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

With 5V–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 3.6V 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 5.5V allows MC74LCX652 inputs to be safely driven from 5V devices. The MC74LCX652 is suitable for memory address driving and all TTL level bus oriented transceiver applications.

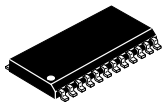
Data on the A or B bus will be clocked into the registers as the appropriate clock pin goes from a LOW–to–HIGH logic level. Two Output Enable pins ($\overline{OEBA}$, OEAB) are provided to control the transceiver outputs. In the transceiver mode, data present at the high impedance port may be stored 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 $\overline{OEBA}$. In this configuration, each output reinforces its input (data retention is not guaranteed in this mode).

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

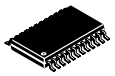
MC74LCX652

LCX

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



DW SUFFIX
24–LEAD PLASTIC SOIC PACKAGE
CASE 751E–04



DT SUFFIX
24–LEAD PLASTIC TSSOP PACKAGE
CASE 948H–01

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
$\overline{OEBA}$, OEAB	Output Enable Inputs

January, 2001 – Rev. 2
Publication Order Number:
MC74LCX652/D

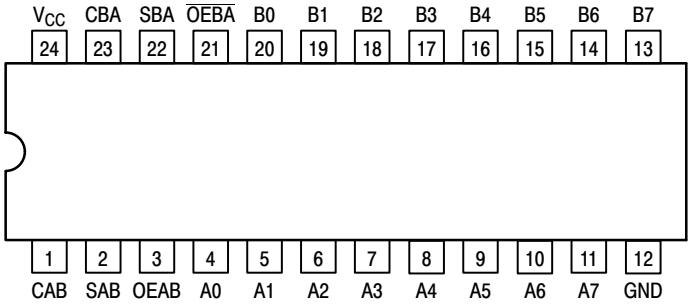


Figure 1. 24–Lead Pinout (Top View)

