SII

S-1731 Series

SUPER-SMALL PACKAGE 2-CIRCUIT HIGH RIPPLE-REJECTION LOW CURRENT CONSUMPTION LOW DROPOUT MIDDLE OUTPUT CURRENT CMOS VOLTAGE REGULATOR

www.sii-ic.com

Rev.2.0_00

S-1731 Series, developed using the CMOS technology, is a 2-channel positive voltage regulator IC which has the low dropout voltage, the high-accuracy output voltage and the low output current consumption of 300 mA.
Users are able to use a small ceramic capacitor of 1.0 μF for this IC. This IC includes two regulator circuits with ±1.0% high-accuracy output voltage in the super-small HSNT-6A package.
Compared with the conventional 300 mA output current 2-channel CMOS voltage regulators, high-density mounting is realized by using the super-small package and a small ceramic capacitor. Also, the low current consumption makes the S-1731 Series ideal for mobile devices.

■ Features

- Output voltage: 1.2 V to 3.3 V, selectable in 0.05 V step.
- A ceramic capacitor of 1.0 μF or more can be used as the I/O capacitor.
- Wide input voltage range: 1.7 V to 5.5 V
- High-accuracy output voltage: ±1.0%
- Low dropout voltage: 200 mV typ. (products having the output of 3.0 V, $I_{OUT} = 300$ mA)
- Low current consumption: During operation: 24 μA typ., 45 μA max. (per circuit)
  During shutdown: 0.1 μA typ., 1.0 μA max.
- Output current: Possible to output 300 mA (at $V_{IN} \geq V_{OUT(S)} + 1.0$ V)*1 (per circuit)
- High ripple rejection: 70 dB typ. (at 1.0 kHz, $V_{OUT} = 1.2$ V)
- Built-in overcurrent protector: limits overcurrent of output transistor
- Built-in power-off circuit: Ensures long battery life.
- Resistor is selectable in pull-up or pull-down
- Lead-free, Sn 100%, halogen-free*2

***1.** Attention should be paid to the power dissipation of the package when the output current is large.
***2.** Refer to "**■ Product Name Structure**" for details.

■ Applications

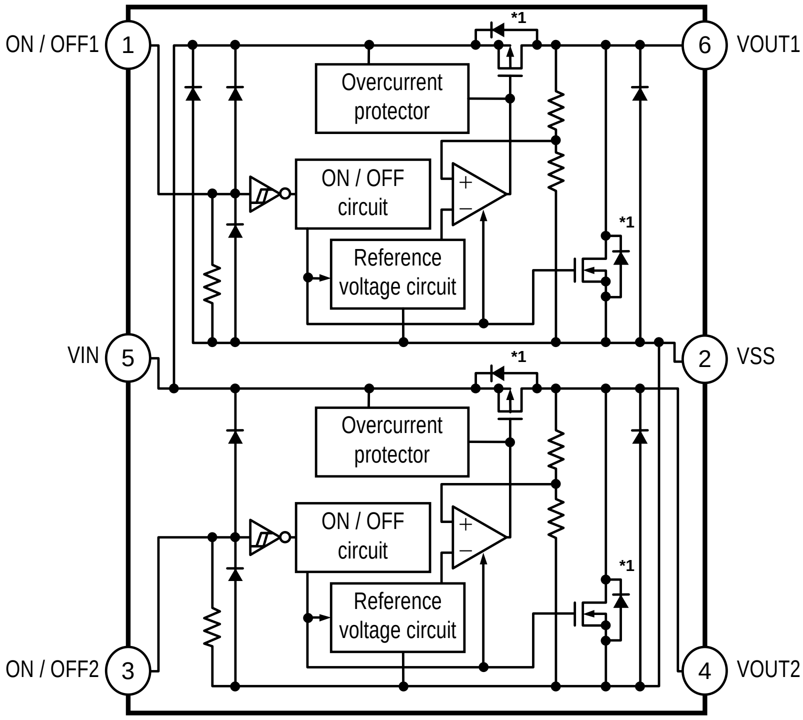
- Power supply for cellular phones
- Power supply for battery-powered devices
- Power supply for home electric/electronic appliances

■ Package

- HSNT-6A

■ Block Diagrams

1. S-1731 Series A type

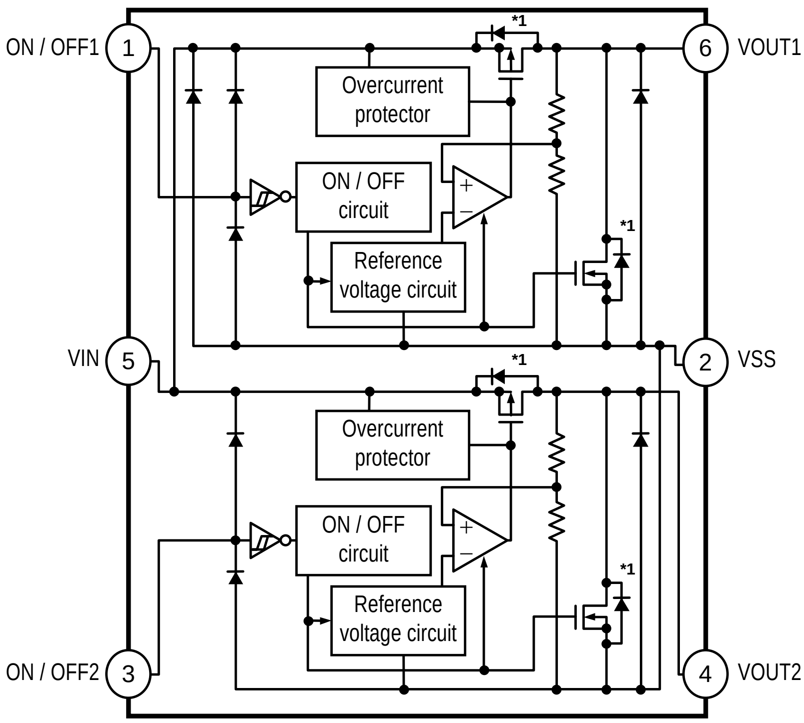


Function	Status
ON/OFF logic	Active "H"
Discharge shunt function	Available
Pull-up resistor	None
Pull-down resistor	Available

***1.** Parasitic diode

Figure 1

2. S-1731 Series B type

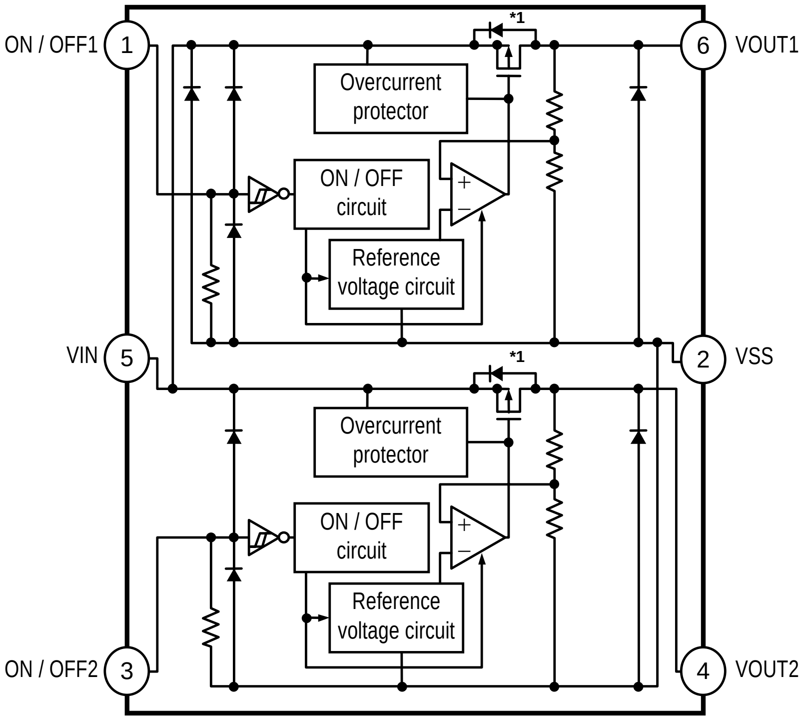


Function	Status
ON/OFF logic	Active "H"
Discharge shunt function	Available
Pull-up resistor	None
Pull-down resistor	None

***1.** Parasitic diode

Figure 2

3. S-1731 Series C type

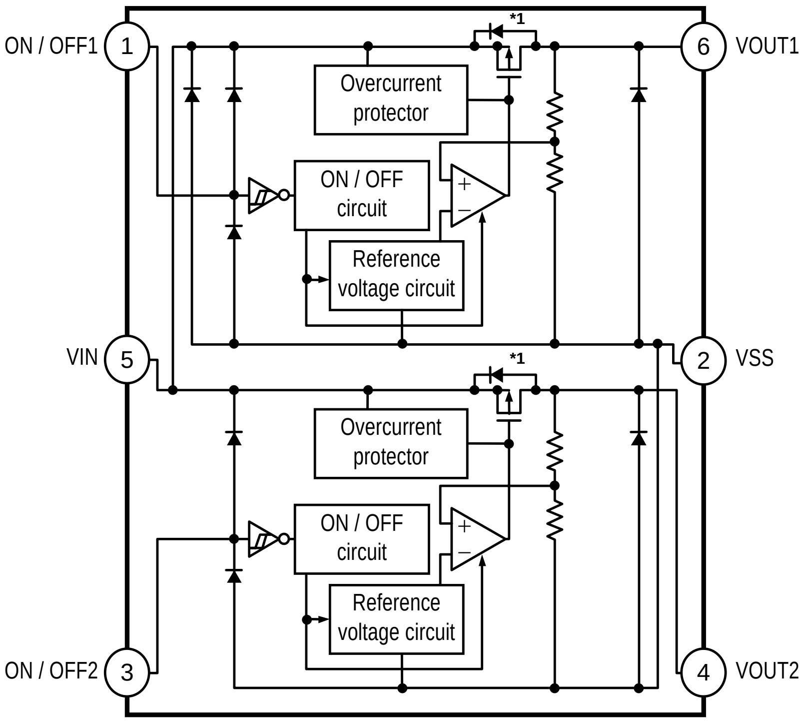


Function	Status
ON/OFF logic	Active “H”
Discharge shunt function	None
Pull-up resistor	None
Pull-down resistor	Available

***1.** Parasitic diode

Figure 3

4. S-1731 Series D type

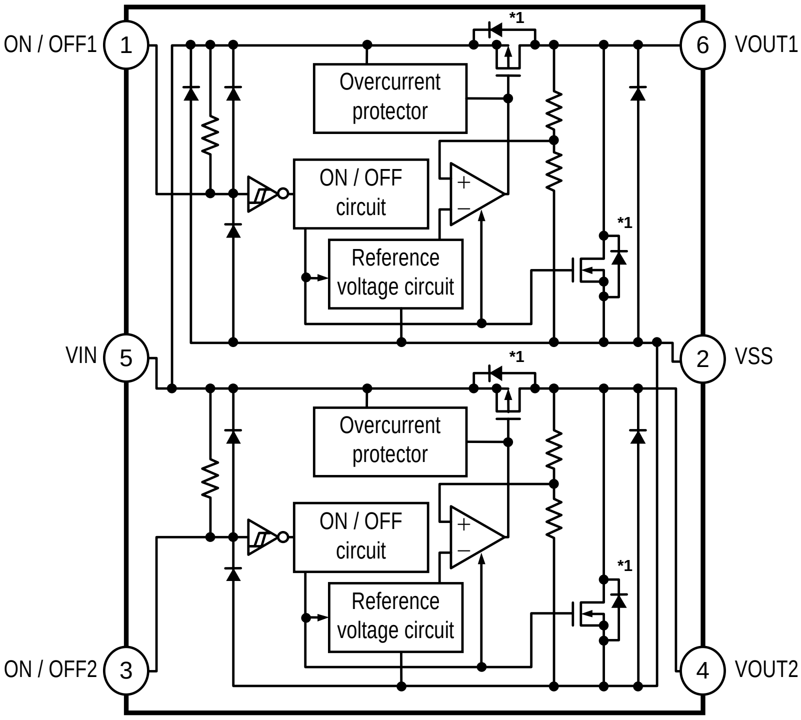


Function	Status
ON/OFF logic	Active “H”
Discharge shunt function	None
Pull-up resistor	None
Pull-down resistor	None

