R3111xxxxA/C SERIES

NO. EA-056-0305

OUTLINE

The R3111 series are CMOS-based voltage detector ICs with high detector threshold accuracy and ultra-low supply current, which can be operated at an extremely low voltage and is used for system reset as an example.

Each of these ICs consists of a voltage reference unit, a comparator, resistors for detector threshold setting, an output driver and a hysteresis circuit. The detector threshold is fixed with high accuracy internally and does not require any adjustment.

Two output types, Nch open drain type and CMOS type are available.

The R3111 Series are operable at a lower voltage than that for the RX5VL series, and can be driven by a single battery.

Five types of packages, TO-92, SOT-89, SOT-23-3, SOT-23-5 and SC-82AB are available.

FEATURES

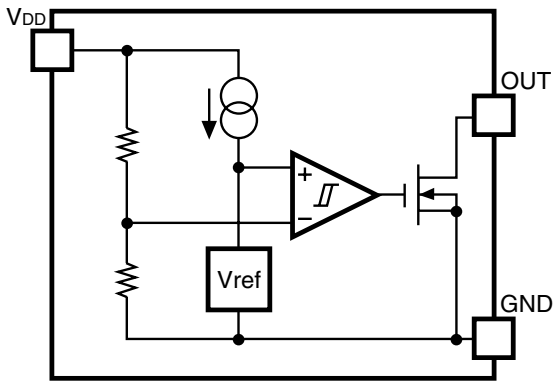
- Ultra-low Supply Current..... Typ. 0.8μA (V_{DD}=1.5V)
- Wide Range of Operating Voltage..... 0.7V to 10.0V (Topt=25°C)
- Detector Threshold..... Stepwise setting with a step of 0.1V in the range of 0.9V to 6.0V is possible.
- High Accuracy Detector Threshold..... ±2.0%
- Low Temperature-Drift Coefficient of Detector Threshold..... Typ. ±100ppm/°C
- Two Output Types ..... Nch Open Drain and CMOS
- Four Types of Packages..... TO-92, SOT-89(Mini-power Mold), SOT-23-3, SOT-23-5 (Mini-mold), SC-82AB

APPLICATIONS

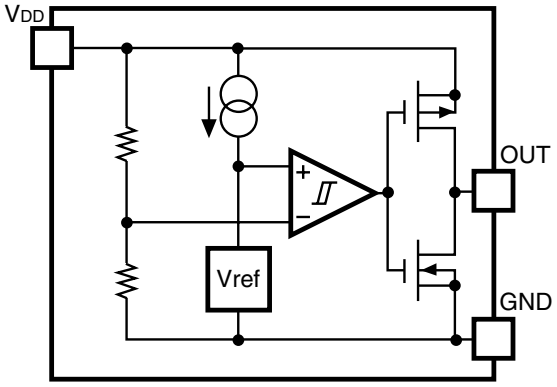
- CPU and Logic Circuit Reset
- Battery Checker
- Window Comparator
- Wave Shaping Circuit
- Battery Back-up Circuit
- Power Failure Detector

BLOCK DIAGRAMS

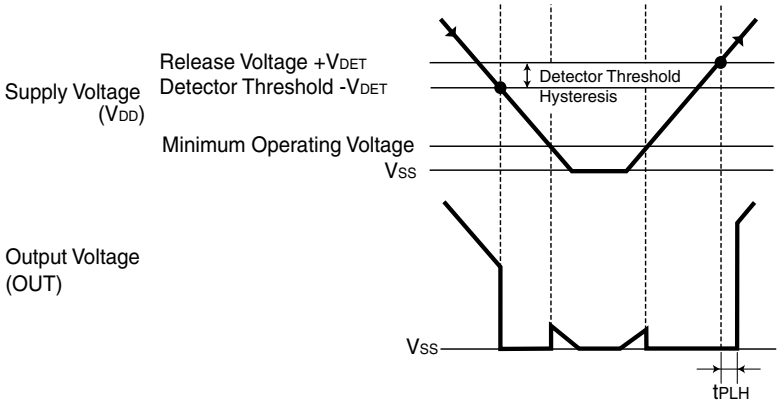
R3111xxxxA



R3111xxxxC



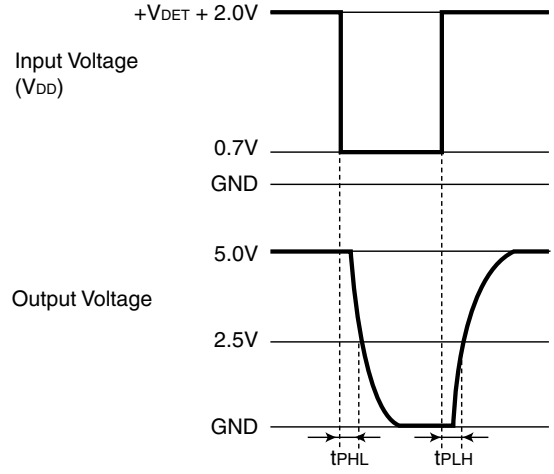
TIMING CHART



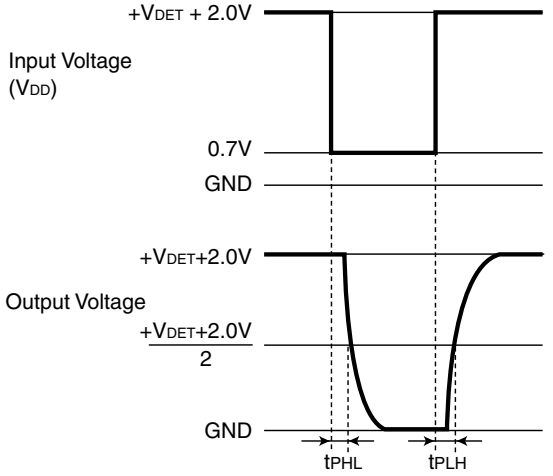
DEFINITION OF OUTPUT DELAY TIME

Output Delay Time t_{PLH} is defined as follows:

1. In the case of Nch Open Drain Output:
   Under the condition of the output pin (OUT) is pulled up through a resistor of 470kΩ to 5V, the time interval between the rising edge of V_{DD} pulse from 0.7V to ($+V_{DET}$)+ 2.0V and becoming of the output voltage to 2.5V.
2. In the case of CMOS Output:
   The time interval between the rising edge of V_{DD} pulse from 0.7V to ($+V_{DET}$)+ 2.0V and becoming of the output voltage to (V_{DD}/2) V.



Nch Open Drain Output



CMOS Output

SELECTION GUIDE

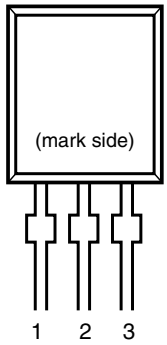
The package type, the detector threshold, the output type and the taping type of R3111 Series can be designated at the users' request by specifying the part number as follows;

R3111xxxxx-xx ←Part Number
↑↑↑↑ ↑
a b cd e

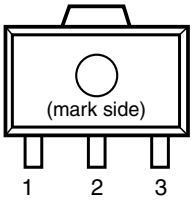
Code	Contents
a	Designation of Package Type; E: TO-92 Q: SC-82AB H: SOT-89 N: SOT-23-5 / SOT-23-3
b	Setting Detector Threshold ($-V_{DET}$); Stepwise setting with a step of 0.1V in the range of 0.9V to 6.0V is possible.
c	Designation of Package Type 1: except SOT-23-3 2: SOT-23-3
d	Designation of Output Type; A: Nch Open Drain C: CMOS
e	Designation of Packing or Taping Type ; Ex.TO-92: TZ, SOT-89: T1, SOT-23-3, SOT-23-5, SC-82AB: TR prescribed as standard directions. (Refer to Taping Specifications.) Antistatic bag for samples: C

