R1525x Series

200 mA 42 V Ultra Low Supply Current Voltage Regulator

No. EA-520-230703

OVERVIEW

The R1525x is a low supply current voltage regulator featuring 200 mA output current and up to 42 V input voltage. By providing excellent noise immunity, this device is suitable for the power source for control unit used under the electromagnetic environment.

KEY BENEFITS

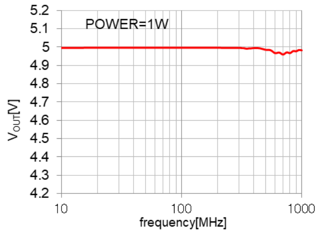
- Achieves low-supply current of 2.2μA (Typ.) with the LDO at maximum rating 50 V (Peak Inrush Voltage: 60 V).
- Ensures the design margin by the output voltage with high-accuracy of ±0.6% (Ta=25°C).
- Protects the output voltage variations in high-frequency noise band (10MHz to 1GHz).

KEY SPECIFICATIONS

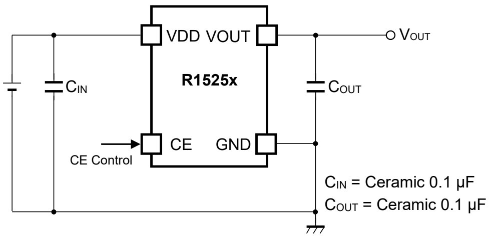
- Input Voltage Range: 3.5 V to 42.0 V
- Maximum Rating: 50 V (Peak Inrush Voltage: 60 V@200ms or less)
- Operating Temperature Range: −40°C to 105°C
- Supply Current: Typ. 2.2 μA (Typ. 0.1 μA at Standby)
- Dropout Voltage: Typ. 0.6 V (I_{OUT} = 200 mA, V_{OUT} = 5.0 V)
- Output Voltage Range: 1.8 V, 2.5 V, 2.8 V, 3.0 V, 3.3 V, 3.4 V, 5.0 V, 5.5 V, 6.0 V, 6.4 V, 8.0 V, 8.5 V, 9.0 V, 10.0 V, 10.5 V, 11.0 V, 12.0 V
- Output Voltage Accuracy: ±0.6% (Ta = 25°C)
  ±1.6% (−40°C ≤ Ta ≤ 105°C)
- Input Stability: Typ. 0.01%/V (V_{SET} + 1 V ≤ V_{IN} ≤ 42 V)
- Short-circuit Protection: Limited to Typ. 80 mA
- Overcurrent Protection: Limited to Typ. 350 mA
- Thermal Shutdown: Detected at Typ.160°C

CHRACTERISTICS

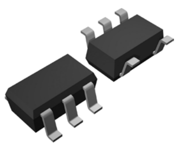
Noise Immunity Characteristic



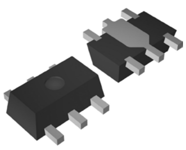
TYPICAL APPLICATIONS



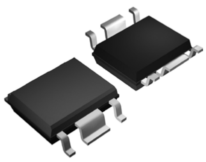
PACKAGES (Unit: mm)



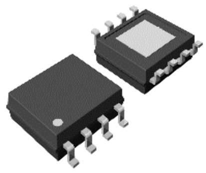
SOT-23-5
2.9 x 2.8 x 1.1



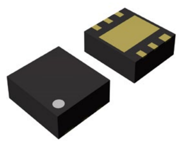
SOT-89-5
4.5 x 4.35 x 1.5



HSOP-6J
5.02 x 6.0 x 1.5



HSOP-8E
5.2 x 6.2 x 1.45



DFN(PL)1820-6
1.8 x 2.0 x 0.6

APPLICATIONS

- Power source for home appliances such as refrigerators, rice cookers, and electric hot-water pot.
- Power source for notebook PCs, digital TVs, cordless phones, and private LAN system.
- Power source for office equipment machines such as copiers, printers, facsimiles, scanners, and projectors.

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SELECTION GUIDE

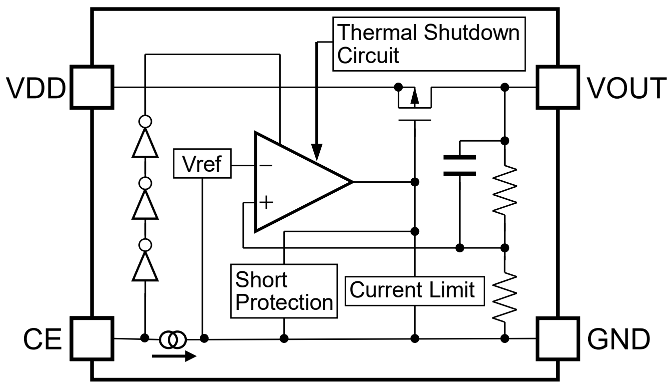
The set output voltage and the package type are user-selectable.

Selection Guide

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R1525NxxxB-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes
R1525HxxxB-T1-FE	SOT-89-5	1,000 pcs	Yes	Yes
R1525SxxxB-E2-FE	HSOP-6J	1,000 pcs	Yes	Yes
R1525SxxxH-E2-FE	HSOP-8E	1,000 pcs	Yes	Yes
R1525KxxxB-TR	DFN(PL)1820-6	5,000 pcs	Yes	Yes

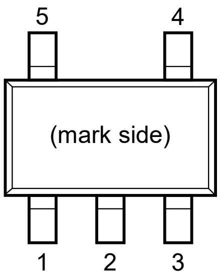
xxx : Specify the set output voltage (V_{SET})
1.8 V (018) / 2.5 V (025) / 2.8 V (028) / 3.0 V (030) / 3.3 V (033) / 3.4 V (034) / 5.0 V (050) /
5.5 V (055) / 6.0 V (060) / 6.4 V (064) / 8.0 V (080) / 8.5 V (085) / 9.0 V (090) / 10.0 V (100) /
10.5V (105) / 11.0 V (110) / 12.0 V (120)

BLOCK DIAGRAM

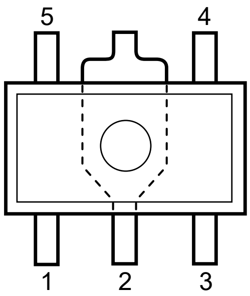


R1525x Block Diagram

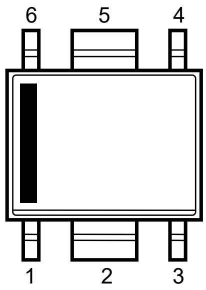
PIN DESCRIPTIONS



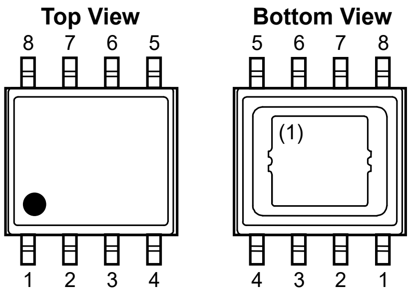
R1525N (SOT-23-5)
Pin Configuration



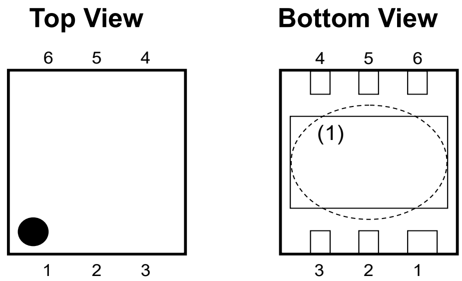
R1525H (SOT-89-5)
Pin Configuration



R1525S (HSOP-6J)
Pin Configuration



R1525S (HSOP-8E) Pin Configuration



R1525K (DFN(PL)1820-6) Pin Configuration

R1525N Pin Description

Pin No.	Pin Name	Description
1	GND[2]	Ground Pin
2	GND[2]	Ground Pin
3	CE	Chip Enable Pin (Active-high)
4	VOUT	Output Pin
5	VDD	Input Pin

R1525H Pin Description

Pin No.	Pin Name	Description
1	VOUT	Output Pin
2	GND[2]	Ground Pin
3	CE	Chip Enable Pin (Active-high)
4	GND[2]	Ground Pin
5	VDD	Input Pin

[1] The tab on the bottom of the package enhances thermal performance and is electrically connected to GND (substrate level). It is recommended that the tab be connected to the ground plane on the board, or otherwise be left open.
[2] The GND pin must be wired together when it is mounted on board.

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R1525S (HSOP-6J) Pin Description

Pin No.	Pin Name	Description
1	VOUT	Output Pin
2	GND[1]	Ground Pin
3	CE	Chip Enable Pin (Active-high)
4	GND[1]	Ground Pin
5	GND[1]	Ground Pin
6	VDD	Input Pin

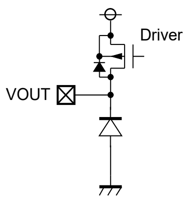
R1525S (HSOP-8E) Pin Description

Pin No.	Pin Name	Description
1	VOUT	Output Pin
2	NC	No Connection
3	NC	No Connection
4	CE	Chip Enable Pin (Active-high)
5	GND	Ground Pin
6	NC	No Connection
7	NC	No Connection
8	VDD	Input Pin

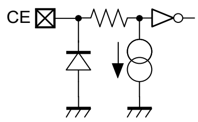
R1525K (DFN(PL)1820-6) Pin Description

Pin No.	Pin Name	Description
1	CE	Chip Enable Pin (Active-high)
2	NC	No Connection
3	GND	Ground Pin
4	VDD	Input Pin
5	NC	No Connection
6	VOUT	Output Pin

Pin Equivalent Circuit Diagrams



VOUT Pin Equivalent Circuit Diagram



CE Pin Equivalent Circuit Diagram

[1] The GND pins are connected to each other on the board.

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings

Symbol	Parameter		Rating	Unit
V_{IN}	Input Voltage		−0.3 to 50	V
V_{IN}	Peak Inrush Voltage[1]		60	V
V_{CE}	CE Pin Input Voltage		−0.3 to 50	V
V_{OUT}	Output Voltage		−0.3 to V_{IN} + 0.3 ≤ 50	V
I_{OUT}	Output Current		300	mA
P_D	Power Dissipation[2] (JEDEC STD. 51-7)	SOT-23-5	660	mW
		SOT-89-5	2600	
		HSOP-6J	2700	
		HSOP-8E	2900	
		DFN(PL)1820-6	2200	
Tj	Junction Temperature		−40 to 125	°C
Tstg	Storage Temperature Range		−55 to 125	°C

ABSOLUTE MAXIMUM RATINGS
Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS

Recommended Operating Conditions

Symbol	Parameter	Rating	Unit
V_{IN}	Input Voltage	3.5 to 42	V
Ta	Operating Temperature Range	−40 to 105	°C

RECOMMENDED OPERATING CONDITONS
All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

(1) Duration: 200 ms or less
(2) Refer to *POWER DISSIPATION* for detailed information.

ELECTRICAL CHARACTERISTICS

C_{IN} = C_{OUT} = 0.1 μF, unless otherwise noted.

The specifications surrounded by [ ] are guaranteed by design engineering at −40°C ≤ Ta ≤ 105°C.

R1525x Electrical Characteristics (Ta = 25°C)

Symbol	Parameter	Conditions		Min.	Typ.	Max.	Unit
I_{SS}	Supply Current	V_{IN} = 14 V, I_{OUT} = 0 mA	V_{SET} ≤ 5.0 V		2.2	6.5	μA
			5.0 V < V_{SET}		2.5	6.8	
Istandby	Supply Current	V_{IN} = 42 V, V_{CE} = 0 V			0.1	1.0	μA
V_{OUT}	Output Voltage	V_{SET} + 1 V(1) ≤ V_{IN} ≤ 42 V, I_{OUT} = 1 mA	Ta = 25°C	×0.994		×1.006	V
			−40°C ≤ Ta ≤ 105°C	×0.984		×1.016	
$\Delta V_{OUT}/\Delta I_{OUT}$	Load Regulation	V_{IN} = V_{SET} + 3.0 V, 1 mA ≤ I_{OUT} ≤ 200 mA		Refer to Product-specific Electrical Characteristics			
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{SET} + 1 V(1) ≤ V_{IN} ≤ 42 V, I_{OUT} = 1 mA	V_{SET} < 3.3 V	-20	5	20	mV
			3.3 V ≤ V_{SET}	-0.02	0.01	0.02	%/V
V_{DIF}	Dropout Voltage	I_{OUT} = 200 mA		Refer to Product-specific Electrical Characteristics			
I_{LIM}	Output Current Limit	V_{IN} = V_{SET} + 3.0 V		220	350	420	mA
I_{SC}	Short-circuit Current	V_{IN} = 3.5 V, V_{OUT} = 0 V		60	80	110	mA
V_{CEH}	CE Pin Input Voltage, high	V_{IN} = V_{SET} + 1 V(1)		2.0		42	V
V_{CEL}	CE Pin Input Voltage, low	V_{IN} = 42 V		0		1.0	V
I_{PD}	CE Pull-down Current	V_{IN} = 42 V, V_{CE} = 2 V			0.2	0.6	μA
T_{TSD}	Thermal Shutdown Detection Temperature	Junction Temperature			160		°C
T_{TSR}	Thermal Shutdown Release Temperature	Junction Temperature			135		°C

All parameters are tested under the pulse load condition (Tj ≈ Ta = 25°C).

(1) V_{SET} ≤ 2.5 V, V_{IN} = 3.5 V

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The specifications surrounded by ☐ are guaranteed by design engineering at -40°C ≤ Ta ≤ 105°C.

