

# Series

**VR x 4, VD x 2 Multi Power Supply**



## ◆CMOS Low Power Consumption

#### ◆4 Voltage Regulators and 2 Voltage Detectors Built-In.

### ◆Output Control Circuit

**◆Output Voltage and Detect Voltage Range**  
:2V ~ 5V

◆Output Voltage Accuracy and Detect Voltage Range:  $\pm 2\%$

◆16 Pin TSSOP Package

## ■ General Description

The XC641A series are highly precise, low power consumption, multi power supply IC s, manufactured using CMOS and laser trimming technologies. The IC consists of a highly precise reference, 4 voltage regulators, 2 voltage detectors, and an output control circuit.

Because the regulators can be disabled through the EN pins, in stand-by, current consumption can be greatly reduced. The minimal input / output differential supports efficient voltage circuit design. The XC641A is particularly suitable for use with battery powered equipment where power supply control is all important.

The series comes in a small TSSOP-16 package.

## ■ Applications

- Battery Operated Power Supply Systems
- Mobile Phones, Cordless Phones, and other Portable Communication Systems.

## ■ Features

### Output Voltage / Detect Voltage Range

: 2V ~ 5V : Selectable in 0.1V increments ( Semi-Custom )

### Highly Accurate

: Setup voltage  $\pm 2\%$ 

**Low power consumption:** TYP 25 $\mu$ A

TYP 6μA [ When the EN input is  
OFF (standard products) ]

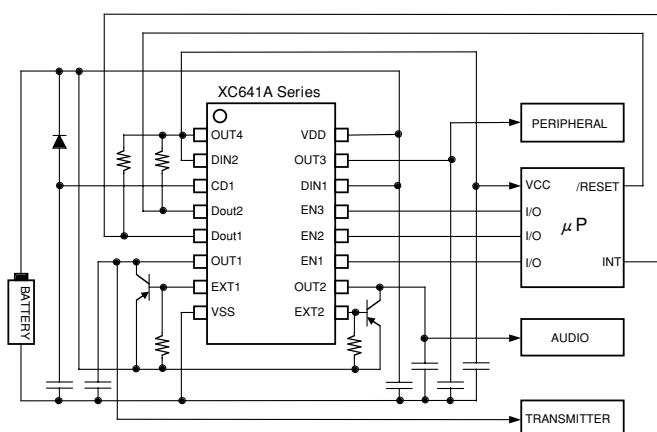
### Output voltage temperature characteristics

: TYP $\pm$ 100ppm/ $^{\circ}$ C

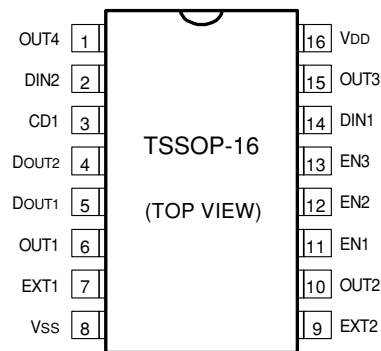
### Small Package

: TSSOP-16

## ■ Typical Application Circuit



Pin Configuration



Pin Assignment

| PIN NUMBER | PIN NAME | FUNCTION                                           |
|------------|----------|----------------------------------------------------|
| 1          | OUT4     | Voltage Regulator 4 Output                         |
| 2          | DIN2     | Voltage Detector 2 Input                           |
| 3          | CD1      | Delay Generating Circuit Output                    |
| 4          | DOUT2    | Voltage Detector 2 Output                          |
| 5          | DOUT1    | Voltage Detector 1 Output                          |
| 6          | OUT1     | Voltage Regulator 1 Output Voltage Monitor         |
| 7          | EXT1     | Voltage Regulator 1 External Transistor Connection |
| 8          | Vss      | Ground                                             |
| 9          | EXT2     | Voltage Regulator 2 External Transistor Connection |
| 10         | OUT2     | Voltage Regulator 2 Output Voltage Monitor         |
| 11         | EN1      | Voltage Regulator 1 Enable ( Positive Logic )      |
| 12         | EN2      | Voltage Regulator 2 Enable ( Positive Logic )      |
| 13         | EN3      | Voltage Regulator 3 Enable ( Positive Logic )      |
| 14         | DIN1     | Voltage Detector 1 Input                           |
| 15         | OUT3     | Voltage Regulator 3 Output                         |
| 16         | VDD      | Power Supply                                       |

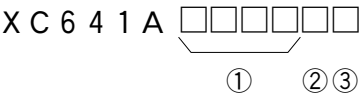
Functions

| INPUT |     |     | VOLTAGE REGULATOR OUTPUT |     |     |
|-------|-----|-----|--------------------------|-----|-----|
| EN1   | EN2 | EN3 | VR1                      | VR2 | VR3 |
| H     | -   | -   | ON                       | -   | -   |
| L     | -   | -   | OFF                      | -   | -   |
| -     | H   | -   | -                        | ON  | -   |
| -     | L   | -   | -                        | OFF | -   |
| -     | -   | H   | -                        | -   | ON  |
| -     | -   | L   | -                        | -   | OFF |

H = High Level : L = Low Level

Product Classification

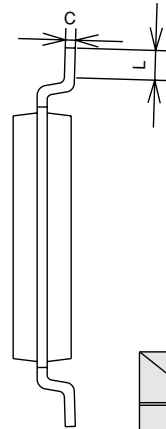
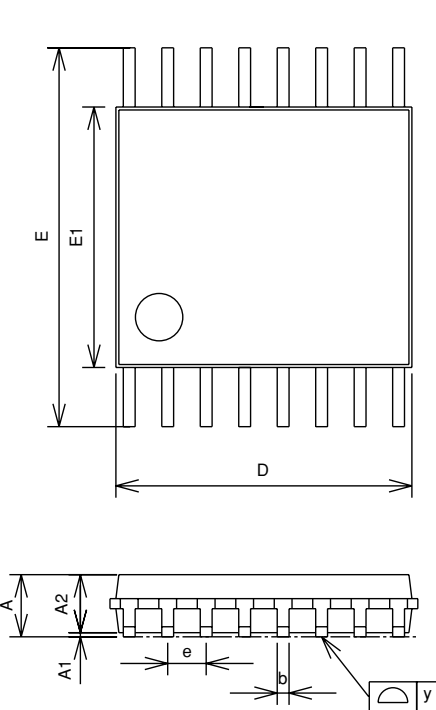
●Ordering Information:



| SYMBOL | DESCRIPTION                                              | SYMBOL | DESCRIPTION                                                                       |
|--------|----------------------------------------------------------|--------|-----------------------------------------------------------------------------------|
| ①      | Voltage Characteristics :<br>Based on internal standards | ②      | Package Type :<br>V = TSSOP-16                                                    |
|        |                                                          | ③      | Device Orientation :<br>R = Embossed Tape ( Right )<br>L = Embossed Tape ( Left ) |

■Packaging Information

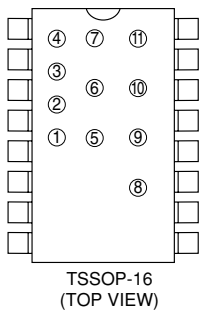
●TSSOP-16



|    | SIZE mm |      |      |
|----|---------|------|------|
|    | MIN     | TYP  | MAX  |
| A  | —       | —    | 1.10 |
| A1 | 0.03    | 0.07 | 0.10 |
| A2 | 0.95    | —    | 1.05 |
| b  | 0.15    | 0.22 | 0.30 |
| C  | 0.12    | 0.17 | 0.22 |
| D  | 4.9     | 5.10 | 5.30 |
| E  | 6.20    | 6.40 | 6.60 |
| E1 | 4.30    | 4.40 | 4.50 |
| e  | —       | 0.65 | —    |
| L  | 0.40    | 0.50 | 0.60 |
| y  | —       | —    | 0.10 |

