

### General Description

This single 2-input exclusive-OR gate is designed for 1.65-V to 5.5-V  $V_{CC}$  operation.

The NC7SZ86 performs the Boolean function  $Y=A \oplus B$  or  $Y=\bar{A}B+A\bar{B}$  in positive logic.

A common application is as a true/complement element. If the input is low, the other input is reproduced in true form at the output. If the input is high, the signal on the other input is reproduced inverted at the output.

This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

### Features

- Supports 5V  $V_{CC}$  Operation
- Inputs Accept Voltages to 5.5 V
- Max  $t_{pd}$  of 4 ns at 3.3 V
- Low Power Consumption, 10 $\mu$ A Max  $I_{CC}$
- $\pm 24$ mA Output Drive at 3.3V
- $I_{off}$  Supports Partial-Power-Down Mode

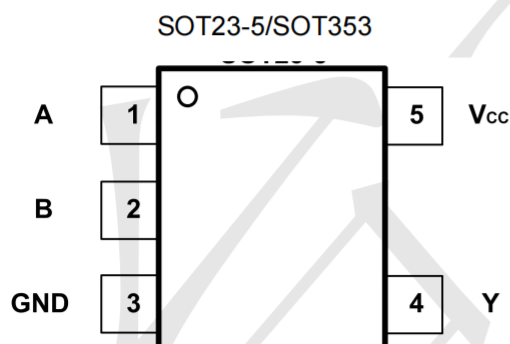
### Applications

- Wireless Headsets
- Motor Drives and Controls
- TVs
- Set-Top Boxes
- Audio

### Ordering Information

| ORDER NUMBER | PACKAGE DESCRIPTION | PACKAGE OPTION     |
|--------------|---------------------|--------------------|
| NC7SZ86M5X   | SOT23-5             | Tape and Reel,3000 |
| NC7SZ86P5X   | SOT353              | Tape and Reel,3000 |

### Pin Configuration

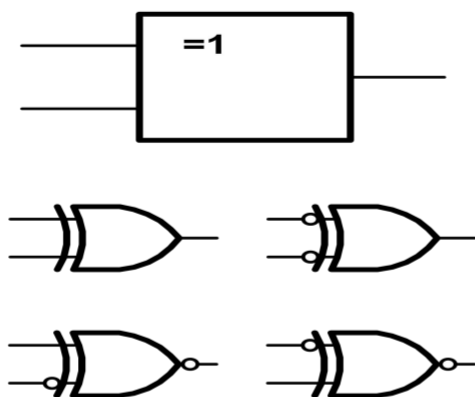


### Marking

NC7SZ86M5X Marking:7Z86D

NC7SZ86P5X Marking:Z86C

## Logic Diagram



## Function Table

| Inputs |   | Output |
|--------|---|--------|
| A      | B | Y      |
| L      | L | L      |
| L      | H | H      |
| H      | L | H      |
| H      | H | L      |

## Absolute Maximum Ratings

| Parameters |                                                                              | Min  | Max.         | Unit               |
|------------|------------------------------------------------------------------------------|------|--------------|--------------------|
| $V_{CC}$   | Supply voltage range                                                         | -0.5 | 6.5          | V                  |
| $V_I$      | Input voltage range                                                          | -0.5 | 6.5          | V                  |
| $V_O$      | Voltage range applied to any output in the high-impedance or power-off state | -0.5 | 6.5          | V                  |
| $V_O$      | Voltage range applied to any output in the high or low state                 | -0.5 | $V_{CC}+0.5$ | V                  |
| $I_{IK}$   | Input clamp current                                                          |      | -50          | mA                 |
| $I_{OK}$   | Output clamp current                                                         |      | -50          | mA                 |
| $I_O$      | Continuous output current                                                    |      | $\pm 50$     | mA                 |
|            | Continuous current through $V_{CC}$ or GND                                   |      | $\pm 100$    | mA                 |
| $T_J$      | Junction temperature under bias                                              |      | 150          | $^{\circ}\text{C}$ |
| $T_{stg}$  | Storage temperature range                                                    | -65  | 150          | $^{\circ}\text{C}$ |

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability..

