

CMOS Digital Integrated Circuits Silicon Monolithic

## **7UL2G126FK**

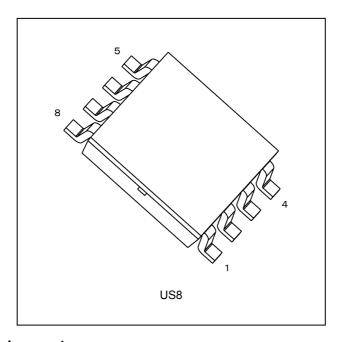
#### 1. Functional Description

• Dual Bus Buffer with 3-State Output

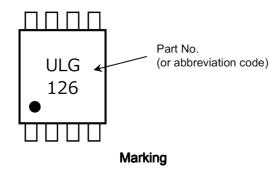
## 2. Features

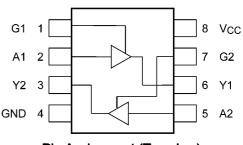
- (1) High output current:  $\pm 8.0$  mA (min) at  $V_{CC} = 3.0$  V
- (2) Super high speed operation:  $t_{pd} = 2.9 \text{ ns}$  (typ.) at  $V_{CC} = 3.3 \text{ V}$ ,  $C_L = 15 \text{ pF}$
- (3) Operation voltage range:  $V_{CC} = 0.9 \text{ to } 3.6 \text{ V}$
- (4) 3.6 V tolerant inputs
- (5) 3.6 V power down protection output

#### 3. Packaging



## 4. Marking and Pin Assignment





Pin Assignment (Top view)

Start of commercial production

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### 5. IEC Logic Symbol



#### 6. Truth Table

G	А	Y
L	X	Z
Н	L	L
Н	Н	Н

X: Don't care

Z: High impedance

## 7. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25 \,^{\circ}\text{C}$ )

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V <sub>CC</sub>		-0.5 to 4.6	V
Input voltage	V <sub>IN</sub>		-0.5 to 4.6	V
DC output voltage	V <sub>OUT</sub>	(Note 1)	-0.5 to 4.6	V
		(Note 2)	-0.5 to V <sub>CC</sub> + 0.5	
Input diode current	I <sub>IK</sub>		-20	mA
Output diode current	l <sub>ok</sub>	(Note 3)	-20	mA
DC output current	I <sub>OUT</sub>		±25	mA
V <sub>CC</sub> /ground current	I <sub>CC</sub>		±50	mA
Power dissipation	P <sub>D</sub>		200	mW
Storage temperature	T <sub>stg</sub>		-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<sub>CC</sub> = 0 V or high impedance condition

Note 2: High (H) or Low (L) state.  $I_{\text{OUT}}$  absolute maximum rating must be observed.

Note 3: V<sub>OUT</sub> < GND



## 8. Operating Ranges (Note)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Supply voltage	V <sub>CC</sub>		_	0.9 to 3.6	V
Input voltage	V <sub>IN</sub>		_	0 to 3.6	V
Output voltage	V <sub>OUT</sub>	(Note 1)	_	0 to 3.6	V
		(Note 2)	_	0 to V <sub>CC</sub>	
Output current	I <sub>OH</sub> ,I <sub>OL</sub>		V <sub>CC</sub> = 3.0 to 3.6 V	±8.0	mA
			V <sub>CC</sub> = 2.3 to 2.7 V	±4.0	
			V <sub>CC</sub> = 1.65 to 1.95 V	±3.0	
			V <sub>CC</sub> = 1.4 to 1.6 V	±1.7	
			V <sub>CC</sub> = 1.1 to 1.3 V	±0.3	
			V <sub>CC</sub> = 0.9 V	±0.02	
Operating temperature	T <sub>opr</sub>		_	-40 to 85	°C
Input rise and fall time	dt/dv		V <sub>IN</sub> = 0.8 to 2.0 V, V <sub>CC</sub> = 3.0 V	0 to 10	ns/V

Note: The operating ranges must be maintained to ensure the normal operation of the device.

Unused inputs must be tied to either  $V_{\mbox{\footnotesize CC}}$  or GND.

Note 1: V<sub>CC</sub> = 0 V or high impedance condition

Note 2: High (H) or Low (L) state.



