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

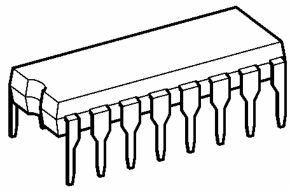
TC4053B

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 × 2 configuration and TC4053B has 2 channel × 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 V V_{SS} = 0 V and V_{EE} = −5 V, signals between −5 V and +5 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.

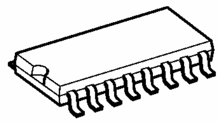
Note: xxxFN (JEDEC SOP) is not available in Japan.

TC4051BP, TC4052BP, TC4053BP

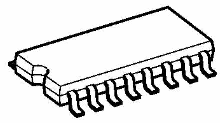


DIP16-P-300-2.54A

TC4051BF, TC4052BF, TC4053BF

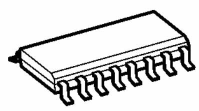


SOP16-P-300-1.27A



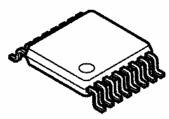
SOP16-P-300-1.27

TC4051BFN, TC4052BFN, TC4053BFN



SOL16-P-150-1.27

TC4051BFT, TC4052BFT, TC4053BFT



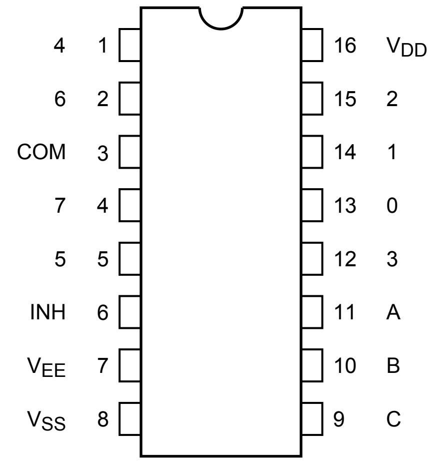
TSSOP16-P-0044-0.65A

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.)

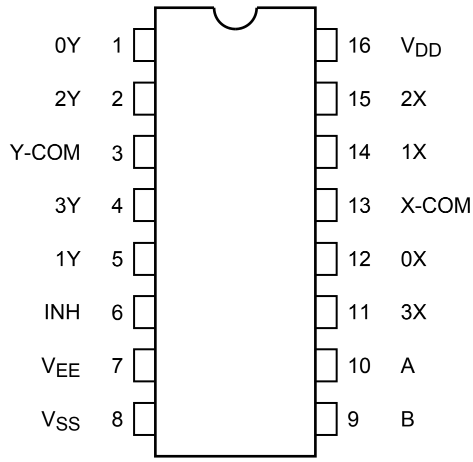
Pin Assignment

TC4051B



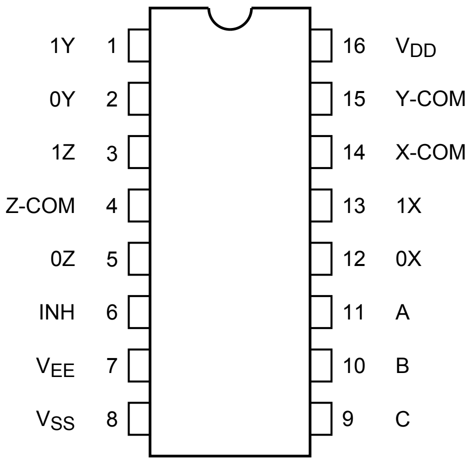
(top view)

TC4052B



(top view)

TC4053B



(top view)

