

## HIGH RIPPLE-REJECTION LOW DROPOUT LOW INPUT-AND-OUTPUT CAPACITANCE CMOS VOLTAGE REGULATOR

## S-1200 Series

The S-1200 Series is a positive voltage regulator with a low dropout voltage, high output voltage accuracy developed based on CMOS technology.

A 0.1  $\mu\text{F}$  small ceramic capacitor can be used. It operates with low current consumption of 18  $\mu\text{A}$  typ.

A built-in Output current protector prevents the load current from exceeding the current capacitance of the output transistor.

Compared with the voltage regulators using the conventional CMOS process, small ceramic capacitors are also available. Furthermore a small HSNT-6A packages realize high-density mounting.

### ■ Features

- Output voltage: 1.5 V to 5.5 V, selectable in 0.1 V steps.
- Low ESR capacitor can be used: A ceramic capacitor of 0.1  $\mu\text{F}$  or more can be used for the output capacitor.
- Wide input voltage range: 2.0 V to 10.0 V
- High-accuracy output voltage:  $\pm 1.0\%$
- Low dropout voltage: 140 mV typ. (3.0 V output product,  $I_{\text{OUT}} = 100 \text{ mA}$ )
- Low current consumption: During operation: 18  $\mu\text{A}$  typ., 40  $\mu\text{A}$  max.  
During shutdown: 0.01  $\mu\text{A}$  typ., 1.0  $\mu\text{A}$  max.
- Output current: 150 mA output is possible (@  $V_{\text{IN}} \geq V_{\text{OUT(S)}} + 1.0 \text{ V}$ )<sup>\*1</sup>
- High ripple rejection: 70 dB typ. (@ 1.0 kHz,  $1.5 \text{ V} \leq V_{\text{OUT}} \leq 3.0 \text{ V}$ )  
65 dB typ. (@ 1.0 kHz,  $3.1 \text{ V} \leq V_{\text{OUT}} \leq 5.5 \text{ V}$ )
- Built-in overcurrent protector: Overcurrent of output transistor can be restricted.
- Built-in ON/OFF circuit: Ensures long battery life.
- Small package: HSNT-6A, SOT-23-5, SNT-6A(H)
- Lead-free products

\*1. Attention should be paid to the power dissipation of the package when the output current is large.

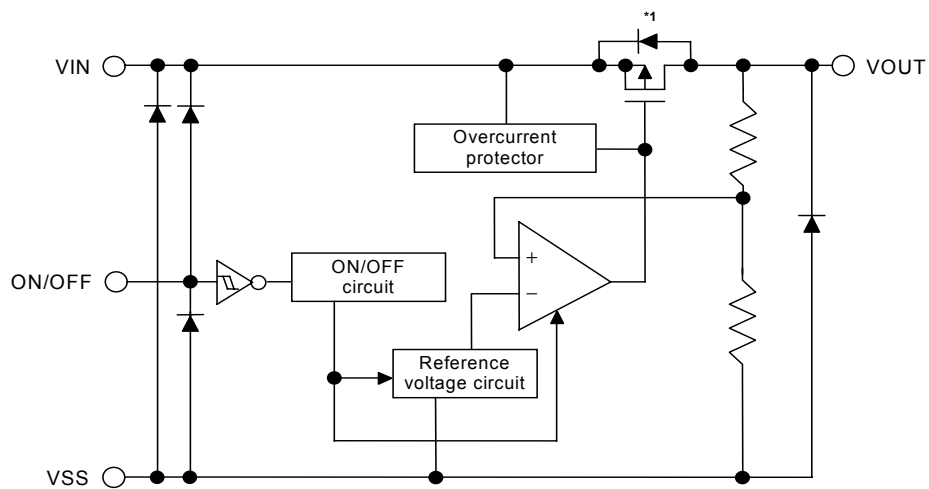
### ■ Applications

- Power supply for battery-powered devices
- Power supply for personal communication devices
- Power supply for home electric/electronic appliances
- Power supply for cellular phones

### ■ Packages

| Package Name | Drawing Code |         |         |         |                 |
|--------------|--------------|---------|---------|---------|-----------------|
|              | Package      | Tape    | Reel    | Land    | Stencil Opening |
| SNT-6A(H)    | PI006-A      | PI006-A | PI006-A | PI006-A | —               |
| SOT-23-5     | MP005-A      | MP005-A | MP005-A | —       | —               |
| HSNT-6A      | PJ006-A      | PJ006-A | PJ006-A | PJ006-A | PJ006-A         |

■ Block Diagram



\*1. Parasitic diode

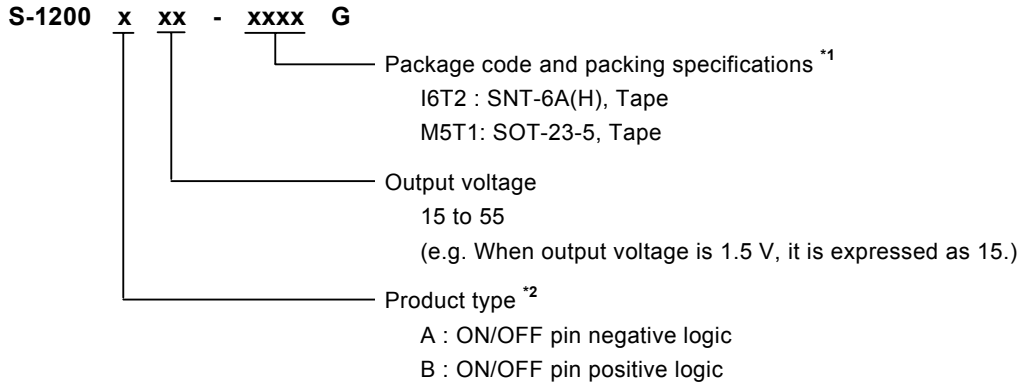
Figure 1

■ **Product Code Structure**

- The product types, output voltage value and package types for the S-1200 Series can be selected at the user's request. Refer to the "Product name" for the meanings of the characters in the product name and "Product name list" for the full product names.

**1. Product name**

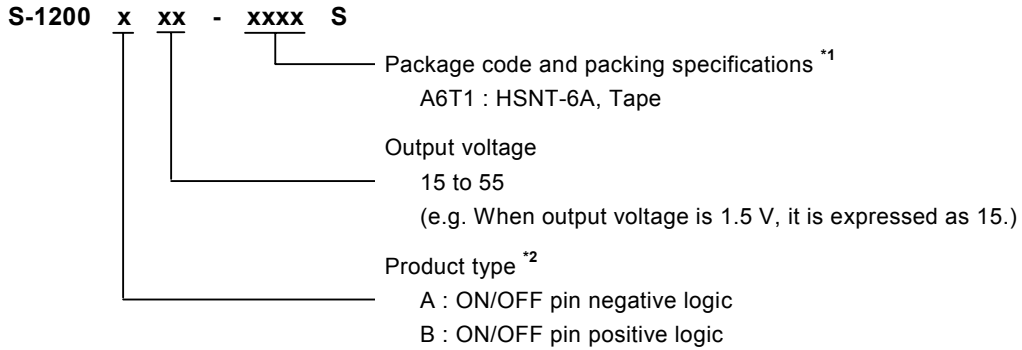
**(1) SNT-6A(H), SOT-23-5**



\*1. Refer to the tape specifications at the end of this book.

\*2. Refer to "3. Shutdown (ON/OFF pin)" in the "■ Operation".

**(2) HSNT-6A**



\*1. Refer to the tape specifications at the end of this book.

\*2. Refer to "3. Shutdown (ON/OFF pin)" in the "■ Operation".

2. Product name list

Table 1

| Output Voltage | SNT-6A(H)       | SOT-23-5        | HSNT-6A         |
|----------------|-----------------|-----------------|-----------------|
| 1.5 V ±1.0%    | S-1200B15-I6T2G | S-1200B15-M5T1G | S-1200B15-A6T1S |
| 1.6 V ±1.0%    | S-1200B16-I6T2G | S-1200B16-M5T1G | S-1200B16-A6T1S |
| 1.7 V ±1.0%    | S-1200B17-I6T2G | S-1200B17-M5T1G | S-1200B17-A6T1S |
| 1.8 V ±1.0%    | S-1200B18-I6T2G | S-1200B18-M5T1G | S-1200B18-A6T1S |
| 1.9 V ±1.0%    | S-1200B19-I6T2G | S-1200B19-M5T1G | S-1200B19-A6T1S |
| 2.0 V ±1.0%    | S-1200B20-I6T2G | S-1200B20-M5T1G | S-1200B20-A6T1S |
| 2.1 V ±1.0%    | S-1200B21-I6T2G | S-1200B21-M5T1G | S-1200B21-A6T1S |
| 2.2 V ±1.0%    | S-1200B22-I6T2G | S-1200B22-M5T1G | S-1200B22-A6T1S |
| 2.3 V ±1.0%    | S-1200B23-I6T2G | S-1200B23-M5T1G | S-1200B23-A6T1S |
| 2.4 V ±1.0%    | S-1200B24-I6T2G | S-1200B24-M5T1G | S-1200B24-A6T1S |
| 2.5 V ±1.0%    | S-1200B25-I6T2G | S-1200B25-M5T1G | S-1200B25-A6T1S |
| 2.6 V ±1.0%    | S-1200B26-I6T2G | S-1200B26-M5T1G | S-1200B26-A6T1S |
| 2.7 V ±1.0%    | S-1200B27-I6T2G | S-1200B27-M5T1G | S-1200B27-A6T1S |
| 2.8 V ±1.0%    | S-1200B28-I6T2G | S-1200B28-M5T1G | S-1200B28-A6T1S |
| 2.9 V ±1.0%    | S-1200B29-I6T2G | S-1200B29-M5T1G | S-1200B29-A6T1S |
| 3.0 V ±1.0%    | S-1200B30-I6T2G | S-1200B30-M5T1G | S-1200B30-A6T1S |
| 3.1 V ±1.0%    | S-1200B31-I6T2G | S-1200B31-M5T1G | S-1200B31-A6T1S |
| 3.2 V ±1.0%    | S-1200B32-I6T2G | S-1200B32-M5T1G | S-1200B32-A6T1S |
| 3.3 V ±1.0%    | S-1200B33-I6T2G | S-1200B33-M5T1G | S-1200B33-A6T1S |
| 3.4 V ±1.0%    | S-1200B34-I6T2G | S-1200B34-M5T1G | S-1200B34-A6T1S |
| 3.5 V ±1.0%    | S-1200B35-I6T2G | S-1200B35-M5T1G | S-1200B35-A6T1S |
| 3.6 V ±1.0%    | S-1200B36-I6T2G | S-1200B36-M5T1G | S-1200B36-A6T1S |
| 3.7 V ±1.0%    | S-1200B37-I6T2G | S-1200B37-M5T1G | S-1200B37-A6T1S |
| 3.8 V ±1.0%    | S-1200B38-I6T2G | S-1200B38-M5T1G | S-1200B38-A6T1S |
| 3.9 V ±1.0%    | S-1200B39-I6T2G | S-1200B39-M5T1G | S-1200B39-A6T1S |
| 4.0 V ±1.0%    | S-1200B40-I6T2G | S-1200B40-M5T1G | S-1200B40-A6T1S |
| 4.1 V ±1.0%    | S-1200B41-I6T2G | S-1200B41-M5T1G | S-1200B41-A6T1S |
| 4.2 V ±1.0%    | S-1200B42-I6T2G | S-1200B42-M5T1G | S-1200B42-A6T1S |
| 4.3 V ±1.0%    | S-1200B43-I6T2G | S-1200B43-M5T1G | S-1200B43-A6T1S |
| 4.4 V ±1.0%    | S-1200B44-I6T2G | S-1200B44-M5T1G | S-1200B44-A6T1S |
| 4.5 V ±1.0%    | S-1200B45-I6T2G | S-1200B45-M5T1G | S-1200B45-A6T1S |
| 4.6 V ±1.0%    | S-1200B46-I6T2G | S-1200B46-M5T1G | S-1200B46-A6T1S |
| 4.7 V ±1.0%    | S-1200B47-I6T2G | S-1200B47-M5T1G | S-1200B47-A6T1S |
| 4.8 V ±1.0%    | S-1200B48-I6T2G | S-1200B48-M5T1G | S-1200B48-A6T1S |
| 4.9 V ±1.0%    | S-1200B49-I6T2G | S-1200B49-M5T1G | S-1200B49-A6T1S |
| 5.0 V ±1.0%    | S-1200B50-I6T2G | S-1200B50-M5T1G | S-1200B50-A6T1S |
| 5.1 V ±1.0%    | S-1200B51-I6T2G | S-1200B51-M5T1G | S-1200B51-A6T1S |
| 5.2 V ±1.0%    | S-1200B52-I6T2G | S-1200B52-M5T1G | S-1200B52-A6T1S |
| 5.3 V ±1.0%    | S-1200B53-I6T2G | S-1200B53-M5T1G | S-1200B53-A6T1S |
| 5.4 V ±1.0%    | S-1200B54-I6T2G | S-1200B54-M5T1G | S-1200B54-A6T1S |
| 5.5 V ±1.0%    | S-1200B55-I6T2G | S-1200B55-M5T1G | S-1200B55-A6T1S |

**Remark** Please contact our sales office for products with an output voltage other than those specified above or type A products.