***1.** Parasitic diode

Figure 4

5. S-1731 Series E type

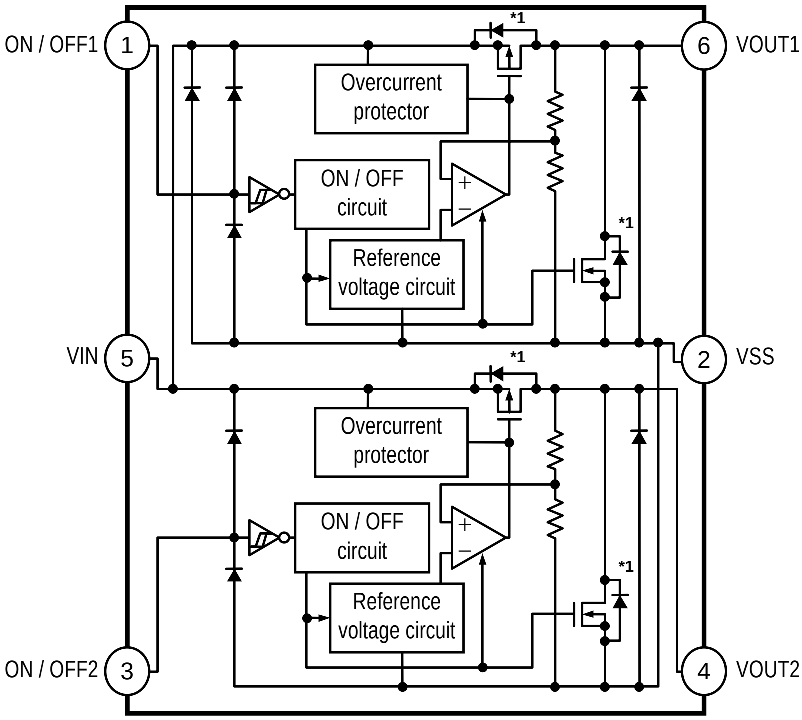


Function	Status
ON/OFF logic	Active "L"
Discharge shunt function	Available
Pull-up resistor	Available
Pull-down resistor	None

***1.** Parasitic diode

Figure 5

6. S-1731 Series F type

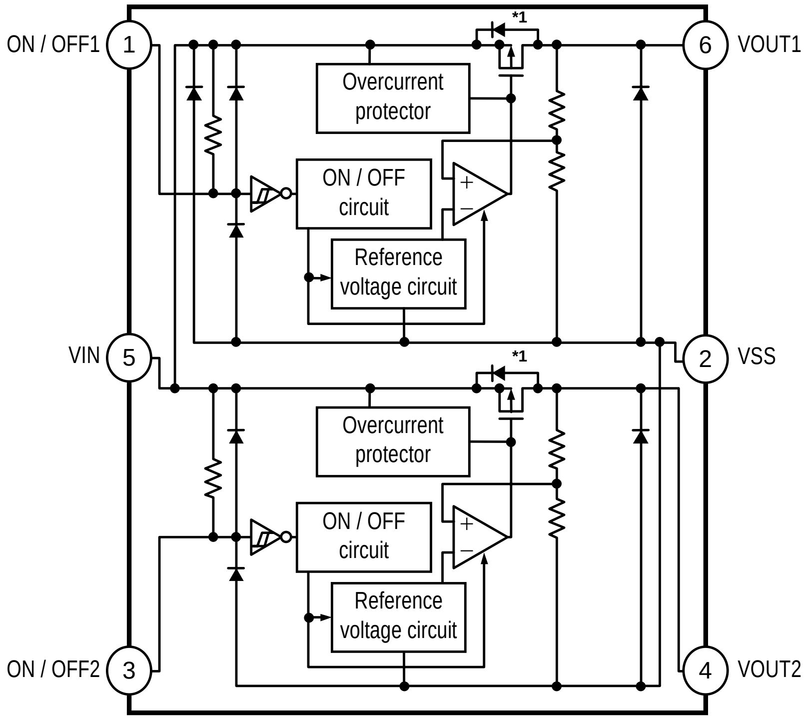


Function	Status
ON/OFF logic	Active "L"
Discharge shunt function	Available
Pull-up resistor	None
Pull-down resistor	None

***1.** Parasitic diode

Figure 6

7. S-1731 Series G type

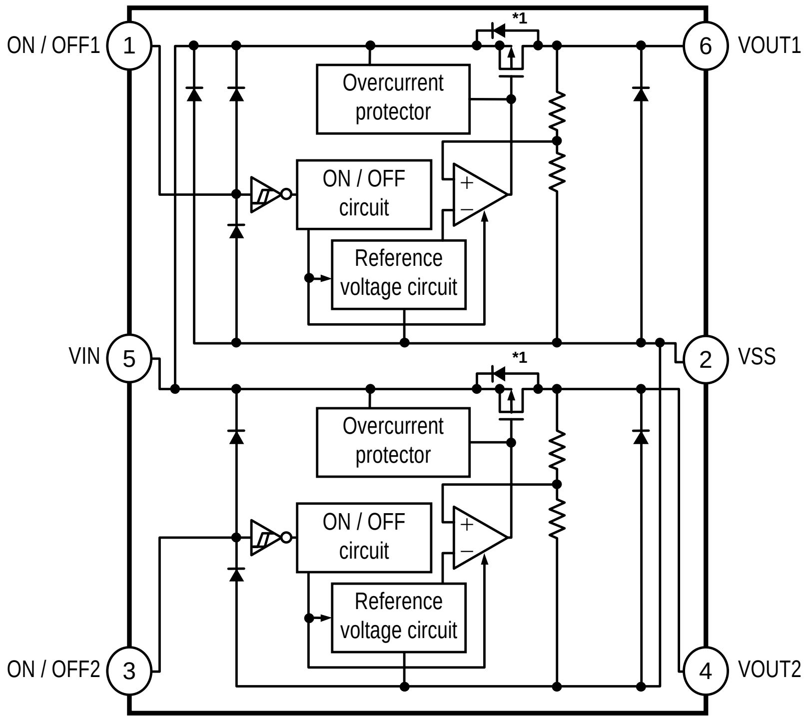


Function	Status
ON/OFF logic	Active “L”
Discharge shunt function	None
Pull-up resistor	Available
Pull-down resistor	None

***1.** Parasitic diode

Figure 7

8. S-1731 Series H type



Function	Status
ON/OFF logic	Active “L”
Discharge shunt function	None
Pull-up resistor	None
Pull-down resistor	None

***1.** Parasitic diode

Figure 8

■ Product Name Structure

Users can select the product type, output voltage, and package type for the S-1731 Series. Refer to "**1. Product name**" regarding the contents of product name, "**2. Function list of product type**" regarding the product type, "**3. Package**" regarding the package drawings and "**4. Product name list**" regarding details of product name.

1. Product name

S-1731 x xx xx - A6T1 x

- Environmental code
  - U : Lead-free (Sn 100%), halogen-free
  - S : Lead-free, halogen-free
- Package abbreviation and IC packing specifications*1
  - A6T1: HSNT-6A, tape product
- Output voltage of voltage regulator 2*3
  - 12 to 33
  - (e.g., when the output voltage is 1.2 V, it is expressed as 12.)
- Output voltage of voltage regulator 1*3
  - 12 to 33
  - (e.g., when the output voltage is 1.2 V, it is expressed as 12.)
- Product type*2
  - A to H

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

2. Function list of product type

Table 1

Product Type	ON / OFF Logic	Discharge Shunt Function	Pull-up Resistor	Pull-down Resistor
A	Active “H”	Available	None	Available
B	Active “H”	Available	None	None
C	Active “H”	None	None	Available
D	Active “H”	None	None	None
E	Active “L”	Available	Available	None
F	Active “L”	Available	None	None
G	Active “L”	None	Available	None
H	Active “L”	None	None	None

3. Package

Package Name	Drawing Code				
	Package	Tape	Reel	Land	Stencil Opening
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-1731 series A type

ON / OFF logic: Active "H"
Discharge shunt function: Available
Pull-up resistor: None
Pull-down resistor: Available

Table 2

Voltage Regulator 1 Output Voltage	Voltage Regulator 2 Output Voltage	HSNT-6A
1.2 V ±15 mV	1.2 V ±15 mV	S-1731A1212-A6T1y
2.8 V ±1.0%	1.5 V ±1.0%	S-1731A2815-A6T1y
2.8 V ±1.0%	1.8 V ±1.0%	S-1731A2818-A6T1y
2.8 V ±1.0%	2.8 V ±1.0%	S-1731A2828-A6T1y
2.8 V ±1.0%	3.0 V ±1.0%	S-1731A2830-A6T1y
2.8 V ±1.0%	3.3 V ±1.0%	S-1731A2833-A6T1y
3.0 V ±1.0%	1.8 V ±1.0%	S-1731A3018-A6T1y
3.0 V ±1.0%	3.3 V ±1.0%	S-1731A3033-A6T1y
3.3 V ±1.0%	3.3 V ±1.0%	S-1731A3333-A6T1y

4. 2 S-1731 series C type

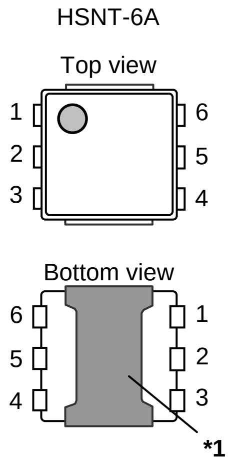
ON / OFF logic: Active "H"
Discharge shunt function: None
Pull-up resistor: None
Pull-down resistor: Available

Table 3

Voltage Regulator 1 Output Voltage	Voltage Regulator 2 Output Voltage	HSNT-6A
2.8 V ±1.0%	1.5 V ±1.0%	S-1731C2815-A6T1y
2.8 V ±1.0%	1.8 V ±1.0%	S-1731C2818-A6T1y
2.8 V ±1.0%	2.8 V ±1.0%	S-1731C2828-A6T1y
2.8 V ±1.0%	3.0 V ±1.0%	S-1731C2830-A6T1y
2.8 V ±1.0%	3.3 V ±1.0%	S-1731C2833-A6T1y
3.0 V ±1.0%	1.8 V ±1.0%	S-1731C3018-A6T1y
3.0 V ±1.0%	3.3 V ±1.0%	S-1731C3033-A6T1y
3.3 V ±1.0%	3.3 V ±1.0%	S-1731C3333-A6T1y

Remark 1. Please contact our sales office for products with specifications other than the above.
2. y: S or U
3. Please select products of environmental code = U for Sn 100%, halogen-free products.

■ Pin Configuration



***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 9

Table 4

Pin No.	Symbol	Description
1	ON / OFF1	ON / OFF pin 1
2	VSS	GND pin
3	ON / OFF2	ON / OFF pin 2
4	VOUT2	Output voltage pin 2
5	VIN	Input voltage pin
6	VOUT1	Output voltage pin 1

■ Absolute Maximum Ratings

Table 5

(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
	$V_{ON/OFF1, 2}$	V_{SS} − 0.3 to V_{IN} + 0.3	V
Output voltage	$V_{OUT1, 2}$	V_{SS} − 0.3 to V_{IN} + 0.3	V
Power dissipation	P_D	1000*1	mW
Operating 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) 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.

