

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74AC283P, TC74AC283F

### 4-Bit Binary Full Adder

The TC74AC283 is an advanced high speed CMOS 4-BIT BINARY FULL ADDER fabricated with silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology.

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

Sum ( $\Sigma$ ) outputs are provided for each bit and a resultant carry (C4) is obtained from the fourth bit.

This adder features full internal look-ahead across all four bits.

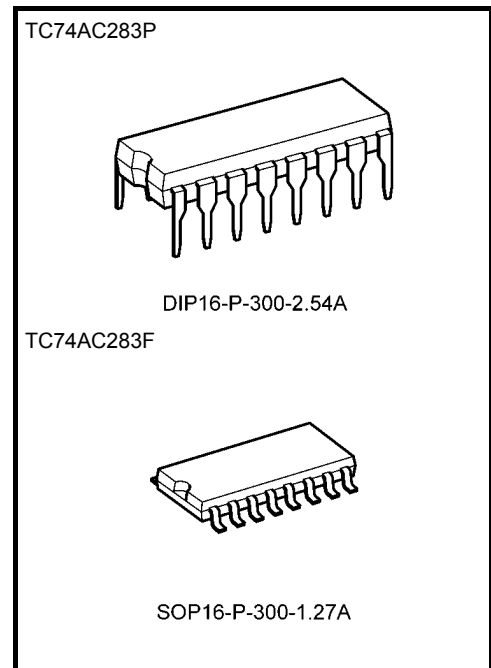
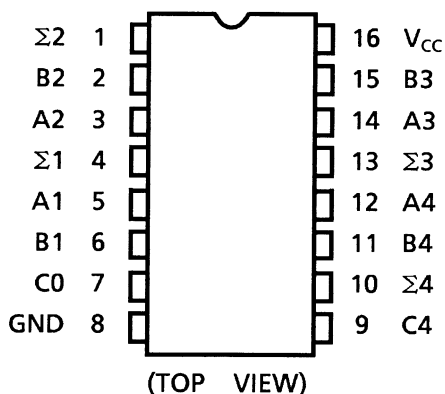
A4 × n bit binary adder is easily built up by cascading the AC283 without any additional logic.

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

### Features

- High speed:  $t_{pd} = 7.0 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 8 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 24 \text{ mA (min)}$   
Capability of driving  $50 \Omega$  transmission lines.
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \sim 5.5 \text{ V}$
- Pin and function compatible with 74F283

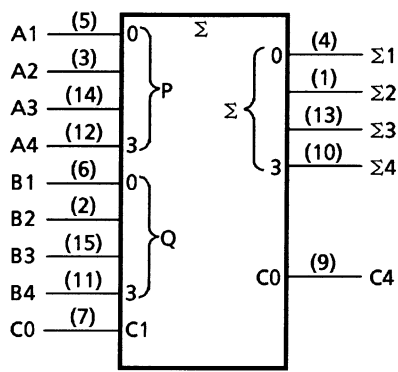
### Pin Assignment



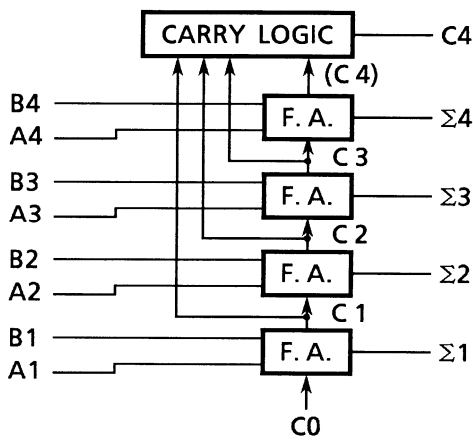
Weight

|                   |                 |
|-------------------|-----------------|
| DIP16-P-300-2.54A | : 1.00 g (typ.) |
| SOP16-P-300-1.27A | : 0.18 g (typ.) |

