SII

S-13A1 Series

HIGH RIPPLE-REJECTION LOW DROPOUT HIGH OUTPUT CURRENT CMOS VOLTAGE REGULATOR

www.sii-ic.com

Rev.1.5_00

The S-13A1 Series is a positive voltage regulator with a low dropout voltage, high-accuracy output voltage, and low current consumption developed based on CMOS technology.
A 2.2 μF small ceramic capacitor can be used, and the very small dropout voltage and the large output current due to the built-in transistor with low on-resistance are provided. The S-13A1 Series includes a load current protection circuit that prevents the output current from exceeding the current capacitance of the output transistor and a thermal shutdown circuit that prevents damage due to overheating. In addition to the types in which output voltage is set inside the IC, a type for which output voltage can be set via an external resistor is added to a lineup. Also, the S-13A1 Series includes an inrush current limit circuit to limit the excess inrush current generated at power-on or at the time when the ON / OFF pin is set to ON. High heat radiation HSOP-6 and small SOT-89-5, HSNT-6A packages realize high-density mounting.

■ Features

- Output voltage (internally set): 1.0 V to 3.5 V, selectable in 0.05 V step
- Output voltage (externally set): 1.05 V to 5.0 V, settable via external resistor (HSOP-6, SOT-89-5 only)
- Input voltage: 1.5 V to 5.5 V
- Output voltage accuracy: ±1.0% (internally set, 1.0 V to 1.45 V output product: ±15 mV)
- Dropout voltage: 70 mV typ. (3.0 V output product, I_{OUT} = 300 mA)
- Current consumption: During operation: 60 μA typ., 90 μA max.
  During power-off: 0.1 μA typ., 1.0 μA max.
- Output current: Possible to output 1000 mA ($V_{IN} \geq V_{OUT(S)} + 1.0$ V)*1
- Input and output capacitors: A ceramic capacitor of 2.2 μF or more can be used.
- Ripple rejection: 70 dB typ. (f = 1.0 kHz)
- Built-in overcurrent protection circuit: Limits overcurrent of output transistor.
- Built-in thermal shutdown circuit: Prevents damage caused by heat.
- Built-in inrush current limit circuit: Limits excessive inrush current generated at power-on or at the time when the ON / OFF pin is set to ON.
  For types in which output voltage is internally set of HSOP-6, SOT-89-5, inrush current limit time can be changed via external resistor (C_{SS}).
  Inrush current limit time 0.7 ms typ.
  (types in which output voltage is internally set of HSOP-6, SOT-89-5, C_{SS} = 1.0 nF)
  Inrush current limit time 0.4 ms typ.
  (types in which output voltage is internally set of HSOP-6, SOT-89-5, SSC pin = open)
  Inrush current limit time 0.4 ms typ.
  (types in which output voltage is externally set of HSOP-6, SOT-89-5, types in which output voltage is internally set of HSNT-6A*2)
- Built-in ON / OFF circuit: Ensures long battery life.
- Pull-down resistor is selectable.
- Discharge shunt function is selectable.
- Operation temperature range: Ta = −40°C to +85°C
- Lead-free (Sn 100%), halogen-free

***1.** Attention should be paid to the power dissipation of the package when the output current is large.
***2.** Types in which output voltage is externally set are unavailable.

■ Applications

- Constant-voltage power supply for battery-powered device
- Constant-voltage power supply for TV, notebook PC and home electric appliance
- Constant-voltage power supply for portable equipment

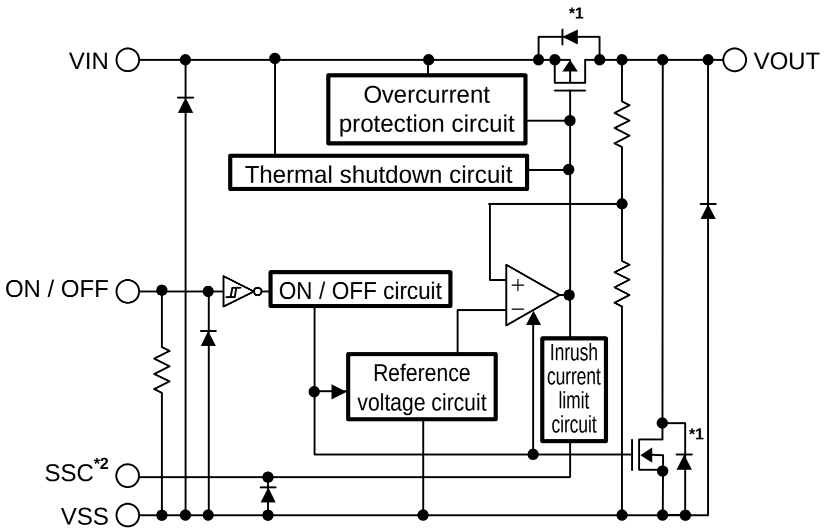
■ Packages

- HSOP-6
- SOT-89-5
- HSNT-6A

■ Block Diagrams

1. Types in which output voltage is internally set

1. 1 S-13A1 Series A type (S-13A1Axx)

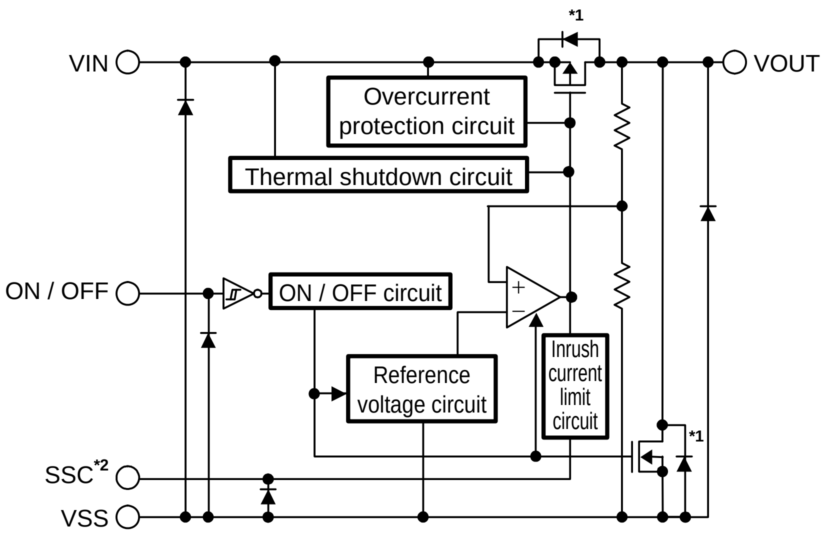


Function	Status
ON / OFF logic	Active "H"
Discharge shunt function	Available
Pull-down resistor	Available

***1.** Parasitic diode
***2.** HSOP-6, SOT-89-5 only.

Figure 1

1. 2 S-13A1 Series B type (S-13A1Bxx)

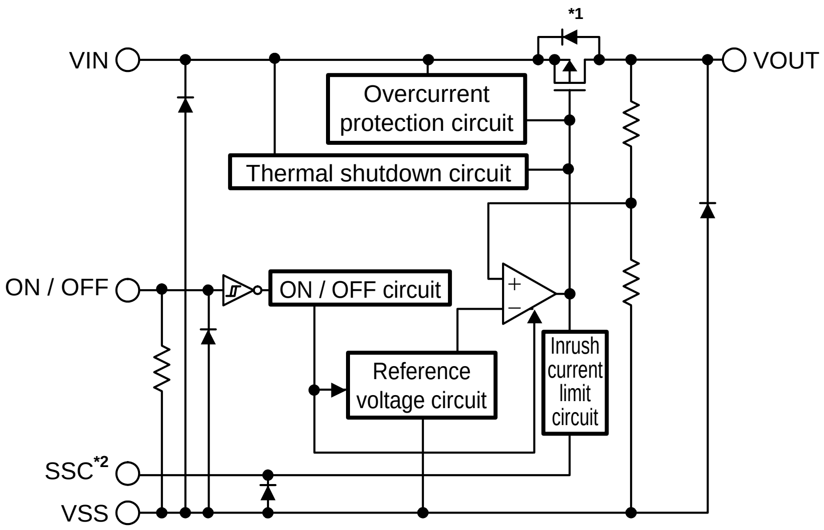


Function	Status
ON / OFF logic	Active "H"
Discharge shunt function	Available
Pull-down resistor	Unavailable

***1.** Parasitic diode
***2.** HSOP-6, SOT-89-5 only.

Figure 2

1. 3 S-13A1 Series C type (S-13A1Cxx)

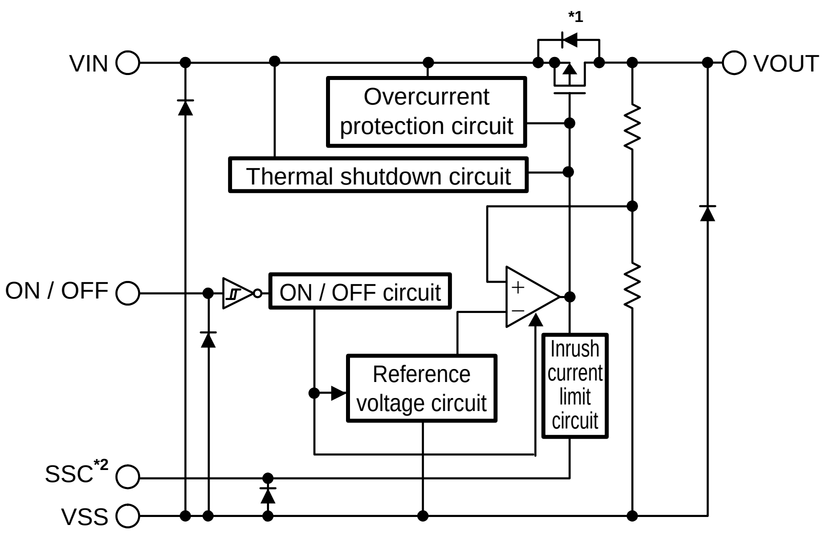


Function	Status
ON / OFF logic	Active "H"
Discharge shunt function	Unavailable
Pull-down resistor	Available

***1.** Parasitic diode
***2.** HSOP-6, SOT-89-5 only.

Figure 3

1. 4 S-13A1 Series D type (S-13A1Dxx)



Function	Status
ON / OFF logic	Active "H"
Discharge shunt function	Unavailable
Pull-down resistor	Unavailable

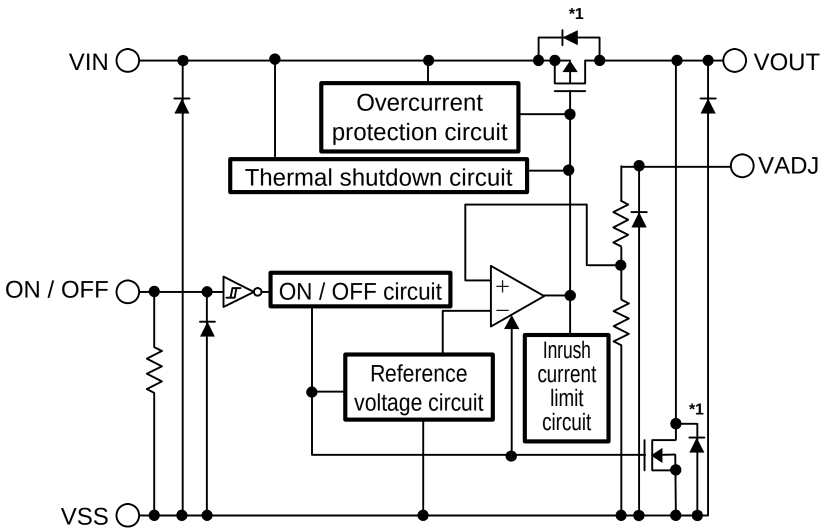
***1.** Parasitic diode
***2.** HSOP-6, SOT-89-5 only.

Figure 4

2. Types in which output voltage is externally set (HSOP-6, SOT-89-5 only)

2. 1 S-13A1 Series A type (S-13A1A00)

Function	Status
ON / OFF logic	Active "H"
Discharge shunt function	Available
Pull-down resistor	Available

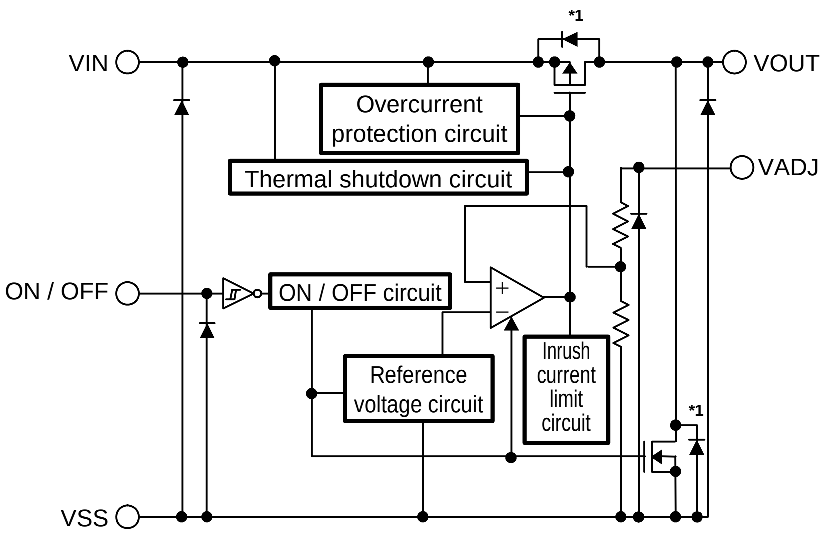


***1.** Parasitic diode

Figure 5

2. 2 S-13A1 Series B type (S-13A1B00)

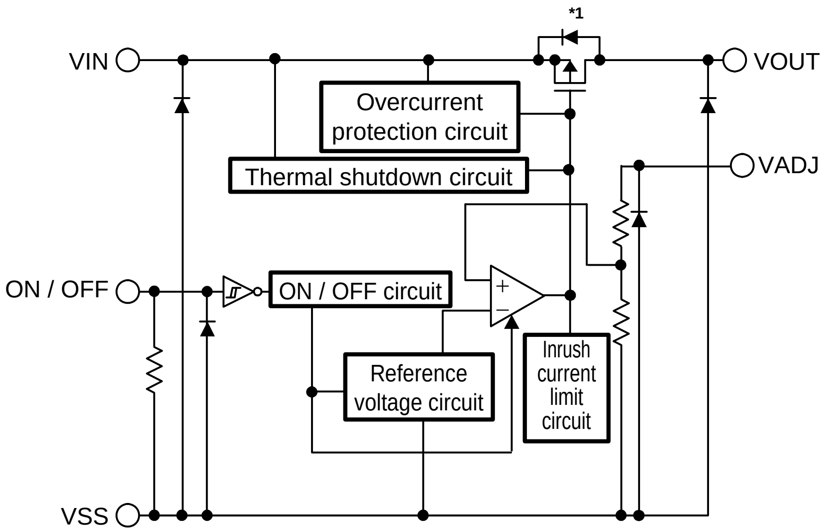
Function	Status
ON / OFF logic	Active "H"
Discharge shunt function	Available
Pull-down resistor	Unavailable



***1.** Parasitic diode

Figure 6

2. 3 S-13A1 Series C type (S-13A1C00)

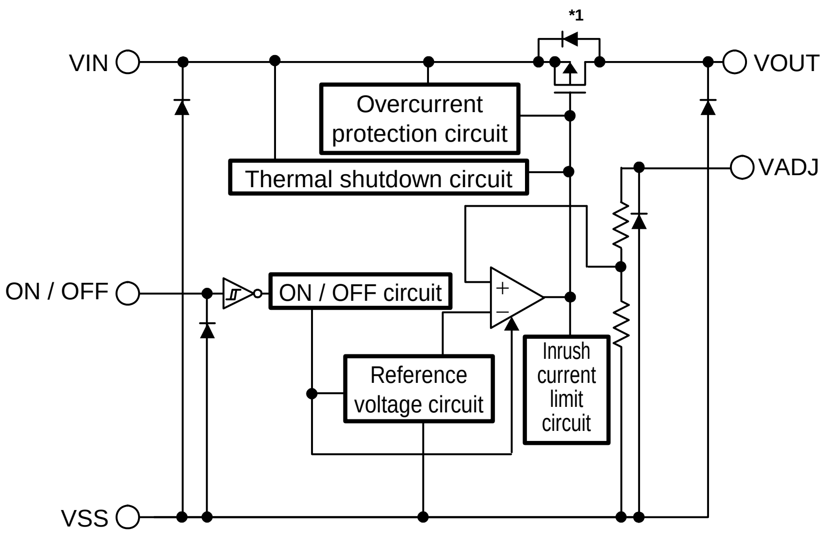


Function	Status
ON / OFF logic	Active "H"
Discharge shunt function	Unavailable
Pull-down resistor	Available

***1.** Parasitic diode

Figure 7

2. 4 S-13A1 Series D type (S-13A1D00)



Function	Status
ON / OFF logic	Active "H"
Discharge shunt function	Unavailable
Pull-down resistor	Unavailable

***1.** Parasitic diode

Figure 8

■ Product Name Structure

Users can select the product type, output voltage, and package type for the S-13A1 Series. Refer to "**1. Product name**" regarding the contents of product name, "**2. Function list of product type**" regarding the product type, "**3. Packages**" regarding the package drawings, "**4. Product name list**" regarding details of the product name.

1. Product name

1. 1 HSOP-6, SOT-89-5

S-13A1 x xx - xxxx U 3

- Environmental code (U)
  - U: Lead-free (Sn 100%), halogen-free
- Package abbreviation and IC packing specifications*1 (xxxx)
  - E6T1: HSOP-6, Tape
  - U5T1: SOT-89-5, Tape
- Output voltage*2 (xx)
  - 00: Externally set
  - 10 to 35: Internally set
  - (e.g., when the output voltage is 1.0 V, it is expressed as 10.)
- Product type*3 (x)
  - A to D

***1.** Refer to the tape drawing.
***2.** If you request the product which has 0.05 V step, contact our sales office.
***3.** Refer to "**2. Function list of product type**".

1. 2 HSNT-6A

S-13A1 x xx - A6T1 U 3

- Environmental code (U)
  - U: Lead-free (Sn 100%), halogen-free
- Package abbreviation and IC packing specifications*1 (A6T1)
  - A6T1: HSNT-6A, Tape
- Output voltage*2 (xx)
  - 10 to 35: Internally set*3
  - (e.g., when the output voltage is 1.0 V, it is expressed as 10.)
- Product type*4 (x)
  - A to D

***1.** Refer to the tape drawing.
***2.** If you request the product which has 0.05 V step, contact our sales office.
***3.** Types in which output voltage is externally set are unavailable.
***4.** Refer to "**2. Function list of product type**".

2. Function list of product type

Table 1

Product Type	ON / OFF Logic	Discharge Shunt Function	Pull-down Resistor	Output Voltage	Inrush Current Limit Time	Package
A	Active "H"	Available	Available	Internally set	Adjustable via an external capacitor (C_{SS})	HSOP-6, SOT-89-5
					Fixed to 0.4 ms typ.	HSNT-6A
				Externally set	Fixed to 0.4 ms typ.	HSOP-6, SOT-89-5
B	Active "H"	Available	Unavailable	Internally set	Adjustable via an external capacitor (C_{SS})	HSOP-6, SOT-89-5
					Fixed to 0.4 ms typ.	HSNT-6A
				Externally set	Fixed to 0.4 ms typ.	HSOP-6, SOT-89-5
C	Active "H"	Unavailable	Available	Internally set	Adjustable via an external capacitor (C_{SS})	HSOP-6, SOT-89-5
					Fixed to 0.4 ms typ.	HSNT-6A
				Externally set	Fixed to 0.4 ms typ.	HSOP-6, SOT-89-5
D	Active "H"	Unavailable	Unavailable	Internally set	Adjustable via an external capacitor (C_{SS})	HSOP-6, SOT-89-5
					Fixed to 0.4 ms typ.	HSNT-6A
				Externally set	Fixed to 0.4 ms typ.	HSOP-6, SOT-89-5

Remark Only types in which output voltage is internally set are available for HSNT-6A package.
Moreover, inrush current limit time is fixed to 0.4 ms typ. that can not be changed.

