

HIGH OPERATING VOLTAGE CMOS VOLTAGE REGULATOR

The S-812C Series is a high-withstand voltage regulator IC which is developed by using the CMOS technology. This IC is suitable for applications which require withstand because its maximum voltage for operation is as high as 16 V, also for portable device having the low current consumption because this IC not only has the low current consumption but also a ON/OFF circuit. This IC operates stably due to the internal phase compensation circuit so that users are able to use ceramic capacitor as the output capacitor.

■ Features

- Output voltage: 2.0 V to 6.0 V, selectable in 0.1 V step
- Input voltage: 16 V max.
- Output voltage accuracy: $\pm 2.0\%$
- Dropout voltage: 120 mV typ. (5.0 V output product, $I_{OUT} = 10$ mA)
- Current consumption: During operation: 1.0 μ A typ., 1.8 μ A max. (3.0 V output product)
- Output current: Possible to output 50 mA (3.0 V output product, $V_{IN} = 5$ V)^{*1}
Possible to output 75 mA (5.0 V output product, $V_{IN} = 7$ V)^{*1}
- Built-in ON/OFF circuit: Selectable available / unavailable of power-off function
Selectable active "H" / "L" in the regulator
- Built-in short-circuit protection circuit: Selectable available / unavailable of short-circuit protection circuit
Available short-circuit protection: Short-circuit current 40 mA typ.
- Operation temperature range: $T_a = -40^\circ\text{C}$ to $+85^\circ\text{C}$
- Lead-free, Sn 100%, halogen-free^{*2}

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

*2. Refer to "■ Product Name Structure" for details.

■ Applications

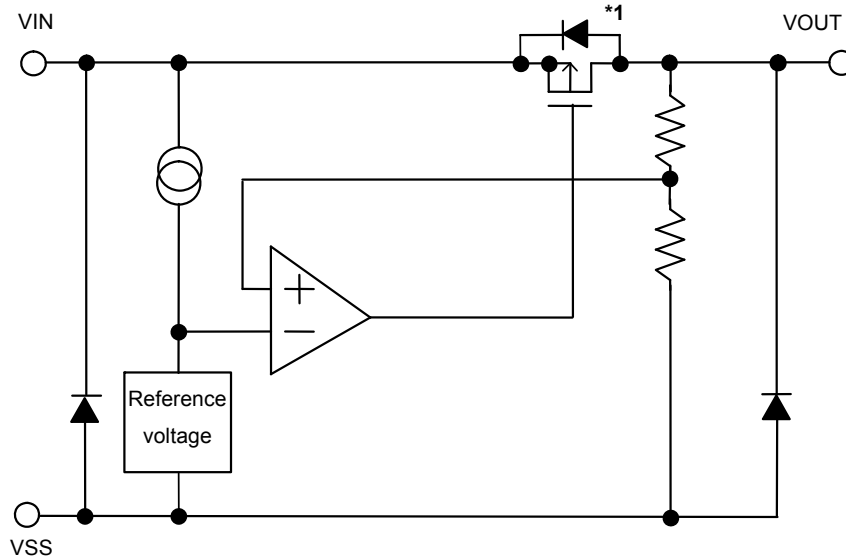
- Constant-voltage power supply for home electric/electronic appliance
- Constant-voltage power supply for battery-powered device
- Constant-voltage power supply for communication device

■ Packages

- SNT-6A(H)
- SOT-23-5
- SOT-89-3
- SOT-89-5
- TO-92

■ **Block Diagrams**

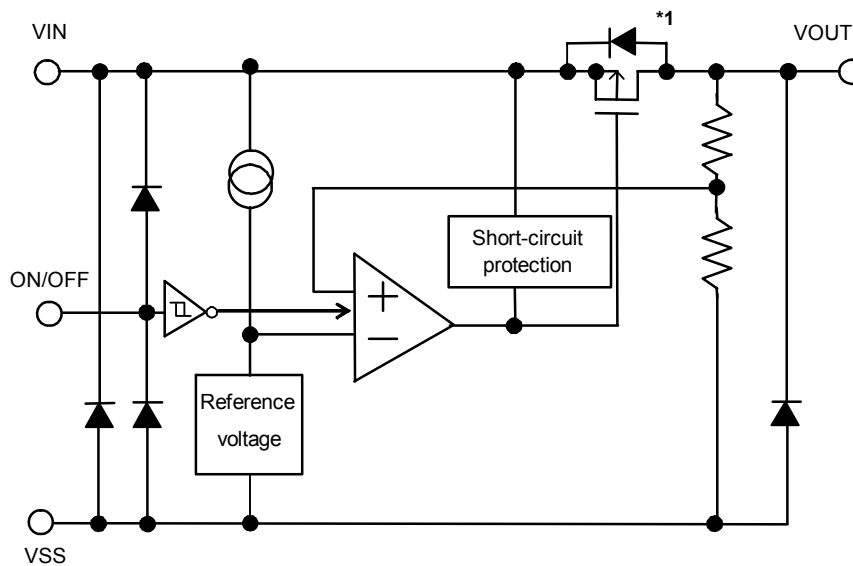
1. S-812CxxA Series (Unavailable short-circuit protection and power-off function)



*1. Parasitic diode

Figure 1

2. S-812CxxB Series (Available short-circuit protection and power-off function)



*1. Parasitic diode

Figure 2

3. S-812CxxE Series (Available Short-circuit protection function, unavailable power-off function)

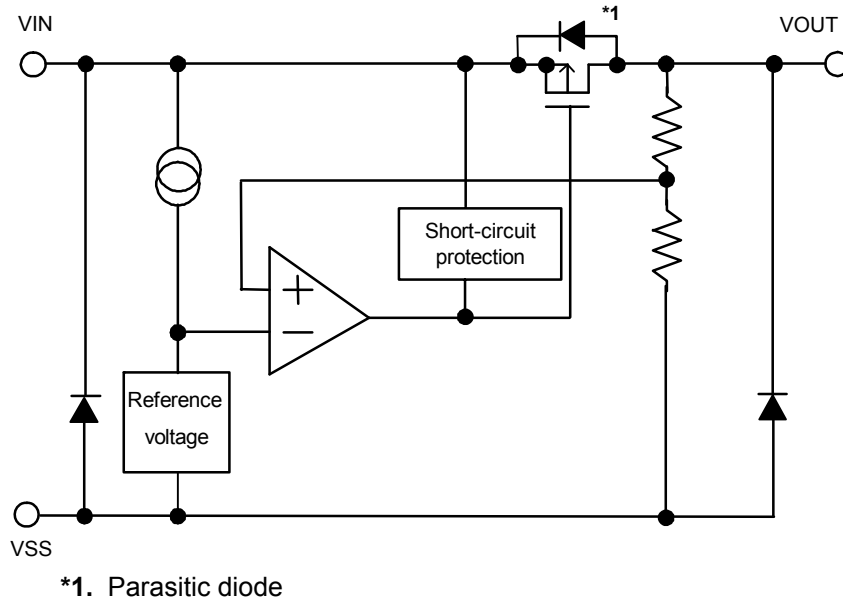


Figure 3

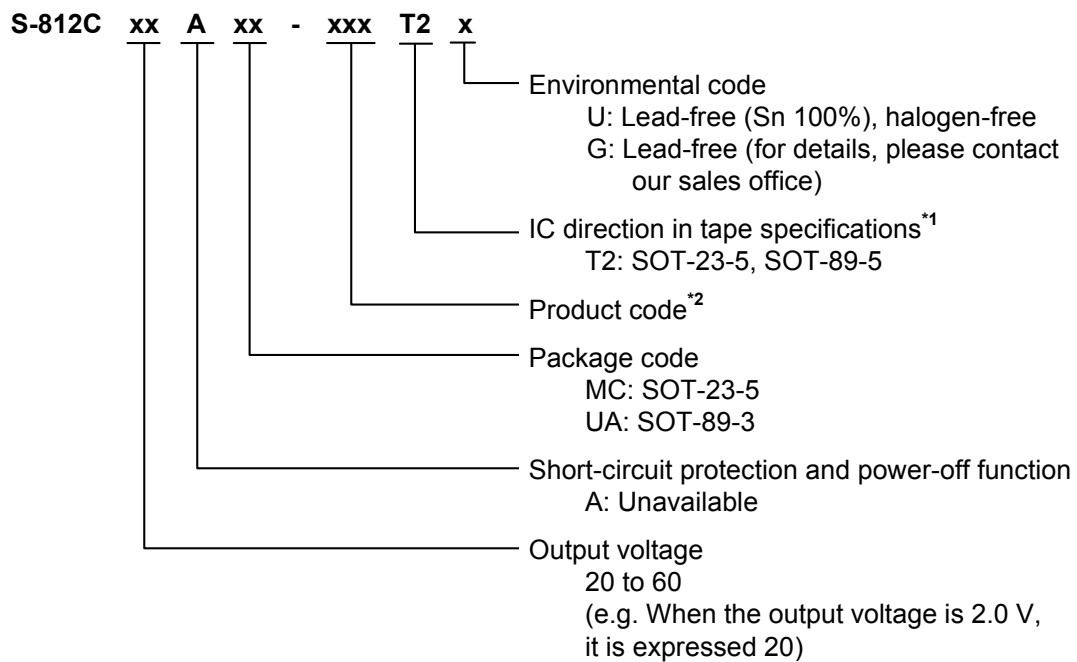
■ **Product Name Structure**

Users can select the product type, output voltage, and package type for the S-812C Series. Refer to “**1. Product name**” regarding the contents of product name, “**2. Packages**” regarding the package drawings, “**3. Product name list**” regarding details of product name.

1. Product name

1. 1 S-812CxxA series

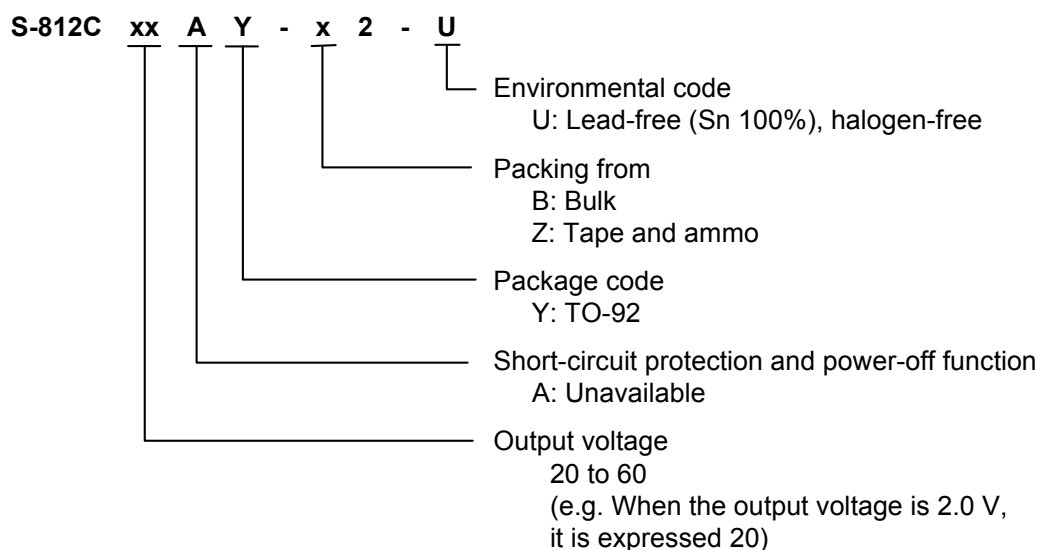
1. 1. 1 SOT-23-5, SOT-89-3



*1. Refer to the tape drawing.

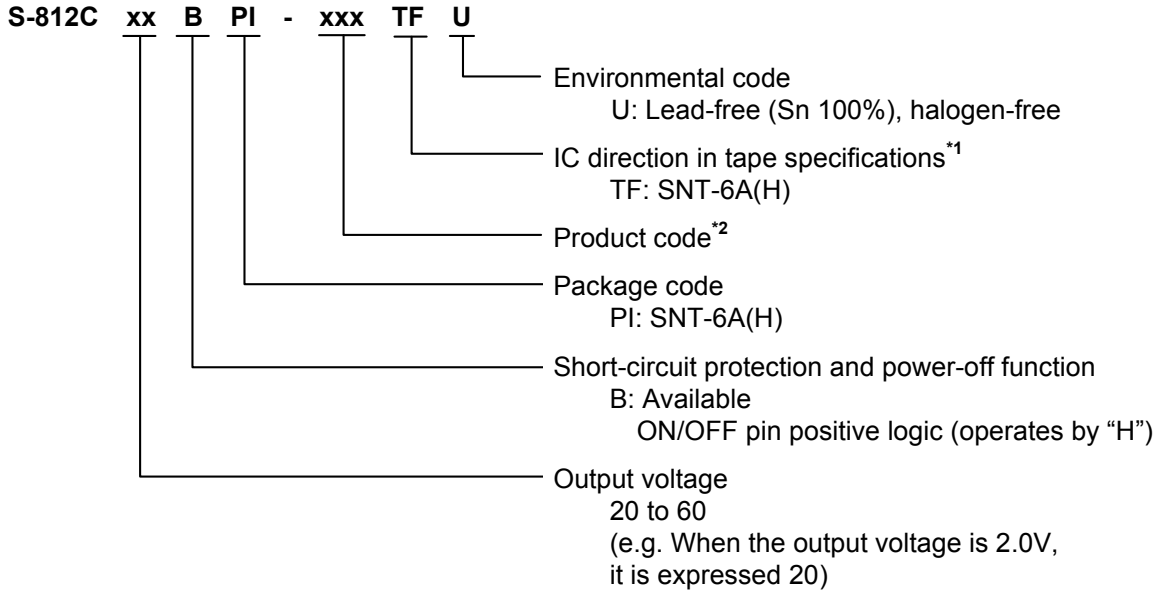
*2. Refer to “**3. Product name list**”.

1. 1. 2 TO-92

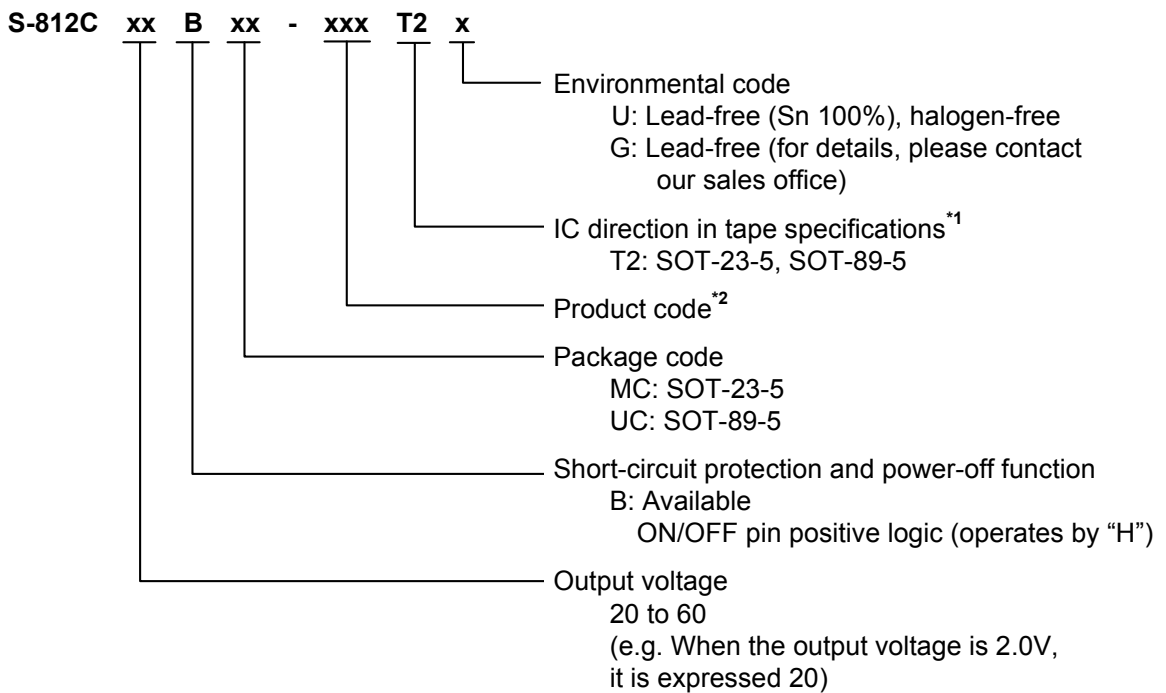


1.2 S-812CxxB series

1.2.1 SNT-6A(H)

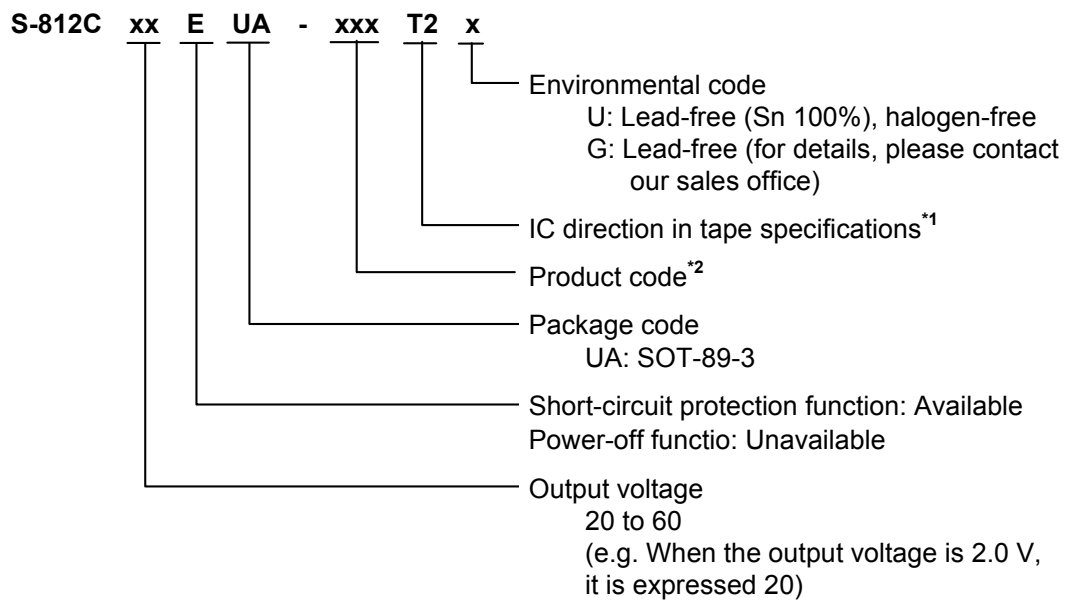


1.2.1 SOT-23-5、SOT-89-5



*1. Refer to the tape drawing.
*2. Refer to "3. Product name list".

1.3 S-812CxxE series



*1. Refer to the tape drawing.

*2. Refer to “3. Product name list”.

