

TC74HCT4053AF, TC74HCT4053AFN, TC74HCT4053AFT

Triple 2-Channel Analog Multiplexer/Demultiplexer

The TC74HCT4053A are high speed CMOS ANALOG MULTIPLEXER/DEMULTIPLEXER fabricated with silicon gate C²MOS technology. They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

This device may be used as a level converter for interfacing TTL or NMOS to High Speed CMOS. This inputs are compatible with TTL, NMOS and CMOS output voltage levels.

The TC74HCT4053A has a 2 channel × 3 configuration.

The digital signal to the control terminal turns "ON" the corresponding switch of each channel a large amplitude signal ($V_{CC} - V_{EE}$) can then be switched by the small logical amplitude ($V_{CC} - GND$) control signal.

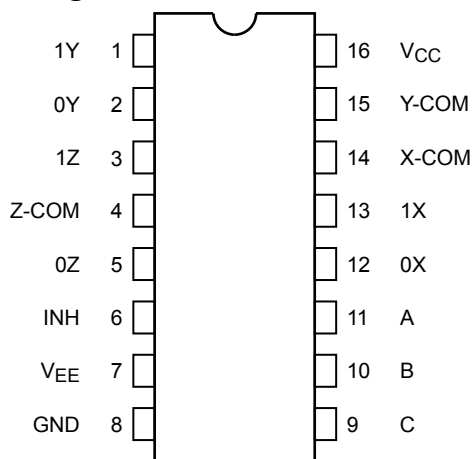
For example, in the case of $V_{CC} = 5\text{ V}$, $GND = 0\text{ V}$, $V_{EE} = -5\text{ V}$, signals between -5 V and $+5\text{ V}$ can be switched from the logical circuit with a single power supply of 5 V . As the ON-resistance of each switch is low, they can be connected to circuits with low input impedance.

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

Features

- High speed: $t_{pd} = 30\text{ ns}$ (typ.) at $V_{CC} = 5\text{ V}$
 $V_{EE} = 0\text{ V}$
- Low power dissipation: $I_{CC} = 4\text{ }\mu\text{A}$ (max) at $T_a = 25^\circ\text{C}$
- Compatible with TTL output: $V_{IH} = 2.0\text{ V}$ (min)
 $V_{IL} = 0.8\text{ V}$ (max)
- Wide interfacing ability: LSTTL, NMOS, CMOS
- Low ON resistance: $R_{ON} = 50\text{ }\Omega$ (typ.) at $V_{CC} - V_{EE} = 9\text{ V}$
- High noise immunity: $THD = 0.02\%$ (typ.) at $V_{CC} - V_{EE} = 9\text{ V}$
- Pin and function compatible with 4053B

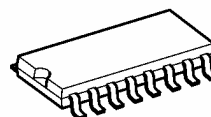
Pin Assignment



(top view)

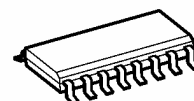
Note: xxxFN (JEDEC SOP) is not available in Japan.

TC74HCT4053AF



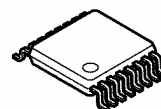
SOP16-P-300-1.27A

TC74HCT4053AFN



SOL16-P-150-1.27

TC74HCT4053AFT



TSSOP16-P-0044-0.65A

Weight

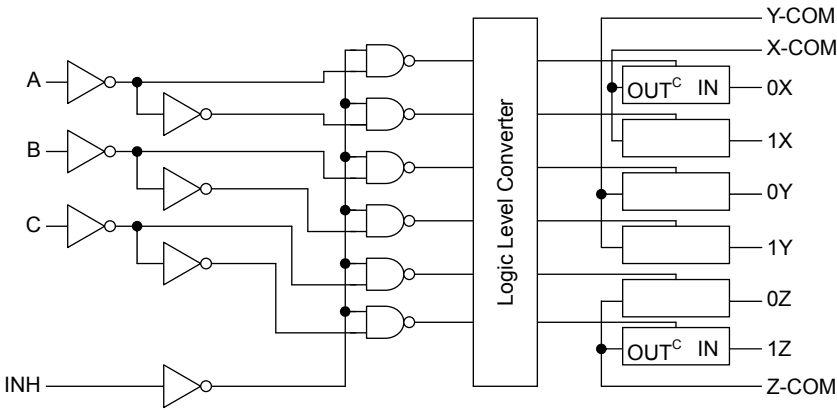
SOP16-P-300-1.27A	: 0.18 g (typ.)
SOL16-P-150-1.27	: 0.13 g (typ.)
TSSOP16-P-0044-0.65A	: 0.06 g (typ.)

