

- ◆ **Low Power Consumption** : 25 μ A (TYP)
- ◆ **Dropout Voltage** : 60mV (IOUT=30mA)
200mV (IOUT=100mA)
- ◆ **Output Current** : 150 mA (VOUT < 1.7V)
240 mA (VOUT \geq 1.8V)
(300mA limit)
- ◆ **Highly Accurate** : $\pm 2\%$ (± 30 mV when VOUT=1.5V)
- ◆ **Output Voltage Range** : 0.9V ~ 5.0 V (50mV Step)
- ◆ **Low ESR capacitor compatible**

■ General Description

The XC6211 series are highly accurate, low noise, CMOS LDO Voltage Regulators. Offering low output noise, high ripple rejection ratio, low dropout and very fast turn-on times, the XC6211 series is ideal for today's cutting edge mobile phone.

Internally the XC6211 includes a reference voltage source, error amplifiers, driver transistors, current limiters and phase compensators. The XC6211's current limiters' foldback circuit also operates as a short protect for the output current limiter and the output pin.

The output voltage is set by laser trimming. Voltages are selectable in 50mV steps within a range of 0.9V to 5.0V. The XC6211 series is also fully compatible with low ESR ceramic capacitors, reducing cost and improving output stability. This high level of output stability is maintained even during frequent load fluctuations, due to the excellent transient response performance and high PSRR achieved across a broad range of frequencies.

The CE function allows the output of regulator to be turned off, resulting in greatly reduced power consumption.

The XC6211 series is available in the SOT-23-5 package.

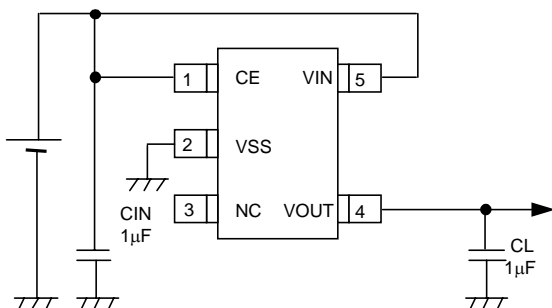
■ Applications

- Mobile phones
- Cordless phones and radio communication equipment
- Portable games
- Cameras, Video recorders
- Reference Voltage Source
- Battery Powered Equipment

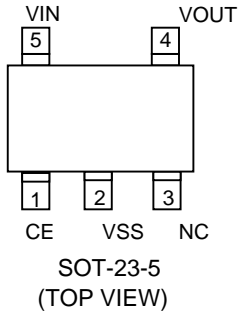
■ Features

| | |
|-------------------------------------|---|
| Maximum Output Current | : 150 mA (VOUT < 1.7V) 240 mA (VOUT \geq 1.8V) (300mA limit) |
| Dropout Voltage | : 200mV (IOUT=100mA) |
| Operating Voltage Range | : 2.0V ~ 6.0V |
| Output Voltage Range | : 0.9V ~ 5.0V (50mV Step) |
| Highly Accurate | : $\pm 2\%$ (VOUT>1.5V) : ± 30 mV (VOUT \leq 1.5V) |
| Low Power Consumption | : 25 μ A (TYP.) |
| Standby Current | : Less than 0.1 μ A (TYP.) |
| High Ripple Rejection | : 65dB (10kHz) |
| Operating Temperature Range | : -40°C ~ +85°C |
| Low ESR Capacitor Compatible | : Ceramic capacitor |
| Ultra Small Packages | : SOT-23-5 |

■ Typical Applications



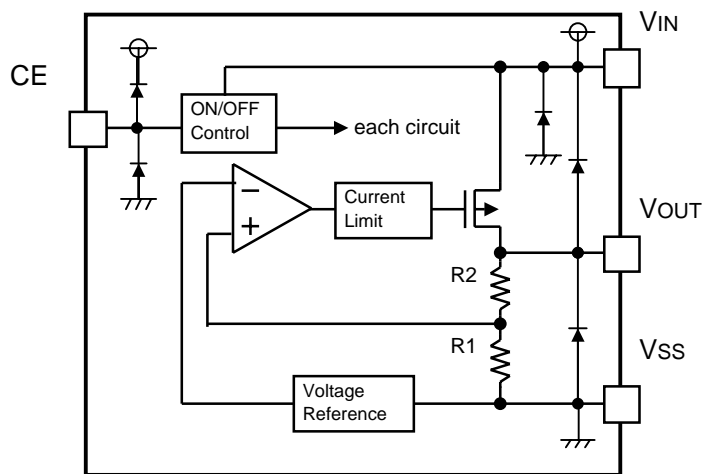
Pin Configuration



Pin Assignment

| PIN NUMBER | PIN NAME | FUNCTION |
|------------|----------|------------------|
| 1 | CE | On/Off Control 1 |
| 2 | VSS | Ground |
| 3 | NC | No Connection |
| 4 | VOUT1 | Output 1 |
| 5 | VIN | Power Input |

Block Diagram



■ Product Classification

● Selection Guide

The following options for the CE pin logic and internal pull-up/down are available:

Active 'High' + no pull-down resistor built-in (standard)

Active 'High' + 2.0MΩ pull-down resistor built-in <between CE-VSS> (semi-custom)

Active 'Low' + no pull-up resistor built-in (semi-custom)

Active 'Low' + 2.0MΩ pull-up resistor built-in <between VIN-CE> (semi-custom)

Note: *With the pull-up resistor or pull-down resistor built-in types,

the supply current during operation will increase by VIN / 2.0MΩ (TYP.)

● Ordering Information XC6211①②③④⑤⑥

| DESIGNATOR | SYMBOL | DESCRIPTION |
|------------|---------|--|
| ① | | CE Pin Logic : |
| | A | Active 'High' (pull-down resistor built in) |
| | B | Active 'High' (no pull-down resistor built in) |
| | C | Active 'Low' (pull-up resistor built in) |
| | D | Active 'Low' (no pull-up resistor built in) |
| ② ③ | Integer | Output Voltage : |
| | | e.g. ②=3, ③=0, ⇒ 3.0V |
| ④ | 2 | Output Voltage: 100mV increments, ±2% accuracy |
| | | e.g. ②=2, ③=8, ④=2 ⇒ 2.80V, ±2% |
| | A | Output Voltage : 50mV increments, ±2% accuracy |
| | | e.g. ②=2, ③=8, ④=A ⇒ 2.85V |
| ⑤ | | Package Type : |
| | M | SOT-25 (SOT-23-5) |
| ⑥ | | Device Orientation : |
| | R | Embossed Tape : Standard Feed |
| | L | Embossed Tape : Reverse Feed |

