

Charging ICs for Rechargeable Batteries Compatible with CV Charging (0.8μA Low Power Consumption Voltage Regulator)

■ GENERAL DESCRIPTION

The XC6240 series of products consists of regulators which have achieved an ultra-low supply current of 0.8μA, and can be used for charging rechargeable batteries compatible with CV (Constant Voltage) charging.

The output voltage of these products is internally fixed to be compatible with the CV voltages of rechargeable batteries.

Even if fluctuations are taken into account, the CV voltages of rechargeable batteries will not be exceeded, so charging can be performed without concern.

The addition of a diode on the input side also allows the sink current flowing from a rechargeable battery to the regulator to be suppressed to 0.24μA, which can greatly contribute to extending the battery-driven time while charging is not being performed.

The CE function can turn the regulator output off and put the IC into a shutdown state where the supply current can be substantially reduced. The available package lineup consists of SSOT-24, USPN-4, and USP-6B06, which are ideal for applications such as mobile devices which require high-density mounting, or smart cards which require thin elements.

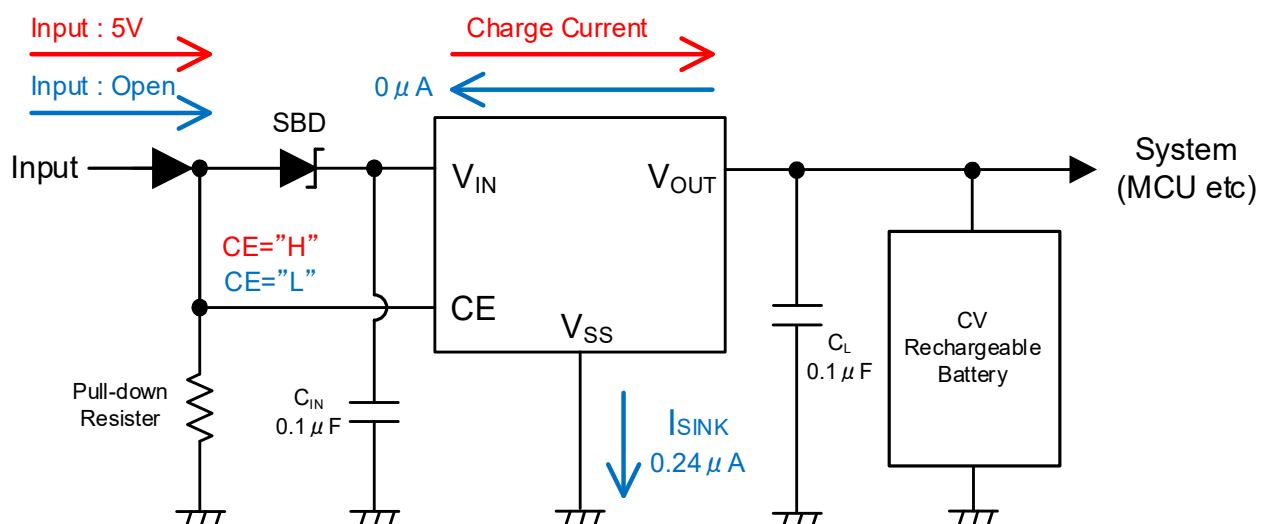
■ APPLICATIONS

- Rechargeable Batteries Compatible with CV Charging
- IoT devices
- Smart cards

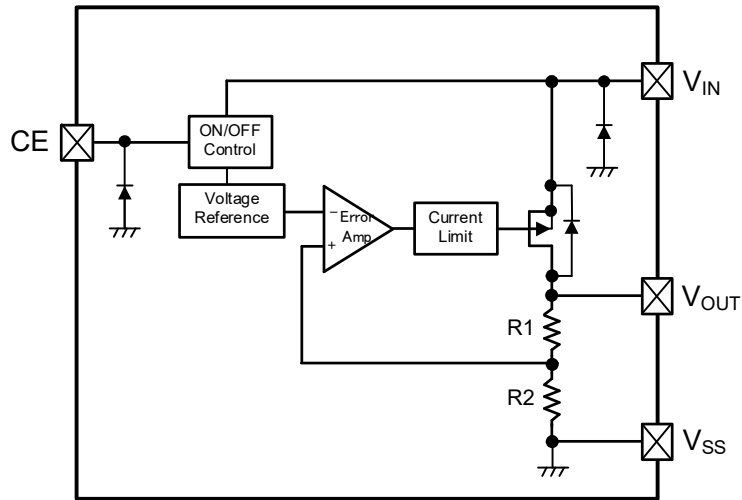
■ FEATURES

| | |
|-----------------------------------|--|
| Operating Voltage Range | : 1.5V ~ 6.0V |
| Output Voltage | : 2.63V ± 1.5% |
| Maximum Output Current | : 150mA (300mA Limit) |
| Dropout Voltage | : 450mV@I _{OUT} =100mA |
| Low Supply Current | : 0.8μA |
| V _{OUT} Pin Sink Current | : 0.24μA |
| Stand-by Current | : 0.01μA |
| Operating Temperature Range | : -40°C ~ 85°C |
| Protective Function | : Current Limit |
| Output Capacitor | : Ceramic capacitor |
| Packages | : SSOT-24 (2.00 x 2.10 x 1.10mm) USPN-4 (0.90 x 1.20 x 0.40mm) USP-6B06 (1.80 x 1.50 x 0.33mm) |
| Environmentally Friendly | : EU RoHS Compliant, Pb Free |

