



January 2000
Revised March 2000

74VCXH162373

Low Voltage 16-Bit Transparent Latch with Bushold and 26Ω Series Resistors in Outputs

General Description

The VCXH162373 contains sixteen non-inverting latches with 3-STATE outputs and is intended for bus oriented applications. The device is byte controlled. The flip-flops appear to be transparent to the data when the Latch enable (LE) is HIGH. When LE is LOW, the data that meets the setup time is latched. Data appears on the bus when the Output Enable ($\overline{OE}$) is LOW. When $\overline{OE}$ is HIGH, the outputs are in a high impedance state.

The VCXH162373 data inputs include active bushold circuitry, eliminating the need for external pull-up resistors to hold unused or floating data inputs at a valid logic level.

The VCXH162373 is also designed with 26Ω series resistors in the outputs. This design reduces line noise in applications such as memory address driver, clock drivers and bus transceivers/transmitters.

The 74VCXH162373 is designed for low voltage (1.65V to 3.6V) V_{CC} applications with output compatibility up to 3.6V.

The 74VCXH162373 is fabricated with an advanced CMOS technology to achieve high speed operation while maintaining low CMOS power dissipation.

Features

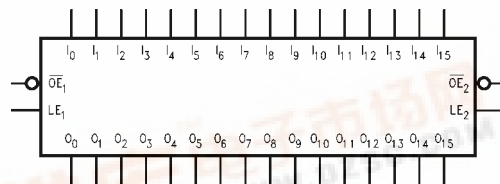
- 1.65V–3.6V V_{CC} supply operation
- 3.6V tolerant control inputs and outputs
- Bushold on data inputs eliminates the need for external pull-up/pull-down resistors
- 26Ω series resistors in outputs
- t_{PD} (I_n to O_n)
 - 3.3 ns max for 3.0V to 3.6V V_{CC}
 - 4.5 ns max for 2.3V to 2.7V V_{CC}
 - 9.0 ns max for 1.65V to 1.95V V_{CC}
- Static Drive (I_{OH}/I_{OL})
 - ±12 mA @ 3.0V V_{CC}
 - ±8 mA @ 2.3V V_{CC}
 - ±3 mA @ 1.65V V_{CC}
- Uses patented noise/EMI reduction circuitry
- Latch-up performance exceeds 300 mA
- ESD performance:
 - Human body model > 2000V
 - Machine model > 200V

Ordering Code:

Ordering Number	Package Number	Package Description
74VCXH162373MTD	MTD48	48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide [TUBES]
74VCXH162373MTX (Note 1)	MTD48	48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide [TAPE and REEL]

Note 1: Use this Order Number to receive devices in Tape and Reel.

Logic Symbol



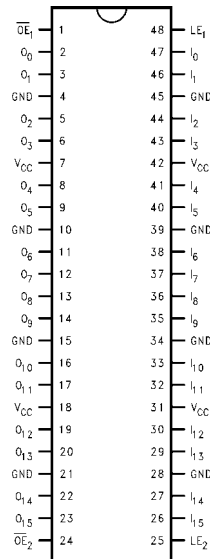
Pin Descriptions

Pin Names	Description
$\overline{OE}_n$	Output Enable Input (Active LOW)
LE_n	Latch Enable Input
I_0 – I_{15}	Bushold Inputs
O_0 – O_{15}	Outputs

74VCXH162373 Low Voltage 16-Bit Transparent Latch with Bushold



Connection Diagram



Truth Tables

Inputs			Outputs
LE ₁	$\overline{OE}_1$	I ₀ -I ₇	O ₀ -O ₇
X	H	X	Z
H	L	L	L
H	L	H	H
L	L	X	O ₀

Inputs			Outputs
LE ₂	$\overline{OE}_2$	I ₈ -I ₁₅	O ₈ -O ₁₅
X	H	X	Z
H	L	L	L
H	L	H	H
L	L	X	O ₀

