TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74HCT4053AF, TC74HCT4053AFT

Triple 2-Channel Analog Multiplexer/Demultiplexer

The TC74HCT4053A are high speed CMOS ANALOG MULTIPLEXER/DEMULTIPLEXER fabricated with silicon gate C^2MOS 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.

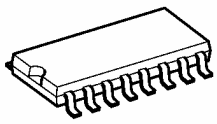
The TC74HCT4053A has a 2 channel × 3 configuration.

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 V, GND = 0 V, V_{EE} = –5 V, signals between –5 V and +5 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.

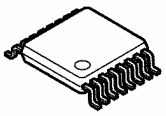
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

TC74HCT4053AF



SOP16-P-300-1.27A

TC74HCT4053AFT



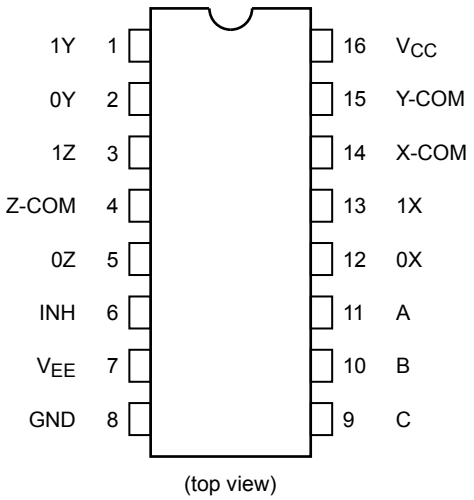
TSSOP16-P-0044-0.65A

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

Features

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

Pin Assignment



(top view)

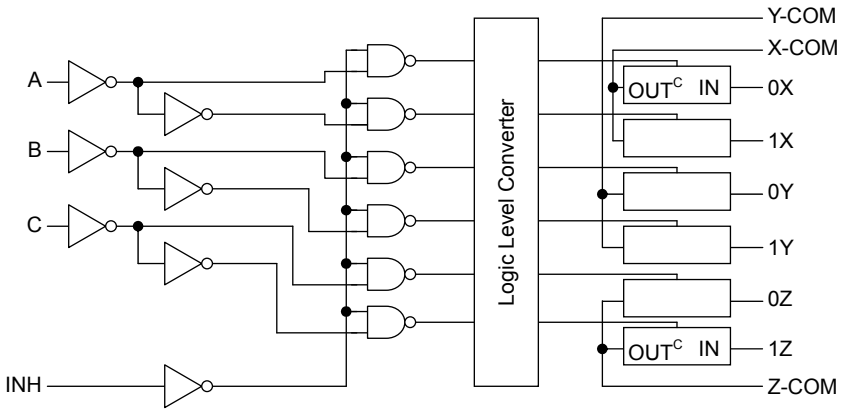
Start of commercial production
1989-11

Truth Table

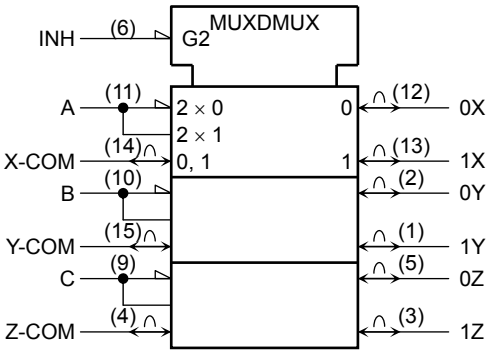
Control Inputs				"ON" Channel
Inhibit	C	B	A	HCT4053A
L	L	L	L	0X, 0Y, 0Z
L	L	L	H	1X, 0Y, 0Z
L	L	H	L	0X, 1Y, 0Z
L	L	H	H	1X, 1Y, 0Z
L	H	L	L	0X, 0Y, 1Z
L	H	L	H	1X, 0Y, 1Z
L	H	H	L	0X, 1Y, 1Z
L	H	H	H	1X, 1Y, 1Z
H	X	X	X	NONE

