

## High Speed LDO Regulators, Low ESR Cap. Compatible, Ultra Small Package

### GENERAL DESCRIPTION

The XC6213 series is a highly precise positive voltage LDO regulator with low noise manufactured using CMOS process. The series achieves high ripple rejection and low dropout and consists of a voltage reference, an error amplifier, a current limiter and a phase compensation circuit plus a driver transistor. Output voltage is selectable in 0.05V increments within a range of 1.2V to 5.0V. The series is also compatible with low ESR ceramic capacitors, which give output stability. The current limiter's foldback circuit also operates as a short circuit protection for the output pin. The CE function enables the output to be turned off, resulting in greatly reduced power consumption. Ultra small package SSOT-24, SOT-25, USPN-4 and USP-4 are available.

### APPLICATIONS

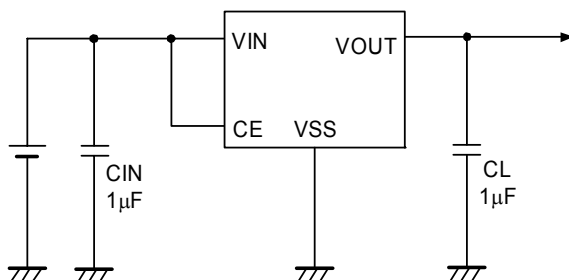
- Smart phones / Mobile phones
- Portable game consoles
- DSC / Camcorders
- Digital audio equipments
- Mobile devices / terminals

### FEATURES

- Maximum Output Current** : 150mA @  $V_{OUT}=3.0V, V_{IN}=4.0V$
- Dropout Voltage** : 400mV @  $I_{OUT} = 100mA$
- Input Voltage Range** : 2.0 ~ 6.0V
- Output Voltage Range** : 1.2 ~ 5.0V (0.05V Increments)
- Highly Accurate** :  $\pm 2\%$
- Low Power Consumption** : 35  $\mu A$  (TYP.)
- Stand-by Current** : Less than 0.1  $\mu A$
- High Ripple Rejection** : 60dB @ 10kHz
- Operating Ambient Temperature**: - 40 ~ 85
- Low ESR Capacitor Compatible** : Ceramic capacitor
- Packages** : SSOT-24  
SOT-25  
USP-4  
USPN-4
- Environmentally Friendly** : EU RoHS Compliant, Pb Free

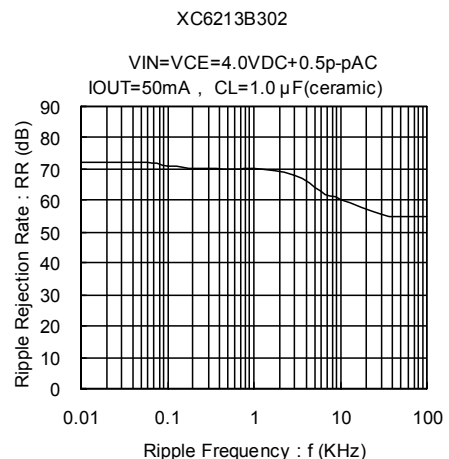
### TYPICAL APPLICATION CIRCUIT

SSOT-24 package

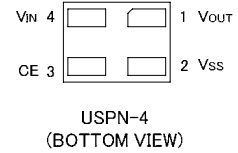
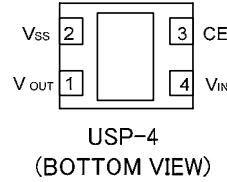
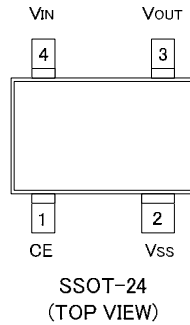
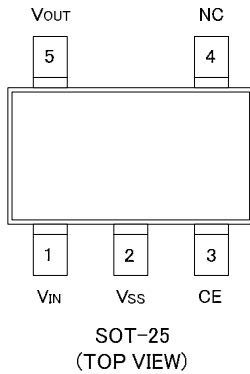


### TYPICAL PERFORMANCE CHARACTERISTICS

Ripple Rejection Rate vs. Ripple Frequency



## PIN CONFIGURATION



\*The dissipation pad for the USP-4 package should be solder-plated in recommended mount pattern and metal masking so as to enhance mounting strength and heat release. If the pad needs to be connected to other pins, it should be connected to the Vss (No. 2) pin

## PIN ASSIGNMENT

| PIN NUMBER |         |       |        | PIN NAME | FUNCTION        |
|------------|---------|-------|--------|----------|-----------------|
| SOT-25     | SSOT-24 | USP-4 | USPN-4 |          |                 |
| 1          | 4       | 4     | 4      | VIN      | Power Supply    |
| 2          | 2       | 2     | 2      | VSS      | Ground          |
| 3          | 1       | 3     | 3      | CE       | On / Off Switch |
| 4          | -       | -     | -      | NC       | No Connection   |
| 5          | 3       | 1     | 1      | VOUT     | Output          |

## PRODUCT CLASSIFICATION

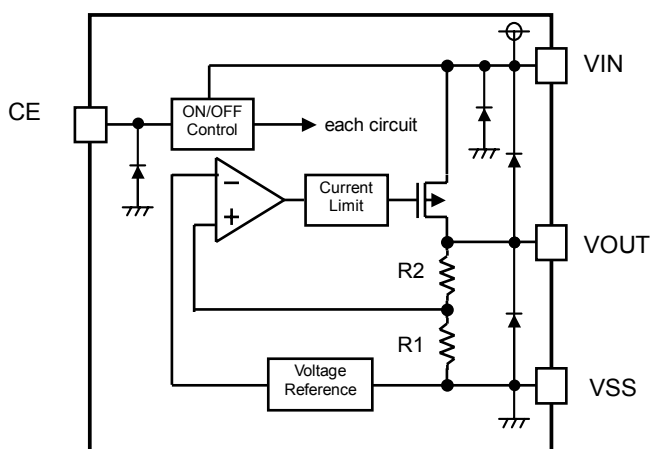
### Ordering Information

XC6213 \_\_\_\_\_ - (\*)

| DESIGNATOR | ITEM                    | SYMBOL | DESCRIPTION   |
|------------|-------------------------|--------|---|
|            | Type of Regulator       | B      | High Active with no pull-down resistor (standard)                     |
|            | Output Voltage          | 12~50  | Output Voltage:<br>ex.) 3.0V      =3,      = 0                        |
|            | Output Voltage Accuracy | 2      | 0.1V increments, ±2% accuracy ex.) 2.80V      =2,      = 8,      = 2  |
|            |                         | A      | 0.05V increments, ±2% accuracy ex.) 2.85V      =2,      = 8,      = A |
|            | Package<br>(Order Unit) | MR     | SOT-25 (3,000/Reel)   |
|            |                         | MR-G   | SOT-25 (3,000/Reel)   |
|            |                         | NR     | SSOT-24 (3,000/Reel)  |
|            |                         | NR-G   | SSOT-24 (3,000/Reel)  |
|            |                         | GR     | USP-4 (3,000/Reel)  |
|            |                         | GR-G   | USP-4 (3,000/Reel)  |
|            |                         | 7 R-G  | USPN-4 (5,000/Reel)   |

(\*) The "-G" suffix indicates that the products are Halogen and Antimony free as well as being fully EU RoHS compliant.

## BLOCK DIAGRAM



\*Diode inside the circuit is a protection diode.

## ABSOLUTE MAXIMUM RATINGS

Ta = 25

| PARAMETER                     | SYMBOL           | RATINGS                                       | UNITS |
|-------------------------------|------------------|---|-------|
| Input Voltage                 | V <sub>IN</sub>  | V <sub>SS</sub> - 0.3 ~ 7.0                   | V     |
| Output Current                | I <sub>OUT</sub> | 500 (*1)                                      | mA    |
| Output Voltage                | V <sub>OUT</sub> | V <sub>SS</sub> - 0.3 ~ V <sub>IN</sub> + 0.3 | V     |
| CE Input Voltage              | V <sub>CE</sub>  | V <sub>SS</sub> - 0.3 ~ 7.0                   | V     |
| Power Dissipation             | SOT-25           | 250   | mW    |
|                               |                  | 600(PCB mounted)(*2)                          |       |
|                               | SSOT-24          | 150   |       |
|                               |                  | 500(PCB mounted)(*2)                          |       |
|                               | USP-4            | 120   |       |
|                               | USPN-4           | 100   |       |
| Operating Ambient Temperature | T <sub>opr</sub> | - 40 ~ + 85                                   |       |
| Storage Temperature Range     | T <sub>stg</sub> | - 55 ~ + 125                                  |       |

\*1: I<sub>OUT</sub>=P<sub>d</sub>/(V<sub>IN</sub>-V<sub>OUT</sub>)

\*2: The power dissipation figure shown is PCB mounted. Please refer to pages 29 to 32 for details.

## ELECTRICAL CHARACTERISTICS

XC6213B series

Ta=25

| PARAMETER                                     | SYMBOL                                  | CONDITIONS  | MIN.                          | TYP.                | MAX.                          | UNITS | CIRCUITS |
|---|---|---|-------------------------------|---------------------|-------------------------------|-------|----------|
| Output Voltage                                | V <sub>OUT(E)</sub>                     | I <sub>OUT</sub> =30mA, CE=V <sub>IN</sub>  | V <sub>OUT(T)</sub><br>x 0.98 | V <sub>OUT(T)</sub> | V <sub>OUT(T)</sub><br>x 1.02 | V     |          |
| Maximum Output Current                        | I <sub>OUTMAX</sub>                     | V <sub>IN</sub> =V <sub>OUT(T)</sub> +1.0V,<br>V <sub>OUT(T)</sub> =1.20~1.45V, CE=V <sub>IN</sub>                          | 100                           | -                   | -                             | mA    |          |
|   |   | V <sub>IN</sub> =V <sub>OUT(T)</sub> +1.0V,<br>V <sub>OUT(T)</sub> =1.50~2.95V, CE=V <sub>IN</sub>                          | 120                           | -                   | -                             |       |          |
|   |   | V <sub>IN</sub> =V <sub>OUT(T)</sub> +1.0V,<br>V <sub>OUT(T)</sub> =3.00~4.05V, CE=V <sub>IN</sub>                          | 150                           | -                   | -                             |       |          |
|   |   | V <sub>IN</sub> =V <sub>OUT(T)</sub> +1.0V,<br>V <sub>OUT(T)</sub> =4.10~5.00V, CE=V <sub>IN</sub>                          | 200                           | -                   | -                             |       |          |
| Load Regulation                               | V <sub>OUT</sub>                        | V <sub>IN</sub> =V <sub>OUT(T)</sub> +1.0V,<br>1mA I <sub>OUT</sub> 100mA, CE=V <sub>IN</sub>                               | -                             | 15                  | 50                            | mV    |          |
| Dropout Voltage                               | V <sub>dif1</sub>                       | I <sub>OUT</sub> = 30mA, CE=V <sub>IN</sub>   | E-1                           |                     |                               | mV    |          |
|   | V <sub>dif2</sub>                       | I <sub>OUT</sub> =100mA, CE=V <sub>IN</sub>   | E-2                           |                     |                               | mV    |          |
| Supply Current                                | I <sub>SS</sub>                         | V <sub>IN</sub> =V <sub>OUT(T)</sub> +1.0V, CE=V <sub>IN</sub>  | 25                            | 35                  | 50                            | μA    |          |
| Stand-by Current                              | I <sub>stby</sub>                       | V <sub>IN</sub> =V <sub>OUT(T)</sub> +1.0V ~ 6.0V, CE=V <sub>SS</sub>   | -                             | 0.01                | 0.10                          | μA    |          |
| Line Regulation                               | $\frac{V_{OUT}}{V_{IN} \cdot V_{OUT}}$  | V <sub>OUT(T)</sub> +1.0V V <sub>IN</sub> 6V<br>I <sub>OUT</sub> =30mA, CE=V <sub>IN</sub>                                  | -                             | 0.01                | 0.20                          | %/V   |          |
| Input Voltage                                 | V <sub>IN</sub>                         | -   | 2.0                           | -                   | 6.0                           | V     | -        |
| Output Voltage<br>Temperature Characteristics | $\frac{V_{OUT}}{T_{opr} \cdot V_{OUT}}$ | I <sub>OUT</sub> =30mA, CE=V <sub>IN</sub><br>- 40 T <sub>opr</sub> 85  | -                             | ± 100               | -                             | ppm/  |          |
| Ripple Rejection Rate                         | PSRR                                    | V <sub>IN</sub> =[V <sub>OUT(T)</sub> +1.0 V] +0.5V <sub>p-pAC</sub><br>I <sub>OUT</sub> =50mA, f=10kHz, CE=V <sub>IN</sub> | -                             | 60                  | -                             | dB    |          |
| Short Circuit Current                         | I <sub>short</sub>                      | V <sub>IN</sub> =V <sub>OUT(T)</sub> + 1.0V, CE=V <sub>IN</sub>   | -                             | 50                  | -                             | mA    |          |
| CE 'H' Level Voltage                          | V <sub>CEH</sub>                        | -   | 1.3                           | -                   | 6.0                           | V     |          |
| CE 'L' Level Voltage                          | V <sub>CEL</sub>                        | -   | -                             | -                   | 0.25                          | V     |          |
| CE 'H' Level Current                          | I <sub>CEH</sub>                        | V <sub>CE</sub> = V <sub>IN</sub> =V <sub>OUT(T)</sub> + 1.0V   | - 0.1                         | -                   | 0.1                           | μA    |          |
| CE 'L' Level Current                          | I <sub>CEL</sub>                        | V <sub>IN</sub> =V <sub>OUT(T)</sub> + 1.0V, V <sub>CE</sub> =V <sub>SS</sub>   | - 0.1                         | -                   | 0.1                           | μA    |          |

NOTE:

- \*1: V<sub>OUT(T)</sub>: Setting output voltage
- \*2: V<sub>OUT(E)</sub> = Effective output voltage  
(i.e. the output voltage when "V<sub>OUT(T)</sub> + 1.0V" is provided at the V<sub>IN</sub> pin while maintaining a certain I<sub>OUT</sub> value).
- \*3: V<sub>dif</sub> = { V<sub>IN1</sub><sup>(5)</sup> - V<sub>OUT1</sub><sup>(4)</sup> }
- \*4: V<sub>OUT1</sub> = A voltage equal to 98% of the output voltage whenever an amply stabilized I<sub>OUT</sub> { V<sub>OUT(T)</sub> + 1.0V } is input.
- \*5: V<sub>IN1</sub> = The input voltage when V<sub>OUT1</sub> appears as input voltage is gradually decreased.
- \*6: Unless otherwise stated, (V<sub>IN</sub> = V<sub>OUT(T)</sub> + 1.0V).
- \*7: V<sub>OUT(T)</sub> ≤ 1.45V = Minimum: V<sub>OUT(T)</sub>-30mV, Maximum: V<sub>OUT(T)</sub>+30mV

