

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC7MET574AFK

### Octal D-Type Flip-Flop with 3-State Output

The TC7MET574AFK is an advanced high speed CMOS octal flip-flop with 3-state output fabricated with silicon gate C<sup>2</sup>MOS technology.

It achieves the high speed operation similar to equivalent bipolar schottky TTL while maintaining the CMOS low power dissipation.

This 8-bit D-type flip-flop is controlled by a clock input (CK) and a output enable input ( $\overline{OE}$ ).

When the  $\overline{OE}$  input is high, the eight outputs are in a high impedance state.

The input voltage are compatible with TTL output voltage.

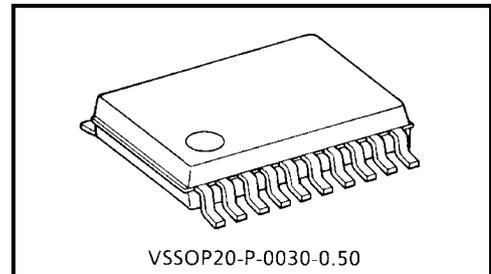
This device may be used as a level converter for interfacing 3.3 V to 5 V system.

Input protection and output circuit ensure that 0 to 5.5 V can be applied to the input and output (\*) pins without regard to the supply voltage. These structure prevents device destruction due to mismatched supply and input/output voltages such as battery back up, hot board insertion, etc.

\*: output in off state

### Features

- High speed:  $f_{max} = 140$  MHz (typ.) ( $V_{CC} = 5$  V)
- Low power dissipation:  $I_{CC} = 4$   $\mu$ A (max) ( $T_a = 25^\circ$ C)
- Compatible with TTL outputs:  $V_{IL} = 0.8$  V (max)  
 $V_{IH} = 2.0$  V (min)
- Power down protection is provided on all inputs and outputs.
- Balanced propagation delays:  $t_{pLH} = t_{pHL}$
- Low noise:  $V_{OLP} = 1.5$  V (max)
- Pin and function compatible with the 74 series (74AC/HC/F/ALS/LS etc.) 574 type.

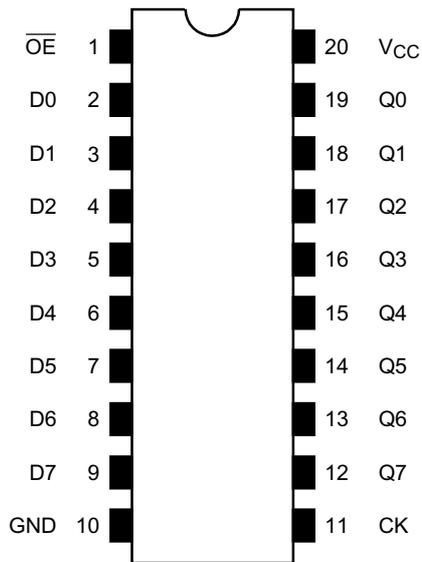


Weight: 0.016 g (typ.)

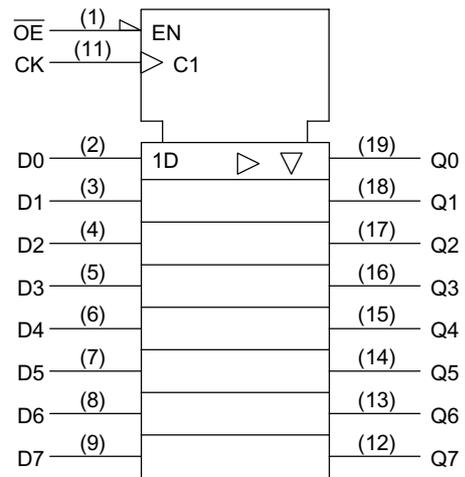
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## Pin Assignment (top view)