(2) The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.

### ESD Ratings

| ESD    |                         | VALUE                     | UNIT |
|--------|-------------------------|---------------------------|------|
| V(ESD) | Electrostatic discharge | Human-body model (HBM)    | 4K V |
|        |                         | Charge device model (CDM) | 2K V |

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

| Symbol              | Parameters                         |                                        | Min.                 | Max.                 | Unit |
|---------------------|------------------------------------|----------------------------------------|----------------------|----------------------|------|
| $V_{CC}$            | Supply Voltage                     |                                        | 1.65                 | 5.5                  | V    |
| $V_{IH}$            | High-level input voltage           | $V_{CC}=1.65V$ to $1.95V$              | $0.65 \times V_{CC}$ |                      | V    |
|                     |                                    | $V_{CC}=2.3V$ to $2.7V$                | 1.7                  |                      |      |
|                     |                                    | $V_{CC}=3V$ to $3.6V$                  | 2                    |                      |      |
|                     |                                    | $V_{CC}=4.5V$ to $5.5V$                | $0.7 \times V_{CC}$  |                      |      |
| $V_{IL}$            | Low-level input voltage            | $V_{CC}=1.65V$ to $1.95V$              |                      | $0.35 \times V_{CC}$ | V    |
|                     |                                    | $V_{CC}=2.3V$ to $2.7V$                |                      | 0.7                  |      |
|                     |                                    | $V_{CC}=3V$ to $3.6V$                  |                      | 0.8                  |      |
|                     |                                    | $V_{CC}=4.5V$ to $5.5V$                |                      | $0.3 \times V_{CC}$  |      |
| $V_I$               | Input voltage                      |                                        | 0                    | 5.5                  | V    |
| $V_O$               | Output voltage                     |                                        | 0                    | $V_{CC}$             | V    |
| $I_{OH}$            | High-level output current          | $V_{CC}=1.65V$                         |                      | -4                   | mA   |
|                     |                                    | $V_{CC}=2.3V$                          |                      | -8                   |      |
|                     |                                    | $V_{CC}=3V$                            |                      | -16                  |      |
|                     |                                    |                                        |                      | -24                  |      |
|                     |                                    | $V_{CC}=4.5V$                          |                      | -32                  |      |
| $I_{OL}$            | Low-level output current           | $V_{CC}=1.65V$                         |                      | 4                    | mA   |
|                     |                                    | $V_{CC}=2.3V$                          |                      | 8                    |      |
|                     |                                    | $V_{CC}=3V$                            |                      | 16                   |      |
|                     |                                    |                                        |                      | 24                   |      |
|                     |                                    | $V_{CC}=4.5V$                          |                      | 32                   |      |
| $\Delta t/\Delta v$ | Input transition rise or fall rate | $V_{CC}=1.8V \pm 0.15V, 2.5V \pm 0.2V$ |                      | 20                   | ns/V |
|                     |                                    | $V_{CC}=3.3V \pm 0.3V$                 |                      | 10                   |      |
|                     |                                    | $V_{CC}=5V \pm 0.5V$                   |                      | 5                    |      |
| $T_A$               | Operating free-air temperature     |                                        | -40                  | 125                  | °C   |

### Electrical Characteristics

FULL=−40°C to +125°C, Typical values are at TA = +25°C. (unless otherwise noted)

