S-1231 Series

105°C OPERATION, 66 V INPUT, 200 mA, VOLTAGE REGULATOR

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Rev.1.1_00

This IC developed by using high-withstand voltage CMOS process technology, is a positive voltage regulator with a high-withstand voltage, low current consumption and high-accuracy output voltage.
It has a high operation voltage of 66 V, making it compatible with 12 V, 24 V, and 48 V battery systems, and it can be operated at a low consumption current of 2.0 µA typ. It also features a built-in overcurrent protection circuit to limit overcurrent of the output transistor, a built-in thermal shutdown circuit to limit heat, and a built-in open-loop protection circuit to control output voltage overvoltage.

■ Features

- Output voltage (internally set): 1.8 V, 3.0 V, 3.3 V, 5.0 V
- Output voltage (externally set): 1.8 V to 15.0 V*1, settable via external resistor
- Input voltage: 6.0 V to 66.0 V
- Output voltage accuracy: ±1.5% (Ta = +25°C)
- Current consumption: During operation: 2.0 µA typ., 5.0 µA max. (Ta = +25°C)
  During power-off: 0.1 µA typ., 2.0 µA max. (Ta = +25°C)
- Output current: Possible to output 200 mA (at $V_{IN} \geq V_{OUT(S)} + 5.0$ V)*2
- Input capacitor: A ceramic capacitor can be used. (0.1 µF or more)
- Output capacitor: A ceramic capacitor can be used. (1.0 µF or more)
- Built-in overcurrent protection circuit: Limits overcurrent of output transistor.
- Built-in thermal shutdown circuit: Detection temperature 170°C typ.
- Built-in open-loop protection circuit: (Only for type in which output voltage is externally set) Controls V_{OUT} overvoltage when the VADJ pin is open or shorted.
- Built-in ON / OFF circuit: Ensures long battery life.
- Operation temperature range: Ta = -40°C to +105°C
- Lead-free (Sn 100%), halogen-free

*1. Please contact our sales representatives before using the product over 15.0 V.
*2. Please make sure that the loss of the IC will not exceed the power dissipation when the output current is large.

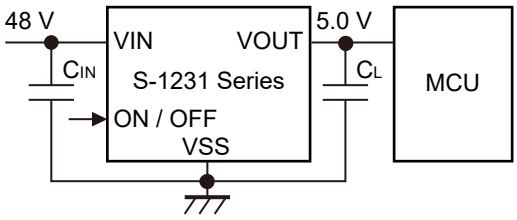
■ Applications

- Constant-voltage power supply for industrial equipment
- Constant-voltage power supply for home electric appliance

■ Packages

- TO-252-5S(A)
- HSOP-8A
- HTMSOP-8

■ Typical Application Circuit

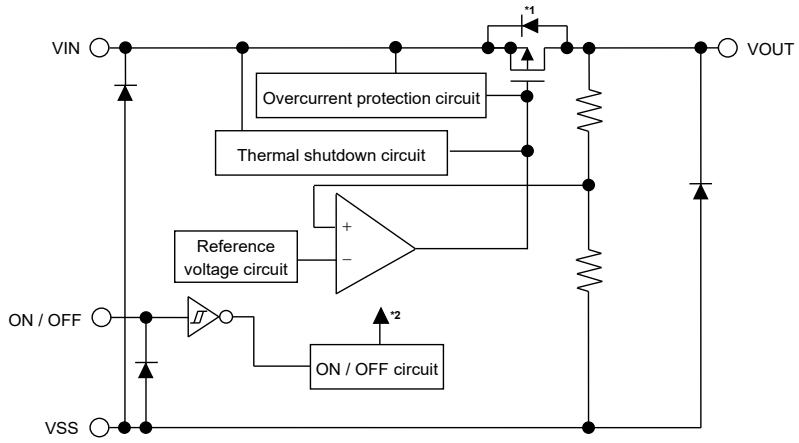


■ Block Diagrams

1. Type in which output voltage is internally set

1. 1 S-1231 Series D type

Function	Status
ON / OFF logic	Active "H"



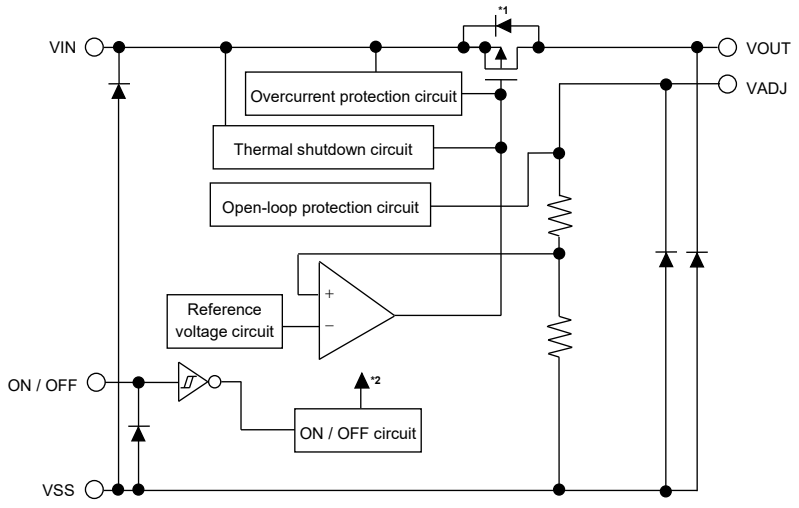
***1.** Parasitic diode
***2.** The ON / OFF circuit controls the internal circuit and the output transistor.

Figure 1

2. Type in which output voltage is externally set

2. 1 S-1231 Series D type

Function	Status
ON / OFF logic	Active "H"

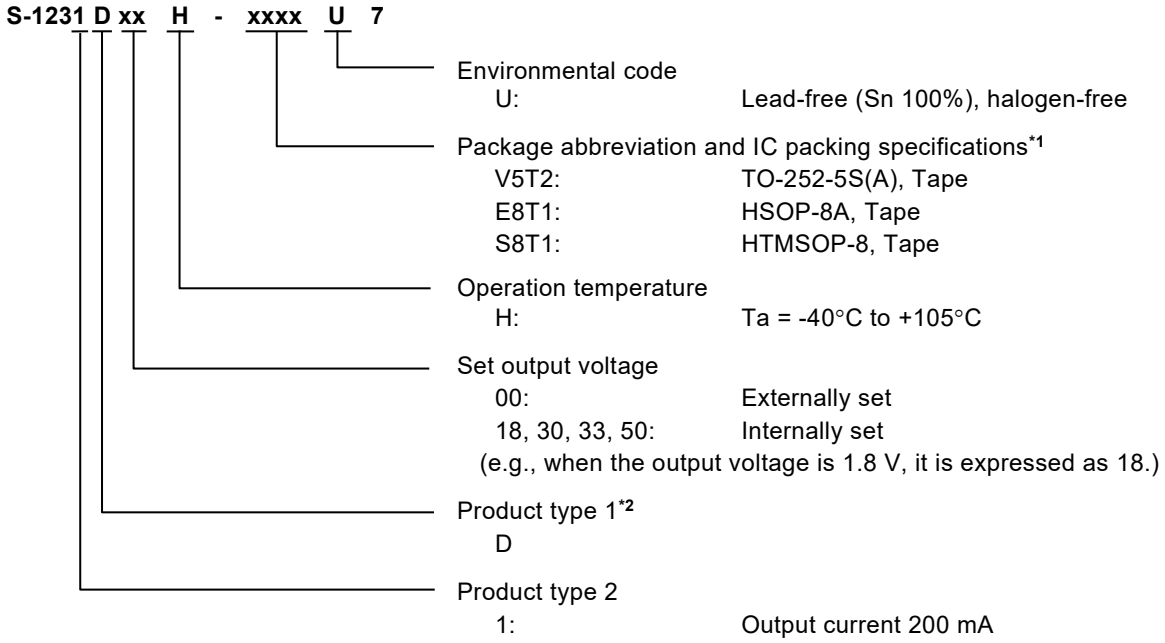


***1.** Parasitic diode
***2.** The ON / OFF circuit controls the internal circuit and the output transistor.

Figure 2

■ Product Name Structure

1. Product name



***1.** Refer to the tape drawing.
***2.** Please refer to "**2. Function list of product types**".

2. Function list of product types

Table 1

Product Type	ON / OFF Logic
D	Active "H"

3. Packages

Table 2 Package Drawing Codes

Package Name	Dimension	Tape	Reel	Land
TO-252-5S(A)	VA005-A-P-SD	VA005-A-C-SD	VA005-A-R-SD	VA005-A-L-SD
HSOP-8A	FH008-A-P-SD	FH008-A-C-SD	FH008-A-R-SD	FH008-A-L-SD
HTMSOP-8	FP008-A-P-SD	FP008-A-C-SD	FP008-A-R-SD	FP008-A-L-SD

4. Product name list

4. 1 S-1231 Series D type

Table 3

Output Voltage	TO-252-5S(A)	HSOP-8A	HTMSOP-8
Externally set	S-1231D00H-V5T2U7	S-1231D00H-E8T1U7	S-1231D00H-S8T1U7
1.8 V ± 1.5%	S-1231D18H-V5T2U7	S-1231D18H-E8T1U7	S-1231D18H-S8T1U7
3.0 V ± 1.5%	S-1231D30H-V5T2U7	S-1231D30H-E8T1U7	S-1231D30H-S8T1U7
3.3 V ± 1.5%	S-1231D33H-V5T2U7	S-1231D33H-E8T1U7	S-1231D33H-S8T1U7
5.0 V ± 1.5%	S-1231D50H-V5T2U7	S-1231D50H-E8T1U7	S-1231D50H-S8T1U7

Remark Please contact our sales representatives for products other than the above.

■ Pin Configurations

1. TO-252-5S(A)

Top view

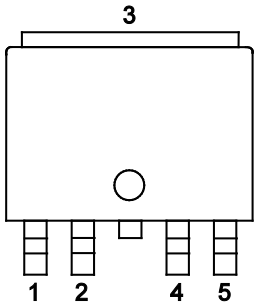


Figure 3

Table 4 Type In Which Output Voltage Is Internally Set

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

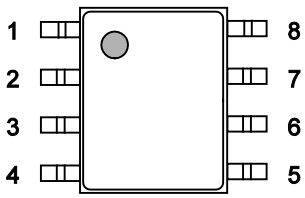
Table 5 Type In Which Output Voltage Is Externally Set

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

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

2. HSOP-8A

Top view



Bottom view

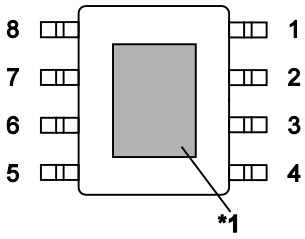


Figure 4

Table 6 Type In Which Output Voltage Is Internally Set

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

Table 7 Type In Which Output Voltage Is Externally Set

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

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

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

3. HTMSOP-8

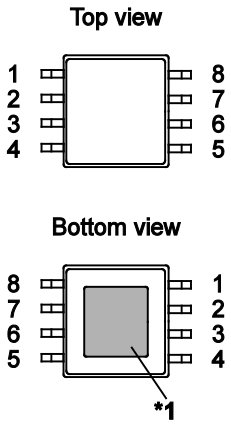


Figure 5

Table 8 Type In Which Output Voltage Is Internally Set

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

Table 9 Type In Which Output Voltage Is Externally Set

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

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

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

■ Absolute Maximum Ratings

Table 10

(Ta = +25°C unless otherwise specified)

Item	Symbol	Absolute Maximum Rating	Unit
Input voltage	V_{IN}	V_{SS} - 0.3 to V_{SS} + 80	V
	$V_{ON / OFF}$	V_{SS} - 0.3 to V_{SS} + 80	V
	V_{VADJ}	V_{SS} - 0.3 to V_{SS} + 45	V
Output voltage	V_{OUT}	V_{SS} - 0.3 to V_{IN} + 0.3 ≤ V_{SS} + 45	V
Output current	I_{OUT}	260	mA
Junction temperature	T_j	-40 to +150	°C
Operation ambient temperature	T_{opr}	-40 to +105	°C
Storage temperature	T_{stg}	-40 to +150	°C

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.

■ Thermal Resistance Value

Table 11

Item	Symbol	Condition		Min.	Typ.	Max.	Unit
Junction-to-ambient thermal resistance*1, *2	θ_{JA}	TO-252-5S(A)	Board A	-	86	-	°C/W
			Board B	-	60	-	°C/W
			Board C	-	38	-	°C/W
			Board D	-	31	-	°C/W
			Board E	-	28	-	°C/W
		HSOP-8A	Board A	-	104	-	°C/W
			Board B	-	74	-	°C/W
			Board C	-	39	-	°C/W
			Board D	-	37	-	°C/W
			Board E	-	31	-	°C/W
		HTMSOP-8	Board A	-	159	-	°C/W
			Board B	-	113	-	°C/W
			Board C	-	39	-	°C/W
			Board D	-	40	-	°C/W
			Board E	-	30	-	°C/W

***1.** Test environment: compliance with JEDEC STANDARD JESD51-2A

***2.** Measurement values when this IC is mounted on each board

Remark Refer to "■ **Power Dissipation**" and "**Test Board**" for details.

■ Recommended Operation Conditions

Table 12

Item	Symbol	Min.	Typ.	Max.	Unit
VIN pin voltage	V_{IN}	6.0	-	66.0	V
VIN pin voltage (I_{OUT} ≤ 10 mA)	V_{IN}	3.0	-	66.0	V
Input capacitor	C_{IN}	0.1	-	-	μF
Output capacitor	C_L	1.0	-	-	μF
Equivalent series resistance	R_{ESR}	-	-	30	Ω

■ Electrical Characteristics

1. Type in which output voltage is internally set

Table 13 (1 / 2)

(Ta = +25°C unless otherwise specified)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Test Circuit
Output voltage*1	$V_{OUT(E)}$	6.0 V ≤ V_{IN} ≤ 64.0 V, 0.1 mA ≤ I_{OUT} ≤ 30 mA	$V_{OUT(S)}$ = 1.8 V	$V_{OUT(S)}$ × 0.985	$V_{OUT(S)}$	$V_{OUT(S)}$ × 1.015	V	1
		$V_{OUT(S)}$ + 3.0 V ≤ V_{IN} ≤ 64.0 V, 0.1 mA ≤ I_{OUT} ≤ 30 mA	$V_{OUT(S)}$ = 3.0 V, 3.3 V, 5.0 V	$V_{OUT(S)}$ × 0.985	$V_{OUT(S)}$	$V_{OUT(S)}$ × 1.015	V	1
Output current*2	I_{OUT}	V_{IN} ≥ 6.8 V	$V_{OUT(S)}$ = 1.8 V	200*7	-	-	mA	3
		V_{IN} ≥ $V_{OUT(S)}$ + 5.0 V	$V_{OUT(S)}$ = 3.0 V, 3.3 V, 5.0 V	200*7	-	-	mA	3
Dropout voltage*3	V_{drop}	I_{OUT} = 200 mA	$V_{OUT(S)}$ = 1.8 V	-	*8	-	V	1
			$V_{OUT(S)}$ = 3.0 V	-	*8	-	V	1
			$V_{OUT(S)}$ = 3.3 V	-	*8	-	V	1
			$V_{OUT(S)}$ = 5.0 V	-	*8	-	V	1
Line regulation*4	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \bullet V_{OUT}}$	6.0 V ≤ V_{IN} ≤ 66.0 V, I_{OUT} = 0.1 mA	$V_{OUT(S)}$ = 1.8 V	-	0.01	0.03	%/V	1
		$V_{OUT(S)}$ + 3.0 V ≤ V_{IN} ≤ 66.0 V, I_{OUT} = 0.1 mA	$V_{OUT(S)}$ = 3.0 V, 3.3 V, 5.0 V	-	0.01	0.03	%/V	1
Load regulation*5	ΔV_{OUT2}	V_{IN} = 6.0 V, 0.1 mA ≤ I_{OUT} ≤ 100 mA	$V_{OUT(S)}$ = 1.8 V	-	20.0	40.0	mV	1
		V_{IN} = $V_{OUT(S)}$ + 3.0 V, 0.1 mA ≤ I_{OUT} ≤ 100 mA	$V_{OUT(S)}$ = 3.0 V, 3.3 V	-	20.0	40.0	mV	1
		V_{IN} = $V_{OUT(S)}$ + 3.0 V, 0.1 mA ≤ I_{OUT} ≤ 100 mA	$V_{OUT(S)}$ = 5.0 V	-	20.0	50.0	mV	1
Current consumption during operation	I_{SS1}	V_{IN} = 48.0 V, ON / OFF pin = ON, no load		-	2.0	5.0	μA	2
Current consumption during power-off	I_{SS2}	V_{IN} = 48.0 V, ON / OFF pin = OFF, no load		-	0.1	2.0	μA	2
Input voltage	V_{IN}	-		6.0	-	66.0	V	-
ON / OFF pin input voltage "H"	V_{SH}	V_{IN} = 48.0 V, R_L = 1.0 kΩ, determined by V_{OUT} output level		2.0	-	-	V	4
ON / OFF pin input voltage "L"	V_{SL}	V_{IN} = 48.0 V, R_L = 1.0 kΩ, determined by V_{OUT} output level		-	-	0.8	V	4
ON / OFF pin input current "H"	I_{SH}	V_{IN} = 48.0 V, $V_{ON / OFF}$ = V_{IN}		-0.1	-	0.1	μA	4
ON / OFF pin input current "L"	I_{SL}	V_{IN} = 48.0 V, $V_{ON / OFF}$ = 0 V		-0.1	-	0.1	μA	4
Ripple rejection	|RR|	V_{IN} = 6.0 V, f = 100 Hz, V_{rip} = 1.0 V_{p-p}, I_{OUT} = 10 mA	$V_{OUT(S)}$ = 1.8 V	-	60	-	dB	5
		V_{IN} = $V_{OUT(S)}$ + 3.0 V, f = 100 Hz, V_{rip} = 1.0 V_{p-p}, I_{OUT} = 10 mA	$V_{OUT(S)}$ = 3.0 V, 3.3 V, 5.0 V	-	60	-	dB	5