IEC Logic Symbol



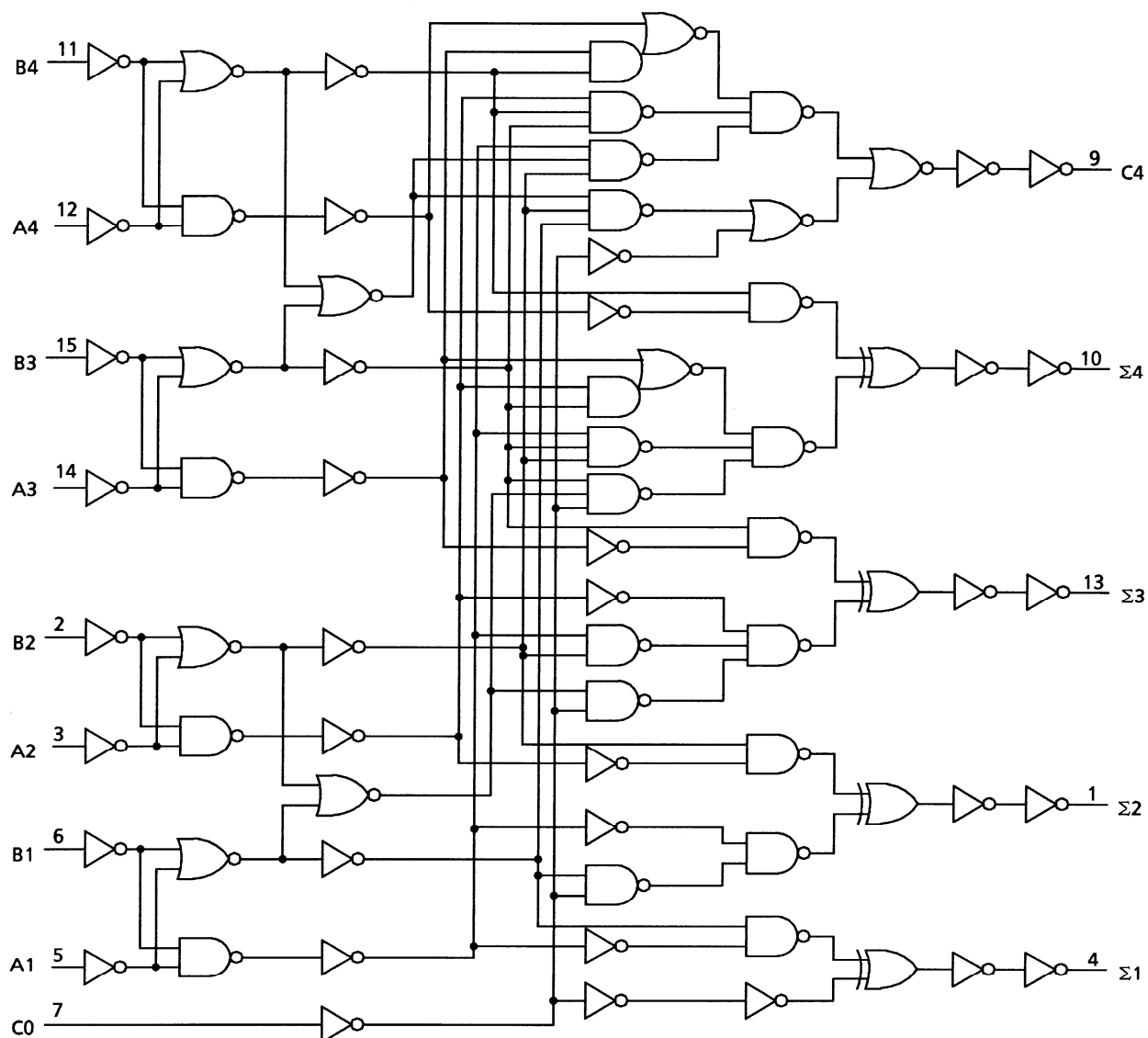
Block Diagram



Truth Table (1 bit)

| Inputs         |                |                    | Outputs        |                |
|----------------|----------------|--------------------|----------------|----------------|
| B <sub>n</sub> | A <sub>n</sub> | C <sub>n</sub> - 1 | Σ <sub>n</sub> | C <sub>n</sub> |
| L              | L              | L                  | L              | L              |
| L              | L              | H                  | H              | L              |
| L              | H              | L                  | H              | L              |
| L              | H              | H                  | L              | H              |
| H              | L              | L                  | H              | L              |
| H              | L              | H                  | L              | H              |
| H              | H              | L                  | L              | H              |
| H              | H              | H                  | H              | H              |

## System Diagram



## Absolute Maximum Ratings (Note 1)

| Characteristics             | Symbol    | Rating                       | Unit               |
|-----------------------------|-----------|------------------------------|--------------------|
| Supply voltage range        | $V_{CC}$  | $-0.5 \sim 7.0$              | V                  |
| DC input voltage            | $V_{IN}$  | $-0.5 \sim V_{CC} + 0.5$     | V                  |
| DC output voltage           | $V_{OUT}$ | $-0.5 \sim V_{CC} + 0.5$     | V                  |
| Input diode current         | $I_{IK}$  | $\pm 20$                     | mA                 |
| Output diode current        | $I_{OK}$  | $\pm 50$                     | mA                 |
| DC output current           | $I_{OUT}$ | $\pm 50$                     | mA                 |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 125$                    | mA                 |
| Power dissipation           | $P_D$     | 500 (DIP) (Note 2)/180 (SOP) | mW                 |
| Storage temperature         | $T_{stg}$ | $-65 \sim 150$               | $^{\circ}\text{C}$ |

