

TC74LVX4051FT, TC74LVX4052FT, TC74LVX4053FT

TC74LVX4051FT 8-Channel Analog Multiplexer/Demultiplexer

TC74LVX4052FT Dual 4-Channel Analog Multiplexer/Demultiplexer

TC74LVX4053FT Triple 2-Channel Analog Multiplexer/Demultiplexer

The TC74LVX4051/4052/4053FT 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 TC74LVX4051/4052/4053FT 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.

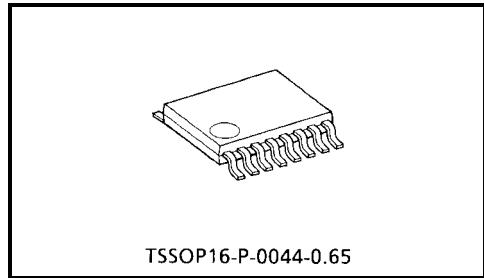
Although the control signal logical amplitude (VCC – GND) is small, the device can perform large-amplitude (VCC – VEE) signal switching.

For example, if VCC = 3 V, GND = 0 V, and VEE = -3 V, signals between -3 V and +3 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 VCC). 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 TC74LVX4051/4052/4053FT 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.) (VCC – VEE = 3 V)
 $R_{on} = 15 \Omega$ (typ.) (VCC – VEE = 6 V)
- High speed: $tpd = 3$ ns (typ.) (VCC = 3.0 V)
- Low power dissipation: $I_{CC} = 4 \mu A$ (max) (Ta = 25°C)
- Input level: $V_{IL} = 0.8$ V (max) (VCC = 3 V)
 $V_{IH} = 2.0$ V (min) (VCC = 3 V)
- Power down protection is provided on all control inputs
- Pin and function compatible with 74HC4051/4052/4053