Table 13 (2 / 2)

(Ta = +25°C unless otherwise specified)

Item	Symbol	Condition		Min.	Typ.	Max.	Unit	Test Circuit
Limit current*6	I_{LIM}	V_{IN} = 6.8 V, ON / OFF pin = ON, V_{OUT} = $V_{OUT(S)}$ × 0.9	$V_{OUT(S)}$ = 1.8 V	250	350	525	mA	3
		V_{IN} = $V_{OUT(S)}$ + 5.0 V, ON / OFF pin = ON, V_{OUT} = $V_{OUT(S)}$ × 0.9	$V_{OUT(S)}$ = 3.0 V, 3.3 V, 5.0 V	250	350	525	mA	3
Short-circuit current	I_{short}	V_{IN} = 6.8 V, ON / OFF pin = ON, V_{OUT} = 0 V	$V_{OUT(S)}$ = 1.8 V	25	50	130	mA	3
		V_{IN} = $V_{OUT(S)}$ + 5.0 V, ON / OFF pin = ON, V_{OUT} = 0 V	$V_{OUT(S)}$ = 3.0 V, 3.3 V, 5.0 V,	25	50	130	mA	3
Thermal shutdown detection temperature	T_{SD}	Junction temperature		-	170	-	°C	-
Thermal shutdown release temperature	T_{SR}	Junction temperature		-	135	-	°C	-

***1.** The accuracy is guaranteed when the input voltage, output current, and temperature satisfy the conditions listed above.
$V_{OUT(S)}$: Set output voltage
$V_{OUT(E)}$: Actual output voltage

***2.** The output current at which the output voltage becomes 95% of $V_{OUT(E)}$ after gradually increasing the output current.

***3.** 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}).
V_{drop}: V_{IN1} - (V_{OUT3} × 0.98)
V_{OUT3}: Output voltage when V_{IN} = $V_{OUT(S)}$ + 5.0 V, I_{OUT} = 200 mA

***4.** The dependency of the output voltage against the input voltage. The value shows how much the output voltage changes due to a change in the input voltage while keeping output current constant.

***5.** The dependency of the output voltage against the output current. The value shows how much the output voltage changes due to a change in the output current while keeping input voltage constant.

***6.** The current limited by overcurrent protection circuit.

***7.** Due to limitation of the power dissipation, this value may not be satisfied. Attention should be paid to the power dissipation when the output current is large. This specification is guaranteed by design.

***8.** The dropout voltage is limited by the difference between the input voltage (min. value) and the set output voltage.
In case of $V_{OUT(S)}$ = 1.8 V: 6.8 V - $V_{OUT(S)}$ = V_{drop}

2. Type in which output voltage is externally set

Table 14

(Ta = +25°C unless otherwise specified, $V_{OUT} = V_{VADJ}$)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Test Circuit
Adjustment pin output voltage*1	V_{VADJ}	6.0 V ≤ V_{IN} ≤ 64.0 V, 0.1 mA ≤ I_{OUT} ≤ 30 mA	1.773	1.8	1.827	V	6
Output voltage range	V_{ROUT}	-	1.8	-	15.0*9	V	11
Adjustment pin input current	I_{VADJ}	V_{ADJ} = 1.8 V	-	0.074	-	µA	-
Output current*2	I_{OUT}	V_{IN} ≥ 6.8 V	200*7	-	-	mA	8
Dropout voltage*3	V_{drop}	I_{OUT} = 200 mA	-	*8	-	V	6
Line regulation*4	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \bullet V_{OUT}}$	6.0 V ≤ V_{IN} ≤ 66.0 V, I_{OUT} = 0.1 mA	-	0.01	0.03	%/V	6
Load regulation*5	ΔV_{OUT2}	V_{IN} = 6.0 V, 0.1 mA ≤ I_{OUT} ≤ 100 mA	-	20	40	mV	6
Current consumption during operation	I_{SS1}	V_{IN} = 48.0 V, ON / OFF pin = ON, no load	-	2.0	5.0	µA	7
Current consumption during power-off	I_{SS2}	V_{IN} = 48.0 V, ON / OFF pin = OFF, no load	-	0.1	2.0	µA	7
Input voltage	V_{IN}	-	6.0	-	66.0	V	-
ON / OFF pin input voltage "H"	V_{SH}	V_{IN} = 48.0 V, R_L = 1.0 kΩ, determined by V_{OUT} output level	2.0	-	-	V	9
ON / OFF pin input voltage "L"	V_{SL}	V_{IN} = 48.0 V, R_L = 1.0 kΩ, determined by V_{OUT} output level	-	-	0.8	V	9
ON / OFF pin input current "H"	I_{SH}	V_{IN} = 48.0 V, $V_{ON / OFF}$ = V_{IN}	-0.1	-	0.1	µA	9
ON / OFF pin input current "L"	I_{SL}	V_{IN} = 48.0 V, $V_{ON / OFF}$ = 0 V	-0.1	-	0.1	µA	9
Ripple rejection	|RR|	V_{IN} = 6.0 V, f = 100 Hz, V_{rip} = 1.0 V_{p-p}, I_{OUT} = 10 mA	-	60	-	dB	10
Limit current*6	I_{LIM}	V_{IN} = 6.8 V, ON / OFF pin = ON, V_{OUT} = $V_{OUT(S)}$ × 0.9	260	350	525	mA	8
Short-circuit current	I_{short}	V_{IN} = 6.8 V, ON / OFF pin = ON, V_{OUT} = 0 V	25	50	130	mA	8
Thermal shutdown detection temperature	T_{SD}	Junction temperature	-	170	-	°C	-
Thermal shutdown release temperature	T_{SR}	Junction temperature	-	135	-	°C	-

***1.** The accuracy is guaranteed when the input voltage, output current, and temperature satisfy the conditions listed above.
$V_{OUT(S)}$: Set output voltage = 1.8 V

***2.** The output current at which the output voltage becomes 95% of $V_{OUT(E)}$ after gradually increasing the output current.

***3.** 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}).
V_{drop}: V_{IN1} - (V_{OUT3} × 0.98)
V_{OUT3}: Output voltage when V_{IN} = $V_{OUT(S)}$ + 5.0 V, I_{OUT} = 200 mA

***4.** The dependency of the output voltage against the input voltage. The value shows how much the output voltage changes due to a change in the input voltage while keeping output current constant.

***5.** The dependency of the output voltage against the output current. The value shows how much the output voltage changes due to a change in the output current while keeping input voltage constant.

***6.** The current limited by overcurrent protection circuit.

***7.** Due to limitation of the power dissipation, this value may not be satisfied. Attention should be paid to the power dissipation when the output current is large. This specification is guaranteed by design.

***8.** The dropout voltage is limited by the difference between the input voltage (min. value) and the set output voltage.
In case of $V_{OUT(S)}$ = 1.8 V: 6.8 V - $V_{OUT(S)}$ = V_{drop}

***9.** Please contact our sales representatives before using products with $V_{OUT(S)}$ > 15.0 V.

■ Test Circuits

1. Type in which output voltage is internally set

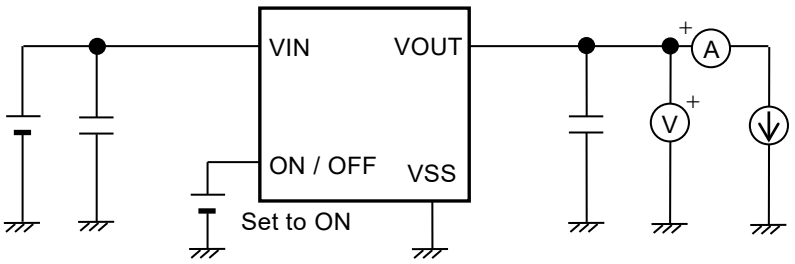


Figure 6 Test Circuit 1

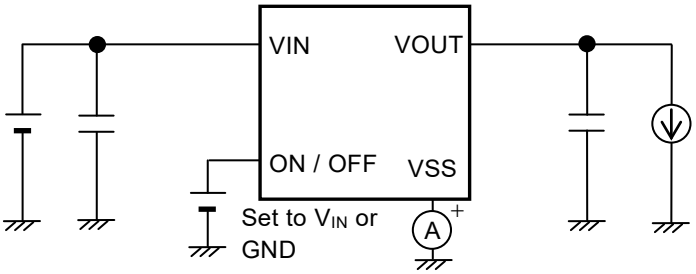


Figure 7 Test Circuit 2

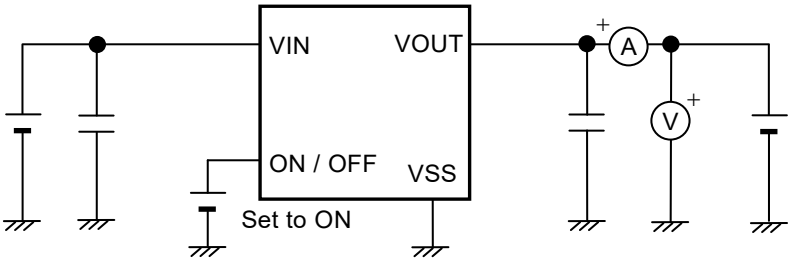


Figure 8 Test Circuit 3

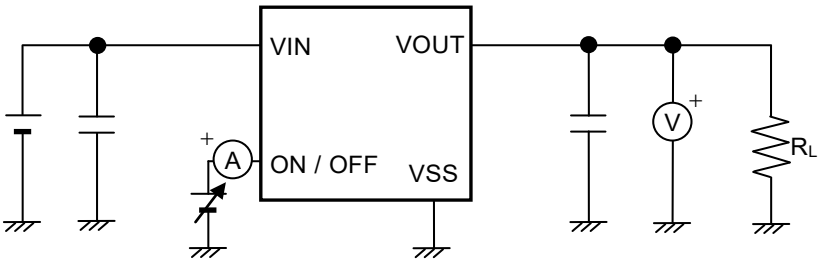


Figure 9 Test Circuit 4

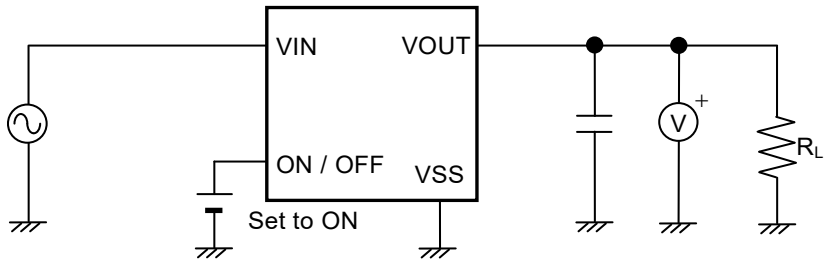


Figure 10 Test Circuit 5

2. Type in which output voltage is externally set

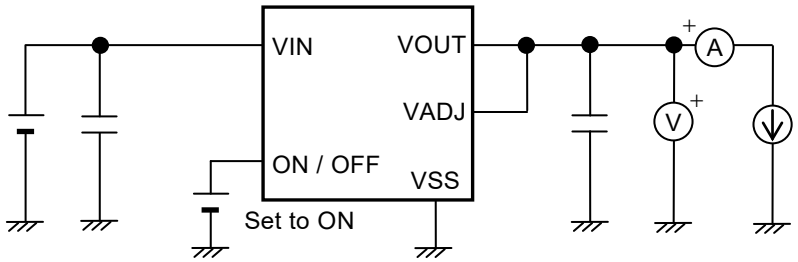


Figure 11 Test Circuit 6

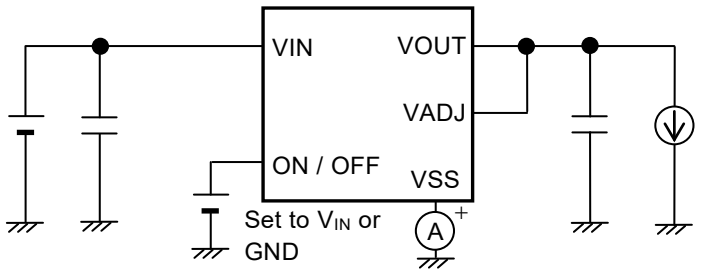


Figure 12 Test Circuit 7

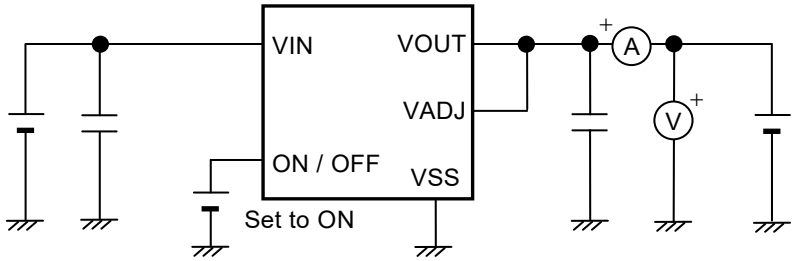


Figure 13 Test Circuit 8

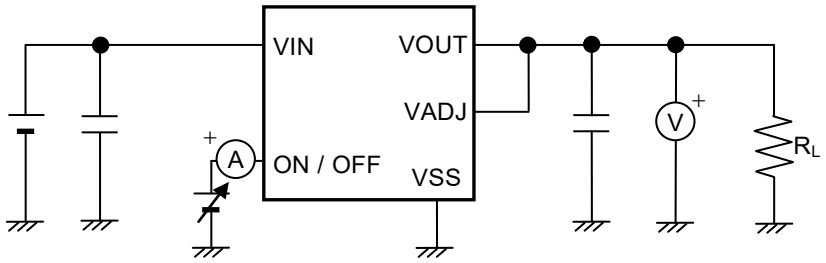


Figure 14 Test Circuit 9

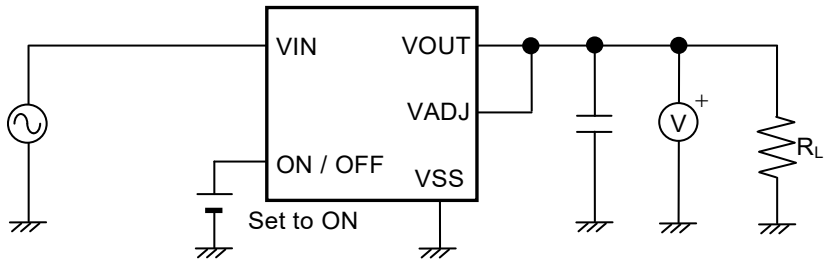


Figure 15 Test Circuit 10

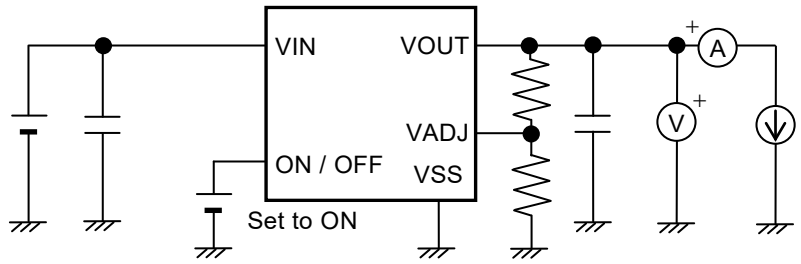
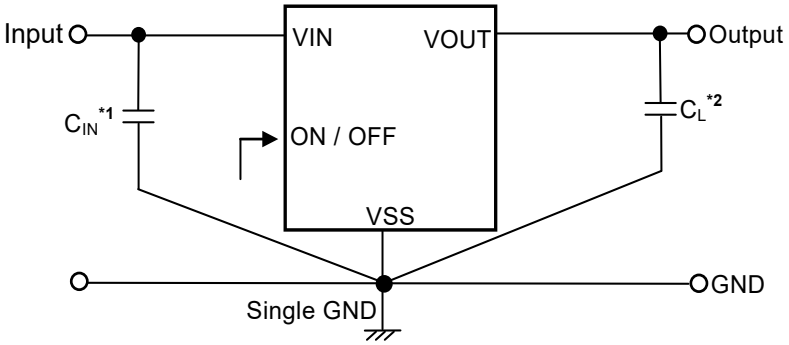


