

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

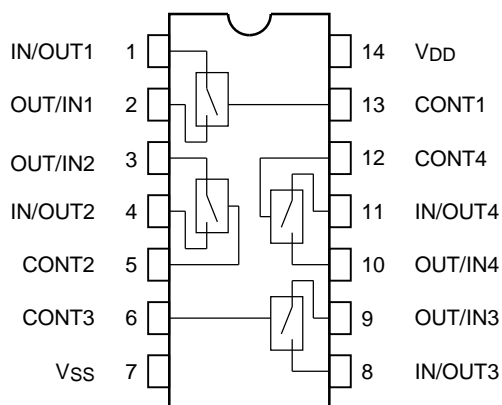
TC4066BP, TC4066BF, TC4066BFT

Quad Bilateral Switch

TC4066B contains four independent circuits of bidirectional switches. When control input CONT is set to "H" level, the impedance between input and output of the switch becomes low and when it is set to "L" level, the impedance becomes high. This can be applied for switching of analog signals and digital signals.

- ON-resistance, R_{on}
 - 250 Ω (typ.) : $V_{DD} - V_{SS} = 5\text{ V}$
 - 110 Ω (typ.) : $V_{DD} - V_{SS} = 10\text{ V}$
 - 70 Ω (typ.) : $V_{DD} - V_{SS} = 15\text{ V}$
- OFF-resistance, R_{off}
 - R_{off} (typ.) $> 10^9\ \Omega$

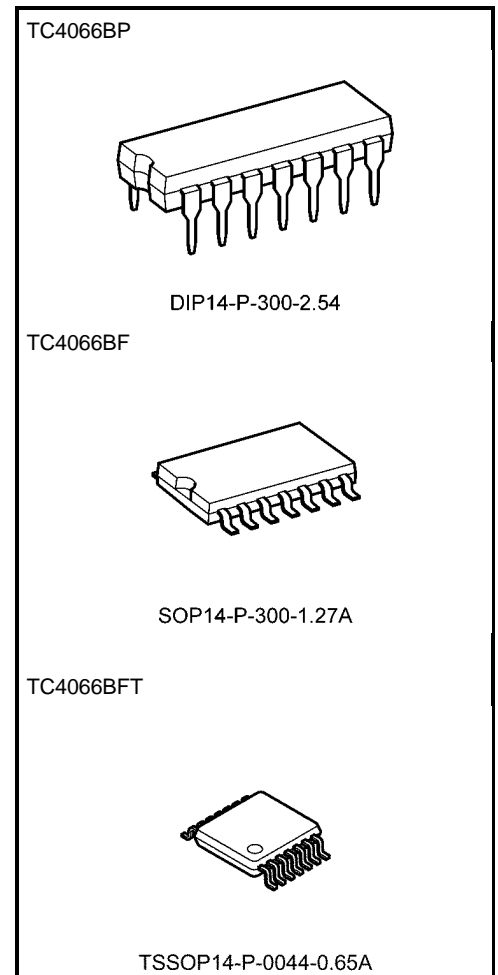
Pin Assignment (top view)



Truth Table

| Control | Impedance between IN/OUT-OUT/IN (Note 1) |
|---------|--|
| H | 0.5 to $5 \times 10^2\ \Omega$ |
| L | $> 10^9\ \Omega$ |

Note 1: See static electrical characteristics



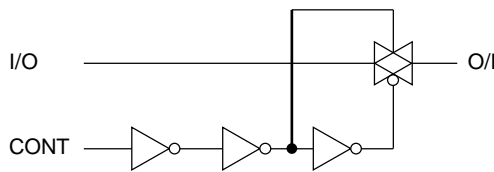
Weight

| | |
|----------------------|-----------------|
| DIP14-P-300-2.54 | : 0.96 g (typ.) |
| SOP14-P-300-1.27A | : 0.18 g (typ.) |
| TSSOP14-P-0044-0.65A | : 0.06 g (typ.) |

