The S-77100/77101 Series is a power sequencer. The S-77100 Series can output enable signals of 4 channels, and controls the external power supply circuit. The S-77100 Series turns on and off the enable signals successively by changing "H" and "L" of the ON pin. The S-77101 Series can output enable signals of 3 channels, and controls the external power supply circuit. The S-77101 Series turns on the enable signals successively by changing the ON pin from "L" to "H", and turns off the enable signals successively by changing OFF pin from "H" to "L". The delay time for each enable signal can be set by the external capacitor. Also, the small 8-Pin TSSOP or SNT-8A package makes high-density mounting possible.

Features

- Easy support for sequencing of multiple power supplies.
- Delay time can be set by the external capacitor.
- Sequence operations of 4 channels can be controlled by 1 input signal. (S-77100 Series)
- On-sequence operation and off-sequence operation can be controlled by the separate input signal. (S-77101 Series)
- Enable output can be increased by cascade connection.
- Low current consumption: 3.0 µA typ. (Off period, power-good period, \( V_{DD} = 3.3 \text{ V} \), \( T_a = +25^\circ\text{C} \))
- Wide range of operation voltage: 2.2 V to 5.5 V
- Operation temperature range: \( T_a = -40^\circ\text{C} \) to +85°C
- Output form is selectable: CMOS output, Nch open-drain output
- Output logic is selectable: Active "H", active "L"
- Lead-free (Sn 100%), halogen-free:

Applications

- Power sequencing for multiple devices
- Sequencing for microprocessor and microcontroller
- Power sequencing for FPGA
- Power sequencing for TV, camera, printer, etc.

Packages

- 8-Pin TSSOP
- SNT-8A
### Block Diagrams

1. **S-77100 Series**

   ![Block Diagram S-77100 Series]

   - ON
   - CDLY
   - VDD
   - VSS
   - Comparator
   - Charge/discharge selection circuit
   - Latch circuit
   - Status control circuit
   - UVLO

   *1. Selectable as the option

   **Figure 1**

2. **S-77101 Series**

   ![Block Diagram S-77101 Series]

   - ON
   - OFF
   - CDLY
   - VDD
   - VSS
   - Comparator
   - Charge/discharge selection circuit
   - Latch circuit
   - Status control circuit
   - UVLO

   *1. Selectable as the option

   **Figure 2**
■ Product Name Structure

Users can select the presence of the OFF pin, order of enable output, and output form, etc. for the S-77100/77101 Series. Refer to “1. Product name” regarding the contents of product name, “2. Product option list” regarding the product type, “3. Packages” regarding the package drawings.

1. Product name

- Environmental code
  U: Lead-free (Sn 100%), halogen-free

- Package abbreviation and IC packing specifications
  *1
  T8T1: 8-Pin TSSOP, Tape
  I8T1: SNT-8A, Tape

- Option code 2
  *2

- Option code 1
  *3
  A: Reverse type
  B: Forward type

- Number of channel
  0: 4 channels (without OFF pin)
  1: 3 channels (with OFF pin)

*1. Refer to the tape drawing.
*2. Code added by the optional function that is user-selected.
   Refer to “2. Product option list” for the kinds of options.
   Please contact our sales office for the option code 2.
*3. Refer to “2. Product option list”.

2. Product option list

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Order of enable output** (Option code 1) | The order that the enable output (ENBL_x pin) inverts during off-sequence period can be selected.  
The S-77100 Series  
A: The ENBL_D pin, the ENBL_C pin, the ENBL_B pin and the ENBL_A pin change to "L" in turn.  
B: The ENBL_A pin, the ENBL_B pin, the ENBL_C pin and the ENBL_D pin change to "L" in turn.  
The S-77101 Series  
A: The ENBL_C pin, the ENBL_B pin and the ENBL_A pin change to "L" in turn.  
B: The ENBL_A pin, the ENBL_B pin and the ENBL_C pin change to "L" in turn.  |
| **Number of times of external capacitor (CDLY) charge and discharge** (Option code 2) | Option for the delay time (tDLY) adjustment.  
The number of times of CDLY charge and discharge can be selected.  
2 times / 4 times / 8 times / 16 times  
This datasheet describes the example when "4 times" is selected.  |
| **Input level** (Option code 2) | Input level of the ON pin and the OFF pin can be selected.  
Schmitt trigger input / Comparator input  |
| **Output form** (Option code 2) | Output form of the ENBL_x pin can be selected.  
CMOS output / Nch open-drain output  |
| **Output logic** (Option code 2) | Output logic of the ENBL_x pin can be selected.  
Active "H": The type which is "H" during power-good period.  
Active "L": The type which is "L" during power-good period.  
This datasheet describes the example when active "H" is selected.  |
3. Packages

Table 2  Package Drawing Codes

<table>
<thead>
<tr>
<th>Package Name</th>
<th>Dimension</th>
<th>Tape</th>
<th>Reel</th>
<th>Land</th>
</tr>
</thead>
<tbody>
<tr>
<td>8-Pin TSSOP</td>
<td>FT008-A-P-SD</td>
<td>FT008-E-C-SD</td>
<td>FT008-E-R-S1</td>
<td>–</td>
</tr>
<tr>
<td>SNT-8A</td>
<td>PH008-A-P-SD</td>
<td>PH008-A-C-SD</td>
<td>PH008-A-R-S1</td>
<td>PH008-A-L-SD</td>
</tr>
</tbody>
</table>

**Pin Configurations**

1. 8-Pin TSSOP

![Top view of 8-Pin TSSOP](image3)

Table 3

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ENBL_A</td>
<td>Enable signal output pin</td>
</tr>
<tr>
<td>2</td>
<td>ENBL_B</td>
<td>Enable signal output pin</td>
</tr>
<tr>
<td>3</td>
<td>CDLY</td>
<td>External capacitor (CDLY) connection pin</td>
</tr>
<tr>
<td>4</td>
<td>VSS</td>
<td>GND pin</td>
</tr>
<tr>
<td>5</td>
<td>ON</td>
<td>Enable trigger input pin</td>
</tr>
<tr>
<td>6</td>
<td>ENBL_D&lt;sup&gt;*&lt;/sup&gt;</td>
<td>Enable signal output pin</td>
</tr>
<tr>
<td>7</td>
<td>ENBL_C</td>
<td>Enable signal output pin</td>
</tr>
<tr>
<td>8</td>
<td>VDD</td>
<td>Positive power supply pin</td>
</tr>
</tbody>
</table>

