RICOH

# R1118 SERIES

## AUTOMATIC MODE SHIFT / 150mA LOW VOLTAGE REGULATOR

EA-175-071023

## OUTLINE

R1118 Series are CMOS-based voltage regulator ICs with ultra low supply current (Typ.5.5μA), and remarkable improved transient response compared with the conventional low supply current voltage regulator. The supply current of these ICs is automatically shifts between fast mode and low power mode, it depending on the load current. (The current threshold is fixed internally). These ICs are capable of the low input voltage (Min.1.4V) and the output voltage range from 0.8V is possible. The output voltage of R1118 is fixed in the IC.

Each of these ICs consists of a voltage reference unit, an error amplifier, a resister net for setting output voltage, a current limit circuits for over-current.

A standby mode with ultra low supply current can be realized with the chip enable function.

Since the packages for these ICs are SOT-23-5 and DFN(PLP)1612-4B (H: 0.4mm), therefore high density mounting of the ICs on boards is possible.

## FEATURES

- Supply Current (Low power Mode) ····· TYP. 5.5μA ($I_{OUT}$=0mA)
- Supply Current (Fast Mode) ····· TYP. 50μA ($I_{OUT}$=11mA)
- Supply Current (Standby Mode) ····· TYP. 0.1μA
- Input Voltage Range ····· 1.4V ~ 6.0V
- Output Voltage Range ····· 0.8V ~ 4.2V
- Dropout Voltage ····· TYP. 0.27V ($I_{OUT}$=150mA, $V_{OUT}$=2.8V)
- Output Voltage Accuracy ····· ±1.0% (1.5V<$V_{OUT}$ ≦ 3.5V)
- Ripple Rejection ····· TYP. 70dB (f=1kHz)

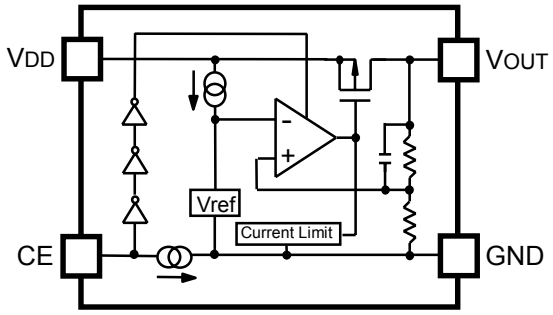
  ····· TYP. 60dB (f=10kHz)
- Excellent Line Regulation ····· TYP. 0.02%/V
- Packages ····· DFN(PLP)1612-4B (H=0.4mm), SOT-23-5
- Built-in Short Current Limit Circuit ····· TYP. 40mA
- Ceramic capacitors are recommended to be used this IC ····· $C_{IN}$=$C_{OUT}$=1.0μF

## APPLICATIONS

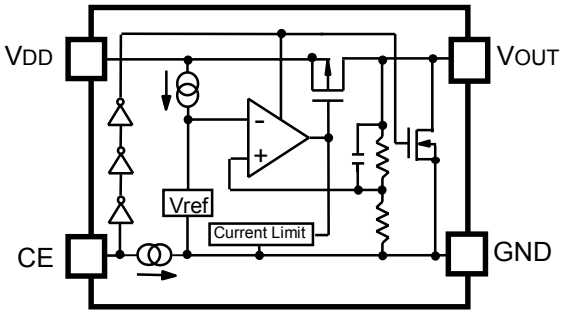
- Power source for portable communication equipment.
- Power source for electrical appliances such as cameras, VCRs and camcorders.
- Power source for battery-powered equipment.
- Power source for home appliances

## BLOCK DIAGRAM

**R1118xxx1B**




**R1118xxx1D**




## SELECTION GUIDE

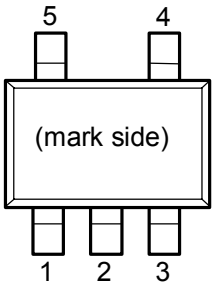
The output voltage, version, and the taping type for the ICs can be selected at the user's request.
The selection can be made with designating the part number as shown below;

R1118x<u>xxxx</u>-<u>xx</u> ←Part Number
↑ ↑ ↑ ↑
a b c d

| Code | Contents |
|---|---|
| a | Designation of Package Type:<br>N: SOT-23-5<br>K: DFN(PLP)1612-4B (H: 0.4mm) |
| b | Setting Output Voltage ($V_{OUT}$) :<br>Fixed Type: 08 to 42 Stepwise setting with 0.1V increment in the range from 0.8V to 4.2V<br>Exception:1.85V=R1118x181x5-xx<br>:2.85V=R1118x281x5-xx |
| c | Designation of Active Type:<br>B: active high type<br>D: active high type, with auto-discharge |
| d | Designation of Taping Type:<br>Ex.TR (refer to Taping Specifications: TR type is the standard direction) |

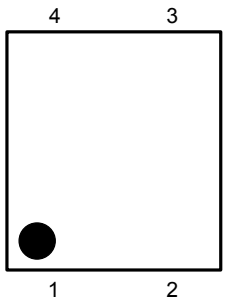
## PIN CONFIGURATION

**SOT-23-5**

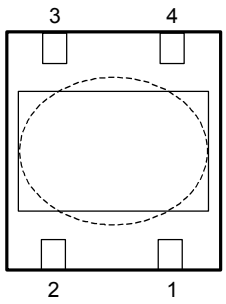



**DFN(PLP)1612-4B**

**Top View**




**Bottom View**




## PIN DESCRIPTIONS

**R1118N : SOT-23-5**

| Pin No. | Symbol | Description |
|---|---|---|
| 1 | $V_{DD}$ | Input Pin |
| 2 | GND | Ground Pin |
| 3 | CE | Chip Enable Pin (“H” Active) |
| 4 | NC | No Connection |
| 5 | $V_{OUT}$ | Output Pin |

**R1118K : DFN(PLP)1612-4B**

| Pin No. | Symbol | Description |
|---|---|---|
| 1 | $V_{OUT}$ | Output Pin |
| 2 | GND | Ground Pin |
| 3 | CE | Chip Enable Pin (“H” Active) |
| 4 | $V_{DD}$ | Input Pin |

Tab is GND level.(They are connected to the reverse side of this IC)
Do not connect to other wires or land patterns.

## ABSOLUTE MAXIMUM RATINGS

| Symbol | Item | Rating | | Unit |
|---|---|---|---|---|
| $V_{IN}$ | Input Voltage | 6.5 | | V |
| $V_{CE}$ | Input Voltage (CE pin) | − 0.3 ~ 6.5 | | V |
| $V_{OUT}$ | Output Voltage | − 0.3 ~ $V_{IN}$ +0.3 | | V |
| $I_{OUT}$ | Output Current | 180 | | mA |
| $P_D$ | Power Dissipation* | SOT-23-5 | 420 | mW |
| | | DFN(PLP)1612-4B | 580 | |
| Ta | Ambience Temperature Range | − 40°C ~ +85°C | | °C |
| Tstg | Storage Temperature Range | − 55°C ~ +125°C | | °C |

* For Power Dissipation, please refer refer to the PACKAGE INFORMATION.

## ELECTRICAL CHARACTERISTICS

$V_{IN}$= Set $V_{OUT}$ + 1V, $I_{OUT}$=1mA, unless otherwise noted.

values indicate -40°C ≦ Ta ≦ 85°C, unless otherwise noted.

(Ta=25°C)

| Symbol | Item | Conditions | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output Voltage | $V_{OUT}$ ≦ 1.5V | -15mV<br>[-40mV] | | 15mV<br>[30mV] | V |
| | | 1.5V<$V_{OUT}$ ≦ 3.5V | $V_{OUT}$ x 0.99<br>[$V_{OUT}$ x 0.973] | | $V_{OUT}$ x 1.01<br>[$V_{OUT}$ x 1.02] | |
| | | 3.5V<$V_{OUT}$ | $V_{OUT}$ x 0.985<br>[$V_{OUT}$ x 0.968] | | $V_{OUT}$ x 1.015<br>[$V_{OUT}$ x 1.025] | |
| $I_{OUT}$ | Output Current | | [150] | | | mA |
| $\Delta V_{OUT}$ /$\Delta I_{OUT}$ | Load Regulation | 1mA ≦ $I_{OUT}$ ≦ 150mA | | | [80] | mV |
| $V_{DIF}$ | Dropout Voltage | Refer to the Dropout Voltage Specifications table | | | | |
| $I_{SS}1$ | Supply Current (Low Power Mode) | $I_{OUT}$=0mA | | 5.5 | [16] | µA |
| $I_{SS}2$ | Supply Current (Fast Mode) | $I_{OUT}$=11mA | | 50 | [105] | µA |
| Istandby | Supply Current (Standby) | $V_{IN}$=6.0V, $V_{CE}$=GND | | 0.1 | [1.0] | µA |
| $I_{OUT}H$ | Fast Mode Current Threshold | $I_{OUT}$=1µA→30mA | | 7 | [12] | mA |
| $I_{OUT}L$ | Low Power Mode Current Threshold | $I_{OUT}$=30mA→1µA | [1] | 2 | | mA |
| $\Delta V_{OUT}$ /$\Delta V_{IN}$ | Line Regulation | $V_{OUT}$+ 0.5V ≦ $V_{IN}$ ≦ 6.0V (Incase that $V_{OUT}$ ≦ 0.9V 1.4V ≦ $V_{IN}$) | | ±0.02 | [±0.2] | %/V |
| RR | Ripple Rejection | f=1kHz<br>f=10kHz<br>Ripple 0.2Vp-p, $I_{OUT}$=30mA<br>(Incase that $V_{OUT}$<1.5V | | 70<br>60 | | dB |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | $V_{IN}$=Set $V_{OUT}$ + 1.5V) | | | | |
| $V_{IN}$ | Input Voltage | | 1.4 | | 6.0 | V |
| $\Delta V_{OUT}$ /$\Delta$T | Output Voltage Temperature Coefficient | − 40°C ≦ Ta ≦ 85°C | | ±100 | | ppm/ °C |
| $I_{LIM}$ | Short Current | $V_{OUT}$=0V | | 40 | | mA |
| $I_{PD}$ | CE Pull-down Constant Current | | 0.01 | 0.30 | 0.6 | µA |
| $V_{CEH}$ | CE Input Voltage "H" | | 1.0 | | | V |
| $V_{CEL}$ | CE Input Voltage "L" | | | | 0.4 | V |
| en | Output Noise | BW10Hz ~ 100kHz | | 100 | | µVrms |
| $R_{LOW}$ | Nch On Resistance for Auto Discharge (D version Only) | $V_{CE}$ =0V | | 40 | | Ω |

The specifications in are guaranteed by design.

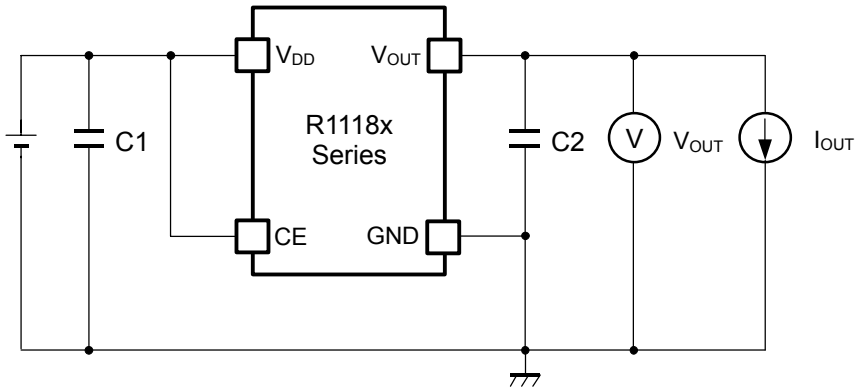
All specifications are specified under load conditions such that Tj ≈ Ta=25°C except for items of Output Noise, Ripple Rejection and Output Voltage Temperature Coefficient.