■Marking

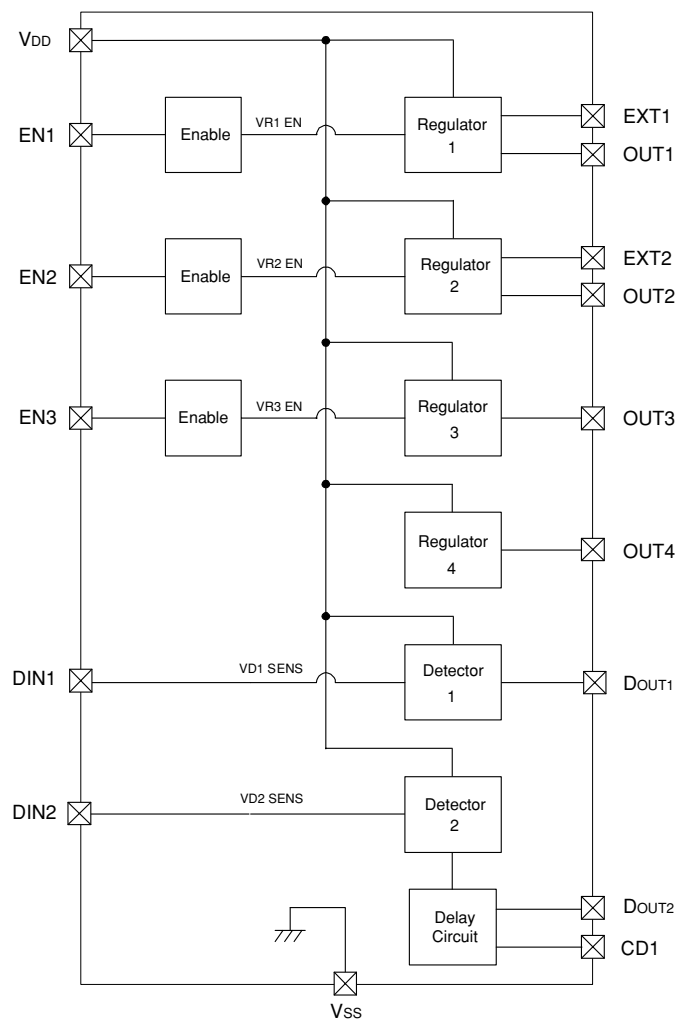
●TSSOP-16



① ~ ④: Represents the diffusion lot.  
⑤ ~ ⑪: Represents the product series.

Example) XC641A1004VR  
                  ↑        ↑  
                  ⑤     ~   ⑪

■Block Diagram



## ■ Absolute Maximum Ratings

Ta = 25 °C

| PARAMETER                     | SYMBOL | RATINGS         | UNITS |
|-------------------------------|--------|-----------------|-------|
| Input Voltage                 | VIN    | -0.3 ~ +12      | V     |
| Output Voltage                | VOUT   | -0.3 ~ VIN +0.3 | V     |
| EXT Pin Voltage               | VEXT   | -0.3 ~ +12      | V     |
| DIN Pin Voltage               | VDIN   | -0.3 ~ VIN +0.3 | V     |
| DOUT Pin Voltage              | VDOUT  | -0.3 ~ 12       | V     |
| CD1 Pin Voltage               | VCD1   | -0.3 ~ VIN +0.3 | V     |
| EN Pin Voltage                | VEN    | -0.3 ~ VIN +0.3 | V     |
| Output Current                | IOUT   | 200             | mA    |
| EXT Pin Current               | IEXT   | 50              | mA    |
| DOUT Pin Current              | IDOUT  | 20              | mA    |
| Power Dissipation             | Pd     | 350             | mW    |
| Power Dissipation ( mounted ) | Pd     | 630             | mW    |
| Operating Ambient Temperature | Topr   | -30 ~ +80       | °C    |
| Storage Temperature           | Tstg   | -40 ~ +125      | °C    |

All voltage is ground standardised.

Note :

Please ensure that the sum total of power used within the IC does not exceed the continuous total power dissipation (Pd) figure.

The figure for total continuous power dissipation ( mounted ) represents the value when tested on a single sided glass epoxy board of dimensions :  
21mm x 32mm ; t = 1.6mm

## ■ Electrical Characteristics (XC641A0001V)

### Voltage Conditions

| CONDITIONS    | SYMBOL | VALUE | UNITS |
|---------------|--------|-------|-------|
| Input Voltage | VINDEF | 4.4   | V     |

### Set-Up Voltage Table

Ta = 25 °C

| CIRCUIT             | PARAMETER      | SYMBOL  | VALUE | UNITS |
|---------------------|----------------|---------|-------|-------|
| Voltage Regulator 1 | Output Voltage | VOUT(T) | 3.0   | V     |
| Voltage Regulator 2 | Output Voltage | VOUT(T) | 3.0   | V     |
| Voltage Regulator 3 | Output Voltage | VOUT(T) | 3.0   | V     |
| Voltage Regulator 4 | Output Voltage | VOUT(T) | 3.0   | V     |
| Voltage Detector 1  | Detect Voltage | VDF1    | 3.4   | V     |
| Voltage Detector 2  | Detect Voltage | VDF2    | 2.5   | V     |

## Voltage Regulator 1

Ta=25°C

| PARAMETER                                    | SYMBOL                                                | CONDITIONS                                                            | MIN  | TYP   | MAX  | UNITS  | CIRCUIT |
|----------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------------------|------|-------|------|--------|---------|
| Output Voltage                               | V <sub>OUT</sub> (E)                                  | I <sub>OUT</sub> =50mA<br>V <sub>IN</sub> =V <sub>INDEF</sub>         | 2.94 | 3.0   | 3.06 | V      | 1       |
| Maximum Output Current *                     | I <sub>OUT</sub> max                                  | V <sub>IN</sub> =V <sub>INDEF</sub>                                   |      | 1000  |      | mA     | 1       |
| Load Stability *                             | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$               | V <sub>IN</sub> =V <sub>INDEF</sub><br>1mA ≤ I <sub>OUT</sub> ≤ 100mA | -50  |       | 50   | mV     | 1       |
| Input-Output Voltage Diff. *                 | V <sub>DIF</sub>                                      | I <sub>OUT</sub> =100mA                                               |      | 100   |      | mV     | 1       |
| Supply Current                               | I <sub>SS</sub>                                       | V <sub>IN</sub> =V <sub>INDEF</sub> , (No Load)                       |      | 8     | 12   | μA     | 2       |
| Input Stability *                            | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$  | I <sub>OUT</sub> =50mA                                                |      | 0.04  | 0.3  | %/V    | 1       |
| Output Voltage Temperature Characteristics * | $\frac{\Delta V_{OUT}}{\Delta T_{opr} \cdot V_{OUT}}$ | I <sub>OUT</sub> =10mA                                                |      | ± 100 |      | ppm/°C | 1       |
| EXT Output Voltage                           | V <sub>EXT</sub>                                      |                                                                       |      |       | 7    | V      | -       |
| EXT Leak Current                             | I <sub>LEAK</sub>                                     |                                                                       |      |       | 0.5  | μA     | 3       |

- Note : 1. V<sub>OUT</sub>(T) = Specified Output Voltage : V<sub>OUT</sub>(E) = Effective Output Voltage.
2. Parameter characteristics marked with an asterisk may vary according to which type of external transistor is used.  
A transistor with a value of hFE = 100 or greater and a low saturation voltage is recommended.  
Unless otherwise stated, use of the following external components are recommended :  
PNP Transistor, 2SA1213-Y : R<sub>BE</sub>, 200K Ω : C<sub>L</sub>, 10 μF Tantalum Capacitor.
3. The values given for I<sub>SS</sub> refer to the actual IC values ( see application circuits )
4. The IC's supply current is calculated as follows :  
Supply Current = I<sub>SS</sub> + ( Load Current / hFE ) + ( 0.6 / R<sub>BE</sub> )
5. V<sub>DIF</sub> = { V<sub>IN1</sub> - V<sub>OUT1</sub> }  
V<sub>OUT1</sub> = A voltage equal to 98% of the Output Voltage whenever an amply stabilised I<sub>OUT</sub> {V<sub>OUT</sub>(T)+1.0V} is input.  
V<sub>IN1</sub> = The Input Voltage when V<sub>OUT1</sub> appears as Input Voltage is gradually decreased.
6. The Maximum Output Current value represents the value at the time the Output Voltage has decreased to V<sub>OUT</sub> (E) x 0.9.  
Due to the limitations of Continuous Total Power Dissipation with the 2SA1213 transistor, the Maximum Output Current Value cannot be continually achieved.

