

# MC74LCX04

## Low-Voltage CMOS Hex Inverter

### With 5 V-Tolerant Inputs

The MC74LCX04 is a high performance hex inverter operating from a 2.3 to 3.6 V supply. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance. A  $V_I$  specification of 5.5 V allows MC74LCX04 inputs to be safely driven from 5 V devices.

Current drive capability is 24 mA at the outputs.

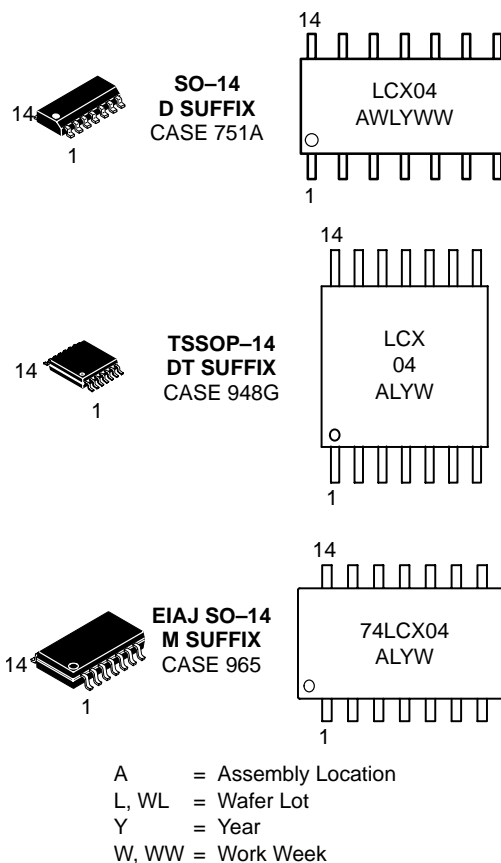
- Designed for 2.3 V to 3.6 V  $V_{CC}$  Operation
- 5 V Tolerant Inputs – Interface Capability With 5 V TTL Logic
- LVTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current (10  $\mu$ A) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500 mA
- ESD Performance: Human Body Model >2000 V;  
Machine Model >200 V



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#### MARKING DIAGRAMS



#### ORDERING INFORMATION

Device	Package	Shipping
MC74LCX04D	SO-14	55 Units/Rail
MC74LCX04DR2	SO-14	2500 Units/Reel
MC74LCX04DT	TSSOP-14	96 Units/Rail
MC74LCX04DTR2	TSSOP-14	2500 Units/Reel
MC74LCX04M	EIAJ SO-14	50 Units/Rail
MC74LCX04MEL	EIAJ SO-14	2000 Units/Reel

# MC74LCX04

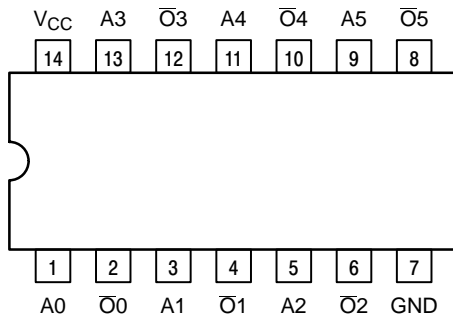


Figure 1. Pinout: 14-Lead (Top View)

