

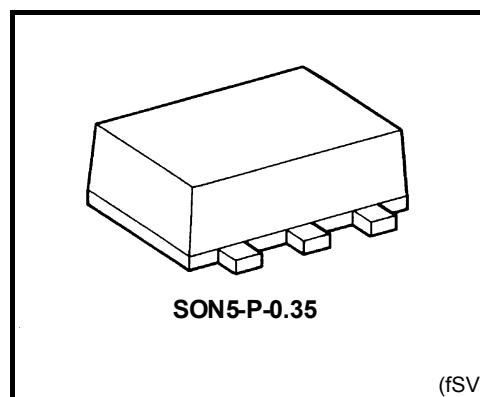
TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC7SZ07AFS

NON-Inverter (Open Drain)

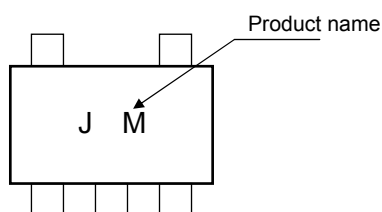
### Features

- High output current : 24 mA (min) at  $V_{CC} = 3\text{ V}$
- Super high speed operation :  $t_{pZL} = 2.3\text{ ns}$  (typ.)  
at  $V_{CC} = 5\text{ V}$ , 50 pF
- Operation voltage range :  $V_{CC}(\text{opr.}) = 1.65\text{ to }5.5\text{ V}$
- 5.5-V tolerant input
- 5.5-V power down protection output

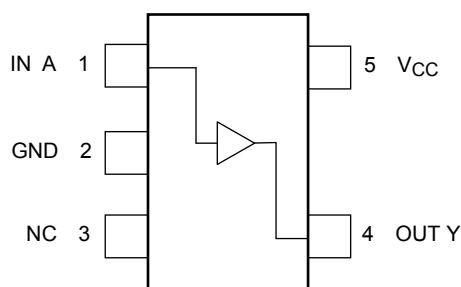


Weight : 0.001 g (typ.)

### Marking



### Pin Assignment (top view)



### Absolute Maximum Ratings ( $T_a = 25^\circ\text{C}$ )

| Characteristics             | Symbol    | Rating             | Unit             |
|-----------------------------|-----------|--------------------|------------------|
| Supply voltage              | $V_{CC}$  | -0.5 to 6          | V                |
| DC input voltage            | $V_{IN}$  | -0.5 to 6          | V                |
| DC output voltage           | $V_{OUT}$ | -0.5 to 6 (Note 1) | V                |
| Input diode current         | $I_{IK}$  | -20                | mA               |
| Output diode current        | $I_{OK}$  | -20 (Note 2)       | mA               |
| DC output current           | $I_{OUT}$ | 50                 | mA               |
| DC $V_{CC}$ /ground current | $I_{CC}$  | $\pm 50$           | mA               |
| Power dissipation           | $P_D$     | 50                 | mW               |
| Storage temperature         | $T_{stg}$ | -65 to 150         | $^\circ\text{C}$ |

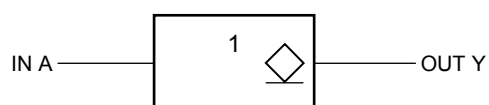
Note: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) 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: Do not exceed  $I_{OUT}$  of absolute maximum ratings.