Truth Table

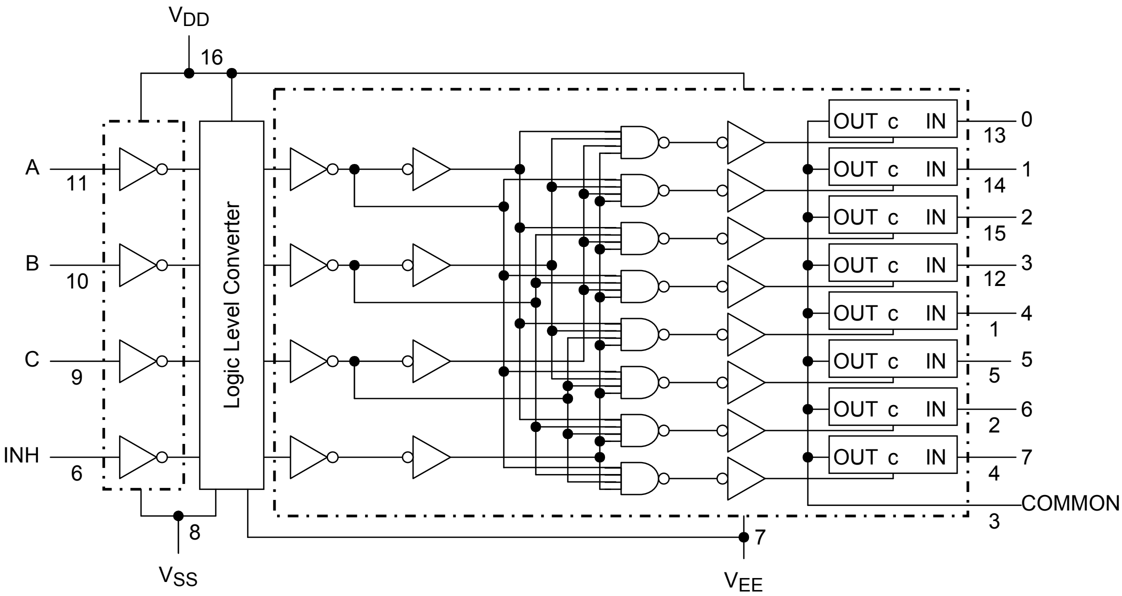
Control Inputs				"ON" Channel		
Inhibit	CΔ	B	A	TC4051B	TC4052B	TC4053B
L	L	L	L	0	0X, 0Y	0X, 0Y, 0Z
L	L	L	H	1	1X, 1Y	1X, 0Y, 0Z
L	L	H	L	2	2X, 2Y	0X, 1Y, 0Z
L	L	H	H	3	3X, 3Y	1X, 1Y, 0Z
L	H	L	L	4	—	0X, 0Y, 1Z
L	H	L	H	5	—	1X, 0Y, 1Z
L	H	H	L	6	—	0X, 1Y, 1Z
L	H	H	H	7	—	1X, 1Y, 1Z
H	X	X	X	None	None	None

