ETR0209-009

## Highly Accurate, Ultra Small, Low Power Consumption Voltage Detector

### **■**GENERAL DESCRIPTION

The XC6120 series are highly precise, low power consumption voltage detectors, manufactured using CMOS and laser trimming technologies. With low power consumption and high accuracy, the series is suitable for precision mobile equipment. The XC6120 in ultra small packages are ideally suited for high-density mounting. The XC6120 is available in both CMOS and N-channel open drain output configurations.

#### ■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  $\begin{array}{ll} :\pm \ 2\% \ (V_{DF} \geqq 1.5 V) \\ :\pm \ 30 mV \ (V_{DF} < 1.5 V) \end{array}$ 

Operating Voltage Range :  $0.7V \sim 6.0V$ Detect Voltage Temperature Characteristics

: ±100ppm/°C (TYP.)

Output Configuration : CMOS (XC6120C)

: N-channel open drain (XC6120N)

Operating

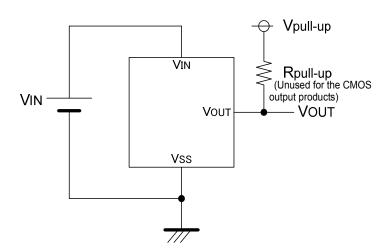
Temperature Range :-40°C~85°C
Packages :USP-3, SSOT-24

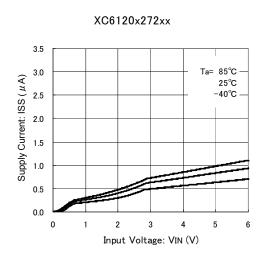
Environmentally Friendly: EU RoHS Compliant, Pb Free

## **■**TYPICAL APPLICATION CIRCUIT

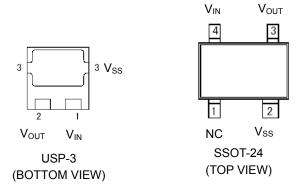
# ■ TYPICAL PERFORMANCE CHARACTERISTICS

Supply Current vs. Input Voltage





## **■PIN CONFIGURATION**



## **■PIN ASSIGNMENT**

PIN NU	JMBER	MBER PIN NAME FUNCTION	
USP-3	SSOT-24	FIN NAME	FONCTION
1	4	V <sub>IN</sub>	Power Input
3	2	$V_{SS}$	Ground
2	3	V <sub>OUT</sub>	Output (Detect "Low")
-	1	NC	No Connection

## **■PRODUCT CLASSIFICATION**

#### Ordering Information

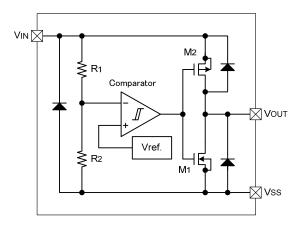
XC6120123456-7 (\*1)

DESIGNATOR	ITEM	SYMBOL	DESCRIPTION
1	Output Configuration	С	CMOS output
U	Output Configuration	N	N-ch open drain output
23	Detect Voltage (V <sub>DF</sub> )	10~50	For example 1.0V → ②1, ③0
4	Detect Accuracy	2	±2%
		HR	USP-3 (3,000/Reel)
<b>5</b> 6-7 <sup>(*1)</sup>	Packages	HR-G	USP-3 (3,000/Reel)
	(Order Unit)	NR	SSOT-24 (3,000/Reel)
		NR-G	SSOT-24 (3,000/Reel)

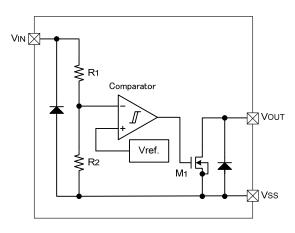
 $<sup>^{(1)}</sup>$  The "-G" suffix indicates that the products are Halogen and Antimony free as well as being fully RoHS compliant.

