FAIRCHILD SEMICONDUCTOR™

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74ABT646
Octal Transceivers and Registers with 3-STATE Outputs

General Description

The ABT646 consists of bus transceiver circuits with 3-STATE, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the input bus or from the internal registers. Data on the A or B bus will be clocked into the registers as the appropriate clock pin goes to a high logic level. Control $\overline{OE}$ and direction pins are provided to control the transceiver function. 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 can multiplex stored and real-time (transparent mode) data. The direction control determines which bus will receive data when the enable control $\overline{OE}$ is Active LOW. In the isolation mode (control $\overline{OE}$ HIGH), A data may be stored in the B register and/or B data may be stored in the A register.

Features

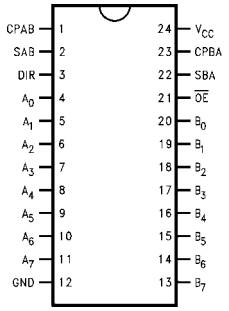
- Independent registers for A and B buses
- Multiplexed real-time and stored data
- A and B output sink capability of 64 mA, source capability of 32 mA
- Guaranteed output skew
- Guaranteed multiple output switching specifications
- Output switching specified for both 50 pF and 250 pF loads
- Guaranteed simultaneous switching noise level and dynamic threshold performance
- Guaranteed latchup protection
- High impedance glitch free bus loading during entire power up and power down cycle
- Nondestructive hot insertion capability

Ordering Code:

Order Number	Package Number	Package Description
74ABT646CSC	M24B	24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-153, 4.4mm Wide
74ABT646CMSA	MSA24	24-Lead Shrink Small Outline Package (SSOP), EIAJ TYPE II, 5.3mm Wide
74ABT646CMTC	MTC24	24-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

Connection Diagram



Pin Descriptions

Pin Names	Description
A_0–A_7	Data Register A Inputs/3-STATE Outputs
B_0–B_7	Data Register B Inputs/3-STATE Outputs
CPAB, CPBA	Clock Pulse Inputs
SAB, SBA	Select Inputs
$\overline{OE}$	Output Enable Input
DIR	Direction Control Input

Truth Table

Inputs						Data I/O (Note 1)		Function
$\overline{OE}$	DIR	CPAB	CPBA	SAB	SBA	A_0–A_7	B_0–B_7	
H	X	H or L	H or L	X	X	Input	Input	Isolation
H	X	↑	X	X	X			Clock A_n Data into A Register
H	X	X	↑	X	X			Clock B_n Data into B Register
L	H	X	X	L	X	Input	Output	A_n to B_n—Real Time (Transparent Mode)
L	H	↑	X	L	X			Clock A_n Data into A Register
L	H	H or L	X	H	X			A Register to B_n (Stored Mode)
L	H	↑	X	H	X			Clock A_n Data into A Register and Output to B_n
L	L	X	X	X	L	Output	Input	B_n to A_n—Real Time (Transparent Mode)
L	L	X	↑	X	L			Clock B_n Data into B Register
L	L	X	H or L	X	H			B Register to A_n (Stored Mode)
L	L	X	↑	X	H			Clock B_n Data into B Register and Output to A_n

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial
↑ = LOW-to-HIGH Transition

Note 1: The data output functions may be enabled or disabled by various signals at the $\overline{OE}$ and DIR inputs. Data input functions are always enabled; i.e., data at the bus pins will be stored on every LOW-to-HIGH transition of the appropriate clock inputs.

Real Time Transfer A-Bus to B-Bus

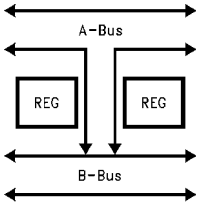


FIGURE 1.

Real Time Transfer B-Bus to A-Bus

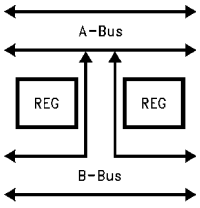


FIGURE 2.

