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Low-Voltage CMOS Octal Transceiver/Registered Transceiver With Dual Enable

With 5 V–Tolerant Inputs and Outputs (3–State, Non–Inverting)

The MC74LCX652 is a high performance, non–inverting octal transceiver/registered transceiver 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 MC74LCX652 inputs to be safely driven from 5 V devices. The MC74LCX652 is suitable for memory address driving and all TTL level bus oriented transceiver applications.

Data on the A or B bus will be clocked into the registers as the appropriate clock pin goes from a LOW–to–HIGH logic level. Two Output Enable pins ($\overline{\text{OEBA}}$, OEAB) are provided to control the transceiver outputs. In the transceiver mode, data present at the high impedance port may be stored in either the A or the B register or in both. The select controls (SBA, SAB) can multiplex stored and real–time (transparent mode) data. In the isolation mode (both outputs disabled), A data may be stored in the B register or B data may be stored in the A register. When in the real–time mode, it is possible to store data without using the internal registers by simultaneously enabling OEAB and $\overline{\text{OEBA}}$. In this configuration, each output reinforces its input (data retention is not guaranteed in this mode).

- Designed for 2.3 to 3.6 V V_{CC} Operation
- 5 V Tolerant – Interface Capability With 5 V TTL Logic
- Supports Live Insertion and Withdrawal
- I_{OFF} Specification Guarantees High Impedance When $V_{CC} = 0$ V
- LVTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current in All Three Logic States (10 μA) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500 mA
- ESD Performance: Human Body Model >2000 V; Machine Model >200 V
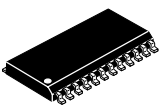
MC74LCX652

LCX

LOW–VOLTAGE CMOS OCTAL TRANSCEIVER/ REGISTERED TRANSCEIVER WITH DUAL ENABLE

DT SUFFIX
24–LEAD PLASTIC TSSOP PACKAGE
CASE 948H

DW SUFFIX
24–LEAD PLASTIC SOIC PACKAGE
CASE 751E

Figure 1. PIN NAMES

Pins	Function
A0–A7	Side A Inputs/Outputs
B0–B7	Side B Inputs/Outputs
CAB, CBA	Clock Pulse Inputs
SAB, SBA	Select Control Inputs
$\overline{\text{OEBA}}$, OEAB	Output Enable Inputs

MC74LCX652
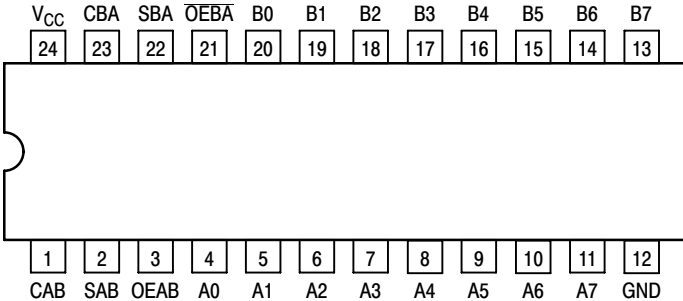
Figure 2. 24−Lead Pinout (Top View)

