

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC4051BP, TC4051BF, TC4051BFN, TC4051BFT TC4052BP, TC4052BF, TC4052BFN, TC4052BFT TC4053BP, TC4053BF, TC4053BFN, TC4053BFT

TC4051B

Single 8-Channel Multiplexer/Demultiplexer

TC4052B

Differential 4-Channel
Multiplexer/Demultiplexer

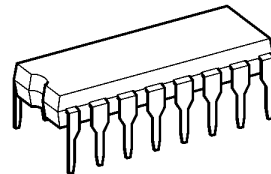
TC4053B

Triple 2-Channel Multiplexer/Demultiplexer

TC4051B, TC4052B and TC4053B are multiplexers with capabilities of selection and mixture of analog signal and digital signal. TC4051B has 8 channels configuration. TC4052B has 4 channel $\times$ 2 configuration and TC4053B has 2 channel $\times$ 3 configuration. The digital signal to the control terminal turns "ON" the corresponding switch of each channel, with large amplitude ($V_{DD} - V_{EE}$) can be switched by the control signal with small logical amplitude ($V_{DD} - V_{SS}$). For example, in the case of $V_{DD} = 5\text{ V}$, $V_{SS} = 0\text{ V}$ and $V_{EE} = -5\text{ V}$, signals between -5 V and $+5\text{ V}$ can be switched from the logical circuit with single power supply of 5 volts. As the ON-resistance of each switch is low, these can be connected to the circuits with low input impedance.

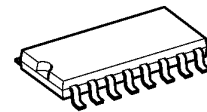
Note: xxxFN (JEDEC SOP) is not available in Japan.

TC4051BP, TC4052BP, TC4053BP

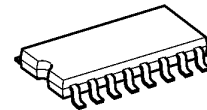


DIP16-P-300-2.54A

TC4051BF, TC4052BF, TC4053BF

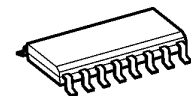


SOP16-P-300-1.27A



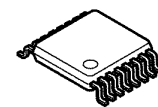
SOP16-P-300-1.27

TC4051BFN, TC4052BFN, TC4053BFN



SOL16-P-150-1.27

TC4051BFT, TC4052BFT, TC4053BFT

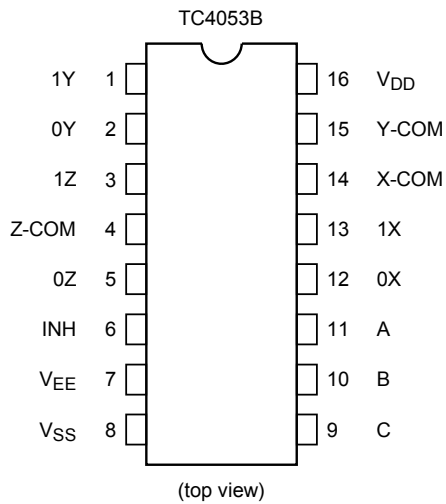
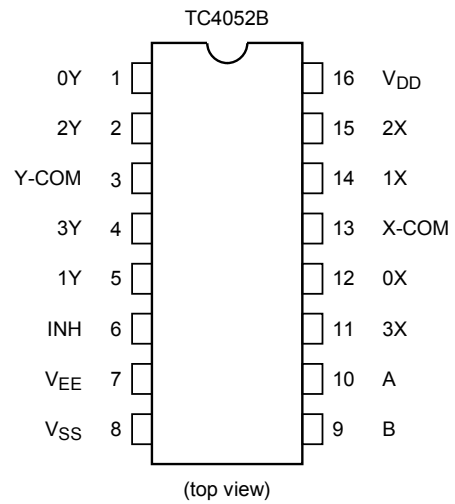
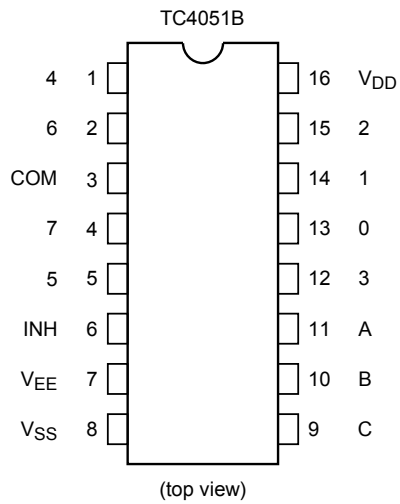


TSSOP16-P-0044-0.65A

Weight

DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)
SOP16-P-300-1.27	: 0.18 g (typ.)
SOL16-P-150-1.27	: 0.13 g (typ.)
TSSOP16-P-0044-0.65A	: 0.06 g (typ.)

