

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MH240FK, TC7MH244FK

Octal Bus Buffer

TC7MH240FK Inverted, 3-State Outputs

TC7MH244FK Non-Inverted, 3-State Outputs

The TC7MH240FK and TC7MH244FK are advanced high speed CMOS octal bus buffers fabricated with silicon gate C²MOS technology.

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

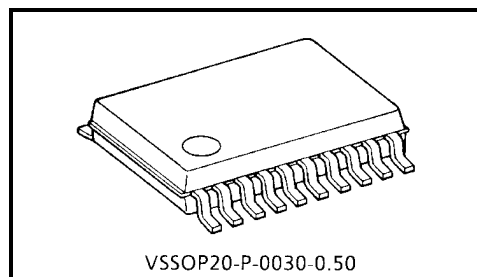
The TC7MH240FK is an inverting 3-state buffer having two active-low output enables. The TC7MH244FK is a non-inverting 3-state buffer, and has two active-low output enables.

These devices are designed to be used with 3-state memory address drivers, etc.

An input protection circuit ensures that 0 to 7 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

Features

- High speed: $t_{pd} = 3.9 \text{ ns (typ.)}$ ($V_{CC} = 5 \text{ V}$)
- Low power dissipation: $I_{CC} = 4 \text{ } \mu\text{A (max)}$ ($T_a = 25^\circ\text{C}$)
- High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- Power down protection is provided on all inputs.
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC \text{ (opr)}} = 2 \sim 5.5 \text{ V}$
- Low noise: $V_{OLP} = 0.8 \text{ (max)}$
- Pin and function compatible with 74ALS240/244



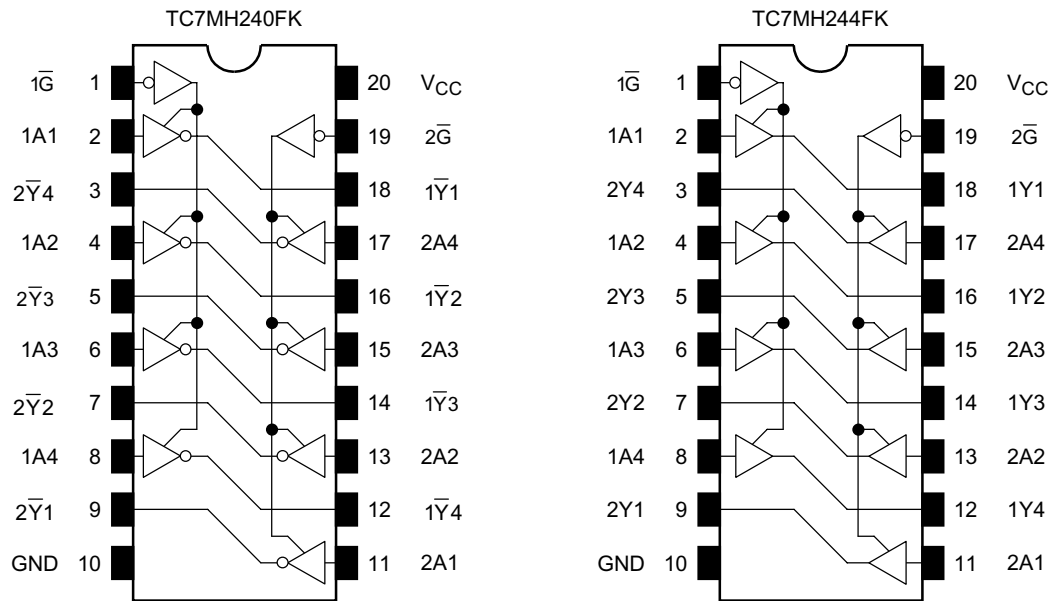
VSSOP20-P-0030-0.50

Weight: 0.03 g (typ.)

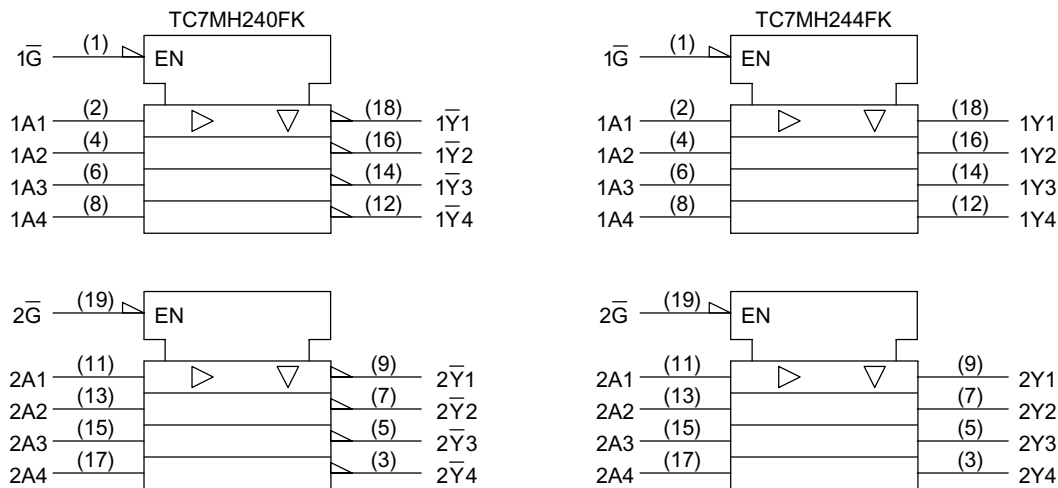
000630EBA1

- 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 are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

