

Low Voltage Detectors ( $V_{DF} = 0.8V \sim 1.5V$ )

Standard Voltage Detectors ( $V_{DF} = 1.6V \sim 6.0V$ )

## ■ GENERAL DESCRIPTION

The XC61G series are highly precise, low power consumption voltage detectors, manufactured using CMOS and laser trimming technologies.

Detect voltage is extremely accurate with minimal temperature drift.

Both CMOS and N-channel open drain output configurations are available.

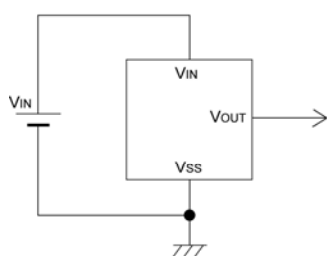
## ■ APPLICATIONS

- Microprocessor reset circuitry
- Memory battery back-up circuits
- Power-on reset circuits
- Power failure detection
- System battery life and charge voltage monitors

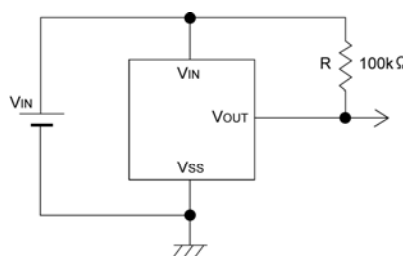
## ■ FEATURES

- Highly Accurate** :  $\pm 2\%$
- Low Power Consumption** :  $0.7 \mu A$  [ $V_{IN}=1.5V$ ] (TYP.)
- Detect Voltage Range** :  $0.8V \sim 1.5V$  in  $0.1V$  increments (Low Voltage)  
:  $1.6V \sim 6.0V$  in  $0.1V$  increments (Standard Voltage)
- Operating Voltage Range** :  $0.7V \sim 6.0V$  (Low Voltage)  
:  $0.7V \sim 10.0V$  (Standard Voltage)
- Detect Voltage Temperature characteristics** :  $\pm 100ppm/^{\circ}C$  (TYP.)
- Output Configuration** : N-channel open drain or CMOS
- CMOS**
- Package** : USP-3
- Environmentally Friendly**: EU RoHS Compliant, Pb Free

## ■ TYPICAL APPLICATION CIRCUITS

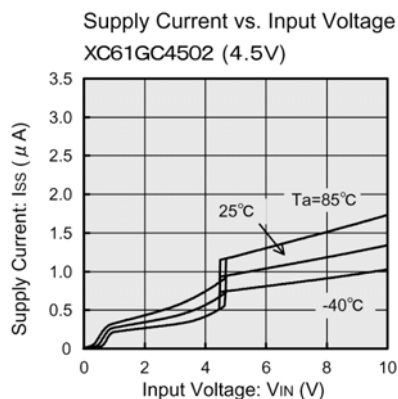
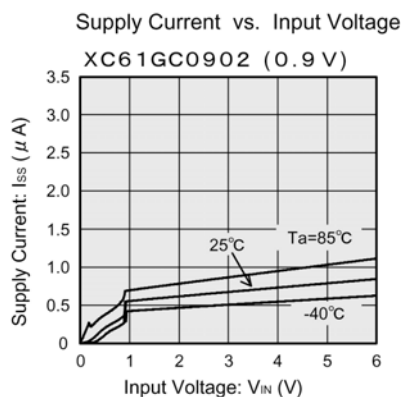


CMOS Output

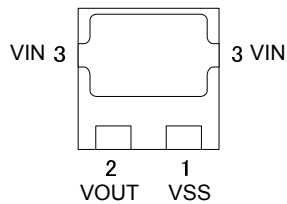


N-ch Open Drain Output

## ■ TYPICAL PERFORMANCE CHARACTERISTICS



## PIN CONFIGURATION



(BOTTOM VIEW)

## PIN ASSIGNMENT

| PIN NUMBER | PIN NAME | FUNCTION       |
|------------|----------|----------------|
| USP-3      |          |                |
| 3          | VIN      | Supply Voltage |
| 1          | VSS      | Ground         |
| 2          | VOUT     | Output         |

## PRODUCT CLASSIFICATION

### Ordering Information

XC61G ①②③④⑤⑥⑦-⑧<sup>(\*)</sup>

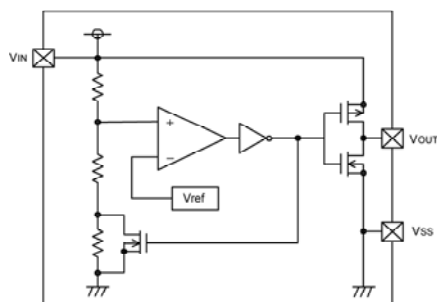
| DESIGNATOR | DESCRIPTION                            | SYMBOL  | DESCRIPTION            |
|------------|----------------------------------------|---------|------------------------|
| ①          | Output Configuration                   | C       | CMOS output            |
|            |                                        | N       | N-ch open drain output |
| ② ③        | Detect Voltage                         | 08 ~ 60 | e.g. 0.8V → ②0, ③8     |
|            |                                        |         | e.g. 1.5V → ②1, ③5     |
| ④          | Output Delay                           | 0       | No delay               |
| ⑤          | Detect Accuracy                        | 2       | Within $\pm 2\%$       |
| ⑥⑦-⑧       | Packages<br>Taping Type <sup>(*)</sup> | HR      | USP-3                  |
|            |                                        | HR-G    | USP-3                  |

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

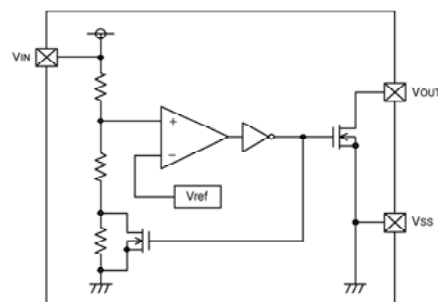
<sup>(\*)</sup> The device orientation is fixed in its embossed tape pocket. For reverse orientation, please contact your local Torex sales office or representative. (Standard orientation: ⑥R-⑧, Reverse orientation: ⑥L-⑧)

## BLOCK DIAGRAMS

(1) CMOS Output



(2) N-ch Open Drain Output



## ■ABSOLUTE MAXIMUM RATINGS

Ta = 25°C

| PARAMETER                   |                           | SYMBOL | RATINGS             | UNITS |
|-----------------------------|---------------------------|--------|---------------------|-------|
| Input Voltage               | *1                        | VIN    | 9.0                 | V     |
|                             | *2                        |        | 12.0                |       |
| Output Current              | *1                        | IOUT   | 50                  | mA    |
|                             | *2                        |        | 50                  |       |
| Output Voltage              | CMOS                      |        | VSS -0.3 ~ VIN +0.3 | V     |
|                             | N-ch Open Drain Output *1 |        | VSS -0.3 ~ 9.0      |       |
|                             | N-ch Open Drain Output *2 |        | VSS -0.3 ~ 12.0     |       |
| Power Dissipation           | USP-3                     |        | Pd                  | mW    |
| Operating Temperature Range |                           | Topr   | -40~+85             | ℃     |
| Storage Temperature Range   |                           | Tstg   | -40~+125            | ℃     |

