

# XC6204

## Series



(Can be used with low ESR Capacitor Compatible. ON-OFF Switch) High Speed LDO Regulators

- ◆CMOS Low Power Consumption
- ◆Dropout Voltage : 60mV @ 30mA,  
200mV @ 100mA
- ◆Maximum Output Current : 150mA
- ◆Highly Accurate :  $\pm 2\%$
- ◆Output Voltage Range : 1.8V ~ 6.0V
- ◆Low ESR capacitor compatible

### General Description

The XC6204 series are highly precise, low noise, positive voltage LDO regulators manufactured using CMOS processes. The series achieves high ripple rejection and low dropout and consists of a standard voltage source, an error correction, current limiter and a phase compensation circuit plus a driver transistor.

Output voltage is selectable in 50mV increments within a range of 1.8V ~ 6.0V.

The series is also compatible with low ESR ceramic capacitors which give added output stability. This stability can be maintained even during load fluctuations due to the excellent transient response of the series.

The current limiter's foldback circuit also operates as a short protect for the output current limiter and the output pin.

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

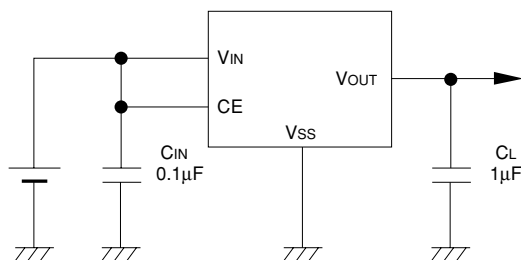
### Applications

- Mobile phones
- Cordless phones
- Cameras, video recorders
- Portable games
- Portable AV equipment
- Reference voltage
- Battery powered equipment

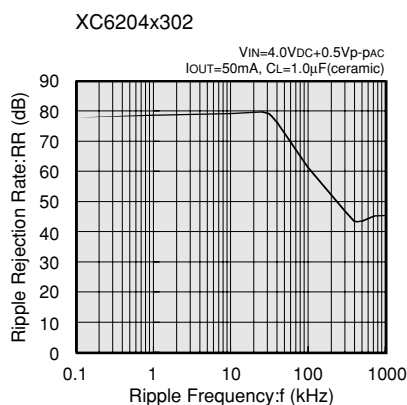
### Features

- Maximum Output Current : 150mA
- Dropout Voltage : 200mV ( $I_{OUT} = 100mA$ )
- Maximum Operating Voltage : 10V
- Output Voltage Range : 1.8V ~ 6.0V in 50mV increments
- Highly Accurate :  $\pm 2\%$
- Low Power Consumption : TYP 70 $\mu$ A
- Standby Current : less than 0.1 $\mu$ A
- High Ripple Rejection : 70dB (10 kHz)
- Low Output Noise : 30 $\mu$ Vrms
- Operational Temperature Range : -40°C ~ +85°C
- Low ESR Capacitor Compatible : Ceramic capacitor

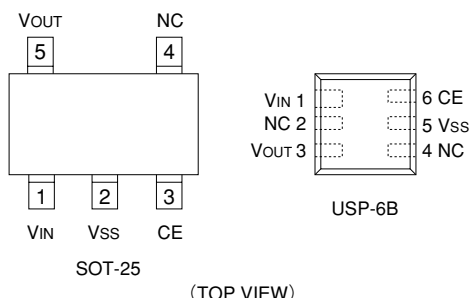
### Typical Application Circuit



### Typical Performance Characteristic



## Pin Configuration



## Pin Assignment

| PIN NUMBER |        | PIN NAME | FUNCTION       |
|------------|--------|----------|----------------|
| SOT-25     | USP-6B |          |                |
| 1          | 1      | VIN      | Input          |
| 2          | 5      | VSS      | Ground         |
| 3          | 6      | CE       | ON/OFF Control |
| 4          | 2, 4   | NC       | No Connection  |
| 5          | 3      | VOUT     | Output         |

## 3

## 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' + 300kΩ pull-down resistor built-in <between CE-VSS> (semi-custom)
- Active 'Low' + no pull-up resistor built-in (semi-custom)
- Active 'Low' + 300kΩ pull-up resistor built-in <between CE-VSS> (semi-custom)

Note: \*With the pull-up resistor or pull-down resistor built-in types, the supply current during operation will increase by  $V_{IN} / 300k\Omega$  (TYP.)

### Ordering Information

XC6204 ①②③④⑤⑥

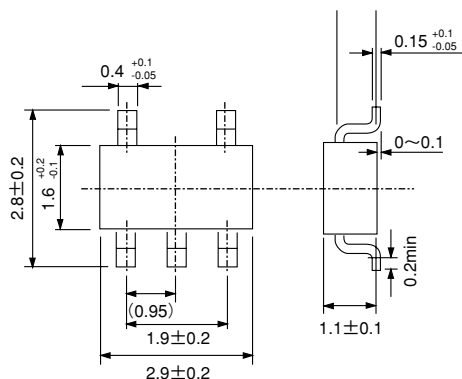
| DESIGNATOR | SYMBOL       | DESCRIPTION                                                                         |
|------------|--------------|-------------------------------------------------------------------------------------|
| ①          | A            | Active 'High' (pull-down resistor built 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)                                         |
| ②③         | 18~16        | Output Voltage :<br>e.g. 20 = 2.0V, 30 = 3.0V etc.                                  |
| ④          | 2            | Output Voltage : 100mV increments, ± 2% accuracy<br>e.g. ②=3, ③=8, ④=2 ⇒ 3.8V, ± 2% |
|            | 1<br>(Note1) | Output Voltage : 100mV increments, ± 1% accuracy<br>e.g. ②=3, ③=0, ④=1 ⇒ 3.0V, ± 1% |
|            | A            | Output Voltage : 50mV increments, ± 2% accuracy<br>e.g. ②=3, ③=8, ④=A ⇒ 3.85V       |
|            | B<br>(Note1) | Output Voltage : 50mV increments, ± 1% accuracy<br>e.g. ②=3, ③=0, ④=B ⇒ 3.05V, ± 1% |
| ⑤          | M            | SOT-25                                                                              |
|            | D            | USP-6B                                                                              |
| ⑥          | R            | Embossed Tape : Standard Feed                                                       |
|            | L            | Embossed Tape : Reverse Feed                                                        |

Please note that the "B" version is the standard part. The A, C, & D versions are semi-custom parts.

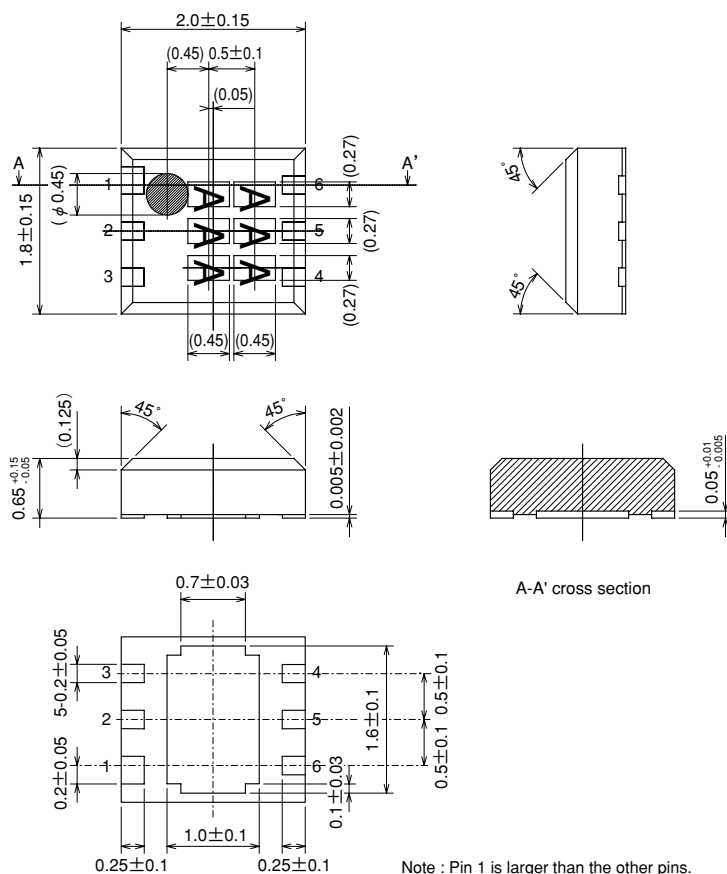
Note 1 : The output voltage range of the ±1% accuracy product is 3.0V ~ 6.0V.

## ■ Packaging Information

### ● SOT-25

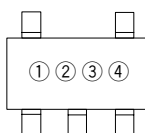


### ● USP-6B



## ■ Marking

### ● SOT-25



SOT-25  
(TOP VIEW)

① Represents the product name

| DESIGNATOR | PRODUCT NAME     |
|------------|------------------|
| 4          | XC6204 * * * M * |

② Represents the type of regulator

| DESIGNATOR                |                  |                          |                    | PRODUCT NAME   |
|---------------------------|------------------|--------------------------|--------------------|----------------|
| Output Voltage 100mV step |                  | Output Voltage 50mV step |                    |                |
| Voltage =0.1~3.0V         | Voltage=3.1~6.0V | Voltage=0.15~3.05V       | Voltage=3.15~6.05V |                |
| V                         | A                | E                        | L                  | XC6204A* * *M* |
| X                         | B                | F                        | M                  | XC6204B* * *M* |
| Y                         | C                | H                        | N                  | XC6204C* * *M* |
| Z                         | D                | K                        | P                  | XC6204D* * *M* |

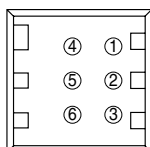
③ Represents the output voltage

| DESIGNATOR | Output Voltage (V) |     |   |      | DESIGNATOR | Output Voltage (V) |     |      |      |
|------------|--------------------|-----|---|------|------------|--------------------|-----|------|------|
| 0          | —                  | 3.1 | — | 3.15 | F          | 1.6                | 4.6 | 1.65 | 4.65 |
| 1          | —                  | 3.2 | — | 3.25 | H          | 1.7                | 4.7 | 1.75 | 4.75 |
| 2          | —                  | 3.3 | — | 3.35 | K          | 1.8                | 4.8 | 1.85 | 4.85 |
| 3          | —                  | 3.4 | — | 3.45 | L          | 1.9                | 4.9 | 1.95 | 4.95 |
| 4          | —                  | 3.5 | — | 3.55 | M          | 2.0                | 5.0 | 2.05 | 5.05 |
| 5          | —                  | 3.6 | — | 3.65 | N          | 2.1                | 5.1 | 2.15 | 5.15 |
| 6          | —                  | 3.7 | — | 3.75 | P          | 2.2                | 5.2 | 2.25 | 5.25 |
| 7          | —                  | 3.8 | — | 3.85 | R          | 2.3                | 5.3 | 2.35 | 5.35 |
| 8          | —                  | 3.9 | — | 3.95 | S          | 2.4                | 5.4 | 2.45 | 5.45 |
| 9          | —                  | 4.0 | — | 4.05 | T          | 2.5                | 5.5 | 2.55 | 5.55 |
| A          | —                  | 4.1 | — | 4.15 | U          | 2.6                | 5.6 | 2.65 | 5.65 |
| B          | —                  | 4.2 | — | 4.25 | V          | 2.7                | 5.7 | 2.75 | 5.75 |
| C          | —                  | 4.3 | — | 4.35 | X          | 2.8                | 5.8 | 2.85 | 5.85 |
| D          | —                  | 4.4 | — | 4.45 | Y          | 2.9                | 5.9 | 2.95 | 5.95 |
| E          | —                  | 4.5 | — | 4.55 | Z          | 3.0                | 6.0 | 3.05 | 6.05 |

④ Denotes the production lot number

0 to 9, A to Z repeated (G, I, J, O, Q, W excepted)

●USP-6B



USP6B  
(TOP VIEW)

①② Represents the product name

| DESIGNATOR |   | PRODUCT NAME       |
|------------|---|--------------------|
| ①          | ② |                    |
| 0          | 4 | XC6204 * * * * D * |

③ Represents the type of regulator

| DESIGNATOR | Type                                                 | PRODUCT NAME      |
|------------|------------------------------------------------------|-------------------|
| A          | CE pin, Active 'High' pull-down resistor built in    | XC6204A * * * D * |
| B          | CE pin, Active 'High' no pull-down resistor built in | XC6204B * * * D * |
| C          | CE pin, Active 'High' pull-up resistor built in      | XC6204C * * * D * |
| D          | CE pin, Active 'High' no pull-up resistor built in   | XC6204D * * * D * |

