

CMOS Digital Integrated Circuits Silicon Monolithic

TC74HC245AP, TC74HC245AF, TC74HC640AP, TC74HC640AF

1. Functional Description

- Octal Bus Transceiver
- TC74HC245AP/AF: 3-State, Non-Inverting
- TC74HC640AP/AF: 3-State, Inverting

2. General

The TC74HC245A, TC74HC640A are high speed CMOS OCTAL BUS TRANSCEIVERS fabricated with silicon gate C²MOS technology.

They achieve the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

They are intended for two-way asynchronous communication between data busses. The direction of data transmission is determined by the level of the DIR input.

The enable input (\overline{G}) can be used to disable the device so that the busses are effectively isolated.

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

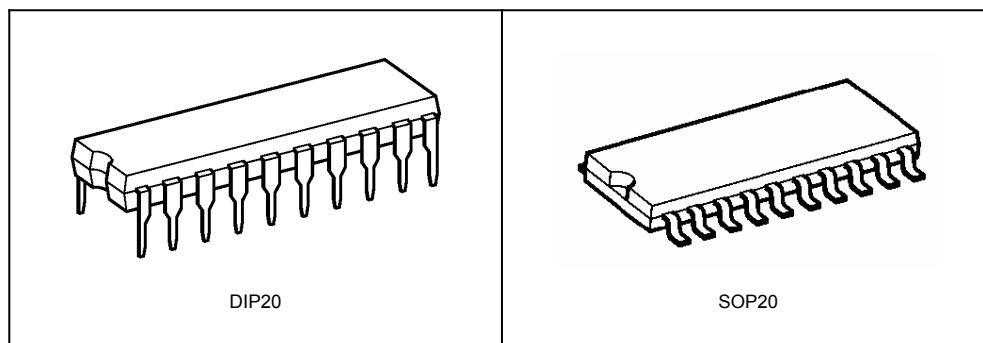
3. Features (Note)

- (1) High speed: $t_{pd} = 10 \text{ ns}$ (typ.) at $V_{CC} = 5.0 \text{ V}$
- (2) Low power dissipation: $I_{CC} = 4.0 \mu\text{A}$ (max) at $T_a = 25 \text{ }^\circ\text{C}$
- (3) High noise immunity: $V_{NIH} = V_{NIL} = 28 \% V_{CC}$ (min)
- (4) Output drive capability: 15 LSTTL loads
- (5) Output current: $|I_{OH}|/I_{OL} = 6 \text{ mA}$ (min) ($V_{CC} = 4.5 \text{ V}$)
- (6) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$
- (7) Wide operating voltage range: $V_{CC(opr)} = 2 \text{ V}$ to 6 V
- (8) Pin and function compatible with 74LS245/640.

Note: Do not apply a signal to any bus pins when it is in the output mode. Damage may result.

All floating (high impedance) bus pins must have their input levels fixed by means of pull-up or pull-down resistors.

