

# TC7SZ08FE

## 1. Functional Description

- 2-Input AND Gate

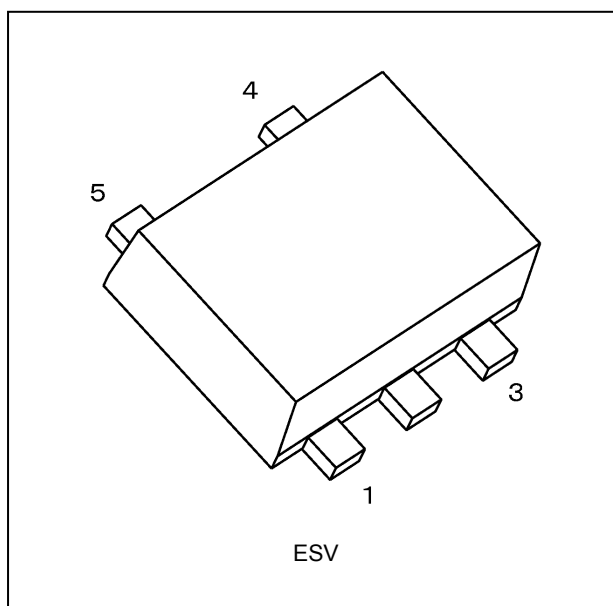
## 2. Features

- (1) AEC-Q100 (Rev. H) (Note 1)
- (2) Wide operating temperature range:  $T_{opr} = -40$  to  $125$  °C (Note 2)
- (3) High output current:  $\pm 24$  mA (min) at  $V_{CC} = 3.0$  V
- (4) Super high speed operation:  $t_{pd} = 2.4$  ns (typ.) at  $V_{CC} = 5.0$  V,  $C_L = 50$  pF
- (5) Operation voltage range:  $V_{CC} = 1.65$  to  $5.5$  V
- (6) 5.5 V tolerant inputs
- (7) 5.5 V power down protection output
- (8) Matches the performance of TC74LCX series when operated at 3.3 V  $V_{CC}$

Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.

Note 2: For devices with the ordering part number ending in J(CT).  $T_{opr} = -40$  to  $85$  °C for the other devices.

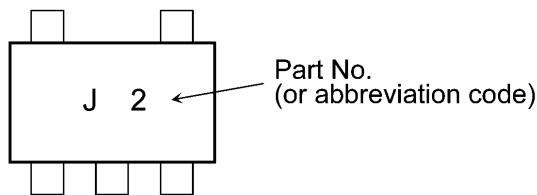
## 3. Packaging



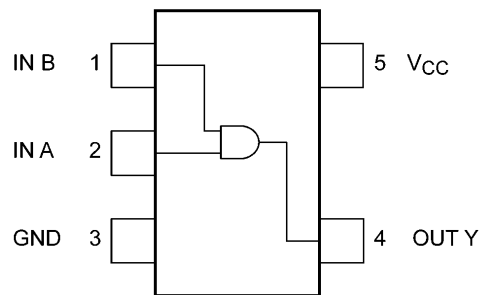
Start of commercial production

2008-02

### 4. Marking and Pin Assignment



Marking



Pin Assignment (Top view)

### 5. IEC Logic Symbol



### 6. Truth Table

| A | B | Y |
|---|---|---|
| L | L | L |
| L | H | L |
| H | L | L |
| H | H | H |

### 7. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$ )

| Characteristics          | Symbol    | Note     | Rating                 | Unit             |
|--------------------------|-----------|----------|------------------------|------------------|
| Supply voltage           | $V_{CC}$  |          | -0.5 to 6.0            | V                |
| Input voltage            | $V_{IN}$  |          | -0.5 to 6.0            | V                |
| DC output voltage        | $V_{OUT}$ | (Note 1) | -0.5 to 6.0            | V                |
|                          |           | (Note 2) | -0.5 to $V_{CC} + 0.5$ |                  |
| Input diode current      | $I_{IK}$  |          | -20                    | mA               |
| Output diode current     | $I_{OK}$  | (Note 3) | -20                    | mA               |
| DC output current        | $I_{OUT}$ |          | $\pm 50$               | mA               |
| $V_{CC}$ /ground current | $I_{CC}$  |          | $\pm 50$               | mA               |
| Power dissipation        | $P_D$     |          | 150                    | mW               |
| Storage temperature      | $T_{stg}$ |          | -65 to 150             | $^\circ\text{C}$ |
| Lead temperature (10 s)  | $T_L$     |          | 260                    | $^\circ\text{C}$ |

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:  $V_{CC} = 0\text{ V}$

Note 2: High (H) or Low (L) state.  $I_{OUT}$  absolute maximum rating must be observed.

