

Low Power Supply LDO Regulators (Ultra Small Packages)

GENERAL DESCRIPTION

XC6218 series are highly precise, low noise, positive voltage LDO regulators manufactured using CMOS processes. The series achieves very low supply current, 1.0 μA (TYP.) and consists of a reference voltage source, an error amplifier, current limit circuit, and a phase compensation circuit plus a driver transistor.

Ultra small USP-3 and SSOT-24 packages make high density mounting possible. Therefore, the series is ideal for applications where high density mounting is required such as in mobile phones.

Output voltage is selectable in 0.1V increments within a range of 0.9V ~ 4.0V by laser trimming. The series is also compatible with low ESR ceramic capacitors (C_L), which give added output stability.

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

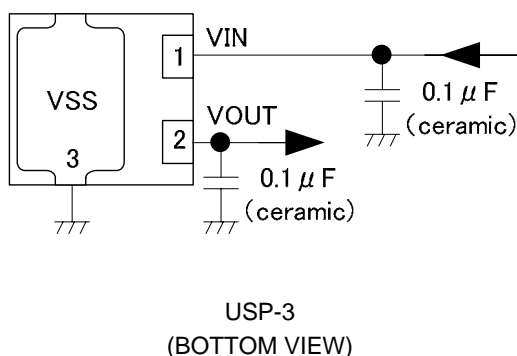
APPLICATIONS

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

FEATURES

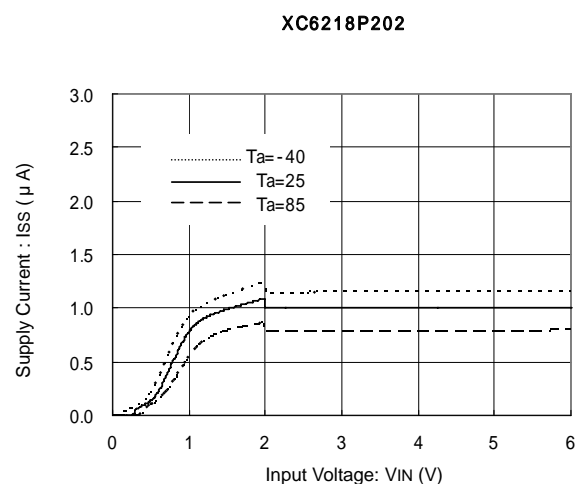
- Maximum Output Current** : 200mA (300mA Limit: TYP.)
(@ $V_{OUT}=3.0V$, $V_{IN}=4.0V$)
- Dropout Voltage** : 200mV @ $I_{OUT}=100mA$
(@ $V_{OUT}=3.0V$)
- Operating Voltage Range** : 1.5V ~ 6.0V
- Output Voltage** : 0.9 ~ 4.0V (0.1V increments)
- High Accuracy** : Setting Voltage Accuracy $\pm 2\%$
($1.5 < V_{OUT(T)} < 4.0V$)
Setting Voltage Accuracy $\pm 30mV$
($0.9 < V_{OUT(T)} < 1.5V$)
- Low Power Supply** : 1.0 μA (TYP.)
- Operating Ambient Temperature** : - 40 ~ 85
- External Capacitor** : 0.1 μF ~ 1.0 μF
- Packages** : USP-3, SSOT-24

TYPICAL APPLICATION CIRCUIT

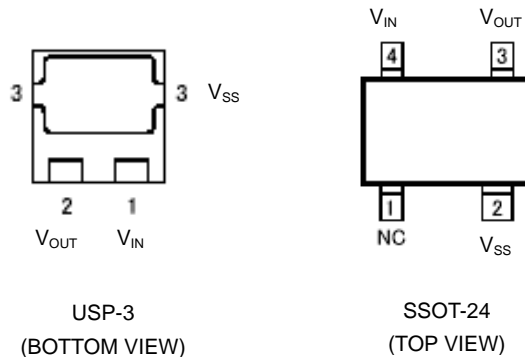


TYPICAL PERFORMANCE CHARACTERISTICS

Supply Current vs. Input Voltage



PIN CONFIGURATION



PIN ASSIGNMENT

| PIN NUMBER | | PIN NAME | FUNCTION |
|------------|---------|------------------|---------------|
| USP-3 | SSOT-24 | | |
| 1 | 4 | V _{IN} | Power Supply |
| 2 | 3 | V _{OUT} | Output |
| 3 | 2 | V _{SS} | Ground |
| - | 1 | NC | No Connection |

PRODUCT CLASSIFICATION

Ordering Information

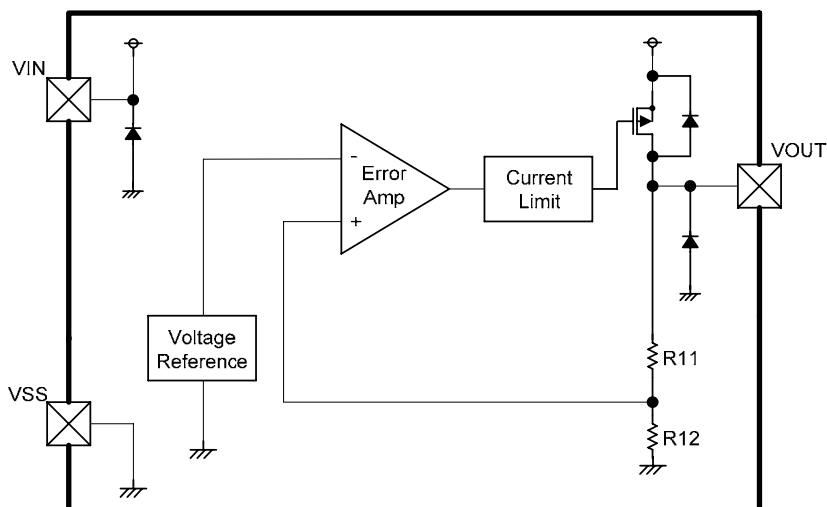
XC6218P _____ - ^(*)

| DESIGNATOR | DESCRIPTION | SYMBOL | DESCRIPTION |
|------------|-------------------------------------|---------|--|
| | Output Voltage | 09 ~ 40 | Output voltage “ ” represents value after the decimal point. ex.) 15 :1, :5 = 1.5V 33 :3, :3 = 3.3V |
| | Output Voltage Accuracy | 2 | Output voltage accuracy less than ±2%, 100mV increments ex.) 2.5V =2, =5, =2 |
| | Packages Taping Type ^(*) | HR | USP-3 |
| | | HR-G | USP-3 |
| | | NR | SSOT-24 |
| | | NR-G | SSOT-24 |

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

^(*) The device orientation is fixed in its embossed tape pocket. For reverse orientation, please contact your local Torex sales office or representative. (Standard orientation: R- , Reverse orientation: L-)

BLOCK DIAGRAM



* The diode inside the circuit is a protection diode for the IC.

ABSOLUTE MAXIMUM RATINGS

Ta=25

| PARAMETER | SYMBOL | RATINGS | UNITS |
|----------------------------------|---------|-----------------------|-------|
| Input Voltage | VIN | VSS - 0.3 ~ 7.0 | V |
| Output Current | IOUT | 500 ^(*) | mA |
| Output Voltage | VOUT | VSS - 0.3 ~ VIN + 0.3 | V |
| Power Dissipation ^(*) | USP-3 | 120 | mW |
| | SSOT-24 | 150 | |
| Operating Temperature Range | Topr | - 40 ~ + 85 | |
| Storage Temperature Range | Tstg | - 55 ~ + 125 | |

*1: $I_{OUT} \cdot P_d / (V_{IN} - V_{OUT})$

ELECTRICAL CHARACTERISTICS

Ta=25

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNITS | CIRCUIT |
|--|--|--|---------------------|-------|------|-------|---------|
| Output Voltage | V _{OUT(E)} ^(*2) | V _{IN} =V _{OUT(T)} ^(*1) +1.0V I _{OUT} =1mA | E-0 ^(*6) | | | V | |
| Load Regulation | V _{load} | 0.9V V _{OUT(T)} < 1.3V V _{IN} =V _{OUT(T)} +1.5V 1mA I _{OUT} 100mA | - | 15 | 70 | mV | |
| | | V _{OUT(T)} 1.3V V _{IN} =V _{OUT(T)} +1.0V 1mA I _{OUT} 100mA | | | | | |
| Dropout Voltage1 | V _{dif1} ^(*3) | I _{OUT} =30mA | E-1 ^(*6) | | | mV | |
| Dropout Voltage2 | V _{dif2} ^(*3) | I _{OUT} =100mA | E-1 ^(*6) | | | mV | |
| Supply Current | I _{SS} | V _{IN} =V _{OUT(T)} +1.0V | - | 1.0 | 5.0 | μA | |
| Line Regulation | V _{line} | V _{OUT(T)} =0.9V 1.5V V _{IN} 6.0V I _{OUT} =1mA | - | 0.05 | 0.15 | %V | |
| | | V _{OUT(T)} 1.0V V _{OUT(T)} +0.5V V _{IN} 6.0V I _{OUT} =1mA | | | | | |
| Input Voltage | V _{IN} | | 1.5 | - | 6.0 | V | - |
| Output Voltage Temperature Characteristics | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$ | V _{IN} =V _{OUT(T)} +1.0V I _{OUT} =1mA - 40 T _{opr} 85 | - | ± 100 | - | ppm/ | |
| Current Limit | I _{lim} | V _{OUT} =V _{OUT(E)} × 0.95 0.9 V _{OUT(T)} 1.5V V _{IN} =2.6V | 200 | 300 | - | mA | |
| | | V _{OUT} =V _{OUT(E)} × 0.95 V _{OUT(T)} 1.6V V _{IN} =V _{OUT(T)} +1.0V | 250 | 300 | - | | |
| Short Circuit Current | I _{short} | V _{IN} =V _{OUT(T)} +1.0V V _{OUT} =0V | - | 50 | - | mA | |

Notes:

*1 : V_{OUT(T)} : Setting output voltage value

*2 : V_{OUT(E)} : Effective output voltage value

(i.e. the output voltage when "(V_{OUT(T)} + 1.0V)" is provided at the V_{IN} pin while maintaining a certain I_{OUT} value.