Figure 16 Test Circuit 11

■ Standard Circuits

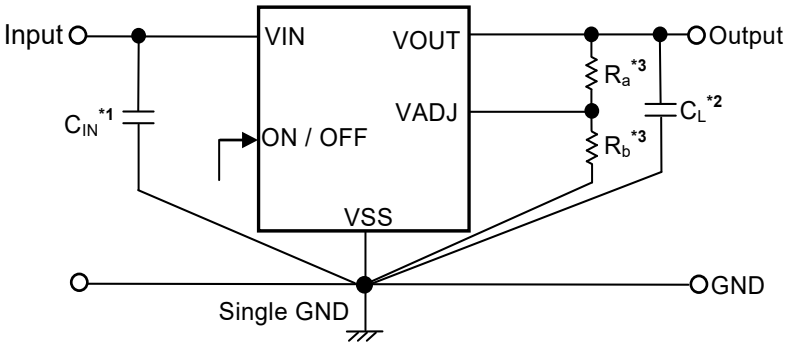
1. Type in which output voltage is internally set



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

Figure 17

2. Type in which output voltage is externally set



***1.** C_{IN} is a capacitor for stabilizing the input.
***2.** C_L is a capacitor for stabilizing the output.
***3.** R_a and R_b are resistors for output voltage external setting.

Figure 18

Caution The above connection diagrams and constants will not guarantee successful operation. Perform thorough evaluation including the temperature characteristics with an actual application to set the constants.

■ Condition of Application

Input capacitor (C_{IN}): A ceramic capacitor with capacitance of 0.1 µF or more is recommended.
Output capacitor (C_L): A ceramic capacitor with capacitance of 1.0 µF or more is recommended.
ESR of output capacitor: A ceramic capacitor with ESR of 30 Ω or less is recommended.

Caution Generally, in a voltage regulator, an oscillation may occur depending on the selection of the external parts. Perform thorough evaluation including the temperature characteristics with an actual application using the above capacitors to confirm no oscillation occurs.

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

This IC requires C_L between the VOUT pin and the VSS pin for phase compensation. The operation is stabilized by a ceramic capacitor with capacitance of 1.0 µF or more. When using an OS capacitor, a tantalum capacitor or an aluminum electrolytic capacitor, the capacitance also must be 1.0 µF or more. However, an oscillation may occur depending on the equivalent series resistance (ESR).
Moreover, this IC requires C_{IN} of 0.1 µF or more between the VIN pin and the VSS pin for a stable operation.
Generally, an oscillaiton may occur when a voltage regulator is used under the conditon that the impedance of the power supply is high.
Note that the output voltage transient characteristics varies depending on the capacitance of C_{IN} and C_L and the value of ESR.

Caution Perform thorough evaluation including the temperature characteristics with an actual application to select C_{IN} and C_L.

■ Selection of Resistors (R_a, R_b) for Output Voltage External Setting

This IC provides the type in which output voltage can be set via the external resistor. The output voltage can be set by connecting a resistor (R_a) between the VOUT pin and the VADJ pin, and a resistor (R_b) between the VADJ pin and the VSS pin.

Depending on the intended output voltage, select R_a and R_b from the range shown in **Table 15**.

Caution Since the VADJ pin impedance is comparatively high and is easily affected by noise, pay adequate attention to the wiring pattern.

Table 15

$V_{OUT(S)}$	R_a	R_b
1.8 V	Connect to VOUT pin	Unnecessary
1.85 V to 15.0 V*1	0.25 kΩ to 2.55 MΩ	10 kΩ to 200 kΩ

***1**. Please contact our sales representatives before using products with $V_{OUT(S)}$ > 15.0 V.

■ Explanation of Terms

1. Output voltage (V_{OUT})

The accuracy of the output voltage is ±1.5% under the specified conditions*1 of input voltage, output current, and temperature.

***1.** Differs depending on the product.

Caution If the certain conditions are not satisfied, the output voltage may deviate from the accuracy range of ±1.5%. Refer to "■ Electrical Characteristics" and "■ Characteristics (Typical Data)" for details.

2. 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.

3. 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.

■ Operation

1. Type in which output voltage is externally set

This IC provides the type in which output voltage can be set via the external resistor. The output voltage can be set by connecting a resistor (R_a) between the VOUT pin and the VADJ pin, and a resistor (R_b) between the VADJ pin and the VSS pin.
The output voltage is determined by the following formulas.

$V_{OUT} = 1.8 + R_a \times I_a$ ·····(1)
By substituting $I_a = I_{VADJ} + 1.8 / R_b$ to above formula (1),
$V_{OUT} = 1.8 + R_a \times (I_{VADJ} + 1.8 / R_b) = 1.8 \times (1.0 + R_a / R_b) + R_a \times I_{VADJ}$ ·····(2)

In above formula (2), $R_a \times I_{VADJ}$ is a factor for the output voltage error.
If $R_a \times I_{VADJ}$ is sufficiently smaller than $1.8 \times (1.0 + R_a / R_b)$, the error can be considered as minute.

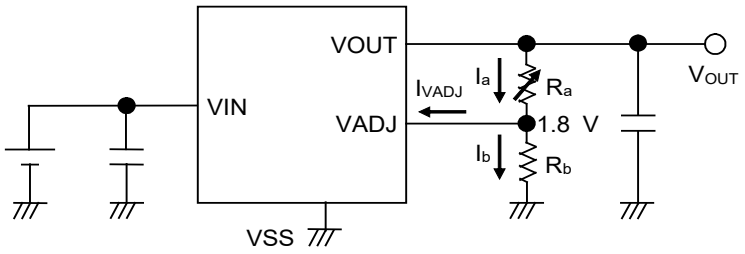


Figure 19

The following expression is in order to determine V_{OUT} = 12.0 V.
In the case of R_b = 10 kΩ, inserting I_{VADJ} = 0.074 μA typ. into equation (2) brings
$R_a = (12.0 - 1.8) / (I_{VADJ} + 1.8 / 10\ k) \approx 56.6\ k\Omega$

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

2. VADJ open-loop protection circuit (Type in which output voltage is externally set)

This IC has a built-in open-loop protection circuit to prevent overvoltage of the output voltage when the circuit becomes open-loop due to an error in the connection between the VOUT pin and VADJ pin.
The open-loop protection circuit controls the internal circuit to suppress the output voltage if the VADJ pin is in the open or short state or if the resistor R_a is in the open state.

If the VADJ pin switches to the open state as shown in **Figure 20**, the open-loop protection circuit will control the internal circuit so that the output voltage is constrained to 0.0 V typ.

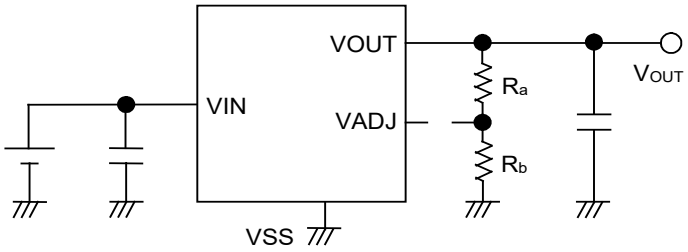


Figure 20 When The VADJ Pin Is In The Open State

If the VADJ pin is in the short state to V_{SS} as shown in **Figure 21**, the open-loop protection circuit will control the internal circuit so that the output voltage is constrained to 1.6 V typ.

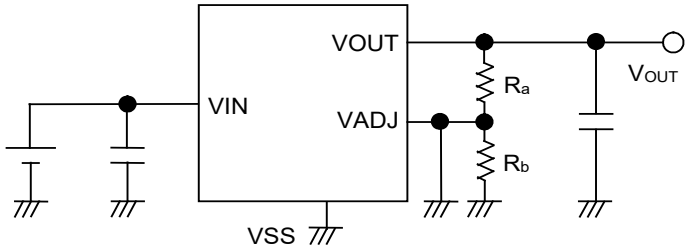


Figure 21 When The VADJ Pin Is In The Short State To V_{SS}

If the VADJ pin is only connected only to the V_{SS} side via resistor R_b, as shown in **Figure 22**, the open-loop protection circuit will control the internal circuit so that the output voltage is constrained to 1.6 V typ.

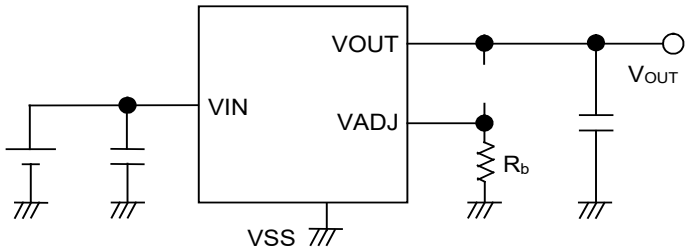


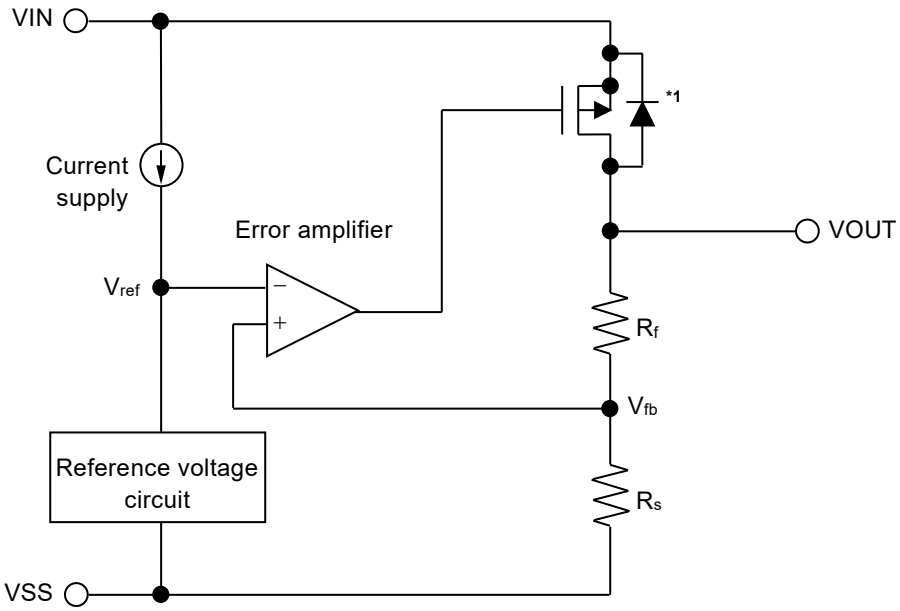
Figure 22 When Resistor R_a Is In The Open State

If 200 kΩ is selected for resistor R_b, ringing may occur in the 0 V to 6 V range of the output voltage.

If the VADJ pin is in the open or short state, or if a connection error such as the open state of resistor R_a is resolved, the set output voltage is output again to the VOUT pin.

3. Basic operation

Figure 23 shows the block diagram of this IC to describe the basic operation.
The error amplifier compares the feedback voltage (V_{fb}) whose output voltage (V_{OUT}) is divided by the feedback resistors (R_s and R_f) with the reference voltage (V_{ref}).
The error amplifier controls the output transistor, consequently, the regulator starts the operation that keeps V_{OUT} constant without the influence of the input voltage (V_{IN}).



***1.** Parasitic diode

Figure 23

4. Output transistor

In this IC, a low on-resistance P-channel MOS FET is used between the VIN pin and the VOUT pin as the output transistor. In order to keep V_{OUT} constant, the on-resistance of the output transistor varies appropriately according to the output current (I_{OUT}).

Caution Since a parasitic diode exists between the VIN pin and the VOUT pin due to the structure of the transistor, the IC may be damaged by a reverse current if V_{OUT} becomes higher than V_{IN}. Therefore, be sure that V_{OUT} does not exceed V_{IN} + 0.3 V.

5. ON / OFF pin

The ON / OFF pin controls the internal circuit and the output transistor in order to start and stop the regulator. When the ON / OFF pin is set to OFF, the internal circuit stops operating and the output transistor between the VIN pin and the VOUT pin is turned off, reducing current consumption significantly.
Note that the current consumption increases when a voltage of 0.8 V to V_{IN} - 0.3 V is applied to the ON / OFF pin.
The ON / OFF pin is configured as shown in **Figure 24**.

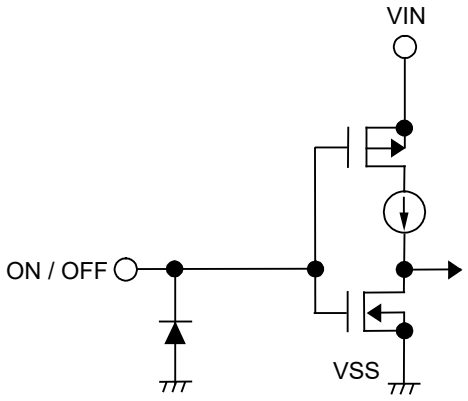


Figure 24

6. Overcurrent protection circuit

This IC has a built-in overcurrent protection circuit to limit the overcurrent of the output transistor. When the VOUT pin is shorted to the VSS pin, that is, at the time of the output short-circuit, the output current is limited to 50 mA typ. due to the overcurrent protection circuit operation. This IC restarts regulating when the output transistor is released from the overcurrent status.

Caution **This overcurrent protection circuit does not work as for thermal protection. For example, when the output transistor keeps the overcurrent status long at the time of output short-circuit or due to other reasons, pay attention to the conditions of the input voltage and the load current so as not to exceed the power dissipation.**

7. Thermal shutdown circuit

This IC has a built-in thermal shutdown circuit to limit overheating. When the junction temperature increases to 170°C typ., the thermal shutdown circuit becomes the detection status, and the regulating is stopped. When the junction temperature decreases to 135°C typ., the thermal shutdown circuit becomes the release status, and the regulator is restarted.

If the thermal shutdown circuit becomes the detection status due to self-heating, the regulating is stopped and V_{OUT} decreases. For this reason, the self-heating is limited and the temperature of the IC decreases. The thermal shutdown circuit becomes release status when the temperature of the IC decreases, and the regulating is restarted thus the self-heating is generated again. Repeating this procedure makes the waveform of V_{OUT} into a pulse-like form. This phenomenon continues unless decreasing either or both of the input voltage and the output current in order to reduce the internal power consumption, or decreasing the ambient temperature. Note that the product may suffer physical damage such as deterioration if the above phenomenon occurs continuously.

Caution **If a large load current flows during the restart process of regulating after the thermal shutdown circuit changes to the release status from the detection status, the thermal shutdown circuit becomes the detection status again due to self-heating, and a problem may happen in the restart of regulating. A large load current, for example, occurs when charging to the C_L whose capacitance is large.**
Perform thorough evaluation including the temperature characteristics with an actual application to select C_L.

