# SOT23-5 3-MODE 200mA LDO REGULATOR

NO. EA-083-0203

# R1160x SERIES

## OUTLINE

The R1160x Series consist of CMOS-based voltage regulator ICs with high output voltage accuracy, low supply current, and low ON-resistance. Each of these voltage regulator ICs consists of a voltage reference unit, an error amplifier, resistors for setting Output Voltage, a current limit circuit, and a chip enable circuit.

These ICs perform with low dropout voltage and a chip enable function. To prevent the destruction by over current, current limit circuit is included. The R1160x Series have 3-mode. One is standby mode with CE or standby control pin. Other two modes are realized with ECO pin™. Fast Transient Mode (FT mode) and Low Power Mode (LP mode) are alternative with ECO pin™. Consumption current is reduced to 1/10 at Low Power Mode compared with Fast Transient Mode. Output voltage is maintained between FT mode and LP mode.

The output voltage of these ICs is internally fixed with high accuracy. Since the packages for these ICs are SOT-23-5 and SON-6 packages, high density mounting of the ICs on boards is possible.

## FEATURES

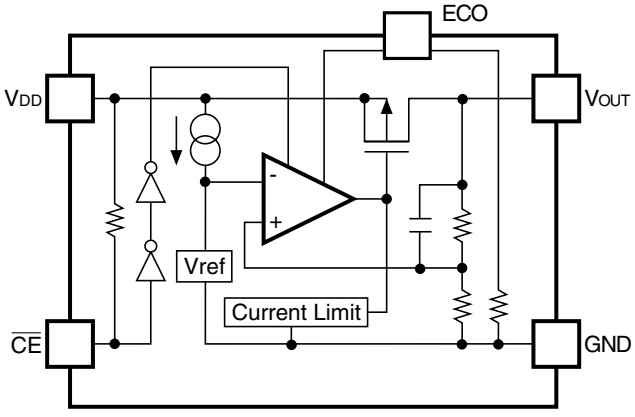
- Ultra-Low Supply Current ..... Typ. 3.5μA (Low Power Mode, $V_{OUT}$≤1.5V),
  Typ. 40μA (Fast Transient Mode)
- Standby Mode ..... Typ. 0.1μA
- Low Dropout Voltage ..... Typ. 0.30V ($I_{OUT}$=200mA Output Voltage=1.0V Type)
  Typ. 0.20V ($I_{OUT}$=200mA Output Voltage=1.5V Type)
  Typ. 0.14V ($I_{OUT}$=200mA Output Voltage=3.0V Type)
- High Ripple Rejection ..... Typ. 70dB (f=1kHz, FT Mode)
- Low Temperature-Drift Coefficient of Output Voltage..... Typ. ±100ppm/°C
- Excellent Line Regulation..... Typ. 0.05%/V
- High Output Voltage Accuracy ..... ±2.0% (±3.0% at LP Mode)
- Small Package ..... SOT-23-5 (Super Mini-mold), SON-6
- Output Voltage ..... Stepwise setting with a step of 0.1V in the range of 0.8V to 3.3V is possible
- Input Voltage..... Min. 1.4V
- Built-in fold-back protection circuit..... Typ. 50mA (Current at short mode)

## APPLICATIONS

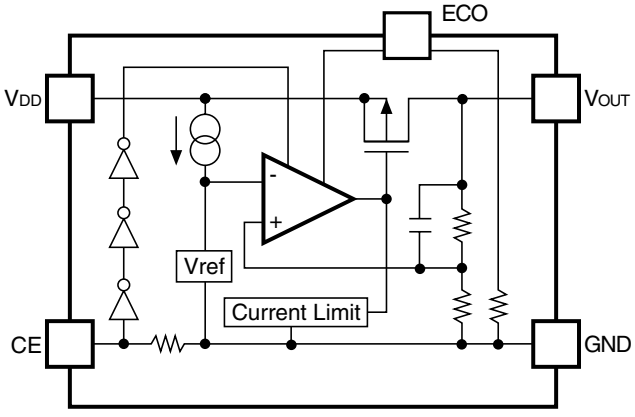
- Precision Voltage References.
- Power source for electrical appliances such as cameras, VCRs and hand-held communication equipment.
- Power source for battery-powered equipment.

## BLOCK DIAGRAM

**R1160xxx1A**




**R1160xxx1B**




## SELECTION GUIDE

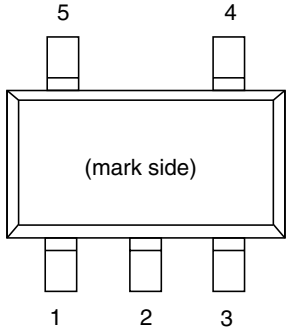
The output voltage, chip enable polarity, and the taping type for the ICs can be selected at the user's request. The selection can be available by designating the part number as shown below;

R1160xxx1x-xx ← Part Number
↑↑ ↑ ↑
a b c d

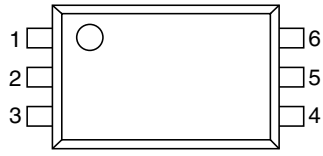
| Code | Contents |
|---|---|
| a | Designation of Package Type :<br>N:SOT-23-5 (Mini-mold) D:SON-6 |
| b | Setting Output Voltage ($V_{OUT}$) :<br>Stepwise setting with a step of 0.1V in the range of 0.8V to 3.3V is possible. |
| c | Designation of Chip Enable Option :<br>A:"L" active type.<br>B:"H" active type. |
| d | Designation of Taping Type :<br>Refer to Taping Specifications; TR type is the standard direction. |

## PIN CONFIGURATION

**SOT-23-5**




**SON-6**




## PIN DESCRIPTION

**SOT-23-5**

| Pin No. | Symbol | Description |
|---|---|---|
| 1 | $V_{DD}$ | Input Pin |
| 2 | GND | Ground Pin |
| 3 | $\overline{CE}$ or CE | Chip Enable Pin |
| 4 | ECO | MODE alternative pin |
| 5 | $V_{OUT}$ | Output pin |

**SON-6**

| Pin No. | Symbol | Description |
|---|---|---|
| 1 | $V_{DD}$ | Input Pin |
| 2 | NC | No Connection |
| 3 | $V_{OUT}$ | Output pin |
| 4 | ECO | MODE alternative pin |
| 5 | GND | Ground Pin |
| 6 | $\overline{CE}$ or CE | Chip Enable Pin |

## ABSOLUTE MAXIMUM RATINGS

| Symbol | Item | Rating | Unit |
|---|---|---|---|
| $V_{IN}$ | Input Voltage | 6.5 | V |
| $V_{ECO}$ | Input Voltage (ECO Pin) | -0.3 ~ $V_{IN}$+0.3 | V |
| $V_{CE}$ | Input Voltage ($\overline{CE}$ /CE Pin) | -0.3 ~ $V_{IN}$+0.3 | V |
| $V_{OUT}$ | Output Voltage | -0.3 ~ $V_{IN}$+0.3 | V |
| $I_{OUT}$ | Output Current | 250 | mA |
| $P_D$ | Power Dissipation | 250 | mW |
| Topt | Operating Temperature Range | -40 ~ 85 | °C |
| Tstg | Storage Temperature Range | -55 ~ 125 | °C |

# ELECTRICAL CHARACTERISTICS

- **R1160xxx1A**

Topt=25°C

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output Voltage | $V_{IN}$ = Set $V_{OUT}$+1V<br>$V_{ECO}$ = $V_{IN}$<br>1μA ≤ $I_{OUT}$ ≤ 30mA (Note 1) | $V_{OUT}$<br>×0.98<br>(-30mV) | | $V_{OUT}$<br>×1.02<br>(30mV) | V |
| | | $V_{IN}$ = Set $V_{OUT}$+1V<br>$V_{ECO}$ = GND<br>1μA ≤ $I_{OUT}$ ≤ 30mA (Note 2) | $V_{OUT}$<br>×0.97<br>(-45mV) | | $V_{OUT}$<br>×1.03<br>(45mV) | V |
| $I_{OUT}$ | Output Current | $V_{IN}$ - $V_{OUT}$ = 0.5V<br>$V_{IN}$ ≥ 1.5V, $V_{OUT}$ ≤ 1.0V | 200 | | | mA |
| $\Delta V_{OUT}$/<br>$\Delta I_{OUT}$ | Load Regulation (FT Mode) | $V_{IN}$ = Set $V_{OUT}$+1V,<br>$V_{ECO}$ = $V_{IN}$<br>1mA ≤ $I_{OUT}$ ≤ 200mA | | 20 | 40 | mV |
| $\Delta V_{OUT}$/<br>$\Delta I_{OUT}$ | Load Regulation (LP Mode) | $V_{IN}$ = Set $V_{OUT}$+1V,<br>$V_{ECO}$ = GND<br>1mA ≤ $I_{OUT}$ ≤ 100mA | | 10 | 40 | mV |
| $V_{DIF}$ | Dropout Voltage | Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE | | | | |
| $I_{SS1}$ | Supply Current (FT Mode) | $V_{IN}$ = Set $V_{OUT}$+1V<br>$V_{ECO}$ = $V_{IN}$, $I_{OUT}$ = 0mA | | 40 | 70 | μA |
| $I_{SS2}$ | Supply Current (LP Mode) | $V_{IN}$ = Set $V_{OUT}$+1V, $I_{OUT}$ = 0mA<br>$V_{OUT}$ ≤ 1.5V, $V_{ECO}$ = GND | | 3.5 | 6.0 | μA |
| | | $V_{IN}$ = Set $V_{OUT}$+1V, $I_{OUT}$ = 0mA<br>$V_{OUT}$ ≤ 1.6V, $V_{ECO}$ = GND | | 4.5 | 8.0 | μA |
| Istandby | Supply Current (Standby) | $V_{IN}$ = $V_{CE}$ = Set $V_{OUT}$+1V | | 0.1 | 1.0 | μA |
| $\Delta V_{OUT}$/<br>$\Delta V_{IN}$ | Line Regulation (FT Mode) | Set $V_{OUT}$+0.5V ≤ $V_{IN}$ ≤ 6V<br>$I_{OUT}$ = 30mA, $V_{ECO}$ = $V_{IN}$ | | 0.05 | 0.20 | %/V |
| $\Delta V_{OUT}$/<br>$\Delta V_{IN}$ | Line Regulation (LP Mode) | Set $V_{OUT}$+0.5V ≤ $V_{IN}$ ≤ 6V<br>$I_{OUT}$ = 30mA, $V_{ECO}$ = GND | | 0.10 | 0.30 | %/V |
| RR | Ripple Rejection (FT Mode) | f = 1kHz, Ripple 0.2Vp-p<br>$V_{IN}$ = Set $V_{OUT}$+1V<br>$I_{OUT}$ = 30mA, $V_{ECO}$ = $V_{IN}$ | | 70 | | dB |
| $V_{IN}$ | Input Voltage | | 1.4 | | 6.0 | V |

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | $I_{OUT}$ = 30mA<br>-40°C ≤ Topt ≤ 85°C | | ±100 | | ppm/°C |
| $I_{LIM}$ | Short Current Limit | $V_{OUT}$ = 0V | | 50 | | mA |
| $R_{PU}$ | $\overline{CE}$ Pull-up Resistance | | 2.0 | 5.0 | 14.0 | MΩ |
| $R_{PD}$ | ECO Pull-down Resistance | | 1.5 | 5.0 | 14.0 | MΩ |
| $V_{CEH}$ | $\overline{CE}$ , ECO Input Voltage "H" | | 1.0 | | $V_{IN}$ | V |
| $V_{CEL}$ | $\overline{CE}$ , ECO Input Voltage "L" | | 0.0 | | 0.3 | V |

Note 1: ±30mV Tolerance for $V_{OUT}$ ≤ 1.5V

Note 2: ±45mV Tolerance for $V_{OUT}$ ≤ 1.5V

- **R1160xxx1B**

Topt=25°C

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output Voltage | $V_{IN}$ = Set $V_{OUT}$+1V<br>$V_{ECO}$=$V_{IN}$<br>1μA ≤ $I_{OUT}$ ≤ 30mA (Note 1) | $V_{OUT}$ ×0.98 (-30mV) | | $V_{OUT}$ ×1.02 (30mV) | V |
| | | $V_{IN}$ = Set $V_{OUT}$+1V<br>$V_{ECO}$ = GND<br>1μA ≤ $I_{OUT}$ ≤ 30mA (Note 2) | $V_{OUT}$ ×0.97 (-45mV) | | $V_{OUT}$ ×1.03 (45mV) | V |
| $I_{OUT}$ | Output Current | $V_{IN}$ - $V_{OUT}$ = 0.5V<br>$V_{IN}$ ≥ 1.5V, $V_{OUT}$ ≤ 1.0V | 200 | | | mA |
| $\Delta V_{OUT}/\Delta I_{OUT}$ | Load Regulation (FT Mode) | $V_{IN}$=Set $V_{OUT}$+1V,$V_{ECO}$=$V_{IN}$<br>1mA ≤ $I_{OUT}$ ≤ 200mA | | 20 | 40 | mV |
| $\Delta V_{OUT}/\Delta I_{OUT}$ | Load Regulation (LP Mode) | $V_{IN}$=Set $V_{OUT}$+1V,$V_{ECO}$=GND<br>1mA ≤ $I_{OUT}$ ≤ 100mA | | 10 | 40 | mV |
| $V_{DIF}$ | Dropout Voltage | Refer to the ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE | | | | |
| $I_{SS1}$ | Supply Current (FT Mode) | $V_{IN}$ = Set $V_{OUT}$+1V<br>$V_{ECO}$ = $V_{IN}$, $I_{OUT}$ = 0mA | | 40 | 70 | μA |
| $I_{SS2}$ | Supply Current (LP Mode) | $V_{IN}$ = Set $V_{OUT}$+1V, $I_{OUT}$ = 0mA<br>$V_{OUT}$ ≤ 1.5V, $V_{ECO}$ = GND | | 3.5 | 6.0 | μA |
| | | $V_{IN}$ = Set $V_{OUT}$+1V, $I_{OUT}$ = 0mA<br>$V_{OUT}$ ≤ 1.6V, $V_{ECO}$ = GND | | 4.5 | 8.0 | μA |

| Symbol | Item | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Istandby | Supply Current (Standby) | $V_{IN}$ = Set $V_{OUT}$+1V<br>$V_{CE}$ = GND | | 0.1 | 1.0 | μA |
| $\Delta V_{OUT}/\Delta V_{IN}$ | Line Regulation (FT Mode) | Set $V_{OUT}$+0.5V ≤ $V_{IN}$ ≤ 6V<br>$I_{OUT}$ = 30mA, $V_{ECO}$ = $V_{IN}$ | | 0.05 | 0.20 | %/V |
| $\Delta V_{OUT}/\Delta V_{IN}$ | Line Regulation (LP Mode) | Set $V_{OUT}$+0.5V ≤ $V_{IN}$ ≤ 6V<br>$I_{OUT}$ = 30mA, $V_{ECO}$ = GND | | 0.10 | 0.30 | %/V |
| RR | Ripple Rejection (FT Mode) | f = 1kHz, Ripple 0.2Vp-p<br>$V_{IN}$ = Set $V_{OUT}$+1V<br>$I_{OUT}$ = 30mA, $V_{ECO}$ = $V_{IN}$ | | 70 | | dB |
| $V_{IN}$ | Input Voltage | | 1.4 | | 6.0 | V |
| $\Delta V_{OUT}/\Delta T$ | Output Voltage Temperature Coefficient | $I_{OUT}$ = 30mA<br>-40°C ≤ Topt ≤ 85°C | | ±100 | | ppm/°C |
| $I_{LIM}$ | Short Current Limit | $V_{OUT}$ = 0V | | 50 | | mA |
| $R_{PDC}$ | CE Pull-down Resistance | | 2.0 | 5.0 | 14.0 | MΩ |
| $R_{PDE}$ | ECO Pull-down Resistance | | 1.5 | 5.0 | 14.0 | MΩ |
| $V_{CEH}$ | CE, ECO Input Voltage "H" | | 1.0 | | $V_{IN}$ | V |
| $V_{CEL}$ | CE, ECO Input Voltage "L" | | 0.0 | | 0.3 | V |

Note 1: ±30mV tolerance for $V_{OUT}$ ≤ 1.5V
Note 2: ±45mV tolerance for $V_{OUT}$ ≤ 1.5V

## ELECTRICAL CHARACTERISTICS by OUTPUT VOLTAGE

Topt = 25°C

| Output Voltage $V_{OUT}$ (V) | Dropout Voltage $V_{DIF}$ (V) | | |
|---|---|---|---|
| | Condition | Typ. | Max. |
| 0.8 ≤ $V_{OUT}$ ≤ 0.9 | $I_{OUT}$ = 200mA | 0.40 | 0.70 |
| 1.0 ≤ $V_{OUT}$ ≤ 1.4 | | 0.30 | 0.50 |
| 1.5 ≤ $V_{OUT}$ ≤ 2.5 | | 0.20 | 0.30 |
| 2.6 ≤ $V_{OUT}$ | | 0.14 | 0.20 ($V_{ECO}$ = "H")<br>0.25 ($V_{ECO}$ = "L") |

# 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, be sure to use a 2.2$\mu$F or more capacitor $C_{OUT}$ with good frequency characteristics and ESR (Equivalent Series Resistance).

