

**TOSHIBA****TC7MET374AFK**

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

**TC7MET374AFK****Octal D - type flip - flop with 3 - state output**

The TC7MET374A 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.

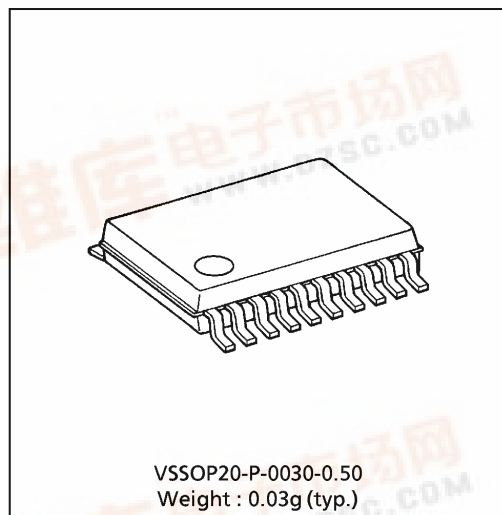
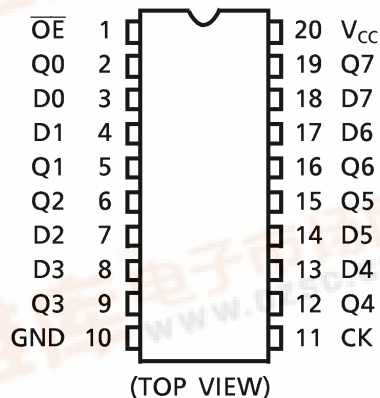
This device may be used as a level converter for interfacing 3.3V to 5V system.

Input protection and output circuit ensure that 0 to 5.5V can be applied to the input and output\*1 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.

\*1: output in off-state

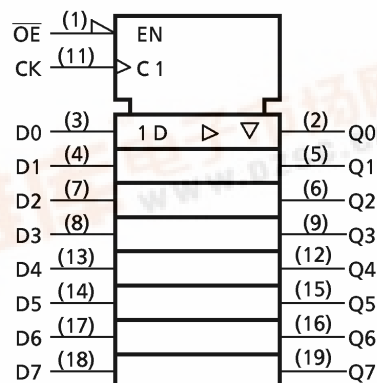
**FEATURES:**

- High Speed.....  $f_{MAX} = 140\text{MHz}(\text{typ.})$   
at  $V_{CC} = 5\text{V}$
- Low Power Dissipation.....  $I_{CC} = 4\mu\text{A}(\text{max})$  at  $T_a = 25^\circ\text{C}$
- Compatible with TTL outputs....  $V_{IL} = 0.8\text{V}(\text{max})$   
 $V_{IH} = 2.0\text{V}(\text{min})$
- Power Down Protection is provided on all inputs and outputs.
- Balanced Propagation Delays.....  $t_{PLH} \approx t_{PHL}$
- Low Noise .....  $V_{OLP} = 1.6\text{V}(\text{max})$
- Pin and Function Compatible with the 74 series (74AC / HC / F / ALS / LS etc.) 374 type.

**Pin Assignment****Truth Table**

| INPUTS          |    |   | OUTPUT |
|-----------------|----|---|--------|
| $\overline{OE}$ | CK | D |        |
| H               | X  | X | Z      |
| L               |    | X | $Q_n$  |
| L               |    | L | L      |
| L               |    | H | H      |