■ Absolute Maximum Rating

Ta = 25°C

| PARAMETER | SYMBOL | RATINGS | UNITS |
|-------------------------------|--------|---------------------|-------|
| Input Voltage | VIN | 7.0 | V |
| Output Current | IOUT | 500 | mA |
| Output Voltage | VOUT | VSS -0.3 ~ VIN +0.3 | V |
| CE Pin Voltage | VCE | VSS -0.3 ~ VIN +0.3 | V |
| Power Dissipation | Pd | 250 | mW |
| Operating Ambient Temperature | Topr | -40 ~ +85 | °C |
| Storage Temperature | Tstg | -55 ~ +125 | °C |

Electrical Characteristics XC6211B Series

Ta=25°C

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | CIRCUIT |
|---|-------------------------|------------------------------------|--------|---------|--------|------------|---------|
| Output Voltage | VOUT (E) | IOUT=30mA | × 0.98 | VOUT(T) | × 1.02 | V | 1 |
| Maximum Output Current | IOUTMAX | * 1 | 150 | | | mA | 1 |
| Load Regulation | ΔVOUT | 1mA≤IOUT≤100mA | | 15 | 50 | mV | 1 |
| Dropout Voltage | Vdif1 | IOUT=30mA | E-1 | | | mV | 1 |
| | Vdif2 | IOUT=100mA | E-2 | | | mV | |
| Supply Current | IDD | VCE=VIN | | 25 | 50 | μA | 2 |
| Standby Current | Istby | VCE=VSS | | 0.01 | 0.10 | μA | 2 |
| Line Regulation | ΔVOUT / ΔVIN · VOUT | VOUT(T)+1.0V≤VIN≤7.0V IOUT=30mA | | 0.01 | 0.20 | % / V | 1 |
| Input Voltage | VIN | | 2.0 | | 6.0 | V | - |
| Output Voltage Temperature Characteristics | ΔVOUT / ΔTopr · VOUT | IOUT=30mA -40°C≤Topr≤85°C | | 100 | | ppm/ °C | 1 |
| Ripple Rejection Rate | PSRR | IOUT=50mA, f=10kHz | | 65 | | dB | 4 |
| Current Limiter | Ilim | | | 300 | | mA | 1 |
| Short-circuit Current | Ishort | | | 50 | | mA | 1 |
| EN "High" Voltage | VCEH | | 1.60 | | VIN | V | 1 |
| EN "Low" Voltage | VCEL | | | | 0.25 | V | 2 |
| EN "High" Current | ICEH | VCE=VIN | -0.10 | | 0.10 | μA | 2 |
| EN "Low" Current | ICEL | VCE=VSS | -0.10 | | 0.10 | μA | 2 |

NOTE

(NOTE 1) VOUT(T)=Specified Output Voltage

(NOTE 2) VOUT(E)=Effective Output Voltage

(I.e. the output voltage when "VOUT(T)+1.0V" is provided at the VIN pin while maintaining a certain IOUT value).

(NOTE 3) Vdif={VIN1(NOTE5)-VOUT1(NOTE4)}

(NOTE 4) VOUT1=A voltage equal to 98% of the Output Voltage whenever an amply stabilized IOUT {VOUT(T)+1.0V} is input.

(NOTE 5) VIN1=The Input Voltage when VOUT1 appears as Input Voltage is gradually decreased.

(NOTE 6) Unless otherwise stated, VIN=VOUT(T)+1.0V

*1 : 150mA (VOUT<1.7V), 240mA (VOUT≥1.8V)

Dropout Voltage

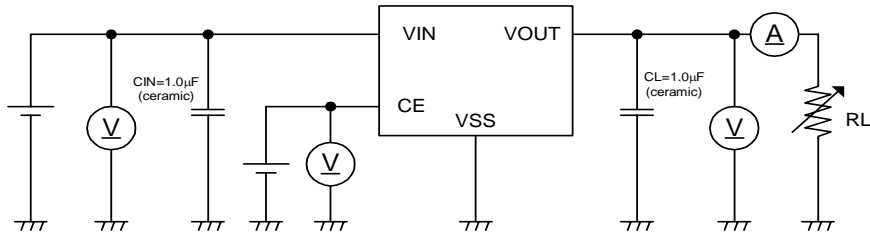
| SYMBOL | E-1 | | | E-2 | | |
|----------------|--------|------|------|--------|------|------|
| | Vdif 1 | | | Vdif 2 | | |
| PARAMETER | MIN | TYP | MAX | MIN | TYP | MAX |
| OUTPUT VOLTAGE | | | | | | |
| 0.90 | 1100 | 1100 | 1110 | 1100 | 1150 | 1200 |
| 1.50 | 500 | 500 | 510 | 500 | 550 | 600 |
| 1.80 ~ 1.85 | 200 | 200 | 210 | 200 | 300 | 400 |
| 1.90 ~ 1.95 | 100 | 120 | 150 | 100 | 280 | 380 |
| 2.00 ~ 2.05 | - | 80 | 120 | - | 240 | 350 |
| 2.10 ~ 2.25 | - | 80 | 120 | - | 240 | 330 |
| 2.30 ~ 2.45 | - | 80 | 120 | - | 240 | 310 |
| 2.50 ~ 2.75 | - | 70 | 100 | - | 220 | 290 |
| 2.80 ~ 2.95 | - | 70 | 100 | - | 220 | 270 |
| 3.00 ~ 3.05 | - | 60 | 90 | - | 200 | 270 |
| 3.10 ~ 3.95 | - | 60 | 90 | - | 200 | 250 |
| 4.00 ~ 4.95 | - | 60 | 80 | - | 180 | 230 |
| 5.00 | - | 50 | 70 | - | 160 | 210 |

* The input voltage 2.0V (Min.) is needed to operate the series. When the output voltage is less than 2.0V,

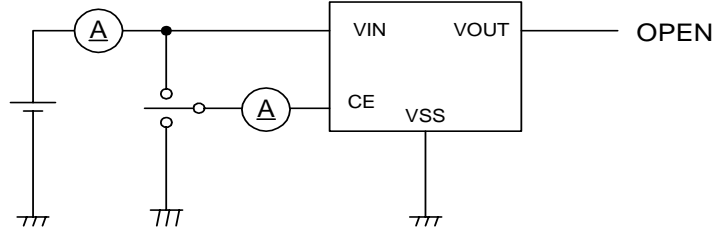
2.0V-VOUT(T) of dropout voltage is needed at minimum.