To 7 Other Channels
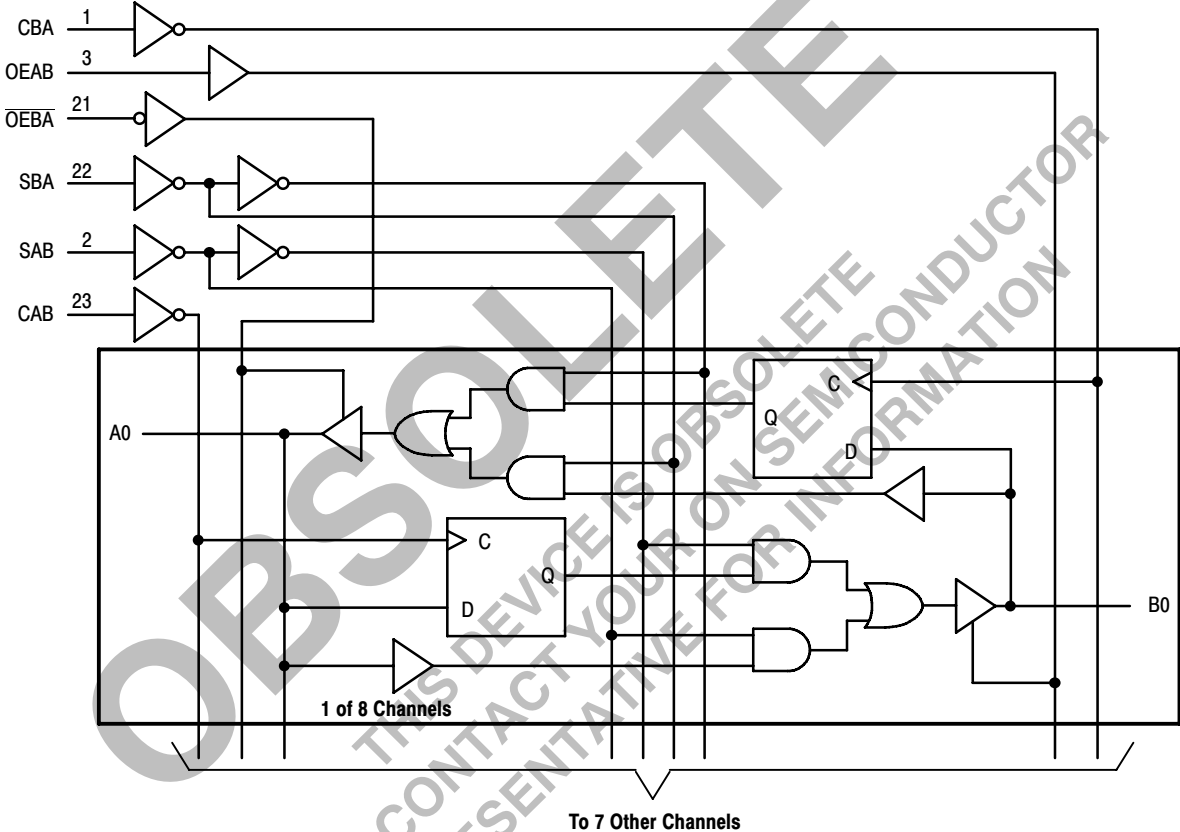
Figure 3. Logic Diagram

TRUTH TABLE

Inputs						Data Ports		Operating Mode
OEAB	$\overline{\text{OEBA}}$	CAB	CBA	SAB	SBA	An	Bn	
L	H					Input	Input	
		↑̸	↑̸	X	X	X	X	Isolation, Hold Storage
		↑	↑	X	X	l h	l h	Store A and/or B Data
H	H					Input	Output	
		↑̸	X*	L	X	L H	L H	Real Time A Data to B Bus
				H	X	X	QA	Stored A Data to B Bus
		↑	X*	L	X	l h	L H	Real Time A Data to B Bus; Store A Data
				H	X	L H	QA QA	Clock A Data to B Bus; Store A Data
L	L					Output	Input	
		X*	↑̸	X	L	L H	L H	Real Time B Data to A Bus
				X	H	QB	X	Stored B Data to A Bus
		X*	↑	X	L	L H	l h	Real Time B Data to A Bus; Store B Data
				X	H	QB QB	L H	Clock B Data to A Bus; Store B Data
H	L					Output	Output	
		↑̸	↑̸	H	H	QB	QA	Stored A Data to B Bus, Stored B Data to A Bus

