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Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
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S-1721 Series

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

www.sii-ic.com

Rev.2.1_01

The S-1721 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 150 mA.
Users are able to use a small ceramic capacitor of 1.0 μF for this IC. This IC includes two regulator circuits in the package SOT-23-6 or super-small SNT-6A.
S-1721 Series has much lower current consumption than the S-1711 Series, this IC is ideal for mobile devices.

■ Features

- Output voltage: 1.2 V to 5.0 V, selectable in 0.05 V step
- Input voltage: 1.7 V to 6.5 V
- Output voltage accuracy: ±1.0%
- Dropout voltage: 130 mV typ. (3.0 V output product, I_{OUT} = 100 mA)
- Current consumption: During operation: 25 μA typ., 45 μA max. (3.0 V output product, per circuit)
  During power-off: 0.1 μA typ., 1.0 μA max.
- Output current: Possible to output 150 mA ($V_{IN} \geq V_{OUT(S)} + 1.0$ V)*1 (per circuit)
- Input and output capacitors: A ceramic capacitor of 1.0 μF or more can be used.
- Ripple rejection: 80 dB typ. (products having the output under 1.8 V, f = 1.0 kHz)
- Built-in overcurrent protection circuit: limits overcurrent of output transistor.
- Built-in ON/OFF circuit: Ensures long battery life.
- Pull-up or pull-down resistor is selectable.
- Operation temperature range: Ta = −40°C to +85°C
- 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

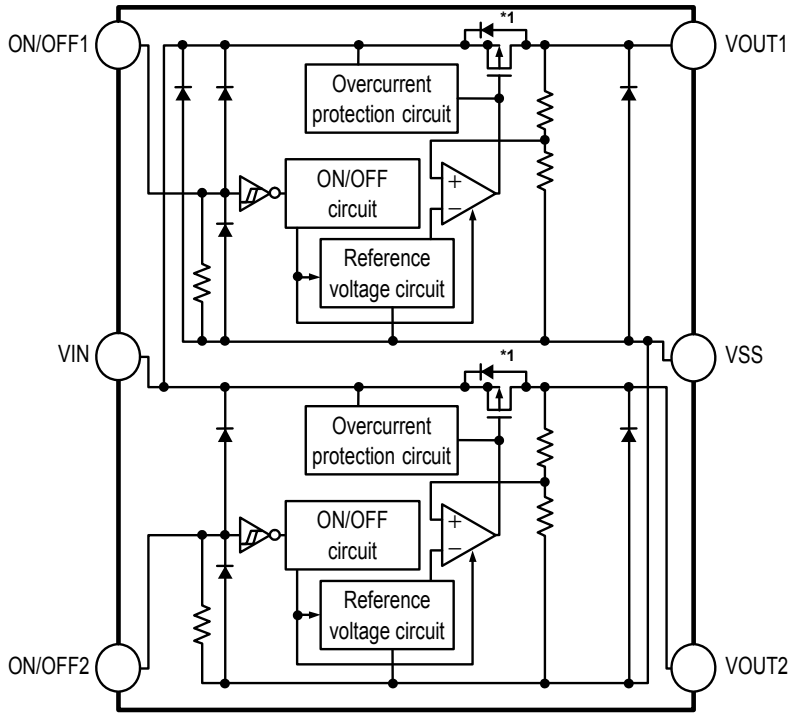
- Constant-voltage power supply for cellular phone
- Constant-voltage power supply for battery-powered device

■ Packages

- SNT-6A
- SOT-23-6

■ Block Diagrams

1. S-1721 Series A type

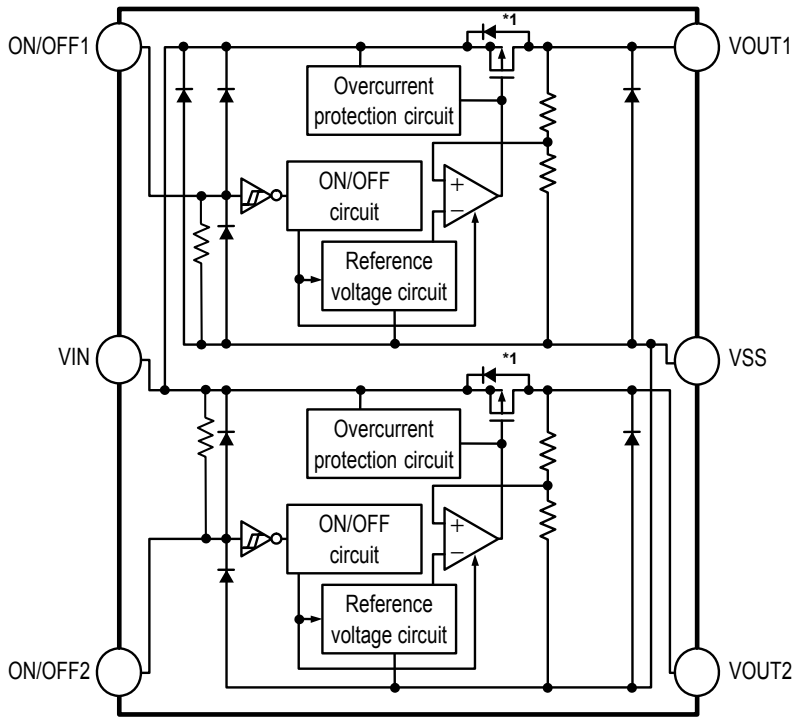


Function		Status
ON/OFF logic	1ch	Active “H”
	2ch	Active “H”
Pull-up resistor	1ch	None
	2ch	None
Pull-down resistor	1ch	Available
	2ch	Available

***1.** Parasitic diode

Figure 1

2. S-1721 Series B type

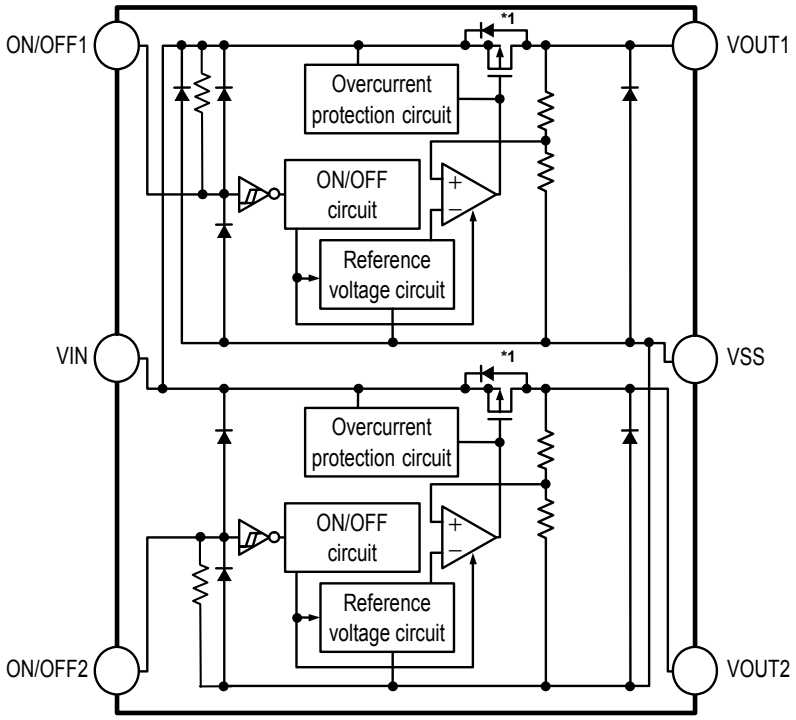


Function		Status
ON/OFF logic	1ch	Active “H”
	2ch	Active “L”
Pull-up resistor	1ch	None
	2ch	Available
Pull-down resistor	1ch	Available
	2ch	None