(Note: When the additional ceramic capacitors are connected to the Output Pin with 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 as much as 1.0$\mu$F capacitor between $V_{DD}$ and GND pin as close as possible.

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

# TEST CIRCUITS

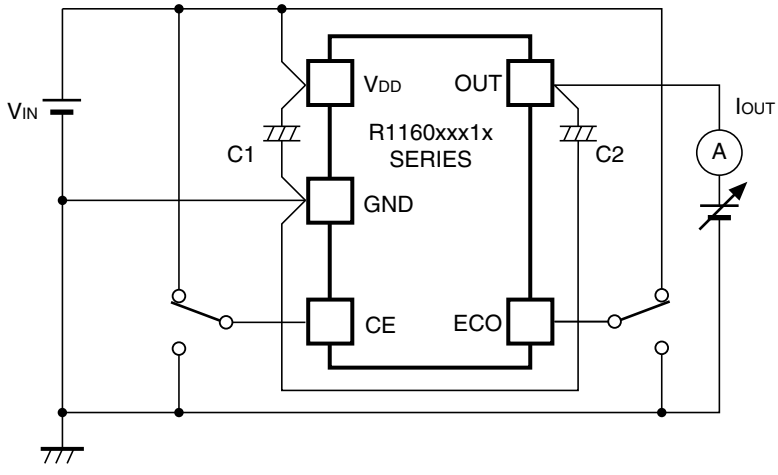
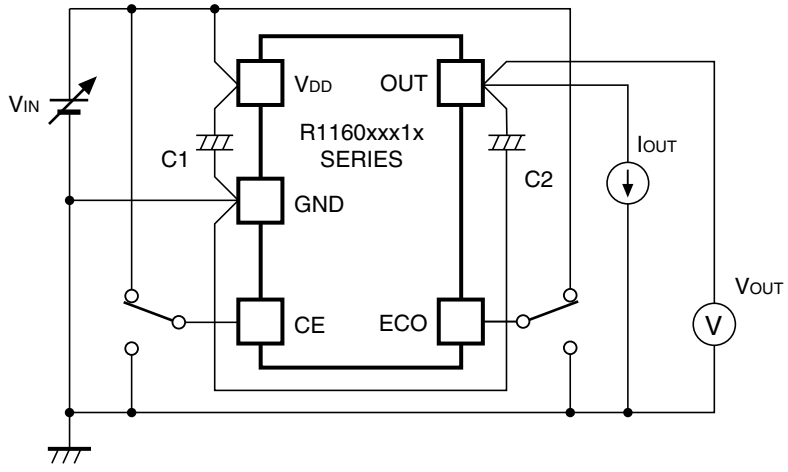
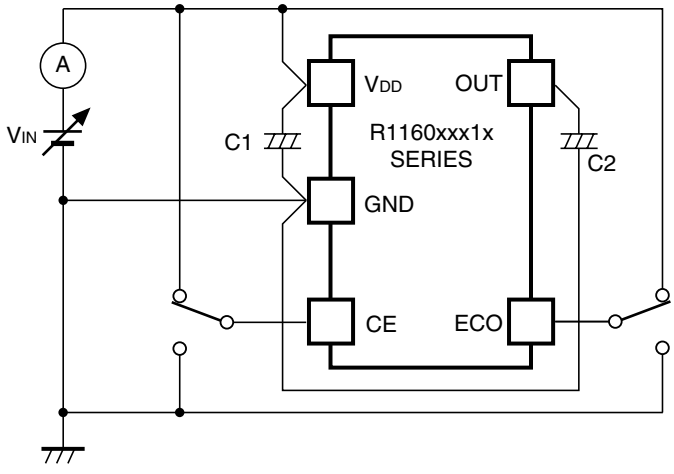