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 V_{CC} 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	2.0	—	—	2.0	—	V
				9.0	2.5	—	—	2.5	—	
Low-level control input voltage	V_{ILC}			4.5 to 5.5	—	—	0.8	—	0.8	V
				9.0	—	—	0.8	—	0.8	
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 V_{IS} = GND or V_{CC} V_{IN} = V_{ILC} or V_{IHC}	GND	5.5	—	—	±60	—	±600	nA
			−5.5	5.5	—	—	±100	—	±1000	
Switch input leakage current (switch ON)	I_{IZ}	V_{OS} = V_{CC} or GND V_{IN} = V_{ILC} or V_{IHC}	GND	5.5	—	—	±60	—	±600	nA
			−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 pF, Input $t_r = t_f$ = 6 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	ϕI/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 kΩ

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:

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

Analog Switch Characteristics (GND = 0 V, Ta = 25°C) (Note 1)

Characteristics	Symbol	Test Condition		V_{EE} (V)	V_{CC} (V)	Typ.	Unit
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} Increase f_{IN} frequency until dB meter reads −3dB R_L = 50 Ω, C_L = 10 pF f_{IN} = 1 MHz, Sine wave	(Note 2) (Note 3) (Note 2) (Note 3)	−4.5 −5.5 	4.5 5.5 	190 150 200 180	MHz
Feed through attenuation (switch OFF)		Vin 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	dB

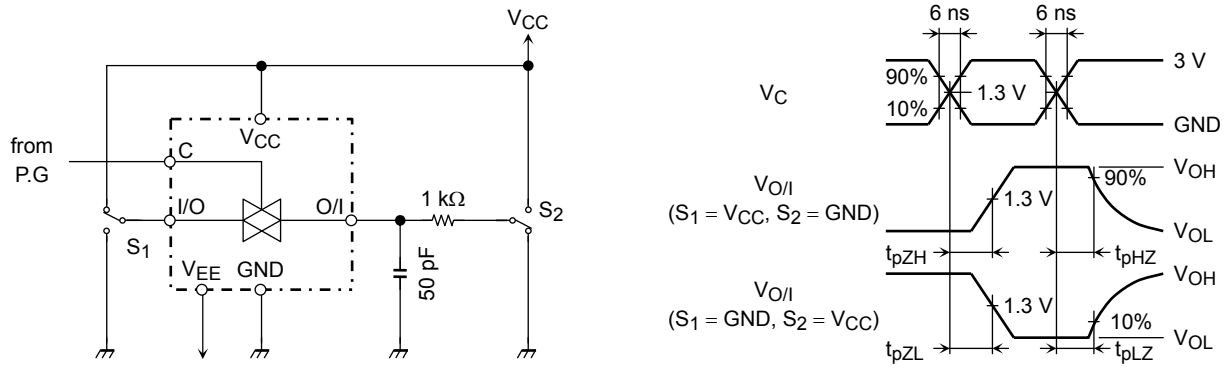
Note 1: These characteristics are determined by design of devices.

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

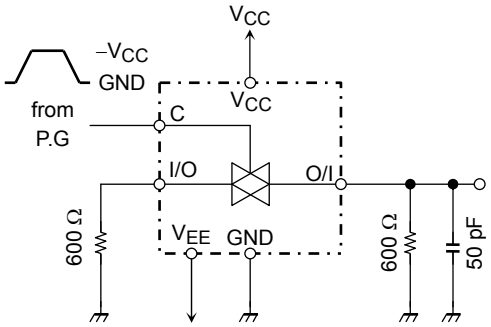
Note 3: Input SWITCH terminal, and measured at COMMON terminal.