Truth Table

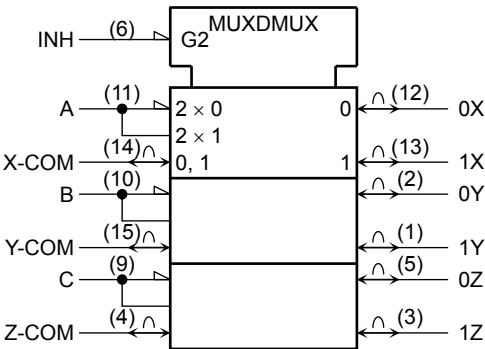
Control Inputs				"ON" Channel
Inhibit	C	B	A	HCT4053A
L	L	L	L	0X, 0Y, 0Z
L	L	L	H	1X, 0Y, 0Z
L	L	H	L	0X, 1Y, 0Z
L	L	H	H	1X, 1Y, 0Z
L	H	L	L	0X, 0Y, 1Z
L	H	L	H	1X, 0Y, 1Z
L	H	H	L	0X, 1Y, 1Z
L	H	H	H	1X, 1Y, 1Z
H	X	X	X	NONE

X: Don't care

System Diagram



IEC Logic Symbol



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	-0.5 to 13	V
Supply voltage range	$V_{CC} - V_{EE}$	-0.5 to 13	V
Control input voltage	V_{IN}	-0.5 to $V_{CC} + 0.5$	V
Switch I/O voltage	$V_{I/O}$	$V_{EE} - 0.5$ to $V_{CC} + 0.5$	V
Control input diode current	I_{ICK}	± 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 to 150	°C

Note: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	4.5 to 12	V
Supply voltage range	V_{EE}	-7.5 to 0	V
Supply voltage range	$V_{CC} - V_{EE}$	4.5 to 12	V
Control input voltage	V_{IN}	0 to V_{CC}	V
Switch I/O voltage	$V_{I/O}$	V_{EE} to V_{CC}	V
Operating temperature	T_{opr}	-40 to 85	°C
Control input rise and fall time	t_r, t_f	0 to 500	ns

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused control inputs must be tied to either VCC or GND.

Electrical Characteristics
DC Characteristics

Characteristics	Symbol	Test Condition			Ta = 25°C			Ta = −40 to 85°C		Unit	
			V _{EE} (V)	V _{CC} (V)	Min	Typ.	Max	Min	Max		
High-level control input voltage	V _{IHC}				4.5 to 5.5 9.0	2.0 2.5	— —	— —	2.0 2.5	— —	V
Low-level control input voltage	V _{ILC}				4.5 to 5.5 9.0	— —	— —	0.8 0.8	— —	0.8 0.8	V
ON resistance	R _{ON}	V _{IN} = V _{ILC} or V _{IHC} V _{I/O} = V _{CC} to V _{EE} I _{I/O} ≤ 2 mA	GND	4.5	—	85	180	—	225	Ω	
			−4.5	4.5	—	55	120	—	150		
			−5.5	5.5	—	50	110	—	140		
			GND	9.0	—	55	120	—	150		
		V _{IN} = V _{ILC} or V _{IHC} V _{I/O} = V _{CC} or V _{EE} I _{I/O} ≤ 2 mA	GND	4.5	—	70	150	—	190		
			−4.5	4.5	—	50	100	—	125		
			−5.5	5.5	—	45	90	—	115		
			GND	9.0	—	50	100	—	125		
Difference of ON resistance between switches	ΔR _{ON}	V _{IN} = V _{ILC} or V _{IHC} V _{I/O} = V _{CC} to V _{EE} I _{I/O} ≤ 2 mA	GND	4.5	—	10	30	—	35	Ω	
			−4.5	4.5	—	5	12	—	15		
			−5.5	5.5	—	5	11	—	14		
Input/output leakage current (switch OFF)	I _{OFF}	V _{OS} = V _{CC} or GND	GND	5.5	—	—	±60	—	±600	nA	
		V _{IS} = GND or V _{CC}	−5.5	5.5	—	—	±100	—	±1000		
		V _{IN} = V _{ILC} or V _{IHC}									
Switch input leakage current (switch ON)	I _{IZ}	V _{OS} = V _{CC} or GND	GND	5.5	—	—	±60	—	±600	nA	
		V _{IN} = V _{ILC} or V _{IHC}	−5.5	5.5	—	—	±100	—	±1000		
Control input current	I _{IN}	V _{IN} = V _{CC} or GND	GND	5.5	—	—	±0.1	—	±1.0	μA	
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND	GND	5.5	—	—	4.0	—	40.0	μA	
			−5.5	5.5	—	—	8.0	—	80.0		
		I _C	Per input: V _{IN} = 0.5 V or 2.4 V Other input: V _{CC} or GND	GND	5.5	—	—	2.0	—	2.9	mA

