CMOS Digital Integrated Circuits Silicon Monolithic

TC7WH126FK

1. Functional Description

- Dual Bus Buffer with 3-State Output

2. Features

(1) AEC-Q100 (Rev. H) (Note 1)

(2) Wide operating temperature range: T_{opr} = -40 to 125 °C (Note 2)

(3) High speed operation: t_{pd} = 3.8 ns (typ.) (V_{CC} = 5.0 V, C_L = 15 pF)

(4) Low power dissipation: I_{CC} = 2.0 μA (max) (T_a = 25 °C)

(5) High noise immunity: $V_{NIH} = V_{NIL}$ = 28 % V_{CC} (min)

(6) 5.5 V tolerant inputs

(7) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$

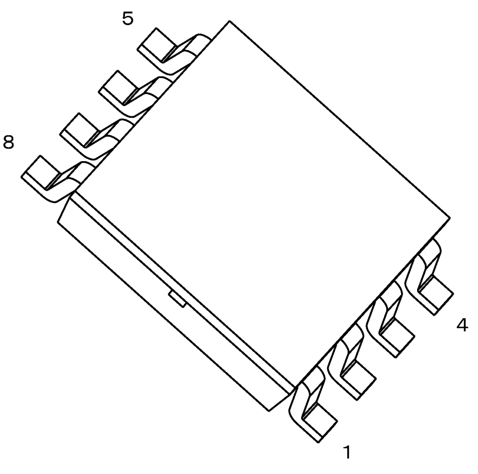
(8) Wide operating voltage range: V_{CC} = 2.0 to 5.5 V

(9) Low noise: V_{OLP} = 0.8 V (max)

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(CT. T_{opr} = -40 to 85 °C for the other devices.

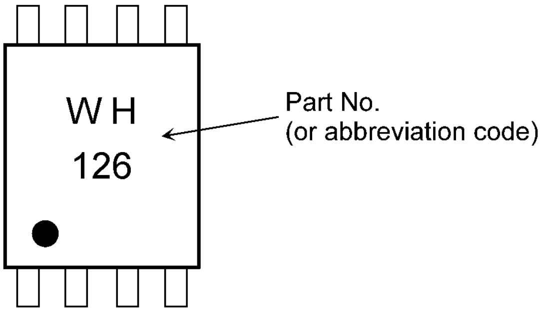
3. Packaging



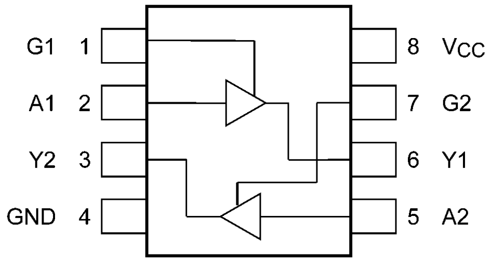
US8

Start of commercial production
1997-02

4. Marking and Pin Assignment

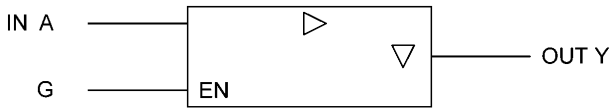


Marking



Pin Assignment (Top view)

5. IEC Logic Symbol



6. Truth Table

G	A	Y
L	X	Z
H	L	L
H	H	H

X: Don't care
Z: High impedance

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

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 7.0	V
Input voltage	V_{IN}		-0.5 to 7.0	
DC output voltage	V_{OUT}		-0.5 to V_{CC} + 0.5	
Input diode current	I_{IK}		-20	mA
Output diode current	I_{OK}	(Note 1)	±20	
DC output current	I_{OUT}		±25	
V_{CC}/ground current	I_{CC}		±50	
Power dissipation	P_D		200	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	Test Condition	Rating	Unit
Supply voltage	V_{CC}		—	2.0 to 5.5	V
Input voltage	V_{IN}		—	0 to 5.5	
Output voltage	V_{OUT}		—	0 to V_{CC}	
Operating temperature	T_{opr}	(Note 1)	—	-40 to 125	°C
		(Note 2)	—	-40 to 85	
Input rise and fall time	dt/dv		$V_{CC} = 3.3 \pm 0.3$ V	0 to 100	ns/V
			$V_{CC} = 5.0 \pm 0.5$ V	0 to 20	

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

Note 2: For devices except those with the ordering part number ending in J(CT.