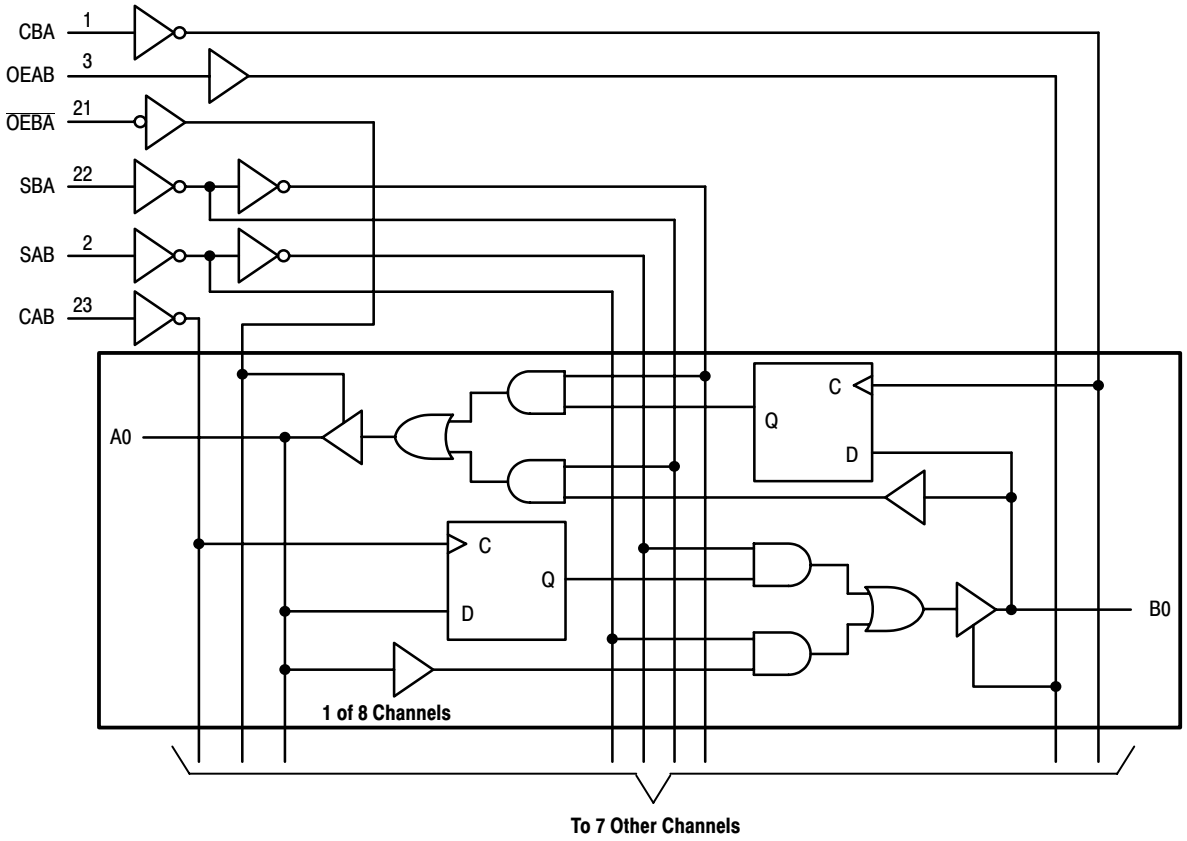


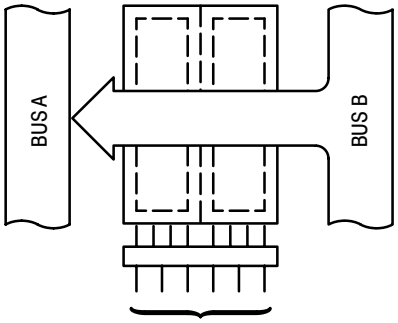
Figure 2. Logic Diagram

FUNCTION 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

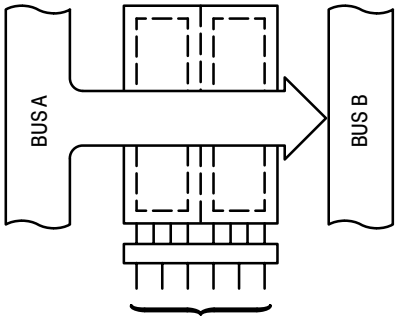
H = High Voltage Level; h = High Voltage Level One Setup Time Prior to the Low–to–High Clock Transition; L = Low Voltage Level; l = Low Voltage Level One Setup Time Prior to the Low–to–High Clock Transition; X = Don't Care; ↑ = Low–to–High Clock Transition; ↥ = NOT Low–to–High Clock Transition; QA = 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



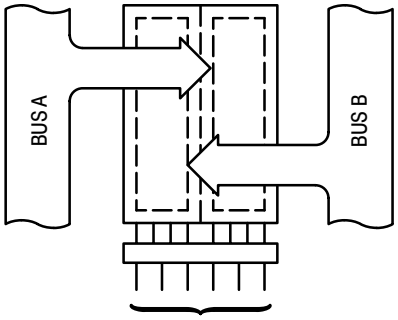
OEAB	$\overline{OEBA}$	CAB	CBA	SAB	SBA
L	L	X	X	X	L

Real Time Transfer – Bus A to Bus B



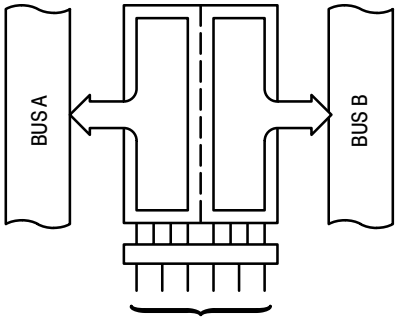
OEAB	$\overline{OEBA}$	CAB	CBA	SAB	SBA
H	H	X	X	L	X

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



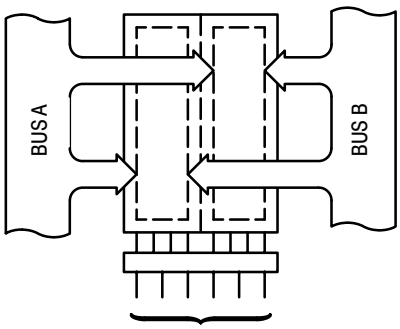
OEAB	$\overline{OEBA}$	CAB	CBA	SAB	SBA
X	H	↑	X	X	X
L	X	X	↑	X	X
L	H	↑	↑	X	X

