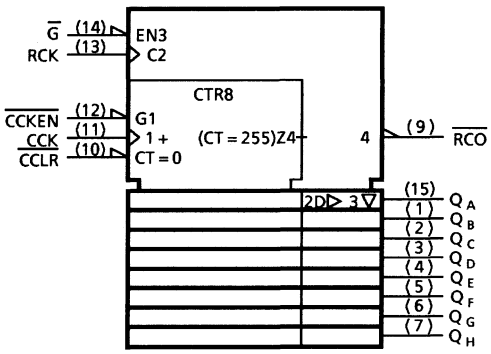
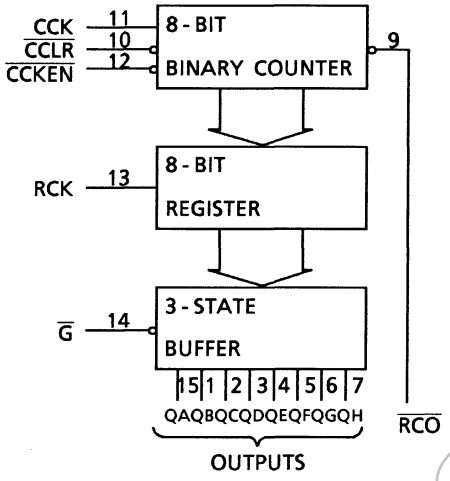
IEC Logic Symbol



Block Diagram



Truth Table

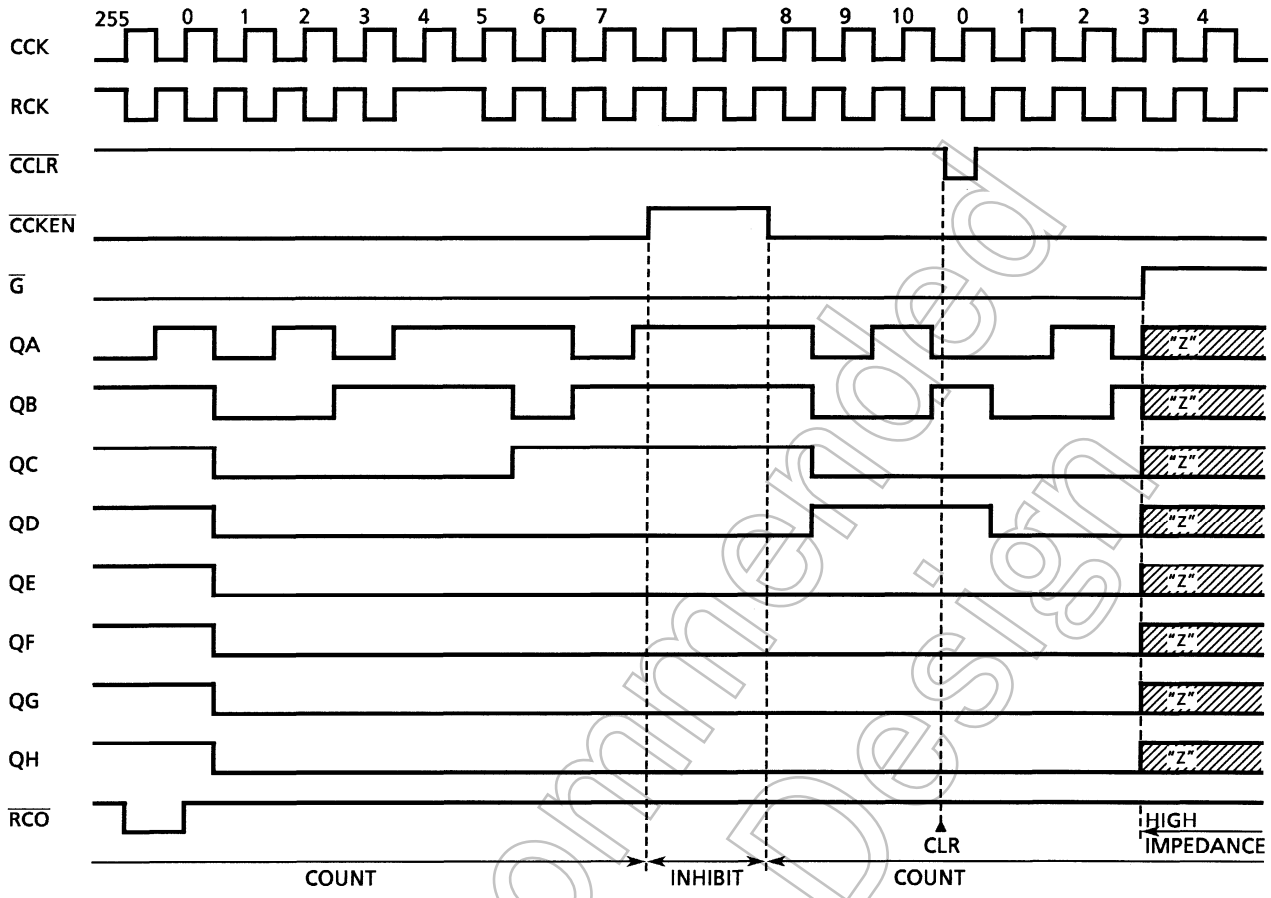
Inputs					Function
G	RCK	$\overline{CCLR}$	$\overline{CCKEN}$	CCK	
H	X	X	X	X	Q Outputs Disable
L	X	X	X	X	Q Outputs Enable
X	↑	X	X	X	Counter Data is Stored into Register
X	↓	X	X	X	Register State is not Changed
X	X	L	X	X	Counter Clear
X	X	H	L	↑	Advance One Count
X	X	H	L	↓	No Count
X	X	H	H	X	No Count