## ■ELECTRICAL CHARACTERISTICS

VDF (T) = 0.9 to 1.5V ± 2%

Ta=25°C

| PARAMETER                            | SYMBOL                                     | CONDITIONS            | MIN.          | TYP.          | MAX.          | UNITS      | CIRCUITS |   |
|--------------------------------------|--------------------------------------------|-----------------------|---------------|---------------|---------------|------------|----------|---|
| Detect Voltage                       | VDF                                        |                       | VDF<br>x 0.98 | VDF           | VDF<br>x 1.02 | V          | 1        |   |
| Hysteresis Range                     | VHYS                                       |                       | VDF<br>x 0.02 | VDF<br>x 0.05 | VDF<br>x 0.08 | V          | 1        |   |
| Supply Current                       | ISS                                        | VIN = 1.5V            | -             | 0.7           | 2.3           | μ A        | 2        |   |
|                                      |                                            | VIN = 2.0V            | -             | 0.8           | 2.7           |            |          |   |
|                                      |                                            | VIN = 3.0V            | -             | 0.9           | 3.0           |            |          |   |
|                                      |                                            | VIN = 4.0V            | -             | 1.0           | 3.2           |            |          |   |
|                                      |                                            | VIN = 5.0V            | -             | 1.1           | 3.6           |            |          |   |
| Operating Voltage                    | VIN                                        | VDF(T) = 0.9V to 1.5V | 0.7           | -             | 6.0           | V          | 1        |   |
|                                      |                                            | VDF(T) = 1.6V to 6.0V | 0.7           | -             | 10.0          |            |          |   |
| Output Current<br>(Low Voltage)      | IOUT                                       | N-ch, VDS = 0.5V      | VIN =0.7V     | 0.10          | 0.80          | -          | mA       | 3 |
|                                      |                                            |                       | VIN =1.0V     | 0.85          | 2.70          | -          |          | 4 |
| N-ch, VDS = 0.5V                     |                                            | CMOS, P-ch, VDS=2.1V  | VIN =6.0V     | -             | -7.5          | -1.5       |          | 3 |
|                                      |                                            |                       | VIN =1.0V     | 1.0           | 2.2           | -          |          |   |
|                                      |                                            |                       | VIN =2.0V     | 3.0           | 7.7           | -          |          |   |
|                                      |                                            |                       | VIN =3.0V     | 5. 0          | 10.1          | -          |          |   |
|                                      |                                            |                       | VIN =4.0V     | 6.0           | 11.5          | -          |          |   |
|                                      |                                            |                       | VIN =5.0V     | 7.0           | 13.0          | -          |          |   |
| CMOS,<br>P-ch, VDS=2.1V              |                                            | VIN =8.0V             | -             | -10.0         | -2.0          | 4          |          |   |
| Temperature<br>Characteristics       | $\frac{\Delta VDF}{\Delta Topr \cdot VDF}$ | -40°C ≤ Topr ≤ 85°C   | -             | ±100          | -             | ppm/<br>°C | -        |   |
| Delay Time<br>(VDR → VOUT inversion) | tDLY                                       |                       | -             | -             | 0.2           | ms         | 5        |   |

NOTE:

VDF (T): Setting detect voltage

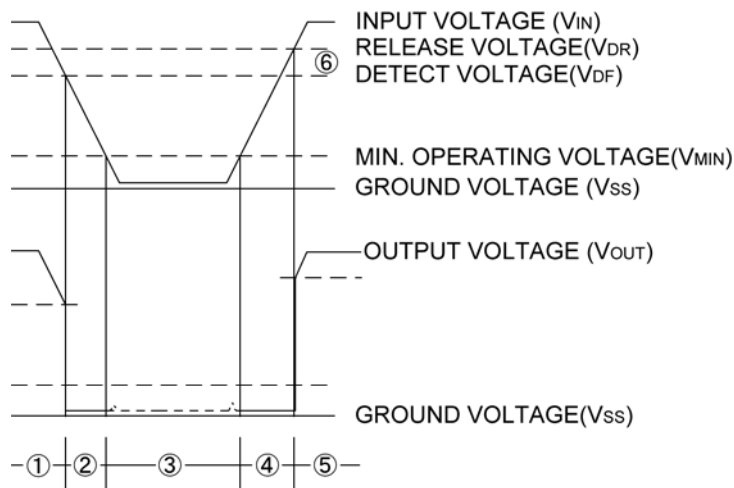
Release Voltage: VDR = VDF + VHYS

## OPERATIONAL EXPLANATION

### CMOS output

- ① When input voltage ( $V_{IN}$ ) rises above detect voltage ( $V_{DF}$ ), output voltage ( $V_{OUT}$ ) will be equal to  $V_{IN}$ .  
(A condition of high impedance exists with N-ch open drain output configurations.)
- ② When input voltage ( $V_{IN}$ ) falls below detect voltage ( $V_{DF}$ ), output voltage ( $V_{OUT}$ ) will be equal to the ground voltage ( $V_{SS}$ ) level.
- ③ When input voltage ( $V_{IN}$ ) falls to a level below that of the minimum operating voltage ( $V_{MIN}$ ), output will become unstable. In this condition,  $V_{IN}$  will equal the pulled-up output (should output be pulled-up.)
- ④ When input voltage ( $V_{IN}$ ) rises above the ground voltage ( $V_{SS}$ ) level, output will be unstable at levels below the minimum operating voltage ( $V_{MIN}$ ). Between the  $V_{MIN}$  and detect release voltage ( $V_{DR}$ ) levels, the ground voltage ( $V_{SS}$ ) level will be maintained.
- ⑤ When input voltage ( $V_{IN}$ ) rises above detect release voltage ( $V_{DR}$ ), output voltage ( $V_{OUT}$ ) will be equal to  $V_{IN}$ .  
(A condition of high impedance exists with N-ch open drain output configurations.)
- ⑥ The difference between  $V_{DR}$  and  $V_{DF}$  represents the hysteresis range.