■ TYPICAL APPLICATION CIRCUIT



■ BLOCK DIAGRAMS



* Diodes inside the circuits are ESD protection diodes and parasitic diodes

■ PRODUCT CLASSIFICATION

● Ordering Information

XC6240①②③④⑤⑥-⑦

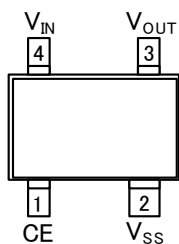
| DESIGNATOR | ITEM | SYMBOL | DESCRIPTION |
|------------|-----------------------|----------|-------------------------------|
| ① | Type | A | CE High Active |
| ②③④ | Output Voltage | 263 | 2.63V ($\pm 1.5\%$ Accuracy) |
| ⑤⑥-⑦ (*1) | Packages (Order Unit) | NR-G(*1) | SSOT-24 (3,000pcs/Reel) |
| | | 7R-G(*1) | USPN-4 (5,000pcs/Reel) |
| | | 8R-G(*1) | USP-6B06 (5,000pcs/Reel) |

(*1) "-G" suffix denotes Halogen and Antimony free as well as being fully EU RoHS compliant.

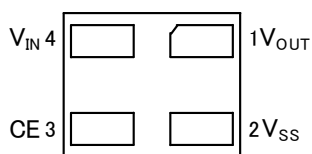
● Selection Guide

| Type | Rechargeable Battery CV Voltage | Output Voltage TYP. | Output Voltage MAX. |
|------------|------------------------------------|------------------------|------------------------|
| XC6240A263 | 2.7V | 2.630V | 2.700V |

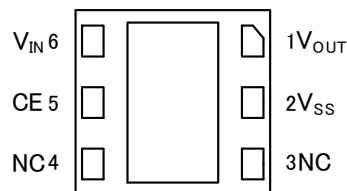
■ PIN CONFIGURATION



SSOT-24
(TOP VIEW)



USPN-4
(BOTTOM VIEW)



USP-6B06
(BOTTOM VIEW)

* For mounting intensity and heat dissipation, please refer to recommended mounting pattern and recommended metal mask when soldering the pad of USP-6B06. Mounting should be electrically isolated or connected to the V_{ss} (No.2) pin.

■ PIN ASSIGNMENT

| PIN NUMBER | | | PIN NAME | FUNCTIONS |
|------------|--------|----------|------------------|----------------|
| SSOT-24 | USPN-4 | USP-6B06 | | |
| 1 | 3 | 5 | CE | ON/OFF Control |
| 2 | 2 | 2 | V _{ss} | Ground |
| 3 | 1 | 1 | V _{OUT} | Output |
| 4 | 4 | 6 | V _{IN} | Power Input |
| - | - | 3,4 | NC | No Connection |

■ FUNCTION CHART

XC6240 Series

| PIN NAME | SIGNAL | STATUS |
|----------|--------|------------------|
| CE | L | Stand-by |
| | H | Active |
| | OPEN | Undefined state* |

* Please do not leave the CE pin open. Each should have a certain voltage.

■ ABSOLUTE MAXIMUM RATINGS

| PARAMETER | | SYMBOL | RATINGS | UNITS |
|---|----------|-----------|---|--------------------|
| Input Voltage | | V_{IN} | -0.3 ~ 7.0 | V |
| Output Voltage | | V_{OUT} | -0.3 ~ $V_{IN} + 0.3$ | V |
| CE Input Voltage | | V_{CE} | -0.3 ~ 7.0 | V |
| Power Dissipation ($T_a=25^{\circ}\text{C}$) | SSOT-24 | Pd | 680 (JESD51-7 Board) ^(*) | mW |
| | USPN-4 | | 600 (40mm x 40mm Standard Board) ^(*) | |
| | USP-6B06 | | 900 (40mm x 40mm Standard Board) ^(*) | |
| Operating Ambient Temperature | | T_{opr} | -40 ~ 85 | $^{\circ}\text{C}$ |
| Storage Temperature | | T_{stg} | -55 ~ 125 | $^{\circ}\text{C}$ |

All voltages are described based on the V_{SS} .

^(*) The power dissipation figure shown is PCB mounted and is for reference only.

