

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

# TC74HC688AP, TC74HC688AF

## 8-Bit Equality Comparator

The TC74HC688A is a high speed CMOS 8-BIT EQUALITY COMPARATOR fabricated with silicon gate C<sup>2</sup>MOS technology.

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

The TC74HC688A compares two 8-bit binary or BCD words applied inputs P0 thru P7, and inputs Q0 thru Q7, and indicates whether or not they are equal.

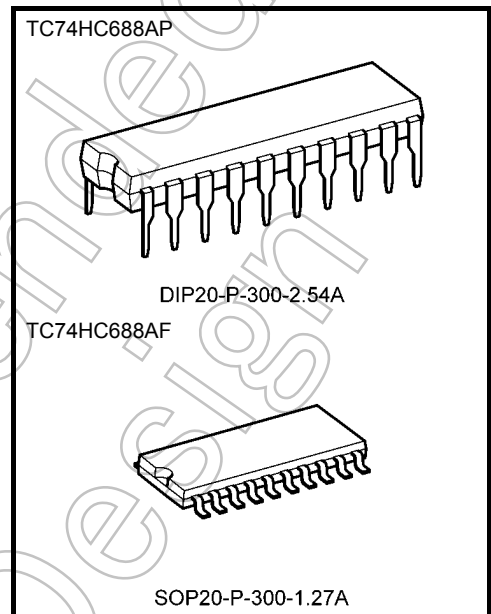
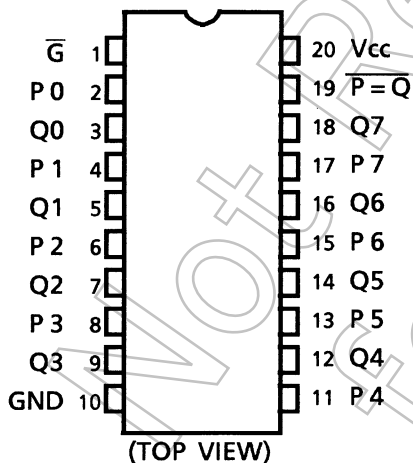
A signal active low enable is provided to facilitate cascading of several packages to compare of words greater than 8 bits.

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

### Features

- High speed:  $t_{pd} = 17 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 4 \text{ mA (min)}$
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS688

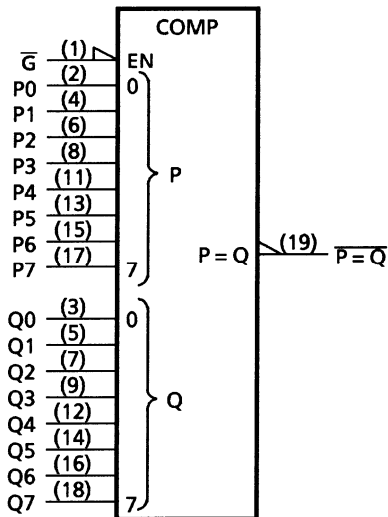
### Pin Assignment



|                   |                 |
|-------------------|-----------------|
| Weight            |                 |
| DIP20-P-300-2.54A | : 1.30 g (typ.) |
| SOP20-P-300-1.27A | : 0.22 g (typ.) |