R1525x Product-specific Electrical Characteristics (Ta = 25°C)

<table>
<tr><th rowspan="2">Product Name</th><th colspan="3">VOUT (V)
(Ta = 25°C)</th><th colspan="3">VOUT (V)
(−40°C ≤ Ta ≤ 105°C)</th><th colspan="3">ΔVOUT/ΔIOUT (mV)</th><th colspan="2">VDIF (V)</th></tr>
<tr><th>MIN.</th><th>TYP.</th><th>MAX.</th><th>MIN.</th><th>TYP.</th><th>MAX.</th><th>MIN.</th><th>TYP.</th><th>MAX.</th><th>TYP.</th><th>MAX.</th></tr>
<tr><td>R1525x018x</td><td>1.7892</td><td>1.80</td><td>1.8108</td><td>1.7712</td><td>1.80</td><td>1.8288</td><td rowspan="7">-10</td><td rowspan="7">10</td><td rowspan="7">40</td><td>1.6</td><td>2.5</td></tr>
<tr><td>R1525x025x</td><td>2.4850</td><td>2.50</td><td>2.5150</td><td>2.4600</td><td>2.50</td><td>2.5400</td><td rowspan="3">1.2</td><td rowspan="3">2.2</td></tr>
<tr><td>R1525x028x</td><td>2.7832</td><td>2.80</td><td>2.8168</td><td>2.7552</td><td>2.80</td><td>2.8448</td></tr>
<tr><td>R1525x030x</td><td>2.9820</td><td>3.00</td><td>3.0180</td><td>2.9520</td><td>3.00</td><td>3.0480</td></tr>
<tr><td>R1525x033x</td><td>3.2802</td><td>3.30</td><td>3.3198</td><td>3.2472</td><td>3.30</td><td>3.3528</td><td rowspan="2">0.8</td><td rowspan="2">2.0</td></tr>
<tr><td>R1525x034x</td><td>3.3796</td><td>3.40</td><td>3.4204</td><td>3.3456</td><td>3.40</td><td>3.4544</td></tr>
<tr><td>R1525x050x</td><td>4.9700</td><td>5.00</td><td>5.0300</td><td>4.9200</td><td>5.00</td><td>5.0800</td><td rowspan="4">0.6</td><td rowspan="11">1.2</td></tr>
<tr><td>R1525x055x</td><td>5.4670</td><td>5.50</td><td>5.5330</td><td>5.4120</td><td>5.50</td><td>5.5880</td><td rowspan="10">-18</td><td rowspan="10">18</td><td rowspan="10">72</td></tr>
<tr><td>R1525x060x</td><td>5.9640</td><td>6.00</td><td>6.0360</td><td>5.9040</td><td>6.00</td><td>6.0960</td></tr>
<tr><td>R1525x064x</td><td>6.3616</td><td>6.40</td><td>6.4384</td><td>6.2976</td><td>6.40</td><td>6.5024</td></tr>
<tr><td>R1525x080x</td><td>7.9520</td><td>8.00</td><td>8.0480</td><td>7.8720</td><td>8.00</td><td>8.1280</td><td rowspan="7">0.5</td></tr>
<tr><td>R1525x085x</td><td>8.4490</td><td>8.50</td><td>8.5510</td><td>8.3640</td><td>8.50</td><td>8.6360</td></tr>
<tr><td>R1525x090x</td><td>8.9460</td><td>9.00</td><td>9.0540</td><td>8.8560</td><td>9.00</td><td>9.1440</td></tr>
<tr><td>R1525x100x</td><td>9.9400</td><td>10.0</td><td>10.0600</td><td>9.8400</td><td>10.0</td><td>10.1600</td></tr>
<tr><td>R1525x105x</td><td>10.4370</td><td>10.5</td><td>10.5630</td><td>10.3320</td><td>10.5</td><td>10.6680</td></tr>
<tr><td>R1525x110x</td><td>10.9340</td><td>11.0</td><td>11.0660</td><td>10.8240</td><td>11.0</td><td>11.1760</td></tr>
<tr><td>R1525x120x</td><td>11.9280</td><td>12.0</td><td>12.0720</td><td>11.8080</td><td>12.0</td><td>12.1920</td></tr>
</table>

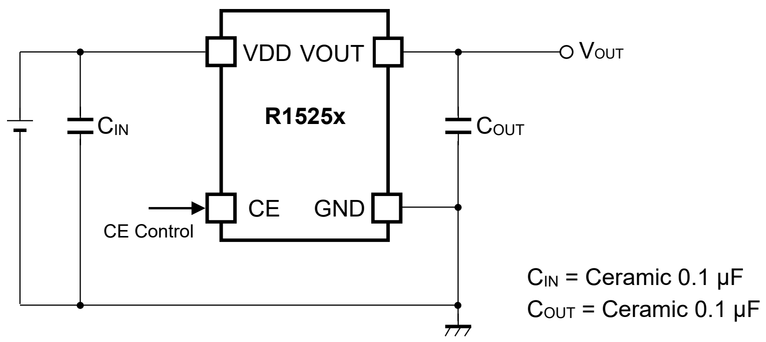
THEORY OF OPERATION

Thermal Shutdown

When the junction temperature of this device exceeds 160°C (Typ.), the built-in thermal shutdown circuit stops the regulator operation. After that, when the temperature drops to 135°C (Typ.) or lower, the regulator restarts the operation. Unless eliminating the overheating problem, the regulator turns on and off repeatedly and a pulse shaped output voltage occurs as result.

APPLICATION INFORMATION

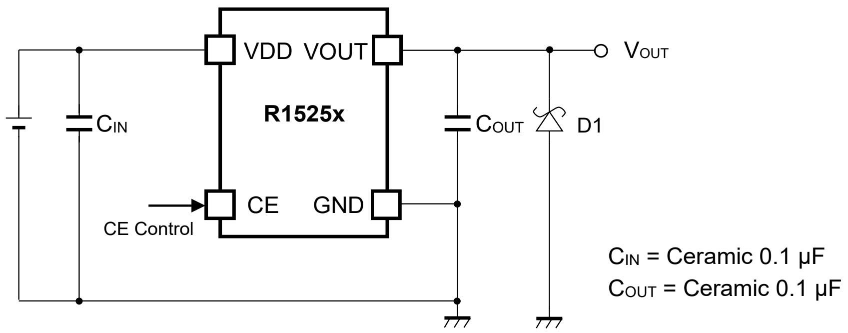
Typical Applications



R1525x Typical Applications

Typical Application for IC Chip Breakdown Prevention

When a sudden surge of electrical current travels along the VOUT pin and GND due to a short-circuit, electrical resonance of a circuit involving an output capacitor and a short circuit inductor generates a negative voltage and may damage the device or the load devices. Connecting a schottky diode (D1) between the VOUT pin and GND has the effect of preventing damage to them.



R1525x Typical Application for IC Chip Breakdown Prevention

TECHNICAL NOTES

Phase Compensation

Phase compensation is provided to secure stable operation even when the load current is varied. For this purpose, make sure to use 0.1 μF or more of a capacitor (C_{OUT}). In case of using a tantalum type capacitor and the ESR (Equivalent Series Resistance) value of the capacitor is large, the output might be unstable. Evaluate the circuit including consideration of frequency characteristics. Connect 0.1 μF or more of a capacitor (C_{IN}) between VDD and GND, and as close as possible to the pins.

PCB Layout

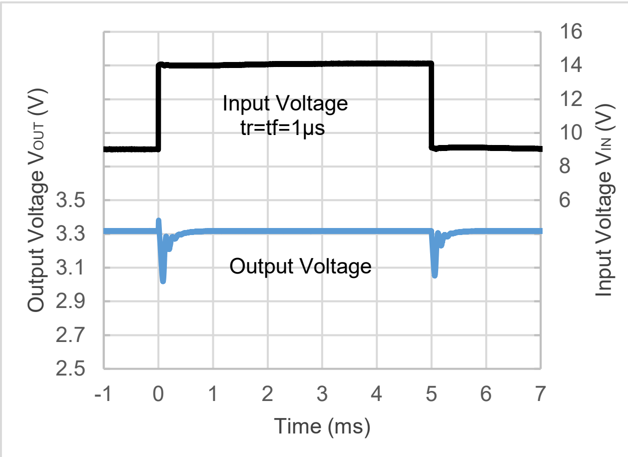
For SOT-23-5 package type, wire the following GND pins together: No. 1 and No. 2
For SOT-89-5 package type, wire the following GND pins together: No. 2 and No. 4.
For HSOP-6J package type, wire the following GND pins together: No. 2, No. 4, and No. 5.

Input Transient / Load Transient vs. Output Capacity (C_{OUT})

R1525x performs a stable operation by using 0.1 µF of ceramic capacitor as the output capacitor. However, the variation of output voltage may not meet the demand of the system when input voltage and load current vary. In such cases, the variation of output voltage can be minimized significantly by using 10 µF or higher ceramic capacitor. When using an electrolytic capacitor for the output line, place the electrolytic capacitor outer side of the ceramic capacitor arranged close to the IC.

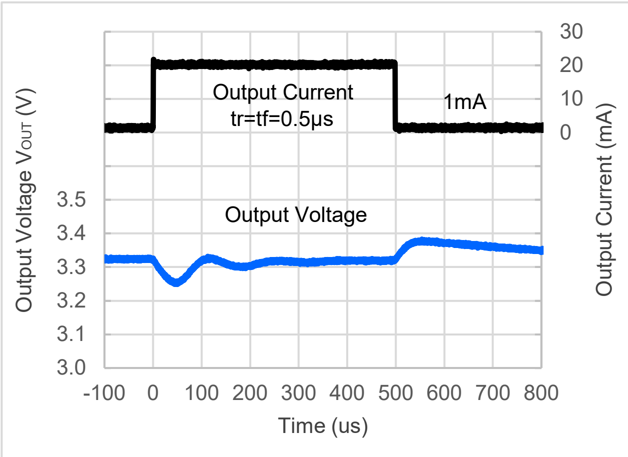
<Input Transient Response>

R1525x033B



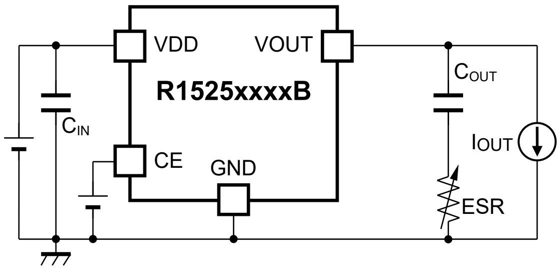
<Load Transient Response>

R1525x033B



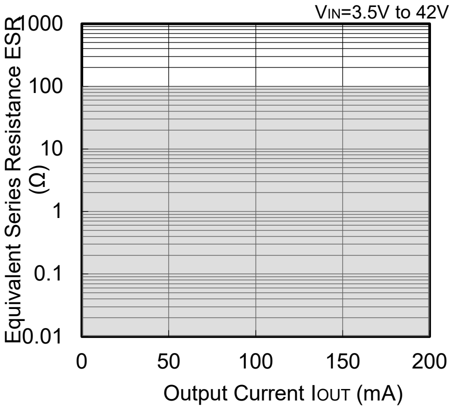
ESR vs. Output Current

Using a ceramic type capacitor is recommended for this device, but also other type capacitors having lower ESR can be used. The relation between the output current (I_{OUT}) and the ESR of output capacitor is shown below.

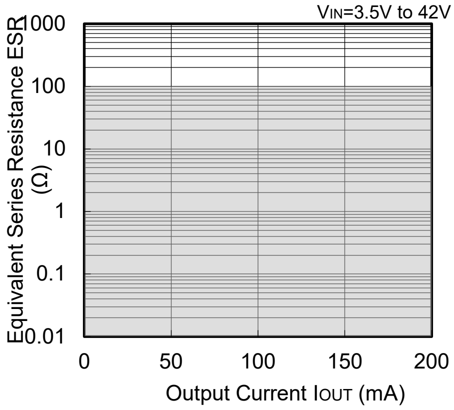


C_{IN} = Ceramic 0.1 µF,
C_{OUT} = Ceramic 0.1 µF

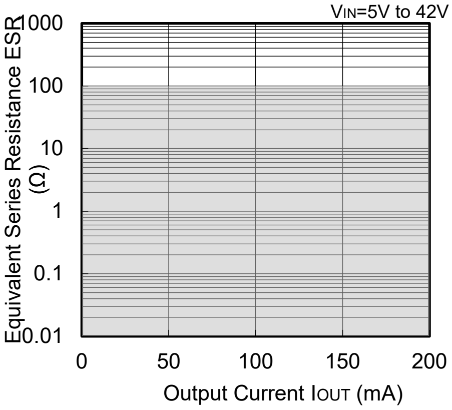
R1525x018B



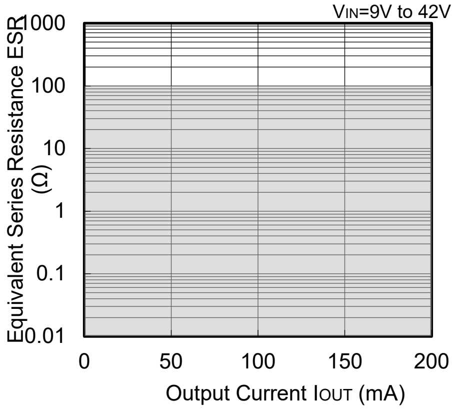
R1525x033B



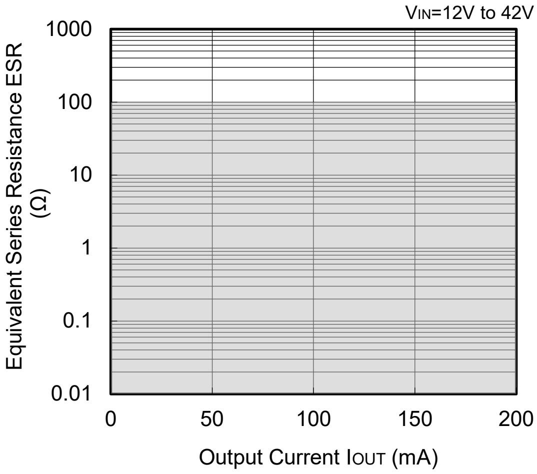
R1525x050B



R1525x090B



R1525x120B



Measurement Conditions

Frequency Band: 10 Hz to 2 MHz

Measurement Temperature: −40°C to 105°C

Noise Level in Hatched Area:
40 μV (average) or below

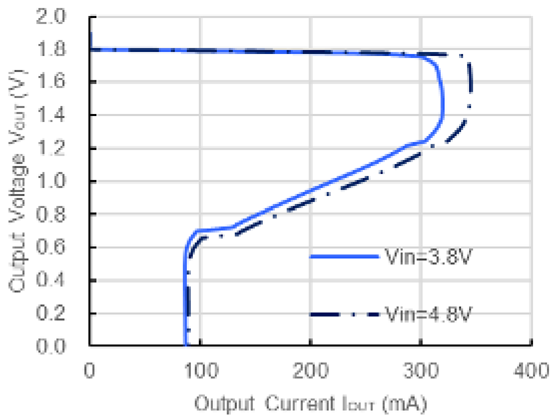
Ceramic Capacitors:
C_{IN} = 0.1 μF, Murata, GRM188R71H104JA93D
C_{OUT} = 0.1 μF, TDK, CGA3E2X7R1E104K

TYPICAL CHARACTERISTICS

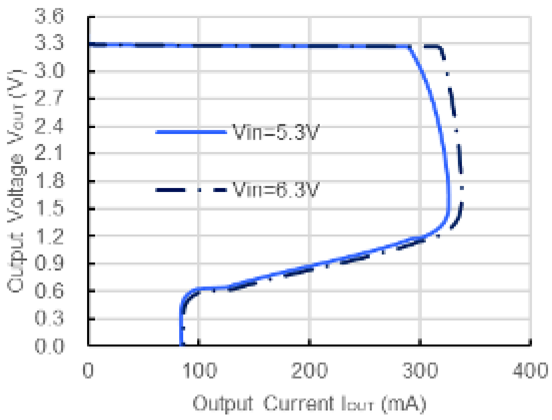
Typical Characteristics are intended to be used as reference data, they are not guaranteed.

