
LOW VOLTAGE DETECTOR

NO.EA-056-091102

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.

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

FEATURES

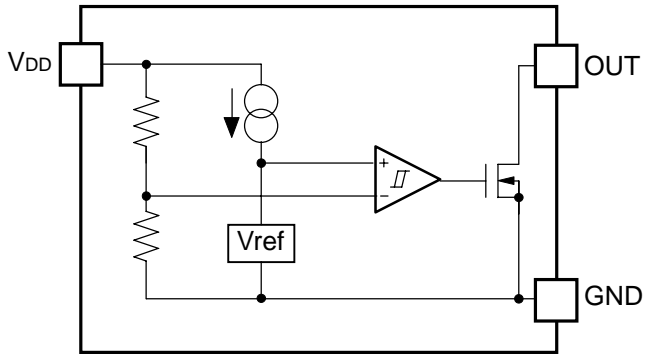
- Supply Current Typ. 0.8 μ A ($-V_{DET}=1.5V$, $V_{DD}=-V_{DET}-0.1V$)
- Operating Voltage Range.....0.7V to 10.0V ($T_{opt}=25^{\circ}C$)
- Detector Threshold Range.....0.9V to 6.0V
- Detector Threshold Accuracy..... $\pm 2.0\%$
- Temperature-Drift Coefficient of Detector Threshold Typ. $\pm 100ppm/^{\circ}C$
- 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

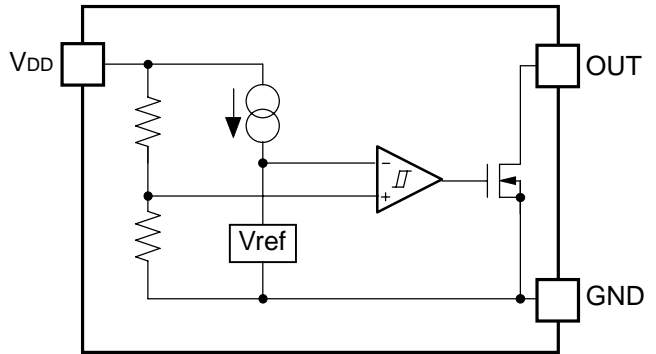
- CPU and Logic Circuit Reset
- Battery Checker
- Window Comparator
- Wave Shaping Circuit
- Battery Back-up Circuit
- Power Failure Detector