Start of commercial production
1978-09

Logic Diagram

1/4 TC4066B



Absolute Maximum Ratings

| Characteristics | Symbol | Rating | Unit |
|---|-------------|----------------------------------|-------------|
| DC supply voltage | V_{DD} | $V_{SS} - 0.5$ to $V_{SS} + 20$ | V |
| Control input voltage | V_{CIN} | $V_{SS} - 0.5$ to $V_{DD} + 0.5$ | V |
| Switch I/O voltage | V_I/V_O | $V_{SS} - 0.5$ to $V_{DD} + 0.5$ | V |
| Power dissipation | P_D | 300 (DIP)/180 (SOP/TSSOP) | mW |
| Potential difference across I/O during ON | $V_I - V_O$ | ± 0.5 | V |
| Control input current | I_{CIN} | ± 10 | mA |
| Operating temperature range | T_{opr} | -40 to 85 | $^{\circ}C$ |
| Storage temperature range | 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 Ranges ($V_{SS} = 0$ V)

| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|----------------------|------------------|----------------|-----|------|----------|------|
| DC supply voltage | V_{DD} | — | 3 | — | 18 | V |
| Input/Output voltage | V_{IN}/V_{OUT} | — | 0 | — | V_{DD} | V |

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

Electrical Characteristics ($V_{SS} = 0\text{ V}$, unless specified otherwise)

| Characteristics | Symbol | Test Condition | V_{DD} (V) | -40°C | | 25°C | | | 85°C | | Unit | |
|--|----------------|---|-------------------------|-------|-----------|------|-----------|------------|------|------------|---------------|---------------|
| | | | | Min | Max | Min | Typ. | Max | Min | Max | | |
| Control input high voltage | V_{IH} | $ I_{IS} = 10\ \mu\text{A}$ | 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} | $ I_{IS} = 10\ \mu\text{A}$ | 5 | — | 1.5 | — | 2.25 | 1.5 | — | 1.5 | V | |
| | | | 10 | — | 3.0 | — | 4.50 | 3.0 | — | 3.0 | | |
| | | | 15 | — | 4.0 | — | 6.75 | 4.0 | — | 4.0 | | |
| On-state resistance | R_{ON} | $0 \leq V_{IS} \leq V_{DD}$ $R_L = 10\ \text{k}\Omega$ | 5 | — | 800 | — | 290 | 950 | — | 1200 | Ω | |
| | | | 10 | — | 210 | — | 120 | 250 | — | 300 | | |
| | | | 15 | — | 140 | — | 85 | 160 | — | 200 | | |
| Δ On-state resistance (between any 2 switches) | $R_{ON\Delta}$ | — | 5 | — | — | — | 10 | — | — | — | Ω | |
| | | | 10 | — | — | — | 6 | — | — | — | | |
| | | | 15 | — | — | — | 4 | — | — | — | | |
| Input/output leakage current | I_{OFF} | $V_{IN} = 18\ \text{V}, V_{OUT} = 0\ \text{V}$ | 18 | — | ± 100 | — | ± 0.1 | ± 100 | — | ± 1000 | nA | |
| | | $V_{IN} = 0\ \text{V}, V_{OUT} = 18\ \text{V}$ | 18 | — | ± 100 | — | ± 0.1 | ± 100 | — | ± 1000 | | |
| Quiescent supply current | I_{DD} | $V_{IN} = V_{SS}, V_{DD}$ (Note 1) | 5 | — | 0.25 | — | 0.001 | 0.25 | — | 7.5 | μA | |
| | | | 10 | — | 0.50 | — | 0.001 | 0.50 | — | 15.0 | | |
| | | | 15 | — | 1.00 | — | 0.002 | 1.00 | — | 30.0 | | |
| Control Input current | "H" level | I_{IH} | $V_{IH} = 18\ \text{V}$ | 18 | — | 0.1 | — | 10^{-5} | 0.1 | — | 1.0 | μA |
| | "L" level | I_{IL} | $V_{IL} = 0\ \text{V}$ | 18 | — | -0.1 | — | -10^{-5} | -0.1 | — | -1.0 | |

Note 1: All valid input combinations.