Switching Characteristics Test Circuits

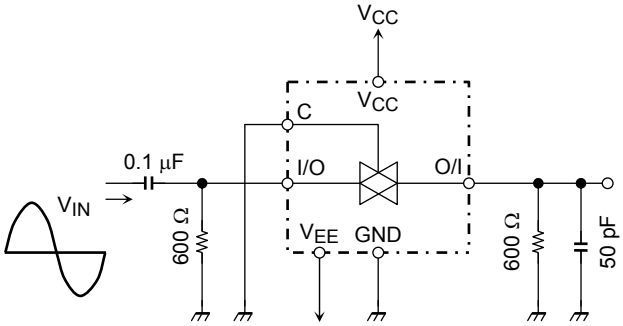
1. t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}



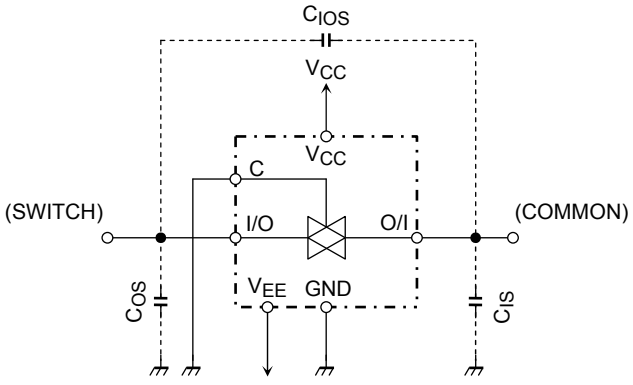
2. Cross Talk (control input – switch output) f_{IN} = 1 MHz duty = 50% $t_r = t_f$ = 6 ns