### Timing Chart



## ■ NOTES ON USE

1. Please use this IC within the stated maximum ratings. Operation beyond these limits may cause degrading or permanent damage to the device.
2. When a resistor is connected between the  $V_{IN}$  pin and the input with CMOS output configurations, oscillation may occur as a result of voltage drops at  $R_{IN}$  if load current ( $I_{OUT}$ ) exists. (refer to the Oscillation Description (1) below)
3. When a resistor is connected between the  $V_{IN}$  pin and the input with CMOS output configurations, irrespective of N-ch output configurations, oscillation may occur as a result of through current at the time of voltage release even if load current ( $I_{OUT}$ ) does not exist. (refer to the Oscillation Description (2) below)
4. With a resistor connected between the  $V_{IN}$  pin and the input, detect and release voltage will rise as a result of the IC's supply current flowing through the  $V_{IN}$  pin.
5. In order to stabilize the IC's operations, please ensure that  $V_{IN}$  pin's input frequency's rise and fall times are more than several  $\mu s / V$ .
6. Please use N-ch open drains configuration, when a resistor  $R_{IN}$  is connected between the  $V_{IN}$  pin and power source. In such cases, please ensure that  $R_{IN}$  is less than  $10k\Omega$  and that  $C$  is more than  $0.1 \mu F$ .

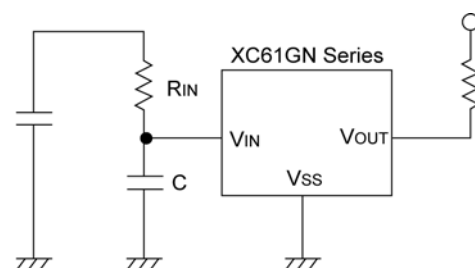


Figure 1: Circuit using an input resistor

## ● Oscillation Description

### (1) Output current oscillation with the CMOS output configuration

When the voltage applied at IN rises, release operations commence and the detector's output voltage increases. Load current ( $I_{OUT}$ ) will flow at  $R_L$ . Because a voltage drop ( $R_{IN} \times I_{OUT}$ ) is produced at the  $R_{IN}$  resistor, located between the input (IN) and the  $V_{IN}$  pin, the load current will flow via the IC's  $V_{IN}$  pin. The voltage drop will also lead to a fall in the voltage level at the  $V_{IN}$  pin. When the  $V_{IN}$  pin voltage level falls below the detect voltage level, detect operations will commence. Following detect operations, load current flow will cease and since voltage drop at  $R_{IN}$  will disappear, the voltage level at the  $V_{IN}$  pin will rise and release operations will begin over again.

Oscillation may occur with this "release - detect - release" repetition.

Further, this condition will also appear via means of a similar mechanism during detect operations.

### (2) Oscillation as a result of through current

Since the XC61G series are CMOS ICs, through current will flow when the IC's internal circuit switching operates (during release and detect operations). Consequently, oscillation is liable to occur as a result of drops in voltage at the through current's resistor ( $R_{IN}$ ) during release voltage operations. (refer to Figure 3)

Since hysteresis exists during detect operations, oscillation is unlikely to occur.

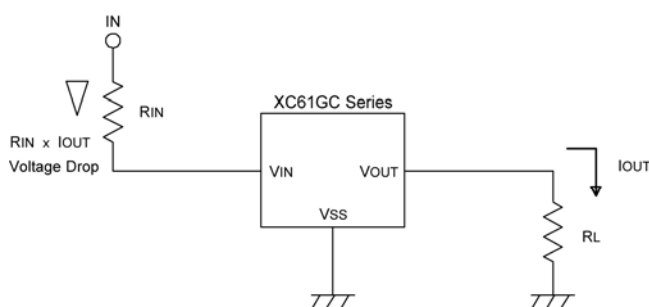


Figure 2: Oscillation in relation to output current

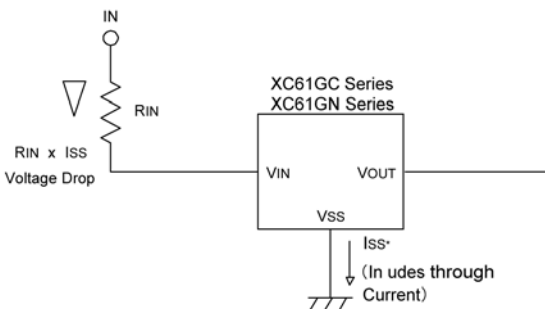
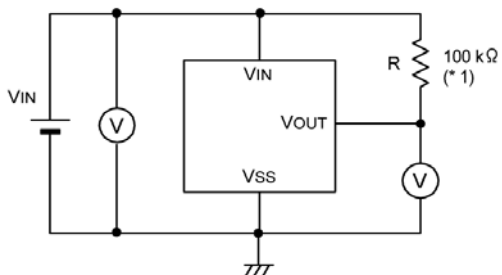


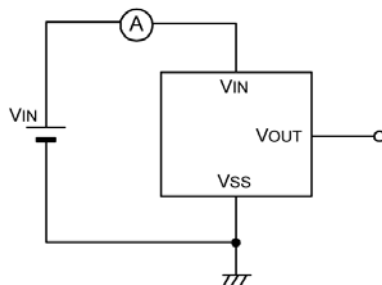
Figure 3: Oscillation in relation to through current