PIN CONFIGURATION

- **TO-92**



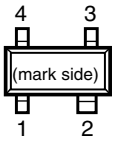
- **SOT-89**



- **SOT-23-3**

- **SOT-23-5**

- **SC-82AB**



PIN DESCRIPTION

- **TO-92**

Pin No.	Symbol
1	V_{DD}
2	GND
3	OUT

- **SOT-89**

Pin No.	Symbol
1	OUT
2	V_{DD}
3	GND

- **SOT-23-3**

Pin No.	Symbol
1	OUT
2	GND
3	V_{DD}

- **SOT-23-5**

Pin No.	Symbol
1	OUT
2	V_{DD}
3	GND
4	NC
5	NC

- **SC-82AB**

Pin No.	Symbol
1	OUT
2	V_{DD}
3	NC
4	GND

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{DD}	Supply Voltage	12	V
V_{OUT1}	Output Voltage (CMOS)	V_{SS}-0.3 to V_{DD}+0.3	V
V_{OUT2}	Output Voltage (Nch)	V_{SS}-0.3 to 12	V
I_{OUT}	Output Current	70	mA
P_D	Power Dissipation 1*Note1	300	mW
P_D	Power Dissipation 2*Note2	150	mW
Topt	Operating Temperature Range	-40 to 85	°C
Tstg	Storage Temperature Range	-55 to 125	°C
Tsolder	Lead temperature (Soldering)	260°C, 10s	

*Note 1: applied to SOT-89 and TO-92

*Note 2: applied to SOT-23-3, SOT-23-5 and SC-82AB

ELECTRICAL CHARACTERISTICS

- **R3111x09xA/C**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold		0.882	0.900	0.918	V
V_{HYS}	Detector Threshold Hysteresis		0.027	0.045	0.063	V
I_{SS}	Supply Current	V_{DD}=0.80V 2.90V		0.8 0.9	2.4 2.7	μA
V_{DDH}	Maximum Operating Voltage				10	V
V_{DDL}	Minimum Operating Voltage*Note1	Topt=25°C		0.55	0.70	V
		-40°C≤Topt≤85°C		0.65	0.80	
I_{OUT}	Output Current (Driver Output Pin)	Nch V_{DS}=0.05V,V_{DD}=0.70V V_{DS}=0.50V,V_{DD}=0.85V	0.01 0.05	0.05 0.50		mA
		Pch V_{DS}=-2.1V,V_{DD}=4.5V	1.0	2.0		mA
t_{PLH}	Output Delay Time*Note2				100	μs
$\Delta-V_{DET}/\Delta T$	Detector Threshold Temperature Coefficient	-40°C≤Topt≤85°C		±100		ppm/°C

- **R3111x18xA/C**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	U=nit
$-V_{DET}$	Detector Threshold		1.764	1.800	1.836	V
V_{HYS}	Detector Threshold Hysteresis		0.054	0.090	0.126	V
I_{SS}	Supply Current	V_{DD}=1.70V 3.80V		0.8 1.0	2.4 3.0	μA
V_{DDH}	Maximum Operating Voltage				10	V
V_{DDL}	Minimum Operating Voltage*Note1	Topt=25°C		0.55	0.70	V
		-40°C≤Topt≤85°C		0.65	0.80	
I_{OUT}	Output Current (Driver Output Pin)	Nch V_{DS}=0.05V, V_{DD}=0.70V V_{DS}=0.50V, V_{DD}=0.85V	0.01 1.00	0.05 2.00		mA
		Pch V_{DS}=-2.1V,V_{DD}=4.5V	1.0	2.0		mA
t_{PLH}	Output Delay Time*Note2				100	μs
$\Delta-V_{DET}/\Delta T$	Detector Threshold Temperature Coefficient	-40°C≤Topt≤85°C		±100		ppm/°C

- **R3111x27xA/C**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold		2.646	2.700	2.754	V
V_{HYS}	Detector Threshold Hysteresis		0.081	0.135	0.189	V
I_{SS}	Supply Current	V_{DD}=2.60V 4.70V		0.9 1.1	2.7 3.3	μA
V_{DDH}	Maximum Operating Voltage				10	V
V_{DDL}	Minimum Operating Voltage*Note1	Topt=25°C		0.55	0.70	V
		-40°C≤Topt≤85°C		0.65	0.80	
I_{OUT}	Output Current (Driver Output Pin)	Nch V_{DS}=0.05V,V_{DD}=0.70V V_{DS}=0.50V,V_{DD}=1.50V	0.01 1.00	0.05 2.00		mA
		Pch V_{DS}=-2.1V,V_{DD}=4.5V	1.0	2.0		mA
t_{PLH}	Output Delay Time*Note2				100	μs
$\Delta-V_{DET}/\Delta T$	Detector Threshold Temperature Coefficient	-40°C≤Topt≤85°C		±100		ppm/°C

- **R3111x36xA/C**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold		3.528	3.600	3.672	V
V_{HYS}	Detector Threshold Hysteresis		0.108	0.180	0.252	V
I_{SS}	Supply Current	V_{DD}=3.47V 5.60V		1.0 1.2	3.0 3.6	μA
V_{DDH}	Maximum Operating Voltage				10	V
V_{DDL}	Minimum Operating Voltage*Note1	Topt=25°C		0.55	0.70	V
		-40°C≤Topt≤85°C		0.65	0.80	
I_{OUT}	Output Current (Driver Output Pin)	Nch V_{DS}=0.05V,V_{DD}=0.70V V_{DS}=0.50V,V_{DD}=1.50V	0.01 1.00	0.05 2.00		mA
		Pch V_{DS}=-2.1V,V_{DD}=4.5V	1.0	2.0		mA
t_{PLH}	Output Delay Time*Note2				100	μs
$\Delta-V_{DET}/\Delta T$	Detector Threshold Temperature Coefficient	-40°C≤Topt≤85°C		±100		ppm/°C

• **R3111x45xA/C**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold		4.410	4.500	4.590	V
V_{HYS}	Detector Threshold Hysteresis		0.135	0.225	0.315	V
I_{SS}	Supply Current	V_{DD}=4.34V 6.50V		1.1 1.3	3.3 3.9	μA
V_{DDH}	Maximum Operating Voltage				10	V
V_{DDL}	Minimum Operating Voltage*Note1	Topt=25°C		0.55	0.70	V
		-40°C≤Topt≤85°C		0.65	0.80	
I_{OUT}	Output Current (Driver Output Pin)	Nch V_{DS}=0.05V, V_{DD}=0.70V V_{DS}=0.50V, V_{DD}=1.50V	0.01 1.00	0.05 2.00		mA
		Pch V_{DS}=-2.1V,V_{DD}=8.0V	1.5	3.0		mA
t_{PLH}	Output Delay Time*Note2				100	μs
$\Delta-V_{DET}/\Delta T$	Detector Threshold Temperature Coefficient	-40°C≤Topt≤85°C		±100		ppm/°C

• **R3111x54xA/C**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold		5.292	5.400	5.508	V
V_{HYS}	Detector Threshold Hysteresis		0.162	0.270	0.378	V
I_{SS}	Supply Current	V_{DD}=5.20V 7.40V		1.2 1.4	3.6 4.2	μA
V_{DDH}	Maximum Operating Voltage				10	V
V_{DDL}	Minimum Operating Voltage*Note1	Topt=25°C		0.55	0.70	V
		-40°C≤Topt≤85°C		0.65	0.80	
I_{OUT}	Output Current (Driver Output Pin)	Nch V_{DS}=0.05V, V_{DD}=0.70V V_{DS}=0.50V, V_{DD}=1.50V	0.01 1.00	0.05 2.00		mA
		Pch V_{DS}=-2.1V, V_{DD}=8.0V	1.5	3.0		mA
t_{PLH}	Output Delay Time*Note2				100	μs
$\Delta-V_{DET}/\Delta T$	Detector Threshold Temperature Coefficient	-40°C≤Topt≤85°C		±100		ppm/°C

*Note1: Minimum operating voltage means the value of input voltage when output voltage maintains 0.1V or less. (In the case of Nch Open Drain Output type, the output pin is pulled up with a resistance of 470kΩ to 5.0V.)

*Note2: In the case of CMOS Output type: The time interval between the rising edge of V_{DD} input pulse from 0.7V to (+V_{DET})+2.0V and output voltage level becoming to V_{DD}/2.
In the case of Nch Open Drain Output type: the output pin is pulled up with a resistance of 470kΩ to 5.0V, The time interval between the rising edge of V_{DD} input pulse from 0.7V to (+V_{DET})+2.0V and output voltage level becoming to 2.5V.