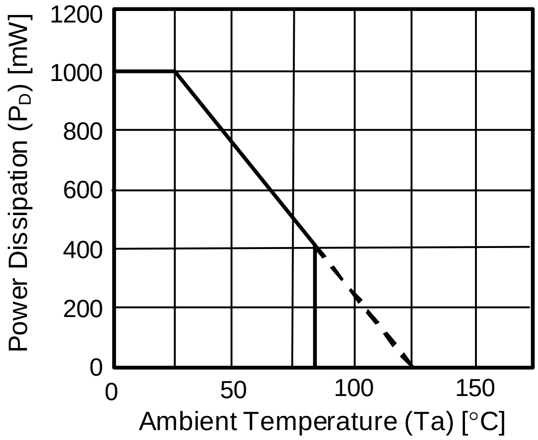


Figure 10 Power Dissipation of Package

■ Electrical Characteristics

Table 6 (1 / 2)

Total (2 circuits) (Ta = 25°C unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
Current consumption	I_{SS}	V_{IN} = 5.5 V, no load	—	48	90	μA	1

Voltage regulator 1 and voltage regulator 2 (per circuit) (Ta = 25°C unless otherwise specified)

Item	Symbol	Conditions		Min.	Typ.	Max.	Unit	Test Circuit
Output voltage*1	$V_{OUT(E)}$	$V_{IN} = V_{OUT(S)} + 1.0$ V, I_{OUT} = 30 mA	1.2 V ≤ $V_{OUT(S)}$ < 1.5 V	$V_{OUT(S)}$ − 0.015	$V_{OUT(S)}$	$V_{OUT(S)}$ + 0.015	V	2, 3
			1.5 V ≤ $V_{OUT(S)}$ ≤ 3.3 V	$V_{OUT(S)}$ × 0.99	$V_{OUT(S)}$	$V_{OUT(S)}$ × 1.01	V	2, 3
Output current*2	I_{OUT}	$V_{IN} \geq V_{OUT(S)} + 1.0$ V		300*5	—	—	mA	4, 5
Dropout voltage*3	V_{drop}	I_{OUT} = 300 mA	1.2 V ≤ $V_{OUT(S)}$ < 1.3 V	0.50	0.52	0.75	V	2, 3
			1.3 V ≤ $V_{OUT(S)}$ < 1.4 V	—	0.45	0.68	V	2, 3
			1.4 V ≤ $V_{OUT(S)}$ < 1.5 V	—	0.40	0.60	V	2, 3
			1.5 V ≤ $V_{OUT(S)}$ < 1.8 V	—	0.35	0.53	V	2, 3
			1.8 V ≤ $V_{OUT(S)}$ < 2.5 V	—	0.29	0.44	V	2, 3
			2.5 V ≤ $V_{OUT(S)}$ < 3.0 V	—	0.24	0.36	V	2, 3
			3.0 V ≤ $V_{OUT(S)}$ ≤ 3.3 V	—	0.20	0.35	V	2, 3
Line regulation	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \bullet V_{OUT}}$	$V_{OUT(S)} + 0.5$ V ≤ V_{IN} ≤ 5.5 V, I_{OUT} = 30 mA		—	0.02	0.1	%/V	2, 3
Load regulation	ΔV_{OUT2}	$V_{IN} = V_{OUT(S)} + 1.0$ V, 1.0 mA ≤ I_{OUT} ≤ 150 mA		—	20	40	mV	2, 3
Output voltage temperature coefficient*4	$\frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}$	$V_{IN} = V_{OUT(S)} + 1.0$ V, I_{OUT} = 30 mA, −40°C ≤ Ta ≤ +85°C		—	±120	—	ppm/°C	2, 3
Current consumption during operation	I_{SS1}	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = ON, no load		—	24	45	μA	1
Current consumption during shutdown	I_{SS2}	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = OFF, no load		—	0.1	1.0	μA	1
Input voltage	V_{IN}	—		1.7	—	5.5	V	1
ON / OFF pin input voltage "H"	V_{SH}	$V_{IN} = V_{OUT(S)} + 1.0$ V, R_L = 1.0 kΩ		1.2	—	—	V	6, 7
ON / OFF pin input voltage "L"	V_{SL}	$V_{IN} = V_{OUT(S)} + 1.0$ V, R_L = 1.0 kΩ		—	—	0.3	V	6, 7
ON / OFF pin input current "H"	I_{SH}	V_{IN} = 5.5 V, $V_{ON / OFF}$ = 5.5 V	B / D / E / F / G / H type	−0.1	—	0.1	μA	6, 7
			A / C type	1.0	2.5	4.2	μA	6, 7
ON / OFF pin input current "L"	I_{SL}	V_{IN} = 5.5 V, $V_{ON / OFF}$ = 0 V	A / B / C / D / F / H type	−0.1	—	0.1	μA	6, 7
			E / G type	1.0	2.5	4.2	μA	6, 7
Ripple rejection	|RR|	$V_{IN} = V_{OUT(S)} + 1.0$ V, f = 1.0 kHz, ΔV_{rip} = 0.5 Vrms, I_{OUT} = 30 mA	1.2 V ≤ $V_{OUT(S)}$ < 1.25 V	—	70	—	dB	8, 9
			1.25 V ≤ $V_{OUT(S)}$ < 1.4 V	—	68	—	dB	8, 9
			1.4 V ≤ $V_{OUT(S)}$ < 1.9 V	—	65	—	dB	8, 9
			1.9 V ≤ $V_{OUT(S)}$ < 2.6 V	—	60	—	dB	8, 9
			2.6 V ≤ $V_{OUT(S)}$ ≤ 3.3 V	—	55	—	dB	8, 9
Short-circuit current	I_{short}	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON / OFF pin = ON, V_{OUT} = 0 V		—	200	—	mA	4, 5

Table 6 (2 / 2)

S-1731 Series A / B / E / F type (Built-in discharge shunt function)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
"L" output Nch ON resistance	R_{LOW}	V_{OUT} = 0.1 V, V_{IN} = 5.5 V	—	100	—	Ω	4, 5

S-1731 Series A / C / E / G type (Built-in pull-up / pull-down resistor)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit	Test Circuit
Shutdown pull-up / pull-down resistor	R_{PD}	—	1.0	2.6	5.0	MΩ	6, 7

***1.** $V_{OUT(S)}$: Specified output voltage
$V_{OUT(E)}$: Actual output voltage at the fixed load
Output voltage when fixing I_{OUT}(= 30 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.
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.

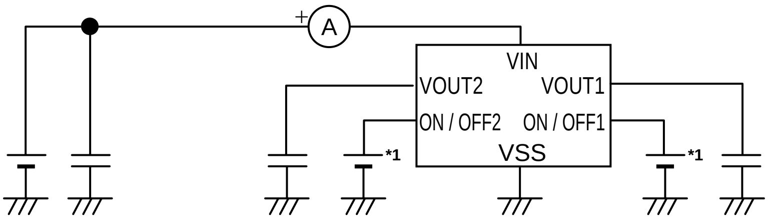
$$\frac{\Delta V_{OUT}}{\Delta Ta}\left[\text{mV/°C}\right]^{*1} = V_{OUT(S)}\left[\text{V}\right]^{*2} \times \frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}\left[\text{ppm/°C}\right]^{*3} \div 1000$$

***1.** 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

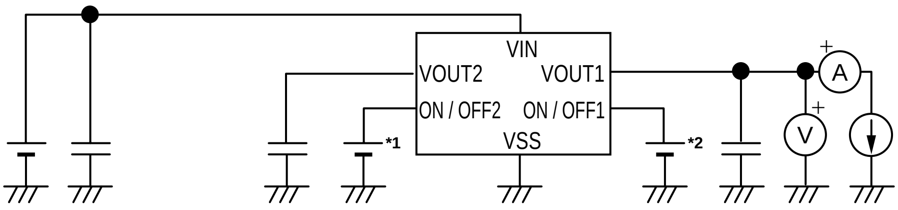
1.



***1.** Set to V_{IN} or GND

Figure 11

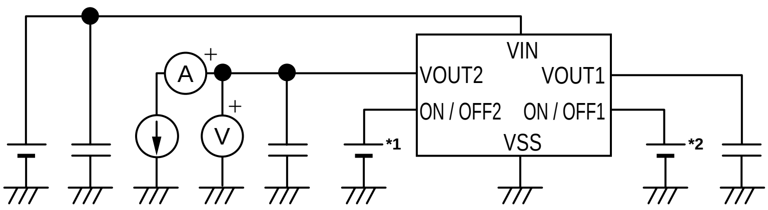
2.



***1.** Set to power-off
***2.** Set to power-on

Figure 12

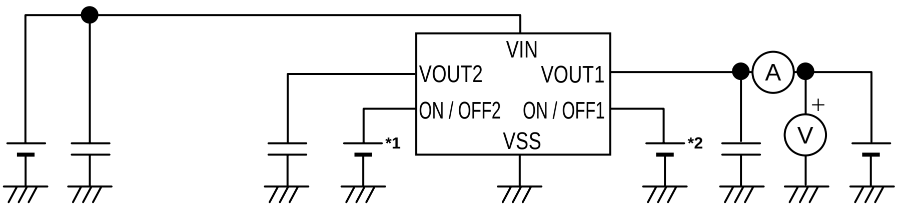
3.



***1.** Set to power-on
***2.** Set to power-off

Figure 13

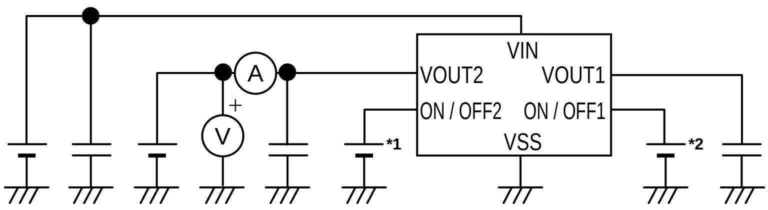
4.



***1.** Set to power-off
***2.** Set to V_{IN} or GND

Figure 14

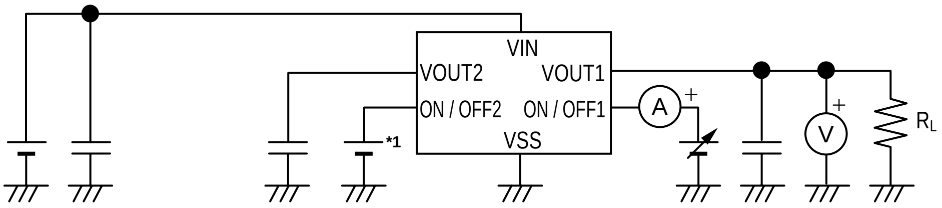
5.



***1.** Set to V_{IN} or GND
***2.** Set to power-off

Figure 15

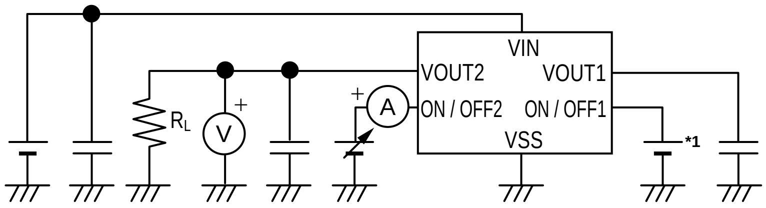
6.



***1.** Set to power-off

Figure 16

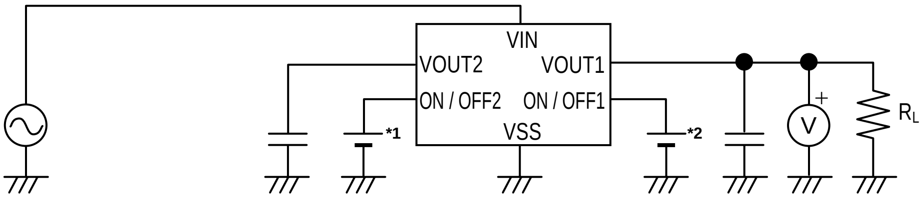
7.