Switching Characteristics (Ta = 25°C)

| Characteristics | Symbol | Test Condition | V _{SS} (V) | | Min | Typ. | Max | Unit |
|--|--------------------------------------|--|---------------------|---------------------|-----|------|-----|------|
| | | | V _{SS} (V) | V _{DD} (V) | | | | |
| Phase difference between input to output | φ _{I-O} | C _L = 50 pF | 0 | 5 | — | 15 | 40 | ns |
| | | | 0 | 10 | — | 8 | 20 | |
| | | | 0 | 15 | — | 5 | 15 | |
| Propagation delay time (control-OUT) | t _{pZL} t _{pZH} | R _L = 1 kΩ C _L = 50 pF | 0 | 5 | — | 55 | 120 | ns |
| | | | 0 | 10 | — | 25 | 40 | |
| | | | 0 | 15 | — | 20 | 30 | |
| Propagation delay time (control -OUT) | t _{pLZ} t _{pHZ} | R _L = 1 kΩ C _L = 50 pF | 0 | 5 | — | 45 | 80 | ns |
| | | | 0 | 10 | — | 30 | 70 | |
| | | | 0 | 15 | — | 25 | 60 | |
| Max control input repetition rate | f _{max} (C) | R _L = 1 kΩ C _L = 50 pF | 0 | 5 | — | 10 | — | MHz |
| | | | 0 | 10 | — | 12 | — | |
| | | | 0 | 15 | — | 12 | — | |
| -3dB cutoff frequency | f _{max} (I-O) | R _L = 1 kΩ C _L = 15 pF (Note 1) | -5 | 5 | — | 30 | — | MHz |
| Total harmonic distortion | — | R _L = 10 kΩ f = 1 kHz (Note 2) | -5 | 5 | — | 0.03 | — | % |
| -50dB feed through frequency | — | R _L = 1 kΩ (Note 3) | -5 | 5 | — | 600 | — | kHz |
| -50dB crosstalk frequency | — | R _L = 1 kΩ (Note 4) | -5 | 5 | — | 1 | — | MHz |
| Crosstalk (control-OUT) | — | R _{IN} = 1 kΩ R _{OUT} = 10 kΩ C _L = 15 pF | 0 | 5 | — | 200 | — | mV |
| | | | 0 | 10 | — | 400 | — | |
| | | | 0 | 15 | — | 600 | — | |
| Input capacitance | C _{IN} | Control input | — | — | — | 5 | 7.5 | pF |
| | | Switch I/O | — | — | — | 10 | — | |
| Feed through capacitance | C _{IN-OUT} | — | — | — | — | 0.5 | — | pF |

Note 1: Sine wave of ±2.5 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}.

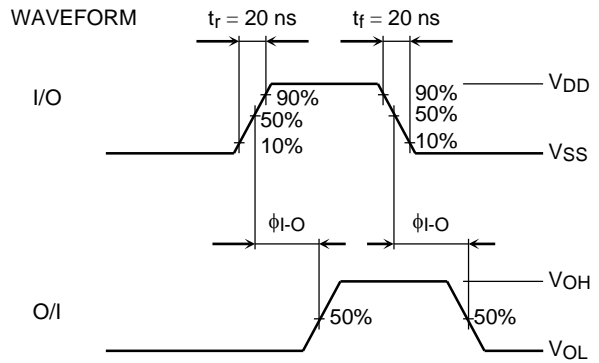
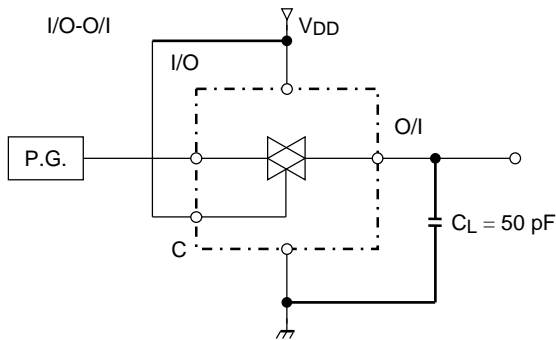
Note 2: V_{IS} shall be sine wave of ±2.5 V_{p-p}

Note 3: Sine wave of ±2.5 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.