The mounting condition is please refer to PACKAGING INFORMATION.

■ ELECTRICAL CHARACTERISTICS

XC6240 Series

Ta=25°C

| PARAMETER | SYMBOL | CONDITIONS | | MIN. | TYP. | MAX. | UNITS | CIRCUIT |
|--|--|--|----------------------------------|-----------------|-------|-------|--------|---------|
| Input Voltage | V _{IN} | | | 1.5 | - | 6.0 | V | - |
| Output Voltage | V _{OUT(E)} ⁽¹⁾ | V _{IN} =V _{CE} =3.63V I _{OUT} =1mA | Ta=25°C | 2.591 | 2.630 | 2.669 | V | ① |
| | | | -40°C ≤ Ta ≤ 85°C ⁽³⁾ | - | 2.630 | 2.700 | | |
| Maximum Output Current | I _{OUTMAX} | V _{IN} =V _{CE} =3.63V | | 150 | - | - | mA | ① |
| Load Regulation | ΔV _{OUT} | V _{IN} =V _{CE} =3.63V 1mA ≤ I _{OUT} ≤ 100mA | | - | 15 | 70 | mV | ① |
| Dropout Voltage | V _{dif} ⁽²⁾ | V _{CE} =V _{IN} I _{OUT} =100mA | | - | 450 | 580 | mV | ① |
| Supply Current | I _{SS} | V _{IN} =V _{CE} =3.63V | | - | 0.8 | 1.5 | μA | ② |
| Stand-by Current | I _{STB} | V _{IN} =3.63V V _{CE} =V _{SS} | | - | 0.01 | 0.10 | μA | ② |
| V _{OUT} Pin Sink Current | I _{SINK} | V _{IN} =V _{OUT} =2.7V V _{CE} =V _{SS} | | - | 0.24 | 0.60 | μA | ③ |
| Line Regulation | ΔV _{OUT} / (ΔV _{IN} · V _{OUT}) | 3.13V ≤ V _{IN} ≤ 6.0V I _{OUT} =30mA V _{CE} =V _{IN} | | - | 0.05 | 0.15 | %/V | ① |
| Output Voltage Temperature Characteristics | ΔV _{OUT} / (ΔT _{opr} · V _{OUT}) | V _{IN} =V _{CE} =3.63V I _{OUT} =30mA -40°C ≤ T _{opr} ≤ 85°C | | - | ±100 | - | ppm/°C | ① |
| Current Limit | I _{LIM} | V _{IN} =V _{CE} =4.63V V _{OUT} =2.50V | | 200 | 300 | - | mA | ① |
| Short Circuit Current | I _{SHORT} | V _{IN} =V _{CE} =3.63V V _{OUT} =0V | | - | 50 | - | mA | ① |
| CE "H" Voltage | V _{CEH} | V _{IN} =3.63V | Ta=25°C | 1.0 | - | 6.0 | V | ① |
| | | | -40°C ≤ Ta ≤ 85°C ⁽³⁾ | | | | | |
| CE "L" Voltage | V _{CEL} | V _{IN} =3.63V | Ta=25°C | V _{SS} | - | 0.3 | V | ① |
| | | | -40°C ≤ Ta ≤ 85°C ⁽³⁾ | | | | | |
| CE "H" Current | I _{CEH} | V _{IN} =V _{CE} =3.63V | | -0.1 | 0.0 | 0.1 | μA | ② |
| CE "L" Current | I _{CEL} | V _{IN} =3.63V V _{CE} =V _{SS} | | -0.1 | 0.0 | 0.1 | μA | ② |

⁽¹⁾ V_{OUT(E)} : Effective output voltage. Unless otherwise stated regarding input voltage conditions, (V_{IN}=3.63V).

⁽²⁾ V_{dif} = { V_{IN1} - V_{OUT1} }

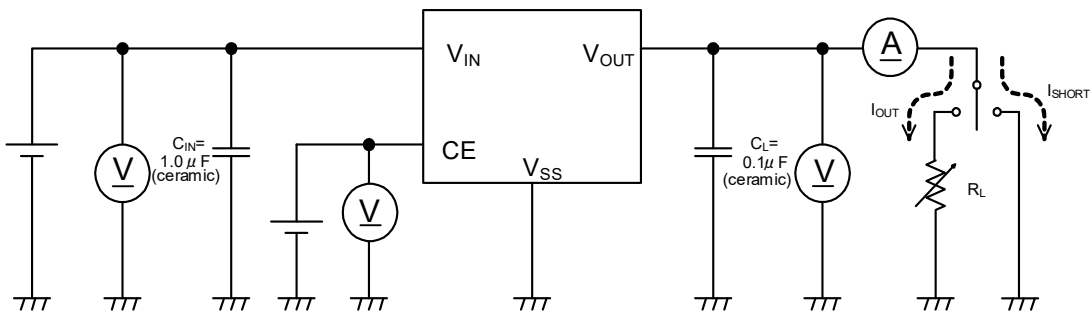
V_{IN1} : The input voltage when V_{OUT1} appears as input voltage is gradually decreased.