**Fig.1 Output Voltage vs. Output Current Test Circuit**



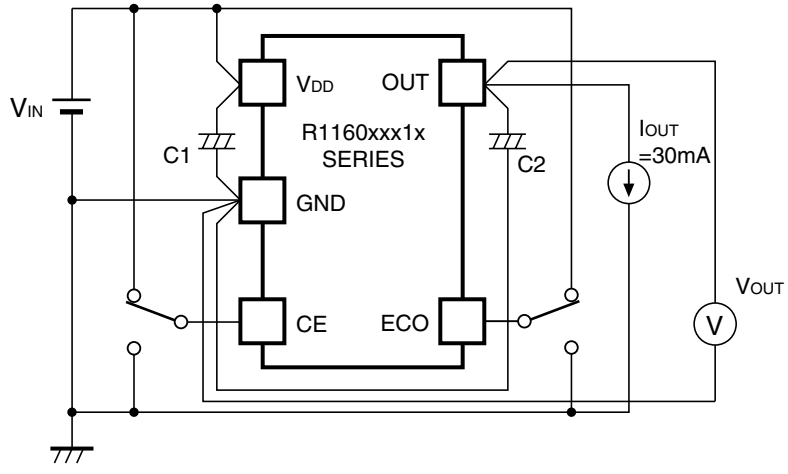

C1=Tantal 1.0μF
C2=Tantal 2.2μF

**Fig.2 Output Voltage vs. Input Voltage Test Circuit**




C1=Tantal 1.0μF
C2=Tantal 2.2μF

**Fig.3 Supply Current vs. Input Voltage Test Circuit**




C1=Tantal 1.0μF
C2=Tantal 2.2μF

**Fig.4 Output Voltage vs. Temperature Test Circuit**

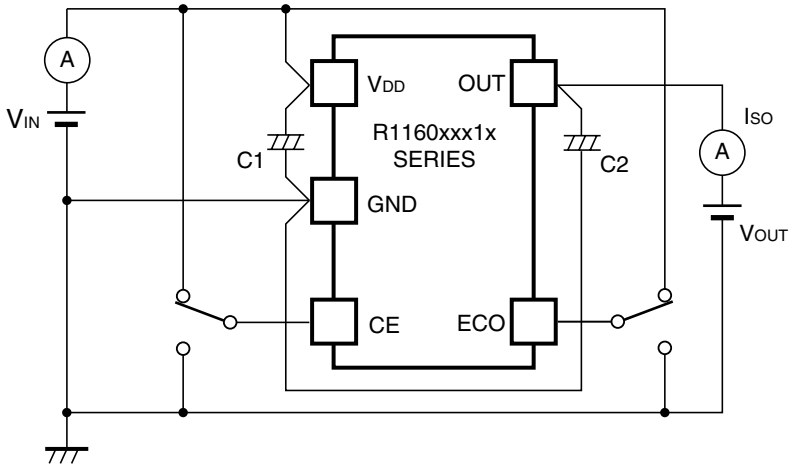



**Fig.5 Supply Current vs. Temperature Test Circuit**

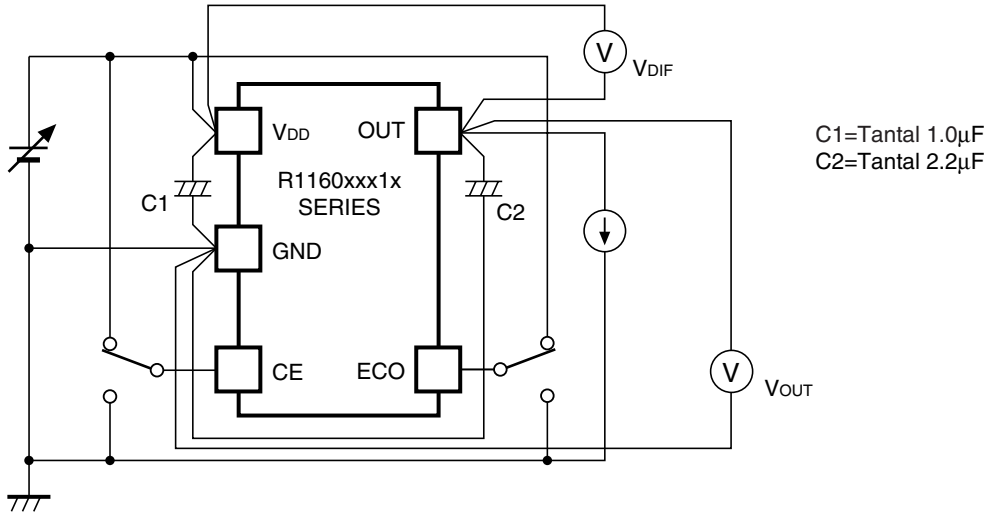



**Fig. 6 Dropout Voltage vs. Output Current/ Set Output Voltage Test Circuit**

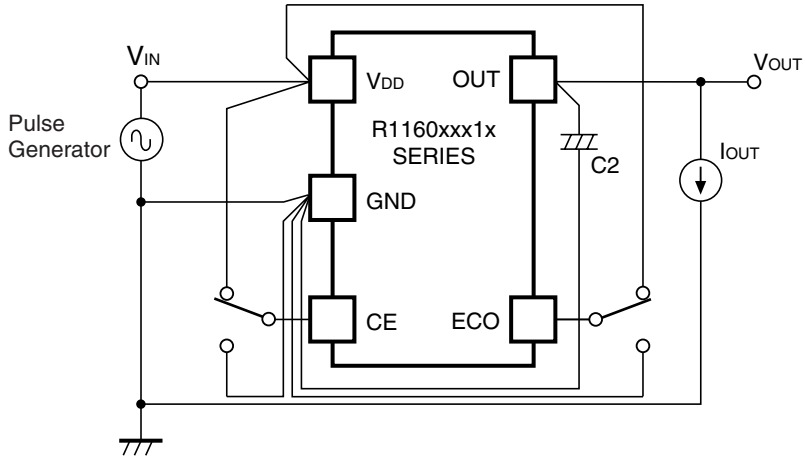



**Fig. 7 Ripple Rejection Test Circuit**

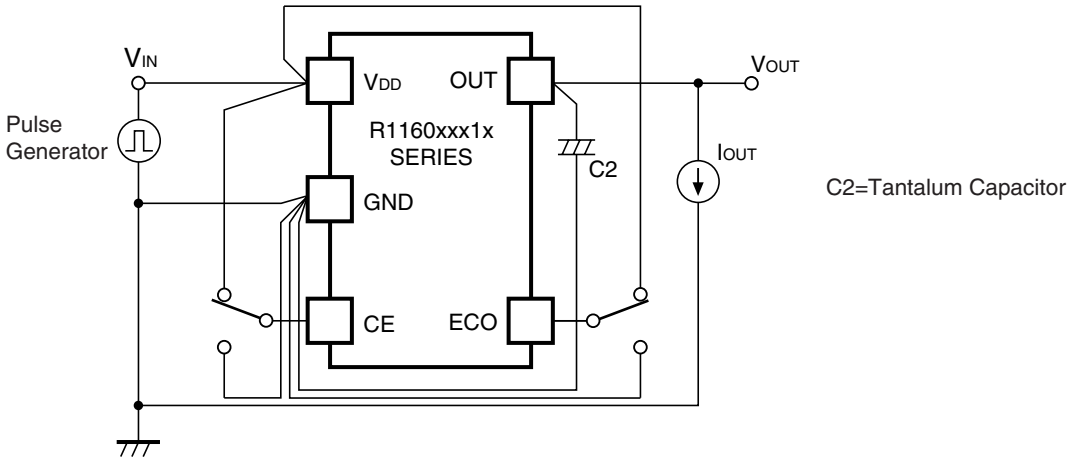



**Fig.8 Input Transient Response Test Circuit**

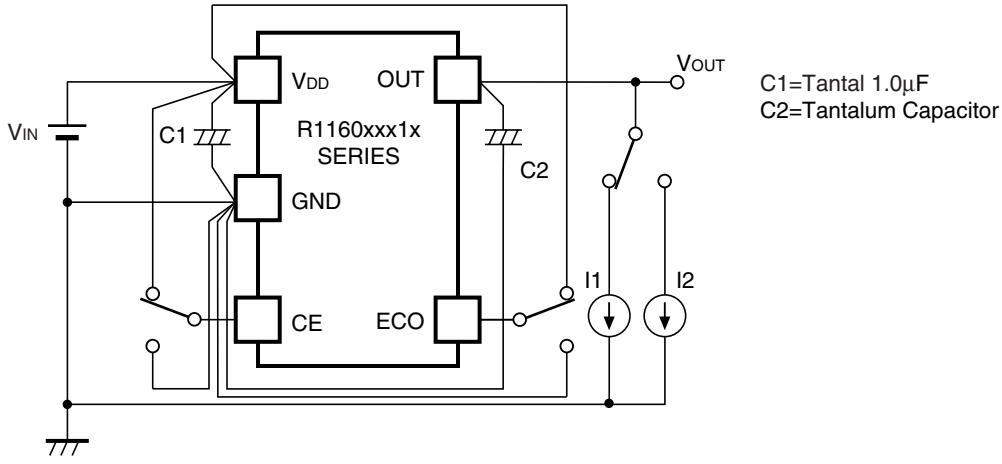



**Fig.9 Load Transient Response Test Circuit**

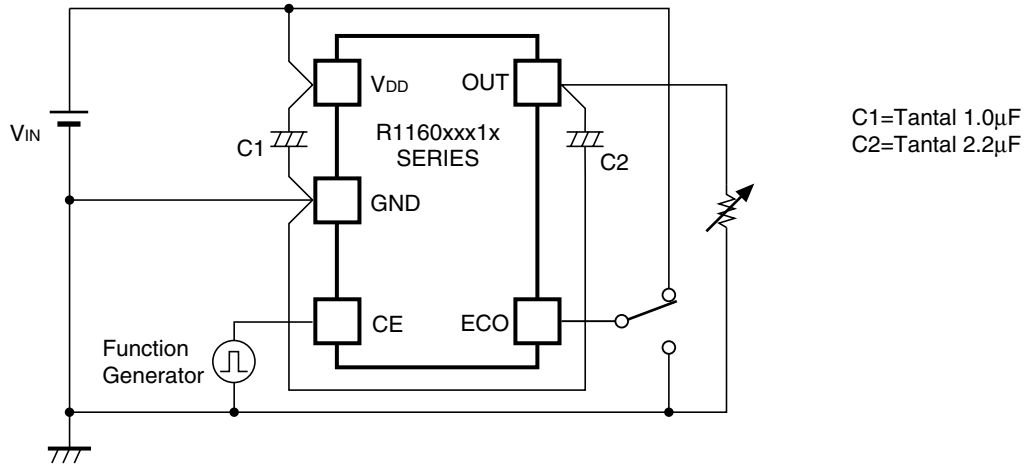



**Fig.10 Turn on Speed with CE pin Test Circuit**

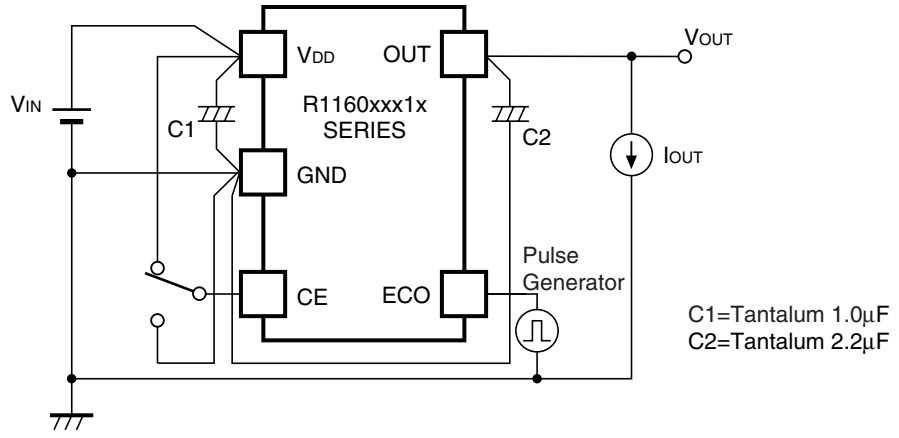



**Fig.11 MODE Transient Response Test Circuit**

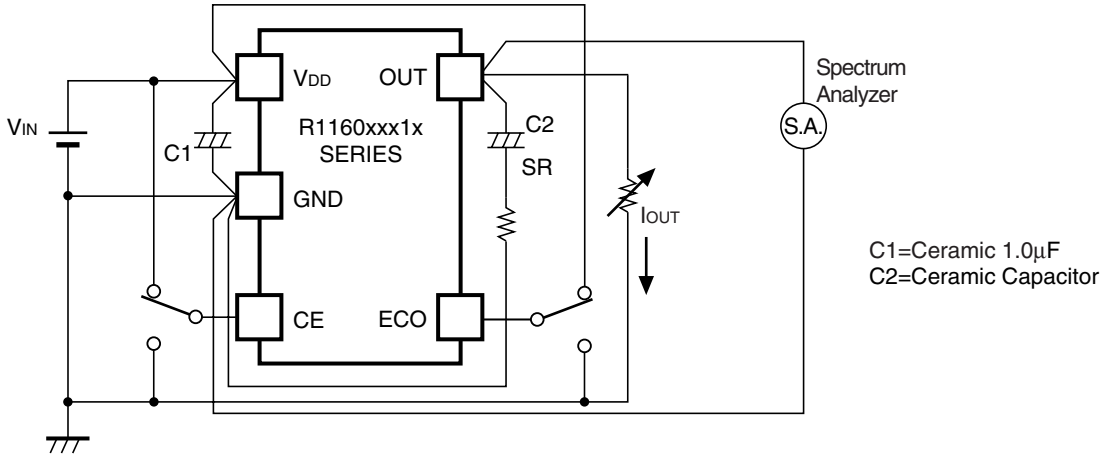


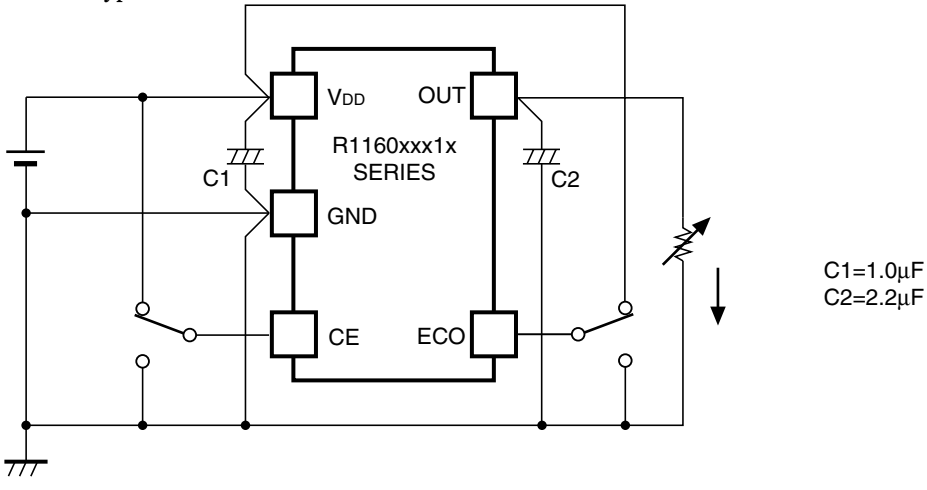

**Fig.12 Output Noise Test Circuit($I_{OUT}$ vs. ESR)**

# TYPICAL APPLICATION

(External Components)

Output Capacitor; Tantalum Type

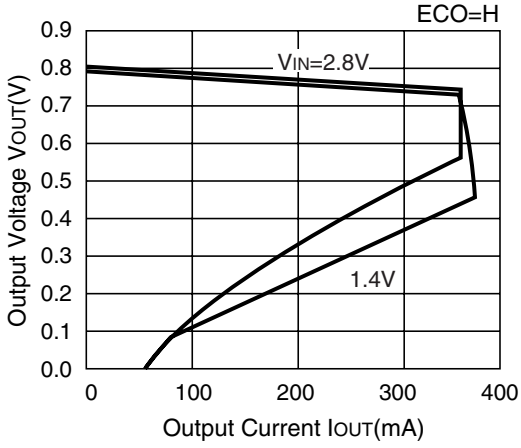
Input Capacitor; Ceramic Type



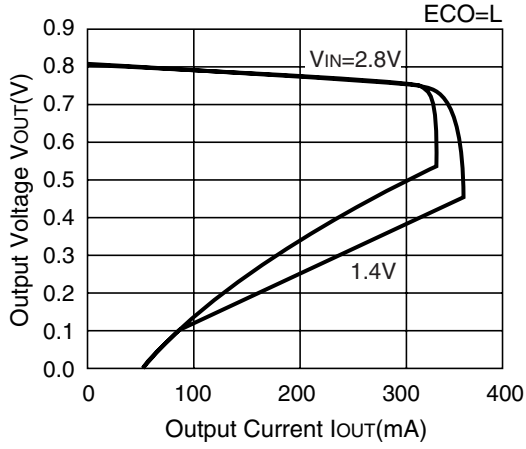
# TYPICAL CHARACTERISTICS

1) Output Voltage vs. Output Current

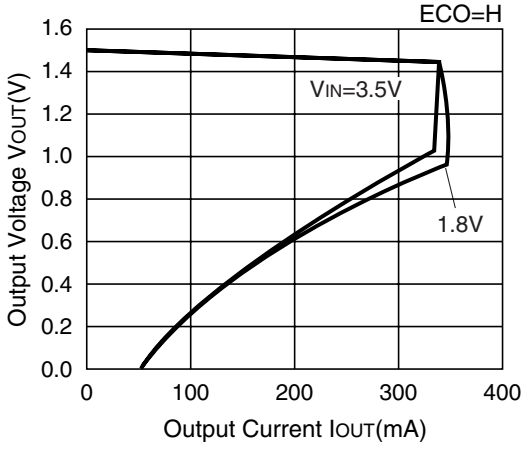
**R1160x081x**



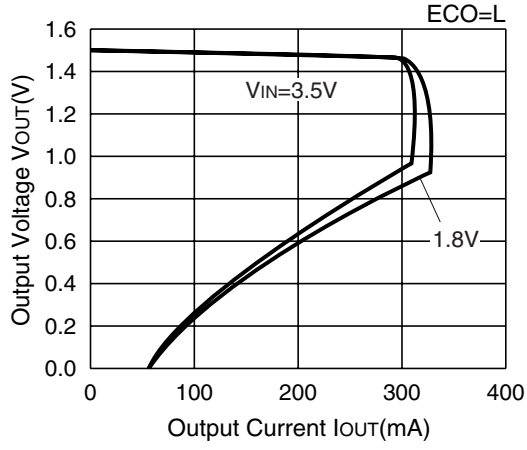

**R1160x081x**



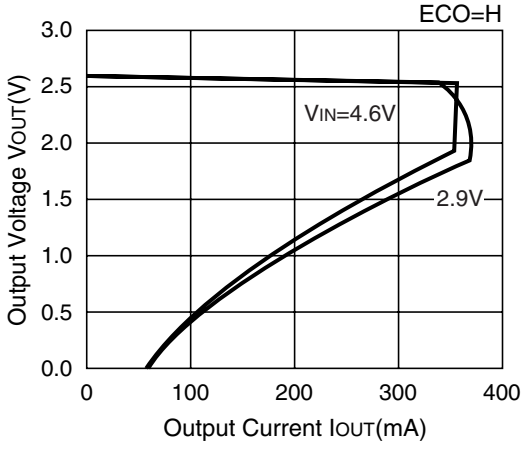

**R1160x151x**



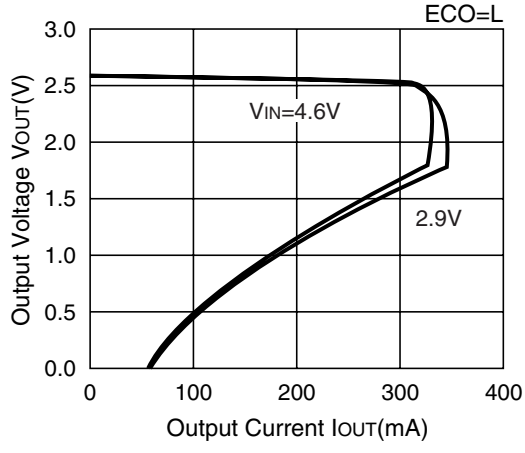

**R1160x151x**



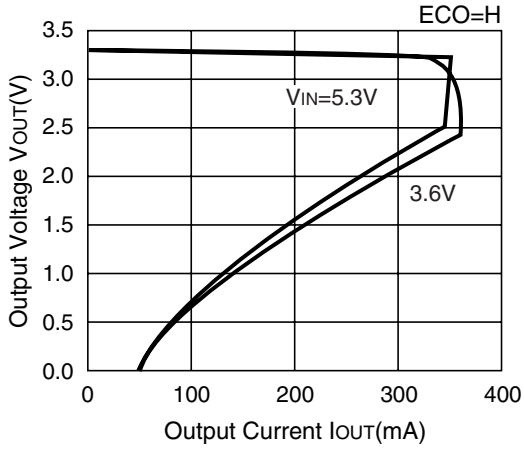

**R1160x261x**



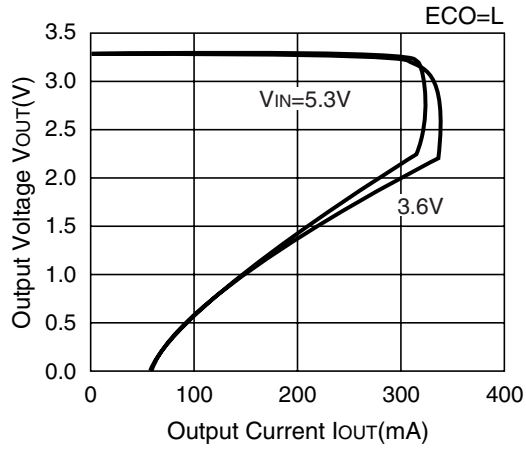

**R1160x261x**



**R1160x331x**

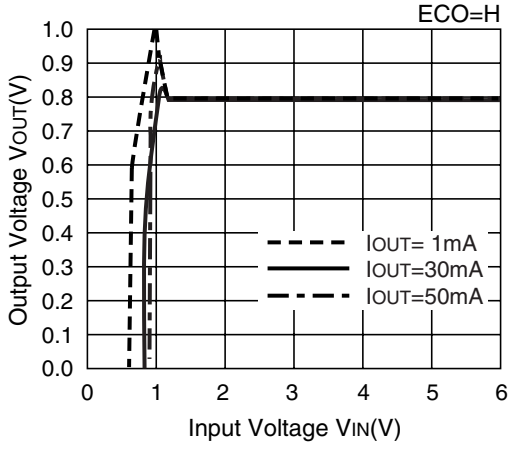



**R1160x331x**

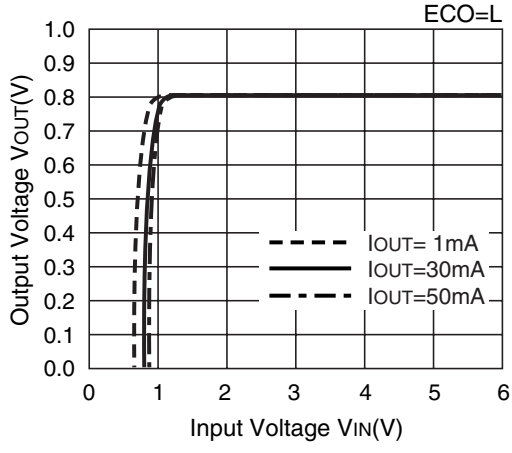



2) Output Voltage vs. Input Voltage

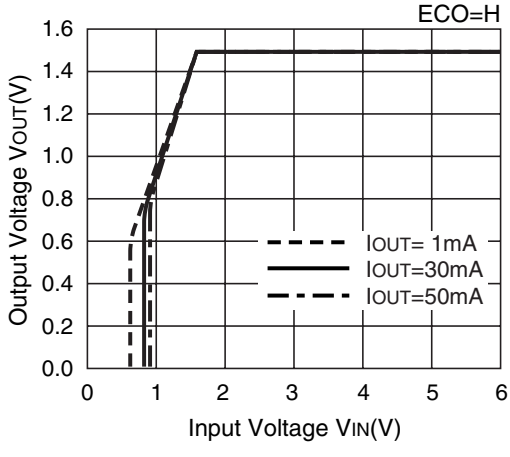
**R1160x081x**



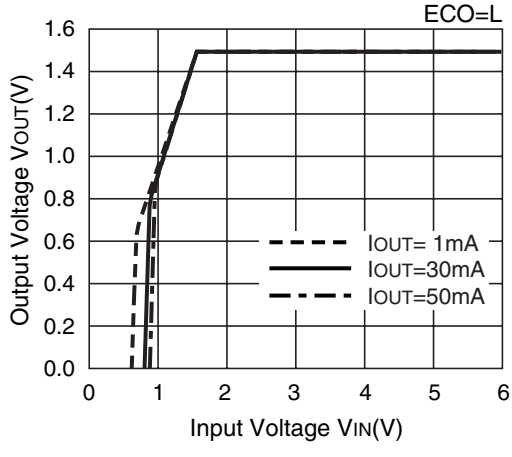

**R1160x081x**



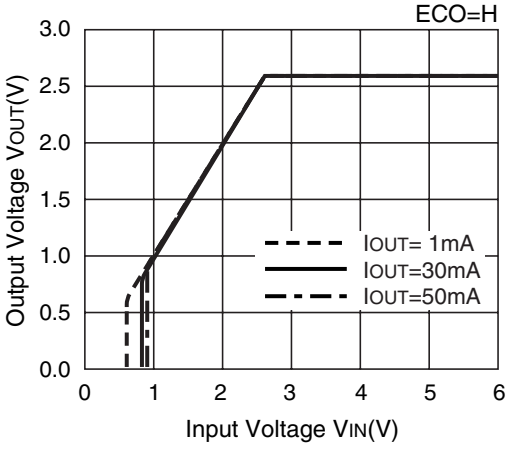

**R1160x151x**




**R1160x151x**



**R1160x261x**

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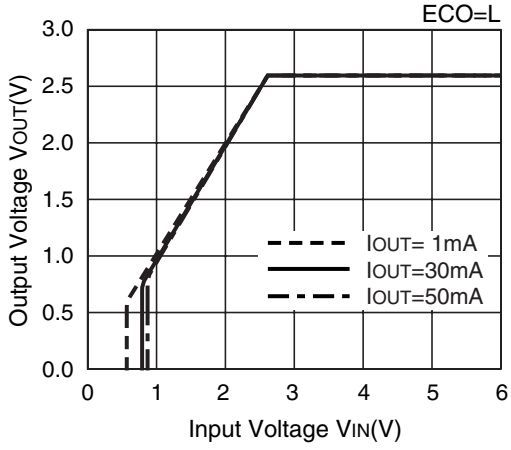
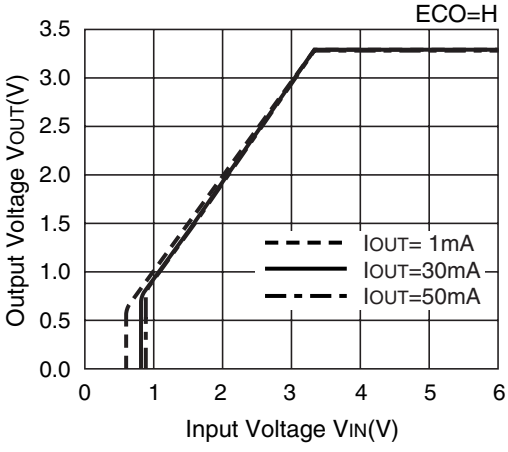
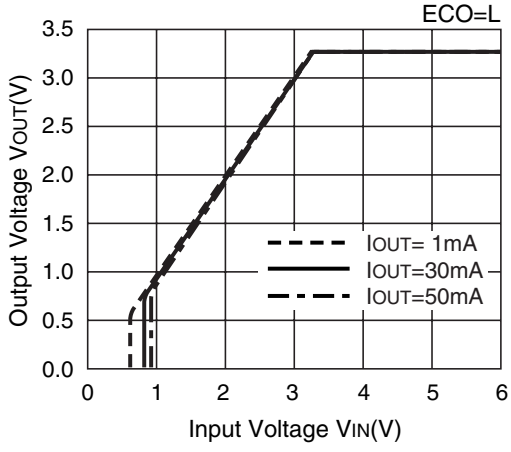