X: Don't care

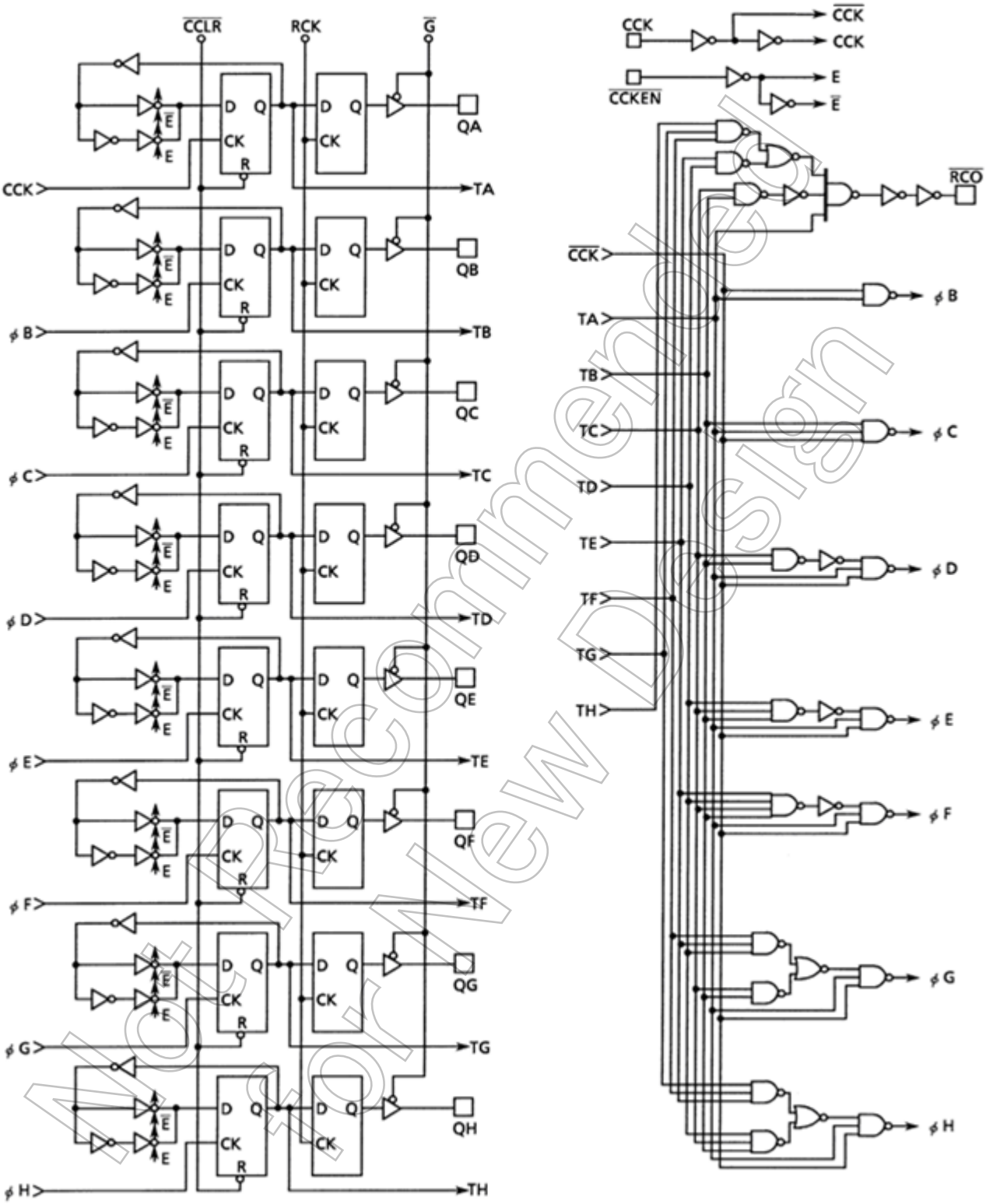
$\overline{RCO} = \overline{QA' \cdot QB' \cdot QC' \cdot QD' \cdot QE' \cdot QF' \cdot QG' \cdot QH'}$