## 9. Electrical Characteristics

## 9.1. DC Characteristics (Unless otherwise specified, T<sub>a</sub> = 25 °C)

Characteristics	Symbol	Test Condition		V <sub>CC</sub> (V)	Min	Тур.	Max	Unit
High-level input voltage	V <sub>IH</sub>	_		0.9	$V_{CC}$	_	_	V
				1.1 to 1.3	V <sub>CC</sub> × 0.70	_	_	
				1.4 to 1.6	V <sub>CC</sub> × 0.65	_	_	
				1.65 to 1.95	V <sub>CC</sub> × 0.65	_	_	
				2.3 to 2.7	1.7	_	_	
				3.0 to 3.6	2.0	_	_	
Low-level input voltage	V <sub>IL</sub>	_		0.9	_	_	GND	V
				1.1 to 1.3	_	_	$V_{CC} \times 0.30$	
				1.4 to 1.6	_		$V_{CC} \times 0.35$	
				1.65 to 1.95	_	_	$V_{CC} \times 0.35$	
				2.3 to 2.7	_	_	0.7	
				3.0 to 3.6	_	_	0.8	
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OH</sub> = -0.02 mA	0.9	0.75	_	_	V
			I <sub>OH</sub> = -0.3 mA	1.1 to 1.3	V <sub>CC</sub> × 0.75	_	_	
			I <sub>OH</sub> = -1.7 mA	1.4 to 1.6	V <sub>CC</sub> × 0.75	_	_	
			I <sub>OH</sub> = -3.0 mA	1.65 to 1.95	V <sub>CC</sub> -0.45	_	_	
			I <sub>OH</sub> = -4.0 mA	2.3 to 2.7	2.0	_	_	
			I <sub>OH</sub> = -8.0 mA	3.0 to 3.6	2.48	_	_	
Low-level output voltage	V <sub>OL</sub>	$V_{IN} = V_{IH}$ or $V_{IL}$	I <sub>OL</sub> = 0.02 mA	0.9	_	_	0.1	V
			$I_{OL}$ = 0.3 mA	1.1 to 1.3	_		$V_{CC} \times 0.25$	
			I <sub>OL</sub> = 1.7 mA	1.4 to 1.6	_	_	$V_{CC} \times 0.25$	
			$I_{OL}$ = 3.0 mA	1.65 to 1.95	_	ı	0.45	
			$I_{OL}$ = 4.0 mA	2.3 to 2.7	_		0.4	
			I <sub>OL</sub> = 8.0 mA	3.0 to 3.6	_	_	0.4	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 0 to 3.6 V		0 to 3.6	_	_	±0.1	μΑ
3-state output OFF-state leakage current	l <sub>OZ</sub>	$V_{IN} = V_{IH} \text{ or } V_{IL},$ $V_{OUT} = 0 \text{ to } 3.6 \text{ V}$		0.9 to 3.6	_	l	±1.0	μА
Power-OFF leakage current	I <sub>OFF</sub>	V <sub>IN</sub> = 0 to 3.6 V, V <sub>OUT</sub> = 0 to 3.6 V		0	_	_	1.0	μА
Quiescent supply current	I <sub>CC</sub>	$V_{IN} = V_{CC}$ or GND		3.6	_	_	1.0	μА



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

Characteristics	Symbol	Test Condition	on	V <sub>CC</sub> (V)	Min	Max	Unit
High-level input voltage	V <sub>IH</sub>	_		0.9	V <sub>CC</sub>	_	V
				1.1 to 1.3	V <sub>CC</sub> × 0.70	_	
				1.4 to 1.6	V <sub>CC</sub> × 0.65	_	
				1.65 to 1.95	V <sub>CC</sub> × 0.65	_	
				2.3 to 2.7	1.7	_	
				3.0 to 3.6	2.0	_	
Low-level input voltage	V <sub>IL</sub>	_		0.9	_	GND	V
				1.1 to 1.3	_	$V_{CC} \times 0.30$	
				1.4 to 1.6	_	$V_{CC} \times 0.35$	
				1.65 to 1.95	_	$V_{CC} \times 0.35$	
				2.3 to 2.7	_	0.7	
				3.0 to 3.6	_	0.8	
High-level output voltage	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub>	I <sub>OH</sub> = -0.02 mA	0.9	0.75	_	V
			I <sub>OH</sub> = -0.3 mA	1.1 to 1.3	V <sub>CC</sub> × 0.75	_	
			I <sub>OH</sub> = -1.7 mA	1.4 to 1.6	V <sub>CC</sub> × 0.75	_	
			$I_{OH}$ = -3.0 mA	1.65 to 1.95	V <sub>CC</sub> -0.45	_	
			$I_{OH}$ = -4.0 mA	2.3 to 2.7	2.0	_	
			$I_{OH} = -8.0 \text{ mA}$	3.0 to 3.6	2.48	_	
Low-level output voltage	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	$I_{OL} = 0.02 \text{ mA}$	0.9	_	0.1	V
			$I_{OL}$ = 0.3 mA	1.1 to 1.3	_	$V_{CC} \times 0.25$	
			$I_{OL}$ = 1.7 mA	1.4 to 1.6	_	$V_{CC} \times 0.25$	
			$I_{OL}$ = 3.0 mA	1.65 to 1.95	_	0.45	
			$I_{OL}$ = 4.0 mA	2.3 to 2.7	_	0.4	
			$I_{OL}$ = 8.0 mA	3.0 to 3.6	_	0.4	
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 0 to 3.6 V		0 to 3.6	_	±0.5	μΑ
3-state output OFF-state leakage current	I <sub>OZ</sub>	$V_{IN} = V_{IH} \text{ or } V_{IL},$ $V_{OUT} = 0 \text{ to } 3.6 \text{ V}$		0.9 to 3.6	_	±10.0	μА
Power-OFF leakage current	I <sub>OFF</sub>	V <sub>IN</sub> = 0 to 3.6 V, V <sub>OUT</sub> = 0 to 3.6 V		0	_	10.0	μА
Quiescent supply current	I <sub>CC</sub>	$V_{IN} = V_{CC}$ or GND		3.6	_	10.0	μΑ