## Voltage Regulator 2

Ta=25°C

| PARAMETER                                    | SYMBOL                                                | CONDITIONS                                                            | MIN  | TYP   | MAX  | UNITS  | CIRCUIT |
|----------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------------------|------|-------|------|--------|---------|
| Output Voltage                               | V <sub>OUT</sub> (E)                                  | I <sub>OUT</sub> =50mA<br>V <sub>IN</sub> =V <sub>INDEF</sub>         | 2.94 | 3.0   | 3.06 | V      | 1       |
| Maximum Output Current *                     | I <sub>OUT</sub> max                                  | V <sub>IN</sub> =V <sub>INDEF</sub>                                   |      | 1000  |      | mA     | 1       |
| Load Stability *                             | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$               | V <sub>IN</sub> =V <sub>INDEF</sub><br>1mA ≤ I <sub>OUT</sub> ≤ 100mA | -50  |       | 50   | mV     | 1       |
| Input-Output Voltage Diff. *                 | V <sub>DIF</sub>                                      | I <sub>OUT</sub> =100mA                                               |      | 100   |      | mV     | 1       |
| Supply Current                               | I <sub>SS</sub>                                       | V <sub>IN</sub> =V <sub>INDEF</sub> , (No Load)                       |      | 8     | 12   | μA     | 2       |
| Input Stability *                            | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$  | I <sub>OUT</sub> =50mA                                                |      | 0.04  | 0.3  | %/V    | 1       |
| Output Voltage Temperature Characteristics * | $\frac{\Delta V_{OUT}}{\Delta T_{opr} \cdot V_{OUT}}$ | I <sub>OUT</sub> =10mA                                                |      | ± 100 |      | ppm/°C | 1       |
| EXT Output Voltage                           | V <sub>EXT</sub>                                      |                                                                       |      |       | 7    | V      | -       |
| EXT Leak Current                             | I <sub>LEAK</sub>                                     |                                                                       |      |       | 0.5  | μA     | 3       |

Note : Characteristics are the same as for Regulator 1.

### Voltage Regulator 3

Ta=25°C

| PARAMETER                                     | SYMBOL                                                | CONDITIONS                        | MIN  | TYP   | MAX  | UNITS  | CIRCUIT |
|-----------------------------------------------|-------------------------------------------------------|-----------------------------------|------|-------|------|--------|---------|
| Output Voltage                                | VOUT(E)                                               | IOUT=35mA<br>VIN=VINDEF           | 2.94 | 3.0   | 3.06 | V      | 1       |
| Load Stability                                | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$               | VIN=VINDEF<br>1mA ≤ IOUT ≤ 35mA   |      |       | 50   | mV     | 1       |
| Input-Output Voltage Diff.                    | VDIF                                                  | IOUT=35mA                         |      |       | 0.3  | V      | 1       |
| Supply Current                                | ISS                                                   | VIN=VINDEF, (No Load)             |      | 3.0   | 4.5  | μA     | 2       |
| Input Stability                               | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$  | IOUT=35mA<br>VINDEF ≤ VIN ≤ 10.0V |      | 0.1   | 0.3  | %/V    | 1       |
| Output Voltage<br>Temperature Characteristics | $\frac{\Delta V_{OUT}}{\Delta T_{opr} \cdot V_{OUT}}$ | IOUT=35mA<br>-30°C ≤ Topr ≤ 80°C  |      | ± 100 |      | ppm/°C | 1       |

Note : 1. VOUT(T) = Specified Output Voltage : VOUT(E) = Effective Output Voltage.

2. VDIF = { VIN1 - VOUT1 }

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

VIN1 = The Input Voltage when VOUT1 appears as Input Voltage is gradually decreased.

### Voltage Regulator 4

Ta=25°C

| PARAMETER                                     | SYMBOL                                                | CONDITIONS                        | MIN  | TYP   | MAX  | UNITS  | CIRCUIT |
|-----------------------------------------------|-------------------------------------------------------|-----------------------------------|------|-------|------|--------|---------|
| Output Voltage                                | VOUT(E)                                               | IOUT=15mA<br>VIN=VINDEF           | 2.94 | 3.0   | 3.06 | V      | 1       |
| Load Stability                                | $\frac{\Delta V_{OUT}}{\Delta I_{OUT}}$               | VIN=VINDEF<br>1mA ≤ IOUT ≤ 15mA   |      |       | 50   | mV     | 1       |
| Input-Output Voltage Diff.                    | VDIF                                                  | IOUT=15mA                         |      |       | 0.3  | V      | 1       |
| Input Stability                               | $\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$  | IOUT=15mA<br>VINDEF ≤ VIN ≤ 10.0V |      | 0.1   | 0.3  | %/V    | 1       |
| Output Voltage<br>Temperature Characteristics | $\frac{\Delta V_{OUT}}{\Delta T_{opr} \cdot V_{OUT}}$ | IOUT=15mA<br>-30°C ≤ Topr ≤ 80°C  |      | ± 100 |      | ppm/°C | 1       |

Note : 1. VOUT(T) = Specified Output Voltage : VOUT(E) = Effective Output Voltage.

2. VDIF = { VIN1 - VOUT1 }

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

VIN1 = The Input Voltage when VOUT1 appears as Input Voltage is gradually decreased.

3. As operational shutdown cannot be achieved with Voltage Regulator 4, please standardize to the IC circuit's stand-by current parameters.

## Voltage Detector 1

Ta=25°C

| PARAMETER                                     | SYMBOL                                         | CONDITIONS                     | MIN    | TYP           | MAX    | UNITS  | CIRCUIT |
|-----------------------------------------------|------------------------------------------------|--------------------------------|--------|---------------|--------|--------|---------|
| Detect Voltage                                | VDF                                            | VIN = VINDEF                   | 3.332  | 3.4           | 3.468  | V      | 4       |
| Hysteresis Range                              | VHYS                                           | VIN = VINDEF                   | x 0.02 | VDF<br>x 0.05 | x 0.08 | V      | 4       |
| Input Current                                 | IIN                                            | VIN = VINDEF                   |        | 0.8           | 1.4    | μA     | 4       |
| Output Current                                | IOUT                                           | Nch VDS = 0.5V<br>VIN = VINDEF | 6.0    | 11.5          |        | mA     | 3       |
| Detect Voltage<br>Temperature Characteristics | $\frac{\Delta VDF}{\Delta T_{opr} \cdot VOUT}$ |                                |        | ± 100         |        | ppm/°C | 4       |

## Voltage Detector 2

Ta=25°C

| PARAMETER                                     | SYMBOL                                         | CONDITIONS                     | MIN    | TYP           | MAX    | UNITS  | CIRCUIT |
|-----------------------------------------------|------------------------------------------------|--------------------------------|--------|---------------|--------|--------|---------|
| Detect Voltage                                | VDF                                            | VIN = VINDEF                   | 2.450  | 2.5           | 2.550  | V      | 4       |
| Hysteresis Range                              | VHYS                                           | VIN = VINDEF                   | x 0.02 | VDF<br>x 0.05 | x 0.08 | V      | 4       |
| Input Current                                 | IIN                                            | VIN = VINDEF                   |        | 0.8           | 1.4    | μA     | 4       |
| Output Current                                | IOUT                                           | Nch VDS = 0.5V<br>VIN = VINDEF | 6.0    | 11.5          |        | mA     | 3       |
| Delay Circuit Current                         | ICDO                                           | VIN = VINDEF                   | 0.25   | 0.50          | 0.80   | μA     | 5       |
| Detect Voltage<br>Temperature Characteristics | $\frac{\Delta VDF}{\Delta T_{opr} \cdot VOUT}$ |                                |        | ± 100         |        | ppm/°C | 4       |

Note :

The delay circuit current is controlled by the set current circuit within the IC.