H   =   High Voltage Level
h   =   High Voltage Level One Setup Time Prior to the Low−to−High Clock Transition
L   =   Low Voltage Level
l   =   Low Voltage Level One Setup Time Prior to the Low−to−High Clock Transition
X   =   Don't Care
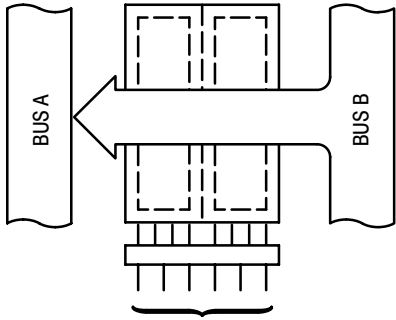↑   =   Low−to−High Clock Transition
↑̸   =   NOT Low−to−High Clock Transition
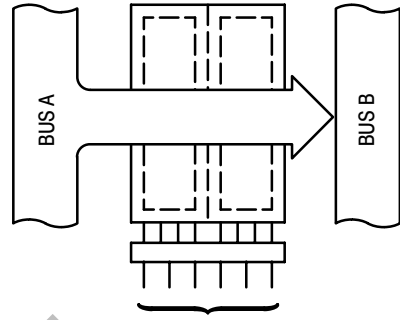QA   =   A input storage register
QB   =   B input storage register
*   =   The clocks are not internally gated with either the Output Enables or the Source Inputs. Therefore, data at the A or B ports may be clocked into the storage registers, at any time. For I_{CC} reasons, Do Not Float Inputs.
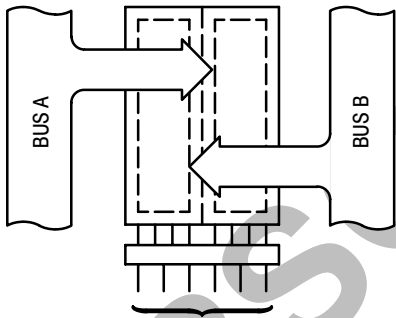
Real Time Transfer – Bus B to Bus A

OEAB	$\overline{OEBA}$	CAB	CBA	SAB	SBA
L	L	X	X	X	L

Real Time Transfer – Bus A to Bus B

OEAB	$\overline{OEBA}$	CAB	CBA	SAB	SBA
H	H	X	X	L	X

Store Data from Bus A, Bus B or Bus A and Bus B

OEAB	$\overline{OEBA}$	CAB	CBA	SAB	SBA
X	H	↑	X	X	X
L	X	X	↑	X	X
L	H	↑	↑	X	X

Transfer A Stored Data to Bus B or B Stored Data to Bus A or Both at the Same Time
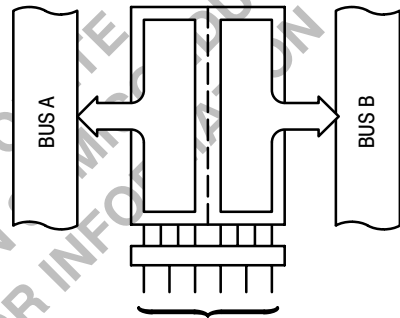
OEAB	$\overline{OEBA}$	CAB	CBA	SAB	SBA
H	H	H or L	X	H	X
L	L	X	H or L	X	H
H	L	H or L	H or L	H	H

Store Bus A in Both Registers or Store Bus B in Both Registers
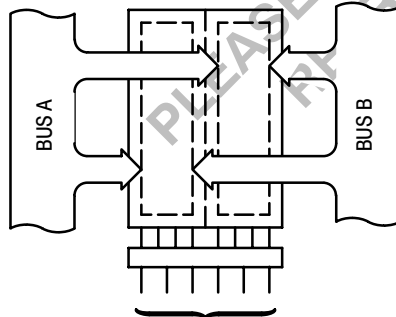
OEAB	$\overline{OEBA}$	CAB	CBA	SAB	SBA
H	H	↑	↑	L	X
L	L	↑	↑	X	L

Isolation
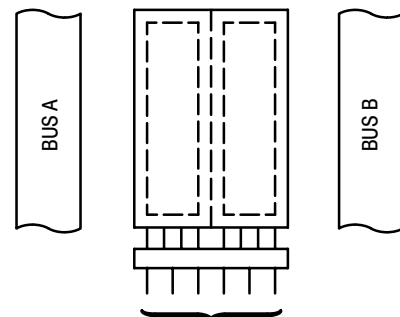
OEAB	$\overline{OEBA}$	CAB	CBA	SAB	SBA
L	H	H or L	H or L	X	X

