

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC7MH367FK, TC7MH368FK

## HEX Bus Buffer

TC7MH367FK Non-Inverted, 3-State Outputs

TC7MH368FK Inverted, 3-State Outputs

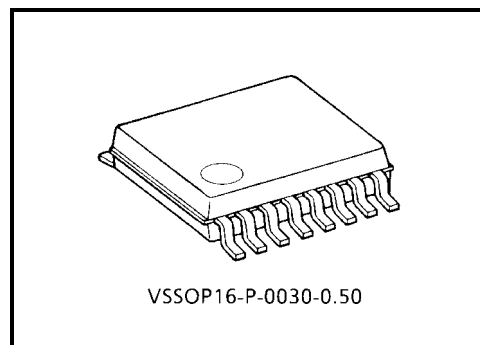
The TC7MH367FK and TC7MH368FK are advanced high speed CMOS HEX bus buffers fabricated with silicon gate C<sup>2</sup>MOS technology.

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

They contain six buffers; four buffers are controlled by an enable input ( $\overline{G1}$ ), and the other two buffers are controlled by another enable input ( $\overline{G2}$ ). The outputs of each buffer group are enabled when  $\overline{G1}$  and/or  $\overline{G2}$  inputs are held low; if held high, these outputs are in a high impedance state.

The TC7MH367FK is a non-inverting output type, while the TC7MH368FK is an inverting output type.

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.

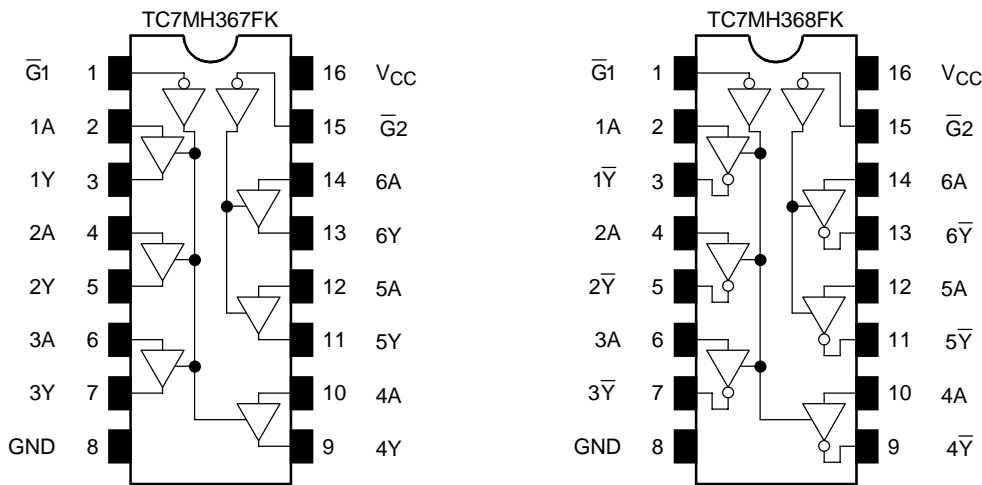


Weight: 0.02 g (typ.)