ELECTRICAL CHARACTERISTICS BY DETECTOR THRESHOLD

- **R3111x09x to R3111x60x**

Part Number	Detector Threshold			Detector Threshold Hysteresis			Supply Current 1			Supply Current 2		
	$-V_{DET}$[V]			V_{HYS}[V]			I_{SS1}[µA]			I_{SS2}[µA]		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Condition	Typ.	Max.	Condition	Typ.	Max.
R3111x09xx	0.882	0.900	0.918	0.027	0.045	0.063	V_{DD}= ($-V_{DET}$) -0.10V	0.8	2.4	V_{DD}= ($-V_{DET}$) +2.0V	0.9	2.7
R3111x10xx	0.980	1.000	1.020	0.030	0.050	0.070					1.0	3.0
R3111x11xx	1.078	1.100	1.122	0.033	0.055	0.077						
R3111x12xx	1.176	1.200	1.224	0.036	0.060	0.084						
R3111x13xx	1.274	1.300	1.326	0.039	0.065	0.091						
R3111x14xx	1.372	1.400	1.428	0.042	0.070	0.098						
R3111x15xx	1.470	1.500	1.530	0.045	0.075	0.105						
R3111x16xx	1.568	1.600	1.632	0.048	0.080	0.112						
R3111x17xx	1.666	1.700	1.734	0.051	0.085	0.119						
R3111x18xx	1.764	1.800	1.836	0.054	0.090	0.126						
R3111x19xx	1.862	1.900	1.938	0.057	0.095	0.133						
R3111x20xx	1.960	2.000	2.040	0.060	0.100	0.140		0.9	2.7		1.1	3.3
R3111x21xx	2.058	2.100	2.142	0.063	0.105	0.147						
R3111x22xx	2.156	2.200	2.244	0.066	0.110	0.154						
R3111x23xx	2.254	2.300	2.346	0.069	0.115	0.161						
R3111x24xx	2.352	2.400	2.448	0.072	0.120	0.168						
R3111x25xx	2.450	2.500	2.550	0.075	0.125	0.175						
R3111x26xx	2.548	2.600	2.652	0.078	0.130	0.182						
R3111x27xx	2.646	2.700	2.754	0.081	0.135	0.189						
R3111x28xx	2.744	2.800	2.856	0.084	0.140	0.196						
R3111x29xx	2.842	2.900	2.958	0.087	0.145	0.203						
R3111x30xx	2.940	3.000	3.060	0.090	0.150	0.210	V_{DD}= ($-V_{DET}$) -0.13V	1.0	3.0		1.2	3.6
R3111x31xx	3.038	3.100	3.162	0.093	0.155	0.217						
R3111x32xx	3.136	3.200	3.264	0.096	0.160	0.224						
R3111x33xx	3.234	3.300	3.366	0.099	0.165	0.231						
R3111x34xx	3.332	3.400	3.468	0.102	0.170	0.238						
R3111x35xx	3.430	3.500	3.570	0.105	0.175	0.245						
R3111x36xx	3.528	3.600	3.672	0.108	0.180	0.252						
R3111x37xx	3.626	3.700	3.774	0.111	0.185	0.259						
R3111x38xx	3.724	3.800	3.876	0.114	0.190	0.266						
R3111x39xx	3.822	3.900	3.978	0.117	0.195	0.273						
R3111x40xx	3.920	4.000	4.080	0.120	0.200	0.280	V_{DD}= ($-V_{DET}$) -0.16V	1.1	3.3		1.3	3.9
R3111x41xx	4.018	4.100	4.182	0.123	0.205	0.287						
R3111x42xx	4.116	4.200	4.284	0.126	0.210	0.294						
R3111x43xx	4.214	4.300	4.386	0.129	0.215	0.301						
R3111x44xx	4.312	4.400	4.488	0.132	0.220	0.308						
R3111x45xx	4.410	4.500	4.590	0.135	0.225	0.315						
R3111x46xx	4.508	4.600	4.692	0.138	0.230	0.322						
R3111x47xx	4.606	4.700	4.794	0.141	0.235	0.329						
R3111x48xx	4.704	4.800	4.896	0.144	0.240	0.336						
R3111x49xx	4.802	4.900	4.998	0.147	0.245	0.343						
R3111x50xx	4.900	5.000	5.100	0.150	0.250	0.350	V_{DD}= ($-V_{DET}$) -0.20V	1.2	3.6		1.4	4.2
R3111x51xx	4.998	5.100	5.202	0.153	0.255	0.357						
R3111x52xx	5.096	5.200	5.304	0.156	0.260	0.364						
R3111x53xx	5.194	5.300	5.406	0.159	0.265	0.371						
R3111x54xx	5.292	5.400	5.508	0.162	0.270	0.378						
R3111x55xx	5.390	5.500	5.610	0.165	0.275	0.385						
R3111x56xx	5.488	5.600	5.712	0.168	0.280	0.392						
R3111x57xx	5.586	5.700	5.814	0.171	0.285	0.399						
R3111x58xx	5.684	5.800	5.916	0.174	0.290	0.406						
R3111x59xx	5.782	5.900	6.018	0.177	0.295	0.413						
R3111x60xx	5.880	6.000	6.120	0.180	0.300	0.420						

Note 1: In the case of CMOS output type; when the voltage is forced to V_{DD} from 0.7V to ($+V_{DET}$)+2.0V, time interval between the rising edge of V_{DD} and the reaching point at 50% of Output Voltage. In the case of Nch open drain output type : The output pin is pulled up to 5V through 470kΩ,and when the voltage is forced to V_{DD} from 0.7V to ($+V_{DET}$)+2.0V, time interval between the rising edge of V_{DD} and the reaching point ar 50% of Output Voltage.

Note 2: V_{DD} value when Output Voltage is equal or less than 0.1V. In the case of Nch open drain output type, the output pin is pulled up to 5V through 470kΩ resistor.
Condition 1: Topt=25°C
Condition 2: -40°C≤Topt≤85°C

Output Current 1			Output Current 2				Output Delay Time	Minimum Operating Voltage		Detector Threshold Temperature Coefficient	
I_{OUT1}[mA]			I_{OUT2}[mA]				t_{PLH}[µs]	V_{DDL}[V]		Δ-V_{DET}/ΔT[ppm/°C]	
Condition	Min.	Typ.	Condition		Min.	Typ.	Max.	Typ.	Max.	Condition	Typ.
Nch V_{DS}=0.05V V_{DD}=0.7V	0.01	0.05	Nch V_{DS}= 0.5V	**V_{DD}= 0.85V**	**0.05**	**0.5**	Note 1 100	Note 2 Condition 1 0.55 Condition 2 0.65	Note 2 Condition 1 0.70 Condition 2 0.80	-40°C≤ Topt ≤85°C	±100
				V_{DD}= 1.0V	**0.2**	**1.0**					
				V_{DD}= 1.5V	1.0	2.0					

OPERATION

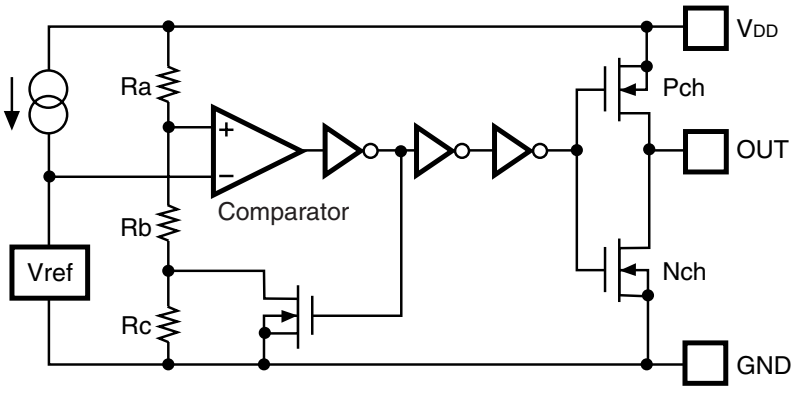
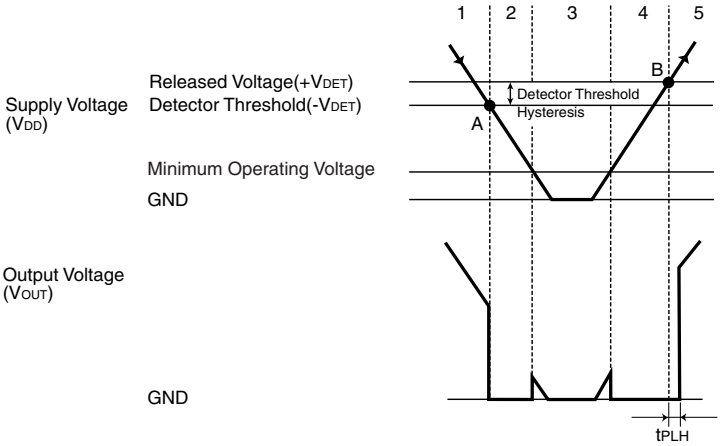


Figure 1. Block Diagram



Step		1	2	3	4	5
Comparator Pin Input Voltage		I	II	III	IV	V
Comparator Output		H	L	Indefinite	L	H
Tr.1		OFF	ON	Indefinite	ON	OFF
Output Tr.	Pch	ON	OFF	Indefinite	OFF	ON
	Nch	OFF	ON	Indefinite	ON	OFF

I. $\frac{Rb + Rc}{Ra + Rb + Rc} \cdot V_{DD}$

II. $\frac{Rb}{Ra + Rb} \cdot V_{DD}$

Figure 2. Operation Diagram

Step 1. The output voltage is equal to the supply voltage (V_{DD}).