## IEC Logic Symbol



## Truth Table

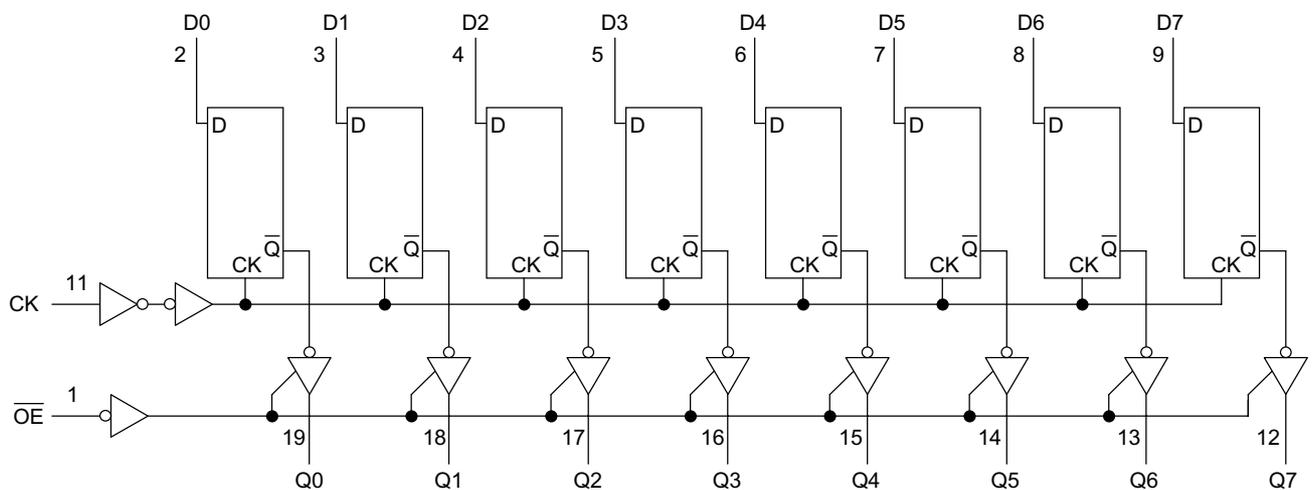
Inputs			Outputs
$\overline{OE}$	CK	D	
H	X	X	Z
L		X	$Q_n$
L		L	L
L		H	H

X: Don't care

Z: High impedance

$Q_n$ : No change

## System Diagram



## Maximum Ratings

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5~7.0	V
DC input voltage	$V_{IN}$	-0.5~7.0	V
DC output voltage	$V_{OUT}$	-0.5~7.0 (Note1)	V
		-0.5~ $V_{CC} + 0.5$ (Note2)	
Input diode current	$I_{IK}$	-20	mA
Output diode current	$I_{OK}$	$\pm 20$ (Note3)	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 75$	mA
Power dissipation	$P_D$	180	mW
Storage temperature	$T_{stg}$	-65~150	$^{\circ}C$

Note1: Output is off-state

Note2: High or low state.  $I_{OUT}$  absolute maximum rating must be observed.

Note3:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

## Recommended Operating Conditions

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	4.5~5.5	V
Input voltage	$V_{IN}$	0~5.5	V
Output voltage	$V_{OUT}$	0~5.5 (Note4)	V
		0~ $V_{CC}$ (Note5)	
Operating temperature	$T_{opr}$	-40~85	$^{\circ}C$
Input rise and fall time	dt/dv	0~20	ns/V

Note4: Output in off state

Note5: High or low state

## Electrical Characteristics

### DC Characteristics

Characteristics		Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit		
				V <sub>CC</sub> (V)	Min	Typ.	Max	Min		Max	
Input voltage	High level	V <sub>IH</sub>	—	4.5~5.5	2.0	—	—	2.0	—	V	
	Low level	V <sub>IL</sub>	—	4.5~5.5	—	—	0.8	—	0.8		
Output voltage	High level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50 μA	4.5	4.4	4.5	—	4.4	—	V
				I <sub>OH</sub> = -8 mA	4.5	3.94	—	—	3.80	—	
	Low level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50 μA	4.5	—	0	0.1	—	0.1	
				I <sub>OL</sub> = 8 mA	4.5	—	—	0.36	—	0.44	
3-state output off-state current	I <sub>OZ</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = V <sub>CC</sub> or GND	5.5	—	—	±0.25	—	±2.50	μA		
Input leakage current	I <sub>IN</sub>	V <sub>IN</sub> = 5.5 V or GND	0~5.5	—	—	±0.1	—	±1.0	μA		
Quiescent supply current	I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	5.5	—	—	4.0	—	40.0	μA		
	I <sub>CCCT</sub>	Per input: V <sub>IN</sub> = 3.4 V Other input: V <sub>CC</sub> or GND	5.5	—	—	1.35	—	1.50	mA		
Output leakage current	I <sub>OPD</sub>	V <sub>OUT</sub> = 5.5 V	0	—	—	0.5	—	5.0	μA		

### Timing Requirements (Input: t<sub>r</sub> = t<sub>f</sub> = 3 ns)

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40~85°C		Unit
			V <sub>CC</sub> (V)	Typ.	Limit	Limit	
Minimum pulse width (CK)	t <sub>w</sub> (H) t <sub>w</sub> (L)	—	5.0 ± 0.5	—	6.5	8.5	ns
Minimum set-up time	t <sub>s</sub>	—	5.0 ± 0.5	—	2.5	2.5	ns
Minimum hold time	t <sub>h</sub>	—	5.0 ± 0.5	—	2.5	2.5	ns

