National Semiconductor

# CD4529BM/CD4529BC Dual 4-Channel or Single 8-Channel Analog Data Selector

## General Description

The CD4529B is a dual 4-channel or a single 8-channel analog data selector, implemented with complementary MOS (CMOS) circuits constructed with N- and P-channel enhancement mode transistors. Dual 4-channel or 8-channel mode operation is selected by proper input coding, with outputs Z and W tied together for the single 8-bit mode. The device is suitable for digital as well as analog applications, including various 1-of-4 and 1-of-8 data selector functions. Since the device is analog and bidirectional, it can also be used for dual binary to 1-of-4 or single binary to 1-of-8 decoder applications.

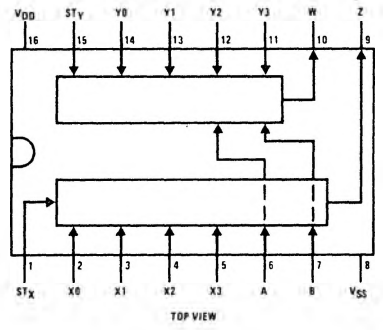
## Features

- Wide supply voltage range — 3.0 V to 15 V
- High noise immunity — 0.45 $V_{DD}$ (typ.)
- Low quiescent power dissipation — 0.005 μW/package (typ.) @ 5.0 $V_{DC}$
- 10 MHz frequency operation (typ.)
- Data paths are bidirectional
- Linear ON resistance [120Ω (typ.) @ 15 V]
- TRI-STATE® outputs (high impedance disable strobe)
- Plug-in replacement for MC14529B

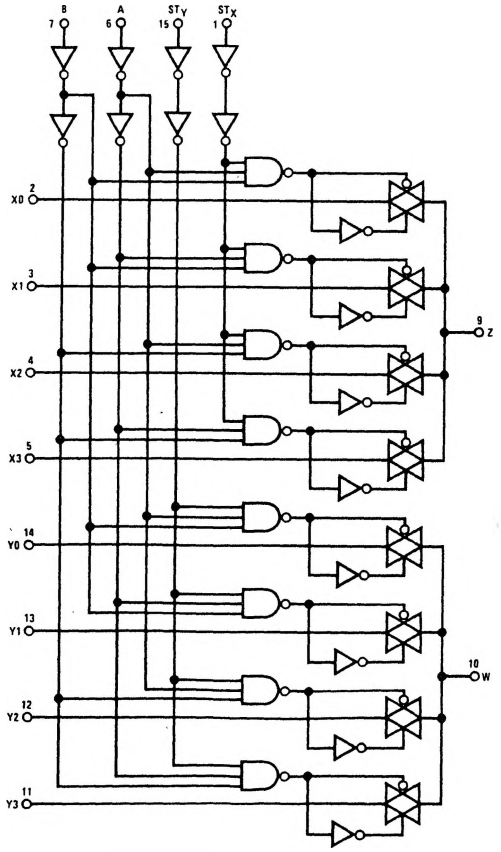
TRI-STATE is a registered trademark of National Semiconductor Corp.

## Connection Diagram

Dual-In-Line Package




## Logic Diagram




## Truth Table

| $ST_X$ | $ST_Y$ | B | A | Z | W | |
|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 0 | X0 | Y0 | Dual 4-Channel Mode 2 Outputs |
| 1 | 1 | 0 | 1 | X1 | Y1 | |
| 1 | 1 | 1 | 0 | X2 | Y2 | |
| 1 | 1 | 1 | 1 | X3 | Y3 | |
| 1 | 0 | 0 | 0 | X0 | | Single 8-Channel Mode 1 Output (Z and W tied together) |
| 1 | 0 | 0 | 1 | X1 | | |
| 1 | 0 | 1 | 0 | X2 | | |
| 1 | 0 | 1 | 1 | X3 | | |
| 0 | 1 | 0 | 0 | Y0 | | |
| 0 | 1 | 0 | 1 | Y1 | | |
| 0 | 1 | 1 | 0 | Y2 | | |
| 0 | 1 | 1 | 1 | Y3 | | |
| 0 | 0 | X | X | High Impedance (TRI-STATE®) | | |