■ Pin Configurations

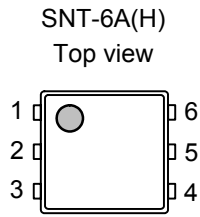


Figure 2

Table 2

| Pin No. | Symbol           | Pin Description    |
|---------|------------------|--------------------|
| 1       | VOUT             | Output voltage pin |
| 2       | VSS              | GND pin            |
| 3       | NC <sup>*1</sup> | No connection      |
| 4       | ON/OFF           | Shutdown pin       |
| 5       | VSS              | GND pin            |
| 6       | VIN              | Input voltage pin  |

\*1. The NC pin is electrically open.  
 The NC pin can be connected to VIN or VSS.

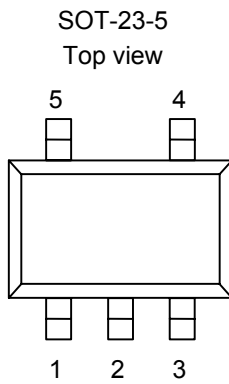


Figure 3

Table 3

| Pin No. | Symbol           | Description        |
|---------|------------------|--------------------|
| 1       | VIN              | Input voltage pin  |
| 2       | VSS              | GND pin            |
| 3       | ON/OFF           | Shutdown pin       |
| 4       | NC <sup>*1</sup> | No connection      |
| 5       | VOUT             | Output voltage pin |

\*1. The NC pin is electrically open.  
 The NC pin can be connected to VIN or VSS.

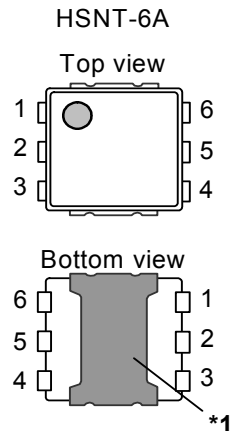


Table 4

| Pin No. | Symbol           | Description        |
|---------|------------------|--------------------|
| 1       | VOUT             | Output voltage pin |
| 2       | NC <sup>*1</sup> | No connection      |
| 3       | VSS              | GND pin            |
| 4       | ON/OFF           | Shutdown pin       |
| 5       | NC <sup>*1</sup> | No connection      |
| 6       | VIN              | Input voltage pin  |

\*1. The NC pin is electrically open.  
 The NC pin can be connected to VIN or VSS.

\*1. Connect the heatsink of backside at shadowed area to the board, and set electric potential open or GND. However, do not use it as the function of electrode.

Figure 4

■ **Absolute Maximum Ratings**

**Table 5**

(Ta = 25°C unless otherwise specified)

| Item                          | Symbol              | Absolute Maximum Rating                        | Unit                            |
|-------------------------------|---------------------|--|---------------------------------|
| Input voltage                 | V <sub>IN</sub>     | V <sub>SS</sub> - 0.3 to V <sub>SS</sub> + 12  | V                               |
|                               | V <sub>ON/OFF</sub> | V <sub>SS</sub> - 0.3 to V <sub>IN</sub> + 0.3 | V                               |
| Output voltage                | V <sub>OUT</sub>    | V <sub>SS</sub> - 0.3 to V <sub>IN</sub> + 0.3 | V                               |
| Power dissipation             | P <sub>D</sub>      | SNT-6A(H)                                      | 500 <sup>*1</sup>               |
|                               |                     | SOT-23-5                                       | 300 (When not mounted on board) |
|                               |                     | HSNT-6A  | 600 <sup>*1</sup>               |
|                               |                     |  | 1000 <sup>*2</sup>              |
| Operating ambient temperature | T <sub>opr</sub>    | -40 to +85                                     | °C                              |
| Storage temperature           | T <sub>stg</sub>    | -40 to +125                                    | °C                              |

\*1. When mounted on board

[Mounted board]

(1) Board size : 114.3 mm × 76.2 mm × t1.6 mm

(2) Board name : JEDEC STANDARD51-7

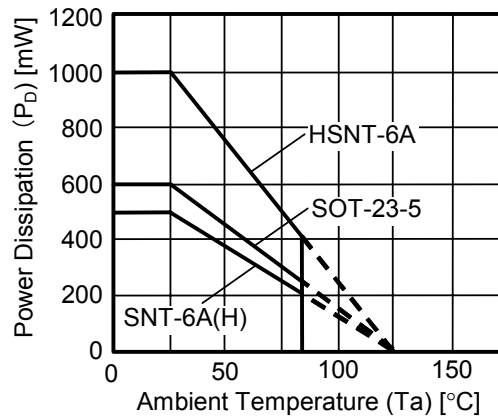
\*2. When mounted on board

[Mounted board]

(1) Board size : 50 mm × 50 mm × t1.6 mm

(2) Wiring ratio : 50%

**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.



**Figure 5 Power Dissipation of The Package (When Mounted on Board)**

■ Electrical Characteristics

Table 6

(Ta = 25°C unless otherwise specified)

| Item                                     | Symbol  | Conditions   | Min.   | Typ.         | Max.                     | Unit       | Test Circuit |   |
|--|---|--|--|--------------|--------------------------|------------|--------------|---|
| Output voltage*1                         | $V_{OUT(E)}$  | $V_{IN} = V_{OUT(S)} + 1.0 \text{ V}$ , $I_{OUT} = 30 \text{ mA}$  | $V_{OUT(S)} \times 0.99$                           | $V_{OUT(S)}$ | $V_{OUT(S)} \times 1.01$ | V          | 1            |   |
| Output current*2                         | $I_{OUT}$   | $V_{IN} \geq V_{OUT(S)} + 1.0 \text{ V}$   | 150*5  | —            | —                        | mA         | 3            |   |
| Dropout voltage*3                        | $V_{drop}$  | $I_{OUT} = 30 \text{ mA}$  | $1.5 \text{ V} \leq V_{OUT(S)} \leq 1.9 \text{ V}$ | 0.50         | 0.50                     | 0.51       | V            | 1 |
|  |   |  | $2.0 \text{ V} \leq V_{OUT(S)} \leq 2.4 \text{ V}$ | —            | 0.08                     | 0.12       | V            | 1 |
|  |   |  | $2.5 \text{ V} \leq V_{OUT(S)} \leq 2.9 \text{ V}$ | —            | 0.06                     | 0.08       | V            | 1 |
|  |   |  | $3.0 \text{ V} \leq V_{OUT(S)} \leq 3.2 \text{ V}$ | —            | 0.05                     | 0.07       | V            | 1 |
|  |   | $I_{OUT} = 100 \text{ mA}$   | $1.5 \text{ V} \leq V_{OUT(S)} \leq 1.9 \text{ V}$ | 0.50         | 0.55                     | 0.60       | V            | 1 |
|  |   |  | $2.0 \text{ V} \leq V_{OUT(S)} \leq 2.4 \text{ V}$ | —            | 0.24                     | 0.31       | V            | 1 |
|  |   |  | $2.5 \text{ V} \leq V_{OUT(S)} \leq 2.9 \text{ V}$ | —            | 0.16                     | 0.23       | V            | 1 |
|  |   |  | $3.0 \text{ V} \leq V_{OUT(S)} \leq 3.2 \text{ V}$ | —            | 0.14                     | 0.21       | V            | 1 |
| Line regulation                          | $\frac{\Delta V_{OUT1}}{\Delta V_{IN} \bullet V_{OUT}}$ | $V_{OUT(S)} + 0.5 \text{ V} \leq V_{IN} \leq 10 \text{ V}$ ,<br>$I_{OUT} = 30 \text{ mA}$  | —  | 0.01         | 0.2                      | % / V      | 1            |   |
|  |   |  | —  | 0.01         | 0.2                      | % / V      | 1            |   |
| Load regulation                          | $\Delta V_{OUT2}$                                       | $V_{IN} = V_{OUT(S)} + 1.0 \text{ V}$ ,<br>$1.0 \text{ mA} \leq I_{OUT} \leq 80 \text{ mA}$  | —  | 15           | 50                       | mV         | 1            |   |
| Output voltage temperature coefficient*4 | $\frac{\Delta V_{OUT}}{\Delta T_a \bullet V_{OUT}}$     | $V_{IN} = V_{OUT(S)} + 1.0 \text{ V}$ , $I_{OUT} = 30 \text{ mA}$ ,<br>$-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$                | —  | $\pm 100$    | —                        | ppm/<br>°C | 1            |   |
| Current consumption during operation     | $I_{SS1}$   | $V_{IN} = V_{OUT(S)} + 1.0 \text{ V}$ , ON/OFF pin = ON,<br>no load  | —  | 18           | 40                       | μA         | 2            |   |
| Current consumption during shutdown      | $I_{SS2}$   | $V_{IN} = V_{OUT(S)} + 1.0 \text{ V}$ , ON/OFF pin = OFF,<br>no load   | —  | 0.01         | 1.0                      | μA         | 2            |   |
| Input voltage                            | $V_{IN}$  | —  | 2.0  | —            | 10                       | V          | —            |   |
| Shutdown pin input voltage "H"           | $V_{SH}$  | $V_{IN} = V_{OUT(S)} + 1.0 \text{ V}$ , $R_L = 1.0 \text{ k}\Omega$  | 1.5  | —            | —                        | V          | 4            |   |
| Shutdown pin input voltage "L"           | $V_{SL}$  | $V_{IN} = V_{OUT(S)} + 1.0 \text{ V}$ , $R_L = 1.0 \text{ k}\Omega$  | —  | —            | 0.25                     | V          | 4            |   |
| Shutdown pin input current "H"           | $I_{SH}$  | $V_{IN} = 6.5 \text{ V}$ , $V_{ON/OFF} = 6.5 \text{ V}$  | -0.1   | —            | 0.1                      | μA         | 4            |   |
| Shutdown pin input current "L"           | $I_{SL}$  | $V_{IN} = 6.5 \text{ V}$ , $V_{ON/OFF} = 0 \text{ V}$  | -0.1   | —            | 0.1                      | μA         | 4            |   |
| Ripple rejection                         | RR  | $V_{IN} = V_{OUT(S)} + 1.0 \text{ V}$ ,<br>$f = 1.0 \text{ kHz}$ ,<br>$\Delta V_{rip} = 0.5 \text{ Vrms}$ ,<br>$I_{OUT} = 50 \text{ mA}$ | $1.5 \text{ V} \leq V_{OUT(S)} \leq 3.0 \text{ V}$ | —            | 70                       | —          | dB           | 5 |
|  |   |  | $3.1 \text{ V} \leq V_{OUT(S)} \leq 5.5 \text{ V}$ | —            | 65                       | —          | dB           | 5 |
| Short-circuit current                    | $I_{short}$   | $V_{IN} = V_{OUT(S)} + 1.0 \text{ V}$ , ON/OFF pin = ON,<br>$V_{OUT} = 0 \text{ V}$  | —  | 250          | —                        | mA         | 3            |   |

- \*1.  $V_{OUT(S)}$ : Specified output voltage  
 $V_{OUT(E)}$ : Actual output voltage at the fixed load  
The output voltage when fixing  $I_{OUT}(= 30 \text{ mA})$  and inputting  $V_{OUT(S)} + 1.0 \text{ V}$
- \*2. The output current at which the output voltage becomes 95% of  $V_{OUT(E)}$  after gradually increasing the output current.
- \*3.  $V_{drop} = V_{IN1} - (V_{OUT3} \times 0.98)$   
 $V_{OUT3}$  is the output voltage when  $V_{IN} = V_{OUT(S)} + 1.0 \text{ V}$  and  $I_{OUT} = 30 \text{ mA}$  or  $I_{OUT} = 100 \text{ mA}$ .  
 $V_{IN1}$  is the input voltage at which the output voltage becomes 98% of  $V_{OUT3}$  after gradually decreasing the input voltage.
- \*4. The change in temperature [ $\text{mV}/^\circ\text{C}$ ] is calculated using the following equation.  
$$\frac{\Delta V_{OUT}}{\Delta T_a} [\text{mV}/^\circ\text{C}]^{*1} = V_{OUT(S)} [\text{V}]^{*2} \times \frac{\Delta V_{OUT}}{\Delta T_a \bullet V_{OUT}} [\text{ppm}/^\circ\text{C}]^{*3} \div 1000$$
  - \*1. The change in temperature of the output voltage
  - \*2. Specified output voltage
  - \*3. Output voltage temperature coefficient
- \*5. The output current can be at least this value.  
Due to restrictions on the package power dissipation, this value may not be satisfied. Attention should be paid to the power dissipation of the package when the output current is large.  
This specification is guaranteed by design.



■ Test Circuits

1.

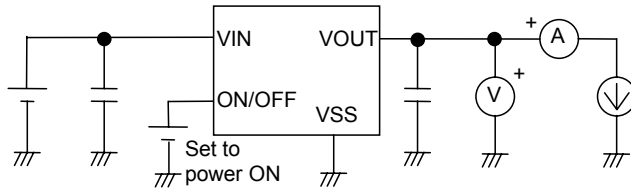


Figure 6

2.

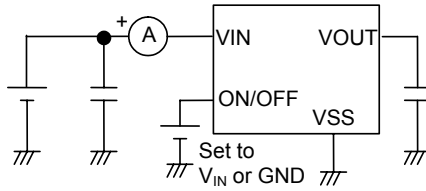


Figure 7

3.

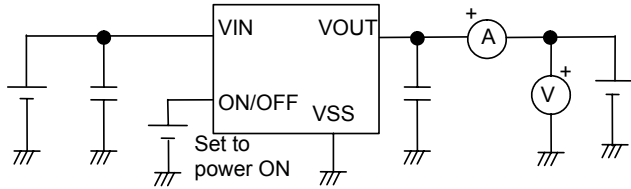


Figure 8

4.