## **■BLOCK DIAGRAMS**

### (1) XC6120C



#### (2) XC6120N



## ■ ABSOLUTE MAXIMUM RATINGS

Ta=25°C

PARA	METER	SYMBOL	RATING	UNITS	
Input	Voltage	V <sub>IN</sub>	V <sub>SS</sub> -0.3~7.0	V	
Outpu	t Current	I <sub>OUT</sub>	10	mA	
Output Voltage	CMOS Output	$V_{OUT}$	V <sub>SS</sub> -0.3~V <sub>IN</sub> +0.3	V	
Output voltage	N-ch Open Drain Output	VOUT	V <sub>SS</sub> -0.3~7.0	V	
Dower Dissipation	USP-3	Pd	120	mW	
Power Dissipation	SSOT-24	Fu	150	IIIVV	
Operating Ten	nperature Range	Topr	-40~+85	°C	
Storage Tem	perature Range	Tstg	-55~+125	°C	

## **■**ELECTRICAL CHARACTERISTICS

XC6120 Series <sub>Ta=25℃</sub>

PARAM	METER	SYMBOL		CONDITION	MIN.	TYP.	MAX.	UNITS	CIRCUIT
Operating	g Voltage	V <sub>IN</sub>	V <sub>DF(T)</sub> =1.0~5.0V <sup>(*1)</sup>		0.7	-	6.0	V	-
Detect	Voltage	$V_{DF}$	١	V <sub>DF(T)</sub> =1.0V∼5.0V E-1			V	1	
Hysteres	sis Width	V <sub>HYS</sub>	١	/ <sub>DF(T)</sub> =1.0V∼5.0V	V <sub>DF</sub> × 0.03	V <sub>DF</sub> × 0.05	V <sub>DF</sub> × 0.07	V	1)
Supply (	Current 1	I <sub>SS1</sub>		$V_{IN}=V_{DF(T)}\times 1.1$		E-2		μΑ	2
Supply (	Current 2	I <sub>SS2</sub>	$V_{IN} = V_{DF(T)} \times 0.9V$			E-3			2
				V <sub>OUT</sub> =0.5V	0.09	0.57	-		
			$V_{IN}=0.7V$	V <sub>OUT</sub> =0.3V	0.08	0.56	-		
		I <sub>OUTN</sub>		V <sub>OUT</sub> =0.1V	0.05	0.30	-		
Output	Current		V <sub>IN</sub> =1.0V	V <sub>OUT</sub> =0.1V, V <sub>DF(T)</sub> >1.0V	0.46	0.71	-	mA	3
Output	Current		V <sub>IN</sub> =2.0V	$V_{OUT}$ =0.1V, $V_{DF(T)}$ >2.0V	1.15	1.41	-		
			V <sub>IN</sub> =3.0V	$V_{OUT}=0.1V, V_{DF(T)}>3.0V$	1.44	1.77	-		
			V <sub>IN</sub> =4.0V	$V_{OUT}$ =0.1V, $V_{DF(T)}>4.0V$	1.61	1.96	-		
		I <sub>OUTP</sub> (*2)	V <sub>IN</sub> =6.0V	V <sub>OUT</sub> =5.5V	-	-0.95	-0.60	mA	3
Leakage	CMOS Output(Pch)	$I_{LEAK}$	V <sub>IN</sub> =	$V_{DF} \times 0.9V$ , $V_{OUT} = 0V$	-	-0.001	-	μΑ	3
Current	N-ch Open Drain	ILEAK	Vı	<sub>N</sub> =6.0V, V <sub>OUT</sub> =6.0V	-	0.001	0.10	μΛ	9
-	erature teristics	$\Delta V_{DF}/$ ( $\Delta Topr \cdot V_{DF}$ )	-40 °C≦Topr≦85 °C		-	±100	1	ppm/°C	1
Detect Del	ay Time <sup>(*3)</sup>	t <sub>DF</sub>	$V_{IN}$ =6.0V $\rightarrow$ 0.7V $V_{IN}$ =V <sub>DF</sub> to V <sub>OUT</sub> =0.5V		-	30	100	μs	4
Release De	elay Time (*5)	t <sub>DR</sub>		$V_{IN}$ =0.7V $\rightarrow$ 6.0V = $V_{DR}$ to $V_{OUT}$ = $V_{DR}$ (*4)	-	20	100	μs	4

<sup>\*1:</sup> VDF (T): Nominal detect voltage

#### ●XC6120N recommended pull-up resistance

Input Voltage Range	Pull-up Resistance
0.7V~6.0V	≧ 220kΩ
0.8V~6.0V	≧ 100kΩ
1.0V~6.0V	≧ 33kΩ

<sup>\*2:</sup> For XC6120C only.