④ Represents the integer of the Output Voltage

| DESIGNATOR | VOLTAGE (V) | PRODUCT NAME       |
|------------|-------------|--------------------|
| 3          | 3.X         | XC6204 * 3 * * D * |
| 5          | 5.X         | XC6204 * 5 * * D * |

⑤ Represents the decimal number of Output Voltage

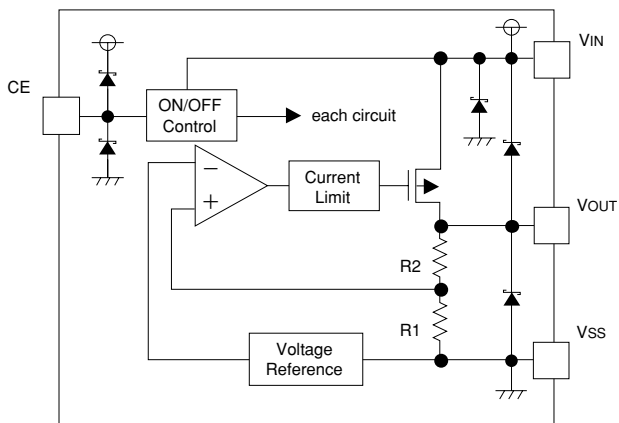
| DESIGNATOR | VOLTAGE (V) | PRODUCT NAME       | DESIGNATOR | VOLTAGE (V) | PRODUCT NAME     |
|------------|-------------|--------------------|------------|-------------|------------------|
| 0          | X.0         | XC6204 * * 0 * D * | A          | X.05        | XC6204 * * 0AD * |
| 1          | X.1         | XC6204 * * 1 * D * | B          | X.15        | XC6204 * * 1AD * |
| 2          | X.2         | XC6204 * * 2 * D * | C          | X.25        | XC6204 * * 2AD * |
| 3          | X.3         | XC6204 * * 3 * D * | D          | X.35        | XC6204 * * 3AD * |
| 4          | X.4         | XC6204 * * 4 * D * | E          | X.45        | XC6204 * * 4AD * |
| 5          | X.5         | XC6204 * * 5 * D * | F          | X.55        | XC6204 * * 5AD * |
| 6          | X.6         | XC6204 * * 6 * D * | H          | X.65        | XC6204 * * 6AD * |
| 7          | X.7         | XC6204 * * 7 * D * | K          | X.75        | XC6204 * * 7AD * |
| 8          | X.8         | XC6204 * * 8 * D * | L          | X.85        | XC6204 * * 8AD * |
| 9          | X.9         | XC6204 * * 9 * D * | M          | X.95        | XC6204 * * 9AD * |

⑥ Denotes the production lot number

0 to 9, A to Z repeated(G.I.J.O.Q.W excepted)

Note : Character inversion is not used.

## ■ Block Diagram



The diode in the circuit above is the protective diode.

### ■ Absolute Maximum Ratings

| PARAMETER                       |        | SYMBOL | RATINGS         | UNITS |
|---------------------------------|--------|--------|-----------------|-------|
| Input Voltage                   |        | VIN    | 12              | V     |
| Output Current                  |        | IOUT   | 500             | mA    |
| Output Voltage                  |        | VOUT   | VSS-0.3~VIN+0.3 | V     |
| CE Input Voltage                |        | VCE    | VSS-0.3~VIN+0.3 | V     |
| Power Dissipation               | SOT-25 | Pd     | 250             | mW    |
|                                 | USP-6B |        | 100             |       |
| Operational Ambient Temperature |        | Topr   | -40~+85         | °C    |
| Storage Temperature             |        | Tstg   | -55~+125        | °C    |

※ IOUT= the range of Pd/ (VIN-VOUT)

## Electrical Characteristics

| XC6204A, B Series                    |                                                       |                                                                                           |         |                      |                 |               |                      |                 |                   |         |
|--------------------------------------|-------------------------------------------------------|-------------------------------------------------------------------------------------------|---------|----------------------|-----------------|---------------|----------------------|-----------------|-------------------|---------|
| PARAMETER                            | SYMBOL                                                | CONDITIONS                                                                                | Ta=25°C |                      |                 | -40°C≤Ta≤85°C |                      |                 | UNITS             | CIRCUIT |
|                                      |                                                       |                                                                                           | MIN.    | TYP.                 | MAX.            | MIN.          | TYP.                 | MAX.            |                   |         |
| Output Voltage                       | V <sub>OUT</sub> (E)                                  | I <sub>OUT</sub> =30mA                                                                    | ×0.98   | V <sub>OUT</sub> (T) | ×1.02           | ×0.97         | V <sub>OUT</sub> (T) | ×1.03           | V                 | 1       |
| Maximum Output Current               | I <sub>OUT</sub> MAX                                  |                                                                                           | 150     |                      |                 | 150           |                      |                 | mA                | 1       |
| Load Regulation                      | ΔV <sub>OUT</sub>                                     | 1mA≤I <sub>OUT</sub> ≤100mA                                                               |         | 15                   | 50              |               | 30                   | 80              | mV                | 1       |
| Dropout Voltage                      | V <sub>dif1</sub>                                     | I <sub>OUT</sub> =30mA                                                                    | E-1     |                      |                 |               |                      |                 | mV                | 1       |
|                                      | V <sub>dif2</sub>                                     | I <sub>OUT</sub> =100mA                                                                   | E-2     |                      |                 |               |                      |                 | mV                |         |
| Supply Current (A series)            | I <sub>DD</sub>                                       | V <sub>IN</sub> =V <sub>CE</sub> =V <sub>OUT</sub> (T)+1.0V                               | 50      | 80                   | 120             | 50            | 90                   | 145             | μA                | 2       |
| Supply Current (B series)            |                                                       | V <sub>IN</sub> =V <sub>CE</sub> =V <sub>OUT</sub> (T)+1.0V                               | 40      | 70                   | 100             | 40            | 80                   | 120             |                   |         |
| Standby Current                      | I <sub>stby</sub>                                     | V <sub>IN</sub> =V <sub>OUT</sub> (T)+1.0V, V <sub>CE</sub> =V <sub>SS</sub>              |         | 0.01                 | 0.10            |               | 0.05                 | 1.00            | μA                | 2       |
| Line Regulation                      | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$  | V <sub>OUT</sub> (T)+1.0V≤V <sub>IN</sub> ≤10V<br>I <sub>OUT</sub> =30mA                  |         | 0.01                 | 0.20            |               | 0.05                 | 0.30            | %/V               | 1       |
| Input Voltage                        | V <sub>IN</sub>                                       |                                                                                           | 2       |                      | 10              | 2             |                      | 10              | V                 | —       |
| Output Voltage Temp. Characteristics | $\frac{\Delta V_{OUT}}{\Delta T_{opr} \cdot V_{OUT}}$ | I <sub>OUT</sub> =30mA<br>-40°C≤T <sub>opr</sub> ≤85°C                                    |         | 100                  |                 |               |                      |                 | ppm/°C            | 1       |
| Output Noise                         | e <sub>n</sub>                                        | I <sub>OUT</sub> =10mA<br>300Hz~50kHz                                                     |         | 30                   |                 |               |                      |                 | μV <sub>rms</sub> | 3       |
| Ripple Rejection Rate                | PSRR                                                  | V <sub>IN</sub> =[V <sub>OUT</sub> (T)+1.0]V+1.0Vp-pac<br>I <sub>OUT</sub> =50mA, f=10kHz |         | 70                   |                 |               |                      |                 | dB                | 4       |
| Current Limiter                      | I <sub>lim</sub>                                      | V <sub>IN</sub> =V <sub>OUT</sub> (T)+1.0V, V <sub>CE</sub> =V <sub>IN</sub>              |         | 300                  |                 |               | 280                  |                 | mA                | 1       |
| Short-circuit Current                | I <sub>short</sub>                                    | V <sub>IN</sub> =V <sub>OUT</sub> (T)+1.0V, V <sub>CE</sub> =V <sub>IN</sub>              |         | 50                   |                 |               | 60                   |                 | mA                | 1       |
| CE "High" Voltage                    | V <sub>CEH</sub>                                      |                                                                                           | 1.6     |                      | V <sub>IN</sub> | 1.7           |                      | V <sub>IN</sub> | V                 | 1       |
| CE "Low" Voltage                     | V <sub>CEL</sub>                                      |                                                                                           |         |                      | 0.25            |               |                      | 0.20            | V                 | 1       |
| CE "High" Current (A series)         | I <sub>CEH</sub>                                      | V <sub>IN</sub> =V <sub>CE</sub> =V <sub>OUT</sub> (T)+1.0V                               | -0.10   |                      | 20              | -0.15         |                      | 25              | μA                | 2       |
| CE "High" Current (B series)         | I <sub>CEH</sub>                                      | V <sub>IN</sub> =V <sub>CE</sub> =V <sub>OUT</sub> (T)+1.0V                               | -0.10   |                      | 0.10            | -0.15         |                      | 0.15            | μA                | 2       |
| CE "Low" Current                     | I <sub>CEL</sub>                                      | V <sub>IN</sub> =V <sub>OUT</sub> (T)+1.0V, V <sub>CE</sub> =V <sub>SS</sub>              | -0.10   |                      | 0.10            | -0.15         |                      | 0.15            | μA                | 2       |

### Note

(NOTE 1) Unless otherwise stated, V<sub>IN</sub>=V<sub>OUT</sub>(T)+1.0V

(NOTE 2) V<sub>OUT</sub>(T)=Specified Output Voltage

(NOTE 3) V<sub>OUT</sub>(E)=Effective Output Voltage (I.e. the output voltage when "V<sub>OUT</sub>(T)+1.0V" is provided at the V<sub>IN</sub> pin while maintaining a certain I<sub>OUT</sub> value).

(NOTE 4) V<sub>dif</sub>=V<sub>IN1</sub>(NOTE6)-V<sub>OUT1</sub>(NOTE5)

(NOTE 5) V<sub>OUT1</sub>=A voltage equal to 98% of the Output Voltage whenever an amply stabilized I<sub>OUT</sub> {V<sub>OUT</sub>(T)+1.0V} is input.

(NOTE 6) V<sub>IN1</sub>=The Input Voltage when V<sub>OUT1</sub> appears as Input Voltage is gradually decreased.

(NOTE 7) The values for -40°C≤T<sub>opr</sub>≤85°C are designed values.