Note 3:  $V_{OUT} < GND$

### 8. Operating Ranges (Note)

| Characteristics          | Symbol    | Note     | Test Condition   | Rating        | Unit |
|--------------------------|-----------|----------|--|---------------|------|
| Supply voltage           | $V_{CC}$  |          | —  | 1.65 to 5.5   | V    |
|                          |           | (Note 1) | —  | 1.5 to 5.5    |      |
| Input voltage            | $V_{IN}$  |          | —  | 0 to 5.5      | V    |
| Output voltage           | $V_{OUT}$ | (Note 2) | —  | 0 to 5.5      | V    |
|                          |           | (Note 3) | —  | 0 to $V_{CC}$ |      |
| Operating temperature    | $T_{opr}$ | (Note 4) | —  | -40 to 125    | °C   |
|                          |           | (Note 5) | —  | -40 to 85     |      |
| Input rise and fall time | dt/dv     |          | $V_{CC} = 1.8 \pm 0.15 \text{ V}, 2.5 \pm 0.2 \text{ V}$ | 0 to 20       | ns/V |
|                          |           |          | $V_{CC} = 3.3 \pm 0.3 \text{ V}$                         | 0 to 10       |      |
|                          |           |          | $V_{CC} = 5.0 \pm 0.5 \text{ V}$                         | 0 to 5        |      |

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.

Note 1: Data retention only

Note 2:  $V_{CC} = 0 \text{ V}$

Note 3: High (H) or Low (L) state.

Note 4: For devices with the ordering part number ending in J(CT).

Note 5: For devices except those with the ordering part number ending in J(CT).

### 9. Electrical Characteristics

#### 9.1. 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  | $V_{IH}$  | —                                     |                                      | 1.65 to 1.95 | $V_{CC} \times 0.75$ | —    | —                    | V             |
|                           |           |                                       |                                      | 2.3 to 5.5   | $V_{CC} \times 0.7$  | —    | —                    |               |
| Low-level input voltage   | $V_{IL}$  | —                                     |                                      | 1.65 to 1.95 | —                    | —    | $V_{CC} \times 0.25$ | V             |
|                           |           |                                       |                                      | 2.3 to 5.5   | —                    | —    | $V_{CC} \times 0.3$  |               |
| High-level output voltage | $V_{OH}$  | $V_{IN} = V_{IH}$                     | $I_{OH} = -100 \text{ } \mu\text{A}$ | 1.65         | 1.55                 | 1.65 | —                    | V             |
|                           |           |                                       |                                      | 2.3          | 2.2                  | 2.3  | —                    |               |
|                           |           |                                       |                                      | 3.0          | 2.9                  | 3.0  | —                    |               |
|                           |           |                                       |                                      | 4.5          | 4.4                  | 4.5  | —                    |               |
|                           |           |                                       | $I_{OH} = -4 \text{ mA}$             | 1.65         | 1.29                 | 1.52 | —                    |               |
|                           |           |                                       | $I_{OH} = -8 \text{ mA}$             | 2.3          | 1.9                  | 2.15 | —                    |               |
|                           |           |                                       | $I_{OH} = -16 \text{ mA}$            | 3.0          | 2.4                  | 2.8  | —                    |               |
|                           |           |                                       | $I_{OH} = -24 \text{ mA}$            | 3.0          | 2.3                  | 2.68 | —                    |               |
| Low-level output voltage  | $V_{OL}$  | $V_{IN} = V_{IH}$ or $V_{IL}$         | $I_{OL} = 100 \text{ } \mu\text{A}$  | 1.65         | —                    | 0.0  | 0.1                  | V             |
|                           |           |                                       |                                      | 2.3          | —                    | 0.0  | 0.1                  |               |
|                           |           |                                       |                                      | 3.0          | —                    | 0.0  | 0.1                  |               |
|                           |           |                                       |                                      | 4.5          | —                    | 0.0  | 0.1                  |               |
|                           |           |                                       | $I_{OL} = 4 \text{ mA}$              | 1.65         | —                    | 0.08 | 0.24                 |               |
|                           |           |                                       | $I_{OL} = 8 \text{ mA}$              | 2.3          | —                    | 0.1  | 0.3                  |               |
|                           |           |                                       | $I_{OL} = 16 \text{ mA}$             | 3.0          | —                    | 0.15 | 0.4                  |               |
|                           |           |                                       | $I_{OL} = 24 \text{ mA}$             | 3.0          | —                    | 0.22 | 0.55                 |               |
| Input leakage current     | $I_{IN}$  | $V_{IN} = 5.5 \text{ V}$ or GND       |                                      | 0 to 5.5     | —                    | —    | $\pm 1$              | $\mu\text{A}$ |
| Power-OFF leakage current | $I_{OFF}$ | $V_{IN}$ or $V_{OUT} = 5.5 \text{ V}$ |                                      | 0            | —                    | —    | 1                    | $\mu\text{A}$ |
| Quiescent supply current  | $I_{CC}$  | $V_{IN} = V_{CC}$ or GND              |                                      | 1.65 to 5.5  | —                    | —    | 2                    | $\mu\text{A}$ |