*<sup>1</sup>. The S-77100 Series only  
*<sup>2</sup>. The S-77101 Series only

2. SNT-8A

![Top view of SNT-8A](image4)

Table 4

<table>
<thead>
<tr>
<th>Pin No.</th>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ENBL_A</td>
<td>Enable signal output pin</td>
</tr>
<tr>
<td>2</td>
<td>ENBL_B</td>
<td>Enable signal output pin</td>
</tr>
<tr>
<td>3</td>
<td>CDLY</td>
<td>External capacitor (CDLY) connection pin</td>
</tr>
<tr>
<td>4</td>
<td>VSS</td>
<td>GND pin</td>
</tr>
<tr>
<td>5</td>
<td>ON</td>
<td>Enable trigger input pin</td>
</tr>
<tr>
<td>6</td>
<td>ENBL_D&lt;sup&gt;*&lt;/sup&gt;</td>
<td>Enable signal output pin</td>
</tr>
<tr>
<td>7</td>
<td>ENBL_C</td>
<td>Enable signal output pin</td>
</tr>
<tr>
<td>8</td>
<td>VDD</td>
<td>Positive power supply pin</td>
</tr>
</tbody>
</table>

*<sup>1</sup>. The S-77100 Series only  
*<sup>2</sup>. The S-77101 Series only
Pin Functions

1. **ON pin**
   This is a trigger input pin to start the sequence operation.
   
   In the S-77100 Series, the on-sequence operation is performed when the rising signal is detected. The off-sequence operation is performed when the falling signal is detected.
   
   In the S-77101 Series, the on-sequence operation is performed when the rising signal is detected.
   
   Refer to "1. Sequence operation" in "Operation" for details.

2. **OFF pin (S-77101 Series only)**
   This is a trigger input pin to start the off-sequence operation. The off-sequence operation is performed when the falling signal is detected. Refer to "1. Sequence operation" in "Operation" for details.

3. **ENBL_A, ENBL_B, ENBL_C, ENBL_D pins (ENBL_D pin is S-77100 Series only)**
   These are pins to output the enable signals to the external power supply circuits.
   
   The ENBL_x pin output form of Nch open-drain output / CMOS output can be selected as the option. Moreover, the ENBL_x pin output logic of active "H" / active "L" can be selected as the option.
   
   Refer to "1. Sequence operation" in "Operation" for the sequence operation, "2. Product option list" in "Product Name Structure" for the options.

4. **CDLY pin**
   This is a pin for connecting the external capacitor (C_{DLY}) in order to generate the delay time (t_{DLY}) of the on-sequence operation and the off-sequence operation. C_{DLY} is charged and discharged by the constant current circuit.
   
   The charge-discharge operation starts when the ON pin rises, the period from the starting to the ENBL_A pin rising is t_{DLY} which is generated by the S-77100/77101 Series.
   
   Refer to "1. Sequence Operation" in "Operation" for the operation timing, "Relation between Delay Time and External Capacitor" for the delay time.

5. **VDD pin**
   Connect this pin with a positive power supply. Refer to "Electrical Characteristics" for the values of voltage to be applied.

6. **VSS pin**
   Connect this pin to GND.
### Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Applicable Pin</th>
<th>Absolute Maximum Rating</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply voltage</td>
<td>VDD</td>
<td></td>
<td>VSS – 0.3 to VSS + 6.5</td>
<td>V</td>
</tr>
<tr>
<td>Input voltage</td>
<td>V&lt;sub&gt;IN&lt;/sub&gt;</td>
<td>ON, OFF (S-77101 Series only)</td>
<td>V&lt;sub&gt;SS&lt;/sub&gt; – 0.3 to V&lt;sub&gt;DD&lt;/sub&gt; + 0.3&lt;sup&gt;1&lt;/sup&gt;</td>
<td>V</td>
</tr>
<tr>
<td>Output voltage</td>
<td>V&lt;sub&gt;OUT&lt;/sub&gt;</td>
<td>ENBL_A, ENBL_B, ENBL_C, ENBL_D (S-77100 Series only)</td>
<td>Nch open-drain output: V&lt;sub&gt;SS&lt;/sub&gt; – 0.3 to V&lt;sub&gt;SS&lt;/sub&gt; + 6.5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CMOS output: V&lt;sub&gt;SS&lt;/sub&gt; – 0.3 to V&lt;sub&gt;DD&lt;/sub&gt; + 0.3&lt;sup&gt;1&lt;/sup&gt;</td>
<td>V</td>
</tr>
<tr>
<td>Operation ambient temperature&lt;sup&gt;2&lt;/sup&gt;</td>
<td>T&lt;sub&gt;opr&lt;/sub&gt;</td>
<td>–</td>
<td>–40 to +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>T&lt;sub&gt;stg&lt;/sub&gt;</td>
<td>–</td>
<td>–55 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

*1. Be sure not to exceed 6.5 V.
*2. Conditions with no condensation or frost. Condensation or frost causes short-circuiting between pins, resulting in a malfunction.