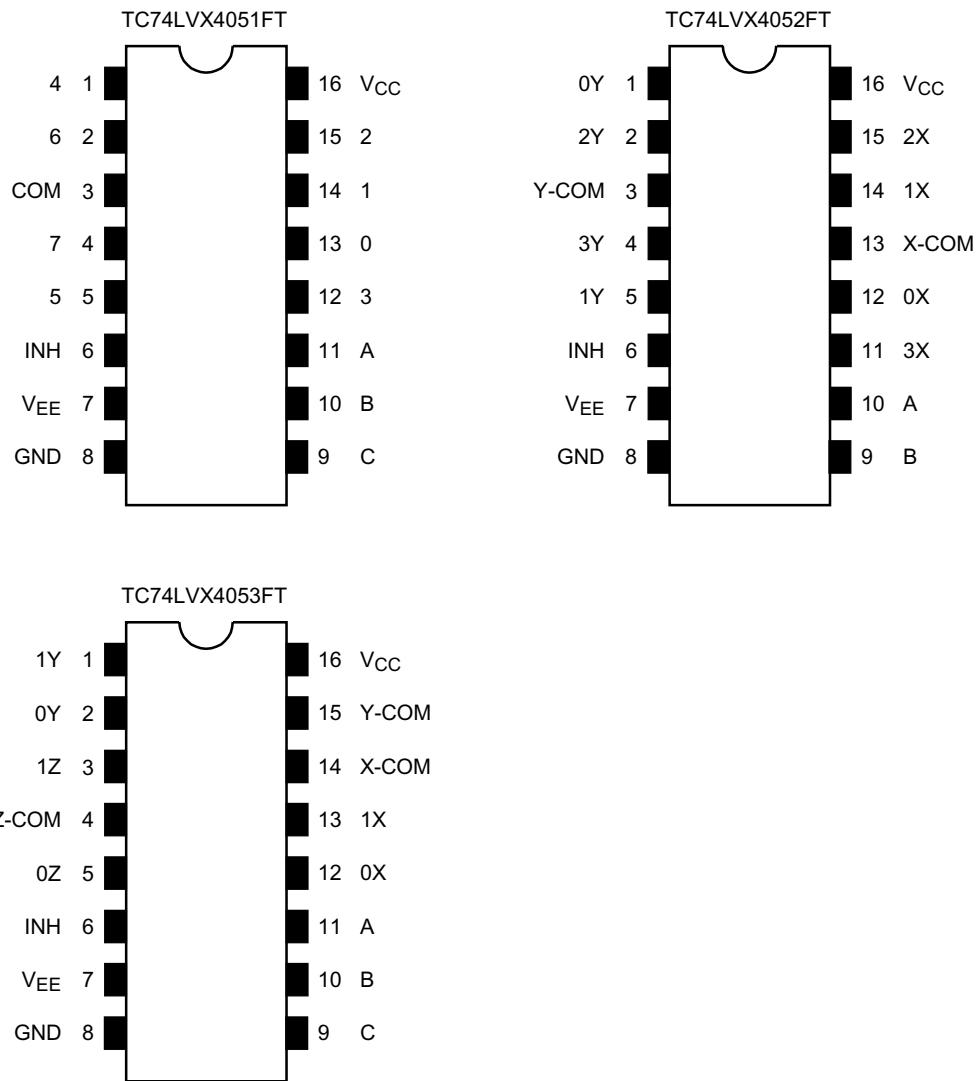
TSSOP16-P-0044-0.65

Weight: 0.06 g (typ.)

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Pin Assignment (top view)



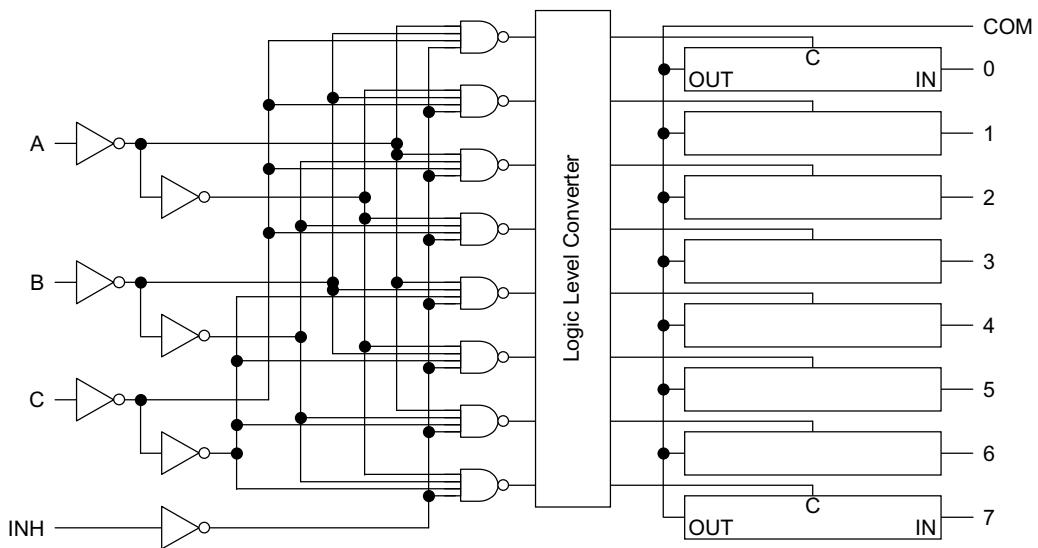
Truth Table

Control Inputs				"ON" Channel		
Inhibit	C*	B	A	LVX4051FT	LVX4052FT	LVX4053FT
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