**Dropout Voltage**

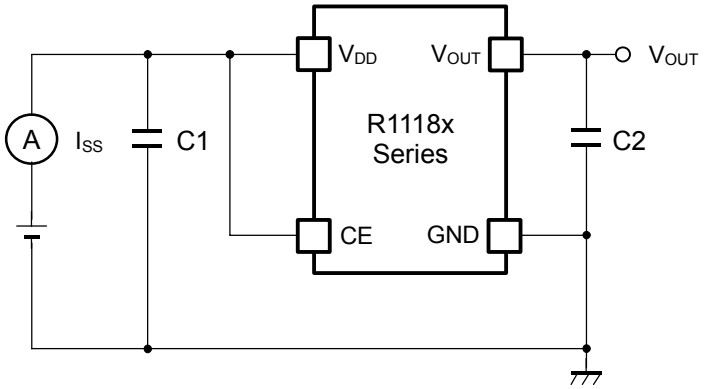
| $V_{OUT}$ (V) | Dropout Voltage (V) | | |
|---|---|---|---|
| | Condition | TYP. | MAX. |
| 0.8 ≦ $V_{OUT}$<0.9 | $I_{OUT}$=150mA | 0.82 | 1.06 |
| 0.9 ≦ $V_{OUT}$<1.0 | | 0.74 | 0.98 |
| 1.0 ≦ $V_{OUT}$<1.2 | | 0.66 | 0.90 |
| 1.2 ≦ $V_{OUT}$<1.5 | | 0.54 | 0.77 |
| 1.5 ≦ $V_{OUT}$<2.0 | | 0.45 | 0.64 |
| 2.0 ≦ $V_{OUT}$<2.8 | | 0.34 | 0.49 |
| 2.8 ≦ $V_{OUT}$ | | 0.27 | 0.37 |

The values in ☐ are guaranteed by design.

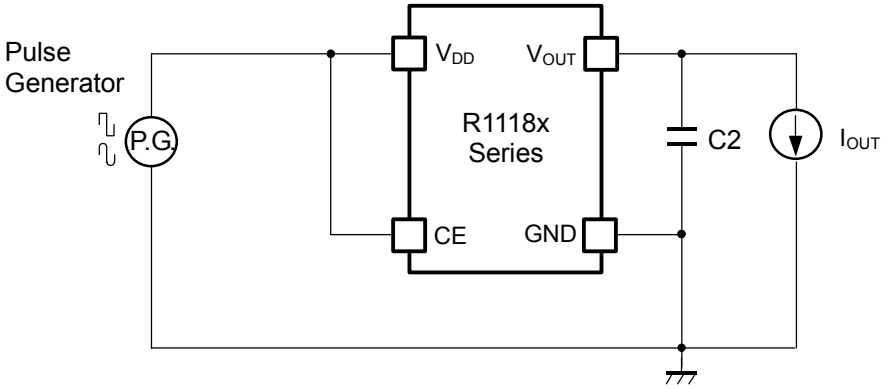
## TEST CIRCUITS



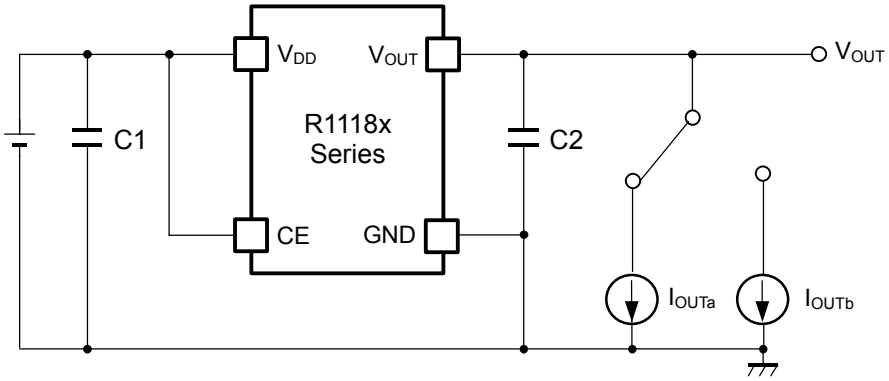

**Standard Test Circuit**




**Test Circuit for Supply Current**




**Test Circuit for Ripple Rejection**




**Test Circuit for Load Transient Response**

## TECHNICAL NOTES

When using these ICs, consider the following points:

Phase Compensation

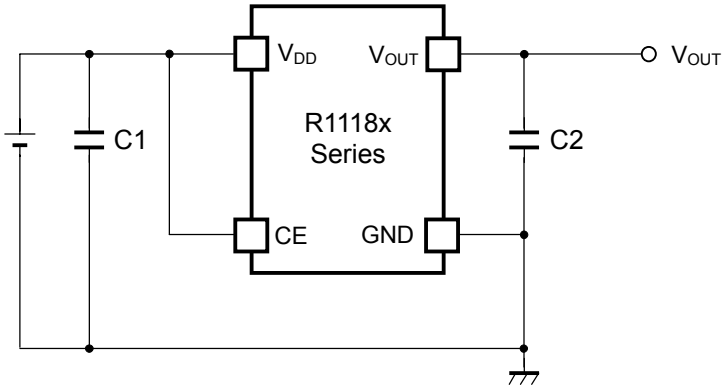
In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, use a capacitor $C_{OUT}$ with good frequency characteristics and ESR (Equivalent Series Resistance). (Note: If additional ceramic capacitors are connected with parallel to the output pin with an output capacitor for phase compensation, the operation might be unstable. Because of this, test these ICs with as same external components as ones to be used on the PCB.)

PCB Layout

Make $V_{DD}$ and GND lines sufficient. If their impedance is high, noise pickup or unstable operation may result. Connect a capacitor with a capacitance value as much as 1.0µF or more between $V_{DD}$ and GND pin, and as close as possible to the pins.

Set external components, especially the output capacitor, as close as possible to the ICs, and make wiring as short as possible

**TYPICAL APPLICATION**



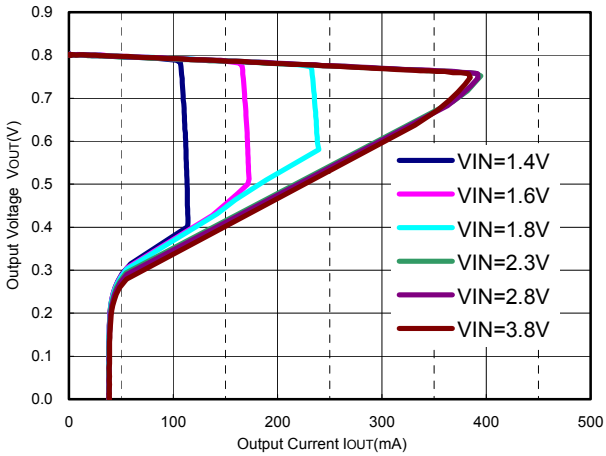

(External Components)

| | | | |
|---|---|---|---|
| Output Capacitor | 1.0µF | TDK | C1005JB0J105K |
| | | Kyocera | CM05X5R105K06AB |

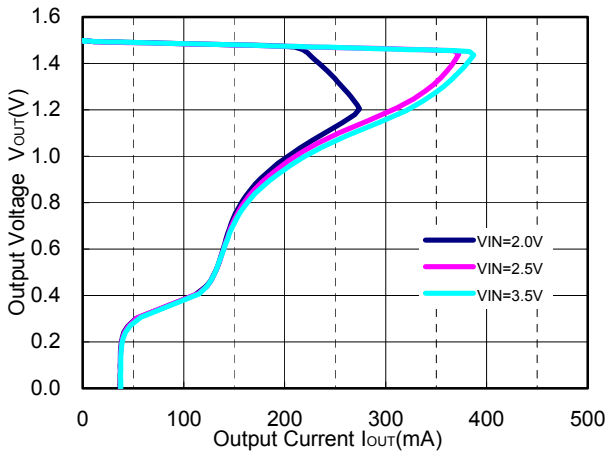
# TYPICAL CHARACTERISTICS

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

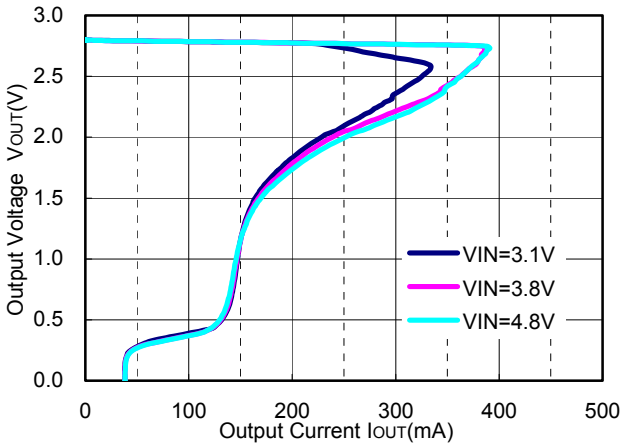
R1118X081X



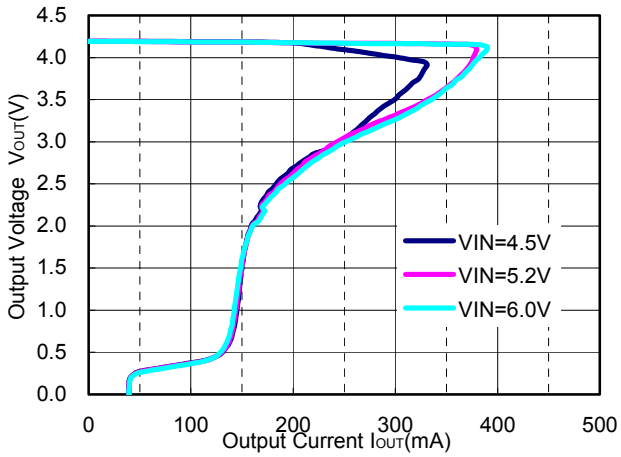

R1118X151X



R1118X281X

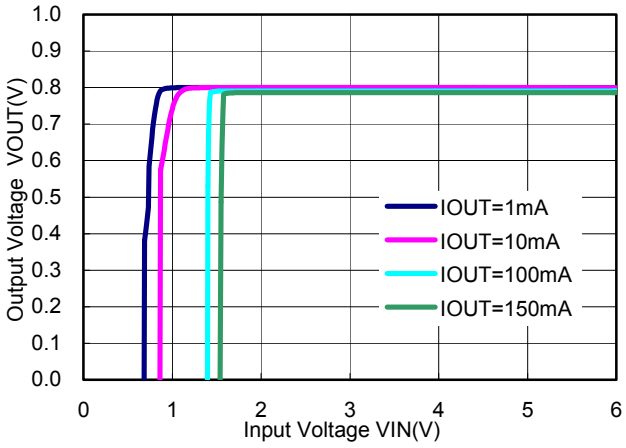



R1118X421X

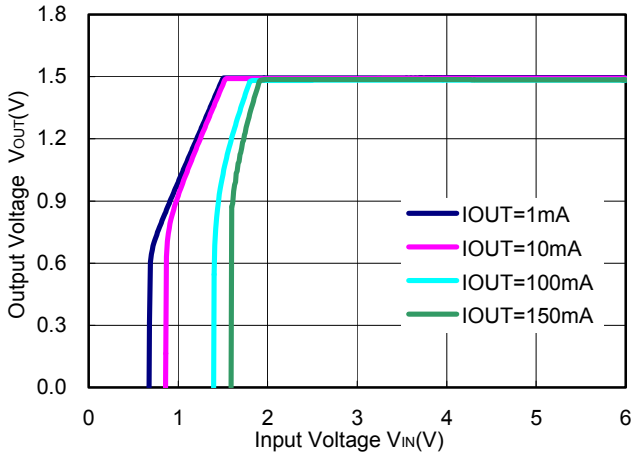



2) Input Voltage vs. Output Voltage (Topt=25°C)