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}	—		2.0	1.5	—	—	V
				3.0 to 5.5	$V_{CC} \times 0.7$	—	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.5	V
				3.0 to 5.5	—	—	$V_{CC} \times 0.3$	
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$	$I_{OH} = -50$ µA	2.0	1.9	2.0	—	V
				3.0	2.9	3.0	—	
				4.5	4.4	4.5	—	
			$I_{OH} = -4$ mA	3.0	2.58	—	—	
			$I_{OH} = -8$ mA	4.5	3.94	—	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 50$ µA	2.0	—	0.0	0.1	V
				3.0	—	0.0	0.1	
				4.5	—	0.0	0.1	
			$I_{OL} = 4$ mA	3.0	—	—	0.36	
			$I_{OL} = 8$ mA	4.5	—	—	0.36	
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = V_{CC}$ or GND		5.5	—	—	±0.25	µA
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	—	±0.1	µA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND		5.5	—	—	2.0	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}	—		2.0	1.5	—	V
				3.0 to 5.5	$V_{CC} \times 0.7$	—	
Low-level input voltage	V_{IL}	—		2.0	—	0.5	V
				3.0 to 5.5	—	$V_{CC} \times 0.3$	
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$	I_{OH} = -50 μA	2.0	1.9	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			I_{OH} = -4 mA	3.0	2.48	—	
			I_{OH} = -8 mA	4.5	3.80	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	I_{OL} = 50 μA	2.0	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			I_{OL} = 4 mA	3.0	—	0.44	
			I_{OL} = 8 mA	4.5	—	0.44	
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = V_{CC}$ or GND		5.5	—	±2.5	μA
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	±1.0	μA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND		5.5	—	20.0	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}	—		2.0	1.5	—	V
				3.0 to 5.5	$V_{CC} \times 0.7$	—	
Low-level input voltage	V_{IL}	—		2.0	—	0.5	V
				3.0 to 5.5	—	$V_{CC} \times 0.3$	
High-level output voltage	V_{OH}	$V_{IN} = V_{IH}$	I_{OH} = -50 μA	2.0	1.9	—	V
				3.0	2.9	—	
				4.5	4.4	—	
			I_{OH} = -4 mA	3.0	2.40	—	
			I_{OH} = -8 mA	4.5	3.70	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	I_{OL} = 50 μA	2.0	—	0.1	V
				3.0	—	0.1	
				4.5	—	0.1	
			I_{OL} = 4 mA	3.0	—	0.55	
			I_{OL} = 8 mA	4.5	—	0.55	
3-state output OFF-state leakage current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = V_{CC}$ or GND		5.5	—	±10.0	μA
Input leakage current	I_{IN}	V_{IN} = 5.5 V or GND		0 to 5.5	—	±2.0	μA
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND		5.5	—	40.0	μA

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

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}		—	3.3 ± 0.3	15	—	5.6	8.0	ns
					50	—	8.1	11.5	
				5.0 ± 0.5	15	—	3.8	5.5	
					50	—	5.3	7.5	
3-state output enable time	t_{PZL},t_{PZH}		R_L = 1 kΩ	3.3 ± 0.3	15	—	5.4	8.0	ns
					50	—	7.9	11.5	
				5.0 ± 0.5	15	—	3.6	5.1	
					50	—	5.1	7.1	
3-state output disable time	t_{PLZ},t_{PHZ}		R_L = 1 kΩ	3.3 ± 0.3	50	—	9.5	13.2	ns
				5.0 ± 0.5	50	—	6.1	8.8	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	3.3 ± 0.3	50	—	—	1.5	ns
				5.0 ± 0.5	50	—	—	1.0	
Input capacitance	C_{IN}		—			—	4	10	pF
Output capacitance	C_{OUT}		—			—	6	—	pF
Power dissipation capacitance	C_{PD}	(Note 2)	—			—	15	—	pF

Note 1: Parameter guaranteed by design. (t_{osLH} = $|t_{PLH}m - t_{PLH}n|$, t_{osHL} = $|t_{PHL}m - t_{PHL}n|$)

Note 2: 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.