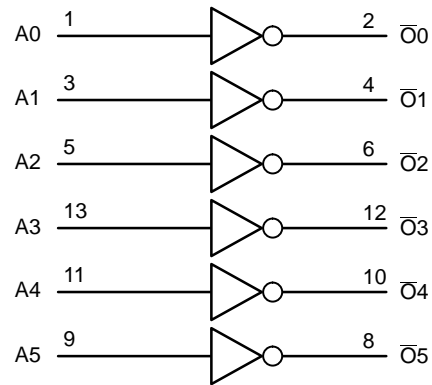


Figure 2. Logic Diagram

## PIN NAMES

Pins	Function
A <sub>n</sub>	Data Inputs
$\overline{O}n$	Outputs

## TRUTH TABLE

A <sub>n</sub>	$\overline{O}n$
L	H
H	L

## MAXIMUM RATINGS

Symbol	Parameter	Value	Condition	Unit
V <sub>CC</sub>	DC Supply Voltage	−0.5 to +7.0		V
V <sub>I</sub>	DC Input Voltage	−0.5 ≤ V <sub>I</sub> ≤ +7.0		V
V <sub>O</sub>	DC Output Voltage	−0.5 ≤ V <sub>O</sub> ≤ V <sub>CC</sub> +0.5	Output in HIGH or LOW State (Note 1.)	V
I <sub>IK</sub>	DC Input Diode Current	−50	V <sub>I</sub> < GND	mA
I <sub>OK</sub>	DC Output Diode Current	−50	V <sub>O</sub> < GND	mA
		+50	V <sub>O</sub> > V <sub>CC</sub>	mA
I <sub>O</sub>	DC Output Source/Sink Current	±50		mA
I <sub>CC</sub>	DC Supply Current Per Supply Pin	±100		mA
I <sub>GND</sub>	DC Ground Current Per Ground Pin	±100		mA
T <sub>STG</sub>	Storage Temperature Range	−65 to +150		°C

Maximum Ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute maximum-rated conditions is not implied. Functional operation should be restricted to the Recommended Operating Conditions.

1. I<sub>O</sub> absolute maximum rating must be observed.

# MC74LCX04

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Type	Max	Unit
$V_{CC}$	Supply Voltage Operating Data Retention Only	2.0 1.5	2.5, 3.3 2.5, 3.3	3.6 3.6	V
$V_I$	Input Voltage	0		5.5	V
$V_O$	Output Voltage (HIGH or LOW State) (3-State)	0		$V_{CC}$	V
$I_{OH}$	HIGH Level Output Current $V_{CC} = 3.0\text{ V} - 3.6\text{ V}$ $V_{CC} = 2.7\text{ V} - 3.0\text{ V}$ $V_{CC} = 2.3\text{ V} - 2.7\text{ V}$			-24 -12 -8	mA
$I_{OL}$	LOW Level Output Current $V_{CC} = 3.0\text{ V} - 3.6\text{ V}$ $V_{CC} = 2.7\text{ V} - 3.0\text{ V}$ $V_{CC} = 2.3\text{ V} - 2.7\text{ V}$			+24 +12 +8	mA
$T_A$	Operating Free-Air Temperature	-40		+85	°C
$\Delta t/\Delta V$	Input Transition Rise or Fall Rate, $V_{IN}$ from 0.8 V to 2.0 V, $V_{CC} = 3.0\text{ V}$	0		10	ns/V

## DC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Condition	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		Unit
			Min	Max	
$V_{IH}$	HIGH Level Input Voltage (Note 2.)	$2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$	1.7		V
		$2.7\text{ V} \leq V_{CC} \leq 3.6\text{ V}$	2.0		
$V_{IL}$	LOW Level Input Voltage (Note 2.)	$2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$		0.7	V
		$2.7\text{ V} \leq V_{CC} \leq 3.6\text{ V}$		0.8	
$V_{OH}$	HIGH Level Output Voltage	$2.3\text{ V} \leq V_{CC} \leq 3.6\text{ V}$ ; $I_{OH} = -100\text{ }\mu\text{A}$	$V_{CC} - 0.2$		V
		$V_{CC} = 2.3\text{ V}$ ; $I_{OH} = -8\text{ mA}$	1.8		
		$V_{CC} = 2.7\text{ V}$ ; $I_{OH} = -12\text{ mA}$	2.2		
		$V_{CC} = 3.0\text{ V}$ ; $I_{OH} = -18\text{ mA}$	2.4		
		$V_{CC} = 3.0\text{ V}$ ; $I_{OH} = -24\text{ mA}$	2.2		
$V_{OL}$	LOW Level Output Voltage	$2.3\text{ V} \leq V_{CC} \leq 3.6\text{ V}$ ; $I_{OL} = 100\text{ }\mu\text{A}$		0.2	V
		$V_{CC} = 2.3\text{ V}$ ; $I_{OL} = 8\text{ mA}$		0.6	
		$V_{CC} = 2.7\text{ V}$ ; $I_{OL} = 12\text{ mA}$		0.4	
		$V_{CC} = 3.0\text{ V}$ ; $I_{OL} = 16\text{ mA}$		0.4	
		$V_{CC} = 3.0\text{ V}$ ; $I_{OL} = 24\text{ mA}$		0.55	
$I_I$	Input Leakage Current	$2.3\text{ V} \leq V_{CC} \leq 3.6\text{ V}$ ; $0\text{ V} \leq V_I \leq 5.5\text{ V}$		$\pm 5$	$\mu\text{A}$
$I_{CC}$	Quiescent Supply Current	$2.3 \leq V_{CC} \leq 3.6\text{ V}$ ; $V_I = \text{GND or } V_{CC}$		10	$\mu\text{A}$
		$2.3 \leq V_{CC} \leq 3.6\text{ V}$ ; $3.6 \leq V_I \text{ or } V_O \leq 5.5\text{ V}$		$\pm 10$	
$\Delta I_{CC}$	Increase in $I_{CC}$ per Input	$2.3 \leq V_{CC} \leq 3.6\text{ V}$ ; $V_{IH} = V_{CC} - 0.6\text{ V}$		500	$\mu\text{A}$

