Quad 2-Channel Analog Multiplexer/Demultiplexer

The MC14551B is a digitally-controlled analog switch. This device implements a 4PDT solid state switch with 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 All Control Inputs
- 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 ≤ V_{SS}
- Linearized Transfer Characteristics
- Low Noise 12 nV $\sqrt{\text{Cycle}}$, f \geq 1.0 kHz typical
- For Low R_{ON}, Use The HC4051, HC4052, or HC4053 High–Speed CMOS Devices
- Switch Function is Break Before Make
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- This Device is Pb-Free and is RoHS Compliant

MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
DC Supply Voltage Range (Referenced to V _{EE} , V _{SS} ≥ V _{EE})	V _{DD}	- 0.5 to + 18.0	V
Input or Output Voltage (DC or Transient) (Referenced to V _{SS} for Control Input and V _{EE} for Switch I/O)	V _{in} , V _{out}	– 0.5 to V _{DD} + 0.5	٧
Input Current (DC or Transient), per Control Pin	l _{in}	±10	mA
Switch Through Current	I _{sw}	±25	mA
Power Dissipation, per Package (Note 1)	P _D	500	mW
Ambient Temperature Range	T _A	- 55 to + 125	°C
Storage Temperature Range	T _{stg}	- 65 to + 150	°C
Lead Temperature (8–Second Soldering)	TL	260	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Temperature Derating: "D/DW" Package: –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 $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ for control inputs and $V_{EE} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$ for Switch I/O.

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.



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SOIC-16 D SUFFIX CASE 751B

PIN ASSIGNMENT

W1 [1●	16	V _{DD}
X0 [2	15] wo
X1 [3	14	þ w
Χ[4	13) z
Υ[5	12] Z1
Y0 [6	11] Z0
V _{EE} [7	10) Y1
v _{ss} [8	9	CONTROL

MARKING DIAGRAM



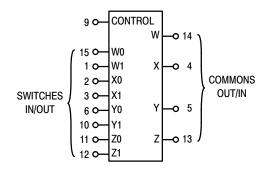
A = Assembly Location

WL, L = Wafer Lot YY, Y = Year

WW, W = Work Week
G = Pb-Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.



V _{DD} = Pin 16
$V_{SS} = Pin 8$
$V_{FF} = Pin 7$

Control	ON						
0	W0 X0 Y0 Z0						
1	W1 X1 Y1 Z1						

NOTE: Control Input referenced to V_{SS} , Analog Inputs and Outputs reference to V_{EE} . V_{EE} must be $\leq V_{SS}$.

ORDERING INFORMATION

Device	Package	Shipping [†]
MC14551BDG	SOIC-16 (Pb-Free)	48 Units / Rail
MC14551BDR2G	SOIC-16 (Pb-Free)	2500 / Tape & Reel
NLV14551BDR2G*	SOIC-16 (Pb-Free)	2500 / 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.

^{*}NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable.