X = Don't care

## Absolute Maximum Ratings

(Notes 1 and 2)

| | |
|---|---|
| $V_{DD}$ DC Supply Voltage | −0.5V to +18V |
| $V_{IN}$ Input Voltage | −0.5V to $V_{DD}$ + 0.5V |
| $T_S$ Storage Temperature Range | −65°C to +150°C |
| $P_D$ Package Dissipation | 500 mW |
| $T_L$ Lead Temperature (Soldering, 10 seconds) | 300°C |

## Recommended Operating Conditions

(Note 2)

| | |
|---|---|
| $V_{DD}$ DC Supply Voltage | 3V to 15V |
| $V_{IN}$ Input Voltage | 0 to $V_{DD}$ |
| $T_A$ Operating Temperature Range | |
| CD4529BM | −55°C to +125°C |
| CD4529BC | −40°C to +85°C |

## DC Electrical Characteristics CD4529BM (Note 2)

| PARAMETER | | CONDITIONS | −55°C | | 25°C | | | 125°C | | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | TYP | MAX | MIN | MAX | |
| $I_{DD}$ | Quiescent Device Current | $V_{DD}$ = 5V | | 1.0 | | 0.001 | 1.0 | | 60 | μA |
| | | $V_{DD}$ = 10V | | 1.0 | | 0.002 | 1.0 | | 60 | μA |
| | | $V_{DD}$ = 15V | | 2.0 | | 0.003 | 2.0 | | 120 | μA |
| $V_{OL}$ | Low Level Output Voltage | $V_{IL}$ = 0V, $V_{IH}$ = $V_{DD}$, $\|I_O\| < 1\ \mu A$ | | | | | | | | |
| | | $V_{DD}$ = 5V | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| | | $V_{DD}$ = 10V | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| | | $V_{DD}$ = 15V | | 0.05 | | 0 | 0.05 | | 0.05 | V |
| $V_{OH}$ | High Level Output Voltage | $V_{IL}$ = 0V, $V_{IH}$ = $V_{DD}$, $\|I_O\| < 1\ \mu A$ | | | | | | | | |
| | | $V_{DD}$ = 5V | 4.95 | | 4.95 | 5.0 | | 4.95 | | V |
| | | $V_{DD}$ = 10V | 9.95 | | 9.95 | 10.0 | | 9.95 | | V |
| | | $V_{DD}$ = 15V | 14.95 | | 14.95 | 15.0 | | 14.95 | | V |
| $V_{IL}$ | Low Level Input Voltage (Note 3) | $V_{DD}$ = 5V | | 1.5 | | 2.25 | 1.5 | | 1.5 | V |
| | | $V_{DD}$ = 10V | | 3.0 | | 4.50 | 3.0 | | 3.0 | V |
| | | $V_{DD}$ = 15V | | 4.0 | | 6.75 | 4.0 | | 4.0 | V |