| XC6204C, D Series                    |                                                       |                                                                                                       |         |                      |                 |               |                      |                 |                   |         |
|--------------------------------------|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------|---------|----------------------|-----------------|---------------|----------------------|-----------------|-------------------|---------|
| PARAMETER                            | SYMBOL                                                | CONDITIONS                                                                                            | Ta=25°C |                      |                 | -40°C≤Ta≤85°C |                      |                 | UNITS             | CIRCUIT |
|                                      |                                                       |                                                                                                       | MIN.    | TYP.                 | MAX.            | MIN.          | TYP.                 | MAX.            |                   |         |
| Output Voltage                       | V <sub>OUT</sub> (E)                                  | I <sub>OUT</sub> =30mA                                                                                | ×0.98   | V <sub>OUT</sub> (T) | ×1.02           | ×0.97         | V <sub>OUT</sub> (T) | ×1.03           | V                 | 1       |
| Maximum Output Current               | I <sub>OUT</sub> MAX                                  |                                                                                                       | 150     |                      |                 | 150           |                      |                 | mA                | 1       |
| Load Regulation                      | ΔV <sub>OUT</sub>                                     | 1mA≤I <sub>OUT</sub> ≤100mA                                                                           |         | 15                   | 50              |               | 30                   | 80              | mV                | 1       |
| Dropout Voltage                      | V <sub>dif1</sub>                                     | I <sub>OUT</sub> =30mA                                                                                | E-1     |                      |                 |               |                      |                 | mV                | 1       |
|                                      | V <sub>dif2</sub>                                     | I <sub>OUT</sub> =100mA                                                                               | E-2     |                      |                 |               |                      |                 | mV                |         |
| Supply Current (C series)            | I <sub>DD</sub>                                       | V <sub>IN</sub> =V <sub>OUT</sub> (T)+1.0V, V <sub>CE</sub> =V <sub>SS</sub>                          | 50      | 80                   | 120             | 50            | 90                   | 145             | μA                | 2       |
| Supply Current (D series)            |                                                       | V <sub>IN</sub> =V <sub>OUT</sub> (T)+1.0V, V <sub>CE</sub> =V <sub>SS</sub>                          | 40      | 70                   | 100             | 40            | 80                   | 120             |                   |         |
| Standby Current                      | I <sub>stby</sub>                                     | V <sub>IN</sub> =V <sub>CE</sub> =V <sub>OUT</sub> (T)+1.0V                                           |         | 0.01                 | 0.10            |               | 0.05                 | 1.00            | μA                | 2       |
| Line Regulation                      | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$  | V <sub>OUT</sub> (T)+1.0V≤V <sub>IN</sub> ≤10V<br>I <sub>OUT</sub> =30mA                              |         | 0.01                 | 0.20            |               | 0.05                 | 0.30            | %/V               | 1       |
| Input Voltage                        | V <sub>IN</sub>                                       |                                                                                                       | 2       |                      | 10              | 2             |                      | 10              | V                 | —       |
| Output Voltage Temp. Characteristics | $\frac{\Delta V_{OUT}}{\Delta T_{opr} \cdot V_{OUT}}$ | I <sub>OUT</sub> =30mA<br>-40°C≤T <sub>opr</sub> ≤85°C                                                |         | 100                  |                 |               |                      |                 | ppm/°C            | 1       |
| Output Noise                         | e <sub>n</sub>                                        | I <sub>OUT</sub> =10mA<br>300Hz~50kHz                                                                 |         | 30                   |                 |               |                      |                 | μV <sub>rms</sub> | 3       |
| Ripple Rejection Rate                | PSRR                                                  | V <sub>IN</sub> =[V <sub>OUT</sub> (T)+1.0]V+1.0V <sub>p-pAC</sub><br>I <sub>OUT</sub> =50mA, f=10kHz |         | 70                   |                 |               |                      |                 | dB                | 4       |
| Current Limiter                      | I <sub>lim</sub>                                      | V <sub>IN</sub> =V <sub>OUT</sub> (T)+1.0V, V <sub>CE</sub> =V <sub>SS</sub>                          |         | 300                  |                 |               | 280                  |                 | mA                | 1       |
| Short-circuit Current                | I <sub>short</sub>                                    | V <sub>IN</sub> =V <sub>OUT</sub> (T)+1.0V, V <sub>CE</sub> =V <sub>SS</sub>                          |         | 50                   |                 |               | 60                   |                 | mA                | 1       |
| CE "High" Voltage                    | V <sub>CEH</sub>                                      |                                                                                                       | 1.6     |                      | V <sub>IN</sub> | 1.7           |                      | V <sub>IN</sub> | V                 | 1       |
| CE "Low" Voltage                     | V <sub>CEL</sub>                                      |                                                                                                       |         |                      | 0.25            |               |                      | 0.20            | V                 | 1       |
| CE "High" Current                    | I <sub>CEH</sub>                                      | V <sub>IN</sub> =V <sub>CE</sub> =V <sub>OUT</sub> (T)+1.0V                                           | -0.10   |                      | 0.10            | -0.15         |                      | 0.15            | μA                | 2       |
| CE "Low" Current (C series)          | I <sub>CEL</sub>                                      | V <sub>IN</sub> =V <sub>OUT</sub> (T)+1.0V, V <sub>CE</sub> =V <sub>SS</sub>                          | -20     |                      | 0.10            | -25           |                      | 0.15            | μA                | 2       |
| CE "Low" Current (D series)          | I <sub>CEL</sub>                                      | V <sub>IN</sub> =V <sub>OUT</sub> (T)+1.0V, V <sub>CE</sub> =V <sub>SS</sub>                          | -0.10   |                      | 0.10            | -0.15         |                      | 0.15            | μA                | 2       |

**Note**

(NOTE 1) Unless otherwise stated, V<sub>IN</sub>=V<sub>OUT</sub>(T)+1.0V

(NOTE 2) V<sub>OUT</sub>(T)=Specified Output Voltage

(NOTE 3) V<sub>OUT</sub>(E)=Effective Output Voltage (I.e. the output voltage when "V<sub>OUT</sub>(T)+1.0V" is provided at the V<sub>IN</sub> pin while maintaining a certain I<sub>OUT</sub> value).

(NOTE 4) V<sub>dif</sub>={V<sub>IN1</sub>(NOTE6)-V<sub>OUT1</sub>(NOTE5)}

(NOTE 5) V<sub>OUT1</sub>=A voltage equal to 98% of the Output Voltage whenever an amply stabilized I<sub>OUT</sub> {V<sub>OUT</sub>(T)+1.0V} is input.

(NOTE 6) V<sub>IN1</sub>=The Input Voltage when V<sub>OUT1</sub> appears as Input Voltage is gradually decreased.

(NOTE 7) The values for -40°C≤T<sub>opr</sub>≤85°C are designed values.



## Dropout Voltage 1

| SYMBOL         | E-0                |       | E-1                                   |       |                 |       | E-2                                    |       |                 |       |
|----------------|--------------------|-------|---------------------------------------|-------|-----------------|-------|----------------------------------------|-------|-----------------|-------|
| PARAMETER      | Output Voltage (V) |       | Dropout Voltage 1 (mV)<br>(IOUT=30mA) |       |                 |       | Dropout Voltage 2 (mV)<br>(IOUT=100mA) |       |                 |       |
| OUTPUT VOLTAGE |                    |       | Ta=25°C                               |       | -40°C≤Topr≤85°C |       | Ta=25°C                                |       | -40°C≤Topr≤85°C |       |
| VOUT(T)        | VOUT               |       | Vdif1V                                | Vdif1 | Vdif1V          | Vdif1 | Vdif2V                                 | Vdif2 | Vdif2V          | Vdif2 |
|                | MIN                | MAX   | TYP                                   | MAX   | TYP             | MAX   | TYP                                    | MAX   | TYP             | MAX   |
| 1.80           | 1.764              | 1.836 | 200                                   | 210   | 210             | 230   | 300                                    | 400   | 340             | 480   |
| 1.85           | 1.813              | 1.887 | 200                                   | 210   | 210             | 230   | 300                                    | 400   | 340             | 480   |
| 1.90           | 1.862              | 1.938 | 120                                   | 150   | 130             | 170   | 280                                    | 380   | 320             | 460   |
| 1.95           | 1.911              | 1.989 | 120                                   | 150   | 130             | 170   | 280                                    | 380   | 320             | 460   |
| 2.00           | 1.960              | 2.040 | 80                                    | 120   | 90              | 140   | 240                                    | 350   | 280             | 430   |
| 2.05           | 2.009              | 2.091 | 80                                    | 120   | 90              | 140   | 240                                    | 350   | 280             | 430   |
| 2.10           | 2.058              | 2.142 | 80                                    | 120   | 90              | 140   | 240                                    | 330   | 280             | 410   |
| 2.15           | 2.107              | 2.193 | 80                                    | 120   | 90              | 140   | 240                                    | 330   | 280             | 410   |
| 2.20           | 2.156              | 2.244 | 80                                    | 120   | 90              | 140   | 240                                    | 330   | 280             | 410   |
| 2.25           | 2.205              | 2.295 | 80                                    | 120   | 90              | 140   | 240                                    | 330   | 280             | 410   |
| 2.30           | 2.254              | 2.346 | 80                                    | 120   | 90              | 140   | 240                                    | 310   | 280             | 390   |
| 2.35           | 2.303              | 2.397 | 80                                    | 120   | 90              | 140   | 240                                    | 310   | 280             | 390   |
| 2.40           | 2.352              | 2.448 | 80                                    | 120   | 90              | 140   | 240                                    | 310   | 280             | 390   |
| 2.45           | 2.401              | 2.499 | 80                                    | 120   | 90              | 140   | 240                                    | 310   | 280             | 390   |
| 2.50           | 2.450              | 2.550 | 70                                    | 100   | 80              | 120   | 220                                    | 290   | 260             | 370   |
| 2.55           | 2.499              | 2.601 | 70                                    | 100   | 80              | 120   | 220                                    | 290   | 260             | 370   |
| 2.60           | 2.548              | 2.652 | 70                                    | 100   | 80              | 120   | 220                                    | 290   | 260             | 370   |
| 2.65           | 2.597              | 2.703 | 70                                    | 100   | 80              | 120   | 220                                    | 290   | 260             | 370   |
| 2.70           | 2.646              | 2.754 | 70                                    | 100   | 80              | 120   | 220                                    | 290   | 260             | 370   |
| 2.75           | 2.695              | 2.805 | 70                                    | 100   | 80              | 120   | 220                                    | 290   | 260             | 370   |
| 2.80           | 2.744              | 2.856 | 70                                    | 100   | 80              | 120   | 220                                    | 270   | 260             | 350   |
| 2.85           | 2.793              | 2.907 | 70                                    | 100   | 80              | 120   | 220                                    | 270   | 260             | 350   |
| 2.90           | 2.842              | 2.958 | 70                                    | 100   | 80              | 120   | 220                                    | 270   | 260             | 350   |
| 2.95           | 2.891              | 3.009 | 70                                    | 100   | 80              | 120   | 220                                    | 270   | 260             | 350   |
| 3.00           | 2.940              | 3.060 | 60                                    | 90    | 70              | 110   | 200                                    | 270   | 240             | 350   |
| 3.05           | 2.989              | 3.111 | 60                                    | 90    | 70              | 110   | 200                                    | 270   | 240             | 350   |
| 3.10           | 3.038              | 3.162 | 60                                    | 90    | 70              | 110   | 200                                    | 250   | 240             | 330   |
| 3.15           | 3.087              | 3.213 | 60                                    | 90    | 70              | 110   | 200                                    | 250   | 240             | 330   |
| 3.20           | 3.136              | 3.264 | 60                                    | 90    | 70              | 110   | 200                                    | 250   | 240             | 330   |

## Dropout Voltage 2

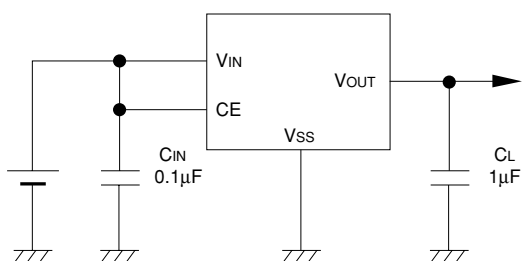
| SYMBOL               | E-0                |       | E-1                                                |                   |                   |                   | E-2                                                 |                   |                   |                   |
|----------------------|--------------------|-------|----------------------------------------------------|-------------------|-------------------|-------------------|-----------------------------------------------------|-------------------|-------------------|-------------------|
| PARAMETER            | Output Voltage (V) |       | Dropout Voltage 1 (mV)<br>(I <sub>OUT</sub> =30mA) |                   |                   |                   | Dropout Voltage 2 (mV)<br>(I <sub>OUT</sub> =100mA) |                   |                   |                   |
| OUTPUT VOLTAGE       |                    |       | Ta=25°C                                            |                   | -40°C≤Topr≤85°C   |                   | Ta=25°C                                             |                   | -40°C≤Topr≤85°C   |                   |
| V <sub>OUT</sub> (T) | V <sub>OUT</sub>   |       | V <sub>dif1</sub>                                  | V <sub>dif1</sub> | V <sub>dif1</sub> | V <sub>dif1</sub> | V <sub>dif2</sub>                                   | V <sub>dif2</sub> | V <sub>dif2</sub> | V <sub>dif2</sub> |
|                      | MIN                | MAX   | TYP                                                | MAX               | TYP               | MAX               | TYP                                                 | MAX               | TYP               | MAX               |
| 3.25                 | 3.185              | 3.315 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.30                 | 3.234              | 3.366 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.35                 | 3.283              | 3.417 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.40                 | 3.332              | 3.468 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.45                 | 3.381              | 3.519 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.50                 | 3.430              | 3.570 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.55                 | 3.479              | 3.621 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.60                 | 3.528              | 3.672 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.65                 | 3.577              | 3.723 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.70                 | 3.626              | 3.774 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.75                 | 3.675              | 3.825 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.80                 | 3.724              | 3.876 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.85                 | 3.773              | 3.927 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.90                 | 3.822              | 3.978 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 3.95                 | 3.871              | 4.029 | 60                                                 | 90                | 70                | 110               | 200                                                 | 250               | 240               | 330               |
| 4.00                 | 3.920              | 4.080 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.05                 | 3.969              | 4.131 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.10                 | 4.018              | 4.182 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.15                 | 4.067              | 4.233 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.20                 | 4.116              | 4.284 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.25                 | 4.165              | 4.335 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.30                 | 4.214              | 4.386 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.35                 | 4.263              | 4.437 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.40                 | 4.312              | 4.488 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.45                 | 4.361              | 4.539 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.50                 | 4.410              | 4.590 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.55                 | 4.459              | 4.641 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.60                 | 4.508              | 4.692 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |
| 4.65                 | 4.557              | 4.743 | 60                                                 | 80                | 70                | 100               | 180                                                 | 230               | 220               | 310               |