***1.** Parasitic diode

Figure 2

3. S-1721 Series C type

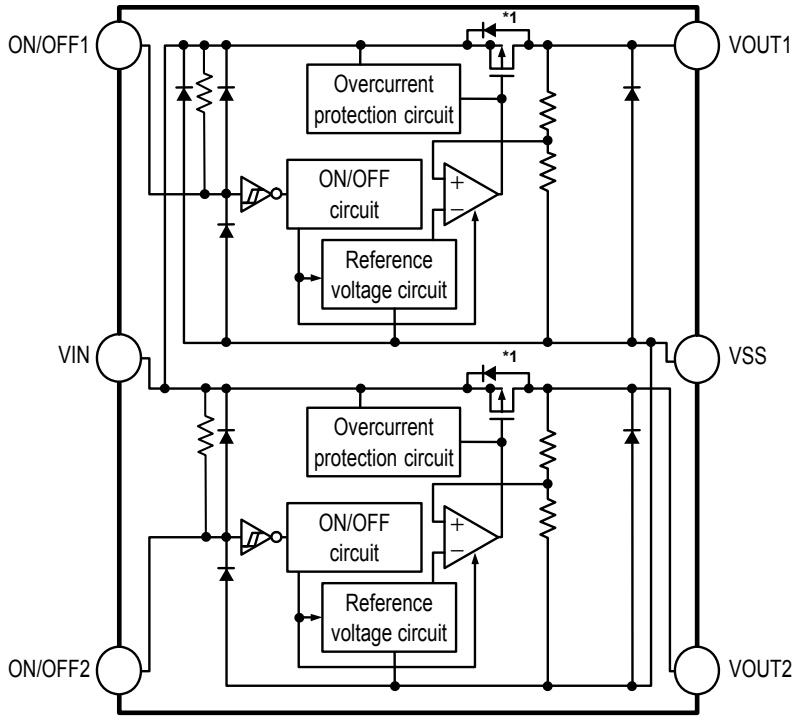


Function		Status
ON/OFF logic	1ch	Active “L”
	2ch	Active “H”
Pull-up resistor	1ch	Available
	2ch	None
Pull-down resistor	1ch	None
	2ch	Available

***1.** Parasitic diode

Figure 3

4. S-1721 Series D type

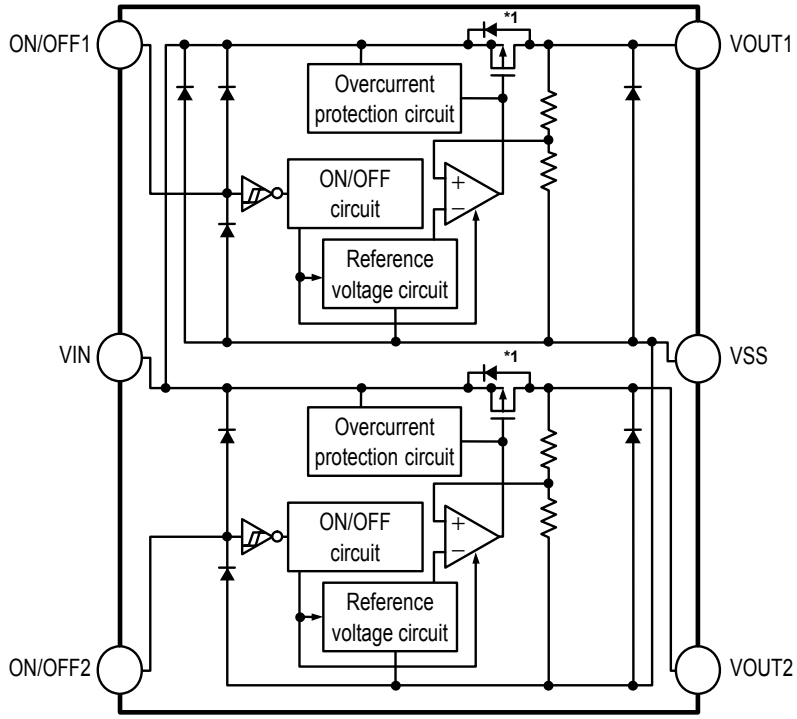


Function		Status
ON/OFF logic	1ch	Active “L”
	2ch	Active “L”
Pull-up resistor	1ch	Available
	2ch	Available
Pull-down resistor	1ch	None
	2ch	None

***1.** Parasitic diode

Figure 4

5. S-1721 Series E type

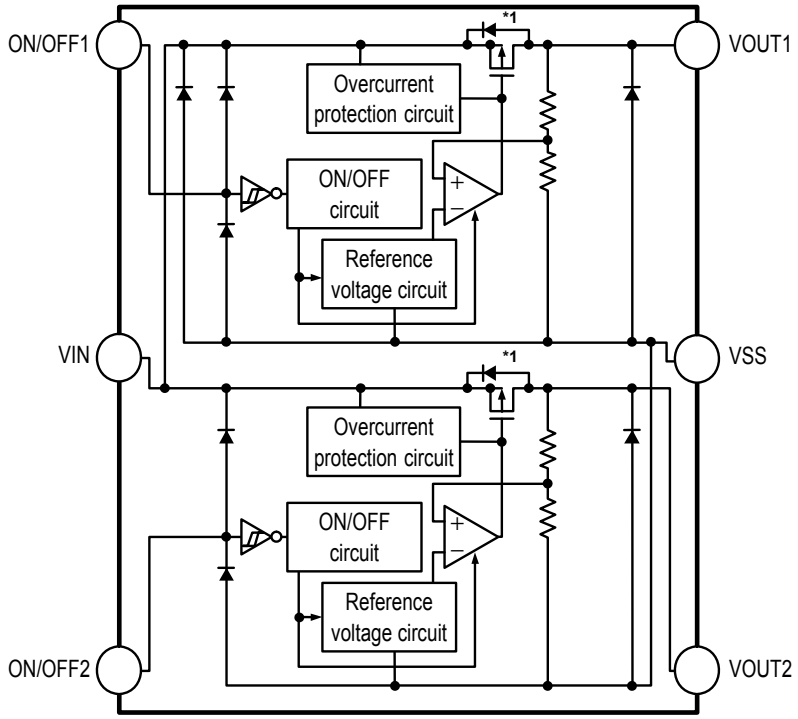


Function		Status
ON/OFF logic	1ch	Active “H”
	2ch	Active “H”
Pull-up resistor	1ch	None
	2ch	None
Pull-down resistor	1ch	None
	2ch	None

***1.** Parasitic diode

Figure 5

6. S-1721 Series F type

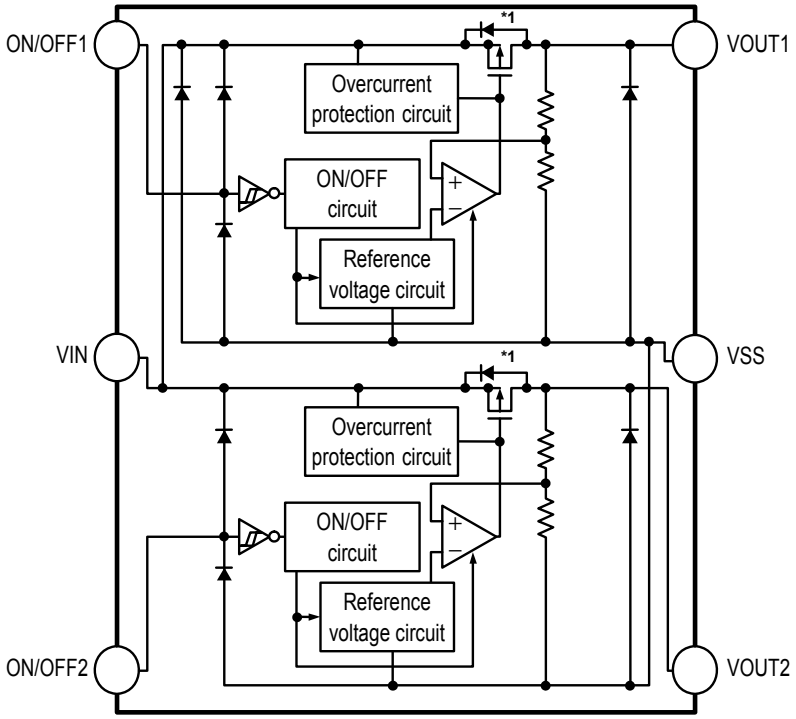


Function		Status
ON/OFF logic	1ch	Active “H”
	2ch	Active “L”
Pull-up resistor	1ch	None
	2ch	None
Pull-down resistor	1ch	None
	2ch	None

