MC74LVXT8053

Analog Multiplexer / Demultiplexer

High−Performance Silicon−Gate CMOS

The MC74LVXT8053 utilizes silicon−gate CMOS technology to achieve fast propagation delays, low ON resistances, and low OFF leakage currents. This analog multiplexer/demultiplexer controls analog voltages that may vary across the complete power supply range (from V_{CC} to GND).

The LVXT8053 is similar in pinout to the high−speed HC4053A, and the metal−gate MC14053B. The Channel−Select inputs determine which one of the Analog Inputs/Outputs is to be connected by means of an analog switch to the Common Output/Input. When the Enable pin is HIGH, all analog switches are turned off.

The Channel−Select and Enable inputs are compatible with TTL−type input thresholds. The input protection circuitry on this device allows overvoltage tolerance on the input, allowing the device to be used as a logic−level translator from 3.0 V CMOS logic to 5.0 V CMOS Logic or from 1.8 V CMOS logic to 3.0 V CMOS Logic while operating at the higher−voltage power supply.

The MC74LVXT8053 input structure provides protection when voltages up to 7.0 V are applied, regardless of the supply voltage. This allows the MC74LVXT8053 to be used to interface 5.0 V circuits to 3.0 V circuits.

This device has been designed so that the ON resistance (R_{on}) is more linear over input voltage than R_{on} of metal−gate CMOS analog switches.

Features

- Fast Switching and Propagation Speeds
- Low Crosstalk Between Switches
- Diode Protection on All Inputs/Outputs
- Analog Power Supply Range (V_{CC} − GND) = 2.0 V to 6.0 V
- Digital (Control) Power Supply Range (V_{CC} − GND) = 2.0 V to 6.0 V
- Improved Linearity and Lower ON Resistance Than Metal−Gate Counterparts
- Low Noise
- In Compliance With the Requirements of JEDEC Standard No. 7A
- Pb−Free Packages are Available*

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

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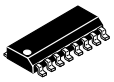
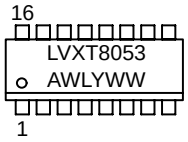
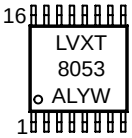
MARKING DIAGRAMS



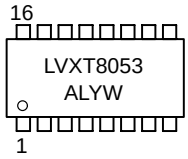
SOIC−16
D SUFFIX
CASE 751B



TSSOP−16
DT SUFFIX
CASE 948F



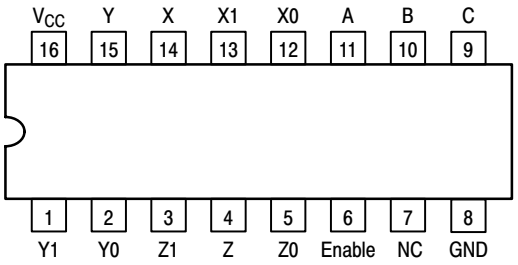
SOEIAJ−16
M SUFFIX
CASE 966



A	=	Assembly Location
WL or L	=	Wafer Lot
Y	=	Year
WW or W	=	Work Week

ORDERING INFORMATION

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

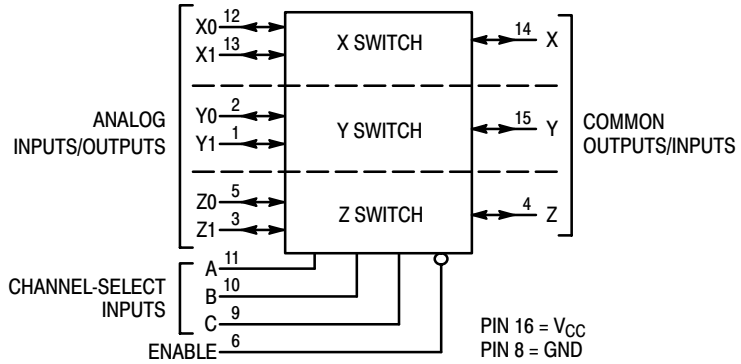


PIN CONNECTION AND MARKING DIAGRAM (Top View)

FUNCTION TABLE − MC74LVXT8053

Control Inputs						
	Select					
Enable	C	B	A	ON Channels		
L	L	L	L	Z0	Y0	X0
L	L	L	H	Z0	Y0	X1
L	L	H	L	Z0	Y1	X0
L	L	H	H	Z0	Y1	X1
L	H	L	L	Z1	Y0	X0
L	H	L	H	Z1	Y0	X1
L	H	H	L	Z1	Y1	X0
L	H	H	H	Z1	Y1	X1
H	X	X	X	NONE		

X = Don't Care



NOTE: This device allows independent control of each switch. Channel−Select Input A controls the X−Switch, Input B controls the Y−Switch and Input C controls the Z−Switch

Figure 1. LOGIC DIAGRAM
Triple Single−Pole, Double−Position Plus Common Off

ORDERING INFORMATION

Device	Package	Shipping†
MC74LVXT8053DR2	SOIC−16	2500 Tape & Reel
MC74LVXT8053DR2G	SOIC−16 (Pb−Free)	2500 Tape & Reel
MC74LVXT8053DTR2	TSSOP−16*	2500 Tape & Reel
MC74LVXT8053M	SOEIAJ−16	50 Units / Rail
MC74LVXT80531MG	SOEIAJ−16 (Pb−Free)	50 Units / Rail
MC74LVXT8053MEL	SOEIAJ−16	2000 Tape & Reel
MC74LVXT8053MELG	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.

MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Positive DC Supply Voltage (Referenced to GND)	–0.5 to + 7.0	V
V_{IS}	Analog Input Voltage	−0.5 to V_{CC} + 0.5	V
V_{in}	Digital Input Voltage (Referenced to GND)	–0.5 to V_{CC} + 0.5	V
I	DC Current, Into or Out of Any Pin	−20	mA
P_D	Power Dissipation in Still Air, SOIC Package† TSSOP Package†	500 450	mW
T_{stg}	Storage Temperature Range	–65 to + 150	°C
T_L	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

†Derating − SOIC Package: – 7 mW/°C from 65°C to 125°C
TSSOP Package: − 6.1 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 GND ≤ (V_{in} or V_{out}) ≤ V_{CC}.

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

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V_{CC}	Positive DC Supply Voltage (Referenced to GND)	2.0	6.0	V
V_{IS}	Analog Input Voltage	0.0	V_{CC}	V
V_{in}	Digital Input Voltage (Referenced to GND)	GND	V_{CC}	V
V_{IO}*	Static or Dynamic Voltage Across Switch		1.2	V
T_A	Operating Temperature Range, All Package Types	–55	+ 85	°C
t_r, t_f	Input Rise/Fall Time (Channel Select or Enable Inputs) V_{CC} = 3.3 V ± 0.3 V V_{CC} = 5.0 V ± 0.5 V	 0 0	 100 20	ns/V

*For voltage drops across switch greater than 1.2 V (switch on), excessive V_{CC} current may be drawn; i.e., the current out of the switch may contain both V_{CC} and switch input components. The reliability of the device will be unaffected unless the Maximum Ratings are exceeded.

DC CHARACTERISTICS − Digital Section (Voltages Referenced to GND)

Symbol	Parameter	Condition	V_{CC} V	Guaranteed Limit			Unit
				−55 to 25°C	≤85°C	≤125°C	
V_{IH}	Minimum High−Level Input Voltage, Channel−Select or Enable Inputs	R_{on} = Per Spec	3.0 4.5 5.5	1.2 2.0 2.0	1.2 2.0 2.0	1.2 2.0 2.0	V
V_{IL}	Maximum Low−Level Input Voltage, Channel−Select or Enable Inputs	R_{on} = Per Spec	3.0 4.5 5.5	0.53 0.8 0.8	0.53 0.8 0.8	0.53 0.8 0.8	V
I_{in}	Maximum Input Leakage Current, Channel−Select or Enable Inputs	V_{in} = V_{CC} or GND,	5.5	± 0.1	± 1.0	± 1.0	μA
I_{CC}	Maximum Quiescent Supply Current (per Package)	Channel Select, Enable and V_{IS} = V_{CC} or GND; V_{IO} = 0 V	5.5	4	40	160	μA

DC ELECTRICAL CHARACTERISTICS Analog Section

Symbol	Parameter	Test Conditions	V_{CC} V	Guaranteed Limit −55 to 25°C	Guaranteed Limit ≤ 85°C	Guaranteed Limit ≤ 125°C	Unit
R_{on}	Maximum “ON” Resistance	$V_{in} = V_{IL}$ or V_{IH} $V_{IS} = V_{CC}$ to GND $\|I_S\| \le 10.0$ mA (Figures 1, 2)	3.0 4.5 5.5	40 30 25	45 32 28	50 37 30	Ω
		$V_{in} = V_{IL}$ or V_{IH} $V_{IS} = V_{CC}$ or GND (Endpoints) $\|I_S\| \le 10.0$ mA (Figures 1, 2)	3.0 4.5 5.5	30 25 20	35 28 25	40 35 30	
ΔR_{on}	Maximum Difference in “ON” Resistance Between Any Two Channels in the Same Package	$V_{in} = V_{IL}$ or V_{IH} V_{IS} = 1/2 (V_{CC} − GND) $\|I_S\| \le 10.0$ mA	3.0 4.5 5.5	15 8.0 8.0	20 12 12	25 15 15	Ω
I_{off}	Maximum Off−Channel Leakage Current, Any One Channel	$V_{in} = V_{IL}$ or V_{IH}; $V_{IO} = V_{CC}$ or GND; Switch Off (Figure 3)	5.5	0.1	0.5	1.0	μA
	Maximum Off−Channel Leakage Current, Common Channel	$V_{in} = V_{IL}$ or V_{IH}; $V_{IO} = V_{CC}$ or GND; Switch Off (Figure 4)	5.5	0.1	1.0	2.0	
I_{on}	Maximum On−Channel Leakage Current, Channel−to−Channel	$V_{in} = V_{IL}$ or V_{IH}; Switch−to−Switch = V_{CC} or GND; (Figure 5)	5.5	0.1	1.0	2.0	μA

AC CHARACTERISTICS (C_L = 50 pF, Input $t_r = t_f$ = 3 ns)

Symbol	Parameter	V_{CC} V	Guaranteed Limit −55 to 25°C	Guaranteed Limit ≤85°C	Guaranteed Limit ≤125°C	Unit
t_{PLH}, t_{PHL}	Maximum Propagation Delay, Channel−Select to Analog Output (Figure 9)	2.0 3.0 4.5 5.5	30 20 15 15	35 25 18 18	40 30 22 20	ns
t_{PLH}, t_{PHL}	Maximum Propagation Delay, Analog Input to Analog Output (Figure 10)	2.0 3.0 4.5 5.5	4.0 3.0 1.0 1.0	6.0 5.0 2.0 2.0	8.0 6.0 2.0 2.0	ns
t_{PLZ}, t_{PHZ}	Maximum Propagation Delay, Enable to Analog Output (Figure 11)	2.0 3.0 4.5 5.5	30 20 15 15	35 25 18 18	40 30 22 20	ns
t_{PZL}, t_{PZH}	Maximum Propagation Delay, Enable to Analog Output (Figure 11)	2.0 3.0 4.5 5.5	20 12 8.0 8.0	25 14 10 10	30 15 12 12	ns
C_{in}	Maximum Input Capacitance, Channel−Select or Enable Inputs		10	10	10	pF
$C_{I/O}$	Maximum Capacitance (All Switches Off) — Analog I/O		35	35	35	pF
	Common O/I		50	50	50	
	Feedthrough		1.0	1.0	1.0	

Symbol		Typical @ 25°C, V_{CC} = 5.0 V	Unit
C_{PD}	Power Dissipation Capacitance (Figure 13)*	45	pF

* Used to determine the no−load dynamic power consumption: $P_D = C_{PD} V_{CC}^2 f + I_{CC} V_{CC}$.