4. Packaging

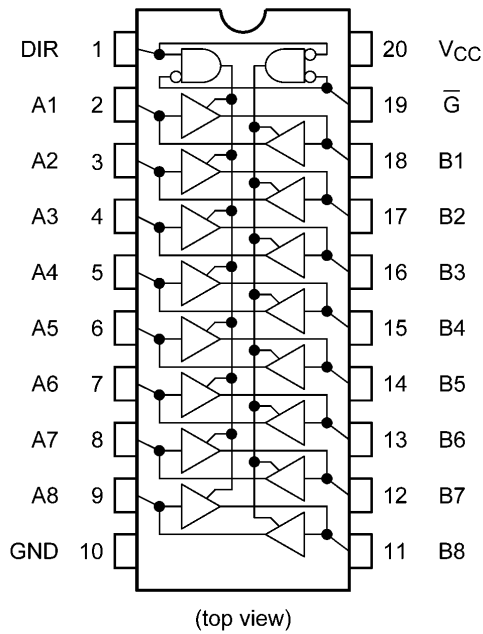


Start of commercial production

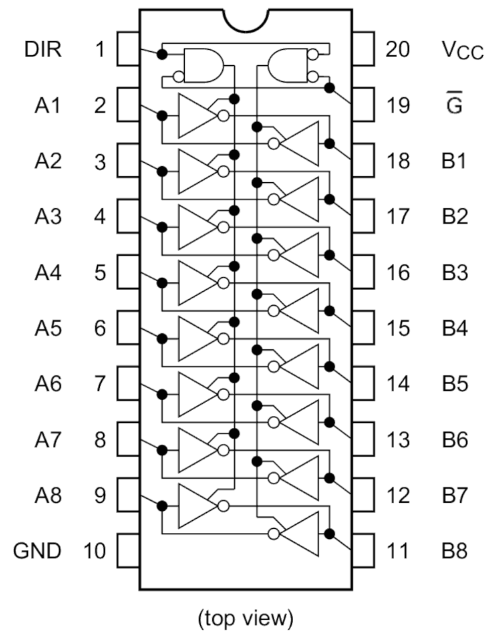
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5. Pin Assignment