(QA' to QH': internal outputs of the counter)

Timing Chart



Logic Diagram



Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	−0.5 to 7	V
DC input voltage	V_{IN}	−0.5 to V_{CC} + 0.5	V
DC output voltage	V_{OUT}	−0.5 to V_{CC} + 0.5	V
Input diode current	I_{IK}	±20	mA
Output diode current	I_{OK}	±20	mA
DC output current ($\overline{RCO}$)	I_{OUT}	±25	mA
DC output current (QA to QH)	I_{OUT}	±35	mA
DC V_{CC}/ground current	I_{CC}	±75	mA
Power dissipation	P_D	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	T_{stg}	−65 to 150	°C

Note 1: 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).

Note 2: 500 mW in the range of Ta = −40 to 65°C. From Ta = 65 to 85°C a derating factor of −10 mW/°C shall be applied until 300 mW.

Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2 to 6	V
Input voltage	V_{IN}	0 to V_{CC}	V
Output voltage	V_{OUT}	0 to V_{CC}	V
Operating temperature	T_{opr}	−40 to 85	°C
Input rise and fall time	t_r, t_f	0 to 1000 (V_{CC} = 2.0 V)	ns
		0 to 500 (V_{CC} = 4.5 V)	
		0 to 400 (V_{CC} = 6.0 V)	

Note: The operating ranges must be maintained to ensure the normal operation of the device.
Unused inputs must be tied to either V_{CC} or GND.