## ELECTRICAL CHARACTERISTICS (Continued)

Dropout Voltage Chart

Ta=25°C

| SYMBOL              | E-0                   |       | E-1                         |                   | E-2                          |                   |
|---------------------|-----------------------|-------|-----------------------------|-------------------|------------------------------|-------------------|
|                     | OUTPUT VOLTAGE<br>(V) |       | DROPOUT VOLTAGE 1           |                   | DROPTOUT VOLTAGE 2           |                   |
|                     |                       |       | I <sub>OUT</sub> =30mA (mV) |                   | I <sub>OUT</sub> =100mA (mV) |                   |
| V <sub>OUT(T)</sub> | V <sub>OUT</sub>      |       | V <sub>dif1</sub>           | V <sub>dif1</sub> | V <sub>dif2</sub>            | V <sub>dif2</sub> |
|                     | MIN.                  | MAX.  | TYP.                        | MAX.              | TYP.                         | MAX.              |
| 1.20                | 1.170                 | 1.230 | 760                         | 800               | 850                          | 1000              |
| 1.25                | 1.220                 | 1.280 | 760                         | 800               | 850                          | 1000              |
| 1.30                | 1.270                 | 1.330 | 660                         | 700               | 810                          | 960               |
| 1.35                | 1.320                 | 1.380 | 660                         | 700               | 810                          | 960               |
| 1.40                | 1.370                 | 1.430 | 560                         | 600               | 770                          | 920               |
| 1.45                | 1.420                 | 1.480 | 560                         | 600               | 770                          | 920               |
| 1.50                | 1.470                 | 1.530 | 460                         | 500               | 730                          | 880               |
| 1.55                | 1.519                 | 1.581 | 460                         | 500               | 730                          | 880               |
| 1.60                | 1.568                 | 1.632 | 360                         | 400               | 690                          | 840               |
| 1.65                | 1.617                 | 1.683 | 360                         | 400               | 690                          | 840               |
| 1.70                | 1.666                 | 1.734 | 260                         | 300               | 650                          | 800               |
| 1.75                | 1.715                 | 1.785 | 260                         | 300               | 650                          | 800               |
| 1.80                | 1.764                 | 1.836 | 200                         | 240               | 600                          | 750               |
| 1.85                | 1.813                 | 1.887 | 200                         | 240               | 600                          | 750               |
| 1.90                | 1.862                 | 1.938 | 200                         | 240               | 600                          | 750               |
| 1.95                | 1.911                 | 1.989 | 200                         | 240               | 600                          | 750               |
| 2.00                | 1.960                 | 2.040 | 190                         | 230               | 530                          | 670               |
| 2.05                | 2.009                 | 2.091 | 190                         | 230               | 530                          | 670               |
| 2.10                | 2.058                 | 2.142 | 190                         | 230               | 530                          | 670               |
| 2.15                | 2.107                 | 2.193 | 190                         | 230               | 530                          | 670               |
| 2.20                | 2.156                 | 2.244 | 190                         | 230               | 530                          | 670               |
| 2.25                | 2.205                 | 2.295 | 190                         | 230               | 530                          | 670               |
| 2.30                | 2.254                 | 2.346 | 190                         | 230               | 530                          | 670               |
| 2.35                | 2.303                 | 2.397 | 190                         | 230               | 530                          | 670               |
| 2.40                | 2.352                 | 2.448 | 190                         | 230               | 530                          | 670               |
| 2.45                | 2.401                 | 2.499 | 190                         | 230               | 530                          | 670               |
| 2.50                | 2.450                 | 2.550 | 180                         | 210               | 470                          | 580               |
| 2.55                | 2.499                 | 2.601 | 180                         | 210               | 470                          | 580               |
| 2.60                | 2.548                 | 2.652 | 180                         | 210               | 470                          | 580               |
| 2.65                | 2.597                 | 2.703 | 180                         | 210               | 470                          | 580               |
| 2.70                | 2.646                 | 2.754 | 180                         | 210               | 470                          | 580               |
| 2.75                | 2.695                 | 2.805 | 180                         | 210               | 470                          | 580               |
| 2.80                | 2.744                 | 2.856 | 180                         | 210               | 470                          | 580               |
| 2.85                | 2.793                 | 2.907 | 180                         | 210               | 470                          | 580               |
| 2.90                | 2.842                 | 2.958 | 180                         | 210               | 470                          | 580               |
| 2.95                | 2.891                 | 3.009 | 180                         | 210               | 470                          | 580               |
| 3.00                | 2.940                 | 3.060 | 150                         | 180               | 400                          | 500               |
| 3.05                | 2.989                 | 3.111 | 150                         | 180               | 400                          | 500               |
| 3.10                | 3.038                 | 3.162 | 150                         | 180               | 400                          | 500               |
| 3.15                | 3.087                 | 3.213 | 150                         | 180               | 400                          | 500               |
| 3.20                | 3.136                 | 3.264 | 150                         | 180               | 400                          | 500               |
| 3.25                | 3.185                 | 3.315 | 150                         | 180               | 400                          | 500               |
| 3.30                | 3.234                 | 3.366 | 150                         | 180               | 400                          | 500               |
| 3.35                | 2.283                 | 3.417 | 150                         | 180               | 400                          | 500               |
| 3.40                | 2.332                 | 3.468 | 150                         | 180               | 400                          | 500               |
| 3.45                | 3.381                 | 3.519 | 150                         | 180               | 400                          | 500               |

## ELECTRICAL CHARACTERISTICS (Continued)

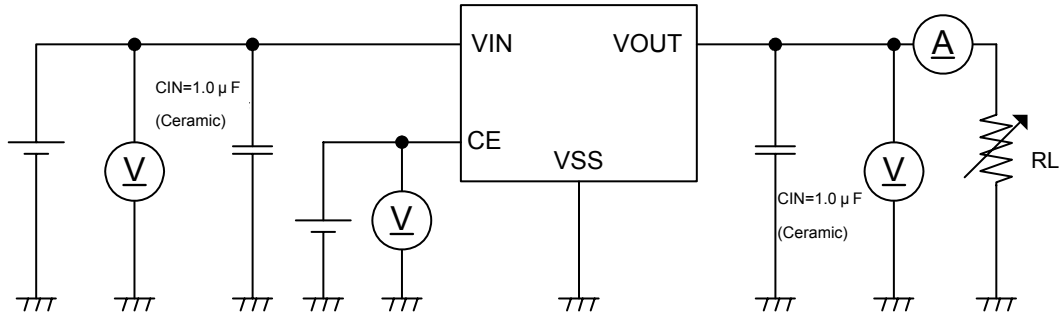
Dropout Voltage Chart (Continued)

Ta=25°C

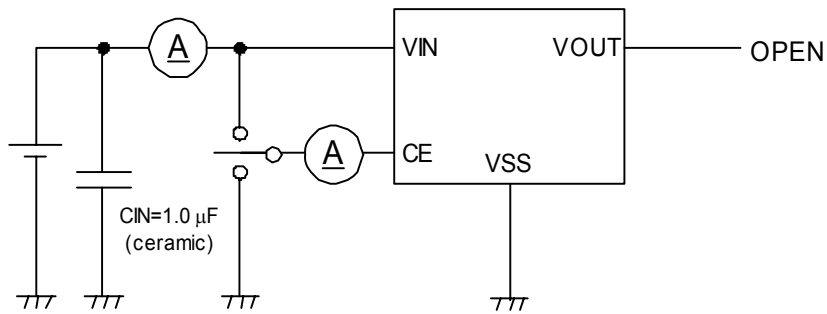
| SYMBOL              | E-0                |       | E-1                         |                   | E-2                          |                   |
|---------------------|--------------------|-------|-----------------------------|-------------------|------------------------------|-------------------|
| SETTING VOLTAGE     | OUTPUT VOLTAGE (V) |       | DROPOUT VOLTAGE 1           |                   | DROPTOUT VOLTAGE 2           |                   |
|                     |                    |       | I <sub>OUT</sub> =30mA (mV) |                   | I <sub>OUT</sub> =100mA (mV) |                   |
| V <sub>OUT(T)</sub> | V <sub>OUT</sub>   |       | V <sub>dif1</sub>           | V <sub>dif1</sub> | V <sub>dif2</sub>            | V <sub>dif2</sub> |
|                     | MIN.               | MAX.  | TYP.                        | MAX.              | TYP.                         | MAX.              |
| 3.50                | 3.430              | 3.570 | 140                         | 170               | 350                          | 450               |
| 3.55                | 3.479              | 3.621 | 140                         | 170               | 350                          | 450               |
| 3.60                | 3.528              | 3.672 | 140                         | 170               | 350                          | 450               |
| 3.65                | 3.577              | 3.723 | 140                         | 170               | 350                          | 450               |
| 3.70                | 3.626              | 3.774 | 140                         | 170               | 350                          | 450               |
| 3.75                | 3.675              | 3.825 | 140                         | 170               | 350                          | 450               |
| 3.80                | 3.724              | 3.876 | 140                         | 170               | 350                          | 450               |
| 3.85                | 3.773              | 3.927 | 140                         | 170               | 350                          | 450               |
| 3.90                | 3.822              | 3.978 | 140                         | 170               | 350                          | 450               |
| 3.95                | 3.871              | 4.029 | 140                         | 170               | 350                          | 450               |
| 4.00                | 3.920              | 4.080 | 130                         | 160               | 320                          | 420               |
| 4.05                | 3.969              | 4.131 | 130                         | 160               | 320                          | 420               |
| 4.10                | 4.018              | 4.182 | 130                         | 160               | 320                          | 420               |
| 4.15                | 4.067              | 4.233 | 130                         | 160               | 320                          | 420               |
| 4.20                | 4.116              | 4.284 | 130                         | 160               | 320                          | 420               |
| 4.25                | 4.165              | 4.335 | 130                         | 160               | 320                          | 420               |
| 4.30                | 4.214              | 4.386 | 130                         | 160               | 320                          | 420               |
| 4.35                | 4.263              | 4.437 | 130                         | 160               | 320                          | 420               |
| 4.40                | 4.312              | 4.488 | 130                         | 160               | 320                          | 420               |
| 4.45                | 4.361              | 4.539 | 130                         | 160               | 320                          | 420               |
| 4.50                | 4.410              | 4.590 | 120                         | 150               | 300                          | 400               |
| 4.55                | 4.459              | 4.641 | 120                         | 150               | 300                          | 400               |
| 4.60                | 4.508              | 4.692 | 120                         | 150               | 300                          | 400               |
| 4.65                | 4.557              | 4.743 | 120                         | 150               | 300                          | 400               |
| 4.70                | 4.606              | 4.794 | 120                         | 150               | 300                          | 400               |
| 4.75                | 4.655              | 4.845 | 120                         | 150               | 300                          | 400               |
| 4.80                | 4.704              | 4.896 | 120                         | 150               | 300                          | 400               |
| 4.85                | 4.753              | 4.947 | 120                         | 150               | 300                          | 400               |
| 4.90                | 4.802              | 4.998 | 120                         | 150               | 300                          | 400               |
| 4.95                | 4.851              | 5.049 | 120                         | 150               | 300                          | 400               |
| 5.00                | 4.900              | 5.100 | 120                         | 150               | 300                          | 400               |

## TEST CIRCUITS

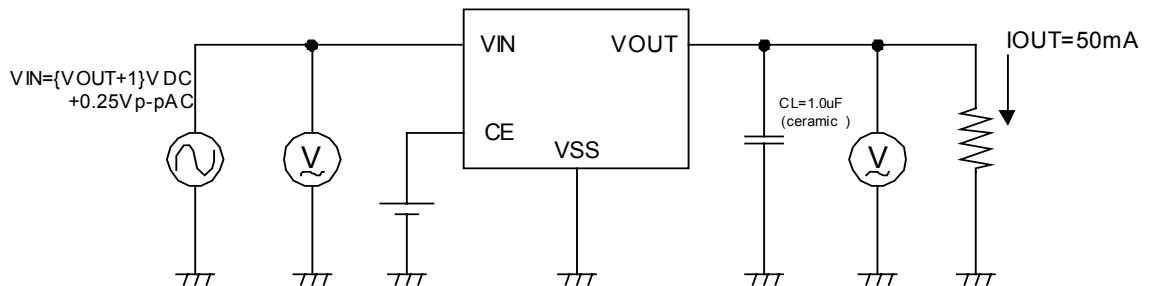
Circuit



Circuit



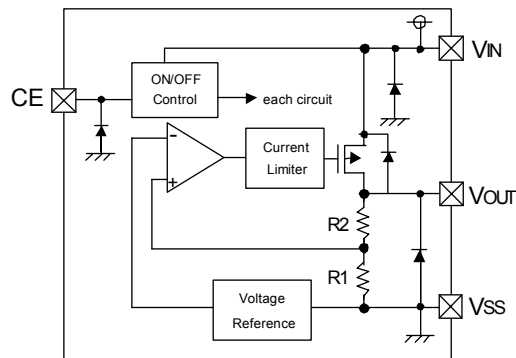
Circuit



## OPERATIONAL EXPLANATION

### <Output Voltage Regulator Control>

The voltage, divided by resistors R1 & R2, which are connected to the VOUT pin 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 & stabilized by negative feedback. The current limit circuit and short circuit protection operate in relation to the level of output current. Further, the voltage regulator's internal circuitry can be shutdown via the CE pin's signal.

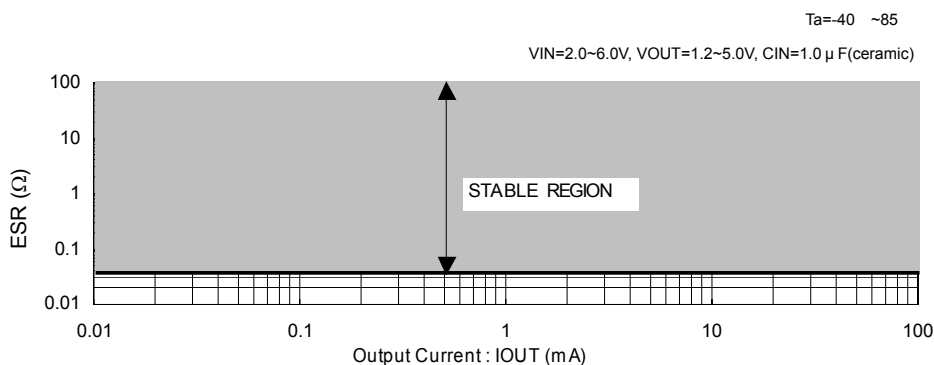


### <Low ESR Capacitor>

With the XC6213 series regulator, a stable output voltage is achievable even if low ESR capacitors are used, as a phase compensation circuit is built-in to the regulator. In order to ensure the effectiveness of the phase compensation, please connect an output capacitor (CL) with a capacitance, based on the chart below. The equivalent serial resistor (ESR) of the output capacitor (CL) should be within the range as the graph below shown. We also suggest an input capacitor (CIN) of 1.0μF: this should be connected between VIN and VSS in order to stabilize input power source.

Output Capacitor Corresponding Chart

| SETTING VOLTAGE | 1.2 ~ 1.75V      | 1.8 ~ 5.0V       |
|-----------------|------------------|------------------|
| CL              | More than 3.3 μF | More than 1.0 μF |



### <Short-Circuit Protection>

The XC6213 series regulator offers circuit protection by means of a built-in foldback circuit. 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, the 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 regulator circuitry can be shut down via the signal from the CE pin with the XC6213 series. In shutdown mode, output at the VOUT pin will be pulled down to the VSS level. Note that as the XC6213B types are 'High Active / No Pull-Down', operations will become unstable with the CE pin open. 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 IC will operate normally. However, supply current may increase as a result of through current in the IC's internal circuitry if a voltage other than VIN or VSS is applied.

### <Minimum Operating Voltage>

Please apply input voltage more than 2.0V or more in order to stabilize the operation of the IC's. Normal output voltage may not be obtained when the input voltage is lower than 2.0V.

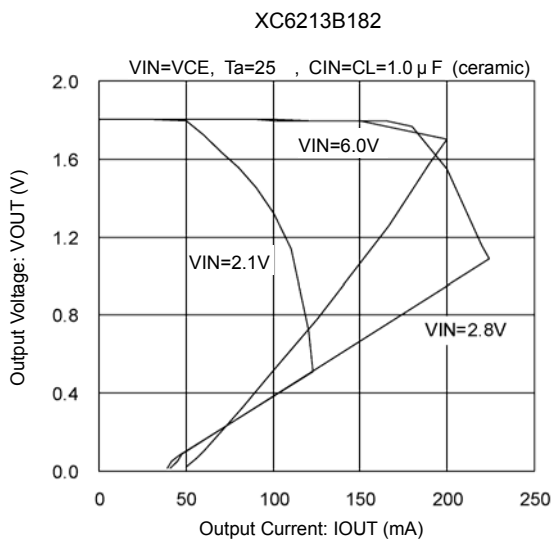
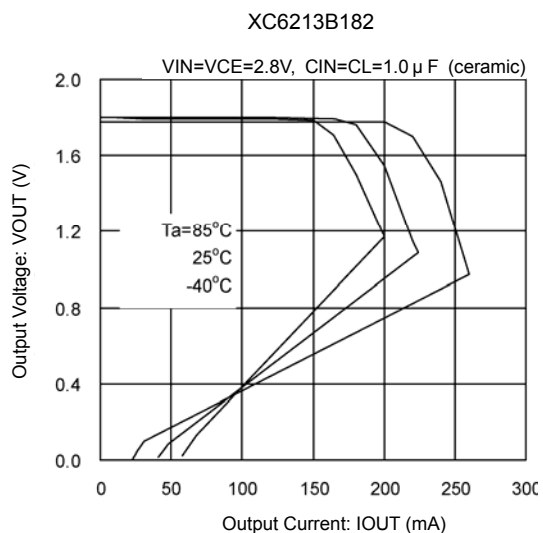
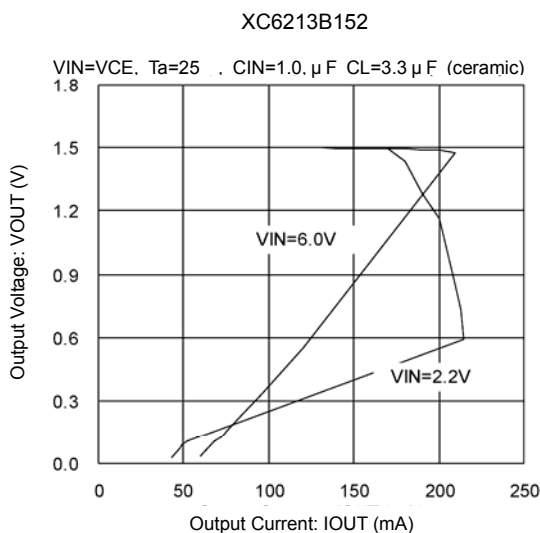
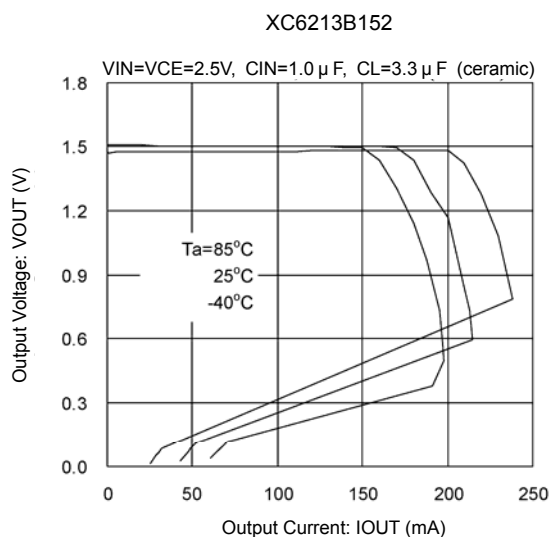
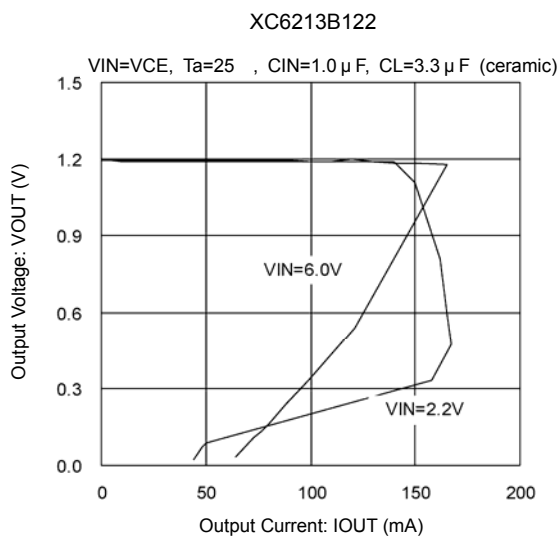
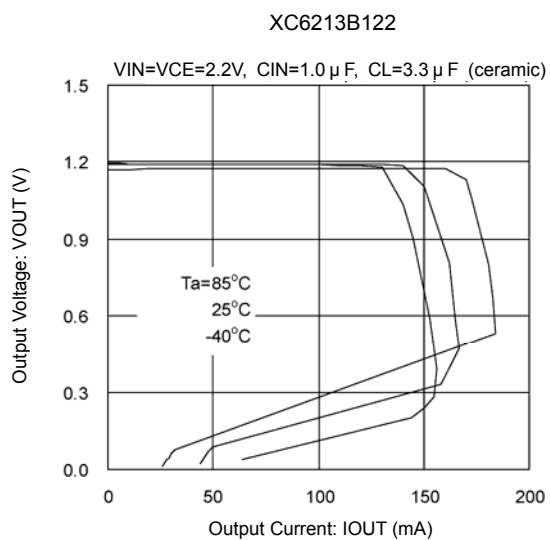
## NOTES ON USE