| Parameters                    | Symbol           | Conditions                                                                      | V <sub>CC</sub> | T <sub>A</sub> | Min.                 | Typ. | Max. | Unit |
|-------------------------------|------------------|---------------------------------------------------------------------------------|-----------------|----------------|----------------------|------|------|------|
| High-level output voltage     | V <sub>OH</sub>  | I <sub>OH</sub> = −100μA                                                        | 1.65V to 5.5V   | FULL           | V <sub>CC</sub> -0.1 |      |      | V    |
|                               |                  | I <sub>OH</sub> = −4mA                                                          | 1.65            |                | 1.2                  |      |      |      |
|                               |                  | I <sub>OH</sub> = −8mA                                                          | 2.3             |                | 1.9                  |      |      |      |
|                               |                  | I <sub>OH</sub> = −16mA                                                         | 3               |                | 2.4                  |      |      |      |
|                               |                  | I <sub>OH</sub> = −24mA                                                         |                 |                | 2.3                  |      |      |      |
|                               |                  | I <sub>OH</sub> = −32mA                                                         | 4.5             |                | 3.8                  |      |      |      |
| Low-level output voltage      | V <sub>OL</sub>  | I <sub>OL</sub> = 100μA                                                         | 1.65V to 5.5V   | FULL           |                      |      | 0.1  | V    |
|                               |                  | I <sub>OL</sub> = 4mA                                                           | 1.65            |                |                      |      | 0.45 |      |
|                               |                  | I <sub>OL</sub> = 8mA                                                           | 2.3             |                |                      |      | 0.3  |      |
|                               |                  | I <sub>OL</sub> = 16mA                                                          | 3               |                |                      |      | 0.4  |      |
|                               |                  | I <sub>OL</sub> = 24mA                                                          |                 |                |                      |      | 0.55 |      |
|                               |                  | I <sub>OL</sub> = 32mA                                                          | 4.5             |                |                      |      | 0.55 |      |
| Input leakage current         | I <sub>I</sub>   | A or B input, V <sub>I</sub> = 5.5V or GND                                      | 0V to 5.5V      | FULL           |                      |      | ±5   | μA   |
|                               | I <sub>off</sub> | V <sub>I</sub> or V <sub>O</sub> = 5.5V                                         | 0V              | FULL           |                      |      | ±10  | μA   |
| Supply current                | I <sub>CC</sub>  | V <sub>I</sub> = 5.5 V or GND, I <sub>O</sub> = 0                               | 1.65V to 5.5V   | FULL           |                      |      | 15   | μA   |
|                               | ΔI <sub>CC</sub> | one input at V <sub>CC</sub> − 0.6 V,<br>other inputs at V <sub>CC</sub> or GND | 3V to 5.5V      | FULL           |                      |      | 500  | μA   |
| Input capacitance             | C <sub>i</sub>   | V <sub>I</sub> = V <sub>CC</sub> or GND                                         | 3.3V            | FULL           |                      | 6    |      | pF   |
| Power dissipation capacitance | C <sub>pd</sub>  | f = 10 MHz                                                                      | 1.8V            | 25°C           |                      | 22   |      | pF   |
|                               |                  |                                                                                 | 2.5V            |                |                      | 22   |      |      |
|                               |                  |                                                                                 | 3.3V            |                |                      | 22   |      |      |
|                               |                  |                                                                                 | 5V              |                |                      | 24   |      |      |
| Propagation delay time        | t <sub>pd</sub>  | Any input to Y (output),<br>C <sub>L</sub> =15pF                                | 1.8V±0.15V      | FULL           | 2.1                  |      | 9.1  | ns   |
|                               |                  |                                                                                 | 2.5V±0.2V       |                | 1                    |      | 4.5  |      |
|                               |                  |                                                                                 | 3.3V±0.3V       |                | 0.6                  |      | 4    |      |
|                               |                  |                                                                                 | 5V±0.5V         |                | 0.8                  |      | 3.3  |      |
|                               |                  | Any input to Y (output),<br>C <sub>L</sub> =30pF or 50pF                        | 1.8V±0.15V      | FULL           | 3.5                  |      | 12   |      |
|                               |                  |                                                                                 | 2.5V±0.2V       |                | 1.8                  |      | 7    |      |
|                               |                  |                                                                                 | 3.3V±0.3V       |                | 1.3                  |      | 6    |      |
|                               |                  |                                                                                 | 5V±0.5V         |                | 1                    |      | 5    |      |

Electrical specifications(continued)

### Detailed Description

The NC7SZ86 device performs the Boolean function  $Y = \bar{A}B + A\bar{B}$  in positive logic. This single 2-input exclusive-OR gate is designed for 1.65V to 5.5V  $V_{CC}$  operation.