TC74HC245AP, TC74HC245AF

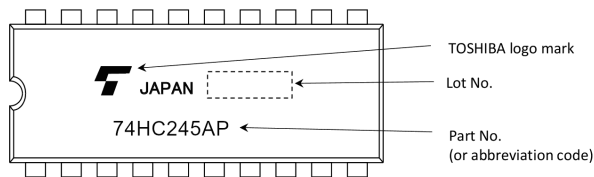


TC74HC640AP, TC74HC640AF

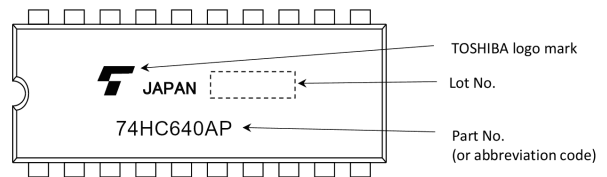


6. Marking

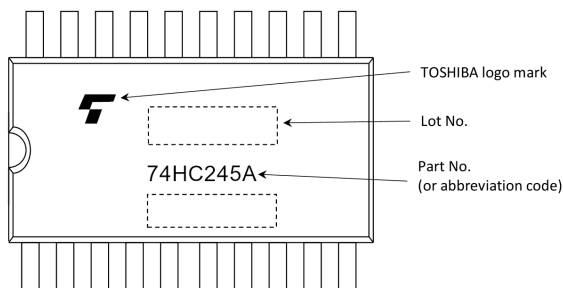
TC74HC245AP



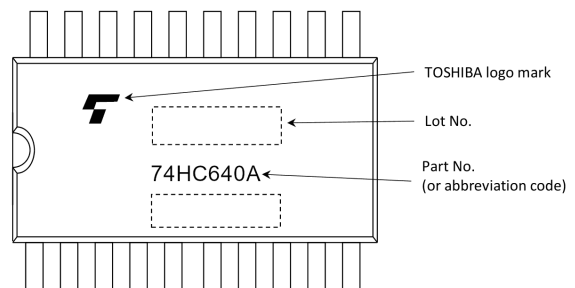
TC74HC640AP



TC74HC245AF

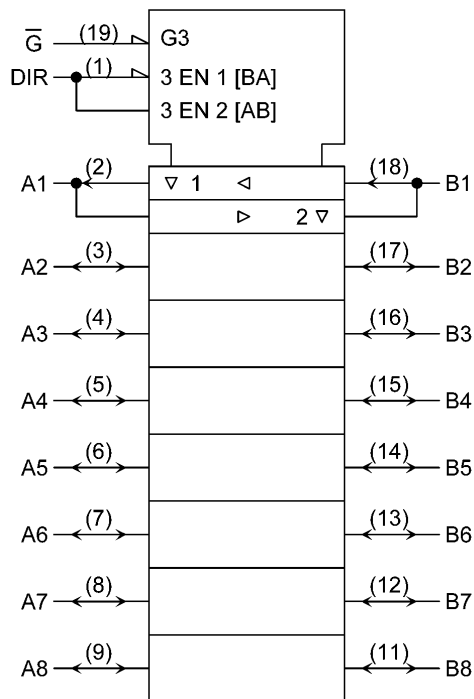


TC74HC640AF

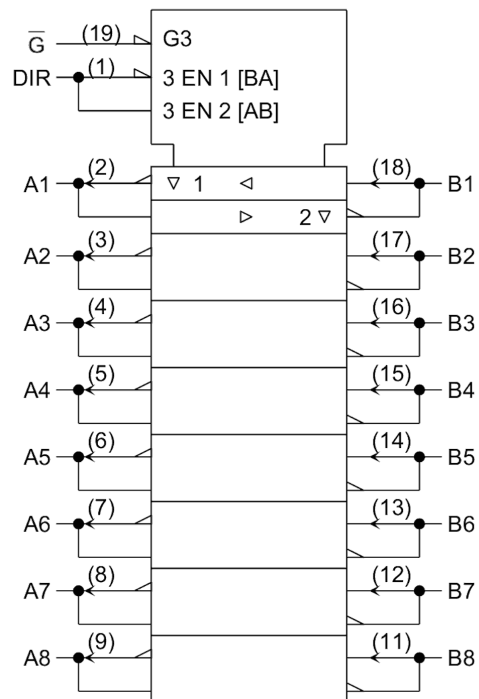


7. IEC Logic Symbol

TC74HC245AP, TC74HC245AF



TC74HC640AP, TC74HC640AF



8. Truth Table

| Inputs \bar{G} | Inputs DIR | Function A BUS | Function B BUS | Outputs TC74HC245A | Outputs TC74HC640A |
|---------------------|---------------|-------------------|-------------------|-----------------------|-----------------------|
| L | L | Output | Input | $A = B$ | $A = \bar{B}$ |
| L | H | Input | Output | $B = A$ | $B = \bar{A}$ |
| H | X | Z | Z | Z | Z |

X: Don't care (L or H)

Z: High impedance

9. Absolute Maximum Ratings (Note)

| Characteristics | Symbol | Note | Rating | Unit |
|--------------------------|-----------|----------|------------------------|--------------------|
| Supply voltage | V_{CC} | | -0.5 to 7.0 | V |
| Input voltage | V_{IN} | | -0.5 to $V_{CC} + 0.5$ | V |
| 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 |
| Output current | I_{OUT} | | ± 35 | mA |
| V_{CC} /ground current | I_{CC} | | ± 75 | mA |
| Power dissipation | P_D | (Note 1) | 500 (DIP) | mW |
| | | | 180 (SOP) | |
| Storage temperature | T_{stg} | | -65 to 150 | $^{\circ}\text{C}$ |

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).

Note 1: 500 mW in the range of $T_a = -40$ to 65°C . From $T_a = 65$ to 85°C a derating factor of $-10\text{ mW}/^{\circ}\text{C}$ shall be applied until 300 mW.

10. Operating Ranges (Note)

| Characteristics | Symbol | Test Condition | 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 | $^{\circ}\text{C}$ |
| Input rise and fall times | t_r, t_f | $V_{CC} = 2.0\text{ V}$ | 0 to 1000 | ns |
| | | $V_{CC} = 4.5\text{ V}$ | 0 to 500 | |
| | | $V_{CC} = 6.0\text{ V}$ | 0 to 400 | |

Note: The operating ranges are required to ensure the normal operation of the device. Unused inputs and bus inputs must be tied to either V_{CC} or GND. Please connect both bus inputs and the bus outputs with V_{CC} or GND when the I/O of the bus terminal changes by the function. In this case, please note that the output is not short-circuited.

11. Electrical Characteristics

11.1. DC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$)

| Characteristics | Symbol | Test Condition | V_{CC} (V) | Min | Typ. | Max | Unit | |
|--|----------|--|-----------------------------------|------|------|-----------|---------------|---|
| High-level input voltage | V_{IH} | — | 2.0 | 1.50 | — | — | V | |
| | | | 4.5 | 3.15 | — | — | | |
| | | | 6.0 | 4.20 | — | — | | |
| Low-level input voltage | V_{IL} | — | 2.0 | — | — | 0.50 | V | |
| | | | 4.5 | — | — | 1.35 | | |
| | | | 6.0 | — | — | 1.80 | | |
| High-level output voltage | V_{OH} | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OH} = -20\text{ }\mu\text{A}$ | 2.0 | 1.9 | 2.0 | — | V |
| | | | | 4.5 | 4.4 | 4.5 | — | |
| | | | $I_{OH} = -6\text{ mA}$ | 4.5 | 4.18 | 4.31 | — | |
| | | | | 6.0 | 5.68 | 5.80 | — | |
| Low-level output voltage | V_{OL} | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OL} = 20\text{ }\mu\text{A}$ | 2.0 | — | 0.0 | 0.1 | V |
| | | | | 4.5 | — | 0.0 | 0.1 | |
| | | | | 6.0 | — | 0.0 | 0.1 | |
| | | | $I_{OL} = 6\text{ mA}$ | 4.5 | — | 0.17 | 0.26 | |
| 6.0 | — | 0.18 | | 0.26 | | | | |
| 3-state output OFF-state leakage current | I_{OZ} | $V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = V_{CC}$ or GND | 6.0 | — | — | ± 0.5 | μA | |
| Input leakage current | I_{IN} | $V_{IN} = V_{CC}$ or GND | 6.0 | — | — | ± 0.1 | μA | |
| Quiescent supply current | I_{CC} | $V_{IN} = V_{CC}$ or GND | 6.0 | — | — | 4.0 | μA | |