V_{OUT1} : A voltage equal to 98% of the output voltage whenever an amply stabilized I_{OUT} { V_{IN}=3.63V } is input.

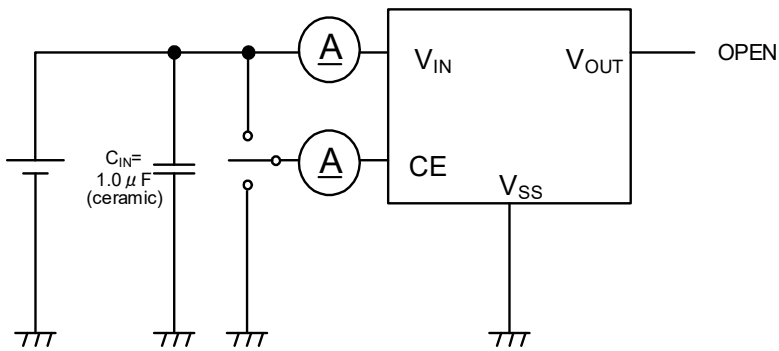
⁽³⁾ The ambient temperature range (-40°C ≤ Ta ≤ 85°C) is design Value.

TEST CIRCUITS

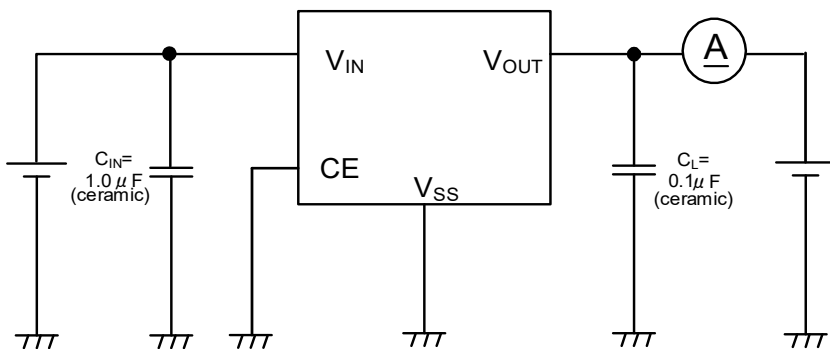
TEST CIRCUITS ①



TEST CIRCUITS ②

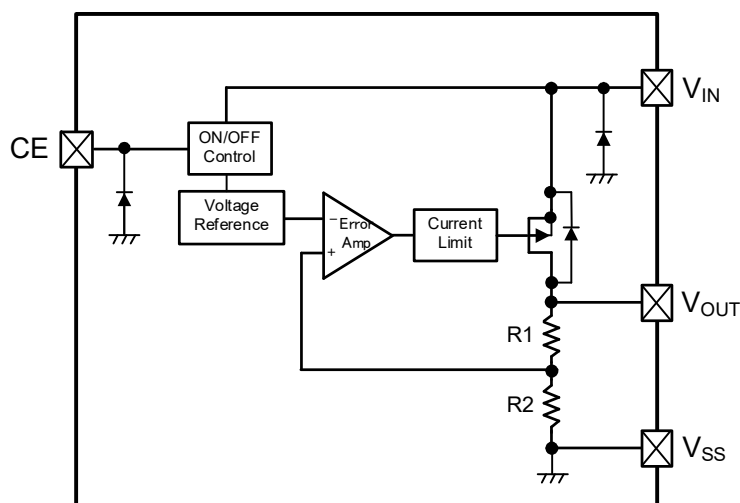


TEST CIRCUITS ③



■ OPERATIONAL EXPLANATION

The voltage divided by resistors R1 & R2 is compared with the internal voltage reference by the error amplifier. The P-channel MOSFET, which is connected to the V_{OUT} pin, is then driven by the subsequent output signal. The output voltage at the V_{OUT} pin is controlled and stabilized by a system of negative feedback.



* Diodes inside the circuits are ESD protection diodes and parasitic diodes.

< Current Limit, Short-Circuit Protection >

The XC6240 series limit output current by current fold-back circuit. When the output current reaches the current limit level (TYP. 300mA), the current fold-back circuit operates and the output current also drops as the output voltage drops. The output voltage drops further and output current decreases. When the output pin is shorted, the output current is I_{SHORT} (TYP. 50mA).

< CE Function >

The IC's internal circuitry can be shutdown via the signal from the CE pin with the XC6240 series. In shutdown mode, output at the V_{OUT} pin will be pulled down to the V_{SS} level via R1 & R2.

The output voltage becomes unstable, when the CE pin is open. Please input a certain voltage within an electrical characteristic into CE pin.