## ■ TEST CIRCUITS

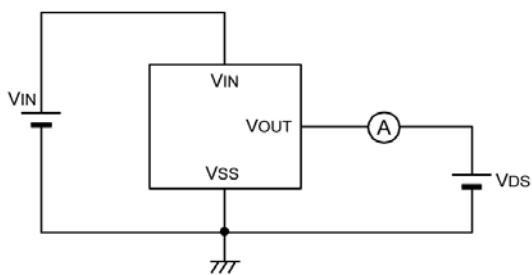
Circuit 1



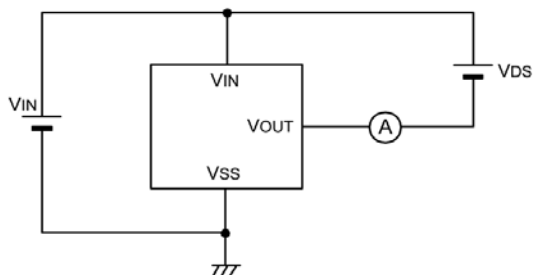
Circuit 2



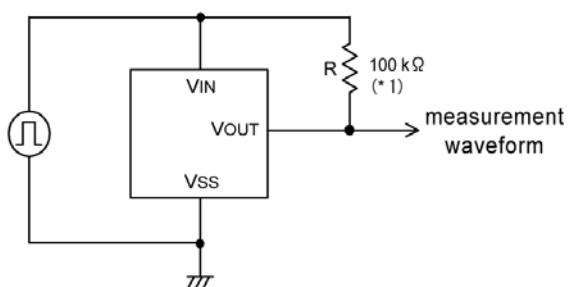
Circuit 3



Circuit 4



Circuit 5

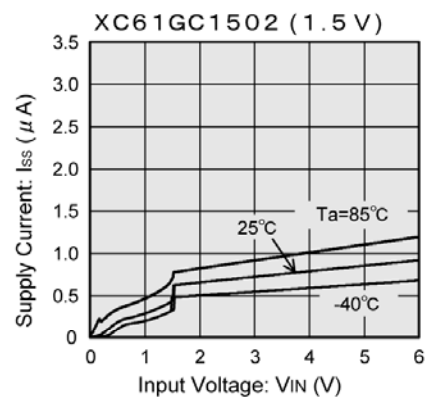
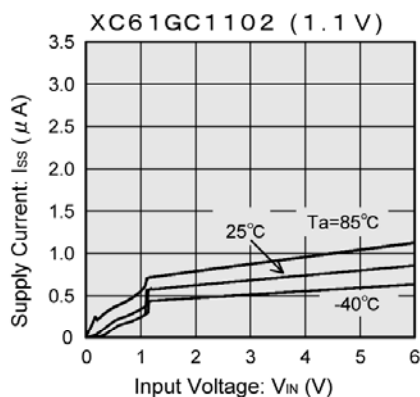
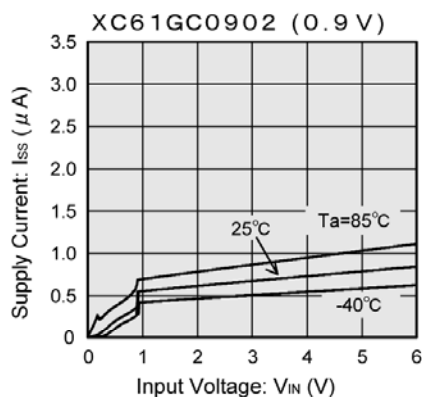


\* 1 : The resistor is not necessary with CMOS output products.

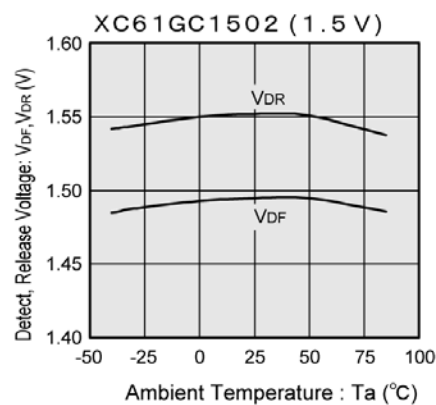
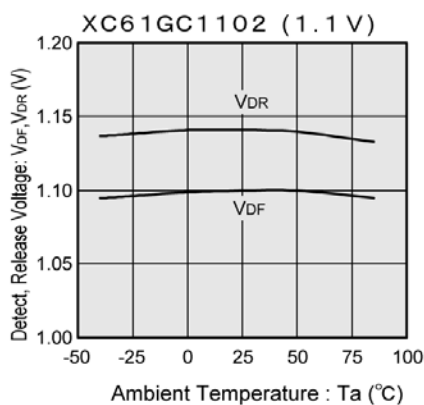
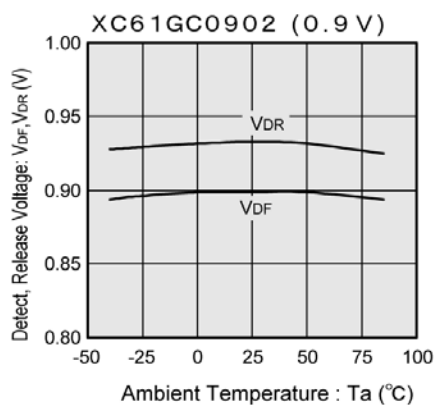
## ■ TYPICAL PERFORMANCE CHARACTERISTICS

### ● Low Voltage

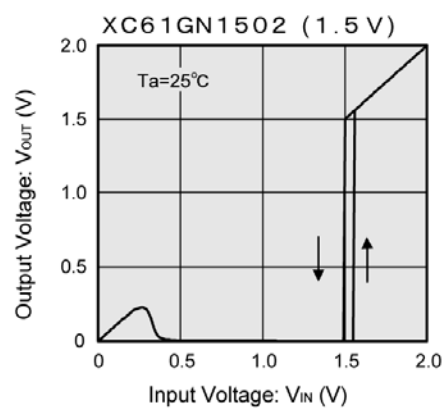
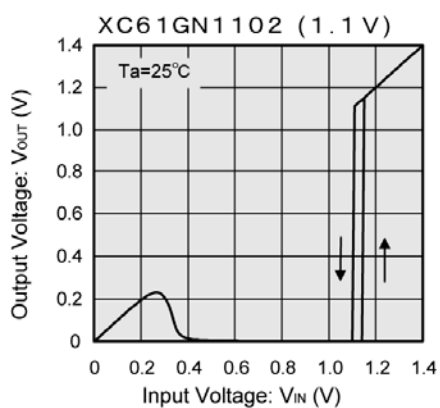
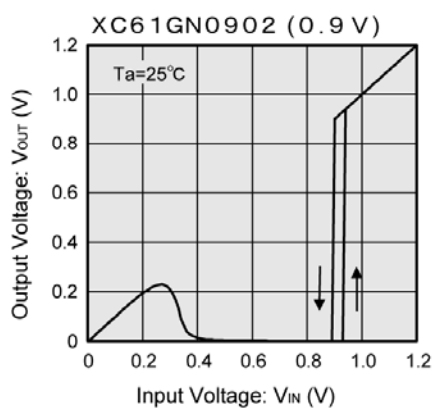
#### (1) Supply Current vs. Input Voltage