***1.** Parasitic diode

Figure 6

7. S-1721 Series G type

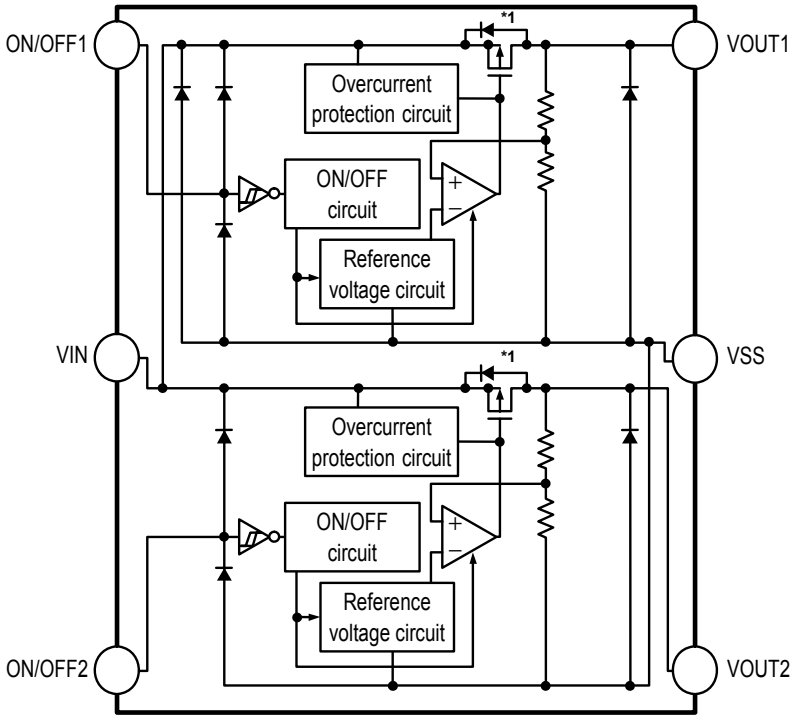


Function		Status
ON/OFF logic	1ch	Active “L”
	2ch	Active “H”
Pull-up resistor	1ch	None
	2ch	None
Pull-down resistor	1ch	None
	2ch	None

***1.** Parasitic diode

Figure 7

8. S-1721 Series H type



Function		Status
ON/OFF logic	1ch	Active “L”
	2ch	Active “L”
Pull-up resistor	1ch	None
	2ch	None
Pull-down resistor	1ch	None
	2ch	None

***1.** Parasitic diode

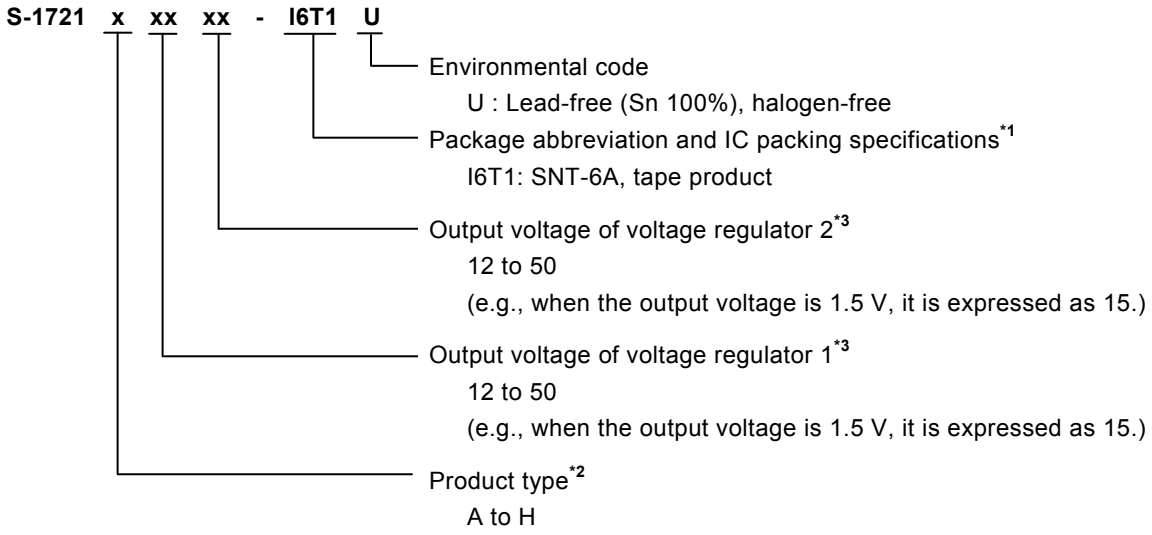
Figure 8

■ Product Name Structure

Users can select the product type, output voltage, and package type for the S-1721 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.

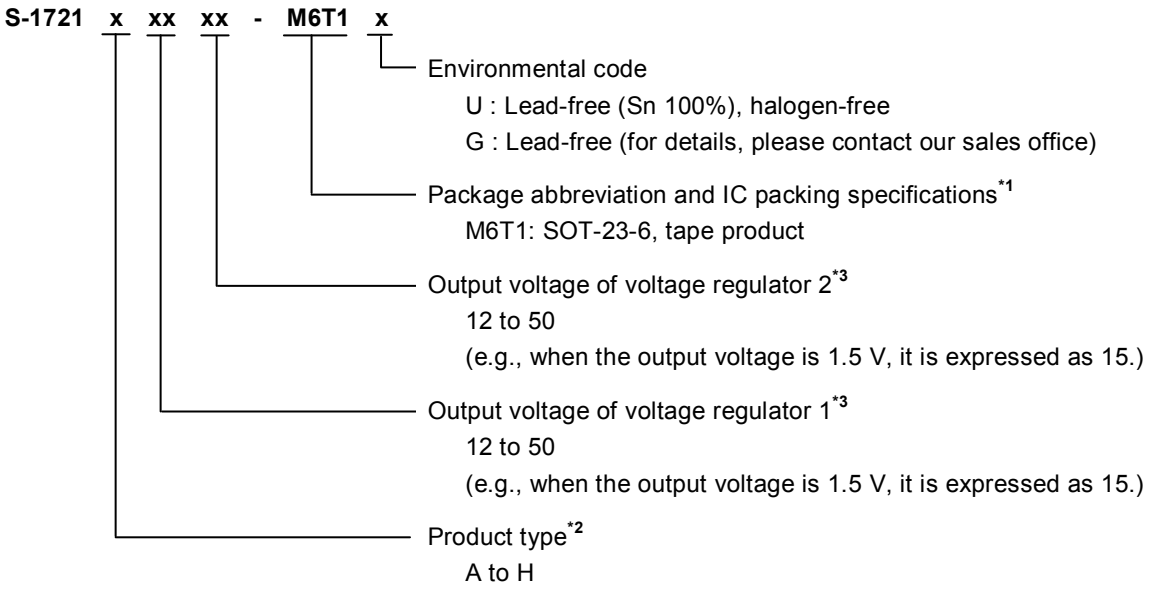
1. Product name

1. 1 SNT-6A



***1.** Refer to the tape drawing.
***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.

1. 2 SOT-23-6



***1.** Refer to the tape drawing.
***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	Pull-up Resistor	Pull-down Resistor
A type	1ch Active "H" 2ch Active "H"	1ch None 2ch None	1ch Available 2ch Available
B type	1ch Active "H" 2ch Active "L"	1ch None 2ch Available	1ch Available 2ch None
C type	1ch Active "L" 2ch Active "H"	1ch Available 2ch None	1ch None 2ch Available
D type	1ch Active "L" 2ch Active "L"	1ch Available 2ch Available	1ch None 2ch None
E type	1ch Active "H" 2ch Active "H"	1ch None 2ch None	1ch None 2ch None
F type	1ch Active "H" 2ch Active "L"	1ch None 2ch None	1ch None 2ch None
G type	1ch Active "L" 2ch Active "H"	1ch None 2ch None	1ch None 2ch None
H type	1ch Active "L" 2ch Active "L"	1ch None 2ch None	1ch None 2ch None