Delay time depends upon the capacity of the external condensor. Approximate delay time can be calculated using the following formula :

$$TD \text{ (msec)} = 1.8 \times C \text{ (nF)}$$

## Input Pin

Ta=25°C

| PARAMETER               | SYMBOL | CONDITIONS | MIN  | TYP | MAX | UNITS | CIRCUIT |
|-------------------------|--------|------------|------|-----|-----|-------|---------|
| EN 'High Level' Voltage | VENH   |            | 1.3  |     |     | V     | 1       |
| EN 'Low Level' Voltage  | VENL   |            |      |     | 0.4 | V     | 1       |
| EN 'High Level' Current | IENH   |            |      |     | 0.1 | μA    | 1       |
| EN 'Low Level' Voltage  | IENL   |            | -0.5 |     | 0   | μA    | 1       |

## Entire Circuit

Ta=25°C

| PARAMETER      | SYMBOL | CONDITIONS                      | MIN | TYP | MAX  | UNITS | CIRCUIT |
|----------------|--------|---------------------------------|-----|-----|------|-------|---------|
| Supply Current | ISS    | VIN = 8V, No Load               |     | 25  | 37.5 | μA    | 2       |
| ( Stand-By )   | ISTB   | VIN = 8V, VR1 = VR2 = VR3 = OFF |     | 6.0 | 9.0  | μA    | 2       |

Note :

The supply current (ISS) value of the entire IC is the IC's internal supply current value.

( This does not include current flowing through externally connected components nor the input current through the detect pins of voltage detectors 1, 2 )

## ■Directions for use

### ●Notes on Use :

#### IC

1. Please sufficiently strengthen the GND wiring and the power supply ( $V_{DD}$ ) line, as when the power supply line impedance is high, the voltage regulators and detectors are prone to oscillation leading to possible instability.
2. In order to lower the power supply line impedance, we recommend that a capacitor of 10 $\mu$ F (Tantalum) or more be connected at the shortest point possible between the  $V_{DD}$  pin and the GND pin.
3. To protect the IC from surge at the input pin, an input protect diode is built-in. Therefore, do not apply voltages that exceed the  $V_{DD}$  pin voltage.
4. Please ensure that the sum total of the IC's power consumption does not exceed the stipulated figure for total continuous power dissipation (  $P_d$  ).

$$P_d < P_1 + P_2 + P_3 + P_4 + P_5 + P_6$$

The following equations can be used to calculate the IC's power consumption :

$$\text{Regulator 1 : } P_1 = ( V_{DD} - 0.6V ) \times I_{EXT1}, I_{EXT1} \text{ to } I_{OUT1} / hFE$$

$$\text{Regulator 2 : } P_2 = ( V_{DD} - 0.6V ) \times I_{EXT2}, I_{EXT2} \text{ to } I_{OUT2} / hFE$$

$$\text{Regulator 3 : } P_3 = ( V_{DD} - V_{OUT3} ) \times I_{OUT3}$$

$$\text{Regulator 4 : } P_4 = ( V_{DD} - V_{OUT4} ) \times I_{OUT4}$$

$$\text{Detector 1 : } P_5 = V_{DOUT1} \times I_{DOUT1}$$

$$\text{Detector 2 : } P_6 = V_{DOUT2} \times I_{DOUT2}$$

#### Voltage Regulator 1, 2 ( External transistor type )

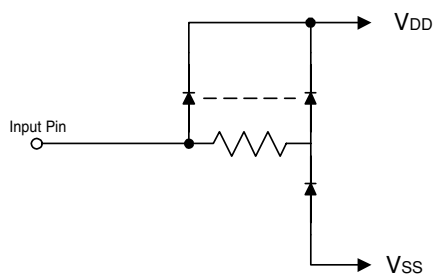
1. In order to prevent regulator oscillation ( caused by power supply impedance ), we recommend that a capacitor of 10 $\mu$ F (Tantalum) or more be connected between the external transistor's emitter and the GND pin.
2. In order to prevent regulator phase compensation, we recommend that a capacitor of 10 $\mu$ F (Tantalum) or more be connected between the  $I_{OUT1}$ ,  $I_{OUT2}$  pins and the GND pin.
3. In order to prevent oscillation we recommend that a resistor of around 200k $\Omega$  be connected between the external transistor's base pin and emitter pin.

#### Voltage Regulator 3, 4 ( Built-in transistor type )

1. Please connect a capacitor of 1 $\mu$ F (Tantalum) or more between the voltage regulator's output pins (  $OUT3$ ,  $OUT4$  ) and the GND pin.
2. In order to prevent regulator oscillation ( caused by power supply impedance ), we recommend that a capacitor be connected between the  $V_{DD}$  pin and the GND pin.
3. Since a short circuit protector is not built-in, when the  $OUT3$  or  $OUT4$  pin is short circuited to the GND pin, resulting surge current may damage the IC.

#### Voltage Detectors

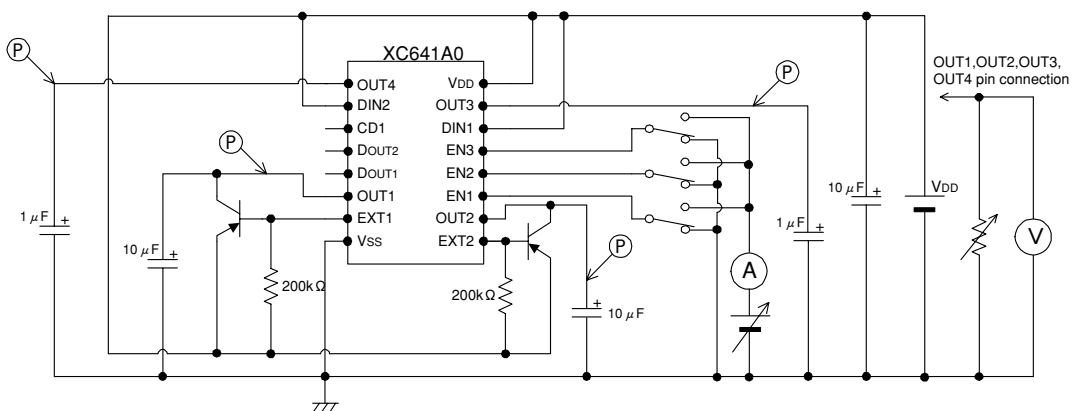
1. In order to prevent regulator oscillation ( caused by power supply impedance ), we recommend that a capacitor be connected between the  $V_{DD}$  pin and the GND pin.
2. Should the  $V_{DD}$  pin voltage become excessively low, we recommend that a Schottky Diode be connected between the CD1 pin and the  $V_{DD}$  pin, in order to prevent voltages over the established  $V_{DD} + 0.3V$  being applied to the capacitor connection pin ( CD1 ).  
Please use a Schottky Diode of  $V_F = 0.3V$  (  $I_F = 10mA$  ). If a large reverse current,  $I_R$  (max.), is used, the delay circuit current will increase and delay time will be shortened.
3. When not using the delay circuit, please use the IC with the CD1 pin open.