#### (2) Detect, Release Voltage vs. Ambient Temperature



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

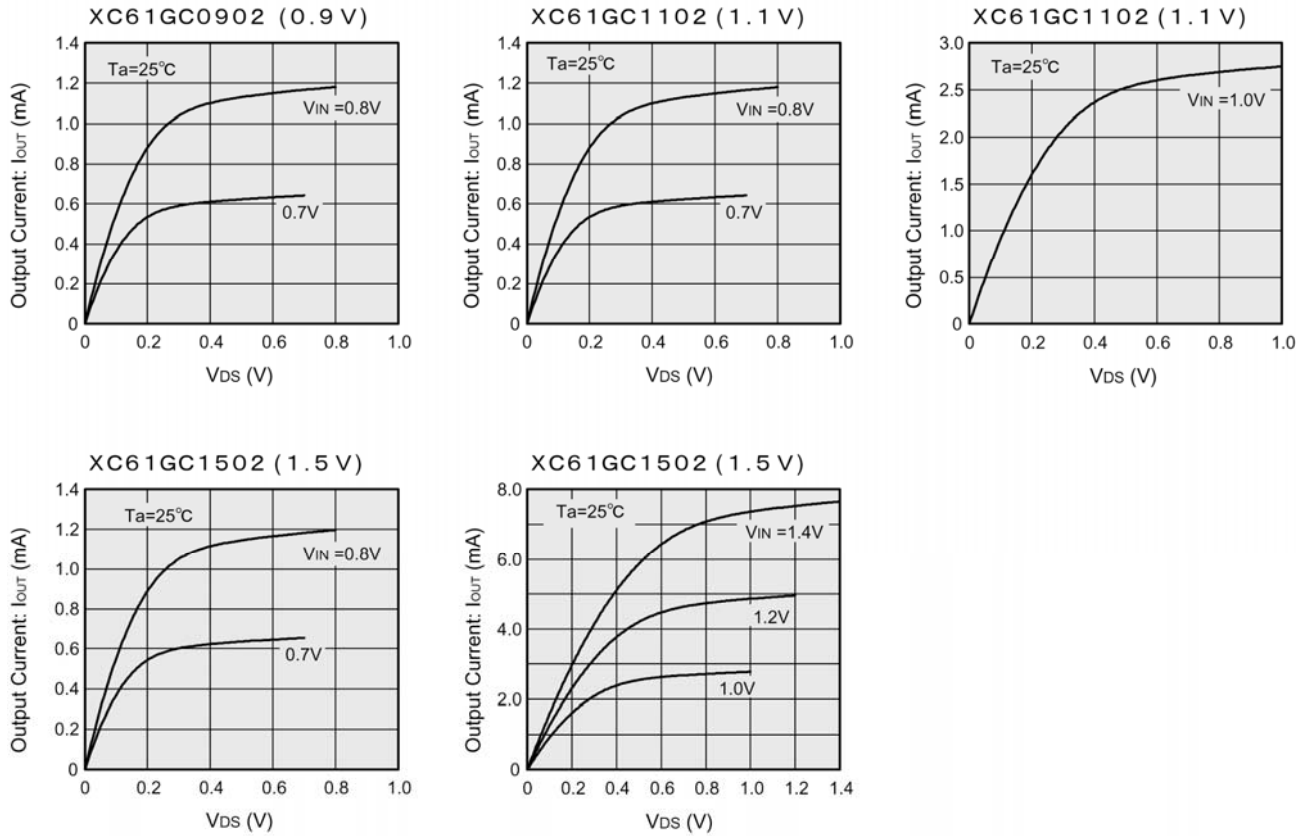


Note : Unless otherwise stated, the N-channel open drain pull-up resistance value is 100k $\Omega$ .

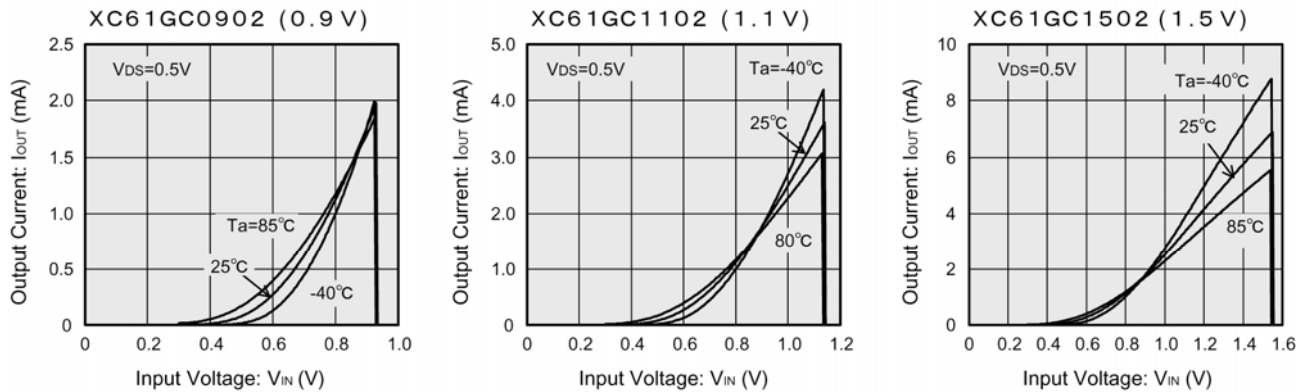
## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### ● Low Voltage (Continued)

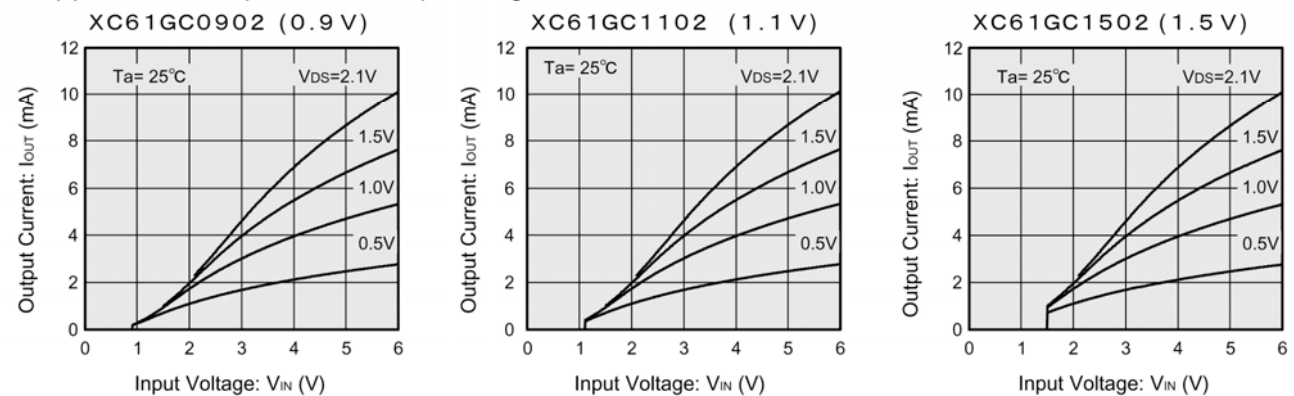
(4) N-ch Driver Output Current vs.  $V_{DS}$



(5) N-ch Driver Output Current vs. Input Voltage



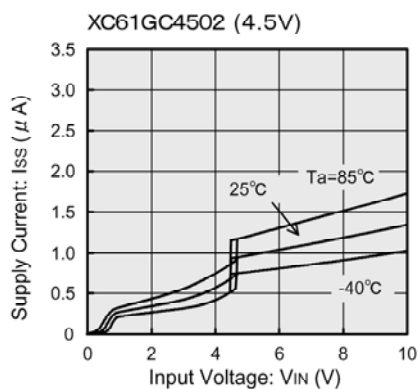
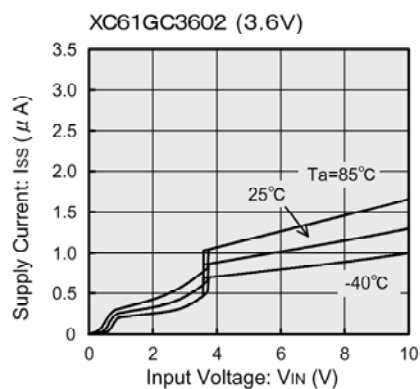
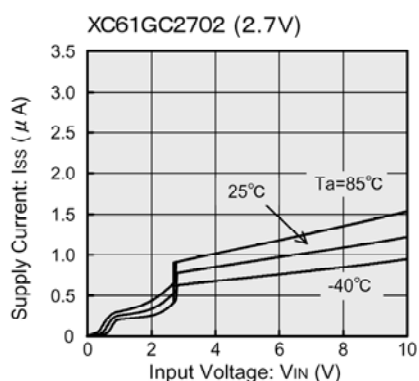
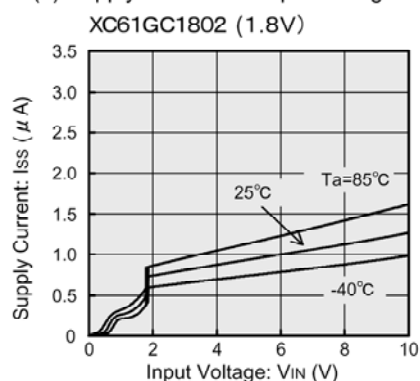
(6) P-ch Driver Output Current vs. Input Voltage



