

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC7MA257FK

Low Voltage Quad 2-Channel Multiplexer with 3.6 V Tolerant Inputs and Outputs

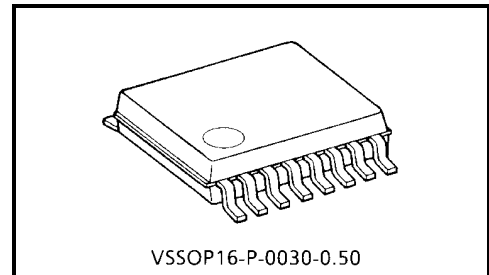
The TC7MA257FK is a high performance CMOS multiplexer. Designed for use in 1.8 , 2.5 or 3.3 V systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

It is also designed with over voltage tolerant inputs and outputs up to 3.6 V.

It consists of four 2-input digital multiplexers with common $\overline{\text{SELECT}}$ and $\overline{\text{OUTPUTENABLE}}$ ($\overline{\text{OE}}$).

If $\overline{\text{OE}}$ is set high the outputs are held in a high-impedance state. The $\overline{\text{SELECT}}$ decoding determines whether the A or B inputs get routed to their corresponding Y outputs.

All inputs are equipped with protection circuits against static discharge.



VSSOP16-P-0030-0.50

Weight: 0.02 g (typ.)

Features

- Low voltage operation: $V_{CC} = 1.8\sim 3.6\text{ V}$
- High speed operation: $t_{pd} = 3.0\text{ ns (max)} (V_{CC} = 3.0\sim 3.6\text{ V})$
 $t_{pd} = 4.0\text{ ns (max)} (V_{CC} = 2.3\sim 2.7\text{ V})$
 $t_{pd} = 8.0\text{ ns (max)} (V_{CC} = 1.8\text{ V})$
- 3.6 V tolerant inputs and outputs.
- Output current: $I_{OH}/I_{OL} = \pm 24\text{ mA (min)} (V_{CC} = 3.0\text{ V})$
 $I_{OH}/I_{OL} = \pm 18\text{ mA (min)} (V_{CC} = 2.3\text{ V})$
 $I_{OH}/I_{OL} = \pm 6\text{ mA (min)} (V_{CC} = 1.8\text{ V})$
- Latch-up performance: $\pm 300\text{ mA}$
- ESD performance: Machine model $> \pm 200\text{ V}$
Human body model $> \pm 2000\text{ V}$
- Package: VSSOP (US16)
- Power down protection is provided on all inputs and outputs.
- Supports live insertion/withdrawal (*)

*: To ensure the high-impedance state during power up or power down, $\overline{\text{OE}}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

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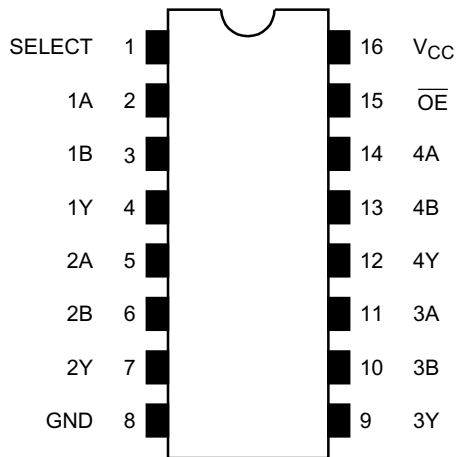
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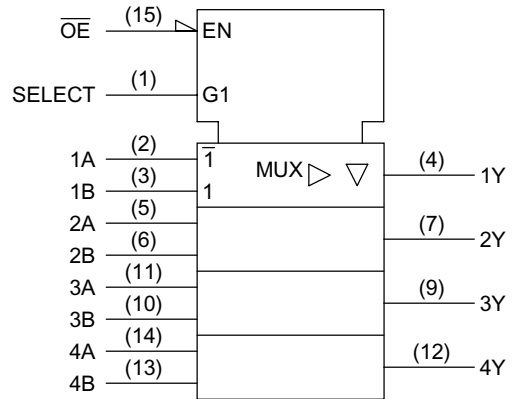
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Pin Assignment (top view)