Step 2. At Point "A", $Vref \geq V_{DD} \times (Rb+Rc)/(Ra+Rb+Rc)$ is true, as a result, the output of comparator is reverse, and output voltage becomes to GND level. The voltage level of Point A means detector threshold voltage, or ($-V_{DET}$).

Step 3. When the supply voltage is less than minimum operating voltage, the operation of output transistor becomes indefinite, and in the case that output is pulled up to V_{DD}, the output voltage equals to V_{DD} voltage.

Step 4. The output voltage equals to GND level.

Step 5. At Point "B", $Vref \leq V_{DD} \times Rb/(Ra+Rb)$ is true, Output of the comparator is reverse, and output voltage is equal to the supply voltage, or (V_{DD}). The voltage level of Point B means released voltage, or ($+V_{DET}$).

* The difference between released voltage and detector threshold voltage is the detector threshold hysteresis.

TEST CIRCUITS

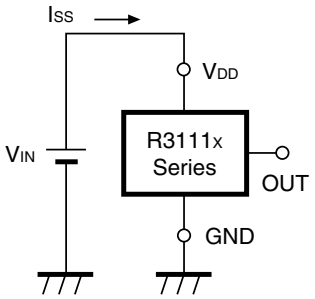
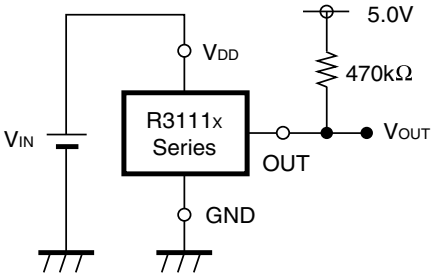


Figure 3. Supply Current Test Circuit



Pull-up circuit is not necessary for CMOS Output type, or R3111XXXXC.

Figure 4. Detector Threshold Test Circuit

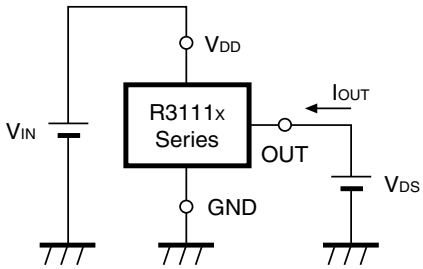
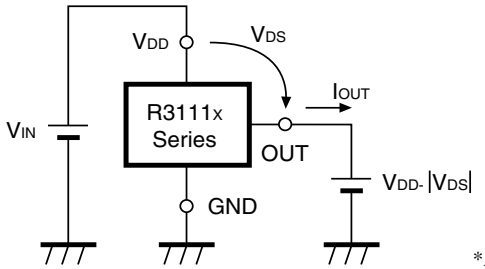


Figure 5. Nch Driver Output Current Test Circuit



*Apply to CMOS Output type only

Figure 6. Pch Driver Output Current Test Circuit

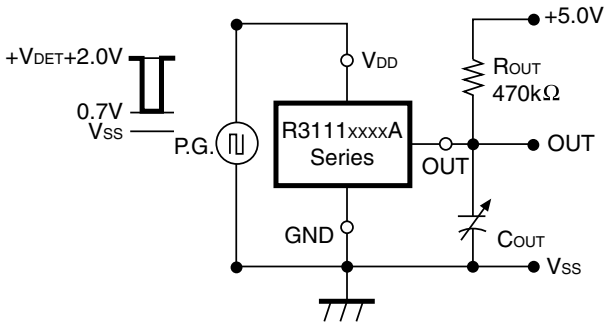


Figure 7. Output Delay Time Test Circuit (1)

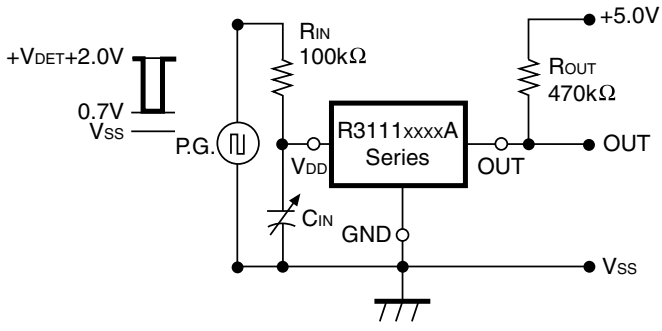
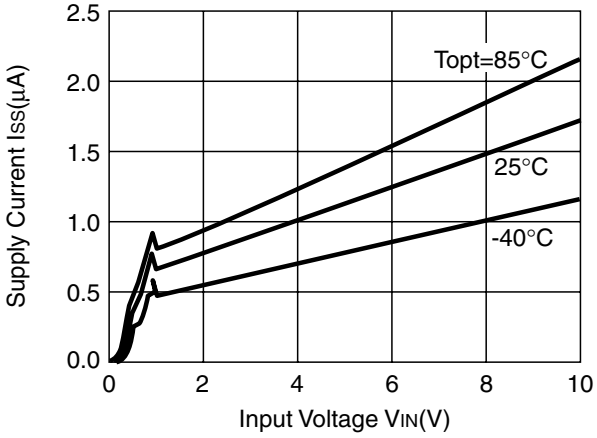


Figure 8. Output Delay Time Test Circuit (2)