If this IC is used with the correct output voltage for the CE pin, the logic is fixed and the IC will operate normally. However, supply current may increase as a result of through current in the IC's internal circuitry when medium voltage is input.

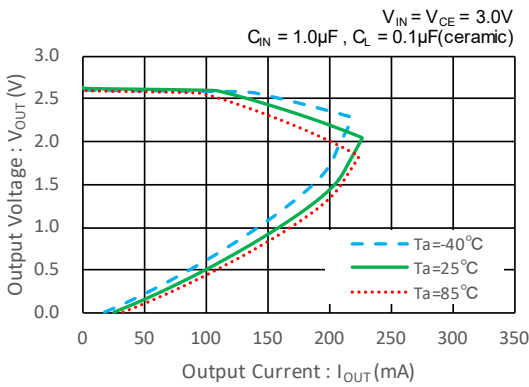
■ NOTES ON USE

- 1) For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
- 2) Where wiring impedance is high, operations may become unstable due to noise and/or phase lag depending on output current.
Please strengthen V_{IN} and V_{SS} wiring in particular.
- 3) As for the XC6240 series, internally achieved phase compensation makes a stable operation of the IC possible even when there is no output capacitor (C_L).
In order to stabilize the input power supply during use, mount a low-ESR capacitor with an effective capacity of 0.1 μ F or greater between the V_{IN} and V_{SS} pins as an input capacitor (C_{IN}).
Also, during transient fluctuation conditions when there are concerns of undershoot or overshoot, it is recommended to mount an output capacitor (C_L) between the V_{OUT} and V_{SS} pins with an effective capacity of roughly 0.1 μ F~10 μ F. If an output capacitor (C_L) which differs from the recommended values is used, the output stability may be affected.
However, please wire the input capacitor (C_{IN}) and the output capacitor (C_L) as close to the IC as possible.
- 4) Torex places an importance on improving our products and its reliability. However, by any possibility, we would request user fail-safe design and post-aging treatment on system or equipment.