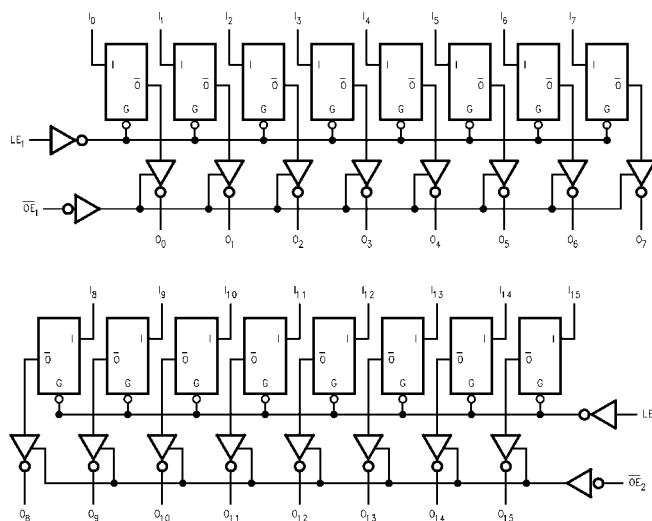
H = HIGH Voltage Level
 L = LOW Voltage Level
 X = Immaterial (HIGH or LOW, control inputs may not float)
 Z = High Impedance
 O₀ = Previous O₀ before HIGH-to-LOW of Latch Enable

Functional Description

The 74VCXH162373 contains sixteen edge D-type latches with 3-STATE outputs. The device is byte controlled with each byte functioning identically, but independent of the other. Control pins can be shorted together to obtain full 16-bit operation. The following description applies to each byte. When the Latch Enable (LE_n) input is HIGH, data on the I_n enters the latches. In this condition the latches are transparent, i.e., a latch output will change state each time

its I input changes. When LE_n is LOW, the latches store information that was present on the I inputs a setup time preceding the HIGH-to-LOW transition on LE_n. The 3-STATE outputs are controlled by the Output Enable ($\overline{OE}_n$) input. When $\overline{OE}_n$ is LOW the standard outputs are in the 2-state mode. When $\overline{OE}_n$ is HIGH, the standard outputs are in the high impedance mode but this does not interfere with entering new data into the latches.

Logic Diagram



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings(Note 2)

Supply Voltage (V_{CC})	−0.5V to +4.6V
DC Input Voltage (V_I)	
$\overline{OE}_n, LE_n$	−0.5V to 4.6V
$I_O - I_{15}$	−0.5V to $V_{CC} + 0.5V$
Output Voltage (V_O)	
Outputs 3-STATE	−0.5V to +4.6V
Outputs Active (Note 3)	−0.5V to $V_{CC} + 0.5V$
DC Input Diode Current (I_{IK})	
$V_I < 0V$	−50 mA
DC Output Diode Current (I_{OK})	
$V_O < 0V$	−50 mA
$V_O > V_{CC}$	+50 mA
DC Output Source/Sink Current (I_{OH}/I_{OL})	±50 mA
DC V_{CC} or GND Current per Supply Pin (I_{CC} or GND)	±100 mA
Storage Temperature Range (T_{STG})	−65°C to +150°C

Recommended Operating Conditions (Note 4)

Power Supply	
Operating	1.65V to 3.6V
Data Retention Only	1.2V to 3.6V
Input Voltage	−0.3V to V_{CC}
Output Voltage (V_O)	
Output in Active States	0V to V_{CC}
Output in "OFF" State	0.0V to 3.6V
Output Current in I_{OH}/I_{OL}	
$V_{CC} = 3.0V$ to 3.6V	±12 mA
$V_{CC} = 2.3V$ to 2.7V	±8 mA
$V_{CC} = 1.65V$ to 2.3V	±3 mA
Free Air Operating Temperature (T_A)	−40°C to +85°C
Minimum Input Edge Rate ($\Delta t/\Delta V$)	
$V_{IN} = 0.8V$ to 2.0V, $V_{CC} = 3.0V$	10 ns/V

Note 2: The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Note 3: I_O Absolute Maximum Rating must be observed.

Note 4: Floating or unused control inputs must be held HIGH or LOW.