**R1160x331x**

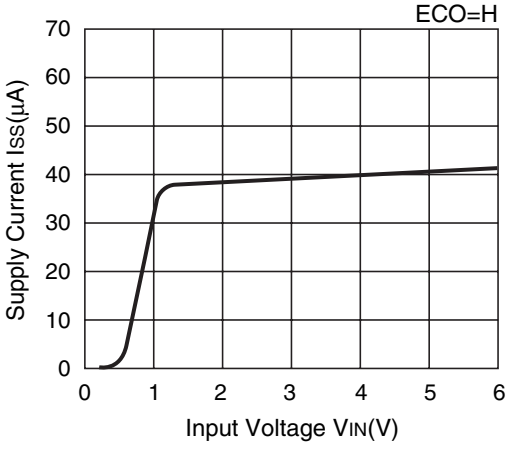



**R1160x331x**

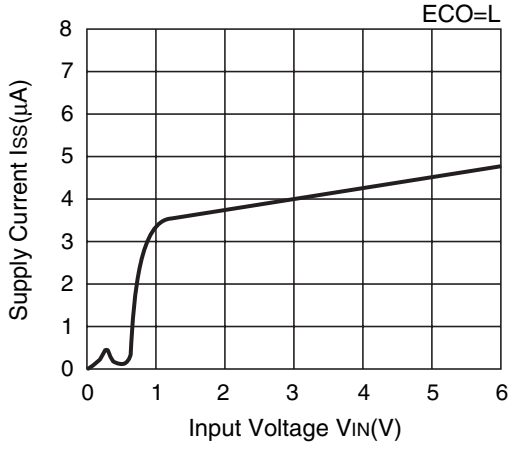



3) Supply Current vs. Input Voltage

**R1160x081x**




**R1160x081x**



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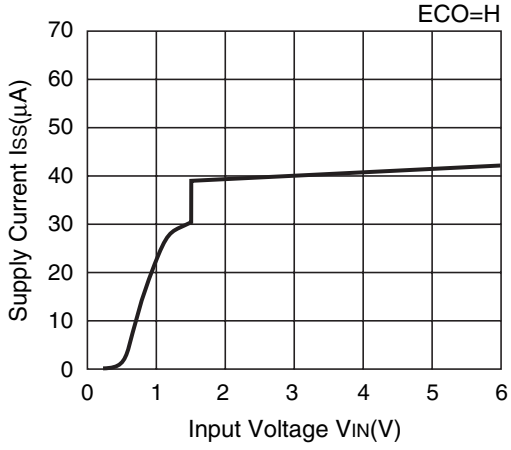
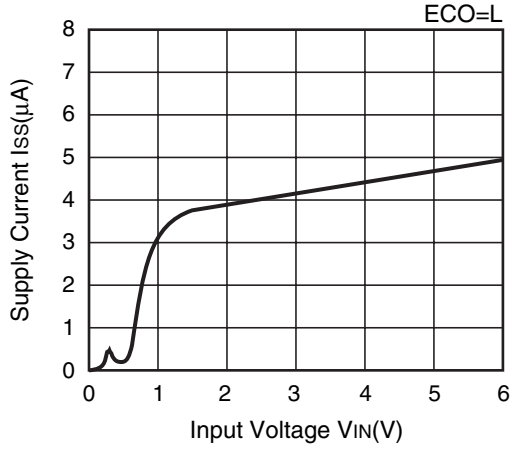



**R1160x151x**

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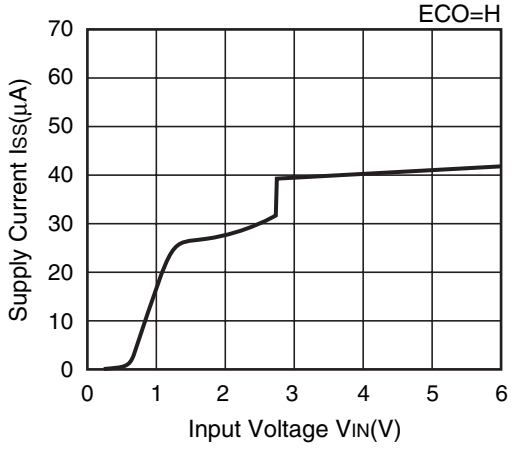
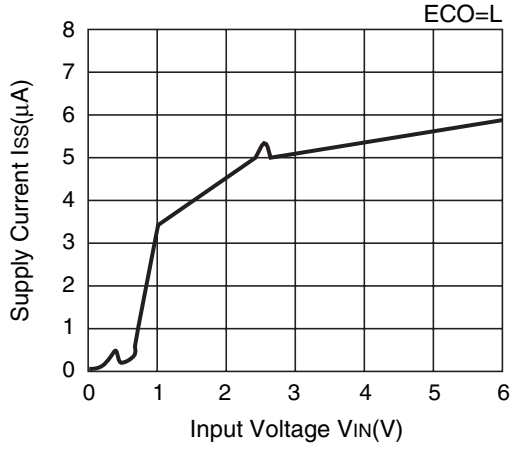
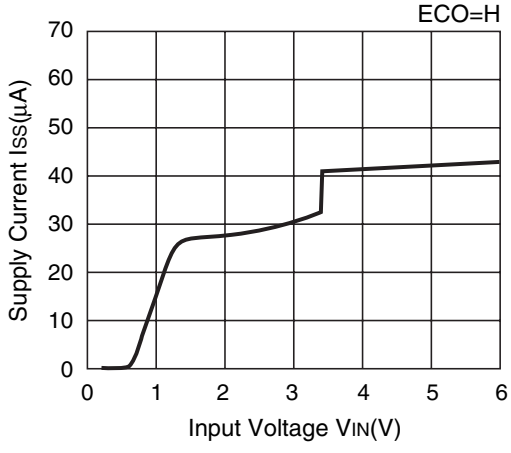