Figure 4. Bus Applications

MAXIMUM RATINGS

Symbol	Parameter	Value	Condition	Unit
V_{CC}	DC Supply Voltage	−0.5 to +7.0		V
V_I	DC Input Voltage	$−0.5 \leq V_I \leq +7.0$		V
V_O	DC Output Voltage	$−0.5 \leq V_O \leq +7.0$	Output in 3−State	V
		$−0.5 \leq V_O \leq V_{CC} + 0.5$	Note 1.	V
I_{IK}	DC Input Diode Current	−50	$V_I <$ GND	mA
I_{OK}	DC Output Diode Current	−50	$V_O <$ GND	mA
		+50	$V_O > V_{CC}$	mA
I_O	DC Output Source/Sink Current	±50		mA
I_{CC}	DC Supply Current Per Supply Pin	±100		mA
I_{GND}	DC Ground Current Per Ground Pin	±100		mA
T_{STG}	Storage Temperature Range	−65 to +150		°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. Output in HIGH or LOW State. I_O absolute maximum rating must be observed.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Typ	Max	Unit
V_{CC}	Supply Voltage	Operating	2.0	3.3	3.6	V
		Data Retention Only	1.5	3.3	3.6	
V_I	Input Voltage		0		5.5	V
V_O	Output Voltage	(HIGH or LOW State)	0		V_{CC}	V
		(3−State)	0		5.5	
I_{OH}	HIGH Level Output Current, V_{CC} = 3.0 V – 3.6 V				−24	mA
I_{OL}	LOW Level Output Current, V_{CC} = 3.0 V – 3.6 V				24	mA
I_{OH}	HIGH Level Output Current, V_{CC} = 2.7 V – 3.0 V				−12	mA
I_{OL}	LOW Level Output Current, V_{CC} = 2.7 V – 3.0 V				12	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 V		0		10	ns/V

DC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Condition	T_A = −40°C to +85°C Min	T_A = −40°C to +85°C Max	Unit
V_{IH}	HIGH Level Input Voltage (Note 2.)	$2.7\ V \leq V_{CC} \leq 3.6\ V$	2.0		V
V_{IL}	LOW Level Input Voltage (Note 2.)	$2.7\ V \leq V_{CC} \leq 3.6\ V$		0.8	V
V_{OH}	HIGH Level Output Voltage	$2.7\ V \leq V_{CC} \leq 3.6\ V$; I_{OH} = −100 μA	V_{CC} − 0.2		V
		V_{CC} = 2.7 V; I_{OH} = −12 mA	2.2		
		V_{CC} = 3.0 V; I_{OH} = −18 mA	2.4		
		V_{CC} = 3.0 V; I_{OH} = −24 mA	2.2		
V_{OL}	LOW Level Output Voltage	$2.7\ V \leq V_{CC} \leq 3.6\ V$; I_{OL} = 100 μA		0.2	V
		V_{CC} = 2.7 V; I_{OL} = 12 mA		0.4	
		V_{CC} = 3.0 V; I_{OL} = 16 mA		0.4	
		V_{CC} = 3.0 V; I_{OL} = 24 mA		0.55	

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

DC ELECTRICAL CHARACTERISTICS (Continued)

Symbol	Characteristic	Condition	T_A = −40°C to +85°C Min	T_A = −40°C to +85°C Max	Unit
I_I	Input Leakage Current	2.7 V ≤ V_{CC} ≤ 3.6 V; 0 V ≤ V_I ≤ 5.5 V		±5.0	µA
I_{OZ}	3−State Output Current	2.7 ≤ V_{CC} ≤ 3.6 V; 0 V ≤ V_O ≤ 5.5 V; V_I = V_{IH} or V_{IL}		±5.0	µA
I_{OFF}	Power−Off Leakage Current	V_{CC} = 0 V; V_I or V_O = 5.5 V		10	µA
I_{CC}	Quiescent Supply Current	2.7 ≤ V_{CC} ≤ 3.6 V; V_I = GND or V_{CC}		10	µA
		2.7 ≤ V_{CC} ≤ 3.6 V; 3.6 ≤ V_I or V_O ≤ 5.5 V		±10	µA
ΔI_{CC}	Increase in I_{CC} per Input	2.7 ≤ V_{CC} ≤ 3.6 V; V_{IH} = V_{CC} − 0.6 V		500	µA