*3 : V_{dif} = {V_{IN1}^(*4) - V_{OUT1}^(*5)}

*4 : V_{IN1} : The input voltage when V_{OUT1} appears as input voltage is gradually decreased.

*5 : V_{OUT1} : A voltage equal to 98% of the output voltage whenever an amply stabilized I_{OUT}(V_{OUT(T)}+1.0V) is input.

*6 : Refer to the VOLTAGE CHART.

*7: V_{OUT(T)} 1.5V Accuracy ± 2.0%

V_{OUT(T)} < 1.5V MIN : V_{OUT(T)} - 30mV, MAX : V_{OUT(T)} + 30mV.

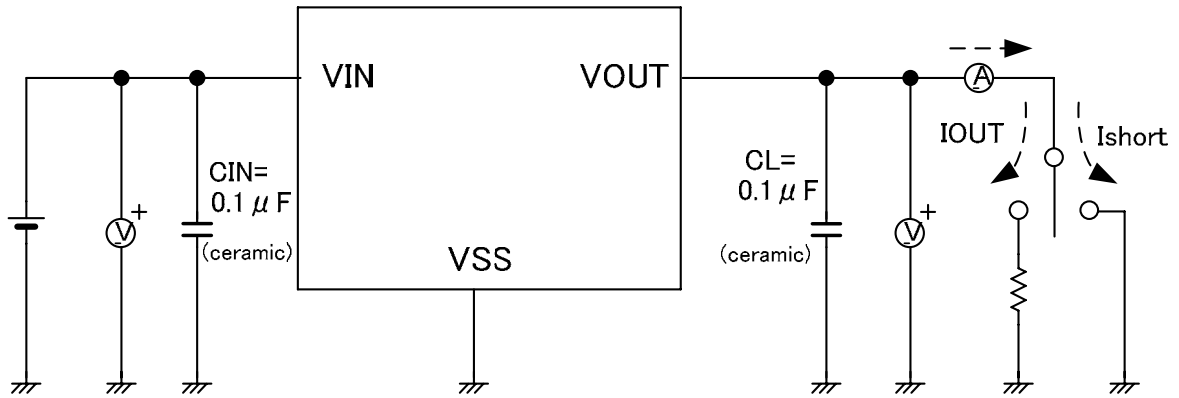
VOLTAGE CHART

Ta=25

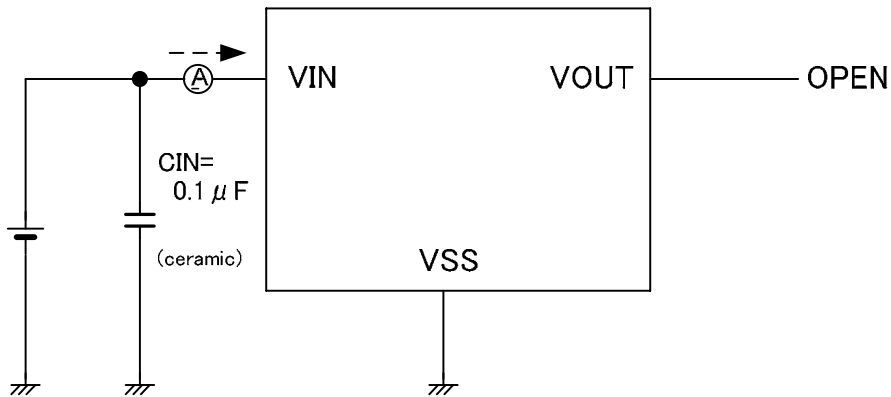
| PARAMETER SETTING VOLTAGE | E-0 | | E-1 | | | |
|---------------------------------|-------------------------------|-------|---------------------------|------|---------------------------|------|
| | OUTPUT VOLTAGE 2.0% (V) | | DROPOUT VOLTAGE 1 (mV) | | DROPOUT VOLTAGE 2 (mV) | |
| VOUT(T) | VOUT(E) | | Vdif1 | | Vdif2 | |
| | MIN. | MAX. | TYP. | MAX. | TYP. | MAX. |
| 0.9 | 0.870 | 0.930 | 460 | 900 | 850 | 1450 |
| 1.0 | 0.970 | 1.030 | 370 | 760 | 750 | 1300 |
| 1.1 | 1.070 | 1.130 | 300 | 650 | 680 | 1190 |
| 1.2 | 1.170 | 1.230 | 240 | 540 | 600 | 1070 |
| 1.3 | 1.270 | 1.330 | 190 | 420 | 530 | 950 |
| 1.4 | 1.370 | 1.430 | 160 | 340 | 470 | 840 |
| 1.5 | 1.470 | 1.530 | | | | |
| 1.6 | 1.568 | 1.632 | | | | |
| 1.7 | 1.666 | 1.734 | 110 | 200 | 350 | 610 |
| 1.8 | 1.764 | 1.836 | | | | |
| 1.9 | 1.862 | 1.938 | | | | |
| 2.0 | 1.960 | 2.040 | 90 | 150 | 290 | 480 |
| 2.1 | 2.058 | 2.142 | | | | |
| 2.2 | 2.156 | 2.244 | | | | |
| 2.3 | 2.254 | 2.346 | | | | |
| 2.4 | 2.352 | 2.448 | | | | |
| 2.5 | 2.450 | 2.550 | 70 | 120 | 240 | 370 |
| 2.6 | 2.548 | 2.652 | | | | |
| 2.7 | 2.646 | 2.754 | | | | |
| 2.8 | 2.744 | 2.856 | | | | |
| 2.9 | 2.842 | 2.958 | | | | |
| 3.0 | 2.940 | 3.060 | 60 | 100 | 200 | 320 |
| 3.1 | 3.038 | 3.162 | | | | |
| 3.2 | 3.136 | 3.264 | | | | |
| 3.3 | 3.234 | 3.366 | | | | |
| 3.4 | 3.332 | 3.468 | | | | |
| 3.5 | 3.430 | 3.570 | | | | |
| 3.6 | 3.528 | 3.672 | | | | |
| 3.7 | 3.626 | 3.774 | | | | |
| 3.8 | 3.724 | 3.876 | | | | |
| 3.9 | 3.822 | 3.978 | | | | |
| 4.0 | 3.920 | 4.080 | | | | |

TEST CIRCUITS

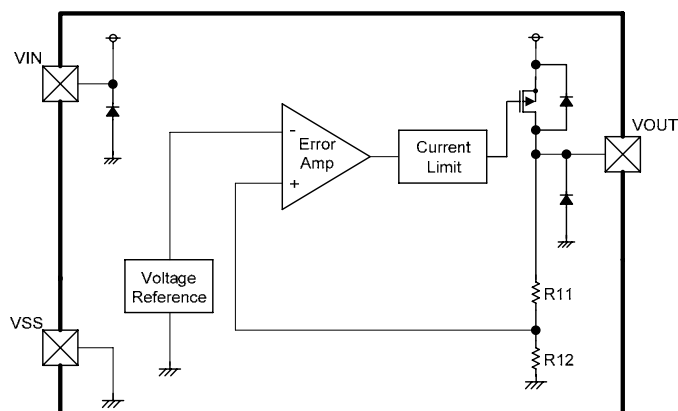
Circuit



Circuit



OPERATIONAL EXPLANATION



<Output Voltage Regulator Control>

The XC6218 series consists of a reference voltage source, an error amplifier, current limit circuit, and a phase compensation circuit plus a driver transistor. The voltage, divided by resistors R11 & R12, 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.

<Current Limit, Short-Circuit Protection>

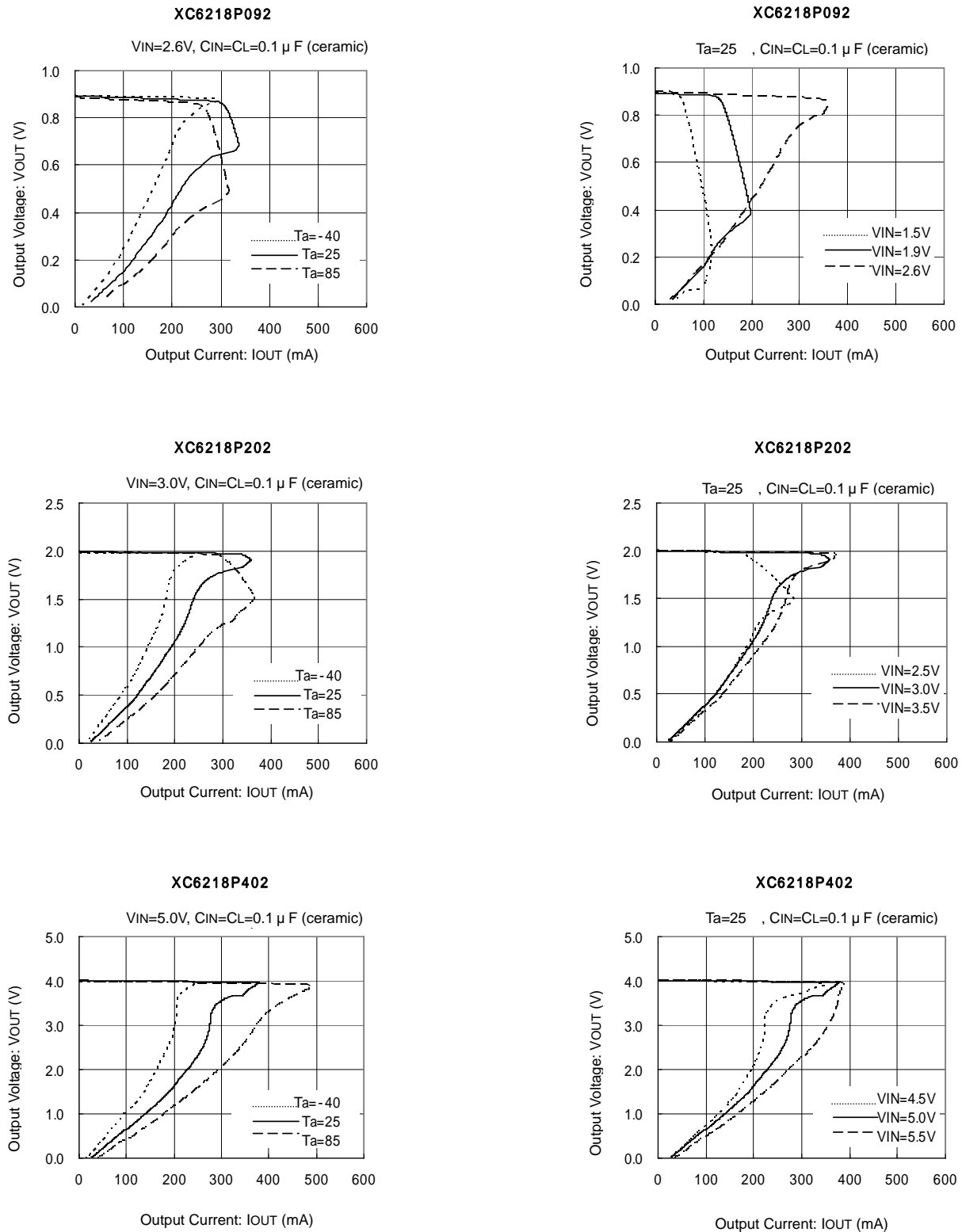
The XC6218 series includes a current limit circuit, which aid the operations of the current limiter and short-circuit protection. When the load current reaches the current limit level (300mA, TYP.), the current limiter circuit operates and output voltage drops. The circuit operates to decrease the current limit as the load impedance decreases further and the output voltage drops. When the output pin is shorted, a current of about 50mA flows.