ADDITIONAL APPLICATION CHARACTERISTICS (GND = 0 V)

Symbol	Parameter	Condition	V_{CC} V	Limit* 25°C	Unit
BW	Maximum On−Channel Bandwidth or Minimum Frequency Response (Figure 6)	f_{in} = 1MHz Sine Wave; Adjust f_{in} Voltage to Obtain 0dBm at V_{OS}; Increase f_{in} Frequency Until dB Meter Reads −3 dB; R_L = 50 Ω, C_L = 10 pF	3.0 4.5 5.5	120 120 120	MHz
−	Off−Channel Feedthrough Isolation (Figure 7)	f_{in} = Sine Wave; Adjust f_{in} Voltage to Obtain 0 dBm at V_{IS} f_{in} = 10kHz, R_L = 600 Ω, C_L = 50 pF	3.0 4.5 5.5	−50 −50 −50	dB
		f_{in} = 1.0MHz, R_L = 50Ω, C_L = 10pF	3.0 4.5 5.5	−37 −37 −37	
−	Feedthrough Noise. Channel−Select Input to Common I/O (Figure 8)	V_{in} ≤ 1MHz Square Wave (t_r = t_f = 3 ns); Adjust R_L at Setup so that I_S = 0A; Enable = GND R_L = 600 Ω, C_L = 50pF	3.0 4.5 5.5	25 105 135	mV_{PP}
		R_L = 10 kΩ, C_L = 10pF	3.0 4.5 5.5	35 145 190	
−	Crosstalk Between Any Two Switches (Figure 12)	f_{in} = Sine Wave; Adjust f_{in} Voltage to Obtain 0dBm at V_{IS} f_{in} = 10 kHz, R_L = 600Ω, C_L = 50pF	3.0 4.5 5.5	−50 −50 −50	dB
		f_{in} = 1.0MHz, R_L = 50Ω, C_L = 10pF	3.0 4.5 5.5	−60 −60 −60	
THD	Total Harmonic Distortion (Figure 14)	f_{in} = 1kHz, R_L = 10 kΩ, C_L = 50pF $THD = THD_{measured} - THD_{source}$ V_{IS} = 2.0V_{PP} sine wave V_{IS} = 4.0V_{PP} sine wave V_{IS} = 5.0V_{PP} sine wave	3.0 4.5 5.5	0.10 0.08 0.05	%

*Limits not tested. Determined by design and verified by qualification.