Note 2:  $V_{OUT} < GND$

## IEC Logic Symbol



## Truth Table

|   |   |
|---|---|
| A | Y |
| L | L |
| H | Z |

Z: High Impedance

## Operating Ranges

| Characteristics          | Symbol    | Rating  | Unit |
|--------------------------|-----------|---|------|
| Supply voltage           | $V_{CC}$  | 1.65 to 5.5   | V    |
|                          |           | 1.5 to 5.5 (Note 3)   |      |
| Input voltage            | $V_{IN}$  | 0 to 5.5  | V    |
| Output voltage           | $V_{OUT}$ | 0 to 5.5  | V    |
| Operating temperature    | $T_{opr}$ | -40 to 85   | °C   |
| Input rise and fall time | $d_t/d_v$ | 0 to 20 ( $V_{CC} = 1.80\text{ V} \pm 0.15\text{ V}, 2.5\text{ V} \pm 0.2\text{ V}$ ) | ns/V |
|                          |           | 0 to 10 ( $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ )                                  |      |
|                          |           | 0 to 5 ( $V_{CC} = 5.0\text{ V} \pm 0.5\text{ V}$ )                                   |      |

Note 3: Data retention only

## 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  |   |
| Input voltage                  | High level | V <sub>IH</sub>  | —  | 1.65 to 1.95             | V <sub>CC</sub> × 0.75 | —    | —                      | V <sub>CC</sub> × 0.75 | —                      | V    |   |
|                                |            |                  |  | 2.3 to 5.5               | V <sub>CC</sub> × 0.7  | —    | —                      | V <sub>CC</sub> × 0.7  | —                      |      |   |
|                                | Low level  | V <sub>IL</sub>  | —  | 1.65 to 1.95             | —                      | —    | V <sub>CC</sub> × 0.25 | —                      | V <sub>CC</sub> × 0.25 |      |   |
|                                |            |                  |  | 2.3 to 5.5               | —                      | —    | V <sub>CC</sub> × 0.3  | —                      | V <sub>CC</sub> × 0.3  |      |   |
| Z-state output leakage current |            | I <sub>LKG</sub> | V <sub>IN</sub> = V <sub>IH</sub><br>V <sub>OUT</sub> = 0 to 5.5 V | 1.65 to 5.5              | —                      | —    | ±5                     | —                      | ±10                    | μA   |   |
| Output voltage                 | Low level  | V <sub>OL</sub>  | V <sub>IN</sub> = V <sub>IL</sub>                                  | I <sub>OL</sub> = 100 μA | 1.65                   | —    | 0                      | 0.1                    | —                      | 0.1  | V |
|                                |            |                  |  |                          | 2.3                    | —    | 0                      | 0.1                    | —                      | 0.1  |   |
|                                |            |                  |  |                          | 3.0                    | —    | 0                      | 0.1                    | —                      | 0.1  |   |
|                                |            |                  |  |                          | 4.5                    | —    | 0                      | 0.1                    | —                      | 0.1  |   |
|                                |            |                  |  | I <sub>OL</sub> = 4 mA   | 1.65                   | —    | 0.08                   | 0.24                   | —                      | 0.24 |   |
|                                |            |                  |  | I <sub>OL</sub> = 8 mA   | 2.3                    | —    | 0.1                    | 0.3                    | —                      | 0.3  |   |
|                                |            |                  |  | I <sub>OL</sub> = 16 mA  | 3.0                    | —    | 0.15                   | 0.4                    | —                      | 0.4  |   |
|                                |            |                  |  | I <sub>OL</sub> = 24 mA  | 3.0                    | —    | 0.22                   | 0.55                   | —                      | 0.55 |   |
|                                |            |                  |  | I <sub>OL</sub> = 32 mA  | 4.5                    | —    | 0.22                   | 0.55                   | —                      | 0.55 |   |
| Input leakage current          |            | I <sub>IN</sub>  | V <sub>IN</sub> = 5.5 V or GND                                     | 0 to 5.5                 | —                      | —    | ±1                     | —                      | ±10                    | μA   |   |
| Power off leakage current      |            | I <sub>OFF</sub> | V <sub>IN</sub> or V <sub>OUT</sub> = 5.5 V                        | 0.0                      | —                      | —    | 1                      | —                      | 10                     | μA   |   |
| Quiescent supply current       |            | I <sub>CC</sub>  | V <sub>IN</sub> = V <sub>CC</sub> or GND                           | 5.5                      | —                      | —    | 2                      | —                      | 20                     | μA   |   |

