

TC74VHC175F, TC74VHC175FT, TC74VHC175FK

Quad D-Type Flip Flop with Clear

The TC74VHC175 is an advanced high speed CMOS QUAD D-TYPE FLIP FLOP fabricated with silicon gate C²MOS technology.

It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

These four flip-flops are controlled by a clock input (CK) and a clear input (CLR).

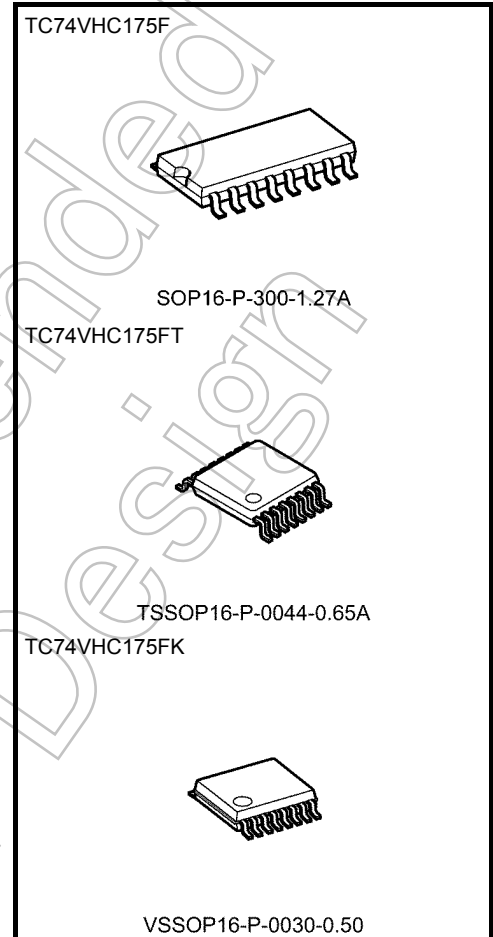
The information data applied to the D inputs (D1 thru D4) are transferred to the outputs (Q1 thru Q4 and $\bar{Q}1$ thru $\bar{Q}4$) on the positive-going edge of the clock pulse.

When the CLR input is held low, the Q outputs are at the low logic level and the \bar{Q} outputs are at the high logic level, regardless of other input conditions.

An input protection circuit ensures that 0 to 5.5 V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5 V to 3 V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

Features

- High speed: $f_{max} = 210$ MHz (typ.) at $V_{CC} = 5$ V
- Low power dissipation: $I_{CC} = 4$ μ A (max) at $T_a = 25^\circ$ C
- High noise immunity: $V_{NIH} = V_{NIL} = 28\%$ V_{CC} (min)
- Power down protection is provided on all inputs.
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC} (opr) = 2$ to 5.5 V
- Low noise: $V_{OLP} = 0.8$ V (max)
- Pin and function compatible with 74ALS175

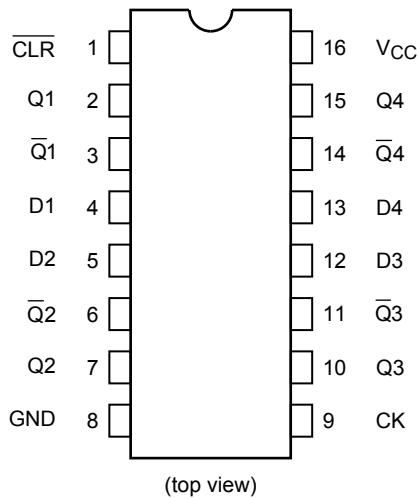


Weight

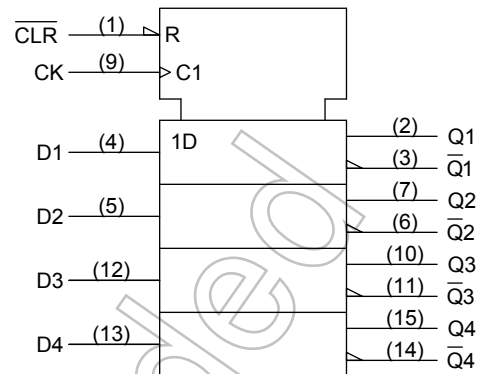
SOP16-P-300-1.27A	: 0.18 g (typ.)
TSSOP16-P-0044-0.65A	: 0.06 g (typ.)
VSSOP16-P-0030-0.50	: 0.02 g (typ.)