3. Packages

Table 2 Package Drawing Codes

Package Name	Dimension	Tape	Reel	Land	Stencil Opening
HSOP-6	FH006-A-P-SD	FH006-A-C-SD	FH006-A-R-S1	FH006-A-L-SD	–
SOT-89-5	UP005-A-P-SD	UP005-A-C-SD	UP005-A-R-SD	–	–
HSNT-6A	PJ006-A-P-SD	PJ006-A-C-SD	PJ006-A-R-SD	PJ006-A-LM-SD	PJ006-A-LM-SD

4. Product name list

4. 1 S-13A1 Series A type

ON / OFF logic: Active "H"
Discharge shunt function: Available Pull-down resistor: Available

Table 3

Output Voltage	HSOP-6	SOT-89-5	HSNT-6A
Externally set	S-13A1A00-E6T1U3	S-13A1A00-U5T1U3	–
1.0 V ± 15 mV	S-13A1A10-E6T1U3	S-13A1A10-U5T1U3	S-13A1A10-A6T1U3
1.1 V ± 15 mV	S-13A1A11-E6T1U3	S-13A1A11-U5T1U3	S-13A1A11-A6T1U3
1.2 V ± 15 mV	S-13A1A12-E6T1U3	S-13A1A12-U5T1U3	S-13A1A12-A6T1U3
1.25 V ± 15 mV	S-13A1A1C-E6T1U3	S-13A1A1C-U5T1U3	S-13A1A1C-A6T1U3
1.3 V ± 15 mV	S-13A1A13-E6T1U3	S-13A1A13-U5T1U3	S-13A1A13-A6T1U3
1.4 V ± 15 mV	S-13A1A14-E6T1U3	S-13A1A14-U5T1U3	S-13A1A14-A6T1U3
1.5 V ± 1.0%	S-13A1A15-E6T1U3	S-13A1A15-U5T1U3	S-13A1A15-A6T1U3
1.6 V ± 1.0%	S-13A1A16-E6T1U3	S-13A1A16-U5T1U3	S-13A1A16-A6T1U3
1.7 V ± 1.0%	S-13A1A17-E6T1U3	S-13A1A17-U5T1U3	S-13A1A17-A6T1U3
1.8 V ± 1.0%	S-13A1A18-E6T1U3	S-13A1A18-U5T1U3	S-13A1A18-A6T1U3
1.85 V ± 1.0%	S-13A1A1J-E6T1U3	S-13A1A1J-U5T1U3	S-13A1A1J-A6T1U3
1.9 V ± 1.0%	S-13A1A19-E6T1U3	S-13A1A19-U5T1U3	S-13A1A19-A6T1U3
2.0 V ± 1.0%	S-13A1A20-E6T1U3	S-13A1A20-U5T1U3	S-13A1A20-A6T1U3
2.1 V ± 1.0%	S-13A1A21-E6T1U3	S-13A1A21-U5T1U3	S-13A1A21-A6T1U3
2.2 V ± 1.0%	S-13A1A22-E6T1U3	S-13A1A22-U5T1U3	S-13A1A22-A6T1U3
2.3 V ± 1.0%	S-13A1A23-E6T1U3	S-13A1A23-U5T1U3	S-13A1A23-A6T1U3
2.4 V ± 1.0%	S-13A1A24-E6T1U3	S-13A1A24-U5T1U3	S-13A1A24-A6T1U3
2.5 V ± 1.0%	S-13A1A25-E6T1U3	S-13A1A25-U5T1U3	S-13A1A25-A6T1U3
2.6 V ± 1.0%	S-13A1A26-E6T1U3	S-13A1A26-U5T1U3	S-13A1A26-A6T1U3
2.7 V ± 1.0%	S-13A1A27-E6T1U3	S-13A1A27-U5T1U3	S-13A1A27-A6T1U3
2.8 V ± 1.0%	S-13A1A28-E6T1U3	S-13A1A28-U5T1U3	S-13A1A28-A6T1U3
2.85 V ± 1.0%	S-13A1A2J-E6T1U3	S-13A1A2J-U5T1U3	S-13A1A2J-A6T1U3
2.9 V ± 1.0%	S-13A1A29-E6T1U3	S-13A1A29-U5T1U3	S-13A1A29-A6T1U3
3.0 V ± 1.0%	S-13A1A30-E6T1U3	S-13A1A30-U5T1U3	S-13A1A30-A6T1U3
3.1 V ± 1.0%	S-13A1A31-E6T1U3	S-13A1A31-U5T1U3	S-13A1A31-A6T1U3
3.2 V ± 1.0%	S-13A1A32-E6T1U3	S-13A1A32-U5T1U3	S-13A1A32-A6T1U3
3.3 V ± 1.0%	S-13A1A33-E6T1U3	S-13A1A33-U5T1U3	S-13A1A33-A6T1U3
3.4 V ± 1.0%	S-13A1A34-E6T1U3	S-13A1A34-U5T1U3	S-13A1A34-A6T1U3
3.5 V ± 1.0%	S-13A1A35-E6T1U3	S-13A1A35-U5T1U3	S-13A1A35-A6T1U3

Remark Please contact our sales office for products with specifications other than the above.

4. 2 S-13A1 Series B type

ON / OFF logic: Active "H"
Discharge shunt function: Available Pull-down resistor: Unavailable

Table 4

Output Voltage	HSOP-6	SOT-89-5	HSNT-6A
Externally set	S-13A1B00-E6T1U3	S-13A1B00-U5T1U3	–
1.0 V ± 15 mV	S-13A1B10-E6T1U3	S-13A1B10-U5T1U3	S-13A1B10-A6T1U3
1.1 V ± 15 mV	S-13A1B11-E6T1U3	S-13A1B11-U5T1U3	S-13A1B11-A6T1U3
1.2 V ± 15 mV	S-13A1B12-E6T1U3	S-13A1B12-U5T1U3	S-13A1B12-A6T1U3
1.25 V ± 15 mV	S-13A1B1C-E6T1U3	S-13A1B1C-U5T1U3	S-13A1B1C-A6T1U3
1.3 V ± 15 mV	S-13A1B13-E6T1U3	S-13A1B13-U5T1U3	S-13A1B13-A6T1U3
1.4 V ± 15 mV	S-13A1B14-E6T1U3	S-13A1B14-U5T1U3	S-13A1B14-A6T1U3
1.5 V ± 1.0%	S-13A1B15-E6T1U3	S-13A1B15-U5T1U3	S-13A1B15-A6T1U3
1.6 V ± 1.0%	S-13A1B16-E6T1U3	S-13A1B16-U5T1U3	S-13A1B16-A6T1U3
1.7 V ± 1.0%	S-13A1B17-E6T1U3	S-13A1B17-U5T1U3	S-13A1B17-A6T1U3
1.8 V ± 1.0%	S-13A1B18-E6T1U3	S-13A1B18-U5T1U3	S-13A1B18-A6T1U3
1.85 V ± 1.0%	S-13A1B1J-E6T1U3	S-13A1B1J-U5T1U3	S-13A1B1J-A6T1U3
1.9 V ± 1.0%	S-13A1B19-E6T1U3	S-13A1B19-U5T1U3	S-13A1B19-A6T1U3
2.0 V ± 1.0%	S-13A1B20-E6T1U3	S-13A1B20-U5T1U3	S-13A1B20-A6T1U3
2.1 V ± 1.0%	S-13A1B21-E6T1U3	S-13A1B21-U5T1U3	S-13A1B21-A6T1U3
2.2 V ± 1.0%	S-13A1B22-E6T1U3	S-13A1B22-U5T1U3	S-13A1B22-A6T1U3
2.3 V ± 1.0%	S-13A1B23-E6T1U3	S-13A1B23-U5T1U3	S-13A1B23-A6T1U3
2.4 V ± 1.0%	S-13A1B24-E6T1U3	S-13A1B24-U5T1U3	S-13A1B24-A6T1U3
2.5 V ± 1.0%	S-13A1B25-E6T1U3	S-13A1B25-U5T1U3	S-13A1B25-A6T1U3
2.6 V ± 1.0%	S-13A1B26-E6T1U3	S-13A1B26-U5T1U3	S-13A1B26-A6T1U3
2.7 V ± 1.0%	S-13A1B27-E6T1U3	S-13A1B27-U5T1U3	S-13A1B27-A6T1U3
2.8 V ± 1.0%	S-13A1B28-E6T1U3	S-13A1B28-U5T1U3	S-13A1B28-A6T1U3
2.85 V ± 1.0%	S-13A1B2J-E6T1U3	S-13A1B2J-U5T1U3	S-13A1B2J-A6T1U3
2.9 V ± 1.0%	S-13A1B29-E6T1U3	S-13A1B29-U5T1U3	S-13A1B29-A6T1U3
3.0 V ± 1.0%	S-13A1B30-E6T1U3	S-13A1B30-U5T1U3	S-13A1B30-A6T1U3
3.1 V ± 1.0%	S-13A1B31-E6T1U3	S-13A1B31-U5T1U3	S-13A1B31-A6T1U3
3.2 V ± 1.0%	S-13A1B32-E6T1U3	S-13A1B32-U5T1U3	S-13A1B32-A6T1U3
3.3 V ± 1.0%	S-13A1B33-E6T1U3	S-13A1B33-U5T1U3	S-13A1B33-A6T1U3
3.4 V ± 1.0%	S-13A1B34-E6T1U3	S-13A1B34-U5T1U3	S-13A1B34-A6T1U3
3.5 V ± 1.0%	S-13A1B35-E6T1U3	S-13A1B35-U5T1U3	S-13A1B35-A6T1U3

Remark Please contact our sales office for products with specifications other than the above.

4. 3 S-13A1 Series C type

ON / OFF logic: Active "H"
Discharge shunt function: Unavailable Pull-down resistor: Available

Table 5

Output Voltage	HSOP-6	SOT-89-5	HSNT-6A
Externally set	S-13A1C00-E6T1U3	S-13A1C00-U5T1U3	–
1.0 V ± 15 mV	S-13A1C10-E6T1U3	S-13A1C10-U5T1U3	S-13A1C10-A6T1U3
1.1 V ± 15 mV	S-13A1C11-E6T1U3	S-13A1C11-U5T1U3	S-13A1C11-A6T1U3
1.2 V ± 15 mV	S-13A1C12-E6T1U3	S-13A1C12-U5T1U3	S-13A1C12-A6T1U3
1.25 V ± 15 mV	S-13A1C1C-E6T1U3	S-13A1C1C-U5T1U3	S-13A1C1C-A6T1U3
1.3 V ± 15 mV	S-13A1C13-E6T1U3	S-13A1C13-U5T1U3	S-13A1C13-A6T1U3
1.4 V ± 15 mV	S-13A1C14-E6T1U3	S-13A1C14-U5T1U3	S-13A1C14-A6T1U3
1.5 V ± 1.0%	S-13A1C15-E6T1U3	S-13A1C15-U5T1U3	S-13A1C15-A6T1U3
1.6 V ± 1.0%	S-13A1C16-E6T1U3	S-13A1C16-U5T1U3	S-13A1C16-A6T1U3
1.7 V ± 1.0%	S-13A1C17-E6T1U3	S-13A1C17-U5T1U3	S-13A1C17-A6T1U3
1.8 V ± 1.0%	S-13A1C18-E6T1U3	S-13A1C18-U5T1U3	S-13A1C18-A6T1U3
1.85 V ± 1.0%	S-13A1C1J-E6T1U3	S-13A1C1J-U5T1U3	S-13A1C1J-A6T1U3
1.9 V ± 1.0%	S-13A1C19-E6T1U3	S-13A1C19-U5T1U3	S-13A1C19-A6T1U3
2.0 V ± 1.0%	S-13A1C20-E6T1U3	S-13A1C20-U5T1U3	S-13A1C20-A6T1U3
2.1 V ± 1.0%	S-13A1C21-E6T1U3	S-13A1C21-U5T1U3	S-13A1C21-A6T1U3
2.2 V ± 1.0%	S-13A1C22-E6T1U3	S-13A1C22-U5T1U3	S-13A1C22-A6T1U3
2.3 V ± 1.0%	S-13A1C23-E6T1U3	S-13A1C23-U5T1U3	S-13A1C23-A6T1U3
2.4 V ± 1.0%	S-13A1C24-E6T1U3	S-13A1C24-U5T1U3	S-13A1C24-A6T1U3
2.5 V ± 1.0%	S-13A1C25-E6T1U3	S-13A1C25-U5T1U3	S-13A1C25-A6T1U3
2.6 V ± 1.0%	S-13A1C26-E6T1U3	S-13A1C26-U5T1U3	S-13A1C26-A6T1U3
2.7 V ± 1.0%	S-13A1C27-E6T1U3	S-13A1C27-U5T1U3	S-13A1C27-A6T1U3
2.8 V ± 1.0%	S-13A1C28-E6T1U3	S-13A1C28-U5T1U3	S-13A1C28-A6T1U3
2.85 V ± 1.0%	S-13A1C2J-E6T1U3	S-13A1C2J-U5T1U3	S-13A1C2J-A6T1U3
2.9 V ± 1.0%	S-13A1C29-E6T1U3	S-13A1C29-U5T1U3	S-13A1C29-A6T1U3
3.0 V ± 1.0%	S-13A1C30-E6T1U3	S-13A1C30-U5T1U3	S-13A1C30-A6T1U3
3.1 V ± 1.0%	S-13A1C31-E6T1U3	S-13A1C31-U5T1U3	S-13A1C31-A6T1U3
3.2 V ± 1.0%	S-13A1C32-E6T1U3	S-13A1C32-U5T1U3	S-13A1C32-A6T1U3
3.3 V ± 1.0%	S-13A1C33-E6T1U3	S-13A1C33-U5T1U3	S-13A1C33-A6T1U3
3.4 V ± 1.0%	S-13A1C34-E6T1U3	S-13A1C34-U5T1U3	S-13A1C34-A6T1U3
3.5 V ± 1.0%	S-13A1C35-E6T1U3	S-13A1C35-U5T1U3	S-13A1C35-A6T1U3

Remark Please contact our sales office for products with specifications other than the above.

4. 4 S-13A1 Series D type

ON / OFF logic: Active "H"
Discharge shunt function: Unavailable Pull-down resistor: Unavailable

Table 6

Output Voltage	HSOP-6	SOT-89-5	HSNT-6A
Externally set	S-13A1D00-E6T1U3	S-13A1D00-U5T1U3	–
1.0 V ± 15 mV	S-13A1D10-E6T1U3	S-13A1D10-U5T1U3	S-13A1D10-A6T1U3
1.1 V ± 15 mV	S-13A1D11-E6T1U3	S-13A1D11-U5T1U3	S-13A1D11-A6T1U3
1.2 V ± 15 mV	S-13A1D12-E6T1U3	S-13A1D12-U5T1U3	S-13A1D12-A6T1U3
1.25 V ± 15 mV	S-13A1D1C-E6T1U3	S-13A1D1C-U5T1U3	S-13A1D1C-A6T1U3
1.3 V ± 15 mV	S-13A1D13-E6T1U3	S-13A1D13-U5T1U3	S-13A1D13-A6T1U3
1.4 V ± 15 mV	S-13A1D14-E6T1U3	S-13A1D14-U5T1U3	S-13A1D14-A6T1U3
1.5 V ± 1.0%	S-13A1D15-E6T1U3	S-13A1D15-U5T1U3	S-13A1D15-A6T1U3
1.6 V ± 1.0%	S-13A1D16-E6T1U3	S-13A1D16-U5T1U3	S-13A1D16-A6T1U3
1.7 V ± 1.0%	S-13A1D17-E6T1U3	S-13A1D17-U5T1U3	S-13A1D17-A6T1U3
1.8 V ± 1.0%	S-13A1D18-E6T1U3	S-13A1D18-U5T1U3	S-13A1D18-A6T1U3
1.85 V ± 1.0%	S-13A1D1J-E6T1U3	S-13A1D1J-U5T1U3	S-13A1D1J-A6T1U3
1.9 V ± 1.0%	S-13A1D19-E6T1U3	S-13A1D19-U5T1U3	S-13A1D19-A6T1U3
2.0 V ± 1.0%	S-13A1D20-E6T1U3	S-13A1D20-U5T1U3	S-13A1D20-A6T1U3
2.1 V ± 1.0%	S-13A1D21-E6T1U3	S-13A1D21-U5T1U3	S-13A1D21-A6T1U3
2.2 V ± 1.0%	S-13A1D22-E6T1U3	S-13A1D22-U5T1U3	S-13A1D22-A6T1U3
2.3 V ± 1.0%	S-13A1D23-E6T1U3	S-13A1D23-U5T1U3	S-13A1D23-A6T1U3
2.4 V ± 1.0%	S-13A1D24-E6T1U3	S-13A1D24-U5T1U3	S-13A1D24-A6T1U3
2.5 V ± 1.0%	S-13A1D25-E6T1U3	S-13A1D25-U5T1U3	S-13A1D25-A6T1U3
2.6 V ± 1.0%	S-13A1D26-E6T1U3	S-13A1D26-U5T1U3	S-13A1D26-A6T1U3
2.7 V ± 1.0%	S-13A1D27-E6T1U3	S-13A1D27-U5T1U3	S-13A1D27-A6T1U3
2.8 V ± 1.0%	S-13A1D28-E6T1U3	S-13A1D28-U5T1U3	S-13A1D28-A6T1U3
2.85 V ± 1.0%	S-13A1D2J-E6T1U3	S-13A1D2J-U5T1U3	S-13A1D2J-A6T1U3
2.9 V ± 1.0%	S-13A1D29-E6T1U3	S-13A1D29-U5T1U3	S-13A1D29-A6T1U3
3.0 V ± 1.0%	S-13A1D30-E6T1U3	S-13A1D30-U5T1U3	S-13A1D30-A6T1U3
3.1 V ± 1.0%	S-13A1D31-E6T1U3	S-13A1D31-U5T1U3	S-13A1D31-A6T1U3
3.2 V ± 1.0%	S-13A1D32-E6T1U3	S-13A1D32-U5T1U3	S-13A1D32-A6T1U3
3.3 V ± 1.0%	S-13A1D33-E6T1U3	S-13A1D33-U5T1U3	S-13A1D33-A6T1U3
3.4 V ± 1.0%	S-13A1D34-E6T1U3	S-13A1D34-U5T1U3	S-13A1D34-A6T1U3
3.5 V ± 1.0%	S-13A1D35-E6T1U3	S-13A1D35-U5T1U3	S-13A1D35-A6T1U3

Remark Please contact our sales office for products with specifications other than the above.

■ Pin Configurations

1. HSOP-6

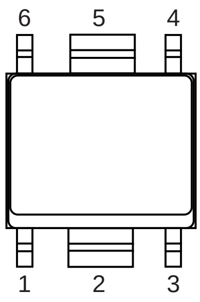


Figure 9

Table 7 Types in Which Output Voltage is Internally Set

Pin No.	Symbol	Description
1	VOUT	Output voltage pin
2	VSS	GND pin
3	ON / OFF	ON / OFF pin
4	SSC*1	Inrush current limit pin
5	VSS	GND pin
6	VIN	Input voltage pin

***1.** Connect a capacitor between the SSC and VSS pins.
By this capacitor's value, the inrush current limit time of VOUT at power-on or at the time when the ON / OFF pin is set to ON is adjustable.
Moreover, the SSC pin can be used even if it is open.
For details, refer to "**■ Selection of Capacitor for Inrush Current Limit (C_{SS}) (Types in Which Output Voltage is Internally Set of HSOP-6, SOT-89-5)**".

Table 8 Types in Which Output Voltage is Externally Set

Pin No.	Symbol	Description
1	VOUT	Output voltage pin
2	VSS	GND pin
3	VADJ	Output voltage adjustment pin
4	ON / OFF	ON / OFF pin
5	VSS	GND pin
6	VIN	Input voltage pin

2. SOT-89-5

Top view

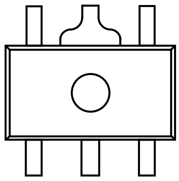


Figure 10

Table 9 Types in Which Output Voltage is Internally Set

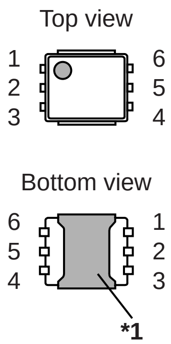
Pin No.	Symbol	Description
1	ON / OFF	ON / OFF pin
2	VSS	GND pin
3	SSC*1	Inrush current limit pin
4	VIN	Input voltage pin
5	VOUT	Output voltage pin

***1.** Connect a capacitor between the SSC and VSS pins.
By this capacitor's value, the inrush current limit time of VOUT at power-on or at the time when the ON / OFF pin is set to ON is adjustable.
Moreover, the SSC pin can be used even if it is open.
For details, refer to "**■ Selection of Capacitor for Inrush Current Limit (C_{SS}) (Types in Which Output Voltage is Internally Set of HSOP-6, SOT-89-5)**".

Table 10 Types in Which Output Voltage is Externally Set

Pin No.	Symbol	Description
1	VADJ	Output voltage adjustment pin
2	VSS	GND pin
3	ON / OFF	ON / OFF pin
4	VIN	Input voltage pin
5	VOUT	Output voltage pin

3. HSNT-6A



***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 11

Table 11 Types in Which Output Voltage is Internally Set*1

Pin No.	Symbol	Description
1	VOUT*2	Output voltage pin
2	VOUT*2	Output voltage pin
3	ON / OFF	ON / OFF pin
4	VSS	GND pin
5	VIN*3	Input voltage pin
6	VIN*3	Input voltage pin

***1.** Types in which output voltage is externally set are unavailable.
***2.** Although pins of number 1 and 2 are connected internally, be sure to short-circuit them nearest in use.
***3.** Although pins of number 5 and 6 are connected internally, be sure to short-circuit them nearest in use.

■ Absolute Maximum Ratings

Table 12

(Ta = +25°C unless otherwise specified)

Item		Symbol	Absolute Maximum Rating	Unit
Input voltage		V_{IN}	V_{SS} − 0.3 to V_{SS} + 6.0	V
		$V_{ON / OFF}$	V_{SS} − 0.3 to V_{SS} + 6.0	V
		V_{SSC}	V_{SS} − 0.3 to V_{IN} + 0.3	V
		V_{VADJ}	V_{SS} − 0.3 to V_{SS} + 6.0	V
Output voltage		V_{OUT}	V_{SS} − 0.3 to V_{IN} + 0.3	V
Output current		I_{OUT}	1000	mA
Power dissipation	HSOP-6	P_D	1900*1	mW
	SOT-89-5		1000*2	mW
	HSNT-6A		1000*3	mW
Operation ambient temperature		T_{opr}	−40 to +85	°C
Storage temperature		T_{stg}	−40 to +125	°C

***1.** When mounted on board
[Mounted board]
(1) Board size: 50 mm × 50 mm × t1.6 mm
(2) Board material: Glass epoxy resin (two layers)
(3) Wiring ratio: 50%
(4) Test conditions: When mounted on board (wind speed: 0 m/s)
(5) Land pattern: Refer to the recommended land pattern (drawing code: FH006-A-L-SD)

***2.** When mounted on board
[Mounted board]
(1) Board size: 114.3 mm × 76.2 mm × t1.6 mm
(2) Name: JEDEC STANDARD51-7

***3.** 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.

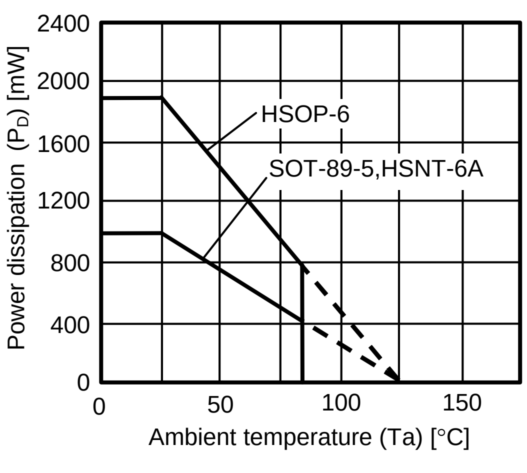


Figure 12 Power Dissipation of Package (When Mounted on Board)

Table 13

Condition	Power Dissipation	Thermal Resistance Value (θj − a)
HSOP-6 (When mounted on board)	1900 mW	53°C/W
SOT-89-5 (When mounted on board)	1000 mW	100°C/W
HSNT-6A (When mounted on board)	1000 mW	100°C/W

Power Dissipation of HSOP-6 (Reference)

Power dissipation of package differs depending on the mounting conditions.
Consider the power dissipation characteristics under the following conditions as reference.