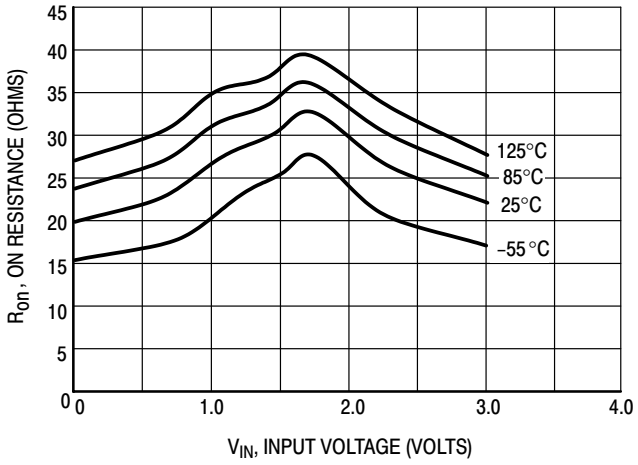


Figure 1a. Typical On Resistance, V_{CC} = 3.0 V

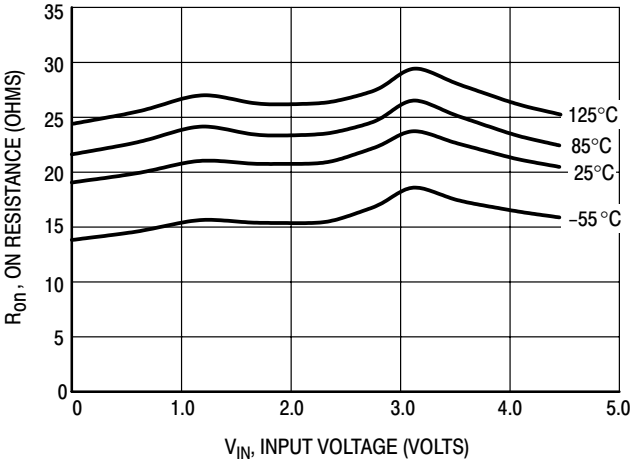


Figure 1b. Typical On Resistance, V_{CC} = 4.5 V

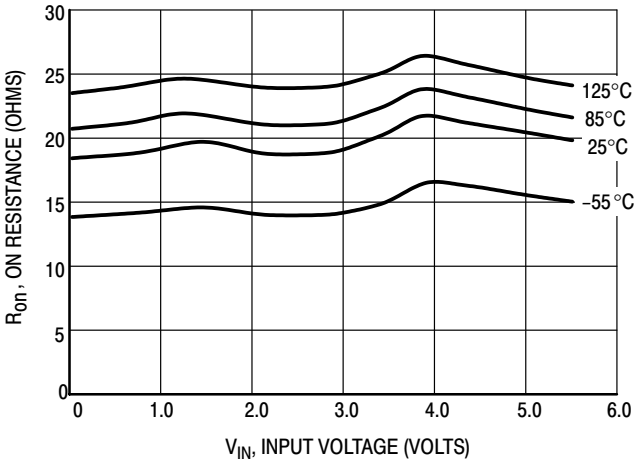


Figure 1c. Typical On Resistance, V_{CC} = 5.5 V

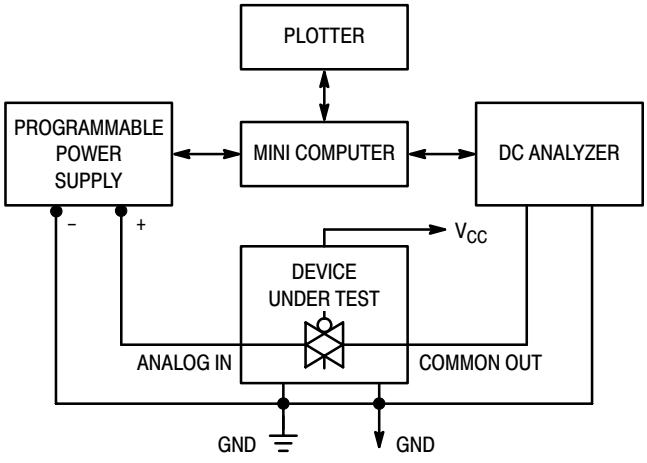


Figure 1. On Resistance Test Set−Up

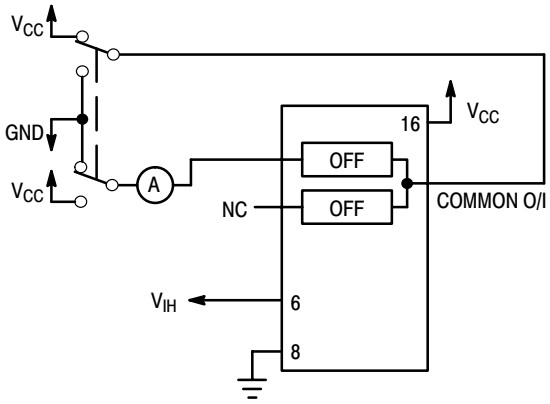


Figure 2. Maximum Off Channel Leakage Current, Any One Channel, Test Set−Up

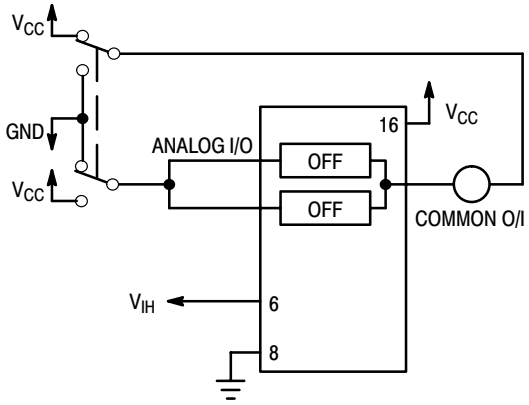


Figure 3. Maximum Off Channel Leakage Current, Common Channel, Test Set−Up

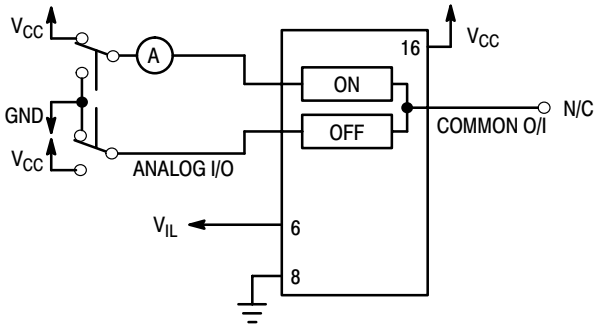
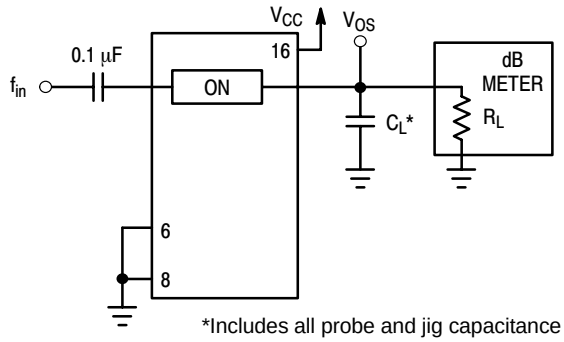
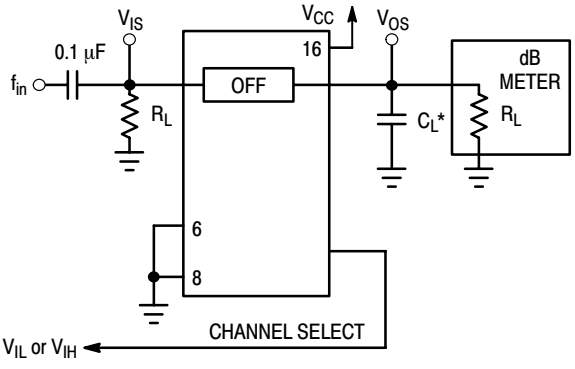