Start of commercial production
1991-11

Pin Assignment



IEC Logic Symbol

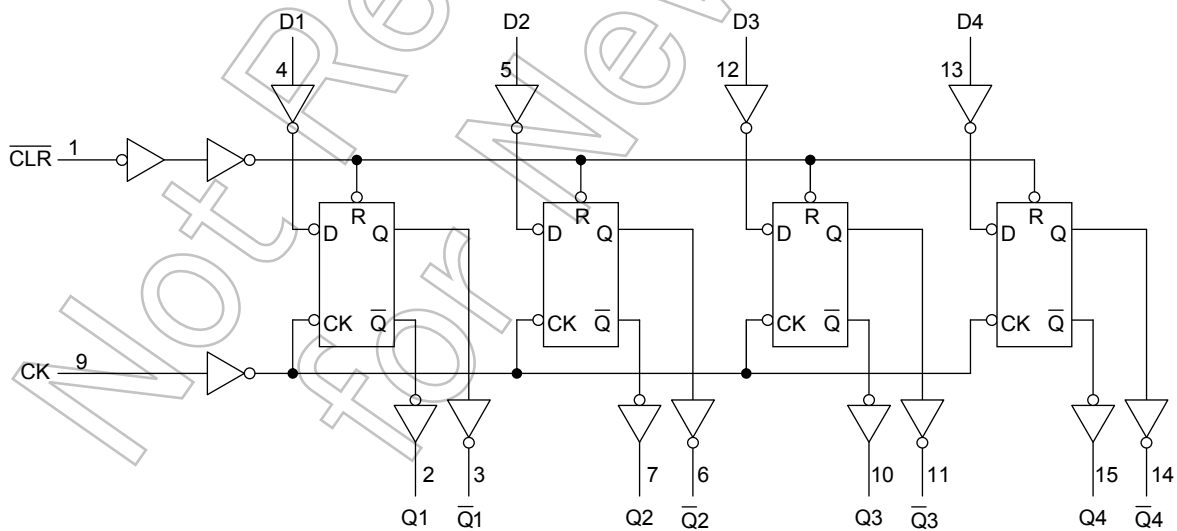


Truth Table

Inputs			Outputs		Function
$\overline{\text{CLR}}$	D	CK	Q	$\overline{\text{Q}}$	
L	X	X	L	H	Clear
H	L		L	H	—
H	H		H	L	—
H	X		Q_n	\overline{Q}_n	No Change

X: Don't care

System Diagram



Absolute Maximum Ratings (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage range	V_{CC}	-0.5 to 7.0	V
DC input voltage	V_{IN}	-0.5 to 7.0	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	I_{OUT}	± 25	mA
DC V_{CC} /ground current	I_{CC}	± 50	mA
Power dissipation	P_D	180	mW
Storage temperature	T_{stg}	-65 to 150	$^{\circ}C$

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 Range (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	2.0 to 5.5	V
Input voltage	V_{IN}	0 to 5.5	V
Output voltage	V_{OUT}	0 to V_{CC}	V
Operating temperature	T_{opr}	-40 to 85	$^{\circ}C$
Input rise and fall time	dt/dv	0 to 100 ($V_{CC} = 3.3 \pm 0.3$ V) 0 to 20 ($V_{CC} = 5 \pm 0.5$ V)	ns/V