2. These values of  $V_I$  are used to test DC electrical characteristics only.

# MC74LCX04

## AC CHARACTERISTICS $t_R = t_F = 2.5 \text{ ns}$ ; $R_L = 500 \Omega$

Symbol	Parameter	Waveform	Limits						Unit
			T <sub>A</sub> = −40°C to +85°C						
			V <sub>CC</sub> = 3.3 V ± 0.3 V		V <sub>CC</sub> = 2.7 V		V <sub>CC</sub> = 2.5 V ± 0.2 V		
			C <sub>L</sub> = 50 pF		C <sub>L</sub> = 50 pF		C <sub>L</sub> = 30 pF		
			Min	Max	Min	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay Time	1	1.5	5.2	1.5	6.0	1.5	6.2	ns
t <sub>PHL</sub>	Input to Output		1.5	5.2	1.5	6.0	1.5	6.2	
t <sub>OSHL</sub>	Output-to-Output Skew			1.0					ns
t <sub>OSLH</sub>	(Note 3.)			1.0					

3. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW ( $t_{OSHL}$ ) or LOW-to-HIGH ( $t_{OSLH}$ ); parameter guaranteed by design.

## DYNAMIC SWITCHING CHARACTERISTICS

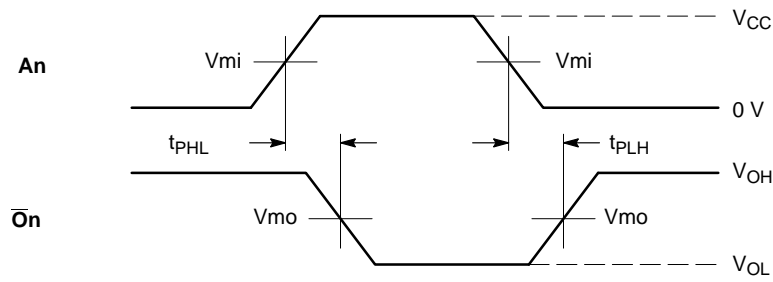
Symbol	Characteristic	Condition	$T_A = +25^\circ\text{C}$			Unit
			Min	Typ	Max	
$V_{OLP}$	Dynamic LOW Peak Voltage (Note 4.)	$V_{CC} = 3.3 \text{ V}$ , $C_L = 50 \text{ pF}$ , $V_{IH} = 3.3 \text{ V}$ , $V_{IL} = 0 \text{ V}$		0.8		V
		$V_{CC} = 2.5 \text{ V}$ , $C_L = 30 \text{ pF}$ , $V_{IH} = 2.5 \text{ V}$ , $V_{IL} = 0 \text{ V}$		0.6		V
$V_{OLV}$	Dynamic LOW Valley Voltage (Note 4.)	$V_{CC} = 3.3 \text{ V}$ , $C_L = 50 \text{ pF}$ , $V_{IH} = 3.3 \text{ V}$ , $V_{IL} = 0 \text{ V}$		-0.8		V
		$V_{CC} = 2.5 \text{ V}$ , $C_L = 30 \text{ pF}$ , $V_{IH} = 2.5 \text{ V}$ , $V_{IL} = 0 \text{ V}$		-0.6		V

4. Number of outputs defined as "n". Measured with "n-1" outputs switching from HIGH-to-LOW or LOW-to-HIGH. The remaining output is measured in the LOW state.

## CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Condition	Typical	Unit
$C_{IN}$	Input Capacitance	$V_{CC} = 3.3 \text{ V}$ , $V_I = 0 \text{ V}$ or $V_{CC}$	7	pF
$C_{OUT}$	Output Capacitance	$V_{CC} = 3.3 \text{ V}$ , $V_O = 0 \text{ V}$ or $V_{CC}$	8	pF
$C_{PD}$	Power Dissipation Capacitance	10 MHz, $V_{CC} = 3.3 \text{ V}$ , $V_I = 0 \text{ V}$ or $V_{CC}$	25	pF

## MC74LCX04

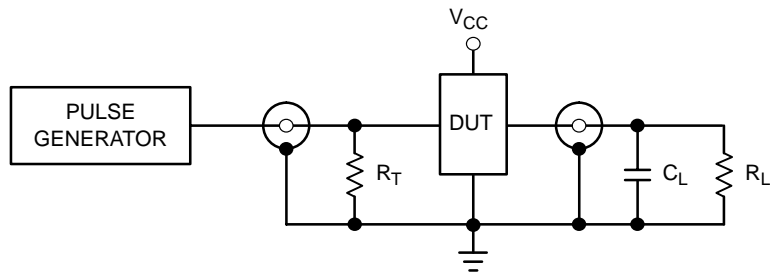


### WAVEFORM 1 – PROPAGATION DELAYS

$t_R = t_F = 2.5 \text{ ns}$ , 10% to 90%;  $f = 1 \text{ MHz}$ ;  $t_W = 500 \text{ ns}$

Symbol	$V_{CC}$		
	$3.3 \text{ V} \pm 0.3 \text{ V}$	$2.7 \text{ V}$	$2.5 \text{ V} \pm 0.2 \text{ V}$
Vmi	1.5 V	1.5 V	$V_{CC}/2$
Vmo	1.5 V	1.5 V	$V_{CC}/2$

Figure 3. AC Waveforms



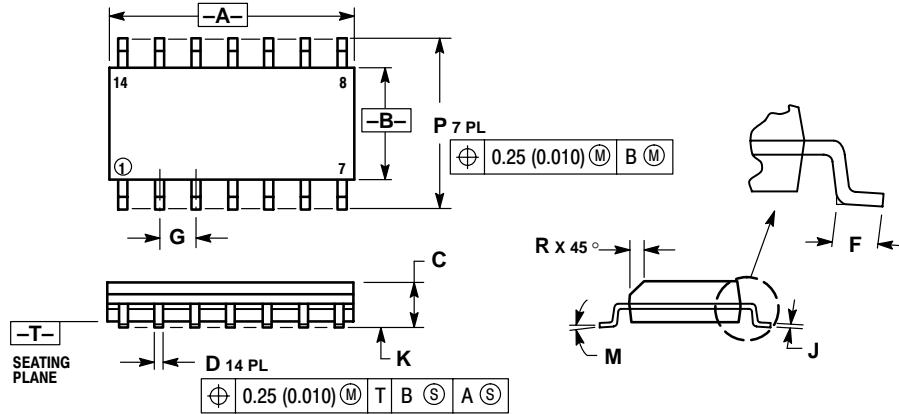
$C_L = 50 \text{ pF}$  at  $V_{CC} = 3.3 \pm 0.3 \text{ V}$  or equivalent (includes jig and probe capacitance)  
 $C_L = 30 \text{ pF}$  at  $V_{CC} = 2.5 \pm 0.2 \text{ V}$  or equivalent (includes jig and probe capacitance)  
 $R_L = R_1 = 500 \Omega$  or equivalent  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50 \Omega$ )