11.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to $85\text{ }^\circ\text{C}$)

| Characteristics | Symbol | Test Condition | V_{CC} (V) | Min | Max | Unit | |
|--|----------|--|-----------------------------------|------|-----------|---------------|---|
| High-level input voltage | V_{IH} | — | 2.0 | 1.50 | — | V | |
| | | | 4.5 | 3.15 | — | | |
| | | | 6.0 | 4.20 | — | | |
| Low-level input voltage | V_{IL} | — | 2.0 | — | 0.50 | V | |
| | | | 4.5 | — | 1.35 | | |
| | | | 6.0 | — | 1.80 | | |
| High-level output voltage | V_{OH} | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OH} = -20\text{ }\mu\text{A}$ | 2.0 | 1.9 | — | V |
| | | | | 4.5 | 4.4 | — | |
| | | | $I_{OH} = -6\text{ mA}$ | 4.5 | 4.13 | — | |
| | | | | 6.0 | 5.63 | — | |
| Low-level output voltage | V_{OL} | $V_{IN} = V_{IH}$ or V_{IL} | $I_{OL} = 20\text{ }\mu\text{A}$ | 2.0 | — | 0.1 | V |
| | | | | 4.5 | — | 0.1 | |
| | | | | 6.0 | — | 0.1 | |
| | | | $I_{OL} = 6\text{ mA}$ | 4.5 | — | 0.33 | |
| 6.0 | — | 0.33 | | | | | |
| 3-state output OFF-state leakage current | I_{OZ} | $V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = V_{CC}$ or GND | 6.0 | — | ± 5.0 | μA | |
| Input leakage current | I_{IN} | $V_{IN} = V_{CC}$ or GND | 6.0 | — | ± 1.0 | μA | |
| Quiescent supply current | I_{CC} | $V_{IN} = V_{CC}$ or GND | 6.0 | — | 40.0 | μA | |

11.3. AC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$, Input: $t_r = t_f = 3\text{ ns}$)

| Characteristics | Symbol | Note | Test Condition | C_L (pF) | V_{CC} (V) | Min | Typ. | Max | Unit |
|-------------------------------|--------------------|----------|--------------------------|------------|--------------|-----|------|-----|------|
| Output transition time | t_{TLH}, t_{THL} | | — | 50 | 2.0 | — | 25 | 60 | ns |
| | | | | | 4.5 | — | 7 | 12 | |
| | | | | | 6.0 | — | 6 | 10 | |
| Propagation delay time | t_{PLH}, t_{PHL} | | — | 50 | 2.0 | — | 33 | 90 | ns |
| | | | | | 4.5 | — | 12 | 18 | |
| | | | | | 6.0 | — | 10 | 15 | |
| | | | | 150 | 2.0 | — | 48 | 120 | |
| | | | | | 4.5 | — | 16 | 24 | |
| | | | | | 6.0 | — | 14 | 20 | |
| Output enable time | t_{PZL}, t_{PZH} | | $R_L = 1\text{ k}\Omega$ | 50 | 2.0 | — | 48 | 150 | ns |
| | | | | | 4.5 | — | 16 | 30 | |
| | | | | | 6.0 | — | 14 | 26 | |
| | | | | 150 | 2.0 | — | 63 | 180 | |
| | | | | | 4.5 | — | 21 | 36 | |
| | | | | | 6.0 | — | 18 | 31 | |
| Output disable time | t_{PLZ}, t_{PHZ} | | $R_L = 1\text{ k}\Omega$ | 50 | 2.0 | — | 37 | 150 | ns |
| | | | | | 4.5 | — | 17 | 30 | |
| | | | | | 6.0 | — | 15 | 26 | |
| Input capacitance | C_{IN} | | DIR, \bar{G} | | | — | 5 | 10 | pF |
| Bus I/O capacitance | $C_{I/O}$ | | An, Bn | | | — | 13 | — | pF |
| Power dissipation capacitance | C_{PD} | (Note 1) | TC74HC245A | | | — | 39 | — | pF |
| | | | TC74HC640A | | | — | 37 | — | |