AC Characteristics ($C_L = 50 \text{ pF}$, Input $t_r = t_f = 6 \text{ ns}$, GND = 0 V)

Characteristics	Symbol	Test Condition			Ta = 25°C			Ta = -40 to 85°C		Unit
			V _{EE} (V)	V _{CC} (V)	Min	Typ.	Max	Min	Max	
Phase difference between input and output	$\phi_{I/O}$		GND	4.5	—	6	12	—	15	ns
			GND	5.5	—	5	11	—	14	
			GND	9.0	—	4	—	—	—	
Output enable time	t_{pZL} t_{pZH}	(Note 1)	GND	4.5	—	33	50	—	63	ns
			GND	5.5	—	26	45	—	57	
			GND	9.0	—	17	—	—	—	
Output disable time	t_{pLZ} t_{pHZ}	(Note 1)	GND	4.5	—	45	65	—	81	ns
			GND	5.5	—	37	59	—	73	
			GND	9.0	—	26	—	—	—	
Control input capacitance	C _{in}		—	—	—	5	10	—	10	pF
COMMON terminal capacitance	C _{IS}		-5.0	5.0	—	11	20	—	20	pF
SWITCH terminal capacitance	C _{OS}		-5.0	5.0	—	7	15	—	15	pF
Feedthrough capacitance	C _{IOS}		-5.0	5.0	—	0.75	2	—	2	pF
Power dissipation capacitance	C _{PD}	(Note 2)	GND	5.0	—	67	—	—	—	pF

Note 1 $R_L = 1 \text{ k}\Omega$

Note 2: 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) (Note 1)

Characteristics	Symbol	Test Condition			Typ.	Unit	
			V _{EE} (V)	V _{CC} (V)			
Sine wave distortion (T.H.D)		R _L = 10 kΩ C _L = 50 pF f _{IN} = 1 kHz	V _{IN} = 8.0 V _{p-p} V _{IN} = 11.0 V _{p-p}	-4.5 -5.5	4.5 5.5	0.020 0.019	%
Frequency response (switch ON)	f _{MAX}	Adjust f _{IN} voltage to obtain 0dBm at V _{OS}	(Note 2)	-4.5	4.5	190	MHz
		Increase f _{IN} frequency until dB meter reads -3dB	(Note 3)			150	
		R _L = 50 Ω, C _L = 10 pF	(Note 2)	-5.5	5.5	200	
		f _{IN} = 1 MHz, Sine wave	(Note 3)			180	
Feed through attenuation (switch OFF)		V _{in} is centered at (V _{CC} - V _{EE})/2 Adjust input for 0dBm R _L = 600 Ω, C _L = 50 pF f _{IN} = 1 MHz, Sine wave		-4.5 -5.5	4.5 5.5	-50 -50	dB
Crosstalk (control input to signal output)		R _L = 600 Ω, C _L = 50 pF f _{IN} = 1 MHz, Square wave (t _r = t _f = 6 ns)		-4.5 -5.5	4.5 5.5	140 180	mV
Crosstalk (between any switches)		Adjust V _{IN} to obtain 0dBm at input R _L = 600 Ω, C _L = 50 pF f _{IN} = 1 MHz, Sine wave		-4.5 -5.5	4.5 5.5	-50 -50	dB
			R _L = 50 Ω, C _L = 15 pF f _{IN} = 100 kHz, V _{SWITCH} = 1 V _{RMS}		-4.5	4.5	-90