Figure 4. Test Circuit

# MC74LCX04

## PACKAGE DIMENSIONS

### SO-14 D SUFFIX CASE 751A-03 ISSUE F

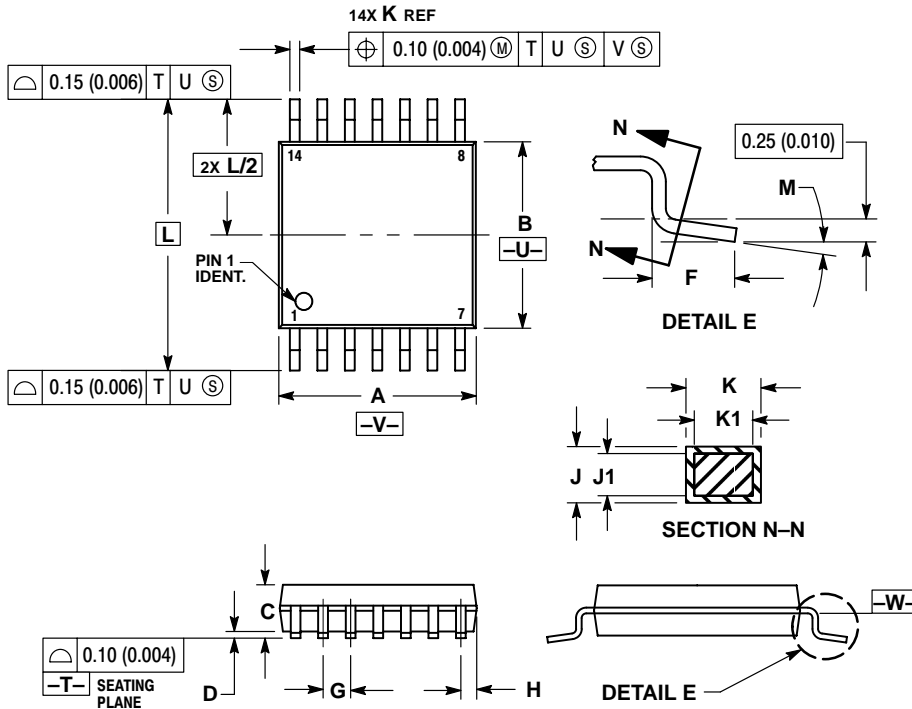


#### NOTES:

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.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
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	0.228	0.244
R	0.25	0.50	0.010	0.019

### TSSOP-14 DT SUFFIX CASE 948G-01 ISSUE O



#### NOTES:

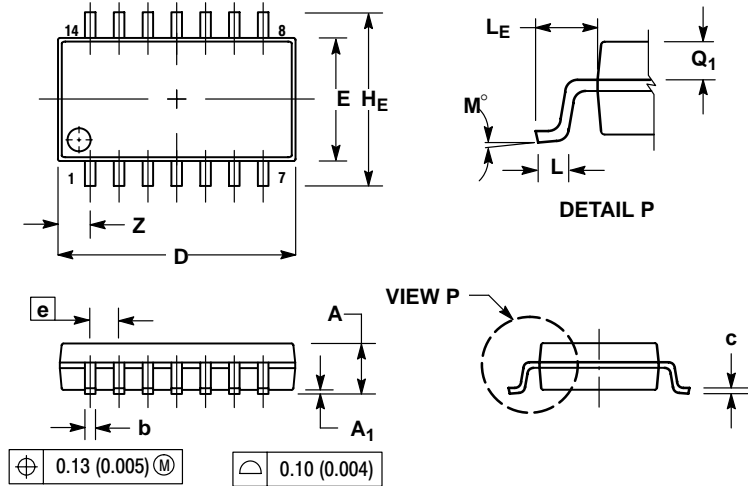
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD 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-.

DIM	MILLIMETERS		INCHES	
	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	0.50	0.60	0.020	0.024
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°

# MC74LCX04

## PACKAGE DIMENSIONS

EIAJ SO-14  
M SUFFIX  
CASE 965-01  
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).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A <sub>1</sub>	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 <sub>E</sub>	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L <sub>E</sub>	1.10	1.50	0.043	0.059
M	0°	10°	0°	10°
Q <sub>1</sub>	0.70	0.90	0.028	0.035
Z	---	1.42	---	0.056

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