

OUTLINE

The R1130xxxx Series are CMOS-based voltage regulator (VR) ICs. VR function has features of high ripple rejection, low dropout voltage, high output voltage accuracy, and ultra-low supply current. Each of these ICs consists of a voltage reference unit, an error amplifier, resistors for setting output voltage, and a current limit circuit. Each of the R1130xxxxA/B type includes also a chip enable circuit.

The output voltage of the R1130xxxxC type is adjustable with external resistors.

The output voltage of R1130xxxxA/B is fixed in the IC. Low supply current by the merit of CMOS process and built-in transistors with low ON-resistance make low dropout voltage. These regulators in the R1130xxxx Series are remarkable improvement on the current regulators in terms of ripple rejection, input transient response, and load transient response. Maximum Output Current is large for its compact size.

Thus, the R1130xxxx series are suitable for power supply for CD-drives, DVD-drives, and so forth.

Since the packages for these ICs are the SOT-89-5 package or HSON-6P, high density mounting of the ICs on boards is possible.

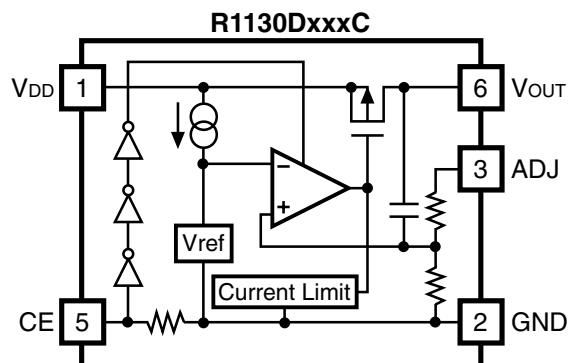
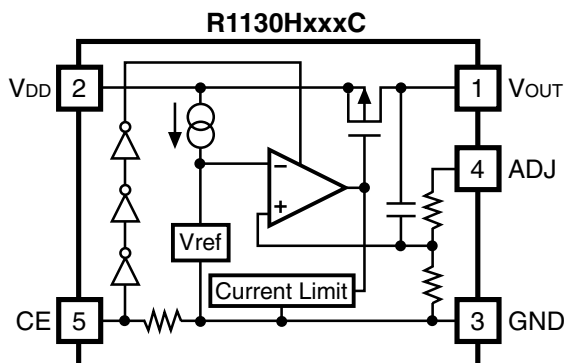
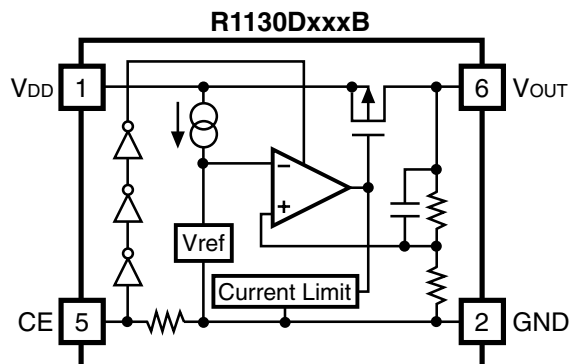
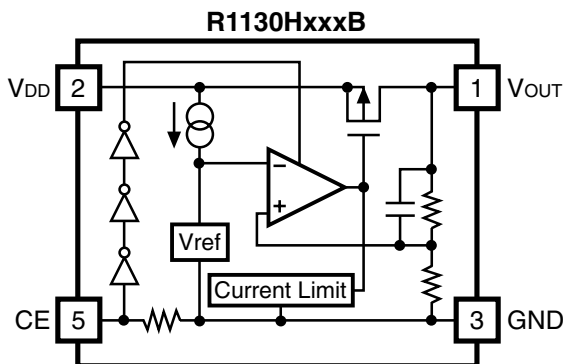
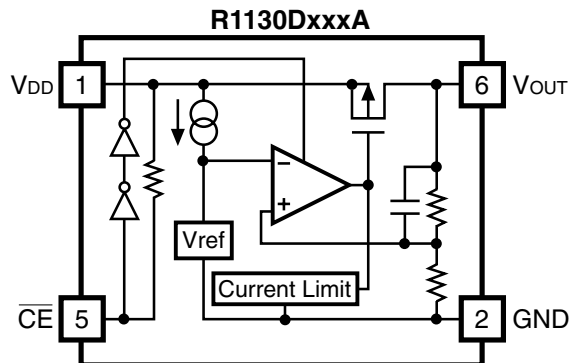
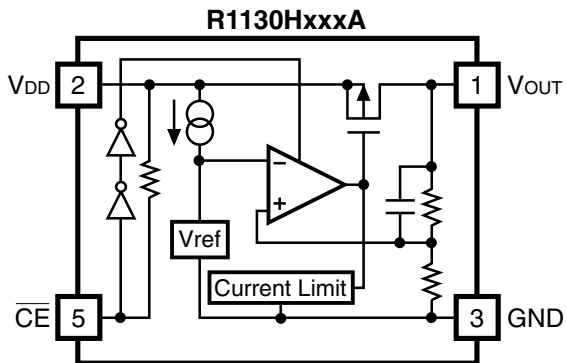
FEATURES

- Ultra-Low Supply Current Typ. 50 μ A
- Low Standby Current..... Typ. 0.1 μ A (VR) for A type
- High Ripple Rejection..... Typ. 60dB (f=1kHz) (VR)
- Output Current..... Min. 300mA ($V_{IN}=V_{OUT}+1V$)
- Output Voltage (VR)..... Stepwise setting with a step of 0.1V in the range of 1.5V to 5.0V (A/B Version) (Reference 1.8V (C Version))
- High Output Voltage Accuracy $\pm 2.0\%$ (VR) for A/B type,
 $\pm 2.0\%$ (Reference Voltage for adjustable VR) for C type
- Low Dropout Voltage..... Typ. 0.2V ($I_{OUT}=100mA$) (VR)
- Small Package..... SOT-89-5, HSON-6P
- Built-in Current Limit Circuit
- Low Temperature-drift Coefficient of Output Voltage Typ. $\pm 100ppm/^{\circ}C$
- Absolute Maximum Voltage..... 9V
- Internal Phase Compensation (small output capacitance such as 0.1 μ F Ceramic can be used with.)

APPLICATIONS

- Power source for CD-drives and DVD-drives, HDD.
- Local Power source for Notebook PC.

BLOCK DIAGRAMS



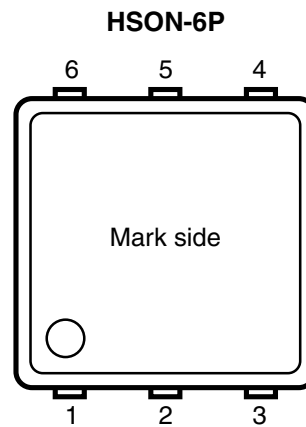
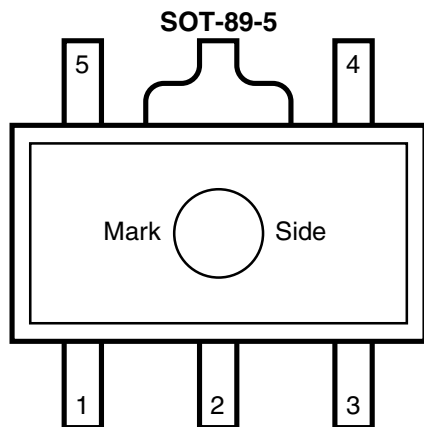
SELECTION GUIDE

The output voltage, chip-enable polarity, the taping type can be selected at the user's request. The selection can be made with designating the part number as follows;

R1130xxxx-xx ← Part Number
 ↑ ↑ ↑ ↑
 a b c d

| Code | Contents |
|------|---|
| a | Package Type; H: SOT-89-5, D: HSON-6P |
| b | Serial Number for Voltage Setting |
| c | Designation of option; A: Fixed Output Voltage Regulator with $\overline{\text{CE}}$ pin ("L" enable) B: Fixed Output Voltage Regulator with CE pin ("H" enable) C: Output Voltage Adjustable Regulator with CE pin ("H" enable) |
| d | Designation of Taping Type; T1 or T2 (Refer to Taping Specifications) for SOT-89-5 TR or TL for HSON-6P |

PIN CONFIGURATION



PIN DESCRIPTION

SOT-89-5

| Pin No. | Symbol | Description |
|---------|---|--|
| 1 | V _{OUT} | Voltage Regulator Output Pin |
| 2 | V _{DD} | Input Pin |
| 3 | GND | Ground Pin |
| 4 | N.C. (A/B type) | No Connection |
| | ADJ (C type) | Adjustable Regulator feedback Input Pin (Connect to resistor voltage divider.) |
| 5 | $\overline{\text{CE}}$ (A type) or CE (B/C type) | Chip Enable Pin |

HSON-6P

| Pin No. | Symbol | Description |
|---------|---|--|
| 1 | V _{DD} | Input Pin |
| 2 | GND | Ground Pin |
| 3 | N.C. (A/B type) | No Connection |
| | ADJ (C type) | Adjustable Regulator feedback Input Pin (Connect to resistor voltage divider.) |
| 4 | N.C. | No Connection |
| 5 | $\overline{\text{CE}}$ (A type) or CE (B/C type) | Chip Enable Pin |
| 6 | V _{OUT} | Voltage Regulator Output Pin |

ABSOLUTE MAXIMUM RATINGS

| Symbol | Item | Rating | Unit |
|------------------|---|-----------------------------|------|
| V _{IN} | Input Voltage | 9.0 | V |
| V _{CE} | Input Voltage ($\overline{\text{CE}}$ or CE Input Pin) | -0.3 ~ V _{IN} +0.3 | V |
| V _{ADJ} | Input Voltage (ADJ Input Pin) | -0.3 ~ V _{IN} +0.3 | V |
| V _{OUT} | Output Voltage | -0.3 ~ V _{IN} +0.3 | V |
| I _{OUT} | Output Current | 450 | mA |
| P _D | Power Dissipation (SOT-89-5) | 500 | mW |
| P _D | Power Dissipation (HSON-6P) | 400 | mW |
| T _{opt} | Operating Temperature | -40 ~ 85 | °C |
| T _{stg} | Storage Temperature | -55 ~ 125 | °C |

