

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MET374AFK

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

The TC7MET374AFK is an advanced high speed CMOS octal flip-flop with 3-state output fabricated with silicon gate C²MOS 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.

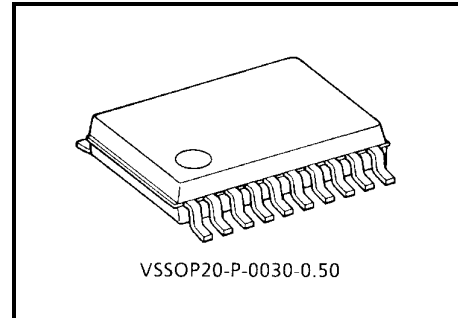
This device may be used as a level converter for interfacing 3.3 V to 5 V system.

Input protection and output circuit ensure that 0 to 5.5 V can be applied to the input and output (^{Note}) 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.

Note: $V_{CC} = 0 V$

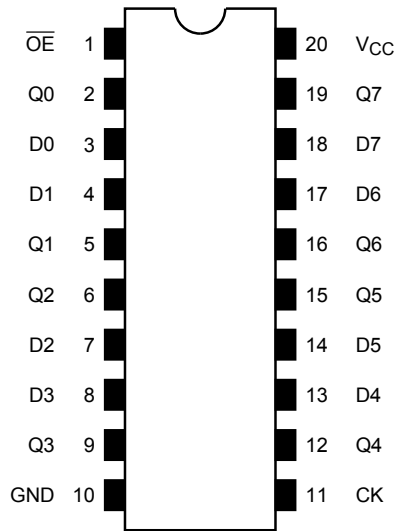
Features

- High speed: $f_{max} = 140 \text{ MHz}$ (typ.) ($V_{CC} = 5 \text{ V}$)
- Low power dissipation: $I_{CC} = 4 \mu\text{A}$ (max) ($T_a = 25^\circ\text{C}$)
- Compatible with TTL outputs: $V_{IL} = 0.8 \text{ V}$ (max)
 $V_{IH} = 2.0 \text{ V}$ (min)
- Power down protection is provided on all inputs and outputs.
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Low noise: $V_{OLP} = 1.5 \text{ V}$ (max)
- Pin and function compatible with the 74 series (74AC/HC/F/ALS/LS etc.) 374 type.

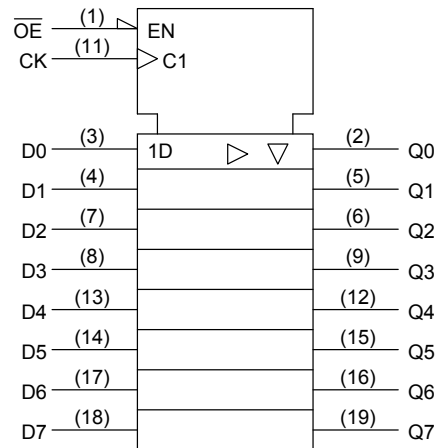


Weight: 0.03 g (typ.)

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

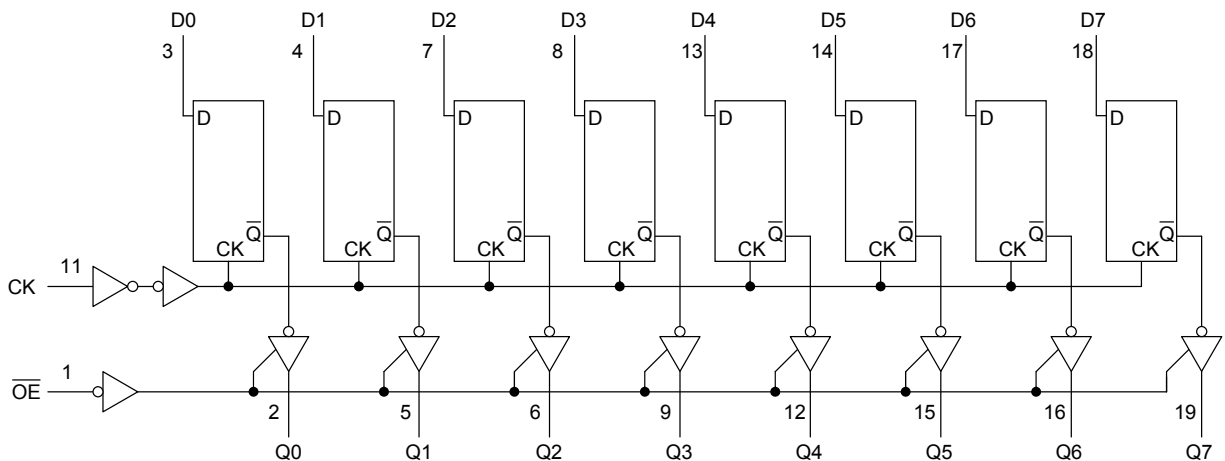
Inputs			Outputs
\overline{OE}	CK	D	
H	X	X	Z
L		X	Q_n
L		L	L
L		H	H

X: Don't care

Z: High impedance

Q_n : No change

System Diagram



Absolute Maximum Ratings (Note 1)

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 (Note 2)	V
		-0.5~ $V_{CC} + 0.5$ (Note 3)	
Input diode current	I_{IK}	-20	mA
Output diode current	I_{OK}	±20 (Note 4)	mA
DC output current	I_{OUT}	±25	mA
DC V_{CC} /ground current	I_{CC}	±75	mA
Power dissipation	P_D	180	mW
Storage temperature	T_{stg}	-65~150	°C

Note 1: 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 2: Output in off-state

Note 3: High or low state. I_{OUT} absolute maximum rating must be observed.