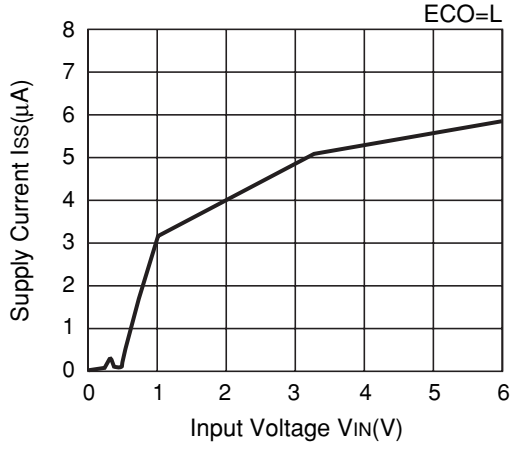

**R1160x261x**




**R1160x331x**

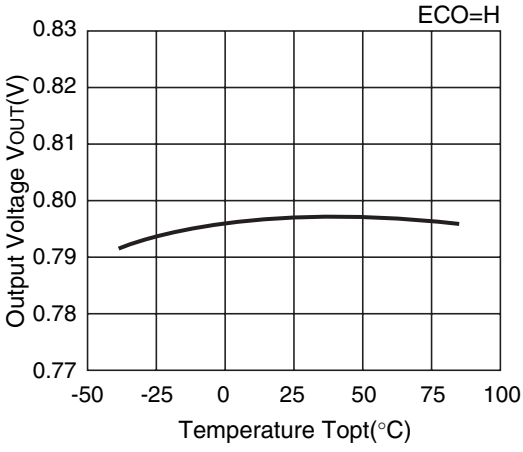



**R1160x331x**

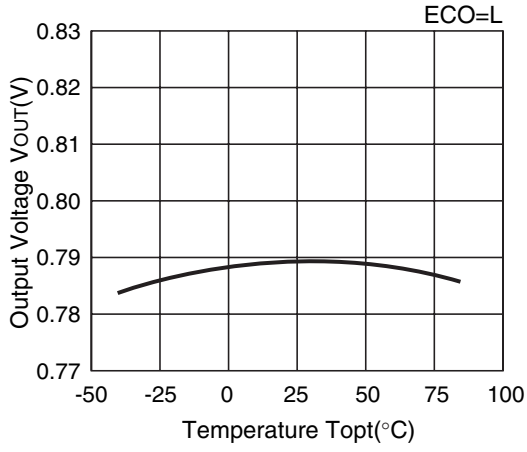


4) Output Voltage vs. Temperature

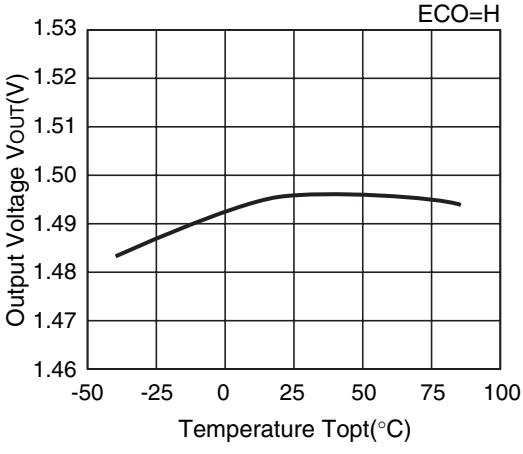
**R1160x081x**



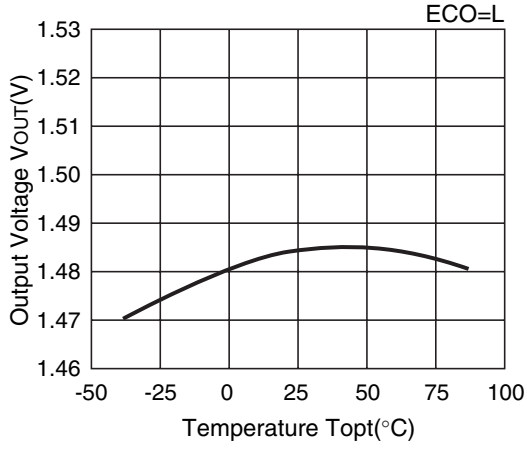

**R1160x081x**



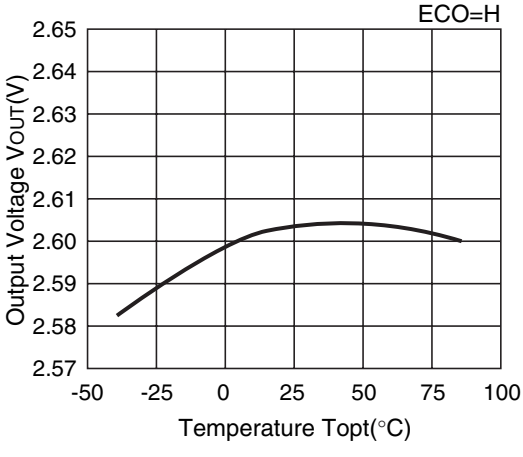

**R1160x151x**



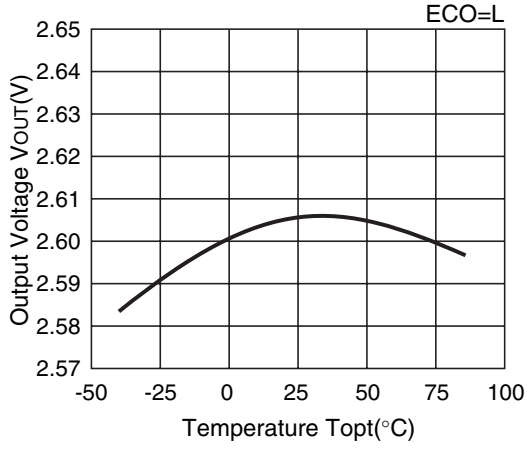

**R1160x151x**



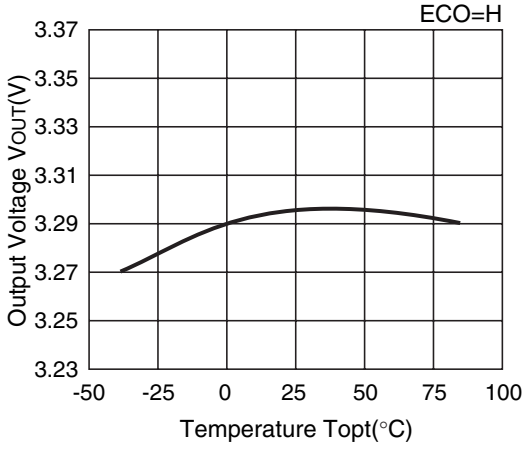

**R1160x261x**



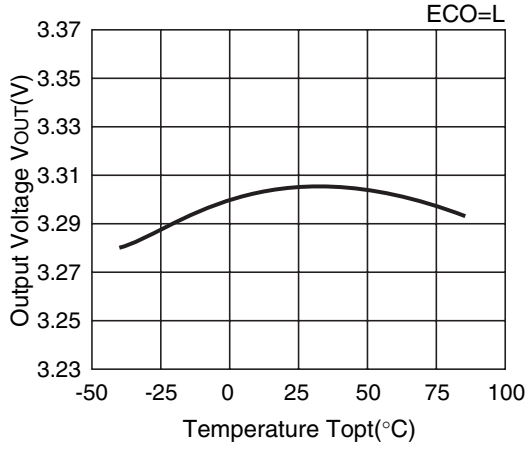

**R1160x261x**



**R1160x331x**

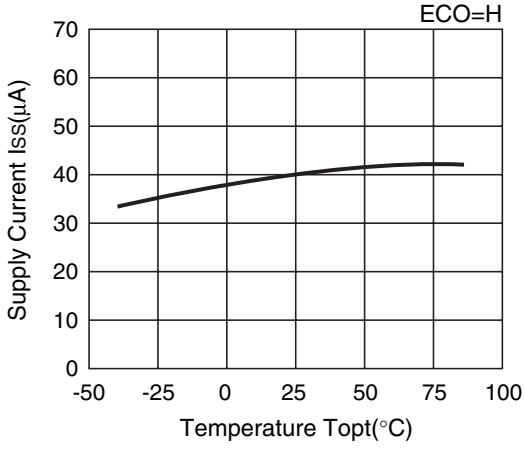



**R1160x331x**

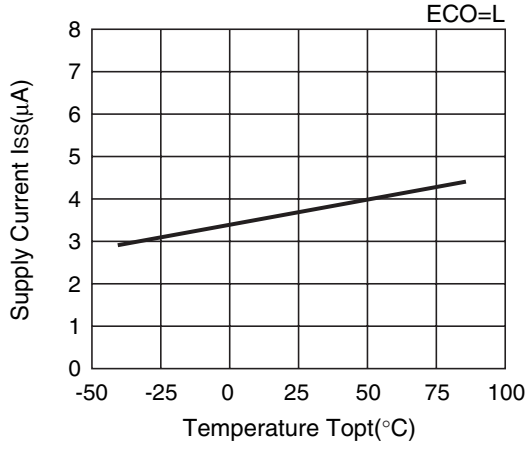



5) Supply Current vs. Temperature

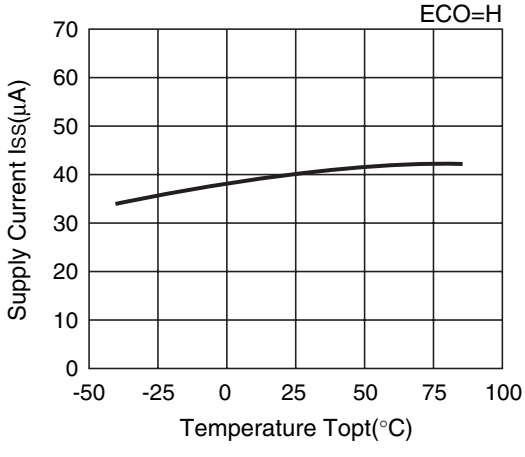
**R1160x081x**



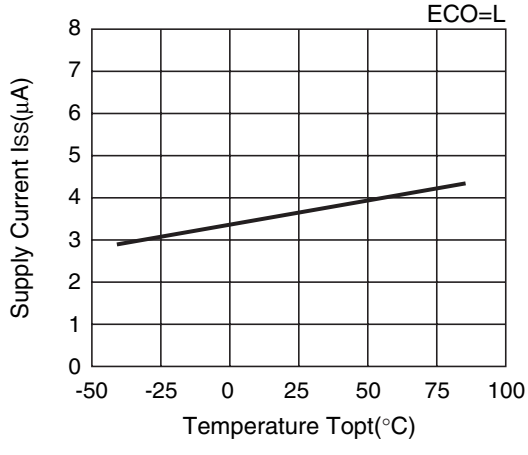

**R1160x081x**



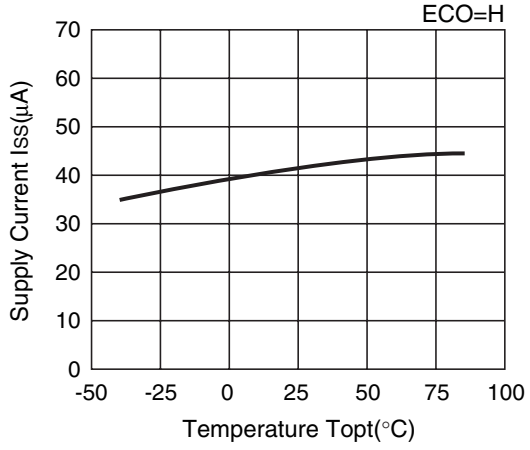

**R1160x151x**




**R1160x151x**



**R1160x261x**

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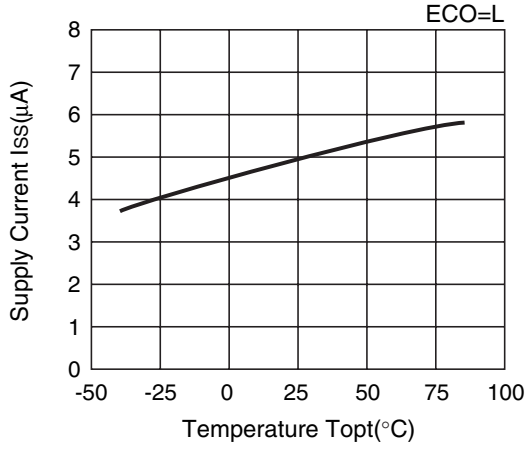
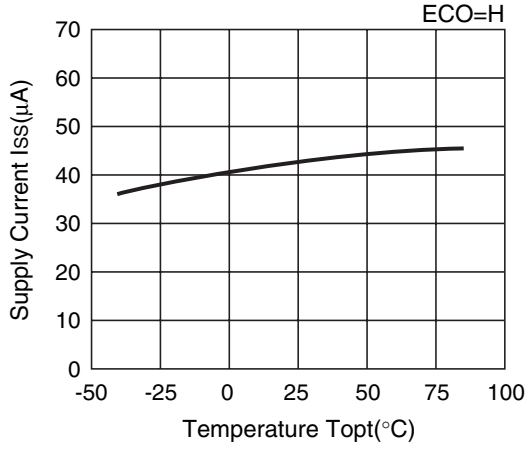
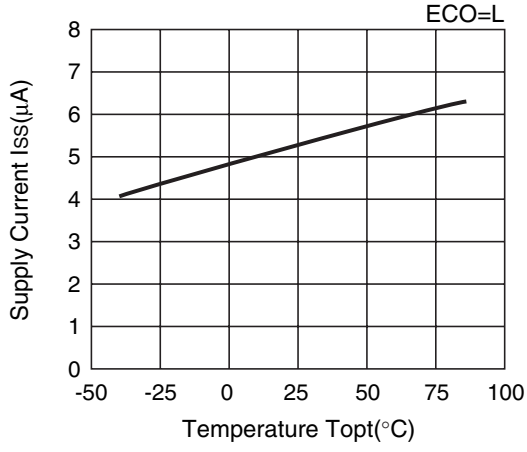



**R1160x331x**

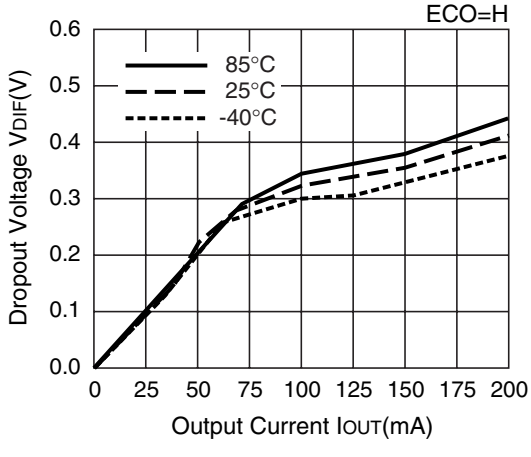



**R1160x331x**

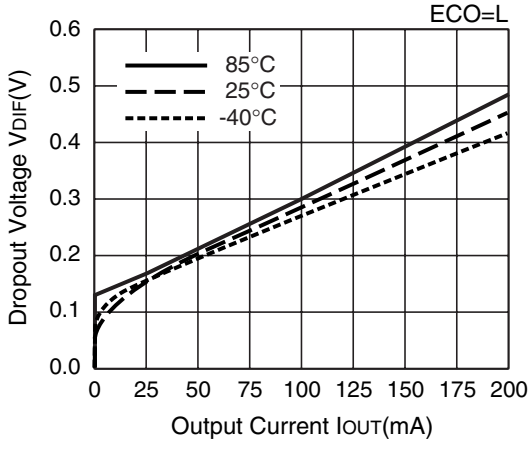



6) Dropout Voltage vs. Output Current

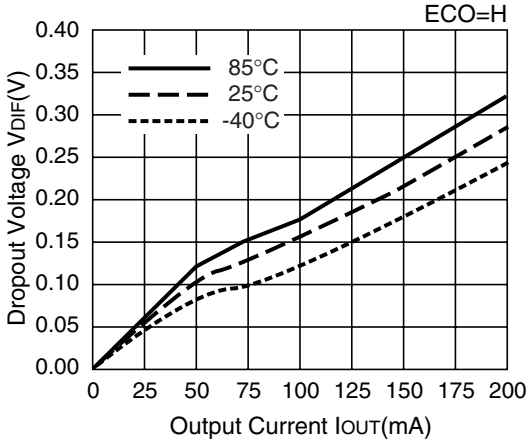
**R1160x081x**



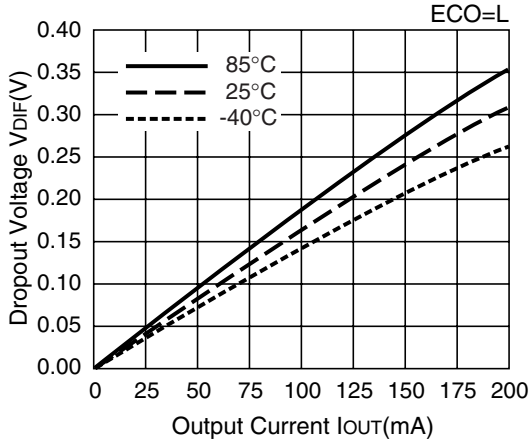

**R1160x081x**



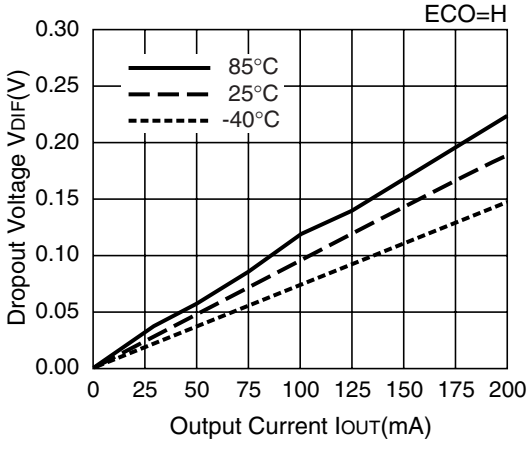
**R1160x101x**



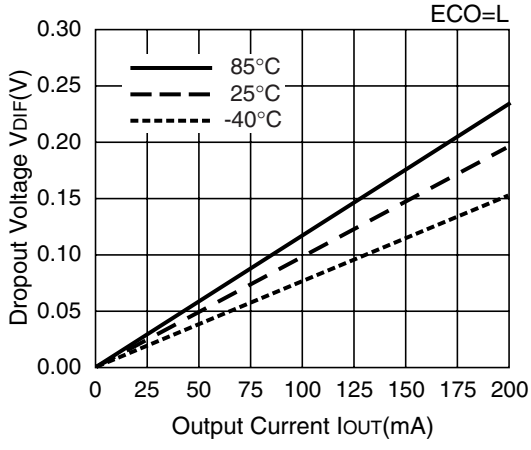

**R1160x101x**



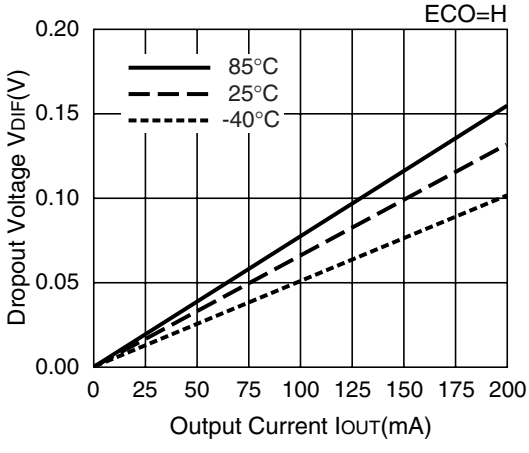

**R1160x151x**



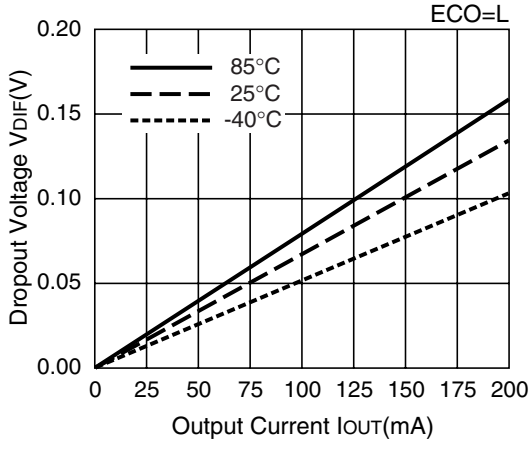

**R1160x151x**



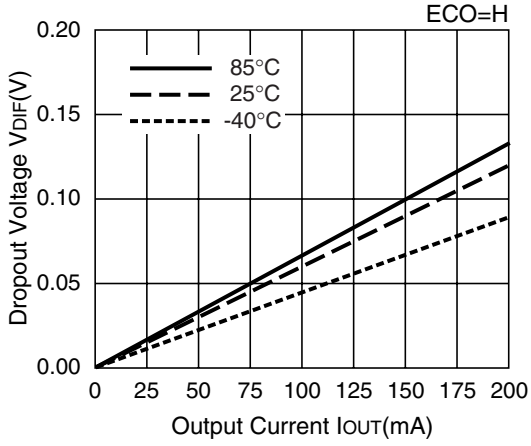

**R1160x261x**



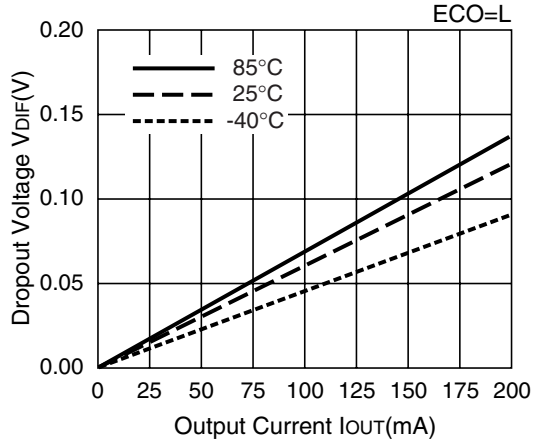

**R1160x261x**



**R1160x331x**

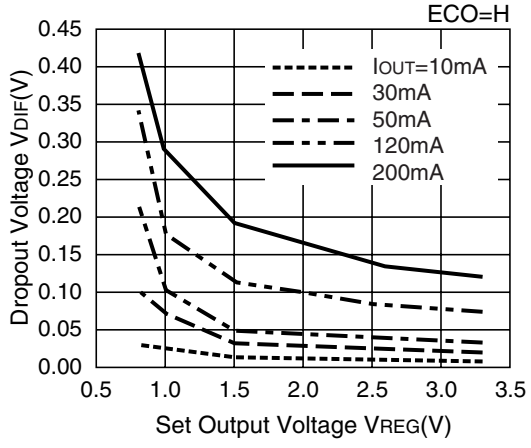



**R1160x331x**

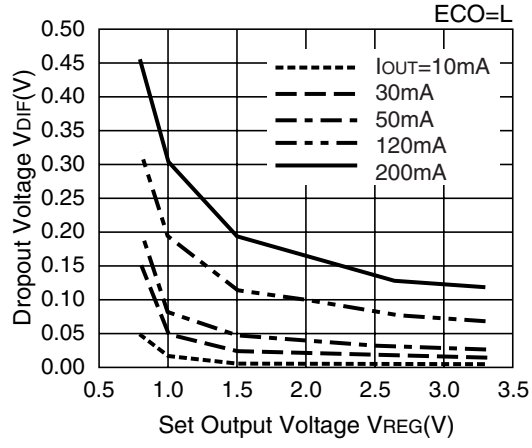



7) Dropout Voltage vs. Set Output Voltage (Topt=25°C)