X: Don't care

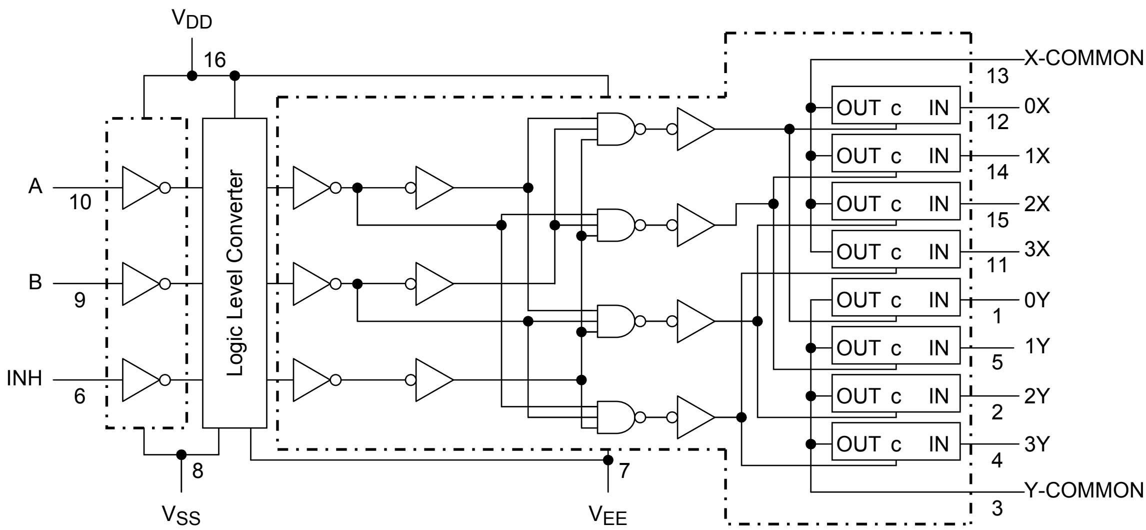
Δ: Except TC4052B

Logic Diagram

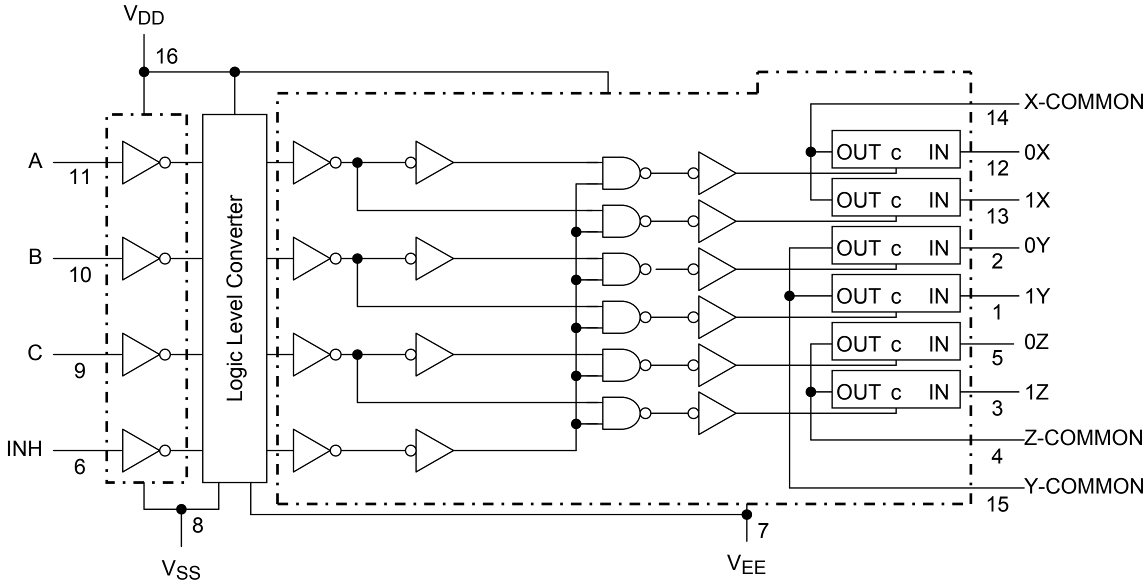
TC4051B



TC4052B



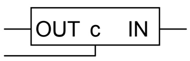
TC4053B



Truth Table

Control C	Impedance between IN-OUT (Note)
H	0.5 to 5 × 10^2 Ω
L	>10^9 Ω

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 to V_{DD} + 0.5	V
Switch I/O voltage	V_I/V_O	V_{EE} − 0.5 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.

Operating Range (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 operating range is required to ensure the normal operation of the device.
Unused inputs must be tied to either V_{DD} or V_{SS}.

