FAIRCHILD SEMICONDUCTOR™

January 1993
Revised August 2000

SCAN182374A
D-Type Flip-Flop with 25Ω Series Resistor Outputs

General Description

The SCAN182374A is a high performance BiCMOS D-type flip-flop featuring separate D-type inputs organized into dual 9-bit bytes with byte-oriented clock and output enable control signals. This device is compliant with IEEE 1149.1 Standard Test Access Port and Boundary Scan Architecture with the incorporation of the defined boundary-scan test logic and test access port consisting of Test Data Input (TDI), Test Data Out (TDO), Test Mode Select (TMS), and Test Clock (TCK).

Features

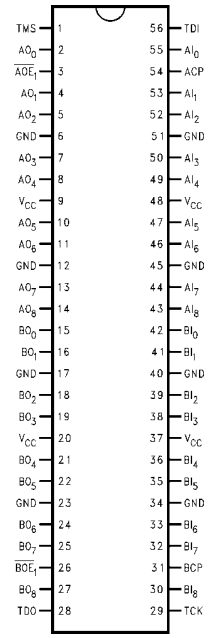
- IEEE 1149.1 (JTAG) Compliant
- High performance BiCMOS technology
- 25Ω series resistor outputs eliminate need for external terminating resistors
- Buffered positive edge-triggered clock
- 3-STATE outputs for bus-oriented applications
- 25 mil pitch SSOP (Shrink Small Outline Package)
- Includes CLAMP, IDCODE and HIGHZ instructions
- Additional instructions SAMPLE-IN, SAMPLE-OUT and EXTEST-OUT
- Power up 3-STATE for hot insert
- Member of Fairchild's SCAN Products

Ordering Code:

Order Number	Package Number	Package Description
SCAN182374ASSC	MS56A	56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118, 0.300 Wide

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

Connection Diagram



Pin Descriptions

Pin Names	Description
$AI_{(0–8)}$, $BI_{(0–8)}$	Data Inputs
ACP, BCP	Clock Pulse Inputs
$\overline{AOE}_1$, $\overline{BOE}_1$	3-STATE Output Enable Inputs
$AO_{(0–8)}$, $BO_{(0–8)}$	3-STATE Outputs

Truth Tables

Inputs			$AO_{(0–8)}$
ACP	**$\overline{AOE}_1$ (Note 1)**	**$AI_{(0–8)}$**	
X	H	X	Z
⌐	L	L	L
⌐	L	H	H

Inputs			$BO_{(0–8)}$
BCP	**$\overline{BOE}_1$ (Note 1)**	**$BI_{(0–8)}$**	
X	H	X	Z
⌐	L	L	L
⌐	L	H	H

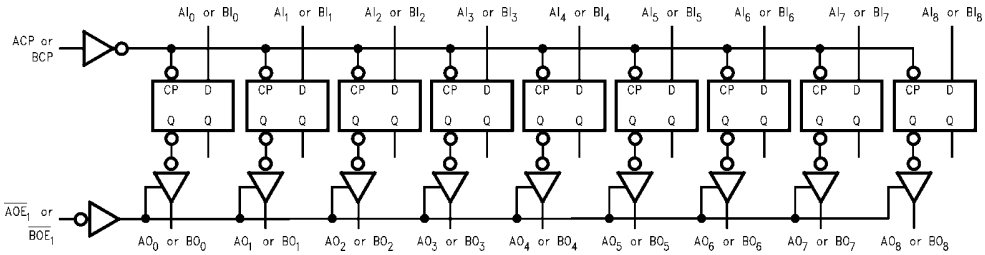
H = HIGH Voltage Level Z = High Impedance
L = LOW Voltage Level ⌐ = L-to-H Transition
X = Immaterial

Note 1: Inactive-to-active transition must occur to enable outputs upon power-up.

Functional Description

The SCAN182374A consists of two sets of nine edge-triggered flip-flops with individual D-type inputs and 3-STATE true outputs. The buffered clock and buffered Output Enable pins are common to all flip-flops. Each set of the nine flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (ACP or BCP) transition. With the Output Enable ($\overline{AOE}_1$ or $\overline{BOE}_1$) LOW, the contents of the nine flip-flops are available at the outputs. When the Output Enable is HIGH, the outputs go to the high impedance state. Operation of the Output Enable input does not affect the state of the flip-flops.