IEC Logic Symbol



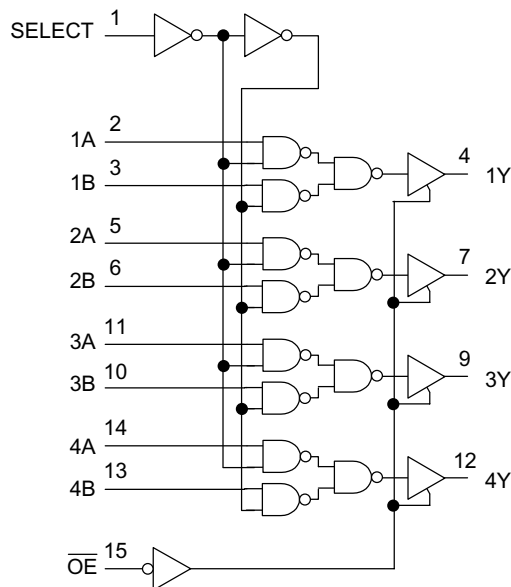
Truth Table

Inputs				Outputs
\overline{OE}	SELECT	A	B	Y
H	X	X	X	Z
L	L	L	X	L
L	L	H	X	H
L	H	X	L	L
L	H	X	H	H

X: Don't care

Z: High impedance

System Diagram



Maximum Ratings

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	-0.5~4.6	V
DC input voltage	V_{IN}	-0.5~4.6	V
DC output voltage	V_{OUT}	-0.5~4.6 (Note1)	V
		-0.5~ $V_{CC} + 0.5$ (Note2)	
Input diode current	I_{IK}	-50	mA
Output diode current	I_{OK}	±50 (Note3)	mA
DC output current	I_{OUT}	±50	mA
Power dissipation	P_D	180	mW
DC V_{CC} /ground current	I_{CC}/I_{GND}	±100	mA
Storage temperature	T_{stg}	-65~150	°C

Note1: Off-state

Note2: High or low state. I_{OUT} absolute maximum rating must be observed.

Note3: $V_{OUT} < GND, V_{OUT} > V_{CC}$

Recommended Operating Range

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	1.8~3.6	V
		1.2~3.6 (Note4)	
Input voltage	V_{IN}	-0.3~3.6	V
Output voltage	V_{OUT}	0~3.6 (Note5)	V
		0~ V_{CC} (Note6)	
Output current	I_{OH}/I_{OL}	±24 (Note7)	mA
		±18 (Note8)	
		±6 (Note9)	
Operating temperature	T_{opr}	-40~85	°C
Input rise and fall time	dt/dv	0~10 (Note10)	ns/V

Note4: Data retention only

Note5: Off-state

Note6: High or low state

Note7: $V_{CC} = 3.0\sim 3.6$ V

Note8: $V_{CC} = 2.3\sim 2.7$ V

Note9: $V_{CC} = 1.8$ V

Note10: $V_{IN} = 0.8\sim 2.0$ V, $V_{CC} = 3.0$ V

Electrical Characteristics

DC Characteristics (Ta = -40~85°C, 2.7 V < VCC ≤ 3.6 V)

Characteristics		Symbol	Test Condition		VCC (V)	Min	Max	Unit
Input voltage	High level	V _{IH}	—		2.7~3.6	2.0	—	V
	Low level	V _{IL}	—		2.7~3.6	—	0.8	
Output voltage	High level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 μA	2.7~3.6	V _{CC} - 0.2	—	V
				I _{OH} = -12 mA	2.7	2.2	—	
				I _{OH} = -18 mA	3.0	2.4	—	
				I _{OH} = -24 mA	3.0	2.2	—	
	Low level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	2.7~3.6	—	0.2	
				I _{OL} = 12 mA	2.7	—	0.4	
				I _{OL} = 18 mA	3.0	—	0.4	
				I _{OL} = 24 mA	3.0	—	0.55	
Input leakage current		I _{IN}	V _{IN} = 0~3.6 V		2.7~3.6	—	±5.0	μA
3-state output off-state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0~3.6 V		2.7~3.6	—	±10.0	μA
Power off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		2.7~3.6	—	20.0	μA
			V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V		2.7~3.6	—	±20.0	
Increase in I _{CC} per input		ΔI _{CC}	V _{IH} = V _{CC} - 0.6 V		2.7~3.6	—	750	

