

Voltage Detector ($V_{DF}=1.6V\sim 5.0V$)

■ GENERAL DESCRIPTION

The XC6101~XC6105, XC6111~XC6117 series are groups of high-precision, low current consumption voltage detectors with manual reset input and watchdog functions incorporating CMOS process technology. The series consist of a reference voltage source, delay circuit, comparator, and output driver. With the built-in delay circuit, the XC6101 ~ XC6105, XC6111 ~ XC6117 series do not require any external components to output signals with release delay time. Moreover, with the manual reset function, reset can be asserted at any time. The ICs produce two types of output; V_{DFL} (low when detected) and V_{DFH} (high when detected). With the XC6101 ~ XC6105, XC6111 ~ XC6115 series, the WD pin can be left open if the watchdog function is not used. Whenever the watchdog pin is opened, the internal counter clears before the watchdog timeout occurs. Since the manual reset pin is internally pulled up to the V_{IN} pin voltage level, the ICs can be used by leaving the manual reset pin unconnected if the pin is unused. The detect voltages are internally fixed 1.6V ~ 5.0V in increments of 0.1V, using laser trimming technology. Six watchdog timeout periods are available in a range from 6.25ms to 1.6s. Seven release delay times are available in a range from 3.13ms to 1.6s.

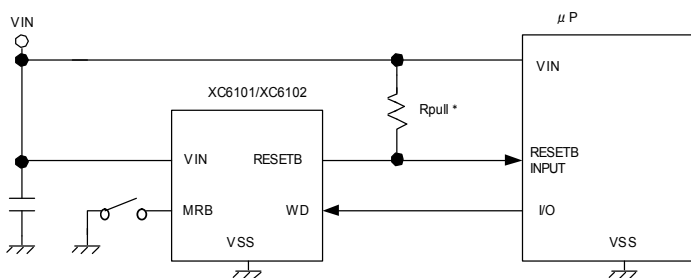
■ APPLICATIONS

- Microprocessor reset circuits
- Memory battery backup circuits
- System power-on reset circuits
- Power failure detection

■ FEATURES

| | |
|---|--|
| Detect Voltage Range | : 1.6V ~ 5.0V, $\pm 2\%$ (0.1V increments) |
| Hysteresis Width | : $V_{DF} \times 5\%$, TYP. (XC6101~XC6105) $V_{DF} \times 0.1\%$, TYP. (XC6111~XC6117) |
| Operating Voltage Range | : 1.0V ~ 6.0V |
| Detect Voltage Temperature Coefficient | : $\pm 100\text{ppm}/^\circ\text{C}$ (TYP.) |
| Output Configuration | : N-channel open drain, CMOS |
| Reset Output Options | : V_{DFL} (Low when detected) V_{DFH} (High when detected) |
| Watchdog Function | : Watchdog input WD; If it remains either high or low for the duration of the watchdog timeout period, a reset is asserted. |
| Manual Reset Function | : Manual Reset Input MRB; When it changes from high to low, a reset is asserted. |
| Release Delay Time | : 1.6s, 400ms, 200ms, 100ms, 50ms, 25ms, 3.13ms (TYP.) |
| Watchdog Timeout Period | : 1.6s, 400ms, 200ms, 100ms, 50ms, 6.25ms (TYP.) |
| Operating Ambient Temperature | : $-40^\circ\text{C} \sim +85^\circ\text{C}$ |
| Packages | : SOT-25, USP-6C |
| Environmentally Friendly | : EU RoHS Compliant, Pb Free |

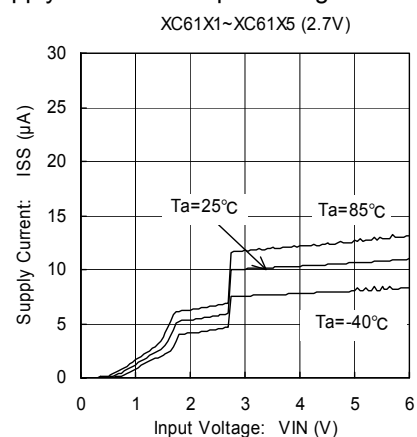
■ TYPICAL APPLICATION CIRCUIT



* Not necessary with CMOS output products.

■ TYPICAL PERFORMANCE CHARACTERISTICS

● Supply Current vs. Input Voltage

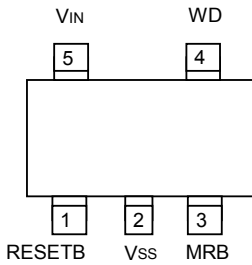


* 'x' represents both '0' and '1'. (ex. XC61x1 ⇒ XC6101 and XC6111)

PIN CONFIGURATION

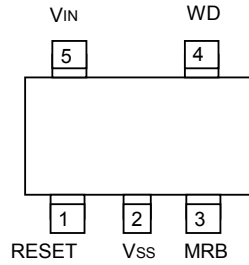
SOT-25

XC6101, XC6102 Series
XC6111, XC6112 Series



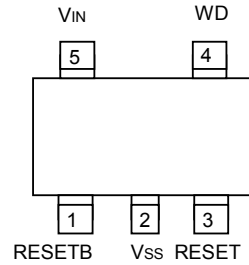
SOT-25 (TOP VIEW)

XC6103 & XC6113 Series



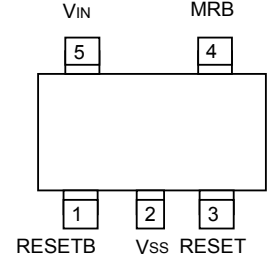
SOT-25 (TOP VIEW)

XC6104, XC6105 Series
XC6114, XC6115 Series



SOT-25 (TOP VIEW)

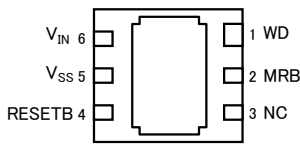
XC6116, XC6117 Series



SOT-25 (TOP VIEW)

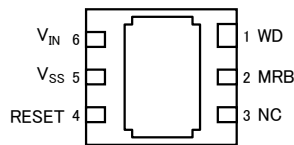
USP-6C

XC6101, XC6102 Series
XC6111, XC6112 Series



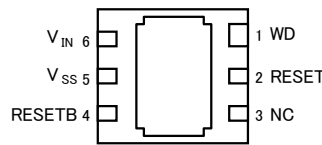
USP-6C (BOTTOM VIEW)

XC6103 & XC6113 Series



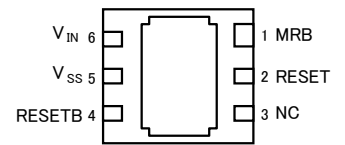
USP-6C (BOTTOM VIEW)

XC6104, XC6105 Series
XC6114, XC6115 Series



USP-6C (BOTTOM VIEW)

XC6116, XC6117 Series



USP-6C (BOTTOM VIEW)

* The dissipation pad for the USP-6C package should be solder-plated in reference mount pattern and metal masking so as to enhance mounting strength and heat release. If the pad needs to be connected to other pins, it should be connected to the Vss (No.5) pin.

PIN ASSIGNMENT

| PIN NUMBER | | | | | | | | PIN NAME | FUNCTION |
|----------------|--------|--------|--------|----------------|--------|----------------|--------|----------|--|
| XC6101, XC6102 | | XC6103 | | XC6104, XC6105 | | XC6116, XC6117 | | | |
| SOT-25 | USP-6C | SOT-25 | USP-6C | SOT-25 | USP-6C | SOT-25 | USP-6C | | |
| 1 | 4 | - | - | 1 | 4 | 1 | 4 | RESETB | Reset Output (VDFL: Low Level When Detected) |
| 2 | 5 | 2 | 5 | 2 | 5 | 2 | 5 | Vss | Ground |
| 3 | 2 | 3 | 2 | - | - | 4 | 1 | MRB | Manual Reset |
| 4 | 1 | 4 | 1 | 4 | 1 | - | - | WD | Watchdog |
| 5 | 6 | 5 | 6 | 5 | 6 | 5 | 6 | VIN | Power Input |
| - | - | 1 | 4 | 3 | 2 | 3 | 2 | RESET | Reset Output (VDFH: High Level When Detected) |

■ PRODUCT CLASSIFICATION

● Selection Guide

| SERIES | | WATCHDOG | MANUAL RESET | RESET OUTPUT | |
|--------|--------|---------------|-----------------|---------------------------|--------------------------|
| | | | | V _{DFL} (RESETB) | V _{DFH} (RESET) |
| XC6101 | XC6111 | Available | Available | CMOS | - |
| XC6102 | XC6112 | Available | Available | N-channel open drain | - |
| XC6103 | XC6113 | Available | Available | - | CMOS |
| XC6104 | XC6114 | Available | Not Available | CMOS | CMOS |
| XC6105 | XC6115 | Available | Not Available | N-channel open drain | CMOS |
| XC6116 | | Not Available | Available | CMOS | CMOS |
| XC6117 | | Not Available | Available | N-channel open drain | CMOS |

● Ordering Information

XC61①②③④⑤⑥⑦⑧-⑨^(*)

| DESIGNATOR | ITEM | SYMBOL | DESCRIPTION |
|------------|------------------------------------|---------|--|
| ① | Hysteresis Width | 0 | V _{DF} x 5% (TYP.) with hysteresis |
| | | 1 | V _{DF} x 0.1% (TYP.) without hysteresis |
| ② | Functions and Type of Reset Output | 1 ~ 7 | Watchdog and manual functions, and reset output type as per Selection Guide in the above chart |
| ③ | Release Delay Time * | A | 3.13ms (TYP.) |
| | | B | 25ms (TYP.) |
| | | C | 50ms (TYP.) |
| | | D | 100ms (TYP.) |
| | | E | 200ms (TYP.) |
| | | F | 400ms (TYP.) |
| | | H | 1.6s (TYP.) |
| ④ | Watchdog Timeout Period | 0 | No WD timeout period for XC6116, XC6117 Series |
| | | 1 | 6.25ms (TYP.) |
| | | 2 | 50ms (TYP.) |
| | | 3 | 100ms (TYP.) |
| | | 4 | 200ms (TYP.) |
| | | 5 | 400ms (TYP.) |
| | | 6 | 1.6s (TYP.) |
| ⑤⑥ | Detect Voltage | 16 ~ 50 | Detect voltage ex.) 4.5V: ⑤⇒4, ⑥⇒5 |
| ⑦⑧-⑨ | Packages (Order Unit) | MR | SOT-25 (3,000/Reel) |
| | | MR-G | SOT-25 (3,000/Reel) |
| | | ER | USP-6C (3,000/Reel) |
| | | ER-G | USP-6C (3,000/Reel) |

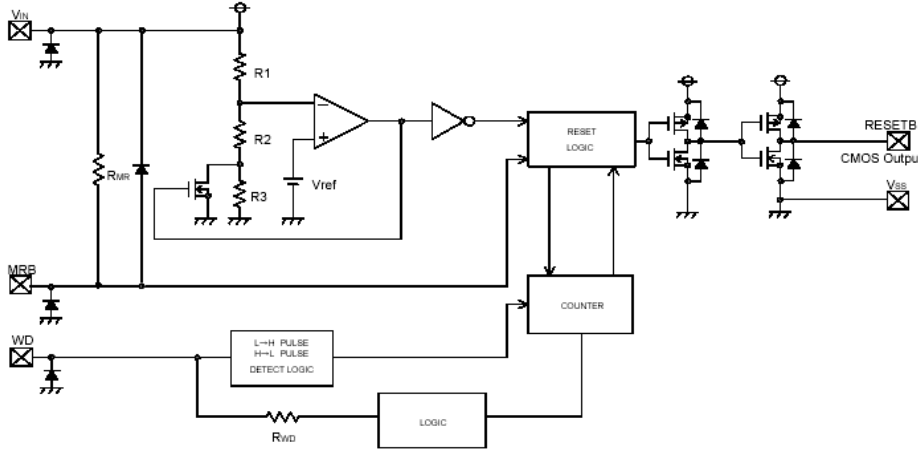
* Please set the release delay time shorter than or equal to the watchdog timeout period.

ex.) XC6101D427MR or XC6101D327MR

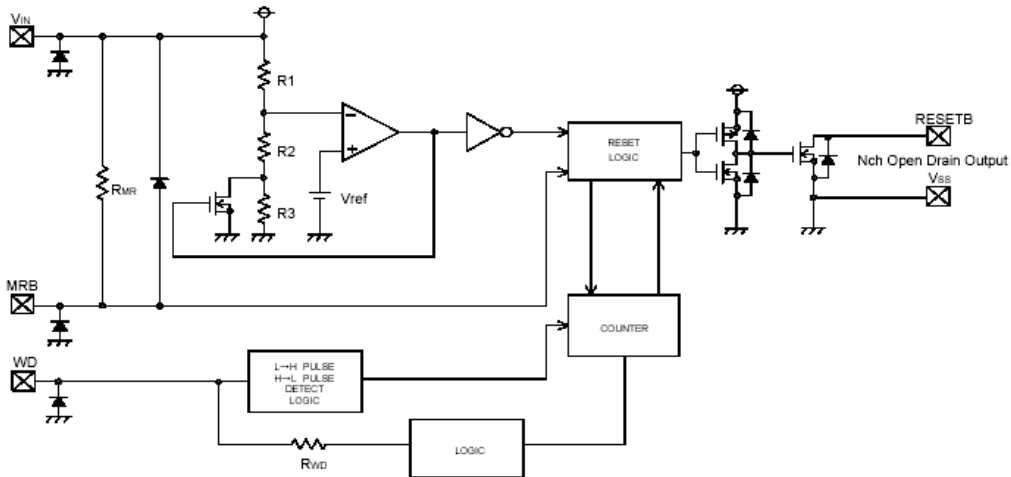
^(*) The "-G" suffix denotes Halogen and Antimony free as well as being fully RoHS compliant.