Figure 4. Maximum On Channel Leakage Current, Channel to Channel, Test Set−Up



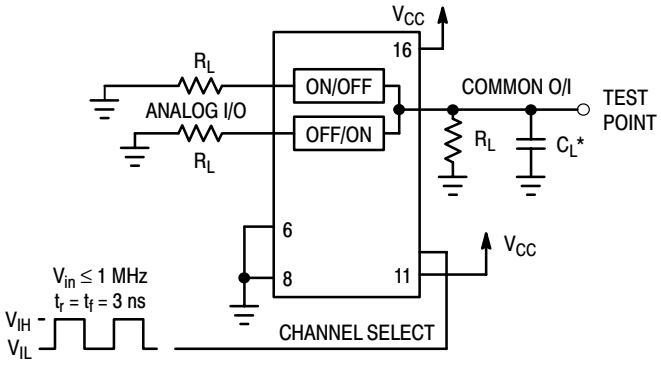
*Includes all probe and jig capacitance

Figure 5. Maximum On Channel Bandwidth, Test Set−Up



*Includes all probe and jig capacitance

Figure 6. Off Channel Feedthrough Isolation, Test Set−Up



*Includes all probe and jig capacitance

Figure 7. Feedthrough Noise, Channel Select to Common Out, Test Set−Up

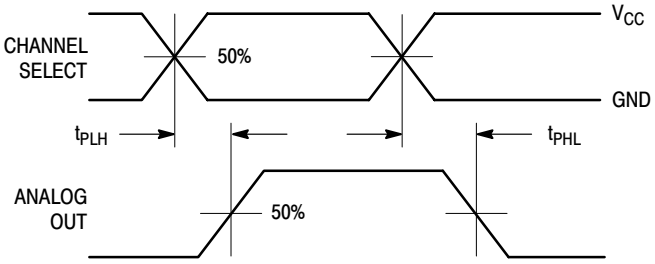
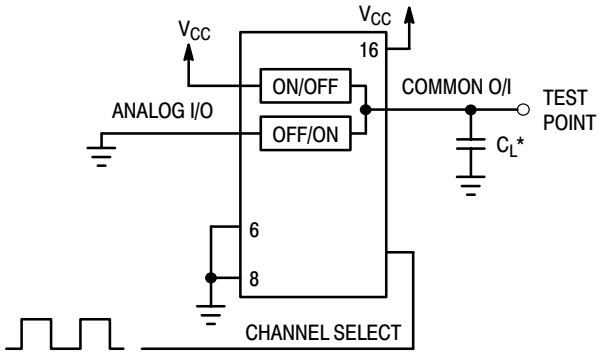


Figure 9a. Propagation Delays, Channel Select to Analog Out



*Includes all probe and jig capacitance

Figure 9b. Propagation Delay, Test Set−Up Channel Select to Analog Out

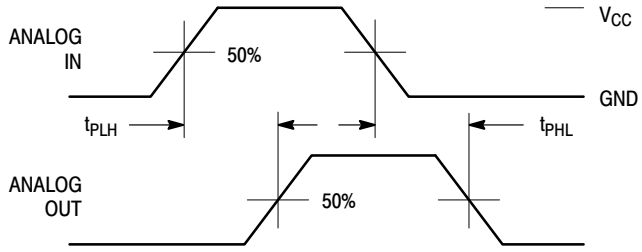
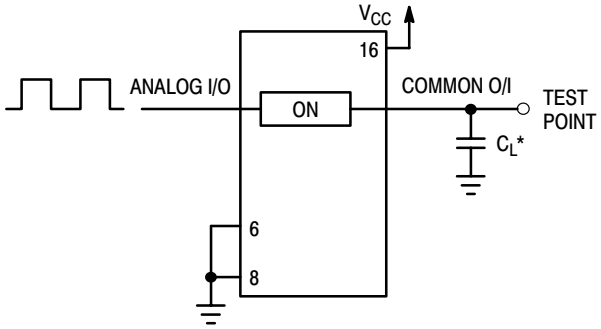