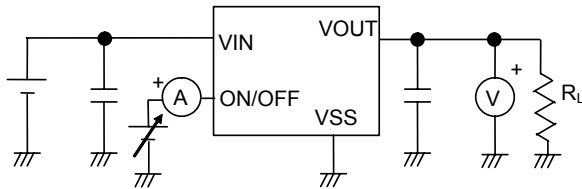


Figure 9

5.

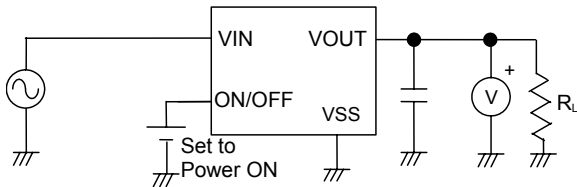
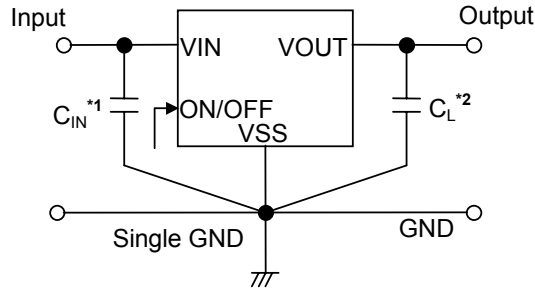


Figure 10

■ Standard Circuit



\*1.  $C_{IN}$  is a capacitor for stabilizing the input.

\*2. A ceramic capacitor of 0.1  $\mu\text{F}$  or more can be used for  $C_L$ .

Figure 11

**Caution** The above connection diagram and constant will not guarantee successful operation. Perform thorough evaluation using the actual application to set the constant.

■ Application Conditions

Input capacitor ( $C_{IN}$ ): 0.1  $\mu\text{F}$  or more  
Output capacitor ( $C_L$ ): 0.1  $\mu\text{F}$  or more  
ESR of output capacitor: 1.0  $\Omega$  or less

**Caution** A general series regulator may oscillate, depending on the external components selected. Check that no oscillation occurs with the application using the above capacitor.

■ Selection of Input and Output Capacitors ( $C_{IN}$ ,  $C_L$ )

The S-1200 Series requires an output capacitor between the VOUT and VSS pins for phase compensation. Operation is stabilized by a ceramic capacitor with an output capacitance of 0.1  $\mu\text{F}$  or more in the entire temperature range. However, when using an OS capacitor, tantalum capacitor, or aluminum electrolytic capacitor, a ceramic capacitor with a capacitance of 0.1  $\mu\text{F}$  or more and an ESR of 1.0  $\Omega$  or less is required. The value of the output overshoot or undershoot transient response varies depending on the value of the output capacitor. The required capacitance of the input capacitor differs depending on the application. The recommended value for an application is 0.1  $\mu\text{F}$  or more for  $C_{IN}$  and 0.1  $\mu\text{F}$  or more for  $C_L$ ; however, when selecting the output capacitor, perform sufficient evaluation, including evaluation of temperature characteristics, on the actual device.

## ■ Explanation of Terms

### 1. Low dropout voltage regulator

The low dropout voltage regulator is a voltage regulator whose dropout voltage is low due to its built-in low on-resistance transistor.

### 2. Low ESR

A capacitor whose ESR (Equivalent Series Resistance) is low. The S-1200 Series enables use of a low ESR capacitor, such as a ceramic capacitor, for the output-side capacitor  $C_L$ . A capacitor whose ESR is  $1.0 \Omega$  or less can be used.

### 3. Output voltage ( $V_{OUT}$ )

The accuracy of the output voltage is ensured at  $\pm 1.0\%$  under the specified conditions of fixed input voltage\*1, fixed output current, and fixed temperature.

\*1. Differs depending on the product.

**Caution** If the above conditions change, the output voltage value may vary and exceed the accuracy range of the output voltage. Please see the electrical characteristics and attached characteristics data for details.

### 4. Line regulation $\left( \frac{\Delta V_{OUT1}}{\Delta V_{IN} \bullet V_{OUT}} \right)$

Indicates the dependency of the output voltage on the input voltage. That is, the values show how much the output voltage changes due to a change in the input voltage with the output current remaining unchanged.

### 5. Load regulation ( $\Delta V_{OUT2}$ )

Indicates the dependency of the output voltage on the output current. That is, the values show how much the output voltage changes due to a change in the output current with the input voltage remaining unchanged.

### 6. Dropout voltage ( $V_{drop}$ )

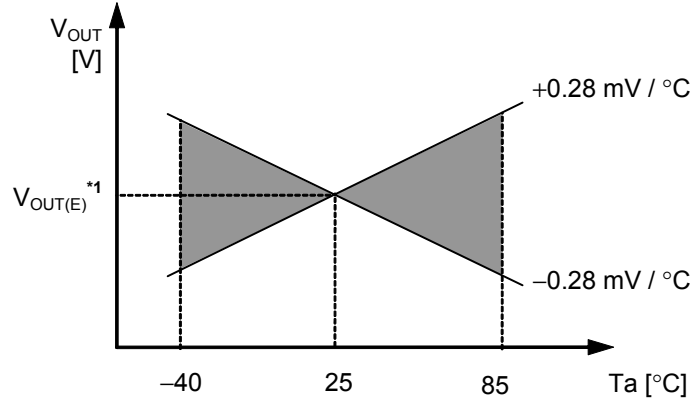
Indicates the difference between the input voltage  $V_{IN1}$ , which is the input voltage ( $V_{IN}$ ) at the point where the output voltage has fallen to 98% of the output voltage value  $V_{OUT3}$  after  $V_{IN}$  was gradually decreased from  $V_{IN} = V_{OUT(S)} + 1.0 \text{ V}$ , and the output voltage at that point ( $V_{OUT3} \times 0.98$ ).

$$V_{drop} = V_{IN1} - (V_{OUT3} \times 0.98)$$

7. Temperature coefficient of output voltage  $\left( \frac{\Delta V_{OUT}}{\Delta T_a \bullet V_{OUT}} \right)$

The shadowed area in **Figure 12** is the range where  $V_{OUT}$  varies in the operating temperature range when the temperature coefficient of the output voltage is  $\pm 100$  ppm/ $^{\circ}\text{C}$ .

Ex. S-1200B28 Typ.



\*1.  $V_{OUT(E)}$  is the value of the output voltage measured at 25 $^{\circ}\text{C}$ .

**Figure 12**

A change in the temperature of the output voltage [mV/ $^{\circ}\text{C}$ ] is calculated using the following equation.

$$\frac{\Delta V_{OUT}}{\Delta T_a} [\text{mV} / ^{\circ}\text{C}]^{*1} = V_{OUT(S)} [\text{V}]^{*2} \times \frac{\Delta V_{OUT}}{\Delta T_a \bullet V_{OUT}} [\text{ppm} / ^{\circ}\text{C}]^{*3} + 1000$$

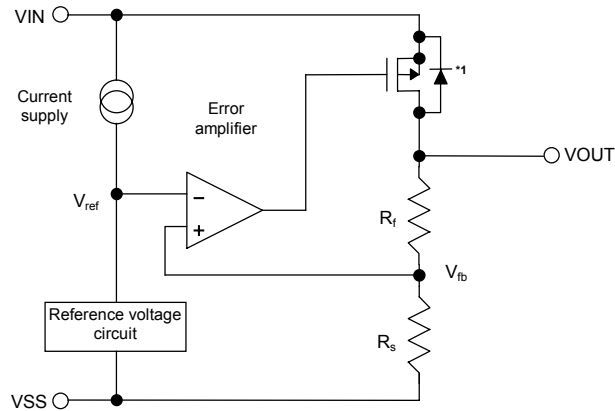
- \*1. Change in temperature of output voltage
- \*2. Specified output voltage
- \*3. Output voltage temperature coefficient

■ **Operation**

**1. Basic operation**

**Figure 13** shows the block diagram of the S-1200 Series.

The error amplifier compares the reference voltage ( $V_{ref}$ ) with  $V_{fb}$ , which is the output voltage resistance-divided by feedback resistors  $R_s$  and  $R_f$ . It supplies the output transistor with the gate voltage necessary to ensure a certain output voltage free of any fluctuations of input voltage and temperature.



\*1. Parasitic diode

**Figure 13**

**2. Output transistor**

The S-1200 Series uses a low on-resistance P-channel MOS FET as the output transistor. Be sure that  $V_{OUT}$  does not exceed  $V_{IN} + 0.3$  V to prevent the voltage regulator from being damaged due to inverse current flowing from the VOUT pin through a parasitic diode to the VIN pin.

**3. Shutdown pin (ON/OFF pin)**

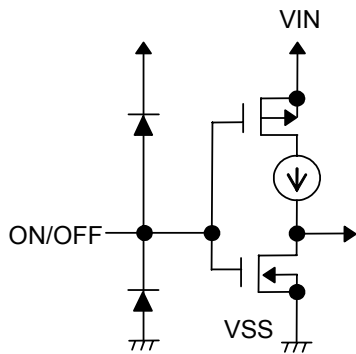
This pin starts and stops the regulator.

When the ON/OFF pin is set to the shutdown level, the operation of all internal circuits stops, and the built-in P-channel MOS FET output transistor between the VIN pin and VOUT pin is turned off to substantially reduce the current consumption. The VOUT pin becomes the V<sub>SS</sub> level due to the internally divided resistance of several hundreds kΩ between the VOUT pin and VSS pin.

The structure of the ON/OFF pin is as shown in **Figure 14**. Since the ON/OFF pin is neither pulled down nor pulled up internally, do not use it in the floating state. In addition, note that the current consumption increases if a voltage of 0.3 V to V<sub>IN</sub> - 0.3 V is applied to the ON/OFF pin. When the ON/OFF pin is not used, connect it to the VSS pin if the logic type is "A" and to the VIN pin if it is "B".

**Table 7**

| Logic Type | ON/OFF Pin     | Internal Circuits | VOUT Pin Voltage      | Current Consumption |
|------------|----------------|-------------------|-----------------------|---------------------|
| A          | "L": Power on  | Operating         | Set value             | I <sub>SS1</sub>    |
| A          | "H": Power off | Stopped           | V <sub>SS</sub> level | I <sub>SS2</sub>    |
| B          | "L": Power off | Stopped           | V <sub>SS</sub> level | I <sub>SS2</sub>    |
| B          | "H": Power on  | Operating         | Set value             | I <sub>SS1</sub>    |



**Figure 14**

## ■ Precautions

- Wiring patterns for the VIN, VOUT and GND pins should be designed so that the impedance is low. When mounting an output capacitor between the VOUT and VSS pins ( $C_L$ ) and a capacitor for stabilizing the input between VIN and VSS pins ( $C_{IN}$ ), the distance from the capacitors to these pins should be as short as possible.
- Note that the output voltage may increase when a series regulator is used at low load current (1.0 mA or less).
- Note that the output voltage may increase due to driver leakage when a series regulator is used at high temperatures.
- Generally a series regulator may cause oscillation, depending on the selection of external parts. The following conditions are recommended for this IC. However, be sure to perform sufficient evaluation under the actual usage conditions for selection, including evaluation of temperature characteristics.

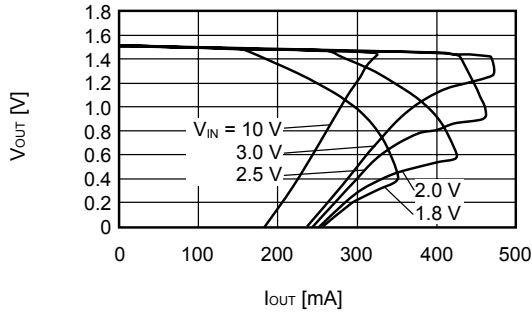
Input capacitor ( $C_{IN}$ ): 0.1  $\mu$ F or more  
Output capacitor ( $C_L$ ): 0.1  $\mu$ F or more  
Equivalent series resistance (ESR): 1.0  $\Omega$  or less

- The voltage regulator may oscillate when the impedance of the power supply is high and the input capacitor is small or an input capacitor is not connected.
- If the capacitance of the IC's output block is small, the power supply fluctuation and load fluctuation characteristics become worse. It is therefore important to sufficiently evaluate the output voltage fluctuation in the actual equipment.
- When the capacitance of the IC's output block is small, if the power supply suddenly increases sharply, a momentary overshoot may be output. It is therefore important to sufficiently evaluate the output voltage at power application in the actual equipment.
- The application conditions for the input voltage, output voltage, and load current should not exceed the package power dissipation.
- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.
- In determining the output current, attention should be paid to the output current value specified in **Table 6** in the "■ **Electrical Characteristics**" and footnote \*5 of the table.
- SII 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.