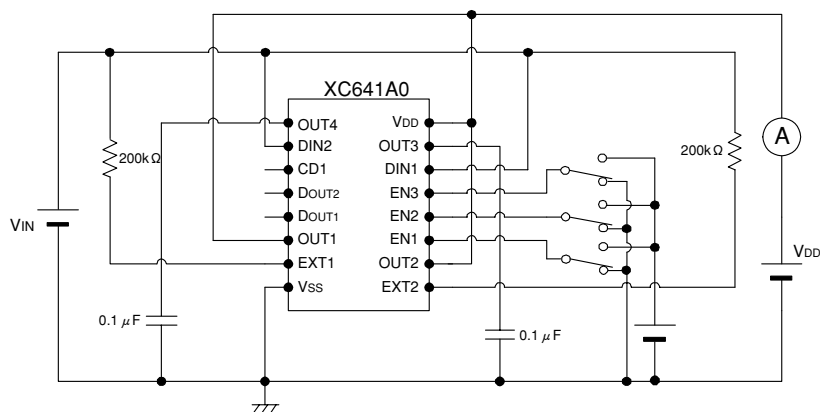
The XC641A has a built-in circuit to protect the IC against surge at the input pin. Should a voltage higher than  $V_{DD}$  be applied at the input pin, please note that current will flow from the input pin to  $V_{DD}$ . (Use within the stipulated absolute maximum ratings).

## Test Circuits

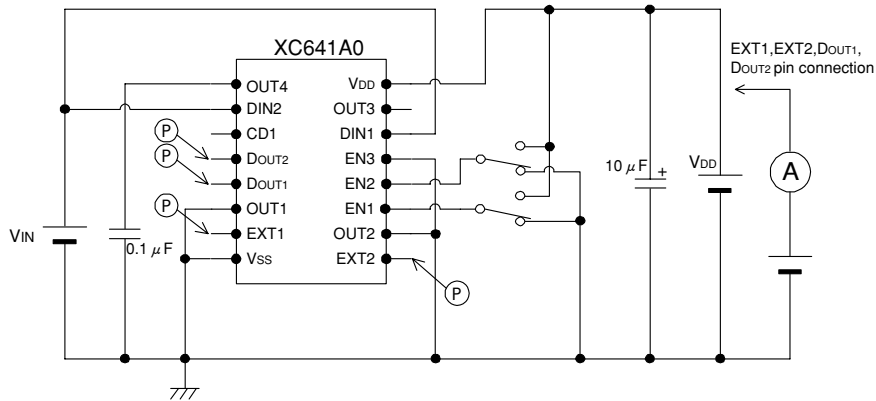
Application Circuit 1



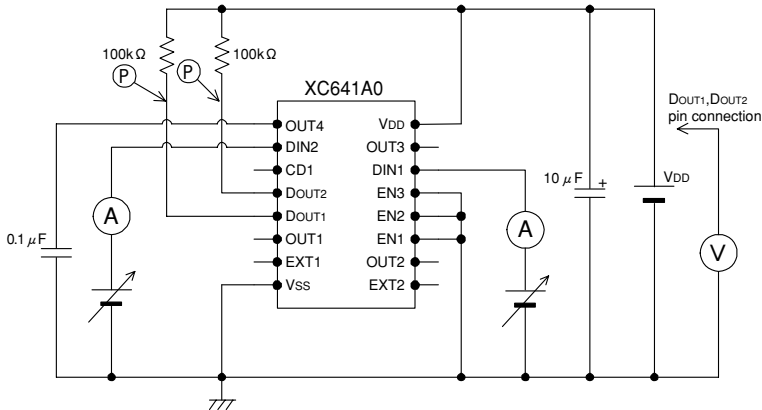
Application Circuit 2



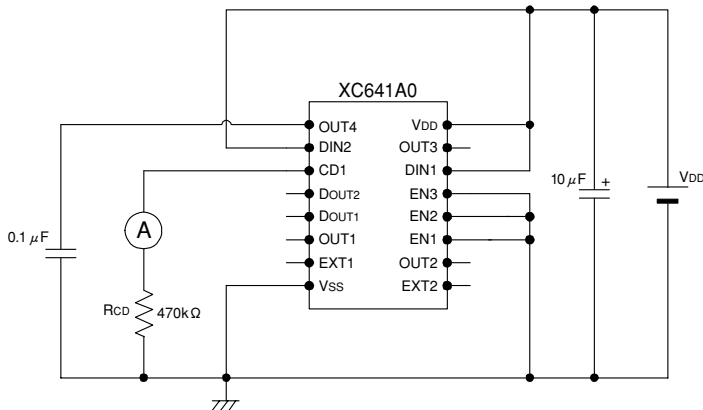
Application Circuit 3



Application Circuit 4

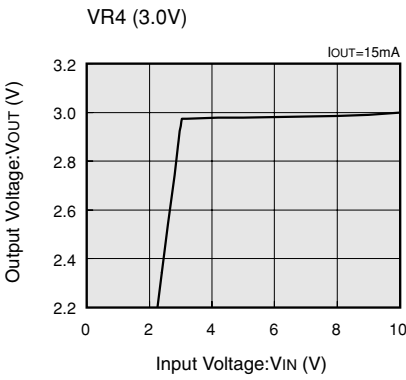
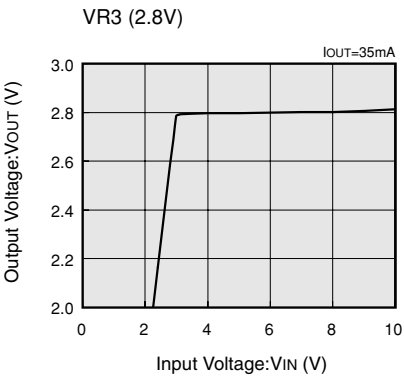
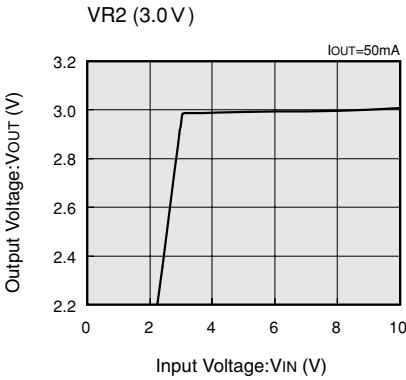
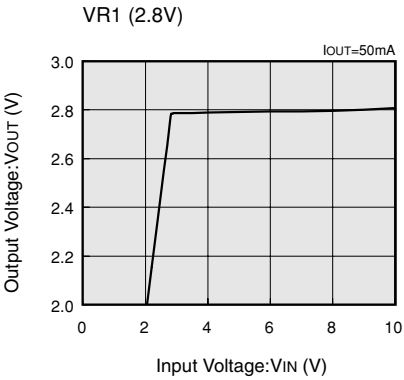


Application Circuit 5



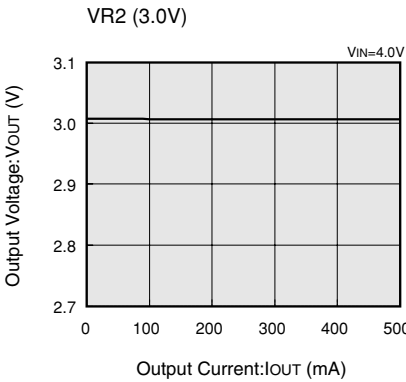
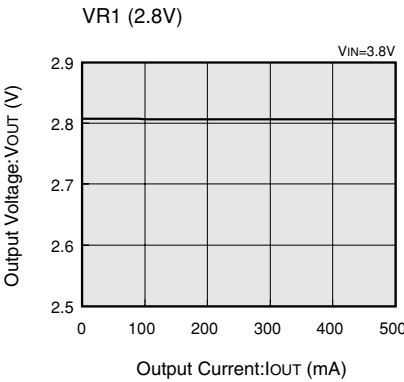
Typical Performance Characteristics