Figure 10a. Propagation Delays, Analog In to Analog Out



*Includes all probe and jig capacitance

Figure 10b. Propagation Delay, Test Set−Up Analog In to Analog Out

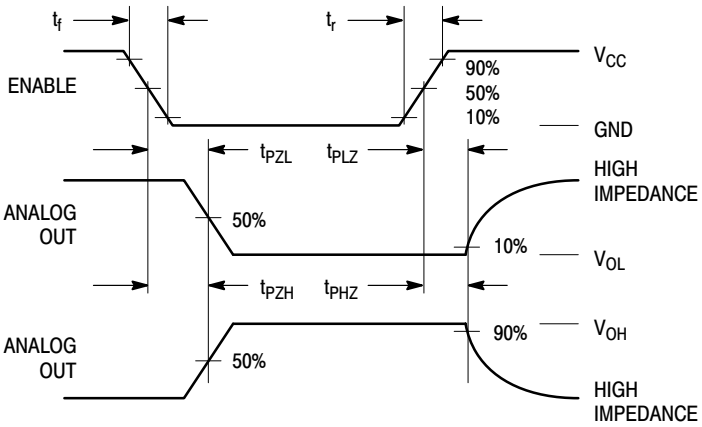


Figure 11a. Propagation Delays, Enable to Analog Out

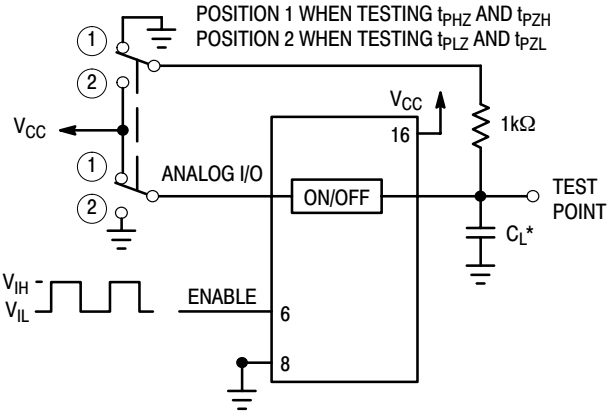


Figure 11b. Propagation Delay, Test Set−Up Enable to Analog Out

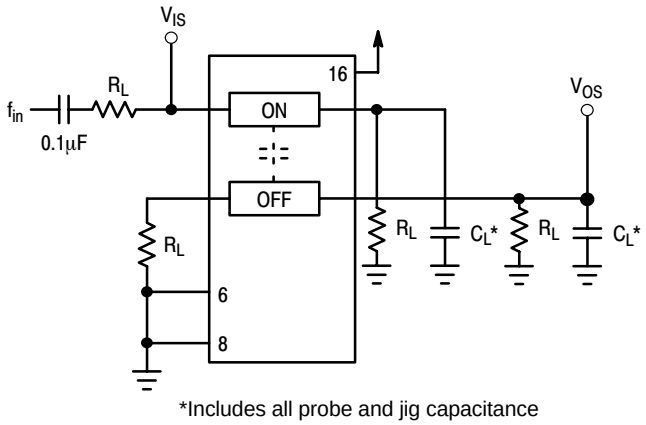


Figure 12. Crosstalk Between Any Two Switches, Test Set−Up

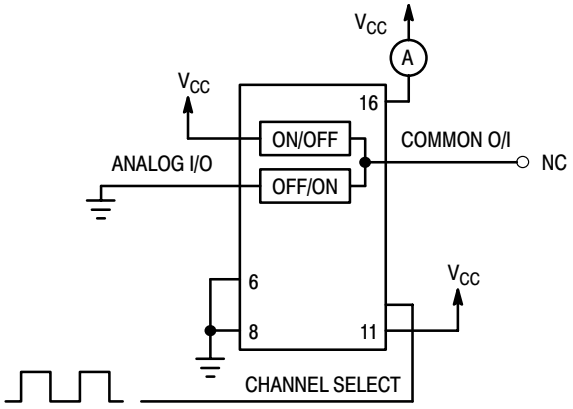


Figure 13. Power Dissipation Capacitance, Test Set−Up

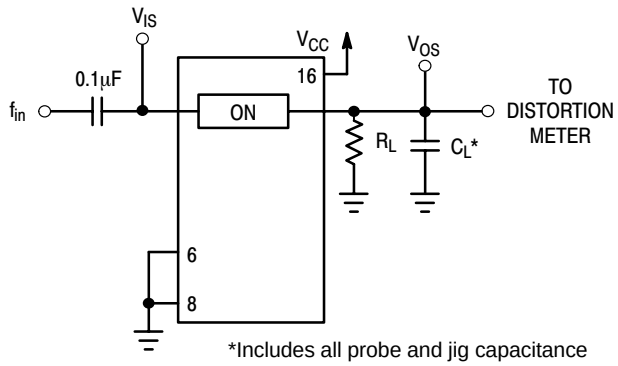


Figure 14a. Total Harmonic Distortion, Test Set−Up

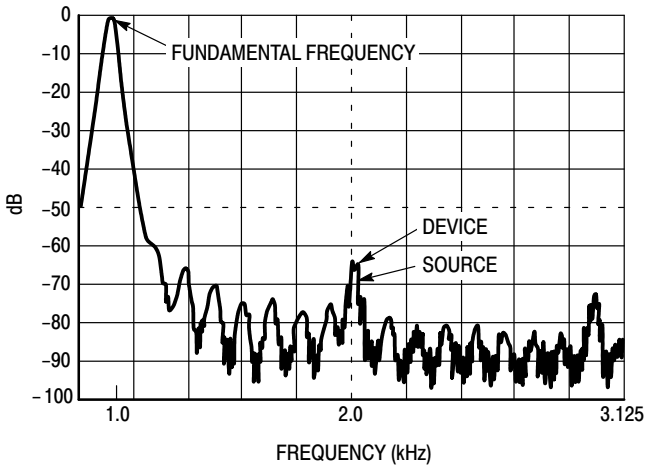


Figure 14b. Plot, Harmonic Distortion

APPLICATIONS INFORMATION

The Channel Select and Enable control pins should be at V_{CC} or GND logic levels. V_{CC} being recognized as a logic high and GND being recognized as a logic low. In this example:

V_{CC} = +5V = logic high
GND = 0V = logic low

The maximum analog voltage swing is determined by the supply voltages V_{CC}. The positive peak analog voltage should not exceed V_{CC}. Similarly, the negative peak analog voltage should not go below GND. In this example, the difference between V_{CC} and GND is five volts. Therefore, using the configuration of Figure 15, a maximum analog signal of five volts peak−to−peak can be controlled. Unused analog inputs/outputs may be left floating (i.e., not connected). However, tying unused analog inputs and outputs to V_{CC} or GND through a low value resistor helps minimize crosstalk and feedthrough noise that may be picked up by an unused switch.

Although used here, balanced supplies are not a requirement. The only constraints on the power supplies are that:

V_{CC} − GND = 2 to 6 volts

When voltage transients above V_{CC} and/or below GND are anticipated on the analog channels, external Germanium or Schottky diodes (D_x) are recommended as shown in Figure 16. These diodes should be able to absorb the maximum anticipated current surges during clipping.