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 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. Should rapid input fluctuation or load fluctuation occur, please increase the capacitor value such as CIN or CL to stabilize the operation.
4. Make sure not to use the IC with large current at high temperature. When exceeding power dissipation of a package, heat occurs before short protection operates, and the IC may break.



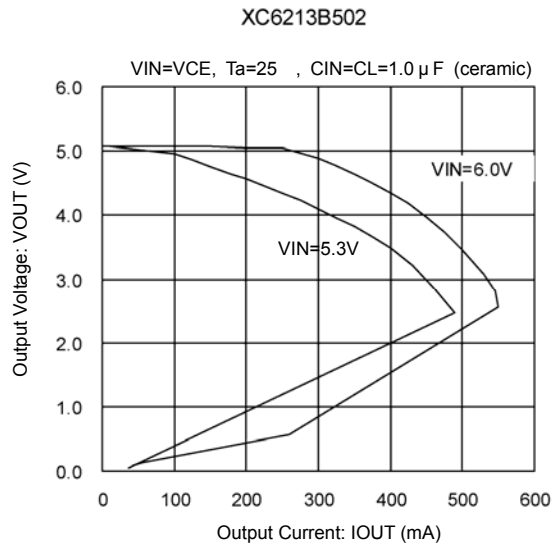
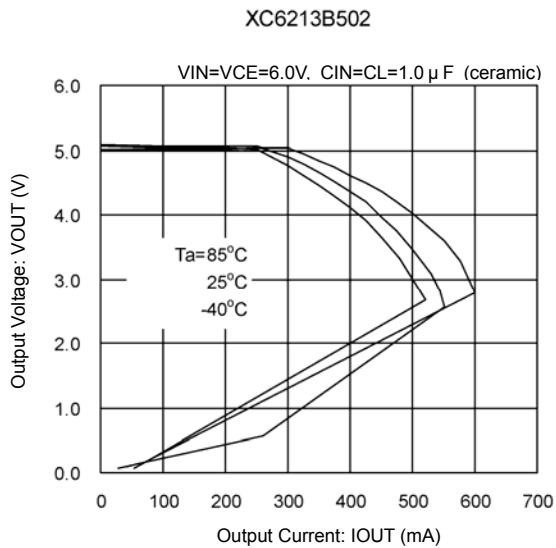
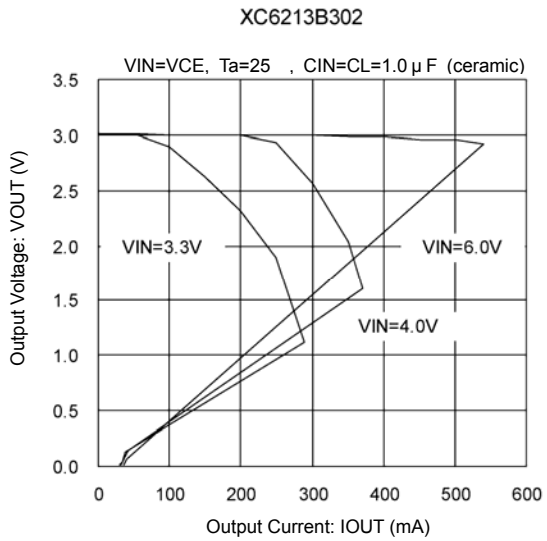
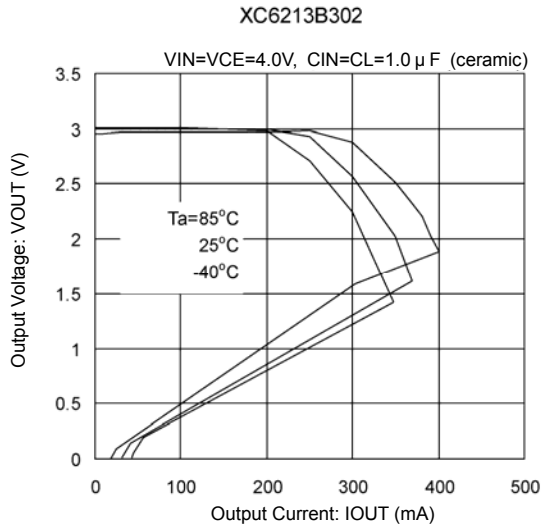
# TYPICAL PERFORMANCE CHARACTERISTICS

## (1) Output Voltage vs. Output Current



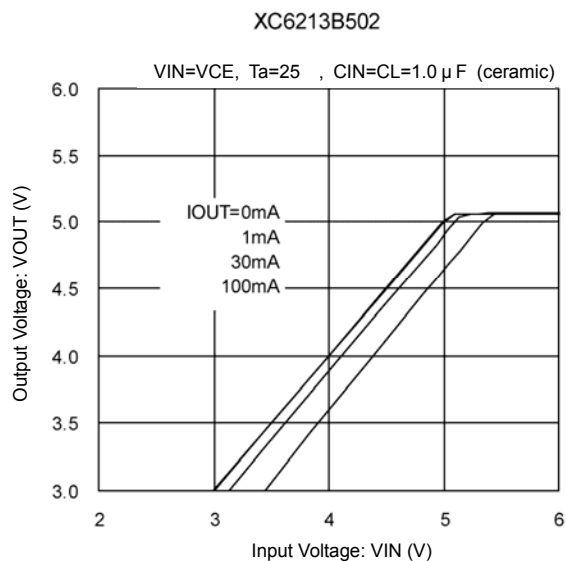
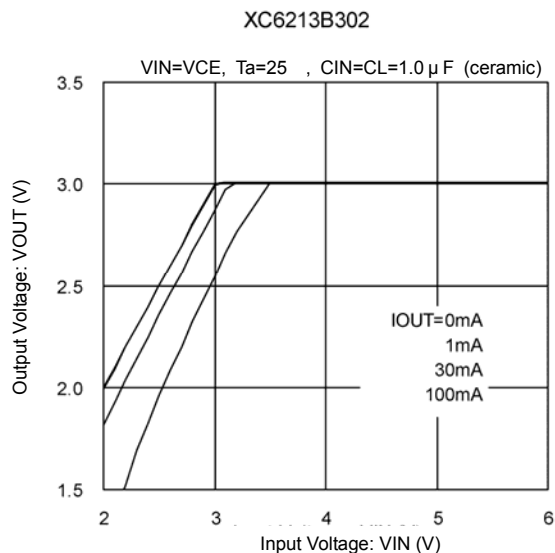
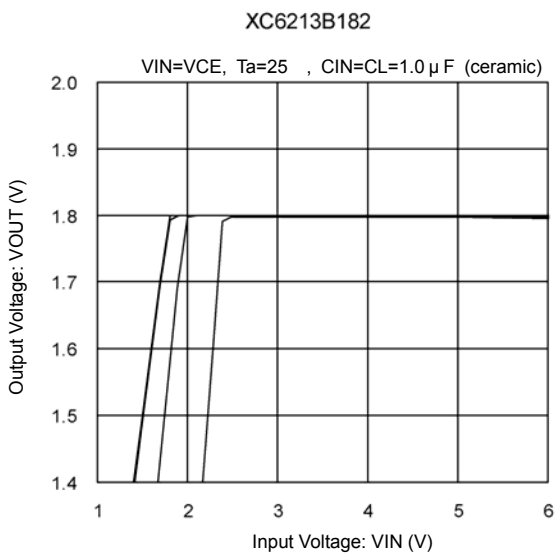
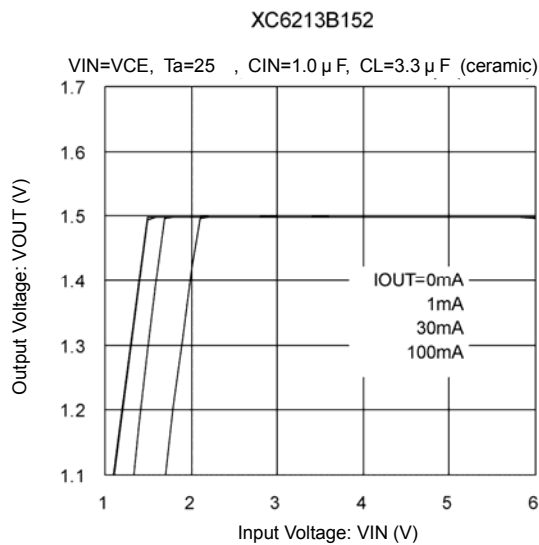
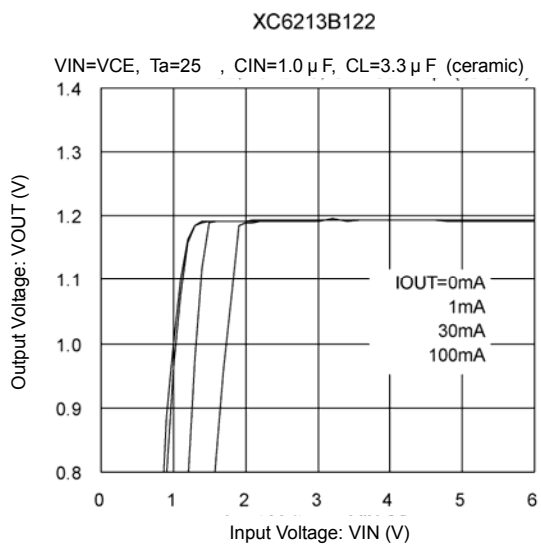
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (1) Output Voltage vs. Output Current (Continued)



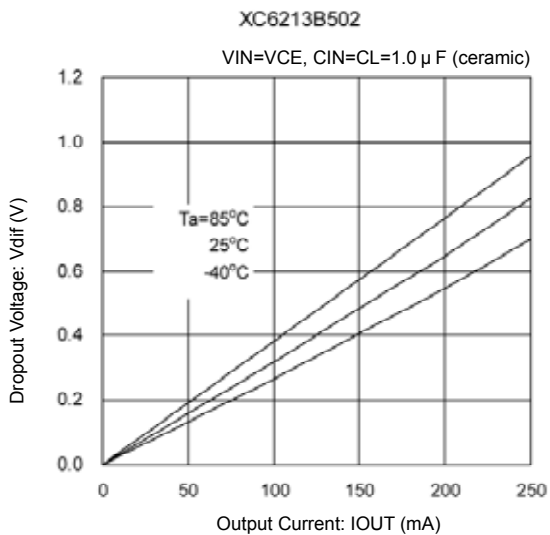
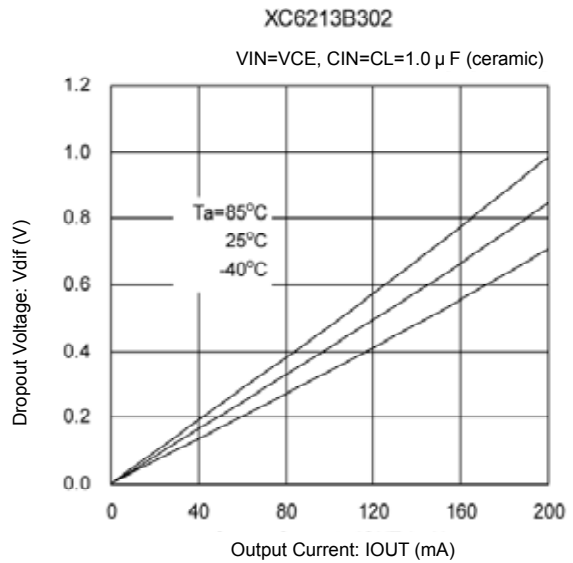
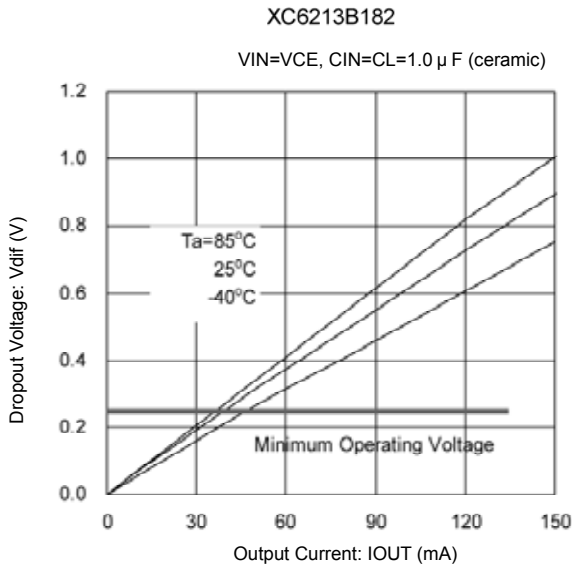
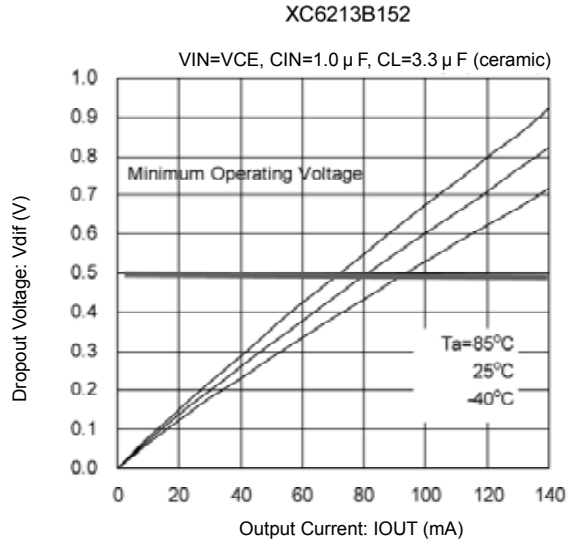
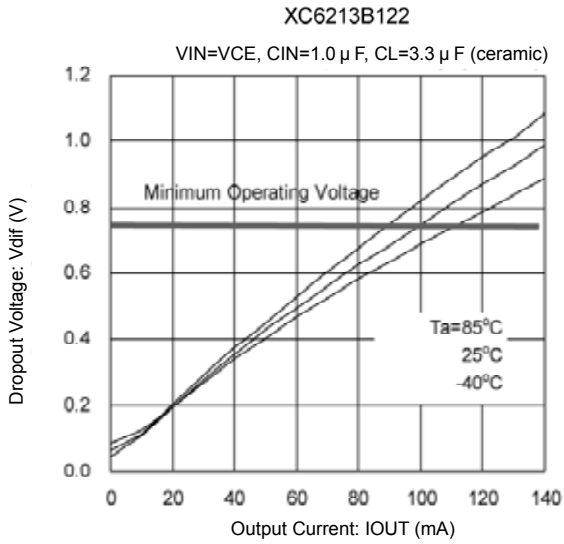
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (2) Output Voltage vs. Input Voltage