Note: The operating range 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		Ta = 25°C			Ta = -40 to 85°C		Unit	
				V _{CC} (V)	Min	Typ.	Max	Min		Max
High-level input voltage	V _{IH}	—	2.0 3.0 to 5.5	1.50 V _{CC} × 0.7	— —	— —	1.50 V _{CC} × 0.7	— —	V	
Low-level input voltage	V _{IL}	—	2.0 3.0 to 5.5	— —	— —	0.50 V _{CC} × 0.3	— —	0.50 V _{CC} × 0.3	V	
High-level output voltage	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = -50 μA	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5	— — —	1.9 2.9 4.4	— — —	V
			I _{OH} = -4 mA	3.0	2.58	—	—	2.48	—	
			I _{OH} = -8 mA	4.5	3.94	—	—	3.80	—	
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 50 μA	2.0 3.0 4.5	— — —	0.0 0.0 0.0	0.1 0.1 0.1	— — —	0.1 0.1 0.1	V
			I _{OL} = 4 mA	3.0	—	—	0.36	—	0.44	
			I _{OL} = 8 mA	4.5	—	—	0.36	—	0.44	
Input leakage current	I _{IN}	V _{IN} = 5.5 V or GND	0 to 5.5	—	—	±0.1	—	±1.0	μA	
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND	5.5	—	—	4.0	—	40.0	μA	

Timing Requirements (input: t_r = t_f = 3 ns)

Characteristics	Symbol	Test Condition		Ta = 25°C		Ta = -40 to 85°C	Unit
				V _{CC} (V)	Typ.	Limit	
Minimum pulse width (CK)	t _w (L)	—	3.3 ± 0.3	—	5.0	5.0	ns
	t _w (H)	—	5.0 ± 0.5	—	5.0	5.0	
Minimum pulse width ($\overline{\text{CLR}}$)	t _w (L)	—	3.3 ± 0.3 5.0 ± 0.5	— —	5.0 5.0	5.0 5.0	ns
Minimum set-up time	t _s	—	3.3 ± 0.3	—	5.0	5.0	ns
			5.0 ± 0.5	—	4.0	4.0	
Minimum hold time	t _h	—	3.3 ± 0.3	—	1.0	1.0	ns
			5.0 ± 0.5	—	1.0	1.0	
Minimum removal time ($\overline{\text{CLR}}$)	t _{rem}	—	3.3 ± 0.3	—	5.0	5.0	ns
			5.0 ± 0.5	—	5.0	5.0	

AC Characteristics (input: $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = -40 to 85°C		Unit	
		V _{CC} (V)	C _L (pF)	Min	Typ.	Max	Min	Max		
Propagation delay time (CK-Q, \bar{Q})	t _{pLH}	—	3.3 ± 0.3	15	—	7.5	11.5	1.0	13.5	ns
				50	—	10.0	15.0	1.0	17.0	
	t _{pHL}		5.0 ± 0.5	15	—	4.8	7.3	1.0	8.5	
				50	—	6.3	9.3	1.0	10.5	
Propagation delay time ($\bar{\text{CLR}}$ -Q, \bar{Q})	t _{pLH}	—	3.3 ± 0.3	15	—	6.3	10.1	1.0	12.0	ns
				50	—	8.8	13.6	1.0	15.5	
	t _{pHL}		5.0 ± 0.5	15	—	4.3	6.4	1.0	7.5	
				50	—	5.8	8.4	1.0	9.5	
Maximum clock frequency	f _{max}	—	3.3 ± 0.3	15	90	140	—	75	—	MHz
				50	50	75	—	45	—	
			5.0 ± 0.5	15	150	210	—	125	—	
				50	85	115	—	75	—	
Output to output skew	t _{osLH}	(Note 1)	3.3 ± 0.3	50	—	—	1.5	—	1.5	ns
	t _{osHL}		5.0 ± 0.5	50	—	—	1.0	—	1.0	
Input capacitance	C _{IN}	—	—	—	4	10	—	10	pF	
Power dissipation capacitance	C _{PD}	—	(Note 2)	—	44	—	—	—	pF	

Note 1: Parameter guaranteed by design.