DC Electrical Characteristics (2.7V < V_{CC} ≤ 3.6V)

Symbol	Parameter		Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage			2.7–3.6	2.0		V
V_{IL}	LOW Level Input Voltage			2.7–3.6		0.8	V
V_{OH}	HIGH Level Output Voltage		$I_{OH} = -100 \mu A$	2.7–3.6	$V_{CC} - 0.2$		V
			$I_{OH} = -6 \text{ mA}$	2.7	2.2		V
			$I_{OH} = -8 \text{ mA}$	3.0	2.4		V
			$I_{OH} = -12 \text{ mA}$	3.0	2.2		V
V_{OL}	LOW Level Output Voltage		$I_{OL} = 100 \mu A$	2.7–3.6		0.2	V
			$I_{OL} = 6 \text{ mA}$	2.7		0.4	V
			$I_{OL} = 8 \text{ mA}$	3.0		0.55	V
			$I_{OL} = 12 \text{ mA}$	3.0		0.8	V
I_I	Input Leakage Current	Control Pins	$0 \leq V_I \leq 3.6V$	2.7–3.6		±5.0	μA
		Data Pins	$V_I = V_{CC}$ or GND	2.7–3.6		±5.0	μA
$I_{I(HOLD)}$	Bushold Input Minimum Drive Hold Current		$V_{IN} = 0.8V$	3.0	75		μA
			$V_{IN} = 2.0V$	3.0	−75		
$I_{I(OD)}$	Bushold Input Over-Drive Current to Change State		(Note 5)	3.6	450		μA
			(Note 6)	3.6	−450		
I_{OZ}	3-STATE Output Leakage		$0 \leq V_O \leq 3.6V$ $V_I = V_{IH}$ or V_{IL}	2.7–3.6		±10	μA
I_{OFF}	Power-OFF Leakage Current		$0 \leq (V_O) \leq 3.6V$	0		10	μA
I_{CC}	Quiescent Supply Current		$V_I = V_{CC}$ or GND	2.7–3.6		20	μA
			$V_{CC} \leq (V_O) \leq 3.6V$ (Note 7)	2.7–3.6		±20	μA
ΔI_{CC}	Increase in I_{CC} per Input		$V_{IH} = V_{CC} - 0.6V$	2.7–3.6		750	μA

Note 5: An external driver must source at least the specified current to switch from LOW-to-HIGH.

Note 6: An external driver must sink at least the specified current to switch from HIGH-to-LOW.

Note 7: Outputs disabled or 3-STATE only.

DC Electrical Characteristics ($2.3V \leq V_{CC} \leq 2.7V$)

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage		2.3 – 2.7	1.6		V
V_{IL}	LOW Level Input Voltage		2.3 – 2.7		0.7	V
V_{OH}	HIGH Level Output Voltage	$I_{OH} = -100 \mu A$	2.3 – 2.7	$V_{CC} - 0.2$		V
		$I_{OH} = -4 \text{ mA}$	2.3	2.0		V
		$I_{OH} = -6 \text{ mA}$	2.3	1.8		V
		$I_{OH} = -8 \text{ mA}$	2.3	1.7		V
V_{OL}	LOW Level Output Voltage	$I_{OL} = 100 \mu A$	2.3 – 2.7		0.2	V
		$I_{OL} = 6 \text{ mA}$	2.3		0.4	V
		$I_{OL} = 8 \text{ mA}$	2.3		0.6	V
I_I	Input Leakage Current	Control Pins $0 \leq V_I \leq 3.6V$	2.3 – 2.7		± 5.0	μA
		Data Pins $V_I = V_{CC}$ or GND	2.3 – 2.7		± 5.0	μA
$I_{I(HOLD)}$	Bushold Input Minimum Drive Hold Current	$V_{IN} = 0.7V$	2.3	45		μA
		$V_{IN} = 1.6V$	2.3	-45		
$I_{I(OD)}$	Bushold Input Over-Drive Current to Change State	(Note 8)	2.7	300		μA
		(Note 9)	2.7	-300		
I_{OZ}	3-STATE Output Leakage	$0 \leq V_O \leq 3.6V$ $V_I = V_{IH}$ or V_{IL}	2.3 – 2.7		± 10	μA
I_{OFF}	Power-OFF Leakage Current	$0 \leq (V_O) \leq 3.6V$	0		10	μA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND	2.3 – 2.7		20	μA
		$V_{CC} \leq (V_O) \leq 3.6V$ (Note 10)	2.3 – 2.7		± 20	μA

Note 8: An external driver must source at least the specified current to switch from LOW-to-HIGH.