BLOCK DIAGRAMS

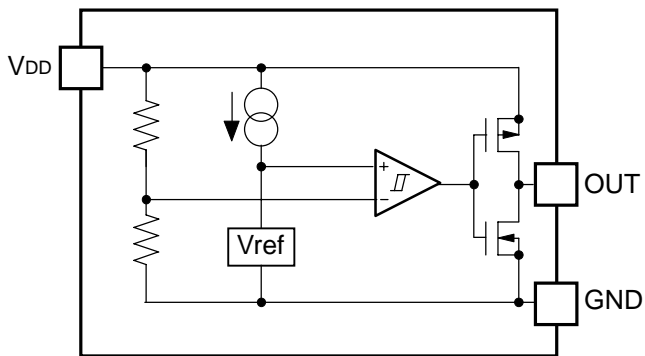
R3111xxxxA



R3111xxxxB



R3111xxxxC



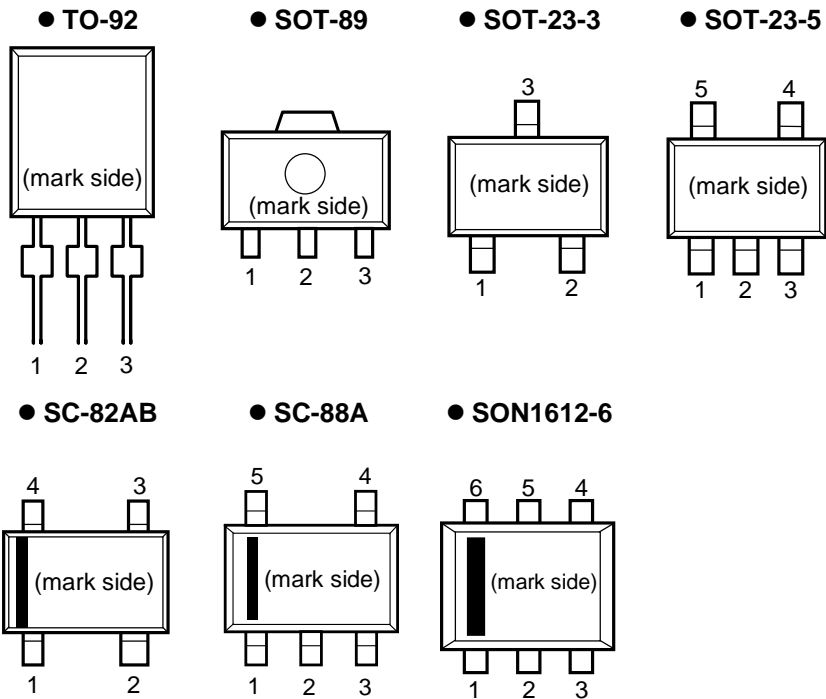
SELECTION GUIDE

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



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	
T_{opt}	Operating Temperature Range	-40 to 85	°C
T_{stg}	Storage Temperature Range	-55 to 125	°C
T_{solder}	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

T_{opt}=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}	T _{opt} =25°C		0.55	0.70	V
		-40°C ≤ T _{opt} ≤ 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
Δ-V _{DET} / ΔT _{opt}	Detector Threshold Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±100		ppm/°C

• R3111x18xA/C

T_{opt}=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}	T _{opt} =25°C		0.55	0.70	V
		-40°C ≤ T _{opt} ≤ 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
Δ-V _{DET} / ΔT _{opt}	Detector Threshold Temperature Coefficient	-40°C ≤ T _{opt} ≤ 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

T_{opt}=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}	T _{opt} =25°C		0.55	0.70	V
		-40°C ≤ T _{opt} ≤ 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
$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±100		ppm/°C

● R3111x36xA/C

T_{opt}=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}	T _{opt} =25°C		0.55	0.70	V
		-40°C ≤ T _{opt} ≤ 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
$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-40°C ≤ T _{opt} ≤ 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.

R3111x

• R3111x45xA/C

T_{opt}=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}	T _{opt} =25°C		0.55	0.70	V
		-40°C ≤ T _{opt} ≤ 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		
t _{PLH}	Output Delay Time ^{*Note2}				100	μs
Δ-V _{DET} / ΔT _{opt}	Detector Threshold Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±100		ppm/°C

• R3111x54xA/C

T_{opt}=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}	T _{opt} =25°C		0.55	0.70	V
		-40°C ≤ T _{opt} ≤ 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		
t _{PLH}	Output Delay Time ^{*Note2}				100	μs
Δ-V _{DET} / ΔT _{opt}	Detector Threshold Temperature Coefficient	-40°C ≤ T _{opt} ≤ 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

T_{opt}=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}	T _{opt} =25°C		0.55	0.70	V
		-40°C ≤ T _{opt} ≤ 85°C		0.65	0.80	
I _{OUT}	Output Current (Driver Output Pin)	Nch V _{DS} =0.10V, V _{DD} =6.5V	2.5			mA
t _{PLH}	Output Delay Time ^{*Note2}				100	μs
Δ-V _{DET} / ΔT _{opt}	Detector Threshold Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±100		ppm/°C