ELECTRICAL CHARACTERISTICS

• R1130xxxxA

(T_{opt}=25°C)

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|---|---|--|---|-------------------------|-----------------|------------|
| V _{IN} | Input Voltage | | 2.5 | | 8.0 | V |
| I _{SS1} | Supply Current 1 | V _{IN} -V _{OUT} =1.0V V _{IN} =GND | | 50 | 100 | μA |
| I _{stby} | Standby Current | V _{IN} -V _{OUT} =1.0V V _{IN} =V _{CE} | | 0.1 | 1.0 | μA |
| V _{OUT} | Output voltage | V _{IN} -V _{OUT} =1.0V 1mA≤I _{OUT} ≤80mA | x0.98 | Set V _{OUT} | x1.02 | V |
| I _{OUT1} | Output Current | Refer to the table of Input Voltage by Set Output Voltage | 300 | | | mA |
| $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Load regulation | V _{IN} -V _{OUT} =1.0V 1mA≤I _{OUT} ≤80mA | | 40 | 80 | mV |
| V _{DIF} | Dropout Voltage | I _{OUT} =100mA | Refer to the Table of Dropout Voltage by Set Output Voltage | | | |
| $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | Line regulation | I _{OUT} =80mA, Set V _{OUT} ≥2.0V: V _{OUT} +0.5V≤V _{IN} ≤8.0V Set V _{OUT} ≤1.9V: 2.5V≤V _{IN} ≤8.0V | | 0.1 | 0.2 | %/V |
| RR | Ripple Rejection | f=1kHz, Ripple 0.5Vp-p, I _{OUT} =80mA Set V _{OUT} ≥1.8V: V _{IN} -V _{OUT} =1.0V Set V _{OUT} ≤1.7V: V _{IN} =2.8V | | 60 | | dB |
| $\frac{\Delta V_{OUT}}{\Delta T}$ | Output Voltage Temperature Coefficient | I _{OUT} =10mA, V _{IN} -V _{OUT} =1.0V -40°C≤T _{opt} ≤85°C | | ±100 | | ppm /°C |
| I _{lim} | Short Current Limit | Set V _{OUT} ≤3.9V, V _{OUT} =0V Set V _{OUT} ≥4.0V, V _{OUT} =0V | | 70 50 | | mA |
| R _{PU} | Pull-up resistance for \overline{CE} pin | | 2.5 | 5.0 | 10.0 | MΩ |
| V _{CEH} | \overline{CE} Input Voltage “H” | V _{IN} =2.5V | 1.5 | | V _{IN} | V |
| V _{CEL} | \overline{CE} Input Voltage “L” | V _{IN} =2.5V | 0.00 | | 0.25 | V |

• R1130xxxxB

(Topt=25°C)

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|---|---|--|---|-------------------------|-----------------|------------|
| V _{IN} | Input Voltage | | 2.5 | | 8.0 | V |
| I _{SS1} | Supply Current 1 | V _{IN} -V _{OUT} =1.0V V _{IN} =V _{CE} | | 50 | 100 | μA |
| I _{stby} | Standby Current | V _{IN} -V _{OUT} =1.0V V _{IN} =GND | | 0.1 | | μA |
| V _{OUT} | Output voltage | V _{IN} -V _{OUT} =1.0V 1mA≤I _{OUT} ≤80mA | x0.98 | Set V _{OUT} | x1.02 | V |
| I _{OUT1} | Output Current | Refer to the table of Input Voltage by Set Output Voltage | 300 | | | mA |
| $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Load regulation | V _{IN} -V _{OUT} =1.0V 1mA≤I _{OUT} ≤80mA | | 40 | 80 | mV |
| V _{DIF} | Dropout Voltage | I _{OUT} =100mA | Refer to the Table of Dropout Voltage by Set Output Voltage | | | |
| $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | Line regulation | I _{OUT} =80mA Set V _{OUT} ≥2.0V: V _{OUT} +0.5V≤V _{IN} ≤8V Set V _{OUT} ≤1.9V: 2.5V≤V _{IN} ≤8.0V | | 0.1 | 0.2 | %/V |
| RR | Ripple Rejection | f=1kHz, Ripple 0.5Vp-p, I _{OUT} =80mA Set V _{OUT} ≥1.8V: V _{IN} -V _{OUT} =1.0V Set V _{OUT} ≤1.7V: V _{IN} =2.8V | | 60 | | dB |
| $\frac{\Delta V_{OUT}}{\Delta T_{opt}}$ | Output Voltage Temperature Coefficient | I _{OUT} =10mA, V _{IN} -V _{OUT} =1.0V -40°C≤Topt≤85°C | | ±100 | | ppm /°C |
| I _{lim} | Short Current Limit | Set V _{OUT} ≤3.9V, V _{OUT} =0V Set V _{OUT} ≥4.0V, V _{OUT} =0V | | 70 50 | | mA |
| R _{PD} | Pull-down resistance for CE pin | | 2.5 | 5.0 | 10.0 | MΩ |
| V _{CEH} | CE Input Voltage “H” | V _{IN} =2.5V | 1.5 | | V _{IN} | V |
| V _{CEL} | CE Input Voltage “L” | V _{IN} =2.5V | 0.00 | | 0.25 | V |

- Dropout Voltage by Set Output Voltage

(T_{opt}=25°C)

| Output Voltage V _{OUT} (V) | Dropout Voltage (V) | |
|-------------------------------------|---------------------|------|
| | Typ. | Max. |
| V _{OUT} =1.5 | 1.00 | 1.05 |
| V _{OUT} =1.6 | 0.90 | 0.95 |
| V _{OUT} =1.7 | 0.80 | 0.85 |
| V _{OUT} =1.8 | 0.70 | 0.75 |
| V _{OUT} =1.9 | 0.60 | 0.65 |
| V _{OUT} =2.0 | 0.50 | 0.60 |
| V _{OUT} =2.1 | 0.40 | 0.55 |
| 2.2V≤V _{OUT} ≤2.5V | 0.30 | 0.49 |
| 2.6V≤V _{OUT} ≤3.3V | 0.25 | 0.34 |
| 3.4V≤V _{OUT} ≤5.0V | 0.20 | 0.28 |

- Input Voltage by Set Output Voltage

(T_{opt}=25°C)

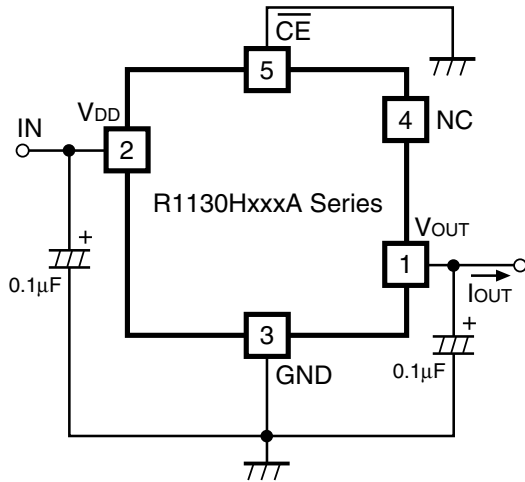
| Output Voltage V _{OUT} (V) | Input Voltage (V) |
|-------------------------------------|---|
| 1.5V≤V _{OUT} ≤1.9V | V _{IN} =V _{OUT} +1.5V |
| 2.0V≤V _{OUT} ≤2.7V | V _{IN} =V _{OUT} +1.3V |
| 2.8V≤V _{OUT} ≤5.0V | V _{IN} =V _{OUT} +1.0V |

• R1130xxxxC

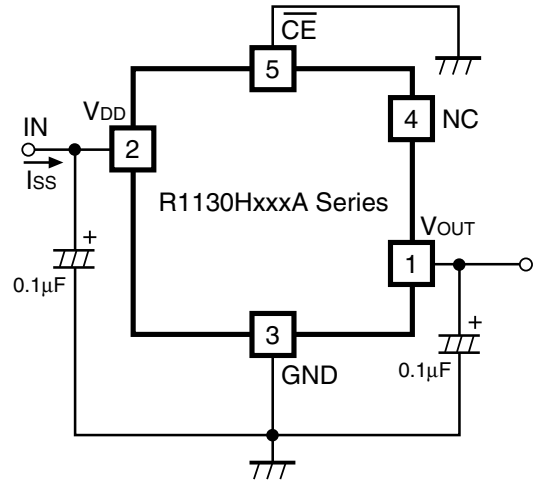
(Topt=25°C)

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|---|--|--|-------|-------|-----------------|------------|
| V _{IN} | Input voltage | | 2.5 | | 8.0 | V |
| I _{SS1} | Supply Current | V _{IN} -V _{OUT} =1.0V, V _{IN} =V _{CE} | | 50 | 100 | μA |
| I _{stby} | Standby Current | V _{IN} -V _{OUT} =1.0V, V _{IN} =GND | | 0.1 | 1.0 | μA |
| V _{OUT} | Reference Voltage for Adjustable Voltage Regulator | V _{OUT} =V _{ADJ} , V _{IN} -V _{OUT} =1.0V I _{OUT} =80mA | 1.764 | 1.800 | 1.836 | V |
| I _{OUT1} | Output Current | V _{OUT} =V _{ADJ} , V _{IN} -V _{OUT} =1.5V | 300 | | | mA |
| $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$ | Load regulation | V _{IN} =2.5V, V _{OUT} =V _{ADJ} 1mA≤I _{OUT} ≤80mA | | 40 | 80 | mV |
| V _{DIF} | Dropout Voltage | I _{OUT} =100mA, V _{OUT} =V _{ADJ} | | 0.70 | 0.75 | V |
| $\frac{\Delta V_{OUT}}{\Delta V_{IN}}$ | Line regulation | I _{OUT} =80mA, V _{OUT} =V _{ADJ} 2.5V≤V _{IN} ≤8V | | 0.1 | 0.2 | %/V |
| RR | Ripple Rejection | f=1kHz, Ripple 0.5Vp-p, I _{OUT} =80mA, V _{IN} -V _{OUT} =1.0V, V _{OUT} =V _{ADJ} , I _{OUT} =80mA | | 60 | | dB |
| $\frac{\Delta V_{OUT}}{\Delta T_{opt}}$ | Output Voltage Temperature Coefficient | I _{OUT} =10mA, V _{IN} -V _{OUT} =1.0V -40°C≤T _{opt} ≤85°C | | ±100 | | ppm /°C |
| I _{lim} | Short Current Limit | V _{OUT} =0V | | 70 | | mA |
| R _{PD} | Pull-down resistance for CE pin | | 2.5 | 5.0 | 10.0 | MΩ |
| V _{CEH} | CE Input Voltage “H” | V _{IN} =2.5V | 1.5 | | V _{IN} | V |
| V _{CEL} | CE Input Voltage “L” | V _{IN} =2.5V | 0.00 | | 0.25 | V |