■ Test Circuits

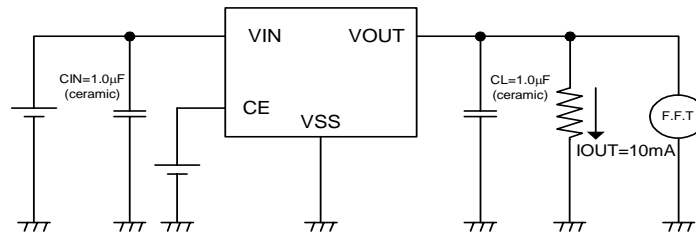
Circuit ①



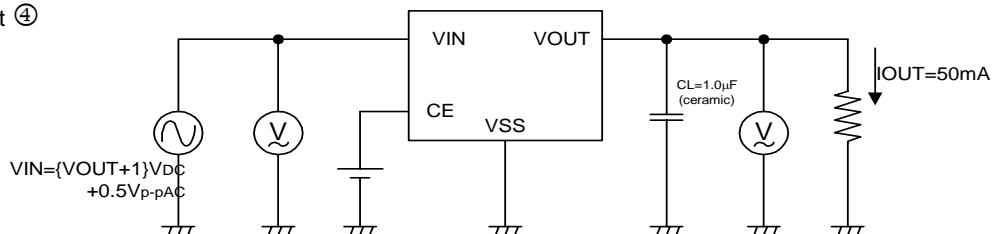
Circuit ②



Circuit ③



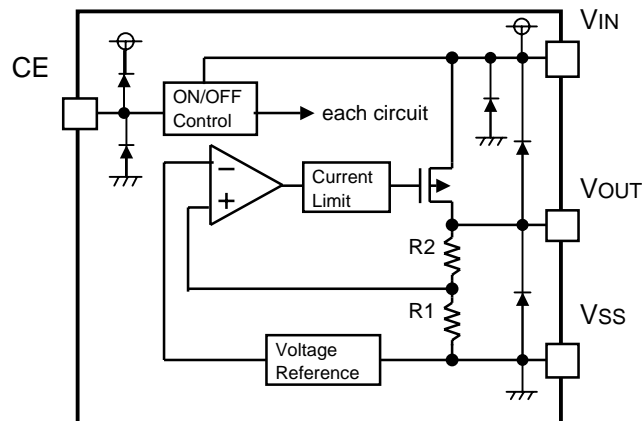
Circuit ④



■ Operational Explanation

Output voltage control with the XC6211 series:

The voltage divided by resistors R1 & R2 is compared with the internal reference voltage by the error amplifier. The P-Channel MOSFET, which is connected to the VOUT pin, is then driven by the subsequent output signal. The output voltage at the VOUT pin is controlled and stabilized by a system of negative feedback. The current limit circuit and short protect circuit operate in relation to the level of output current. Further, the IC's internal circuitry can be shutdown via the CE pin's signal.



Low ESR Capacitors

With the XC6211 series, a stable output voltage is achievable even if used with low ESR capacitors as a phase compensation circuit is built-in. In order to ensure the effectiveness of the phase compensation, we suggest that an output capacitor (CL) is connected as close as possible to the output pin (VOUT) and the VSS pin. Please use an output capacitor with a capacitance value of at least 1 μ F. Also, please connect an input capacitor (CIN) of 0.1 μ F between the VIN pin and the VSS pin in order to ensure a stable power input.

Current Limiter, Short-Circuit Protection

The XC6211 series includes a combination of a fixed current limiter circuit & a foldback circuit which aid the operations of the current limiter and circuit protection. When the load current reaches the current limit level, the fixed current limiter circuit operates and output voltage drops. As a result of this drop in output voltage, the foldback circuit operates, output voltage drops further and output current decreases. When the output pin is shorted, a current of about 50mA flows.

CE Pin

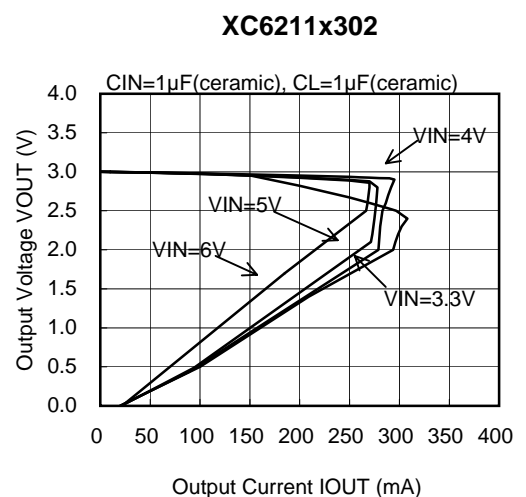
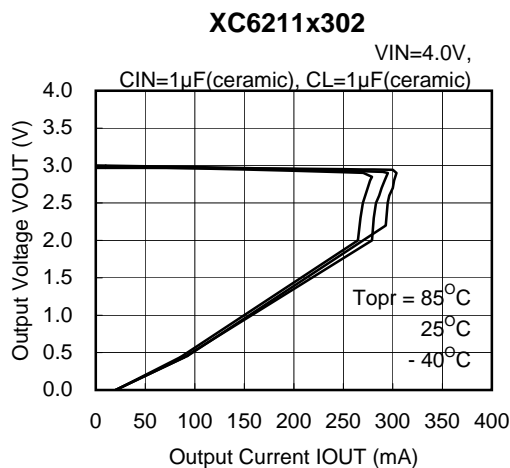
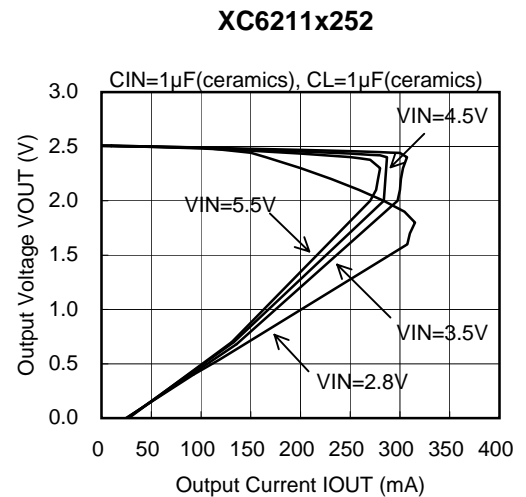
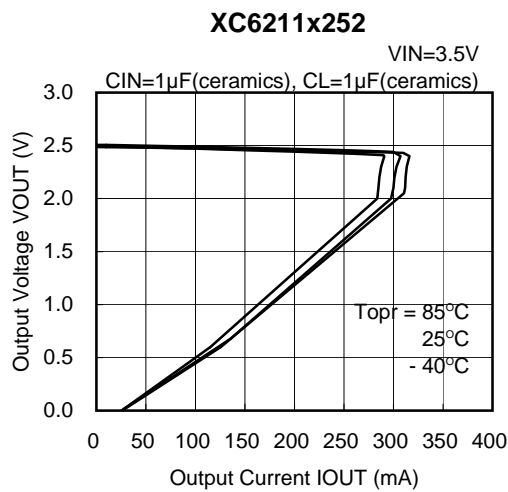
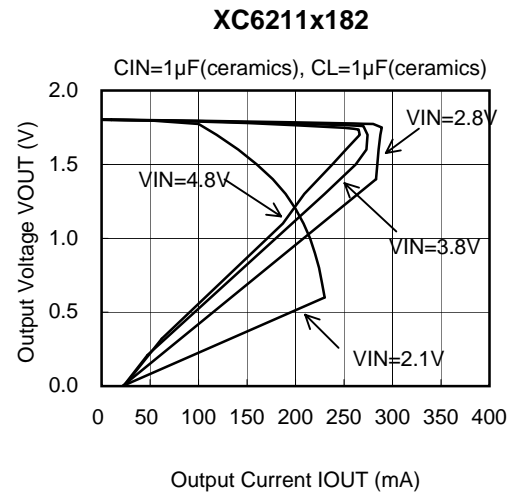
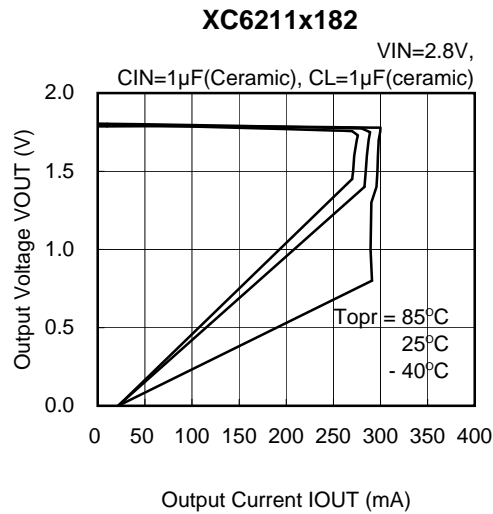
The IC's internal circuitry can be shutdown via the signal from the CE pin with the XC6211 series. In shutdown mode, output at the VOUT pin will be pulled down to the VSS level via R1 & R2. The operational logic of the IC's CE pin is selectable (please refer to the selection guide on page 3). Note that as the standard XC6211B type's regulator 1 and 2 are both 'High Active/No Pull Down', operations will become unstable with the CE pin open. Although the CE pin is equal to an inverter input with CMOS hysteresis, with either the pull-up or pull-down options, the CE pin input current will increase when the IC is in operation. We suggest that you use this IC with either a VIN voltage or a VSS voltage input at the CE pin. If this IC is used with the correct specifications for the CE pin, the operational logic is fixed and the IC will operate normally. However, supply current may increase as a result of through current in the IC's internal circuitry.