Pin Assignment



Truth Table

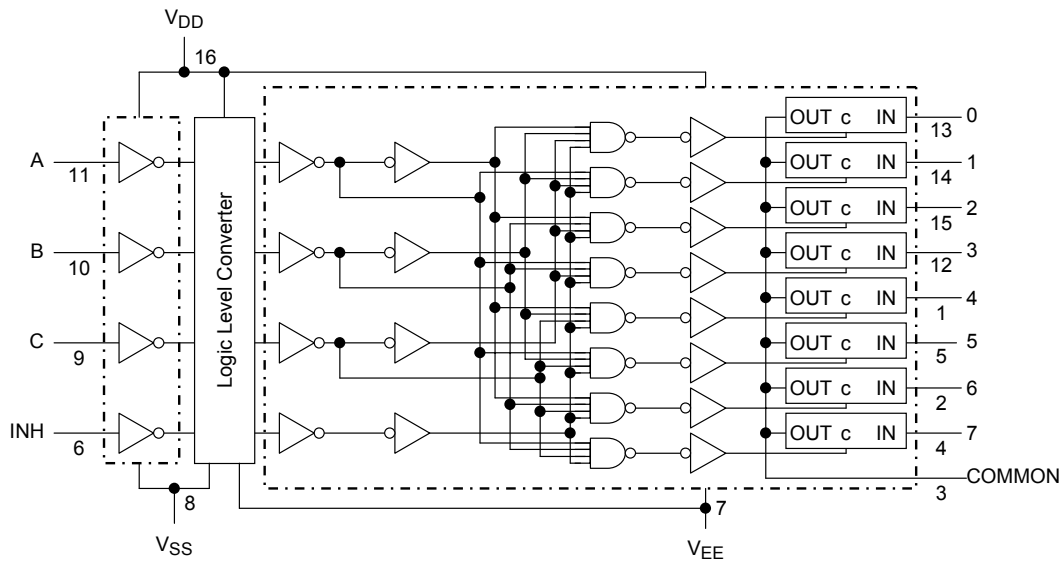
Control Inputs				"ON" Channel		
Inhibit	$C\Delta$	B	A	TC4051B	TC4052B	TC4053B
L	L	L	L	0	0X, 0Y	0X, 0Y, 0Z
L	L	L	H	1	1X, 1Y	1X, 0Y, 0Z
L	L	H	L	2	2X, 2Y	0X, 1Y, 0Z
L	L	H	H	3	3X, 3Y	1X, 1Y, 0Z
L	H	L	L	4	—	0X, 0Y, 1Z
L	H	L	H	5	—	1X, 0Y, 1Z
L	H	H	L	6	—	0X, 1Y, 1Z
L	H	H	H	7	—	1X, 1Y, 1Z
H	X	X	X	None	None	None