<sup>\*3:</sup> A time taking from the time at  $V_{IN} = V_{DF}$  to the time at  $V_{OUT}$ =0.5V when  $V_{IN}$  falls from 6.0V to 0.7V.

<sup>\*4:</sup>  $V_{DR}$ : Release voltage ( $V_{DR} = V_{DF} + V_{HYS}$ )

<sup>\*5:</sup> A time taking from the time at  $V_{IN} = V_{DR}$  to the time at  $V_{OUT} = V_{DR}$  when  $V_{IN}$  rise from 0.7V to 6.0V.

## ■ ELECTRICAL CHARACTERISTICS (Continued)

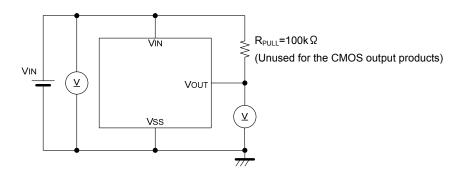
• DETECT VOLTAGE ACCURACY AND SUPPLY CURRENT SPECIFICATIONS

SYMBOL	E-	-1	E	-2	E	-3	
PARAMETER	DETECT VOLTAGE						
	V <sub>DF</sub> (V)		SUPPLY CURRENT 1		SUPPLY CURRENT 2		
NOMINAL DETECT	XC6120xx	x2 Series	I <sub>SS1</sub> ( μ A)		I <sub>SS2</sub> ( μ A)		
VOLTAGE							
$V_{DF(T)}$	MIN.	MAX.	TYP.	MAX.	TYP.	MAX.	
1.0	0.970	1.030					
1.1	1.070	1.130					
1.2	1.170	1.230					
1.3	1.270	1.330					
1.4	1.370	1.430	0.5	1.4	0.4	1.35	
1.5	1.470	1.530	0.5	1.4	0.4	1.55	
1.6	1.568	1.632					
1.7	1.666	1.734					
1.8	1.764	1.836					
1.9	1.862	1.938					
2.0	1.960	2.040					
2.1	2.058	2.142					
2.2	2.156	2.244					
2.3	2.254	2.346	0.6	1.7	0.5	1.60	
2.4	2.352	2.448	0.0	1.7	0.5	1.00	
2.5	2.450	2.550					
2.6	2.548	2.652					
2.7	2.646	2.754					
2.8	2.744	2.856					
2.9	2.842	2.958					
3.0	2.940	3.060					
3.1	3.038	3.162					
3.2	3.136	3.264					
3.3	3.234	3.366					
3.4	3.332	3.468					
3.5	3.430	3.570					
3.6	3.528	3.672					
3.7	3.626	3.774	]				
3.8	3.724	3.876	]				
3.9	3.822	3.978	0.7	1.9	0.6	1.80	
4.0	3.920	4.080	]				
4.1	4.018	4.182	]				
4.2	4.116	4.284	]				
4.3	4.214	4.386	]				
4.4	4.312	4.488	]				
4.5	4.410	4.590	]				
4.6	4.508	4.692					
4.7	4.606	4.794	]				
4.8	4.704	4.896	]				
4.9	4.802	4.998					
5.0	4.900	5.100					

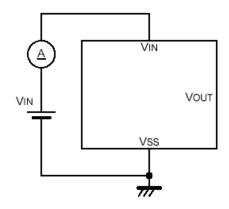
When detect voltage is 1.0V  $\leq$  V<sub>DF(T)</sub> < 1.5V, detect accuracy is  $\pm$  30mV. When detect voltage is 1.5V  $\leq$  V<sub>DF(T)</sub>  $\leq$  5.0V, detect accuracy is  $\pm$  2%.