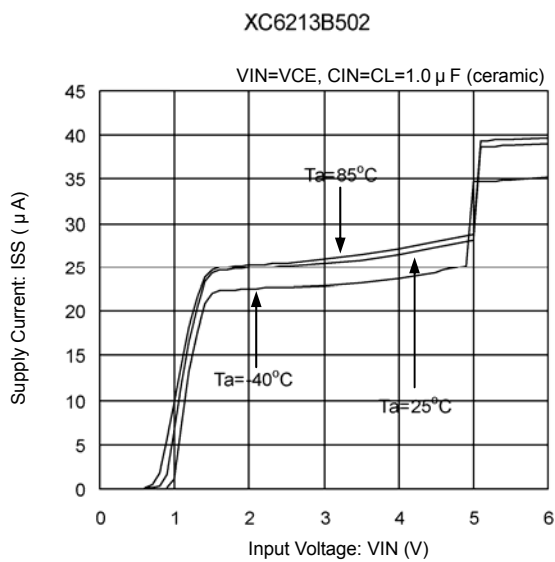
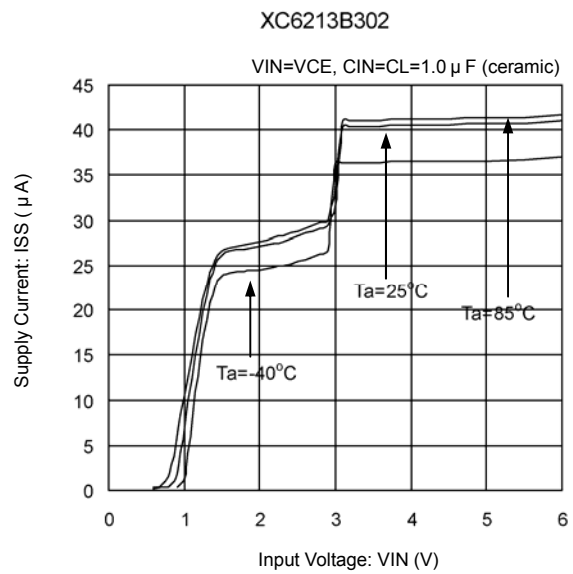
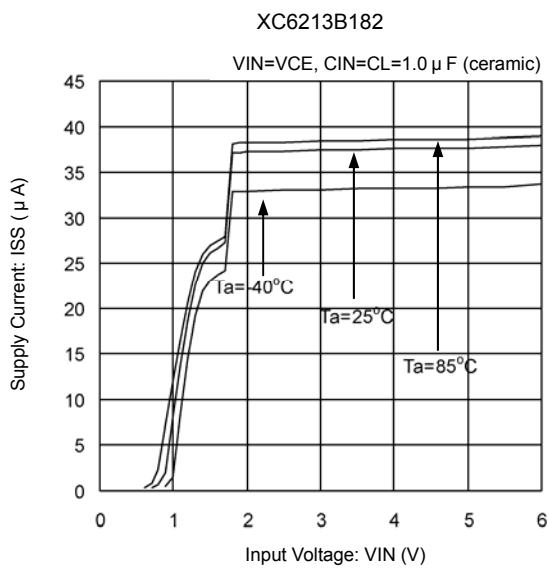
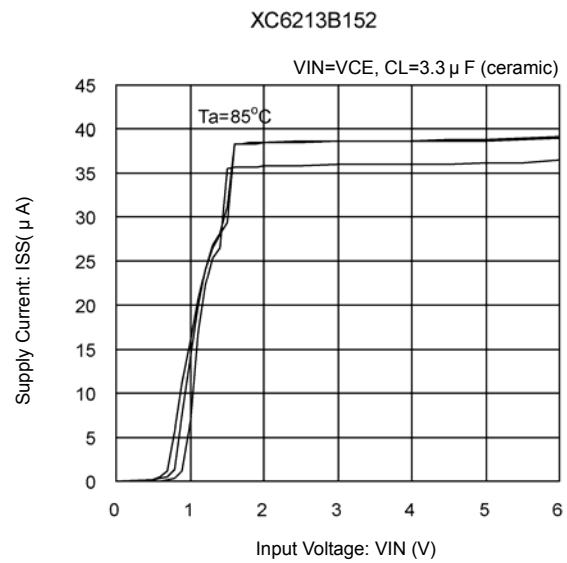
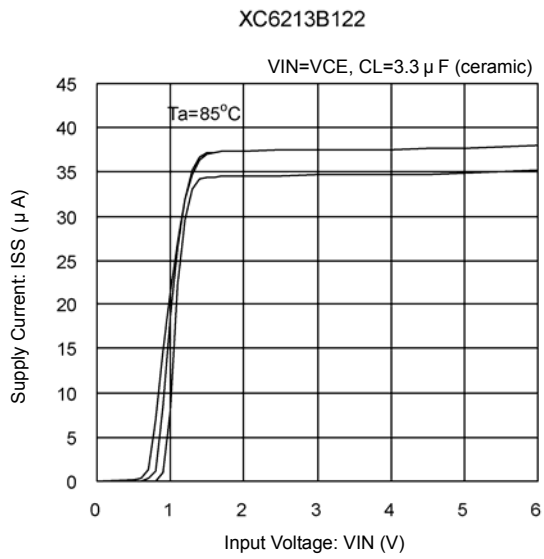
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (3) Dropout Voltage vs. Output Current



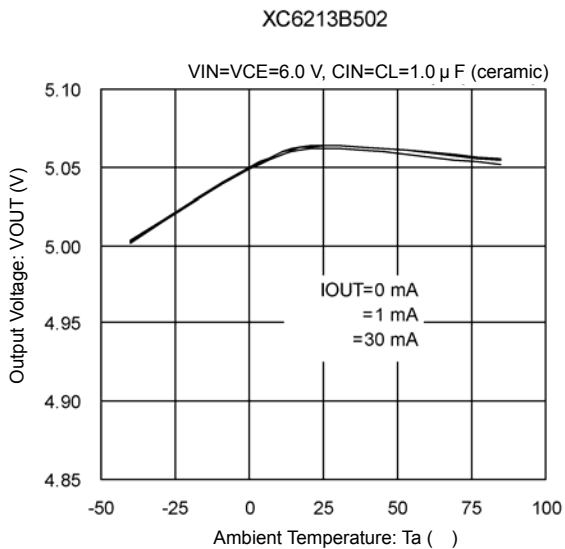
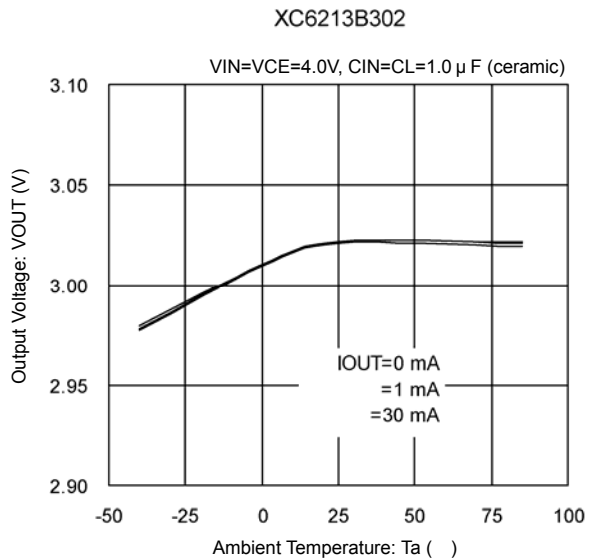
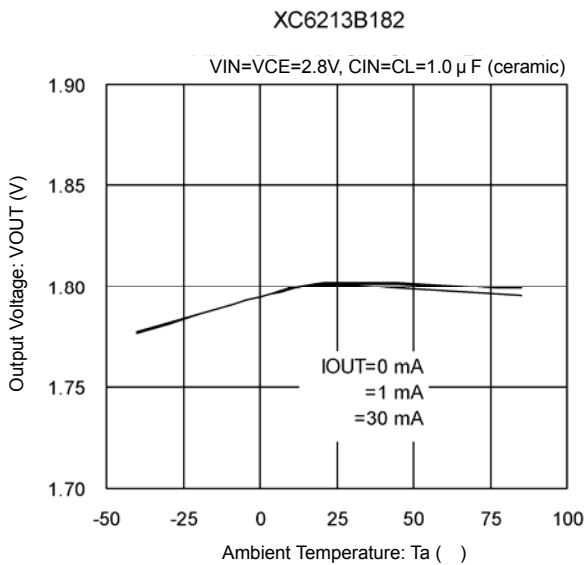
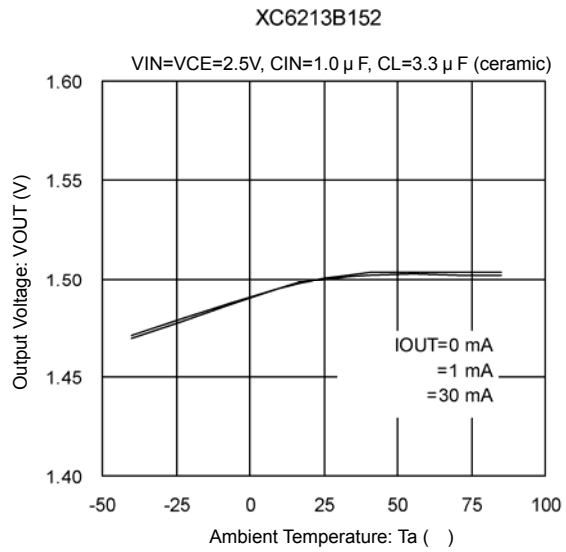
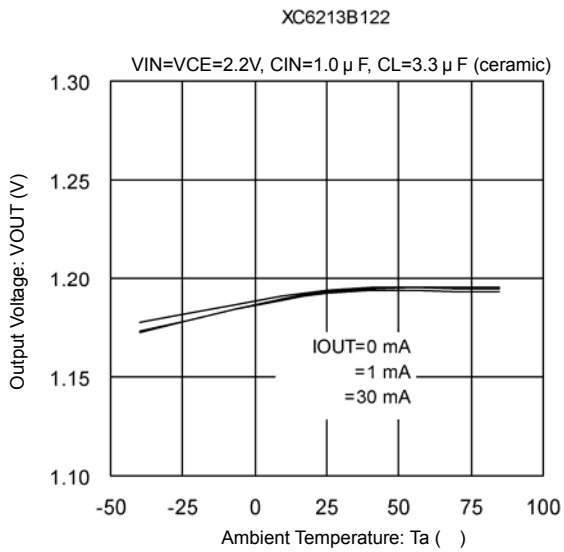
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

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



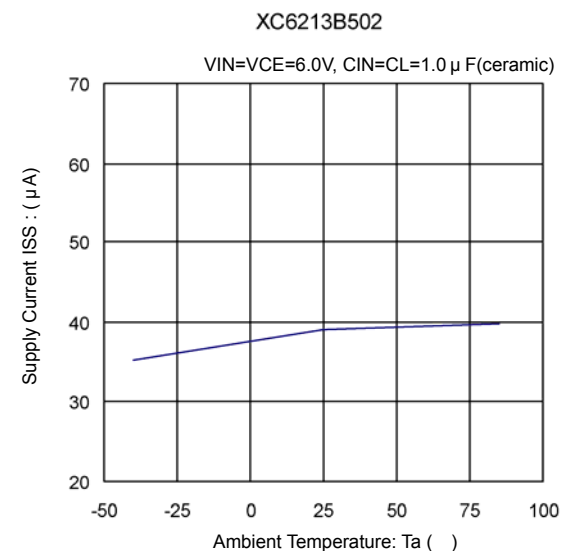
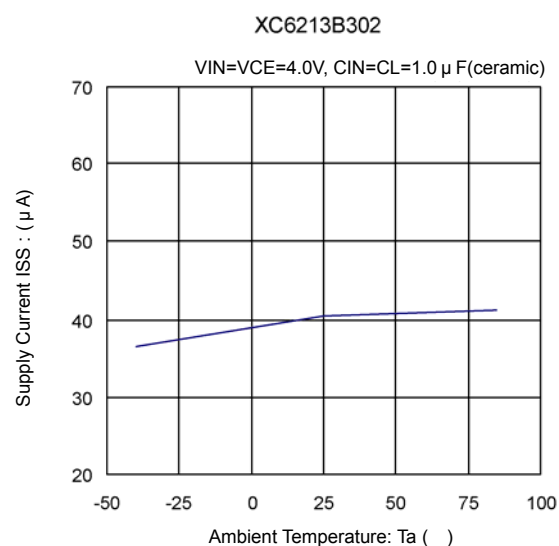
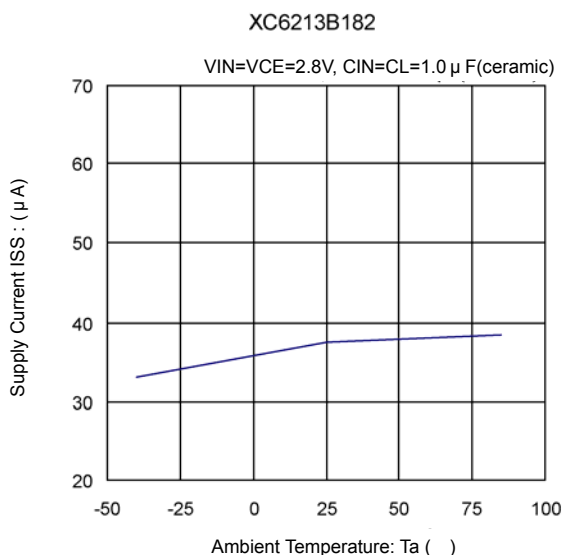
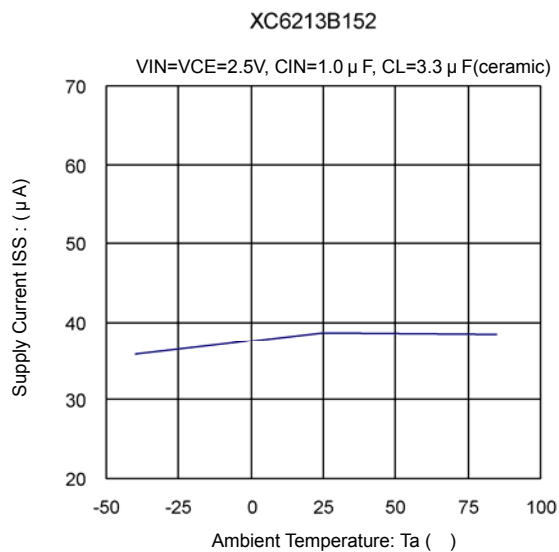
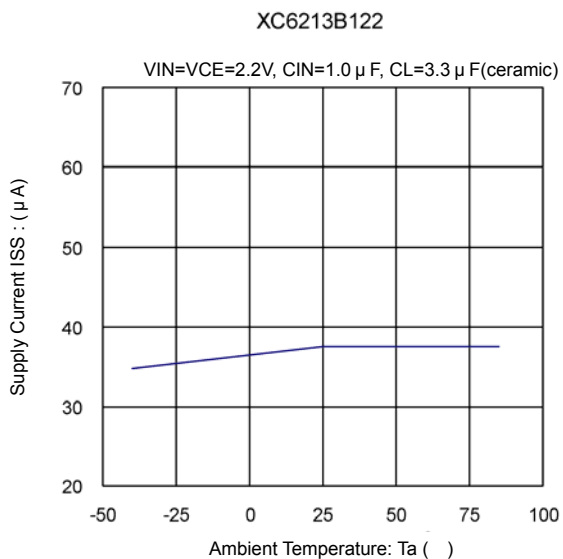
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (5) Output Voltage vs. Ambient Temperature

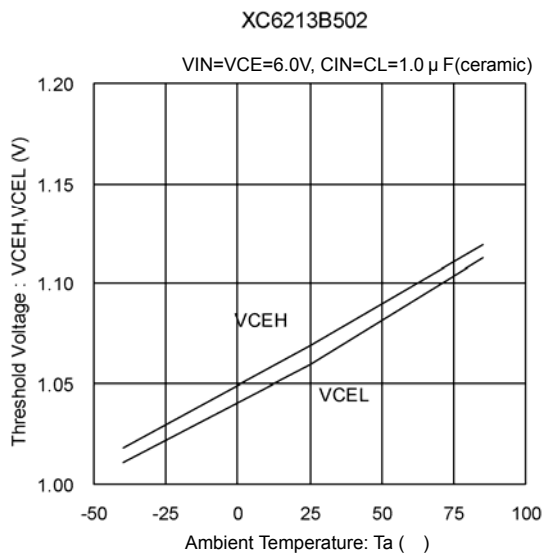


## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (6) Supply Current vs. Ambient Temperature