**Caution** The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.
### Electrical Characteristics

(\(Ta = -40°C \) to +85°C, \(V_{DD} = 2.2\) V to 5.5 V, \(V_{SS} = 0\) V unless otherwise specified)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Applied Pin</th>
<th>Condition</th>
<th>Min.</th>
<th>Typ. (^1)</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation power supply voltage</td>
<td>(V_{DD})</td>
<td>VDD</td>
<td>(V_{DD} = 3.3) V, ON pin, (OFF) pin(^2) = (V_{SS}), (ENBL_A) pin = Open</td>
<td>–</td>
<td>2.2</td>
<td>–</td>
<td>5.5</td>
</tr>
<tr>
<td>Current consumption 1 (Off period)</td>
<td>(I_{DD1})</td>
<td>VDD</td>
<td>(V_{DD} = 3.3) V, ON pin, (OFF) pin(^2) = (V_{DD}), (ENBL_A) pin = Open</td>
<td>–</td>
<td>3.0</td>
<td>6.0</td>
<td>(\mu)A</td>
</tr>
<tr>
<td>Current consumption 2 (Power-good period)</td>
<td>(I_{DD2})</td>
<td>VDD</td>
<td>(V_{DD} = 3.3) V, ON pin, (OFF) pin(^2) = (V_{DD}) or (V_{SS}), (ENBL_A) pin = Open</td>
<td>–</td>
<td>–</td>
<td>8.0</td>
<td>(\mu)A</td>
</tr>
<tr>
<td>Current consumption 3 (On-sequence period, off-sequence period)</td>
<td>(I_{DD3})</td>
<td>VDD</td>
<td>(V_{DD} = 3.3) V, ON pin, (OFF) pin(^2) = (V_{DD}) or (V_{SS}), (ENBL_A) pin = Open</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>(\mu)A</td>
</tr>
<tr>
<td>Low voltage detection voltage</td>
<td>(V_{UVLO})</td>
<td>VDD</td>
<td>–</td>
<td>1.85</td>
<td>2.0</td>
<td>2.13</td>
<td>V</td>
</tr>
<tr>
<td>High level input leakage current</td>
<td>(I_{ZH})</td>
<td>ON, (OFF)(^2)</td>
<td>(V_{IN} = V_{DD})</td>
<td>–</td>
<td>0.3</td>
<td>–</td>
<td>0.3</td>
</tr>
<tr>
<td>Low level input leakage current</td>
<td>(I_{ZL})</td>
<td>ON, (OFF)(^2)</td>
<td>(V_{IN} = V_{SS})</td>
<td>–</td>
<td>–</td>
<td>0.3</td>
<td>(\mu)A</td>
</tr>
<tr>
<td>Input voltage (When Schmitt trigger input is selected)</td>
<td>(V_{IL})</td>
<td>ON, (OFF)(^2)</td>
<td>(V_{SS} ) – 0.3</td>
<td>–</td>
<td>0.2 (\times) (V_{DD})</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>(V_{IH})</td>
<td>ON, (OFF)(^2)</td>
<td>–</td>
<td>0.8 (\times) (V_{DD})</td>
<td>–</td>
<td>(V_{DD} + 0.3)</td>
<td>–</td>
</tr>
<tr>
<td>Input threshold voltage (When comparator input is selected)</td>
<td>(V_{IT_ON})</td>
<td>ON, (OFF)(^2)</td>
<td>–</td>
<td>0.3</td>
<td>0.8</td>
<td>1.3</td>
<td>V</td>
</tr>
<tr>
<td>High level output leakage current(^3)</td>
<td>(I_{OH})</td>
<td>(ENBL_A), (ENBL_B), (ENBL_C), (ENBL_D)(^4)</td>
<td>(V_{OUT} = V_{DD})</td>
<td>–</td>
<td>0.3</td>
<td>–</td>
<td>0.3</td>
</tr>
<tr>
<td>Low level output leakage current(^3)</td>
<td>(I_{OL})</td>
<td>(ENBL_A), (ENBL_B), (ENBL_C), (ENBL_D)(^4)</td>
<td>(V_{OUT} = V_{SS})</td>
<td>–</td>
<td>–</td>
<td>0.3</td>
<td>(\mu)A</td>
</tr>
<tr>
<td>Low level output voltage</td>
<td>(V_{OL})</td>
<td>(ENBL_A), (ENBL_B), (ENBL_C), (ENBL_D)(^4)</td>
<td>(I_{OL} = 2.0) mA</td>
<td>–</td>
<td>–</td>
<td>0.4</td>
<td>V</td>
</tr>
<tr>
<td>High level output voltage(^5)</td>
<td>(V_{OH})</td>
<td>(ENBL_A), (ENBL_B), (ENBL_C), (ENBL_D)(^4)</td>
<td>(I_{OH} = -0.4) mA</td>
<td>0.8 (\times) (V_{DD})</td>
<td>–</td>
<td>–</td>
<td>V</td>
</tr>
<tr>
<td>Delay time(^6)</td>
<td>(t_{DLY})</td>
<td>(ENBL_A), (ENBL_B), (ENBL_C), (ENBL_D)(^4)</td>
<td>(Ta = +25°C), (V_{DD} = 3.3) V, The period from (ENBL_A) pin rising to (ENBL_B) pin rising, (C_{DLY} = 10) nF, The number of times of (C_{DLY}) charge and discharge = 4 times</td>
<td>40</td>
<td>45</td>
<td>50</td>
<td>ms</td>
</tr>
</tbody>
</table>

\(^1\) Typ. values are the values at the time of \(Ta = +25°C\).
\(^2\) The S-77101 Series only
\(^3\) When Nch open-drain output is selected as the option.
\(^4\) The S-77100 Series only
\(^5\) When CMOS output is selected as the option.
\(^6\) The delay time varies depending on the usage environment. Perform thorough evaluation using the actual application to set the constant. Refer to “■ Relation between Delay Time and External Capacitors” for details.
Operation

1. Sequence operation
   
   1.1 S-77100A (Reverse type), S-77100B (Forward type)

   The S-77100 Series has enable outputs of 4 channels (the ENBL_A pin, the ENBL_B pin, the ENBL_C pin and the ENBL_D pin). The order of the off-sequence operation is different in reverse type and forward type.

   1.1.1 Sequence operation outline

   (1) On-sequence operation

   After the ON pin changes from "L" to "H", the external capacitor ($C_{DLY}$) charge operation is started, and the discharge operation is performed when $C_{DLY}$ is fully charged. The period during which this is repeated $n$ times is the delay time ($t_{DLY}$), and the ENBL_A pin changes to "H". Similarly, each time $t_{DLY}$ elapses, the ENBL_B pin, the ENBL_C pin and the ENBL_D pin change to "H" in turn. The period from when the ON pin changes from "L" to "H" to when the ENBL_D pin changes to "H" is called "on-sequence period".

   (2) Off-sequence operation

   After the ON pin changes from "H" to "L", $C_{DLY}$ charge operation is started, and the discharge operation is performed when $C_{DLY}$ is fully charged. The period during which this is repeated $n$ times is $t_{DLY}$, and the ENBL_D pin, the ENBL_C pin, the ENBL_B pin and the ENBL_A pin change to "L" in turn in S-77100A. The ENBL_A pin, the ENBL_B pin, the ENBL_C pin and the ENBL_D pin change to "L" in turn in S-77100B. The period from when the ON pin changes from "H" to "L" to when the ENBL_A pin in S-77100A or the ENBL_D pin in S-77100B changes to "L" is called "off-sequence period".

   Do not change the ON pin during on-sequence period and off-sequence period in order to perform the sequence operation normally.

   The number of times of $C_{DLY}$ charge and discharge which determines $t_{DLY}$ can be selected from 2 times / 4 times / 8 times / 16 times as the option.