Storage from Bus to Register

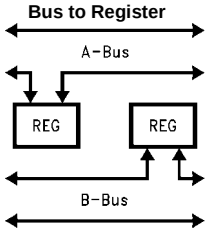


FIGURE 3.

Transfer from Register to Bus

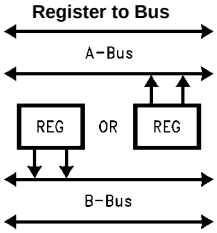
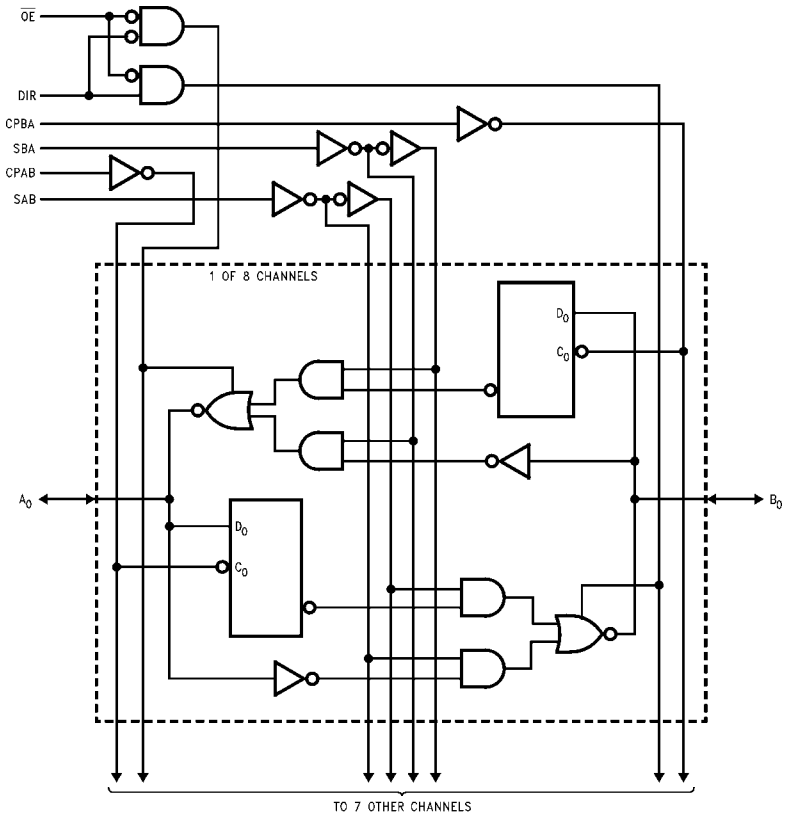


FIGURE 4.

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)

Storage Temperature	−65°C to +150°C
Ambient Temperature under Bias	−55°C to +125°C
Junction Temperature under Bias	−55°C to +150°C
V_{CC} Pin Potential to Ground Pin	−0.5V to +7.0V
Input Voltage (Note 3)	−0.5V to +7.0V
Input Current (Note 3)	−30 mA to +5.0 mA
Voltage Applied to Any Output	
in the Disable or	
Power-Off State	−0.5V to +5.5V
in the HIGH State	−0.5V to V_{CC}
Current Applied to Output	
in LOW State (Max)	twice the rated I_{OL} (mA)
DC Latchup Source Current	−500 mA
Over Voltage Latchup (I/O)	10V

Recommended Operating Conditions

Free Air Ambient Temperature	−40°C to +85°C
Supply Voltage	+4.5V to +5.5V
Minimum Input Edge Rate (ΔV/Δt)	
Data Input	50 mV/ns
Enable Input	20 mV/ns
Clock Input	100 mV/ns

Note 2: Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

Note 3: Either voltage limit or current limit is sufficient to protect inputs.