A common application is as a true and complement element. If the input is low, the other input is reproduced in true form at the output. If the input is high, the signal on the other input is reproduced inverted at the output.

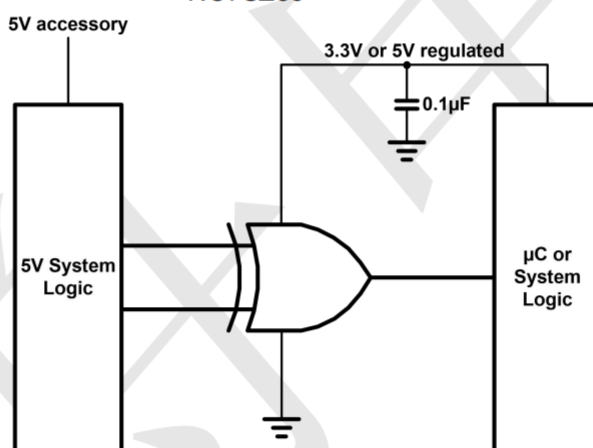
This device is fully specified for partial-power-down applications using  $I_{off}$ . The  $I_{off}$  circuitry disables the outputs, preventing damaging current backflow through the device when it is powered down.

**Function Table**

| Inputs |   | Output |
|--------|---|--------|
| A      | B | Y      |
| L      | L | L      |
| L      | H | H      |
| H      | L | H      |
| H      | H | L      |

### Application Note

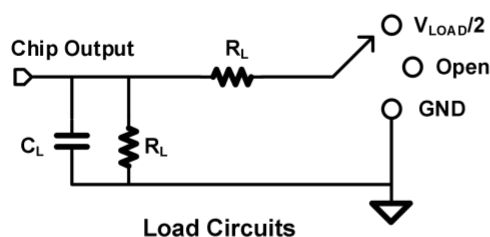
The NC7SZ86 device can accept input voltages up to 5.5 V at any valid  $V_{CC}$  which makes the device suitable for down translation. This feature of the NC7SZ86 makes it ideal for various bus interface applications.



**Typical Application Schematic**

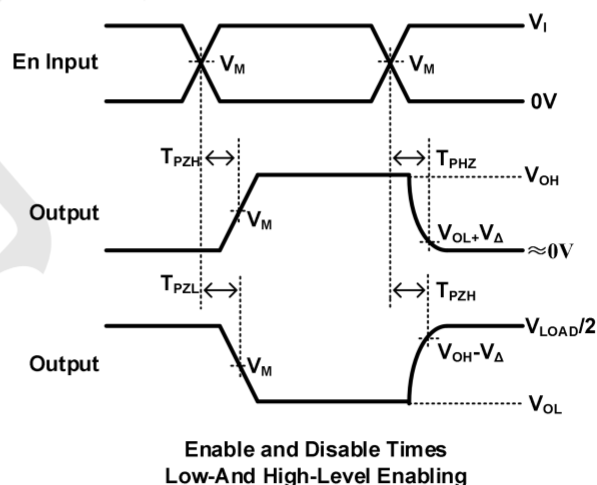
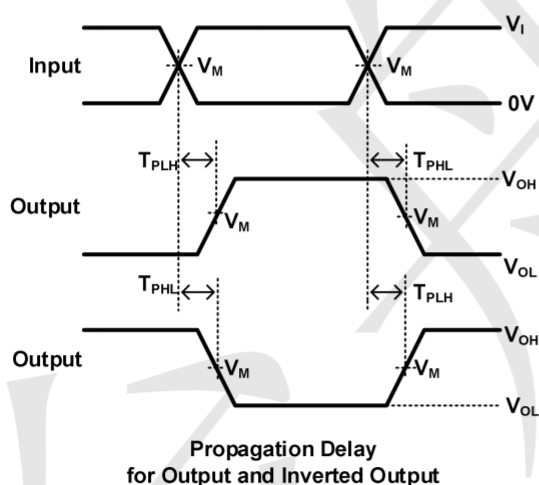
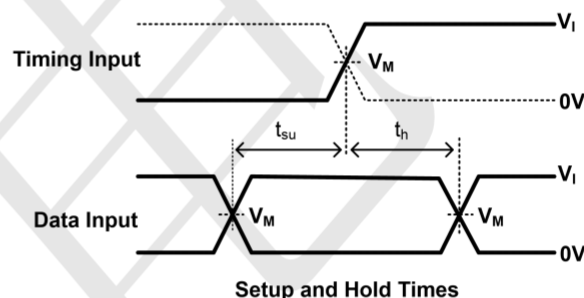
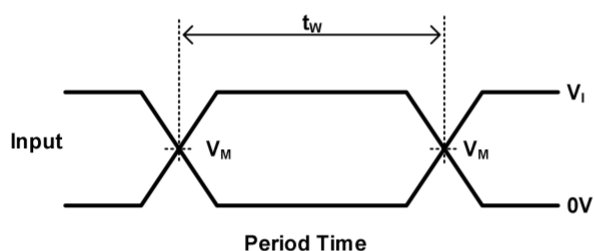
This device uses CMOS technology and has balanced output drive. Take care to avoid bus contention because it can drive currents that would exceed maximum limits. The high drive will also create fast edges into light loads, so routing and load conditions should be considered to prevent ringing.