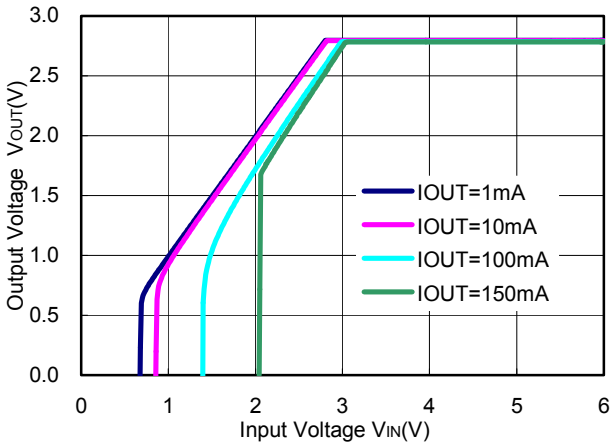
R1118X081X



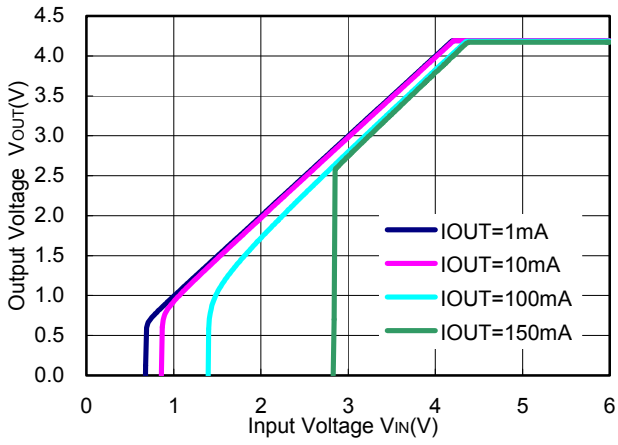

R1118X151X




R1118X281X

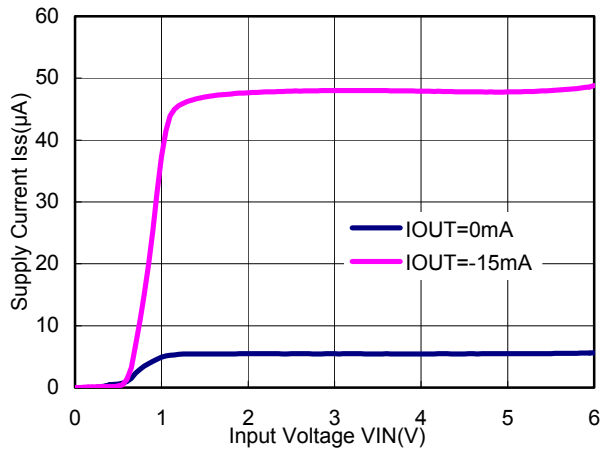



R1118X421X

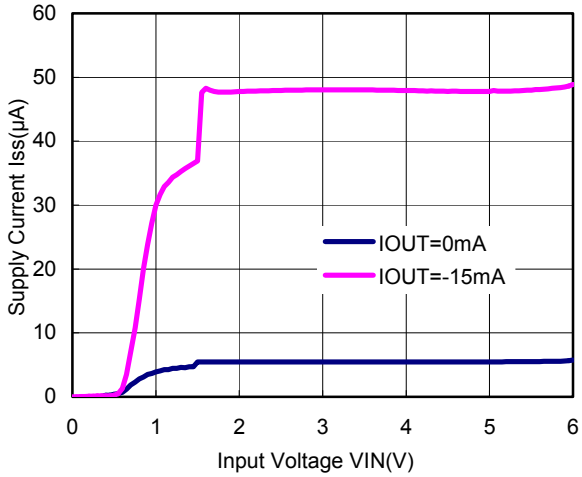


3) Supply Current vs. Input Voltage (Topt=25°C)

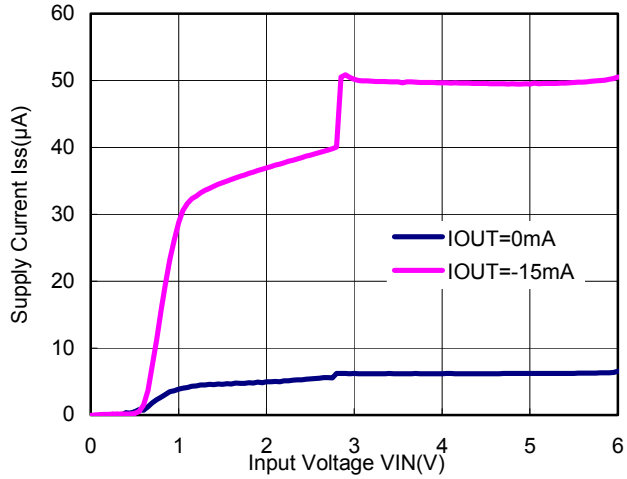
R1118X081X



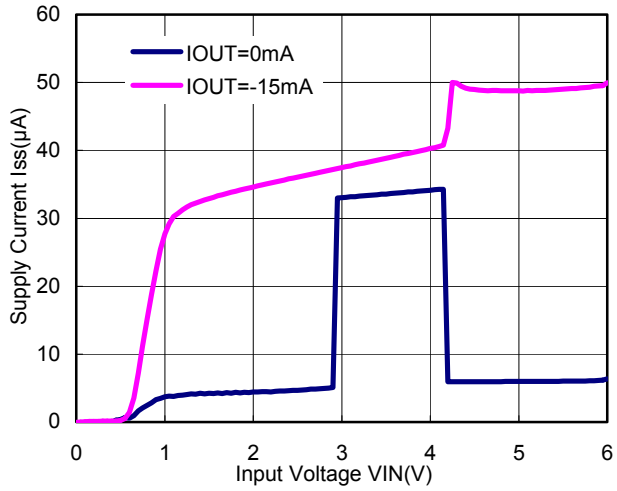

R1118X151X




R1118X281X

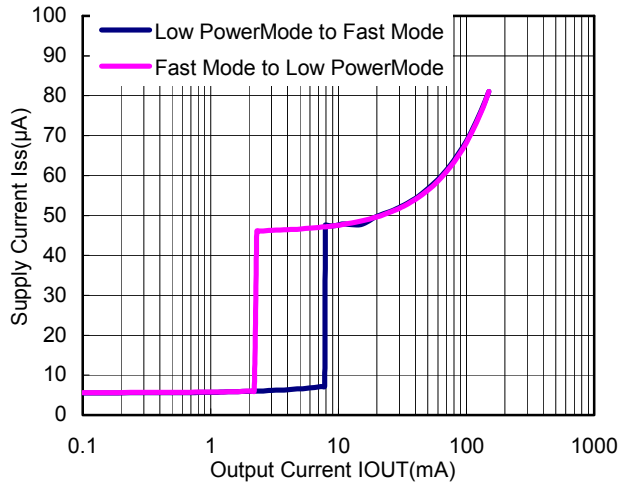



R1118X421X



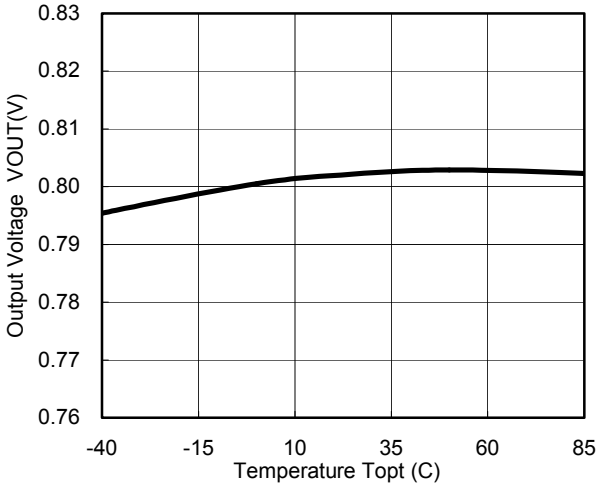

4) Supply Current vs. Output Current (Topt=25°C)