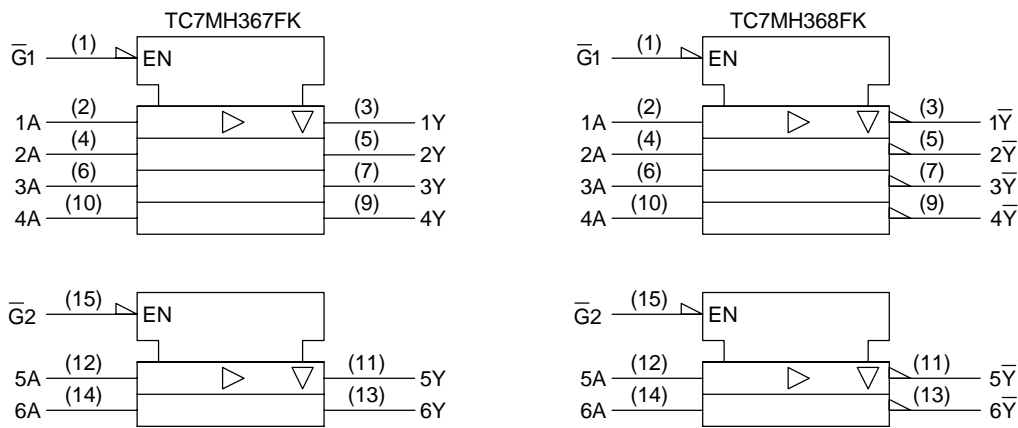
## Features

- High speed:  $t_{pd} = 3.8 \text{ ns (typ.)}$  ( $V_{CC} = 5 \text{ V}$ )
- 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:  $V_{OLP} = 0.8 \text{ V (max)}$
- Pin and function compatible with 74ALS367/368

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

Inputs		Outputs	
$\bar{G}$	A	Y (367)	$\bar{Y}$ (368)
L	L	L	H
L	H	H	L
H	X	Z	Z

X: Don't care

Z: High impedance

**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	$I_{CC}$	±50	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)	ns/V
		0~20 ( $V_{CC} = 5 \pm 0.5$ V)	

**Electrical Characteristics**
**DC Characteristics**

Characteristics		Symbol	Test Condition		Ta = 25°C				Ta = -40~85°C		Unit
					VCC (V)	Min	Typ.	Max	Min	Max	
Input voltage	High level	VIH	—		2.0	1.50	—	—	1.50	—	V
					3.0~5.5	VCC × 0.7	—	—	VCC × 0.7	—	
	Low level	VIL	—		2.0	—	—	0.50	—	0.50	
					3.0~5.5	—	—	VCC × 0.3	—	VCC × 0.3	
Output voltage	High level	VOH	VIN = VIH or VIL	IOH = -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	—	
				IOH = -4 mA	3.0	2.58	—	—	2.48	—	
					IOH = -8 mA	4.5	3.94	—	—	3.80	
	Low level	VOL	VIN = VIH or VIL	IOL = 50 μA	2.0	—	0	0.1	—	0.1	
					3.0	—	0	0.1	—	0.1	
					4.5	—	0	0.1	—	0.1	
				IOL = 4 mA	3.0	—	—	0.36	—	0.44	
					IOL = 8 mA	4.5	—	—	0.36	—	
3-state output off-state current		IOZ	VIN = VIH or VIL VOUT = VCC or GND		5.5	—	—	±0.25	—	±2.50	μA
Input leakage current		IIN	VIN = 5.5 V or GND		0~5.5	—	—	±0.1	—	±1.0	μA
Quiescent supply current		ICC	VIN = VCC 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
			VCC (V)	CL (pF)	Min	Typ.	Max	Min	Max	
Propagation delay time (TC7MH367)	t <sub>pLH</sub> t <sub>pHL</sub>	—	3.3 ± 0.3	15	—	5.9	8.3	1.0	10.0	ns
				50	—	8.4	11.8	1.0	13.5	
			5.0 ± 0.5	15	—	4.1	5.9	1.0	7.0	
				50	—	5.6	7.9	1.0	9.0	
Propagation delay time (TC7MH368)	t <sub>pLH</sub> t <sub>pHL</sub>	—	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	—	3.8	5.5	1.0	6.5	
				50	—	5.3	7.5	1.0	8.5	
3-state output enable time	t <sub>pZL</sub> t <sub>pZH</sub>	RL = 1 kΩ	3.3 ± 0.3	15	—	6.8	10.5	1.0	12.5	ns
				50	—	9.3	14.0	1.0	16.0	
			5.0 ± 0.5	15	—	4.8	7.2	1.0	8.5	
				50	—	6.3	9.2	1.0	10.5	
3-state output disable time	t <sub>pLZ</sub> t <sub>pHZ</sub>	RL = 1 kΩ	3.3 ± 0.3	50	—	9.9	13.6	1.0	15.5	ns
			5.0 ± 0.5	50	—	6.3	9.2	1.0	10.5	
Output to output skew	t <sub>osLH</sub> t <sub>osHL</sub>	(Note1)	3.3 ± 0.3	50	—	—	1.5	—	1.5	ns
			5.0 ± 0.5	50	—	—	1.0	—	1.0	
Input capacitance	CIN	—			—	4	10	—	10	pF
Output capacitance	COUT	—			—	6	—	—	—	pF
Power dissipation capacitance	CPD	(Note2)			—	19	—	—	—	pF

Note1: Parameter guaranteed by design.