● R3111Q441B

T_{opt}=25°C

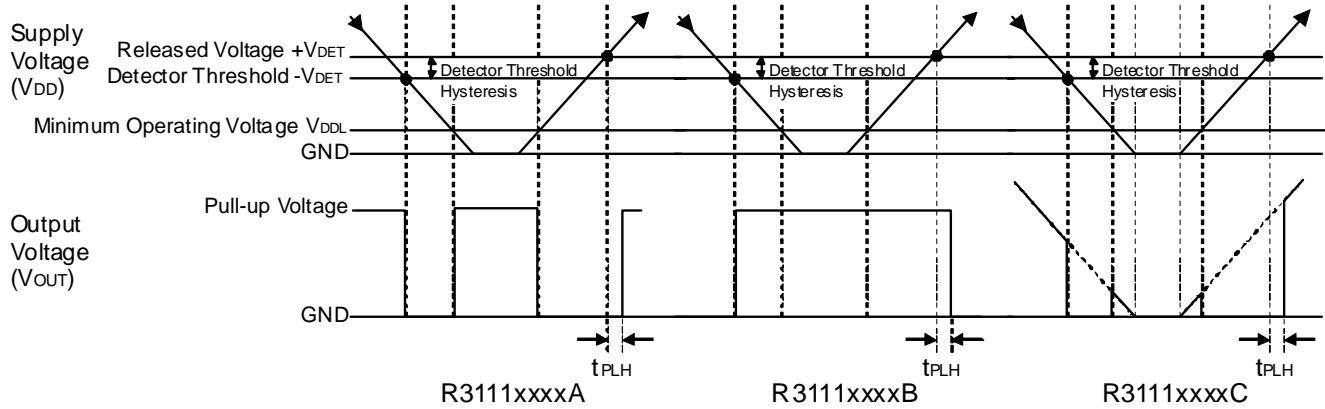
Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
-V _{DET}	Detector Threshold		4.312	4.400	4.488	V
V _{HYS}	Detector Threshold Hysteresis		0.132	0.220	0.308	V
I _{SS}	Supply Current	V _{DD} =4.24V V _{DD} =6.4V		1.1 1.3	3.3 3.9	μA
V _{DDH}	Maximum Operating Voltage				10	V
V _{DDL}	Minimum Operating Voltage ^{*Note1}	T _{opt} =25°C		0.55	0.70	V
		-40°C ≤ T _{opt} ≤ 85°C		0.65	0.80	
I _{OUT}	Output Current (Driver Output Pin)	Nch V _{DS} =0.10V, V _{DD} =6.5V	2.5			mA
t _{PLH}	Output Delay Time ^{*Note2}				100	μs
Δ-V _{DET} / ΔT _{opt}	Detector Threshold Temperature Coefficient	-40°C ≤ T _{opt} ≤ 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

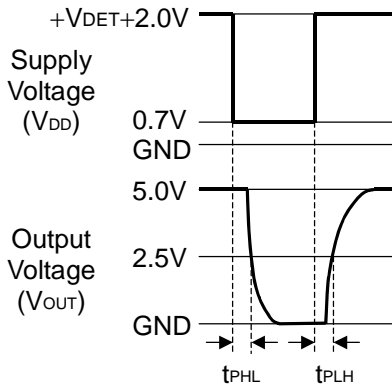
Output Delay Time (t_{PLH}) is defined as follows:

1. In the case of Nch Open Drain Output:(R3111xxxxA/B)

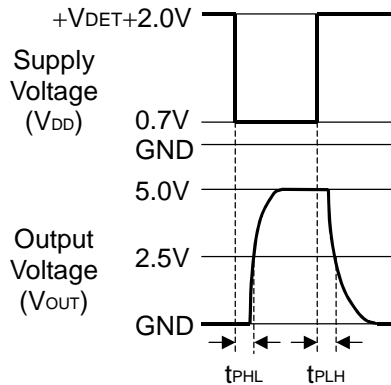
Under the condition of the output pin (OUT) is pulled up through a resistor of 470k Ω to 5V, the time interval between the rising edge of V_{DD} pulse from 0.7V to $(+V_{DET})+2.0V$ and becoming of the output voltage to 2.5V.