ELECTRICAL CHARACTERISTICS

				– 55°C 25°C			125°C				
						Typ (Note 2)	Max	Min	Mov	.	
Characteristic	Voltage	Test Conditions	Symbol	Min	Max	Min	(Note 2)	Max	Min	Max	Unit
SUPPLY REQUIREMENTS (voitage	t	1	1	i	1	1			1	
Power Supply Voltage Range	_	$V_{DD} - 3.0 \ge V_{SS} \ge V_{EE}$	V _{DD}	3.0	18	3.0	_	18	3.0	18	V
Quiescent Current Per Package	5.0 10 15	$ \begin{array}{l} \text{Control Inputs: V}_{\text{in}} = \\ \text{V}_{\text{SS}} \text{ or V}_{\text{DD}}, \\ \text{Switch I/O: V}_{\text{EE}} \leq \text{V}_{\text{I/O}} \\ \leq \text{V}_{\text{DD}}, \text{ and } \Delta \text{V}_{\text{switch}} \leq \\ \text{500 mV (Note 3)} \end{array} $	I _{DD}	- - -	5.0 10 20	_ _ _	0.005 0.010 0.015	5.0 10 20	- - -	150 300 600	μА
Total Supply Current (Dynamic Plus Quiescent, Per Package)	5.0 10 15	T _A = 25°C only (The channel component, (V _{in} – V _{out})/R _{on} , is not included.)	I _{D(AV)}			Typical	(0.07 μΑ/ (0.20 μΑ/ (0.36 μΑ/	kHz) f +	I_{DD}		μΑ
CONTROL INPUT (Voltages	Refere	nced to V _{SS})									
Low-Level Input Voltage	5.0 10 15	R _{on} = per spec, I _{off} = per spec	V _{IL}	- - -	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	5.0 10 15	R _{on} = per spec, I _{off} = per spec	V _{IH}	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	15	V _{in} = 0 or V _{DD}	I _{in}	_	±0.1	_	±0.00001	±0.1	-	±1.0	μΑ
Input Capacitance	_		C _{in}	_	_	_	5.0	7.5	-	_	pF
SWITCHES IN/OUT AND CO	OMMO	IS OUT/IN — W, X, Y, Z (\	/oltages Re	eference	ed to V _E	E)					
Recommended Peak-to- Peak Voltage Into or Out of the Switch	_	Channel On or Off	V _{I/O}	0	V _{DD}	0	-	V _{DD}	0	V _{DD}	V _{p-p}
Recommended Static or Dynamic Voltage Across the Switch (Note 3) (Figure 3)	-	Channel On	ΔV_{switch}	0	600	0	-	600	0	300	mV
Output Offset Voltage	-	V _{in} = 0 V, No Load	Voo	-	-	-	10	-	-	-	μV
ON Resistance	5.0 10 15	$\begin{array}{l} \Delta V_{switch} \leq 500 \text{ mV} \\ \text{(Note 3),} \\ V_{in} = V_{IL} \text{ or } V_{IH} \\ \text{(Control), and } V_{in} = 0 \text{ to} \\ V_{DD} \text{ (Switch)} \end{array}$	R _{on}	_	800 400 220	- - -	250 120 80	1050 500 280	- - -	1200 520 300	Ω
ΔΟΝ Resistance Between Any Two Channels in the Same Package	5.0 10 15		ΔR_{on}	- - -	70 50 45	- - -	25 10 10	70 50 45	- - -	135 95 65	Ω
Off-Channel Leakage Current (Figure 8)	15	V _{in} = V _{IL} or V _{IH} (Control) Channel to Channel or Any One Channel	l _{off}	l _{off} - ±100 - ±0.05 ±100 - ±1		±1000	nA				
Capacitance, Switch I/O	_	Switch Off	C _{I/O}	_	_	_	10	-	-	-	pF
Capacitance, Common O/I	_		C _{O/I}	-	_	_	17	_	-	-	pF
Capacitance, Feedthrough (Channel Off)	1 1	Pins Not Adjacent Pins Adjacent	C _{I/O}	- 1	-	- 1	0.15 0.47	-	-	-	pF

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Data labeled "Typ" is not to be used for design purposes, but is intended as an indication of the IC's potential performance.

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 (C_L = 50 pF, T_A = 25°C, $V_{EE} \leq V_{SS}$)

Characteristic	Symbol	V _{DD} – V _{EE} Vdc	Min	Typ (Note 4)	Max	Unit
Propagation Delay Times Switch Input to Switch Output ($R_L = 10 \text{ k}\Omega$) t_{PLH} , $t_{PHL} = (0.17 \text{ ns/pF}) C_L + 26.5 \text{ ns}$ t_{PLH} , $t_{PHL} = (0.08 \text{ ns/pF}) C_L + 11 \text{ ns}$ t_{PLH} , $t_{PHL} = (0.06 \text{ ns/pF}) C_L + 9.0 \text{ ns}$	t _{PLH} , t _{PHL}	5.0 10 15	-	35 15 12	90 40 30	ns
Control Input to Output ($R_L = 10 \text{ k}\Omega$) $V_{EE} = V_{SS}$ (Figure 4)	t _{PLH} , t _{PHL}	5.0 10 15	-	350 140 100	875 350 250	ns
Second Harmonic Distortion $R_L = 10 \text{ k}\Omega, f = 1 \text{ kHz}, V_{in} = 5 \text{ V}_{p-p}$	_	10	-	0.07	-	%
Bandwidth (Figure 5) $R_L = 1 \text{ k}\Omega, V_{in} = 1/2 (V_{DD} - V_{EE})_{p-p},$ $20 \text{ Log} (V_{out}/V_{in}) = -3 \text{ dB}, C_L = 50 \text{ pF}$	BW	10	-	17	_	MHz
Off Channel Feedthrough Attenuation, Figure 5 $R_L = 1 \text{ k}\Omega, \text{ V}_{in} = 1/2 \text{ (V}_{DD} - \text{V}_{EE})_{p-p}, f_{in} = 55 \text{ MHz}$	-	10	-	- 50	-	dB
Channel Separation (Figure 6) R _L = 1 k Ω , V _{in} = 1/2 (V _{DD} – V _{EE}) _{p-p} , f _{in} = 3 MHz	-	10	-	- 50	_	dB
Crosstalk, Control Input to Common O/I, Figure 7 R1 = 1 k Ω , R _L = 10 k Ω , Control t _f = t _f = 20 ns	-	10	-	75	-	mV