Static Electrical Characteristics

Characteristics	Symbol	Test Condition	V_{SS} (V)	V_{EE} (V)	V_{DD} (V)	−40°C Min	−40°C Max	25°C Min	25°C Typ.	25°C Max	85°C Min	85°C Max	Unit
Control input high voltage	V_{IH}	$V_{IS} = V_{DD}$ thru 1 kΩ	$V_{EE} = V_{SS}$, $R_L = 1$ kΩ to V_{SS}, $I_{IS} < 2$ µA on all OFF channels		5	3.5	—	3.5	2.75	—	3.5	—	V
					10	7.0	—	7.0	5.50	—	7.0	—	
					15	11.0	—	11.0	8.25	—	11.0	—	
Control input low voltage	V_{IL}				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}	$0 \leq V_{IS} \leq V_{DD}$, $R_L = 10$ kΩ	0	0	5	—	850	—	240	950	—	1200	Ω
			0	0	10	—	210	—	110	250	—	300	
			0	0	15	—	140	—	80	160	—	200	
ΔOn-state resistance between any 2 switches	$R_{ON\Delta}$	—	0	0	5	—	—	—	10	—	—	—	Ω
			0	0	10	—	—	—	6	—	—	—	
			0	0	15	—	—	—	4	—	—	—	
Input/output leakage current	I_{OFF}	$V_{IN} = 18$ V, $V_{OUT} = 0$ V			18	—	±100	—	±0.01	±100	—	±1000	nA
		$V_{IN} = 0$ V, $V_{OUT} = 18$ V			18	—	±100	—	±0.01	±100	—	±1000	
Quiescent supply current	I_{DD}	$V_{IN} = V_{SS}$, V_{DD} (Note)			5	—	5.0	—	0.005	5.0	—	150	µA
					10	—	10	—	0.010	10	—	300	
					15	—	20	—	0.015	20	—	600	
Input current	I_{IN}	$V_{IH} = 18$ V			18	—	0.1	—	10^{-5}	0.1	—	1.0	µA
		$V_{IL} = 0$ 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, C_L = 50 pF)

Characteristics	Symbol	Test Condition	V_{SS} (V)	V_{EE} (V)	V_{DD} (V)	Min	Typ.	Max	Unit
Phase difference between input to output	$\phi_{I\text{-}O}$	—	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 kΩ	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 kΩ	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 kΩ	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	f_{max} (I-O)	R_L = 1 kΩ (Note 1)	−5	−5	5	—	20	—	MHz
TC4052B			−5	−5	5	—	30	—	
TC4053B			−5	−5	5	—	40	—	
Total harmonic distortion	—	R_L = 10 kΩ f = 1 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 kΩ (Note 3)	−5	−5	5	—	500	—	kHz
Crosstalk	—	R_L = 1 kΩ (Note 4)	−5	−5	5	—	1.5	—	MHz
Crosstalk (control-OUT)	—	R_{IN} = 1 kΩ	0	0	5	—	200	—	mV
		R_{OUT} = 10 kΩ	0	0	10	—	400	—	
		C_L = 15 pF	0	0	15	—	600	—	

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

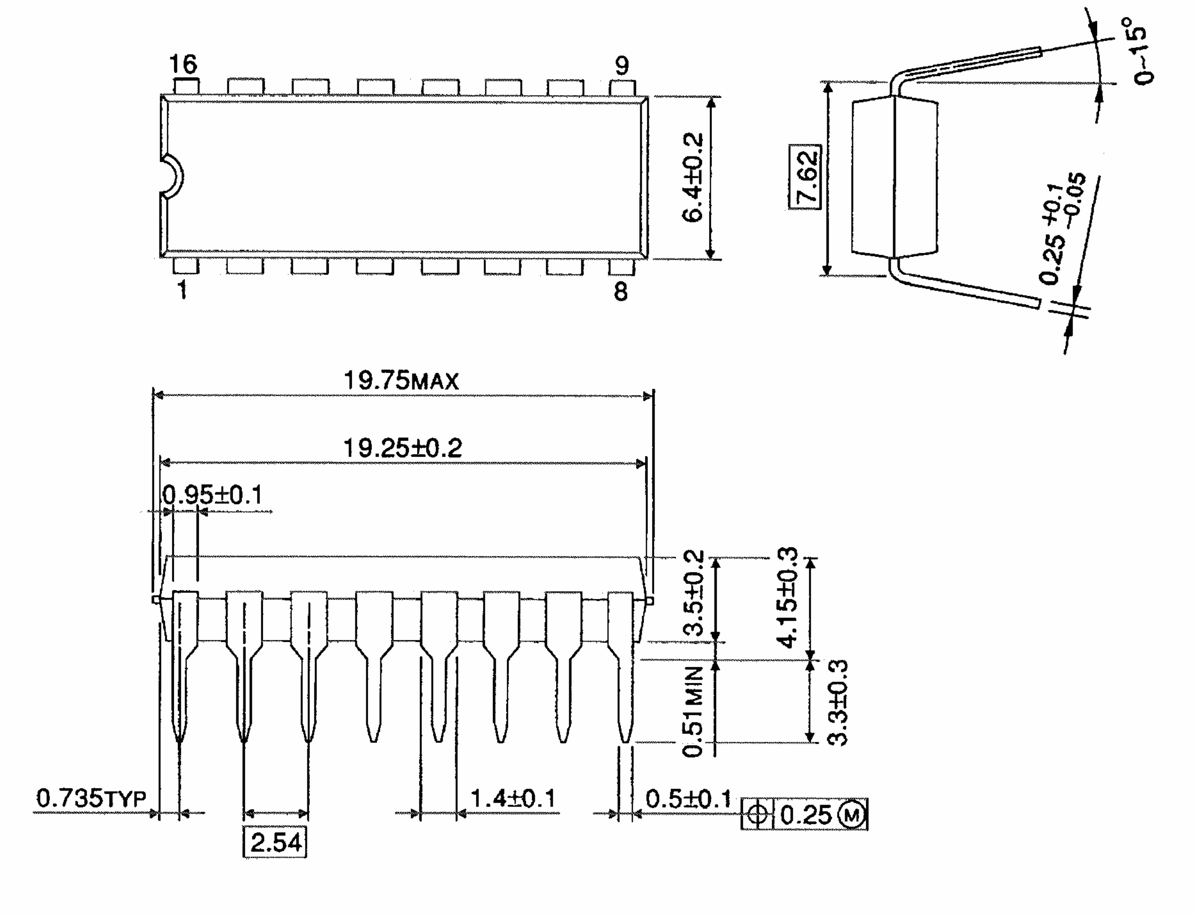
Note 2: V_{is} shall be sine wave of $\pm\left(\frac{V_{DD} - V_{EE}}{4}\right)$ p-p.