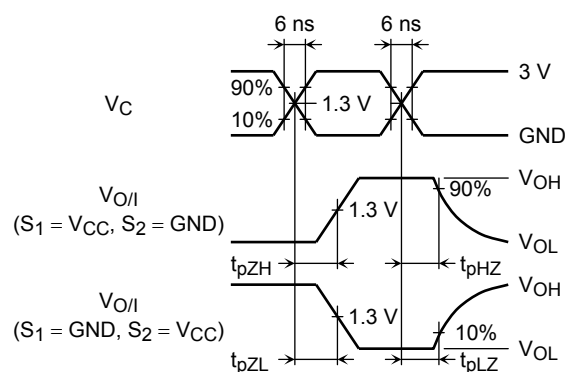
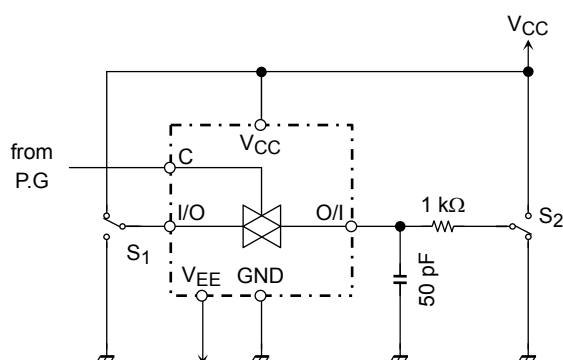
Note 1: These characteristics are determined by design of devices.

Note 2: Input COMMON terminal, and measured at SWITCH terminal.

Note 3: Input SWITCH terminal, and measured at COMMON terminal.

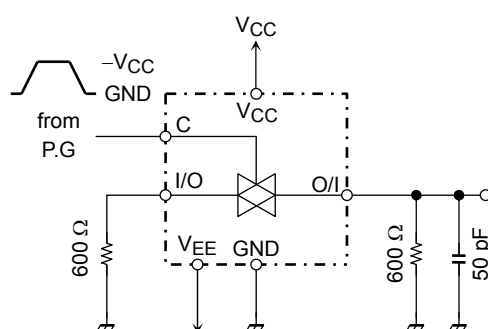
Switching Characteristics Test Circuits

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

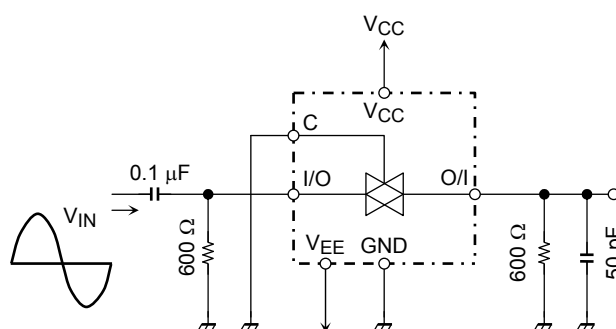


2. Cross Talk (control input – switch output)

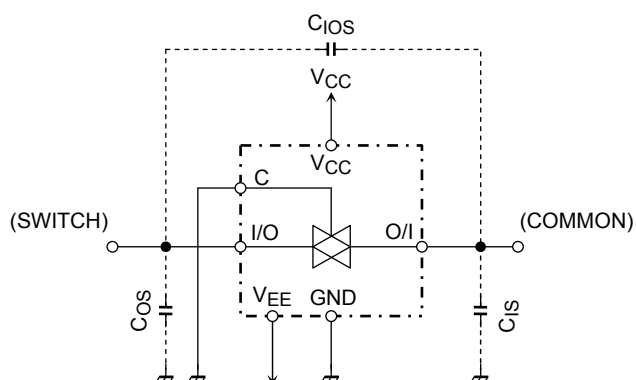
$f_{IN} = 1 \text{ MHz}$ duty = 50% $t_r = t_f = 6 \text{ ns}$