| Inputs | | Outputs | |
|----------------|-------|---------|------------------|
| \overline{G} | A_n | Y_n | \overline{Y}_n |
| L | L | L | H |
| L | H | H | L |
| H | X | Z | Z |

X : Don't care
Z : High impedance
 Y_n : TC7MH244FK
 \overline{Y}_n : TC7MH240FK

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~ $V_{CC} + 0.5$ | V |
| Input diode current | I_{IK} | -20 | mA |
| Output diode current | I_{OK} | ±20 | 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 |

Recommended Operating Conditions

| Characteristics | Symbol | Rating | Unit |
|--------------------------|-----------|---|------|
| Supply voltage | V_{CC} | 2.0~5.5 | V |
| Input voltage | V_{IN} | 0~5.5 | V |
| Output voltage | V_{OUT} | 0~ V_{CC} | V |
| Operating temperature | T_{opr} | -40~85 | °C |
| Input rise and fall time | dt/dv | 0~100 ($V_{CC} = 3.3 \pm 0.3$ V) 0~20 ($V_{CC} = 5 \pm 0.5$ V) | ns/V |

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} | — | | 2.0 3.0~5.5 | 1.50 V _{CC} × 0.7 | — — | — — | 1.50 V _{CC} × 0.7 | — — | V |
| | Low level | V _{IL} | — | | 2.0 3.0~5.5 | — — | — V _{CC} × 0.3 | 0.50 — | — V _{CC} × 0.3 | 0.50 — | |
| Output voltage | High level | V _{OH} | V _{IN} = V _{IH} or V _{IL} | I _{OH} = -50 μA | 2.0 | 1.9 | 2.0 | — | 1.9 | — | V |
| | | | | | 3.0 | 2.9 | 3.0 | — | 2.9 | — | |
| | | | | | 4.5 | 4.4 | 4.5 | — | 4.4 | — | |
| | | | | I _{OH} = -4 mA | 3.0 | 2.58 | — | — | 2.48 | — | |
| | | | | | 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 | 2.0 | — | 0 | 0.1 | — | 0.1 | |
| | | | | | 3.0 | — | 0 | 0.1 | — | 0.1 | |
| | | | | | 4.5 | — | 0 | 0.1 | — | 0.1 | |
| | | | | I _{OL} = 4 mA | 3.0 | — | — | 0.36 | — | 0.44 | |
| | | | | | I _{OL} = 8 mA | 4.5 | — | — | 0.36 | — | |
| 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 |

AC 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 (TC7MH240FK) | t_{pLH} t_{pHL} | — | 3.3 ± 0.3 | 15 | — | 5.3 | 7.5 | 1.0 | 9.0 | ns |
| | | | | 50 | — | 7.8 | 11.0 | 1.0 | 12.5 | |
| | | | 5.0 ± 0.5 | 15 | — | 3.6 | 5.5 | 1.0 | 6.5 | |
| | | | | 50 | — | 5.1 | 7.5 | 1.0 | 8.5 | |
| Propagation delay time (TC7MH244FK) | t_{pLH} t_{pHL} | — | 3.3 ± 0.3 | 15 | — | 5.8 | 8.4 | 1.0 | 10.0 | ns |
| | | | | 50 | — | 8.3 | 11.9 | 1.0 | 13.5 | |
| | | | 5.0 ± 0.5 | 15 | — | 3.9 | 5.5 | 1.0 | 6.5 | |
| | | | | 50 | — | 5.4 | 7.5 | 1.0 | 8.5 | |
| 3-state output enable time | t_{pZL} t_{pZH} | $R_L = 1 \text{ k}\Omega$ | 3.3 ± 0.3 | 15 | — | 6.6 | 10.6 | 1.0 | 12.5 | ns |
| | | | | 50 | — | 9.1 | 14.1 | 1.0 | 16.0 | |
| | | | 5.0 ± 0.5 | 15 | — | 4.7 | 7.3 | 1.0 | 8.5 | |
| | | | | 50 | — | 6.2 | 9.3 | 1.0 | 10.5 | |
| 3-state output disable time | t_{pLZ} t_{pHZ} | $R_L = 1 \text{ k}\Omega$ | 3.3 ± 0.3 | 50 | — | 10.3 | 14.0 | 1.0 | 16.0 | ns |
| | | | 5.0 ± 0.5 | 50 | — | 6.7 | 9.2 | 1.0 | 10.5 | |
| Output to output skew | t_{osLH} t_{osHL} | (Note1) | 3.3 ± 0.3 | 50 | — | — | 1.5 | — | 1.5 | ns |
| | | | 5.0 ± 0.5 | 50 | — | — | 1.0 | — | 1.0 | |
| Input capacitance | C _{IN} | — | — | — | — | 4 | 10 | — | 10 | pF |
| Output capacitance | C _{OUT} | — | — | — | — | 6 | — | — | — | pF |
| Power dissipation capacitance (Note2) | C _{PD} | TC7MH240FK | — | — | — | 17 | — | — | — | pF |
| | | TC7MH244FK | — | — | — | 19 | — | — | — | |