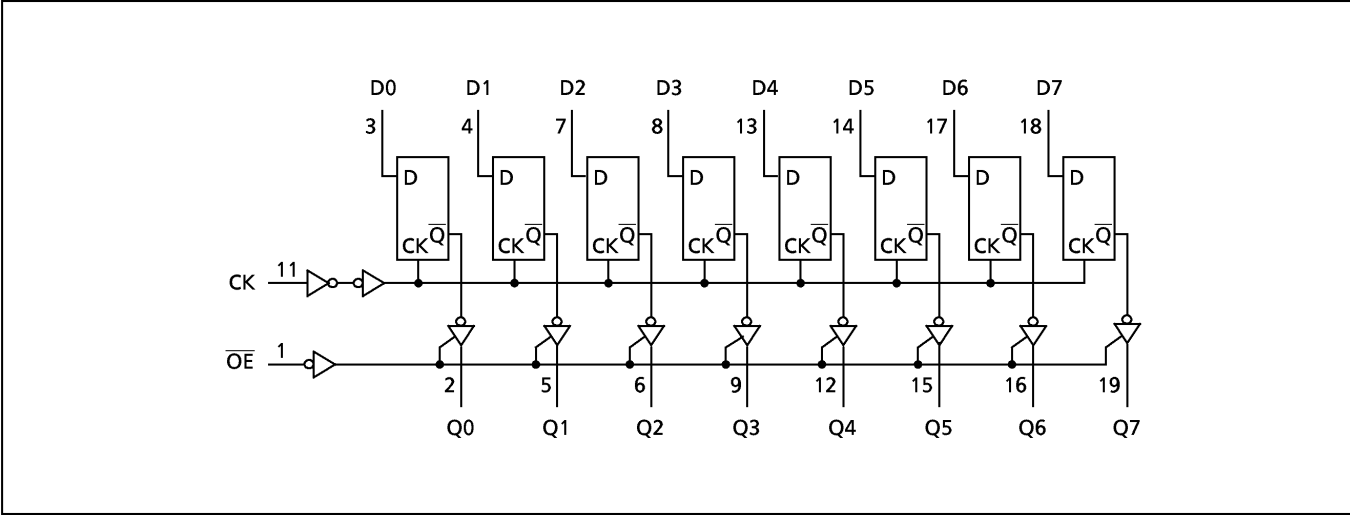
X : Don't Care  
Z : High Impedance  
 $Q_n$  : No Change

**IEC Logic Symbol**

980910EBA2

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System Diagram



Absolute Maximum Ratings

| PARAMETER             | SYMBOL    | VALUE                             | UNIT               |
|-----------------------|-----------|-----------------------------------|--------------------|
| Supply Voltage Range  | $V_{CC}$  | $-0.5 \sim 7.0$                   | V                  |
| DC Input Voltage      | $V_{IN}$  | $-0.5 \sim 7.0$                   | V                  |
| DC Output Voltage     | $V_{OUT}$ | $-0.5 \sim 7.0$ (Note 1)          | V                  |
|                       |           | $-0.5 \sim V_{CC} + 0.5$ (Note 2) |                    |
| Input Diode Current   | $I_{IK}$  | $-20$                             | mA                 |
| Output Diode Current  | $I_{OK}$  | $\pm 20$ (Note 3)                 | mA                 |
| DC Output Current     | $I_{OUT}$ | $\pm 25$                          | mA                 |
| DC Vcc/Ground Current | $I_{CC}$  | $\pm 75$                          | mA                 |
| Power Dissipation     | $P_D$     | 180                               | mW                 |
| Storage Temperature   | $T_{stg}$ | $-65 \sim 150$                    | $^{\circ}\text{C}$ |

- (Note 1): Output in Off-State  
(Note 2): High or Low State.  $I_{OUT}$  absolute maximum rating must be observed.  
(Note 3):  $V_{OUT} < \text{GND}$ ,  $V_{OUT} > V_{CC}$

Recommended Operating Conditions

| PARAMETER                | SYMBOL    | VALUE          | 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 4) | V                  |
|                          |           | 0~VCC (Note 5) |                    |
| Operating Temperature    | $T_{opr}$ | $-40 \sim 85$  | $^{\circ}\text{C}$ |
| Input Rise and Fall Time | $dt / dV$ | 0~20           | ns / V             |

- (Note 4): Output in Off-State  
(Note 5): High or Low State

980910EBA2'