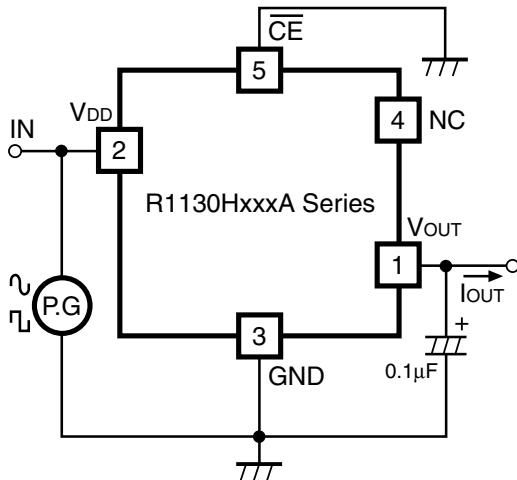
TEST CIRCUITS (Pin number is applied to R1130H Series)



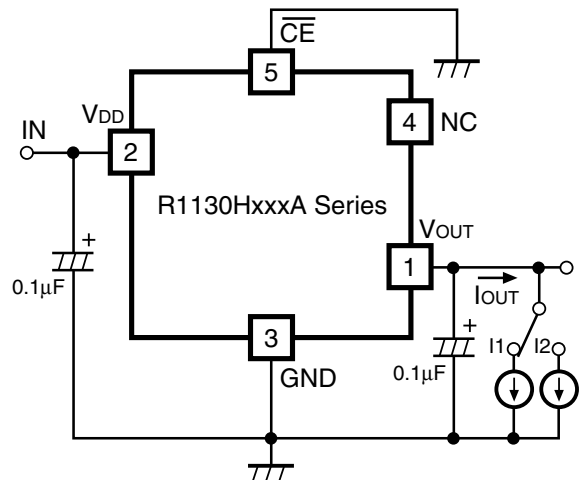
Standard Test Circuit



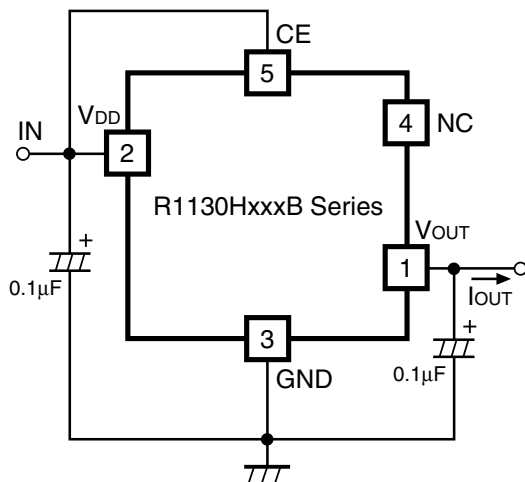
Test Circuit Supply Current



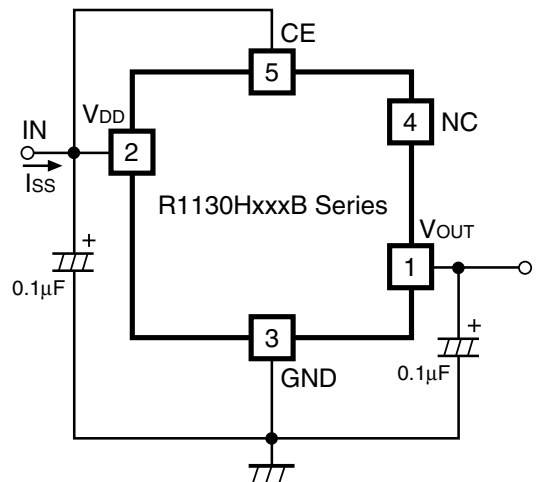
Test Circuit for Ripple Rejection and Input Transient Response



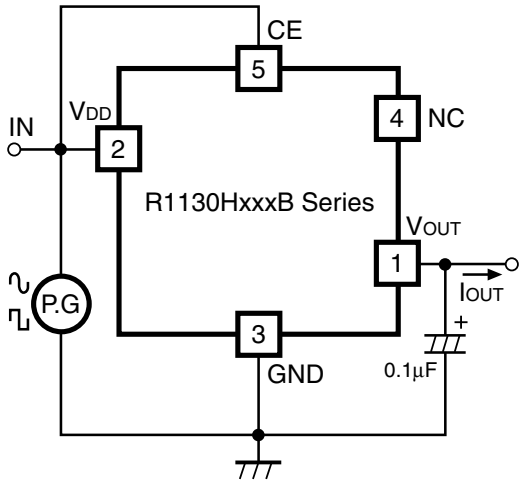
Test Circuit for Load Transient Response



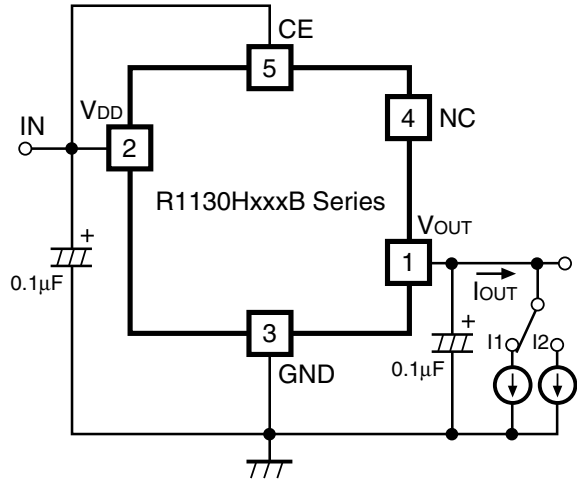
Standard Test Circuit



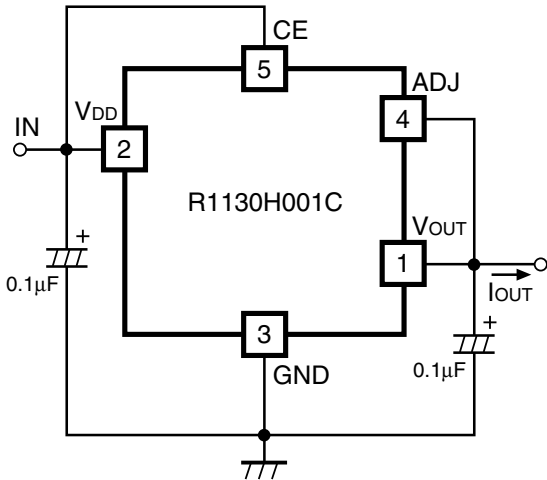
Test Circuit Supply Current



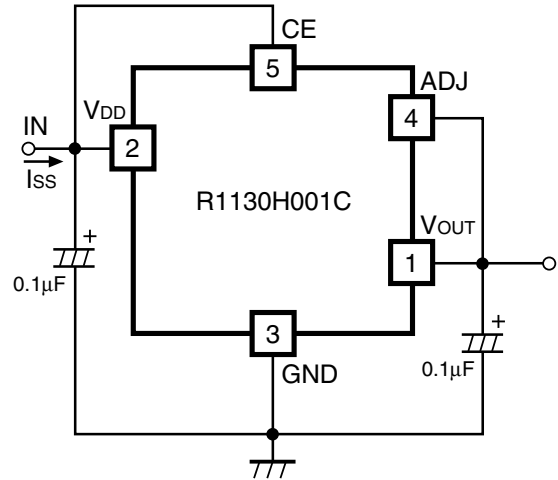
Test Circuit for Ripple Rejection and Input Transient Response



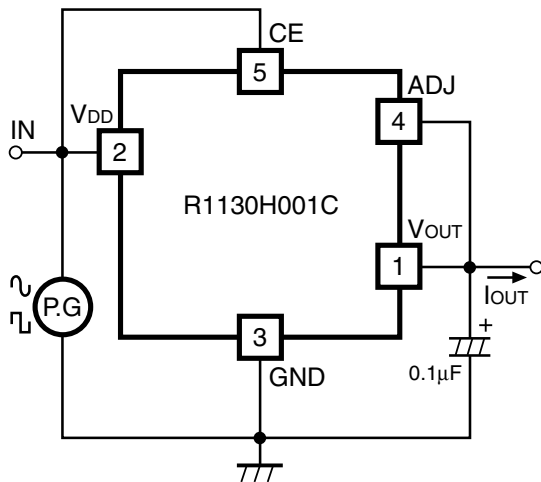
Test Circuit for Load Transient Response



