MC14051B, MC14052B, MC14053B

Analog Multiplexers/Demultiplexers

ON Semiconductor®

The MC14051B, MC14052B, and MC14053B analog multiplexers are digitally−controlled analog switches. The MC14051B effectively implements an SP8T solid state switch, the MC14052B a DP4T, and the MC14053B a Triple SPDT. All three devices feature low ON impedance and very low OFF leakage current. Control of analog signals up to the complete supply voltage range can be achieved.

Features

- Triple Diode Protection on Control Inputs
- Switch Function is Break Before Make
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Analog Voltage Range ($V_{DD} - V_{EE}$) = 3.0 to 18 V
  Note: V_{EE} must be $\leq V_{SS}$
- Linearized Transfer Characteristics
- Low−noise − 12 nV/$\sqrt{\text{Cycle}}$, f ≥ 1.0 kHz Typical
- Pin−for−Pin Replacement for CD4051, CD4052, and CD4053
- For 4PDT Switch, See MC14551B
- For Lower R_{ON}, Use the HC4051, HC4052, or HC4053 High−Speed CMOS Devices
- Pb−Free Packages are Available*

MAXIMUM RATINGS (Voltages Referenced to V_{SS})

Symbol	Parameter	Value	Unit
V_{DD}	DC Supply Voltage Range (Referenced to V_{EE}, $V_{SS} \geq V_{EE}$)	−0.5 to +18.0	V
V_{in}, V_{out}	Input or Output Voltage Range (DC or Transient) (Referenced to V_{SS} for Control Inputs and V_{EE} for Switch I/O)	−0.5 to V_{DD} + 0.5	V
I_{in}	Input Current (DC or Transient) per Control Pin	+10	mA
I_{SW}	Switch Through Current	±25	mA
P_D	Power Dissipation per Package (Note 1)	500	mW
T_A	Ambient Temperature Range	−55 to +125	°C
T_{stg}	Storage Temperature Range	−65 to +150	°C
T_L	Lead Temperature (8−Second Soldering)	260	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

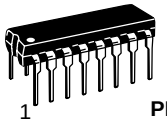
1. Temperature Derating: Plastic “P and D/DW” Packages: – 7.0 mW/°C From 65°C To 125°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high−impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range $V_{SS} \leq (V_{in}$ or $V_{out}) \leq V_{DD}$.

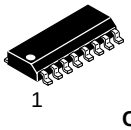
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS}, V_{EE} or V_{DD}). Unused outputs must be left open.

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

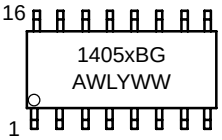
MARKING DIAGRAMS

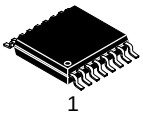


PDIP−16
P SUFFIX
CASE 648

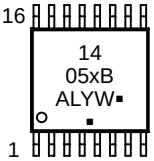


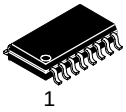
SOIC−16
D SUFFIX
CASE 751B



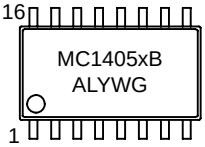


TSSOP−16
DT SUFFIX
CASE 948F





SOEIAJ−16
F SUFFIX
CASE 966



x = 1, 2, or 3
A = Assembly Location
WL, L = Wafer Lot
Y = Year
WW, W = Work Week
G or ▪ = Pb−Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