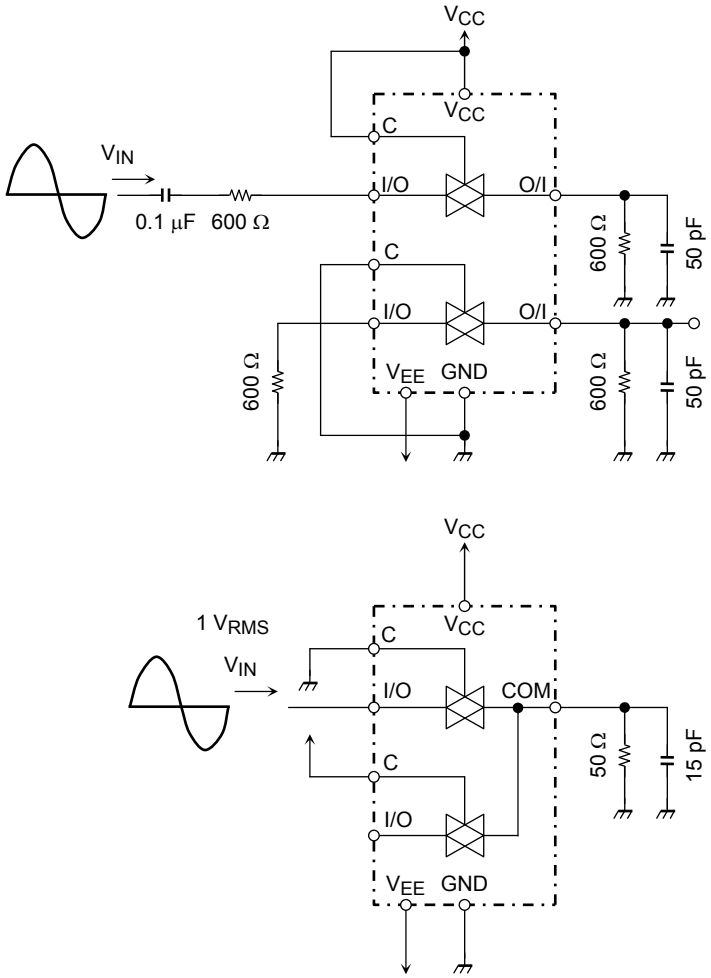
3. Feedthrough Attenuation



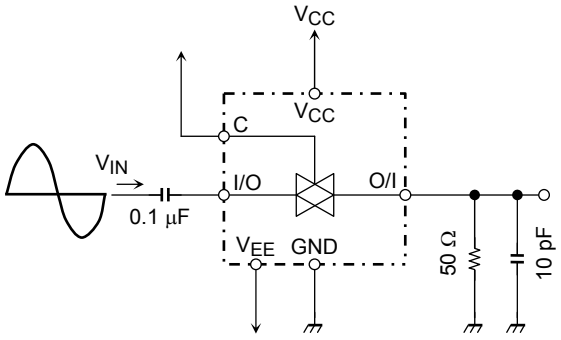
4. C_{IOS}, C_{IS}, C_{OS}



5. Cross Talk (between any two switches)

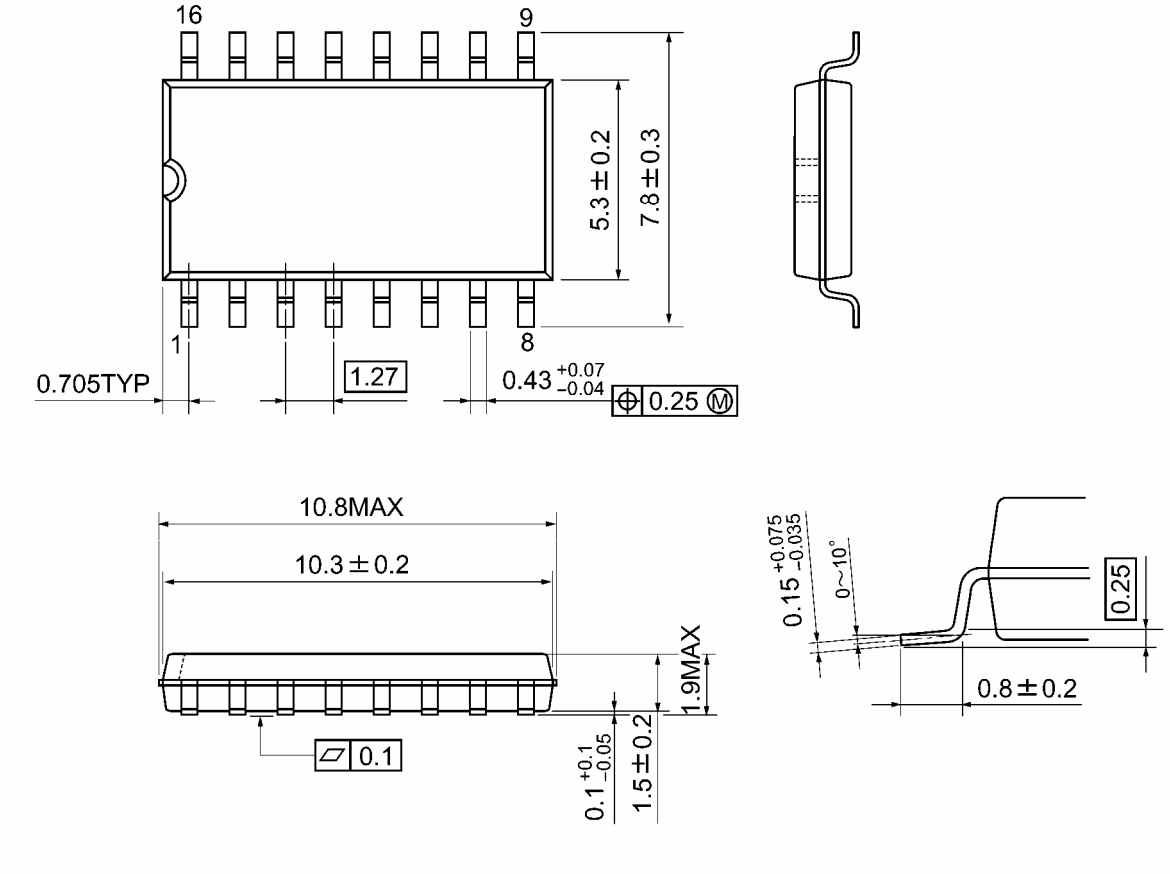


6. Frequency Response (switch ON)



