CMOS Digital Integrated Circuits Silicon Monolithic

TC7SZU04AFS

1. Functional Description

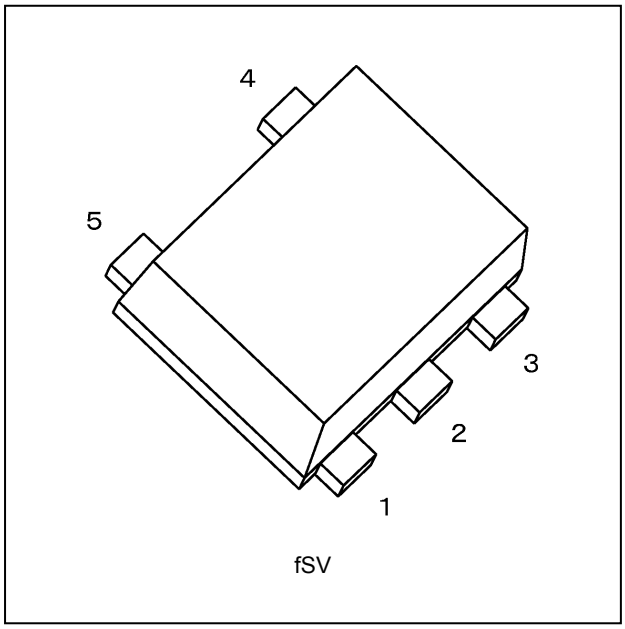
- Inverter (Unbuffer)

2. Features

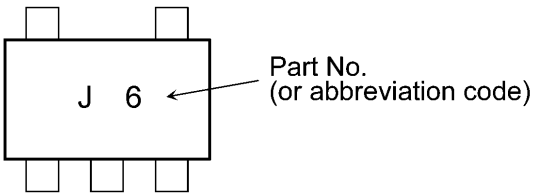
(1) AEC-Q100 (Rev. H) (Note 1)
(2) Wide operating temperature range: T_{opr} = -40 to 125 °C (Note 2)
(3) High output current: ±32 mA (min) at V_{CC} = 4.5 V
(4) Operation voltage range: V_{CC} = 1.65 to 5.5 V
(5) 5.5 V tolerant inputs

Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.
Note 2: For devices with the ordering part number ending in J(T. T_{opr} = -40 to 85 °C for the other devices.

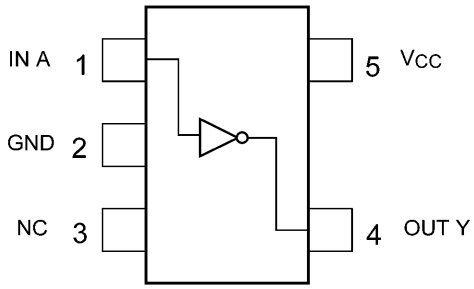
3. Packaging



4. Marking and Pin Assignment



Marking



Pin Assignment (Top view)

Start of commercial production
2008-05

5. IEC Logic Symbol

6. Truth Table

A	Y
L	H
H	L

7. Absolute Maximum Ratings (Note) (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 6.0	V
Input voltage	V_{IN}		-0.5 to 6.0	V
DC output voltage	V_{OUT}		-0.5 to V_{CC} + 0.5	V
Input diode current	I_{IK}		-20	mA
Output diode current	I_{OK}	(Note 1)	±20	mA
DC output current	I_{OUT}		±50	mA
V_{CC}/ground current	I_{CC}		±50	mA
Power dissipation	P_D		50	mW
Storage temperature	T_{stg}		-65 to 150	°C

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.
Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 1: V_{OUT} < GND, V_{OUT} > V_{CC}

8. Operating Ranges (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		1.65 to 5.5	V
		(Note 1)	1.5 to 5.5	
Input voltage	V_{IN}		0 to 5.5	V
Output voltage	V_{OUT}		0 to V_{CC}	V
Operating temperature	T_{opr}	(Note 2)	-40 to 125	°C
		(Note 3)	-40 to 85	

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs must be tied to either V_{CC} or GND.

Note 1: Data retention only

Note 2: For devices with the ordering part number ending in J(T.

Note 3: For devices except those with the ordering part number ending in J(T.