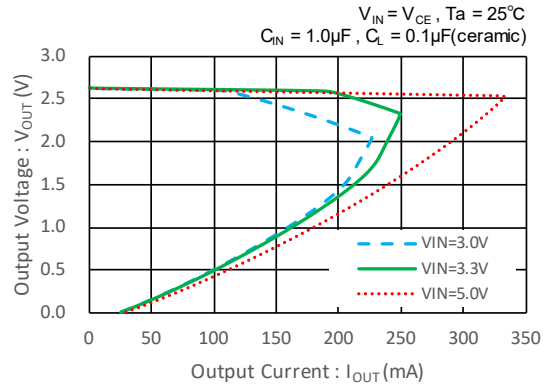
TYPICAL PERFORMANCE CHARACTERISTICS

(1) Output Voltage vs. Output Current

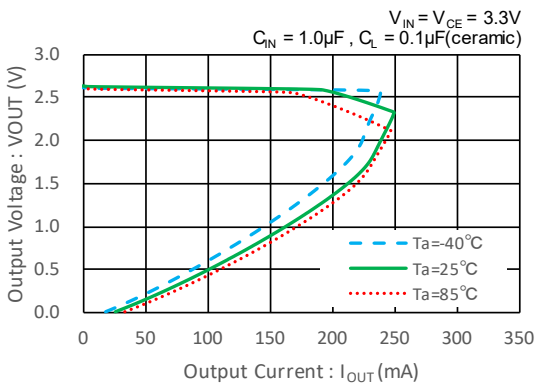
XC6240A263



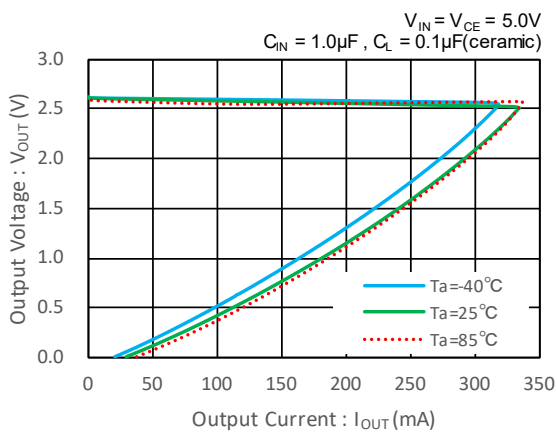
XC6240A263



XC6240A263

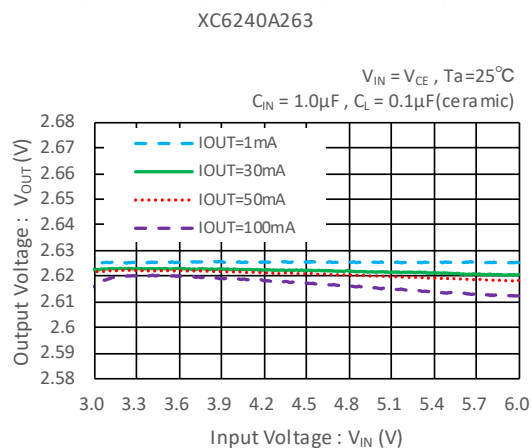
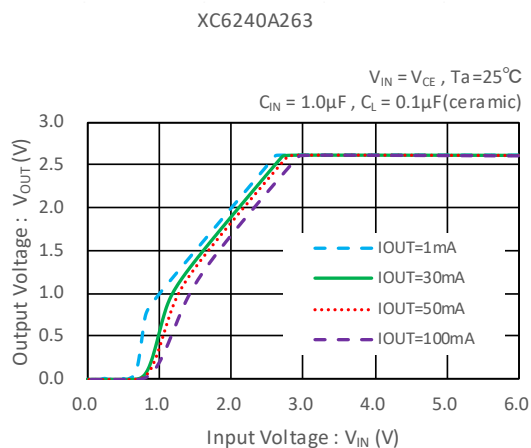


XC6240A263

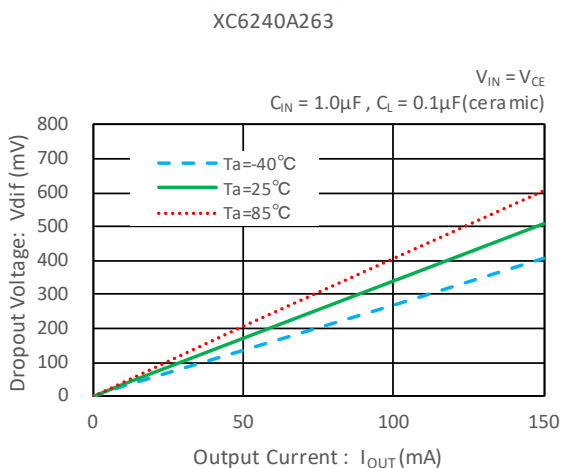


■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

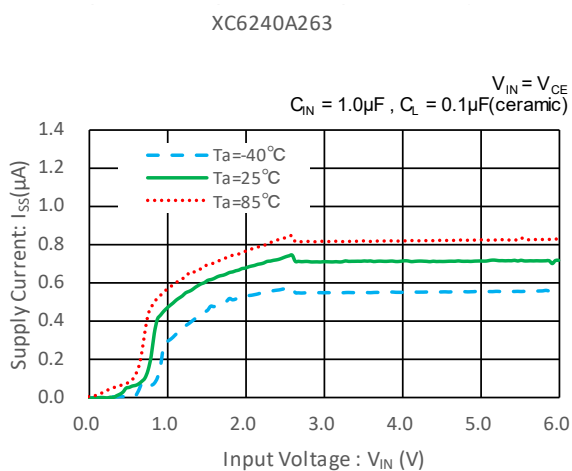
(2) Output Voltage vs. Input Voltage



(3) Dropout Voltage vs. Output Current

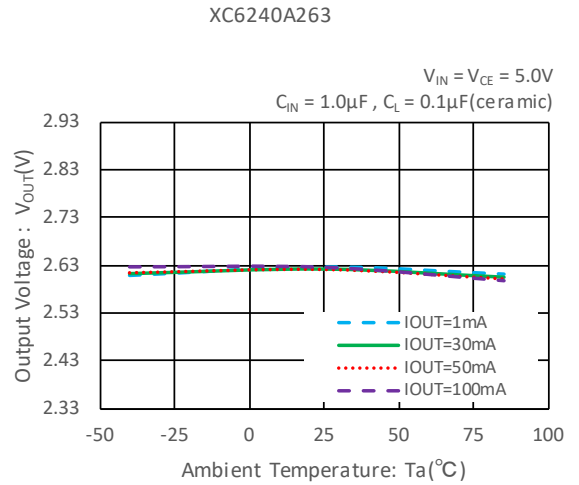
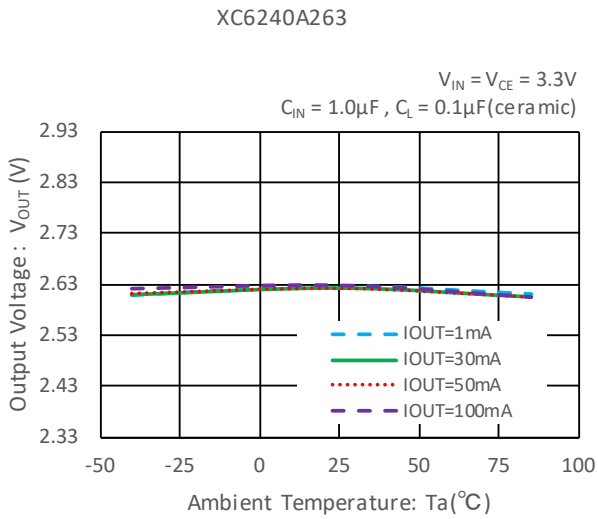