[Mounted board]

(1) Board size: 50 mm × 50 mm × t1.6 mm
(2) Board material: Glass epoxy resin (two layers)
(3) Wiring ratio: 90%
(4) Test conditions: When mounted on board (wind speed: 0 m/s)
(5) Land pattern: Refer to the recommended land pattern (drawing code: FH006-A-L-SD)

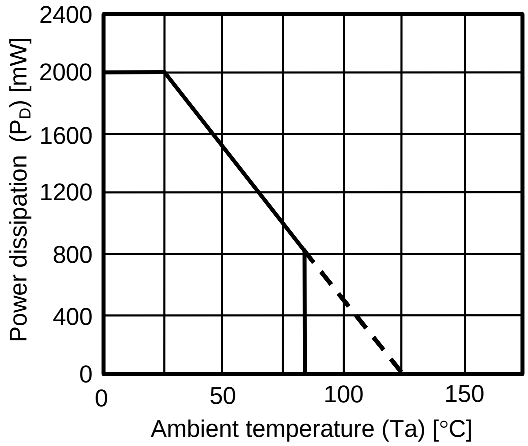


Figure 13 Power Dissipation of Package (When Mounted on Board)

Table 14

Condition	Power Dissipation (Reference)	Thermal Resistance Value (θj − a)
HSOP-6 (When mounted on board)	2000 mW	50°C/W

■ Electrical Characteristics

1. Types in which output voltage is internally set (S-13A1x10 to S-13A1x35)

Table 15 (1 / 2)

(Ta = +25°C unless otherwise specified)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Test Circuit
Output voltage*1	$V_{OUT(E)}$	$V_{IN} = V_{OUT(S)} + 1.0$ V, I_{OUT} = 100 mA	1.0 V ≤ $V_{OUT(S)}$ < 1.5 V	$V_{OUT(S)}$ − 0.015	$V_{OUT(S)}$	$V_{OUT(S)}$ + 0.015	V	1
			1.5 V ≤ $V_{OUT(S)}$ ≤ 3.5 V	$V_{OUT(S)}$ × 0.99	$V_{OUT(S)}$	$V_{OUT(S)}$ × 1.01	V	1
Output current*2	I_{OUT}	$V_{IN} \geq V_{OUT(S)} + 1.0$ V		1000*5	−	−	mA	3
Dropout voltage*3	V_{drop}	I_{OUT} = 300 mA	1.0 V ≤ $V_{OUT(S)}$ < 1.1 V	0.50	0.54	0.58	V	1
			1.1 V ≤ $V_{OUT(S)}$ < 1.2 V	−	0.44	0.48	V	1
			1.2 V ≤ $V_{OUT(S)}$ < 1.3 V	−	0.34	0.38	V	1
			1.3 V ≤ $V_{OUT(S)}$ < 1.4 V	−	0.24	0.28	V	1
			1.4 V ≤ $V_{OUT(S)}$ < 1.5 V	−	0.14	0.18	V	1
			1.5 V ≤ $V_{OUT(S)}$ < 2.6 V	−	0.10	0.15	V	1
			2.6 V ≤ $V_{OUT(S)}$ ≤ 3.5 V	−	0.07	0.10	V	1
		I_{OUT} = 1000 mA	1.0 V ≤ $V_{OUT(S)}$ < 1.1 V	−	0.90	−	V	1
			1.1 V ≤ $V_{OUT(S)}$ < 1.2 V	−	0.80	−	V	1
			1.2 V ≤ $V_{OUT(S)}$ < 1.3 V	−	0.70	−	V	1
			1.3 V ≤ $V_{OUT(S)}$ < 1.4 V	−	0.60	−	V	1
			1.4 V ≤ $V_{OUT(S)}$ < 1.5 V	−	0.50	−	V	1
			1.5 V ≤ $V_{OUT(S)}$ < 2.0 V	−	0.40	−	V	1
			2.0 V ≤ $V_{OUT(S)}$ < 2.6 V	−	0.32	−	V	1
			2.6 V ≤ $V_{OUT(S)}$ ≤ 3.5 V	−	0.23	−	V	1
Line regulation	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \bullet V_{OUT}}$	$V_{OUT(S)} + 0.5 \text{ V} \leq V_{IN} \leq 5.5$ V, I_{OUT} = 100 mA		−	0.05	0.2	%/V	1
Load regulation	ΔV_{OUT2}	$V_{IN} = V_{OUT(S)} + 1.0$ V, 1 mA ≤ I_{OUT} ≤ 300 mA		−20	−3	20	mV	1
Output voltage temperature coefficient*4	$\frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}$	$V_{IN} = V_{OUT(S)} + 1.0$ V, I_{OUT} = 100 mA, −40°C ≤ Ta ≤ +85°C		−	±100	−	ppm/°C	1
Current consumption during operation	I_{SS1}	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = ON, no load		−	60	90	μA	2
Current consumption during power-off	I_{SS2}	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = OFF, no load		−	0.1	1.0	μA	2
Input voltage	V_{IN}	−		1.5	−	5.5	V	−
ON / OFF pin input voltage "H"	V_{SH}	$V_{IN} = V_{OUT(S)} + 1.0$ V, R_L = 1.0 kΩ determined by V_{OUT} output level		1.0	−	−	V	4
ON / OFF pin input voltage "L"	V_{SL}	$V_{IN} = V_{OUT(S)} + 1.0$ V, R_L = 1.0 kΩ determined by V_{OUT} output level		−	−	0.3	V	4
ON / OFF pin input current "H"	I_{SH}	V_{IN} = 5.5 V, $V_{ON / OFF}$ = 5.5 V	B / D type (without pull-down resistor)	−0.1	−	0.1	μA	4
			A / C type (with pull-down resistor)	1.0	2.5	5.0	μA	4
ON / OFF pin input current "L"	I_{SL}	V_{IN} = 5.5 V, $V_{ON / OFF}$ = 0 V		−0.1	−	0.1	μA	4
Ripple rejection	|RR|	$V_{IN} = V_{OUT(S)} + 1.0$ V, f = 1.0 kHz, ΔV_{rip} = 0.5 Vrms, I_{OUT} = 100 mA	1.0 V ≤ $V_{OUT(S)}$ < 1.2 V	−	70	−	dB	5
			1.2 V ≤ $V_{OUT(S)}$ < 3.0 V	−	65	−	dB	5
			3.0 V ≤ $V_{OUT(S)}$ ≤ 3.5 V	−	60	−	dB	5
Short-circuit current	I_{short}	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = ON, V_{OUT} = 0 V		−	200	−	mA	3
Thermal shutdown detection temperature	T_{SD}	Junction temperature		−	150	−	°C	−
Thermal shutdown release temperature	T_{SR}	Junction temperature		−	120	−	°C	−

Table 15 (2 / 2)

(Ta = +25°C unless otherwise specified)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Test Circuit
Inrush current limit time	t_{RUSH}	HSOP-6, SOT-89-5	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = ON, $I_{OUT} = 1000$ mA, $C_{SS} = 1.0$ nF	−	0.7	−	ms	6
			$V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = ON, $I_{OUT} = 1000$ mA, $C_{SS} = 0$ nF	−	0.4	−	ms	6
		HSNT-6A	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = ON, $I_{OUT} = 1000$ mA	−	0.4	−	ms	6
"L" output Nch ON resistance	R_{LOW}	$V_{IN} = 5.5$ V, $V_{OUT} = 0.1$ V	A / B type (with discharge shunt function)	−	35	−	Ω	3
Power-off pull-down resistance	R_{PD}	−	A / C type (with pull-down resistor)	1.1	2.2	5.5	MΩ	4

***1.** $V_{OUT(S)}$: Set output voltage
$V_{OUT(E)}$: Actual output voltage
Output voltage when fixing I_{OUT} (= 100 mA) and inputting $V_{OUT(S)} + 1.0$ 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 $V_{IN} = V_{OUT(S)} + 1.0$ V and I_{OUT} = 300 mA, 1000 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 [mV/℃] is calculated using the following equation.

$$\frac{\Delta V_{OUT}}{\Delta Ta}\ [\text{mV/℃}]^{*1} = V_{OUT(S)}\ [\text{V}]^{*2} \times \frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}\ [\text{ppm/℃}]^{*3} \div 1000$$

***1.** Change in temperature of the output voltage
***2.** Set 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.

2. Types in which output voltage is externally set (S-13A1x00, HSOP-6, SOT-89-5 only)

Table 16

(Ta = +25°C unless otherwise specified)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Test Circuit
Output voltage of adjust pin*1	V_{VADJ}	$V_{VADJ} = V_{OUT}$, $V_{IN} = V_{OUT(S)} + 1.0$ V, I_{OUT} = 100 mA		0.985	1.0	1.015	V	7
Output voltage range	V_{ROUT}	−		1.05	−	5.00	V	13
Internal resistance value of adjust pin	R_{VADJ}	−		−	400	−	kΩ	−
Output current*2	I_{OUT}	$V_{IN} \geq V_{OUT(S)} + 1.0$ V		1000*5	−	−	mA	9
Dropout voltage*3	V_{drop}	$V_{VADJ} = V_{OUT}$, I_{OUT} = 300 mA, $V_{OUT(S)}$ = 1.0 V		0.50	0.54	0.58	V	7
		$V_{VADJ} = V_{OUT}$, I_{OUT} = 1000 mA, $V_{OUT(S)}$ = 1.0 V		−	0.90	−	V	7
Line regulation	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \bullet V_{OUT}}$	$V_{VADJ} = V_{OUT}$, $V_{OUT(S)} + 0.5\ V \leq V_{IN} \leq 5.5$ V, I_{OUT} = 100 mA		−	0.05	0.2	%/V	7
Load regulation	ΔV_{OUT2}	$V_{VADJ} = V_{OUT}$, $V_{IN} = V_{OUT(S)} + 1.0$ V, 1 mA $\leq I_{OUT} \leq$ 300 mA		−20	−3	20	mV	7
Output voltage temperature coefficient*4	$\frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}$	$V_{IN} = V_{OUT(S)} + 1.0$ V, I_{OUT} = 100 mA, −40°C ≤ Ta ≤ +85°C		−	±100	−	ppm/°C	7
Current consumption during operation	I_{SS1}	$V_{VADJ} = V_{OUT}$, $V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = ON, no load		−	60	90	μA	8
Current consumption during power-off	I_{SS2}	$V_{VADJ} = V_{OUT}$, $V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = OFF, no load		−	0.1	1.0	μA	8
Input voltage	V_{IN}	−		1.5	−	5.5	V	−
ON / OFF pin input voltage "H"	V_{SH}	$V_{IN} = V_{OUT(S)} + 1.0$ V, R_L = 1.0 kΩ determined by V_{OUT} output level		1.0	−	−	V	10
ON / OFF pin input voltage "L"	V_{SL}	$V_{IN} = V_{OUT(S)} + 1.0$ V, R_L = 1.0 kΩ determined by V_{OUT} output level		−	−	0.3	V	10
ON / OFF pin input current "H"	I_{SH}	V_{IN} = 5.5 V, $V_{ON / OFF}$ = 5.5 V	B / D type (without pull-down resistor)	−0.1	−	0.1	μA	10
			A / C type (with pull-down resistor)	1.0	2.5	5.0	μA	10
ON / OFF pin input current "L"	I_{SL}	V_{IN} = 5.5 V, $V_{ON / OFF}$ = 0 V		−0.1	−	0.1	μA	10
Ripple rejection	|RR|	$V_{VADJ} = V_{OUT}$, $V_{IN} = V_{OUT(S)} + 1.0$ V, f = 1.0 kHz, ΔV_{rip} = 0.5 Vrms, I_{OUT} = 100 mA, V_{OUT} = 1.0 V		−	70	−	dB	11
Short-circuit current	I_{short}	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = ON, V_{OUT} = 0 V		−	200	−	mA	9
Thermal shutdown detection temperature	T_{SD}	Junction temperature		−	150	−	°C	−
Thermal shutdown release temperature	T_{SR}	Junction temperature		−	120	−	°C	−
Inrush current limit time	t_{RUSH}	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = ON, I_{OUT} = 1000 mA		−	0.4	−	ms	12
"L" output Nch ON resistance	R_{LOW}	V_{IN} = 5.5 V, V_{OUT} = 0.1 V	A / B type (with discharge shunt function)	−	35	−	Ω	9
Power-off pull-down resistor	R_{PD}	−	A / C type (with pull-down resistor)	1.1	2.2	5.5	MΩ	10

***1.** $V_{OUT(S)}$: Set output voltage (= 1.0 V)

***2.** The output current at which the output voltage becomes 95% of V_{VADJ} after gradually increasing the output current.

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

V_{OUT3} is the output voltage when $V_{IN} = V_{OUT(S)} + 1.0$ V and I_{OUT} = 300 mA, 1000 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 [mV/°C] is calculated using the following equation.

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

***1.** Change in temperature of the output voltage

***2.** Set 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. Types in which output voltage is internally set (S-13A1x10 to S-13A1x35)

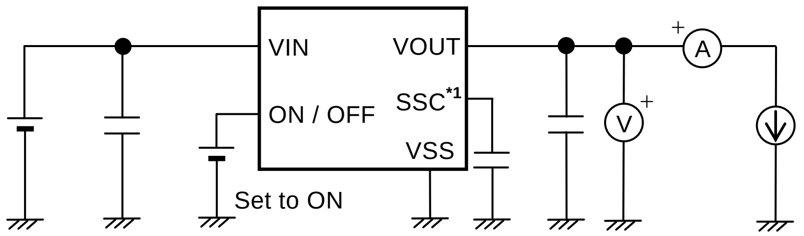


Figure 14 Test Circuit 1

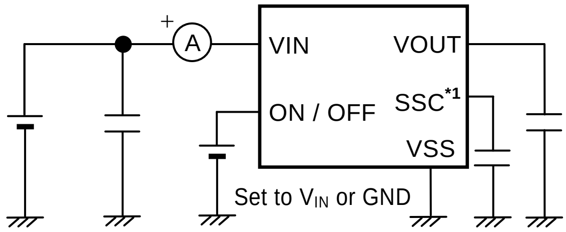


Figure 15 Test Circuit 2

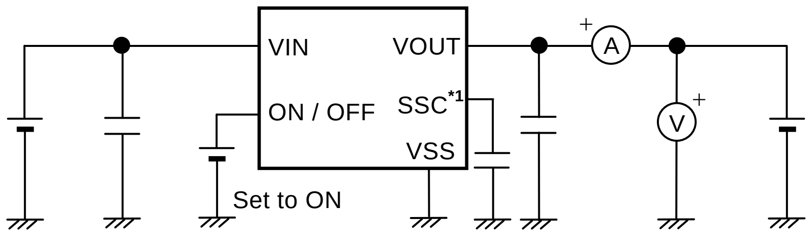


Figure 16 Test Circuit 3

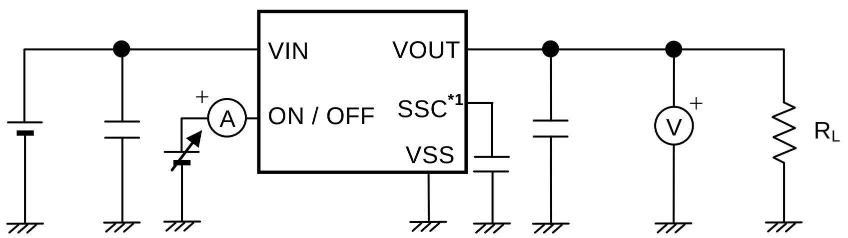


Figure 17 Test Circuit 4

***1.** HSOP-6, SOT-89-5 only.

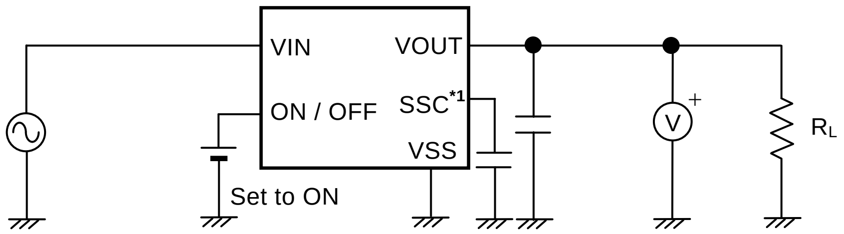


Figure 18 Test Circuit 5

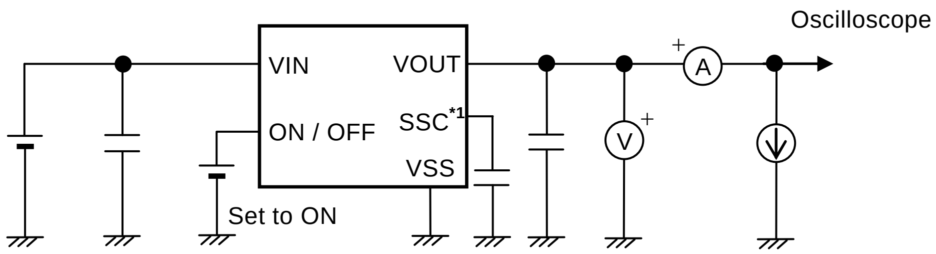


Figure 19 Test Circuit 6

***1.** HSOP-6, SOT-89-5 only.

2. Types in which output voltage is externally set (S-13A1x00, HSOP-6, SOT-89-5 only)

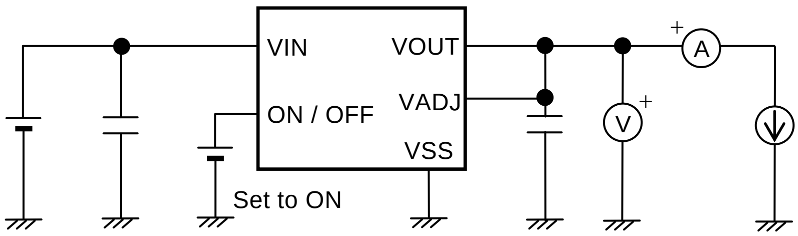


Figure 20 Test Circuit 7

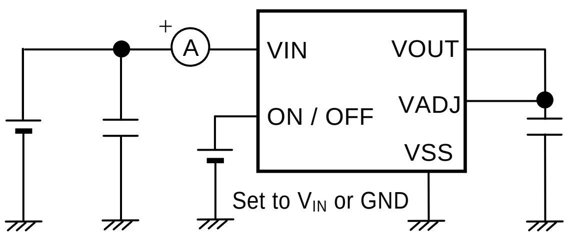


Figure 21 Test Circuit 8

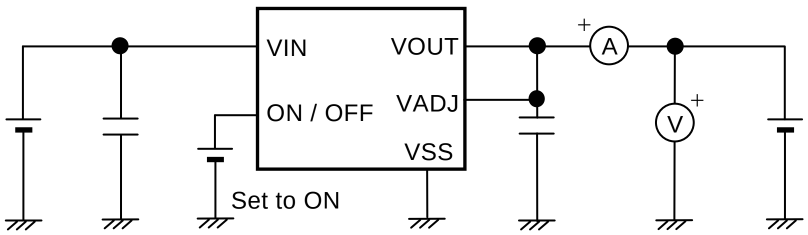


Figure 22 Test Circuit 9

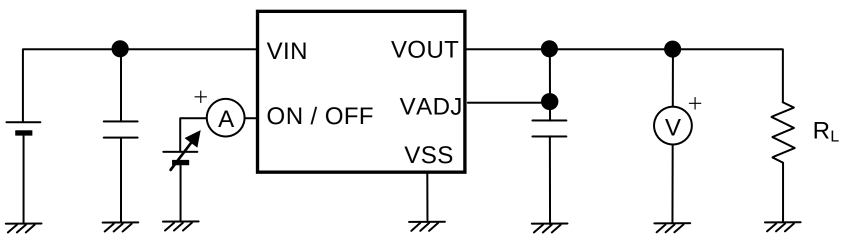


Figure 23 Test Circuit 10

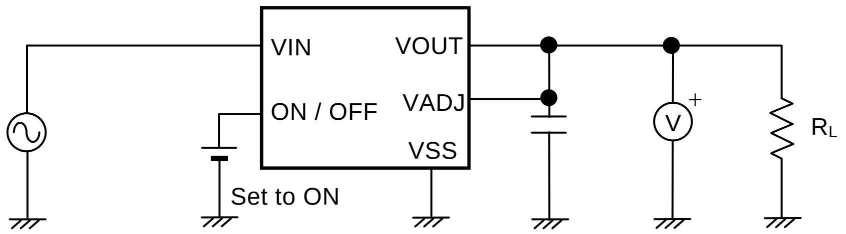


Figure 24 Test Circuit 11

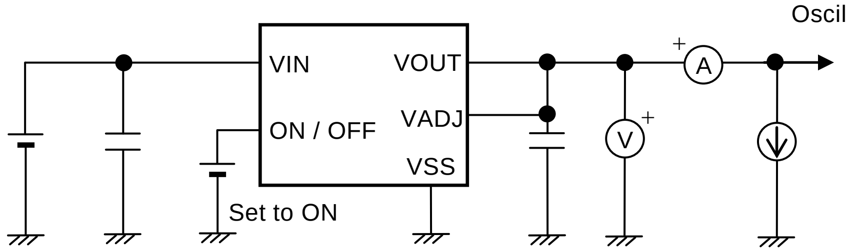


Figure 25 Test Circuit 12

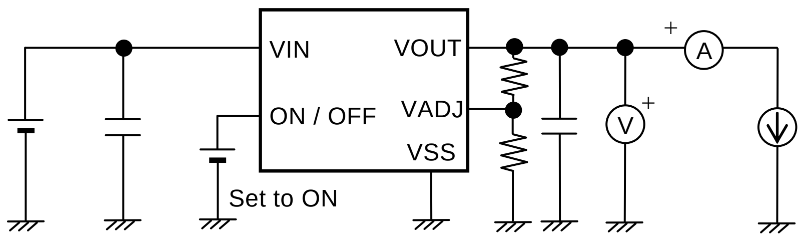
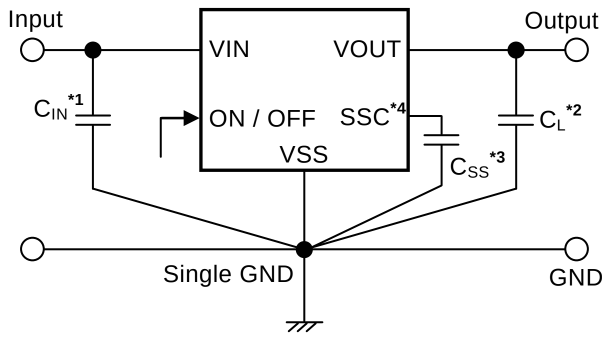


Figure 26 Test Circuit 13

■ Standard Circuit

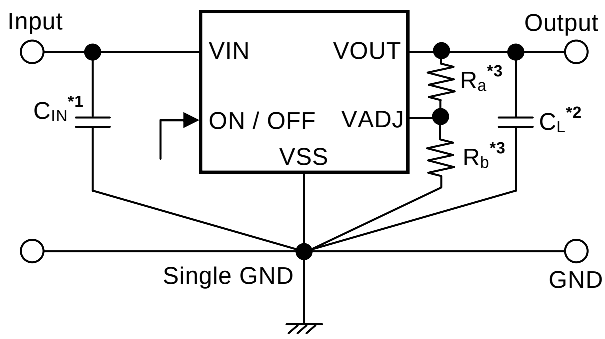
1. Types in which output voltage is internally set (S-13A1x10 to S-13A1x35)



***1.** C_{IN} is a capacitor for stabilizing the input.
***2.** A Ceramic capacitor of 2.2 μF or more can be used as C_L.
***3.** A Ceramic capacitor of 22 nF or less can be used as C_{SS}.
***4.** HSOP-6, SOT-89-5 only.