$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/2$ (per 1 bit)

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

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time	t_{PLH},t_{PHL}		—	3.3 ± 0.3	15	1.0	9.5	ns
					50	1.0	13.0	
				5.0 ± 0.5	15	1.0	6.5	
					50	1.0	8.5	
3-state output enable time	t_{PZL},t_{PZH}		R_L = 1 kΩ	3.3 ± 0.3	15	1.0	9.5	ns
					50	1.0	13.0	
				5.0 ± 0.5	15	1.0	6.0	
					50	1.0	8.0	
3-state output disable time	t_{PLZ},t_{PHZ}		R_L = 1 kΩ	3.3 ± 0.3	50	1.0	15.0	ns
				5.0 ± 0.5	50	1.0	10.0	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	3.3 ± 0.3	50	—	1.5	ns
				5.0 ± 0.5	50	—	1.0	
Input capacitance	C_{IN}		—			—	10	pF

Note 1: Parameter guaranteed by design. (t_{osLH} = $|t_{PLH}m - t_{PLH}n|$, t_{osHL} = $|t_{PHL}m - t_{PHL}n|$)

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

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time	t_{PLH},t_{PHL}		—	3.3 ± 0.3	15	1.0	11.0	ns
					50	1.0	14.5	
				5.0 ± 0.5	15	1.0	7.5	
					50	1.0	9.5	
3-state output enable time	t_{PZL},t_{PZH}		R_L = 1 kΩ	3.3 ± 0.3	15	1.0	11.0	ns
					50	1.0	14.5	
				5.0 ± 0.5	15	1.0	7.0	
					50	1.0	9.0	
3-state output disable time	t_{PLZ},t_{PHZ}		R_L = 1 kΩ	3.3 ± 0.3	50	1.0	16.5	ns
				5.0 ± 0.5	50	1.0	11.0	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	3.3 ± 0.3	50	—	1.5	ns
				5.0 ± 0.5	50	—	1.0	
Input capacitance	C_{IN}		—			—	10	pF

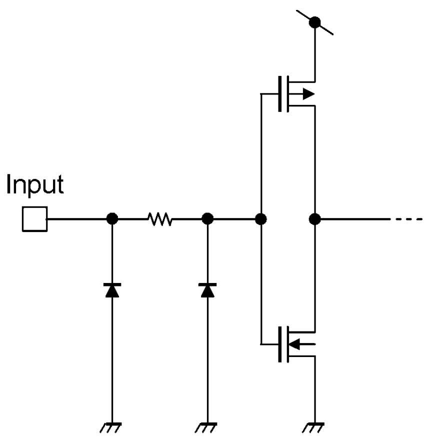
Note: For devices with the ordering part number ending in J(CT.

Note 1: Parameter guaranteed by design. (t_{osLH} = |t_{PLHm}-t_{PLHn}|, t_{osHL} = |t_{PHLm}-t_{PHLn}|)