   $C_{DLY}$ charge operation and discharge operation to generate $t_{DLY}$ are performed by the constant current circuit. Refer to "Relation between Delay Time and External Capacitor" for the relation of $C_{DLY}$ and $t_{DLY}$.

   In addition, the period from when the ENBL_A pin, the ENBL_B pin, the ENBL_C pin and the ENBL_D pin all change to "H" to when the off-sequence operation starts is called "power-good period", and the period from when the ENBL_A pin, the ENBL_B pin, the ENBL_C pin and the ENBL_D pin all change to "L" to when the on-sequence operation starts is called "off period".

   Refer to Figure 5 for the peripheral circuit connection example. Timing charts are shown in Figure 6 and Figure 7 for S-77100A and S-77100B, respectively.

   Caution 1. The input should be performed after the power supply voltage applied to the S-77100 Series becomes stable condition.

   2. The above connection diagram does not guarantee successful operation. Perform thorough evaluation using the actual application to set the constant.

   Remark The ENBL_x pin is CMOS output.

   Figure 5 Peripheral Circuit Connection Example (S-77100A: Reverse type, S-77100B: Forward type)
1.1 V : CORE
1.5 V : MEMORY
1.8 V : LOGIC
2.5 V : I/O

ON CDLY

ENBL_A
ENBL_B
ENBL_C
ENBL_D

Off period Off period On-sequence period Off-sequence period Power-good period

*1. Selectable as the option: 2 times / 4 times / 8 times / 16 times

Figure 6  Timing Chart (S-77100A: Reverse Type)

2.5 V : I/O

1.8 V : LOGIC

1.5 V : MEMORY

1.1 V : CORE

*1. Selectable as the option: 2 times / 4 times / 8 times / 16 times

Figure 7  Timing Chart (S-77100B: Forward type)
1.2 S-77101A (Reverse type, with OFF pin), S-77101B (Forward type, with OFF pin)

The S-77101 Series has enable outputs of 3 channels (the ENBL_A pin, the ENBL_B pin and the ENBL_C pin) and the OFF pin. The order of the off-sequence operation is different in reverse type and forward type.

1.2.1 Sequence operation outline

(1) On-sequence operation

After the ON pin changes from "L" to "H", the external capacitor (C\text{DLY}) charge operation is started, and the discharge operation is performed when C\text{DLY} is fully charged. The period during which this is repeated n times is the delay time (t\text{DLY}), and the ENBL_A pin changes to "H". Similarly, each time t\text{DLY} elapses, the ENBL_B pin and the ENBL_C pin change to "H" in turn. The period from when the ON pin changes from "L" to "H" to when the ENBL_C pin changes to "H" is called "on-sequence period".

(2) Off-sequence operation

After the OFF pin changes from "H" to "L", C\text{DLY} charge operation is started, and the discharge operation is performed when C\text{DLY} is fully charged. The period during which this is repeated n times is t\text{DLY}, and the ENBL_C pin, the ENBL_B pin and the ENBL_A pin change to "L" in turn in S-77101A. The ENBL_A pin, the ENBL_B pin and the ENBL_C pin change to "L" in turn in S-77101B. The period from when the OFF pin changes from "H" to "L" to when the ENBL_A pin in S-77101A or the ENBL_C pin in S-77101B changes to "L" is called "off-sequence period".

Do not change the ON pin and the OFF pin during on-sequence period and off-sequence period in order to perform the sequence operation normally.

The number of times of C\text{DLY} charge and discharge which determines t\text{DLY} can be selected from 2 times / 4 times / 8 times / 16 times as the option. C\text{DLY} charge operation and the discharge operation to generate the t\text{DLY} are performed by the constant current circuit. Refer to "Relation between Delay Time and External Capacitor" for the relation of C\text{DLY} and t\text{DLY}.

In addition, the period from when the ENBL_A pin, the ENBL_B pin and the ENBL_C pin all change to "H" to when the off-sequence operation starts is called "power-good period", and the period from when the ENBL_A pin, the ENBL_B pin and the ENBL_C pin all change to "L" to when the on-sequence operation starts is called "off period". The sequence operation is not affected even if the ON pin changes from "H" to "L" during power-good period or the OFF pin changes from "L" to "H" during off period.

Refer to Figure 8 for the peripheral circuit connection example.

Timing charts are shown in Figure 9 and Figure 10 for S-77101A and S-77101B, respectively.

---

**Figure 8** Peripheral Circuit Connection Example

(S-77101A: Reverse Type, with OFF pin, S-77101B: Forward Type, with OFF pin)

**Caution**

1. The input should be performed after the power supply voltage applied to the S-77101 Series becomes stable condition.
2. The above connection diagram does not guarantee successful operation. Perform thorough evaluation using the actual application to set the constant.

---

**Remark** The ENBL_x pin is CMOS output.
Figure 9  Timing Chart (S-77101A: Reverse Type, with OFF pin)

*1. Selectable as the option: 2 times / 4 times / 8 times / 16 times

Figure 10  Timing Chart (S-77101B: Forward Type, with OFF pin)

*1. Selectable as the option: 2 times / 4 times / 8 times / 16 times
2. Cascade connection

2.1 S-77100B (Forward type)

The enable output can be increased by connecting S-77100B in cascade. The peripheral circuit connection example how two S-77100B devices are connected in cascade is shown in Figure 11.

Connect the ENBL_D pin of S-77100B(1) and the ON pin of S-77100B(2).

Figure 12 shows the timing chart.

Remark The ENBL_x pin is CMOS output.

Figure 11 Peripheral Circuit Connection Example (S-77100B: Forward Type)

Caution 1. The input should be performed after the power supply voltage applied to S-77100B becomes stable condition.
2. The above connection diagram does not guarantee successful operation. Perform thorough evaluation using the actual application to set the constant.
3. The external capacitors (C_DLY) connected to the CDLY pin of S-77100B(1) and S-77100B(2) cannot use the same capacitor.
After the ON pin of S-77100B(1) changes from "L" to "H", the ENBL_A pin, the ENBL_B pin, the ENBL_C pin and the ENBL_D pin of S-77100B(1) change to "H" in turn.

After the ENBL_D pin of S-77100B(1) changes from "L" to "H", the ENBL_A pin, the ENBL_B pin, the ENBL_C pin and the ENBL_D pin of S-77100B(2) change to "H" in turn.

After the ON pin of S-77100B(1) changes from "H" to "L", the ENBL_A pin, the ENBL_B pin the ENBL_C pin and the ENBL_D pin of S-77100B(1) change to "L" in turn.