Figure 27

2. Types in which output voltage is externally set (S-13A1x00, HSOP-6, SOT-89-5 only)



***1.** C_{IN} is a capacitor for stabilizing the input.
***2.** A Ceramic capacitor of 2.2 μF or more can be used as C_L.
***3.** Resistance of 0.1 kΩ to 606 kΩ as R_a, 2 kΩ to 200 kΩ as R_b can be used.

Figure 28

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

■ Condition of Application

Input capacitor (C_{IN}): 2.2 μF or more
Output capacitor (C_L): 2.2 μF or more

Caution 1. Set input capacitor (C_{IN}) and output capacitor (C_L) as $C_{IN} = C_L$.
2. Generally a series regulator may cause oscillation, depending on the selection of external parts. Confirm that no oscillation occurs in the application for which the above capacitors are used.

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

The S-13A1 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 2.2 μF or more over the entire temperature range. When using an OS capacitor, a tantalum capacitor, or an aluminum electrolytic capacitor, the capacitance must be 2.2 μF or more.
The values of output overshoot and undershoot, which are transient response characteristics, vary depending on the value of output capacitor.
The required value of capacitance for the input capacitor differs depending on the application.
Set the value for input capacitor (C_{IN}) and output capacitor (C_L) as follows.

- $C_{IN} \geq 2.2$ μF
- $C_L \geq 2.2$ μF
- $C_{IN} = C_L$

Caution The S-13A1 Series may oscillate if setting the value as $C_{IN} \geq 2.2$ μF, $C_L \geq 2.2$ μF, $C_{IN} < C_L$.
Define the values by sufficient evaluation including the temperature characteristics under the usage condition.

■ Selection of Capacitor for Inrush Current Limit (C_{SS}) (Types in Which Output Voltage is Internally Set of HSOP-6, SOT-89-5)

In the S-13A1 Series, the inrush current limit time (t_{RUSH}) is adjustable by connecting a capacitor for inrush current limit (C_{SS}) between the SSC and VSS pins. The time that the output voltage rises to 99% is 0.7 ms typ. when C_{SS} = 1.0 nF.
The S-13A1 Series operates stably even with no C_{SS} connection (in the state the SSC pin is leaved open).
The recommended value for C_{SS} is 0 nF[*1] $\leq C_{SS} \leq$ 22 nF, however, define the values by sufficient evaluation including the temperature characteristics under the usage condition.

***1.** In case the S-13A1 Series is used without C_{SS} connection (C_{SS} = 0 nF), be sure to leave the SSC pin open and do not connect it to the VIN and VSS pins.

■ Explanation of Terms

1. Low dropout voltage regulator

This voltage regulator has the low dropout voltage due to its built-in low on-resistance transistor.

2. Output voltage (V_{OUT})

The accuracy of the output voltage is ensured at ±1.0% or ±15 mV*1 under the specified conditions of fixed input voltage*2, fixed output current, and fixed temperature.

***1.** When $V_{OUT} < 1.5$ V: ±15 mV, when $V_{OUT} \geq 1.5$ V: ±1.0%
***2.** 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. Refer to "■ Electrical Characteristics" and "■ Characteristics (Typical Data)" for details.

3. 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.

4. Load regulation (ΔV_{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.

5. Dropout voltage (V_{drop})

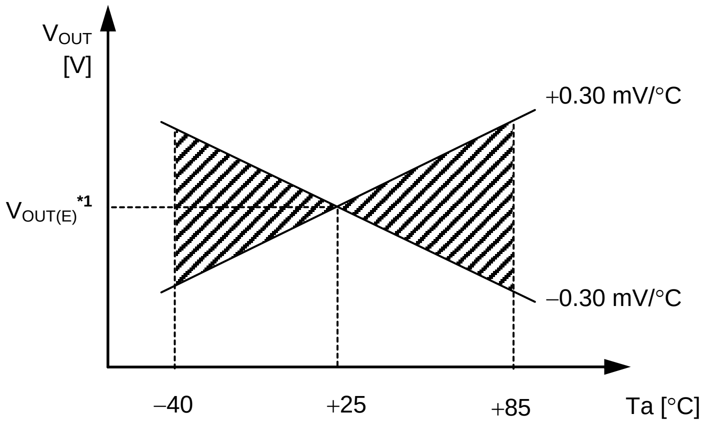
Indicates the difference between input voltage (V_{IN1}) and the output voltage when; decreasing input voltage (V_{IN}) gradually until the output voltage has dropped out to the value of 98% of output voltage (V_{OUT3}), which is at $V_{IN} = V_{OUT(S)} + 1.0$ V.

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

6. Output voltage temperature coefficient $\left(\frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}\right)$

The shaded area in **Figure 29** is the range where V_{OUT} varies in the operation temperature range when the output voltage temperature coefficient is ±100 ppm/°C.

Example of S-13A1B30 typ. product



***1.** $V_{OUT(E)}$ is the value of the output voltage measured at Ta = +25°C.

Figure 29

A change in the temperature of the output voltage [mV/°C] is calculated using the following equation.

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

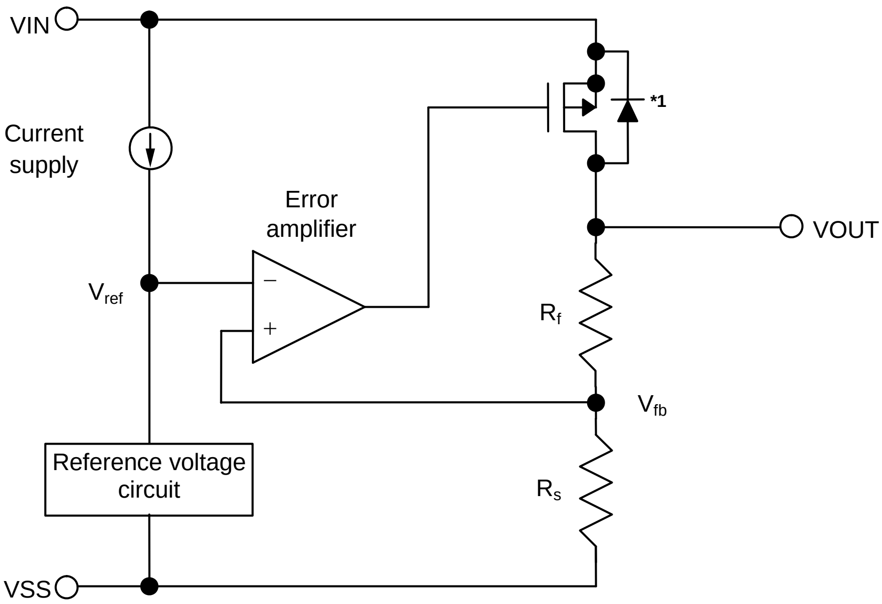
***1.** Change in temperature of output voltage
***2.** Set output voltage
***3.** Output voltage temperature coefficient

■ Operation

1. Basic operation

Figure 30 shows the block diagram the S-13A1 Series.

The error amplifier compares the reference voltage (V_{ref}) with feedback voltage (V_{fb}), which is the output voltage resistance-divided by feedback resistors (R_s and R_f). It supplies the gate voltage necessary to maintain the constant output voltage which is not influenced by the input voltage and temperature change, to the output transistor.



***1**. Parasitic diode

Figure 30

2. Output transistor

In the S-13A1 Series, a low on-resistance P-channel MOS FET is used 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 reverse current flowing from the VOUT pin through a parasitic diode to the VIN pin, when the potential of V_{OUT} became higher than V_{IN}.

3. ON / OFF pin

This pin starts and stops the regulator.

When the ON / OFF pin is set to OFF level, the entire internal circuit stops operating, and the built-in P-channel MOS FET output transistor between the VIN and VOUT pins is turned off, reducing current consumption significantly. Note that the current consumption increases when a voltage of 0.3 V to V_{IN} − 0.3 V is applied to the ON / OFF pin.
The ON / OFF pin is configured as shown in **Figure 31** and **Figure 32**.

3. 1 S-13A1 Series A / C type

The ON / OFF pin is internally pulled down to the VSS pin in the floating status, so the VOUT pin is set to the V_{SS} level.

3. 2 S-13A1 Series B / D type

The ON / OFF pin is not internally pulled down to the VSS pin, so do not use these types with the ON / OFF pin in the floating status. When not using the ON / OFF pin, connect the pin to the VIN pin.

Table 17

Product Type	ON / OFF Pin	Internal Circuit	VOUT Pin Voltage	Current Consumption
A / B / C / D	"H": ON	Operate	Set value	I_{SS1} *1
A / B / C / D	"L": OFF	Stop	V_{SS} level	I_{SS2}

***1**. Note that the IC's current consumption increases as much as current flows into the pull-down resistor of 2.5 MΩ typ. when the ON / OFF pin is connected to the VIN pin and the S-13A1 Series A / C type is operating (refer to **Figure 31**).

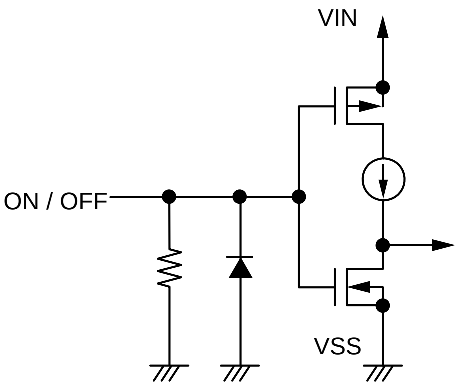


Figure 31 S-13A1 Series A / C type

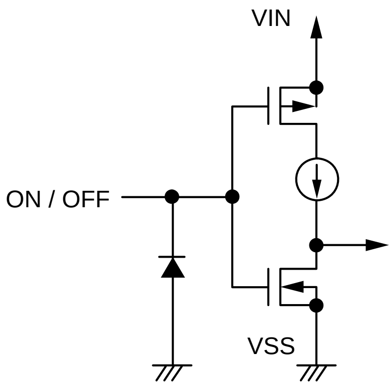


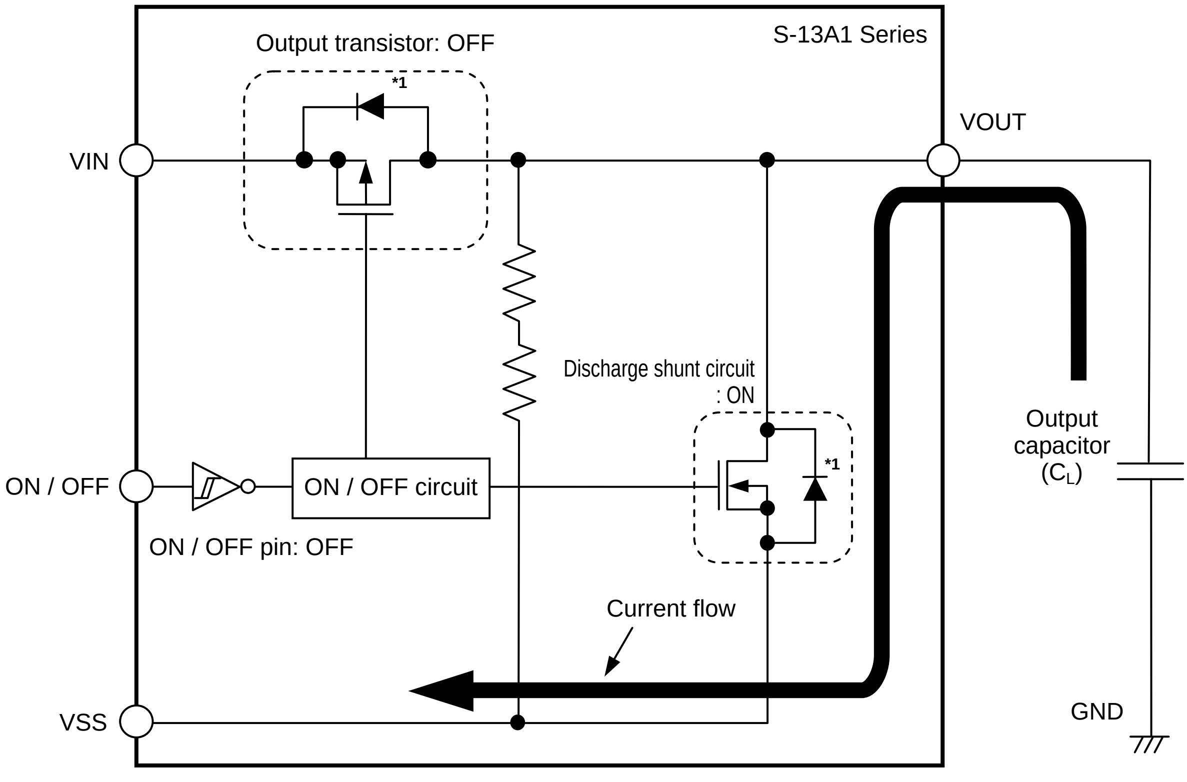
Figure 32 S-13A1 Series B / D type

4. Discharge shunt function (S-13A1 Series A / B type)

The S-13A1 Series A / B type has a built-in discharge shunt circuit to discharge the output capacitance. The output capacitance is discharged as follows so that the VOUT pin reaches the V_{SS} level.

(1) The ON / OFF pin is set to OFF level.
(2) The output transistor is turned off.
(3) The discharge shunt circuit is turned on.
(4) The output capacitor discharges.

Since the S-13A1 Series C / D type does not have a discharge shunt circuit, the VOUT pin is set to the V_{SS} level through several hundred kΩ internal divided resistors between the VOUT pin and the VSS pin. The S-13A1 Series A / B type allows the VOUT pin to reach the V_{SS} level rapidly due to the discharge shunt circuit.



***1**. Parasitic diode

Figure 33

5. Pull-down resistor (S-13A1 Series A / C type)

The ON / OFF pin is internally pulled down to the VSS pin in the floating status, so the VOUT pin is set to the V_{SS} level.

Note that the IC's current consumption increases as much as current flows into the pull-down resistor of 2.5 MΩ typ. when the ON / OFF pin is connected to the VIN pin and the S-13A1 Series A / C type is operating.

6. Overcurrent protection circuit

The S-13A1 Series includes an overcurrent protection circuit having the characteristics shown in "**1. Output Voltage vs. Output Current (When load current increases) (Ta = +25°C)**" in "**■ Characteristics (Typical Data)**", in order to protect the output transistor against an excessive output current and short circuiting between the VOUT and VSS pins. The current when the output pin is short-circuited (I_{short}) is internally set at approx. 200 mA typ., and the normal value is restored for the output voltage, if releasing a short circuit once.

Caution This overcurrent protection circuit does not work as for thermal protection. If this IC long keeps short circuiting inside, pay attention to the conditions of input voltage and load current so that, under the usage conditions including short circuit, the loss of the IC will not exceed power dissipation of the package.

7. Thermal shutdown circuit

The S-13A1 Series has a thermal shutdown circuit to protect the device from damage due to overheat. When the junction temperature rises to 150°C typ., the thermal shutdown circuit operates to stop regulating. When the junction temperature drops to 120°C typ., the thermal shutdown circuit is released to restart regulating.

Due to self-heating of the S-13A1 Series, if the thermal shutdown circuit starts operating, it stops regulating so that the output voltage drops. When regulation stops, the S-13A1 does not itself generate heat so that the IC's temperature drops. When the temperature drops, the thermal shutdown circuit is released to restart regulating, thus the S-13A1 Series generates heat again. Repeating this procedure makes waveform of the output voltage pulse-like form. Stop or restart of regulation continues unless decreasing either or both of the input voltage and the output voltage in order to reduce the internal power consumption, or decreasing the ambient temperature.

Table 18

Thermal Shutdown Circuit	VOUT Pin Voltage
Operation: 150°C typ.*1	V_{SS} level
Release: 120°C typ.*1	Set value

***1.** Junction temperature

8. Inrush current limit circuit

The S-13A1 Series has a built-in inrush current limit circuit to limit the inrush current and the overshoot of the output voltage generated at power-on or at the time when the ON / OFF pin is set to ON. The inrush current is limited to 500 mA typ. The inrush current limit circuit starts to operate from the following times.

- Immediately after power-on
- At the time when the ON / OFF pin is set to ON

Figure 34 shows the relation between the inrush current limit time (t_{RUSH}) and the inrush current limit capacitor (C_{SS}).

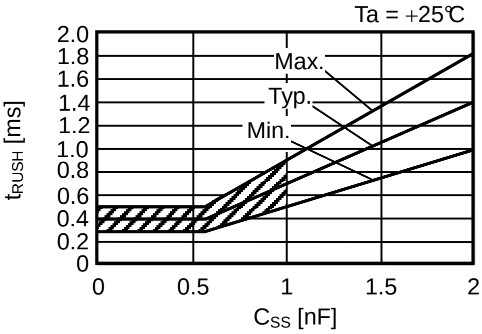


Figure 34

(1) C_{SS} = 0 nF

t_{RUSH} is determined by the internal capacitor (about 20 pF) and the time constant of the built-in constant current (about 0.04 μA). t_{RUSH} value is 0.28 ms min., 0.40 ms typ., 0.52 ms max.

(2) $C_{SS} \geq$ 1 nF

t_{RUSH} can be adjusted by the C_{SS} which is connected externally between the SSC*1 and VSS pins. It is calculated by the following formula depending on the built-in constant (about 1 μA) and the C_{SS} time constant.
The inrush current limit coefficient is 0.49 min., 0.7 typ., 0.91 max. at Ta = +25°C.

t_{RUSH} [ms] = the inrush current limit coefficient × C_{SS} [nF]

(3) 0 nF < C_{SS} < 1 nF

Since the internal capacitor, the built-in constant current and C_{SS} have a variation each, t_{RUSH} is the one of following (a) and (b) in which the time is longer.

(a) The time determined by the internal capacitor (about 20 pF) and the time constant of the built-in constant current (about 0.04 μA).
(b) The time determined by C_{SS} connected externally between the SSC*1 and VSS pins and the built-in constant current (about 1 μA).

When 0 nF < C_{SS}< 1 nF, t_{RUSH} is the range of the shaded area shown in **Figure 34**.

***1.** Types in which output voltage is internally set of HSOP-6, SOT-89-5 only.

9. Externally setting output voltage (HSOP-6, SOT-89-5 only)

The S-13A1 Series provides the types in which output voltage can be set via the external resistor. The output voltage can be set by connecting a resistor (R_a) between VOUT and VADJ pins, and a resistor (R_b) between VADJ and VSS pins.
The output voltage is determined by the following formulas.

$V_{OUT} = 1.0 + R_a \times I_a$ ·························· (1)
By substituting $I_a = I_{VADJ} + 1.0 / R_b$ to above formula (1),
$V_{OUT} = 1.0 + R_a \times (I_{VADJ} + 1.0 / R_b) = 1.0 \times (1.0 + R_a / R_b) + R_a \times I_{VADJ}$ ·········· (2)

In above formula (2), $R_a \times I_{VADJ}$ is a factor for the output voltage error.
Whether the output voltage error is minute is judged depending on the following (3) formula.

By substituting $I_{VADJ} = 1.0 / R_{VADJ}$ to $R_a \times I_{VADJ}$
$V_{OUT} = 1.0 \times (1.0 + R_a / R_b) + 1.0 \times R_a / R_{VADJ}$ ······················(3)

If R_{VADJ} is sufficiently larger than R_a, the error is judged as minute.

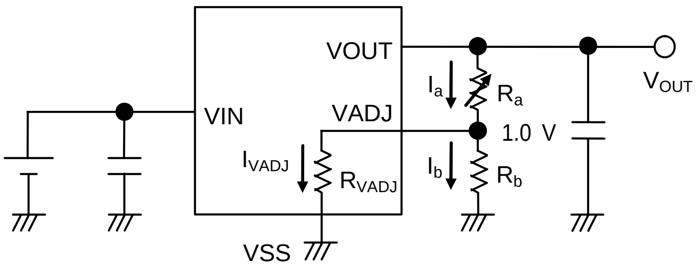


Figure 35

The following expression is in order to determine output voltage V_{OUT} = 3.0 V.
If resistance R_b = 2 kΩ, substitute internal resistance in adjust pin R_{VADJ} = 400 kΩ typ. into (3),
Resistance $R_a = (3.0 / 1.0 - 1) \times ((2\text{ k} \times 400\text{ k}) / (2\text{ k} + 400\text{ k})) \cong 4.0\text{ k}\Omega$

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

■ Precautions

- Wiring patterns for the VIN pin, the VOUT pin and GND should be designed so that the impedance is low. When mounting an output capacitor between the VOUT and VSS pins (C_L), a capacitor for stabilizing the input between the VIN and VSS pins (C_{IN}), and a capacitor for limiting the inrush current between the SSC and VSS pins (C_{SS}), the distance from the capacitors to these pins should be as short as possible.
- Note that generally the output voltage may increase when a series regulator is used at low load current (1.0 mA or less).
- Note that generally the output voltage may increase due to the leakage current from an output driver when a series regulator is used at high temperature.
- Note that the output voltage may increase due to the leakage current from an output driver even if the ON / OFF pin is at OFF level when a series regulator is used at high temperature.
- Generally a series regulator may cause oscillation, depending on the selection of external parts. The following conditions are recommended for the S-13A1 Series. However, be sure to perform sufficient evaluation under the actual usage conditions for selection, including evaluation of temperature characteristics. Refer to "**6. Example of equivalent series resistance vs. Output current characteristics (Ta = +25°C)**" in "**■ Reference Data**" for the equivalent series resistance (R_{ESR}) of the output capacitor.