2. Packages

Package name	Drawing code				
	Package	Tape	Reel	Zigzag	Land
SNT-6A(H)	PI006-A-P-SD	PI006-A-C-SD	PI006-A-R-SD	—	PI006-A-L-SD
SOT-23-5	MP005-A-P-SD	MP005-A-C-SD	MP005-A-R-SD	—	—
SOT-89-3	UP003-A-P-SD	UP003-A-C-SD	UP003-A-R-SD	—	—
SOT-89-5	UP005-A-P-SD	UP005-A-C-SD	UP005-A-R-SD	—	—
TO-92 (Bulk)	YS003-D-P-SD	—	—	—	—
TO-92 (Tape and ammo)	YZ003-E-P-SD	YZ003-E-C-SD	—	YZ003-E-Z-SD	—

3. Product name list

3.1 S-812CxxA Series (Unavailable short-circuit protection and power-off function)

Table 1

Output voltage	SOT-23-5	SOT-89-3	SOT-89-5	TO-92*1
2.0 V±2.0 %	S-812C20AMC-C2AT2x	S-812C20AUA-C2AT2x	—	S-812C20AY-n2-U
2.1 V±2.0 %	S-812C21AMC-C2BT2x	S-812C21AUA-C2BT2x	—	S-812C21AY-n2-U
2.2 V±2.0 %	S-812C22AMC-C2CT2x	S-812C22AUA-C2CT2x	—	S-812C22AY-n2-U
2.3 V±2.0 %	S-812C23AMC-C2DT2x	S-812C23AUA-C2DT2x	—	S-812C23AY-n2-U
2.4 V±2.0 %	S-812C24AMC-C2ET2x	S-812C24AUA-C2ET2x	—	S-812C24AY-n2-U
2.5 V±2.0 %	S-812C25AMC-C2FT2x	S-812C25AUA-C2FT2x	—	S-812C25AY-n2-U
2.6 V±2.0 %	S-812C26AMC-C2GT2x	S-812C26AUA-C2GT2x	—	S-812C26AY-n2-U
2.7 V±2.0 %	S-812C27AMC-C2HT2x	S-812C27AUA-C2HT2x	—	S-812C27AY-n2-U
2.8 V±2.0 %	S-812C28AMC-C2IT2x	S-812C28AUA-C2IT2x	—	S-812C28AY-n2-U
2.9 V±2.0 %	S-812C29AMC-C2JT2x	S-812C29AUA-C2JT2x	—	S-812C29AY-n2-U
3.0 V±2.0 %	S-812C30AMC-C2KT2x	S-812C30AUA-C2KT2x	—	S-812C30AY-n2-U
3.1 V±2.0 %	S-812C31AMC-C2LT2x	S-812C31AUA-C2LT2x	—	S-812C31AY-n2-U
3.2 V±2.0 %	S-812C32AMC-C2MT2x	S-812C32AUA-C2MT2x	—	S-812C32AY-n2-U
3.3 V±2.0 %	S-812C33AMC-C2NT2x	S-812C33AUA-C2NT2x	—	S-812C33AY-n2-U
3.4 V±2.0 %	S-812C34AMC-C2OT2x	S-812C34AUA-C2OT2x	—	S-812C34AY-n2-U
3.5 V±2.0 %	S-812C35AMC-C2PT2x	S-812C35AUA-C2PT2x	—	S-812C35AY-n2-U
3.6 V±2.0 %	S-812C36AMC-C2QT2x	S-812C36AUA-C2QT2x	—	S-812C36AY-n2-U
3.7 V±2.0 %	S-812C37AMC-C2RT2x	S-812C37AUA-C2RT2x	—	S-812C37AY-n2-U
3.8 V±2.0 %	S-812C38AMC-C2ST2x	S-812C38AUA-C2ST2x	—	S-812C38AY-n2-U
3.9 V±2.0 %	S-812C39AMC-C2TT2x	S-812C39AUA-C2TT2x	—	S-812C39AY-n2-U
4.0 V±2.0 %	S-812C40AMC-C2UT2x	S-812C40AUA-C2UT2x	—	S-812C40AY-n2-U
4.1 V±2.0 %	S-812C41AMC-C2VT2x	S-812C41AUA-C2VT2x	—	S-812C41AY-n2-U
4.2 V±2.0 %	S-812C42AMC-C2WT2x	S-812C42AUA-C2WT2x	—	S-812C42AY-n2-U
4.3 V±2.0 %	S-812C43AMC-C2XT2x	S-812C43AUA-C2XT2x	—	S-812C43AY-n2-U
4.4 V±2.0 %	S-812C44AMC-C2YT2x	S-812C44AUA-C2YT2x	—	S-812C44AY-n2-U
4.5 V±2.0 %	S-812C45AMC-C2ZT2x	S-812C45AUA-C2ZT2x	—	S-812C45AY-n2-U
4.6 V±2.0 %	S-812C46AMC-C3AT2x	S-812C46AUA-C3AT2x	—	S-812C46AY-n2-U
4.7 V±2.0 %	S-812C47AMC-C3BT2x	S-812C47AUA-C3BT2x	—	S-812C47AY-n2-U
4.8 V±2.0 %	S-812C48AMC-C3CT2x	S-812C48AUA-C3CT2x	—	S-812C48AY-n2-U
4.9 V±2.0 %	S-812C49AMC-C3DT2x	S-812C49AUA-C3DT2x	—	S-812C49AY-n2-U
5.0 V±2.0 %	S-812C50AMC-C3ET2x	S-812C50AUA-C3ET2x	—	S-812C50AY-n2-U
5.1 V±2.0 %	S-812C51AMC-C3FT2x	S-812C51AUA-C3FT2x	—	S-812C51AY-n2-U
5.2 V±2.0 %	S-812C52AMC-C3GT2x	S-812C52AUA-C3GT2x	—	S-812C52AY-n2-U
5.3 V±2.0 %	S-812C53AMC-C3HT2x	S-812C53AUA-C3HT2x	—	S-812C53AY-n2-U
5.4 V±2.0 %	S-812C54AMC-C3IT2x	S-812C54AUA-C3IT2x	—	S-812C54AY-n2-U
5.5 V±2.0 %	S-812C55AMC-C3JT2x	S-812C55AUA-C3JT2x	—	S-812C55AY-n2-U
5.6 V±2.0 %	S-812C56AMC-C3KT2x	S-812C56AUA-C3KT2x	—	S-812C56AY-n2-U
5.7 V±2.0 %	S-812C57AMC-C3LT2x	S-812C57AUA-C3LT2x	—	S-812C57AY-n2-U
5.8 V±2.0 %	S-812C58AMC-C3MT2x	S-812C58AUA-C3MT2x	—	S-812C58AY-n2-U
5.9 V±2.0 %	S-812C59AMC-C3NT2x	S-812C59AUA-C3NT2x	—	S-812C59AY-n2-U
6.0 V±2.0 %	S-812C60AMC-C3OT2x	S-812C60AUA-C3OT2x	—	S-812C60AY-n2-U

*1. "n" changes according to the packing form in TO-92.

B: Bulk, Z: Tape and ammo.

Remark 1. Please contact our sales office for products with an output voltage value other than those specified above.

2. x: G or U

3. Please select products of environmental code = U for Sn 100%, halogen-free products.

3.2 S-812CxxB Series (Available short-circuit protection and power-off function)

Table 2

Output voltage	SNT-6A(H)	SOT-23-5	SOT-89-5
2.0 V±2.0 %	S-812C20BPI-C4ATFU	S-812C20BMC-C4AT2x	—
2.1 V±2.0 %	S-812C21BPI-C4BTFU	S-812C21BMC-C4BT2x	—
2.2 V±2.0 %	S-812C22BPI-C4CTFU	S-812C22BMC-C4CT2x	—
2.3 V±2.0 %	S-812C23BPI-C4DTFU	S-812C23BMC-C4DT2x	—
2.4 V±2.0 %	S-812C24BPI-C4ETFU	S-812C24BMC-C4ET2x	—
2.5 V±2.0 %	S-812C25BPI-C4FTFU	S-812C25BMC-C4FT2x	—
2.6 V±2.0 %	S-812C26BPI-C4GTFU	S-812C26BMC-C4GT2x	—
2.7 V±2.0 %	S-812C27BPI-C4HTFU	S-812C27BMC-C4HT2x	—
2.8 V±2.0 %	S-812C28BPI-C4ITFU	S-812C28BMC-C4IT2x	—
2.9 V±2.0 %	S-812C29BPI-C4JTFU	S-812C29BMC-C4JT2x	—
3.0 V±2.0 %	S-812C30BPI-C4KTFU	S-812C30BMC-C4KT2x	—
3.1 V±2.0 %	S-812C31BPI-C4LTFU	S-812C31BMC-C4LT2x	—
3.2 V±2.0 %	S-812C32BPI-C4MTFU	S-812C32BMC-C4MT2x	—
3.3 V±2.0 %	S-812C33BPI-C4NTFU	S-812C33BMC-C4NT2x	S-812C33BUC-C4NT2x
3.4 V±2.0 %	S-812C34BPI-C4OTFU	S-812C34BMC-C4OT2x	—
3.5 V±2.0 %	S-812C35BPI-C4PTFU	S-812C35BMC-C4PT2x	—
3.6 V±2.0 %	S-812C36BPI-C4QTFU	S-812C36BMC-C4QT2x	—
3.7 V±2.0 %	S-812C37BPI-C4RTFU	S-812C37BMC-C4RT2x	—
3.8 V±2.0 %	S-812C38BPI-C4STFU	S-812C38BMC-C4ST2x	—
3.9 V±2.0 %	S-812C39BPI-C4TTFU	S-812C39BMC-C4TT2x	—
4.0 V±2.0 %	S-812C40BPI-C4UTFU	S-812C40BMC-C4UT2x	—
4.1 V±2.0 %	S-812C41BPI-C4VTFU	S-812C41BMC-C4VT2x	—
4.2 V±2.0 %	S-812C42BPI-C4WTFU	S-812C42BMC-C4WT2x	—
4.3 V±2.0 %	S-812C43BPI-C4XTFU	S-812C43BMC-C4XT2x	—
4.4 V±2.0 %	S-812C44BPI-C4YTFU	S-812C44BMC-C4YT2x	—
4.5 V±2.0 %	S-812C45BPI-C4ZTFU	S-812C45BMC-C4ZT2x	—
4.6 V±2.0 %	S-812C46BPI-C5ATFU	S-812C46BMC-C5AT2x	—
4.7 V±2.0 %	S-812C47BPI-C5BTFU	S-812C47BMC-C5BT2x	—
4.8 V±2.0 %	S-812C48BPI-C5CTFU	S-812C48BMC-C5CT2x	—
4.9 V±2.0 %	S-812C49BPI-C5DTFU	S-812C49BMC-C5DT2x	—
5.0 V±2.0 %	S-812C50BPI-C5ETFU	S-812C50BMC-C5ET2x	S-812C50BUC-C5ET2x
5.1 V±2.0 %	S-812C51BPI-C5FTFU	S-812C51BMC-C5FT2x	—
5.2 V±2.0 %	S-812C52BPI-C5GTFU	S-812C52BMC-C5GT2x	—
5.3 V±2.0 %	S-812C53BPI-C5HTFU	S-812C53BMC-C5HT2x	—
5.4 V±2.0 %	S-812C54BPI-C5ITFU	S-812C54BMC-C5IT2x	—
5.5 V±2.0 %	S-812C55BPI-C5JTFU	S-812C55BMC-C5JT2x	—
5.6 V±2.0 %	S-812C56BPI-C5KTFU	S-812C56BMC-C5KT2x	—
5.7 V±2.0 %	S-812C57BPI-C5LTFU	S-812C57BMC-C5LT2x	—
5.8 V±2.0 %	S-812C58BPI-C5MTFU	S-812C58BMC-C5MT2x	—
5.9 V±2.0 %	S-812C59BPI-C5NTFU	S-812C59BMC-C5NT2x	—
6.0 V±2.0 %	S-812C60BPI-C5OTFU	S-812C60BMC-C5OT2x	—

Remark 1. Please contact our sales office for products with an output voltage value other than those specified above.

2. x: G or U

3. Please select products of environmental code = U for Sn 100%, halogen-free products.

HIGH OPERATING VOLTAGE CMOS VOLTAGE REGULATOR
S-812C Series

Rev.6.3_00

3.3 S-812CxxE Series (Available short-circuit protection function, unavailable power-off function)

Table 3

Output voltage	SOT-23-5	SOT-89-3	SOT-89-5	TO-92*1
3.3 V \pm 2.0 %	—	S-812C33EUA-C5PT2x	—	—
3.6 V \pm 2.0 %	—	S-812C36EUA-C5RT2x	—	—
4.0 V \pm 2.0 %	—	S-812C40EUA-C5QT2x	—	—

*1. "n" changes according to the packing form in TO-92.

B: Bulk, Z: Tape and ammo.

Remark 1. Please contact our sales office for products with an output voltage value other than those specified above.

2. x: G or U

3. Please select products of environmental code = U for Sn 100%, halogen-free products.

■ **Pin Configurations**

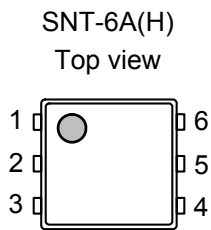


Figure 4

Table 4

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

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

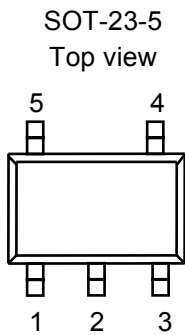


Figure 5

Table 5

Pin No.	Symbol	Description
1	VSS	GND pin
2	VIN	Input voltage pin
3	VOUT	Output voltage pin
4	NC*1	No connection
5	ON/OFF	ON/OFF pin (B type)
	NC*1	No connection (A type, E type)

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

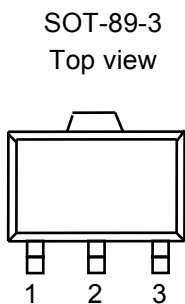


Figure 6

Table 6

Pin No.	Symbol	Description
1	VSS	GND pin
2	VIN	Input voltage pin
3	VOUT	Output voltage pin

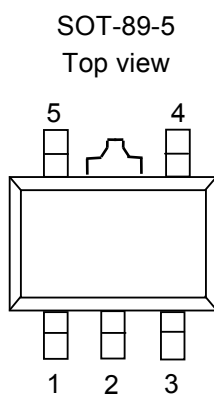


Figure 7

Table 7

Pin No.	Symbol	Description
1	VOUT	Output voltage pin
2	VIN	Input voltage pin
3	VSS	GND pin
4	ON/OFF	ON/OFF pin (B type)
	NC*1	No connection (A type, E type)
5	NC*1	No connection

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

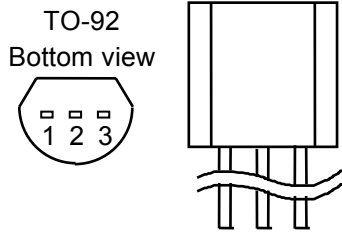


Figure 8

Table 8

Pin No.	Symbol	Description
1	VSS	GND pin
2	VIN	Input voltage pin
3	VOU	Output voltage pin

■ **Absolute Maximum Ratings**

Table 9

(Ta=25°C unless otherwise specified)

Item	Symbol	Absolute Maximum Rating	Units
Input voltage	V _{IN}	V _{SS} -0.3 to V _{SS} +18	V
	V _{ON/OFF}	V _{SS} -0.3 to V _{IN} +0.3	V
Output voltage	V _{OU}	V _{SS} -0.3 to V _{IN} +0.3	V
Power dissipation	P _D	500 ^{*1}	mW
		250 (When not mounted on board)	mW
		600 ^{*1}	mW
		500 (When not mounted on board)	mW
		1000 ^{*1}	mW
		500 (When not mounted on board)	mW
Operation ambient temperature	T _{opr}	-40 to +85	°C
	T _{stg}	-40 to +125	°C

*1. When mounted on board

[Mounted board]

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

(2) Board name : JEDEC STANDARD51-7

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.

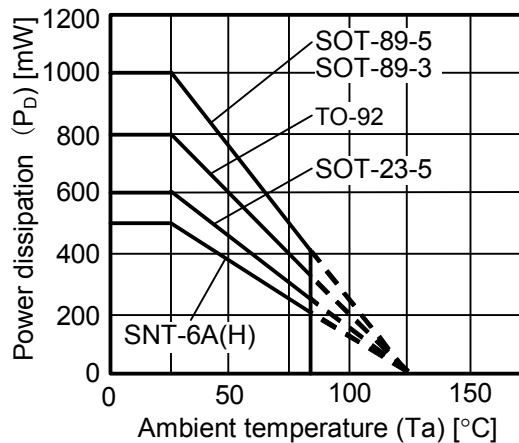


Figure 9 Power Dissipation of The Package (When mounted on Board)

■ **Electrical Characteristics**

Table 10

(Ta=25°C unless otherwise specified)