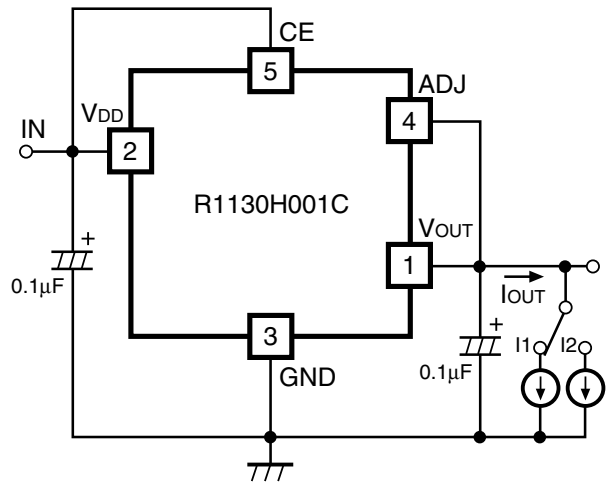
Standard Test Circuit



Test Circuit Supply Current



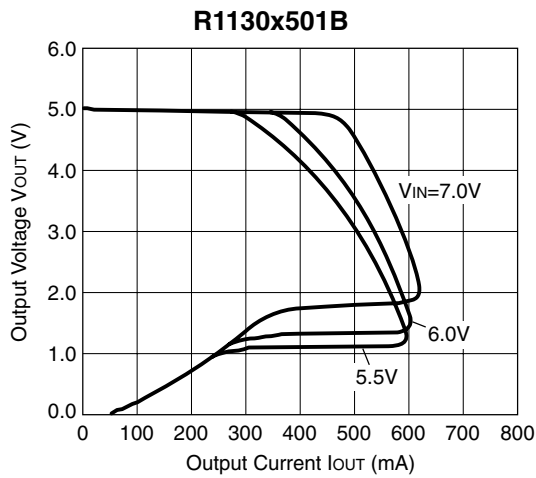
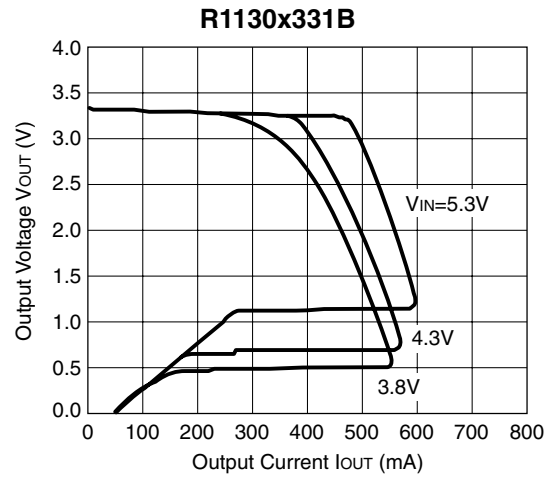
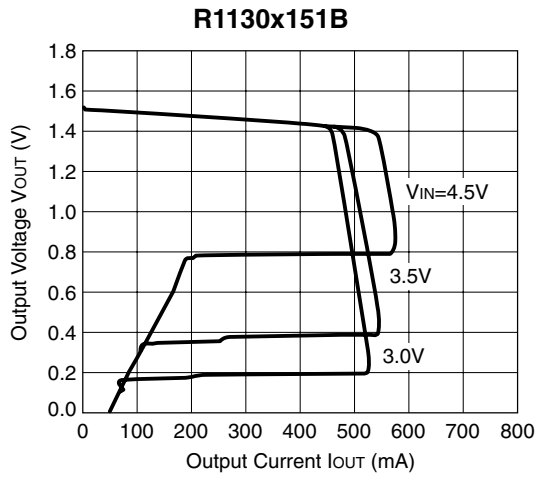
Test Circuit for Ripple Rejection and Input Transient Response



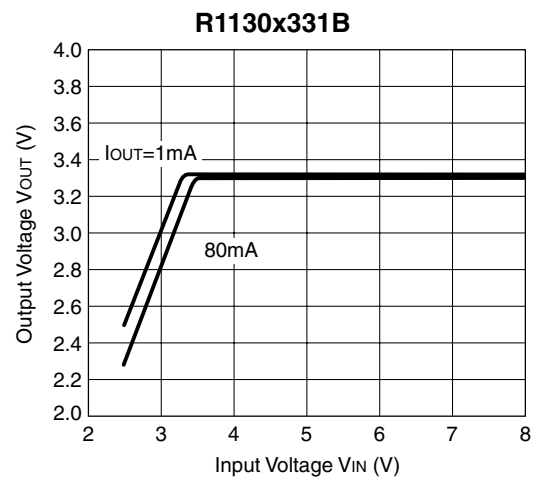
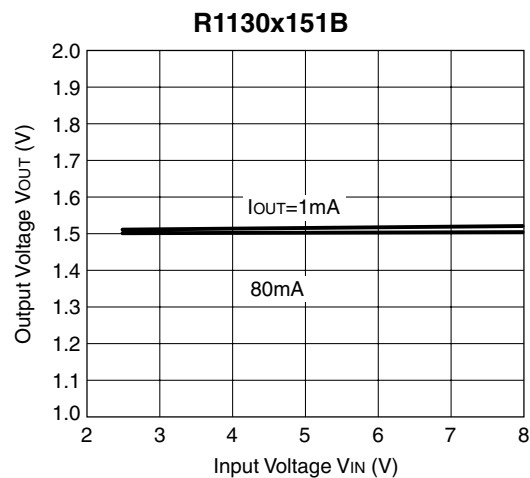
Test Circuit for Load Transient Response

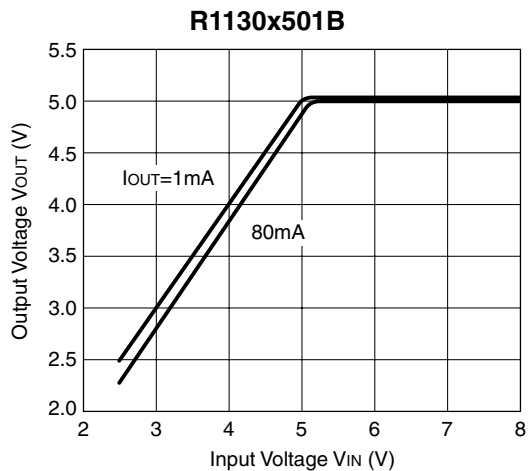
TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current (Topt=25°C)

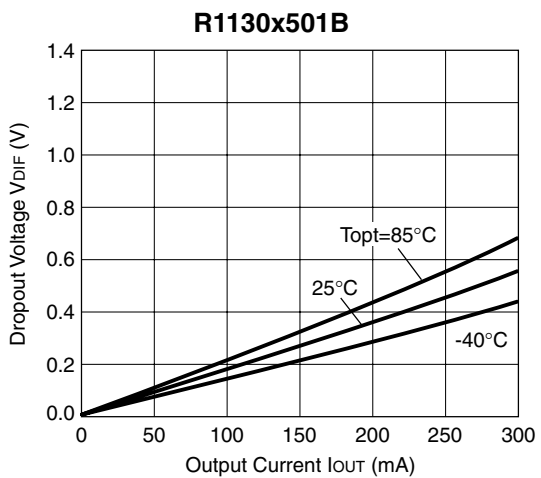
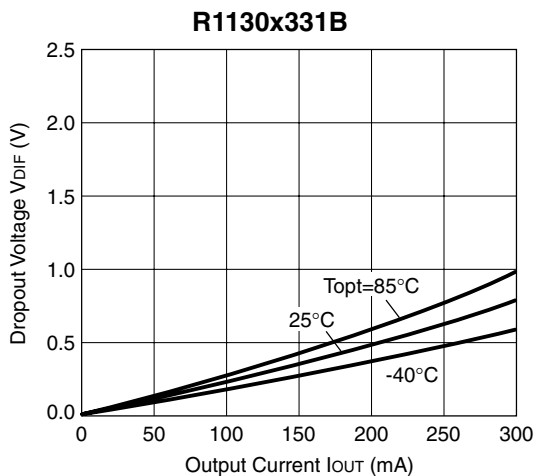
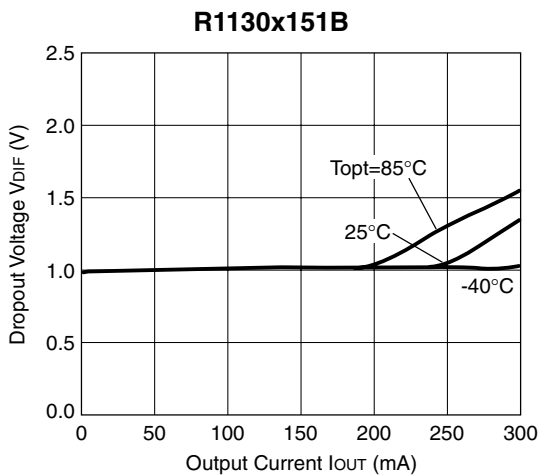


2) Input Voltage vs. Output Voltage (Topt=25°C)

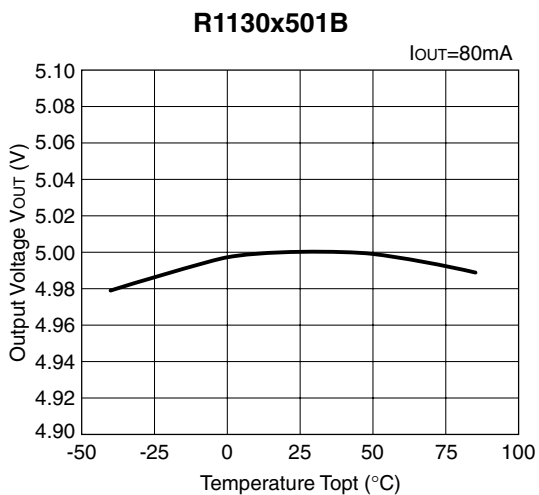
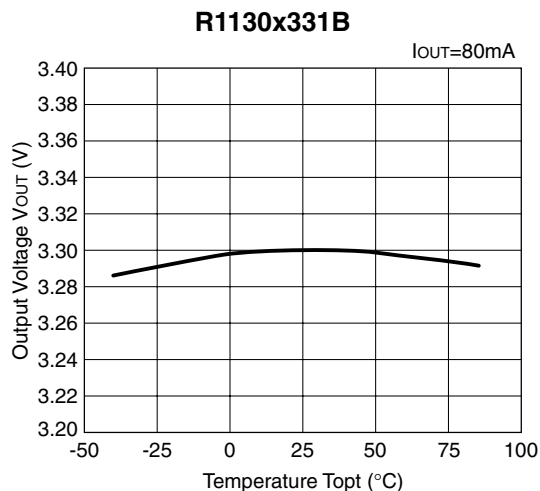
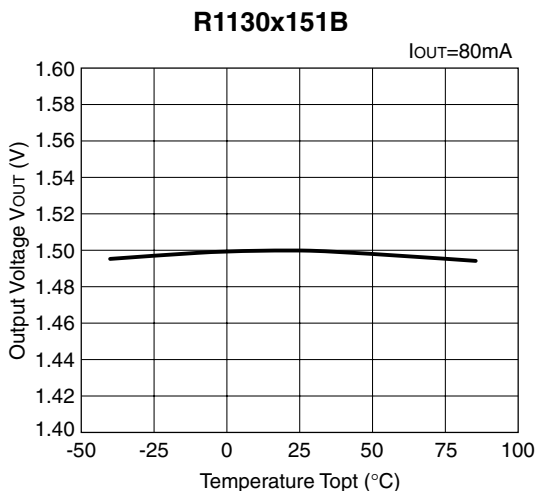