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.
3. The XC6218 series oscillates normally even without an input capacitor, C_{IN}, or an output capacitor, C_L, because the series compensates by the phase compensation circuit. However, when an input wiring is long, about 0.1 μF to 1.0 μF of the input capacitor, C_{IN}, is required for stabilizing input. When an under-shoot or over-shoot is large at transient response, about 0.1 μF to 1.0 μF of output capacitor, which prevents output fluctuation occurred by load fluctuation, is also recommended. Please wire the input capacitor (C_{IN}) and the output capacitor (C_L) as close to the IC as possible. Please wire the input capacitor (C_{IN}) and the output capacitor (C_L) as close to the IC as possible.
4. When the input voltage starts from 0V, over-shoot may occur because of the slope of the input rising. In order to avoid the over-shoot, please use the IC by setting the slope of the input rising within 0.1V/ms.

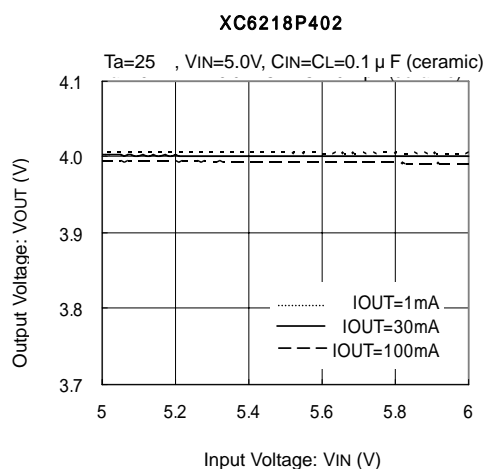
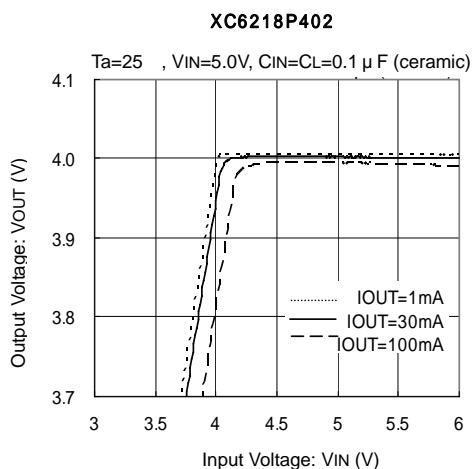
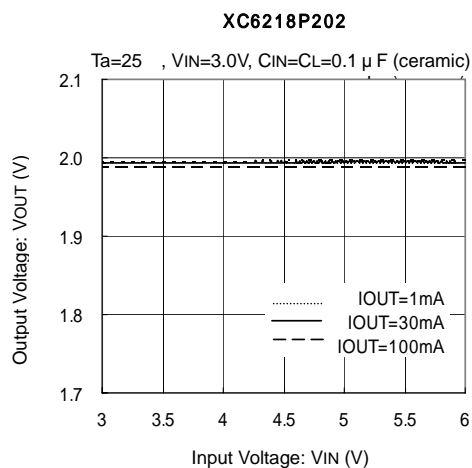
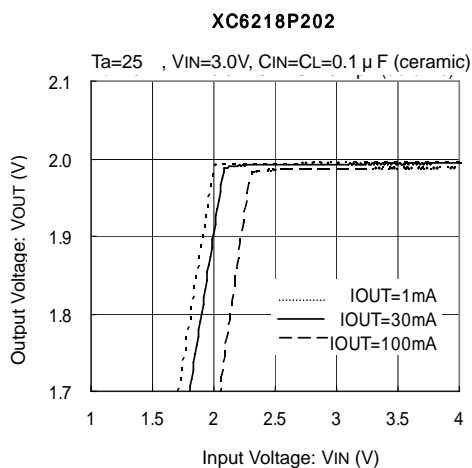
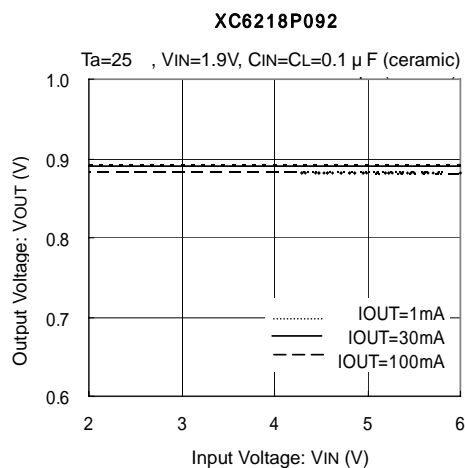
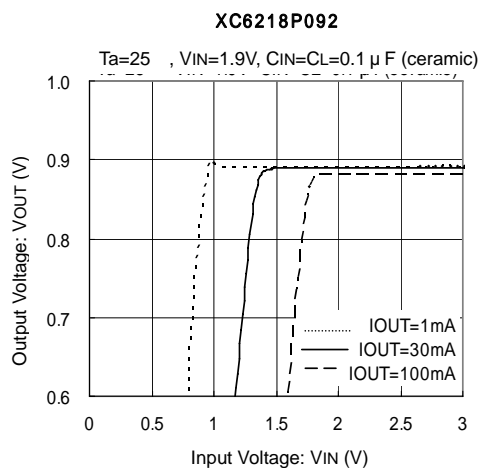
TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current



TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

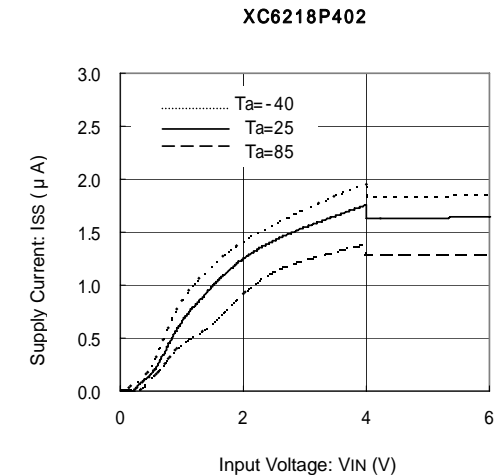
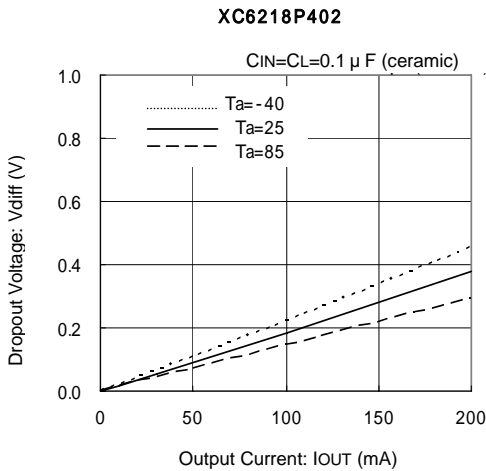
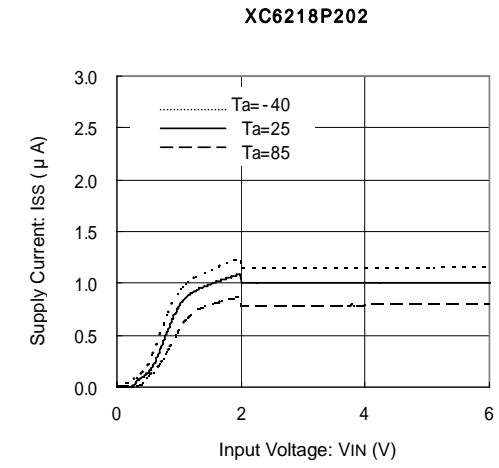
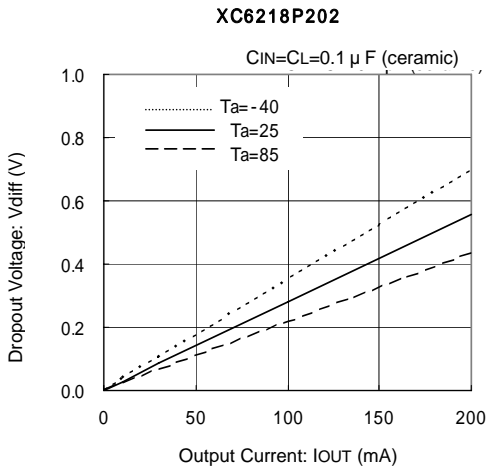
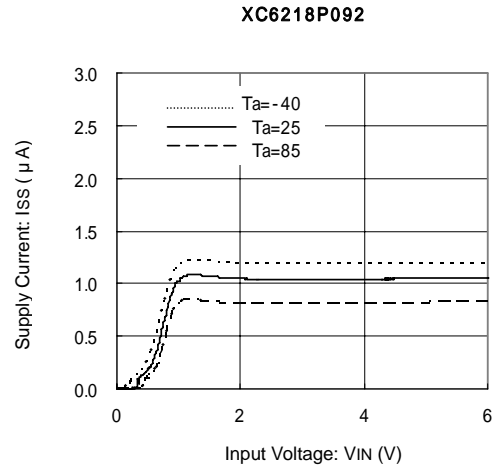
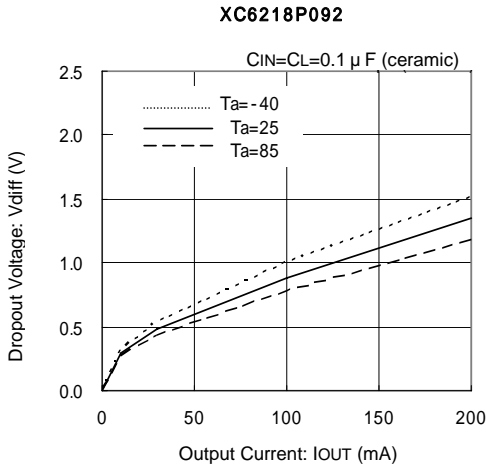
(2) Output Voltage vs. Input Voltage



TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

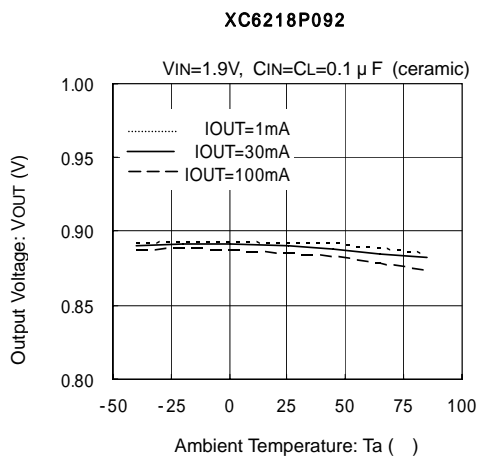
(3) Dropout Voltage vs. Output Current

(4) Supply Current vs. Input Voltage

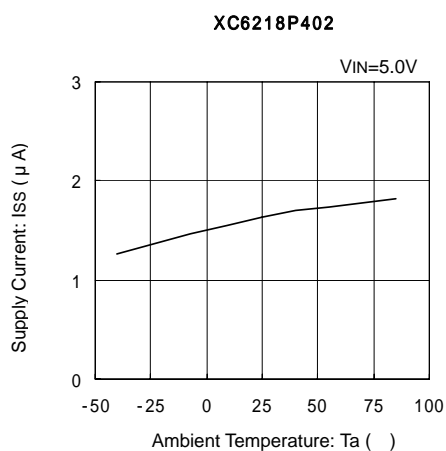
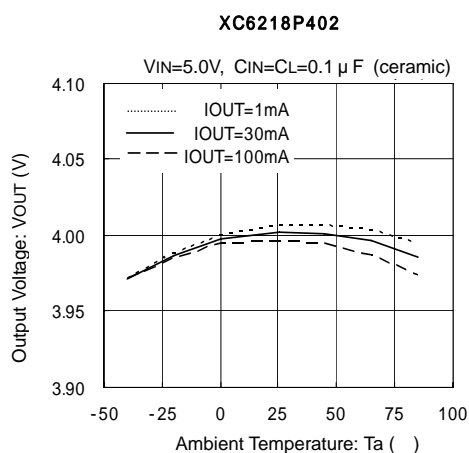
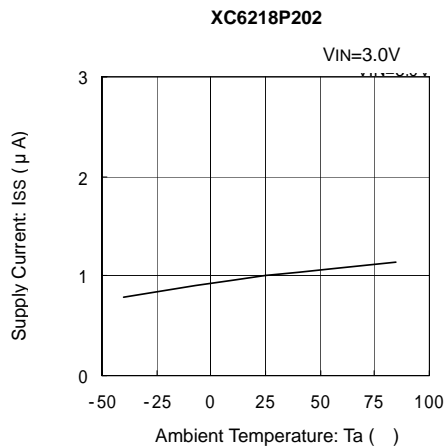
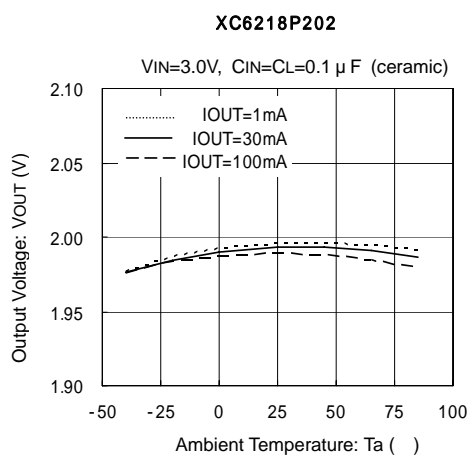
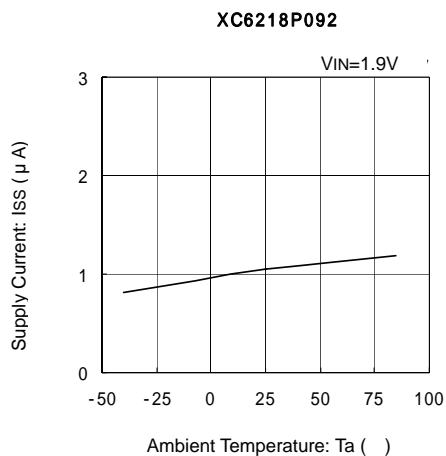


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(5) Output Voltage vs. Ambient Temperature

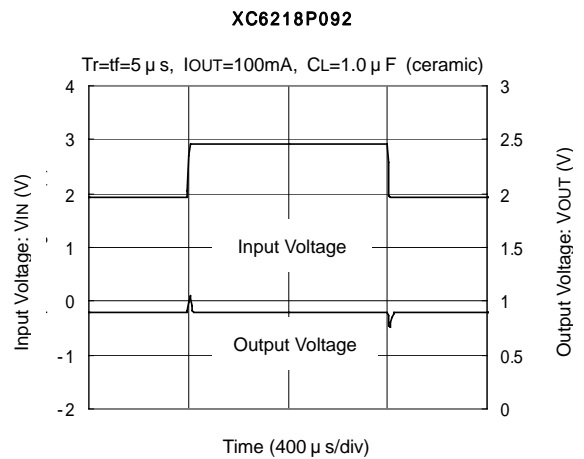
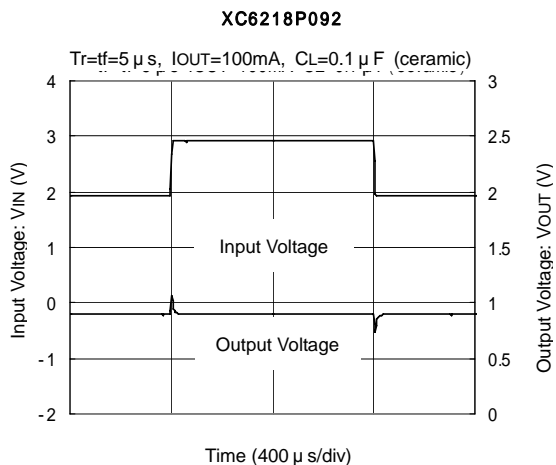
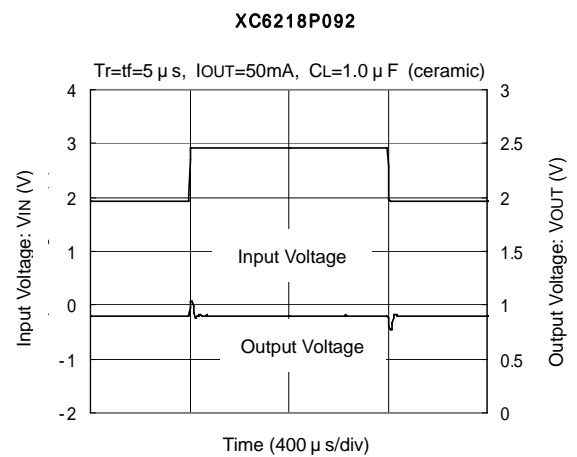
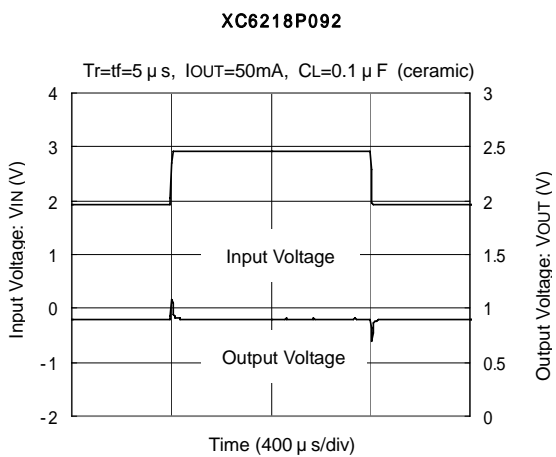
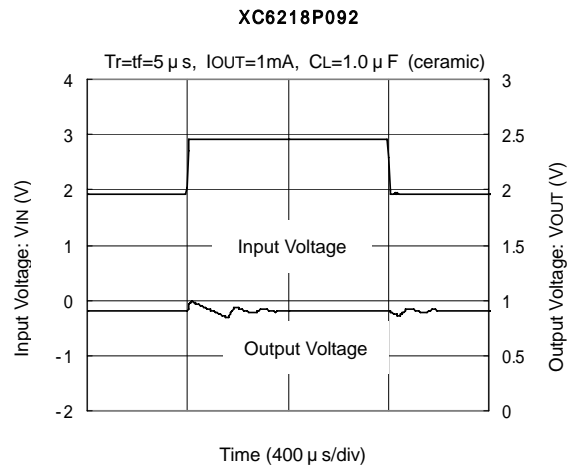
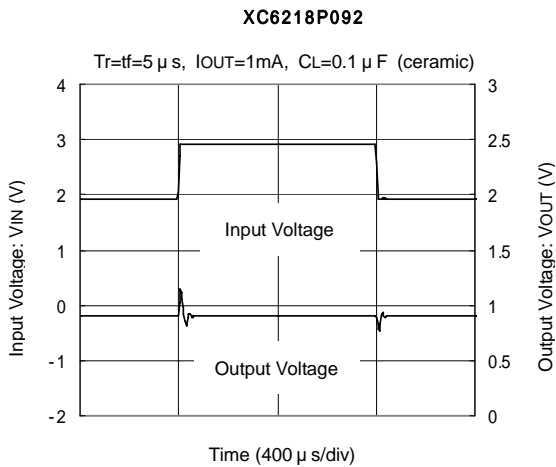