DC Electrical Characteristics

Symbol	Parameter	Min	Typ	Max	Units	V_{CC}	Conditions
V_{IH}	Input HIGH Voltage	2.0			V		Recognized HIGH Signal
V_{IL}	Input LOW Voltage			0.8	V		Recognized LOW Signal
V_{CD}	Input Clamp Diode Voltage			−1.2	V	Min	I_{IN} = −18 mA (Non I/O Pins)
V_{OH}	Output HIGH Voltage	2.5 2.0					I_{OH} = −3 mA, (A_n, B_n) I_{OH} = −32 mA, (A_n, B_n)
V_{OL}	Output LOW Voltage			0.55			I_{OL} = 64 mA, (A_n, B_n)
V_{ID}	Input Leakage Test	4.75			V	0.0	I_{ID} = 1.9 µA, (Non-I/O Pins) All Other Pins Grounded
I_{IH}	Input HIGH Current			1 1	µA	Max	V_{IN} = 2.7V (Non-I/O Pins) (Note 4) V_{IN} = V_{CC} (Non-I/O Pins)
I_{BVI}	Input HIGH Current Breakdown Test			7	µA	Max	V_{IN} = 7.0V (Non-I/O Pins)
I_{BVIT}	Input HIGH Current Breakdown Test (I/O)			100	µA	Max	V_{IN} = 5.5V (A_n, B_n)
I_{IL}	Input LOW Current			−1 −1	µA	Max	V_{IN} = 0.5V (Non-I/O Pins) (Note 4) V_{IN} = 0.0V (Non-I/O Pins)
$I_{IH} + I_{OZH}$	Output Leakage Current			10	µA	0V–5.5V	V_{OUT} = 2.7V (A_n, B_n); $\overline{OE}$ = 2.0V
$I_{IL} + I_{OZL}$	Output Leakage Current			−10	µA	0V–5.5V	V_{OUT} = 0.5V (A_n, B_n); $\overline{OE}$ = 2.0V
I_{OS}	Output Short-Circuit Current	−100		−275	mA	Max	V_{OUT} = 0V (A_n, B_n)
I_{CEX}	Output HIGH Leakage Current			50	µA	Max	V_{OUT} = V_{CC} (A_n, B_n)
I_{ZZ}	Bus Drainage Test			100	µA	0.0V	V_{OUT} = 5.5V (A_n, B_n); All Others GND
I_{CCH}	Power Supply Current			250	µA	Max	All Outputs HIGH
I_{CCL}	Power Supply Current			30	mA	Max	All Outputs LOW
I_{CCZ}	Power Supply Current			50	µA	Max	Outputs 3-STATE; All Others GND
I_{CCT}	Additional I_{CC}/Input			2.5	mA	Max	V_I = V_{CC} − 2.1V All Other Outputs at V_{CC} or GND
I_{CCD}	Dynamic I_{CC} No Load (Note 4)			0.18	mA/MHz	Max	Outputs OPEN $\overline{OE}$ and DIR = GND, Non-I/O = GND or V_{CC} (Note 5) One Bit toggling, 50% duty cycle

Note 4: Guaranteed but not tested.

Note 5: For 8-bit toggling, I_{CCD} < 1.4 mA/MHz.

DC Electrical Characteristics

Symbol	Parameter	Min	Typ	Max	Units	V_{CC}	Conditions C_L = 50 pF, R_L = 500Ω
V_{OLP}	Quiet Output Maximum Dynamic V_{OL}		0.6	0.8	V	5.0	T_A = 25°C (Note 6)
V_{OLV}	Quiet Output Minimum Dynamic V_{OL}	–1.2	–0.9		V	5.0	T_A = 25°C (Note 6)
V_{OHV}	Minimum HIGH Level Dynamic Output Voltage	2.5	3.0		V	5.0	T_A = 25° (Note 7)
V_{IHD}	Minimum HIGH Level Dynamic Input Voltage	2.2	1.8		V	5.0	T_A = 25°C (Note 8)
V_{ILD}	Maximum LOW Level Dynamic Input Voltage		0.8	0.5	V	5.0	T_A = 25°C (Note 8)

Note 6: Max number of outputs defined as (n). n – 1 data inputs are driven 0V to 3V. One output at LOW. Guaranteed, but not tested.