Electrical Characteristics

DC Characteristics

Characteristics	Symbol	Test Condition			V_{CC} (V)	Ta = 25°C Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40 to 85°C Min	Ta = −40 to 85°C Max	Unit
High-level input voltage	V_{IH}	—			2.0	1.50	—	—	1.50	—	V
					4.5	3.15	—	—	3.15	—	
					6.0	4.20	—	—	4.20	—	
Low-level input voltage	V_{IL}	—			2.0	—	—	0.50	—	0.50	V
					4.5	—	—	1.35	—	1.35	
					6.0	—	—	1.80	—	1.80	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}		I_{OH} = −20 μA	2.0	1.9	2.0	—	1.9	—	V
					4.5	4.4	4.5	—	4.4	—	
					6.0	5.9	6.0	—	5.9	—	
			$\overline{RCO}$	I_{OH} = −4 mA	4.5	4.18	4.31	—	4.13	—	
				I_{OH} = −5.2 mA	6.0	5.68	5.80	—	5.63	—	
			QA to QH	I_{OH} = −6 mA	4.5	4.18	4.31	—	4.13	—	
				I_{OH} = −7.8 mA	6.0	5.68	5.80	—	5.63	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}		I_{OL} = 20 μA	2.0	—	0.0	0.1	—	0.1	V
					4.5	—	0.0	0.1	—	0.1	
					6.0	—	0.0	0.1	—	0.1	
			$\overline{RCO}$	I_{OL} = 4 mA	4.5	—	0.17	0.26	—	0.33	
				I_{OL} = 5.2 mA	6.0	—	0.18	0.26	—	0.33	
			QA to QH	I_{OL} = 6 mA	4.5	—	0.17	0.26	—	0.33	
				I_{OL} = 7.8 mA	6.0	—	0.18	0.26	—	0.33	
3-state output off-state current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC} or GND			6.0	—	—	±0.5	—	±5.0	μA
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND			6.0	—	—	±0.1	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND			6.0	—	—	4.0	—	40.0	μA

Timing Requirements (input: $t_r = t_f = 6$ ns)

Characteristics	Symbol	Test Condition		Ta = 25°C		Ta = −40 to 85°C	Unit
			V_{CC} (V)	Typ.	Limit	Limit	
Minimum pulse width (CCK, RCK)	$t_{W(H)}$ $t_{W(L)}$	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum pulse width ($\overline{CCLR}$)	$t_{W(L)}$	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Minimum set-up time ($\overline{CCKEN}$-CCK)	t_s	—	2.0	—	100	125	ns
			4.5	—	20	25	
			6.0	—	17	21	
Minimum set-up time (CCK-RCK)	t_s	—	2.0	—	200	250	ns
			4.5	—	40	50	
			6.0	—	34	43	
Minimum hold time	t_h	—	2.0	—	0	0	ns
			4.5	—	0	0	
			6.0	—	0	0	
Minimum removal time ($\overline{CCLR}$)	t_{rem}	—	2.0	—	75	95	ns
			4.5	—	15	19	
			6.0	—	13	16	
Clock frequency	f	—	2.0	—	6	5	MHz
			4.5	—	33	26	
			6.0	—	39	31	

AC Characteristics ($C_L = 15$ pF, $V_{CC} = 5$ V, Ta = 25°C, input: $t_r = t_f = 6$ ns)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time ($\overline{RCO}$)	t_{TLH} t_{THL}	—	—	4	8	ns
Propagation delay time (CCK-$\overline{RCO}$)	t_{pLH} t_{pHL}	—	—	18	28	ns
Propagation delay time ($\overline{CCLR}$ - $\overline{RCO}$)	t_{pLH}	—	—	20	30	ns
Maximum clock frequency	f_{max}	—	32	62	—	MHz

AC Characteristics (input: $t_r = t_f = 6$ ns)