Note 4: $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

Operating Ranges (Note 1)

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 (Note 2)	V
		0~ V_{CC} (Note 3)	
Operating temperature	T_{opr}	-40~85	°C
Input rise and fall time	dt/dv	0~20	ns/V

Note 1: 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 2: Output in off-state

Note 3: High or low state

Electrical Characteristics

DC Characteristics

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

Timing Requirements (Input: t_r = t_f = 3 ns)

Characteristics	Symbol	Test Condition	Ta = 25°C		Ta = -40~85°C		Unit
			V _{CC} (V)	Typ.	Limit	Limit	
Minimum pulse width (CK)	t _w (H) t _w (L)	—	5.0 ± 0.5	—	6.5	8.5	ns
Minimum set-up time	t _s	—	5.0 ± 0.5	—	2.5	2.5	ns
Minimum hold time	t _h	—	5.0 ± 0.5	—	2.5	2.5	ns

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

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit		
			V _{CC} (V)	C _L (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 _L = 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} f _{max}	R _L = 1 kΩ	5.0 ± 0.5	15	—	7.0	11.2	1.0	12.0	ns
				50	90	140	—	80	—	
Maximum clock frequency	f _{max}	—	5.0 ± 0.5	50	85	130	—	75	—	MHz
Output to output skew	t _{osLH} t _{osHL}	(Note 1)	5.0 ± 0.5	50	—	—	1.0	—	1.0	ns
Input capacitance	C _{IN}	—	—	—	—	4	10	—	10	pF
Output capacitance	C _{OUT}	—	—	—	—	9	—	—	—	pF
Power dissipation capacitance	C _{PD}	—	—	(Note 2)	—	25	—	—	—	pF

Note 1: Parameter guaranteed by design.

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

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:

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

And the total C_{PD} when n pcs. of latch operate can be gained by the following equation:

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

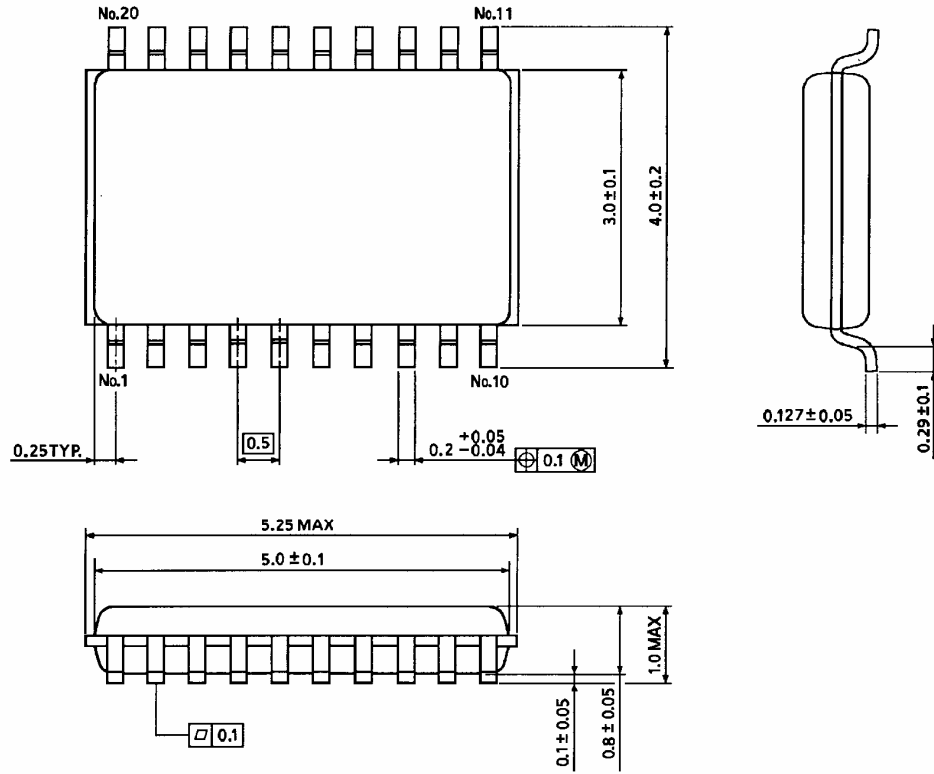
Noise Characteristics (Input: $t_r = t_f = 3 \text{ ns}$)

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

Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)

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20070701-EN GENERAL

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