

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MH238FK

3-to-8 Line Decoder

The TC7MH238FK is an advanced high speed CMOS 3-to-8 decoder 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.

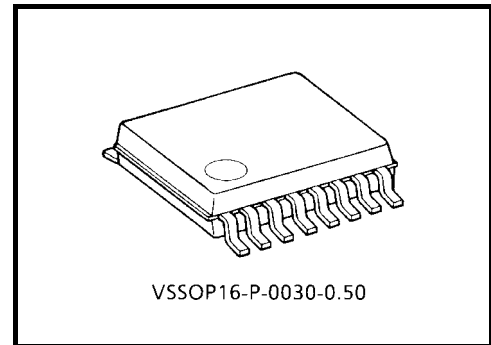
When the device is enabled, 3 binary select inputs (A, B and C) determine which one of the outputs (Y0-Y7) will go high.

When enable input G1 is held low or either $\overline{G2A}$ or $\overline{G2B}$ is held high, decoding function is inhibited and all outputs go low.

G1, $\overline{G2A}$ and $\overline{G2B}$ inputs are provided to ease cascade connection and for use as an address decoder for memory systems.

An input protection circuit ensures that 0 to 5.5 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.

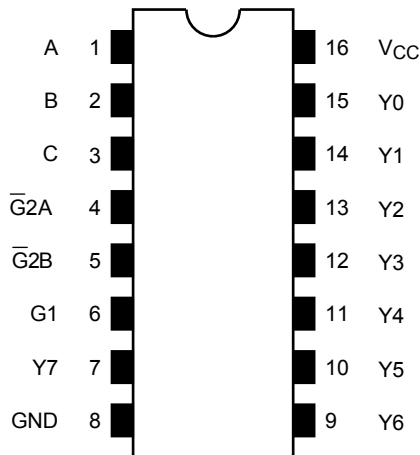


Weight: 0.02 g (typ.)

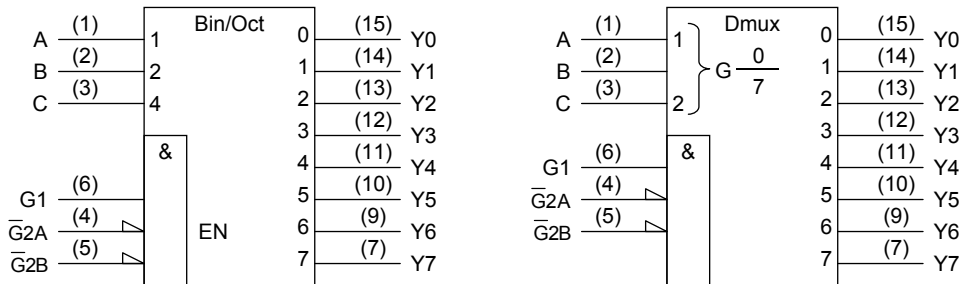
Features

- High speed: $t_{pd} = 5.5$ ns (typ.) ($V_{CC} = 5$ V)
- Low power dissipation: $I_{CC} = 4$ μ A (max) ($T_a = 25^\circ\text{C}$)
- High noise immunity: $V_{NIH} = V_{NIL} = 28\%$ V_{CC} (min)
- Power down protection is provided on all inputs.
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC}(\text{opr}) = 2\sim 5.5$ V
- Pin and function compatible with 74ALS238

Pin Assignment (top view)