2. In the case of CMOS Output:(R3111xxxxC)

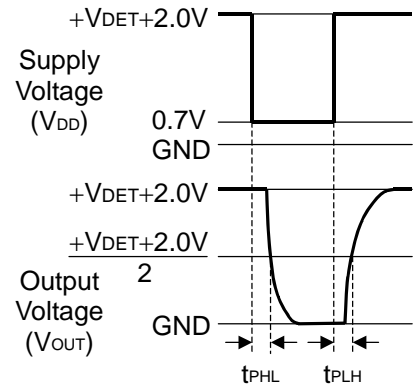
The time interval between the rising edge of V_{DD} pulse from 0.7V to $(+V_{DET})+2.0V$ and becoming of the output voltage to $((+V_{DET})+2.0V)/2$.



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

*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 V_{DD} 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: T_{opt}=25°C

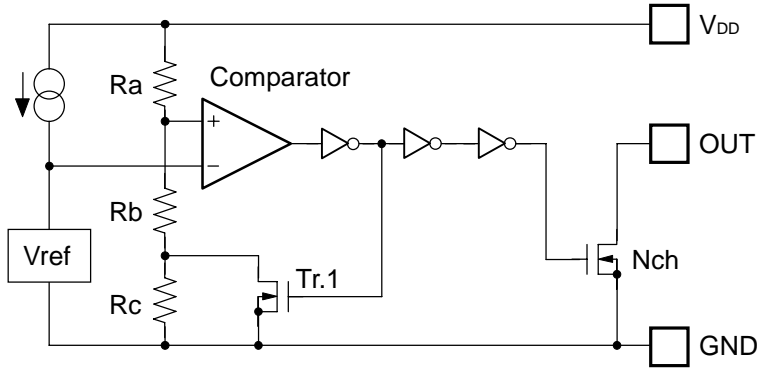
Condition 2: -40°C ≤ T_{opt} ≤ 85°C

Output Current 1			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]		Δ-V _{DET} /ΔT _{opt} [ppm/°C]		
Condition	Min.	Typ.	Condition	Min.	Typ.	Max.	Typ.	Max.	Condition	Typ.	
<A/C version> Nch V _{DS} =0.05V V _{DD} =0.7V	0.01	0.05	V _{DD} = 0.85V	0.05	0.5						
			V _{DD} = 1.0V	0.2	1.0						
<B version> Nch V _{DS} =0.10V V _{DD} =6.5V	2.5	-	Nch V _{DS} = 0.5V	V _{DD} = 1.5V	1.0	2.0	100 *1	*2 Condition 1 0.55	*2 Condition 1 0.70	-40°C ≦ T _{opt} ≦ 85°C	±100
								Condition 2 0.65	Condition 2 0.80		

*3) Only A/C versions.

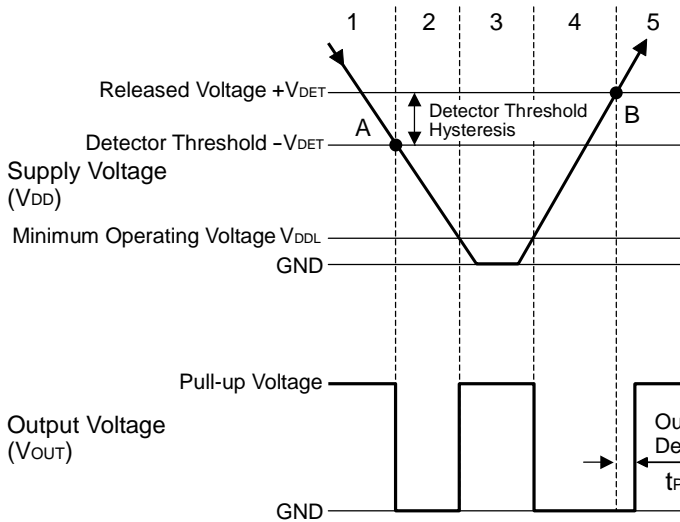
OPERATION

• 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

$$I \quad \frac{R_b + R_c}{R_a + R_b + R_c} \times V_{DD}$$

$$II \quad \frac{R_b}{R_a + R_b} \times V_{DD}$$

Operation Diagram

• Explanation of operation

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

Step 2. At Point "A", $V_{ref} \geq V_{DD} \times (R_b + R_c) / (R_a + R_b + R_c)$ 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 ($-V_{DET}$).