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

Characteristics	Symbol	Note	Test Condition	V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Тур.	Max	Unit
Propagation delay time	t <sub>PLH</sub> ,t <sub>PHL</sub>		$R_L = 1 M\Omega$	0.9	10	_	20.7	_	ns
				1.1 to 1.3		_	10.5	18.4	
				1.4 to 1.6		_	6.1	8.5	
				1.65 to 1.95	1 1	_	4.5	6.2	
				2.3 to 2.7		_	3.0	3.9	
				3.0 to 3.6		_	2.3	3.1	
			$R_L = 1 M\Omega$	0.9	15	_	24.5	_	
				1.1 to 1.3		_	12.7	21.5	
				1.4 to 1.6		_	7.3	10.1	
				1.65 to 1.95		_	5.4	7.3	
				2.3 to 2.7		_	3.5	4.5	
				3.0 to 3.6		_	2.9	3.6	
			R <sub>L</sub> = 1 MΩ	0.9	30	_	31.8	_	
				1.1 to 1.3		_	16.3	29.6	
				1.4 to 1.6		_	9.2	13.1	
				1.65 to 1.95		_	6.9	9.3	
				2.3 to 2.7		_	4.7	6.4	
				3.0 to 3.6		_	3.8	4.9	
Output enable time	$t_{PZL},t_{PZH}$		R <sub>L</sub> = 100 kΩ	0.9	10	_	23.9	_	ns
			$R_L = 5 k\Omega$	1.1 to 1.3		_	11.5	20.3	
				1.4 to 1.6		_	6.2	9.5	
				1.65 to 1.95		_	5.1	7.3	
				2.3 to 2.7		_	3.4	4.6	
				3.0 to 3.6		_	2.9	4.0	
			R <sub>L</sub> = 100 kΩ	0.9	15	_	25.2	_	
			R <sub>L</sub> = 5 kΩ	1.1 to 1.3		_	12.6	21.3	
				1.4 to 1.6		_	7.3	10.5	
				1.65 to 1.95		_	5.5	7.7	
				2.3 to 2.7		_	4.1	5.1	
				3.0 to 3.6		_	3.1	3.9	
			R <sub>L</sub> = 100 kΩ	0.9	30	_	31.0	_	
			$R_L = 5 \text{ k}\Omega$	1.1 to 1.3		_	16.1	30.7	
				1.4 to 1.6		_	9.2	13.1	
				1.65 to 1.95		_	8.7	11.6	
				2.3 to 2.7		_	4.8	6.0	
				3.0 to 3.6	] [	_	3.9	4.7	
Output disable time	$t_{PLZ},t_{PHZ}$		R <sub>L</sub> = 100 kΩ	0.9	10	_	123.5	_	ns
			$R_L = 5 \text{ k}\Omega$	1.1 to 1.3		_	10.6	16.0	
				1.4 to 1.6		_	6.3	9.1	
				1.65 to 1.95		_	7.3	8.8	
				2.3 to 2.7		_	5.1	6.4	
				3.0 to 3.6		_	5.8	7.9	
			R <sub>L</sub> = 100 kΩ	0.9	15	_	172.0	_	
			$R_L = 5 \text{ k}\Omega$	1.1 to 1.3	] [	_	12.2	16.9	
				1.4 to 1.6		_	7.5	9.8	
				1.65 to 1.95	] [	_	8.3	9.9	
				2.3 to 2.7	[	_	6.0	9.4	
				3.0 to 3.6		_	7.1	9.5	