Item	Symbol	Conditions	Min.	Typ.	Max.	Units	Test circuits	
Output voltage*1	$V_{OUT(E)}$	$V_{IN} = V_{OUT(S)} + 2V, I_{OUT} = 10mA$	$\frac{V_{OUT(S)}}{\times 0.98}$	$V_{OUT(S)}$	$\frac{V_{OUT(S)}}{\times 1.02}$	V	1	
Output current*2	I_{OUT}	$V_{OUT(S)} + 2V \leq V_{IN} \leq 16V$	$2.0V \leq V_{OUT(S)} \leq 2.9V$	30	—	—	mA	3
			$3.0V \leq V_{OUT(S)} \leq 3.9V$	50	—	—	mA	3
			$4.0V \leq V_{OUT(S)} \leq 4.9V$	65	—	—	mA	3
			$5.0V \leq V_{OUT(S)} \leq 6.0V$	75	—	—	mA	3
Dropout voltage*3	V_{drop}	$I_{OUT} = 10mA$	$2.0V \leq V_{OUT(S)} \leq 2.4V$	—	0.46	0.95	V	1
			$2.5V \leq V_{OUT(S)} \leq 2.9V$	—	0.32	0.68	V	1
			$3.0V \leq V_{OUT(S)} \leq 3.4V$	—	0.23	0.41	V	1
			$3.5V \leq V_{OUT(S)} \leq 3.9V$	—	0.19	0.35	V	1
			$4.0V \leq V_{OUT(S)} \leq 4.4V$	—	0.16	0.30	V	1
			$4.5V \leq V_{OUT(S)} \leq 4.9V$	—	0.14	0.27	V	1
			$5.0V \leq V_{OUT(S)} \leq 5.4V$	—	0.12	0.25	V	1
$5.5V \leq V_{OUT(S)} \leq 6.0V$	—	0.11	0.23	V	1			
Line regulation 1	ΔV_{OUT1}	$V_{OUT(S)} + 1V \leq V_{IN} \leq 16V, I_{OUT} = 1mA$	—	5	20	mV	1	
Line regulation 2	ΔV_{OUT2}	$V_{OUT(S)} + 1V \leq V_{IN} \leq 16V, I_{OUT} = 1\mu A$	—	5	20	mV	1	
Load regulation	ΔV_{OUT3}	$V_{IN} = V_{OUT(S)} + 2V$	$2.0V \leq V_{OUT(S)} \leq 2.9V, 1\mu A \leq I_{OUT} \leq 20mA$	—	6	30	mV	1
			$3.0V \leq V_{OUT(S)} \leq 3.9V, 1\mu A \leq I_{OUT} \leq 30mA$	—	10	45	mV	1
			$4.0V \leq V_{OUT(S)} \leq 4.9V, 1\mu A \leq I_{OUT} \leq 40mA$	—	13	65	mV	1
			$5.0V \leq V_{OUT(S)} \leq 6.0V, 1\mu A \leq I_{OUT} \leq 50mA$	—	17	80	mV	1
Output voltage temperature coefficient*4	$\frac{\Delta V_{OUT}}{\Delta Ta \cdot V_{OUT}}$	$V_{IN} = V_{OUT(S)} + 1V, I_{OUT} = 10mA, -40^\circ C \leq Ta \leq 85^\circ C$	—	± 100	—	ppm/°C	1	
Current consumption	I_{SS}	$V_{IN} = V_{OUT(S)} + 2V, \text{no load}$	$2.0V \leq V_{OUT(S)} \leq 2.7V$	—	0.9	1.6	μA	2
			$2.8V \leq V_{OUT(S)} \leq 3.7V$	—	1.0	1.8	μA	2
			$3.8V \leq V_{OUT(S)} \leq 5.1V$	—	1.2	2.1	μA	2
			$5.2V \leq V_{OUT(S)} \leq 6.0V$	—	1.5	2.5	μA	2
Input voltage	V_{IN}	—	—	—	16	V	1	
Applied to products with power-off function								
Current consumption during power-off	I_{SS2}	$V_{IN} = V_{OUT(S)} + 2V, V_{ON/OFF} = 0V, \text{no load}$	—	0.1	0.5	μA	2	
ON/OFF pin input voltage "H"	V_{SH}	$V_{IN} = V_{OUT(S)} + 2V, R_L = 1k\Omega, \text{determined by } V_{OUT} \text{ output level}$	2.0	—	—	V	4	
ON/OFF pin input voltage "L"	V_{SL}	$V_{IN} = V_{OUT(S)} + 2V, R_L = 1k\Omega, \text{determined by } V_{OUT} \text{ output level}$	—	—	0.4	V	4	
ON/OFF pin input current "H"	I_{SH}	$V_{IN} = 7V, V_{ON/OFF} = 7V$	-0.1	—	0.1	μA	4	
ON/OFF pin input current "L"	I_{SL}	$V_{IN} = V_{OUT(S)} + 2V, V_{ON/OFF} = 0V$	-0.1	—	0.1	μA	4	
Applied to products with short-circuit protection function								
Short-circuit current	I_{OS}	$V_{IN} = V_{OUT(S)} + 2V, V_{OUT} = 0V$	—	40	—	mA	3	

- *1. $V_{OUT(S)}$: Set output voltage
 $V_{OUT(E)}$: Actual output voltage
 Output voltage when fixing $I_{OUT}(=10 \text{ mA})$ and inputting $V_{OUT(S)}+2.0 \text{ V}$.
- *2. The output current at which the output voltage becomes 95% of $V_{OUT(E)}$ after gradually increasing the output current.
- *3. $V_{drop} = V_{IN1} - (V_{OUT(E)} \times 0.98)$
 V_{IN1} is the input voltage at which the output voltage becomes 98% of $V_{OUT(E)}$ after gradually decreasing the input voltage.
- *4. A change in the temperature of the output voltage [$\text{mV}/^\circ\text{C}$] is calculated using the following equation.
- $$\frac{\Delta V_{OUT}}{\Delta T_a} [\text{mV}/^\circ\text{C}]^{*1} = V_{OUT(S)} [\text{V}]^{*2} \times \frac{\Delta V_{OUT}}{\Delta T_a \bullet V_{OUT}} [\text{ppm}/^\circ\text{C}]^{*3} \div 1000$$
- *1. Change in temperature of output voltage
 *2. Set output voltage
 *3. Output voltage temperature coefficient

■ **Test Circuits**

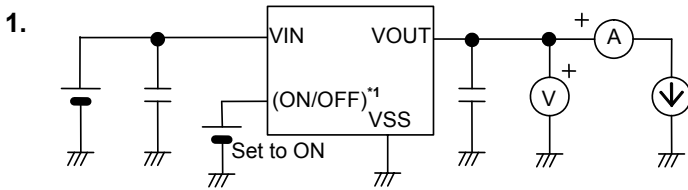


Figure 10

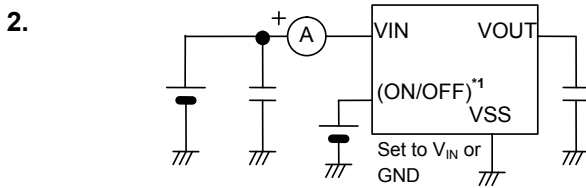


Figure 11

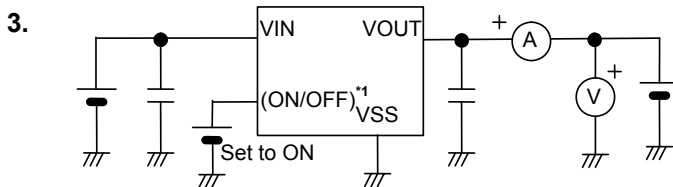


Figure 12

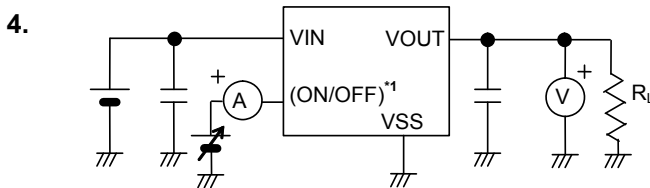
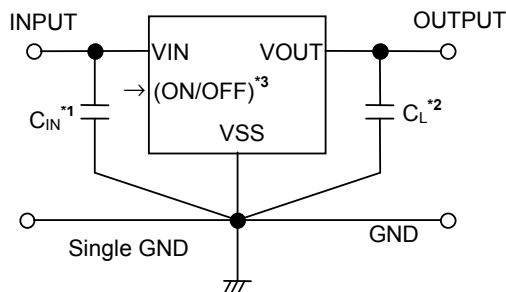


Figure 13

*1. In case of product with power-off function.

■ **Standard Circuit**



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

*2. In addition to tantalum capacitor, ceramic capacitor can be used for C_L .

*3. Control this ON/OFF pin in the product with power-off function.

Figure 14

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

■ **Explanation of Terms**

1. Output capacitor (C_L)

Generally in voltage regulator, output capacitor is used to stabilize regulation and to improve the characteristics of transient response. The S-812C Series operates stably without output capacitor C_L . Thus the output capacitor C_L is used only for improvement of the transient response. In the applications that users will use the S-812C Series, and they are not cautious about the transient response, it is possible to omit an output capacitor. If using an output capacitor for this IC, users are able to use devices such as ceramic capacitor which has small ESR (Equivalent Series Resistance).

2. Output voltage (V_{OUT})

The accuracy of the output voltage $\pm 2.0\%$ is assured under the specified conditions for input voltage, which differs depending upon the product items, output current, and temperature.

Caution If the above conditions change, the output voltage value may vary and go out of the accuracy range of the output voltage. Refer to "■ Electrical Characteristics" and "■ Characteristics (Typical Data)" for details.

3. Line regulations 1 and 2 (ΔV_{OUT1} , ΔV_{OUT2})

Indicate the dependency of the output voltage against the input voltage. That is, the value shows how much the output voltage changes due to a change in the input voltage after fixing output current constant.

4. Load regulation (ΔV_{OUT3})

Indicates the dependency of the output voltage against the output current. That is, the value shows how much the output voltage changes due to a change in the output current after fixing output current constant.

5. Dropout voltage (V_{drop})

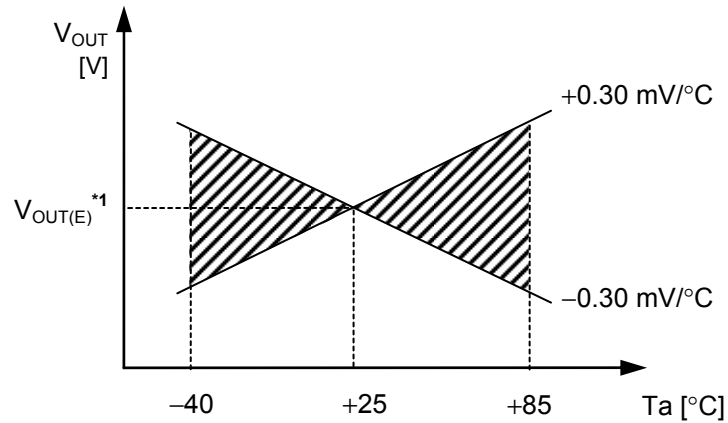
Indicates the difference between input voltage (V_{IN1}) and the output voltage when; decreasing input voltage (V_{IN}) gradually until the output voltage has dropped out to the value of 98% of output voltage ($V_{OUT(E)}$), which is at $V_{IN} = V_{OUT(S)} + 1.0$ V.

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

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

The shaded area in **Figure 15** is the range where V_{OUT} varies in the operation temperature range when the output voltage temperature coefficient is ± 100 ppm/ $^{\circ}\text{C}$.

Example of S-812C30A typ. product



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

Figure 15

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

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

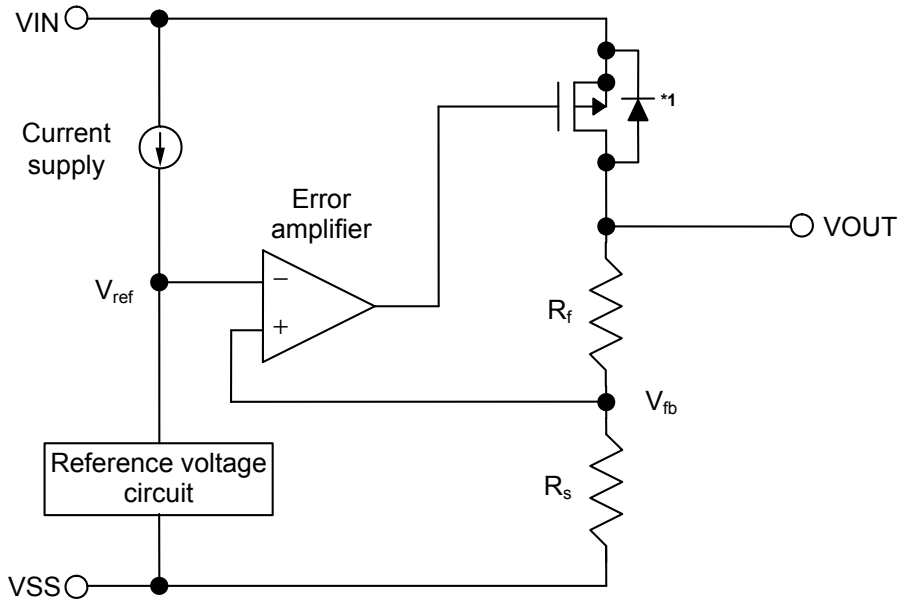
- *1. Change in temperature of output voltage
- *2. Set output voltage
- *3. Output voltage temperature coefficient

■ **Operation**

1. Basic operation

Figure 16 shows the block diagram of the S-812C 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 16

2. Output transistor

In the S-812C 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 pin and the VOUT pin is turned off, reducing current consumption significantly. The VOUT pin becomes the V_{SS} level due to the internally divided resistance of several MΩ between the VOUT pin and the VSS pin.

The structure of the ON/OFF pin is as shown in **Figure 17**. Since the ON/OFF pin is neither pulled down nor pulled up internally, do not use it in the floating status. Note that if applying the voltage of V_{IN} + 0.3 V or more, the current flows to V_{IN} via a parasitic diode in the IC.

When not using the ON/OFF pin in the product with the power-off function, connect the ON/OFF pin to the VIN pin (in positive logic), or to the VSS pin (in negative logic).

The output voltage may increase by stopping regulation when a lower current (100 μA or less) is applied.

If the output voltage increased during power-off, pull the VOUT pin down to the VSS pin and set the ON/OFF pin to the power-down level.

Table 11

Product Type	ON/OFF Pin	Internal Circuit	VOUT Pin Voltage	Current Consumption
B	“L”: OFF	Stop	V _{SS} level	I _{SS2}
B	“H”: ON	Operate	Set value	I _{SS}

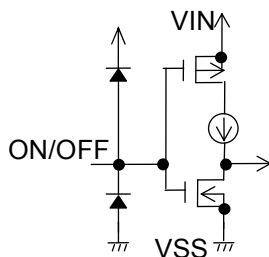


Figure 17

4. Short-circuit protection circuit

In the S-812C Series, users are able to select whether to set the short circuit protection, which protects the output capacitor from short-circuiting between the VOUT pin and the VSS pin.

The short circuit protection circuit controls the output current against voltage V_{OUT}, as seen in “**■ Characteristics (Typical Data)**”, “**1. Output Voltage vs Output Current (When load current increases)**”, and limits the output current at approx. 40 mA even if the VOUT pin and the VSS pins are short-circuited.

However, this short circuit protection circuit does not work as for thermal protection. Pay attention to the conditions of input voltage and load current so that, under the usage condition including short circuit, the loss of the IC will not exceed power dissipation of the package.

Even if pins are not short-circuited, this protection circuit works to limit the current to the specified value, in order to protect the output capacitor, when the output current and the potential difference between input and output voltages increase.

In the product without the short circuit protection circuit, the S-812C Series allows the relatively larger current because this protection circuit is detached.

■ **Selection of External Components**

1. **Output capacitor (C_L)**

The S-812C Series has an internal phase compensation circuit which stabilizes the operation regardless of the change of output load. Therefore it is possible for users to have a stable operation without an output capacitor (C_L). However, the values of output overshoot and undershoot, which are the characteristics of transient response, vary depending on the output capacitor. In selecting the value of output capacitor, refer to the data on C_L dependency in “■ Reference data”, “1. Transient response characteristics (Typical data: $T_a=25\text{ }^\circ\text{C}$)”.

Set ESR $10\ \Omega$ or less when using a tantalum capacitor or an aluminum electrolytic capacitor. Pay attention at low temperature, that aluminum electrolytic capacitor especially may oscillate because ESR increases. Evaluate sufficiently including the temperature characteristics in use.

■ **Application Circuit**

1. **Output current boost circuit**

As shown in **Figure 18**, the output current can be boosted by externally attaching a PNP transistor. Between the input voltage V_{IN} and the VIN pin (for power supply) in the S-812C Series, if setting the base-emitter voltage V_{BE} which fully switches the PNP transistor on, S-812C Series controls the base current in a PNP transistor so that the output voltage V_{OUT} reaches the level of voltage which is set by the S-812C Series.

Since the output current boosting circuit in **Figure 18** does not have the good characteristics of transient response, under the usage condition, confirm if output fluctuation due to power-on, and fluctuations of power supply and load affect on the operation or not before use.

Note that the short-circuit protection circuit in the S-812C Series does not work as short-circuit protection for this boost circuit.

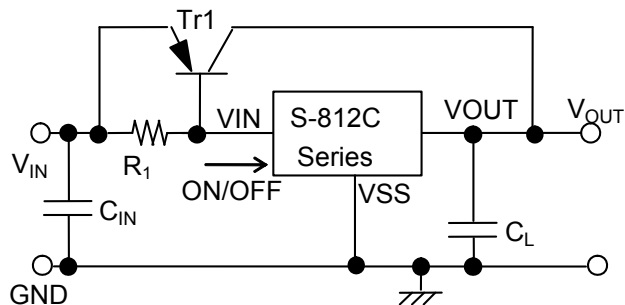


Figure 18

2. Constant current circuit

This circuit can be used as a constant current circuit if making the composition seen in **Figure 19** and **20**. Constant current I_o is calculated from the following equation ($V_{OUT(E)}$ = actual output voltage):

$$I_o = (V_{OUT(E)} \div R_L) + I_{SS}$$

Note that by using a circuit in **Figure 19**, it is impossible to set the better driving ability to the constant amperage (I_o) than the S-812C Series basically has.

To gain the driving ability which exceeds the S-812C Series, there's a way to combine a constant current circuit and a current boosting circuit, as seen in **Figure 20**.

The maximum input voltage for a constant current circuit is 16 V + the voltage for device (V_o).

It is not recommended to add a capacitor between the VIN pin (power supply) and the VSS pin or the VOUT pin (output) and the VSS pin because the rush current flows at power-on.

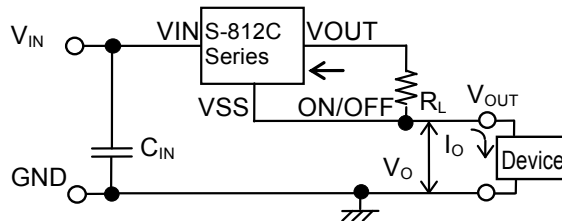


Figure 19 Constant Current Circuit

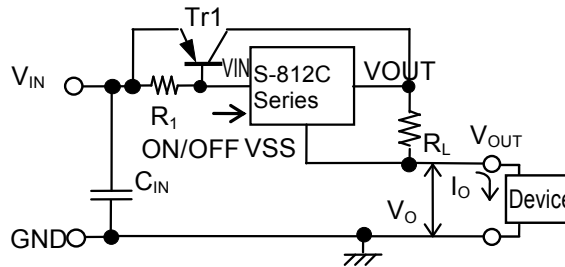


Figure 20 Constant Current Boost Circuit

3. Output voltage adjustment circuit

(Only for S-812CxxA Series (Unavailable short-circuit protection and power-off function))

By using the composition seen in **Figure 21**, users are able to increase the output voltage. The value of output voltage V_{OUT1} is calculated from the following equation ($V_{OUT(E)}$ = actual output voltage):

$$V_{OUT1} = V_{OUT(E)} \times (R_1 + R_2) \div R_1 + R_2 \times I_{SS}$$

Set the value of resistors R1 and R2 so that the S-812C Series is not affected by current consumption I_{SS} .

Capacitor C_1 reduces output fluctuation due to power-on, power fluctuation and load fluctuation. Set the value according to the actual evaluation.

It is not recommended to add a capacitor between the VIN pin (power supply) and the VSS pin or the VOUT pin (output) and the VSS pin because it causes output fluctuation and output oscillation due to power-on.