Start of commercial production  
1987-11

**IEC Logic Symbol**

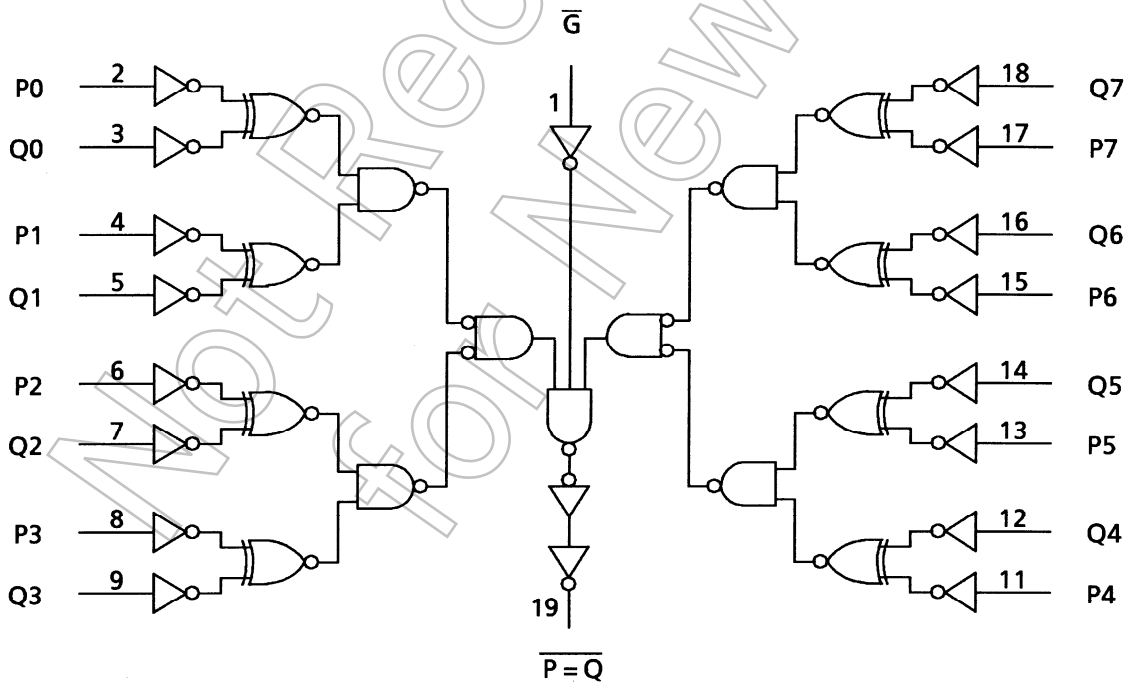


**Truth Table**

| Inputs     |           | Output           |
|------------|-----------|------------------|
| P, Q       | $\bar{G}$ | $\overline{P=Q}$ |
| P = Q      | L         | L                |
| P $\neq$ Q | L         | H                |
| X          | H         | H                |

X: Don't care

**System Diagram**



**Absolute Maximum Ratings (Note 1)**

| Characteristics             | Symbol    | Rating                       | Unit               |
|-----------------------------|-----------|------------------------------|--------------------|
| Supply voltage range        | $V_{CC}$  | -0.5 to 7.0                  | 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         | $I_{IK}$  | $\pm 20$                     | mA                 |
| Output diode current        | $I_{OK}$  | $\pm 20$                     | mA                 |
| DC output current           | $I_{OUT}$ | $\pm 25$                     | mA                 |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 50$                     | mA                 |
| Power dissipation           | $P_D$     | 500 (DIP) (Note 2)/180 (SOP) | mW                 |
| Storage temperature         | $T_{stg}$ | -65 to 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  $T_a = -40$  to  $65^{\circ}\text{C}$ . From  $T_a = 65$  to  $85^{\circ}\text{C}$  a derating factor of  $-10$  mW/ $^{\circ}\text{C}$  should 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   | $^{\circ}\text{C}$ |
| Input rise and fall time | $t_r, t_f$ | 0 to 1000 ( $V_{CC} = 2.0$ V)<br>0 to 500 ( $V_{CC} = 4.5$ V)<br>0 to 400 ( $V_{CC} = 6.0$ V) | ns                 |