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## DC Electrical Characteristics

| PARAMETER                            | SYMBOL           | CONDITON                                                                                          |                         | V <sub>CC</sub> (V) | Ta = 25°C |      |        | Ta = -40~85°C |        | UNIT |
|--------------------------------------|------------------|---------------------------------------------------------------------------------------------------|-------------------------|---------------------|-----------|------|--------|---------------|--------|------|
|                                      |                  |                                                                                                   |                         |                     | Min       | Typ. | Max    | Min           | Max    |      |
| High - Level Input Voltage           | V <sub>IH</sub>  |                                                                                                   |                         | 4.5~5.5             | 2.0       | —    | —      | 2.0           | —      | V    |
| Low - Level Input Voltage            | V <sub>IL</sub>  |                                                                                                   |                         | 4.5~5.5             | —         | —    | 0.8    | —             | 0.8    | V    |
| High - Level Output Voltage          | V <sub>OH</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                              | I <sub>OH</sub> = -50μA | 4.5                 | 4.40      | 4.50 | —      | 4.40          | —      | V    |
|                                      |                  |                                                                                                   | I <sub>OH</sub> = -8mA  | 4.5                 | 3.94      | —    | —      | 3.80          | —      |      |
| Low - Level Output Voltage           | V <sub>OL</sub>  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                              | I <sub>OL</sub> = 50μA  | 4.5                 | —         | 0.0  | 0.10   | —             | 0.10   | V    |
|                                      |                  |                                                                                                   | I <sub>OL</sub> = 8mA   | 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><br>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> = 5.5V or GND                                                                     |                         | 0~5.5               | —         | —    | ± 0.1  | —             | ± 1.0  |      |
| Quiescent Supply Current             | I <sub>CC</sub>  | V <sub>IN</sub> = V <sub>CC</sub> or GND                                                          |                         | 5.5                 | —         | —    | 4.0    | —             | 40.0   |      |
|                                      | I <sub>CCT</sub> | PER INPUT : V <sub>IN</sub> = 3.4V<br>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> = 5.5V                                                                           |                         | 0                   | —         | —    | + 0.5  | —             | + 5.0  | μA   |

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

| PARAMETER                | SYMBOL                                   | TEST CONDITION | V <sub>CC</sub> (V) | Ta = 25°C |       | Ta = -40~85°C | UNIT |
|--------------------------|------------------------------------------|----------------|---------------------|-----------|-------|---------------|------|
|                          |                                          |                |                     | Typ .     | Limit | Limit         |      |
| Minimum Pulse Width (CK) | t <sub>W</sub> (H)<br>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           |      |
| Minimum Hold Time        | t <sub>h</sub>                           |                | 5.0 ± 0.5           | —         | 2.5   | 2.5           |      |

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

| PARAMETER                        | SYMBOL                                 | TEST CONDITION |                     |         | Ta = 25°C |      |      | Ta = − 40~85°C |      | UNIT |
|----------------------------------|----------------------------------------|----------------|---------------------|---------|-----------|------|------|----------------|------|------|
|                                  |                                        |                | V <sub>CC</sub> (V) | CL (pF) | Min       | Typ. | Max  | Min            | Max  |      |
| Propagation Delay Time<br>(CK-Q) | t <sub>pLH</sub>                       |                | 5.0 ± 0.5           | 15      | —         | 4.1  | 9.4  | 1.0            | 10.5 | ns   |
|                                  | t <sub>pHL</sub>                       |                |                     | 50      | —         | 5.6  | 10.4 | 1.0            | 11.5 |      |
| 3-State Output Enable Time       | t <sub>pZL</sub>                       | RL = 1kΩ       | 5.0 ± 0.5           | 15      | —         | 6.5  | 10.2 | 1.0            | 11.5 |      |
|                                  | t <sub>pZH</sub>                       |                |                     | 50      | —         | 7.3  | 11.2 | 1.0            | 12.5 |      |
| 3-State Output Disable Time      | t <sub>pLZ</sub><br>t <sub>pHZ</sub>   | RL = 1kΩ       | 5.0 ± 0.5           | 50      | —         | 7.0  | 11.2 | 1.0            | 12.0 |      |
| Maximum Clock Frequency          | f <sub>MAX</sub>                       |                | 5.0 ± 0.5           | 15      | 90        | 140  | —    | 80             | —    | MHz  |
|                                  |                                        |                |                     | 50      | 85        | 130  | —    | 95             | —    |      |
| Output to Output Skew            | t <sub>osLH</sub><br>t <sub>osHL</sub> | (Note 6)       | 5.0 ± 0.5           | 50      | —         | —    | 1.0  | —              | 1.0  | ns   |
| Input Capacitance                | C <sub>I N</sub>                       |                |                     |         | —         | 4    | 10   | —              | 10   | pF   |
| Output Capacitance               | C <sub>OUT</sub>                       |                |                     |         | —         | 9    | —    | —              | —    |      |
| Power Dissipation Capacitance    | C <sub>PD</sub>                        | (Note 7)       |                     |         | —         | 25   | —    | —              | —    |      |

