** Supply Current vs. Frequency.



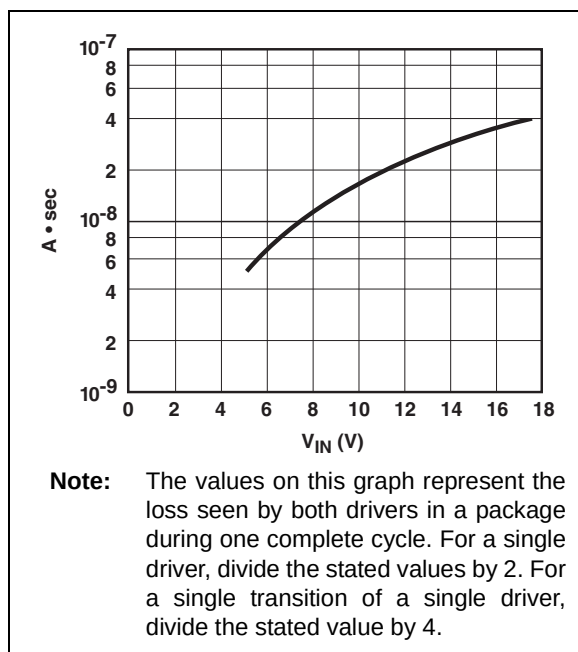
**FIGURE 2-15:** Supply Current vs. Capacitive Load.



**FIGURE 2-18:** Supply Current vs. Frequency.

# TC4423M/TC4424M/TC4425M

## Typical Performance Curves (Continued)



**FIGURE 2-19:** TC4423M Crossover Energy.



## 3.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 3-1.

**TABLE 3-1: PIN FUNCTION TABLE**

| 8-Pin Cerdip | Symbol          | Description   |
|--------------|-----------------|---------------|
| 1            | NC              | No connection |
| 2            | IN A            | Input A       |
| 3            | GND             | Ground        |
| 4            | IN B            | Input B       |
| 5            | OUT B           | Output B      |
| 6            | V <sub>DD</sub> | Supply input  |
| 7            | OUT A           | Output A      |
| 8            | NC              | No connection |

### 3.1 Input A (IN A)

IN A is a TTL/CMOS-compatible input that controls OUT A. This input has 300 mV of hysteresis between the high and low input levels that allows it to be driven from slow rising and falling signals, as well as providing noise immunity.

### 3.2 Input B (IN B)

IN B is a TTL/CMOS-compatible input that controls OUT B. This input has 300 mV of hysteresis between the high and low input levels that allows it to be driven from slow rising and falling signals, as well as providing noise immunity.

### 3.3 Output B (OUT B)

OUT B is a CMOS push-pull output that is capable of sourcing and sinking 3A peaks of current ( $V_{DD} = 18V$ ). The low output impedance ensures the gate of the external MOSFET will stay in the intended state even during large transients. This output also has a reverse current latch-up rating of 1.5A.

### 3.4 Output A (OUT A)

OUT A is a CMOS, push-pull output that is capable of sourcing and sinking 3A peaks of current ( $V_{DD} = 18V$ ). The low output impedance ensures the gate of the external MOSFET will stay in the intended state even during large transients. This output also has a reverse current latch-up rating of 1.5A.

### 3.5 Supply Input (V<sub>DD</sub>)

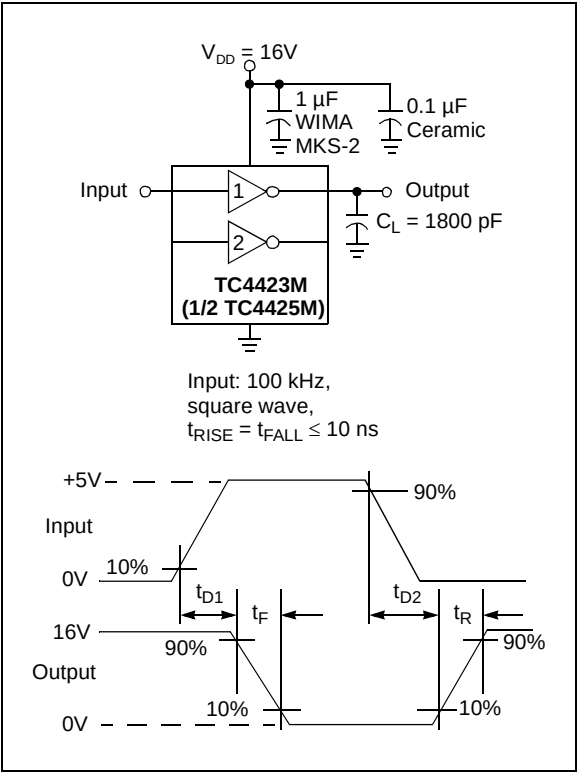
V<sub>DD</sub> is the bias supply input for the MOSFET driver and has a voltage range of 4.5V to 18V. This input must be decoupled to ground with a local ceramic capacitor. This bypass capacitor provides a localized low-impedance path for the peak currents that are to be provided to the load.