AC CHARACTERISTICS (t_R = t_F = 2.5 ns; C_L = 50 pF; R_L = 500 Ω)

Symbol	Parameter	Waveform	V_{CC} = 3.0 V to 3.6 V Min	V_{CC} = 3.0 V to 3.6 V Max	V_{CC} = 2.7 V Min	V_{CC} = 2.7 V Max	Unit
f_{max}	Clock Pulse Frequency	3	150				MHz
t_{PLH} t_{PHL}	Propagation Delay Input to Output	1	1.5 1.5	7.0 7.0	1.5 1.5	8.0 8.0	ns
t_{PLH} t_{PHL}	Propagation Delay Clock to Output	3	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t_{PLH} t_{PHL}	Propagation Delay Select to Output	1	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t_{PZH} t_{PZL}	Output Enable Time to High and Low Level	2	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t_{PHZ} t_{PLZ}	Output Disable Time From High and Low Level	2	1.5 1.5	8.5 8.5	1.5 1.5	9.5 9.5	ns
t_s	Setup Time, HIGH or LOW Data to Clock	3	2.5		2.5		ns
t_h	Hold Time, HIGH or LOW Data to Clock	3	1.5		1.5		ns
t_w	Clock Pulse Width, HIGH or LOW	3	3.3		3.3		ns
t_{OSHL} t_{OSLH}	Output−to−Output Skew (Note 3.)			1.0 1.0			ns

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	Condition	T_A = +25°C Min	T_A = +25°C Typ	T_A = +25°C Max	Unit
V_{OLP}	V_{CC} = 3.3 V, C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V		0.8		V
V_{OLV}	V_{CC} = 3.3 V, C_L = 50 pF, V_{IH} = 3.3 V, V_{IL} = 0 V		0.8		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. The LCX652 is characterized with 7 outputs switching with 1 output held LOW.
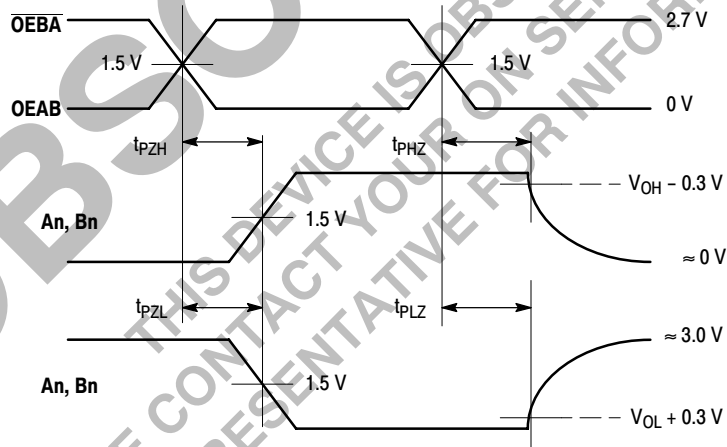
CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Condition	Typical	Unit
C_{IN}	Input Capacitance	V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	7	pF
$C_{I/O}$	Input/Output Capacitance	V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	8	pF
C_{PD}	Power Dissipation Capacitance	10 MHz, V_{CC} = 3.3 V, V_I = 0 V or V_{CC}	25	pF
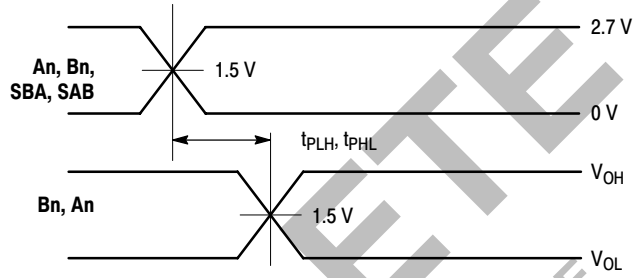
WAVEFORM 1 – SAB to B and SBA to A, An to Bn PROPAGATION DELAYS
$t_R = t_F$ = 2.5 ns, 10% to 90%; f = 1 MHz; t_W = 500 ns

WAVEFORM 2 – $\overline{OEBA}$/OEAB to An/Bn OUTPUT ENABLE AND DISABLE TIMES
$t_R = t_F$ = 2.5 ns, 10% to 90%; f = 1 MHz; t_W = 500 ns