R1118X

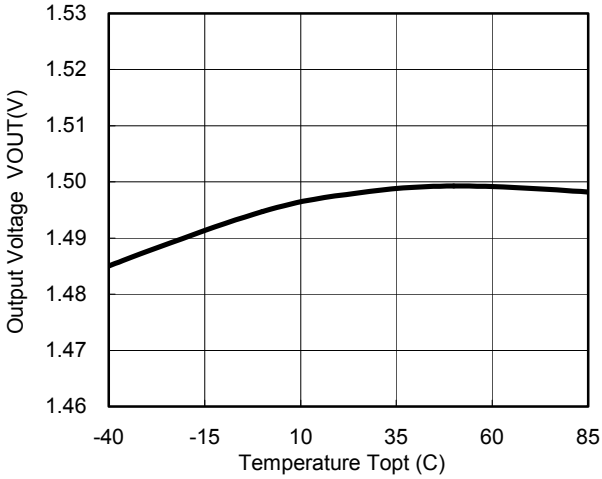


5) Output Voltage vs. Temperature

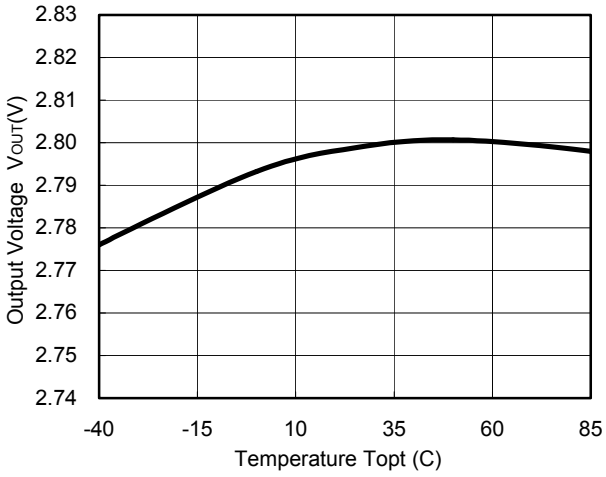
R1118X081X



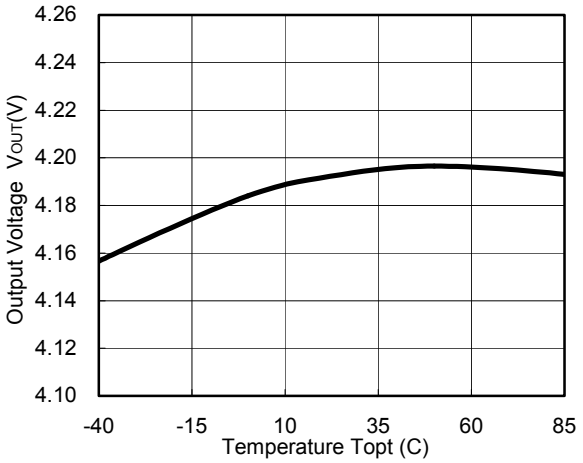

R1118X151X




R1118X281X

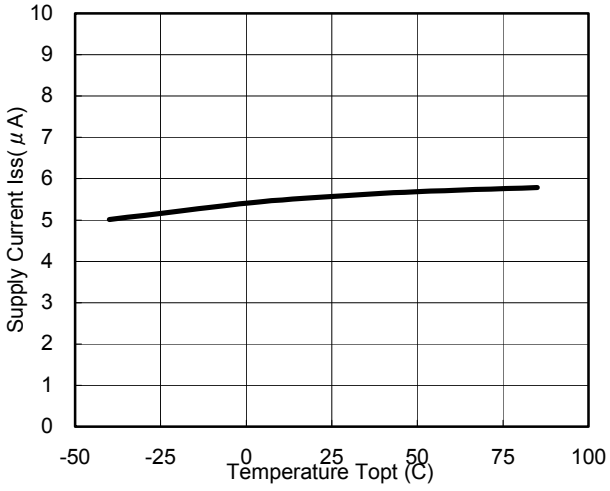



R1118X421X

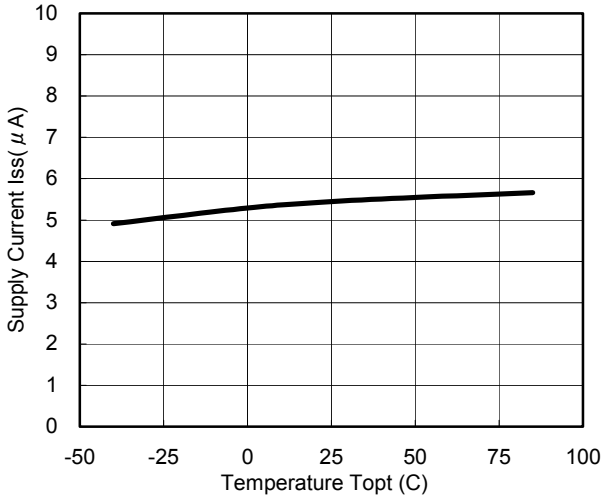



6) Supply Current vs. Temperature

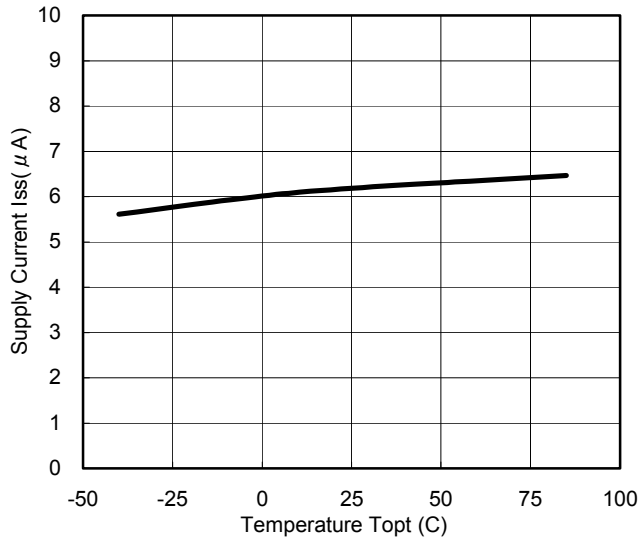
R1118X081X



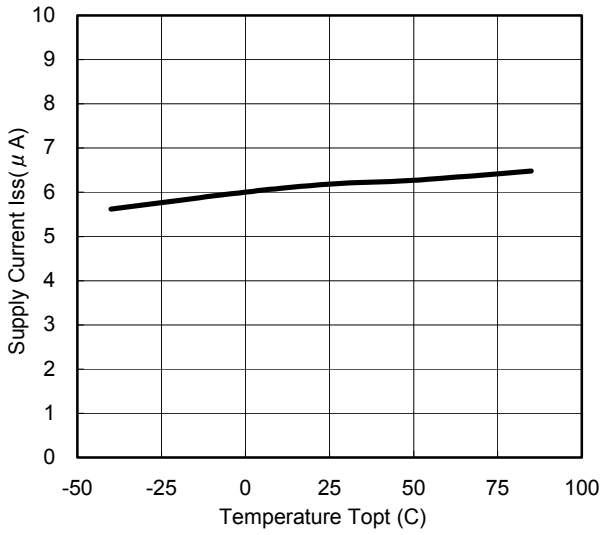

R1118X151X



R1118X281X

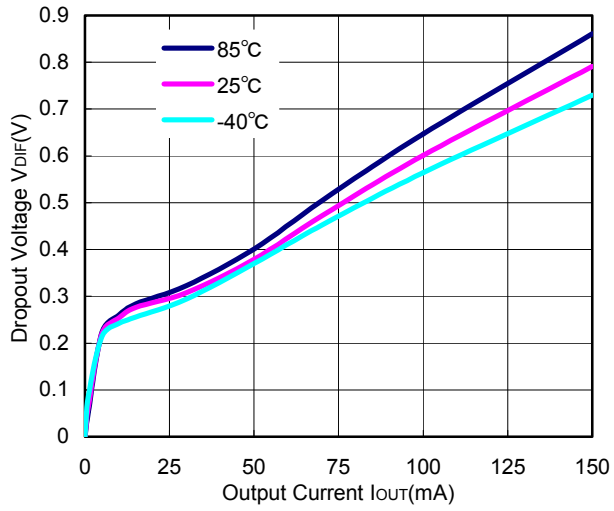



R1118X421X

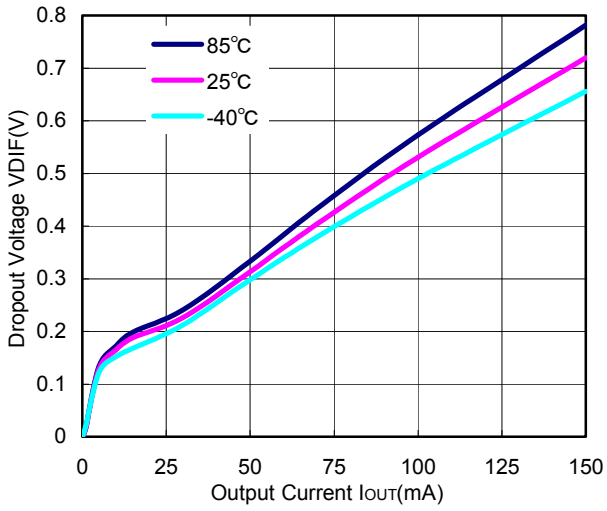



7) Dropout Voltage vs. Output Current

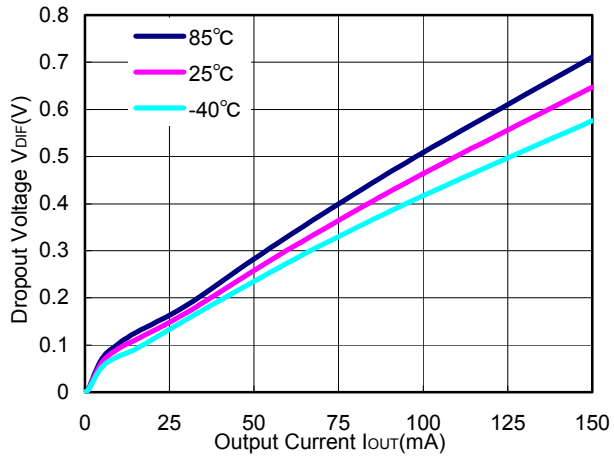
R1118X081X



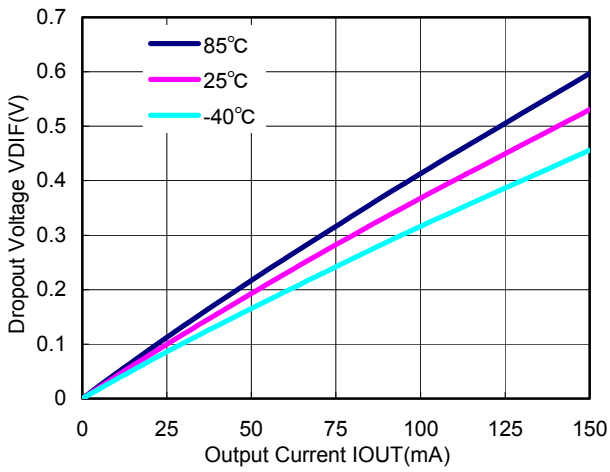

R1118X091X



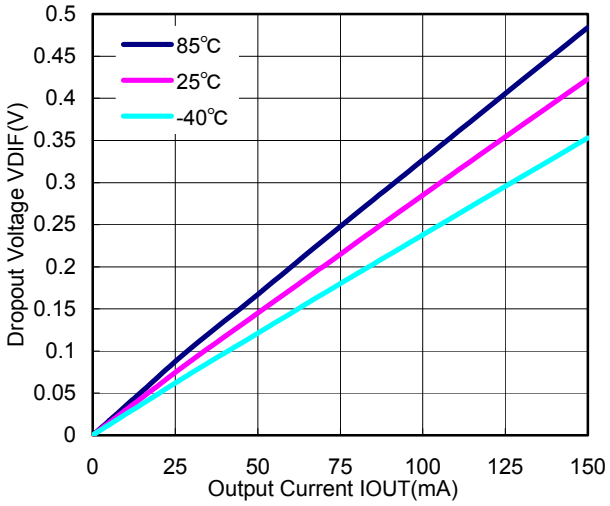

R1118X101X



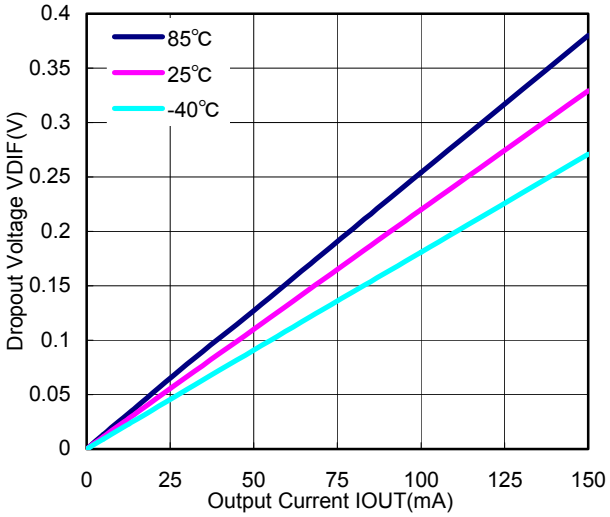

R1118X121X