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                                       |                          | Ta = 25°C                 |      |      | Ta = -40 to 85°C |      | Unit |     |
|---------------------------|-----------------|--|--------------------------|---------------------------|------|------|------------------|------|------|-----|
|                           |                 |  |                          | V <sub>CC</sub> (V)       | Min  | Typ. | Max              | Min  |      | Max |
| High-level input voltage  | V <sub>IH</sub> | —  |                          | 2.0                       | 1.50 | —    | —                | 1.50 | —    | V   |
|                           |                 |  |                          | 4.5                       | 3.15 | —    | —                | 3.15 | —    |     |
|                           |                 |  |                          | 6.0                       | 4.20 | —    | —                | 4.20 | —    |     |
| Low-level input voltage   | V <sub>IL</sub> | —  |                          | 2.0                       | —    | —    | 0.50             | —    | 0.50 | V   |
|                           |                 |  |                          | 4.5                       | —    | —    | 1.35             | —    | 1.35 |     |
|                           |                 |  |                          | 6.0                       | —    | —    | 1.80             | —    | 1.80 |     |
| High-level output voltage | V <sub>OH</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OH</sub> = -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  | —    |     |
|                           |                 |  | I <sub>OH</sub> = -4 mA  | 4.5                       | 4.18 | 4.31 | —                | 4.13 | —    |     |
|                           |                 |  |                          | 6.0                       | 5.68 | 5.80 | —                | 5.63 | —    |     |
|                           |                 |  |                          | I <sub>OH</sub> = -5.2 mA | 4.5  | —    | —                | —    | —    |     |
| Low-level output voltage  | V <sub>OL</sub> | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | I <sub>OL</sub> = 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  |     |
|                           |                 |  | I <sub>OL</sub> = 4 mA   | 4.5                       | —    | 0.17 | 0.26             | —    | 0.33 |     |
|                           |                 |  |                          | 6.0                       | —    | 0.18 | 0.26             | —    | 0.33 |     |
|                           |                 |  |                          | I <sub>OL</sub> = 5.2 mA  | 4.5  | —    | —                | —    | —    |     |
| Input leakage current     | I <sub>IN</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND             |                          | 6.0                       | —    | —    | ±0.1             | —    | ±1.0 | μA  |
| Quiescent supply current  | I <sub>CC</sub> | V <sub>IN</sub> = V <sub>CC</sub> or GND             |                          | 6.0                       | —    | —    | 4.0              | —    | 40.0 | μA  |

### AC Characteristics (C<sub>L</sub> = 15 pF, V<sub>CC</sub> = 5 V, Ta = 25°C, input: t<sub>r</sub> = t<sub>f</sub> = 6 ns)

| Characteristics   | Symbol           | Test Condition | Min | Typ. | Max | Unit |
|---|------------------|----------------|-----|------|-----|------|
| Output transition time  | t <sub>TLH</sub> | —              | —   | 4    | 8   | ns   |
|   | t <sub>THL</sub> |                |     |      |     |      |
| Propagation delay time<br>(P <sub>n</sub> , Q <sub>n</sub> - $\overline{P=Q}$ ) | t <sub>pLH</sub> | —              | —   | 17   | 29  | ns   |
|   | t <sub>pHL</sub> |                |     |      |     |      |
| Propagation delay time<br>( $\overline{G} - \overline{P=Q}$ )                   | t <sub>pLH</sub> | —              | —   | 10   | 18  | ns   |
|   | t <sub>pHL</sub> |                |     |      |     |      |