***1.** Set to power-off

Figure 17

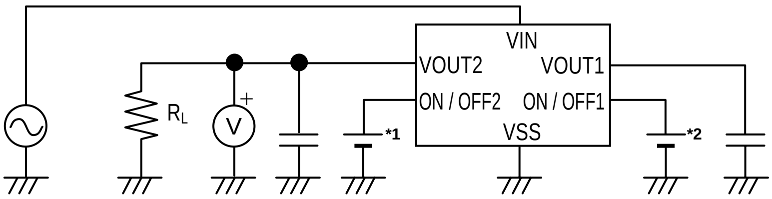
8.



***1.** Set to power-off
***2.** Set to power-on

Figure 18

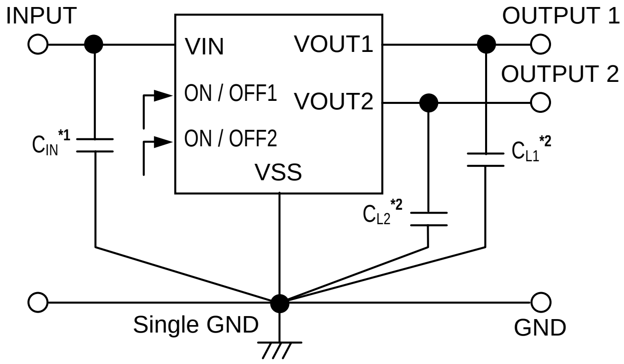
9.



***1.** Set to power-on
***2.** Set to power-off

Figure 19

■ Standard Circuit



***1.** C_{IN} is a capacitor for stabilizing the input.
***2.** A ceramic capacitor of 1.0 μF or more can be used for C_{L1} and C_{L2}.

Figure 20

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}) : 1.0 μF or more
Output capacitor (C_{L1}, C_{L2}) : 1.0 μF or more (ceramic capacitor)

Caution A general series regulator may oscillate, depending on the external components. Confirm that no oscillation occurs in the application for which the above capacitors are used.

■ Selection of Input and Output Capacitors (C_{IN}, C_{L1}, C_{L2})

The S-1731 Series requires an output capacitor between the VOUT and VSS pin for phase compensation. Operation is stabilized by a ceramic capacitor with an output capacitance of 1.0 μF or more over the entire temperature range. When using an OS capacitor, tantalum capacitor, or aluminum electrolytic capacitor, the capacitance must be 1.0 μF or more.

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 capacitance for an application is $C_{IN} \geq 1.0$ μF, $C_{L1} \geq 1.0$ μF, $C_{L2} \geq 1.0$ μF; 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

This IC's 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% 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. See "■ Electrical Characteristics" and "■ Characteristics (Typical Data) (Per Circuit)" 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})

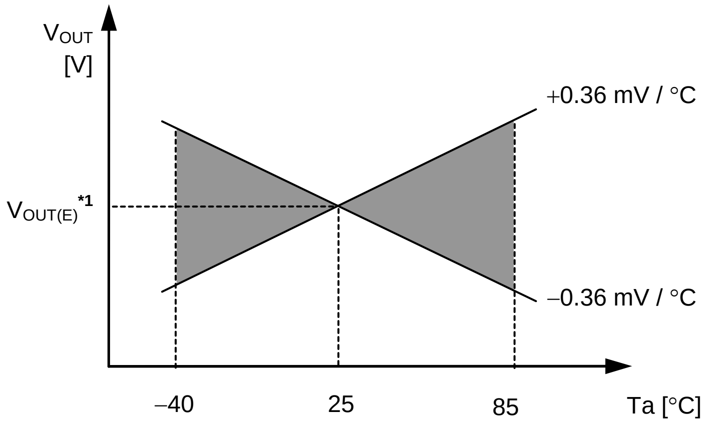
Indicates the difference between input voltage V_{IN} and the output voltage when; decreasing input voltage V_{IN} gradually until the output voltage has dropped out to the value of 98% of output voltage V_{OUT3}, which is at $V_{IN} = V_{OUT(S)} + 1.0$ V.

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

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

The shaded area in **Figure 21** is the range where V_{OUT} varies in the operating temperature range when the temperature coefficient of the output voltage is ±120 ppm/°C.

Example of V_{OUT} = 3.0 V Typ. products



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

Figure 21

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

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

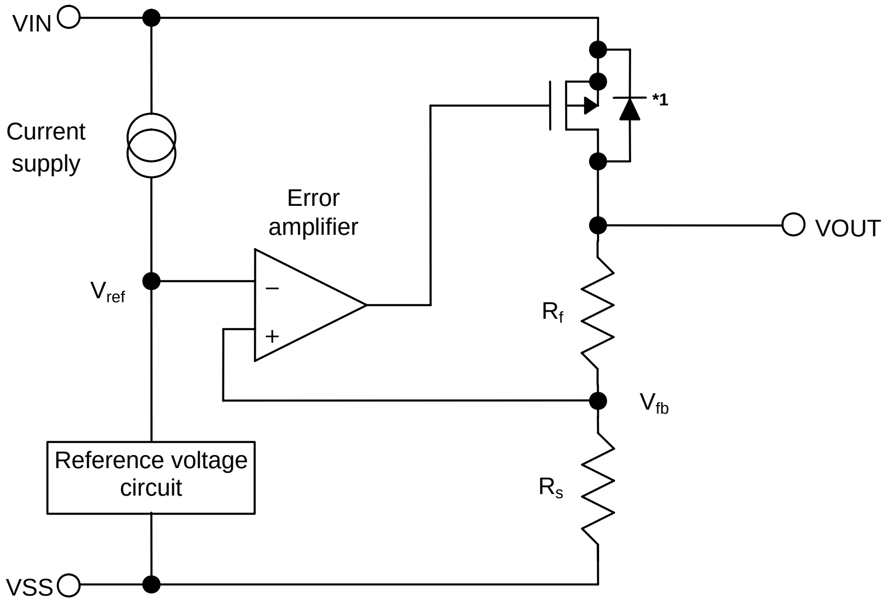
***1.** Change in temperature of output voltage
***2.** Specified output voltage
***3.** Output voltage temperature coefficient

■ Operation

1. Basic operation

Figure 22 shows the block diagram of S-1731 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 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 22

2. Output transistor

In the S-1731 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 inverse current flowing from the VOUT pin through a parasitic diode to the VIN pin.

3. ON / OFF pins 1 and 2

These pins start and stop the regulator.

When the ON / OFF pin is set to the shutdown 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.

Since the S-1731 Series A / B / E / F types have a built-in discharge shunt circuit to discharge the output capacitance, the VOUT pin is forcibly set to V_{SS} level. In the S-1731 Series C / D / G / H types, the VOUT pin is set to V_{SS} level through several hundred kΩ internal divided resistors between the VOUT and VSS pins. Note that the current consumption increases when a voltage of 0.3 V to 1.2 V (Ta = 25°C) is applied to the ON / OFF pin.

The ON / OFF pin is configured as shown in **Figures 23** and **24**. In the S-1731 Series A / C / E / G types, the ON / OFF pin is internally pulled up or pulled down to VSS when in the floating status, so the VOUT pin is set to the V_{SS} level. In the S-1731 Series B / D / F / H types, the ON / OFF pin is not internally pulled up or pulled down, so do not use these types with the ON / OFF pin in the floating status. When the ON / OFF pin is not used in the S-1731 Series B / D / F / H types, connect the pin to the VIN pin in the B / D types, and connect it to the VSS pin in the F / H types.

Table 7

Logic Type	ON / OFF Pin	Internal Circuits	VOUT Pin Voltage	Current Consumption
A / B / C / D	"H": Power on	Operating	Set value	I_{SS1} *1
A / B / C / D	"L": Shutdown	Stopped	V_{SS} level	I_{SS2}
E / F / G / H	"H": Shutdown	Stopped	V_{SS} level	I_{SS2}
E / F / G / H	"L": Power on	Operating	Set value	I_{SS1} *1

***1**. Note that the IC's current consumption increases as much as current flows into the pull-up / pull-down resistor when; the ON / OFF pin is connected to VIN in the A / C type, the ON / OFF pin is connected to VSS in the E / G type (**Figure 23**).

(1) S-1731 Series A / C / E / G Type

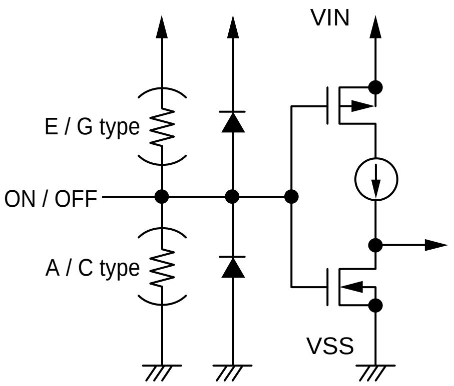


Figure 23

(2) S-1731 Series B / D / F / H Type

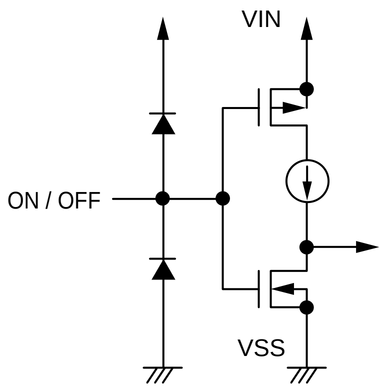
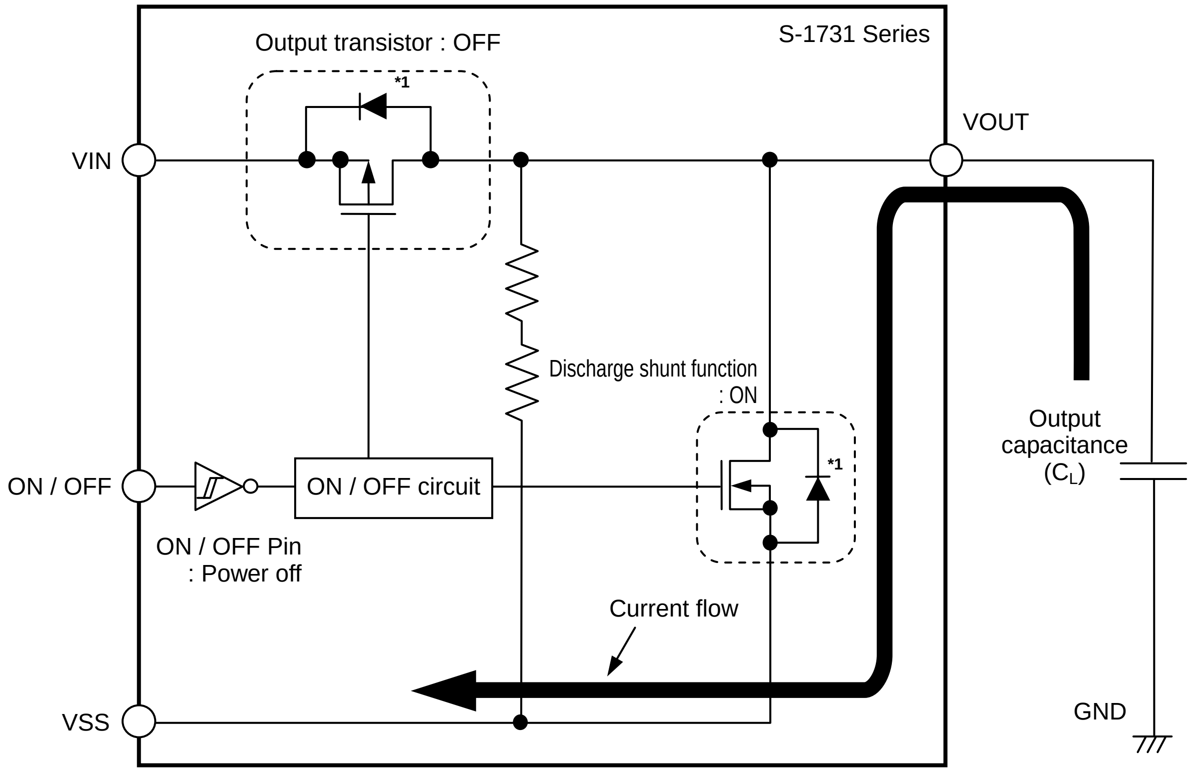


Figure 24

4. Discharge shunt function (S-1731 Series A / B / E / F types)

The S-1731 Series A / B / E / F types have a built-in discharge shunt circuit to discharge the output capacitance. When the ON / OFF pin is set to shutdown level, turns the output transistor off, and turns the discharge shunt function on so that the output capacitor discharges. These types allow for the VOUT pin reach the V_{SS} level faster than the S-1731 Series C / D / G / H types that does not have a discharge shunt circuit.