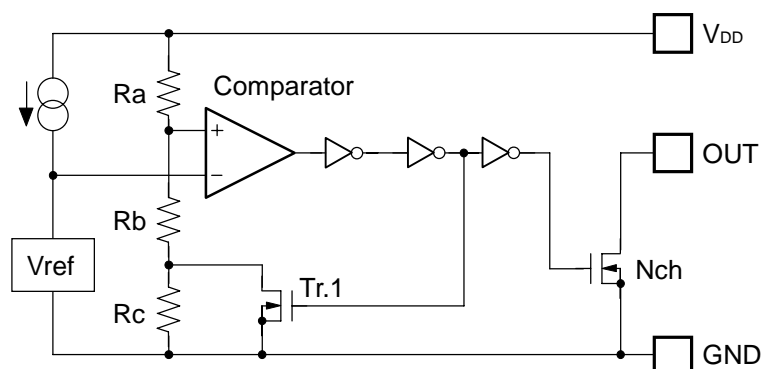
Step 3. When the supply voltage is lower than the minimum operating voltage, the operation of the output transistor becomes indefinite. The output voltage is equal to the pull-up voltage.

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

Step 5. At Point "B", $V_{ref} \leq V_{DD} \times R_b / (R_a + R_b)$ 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 ($+V_{DET}$).

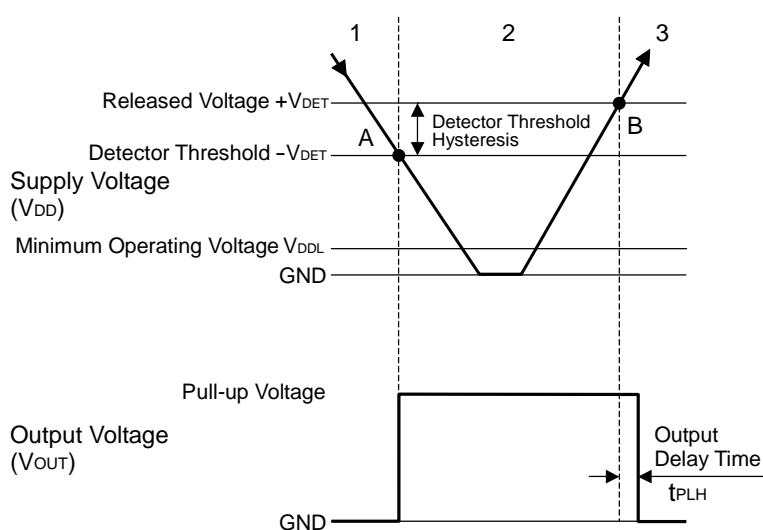
*) The difference between a released voltage and a detector threshold voltage is a detector threshold hysteresis.

• 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

$$I \quad \frac{R_b + R_c}{R_a + R_b + R_c} \times V_{DD}$$

$$II \quad \frac{R_b}{R_a + R_b} \times V_{DD}$$

Operation Diagram

• Explanation of operation

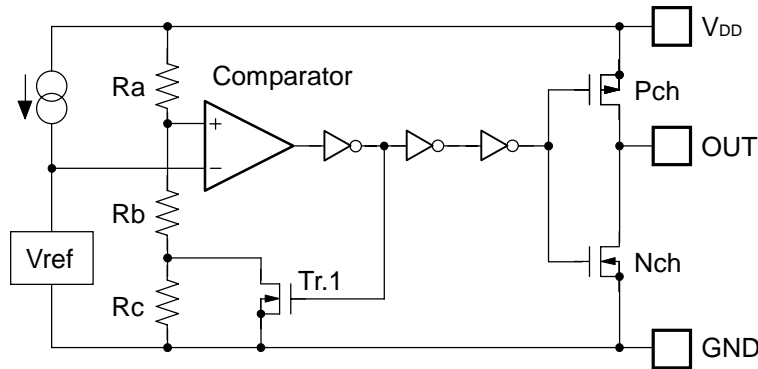
Step 1. The output voltage is equal to the GND level.