## AC Characteristics (unless otherwise specified, Input: $t_r = t_f = 3$ ns)

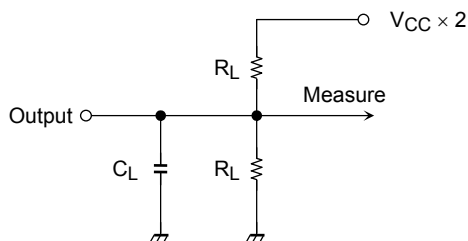
| Characteristics               | Symbol           | Test Condition                                 | Ta = 25°C           |     |      | Ta = -40 to 85°C |     | Unit |     |
|-------------------------------|------------------|--|---------------------|-----|------|------------------|-----|------|-----|
|                               |                  |  | V <sub>CC</sub> (V) | Min | Typ. | Max              | Min |      | Max |
| Propagation delay time        | t <sub>pZL</sub> | C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω | 1.80 ± 0.15         | 1.8 | 5.5  | 9.5              | 1.8 | 10.5 | ns  |
|                               |                  |  | 2.5 ± 0.2           | 1.2 | 3.7  | 5.8              | 1.2 | 6.4  |     |
|                               |                  |  | 3.3 ± 0.3           | 0.8 | 2.9  | 4.4              | 0.8 | 4.8  |     |
|                               |                  |  | 5.0 ± 0.5           | 0.5 | 2.3  | 3.5              | 0.5 | 3.9  |     |
|                               | t <sub>pLZ</sub> | C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω | 1.80 ± 0.15         | 1.8 | 4.3  | 9.5              | 1.8 | 10.5 |     |
|                               |                  |  | 2.5 ± 0.2           | 1.2 | 2.8  | 5.8              | 1.2 | 6.4  |     |
|                               |                  |  | 3.3 ± 0.3           | 0.8 | 2.1  | 4.4              | 0.8 | 4.8  |     |
|                               |                  |  | 5.0 ± 0.5           | 0.5 | 1.4  | 3.5              | 0.5 | 3.9  |     |
| Input capacitance             | C <sub>IN</sub>  | —  | 0 to 5.5            | —   | 4    | —                | —   | —    | pF  |
| Output capacitance            | C <sub>OUT</sub> | —  | 0 to 5.5            | —   | 4    | —                | —   | —    | pF  |
| Power dissipation capacitance | C <sub>PD</sub>  | (Note 4)                                       | 3.3                 | —   | 4    | —                | —   | —    | pF  |
|                               |                  |  | 5.5                 | —   | 10   | —                | —   | —    |     |

Note4: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

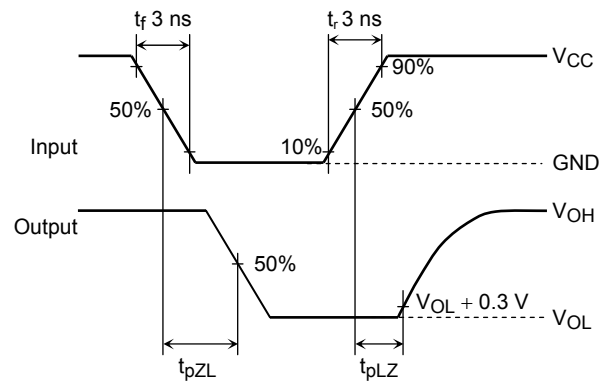
Average operating current can be obtained by the equation.