■ Notes on Use

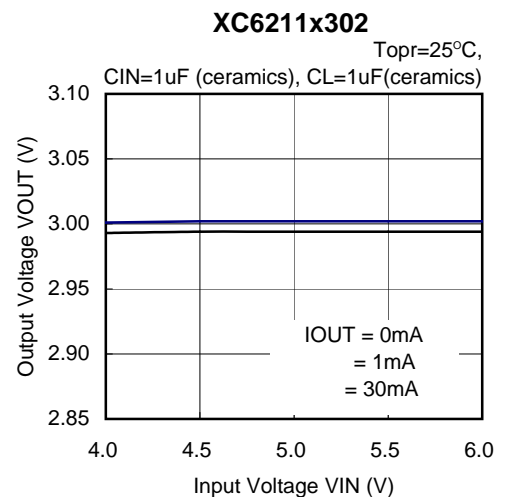
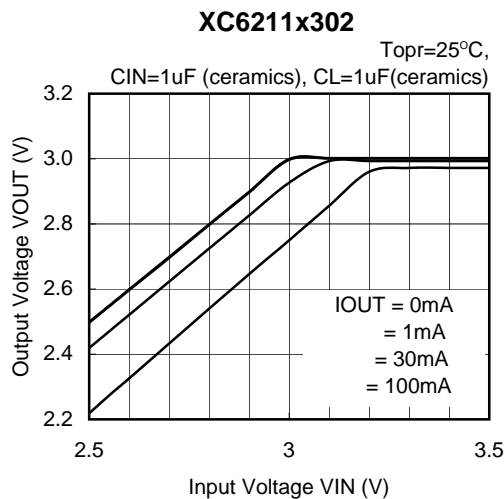
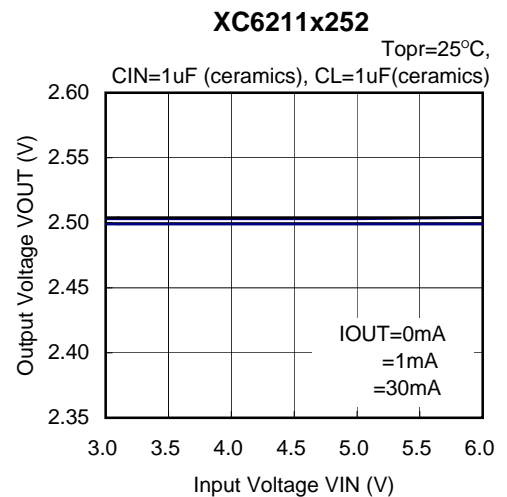
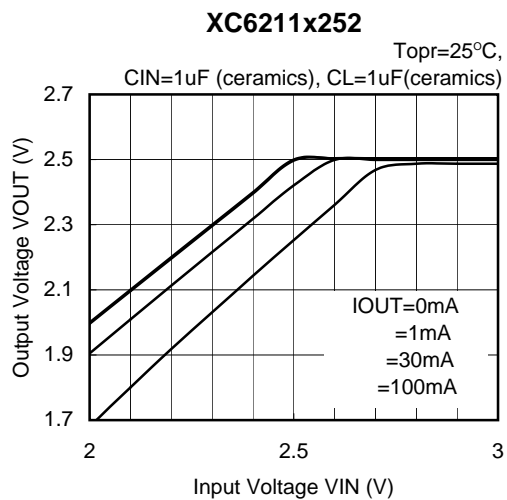
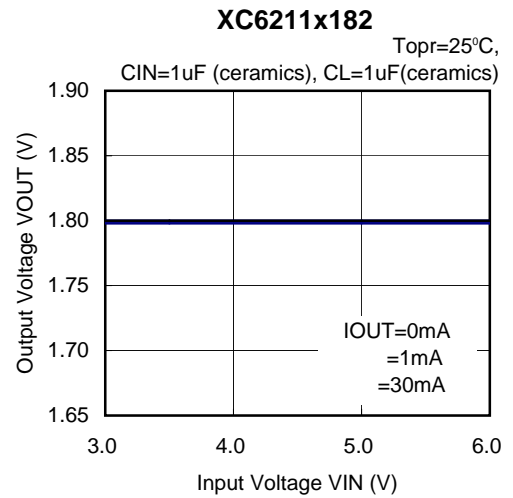
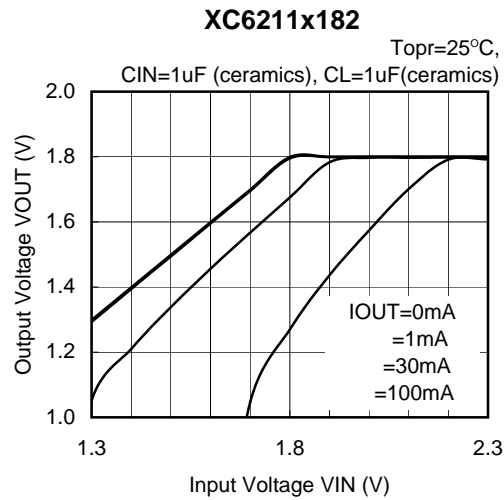
- 1 Please use this IC within the stated absolute maximum ratings.
The IC is liable to malfunction should the ratings be exceeded.
- 2 Where wiring impedance is high, operations may become unstable due to noise and/or phase lag depending on output current. Please keep the resistance low between VIN and VSS wiring in particular.
- 3 Please wire the input capacitor (CIN) and the output capacitor (CL) as close to the IC as possible.