■ BLOCK DIAGRAMS

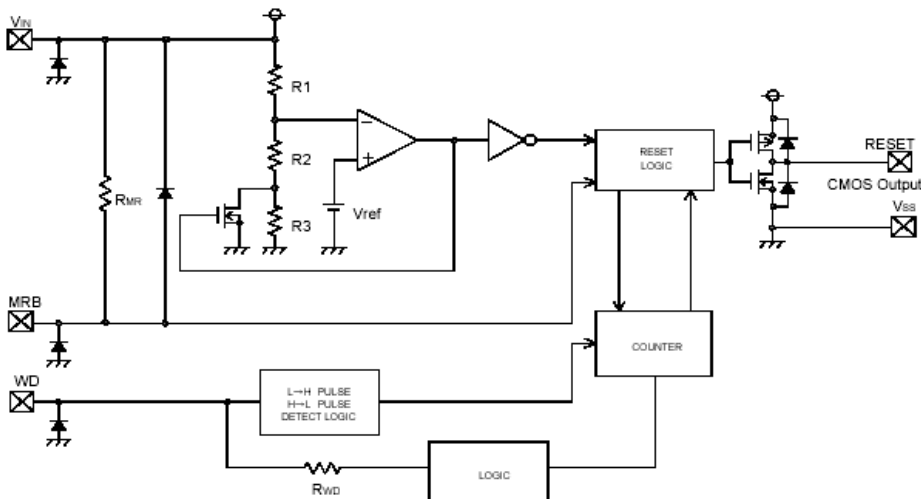
● XC6101, XC6111 Series



● XC6102, XC6112 Series

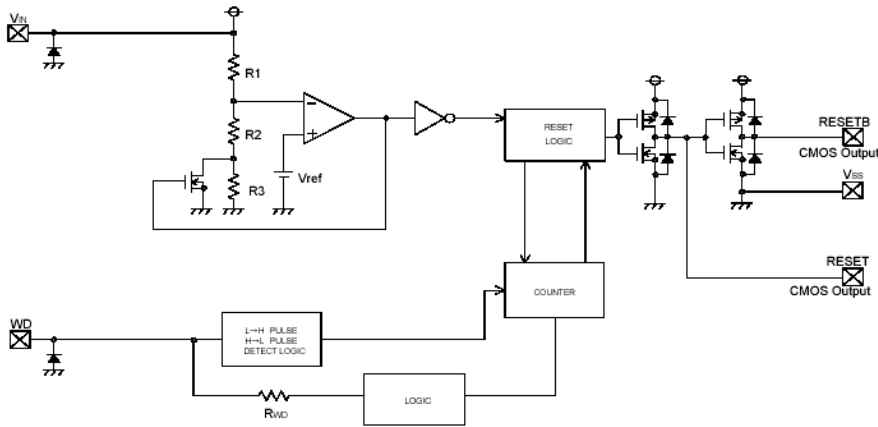


● XC6103, XC6113 Series

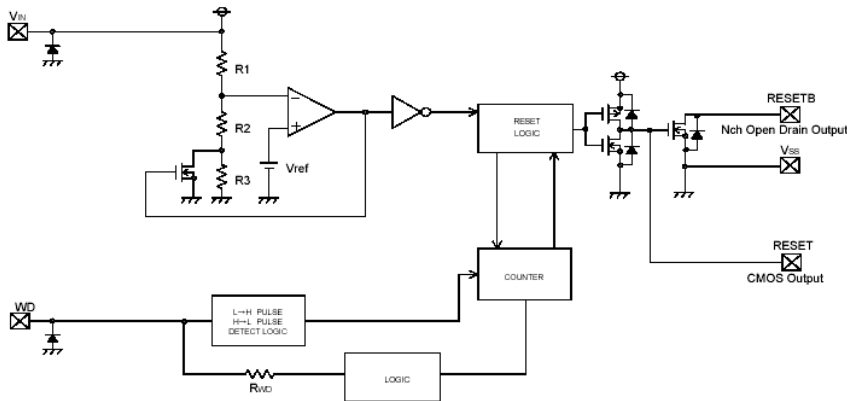


■ BLOCK DIAGRAMS (Continued)

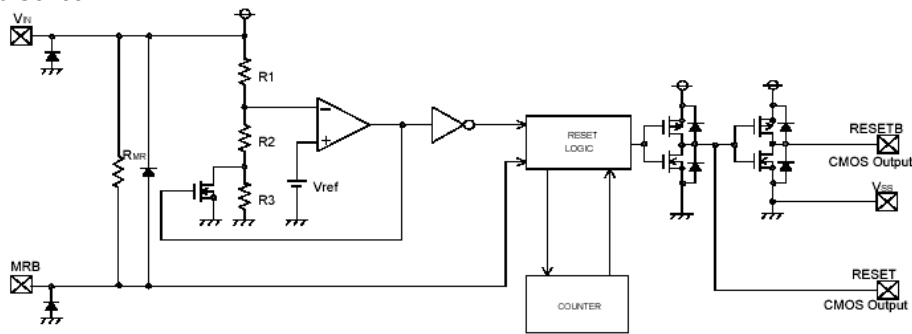
● XC6104, XC6114 Series



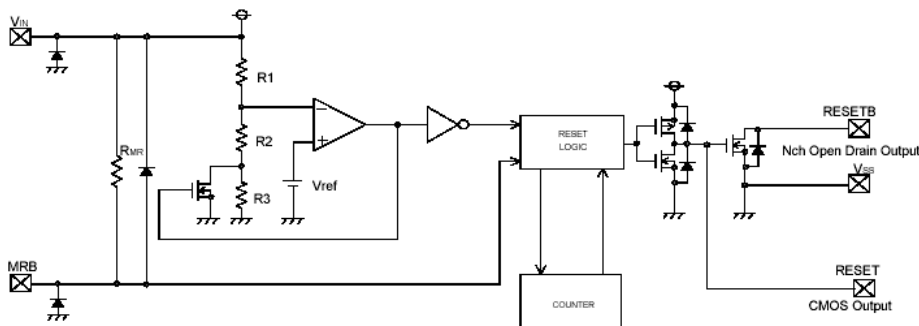
● XC6105, XC6115 Series



● XC6116 Series



● XC6117 Series



■ ABSOLUTE MAXIMUM RATINGS

Ta = 25°C

| PARAMETER | | SYMBOL | RATINGS | UNITS |
|-------------------------------|------------------------|---|---|-------|
| Input Voltage | | V _{IN} | V _{SS} -0.3 ~ 7.0 | V |
| | | V _{M_{RB}} | V _{SS} -0.3~V _{IN} +0.3≦7.0 | V |
| | | V _{WD} | V _{SS} -0.3 ~ 7.0 | V |
| Output Current | | I _{R_{BOU}T} /I _{R_{OU}T} | 20 | mA |
| Output Voltage | CMOS Output | V _{RESE_{TB}} /V _{RESE_T} | V _{SS} -0.3~V _{IN} +0.3≦7.0 | V |
| | N-ch Open Drain Output | V _{RESE_{TB}} | V _{SS} -0.3 ~ 7.0 | |
| Power Dissipation | SOT-25 | P _d | 250 | mW |
| | USP-6C | | 100 | |
| Operating Ambient Temperature | | T _{opr} | -40 ~ +85 | °C |
| Storage Temperature | | T _{stg} | -40 ~ +125 | °C |

■ ELECTRICAL CHARACTERISTICS

●XC6101~XC6105, XC6111~XC6117 Series

Ta = 25 °C

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNITS | CIRCUIT | | |
|--|---|--|---------------------------------|---------------------------|------------------|---------|---------|---|--------|
| Detect Voltage | VDFL VDFH | | VDF(T) ⁽¹⁾ × 0.98 | VDF(T) | VDF(T) × 1.02 | V | ① | | |
| Hysteresis Width XC6101~XC6105 ^(*)3) | VHYS | | VDF ⁽²⁾ × 0.02 | VDF × 0.05 | VDF × 0.08 | V | ① | | |
| Hysteresis Width XC6111~XC6117 ^(*)4) | VHYS | | 0 | VDF × 0.001 | VDF × 0.01 | V | ① | | |
| Supply Current | Iss | XC6101~XC6105 XC6111~XC6115 (The MRB & the WD Pin: No connection) | VIN=VDF(T)×0.9V | - | 5 | 11 | μA | ② | |
| | | | VIN=VDF(T)×1.1V | - | 10 | 16 | | | |
| | | | VIN=6.0V | - | 12 | 18 | | | |
| | | XC6116/XC6117 (The MRB Pin: No connection) | VIN=VDF(T)×0.9V | - | 4 | 10 | | | |
| | | | VIN=VDF(T)×1.1V | - | 8 | 14 | | | |
| | | | VIN=6.0V | - | 10 | 16 | | | |
| Operating Voltage | VIN | | 1.0 | - | 6.0 | V | ① | | |
| VDFL Output Current (RESETB) | IRBOUT | N-ch. VDS = 0.5V | VIN=1.0V | 0.15 | 0.5 | - | mA | ③ | |
| | | | VIN=2.0V (VDFL(T) > 2.0V) | 2.0 | 2.5 | - | | | |
| | | | VIN=3.0V (VDFL(T) > 3.0V) | 3.0 | 3.5 | - | | | |
| | | | VIN=4.0V (VDFL(T) > 4.0V) | 3.5 | 4.0 | - | | | |
| | | CMOS, P-ch VDS = 0.5V | VIN=6.0V | - | - 1.1 | -0.8 | | ④ | |
| VDFH Output Current (RESET) | IROUT | N-ch VDS = 0.5V | VIN=6.0V | 4.4 | 4.9 | - | mA | ③ | |
| | | | | VIN=1.0V | - | - 0.08 | | | - 0.02 |
| | | | P-ch. VDS = 0.5V | VIN=2.0V (VDFH(T) > 2.0V) | - | - 0.50 | | | - 0.30 |
| | | | | VIN=3.0V (VDFH(T) > 3.0V) | - | - 0.75 | | | - 0.55 |
| | | | VIN=4.0V (VDFH(T) > 4.0V) | - | - 0.95 | - 0.75 | | ④ | |
| Temperature Coefficient | $\frac{\Delta VDF}{(\Delta T_{opr} \cdot VDF)}$ | -40°C ≤ Topr ≤ 85 °C | - | +100 | - | ppm/ °C | ① | | |
| Release Delay Time (VDF ≤ 1.8V) | tDR | Time until VIN is increased from 1.0V to 2.0V and attains to the release time level, and the Reset output pin inverts. | | 2 | 3.13 | 5 | ms | ⑤ | |
| | | | | 18 | 25 | 31 | | | |
| | | | | 37 | 50 | 63 | | | |
| | | | | 75 | 100 | 125 | | | |
| | | | | 150 | 200 | 250 | | | |
| | | | | 300 | 400 | 500 | | | |
| | | | | 1200 | 1600 | 2000 | | | |
| Release Delay Time (VDF ≥ 1.9V) | tDR | Time until VIN is increased from 1.0V to (VDFx1.1V) and attains to the release time level, and the Reset output pin inverts. | | 2 | 3.13 | 5 | ms | ⑤ | |
| | | | | 18 | 25 | 31 | | | |
| | | | | 37 | 50 | 63 | | | |
| | | | | 75 | 100 | 125 | | | |
| | | | | 150 | 200 | 250 | | | |
| | | | | 300 | 400 | 500 | | | |
| | | | | 1200 | 1600 | 2000 | | | |
| Detect Delay Time | tDF | Time until VIN is decreased from 6.0V to 1.0V and attains to the detect voltage level, and the Reset output pin detects while the WD pin left opened. | - | 3 | 30 | μs | ⑤ | | |
| Leakage Current | VDFL CMOS Output | ILEAK | VIN=VDFL×0.9V, VRESETB=0V | | -0.01 | | μA | ③ | |
| | VDFH CMOS Output | | VIN=6V, VRESET=0V | | | | | | |
| | VDFL Nch N-ch Open Drain Output | | VIN=6V, VRESETB=6V | | 0.01 | 0.1 | | | |