X: Don't care

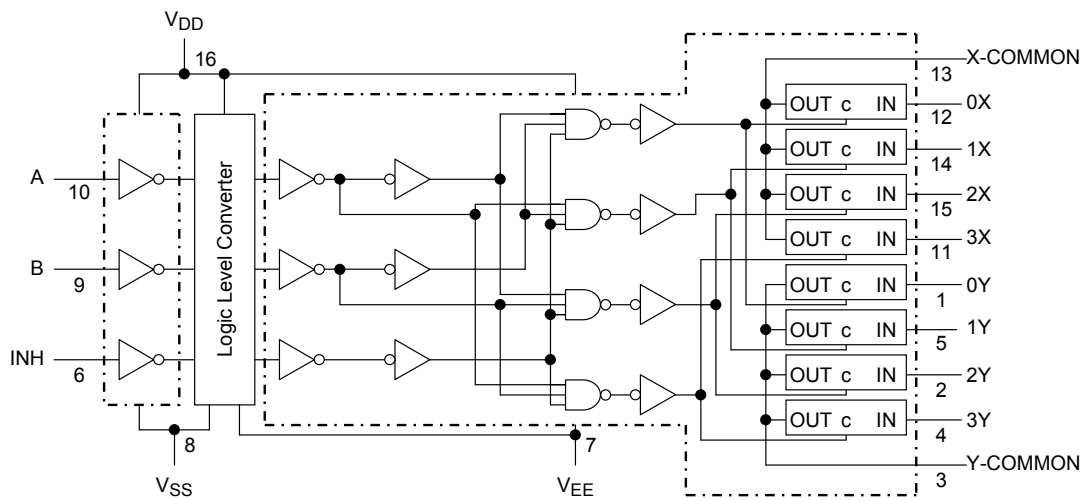
Δ : Except TC4052B

Logic Diagram

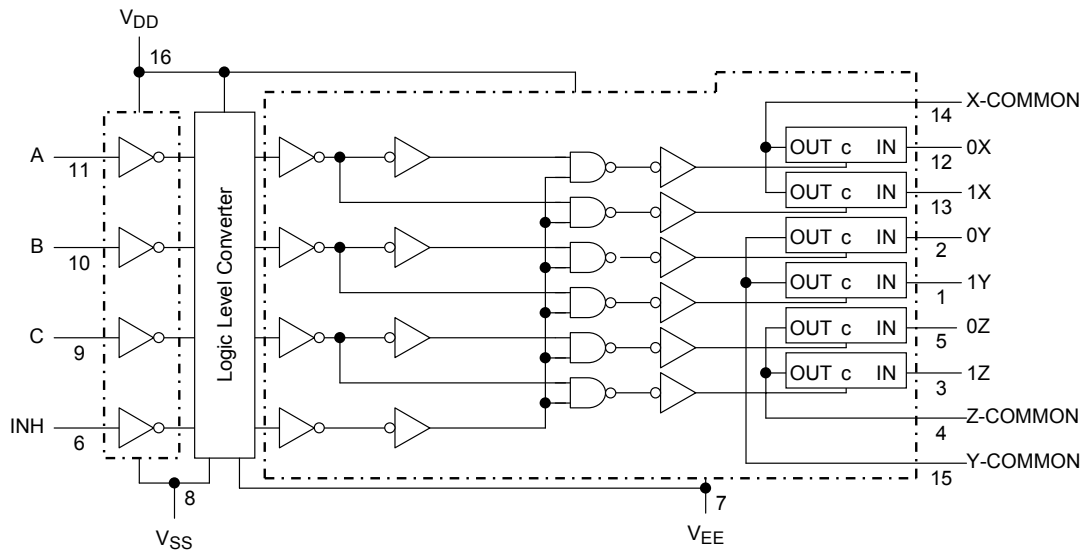
TC4051B



TC4052B



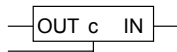
TC4053B



Truth Table

Control C	Impedance between IN-OUT (Note)
H	$0.5 \text{ to } 5 \times 10^2 \Omega$
L	$>10^9 \Omega$

Note: See electrical characteristics



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
DC supply voltage	$V_{DD}-V_{SS}$	-0.5 to 20	V
DC supply voltage	$V_{DD}-V_{EE}$	-0.5 to 20	V
Control input voltage	V_{CIN}	$V_{SS} - 0.5 \text{ to } V_{DD} + 0.5$	V
Switch I/O voltage	V_I/V_O	$V_{EE} - 0.5 \text{ to } V_{DD} + 0.5$	V
Control input current	I_{CIN}	± 10	mA
Potential difference across I/O during ON	V_I-V_O	-0.5 to 0.5	V
Power dissipation	P_D	300 (DIP)/180 (SOIC)	mW
Operating temperature range	T_{opr}	-40 to 85	°C
Storage temperature range	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.

Recommended Operating Conditions (Note)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
DC supply voltage	$V_{DD}-V_{SS}$	—	3	—	18	V
	$V_{DD}-V_{EE}$	—	3	—	18	
Control input voltage	V_{IN}	—	V_{SS}	—	V_{DD}	V
Input/output voltage	V_{IN}/V_{OUT}	—	V_{EE}	—	V_{DD}	V

Note: The recommended operating conditions are required to ensure the normal operation of the device.
Unused inputs must be tied to either VCC or GND.

