RICOH

R3111x SERIES

LOW VOLTAGE DETECTOR

NO.EA-056-090421

OUTLINE

The R3111x 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.

Three output types, Nch open drain “L” type, Nch open drain “H” type and CMOS type are available.

The R3111x Series are operable at a lower voltage than that for the Rx5VL series, and can be driven by a single battery.

Six types of packages, TO-92, SOT-89, SOT-23-3, SOT-23-5, SC-82AB, SC-88A and SON1612-6 are available.

FEATURES

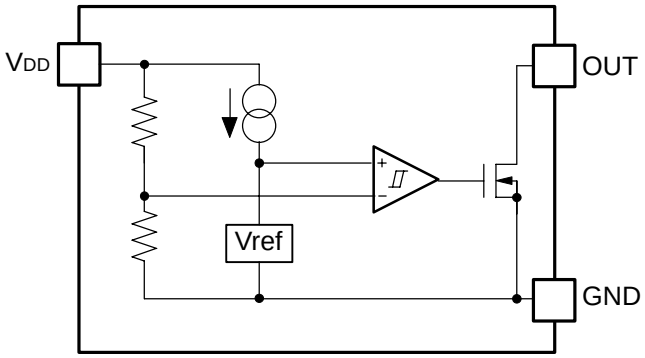
- Supply Current ..... Typ. 0.8μA ($-V_{DET}$=1.5V, V_{DD}=$-V_{DET}$−0.1V)
- Range of Operating Voltage Range ..... 0.7V to 10.0V (T_{opt}=25°C)
- Detector Threshold Range ..... 0.9V to 6.0V
- Accuracy Detector Threshold ..... ±2.0%
- Temperature-Drift Coefficient of Detector Threshold ..... Typ. ±100ppm/°C
- Output Types ..... Nch Open Drain “L”, Nch Open Drain “H”, and CMOS
- Packages TO-92, SOT-89, SOT-23-3, SOT-23-5, SC-82AB, SC-88A, SON1612-6

APPLICATIONS

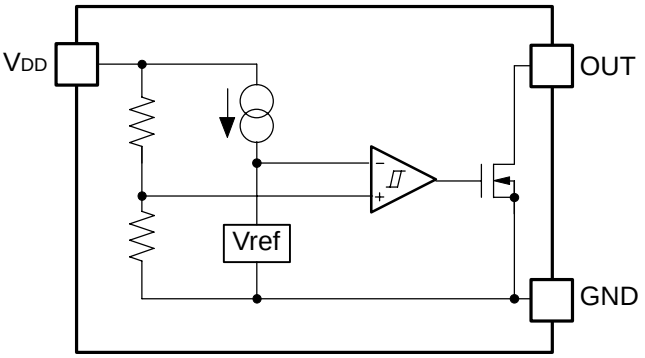
- CPU and Logic Circuit Reset
- Battery Checker
- Window Comparator
- Wave Shaping Circuit
- Battery Back-up Circuit
- Power Failure Detector

BLOCK DIAGRAMS

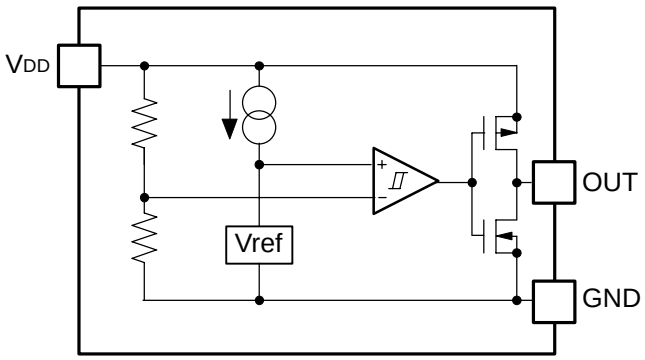
R3111xxxxA



R3111xxxxB



R3111xxxxC



SELECTION GUIDE

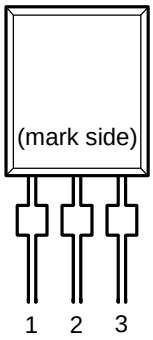
The package type, the detector threshold, the output type and the taping type for the ICs can be selected at the users' request. The selection can be made with designating the part number as shown below;

R3111xXXXX-XX -X ← Part Number
↑ ↑↑↑ ↑ ↑
a b c d e f

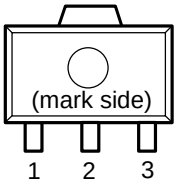
Code	Contents
a	Designation of Package Type; R3111Dxx1x: SON1612-6 R3111Exx1x: TO-92 R3111Hxx1x: SOT-89 R3111Nxx1x: SOT-23-5 R3111Nxx2x: SOT-23-3 R3111Qxx1x: SC-82AB R3111Qxx2x: SC-88A
b	Setting Detector Threshold ($-V_{DET}$); Stepwise setting with a step of 0.1V in the range of 0.9V to 6.0V is possible.
c	Designation of Package Type 1: except SOT-23-3, SC-88A 2: SOT-23-3, SC-88A
d	Designation of Output Type; A: Nch Open Drain (Output "L" at $V_{DD}=-V_{DET}$) B: Nch Open Drain (Output "H" at $V_{DD}=-V_{DET}$) C: CMOS (Output "L" at $V_{DD}=-V_{DET}$)
e	Designation of Packing or Taping Type ; Ex.TO-92: TZ, SOT-89: T1, SOT-23-3, SOT-23-5, SC-82AB, SC-88A, SON1612-6: TR prescribed as standard directions. (Refer to Taping Specifications.) Antistatic bag for TO-92: C
f	Designation of Composition of pin plating -F: Lead free solder plating (TO-92, SOT-89, SOT-23-3, SOT-23-5, SC-82AB, SC-88A, SON1612-6)

PIN CONFIGURATIONS

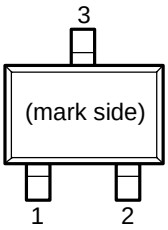
● TO-92



● SOT-89



● SOT-23-3



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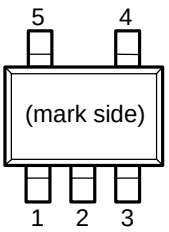
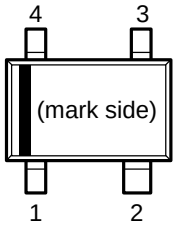


● SC-82AB



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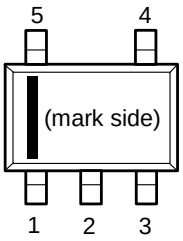
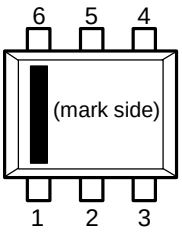


● SON1612-6



PIN DESCRIPTIONS

● 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

● SC-88A

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

● SON1612-6

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

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 (TO-92)*	300	mW
	Power Dissipation (SOT-89)*	900	
	Power Dissipation (SOT-23-3)*	420	
	Power Dissipation (SOT-23-5)*	420	
	Power Dissipation (SC-82AB)*	380	
	Power Dissipation (SC-88A)*	380	
	Power Dissipation (SON1612-6)*	500	
Topt	Operating Temperature Range	–40 to 85	°C
Tstg	Storage Temperature Range	–55 to 125	°C
Tsolder	Lead temperature (Soldering)	260°C, 10s	

*) For Power Dissipation, please refer to PACKAGE INFORMATION.

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause the permanent damages and may degrade the life time and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

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 V_{DD}=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
$\Delta-V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±100		ppm/°C

- **R3111x18xA/C**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	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 V_{DD}=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}=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
$\Delta-V_{DET}/\Delta Topt$	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_{DET})+2.0V)/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.

- **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 V_{DD}=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
$\Delta-V_{DET}/\Delta Topt$	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 V_{DD}= 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
$\Delta-V_{DET}/\Delta Topt$	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_{DET})+2.0V)/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.

- **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 V_{DD}=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
$\Delta-V_{DET}/\Delta Topt$	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 V_{DD}=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
$\Delta-V_{DET}/\Delta Topt$	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_{DET})+2.0V)/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.