3. Package

Package Name	Drawing Code			
	Package	Tape	Reel	Land
SNT-6A	PG006-A-P-SD	PG006-A-C-SD	PG006-A-R-SD	PG006-A-L-SD
SOT-23-6	MP006-A-P-SD	MP006-A-C-SD	MP006-A-R-SD	–

4. Product name list

4.1 S-1721 series A type

ON/OFF logic : 1ch : Active “H”, 2ch : Active “H”
Pull-up resistor : 1ch : None, 2ch : None
Pull-down resistor : 1ch : Available, 2ch : Available

Table 2 (1 / 2)

Voltage Regulator 1 Output Voltage	Voltage Regulator 2 Output Voltage	SNT-6A	SOT-23-6
1.2 V ±15 mV	1.2 V ±15 mV	S-1721A1212-I6T1U	S-1721A1212-M6T1x
1.2 V ±15 mV	1.5 V ±1.0%	S-1721A1215-I6T1U	S-1721A1215-M6T1x
1.2 V ±15 mV	1.8 V ±1.0%	S-1721A1218-I6T1U	–
1.2 V ±15mV	2.5 V ±1.0%	S-1721A1225-I6T1U	–
1.2 V ±15 mV	2.6 V ±1.0%	S-1721A1226-I6T1U	–
1.2 V ±15 mV	2.8 V ±1.0%	S-1721A1228-I6T1U	S-1721A1228-M6T1x
1.2 V ±15 mV	2.85 V ±1.0%	S-1721A122J-I6T1U	–
1.2 V ±15 mV	3.0 V ±1.0%	S-1721A1230-I6T1U	–
1.2 V ±15 mV	3.3 V ±1.0%	S-1721A1233-I6T1U	S-1721A1233-M6T1x
1.25 V ±15 mV	1.8 V ±1.0%	S-1721A1C18-I6T1U	–
1.3 V ±15 mV	2.8 V ±1.0%	–	S-1721A1328-M6T1x
1.3 V ±15 mV	3.0 V ±1.0%	–	S-1721A1330-M6T1x
1.5 V ±1.0%	1.2 V ±15 mV	S-1721A1512-I6T1U	–
1.5 V ±1.0%	1.3 V ±15 mV	S-1721A1513-I6T1U	–
1.5 V ±1.0%	1.5 V ±1.0%	S-1721A1515-I6T1U	–
1.5 V ±1.0%	1.8 V ±1.0%	S-1721A1518-I6T1U	–
1.5 V ±1.0%	2.5 V ±1.0%	S-1721A1525-I6T1U	–
1.5 V ±1.0%	2.8 V ±1.0%	–	S-1721A1528-M6T1x
1.5 V ±1.0%	2.85 V ±1.0%	S-1721A152J-I6T1U	–
1.5 V ±1.0%	3.0 V ±1.0%	S-1721A1530-I6T1U	S-1721A1530-M6T1x
1.5 V ±1.0%	3.3 V ±1.0%	S-1721A1533-I6T1U	S-1721A1533-M6T1x
1.8 V ±1.0%	1.2 V ±15 mV	S-1721A1812-I6T1U	–
1.8 V ±1.0%	1.5 V ±1.0%	S-1721A1815-I6T1U	–
1.8 V ±1.0%	1.8 V ±1.0%	S-1721A1818-I6T1U	–
1.8 V ±1.0%	2.5 V ±1.0%	S-1721A1825-I6T1U	S-1721A1825-M6T1x
1.8 V ±1.0%	2.6 V ±1.0%	S-1721A1826-I6T1U	–
1.8 V ±1.0%	2.8 V ±1.0%	S-1721A1828-I6T1U	S-1721A1828-M6T1x
1.8 V ±1.0%	2.9 V ±1.0%	S-1721A1829-I6T1U	–
1.8 V ±1.0%	2.85 V ±1.0%	S-1721A182J-I6T1U	–
1.8 V ±1.0%	3.0 V ±1.0%	S-1721A1830-I6T1U	S-1721A1830-M6T1x
1.8 V ±1.0%	3.3 V ±1.0%	S-1721A1833-I6T1U	S-1721A1833-M6T1x
2.0 V ±1.0%	2.0 V ±1.0%	S-1721A2020-I6T1U	S-1721A2020-M6T1x
2.1 V ±1.0%	2.1 V ±1.0%	S-1721A2121-I6T1U	–
2.5 V ±1.0%	1.2 V ±15 mV	S-1721A2512-I6T1U	–
2.5 V ±1.0%	1.5 V ±1.0%	S-1721A2515-I6T1U	–
2.5 V ±1.0%	1.8 V ±1.0%	S-1721A2518-I6T1U	S-1721A2518-M6T1x

Table 2 (2 / 2)

Voltage Regulator 1 Output Voltage	Voltage Regulator 2 Output Voltage	SNT-6A	SOT-23-6
2.5 V ±1.0%	2.5 V ±1.0%	S-1721A2525-I6T1U	–
2.5 V ±1.0%	2.8 V ±1.0%	S-1721A2528-I6T1U	S-1721A2528-M6T1x
2.5 V ±1.0%	2.85 V ±1.0%	S-1721A252J-I6T1U	–
2.5 V ±1.0%	3.0 V ±1.0%	S-1721A2530-I6T1U	–
2.5 V ±1.0%	3.3 V ±1.0%	S-1721A2533-I6T1U	–
2.6 V ±1.0%	1.3 V ±15 mV	S-1721A2613-I6T1U	–
2.8 V ±1.0%	1.2 V ±15 mV	S-1721A2812-I6T1U	S-1721A2812-M6T1x
2.8 V ±1.0%	1.5 V ±1.0%	S-1721A2815-I6T1U	S-1721A2815-M6T1x
2.8 V ±1.0%	1.8 V ±1.0%	S-1721A2818-I6T1U	S-1721A2818-M6T1x
2.8 V ±1.0%	2.5 V ±1.0%	S-1721A2825-I6T1U	–
2.8 V ±1.0%	2.6 V ±1.0%	S-1721A2826-I6T1U	–
2.8 V ±1.0%	2.8 V ±1.0%	S-1721A2828-I6T1U	S-1721A2828-M6T1x
2.8 V ±1.0%	2.85 V ±1.0%	S-1721A282J-I6T1U	–
2.8 V ±1.0%	3.0 V ±1.0%	S-1721A2830-I6T1U	S-1721A2830-M6T1x
2.8 V ±1.0%	3.3 V ±1.0%	S-1721A2833-I6T1U	S-1721A2833-M6T1x
2.85 V ±1.0%	1.2 V ±15 mV	S-1721A2J12-I6T1U	–
2.85 V ±1.0%	1.5 V ±1.0%	S-1721A2J15-I6T1U	–
2.85 V ±1.0%	1.8 V ±1.0%	S-1721A2J18-I6T1U	–
2.85 V ±1.0%	2.85 V ±1.0%	S-1721A2J2J-I6T1U	S-1721A2J2J-M6T1x
2.85 V ±1.0%	3.3 V ±1.0%	S-1721A2J33-I6T1U	–
3.0 V ±1.0%	1.8 V ±1.0%	S-1721A3018-I6T1U	–
3.0 V ±1.0%	2.8 V ±1.0%	S-1721A3028-I6T1U	–
3.0 V ±1.0%	3.0 V ±1.0%	S-1721A3030-I6T1U	–
3.0 V ±1.0%	3.3 V ±1.0%	S-1721A3033-I6T1U	–
3.1 V ±1.0%	1.9 V ±1.0%	S-1721A3119-I6T1U	–
3.3 V ±1.0%	1.2 V ±15 mV	–	S-1721A3312-M6T1x
3.3 V ±1.0%	1.8 V ±1.0%	S-1721A3318-I6T1U	S-1721A3318-M6T1x
3.3 V ±1.0%	2.8 V ±1.0%	–	S-1721A3328-M6T1x
3.3 V ±1.0%	3.0 V ±1.0%	S-1721A3330-I6T1U	–
3.3 V ±1.0%	3.3 V ±1.0%	S-1721A3333-I6T1U	S-1721A3333-M6T1x