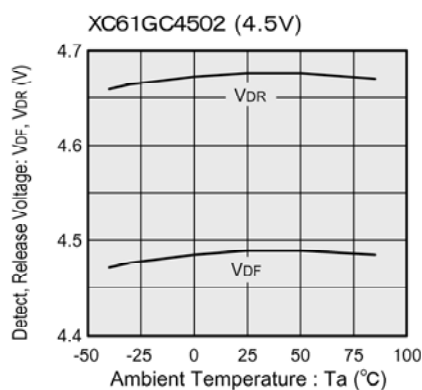
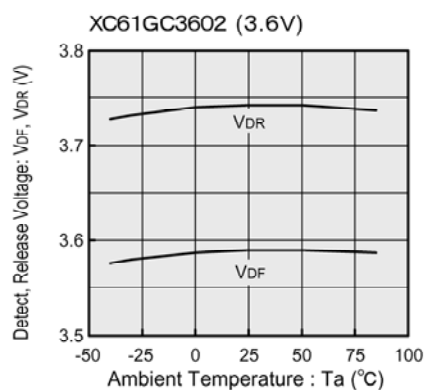
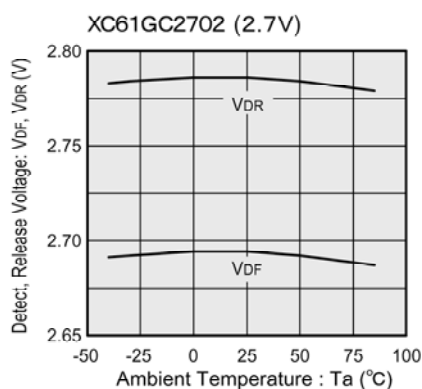
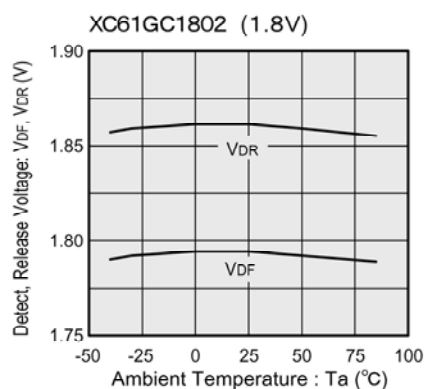
## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### ● Standard Voltage

(1) Supply Current vs. Input Voltage



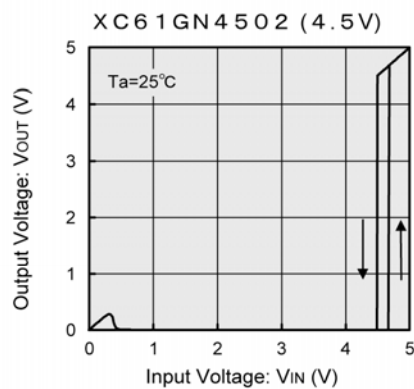
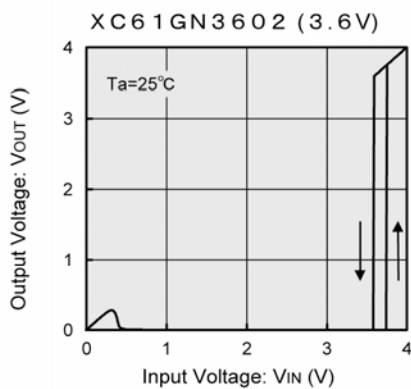
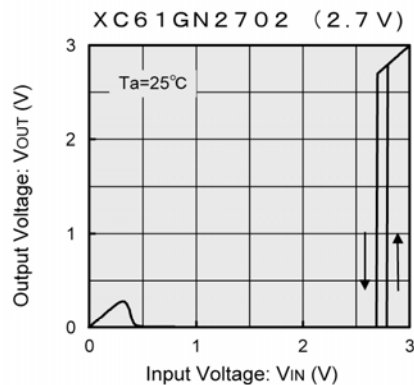
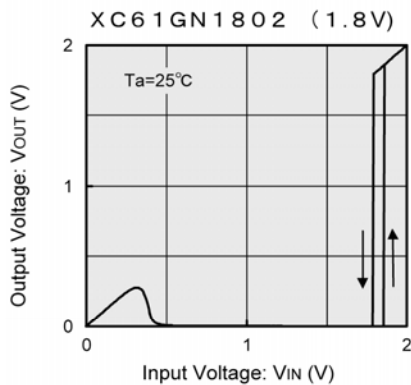
(2) Detect, Release Voltage vs. Ambient Temperature



## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

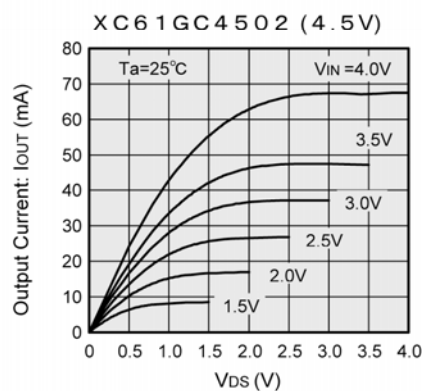
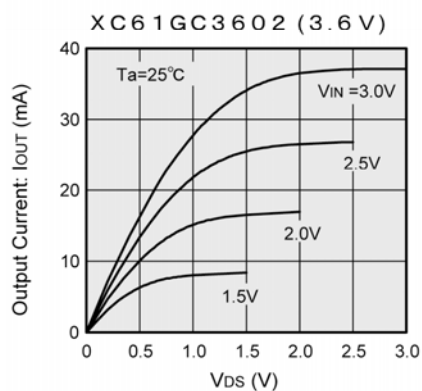
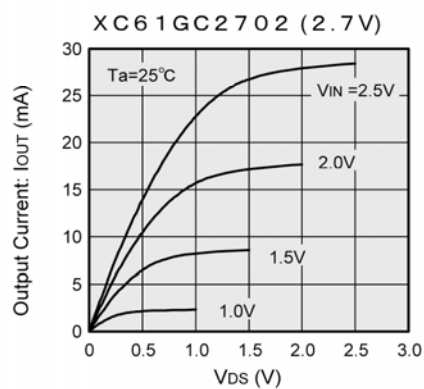
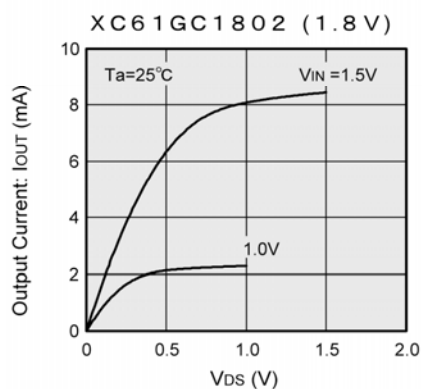
### ● Standard Voltage (Continued)

(3) Output Voltage vs. Input Voltage



Note : The N-channel open drain pull up resistance value is  $100\text{k}\Omega$ .