■ Typical Performance Characteristics

(1) Output Voltage vs. Output Current

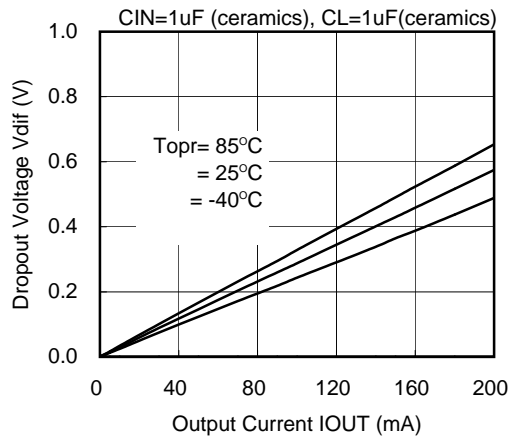


(2) Output Voltage vs. Input Voltage

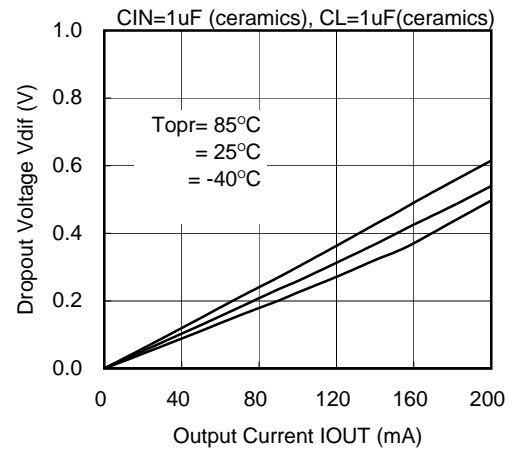


(3) Dropout Voltage vs. Output Current

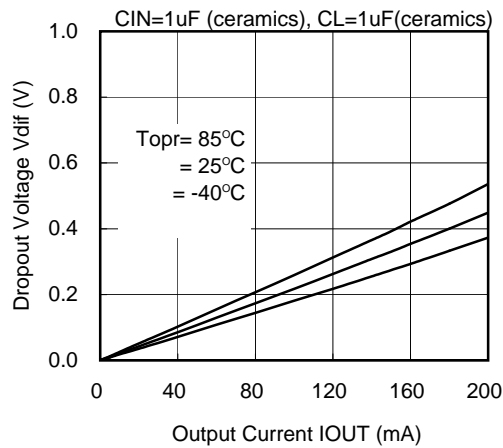
XC6211x182



XC6211x252

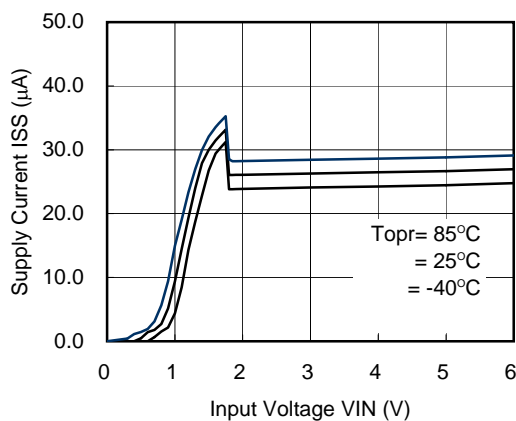


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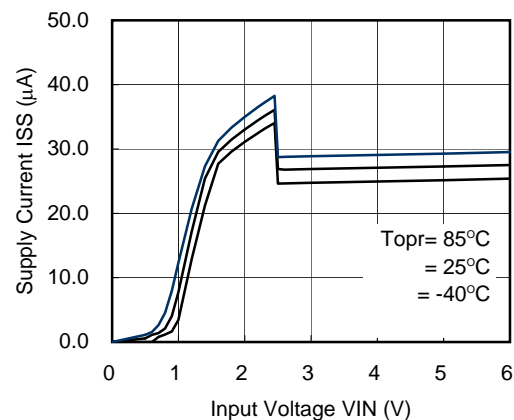


(4) Supply Current vs. Input Voltage

XC6211x182

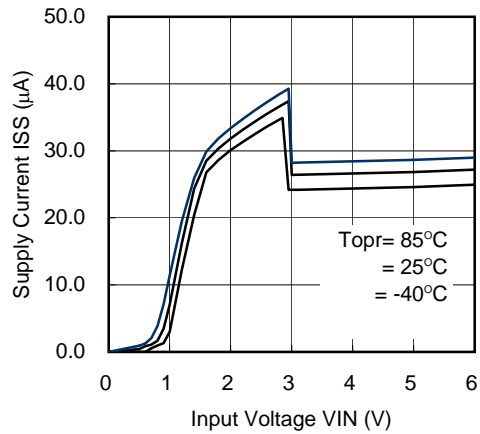


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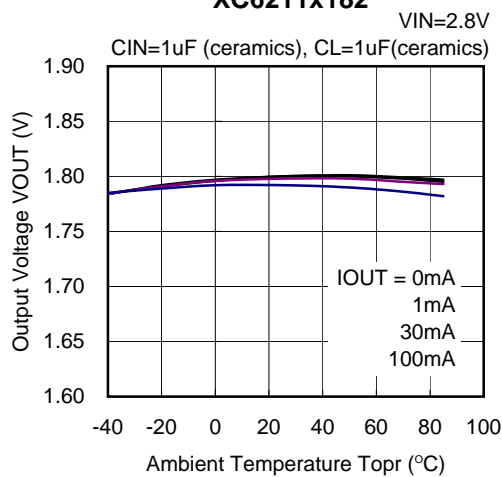
(4) Supply Current vs. Input Voltage (Continued)

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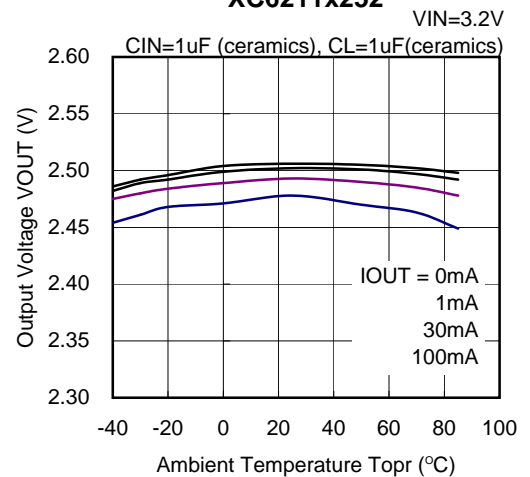