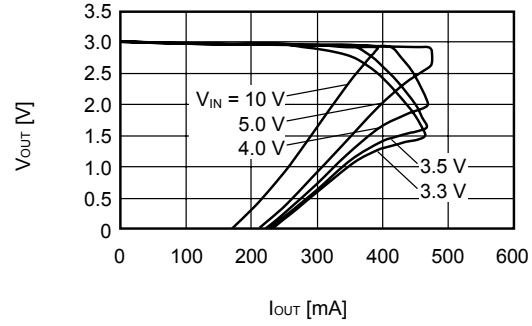
■ **Characteristics (Typical Data)**

(1) Output Voltage vs. Output current (when load current increases)

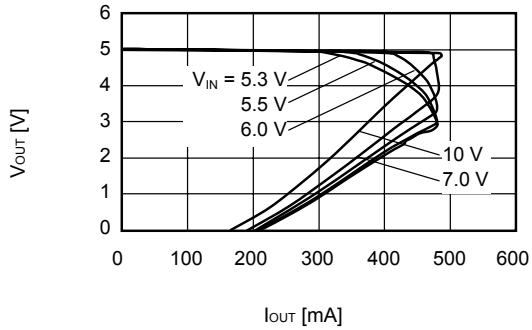
S-1200B15 (Ta = 25°C)



S-1200B30 (Ta = 25°C)



S-1200B50 (Ta = 25°C)

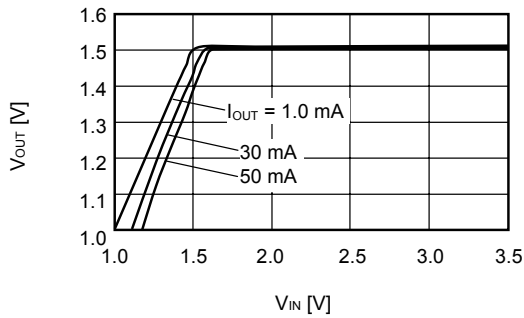


**Remark** In determining the output current, attention should be paid to the following.

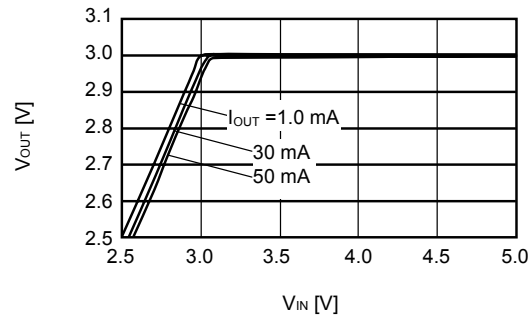
- 1) The minimum output current value and footnote \*5 in the “■ **Electrical Characteristics**”
- 2) The package power dissipation

(2) Output voltage vs. Input voltage

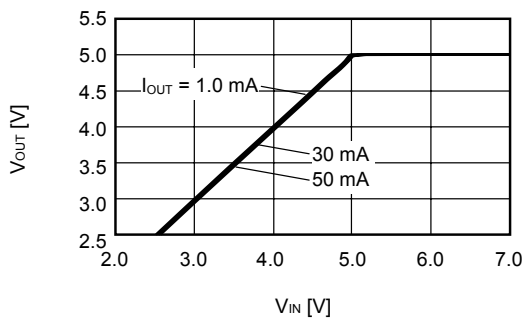
S-1200B15 (Ta = 25°C)



S-1200B30 (Ta = 25°C)



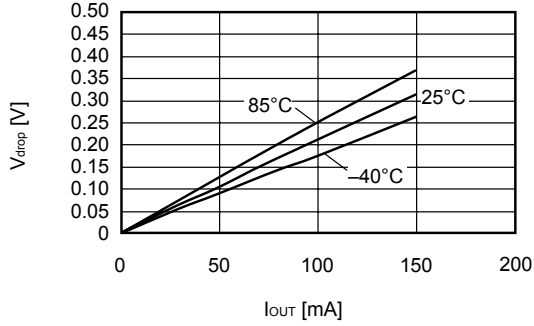
S-1200B50 (Ta = 25°C)



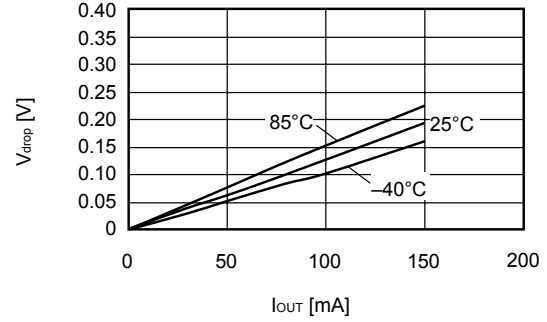


(3) Dropout voltage vs. Output current

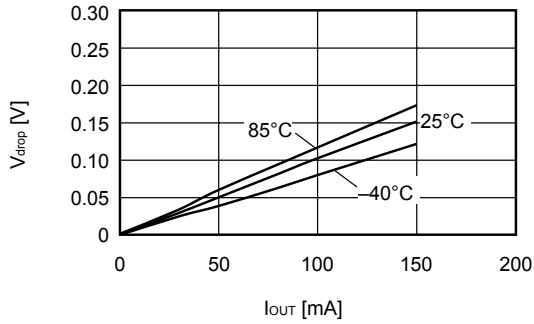
S-1200B15



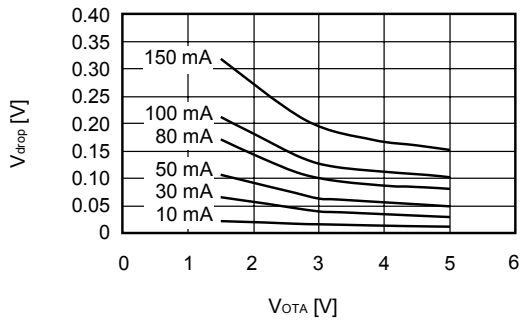
S-1200B30



S-1200B50

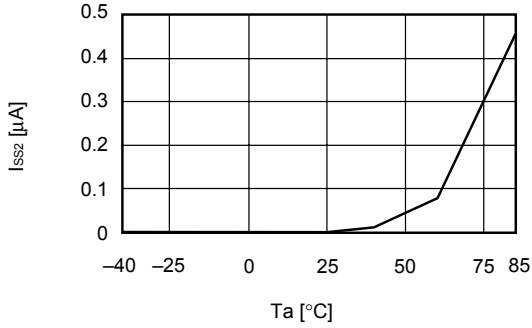


(4) Dropout voltage vs. Set output voltage



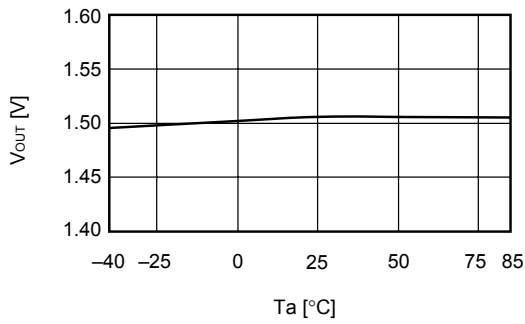
(5) Current consumption during shutdown vs. Ambient temperature

S-1200B15 ( $V_{IN} = 2.5\text{ V}$ )

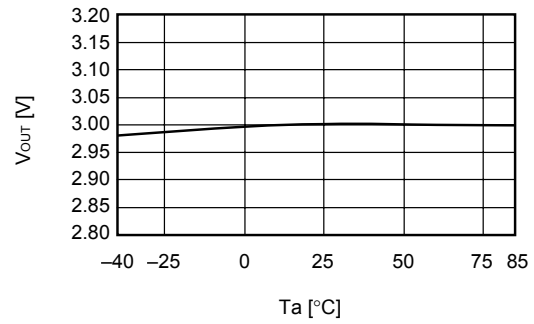


(6) Output voltage vs. Ambient temperature

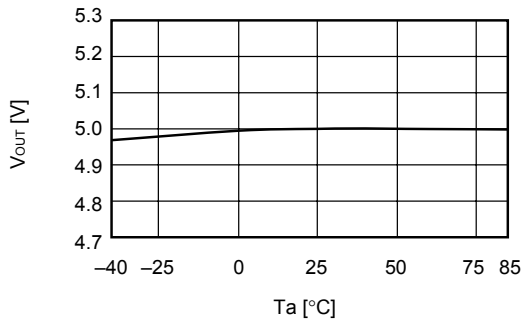
S-1200B15



S-1200B30

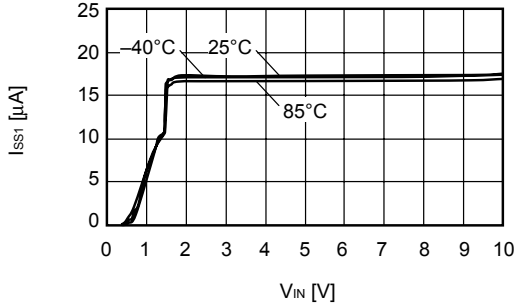


S-1200B50

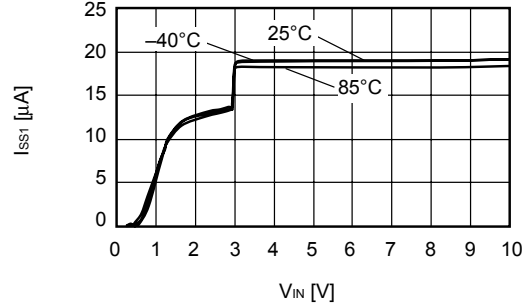


(7) Current consumption vs. Input voltage

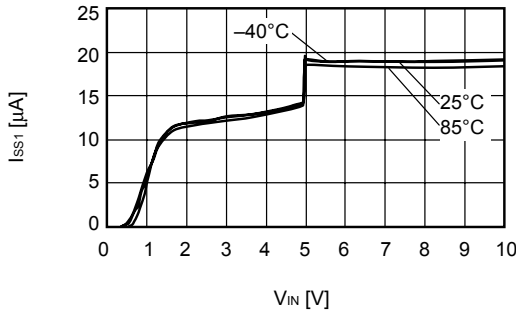
S-1200B15



S-1200B30



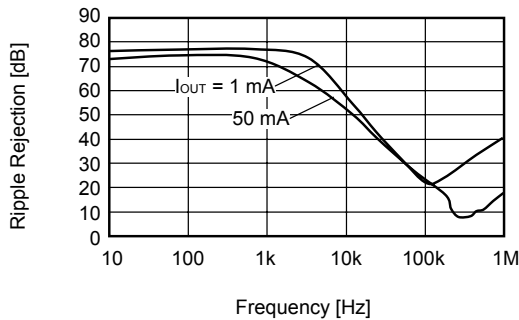
S-1200B50



(8) Ripple rejection

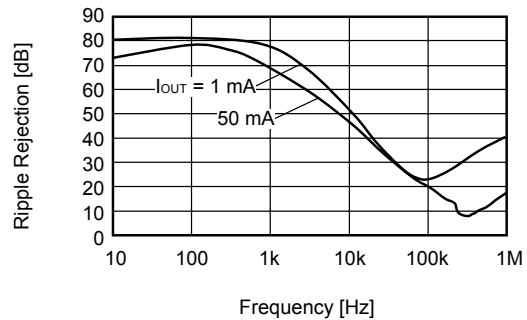
S-1200B15 ( $T_a = 25^\circ C$ )

$V_{IN} = 2.5$  V,  $C_{OUT} = 0.1$   $\mu F$



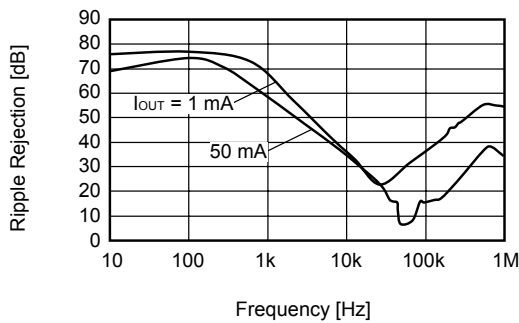
S-1200B30 ( $T_a = 25^\circ C$ )

$V_{IN} = 4.0$  V,  $C_{OUT} = 0.1$   $\mu F$



S-1200B50 ( $T_a = 25^\circ C$ )

$V_{IN} = 6.0$  V,  $C_{OUT} = 0.1$   $\mu F$

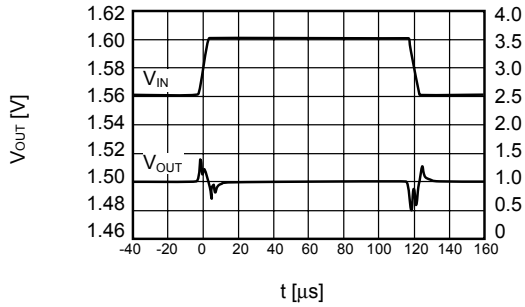


■ **Reference Data**

(1) Input transient response characteristics

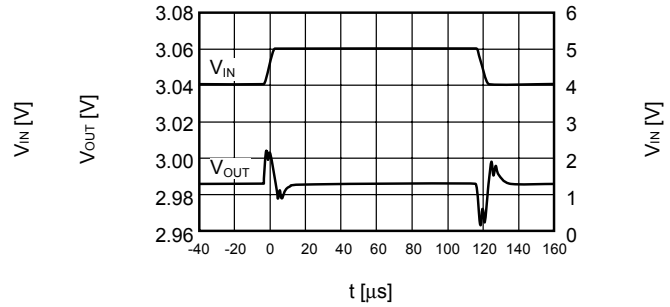
S-1200B15 (Ta = 25°C)

I<sub>OUT</sub> = 30 mA, tr = tf = 5.0 μs, C<sub>OUT</sub> = 0.1 μF, C<sub>IN</sub> = 0.1 μF