Note 7: Max number of outputs defined as (n). n – 1 data inputs are driven 0V to 3V. One output HIGH. Guaranteed, but not tested.

Note 8: Max number of data inputs (n) switching. n – 1 inputs switching 0V to 3V. Input-under-test switching: 3V to threshold (V_{ILD}), 0V to threshold (V_{IHD}). Guaranteed, but not tested.

AC Electrical Characteristics

(SOIC and SSOP package)

Symbol	Parameter	T_A = +25°C, V_{CC} = +5.0V, C_L = 50 pF			T_A = −55°C to +125°C, V_{CC} = 4.5V–5.5V, C_L = 50 pF		T_A = −40°C to +85°C, V_{CC} = 4.5V–5.5V, C_L = 50 pF		Units
		Min	Typ	Max	Min	Max	Min	Max	
f_{MAX}	Maximum Clock Frequency	200			200		200		MHz
t_{PLH}	Propagation Delay	1.7	3.0	5.6	2.2	8.8	1.7	5.6	ns
t_{PHL}	Clock to Bus	1.7	3.4	5.6	1.7	8.8	1.7	5.6	
t_{PLH}	Propagation Delay	1.5	2.6	4.8	1.5	7.9	1.5	4.8	ns
t_{PHL}	Bus to Bus	1.5	3.0	4.8	1.5	7.9	1.5	4.8	
t_{PLH}	Propagation Delay	1.5	3.0	5.9	1.5	8.1	1.5	5.9	ns
t_{PHL}	SBA or SAB to A_n to B_n	1.5	3.4	5.9	1.5	8.9	1.5	5.9	
t_{PZH}	Enable Time	1.5	3.2	6.3	1.0	7.3	1.5	6.3	ns
t_{PZL}	$\overline{OE}$ to $A_n$or B_n	1.5	3.5	6.3	1.9	8.8	1.5	6.3	
t_{PHZ}	Disable Time	1.5	3.7	6.0	1.5	9.3	1.5	6.0	ns
t_{PLZ}	$\overline{OE}$ to $A_n$or B_n	1.5	3.2	6.0	1.5	9.3	1.5	6.0	
t_{PZH}	Enable Time	1.5	3.4	6.3	1.0	7.7	1.5	6.3	ns
t_{PZL}	DIR to A_n or B $_n$	1.5	3.7	6.3	2.2	9.5	1.5	6.3	
t_{PHZ}	Disable Time	1.5	3.8	6.0	1.5	8.7	1.5	6.0	ns
t_{PLZ}	DIR to A_n or B $_n$	1.5	3.2	6.0	1.5	9.2	1.5	6.0	

AC Operating Requirements

Symbol	Parameter	T_A = +25°C, V_{CC} = +5.0V, C_L = 50 pF		T_A = −55°C to +125°C, V_{CC} = 4.5V–5.5V, C_L = 50 pF		T_A = −40°C to +85°C, V_{CC} = 4.5V–5.5V, C_L = 50 pF		Units
		Min	Max	Min	Max	Min	Max	
t_S(H)	Setup Time, HIGH	1.5		1.5	3.0	1.5		ns
t_S(L)	or LOW Bus to Clock							
t_H(H)	Hold Time, HIGH	1.0		1.0	1.0	1.0		ns
t_H(L)	or LOW Bus to Clock							
t_W(H)	Pulse Width,	3.0		3.0	4.0	3.0		ns
t_W(L)	HIGH or LOW							

Extended AC Electrical Characteristics

(SOIC Package)