Table 16

Thermal Shutdown Circuit	VOUT Pin Voltage
Release: 135°C typ.*1	Constant value*2
Detection: 170°C typ.*1	Pulled down to V_{SS}*3

***1.** Junction temperature
***2.** The constant value is output due to the regulating based on the set output voltage value.
***3.** The VOUT pin voltage is pulled down to V_{SS} due to the feedback resistors (R_s and R_f) and a load.

■ Precautions

- Generally, when a voltage regulator is used under the condition that the load current value is small (0.1 mA or less), the output voltage may increase due to the leakage current of an output transistor.
- Generally, when a voltage regulator is used under the condition that the temperature is high, the output voltage may increase due to the leakage current of an output transistor.
- Generally, when the ON / OFF pin is used under the condition of OFF, the output voltage may increase due to the leakage current of an output transistor.
- Generally, when a voltage regulator is used under the condition that the impedance of the power supply is high, an oscillation may occur. Perform thorough evaluation including the temperature characteristics with an actual application to select C_{IN}.
- Generally, in a voltage regulator, an oscillation may occur depending on the selection of the external parts. The following use conditions are recommended in this IC; however, perform thorough evaluation including the temperature characteristics with an actual application to select C_{IN} and C_L.

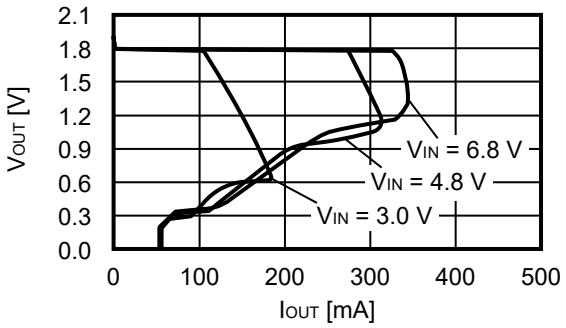
  Input capacitor (C_{IN}): A ceramic capacitor with capacitance of 0.1 µF or more is recommended.
  Output capacitor (C_L): A ceramic capacitor with capacitance of 1.0 µF or more is recommended.

- Generally, in a voltage regulator, the values of an overshoot and an undershoot in the output voltage vary depending on the variation factors of input voltage start-up, input voltage fluctuation, load fluctuation etc., or the capacitance of C_{IN} or C_L and the value of the equivalent series resistance (ESR), which may cause a problem to the stable operation. Perform thorough evaluation including the temperature characteristics with an actual application to select C_{IN} and C_L.
- Generally, in a voltage regulator, an overshoot may occur in the output voltage momentarily if the input voltage steeply changes when the input voltage is started up, the input voltage fluctuates, etc. Perform thorough evaluation including the temperature characteristics with an actual application to confirm no problems happen.
- Generally, in a voltage regulator, if the VOUT pin is steeply shorted with GND, a negative voltage exceeding the absolute maximum ratings may occur in the VOUT pin due to resonance phenomenon of the inductance and the capacitance including C_L on the application. The resonance phenomenon is expected to be weakened by inserting a series resistor into the resonance path, and the negative voltage is expected to be limited by inserting a protection diode between the VOUT pin and the VSS pin.
- If the input voltage is started up steeply under the condition that the capacitance of C_L is large, the thermal shutdown circuit may be in the detection status by self-heating due to the charge current to C_L.
- Make sure of the conditions for the input voltage, output voltage and the load current so that the internal loss does not exceed the power dissipation.
- Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.
- When considering the output current value that the IC is able to output, make sure of the output current value specified in **Table 13** and **Table 14** in "**■ Electrical Characteristics**" and footnote ***7** of the table.
- Wiring patterns on the application related to the VIN pin, the VOUT pin and the VSS pin should be designed so that the impedance is low. When mounting C_{IN} between the VIN pin and the VSS pin and C_L between the VOUT pin and the VSS pin, connect the capacitors as close as possible to the respective destination pins of the IC.
- When setting the output voltage by using an external resistor, connect a resistor (R_a) between the VOUT pin and the VADJ pin and a resistor (R_b) between the VADJ pin and the VSS pin close to the respective pins.
- In the package equipped with heat sink of backside, mount the heat sink firmly. Since the heat radiation differs according to the condition of the application, perform thorough evaluation with an actual application to confirm no problems happen.
- ABLIC Inc. claims no responsibility for any disputes arising out of or in connection with any infringement by products including this IC of patents owned by a third party.

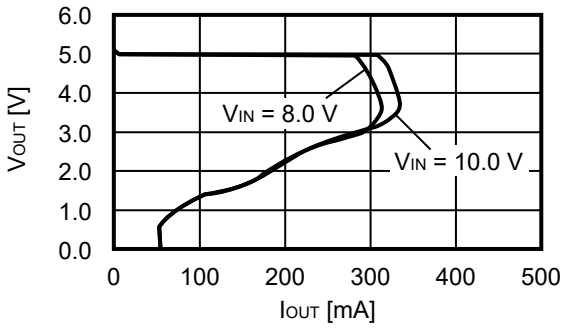
■ Characteristics (Typical Data)

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

1. 1 V_{OUT} = 1.8 V



1. 2 V_{OUT} = 5.0 V

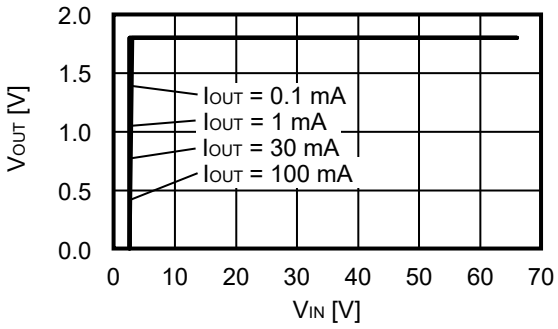


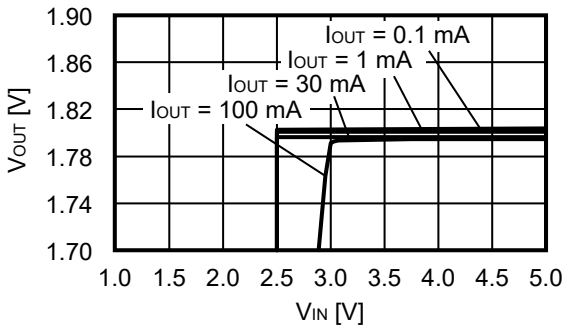
Remark In determining the output current, attention should be paid to the following.

1. The minimum output current value and footnote ***7** of **Table 13** and **Table 14** in "**■ Electrical Characteristics**"
2. Power dissipation

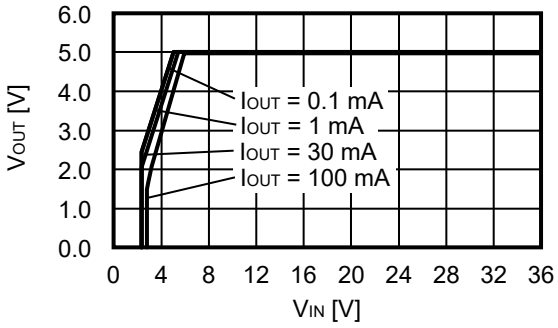
2. Output voltage vs. Input voltage (Ta = +25°C)

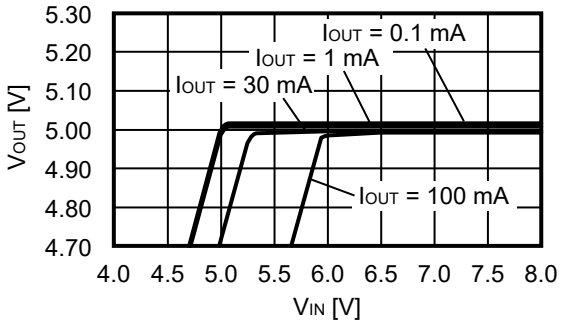
2. 1 V_{OUT} = 1.8 V





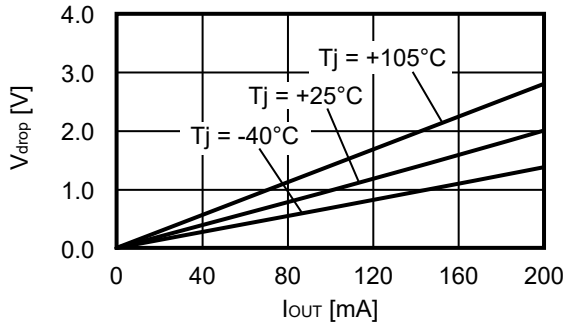
2. 2 V_{OUT} = 5.0 V



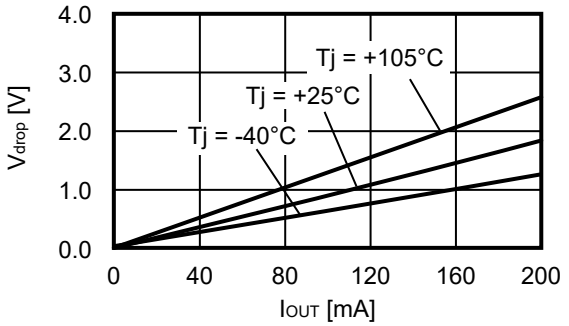


3. Dropout voltage vs. Output current

3. 1 V_{OUT} = 3.3 V

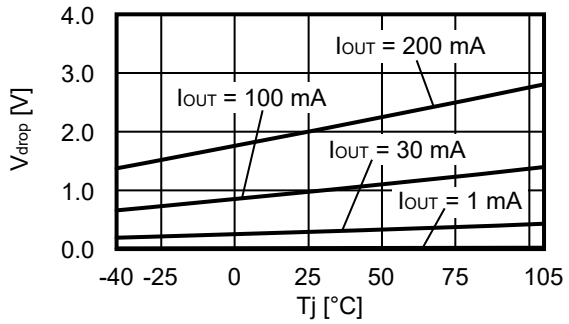


3. 2 V_{OUT} = 5.0 V

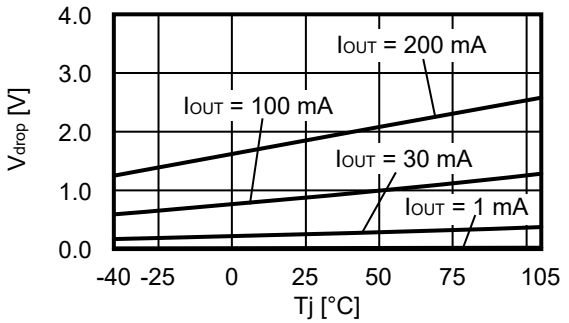


4. Dropout voltage vs. Junction temperature

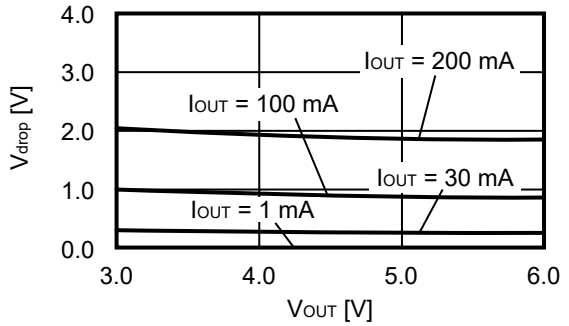
4. 1 V_{OUT} = 3.3 V



4. 2 V_{OUT} = 5.0 V

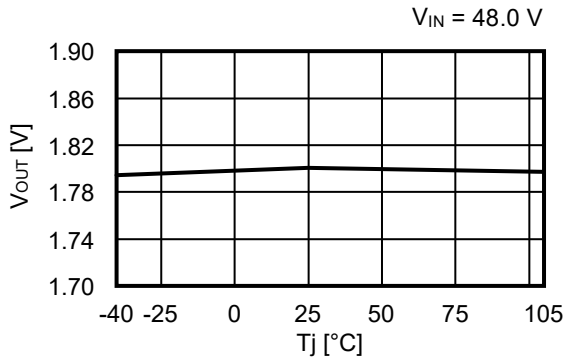


5. Dropout voltage vs. Set output voltage (Ta = +25°C)

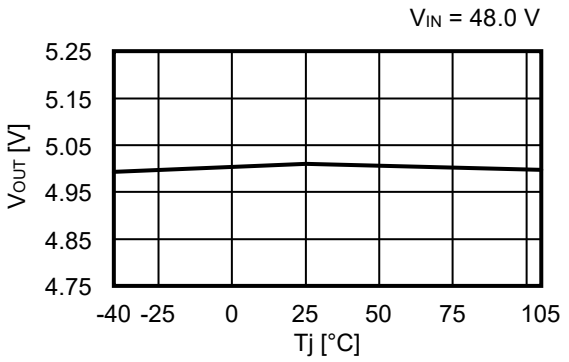


6. Output voltage vs. Junction temperature

6. 1 V_{OUT} = 1.8 V

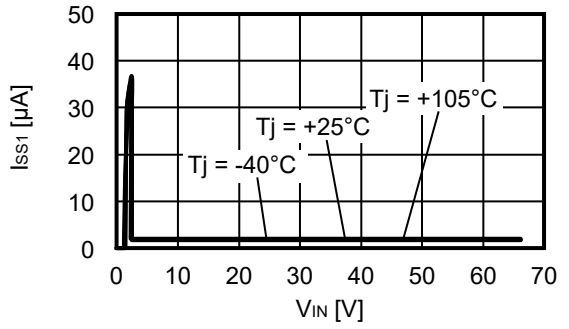


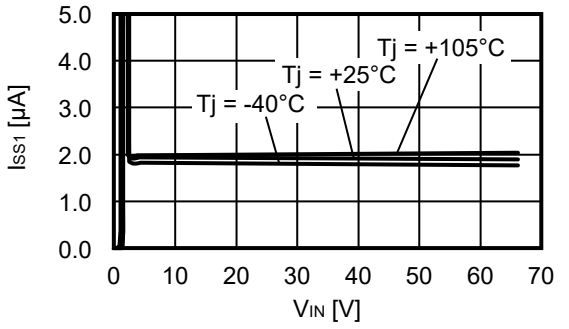
6. 2 V_{OUT} = 5.0 V



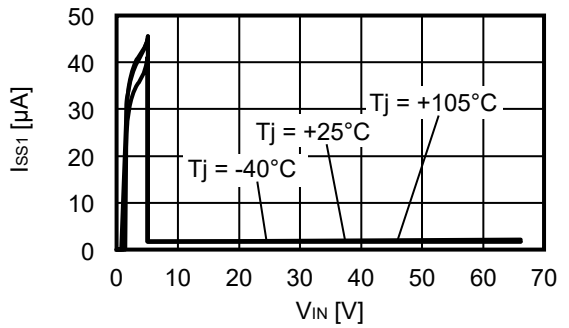
7. Current consumption during operation vs. Input voltage (When ON / OFF pin is ON, no load)