Note 1: 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.

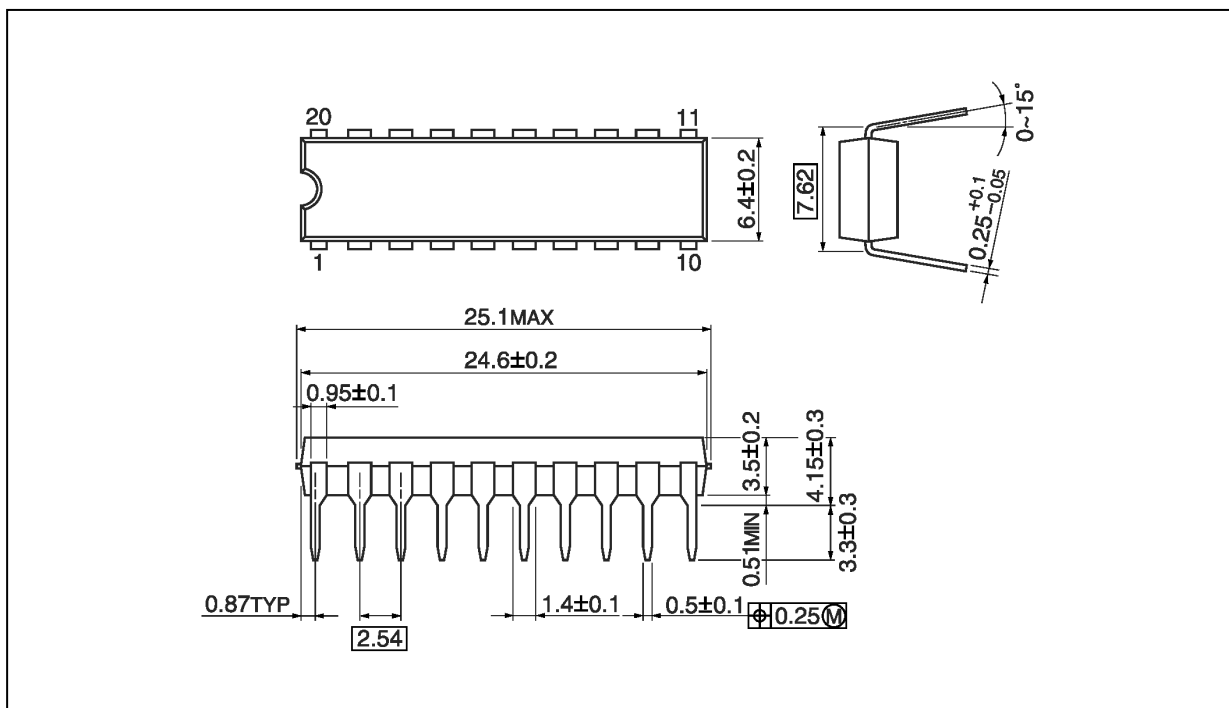
$$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8 \text{ (per bit)}$$