| $V_{IH}$ | High Level Input Voltage (Note 3) | $V_{DD}$ = 5V | 3.5 | | 3.5 | 2.75 | | 3.5 | | V |
| | | $V_{DD}$ = 10V | 7.0 | | 7.0 | 5.50 | | 7.0 | | V |
| | | $V_{DD}$ = 15V | 11.0 | | 11.0 | 8.25 | | 11.0 | | V |
| $I_{IN}$ | Input Current | $V_{DD}$ = 15V | | | | | | | | |
| | | $V_{IN}$ = 0V | | −0.1 | | $-10^{-5}$ | −0.1 | | −1.0 | μA |
| | | $V_{IN}$ = 15V | | 0.1 | | $10^{-5}$ | 0.1 | | 1.0 | μA |
| $R_{ON}$ | ON Resistance | $V_{DD}$ = 5V, $V_{SS}$ = −5V | | | | | | | | |
| | | $V_{IN}$ = 5V | | 400 | | 165 | 480 | | 640 | Ω |
| | | $V_{IN}$ = −5V | | 400 | | 100 | 480 | | 640 | Ω |
| | | $V_{IN}$ = ±0.25V | | 400 | | 155 | 480 | | 640 | Ω |
| | | $V_{DD}$ = 7.5V, $V_{SS}$ = −7.5V | | | | | | | | |
| | | $V_{IN}$ = 7.5V | | 240 | | 135 | 270 | | 400 | Ω |
| | | $V_{IN}$ = −7.5V | | 240 | | 75 | 270 | | 400 | Ω |
| | | $V_{IN}$ = ±0.25V | | 240 | | 100 | 270 | | 400 | Ω |
| | | $V_{DD}$ = 10V, $V_{SS}$ = 0V | | | | | | | | |
| | | $V_{IN}$ = 10V | | 400 | | 165 | 480 | | 640 | Ω |
| | | $V_{IN}$ = 0.25V | | 400 | | 100 | 480 | | 640 | Ω |
| | | $V_{IN}$ = 5.6V | | 400 | | 160 | 480 | | 640 | Ω |
| | | $V_{DD}$ = 15V, $V_{SS}$ = 0V | | | | | | | | |
| | | $V_{IN}$ = 15V | | 250 | | 135 | 270 | | 400 | Ω |
| | | $V_{IN}$ = 0.25V | | 250 | | 75 | 270 | | 400 | Ω |
| | | $V_{IN}$ = 9.3V | | 250 | | 110 | 270 | | 400 | Ω |
| $I_{OFF}$ | Input to Output Leakage Current | $V_{SS}$ = −5V, $V_{DD}$ = 5V, $V_{IN}$ = 5V, $V_{OUT}$ = −5V | | ±125 | | ±0.001 | ±125 | | ±1250 | nA |
| | | $V_{SS}$ = −5V, $V_{DD}$ = 5V, $V_{IN}$ = −5V, $V_{OUT}$ = 5V | | ±125 | | ±0.001 | ±125 | | ±1250 | nA |
| | | $V_{SS}$ = −7.5V, $V_{DD}$ = 7.5V, $V_{IN}$ = 7.5V, $V_{OUT}$ = −7.5V | | ±250 | | ±0.0015 | ±250 | | ±2500 | nA |
| | | $V_{SS}$ = −7.5V, $V_{DD}$ = 7.5V, $V_{IN}$ = −7.5V, $V_{OUT}$ = 7.5V | | ±250 | | ±0.0015 | ±250 | | ±2500 | nA |