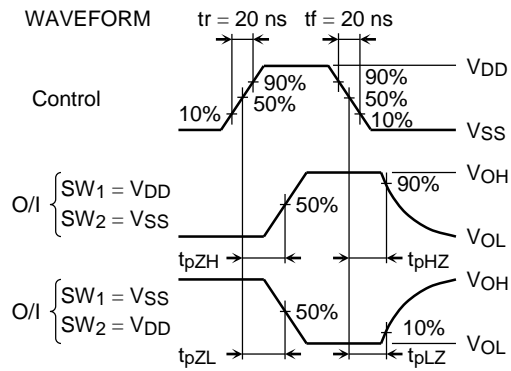
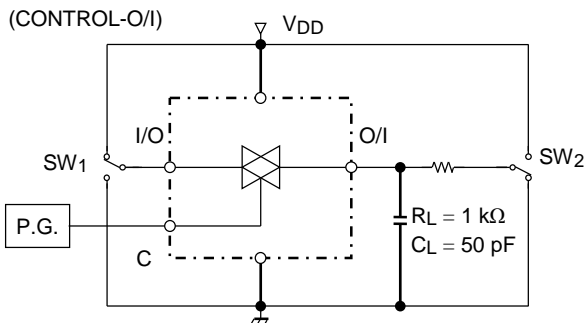
Note 4: Sine wave of ±2.5 V_{p-p} shall be used for V_{IS} and the frequency of $20 \log_{10} \frac{V_{OS}}{V_{IS}} = -50 \text{ dB}$ shall be crosstalk.

Circuit for Measurement of Electrical Characteristics

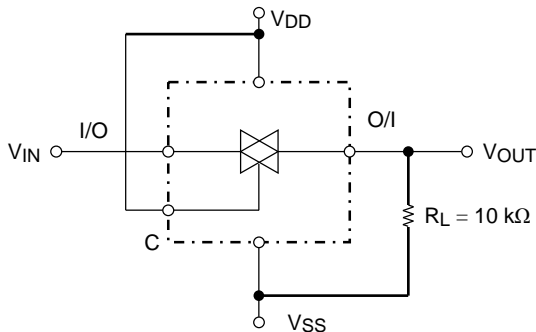
1. ϕ I-O



2. t_{pZL} , t_{pZH} , t_{pLZ} , t_{pHZ}



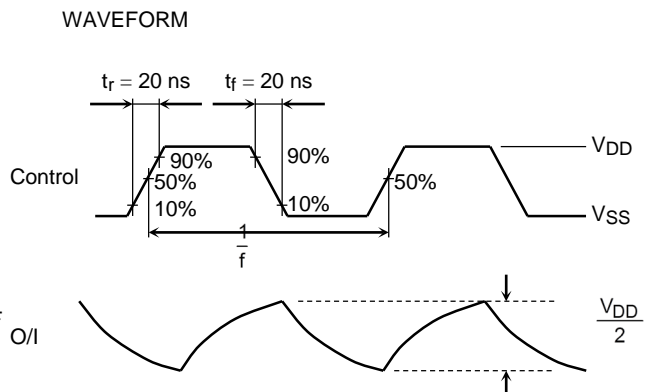
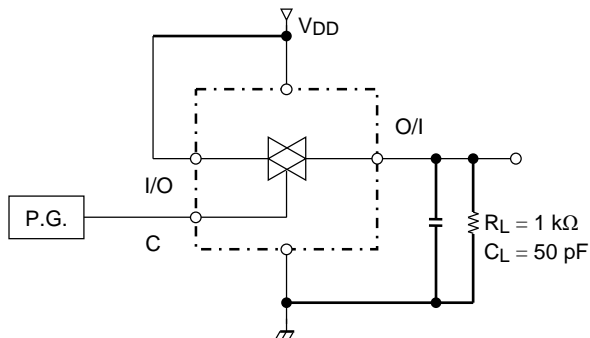
3. RON