Transfer A Stored Data to Bus B or B Stored Data to Bus A or Both at the Same Time



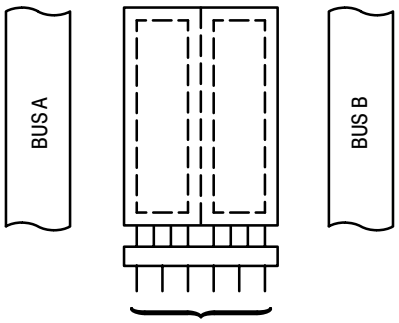
OEAB	$\overline{OEBA}$	CAB	CBA	SAB	SBA
H	H	H or L	X	H	X
L	L	X	H or L	X	H
H	L	H or L	H or L	H	H

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 3. Bus Applications

ABSOLUTE MAXIMUM RATINGS*

Symbol	Parameter	Value	Condition	Unit
V_{CC}	DC Supply Voltage	–0.5 to +7.0		V
V_I	DC Input Voltage	$–0.5 \le V_I \le +7.0$		V
V_O	DC Output Voltage	$–0.5 \le V_O \le +7.0$	Output in 3–State	V
		$–0.5 \le V_O \le V_{CC} + 0.5$	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

* Absolute maximum continuous 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.

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 Data Retention Only	2.0 1.5	3.3 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 0		V_{CC} 5.5	V
I_{OH}	HIGH Level Output Current, V_{CC} = 3.0V – 3.6V			–24	mA
I_{OL}	LOW Level Output Current, V_{CC} = 3.0V – 3.6V			24	mA
I_{OH}	HIGH Level Output Current, V_{CC} = 2.7V – 3.0V			–12	mA
I_{OL}	LOW Level Output Current, V_{CC} = 2.7V – 3.0V			12	mA
T_A	Operating Free–Air Temperature	–40		+85	°C
$\Delta t/\Delta V$	Input Transition Rise or Fall Rate, V_{IN} from 0.8V to 2.0V, V_{CC} = 3.0V	0		10	ns/V

DC ELECTRICAL CHARACTERISTICS

Symbol	Characteristic	Condition	T_A = –40°C to +85°C		Unit
			Min	Max	
V_{IH}	HIGH Level Input Voltage (Note 2.)	$2.7V \le V_{CC} \le 3.6V$	2.0		V
V_{IL}	LOW Level Input Voltage (Note 2.)	$2.7V \le V_{CC} \le 3.6V$		0.8	V
V_{OH}	HIGH Level Output Voltage	$2.7V \le V_{CC} \le 3.6V$; I_{OH} = –100µA	V_{CC} – 0.2		V
		V_{CC} = 2.7V; I_{OH} = –12mA	2.2		
		V_{CC} = 3.0V; I_{OH} = –18mA	2.4		
		V_{CC} = 3.0V; I_{OH} = –24mA	2.2		
V_{OL}	LOW Level Output Voltage	$2.7V \le V_{CC} \le 3.6V$; I_{OL} = 100µA		0.2	V
		V_{CC} = 2.7V; I_{OL}= 12mA		0.4	
		V_{CC} = 3.0V; I_{OL} = 16mA		0.4	
		V_{CC} = 3.0V; I_{OL} = 24mA		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		Unit
			Min	Max	
I_I	Input Leakage Current	$2.7V \le V_{CC} \le 3.6V$; $0V \le V_I \le 5.5V$		±5.0	μA
I_{OZ}	3–State Output Current	$2.7 \le V_{CC} \le 3.6V$; $0V \le V_O \le 5.5V$; $V_I = V_{IH}$ or V_{IL}		±5.0	μA
I_{OFF}	Power–Off Leakage Current	V_{CC} = 0V; V_I or V_O = 5.5V		10	μA
I_{CC}	Quiescent Supply Current	$2.7 \le V_{CC} \le 3.6V$; V_I = GND or V_{CC}		10	μA
		$2.7 \le V_{CC} \le 3.6V$; $3.6 \le V_I$ or $V_O \le 5.5V$		±10	μA
ΔI_{CC}	Increase in I_{CC} per Input	$2.7 \le V_{CC} \le 3.6V$; $V_{IH} = V_{CC} – 0.6V$		500	μA

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

Symbol	Parameter	Waveform	Limits				Unit
			T_A = –40°C to +85°C				
			V_{CC} = 3.0V to 3.6V		V_{CC} = 2.7V		
			Min	Max	Min	Max	
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.