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

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

Package Dimensions

DIP16-P-300-2.54A Unit : mm

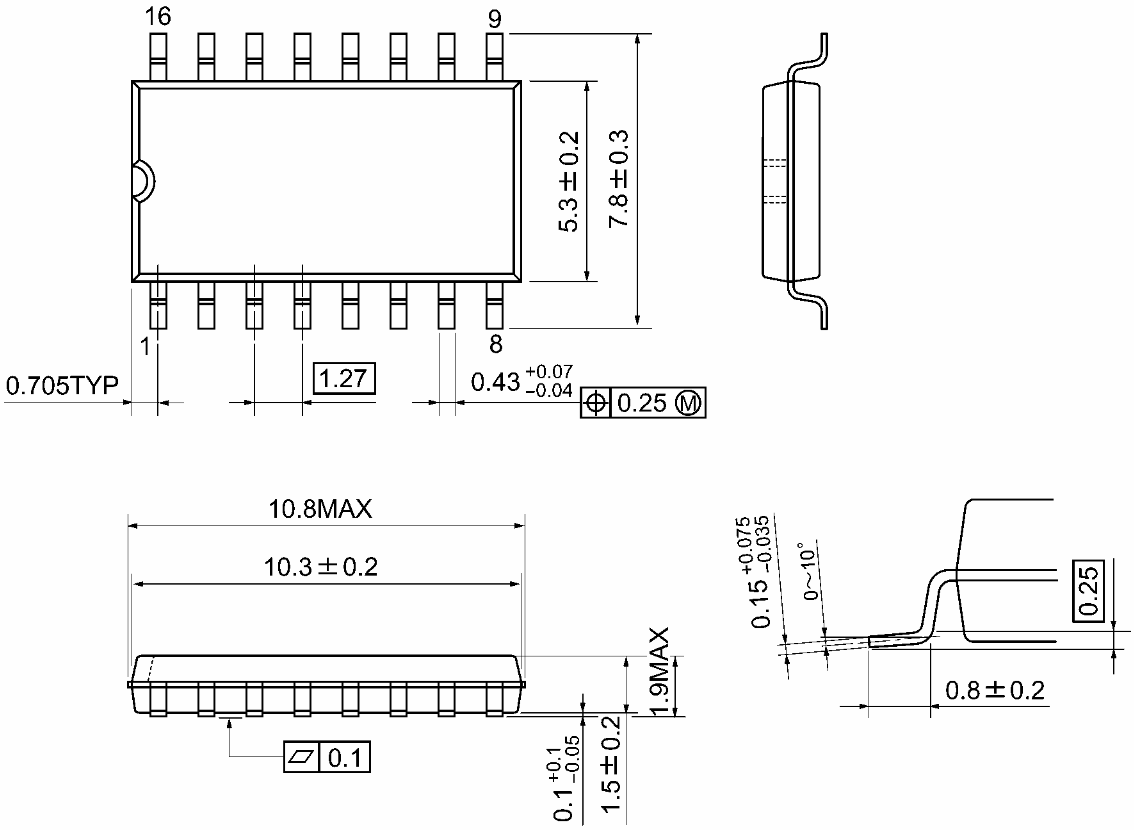


Weight: 1.00 g (typ.)

Package Dimensions

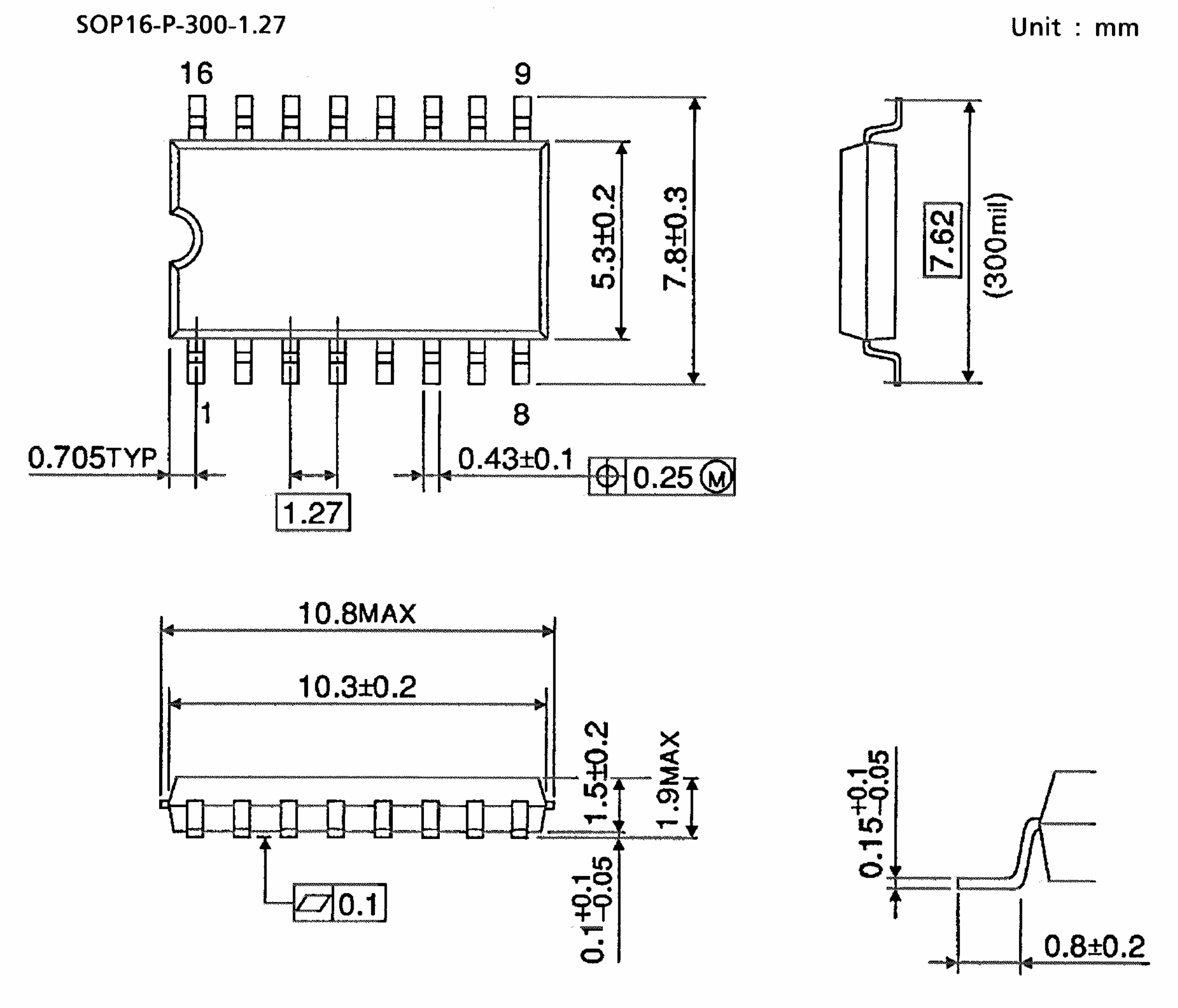
SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