**R1160xxx1x**

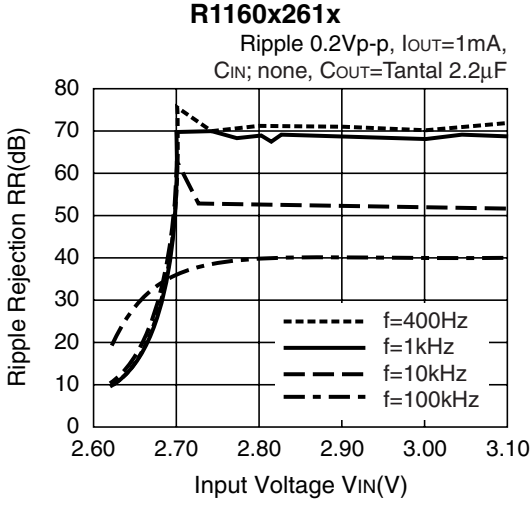



**R1160xxx1x**

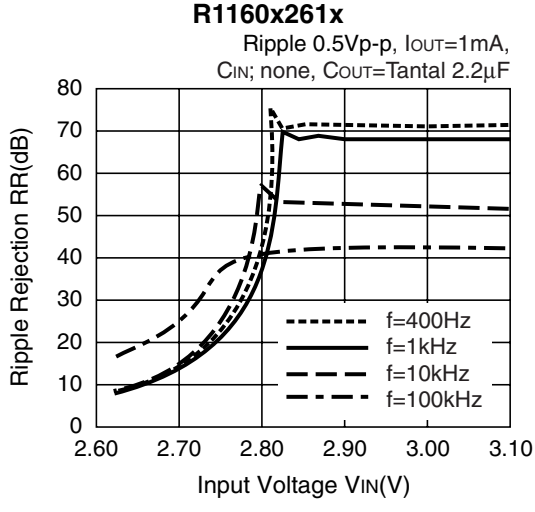



8) Ripple Rejection vs. Input Bias (Topt=25°C)

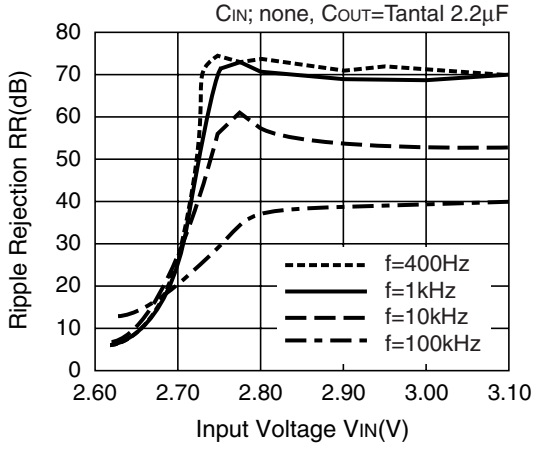
**R1160x261x**



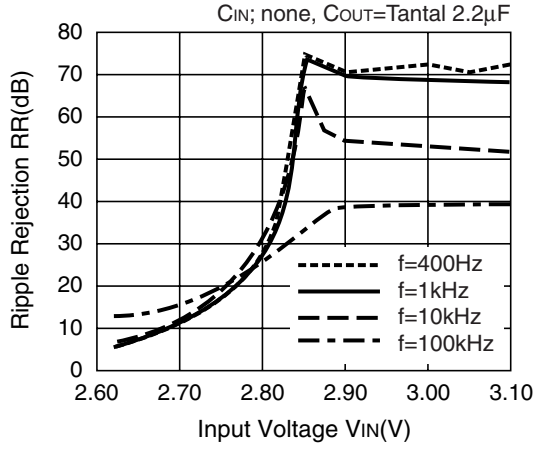

**R1160x261x**



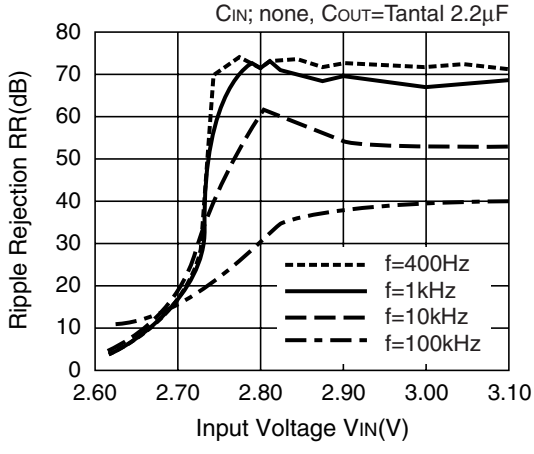
**R1160x261x**
Ripple 0.2Vp-p, $I_{OUT}$=30mA,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF



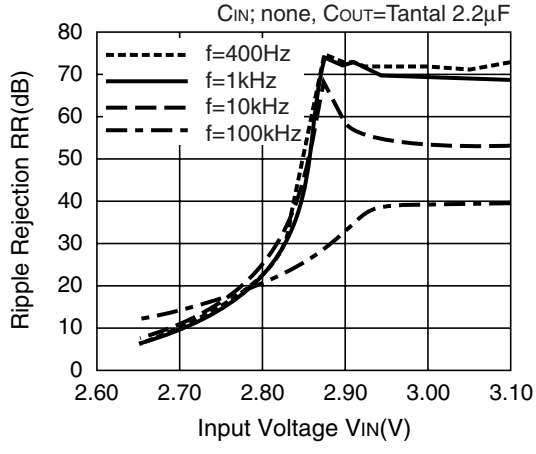

**R1160x261x**
Ripple 0.5Vp-p, $I_{OUT}$=30mA,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF




**R1160x261x**
Ripple 0.2Vp-p, $I_{OUT}$=50mA,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF

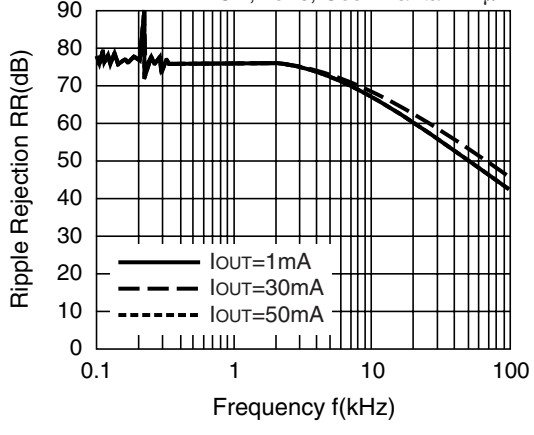



**R1160x261x**
Ripple 0.5Vp-p, $I_{OUT}$=50mA,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF

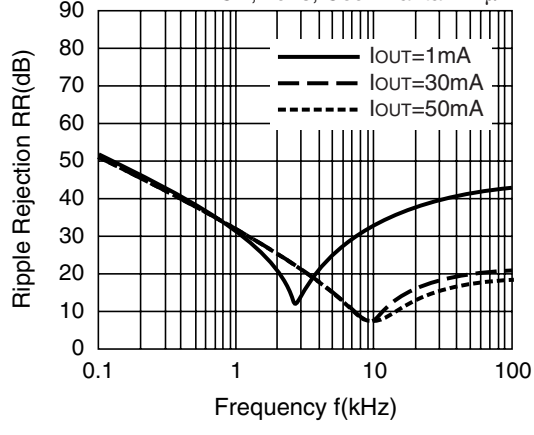



9) Ripple Rejection vs. Frequency

**R1160x081x**
ECO=H, $V_{IN}$1.8$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF

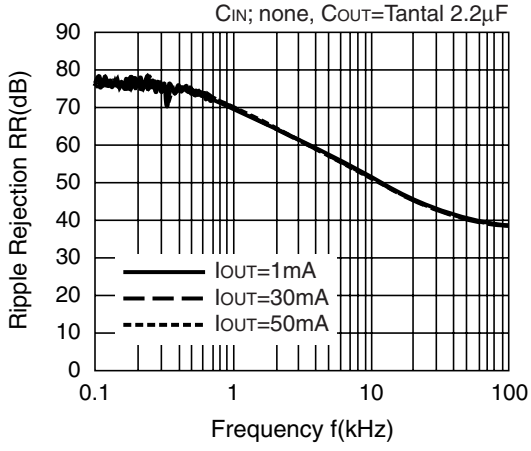



**R1160x081x**
ECO=L, $V_{IN}$1.8$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF



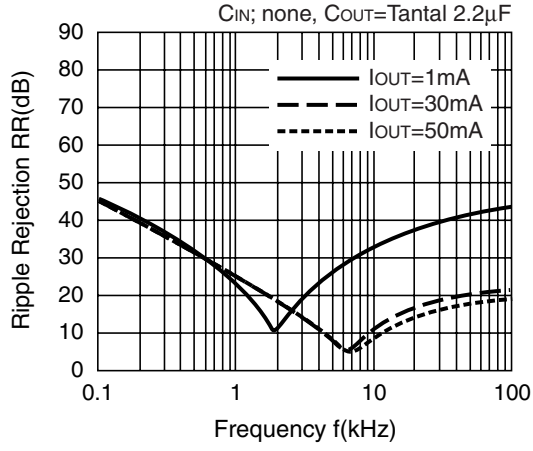
**R1160x151x**

ECO=H, $V_{IN}$2.5$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF



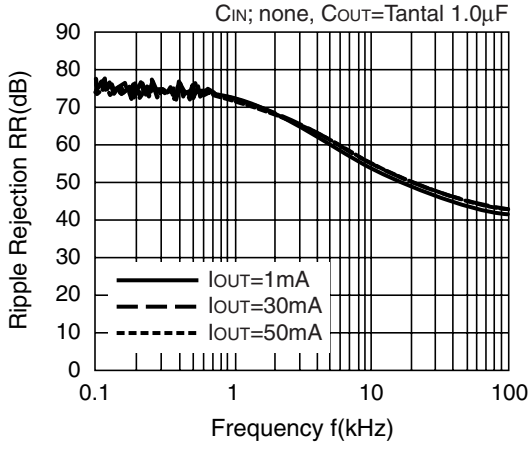

**R1160x151x**

ECO=L, $V_{IN}$2.5$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF



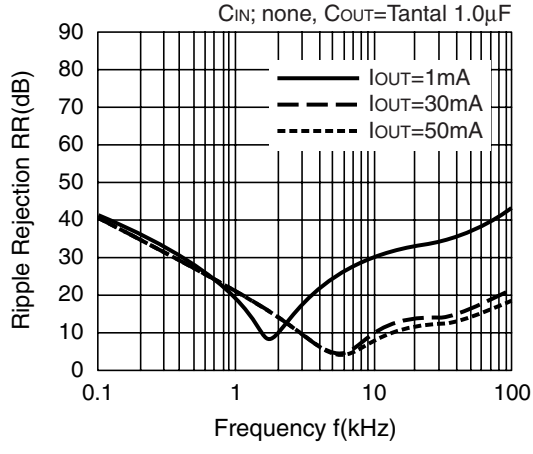

**R1160x261x**

ECO=H, $V_{IN}$3.6$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 1.0µF



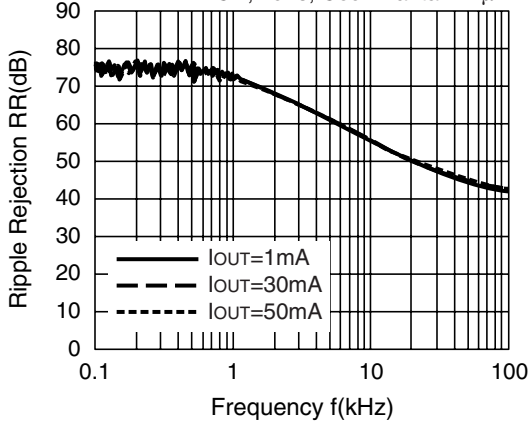

**R1160x261x**

ECO=L, $V_{IN}$3.6$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 1.0µF



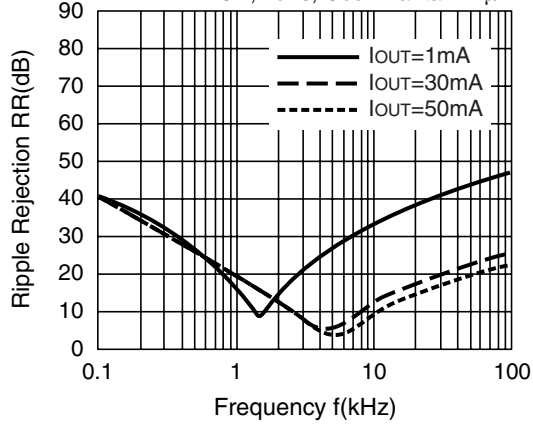

**R1160x261x**

ECO=H, $V_{IN}$3.6$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF



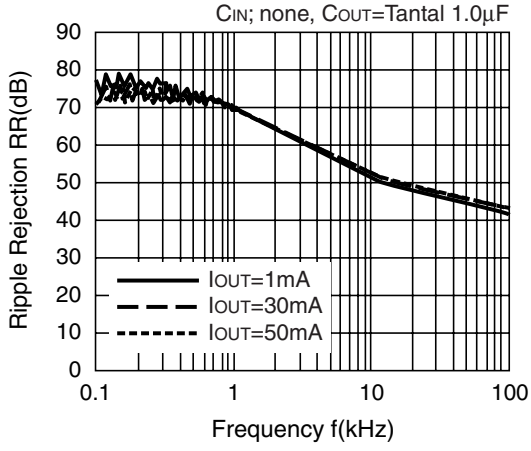

**R1160x261x**

ECO=L, $V_{IN}$3.6$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF



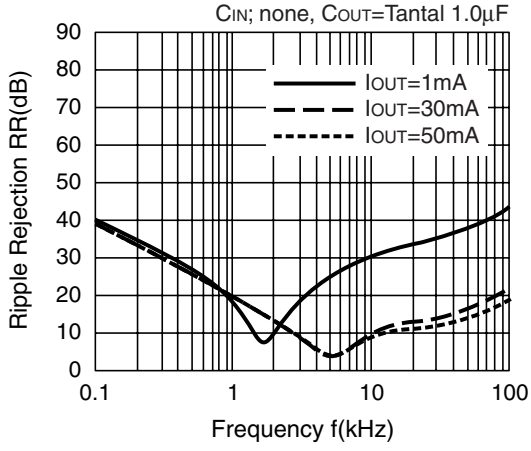
**R1160x331x**

ECO=H, $V_{IN}$4.3$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 1.0µF



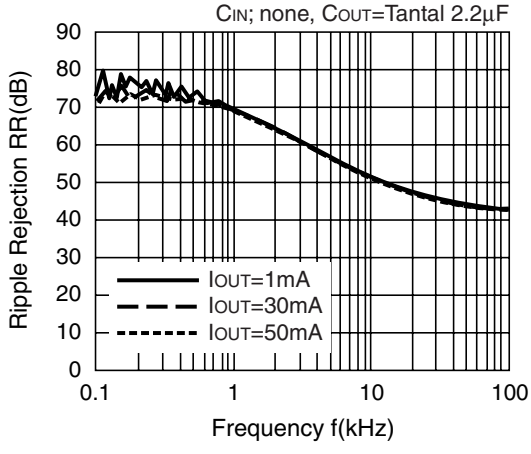

**R1160x331x**

ECO=L, $V_{IN}$4.3$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 1.0µF



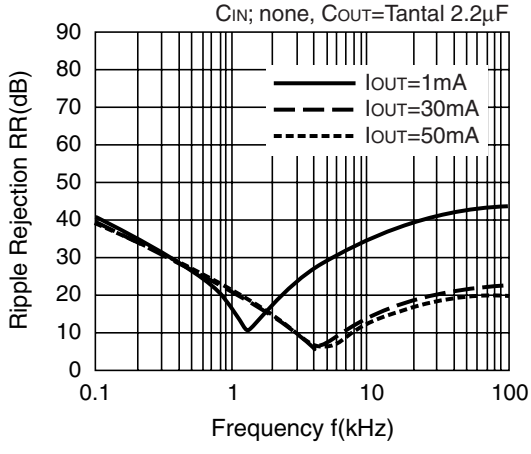

**R1160x331x**

ECO=H, $V_{IN}$4.3$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF




**R1160x331x**

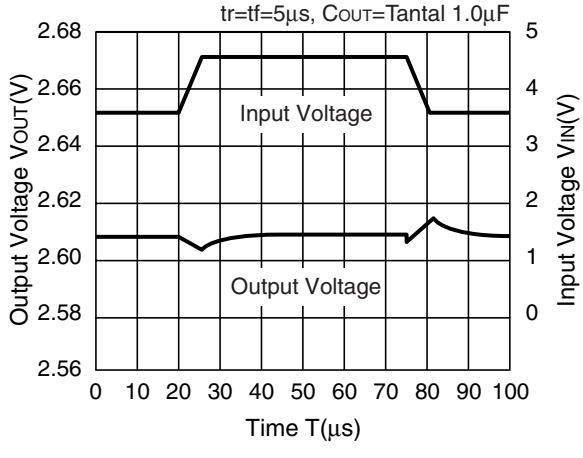
ECO=L, $V_{IN}$4.3$V_{DC}$+0.2Vp-p,
$C_{IN}$; none, $C_{OUT}$=Tantal 2.2µF