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

Note2: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

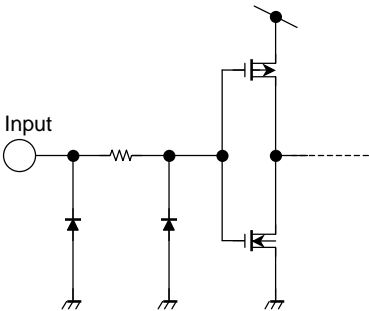
Average operating current can be obtained by the equation:

$$I_{CC}(\text{opr}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/6 \text{ (per bit)}$$

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

Characteristics	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> = 50 pF	5.0	0.4	0.8	V
Quiet output minimum dymnamic V <sub>OL</sub>	V <sub>OLV</sub>	C <sub>L</sub> = 50 pF	5.0	-0.4	-0.8	V
Minimum high level dynamic input voltage V <sub>IH</sub>	V <sub>IHD</sub>	C <sub>L</sub> = 50 pF	5.0	—	3.5	V
Maximum low level dynamic input voltage V <sub>IL</sub>	V <sub>ILD</sub>	C <sub>L</sub> = 50 pF	5.0	—	1.5	V

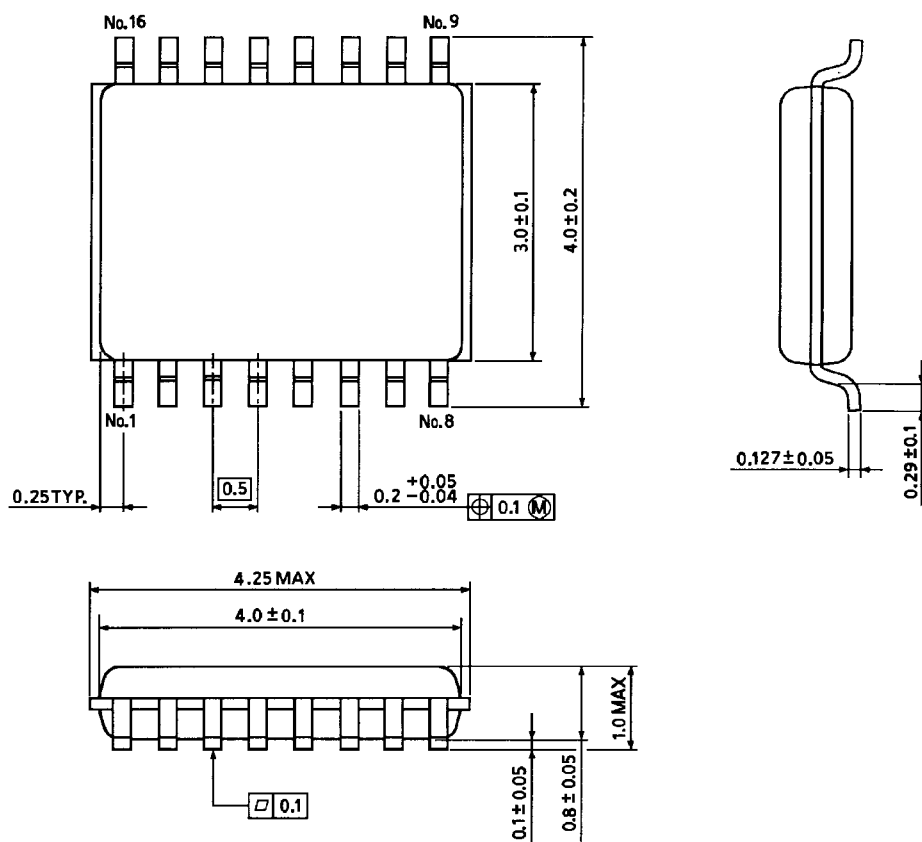
Input Equivalent Circuit



## Package Dimensions

VSSOP16-P-0030-0.50

Unit : mm



Weight: 0.02 g (typ.)

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