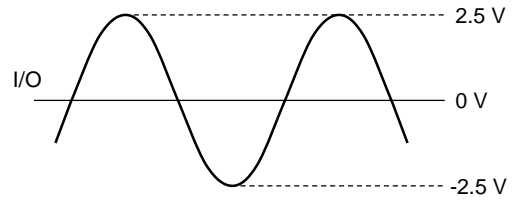
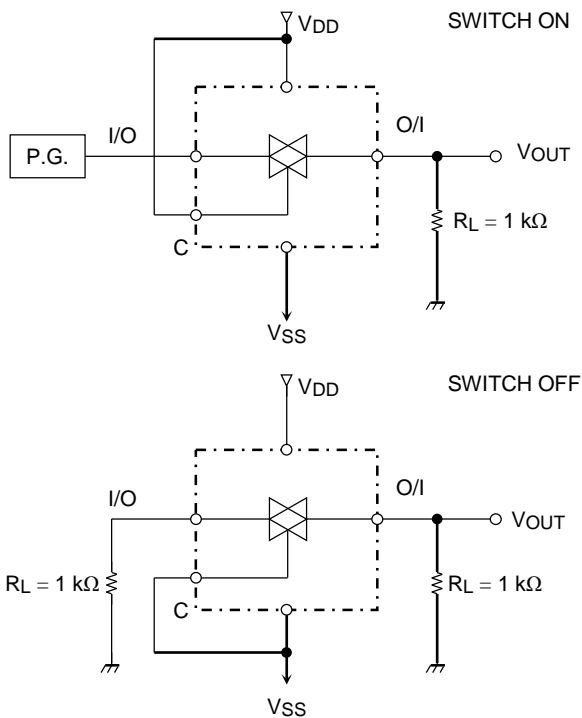
RON Calculation Method

$$R_{ON} = 10 \times \frac{(V_{IN} - V_{OUT})}{V_{OUT}} [k\Omega]$$

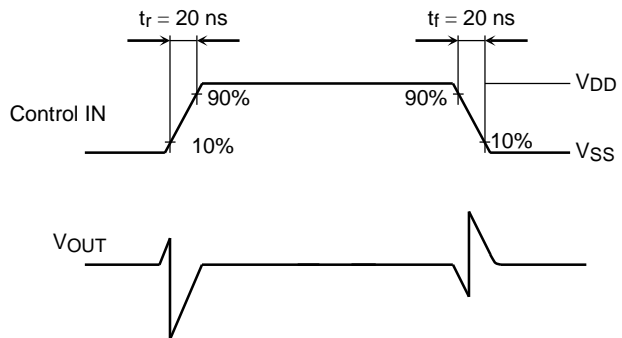
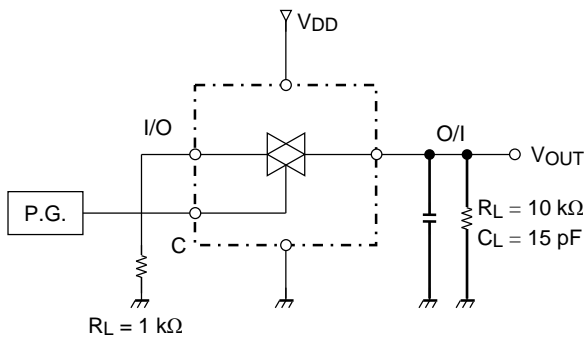
4. $f_{max}(C)$