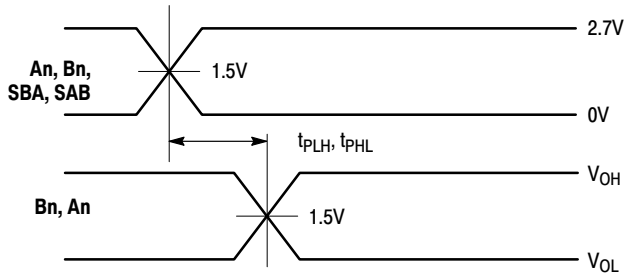
DYNAMIC SWITCHING CHARACTERISTICS

Symbol	Characteristic	Condition	T_A = +25°C			Unit
			Min	Typ	Max	
V_{OLP}	Dynamic LOW Peak Voltage (Note 4.)	V_{CC} = 3.3V, C_L = 50pF, V_{IH} = 3.3V, V_{IL} = 0V		0.8		V
V_{OLV}	Dynamic LOW Valley Voltage (Note 4.)	V_{CC} = 3.3V, C_L = 50pF, V_{IH} = 3.3V, V_{IL} = 0V		0.8		V

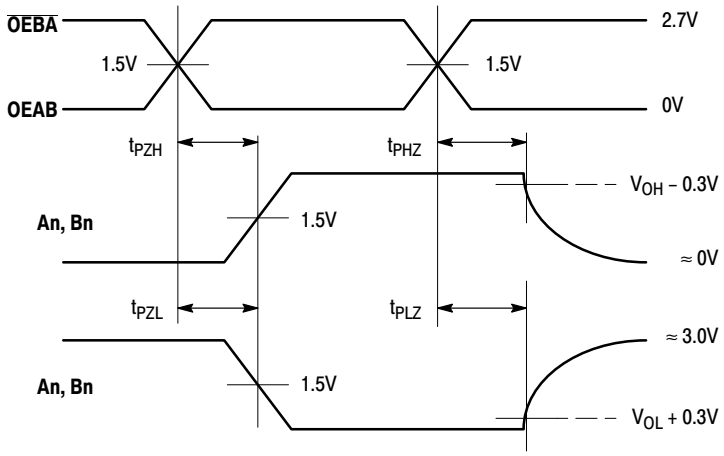
4. Number of outputs defined as “n”. Measured with “n–1” outputs switching from HIGH–to–LOW or LOW–to–HIGH. The remaining output is measured in the LOW state. The LCX652 is characterized with 7 outputs switching with 1 output held LOW.

CAPACITIVE CHARACTERISTICS

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

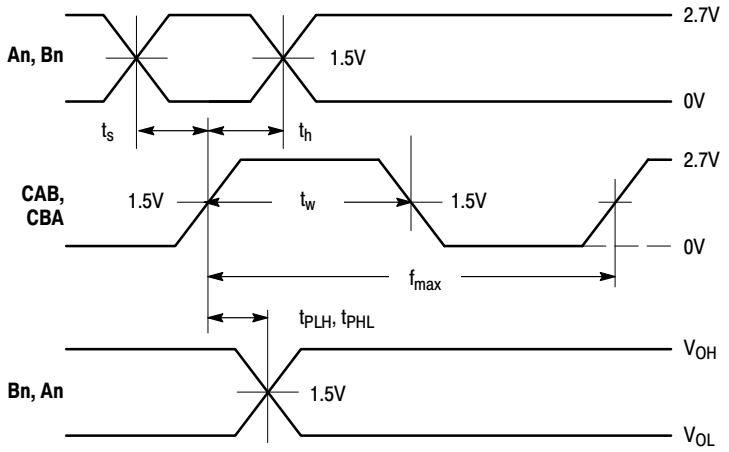


WAVEFORM 1 – SAB to B and SBA to A, An to Bn PROPAGATION DELAYS
$t_R = t_F$ = 2.5ns, 10% to 90%; f = 1MHz; t_W = 500ns