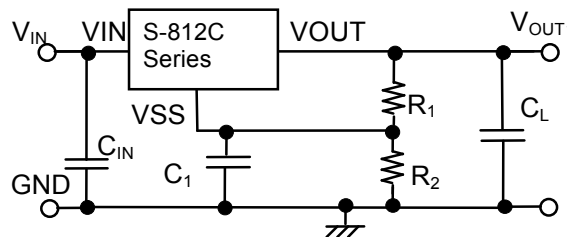


Figure 21

■ 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 pin and the VSS pin (C_L) and a capacitor for stabilizing the input between the VIN pin and the VSS pin (C_{IN}), 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 μ A or less).
- At low load current (100 μ A or less) output voltage may increase when the regulating operation is halted by the ON/OFF pin.
- Generally a series regulator may cause oscillation, depending on the selection of external parts. The following conditions are recommended for the S-812C Series. However, be sure to perform sufficient evaluation under the actual usage conditions for selection, including evaluation of temperature characteristics.

Equivalent Series Resistance (ESR): 10 Ω or less (in case of using output capacitor)

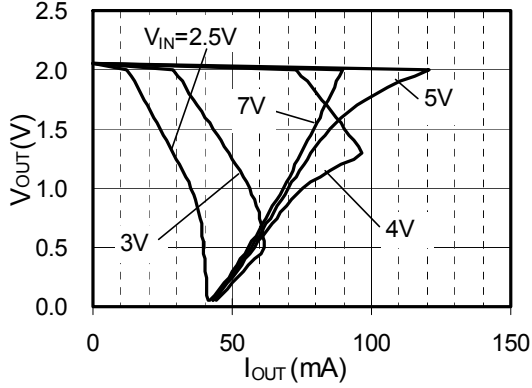
Input series resistance (R_{IN}): 10 Ω or less

- 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.
- 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.
- SII claims no responsibility for any disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.

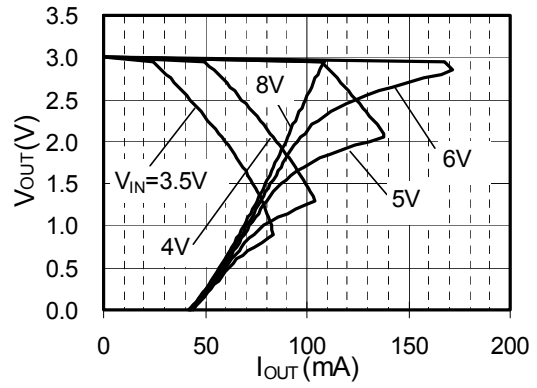
■ Characteristics (Typical Data)

1. Output Voltage vs Output Current (When load current increases)

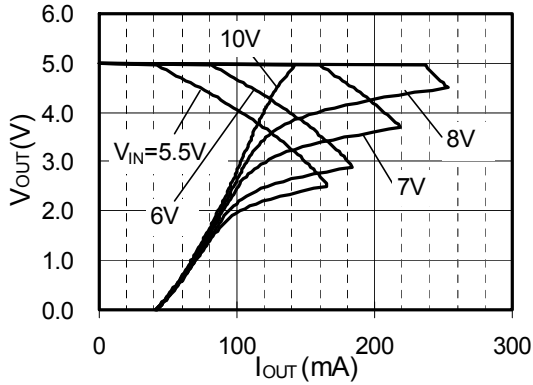
S-812C20B (Ta=25°C) Short-circuit protection



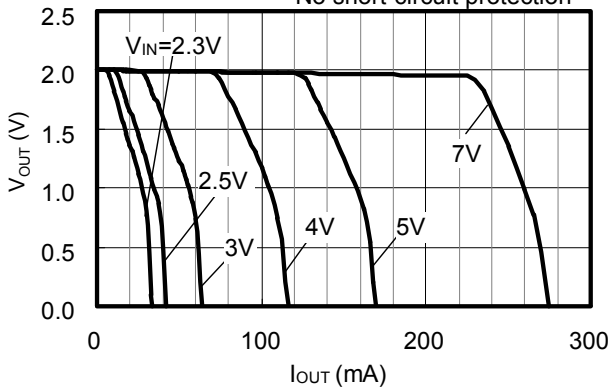
S-812C30B (Ta=25°C) Short-circuit protection



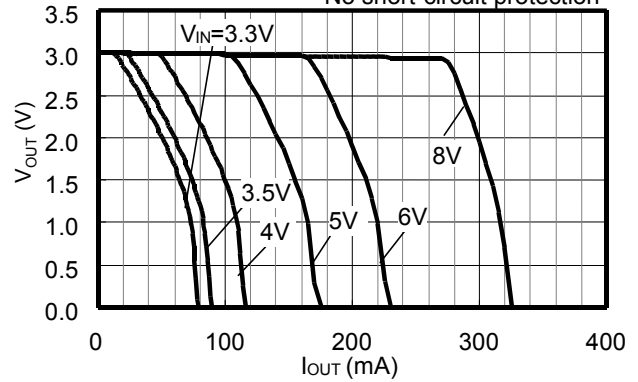
S-812C50B (Ta=25°C) Short-circuit protection



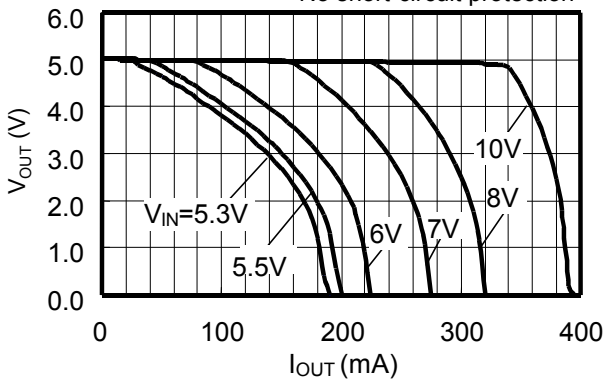
S-812C20A (Ta=25°C) No short-circuit protection



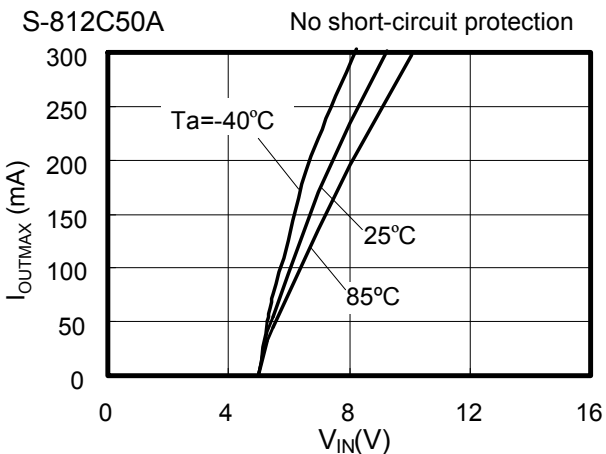
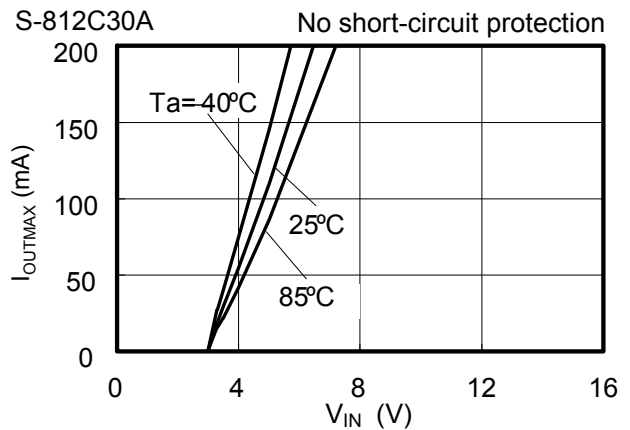
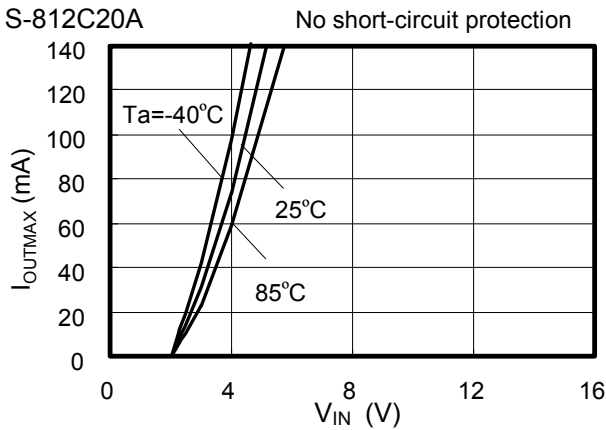
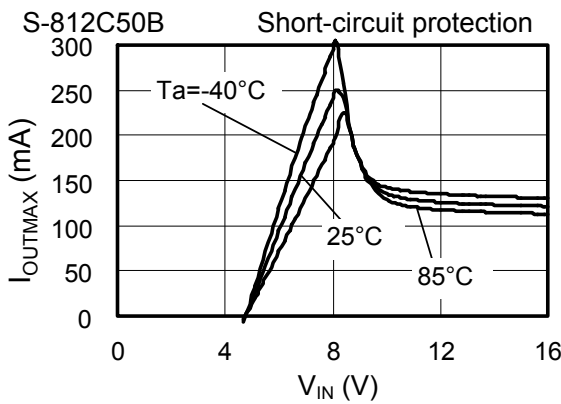
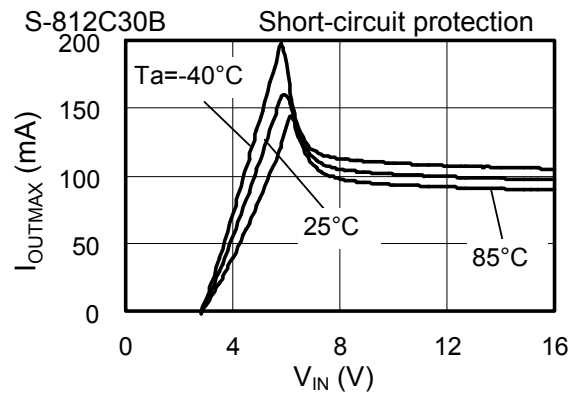
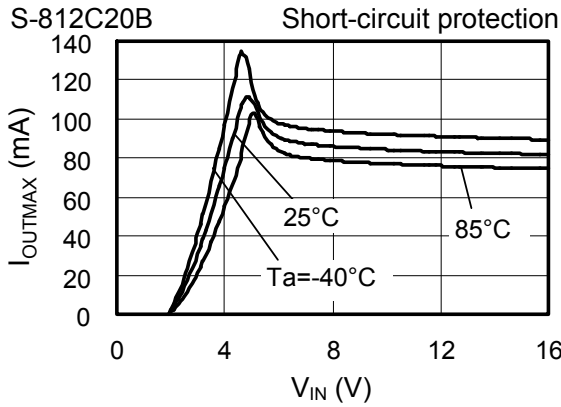
S-812C30A (Ta=25°C) No short-circuit protection



S-812C50A (Ta=25°C) No short-circuit protection

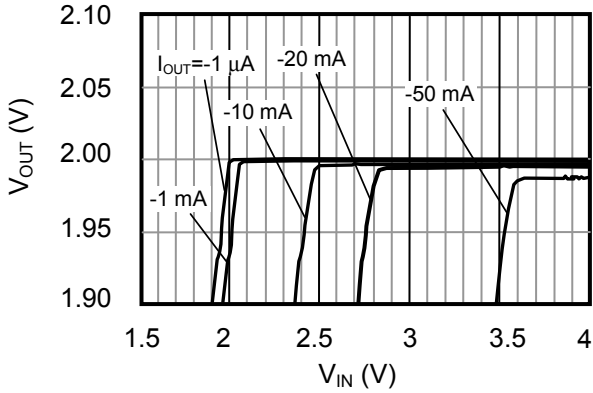


2. Maximum Output Current vs Input Voltage

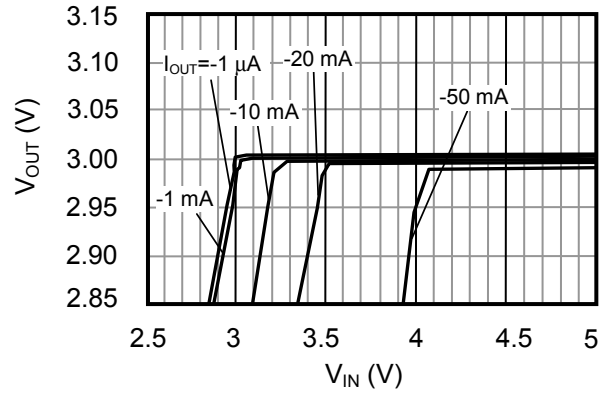


3. Output Current vs. Input Voltage

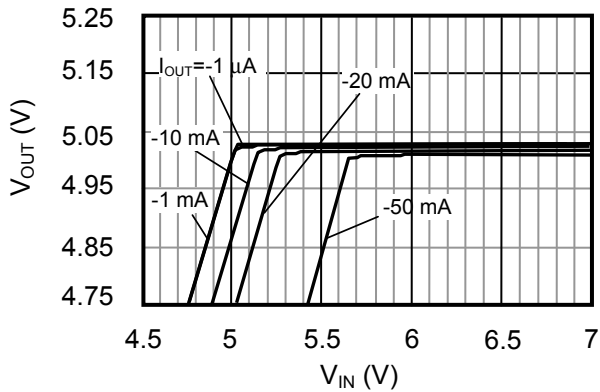
S-812C20B (Ta=25°C)



S-812C30B (Ta=25°C)

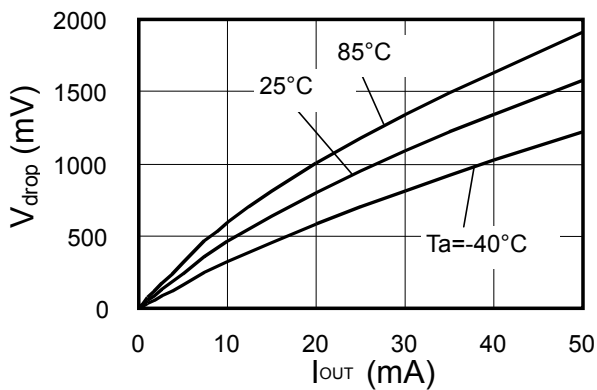


S-812C50B (Ta=25°C)

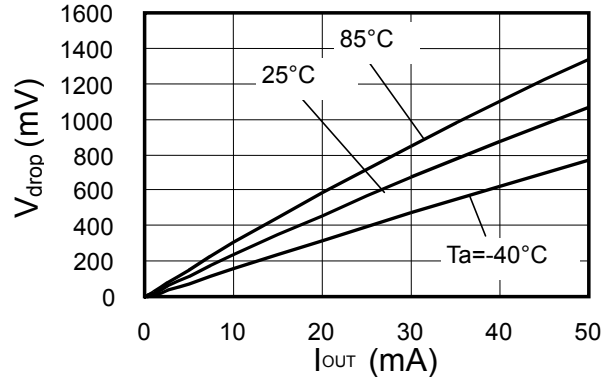


4. Dropout Voltage vs Output Current

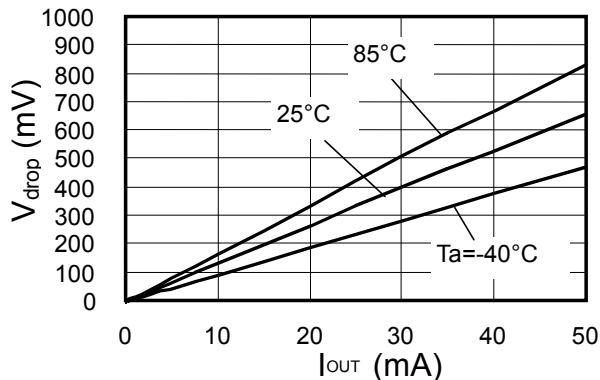
S-812C20B



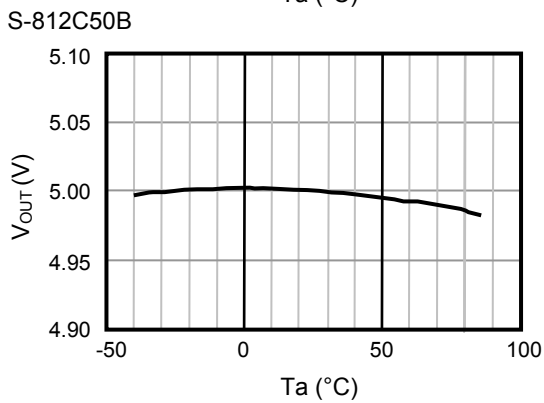
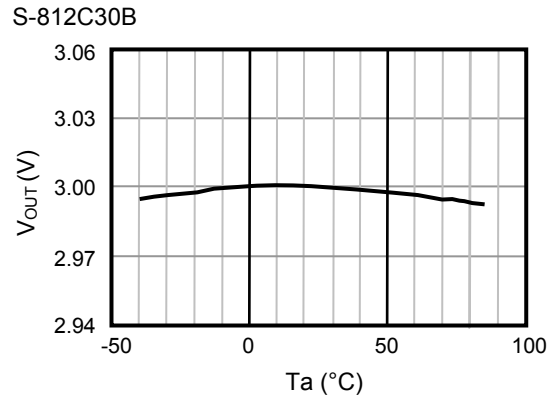
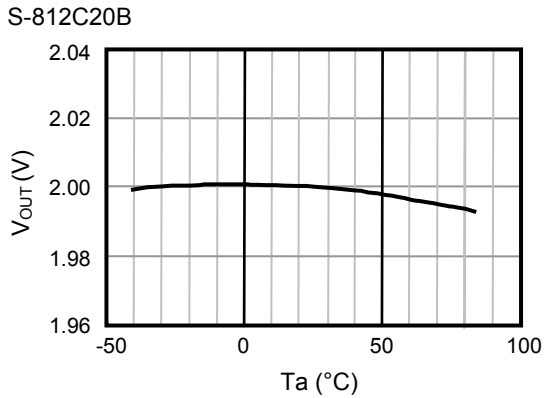
S-812C30B



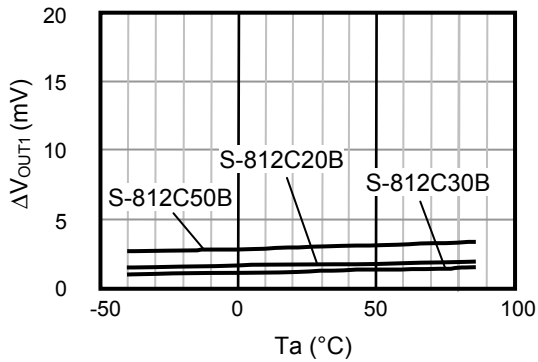
S-812C50B



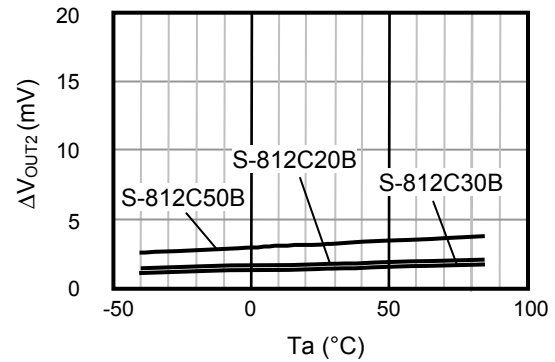
5. Output Voltage vs Ambient Temperature