9. Electrical Characteristics

9.1. DC Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Typ.	Max	Unit
High-level input voltage	V_{IH}	—		1.65 to 1.95	V_{CC} × 0.85	—	—	V
				2.3 to 5.5	V_{CC} × 0.8	—	—	
Low-level input voltage	V_{IL}	—		1.65 to 1.95	—	—	V_{CC} × 0.15	V
				2.3 to 5.5	—	—	V_{CC} × 0.2	
High-level output voltage	V_{OH}	V_{IN} = V_{IL}	I_{OH} = -100 μA	1.65	1.45	1.64	—	V
				2.3	2.1	2.3	—	
				3.0	2.7	3.0	—	
				4.5	4.0	4.4	—	
		V_{IN} = GND	I_{OH} = -4 mA	1.65	1.29	1.52	—	
			I_{OH} = -8 mA	2.3	1.9	2.14	—	
			I_{OH} = -16 mA	3.0	2.4	2.75	—	
			I_{OH} = -24 mA	3.0	2.3	2.61	—	
			I_{OH} = -32 mA	4.5	3.8	4.13	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH}	I_{OL} = 100 μA	1.65	—	0.0	0.2	V
				2.3	—	0.0	0.2	
				3.0	—	0.0	0.3	
				4.5	—	0.0	0.5	
		V_{IN} = V_{CC}	I_{OL} = 4 mA	1.65	—	0.08	0.24	
			I_{OL} = 8 mA	2.3	—	0.1	0.3	
			I_{OL} = 16 mA	3.0	—	0.17	0.4	
			I_{OL} = 24 mA	3.0	—	0.25	0.55	
			I_{OL} = 32 mA	4.5	—	0.26	0.55	
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	—	±1	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	—	2	μA

9.2. DC Characteristics (Unless otherwise specified, T_a = -40 to 85 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	—		1.65 to 1.95	V_{CC} × 0.85	—	V
				2.3 to 5.5	V_{CC} × 0.8	—	
Low-level input voltage	V_{IL}	—		1.65 to 1.95	—	V_{CC} × 0.15	V
				2.3 to 5.5	—	V_{CC} × 0.2	
High-level output voltage	V_{OH}	V_{IN} = V_{IL}	I_{OH} = -100 μA	1.65	1.45	—	V
				2.3	2.1	—	
				3.0	2.7	—	
				4.5	4.0	—	
		V_{IN} = GND	I_{OH} = -4 mA	1.65	1.29	—	
			I_{OH} = -8 mA	2.3	1.9	—	
			I_{OH} = -16 mA	3.0	2.4	—	
			I_{OH} = -24 mA	3.0	2.3	—	
			I_{OH} = -32 mA	4.5	3.8	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH}	I_{OL} = 100 μA	1.65	—	0.2	V
				2.3	—	0.2	
				3.0	—	0.3	
				4.5	—	0.5	
		V_{IN} = V_{CC}	I_{OL} = 4 mA	1.65	—	0.24	
			I_{OL} = 8 mA	2.3	—	0.3	
			I_{OL} = 16 mA	3.0	—	0.4	
			I_{OL} = 24 mA	3.0	—	0.55	
			I_{OL} = 32 mA	4.5	—	0.55	
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	±10	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	20	μA

9.3. DC Characteristics (Note) (Unless otherwise specified, T_a = -40 to 125 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	—		1.65 to 1.95	V_{CC} × 0.85	—	V
				2.3 to 5.5	V_{CC} × 0.8	—	
Low-level input voltage	V_{IL}	—		1.65 to 1.95	—	V_{CC} × 0.15	V
				2.3 to 5.5	—	V_{CC} × 0.2	
High-level output voltage	V_{OH}	V_{IN} = V_{IL}	I_{OH} = -100 μA	1.65	1.45	—	V
				2.3	2.1	—	
				3.0	2.7	—	
				4.5	4.0	—	
		V_{IN} = GND	I_{OH} = -4 mA	1.65	0.95	—	
			I_{OH} = -8 mA	2.3	1.7	—	
			I_{OH} = -16 mA	3.0	2.2	—	
			I_{OH} = -24 mA	3.0	2.0	—	
			I_{OH} = -32 mA	4.5	3.4	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH}	I_{OL} = 100 μA	1.65	—	0.2	V
				2.3	—	0.2	
				3.0	—	0.3	
				4.5	—	0.5	
		V_{IN} = V_{CC}	I_{OL} = 4 mA	1.65	—	0.7	
			I_{OL} = 8 mA	2.3	—	0.45	
			I_{OL} = 16 mA	3.0	—	0.6	
			I_{OL} = 24 mA	3.0	—	0.8	
			I_{OL} = 32 mA	4.5	—	0.8	
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	±20	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		5.5	—	200	μA

Note: For devices with the ordering part number ending in J(T.

9.4. AC Characteristics (Unless otherwise specified, T_a = 25 °C, Input: $t_r = t_f$ = 3 ns)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Typ.	Max	Unit
Propagation delay time	t_{PLH},t_{PHL}		R_L = 1 MΩ	1.8 ± 0.15	15	1.0	—	8.5	ns
				2.5 ± 0.2		0.8	—	6.2	
				3.3 ± 0.3		0.5	—	4.5	
				5.0 ± 0.5		0.5	—	3.9	
			R_L = 500 Ω	3.3 ± 0.3	50	1.0	—	6.0	ns
				5.0 ± 0.5		0.8	—	5.0	
Input capacitance	C_{IN}		—	0 to 5.5	—	—	5	—	pF
Power dissipation capacitance	C_{PD}	(Note 1)	—	3.3	—	—	10	—	pF
				5.5		—	25	—	

Note 1: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation.