1) Output Voltage vs. Output Current

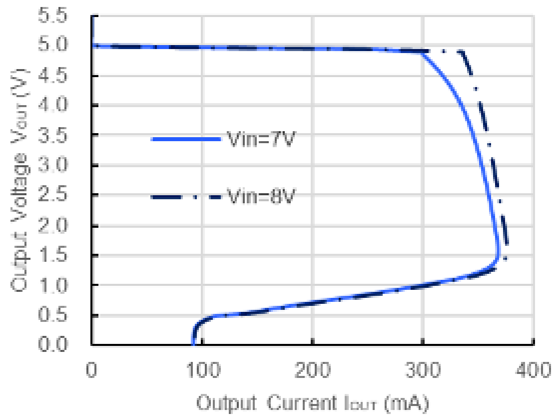
R1525x018B



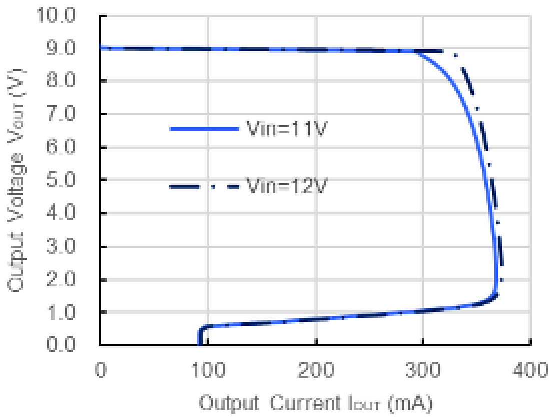
R1525x033B



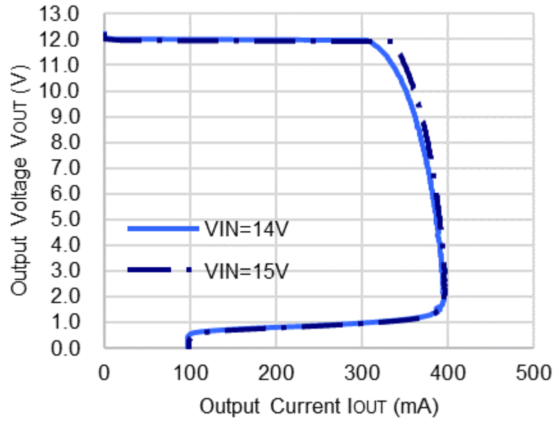
R1525x050B



R1525x090B

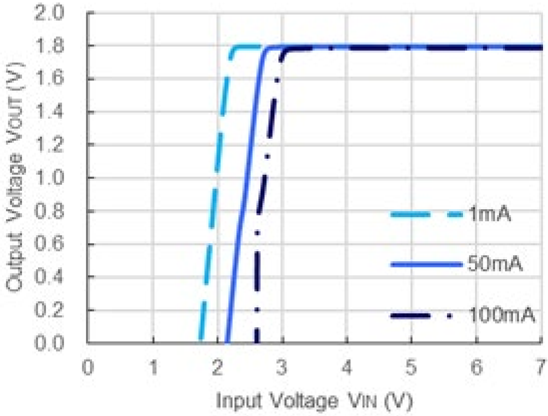


R1525x120B

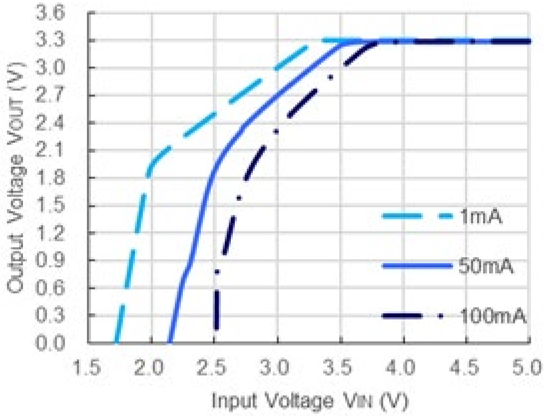


2) Output Voltage vs. Input Voltage

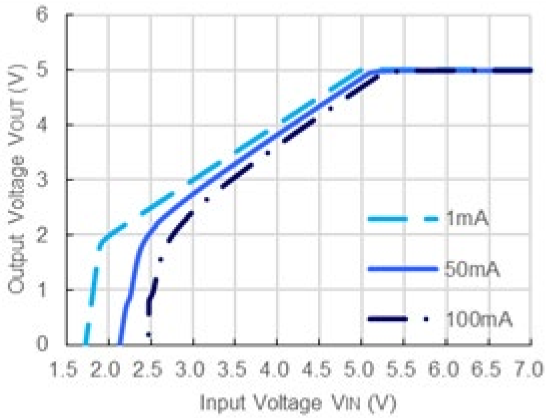
R1525x018B



R1525x033B



R1525x050B



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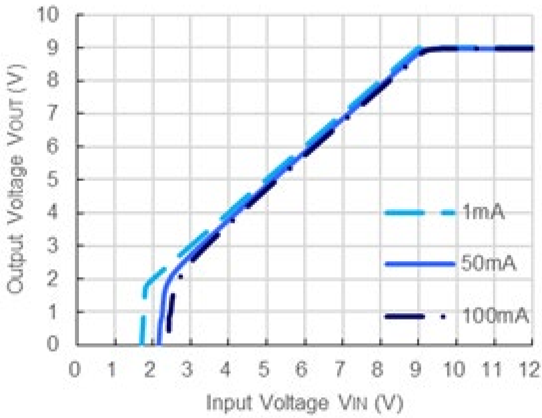
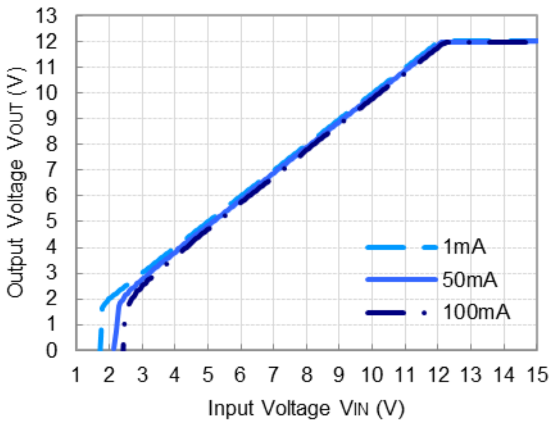
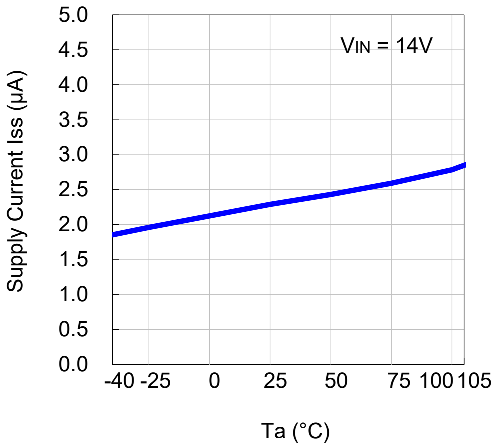


R1525x120B

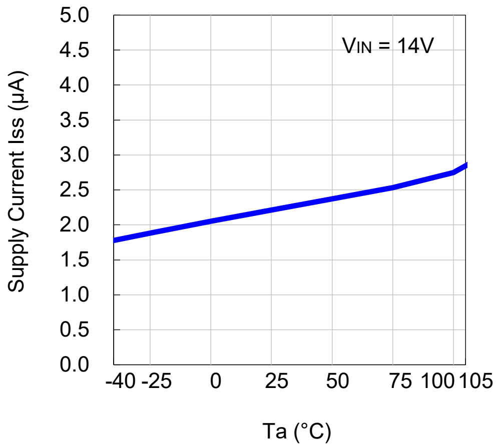


3) Supply Current vs. Temperature

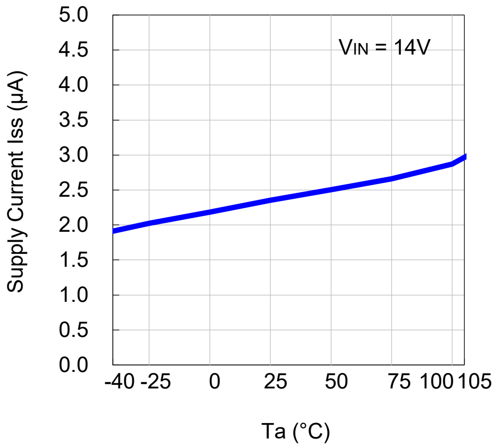
R1525x018B



R1525x033B



R1525x050B



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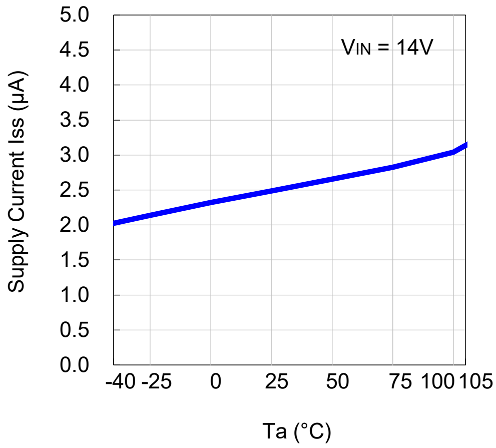
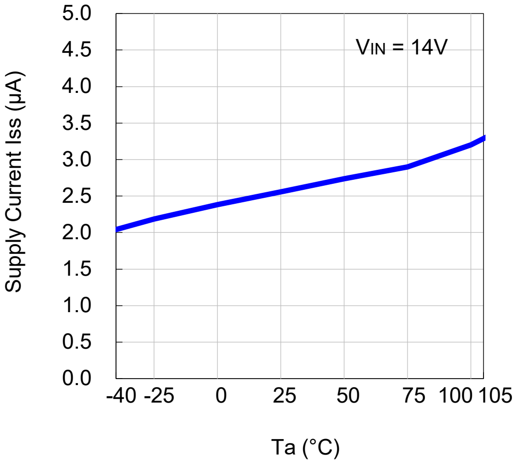
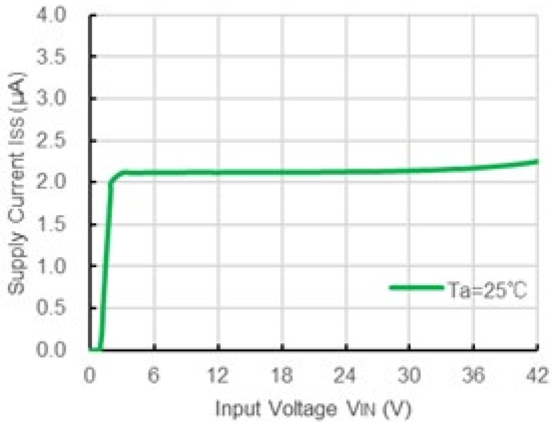


R1525x120B

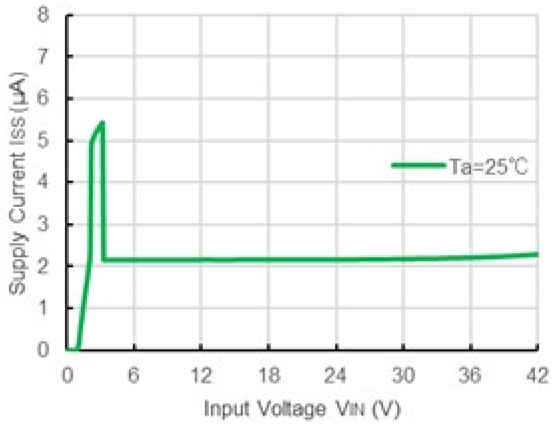


4) **Supply Current vs. Input Voltage**

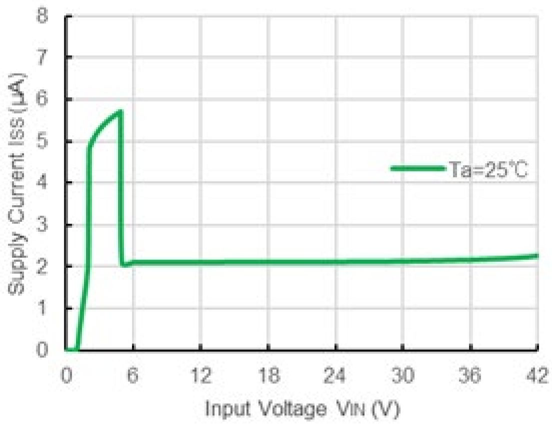
R1525x018B



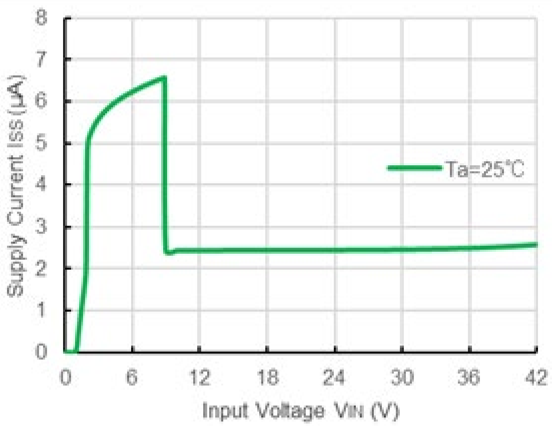
R1525x033B



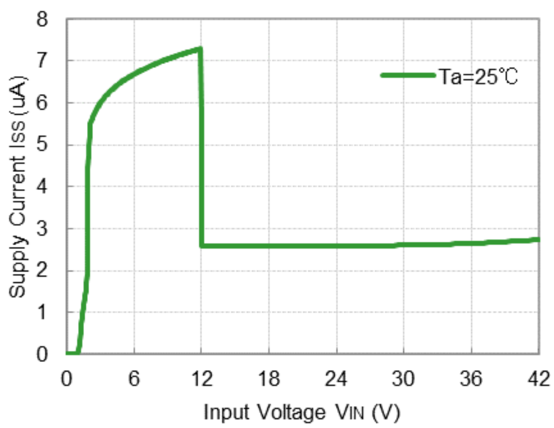
R1525x050B



R1525x090B

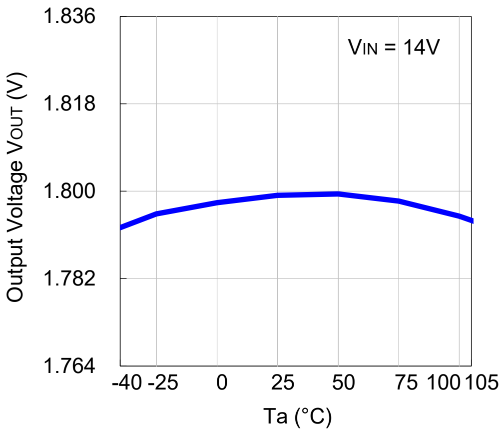


R1525x120B

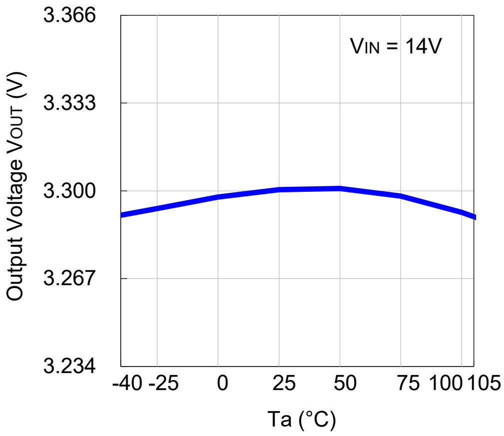


5) Output Voltage vs. Temperature (I_{OUT} = 1.0 mA)