IEC Logic Symbol

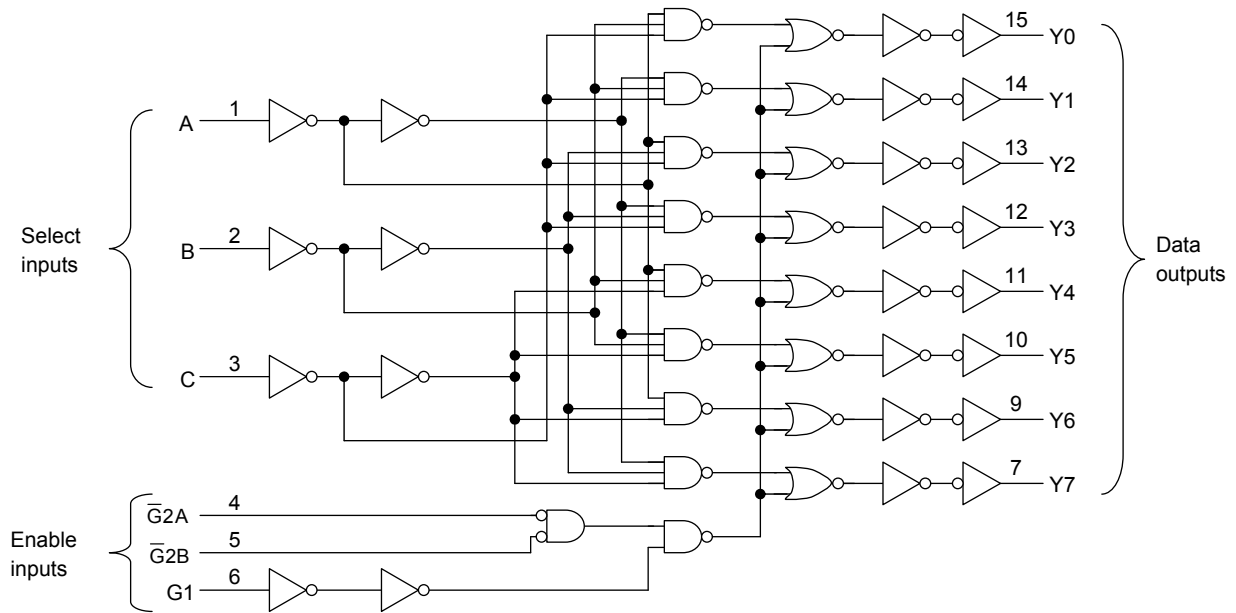


Truth Table

| Inputs | | | | | | Outputs | | | | | | | | Selected Output |
|--------|-----|-----|--------|---|---|---------|----|----|----|----|----|----|----|-----------------|
| Enable | | | Select | | | Y0 | Y1 | Y2 | Y3 | Y4 | Y5 | Y6 | Y7 | |
| G1 | G2A | G2B | C | B | A | | | | | | | | | |
| L | X | X | X | X | X | L | L | L | L | L | L | L | L | None |
| X | H | X | X | X | X | L | L | L | L | L | L | L | L | None |
| X | X | H | X | X | X | L | L | L | L | L | L | L | L | None |
| H | L | L | L | L | L | H | L | L | L | L | L | L | L | Y0 |
| H | L | L | L | L | H | L | H | L | L | L | L | L | L | Y1 |
| H | L | L | L | H | L | L | L | H | L | L | L | L | L | Y2 |
| H | L | L | L | H | H | L | L | L | H | L | L | L | L | Y3 |
| H | L | L | H | L | L | L | L | L | L | H | L | L | L | Y4 |
| H | L | L | H | L | H | L | L | L | L | L | H | L | L | Y5 |
| H | L | L | H | H | L | L | L | L | L | L | L | H | L | Y6 |
| H | L | L | H | H | H | L | L | L | L | L | L | L | H | Y7 |

X: Don't care

System Diagram



Absolute Maximum Ratings (Note)

| 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 |

Note: 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).

Operating Ranges (Note)

| 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) | ns/V |
| | | 0~20 ($V_{CC} = 5 \pm 0.5$ V) | |

Note: 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.

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 | 1.50 | — | — | 1.50 | — | V | |
| | | | | | 3.0~5.5 | V _{CC} × 0.7 | — | — | V _{CC} × 0.7 | — | | |
| | Low level | V _{IL} | — | | 2.0 | — | — | 0.50 | — | 0.50 | | |
| | | | | | 3.0~5.5 | — | — | V _{CC} × 0.3 | — | V _{CC} × 0.3 | | |
| 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 | — | |
| | 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 | — | — | — | — | 3.0 | — | — | 0.36 | — | 0.44 | | |
| | | | | | 4.5 | — | — | 0.36 | — | 0.44 | | |
| 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: $t_r = t_f = 3 \text{ ns}$)