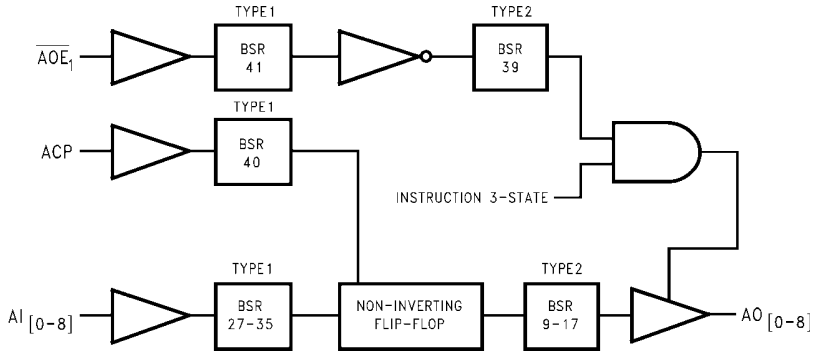
Logic Diagram



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

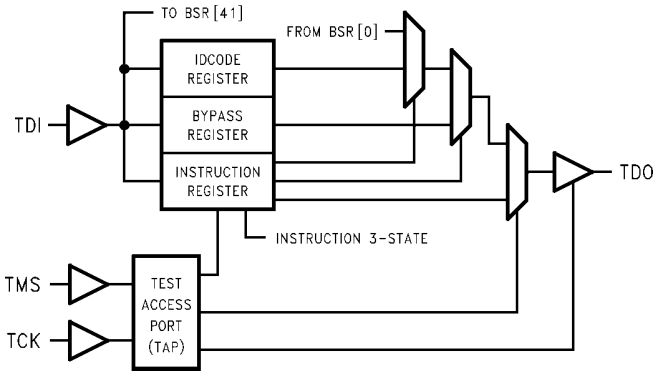
Block Diagrams

Byte-A



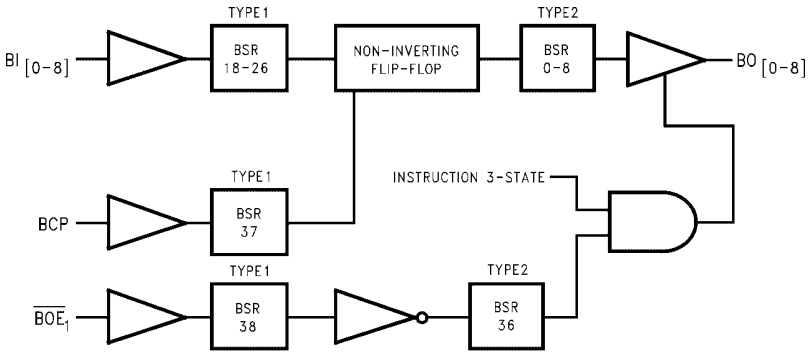
Note: BSR stands for Boundary Scan Register

Tap Controller



Block Diagrams (Continued)

Byte-B



Note: BSR stands for BOUNDARY-SCAN Register

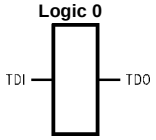
Description of BOUNDARY-SCAN Circuitry

The scan cells used in the BOUNDARY-SCAN register are one of the following two types depending upon their location. Scan cell TYPE1 is intended to solely observe system data, while TYPE2 has the additional ability to control system data.

Scan cell TYPE1 is located on each system input pin while scan cell TYPE2 is located at each system output pin as well as at each of the two internal active-high output enable signals. AOE controls the activity of the A-outputs while BOE controls the activity of the B-outputs. Each will activate their respective outputs by loading a logic high.

The BYPASS register is a single bit shift register stage identical to scan cell TYPE1. It captures a fixed logic low.