$$t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|$$

Note 2: 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:

$$I_{CC (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/4 \text{ (per bit)}$$

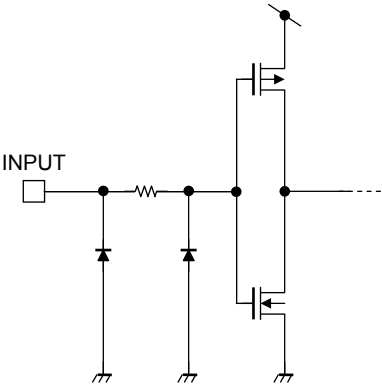
And the total C_{PD} when n pcs. of flip flop operate can be gained by the following equation:

$$C_{PD (total)} = 30 + 14 \cdot n$$

Noise Characteristics (input: $t_r = t_f = 3 \text{ ns}$)

Characteristics	Symbol	Test Condition	Ta = 25°C			Unit
			V _{CC} (V)	Typ.	Max	
Quiet output maximum dynamic V _{OL}	V _{OLP}	C _L = 50 pF	5.0	0.4	0.8	V
Quiet output minimum dynamic V _{OL}	V _{OLV}	C _L = 50 pF	5.0	-0.4	-0.8	V
Minimum high level dynamic input voltage	V _{IHD}	C _L = 50 pF	5.0	—	3.5	V
Maximum low level dynamic input voltage	V _{ILD}	C _L = 50 pF	5.0	—	1.5	V