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

4.2 S-1721 series B type

ON/OFF logic : 1ch : Active “H”, 2ch : Active “L”
Pull-up resistor : 1ch : None, 2ch : Available
Pull-down resistor : 1ch : Available, 2ch : None

Table 3

Voltage Regulator 1 Output Voltage	Voltage Regulator 2 Output Voltage	SNT-6A	SOT-23-6
1.5 V ±1.0%	1.5 V ±1.0%	S-1721B1515-I6T1U	–
1.5 V ±1.0%	1.8 V ±1.0%	S-1721B1518-I6T1U	–
1.8 V ±1.0%	1.2 V ±15 mV	S-1721B1812-I6T1U	–
1.8 V ±1.0%	1.8 V ±1.0%	S-1721B1818-I6T1U	–
2.8 V ±1.0%	1.8 V ±1.0%	S-1721B2818-I6T1U	–
2.8 V ±1.0%	2.8 V ±1.0%	–	S-1721B2828-M6T1x
2.85 V ±1.0%	2.85 V ±1.0%	S-1721B2J2J-I6T1U	–

4.3 S-1721 series C type

ON/OFF logic : 1ch : Active “L”, 2ch : Active “H”
Pull-up resistor : 1ch : Available, 2ch : None
Pull-down resistor : 1ch : None, 2ch : Available

Table 4

Voltage Regulator 1 Output Voltage	Voltage Regulator 2 Output Voltage	SNT-6A	SOT-23-6
2.85 V ±1.0%	2.85 V ±1.0%	S-1721C2J2J-I6T1U	S-1721C2J2J-M6T1x

4.4 S-1721 series D type

ON/OFF logic : 1ch : Active “L”, 2ch : Active “L”
Pull-up resistor : 1ch : Available, 2ch : Available
Pull-down resistor : 1ch : None, 2ch : None

Table 5

Voltage Regulator 1 Output Voltage	Voltage Regulator 2 Output Voltage	SNT-6A	SOT-23-6
1.8 V ±1.0%	1.8 V ±1.0%	S-1721D1818-I6T1U	–
1.8 V ±1.0%	2.8 V ±1.0%	–	S-1721D1828-M6T1x
3.3 V ±1.0%	1.8 V ±1.0%	S-1721D3318-I6T1U	S-1721D3318-M6T1x

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

4.5 S-1721 series E type

ON/OFF logic : 1ch : Active “H”, 2ch : Active “H”
Pull-up resistor : 1ch : None, 2ch : None
Pull-down resistor : 1ch : None, 2ch : None

Table 6

Voltage Regulator 1 Output Voltage	Voltage Regulator 2 Output Voltage	SNT-6A	SOT-23-6
1.3 V ±15 mV	2.8 V ±1.0%	S-1721E1328-I6T1U	–
1.5 V ±1.0%	2.8 V ±1.0%	S-1721E1528-I6T1U	S-1721E1528-M6T1x
1.8 V ±1.0%	2.5 V ±1.0%	–	S-1721E1825-M6T1x
1.8 V ±1.0%	2.6 V ±1.0%	–	S-1721E1826-M6T1x
1.8 V ±1.0%	2.8 V ±1.0%	S-1721E1828-I6T1U	S-1721E1828-M6T1x
1.8 V ±1.0%	3.0 V ±1.0%	–	S-1721E1830-M6T1x
1.8 V ±1.0%	3.3 V ±1.0%	S-1721E1833-I6T1U	S-1721E1833-M6T1x
2.0 V ±1.0%	2.5 V ±1.0%	–	S-1721E2025-M6T1x
2.5 V ±1.0%	1.8 V ±1.0%	S-1721E2518-I6T1U	–
2.5 V ±1.0%	2.5 V ±1.0%	S-1721E2525-I6T1U	–
2.5 V ±1.0%	3.0 V ±1.0%	S-1721E2530-I6T1U	–
2.8 V ±1.0%	1.3 V ±15 mV	–	S-1721E2813-M6T1x
2.8 V ±1.0%	1.8 V ±1.0%	S-1721E2818-I6T1U	S-1721E2818-M6T1x
2.8 V ±1.0%	3.3 V ±1.0%	S-1721E2833-I6T1U	S-1721E2833-M6T1x
2.85 V ±1.0%	2.5 V ±1.0%	S-1721E2J25-I6T1U	S-1721E2J25-M6T1x
2.85 V ±1.0%	2.85 V ±1.0%	S-1721E2J2J-I6T1U	–
3.0 V ±1.0%	1.2 V ±15 mV	S-1721E3012-I6T1U	–
3.0 V ±1.0%	2.5 V ±1.0%	S-1721E3025-I6T1U	–
3.0 V ±1.0%	3.3 V ±1.0%	S-1721E3033-I6T1U	–
3.3 V ±1.0%	1.2 V ±15 mV	–	S-1721E3312-M6T1x

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

■ Pin Configurations

1. SNT-6A

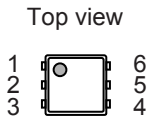


Figure 9

Table 7

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

2. SOT-23-6

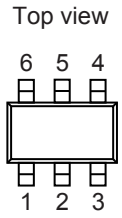


Figure 10

Table 8

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

■ Absolute Maximum Ratings

Table 9

(Ta = 25°C unless otherwise specified)

Item		Symbol	Absolute Maximum Rating	Unit
Input voltage		V_{IN}	V_{SS} – 0.3 to V_{SS} + 7.0	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	SNT-6A	P_D	400*1	mW
	SOT-23-6		650*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 : 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.

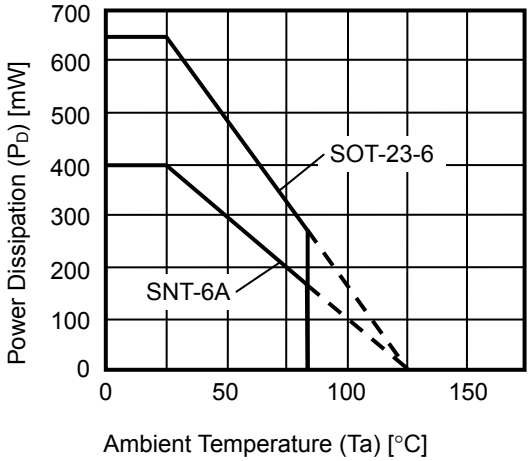


Figure 11 Power Dissipation of Package (when mounted on board)