Note1: Parameter guaranteed by design.

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

Note2: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

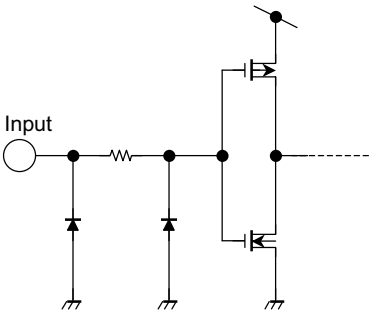
Average operating current can be obtained by the equation:

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

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

| Characteristics | Symbol | Test Condition | Ta = 25°C | | | Unit |
|--|--------|----------------|-----------|------|-------|------|
| | | | VCC (V) | Typ. | Limit | |
| Quiet output maximum dynamic VOL | VOLP | CL = 50 pF | 5.0 | 0.5 | 0.8 | V |
| Quiet output minimum dymnamic VOL | VOLV | CL = 50 pF | 5.0 | -0.5 | -0.8 | V |
| Minimum high level dynamic input voltage VIH | VIHD | CL = 50 pF | 5.0 | — | 3.5 | V |
| Maximum low level dynamic input voltage VIL | VILD | CL = 50 pF | 5.0 | — | 1.5 | V |

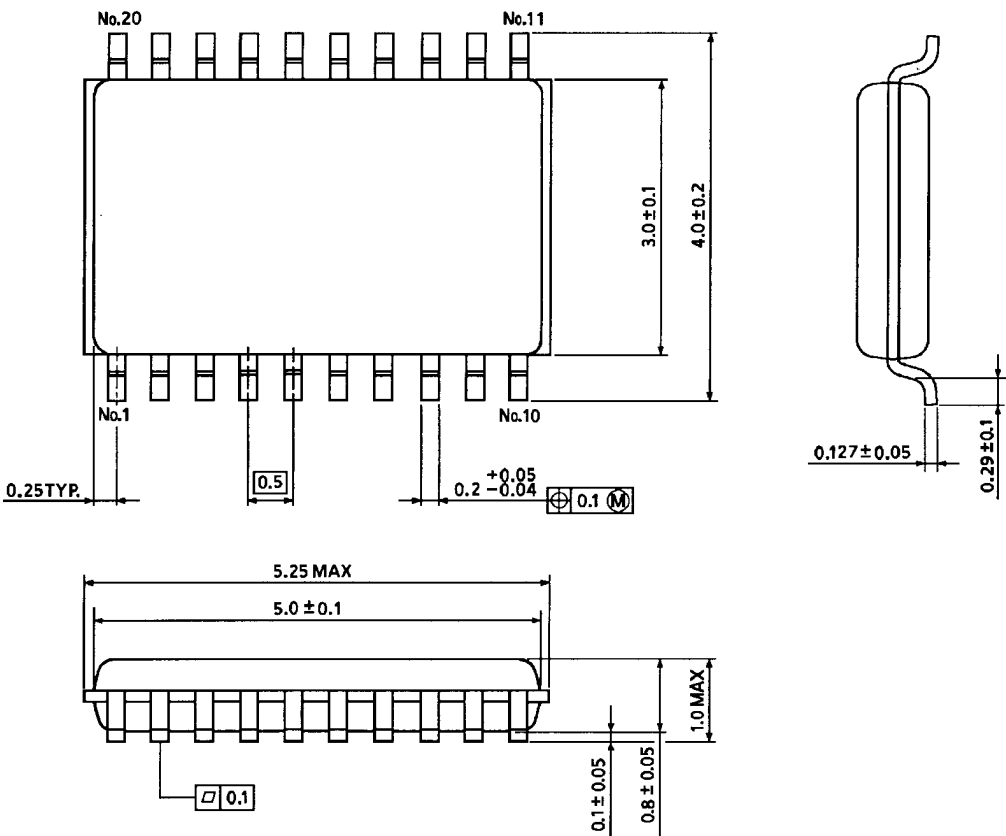
Input Equivalent Circuit



Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)