(6) Supply Current vs. Ambient Temperature



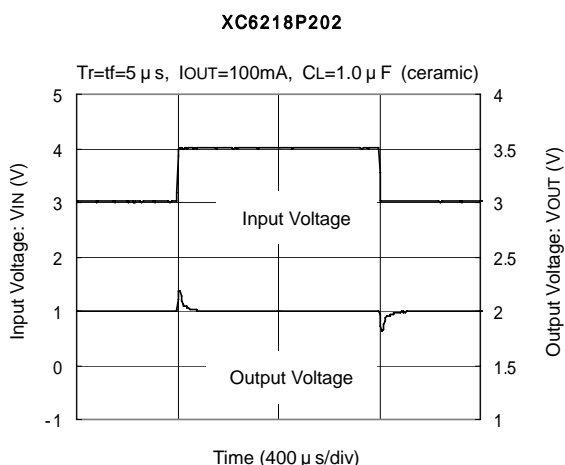
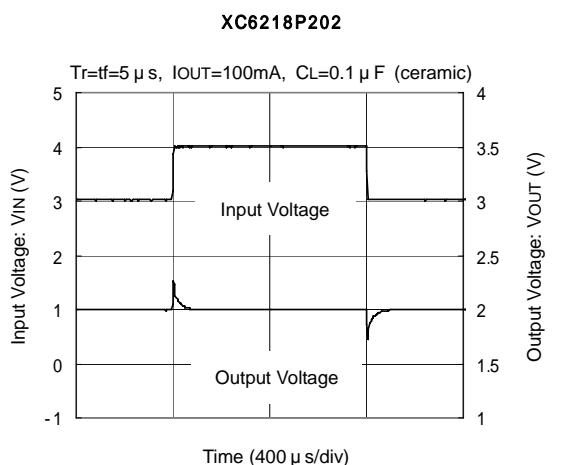
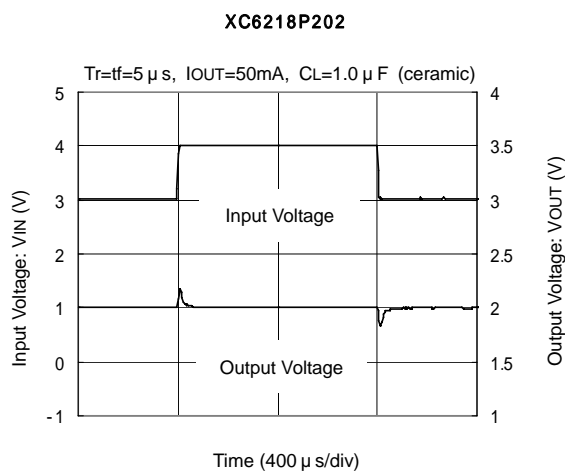
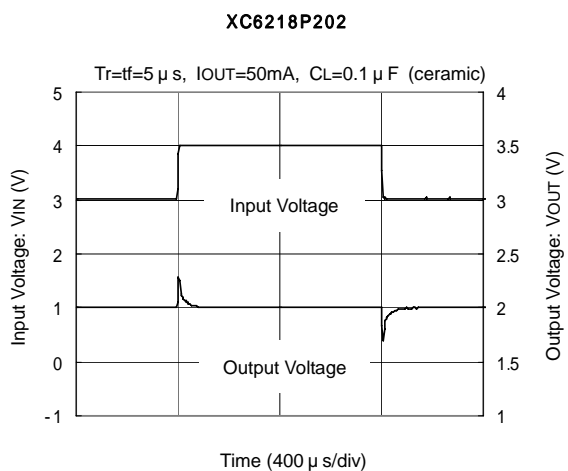
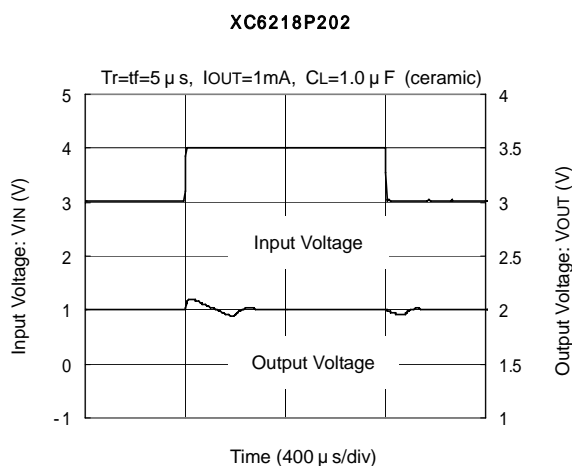
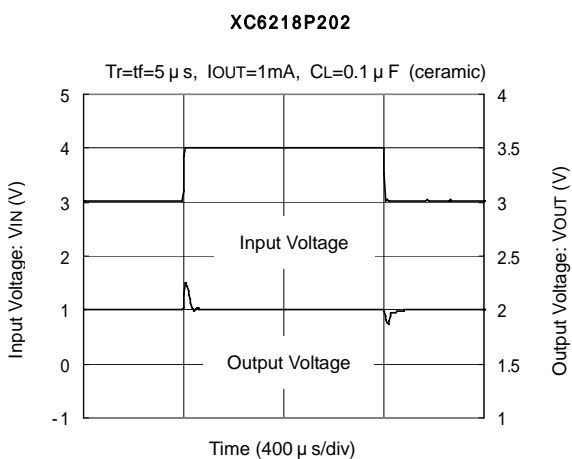
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(7) Input Transient Response



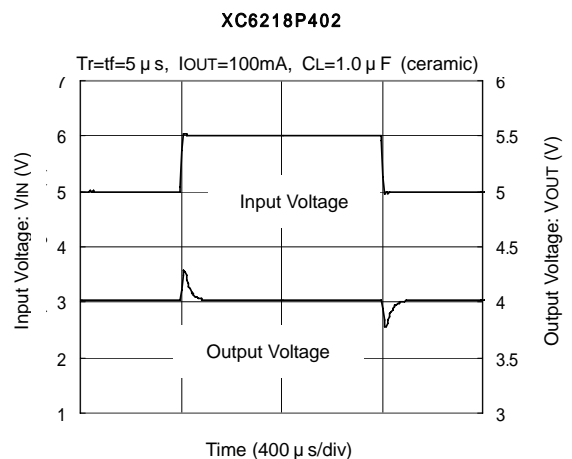
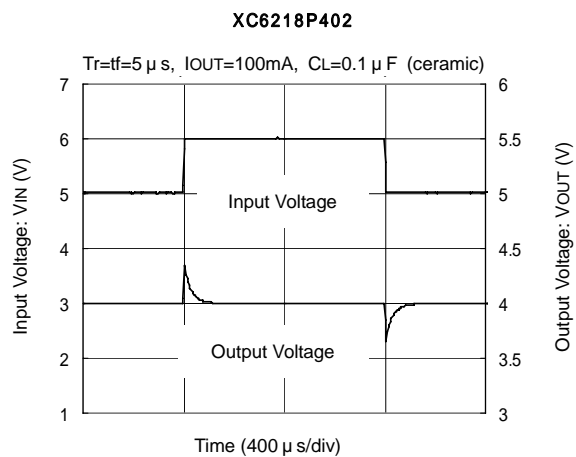
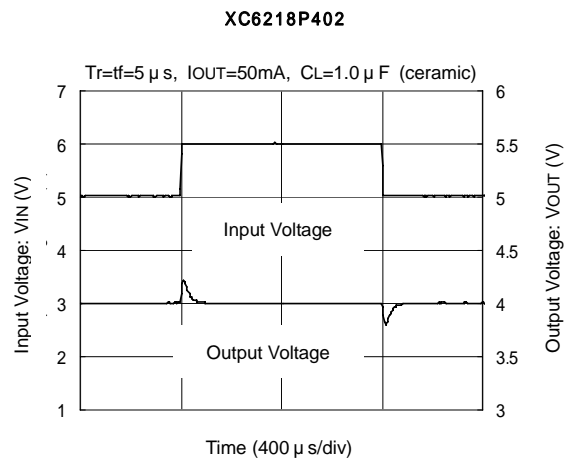
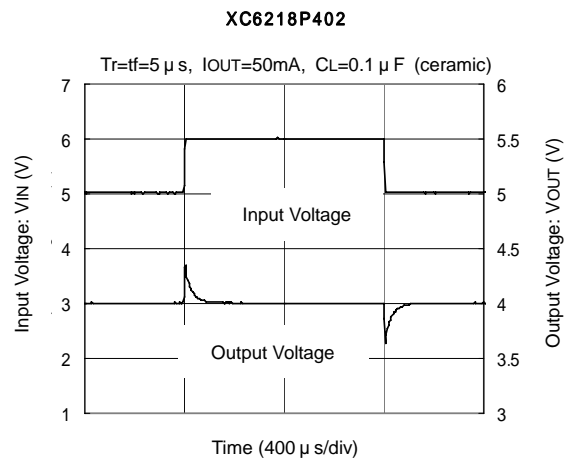
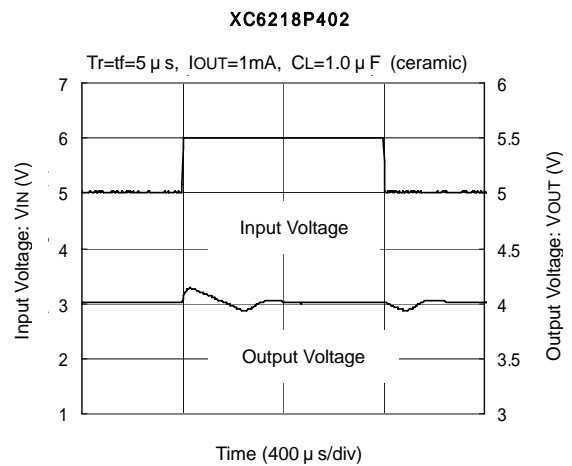
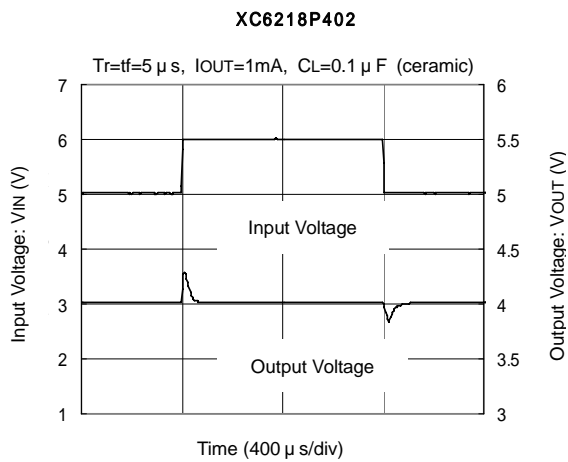
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(7) Input Transient Response (Continued)