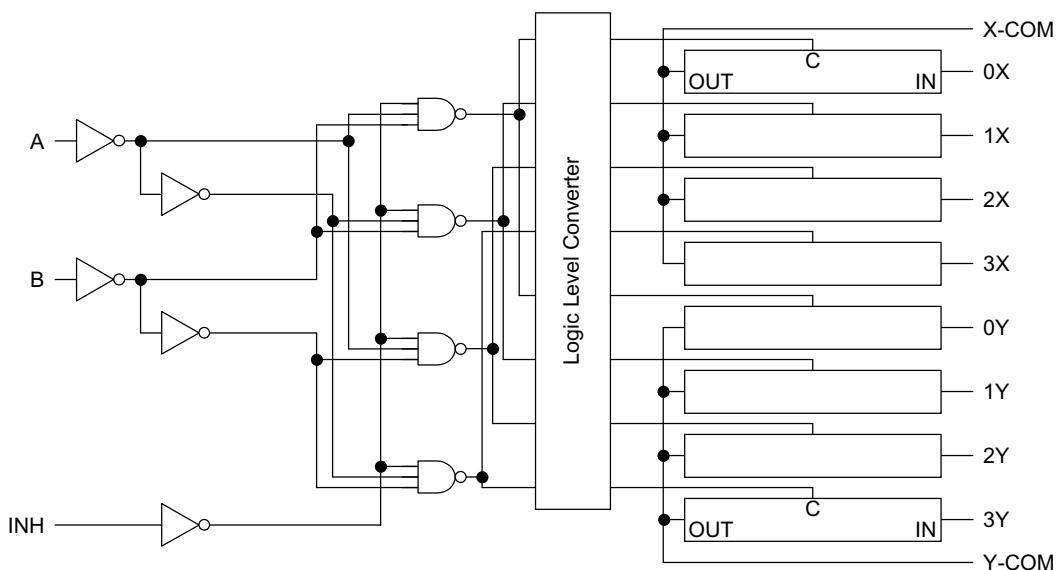
X: Don't care, *: Except LVX4052FT

System Diagram

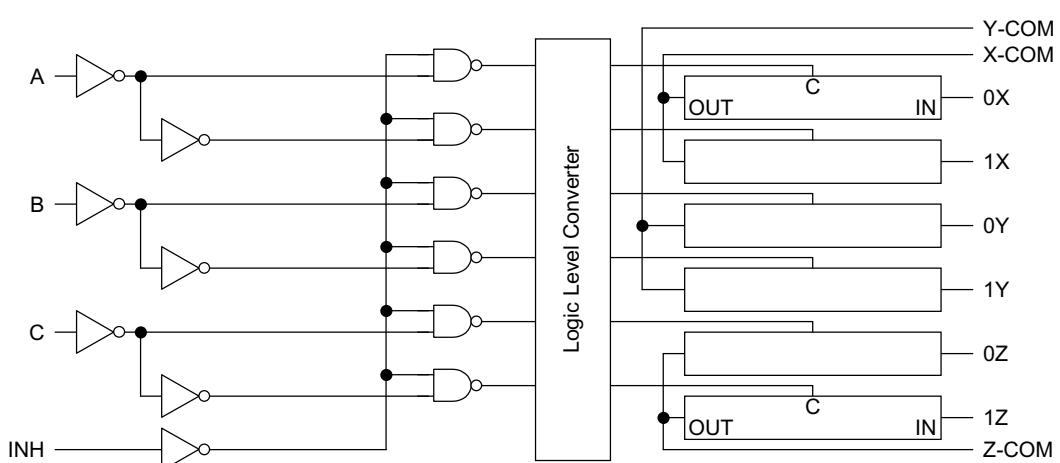
TC74LVX4051FT



TC74LVX4052FT



TC74LVX4053FT



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~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	°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} ~V _{CC}	V
Operating temperature	T _{opr}	-40~85	°C
Input rise and fall time	dt/dv	0~100 (V _{CC} = 3.3 ± 0.3 V)	ns/V
		0~20 (V _{CC} = 5 ± 0.5 V)	

Electrical Characteristics

DC Electrical Characteristics

Characteristics		Symbol	Test Condition	V _{EE} (V)	V _{CC} (V)	Ta = 25°C			Ta = -40~85°C		Unit
						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 V)

Characteristics	Symbol	Test Condition	Ta = 25°C			Ta = -40~85°C		Unit	
			V_{EE} (V)	V_{CC} (V)	Min	Typ.	Max		
Phase difference between input and output	ϕ I/O	All types	GND	2.0	—	3.2	6.0	—	6.9
			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
			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
			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}	Figure 2 (Note 2)	—3.0	3.0	—	11	25	—	25 pF
						9	20		20
						7	15		15
SWITCH terminal capacitance	C_{OS}	Figure 2 (Note 2)	—3.0	3.0	—	6	13	—	13 pF
						6	13		13
						6	13		13
Feedthrough capacitance	C_{IOS}	Figure 2 (Note 2)	—3.0	3.0	—	3	6	—	6 pF
						3	6		6
						3	6		6
Power dissipation capacitance	C_{PD}	Figure 2 (Note 3)	GND	6.0	—	14	—	—	pF
						24			
						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.