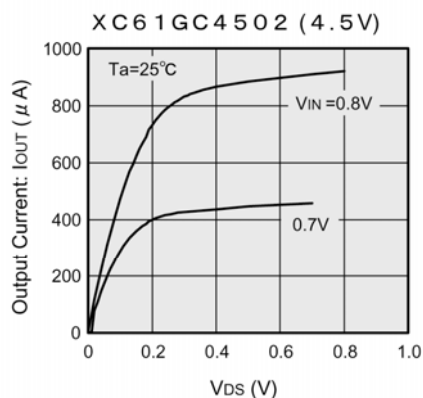
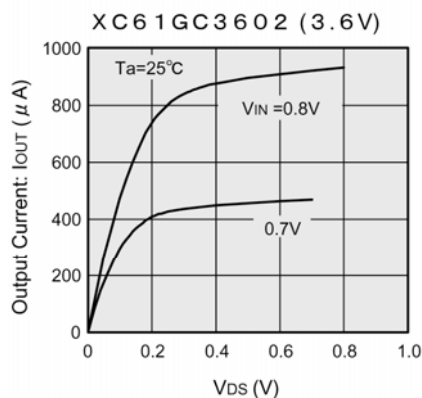
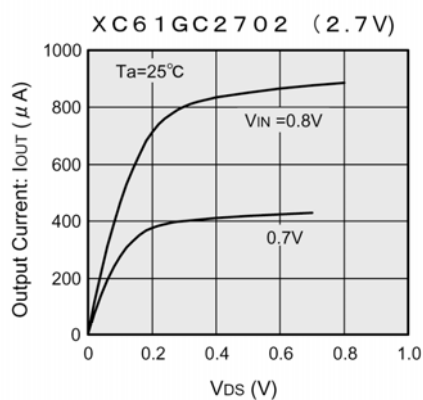
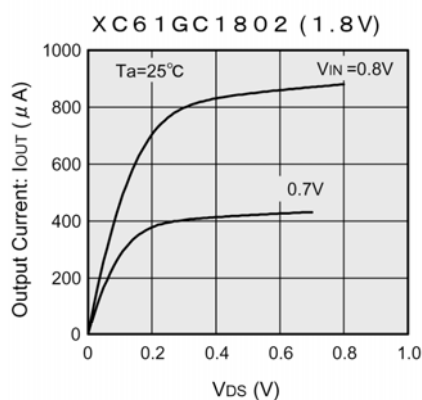
(4) N-ch Driver Output Current vs.  $V_{DS}$



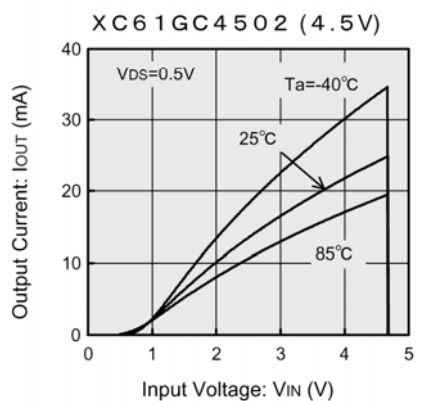
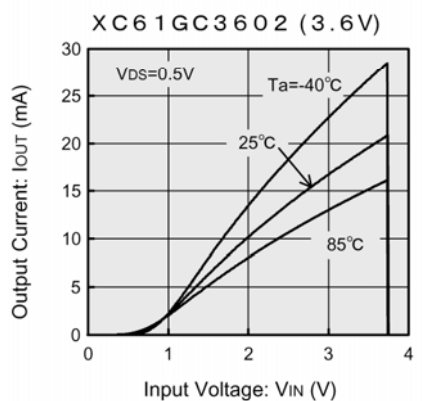
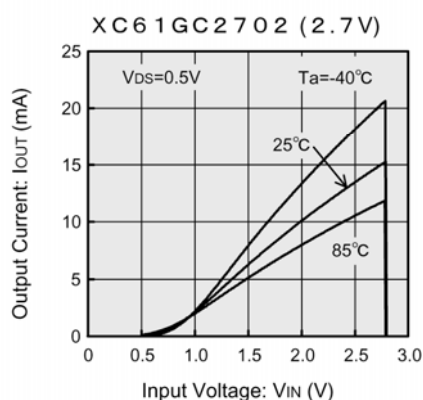
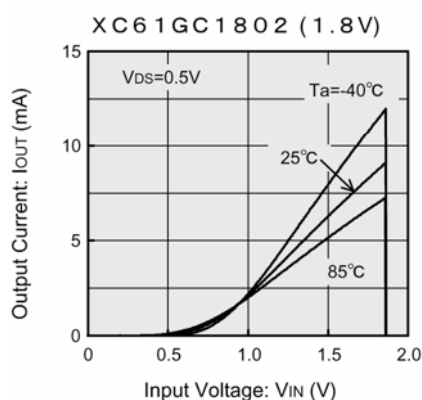
## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### ● Standard Voltage (Continued)