Bypass Register Scan Chain Definition

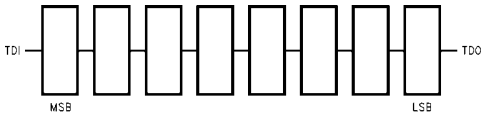


SCAN182374A Product IDCODE (32-Bit Code per IEEE 1149.1)

Version	Entity	Per Number	Manufacturer ID	Required by 1149.1
0000	111111	0000000111	00000001111	1
MSB				**LSB**

The INSTRUCTION register is an 8-bit register which captures the default value of 10000001 (SAMPLE/PRELOAD) during the CAPTURE-IR instruction command. The benefit of capturing SAMPLE/PRELOAD as the default instruction during CAPTURE-IR is that the user is no longer required to shift in the 8-bit instruction for SAMPLE/PRELOAD. The sequence of: CAPTURE-IR $\rightarrow$ EXIT1-IR $\rightarrow$ UPDATE-IR will update the SAMPLE/PRELOAD instruction. For more information refer to the section on instruction definitions.

Instruction Register Scan Chain Definition

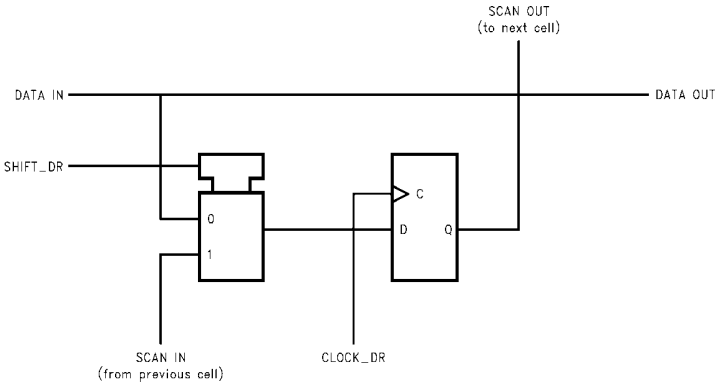


MSB $\rightarrow$ LSB

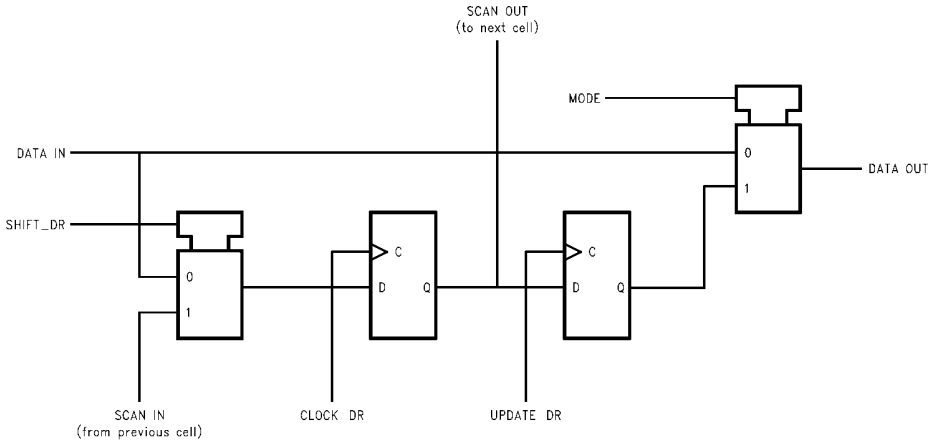
Instruction Code	Instruction
00000000	EXTEST
10000001	SAMPLE/PRELOAD
10000010	CLAMP
00000011	HIGH-Z
01000001	SAMPLE-IN
01000010	SAMPLE-OUT
00100010	EXTEST-OUT
10101010	IDCODE
11111111	BYPASS
All Other	BYPASS

Description of BOUNDARY-SCAN Circuitry (Continued)