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

### AC Characteristics Measurement Circuit



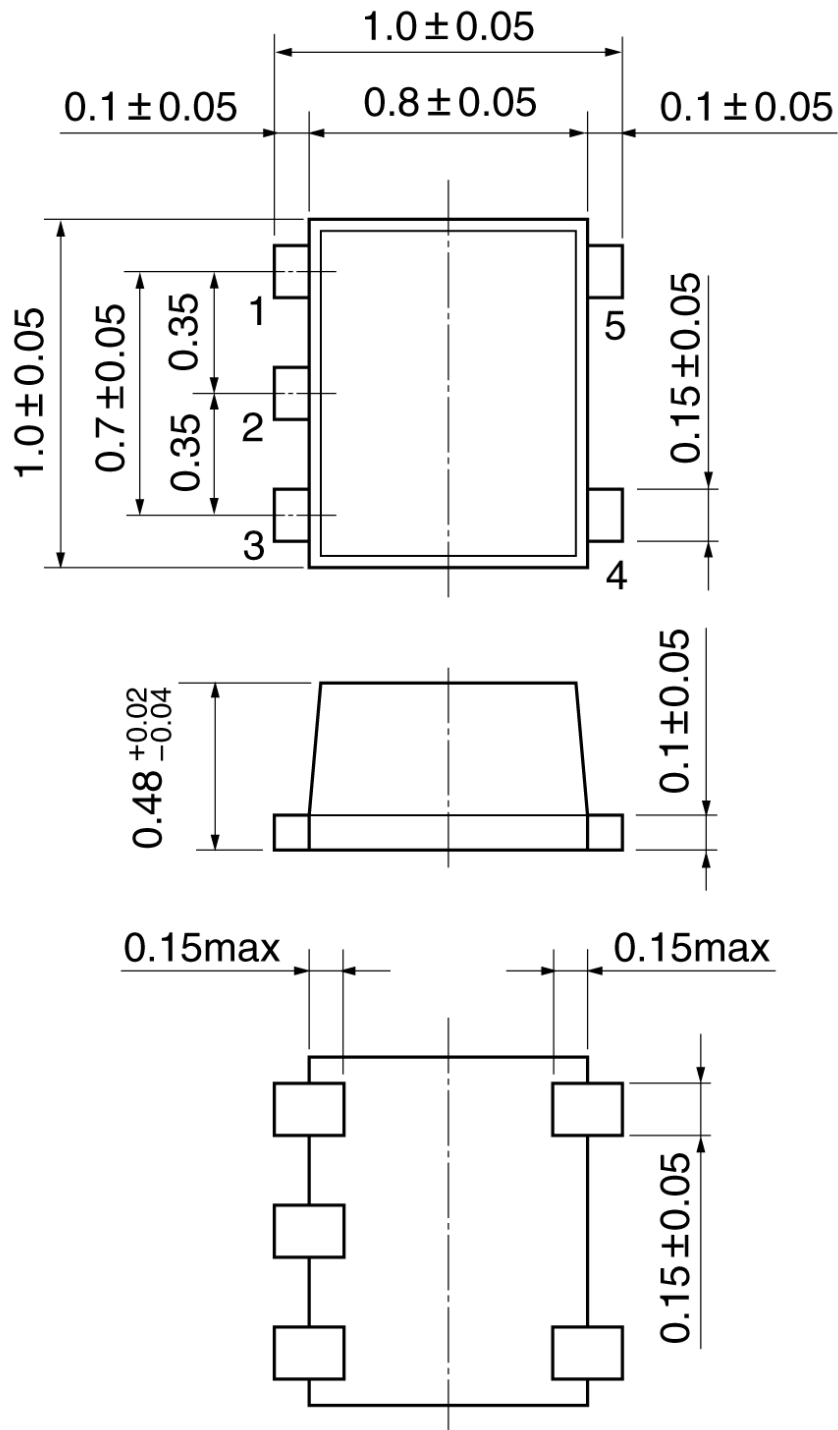
### AC Waveforms



## Package Dimensions

SON5-P-0.35

Unit: mm



Weight: 0.001 g (typ.)

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Тел: +7 (812) 336 43 04 (многоканальный)

Email: [org@lifeelectronics.ru](mailto:org@lifeelectronics.ru)