Note 9: An external driver must sink at least the specified current to switch from HIGH-to-LOW.

Note 10: Outputs disabled or 3-STATE only.

DC Electrical Characteristics ($1.65V \leq V_{CC} < 2.3V$)

Symbol	Parameter	Conditions	V_{CC} (V)	Min	Max	Units
V_{IH}	HIGH Level Input Voltage		1.65 - 2.3	$0.65 \times V_{CC}$		V
V_{IL}	LOW Level Input Voltage		1.65 - 2.3		$0.35 \times V_{CC}$	V
V_{OH}	HIGH Level Output Voltage	$I_{OH} = -100 \mu A$	1.65 - 2.3	$V_{CC} - 0.2$		V
		$I_{OH} = -3 \text{ mA}$	1.65	1.25		V
V_{OL}	LOW Level Output Voltage	$I_{OL} = 100 \mu A$	1.65 - 2.3		0.2	V
		$I_{OL} = 3 \text{ mA}$	1.65		0.3	V
I_I	Input Leakage Current	Control Pins $0 \leq V_I \leq 3.6V$	1.65 - 2.3		± 5.0	μA
		Data Pins $V_I = V_{CC}$ or GND	1.65 - 2.3		± 5.0	μA
$I_{I(HOLD)}$	Bushold Input Minimum Drive Hold Current	$V_{IN} = 0.57V$	1.65	25		μA
		$V_{IN} = 1.07V$	1.65	-25		
$I_{I(OD)}$	Bushold Input Over-Drive Current to Change State	(Note 11)	1.95	200		μA
		(Note 12)	1.95	-200		
I_{OZ}	3-STATE Output Leakage	$0 \leq V_O \leq 3.6V$ $V_I = V_{IH}$ or V_{IL}	1.65 - 2.3		± 10	μA
I_{OFF}	Power-OFF Leakage Current	$0 \leq (V_O) \leq 3.6V$	0		10	μA
I_{CC}	Quiescent Supply Current	$V_I = V_{CC}$ or GND	1.65 - 2.3		20	μA
		$V_{CC} \leq (V_O) \leq 3.6V$ (Note 13)	1.65 - 2.3		± 20	μA

Note 11: An external driver must source at least the specified current to switch from LOW-to-HIGH.

Note 12: An external driver must sink at least the specified current to switch from HIGH-to-LOW.

Note 13: Outputs disabled or 3-STATE only.

AC Electrical Characteristics (Note 14)

Symbol	Parameter	T _A = −40°C to +85°C, C _L = 30 pF, R _L = 500Ω						Units
		V _{CC} = 3.3V ± 0.3V		V _{CC} = 2.5V ± 0.2V		V _{CC} = 1.8V ± 0.15V		
		Min	Max	Min	Max	Min	Max	
t _{PHL} , t _{PLH}	Prop Delay I _n to O _n	0.8	3.3	1.0	4.5	1.5	9.0	ns
t _{PHL} , t _{PLH}	Prop Delay LE to O _n	0.8	3.6	1.0	4.9	1.5	9.8	ns
t _{PZL} , t _{PZH}	Output Enable Time	0.8	3.9	1.0	5.4	1.5	9.8	ns
t _{PLZ} , t _{PHZ}	Output Disable Time	0.8	4.0	1.0	4.4	1.5	7.9	ns
t _S	Setup Time	1.5		1.5		2.5		ns
t _H	Hold Time	1.0		1.0		1.0		ns
t _W	Pulse Width	1.5		1.5		4.0		ns
t _{OSHL} t _{OSLH}	Output to Output Skew (Note 15)		0.5		0.5		0.75	ns

Note 14: For $C_L = 50\text{ pF}$, add approximately 300 ps to the AC maximum specification.

Note 15: 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}).