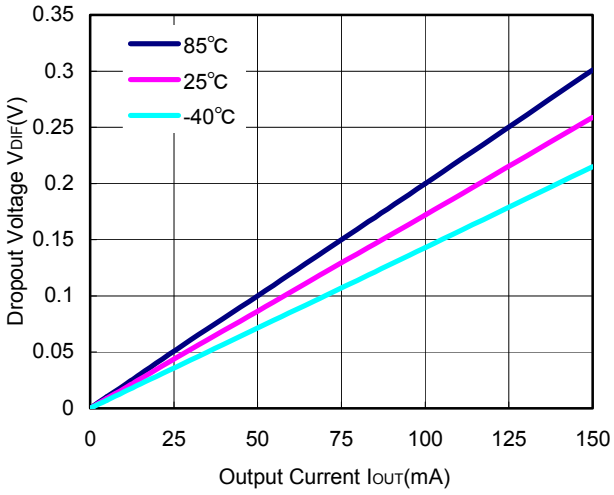
R1118X151X



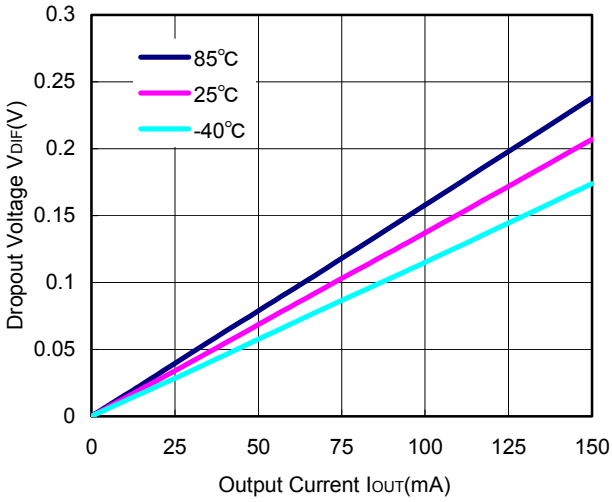

R1118X201X



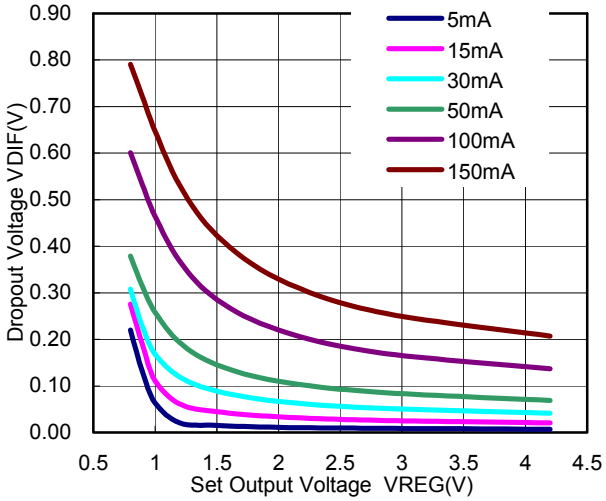

R1118X281X




R1118X421X

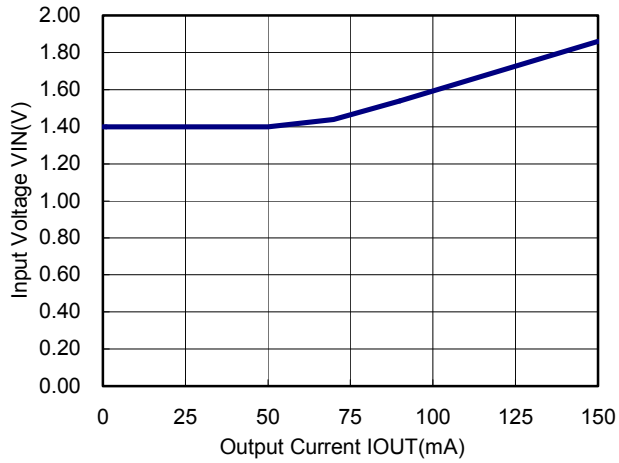



8) Dropout Voltage vs. Set Output Voltage (Topt=25°C)



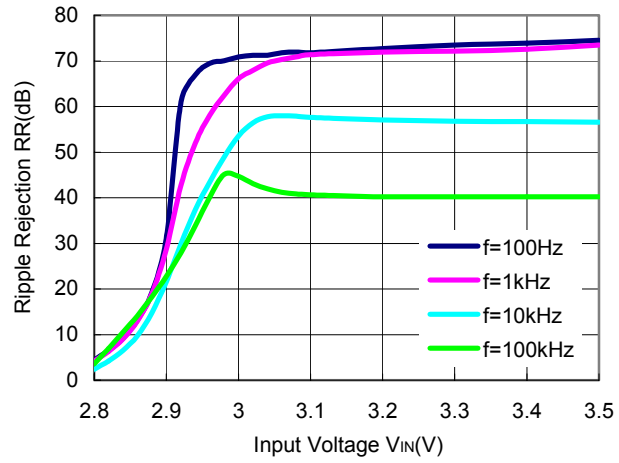
9) Minimum Operating Voltage

R1118X081X

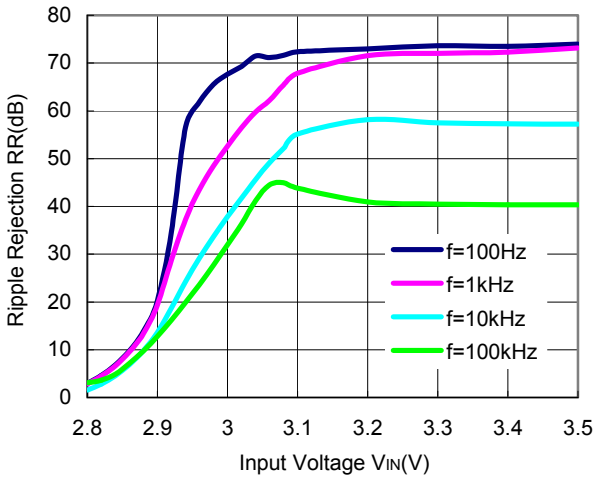



10) Ripple Rejection vs. Input Voltage(Topt=25°C),Ripple=0.2Vp-p,CIN=none,COUT=Ceramic1.0µF, R1118X281X

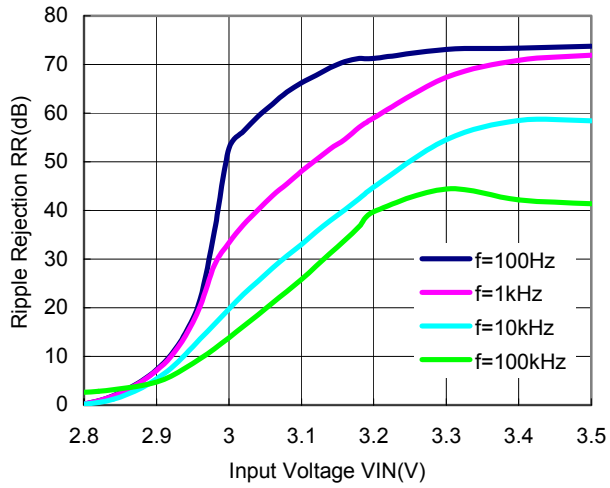
IOUT=5mA




IOUT=15mA

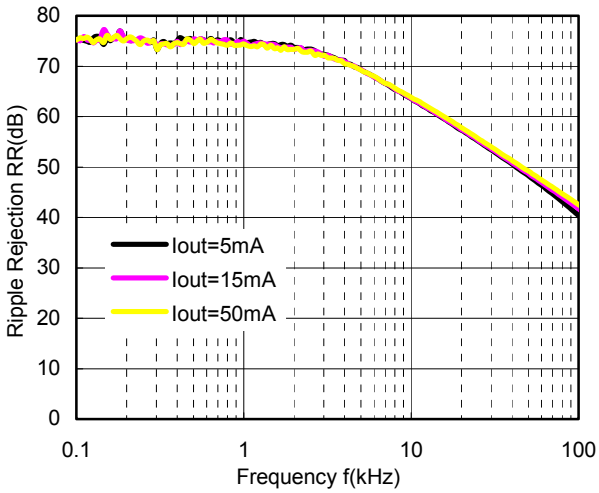



IOUT=50mA

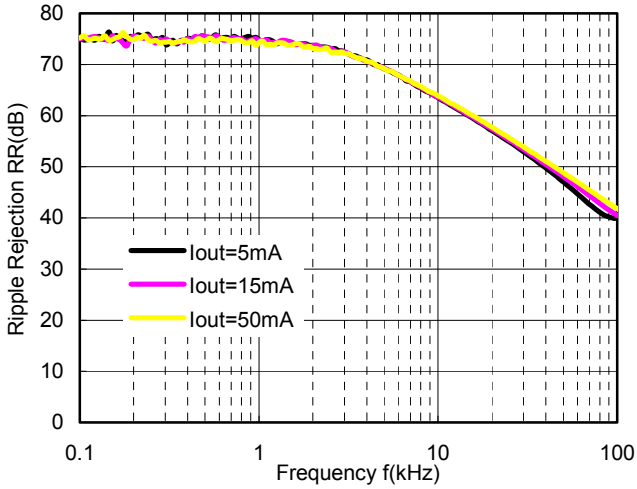


11) Ripple Rejection vs. Frequency (Topt=25°C), CIN=none

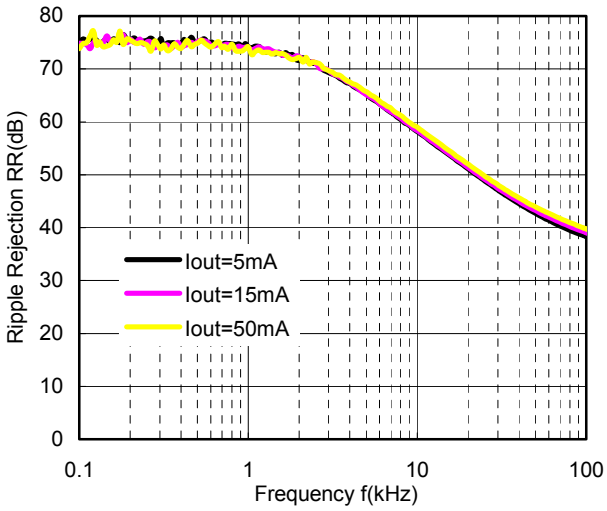
R1118X081X VIN=2.3VDC+0.2Vp-p, Cout=1.0uF