## AC Characteristics (Input: $t_r = t_f = 3 \text{ ns}$ )

Characteristics	Symbol	Test Condition			Ta = 25°C			Ta = -40~85°C		Unit
			V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	Min	Typ.	Max	Min	Max	
Propagation delay time (CK-Q)	$t_{pLH}$ $t_{pHL}$	—	5.0 ± 0.5	15	—	4.1	9.4	1.0	10.5	ns
				50	—	5.6	10.4	1.0	11.5	
3-state output enable time	$t_{pZL}$ $t_{pZH}$	R <sub>L</sub> = 1 kΩ	5.0 ± 0.5	15	—	6.5	10.2	1.0	11.5	ns
				50	—	7.3	11.2	1.0	12.5	
3-state output disable time	$t_{pLZ}$ $t_{pHZ}$	R <sub>L</sub> = 1 kΩ	5.0 ± 0.5	50	—	7.0	11.2	1.0	12.0	ns
Maximum clock frequency	f <sub>max</sub>	—	5.0 ± 0.5	15	90	140	—	80	—	MHz
				50	85	130	—	75	—	
Output to output skew	$t_{osLH}$ $t_{osHL}$	(Note6)	5.0 ± 0.5	50	—	—	1.0	—	1.0	ns
Input capacitance	C <sub>IN</sub>	—	—	—	—	4	10	—	10	pF
Output capacitance	C <sub>OUT</sub>	—	—	—	—	9	—	—	—	pF
Power dissipation capacitance	C <sub>PD</sub>	—	(Note7)	—	—	25	—	—	—	pF

Note6: Parameter guaranteed by design.

$$t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|$$

Note7: C<sub>PD</sub> 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:

$$I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per F/F)}$$

And the total C<sub>PD</sub> when n pcs. of latch operate can be gained by the following equation:

$$C_{PD (total)} = 14 + 11 \cdot n$$

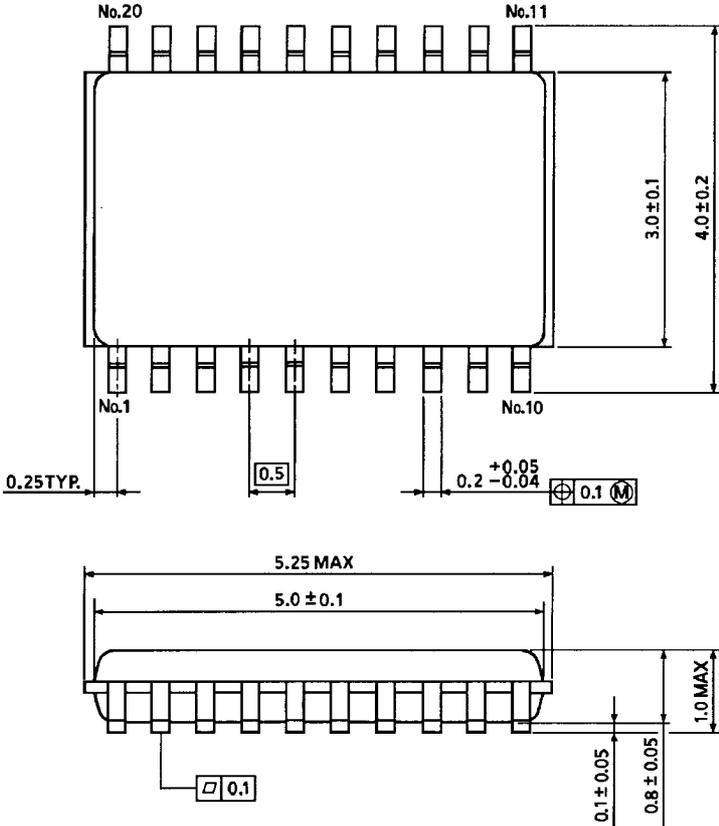
## Noise Characteristics (Input: $t_r = t_f = 3 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Ta = 25°C			Unit
			V <sub>CC</sub> (V)	Typ.	Limit	
Quiet output maximum dynamic V <sub>OL</sub>	V <sub>OLP</sub>	C <sub>L</sub> = 50 pF	5.0	1.1	1.5	V
Quiet output minimum dynamic V <sub>OL</sub>	V <sub>OLV</sub>	C <sub>L</sub> = 50 pF	5.0	-1.1	-1.5	V
Minimum high level dynamic input voltage V <sub>IH</sub>	V <sub>IHD</sub>	C <sub>L</sub> = 50 pF	5.0	—	2.0	V
Maximum low level dynamic input voltage V <sub>IL</sub>	V <sub>ILD</sub>	C <sub>L</sub> = 50 pF	5.0	—	0.8	V

Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)