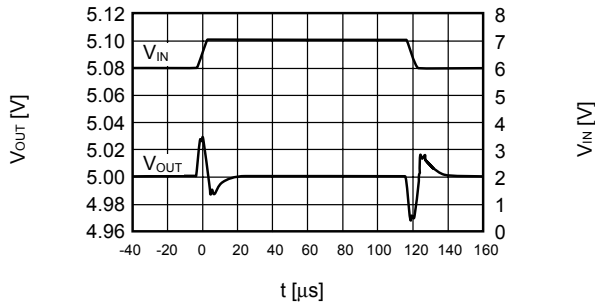
S-1200B30 (Ta = 25°C)

I<sub>OUT</sub> = 30 mA, tr = tf = 5.0 μs, C<sub>OUT</sub> = 0.1 μF, C<sub>IN</sub> = 0.1 μF



S-1200B50 (Ta = 25°C)

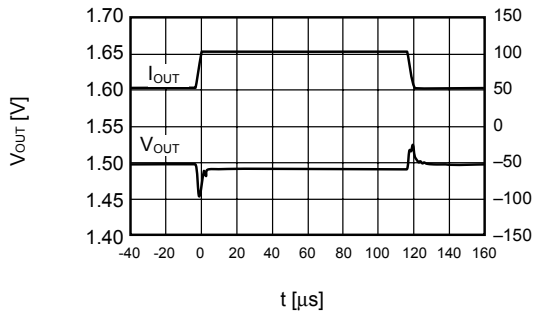
I<sub>OUT</sub> = 30 mA, tr = tf = 5.0 μs, C<sub>OUT</sub> = 0.1 μF, C<sub>IN</sub> = 0.1 μF



(2) Load transient response characteristics

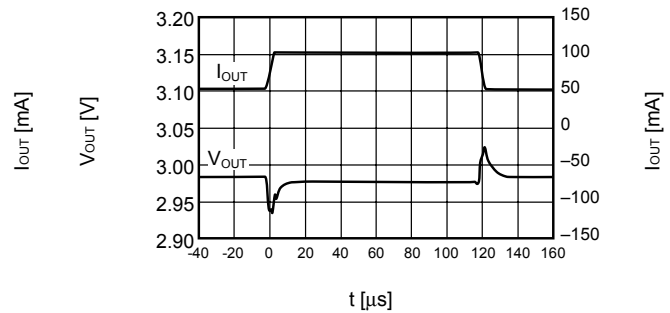
S-1200B15 (Ta = 25°C)

V<sub>IN</sub> = 2.5 V, C<sub>OUT</sub> = 0.1 μF, C<sub>IN</sub> = 0.1 μF, I<sub>OUT</sub> = 50↔100 mA



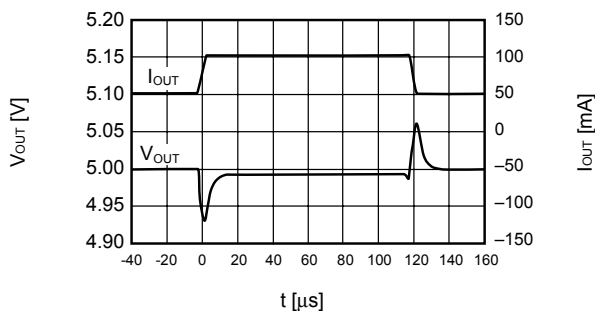
S-1200B30 (Ta = 25°C)

V<sub>IN</sub> = 4.0 V, C<sub>OUT</sub> = 0.1 μF, C<sub>IN</sub> = 0.1 μF, I<sub>OUT</sub> = 50↔100 mA



S-1200B50 (Ta = 25°C)

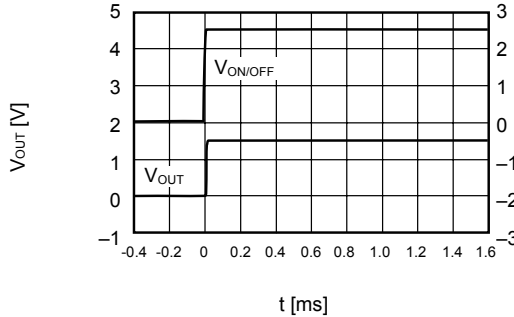
V<sub>IN</sub> = 6.0 V, C<sub>OUT</sub> = 0.1 μF, C<sub>IN</sub> = 0.1 μF, I<sub>OUT</sub> = 50↔100 mA



**(3) Shutdown pin transient response characteristics**

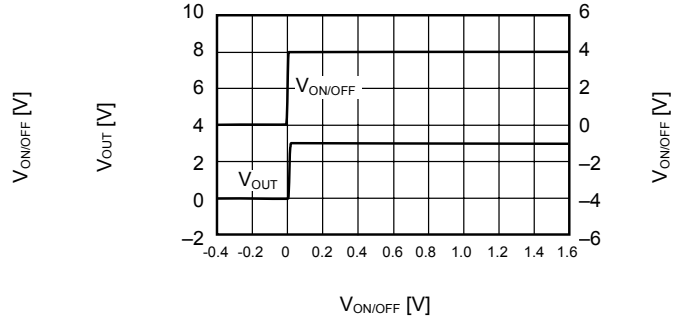
**S-1200B15 (Ta = 25°C)**

V<sub>IN</sub> = 2.5 V, C<sub>OUT</sub> = 0.1 μF, C<sub>IN</sub> = 0.1 μF, I<sub>OUT</sub> = 30 mA



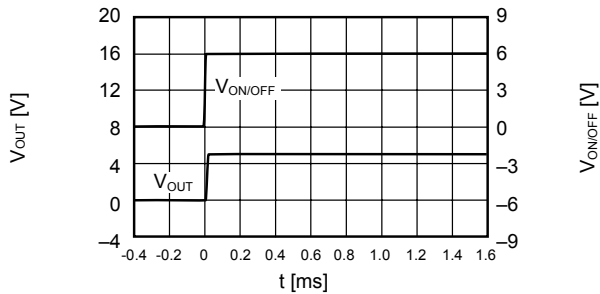
**S-1200B30 (Ta = 25°C)**

V<sub>IN</sub> = 4.0 V, C<sub>OUT</sub> = 0.1 μF, C<sub>IN</sub> = 0.1 μF, I<sub>OUT</sub> = 30 mA



**S-1200B50 (Ta = 25°C)**

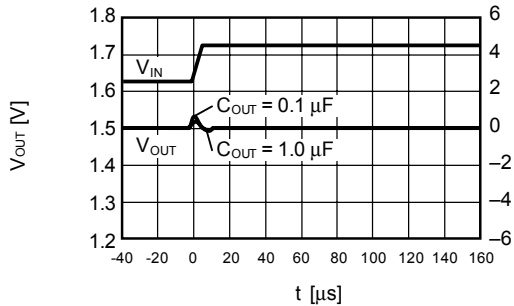
V<sub>IN</sub> = 6.0 V, C<sub>OUT</sub> = 0.1 μF, C<sub>IN</sub> = 0.1 μF, I<sub>OUT</sub> = 30 mA



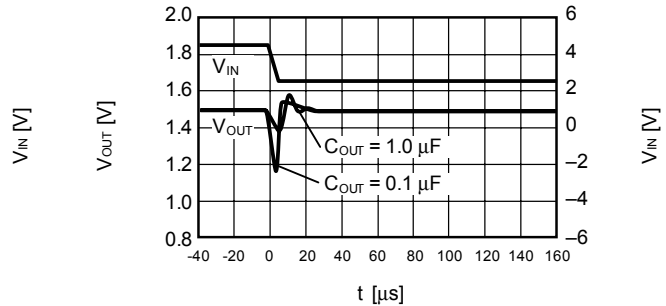
**(4) Input transient response characteristics —Capacity Value characteristics**

**S-1200B15 (Ta = 25°C)**

V<sub>IN</sub> = 2.5 → 4.5 V, tr = 5 μs, I<sub>OUT</sub> = 50 mA



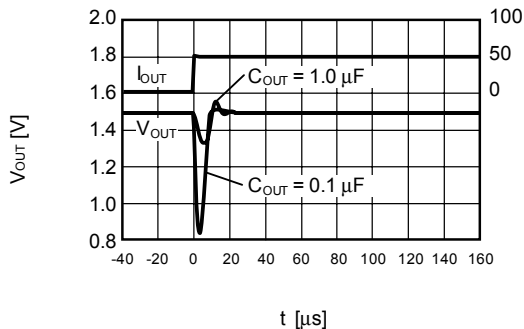
V<sub>IN</sub> = 4.5 → 2.5 V, tr = 5 μs, I<sub>OUT</sub> = 50 mA



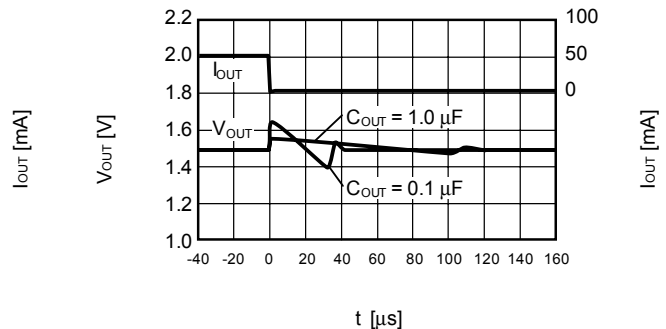
**(5) Load transient response characteristics — Capacity Value characteristics**

**S-1200B15 (Ta = 25°C)**

V<sub>IN</sub> = 2.5 V, I<sub>OUT</sub> = 1 → 50 mA

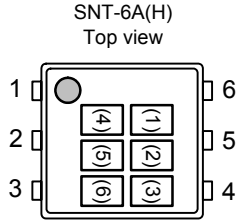


V<sub>IN</sub> = 2.5 V, I<sub>OUT</sub> = 50 → 1 mA



■ **Marking Specifications**

(1) SNT-6A(H)



(1) to (3) : Product code (Refer to **Product name vs. Product code**)  
 (4) to (6) : Lot number

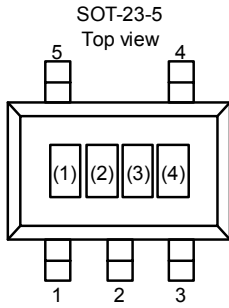
**Product name vs. Product code**

| Product name    | Product code |     |     |
|-----------------|--------------|-----|-----|
|                 | (1)          | (2) | (3) |
| S-1200B15-I6T2G | P            | O   | A   |
| S-1200B16-I6T2G | P            | O   | B   |
| S-1200B17-I6T2G | P            | O   | C   |
| S-1200B18-I6T2G | P            | O   | D   |
| S-1200B19-I6T2G | P            | O   | E   |
| S-1200B20-I6T2G | P            | O   | F   |
| S-1200B21-I6T2G | P            | O   | G   |
| S-1200B22-I6T2G | P            | O   | H   |
| S-1200B23-I6T2G | P            | O   | I   |
| S-1200B24-I6T2G | P            | O   | J   |
| S-1200B25-I6T2G | P            | O   | K   |
| S-1200B26-I6T2G | P            | O   | L   |
| S-1200B27-I6T2G | P            | O   | M   |
| S-1200B28-I6T2G | P            | O   | N   |
| S-1200B29-I6T2G | P            | O   | O   |
| S-1200B30-I6T2G | P            | O   | P   |
| S-1200B31-I6T2G | P            | O   | Q   |
| S-1200B32-I6T2G | P            | O   | R   |
| S-1200B33-I6T2G | P            | O   | S   |
| S-1200B34-I6T2G | P            | O   | T   |
| S-1200B35-I6T2G | P            | O   | U   |

| Product name    | Product code |     |     |
|-----------------|--------------|-----|-----|
|                 | (1)          | (2) | (3) |
| S-1200B36-I6T2G | P            | O   | V   |
| S-1200B37-I6T2G | P            | O   | W   |
| S-1200B38-I6T2G | P            | O   | X   |
| S-1200B39-I6T2G | P            | O   | Y   |
| S-1200B40-I6T2G | P            | O   | Z   |
| S-1200B41-I6T2G | P            | P   | A   |
| S-1200B42-I6T2G | P            | P   | B   |
| S-1200B43-I6T2G | P            | P   | C   |
| S-1200B44-I6T2G | P            | P   | D   |
| S-1200B45-I6T2G | P            | P   | E   |
| S-1200B46-I6T2G | P            | P   | F   |
| S-1200B47-I6T2G | P            | P   | G   |
| S-1200B48-I6T2G | P            | P   | H   |
| S-1200B49-I6T2G | P            | P   | I   |
| S-1200B50-I6T2G | P            | P   | J   |
| S-1200B51-I6T2G | P            | P   | K   |
| S-1200B52-I6T2G | P            | P   | L   |
| S-1200B53-I6T2G | P            | P   | M   |
| S-1200B54-I6T2G | P            | P   | N   |
| S-1200B55-I6T2G | P            | P   | O   |

**Remark** Please contact our sales office for products with type A products.

(2) SOT-23-5



(1) to (3) : Product code (Refer to **Product name vs. Product code**)  
 (4) : Lot number