ELECTRICAL CHARACTERISTICS (Continued)

●XC6101~XC6105, XC6111~XC6117 Series

Ta = 25 °C

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNITS | CIRCUIT |
|------------------------------------|-------------------|---|-----------------------|------|-----------------------|-------|---------|
| Watchdog Timeout Period (VDF≤1.8V) | t _{WD} | Time until V _{IN} increases from 1.0V to 2.0V and the Reset output pin is released to go into the detection state. (V _{WD} =V _{SS}) | 4.25 | 6.25 | 8.25 | ms | ⑥ |
| | | | 37 | 50 | 63 | | |
| | | | 75 | 100 | 125 | | |
| | | | 150 | 200 | 250 | | |
| | | | 300 | 400 | 500 | | |
| | | | 1200 | 1600 | 2000 | | |
| Watchdog Timeout Period (VDF≥1.9V) | t _{WD} | Time until V _{IN} increases from 1.0V to (VDF×1.1V) and the Reset output pin is released to go into the detection state. (V _{WD} =V _{SS}) | 4.25 | 6.25 | 8.25 | ms | ⑥ |
| | | | 37 | 50 | 63 | | |
| | | | 75 | 100 | 125 | | |
| | | | 150 | 200 | 250 | | |
| | | | 300 | 400 | 500 | | |
| | | | 1200 | 1600 | 2000 | | |
| Watchdog Minimum Pulse Width | t _{WDIN} | V _{IN} =6.0V, Apply pulse from 6.0V to 0V to the WD pin. | 300 | - | - | ns | ⑦ |
| Watchdog High Level Voltage | V _{WDH} | V _{IN} =VDF × 1.1V ~ 6.0V | V _{IN} × 0.7 | - | 6 | V | ⑦ |
| Watchdog Low Level Voltage | V _{WDL} | V _{IN} =VDF × 1.1V ~ 6.0V | 0 | - | V _{IN} × 0.3 | V | ⑦ |
| Watchdog Input Current | I _{WD} | V _{IN} =6.0V, V _{WD} =6.0V (Avg. when peak) | - | 12 | 19 | μA | ⑧ |
| | | V _{IN} =6.0V, V _{WD} =0V (Avg. when peak) | -19 | -12 | - | | |
| Watchdog Input Resistance | R _{WD} | V _{IN} =6.0V, V _{WD} =0V, R _{WD} =V _{IN} / I _{WD} | 315 | 500 | 880 | kΩ | ⑧ |

●XC6101 ~ XC6103, XC6111 ~ XC6113, XC6116 , XC6117 Series

Ta = 25 °C

| PARAMETER | SYMBOL | CONDITIONS | MIN. | TYP. | MAX. | UNITS | CIRCUIT |
|--|-------------------|---|------|------|-----------------|-------|---------|
| MRB High Level Voltage | V _{MRH} | V _{IN} =VDF×1.1V ~ 6.0V | 1.4 | - | V _{IN} | V | ⑨ |
| MRB Low Level Voltage | V _{MRL} | V _{IN} =VDF×1.1V ~ 6.0V | 0 | - | 0.35 | | ⑨ |
| MRB Pull-up Resistance | R _{MR} | V _{IN} =6.0V, MRB=0V, R _{MR} =V _{IN} / I _{MRB} | 1.6 | 2.4 | 3.0 | MΩ | ⑩ |
| MRB Minimum Pulse Width ⁽⁵⁾ XC6101~XC6105 XC6111~XC6115 | t _{MRIN} | V _{IN} =6.0V, Apply pulse from 6.0V to 0V to the MRB pin | 2.8 | - | - | μs | ⑪ |
| MRB Minimum Pulse Width ⁽⁶⁾ XC6116, XC6117 | t _{MRIN} | V _{IN} =6.0V, Apply pulse from 6.0V to 0V to the MRB pin | 1.2 | - | - | | |

NOTE:

- *1: V_{DF(T)}: Setting detect voltage
- *2: If only "V_{DF}" is indicated, it represents both V_{DFL} (low when detected) and V_{DFH} (high when detected).
- *3: XC6101~XC6105 (with hysteresis)
- *4: XC6111~XC6117 (without hysteresis)
- *5: Watchdog function is available.
- *6: Watchdog function is not available.

■ OPERATIONAL EXPLANATION

The XC6101~XC6105, XC6111~XC6117 series compare, using the amplifier, the voltage of the internal voltage reference source with the voltage divided by R1, R2 and R3 connected to the VIN pin. The resulting output signal from the error amplifier activates the watchdog logic, manual reset logic, delay circuit and the output driver. When the VIN pin voltage gradually falls and finally reaches the detect voltage, the RESETB pin output goes from high to low in the case of the VDFL type ICs, and the RESET pin output goes from low to high in the case of the VDFH type ICs.

<RESETB / RESET Pin Output Signal>

* VDFL (RESETB) type - output signal: Low when detected.

The RESETB pin output goes from high to low whenever the VIN pin voltage falls below the detect voltage, or whenever the MRB pin is driven from high to low. The RESETB pin remains low for the release delay time (tDR) after the VIN pin voltage reaches the release voltage. If neither rising nor falling signals are applied to the WD pin within the watchdog timeout period, the RESETB pin output remains low for the release delay time (tDR), and thereafter the RESET pin outputs high level signal.

* VDFH (RESET) type – output signal: High when detected.

The RESET pin output goes from low to high whenever the VIN pin voltage falls below the detect voltage, or whenever the MRB pin is driven from high to low. The RESET pin remains high for the release delay time (tDR) after the VIN pin voltage reaches the release voltage. If neither rising nor falling signals are applied to the WD pin within the watchdog timeout period, the VOUT pin output remains high for the release delay time (tDR), and thereafter the RESET pin outputs low level signal.

<Hysteresis>

When the internal comparator output is high, the N-Channel transistor connected in parallel to R3 is turned ON, activating the hysteresis circuit. The difference between the release and detect voltages represents the hysteresis width, as shown by the following calculations:

$$VDF \text{ (detect voltage)} = (R1+R2+R3) \times Vref(R2+R3)$$

$$VDR \text{ (release voltage)} = (R1+R2) \times Vref(R2)$$

$$VHYS \text{ (hysteresis width)} = VDR - VDF \text{ (V)}$$

$$VDR > VDF$$

* Detect voltage (VDF) includes conditions of both VDFL (low when detected) and VDFH (high when detected).

* Please refer to the block diagrams for R1, R2, R3 and Vref.

Hysteresis width is selectable from $VDF \times 0.05V$ (XC6101~XC6105) or $VDF \times 0.001V$ (XC6111~XC6117).

<Watchdog (WD) Pin>

The XC6101~XC6105, XC6111~XC6117 series use a watchdog timer to detect malfunction or “runaway” of the microprocessor. If neither rising nor falling signals are applied from the microprocessor within the watchdog timeout period, the RESETB/RESET pin output maintains the detection state for the release delay time (tDR), and thereafter the RESET/RESETB pin output returns to the release state (Please refer to the FUNCTION CHART). The timer in the watchdog is then restarted. Six watchdog timeout period settings are available in 1.6s, 400ms, 200ms, 100ms, 50ms, 6.25ms.

<MRB Pin>

Using the MRB voltage pin input, the RESET/RESETB pin signal can be forced to the detection state. When the MRB pin is driven from high to low, the RESETB pin output goes from high to low level signal in the case of the VDFL type ICs, and the RESET pin output goes from low to high in the case of the VDFH type. Even after the MRB pin is driven back high, the RESET/RESETB pin output maintains the detection state for the release delay time (tDR). Since the MRB pin is internally pulled up to the VIN pin voltage level, leave the MRB pin open if unused (Please refer to the FUNCTION CHART). A diode, which is an input protection element, is connected between the MRB pin and VIN pin. Therefore, if the MRB pin is applied voltage that exceeds VIN, the current will flow to VIN through the diode. Please use this IC within the stated maximum ratings ($V_{SS}-0.3 \sim V_{IN}+0.3 \leq 7.0V$) on the MRB pin.

<Release Delay Time>

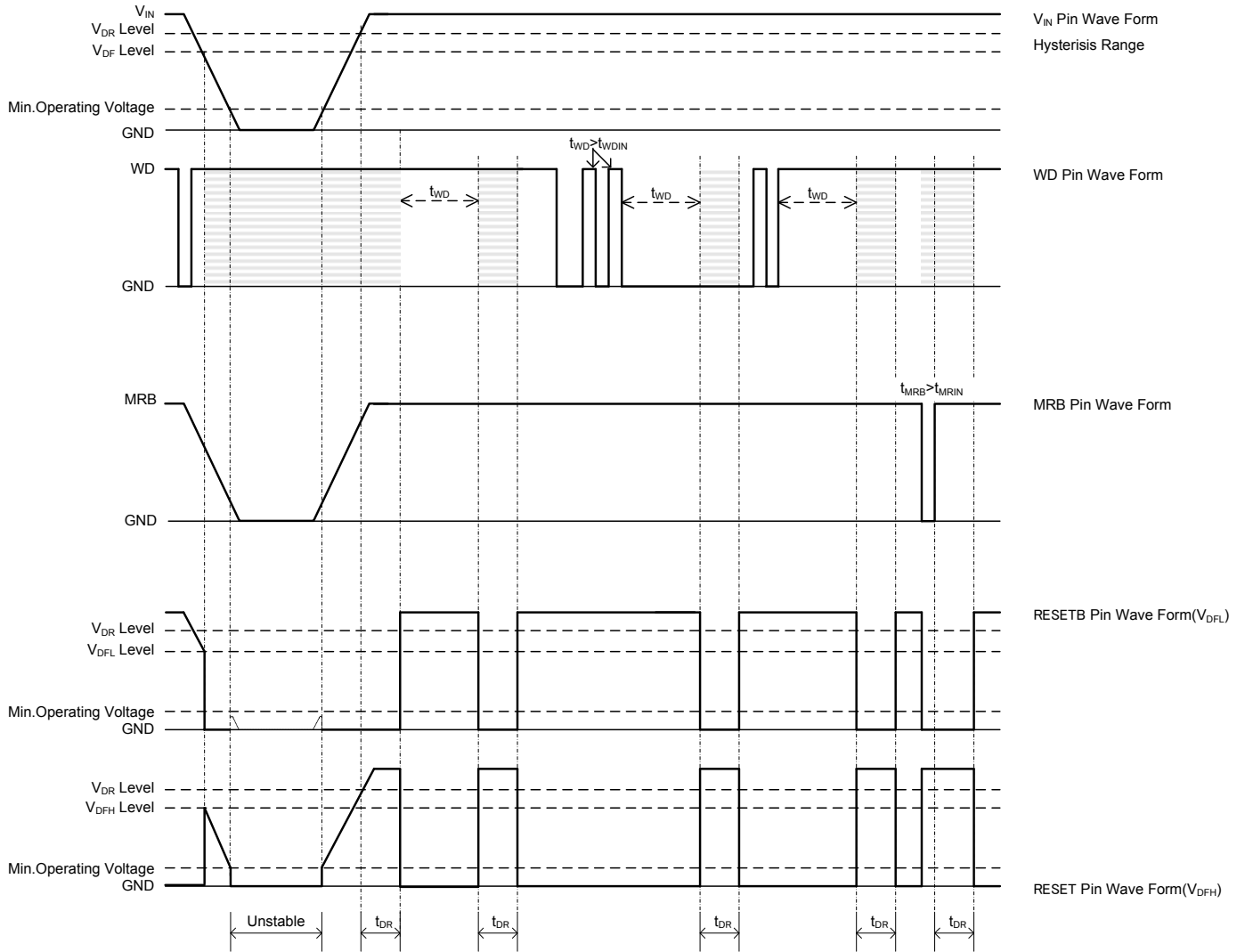
Release delay time (tDR) is the time that elapses from when the VIN pin reaches the release voltage, or when the watchdog timeout period expires with no rising signal applied to the WD pin, until the RESET/RESETB pin output is released from the detection state. Seven release delay time (tWD) watchdog timeout period settings are available in 1.6s, 400ms, 200ms, 100ms, 50ms, 25ms, 3.13ms.