Step 2. At Point "A", $V_{ref} \geq V_{DD} \times (R_b + R_c) / (R_a + R_b + R_c)$ 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 ($-V_{DET}$).

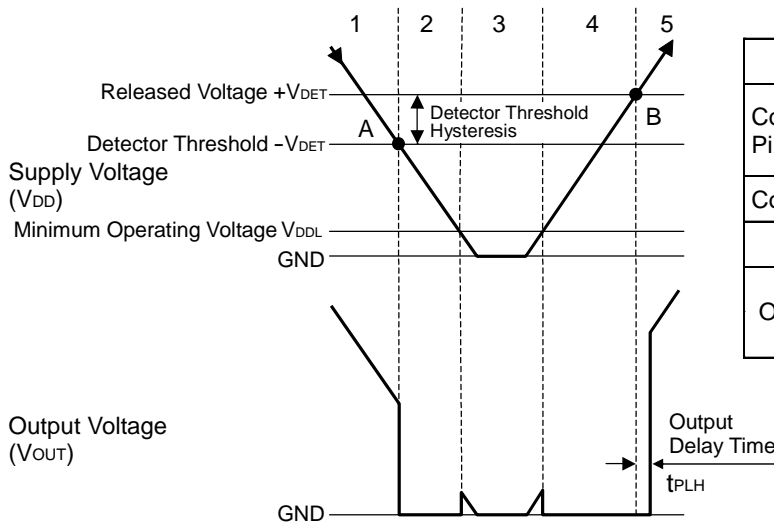
Step 3. At Point "B", $V_{ref} \leq V_{DD} \times R_b / (R_a + R_b)$ is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the GND level. The voltage level of Point B means a released voltage ($+V_{DET}$).

*) 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
	Nch	OFF	ON	Indefinite	ON

$$I \quad \frac{R_b + R_c}{R_a + R_b + R_c} \times V_{DD}$$

$$II \quad \frac{R_b}{R_a + R_b} \times V_{DD}$$

Operation Diagram

• Explanation of operation

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

Step 2. At Point "A", $V_{ref} \geq V_{DD} \times (R_b + R_c) / (R_a + R_b + R_c)$ 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 ($-V_{DET}$).

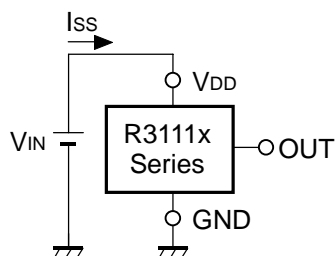
Step 3. When the supply voltage is lower than the minimum operating voltage, the operation of the output transistor becomes indefinite.

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

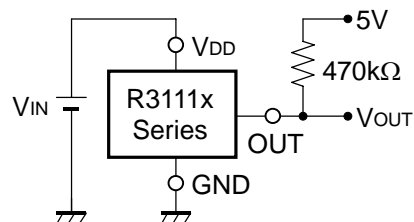
Step 5. At Point "B", $V_{ref} \leq V_{DD} \times R_b / (R_a + R_b)$ is true, as a result, the output of comparator is reversed from "L" to "H", then the output voltage is equal to the supply voltage (V_{DD}). The voltage level of Point B means a released voltage ($+V_{DET}$).

