

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MH367FK, TC7MH368FK

HEX Bus Buffer
TC7MH367FK Non-Inverted, 3-State Outputs
TC7MH368FK Inverted, 3-State Outputs

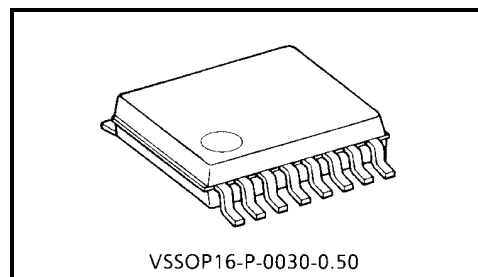
The TC7MH367FK and TC7MH368FK are advanced high speed CMOS HEX bus buffers fabricated with silicon gate C²MOS technology.

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.)

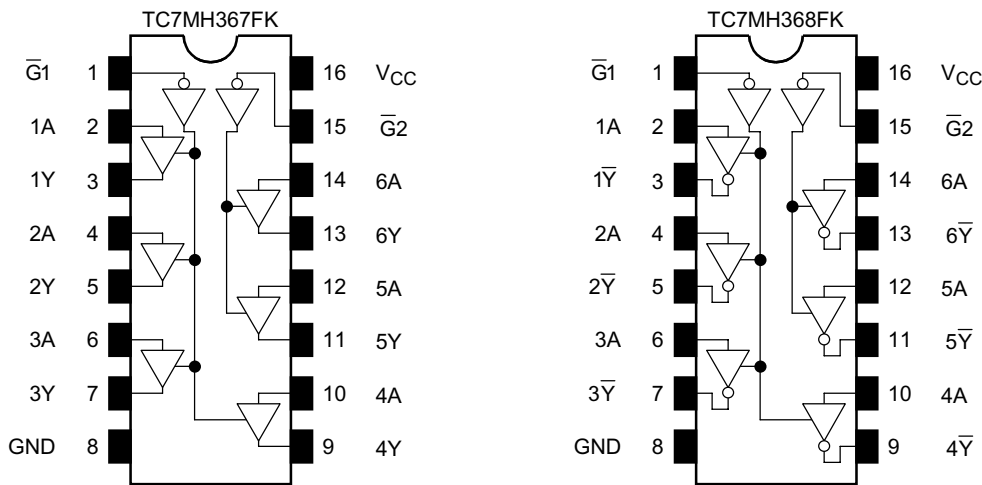
Features

- 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: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (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

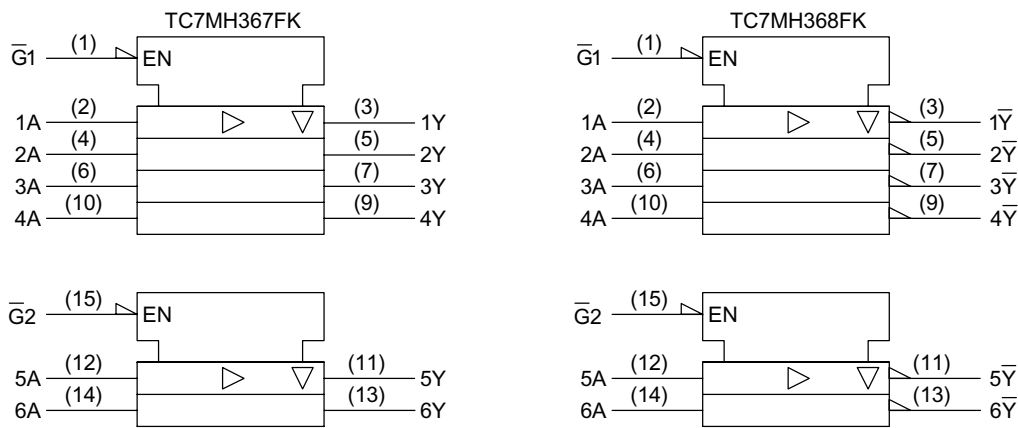
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Pin Assignment (top view)



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) 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 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5	— — —	1.9 2.9 4.4	— — —	V
				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 3.0 4.5	— — —	0 0 0	0.1 0.1 0.1	— — —	0.1 0.1 0.1	
				I _{OL} = 4 mA	3.0	—	—	0.36	—	0.44	
				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	