Characteristics	Symbol	Test Condition			Ta = 25°C			Ta = −40 to 85°C		Unit
			CL (pF)	V_{CC} (V)	Min	Typ.	Max	Min	Max	
Output transition time (Qn)	t_{TLH} t_{THL}	—	50	2.0	—	25	60	—	75	ns
				4.5	—	7	12	—	15	
				6.0	—	6	10	—	13	
Output transition time ($\overline{RCO}$)	t_{TLH} t_{THL}	—	50	2.0	—	30	75	—	95	ns
				4.5	—	8	15	—	19	
				6.0	—	7	13	—	16	
Propagation delay time ($CCK-\overline{RCO}$)	t_{pLH} t_{pHL}	—	50	2.0	—	75	163	—	205	ns
				4.5	—	22	33	—	41	
				6.0	—	17	28	—	35	
Propagation delay time ($\overline{CCLR}-\overline{RCO}$)	t_{pLH}	—	50	2.0	—	78	175	—	220	ns
				4.5	—	23	35	—	44	
				6.0	—	18	30	—	37	
Propagation delay time (RCK-Qn)	t_{pLH} t_{pHL}	—	50	2.0	—	62	145	—	180	ns
				4.5	—	19	29	—	36	
				6.0	—	15	25	—	31	
			150	2.0	—	78	185	—	230	
				4.5	—	24	37	—	46	
				6.0	—	19	31	—	39	
Output enable time	t_{pZL} t_{pZH}	R_L = 1 kΩ	50	2.0	—	43	105	—	130	ns
				4.5	—	14	21	—	26	
				6.0	—	12	18	—	22	
			150	2.0	—	58	150	—	190	
				4.5	—	19	30	—	38	
				6.0	—	16	26	—	33	
Output disable time	t_{pLZ} t_{pHZ}	R_L = 1 kΩ	50	2.0	—	33	105	—	130	ns
				4.5	—	16	21	—	26	
				6.0	—	12	18	—	22	
Maximum clock frequency	f_{max}	—	50	2.0	6	12	—	5	—	MHz
				4.5	30	51	—	24	—	
				6.0	35	80	—	28	—	
Input capacitance	C_{IN}	—			—	5	10	—	10	pF
Power dissipation capacitance	C_{PD} (Note)	—			—	34	—	—	—	pF

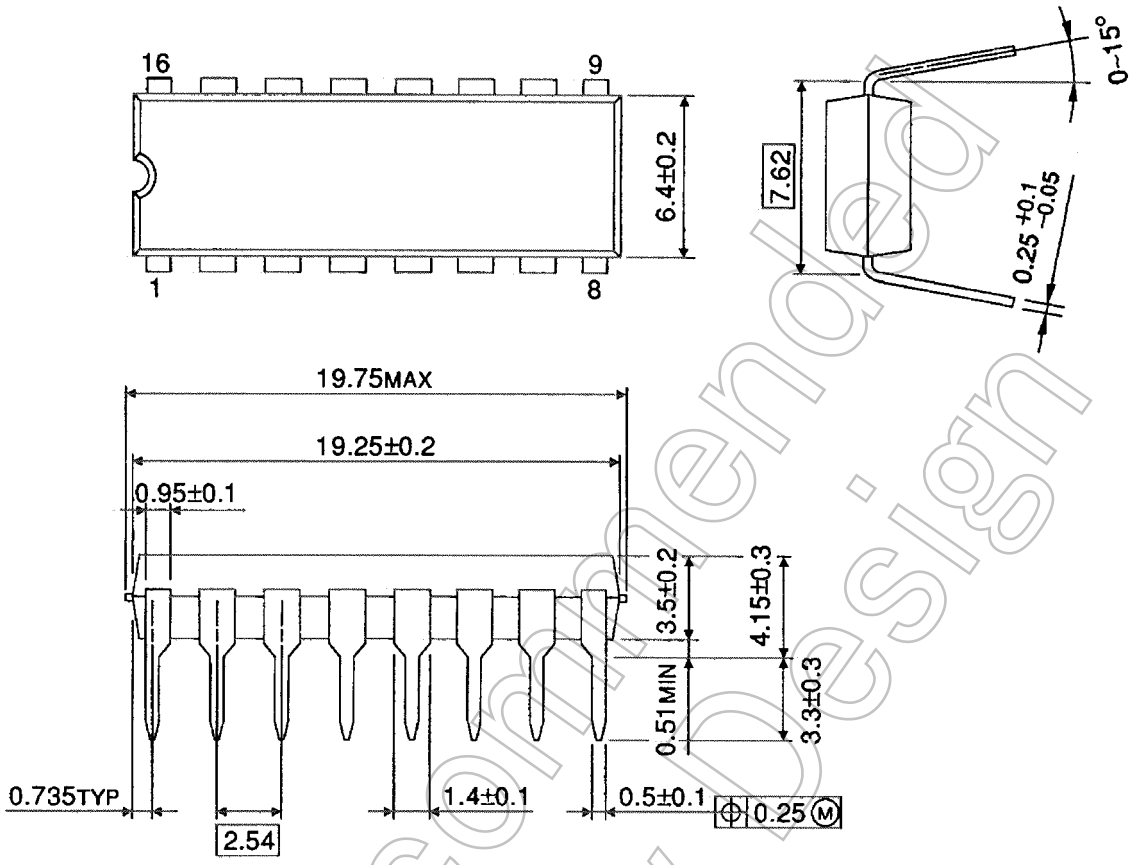
Note: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