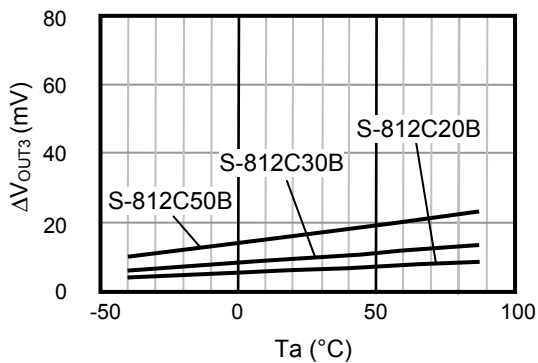
6. Line Regulation 1 vs Ambient Temperature



7. Line Regulation 2 vs Ambient Temperature

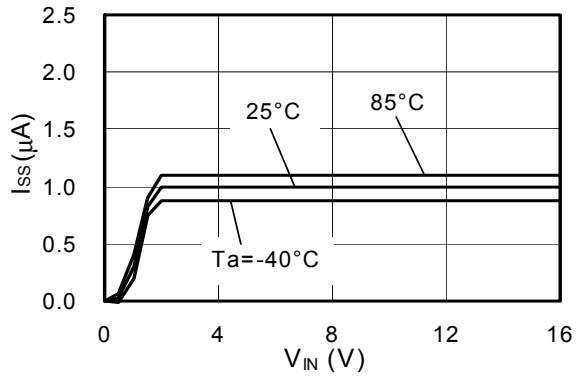


8. Load Regulation vs Ambient Temperature

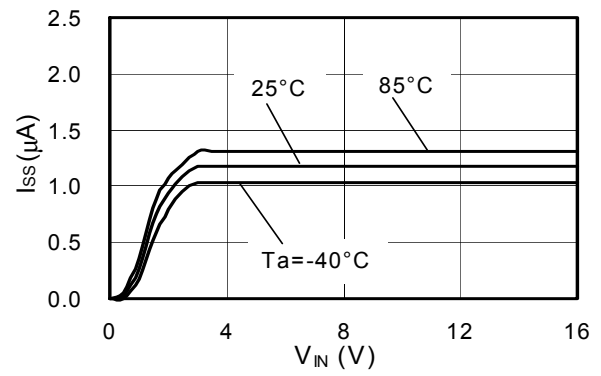


9. Current Consumption vs Input Voltage

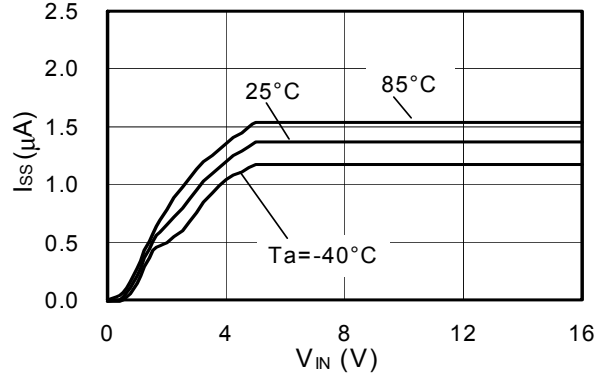
S-812C20B



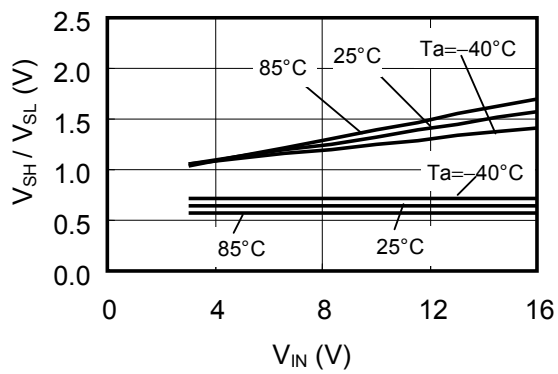
S-812C30B



S-812C50B

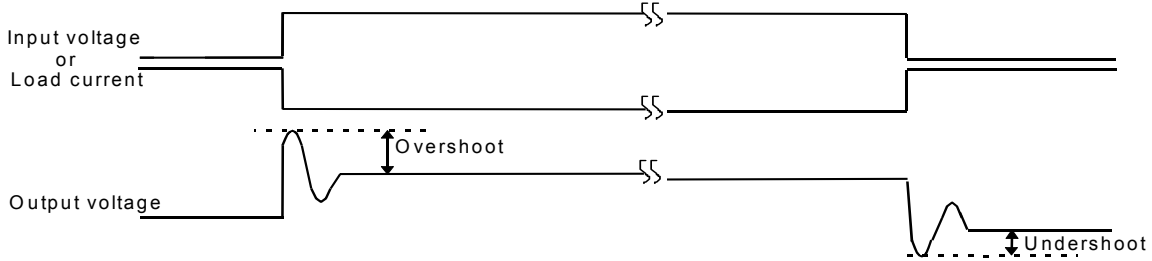


10. ON/OFF Pin Input Threshold vs Input Voltage

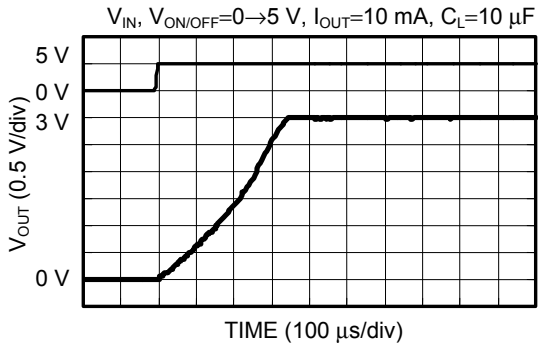


■ Reference Data

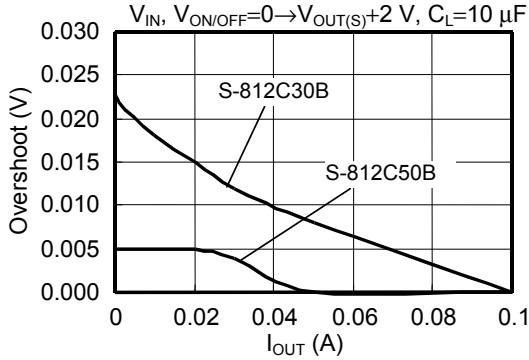
1. Transient Response Characteristics (Typical data: Ta=25 °C)



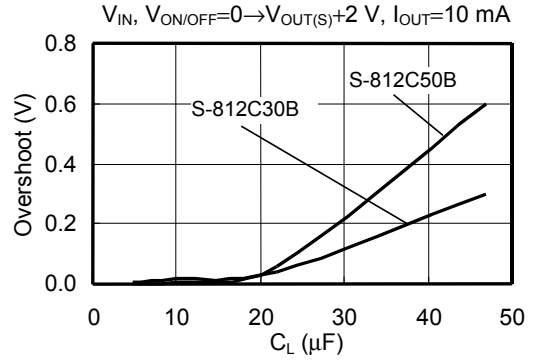
1-1. Power-on : S-812C30B (C_L=10μF; ceramic capacitor)



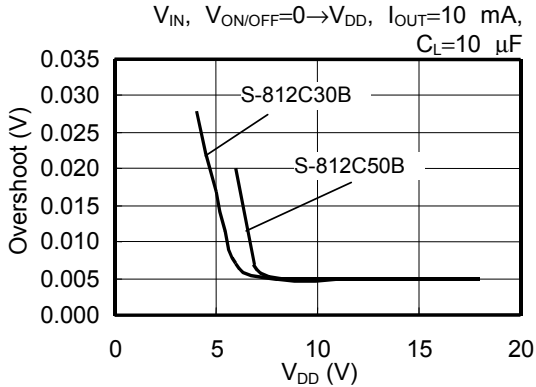
Load dependency of overshoot at power-on



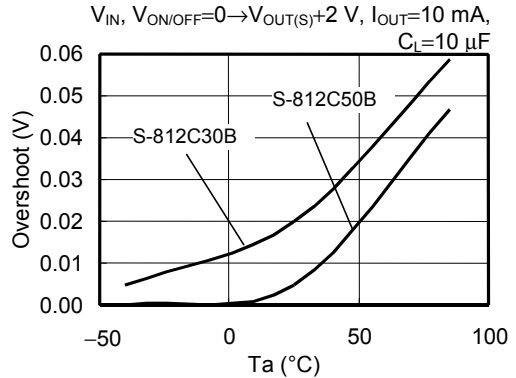
C_L dependency of overshoot at power-on



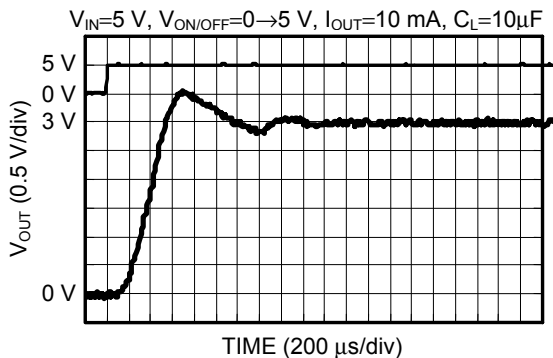
V_{DD} dependency of overshoot at power-on



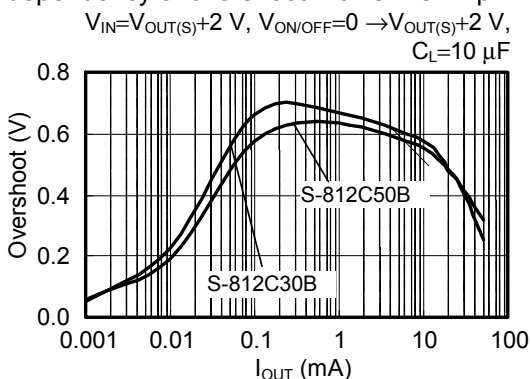
“Ta” dependency of overshoot at power-on



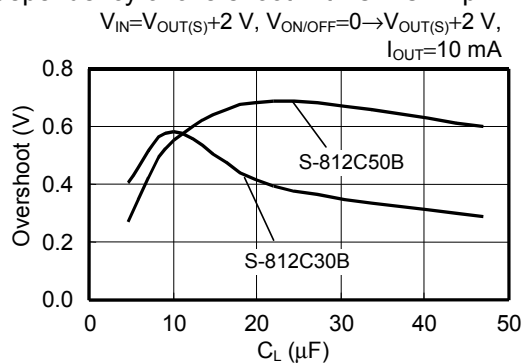
1-2. ON/OFF pin : S-812C30A ($C_L=10\mu\text{F}$; ceramic capacitor)



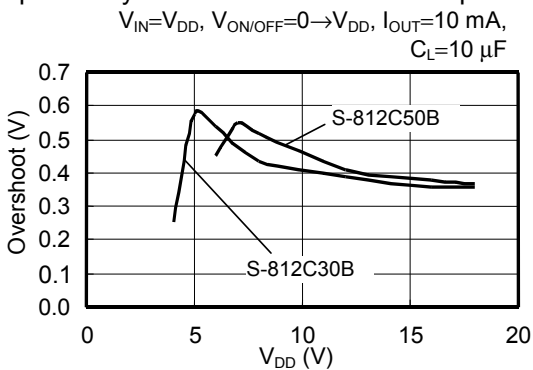
load dependency of overshoot with ON/OFF pin



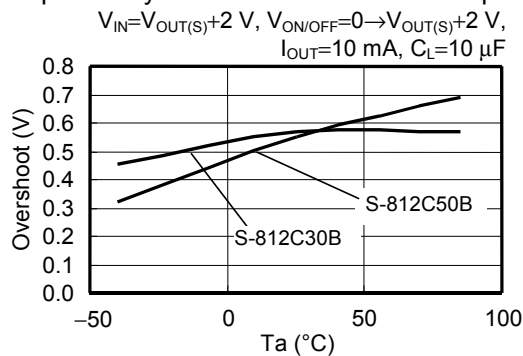
C_L dependency of overshoot with ON/OFF pin



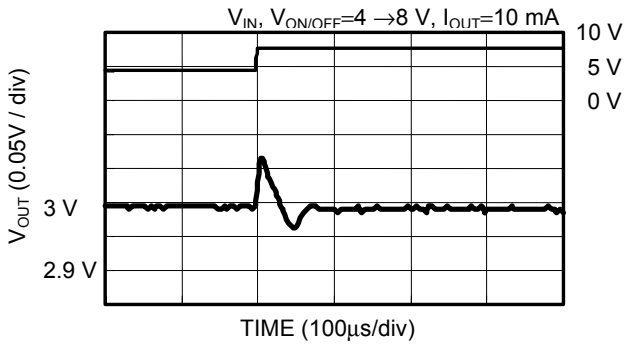
V_{DD} dependency of overshoot with ON/OFF pin



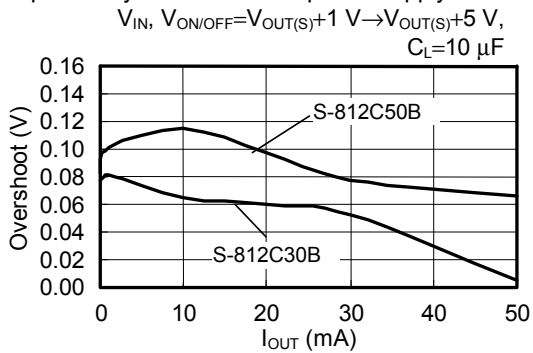
“Ta” dependency of overshoot with ON/OFF pin



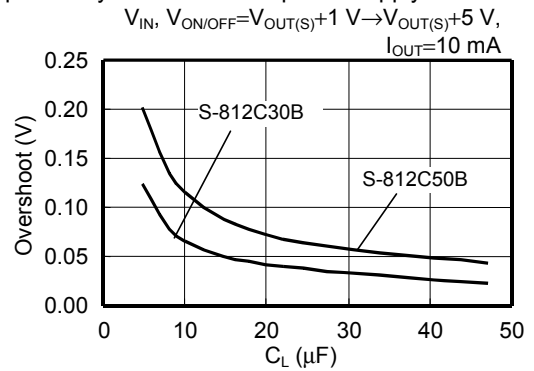
1-3. Power supply fluctuates: S-812C30B ($C_L=10\mu\text{F}$; ceramic capacitor)



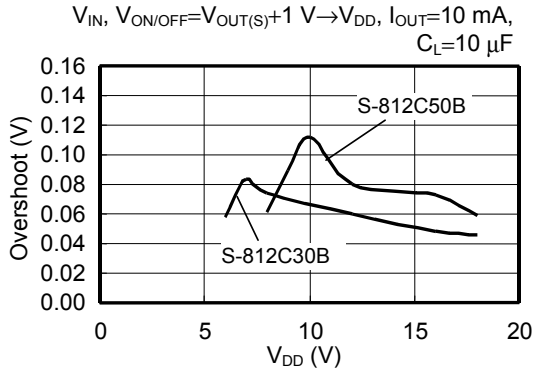
Load dependency of overshoot at power supply fluctuates



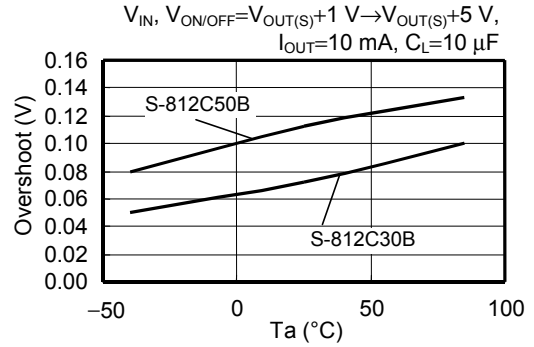
C_L dependency of overshoot at power supply fluctuates

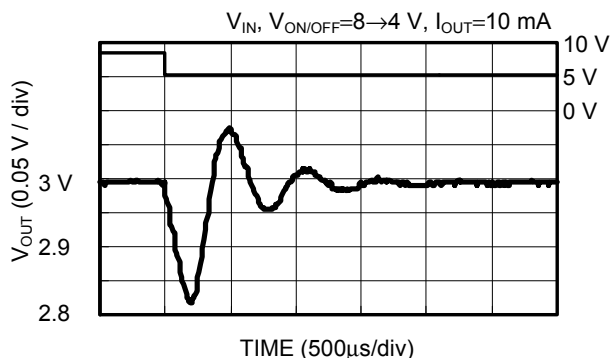


V_{DD} dependency of overshoot at power supply fluctuates

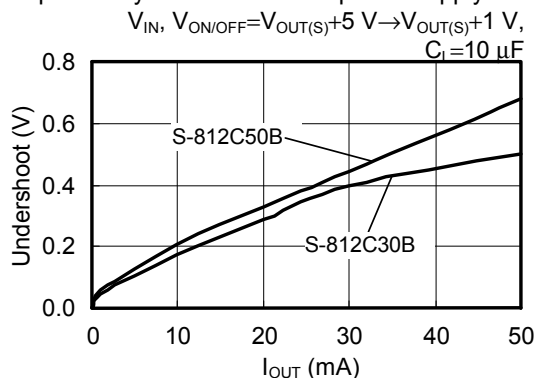


"Ta" dependency of overshoot at power supply fluctuates

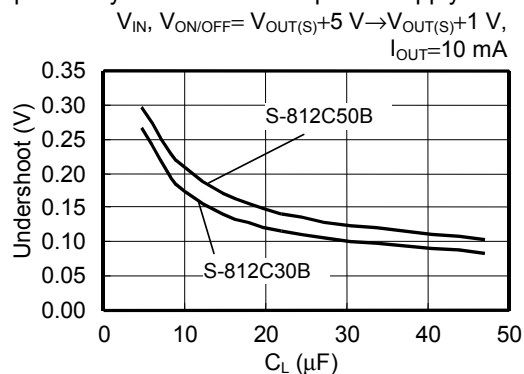




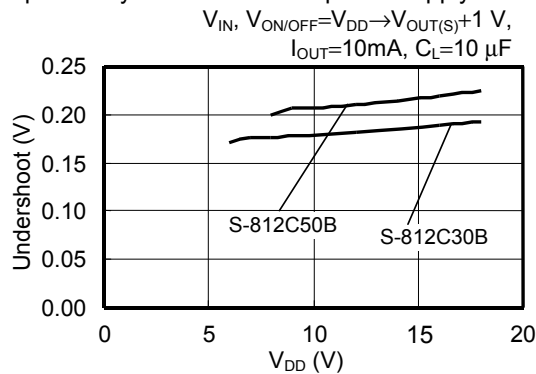
Load dependency of undershoot at power supply fluctuates



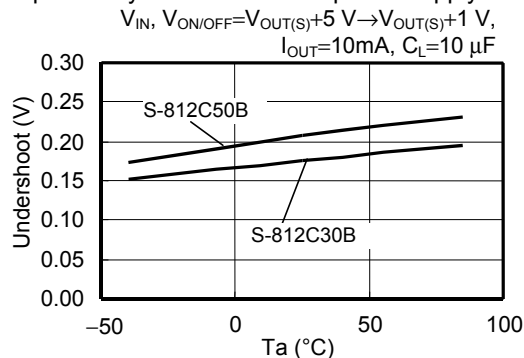
C_L dependency of undershoot at power supply fluctuates