## Dropout Voltage 3

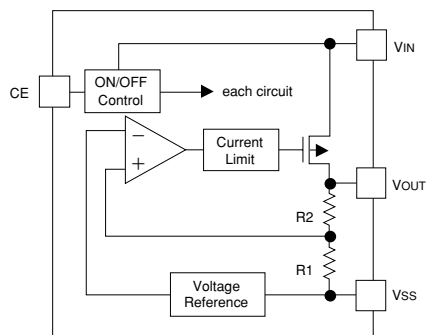
| SYMBOL               | E-0                |       | E-1                                                |                   |                              |                   | E-2                                                 |                   |                              |                   |
|----------------------|--------------------|-------|----------------------------------------------------|-------------------|------------------------------|-------------------|-----------------------------------------------------|-------------------|------------------------------|-------------------|
| PARAMETER            | Output Voltage (V) |       | Dropout Voltage 1 (mV)<br>(I <sub>OUT</sub> =30mA) |                   |                              |                   | Dropout Voltage 2 (mV)<br>(I <sub>OUT</sub> =100mA) |                   |                              |                   |
| OUTPUT VOLTAGE       |                    |       | T <sub>a</sub> =25°C                               |                   | -40°C≤T <sub>opr</sub> ≤85°C |                   | T <sub>a</sub> =25°C                                |                   | -40°C≤T <sub>opr</sub> ≤85°C |                   |
| V <sub>OUT</sub> (T) | V <sub>OUT</sub>   |       | V <sub>dif1</sub>                                  | V <sub>dif1</sub> | V <sub>dif1</sub>            | V <sub>dif1</sub> | V <sub>dif2</sub>                                   | V <sub>dif2</sub> | V <sub>dif2</sub>            | V <sub>dif2</sub> |
|                      | MIN                | MAX   | TYP                                                | MAX               | TYP                          | MAX               | TYP                                                 | MAX               | TYP                          | MAX               |
| 4.70                 | 4.606              | 4.794 | 60                                                 | 80                | 70                           | 100               | 180                                                 | 230               | 220                          | 310               |
| 4.75                 | 4.655              | 4.845 | 60                                                 | 80                | 70                           | 100               | 180                                                 | 230               | 220                          | 310               |
| 4.80                 | 4.704              | 4.896 | 60                                                 | 80                | 70                           | 100               | 180                                                 | 230               | 220                          | 310               |
| 4.85                 | 4.753              | 4.947 | 60                                                 | 80                | 70                           | 100               | 180                                                 | 230               | 220                          | 310               |
| 4.90                 | 4.802              | 4.998 | 60                                                 | 80                | 70                           | 100               | 180                                                 | 230               | 220                          | 310               |
| 4.95                 | 4.851              | 5.049 | 60                                                 | 80                | 70                           | 100               | 180                                                 | 230               | 220                          | 310               |
| 5.00                 | 4.900              | 5.100 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.05                 | 4.949              | 5.151 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.10                 | 4.998              | 5.202 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.15                 | 5.047              | 5.253 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.20                 | 5.096              | 5.304 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.25                 | 5.145              | 5.355 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.30                 | 5.194              | 5.406 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.35                 | 5.243              | 5.457 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.40                 | 5.292              | 5.508 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.45                 | 5.341              | 5.559 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.50                 | 5.390              | 5.610 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.55                 | 5.439              | 5.661 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.60                 | 5.488              | 5.712 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.65                 | 5.537              | 5.763 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.70                 | 5.586              | 5.814 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.75                 | 5.635              | 5.865 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.80                 | 5.684              | 5.916 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.85                 | 5.733              | 5.967 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.90                 | 5.782              | 6.018 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 5.95                 | 5.831              | 6.069 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |
| 6.00                 | 5.880              | 6.120 | 50                                                 | 70                | 60                           | 90                | 160                                                 | 210               | 200                          | 290               |

3

## ■ Typical Application Circuit



## Operational Explanation



Output voltage control with the XC6204 series :

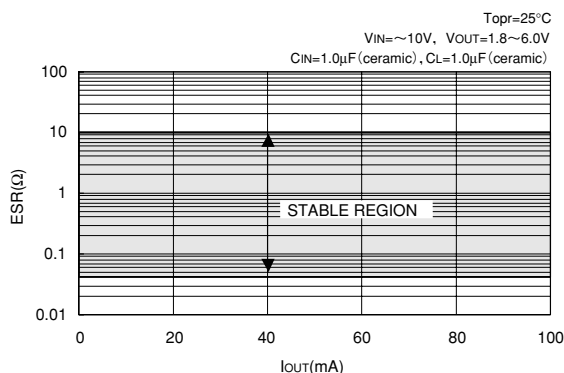
The voltage divided by resistors R1 & R2 is compared with the internal reference voltage by the error amplifier.

The P-Channel MOSFET, which is connected to the V<sub>OUT</sub> pin, is then driven by the subsequent output signal. The output voltage at the V<sub>OUT</sub> pin is controlled & stabilised 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 XC6204 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 (C<sub>L</sub>) is connected as close as possible to the output pin (V<sub>OUT</sub>) and the V<sub>SS</sub> pin. Please use an output capacitor with a capacitance value of at least 1μF. Also, please connect an input capacitor (C<sub>IN</sub>) of 0.1μF between the V<sub>IN</sub> pin and the V<sub>SS</sub> pin in order to ensure a stable power input.



### <Current Limiter, Short-Circuit Protection>

The XC6204 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 (refer to the data on page 5). When the output pin is shorted, a current of about 60mA flows.

### <CE Pin>

The IC's internal circuitry can be shutdown via the signal from the CE pin with the XC6204 series. In shutdown mode, output at the V<sub>OUT</sub> pin will be pulled down to the V<sub>SS</sub> level via R1 & R2. The operational logic of the IC's CE pin is selectable (please refer to the selection guide on page 2). Note that as the standard XC6204B type is '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 V<sub>IN</sub> voltage or a V<sub>SS</sub> voltage input at the CE pin. If this IC is used with the correct specifications for the CE pin, the IC will operate normally. However, supply current may increase as a result of through current in the IC's internal circuitry if a voltage between 0.25V and 1.5V is input.

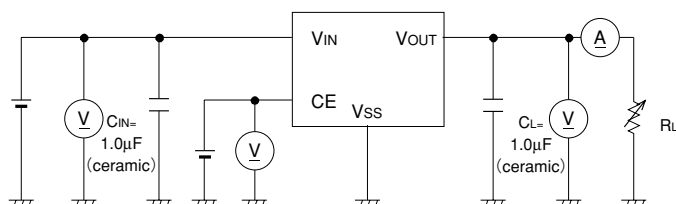
## Directions for use

### Notes on Use

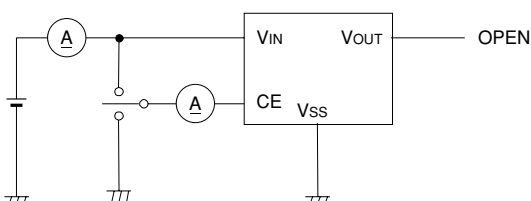
1. Please use this IC within the stated absolute maximum ratings. The IC is liable to malfunction should the ratings be exceeded.
2. Where wiring impedance is high, operations may become unstable due to noise and/or phase lag depending on output current.  
Please strengthen V<sub>IN</sub> and V<sub>SS</sub> wiring in particular.
3. Please wire the input capacitor (C<sub>IN</sub>) and the output capacitor (C<sub>L</sub>) as close to the IC as possible.

## ■ Test Circuits

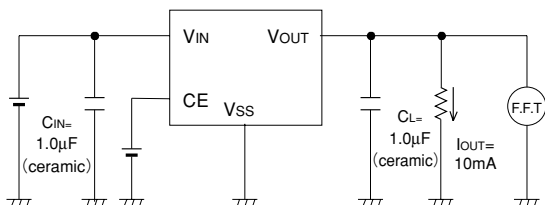
Circuit 1



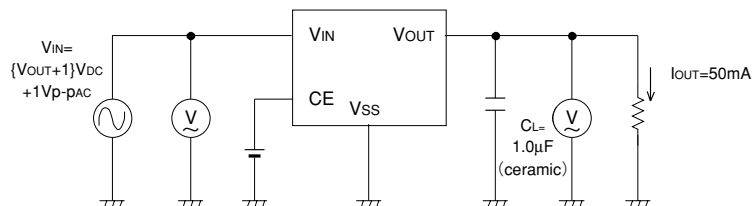
Circuit 2



Circuit 3

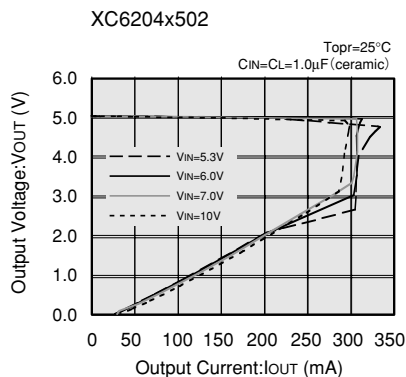
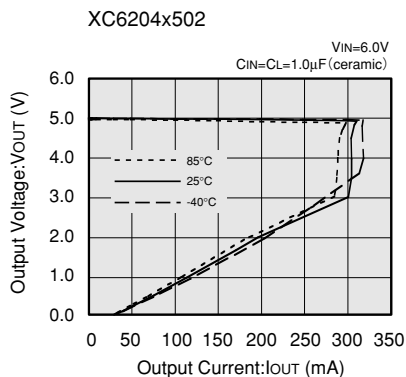
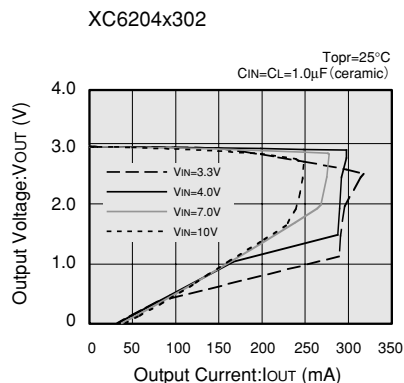
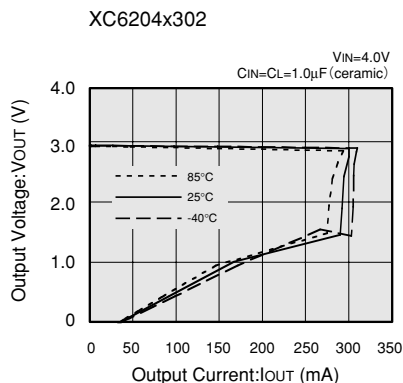
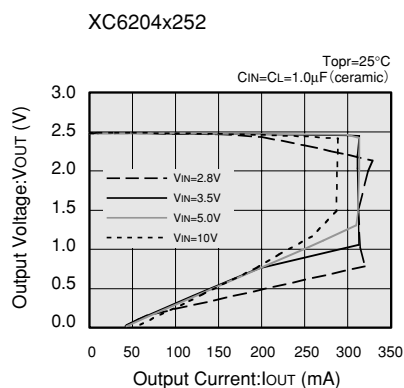
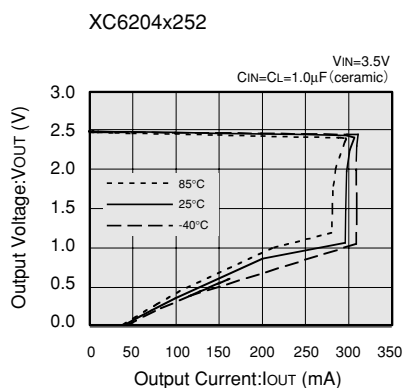
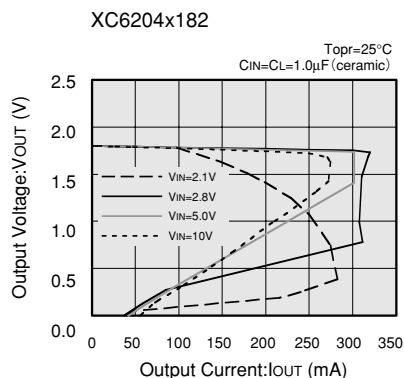
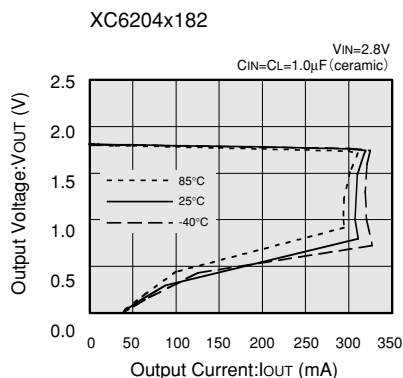


