

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MET373AFK

Octal D-Type Latch with 3-State Output

The TC7MET373AFK is an advanced high speed CMOS octal latch 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 latch is controlled by a latch enable input (LE) and an 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.

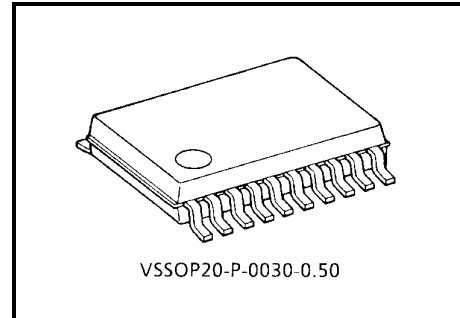
This device may be used as a level converter for interfacing 3.3 V to 5 V system.

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: $V_{CC} = 0\text{ V}$

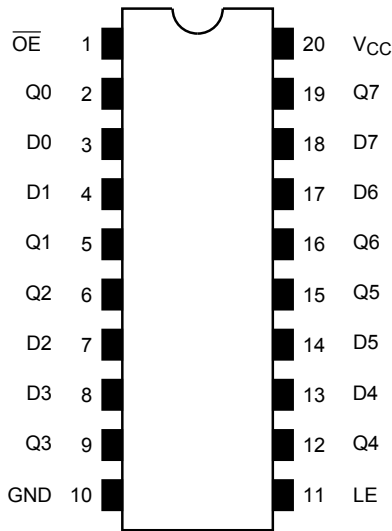
Features

- High speed: $t_{pd} = 7.7\text{ ns}$ (typ.) ($V_{CC} = 5\text{ V}$)
- Low power dissipation: $I_{CC} = 4\text{ }\mu\text{A}$ (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.) 373 type.

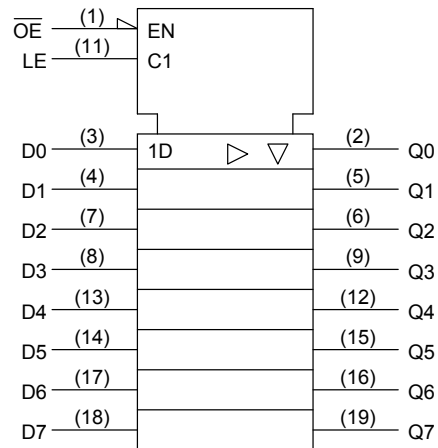


Weight: 0.03 g (typ.)

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

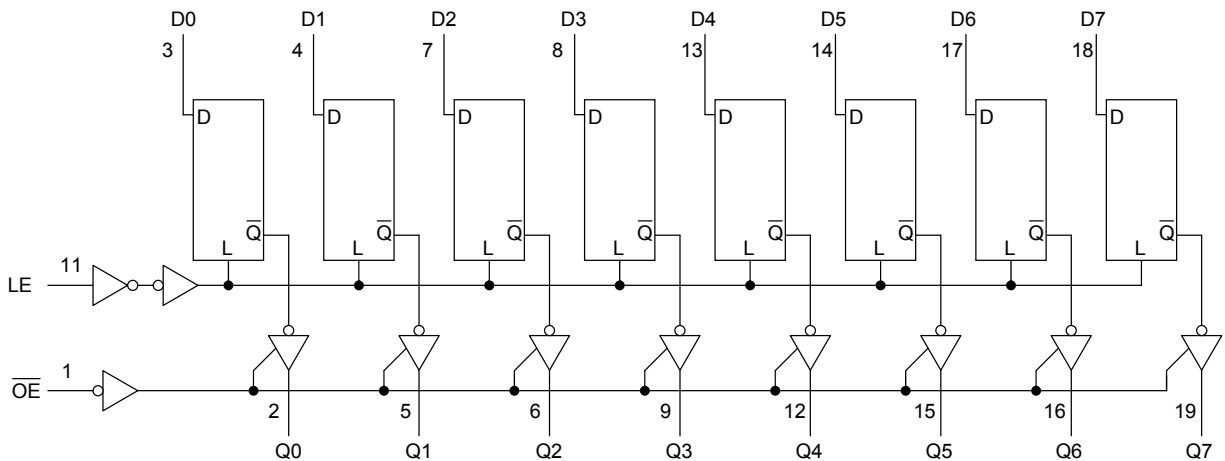
Inputs			Outputs
\overline{OE}	LE	D	
H	X	X	Z
L	L	X	Q_n
L	H	L	L
L	H	H	H

X: Don't care

Z: High impedance

Q_n : Q outputs are latched at the time when the LE input is taken to a low logic level.