(5) Output Voltage vs. Ambient Temperature

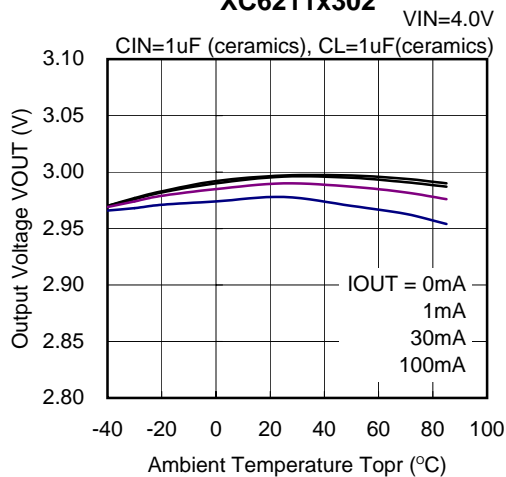
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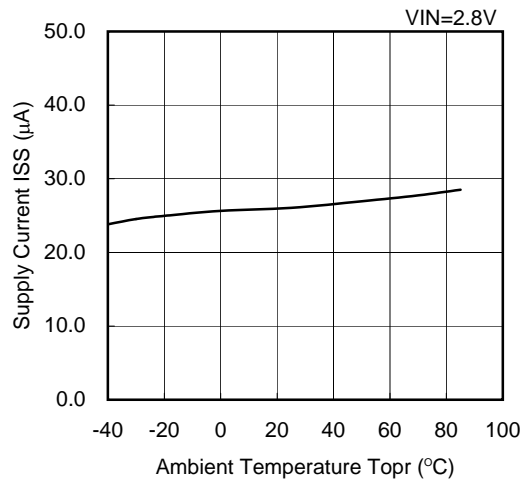


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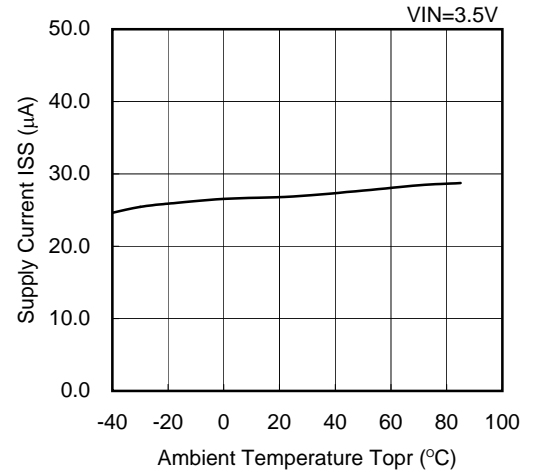


(6) Supply Current vs. Ambient Temperature

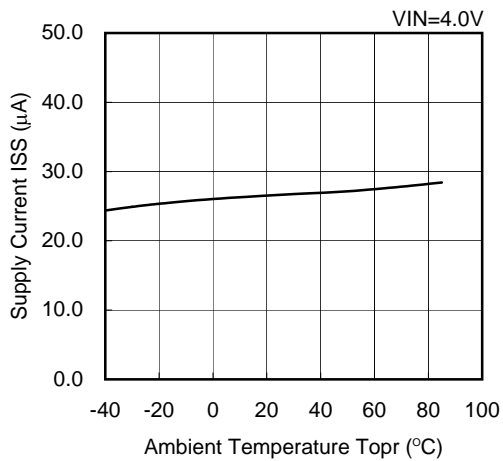
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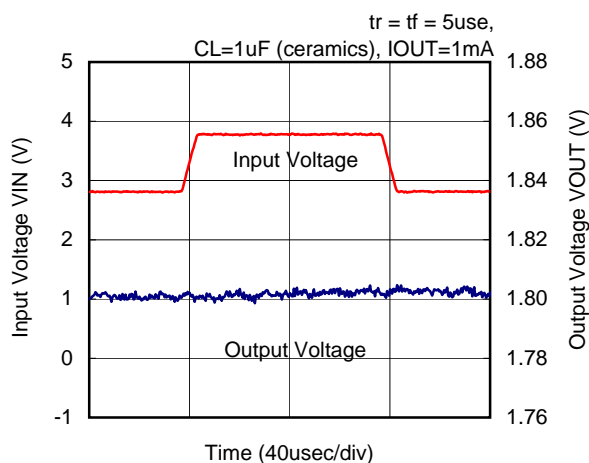


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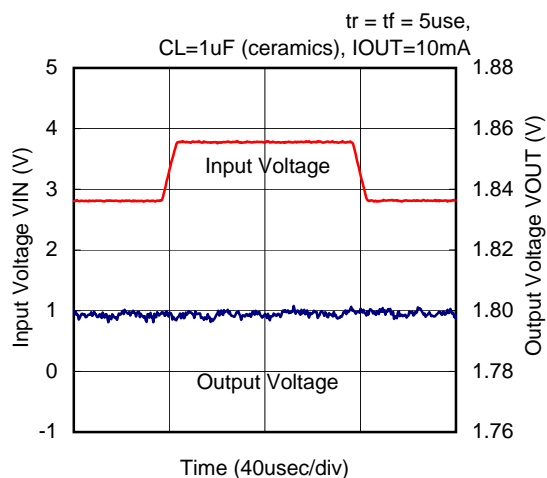