Publication Order Number:
MC14051B/D

ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	V_{DD}	Test Conditions	−55°C Min	−55°C Max	25°C Min	25°C Typ (Note 2)	25°C Max	125°C Min	125°C Max	Unit
SUPPLY REQUIREMENTS (Voltages Referenced to V_{EE})											
Power Supply Voltage Range	V_{DD}	−	$V_{DD} - 3.0 \geq V_{SS} \geq V_{EE}$	3.0	18	3.0	−	18	3.0	18	V
Quiescent Current Per Package	I_{DD}	5.0 10 15	Control Inputs: $V_{in} = V_{SS}$ or V_{DD}, Switch I/O: $V_{EE} \leq V_{I/O} \leq V_{DD}$, and $\Delta V_{switch} \leq$ 500 mV (Note 3)	− − −	5.0 10 20	− − −	0.005 0.010 0.015	5.0 10 20	− − −	150 300 600	μA
Total Supply Current (Dynamic Plus Quiescent, Per Package	$I_{D(AV)}$	5.0 10 15	$T_A = 25°C$ only (The channel component, $(V_{in} - V_{out})/R_{on}$, is not included.)	Typical			(0.07 μA/kHz) f + I_{DD} (0.20 μA/kHz) f + I_{DD} (0.36 μA/kHz) f + I_{DD}				μA
CONTROL INPUTS — INHIBIT, A, B, C (Voltages Referenced to V_{SS})											
Low−Level Input Voltage	V_{IL}	5.0 10 15	R_{on} = per spec, I_{off} = per spec	− − −	1.5 3.0 4.0	− − −	2.25 4.50 6.75	1.5 3.0 4.0	− − −	1.5 3.0 4.0	V
High−Level Input Voltage	V_{IH}	5.0 10 15	R_{on} = per spec, I_{off} = per spec	3.5 7.0 11	− − −	3.5 7.0 11	2.75 5.50 8.25	− − −	3.5 7.0 11	− − −	V
Input Leakage Current	I_{in}	15	V_{in} = 0 or V_{DD}	−	± 0.1	−	±0.00001	± 0.1	−	1.0	μA
Input Capacitance	C_{in}	−		−	−	−	5.0	7.5	−	−	pF
SWITCHES IN/OUT AND COMMONS OUT/IN — X, Y, Z (Voltages Referenced to V_{EE})											
Recommended Peak−to−Peak Voltage Into or Out of the Switch	$V_{I/O}$	−	Channel On or Off	0	V_{DD}	0	−	V_{DD}	0	V_{DD}	V_{PP}
Recommended Static or Dynamic Voltage Across the Switch (Note 3) (Figure 5)	ΔV_{switch}	−	Channel On	0	600	0	−	600	0	300	mV
Output Offset Voltage	V_{OO}	−	V_{in} = 0 V, No Load	−	−	−	10	−	−	−	μV
ON Resistance	R_{on}	5.0 10 15	$\Delta V_{switch} \leq$ 500 mV (Note 3) $V_{in} = V_{IL}$ or V_{IH} (Control), and V_{in} = 0 to V_{DD} (Switch)	− − −	800 400 220	− − −	250 120 80	1050 500 280	− − −	1200 520 300	Ω
ΔON Resistance Between Any Two Channels in the Same Package	ΔR_{on}	5.0 10 15		− − −	70 50 45	− − −	25 10 10	70 50 45	− − −	135 95 65	Ω
Off−Channel Leakage Current (Figure 10)	I_{off}	15	$V_{in} = V_{IL}$ or V_{IH} (Control) Channel to Channel or Any One Channel	−	± 100	−	± 0.05	± 100	−	±1000	nA
Capacitance, Switch I/O	$C_{I/O}$	−	Inhibit = V_{DD}	−	−	−	10	−	−	−	pF
Capacitance, Common O/I	$C_{O/I}$	−	Inhibit = V_{DD} (MC14051B) (MC14052B) (MC14053B)	 − − −	 − − −	 − − −	 60 32 17	 − − −	 − − −	 − − −	pF
Capacitance, Feedthrough (Channel Off)	$C_{I/O}$	− −	Pins Not Adjacent Pins Adjacent	− −	− −	− −	0.15 0.47	− −	− −	− −	pF

2. Data labeled “Typ” is not to be used for design purposes, but is intended as an indication of the IC’s potential performance.
3. For voltage drops across the switch (ΔV_{switch}) > 600 mV (> 300 mV at high temperature), excessive V_{DD} current may be drawn, i.e. the current out of the switch may contain both V_{DD} and switch input components. The reliability of the device will be unaffected unless the Maximum Ratings are exceeded. (See first page of this data sheet.)

ELECTRICAL CHARACTERISTICS (Note 4) (C_L = 50 pF, T_A = 25°C) ($V_{EE} \le V_{SS}$ unless otherwise indicated)