R1525x018B



R1525x033B



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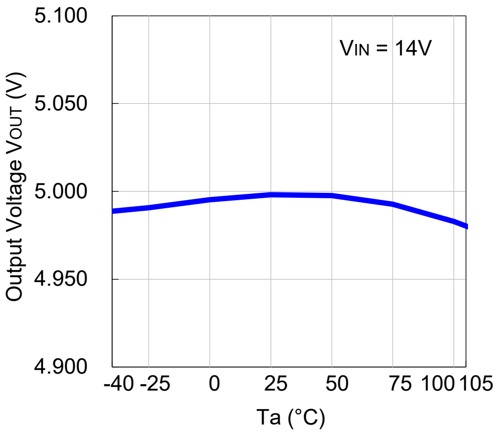

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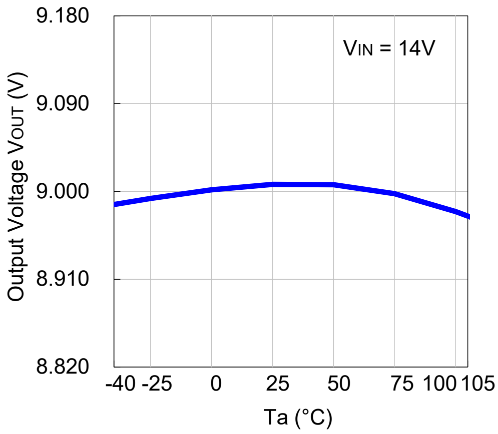
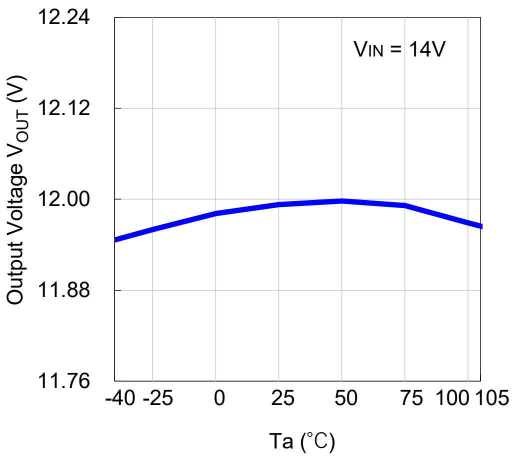
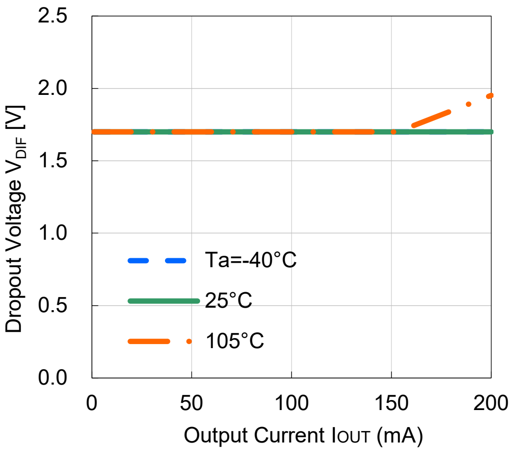


R1525x120B

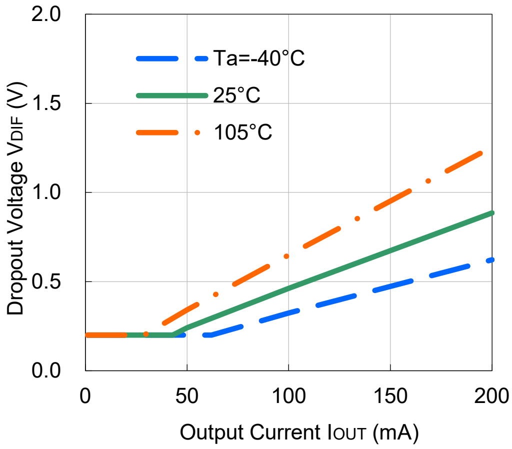


6) Dropout Voltage vs. Output Current

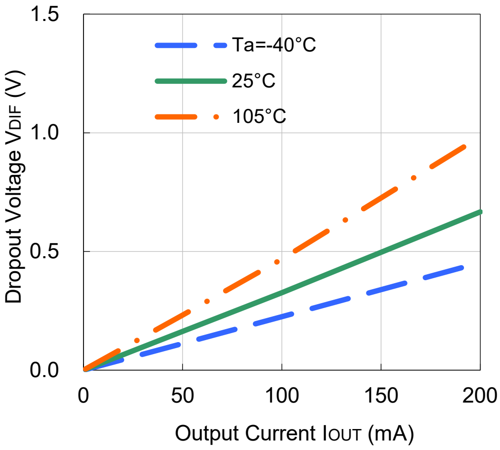
R1525x018B



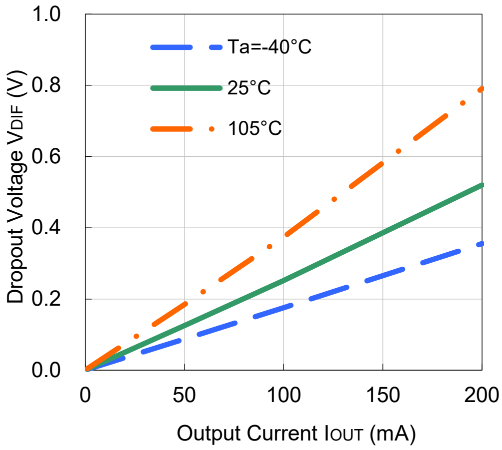
R1525x033B



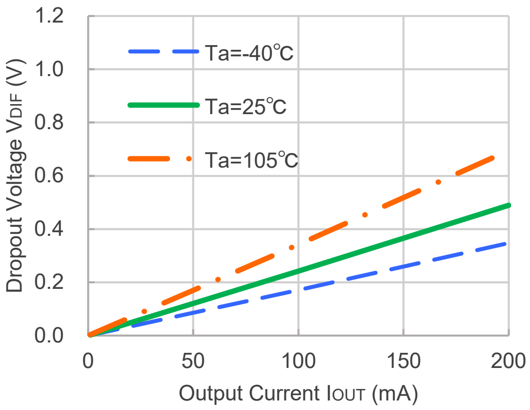
R1525x050B



R1525x090B

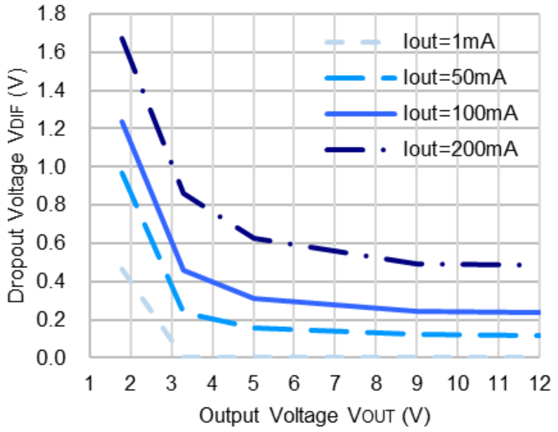


R1525x120B



7) Dropout Voltage vs. Output Voltage

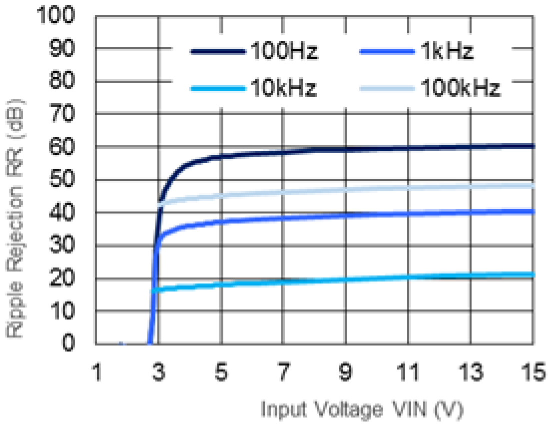
I_{OUT} = 1 mA / 50 mA / 100 mA / 200 mA