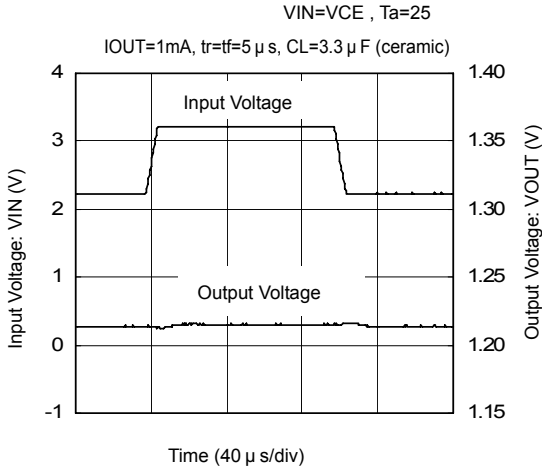
### (7) CE Threshold Voltage vs. Ambient Temperature



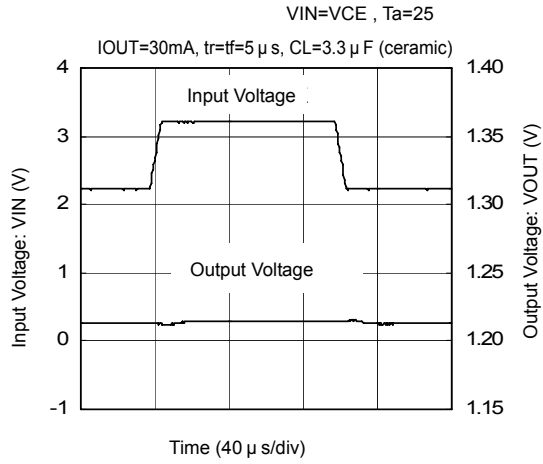
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (8) Input Transient Response

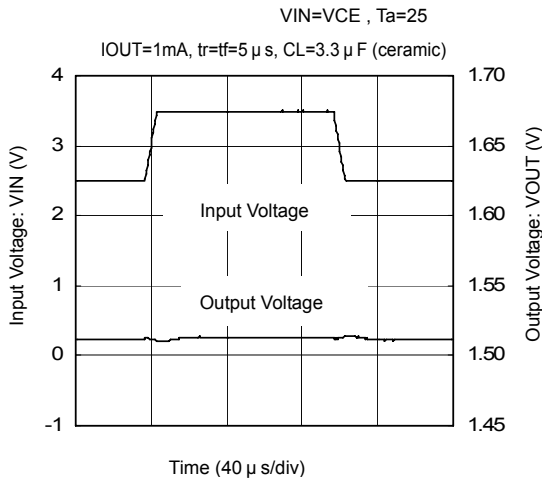
XC6213 B122



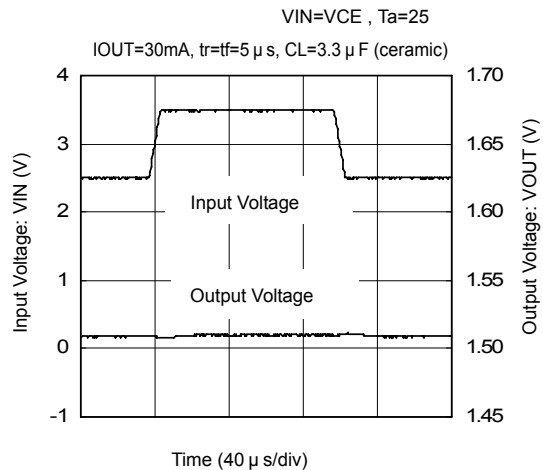
XC6213 B122



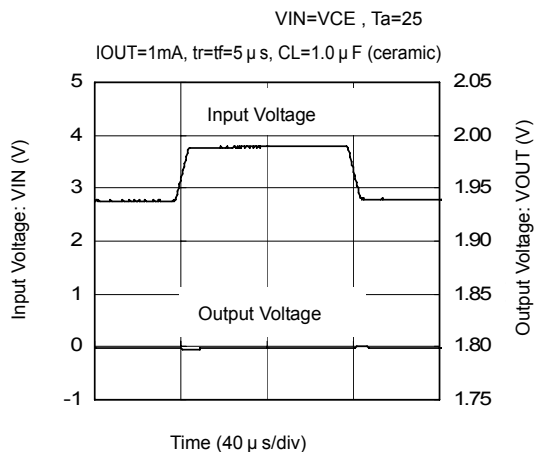
XC6213 B152



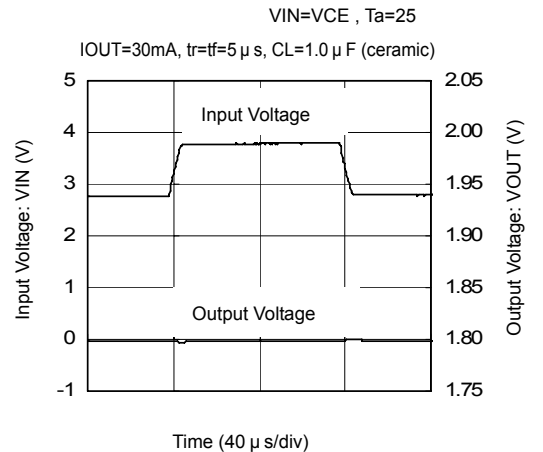
XC6213 B152



XC6213 B182



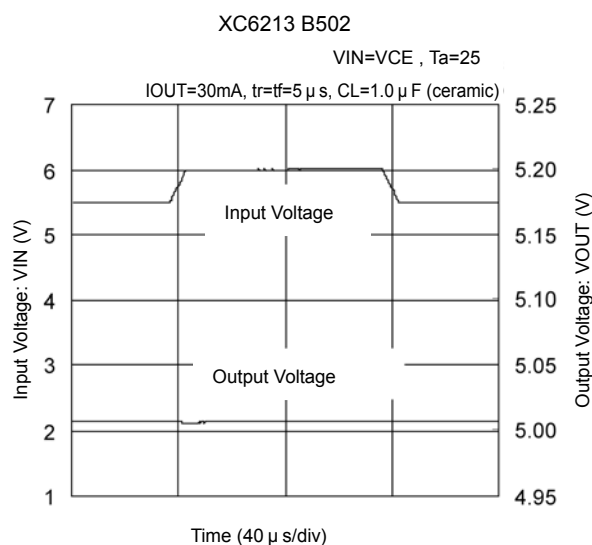
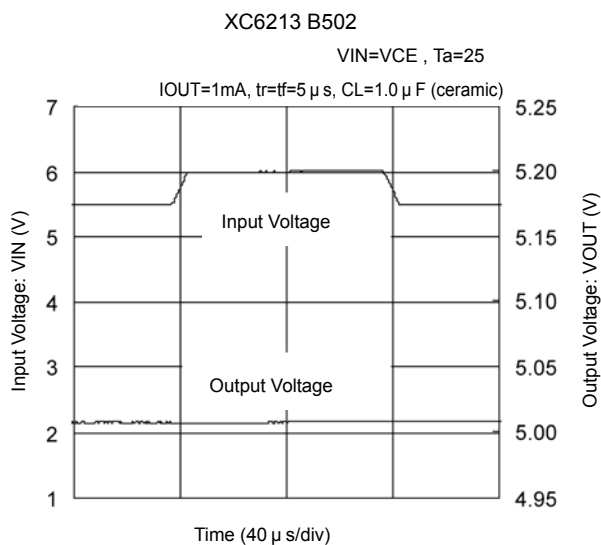
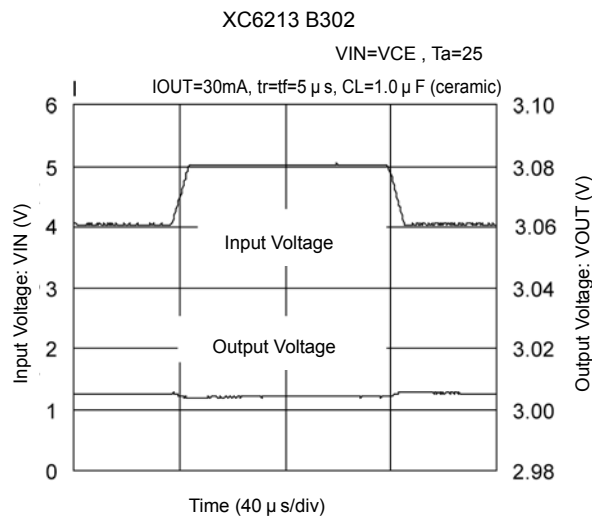
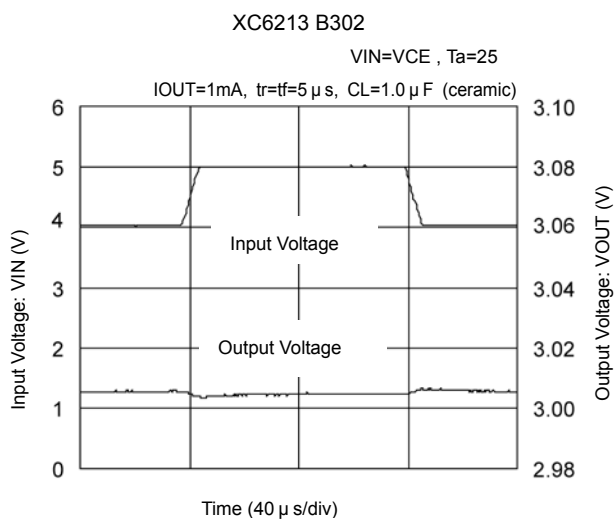
XC6213 B182





## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

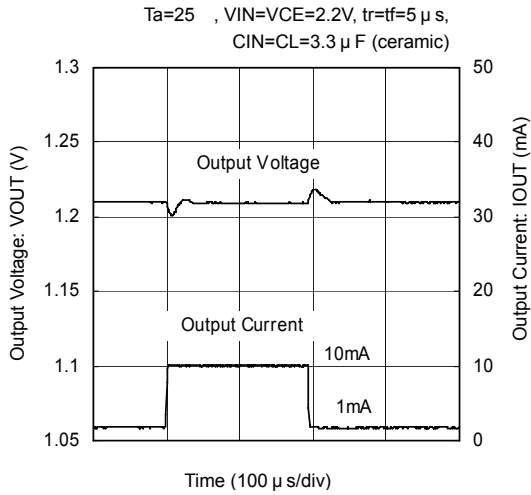
### (8) Input Transient Response (continued)



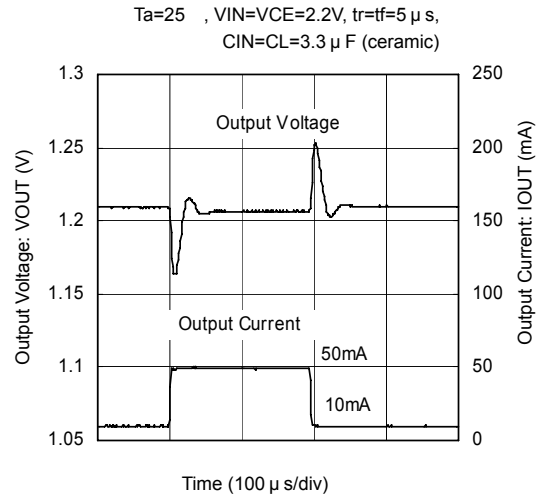
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (9) Load Transient Response

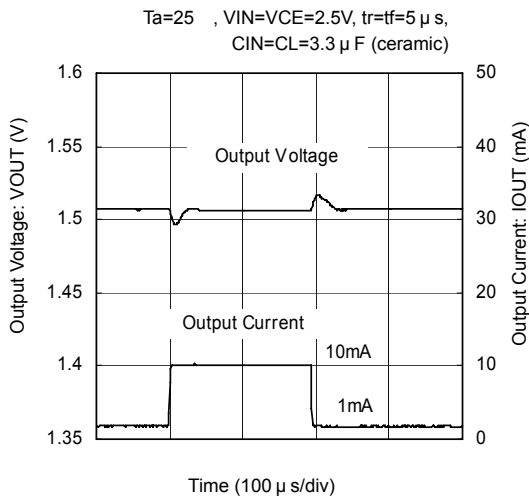
XC6213 B122



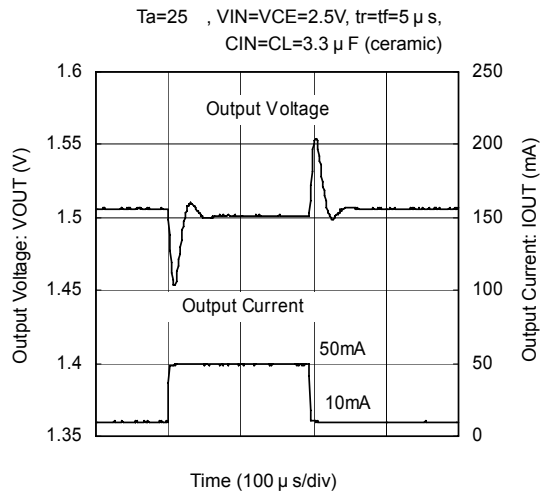
XC6213 B122



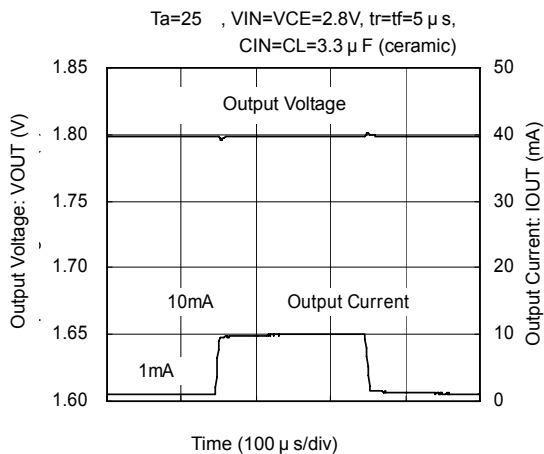
XC6213 B152



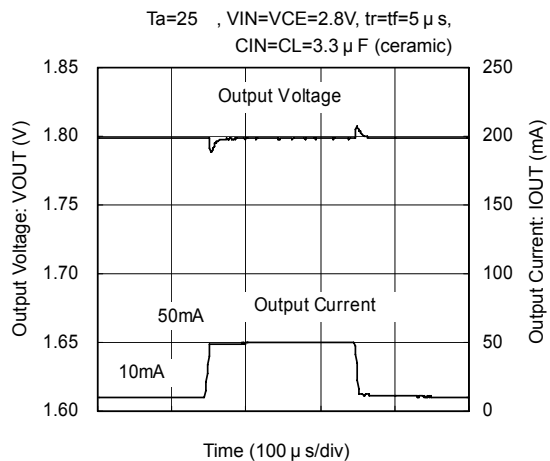
XC6213 B152



XC6213 B182

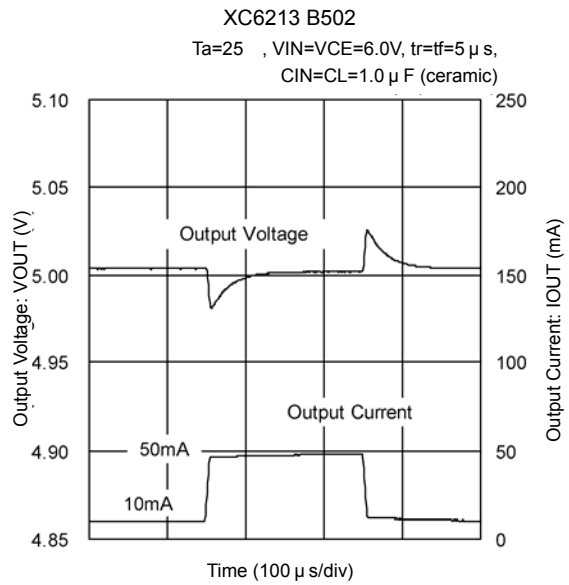
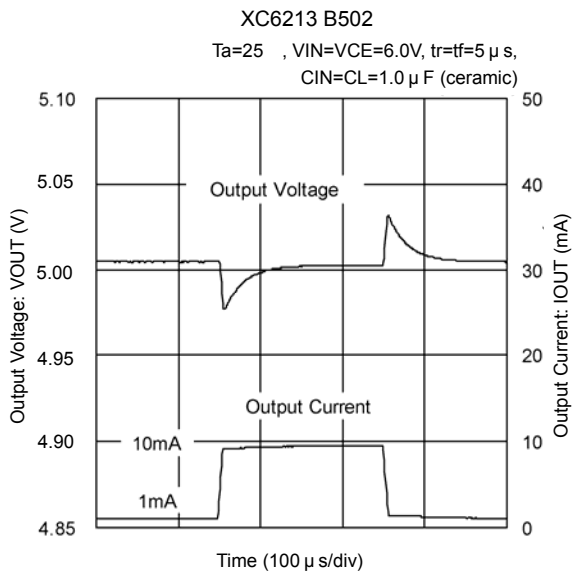
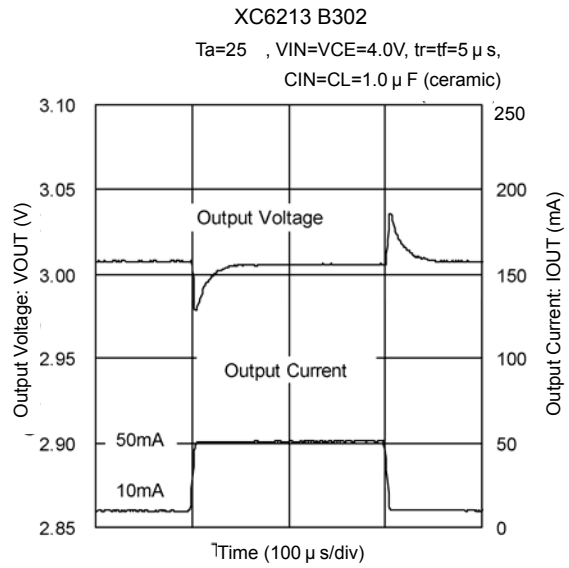
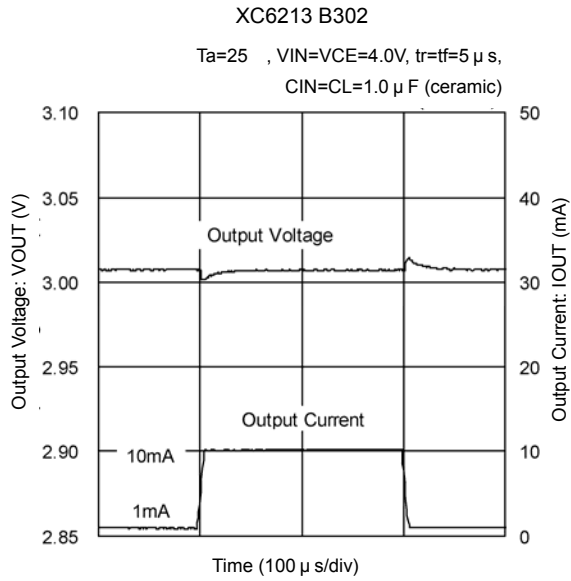