***1**. Parasitic diode

Figure 25

5. Overcurrent protection circuit

The S-1731 Series has an overcurrent protection circuit having the characteristics shown in "**(1) Output Voltage vs. Output Current (When load current is increased) (Ta = 25°C)**" in "**■ Characteristics (Typical Data) (Per Circuit)**", in order to protect the output transistor against an excessive output current and short circuiting between the VOUT and VSS pins. The current (I_{short}) when the output pin is short-circuited 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 Using the overcurrent protection circuit is to protect the output transistor from accidental conditions such as short circuited load and the rapid and large current flow in the large capacitor. The overcurrent protection circuit is not suitable for use under the short circuit status or large current flowing (300 mA or more) that last long.

6. Pull-down / pull-up resistor (S-1731 Series A / C / E / G types)

In the S-1731 Series A / C / E / G types, the ON / OFF pin is internally pulled up to VIN or pulled down to VSS, so the VOUT pin is in the V_{SS} level when in the floating status.

Note that the IC's current consumption increases as much as current flows into the pull-up / pull-down resistor of 2.6 MΩ (typ.) when; the ON / OFF pin is connected to VIN in the A / C type, the ON / OFF pin is connected to VSS in the E / G type.

■ 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 pin (C_{L1}, C_{L2}) and a capacitor for stabilizing the input between VIN and VSS pin (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 the leakage current from a driver 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 this IC. However, be sure to perform sufficient evaluation under the actual usage conditions for selection, including evaluation of temperature characteristics. See "**(6) Example of Equivalent Series Resistance vs. Output Current Characteristics (Ta = 25°C)**" in "**■ Reference Data (Per Circuit)**" for the equivalent series resistance (R_{ESR}) of the output capacitor.

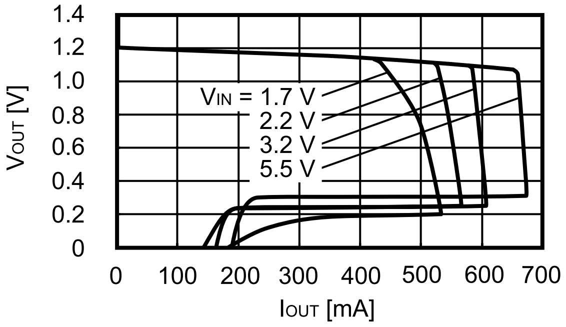
Input capacitor (C_{IN}) :	1.0 μF or more
Output capacitor (C_{L1}, C_{L2}) :	1.0 μF or more

- 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.
- Concerning the fluctuation of output voltage due to power-supplying and load, confirm with the actual device.
- If the power supply suddenly increases, 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 "**■ 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.

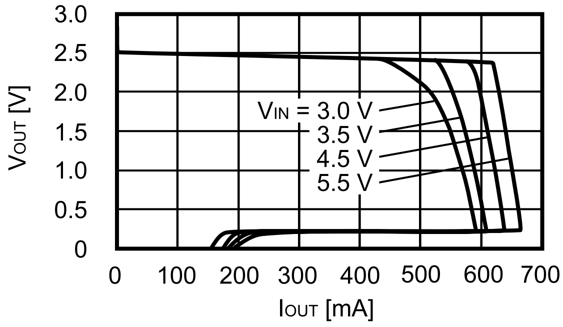
■ Characteristics (Typical Data) (Per Circuit)

(1) Output Voltage vs. Output Current (When Load Current Increases) (Ta = 25°C)

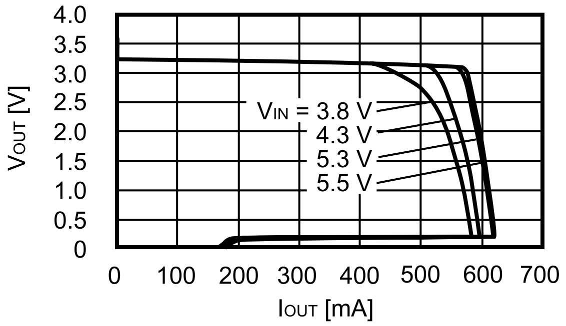
V_{OUT} = 1.2 V



V_{OUT} = 2.5 V



V_{OUT} = 3.3 V

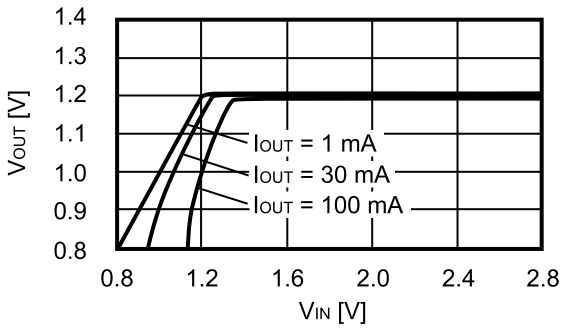


Remark In determining the output current, attention should be paid to the following.

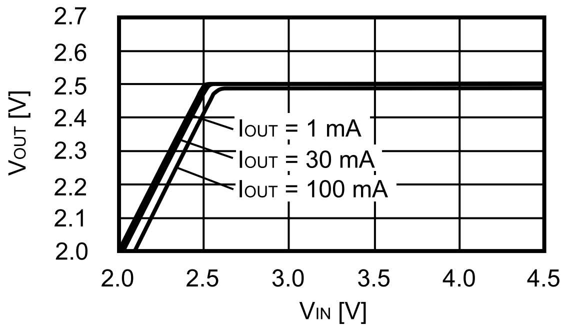
1. The minimum output current value and footnote ***5** in **Table 6** in the "■ **Electrical Characteristics**"
2. The package power dissipation

