

TC7MZ4051FK,TC7MZ4052FK,TC7MZ4053FK

TC7MZ4051FK 8-Channel Analog Multiplexer/Demultiplexer

TC7MZ4052FK Dual 4-Channel Analog Multiplexer/Demultiplexer

TC7MZ4053FK Triple 2-Channel Analog Multiplexer/Demultiplexer

The TC7MZ4051/4052/4053FK are high-speed, low-voltage drive analog multiplexer/demultiplexers using silicon gate CMOS technology. In 3 V and 5 V systems these can achieve high-speed operation with the low power dissipation that is a feature of CMOS.

The TC7MZ4051/4052/4053FK offer analog/digital signal selection as well as mixed signals. The 4051 has an 8-channel configuration, the 4052 has an 4-channel \times 2 configuration, and the 4053 has a 2-channel \times 3 configuration.

The switches for each channel are turned ON by the control pin digital signals.

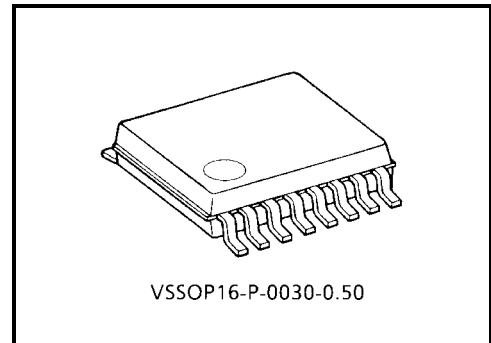
Although the control signal logical amplitude ($V_{CC} - GND$) is small, the device can perform large-amplitude ($V_{CC} - V_{EE}$) signal switching.

For example, if $V_{CC} = 3\text{ V}$, $GND = 0\text{ V}$, and $V_{EE} = -3\text{ V}$, signals between -3 V and $+3\text{ V}$ can be switched from the logical circuit using a single 3 V power supply.

All input pins are equipped with a newly developed input protection circuit that avoids the need for a diode on the plus side (forward side from the input to the V_{CC}). As a result, for example, 5 V signals can be permitted on the inputs even when the power supply voltage to the circuits is off. As a result of this input power protection, the TC7MZ4051/4052/4053FK can be used in a variety of applications, including in the system which has two power supplies, and in battery backup circuits.