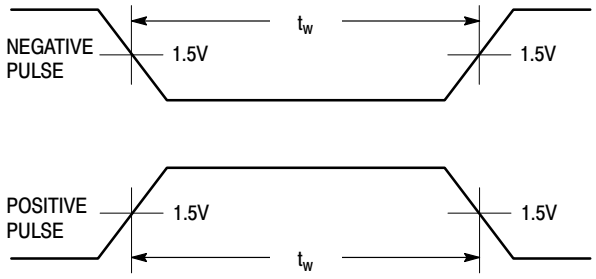
WAVEFORM 2 – $\overline{OEBA}$/OEAB to An/Bn OUTPUT ENABLE AND DISABLE TIMES
$t_R = t_F$ = 2.5ns, 10% to 90%; f = 1MHz; t_W = 500ns

Figure 4. AC Waveforms



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

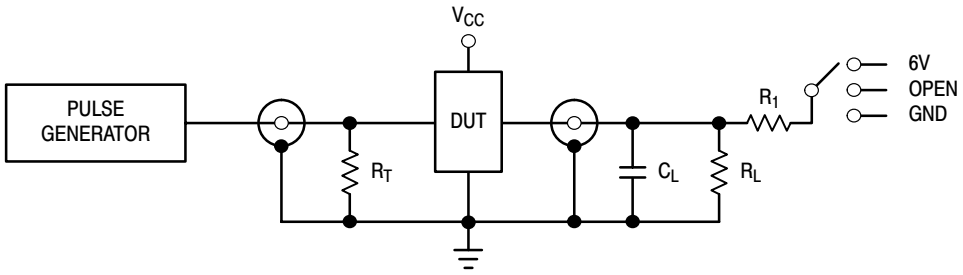
$t_R = t_F$ = 2.5ns, 10% to 90%; f = 1MHz; t_W = 500ns except when noted



WAVEFORM 4 – INPUT PULSE DEFINITION

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

Figure 5. AC Waveforms (continued)



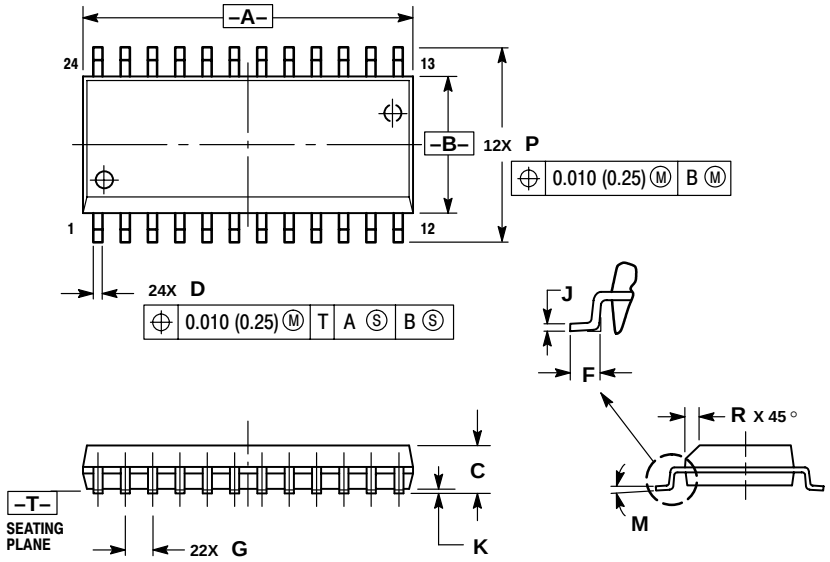
TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V
Open Collector/Drain t_{PLH} and t_{PHL}	6V
t_{PZH}, t_{PHZ}	GND