Static Electrical Characteristics

Characteristics	Symbol	Test Condition				-40°C		25°C			85°C		Unit
		V_{SS} (V)	V_{EE} (V)	V_{DD} (V)	Min	Max	Min	Typ.	Max	Min	Max		
Control input high voltage	V_{IH}	$V_{IS} = V_{DD}$ thru 1 k Ω	$V_{EE} = V_{SS}$ $R_L = 1 \text{ k}\Omega$ to V_{SS}		5	3.5	—	3.5	2.75	—	3.5	—	V
Control input low voltage	V_{IL}				10	7.0	—	7.0	5.50	—	7.0	—	—
					15	11.0	—	11.0	8.25	—	11.0	—	—
			5	—	1.5	—	2.25	1.5	—	1.5	V		
10	—		3.0	—	4.5	3.0	—	3.0	—	—			
15	—		4.0	—	6.75	4.0	—	4.0	—	—			
On-state resistance	R_{ON}	$0 \leq V_{IS} \leq V_{DD}$ $R_L = 10 \text{ k}\Omega$	0	0	5	—	850	—	240	950	—	1200	Ω
Δ On-state resistance between any 2 switches	$R_{ON\Delta}$		0	0	10	—	210	—	110	250	—	300	
			0	0	15	—	140	—	80	160	—	200	
		0	0	5	—	—	—	10	—	—	—	Ω	
0	0	10	—	—	—	6	—	—	—				
0	0	15	—	—	—	4	—	—	—				
Input/output leakage current	I_{OFF}	$V_{IN} = 18 \text{ V}, V_{OUT} = 0 \text{ V}$			18	—	± 100	—	± 0.01	± 100	—	± 1000	nA
		$V_{IN} = 0 \text{ V}, V_{OUT} = 18 \text{ V}$			18	—	± 100	—	± 0.01	± 100	—	± 1000	
Quiescent supply current	I_{DD}	$V_{IN} = V_{SS}, V_{DD}$			5	—	5.0	—	0.005	5.0	—	150	μA
		(Note)			10	—	10	—	0.010	10	—	300	
					15	—	20	—	0.015	20	—	600	
Input current	I_{IN}	$V_{IH} = 18 \text{ V}$			18	—	0.1	—	10^{-5}	0.1	—	1.0	μA
		$V_{IL} = 0 \text{ V}$			18	—	-0.1	—	-10^{-5}	-0.1	—	-1.0	
Input capacitance	C_{IN}	—			—	—	—	—	5	7.5	—	—	pF
Switch input capacitance	C_{IN}	—			—	—	—	—	10	—	—	—	pF
Output capacitance	C_{OUT}	TC4051B			10	—	—	—	58	—	—	—	pF
		TC4052B			10	—	—	—	30	—	—	—	
		TC4053B			10	—	—	—	17	—	—	—	
Feedthrough capacitance	$C_{IN-C-OUT}$	TC4051B			10	—	—	—	0.2	—	—	—	pF
		TC4052B			10	—	—	—	0.2	—	—	—	
		TC4053B			10	—	—	—	0.2	—	—	—	

Note: All valid input combinations.

Dynamic Electrical Characteristics (Ta = 25°C, CL = 50 pF)

Characteristics	Symbol	Test Condition	Test Condition			Min	Typ.	Max	Unit
			VSS (V)	VEE (V)	VDD (V)				
Phase difference between input to output	ϕ_{I-O}	—	0	0	5	—	15	45	ns
			0	0	10	—	8	20	
			0	0	15	—	6	15	
Propagation delay time (A, B, C, -OUT)	t_{pZL} t_{pZH} t_{pLZ} t_{pHZ}	$R_L = 1\text{ k}\Omega$	0	0	5	—	170	550	ns
			0	0	10	—	90	240	
			0	0	15	—	70	160	
			0	-5	5	—	100	240	
			0	-7.5	7.5	—	80	160	
Propagation delay time (INH-OUT)	t_{pZL} t_{pZH}	$R_L = 1\text{ k}\Omega$	0	0	5	—	120	380	ns
			0	0	10	—	60	200	
			0	0	15	—	50	160	
			0	-5	5	—	80	200	
			0	-7.5	7.5	—	60	160	
Propagation delay time (INH-OUT)	t_{pLZ} t_{pHZ}	$R_L = 1\text{ k}\Omega$	0	0	5	—	170	450	ns
			0	0	10	—	90	210	
			0	0	15	—	70	160	
			0	-5	5	—	100	210	
			0	-7.5	7.5	—	80	160	
-3dB cutoff frequency TC4051B TC4052B TC4053B	$f_{\max}$ (I-O)	$R_L = 1\text{ k}\Omega$ (Note 1)	-5	-5	5	—	20	—	MHz
			-5	-5	5	—	30	—	
			-5	-5	5	—	40	—	
Total harmonic distortion	—	$R_L = 10\text{ k}\Omega$ $f = 1\text{ kHz}$ (Note 2)	-2.5	-2.5	2.5	—	0.15	—	%
			-5	-5	5	—	0.03	—	
			-7.5	-7.5	7.5	—	0.02	—	
-50dB feedthrough (switch off)	—	$R_L = 1\text{ k}\Omega$ (Note 3)	-5	-5	5	—	500	—	kHz
Crosstalk	—	$R_L = 1\text{ k}\Omega$ (Note 4)	-5	-5	5	—	1.5	—	MHz
Crosstalk (control-OUT)	—	$R_{IN} = 1\text{ k}\Omega$ $R_{OUT} = 10\text{ k}\Omega$ $C_L = 15\text{ pF}$	0	0	5	—	200	—	mV
			0	0	10	—	400	—	
			0	0	15	—	600	—	