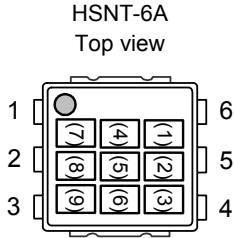
**Product name vs. Product code**

| Product name    | Product code |     |     |
|-----------------|--------------|-----|-----|
|                 | (1)          | (2) | (3) |
| S-1200B15-M5T1G | P            | O   | A   |
| S-1200B16-M5T1G | P            | O   | B   |
| S-1200B17-M5T1G | P            | O   | C   |
| S-1200B18-M5T1G | P            | O   | D   |
| S-1200B19-M5T1G | P            | O   | E   |
| S-1200B20-M5T1G | P            | O   | F   |
| S-1200B21-M5T1G | P            | O   | G   |
| S-1200B22-M5T1G | P            | O   | H   |
| S-1200B23-M5T1G | P            | O   | I   |
| S-1200B24-M5T1G | P            | O   | J   |
| S-1200B25-M5T1G | P            | O   | K   |
| S-1200B26-M5T1G | P            | O   | L   |
| S-1200B27-M5T1G | P            | O   | M   |
| S-1200B28-M5T1G | P            | O   | N   |
| S-1200B29-M5T1G | P            | O   | O   |
| S-1200B30-M5T1G | P            | O   | P   |
| S-1200B31-M5T1G | P            | O   | Q   |
| S-1200B32-M5T1G | P            | O   | R   |
| S-1200B33-M5T1G | P            | O   | S   |
| S-1200B34-M5T1G | P            | O   | T   |
| S-1200B35-M5T1G | P            | O   | U   |

| Product name    | Product code |     |     |
|-----------------|--------------|-----|-----|
|                 | (1)          | (2) | (3) |
| S-1200B36-M5T1G | P            | O   | V   |
| S-1200B37-M5T1G | P            | O   | W   |
| S-1200B38-M5T1G | P            | O   | X   |
| S-1200B39-M5T1G | P            | O   | Y   |
| S-1200B40-M5T1G | P            | O   | Z   |
| S-1200B41-M5T1G | P            | P   | A   |
| S-1200B42-M5T1G | P            | P   | B   |
| S-1200B43-M5T1G | P            | P   | C   |
| S-1200B44-M5T1G | P            | P   | D   |
| S-1200B45-M5T1G | P            | P   | E   |
| S-1200B46-M5T1G | P            | P   | F   |
| S-1200B47-M5T1G | P            | P   | G   |
| S-1200B48-M5T1G | P            | P   | H   |
| S-1200B49-M5T1G | P            | P   | I   |
| S-1200B50-M5T1G | P            | P   | J   |
| S-1200B51-M5T1G | P            | P   | K   |
| S-1200B52-M5T1G | P            | P   | L   |
| S-1200B53-M5T1G | P            | P   | M   |
| S-1200B54-M5T1G | P            | P   | N   |
| S-1200B55-M5T1G | P            | P   | O   |

**Remark** Please contact our sales office for products with type A products.

(3) HSNT-6A



- (1) to (3) : Product code (Refer to **Product name vs. Product code**)
- (4) : Blank
- (5) to (9) : Lot number

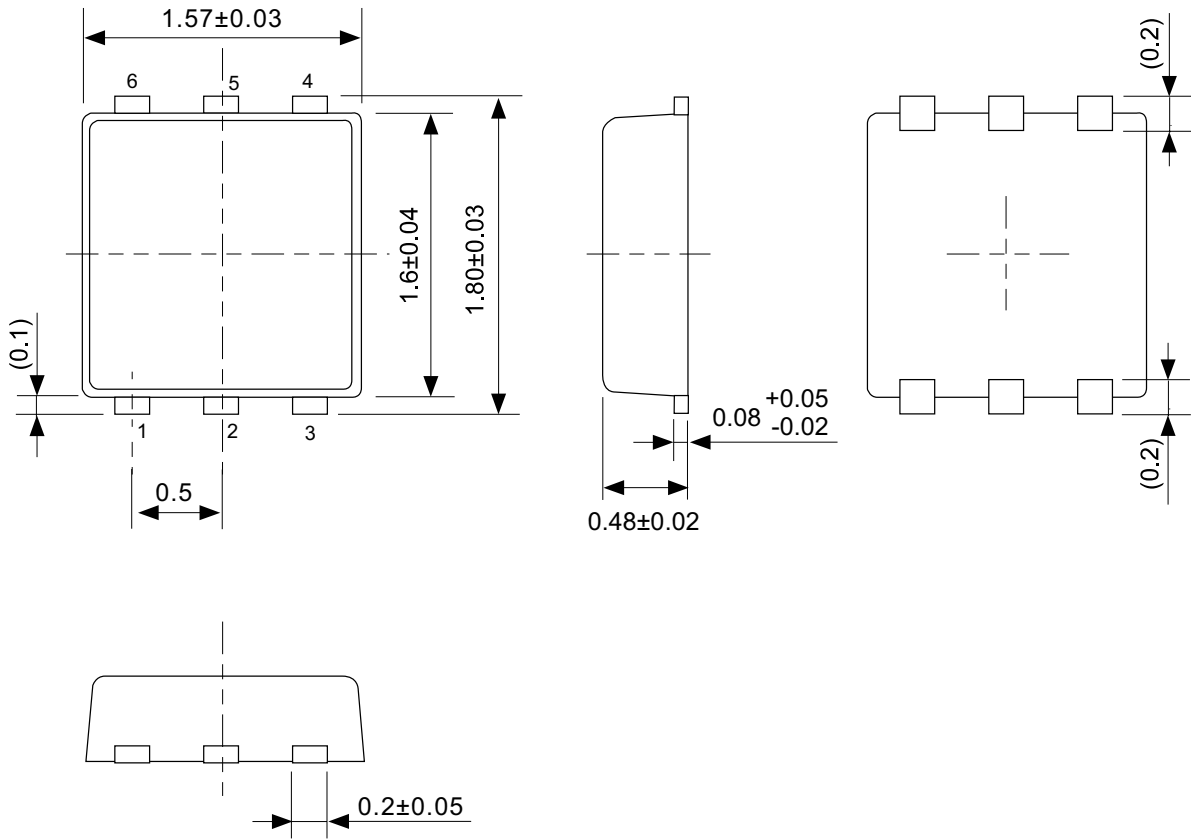
**Product name vs. Product code**

| Product name    | Product code |     |     |
|-----------------|--------------|-----|-----|
|                 | (1)          | (2) | (3) |
| S-1200B15-A6T1S | P            | O   | A   |
| S-1200B16-A6T1S | P            | O   | B   |
| S-1200B17-A6T1S | P            | O   | C   |
| S-1200B18-A6T1S | P            | O   | D   |
| S-1200B19-A6T1S | P            | O   | E   |
| S-1200B20-A6T1S | P            | O   | F   |
| S-1200B21-A6T1S | P            | O   | G   |
| S-1200B22-A6T1S | P            | O   | H   |
| S-1200B23-A6T1S | P            | O   | I   |
| S-1200B24-A6T1S | P            | O   | J   |
| S-1200B25-A6T1S | P            | O   | K   |
| S-1200B26-A6T1S | P            | O   | L   |
| S-1200B27-A6T1S | P            | O   | M   |
| S-1200B28-A6T1S | P            | O   | N   |
| S-1200B29-A6T1S | P            | O   | O   |
| S-1200B30-A6T1S | P            | O   | P   |
| S-1200B31-A6T1S | P            | O   | Q   |
| S-1200B32-A6T1S | P            | O   | R   |
| S-1200B33-A6T1S | P            | O   | S   |
| S-1200B34-A6T1S | P            | O   | T   |
| S-1200B35-A6T1S | P            | O   | U   |

| Product name    | Product code |     |     |
|-----------------|--------------|-----|-----|
|                 | (1)          | (2) | (3) |
| S-1200B36-A6T1S | P            | O   | V   |
| S-1200B37-A6T1S | P            | O   | W   |
| S-1200B38-A6T1S | P            | O   | X   |
| S-1200B39-A6T1S | P            | O   | Y   |
| S-1200B40-A6T1S | P            | O   | Z   |
| S-1200B41-A6T1S | P            | P   | A   |
| S-1200B42-A6T1S | P            | P   | B   |
| S-1200B43-A6T1S | P            | P   | C   |
| S-1200B44-A6T1S | P            | P   | D   |
| S-1200B45-A6T1S | P            | P   | E   |
| S-1200B46-A6T1S | P            | P   | F   |
| S-1200B47-A6T1S | P            | P   | G   |
| S-1200B48-A6T1S | P            | P   | H   |
| S-1200B49-A6T1S | P            | P   | I   |
| S-1200B50-A6T1S | P            | P   | J   |
| S-1200B51-A6T1S | P            | P   | K   |
| S-1200B52-A6T1S | P            | P   | L   |
| S-1200B53-A6T1S | P            | P   | M   |
| S-1200B54-A6T1S | P            | P   | N   |
| S-1200B55-A6T1S | P            | P   | O   |

**Remark** Please contact our sales office for products with type A products.

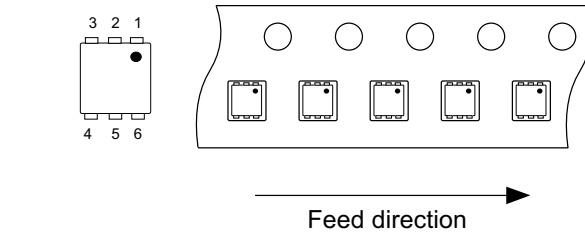
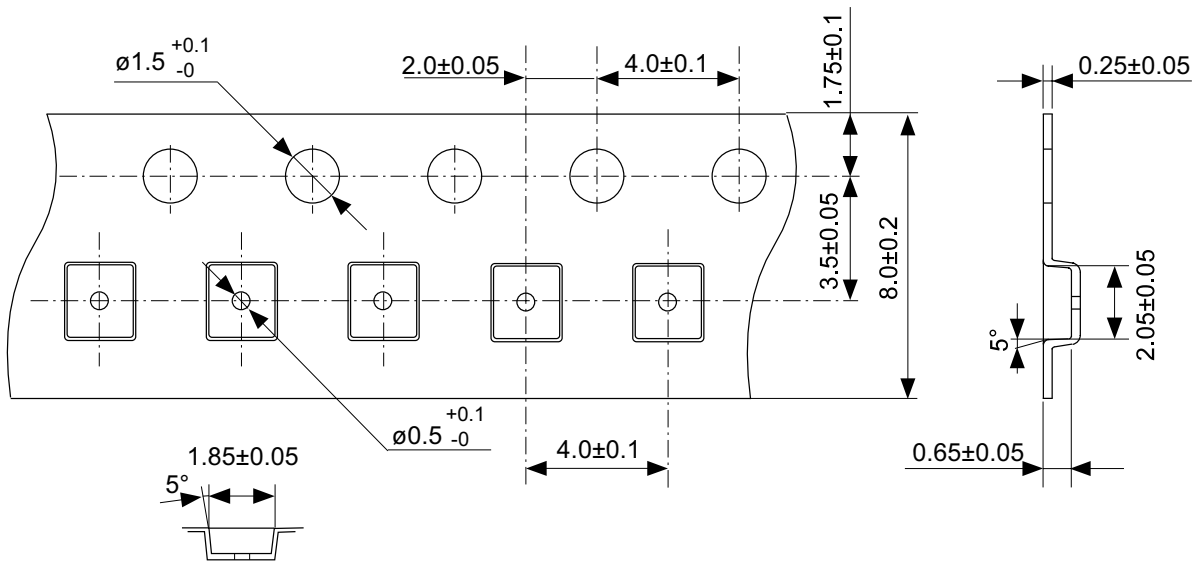




No. PI006-A-P-SD-2.0

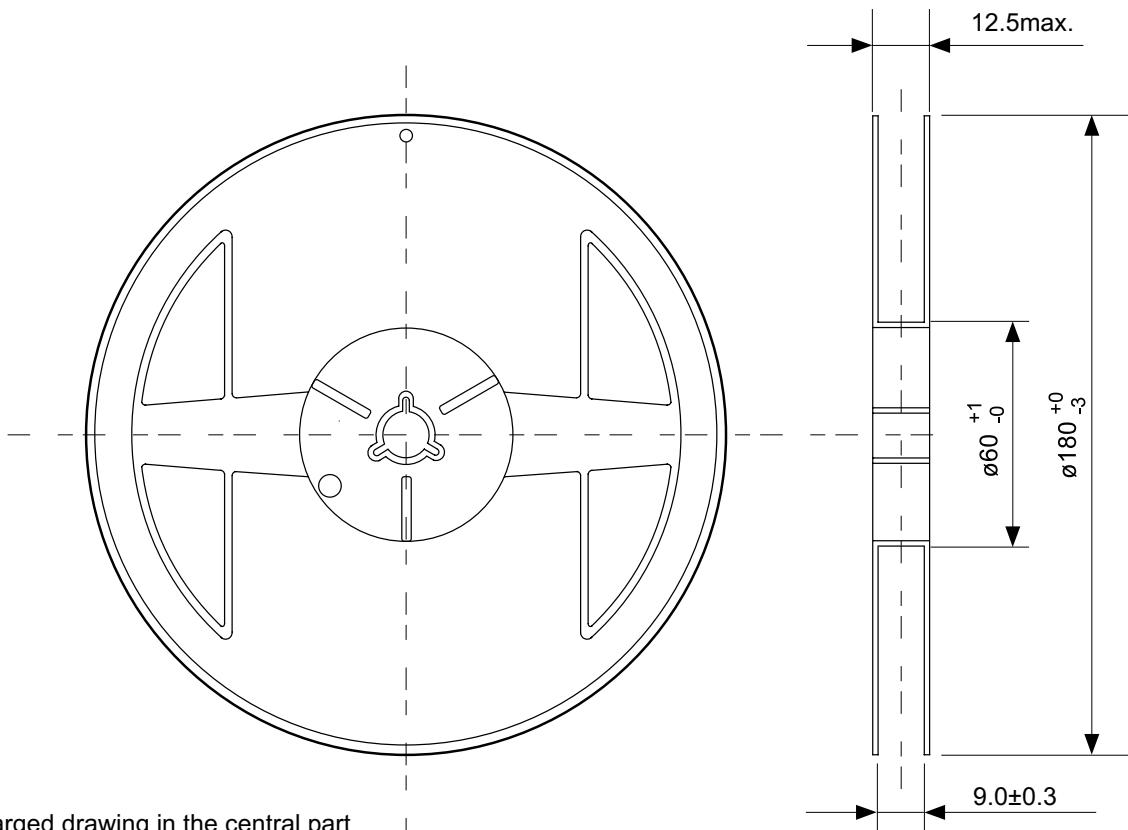
|       |                            |
|-------|----------------------------|
| TITLE | SNT-6A(H)-A-PKG Dimensions |
| No.   | PI006-A-P-SD-2.0           |
| SCALE |                            |
| UNIT  | mm                         |
|       |                            |

Seiko Instruments Inc.