Package Dimensions

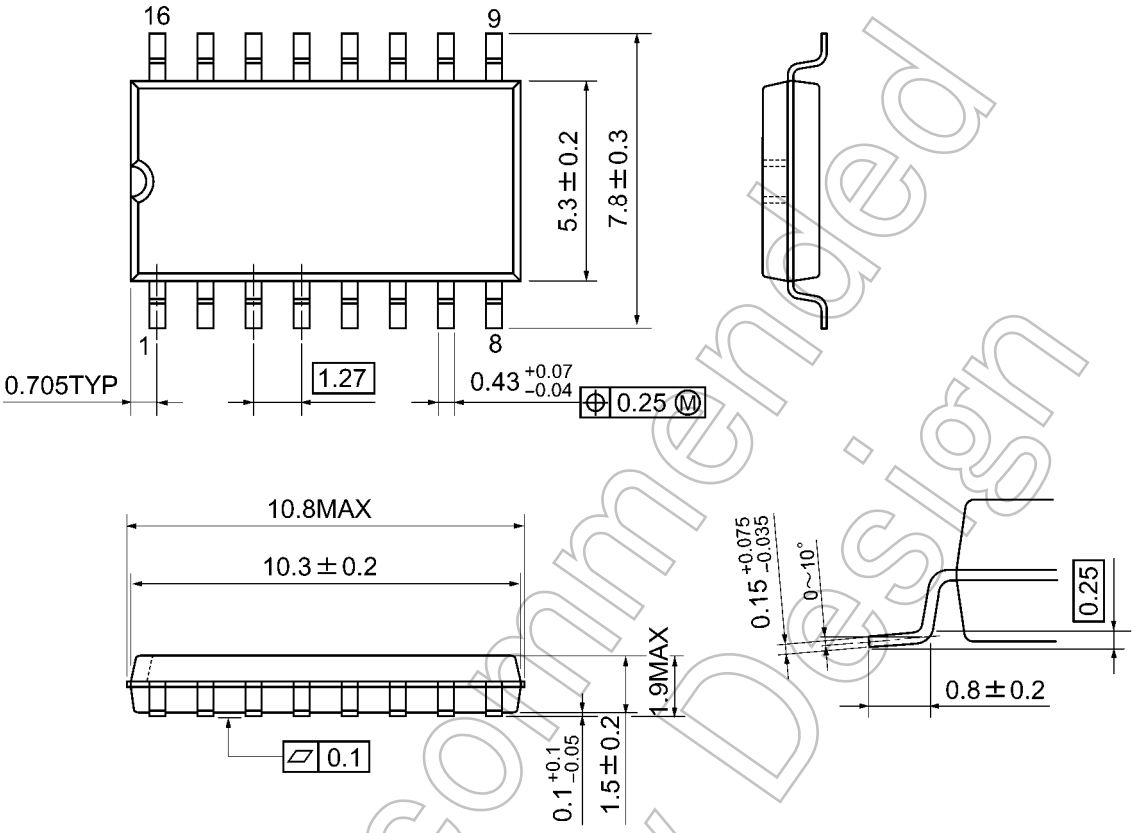
DIP16-P-300-2.54A Unit : mm



Weight: 1.00 g (typ.)

Package Dimensions

SOP16-P-300-1.27A Unit: mm



Weight: 0.18 g (typ.)

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