$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$

9.5. AC Characteristics (Unless otherwise specified, T_a = -40 to 85 °C, Input: $t_r = t_f$ = 3 ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time	t_{PLH},t_{PHL}	R_L = 1 MΩ	1.8 ± 0.15	15	1.0	9.0	ns
			2.5 ± 0.2		0.8	6.5	
			3.3 ± 0.3		0.5	4.8	
			5.0 ± 0.5		0.5	4.1	
		R_L = 500 Ω	3.3 ± 0.3	50	1.0	6.5	ns
			5.0 ± 0.5		0.8	5.5	

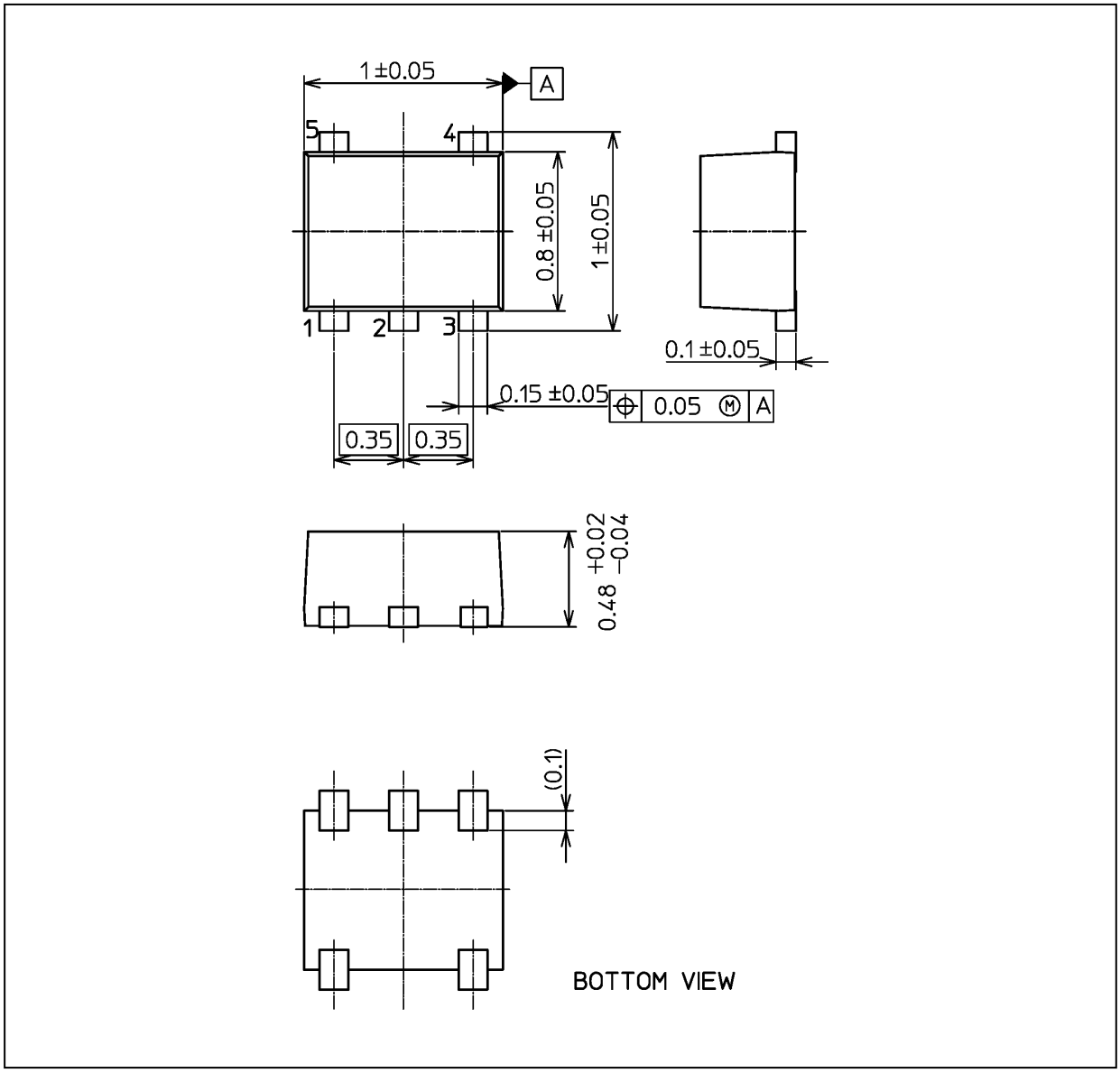
9.6. AC Characteristics (Note) (Unless otherwise specified, T_a = -40 to 125 °C, Input: $t_r = t_f$ = 3 ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time	t_{PLH},t_{PHL}	R_L = 1 MΩ	1.8 ± 0.15	15	1.0	10.0	ns
			2.5 ± 0.2		0.8	7.5	
			3.3 ± 0.3		0.5	5.5	
			5.0 ± 0.5		0.5	5.0	
		R_L = 500 Ω	3.3 ± 0.3	50	1.0	7.5	ns
			5.0 ± 0.5		0.8	6.5	

Note: For devices with the ordering part number ending in J(T.

Package Dimensions

Unit: mm



Weight: 1.0 mg (typ.)

Package Name(s)
JEDEC: SOT-953
Nickname: fSV

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