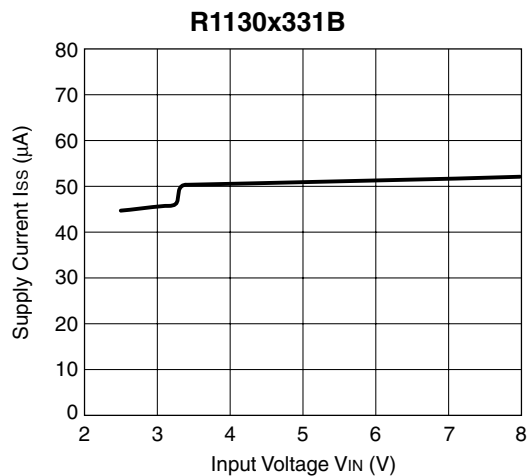
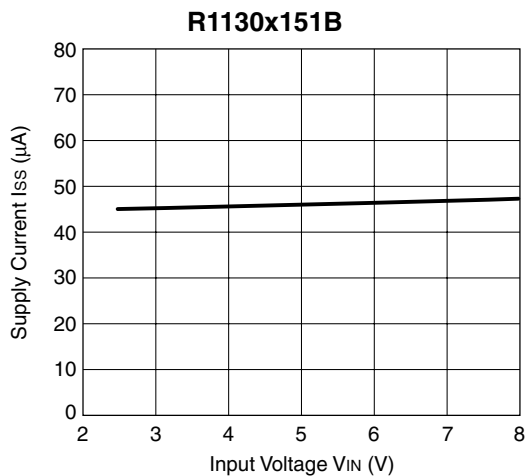
3) Dropout Voltage vs. Output Current

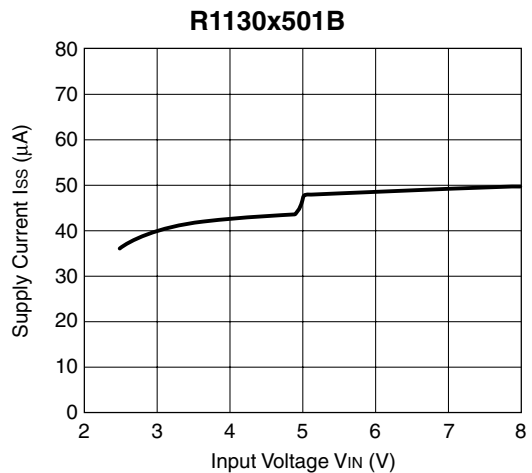


4) Output Voltage vs. Temperature

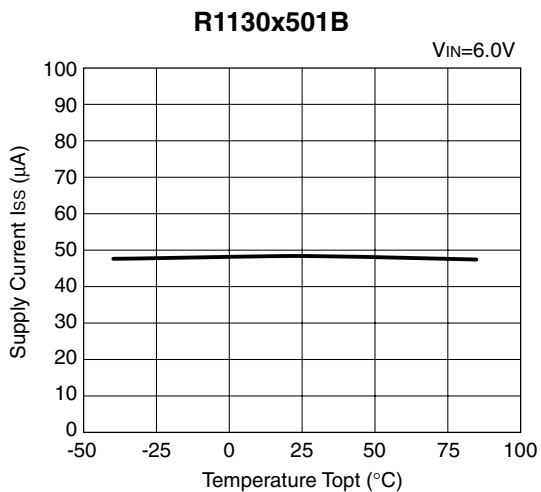
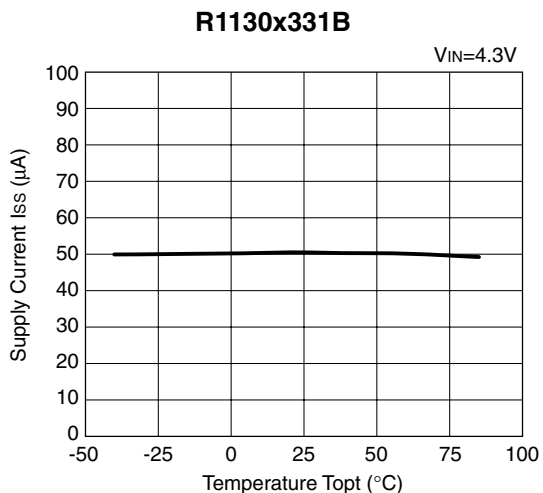
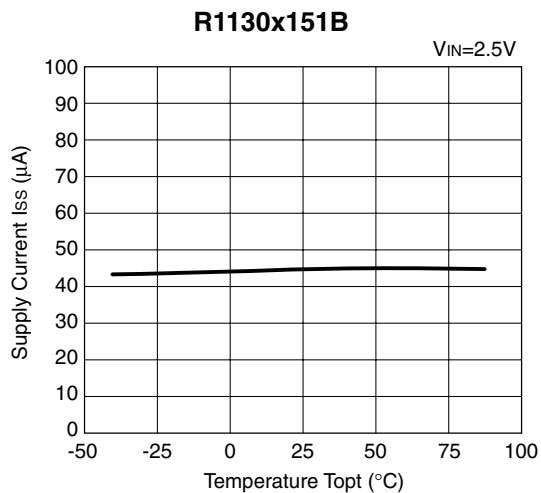


5) Supply Current vs. Input Voltage ($T_{opt}=25^{\circ}C$)

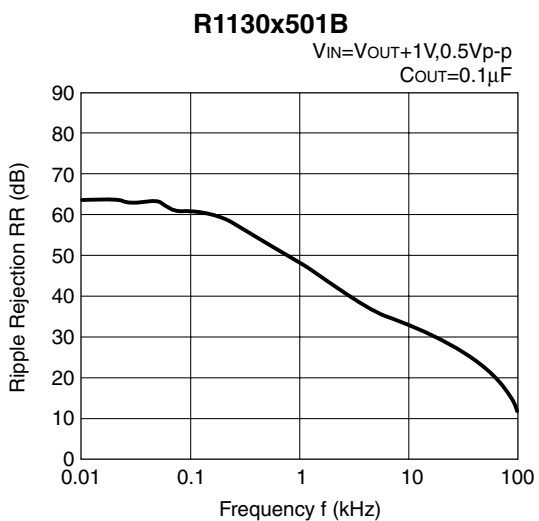
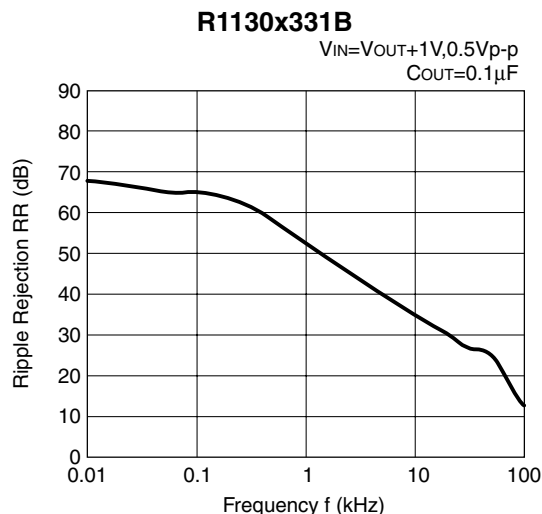
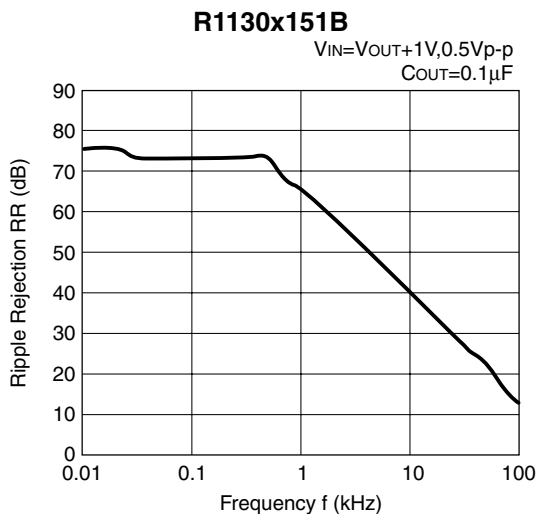




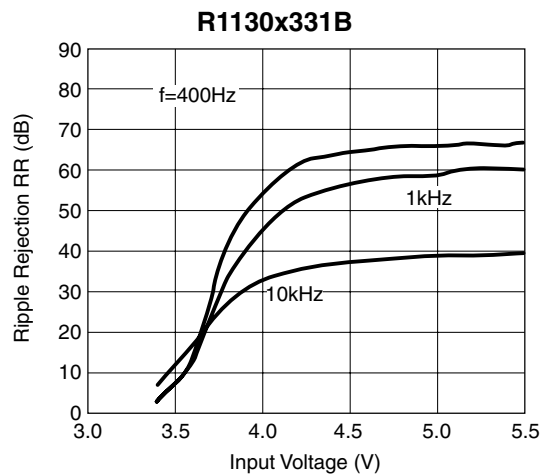
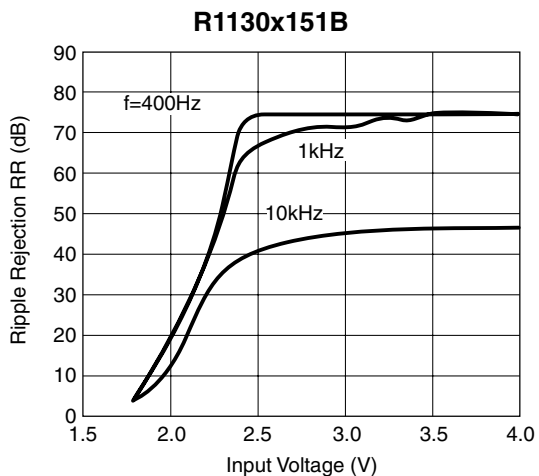
6) Supply Current vs. Temperature

