CMOS Digital Integrated Circuits Silicon Monolithic

TC7WHU04FK

1. Functional Description

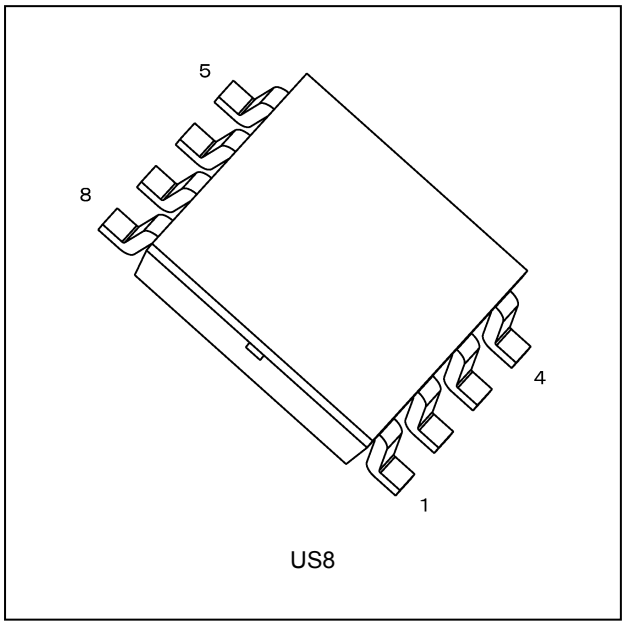
- Triple Inverter (Unbuffer)

2. Features

(1) AEC-Q100 (Rev. H) (Note 1)
(2) Wide operating temperature range: T_{opr} = -40 to 125 °C (Note 2)
(3) High speed operation: t_{pd} = 3.5 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} = 10 % 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) Identical pin assignment and function with TC7WU04

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.

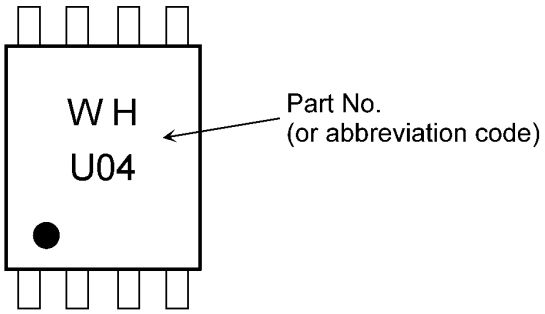
3. Packaging



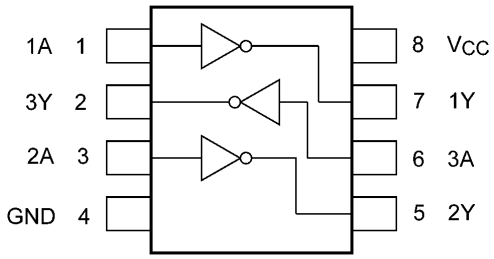
US8

Start of commercial production
1998-03

4. Marking and Pin Assignment



Marking



Pin Assignment (Top view)

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 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	

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	1.7	—	—	V
				3.0 to 5.5	V_{CC} × 0.8	—	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.3	V
				3.0 to 5.5	—	—	V_{CC} × 0.2	
High-level output voltage	V_{OH}	V_{IN} = V_{IL}	I_{OH} = -50 μA	2.0	1.8	2.0	—	V
				3.0	2.7	3.0	—	
				4.5	4.0	4.5	—	
		V_{IN} = GND	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}	I_{OL} = 50 μA	2.0	—	0.0	0.2	V
				3.0	—	0.0	0.3	
				4.5	—	0.0	0.5	
		V_{IN} = V_{CC}	I_{OL} = 4 mA	3.0	—	—	0.36	
			I_{OL} = 8 mA	4.5	—	—	0.36	
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	1.7	—	V
				3.0 to 5.5	V_{CC} × 0.8	—	
Low-level input voltage	V_{IL}	—		2.0	—	0.3	V
				3.0 to 5.5	—	V_{CC} × 0.2	
High-level output voltage	V_{OH}	V_{IN} = V_{IL}	I_{OH} = -50 μA	2.0	1.8	—	V
				3.0	2.7	—	
				4.5	4.0	—	
		V_{IN} = GND	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}	I_{OL} = 50 μA	2.0	—	0.2	V
				3.0	—	0.3	
				4.5	—	0.5	
		V_{IN} = V_{CC}	I_{OL} = 4 mA	3.0	—	0.44	
			I_{OL} = 8 mA	4.5	—	0.44	
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	1.7	—	V
				3.0 to 5.5	V_{CC} × 0.8	—	
Low-level input voltage	V_{IL}	—		2.0	—	0.3	V
				3.0 to 5.5	—	V_{CC} × 0.2	
High-level output voltage	V_{OH}	V_{IN} = V_{IL}	I_{OH} = -50 μA	2.0	1.8	—	V
				3.0	2.7	—	
				4.5	4.0	—	
		V_{IN} = GND	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}	I_{OL} = 50 μA	2.0	—	0.2	V
				3.0	—	0.3	
				4.5	—	0.5	
		V_{IN} = V_{CC}	I_{OL} = 4 mA	3.0	—	0.55	
			I_{OL} = 8 mA	4.5	—	0.55	
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	—	5.0	8.9	ns
					50	—	7.5	11.4	
				5.0 ± 0.5	15	—	3.5	5.5	
					50	—	5.0	7.0	
Input capacitance	C_{IN}		—			—	5	10	pF
Power dissipation capacitance	C_{PD}	(Note 1)	—			—	11	—	pF

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.