(1) OUTPUT VOLTAGE vs. INPUT VOLTAGE

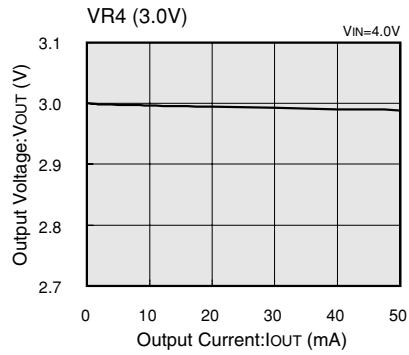
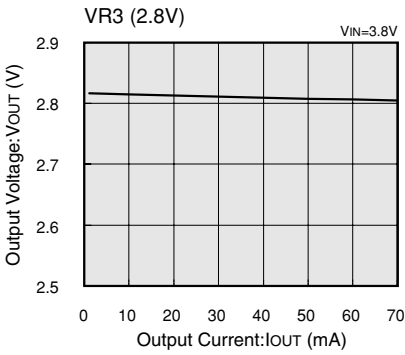


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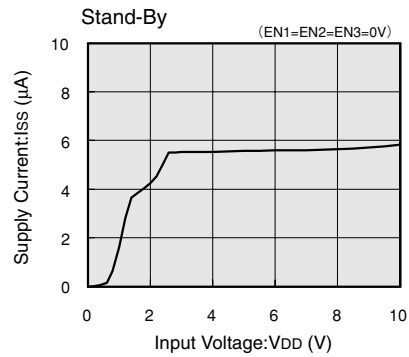
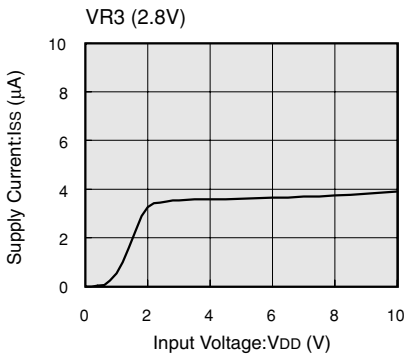
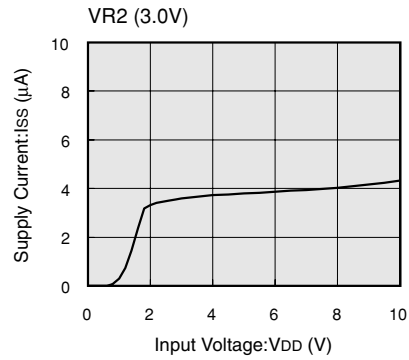
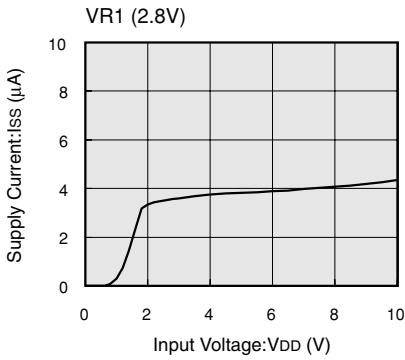
(2) OUTPUT VOLTAGE vs. OUTPUT CURRENT



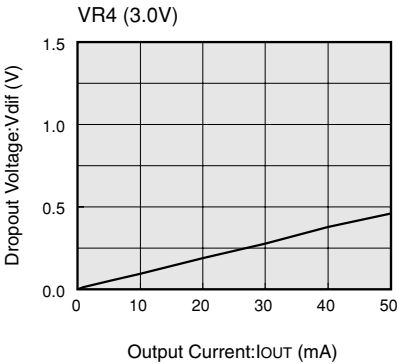
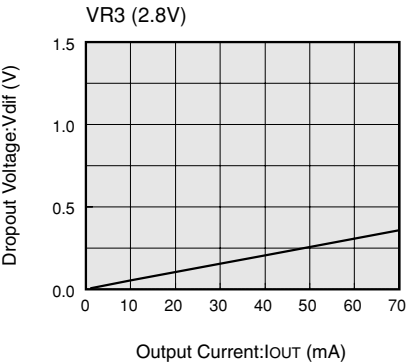
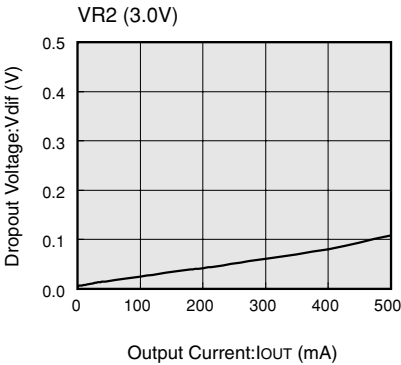
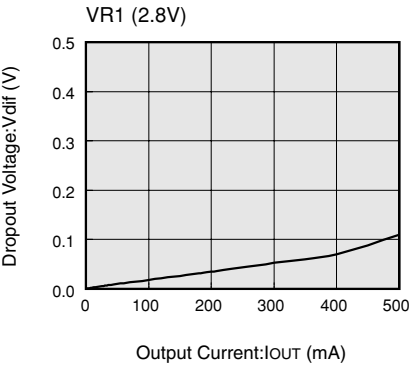
(2) OUTPUT VOLTAGE vs. OUTPUT CURRENT



(3) SUPPLY CURRENT vs. INPUT VOLTAGE

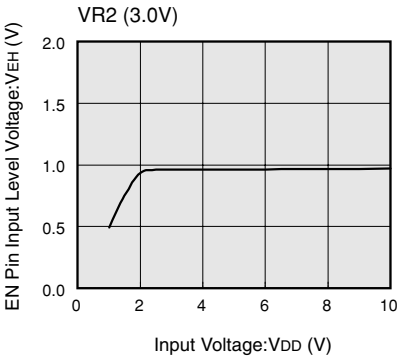
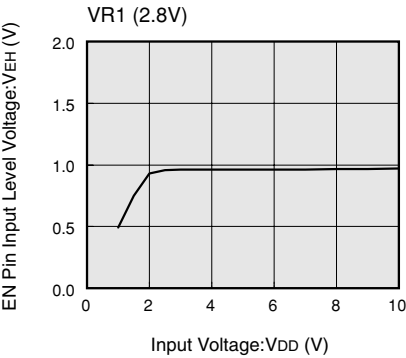


(4) DROPOUT VOLTAGE vs. OUTPUT CURRENT

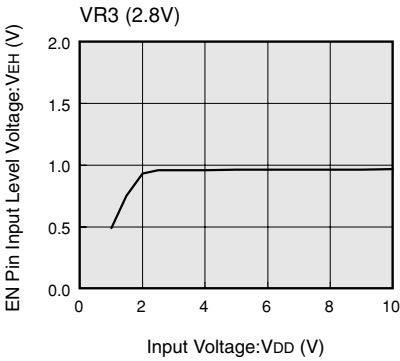


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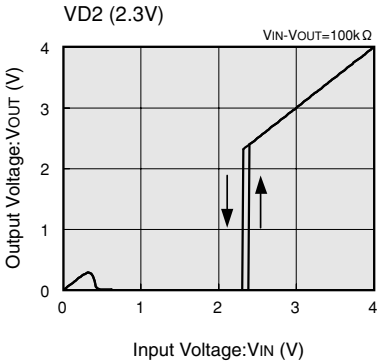
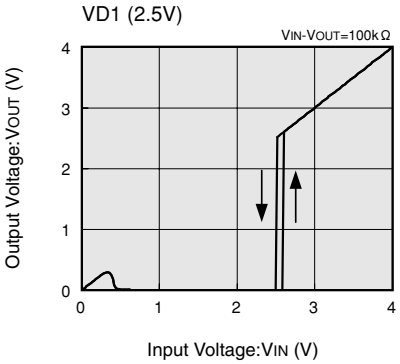
(5) EN PIN INPUT LEVEL VOLTAGE vs. INPUT VOLTAGE