Symbol	Parameter	$T_A = -40°C$ to $+85°C$, $V_{CC} = 4.5V–5.5V$, $C_L = 50$ pF, 8 Outputs Switching (Note 9)		$T_A = -40°C$ to $+85°C$, $V_{CC} = 4.5V–5.5V$, $C_L = 250$ pF, 1 Output Switching (Note 10)		$T_A = -40°C$ to $+85°C$, $V_{CC} = 4.5V–5.5V$, $C_L = 250$ pF, 8 Outputs Switching (Note 11)		Units
		Min	Max	Min	Max	Min	Max	
t_{PLH}	Propagation Delay	1.5	5.5	2.0	7.5	2.5	10.0	ns
t_{PHL}	Clock to Bus	1.5	5.5	2.0	7.5	2.5	10.0	
t_{PLH}	Propagation Delay	1.5	6.0	2.0	7.0	2.5	9.5	ns
t_{PHL}	Bus to Bus	1.5	6.0	2.0	7.0	2.5	9.5	
t_{PLH}	Propagation Delay	1.5	6.0	2.0	7.5	2.5	10.0	ns
t_{PHL}	SBA or SAB to A_n or B_n	1.5	6.0	2.0	7.5	2.5	10.0	
t_{PZH}	Output Enable Time	1.5	6.0	2.0	8.0	2.5	10.5	ns
t_{PZL}	$\overline{OE}_n$ or DIR to A_n or B_n	1.5	6.0	2.0	8.0	2.5	10.5	
t_{PHZ}	Output Disable Time	1.5	6.0	(Note 12)		(Note 12)		ns
t_{PLZ}	$\overline{OE}_n$ or DIR to A_n or B_n	1.5	6.0					

Note 9: This specification is guaranteed but not tested. The limits apply to propagation delays for all paths described switching in phase (i.e., all LOW-to-HIGH, HIGH-to-LOW, etc.).

Note 10: This specification is guaranteed but not tested. The limits represent propagation delay with 250 pF load capacitors in place of the 50 pF load capacitors in the standard AC load. This specification pertains to single output switching only.

Note 11: This specification is guaranteed but not tested. The limits represent propagation delays for all paths described switching in phase (i.e., all LOW-to-HIGH, HIGH-to-LOW, etc.) with 250 pF load capacitors in place of the 50 pF load capacitors in the standard AC load.

Note 12: The 3-STATE delays are dominated by the RC network (500Ω, 250 pF) on the output and has been excluded from the datasheet.

Skew

(SOIC Package)

Symbol	Parameter	$T_A = -40°C$ to $+85°C$, $V_{CC} = 4.5V–5.5V$, $C_L = 50$ pF, 8 Outputs Switching (Note 13)	$T_A = -40°C$ to $+85°C$, $V_{CC} = 4.5V–5.5V$, $C_L = 250$ pF, 8 Outputs Switching (Note 14)	Units
		Max	Max	
t_{OSHL} (Note 15)	Pin to Pin Skew, HL Transitions	1.3	2.5	ns
t_{OSLH} (Note 15)	Pin to Pin Skew, LH Transitions	1.0	2.0	ns
t_{PS} (Note 16)	Duty Cycle, LH–HL Skew	2.0	4.0	ns
t_{OST} (Note 15)	Pin to Pin Skew, LH/HL Transitions	2.0	4.0	ns
t_{PV} (Note 17)	Device to Device Skew, LH/HL Transitions	2.5	4.5	ns

Note 13: This specification is guaranteed but not tested. The limits apply to propagation delays for all paths described switching in phase (i.e., all LOW-to-HIGH, HIGH-to-LOW, etc.).

Note 14: This specification is guaranteed but not tested. The limits represent propagation delays with 250 pF load capacitors in place of the 50 pF load capacitors in the standard AC load.