(4) N-ch Driver Output Current vs.  $V_{DS}$



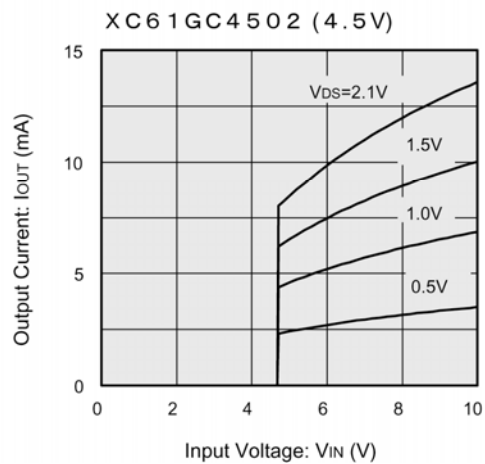
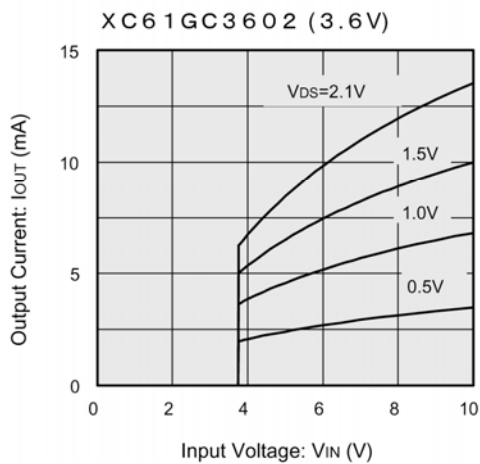
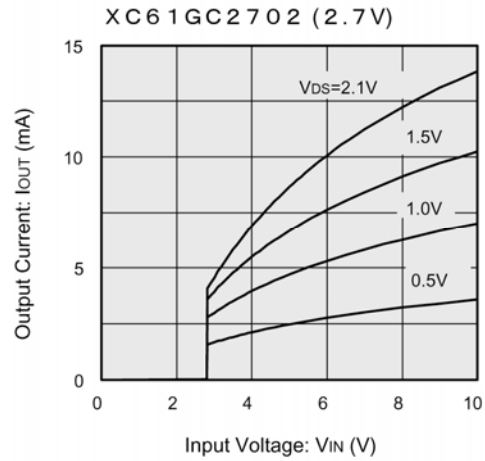
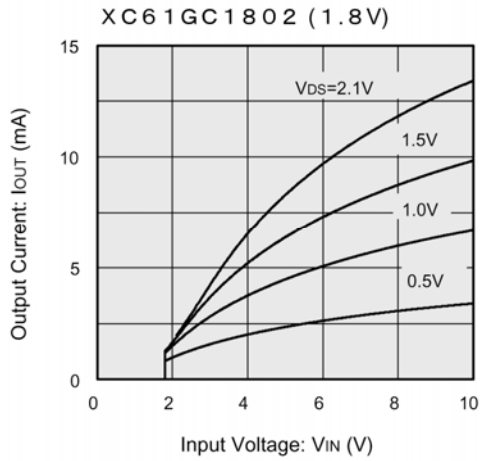
(5) N-ch Driver Output Current vs. Input Voltage



## ■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

### ● Standard Voltage (Continued)

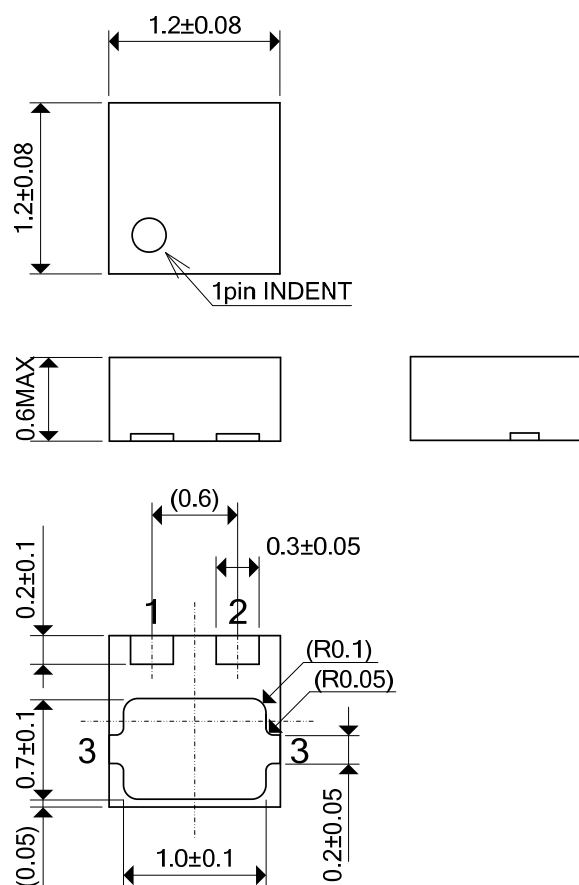
(6) P-ch Driver Output Current vs. Input Voltage



## ■ PACKAGING INFORMATION

● USP-3

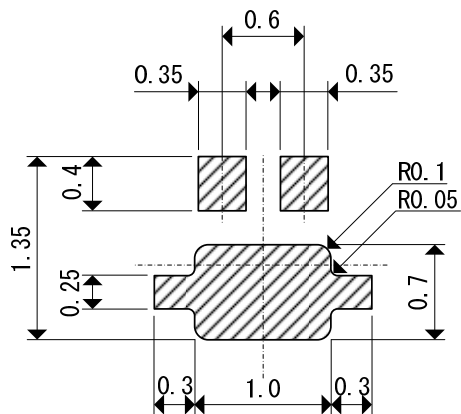
(unit : mm)



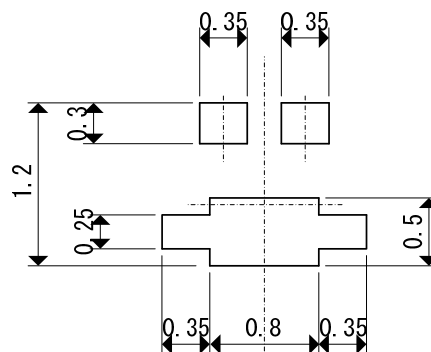
## PACKAGING INFORMATION (Continued)

### ● USP-3

Reference Pattern Layout Dimension

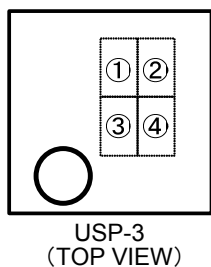


Reference metal mask design



## ■ MARKING RULE

### ● USP-3



① represents integer of output voltage and detect voltage  
CMOS Output (XC61GC series)

| MARK | CONFIGURATION | VOLTAGE (V) |
|------|---------------|-------------|
| A    | CMOS          | 0.x         |
| B    | CMOS          | 1.x         |
| C    | CMOS          | 2.x         |
| D    | CMOS          | 3.x         |
| E    | CMOS          | 4.x         |
| F    | CMOS          | 5.x         |
| G    | CMOS          | 6.x         |

N-channel Open Drain Output (XC61GN series)

| MARK | CONFIGURATION | VOLTAGE (V) |
|------|---------------|-------------|
| K    | N-ch          | 0.x         |
| L    | N-ch          | 1.x         |
| M    | N-ch          | 2.x         |
| N    | N-ch          | 3.x         |
| P    | N-ch          | 5.x         |
| R    | N-ch          | 6.x         |
| S    | N-ch          | 7.x         |

② represents decimal number of detect voltage

| MARK | VOLTAGE (V) | MARK | VOLTAGE (V) |
|------|-------------|------|-------------|
| 0    | x.0         | 5    | x.5         |
| 1    | x.1         | 6    | x.6         |
| 2    | x.2         | 7    | x.7         |
| 3    | x.3         | 8    | x.8         |
| 4    | x.4         | 9    | x.9         |

③ based on internal standards

| MARK |
|------|
| 3    |

④ represents production lot number

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

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