Package Dimensions

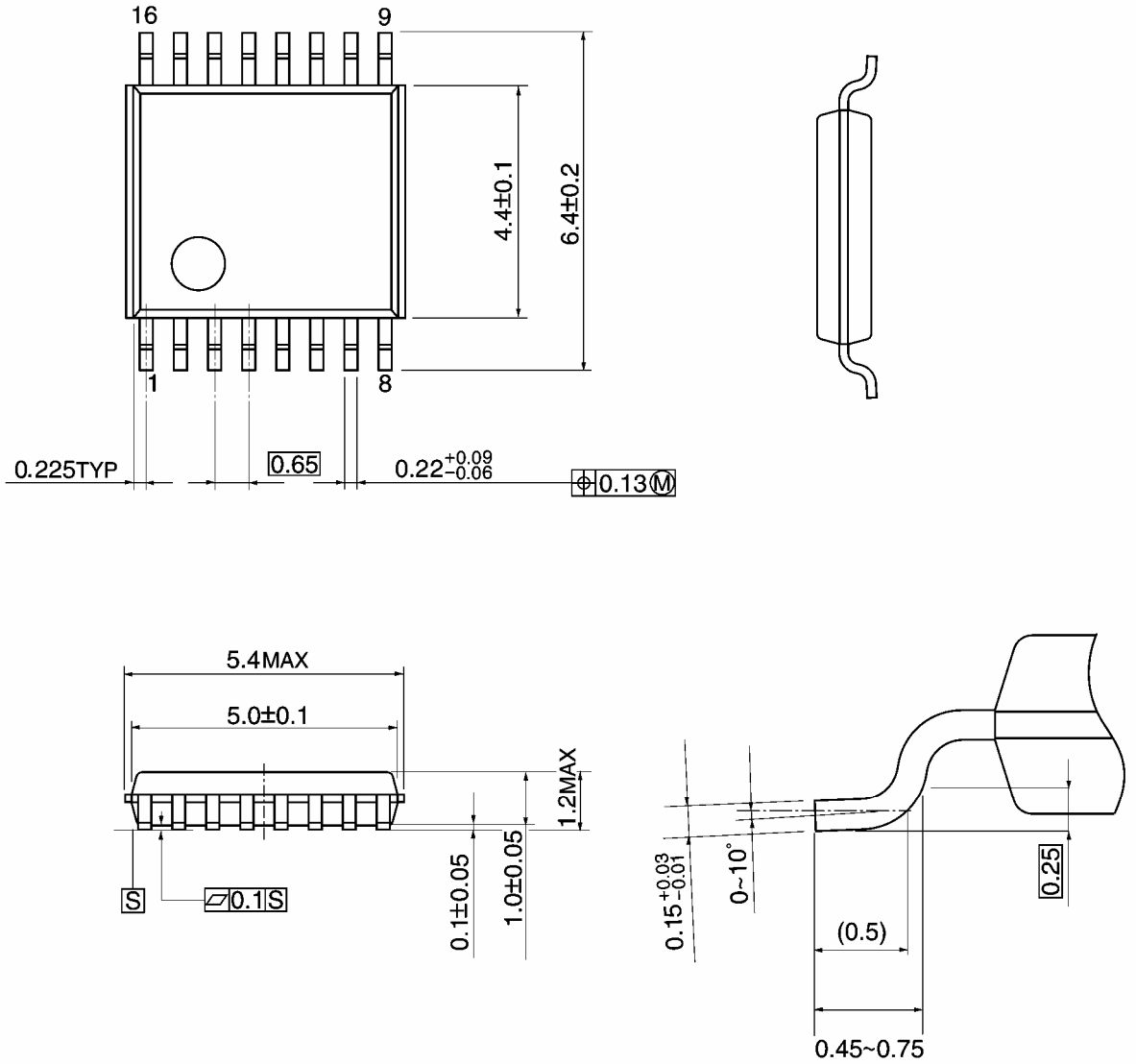
SOP16-P-300-1.27A Unit: mm



Weight: 0.18 g (typ.)

Package Dimensions

TSSOP16-P-0044-0.65A Unit: mm



Weight: 0.06 g (typ.)

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