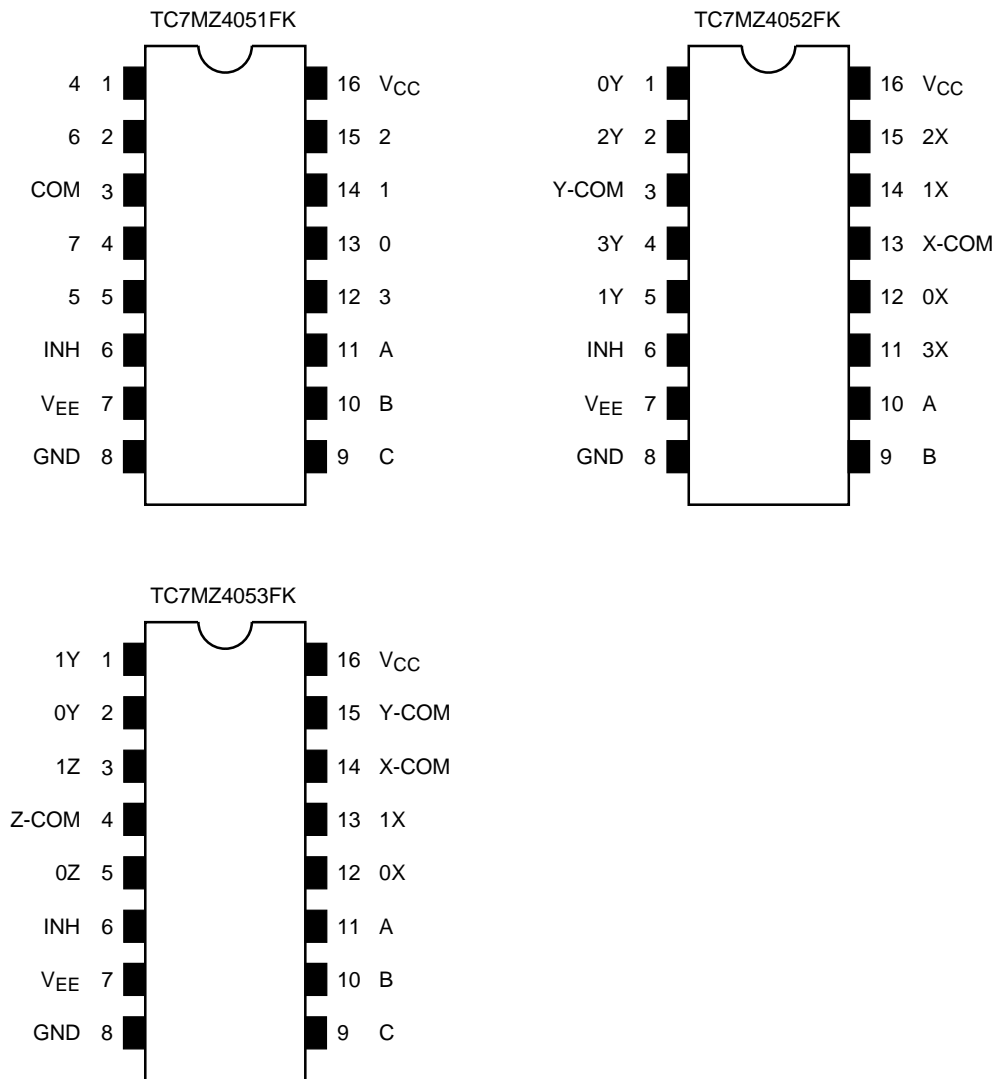
Features

- Low ON resistance: $R_{on} = 22\ \Omega$ (typ.) ($V_{CC} - V_{EE} = 3\text{ V}$)
 $R_{on} = 15\ \Omega$ (typ.) ($V_{CC} - V_{EE} = 6\text{ V}$)
- High speed: $t_{pd} = 3\text{ ns}$ (typ.) ($V_{CC} = 3.0\text{ V}$)
- Low power dissipation: $I_{CC} = 4\ \mu\text{A}$ (max) ($T_a = 25^\circ\text{C}$)
- Input level: $V_{IL} = 0.8\text{ V}$ (max) ($V_{CC} = 3\text{ V}$)
 $V_{IH} = 2.0\text{ V}$ (min) ($V_{CC} = 3\text{ V}$)
- Power down protection is provided on all control inputs
- Pin and function compatible with 74HC4051/4052/4053



Weight: 0.02 g (typ.)

Pin Assignment (top view)