(Note 6): Parameter guaranteed by design.  $t_{osLH} = |t_{pLHm} - t_{pLHn}|$ ,  $t_{osHL} = |t_{pHLm} - t_{pHLn}|$

(Note 7): 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 :

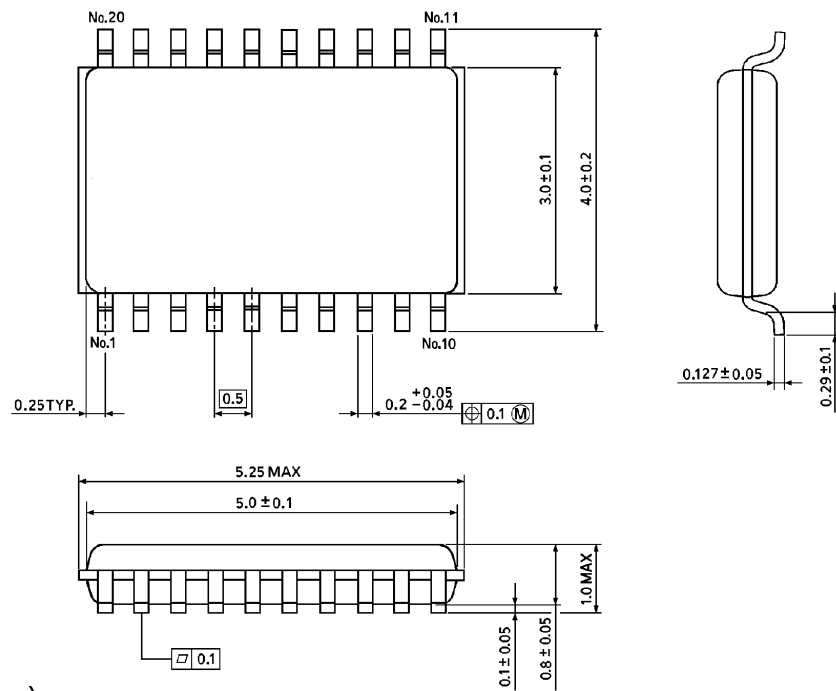
$$C_{PD} \text{ (total)} = 14 + 11 \cdot n$$

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

| PARAMETER                                    | 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> = 50pF | 5.0                 | 1.1       | 1.5   | V    |
| Quiet Output Minimum Dynamic V <sub>OL</sub> | V <sub>OLV</sub> | C <sub>L</sub> = 50pF | 5.0                 | - 1.1     | - 1.5 | V    |
| Minimum High Level Dynamic Input Voltage     | V <sub>IHD</sub> | C <sub>L</sub> = 50pF | 5.0                 | —         | 3.5   | V    |
| Maximum Low Level Dynamic Input Voltage      | V <sub>ILD</sub> | C <sub>L</sub> = 50pF | 5.0                 | —         | 1.5   | V    |

**PACKAGE DIMENSIONS (VSSOP20-P-0030-0.50)**

Unit in mm



Weight : 0.03g (typ.)