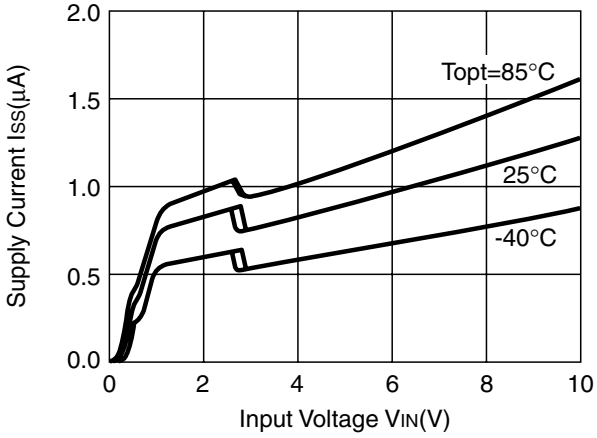
TYPICAL CHARACTERISTICS

1) Supply Current vs. Input Voltage

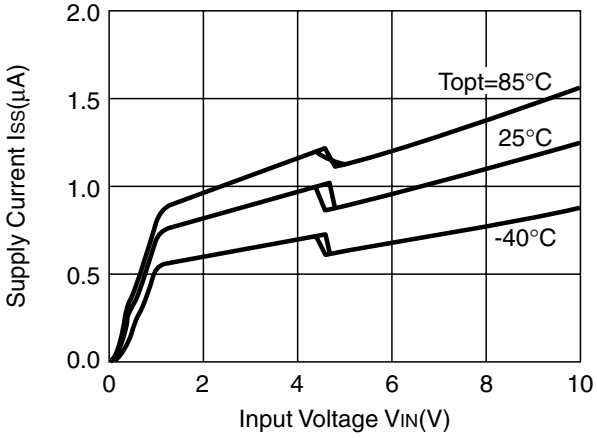
R3111x09xC



R3111x27xC

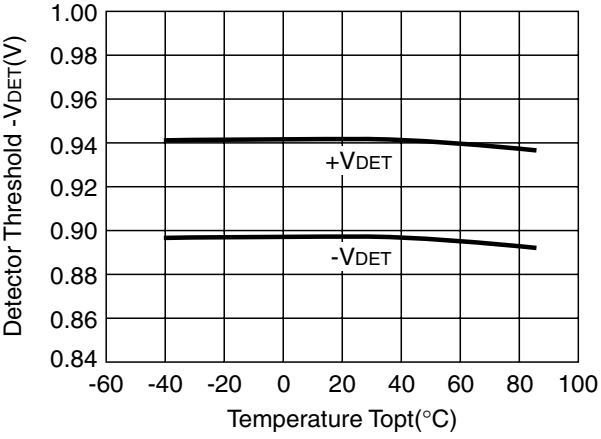


R3111x45xC

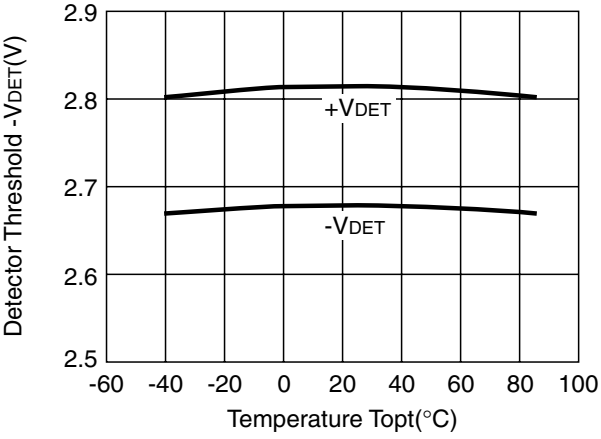


2) Detector Threshold Hysteresis vs. Temperature

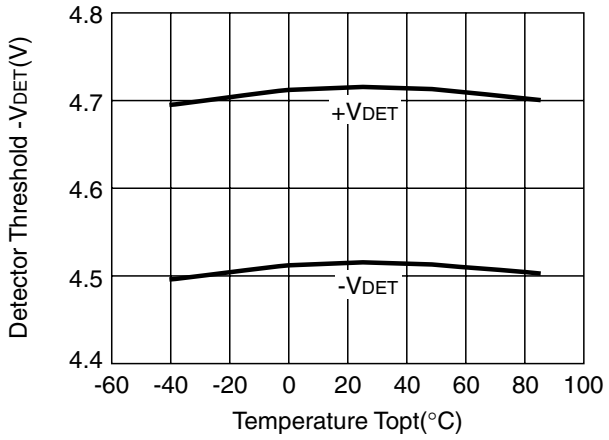
R3111x09xC



R3111x27xC

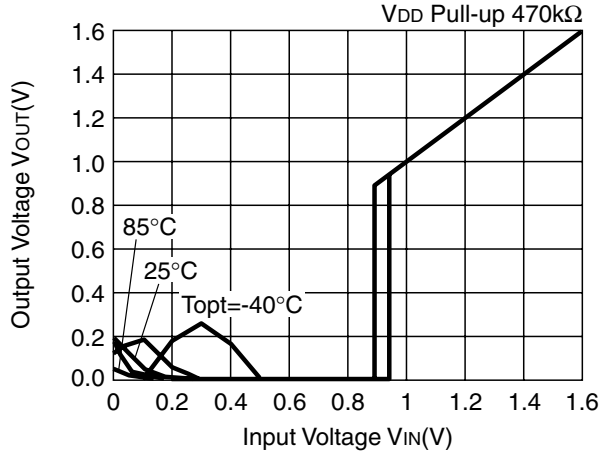


R3111x45xC

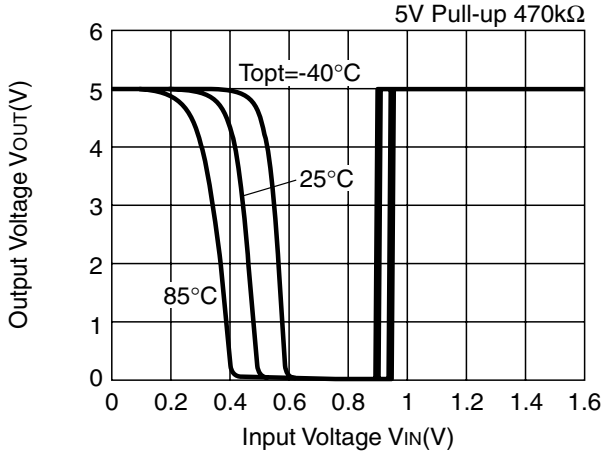


3) Output Voltage vs. Input Voltage

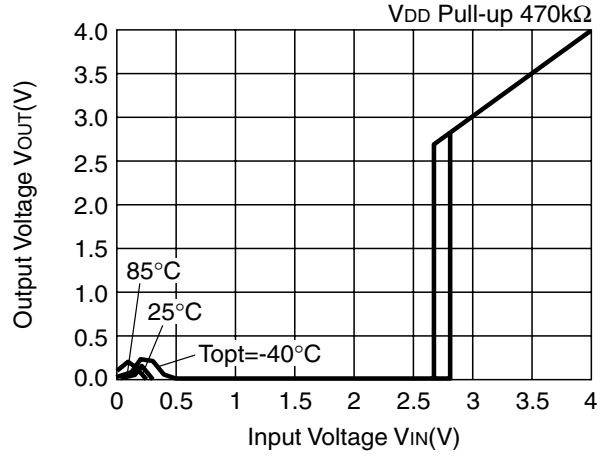
R3111x09xA



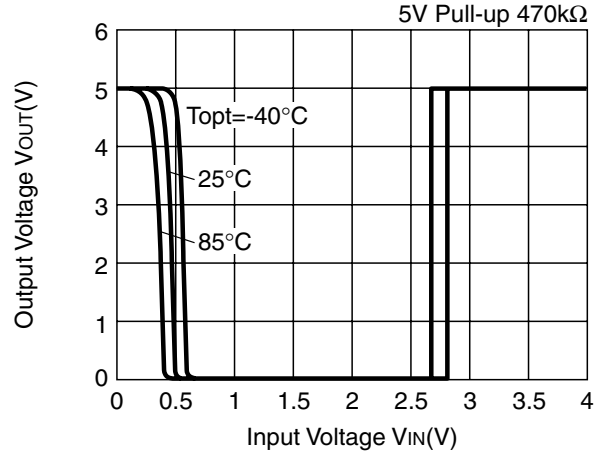
R3111x09xA



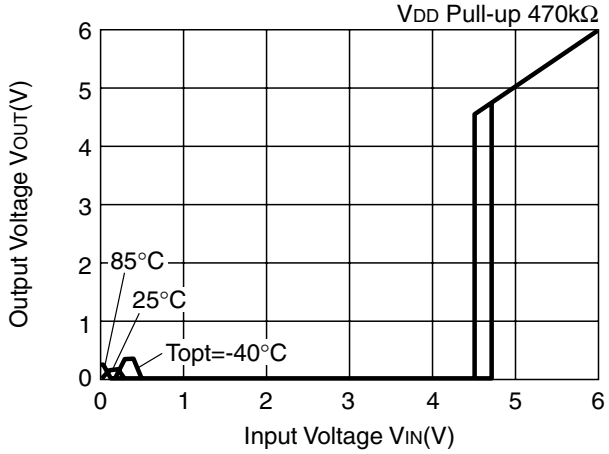
R3111x27xA



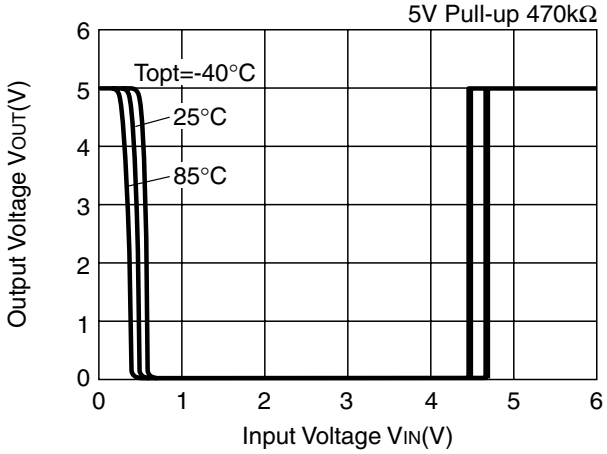
R3111x27xA



R3111x45xA

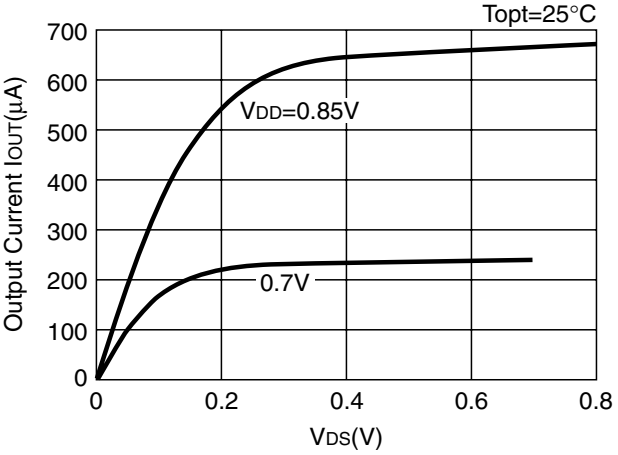


R3111x45xA

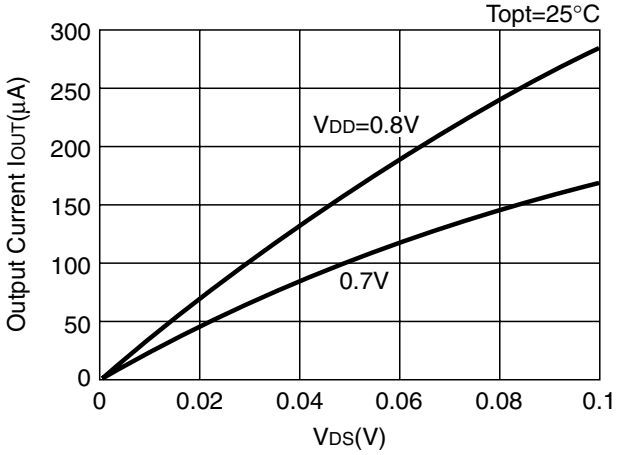


4) Nch Driver Output Current vs. V_{DS}

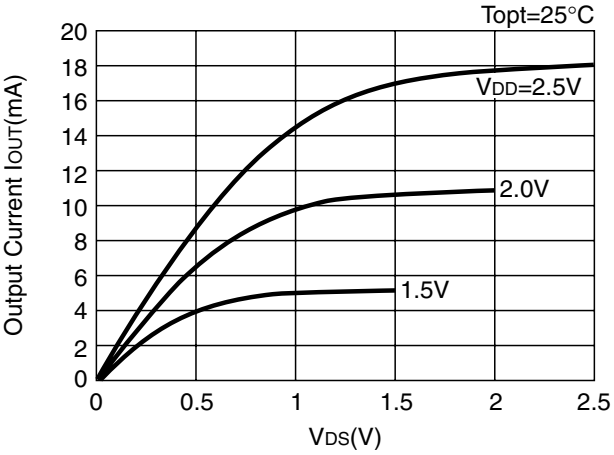
R3111x09xC



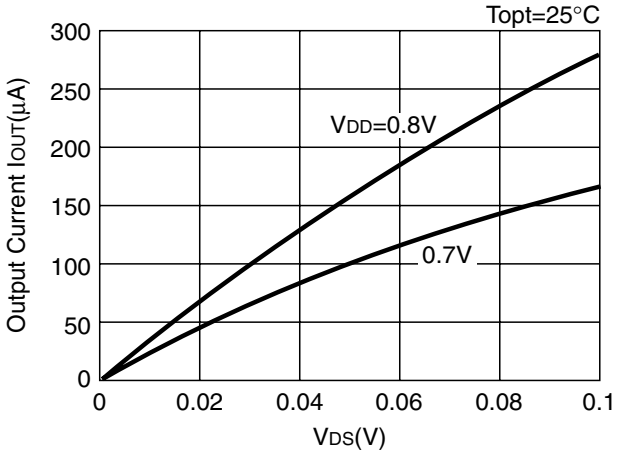
R3111x09xC