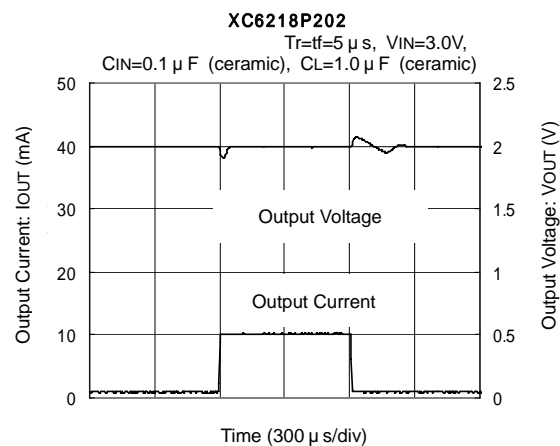
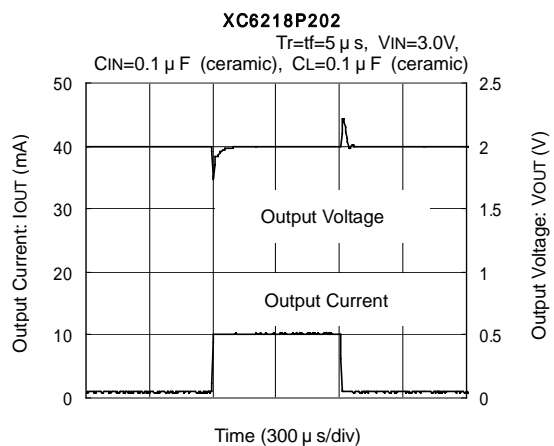
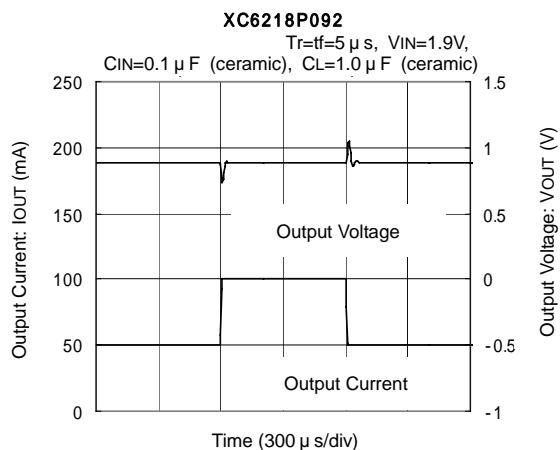
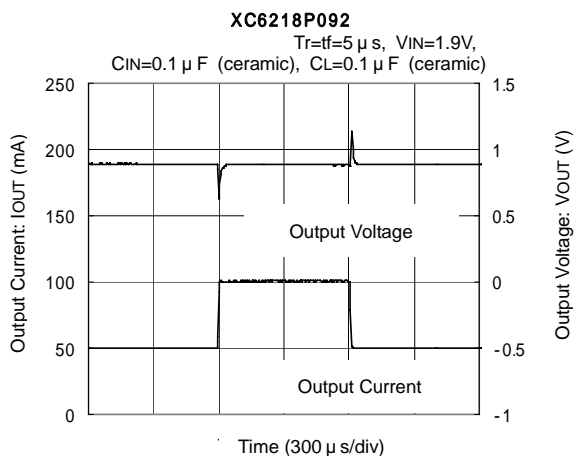
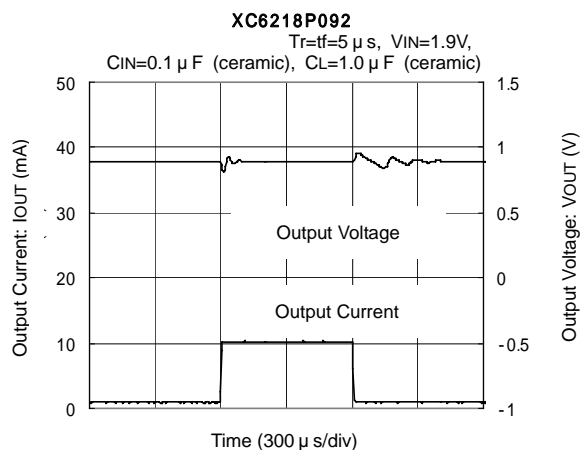
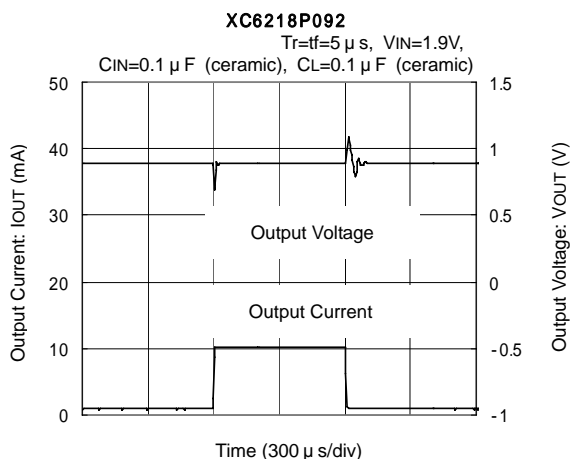
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(7) Input Transient Response (Continued)



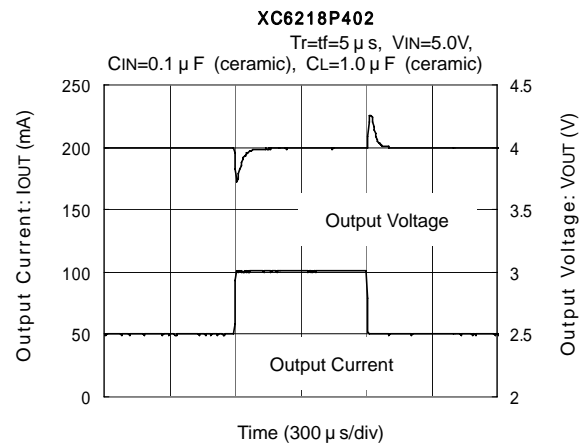
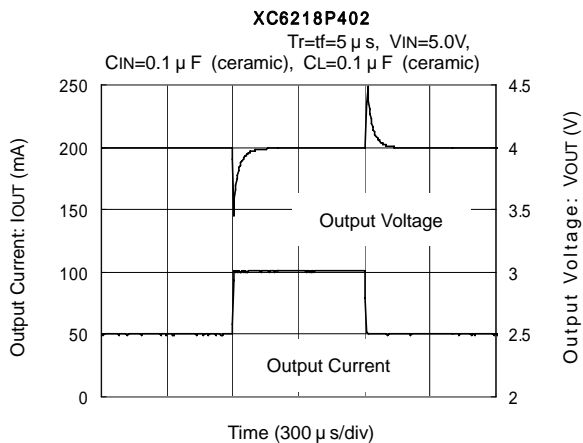
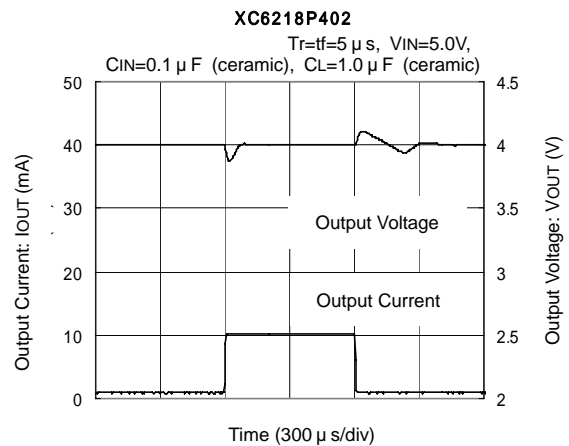
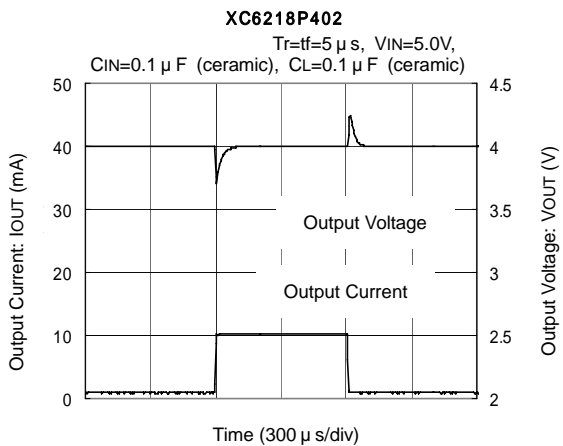
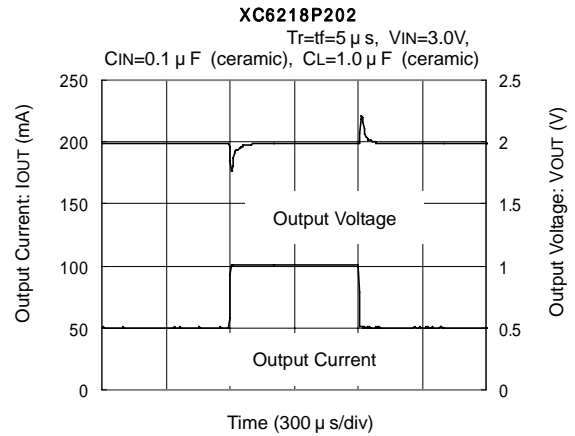
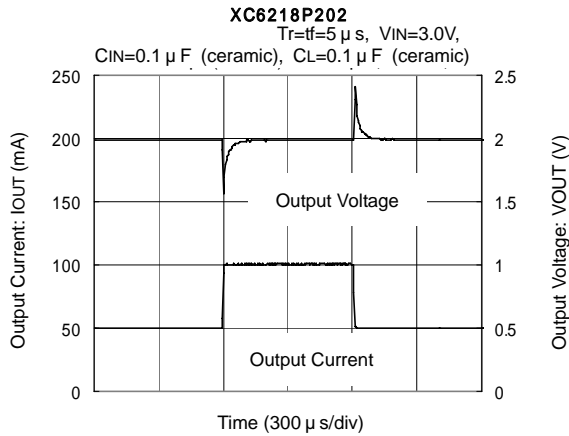
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(8) Load Transient Response