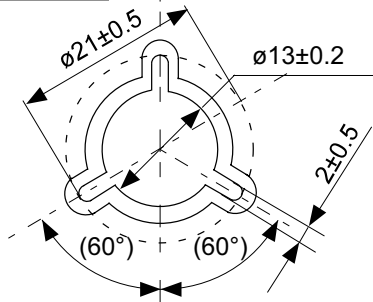


No. PI006-A-C-SD-1.0

|                        |                          |
|------------------------|--------------------------|
| TITLE                  | SNT-6A(H)-A-Carrier Tape |
| No.                    | PI006-A-C-SD-1.0         |
| SCALE                  |                          |
| UNIT                   | mm                       |
| Seiko Instruments Inc. |                          |

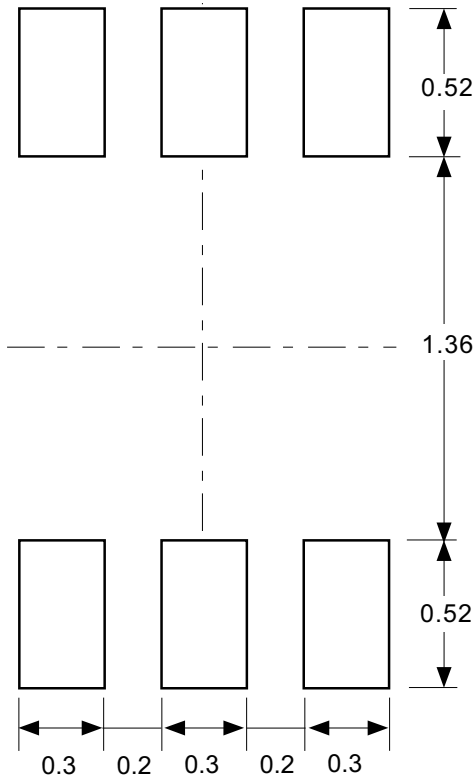


Enlarged drawing in the central part



No. PI006-A-R-SD-1.0

|                        |                  |      |       |
|------------------------|------------------|------|-------|
| TITLE                  | SNT-6A(H)-A-Reel |      |       |
| No.                    | PI006-A-R-SD-1.0 |      |       |
| SCALE                  |                  | QTY. | 5,000 |
| UNIT                   | mm               |      |       |
|                        |                  |      |       |
| Seiko Instruments Inc. |                  |      |       |

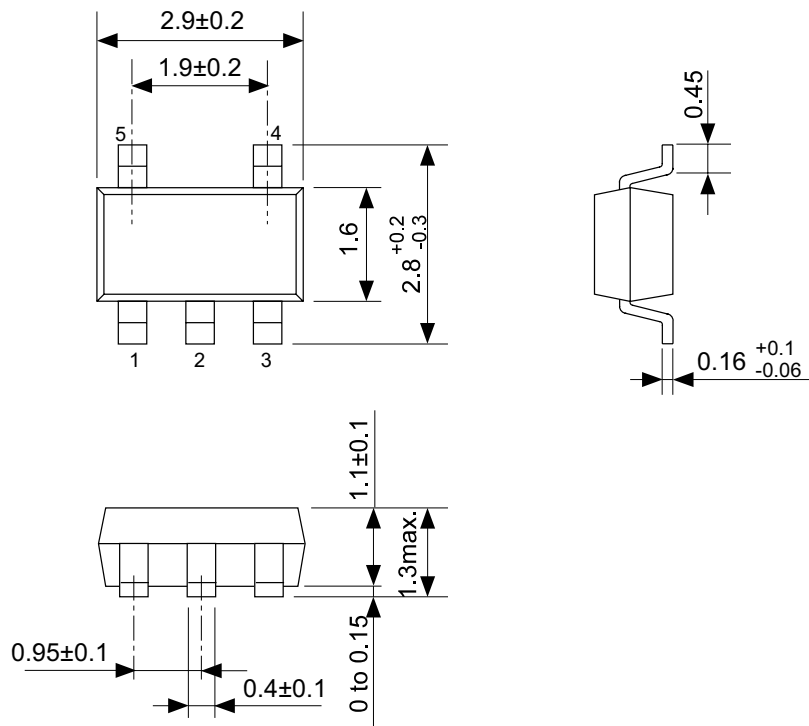


Caution Making the wire pattern under the package is possible. However, note that the package may be upraised due to the thickness made by the silk screen printing and of a solder resist on the pattern because this package does not have the standoff.

注意 パッケージ下への配線パターン形成は可能ですが、本パッケージはスタンドオフが無いので、パターン上のレジスト厚み、シルク印刷の厚みによってパッケージが持ち上がる場合がありますのでご配慮ください。

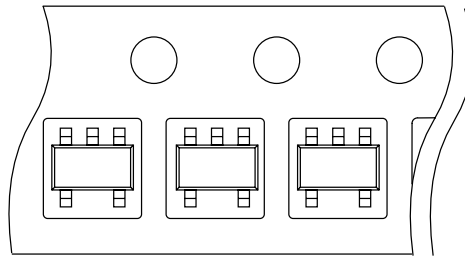
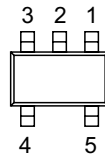
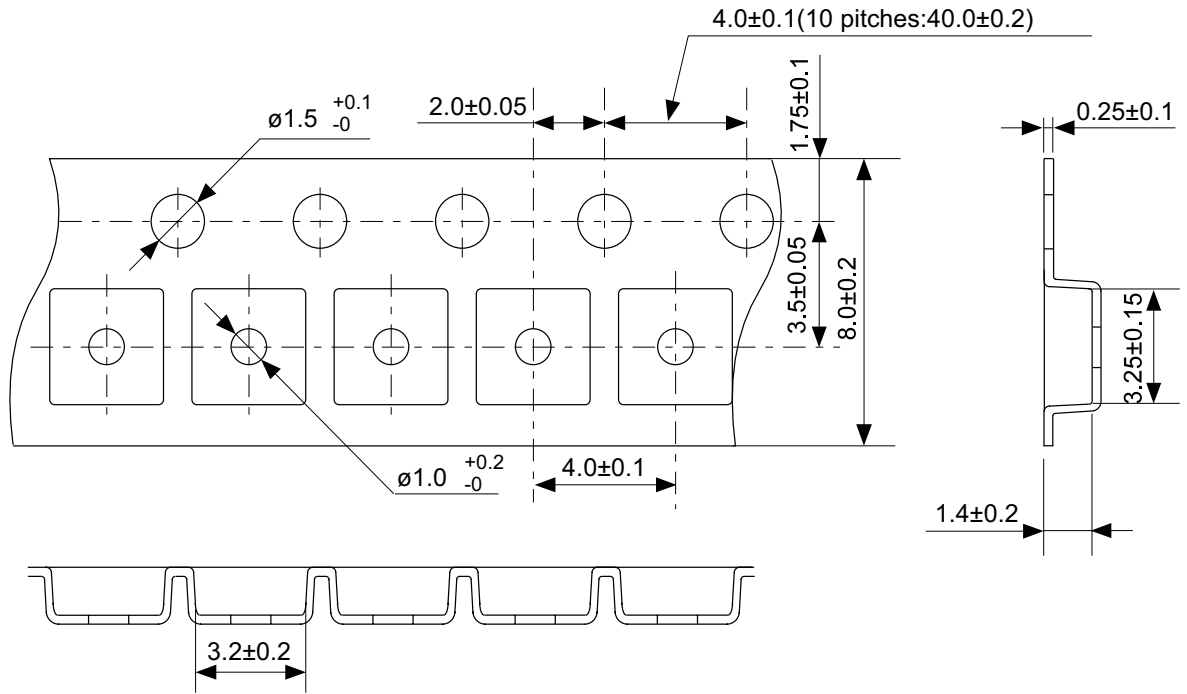
No. PI006-A-L-SD-3.0

|                        |                                 |
|------------------------|---------------------------------|
| TITLE                  | SNT-6A(H)-A-Land Recommendation |
| No.                    | PI006-A-L-SD-3.0                |
| SCALE                  |                                 |
| UNIT                   | mm                              |
|                        |                                 |
| Seiko Instruments Inc. |                                 |



No. MP005-A-P-SD-1.2

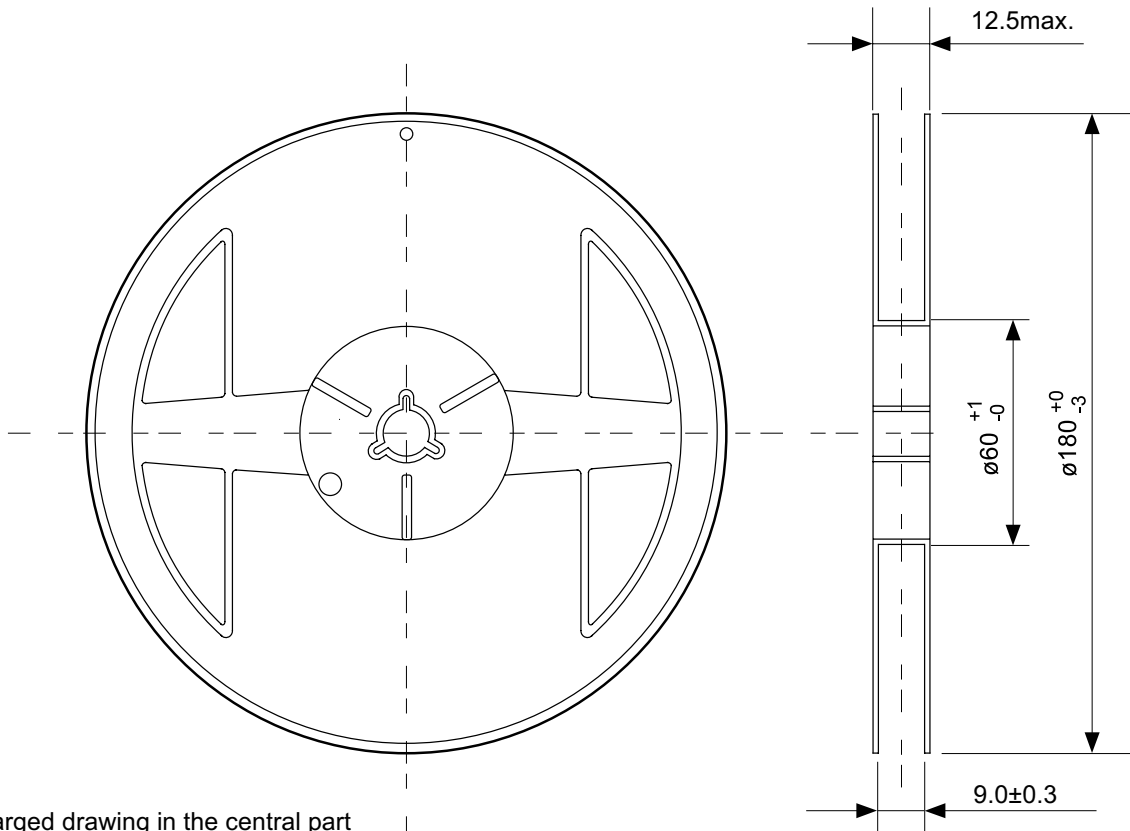
|                        |                         |
|------------------------|-------------------------|
| TITLE                  | SOT235-A-PKG Dimensions |
| No.                    | MP005-A-P-SD-1.2        |
| SCALE                  |                         |
| UNIT                   | mm                      |
| Seiko Instruments Inc. |                         |



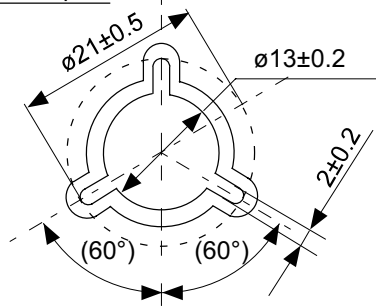
→  
Feed direction

No. MP005-A-C-SD-2.1

|                        |                       |
|------------------------|-----------------------|
| TITLE                  | SOT235-A-Carrier Tape |
| No.                    | MP005-A-C-SD-2.1      |
| SCALE                  |                       |
| UNIT                   | mm                    |
| Seiko Instruments Inc. |                       |