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  $T_a = -40 \sim 65^{\circ}\text{C}$ . From  $T_a = 65$  to  $85^{\circ}\text{C}$  a derating factor of  $-10 \text{ mW}/^{\circ}\text{C}$  should be applied up to 300 mW.

## Operating Ranges (Note)

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

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

## Electrical Characteristics

### DC Characteristics

| Characteristics           | Symbol          | Test Condition                                             |                                                                                        | V <sub>CC</sub><br>(V) | Ta = 25°C            |             |                      | Ta = -40~85°C        |                      | Unit |
|---------------------------|-----------------|------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------|----------------------|-------------|----------------------|----------------------|----------------------|------|
|                           |                 |                                                            |                                                                                        |                        | Min                  | Typ.        | Max                  | Min                  | Max                  |      |
| High-level input voltage  | V <sub>IH</sub> | —                                                          |                                                                                        | 2.0<br>3.0<br>5.5      | 1.50<br>2.10<br>3.85 | —<br>—<br>— | —<br>—<br>—          | 1.50<br>2.10<br>3.85 | —<br>—<br>—          | V    |
| Low-level input voltage   | V <sub>IL</sub> | —                                                          |                                                                                        | 2.0<br>3.0<br>5.5      | —<br>—<br>—          | —<br>—<br>— | 0.50<br>0.90<br>1.65 | —<br>—<br>—          | 0.50<br>0.90<br>1.65 | V    |
| High-level output voltage | V <sub>OH</sub> | V <sub>IN</sub><br>= V <sub>IH</sub> or<br>V <sub>IL</sub> | I <sub>OH</sub> = -50 μA                                                               | 2.0                    | 1.9                  | 2.0         | —                    | 1.9                  | —                    | V    |
|                           |                 |                                                            |                                                                                        | 3.0                    | 2.9                  | 3.0         | —                    | 2.9                  | —                    |      |
|                           |                 |                                                            |                                                                                        | 4.5                    | 4.4                  | 4.5         | —                    | 4.4                  | —                    |      |
|                           |                 |                                                            | I <sub>OH</sub> = -4 mA<br>I <sub>OH</sub> = -24 mA<br>I <sub>OH</sub> = -75 mA (Note) | 3.0                    | 2.58                 | —           | —                    | 2.48                 | —                    |      |
|                           |                 |                                                            |                                                                                        | 4.5                    | 3.94                 | —           | —                    | 3.80                 | —                    |      |
|                           |                 |                                                            |                                                                                        | 5.5                    | —                    | —           | —                    | 3.85                 | —                    |      |
| Low-level output voltage  | V <sub>OL</sub> | V <sub>IN</sub><br>= V <sub>IH</sub> or<br>V <sub>IL</sub> | I <sub>OL</sub> = 50 μA                                                                | 2.0                    | —                    | 0.0         | 0.1                  | —                    | 0.1                  | V    |
|                           |                 |                                                            |                                                                                        | 3.0                    | —                    | 0.0         | 0.1                  | —                    | 0.1                  |      |
|                           |                 |                                                            |                                                                                        | 4.5                    | —                    | 0.0         | 0.1                  | —                    | 0.1                  |      |
|                           |                 |                                                            | I <sub>OL</sub> = 12 mA<br>I <sub>OL</sub> = 24 mA<br>I <sub>OL</sub> = 75 mA (Note)   | 3.0                    | —                    | —           | 0.36                 | —                    | 0.44                 |      |
|                           |                 |                                                            |                                                                                        | 4.5                    | —                    | —           | 0.36                 | —                    | 0.44                 |      |
|                           |                 |                                                            |                                                                                        | 5.5                    | —                    | —           | —                    | —                    | 1.65                 |      |
| Input leakage current     | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                   |                                                                                        | 5.5                    | —                    | —           | ±0.1                 | —                    | ±1.0                 | μA   |
| Quiescent supply current  | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND                   |                                                                                        | 5.5                    | —                    | —           | 8.0                  | —                    | 80.0                 | μA   |

Note: This spec indicates the capability of driving 50 Ω transmission lines.