Scan Cell TYPE1



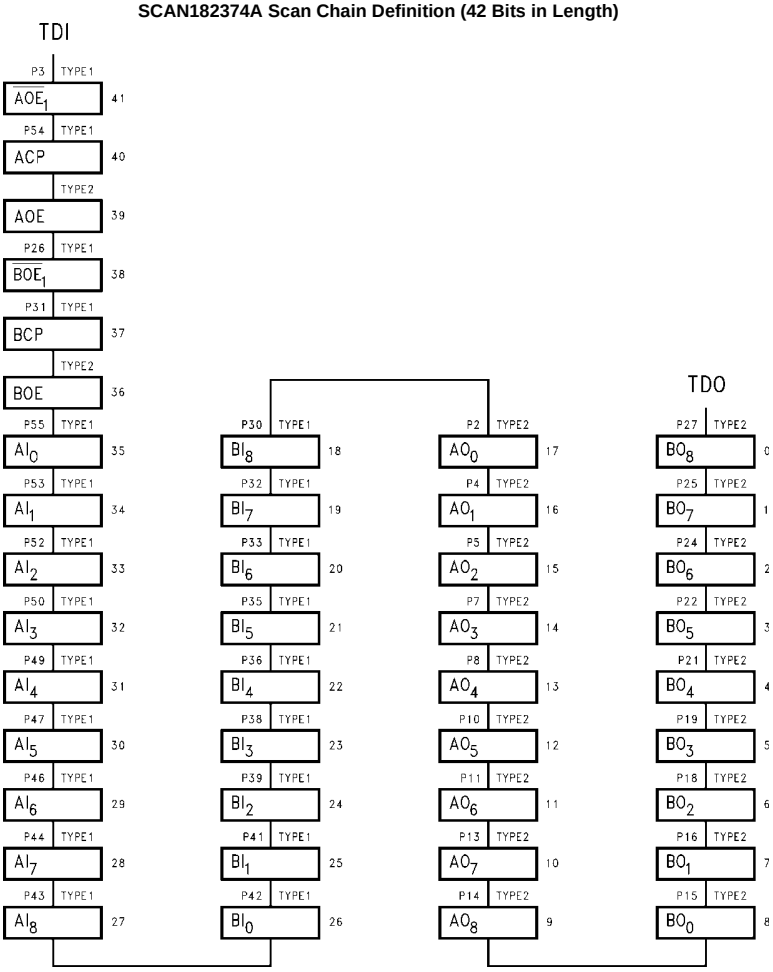
Scan Cell TYPE2



Description of BOUNDARY-SCAN Circuitry (Continued)

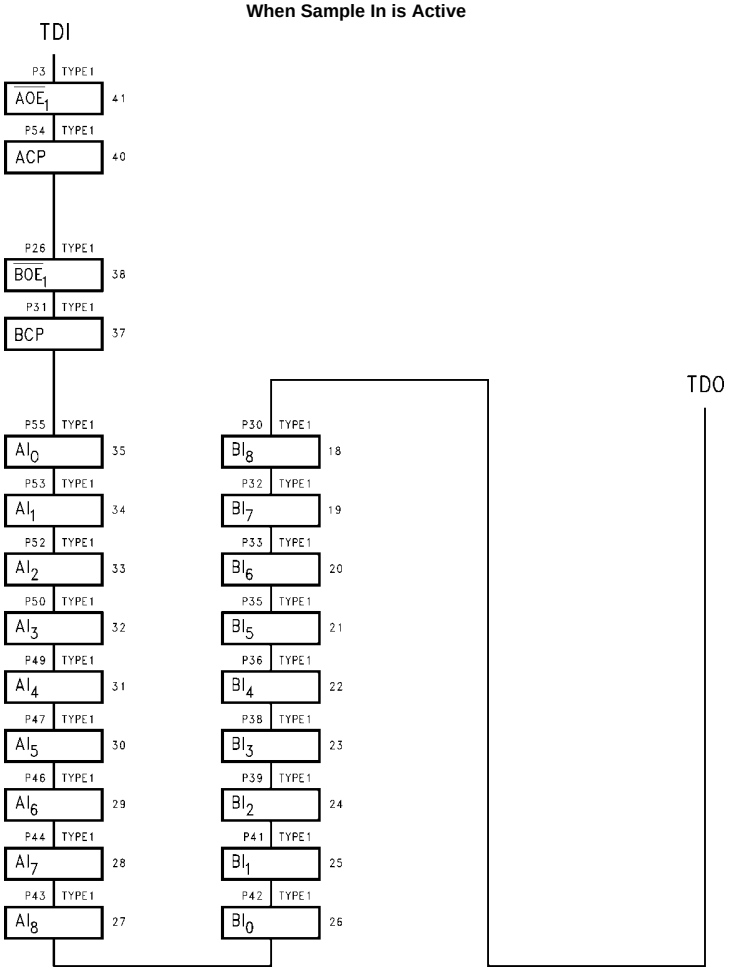
BOUNDARY-SCAN Register

SCAN182374A Scan Chain Definition (42 Bits in Length)