- **R3111Q231B**

Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold		2.254	2.300	2.346	V
V_{HYS}	Detector Threshold Hysteresis		0.069	0.115	0.161	V
I_{SS}	Supply Current	V_{DD}=2.2V V_{DD}=4.3V		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}=0.50V,V_{DD}=3.0V	2.5			mA
t_{PLH}	Output Delay Time*Note2				100	μs
$\Delta-V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±100		ppm/°C

- **R3111Q441B**

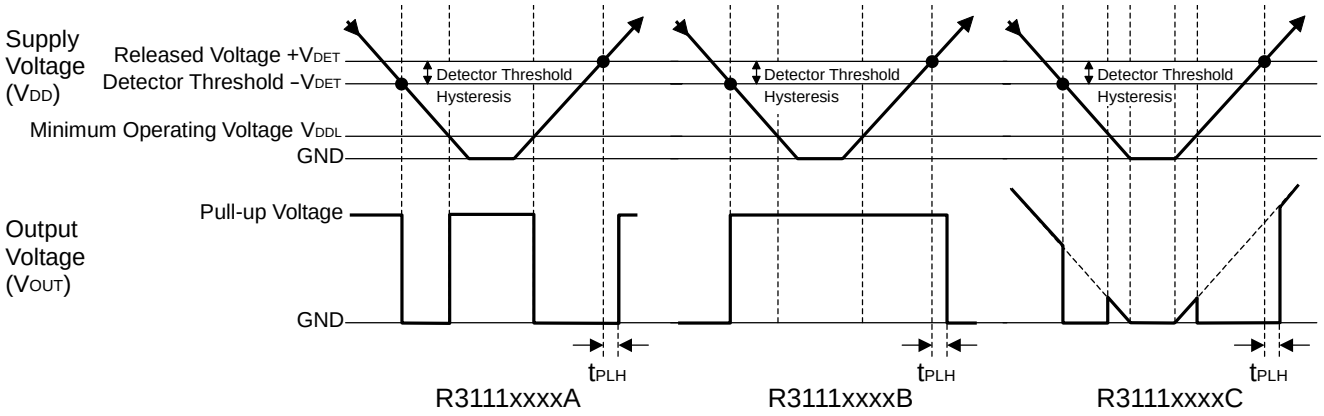
Topt=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold		4.312	4.400	4.488	V
V_{HYS}	Detector Threshold Hysteresis		0.132	0.220	0.308	V
I_{SS}	Supply Current	V_{DD}=4.24V V_{DD}=6.4V		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}=0.50V, V_{DD}=5.5V	2.5			mA
t_{PLH}	Output Delay Time*Note2				100	μs
$\Delta-V_{DET}/\Delta Topt$	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 (($+V_{DET}$)+2.0V)/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.

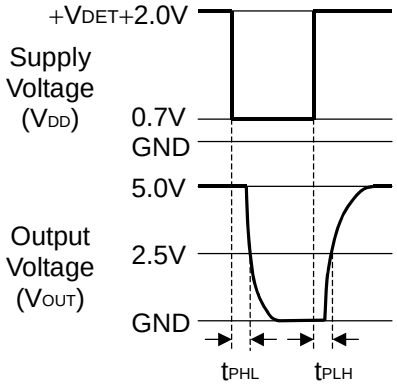
TIMING CHART



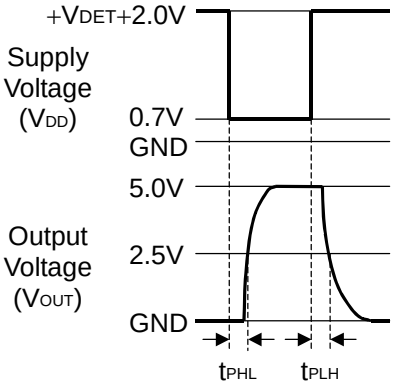
DEFINITION OF OUTPUT DELAY TIME

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

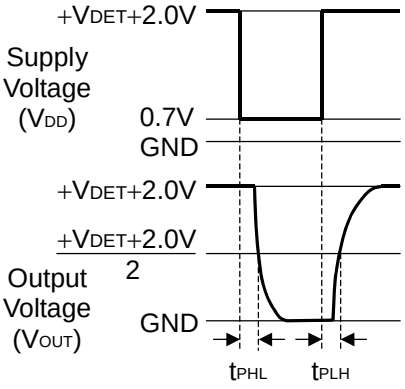
1. In the case of Nch Open Drain Output:(R3111xxxxA/B)
   Under the condition of the output pin (OUT) is pulled up through a resistor of 470kΩ to 5V, the time interval between the rising edge of V_{DD} pulse from 0.7V to ($+V_{DET}$)+2.0V and becoming of the output voltage to 2.5V.
2. In the case of CMOS Output:(R3111xxxxC)
   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 (($+V_{DET}$)+2.0V)/2.



Nch Open Drain Output (R3111xxxxA)



Nch Open Drain Output (R3111xxxxB)



CMOS Output (R3111xxxxC)

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						

*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 (($+V_{DET}$)+2.0V)/2. 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 VDD and the reaching point at (($+V_{DET}$)+2.0V)/2.

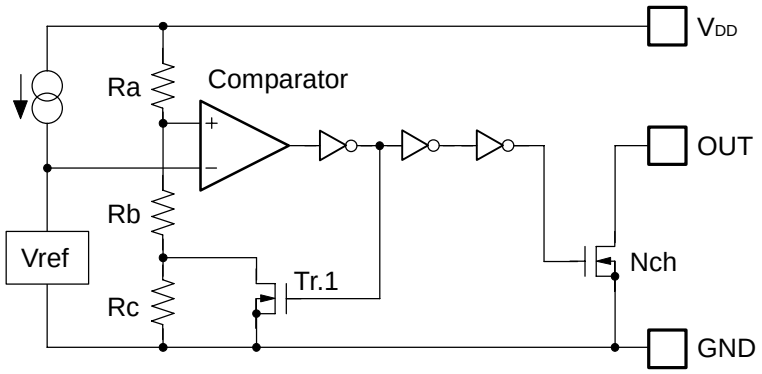
*2) V_{DD} value when Output Voltage is equal or less than 0.1V. In the case of Nch open drain output type, the output pin is pulled up to 5V through 470kΩ resistor.
Condition 1: Topt=25°C
Condition 2: −40°C ≦ Topt ≦ 85°C

Output Current 1 *3			Output Current 2 *3				Output Delay Time	Minimum Operating Voltage		Detector Threshold Temperature Coefficient	
I_{OUT1}[mA]			I_{OUT2}[mA]				t_{PLH}[µs]	V_{DDL}[V]		$\Delta-V_{DET}/\Delta Topt$[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	100 *1	*2 Condition 1 0.55 Condition 2 0.65	*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					

*3) Output Current (I_{OUT}) of R3111xxxxB has not been described. Please inquire details.

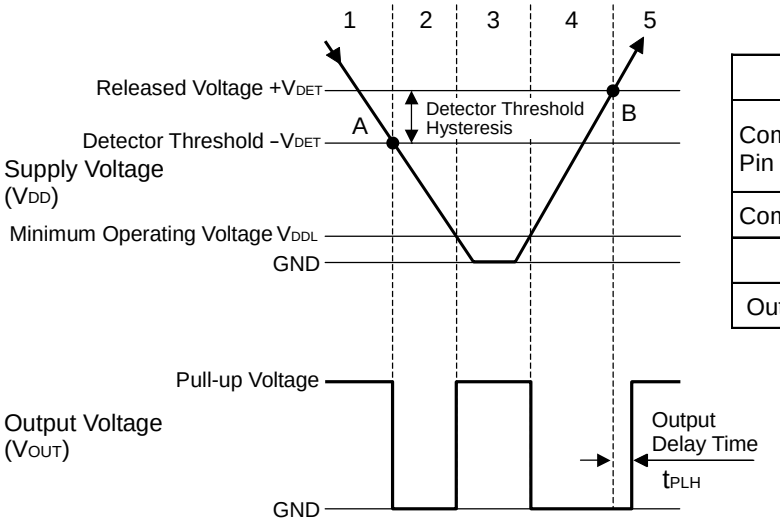
OPERATION

- **Operation of R3111xxxxA**



OUT pin should be pulled-up to V_{DD} or an external voltage level.