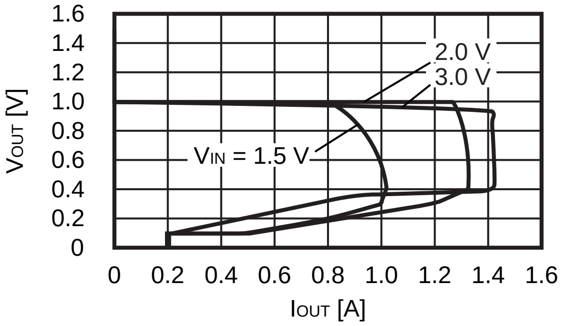
  Input capacitor (C_{IN}): 2.2 μF or more
  Output capacitor (C_L): 2.2 μF or more

- The voltage regulator may oscillate when the impedance of the power supply is high and the input capacitance is small or an input capacitor is not connected.
- If the output capacitance is small, power supply's fluctuation and the characteristics of load fluctuation become worse. Sufficiently evaluate the output voltage's fluctuation with the actual device.
- Overshoot may occur in the output voltage momentarily if the voltage is rapidly raised at power-on or when the power supply fluctuates. Sufficiently evaluate the output voltage at power-on with the actual device.
- The application conditions for the input voltage, the output voltage, and the 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 15** and **Table 16** in "**■ 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.

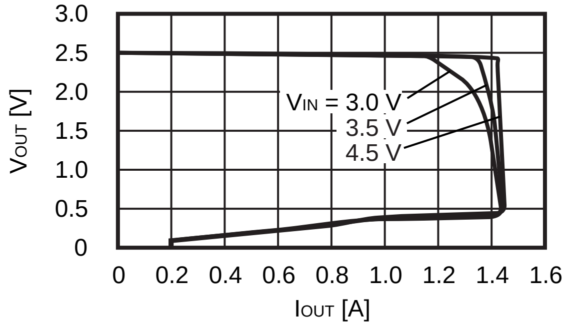
■ Characteristics (Typical Data)

1. Output voltage vs. Output current (When load current increases) (Ta = +25°C)

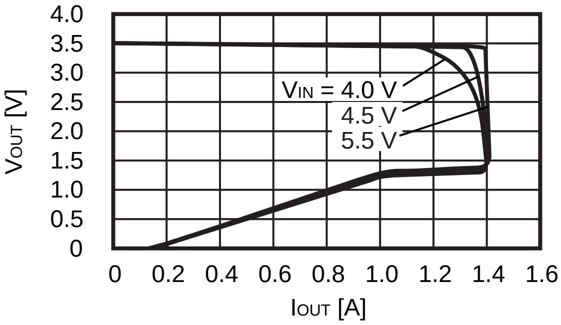
1. 1 V_{OUT} = 1.0 V



1. 2 V_{OUT} = 2.5 V



1. 3 V_{OUT} = 3.5 V

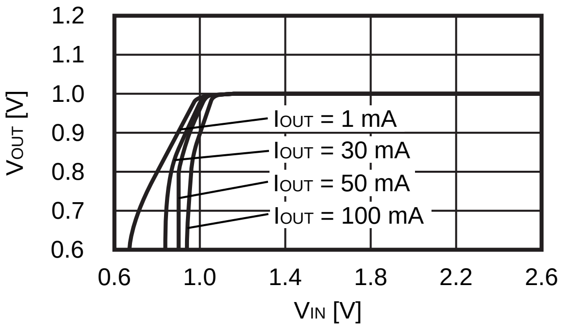


Remark In determining the output current, attention should be paid to the following.

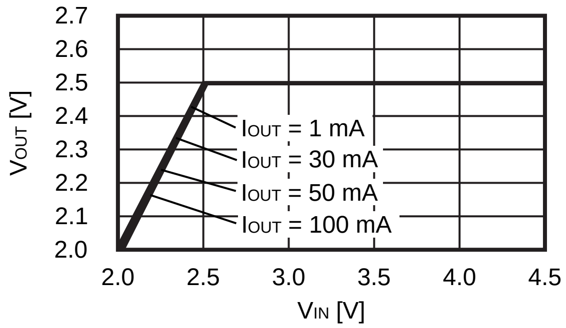
1. The minimum output current value and footnote ***5** of **Table 15** and **Table 16** in "**■ Electrical Characteristics**"
2. The package power dissipation

2. Output voltage vs. Input voltage (Ta = +25°C)

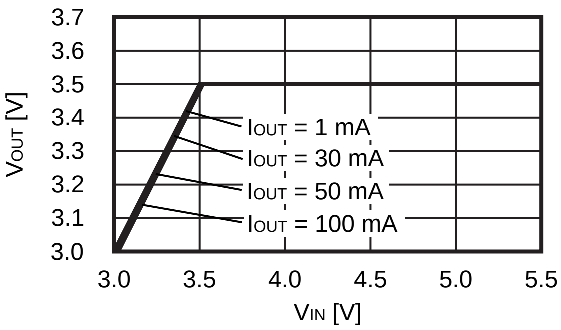
2. 1 V_{OUT} = 1.0 V



2. 2 V_{OUT} = 2.5 V

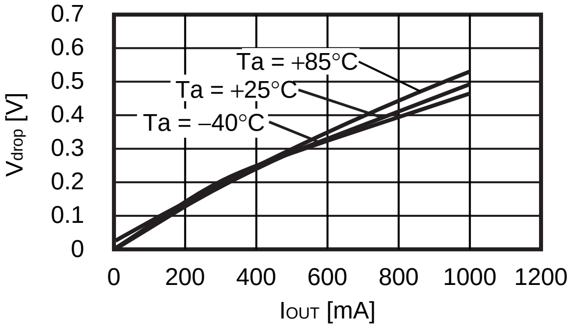


2. 3 V_{OUT} = 3.5 V

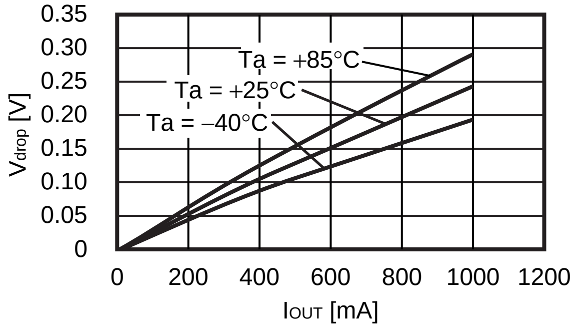


3. Dropout voltage vs. Output current

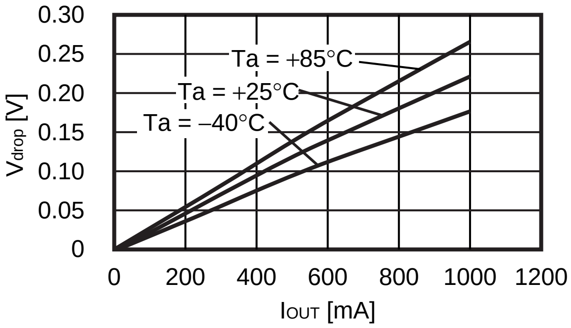
3. 1 V_{OUT} = 1.0 V



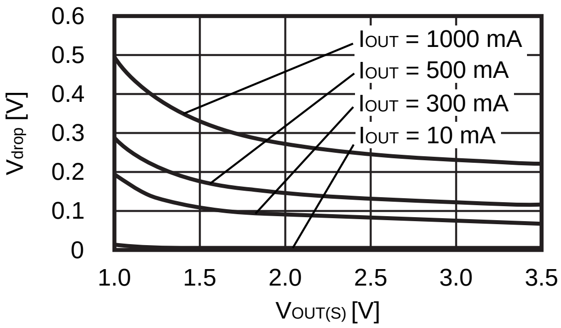
3. 2 V_{OUT} = 2.5 V



3. 3 V_{OUT} = 3.5 V

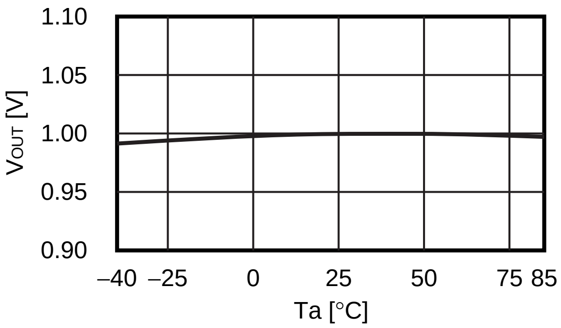


4. Dropout voltage vs. Set output voltage

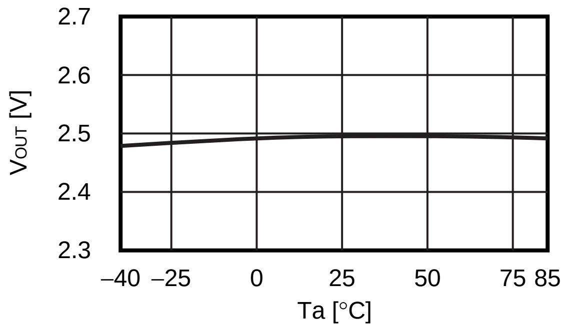


5. Output voltage vs. Ambient temperature

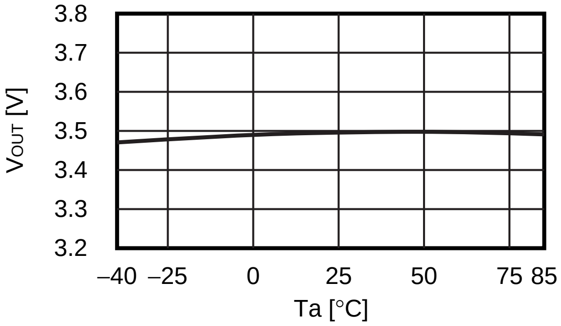
5. 1 V_{OUT} = 1.0 V



5. 2 V_{OUT} = 2.5 V

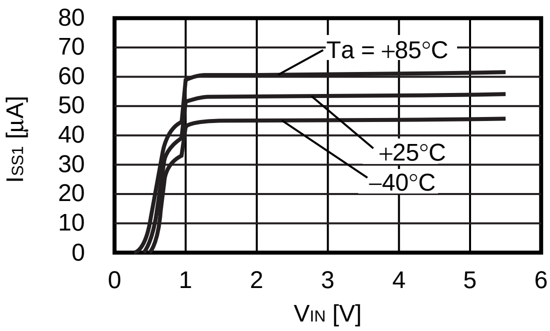


5. 3 V_{OUT} = 3.5 V

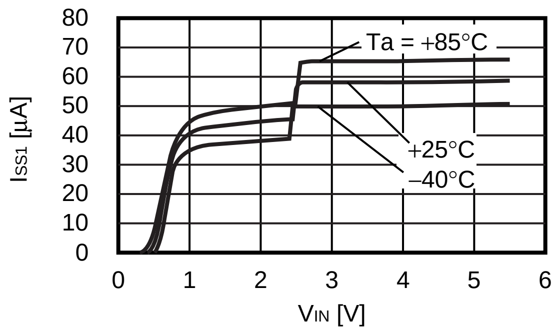


6. Current consumption vs. Input voltage

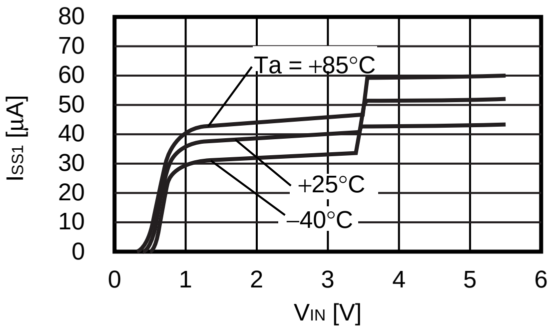
6. 1 V_{OUT} = 1.0 V



6. 2 V_{OUT} = 2.5 V

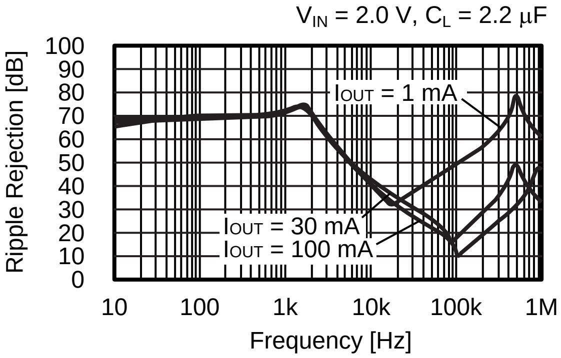


6. 3 V_{OUT} = 3.5 V

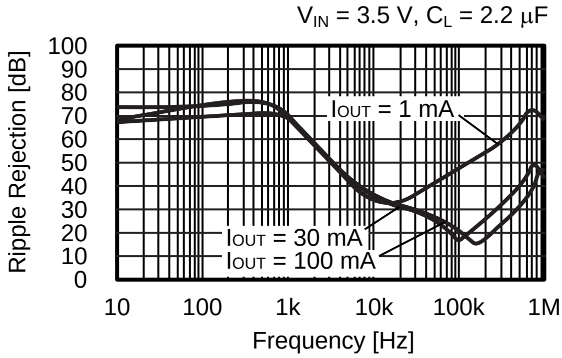


7. Ripple rejection (Ta = +25°C)

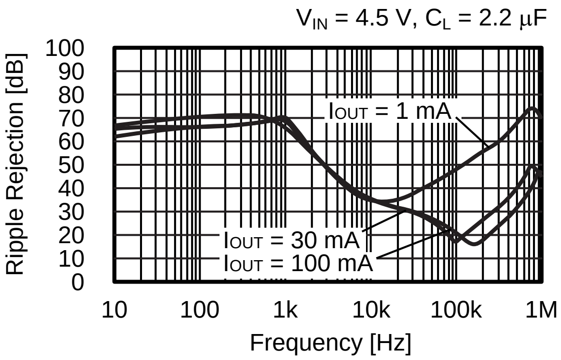
7. 1 V_{OUT} = 1.0 V



7. 2 V_{OUT} = 2.5 V



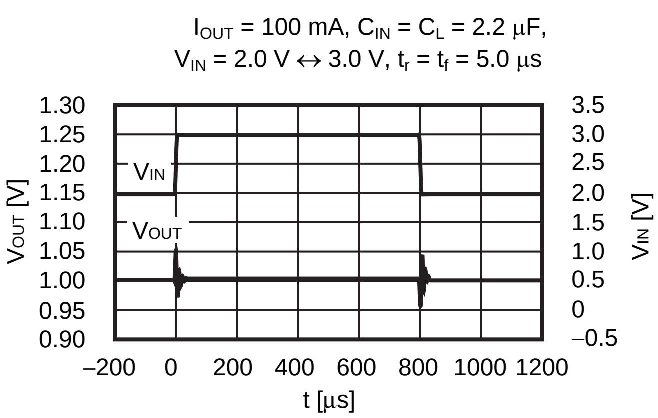
7. 3 V_{OUT} = 3.5 V



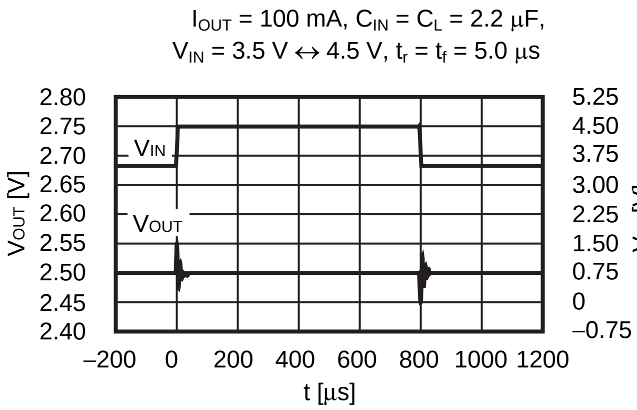
■ Reference Data

1. Transient response characteristics when input (Ta = +25°C)

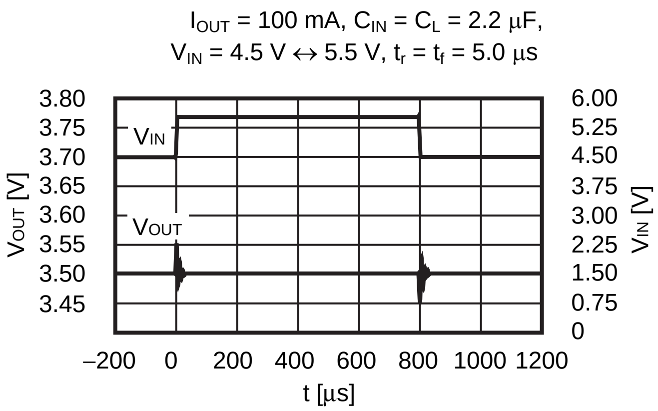
1. 1 V_{OUT} = 1.0 V



1. 2 V_{OUT} = 2.5 V



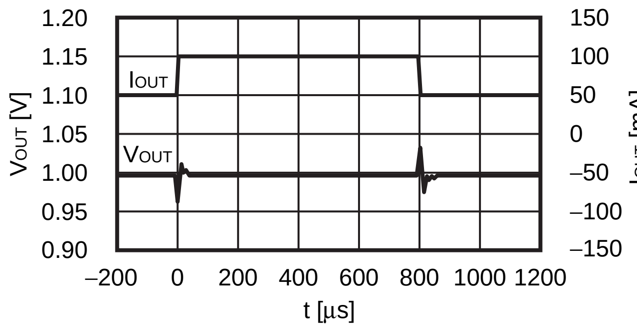
1. 3 V_{OUT} = 3.5 V



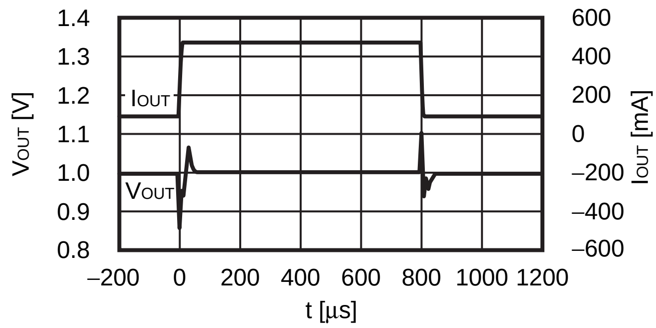
2. Transient response characteristics of load (Ta = +25°C)

2. 1 V_{OUT} = 1.0 V

V_{IN} = 2.0 V, C_{IN} = C_L = 2.2 μF, I_{OUT} = 50 mA ↔ 100 mA

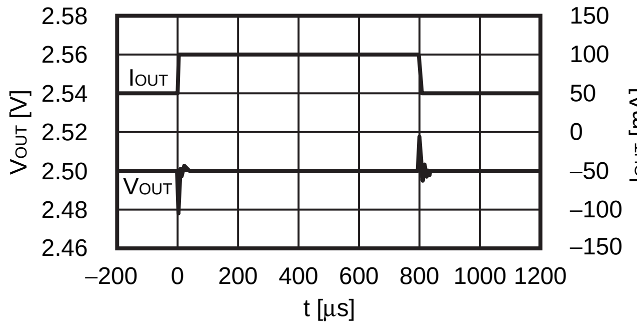


V_{IN} = 2.0 V, C_{IN} = C_L = 2.2 μF, I_{OUT} = 100 mA ↔ 500 mA

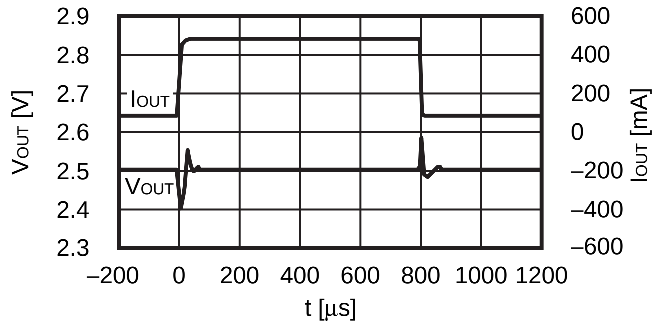


2. 2 V_{OUT} = 2.5 V

V_{IN} = 3.5 V, C_{IN} = C_L = 2.2 μF, I_{OUT} = 50 mA ↔ 100 mA

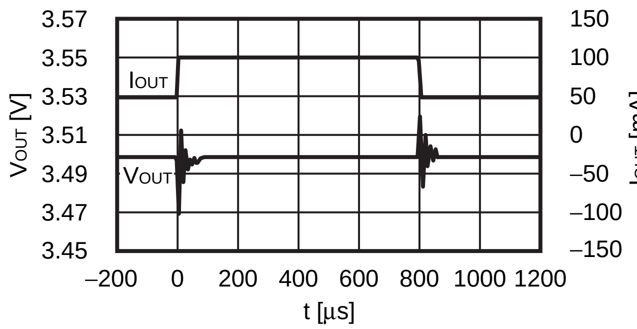


V_{IN} = 3.5 V, C_{IN} = C_L = 2.2 μF, I_{OUT} = 100 mA ↔ 500 mA

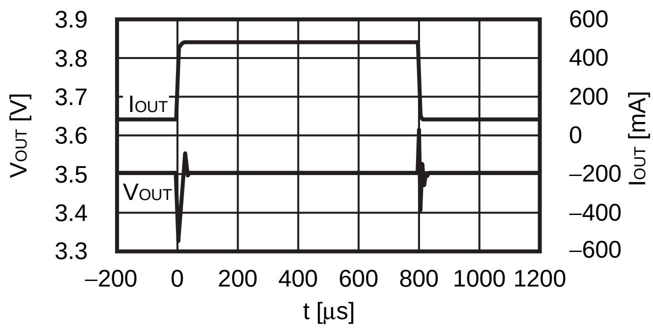


2. 3 V_{OUT} = 3.5 V

V_{IN} = 4.5 V, C_{IN} = C_L = 2.2 μF, I_{OUT} = 50 mA ↔ 100 mA



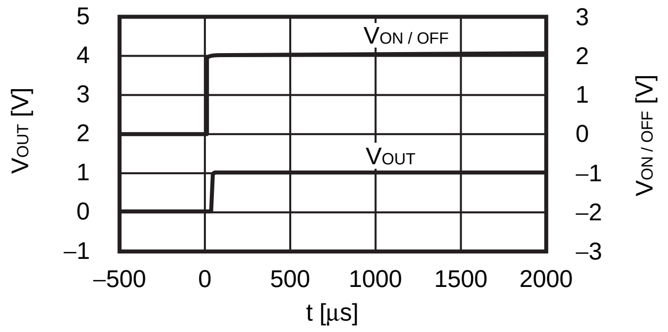
V_{IN} = 4.5 V, C_{IN} = C_L = 2.2 μF, I_{OUT} = 100 mA ↔ 500 mA