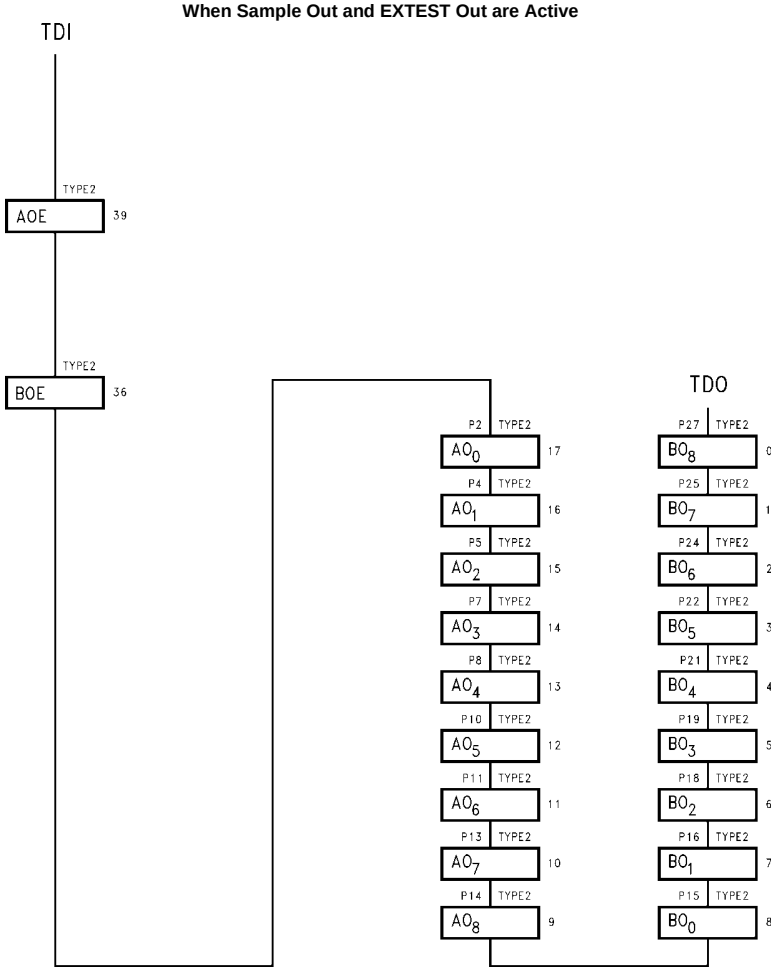
Description of BOUNDARY-SCAN Circuitry (Continued)

Input BOUNDARY-SCAN Register
Scan Chain Definition (22 Bits in Length)
When Sample In is Active



Description of BOUNDARY-SCAN Circuitry (Continued)

Output BOUNDARY-SCAN Register
Scan Chain Definition (20 Bits in Length)
When Sample Out and EXTEST Out are Active



Description of BOUNDARY-SCAN Circuitry (Continued)