Circuit 4

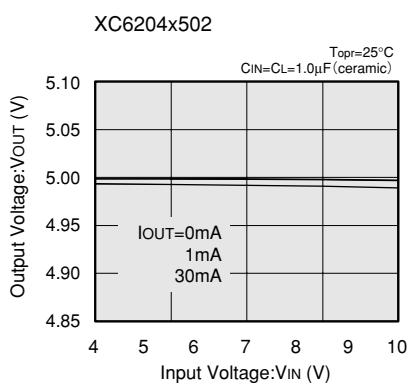
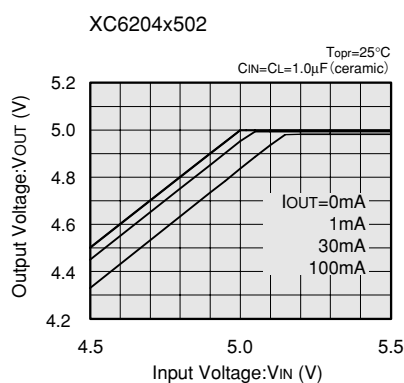
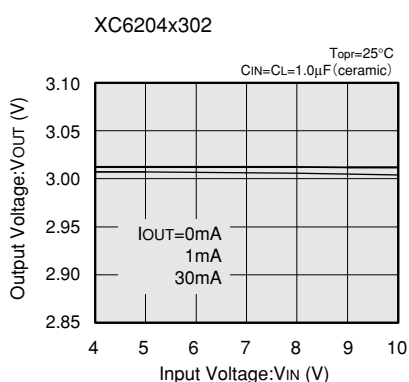
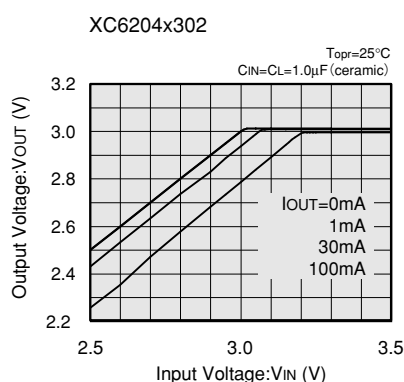
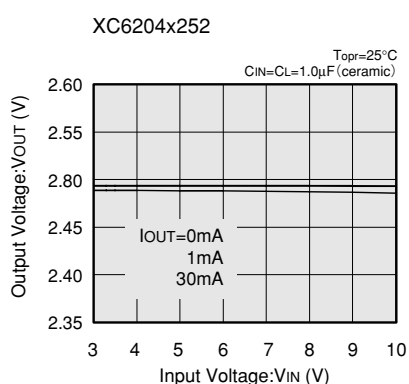
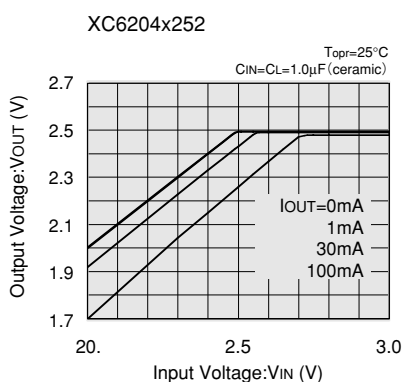
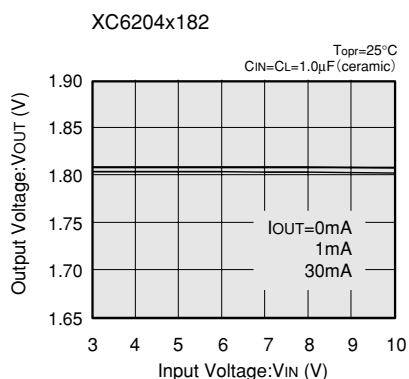
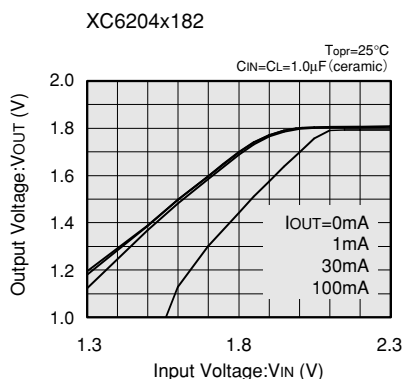


## Typical Performance Characteristics

### (1) OUTPUT VOLTAGE vs. OUTPUT CURRENT

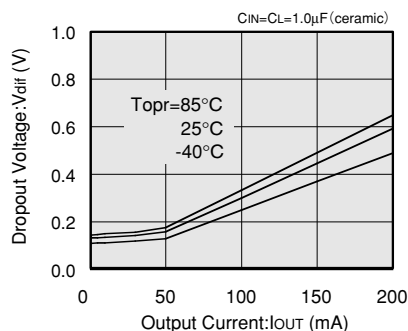


## (2) OUTPUT VOLTAGE vs. INPUT VOLTAGE

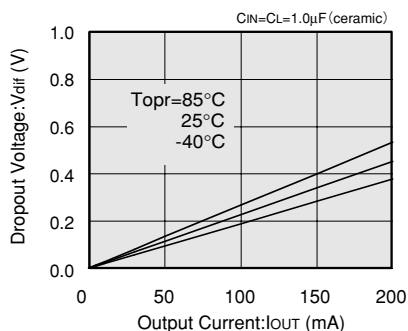


## (3) DROPOUT VOLTAGE vs. OUTPUT CURRENT

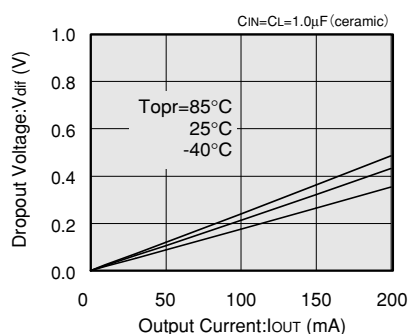
XC6204x182



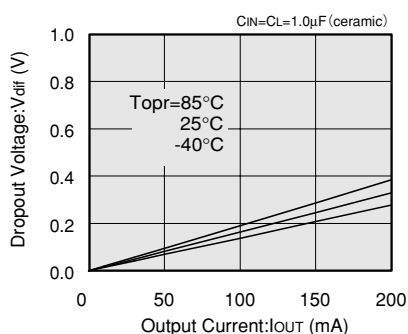
XC6204x252



XC6204x302

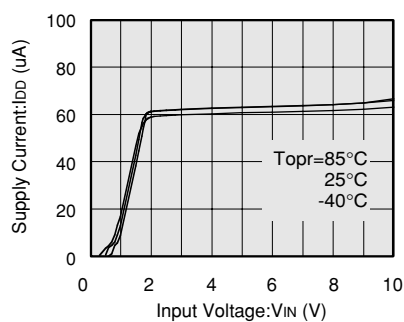


XC6204x502

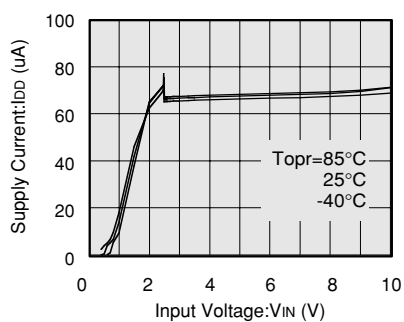


## (4) SUPPLY CURRENT vs. INPUT VOLTAGE

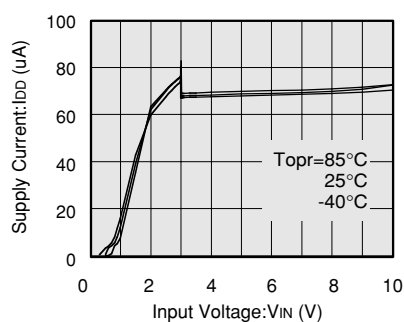
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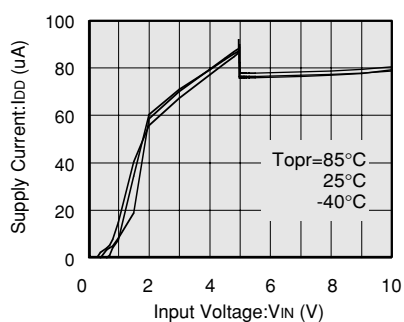
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XC6204B302

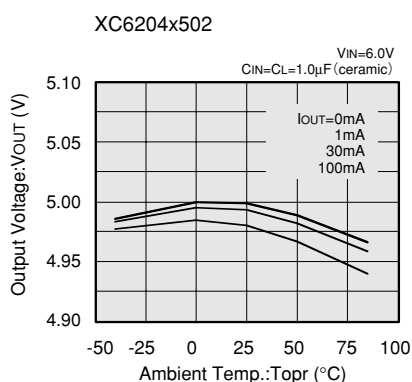
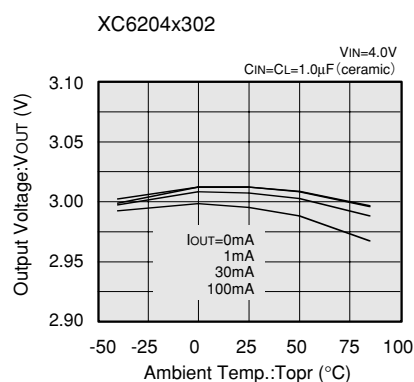
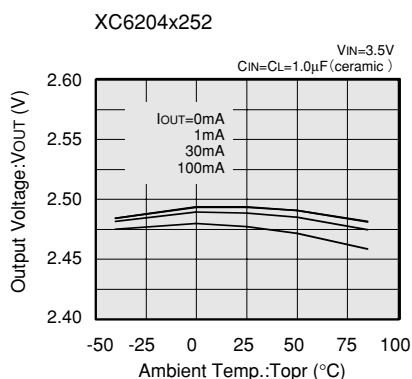
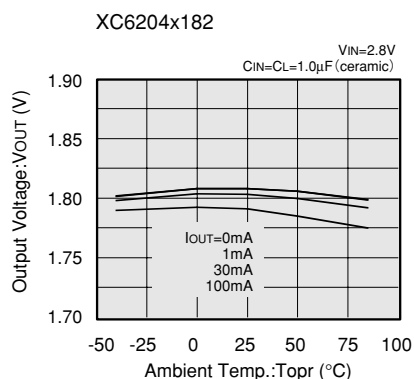