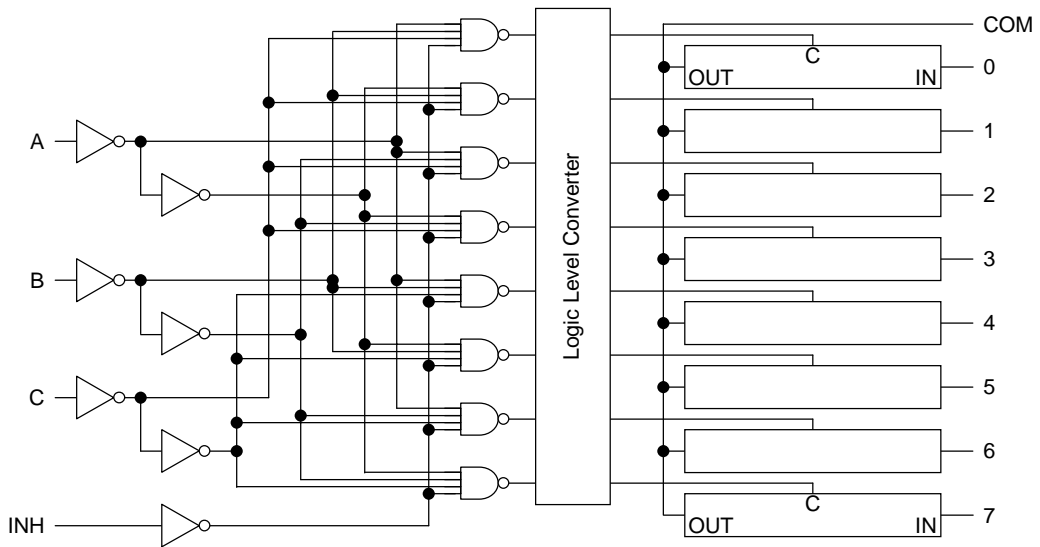
Truth Table

Control Inputs				"ON" Channel		
Inhibit	C*	B	A	MZ4051FK	MZ4052FK	MZ4053FK
L	L	L	L	0	0X, 0Y	0X, 0Y, 0Z
L	L	L	H	1	1X, 1Y	1X, 0Y, 0Z
L	L	H	L	2	2X, 2Y	0X, 1Y, 0Z
L	L	H	H	3	3X, 3Y	1X, 1Y, 0Z
L	H	L	L	4	—	0X, 0Y, 1Z
L	H	L	H	5	—	1X, 0Y, 1Z
L	H	H	L	6	—	0X, 1Y, 1Z
L	H	H	H	7	—	1X, 1Y, 1Z
H	X	X	X	None	None	None

