

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MH540FK, TC7MH541FK

Octal Bus Buffer

TC7MH540FK Inverted, 3-State Outputs

TC7MH541FK Non-Inverted, 3-State Outputs

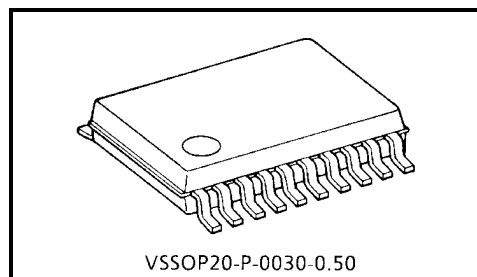
The TC7MH540FK and TC7MH541FK are advanced high speed CMOS octal bus buffers fabricated with silicon gate C²MOS technology.

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

The TC7MH540FK is an inverting type, and the TC7MH541FK is a non-inverting type.

When either $\overline{G1}$ or $\overline{G2}$ are high, the terminal outputs are in the high-impedance state.

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: 0.03 g (typ.)

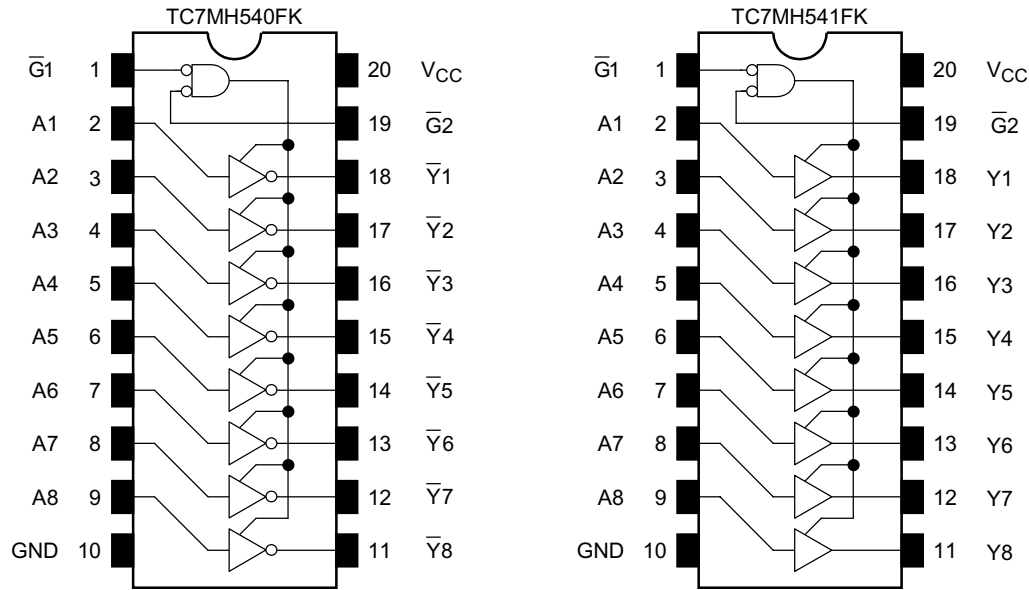
Features

- High speed: $t_{pd} = 3.7 \text{ ns (typ.)}$ ($V_{CC} = 5 \text{ V}$)
- Low power dissipation: $I_{CC} = 4 \mu\text{A (max)}$ ($T_a = 25^\circ\text{C}$)
- 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: $V_{CC (opr)} = 2 \sim 5.5 \text{ V}$
- Low noise: $V_{OLP} = 1.0 \text{ V (max)}$
- Pin and function compatible with 74ALS540/541

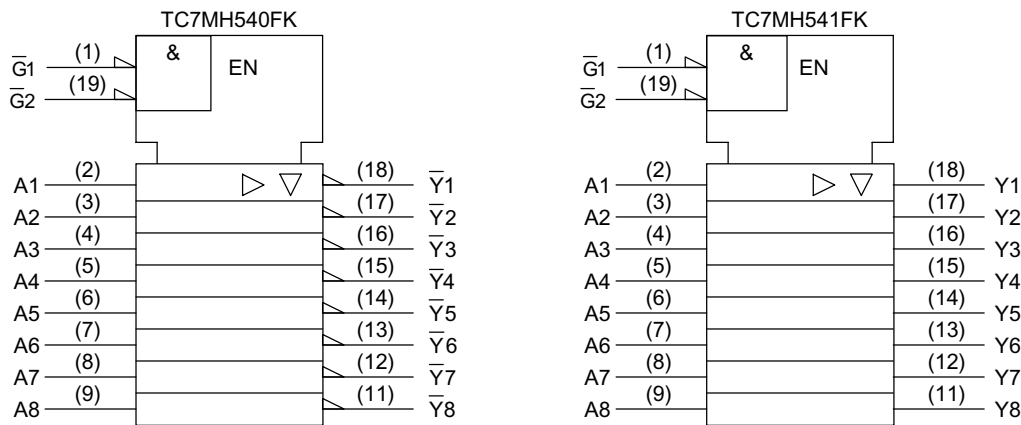
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Pin Assignment (top view)



IEC Logic Symbol



Truth Table

Inputs			Outputs	
$\overline{G1}$	$\overline{G2}$	A_n	Y_n (541)	$\overline{Y}_n$ (540)
H	X	X	Z	Z
X	H	X	Z	Z
L	L	H	H	L
L	L	L	L	H