8) Ripple Rejection vs. Input Voltage

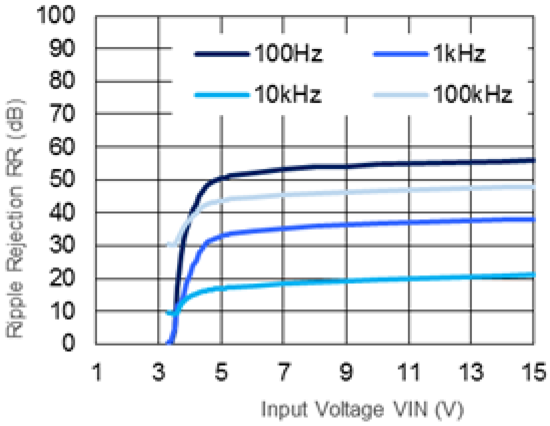
I_{OUT} = 50 mA, V_{RIPPLE} = ± 0.2 V

R1525x018B



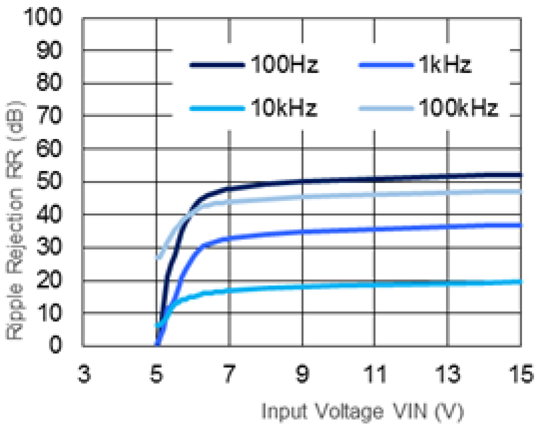
I_{OUT} = 50 mA, V_{RIPPLE} = ± 0.2 V

R1525x033B



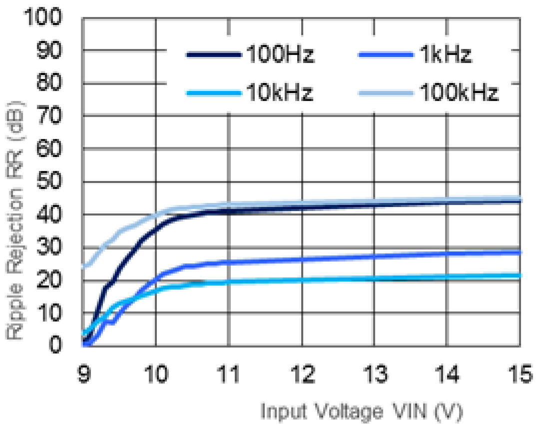
I_{OUT} = 50 mA, V_{RIPPLE} = ± 0.2 V

R1525x050B



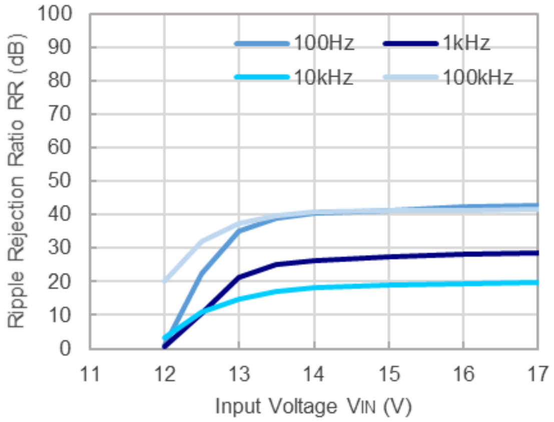
I_{OUT} = 50 mA, V_{RIPPLE} = ± 0.2 V

R1525x090B



I_{OUT} = 50 mA, V_{RIPPLE} = ± 0.2 V

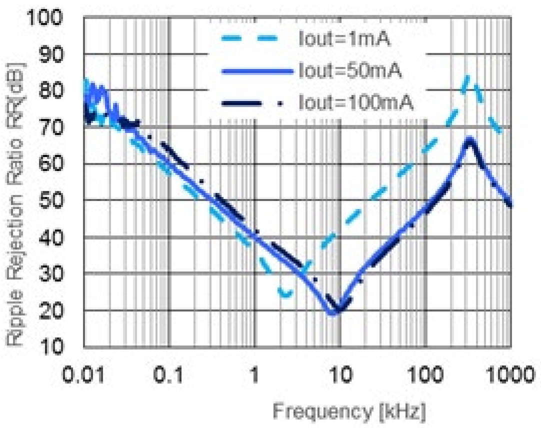
R1525x120B



9) Ripple Rejection vs. Frequency

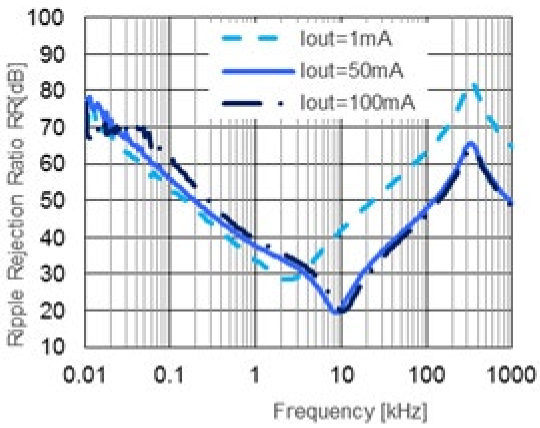
V_{RIPPLE} = ± 0.2 V

R1525x018B



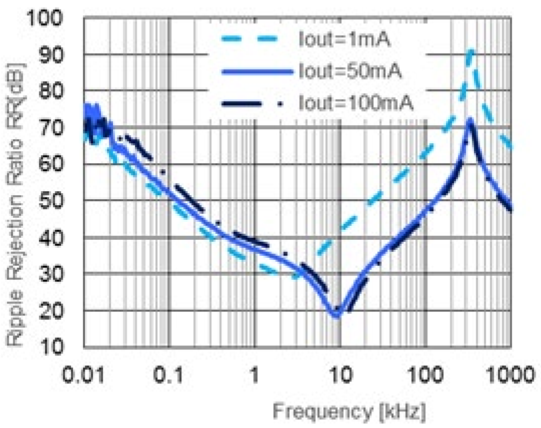
V_{RIPPLE} = ± 0.2 V

R1525x033B



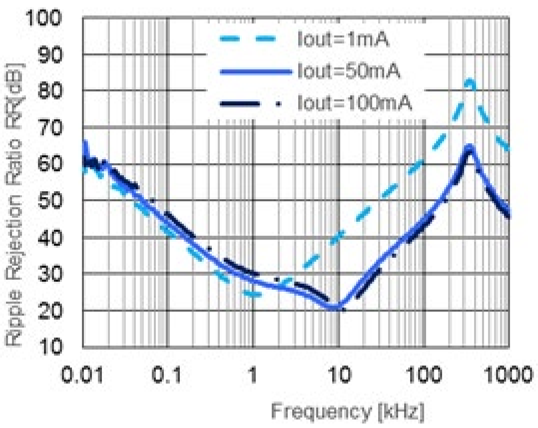
V_{RIPPLE} = ± 0.2 V

R1525x050B



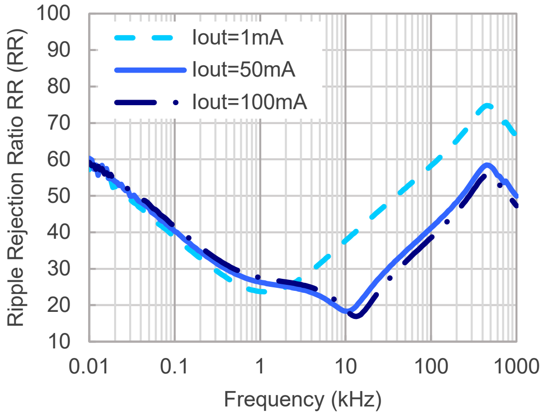
V_{RIPPLE} = ± 0.2 V

R1525x090B



V_{RIPPLE} = ± 0.2 V

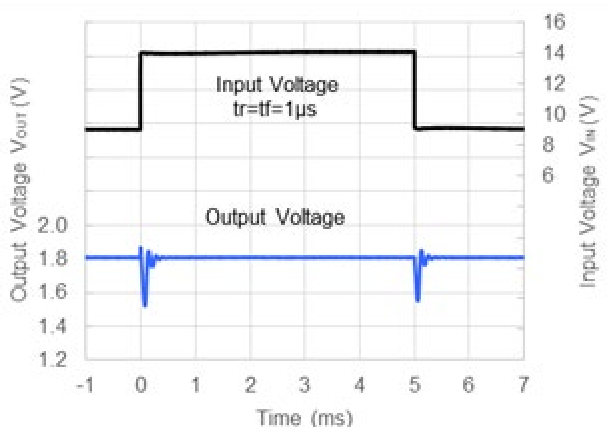
R1525x120B



10) Input Transient Response

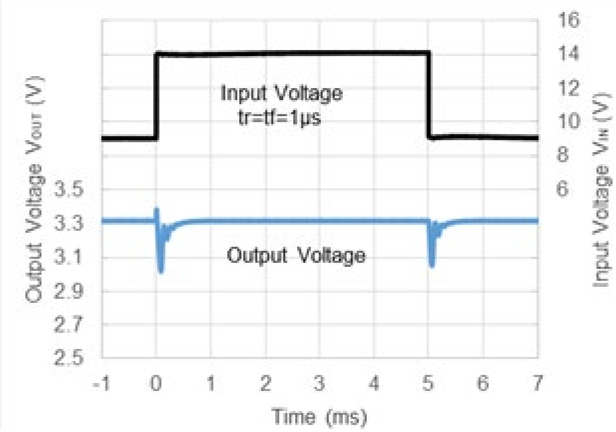
I_{OUT} = 50 mA, C_{OUT} = 10μF

R1525x018B



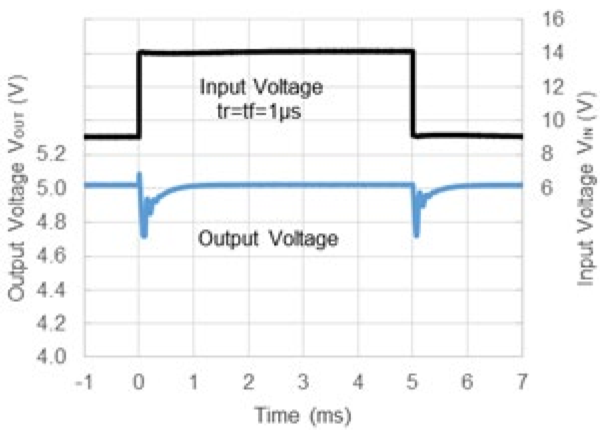
I_{OUT} = 50 mA, C_{OUT} = 10μF

R1525x033B



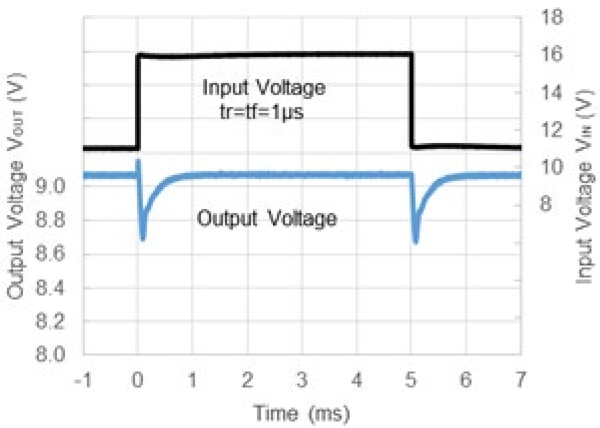
I_{OUT} = 50 mA, C_{OUT} = 10μF

R1525x050B

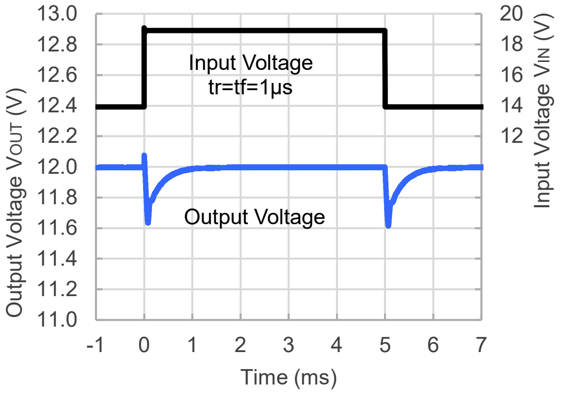


I_{OUT} = 50 mA, C_{OUT} = 10μF

R1525x090B

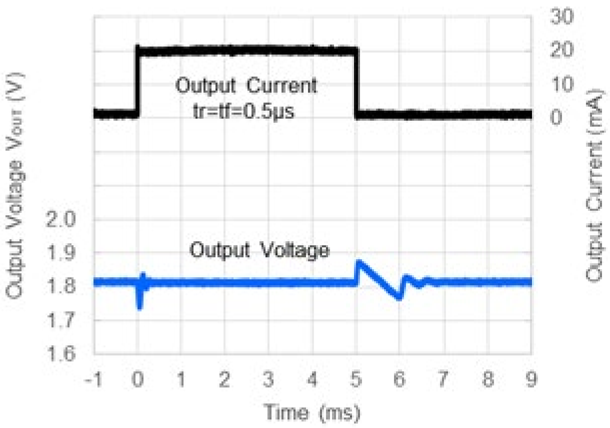


I_{OUT} = 50 mA, C_{OUT} = 10μF
R1525x120B

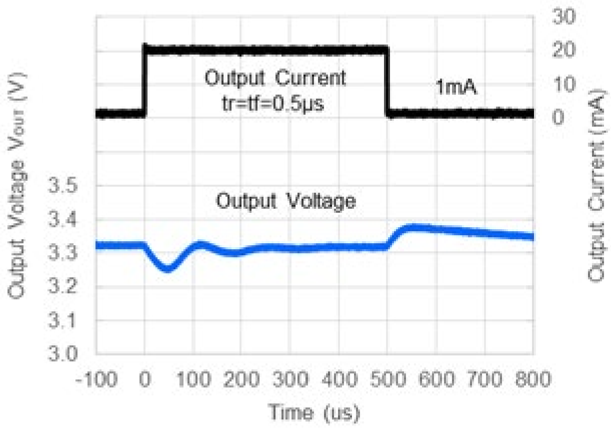


11) Load Transient Response

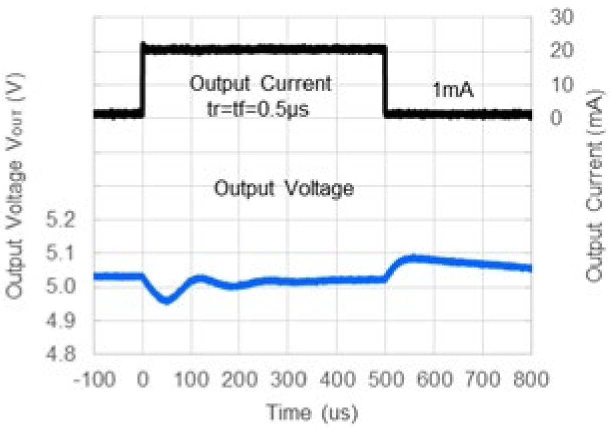
V_{IN} = 14 V, I_{OUT} = 1.0 mA → 20 mA, C_{OUT} = 10μF
R1525x018B



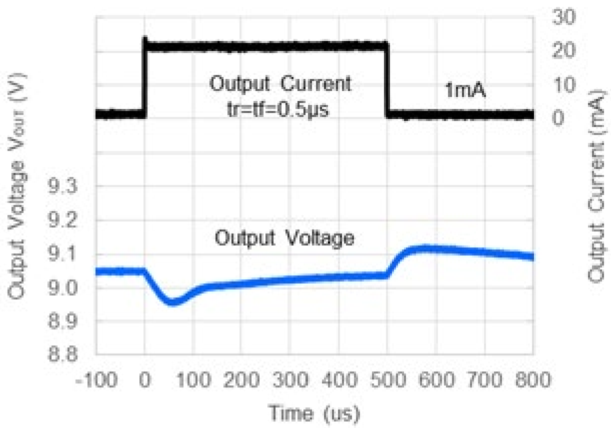
V_{IN} = 14 V, I_{OUT} = 1.0 mA → 20 mA, C_{OUT} = 10μF
R1525x033B



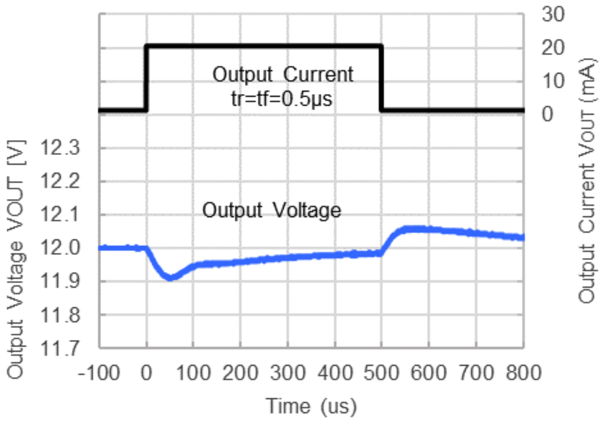
V_{IN} = 14 V, I_{OUT} = 1.0 mA → 20 mA, C_{OUT} = 10μF
R1525x050B



V_{IN} = 14 V, I_{OUT} = 1.0 mA → 20 mA, C_{OUT} = 10μF
R1525x090B

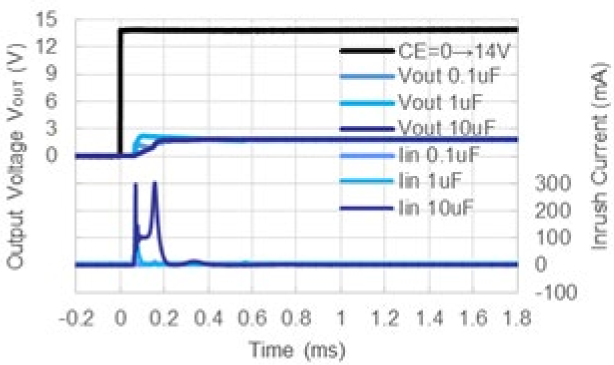


V_{IN} = 14 V, I_{OUT} = 1.0 mA → 20 mA, C_{OUT} = 10µF
R1525x120B

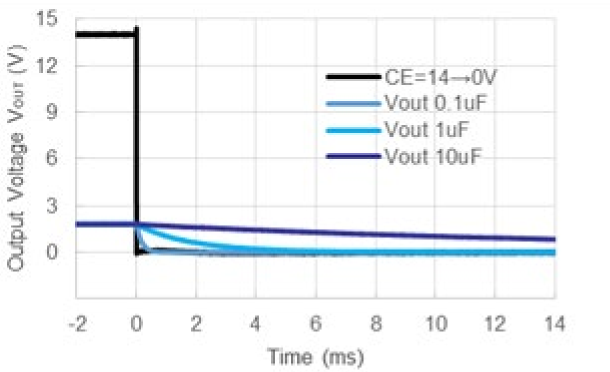


12) CE Transient Response

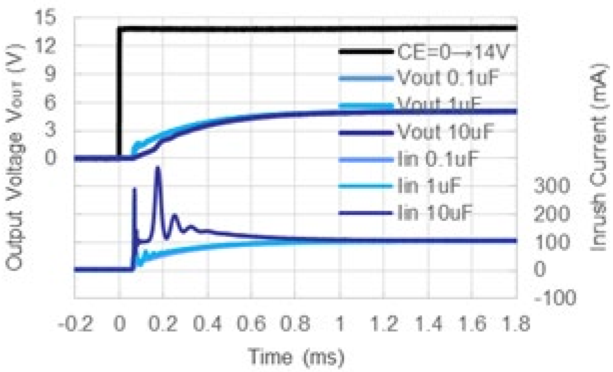
V_{IN} = 14 V, V_{CE} = 0 V → 14 V
R1525x018B