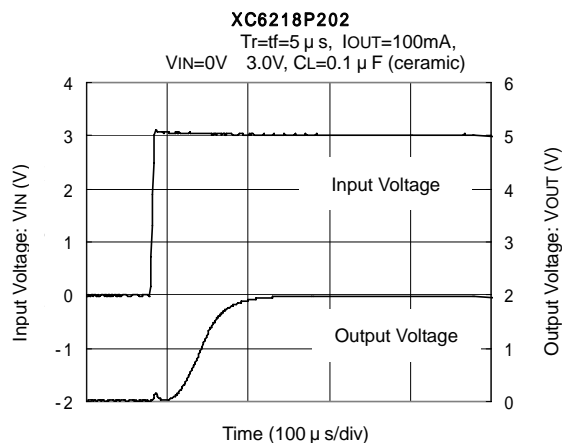
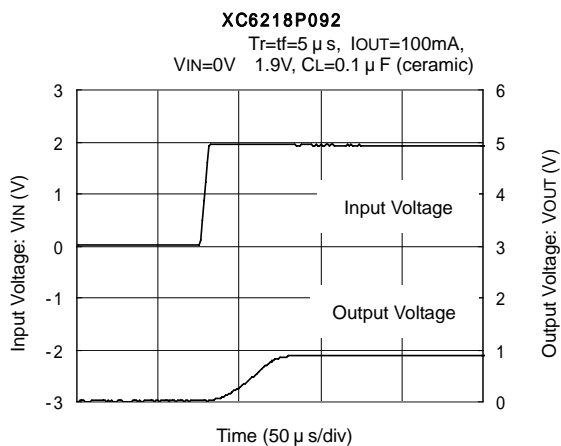
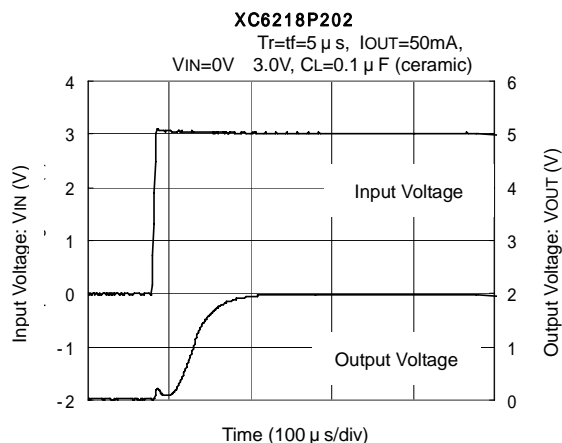
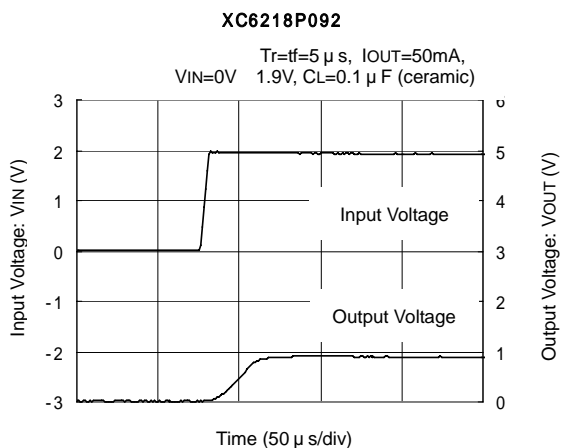
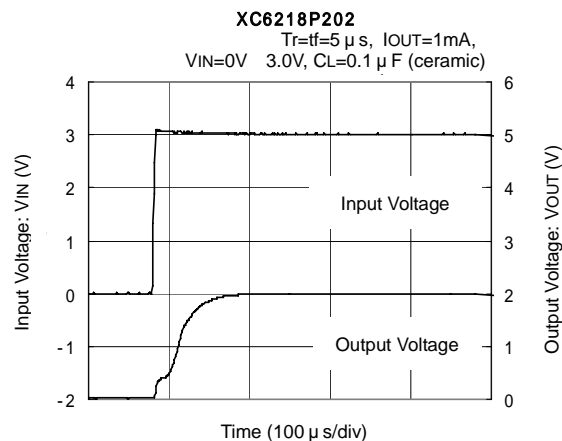
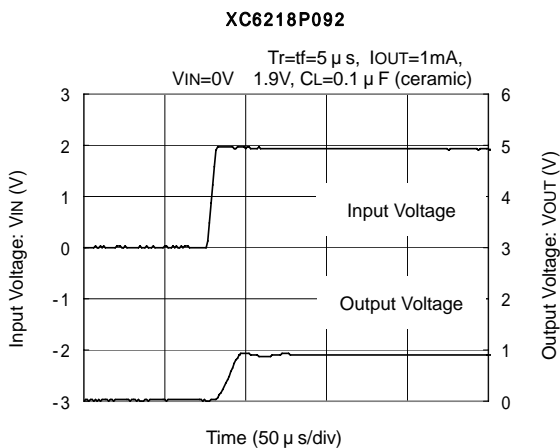
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(8) Load Transient Response (Continued)



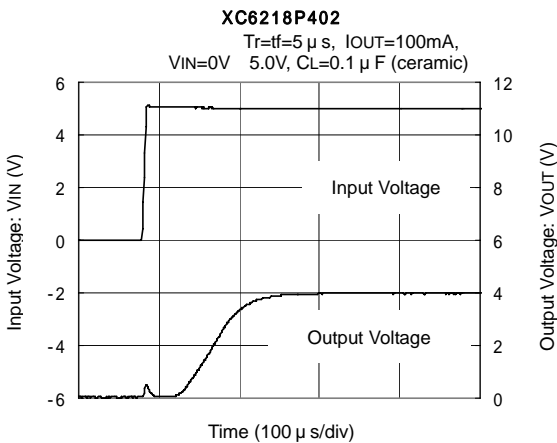
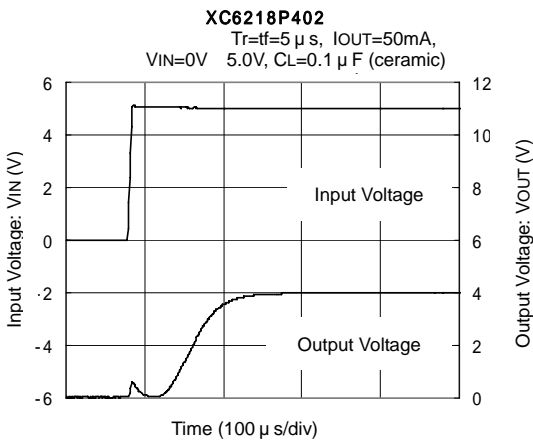
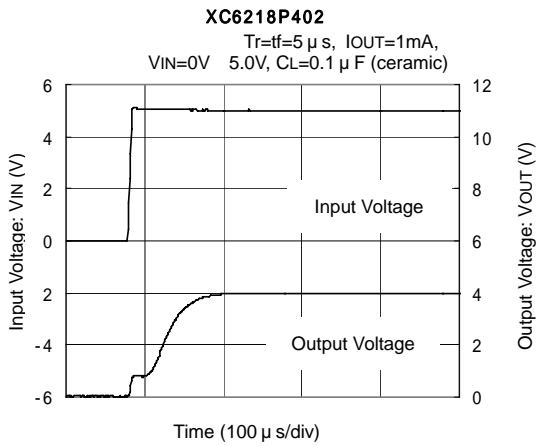
TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(9) Input Turn-On Transient Response