DC Characteristics (Ta = -40~85°C, 2.3 V ≤ VCC ≤ 2.7 V)

Characteristics		Symbol	Test Condition		VCC (V)	Min	Max	Unit
Input voltage	High level	V _{IH}	—		2.3~2.7	1.6	—	V
	Low level	V _{IL}	—		2.3~2.7	—	0.7	
Output voltage	High level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 μA	2.3~2.7	V _{CC} - 0.2	—	V
				I _{OH} = -6 mA	2.3	2.0	—	
				I _{OH} = -12 mA	2.3	1.8	—	
				I _{OH} = -18 mA	2.3	1.7	—	
	Low level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	2.3~2.7	—	0.2	
				I _{OL} = 12 mA	2.3	—	0.4	
				I _{OL} = 18 mA	2.3	—	0.6	
				Input leakage current		I _{IN}	V _{IN} = 0~3.6 V	
3-state output off-state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0~3.6 V		2.3~2.7	—	±10.0	μA
Power off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		2.3~2.7	—	20.0	μA
			V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V		2.3~2.7	—	±20.0	

DC Characteristics (Ta = -40~85°C, 1.8 V ≤ VCC < 2.3 V)

Characteristics		Symbol	Test Condition		VCC (V)	Min	Max	Unit
Input voltage	High level	V _{IH}	—		1.8~2.3	0.7 × V _{CC}	—	V
	Low level	V _{IL}	—		1.8~2.3	—	0.2 × V _{CC}	
Output voltage	High level	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -100 μA	1.8	V _{CC} - 0.2	—	V
				I _{OH} = -6 mA	1.8	1.4	—	
	Low level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	1.8	—	0.2	
				I _{OL} = 6 mA	1.8	—	0.3	
Input leakage current		I _{IN}	V _{IN} = 0~3.6 V		1.8	—	±5.0	μA
3-state output off-state current		I _{OZ}	V _{IN} = V _{IH} or V _{IL} V _{OUT} = 0~3.6 V		2.3~2.7	—	±10.0	μA
Power off leakage current		I _{OFF}	V _{IN} , V _{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent supply current		I _{CC}	V _{IN} = V _{CC} or GND		1.8	—	20.0	μA
			V _{CC} ≤ (V _{IN} , V _{OUT}) ≤ 3.6 V		1.8	—	±20.0	

AC Characteristics (Ta = -40~85°C, Input: t_r = t_f = 2.0 ns, C_L = 30 pF, R_L = 500 Ω)

Characteristics		Symbol	Test Condition		VCC (V)	Min	Max	Unit
Propagation delay time (A, B-Y)	t _{pLH} t _{pHL}	Figure 1, Figure 2	1.8	1.0	8.0	ns		
			2.5 ± 0.2	0.8	4.0			
			3.3 ± 0.3	0.6	3.0			
Propagation delay time (SELECT-Y)	t _{pLH} t _{pHL}	Figure 1, Figure 2	1.8	1.0	9.6	ns		
			2.5 ± 0.2	0.8	4.8			
			3.3 ± 0.3	0.6	4.0			
3-state output enable time	t _{pZL} t _{pZH}	Figure 1, Figure 3	1.8	1.0	9.2	ns		
			2.5 ± 0.2	0.8	4.6			
			3.3 ± 0.3	0.6	3.5			
3-state output disable time	t _{pLZ} t _{pHZ}	Figure 1, Figure 3	1.8	1.0	6.8	ns		
			2.5 ± 0.2	0.8	3.8			
			3.3 ± 0.3	0.6	3.5			
Output to output skew	t _{osLH} t _{osHL}	(Note11)	1.8	—	0.5	ns		
			2.5 ± 0.2	—	0.5			
			3.3 ± 0.3	—	0.5			

For C_L = 50 pF, add approximately 300 ps to the AC maximum specification.