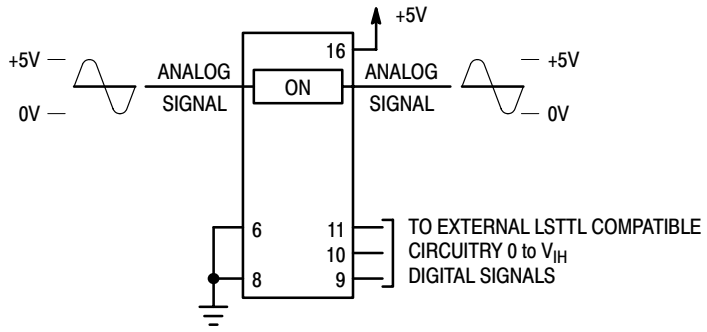


Figure 15. Application Example

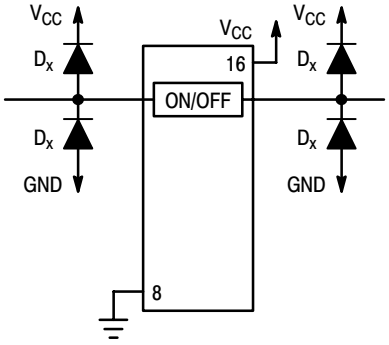
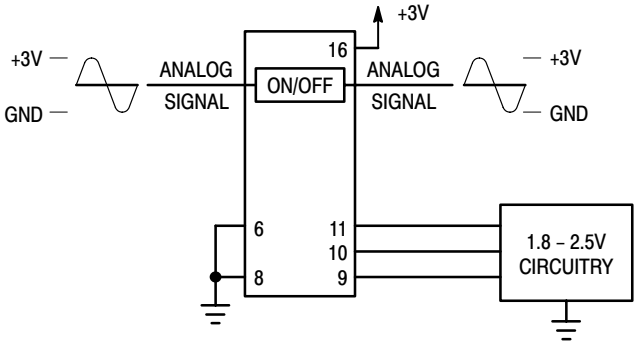
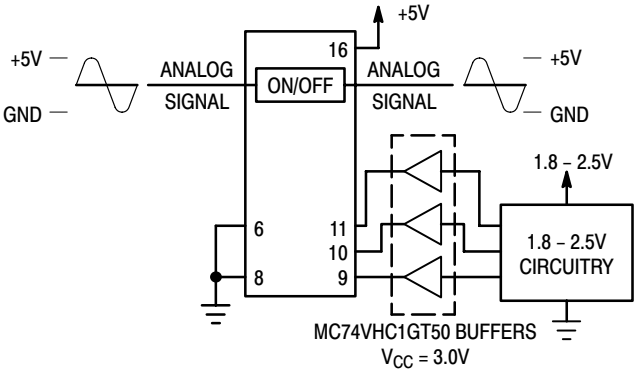


Figure 16. External Germanium or Schottky Clipping Diodes



a. Low Voltage Logic Level Shifting Control



b. 2−Stage Logic Level Shifting Control

Figure 17. Interfacing Low Voltage CMOS Inputs

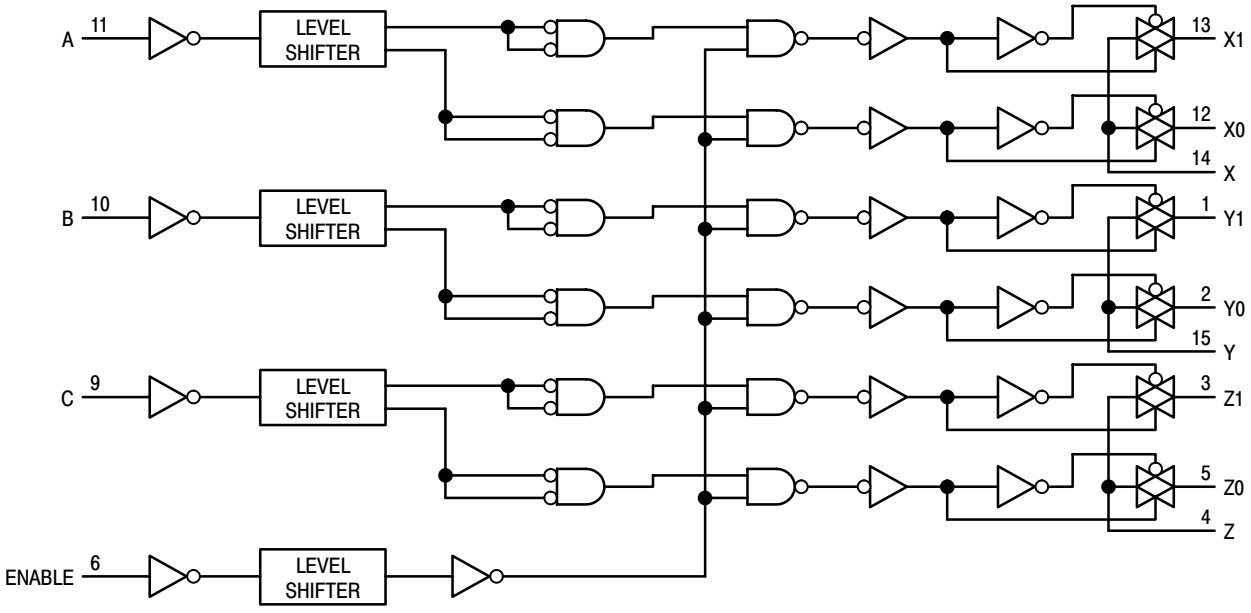
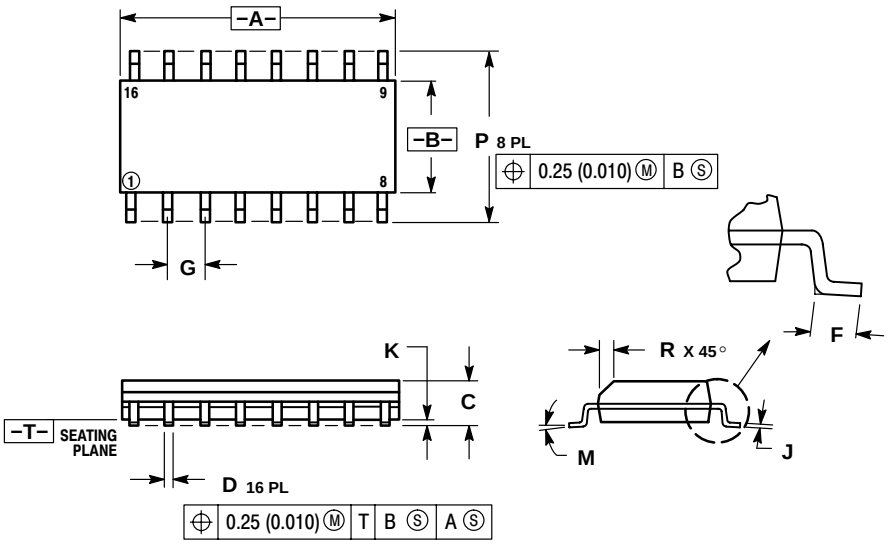