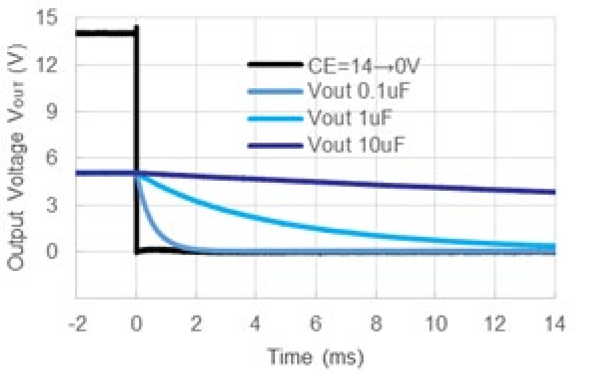
V_{IN} = 14 V, V_{CE} = 14 V → 0 V
R1525x018B



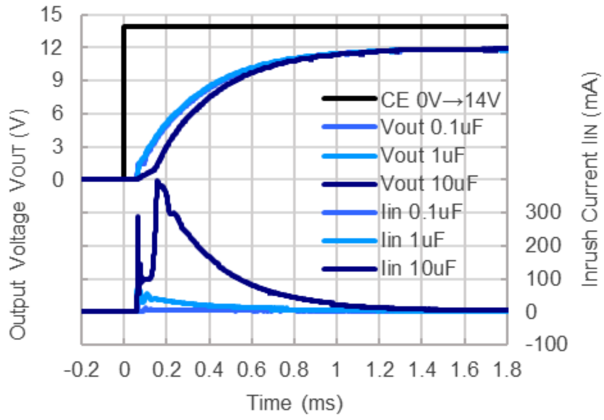
V_{IN} = 14 V, V_{CE} = 0 V → 14 V
R1525x050B



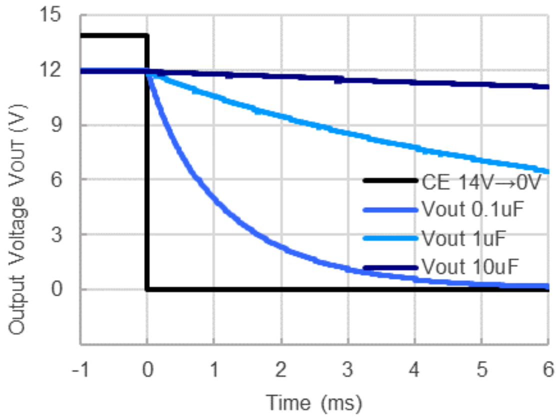
V_{IN} = 14 V, V_{CE} = 14 V → 0 V
R1525x050B



V_{IN} = 14 V, V_{CE} = 0 V → 14 V
R1525x120B

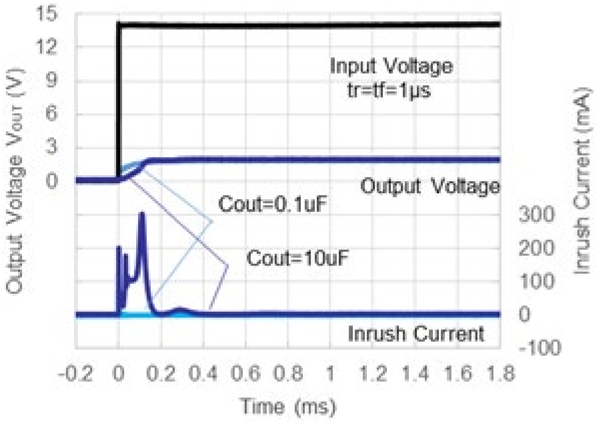


V_{IN} = 14 V, V_{CE} = 14 V → 0 V
R1525x120B

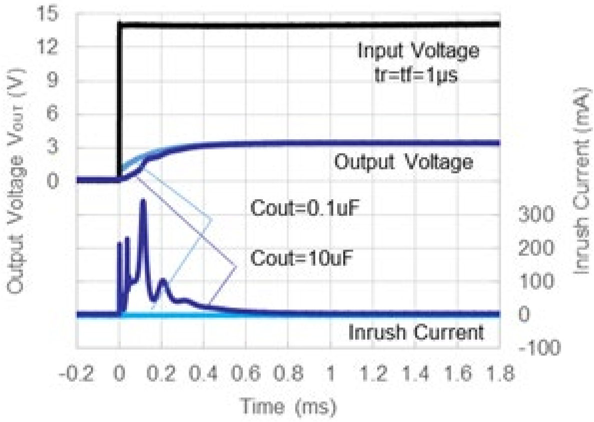


13) Power-on Transient Response

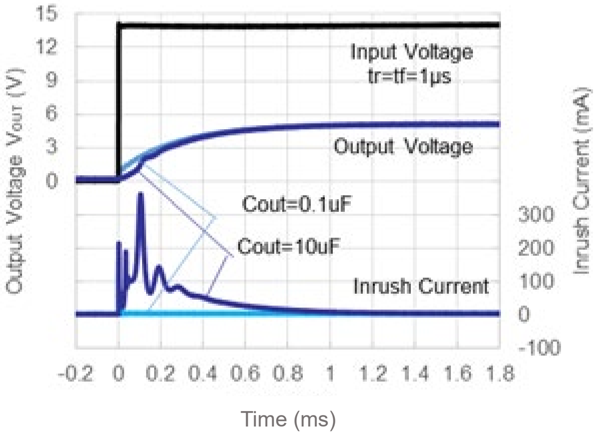
V_{IN} = 0 V → 14 V, V_{CE} = 5 V
R1525x018B



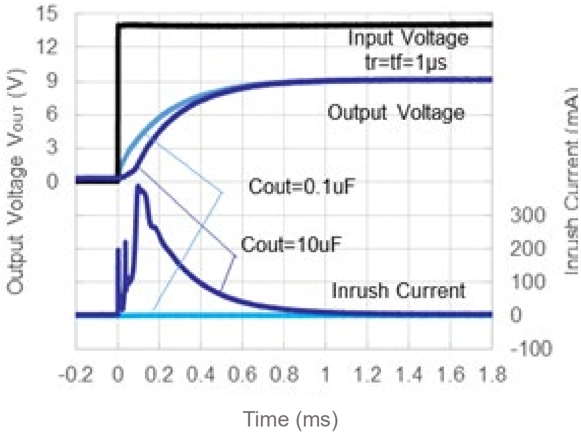
V_{IN} = 0 V → 14 V, V_{CE} = 5 V
R1525x033B



V_{IN} = 0 V → 14 V, V_{CE} = 5 V
R1525x050B

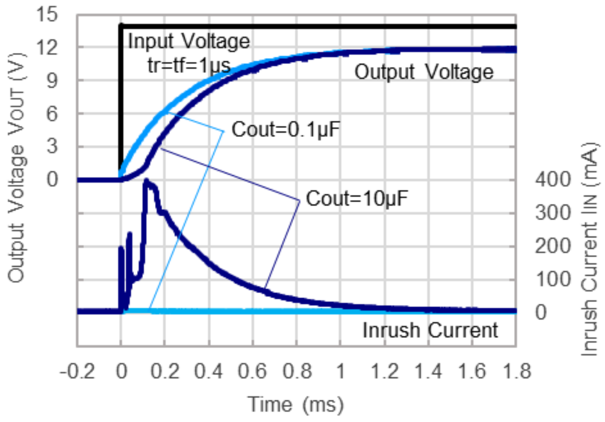


R1525x090B



V_{IN} = 0 V → 14 V, V_{CE} = 5 V

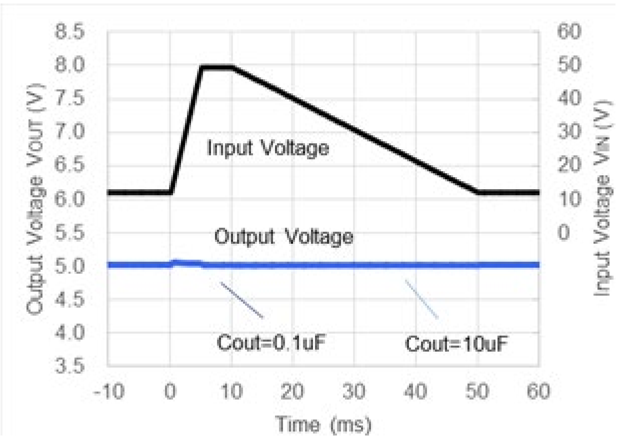
R1525x120B



14) Load Dump

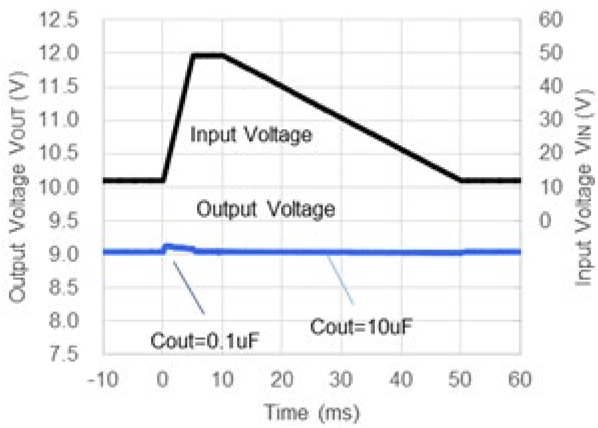
V_{IN} = 12 V → 50 V, V_{CE} = V_{IN} ,I_{OUT} = 1.0 mA

R1525x050B



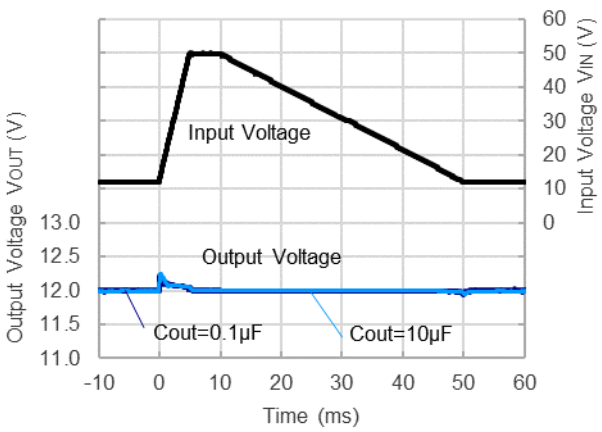
V_{IN} = 12 V → 50 V, V_{CE} = V_{IN}, I_{OUT} = 1.0 mA

R1525x090B



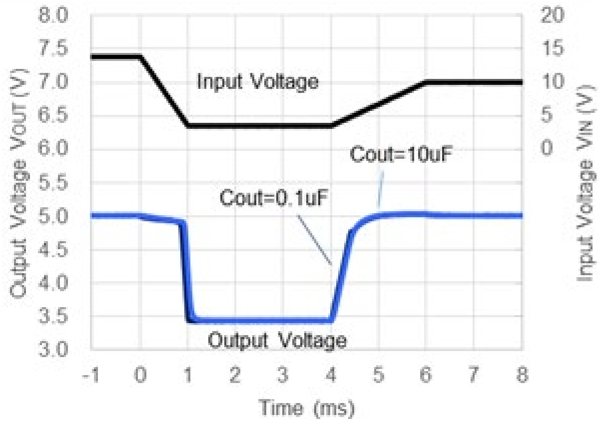
V_{IN} = 12 V → 50 V, V_{CE} = V_{IN} ,I_{OUT} = 1.0 mA

R1525x120B

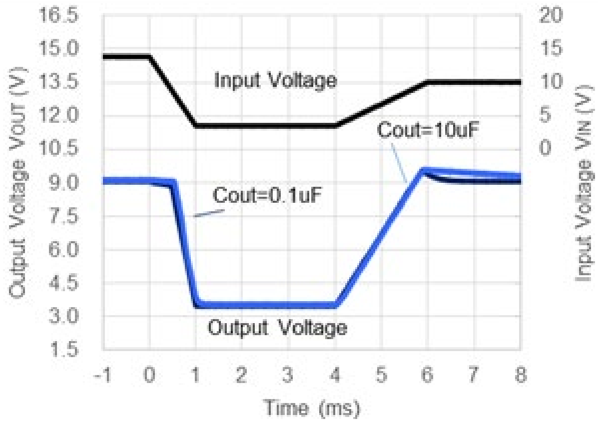


15) Cranking

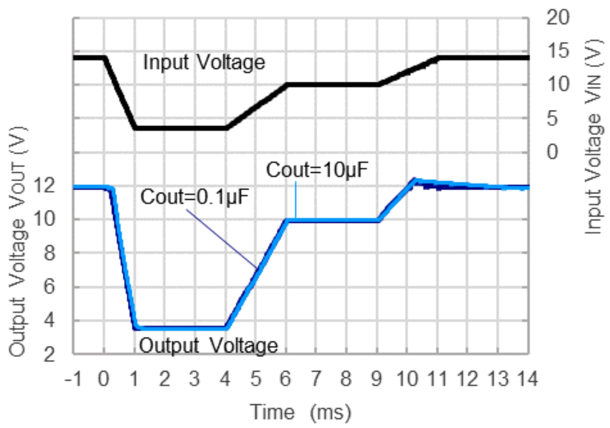
V_{IN} = 14 V → 3.5 V → 10 V, I_{OUT} = 1.0 mA
R1525x050B