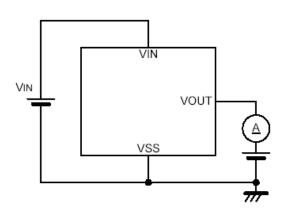
## **■**TEST CIRCUITS

Circuit 1

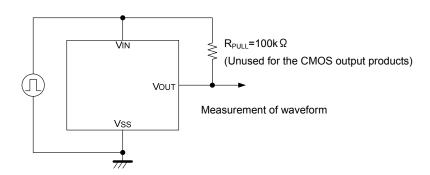


Circuit 2 Circuit 3



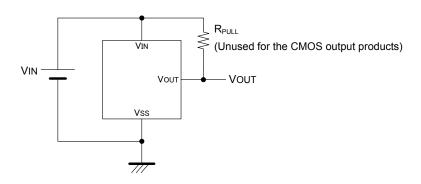


Circuit 4

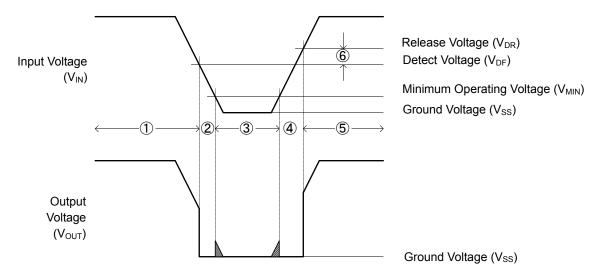


### ■ OPERATIONAL EXPLANATION

#### Typical Application Circuit



#### Timing Charge



Note: For explaining in a simplified case, an operation time of the circuit is not counted.

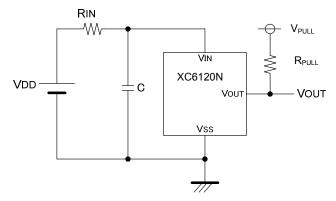
The following explains the operation of the typical application circuit along number symbols shown in the timing chart.

- ① When input voltage  $(V_{IN})$  is higher than detect voltage  $(V_{DF})$ , output voltage  $(V_{OUT})$  will be equal to input voltage  $(V_{IN})$ . (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.
- When input voltage  $(V_{IN})$  rises above the minimum operating voltage  $(V_{MIN})$  level until it achieves a release voltage  $(V_{DR})$ , output keeps the ground voltage level  $(V_{SS})$ .
- When the input voltage  $(V_{IN})$  rises above the release voltage  $(V_{DR})$ , output voltage  $(V_{OUT}$  will be equal to input voltage  $(V_{IN})$ . (A condition of high impedance exists with N-ch open drain output configurations.)
- 6 The difference between V<sub>DR</sub> and V<sub>DF</sub> represents the hysteresis width.

#### ■NOTE 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. 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.
- 3. With a resistor connected between the  $V_{IN}$  pin and the power supply  $V_{DD}$  some errors may be observed from the input voltage at the detect and release voltage. Those errors are not constant because of the fluctuation of the supply current.
- 4. When a resistor is connected between the V<sub>IN</sub> pin and the power supply V<sub>DD</sub>, oscillation may occur as a result of through current and voltage drop at the R<sub>IN</sub> at the time of voltage release. (refer to the Oscillation Description (1) below ) Especially in the CMOS output configurations, oscillation may occur regardless of detect/release operation if load current (I<sub>OUT</sub>) exists. (refer to the Oscillation Description (2) below)
- 5. Please use N-ch open drains configuration, when a resistor  $R_{IN}$  is connected between the  $V_{IN}$  pin and the power supply  $V_{DD}$  power source. In such cases, please ensure that  $R_{IN}$  is less than 10kΩ and that C is more than 0.1 μ F.
- 6. 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.



[Figure 1: Circuit connected with the input resistor]

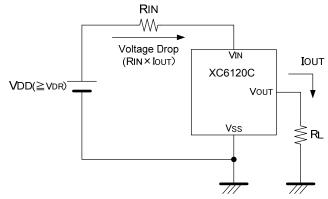
#### Oscillation Description

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

Since the XC6120 series are CMOS ICs, transient through current will flow when the IC's internal circuit switching operates regardless of output configuration. Consequently, oscillation is liable to occur as a result of the similar operations as in (1) above. This oscillation does not occur during the detect operation.