Figure 5. AC Waveforms

MC74LCX652
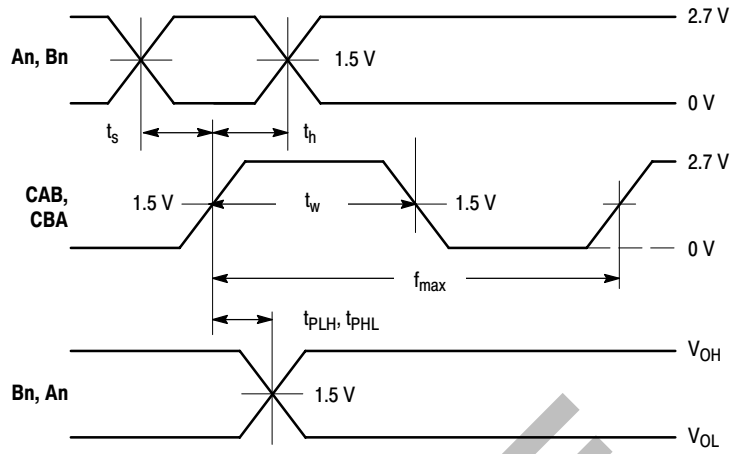
**WAVEFORM 3 – CLOCK to Bn/An PROPAGATION DELAYS, CLOCK MINIMUM PULSE WIDTH,
An/Bn to CLOCK SETUP AND HOLD TIMES**

$t_R = t_F = 2.5$ ns, 10% to 90%; $f = 1$ MHz; $t_W = 500$ ns except when noted
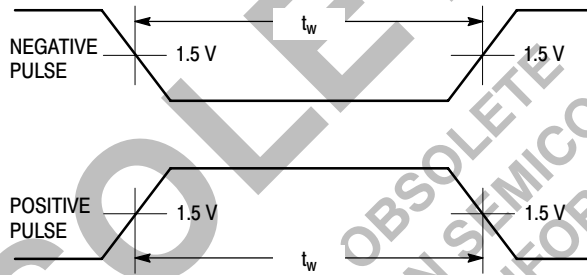
WAVEFORM 4 – INPUT PULSE DEFINITION

$t_R = t_F = 2.5$ ns, 10% to 90% of 0 V to 2.7 V

Figure 5. AC Waveforms (Continued)
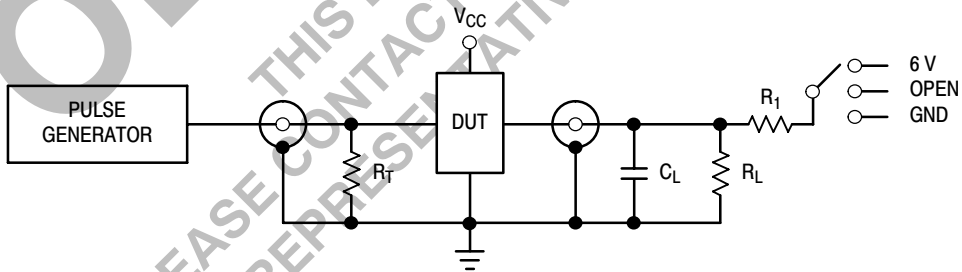
TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6 V
Open Collector/Drain t_{PLH} and t_{PHL}	6 V
t_{PZH}, t_{PHZ}	GND

$C_L = 50$ pF or equivalent (Includes jig and probe capacitance)
$R_L = R_1 = 500 \, \Omega$ or equivalent
$R_T = Z_{OUT}$ of pulse generator (typically 50 Ω)