BOUNDARY-SCAN Register Definition Index

Bit No.	Pin Name	Pin No.	Pin Type	Scan Cell Type	
41	$\overline{AOE}_1$	3	Input	TYPE1	
40	ACP	54	Input	TYPE1	
39	AOE		Internal	TYPE2	Control Signals
38	$\overline{BOE}_1$	26	Input	TYPE1	
37	BCP	31	Input	TYPE1	
36	BOE		Internal	TYPE2	
35	AI_0	55	Input	TYPE1	
34	AI_1	53	Input	TYPE1	
33	AI_2	52	Input	TYPE1	
32	AI_3	50	Input	TYPE1	
31	AI_4	49	Input	TYPE1	A–in
30	AI_5	47	Input	TYPE1	
29	AI_6	46	Input	TYPE1	
28	AI_7	44	Input	TYPE1	
27	AI_8	43	Input	TYPE1	
26	BI_0	42	Input	TYPE1	
25	BI_1	41	Input	TYPE1	
24	BI_2	39	Input	TYPE1	
23	BI_3	38	Input	TYPE1	
22	BI_4	36	Input	TYPE1	B–in
21	BI_5	35	Input	TYPE1	
20	BI_6	33	Input	TYPE1	
19	BI_7	32	Input	TYPE1	
18	BI_8	30	Input	TYPE1	
17	AO_0	2	Output	TYPE2	
16	AO_1	4	Output	TYPE2	
15	AO_2	5	Output	TYPE2	
14	AO_3	7	Output	TYPE2	
13	AO_4	8	Output	TYPE2	A–out
12	AO_5	10	Output	TYPE2	
11	AO_6	11	Output	TYPE2	
10	AO_7	13	Output	TYPE2	
9	AO_8	14	Output	TYPE2	
8	BO_0	15	Output	TYPE2	
7	BO_1	16	Output	TYPE2	
6	BO_2	18	Output	TYPE2	
5	BO_3	19	Output	TYPE2	
4	BO_4	21	Output	TYPE2	B–out
3	BO_5	22	Output	TYPE2	
2	BO_6	24	Output	TYPE2	
1	BO_7	25	Output	TYPE2	
0	BO_8	27	Output	TYPE2	

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 Disabled 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
ESD (HBM) Min.	2000V

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

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		V_{CC}	Min	Typ	Max	Units	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		Min			−1.2	V	I_{IN} = −18 mA
V_{OH}	Output HIGH Voltage		Min	2.5			V	I_{OH} = −3 mA
			Min	2.0			V	I_{OH} = −32 mA
V_{OL}	Output LOW Voltage		Min			0.8	V	I_{OL} = 15 mA
I_{IH}	Input HIGH Current	All Others	Max			5	µA	V_{IN} = 2.7V (Note 4)
			Max			5	µA	V_{IN} = V_{CC}
		TMS, TDI Inputs	Max			5	µA	V_{IN} = V_{CC}
I_{BVI}	Input HIGH Current Breakdown Test		Max			7	µA	V_{IN} = 7.0V
I_{BVIT}	Input HIGH Current Breakdown Test (I/O)		Max			100	µA	V_{IN} = 5.5V
I_{IL}	Input LOW Current	All Others	Max			−5	µA	V_{IN} = 0.5V (Note 4)
			Max			−5	µA	V_{IN} = 0.0V
		TMS, TDI	Max			−385	µA	V_{IN} = 0.0V
V_{ID}	Input Leakage Test		0.0	4.75			V	I_{ID} = 1.9 µA All Other Pins Grounded
$I_{IH} + I_{OZH}$	Output Leakage Current		Max			50	µA	V_{OUT} = 2.7V
$I_{IL} + I_{OZL}$	Output Leakage Current		Max			−50	µA	V_{OUT} = 0.5V
I_{OZH}	Output Leakage Current		Max			50	µA	V_{OUT} = 2.7V
I_{OZL}	Output Leakage Current		Max			−50	µA	V_{OUT} = 0.5V
I_{OS}	Output Short-Circuit Current		Max	−100		−275	mA	V_{OUT} = 0.0V
I_{CEX}	Output HIGH Leakage Current		Max			50	µA	V_{OUT} = V_{CC}
I_{ZZ}	Bus Drainage Test		0.0			100	µA	V_{OUT} = 5.5V All Others Grounded
I_{CCH}	Power Supply Current		Max			250	µA	V_{OUT} = V_{CC}; TDI, TMS = V_{CC}
			Max			1.0	mA	V_{OUT} = V_{CC}; TDI, TMS = GND
I_{CCL}	Power Supply Current		Max			65	mA	V_{OUT} = LOW; TDI, TMS = V_{CC}
			Max			65.8	mA	V_{OUT} = LOW; TDI, TMS = GND
I_{CCZ}	Power Supply Current		Max			250	µA	TDI, TMS = V_{CC}
			Max			1.0	mA	TDI, TMS = GND
I_{CCT}	Additional I_{CC}/Input	All Other Inputs	Max			2.9	mA	V_{IN} = V_{CC} − 2.1V
		TDI, TMS Inputs	Max			3	mA	V_{IN} = V_{CC} − 2.1V
I_{CCD}	Dynamic I_{CC}	No Load	Max			0.2	mA/ MHz	Outputs Open One Bit Toggling, 50% Duty Cycle

Note 4: Guaranteed not tested.