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	—	
	High 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 (LE)	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	—	1.5	1.5	ns
Minimum hold time	t _h	—	5.0 ± 0.5	—	3.5	3.5	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 (LE-Q)	t _{pLH} t _{pHL}	—	5.0 ± 0.5	15	—	7.7	12.3	1.0	13.5	ns
				50	—	8.5	13.3	1.0	14.5	
Propagation delay time (D-Q)	t _{pLH} t _{pHL}	—	5.0 ± 0.5	15	—	5.1	8.5	1.0	9.5	ns
				50	—	5.9	9.5	1.0	10.5	
3-state output enable time	t _{pZL} t _{pZH}	R _L = 1 kΩ	5.0 ± 0.5	15	—	6.3	10.9	1.0	12.5	ns
				50	—	7.1	11.9	1.0	13.5	
3-state output disable time	t _{pLZ} t _{pHZ}	R _L = 1 kΩ	5.0 ± 0.5	50	—	8.8	11.2	1.0	12.0	ns
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:

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

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

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

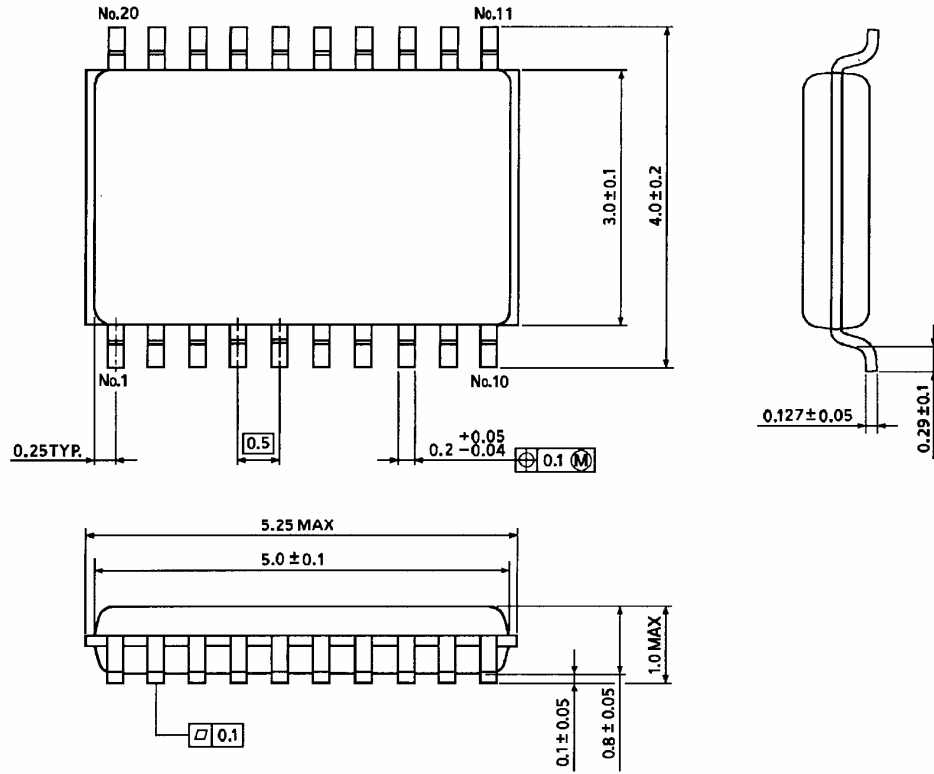
Noise Characteristics (Input: $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition	Ta = 25°C			Unit
			V _{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.)

RESTRICTIONS ON PRODUCT USE

20070701-EN GENERAL

- The information contained herein is subject to change without notice.
- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc.
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The products described in this document shall not be used or embedded to any downstream products of which manufacture, use and/or sale are prohibited under any applicable laws and regulations.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patents or other rights of TOSHIBA or the third parties.
- Please contact your sales representative for product-by-product details in this document regarding RoHS compatibility. Please use these products in this document in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances. Toshiba assumes no liability for damage or losses occurring as a result of noncompliance with applicable laws and regulations.