<Detect Delay Time>

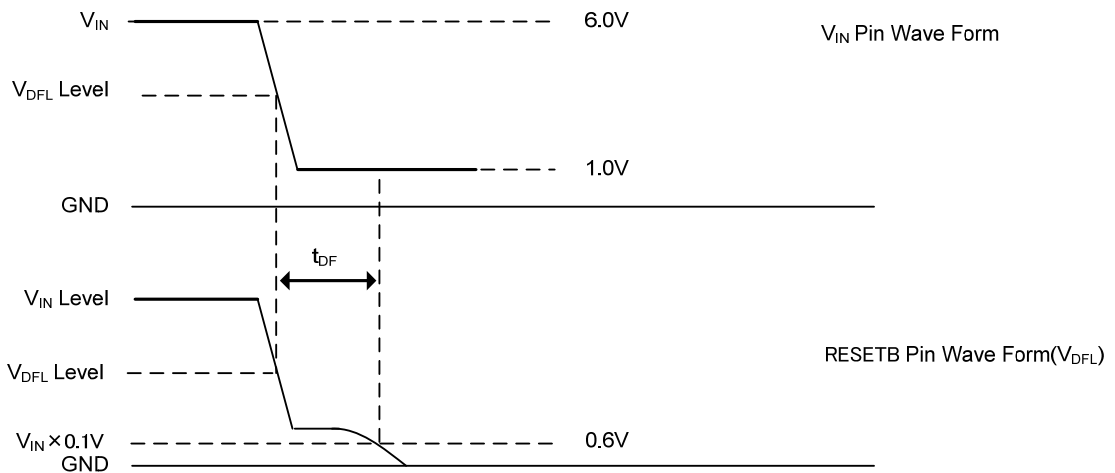
Detect Delay Time (tDF) is the time that elapses from when the VIN pin voltage falls to the detect voltage until the RESET/RESETB pin output goes into the detection state.

■ TIMING CHARTS

● CMOS Output



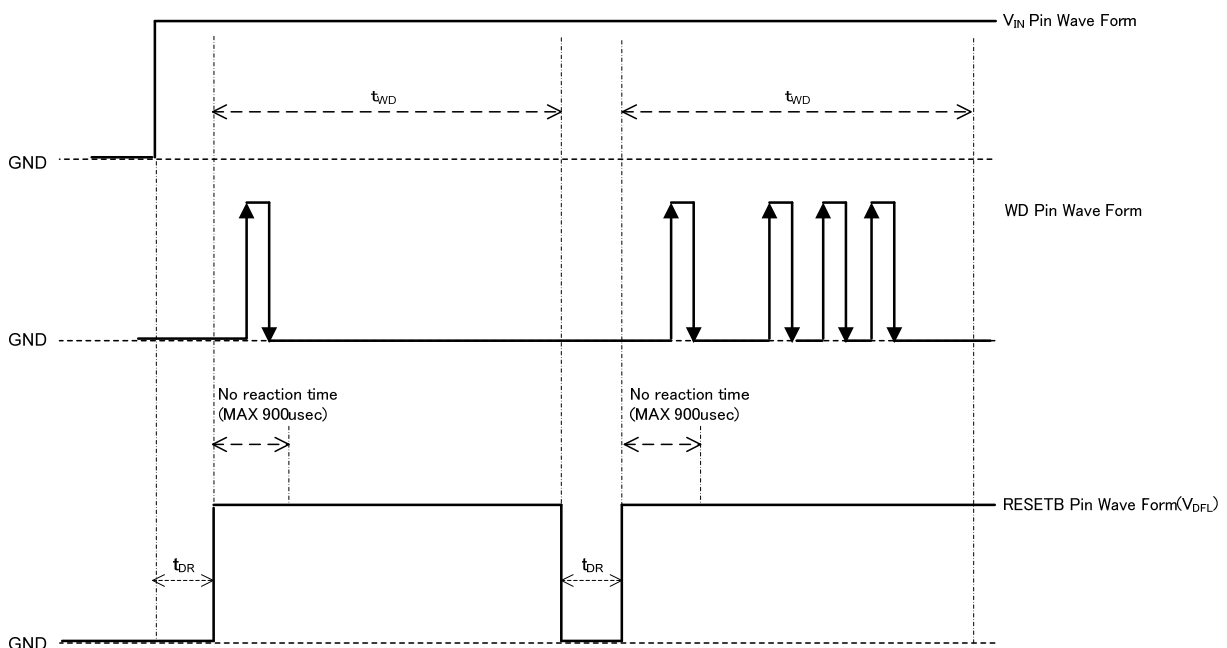
* t_{DF} (CMOS output)



■ NOTES ON USE

1. Please use this IC within the stated maximum ratings. For temporary, transitional voltage drop or voltage rising phenomenon, the IC is liable to malfunction should the ratings be exceeded.
2. When a resistor is connected between the V_{IN} pin and the input, the V_{IN} voltage drops while the IC is operating and a malfunction may occur as a result of the IC's through current. For the CMOS output products, the V_{IN} voltage drops while the IC is operating and malfunction may occur as a result of the IC's output current. Please be careful with using the XC6111~XC6117 series (without hysteresis).
3. In order to stabilize the IC's operations, please ensure that the V_{IN} pin's input frequency's rise and fall times are more than some $\mu s/V$.
4. Noise at the power supply may cause a malfunction of the watchdog operation or the circuit. In such case, please strength the line between V_{IN} and the GND pin and connect about $0.22 \mu F$ of a capacitor between the V_{IN} pin and the GND pin.
5. Protecting against a malfunction while the watchdog time out period, an ignoring time (no reaction time) occurs to the rise and fall times. Referring to the figure below, the ignoring time (no reaction time) lasts for $900 \mu s$ at maximum.
6. The watchdog function can be disabled by connecting a three-state device to the WDI pin as a result of the high impedance state of the WDI pin. This is effective when the watchdog function is not required, for example, during data loading to the CPU. The WDI input is internally driven through a buffer (LOGIC) and series resistor (R_{WD}) from the watchdog counter as showed in the block diagrams of page 4 and 5. The WDI input is designed for minimizing the input current by placing the series resistor (R_{WD}) in the maximum resistance of $880k\Omega$. A voltage drop occurs in proportion to the leakage current of the three-state device multiplied by the resistance value of the series resistor (R_{WD}) when the three-state device is in the state of high impedance. The voltage level must be reaching the threshold level of the WD so that a three-state device with small leakage current should be selected.
The other series is available in the name of XC6121~XC6124 with the ON/OFF control pin for the watchdog function. When these series is used, external parts such as the three-state device is not required.
7. 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.

● No Reaction Time



PIN LOGIC CONDITIONS

| PIN NAME | LOGIC | CONDITIONS |
|----------|-------|---|
| VIN | H | $V_{IN} \geq V_{DF} + V_{HYS}$ |
| | L | $V_{IN} \leq V_{DF}$ |
| MRB | H | $V_{MRB} \geq 1.40V$ |
| | L | $V_{MRB} \leq 0.35V$ |
| WD | H | When keeping $V_{WD} \geq V_{WDH}$ more than t_{WD} |
| | L | When keeping $V_{WD} \leq V_{WDL}$ more than t_{WD} |
| | L → H | $V_{WDL} \rightarrow V_{WDH}, t_{WDIN} \geq 300ns$ |
| | H → L | $V_{WDH} \rightarrow V_{WDL}, t_{WDIN} \geq 300ns$ |

NOTE:

*1: If only "VDF" is indicated, it represents both VDFL (low when detected) and VDFH (high when detected).

*2: For the details of each parameter, please see the electrical characteristics.

VDF: Detect Voltage

V_{HYS}: Hysteresis Width

V_{WDH}: WD High Level Voltage

V_{WDL}: WD Low Level Voltage

t_{WDIN}: WD Pulse Width

t_{WD}: WD Timeout Period

FUNCTION CHART

●XC6101/XC61111, XC6102/6112 Series

| V _{IN} | V _{MRB} | V _{WD} | V _{RESETB} ^(*2) | |
|-----------------|------------------|-----------------|-------------------------------------|---|
| H | H or Open | H | Repeat detect and release (H→L→H) | |
| H | | L | | |
| H | | Open | | |
| H | | L → H | | H |
| H | | H → L | | |
| H | L | *1 | L | |
| L | | | | |

●XC6103/XC61113 Series

| V _{IN} | V _{MRB} | V _{WD} | V _{RESET} ^(*3) | |
|-----------------|------------------|-----------------|------------------------------------|---|
| H | H or Open | H | Repeat detect and release (L→H→L) | |
| H | | L | | |
| H | | Open | | |
| H | | L → H | | L |
| H | | H → L | | |
| H | L | *1 | H | |
| L | | | | |

●XC6104/XC61114, XC6105/XC6115 Series

| V _{IN} | V _{WD} | V _{RESETB} ^(*2) | V _{RESET} ^(*3) | | |
|-----------------|-----------------|-------------------------------------|------------------------------------|---|---|
| H | H | Repeat detect and release (H→L→H) | Repeat detect and release (L→H→L) | | |
| H | L | | | | |
| H | Open | | | | |
| H | L → H | | | H | L |
| H | H → L | | | | |
| L | *1 | L | H | | |

●XC61116, XC6117 Series

| V _{IN} | V _{MRB} | V _{RESETB} ^(*2) | V _{RESET} ^(*3) |
|-----------------|------------------|-------------------------------------|------------------------------------|
| H | H or Open | H | L |
| H | L | L | H |
| L | | | |

*1: Including all logic of WD (V_{WD}=H, L, L→H, H→L, OPEN).

*2: When the V_{RESETB} is High, the circuit is in the release state.
When the V_{RESETB} is Low, the circuit is in the detection state.

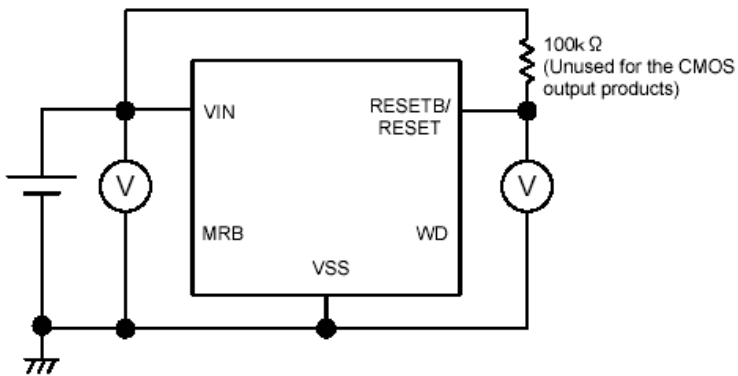
*3: When the V_{RESET} is Low, the circuit is in the release state.
When the V_{RESET} is High, the circuit is in the detection state.

*4: V_{IN}=L and V_{MRB}=H can not be combined for the rated input voltage of the V_{MRB} pin is V_{SS}-0.3V to V_{IN}+0.3V.

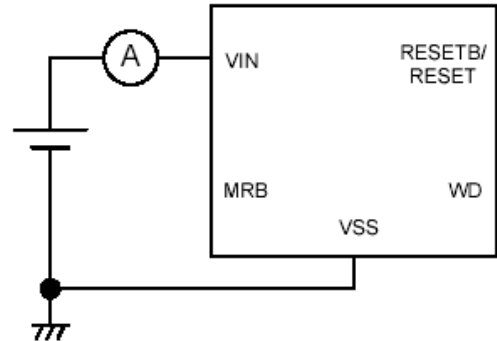
*5: The RESET/RESETB pin becomes indefinite operation while 0.35V<V_{MRB}<1.4V.