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

4. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

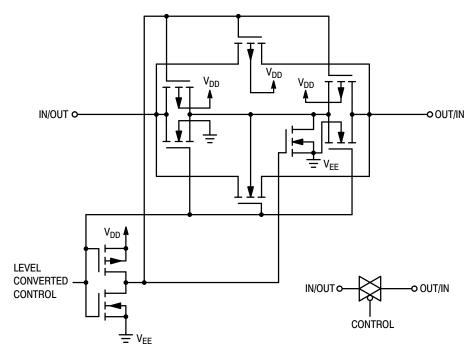


Figure 1. Switch Circuit Schematic

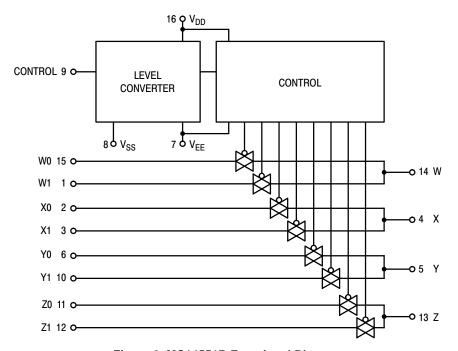


Figure 2. MC14551B Functional Diagram

TEST CIRCUITS

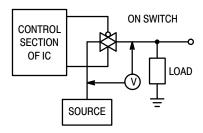


Figure 3. ΔV Across Switch

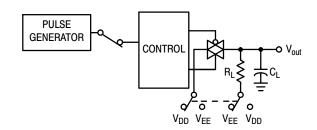


Figure 4. Propagation Delay Times, Control to Output

Control input used to turn ON or OFF the switch under test.

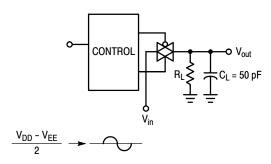


Figure 5. Bandwidth and Off-Channel Feedthrough Attenuation

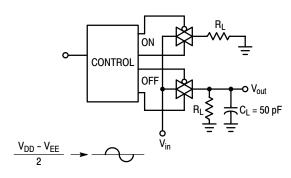


Figure 6. Channel Separation (Adjacent Channels Used for Setup)

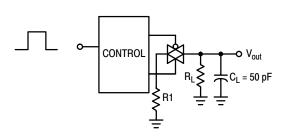


Figure 7. Crosstalk, Control Input to Common O/I

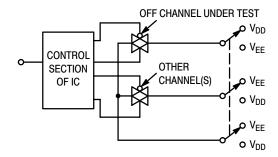


Figure 8. Off Channel Leakage

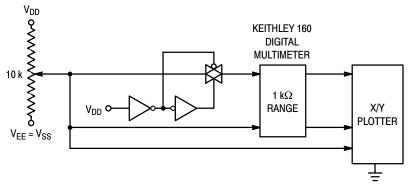


Figure 9. Channel Resistance (R_{ON}) Test Circuit

TYPICAL RESISTANCE CHARACTERISTICS

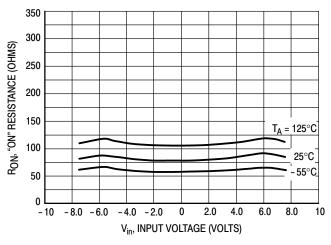


Figure 10. V_{DD} @ 7.5 V, V_{EE} @ – 7.5 V

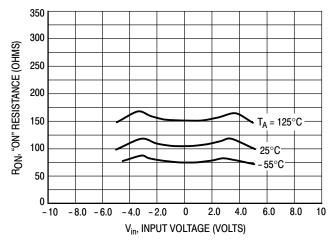


Figure 11. V_{DD} @ 5.0 V, V_{EE} @ – 5.0 V

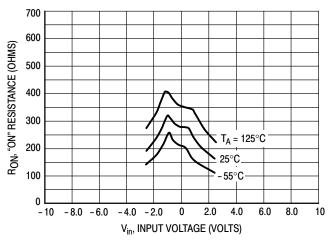


Figure 12. V_{DD} @ 2.5 V, V_{EE} @ – 2.5 V

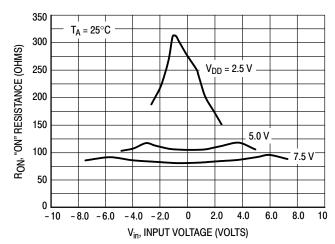


Figure 13. Comparison at 25 $^{\circ}\text{C},\,\text{V}_\text{DD}$ @ – V_EE

APPLICATIONS INFORMATION

Figure A illustrates use of the on–chip level converter detailed in Figure 2. The 0–to–5.0 V Digital Control signal is used to directly control a 9 V_{p-p} analog signal.