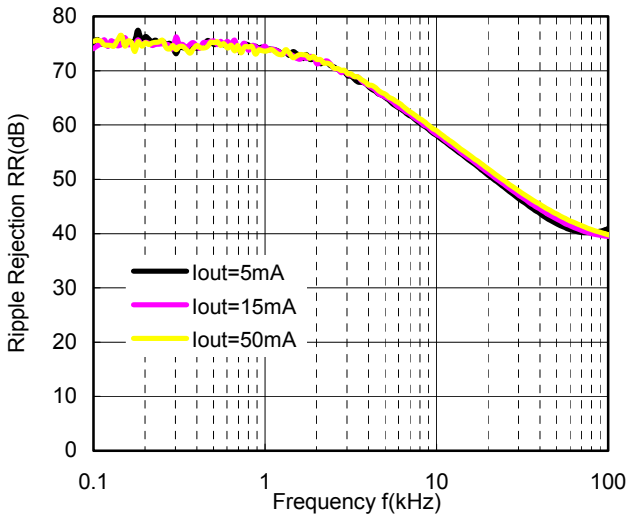

R1118X081X VIN=2.3VDC+0.2Vp-p, Cout=2.2uF



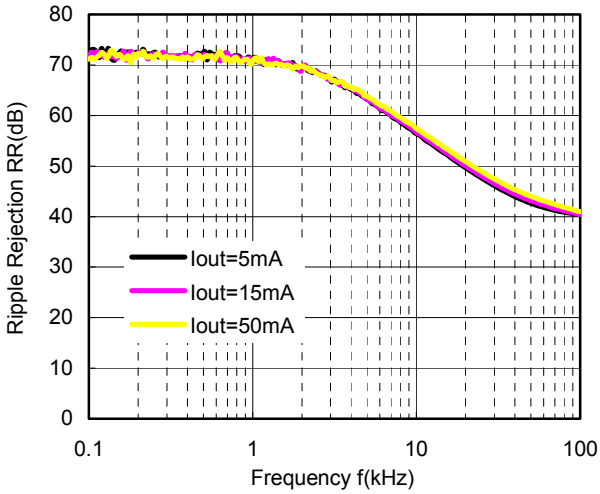

R1118X151X VIN=2.5VDC+0.2Vp-p, Cout=1.0uF



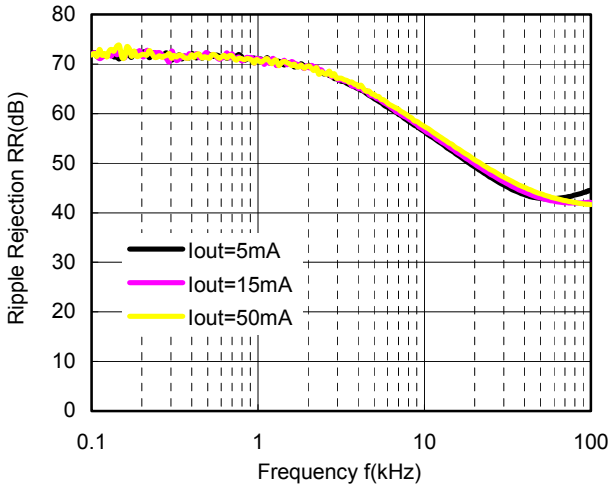

R1118X151X VIN=2.5VDC+0.2Vp-p, Cout=2.2uF



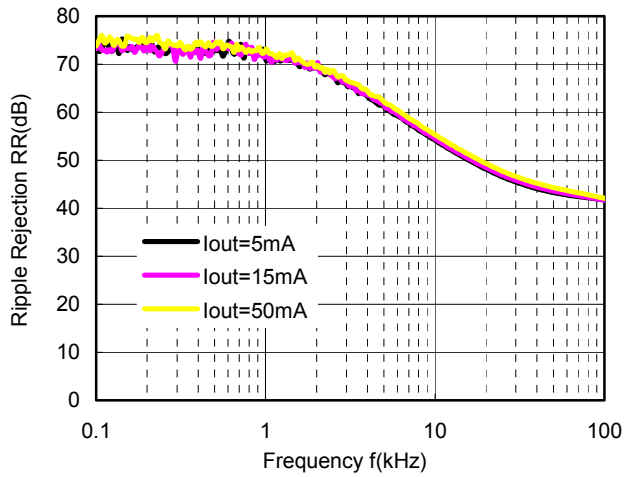

R1118X281X VIN=3.8VDC+0.2Vp-p, Cout=1.0uF



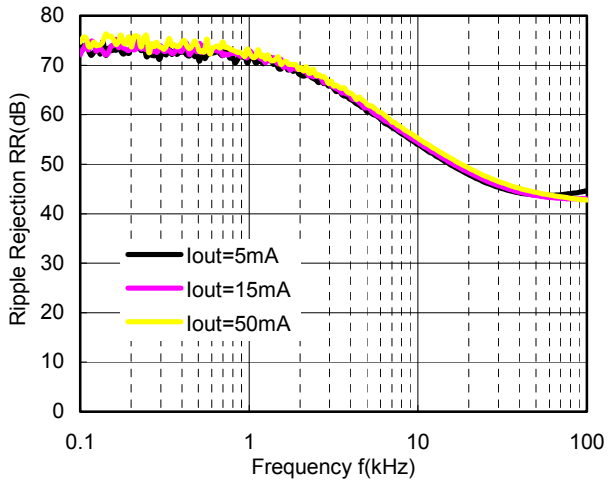

R1118X281X VIN=3.8VDC+0.2Vp-p, Cout=2.2uF



R1118X421X $V_{IN}$=5.2$V_{DC}$+0.2Vp-p, Cout=1.0uF

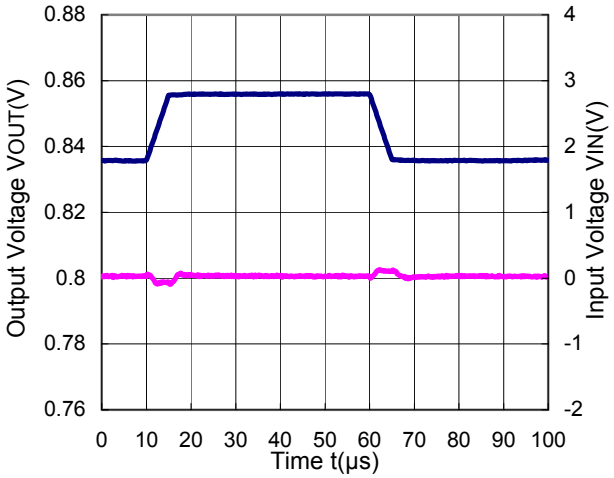



R1118X421X $V_{IN}$=5.2$V_{DC}$+0.2Vp-p, Cout=2.2uF

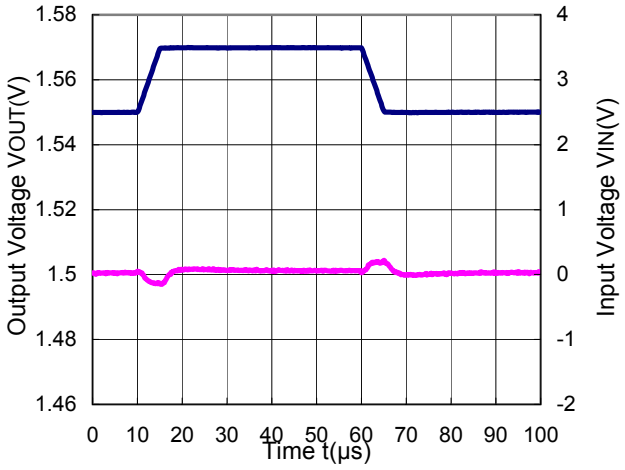



12) Input Transient Response ($I_{OUT}$=30mA,tr=tf=5µs,$C_{IN}$=none, $C_{OUT}$=1µF Topt=25°C)

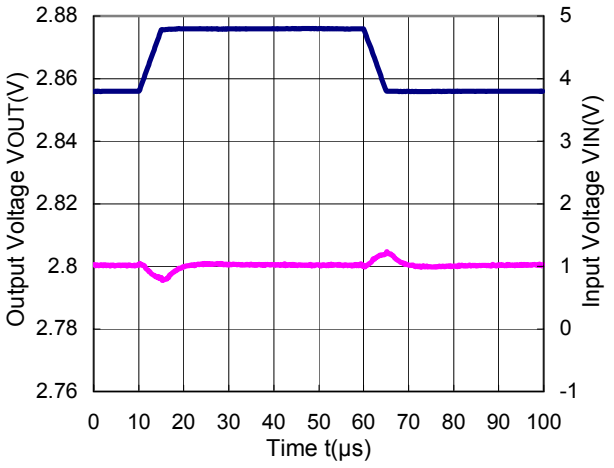
R1118X081X



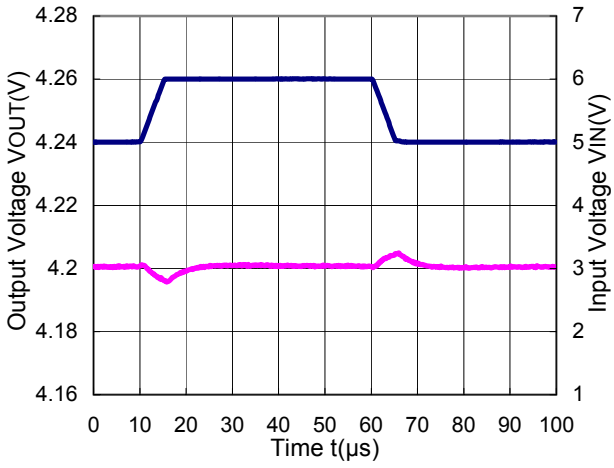

R1118X151X




R1118X281X

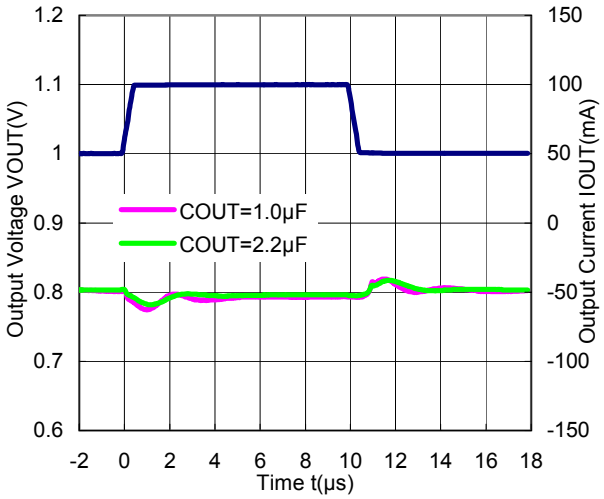



R1118X421X

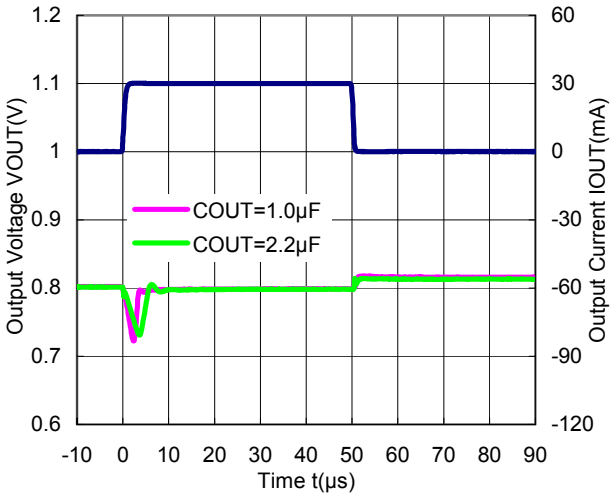


13) Load Transient Response (tr=tf=500ns, CIN=Ceramic1.0µF, Topt=25°C)