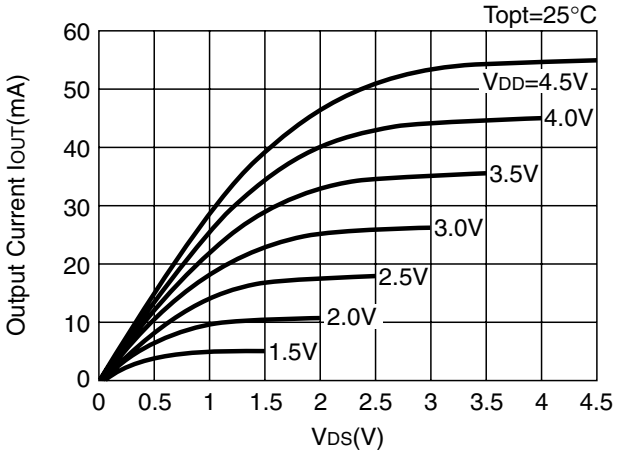
R3111x27xC



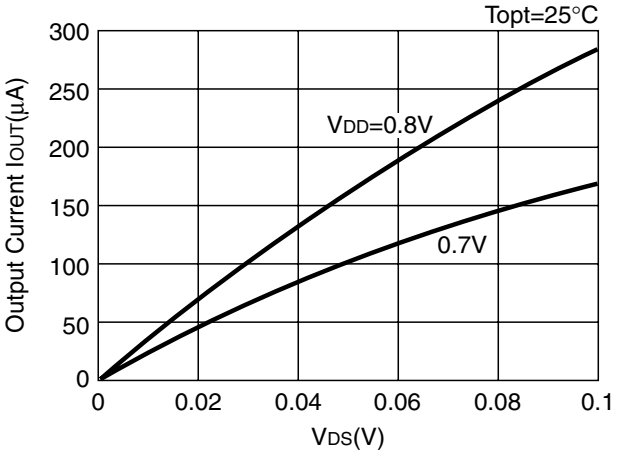
R3111x27xC



R3111x45xC

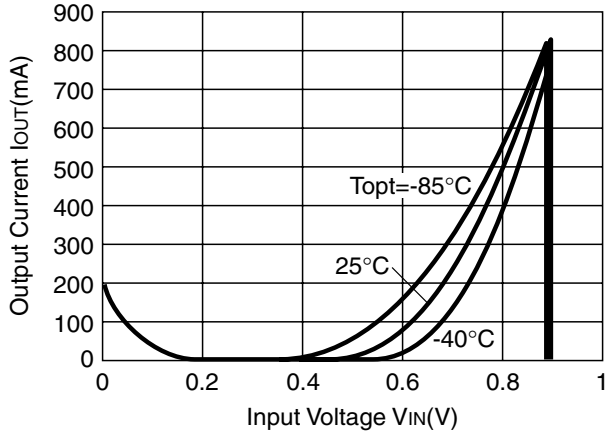


R3111x45xC

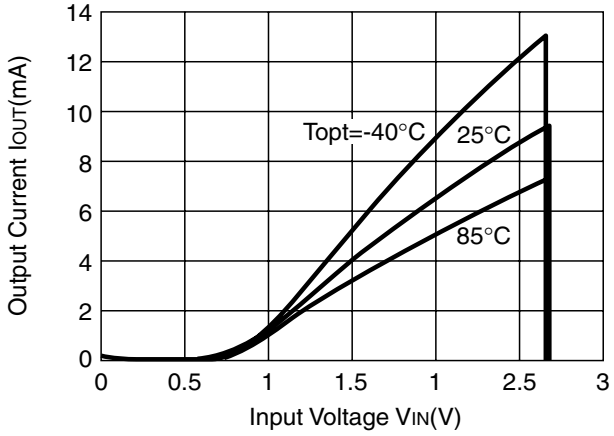


5) Nch Driver Output Current vs. Input Voltage

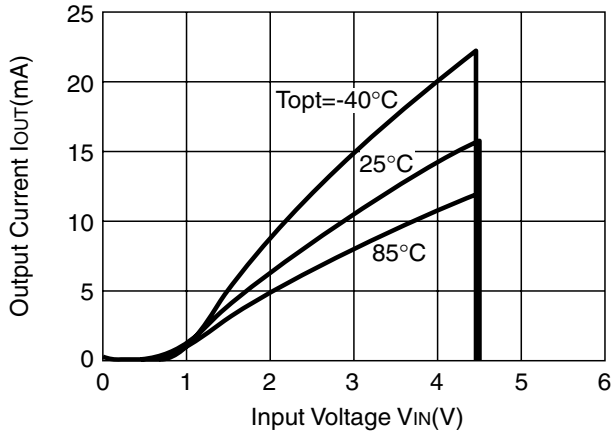
R3111x09xC



R3111x27xC

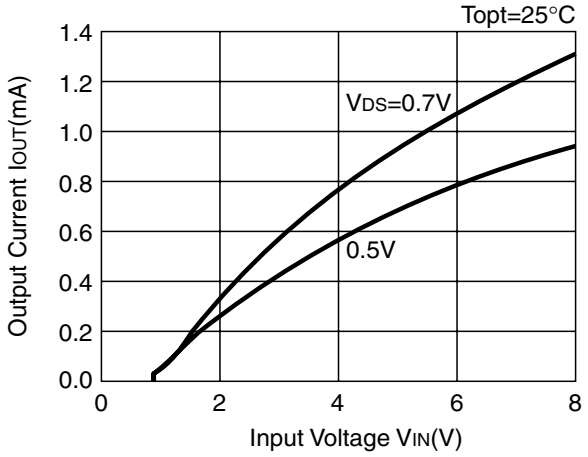


R3111x45xC

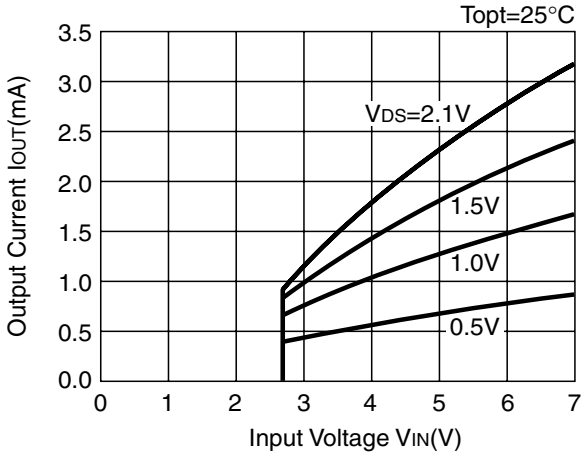


6) Pch Driver Output Current vs. Input Voltage

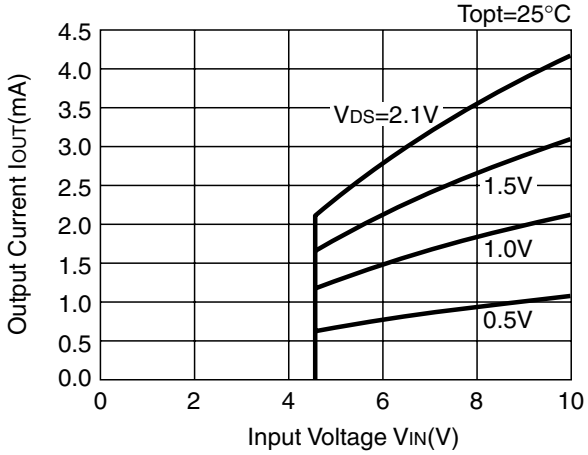
R3111x09xC



R3111x27xC

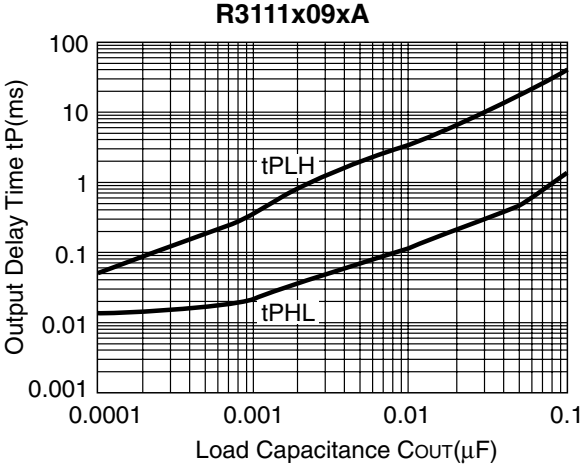


R3111x45xC

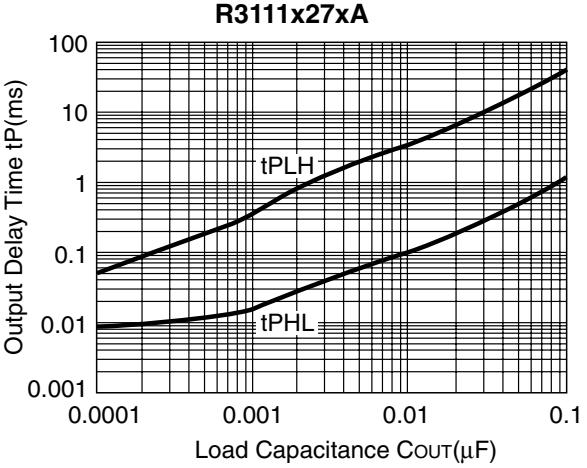


7) Output Delay Time vs. Load Capacitance

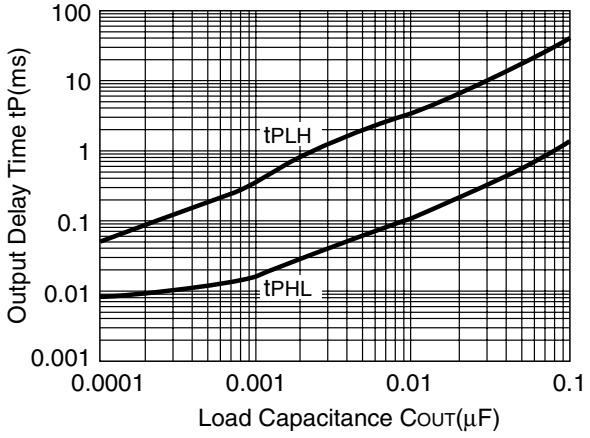
R3111x09xA



R3111x27xA

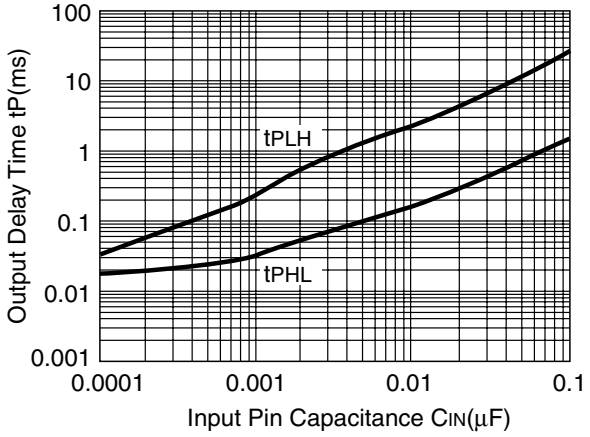


R3111x45xA

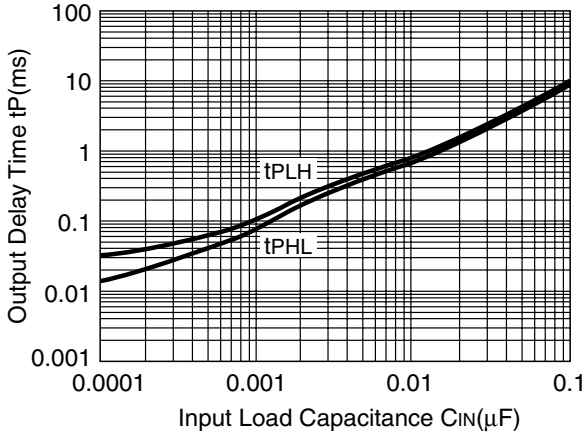


8) Output Delay Time vs. Input Pin Capacitance

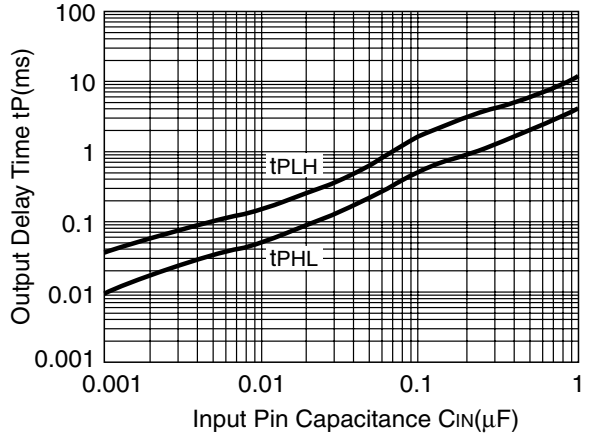
R3111x09xA



R3111x27xA



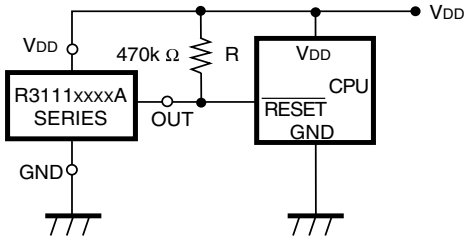