3. Transient response characteristics of ON / OFF pin (Ta = +25°C)

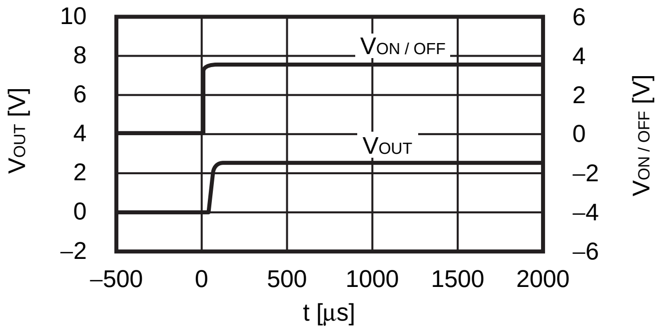
3. 1 V_{OUT} = 1.0 V

V_{IN} = 2.0 V, C_{IN} = C_L = 2.2 μF, I_{OUT} = 100 mA,
$V_{ON / OFF}$ = 0 V → 2.0 V, t_r = 1.0 μs



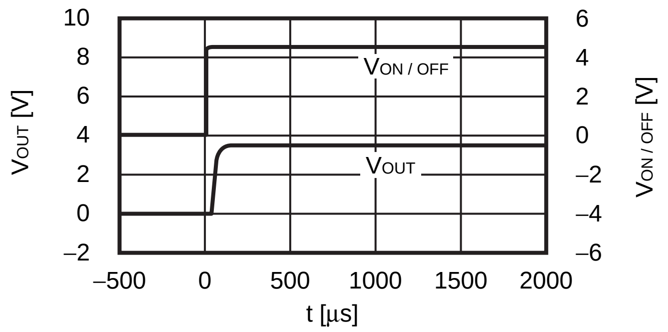
3. 2 V_{OUT} = 2.5 V

V_{IN} = 3.5 V, C_{IN} = C_L = 2.2 μF, I_{OUT} = 100 mA,
$V_{ON / OFF}$ = 0 V → 3.5 V, t_r = 1.0 μs



3. 3 V_{OUT} = 3.5 V

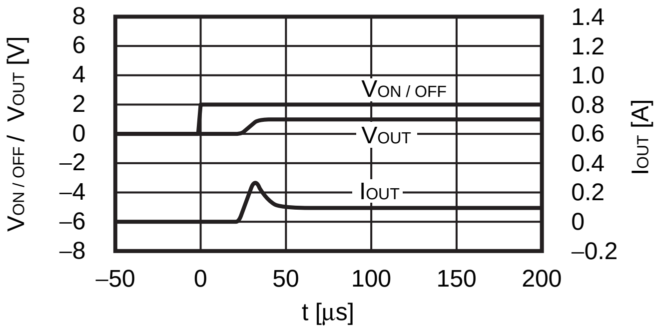
V_{IN} = 4.5 V, C_{IN} = C_L = 2.2 μF, I_{OUT} = 100 mA,
$V_{ON / OFF}$ = 0 V → 4.5 V, t_r = 1.0 μs



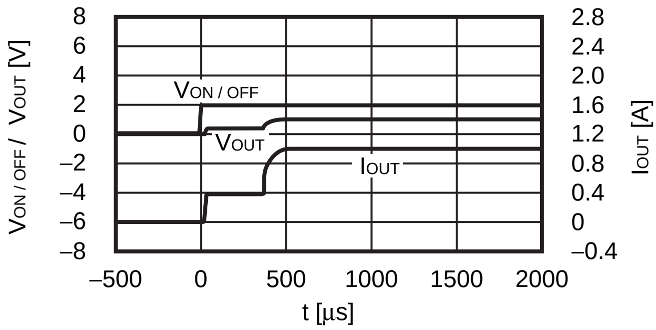
4. Inrush current (Ta = +25°C)

4. 1 V_{OUT} = 1.0 V

V_{IN} = 2.0 V, C_{IN} = C_L = 2.2 μF, C_{SS} = 0 nF, I_{OUT} = 100 mA, $V_{ON / OFF}$ = 0 V → 2.0 V, t_r = 1.0 μs

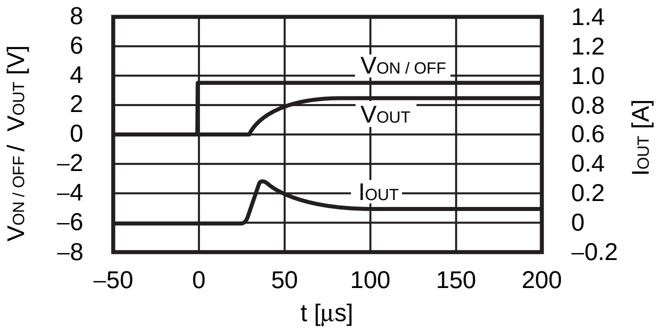


V_{IN} = 2.0 V, C_{IN} = C_L = 2.2 μF, C_{SS} = 0 nF, I_{OUT} = 1000 mA, $V_{ON / OFF}$ = 0 V → 2.0 V, t_r = 1.0 μs

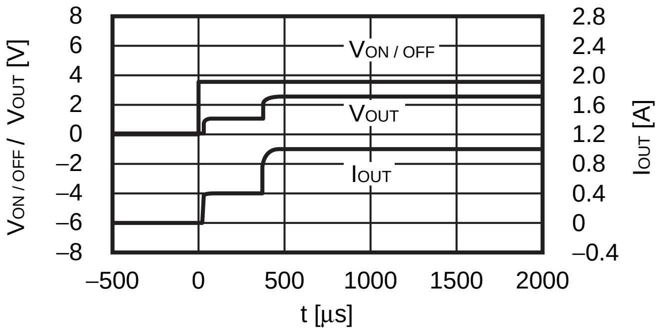


4. 2 V_{OUT} = 2.5 V

V_{IN} = 3.5 V, C_{IN} = C_L = 2.2 μF, C_{SS} = 0 nF, I_{OUT} = 100 mA, $V_{ON / OFF}$ = 0 V → 3.5 V, t_r = 1.0 μs

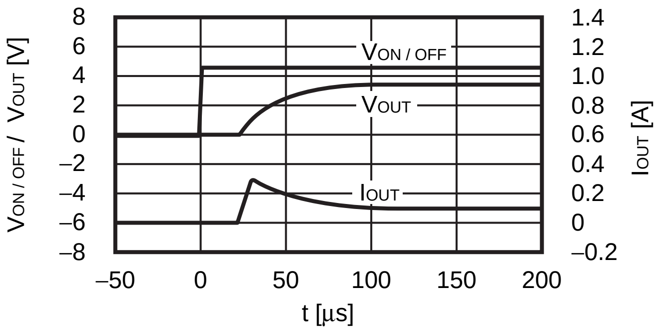


V_{IN} = 3.5 V, C_{IN} = C_L = 2.2 μF, C_{SS} = 0 nF, I_{OUT} = 1000 mA, $V_{ON / OFF}$ = 0 V → 3.5 V, t_r = 1.0 μs

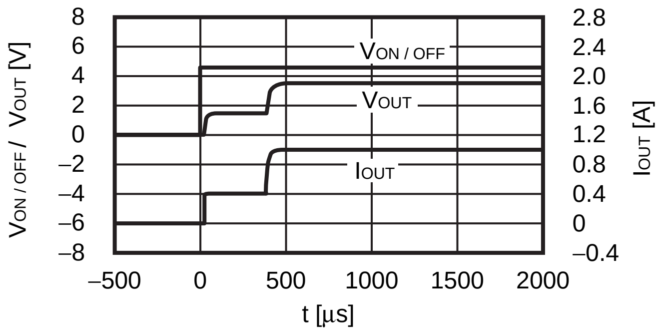


4. 3 V_{OUT} = 3.5 V

V_{IN} = 4.5 V, C_{IN} = C_L = 2.2 μF, C_{SS} = 0 nF, I_{OUT} = 100 mA, $V_{ON / OFF}$ = 0 V → 4.5 V, t_r = 1.0 μs



V_{IN} = 4.5 V, C_{IN} = C_L = 2.2 μF, C_{SS} = 0 nF, I_{OUT} = 1000 mA, $V_{ON / OFF}$ = 0 V → 4.5 V, t_r = 1.0 μs



5. Output capacitance vs. Characteristics of discharge time (Ta = +25°C)

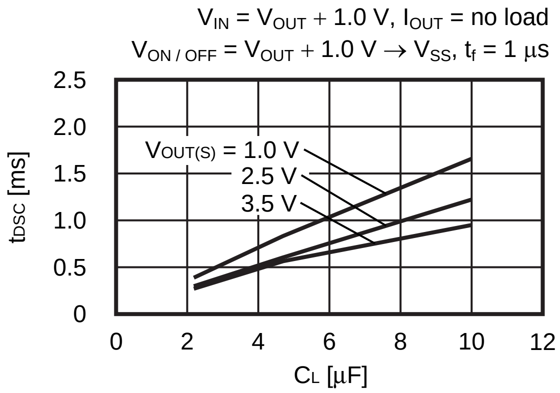


Figure 36 S-13A1 Series A / B type (with discharge shunt function)

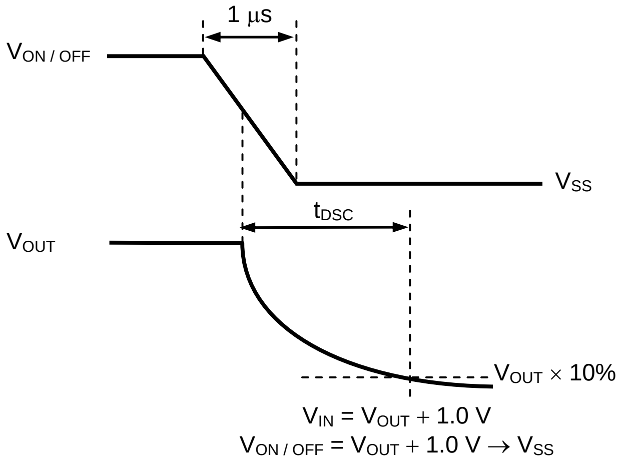
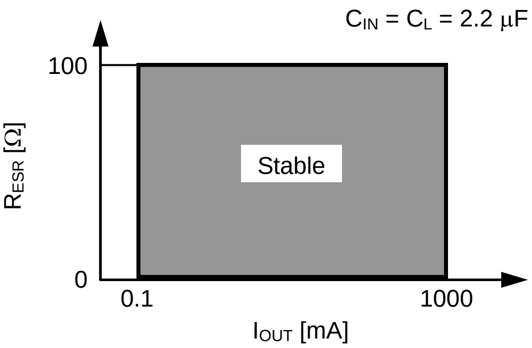
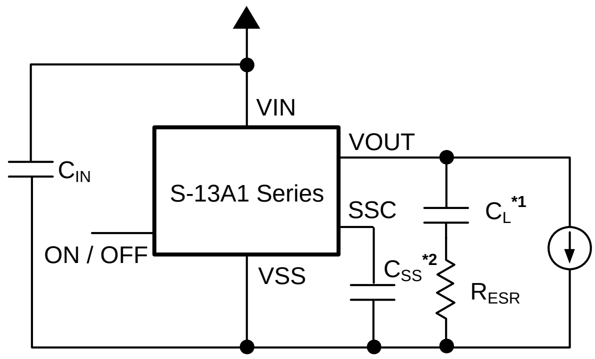


Figure 37 Measurement Condition of Discharge Time

6. Example of equivalent series resistance vs. Output current characteristics (Ta = +25°C)





***1.** C_L: TDK Corporation C3225X8R1E225K (2.2 µF)
***2.** C_{SS}: Murata Manufacturing Co., Ltd. GRM1882C1H102JA01 (1.0 nF)

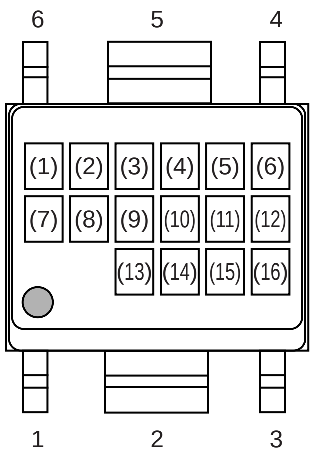
Figure 38

Figure 39

■ Marking Specifications

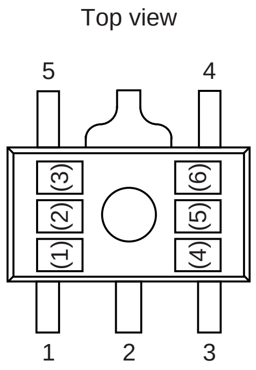
1. HSOP-6

Top view



(1) to (5):	Product name: S13A1 (Fixed)
(6):	Product type
(7) and (8):	Value of output voltage
(9) to (16):	Lot number

2. SOT-89-5



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

Product name vs. Product code

2. 1 S-13A1 Series A type

Product Name	Product Code		
	(1)	(2)	(3)
S-13A1A00-U5T1U3	W	R	A
S-13A1A10-U5T1U3	W	R	B
S-13A1A11-U5T1U3	W	R	C
S-13A1A12-U5T1U3	W	R	D
S-13A1A1C-U5T1U3	W	R	5
S-13A1A13-U5T1U3	W	R	E
S-13A1A14-U5T1U3	W	R	F
S-13A1A15-U5T1U3	W	R	G
S-13A1A16-U5T1U3	W	R	H
S-13A1A17-U5T1U3	W	R	I
S-13A1A18-U5T1U3	W	R	J
S-13A1A1J-U5T1U3	W	R	K
S-13A1A19-U5T1U3	W	R	L
S-13A1A20-U5T1U3	W	R	M
S-13A1A21-U5T1U3	W	R	N
S-13A1A22-U5T1U3	W	R	O
S-13A1A23-U5T1U3	W	R	P
S-13A1A24-U5T1U3	W	R	Q
S-13A1A25-U5T1U3	W	R	R
S-13A1A26-U5T1U3	W	R	S
S-13A1A27-U5T1U3	W	R	T
S-13A1A28-U5T1U3	W	R	U
S-13A1A2J-U5T1U3	W	R	V
S-13A1A29-U5T1U3	W	R	W
S-13A1A30-U5T1U3	W	R	X
S-13A1A31-U5T1U3	W	R	Y
S-13A1A32-U5T1U3	W	R	Z
S-13A1A33-U5T1U3	W	R	2
S-13A1A34-U5T1U3	W	R	3
S-13A1A35-U5T1U3	W	R	4

2. 2 S-13A1 Series B type

Product Name	Product Code		
	(1)	(2)	(3)
S-13A1B00-U5T1U3	W	S	A
S-13A1B10-U5T1U3	W	S	B
S-13A1B11-U5T1U3	W	S	C
S-13A1B12-U5T1U3	W	S	D
S-13A1B1C-U5T1U3	W	S	5
S-13A1B13-U5T1U3	W	S	E
S-13A1B14-U5T1U3	W	S	F
S-13A1B15-U5T1U3	W	S	G
S-13A1B16-U5T1U3	W	S	H
S-13A1B17-U5T1U3	W	S	I
S-13A1B18-U5T1U3	W	S	J
S-13A1B1J-U5T1U3	W	S	K
S-13A1B19-U5T1U3	W	S	L
S-13A1B20-U5T1U3	W	S	M
S-13A1B21-U5T1U3	W	S	N
S-13A1B22-U5T1U3	W	S	O
S-13A1B23-U5T1U3	W	S	P
S-13A1B24-U5T1U3	W	S	Q
S-13A1B25-U5T1U3	W	S	R
S-13A1B26-U5T1U3	W	S	S
S-13A1B27-U5T1U3	W	S	T
S-13A1B28-U5T1U3	W	S	U
S-13A1B2J-U5T1U3	W	S	V
S-13A1B29-U5T1U3	W	S	W
S-13A1B30-U5T1U3	W	S	X
S-13A1B31-U5T1U3	W	S	Y
S-13A1B32-U5T1U3	W	S	Z
S-13A1B33-U5T1U3	W	S	2
S-13A1B34-U5T1U3	W	S	3
S-13A1B35-U5T1U3	W	S	4

2. 3 S-13A1 Series C type

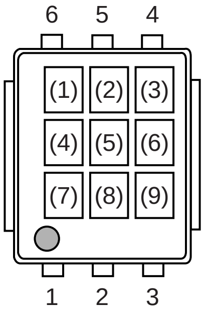
Product Name	Product Code		
	(1)	(2)	(3)
S-13A1C00-U5T1U3	W	T	A
S-13A1C10-U5T1U3	W	T	B
S-13A1C11-U5T1U3	W	T	C
S-13A1C12-U5T1U3	W	T	D
S-13A1C1C-U5T1U3	W	T	5
S-13A1C13-U5T1U3	W	T	E
S-13A1C14-U5T1U3	W	T	F
S-13A1C15-U5T1U3	W	T	G
S-13A1C16-U5T1U3	W	T	H
S-13A1C17-U5T1U3	W	T	I
S-13A1C18-U5T1U3	W	T	J
S-13A1C1J-U5T1U3	W	T	K
S-13A1C19-U5T1U3	W	T	L
S-13A1C20-U5T1U3	W	T	M
S-13A1C21-U5T1U3	W	T	N
S-13A1C22-U5T1U3	W	T	O
S-13A1C23-U5T1U3	W	T	P
S-13A1C24-U5T1U3	W	T	Q
S-13A1C25-U5T1U3	W	T	R
S-13A1C26-U5T1U3	W	T	S
S-13A1C27-U5T1U3	W	T	T
S-13A1C28-U5T1U3	W	T	U
S-13A1C2J-U5T1U3	W	T	V
S-13A1C29-U5T1U3	W	T	W
S-13A1C30-U5T1U3	W	T	X
S-13A1C31-U5T1U3	W	T	Y
S-13A1C32-U5T1U3	W	T	Z
S-13A1C33-U5T1U3	W	T	2
S-13A1C34-U5T1U3	W	T	3
S-13A1C35-U5T1U3	W	T	4

2. 4 S-13A1 Series D type

Product Name	Product Code		
	(1)	(2)	(3)
S-13A1D00-U5T1U3	W	U	A
S-13A1D10-U5T1U3	W	U	B
S-13A1D11-U5T1U3	W	U	C
S-13A1D12-U5T1U3	W	U	D
S-13A1D1C-U5T1U3	W	U	5
S-13A1D13-U5T1U3	W	U	E
S-13A1D14-U5T1U3	W	U	F
S-13A1D15-U5T1U3	W	U	G
S-13A1D16-U5T1U3	W	U	H
S-13A1D17-U5T1U3	W	U	I
S-13A1D18-U5T1U3	W	U	J
S-13A1D1J-U5T1U3	W	U	K
S-13A1D19-U5T1U3	W	U	L
S-13A1D20-U5T1U3	W	U	M
S-13A1D21-U5T1U3	W	U	N
S-13A1D22-U5T1U3	W	U	O
S-13A1D23-U5T1U3	W	U	P
S-13A1D24-U5T1U3	W	U	Q
S-13A1D25-U5T1U3	W	U	R
S-13A1D26-U5T1U3	W	U	S
S-13A1D27-U5T1U3	W	U	T
S-13A1D28-U5T1U3	W	U	U
S-13A1D2J-U5T1U3	W	U	V
S-13A1D29-U5T1U3	W	U	W
S-13A1D30-U5T1U3	W	U	X
S-13A1D31-U5T1U3	W	U	Y
S-13A1D32-U5T1U3	W	U	Z
S-13A1D33-U5T1U3	W	U	2
S-13A1D34-U5T1U3	W	U	3
S-13A1D35-U5T1U3	W	U	4

3. HSNT-6A

Top view



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

Product name vs. Product code

3. 1 S-13A1 Series A type

Product Name	Product Code		
	(1)	(2)	(3)
S-13A1A10-A6T1U3	W	R	B
S-13A1A11-A6T1U3	W	R	C
S-13A1A12-A6T1U3	W	R	D
S-13A1A1C-A6T1U3	W	R	5
S-13A1A13-A6T1U3	W	R	E
S-13A1A14-A6T1U3	W	R	F
S-13A1A15-A6T1U3	W	R	G
S-13A1A16-A6T1U3	W	R	H
S-13A1A17-A6T1U3	W	R	I
S-13A1A18-A6T1U3	W	R	J
S-13A1A1J-A6T1U3	W	R	K
S-13A1A19-A6T1U3	W	R	L
S-13A1A20-A6T1U3	W	R	M
S-13A1A21-A6T1U3	W	R	N
S-13A1A22-A6T1U3	W	R	O
S-13A1A23-A6T1U3	W	R	P
S-13A1A24-A6T1U3	W	R	Q
S-13A1A25-A6T1U3	W	R	R
S-13A1A26-A6T1U3	W	R	S
S-13A1A27-A6T1U3	W	R	T
S-13A1A28-A6T1U3	W	R	U
S-13A1A2J-A6T1U3	W	R	V
S-13A1A29-A6T1U3	W	R	W
S-13A1A30-A6T1U3	W	R	X
S-13A1A31-A6T1U3	W	R	Y
S-13A1A32-A6T1U3	W	R	Z
S-13A1A33-A6T1U3	W	R	2
S-13A1A34-A6T1U3	W	R	3
S-13A1A35-A6T1U3	W	R	4