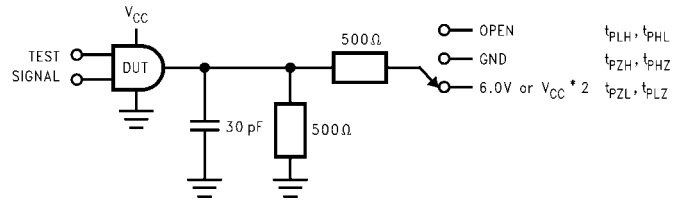
Dynamic Switching Characteristics

Symbol	Parameter	Conditions	V_{CC} (V)	$T_A = +25^{\circ}\text{C}$	Units
				Typical	
V_{OLP}	Quiet Output Dynamic Peak V_{OL}	$C_L = 30\text{ pF}, V_{IH} = V_{CC}, V_{IL} = 0V$	1.8 2.5 3.3	0.15 0.25 0.35	V
V_{OLV}	Quiet Output Dynamic Valley V_{OL}	$C_L = 30\text{ pF}, V_{IH} = V_{CC}, V_{IL} = 0V$	1.8 2.5 3.3	-0.15 -0.25 -0.35	V
V_{OHV}	Quiet Output Dynamic Valley V_{OH}	$C_L = 30\text{ pF}, V_{IH} = V_{CC}, V_{IL} = 0V$	1.8 2.5 3.3	1.55 2.05 2.65	V

Capacitance

Symbol	Parameter	Conditions	$T_A = +25^{\circ}\text{C}$	Units
			Typical	
C_{IN}	Input Capacitance	$V_{CC} = 1.8V, 2.5V \text{ or } 3.3V, V_I = 0V \text{ or } V_{CC}$	6	pF
C_{OUT}	Output Capacitance	$V_I = 0V \text{ or } V_{CC}, V_{CC} = 1.8V, 2.5V \text{ or } 3.3V$	7	pF
C_{PD}	Power Dissipation Capacitance	$V_I = 0V \text{ or } V_{CC}, f = 10\text{ MHz}, V_{CC} = 1.8V, 2.5V \text{ or } 3.3V$	20	pF

AC Loading and Waveforms



TEST	SWITCH
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V at $V_{CC} = 3.3 \pm 0.3V$; $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V, 1.8V \pm 0.15V$
t_{PZH}, t_{PHZ}	GND