Block Diagram (R3111xxxxA)



Step		1	2	3	4	5
Comparator (+) Pin Input Voltage		I	II	II	II	I
Comparator Output		H	L	Indefinite	L	H
Tr.1		OFF	ON	Indefinite	ON	OFF
Output Tr.	Nch	OFF	ON	Indefinite	ON	OFF

$$\text{I} \quad \frac{Rb+Rc}{Ra+Rb+Rc} \times V_{DD}$$

$$\text{II} \quad \frac{Rb}{Ra+Rb} \times V_{DD}$$

Operation Diagram

- **Explanation of operation**

Step 1. The output voltage is equal to the pull-up voltage.

Step 2. At Point “A”, Vref ≧ V_{DD}×(Rb+Rc)/(Ra+Rb+Rc) is true, as a result, the output of comparator is reversed from "H" to "L", therefore the output voltage becomes the GND level. The voltage level of Point A means a detector threshold voltage (−V_{DET}).

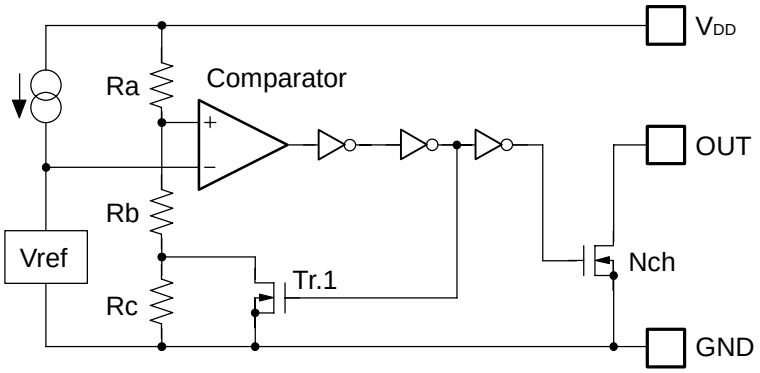
Step 3. When the supply voltage is lower than the minimum operating voltage, the operation of the output transistor becomes indefinite. The output voltage is equal to the pull-up voltage.

Step 4. The output Voltage is equal to the GND level.

Step 5. At Point “B”, Vref ≦ V_{DD}×Rb/(Ra+Rb) is true, as a result, the output of comparator is reversed from "L" to "H", then the output voltage is equal to the pull-up voltage. The voltage level of Point B means a released voltage (+V_{DET}).

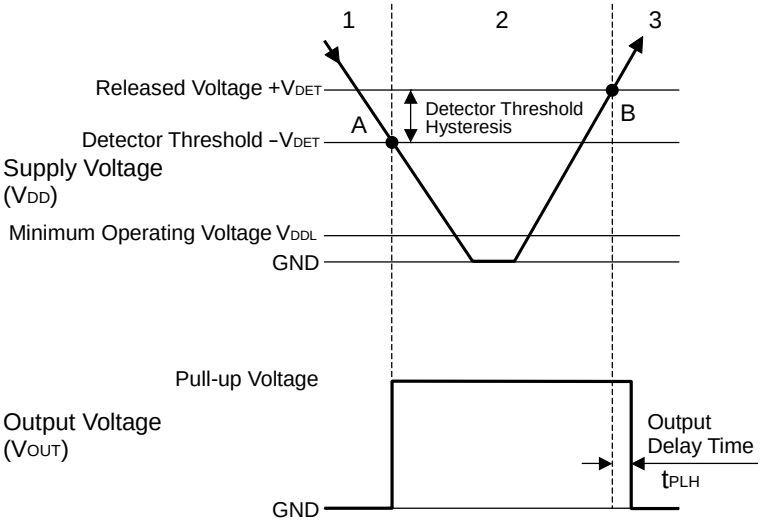
∗) The difference between a released voltage and a detector threshold voltage is a detector threshold hysteresis.

• Operation of R3111xxxxB



OUT pin should be pulled-up to V_{DD} or an external voltage level.

Block Diagram (R3111xxxxB)



Step		1	2	3
Comparator (–) Pin Input Voltage		I	II	I
Comparator Output		L	H	L
Tr.1		OFF	ON	OFF
Output Tr.	Nch	ON	OFF	ON

$$\text{I} \quad \frac{Rb+Rc}{Ra+Rb+Rc} \times V_{DD}$$

$$\text{II} \quad \frac{Rb}{Ra+Rb} \times V_{DD}$$

Operation Diagram

• Explanation of operation

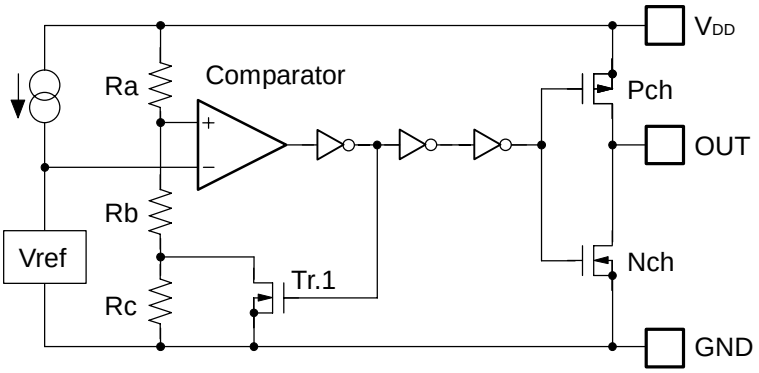
Step 1. The output voltage is equal to the GND level.

Step 2. At Point “A”, Vref ≧ V_{DD}×(Rb+Rc)/(Ra+Rb+Rc) is true, as a result, the output of comparator is reversed from "L" to "H", therefore the output voltage becomes the pull-up voltage. The voltage level of Point A means a detector threshold voltage (–V_{DET}).

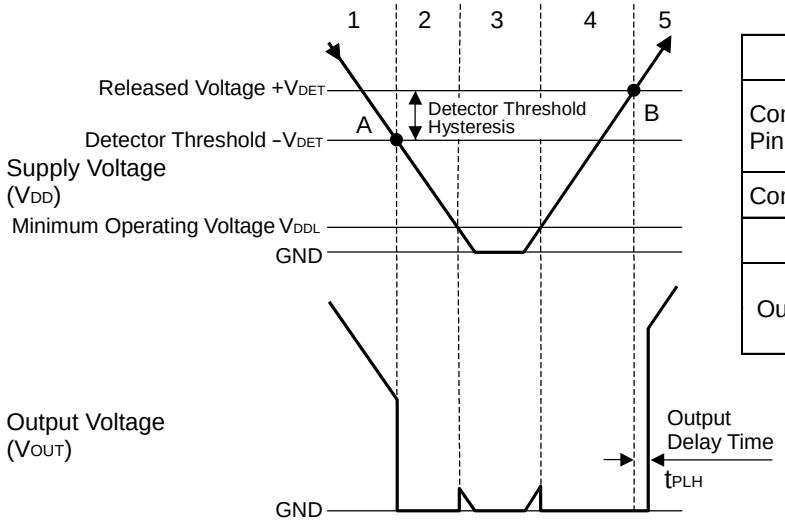
Step 3. At Point “B”, Vref ≦ V_{DD}×Rb/(Ra+Rb) is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the GND level. The voltage level of Point B means a released voltage (+V_{DET}).

∗) The difference between a released voltage and a detector threshold voltage is a detector threshold hysteresis.