TEST CIRCUITS

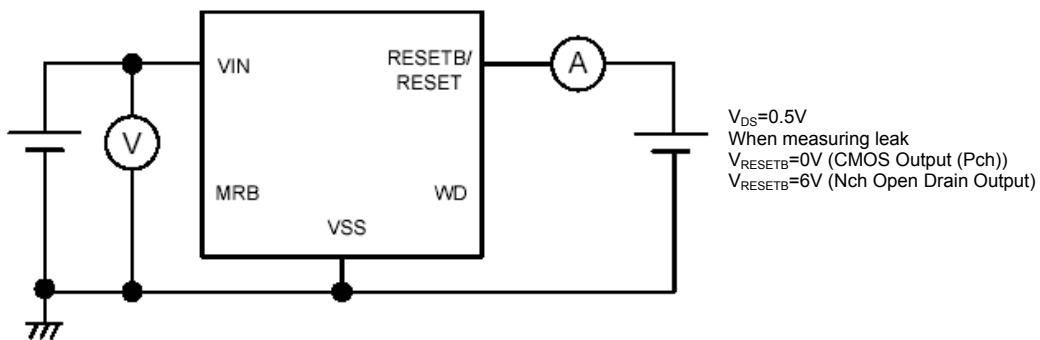
Circuit 1



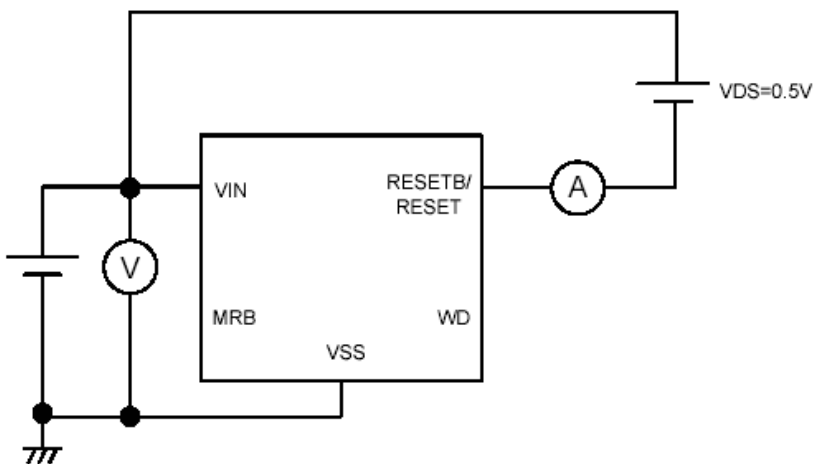
Circuit 2



Circuit 3

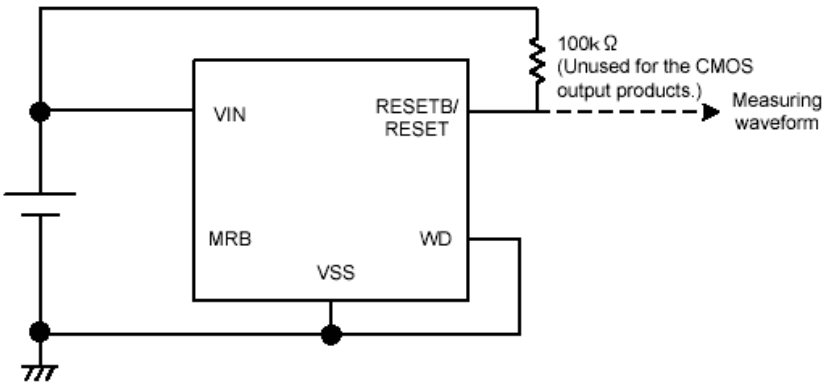


Circuit 4

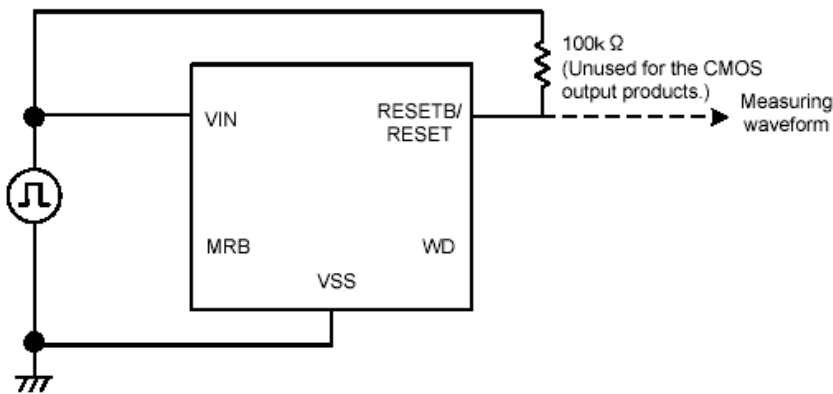


TEST CIRCUITS (Continued)

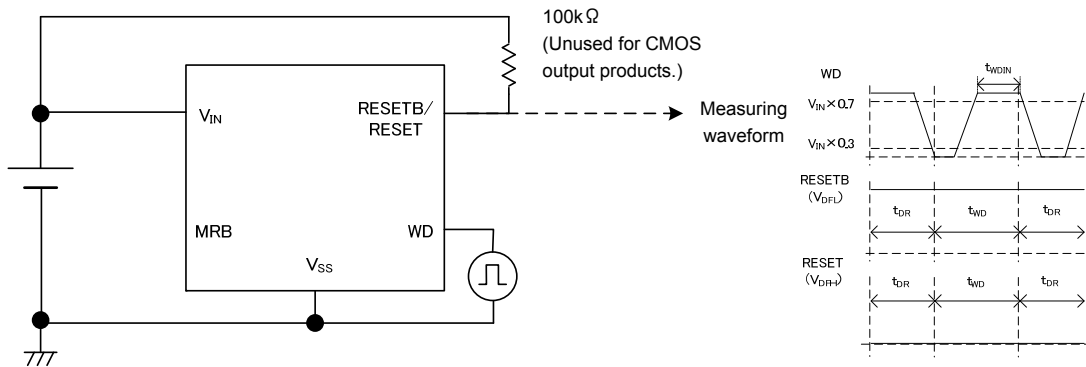
Circuit 5



Circuit 6

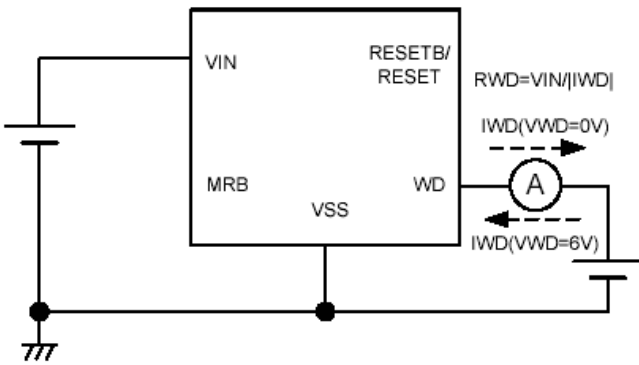


Circuit 7

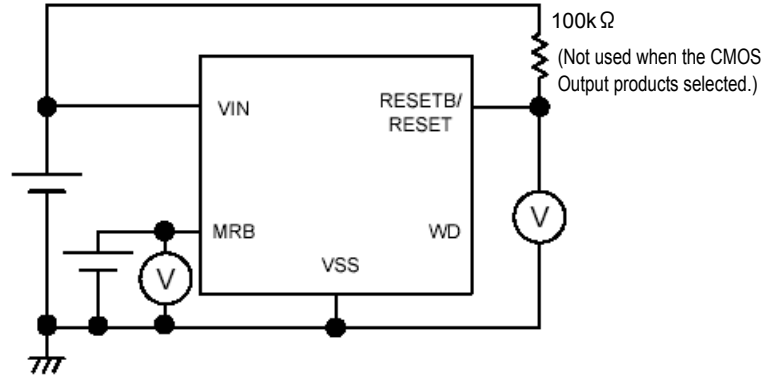


■ TEST CIRCUITS (Continued)

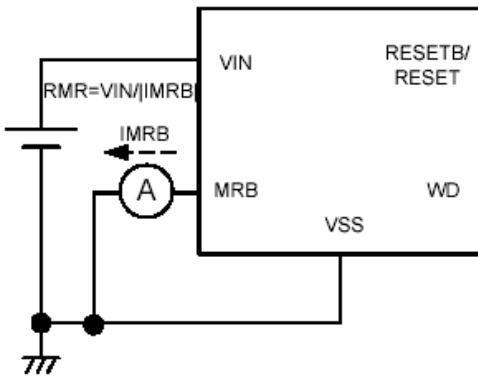
Circuit 8



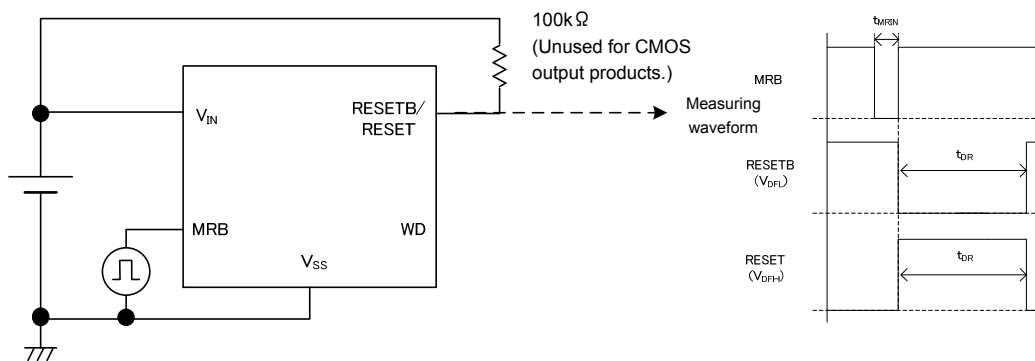
Circuit 9



Circuit 10

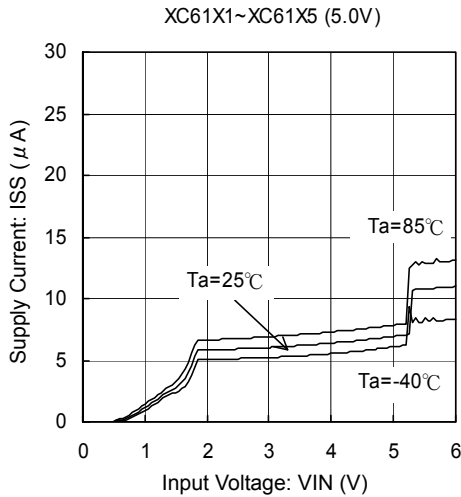
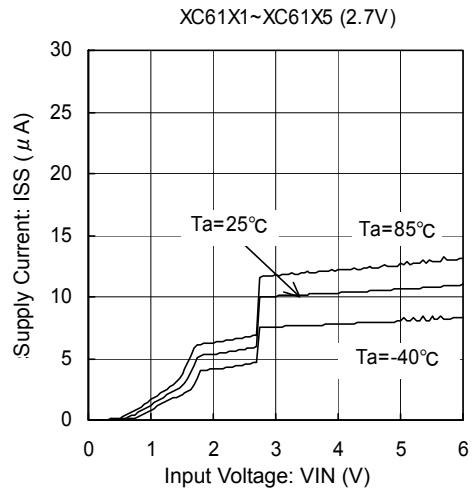
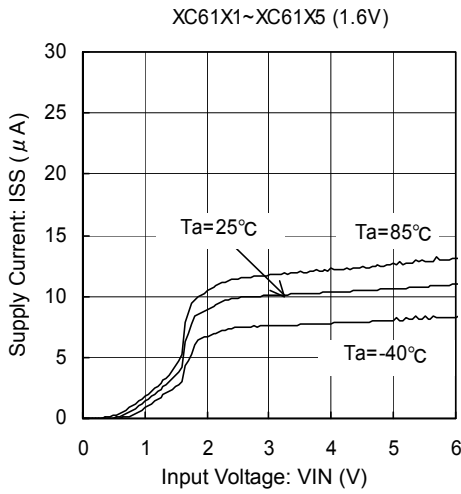


Circuit 11

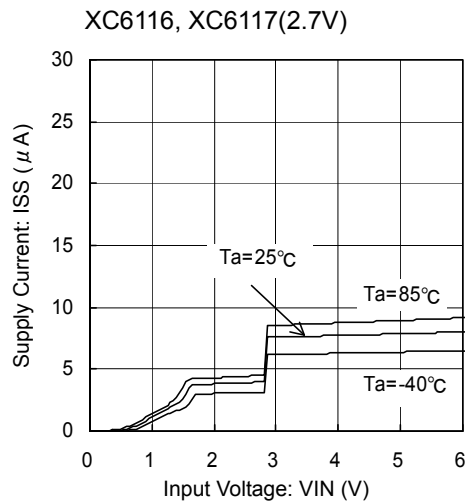
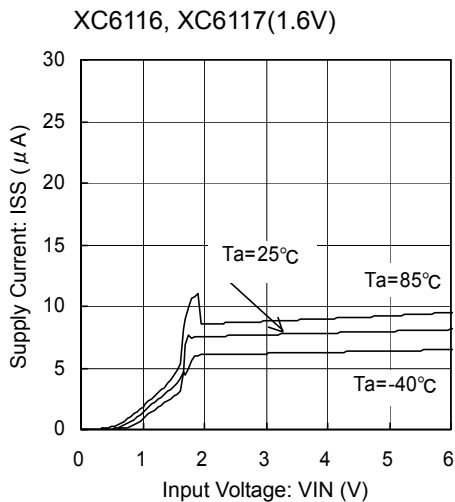


■ TYPICAL PERFORMANCE CHARACTERISTICS

(1.1) Supply Current vs. Input Voltage



(1.2) Supply Current vs. Input Voltage

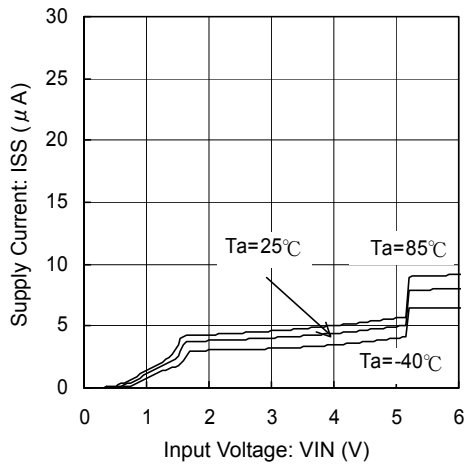


* 'X' represents both '0' and '1'. (ex. XC61X1⇒XC6101 and XC6111)