Input Equivalent Circuit

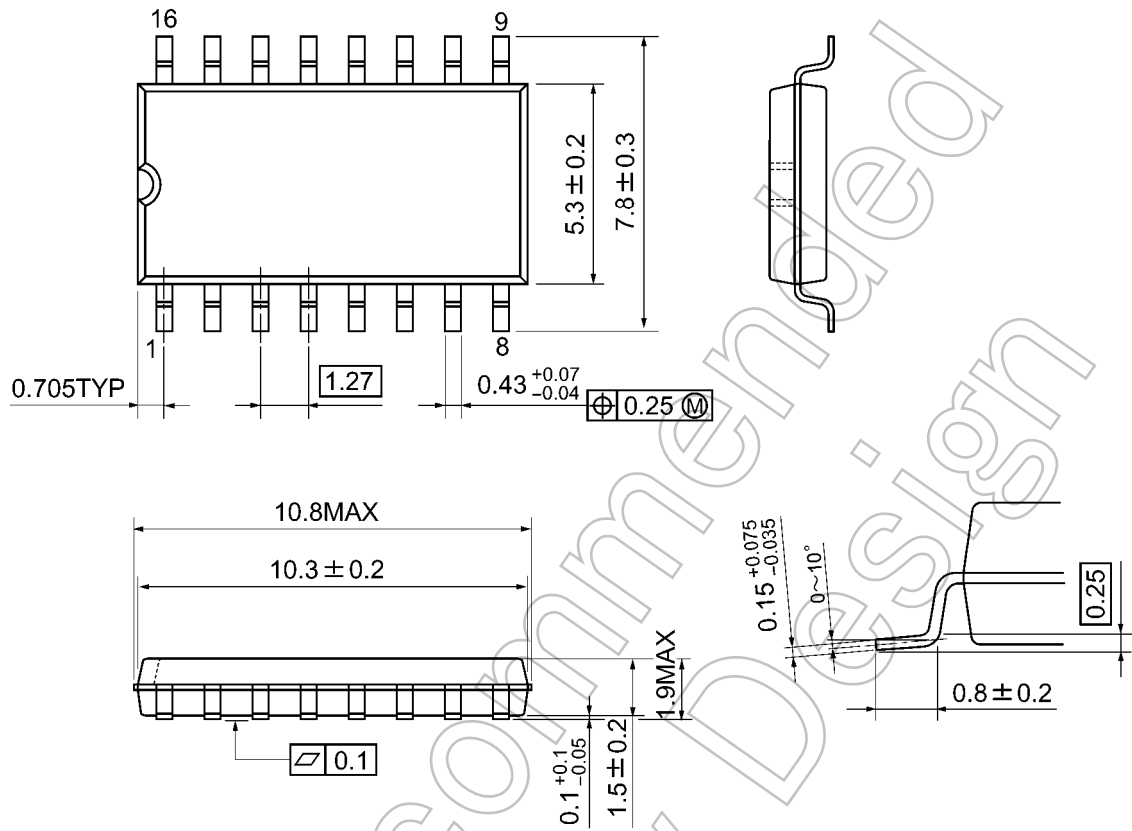


Not Recommended
for New Design

Package Dimensions

SOP16-P-300-1.27A

Unit: mm



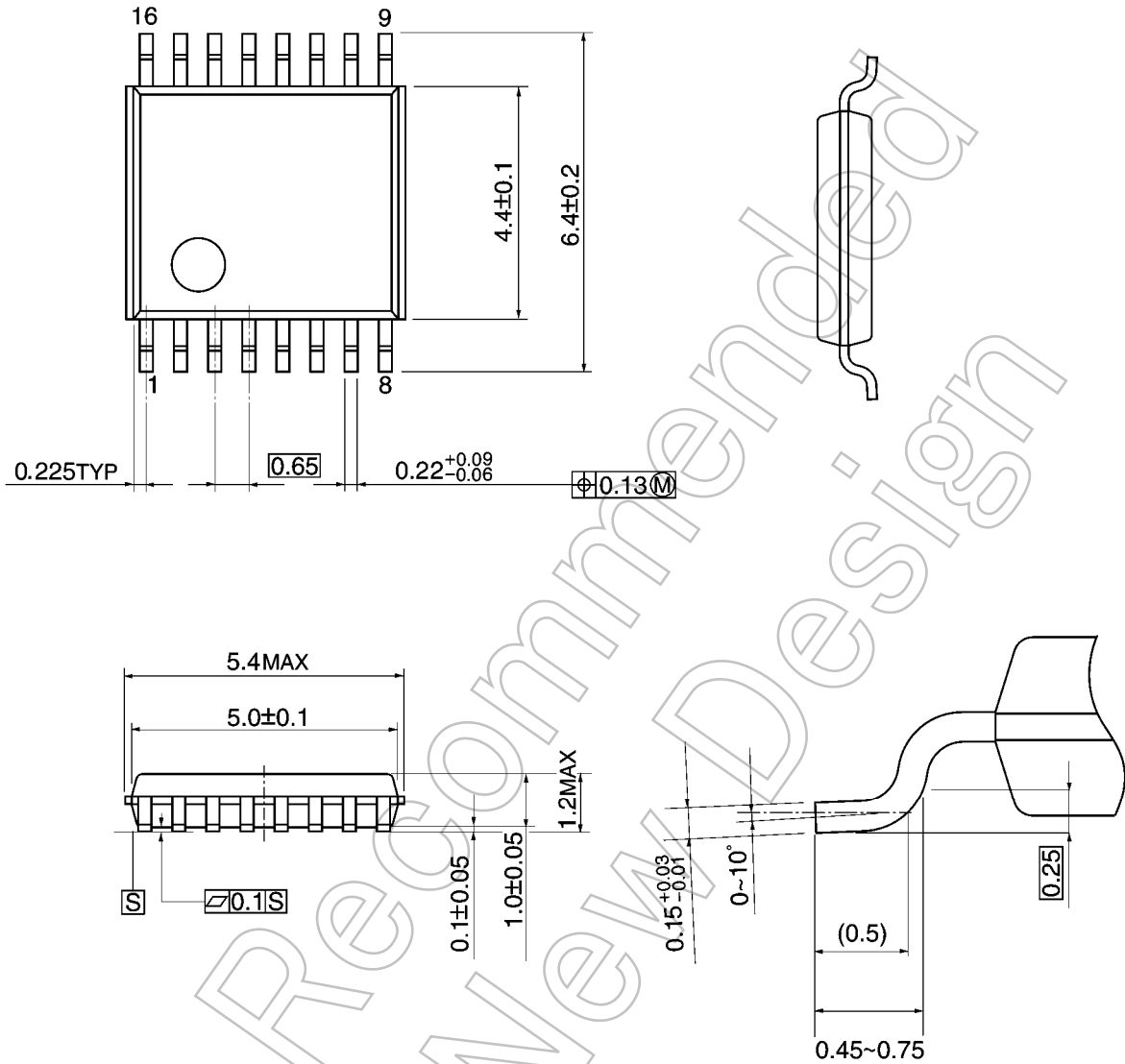
Weight: 0.18 g (typ.)