### 9.2. DC Characteristics (Unless otherwise specified, $T_a = -40$ to $85$ °C)

| Characteristics           | Symbol    | Test Condition                | $V_{CC}$ (V)          | Min                  | Max                  | Unit    |   |
|---------------------------|-----------|-------------------------------|-----------------------|----------------------|----------------------|---------|---|
| High-level input voltage  | $V_{IH}$  | —                             | 1.65 to 1.95          | $V_{CC} \times 0.75$ | —                    | V       |   |
|                           |           |                               | 2.3 to 5.5            | $V_{CC} \times 0.7$  | —                    |         |   |
| Low-level input voltage   | $V_{IL}$  | —                             | 1.65 to 1.95          | —                    | $V_{CC} \times 0.25$ | V       |   |
|                           |           |                               | 2.3 to 5.5            | —                    | $V_{CC} \times 0.3$  |         |   |
| High-level output voltage | $V_{OH}$  | $V_{IN} = V_{IH}$             | $I_{OH} = -100 \mu A$ | 1.65                 | 1.55                 | —       | V |
|                           |           |                               |                       | 2.3                  | 2.2                  | —       |   |
|                           |           |                               |                       | 3.0                  | 2.9                  | —       |   |
|                           |           |                               |                       | 4.5                  | 4.4                  | —       |   |
|                           |           |                               | $I_{OH} = -4$ mA      | 1.65                 | 1.29                 | —       |   |
|                           |           |                               | $I_{OH} = -8$ mA      | 2.3                  | 1.9                  | —       |   |
|                           |           |                               | $I_{OH} = -16$ mA     | 3.0                  | 2.4                  | —       |   |
|                           |           |                               | $I_{OH} = -24$ mA     | 3.0                  | 2.3                  | —       |   |
| Low-level output voltage  | $V_{OL}$  | $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OL} = 100 \mu A$  | 1.65                 | —                    | 0.1     | V |
|                           |           |                               |                       | 2.3                  | —                    | 0.1     |   |
|                           |           |                               |                       | 3.0                  | —                    | 0.1     |   |
|                           |           |                               |                       | 4.5                  | —                    | 0.1     |   |
|                           |           |                               | $I_{OL} = 4$ mA       | 1.65                 | —                    | 0.24    |   |
|                           |           |                               | $I_{OL} = 8$ mA       | 2.3                  | —                    | 0.3     |   |
|                           |           |                               | $I_{OL} = 16$ mA      | 3.0                  | —                    | 0.4     |   |
|                           |           |                               | $I_{OL} = 24$ mA      | 3.0                  | —                    | 0.55    |   |
| Input leakage current     | $I_{IN}$  | $V_{IN} = 5.5$ V or GND       | 0 to 5.5              | —                    | $\pm 10$             | $\mu A$ |   |
| Power-OFF leakage current | $I_{OFF}$ | $V_{IN}$ or $V_{OUT} = 5.5$ V | 0                     | —                    | 10                   | $\mu A$ |   |
| Quiescent supply current  | $I_{CC}$  | $V_{IN} = V_{CC}$ or GND      | 1.65 to 5.5           | —                    | 20                   | $\mu A$ |   |