After the ENBL_D pin of S-77100B(1) changes from "H" to "L", the ENBL_A pin, the ENBL_B pin, the ENBL_C pin and the ENBL_D pin of S-77100B(2) change to "L" in turn.

Do not change the ON pin during on-sequence period and off-sequence period in order to perform the sequence operation normally.
2.2 S-77101A (Reverse type, with OFF pin)

The enable output can be increased by connecting S-77101A in cascade. The peripheral circuit connection example how two S-77101A devices are connected in cascade is shown in Figure 13. Connect the ENBL_C pin of S-77101A(1) and the ON pin of S-77101A(2), and the OFF pin of S-77101A(1) and the ENBL_A pin of S-77101A(2). Figure 14 shows the timing chart.

Remark The ENBL_x pin is CMOS output.

Caution 1. The input should be performed after the power supply voltage applied to S-77101A becomes stable condition.
2. The above connection diagram does not guarantee successful operation. Perform thorough evaluation using the actual application to set the constant.
3. The external capacitors (C_{DLX}) connected to the CDLY pin of S-77101A(1) and S-77101A(2) cannot use the same capacitor.
Figure 14  Timing Chart at Cascade Connection (S-77101A: Reverse Type, with OFF pin)

After the ON pin of S-77101A(1) changes from "L" to "H", the ENBL_A pin, the ENBL_B pin and the ENBL_C pin of S-77101A(1) change to "H" in turn.

After the ENBL_C pin of S-77101A(1) changes from "L" to "H", the ENBL_A pin, the ENBL_B pin and the ENBL_C pin of S-77101A(2) change to "H" in turn.

After the OFF pin of S-77101A(2) changes from "H" to "L", the ENBL_C pin, the ENBL_B pin and the ENBL_A pin of S-77101A(2) change to "L" in turn.

After the ENBL_A pin of S-77101A(2) changes from "H" to "L", the ENBL_C pin, the ENBL_B pin and the ENBL_A pin of S-77101A(1) change to "L" in turn.

Do not change the ON pin and the OFF pin during on-sequence period and off-sequence period in order to perform the sequence operation normally.
As shown in Figure 14, after the ON pin of S-77101A(1) changes from "L" to "H", the on-sequence operation is performed if the OFF pin of S-77101A(2) is either "H" or "L". Similarly, after the OFF pin of S-77101A(2) changes from "H" to "L", the off-sequence operation is performed if the ON pin of S-77101A(1) is either "H" or "L". Therefore, due to connecting the control signal pin of the sequence controller, the ON pin of S-77101A(1) and the OFF pin of S-77101A(2), it is possible to control S-77101A(1) and S-77101A(2) with 1 signal. Figure 15 shows the connection example.

Remark  The ENBL_x pin is CMOS output.

Figure 15  Cascade Connection Example (S-77101A: Reverse Type, with OFF pin)
3. Special Operation

3.1 S-77100 Series special operation

The operation when the sequence operation is not completed normally, the power supply voltage drops significantly or connecting the VDD pin and the ON pin is a special operation.

3.1.1 Special operations during on-sequence period and off-sequence period

Do not change the ON pin during on-sequence period and off-sequence period in order to perform the sequence operation normally.

(1) When ON pin changes from "H" to "L" during on-sequence period

Since the ENBL_x pins all change to "L", the off-sequence operation timing is not guaranteed. In addition, C_{DLY} charge operation is stopped, and the automatic discharge operation is started. The operation example is shown in Figure 16.

(2) When ON pin changes from "L" to "H" during off-sequence period

Since the ENBL_x pins all change to "L", the off-sequence operation timing is not guaranteed. In addition, C_{DLY} charge operation is stopped and the automatic discharge operation is started. In order to perform the on-sequence operation again, change the ON pin to "H" after setting the pin "L" once. The operation example is shown in Figure 17.

Remark Refer to "3. Automatic discharge time (t_{DCHG}) approximate calculation formula" in "■ Relation between Delay Time and External Capacitor" for the automatic discharge operation.
3. 1. 2 Operation when low voltage is detected

(1) When low voltage is detected during power-good period

Since the ENBL_x pins all change to "L" when the power supply voltage (V_{DD}) is equal to or lower than the low voltage detection voltage (V_{UVLO}), the off-sequence operation timing is not guaranteed. Thereafter, if the ON pin is "H" when V_{DD} exceeds V_{UVLO}, the on-sequence operation is performed automatically. If the ON pin is "L" when V_{DD} exceeds V_{UVLO}, the on-sequence operation is not performed. In order to perform the on-sequence operation, set the ON pin to "H" again. The operation example is shown in Figure 18.

![Figure 18](image18)

(2) When low voltage is detected during on-sequence period and off-sequence period

Since the ENBL_x pins all change to "L" when V_{DD} is equal to or lower than V_{UVLO} during on-sequence period or off-sequence period, the off-sequence operation timing is not guaranteed. In addition, C_{DLY} charge operation is stopped and the automatic discharge operation is started. The operation example is shown in Figure 19.

![Figure 19](image19)

Remark Refer to "3. Automatic discharge time (t_{DCHG}) approximate calculation formula" in "Relation between Delay Time and External Capacitor" for the automatic discharge operation.
3.1.3 Operation when connecting VDD pin and ON pin

The on-sequence operation is performed automatically when connecting the VDD pin and the ON pin and the power supply is raised. However, since the ENBL_x pins all change to "L" if VDD is equal to or lower than VUVLO when the power supply is fallen, the off-sequence operation timing is not guaranteed. The operation example is shown in Figure 20.

![Figure 20](image-url)
3.2 S-77101 Series special operation

The operation when the sequence operation is not completed normally, the power supply voltage drops significantly or connecting the VDD pin, the ON pin and the OFF pin is a special operation.

3.2.1 Special operations during on-sequence period and off-sequence period

Do not change the ON pin and the OFF pin during on-sequence period and off-sequence period in order to perform the sequence operation normally.

(1) When ON pin or OFF pin changes from "H" to "L" during on-sequence period

Since the ENBL_x pins all change to "L" when the ON pin changes from "H" to "L" during on-sequence period, the off-sequence operation timing is not guaranteed. In addition, CDLY charge operation is stopped and the automatic discharge operation is started. When the OFF pin changes from "H" to "L" during on-sequence period, the off-sequence operation is performed after the on-sequence operation is completed. The operation example is shown in Figure 21.