X: Don't care

Z: High impedance

Y_n : TC7MH541

$\overline{Y}_n$: TC7MH540

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 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 (TC7MH540FK)	t_{pLH} t_{pHL}	—	3.3 ± 0.3	15	—	4.8	7.0	1.0	8.5	ns
				50	—	7.3	10.5	1.0	12.0	
			5.0 ± 0.5	15	—	3.7	5.0	1.0	6.0	
				50	—	5.2	7.0	1.0	8.0	
Propagation delay time (TC7MH541FK)	t_{pLH} t_{pHL}	—	3.3 ± 0.3	15	—	5.0	7.0	1.0	8.5	ns
				50	—	7.5	10.5	1.0	12.0	
			5.0 ± 0.5	15	—	3.5	5.0	1.0	6.0	
				50	—	5.0	7.0	1.0	8.0	
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	—	4.7	7.2	1.0	8.5	
				50	—	6.2	9.2	1.0	10.5	
3-state output disable time	t_{pLZ} t_{pHZ}	R _L = 1 kΩ	3.3 ± 0.3	50	—	11.2	15.4	1.0	17.5	ns
			5.0 ± 0.5	50	—	6.0	8.8	1.0	10.0	
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}	TC7MH540FK	—	—	—	17	—	—	—	pF
		TC7MH541FK	—	—	—	18	—	—	—	

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.

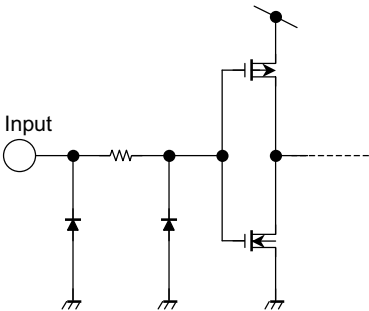
Average operating current can be obtained by the equation:

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

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	0.7	1.0	V
Quiet output minimum dymnamic VOL	VOLV	CL = 50 pF	5.0	-0.7	-1.0	V
Minimum high level dynamic input voltage VIH	VIHD	CL = 50 pF	5.0	—	1.5	V
Maximum low level dynamic input voltage VIL	VILD	CL = 50 pF	5.0	—	3.5	V

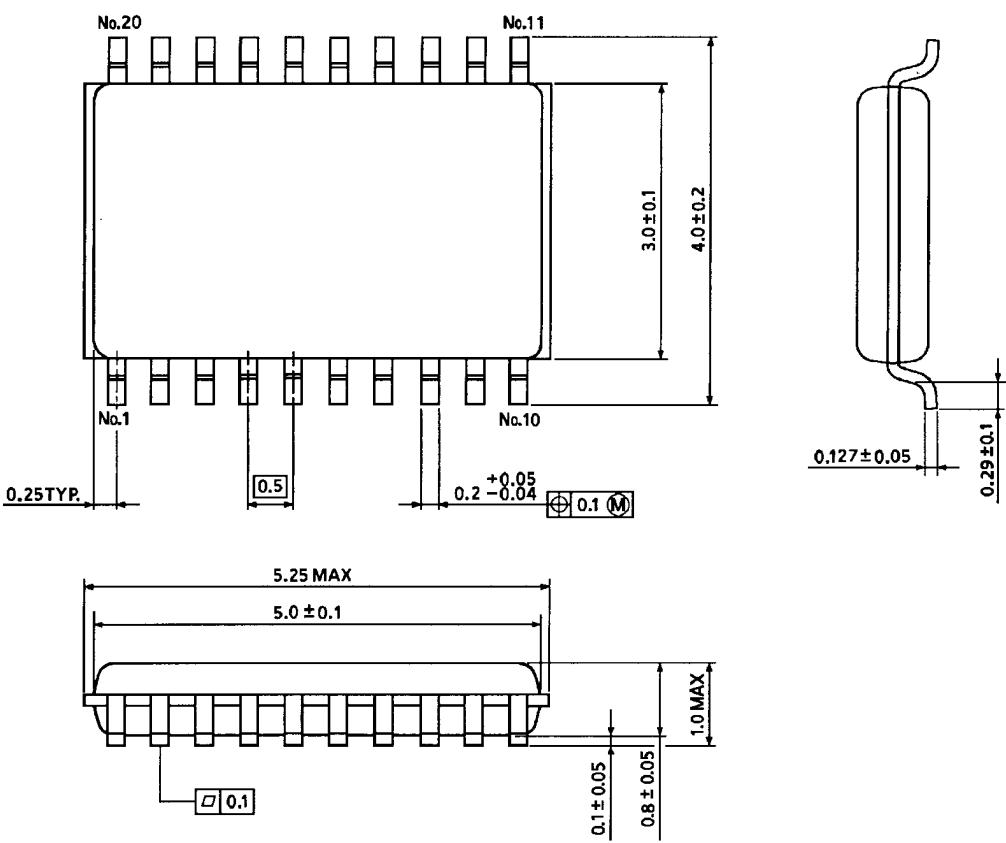
Input Equivalent Circuit



Package Dimensions

VSSOP20-P-0030-0.50

Unit : mm



Weight: 0.03 g (typ.)