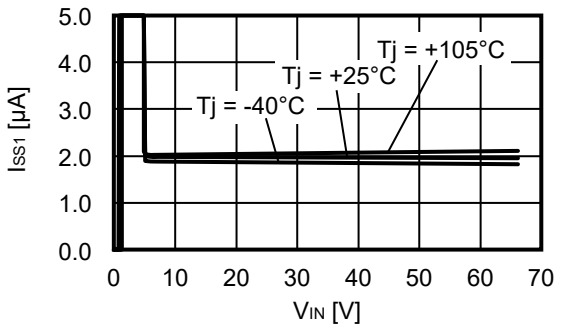
7. 1 V_{OUT} = 1.8 V





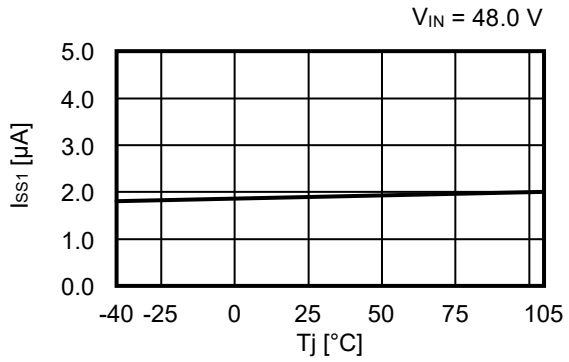
7. 2 V_{OUT} = 5.0 V



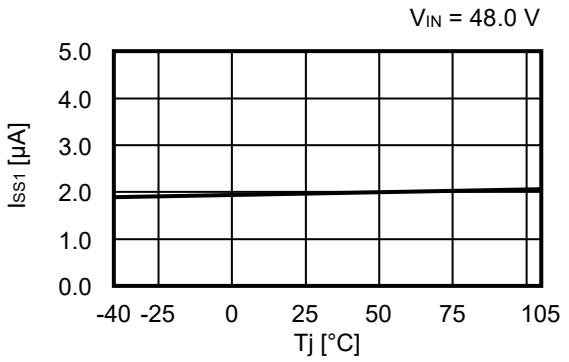


8. Current consumption during operation vs. Junction temperature

8. 1 V_{OUT} = 1.8 V

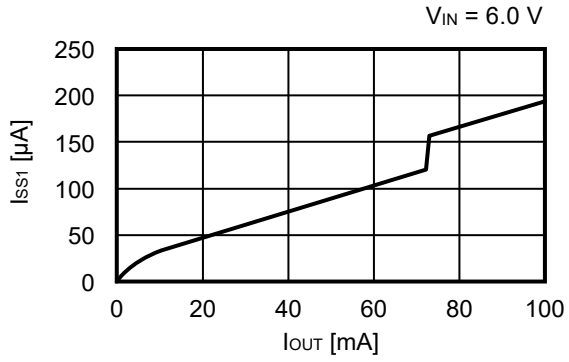


8. 2 V_{OUT} = 5.0 V

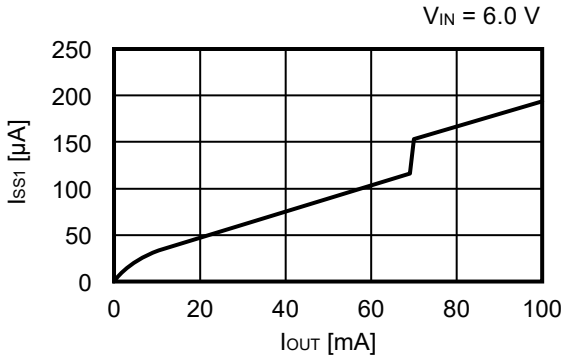


9. Current consumption during operation vs. Output current (Ta = +25°C)

9. 1 V_{OUT} = 1.8 V

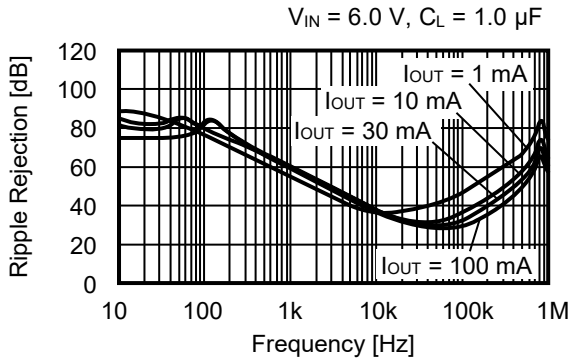


9. 2 V_{OUT} = 5.0 V

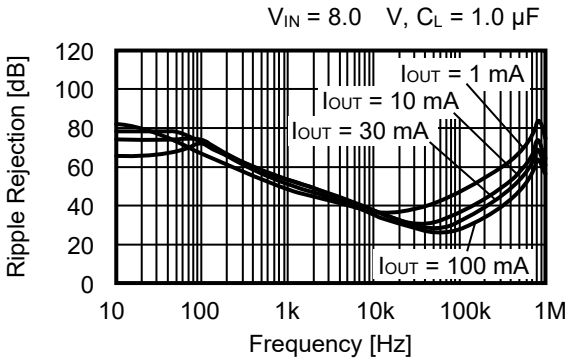


10. Ripple rejection (Ta = +25°C)

10. 1 V_{OUT} = 1.8 V



10. 2 V_{OUT} = 5.0 V

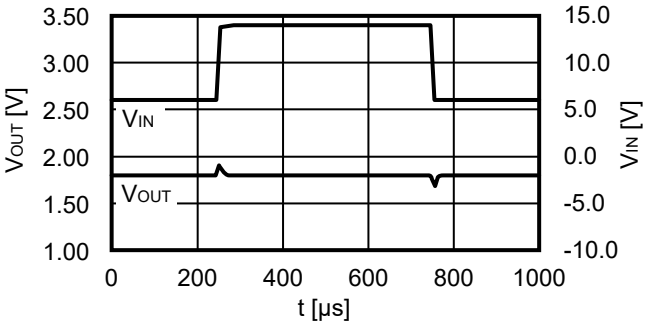


■ Reference Data

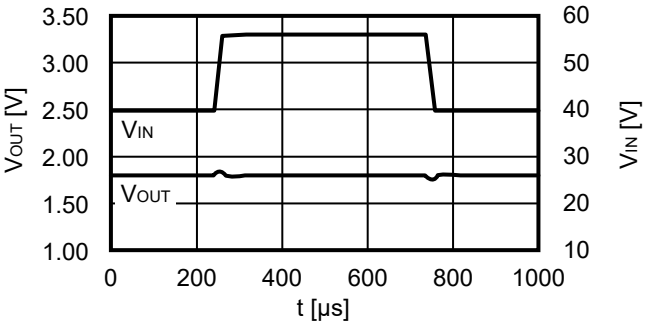
1. Characteristics of input transient response (Ta = +25°C)

1. 1 V_{OUT} = 1.8 V

I_{OUT} = 30 mA, C_L = 1.0 µF,
V_{IN} = 6.0 V ↔ 14.0 V, t_r = t_f = 8.0 µs

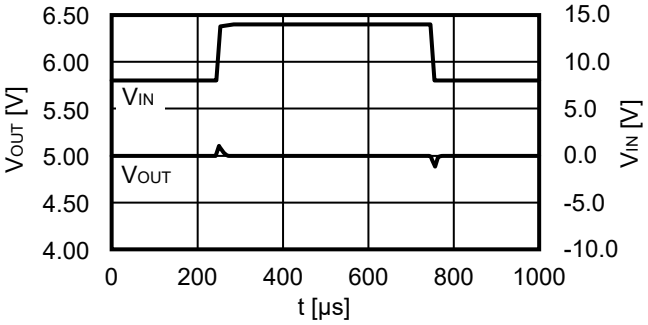


I_{OUT} = 30 mA, C_L = 1.0 µF,
V_{IN} = 40.0 V ↔ 56.0 V, t_r = t_f = 16.0 µs

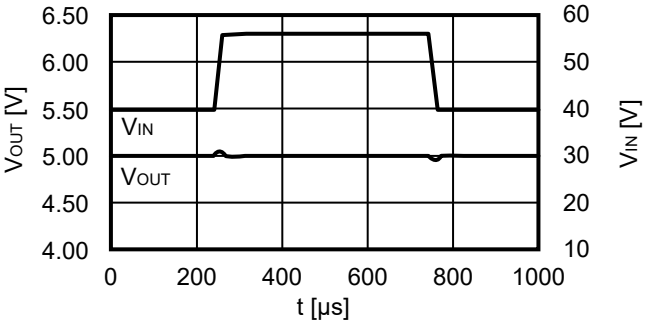


1. 2 V_{OUT} = 5.0 V

I_{OUT} = 30 mA, C_L = 1.0 µF F,
V_{IN} = 8.0 V ↔ 14.0 V, t_r = t_f =6.0 µs



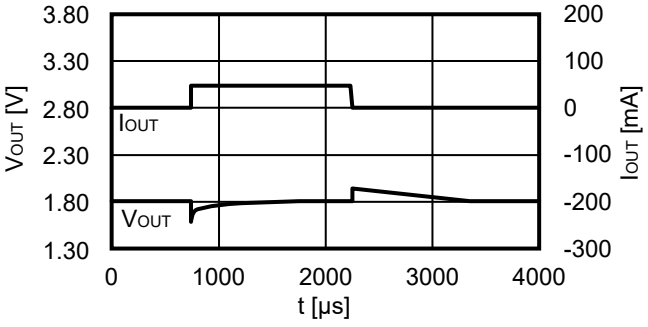
I_{OUT} = 30 mA, C_L = 1.0 µF,
V_{IN} = 40.0 V ↔ 56.0 V, t_r = t_f = 16.0 µs



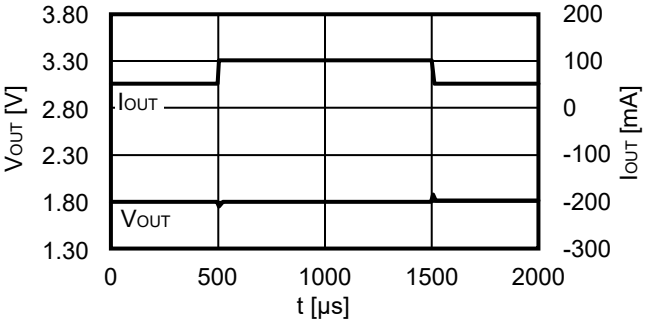
2. Characteristics of load transient response (Ta = +25°C)

2. 1 V_{OUT} = 1.8 V

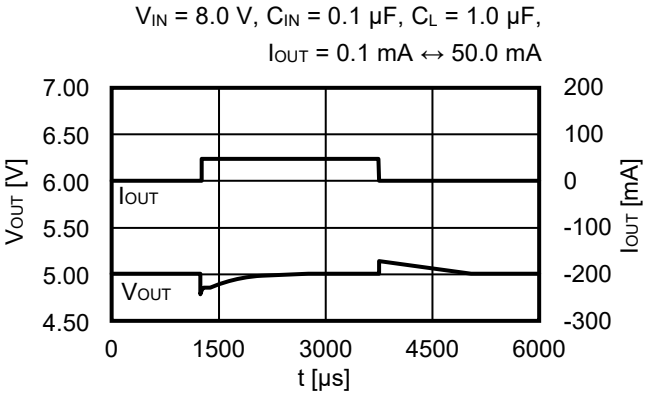
V_{IN} = 6.0 V, C_{IN} = 0.1 µF, C_L = 1.0 µF,
I_{OUT} = 0.1 mA ↔ 50.0 mA

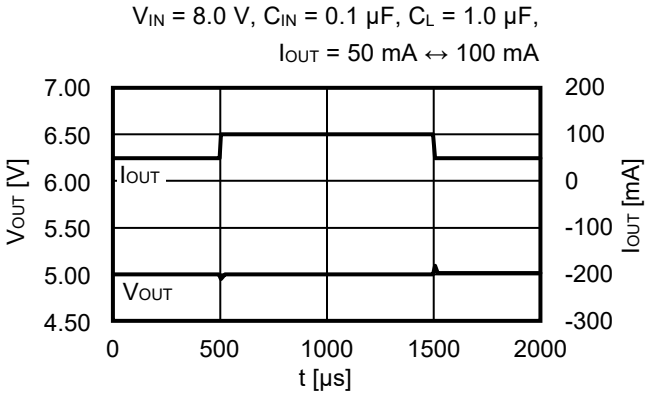


V_{IN} = 6.0 V, C_{IN} = 0.1 µF, C_L = 1.0 µF,
I_{OUT} = 50 mA ↔ 100 mA



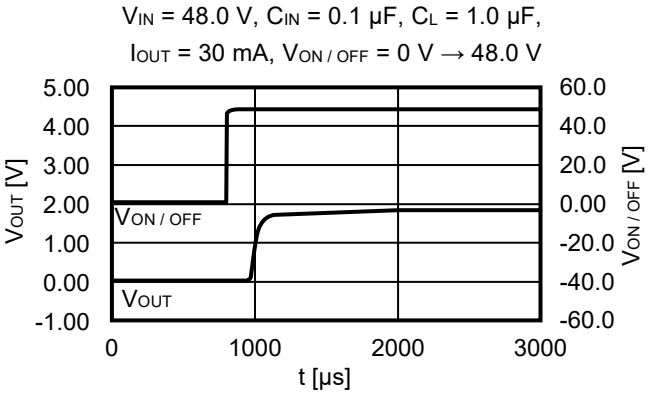
2. 2 V_{OUT} = 5.0 V



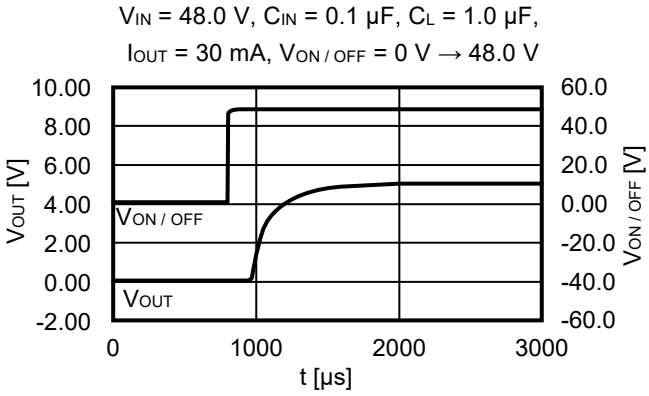


3. Transient response characteristics of ON / OFF pin (Ta = +25°C)

3. 1 V_{OUT} = 1.8 V



3. 2 V_{OUT} = 5.0 V



4. Example of equivalent series resistance vs. Output current characteristics (Ta = -40°C to +105°C)

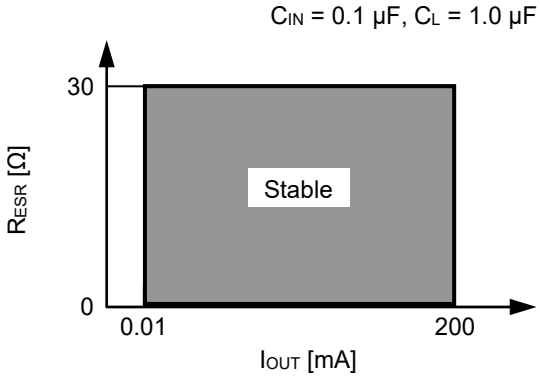
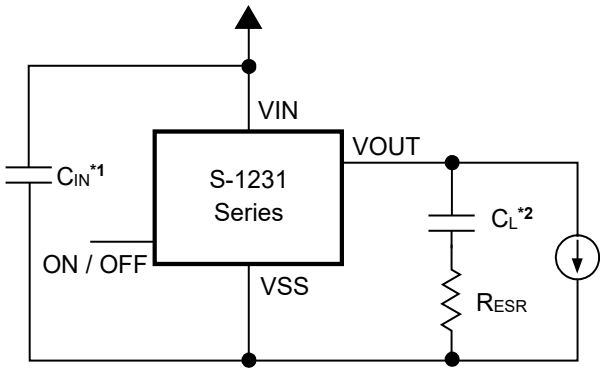


Figure 25

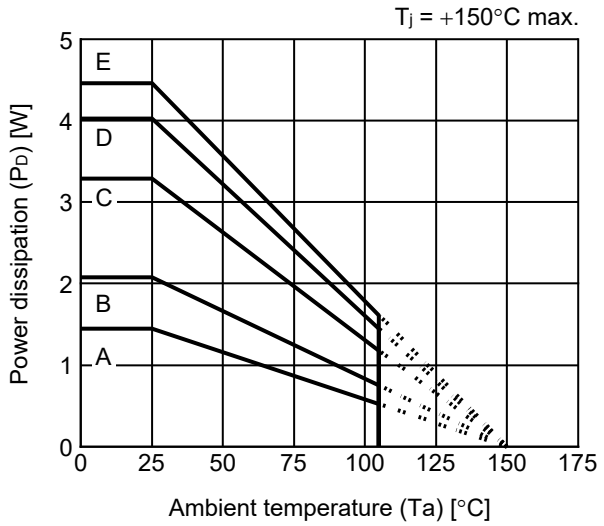


***1.** C_{IN}: TDK Corporation CGA4J2X8R1H104K (0.1 µF)
***2.** C_L: TDK Corporation CGA5L2X7R2A105K (1.0 µF)

Figure 26

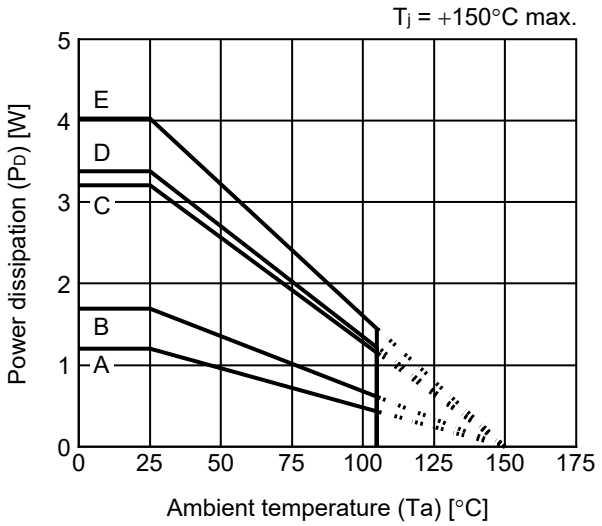
■ Power Dissipation

TO-252-5S(A)