- **Operation of R3111xxxxC**



Block Diagram (R3111xxxxC)



Step		1	2	3	4	5
Comparator (+) Pin Input Voltage		I	II	II	II	I
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

$$\text{I} \quad \frac{Rb+Rc}{Ra+Rb+Rc} \times V_{DD}$$

$$\text{II} \quad \frac{Rb}{Ra+Rb} \times V_{DD}$$

Operation Diagram

- **Explanation of operation**

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

Step 2. At Point “A”, Vref ≧ V_{DD}×(Rb+Rc)/(Ra+Rb+Rc) is true, as a result, the output of comparator is reversed from "H" to "L", therefore the output voltage becomes the GND level. The voltage level of Point A means a detector threshold voltage (–V_{DET}).

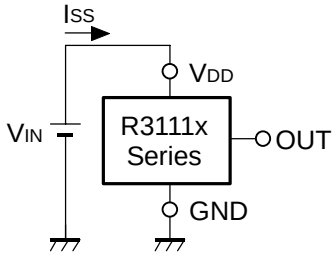
Step 3. When the supply voltage is lower than the minimum operating voltage, the operation of the output transistor becomes indefinite.

Step 4. The output Voltage is equal to the GND level.

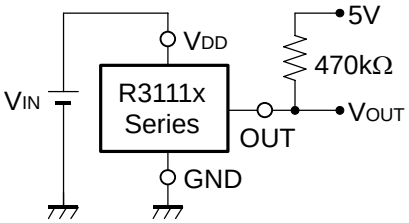
Step 5. At Point “B”, Vref ≦ V_{DD}×Rb/(Ra+Rb) is true, as a result, the output of comparator is reversed from "L" to "H", then the output voltage is equal to the supply voltage (V_{DD}). The voltage level of Point B means a released voltage (+V_{DET}).

∗) The difference between a released voltage and a detector threshold voltage is a detector threshold hysteresis.

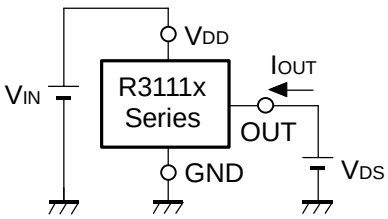
TEST CIRCUITS



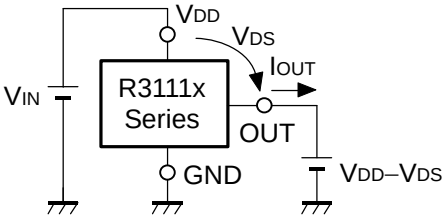
Supply Current Test Circuit



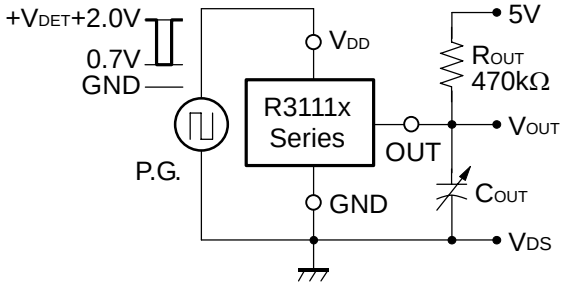
Detector Threshold Test Circuit
(Pull-up circuit is not necessary for CMOS Output type.)



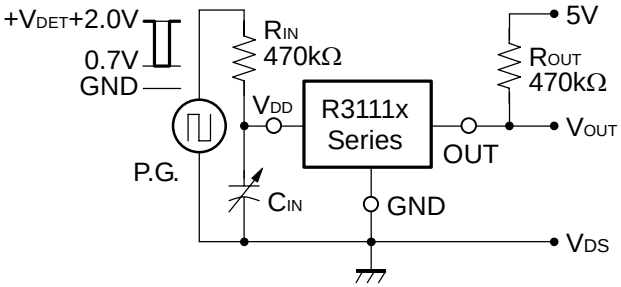
Nch Driver Output Current Test Circuit



Pch Driver Output Current Test Circuit
∗Apply to CMOS Output type only



Output Delay Time Test Circuit (1)
(Pull-up circuit is not necessary for CMOS Output type.)

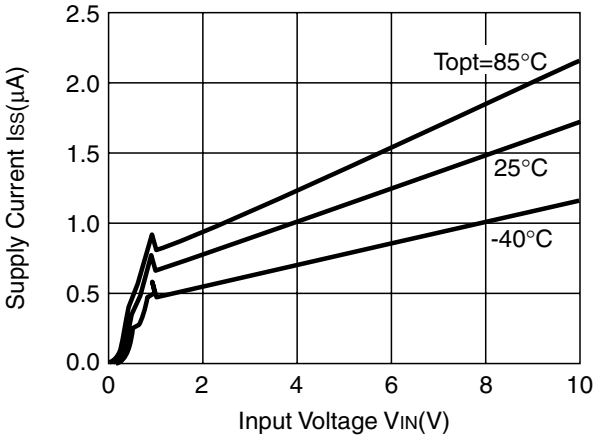


Output Delay Time Test Circuit (2)