## DC Electrical Characteristics CD4529BC (Note 2)

| PARAMETER | | CONDITIONS | −40°C | | 25°C | | | 85°C | | UNITS |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | MIN | MAX | MIN | TYP | MAX | MIN | MAX | |
| $I_{DD}$ | Quiescent Device Current | $V_{DD}$ = 5V | | 5.0 | | 0.001 | 5.0 | | 70 | μA |
| | | $V_{DD}$ = 10V | | 5.0 | | 0.002 | 5.0 | | 70 | μA |
| | | $V_{DD}$ = 15V | | 10.0 | | 0.003 | 10.0 | | 140 | μA |
| $V_{OL}$ | Low Level Output Voltage | $V_{IL}$ = 0V, $V_{IH}$ = $V_{DD}$, $\|I_O\| < 1\ \mu A$ | | | | | | | | |
| | | $V_{DD}$ = 5V | | 0.05 | | | 0.05 | | 0.05 | V |
| | | $V_{DD}$ = 10V | | 0.05 | | | 0.05 | | 0.05 | V |
| | | $V_{DD}$ = 15V | | 0.05 | | | 0.05 | | 0.05 | V |
| $V_{OH}$ | High Level Output Voltage | $V_{IL}$ = 0V, $V_{IH}$ = $V_{DD}$, $\|I_O\| < 1\ \mu A$ | | | | | | | | |
| | | $V_{DD}$ = 5V | 4.95 | | 4.95 | 5.00 | | 4.95 | | V |
| | | $V_{DD}$ = 10V | 9.95 | | 9.95 | 10.00 | | 9.95 | | V |
| | | $V_{DD}$ = 15V | 14.95 | | 14.95 | 15.00 | | 14.95 | | V |
| $V_{IL}$ | Low Level Input Voltage (Note 3) | $V_{DD}$ = 5V | | 1.5 | | 2.25 | 1.5 | | 1.5 | V |
| | | $V_{DD}$ = 10V | | 3.0 | | 4.50 | 3.0 | | 3.0 | V |
| | | $V_{DD}$ = 15V | | 4.0 | | 6.75 | 4.0 | | 4.0 | V |
| $V_{IH}$ | High Level Input Voltage (Note 3) | $V_{DD}$ = 5V | 3.5 | | 3.5 | 2.75 | | 3.5 | | V |
| | | $V_{DD}$ = 10V | 7.0 | | 7.0 | 5.50 | | 7.0 | | V |
| | | $V_{DD}$ = 15V | 11.0 | | 11.0 | 8.25 | | 11.0 | | V |
| $I_{IN}$ | Input Current | $V_{DD}$ = 15V | | | | | | | | |
| | | $V_{IN}$ = 0V | | −0.3 | | $-10^{-5}$ | −0.3 | | −1.0 | μA |
| | | $V_{IN}$ = 15V | | 0.3 | | $10^{-5}$ | 0.3 | | 1.0 | μA |
| $R_{ON}$ | ON Resistance | $V_{DD}$ = 5V, $V_{SS}$ = −5V | | | | | | | | |
| | | $V_{IN}$ = 5V | | 410 | | 165 | 480 | | 560 | Ω |
| | | $V_{IN}$ = −5V | | 410 | | 100 | 480 | | 560 | Ω |
| | | $V_{IN}$ = ±0.25V | | 410 | | 155 | 480 | | 560 | Ω |
| | | $V_{DD}$ = 7.5V, $V_{SS}$ = −7.5V | | | | | | | | |
| | | $V_{IN}$ = 7.5V | | 250 | | 135 | 270 | | 350 | Ω |
| | | $V_{IN}$ = −7.5V | | 250 | | 75 | 270 | | 350 | Ω |
| | | $V_{IN}$ = ±0.25V | | 250 | | 100 | 270 | | 350 | Ω |
| | | $V_{DD}$ = 10V, $V_{SS}$ = 0V | | | | | | | | |
| | | $V_{IN}$ = 10V | | 410 | | 165 | 480 | | 560 | Ω |
| | | $V_{IN}$ = 0.25V | | 410 | | 100 | 480 | | 560 | Ω |
| | | $V_{IN}$ = 5.6V | | 410 | | 160 | 480 | | 560 | Ω |
| | | $V_{DD}$ = 15V, $V_{SS}$ = 0V | | | | | | | | |
| | | $V_{IN}$ = 15V | | 250 | | 135 | 270 | | 350 | Ω |
| | | $V_{IN}$ = 0.25V | | 250 | | 75 | 270 | | 350 | Ω |
| | | $V_{IN}$ = 9.3V | | 250 | | 110 | 270 | | 350 | Ω |
| $I_{OFF}$ | Input-Output Leakage Current | $V_{SS}$ = −5V, $V_{DD}$ = 5V | | | | | | | | |
| | | $V_{IN}$ = 5V, $V_{OUT}$ = −5V | | ±125 | | ±0.001 | ±125 | | ±500 | nA |
| | | $V_{IN}$ = −5V, $V_{OUT}$ = 5V | | ±125 | | ±0.001 | ±125 | | ±500 | nA |
| | | $V_{SS}$ = −7.5V, $V_{DD}$ = 7.5V | | | | | | | | |
| | | $V_{IN}$ = 7.5V, $V_{OUT}$ = −7.5V | | ±250 | | ±0.0015 | ±250 | | ±1000 | nA |
| | | $V_{IN}$ = −7.5V, $V_{OUT}$ = 7.5V | | ±250 | | ±0.0015 | ±250 | | ±1000 | nA |

**Note 1:** "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. Except for "Operating Temperature Range" they are not meant to imply that the devices should be operated at these limits. The tables of "Recommended Operating Conditions" and "Electrical Characteristics" provide conditions for actual device operation.