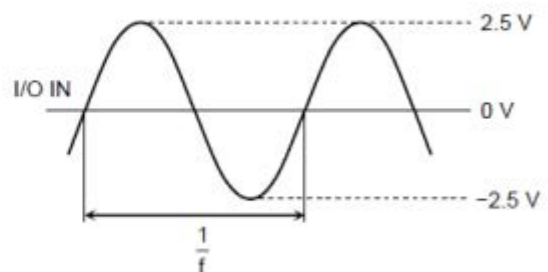
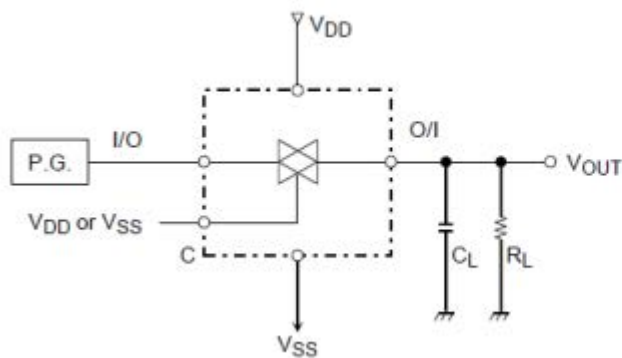
5. Crosstalk between Any Two Switches