3. 2 S-13A1 Series B type

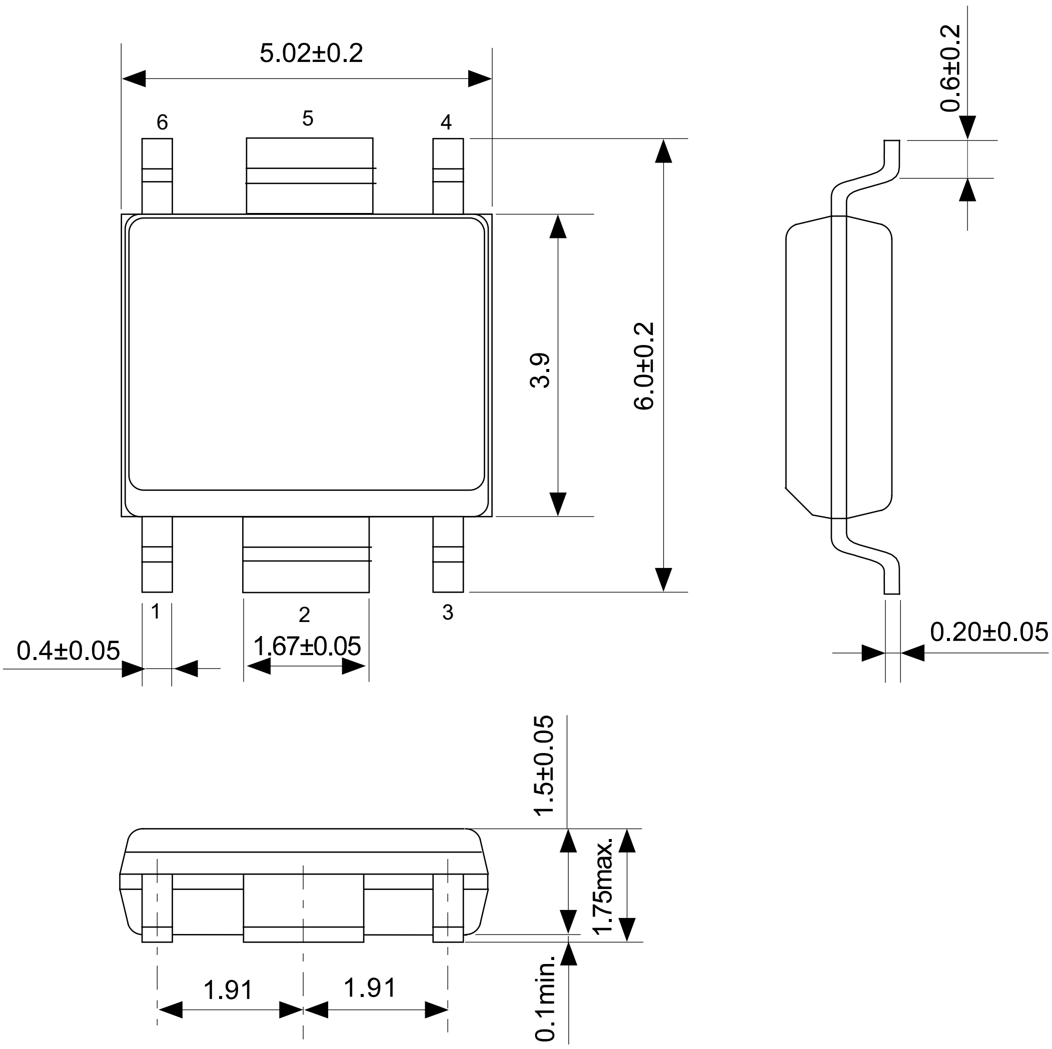
Product Name	Product Code		
	(1)	(2)	(3)
S-13A1B10-A6T1U3	W	S	B
S-13A1B11-A6T1U3	W	S	C
S-13A1B12-A6T1U3	W	S	D
S-13A1B1C-A6T1U3	W	S	5
S-13A1B13-A6T1U3	W	S	E
S-13A1B14-A6T1U3	W	S	F
S-13A1B15-A6T1U3	W	S	G
S-13A1B16-A6T1U3	W	S	H
S-13A1B17-A6T1U3	W	S	I
S-13A1B18-A6T1U3	W	S	J
S-13A1B1J-A6T1U3	W	S	K
S-13A1B19-A6T1U3	W	S	L
S-13A1B20-A6T1U3	W	S	M
S-13A1B21-A6T1U3	W	S	N
S-13A1B22-A6T1U3	W	S	O
S-13A1B23-A6T1U3	W	S	P
S-13A1B24-A6T1U3	W	S	Q
S-13A1B25-A6T1U3	W	S	R
S-13A1B26-A6T1U3	W	S	S
S-13A1B27-A6T1U3	W	S	T
S-13A1B28-A6T1U3	W	S	U
S-13A1B2J-A6T1U3	W	S	V
S-13A1B29-A6T1U3	W	S	W
S-13A1B30-A6T1U3	W	S	X
S-13A1B31-A6T1U3	W	S	Y
S-13A1B32-A6T1U3	W	S	Z
S-13A1B33-A6T1U3	W	S	2
S-13A1B34-A6T1U3	W	S	3
S-13A1B35-A6T1U3	W	S	4

3. 3 S-13A1 Series C type

Product Name	Product Code		
	(1)	(2)	(3)
S-13A1C10-A6T1U3	W	T	B
S-13A1C11-A6T1U3	W	T	C
S-13A1C12-A6T1U3	W	T	D
S-13A1C1C-A6T1U3	W	T	5
S-13A1C13-A6T1U3	W	T	E
S-13A1C14-A6T1U3	W	T	F
S-13A1C15-A6T1U3	W	T	G
S-13A1C16-A6T1U3	W	T	H
S-13A1C17-A6T1U3	W	T	I
S-13A1C18-A6T1U3	W	T	J
S-13A1C1J-A6T1U3	W	T	K
S-13A1C19-A6T1U3	W	T	L
S-13A1C20-A6T1U3	W	T	M
S-13A1C21-A6T1U3	W	T	N
S-13A1C22-A6T1U3	W	T	O
S-13A1C23-A6T1U3	W	T	P
S-13A1C24-A6T1U3	W	T	Q
S-13A1C25-A6T1U3	W	T	R
S-13A1C26-A6T1U3	W	T	S
S-13A1C27-A6T1U3	W	T	T
S-13A1C28-A6T1U3	W	T	U
S-13A1C2J-A6T1U3	W	T	V
S-13A1C29-A6T1U3	W	T	W
S-13A1C30-A6T1U3	W	T	X
S-13A1C31-A6T1U3	W	T	Y
S-13A1C32-A6T1U3	W	T	Z
S-13A1C33-A6T1U3	W	T	2
S-13A1C34-A6T1U3	W	T	3
S-13A1C35-A6T1U3	W	T	4

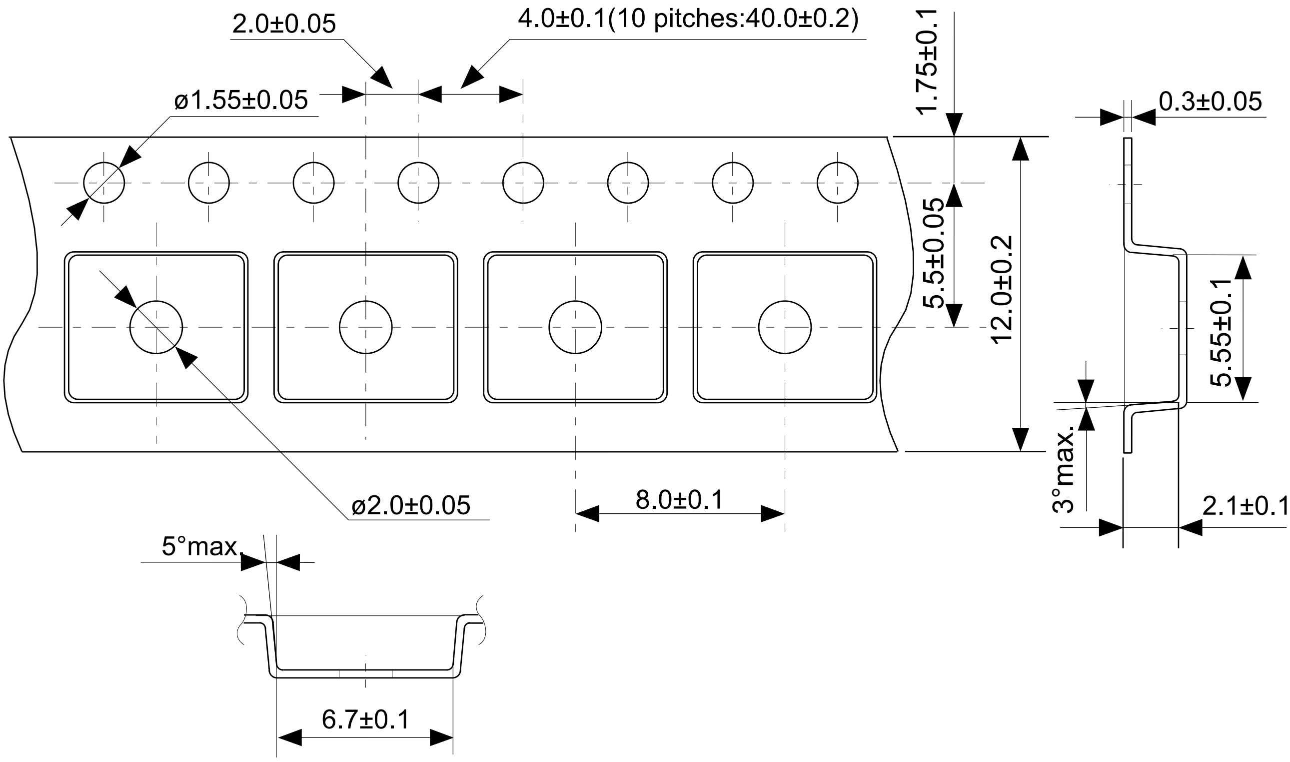
3. 4 S-13A1 Series D type

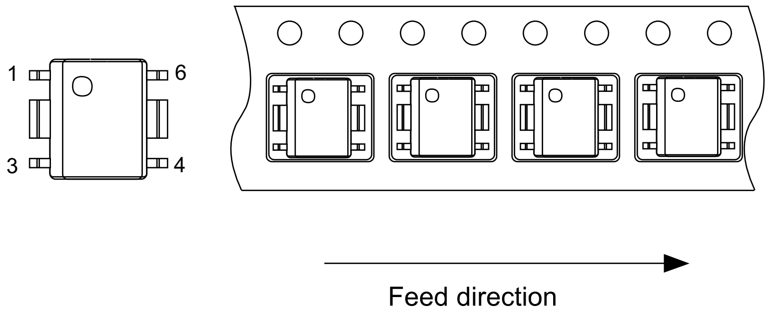
Product Name	Product Code		
	(1)	(2)	(3)
S-13A1D10-A6T1U3	W	U	B
S-13A1D11-A6T1U3	W	U	C
S-13A1D12-A6T1U3	W	U	D
S-13A1D1C-A6T1U3	W	U	5
S-13A1D13-A6T1U3	W	U	E
S-13A1D14-A6T1U3	W	U	F
S-13A1D15-A6T1U3	W	U	G
S-13A1D16-A6T1U3	W	U	H
S-13A1D17-A6T1U3	W	U	I
S-13A1D18-A6T1U3	W	U	J
S-13A1D1J-A6T1U3	W	U	K
S-13A1D19-A6T1U3	W	U	L
S-13A1D20-A6T1U3	W	U	M
S-13A1D21-A6T1U3	W	U	N
S-13A1D22-A6T1U3	W	U	O
S-13A1D23-A6T1U3	W	U	P
S-13A1D24-A6T1U3	W	U	Q
S-13A1D25-A6T1U3	W	U	R
S-13A1D26-A6T1U3	W	U	S
S-13A1D27-A6T1U3	W	U	T
S-13A1D28-A6T1U3	W	U	U
S-13A1D2J-A6T1U3	W	U	V
S-13A1D29-A6T1U3	W	U	W
S-13A1D30-A6T1U3	W	U	X
S-13A1D31-A6T1U3	W	U	Y
S-13A1D32-A6T1U3	W	U	Z
S-13A1D33-A6T1U3	W	U	2
S-13A1D34-A6T1U3	W	U	3
S-13A1D35-A6T1U3	W	U	4



No. FH006-A-P-SD-2.0

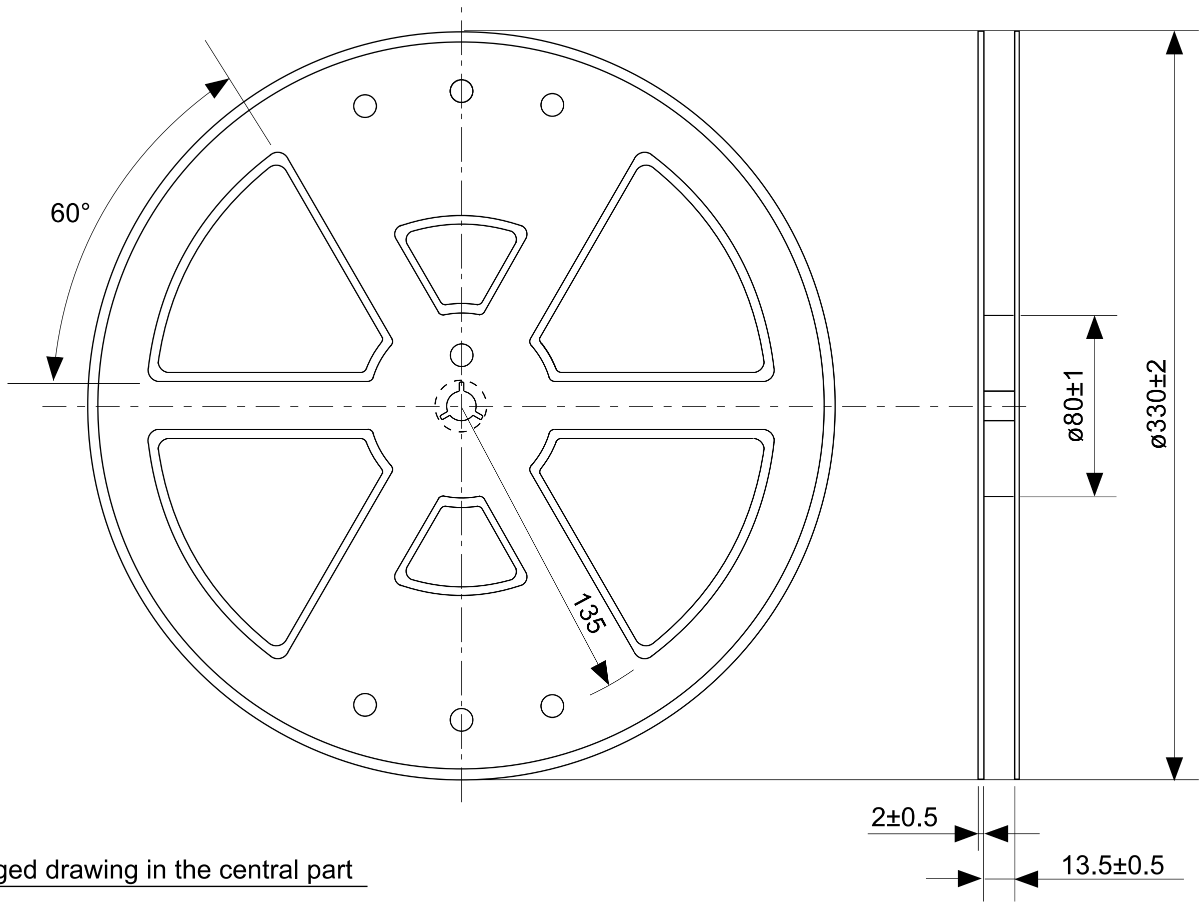
TITLE	HSOP6-A-PKG Dimensions
No.	FH006-A-P-SD-2.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	



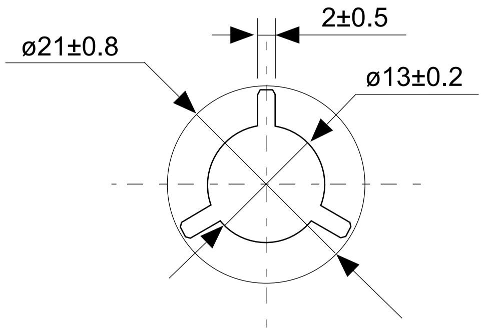


No. FH006-A-C-SD-1.0

TITLE	HSOP6-A-Carrier Tape
No.	FH006-A-C-SD-1.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	



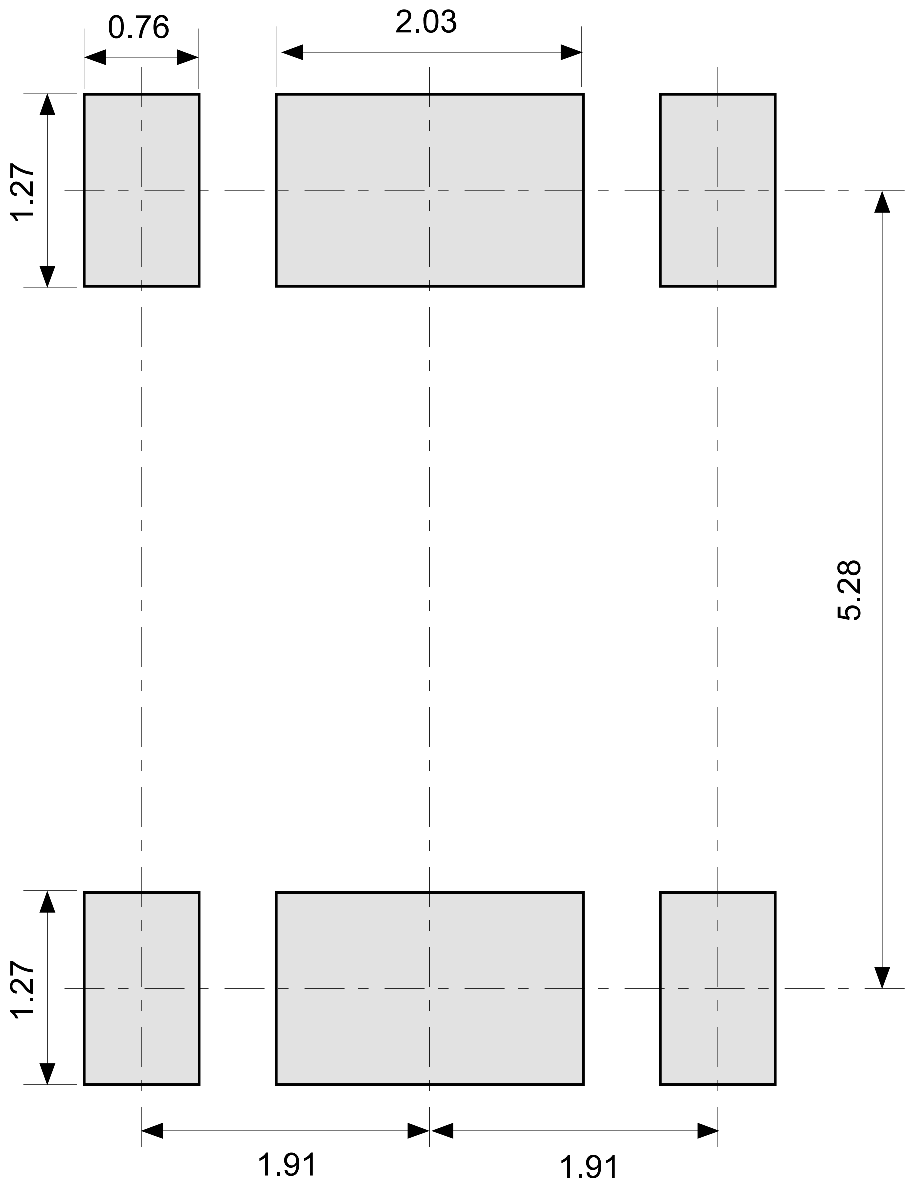
Enlarged drawing in the central part



No. FH006-A-R-S1-1.0

TITLE	HSOP6-A-Reel		
No.	FH006-A-R-S1-1.0		
SCALE		QTY.	4,000
UNIT	mm		

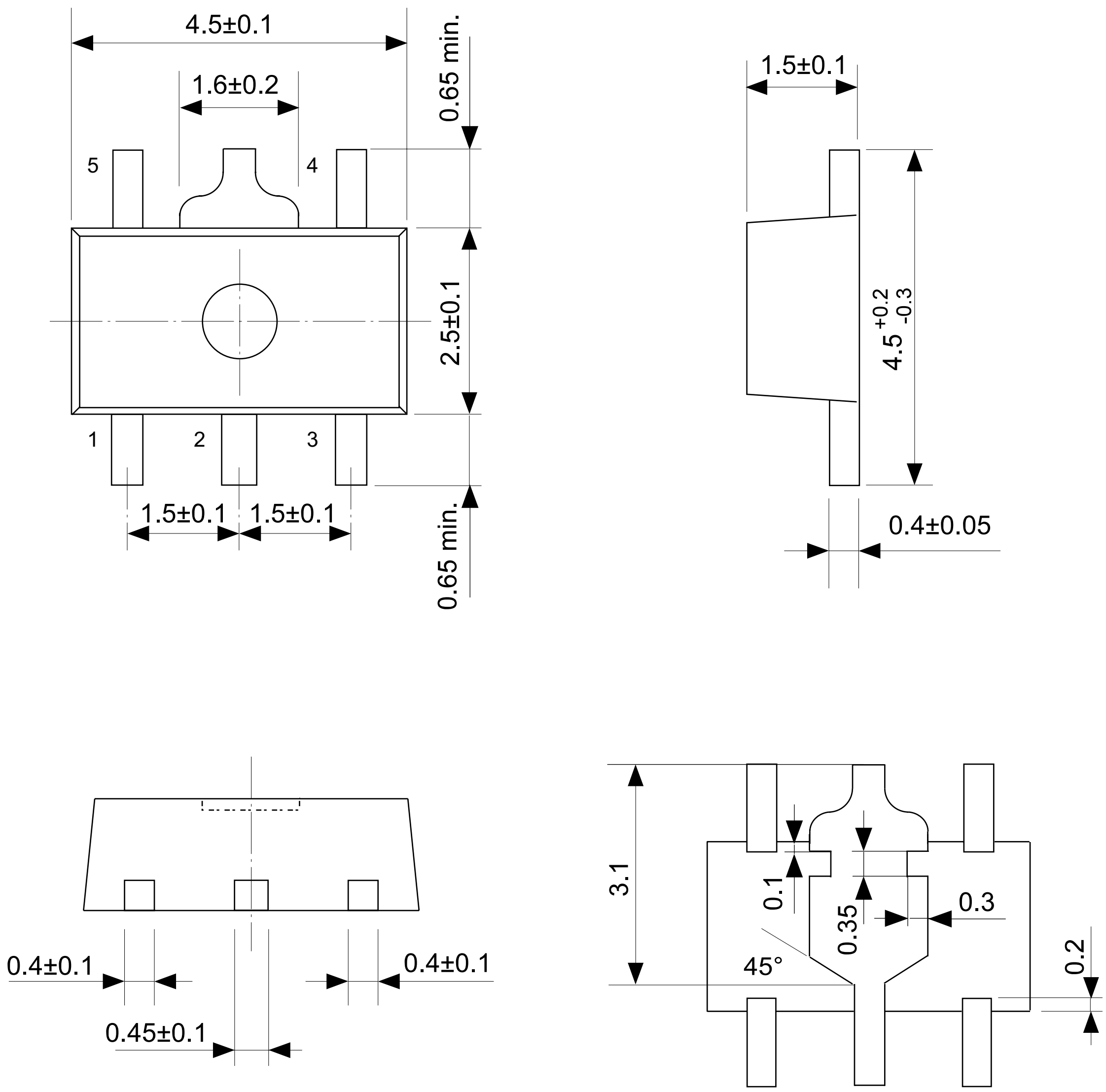
Seiko Instruments Inc.