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

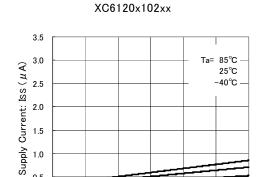
As shown in figure 2, when the voltage applied at the power supply  $(V_{DD})$  rises from below detect voltage to above release voltage, the IC commence release operations and the internal P-ch driver transistor will be on. The output current  $(I_{OUT})$  flows the input resistor  $(R_{IN})$  via the P-ch driver transistor. Because of the input resistor  $(R_{IN})$  and the output current  $(I_{OUT})$ , an input pin voltage drops  $R_{IN} \times I_{OUT}$ . If the voltage drop level is larger than the IC's hysteresis width  $(V_{HYS})$ , the input pin voltage will falls below the  $V_{DF}$  and detect operations will commerce so that the internal P-ch driver transistor will be off. The voltage drop will stop because the output current  $(I_{OUT})$  which was flowing the P-ch driver transistor will run down. The input pin voltage will become the same voltage level as the input voltage  $(V_{IN})$ . For this, the input pin voltage will rise above the release voltage  $(V_{DR})$ , therefore, the release operations will begin over again. Oscillation may occur with this repetition. Further, this condition will also appear via means of a similar mechanism during detect operations.



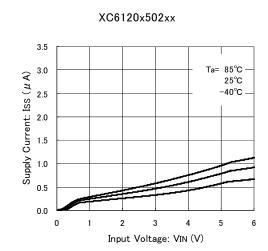
[Figure 2: Oscillation caused by the input resistor of the CMOS output product and the output current]

## **■**TYPICAL PERFORMANCE CHARACTERISTICS

(1) Supply Current vs. Input Voltage



2 3 Input Voltage: VIN (V)

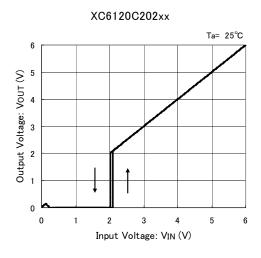


(2) Output Voltage vs. Input Voltage

0.5

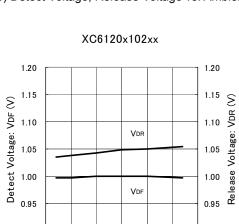
0.0

0



(3) Detect Voltage, Release Voltage vs. Ambient Temperature

0.90



XC6120N202xx Vpull-up=6V Rpull-up=100kΩ Ta= 85°C Output Voltage: Vour (V) 5 3 2

0.0

0.5

1.0

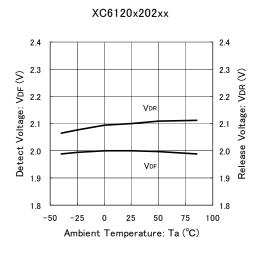
1.5

Input Voltage: VIN (V)

2.0

2.5

3.0



0.90

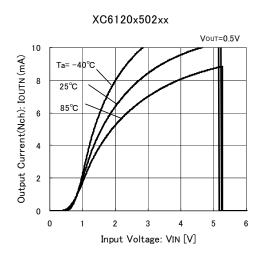
-50

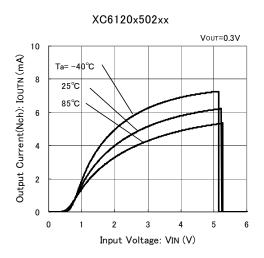
0

Ambient Temperature: Ta (°C)

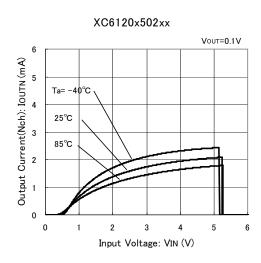
## ■TYPICAL PERFORMANCE CHARACTERISTICS (Continued)

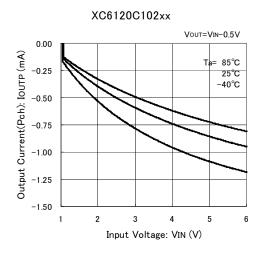
#### (4) Output Current (Nch Driver) vs. Input Voltage