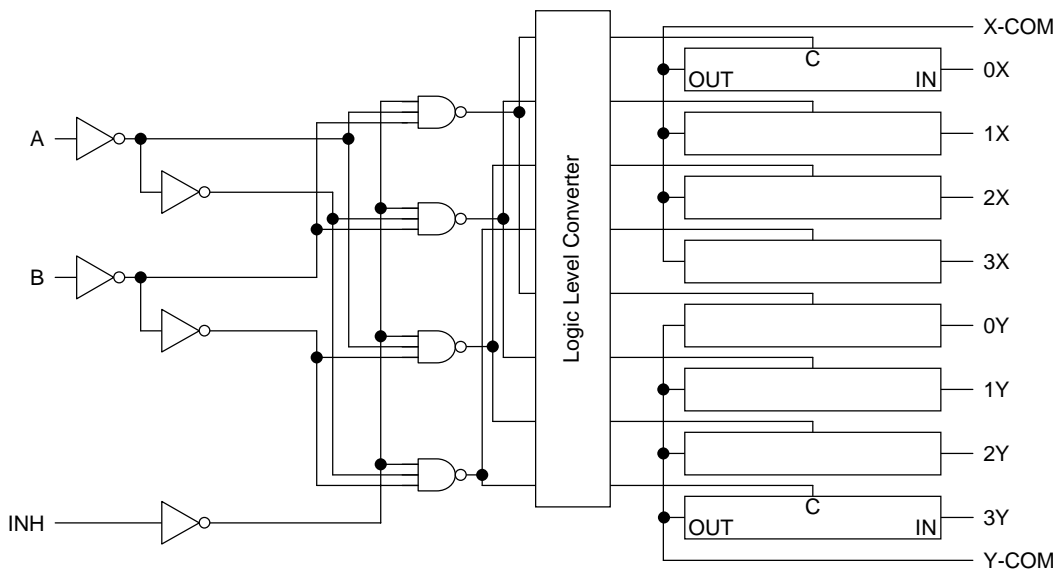
X: Don't care, *: Except MZ4052FK

System Diagram

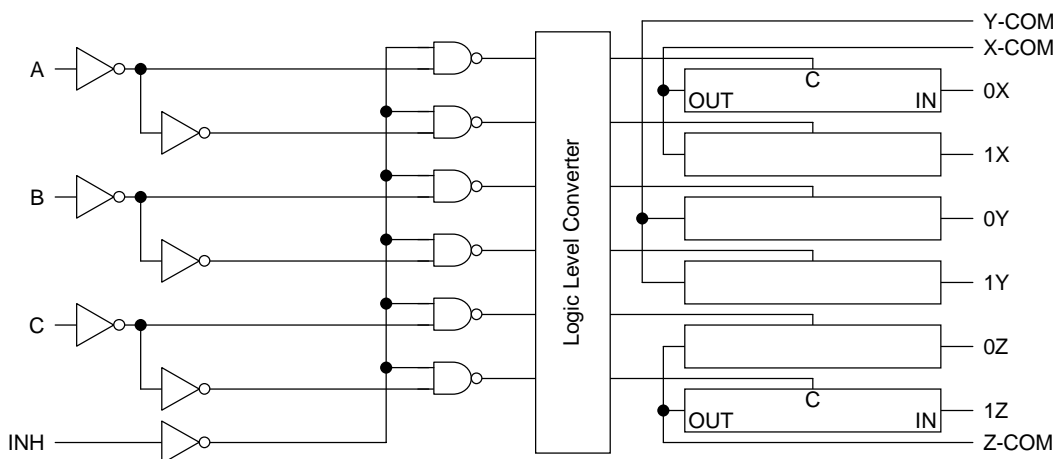
TC7MZ4051FK



TC7MZ4052FK



TC7MZ4053FK



Absolute Maximum Ratings

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	-0.5~7.0	V
	$V_{CC}-V_{EE}$	-0.5~7.0	
Control input voltage	V_{IN}	-0.5~7.0	V
Switch I/O voltage	$V_{I/O}$	$V_{EE} - 0.5 \sim V_{CC} + 0.5$	V
Input diode current	I_{IK}	-20	mA
I/O diode current	I_{IOK}	± 20	mA
Switch through current	I_T	± 25	mA
DC V_{CC} or ground current	I_{CC}	± 50	mA
Power dissipation	P_D	180	mW
Storage temperature	T_{stg}	-65~150	$^{\circ}C$

Recommended Operating Conditions

Characteristics	Symbol	Rating	Unit
Power supply voltage	V_{CC}	2~6	V
	V_{EE}	-4~0	
	$V_{CC}-V_{EE}$	2~6	
Input voltage	V_{IN}	0~6.0	V
Switch I/O voltage	$V_{I/O}$	$V_{EE} \sim V_{CC}$	V
Operating temperature	T_{opr}	-40~85	$^{\circ}C$
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 Electrical Characteristics

Characteristics		Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit			
				V _{EE} (V)	V _{CC} (V)	Min	Typ.	Max		Min	Max	
Input voltage	High-level	V _{IH}	—		2.0	1.5	—	—	1.5	—	V	
					3.0	2.0	—	—	2.0	—		
					4.5	3.15	—	—	3.15	—		
					6.0	4.2	—	—	4.2	—		
	Low-level	V _{IL}	—			2.0	—	—	0.5	—		0.5
						3.0	—	—	0.8	—		0.8
						4.5	—	—	1.35	—		1.35
						6.0	—	—	1.8	—		1.8
ON resistance	R _{ON}	V _{IN} = V _{IL} or V _{IH} V _{I/O} = V _{CC} to V _{EE} I _{I/O} = 2 mA		GND	2.0	—	200	—	—	—	Ω	
				GND	3.0	—	45	86	—	108		
				GND	4.5	—	24	37	—	46		
				-3.0	3.0	—	17	26	—	33		
		V _{IN} = V _{IL} or V _{IH} V _{I/O} = V _{CC} or V _{EE} I _{I/O} = 2 mA		GND	2.0	—	28	73	—	84		
				GND	3.0	—	22	38	—	44		
				GND	4.5	—	17	27	—	31		
				-3.0	3.0	—	15	24	—	28		
Difference of ON resistance between switches	ΔR _{ON}	V _{IN} = V _{IL} or V _{IH} V _{I/O} = V _{CC} to V _{EE} I _{I/O} = 2 mA		GND	2.0	—	10	25	—	35	Ω	
				GND	3.0	—	5	15	—	20		
				GND	4.5	—	5	13	—	18		
				-3.0	3.0	—	5	10	—	15		
Input/Output leakage current (switch OFF)	I _{OFF}	V _{OS} = V _{CC} or GND V _{IS} = GND to V _{CC} V _{IN} = V _{IL} or V _{IH}		GND	3.0	—	—	±0.25	—	±2.5	μA	
				-3.0	3.0	—	—	±0.5	—	±5.0		
Input/Output leakage current (switch ON, output open)	I _{IN}	V _{OS} = V _{CC} or GND V _{IN} = V _{IL} or V _{IH}		GND	3.0	—	—	±0.25	—	±2.5	μA	
				-3.0	3.0	—	—	±0.5	—	±5.0		
Control input current	I _{IN}	V _{IN} = V _{CC} or GND		GND	6.0	—	—	±0.1	—	±0.1	μA	
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND		GND	3.0	—	—	4.0	—	40.0	μA	
				-3.0	3.0	—	—	8.0	—	80.0		