(2) When OFF pin or ON pin changes from "L" to "H" during off-sequence period

Since the ENBL_x pins all change to "L" when the OFF pin changes from "L" to "H" during off-sequence period, the off-sequence operation timing is not guaranteed. In addition, CDLY charge operation is stopped and the automatic discharge operation is started. When the ON pin changes from "L" to "H" during off-sequence period, the on-sequence operation is performed after the off-sequence operation is completed. The operation example is shown in Figure 22.

Remark Refer to "3. Automatic discharge time (tDCHG) approximate calculation formula" in "Relation between Delay Time and External Capacitor" for the automatic discharge operation.
3. 2. 2 Operation when low voltage is detected

(1) When low voltage is detected during power-good period

Since the ENBL_x pins all change to "L" when the power supply voltage (VDD) is equal to or lower than the low voltage detection voltage (VUVLO), the off-sequence operation timing is not guaranteed. Thereafter, if the ON pin is "H" when VDD exceeds VUVLO, the on-sequence operation is performed automatically. If the ON pin is "L" when VDD exceeds VUVLO, the on-sequence operation is not performed. In order to perform the on-sequence operation, set the ON pin to "H" again. The operation example is shown in Figure 23.

![Figure 23](image)

(2) When low voltage is detected during on-sequence period and off-sequence period

Since the ENBL_x pins all change to "L" when VDD is equal to or lower than VUVLO during on-sequence period or off-sequence period, the off-sequence operation timing is not guaranteed. In addition, CDLY charge operation is stopped and the automatic discharge operation is started. The operation example is shown in Figure 24.

![Figure 24](image)

Remark: Refer to “3. Automatic discharge time (tDCHG) approximate calculation formula” in “■ Relation between Delay Time and External Capacitor” for the automatic discharge operation.
3. 2. 3 Operation when connecting VDD pin, ON pin and OFF pin

The on-sequence operation is performed automatically when connecting the VDD pin, the ON pin and the OFF pin and the power supply is raised. However, since the ENBL_x pins all change to "L" if VDD is equal to or lower than \( V_{UVLO} \) when the power supply is fallen, the off-sequence operation timing is not guaranteed. The operation example is shown in Figure 25.

![Figure 25](image-url)
■ Input of ON Pin and OFF Pin

1. Input level (Selectable as the option)

   The input level of the ON pin in the S-77100 Series, the ON pin and the OFF pin in the S-77101 Series can be selected from the following 2 options.

1.1 Schmitt trigger input

   Schmitt trigger input has the power supply voltage dependency in the input voltage level. Refer to "Electrical Characteristics" for the input voltage.

1.2 Comparator input

   The input threshold voltage of the comparator input has almost no power supply voltage dependency. For this reason, the sequence operation control by I/O interface of the low voltage microcomputer is also available. Refer to "Electrical Characteristics" for the input threshold voltage of the comparator input.

2. Pulse width

   In order to surely input the signal to the S-77100/77101 Series, the pulse width to the ON pin and the OFF pin should be 5 μs or longer.

   ![Figure 26](image-url)
## Relation between Delay Time and External Capacitor

The S-77100/77101 Series sets the delay time (\(t_{DLY}\)) with an external capacitor (\(C_{DLY}\)). \(t_{DLY}\) is generated by performing \(C_{DLY}\) charge-discharge operation.

### 1. \(t_{DLY}\) approximate calculation formula

\(t_{DLY}\) is calculated by using the following approximate calculation formula.

\[
\text{When } C_{DLY} \leq 1 \text{ nF} \quad t_{DLY} [\text{ms}] = (1.206 \times C_{DLY} [\text{nF}] + 0.023) \times \text{the number of times of charge and discharge}
\]
\[
\text{When } C_{DLY} > 1 \text{ nF} \quad t_{DLY} [\text{ms}] = (1.155 \times C_{DLY} [\text{nF}] - 0.023) \times \text{the number of times of charge and discharge}
\]

### 2. Offset delay time (\(t_{DLY\_OFFSET}\)) approximate calculation formula

As shown in Figure 27, the CDLY pin during off period or power-good period is discharged to the VSS level. For this reason, there is an offset delay time (\(t_{DLY\_OFFSET}\)) immediately after the transition from off period to on-sequence period or from power-good period to off-sequence period. \(t_{DLY\_OFFSET}\) varies depending on the capacitance of \(C_{DLY}\). \(t_{DLY\_OFFSET}\) is calculated by using the following approximate calculation formula.

\[
\text{When } C_{DLY} \leq 1 \text{ nF} \quad t_{DLY\_OFFSET} [\text{ms}] = 0.241 \times C_{DLY} [\text{nF}] - 0.024
\]
\[
\text{When } C_{DLY} > 1 \text{ nF} \quad t_{DLY\_OFFSET} [\text{ms}] = 0.299 \times C_{DLY} [\text{nF}] - 0.150
\]
3. Automatic discharge time \((t_{\text{DCHG}})\) approximate calculation formula

Automatic discharge operation is the operation that electrical charge remained in \(C_{\text{DLY}}\) is discharged. After the charge-discharge operation is completed, the automatic discharge operation is performed by the constant current circuit.

\[
t_{\text{DCHG}}[\text{ms}] = 0.219 \times C_{\text{DLY}}[\text{nF}]
\]

The automatic discharge operation of the S-77100/77101 Series is performed in the following cases.

- When the ON pin changes during on-sequence period. (Refer to Figure 28.)
- When on-sequence period is completed.
- When the ON pin changes during off-sequence period. (The S-77100 Series only)
- When the OFF pin changes during off-sequence period. (The S-77101 Series only)
- When off-sequence period is completed.
- When \(V_{\text{DD}}\) is equal to or lower than \(V_{\text{UVLO}}\) during on-sequence period or off-sequence period.

\(t_{\text{DCHG}}\) varies depending on the capacitance of \(C_{\text{DLY}}\) and is calculated by using the following approximate calculation formula.

Caution 1. The capacitor of 100 pF to 47 nF can be used as \(C_{\text{DLY}}\). \(C_{\text{DLY}}\) should be placed as close to the S-77100/77101 Series as possible since the CDLY pin internal impedance is high and the pin is easily affected by external noise etc.

2. \(t_{\text{DLY}}, t_{\text{DLY,OFFSET}}\) and \(t_{\text{DCHG}}\) may not match the calculation formula due to parasitic capacitance of the CDLY pin or internal delay in the IC. Perform thorough evaluation to determine the capacitance of \(C_{\text{DLY}}\).