### Parameter Measurement Information



| Test              | S1         |
|-------------------|------------|
| $T_{PHL}/T_{PLH}$ | OPEN       |
| $T_{PLZ}/T_{PZL}$ | $V_{LOAD}$ |
| $T_{PHZ}/T_{PZH}$ | GND        |

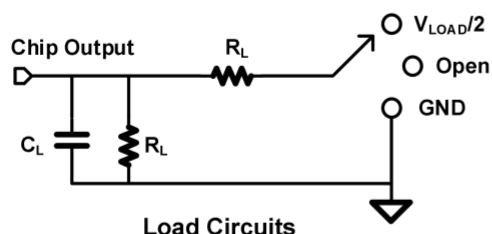
| $V_{CC}$         | Inputs   |              | $V_M$      | $V_{LOAD}$        | $C_L$ | $R_L$       | $V_{\Delta}$ |
|------------------|----------|--------------|------------|-------------------|-------|-------------|--------------|
|                  | $V_I$    | $T_r/T_f$    |            |                   |       |             |              |
| $1.8V \pm 0.15V$ | $V_{CC}$ | $\leq 2ns$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 15pF  | 1M $\Omega$ | 0.15V        |
| $2.5V \pm 0.15V$ | $V_{CC}$ | $\leq 2ns$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 15pF  | 1M $\Omega$ | 0.15V        |
| $3.3V \pm 0.15V$ | 3V       | $\leq 2.5ns$ | 1.5V       | 6V                | 15pF  | 1M $\Omega$ | 0.3V         |
| $5V \pm 0.15V$   | $V_{CC}$ | $\leq 2.5ns$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 15pF  | 1M $\Omega$ | 0.3V         |



Notes: A. C includes probe and jig capacitance.  
B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.  
C. All input pulses are supplied by generators having the following characteristics: PRR 10 MHz, Z = 50 .