10) Input Transient Response

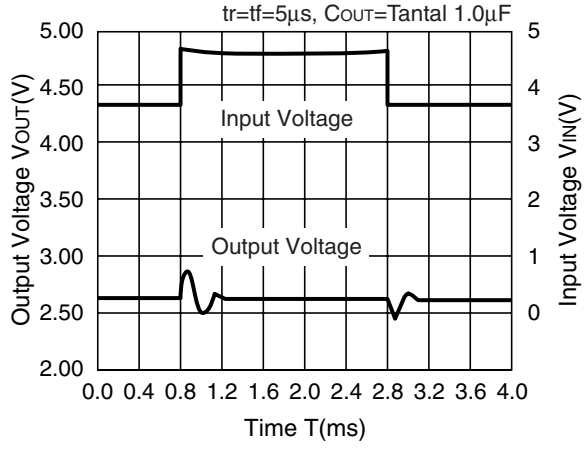
**R1160x261x**

ECO=H, $I_{OUT}$=30mA,
tr=tf=5µs, $C_{OUT}$=Tantal 1.0µF



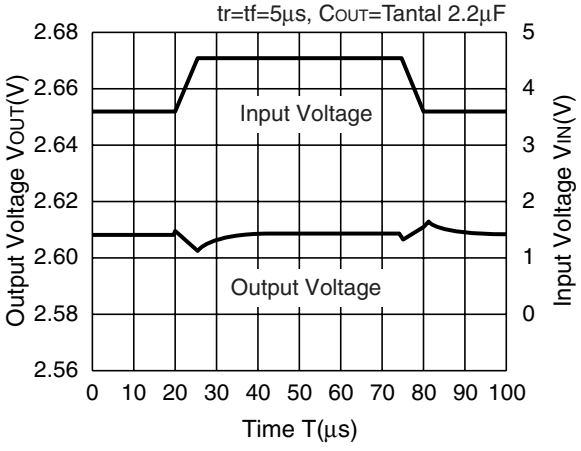

**R1160x261x**

ECO=L, $I_{OUT}$=10mA,
tr=tf=5µs, $C_{OUT}$=Tantal 1.0µF



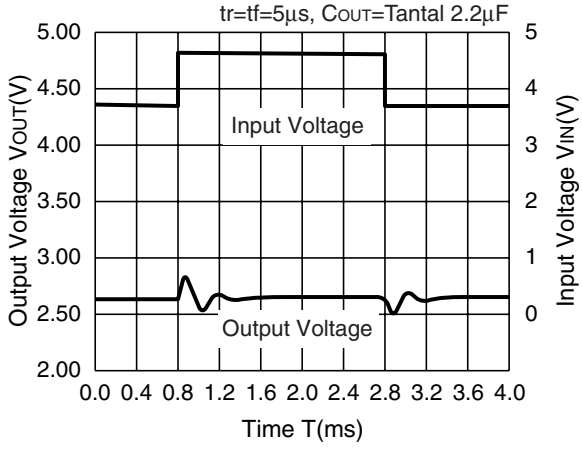
**R1160x261x**

ECO=H, $I_{OUT}$=30mA,
tr=tf=5µs, $C_{OUT}$=Tantal 2.2µF



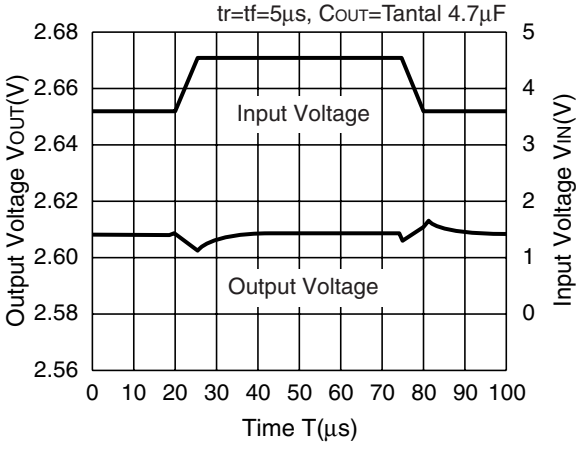

**R1160x261x**

ECO=L, $I_{OUT}$=10mA,
tr=tf=5µs, $C_{OUT}$=Tantal 2.2µF



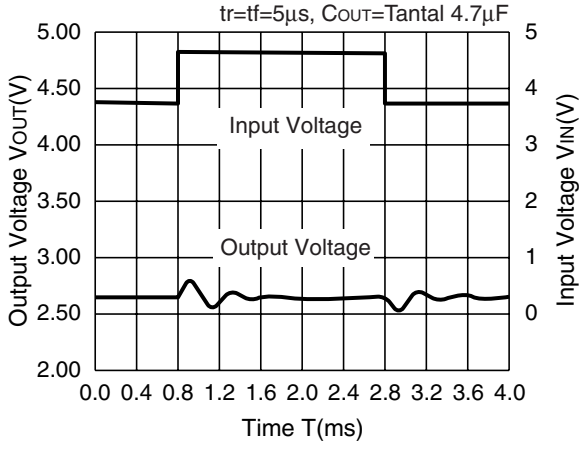

**R1160x261x**

ECO=H, $I_{OUT}$=30mA,
tr=tf=5µs, $C_{OUT}$=Tantal 4.7µF




**R1160x261x**

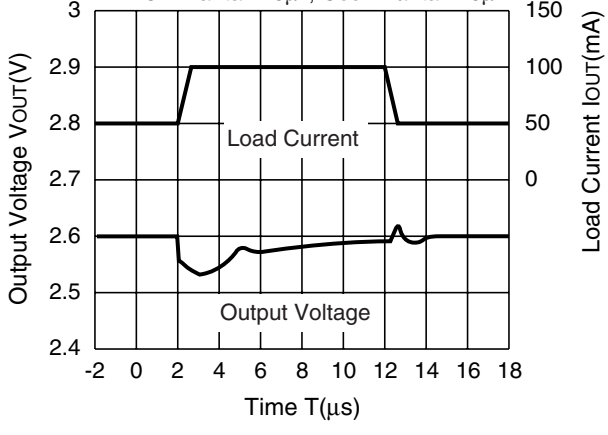
ECO=L, $I_{OUT}$=10mA,
tr=tf=5µs, $C_{OUT}$=Tantal 4.7µF




11) Load Transient Response

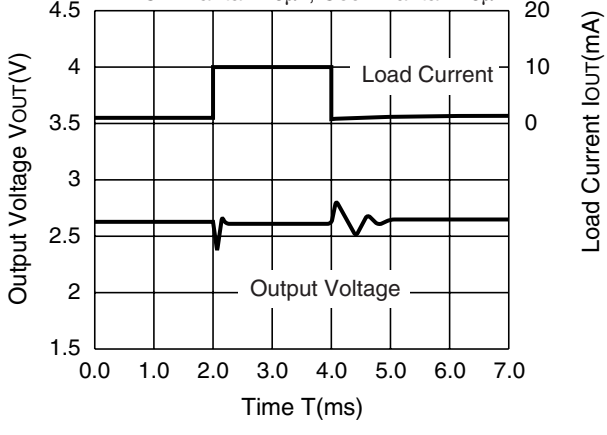
**R1160x261x**

ECO=H, $V_{IN}$=3.6V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 1.0µF



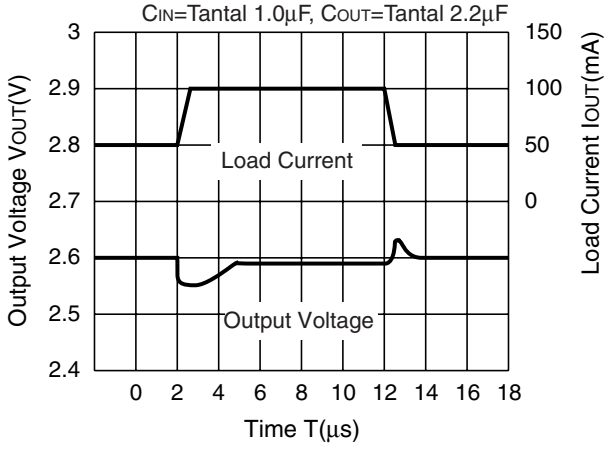

**R1160x261x**

ECO=L, $V_{IN}$=3.6V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 1.0µF



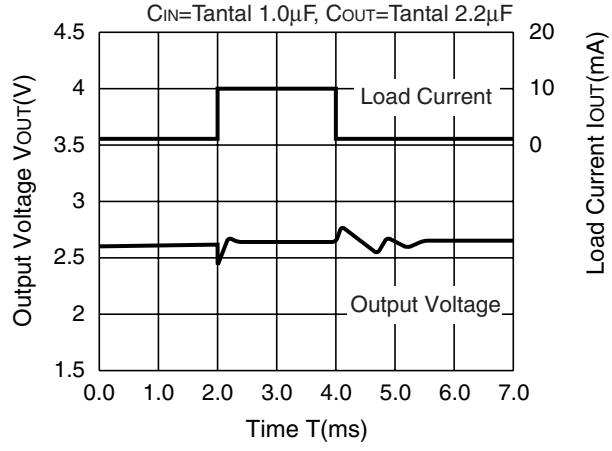
**R1160x261x**

ECO=H, $V_{IN}$=3.6V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 2.2µF



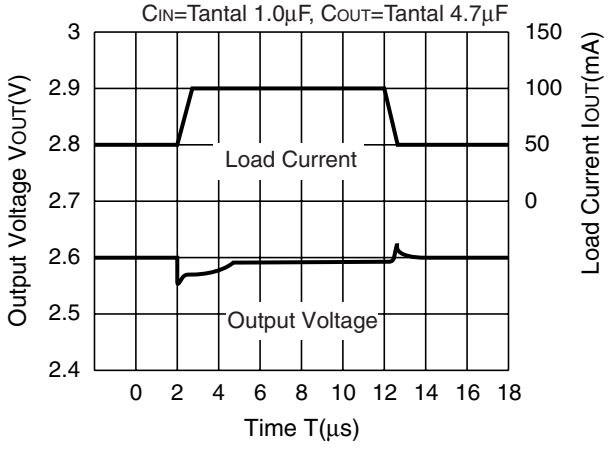

**R1160x261x**

ECO=L, $V_{IN}$=3.6V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 2.2µF



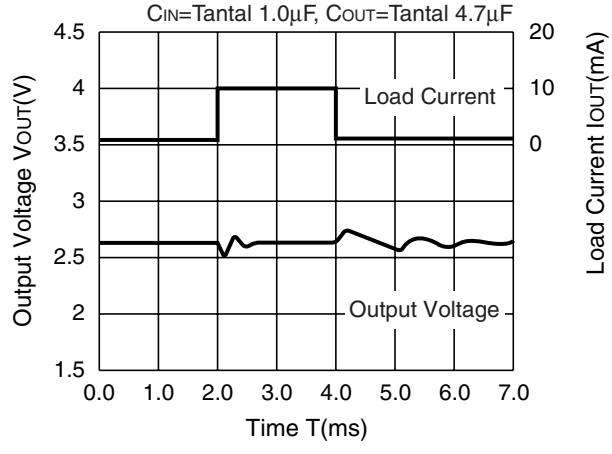

**R1160x261x**

ECO=H, $V_{IN}$=3.6V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 4.7µF




**R1160x261x**

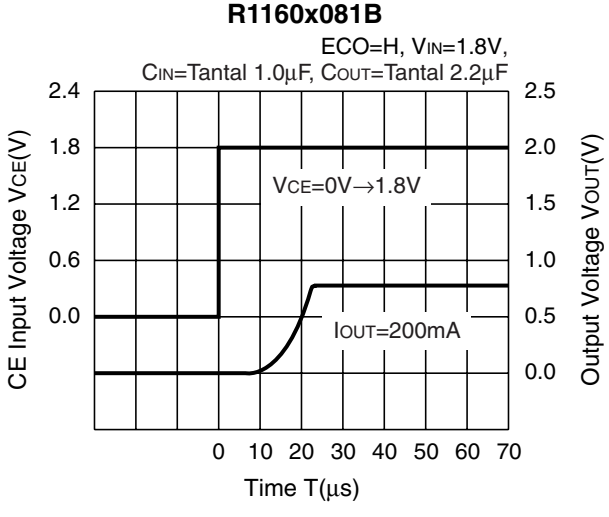
ECO=L, $V_{IN}$=3.6V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 4.7µF