### 3.6 Ground (GND)

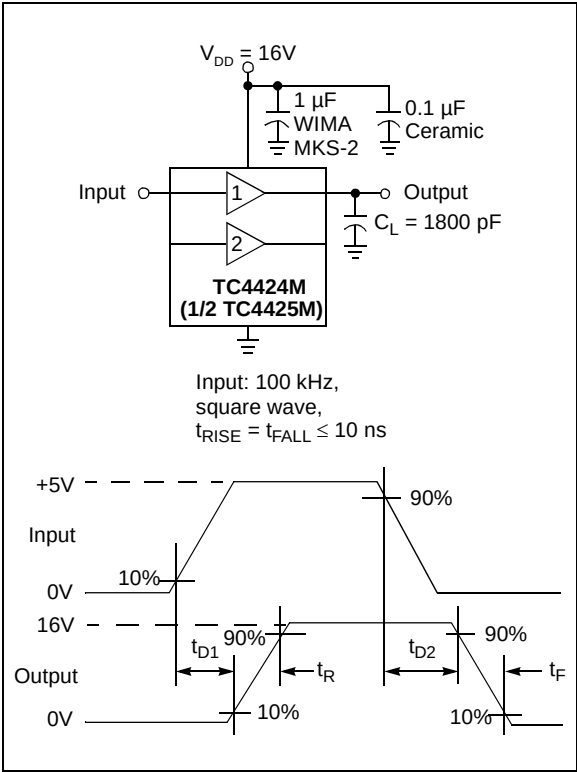
GND is the device return pin. The ground pin(s) should have a low-impedance connection to the bias supply source return. High peak currents will flow out the ground pin(s) when the capacitive load is being discharged.

# TC4423M/TC4424M/TC4425M

## 4.0 APPLICATIONS INFORMATION



**FIGURE 4-1:** Inverting Driver Switching Time.

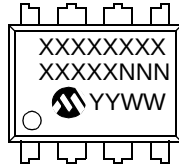


**FIGURE 4-2:** Non-inverting Driver Switching Time.

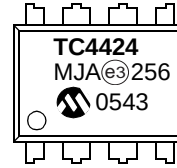
## 5.0 PACKAGING INFORMATION

### 5.1 Package Marking Information

8-Lead CERDIP (300 mil)



Example:



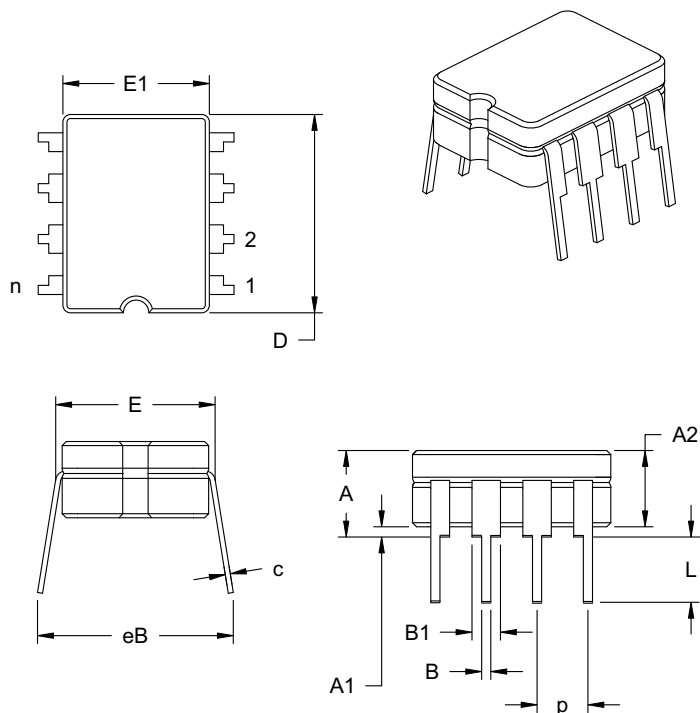
|                |        |                                                                                                                    |
|----------------|--------|--------------------------------------------------------------------------------------------------------------------|
| <b>Legend:</b> | XX...X | Customer-specific information                                                                                      |
|                | Y      | Year code (last digit of calendar year)                                                                            |
|                | YY     | Year code (last 2 digits of calendar year)                                                                         |
|                | WW     | Week code (week of January 1 is week '01')                                                                         |
|                | NNN    | Alphanumeric traceability code                                                                                     |
|                | (e3)   | Pb-free JEDEC designator for Matte Tin (Sn)                                                                        |
|                | *      | This package is Pb-free. The Pb-free JEDEC designator ((e3)) can be found on the outer packaging for this package. |