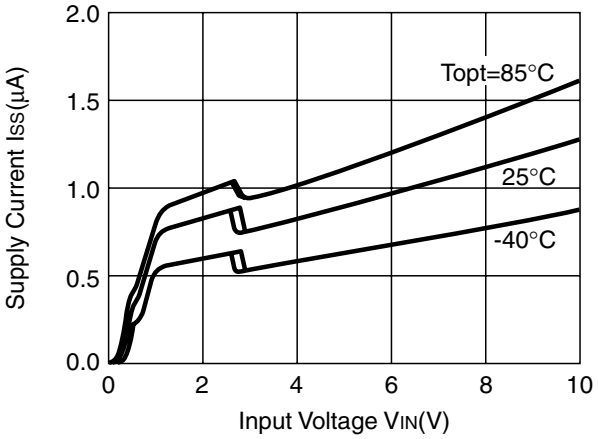
TYPICAL CHARACTERISTICS

1) Supply Current vs. Input Voltage

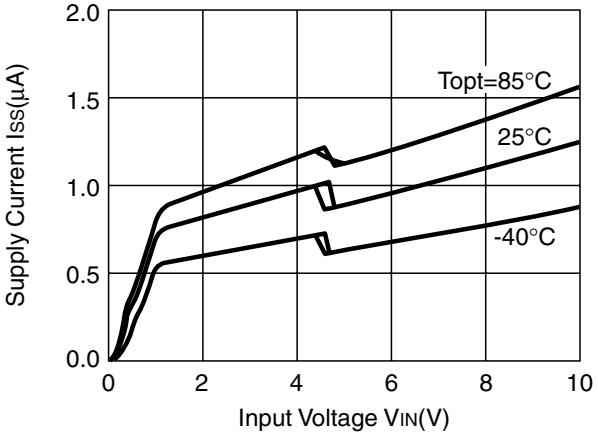
R3111x09xC



R3111x27xC

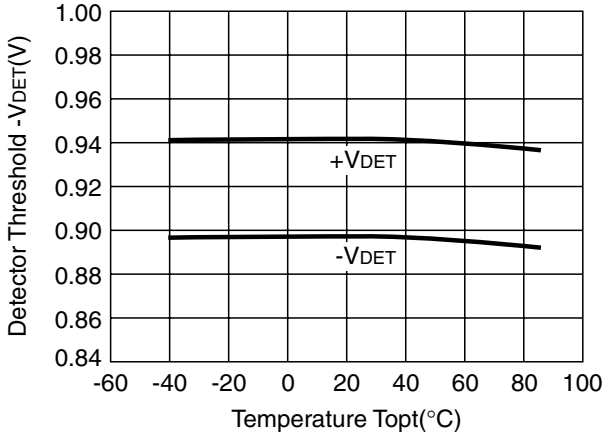


R3111x45xC

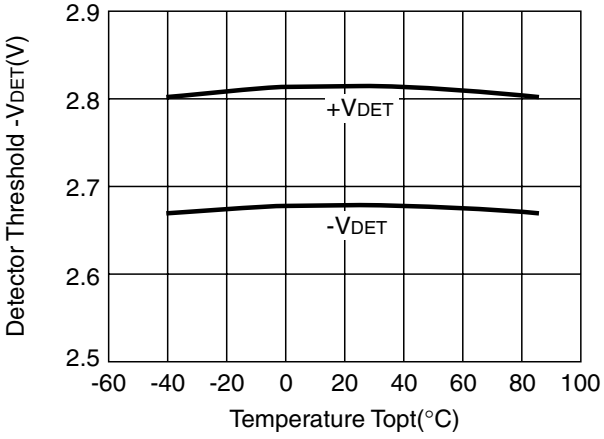


2) Detector Threshold Hysteresis vs. Temperature

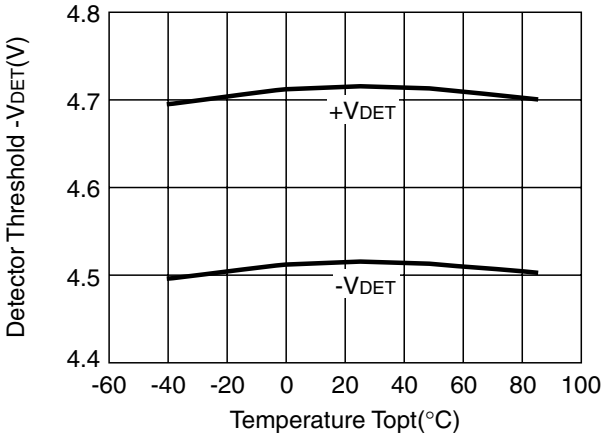
R3111x09xC



R3111x27xC

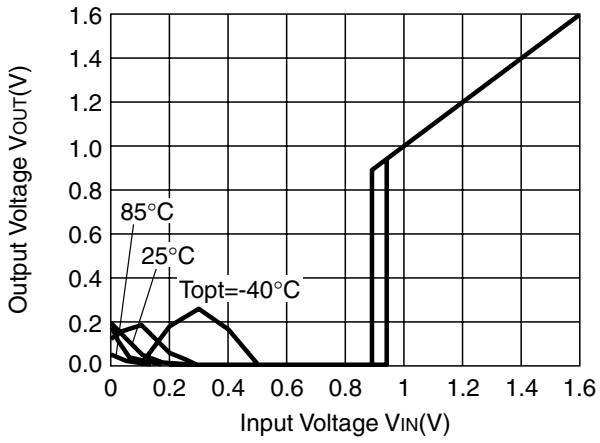


R3111x45xC

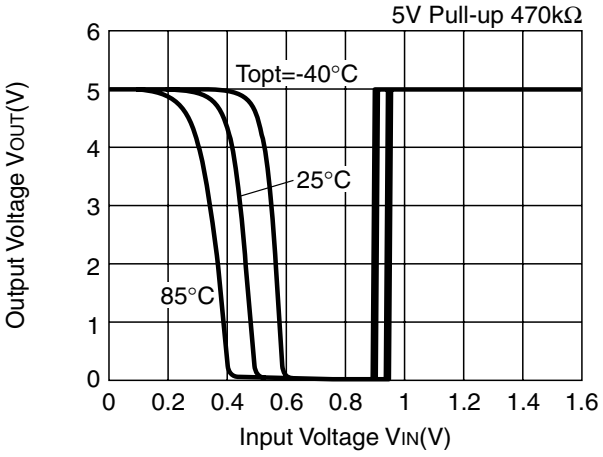


3) Output Voltage vs. Input Voltage

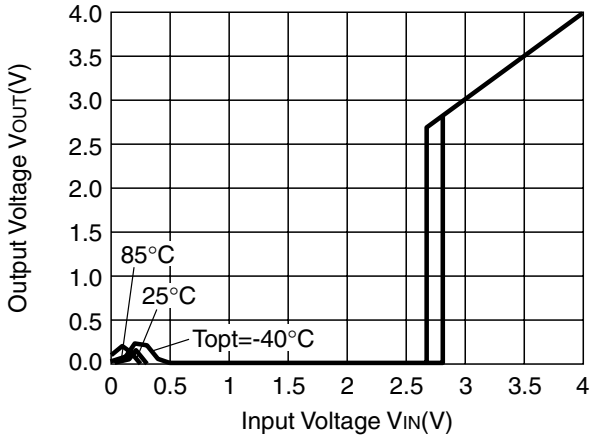
R3111x09xC



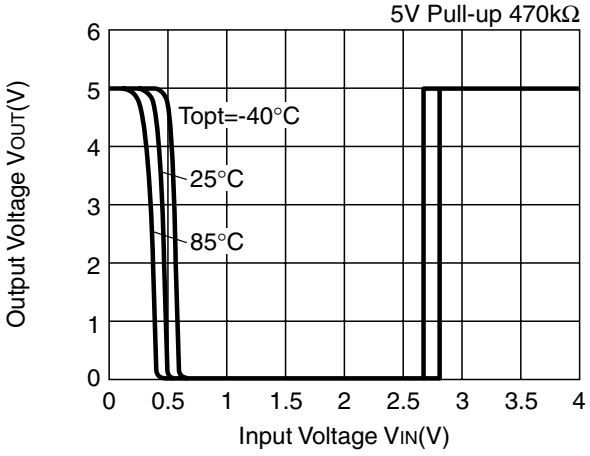
R3111x09xA



R3111x27xC



R3111x27xA



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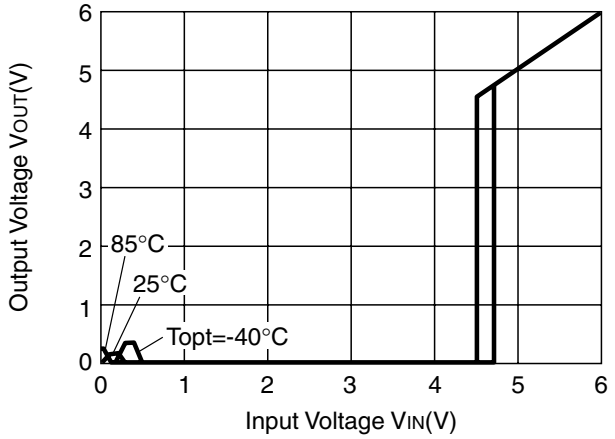
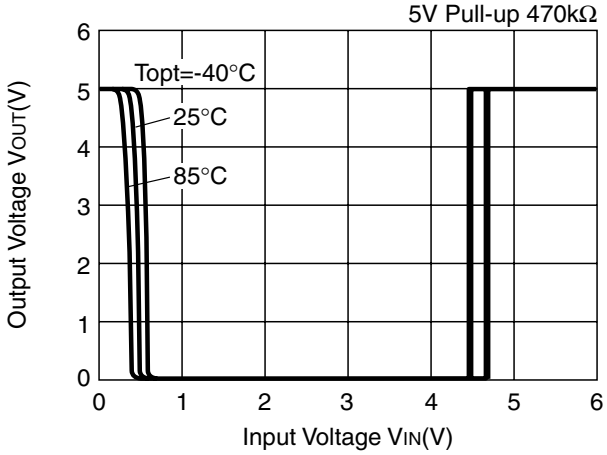
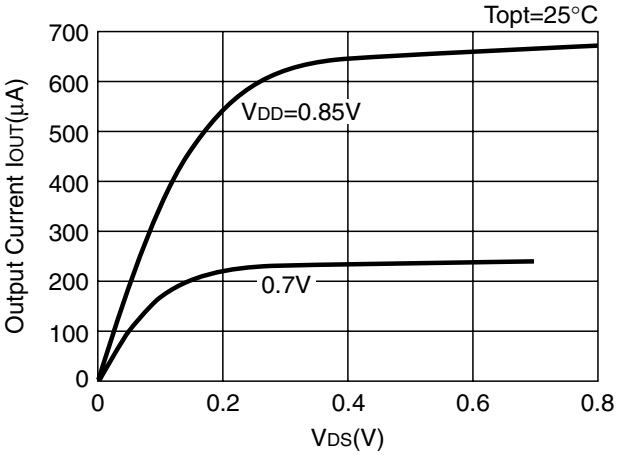