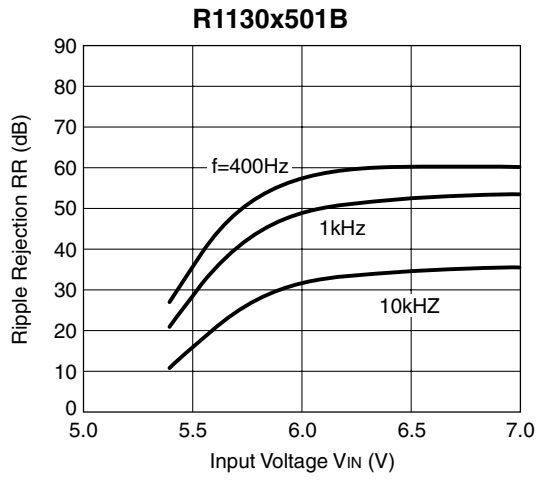


7) Ripple Rejection vs. Frequency

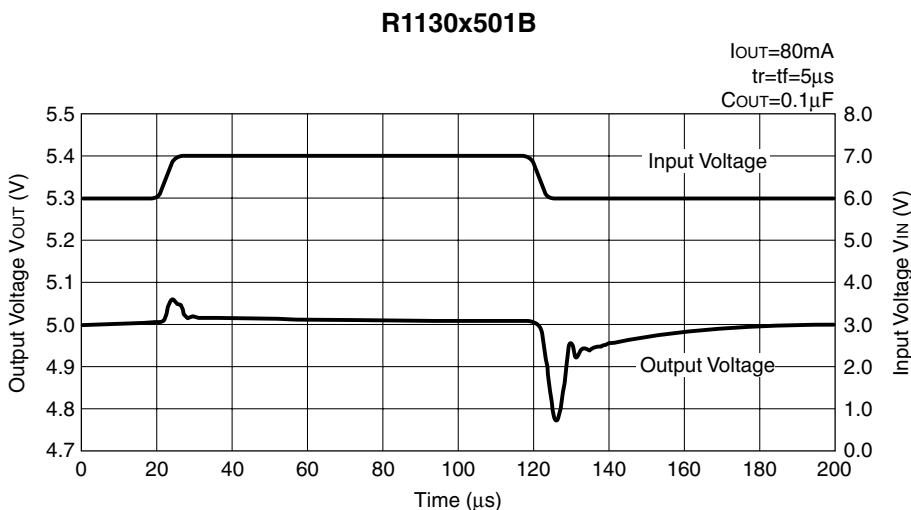
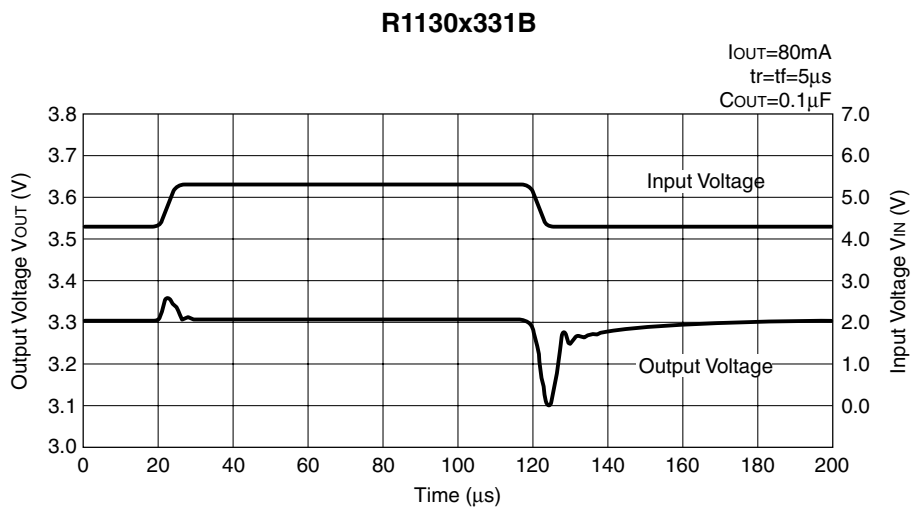
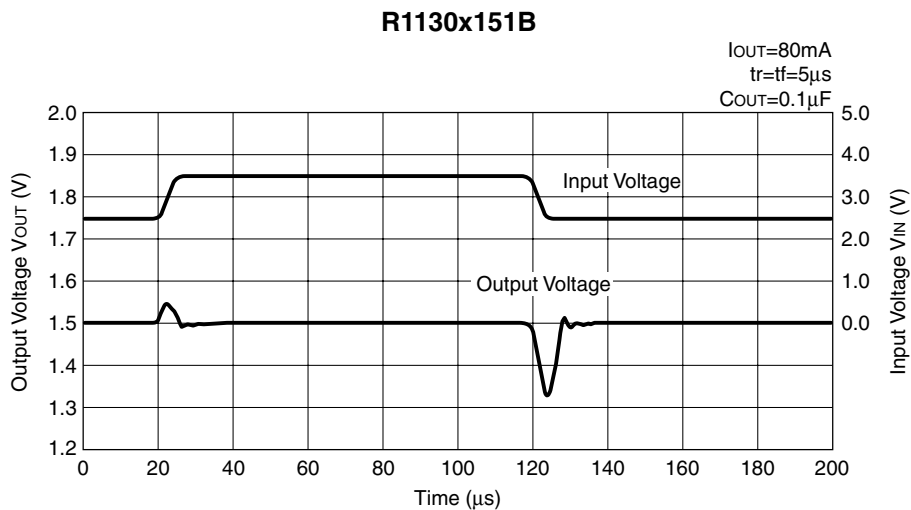


8) Ripple Rejection vs. Input Voltage



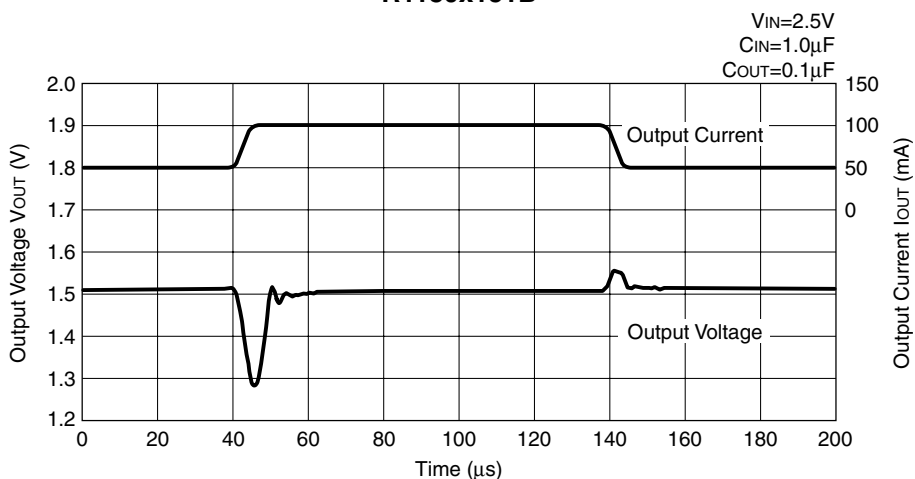


9) Input Transient Response

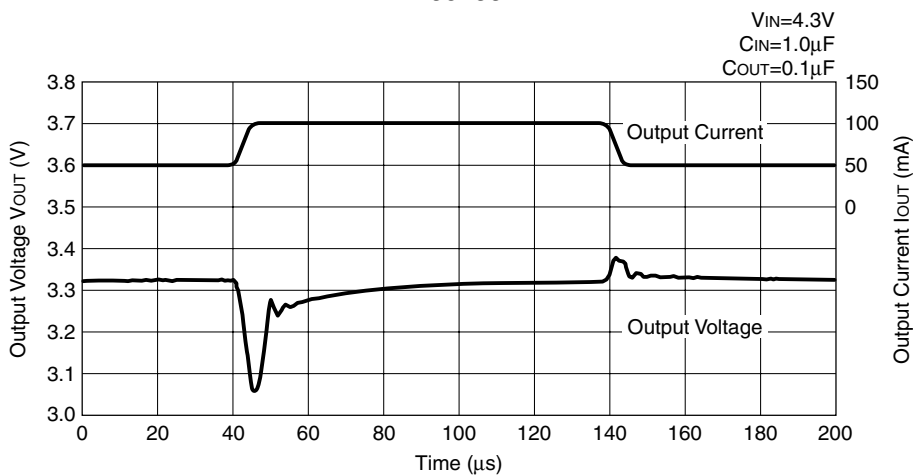


10) Load Transient Response

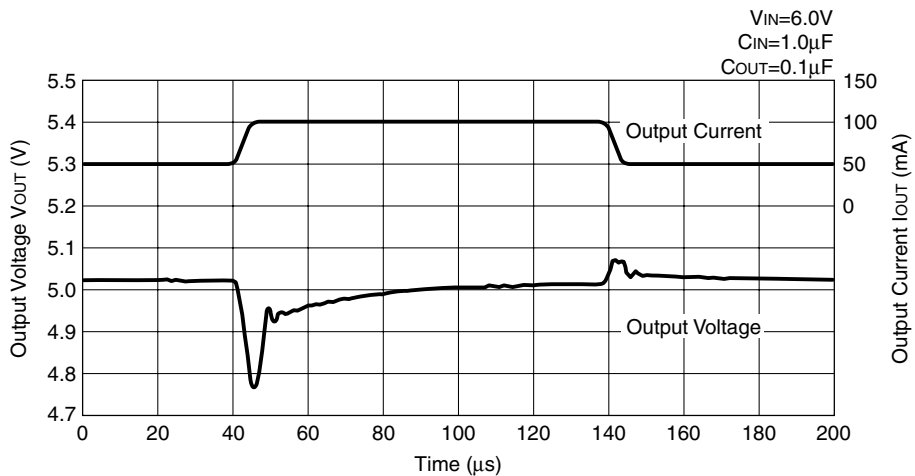
R1130x151B



R1130x331B



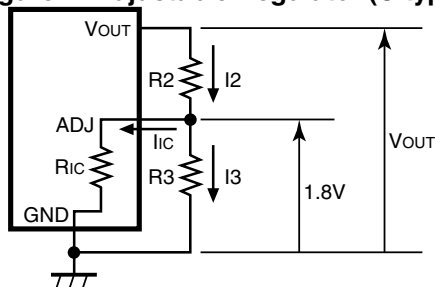
R1130x501B



APPENDIX

* Technical Notes on Output Voltage Setting of C type

Figure 1. Adjustable Regulator (C type)