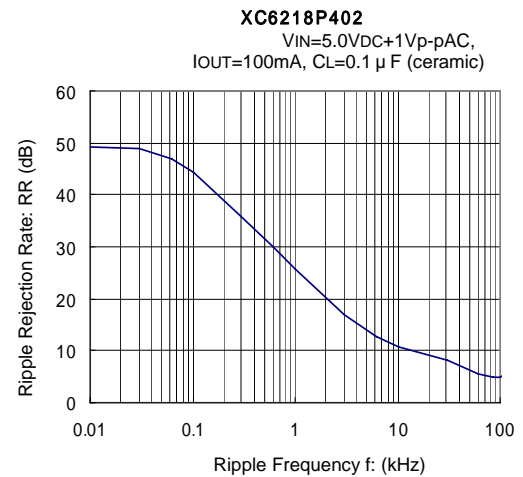
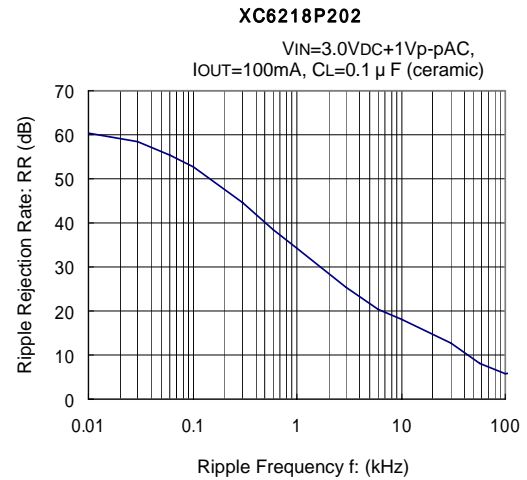
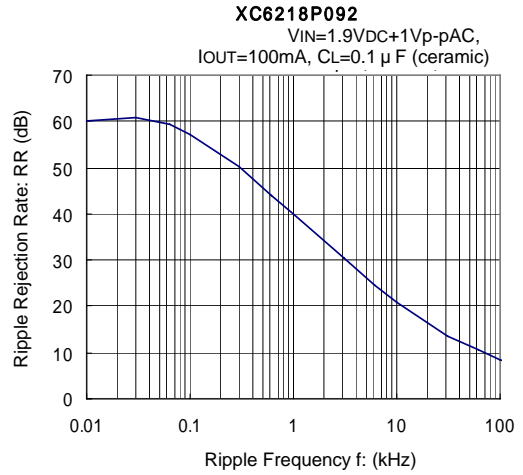


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(9) Input Turn-On Transient Response (Continued)

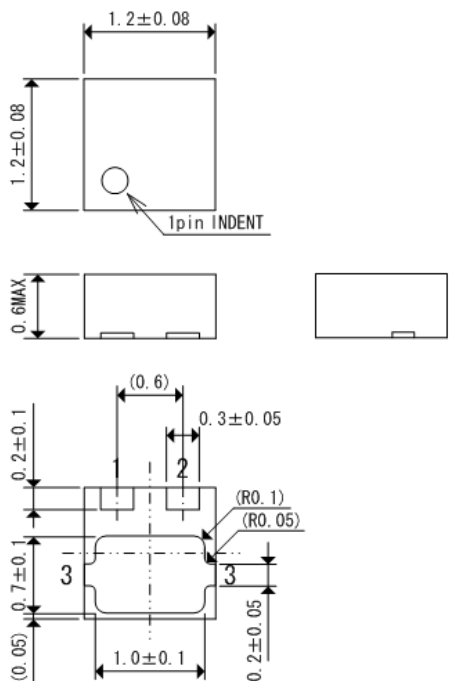


(10) Ripple Rejection Rate

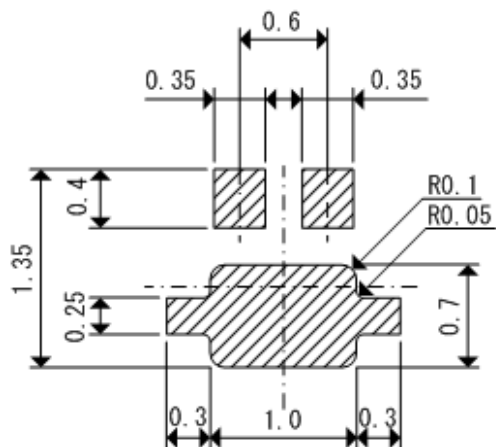


PACKAGING INFORMATION

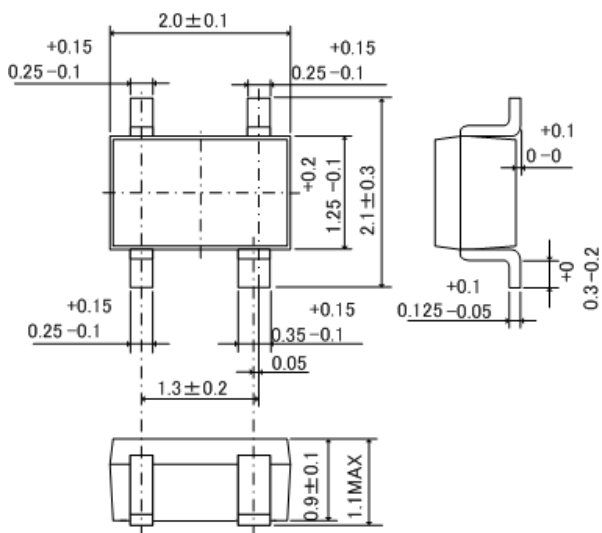
USP-3



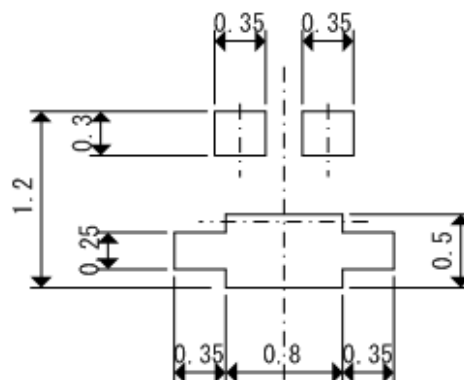
USP-3 Reference Pattern Layout



SSOT-24

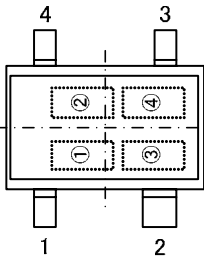


USP-3 Reference metal mask design



MARKING RULE

SSOT-24



SSOT-24
(TOP VIEW)

represents type of regulator and output voltage range

| MARK | OUTPUT VOLTAGE RANGE | PRODUCT SERIES |
|------|----------------------|----------------|
| P | 0.9V ~ 3.0V | XC6218P**** |
| R | 3.1V ~ 4.0V | |

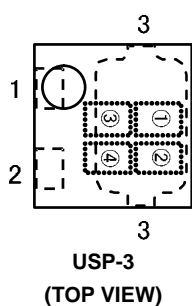
represents the decimal point of output voltage

| MARK | OUTPUT VOLTAGE (V) | | | MARK | OUTPUT VOLTAGE(V) | | |
|------|--------------------|-----|---|------|-------------------|---|---|
| 0 | - | 3.1 | - | F | 1.6 | - | - |
| 1 | - | 3.2 | - | H | 1.7 | - | - |
| 2 | - | 3.3 | - | K | 1.8 | - | - |
| 3 | - | 3.4 | - | L | 1.9 | - | - |
| 4 | - | 3.5 | - | M | 2.0 | - | - |
| 5 | - | 3.6 | - | N | 2.1 | - | - |
| 6 | - | 3.7 | - | P | 2.2 | - | - |
| 7 | - | 3.8 | - | R | 2.3 | - | - |
| 8 | 0.9 | 3.9 | - | S | 2.4 | - | - |
| 9 | 1.0 | 4.0 | - | T | 2.5 | - | - |
| A | 1.1 | - | - | U | 2.6 | - | - |
| B | 1.2 | - | - | V | 2.7 | - | - |
| C | 1.3 | - | - | X | 2.8 | - | - |
| D | 1.4 | - | - | Y | 2.9 | - | - |
| E | 1.5 | - | - | Z | 3.0 | - | - |

, represents production lot number
0 to 9, A to Z repeated (G, I, J, O, Q, W, excluded)
*No character inversion used.

MARKING RULE (Continued)

USP-3



represents product series

| MARK | PRODUCT SERIES |
|------|----------------|
| T | XC6218P***** |

represents output voltage range

| MARK | OUTPUT VOLTAGE RANGE | PRODUCT SERIES |
|------|----------------------|----------------|
| 7 | 0.9V ~ 3.0V | XC6218P***** |
| 8 | 3.1V ~ 4.0V | |

represents output voltage

| MARK | OUTPUT VOLTAGE (V) | | | MARK | OUTPUT VOLTAGE (V) | | |
|------|--------------------|-----|---|------|--------------------|---|---|
| 0 | - | 3.1 | - | F | 1.6 | - | - |
| 1 | - | 3.2 | - | H | 1.7 | - | - |
| 2 | - | 3.3 | - | K | 1.8 | - | - |
| 3 | - | 3.4 | - | L | 1.9 | - | - |
| 4 | - | 3.5 | - | M | 2.0 | - | - |
| 5 | - | 3.6 | - | N | 2.1 | - | - |
| 6 | - | 3.7 | - | P | 2.2 | - | - |
| 7 | - | 3.8 | - | R | 2.3 | - | - |
| 8 | 0.9 | 3.9 | - | S | 2.4 | - | - |
| 9 | 1.0 | 4.0 | - | T | 2.5 | - | - |
| A | 1.1 | - | - | U | 2.6 | - | - |
| B | 1.2 | - | - | V | 2.7 | - | - |
| C | 1.3 | - | - | X | 2.8 | - | - |
| D | 1.4 | - | - | Y | 2.9 | - | - |
| E | 1.5 | - | - | Z | 3.0 | - | - |

represents production lot number

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

*No character inversion used.

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