Not Recommended for New Design

Package Dimensions

TSSOP16-P-0044-0.65A

Unit: mm



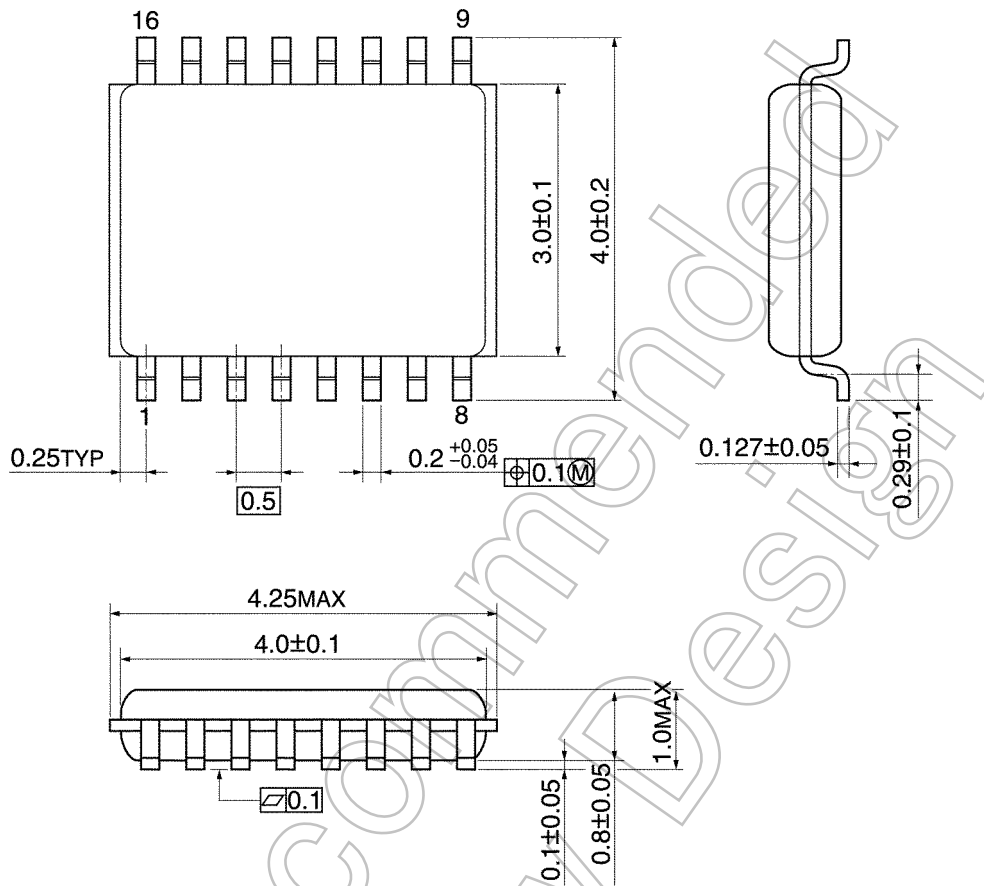
Weight: 0.06 g (typ.)

Not Recommended for New Design

Package Dimensions

VSSOP16-P-0030-0.50

Unit: mm



Weight: 0.02 g (typ.)

Not Recommended for New Design

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