■ Electrical Characteristics

Table 10

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 ≤ $V_{OUT(S)}$ ≤ 5.0 V	$V_{OUT(S)} \times 0.99$	$V_{OUT(S)}$	$V_{OUT(S)} \times 1.01$	V	2, 3
Output current*2	I_{OUT}	$V_{IN} \geq V_{OUT(S)} + 1.0$ V		150*5	—	—	mA	4, 5
Dropout voltage*3	V_{drop}	I_{OUT} = 100 mA	1.2 V ≤ $V_{OUT(S)}$ < 1.3 V	0.50	0.54	0.58	V	2, 3
			1.3 V ≤ $V_{OUT(S)}$ < 1.4 V	0.40	0.44	0.48	V	2, 3
			1.4 V ≤ $V_{OUT(S)}$ < 1.5 V	0.30	0.34	0.39	V	2, 3
			1.5 V ≤ $V_{OUT(S)}$ < 1.7 V	—	0.26	0.39	V	2, 3
			1.7 V ≤ $V_{OUT(S)}$ < 2.0 V	—	0.20	0.35	V	2, 3
			2.0 V ≤ $V_{OUT(S)}$ < 2.8 V	—	0.16	0.24	V	2, 3
			2.8 V ≤ $V_{OUT(S)}$ ≤ 5.0 V	—	0.13	0.23	V	2, 3
Line regulation	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \bullet V_{OUT}}$	$V_{OUT(S)} + 0.5$ V ≤ V_{IN} ≤ 6.5 V, I_{OUT} = 30 mA		—	0.05	0.2	%/V	2, 3
Load regulation	ΔV_{OUT2}	$V_{IN} = V_{OUT(S)} + 1.0$ V, 100 μA ≤ I_{OUT} ≤ 100 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 (per circuit)	I_{SS1}	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON/OFF pin = ON, no load	1.2 V ≤ $V_{OUT(S)}$ < 1.5 V	—	35	45	μA	1
		$V_{IN} = V_{OUT(S)} + 1.0$ V, ON/OFF pin = ON, no load	1.5 V ≤ $V_{OUT(S)}$ < 1.8 V	—	32	45	μA	1
		$V_{IN} = V_{OUT(S)} + 1.0$ V, ON/OFF pin = ON, no load	1.8 V ≤ $V_{OUT(S)}$ ≤ 5.0 V	—	25	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	—	6.5	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} = 6.5 V, $V_{ON/OFF}$ = 6.5 V	B (2ch)/C (1ch)/D/E/F/G/H type	−0.1	—	0.1	μA	6, 7
			A/B (1ch)/C (2ch) type	1.0	2.5	4.2	μA	
ON/OFF pin input current "L"	I_{SL}	V_{IN} = 6.5 V, $V_{ON/OFF}$ = 0 V	A/B (1ch)/C (2ch)/E/F/G/H type	−0.1	—	0.1	μA	6, 7
			B (2ch)/C (1ch)/D type	1.0	2.5	4.2	μA	
Ripple rejection	$\lvert RR \rvert$	$V_{IN} = V_{OUT(S)} + 1.0$ V, f = 1.0 kHz, ΔV_{rip} = 0.5 Vrms, I_{OUT} = 30 mA	1.2 V ≤ $V_{OUT(S)}$ < 1.8 V	—	80	—	dB	8, 9
			1.8 V ≤ $V_{OUT(S)}$ < 3.1 V	—	75	—	dB	8, 9
			3.1 V ≤ $V_{OUT(S)}$ ≤ 5.0 V	—	70	—	dB	8, 9
Short-circuit current	I_{short}	$V_{IN} = V_{OUT(S)} + 1.0$ V, ON/OFF pin = ON, V_{OUT} = 0 V		—	150	—	mA	4, 5
Shutdown pull-up/pull-down resistor	R_{PD}	—		1.5	2.6	6.5	MΩ	6, 7

***1.** $V_{OUT(S)}$: Set output voltage
$V_{OUT(E)}$: Actual output voltage
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} = 100 mA.
V_{IN1} is the input voltage at which the output voltage becomes 98% of V_{OUT3} after gradually decreasing the input voltage.

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

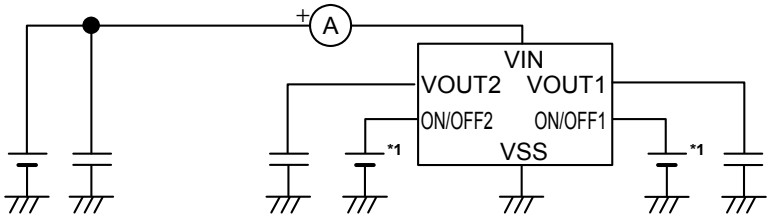
$$\frac{\Delta V_{OUT}}{\Delta Ta}[\text{mV/°C}]^{*1} = V_{OUT(S)}[\text{V}]^{*2} \times \frac{\Delta V_{OUT}}{\Delta Ta \bullet V_{OUT}}[\text{ppm/°C}]^{*3} \div 1000$$

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

***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 Circuit

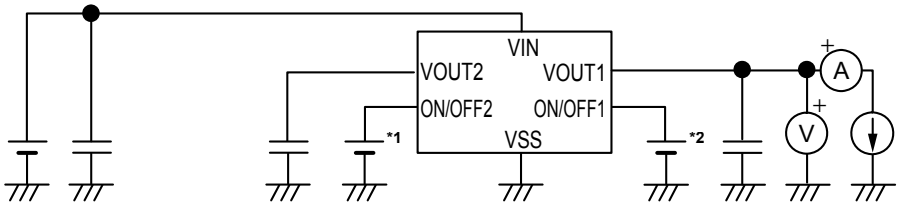
1.



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

Figure 12

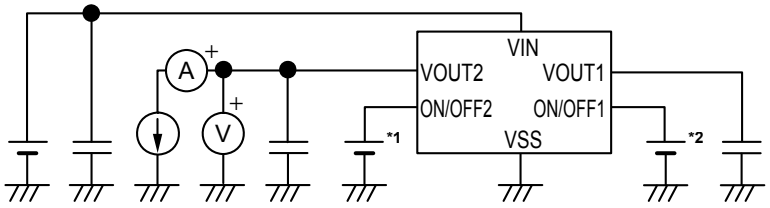
2.



***1.** Set to OFF
***2.** Set to ON

Figure 13

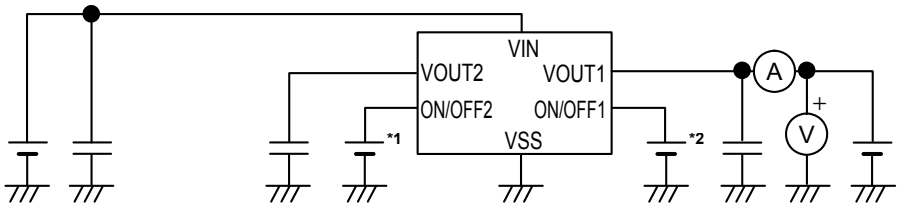
3.



***1.** Set to ON
***2.** Set to OFF

Figure 14

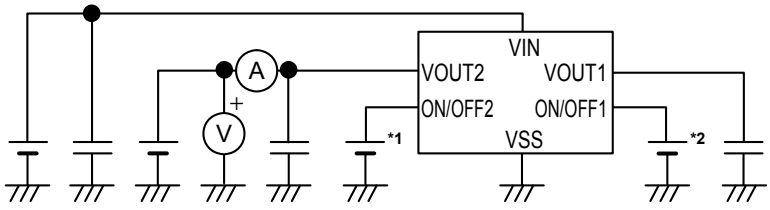
4.



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

Figure 15

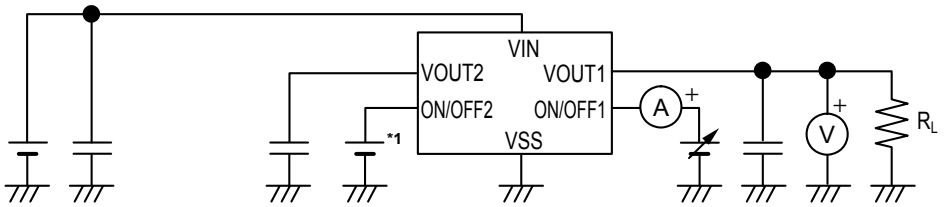
5.