One output should be tested at a time for a 10 ms maximum duration.

## AC Characteristics ( $C_L = 50 \text{ pF}$ , $R_L = 500 \Omega$ , input: $t_r = t_f = 3 \text{ ns}$ )

| Characteristics                                          | Symbol             | Test Condition | $V_{CC} \text{ (V)}$ | $T_a = 25^\circ\text{C}$ |      |      | $T_a = -40\sim 85^\circ\text{C}$ |      | Unit |
|----------------------------------------------------------|--------------------|----------------|----------------------|--------------------------|------|------|----------------------------------|------|------|
|                                                          |                    |                |                      | Min                      | Typ. | Max  | Min                              | Max  |      |
| Propagation delay time<br>( $C0\text{-}\Sigma n$ )       | $t_{pLH}$          | —              | $3.3 \pm 0.3$        | —                        | 10.6 | 17.5 | 1.0                              | 20.0 | ns   |
|                                                          | $t_{pHL}$          |                | $5.0 \pm 0.5$        | —                        | 7.1  | 10.6 | 1.0                              | 12.1 |      |
| Propagation delay time<br>( $C0\text{-}C4$ )             | $t_{pLH}$          | —              | $3.3 \pm 0.3$        | —                        | 9.4  | 15.5 | 1.0                              | 17.7 | ns   |
|                                                          | $t_{pHL}$          |                | $5.0 \pm 0.5$        | —                        | 6.5  | 9.6  | 1.0                              | 11.0 |      |
| Propagation delay time<br>( $A_n, B_n\text{-}\Sigma n$ ) | $t_{pLH}$          | —              | $3.3 \pm 0.3$        | —                        | 12.1 | 20.2 | 1.0                              | 23.0 | ns   |
|                                                          | $t_{pHL}$          |                | $5.0 \pm 0.5$        | —                        | 7.7  | 12.0 | 1.0                              | 13.6 |      |
| Propagation delay time<br>( $A_n, B_n\text{-}C4$ )       | $t_{pLH}$          | —              | $3.3 \pm 0.3$        | —                        | 11.6 | 19.3 | 1.0                              | 22.0 | ns   |
|                                                          | $t_{pHL}$          |                | $5.0 \pm 0.5$        | —                        | 7.5  | 11.4 | 1.0                              | 13.0 |      |
| Input capacitance                                        | $C_{IN}$           | —              | —                    | —                        | 5    | 10   | —                                | 10   | pF   |
| Power dissipation capacitance                            | $C_{PD}$<br>(Note) | —              | —                    | —                        | 125  | —    | —                                | —    | pF   |

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

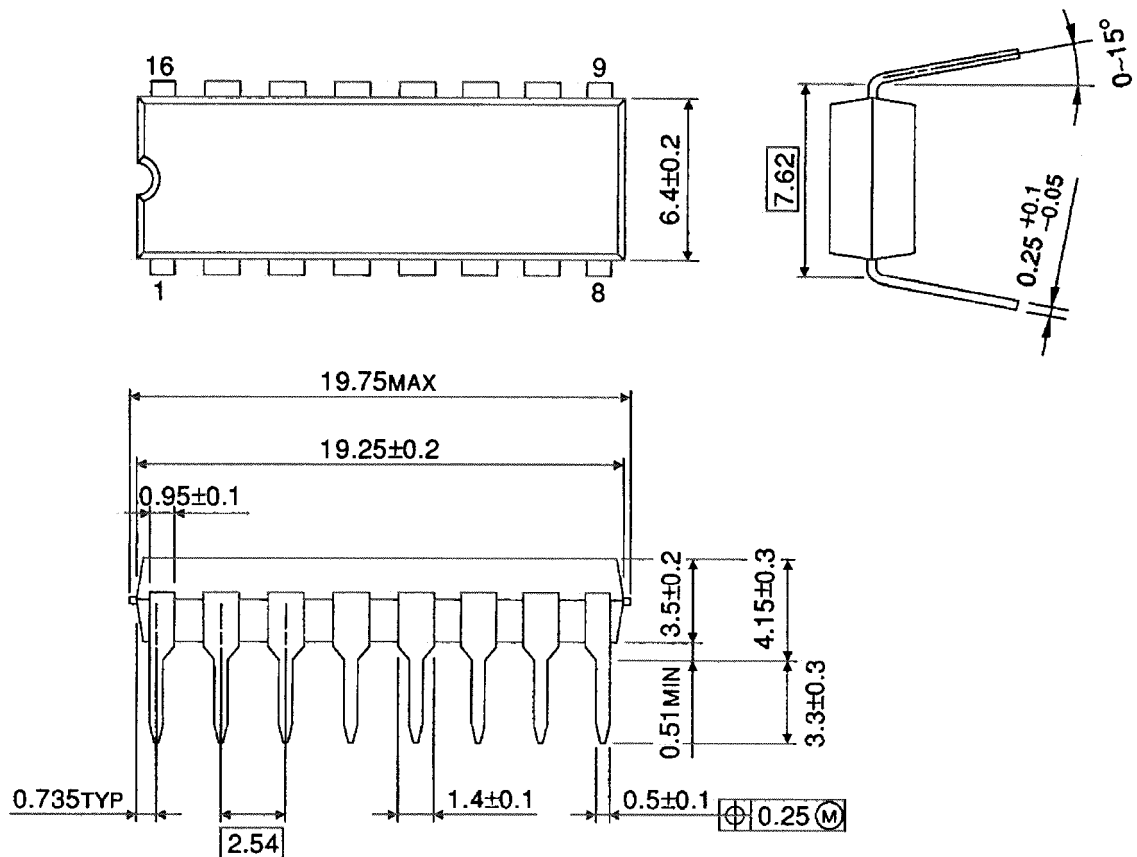
Average operating current can be obtained by the equation:

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

## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

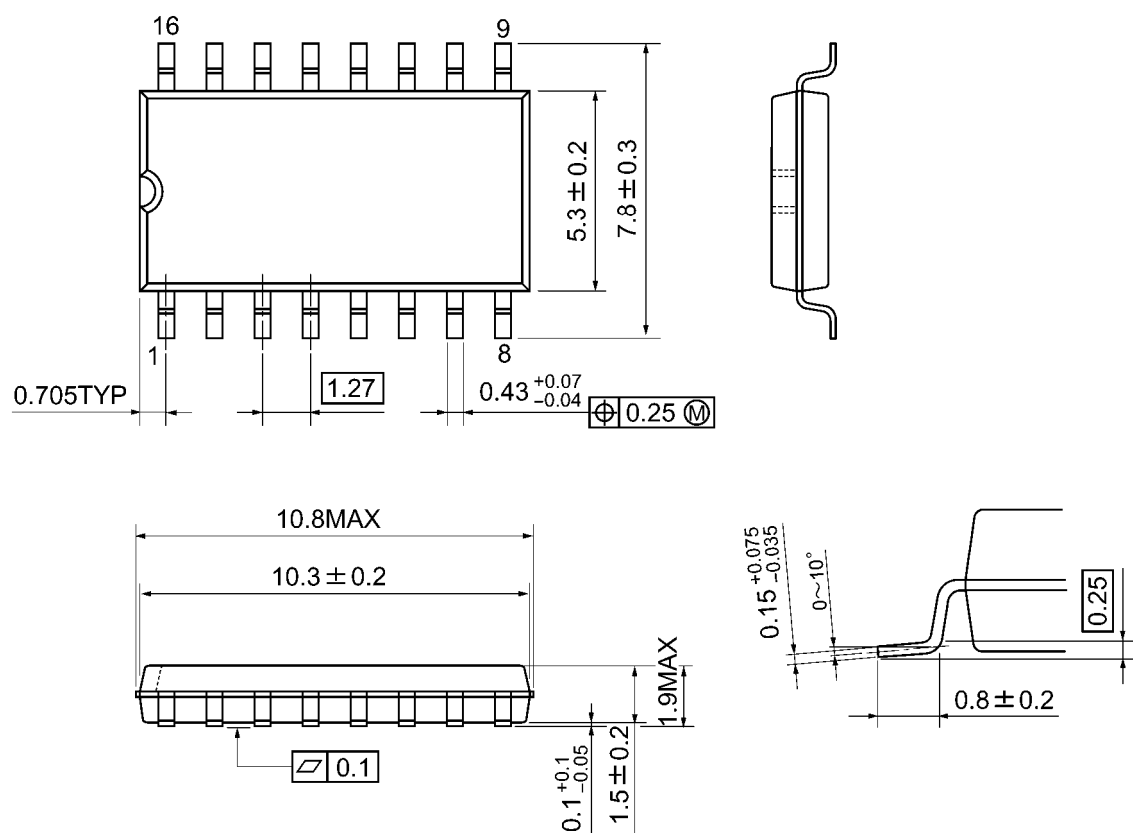


Weight: 1.00 g (typ.)

## Package Dimensions

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)



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