**Note 2:** $V_{SS}$ = 0V unless otherwise specified.

**Note 3:** Switch OFF is defined as $|I_O| \leq 10\ \mu A$, switch ON as defined by $R_{ON}$ specification.

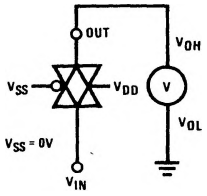
## AC Electrical Characteristics CD4529BM/CD4529BC

$T_A = 25°C$, $R_L = 1\ k\Omega$, $t_r = t_f = 20$ ns, unless otherwise specified.

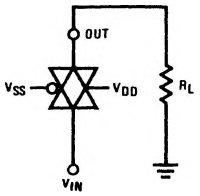
| PARAMETER | | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| $t_{PLH}$, $t_{PHL}$ | $V_{IN}$ to $V_{OUT}$ Propagation Delay | $V_{SS} = 0V$, $C_L = 50$ pF | | | | |
| | | $V_{DD} = 5V$ | | 20 | 40 | ns |
| | | $V_{DD} = 10V$ | | 10 | 20 | ns |
| | | $V_{DD} = 15V$ | | 8 | 15 | ns |
| $t_{PLH}$, $t_{PHL}$ | Control to Output Propagation Delay | $V_{IN} = V_{DD}$ or $V_{SS}$, $C_L = 50$ pF | | | | |
| | | $V_{IN} \leq 10V$ | | | | |
| | | $V_{DD} = 5V$ | | 200 | 400 | ns |
| | | $V_{DD} = 10V$ | | 80 | 160 | ns |
| | | $V_{DD} = 15V$ | | 50 | 120 | ns |
| $f_{MAX}$ | Maximum Control Input Pulse Frequency | $V_{SS} = 0V$, $C_L = 50$ pF | | | | |
| | | $V_{DD} = 5V$ | | 5 | | MHz |
| | | $V_{DD} = 10V$ | | 10 | | MHz |
| | | $V_{DD} = 15V$ | | 12 | | MHz |
| | Crosstalk, Control to Output | $R_{OUT} = 10\ k\Omega$, $C_L = 50$ pF, $V_{SS} = 0$ | | | | |
| | | $V_{DD} = 5V$ | | 5.0 | | mV |
| | | $V_{DD} = 10V$ | | 5.0 | | mV |
| | | $V_{DD} = 15V$ | | 5.0 | | mV |
| | Noise Voltage | $f = 100$ Hz, $V_{SS} = 0V$ | | | | |
| | | $V_{DD} = 5V$ | | 24 | | $nV/\sqrt{cycle}$ |
| | | $V_{DD} = 10V$ | | 25 | | $nV/\sqrt{cycle}$ |
| | | $V_{DD} = 15V$ | | 30 | | $nV/\sqrt{cycle}$ |
| | | $f = 100$ kHz, $V_{SS} = 0V$ | | | | |
| | | $V_{DD} = 5V$ | | 12 | | $nV/\sqrt{cycle}$ |
| | | $V_{DD} = 10V$ | | 12 | | $nV/\sqrt{cycle}$ |
| | | $V_{DD} = 15V$ | | 15 | | $nV/\sqrt{cycle}$ |
| | Sine Wave (Distortion) | $V_{IN} = 1.77$Vrms Centered at 0V, $R_L = 10\ k\Omega$, $f = 1$ kHz, $V_{SS} = -5V$, $V_{DD} = 5V$ | | 0.36 | | % |
| $I_{LOSS}$ | Insertion Loss, $I_{LOSS} = 20\ Log_{10} \frac{V_{OUT}}{V_{IN}}$ | $V_{IN} = 1.77$Vrms Centered at 0V, $V_{SS} = -5V$, $V_{DD} = 5V$ | | | | |
| | | $R_L = 1\ k\Omega$ | | 2.0 | | dB |
| | | $R_L = 10\ k\Omega$ | | 0.8 | | dB |
| | | $R_L = 100\ k\Omega$ | | 0.25 | | dB |
| | | $R_L = 1\ M\Omega$ | | 0.01 | | dB |
| BW | Bandwidth, −3 dB | $V_{IN} = 1.77$Vrms Centered at 0 Vdc, $V_{SS} = -5V$, $V_{DD} = 5V$ | | | | |
| | | $R_L = 1\ k\Omega$ | 35 | | | MHz |
| | | $R_L = 10\ k\Omega$ | 28 | | | MHz |
| | | $R_L = 100\ k\Omega$ | 27 | | | MHz |
| | | $R_L = 1\ M\Omega$ | 26 | | | MHz |
| | Feedthrough and Crosstalk, $20\ Log_{10} \frac{V_{OUT}}{V_{IN}} = -50$ dB | $V_{SS} = -5V$, $V_{DD} = 5V$ | | | | |
| | | $R_L = 1\ k\Omega$ | 850 | | | kHz |
| | | $R_L = 10\ k\Omega$ | 100 | | | kHz |
| | | $R_L = 100\ k\Omega$ | 12 | | | kHz |
| | | $R_L = 1\ M\Omega$ | 1.5 | | | kHz |