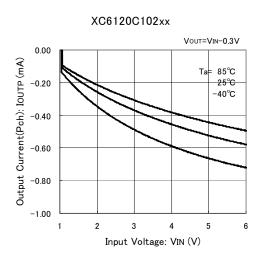


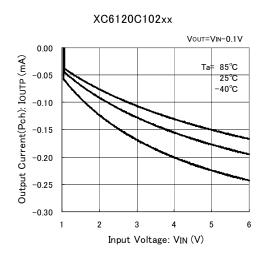


#### (5) Output Current (Pch Driver) vs. Input Voltage







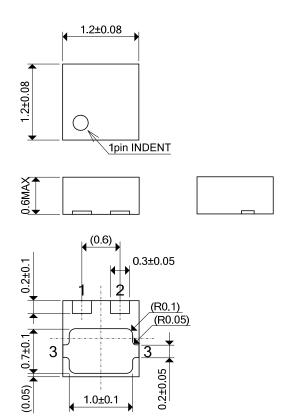


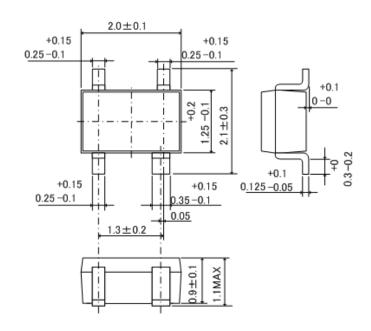
## **■PACKAGING INFORMATION**

●USP-3

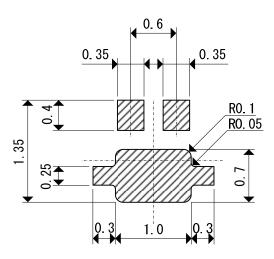
(unit: mm)

●SSOT-24 (unit:mm)

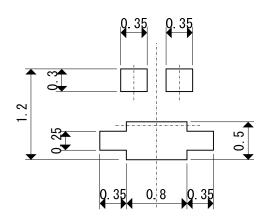




●USP-3 Reference Pattern Layout

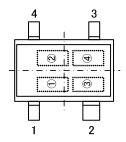


●USP-3 Reference Metal Mask Design



## ■ MARKING RULE

#### ●SSOT-24



① represents output configuration and detect voltage Range

MARK	OUTPUT CONFIGURATION	OUTPUT VOLTAGE	PRODUCT SERIES
K	CMOS	1.0V~2.9V	XC6120C
L	CIVIOS	3.0V~5.0V	AG0120C
M	Nch open drain	1.0V~2.9V	XC6120N
N	inch open drain	3.0V~5.0V	AG0120N

SSOT-24 (TOP VIEW)

② represents detect voltage

MARK	DETECT VOLTAGE (V)		MARK	DETECT V	OLTAGE (V)
0	-	3.0	F	1.5	4.5
1	-	3.1	Н	1.6	4.6
2	-	3.2	K	1.7	4.7
3	-	3.3	L	1.8	4.8
4	-	3.4	M	1.9	4.9
5	-	3.5	N	2.0	5.0
6	-	3.6	Р	2.1	-
7	-	3.7	R	2.2	-
8	-	3.8	S	2.3	-
9	-	3.9	Т	2.4	-
Α	1.0	4.0	U	2.5	-
В	1.1	4.1	V	2.6	-
С	1.2	4.2	Х	2.7	-
D	1.3	4.3	Y	2.8	-
E	1.4	4.4	Z	2.9	-

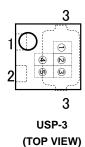
③, ④ represents production lot number

01 to 09, 10, 11, ..., 99, 0A, ..., 0Z, 1A, ...repeated.

(G, I, J, O, Q, W excluded. Reversed character is not used.)

## ■ MARKING RULE (Continued)

#### ●USP-3



1 represents product series

MARK	PRODUCT SERIES
0	XC6120*****

② standard : represents output configuration and integer number of detect voltage

●CMOS Output (XC6120C Series)

MARK	DETECT VOLTAGE (V)
Α	1.X
В	2.X
С	3.X
D	4.X
Е	5.X

●Nch open drain (XC6120N Series)

MARK	DETECT VOLTAGE (V)
F	1.X
Н	2.X
K	3.X
L	4.X
М	5.X

3 standard : represents decimal point of detect voltage

MARK	DETECT VOLTAGE (V)	PRODUCT SERIES
3	X.3	XC6120**3***
0	X.0	XC6120**0***

④, ⑤ represents production lot number 01 to 09, 10, 11, ..., 99, 0A, ..., 0Z, 1A, ...repeated. (G, I, J, O, Q, W excluded.)

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