XC6213 B182



## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

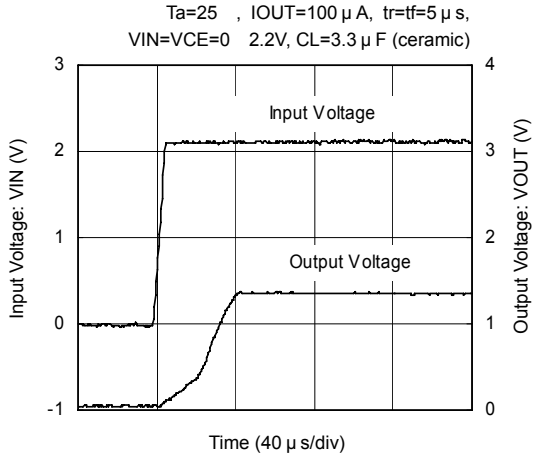
### (9) Load Transient Response (Continued)



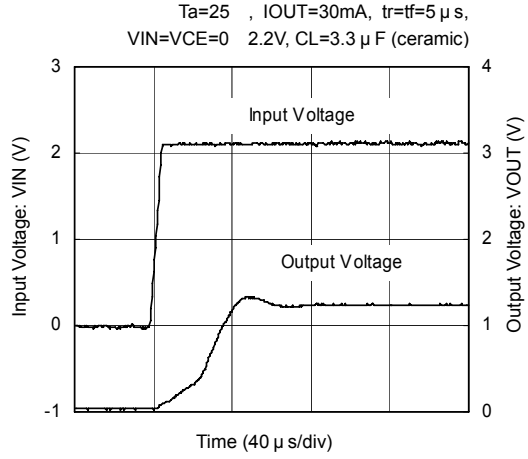
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (10) Turn-On Response

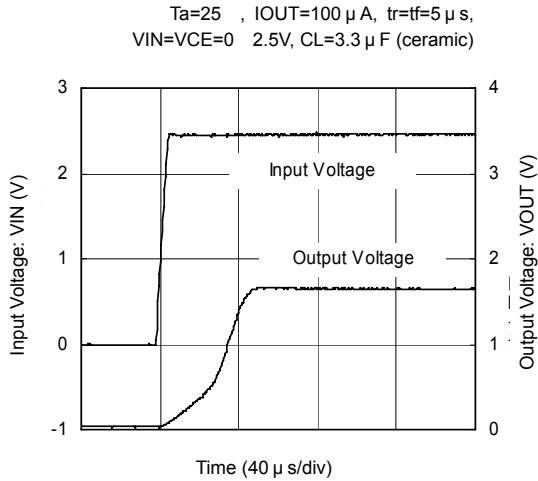
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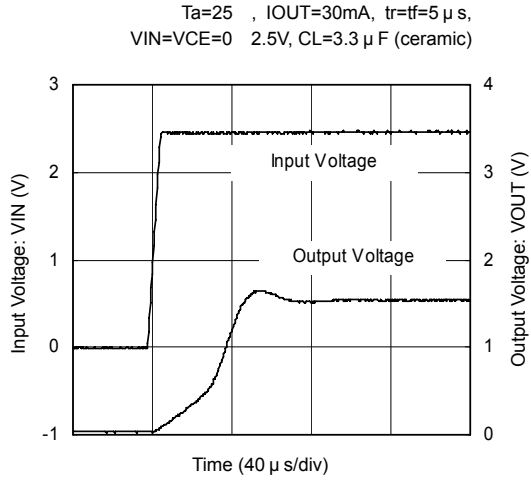
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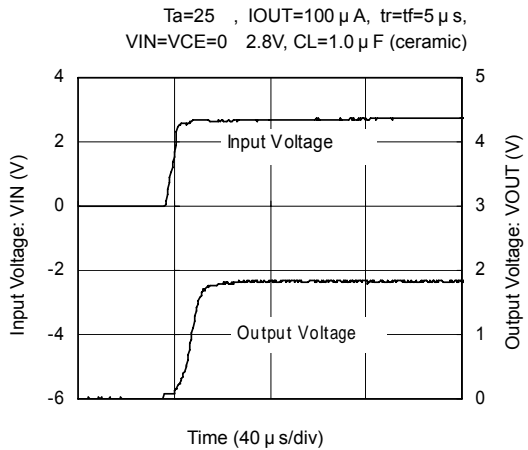
XC6213 B152



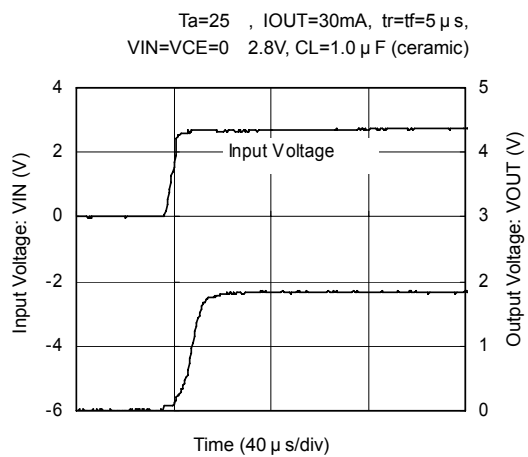
XC6213 B152



XC6213 B182

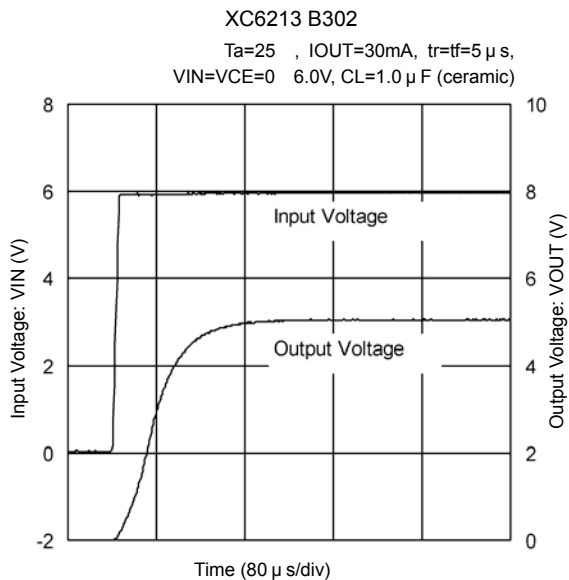
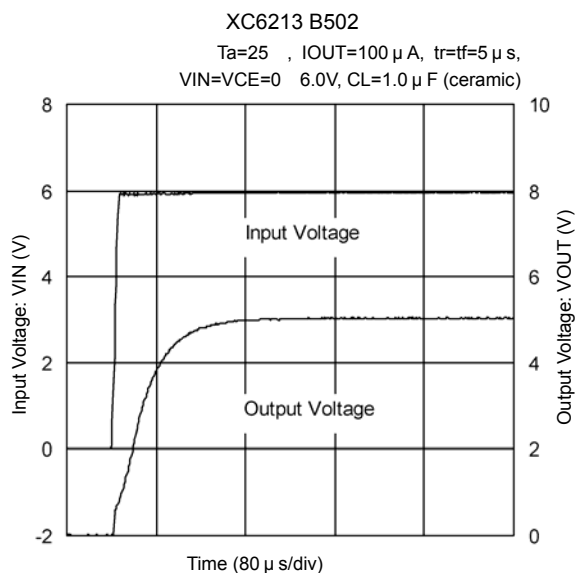
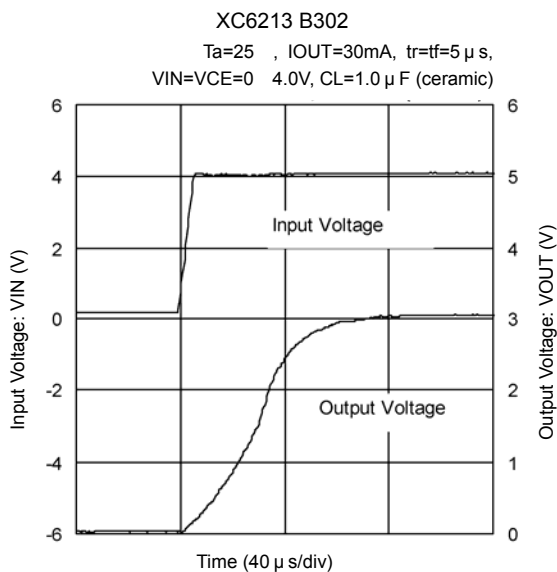
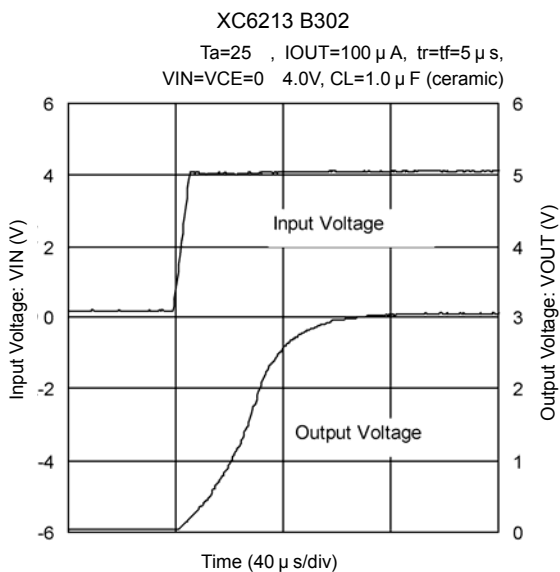


XC6213 B182



## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

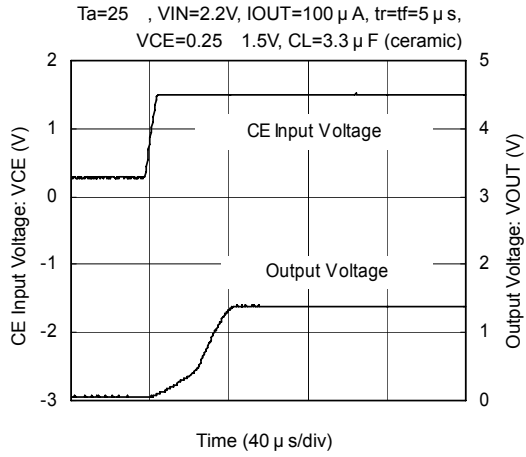
### (10) Turn-On Response (Continued)



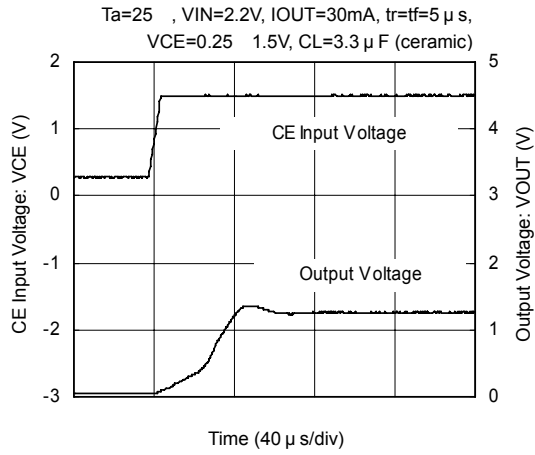
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (11) Enable Response