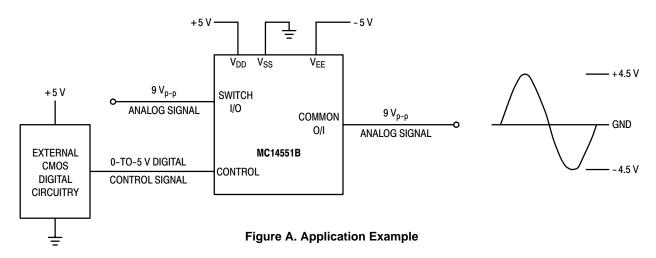
The digital control logic levels are determined by V_{DD} and V_{SS} . The V_{DD} voltage is the logic high voltage; the V_{SS} voltage is logic low. For the example, $V_{DD} = +5.0 \text{ V} = \text{logic}$ high at the control inputs; $V_{SS} = GND = 0 \text{ V} = \text{logic low}$.

The maximum analog signal level is determined by V_{DD} and V_{EE} . The V_{DD} voltage determines the maximum recommended peak above V_{SS} . The V_{EE} voltage determines the maximum swing below V_{SS} . For the example, $V_{DD} - V_{SS} = 5.0 \text{ V}$ maximum swing above V_{SS} ; $V_{SS} - V_{EE} = 5.0 \text{ V}$ maximum swing below V_{SS} . The example shows a $\pm 4.5 \text{ V}$

signal which allows a 1/2 V margin at each peak. If voltage transients above V_{DD} and/or below V_{EE} are anticipated on the analog channels, external diodes (D_x) are recommended as shown in Figure B. These diodes should be small signal types able to absorb the maximum anticipated current surges during clipping.

The absolute maximum potential difference between V_{DD} and V_{EE} is 18 V. Most parameters are specified up to 15 V which is the recommended maximum difference between V_{DD} and V_{EE} .

Balanced supplies are not required. However, V_{SS} must be greater than or equal to V_{EE} . For example, $V_{DD} = +10 \text{ V}$, $V_{SS} = +5.0 \text{ V}$, and $V_{EE} = -3.0 \text{ V}$ is acceptable. See the table below.



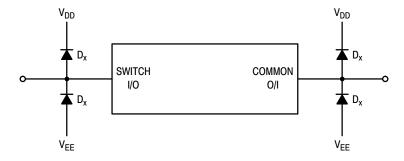


Figure B. External Schottky or Germanium Clipping Diodes

POSSIBLE SUPPLY CONNECTIONS

V _{DD} In Volts	V _{SS} In Volts	V _{EE} In Volts	Control Inputs Logic High/Logic Low In Volts	Maximum Analog Signal Range In Volts
+ 8	0	- 8	+ 8/0	$+ 8 \text{ to} - 8 = 16 \text{ V}_{p-p}$
+ 5	0	- 12	+ 5/0	+ 5 to - 12 = 17 V _{p-p}
+ 5	0	0	+ 5/0	+ 5 to 0 = 5 V _{p-p}
+ 5	0	- 5	+ 5/0	$+ 5 \text{ to } - 5 = 10 \text{ V}_{p-p}$
+ 10		- 5	+ 10/ + 5	+ 10 to - 5 = 15 V _{p-p}

MECHANICAL CASE OUTLINE



DATE 29 DEC 2006

- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI
- THE NOTION AND TOLETANOING FER ANSI'Y 14.5M, 1982.
 CONTROLLING DIMENSION: MILLIMETER.
 DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
- PHOI HUSION.

 MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.

 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.