Note 15: Skew is defined as the absolute value of the difference between the actual propagation delays for any two separate outputs of the same device. The specification applies to any outputs switching HIGH-to-LOW (t_{OSHL}), LOW-to-HIGH (t_{OSLH}), or any combination switching LOW-to-HIGH and/or HIGH-to-LOW (t_{OST}). This specification is guaranteed but not tested.

Note 16: This describes the difference between the delay of the LOW-to-HIGH and the HIGH-to-LOW transition on the same pin. It is measured across all the outputs (drivers) on the same chip, the worst (largest delta) number is the guaranteed specification. This specification is guaranteed but not tested.

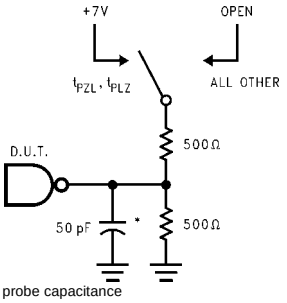
Note 17: Propagation delay variation for a given set of conditions (i.e., temperature and V_{CC}) from device to device. This specification is guaranteed but not tested.

Capacitance

Symbol	Parameter	Typ	Units	Conditions $T_A = 25°C$
C_{IN}	Input Capacitance	5	pF	$V_{CC} = 0V$ (non I/O pins)
$C_{I/O}$ (Note 18)	Output Capacitance	11	pF	$V_{CC} = 5.0V$ (A_n, B_n)

Note 18: $C_{I/O}$ is measured at frequency, f = 1 MHz, per MIL-STD-883, Method 3012.