AC Electrical Characteristics

Normal Operation

Symbol	Parameter	V_{CC} (V) (Note 5)	$T_A = -40°C$ to $+85°C$ $C_L = 50$ pF			Units
			Min	Typ	Max	
t_{PLH}	Propagation Delay	5.0	1.4	4.6	6.1	ns
t_{PHL}	CP to Q		2.1	4.9	6.8	
t_{PLZ}	Disable Time	5.0	1.9	4.6	8.0	ns
t_{PHZ}			1.8	4.8	8.7	
t_{PZL}	Enable Time	5.0	2.0	6.7	9.4	ns
t_{PZH}			1.4	6.0	8.2	

Note 5: Voltage Range 5.0V ± 0.5V

AC Operating Requirements

Normal Operation

Symbol	Parameter	V_{CC} (V) (Note 6)	$T_A = -40°C$ to $+85°C$ $C_L = 50$ pF	Units
			Guaranteed Minimum	
t_S	Setup Time, H or L Data to CP	5.0	2.8	ns
t_H	Hold Time, H or L CP to Data	5.0	2.4	ns
t_W	CP Pulse Width	5.0	0.0	ns
f_{MAX}	Maximum ACP/BCP Clock Frequency	5.0	50	MHz

Note 6: Voltage Range is 5.0V ± 0.5V.

AC Electrical Characteristics

Scan Test Operation

Symbol	Parameter	V_{CC} (V) (Note 7)	$T_A = -40°C$ to $+85°C$ $C_L = 50$ pF			Units
			Min	Typ	Max	
t_{PLH}	Propagation Delay	5.0	2.9	5.8	9.5	ns
t_{PHL}	TCK to TDO		4.0	7.3	11.5	
t_{PLZ}	Disable Time	5.0	1.9	5.6	10.0	ns
t_{PHZ}	TCK to TDO		3.0	7.1	12.1	
t_{PZL}	Enable Time	5.0	4.4	8.4	13.2	ns
t_{PZH}	TCK to TDO		2.7	6.4	10.9	
t_{PLH}	Propagation Delay	5.0	3.4	6.5	10.5	ns
t_{PHL}	TCK to Data Out during Update-DR State		4.3	8.1	12.7	
t_{PLH}	Propagation Delay	5.0	3.9	7.8	12.8	ns
t_{PHL}	TCK to Data Out during Update-IR State		4.7	9.1	14.5	
t_{PLH}	Propagation Delay	5.0	4.7	9.5	15.6	ns
t_{PHL}	TCK to Data Out during Test Logic Reset State		5.6	10.9	17.4	
t_{PLZ}	Disable Time	5.0	3.2	7.8	13.6	ns
t_{PHZ}	TCK to Data Out during Update-DR State		3.9	8.5	14.2	
t_{PLZ}	Disable Time	5.0	3.2	8.6	15.0	ns
t_{PHZ}	TCK to Data Out during Update-IR State		3.8	9.3	15.6	
t_{PLZ}	Disable Time	5.0	4.2	10.2	18.0	ns
t_{PHZ}	TCK to Data Out during Test Logic Reset State		5.0	11.0	18.5	
t_{PZL}	Enable Time	5.0	5.0	9.6	15.3	ns
t_{PZH}	TCK to Data Out during Update-DR State		3.7	7.7	13.0	
t_{PZL}	Enable Time	5.0	5.3	10.8	17.4	ns
t_{PZH}	TCK to Data Out during Update-IR State		4.0	9.0	15.1	
t_{PZL}	Enable Time	5.0	6.2	12.6	20.4	ns
t_{PZH}	TCK to Data Out during Test Logic Reset State		4.7	10.7	18.1	