6. Crosstalk, Control to Input



7. Total Harmonic Distortion, fmax (I-O), Feedthrough (Switch OFF)

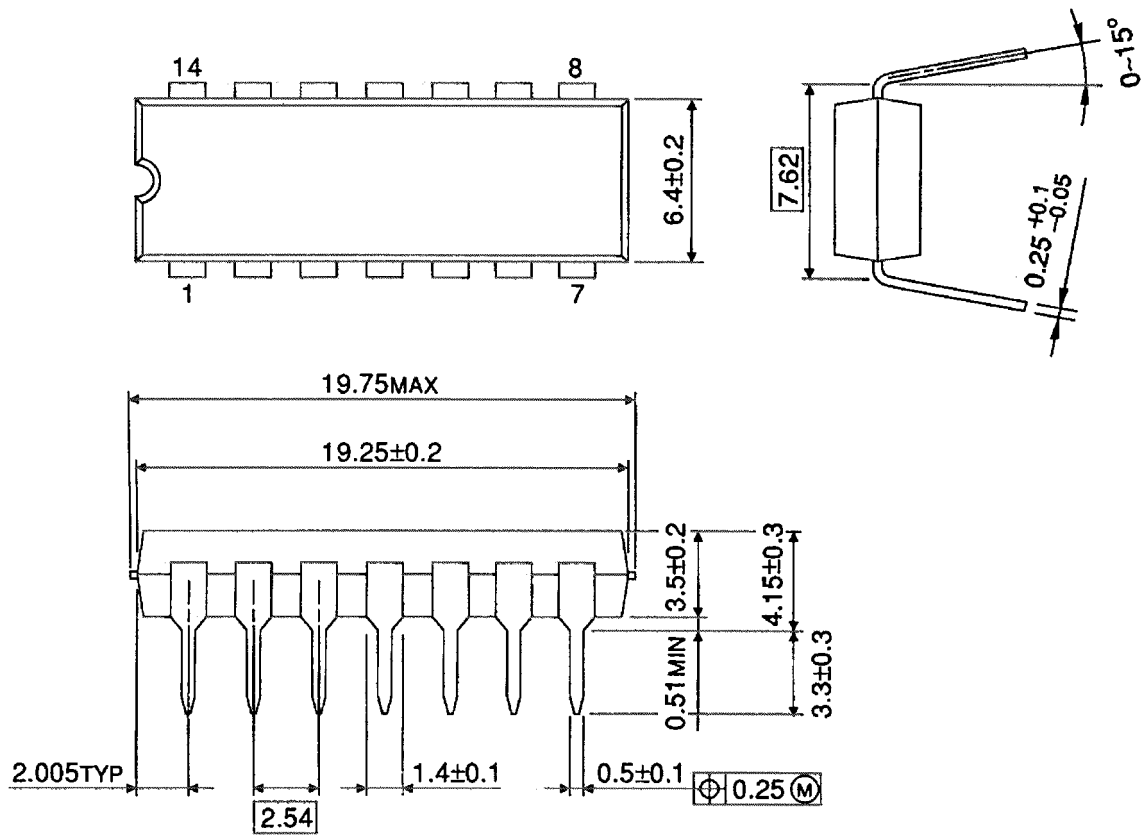


CL, RL: Reference to Test Condition

Package Dimensions

DIP14-P-300-2.54

Unit : mm

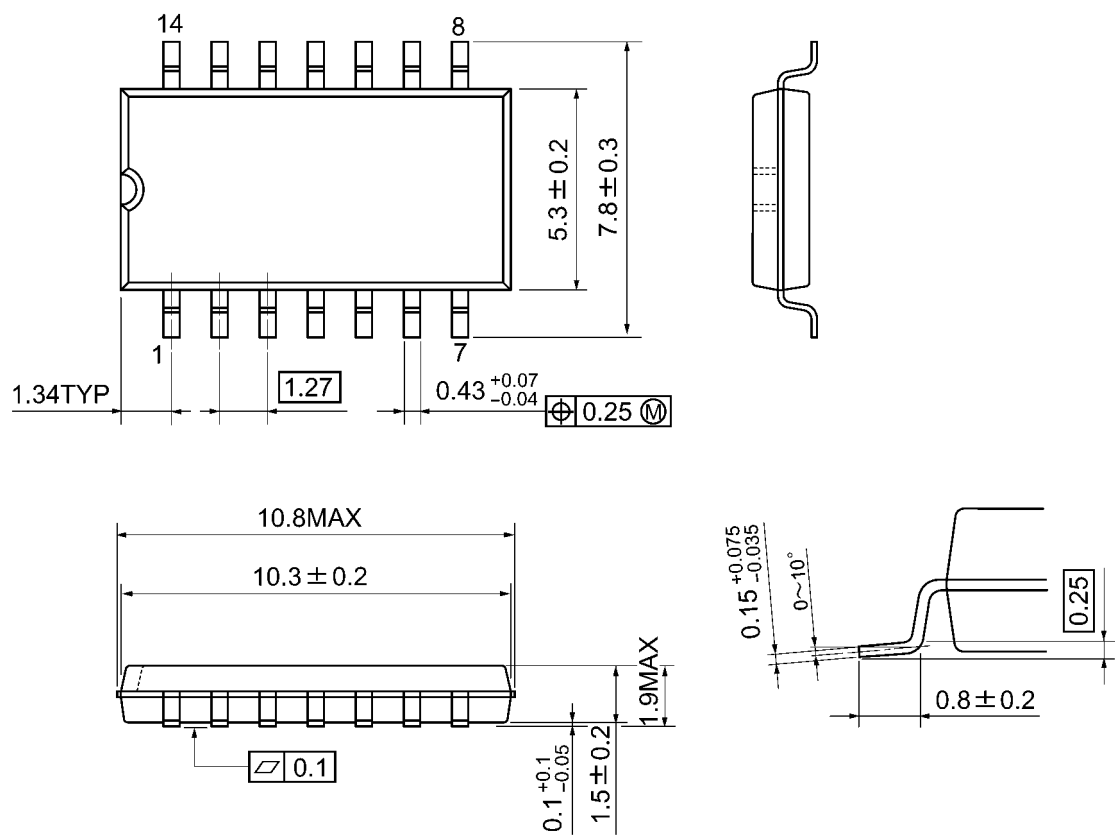


Weight: 0.96 g (typ.)