Note11: This parameter is guaranteed by design.

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

Dynamic Switching Characteristics (Ta = 25°C, Input: tr = tf = 2.0 ns, CL = 30 pF)

Characteristics	Symbol	Test Condition		Typ.	Unit
			VCC (V)		
Quiet output maximum dynamic VOL	VOLP	VIH = 1.8 V, VIL = 0 V	(Note12) 1.8	0.25	V
		VIH = 2.5 V, VIL = 0 V	(Note12) 2.5	0.6	
		VIH = 3.3 V, VIL = 0 V	(Note12) 3.3	0.8	
Quiet output minimum dynamic VOL	VOLV	VIH = 1.8 V, VIL = 0 V	(Note12) 1.8	-0.25	V
		VIH = 2.5 V, VIL = 0 V	(Note12) 2.5	-0.6	
		VIH = 3.3 V, VIL = 0 V	(Note12) 3.3	-0.8	
Quiet output minimum dynamic VOH	VOHV	VIH = 1.8 V, VIL = 0 V	(Note12) 1.8	1.5	V
		VIH = 2.5 V, VIL = 0 V	(Note12) 2.5	1.9	
		VIH = 3.3 V, VIL = 0 V	(Note12) 3.3	2.2	

Note12: This parameter is guaranteed by design.

Capacitive Characteristics (Ta = 25°C)

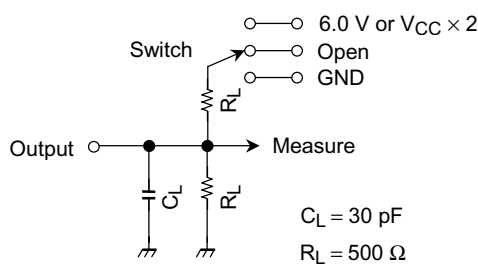
Characteristics	Symbol	Test Condition		Typ.	Unit
			VCC (V)		
Input capacitance	CIN	—	1.8, 2.5, 3.3	6	pF
Output capacitance	CO	—	1.8, 2.5, 3.3	7	pF
Power dissipation capacitance	C _{PD}	f _{IN} = 10 MHz	(Note13) 1.8, 2.5, 3.3	20	pF

Note13: 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:

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

AC Test Circuit



Parameter	Switch
t _{pLH} , t _{pHL}	Open
t _{pLZ} , t _{pZL}	6.0 V @V _{CC} = 3.3 ± 0.3 V V _{CC} × 2 @V _{CC} = 2.5 ± 0.2 V @V _{CC} = 1.8 V
t _{pHZ} , t _{pZH}	GND