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

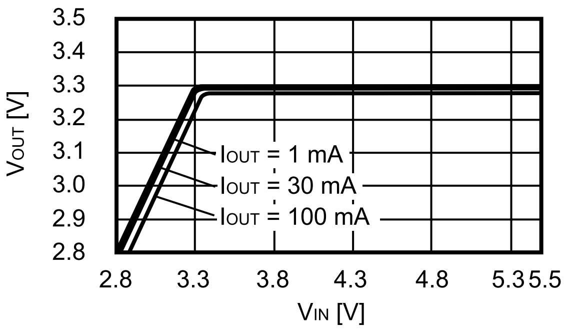
V_{OUT} = 1.2 V



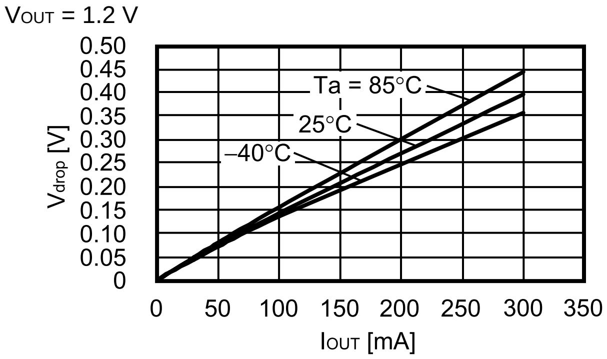
V_{OUT} = 2.5 V

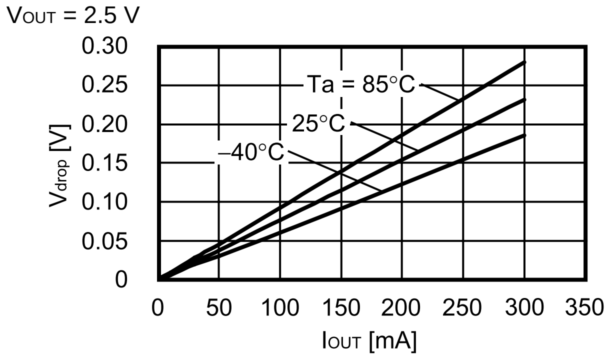


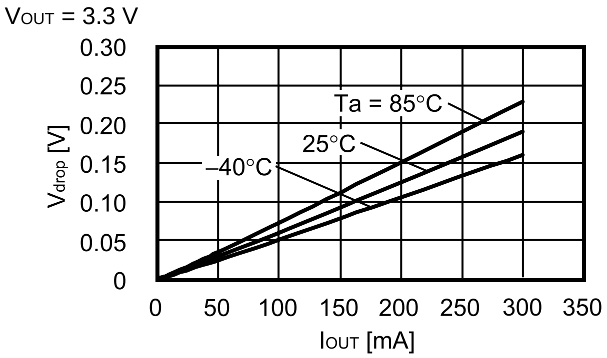
V_{OUT} = 3.3 V



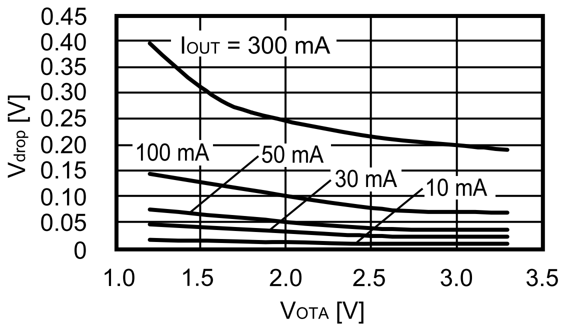
(3) Dropout Voltage vs. Output Current





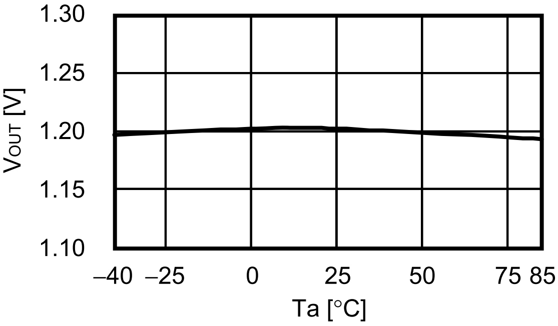


(4) Dropout Voltage vs. Set Output Voltage

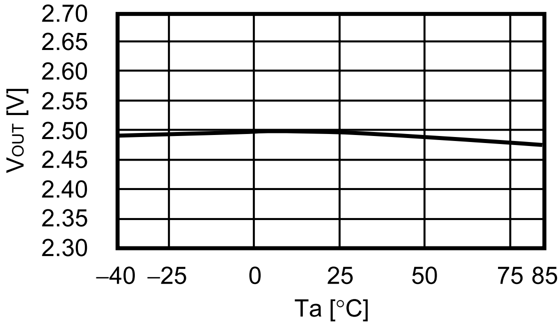


(5) Output Voltage vs. Ambient Temperature

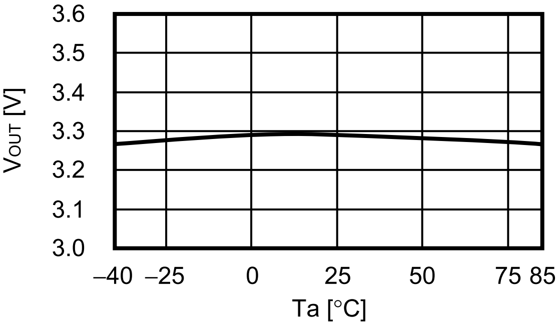
V_{OUT} = 1.2 V



V_{OUT} = 2.5 V

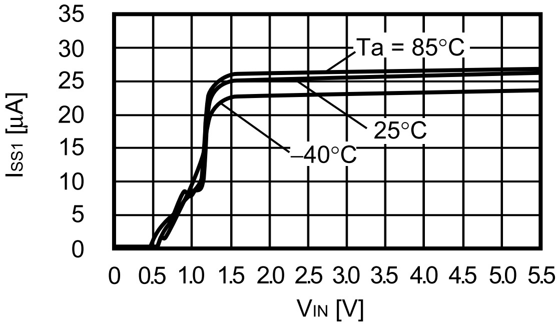


V_{OUT} = 3.3 V

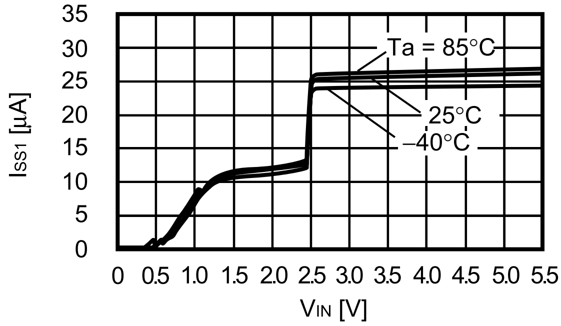


(6) Current Consumption vs. Input Voltage

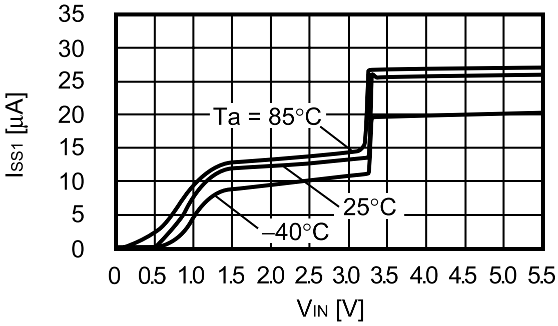
V_{OUT} = 1.2 V



V_{OUT} = 2.5 V



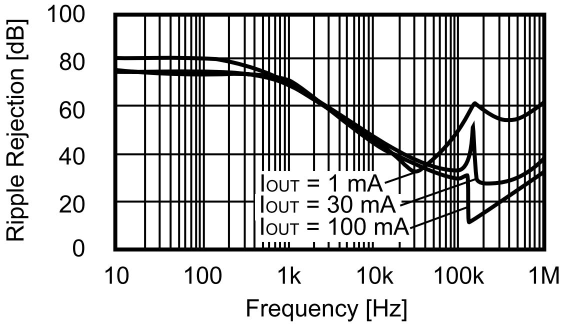
V_{OUT} = 3.3 V



(7) Ripple Rejection (Ta = 25°C)

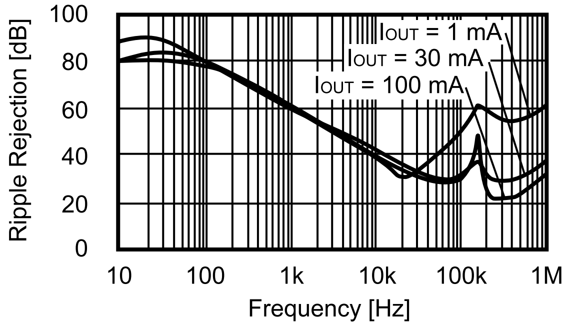
V_{OUT} = 1.2 V

V_{IN} = 2.2 V, C_{Ln} = 1.0 μF



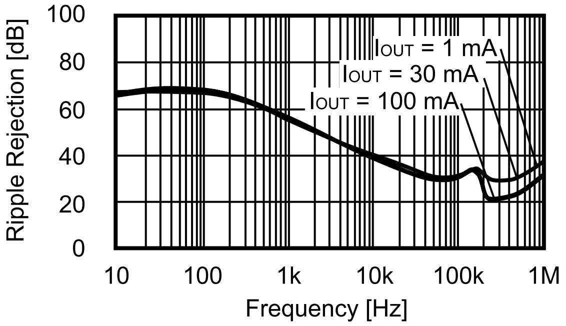
V_{OUT} = 2.5 V

V_{IN} = 3.5 V, C_{Ln} = 1.0 μF



V_{OUT} = 3.3 V

V_{IN} = 4.3 V, C_{Ln} = 1.0 μF

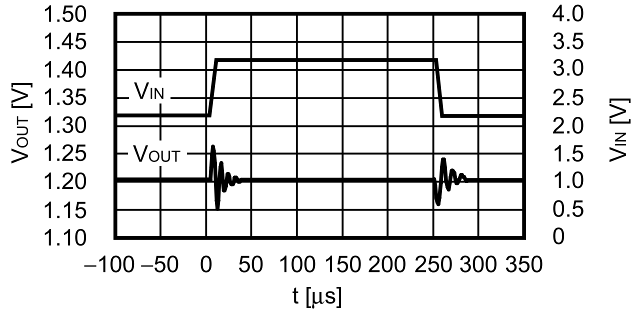


Remark C_{Ln}: Capacitor set to VOUTn pin externally (n = 1, 2)

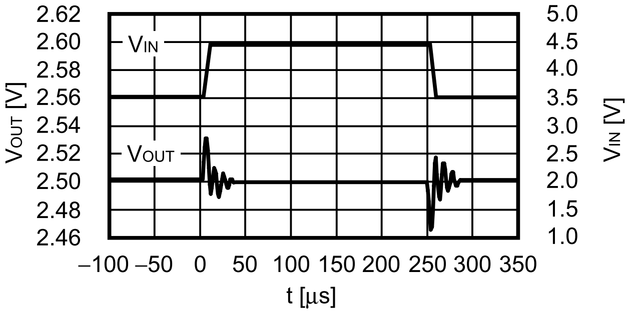
■ Reference Data (Per Circuit)

(1) Transient Response Characteristics when Input (Ta = 25°C) Common to VR1 and VR2

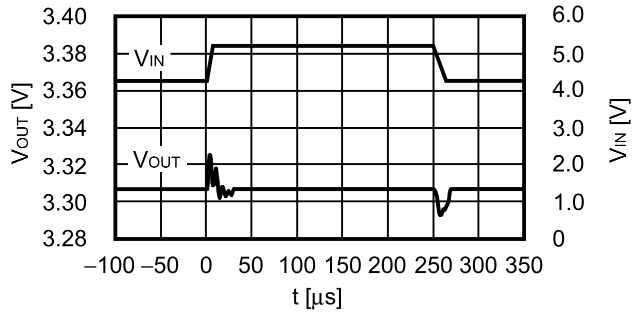
V_{OUT} = 1.2 V
I_{OUT} = 30 mA, tr = tf = 5.0 μs, C_{Ln} = 1.0 μF, C_{IN} = 1.0 μF



V_{OUT} = 2.5 V
I_{OUT} = 30 mA, tr = tf = 5.0 μs, C_{Ln} = 1.0 μF, C_{IN} = 1.0 μF

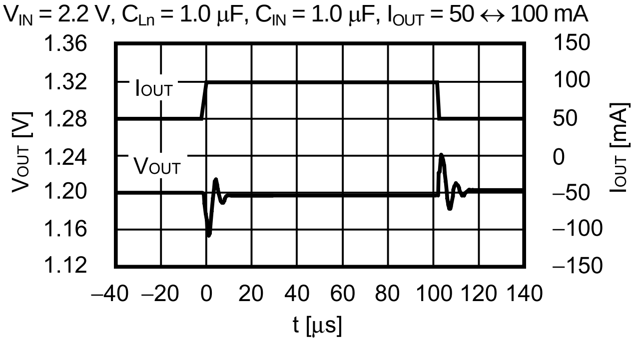


V_{OUT} = 3.3 V
I_{OUT} = 30 mA, tr = tf = 5.0 μs, C_{Ln} = 1.0 μF, C_{IN} = 1.0 μF

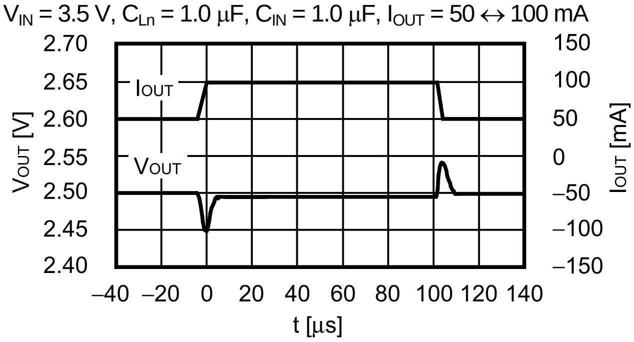


(2) Transient Response Characteristics of Load (Ta = 25°C)

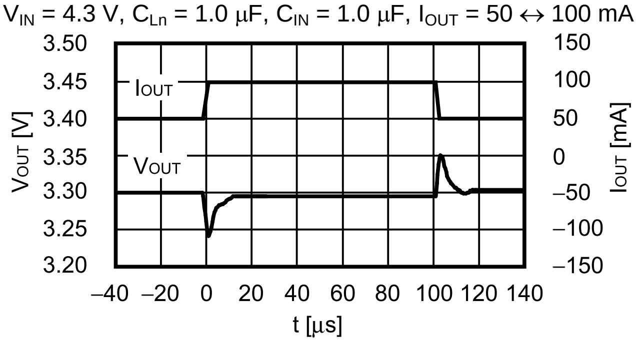
V_{OUT} = 1.2 V
V_{IN} = 2.2 V, C_{Ln} = 1.0 μF, C_{IN} = 1.0 μF, I_{OUT} = 50 ↔ 100 mA



V_{OUT} = 2.5 V
V_{IN} = 3.5 V, C_{Ln} = 1.0 μF, C_{IN} = 1.0 μF, I_{OUT} = 50 ↔ 100 mA



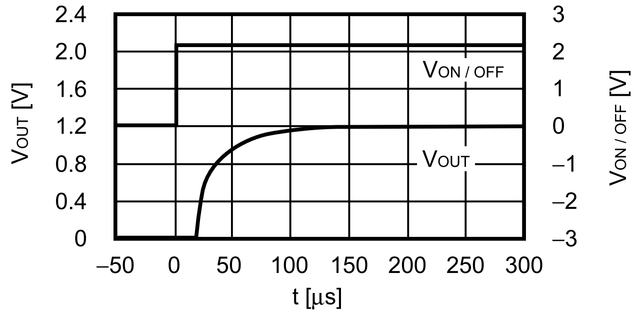
V_{OUT} = 3.3 V
V_{IN} = 4.3 V, C_{Ln} = 1.0 μF, C_{IN} = 1.0 μF, I_{OUT} = 50 ↔ 100 mA



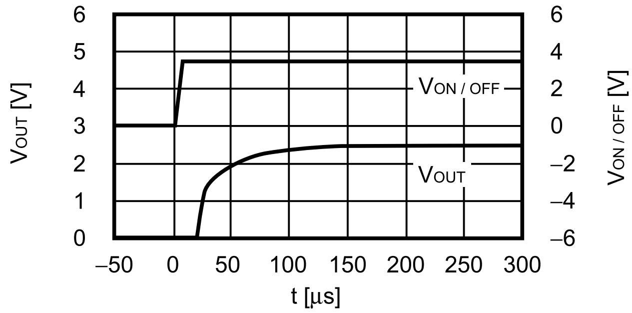
Remark C_{Ln}: Capacitor set to VOUTn pin externally (n = 1, 2)

(3) Transient Response Characteristics of ON / OFF Pin (Ta = 25°C)

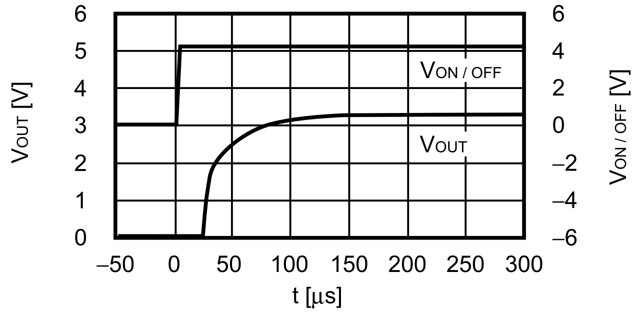
V_{OUT} = 1.2 V
V_{IN} = 2.2 V, tr = 5.0 μs, C_{Ln} = 1.0 μF, C_{IN} = 1.0 μF, I_{OUT} = 100 mA