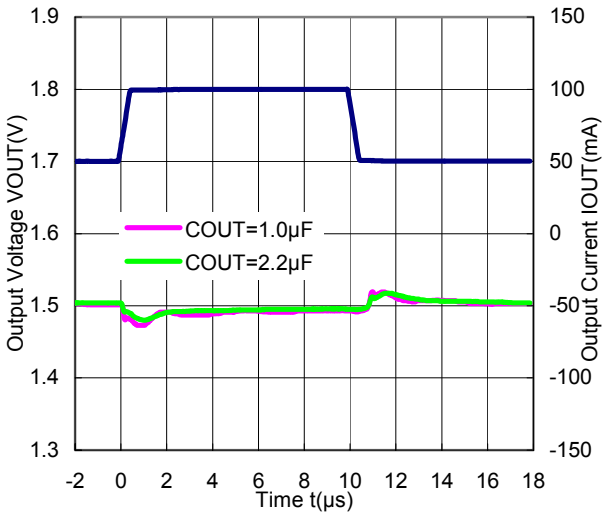
R1118X081X



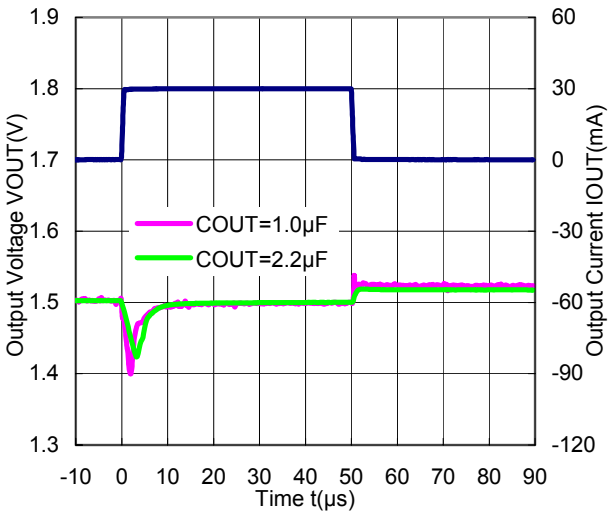

R1118X081X



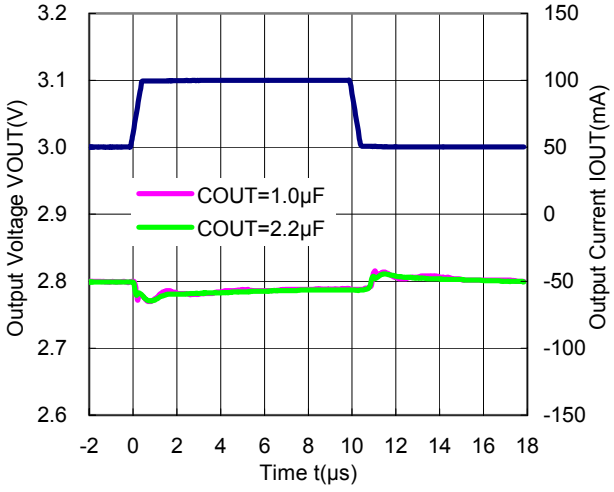

R1118X151X



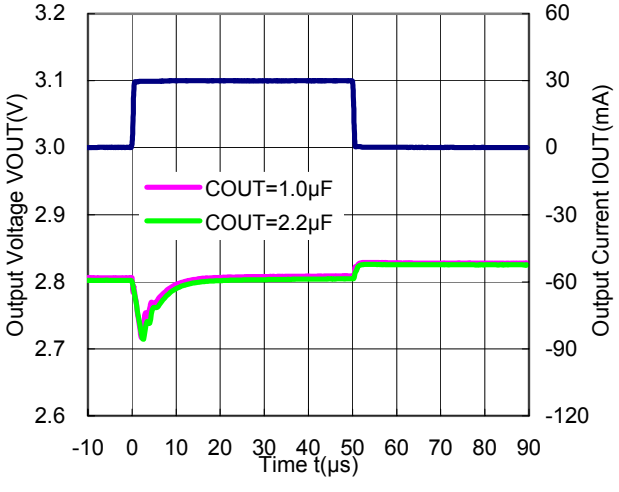

R1118X151X



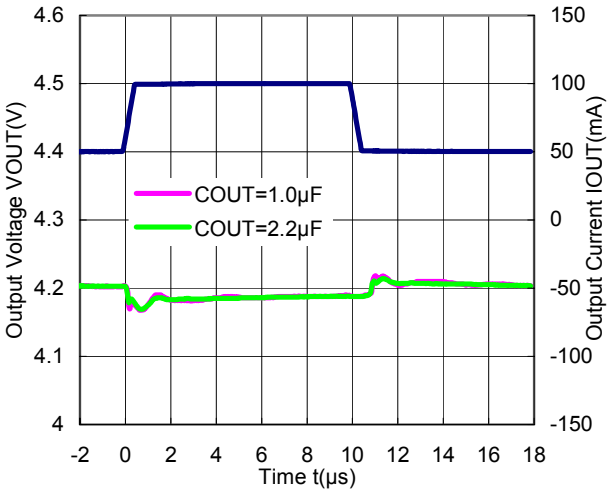

R1118X281X



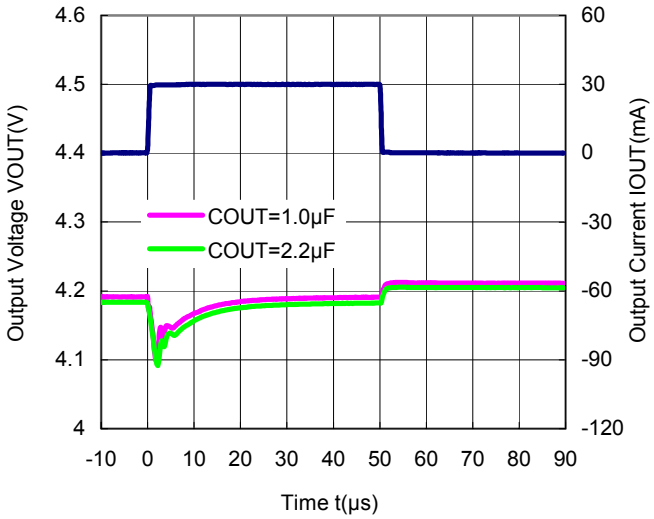

R1118X281X



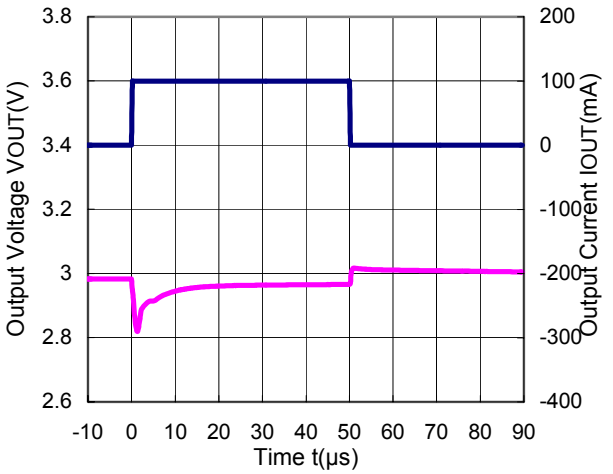
R1118X421X




R1118X421X

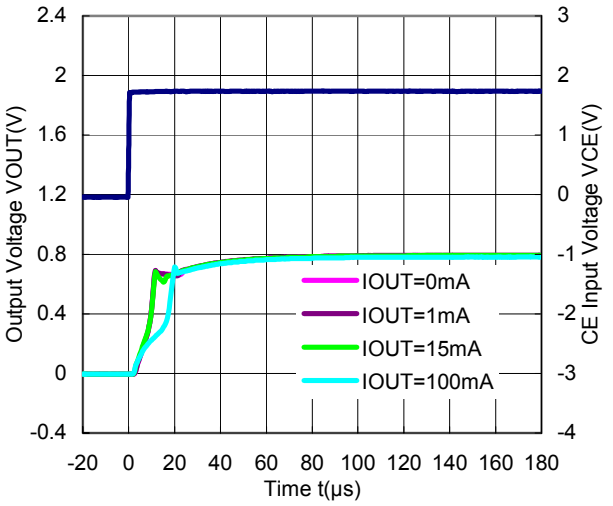



R1118X301X

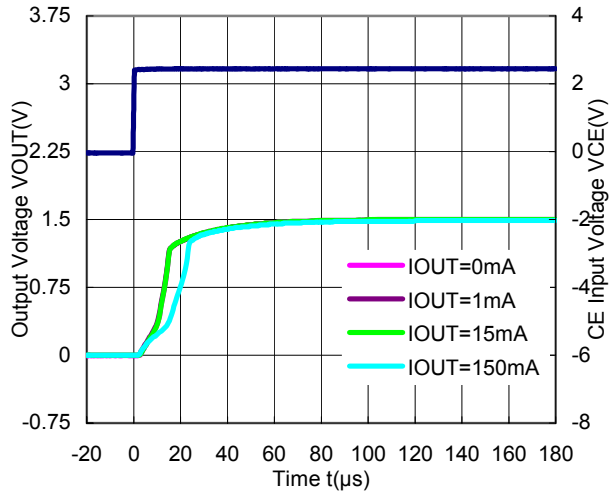



14) Turn-on speed by CE signal ($C_{IN}$=Ceramic1.0µF, $C_{OUT}$=Ceramic1.0µF, Topt=25°C)

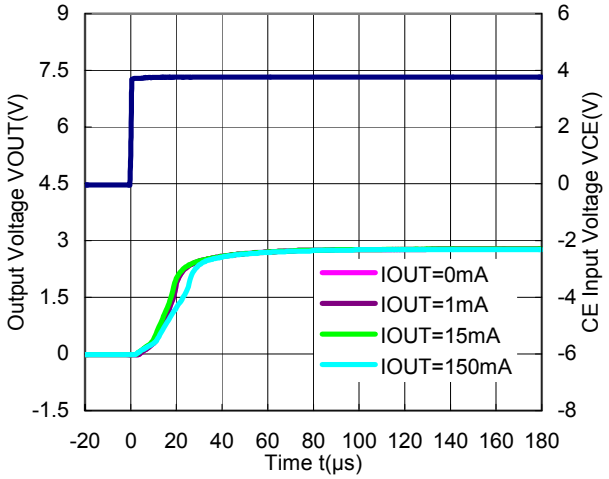
R1118X081X ($V_{IN}$=1.8V)



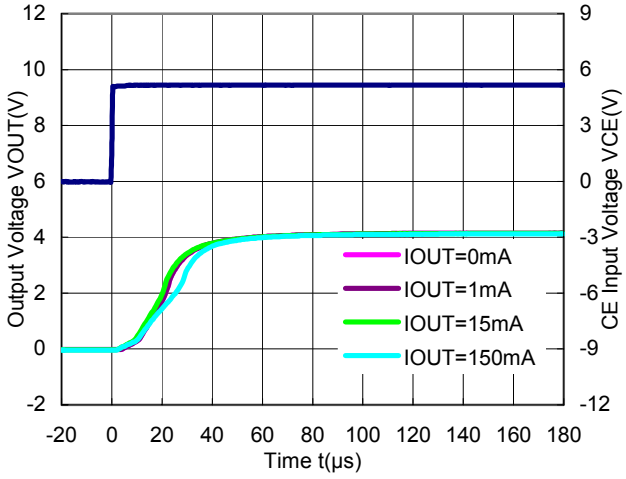

R1118X151X ($V_{IN}$=2.5V)



R1118X281X (VIN=3.8V)

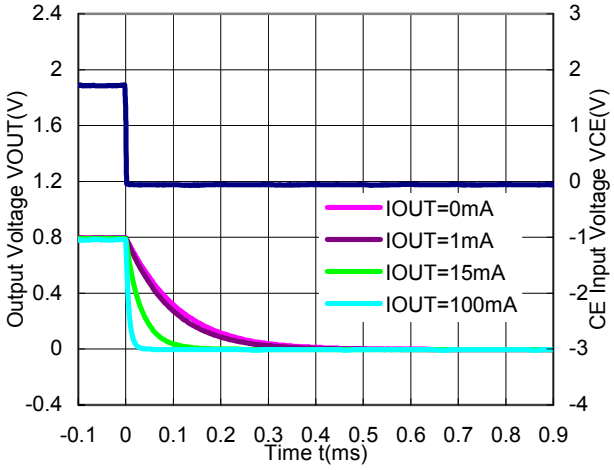



R1118X421X (VIN=5.2V)

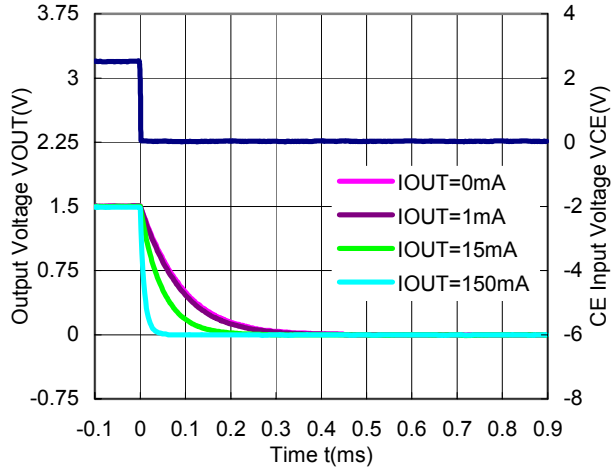



15) Turn-off speed by CE signal (CIN=Ceramic1.0µF, COUT=Ceramic1.0µF, Topt=25°C)