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

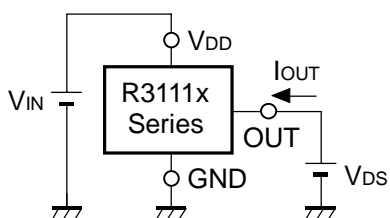
TEST CIRCUITS



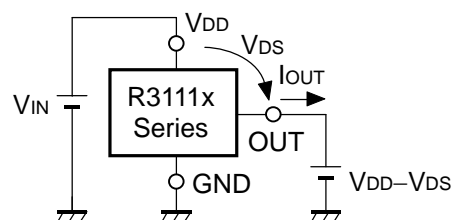
Supply Current Test Circuit



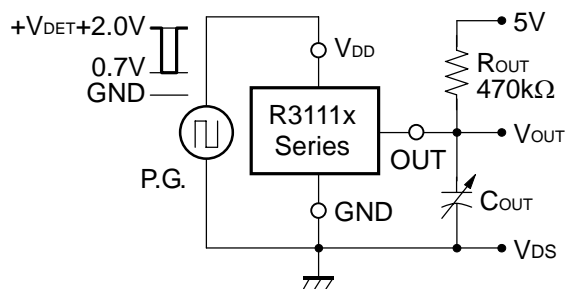
Detector Threshold Test Circuit
(Pull-up circuit is not necessary for CMOS Output type.)



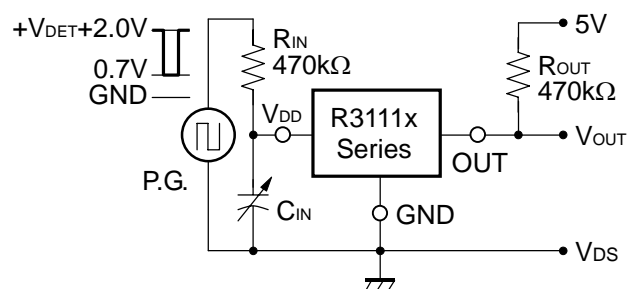
Nch Driver Output Current Test Circuit



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



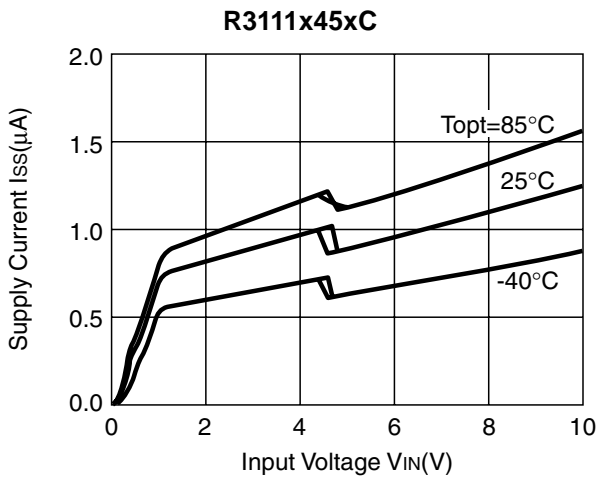
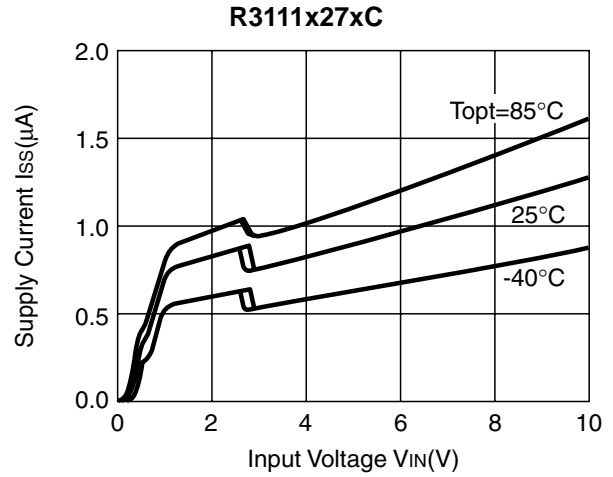
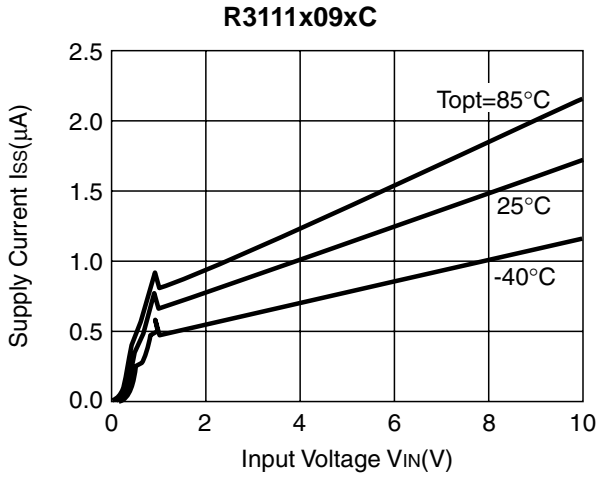
Output Delay Time Test Circuit (1)
(Pull-up circuit is not necessary for CMOS Output type.)