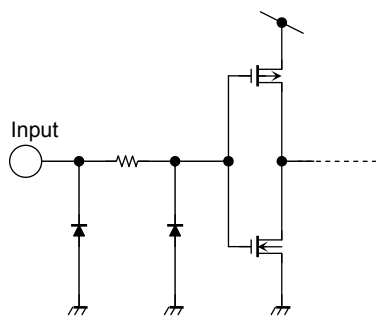
| Characteristics | Symbol | Test Condition | | | Ta = 25°C | | | Ta = -40~85°C | | Unit |
|--|------------------------|----------------|---------------------|---------------------|-----------|------|------|---------------|------|------|
| | | | V _{CC} (V) | C _L (pF) | Min | Typ. | Max | Min | Max | |
| Propagation delay time (A, B, C-Y) | t_{pLH} t_{pHL} | — | 3.3 ± 0.3 | 15 | — | 8.0 | 12.3 | 1.0 | 14.5 | ns |
| | | | | 50 | — | 10.5 | 15.8 | 1.0 | 18.0 | |
| | | | 5.0 ± 0.5 | 15 | — | 5.5 | 8.1 | 1.0 | 9.5 | |
| | | | | 50 | — | 7.0 | 10.1 | 1.0 | 11.5 | |
| Propagation delay time (G1-Y) | t_{pLH} t_{pHL} | — | 3.3 ± 0.3 | 15 | — | 8.1 | 12.8 | 1.0 | 15.0 | ns |
| | | | | 50 | — | 10.6 | 16.3 | 1.0 | 18.5 | |
| | | | 5.0 ± 0.5 | 15 | — | 5.4 | 8.1 | 1.0 | 9.5 | |
| | | | | 50 | — | 6.9 | 10.1 | 1.0 | 11.5 | |
| Propagation delay time ($\bar{G}2$ -Y) | t_{pLH} t_{pHL} | — | 3.3 ± 0.3 | 15 | — | 8.1 | 12.3 | 1.0 | 14.5 | ns |
| | | | | 50 | — | 10.6 | 15.8 | 1.0 | 18.0 | |
| | | | 5.0 ± 0.5 | 15 | — | 5.7 | 8.1 | 1.0 | 9.5 | |
| | | | | 50 | — | 7.2 | 10.1 | 1.0 | 11.5 | |
| Input capacitance | C _{IN} | — | — | — | 4 | — | — | 10 | pF | |
| Power dissipation capacitance | C _{PD} | (Note) | | | — | 37 | — | — | — | pF |

Note: 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:

$$I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

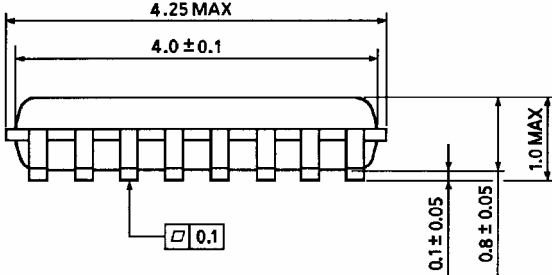
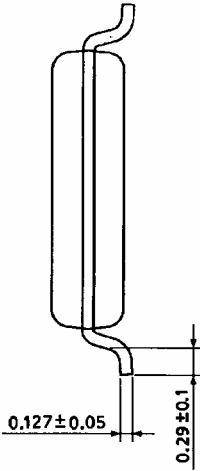
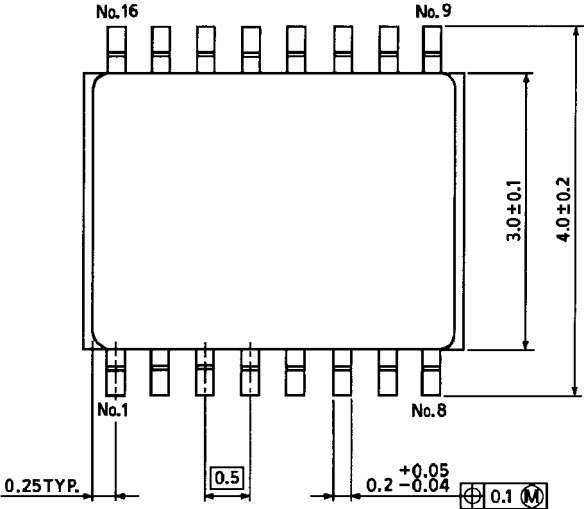
Input Equivalent Circuit



Package Dimensions

VSSOP16-P-0030-0.50

Unit : mm



Weight: 0.02 g (typ.)

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20070701-EN GENERAL

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