(7) Input Transient Response

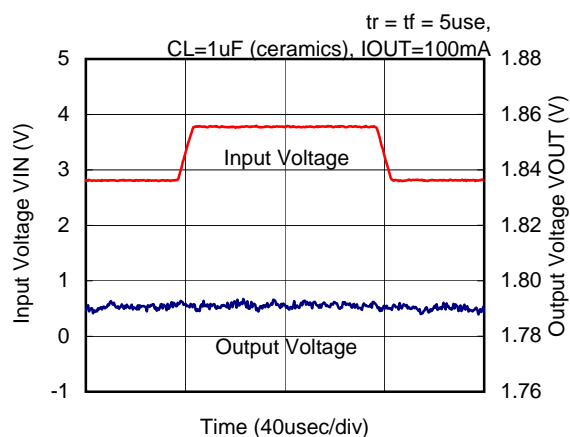
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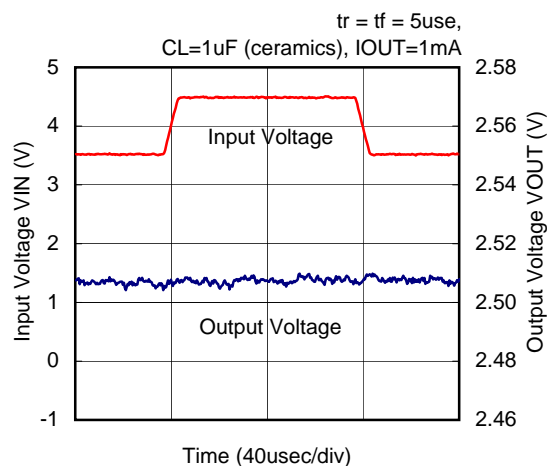
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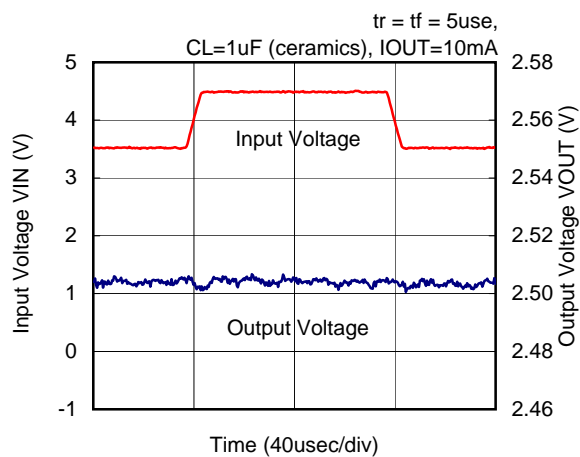
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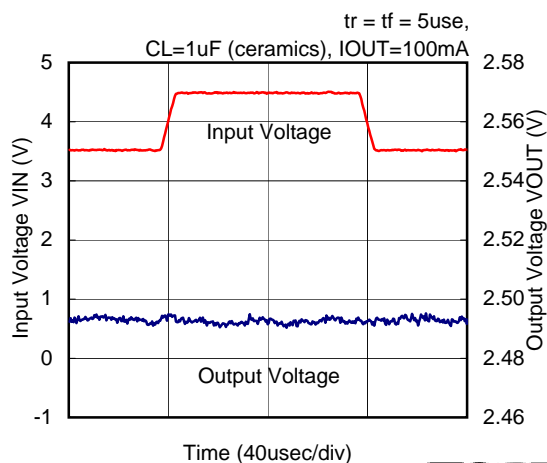
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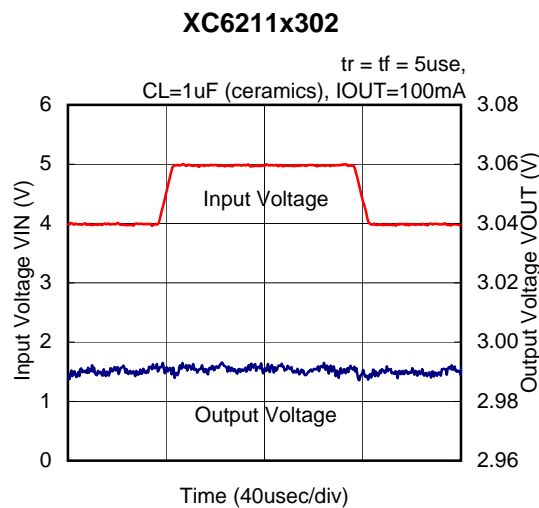
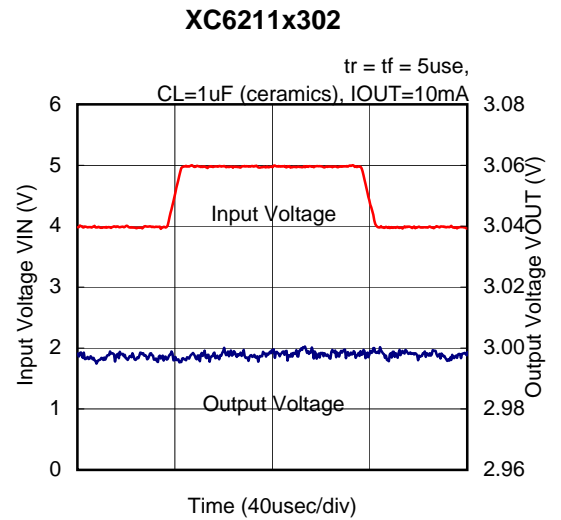
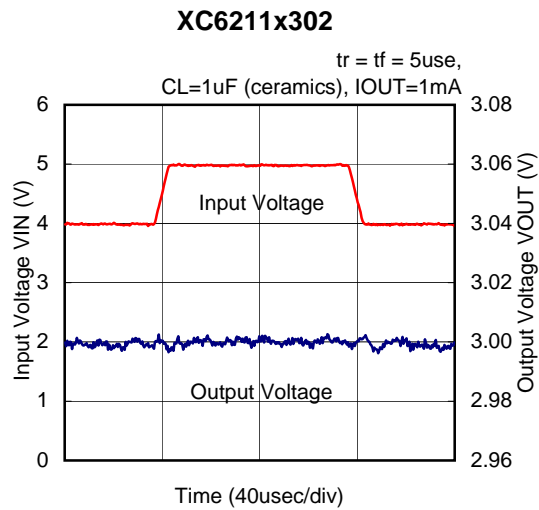
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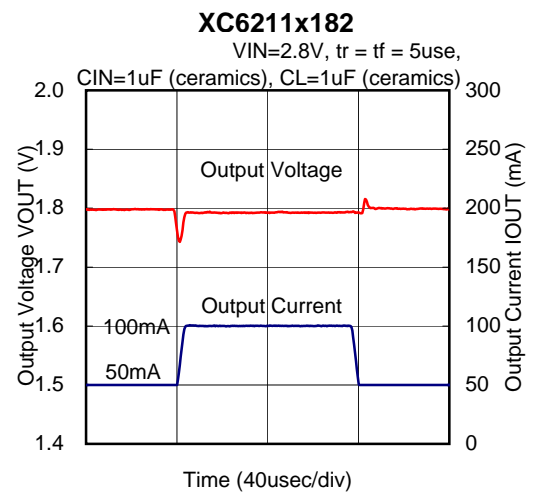