FIGURE 1. AC Test Circuit

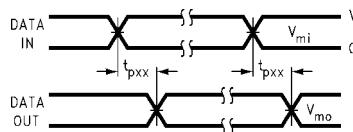


FIGURE 2. Waveform for Inverting and Non-Inverting Functions

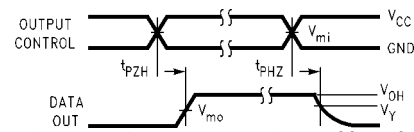


FIGURE 3. 3-STATE Output HIGH Enable and Disable Times for Low Voltage Logic

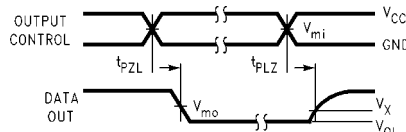


FIGURE 4. 3-STATE Output LOW Enable and Disable Times for Low Voltage Logic

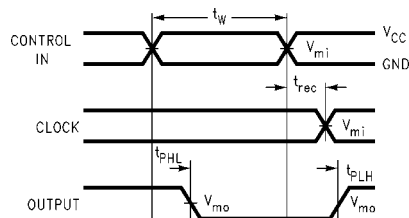


FIGURE 5. Propagation Delay, Pulse Width and t_{REC} Waveforms

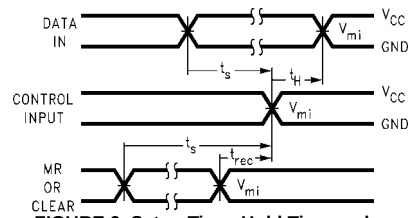
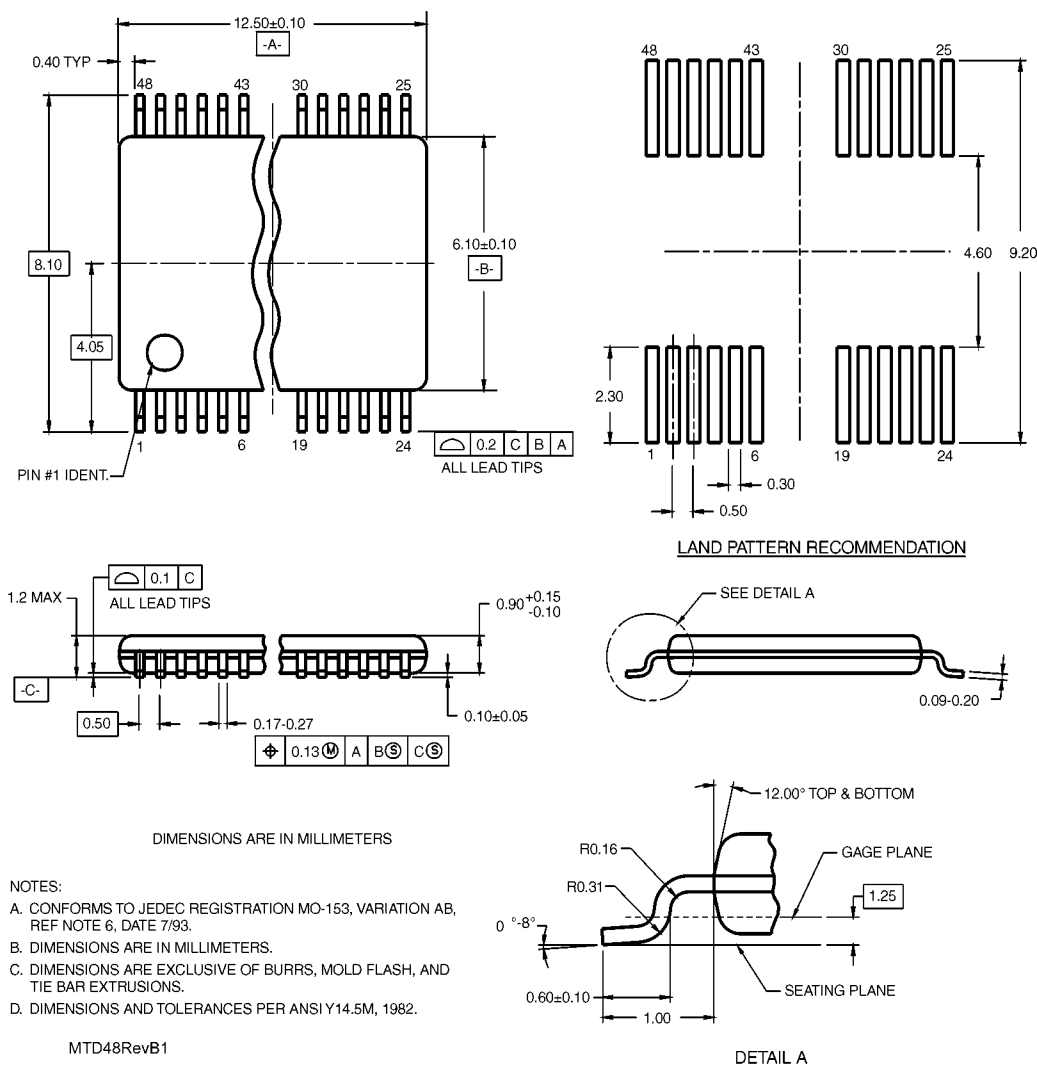


FIGURE 6. Setup Time, Hold Time and Recovery Time for Low Voltage Logic

Symbol	V_{CC}		
	$3.3V \pm 0.3V$	$2.5V \pm 0.2V$	$1.8V \pm 0.15V$
V_{mi}	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_{mo}	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_X	$V_{OL} + 0.3V$	$V_{OL} + 0.15V$	$V_{OL} + 0.15V$
V_Y	$V_{OH} - 0.3V$	$V_{OH} - 0.15V$	$V_{OH} - 0.15V$



DIMENSIONS ARE IN MILLIMETERS

NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB, REF NOTE 6, DATE 7/93.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND THE BAR EXTRUSIONS.
- D. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.

MTD48RevB1

**48-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 6.1mm Wide
Package Number MTD48**

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