### 9.3. DC Characteristics (Note) (Unless otherwise specified, $T_a = -40$ to $125$ °C)

| Characteristics           | Symbol    | Test Condition                | $V_{CC}$ (V)          | Min                  | Max                  | Unit    |   |
|---------------------------|-----------|-------------------------------|-----------------------|----------------------|----------------------|---------|---|
| High-level input voltage  | $V_{IH}$  | —                             | 1.65 to 1.95          | $V_{CC} \times 0.75$ | —                    | V       |   |
|                           |           |                               | 2.3 to 5.5            | $V_{CC} \times 0.7$  | —                    |         |   |
| Low-level input voltage   | $V_{IL}$  | —                             | 1.65 to 1.95          | —                    | $V_{CC} \times 0.25$ | V       |   |
|                           |           |                               | 2.3 to 5.5            | —                    | $V_{CC} \times 0.3$  |         |   |
| High-level output voltage | $V_{OH}$  | $V_{IN} = V_{IH}$             | $I_{OH} = -100 \mu A$ | 1.65                 | 1.55                 | —       | V |
|                           |           |                               |                       | 2.3                  | 2.2                  | —       |   |
|                           |           |                               |                       | 3.0                  | 2.9                  | —       |   |
|                           |           |                               |                       | 4.5                  | 4.4                  | —       |   |
|                           |           |                               | $I_{OH} = -4$ mA      | 1.65                 | 0.95                 | —       |   |
|                           |           |                               | $I_{OH} = -8$ mA      | 2.3                  | 1.7                  | —       |   |
|                           |           |                               | $I_{OH} = -16$ mA     | 3.0                  | 2.2                  | —       |   |
|                           |           |                               | $I_{OH} = -24$ mA     | 3.0                  | 2.0                  | —       |   |
|                           |           |                               | $I_{OH} = -32$ mA     | 4.5                  | 3.4                  | —       |   |
| Low-level output voltage  | $V_{OL}$  | $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OL} = 100 \mu A$  | 1.65                 | —                    | 0.1     | V |
|                           |           |                               |                       | 2.3                  | —                    | 0.1     |   |
|                           |           |                               |                       | 3.0                  | —                    | 0.1     |   |
|                           |           |                               |                       | 4.5                  | —                    | 0.1     |   |
|                           |           |                               | $I_{OL} = 4$ mA       | 1.65                 | —                    | 0.7     |   |
|                           |           |                               | $I_{OL} = 8$ mA       | 2.3                  | —                    | 0.45    |   |
|                           |           |                               | $I_{OL} = 16$ mA      | 3.0                  | —                    | 0.6     |   |
|                           |           |                               | $I_{OL} = 24$ mA      | 3.0                  | —                    | 0.8     |   |
|                           |           |                               | $I_{OL} = 32$ mA      | 4.5                  | —                    | 0.8     |   |
| Input leakage current     | $I_{IN}$  | $V_{IN} = 5.5$ V or GND       | 0 to 5.5              | —                    | $\pm 20$             | $\mu A$ |   |
| Power-OFF leakage current | $I_{OFF}$ | $V_{IN}$ or $V_{OUT} = 5.5$ V | 0                     | —                    | 100                  | $\mu A$ |   |
| Quiescent supply current  | $I_{CC}$  | $V_{IN} = V_{CC}$ or GND      | 1.65 to 5.5           | —                    | 200                  | $\mu A$ |   |

Note: For devices with the ordering part number ending in J(CT).