V_{OUT} = 2.5 V
V_{IN} = 3.5 V, tr = 5.0 μs, C_{Ln} = 1.0 μF, C_{IN} = 1.0 μF, I_{OUT} = 100 mA

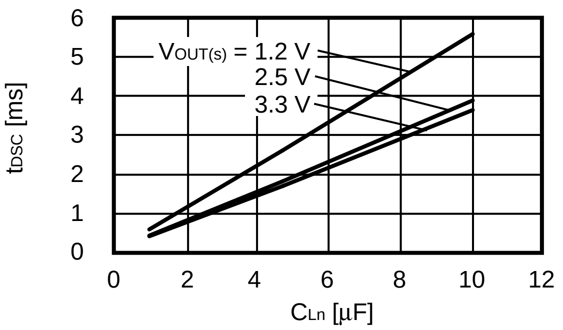


V_{OUT} = 3.3 V
V_{IN} = 4.3 V, tr = 5.0 μs, C_{Ln} = 1.0 μF, C_{IN} = 1.0 μF, I_{OUT} = 100 mA



(4) Output Capacitance vs. Characteristics of Discharge Time (Ta = 25°C)
S-1731 Series A / B type (with discharge shunt function)

V_{IN} = V_{OUT} + 1.0 V, I_{OUT} = no load
$V_{ON/OFF}$ = V_{OUT} + 1.0 V → V_{SS}, tf = 1 ms



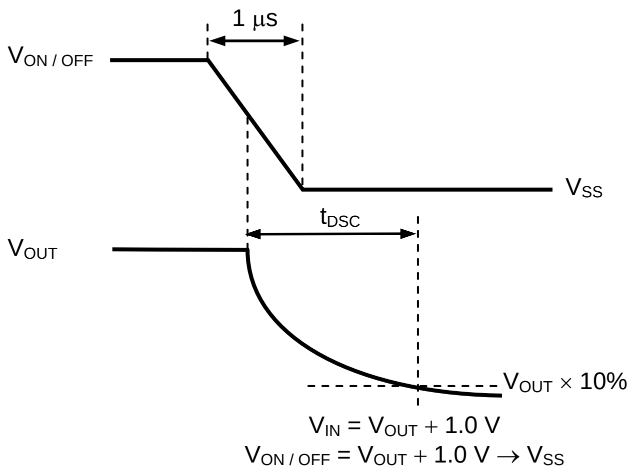
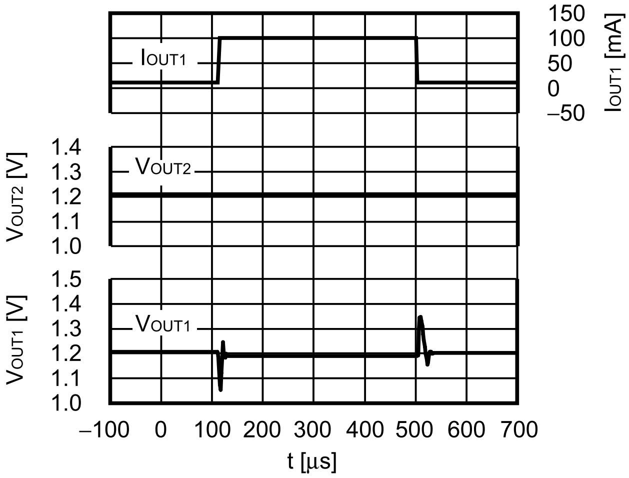


Figure 26 Measurement Condition of Discharge Time

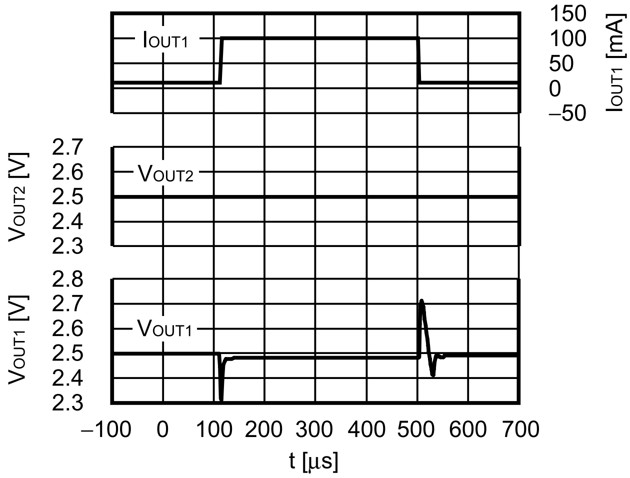
Remark C_{Ln}: Capacitor set to VOUTn pin externally (n = 1, 2)

(5) Transient Response Characteristics of Load's Mutual Interference (Ta = 25°C)

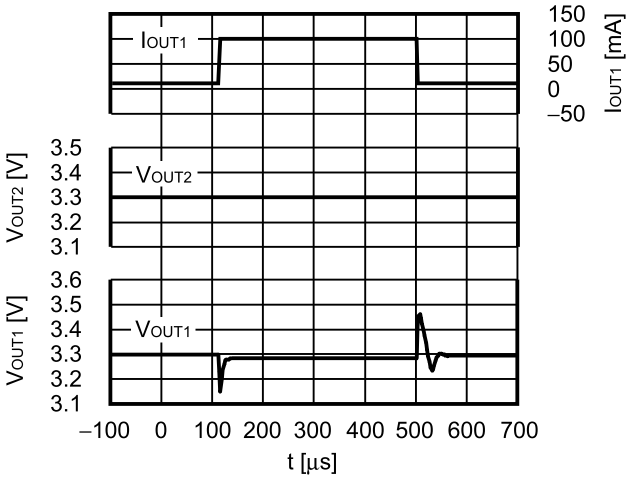
$V_{OUT1} = V_{OUT2} = 1.2$ V
$V_{IN} = 2.2$ V, $C_{L1} = C_{L2} = 1.0$ μF, $C_{IN} = 1.0$ μF,
$I_{OUT1} = 10 \leftrightarrow 100$ mA, I_{OUT2} = no load



$V_{OUT1} = V_{OUT2} = 2.5$ V
$V_{IN} = 3.5$ V, $C_{L1} = C_{L2} = 1.0$ μF, $C_{IN} = 1.0$ μF,
$I_{OUT1} = 10 \leftrightarrow 100$ mA, I_{OUT2} = no load

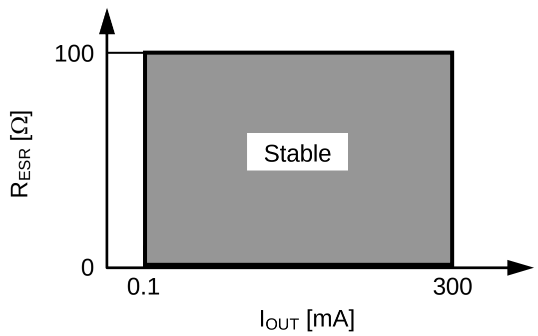


$V_{OUT1} = V_{OUT2} = 3.3$ V
$V_{IN} = 4.3$ V, $C_{L1} = C_{L2} = 1.0$ μF, $C_{IN} = 1.0$ μF,
$I_{OUT1} = 10 \leftrightarrow 100$ mA, I_{OUT2} = no load

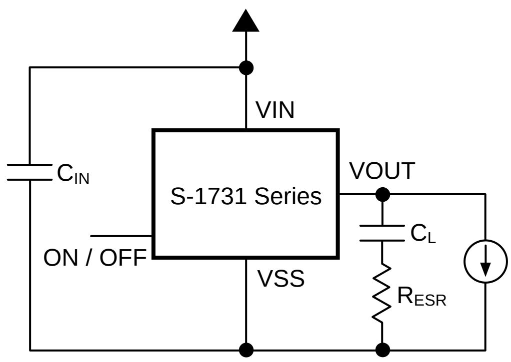


(6) Example of Equivalent Series Resistance vs. Output Current Characteristics (Ta = 25°C)

$C_{IN} = C_{L1} = C_{L2} = 1.0$ μF



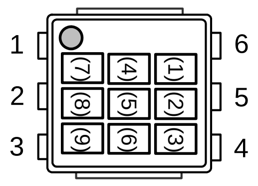
C_L : TAIYO YUDEN EMK212BJ105K (1.0 μF)



Remark C_{Ln}: Capacitor set to VOUTn pin externally (n = 1, 2)

■ Marking Specifications

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

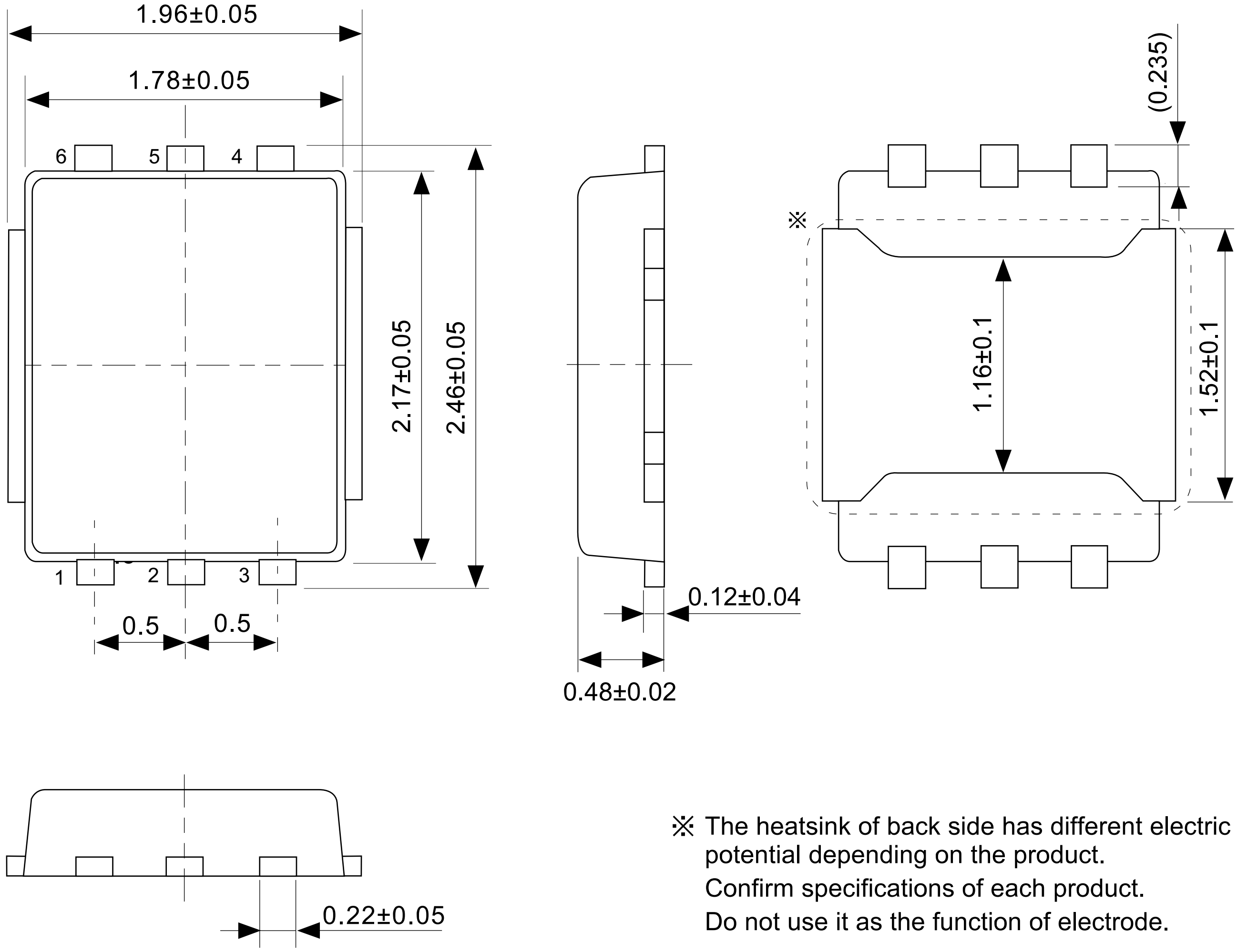
(a) S-1731 Series A type

Product Name	Product code		
	(1)	(2)	(3)
S-1731A1212-A6T1y	U	R	A
S-1731A2815-A6T1y	U	R	B
S-1731A2818-A6T1y	U	R	C
S-1731A2828-A6T1y	U	R	D
S-1731A2830-A6T1y	U	R	E
S-1731A2833-A6T1y	U	R	F
S-1731A3018-A6T1y	U	R	G
S-1731A3033-A6T1y	U	R	H
S-1731A3333-A6T1y	U	R	I