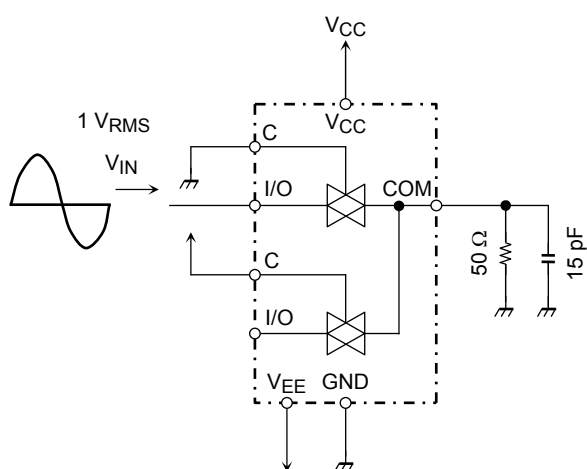
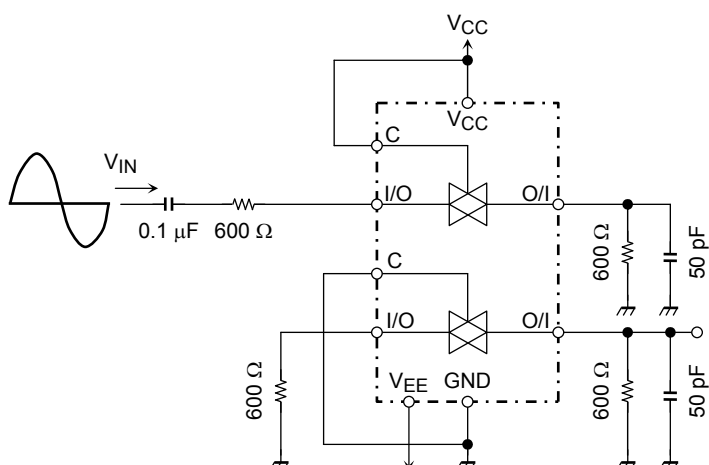
3. Feedthrough Attenuation



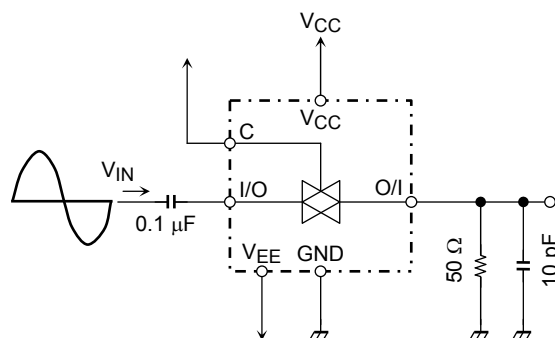
4. C_{IOS} , C_{IS} , C_{OS}



5. Cross Talk (between any two switches)



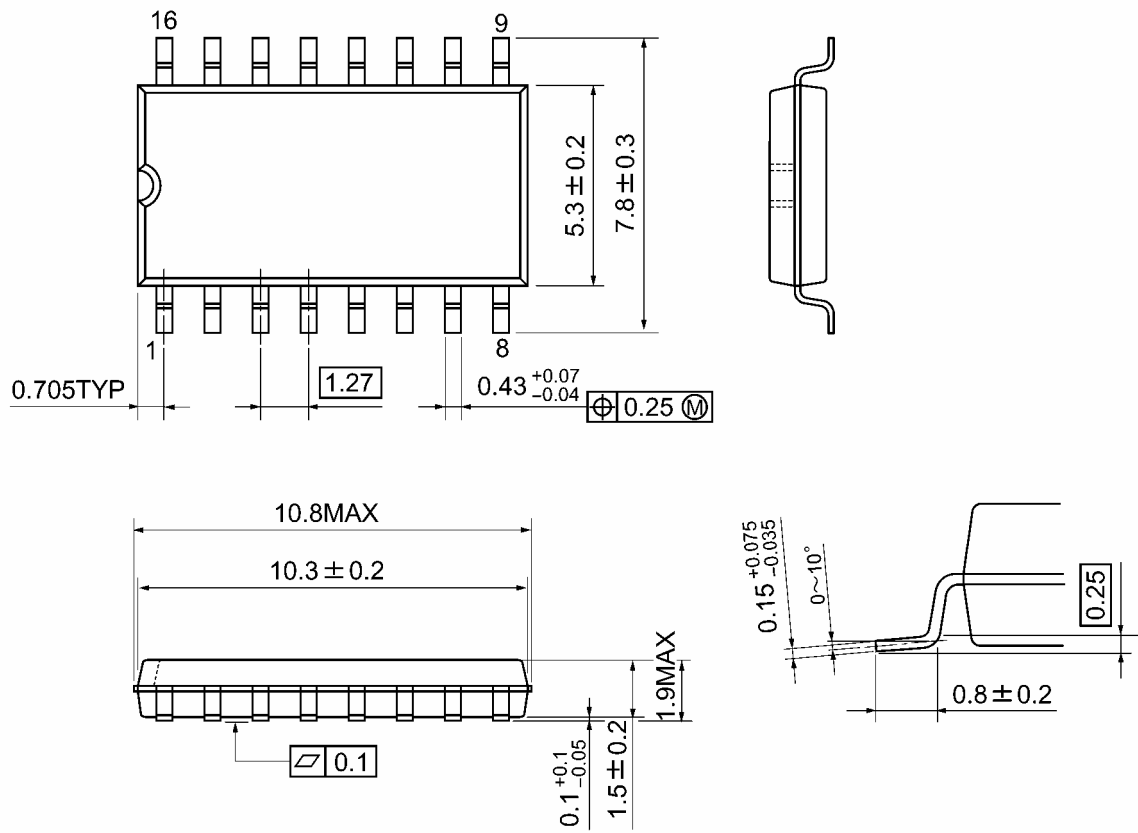
6. Frequency Response (switch ON)