$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/3$ (per 1 gate)

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}	—	3.3 ± 0.3	15	1.0	10.5	ns
				50	1.0	13.0	
			5.0 ± 0.5	15	1.0	6.5	
				50	1.0	8.0	
Input capacitance	C_{IN}	—			—	10	pF

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

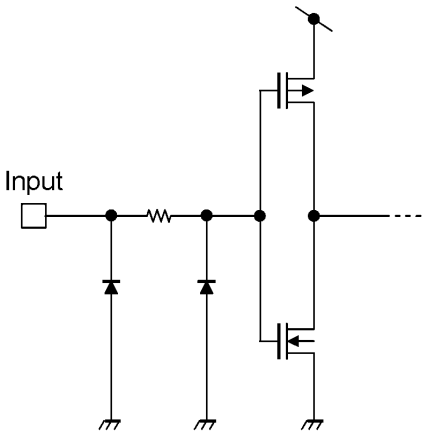
Characteristics	Symbol	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time	t_{PLH},t_{PHL}	—	3.3 ± 0.3	15	1.0	11.0	ns
				50	1.0	14.5	
			5.0 ± 0.5	15	1.0	7.0	
				50	1.0	9.0	
Input capacitance	C_{IN}	—			—	10	pF

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

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

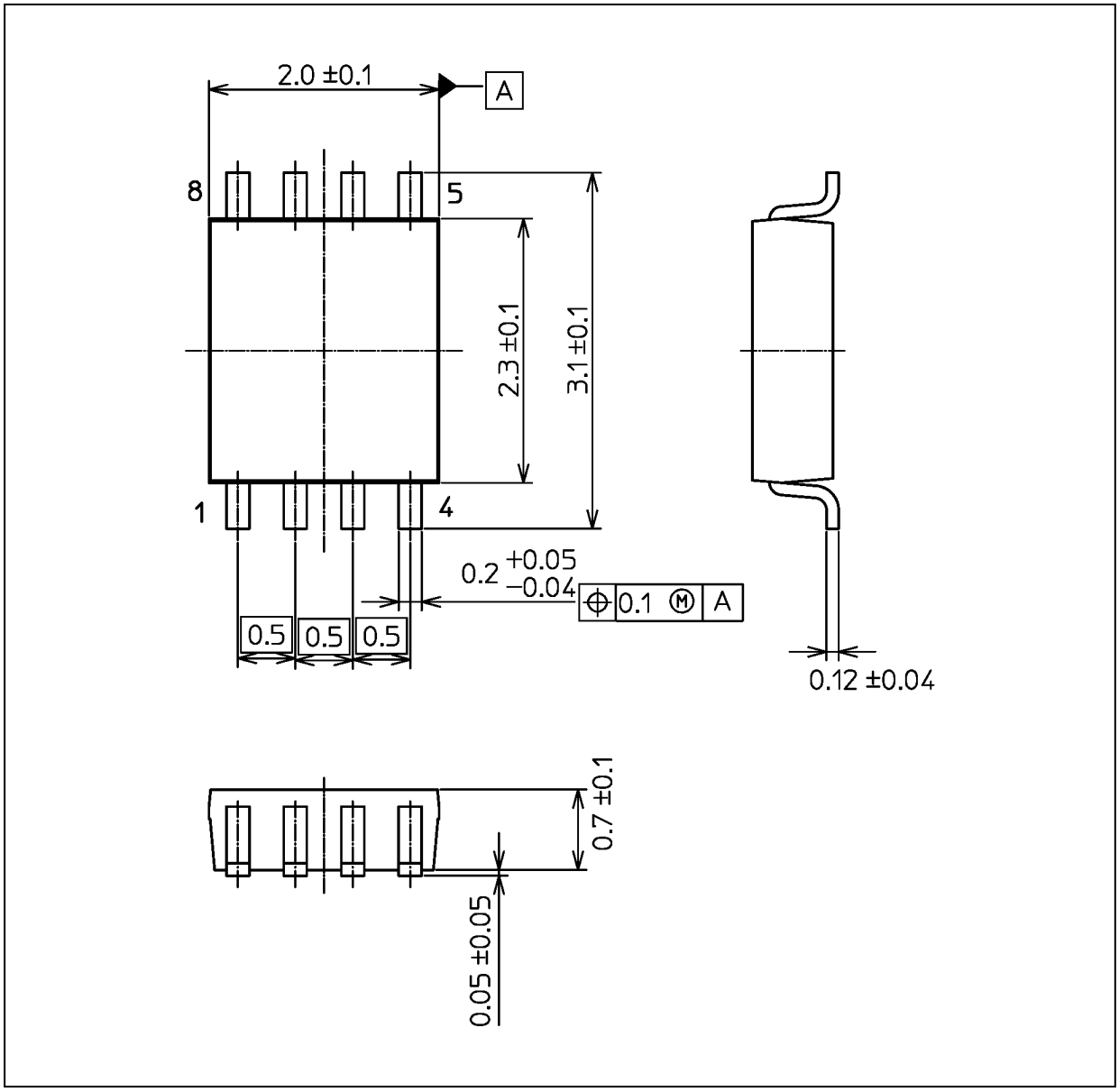
Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Limit	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	C_L = 50 pF	5.0	0.3	0.8	V
Quiet output minimum dynamic V_{OL}	V_{OLV}	C_L = 50 pF	5.0	-0.3	-0.8	V
Minimum high-level dynamic input voltage	V_{IHD}	C_L = 50 pF	5.0	—	4.0	V
Maximum low-level dynamic input voltage	V_{ILD}	C_L = 50 pF	5.0	—	1.0	V

9.8. Input Equivalent Circuit



Package Dimensions

Unit: mm



Weight: 0.01 g (typ.)

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

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