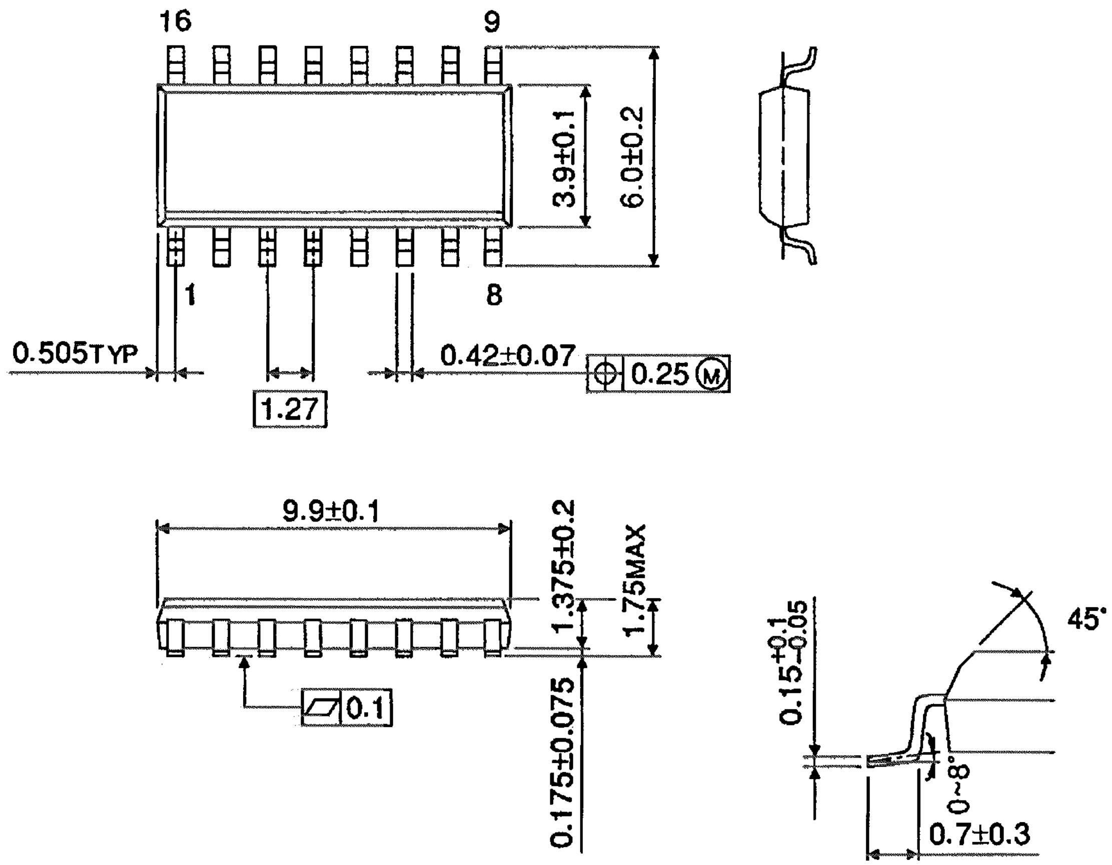
Package Dimensions



Weight: 0.18 g (typ.)