Package Dimensions

SOP16-P-300-1.27A

Unit: mm

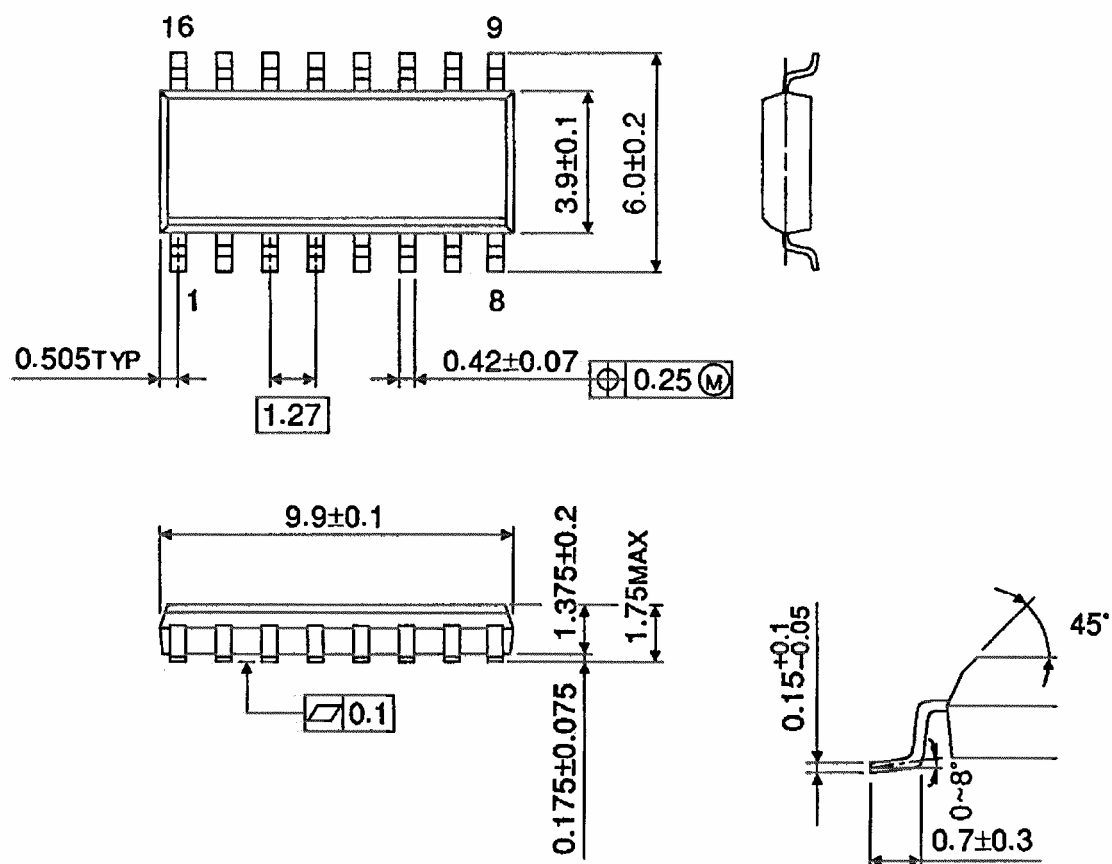


Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL16-P-150-1.27

Unit : mm



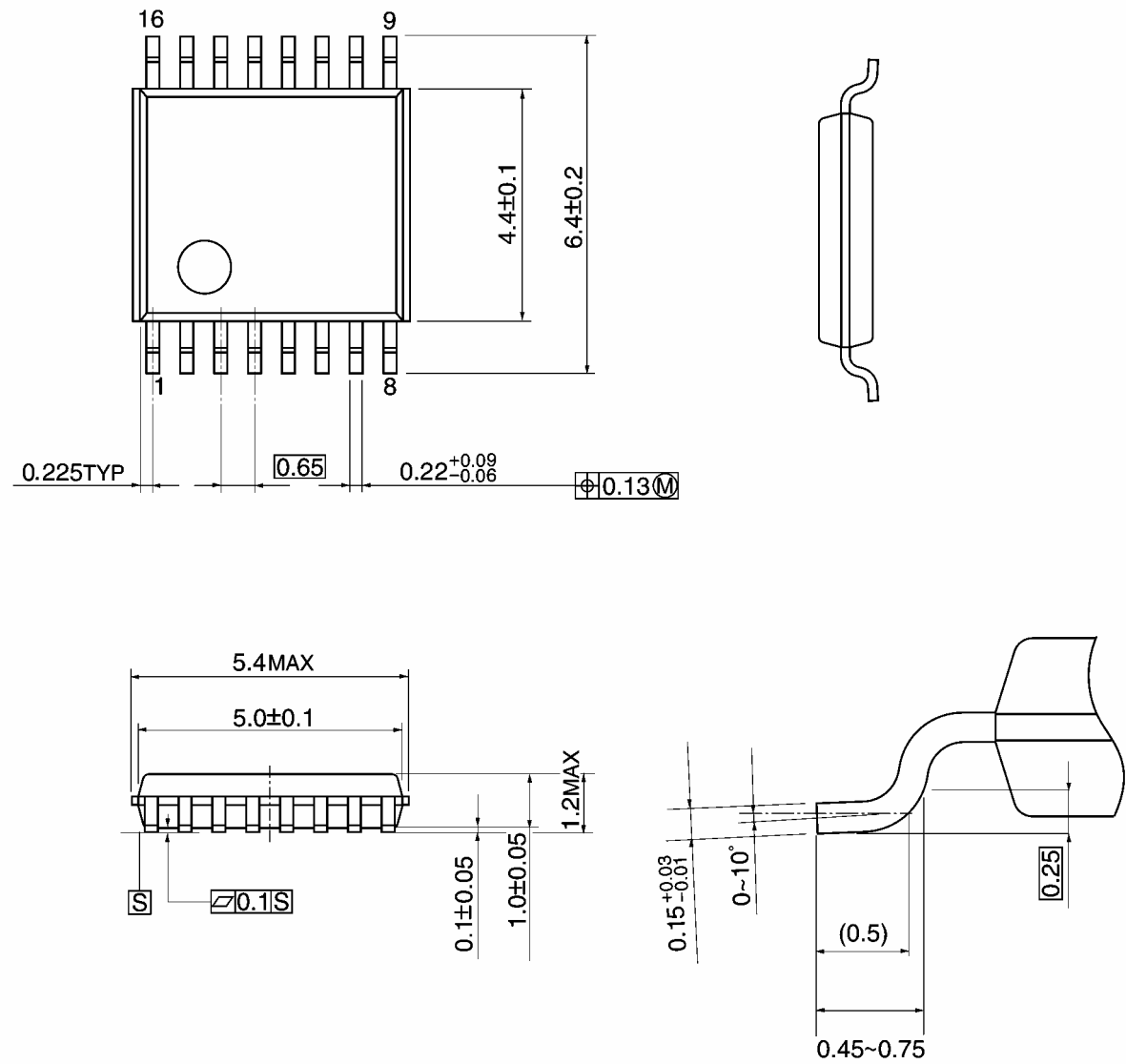
Note: This package is not available in Japan.

Weight: 0.13 g (typ.)

Package Dimensions

TSSOP16-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

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20070701-EN GENERAL

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