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

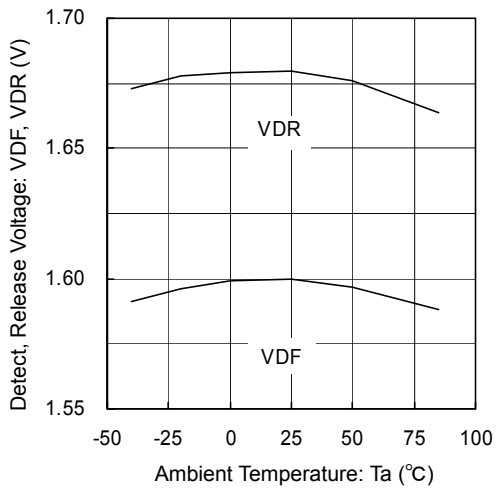
(1.2) Supply Current vs. Input Voltage (Continued)

XC6116, XC6117(5.0V)

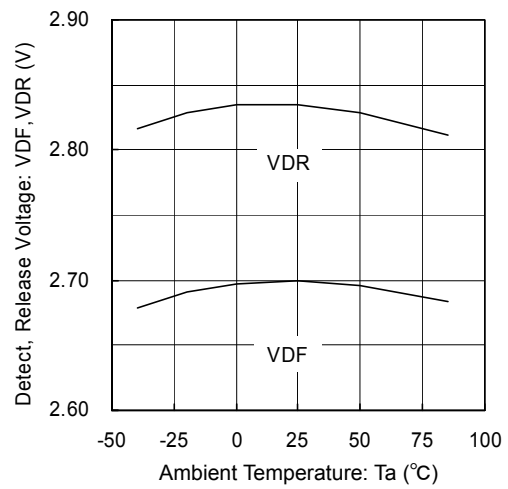


(2) Detect, Release Voltage vs. Ambient Temperature

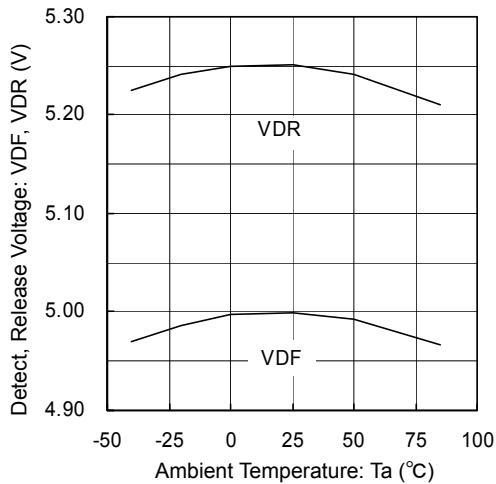
XC61X1~XC61X7 (1.6V)



XC61X1~XC61X7 (2.7V)



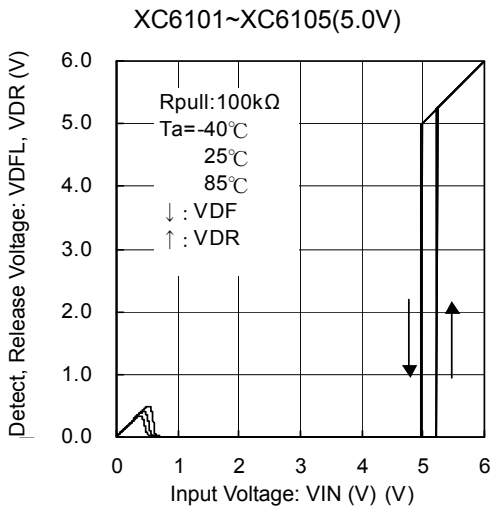
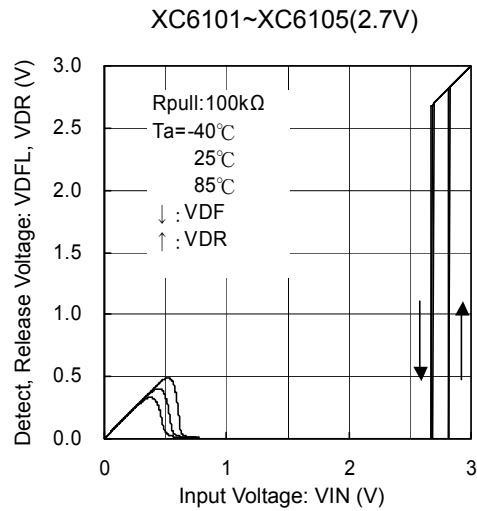
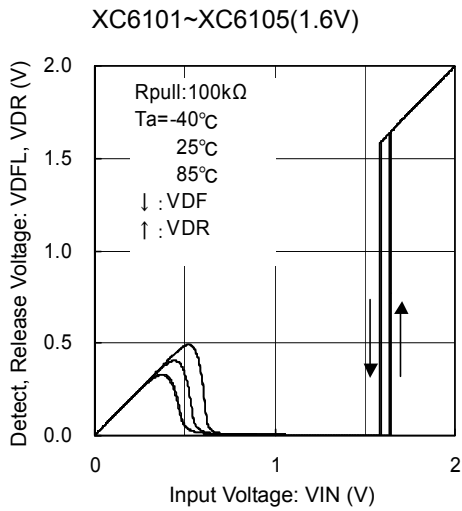
XC61X1~XC61X7 (5.0V)



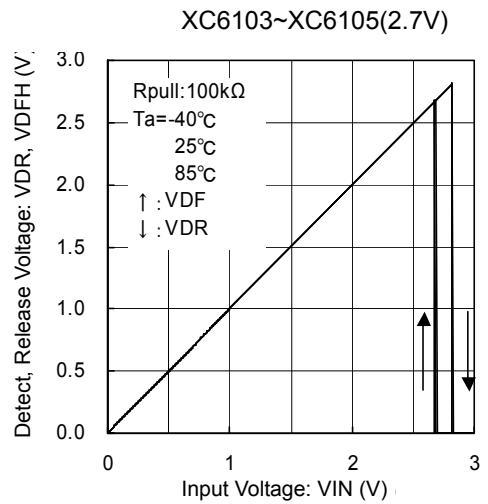
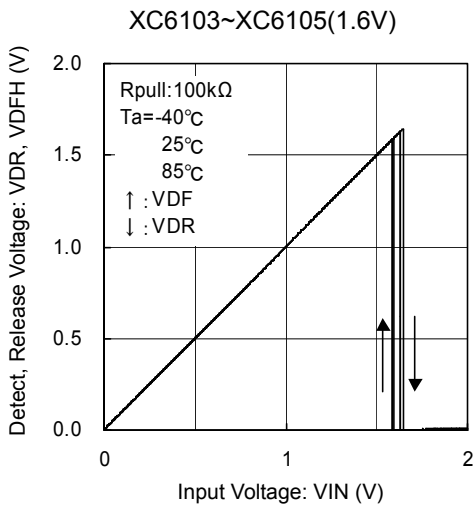
* 'X' represents both '0' and '1'. (ex. XC61X1⇒XC6101 and XC6111)

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

(3.1) Detect, Release Voltage vs. Input Voltage (VDFL)



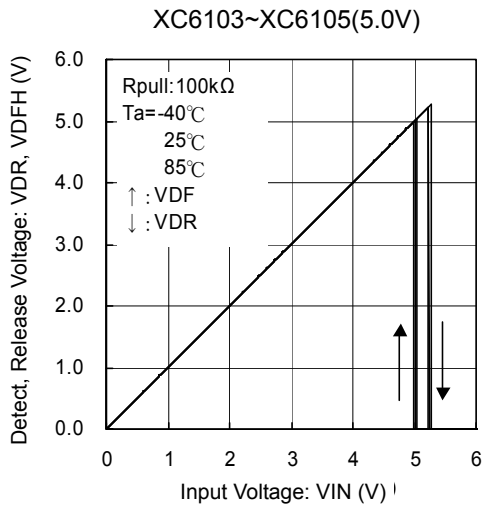
(3.2) Detect, Release Voltage vs. Input Voltage (VDFH)



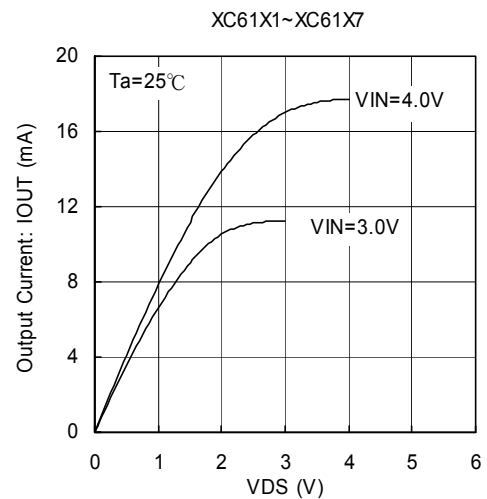
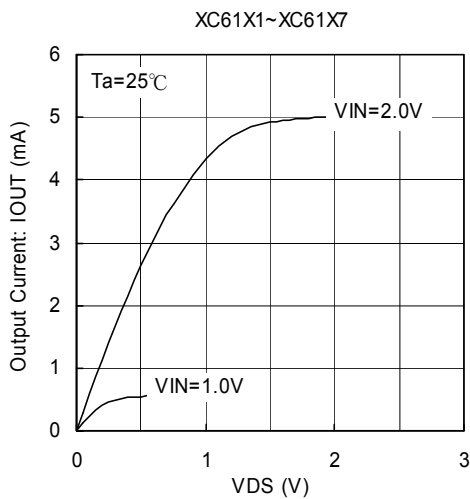
* 'X' represents both '0' and '1'. (ex. XC61X1⇒XC6101 and XC6111)

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

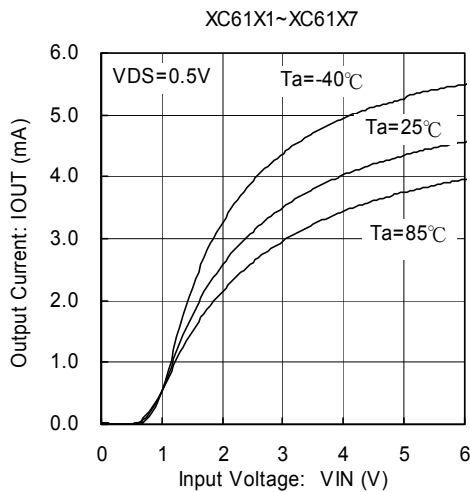
(3.2) Detect, Release Voltage vs. Input Voltage (VDFH) (Continued)



(4) N-ch Driver Output Current vs. VDS



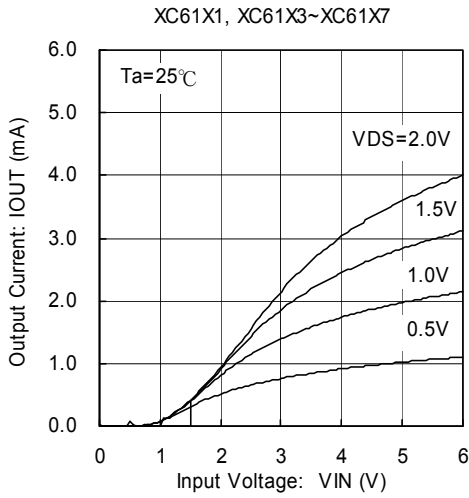
(5) N-ch Driver Output Current vs. Input Voltage



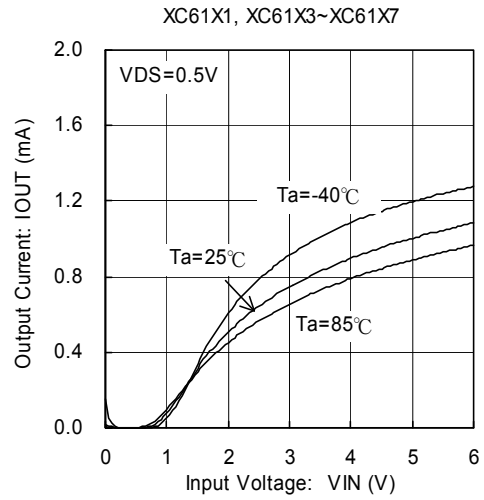
* 'X' represents both '0' and '1'. (ex. XC61X1⇒XC6101 and XC6111)