(4) Supply Current vs. Input Voltage

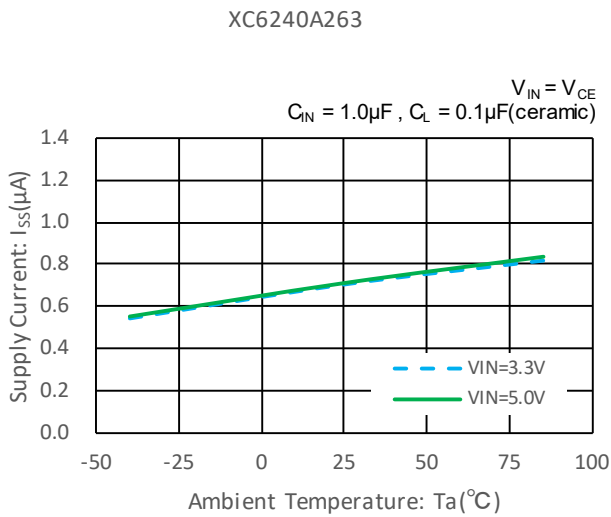


TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

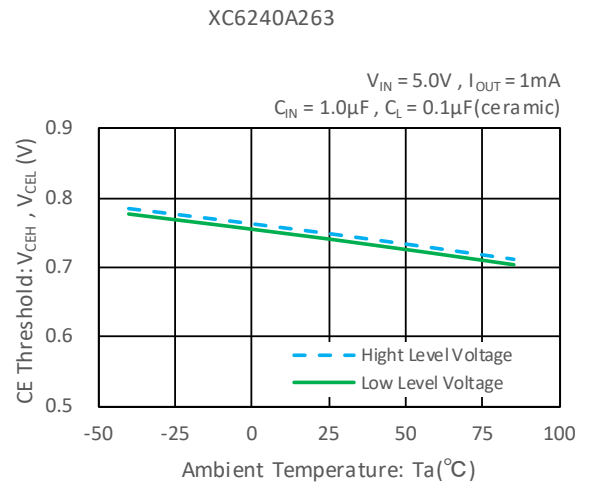
(5) Output Voltage vs. Ambient Temperature



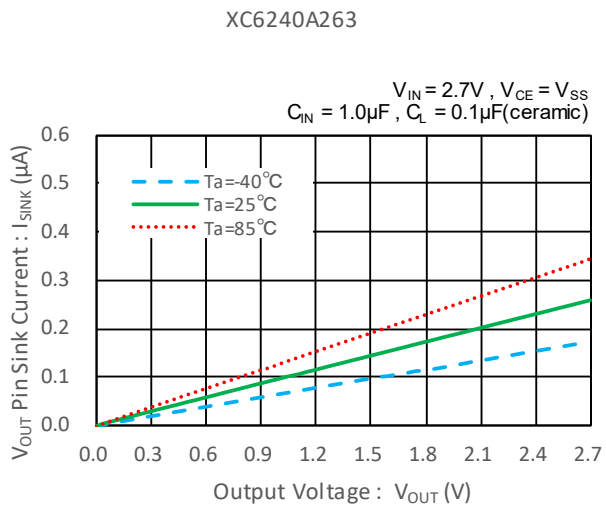
(6) Supply Current vs. Ambient Temperature



(7) CE Threshold Voltage vs. Ambient Temperature

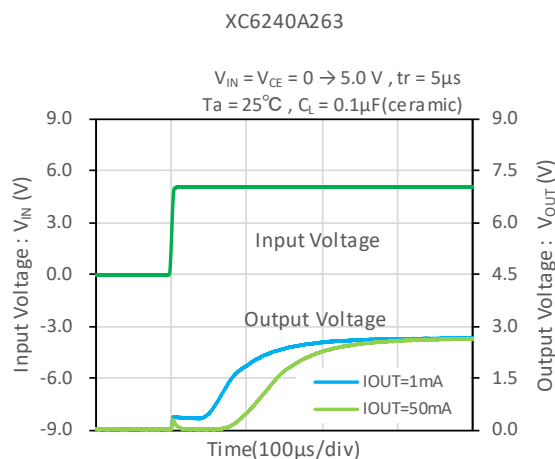
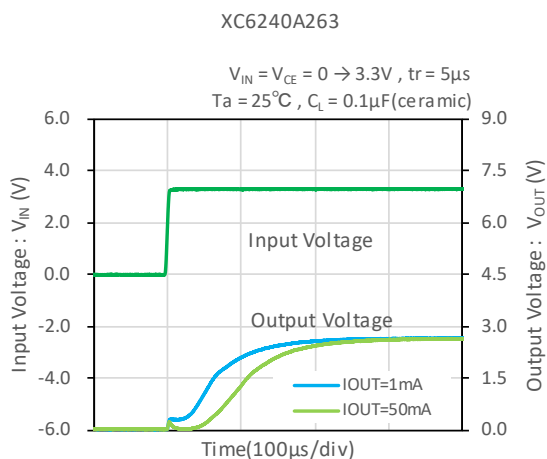