Remark All of the above are approximate calculation formulas at \(T_a = +25^\circ\text{C}\).
Power-on

When the power supply is raised, the S-77100/77101 Series performs initialization due to the power-on reset circuit. If initialization is not performed normally, a malfunction may occur. In order to operate the power-on reset circuit normally, raise the power supply with the following method.

1. Power supply raising method

As shown in Figure 29, start to raise the power supply from 0.2 V or lower. Moreover, the time the voltage reaches to the operation power supply voltage min. should be within 10 ms.

*1. 0 V indicates that there is no potential difference between the VDD pin and the VSS pin of the S-77100/77101 Series.

*2. Initialization time ($t_{INIT}$) indicates the time that the S-77100/77101 Series performs the initialization internally. During this duration, the S-77100/77101 Series does not accept the input. Refer to "2. Initialization time" for the details.

Figure 29

If initialization is completed normally due to the power-on reset circuit, the S-77100/77101 Series becomes off period when the ON pin is "L", and on-sequence period when the ON pin is "H". When the operation conditions of the power-on reset circuit are not satisfied, a malfunction may occur since the S-77100/77101 Series cannot perform initialization. When the operation is unstable, raise the power supply voltage again so as to satisfy the condition of Figure 29 after lowering the power supply voltage to the $V_{SS}$ level.
2. Initialization time

When the power supply is raised, the S-77100/77101 Series performs initialization. During initialization period, the S-77100/77101 Series does not accept the inputs to the ON pin and the OFF pin. The relation between the initialization time and the power supply rising (0 V → 2.2 V) time (t\text{RISE}) is shown in Figure 30.
UVLO (under voltage lock out) Operation

The power supply voltage range and the output pin status are shown in Figure 31.

In the S-77100/77101 Series, the output pin status is not guaranteed when the power supply voltage (V_{DD}) is equal to or lower than 1.3 V typ. The output pin status is fixed when V_{DD} rises and exceeds 1.3 V typ. The sequence operation is invalid when V_{DD} is equal to or lower than V_{UVLO}. V_{DD} is operation voltage when it exceeds V_{UVLO}, however, the operation guaranteed voltage as the power sequencer is 2.2 V to 5.5 V.
Precautions

- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.

- ABLIC Inc. claims no responsibility for any disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.
Characteristics (Typical Data)

1. Current consumption 1, current consumption 2, current consumption 3
   1.1 Current consumption vs. Power supply voltage
       S-77100 Series
       ON pin = Vss or Vdd, ENBL_x pin = Open
       Schmitt trigger input, Ta = +25°C

2. Low voltage detection voltage
   2.1 Low voltage detection voltage vs. Temperature

3. High level input leakage current, low level input leakage current
   3.1 Input leakage current vs. Power supply voltage
       ON pin, OFF pin
       V_IN = VDD (IZH), V_IN = VSS (IzL)
       Ta = +25°C

*1. The S-77101 Series only
4. Input voltage (When Schmitt trigger input is selected)

4.1 Input voltage vs. Power supply voltage

4.2 Input voltage vs. Temperature

5. Input threshold voltage (When comparator input is selected)

5.1 Input threshold voltage vs. Power supply voltage

5.2 Input threshold voltage vs. Temperature

6. High level output leakage current, low level output leakage current

6.1 Output leakage current vs. Power supply voltage

6.2 Output leakage current vs. Temperature

*1. The S-77101 Series only
*2. The S-77100 Series only
7. **Low level output voltage**
   7.1 **Low level output voltage vs. Low level output current**
   
   ![Graph showing low level output voltage vs. low level output current](image)

   
   **Chart**

   **Parameters:**
   - ENBL_A pin, ENBL_B pin, ENBL_C pin, ENBL_D pin
   - Ta = +25°C
   - VDD = 2.2 V
   - VDD = 3.3 V
   - VDD = 5.5 V
   - IOL = 2.0 mA

   **Legend:**
   - VDD = 2.2 V
   - VDD = 3.3 V
   - VDD = 5.5 V

   7.2 **Low level output voltage vs. Temperature**

   ![Graph showing low level output voltage vs. temperature](image)

   **Chart**

   **Parameters:**
   - ENBL_A pin, ENBL_B pin, ENBL_C pin, ENBL_D pin
   - Ta = +25°C

   **Legend:**
   - VDD = 2.2 V
   - VDD = 3.3 V
   - VDD = 5.5 V

8. **High level output voltage**
   8.1 **High level output voltage vs. High level output current**

   ![Graph showing high level output voltage vs. high level output current](image)

   **Chart**

   **Parameters:**
   - ENBL_A pin, ENBL_B pin, ENBL_C pin, ENBL_D pin
   - CMOS output, Ta = +25°C
   - VDD = 2.2 V
   - VDD = 3.3 V
   - VDD = 5.5 V

   **Legend:**
   - VDD = 2.2 V
   - VDD = 3.3 V
   - VDD = 5.5 V

   8.2 **High level output voltage vs. Temperature**

   ![Graph showing high level output voltage vs. temperature](image)

   **Chart**

   **Parameters:**
   - ENBL_A pin, ENBL_B pin, ENBL_C pin, ENBL_D pin
   - CMOS output, IOH = -0.4 mA

   **Legend:**
   - VDD = 2.2 V
   - VDD = 3.3 V
   - VDD = 5.5 V

9. **Delay time**
   9.1 **Delay time vs. Power supply voltage**

   ![Graph showing delay time vs. power supply voltage](image)

   **Chart**

   **Parameters:**
   - The number of times of C_DLY charge and discharge = 4 times,
   - C_DLY = 10 nF, Ta = +25°C

   **Legend:**
   - VDD = 2.2 V
   - VDD = 3.3 V
   - VDD = 5.5 V

   9.2 **Delay time vs. C_DLY**

   ![Graph showing delay time vs. C_DLY](image)

   **Chart**

   **Parameters:**
   - The number of times of C_DLY charge and discharge = 4 times,
   - VDD = 3.3 V, Ta = +25°C

   **Legend:**
   - C_DLY = 10 nF
   - C_DLY = 50 nF
   - C_DLY = 100 nF
   - C_DLY = 150 nF
   - C_DLY = 200 nF
   - C_DLY = 250 nF