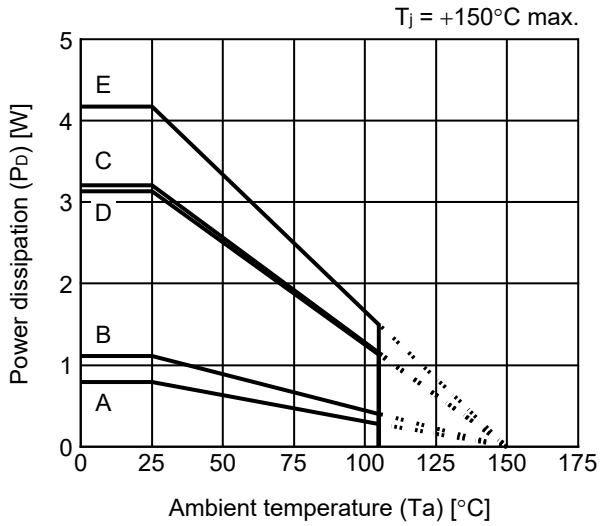
Board	Power Dissipation (P_D)
A	1.45 W
B	2.08 W
C	3.29 W
D	4.03 W
E	4.46 W

HSOP-8A



Board	Power Dissipation (P_D)
A	1.20 W
B	1.69 W
C	3.21 W
D	3.38 W
E	4.03 W

HTMSOP-8

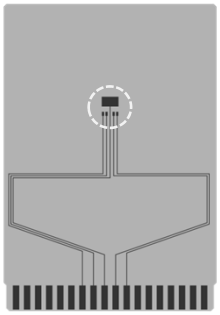


Board	Power Dissipation (P_D)
A	0.79 W
B	1.11 W
C	3.21 W
D	3.13 W
E	4.17 W

TO-252-5S Test Board

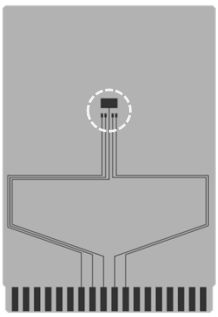
(1) Board A

IC Mount Area



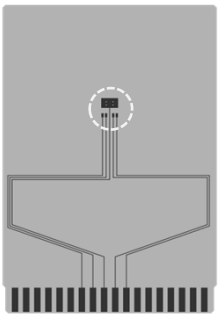
Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		2
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	-
	3	-
	4	74.2 x 74.2 x t0.070
Thermal via		-

(2) Board B

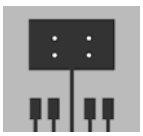


Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		-

(3) Board C



Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		Number: 4 Diameter: 0.3 mm



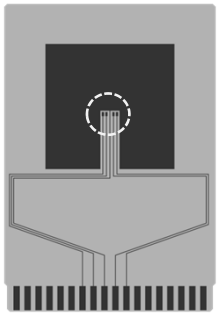
enlarged view

No. TO252-5S-A-Board-SD-1.0

TO-252-5S Test Board

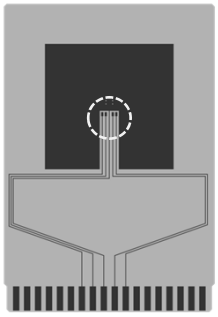
(4) Board D

IC Mount Area



Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Pattern for heat radiation: 2000mm^2 t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		-

(5) Board E



Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Pattern for heat radiation: 2000mm^2 t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		Number: 4 Diameter: 0.3 mm

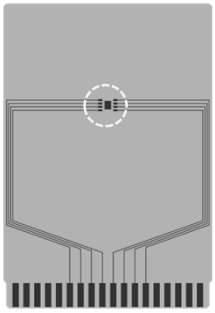
enlarged view

No. TO252-5S-A-Board-SD-1.0

HSOP-8A Test Board

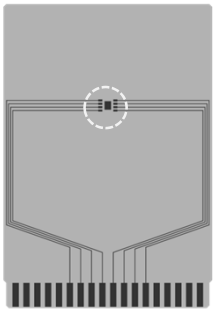
(1) Board A

IC Mount Area



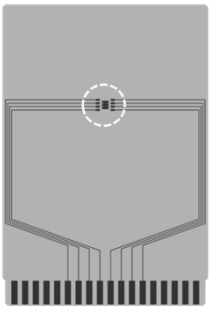
Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		2
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	-
	3	-
	4	74.2 x 74.2 x t0.070
Thermal via		-

(2) Board B

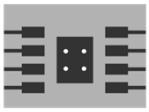


Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		-

(3) Board C



Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		Number: 4 Diameter: 0.3 mm



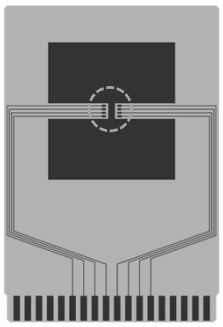
enlarged view

No. HSOP8A-A-Board-SD-1.0

HSOP-8A Test Board

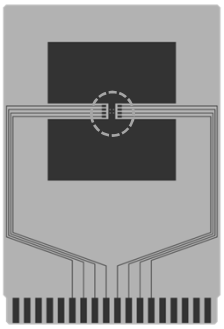
(4) Board D

IC Mount Area

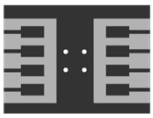


Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Pattern for heat radiation: 2000mm2 t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		-

(5) Board E



Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Pattern for heat radiation: 2000mm^2 t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		Number: 4 Diameter: 0.3 mm



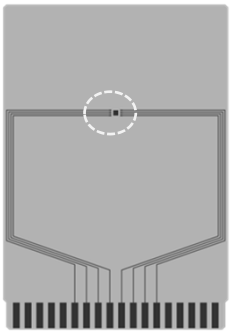
enlarged view

No. HSOP8A-A-Board-SD-1.0

HTMSOP-8 Test Board

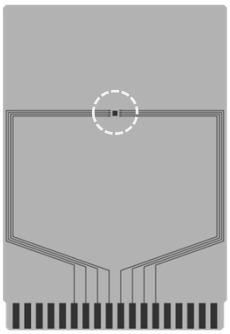
IC Mount Area

(1) Board A



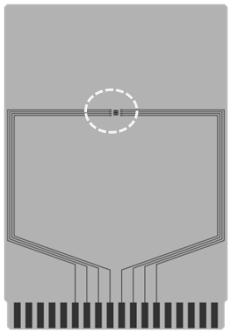
Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		2
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	-
	3	-
	4	74.2 x 74.2 x t0.070
Thermal via		-

(2) Board B



Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		-

(3) Board C



enlarged view

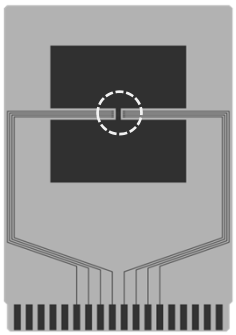
Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Land pattern and wiring for testing: t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		Number: 4 Diameter: 0.3 mm

No. HTMSOP8-A-Board-SD-1.0

HTMSOP-8 Test Board

IC Mount Area

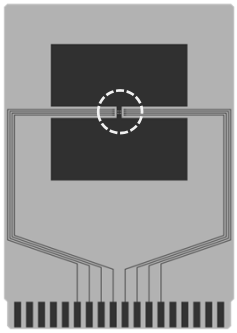
(4) Board D



enlarged view

Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Pattern for heat radiation: 2000mm^2 t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		-

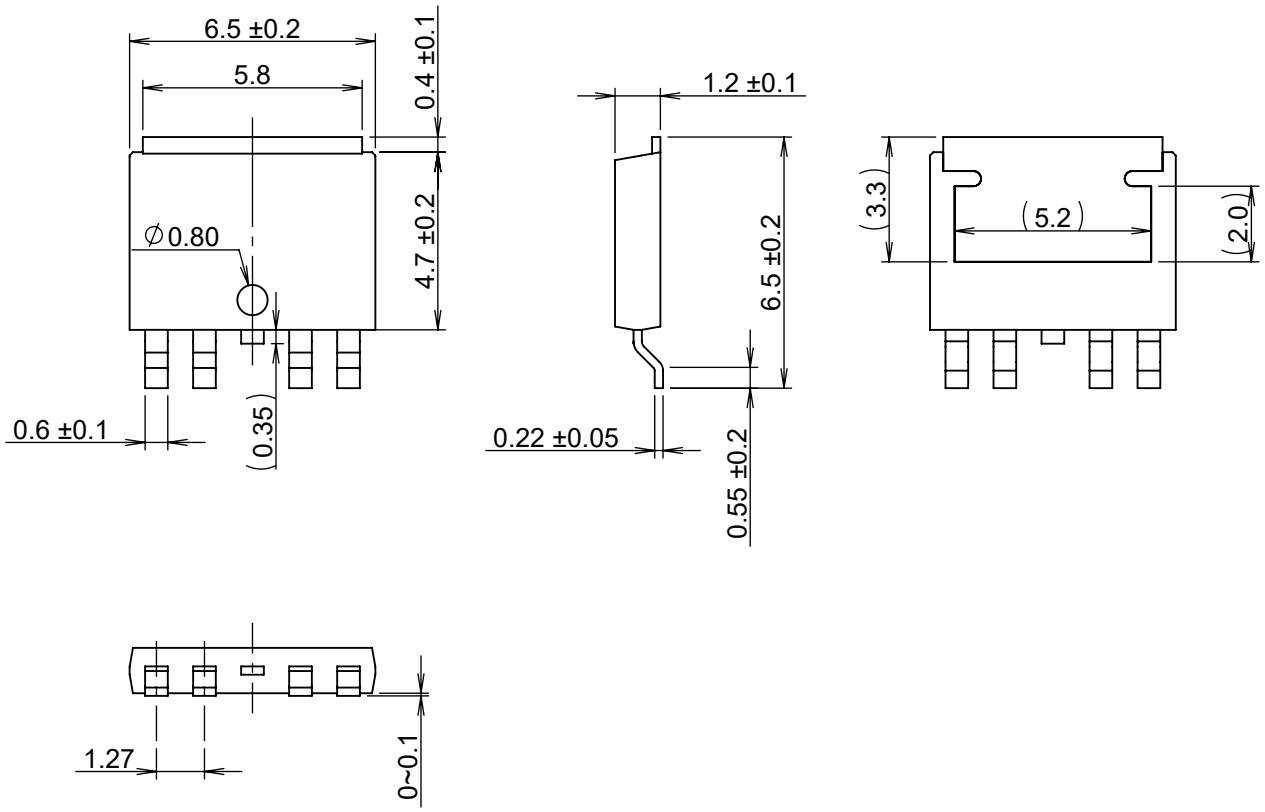
(5) Board E



enlarged view

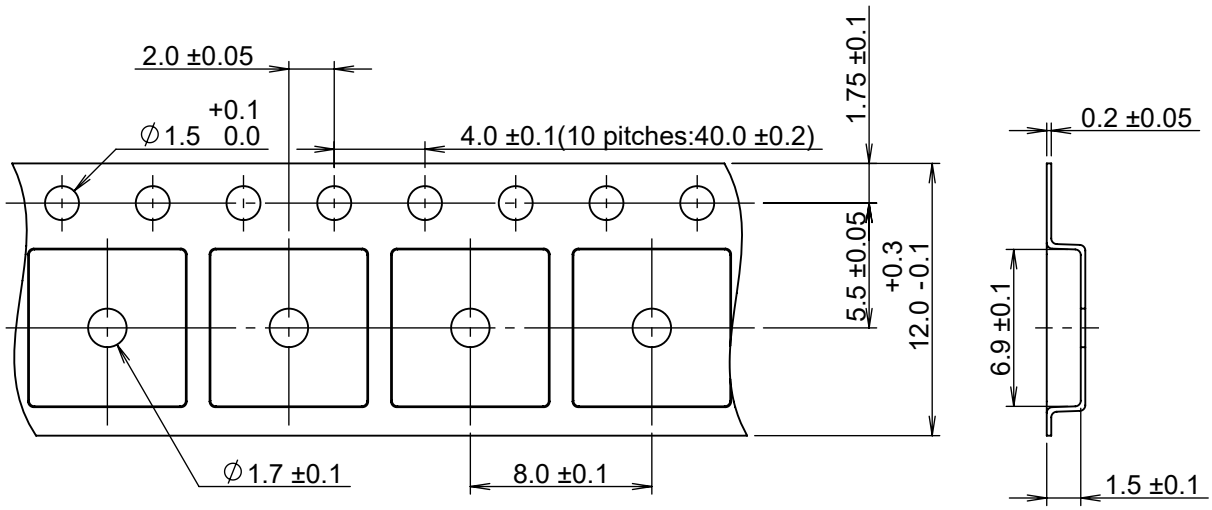
Item		Specification
Size [mm]		114.3 x 76.2 x t1.6
Material		FR-4
Number of copper foil layer		4
Copper foil layer [mm]	1	Pattern for heat radiation: 2000mm^2 t0.070
	2	74.2 x 74.2 x t0.035
	3	74.2 x 74.2 x t0.035
	4	74.2 x 74.2 x t0.070
Thermal via		Number: 4 Diameter: 0.3 mm

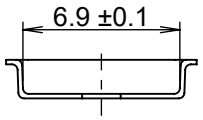
No. HTMSOP8-A-Board-SD-1.0

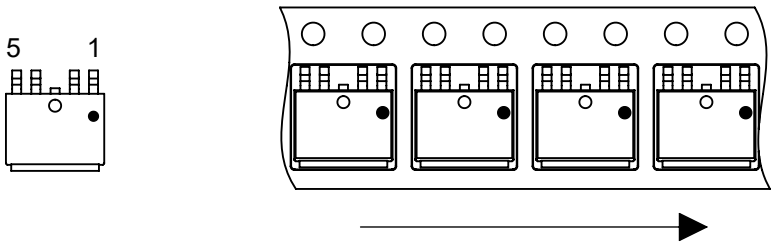


No. VA005-A-P-SD-2.0

TITLE	TO-252-5S-A-PKG Dimensions
No.	VA005-A-P-SD-2.0
ANGLE	
UNIT	mm
ABLIC Inc.	