(8) V_{OUT} Pin Sink Current vs. Output Voltage

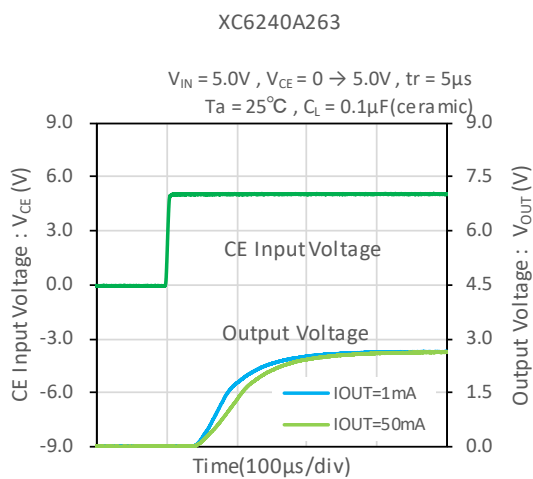
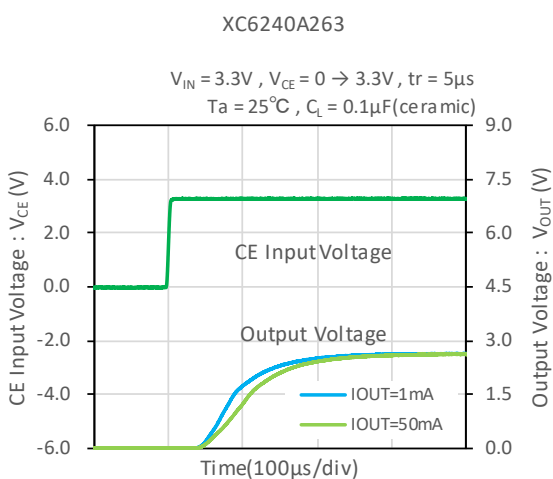


■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(9) Turn-On Response



(10) CE Transient Response



■ PACKAGING INFORMATION

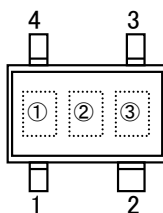
For the latest package information go to, www.torexsemi.com/technical-support/packages

| PACKAGE | OUTLIN / LAND PATTERN | THERMAL CHARACTERISTICS | |
|----------|------------------------------|-------------------------|--|
| SSOT-24 | SSOT-24 PKG | JESD51-7 Board | SSOT-24 Power Dissipation |
| USPN-4 | USPN-4 PKG | Standard Board | USPN-4 Power Dissipation |
| USP-6B06 | USP-6B06 PKG | Standard Board | USP-6B06 Power Dissipation |

MARKING RULE

●SSOT-24

SSOT-24



①represents type of regulator and output voltage range

| MARK | Regulator type | OUTPUT VOLTAGE RANGE | PRODUCT SERIES |
|------|---|----------------------|----------------|
| V | CE "H" Active, Without pulldown resistor | 2.63V | XC6240A263* |

②represents output voltage.

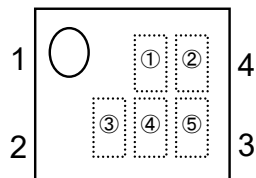
| MARK | OUTPUT VOLTAGE(V) |
|------|-------------------|
| U | 2.63 |

③represents production lot number 0~9, A~Z in order.
(G, I, J, O, Q, W excepted) *No character inversion used.

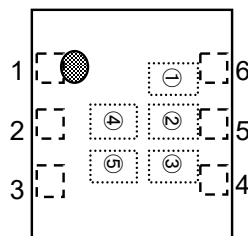
MARKING RULE

●USPN-4 / USP-6B06

USPN-4



USP-6B06



①represents product number

| MARK | PRODUCT SERIES |
|------|----------------|
| E | XC6240***** |

②represents type of regulator and output voltage range

| MARK | Regulator type | OUTPUT VOLTAGE RANGE | PRODUCT SERIES |
|------|---|----------------------|----------------|
| A | CE "H" Active, Without pulldown resistor | 2.63V | XC6240A263* |

③represents output voltage

| MARK | OUTPUT VOLTAGE (V) |
|------|--------------------|
| U | 2.63 |

④,⑤ represents production lot number. 01~09, 0A~0Z, 11...9Z, A1~A9, AA...Z9, ZA~ZZ in order.

(G, I, J, O, Q, W excepted) *No character inversion used.

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