## Test Circuits and Switching Time Waveforms

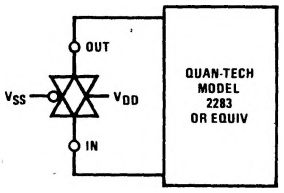
### Output Voltage



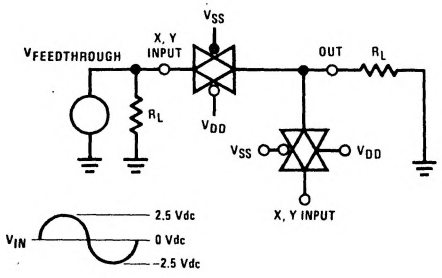

### $R_{ON}$ Characteristics



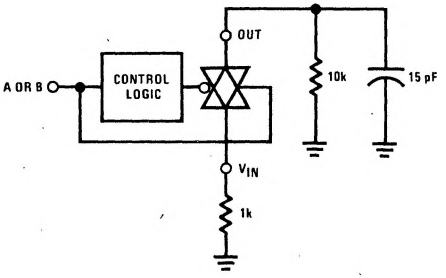

### Noise Voltage



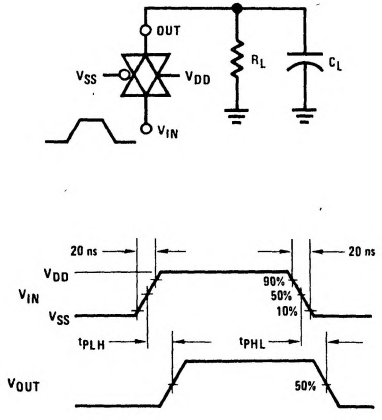

### Frequency Response



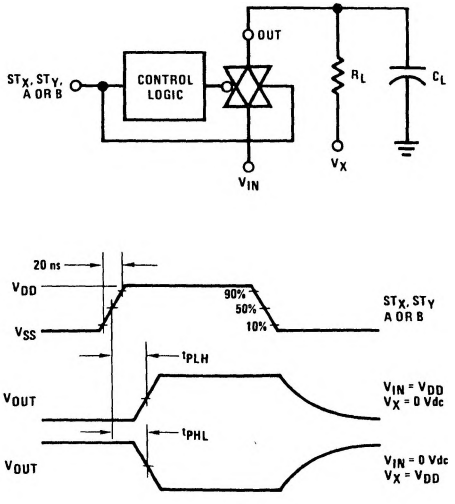

### Crosstalk




### Propagation Delay

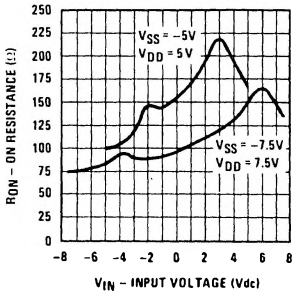



### Turn-ON Delay Time

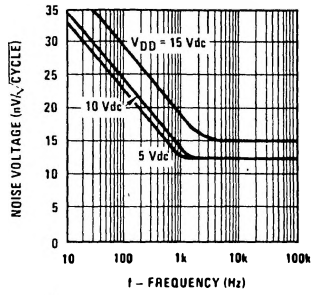


## Typical Performance Characteristics

Typical $R_{ON}$ vs $V_{IN}$




Typical Noise Characteristics




Typical Insertion Loss/ Bandwidth Characteristics