Note 1: Sine wave of $\pm 2.5\text{ V}_{p-p}$ shall be used for V_{IS} and the frequency of $20\log 10 \frac{V_{OS}}{V_{IS}} = -3\text{dB}$ shall be $f_{\max}$.

Note 2: V_{IS} shall be sine wave of $\pm \left(\frac{V_{DD} - V_{EE}}{4} \right)$ p-p.

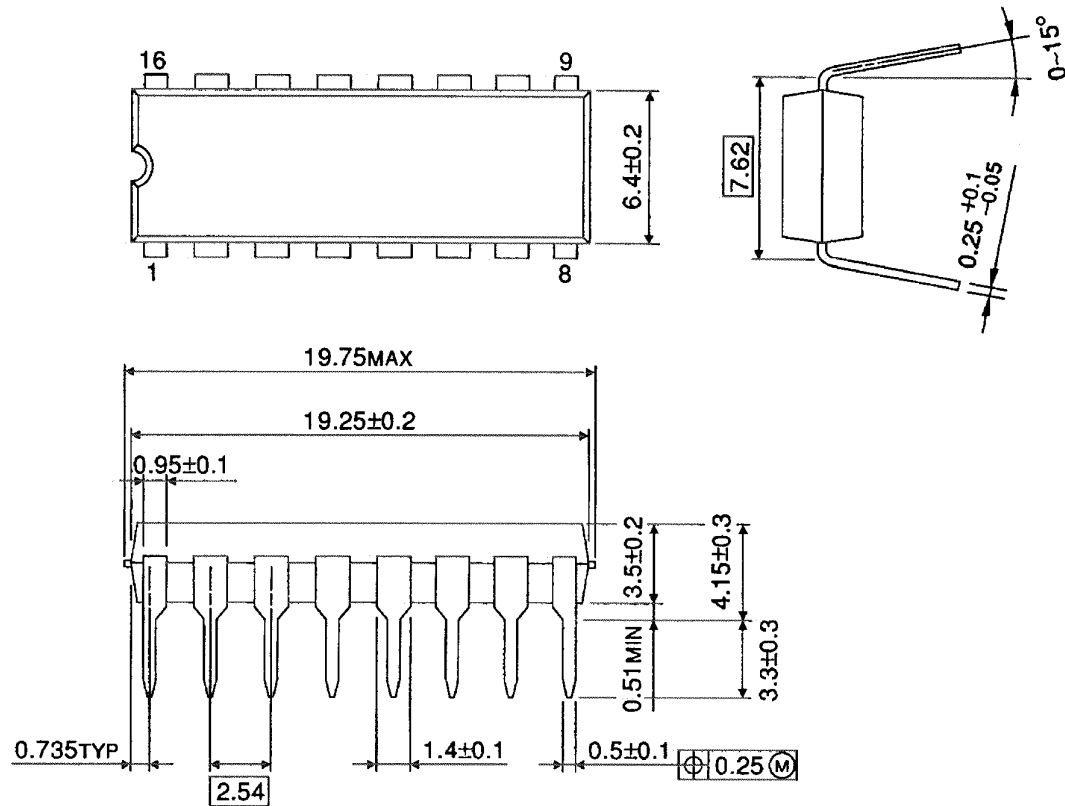
Note 3: Sine wave of $\pm 2.5\text{ V}_{p-p}$ shall be used for V_{IS} and the frequency of $20\log 10 \frac{V_{OS}}{V_{IS}} = -50\text{dB}$ shall be feed-through.