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

Figure 6. Test Circuit

OUTLINE DIMENSIONS

DW SUFFIX
PLASTIC SOIC PACKAGE
CASE 751E–04
ISSUE E

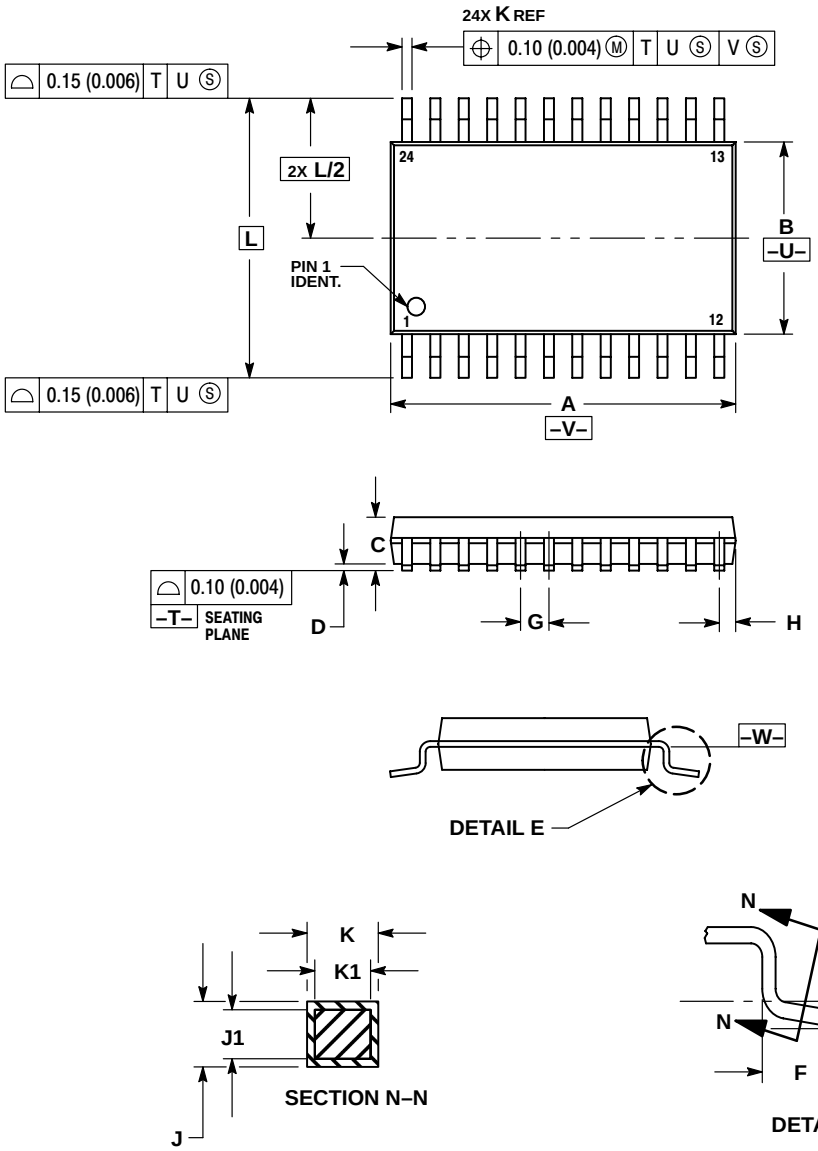


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.13 (0.005)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

	MILLIMETERS		INCHES	
DIM	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

OUTLINE 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–.

	MILLIMETERS		INCHES	
DIM	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°

Notes

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ASIA/PACIFIC: LDC for ON Semiconductor – Asia Support
Phone: 303–675–2121 (Tue–Fri 9:00am to 1:00pm, Hong Kong Time)
Toll Free from Hong Kong & Singapore:
001–800–4422–3781
Email: ONlit–asia@hibbertco.com

JAPAN: ON Semiconductor, Japan Customer Focus Center
4–32–1 Nishi–Gotanda, Shinagawa–ku, Tokyo, Japan 141–0031
Phone: 81–3–5740–2700
Email: r14525@onsemi.com

ON Semiconductor Website: http://onsemi.com

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