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

Figure 16

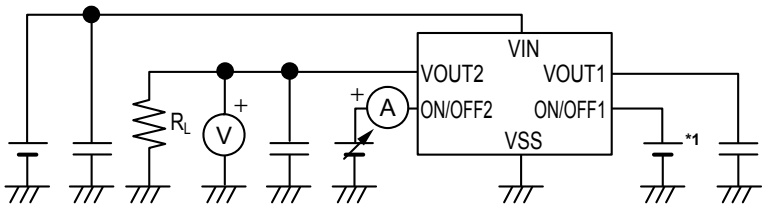
6.



***1.** Set to OFF

Figure 17

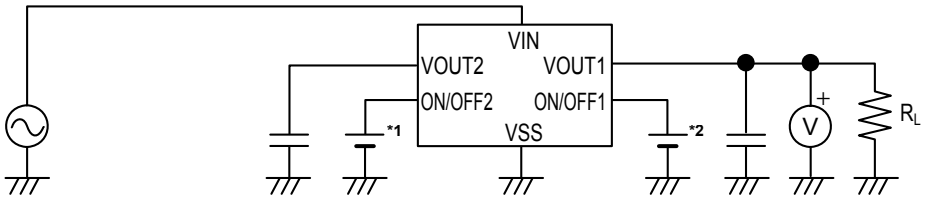
7.



***1.** Set to OFF

Figure 18

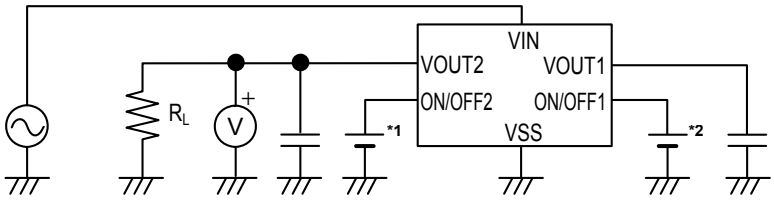
8.



***1.** Set to OFF
***2.** Set to ON

Figure 19

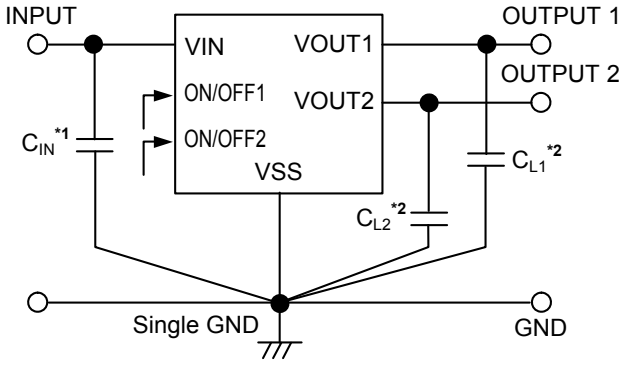
9.



***1.** Set to ON
***2.** Set to OFF

Figure 20

■ 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 21

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

Caution Generally a series regulator may cause oscillation, depending on the selection of external parts. Confirm that no oscillation occurs in the application for which the above capacitors are used.

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

The S-1721 Series requires an output capacitor between the VOUT pin 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, a tantalum capacitor, or an 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 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. Refer to the "■ 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})

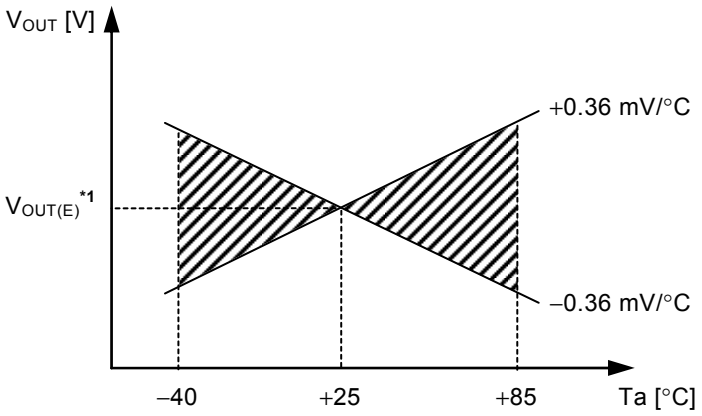
Indicates the difference between input voltage (V_{IN1}) and the output voltage when; decreasing input voltage (V_{IN}) gradually until the output voltage has dropped out to the value of 98% of output voltage (V_{OUT3}), which is at V_{IN} = $V_{OUT(S)}$ + 1.0 V.

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

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

The shaded area in **Figure 22** is the range where V_{OUT} varies in the operation temperature range when the output voltage temperature coefficient is ±120 ppm/°C.

Example of V_{OUT} = 3.0 V typ. product



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

Figure 22

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

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

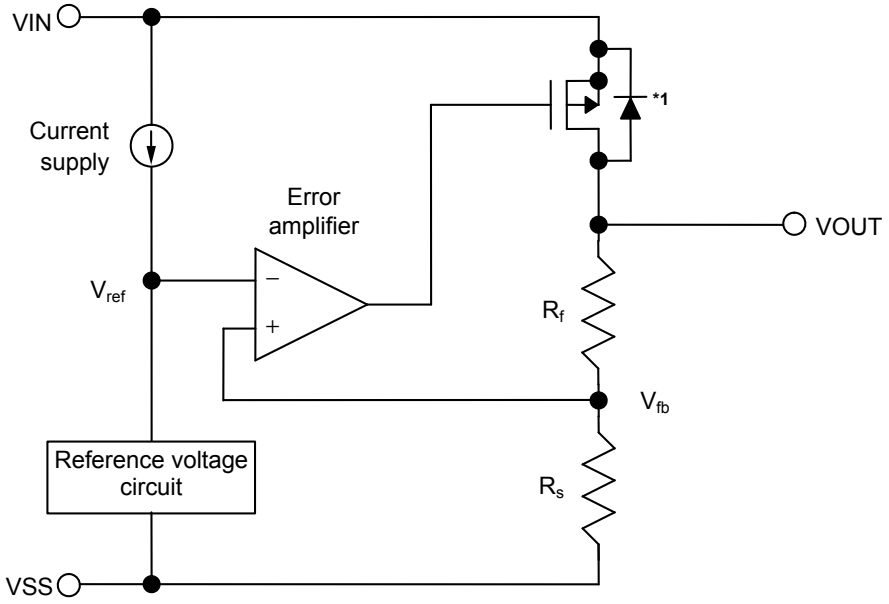
***1.** Change in temperature of output voltage
***2.** Set output voltage
***3.** Output voltage temperature coefficient

■ Operation

1. Basic operation

Figure 23 shows the block diagram of S-1721 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 23

2. Output transistor

In the S-1721 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 1 and 2

These pins start and stop 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 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 hundreds kΩ between the VOUT pin and the VSS pin.
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 24** and **25**. In the S-1721 Series A, B C, and D type, the ON/OFF pin is internally pulled up to VIN pin or pulled down to VSS pin when in the floating status, so the VOUT pin is set to the V_{SS} level.
In the S-1721 Series E, F, G and H type, the ON/OFF pin is not internally pulled up or pulled down, so do not use it in the floating status.
When not using the ON/OFF pin in the S-1721 Series E, F, G, and H type, connect the ON/OFF pin to the VIN pin in the E/F (1ch only), and G (2ch only) type. In the F (2ch only)/G (1ch only) and H type, connect the ON/OFF pin to the VSS pin.