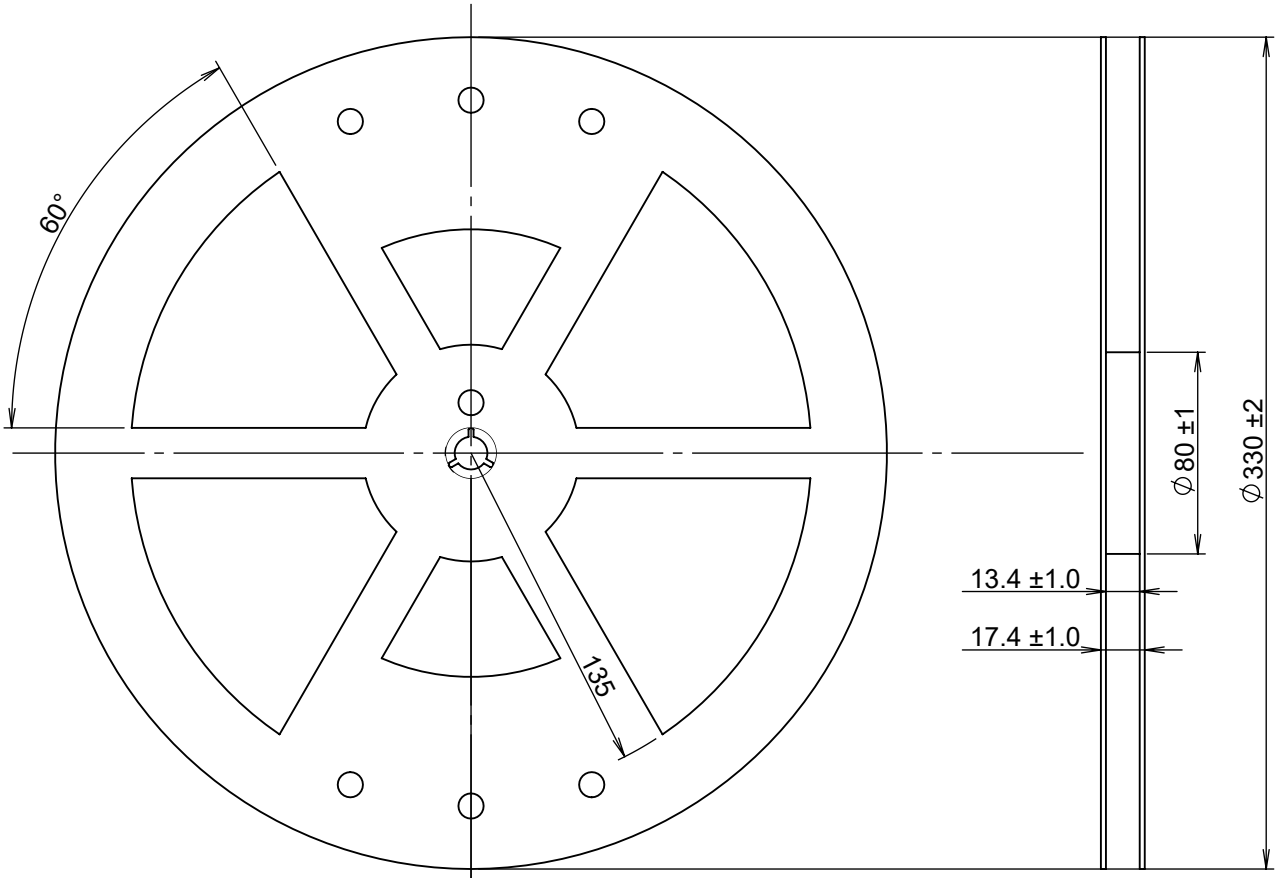




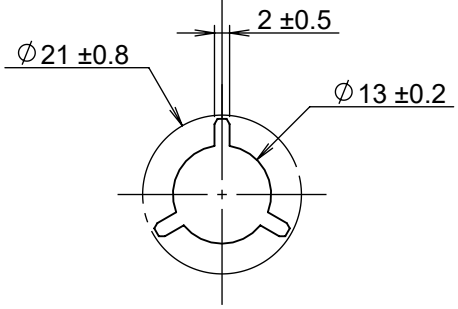


No. VA005-A-C-SD-1.0

TITLE	TO-252-5S-A-Carrier Tape
No.	VA005-A-C-SD-1.0
ANGLE	
UNIT	mm
ABLIC Inc.	

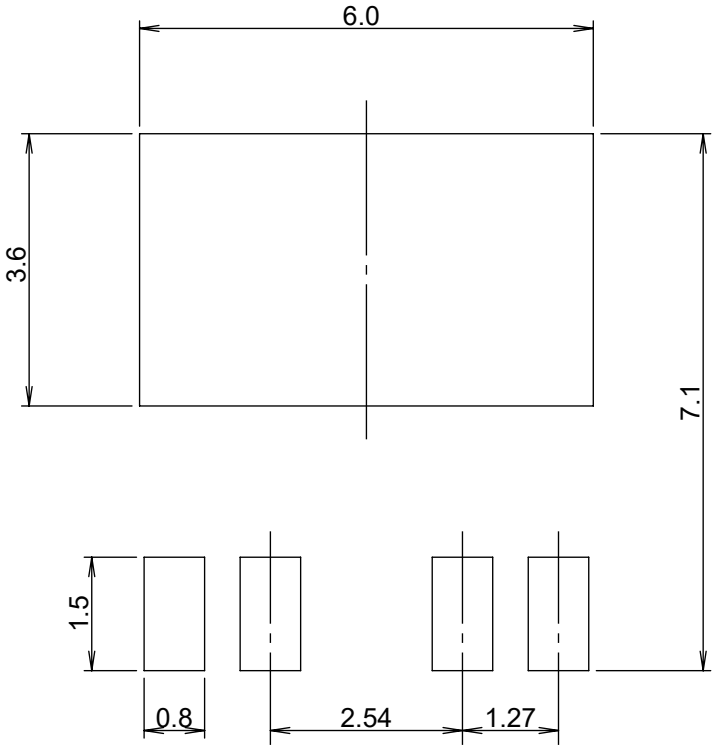


Enlarged drawing in the central part



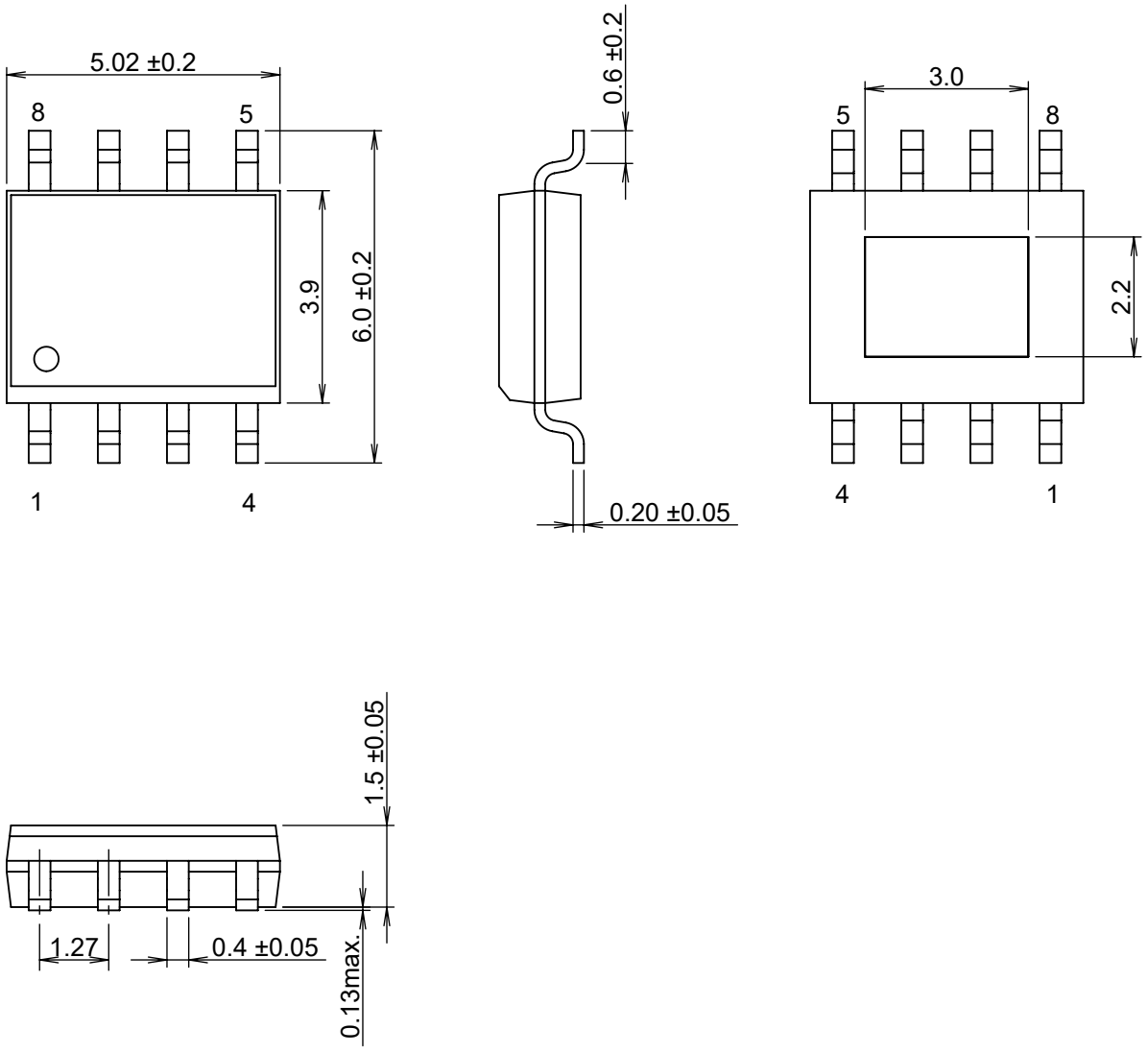
No. VA005-A-R-SD-1.1

TITLE	TO-252-5S-A-Reel		
No.	VA005-A-R-SD-1.1		
ANGLE		QTY.	4,000
UNIT	mm		
ABLIC Inc.			



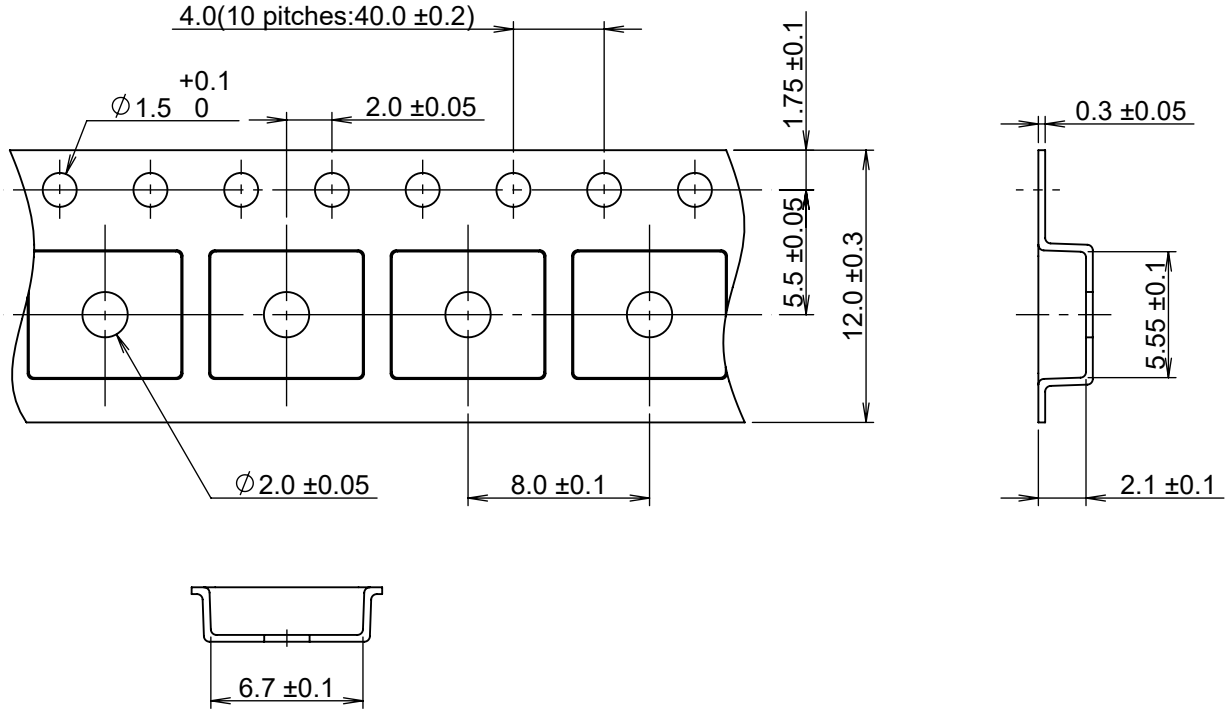
No. VA005-A-L-SD-1.0

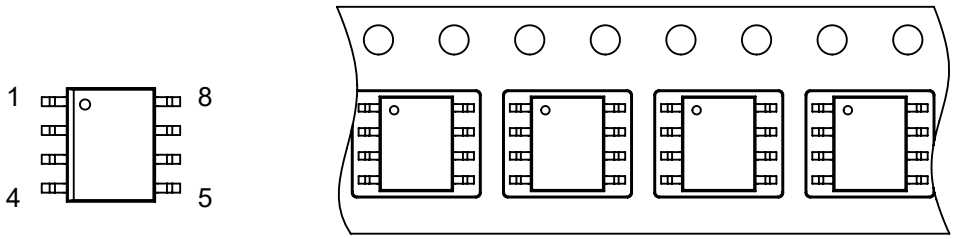
TITLE	TO-252-5S-A -Land Recommendation
No.	VA005-A-L-SD-1.0
ANGLE	
UNIT	mm
ABLIC Inc.	



No.FH008-A-P-SD-2.0

TITLE	HSOP8A-A-PKG Dimensions
No.	FH008-A-P-SD-2.0
ANGLE	
UNIT	mm
ABLIC Inc.	

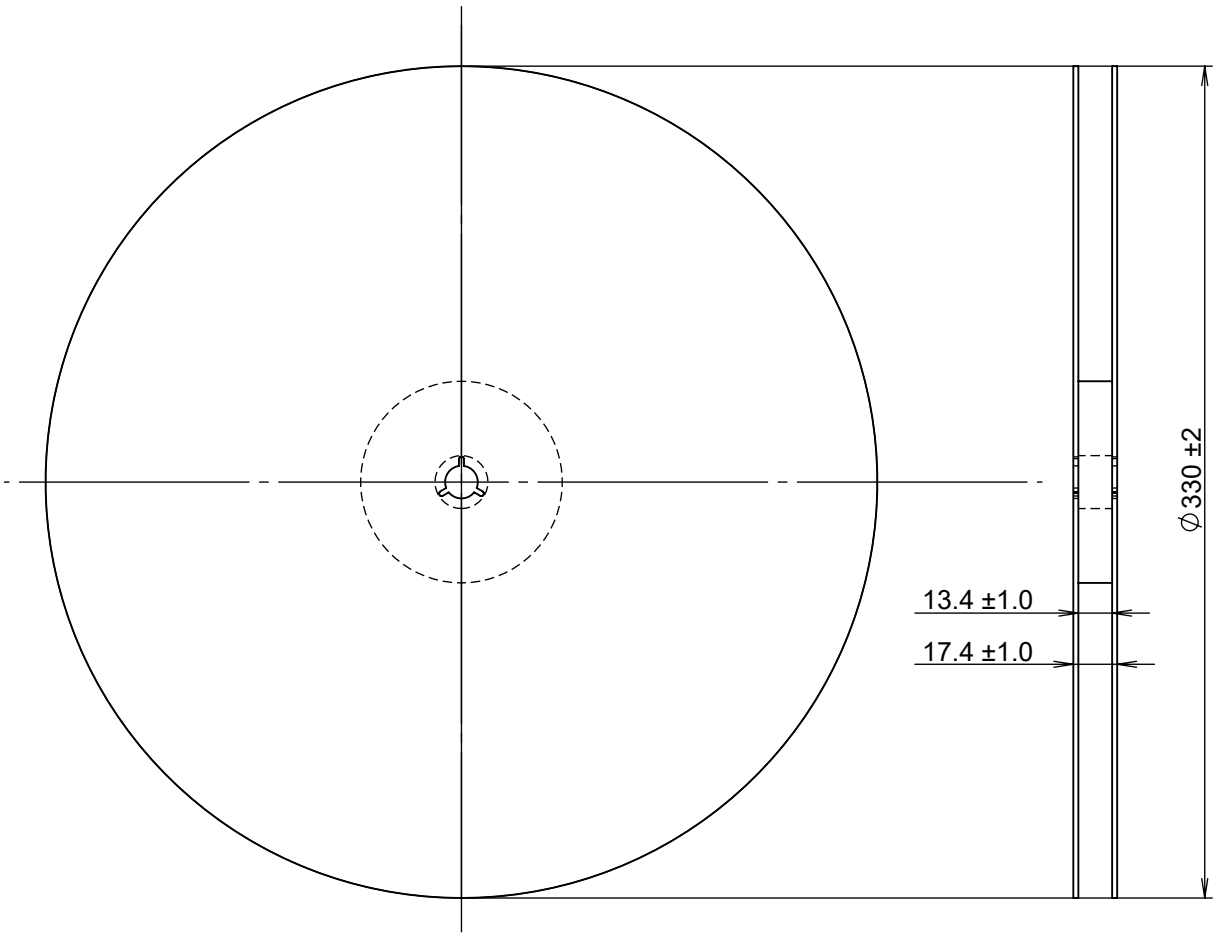




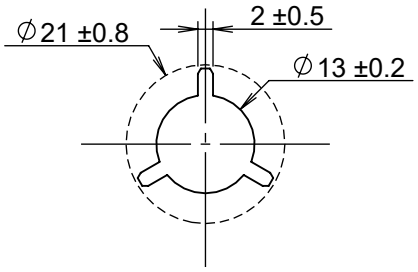
Feed direction

No. FH008-A-C-SD-1.0

TITLE	HSOP8A-A-Carrier Tape
No.	FH008-A-C-SD-1.0
ANGLE	
UNIT	mm
ABLIC Inc.	