AC Loading



*Includes jig and probe capacitance

FIGURE 5. Standard AC Test Load

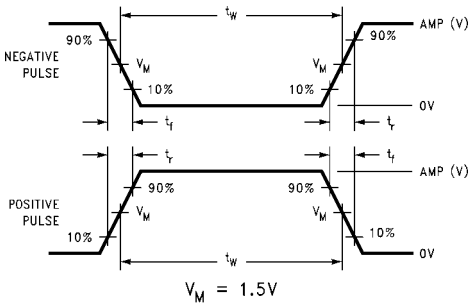


FIGURE 6. Test Input Signal Levels Input Pulse Requirements

Amplitude	Rep. Rate	t_W	t_r	t_f
3.0V	1 MHz	500 ns	2.5 ns	2.5 ns

FIGURE 7. Test Input Signal Requirements

AC Waveforms

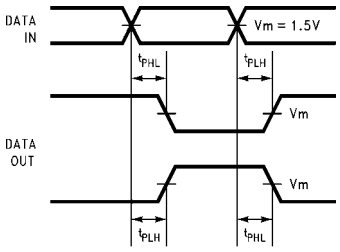


FIGURE 8. Propagation Delay Waveforms for Inverting and Non-Inverting Functions

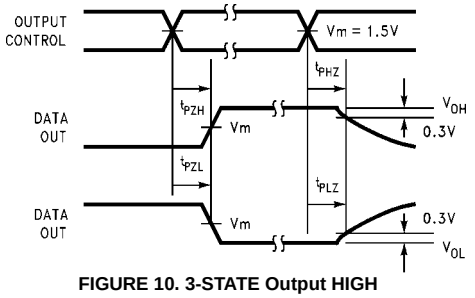


FIGURE 10. 3-STATE Output HIGH and LOW Enable and Disable Times

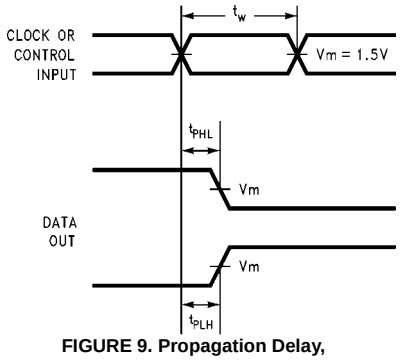


FIGURE 9. Propagation Delay, Pulse Width Waveforms

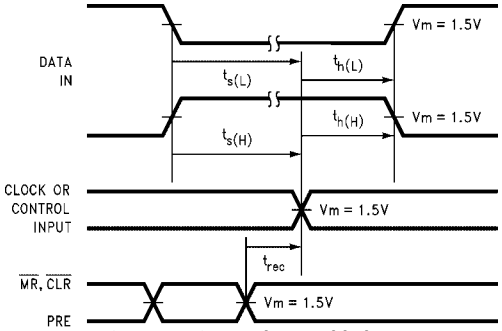
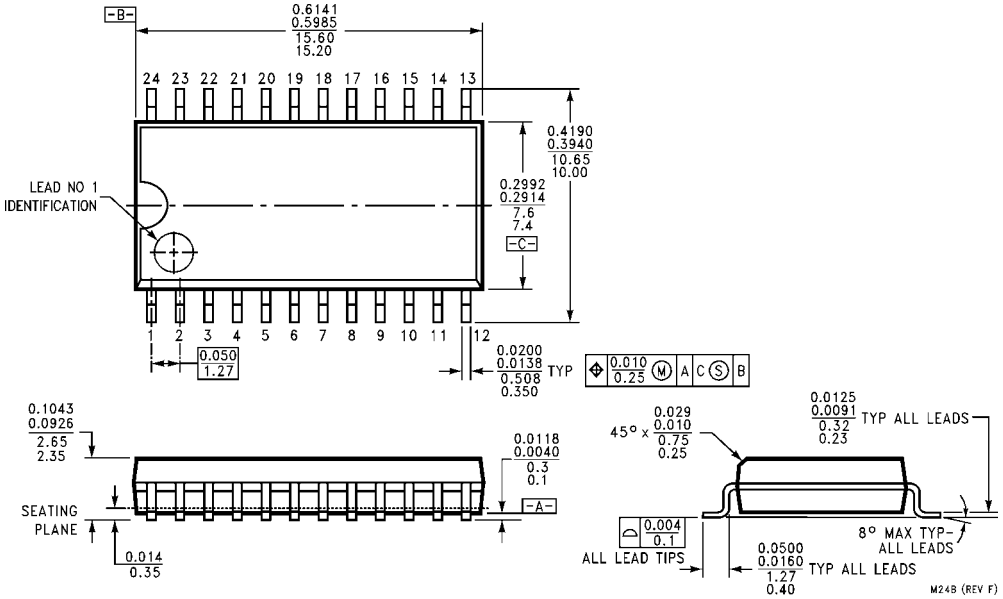
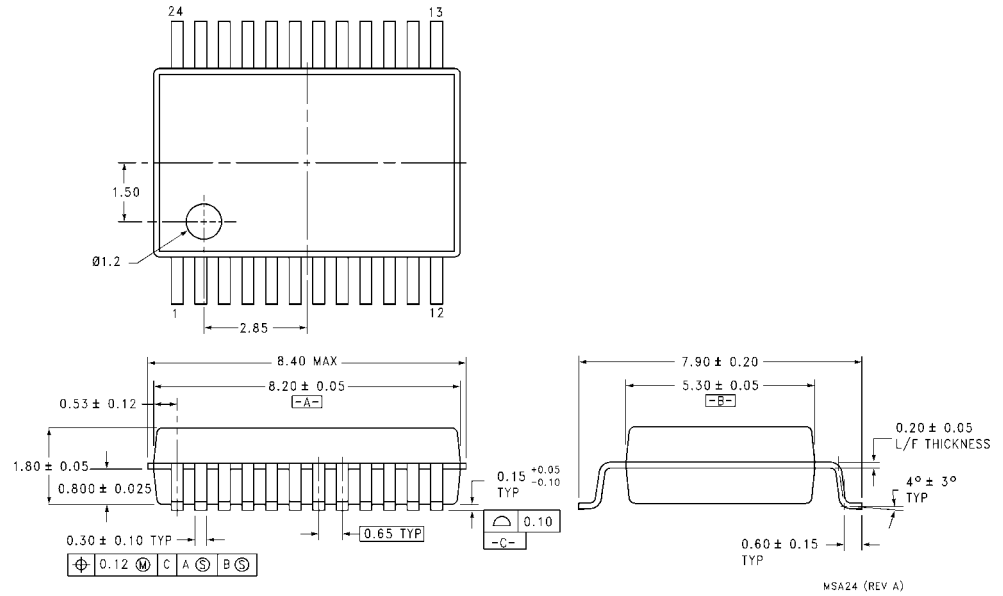