Package Dimensions

SOP14-P-300-1.27A

Unit: mm

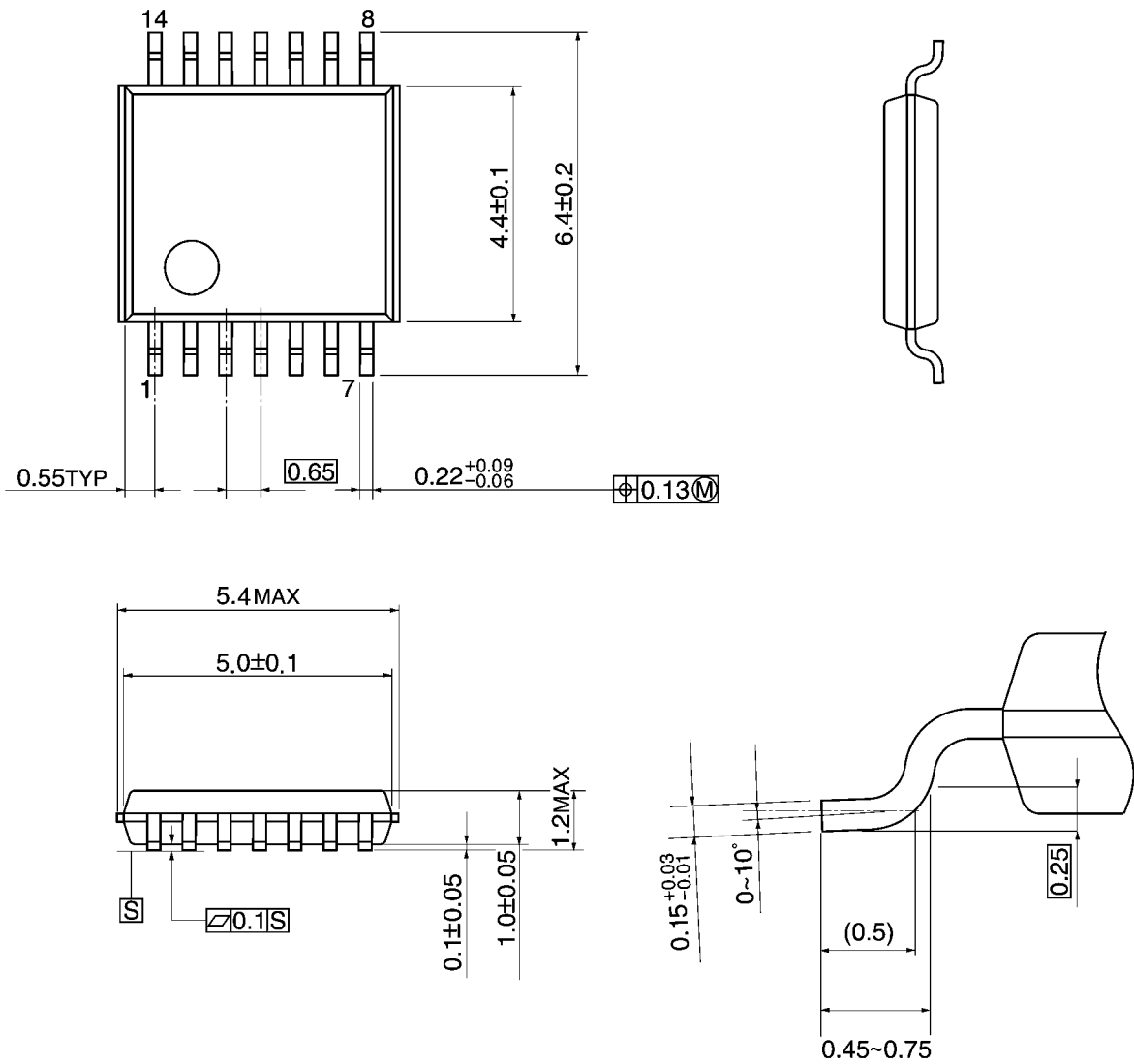


Weight: 0.18 g (typ.)

Package Dimensions

TSSOP14-P-0044-0.65A

Unit: mm



Weight: 0.06 g (typ.)

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