General Description

The MIC4467/8/9 family of 4-output CMOS buffer/drivers is an expansion from the earlier single- and dual-output drivers, to which they are functionally closely related. Because package pin count permitted it, each driver has been equipped with a 2-input logic gate for added flexibility. Placing four high-power drivers in a single package also improves system reliability and reduces total system cost. In some applications, one of these drivers can replace not only two packages of single-input drivers, but some of the associated logic as well.

Although primarily intended for driving power MOSFETs, and similar highly capacitive loads, these drivers are equally well suited to driving any other load (capacitive, resistive, or inductive), which requires a high-efficiency, low-impedance driver capable of high peak currents, rail-to-rail voltage swings, and fast switching times. For example, heavily loaded clock lines, coaxial cables, and piezoelectric transducers can all be driven easily with MIC446X series drivers. The only limitation

Features

- Built using reliable, low power CMOS processes
- Latchproof. Withstands 500mA Inductive Kickback
- 3 Input Logic Choices
- Symmetrical Rise and Fall Times: 25ns
- Short, Equal Delay Times: 75ns
- High Peak Output Current: 1.2A
- Wide Operating Range: 4.5 to 18V
- Low Equivalent Input Capacitance (typ): 6pF
- Inputs = Logic 1 for Any Input From 2.4V to $V_s$
- ESD Protected

Applications

- General-Purpose CMOS Logic Buffer
- Driving All 4 MOSFETs in an H-Bridge
- Direct Small-Motor Driver
- Relay or Peripheral Drivers
- Dual Differential Output Power Drivers
- CCD Driver
- Pin-Switching Network Driver

Logic Diagrams

![Logic Diagrams](image-url)
on loading is that total power dissipation in the IC must be kept within the power dissipation limits of the package. The MIC446X series drivers are built using a BCD process. They will not latch under any conditions within their power and voltage ratings. They are not subject to damage when up to 5V of noise spiking (either polarity) occurs on the ground line. They can accept up to half an amp of inductive kickback current (either polarity) into their outputs without damage or logic upset.

### Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Temperature Range</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>Pb-Free</td>
<td></td>
</tr>
<tr>
<td>MIC4467CN*</td>
<td>0°C to +70°C</td>
<td>14-pin Plastic DIP</td>
</tr>
<tr>
<td>MIC4468ZN*</td>
<td>0°C to +70°C</td>
<td>16-pin Wide SOIC</td>
</tr>
<tr>
<td>MIC4469BN*</td>
<td>-40°C to +85°C</td>
<td>14-pin Plastic DIP</td>
</tr>
<tr>
<td>MIC4469YWM*</td>
<td>-40°C to +85°C</td>
<td>16-pin Wide SOIC</td>
</tr>
</tbody>
</table>

* xx identifies input logic:
  67 — NAND
  68 — AND
  69 — AND with 1 inverting input

**Pb-Free industrial grade PDIP available in MIC4468 & MIC4469 only.

### Truth Table

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Inputs</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>MIC4467</td>
<td>L</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>MIC4468</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>X</td>
<td>L</td>
</tr>
<tr>
<td>MIC4469</td>
<td>L</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>H</td>
<td>L</td>
</tr>
</tbody>
</table>

### Pin Configurations

**14-Pin DIP (N)**

1A 1
1B 2
2A 3
2B 4
3A 5
3B 6
GND 7

14 VS
13 Y
12 2Y
11 3Y
10 4Y
9 4B
8 4A

**16-Pin Wide SOIC (WM)**

1A 1
1B 2
2A 3
2B 4
3A 5
3B 6
GND 7
GND 8

16 VS
15 Y
14 1Y
13 2Y
12 3Y
11 4Y
10 4B
9 4A
Block Diagrams

Functional Diagram for One Driver (Four Drivers per Package–Ground Unused Inputs)

MIC4468

Functional Diagram for One Driver (Four Drivers per Package–Ground Unused Inputs)

MIC4469

Functional Diagram for One Driver (Four Drivers per Package–Ground Unused Inputs)
**Absolute Maximum Ratings** (Notes 1 and 2)

Supply Voltage 22V  
Input Voltage (GND – 5V) to (V<sub>S</sub> + 0.3V)  
Maximum Chip Temperature  
   Operating 150°C  
   Storage -65° to +150°C  
Maximum Load Temperature  
(10 sec, for soldering) 300°C  
Operating Ambient Temperature  
   C Version 0° to +70°C  
   B Version -40° to +85°C  

| Power Dissipation | N Package (14-Pin Plastic DIP) | 1.5W  
| WM Package (16-Pin Wide SOIC) | 1W  

| Package Thermal Resistance | N Package (14-Pin Plastic DIP) θ<sub>JA</sub> | 80°C/W  
| WM Package (16-Pin Wide SOIC) θ<sub>JA</sub> | 120°C/W  