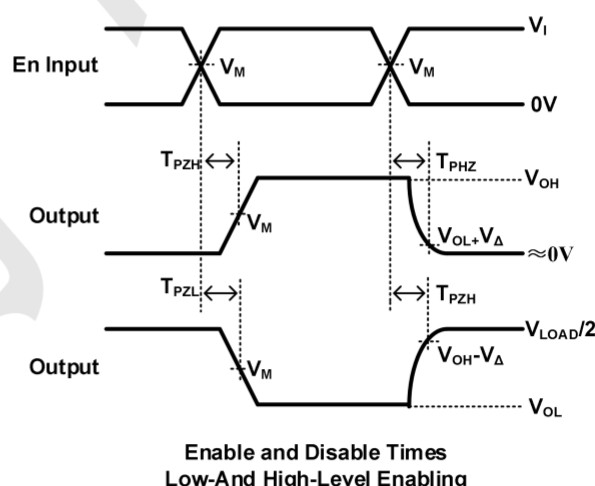
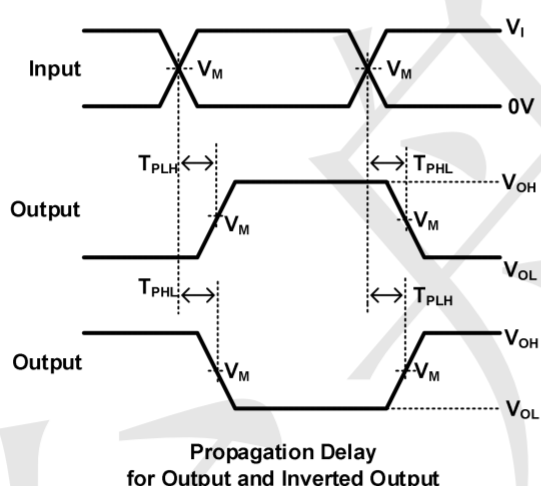
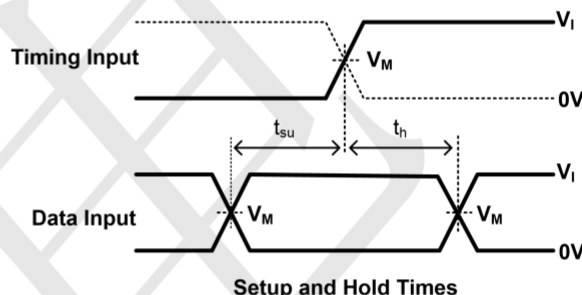
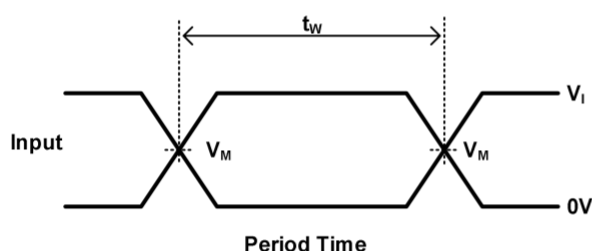
D. The outputs are measured one at a time, with one transition per measurement.  
E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$  .  
F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$  .  
G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$  .  
H. All parameters and waveforms are not applicable to all device.

**Parameter Measurement Information(continued)**



| Test              | S1         |
|-------------------|------------|
| $T_{PHL}/T_{PLH}$ | OPEN       |
| $T_{PLZ}/T_{PZL}$ | $V_{LOAD}$ |
| $T_{PHZ}/T_{PZH}$ | GND        |

| $V_{CC}$         | Inputs   |              | $V_M$      | $V_{LOAD}$        | $C_L$ | $R_L$        | $V_{\Delta}$ |
|------------------|----------|--------------|------------|-------------------|-------|--------------|--------------|
|                  | $V_I$    | $T_r/T_f$    |            |                   |       |              |              |
| $1.8V \pm 0.15V$ | $V_{CC}$ | $\leq 2ns$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 30pF  | 1k $\Omega$  | 0.15V        |
| $2.5V \pm 0.15V$ | $V_{CC}$ | $\leq 2ns$   | $V_{CC}/2$ | $2 \times V_{CC}$ | 30pF  | 500 $\Omega$ | 0.15V        |
| $3.3V \pm 0.15V$ | 3V       | $\leq 2.5ns$ | 1.5V       | 6V                | 50pF  | 500 $\Omega$ | 0.3V         |
| $5V \pm 0.15V$   | $V_{CC}$ | $\leq 2.5ns$ | $V_{CC}/2$ | $2 \times V_{CC}$ | 50pF  | 500 $\Omega$ | 0.3V         |



Notes: A. C includes probe and jig capacitance.

B. Waveform 1 is for an output with internal conditions such that the output is low, except when disabled by the output control. Waveform 2 is for an output with internal conditions such that the output is high, except when disabled by the output control.