Characteristic	Symbol	$V_{DD} - V_{EE}$ Vdc	Typ (Note 5) All Types	Max	Unit
Propagation Delay Times (Figure 6)	t_{PLH}, t_{PHL}				ns
Switch Input to Switch Output (R_L = 10 kΩ)					
MC14051					
t_{PLH}, t_{PHL} = (0.17 ns/pF) C_L + 26.5 ns		5.0	35	90	
t_{PLH}, t_{PHL} = (0.08 ns/pF) C_L + 11 ns		10	15	40	
t_{PLH}, t_{PHL} = (0.06 ns/pF) C_L + 9.0 ns		15	12	30	
MC14052					ns
t_{PLH}, t_{PHL} = (0.17 ns/pF) C_L + 21.5 ns		5.0	30	75	
t_{PLH}, t_{PHL} = (0.08 ns/pF) C_L + 8.0 ns		10	12	30	
t_{PLH}, t_{PHL} = (0.06 ns/pF) C_L + 7.0 ns		15	10	25	
MC14053					ns
t_{PLH}, t_{PHL} = (0.17 ns/pF) C_L + 16.5 ns		5.0	25	65	
t_{PLH}, t_{PHL} = (0.08 ns/pF) C_L + 4.0 ns		10	8.0	20	
t_{PLH}, t_{PHL} = (0.06 ns/pF) C_L + 3.0 ns		15	6.0	15	
Inhibit to Output (R_L = 10 kΩ, $V_{EE} = V_{SS}$) Output “1” or “0” to High Impedance, or High Impedance to “1” or “0” Level	t_{PHZ}, t_{PLZ}, t_{PZH}, t_{PZL}				ns
MC14051B		5.0	350	700	
		10	170	340	
		15	140	280	
MC14052B		5.0	300	600	ns
		10	155	310	
		15	125	250	
MC14053B		5.0	275	550	ns
		10	140	280	
		15	110	220	
Control Input to Output (R_L = 10 kΩ, $V_{EE} = V_{SS}$)	t_{PLH}, t_{PHL}				ns
MC14051B		5.0	360	720	
		10	160	320	
		15	120	240	
MC14052B		5.0	325	650	ns
		10	130	260	
		15	90	180	
MC14053B		5.0	300	600	ns
		10	120	240	
		15	80	160	
Second Harmonic Distortion (R_L = 10KΩ, f = 1 kHz) V_{in} = 5 V_{PP}	–	10	0.07	–	%
Bandwidth (Figure 7) (R_L = 1 kΩ, V_{in} = 1/2 (V_{DD}–V_{EE}) p–p, C_L = 50pF 20 Log (V_{out}/V_{in}) = – 3 dB)	BW	10	17	–	MHz
Off Channel Feedthrough Attenuation (Figure 7) R_L = 1KΩ, V_{in} = 1/2 (V_{DD} – V_{EE}) p–p f_{in} = 4.5 MHz — MC14051B f_{in} = 30 MHz — MC14052B f_{in} = 55 MHz — MC14053B	–	10	– 50	–	dB
Channel Separation (Figure 8) (R_L = 1 kΩ, V_{in} = 1/2 (V_{DD}–V_{EE}) p–p, f_{in} = 3.0 MHz	–	10	– 50	–	dB
Crosstalk, Control Input to Common O/I (Figure 9) (R_1 = 1 kΩ, R_L = 10 kΩ Control $t_{TLH} = t_{THL}$ = 20 ns, Inhibit = V_{SS})	–	10	75	–	mV

4. The formulas given are for the typical characteristics only at 25°C.
5. Data labelled “Typ” is not lo be used for design purposes but In intended as an indication of the IC’s potential performance.