(b) S-1731 Series C type

Product Name	Product code		
	(1)	(2)	(3)
S-1731C2815-A6T1y	U	T	A
S-1731C2818-A6T1y	U	T	B
S-1731C2828-A6T1y	U	T	C
S-1731C2830-A6T1y	U	T	D
S-1731C2833-A6T1y	U	T	E
S-1731C3018-A6T1y	U	T	F
S-1731C3033-A6T1y	U	T	G
S-1731C3333-A6T1y	U	T	H

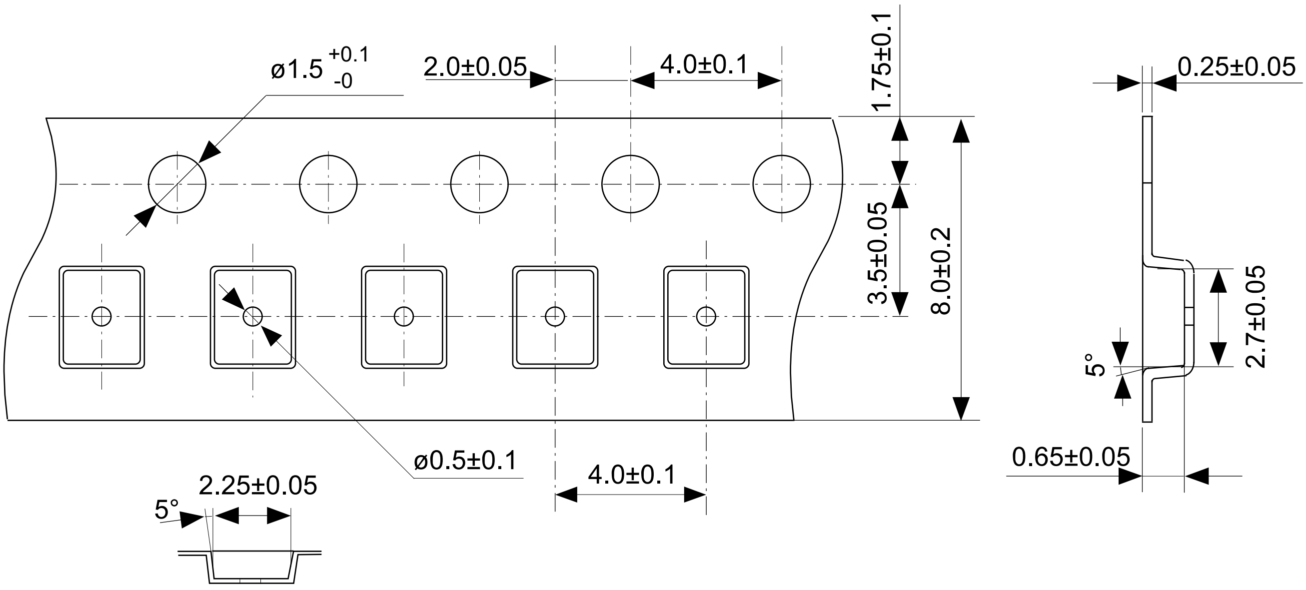
Remark 1. Please contact our sales office for products with specifications other than the above.
2. y: S or U
3. Please select products of environmental code = U for Sn 100%, halogen-free products.

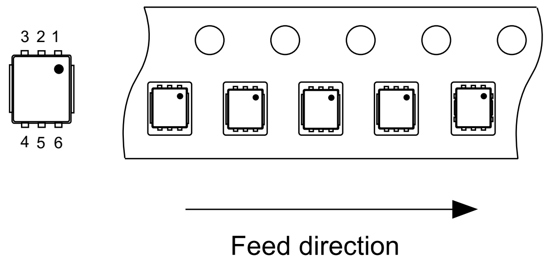


※ The heatsink of back side has different electric potential depending on the product.
Confirm specifications of each product.
Do not use it as the function of electrode.

No. PJ006-A-P-SD-2.0

TITLE	HSNT-6A-A-PKG Dimensions
No.	PJ006-A-P-SD-2.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	

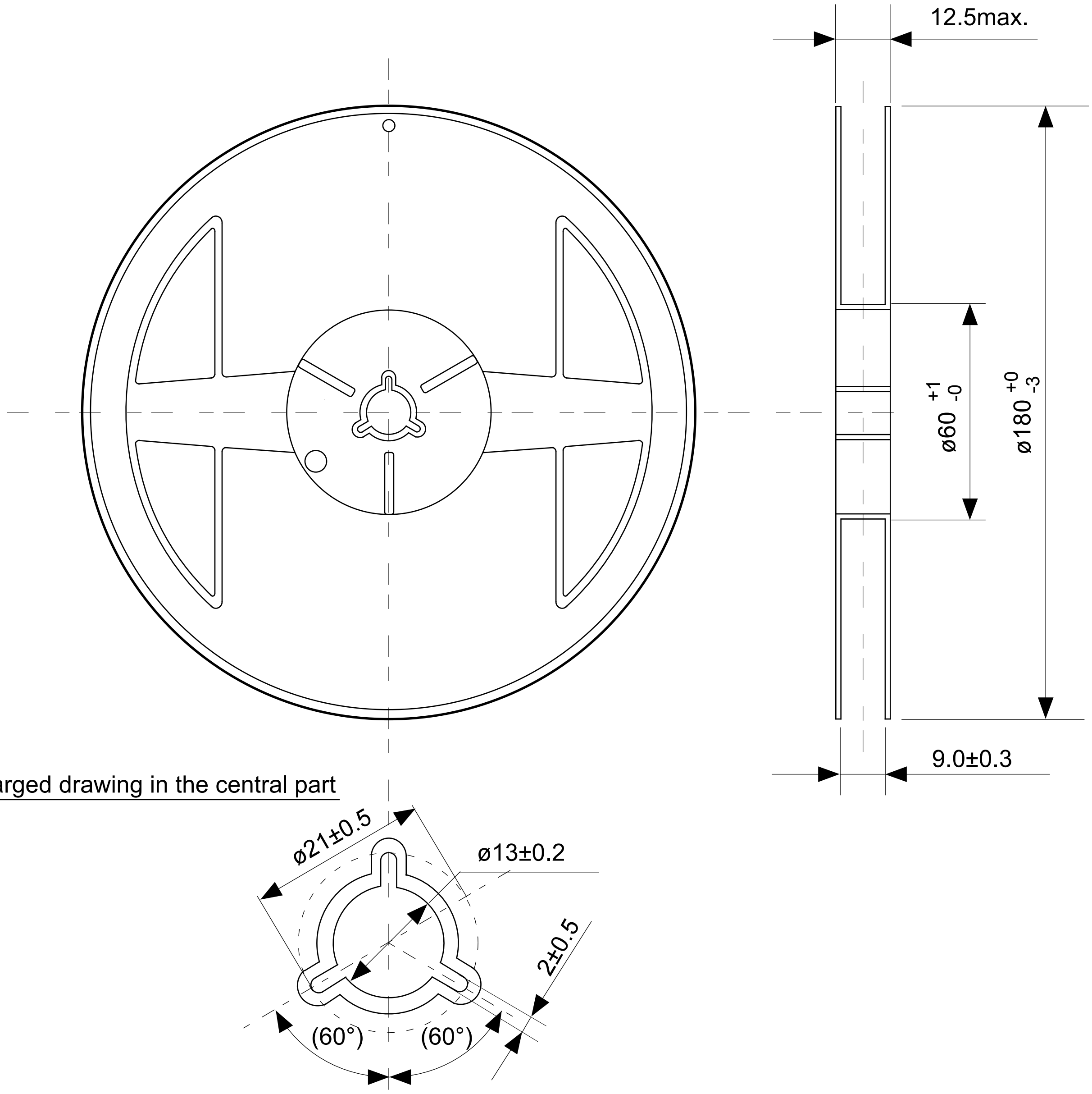




No. PJ006-A-C-SD-1.0

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

Seiko Instruments Inc.

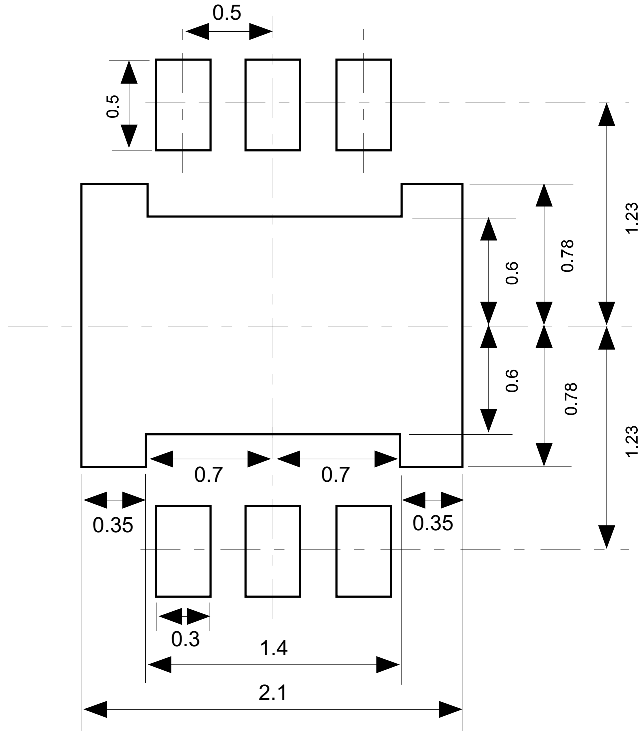


No. PJ006-A-R-SD-1.0

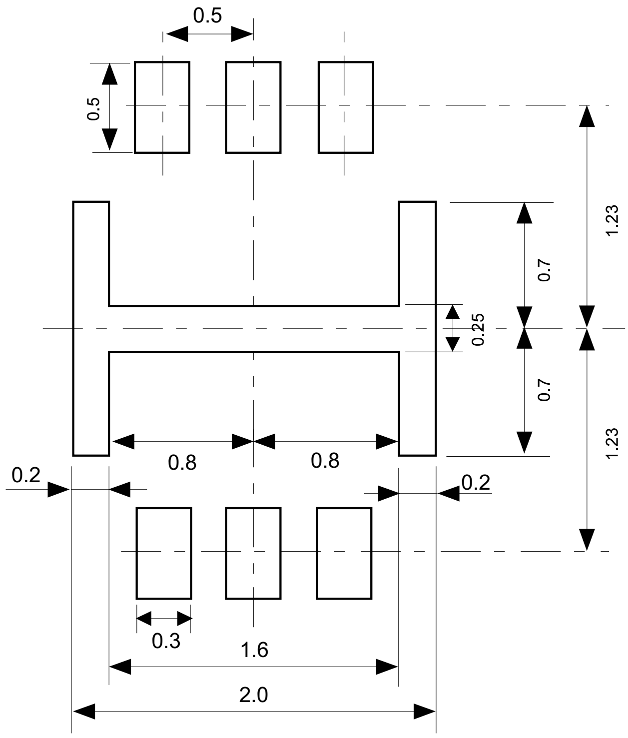
TITLE	HSNT-6A-A-Reel
No.	PJ006-A-R-SD-1.0
SCALE	QTY. 5,000
UNIT	mm

Seiko Instruments Inc.

Land Recommendation



Stencil Opening



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.