XC6204B502

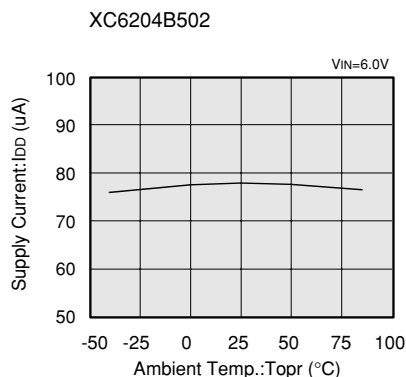
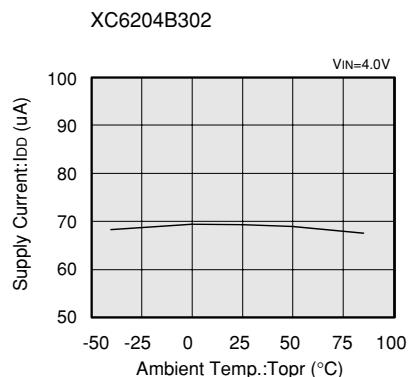
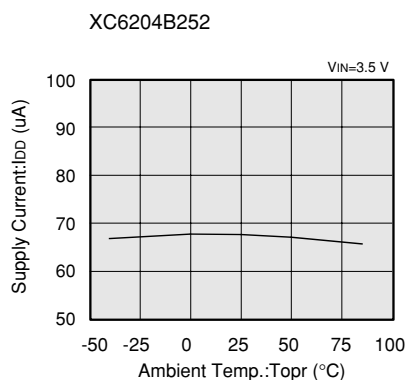
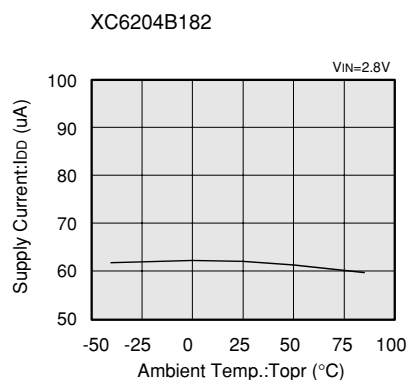




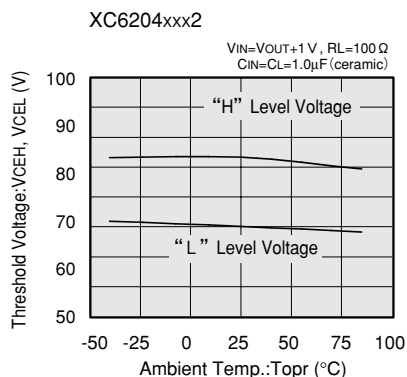
## (5) OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE



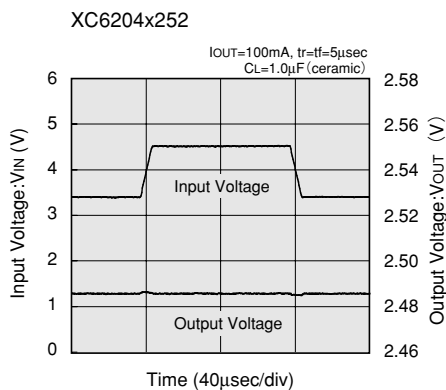
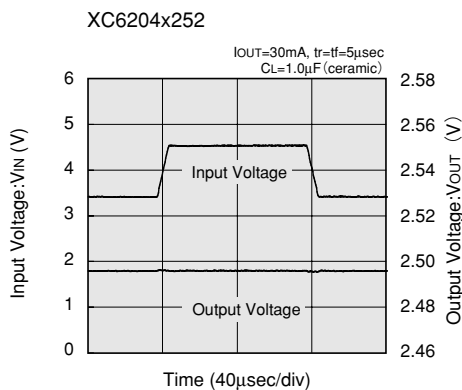
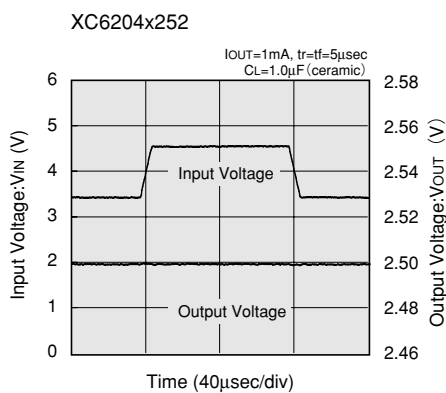
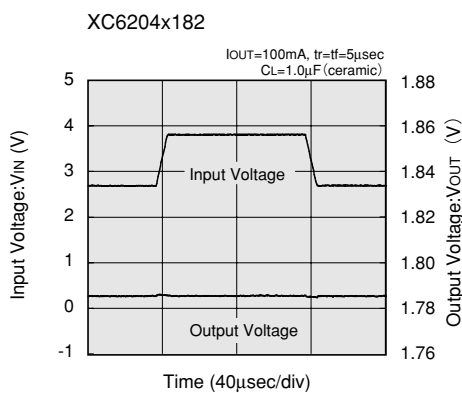
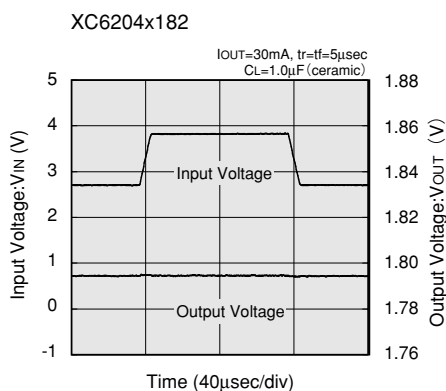
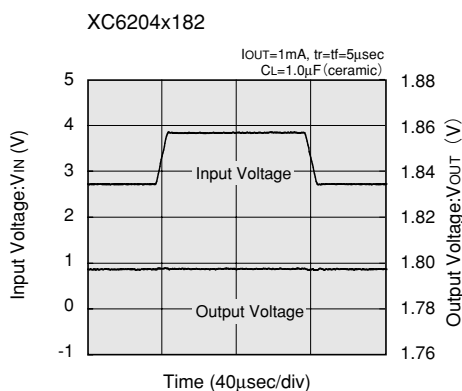
## (6) SUPPLY CURRENT vs. AMBIENT TEMPERATURE



## (7) CE PIN THRESHOLD VOLTAGE vs. AMBIENT TEMPERATURE

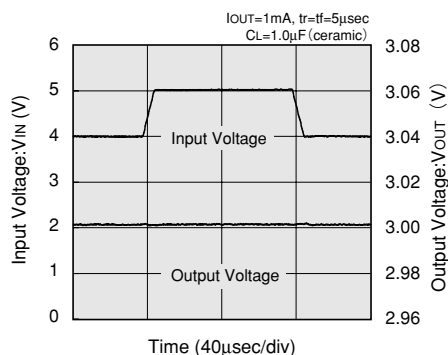


## (8) INPUT TRANSIENT RESPONSE

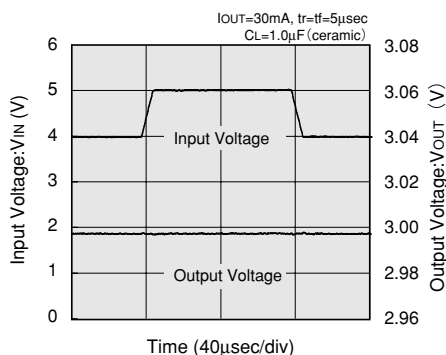


## (8) INPUT TRANSIENT RESPONSE

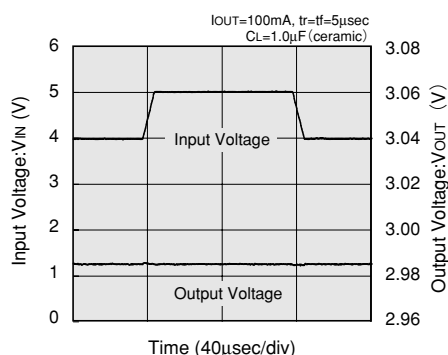
XC6204x302



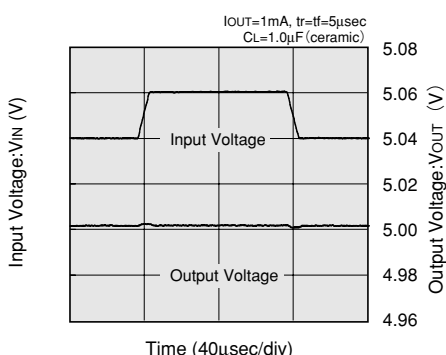
XC6204x302



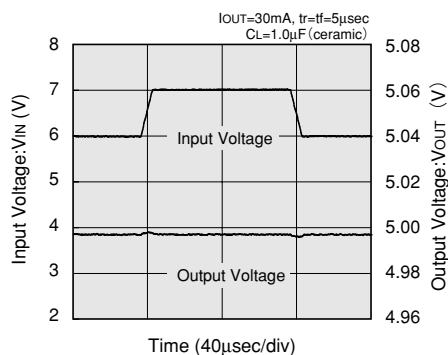
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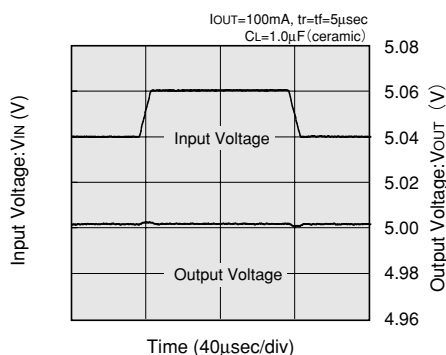
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XC6204x502

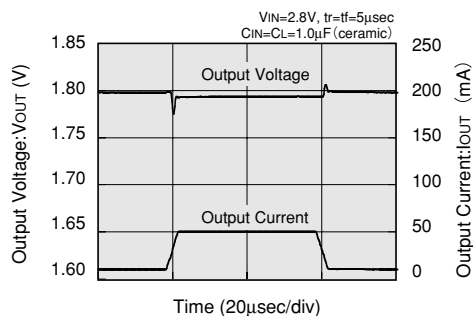


XC6204x502

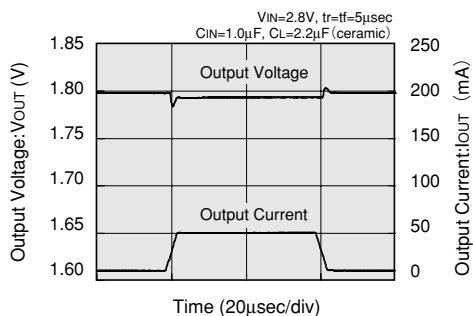


## (9) LOAD TRANSIENT RESPONSE

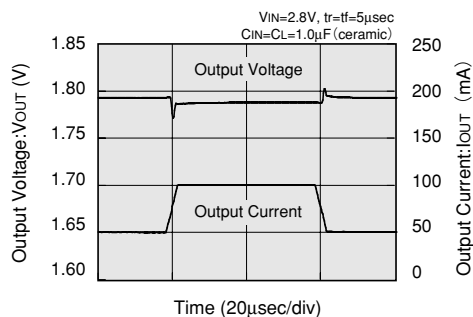
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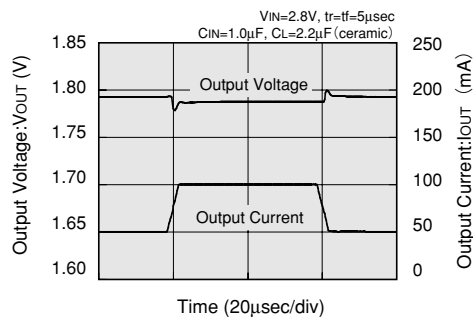
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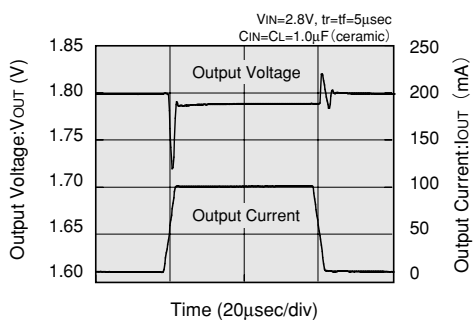
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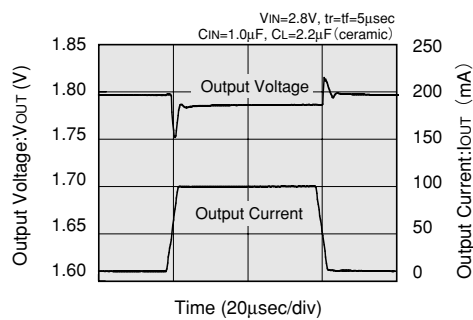
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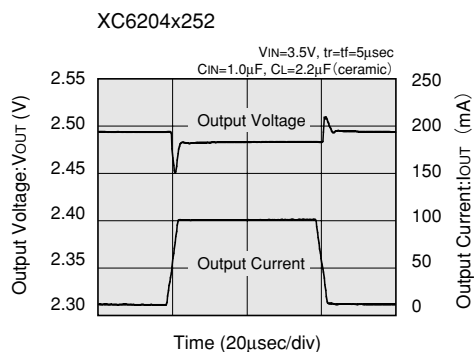
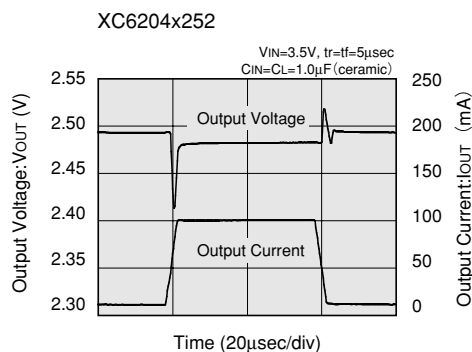
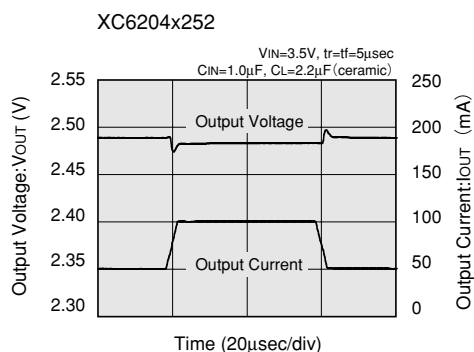
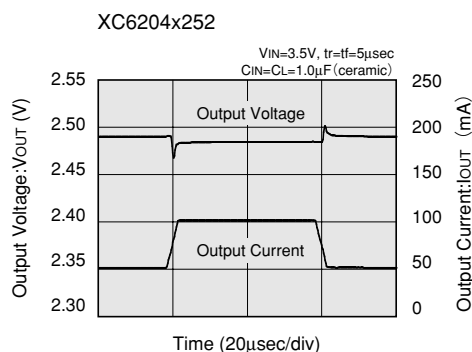
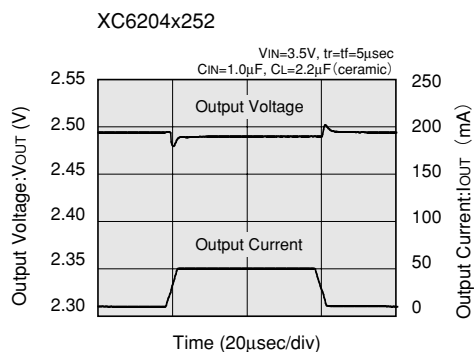
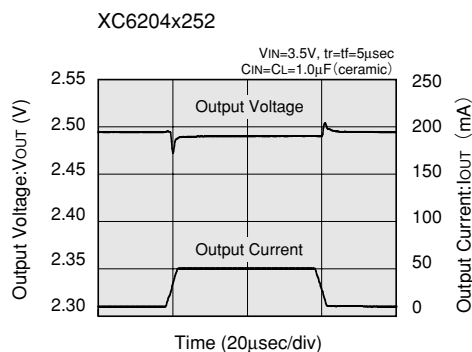
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XC6204x182