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 (TC7MH367)	t _{pLH} t _{pHL}	—	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		9.0
				50	—	5.6	7.9	1.0	9.0		
Propagation delay time (TC7MH368)	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	—	3.8	5.5	1.0	6.5		8.5
				50	—	5.3	7.5	1.0	8.5		
3-state output enable time	t _{pZL} t _{pZH}	R _L = 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		10.5
				50	—	6.3	9.2	1.0	10.5		
3-state output disable time	t _{pLZ} t _{pHZ}	R _L = 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 _{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	C _{PD}	(Note2)			—	19	—	—	—	pF	

Note1: Parameter guaranteed by design.

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

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

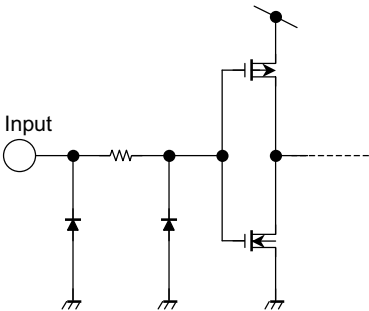
Average operating current can be obtained by the equation:

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

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

Characteristics	Symbol	Test Condition	Ta = 25°C			Unit
			VCC (V)	Typ.	Limit	
Quiet output maximum dynamic VOL	VOLP	CL = 50 pF	5.0	0.4	0.8	V
Quiet output minimum dymnamic VOL	VOLV	CL = 50 pF	5.0	-0.4	-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

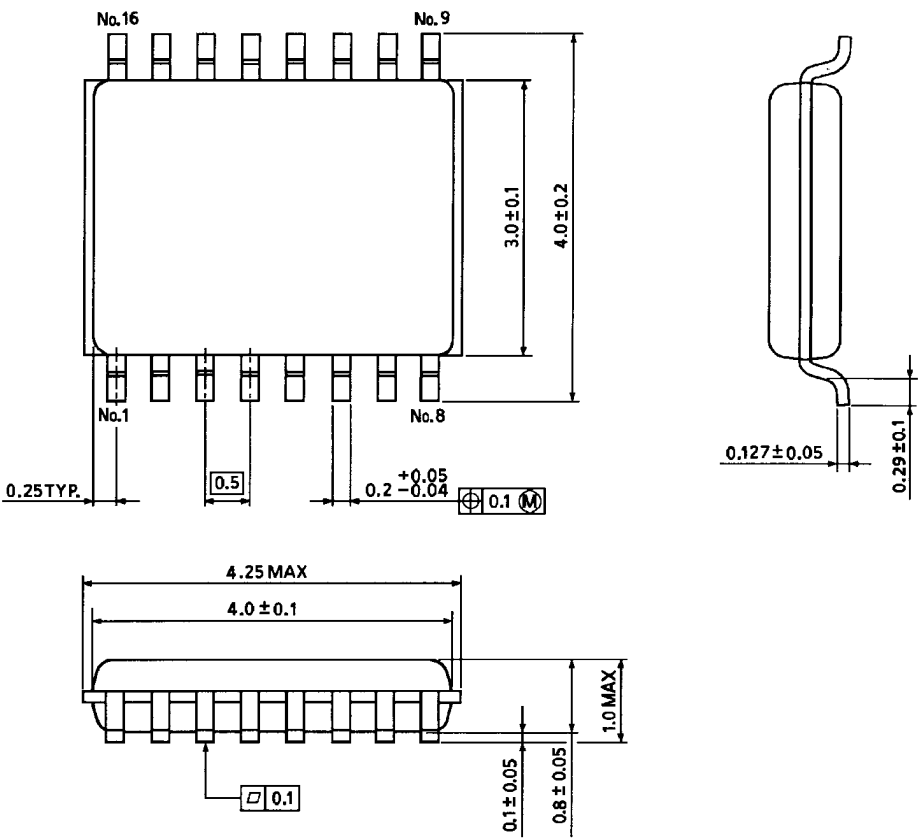
Input Equivalent Circuit



Package Dimensions

VSSOP16-P-0030-0.50

Unit : mm



Weight: 0.02 g (typ.)