AC Electrical Characteristics ($C_L = 50 \text{ pF}$, Input: $t_r = t_f = 3 \text{ ns}$, $GND = 0 \text{ V}$)

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40~85°C		Unit		
				V _{EE} (V)	V _{CC} (V)	Min	Typ.	Max		Min	Max
Phase difference between input and output	$\phi_{I/O}$	All types		GND	2.0	—	3.2	6.0	—	6.9	ns
				GND	3.0	—	1.8	3.0	—	3.5	
				GND	4.5	—	1.3	1.8	—	2.1	
				-3.0	3.0	—	1.1	1.3	—	1.5	
Output enable time	t_{pZL} t_{pZH}	Figure 1 (Note 1)		GND	2.0	—	9.0	17	—	20	ns
				GND	3.0	—	5.7	9.0	—	11	
				GND	4.5	—	4.5	6.0	—	7.0	
				-3.0	3.0	—	5.8	8.0	—	10	
Output disable time	t_{pLZ} t_{pHZ}	Figure 1 (Note 1)		GND	2.0	—	13.5	21	—	25	ns
				GND	3.0	—	11.3	15	—	18	
				GND	4.5	—	10.3	12	—	14	
				-3.0	3.0	—	10.9	13	—	15	
Control input capacitance	C_{in}	All types (Note 2)		—	—	—	5	10	—	10	pF
COMMON terminal capacitance	C_{IS}	4051	Figure 2 (Note 2)	-3.0	3.0	—	11	25	—	25	pF
		4052					9	20		20	
		4053					7	15		15	
SWITCH terminal capacitance	C_{OS}	4051	Figure 2 (Note 2)	-3.0	3.0	—	6	13	—	13	pF
		4052					6	13		13	
		4053					6	13		13	
Feedthrough capacitance	C_{IOS}	4051	Figure 2 (Note 2)	-3.0	3.0	—	3	6	—	6	pF
		4052					3	6		6	
		4053					3	6		6	
Power dissipation capacitance	C_{PD}	4051	Figure 2 (Note 3)	GND	6.0	—	14	—	—	—	pF
		4052					24				
		4053					18				

Note1: $R_L = 1 \text{ k}\Omega$

Note2: C_{in} , C_{IS} , C_{OS} and C_{IOS} are guaranteed by the design.

Note3: C_{PD} is defined as the value of the internal equivalent capacitance of IC which is calculated from the operating current consumption without load.

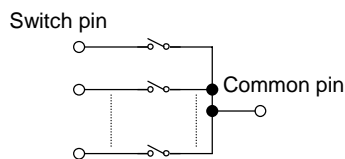
Average operating current can be obtained by the equation:

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

*Analog Switch Characteristics (GND = 0 V, Ta = 25°C)