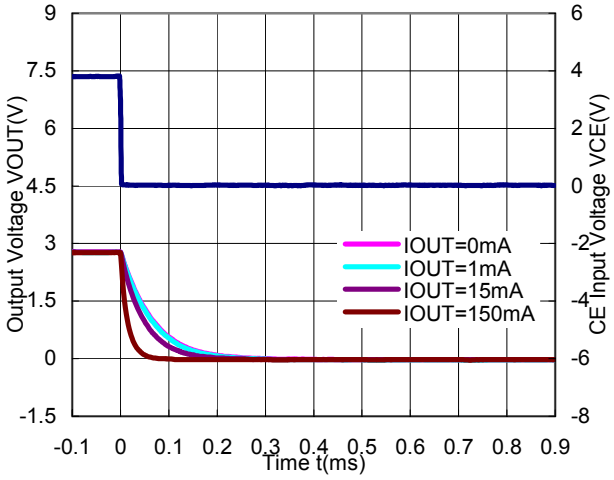
R1118X081X (VIN=1.8V)



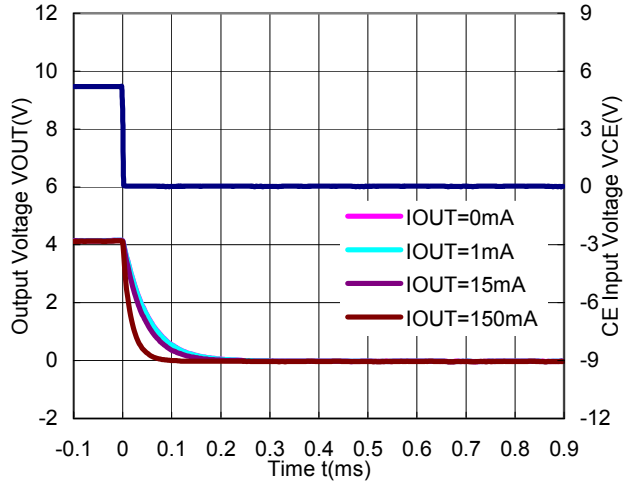

R1118X151X (VIN=2.5V)




R1118X281X (VIN=3.8V)

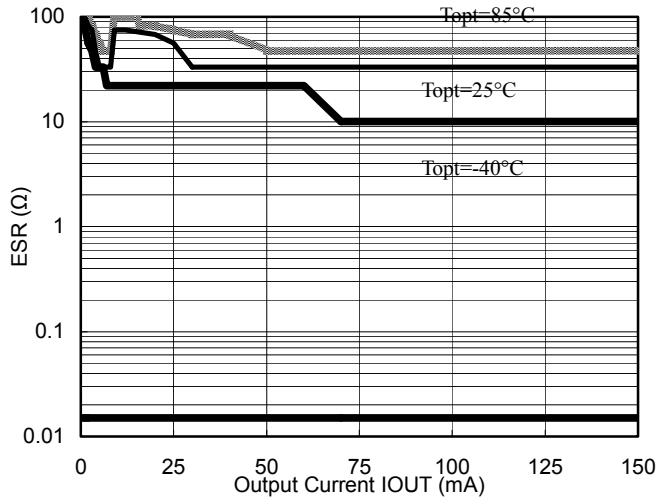



R1118X421X (VIN=5.2V)

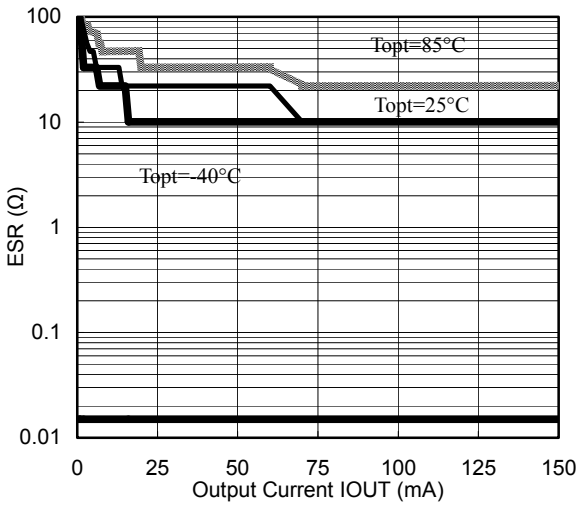


16) Output Capacitor ESR value vs. Output Current (describes the operation stable area border) CIN, COUT:1.0µF (Murata,GRM155B31A105KE)

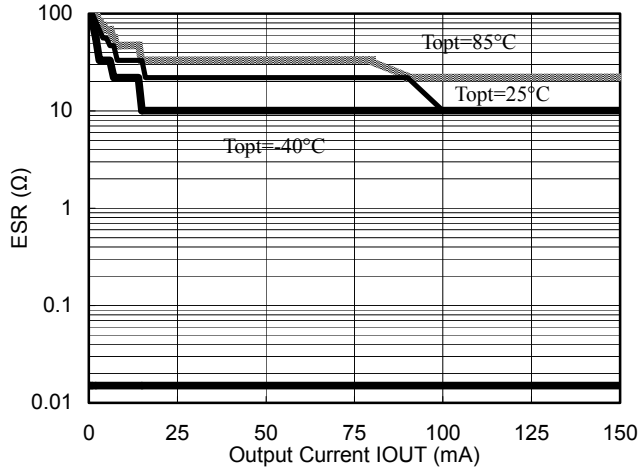
R1118X081X (VIN=1.4V to 6.0V)




R1118X281X (VIN=2.9V to 6.0V)




R1118X421X (VIN=4.3V to 6.0V)



# POWER DISSIPATION (SOT-23-5)

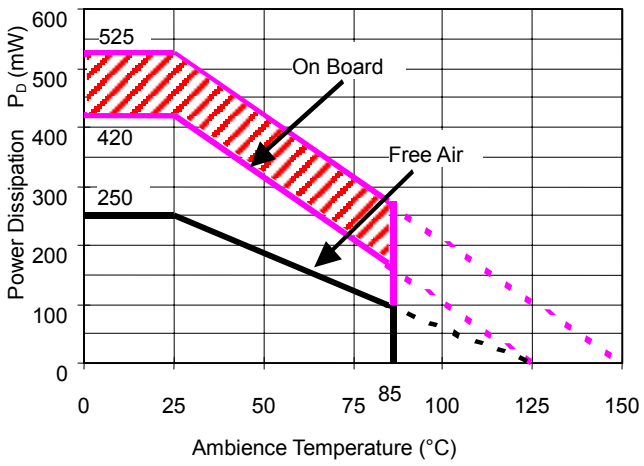
This specification is at mounted on board. Power Dissipation ($P_D$) depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
(Power Dissipation (SOT-23-5) is substitution of SOT-23-6.)

Measurement Conditions

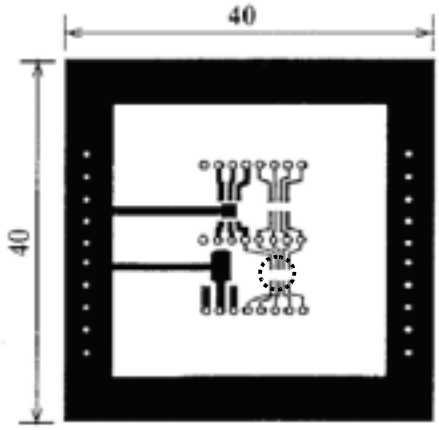
| | **Standard Test Land Pattern** |
|---|---|
| Environment | Mounting on Board (Wind velocity=0m/s) |
| Board Material | Glass cloth epoxy plastic (Double sided) |
| Board Dimensions | 40mm*40mm*1.6mm |
| Copper Ratio | Top side: Approx. 50%, Back side: Approx. 50% |
| Through-holes | $\phi$ 0.5mm * 44pcs |

Measurement Result (Ta=25°C)

| | **Standard Test Land Pattern** | **Free Air** |
|---|---|---|
| Power Dissipation | 420mW(Tjmax=125°C)<br>525mW(Tjmax=150°C) | 250mW(Tjmax=125°C) |
| Thermal Resistance | $\theta$ja = (125-25°C)/0.42W= 263°C/W | 400°C/W |




**Power Dissipation**




**Measurement Board Pattern**

IC Mount Area (Unit: mm)

Use in the oblique-line-area may have a bad influence on the long-term quality assurance. Recommendation duration time is up to 9,000 hours. 9,000 hours are corresponding to six years in case that this device is used for four hours a day.

# POWER DISSIPATION (DFN (PLP)1612-4B)

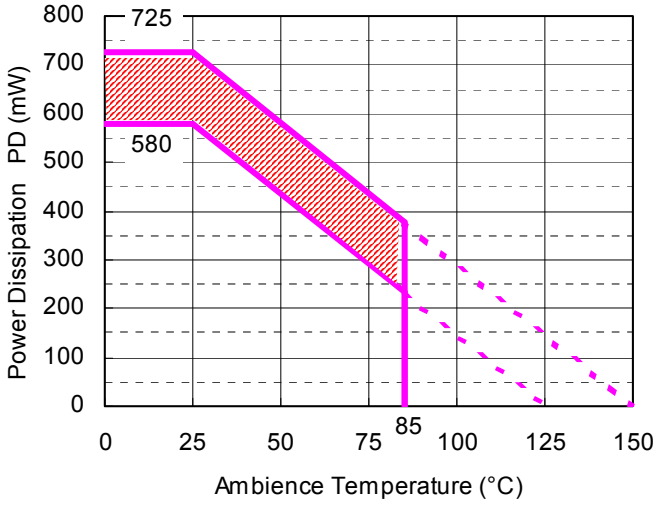
This specification is determined under the condition of the device mounting on board. Power Dissipation ($P_D$) depends on conditions of mounting on board. This specification is based on the measurement at the conditions below:

Measurement Conditions

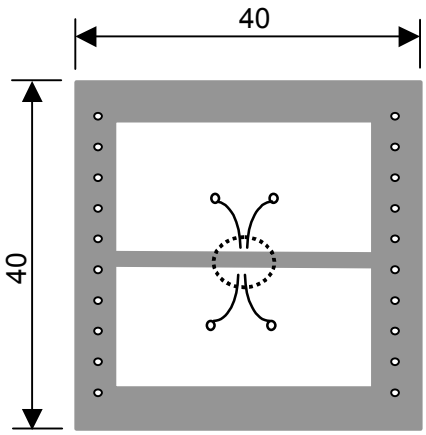
| | Standard Test Land Pattern |
|---|---|
| Environment | Mounting on Board (Wind velocity=0m/s) |
| Board Material | Glass cloth epoxy plastic (Double sided) |
| Board Dimensions | 40mm*40mm*1.6mm |
| Copper Ratio | Top side: Approx. 50%, Back side: Approx. 50% |
| Through-holes | ϕ 0.54mm * 24pcs |

Measurement Result (Ta=25°C)

| | Standard Test Land Pattern |
|---|---|
| Power Dissipation | 580mW (Tjmax=125°C)<br>725mW (Tjmax=150°C) |
| Thermal Resistance | θja = (125-25 °C) / 0.58W= 172 °C/W |
| | θjc = 51°C/W |




**Power Dissipation**




**Measurent Board Pattern**

IC Mount Area Unit: mm

* Use in the oblique-line-area may have a bad influence on the long-term quality assurance, Recommendation operating duration time is up to 13,000 hours. 13,000 hours are corresponding to nine years in case that this device is used for four hours a day.