Note 4: Sine wave of $\pm 2.5\text{ V}_{p-p}$ shall be used for V_{IS} and the frequency of $20\log 10 \frac{V_{OS}}{V_{IS}} = -50\text{dB}$ shall be crosstalk.

Package Dimensions

DIP16-P-300-2.54A

Unit : mm

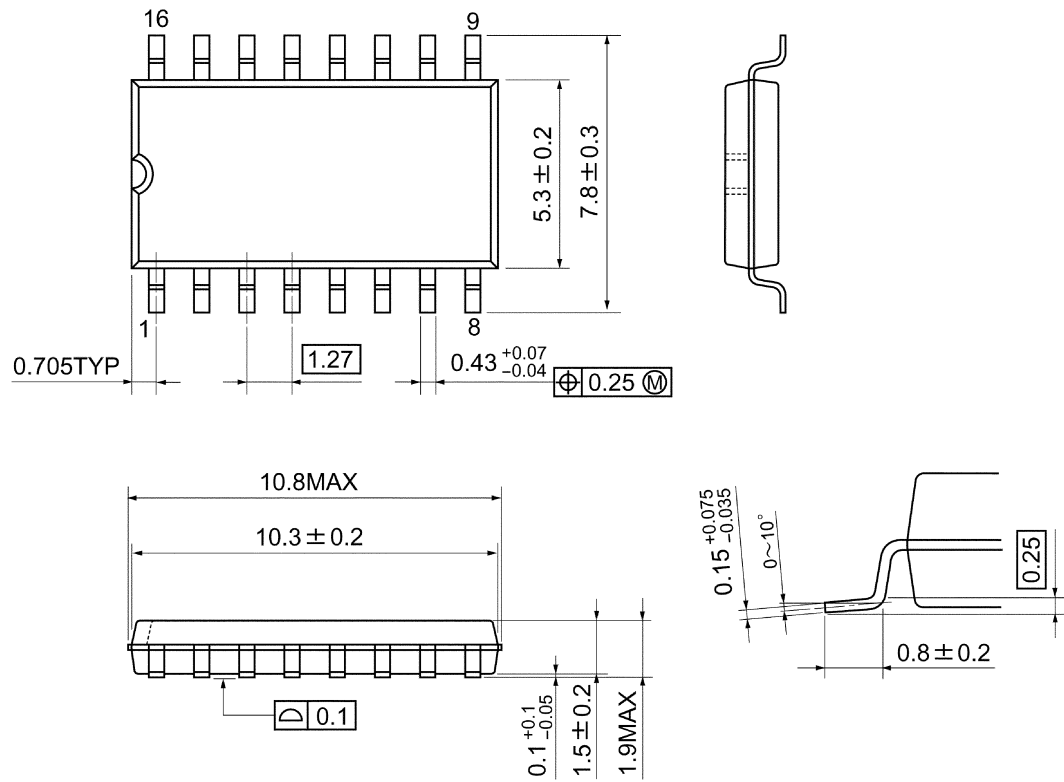


Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A

Unit: mm

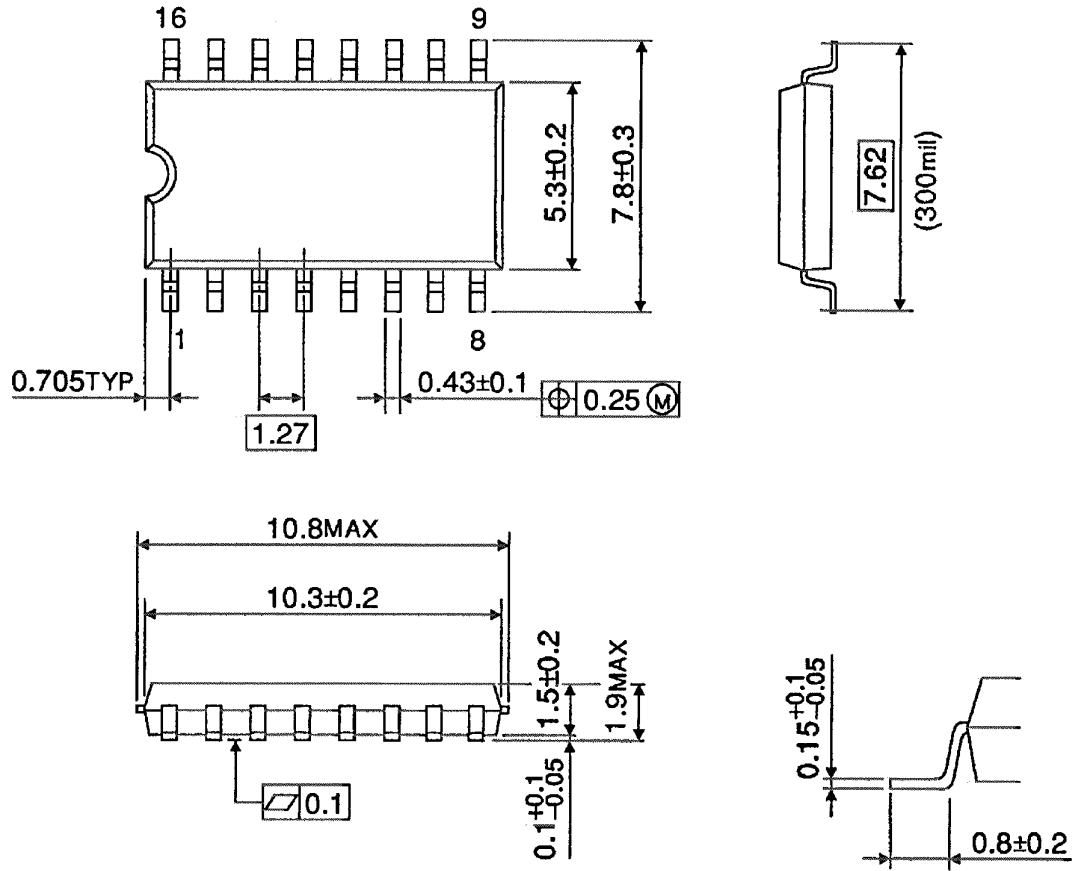


Weight: 0.18 g (typ.)