*1. The S-77100 Series only
No. FT008-E-C-SD-1.0

<table>
<thead>
<tr>
<th>TITLE</th>
<th>TSSOP8-E-Carrier Tape</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>FT008-E-C-SD-1.0</td>
</tr>
<tr>
<td>ANGLE</td>
<td></td>
</tr>
<tr>
<td>UNIT</td>
<td>mm</td>
</tr>
</tbody>
</table>

ABLIC Inc.
No. PH008-A-P-SD-2.1

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SNT-8A-A-PKG Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>PH008-A-P-SD-2.1</td>
</tr>
<tr>
<td>ANGLE</td>
<td></td>
</tr>
<tr>
<td>UNIT</td>
<td>mm</td>
</tr>
</tbody>
</table>

ABLIC Inc.
Enlarged drawing in the central part

No. PH008-A-R-SD-1.0

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SNT-8A-A-Reel</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>PH008-A-R-SD-1.0</td>
</tr>
<tr>
<td>ANGLE</td>
<td>QTY.</td>
</tr>
<tr>
<td>UNIT</td>
<td>mm</td>
</tr>
</tbody>
</table>

ABLIC Inc.
※1. ランドパターンの幅に注意してください (0.25 mm min. / 0.30 mm typ.)。
※2. パッケージ中央にランドパターンを広げないでください (1.96 mm 〜 2.06 mm)。

注意
1. パッケージのモールド樹脂下にシルク印刷やハンダ印刷などしないでください。
2. パッケージ下の配線上のソルダーレジストなどの厚みをランドパターン表面から0.03 mm 以下にしてください。
3. マスク開口サイズと開口位置はランドパターンと合わせてください。
4. 詳細は“SNTパッケージ活用の手引き”を参照してください。

※1. Pay attention to the land pattern width (0.25 mm min. / 0.30 mm typ.).
※2. Do not widen the land pattern to the center of the package (1.96 mm to 2.06 mm).

Caution
1. Do not do silkscreen printing and solder printing under the mold resin of the package.
2. The thickness of the solder resist on the wire pattern under the package should be 0.03 mm or less from the land pattern surface.
3. Match the mask aperture size and aperture position with the land pattern.

※1. 请注意焊盘模式的宽度 (0.25 mm min. / 0.30 mm typ.)。
※2. 请勿向封装中间扩展焊盘模式 (1.96 mm 〜 2.06 mm)

注意
1. 请勿在端座型封装的下面印刷丝网、焊锡。
2. 在封装下、布线上的阻焊膜厚度 (从焊盘模式表面起) 请控制在 0.03 mm 以下。
3. 钢网的开口尺寸和开口位置请与焊盘模式对齐。
4. 详细内容请参阅 “SNT 封装的应用指南”。

<table>
<thead>
<tr>
<th>TITLE</th>
<th>SNT-8A-A -Land Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>PH008-A-L-SD-4.1</td>
</tr>
<tr>
<td>ANGLE</td>
<td>PH008-A-L-SD-4.1</td>
</tr>
<tr>
<td>UNIT</td>
<td>mm</td>
</tr>
</tbody>
</table>

ABLIC Inc.
Disclaimers (Handling Precautions)

1. All the information described herein (product data, specifications, figures, tables, programs, algorithms and application circuit examples, etc.) is current as of publishing date of this document and is subject to change without notice.

2. The circuit examples and the usages described herein are for reference only, and do not guarantee the success of any specific mass-production design. ABLIC Inc. is not liable for any losses, damages, claims or demands caused by the reasons other than the products described herein (hereinafter “the products”) or infringement of third-party intellectual property right and any other right due to the use of the information described herein.

3. ABLIC Inc. is not liable for any losses, damages, claims or demands caused by the incorrect information described herein.

4. Be careful to use the products within their ranges described herein. Pay special attention for use to the absolute maximum ratings, operation voltage range and electrical characteristics, etc. ABLIC Inc. is not liable for any losses, damages, claims or demands caused by failures and / or accidents, etc. due to the use of the products outside their specified ranges.

5. Before using the products, confirm their applications, and the laws and regulations of the region or country where they are used and verify suitability, safety and other factors for the intended use.

6. When exporting the products, comply with the Foreign Exchange and Foreign Trade Act and all other export-related laws, and follow the required procedures.

7. The products are strictly prohibited from using, providing or exporting for the purposes of the development of weapons of mass destruction or military use. ABLIC Inc. is not liable for any losses, damages, claims or demands caused by any provision or export to the person or entity who intends to develop, manufacture, use or store nuclear, biological or chemical weapons or missiles, or use any other military purposes.

8. The products are not designed to be used as part of any device or equipment that may affect the human body, human life, or assets (such as medical equipment, disaster prevention systems, security systems, combustion control systems, infrastructure control systems, vehicle equipment, traffic systems, in-vehicle equipment, aviation equipment, aerospace equipment, and nuclear-related equipment), excluding when specified for in-vehicle use or other uses by ABLIC Inc. Do not apply the products to the above listed devices and equipments. ABLIC Inc. is not liable for any losses, damages, claims or demands caused by unauthorized or unspecified use of the products.

9. In general, semiconductor products may fail or malfunction with some probability. The user of the products should therefore take responsibility to give thorough consideration to safety design including redundancy, fire spread prevention measures, and malfunction prevention to prevent accidents causing injury or death, fires and social damage, etc. that may ensue from the products’ failure or malfunction. The entire system in which the products are used must be sufficiently evaluated and judged whether the products are allowed to apply for the system on customer's own responsibility.

10. The products are not designed to be radiation-proof. The necessary radiation measures should be taken in the product design by the customer depending on the intended use.

11. The products do not affect human health under normal use. However, they contain chemical substances and heavy metals and should therefore not be put in the mouth. The fracture surfaces of wafers and chips may be sharp. Be careful when handling these with the bare hands to prevent injuries, etc.

12. When disposing of the products, comply with the laws and ordinances of the country or region where they are used.

13. The information described herein contains copyright information and know-how of ABLIC Inc. The information described herein does not convey any license under any intellectual property rights or any other rights belonging to ABLIC Inc. or a third party. Reproduction or copying of the information from this document or any part of this document described herein for the purpose of disclosing it to a third-party is strictly prohibited without the express permission of ABLIC Inc.

14. For more details on the information described herein or any other questions, please contact ABLIC Inc.’s sales representative.

15. This Disclaimers have been delivered in a text using the Japanese language, which text, despite any translations into the English language and the Chinese language, shall be controlling.