Figure 6. Test Circuit

PACKAGE DIMENSIONS

DT SUFFIX
PLASTIC TSSOP PACKAGE
CASE 948H–01
ISSUE O
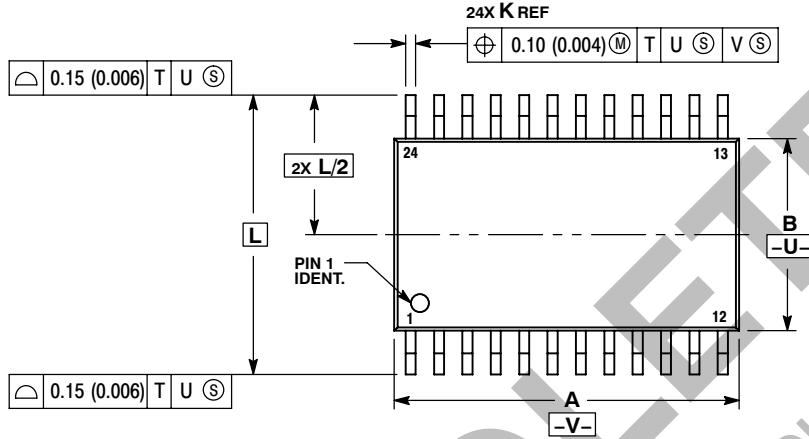
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD 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	7.70	7.90	0.303	0.311
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	0.27	0.37	0.011	0.015
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°
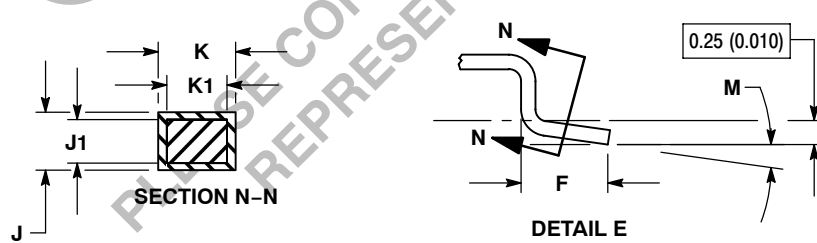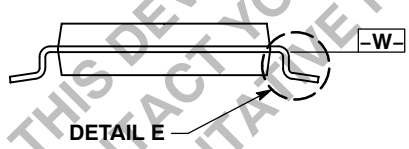
MC74LCX652

PACKAGE DIMENSIONS

DW SUFFIX
PLASTIC SOIC PACKAGE
CASE 751E–04
ISSUE E
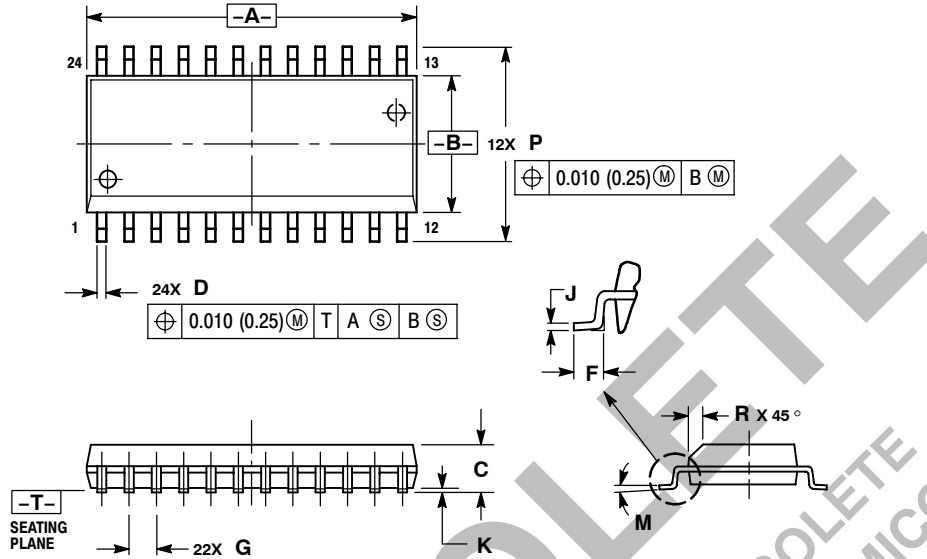
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005) TOTAL IN EXCESS OF D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	15.25	15.54	0.601	0.612
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.41	0.90	0.016	0.035
G	1.27 BSC		0.050 BSC	
J	0.23	0.32	0.009	0.013
K	0.13	0.29	0.005	0.011
M	0 °	8 °	0 °	8 °
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

MC74LCX652/D