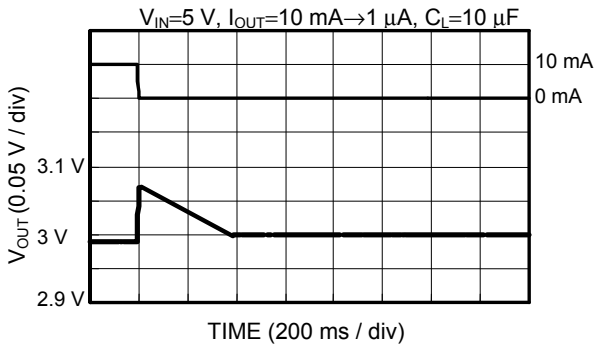
V_{DD} dependency of undershoot at power supply fluctuates



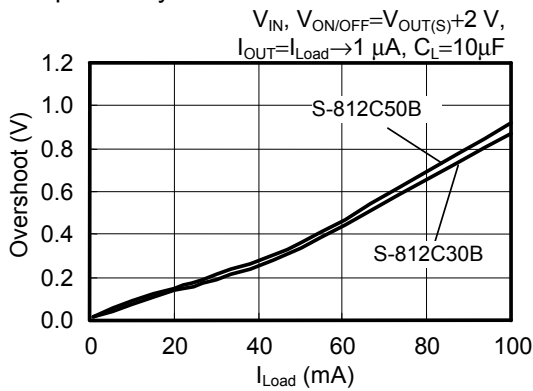
"Ta" dependency of undershoot at power supply fluctuates



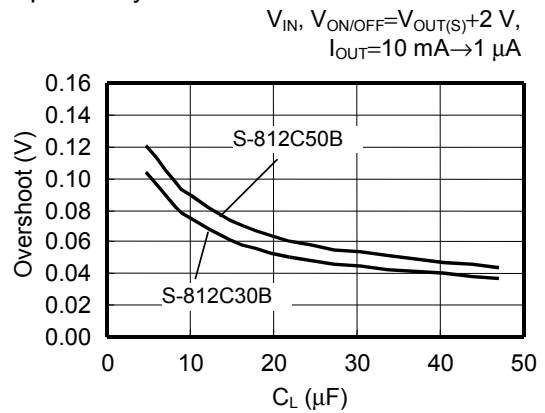
1-4. Load fluctuation: S-812C30B ($C_L=10\mu\text{F}$; ceramic capacitor)



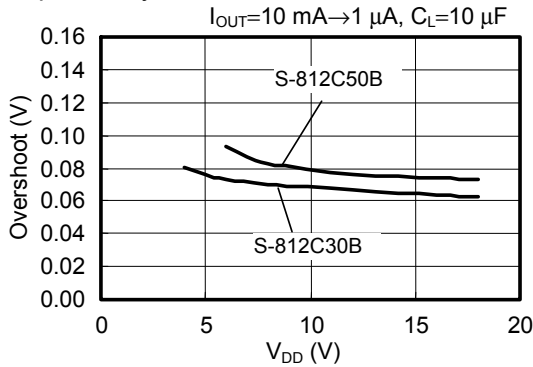
Load dependency of overshoot at load fluctuation



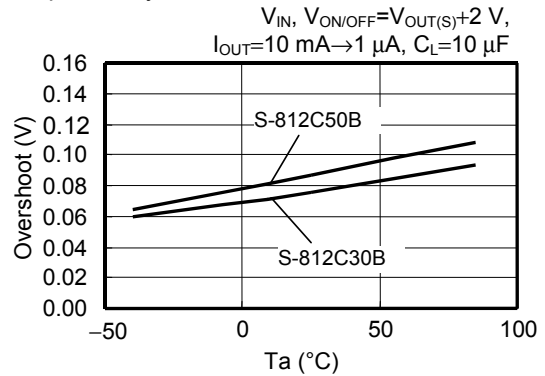
C_L dependency of overshoot at load fluctuation

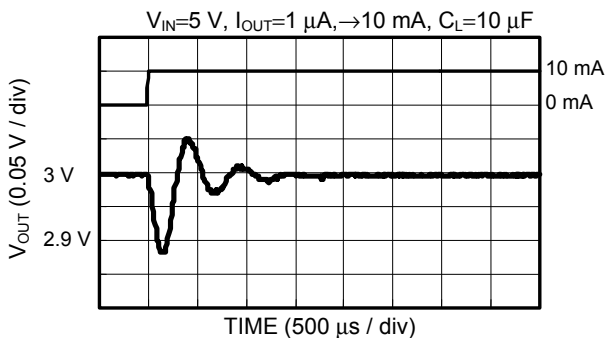


V_{DD} dependency of overshoot at load fluctuation

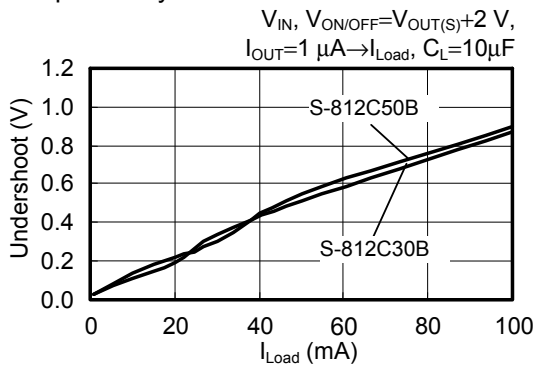


"Ta" dependency of overshoot at load fluctuation

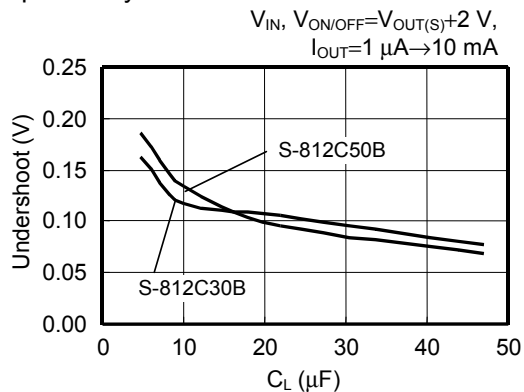




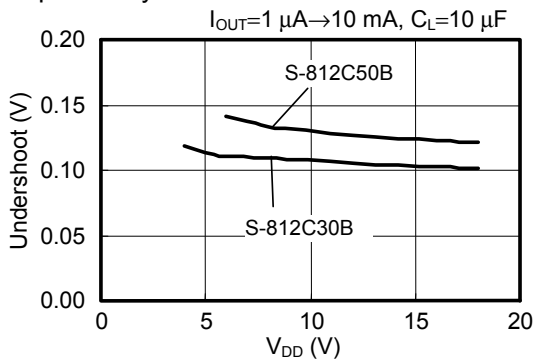
Load dependency of undershoot at load fluctuation



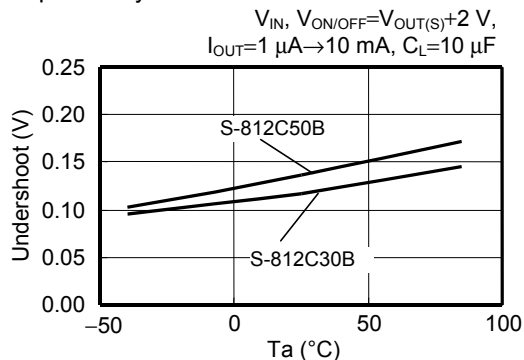
C_L dependency of undershoot at load fluctuation

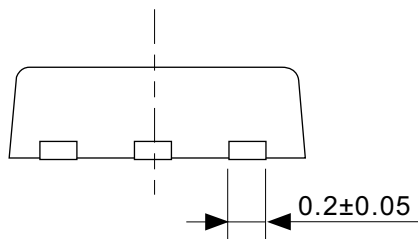
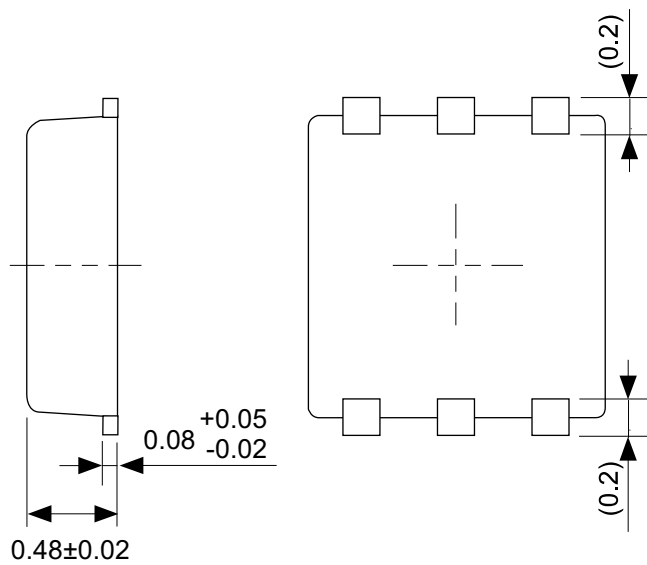
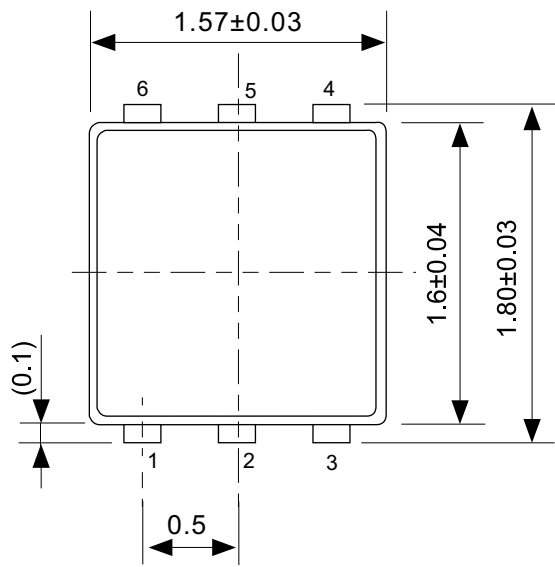


V_{DD} dependency of undershoot at load fluctuation



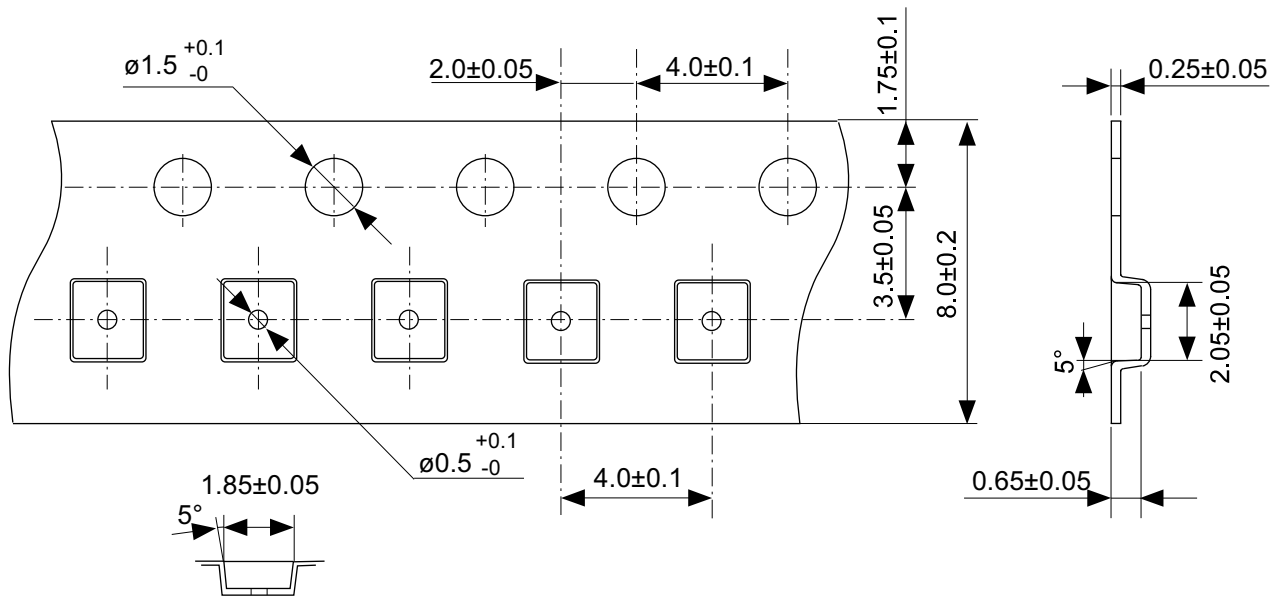
“ T_a ” dependency of undershoot at load fluctuation





No. PI006-A-P-SD-2.0

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



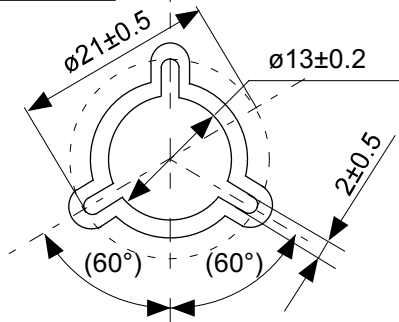
Feed direction →

No. PI006-A-C-SD-1.0

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

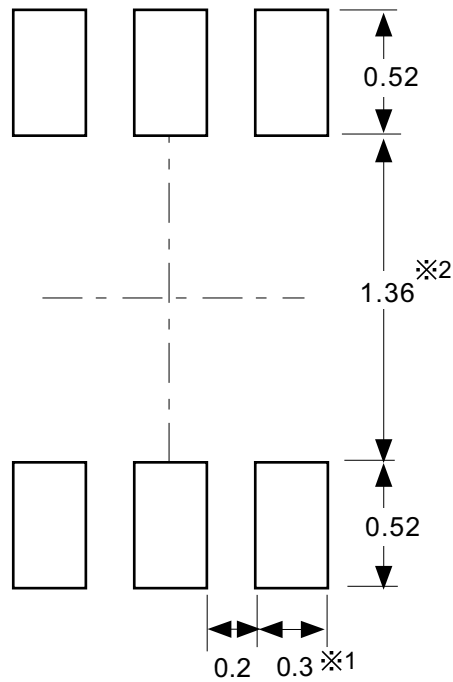


Enlarged drawing in the central part



No. PI006-A-R-SD-1.0

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



※1. ランドパターンの幅に注意してください (0.25 mm min. / 0.30 mm typ.).

※2. パッケージ中央にランドパターンを広げないでください (1.30 mm ~ 1.40 mm)。

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

※1. Pay attention to the land pattern width (0.25 mm min. / 0.30 mm typ.).

※2. Do not widen the land pattern to the center of the package (1.30 mm to 1.40 mm).

- Caution**
1. Do not do silkscreen printing and solder printing under the mold resin of the package.
 2. The thickness of the solder resist on the wire pattern under the package should be 0.03 mm or less from the land pattern surface.
 3. Match the mask aperture size and aperture position with the land pattern.
 4. Refer to "SNT Package User's Guide" for details.

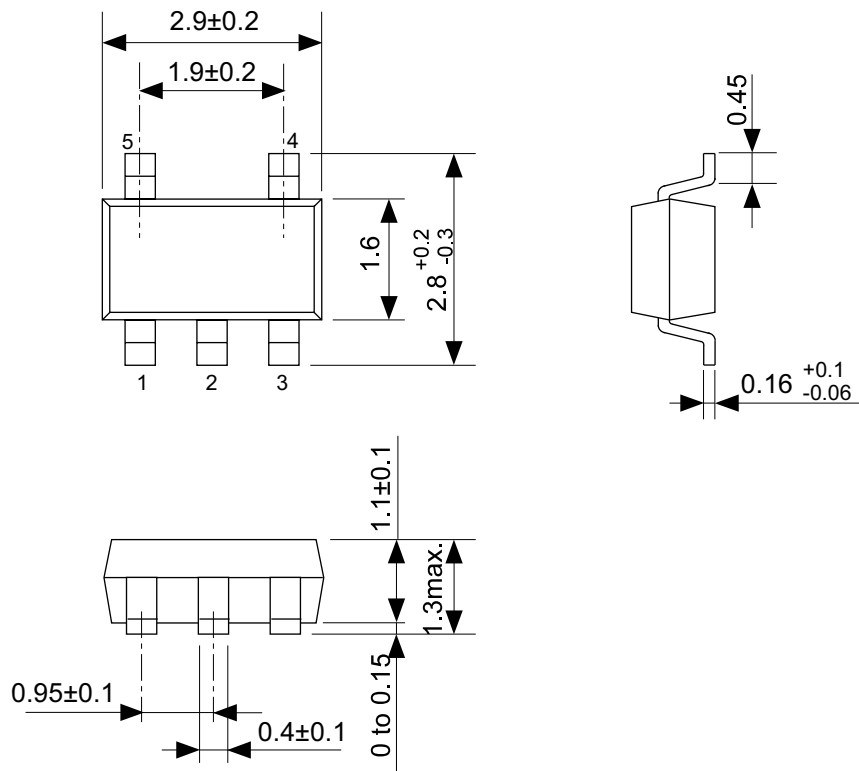
※1. 请注意焊盘模式的宽度 (0.25 mm min. / 0.30 mm typ.).