2020-04-14



Characteristics	Symbol	Note	Test Condition	V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Тур.	Max	Unit
Output disable time	$t_{PLZ}, t_{PHZ}$		$R_L$ = 100 k $\Omega$	0.9	30	_	266.7	_	ns
			$R_L = 5 k\Omega$	1.1 to 1.3		_	16.9	20.8	
				1.4 to 1.6		_	10.1	13.2	
				1.65 to 1.95		-	12.7	14.6	
				2.3 to 2.7		_	8.6	10.8	
				3.0 to 3.6		-	12.2	14.4	
Input capacitance	C <sub>IN</sub>		_	3.6	_	_	3	_	pF
Power dissipation capacitance	C <sub>PD</sub>	(Note 1)	_	0.9 to 3.6	_	_	9	_	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.  $I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$ 

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

Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Max	Unit
Propagation delay time	t <sub>PLH</sub> ,t <sub>PHL</sub>	$R_L = 1 M\Omega$	0.9	10	-	_	ns
			1.1 to 1.3		1.0	34.2	
			1.4 to 1.6		1.0	10.0	
			1.65 to 1.95		1.0	6.8	
			2.3 to 2.7		1.0	4.7	
			3.0 to 3.6		1.0	3.9	
		$R_L = 1 M\Omega$	0.9	15	_	_	
			1.1 to 1.3		1.0	37.2	
			1.4 to 1.6		1.0	11.2	
			1.65 to 1.95		1.0	8.6	
			2.3 to 2.7	]	1.0	5.8	
			3.0 to 3.6		1.0	4.8	
		$R_L = 1 M\Omega$	0.9	30	_	_	
			1.1 to 1.3		1.0	56.0	
			1.4 to 1.6		1.0	15.9	
			1.65 to 1.95		1.0	10.6	
			2.3 to 2.7		1.0	7.3	
			3.0 to 3.6		1.0	5.9	
Output enable time	t <sub>PZL</sub> ,t <sub>PZH</sub>	R <sub>L</sub> = 100 kΩ	0.9	10	-	_	ns
		$R_L = 5 k\Omega$	1.1 to 1.3		1.0	29.8	
			1.4 to 1.6		1.0	11.3	
			1.65 to 1.95		1.0	8.3	
			2.3 to 2.7		1.0	5.6	
			3.0 to 3.6		1.0	4.7	
		R <sub>L</sub> = 100 kΩ	0.9	15	_	_	
		$R_L = 5 k\Omega$	1.1 to 1.3		1.0	34.7	
			1.4 to 1.6		1.0	11.4	
			1.65 to 1.95	]	1.0	8.9	
			2.3 to 2.7	]	1.0	6.8	
			3.0 to 3.6		1.0	4.9	
		R <sub>L</sub> = 100 kΩ	0.9	30	_	_	
		$R_L = 5 \text{ k}\Omega$	1.1 to 1.3	]	1.0	50.5	
			1.4 to 1.6	]	1.0	15.1	
			1.65 to 1.95	]	1.0	13.8	
			•	•			

2020-04-14



Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Max	Unit
Output enable time	t <sub>PZL</sub> ,t <sub>PZH</sub>	$R_L = 5 k\Omega$	2.3 to 2.7	30	1.0	7.6	ns
			3.0 to 3.6	]	1.0	6.1	
Output disable time	t <sub>PLZ</sub> ,t <sub>PHZ</sub>	R <sub>L</sub> = 100 kΩ	0.9	10		_	ns
		$R_L = 5 k\Omega$	1.1 to 1.3		1.0	22.4	
			1.4 to 1.6		1.0	10.4	
			1.65 to 1.95		1.0	9.8	
			2.3 to 2.7		1.0	7.2	
			3.0 to 3.6	]	1.0	9.3	
		R <sub>L</sub> = 100 kΩ	0.9	15	_	_	
		$R_L = 5 k\Omega$	1.1 to 1.3		1.0	25.1	
			1.4 to 1.6		1.0	11.3	
			1.65 to 1.95		1.0	11.1	
			2.3 to 2.7		1.0	12.4	
			3.0 to 3.6	]	1.0	13.2	
		R <sub>L</sub> = 100 kΩ	0.9	30	-	_	
		$R_L = 5 k\Omega$	1.1 to 1.3		1.0	31.9	
			1.4 to 1.6	1	1.0	14.9	1 I
			1.65 to 1.95	1	1.0	16.6	1 I
			2.3 to 2.7	1	1.0	12.2	1 I
			3.0 to 3.6	]	1.0	16.4	1 <b>I</b>