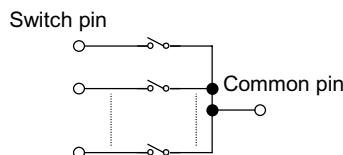
Average operating current can be obtained by the equation:

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

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

Characteristics	Symbol	Test Condition	V _{EE} (V)	V _{CC} (V)	Typ.	Unit	
Sine Wave Distortion (T.H.D)		$R_L = 10 \text{ k}\Omega, C_L = 50 \text{ pF}, f_{IN} = 1 \text{ kHz}$	$V_{IN} = 2.0 \text{ V}_{\text{p-p}}$	0	3.0	0.100	%
			$V_{IN} = 4.0 \text{ V}_{\text{p-p}}$	0	4.5	0.030	
			$V_{IN} = 6.0 \text{ V}_{\text{p-p}}$	-0.3	3.0	0.020	
Frequency response (switch ON)	f_{max}	Adjust f_{IN} voltage to obtain 0dBm at V_{OS} .	4051	0	3.0	150	MHz
			4052			180	
			4053			200	
		Increase f_{IN} frequency until dB meter reads -3dB.	4051	0	4.5	150	
			4052			180	
			4053			200	
		Figure 3	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		
		$R_L = 50 \Omega, C_L = 10 \text{ pF}, f_{IN} = 1 \text{ MHz, sine wave}$	0	4.5	-60		
			-3.0	3.0	-60		
			0	3.0	90	mV	
			0	4.5	150		
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	-3.0	3.0	120	mV	
			0	3.0	-45		
			0	4.5	-45		
		Figure 6	-3.0	3.0	-45	dB	
			0	3.0	-45		
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	4.5	-45	dB	
			-3.0	3.0	-45		
			0	3.0	-45		
			-3.0	3.0	-45		

*: These characteristics are determined by design of devices.



AC Test Circuit

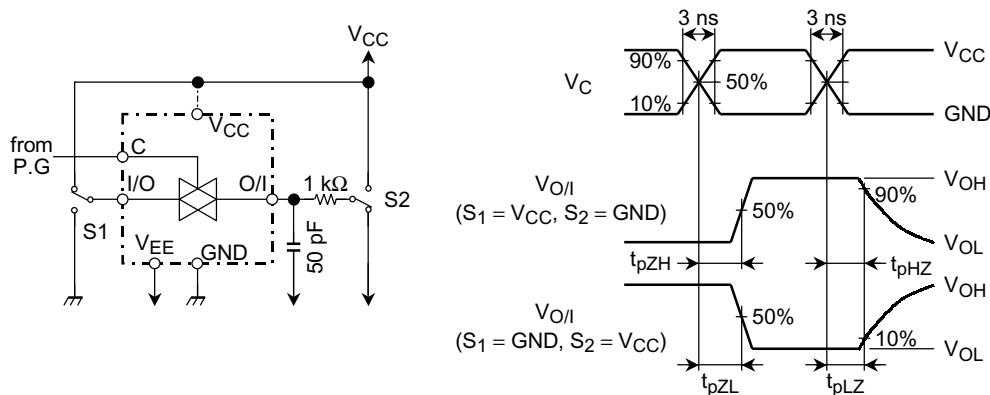


Figure 1 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}

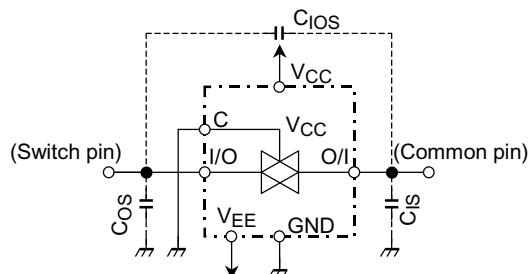


Figure 2 C_{lOS} , C_{lIs} , C_{lOs}

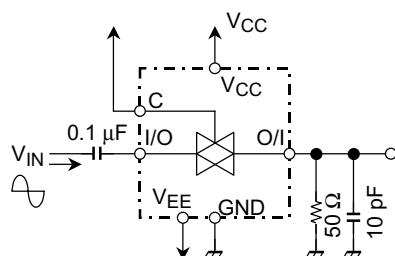


Figure 3 Frequency Response (switch on)