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

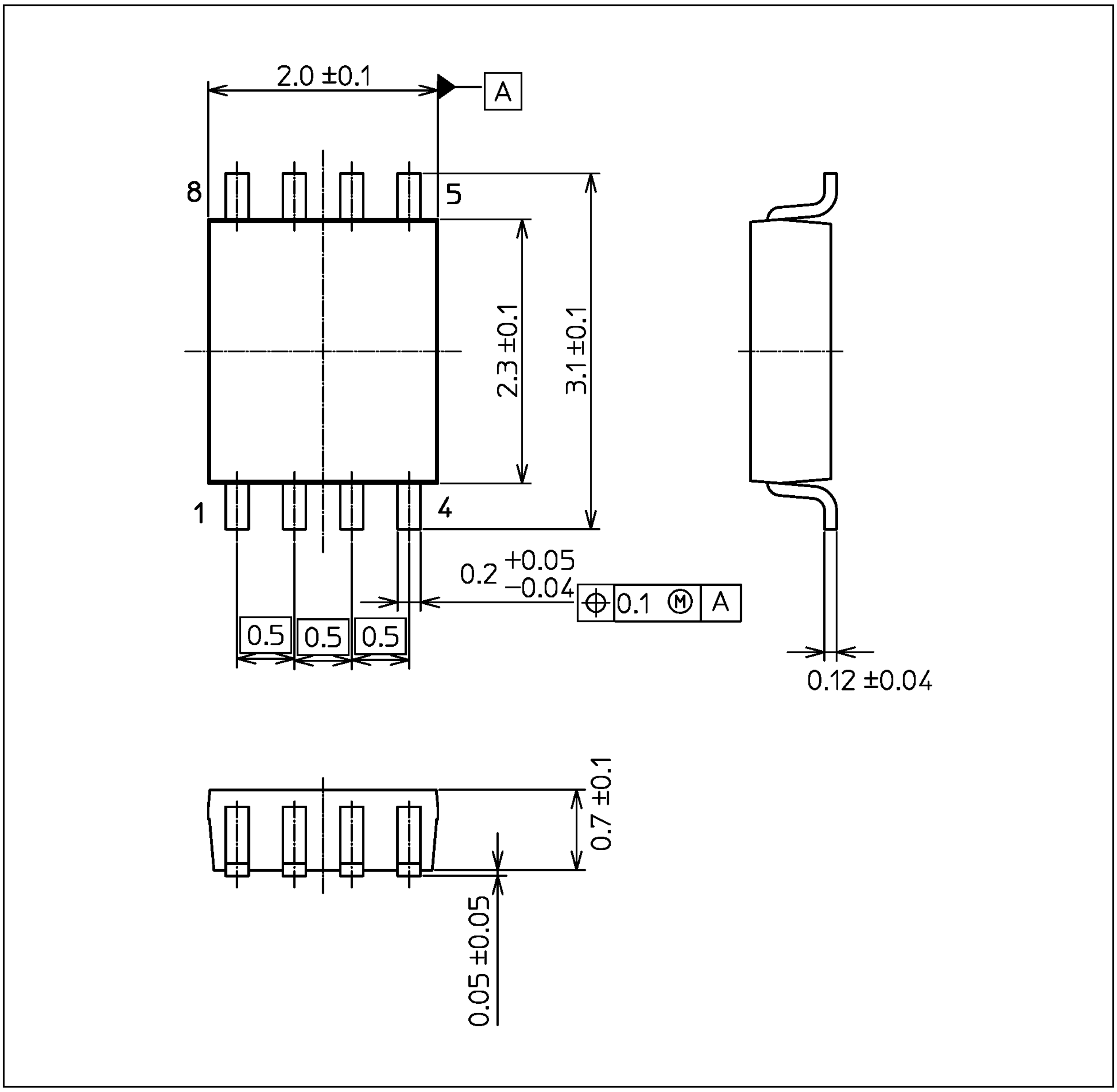
Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Limit	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	C_L = 50 pF	5.0	0.3	0.8	V
Quiet output minimum dynamic V_{OL}	V_{OLV}	C_L = 50 pF	5.0	-0.3	-0.8	V
Minimum high-level dynamic input voltage	V_{IHD}	C_L = 50 pF	5.0	—	3.5	V
Maximum low-level dynamic input voltage	V_{ILD}	C_L = 50 pF	5.0	—	1.5	V

10. Input Equivalent Circuit



Package Dimensions

Unit: mm



Weight: 0.01 g (typ.)

Package Name(s)
JEDEC: SOT-765
Nickname: US8

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