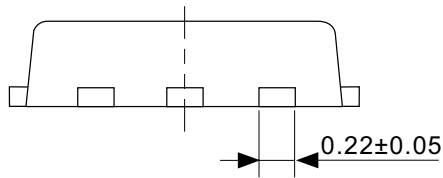
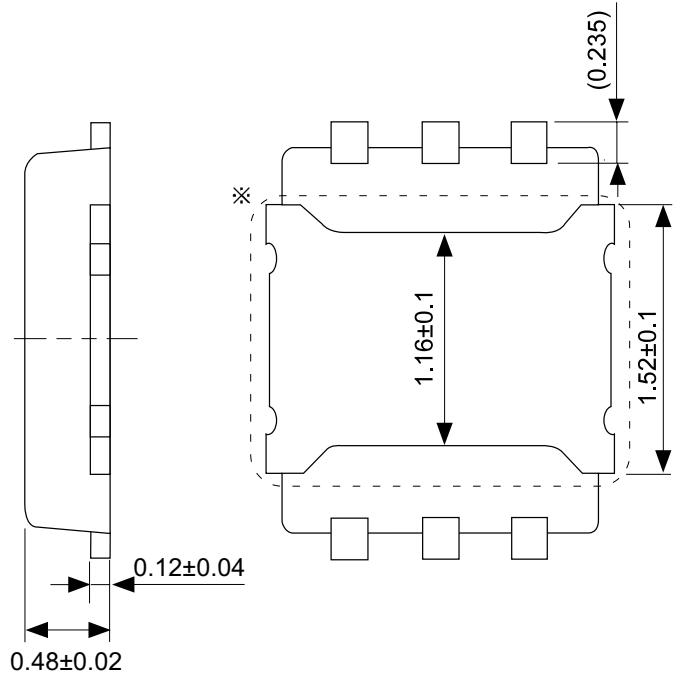
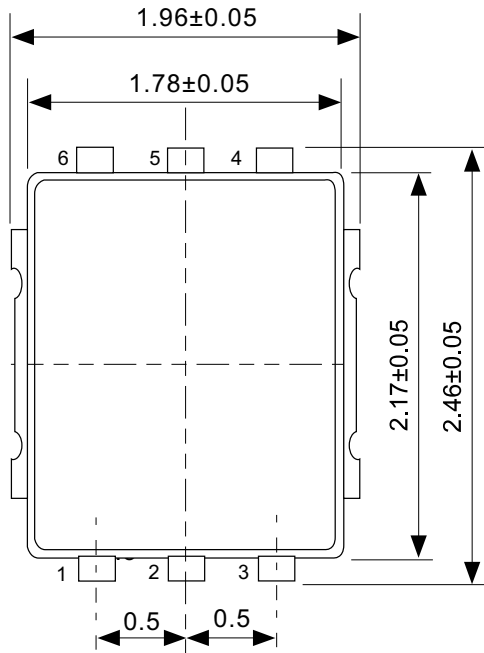


Enlarged drawing in the central part



No. MP005-A-R-SD-1.1

|                        |                  |      |       |
|------------------------|------------------|------|-------|
| TITLE                  | SOT235-A-Reel    |      |       |
| No.                    | MP005-A-R-SD-1.1 |      |       |
| SCALE                  |                  | QTY. | 3,000 |
| UNIT                   | mm               |      |       |
|                        |                  |      |       |
| Seiko Instruments Inc. |                  |      |       |

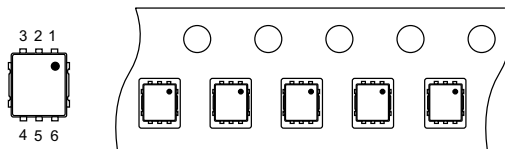
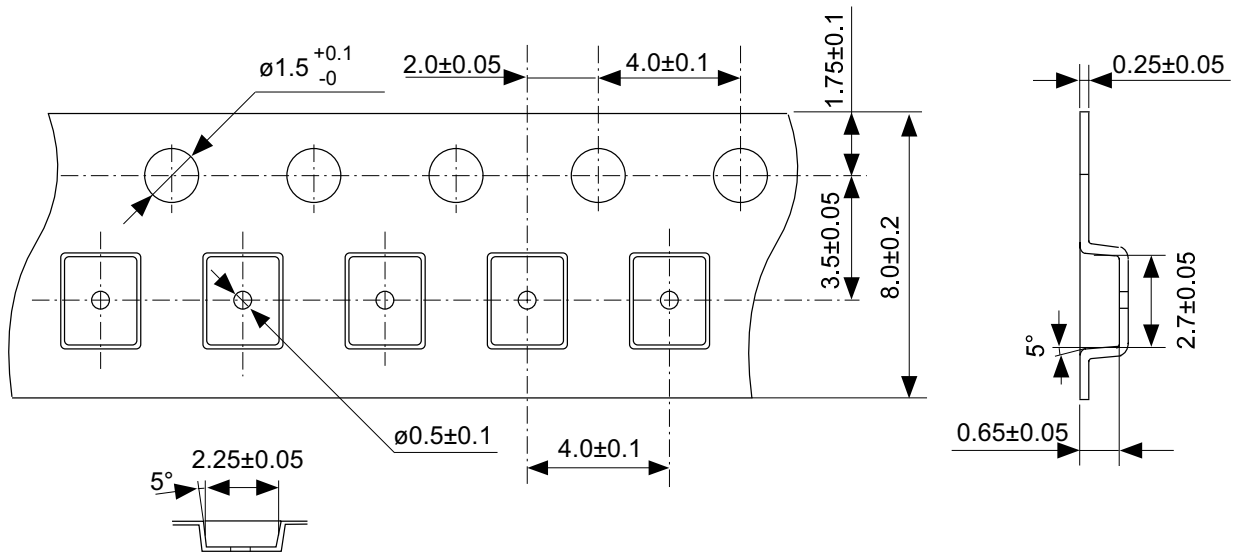


※ The heatsink of back side has different electric potential depending on the product.  
 Confirm specifications of each product.  
 Do not use it as the function of electrode.

No. PJ006-A-P-SD-1.0

|                        |                          |
|------------------------|--------------------------|
| TITLE                  | HSNT-6A-A-PKG Dimensions |
| No.                    | PJ006-A-P-SD-1.0         |
| SCALE                  |                          |
| UNIT                   | mm                       |
| Seiko Instruments Inc. |                          |

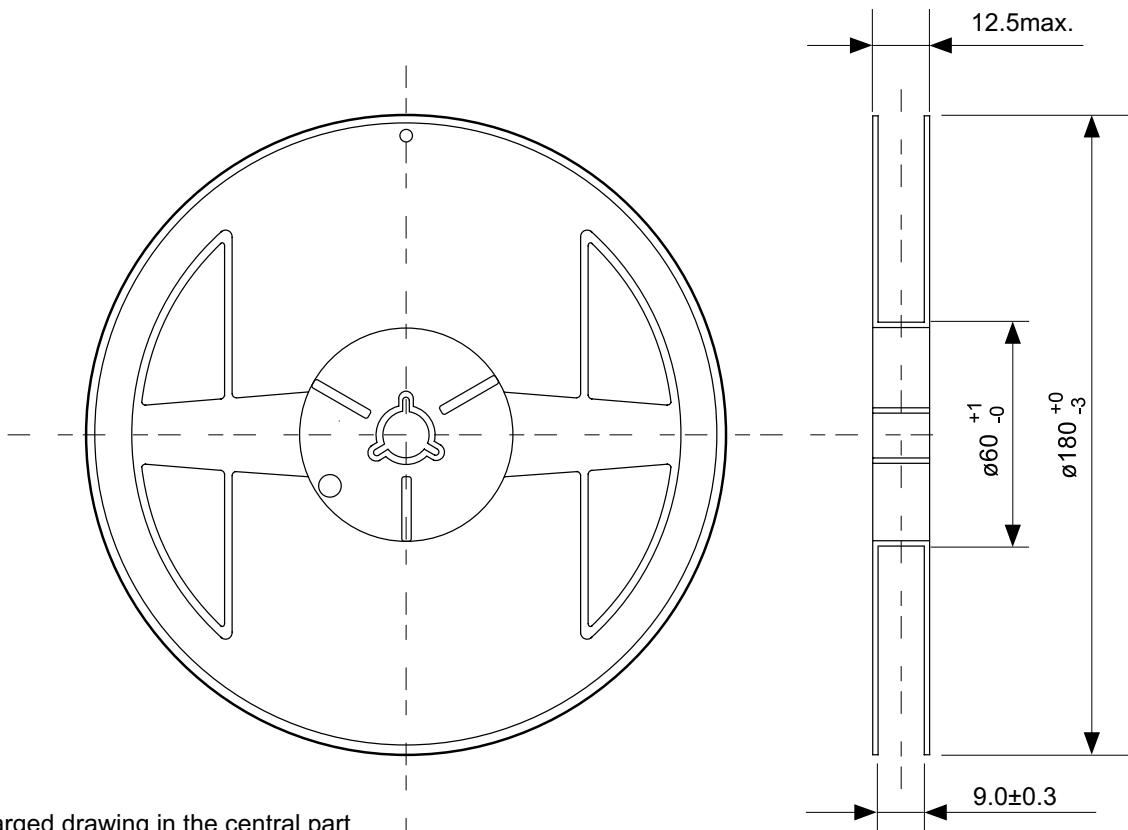




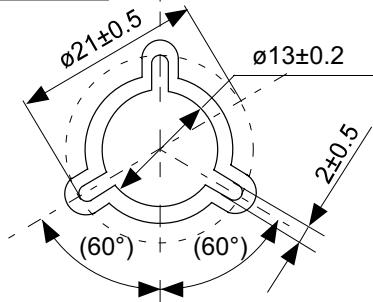
Feed direction

No. PJ006-A-C-SD-1.0

|                        |                        |
|------------------------|------------------------|
| TITLE                  | HSNT-6A-A-Carrier Tape |
| No.                    | PJ006-A-C-SD-1.0       |
| SCALE                  |                        |
| UNIT                   | mm                     |
| Seiko Instruments Inc. |                        |



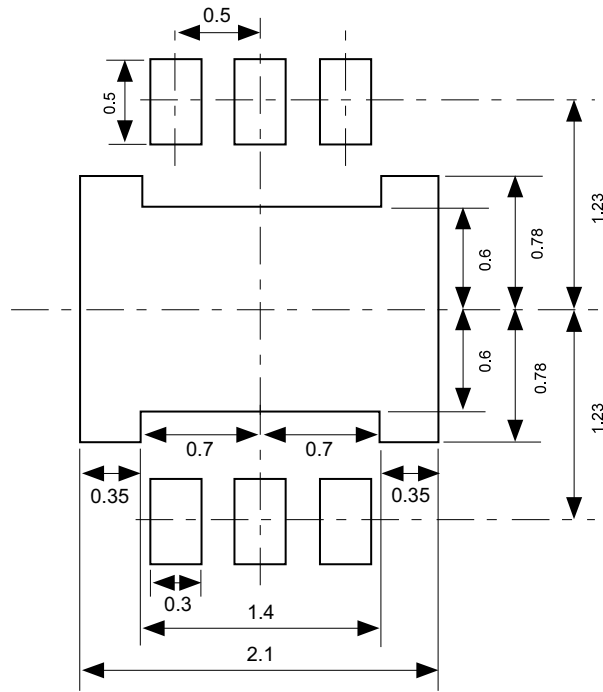
Enlarged drawing in the central part



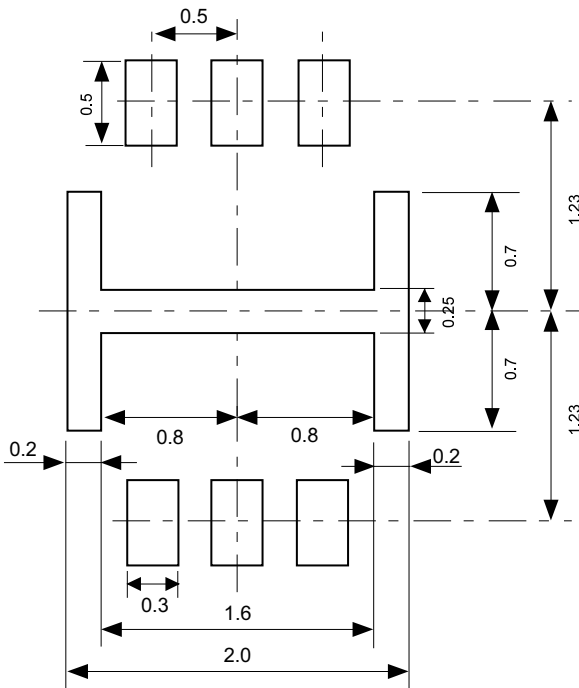
No. PJ006-A-R-SD-1.0

|                        |                  |      |       |
|------------------------|------------------|------|-------|
| TITLE                  | HSNT-6A-A-Reel   |      |       |
| No.                    | PJ006-A-R-SD-1.0 |      |       |
| SCALE                  |                  | QTY. | 5,000 |
| UNIT                   | mm               |      |       |
|                        |                  |      |       |
| Seiko Instruments Inc. |                  |      |       |

## Land Recommendation



## Stencil Opening Recommendation



No. PJ006-A-LM-SD-1.0

|                        |                                  |
|------------------------|----------------------------------|
| TITLE                  | HSNT-6A-A-Land & Stencil Opening |
| No.                    | PJ006-A-LM-SD-1.0                |
| SCALE                  |                                  |
| UNIT                   | mm                               |
| Seiko Instruments Inc. |                                  |

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