※2. 请勿向封装中间扩展焊盘模式 (1.30 mm ~ 1.40 mm)。

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

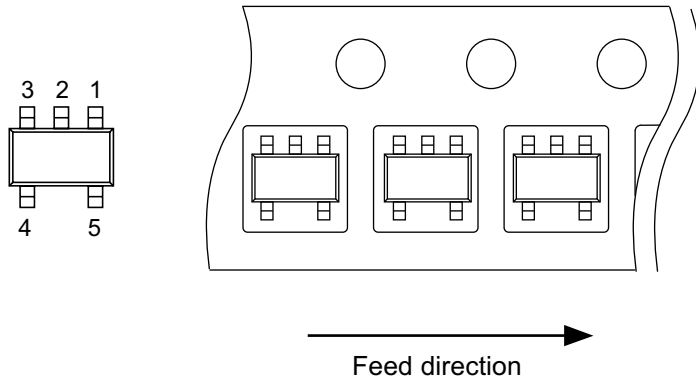
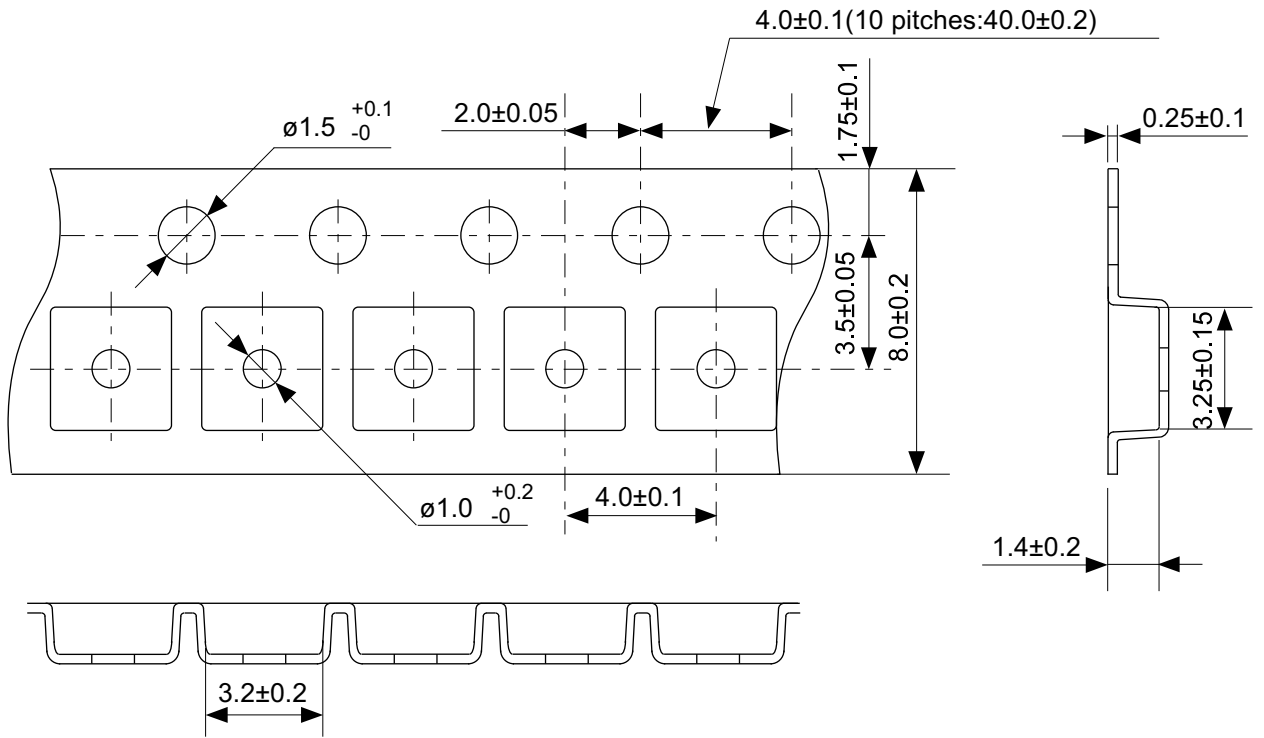
No. PI006-A-L-SD-4.1

TITLE	SNT-6A(H)-A-Land Recommendation
No.	PI006-A-L-SD-4.1
SCALE	
UNIT	mm
Seiko Instruments Inc.	



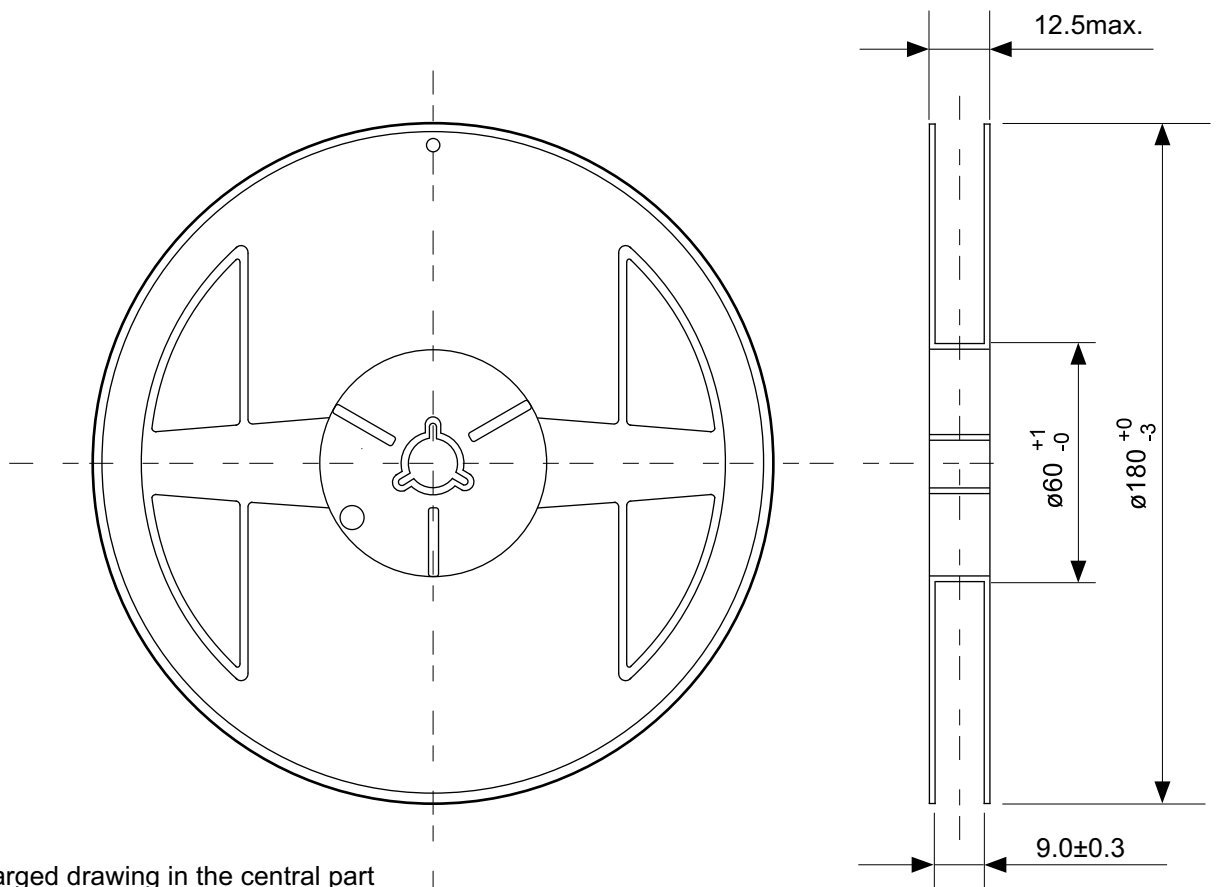
No. MP005-A-P-SD-1.2

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

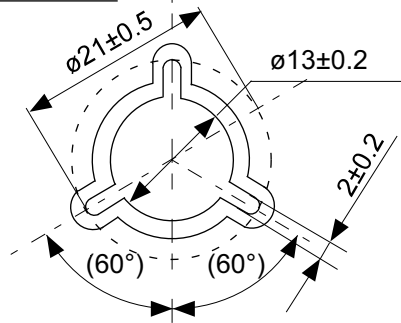


No. MP005-A-C-SD-2.1

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

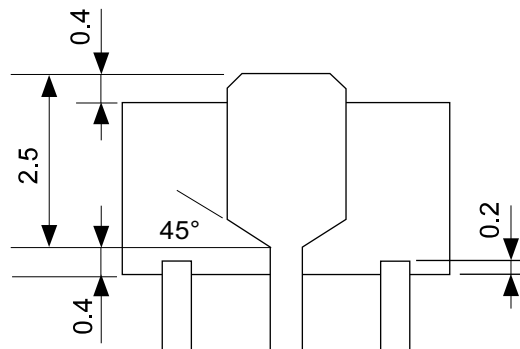
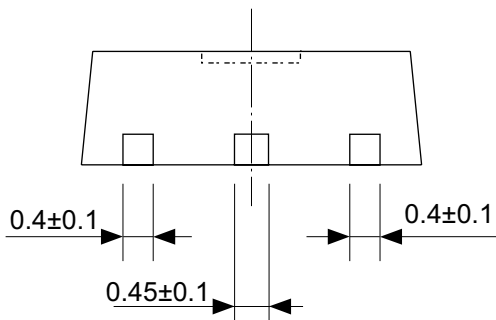
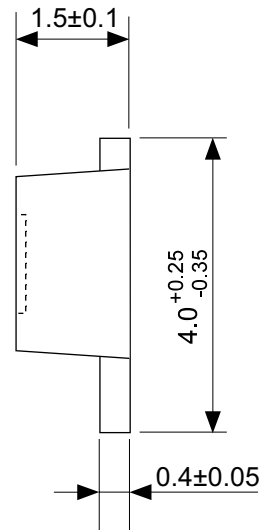
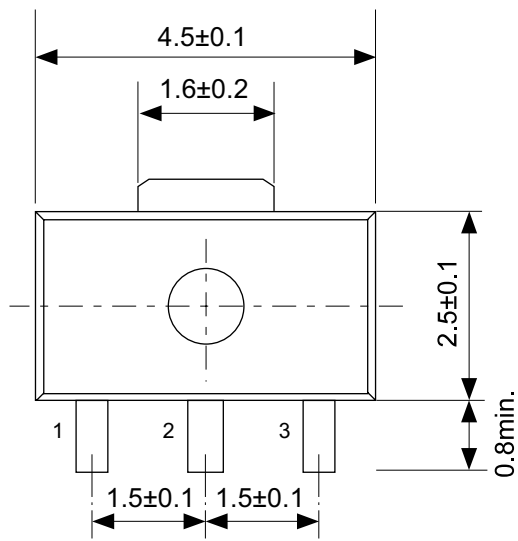


Enlarged drawing in the central part



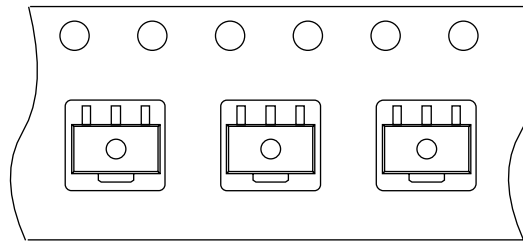
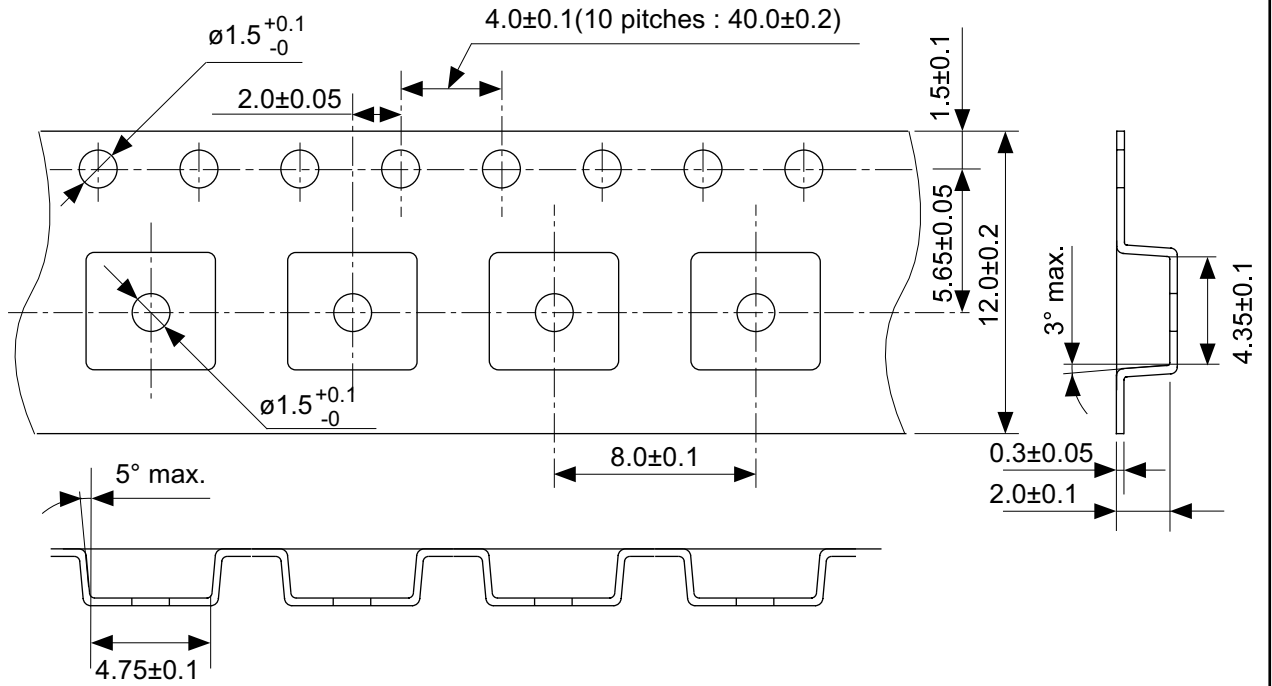
No. MP005-A-R-SD-1.1

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



No. UP003-A-P-SD-1.1

TITLE	SOT893-A-PKG Dimensions
No.	UP003-A-P-SD-1.1
SCALE	
UNIT	mm
Seiko Instruments Inc.	

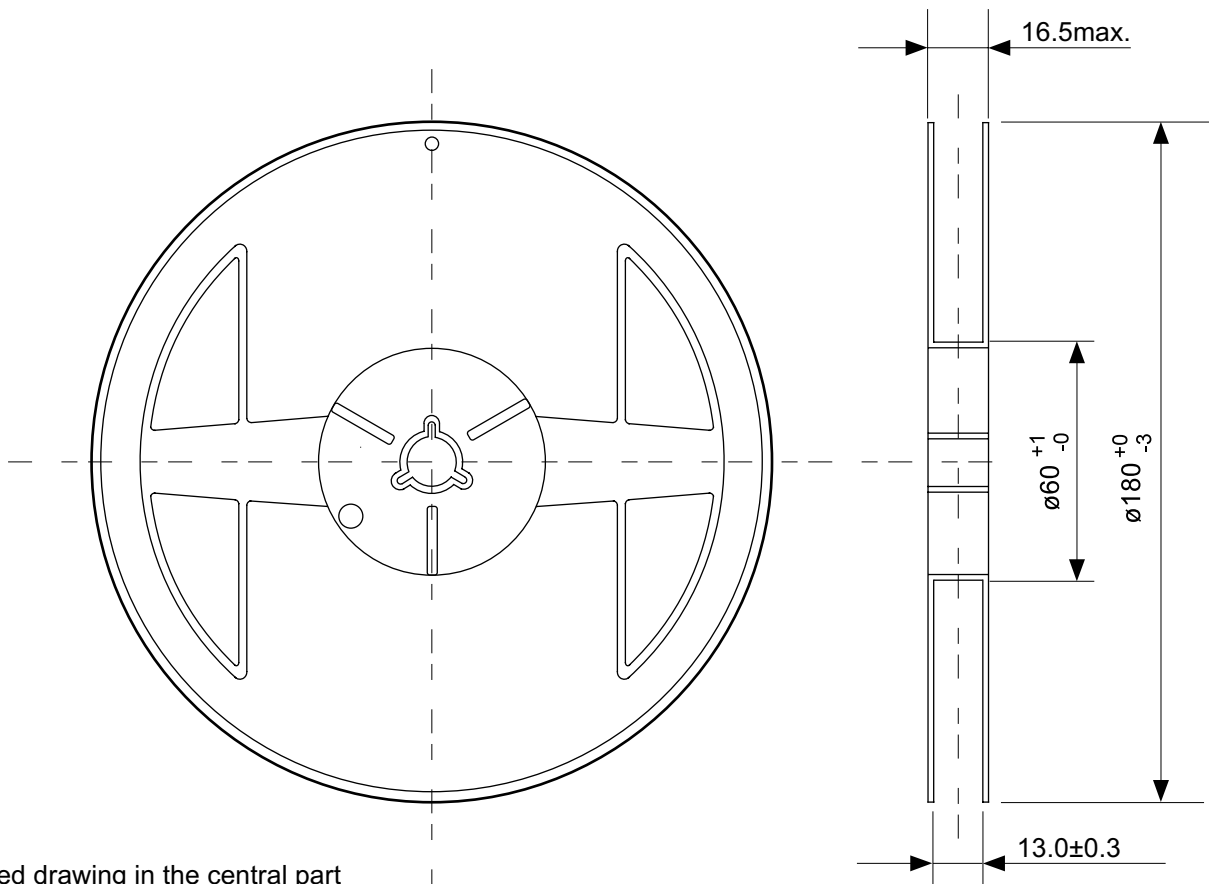


→
Feed direction

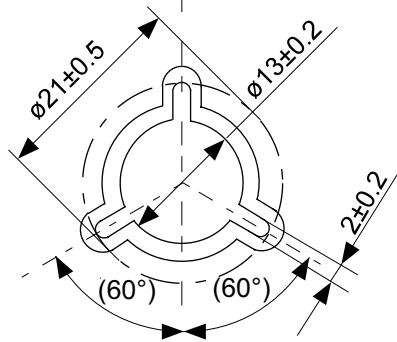
No. UP003-A-C-SD-1.1

TITLE	SOT893-A-Carrier Tape
No.	UP003-A-C-SD-1.1
SCALE	
UNIT	mm

Seiko Instruments Inc.