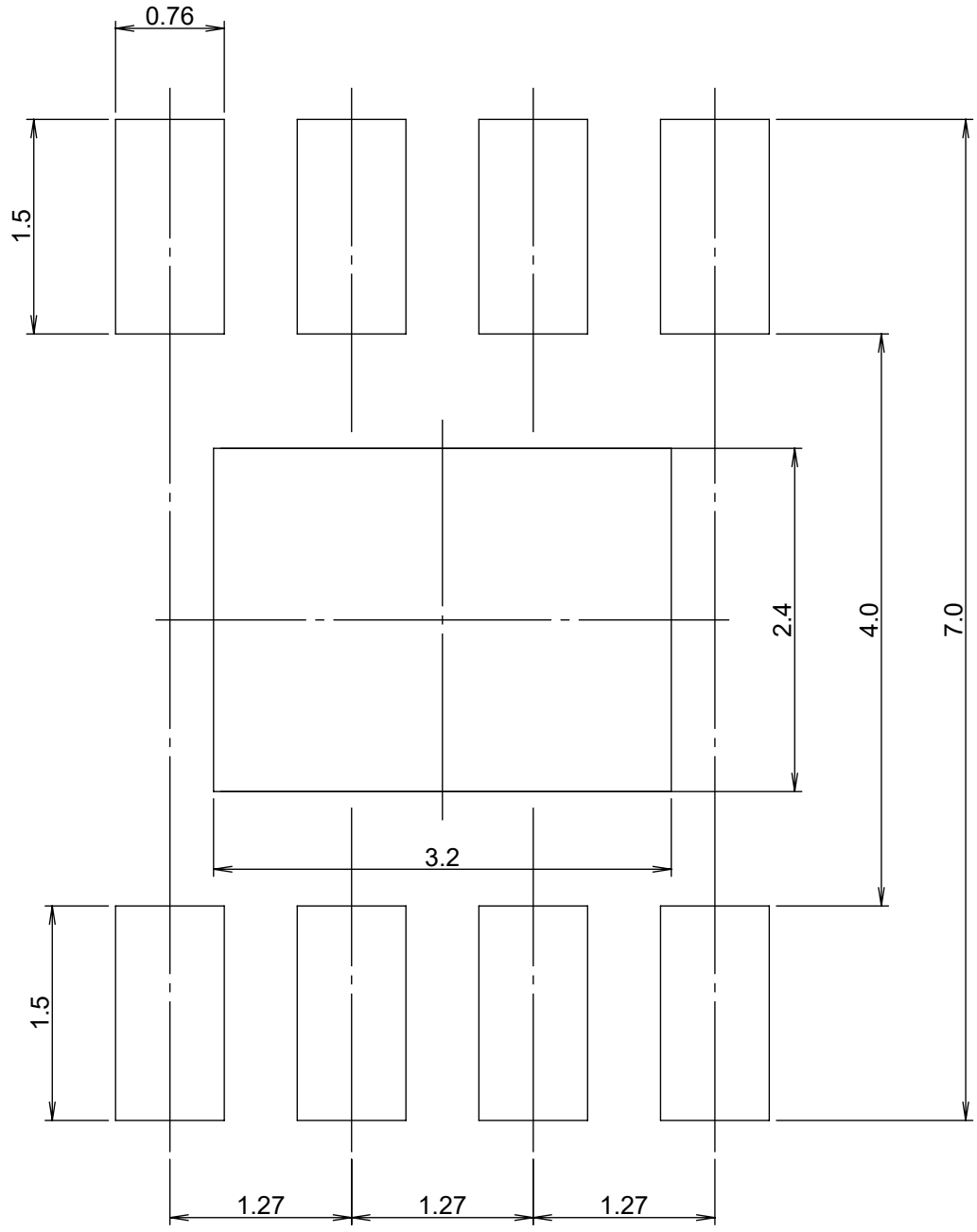


Enlarged drawing in the central part



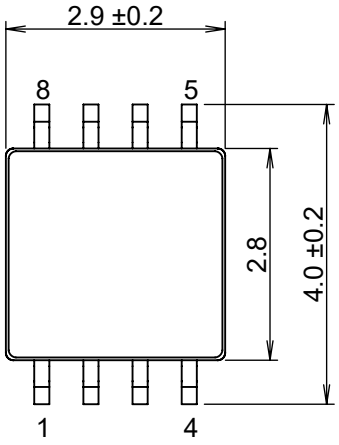
No. FH008-A-R-SD-1.1

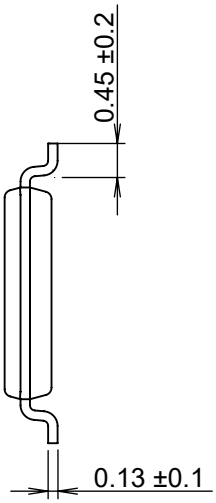
TITLE	HSOP8A-A-Reel		
No.	FH008-A-R-SD-1.1		
ANGLE		QTY.	4,000
UNIT	mm		
ABLIC Inc.			

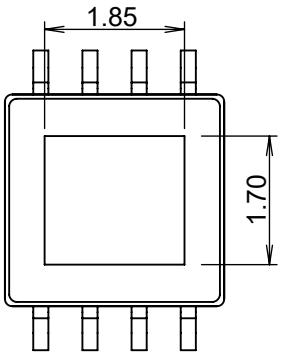


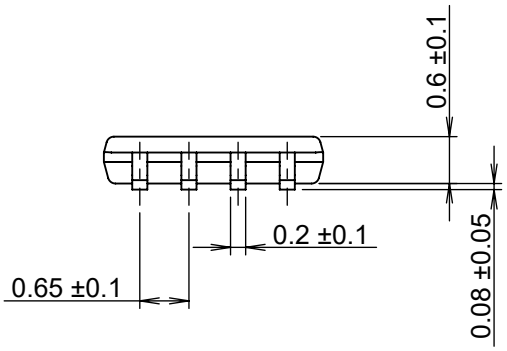
No. FH008-A-L-SD-1.0

TITLE	HSOP8A-A -Land Recommendation
No.	FH008-A-L-SD-1.0
ANGLE	
UNIT	mm
ABLIC Inc.	



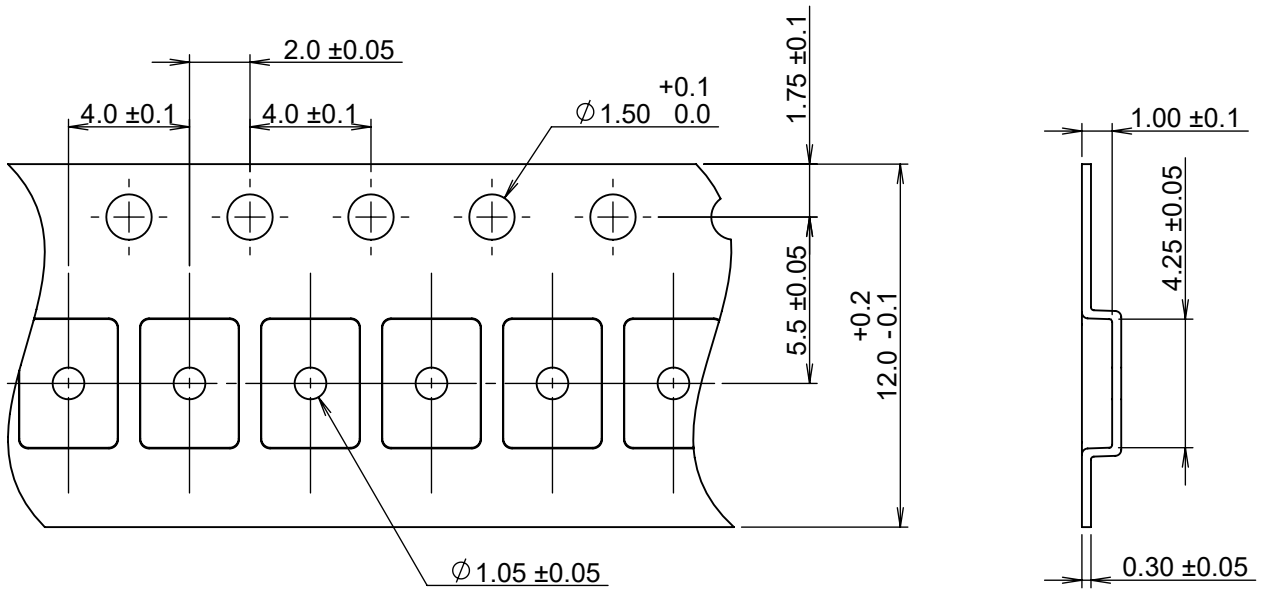


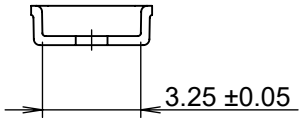


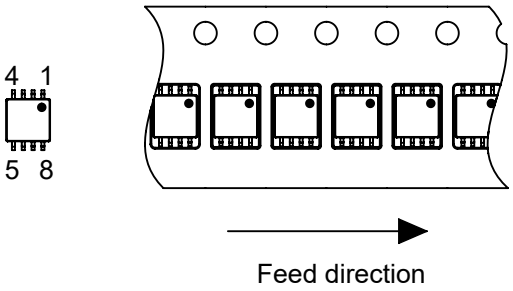


No. FP008-A-P-SD-2.0

TITLE	HTMSOP8-A-PKG Dimensions
No.	FP008-A-P-SD-2.0
ANGLE	
UNIT	mm
ABLIC Inc.	

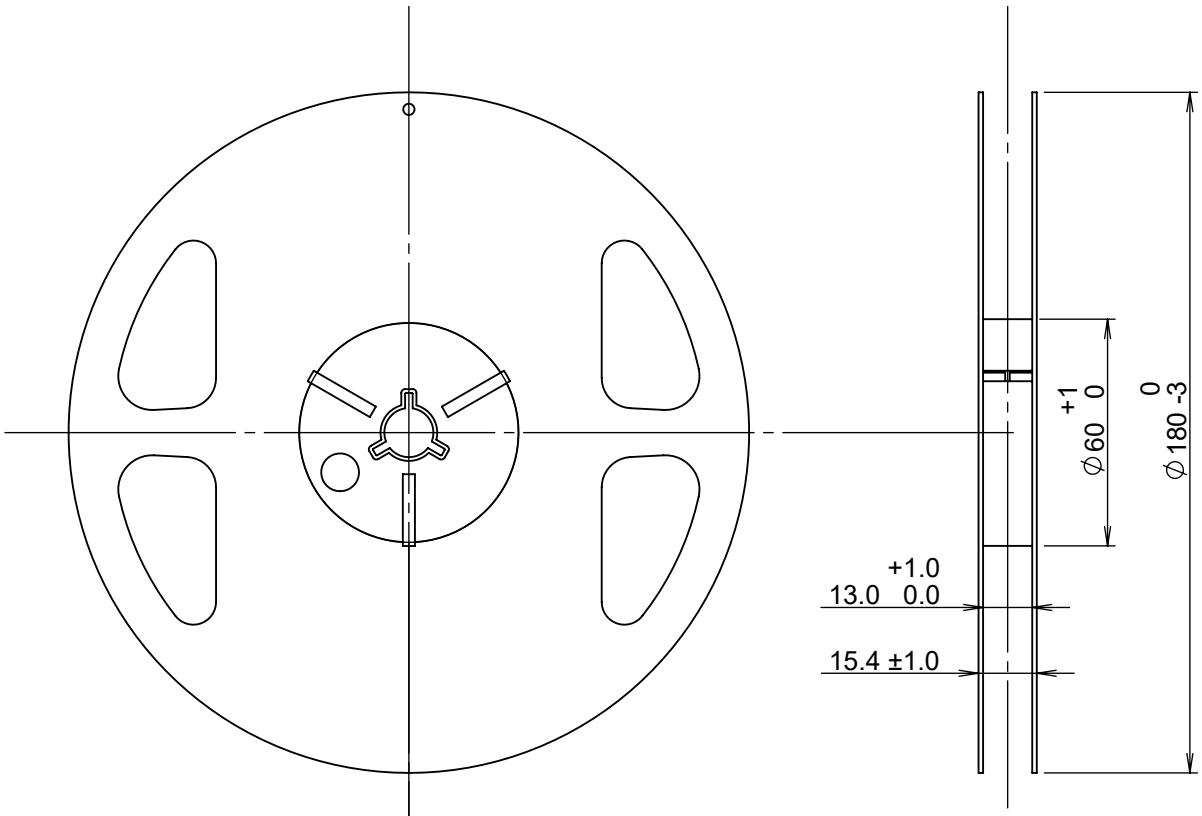




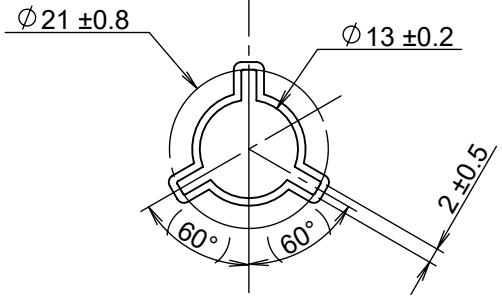


No. FP008-A-C-SD-1.0

TITLE	HTMSOP8-A-Carrier Tape
No.	FP008-A-C-SD-1.0
ANGLE	
UNIT	mm
ABLIC Inc.	

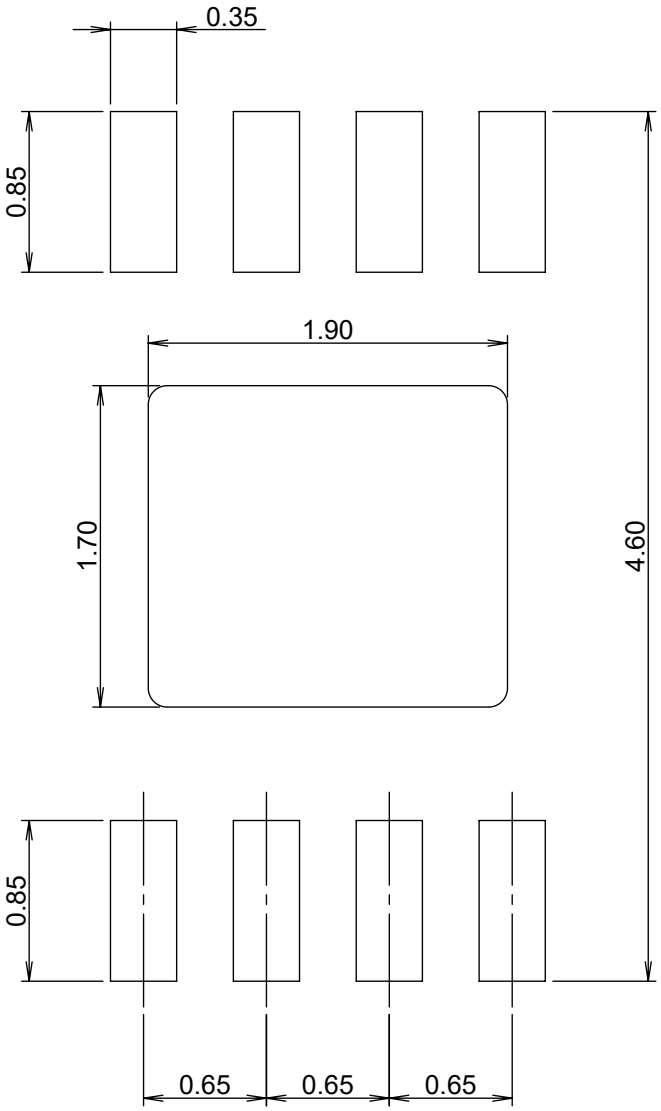


Enlarged drawing in the central part



No. FP008-A-R-SD-2.0

TITLE	HTMSOP8-A-Reel		
No.	FP008-A-R-SD-2.0		
ANGLE		QTY.	4,000
UNIT	mm		
ABLIC Inc.			



No. FP008-A-L-SD-2.0

TITLE	HTMSOP8-A -Land Recommendation
No.	FP008-A-L-SD-2.0
ANGLE	
UNIT	mm
ABLIC Inc.	

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2.4-2019.07