V_{IN} = 14 V → 3.5 V → 10 V, I_{OUT} = 1.0 mA
R1525x090B

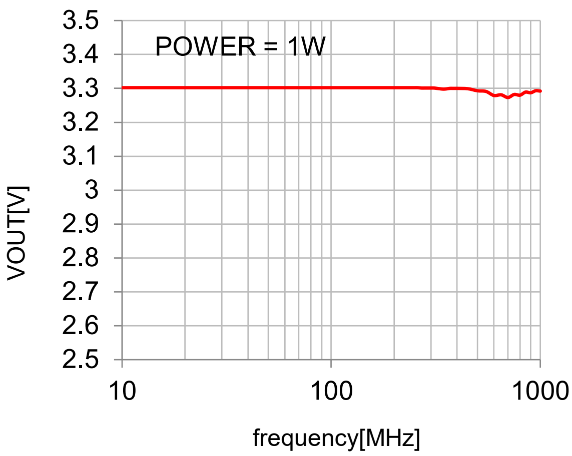


V_{IN} = 14 V → 3.5 V → 10 V, I_{OUT} = 1.0 mA
R1525x120B

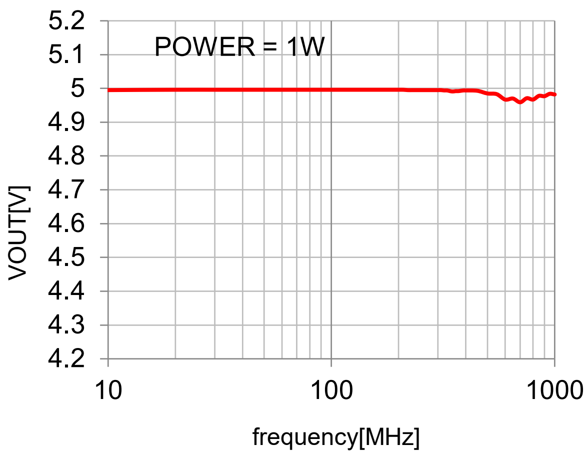


16) DPI (VOUT Pin impressed at 1W)

V_{IN} = 14 V
R1525x033B



V_{IN} = 14 V
R1525x050B



PD-SOT-23-5-(105125150)-E-A

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

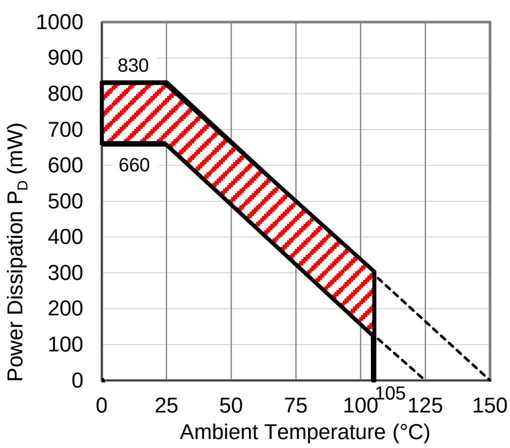
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 7 pcs

Measurement Result (Ta = 25°C, Tjmax = 125°C)

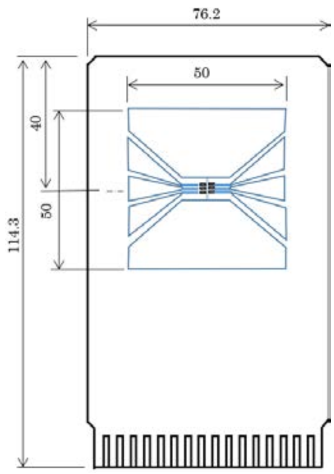
Item	Measurement Result
Power Dissipation	660 mW
Thermal Resistance (θja)	θja = 150°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 51°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature

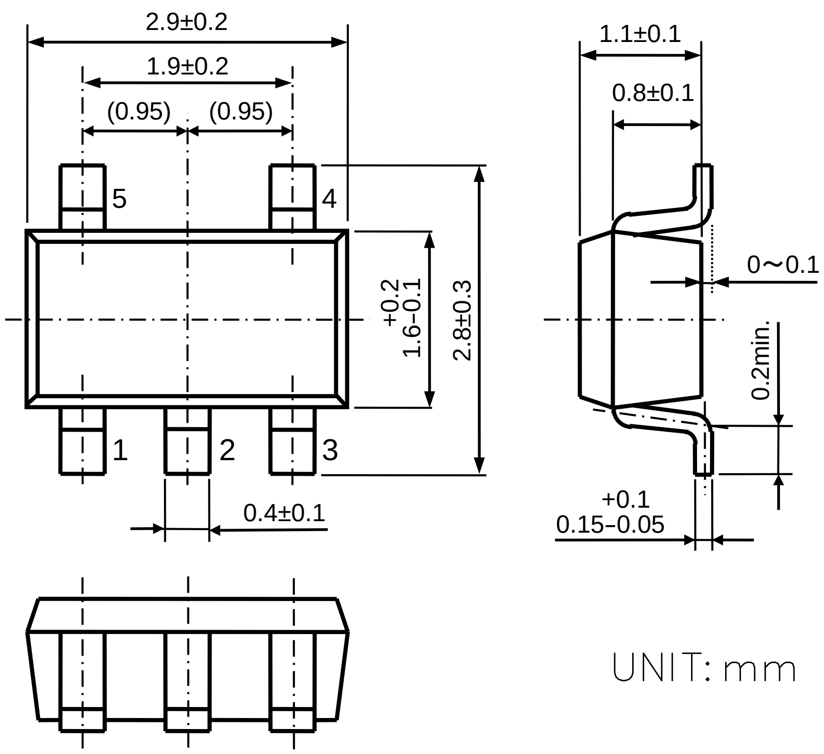


Measurement Board Pattern

The above graph shows the power dissipation of the package at Tjmax = 125°C and Tjmax = 150°C. Operating the device in the hatched range might have a negative influence on its lifetime. The total hours of use and the total years of use must be limited as follows:

Total Hours of Use	Total Years of Use (4 hours/day)
13,000 hours	9 years

DM-SOT-23-5-JE-B



SOT-23-5 Package Dimensions

PD-SOT-89-5-(105125150)-JE-A

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

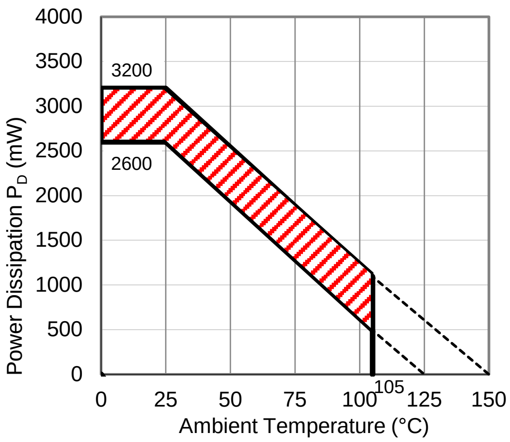
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 13 pcs

Measurement Result (Ta = 25°C, Tjmax = 125°C)

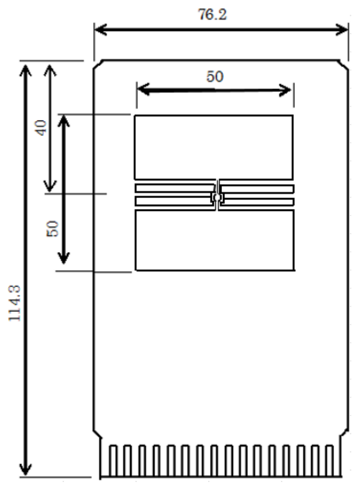
Item	Measurement Result
Power Dissipation	2600 mW
Thermal Resistance (θja)	θja = 38°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 13°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter



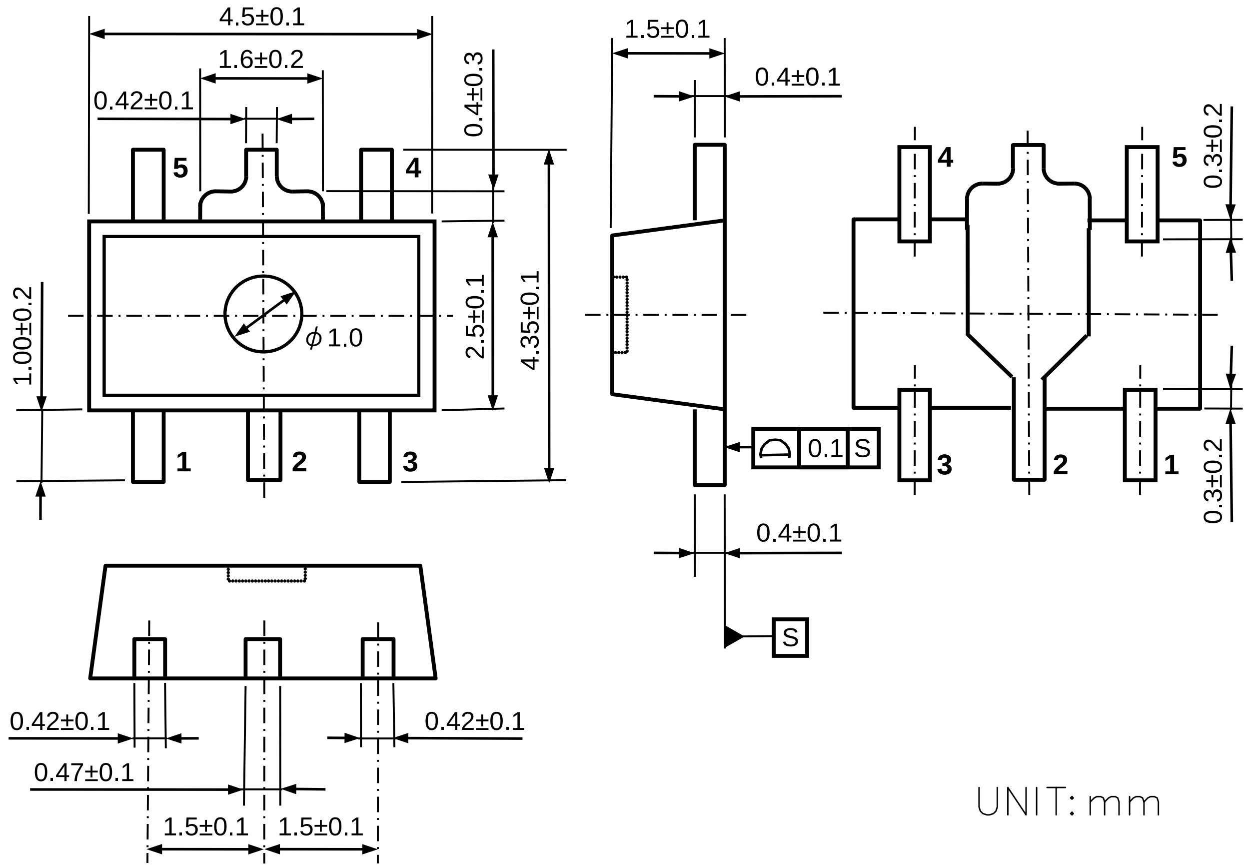
Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

The above graph shows the power dissipation of the package at Tjmax = 125°C and Tjmax = 150°C. Operating the device in the hatched range might have a negative influence on its lifetime. The total hours of use and the total years of use must be limited as follows:

Total Hours of Use	Total Years of Use (4 hours/day)
13,000 hours	9 years



SOT-89-5 Package Dimensions

PD-HSOP-6J-(105125150)-JE-A

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

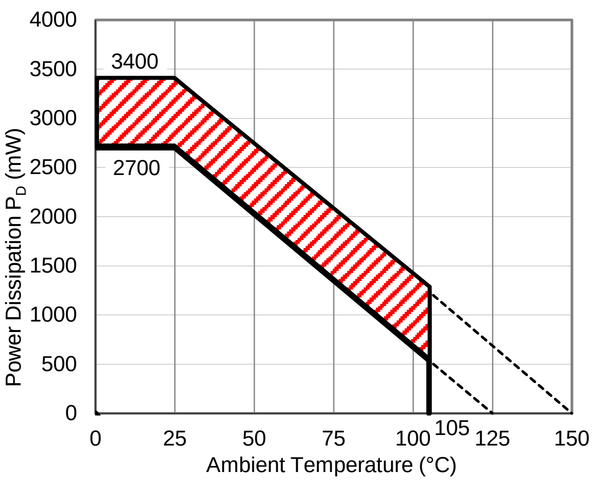
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 28 pcs

Measurement Result (Ta = 25°C, Tjmax = 125°C)

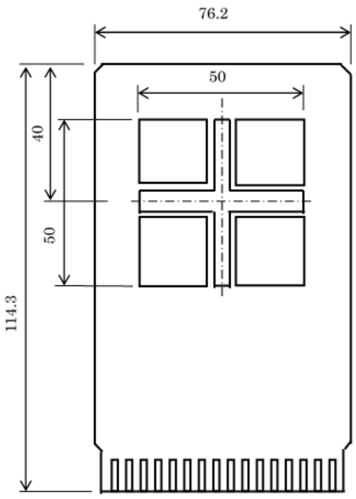
Item	Measurement Result
Power Dissipation	2700 mW
Thermal Resistance (θja)	θja = 37°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 7°C/W