C. All input pulses are supplied by generators having the following characteristics: PRR 10 MHz, Z = 50 .

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E.  $t_{PLZ}$  and  $t_{PHZ}$  are the same as  $t_{dis}$  .

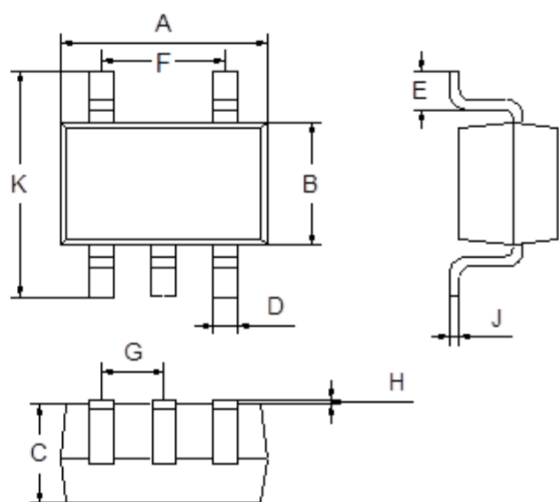
F.  $t_{PZL}$  and  $t_{PZH}$  are the same as  $t_{en}$  .

G.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{pd}$  .

H. All parameters and waveforms are not applicable to all device.

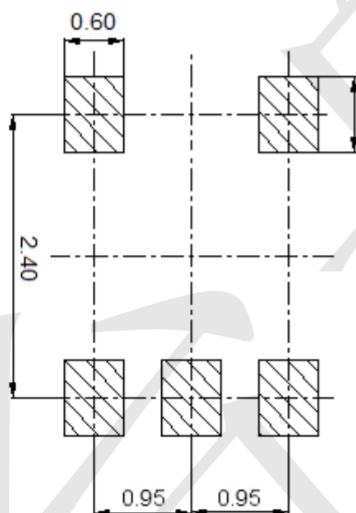
**Package Outline Dimensions** (Unit: mm)

SOT23-5



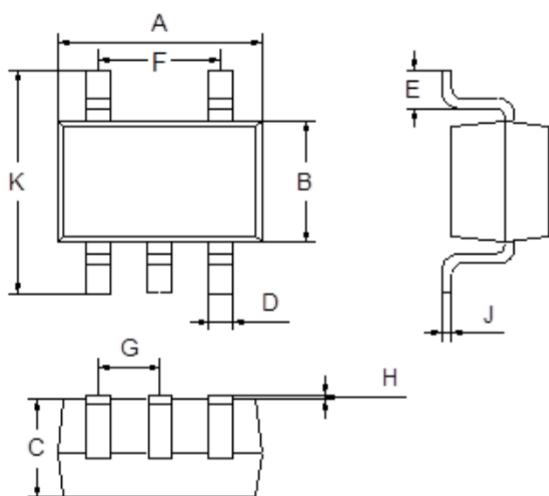
| Dimension | Min. | Max. |
|-----------|------|------|
| A         | 2.80 | 3.00 |
| B         | 1.50 | 1.70 |
| C         | 1.00 | 1.20 |
| D         | 0.35 | 0.45 |
| E         | 0.35 | 0.55 |
| F         | 1.80 | 2.00 |
| G         | 0.90 | 1.00 |
| H         | 0.02 | 0.10 |
| J         | 0.10 | 0.20 |
| K         | 2.60 | 3.00 |

**Mounting Pad Layout** (Unit: mm)



**Package Outline Dimensions** (Unit: mm)

SOT353



| Dimension | Min. | Max. |
|-----------|------|------|
| A         | 2.00 | 2.20 |
| B         | 1.15 | 1.35 |
| C         | 0.85 | 1.05 |
| D         | 0.15 | 0.35 |
| E         | 0.25 | 0.40 |
| F         | 1.20 | 1.40 |
| G         | 0.60 | 0.70 |
| H         | 0.02 | 0.10 |
| J         | 0.05 | 0.15 |
| K         | 2.20 | 2.40 |

**Mounting Pad Layout** (Unit: mm)