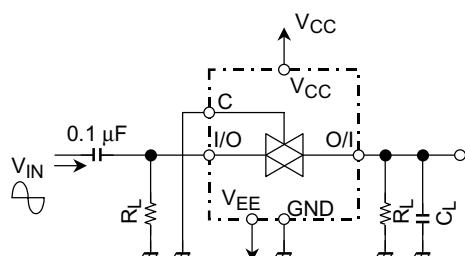


Figure 4 Feedthrough

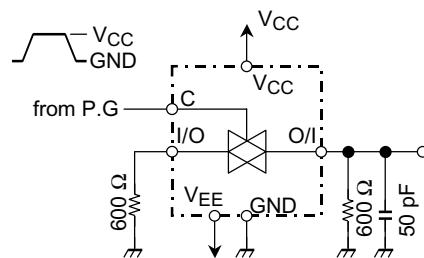


Figure 5 Cross Talk (control input to output signal)

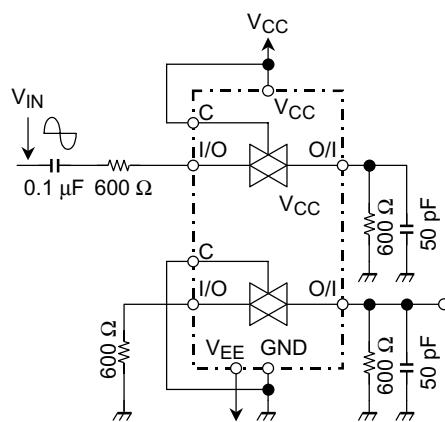
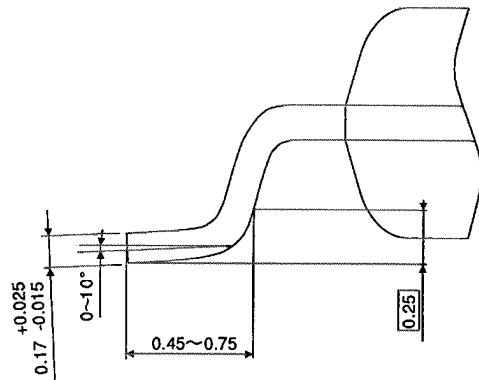
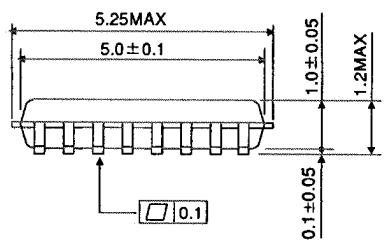
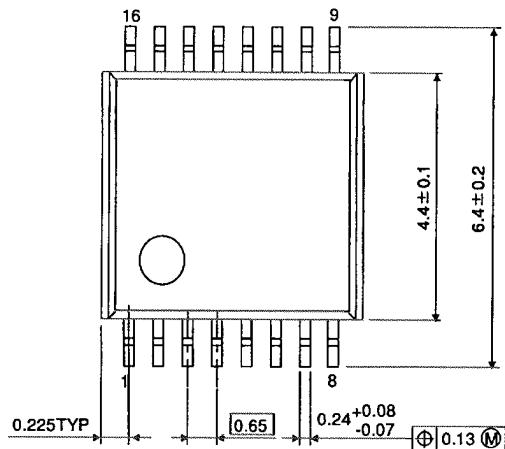


Figure 6 Cross Talk (between any two switches)

Package Dimensions

TSSOP16-P-0044-0.65

Unit : mm



Weight: 0.06 g (typ.)