R3111x45xA

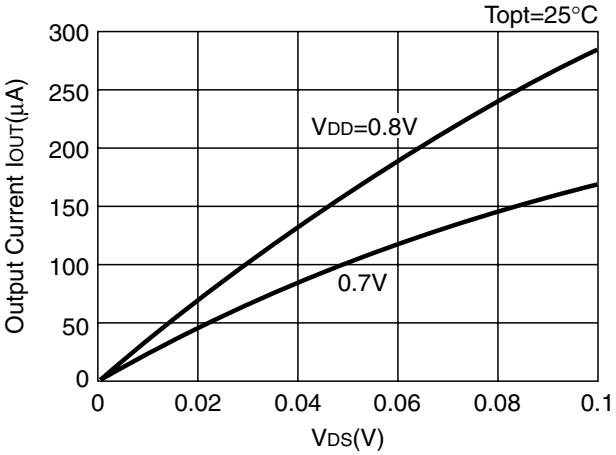


4) Nch Driver Output Current vs. V_{DS}

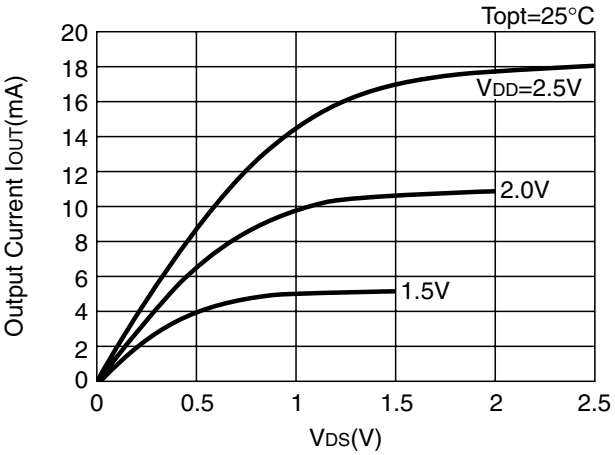
R3111x09xC



R3111x09xC



R3111x27xC



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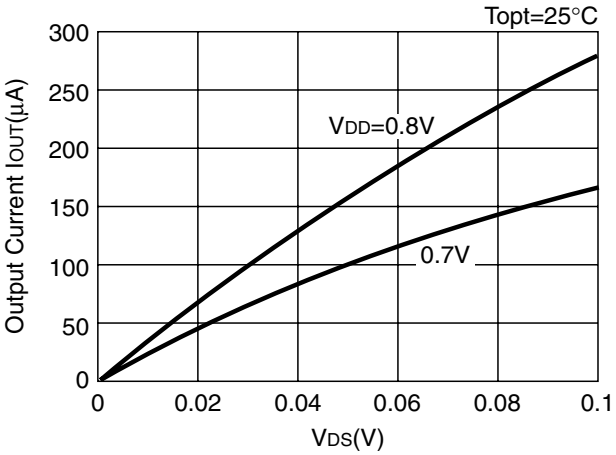

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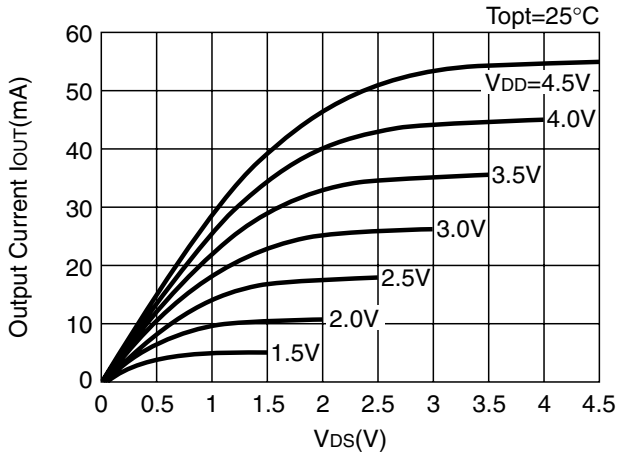
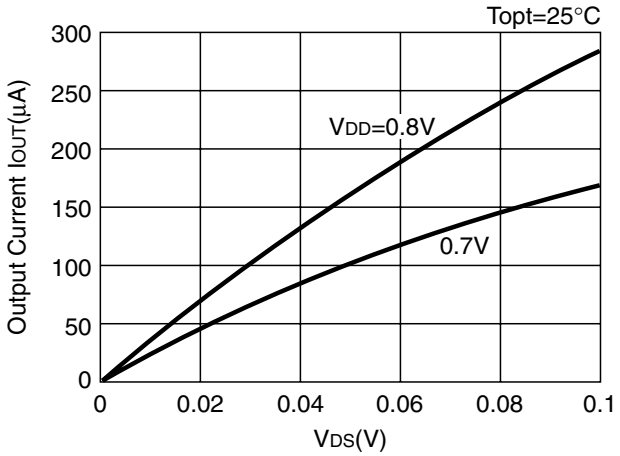
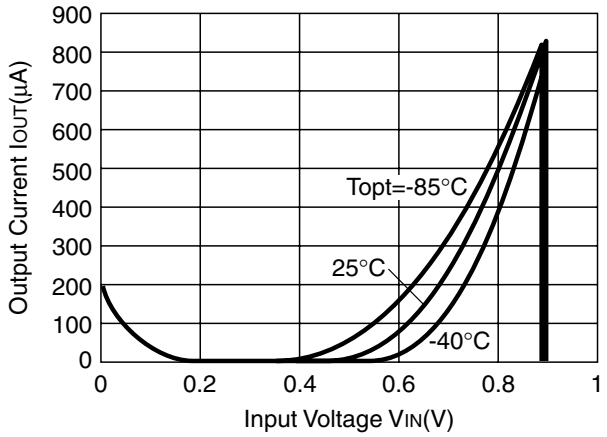


R3111x45xC

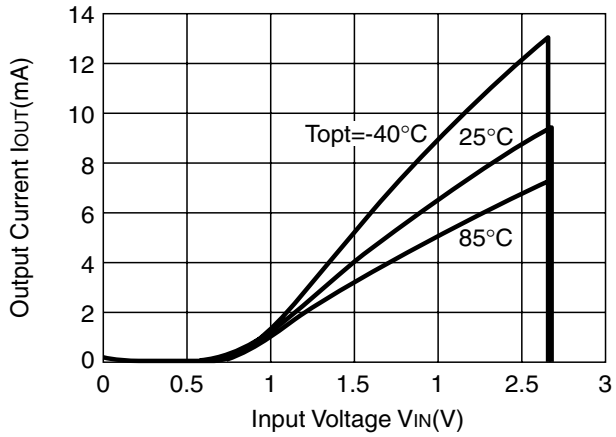


5) Nch Driver Output Current vs. Input Voltage

R3111x09xC



R3111x27xC



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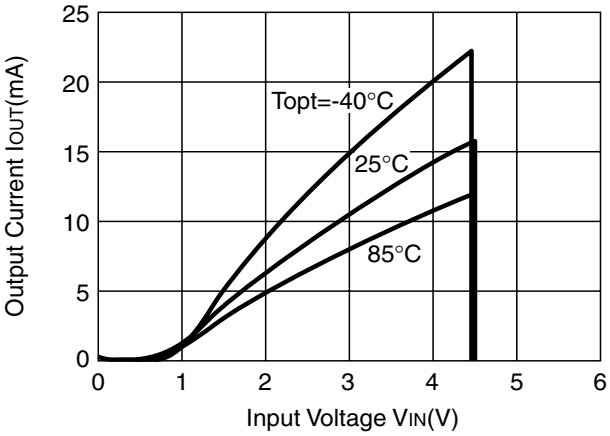
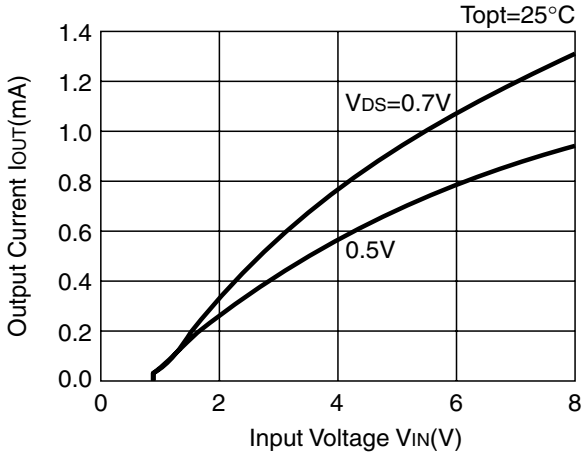
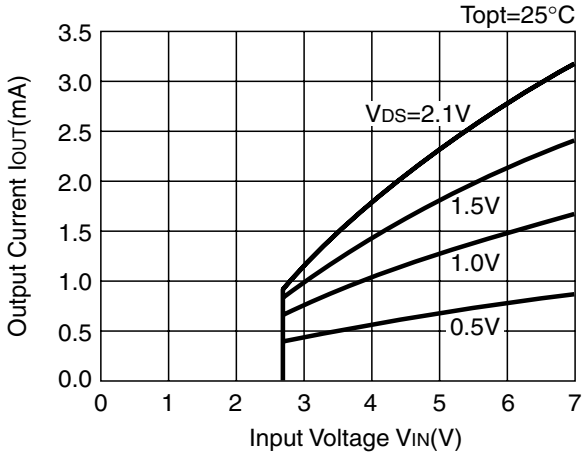