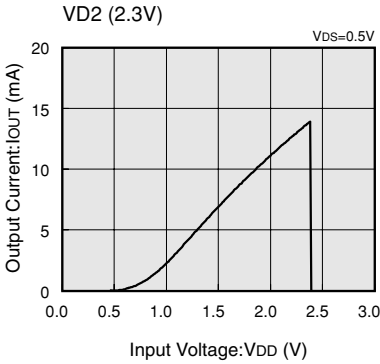
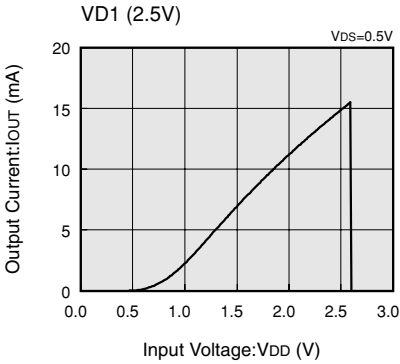
(5) EN PIN INPUT LEVEL VOLTAGE vs. INPUT VOLTAGE



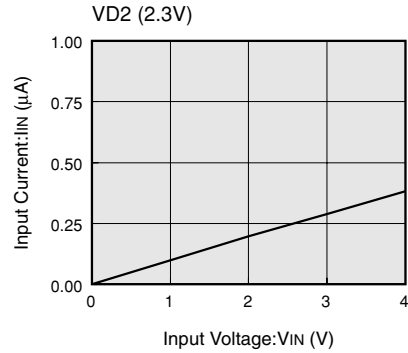
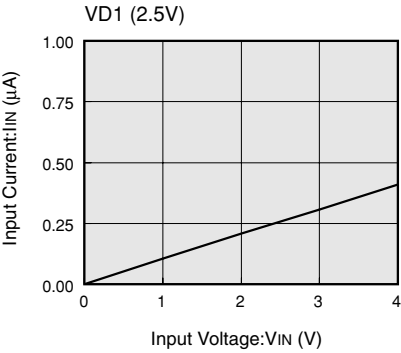
(6) VD OUTPUT VOLTAGE vs. INPUT VOLTAGE



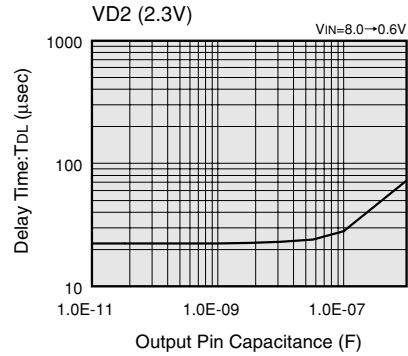
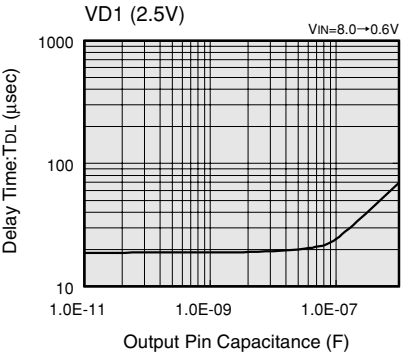
(7) OUTPUT CURRENT vs. INPUT VOLTAGE



(8) VD INPUT CURRENT vs. INPUT VOLTAGE

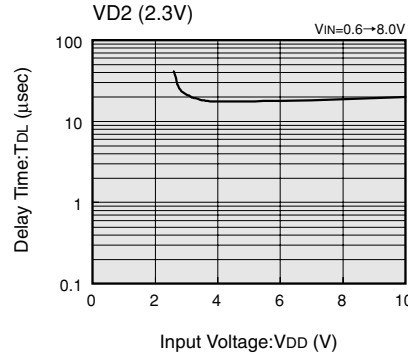
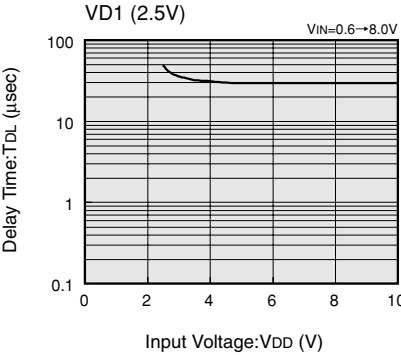


(9) DELAY TIME (FALL) vs. OUTPUT PIN CAPACITANCE

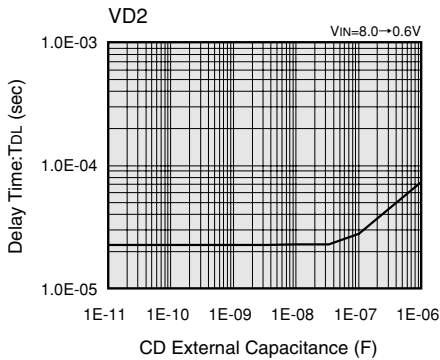


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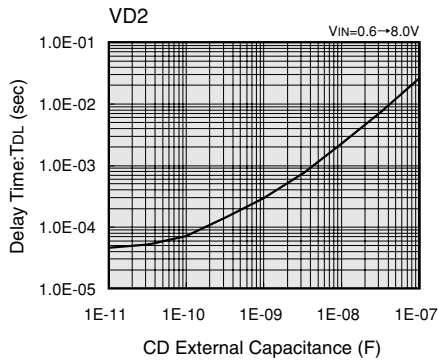
(10) DELAY TIME (RISE) vs. INPUT VOLTAGE



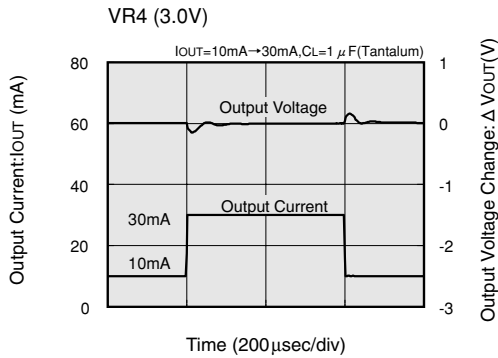
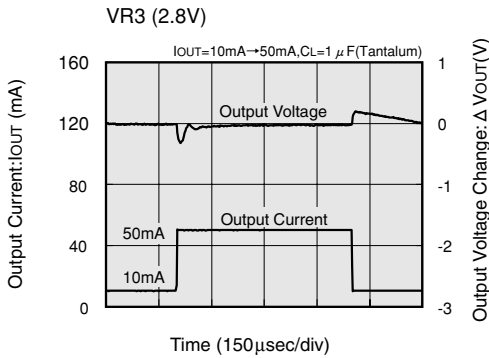
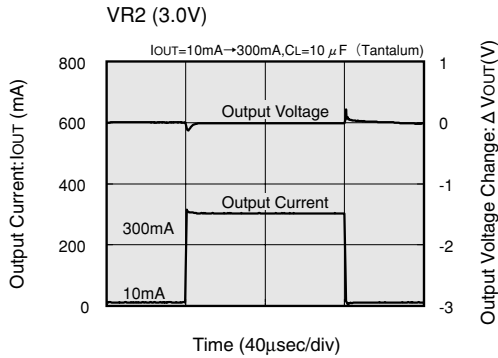
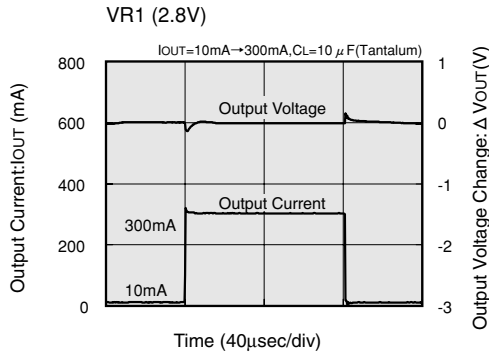
(11) DELAY TIME (FALL) vs. CD PIN EXTERNAL CAPACITANCE