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

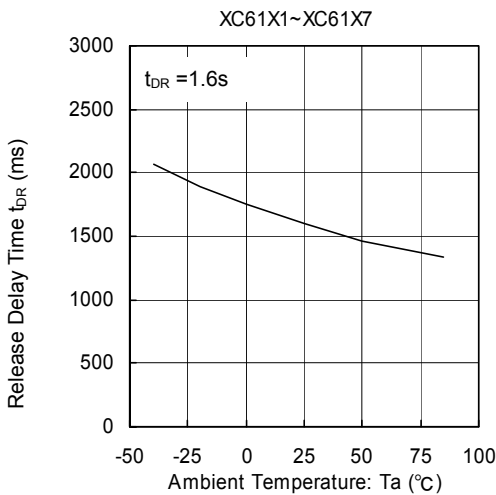
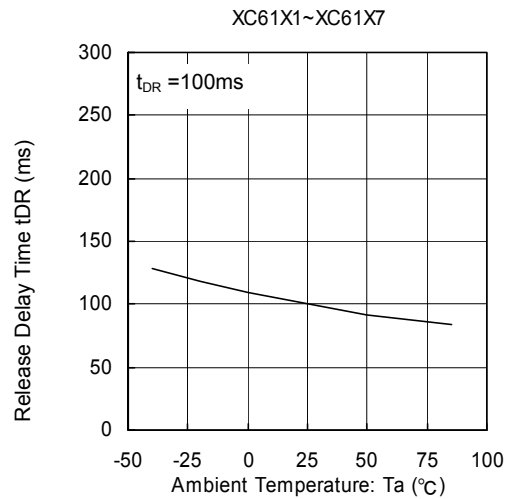
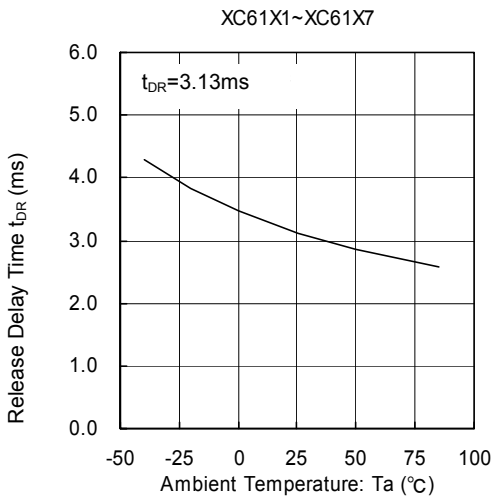
(6) P-ch Driver Output Current vs. Input Voltage 1



(7) P-ch Driver Output Current vs. Input Voltage 2



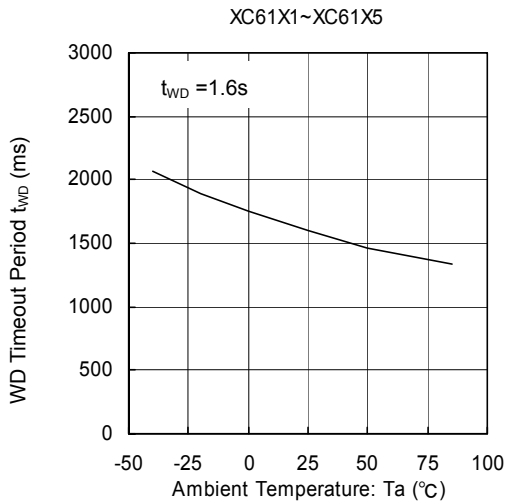
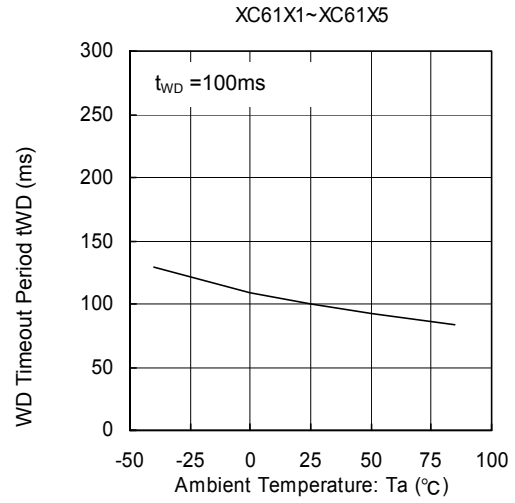
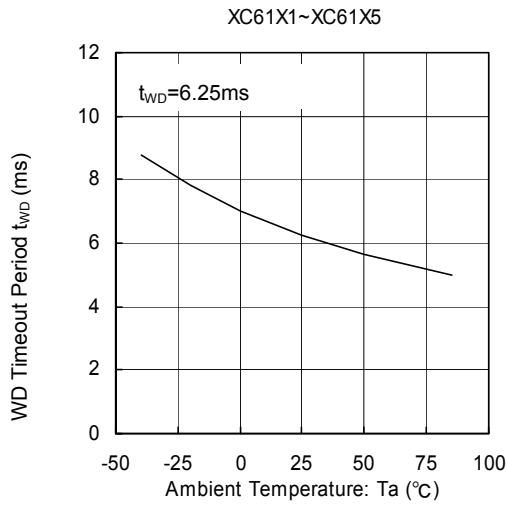
(8) Release Delay Time vs. Ambient Temperature



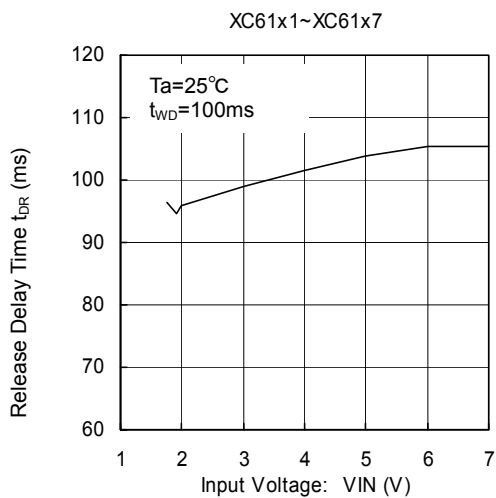
* 'X' represents both '0' and '1'. (ex. XC61X1⇒XC6101 and XC6111)

TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

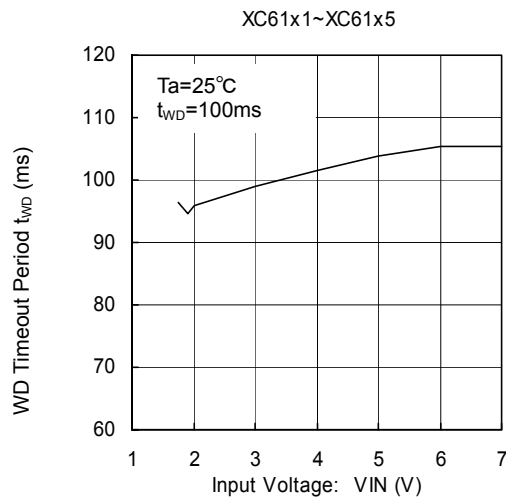
(9) Watchdog Timeout Period vs. Ambient Temperature



(10) Release Delay Time vs. Input Voltage



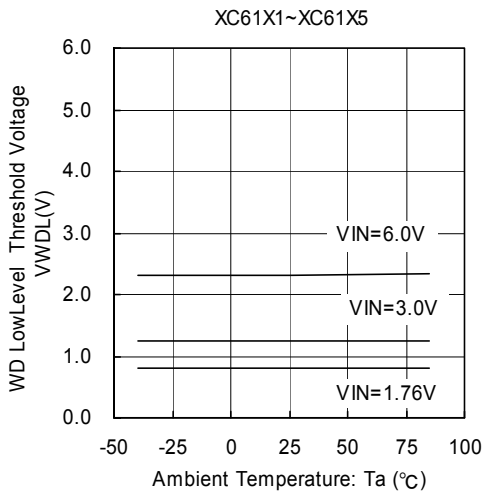
(11) Watchdog Timeout Period vs. Input Voltage



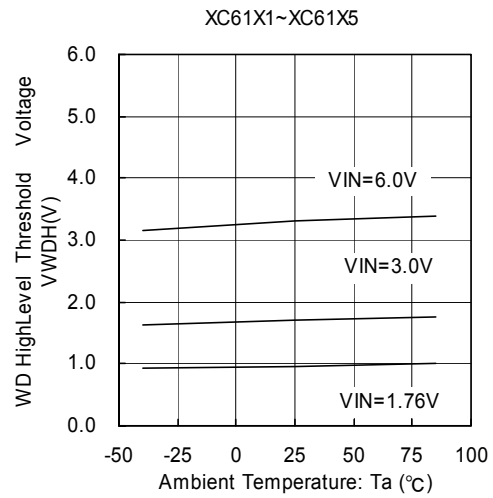
* 'X' represents both '0' and '1'. (ex. XC61X1⇒XC6101 and XC6111)

■ TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

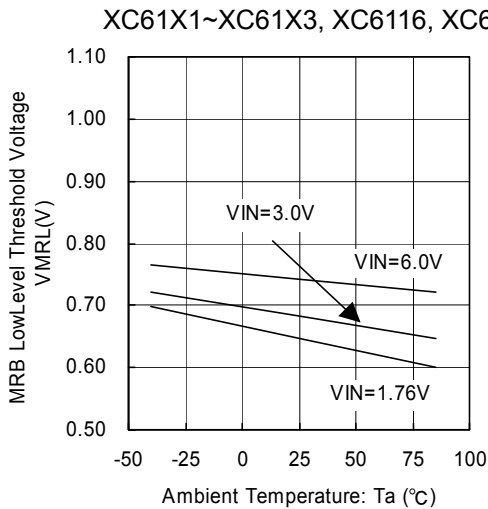
(12) Watchdog Low Level Voltage vs. Ambient Temperature



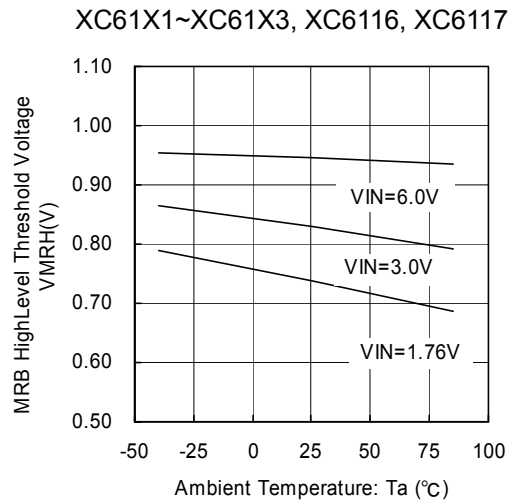
(13) Watchdog High Level Voltage vs. Ambient Temperature



(14) MRB Low Level Voltage vs. Ambient Temperature



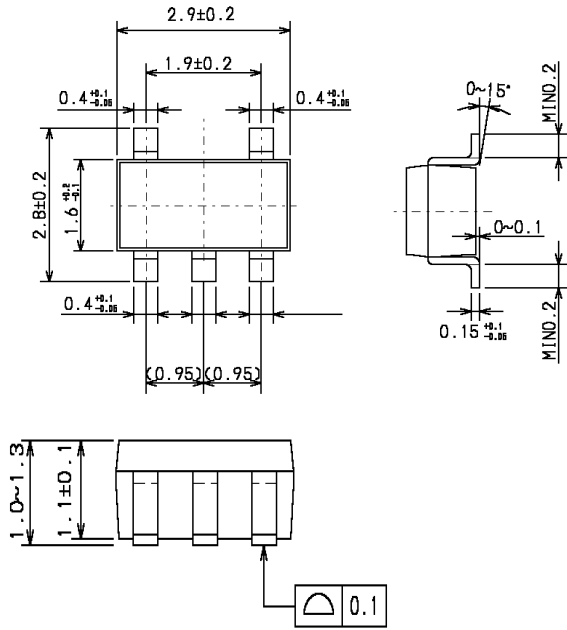
(15) MRB High Level Voltage vs. Ambient Temperature



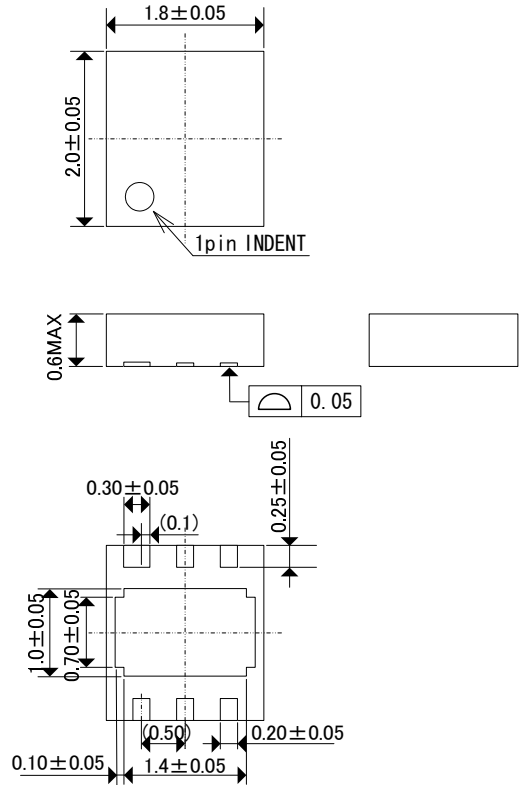
* 'X' represents both '0' and '1'. (ex. XC61X1⇒XC6101 and XC6111)