The Output Voltage of Regulator in R1130xxxxC may be adjustable for any output voltage between its 1.8V reference and its V_{DD} setting level. An external pair of resistors is required, as shown in Figure 1.

The complete equation for the output voltage is described step by step as follows;

$$I_2 = I_{IC} + I_3 \dots\dots\dots (1)$$

$$I_3 = 1.8/R_3 \dots\dots\dots (2)$$

Thus,

$$I_2 = I_{IC} + 1.8/R_3 \dots\dots\dots (3)$$

Therefore,

$$V_{OUT} = 1.8 + R_2 \times I_2 \dots\dots\dots (4)$$

Put Equation (3) into Equation (4), then

$$\begin{aligned} V_{OUT} &= 1.8 + R_2 \times (I_{IC} + 1.8/R_3) \\ &= 1.8 \times (1 + R_2/R_3) + R_2 \times I_{IC} \dots\dots\dots (5) \end{aligned}$$

In 2nd term, or $R_2 \times I_{IC}$ will produce an error in V_{OUT} .

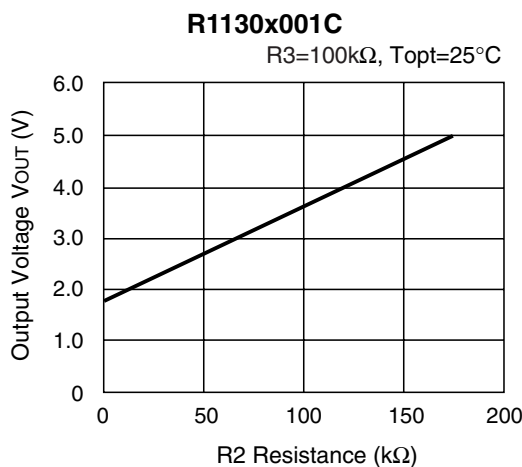
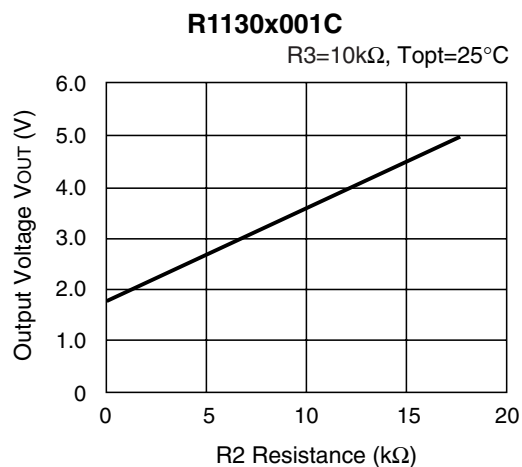
In Equation (5),

$$I_{IC} = 1.8/R_{1C} \dots\dots\dots (6)$$

$$\begin{aligned} R_2 \times I_{IC} &= R_2 \times 1.8/R_{1C} \\ &= 1.8 \times R_2/R_{1C} \dots\dots\dots (7) \end{aligned}$$

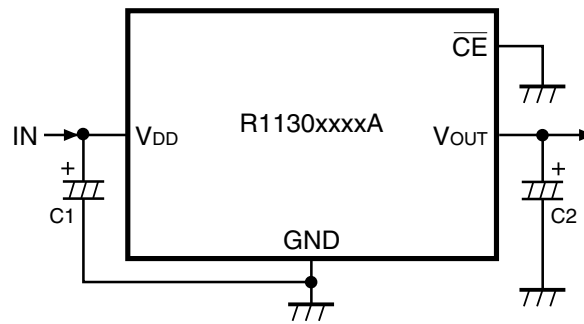
For better accuracy, choosing $R_2 (<< R_{1C})$ reduces this error.

* Adjustable Resistor Dependence of Output Voltage



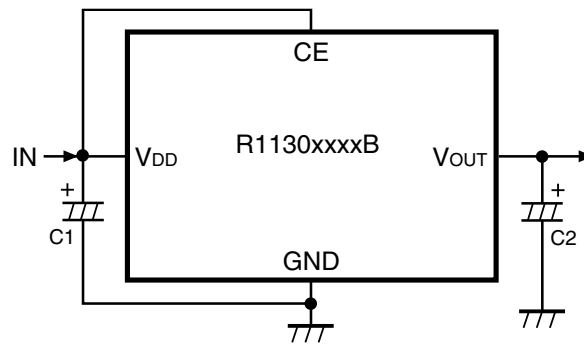
TYPICAL APPLICATION

R1130xxxxA



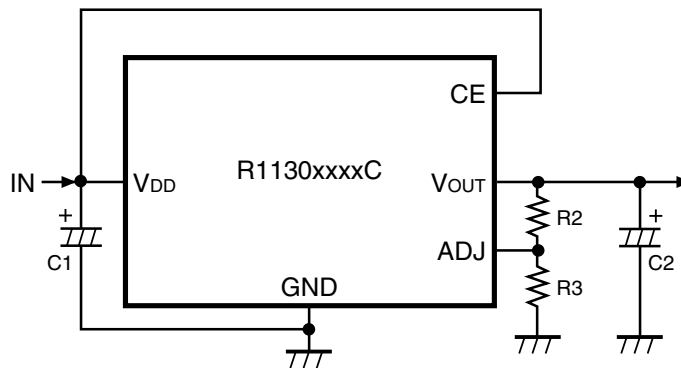
$C1=C2=0.1\mu\text{F}$

R1130xxxxB



$C1=C2=0.1\mu\text{F}$

R1130xxxxC

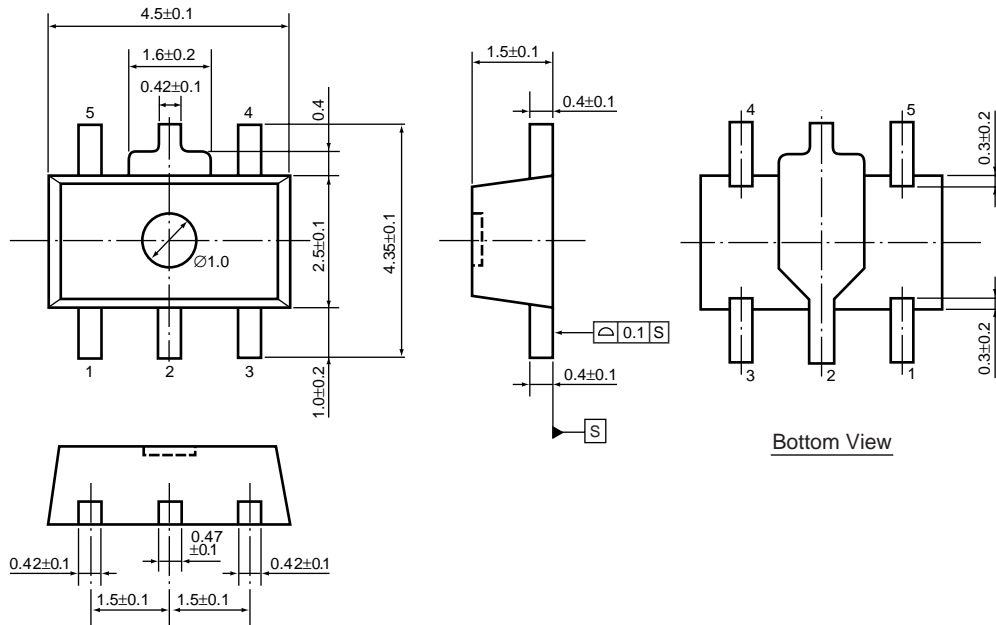


$C1=C2=0.1\mu\text{F}$, R2, R3: Refer to the Technical Notes on Output Voltage setting of C type.