11.4. AC Characteristics (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$, Input: $t_r = t_f = 3\text{ ns}$)

| Characteristics | Symbol | Test Condition | C_L (pF) | V_{CC} (V) | Min | Max | Unit |
|------------------------|--------------------|--------------------------|------------|--------------|-----|-----|------|
| Output transition time | t_{TLH}, t_{THL} | — | 50 | 2.0 | — | 75 | ns |
| | | | | 4.5 | — | 15 | |
| | | | | 6.0 | — | 13 | |
| Propagation delay time | t_{PLH}, t_{PHL} | — | 50 | 2.0 | — | 115 | ns |
| | | | | 4.5 | — | 23 | |
| | | | | 6.0 | — | 20 | |
| | | | 150 | 2.0 | — | 150 | |
| | | | | 4.5 | — | 30 | |
| | | | | 6.0 | — | 26 | |
| Output enable time | t_{PZL}, t_{PZH} | $R_L = 1\text{ k}\Omega$ | 50 | 2.0 | — | 190 | ns |
| | | | | 4.5 | — | 38 | |
| | | | | 6.0 | — | 32 | |
| | | | 150 | 2.0 | — | 225 | |
| | | | | 4.5 | — | 45 | |
| | | | | 6.0 | — | 38 | |
| Output disable time | t_{PLZ}, t_{PHZ} | $R_L = 1\text{ k}\Omega$ | 50 | 2.0 | — | 190 | ns |
| | | | | 4.5 | — | 38 | |
| | | | | 6.0 | — | 32 | |
| Input capacitance | C_{IN} | DIR, \bar{G} | | | — | 10 | pF |

Package Dimensions

Unit: mm

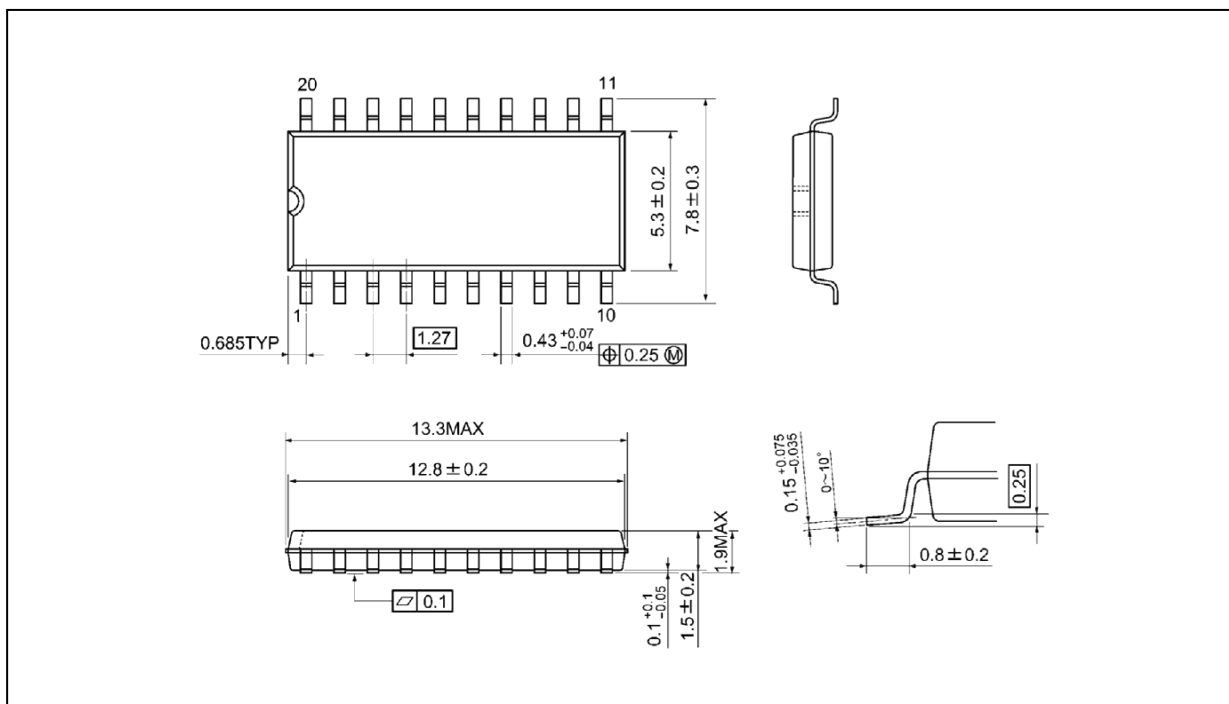


Weight: 1.30 g (typ.)

| |
|-----------------|
| Package Name(s) |
| Nickname: DIP20 |

Package Dimensions

Unit: mm



Weight: 0.22 g (typ.)

| Package Name(s) |
|----------------------------|
| TOSHIBA: SOP20-P-300-1.27A |
| Nickname: SOP20 |

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