	MILLIN	METERS	INC	HES	
DIM	MIN	MAX	MIN	MAX	
Α	9.80	10.00	0.386	0.393	
В	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	

STYLE 1:		STYLE 2:		STYLE 3:		STYLE 4:			
PIN 1.	COLLECTOR	PIN 1.	CATHODE	PIN 1.	COLLECTOR, DYE #1	PIN 1.	COLLECTOR, DYE	#1	
2.	BASE	2.	ANODE	2.	BASE, #1	2.	COLLECTOR, #1		
3.	EMITTER	3.	NO CONNECTION	3.	EMITTER, #1	3.	COLLECTOR, #2		
4.	NO CONNECTION	4.	CATHODE	4.	COLLECTOR, #1	4.	COLLECTOR, #2		
5.	EMITTER	5.	CATHODE	5.	COLLECTOR, #2	5.	COLLECTOR, #3		
6.	BASE	6.	NO CONNECTION	6.	BASE, #2	6.	COLLECTOR, #3		
7.	COLLECTOR	7.	ANODE	7.	EMITTER, #2	7.	COLLECTOR, #4		
8.	COLLECTOR	8.	CATHODE	8.	COLLECTOR, #2	8.	COLLECTOR, #4		
9.	BASE	9.	CATHODE	9.	COLLECTOR, #3	9.	BASE, #4		
10.	EMITTER	10.	ANODE	10.	BASE, #3	10.	EMITTER, #4		
11.	NO CONNECTION	11.	NO CONNECTION	11.	EMITTER, #3	11.	BASE, #3		
12.	EMITTER	12.	CATHODE	12.	COLLECTOR, #3	12.	EMITTER, #3		
13.	BASE	13.	CATHODE	13.	COLLECTOR, #4	13.	BASE, #2	COL DEDING	FOOTPRINT
14.	COLLECTOR	14.	NO CONNECTION	14.	BASE, #4	14.	EMITTER, #2	SOLDERING	3 FOOTPRINT
15.	EMITTER	15.	ANODE	15.	EMITTER, #4	15.	BASE, #1		8X
16.	COLLECTOR	16.	CATHODE	16.	COLLECTOR, #4	16.	EMITTER, #1		5.40 →
								7	,.40
STYLE 5:		STYLE 6:		STYLE 7:					16X 1.12 <
PIN 1.	DRAIN, DYE #1		CATHODE	PIN 1.	SOURCE N-CH				
2.	DRAIN, #1		CATHODE	2.	COMMON DRAIN (OUTPU	T)		. 1	16
3.	DRAIN, #2	3.		3.	COMMON DRAIN (OUTPU			↓ └── ·	" 🗀
4.	DRAIN, #2	4.	CATHODE	4.	GATE P-CH	•,		- —	
5.	DRAIN, #3	5.	CATHODE	5.	COMMON DRAIN (OUTPU	T)	16	5X T	
6.	DRAIN, #3	6.	CATHODE	6.	COMMON DRAIN (OUTPU		0.5	iii I	· —
7.	DRAIN, #4	7.	CATHODE	7.	COMMON DRAIN (OUTPU		0.0		
8.	DRAIN, #4	8.	CATHODE	8.	SOURCE P-CH	,			
9.	GATE, #4	9.	ANODE	9.	SOURCE P-CH				
10.	SOURCE, #4	10.	ANODE	10.	COMMON DRAIN (OUTPU	T)			
11.	GATE, #3	11.	ANODE	11.	COMMON DRAIN (OUTPU	T)			
12.	SOURCE, #3	12.	ANODE	12.	COMMON DRAIN (OUTPU	T)			
13.	GATE, #2	13.	ANODE	13.	GATE N-CH				
14.	SOURCE, #2	14.	ANODE	14.	COMMON DRAIN (OUTPU	T)			— V PITCH
15.	GATE, #1	15.	ANODE	15.	COMMON DRAIN (OUTPU				<u> </u>
16.	SOURCE, #1	16.	ANODE	16.	SOURCE N-CH				
								8	9 + - + -
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									DIMENSIONS: MILLIMETERS

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PI2SSD3212NCE NLAS3257CMX2TCG PI5A3157BC6EX PI3DBS12412AZLEX PI3V512QEX PI3DBS16213ZLEX PI3DBS16415ZHEX
PS509LEX MUX36S16IRSNR 74LVC1G3157GM-Q10X TC7W53FK,LF CD4053BM96 TC4066BP-NF HEF4053BT.653 PI3L720ZHEX
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ADG658TRUZ-EP 74HC4053D.653 74HCT4052PW.118 74LVC2G53DP.125 74HC4052DB.112 74HC4052PW.112 74HC4053DB.112
74HC4067DB.112 74HC4351DB.112 74HCT4052D.112 74HCT4052DB.112 74HCT4053DB.112 74HCT4351D.112 74LV4051PW.112
FSA1256L8X_F113 PI5V330QE PI5V331QE 5962-8771601EA 5962-87716022A ADG5249FBRUZ ADG1439BRUZ