No. FH006-A-L-SD-2.0

TITLE	HSOP6-A-Land Recommendation
No.	FH006-A-L-SD-2.0
SCALE	
UNIT	mm

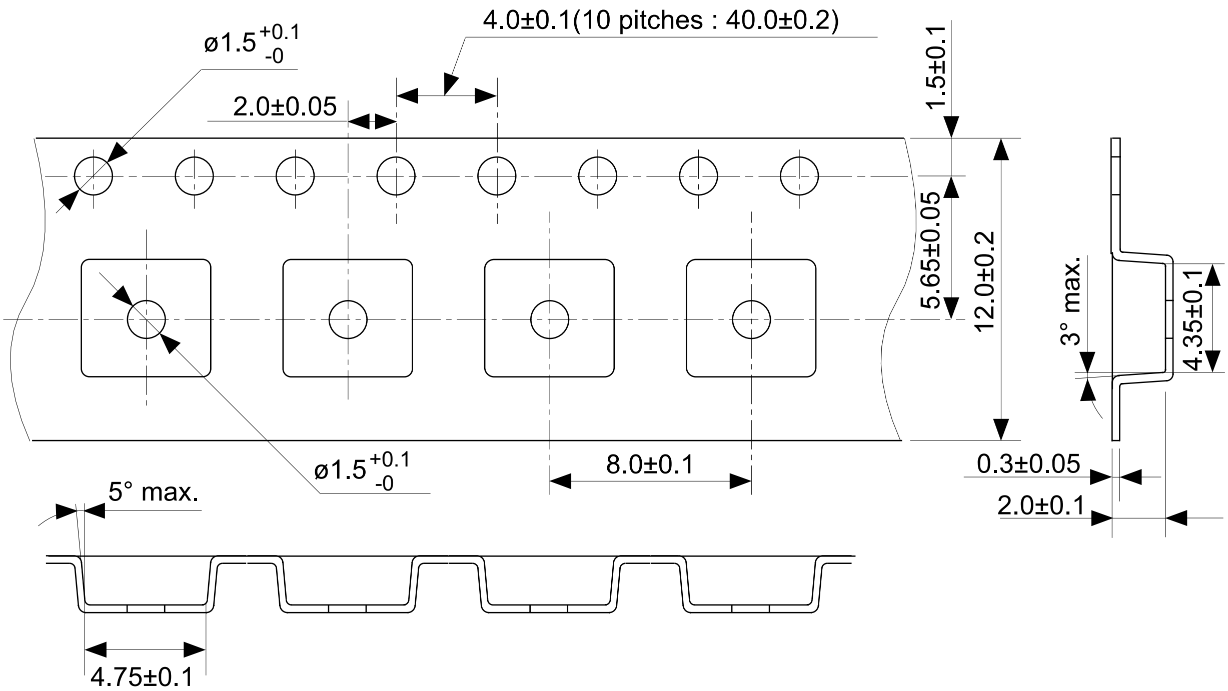
Seiko Instruments Inc.

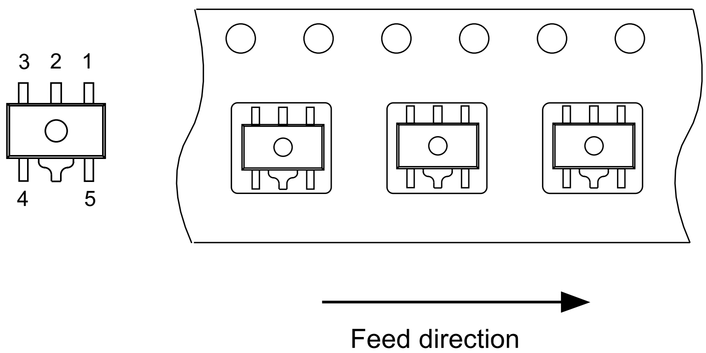


No. UP005-A-P-SD-1.1

TITLE	SOT895-A-PKG Dimensions
No.	UP005-A-P-SD-1.1
SCALE	
UNIT	mm

Seiko Instruments Inc.

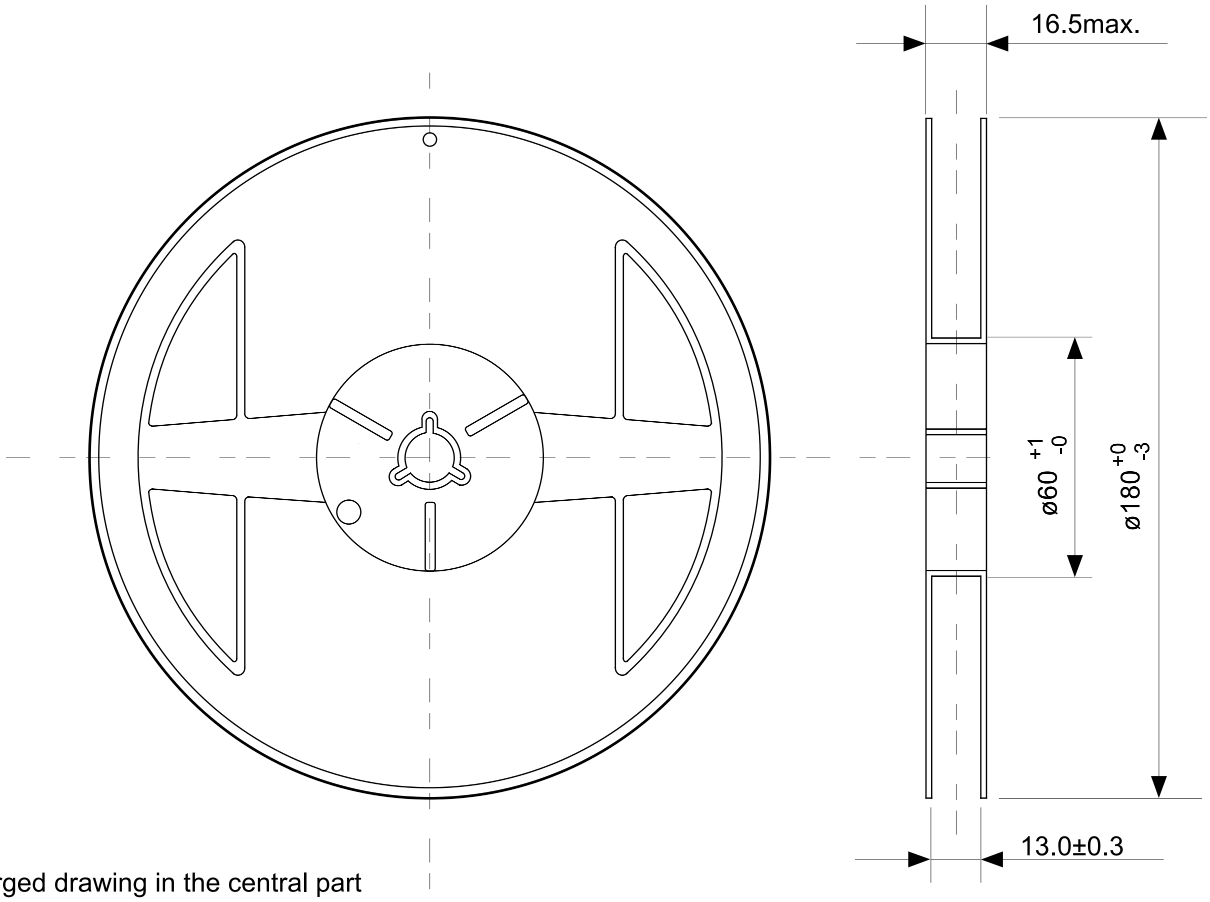




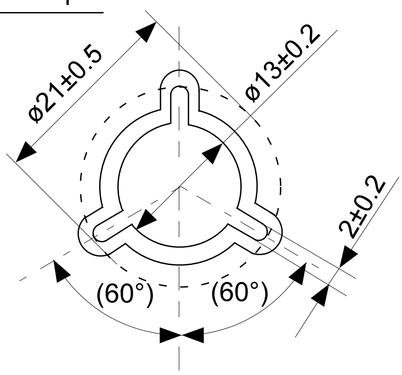
No. UP005-A-C-SD-1.1

TITLE	SOT895-A-Carrier Tape
No.	UP005-A-C-SD-1.1
SCALE	
UNIT	mm

Seiko Instruments Inc.



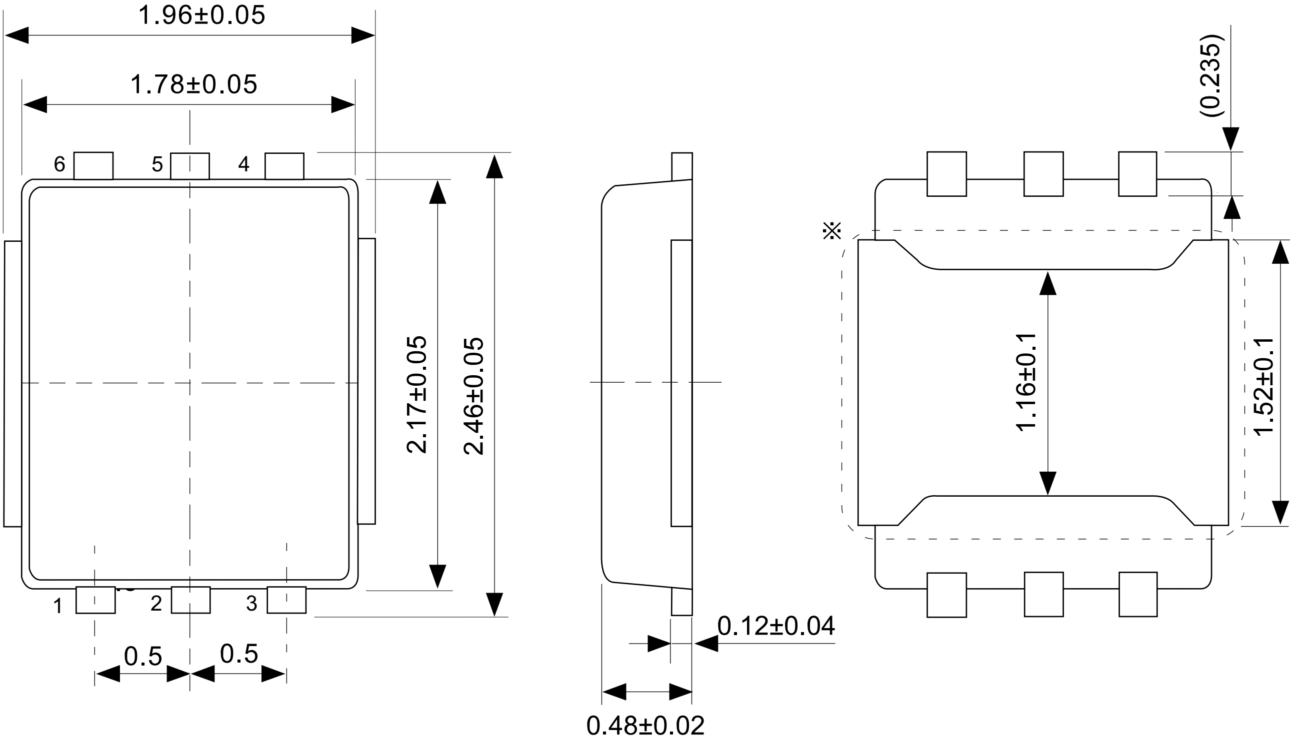
Enlarged drawing in the central part

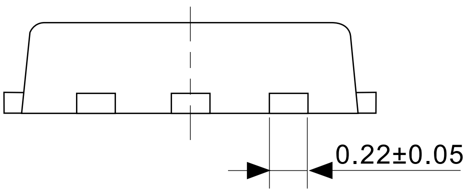


No. UP005-A-R-SD-1.1

TITLE	SOT895-A-Reel		
No.	UP005-A-R-SD-1.1		
SCALE		QTY.	1,000
UNIT	mm		

Seiko Instruments Inc.

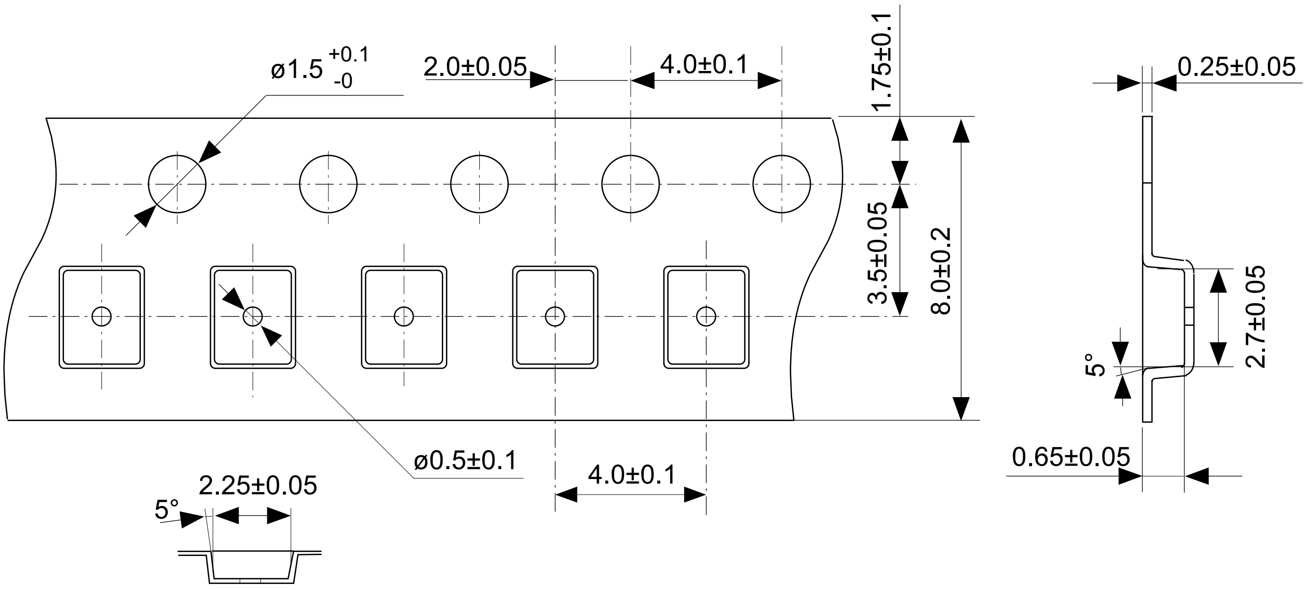


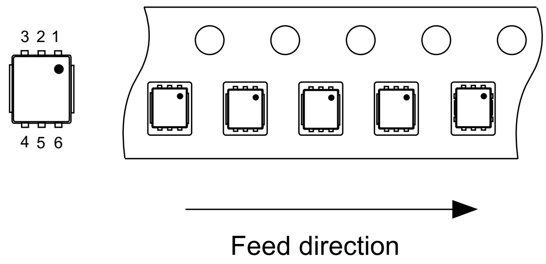


※ The heatsink of back side has different electric potential depending on the product.
Confirm specifications of each product.
Do not use it as the function of electrode.

No. PJ006-A-P-SD-3.0

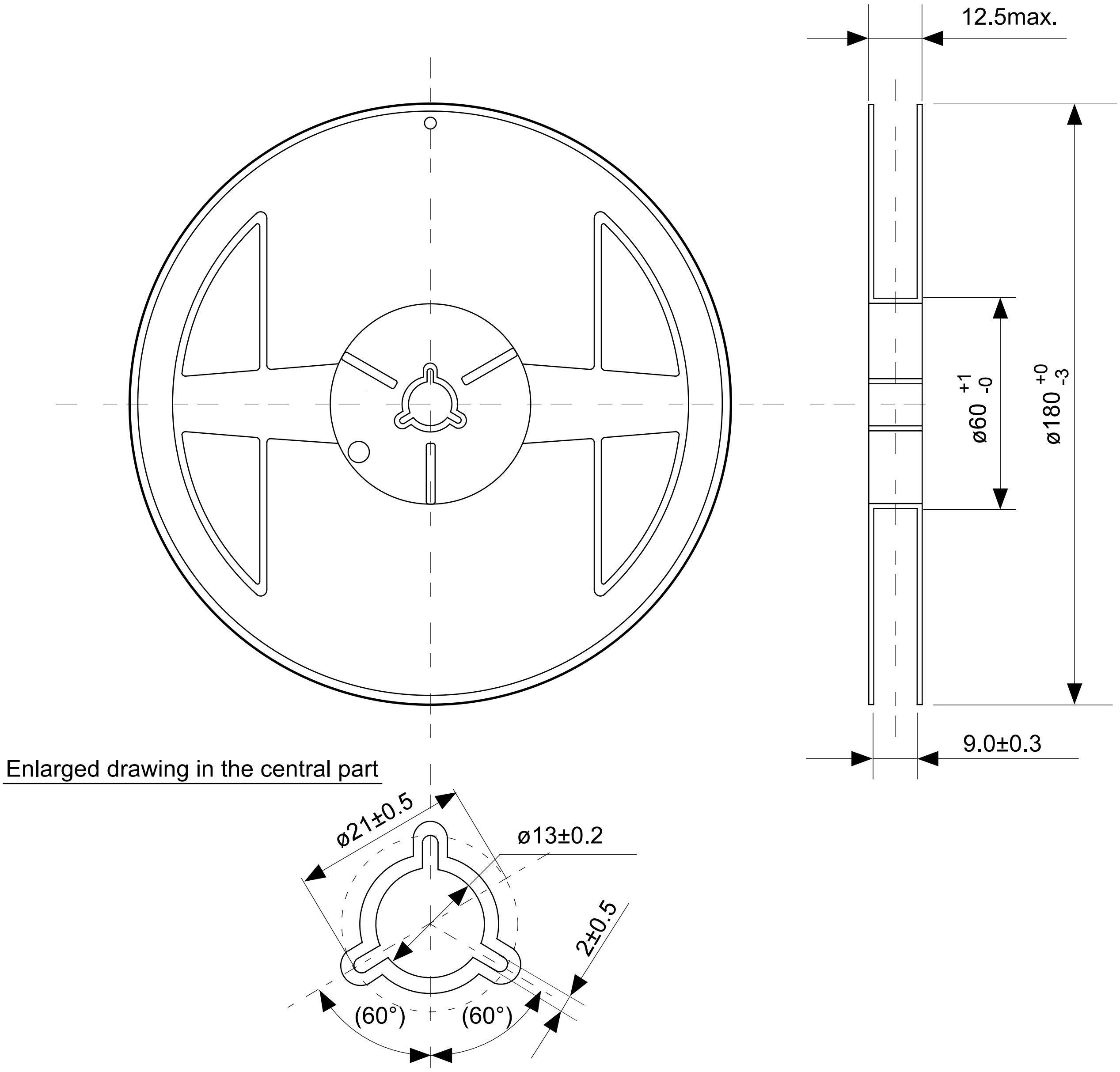
TITLE	HSNT-6A-A-PKG Dimensions
No.	PJ006-A-P-SD-3.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	





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.	

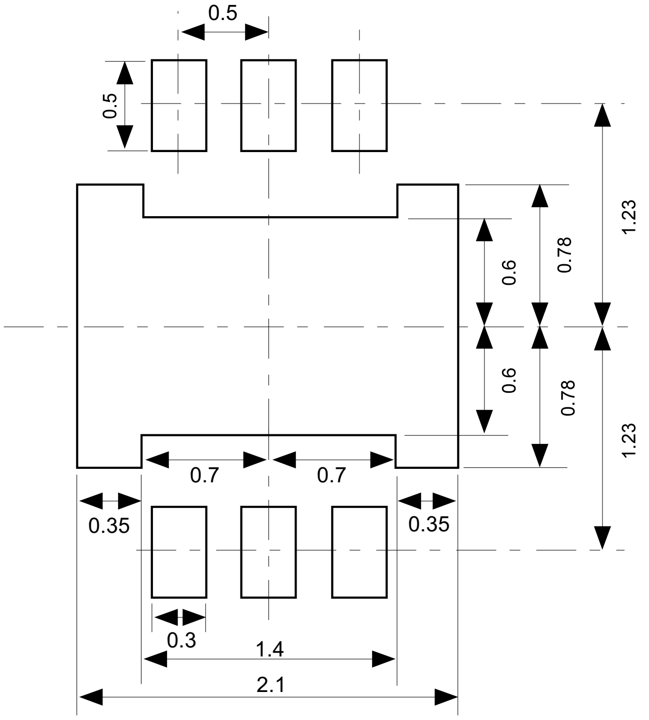


No. PJ006-A-R-SD-1.0

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

Seiko Instruments Inc.

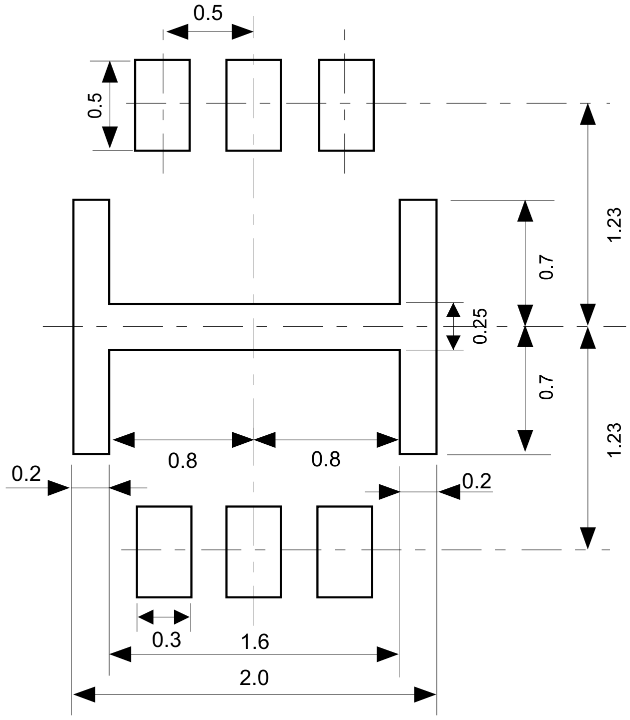
Land Recommendation



Caution It is recommended to solder the heatsink to a board in order to ensure the heat radiation.

注意 放熱性を確保する為に、PKGの裏面放熱板（ヒートシンク）を基板に半田付けする事を推奨いたします。

Stencil Opening



TITLE	HSNT-6A-A-Land &Stencil Opening
No.	PJ006-A-LM-SD-1.1
SCALE	
UNIT	mm
Seiko Instruments Inc.	

No. PJ006-A-LM-SD-1.1

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