**Note:** In the event the full Microchip part number cannot be marked on one line, it will be carried over to the next line, thus limiting the number of available characters for customer-specific information.

# TC4423M/TC4424M/TC4425M

## 8-Lead Ceramic Dual In-line – 300 mil (CERDIP)

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



| Units                      |    | INCHES* |      |      | MILLIMETERS |      |       |
|----------------------------|----|---------|------|------|-------------|------|-------|
| Dimension Limits           |    | MIN     | NOM  | MAX  | MIN         | NOM  | MAX   |
| Number of Pins             | n  |         | 8    |      |             | 8    |       |
| Pitch                      | p  |         | .100 |      |             | 2.54 |       |
| Top to Seating Plane       | A  | .160    | .180 | .200 | 4.06        | 4.57 | 5.08  |
| Standoff §                 | A1 | .020    | .030 | .040 | 0.51        | 0.77 | 1.02  |
| Shoulder to Shoulder Width | E  | .290    | .305 | .320 | 7.37        | 7.75 | 8.13  |
| Ceramic Pkg. Width         | E1 | .230    | .265 | .300 | 5.84        | 6.73 | 7.62  |
| Overall Length             | D  | .370    | .385 | .400 | 9.40        | 9.78 | 10.16 |
| Tip to Seating Plane       | L  | .125    | .163 | .200 | 3.18        | 4.13 | 5.08  |
| Lead Thickness             | c  | .008    | .012 | .015 | 0.20        | 0.29 | 0.38  |
| Upper Lead Width           | B1 | .045    | .055 | .065 | 1.14        | 1.40 | 1.65  |
| Lower Lead Width           | B  | .016    | .018 | .020 | 0.41        | 0.46 | 0.51  |
| Overall Row Spacing        | eB | .320    | .360 | .400 | 8.13        | 9.15 | 10.16 |

\*Controlling Parameter

JEDEC Equivalent: MS-030

Drawing No. C04-010

## **APPENDIX A: REVISION HISTORY**

### **Revision B (January 2013)**

Added a note to each package outline drawing.

### **Revision A (March 2005)**

- Original Release of this Document.

# TC4423M/TC4424M/TC4425M

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NOTES:

# TC4423M/TC4424M/TC4425M

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

| <u>PART NO.</u>                                                                                                                                                                                        | <u>XX</u>                                                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Device and Temperature Range                                                                                                                                                                           | Package                                                                                                                                                                                                                                                                                |
| Device: TC4423M: 3A Dual MOSFET Driver, Inverting, -55°C to +125°C<br>TC4424M: 3A Dual MOSFET Driver, Non-Inverting, -55°C to +125°C<br>TC4425M: 3A Dual MOSFET Driver, Complementary, -55°C to +125°C | Examples:<br>a) TC4423MJA: 3A Dual MOSFET Driver, Inverting, -55°C to +125°C 8LD Cerdip package.<br>a) TC4424MJA: 3A Dual MOSFET Driver, Non-Inverting, -55°C to +125°C 8LD Cerdip package.<br>a) TC4425MJA: 3A Dual MOSFET Driver, Complementary, -55°C to +125°C 8LD Cerdip package. |
| Package: JA = Ceramic DIP, (300 mil body), 8-lead                                                                                                                                                      |                                                                                                                                                                                                                                                                                        |

# TC4423M/TC4424M/TC4425M

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NOTES:



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**Note the following details of the code protection feature on Microchip devices:**

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

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