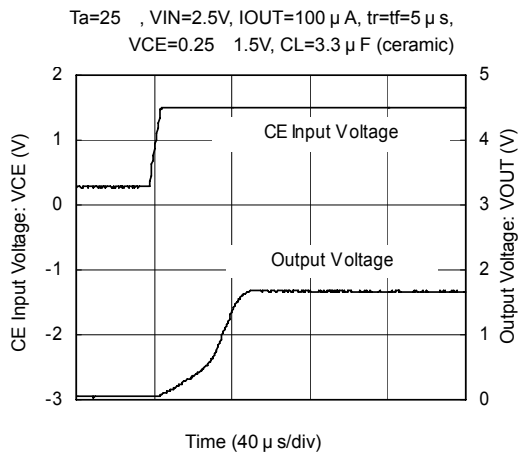
XC6213 B122



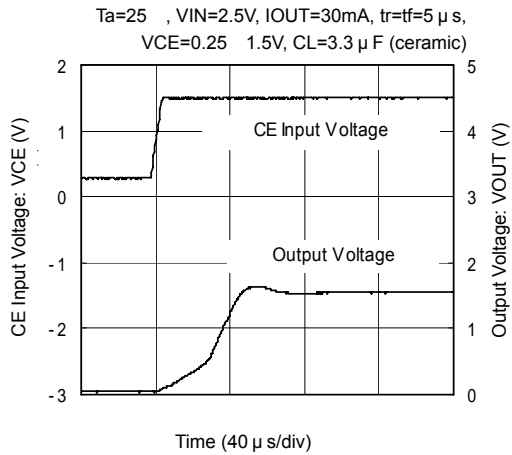
XC6213 B122



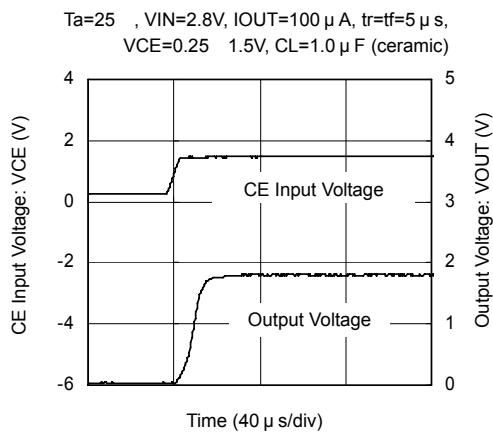
XC6213 B152



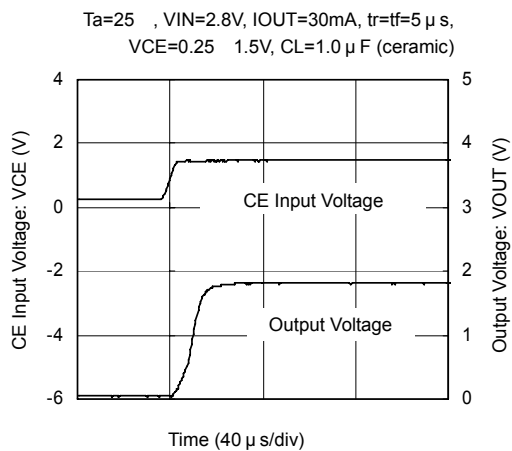
XC6213 B152



XC6213 B182

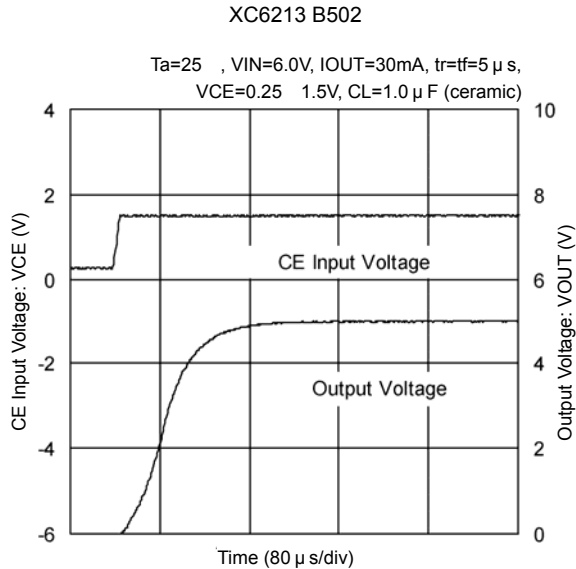
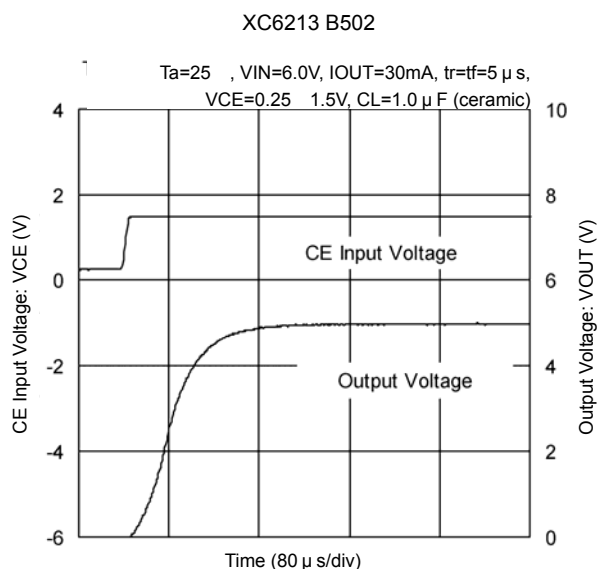
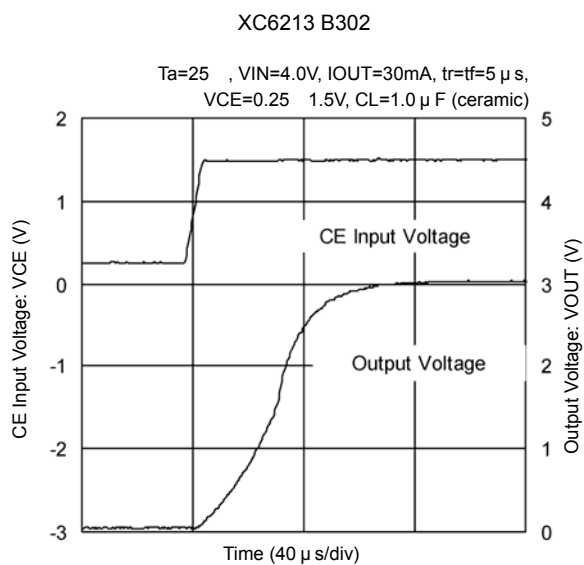
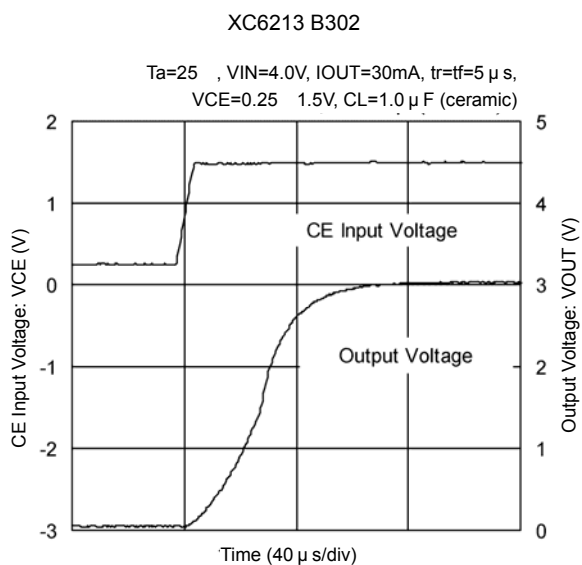


XC6213 B182



## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

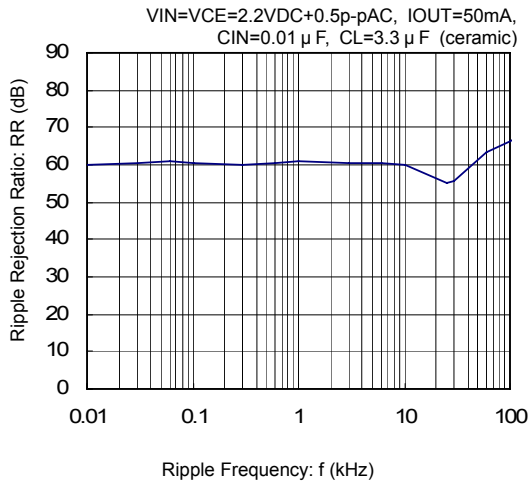
### (11) Enable Response (Continued)



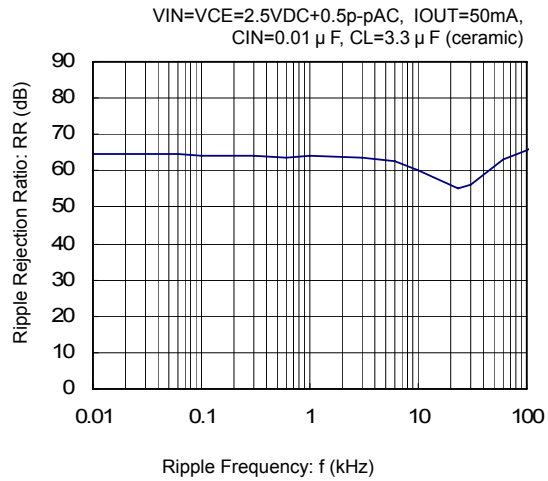
## TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### (12) Ripple Rejection Rate

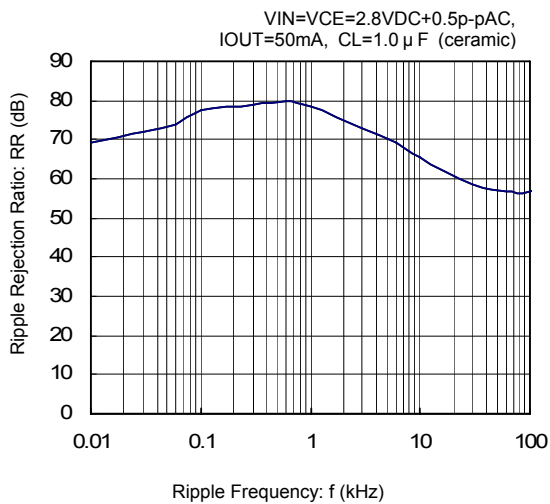
XC6213 B122



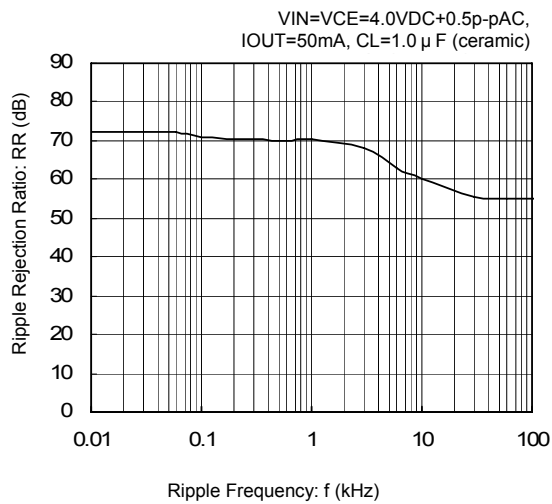
XC6213 B152



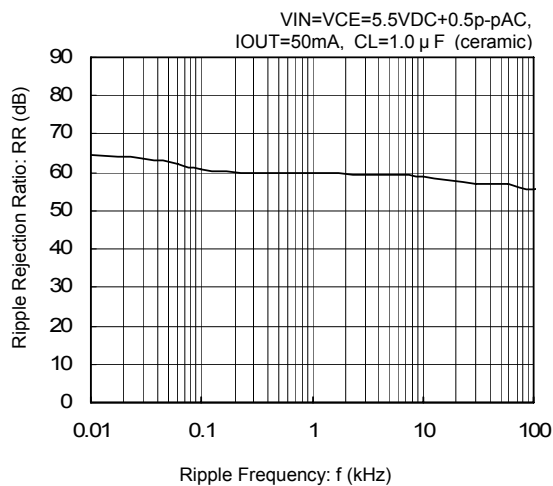
XC6213 B182



XC6213 B302



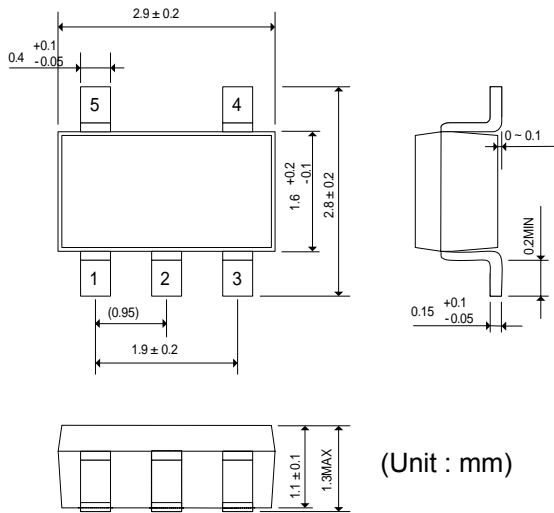
XC6213 B502



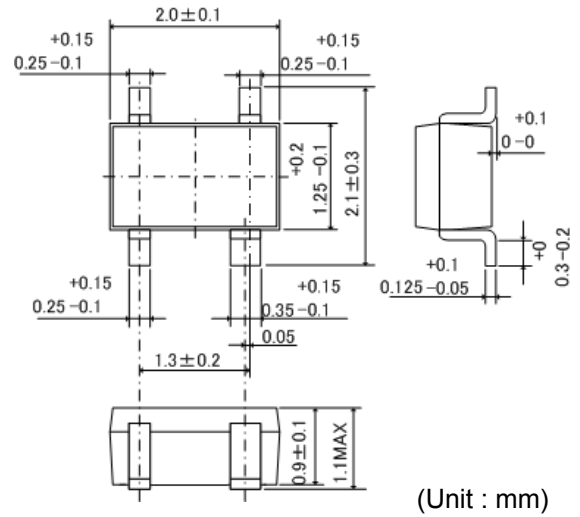


# PACKAGING INFORMATION

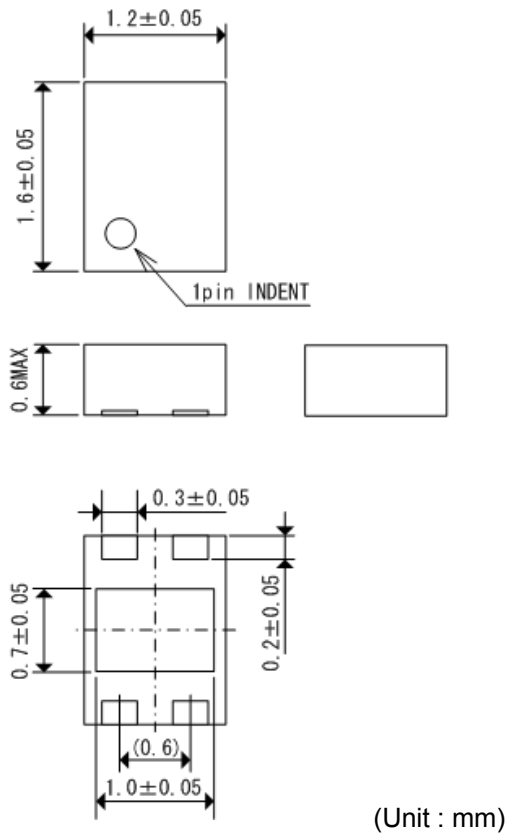
SOT-25



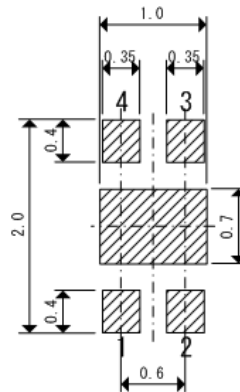
SSOT-24



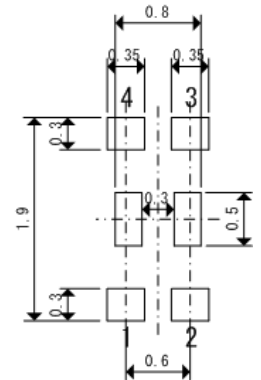
USP-4



Reference Pattern Layout

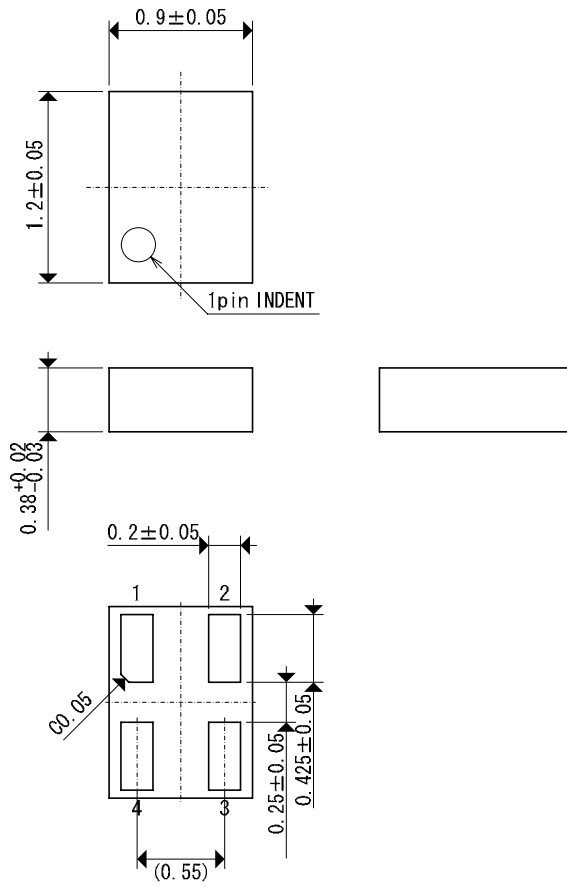


Reference Metal Mask Design

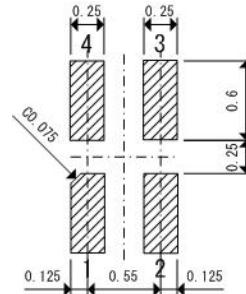


## PACKAGING INFORMATION (Continued)

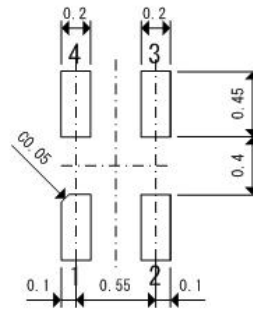
USPN-4



Reference pattern Layout

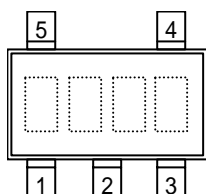


Reference metal mask design

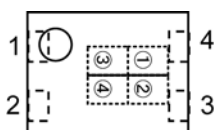


# MARKING RULE

SOT-25 & USP-4



SOT-25  
(TOP VIEW)



USP-4  
(TOP VIEW)

represents product series

| MARK | PRODUCT SERIES |
|------|----------------|
| C    | XC6213xxxxxx   |

represents type of regulator

| MARK                 |                      |                        |                        | PRODUCT SERIES |
|----------------------|----------------------|------------------------|------------------------|----------------|
| VOLTAGE<br>=0.1~3.0V | VOLTAGE<br>=3.1~6.0V | VOLTAGE<br>=0.15~3.05V | VOLTAGE<br>=3.15~6.05V |                |
| X                    | B                    | F                      | M                      | XC6213xxxxxx   |

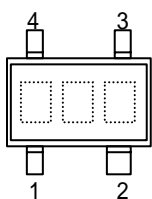
represents output voltage

| MARK | OUTPUT VOLTAGE (V) |     |      |      | MARK | 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    | -                  | 3.6 | -    | 3.65 | N    | 2.1                | -   | 2.15 | -    |
| 6    | -                  | 3.7 | -    | 3.75 | P    | 2.2                | -   | 2.25 | -    |
| 7    | -                  | 3.8 | -    | 3.85 | R    | 2.3                | -   | 2.35 | -    |
| 8    | -                  | 3.9 | -    | 3.95 | S    | 2.4                | -   | 2.45 | -    |
| 9    | -                  | 4.0 | -    | 4.05 | T    | 2.5                | -   | 2.55 | -    |
| A    | -                  | 4.1 | -    | 4.15 | U    | 2.6                | -   | 2.65 | -    |
| B    | 1.2                | 4.2 | 1.25 | 4.25 | V    | 2.7                | -   | 2.75 | -    |
| C    | 1.3                | 4.3 | 1.35 | 4.35 | X    | 2.8                | -   | 2.85 | -    |
| D    | 1.4                | 4.4 | 1.45 | 4.45 | Y    | 2.9                | -   | 2.95 | -    |
| E    | 1.5                | 4.5 | 1.55 | 4.55 | Z    | 3.0                | -   | 3.05 | -    |

represents production lot number

0 to 9, to Z reverse character 0 to 9, A to Z repeated (G, I, J, O, Q, W excluded)

SSOT-24



SSOT-24 (SC-82)  
(TOP VIEW)

represents integer of output voltage

| MARK | VOLTAGE (V) | PRODUCT SERIES |
|------|-------------|----------------|
| 3    | 3.X         | XC6213B3xxNx   |
| 5    | 5.X         | XC6213B5xxNx   |

represents decimal point of output voltage

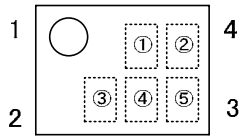
| MARK | VOLTAGE (V) | PRODUCT SERIES | MARK | VOLTAGE (V) | PRODUCT SERIES |
|------|-------------|----------------|------|-------------|----------------|
| 0    | X.0         | XC6213Bx0xNx   | A    | X.05        | XC6213Bx0ANx   |
| 1    | X.1         | XC6213Bx1xNx   | B    | X.15        | XC6213Bx1ANx   |
| 2    | X.2         | XC6213Bx2xNx   | C    | X.25        | XC6213Bx2ANx   |
| 3    | X.3         | XC6213Bx3xNx   | D    | X.35        | XC6213Bx3ANx   |
| 4    | X.4         | XC6213Bx4xNx   | E    | X.45        | XC6213Bx4ANx   |
| 5    | X.5         | XC6213Bx5xNx   | F    | X.55        | XC6213Bx5ANx   |
| 6    | X.6         | XC6213Bx6xNx   | H    | X.65        | XC6213Bx6ANx   |
| 7    | X.7         | XC6213Bx7xNx   | K    | X.75        | XC6213Bx7ANx   |
| 8    | X.8         | XC6213Bx8xNx   | L    | X.85        | XC6213Bx8ANx   |
| 9    | X.9         | XC6213Bx9xNx   | M    | X.95        | XC6213Bx9ANx   |

represents production lot number

0 to 9, A to Z repeated (G, I, J, O, Q, W excluded). Note: No character inversion used.