θja: Junction-to-Ambient Thermal Resistance

ψjt: Junction-to-Top Thermal Characterization Parameter



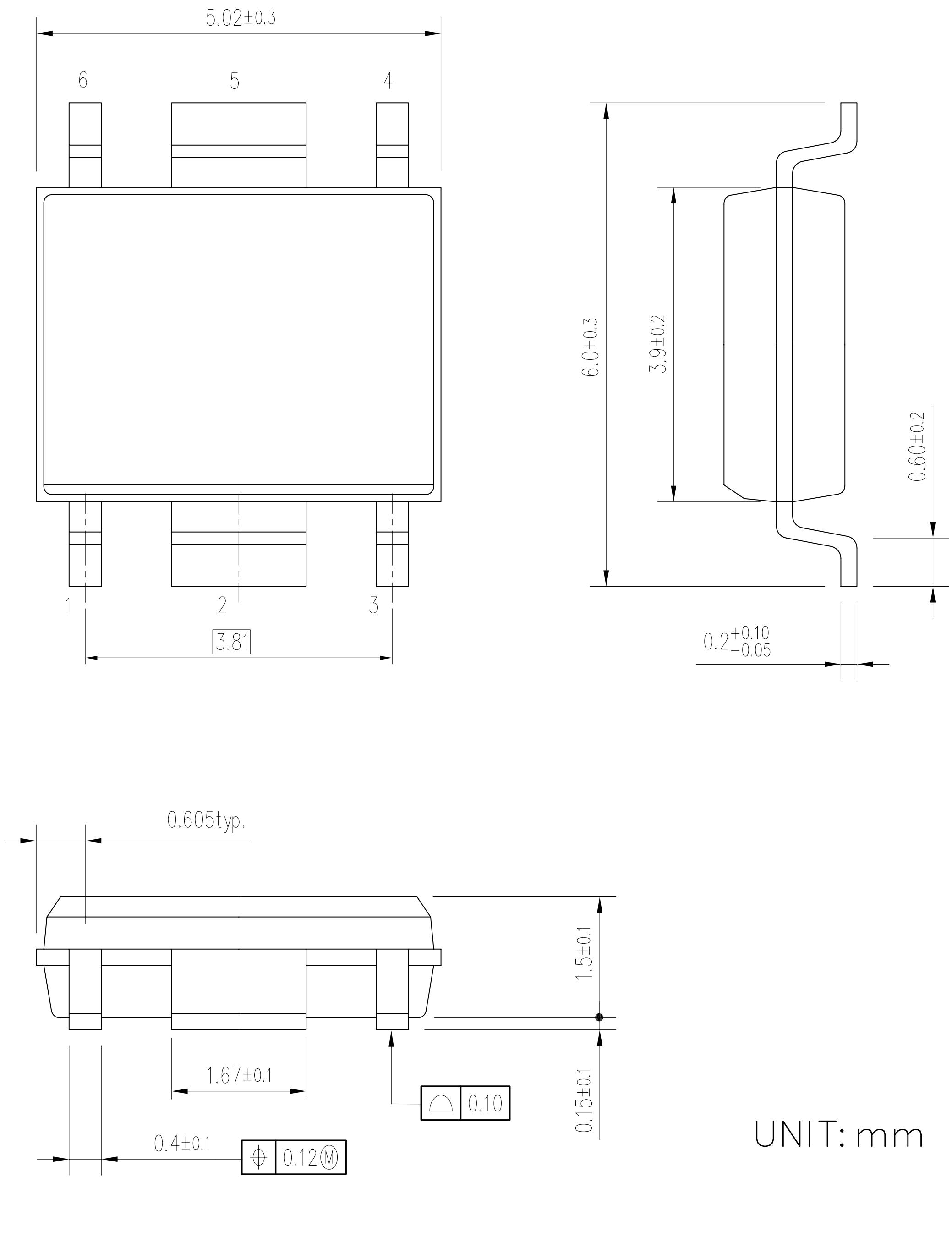
Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

The above graph shows the power dissipation of the package at Tjmax = 125°C and Tjmax = 150°C. Operating the device in the hatched range might have a negative influence on its lifetime. The total hours of use and the total years of use must be limited as follows:

Total Hours of Use	Total Years of Use (4 hours/day)
13,000 hours	9 years



HSOP-6J Package Dimensions

PD-HSOP-8E-(105125150)-JE-B

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 21 pcs

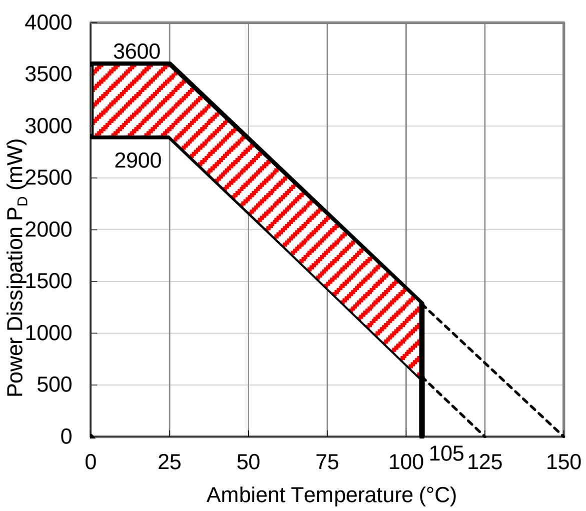
Measurement Result

(Ta = 25°C, Tjmax = 125°C)

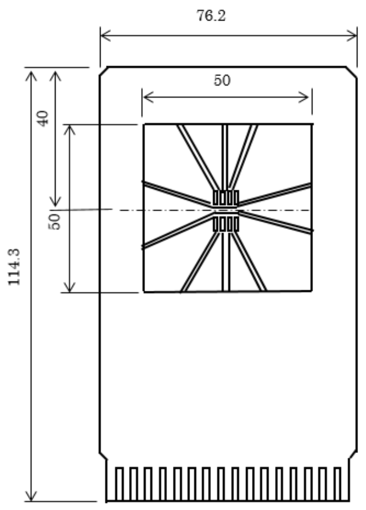
Item	Measurement Result
Power Dissipation	2900 mW
Thermal Resistance (θja)	θja = 34.5°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 10 °C/W

θja: Junction-to–ambient thermal resistance.

ψjt: Junction–to-top of package thermal characterization parameter.



Power Dissipation vs. Ambient Temperature

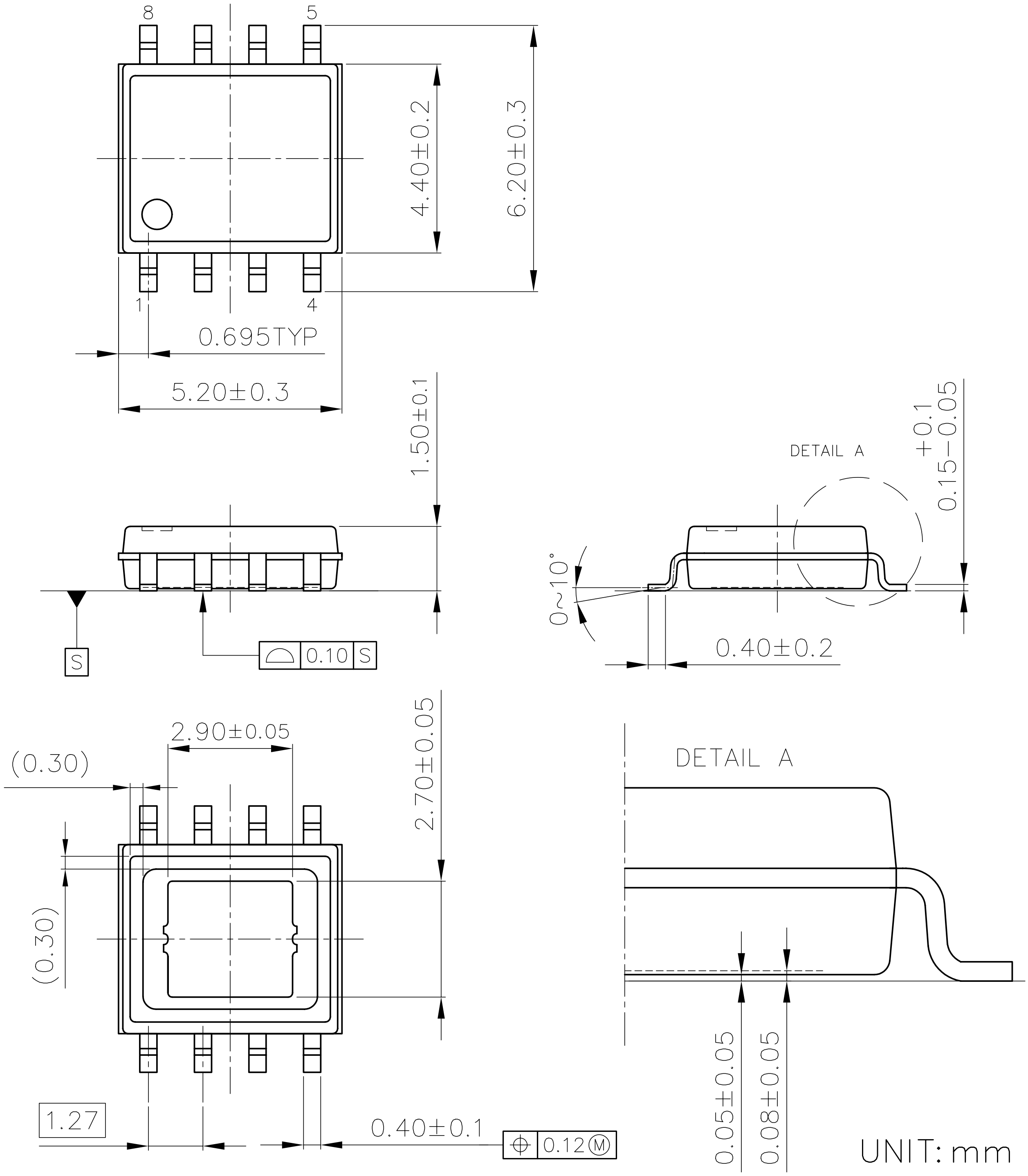


Measurement Board Pattern

The above graph shows the power dissipation of the package at Tjmax = 125°C and Tjmax = 150°C. Operating the device in the hatched range might have a negative influence on its lifetime. The total hours of use and the total years of use must be limited as follows:

Total Hours of Use	Total Years of Use (4 hours/day)
13,000 hours	9 years

DM-HSOP-8E-JE-B



HSOP-8E Package Dimensions

PD-DFN(PL)1820-6-(105125150)-JE-C

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51.

Measurement Conditions

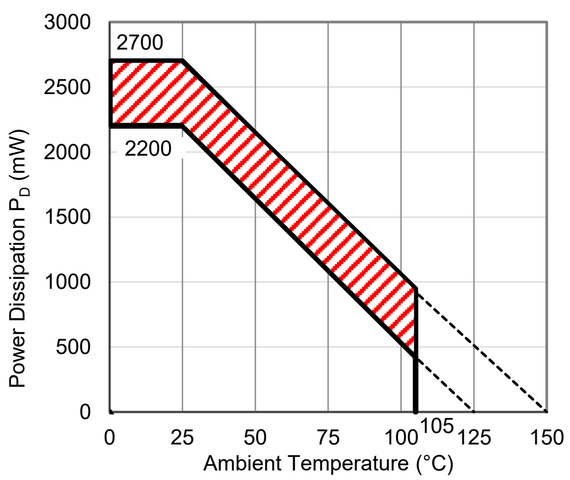
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.2 mm × 36 pcs

Measurement Result (Ta = 25°C, Tjmax = 125°C)

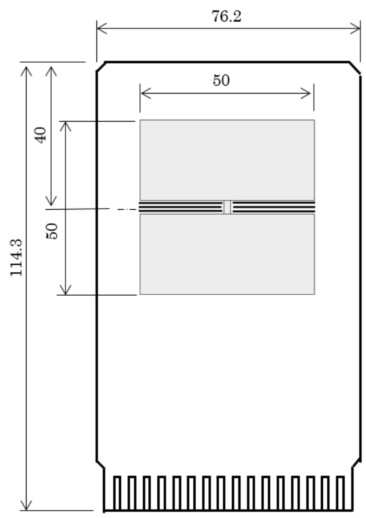
Item	Measurement Result
Power Dissipation	2200 mW
Thermal Resistance (θja)	θja = 45°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 18°C/W

θja: Junction-to–ambient thermal resistance.

ψjt: Junction–to-top of package thermal characterization parameter.



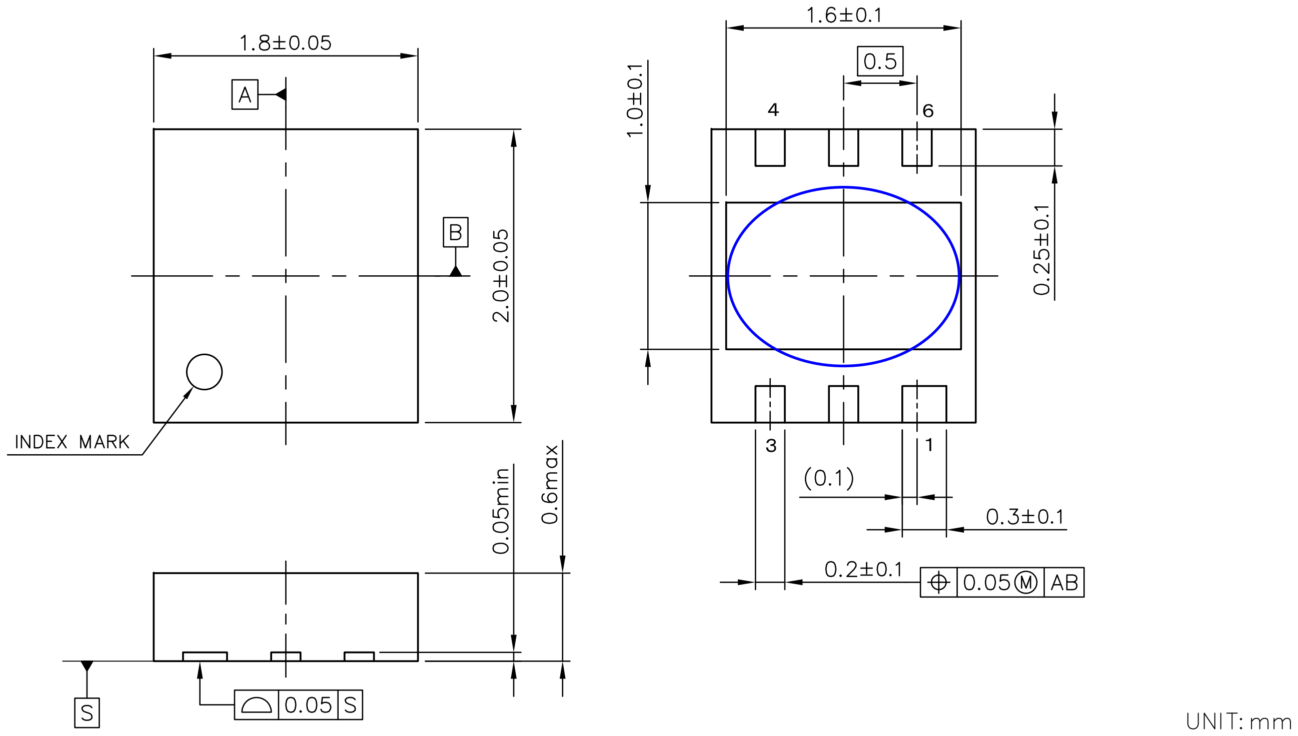
Power Dissipation vs. Ambient Temperature



Measurement Board Pattern

The above graph shows the power dissipation of the package at Tjmax = 125°C and Tjmax = 150°C. Operating the device in the hatched range might have a negative influence on its lifetime. The total hours of use and the total years of use must be limited as follows:

Total Hours of Use	Total Years of Use (4 hours/day)
13,000 hours	9 years



DFN(PL)1820-6 Package Dimensions

∗ The tab on the bottom of the package is substrate level (GND/V_{DD}). It is recommended that the tab be connected to the ground plane/the VDD pin on the board, or otherwise be left floating.

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7. The products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. We shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products.
8. Quality Warranty

    8-1. Quality Warranty Period

    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.

    8-2. Quality Warranty Remedies

    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.
    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.

    8-3. Remedies after Quality Warranty Period

    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.