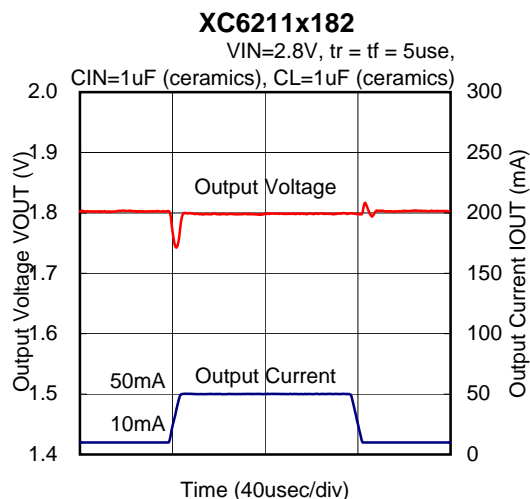
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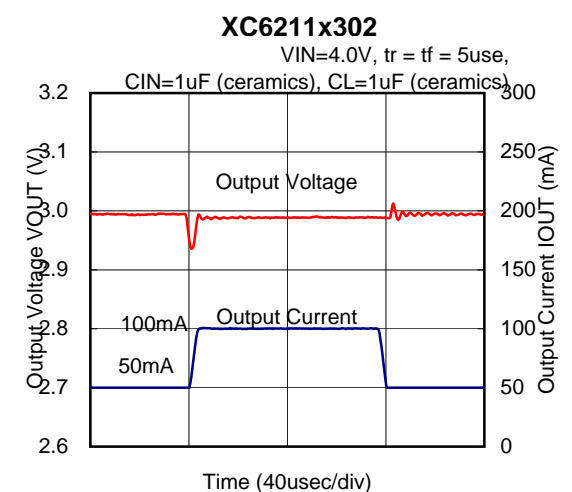
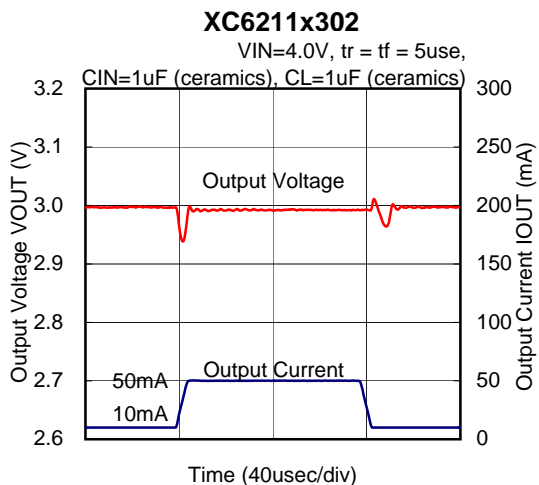
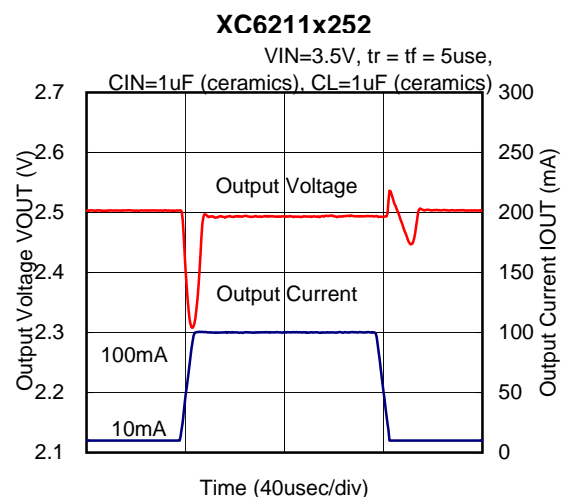
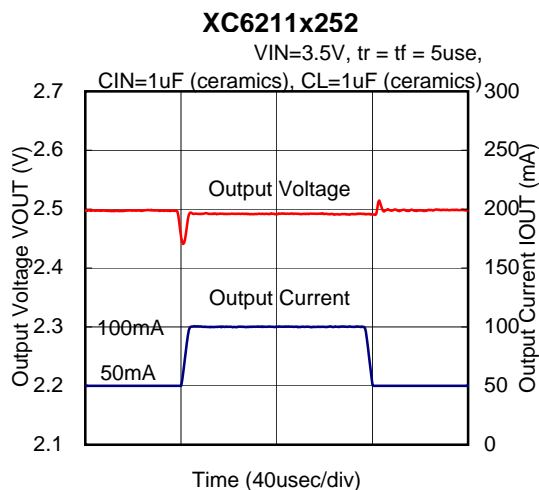
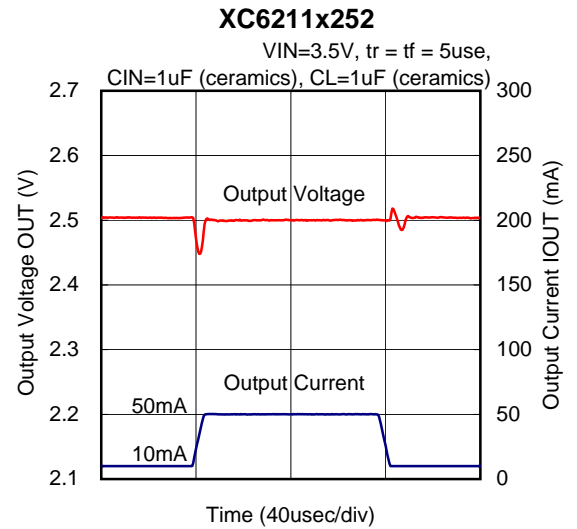
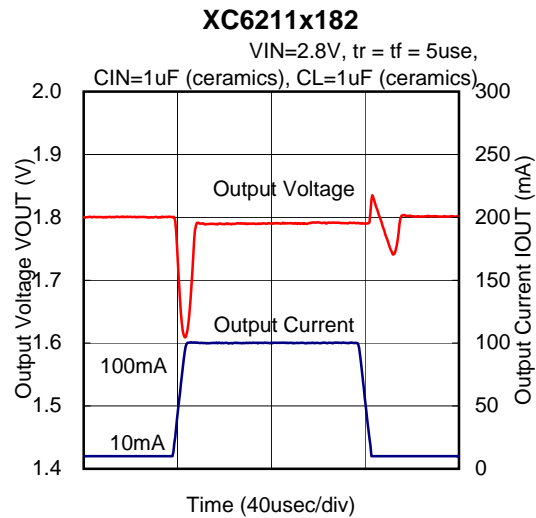
(7) Input Transient Response (Continued)



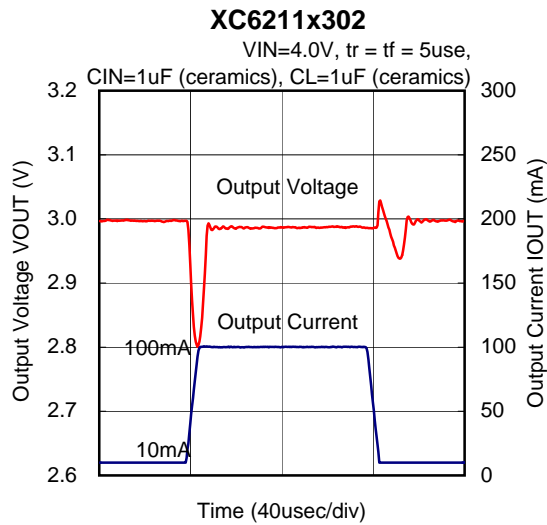
(8) Load Transient Response



(8) Load Transient Response (Continued)



(8) Load Transient Response (Continued)



(9) Ripple Rejection Rate