## 9.5. AC Test Circuit

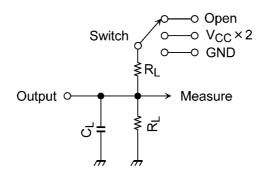
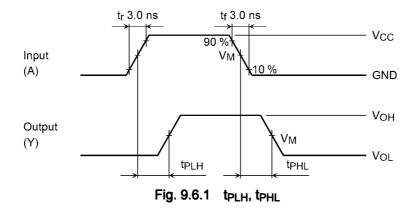


Table 9.5.1 Parameter for AC Test Circuit

Characteristics	Switch
t <sub>PLH</sub> , t <sub>PHL</sub>	Open
t <sub>PLZ</sub> , t <sub>PZL</sub>	V <sub>CC</sub> × 2
t <sub>PHZ</sub> , t <sub>PZH</sub>	GND



## 9.6. AC Waveform



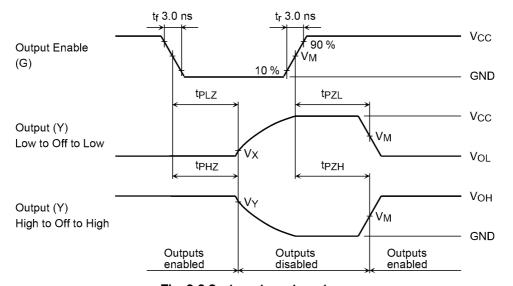


Fig. 9.6.2 t<sub>PLZ</sub>, t<sub>PHZ</sub>, t<sub>PZL</sub>, t<sub>PZH</sub>

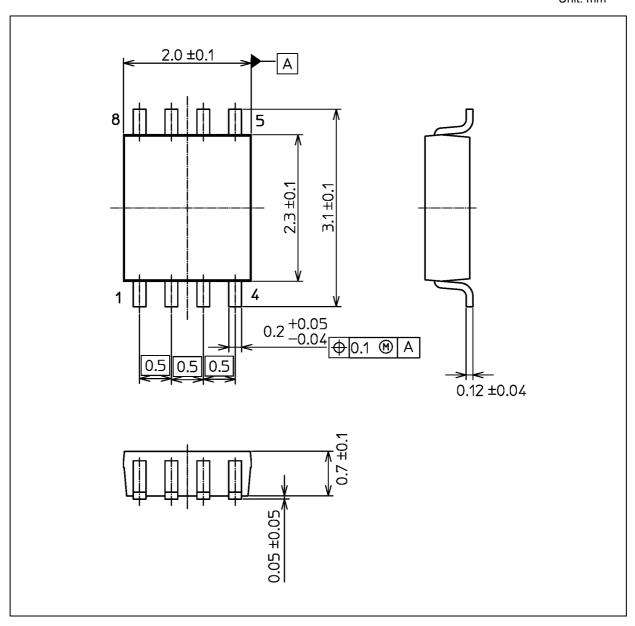
Table 9.6.1 AC Waveform Symbols

Symbol	V <sub>CC</sub> = 3.3 ± 0.3 V	V <sub>CC</sub> = 2.5 ± 0.2 V	V <sub>CC</sub> = 1.8 ± 0.15 V	V <sub>CC</sub> = 1.5 ± 0.1 V	V <sub>CC</sub> = 1.2 ± 0.1 V	V <sub>CC</sub> = 0.9 V
$V_{M}$	V <sub>CC</sub> /2	V <sub>CC</sub> /2	V <sub>CC</sub> /2	V <sub>CC</sub> /2	V <sub>CC</sub> /2	V <sub>CC</sub> /2
$V_X$	V <sub>OL</sub> + 0.3 V	V <sub>OL</sub> + 0.15 V	V <sub>OL</sub> + 0.15 V	V <sub>OL</sub> + 0.1 V	V <sub>OL</sub> + 0.1 V	V <sub>OL</sub> + 0.1 V
$V_{Y}$	V <sub>OH</sub> - 0.3 V	V <sub>OH</sub> - 0.15 V	V <sub>OH</sub> - 0.15 V	V <sub>OH</sub> - 0.1 V	V <sub>OH</sub> - 0.1 V	V <sub>OH</sub> - 0.1 V



## **Package Dimensions**

Unit: mm



Weight: 0.01 g (typ.)

	Package Name(s)	
Nickname: US8		



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