Figure 1

AC Waveform

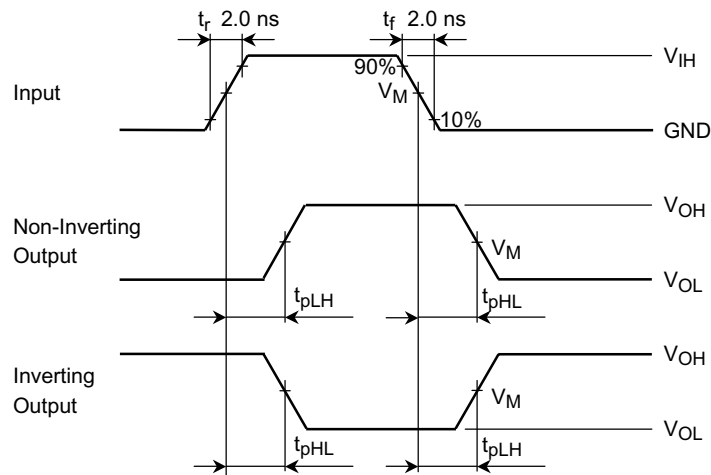
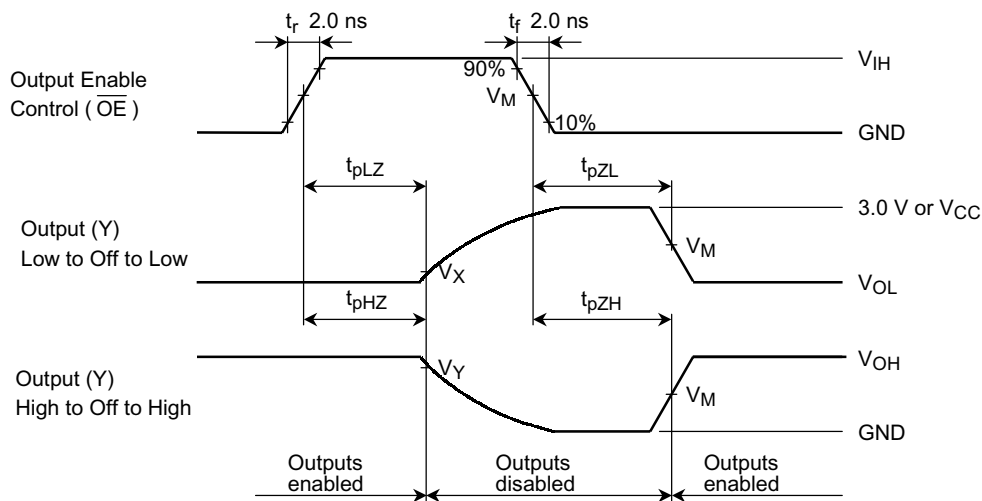


Figure 2 t_{pLH} , t_{pHL}



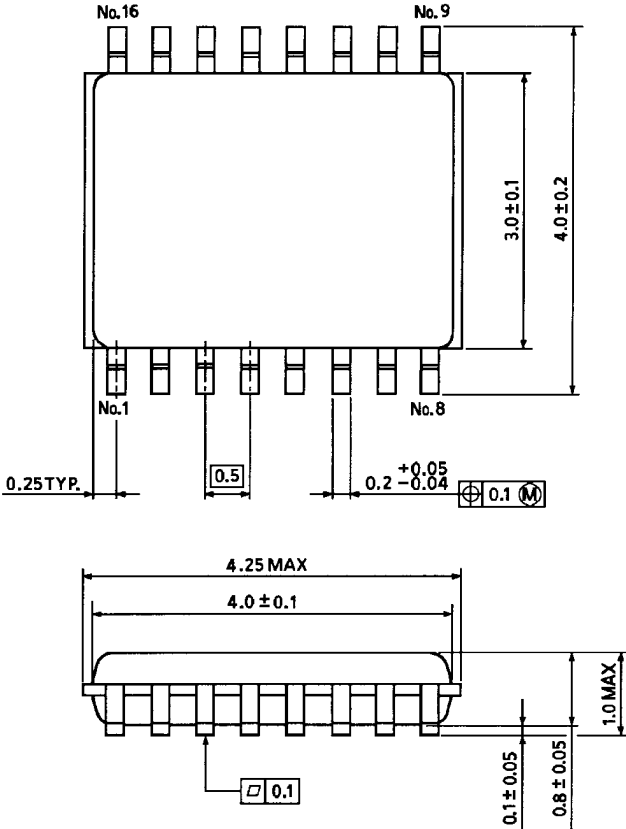
Symbol	V_{CC}		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$
V_X	$V_{OL} + 0.3 \text{ V}$	$V_{OL} + 0.15 \text{ V}$	$V_{OL} + 0.15 \text{ V}$
V_Y	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$

Figure 3 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}

Package Dimensions

VSSOP16-P-0030-0.50

Unit : mm



Weight: 0.02 g (typ.)