Package Dimensions (Note)

SOL16-P-150-1.27 Unit : mm

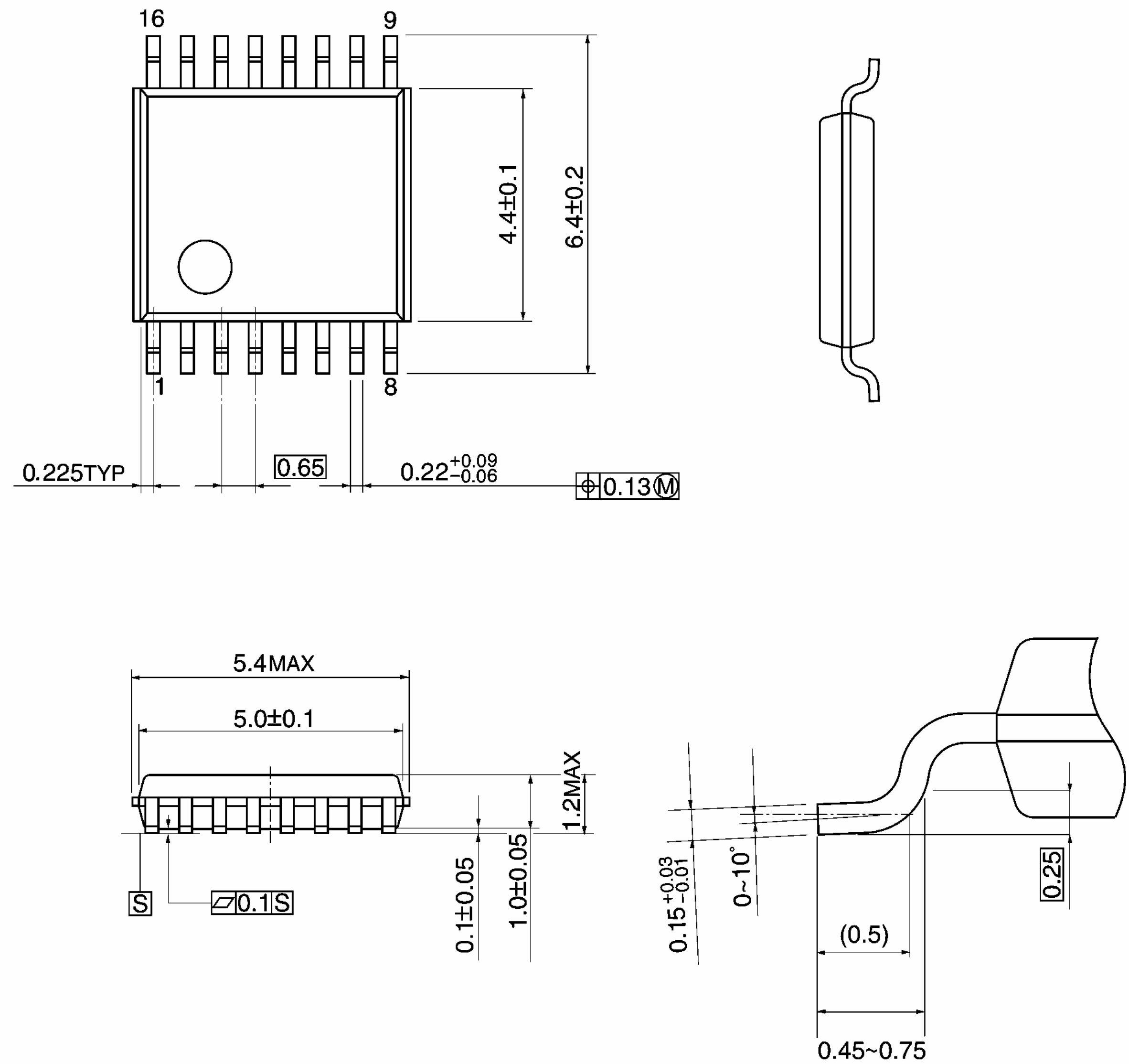


Note: This package is not available in Japan.

Weight: 0.13 g (typ.)

Package Dimensions

TSSOP16-P-0044-0.65A Unit: mm



Weight: 0.06 g (typ.)