6) Pch Driver Output Current vs. Input Voltage

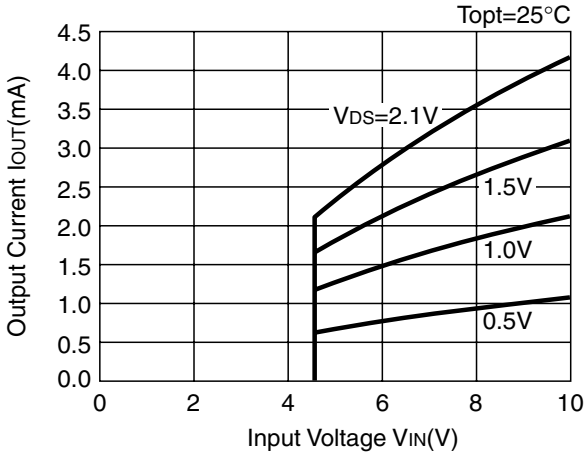
R3111x09xC



R3111x27xC

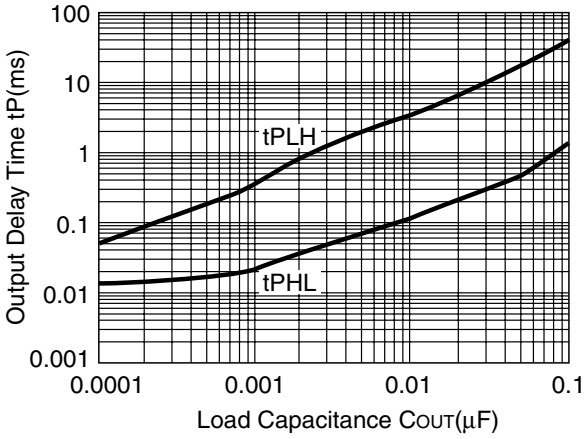


R3111x45xC

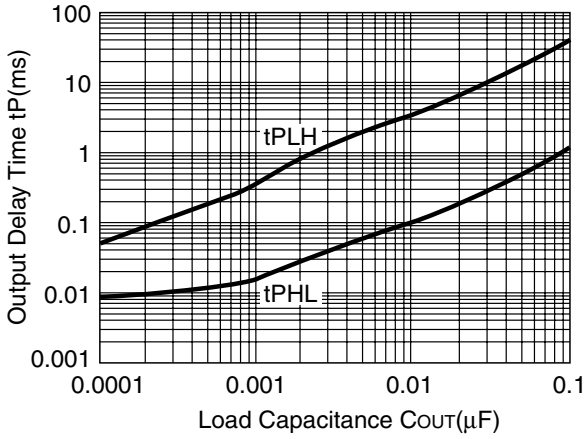


7) Output Delay Time vs. Load Capacitance (Topt=25°C)

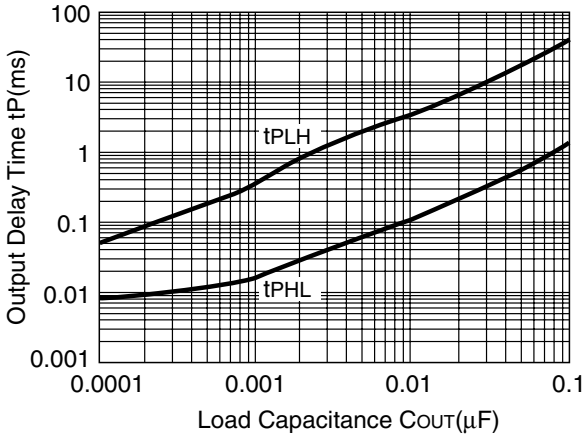
R3111x09xA



R3111x27xA

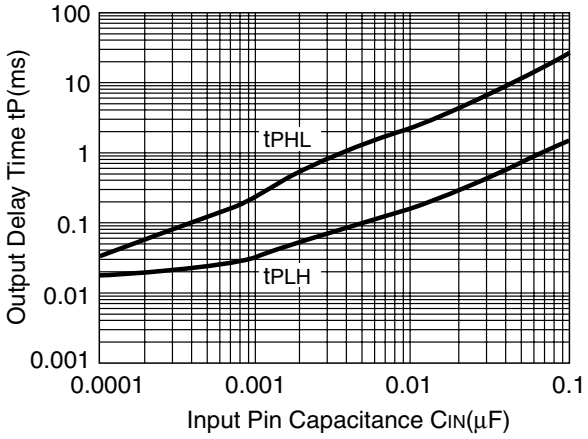


R3111x45xA

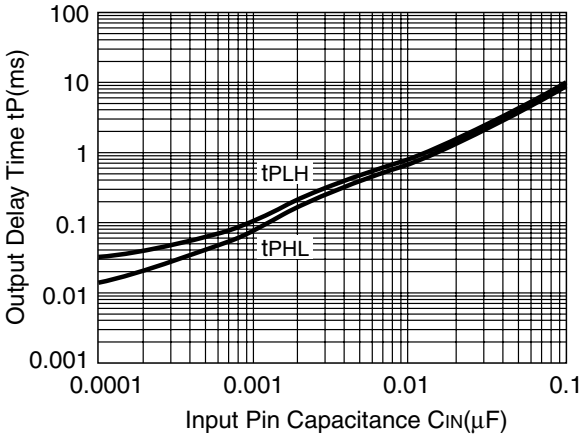


8) Output Delay Time vs. Input Pin Capacitance

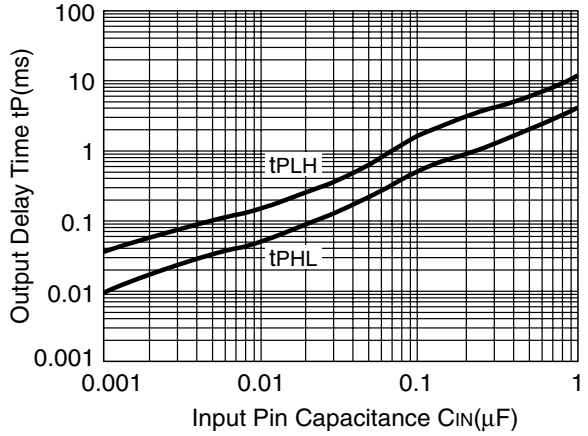
R3111x09xA



R3111x27xA



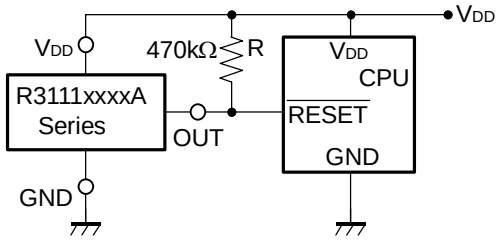
R3111x45xA



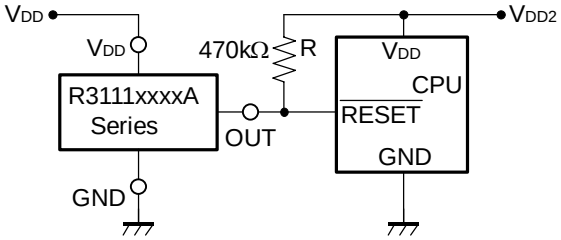
TYPICAL APPLICATION

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

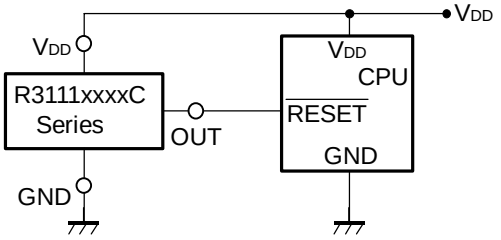
Case 1. Input Voltage to R3111xxxxA is equal to Input Voltage to CPU