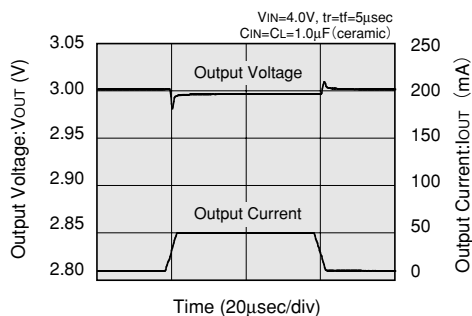


# (9) LOAD TRANSIENT RESPONSE

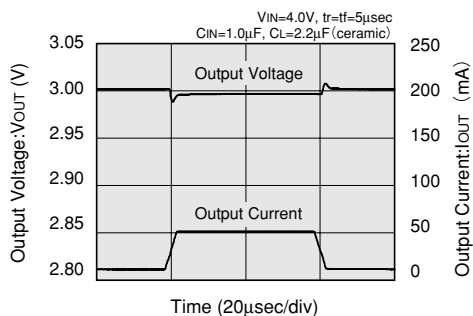


## (9) LOAD TRANSIENT RESPONSE

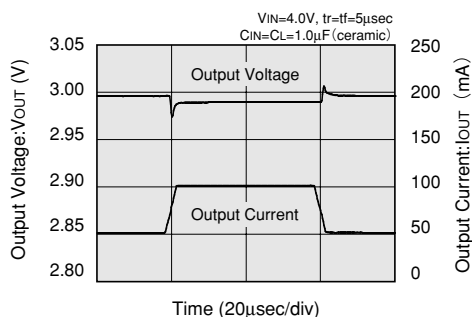
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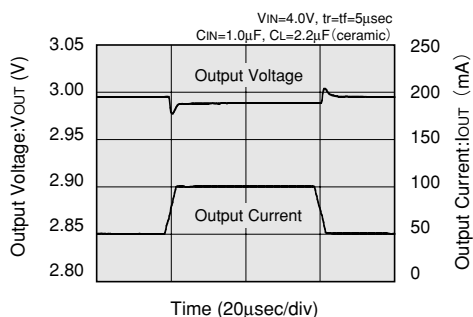
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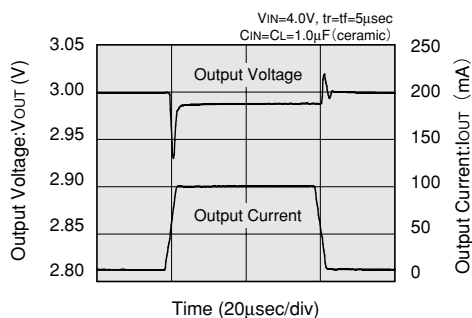
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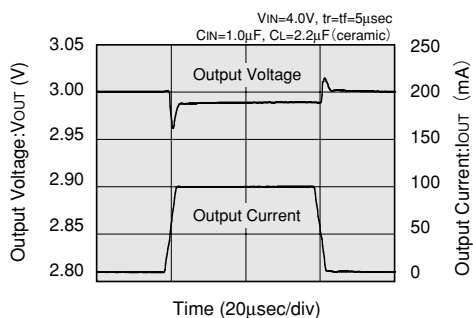
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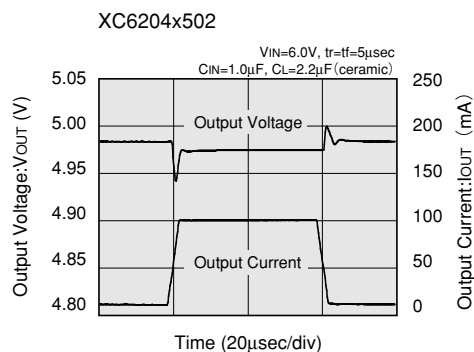
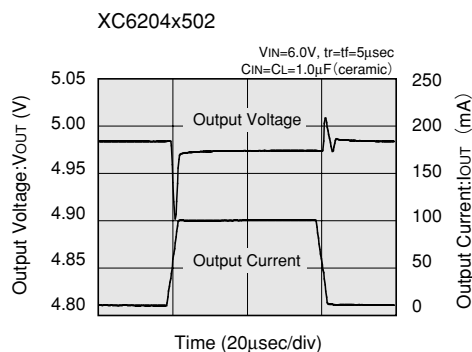
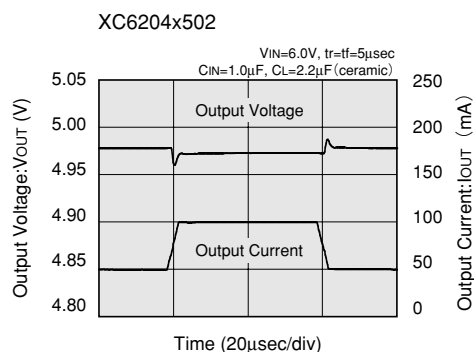
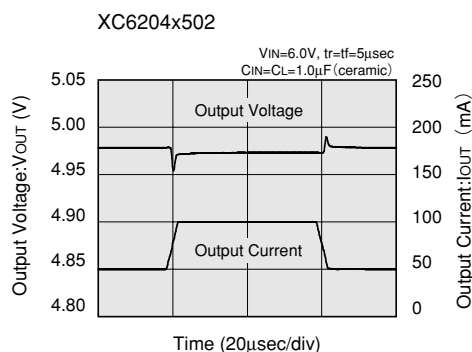
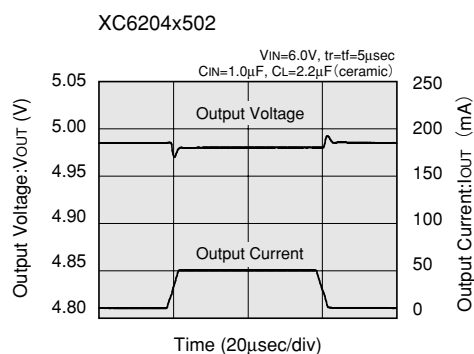
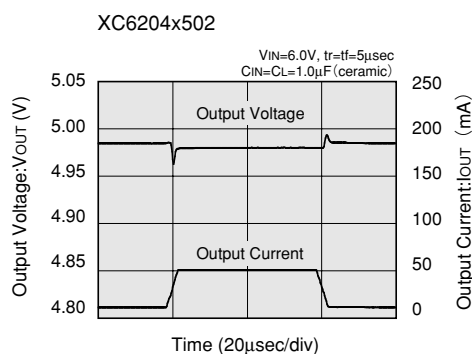
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XC6204x302

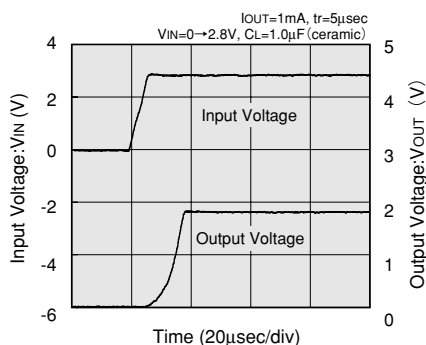


# (9) LOAD TRANSIENT RESPONSE

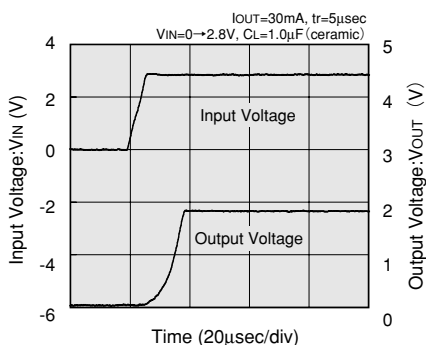


## (10) TURN-ON RESPONSE TIME

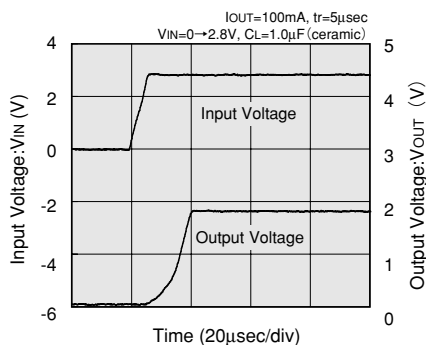
XC6204x182



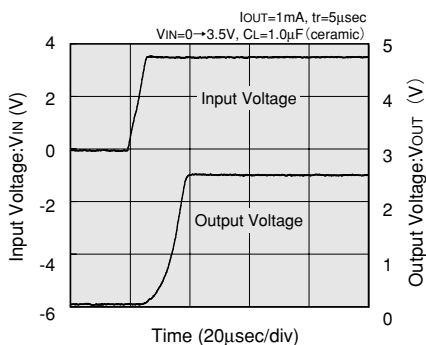
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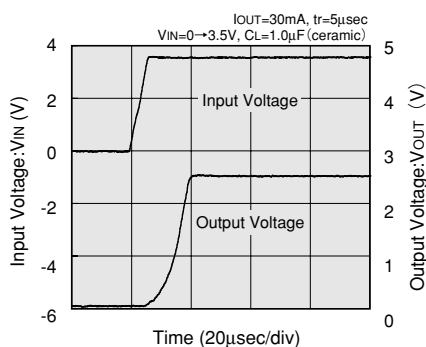
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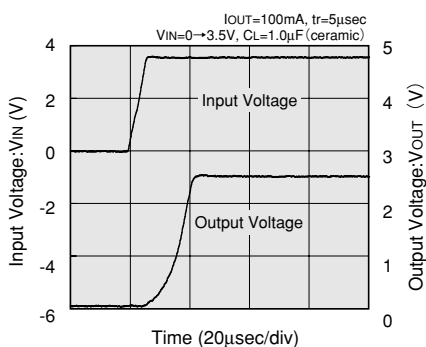
XC6204x252