## MARKING RULE (Continued)

USPN-4



represents product series

| MARK | PRODUCT SERIES |
|------|----------------|
| C    | XC6213xxxxxx   |

represents type of regulator

| MARK                 |                      |                        |                        | PRODUCT SERIES |
|----------------------|----------------------|------------------------|------------------------|----------------|
| VOLTAGE<br>=0.1~3.0V | VOLTAGE<br>=3.1~6.0V | VOLTAGE<br>=0.15~3.05V | VOLTAGE<br>=3.15~6.05V |                |
| X                    | B                    | F                      | M                      | XC6213Bxxxxx   |

represents output voltage

| MARK | OUTPUT VOLTAGE (V) |     |      |      | MARK | 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    | -                  | 3.6 | -    | 3.65 | N    | 2.1                | -   | 2.15 | -    |
| 6    | -                  | 3.7 | -    | 3.75 | P    | 2.2                | -   | 2.25 | -    |
| 7    | -                  | 3.8 | -    | 3.85 | R    | 2.3                | -   | 2.35 | -    |
| 8    | -                  | 3.9 | -    | 3.95 | S    | 2.4                | -   | 2.45 | -    |
| 9    | -                  | 4.0 | -    | 4.05 | T    | 2.5                | -   | 2.55 | -    |
| A    | -                  | 4.1 | -    | 4.15 | U    | 2.6                | -   | 2.65 | -    |
| B    | 1.2                | 4.2 | 1.25 | 4.25 | V    | 2.7                | -   | 2.75 | -    |
| C    | 1.3                | 4.3 | 1.35 | 4.35 | X    | 2.8                | -   | 2.85 | -    |
| D    | 1.4                | 4.4 | 1.45 | 4.45 | Y    | 2.9                | -   | 2.95 | -    |
| E    | 1.5                | 4.5 | 1.55 | 4.55 | Z    | 3.0                | -   | 3.05 | -    |

represents production lot number

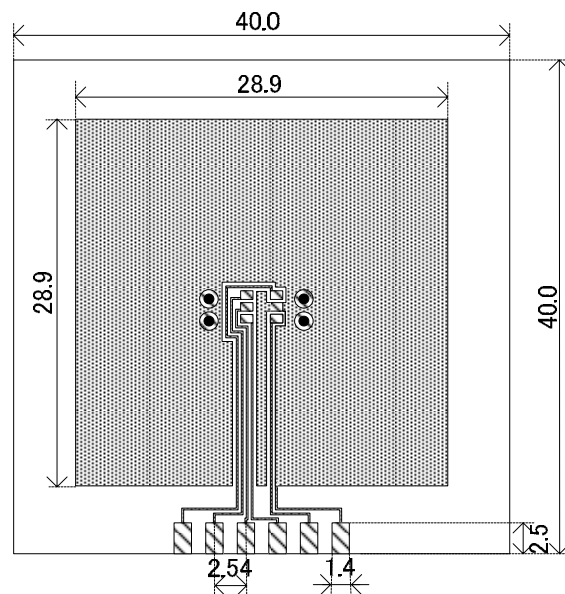
01 to 09, 0A to 0Z 11 to 9Z, A1 to A9, AA to Z9, ZA to ZZ repeated  
(G, I, J, O, Q, W excluded). Note: No character inversion used.

SOT-25 Power Dissipation

Power dissipation data for the SOT-25 is shown in this page.  
The value of power dissipation varies with the mount board conditions.  
Please use this data as one of reference data taken in the described condition.

1. Measurement Condition (Reference data)

- Condition: Mount on a board
- Ambient: Natural convection
- Soldering: Lead (Pb) free
- Board: Dimensions 40 x 40 mm (1600 mm<sup>2</sup> in one side)  
Copper (Cu) traces occupy 50% of the board area  
In top and back faces  
Package heat-sink is tied to the copper traces  
(Board of SOT-26 is used.)
- Material: Glass Epoxy (FR-4)
- Thickness: 1.6 mm
- Through-hole: 4 x 0.8 Diameter

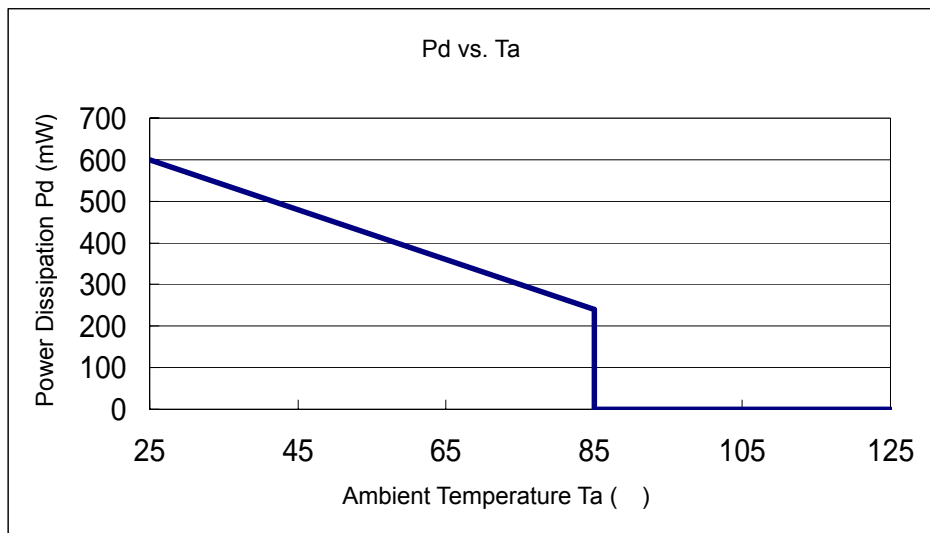


Evaluation Board (Unit: mm)

2. Power Dissipation vs. Ambient temperature

Board Mount (T<sub>j</sub> max = 125 °C)

| Ambient Temperature ( °C ) | Power Dissipation Pd (mW) | Thermal Resistance ( °C/W ) |
|----------------------------|---------------------------|-----------------------------|
| 25                         | 600                       | 166.67                      |
| 85                         | 240                       |                             |

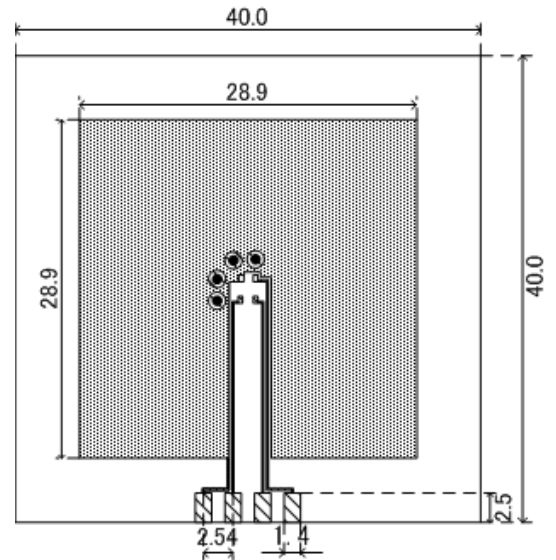


## SSOT-24 Power Dissipation

Power dissipation data for the SSOT-24 is shown in this page. The value of power dissipation varies with the mount board conditions. Please use this data as one of reference data taken in the described condition.

### 1. Measurement Condition (Reference data)

- Condition: Mount on a board
- Ambient: Natural convection
- Soldering: Lead (Pb) free
- Board: Dimensions 40 x 40 mm (1600 mm<sup>2</sup> in one side)  
Copper (Cu) traces occupy 50% of the board area  
In top and back faces  
Package heat-sink is tied to the copper traces
- Material: Glass Epoxy (FR-4)
- Thickness: 1.6 mm
- Through-hole: 4 x 0.8 Diameter

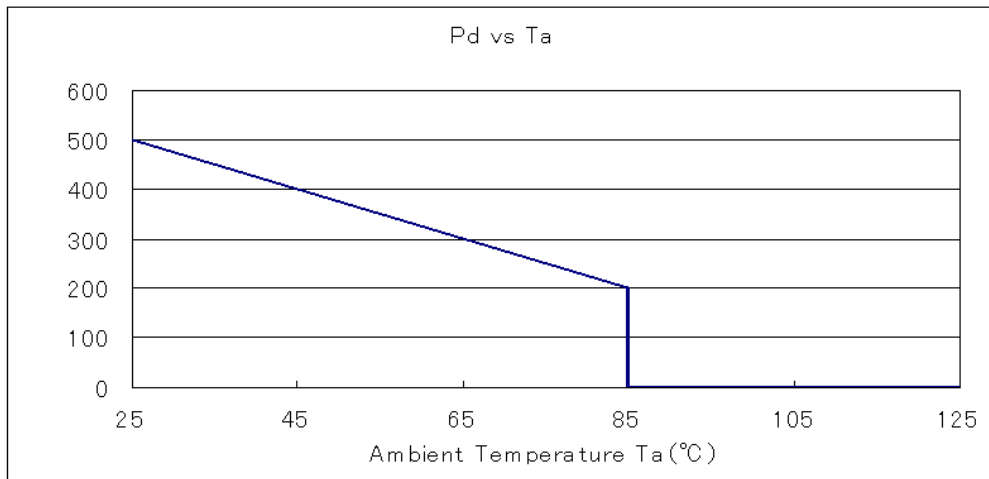


Evaluation Board (Unit: mm)

### 2. Power Dissipation vs. Ambient temperature

Board Mount ( $T_j \text{ max} = 125$  )

| Ambient Temperature ( ) | Power Dissipation Pd (mW) | Thermal Resistance ( /W) |
|-------------------------|---------------------------|--------------------------|
| 25                      | 500                       | 200.00                   |
| 85                      | 200                       |                          |

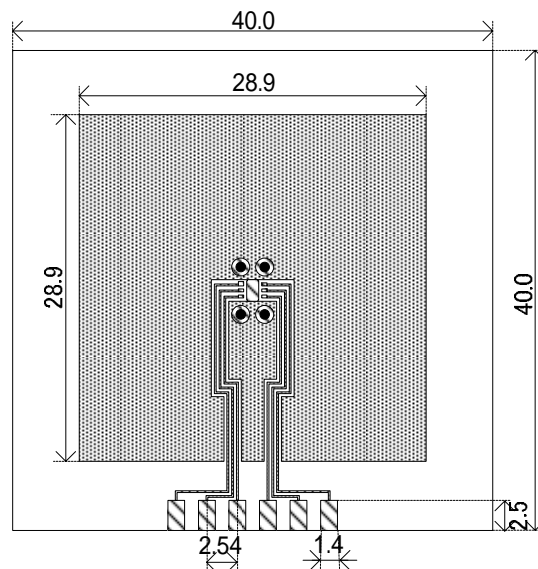


**USP-4 Power Dissipation**

Power dissipation data for the USP-4 is shown in this page.  
The value of power dissipation varies with the mount board conditions.  
Please use this data as one of reference data taken in the described condition.

**1. Measurement Condition (Reference data)**

- Condition: Mount on a board
- Ambient: Natural convection
- Soldering: Lead (Pb) free
- Board: Dimensions 40 x 40 mm (1600 mm<sup>2</sup> in one side)  
Copper (Cu) traces occupy 50% of the board area  
In top and back faces  
Package heat-sink is tied to the copper traces
- Material: Glass Epoxy (FR-4)
- Thickness: 1.6 mm
- Through-hole: 4 x 0.8 Diameter

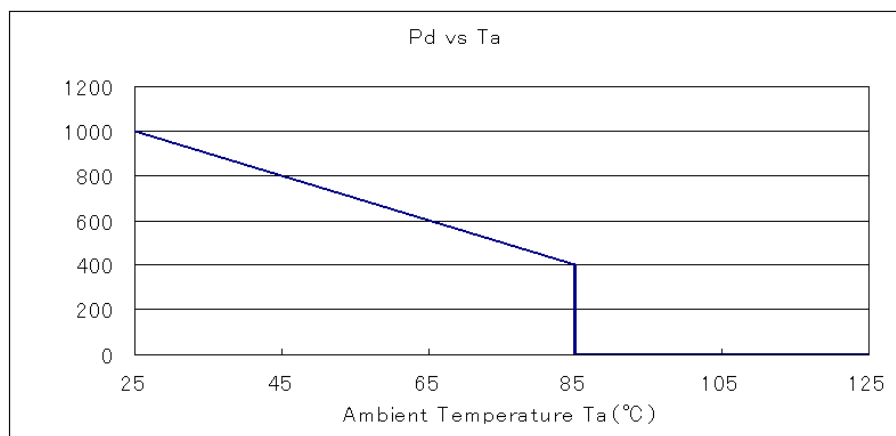


Evaluation Board (Unit: mm)

**2. Power Dissipation vs. Ambient temperature**

Board Mount ( $T_j \text{ max} = 125$  )

| Ambient Temperature ( ) | Power Dissipation Pd (mW) | Thermal Resistance ( /W) |
|-------------------------|---------------------------|--------------------------|
| 25                      | 1000                      | 100.00                   |
| 85                      | 400                       |                          |

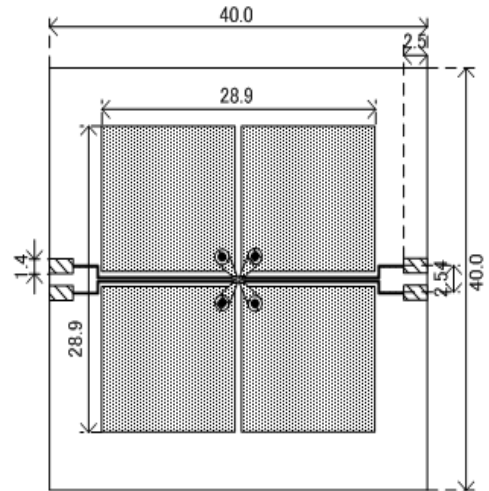


## USPN-4 Power Dissipation

Power dissipation data for the USPN-4 is shown in this page. The value of power dissipation varies with the mount board conditions. Please use this data as one of reference data taken in the described condition.

### 1. Measurement Condition (Reference data)

- Condition: Mount on a board
- Ambient: Natural convection
- Soldering: Lead (Pb) free
- Board: Dimensions 40 x 40 mm (1600 mm<sup>2</sup> in one side)  
Copper (Cu) traces occupy 50% of the front and 50% of the back.  
The copper area is divided into four block, one block is 12.5% of total.  
The USPN-4 package has for terminals.  
Each terminal connects one copper block in the front and one in the back.
- Material: Glass Epoxy (FR-4)
- Thickness: 1.6 mm
- Through-hole: 4 x 0.8 Diameter



Evaluation Board (Unit: mm)

### 2. Power Dissipation vs. Ambient temperature

Board Mount (T<sub>j</sub> max = 125 °C)

| Ambient Temperature ( °C ) | Power Dissipation Pd (mW) | Thermal Resistance ( °C/W ) |
|----------------------------|---------------------------|-----------------------------|
| 25                         | 600                       | 166.67                      |
| 85                         | 240                       |                             |