R3111x45xA



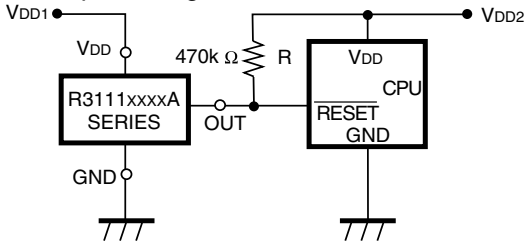
TYPICAL APPLICATION

- **R3111xxxxA CPU Reset Circuit (Nch Open Drain Output)**

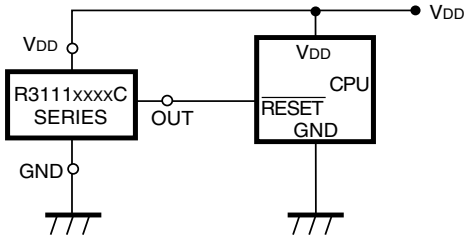
Case 1. Input Voltage to R3111xxxxA is equal to Input Voltage to CPU



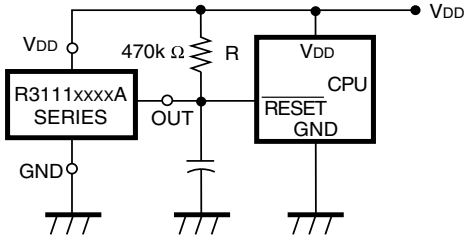
Case 2. Input Voltage to R3111xxxxA is unequal to Input Voltage to CPU



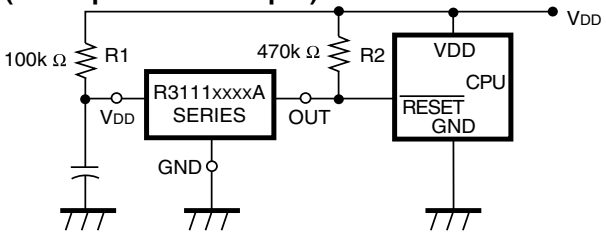
- **R3111xxxxA CPU Reset Circuit CMOS Output**



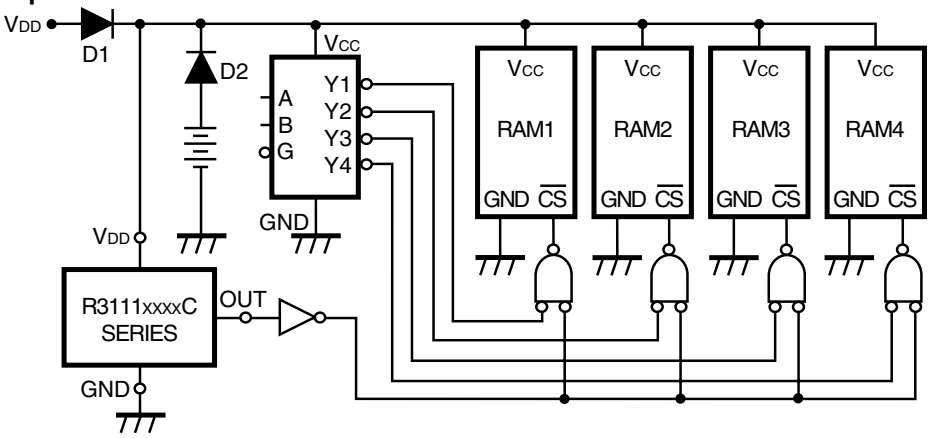
- **R3111xxxxA Output Delay Time Circuit 1 (Nch Open Drain Output)**



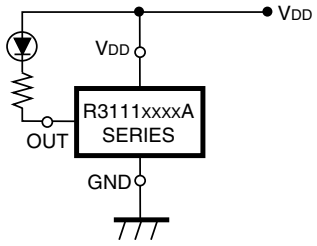
- **R3111xxxxA Output Delay Time Circuit 2 (Nch Open Drain Output)**



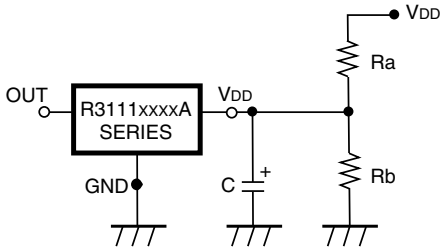
- **Memory Back-up Circuit**



- **Voltage level Indicator Circuit (lighted when the power runs out)**
  (Nch Open Drain Output)



- **Detector Threshold Adjustable Circuit**
  (Nch Open Drain Output)

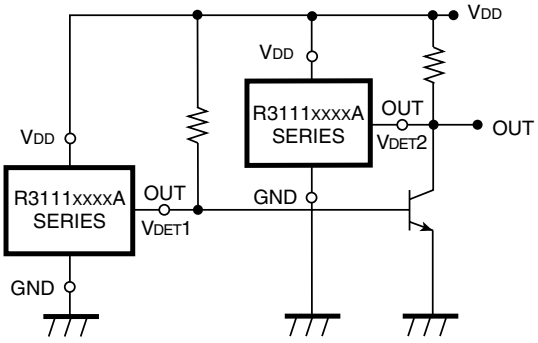


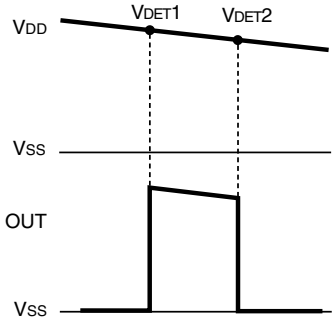