XC6204x252

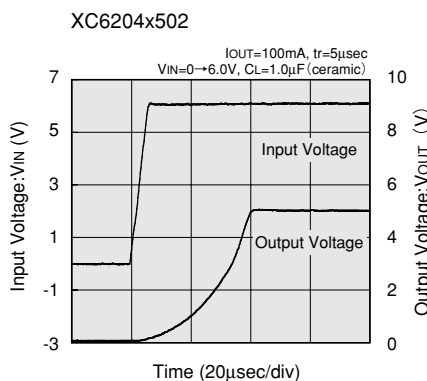
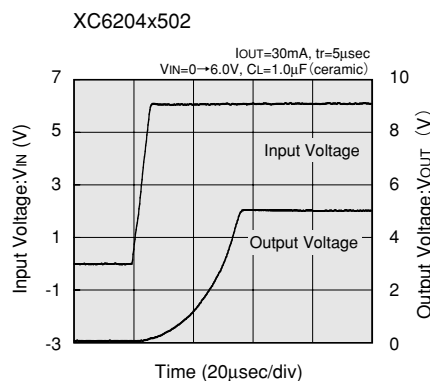
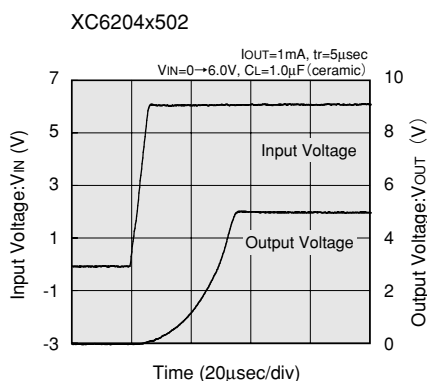
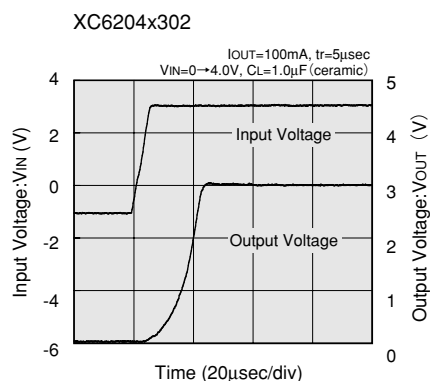
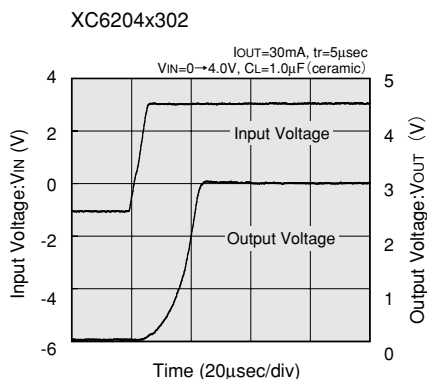
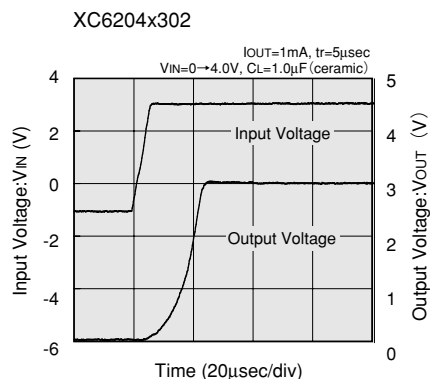


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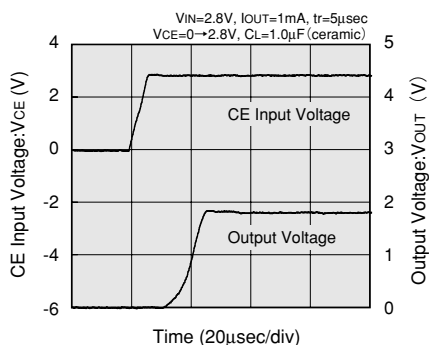


(10) TURN-ON RESPONSE TIME

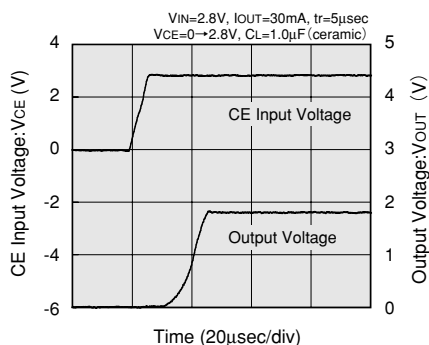


## (11) ENABLE RESPONSE TIME (These characteristics will not be affected by the nature of the CE pin's logic)

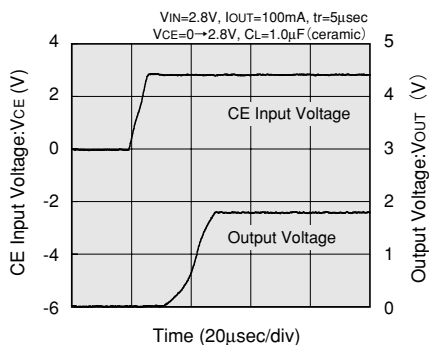
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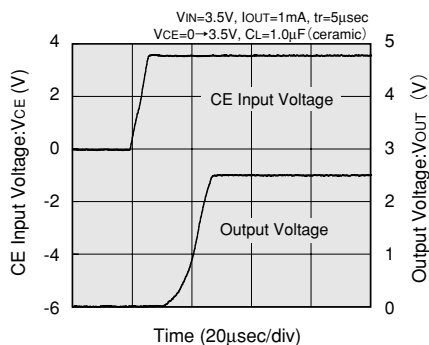
XC6204x182



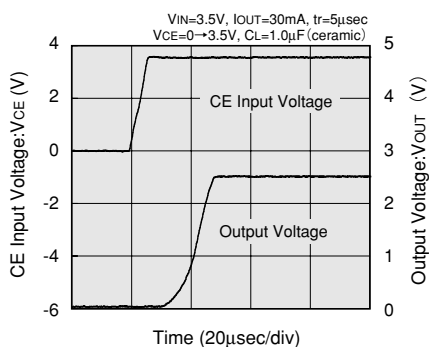
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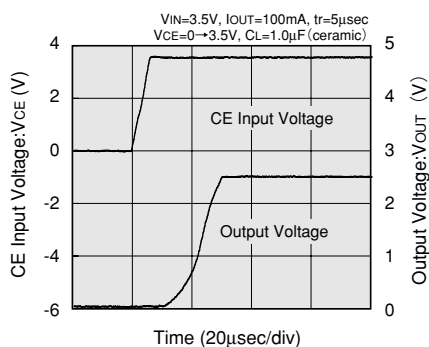
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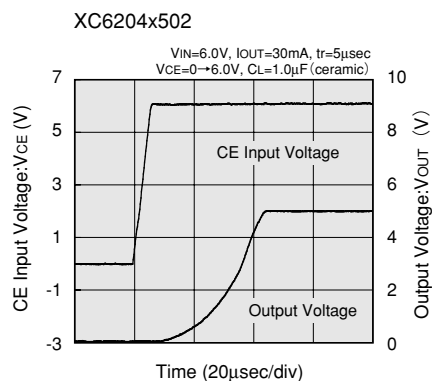
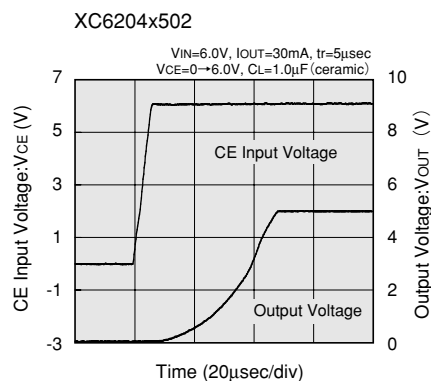
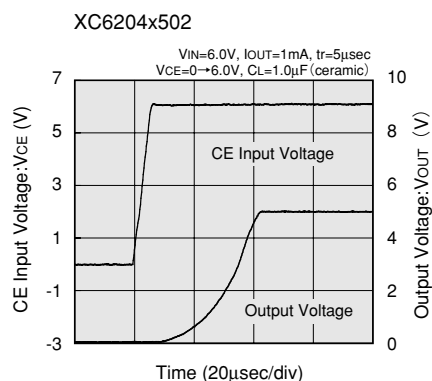
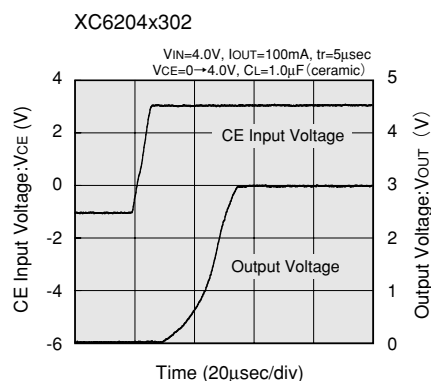
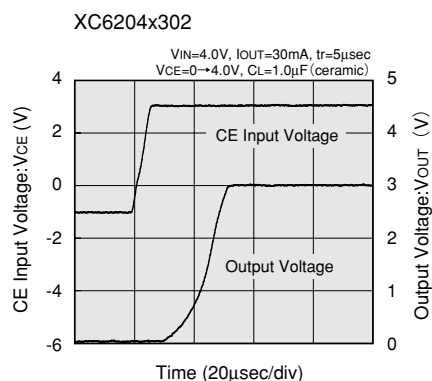
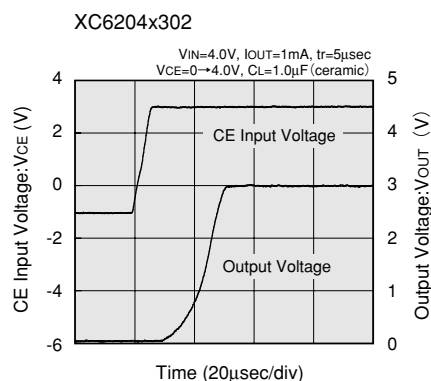
XC6204x252



XC6204x252



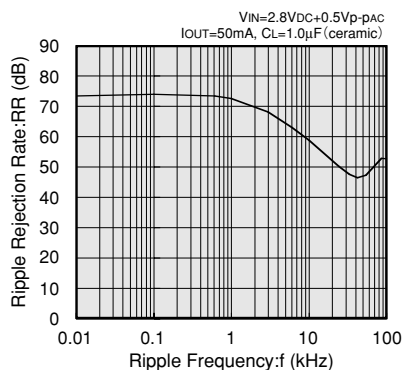
(11) ENABLE RESPONSE TIME (These characteristics will not be affected by the nature of the CE pin's logic)



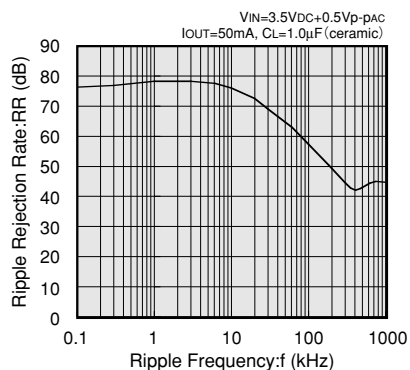
3

## (12) RIPPLE REJECTION RATE

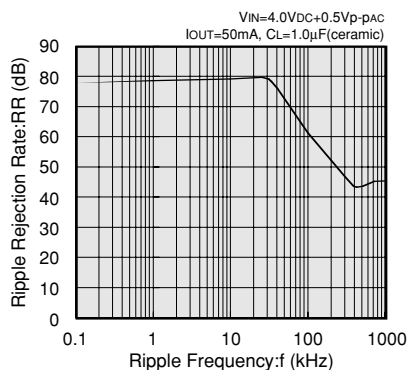
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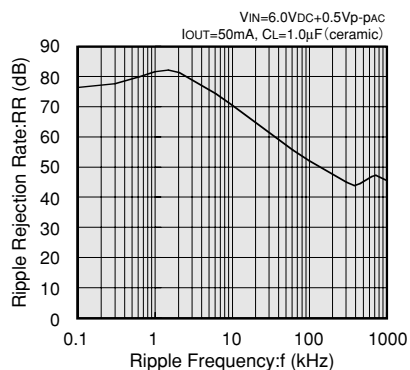
XC6204x252



XC6204x302



XC6204x502



## (13) OUTPUT NOISE DENSITY

XC6204x302