Table 11

Product Type	ON/OFF Pin	Internal Circuits	VOUT Pin Voltage	Current Consumption
A type	1ch "H": ON 2ch "H": ON	Operate Operate	Set value Set value	I_{SS1} I_{SS1}
B type	1ch "H": ON 2ch "L": ON	Operate Operate	Set value Set value	I_{SS1} I_{SS1}
C type	1ch "L": ON 2ch "H": ON	Operate Operate	Set value Set value	I_{SS1} I_{SS1}
D type	1ch "L": ON 2ch "L": ON	Operate Operate	Set value Set value	I_{SS1} I_{SS1}
E type	1ch "L": OFF 2ch "L": OFF	Stop Stop	V_{SS} level V_{SS} level	I_{SS2} I_{SS2}
F type	1ch "L": OFF 2ch "H": OFF	Stop Stop	V_{SS} level V_{SS} level	I_{SS2} I_{SS2}
G type	1ch "H": OFF 2ch "L": OFF	Stop Stop	V_{SS} level V_{SS} level	I_{SS2} I_{SS2}
H type	1ch "H": OFF 2ch "H": OFF	Stop Stop	V_{SS} level V_{SS} level	I_{SS2} I_{SS2}

(1) S-1721 Series A, B, C, D type

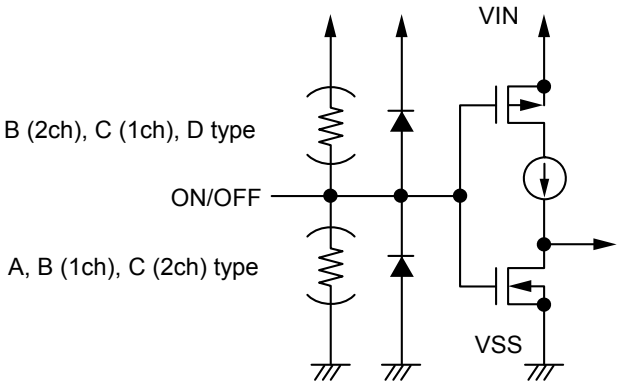


Figure 24

(2) S-1721 Series E, F, G, H type

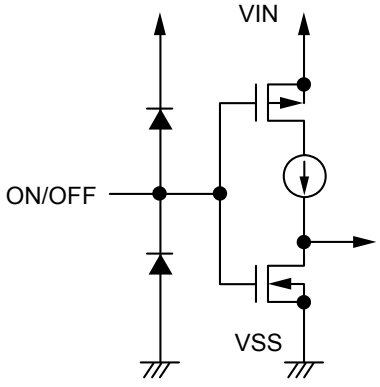


Figure 25

4. Overcurrent protection circuit

The S-1721 Series has a built-in overcurrent protection circuit having the characteristics shown in "**(1) Output Voltage vs. Output Current (When Load Current Increases) (Ta = 25°C)**" in "■ **Characteristics (Typical Data) (Per Circuit)**", in order to protect the output transistor against an excessive output current and short circuiting between the VOUT pin and the VSS pin. The current when the output pin is short-circuited (I_{short}) is internally set at approx. 150 mA typ., and the normal value is restored for the output voltage, if releasing a short circuit once.

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

5. Pull-down/pull-up resistor (S-1721 Series A, B, C, and D type)

In the S-1721 Series A, B, C, and D type, the ON/OFF pin is internally pulled up to VIN pin or pulled down to VSS pin in the floating status, so the VOUT pin is set to V_{SS} level.

In A/B (1ch only) and C (2ch only), the ON/OFF pin is connected to VIN pin,
In B (2ch only)/C (1ch only)/D type, the ON/OFF pin is connected to VSS pin;
Note that during operation in these cases, the current consumption of the IC is generated as much as the current which flows into a pull-up resistor of 2.6 MΩ or a pull-down resistor of 2.6 MΩ.

■ Precautions

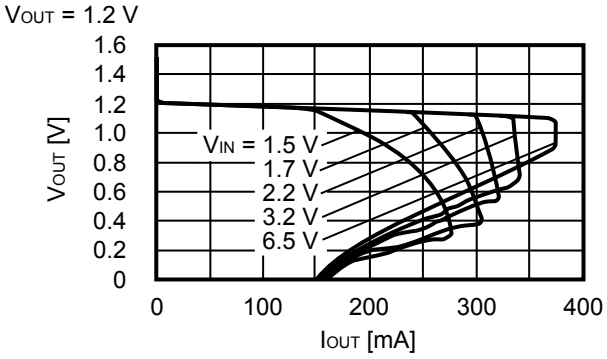
- Wiring patterns for the VIN pin, the VOUT pin and GND should be designed and that the impedance is low. When mounting an output capacitor between the VOUT pin and VSS pin (C_{L1}, C_{L2}), a capacitor for stabilizing the input between the VIN pin and the VSS pin (C_{IN}), the distance from the capacitors 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 (1.0 mA or less).
- Note that generally the output voltage may increase due to the leakage current from an output driver when a series regulator is used at high temperature.
- Generally a series regulator may cause oscillation, depending on the selection of external parts. The following conditions are recommended for the S-1721 Series. However, be sure to perform sufficient evaluation under the actual usage conditions for selection, including evaluation of temperature characteristics. Refer to "**(5) 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.

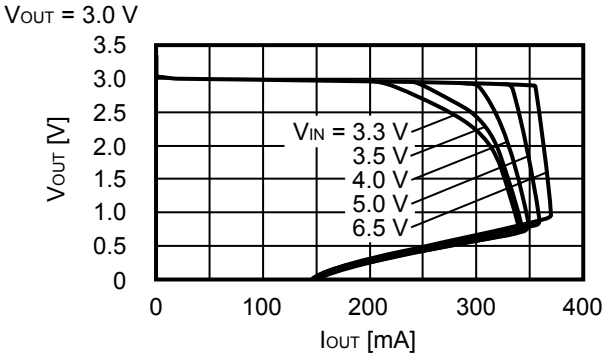
  Input capacitor (C_{IN}) : 1.0 μF or more
  Output capacitor (C_{L1}, C_{L2}) : 1.0 μF or more

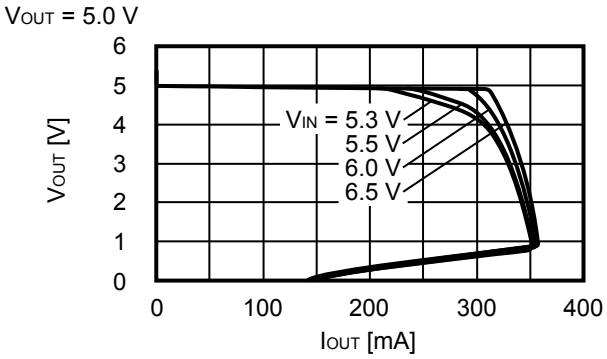
- The voltage regulator may oscillate when the impedance of the power supply is high and the input capacitor is small or an input capacitor is not connected. Note that, if the capacitance of the output capacitor is greater than that of the input capacitor, the voltage regulator may oscillate.
- Note that an oscillation may occur when the load current is high (100 mA or higher) and the difference between the voltage input and output is around the dropout voltage if the inductance of the power supply is high. Perform sufficient evaluation including electrical characteristics under the actual use conditions to select an input capacitor.
- Concerning the fluctuation of output voltage due to power-supplying and load, confirm with the actual device.
- Overshoot may occur in the output voltage momentarily if the voltage is rapidly raised at power-on or when the power supply fluctuates. Sufficiently evaluate the output voltage at power-on with the actual device.
- The application conditions for the input voltage, the output voltage, and the load current should not exceed the package power dissipation.
- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.
- In determining the output current, attention should be paid to the output current value specified in **Table 10** in "■ **Electrical Characteristics**" and footnote ***5** of the table.
- SII Semiconductor Corporation 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)







Remark In determining the output current, attention should be paid to the following.
1. The minimum output current value and footnote ***5** of **Table 10** in the "■ **Electrical Characteristics**"
2. The package power dissipation

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