**AC Characteristics (C<sub>L</sub> = 50 pF, input: t<sub>r</sub> = t<sub>f</sub> = 6 ns)**

| Characteristics   | Symbol                               | Test Condition | Ta = 25°C           |     |      | Ta = -40 to 85°C |     | Unit |     |
|---|--------------------------------------|----------------|---------------------|-----|------|------------------|-----|------|-----|
|   |                                      |                | V <sub>CC</sub> (V) | Min | Typ. | Max              | Min |      | Max |
| Output transition time  | t <sub>TLH</sub><br>t <sub>THL</sub> | —              | 2.0                 | —   | 30   | 75               | —   | 95   | ns  |
|   |                                      |                | 4.5                 | —   | 8    | 15               | —   | 19   |     |
|   |                                      |                | 6.0                 | —   | 7    | 13               | —   | 16   |     |
| Propagation delay time<br>(P <sub>n</sub> , Q <sub>n</sub> - $\overline{P=Q}$ ) | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 2.0                 | —   | 60   | 170              | —   | 215  | ns  |
|   |                                      |                | 4.5                 | —   | 21   | 34               | —   | 43   |     |
|   |                                      |                | 6.0                 | —   | 17   | 29               | —   | 37   |     |
| Propagation delay time<br>( $\overline{G - P=Q}$ )                              | t <sub>pLH</sub><br>t <sub>pHL</sub> | —              | 2.0                 | —   | 40   | 110              | —   | 140  | ns  |
|   |                                      |                | 4.5                 | —   | 13   | 22               | —   | 28   |     |
|   |                                      |                | 6.0                 | —   | 10   | 19               | —   | 24   |     |
| Input capacitance   | C <sub>IN</sub>                      | —              | —                   | 5   | 10   | —                | 10  | pF   |     |
| Power dissipation capacitance   | C <sub>PD</sub><br>(Note)            | —              | —                   | 32  | —    | —                | —   | pF   |     |

Note: C<sub>PD</sub> 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:

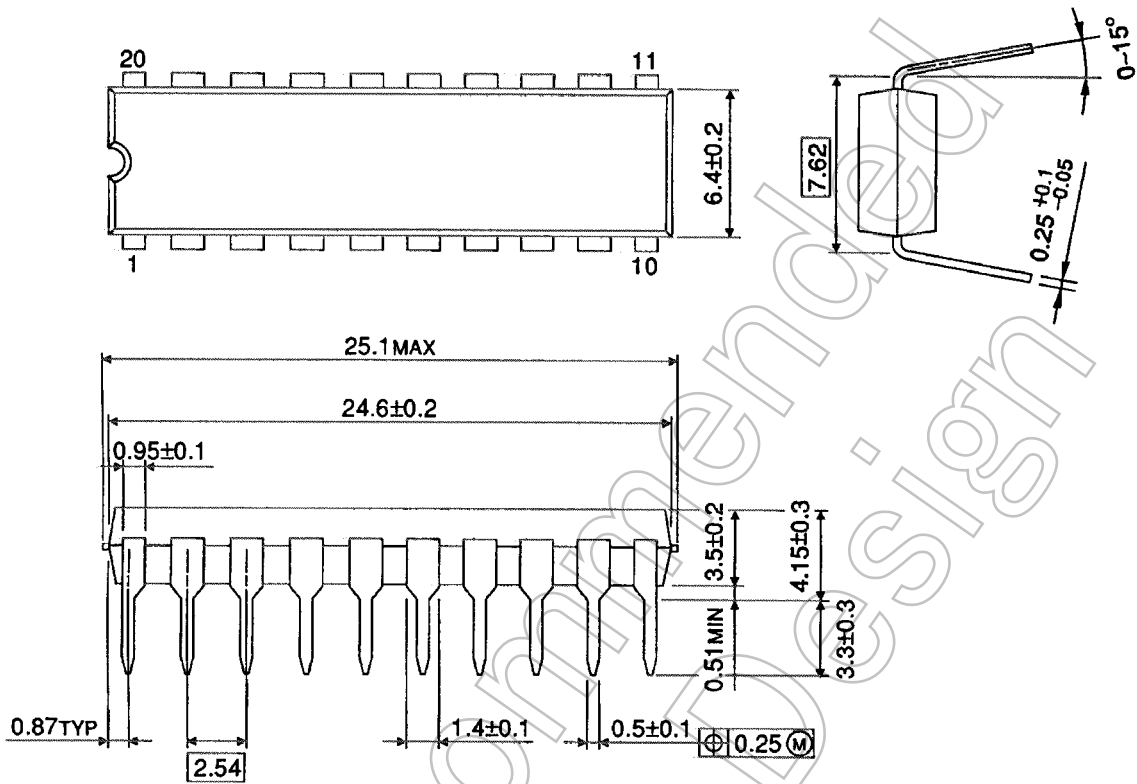
$$I_{CC} (opr) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