**Electrical Characteristics:** Measured at T<sub>A</sub> = 25°C with 4.5V ≤ V<sub>S</sub> ≤ 18V unless otherwise specified. *(Note 3)*

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>V&lt;sub&gt;ih&lt;/sub&gt;</td>
<td>Logic 1 Input Voltage</td>
<td></td>
<td>2.4</td>
<td>1.3</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V&lt;sub&gt;il&lt;/sub&gt;</td>
<td>Logic 0 Input Voltage</td>
<td></td>
<td>1.2</td>
<td>0.8</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;in&lt;/sub&gt;</td>
<td>Input Current</td>
<td>0 ≤ V&lt;sub&gt;in&lt;/sub&gt; ≤ V&lt;sub&gt;S&lt;/sub&gt;</td>
<td>-1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V&lt;sub&gt;oh&lt;/sub&gt;</td>
<td>High Output Voltage</td>
<td>I&lt;sub&gt;LOAD&lt;/sub&gt; = 10mA</td>
<td>V&lt;sub&gt;S&lt;/sub&gt;-0.15</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>V&lt;sub&gt;ol&lt;/sub&gt;</td>
<td>Low Output Voltage</td>
<td>I&lt;sub&gt;LOAD&lt;/sub&gt; = 10mA</td>
<td>0.15</td>
<td></td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>R&lt;sub&gt;o&lt;/sub&gt;</td>
<td>Output Resistance</td>
<td>I&lt;sub&gt;OUT&lt;/sub&gt; = 10mA, V&lt;sub&gt;S&lt;/sub&gt; = 18V</td>
<td>5</td>
<td>15</td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>I&lt;sub&gt;PK&lt;/sub&gt;</td>
<td>Peak Output Current</td>
<td></td>
<td>1.2</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Latch-Up Protection</td>
<td>Withstand Reverse Current</td>
<td>&gt;500</td>
<td></td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>

**Switching Time**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>t&lt;sub&gt;r&lt;/sub&gt;</td>
<td>Rise Time</td>
<td>Test Figure 1</td>
<td>14</td>
<td>25</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>t&lt;sub&gt;f&lt;/sub&gt;</td>
<td>Fall Time</td>
<td>Test Figure 1</td>
<td>13</td>
<td>25</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>t&lt;sub&gt;d1&lt;/sub&gt;</td>
<td>Delay Time</td>
<td>Test Figure 1</td>
<td>30</td>
<td>75</td>
<td>ns</td>
<td></td>
</tr>
<tr>
<td>t&lt;sub&gt;d2&lt;/sub&gt;</td>
<td>Delay Time</td>
<td>Test Figure 1</td>
<td>45</td>
<td>75</td>
<td>ns</td>
<td></td>
</tr>
</tbody>
</table>

**Power Supply**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>I&lt;sub&gt;S&lt;/sub&gt;</td>
<td>Power Supply Current</td>
<td></td>
<td>0.2</td>
<td>4</td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>

**Note 3.** Specification for packaged product only.
**Electrical Characteristics:**

Measured over operating temperature range with $4.5V \leq V_s \leq 18V$ unless otherwise specified.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{IH}$</td>
<td>Logic 1 Input Voltage</td>
<td></td>
<td>2.4</td>
<td>1.4</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{IL}$</td>
<td>Logic 0 Input Voltage</td>
<td></td>
<td>1.0</td>
<td>0.8</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$I_{IN}$</td>
<td>Input Current</td>
<td>$0 \leq V_{in} \leq V_s$</td>
<td>–1</td>
<td></td>
<td></td>
<td>µA</td>
</tr>
</tbody>
</table>

**INPUT**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{OH}$</td>
<td>High Output Voltage $I_{LOAD} = 10$ mA</td>
<td>$V_s - 0.3$</td>
<td></td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$V_{OL}$</td>
<td>Low Output Voltage $I_{LOAD} = 10$ mA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>$R_O$</td>
<td>Output Resistance $I_{OUT} = 10$ mA, $V_s = 18V$</td>
<td>7</td>
<td>30</td>
<td></td>
<td>Ω</td>
<td></td>
</tr>
<tr>
<td>$I_{PK}$</td>
<td>Peak Output Current</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
<tr>
<td>$I$</td>
<td>Latch-Up Protection Withstand Reverse Current</td>
<td></td>
<td>500</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

**OUTPUT**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$t_R$</td>
<td>Rise Time</td>
<td>Test Figure 1</td>
<td>17</td>
<td>50</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_F$</td>
<td>Fall Time</td>
<td>Test Figure 1</td>
<td>16</td>
<td>50</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_{D1}$</td>
<td>Delay Time</td>
<td>Test Figure 1</td>
<td>35</td>
<td>100</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>$t_{D2}$</td>
<td>Delay Time</td>
<td>Test Figure 1</td>
<td>55</td>
<td>100</td>
<td></td>
<td>ns</td>
</tr>
</tbody>
</table>