### 9.4. 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           | $V_{CC}$ (V)   | $C_L$ (pF) | Min | Typ. | Max | Unit |
|-------------------------------|--------------------|----------|--------------------------|----------------|------------|-----|------|-----|------|
| Propagation delay time        | $t_{PLH}, t_{PHL}$ |          | $R_L = 1\text{ M}\Omega$ | $1.8 \pm 0.15$ | 15         | 2.0 | 5.3  | 9.6 | ns   |
|                               |                    |          |                          | $2.5 \pm 0.2$  |            | 0.8 | 3.2  | 5.3 |      |
|                               |                    |          |                          | $3.3 \pm 0.3$  |            | 0.5 | 2.4  | 3.7 |      |
|                               |                    |          |                          | $5.0 \pm 0.5$  |            | 0.5 | 1.9  | 2.9 |      |
|                               |                    |          | $R_L = 500\ \Omega$      | $3.3 \pm 0.3$  | 50         | 1.5 | 3.0  | 4.6 | ns   |
|                               |                    |          |                          | $5.0 \pm 0.5$  |            | 0.8 | 2.4  | 3.6 |      |
| Input capacitance             | $C_{IN}$           |          | —                        | 0 to 5.5       | —          | —   | 4    | —   | pF   |
| Power dissipation capacitance | $C_{PD}$           | (Note 1) | —                        | 3.3            | —          | —   | 19   | —   | pF   |
|                               |                    |          |                          | 5.5            |            | —   | 26   | —   |      |

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.

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

### 9.5. 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           | $V_{CC}$ (V)   | $C_L$ (pF) | Min | Max | Unit |
|------------------------|--------------------|--------------------------|----------------|------------|-----|-----|------|
| Propagation delay time | $t_{PLH}, t_{PHL}$ | $R_L = 1\text{ M}\Omega$ | $1.8 \pm 0.15$ | 15         | 2.0 | 9.8 | ns   |
|                        |                    |                          | $2.5 \pm 0.2$  |            | 0.8 | 5.7 |      |
|                        |                    |                          | $3.3 \pm 0.3$  |            | 0.5 | 4.0 |      |
|                        |                    |                          | $5.0 \pm 0.5$  |            | 0.5 | 3.2 |      |
|                        |                    | $R_L = 500\ \Omega$      | $3.3 \pm 0.3$  | 50         | 1.5 | 4.9 | ns   |
|                        |                    |                          | $5.0 \pm 0.5$  |            | 0.8 | 3.9 |      |

### 9.6. AC Characteristics (Note) (Unless otherwise specified, $T_a = -40\text{ to }125\text{ }^\circ\text{C}$ , Input: $t_r = t_f = 3\text{ ns}$ )

| Characteristics        | Symbol             | Test Condition           | $V_{CC}$ (V)   | $C_L$ (pF) | Min | Max  | Unit |
|------------------------|--------------------|--------------------------|----------------|------------|-----|------|------|
| Propagation delay time | $t_{PLH}, t_{PHL}$ | $R_L = 1\text{ M}\Omega$ | $1.8 \pm 0.15$ | 15         | 2.0 | 11.0 | ns   |
|                        |                    |                          | $2.5 \pm 0.2$  |            | 0.8 | 6.5  |      |
|                        |                    |                          | $3.3 \pm 0.3$  |            | 0.5 | 4.5  |      |
|                        |                    |                          | $5.0 \pm 0.5$  |            | 0.5 | 4.0  |      |
|                        |                    | $R_L = 500\ \Omega$      | $3.3 \pm 0.3$  | 50         | 1.5 | 5.5  | ns   |
|                        |                    |                          | $5.0 \pm 0.5$  |            | 0.8 | 4.5  |      |

Note: For devices with the ordering part number ending in J(CT).



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[NLV7SZ57DFT2G](#) [NLV74VHC04DTR2G](#) [NLV27WZ00USG](#) [NLU1G86CMUTCG](#) [NLU1G08CMUTCG](#) [NL17SZ32P5T5G](#)  
[NL17SZ00P5T5G](#) [NL17SH02P5T5G](#) [74AUP2G00RA3-7](#) [NLVVHC1GT00DFT2G](#) [NLV74HC02ADTR2G](#) [NLX1G332CMUTCG](#)  
[NLVHCT132ADTR2G](#) [NL17SG86P5T5G](#) [NL17SZ05P5T5G](#) [NLV74VHC00DTR2G](#) [NLVVHC1G02DFT1G](#) [NLV74HC86ADR2G](#)  
[74LVC2G32HK3-7](#) [74LVC2G86RA3-7](#) [NL17SZ38DBVT1G](#) [NLV18SZ00DFT2G](#) [NLVVHC1G07DFT1G](#)