Characteristics	Symbol	Test Condition		Typ.	Unit		
		V_{EE} (V)	V_{CC} (V)				
Sine Wave Distortion (T.H.D)		$R_L = 10\text{ k}\Omega$, $C_L = 50\text{ pF}$, $f_{IN} = 1\text{ kHz}$	$V_{IN} = 2.0\text{ V}_{p-p}$	0	3.0	0.100	%
			$V_{IN} = 4.0\text{ V}_{p-p}$	0	4.5	0.030	
			$V_{IN} = 6.0\text{ V}_{p-p}$	-0.3	3.0	0.020	
Frequency response (switch ON)	f_{max}	$R_L = 50\ \Omega$, $C_L = 10\text{ pF}$, $f_{IN} = 1\text{ MHz}$, sine wave Figure 3	4051	0	3.0	150	MHz
			4052			180	
			4053			200	
			4051	0	4.5	150	
			4052			180	
			4053			200	
			4051	-3.0	3.0	150	
			4052			180	
			4053			200	
Feed through attenuation (switch OFF)		V_{IN} is centered at $(V_{CC} - V_{EE})/2$. Adjust input for 0dBm. $R_L = 600\ \Omega$, $C_L = 50\text{ pF}$, $f_{IN} = 1\text{ MHz}$, sine wave Figure 4	0	3.0	-45	dB	
			0	4.5	-45		
			-3.0	3.0	-45		
			0	3.0	-60		
			0	4.5	-60		
			-3.0	3.0	-60		
Crosstalk (control input to signal output)		$R_L = 600\ \Omega$, $C_L = 50\text{ pF}$, $f_{IN} = 1\text{ MHz}$, square wave ($t_r = t_f = 6\text{ ns}$) Figure 5	0	3.0	90	mV	
			0	4.5	150		
			-3.0	3.0	120		
Crosstalk (between any switches)		Adjust V_{IN} to obtain 0dBm at input. $R_L = 600\ \Omega$, $C_L = 50\text{ pF}$, $f_{IN} = 1\text{ MHz}$, sine wave Figure 6	0	3.0	-45	dB	
			0	4.5	-45		
			-3.0	3.0	-45		

*: These characteristics are determined by design of devices.



AC Test Circuit

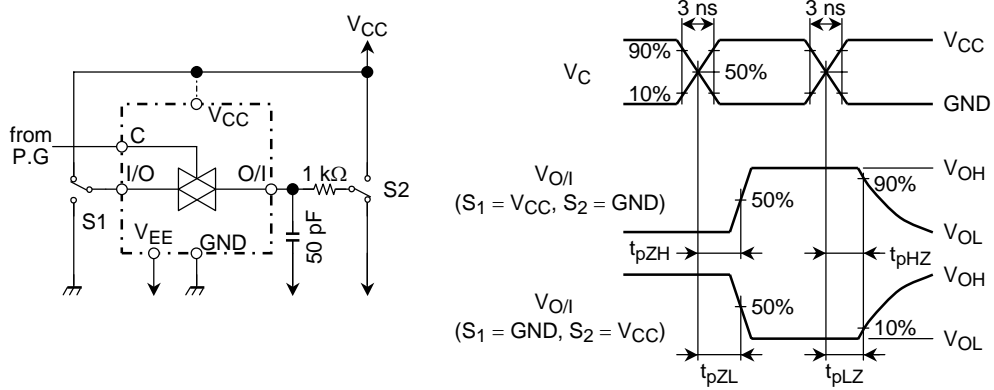


Figure 1 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}

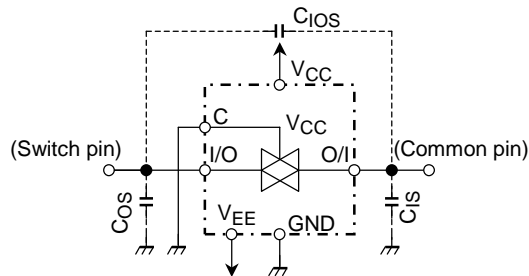


Figure 2 C_{IOS} , C_{IS} , C_{OS}

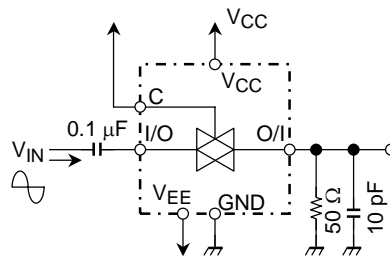


Figure 3 Frequency Response (switch on)