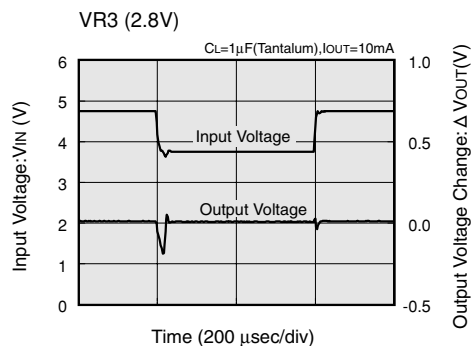
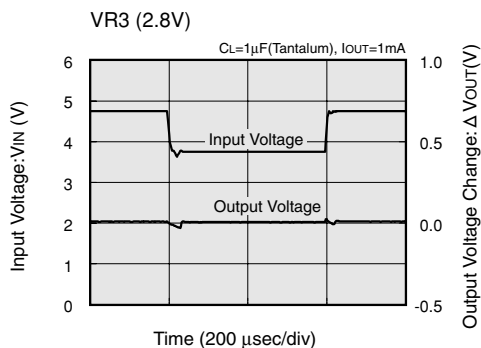
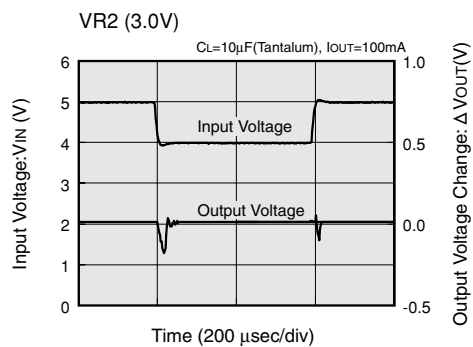
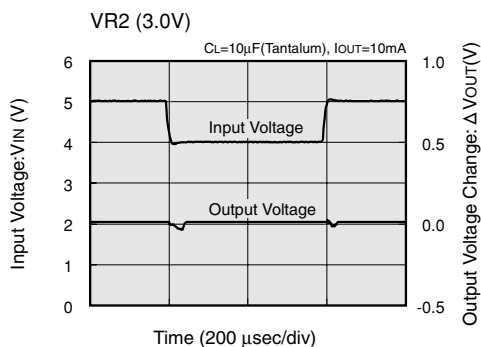
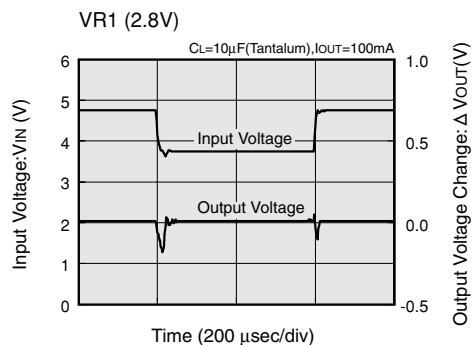
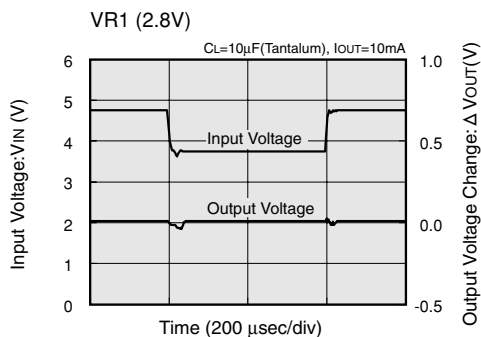
(12) DELAY TIME (RISE) vs. CD PIN EXTERNAL CAPACITANCE



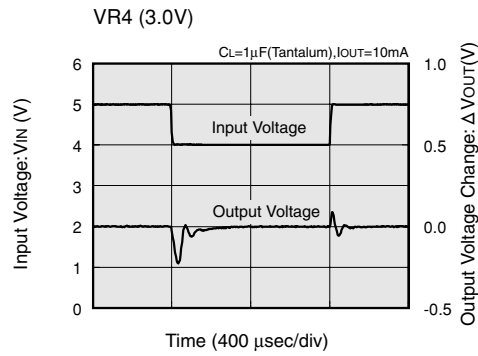
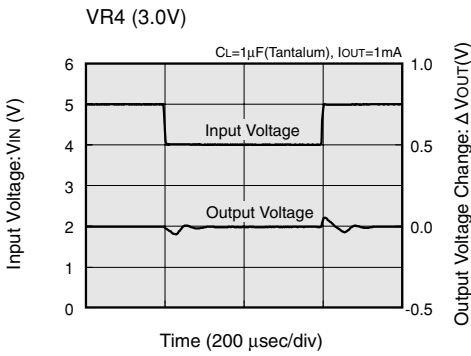
(13) LOAD TRANSIENT RESPONSE



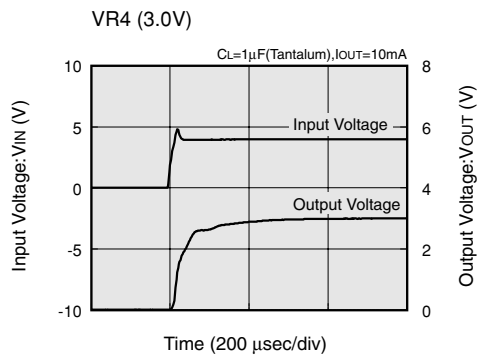
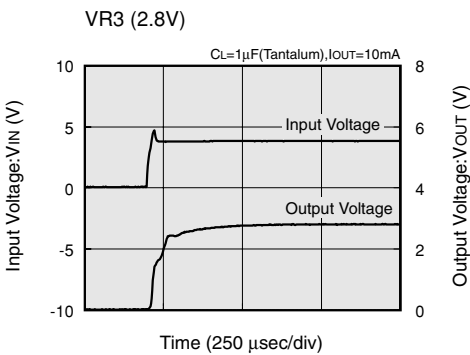
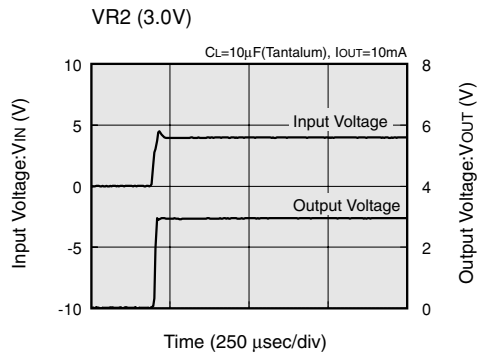
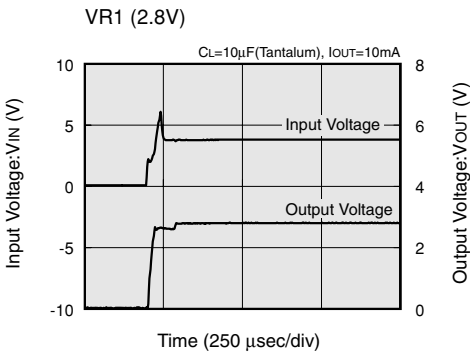
## (14) INPUT TRANSIENT RESPONSE 1



(14) INPUT TRANSIENT RESPONSE 1

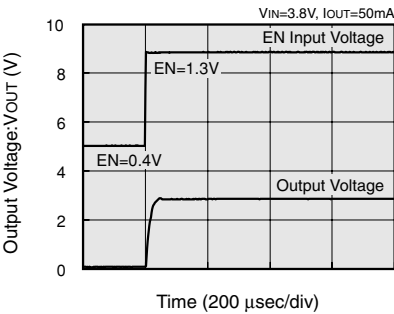


(15) INPUT TRANSIENT RESPONSE 2

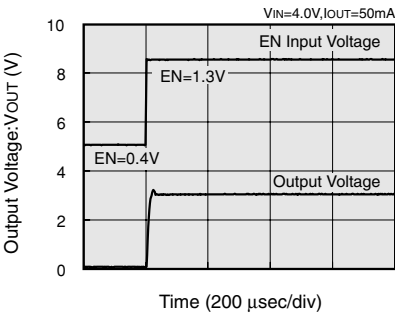


(16) EN TRANSIENT RESPONSE

VR1 (2.8V)



VR2 (3.0V)



VR3 (2.8V)