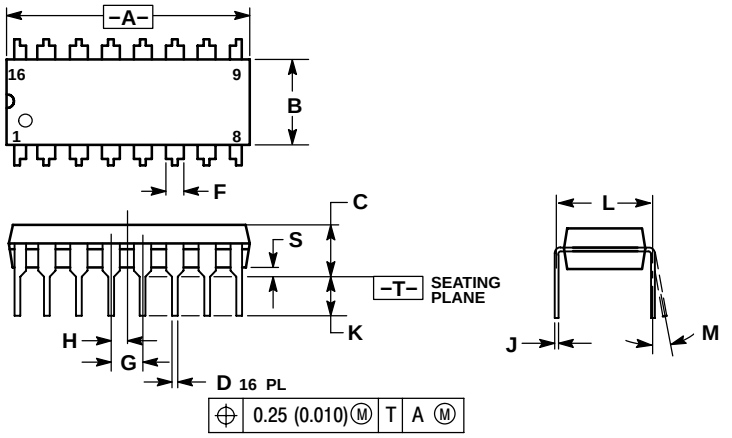
ORDERING INFORMATION

Device	Package	Shipping†
MC14051BCP	PDIP−16	500 Units / Rail
MC14051BCPG	PDIP−16 (Pb−Free)	500 Units / Rail
MC14051BD	SOIC−16	48 Units / Rail
MC14051BDG	SOIC−16 (Pb−Free)	48 Units / Rail
MC14051BDR2	SOIC−16	2500 / Tape & Reel
MC14051BDR2G	SOIC−16 (Pb−Free)	2500 / Tape & Reel
MC14051BDTR2	TSSOP−16*	2500 / Tape & Reel
MC14051BDTR2G	TSSOP−16*	2500 / Tape & Reel
MC14051BF	SOEIAJ−16	50 Units / Rail
MC14051BFG	SOEIAJ−16 (Pb−Free)	50 Units / Rail
MC14051BFEL	SOEIAJ−16	2000 / Tape & Reel
MC14051BFELG	SOEIAJ−16 (Pb−Free)	2000 / Tape & Reel
MC14052BCP	PDIP−16	500 Units / Rail
MC14052BCPG	PDIP−16 (Pb−Free)	500 Units / Rail
MC14052BD	SOIC−16	48 Units / Rail
MC14052BDG	SOIC−16 (Pb−Free)	48 Units / Rail
MC14052BDR2	SOIC−16	2500 / Tape & Reel
MC14052BDR2G	SOIC−16 (Pb−Free)	2500 / Tape & Reel
MC14052BDTR2	TSSOP−16*	2500 / Tape & Reel
MC14052BDTR2G	TSSOP−16*	2500 / Tape & Reel
MC14052BF	SOEIAJ−16	50 Units / Rail
MC14052BFG	SOEIAJ−16 (Pb−Free)	50 Units / Rail
MC14052BFEL	SOEIAJ−16	2000 / Tape & Reel
MC14052BFELG	SOEIAJ−16 (Pb−Free)	2000 / Tape & Reel
MC14053BCP	PDIP−16	500 Units / Rail
MC14053BCPG	PDIP−16 (Pb−Free)	500 Units / Rail
MC14053BD	SOIC−16	48 Units / Rail
MC14053BDG	SOIC−16 (Pb−Free)	48 Units / Rail
MC14053BDR2	SOIC−16	2500 / Tape & Reel
MC14053BDR2G	SOIC−16 (Pb−Free)	2500 / Tape & Reel
MC14053BDTR2	TSSOP−16*	2500 / Tape & Reel
MC14053BDTR2G	TSSOP−16*	2500 / Tape & Reel
MC14053BF	SOEIAJ−16	50 Units / Rail
MC14053BFG	SOEIAJ−16 (Pb−Free)	50 Units / Rail
MC14053BFEL	SOEIAJ−16	2000 / Tape & Reel
MC14053BFELG	SOEIAJ−16 (Pb−Free)	2000 / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.
*This package is inherently Pb−Free.

PACKAGE DIMENSIONS

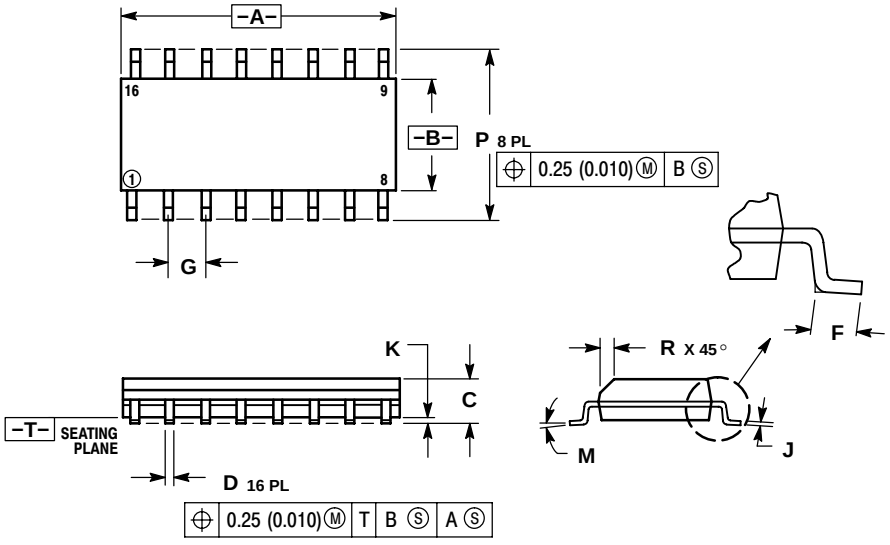
PDIP−16
P SUFFIX
PLASTIC DIP PACKAGE
CASE 648−08
ISSUE T



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0 °	10 °	0 °	10 °
S	0.020	0.040	0.51	1.01

SOIC−16
D SUFFIX
PLASTIC SOIC PACKAGE
CASE 751B−05
ISSUE J



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0 °	7 °	0 °	7 °
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019