Figure 18. Function Diagram, LVXT8053

PACKAGE DIMENSIONS

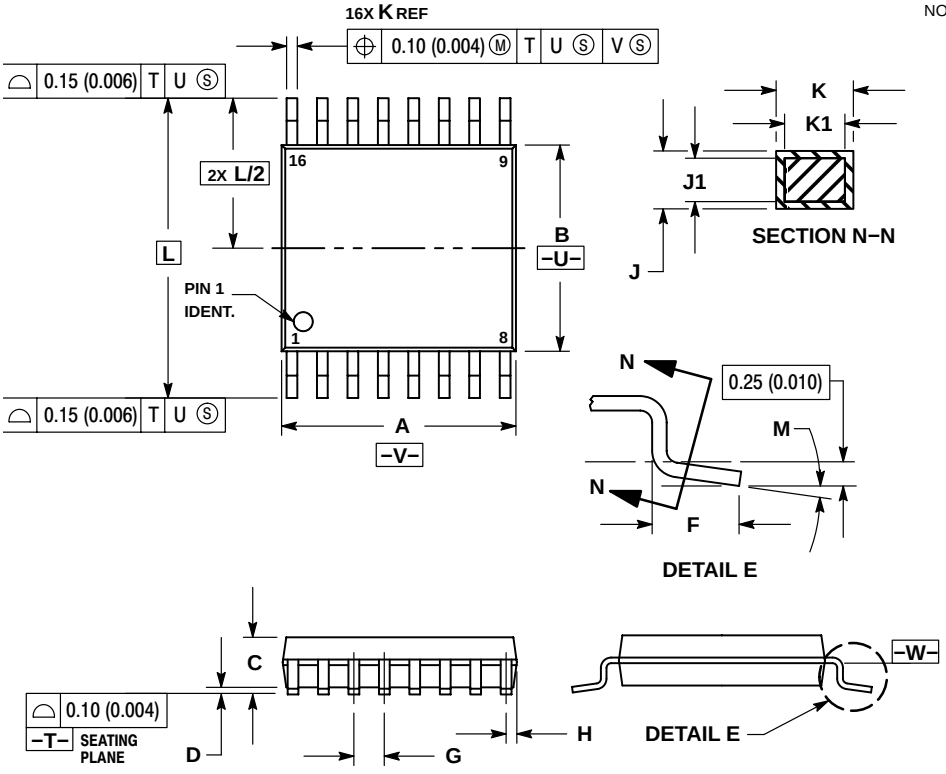
SOIC−16
D SUFFIX
CASE 751B−05
ISSUE J



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

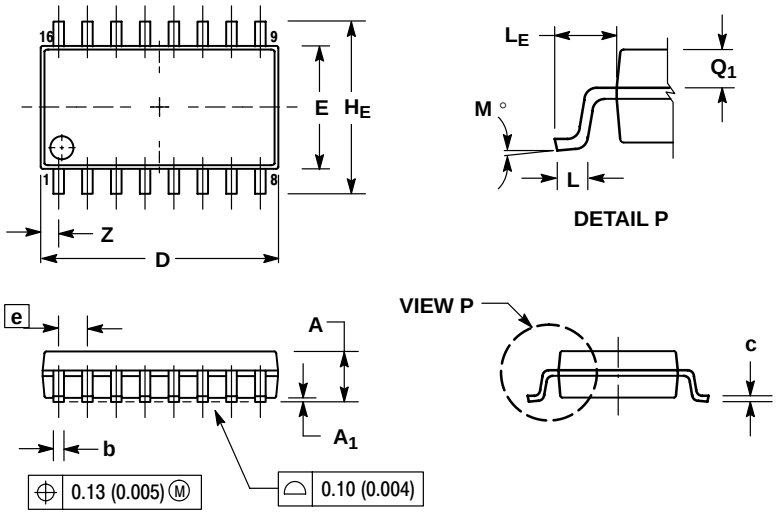
TSSOP−16
DT SUFFIX
CASE 948F−01
ISSUE A



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE −W−.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	−−−	1.20	−−−	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0 °	8 °	0 °	8 °

SOEIAJ−16
M SUFFIX
CASE 966−01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	−−−	2.05	−−−	0.081
A_1	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.18	0.27	0.007	0.011
D	9.90	10.50	0.390	0.413
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
H_E	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L_E	1.10	1.50	0.043	0.059
M	0 °	10 °	0 °	10 °
Q_1	0.70	0.90	0.028	0.035
Z	−−−	0.78	−−−	0.031

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