PACKAGING INFORMATION

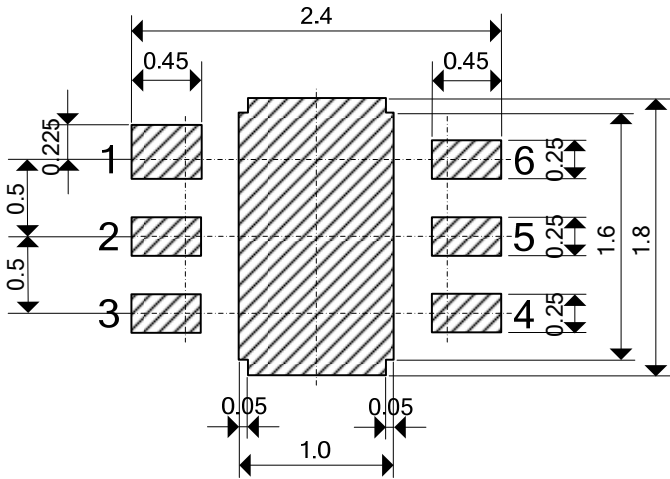
●SOT-25



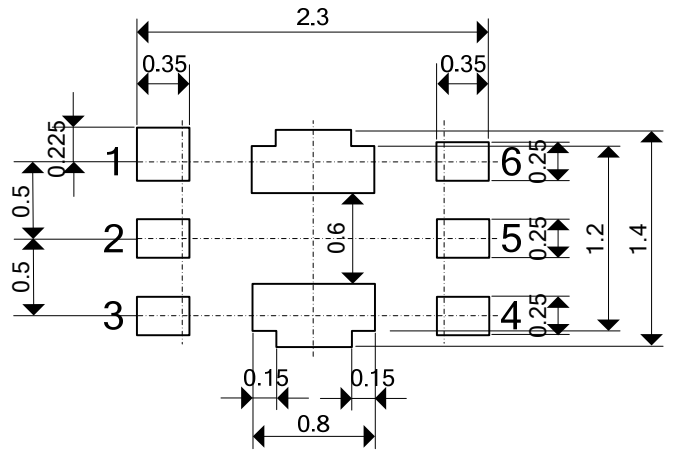
●USP-6C



●USP-6C Reference Pattern Layout (Reference)

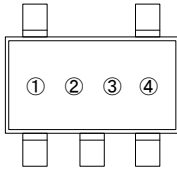


●USP-6C Reference Metal Mask Design (Reference)



MARKING RULE

● SOT-25



① represents product series

| MARK | PRODUCT SERIES | MARK | PRODUCT SERIES |
|----------|----------------|----------|----------------|
| <u>0</u> | XC6101xxxxxx | <u>8</u> | XC6112xxxxxx |
| <u>1</u> | XC6102xxxxxx | <u>9</u> | XC6113xxxxxx |
| <u>2</u> | XC6103xxxxxx | <u>A</u> | XC6114xxxxxx |
| <u>3</u> | XC6104xxxxxx | <u>B</u> | XC6115xxxxxx |
| <u>4</u> | XC6105xxxxxx | <u>C</u> | XC6116xxxxxx |
| <u>7</u> | XC6111xxxxxx | <u>D</u> | XC6117xxxxxx |

② represents release delay time and watchdog timeout period

| MARK | RELEASE DELAY TIME | WATCH DOG TIMEOUT PERIOD | PRODUCT SERIES | MARK | RELEASE DELAY TIME | WATCH DOG TIMEOUT PERIOD | PRODUCT SERIES |
|------|--------------------|--------------------------|----------------|------|--------------------|--------------------------|----------------|
| A | 3.13ms | XC6116, XC6117 series | XC61xxA0xxxx | E | 50ms | 400ms | XC61xxC5xxxx |
| 0 | 3.13ms | 6.25ms | XC61xxA1xxxx | F | 50ms | 1.6s | XC61xxC6xxxx |
| 1 | 3.13ms | 50ms | XC61xxA2xxxx | D | 100ms | XC6116, XC6117 series | XC61xxD0xxxx |
| 2 | 3.13ms | 100ms | XC61xxA3xxxx | H | 100ms | 100ms | XC61xxD3xxxx |
| 3 | 3.13ms | 200ms | XC61xxA4xxxx | K | 100ms | 200ms | XC61xxD4xxxx |
| 4 | 3.13ms | 400ms | XC61xxA5xxxx | L | 100ms | 400ms | XC61xxD5xxxx |
| 5 | 3.13ms | 1.6s | XC61xxA6xxxx | M | 100ms | 1.6s | XC61xxD6xxxx |
| B | 25ms | XC6116, XC6117 series | XC61xxB0xxxx | E | 200ms | XC6116, XC6117 series | XC61xxE0xxxx |
| 6 | 25ms | 50ms | XC61xxB2xxxx | P | 200ms | 200ms | XC61xxE4xxxx |
| 7 | 25ms | 100ms | XC61xxB3xxxx | R | 200ms | 400ms | XC61xxE5xxxx |
| 8 | 25ms | 200ms | XC61xxB4xxxx | S | 200ms | 1.6s | XC61xxE6xxxx |
| 9 | 25ms | 400ms | XC61xxB5xxxx | F | 400ms | XC6116, XC6117 series | XC61xxF0xxxx |
| A | 25ms | 1.6s | XC61xxB6xxxx | T | 400ms | 400ms | XC61xxF5xxxx |
| C | 50ms | XC6116, XC6117 series | XC61xxC0xxxx | U | 400ms | 1.6s | XC61xxF6xxxx |
| B | 50ms | 50ms | XC61xxC2xxxx | H | 1.6s | XC6116, XC6117 series | XC61xxH0xxxx |
| C | 50ms | 100ms | XC61xxC3xxxx | V | 1.6s | 1.6s | XC61xxH6xxxx |
| D | 50ms | 200ms | XC61xxC4xxxx | | | | |

③ represents detect voltage

XC6101/11/02/12/03/13/04/14/15/16/17Series

| MARK | DETECT VOLTAGE | PRODUCT SERIES | MARK | DETECT VOLTAGE | PRODUCT SERIES |
|----------|----------------|----------------|----------|----------------|----------------|
| F | 1.6 | XC61Xxxx16xx | <u>3</u> | 3.4 | XC61Xxxx34xx |
| H | 1.7 | XC61Xxxx17xx | <u>4</u> | 3.5 | XC61Xxxx35xx |
| K | 1.8 | XC61Xxxx18xx | <u>5</u> | 3.6 | XC61Xxxx36xx |
| L | 1.9 | XC61Xxxx19xx | <u>6</u> | 3.7 | XC61Xxxx37xx |
| M | 2.0 | XC61Xxxx20xx | <u>7</u> | 3.8 | XC61Xxxx38xx |
| N | 2.1 | XC61Xxxx21xx | <u>8</u> | 3.9 | XC61Xxxx39xx |
| P | 2.2 | XC61Xxxx22xx | <u>9</u> | 4.0 | XC61Xxxx40xx |
| R | 2.3 | XC61Xxxx23xx | <u>A</u> | 4.1 | XC61Xxxx41xx |
| S | 2.4 | XC61Xxxx24xx | <u>B</u> | 4.2 | XC61Xxxx42xx |
| T | 2.5 | XC61Xxxx25xx | <u>C</u> | 4.3 | XC61Xxxx43xx |
| U | 2.6 | XC61Xxxx26xx | <u>D</u> | 4.4 | XC61Xxxx44xx |
| V | 2.7 | XC61Xxxx27xx | <u>E</u> | 4.5 | XC61Xxxx45xx |
| X | 2.8 | XC61Xxxx28xx | <u>F</u> | 4.6 | XC61Xxxx46xx |
| Y | 2.9 | XC61Xxxx29xx | <u>H</u> | 4.7 | XC61Xxxx47xx |
| Z | 3.0 | XC61Xxxx30xx | <u>K</u> | 4.8 | XC61Xxxx48xx |
| <u>0</u> | 3.1 | XC61Xxxx31xx | <u>L</u> | 4.9 | XC61Xxxx49xx |
| <u>1</u> | 3.2 | XC61Xxxx32xx | <u>M</u> | 5.0 | XC61Xxxx50xx |
| <u>2</u> | 3.3 | XC61Xxxx33xx | | | |

■ MARKING RULE (Continued)

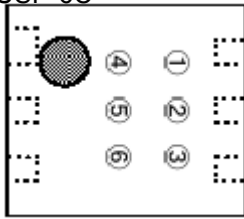
③ represents detect voltage
XC6105 Series

| MARK | DETECT VOLTAGE | PRODUCT SERIES | MARK | DETECT VOLTAGE | PRODUCT SERIES |
|------|----------------|----------------|----------|----------------|----------------|
| F | 1.6 | XC6105XX16XX | 3 | 3.4 | XC6105XX34XX |
| H | 1.7 | XC6105XX17XX | 4 | 3.5 | XC6105XX35XX |
| K | 1.8 | XC6105XX18XX | 5 | 3.6 | XC6105XX36XX |
| L | 1.9 | XC6105XX19XX | 6 | 3.7 | XC6105XX37XX |
| M | 2.0 | XC6105XX20XX | 7 | 3.8 | XC6105XX38XX |
| N | 2.1 | XC6105XX21XX | 8 | 3.9 | XC6105XX39XX |
| P | 2.2 | XC6105XX22XX | 9 | 4.0 | XC6105XX40XX |
| R | 2.3 | XC6105XX23XX | <u>A</u> | 4.1 | XC6105XX41XX |
| S | 2.4 | XC6105XX24XX | <u>B</u> | 4.2 | XC6105XX42XX |
| T | 2.5 | XC6105XX25XX | <u>C</u> | 4.3 | XC6105XX43XX |
| U | 2.6 | XC6105XX26XX | <u>D</u> | 4.4 | XC6105XX44XX |
| V | 2.7 | XC6105XX27XX | <u>E</u> | 4.5 | XC6105XX45XX |
| X | 2.8 | XC6105XX28XX | <u>F</u> | 4.6 | XC6105XX46XX |
| Y | 2.9 | XC6105XX29XX | <u>H</u> | 4.7 | XC6105XX47XX |
| Z | 3.0 | XC6105XX30XX | <u>K</u> | 4.8 | XC6105XX48XX |
| 0 | 3.1 | XC6105XX31XX | <u>L</u> | 4.9 | XC6105XX49XX |
| 1 | 3.2 | XC6105XX32XX | <u>M</u> | 5.0 | XC6105XX50XX |
| 2 | 3.3 | XC6105XX33XX | | | |

④ represents production lot number
0 to 9 and A to Z and inverted 0 to 9 and A to Z repeated. (G, I, J, O, Q, W excluded.)

MARKING RULE (Continued)

● USP-6C



① represents product series

| MARK | PRODUCT SERIES | MARK | PRODUCT SERIES |
|------|----------------|------|----------------|
| 3 | XC6101xxxxxx | 9 | XC6112xxxxxx |
| 4 | XC6102xxxxxx | A | XC6113xxxxxx |
| 5 | XC6103xxxxxx | B | XC6114xxxxxx |
| 6 | XC6104xxxxxx | C | XC6115xxxxxx |
| 7 | XC6105xxxxxx | 8 | XC6116xxxxxx |
| 8 | XC6111xxxxxx | 9 | XC6117xxxxxx |

② represents release delay time

| MARK | RELEASE DELAY TIME | PRODUCT SERIES |
|------|--------------------|----------------|
| A | 3.13ms | XC61XxAxxxxx |
| B | 25ms | XC61XxBxxxxx |
| C | 50ms | XC61XxCxxxxx |
| D | 100ms | XC61XxDxxxxx |
| E | 200ms | XC61XxExxxxx |
| F | 400ms | XC61XxFxxxxx |
| H | 1.6s | XC61XxHxxxxx |

③ represents watchdog timeout period

| MARK | WATCHDOG TIMEOUT PERIOD | PRODUCT SERIES |
|------|-------------------------|----------------|
| 0 | XC6116, XC6117 series | XC61Xxx0xxxx |
| 1 | 6.25ms | XC61Xxx1xxxx |
| 2 | 50ms | XC61Xxx2xxxx |
| 3 | 100ms | XC61Xxx3xxxx |
| 4 | 200ms | XC61Xxx4xxxx |
| 5 | 400ms | XC61Xxx5xxxx |
| 6 | 1.6s | XC61Xxx6xxxx |

④⑤ represents detect voltage

| MARK | | DETECT VOLTAGE (V) | PRODUCT SERIES |
|------|---|--------------------|----------------|
| ④ | ⑤ | | |
| 3 | 3 | 3.3 | XC61Xxxx33xx |
| 5 | 0 | 5.0 | XC61Xxxx50xx |

⑥ represents production lot number

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

X No character inversion used.

XX 'X' represents both '0' and '1'. (ex. XC61X1⇒XC6101 and XC6111)

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