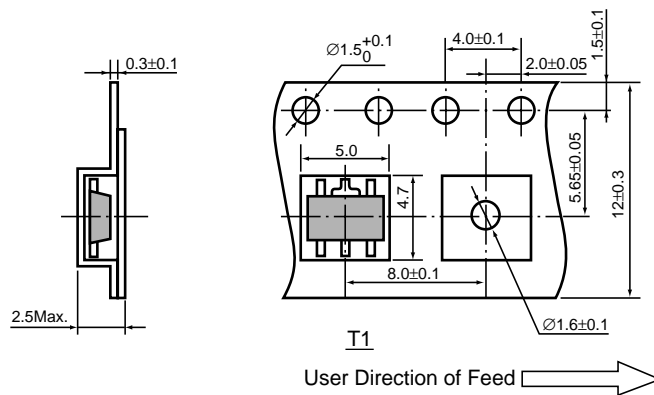
• SOT-89-5

Unit: mm

PACKAGE DIMENSIONS

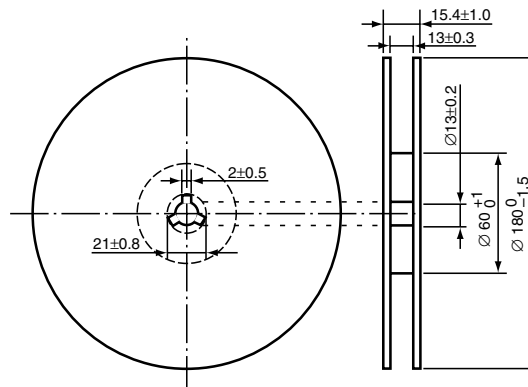


TAPING SPECIFICATION (T1: Standard Type)



TAPING REEL DIMENSIONS REUSE REEL (EIAJ-RRM-12Bc)

(1reel=1000pcs)



POWER DISSIPATION (SOT-89-5)

This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

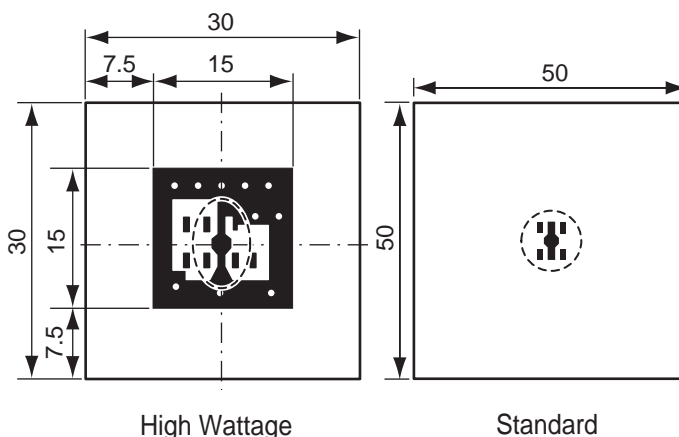
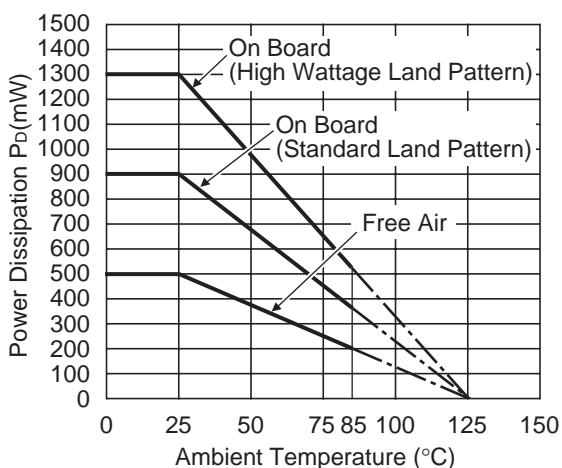
Measurement Conditions

| | High Wattage Land Pattern | Standard Land Pattern |
|------------------|--|--|
| Environment | Mounting on Board (Wind velocity=0m/s) | Mounting on Board (Wind velocity=0m/s) |
| Board Material | Glass cloth epoxy plastic (Double sided) | Glass cloth epoxy plastic (Double sided) |
| Board Dimensions | 30mm × 30mm × 1.6mm | 50mm × 50mm × 1.6mm |
| Copper Ratio | Top side : Approx. 20% , Back side : Approx. 100% | Top side : Approx. 10% , Back side : Approx. 100% |
| Through-hole | φ0.85mm × 10pcs | - |

Measurement Result

($T_{opt}=25^{\circ}C, T_{jmax}=125^{\circ}C$)

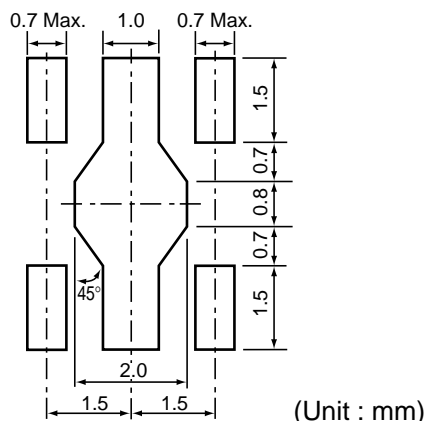
| | High Wattage Land Pattern | Standard Land Pattern | Free Air |
|--------------------|---------------------------|-----------------------|----------|
| Power Dissipation | 1300mW | 900mW | 500mW |
| Thermal Resistance | 77°C/W | 111°C/W | 200°C/W |



Measurement Board Pattern

○ IC Mount Area (Unit : mm)

RECOMMENDED LAND PATTERN (SOT-89-5)

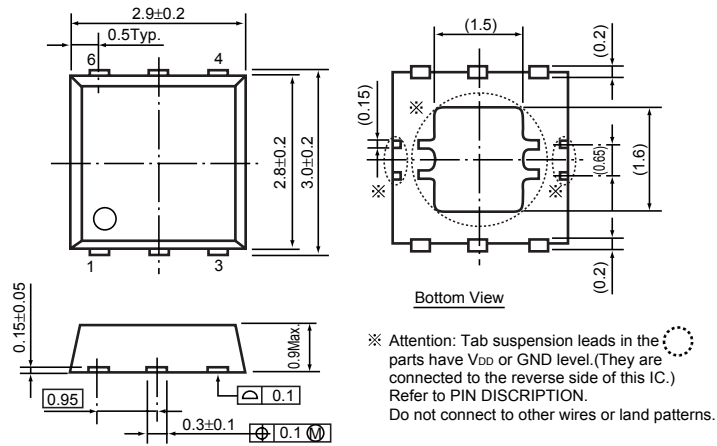


(Unit : mm)

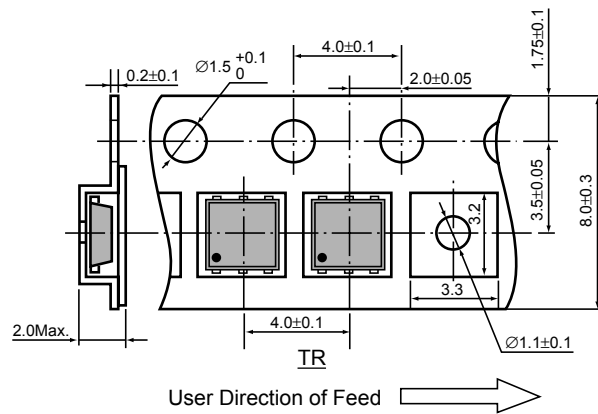
• HSON-6

Unit: mm

PACKAGE DIMENSIONS

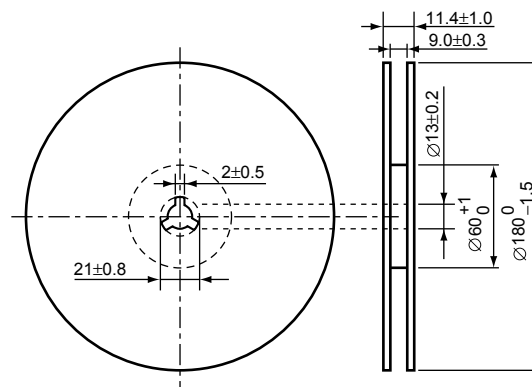


TAPING SPECIFICATION



TAPING REEL DIMENSIONS REUSE REEL (EIAJ-RRM-08Bc)

(1reel=3000pcs)



POWER DISSIPATION (HSON-6)

This specification is at mounted on board. Power Dissipation (P_D) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:

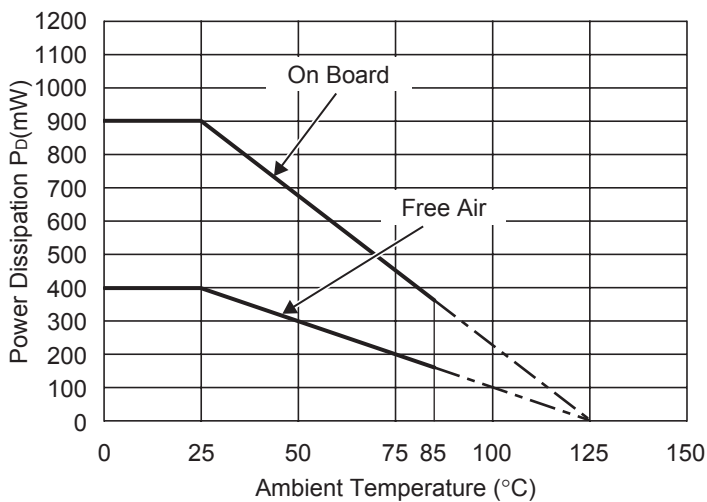
Measurement Conditions

| | |
|------------------|--|
| | Standard Land Pattern |
| Environment | Mounting on Board (Wind velocity=0m/s) |
| Board Material | Glass cloth epoxy plactic (Double sided) |
| Board Dimensions | 40mm × 40mm × 1.6mm |
| Copper Ratio | Top side : Approx. 50% , Back side : Approx. 50% |
| Through-hole | φ0.5mm × 44pcs |

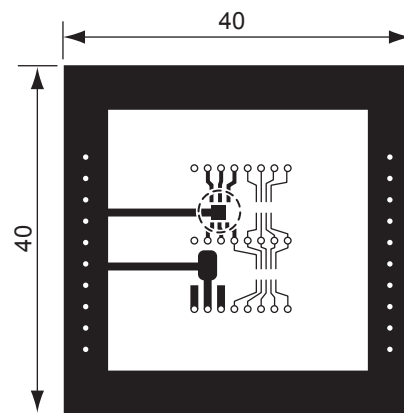
Measurement Result

($T_{opt}=25^{\circ}C, T_{jmax}=125^{\circ}C$)

| | | |
|--------------------|---|----------|
| | Standard Land Pattern | Free Air |
| Power Dissipation | 900mW | 400mW |
| Thermal Resistance | $\theta_{ja}=(125-25^{\circ}C)/0.9W=111^{\circ}C/W$ | 250°C/W |



Power Dissipation



Measurement Board Pattern

○ IC Mount Area Unit : mm

RECOMMENDED LAND PATTERN