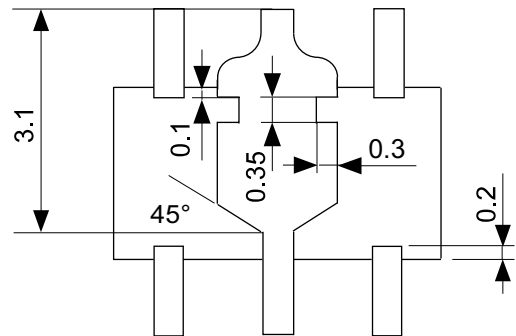
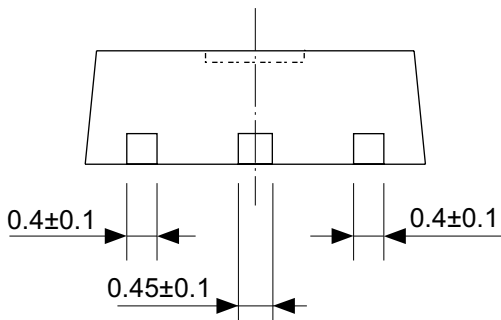
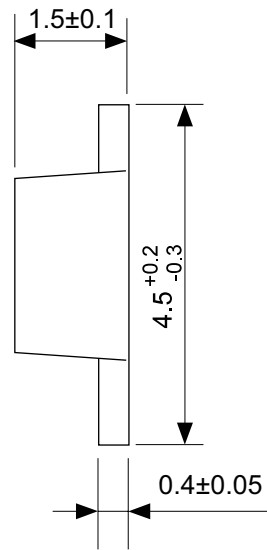
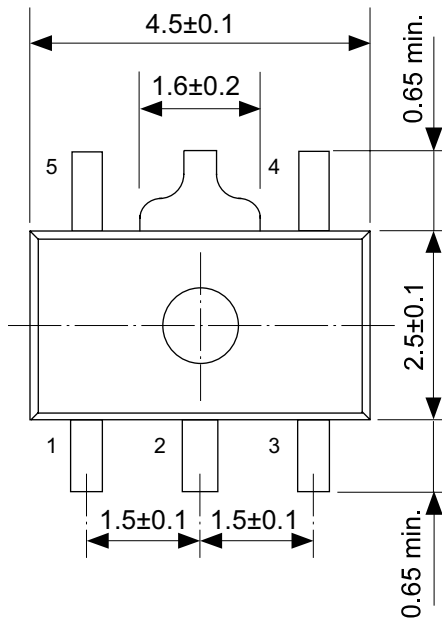
Enlarged drawing in the central part



No. UP003-A-R-SD-1.1

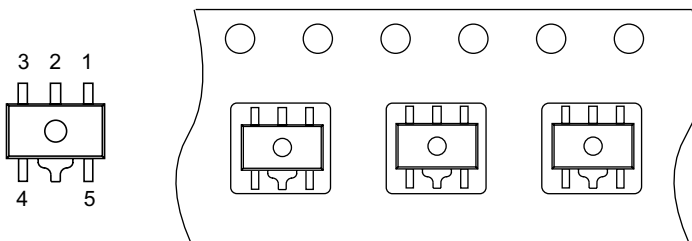
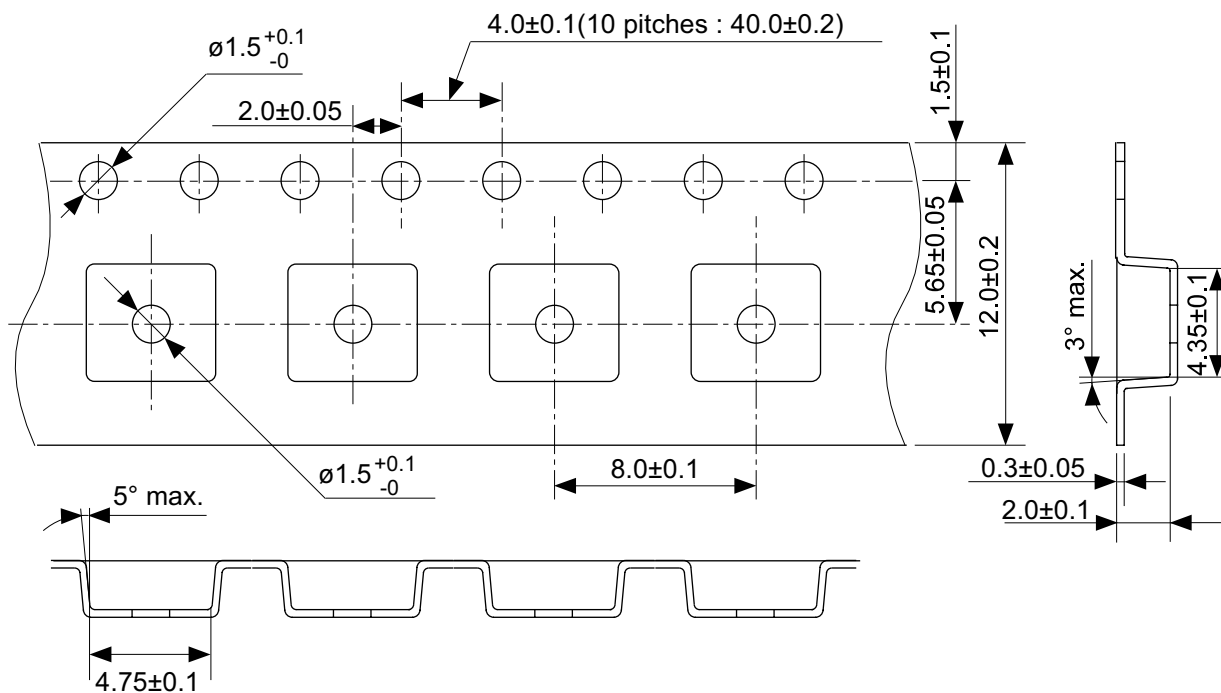
TITLE	SOT893-A-Reel		
No.	UP003-A-R-SD-1.1		
SCALE		QTY.	1,000
UNIT	mm		

Seiko Instruments Inc.



No. UP005-A-P-SD-1.1

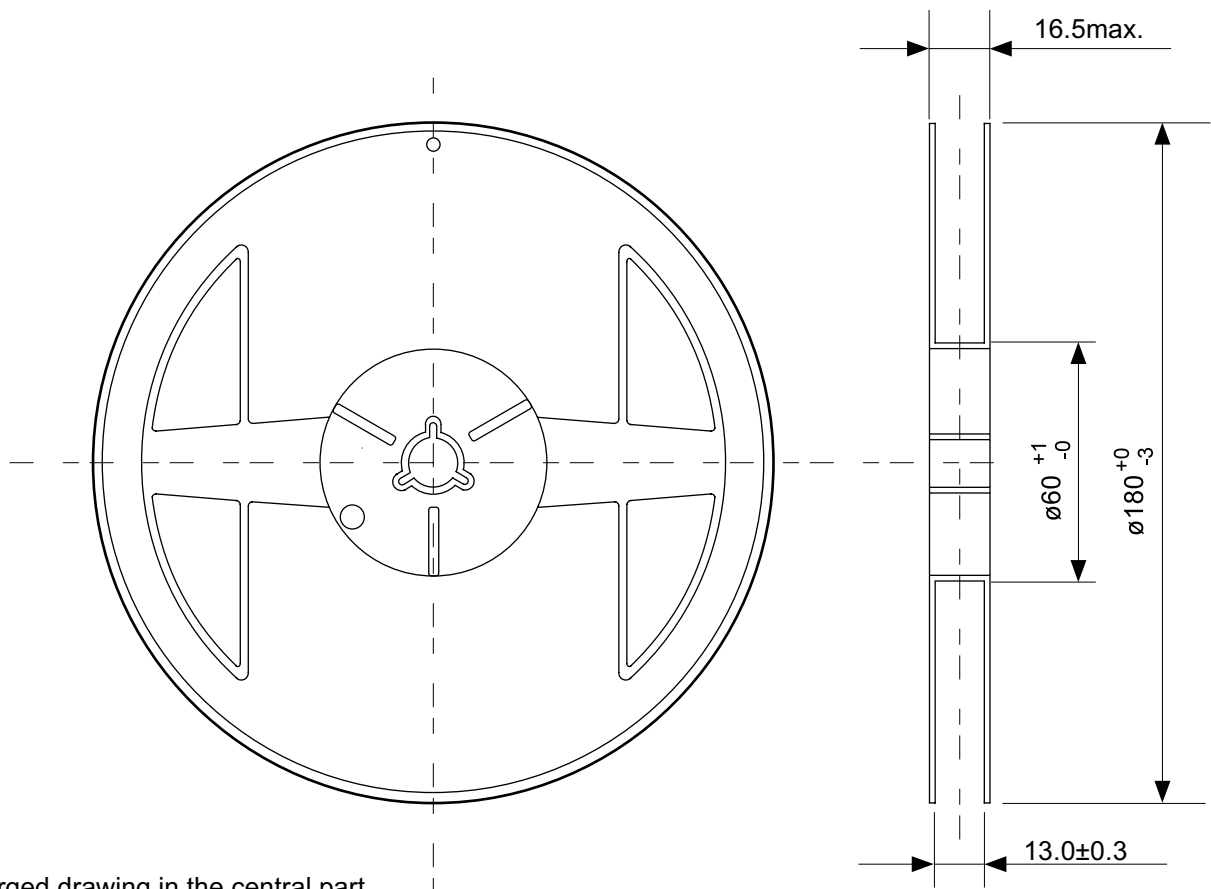
TITLE	SOT895-A-PKG Dimensions
No.	UP005-A-P-SD-1.1
SCALE	
UNIT	mm
Seiko Instruments Inc.	



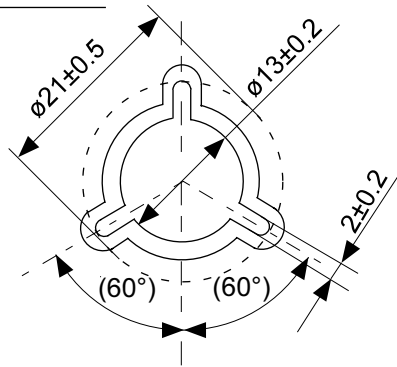
→
Feed direction

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.	

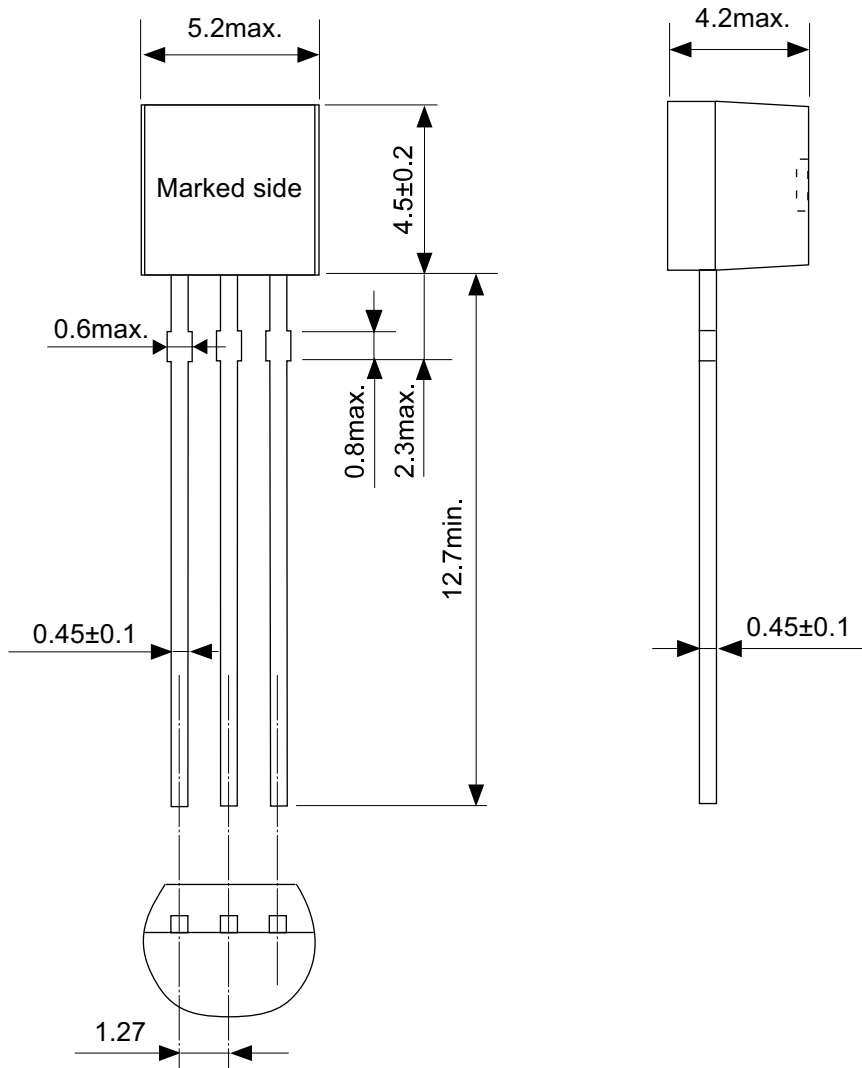


Enlarged drawing in the central part



No. UP005-A-R-SD-1.1

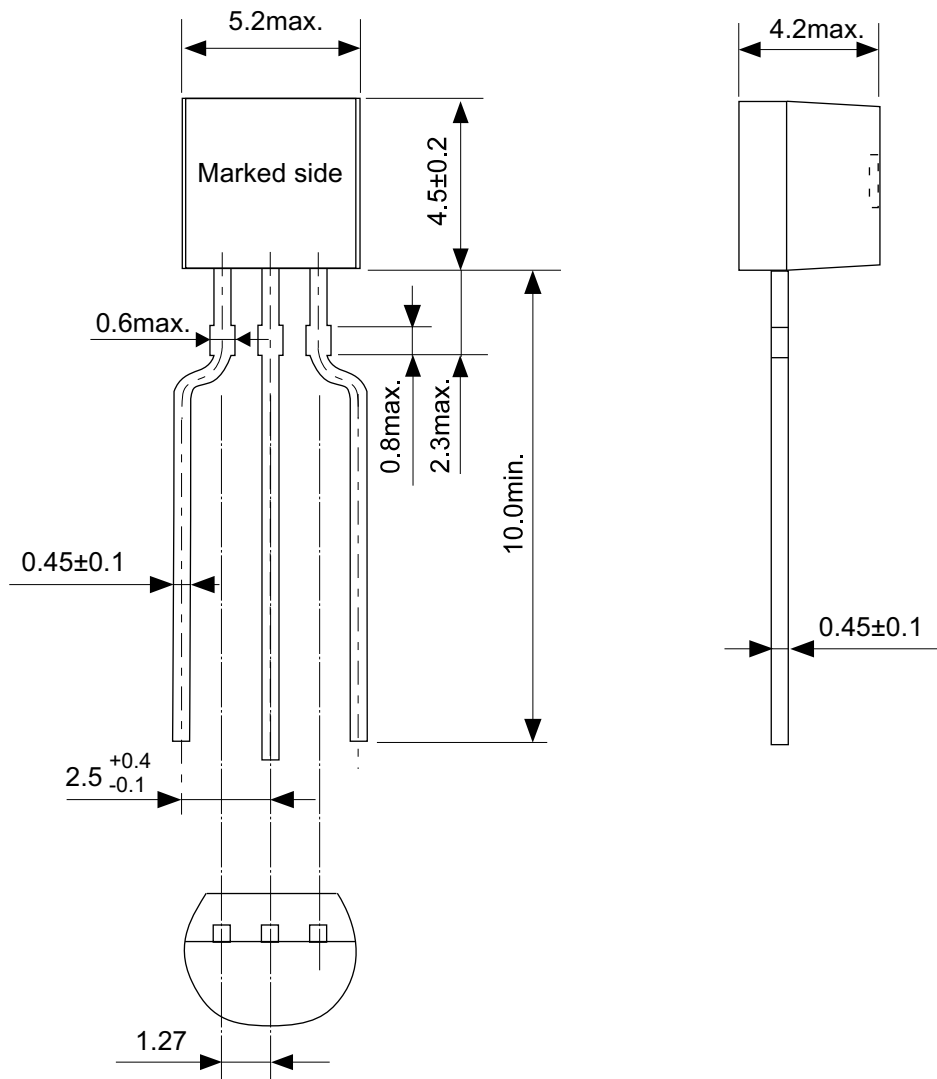
TITLE	SOT895-A-Reel		
No.	UP005-A-R-SD-1.1		
SCALE		QTY.	1,000
UNIT	mm		
Seiko Instruments Inc.			



No. YS003-D-P-SD-2.0

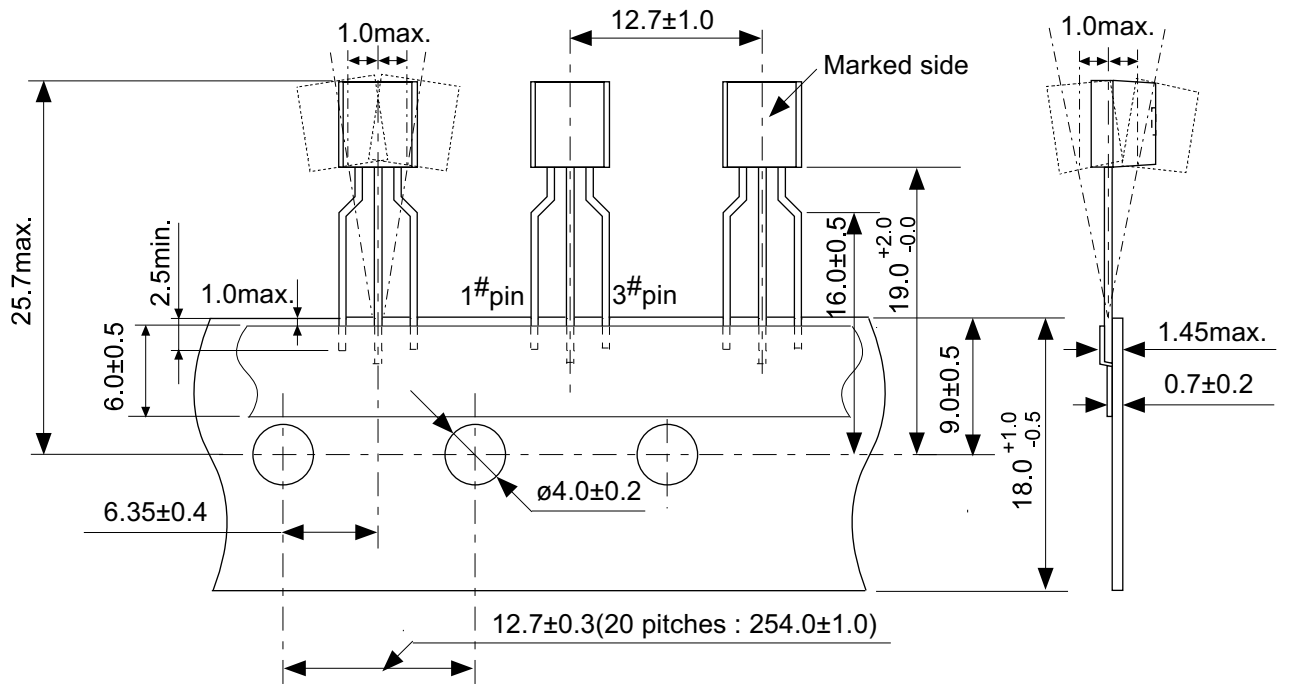
TITLE	TO92-D-PKG Dimensions
No.	YS003-D-P-SD-2.0
SCALE	
UNIT	mm

Seiko Instruments Inc.

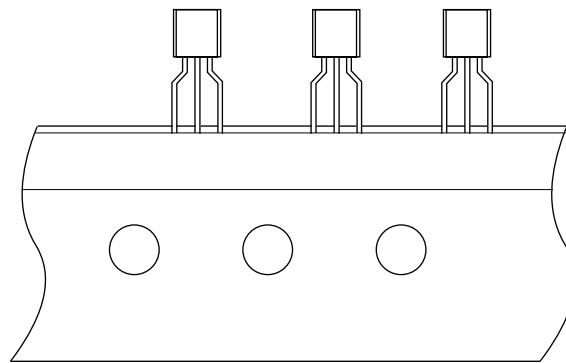


No. YZ003-E-P-SD-2.0

TITLE	TO92-E-PKG Dimensions
No.	YZ003-E-P-SD-2.0
SCALE	
UNIT	mm
Seiko Instruments Inc.	



Z type



→
Feed direction

No. YZ003-E-C-SD-1.1

TITLE	TO92-E-Radial Tape
No.	YZ003-E-C-SD-1.1
SCALE	
UNIT	mm
Seiko Instruments Inc.	



Side spacer placed in front side



Space more than 4 strokes



No. YZ003-E-Z-SD-2.0

TITLE	TO92-E-Ammo Packing		
No.	YZ003-E-Z-SD-2.0		
SCALE		QTY.	2,000
UNIT	mm		
Seiko Instruments Inc.			



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