12) Turn on speed with CE pin

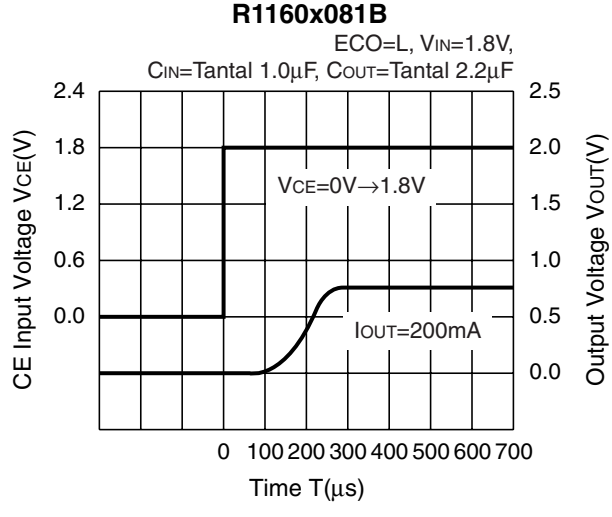
**R1160x081B**

ECO=H, $V_{IN}$=1.8V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 2.2µF



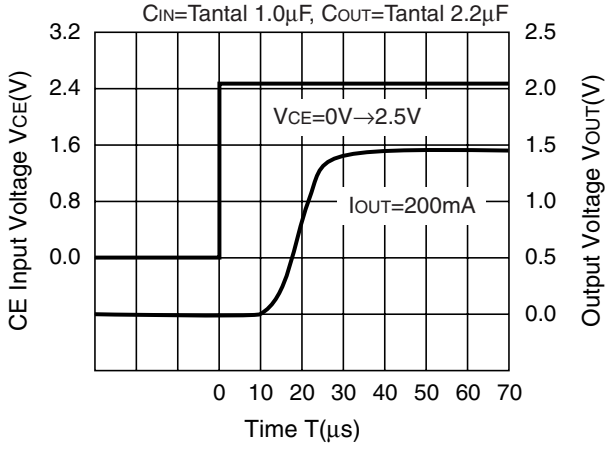

**R1160x081B**

ECO=L, $V_{IN}$=1.8V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 2.2µF



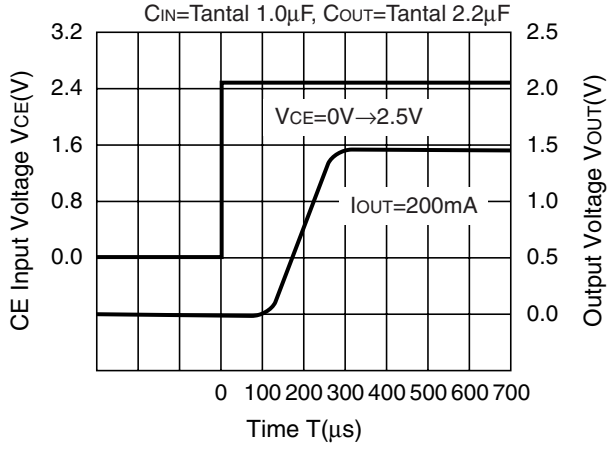
**R1160x151B**

ECO=H, $V_{IN}$=2.5V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 2.2µF



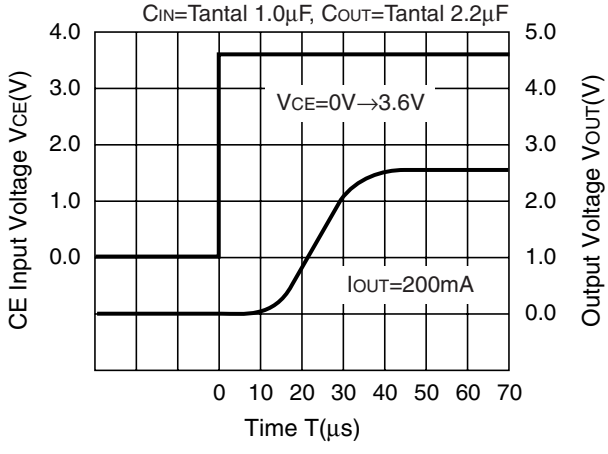

**R1160x151B**

ECO=L, $V_{IN}$=2.5V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 2.2µF



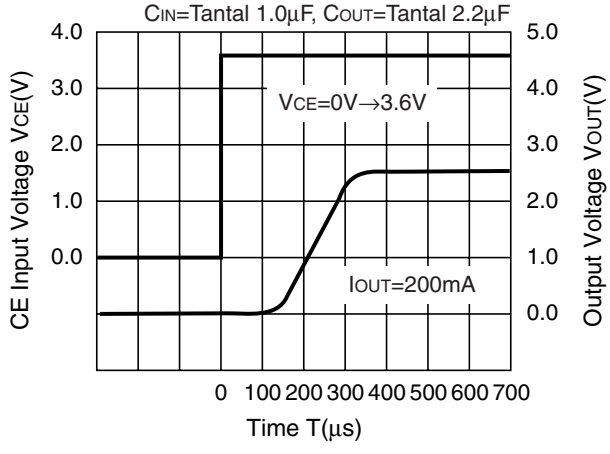

**R1160x261B**

ECO=H, $V_{IN}$=3.6V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 2.2µF



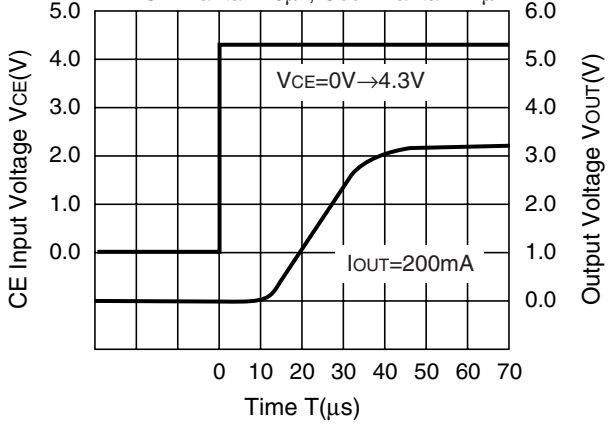

**R1160x261B**

ECO=L, $V_{IN}$=3.6V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 2.2µF



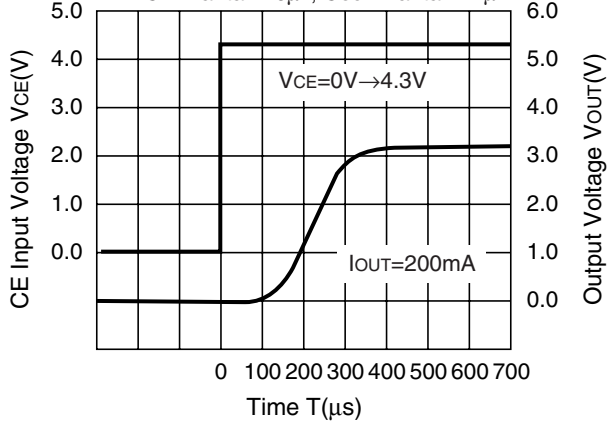

**R1160x331B**

ECO=H, $V_{IN}$=4.3V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 2.2µF



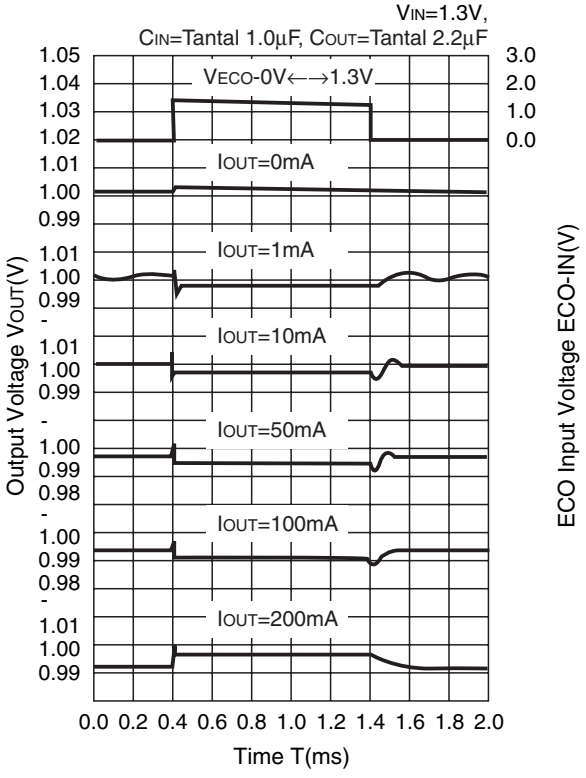

**R1160x331B**

ECO=L, $V_{IN}$=4.3V,
$C_{IN}$=Tantal 1.0µF, $C_{OUT}$=Tantal 2.2µF

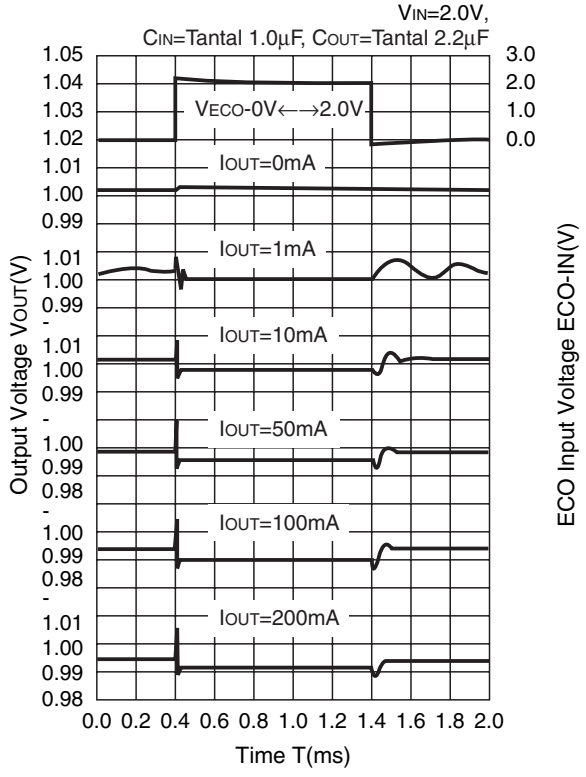


13) Output Voltage at Mode alternative point

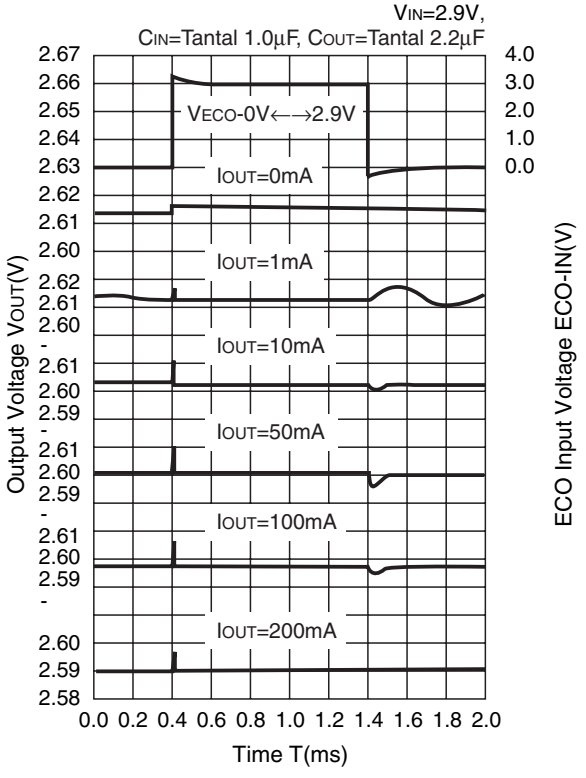
**R1160x101x**



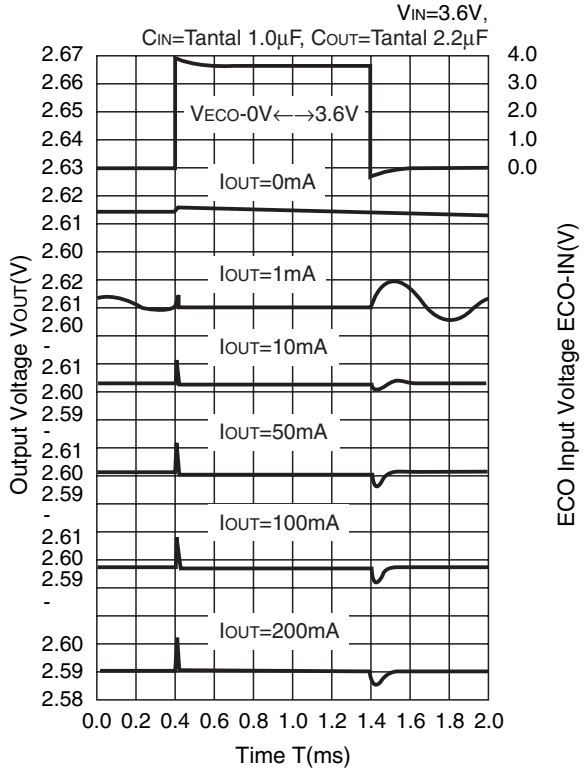

**R1160x101x**




**R1160x261x**




**R1160x261x**



# TECHNICAL NOTES

When using these ICs, consider the following points:

In these ICs, phase compensation is made for securing stable operation even if the load current is varied. For this purpose, be sure to use a capacitor $C_{OUT}$ with good frequency characteristics and ESR (Equivalent Series Resistance) in the range described as follows:

The relations between $I_{OUT}$ (Output Current) and ESR of Output Capacitor are shown below. The conditions when the white noise level is under 40$\mu$V (Avg.) are marked as the hatched area in the graph.

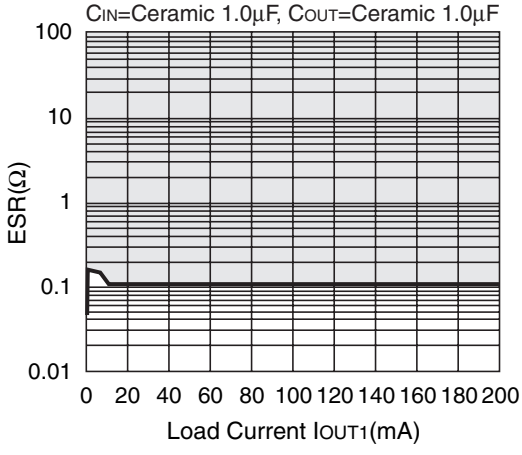
<Test conditions>

(1) Frequency band: 10Hz to 2MHz

(2) Temperature: 25°C

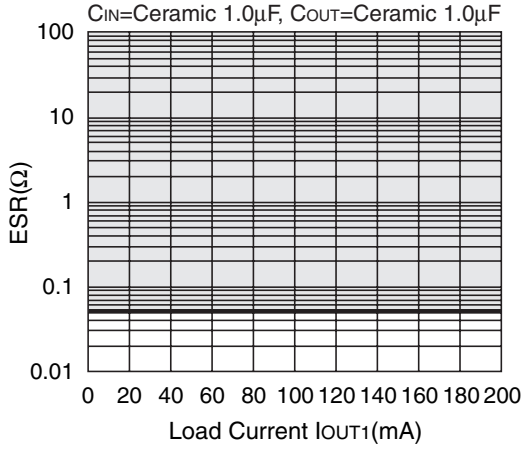
**R1160x261x**

ECO=H, $V_{IN}$=3.6V,
$C_{IN}$=Ceramic 1.0µF, $C_{OUT}$=Ceramic 1.0µF



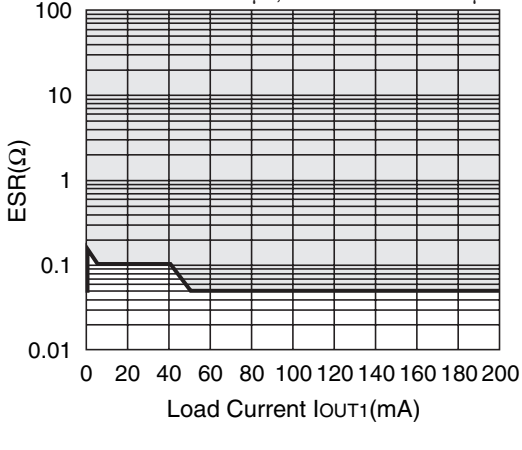

**R1160x261x**

ECO=L, $V_{IN}$=3.6V,
$C_{IN}$=Ceramic 1.0µF, $C_{OUT}$=Ceramic 1.0µF



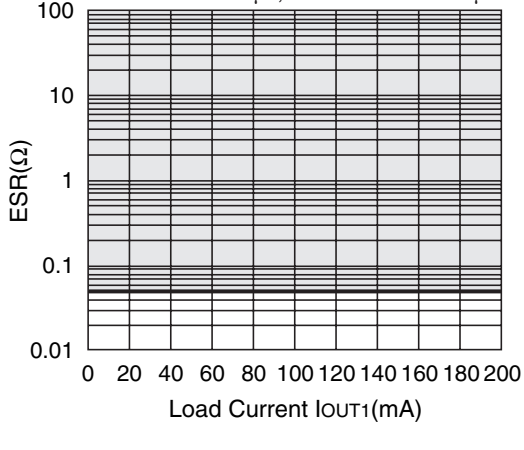

**R1160x261x**

ECO=H, $V_{IN}$=3.6V,
$C_{IN}$=Ceramic 1.0µF, $C_{OUT}$=Ceramic 2.2µF



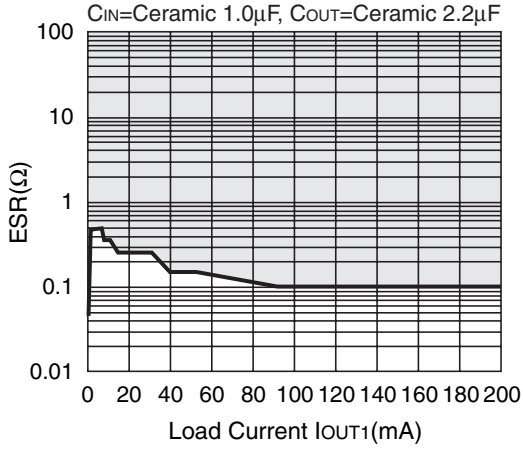

**R1160x261x**

ECO=L, $V_{IN}$=3.6V,
$C_{IN}$=Ceramic 1.0µF, $C_{OUT}$=Ceramic 2.2µF



**R1160x081x**

ECO=H, $V_{IN}$=1.8V,
$C_{IN}$=Ceramic 1.0µF, $C_{OUT}$=Ceramic 2.2µF




**R1160x081x**

ECO=L, $V_{IN}$=1.8V,
$C_{IN}$=Ceramic 1.0µF, $C_{OUT}$=Ceramic 2.2µF