Note 7: Voltage Range 5.0V ± 0.5V

AC Operating Requirements

Scan Test Operation

Symbol	Parameter	V_{CC} (V) (Note 8)	$T_A = -40°C$ to $+85°C$, $C_L = 50$ pF Guaranteed Minimum	Units
t_S	Setup Time Data to TCK (Note 9)	5.0	2.7	ns
t_H	Hold Time Data to TCK (Note 9)	5.0	3.1	ns
t_S	Setup Time, H or L $\overline{AOE}_1$, $\overline{BOE}_1$ to TCK (Note 10)	5.0	5.0	ns
t_H	Hold Time, H or L TCK to $\overline{AOE}_1$, $\overline{BOE}_1$ (Note 10)	5.0	1.8	ns
t_S	Setup Time, H or L Internal AOE, BOE to TCK (Note 11)	5.0	3.6	ns
t_H	Hold Time, H or L TCK to Internal AOE, BOE (Note 11)	5.0	2.1	ns
t_S	Setup Time ACP, BCP (Note 12) to TCK	5.0	3.4	ns
t_H	Hold Time TCK to ACP, BCP (Note 12)	5.0	1.8	ns
t_S	Setup Time, H or L TMS to TCK	5.0	8.7	ns
t_H	Hold Time, H or L TCK to TMS	5.0	1.8	ns
t_S	Setup Time, H or L TDI to TCK	5.0	6.4	ns
t_H	Hold Time, H or L TCK to TDI	5.0	3.2	ns
t_W	Pulse Width TCK H L	5.0	8.2 11.2	ns
f_{MAX}	Maximum TCK Clock Frequency	5.0	50	MHz
t_{PU}	Wait Time, Power Up to TCK	5.0	100	ns
t_{DN}	Power Down Delay	0.0	100	ms

Note 8: Voltage Range $5.0V \pm 0.5V$

Note 9: This delay represents the timing relationship between the data input and TCK at the associated scan cells numbered 0–8, 9–17, 18–26 and 27–35.

Note 10: Timing pertains to BSR 38 and 41 only.

Note 11: This delay represents the timing relationship between AOE/BOE and TCK for scan cells 36 and 39 only.

Note 12: Timing pertains to BSR 37 and 40 only.

Note: All Input Timing Delays involving TCK are measured from the rising edge of TCK.

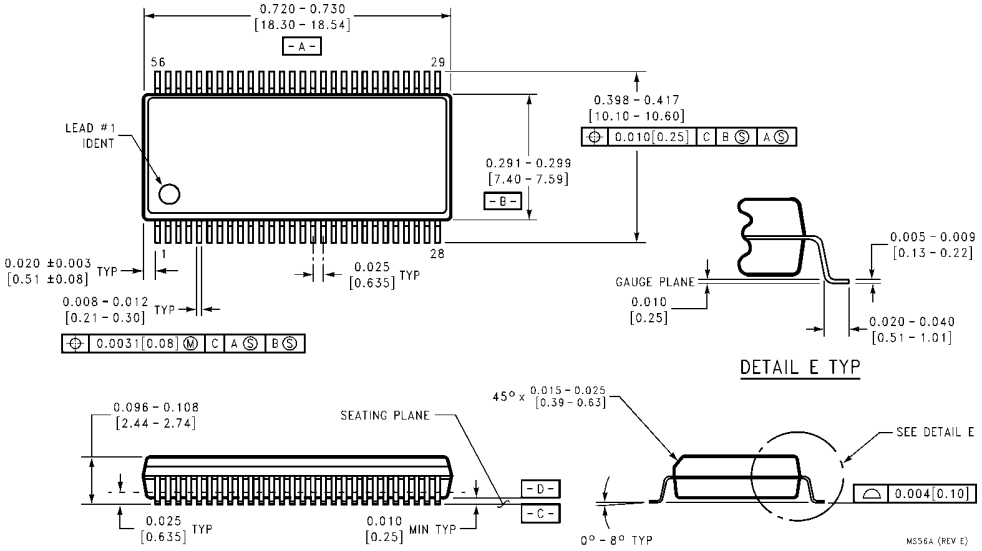
Capacitance

$T_A = 25°C$

Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	5.8	pF	$V_{CC} = 0.0V$
C_{OUT} (Note 13)	Output Capacitance	13.8	pF	$V_{CC} = 5.0V$

Note 13: C_{OUT} is measured at frequency f = 1 MHz, per MIL-STD-883B, Method 3012.

Physical Dimensions inches (millimeters) unless otherwise noted



56-Lead Shrink Small Outline Package (SSOP), JEDEC MO-118, 0.300 Wide
Package Number MS56A

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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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