Adjusted Detector Threshold
$=(-V_{DET})*(Ra+Rb)/Rb$

Hysteresis Voltage
$=(V_{HYS})*(Ra+Rb)/Rb$

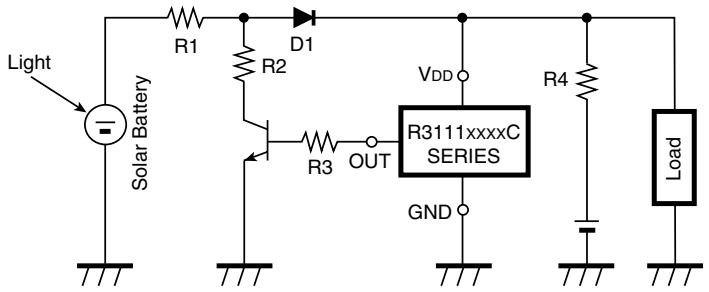
*) If the value of Ra is set excessively large, voltage drop may occur caused by the supply current of IC itself, and detector threshold may vary.

- **Window Comparator Circuit**
  (Nch Open Drain Output)





- **Over-charge Preventing Circuit**



TECHNICAL NOTES

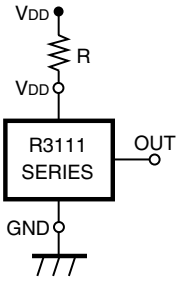


Figure 9

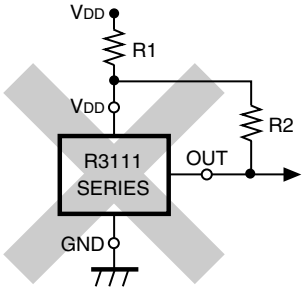


Figure 10

1. In Figure 9, When R3111xxxxC is used, and if an impedance is connected between Voltage Supplier and the V_{DD} Pin of R3111xxxxC Series, the operation might be unstable by cross conduction current at detection.
   When R3111xxxxA is used in Figure 9, if the value of R is set excessively large, voltage drop may occur caused by supply crrent of IC itself and Detector threshold may vary.
2. Wiring as shown in Figure 10 may cause the oscillation in both output types of R3111 Series.