FIGURE 11. Setup Time, Hold Time and Recovery Time Waveforms

Physical Dimensions inches (millimeters) unless otherwise noted

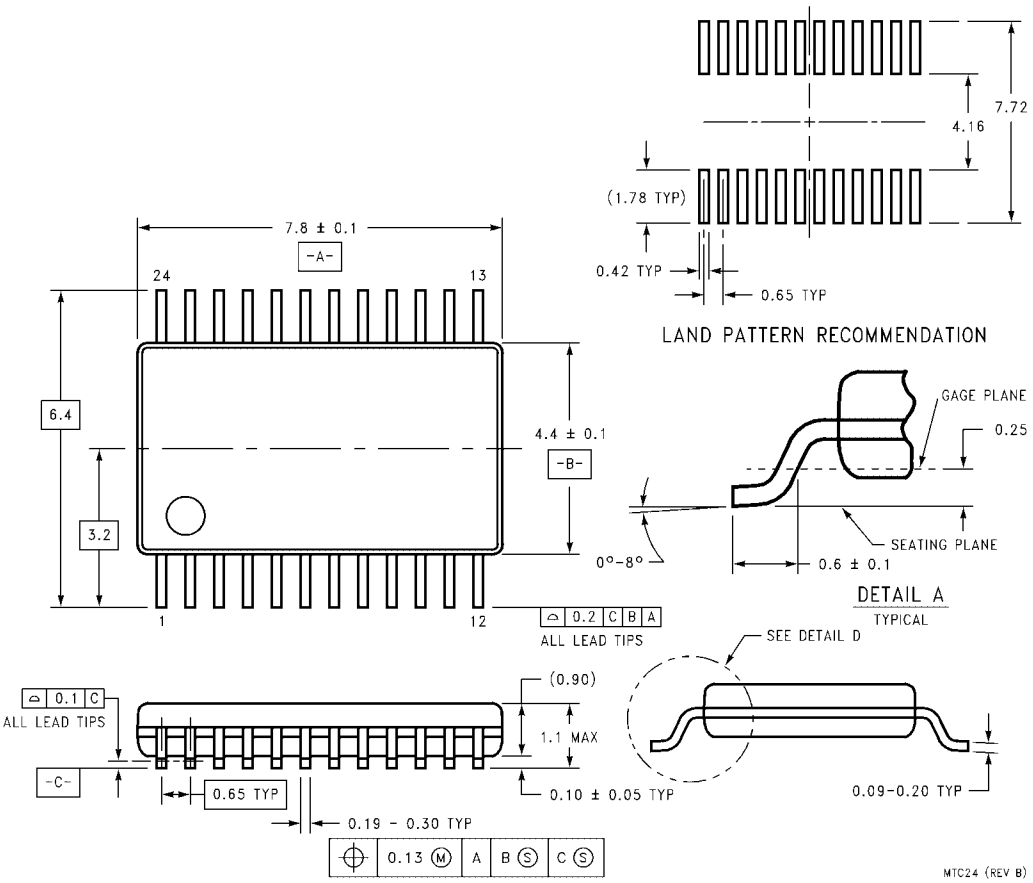


24-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide Body
Package Number M24B



24-Lead Shrink Small Outline Package (SSOP), EIAJ TYPE II, 5.3mm Wide
Package Number MSA24

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



24-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
Package Number MTC24

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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