Package Dimensions

SOP16-P-300-1.27

Unit : mm

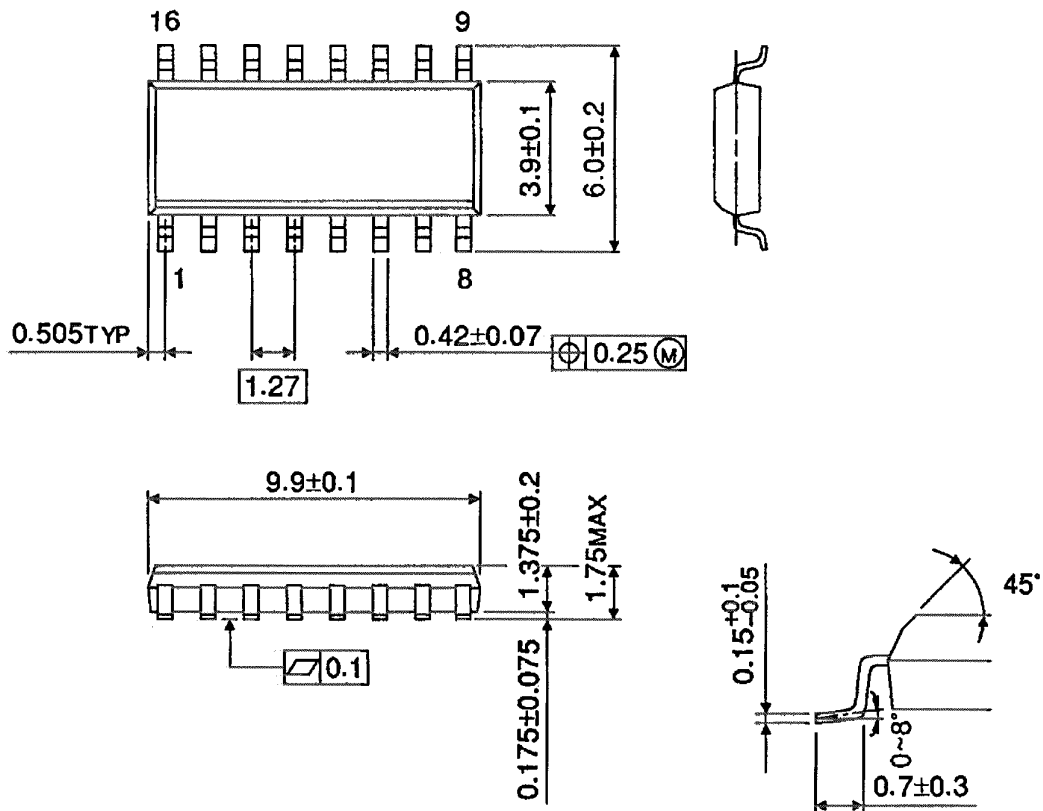


Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL16-P-150-1.27

Unit : mm



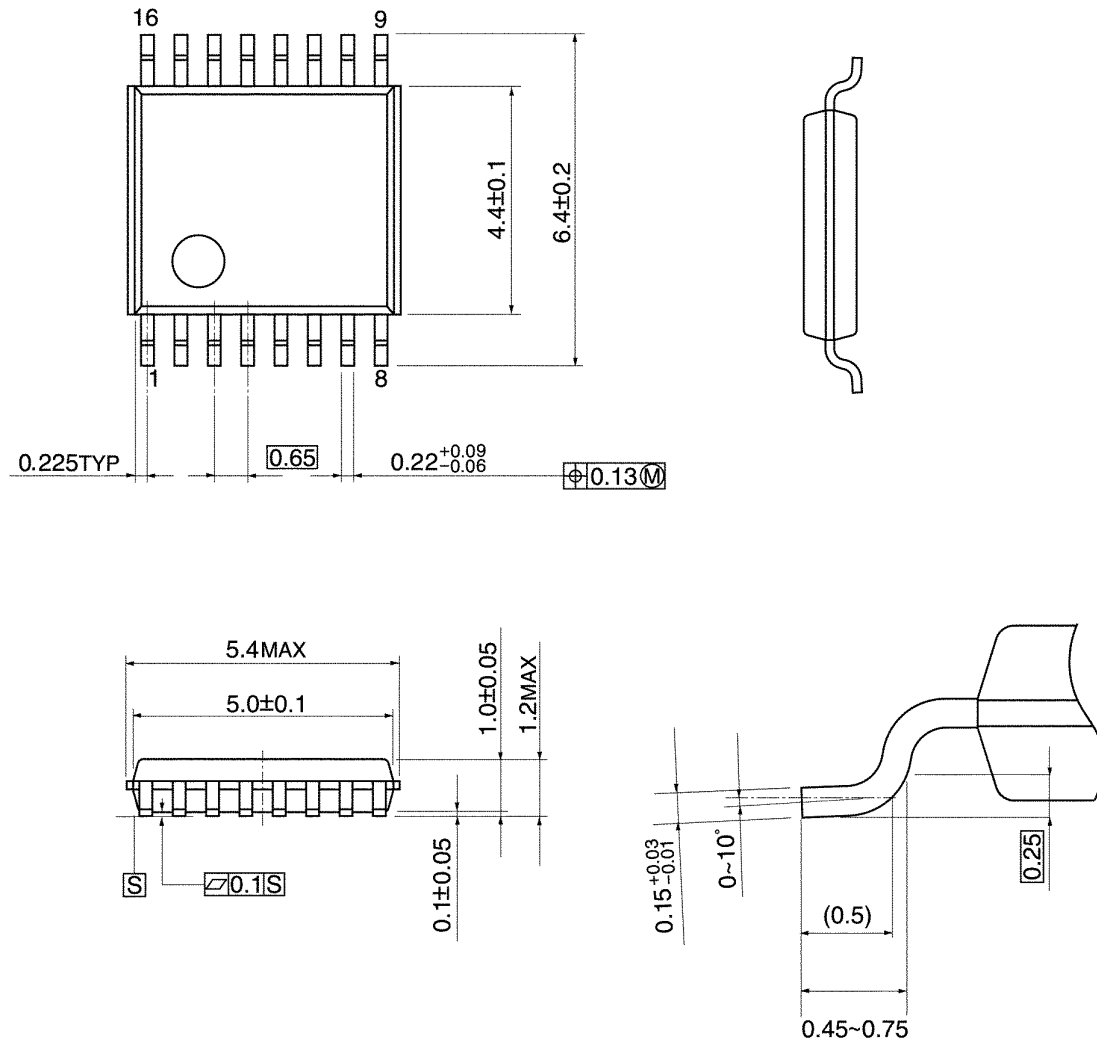
Note: This package is not available in Japan.

Weight: 0.13 g (typ.)

Package Dimensions

TSSOP16-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

Note: Lead (Pb)-Free Packages

DIP16-P-300-2.54A SOP16-P-300-1.27A SOL16-P-150-1.27 TSSOP16-P-0044-0.65A

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