**POWER SUPPLY**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_s$</td>
<td>Power Supply Current Supply</td>
<td></td>
<td>0.4</td>
<td></td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

**NOTE 1:** Functional operation above the absolute maximum stress ratings is not implied.

**NOTE 2:** Static sensitive device. Store only in conductive containers. Handling personnel and equipment should be grounded to prevent static damage.
Typical Characteristics

Rise and Fall Time vs. Supply Voltage

Delay Time vs. Supply Voltage

Rise and Fall Time vs. Temperature

Delay Time vs. Temperature

Supply Current vs. Capacitive Load

Rise and Fall Time vs. Capacitive Load

Supply Current vs. Frequency

High Output vs. Current

Low Output vs. Current

Rise and Fall

Time vs. Capacitive Load

Delay Time vs. Capacitive Load

Supply Current vs. Frequency

High Output vs. Current

Low Output vs. Current
Test Figure 1

Quiescent Power Supply Current vs. Supply Voltage

0 5 10 15 20
SUPPLY VOLTAGE (V)
0 0.5 1.0 1.5 2.0 2.5
SUPPLY CURRENT (mA)

NO LOAD
BOTH INPUTS LOGIC "1"
$T_A = 25 \, ^\circ C$

INVERTING INPUT T

$V_{INPUT}$

+5V

$V_{OUTPUT}$

10%

90%

$V_{INPUT}$

10%

90%

$V_{OUTPUT}$

0V

18V

10%

90%

$V_{OUTPUT}$

100%

100%

$V_{OUTPUT}$

18V

0V

NO LOAD
BOTH INPUTS LOGIC "0"

$T_A = 25 \, ^\circ C$

Quiescent Power Supply Current vs. Supply Voltage

0 5 10 15 20
SUPPLY VOLTAGE (V)
0 50 100 150 200 250
SUPPLY CURRENT (µA)

Package Power Dissipation

$P_D$ (mW)

25 50 75 100 125 150
AMBIENT TEMPERATURE (°C)

14-PIN PDIP
SLOPE = –12 mW/°C

16-PIN WIDE SOIC
SLOPE = –8 mW/°C

Quad Driver Drives H Bridge to Control Motor Speed and Direction

INVERSE INPUT T

$V_{INPUT}$

+5V

$V_{OUTPUT}$

10%

90%

$V_{INPUT}$

10%

90%

$V_{OUTPUT}$

18V

0V

DC BRUSH MOTOR

MIC4467

CW

CCW

PWM SPEED

$+5V$ TO $+15V$

GND

1 µF FILM

0.1 µF CERAMIC

IN1

IN2

IN3

IN4

$\bar{IN}_1$

$\bar{IN}_2$

$\bar{IN}_3$

$\bar{IN}_4$

$V_{OUT}$

470 pF

10% INVERTING INPUT T

+5V

$V_{INPUT}$

$V_{OUTPUT}$

10%

90%

$V_{INPUT}$

10%

90%

$V_{OUTPUT}$

18V

0V

100%

100%

$V_{OUTPUT}$

18V

0V

100%

100%

$V_{OUTPUT}$

$18V$

$0V$

$V_{OUTPUT}$

$V_{INPUT}$

$V_{OUTPUT}$

$V_{INPUT}$

$V_{OUTPUT}$

$V_{INPUT}$

$V_{OUTPUT}$

$V_{INPUT}$

$V_{OUTPUT}$

$V_{INPUT}$

$V_{OUTPUT}$

14-PIN PDIP

SLOPE = –12 mW/°C

16-PIN WIDE SOIC

SLOPE = –8 mW/°C

$V_{S}$
Package Information

14-Pin Plastic DIP (N)

16-Pin Wide SOP (WM)

This information furnished by Micrel in this data sheet is believed to be accurate and reliable. However no responsibility is assumed by Micrel for its use. Micrel reserves the right to change circuitry and specifications at any time without notification to the customer.

Micrel Products are not designed or authorized for use as components in life support appliances, devices or systems where malfunction of a product can reasonably be expected to result in personal injury. Life support devices or systems are devices or systems that (a) are intended for surgical implant into the body or (b) support or sustain life, and whose failure to perform can be reasonably expected to result in a significant injury to the user. A Purchaser's use or sale of Micrel Products for use in life support appliances, devices or systems is a Purchaser's own risk and Purchaser agrees to fully indemnify Micrel for any damages resulting from such use or sale.

© 1998 Micrel, Inc.