Not Recommended for New Design

## Package Dimensions

DIP20-P-300-2.54A

Unit : mm



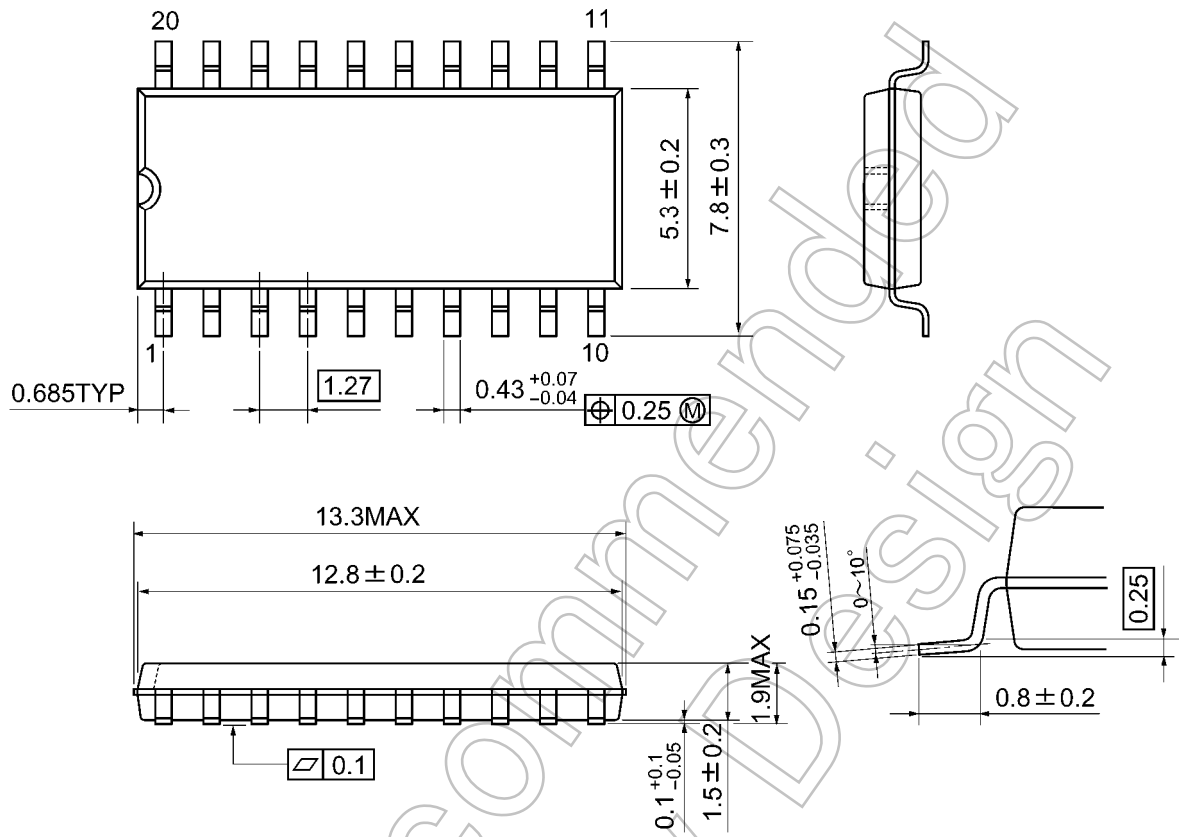
Weight: 1.30 g (typ.)

Not Recommended for New Design

**Package Dimensions**

SOP20-P-300-1.27A

Unit: mm



Weight: 0.22 g (typ.)

Not Recommended for New Design

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