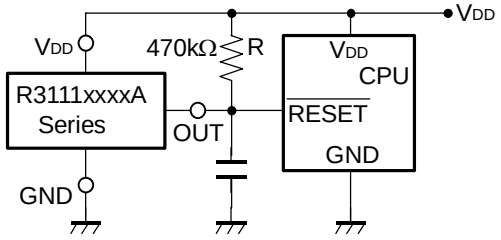
Case 2. Input Voltage to R3111xxxxA is unequal to Input Voltage to CPU



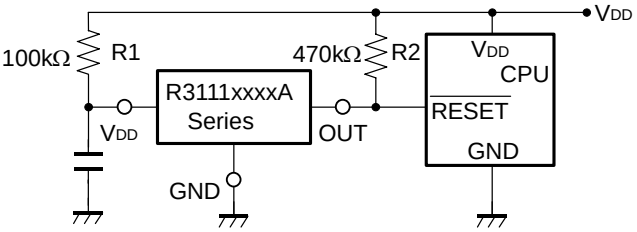
- **R3111xxxxC CPU Reset Circuit (CMOS Output)**



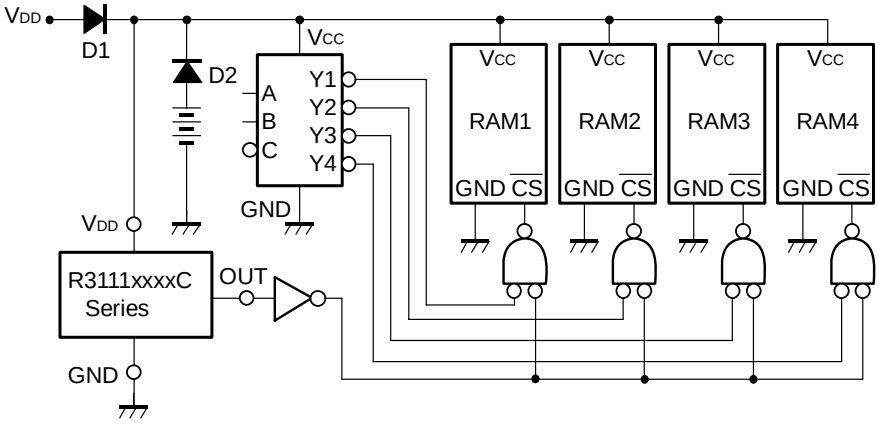
- **R3111xxxxA Output Delay Time Circuit 1 (Nch Open Drain Output)**



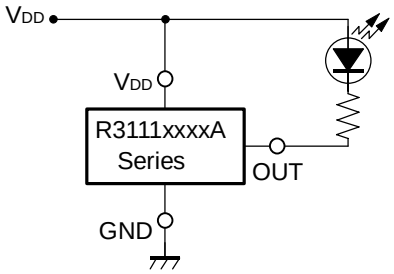
- **R3111xxxxA Output Delay Time Circuit 2 (Nch Open Drain Output)**



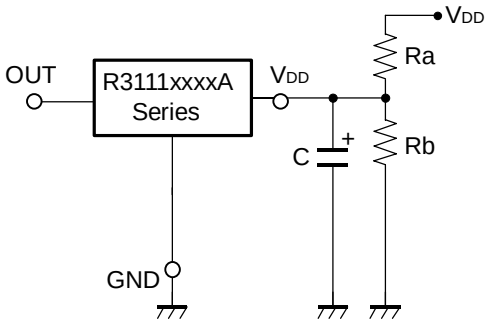
- **Memory Back-up Circuit**



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



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

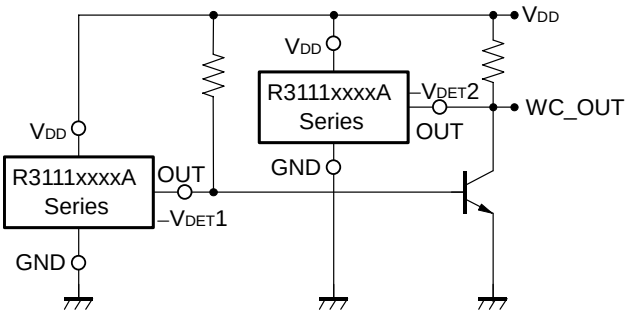


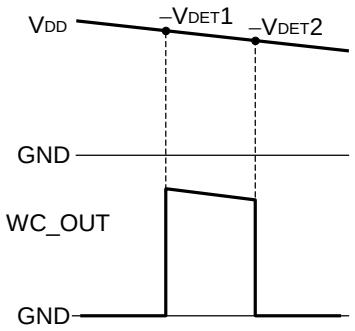
Adjusted Detector Threshold
$=(-V_{DET})\times(Ra+Rb)/Rb$

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

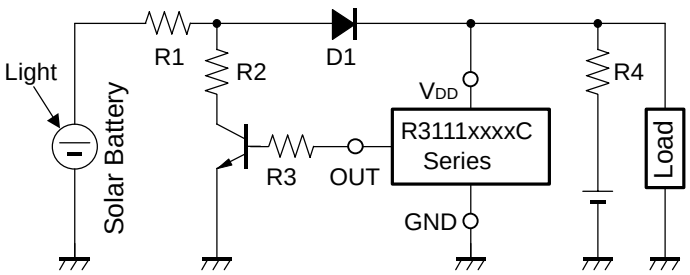
∗) If the value of Ra is set excessively large, voltage drop may occur caused by the supply current of IC itself, and detector threshold may vary.

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





- **Over-charge Preventing Circuit**



TECHNICAL NOTES

When R3111xxxxA/B (Nch Open Drain Output Type) is used in Figure A or Figure B, if impedance of Voltage Supply pin, V_{DD} and V_{DD} of this IC is large, detector threshold level would shift by voltage dropdown caused by the consumption current of the IC itself. Released voltage may also shift and delay time for start-up might be generated by this usage.

When R3111xxxxC (CMOS Output Type) is used in Figure A or Figure B, Output level could be unstable by cross conduction current which is generated at detector threshold level or at released voltage level, therefore, do not use this IC with the connection in Figure A or Figure B.

The connection in Figure C may cause the oscillation in both R3111xxxxC (CMOS Output) and R3111xxxxA/B (Nch Open Drain Output), therefore do not use R3111x Series with the connection in Figure C.

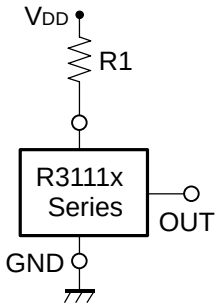


Figure A

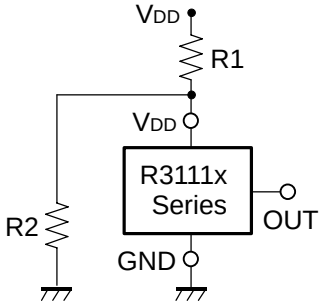


Figure B

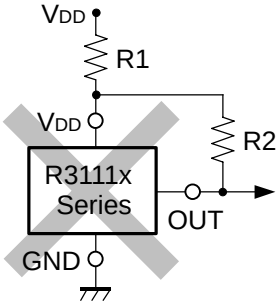


Figure C