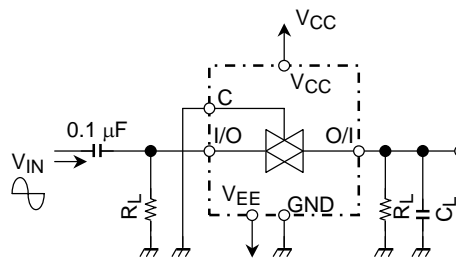


Figure 4 Feedthrough

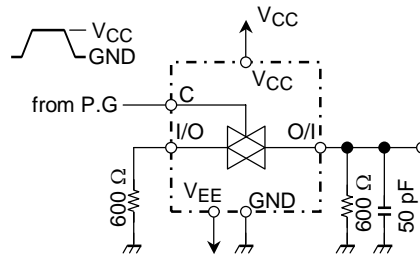


Figure 5 Cross Talk (control input to output signal)

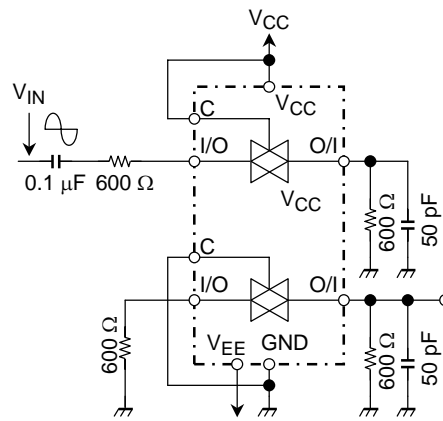
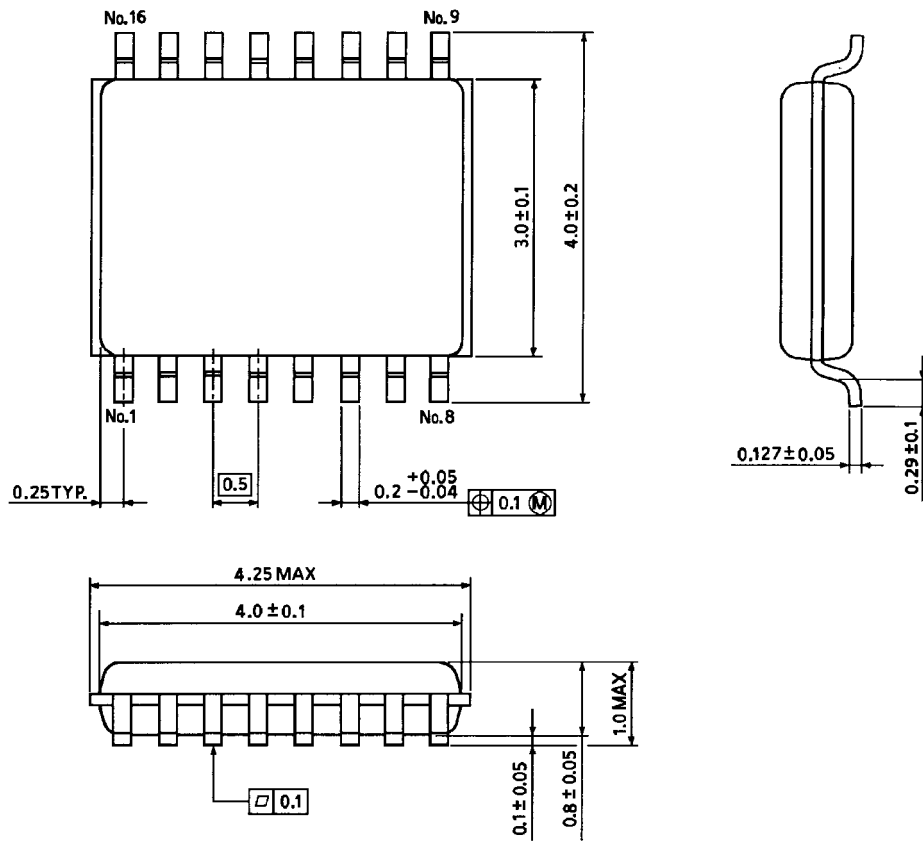


Figure 6 Cross Talk (between any two switches)

Package Dimensions

VSSOP16-P-0030-0.50

Unit : mm



Weight: 0.02 g (typ.)

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