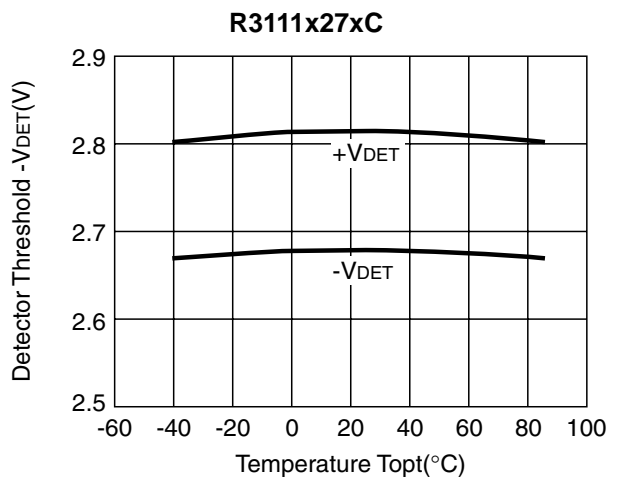
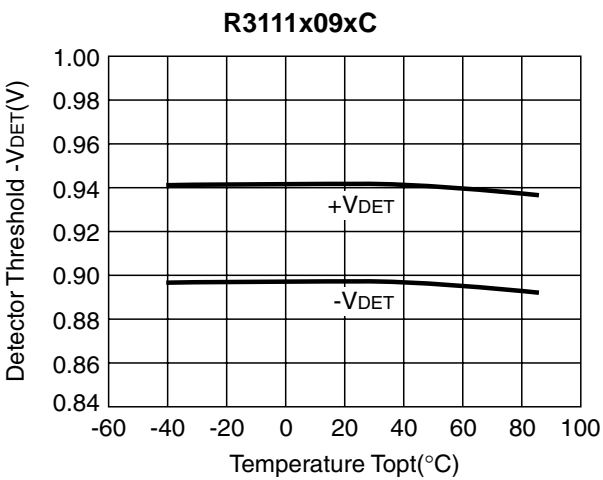
Output Delay Time Test Circuit (2)

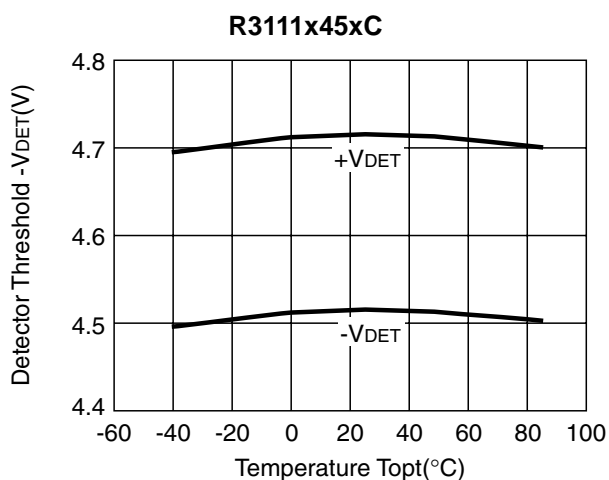
TYPICAL CHARACTERISTICS

1) Supply Current vs. Input Voltage

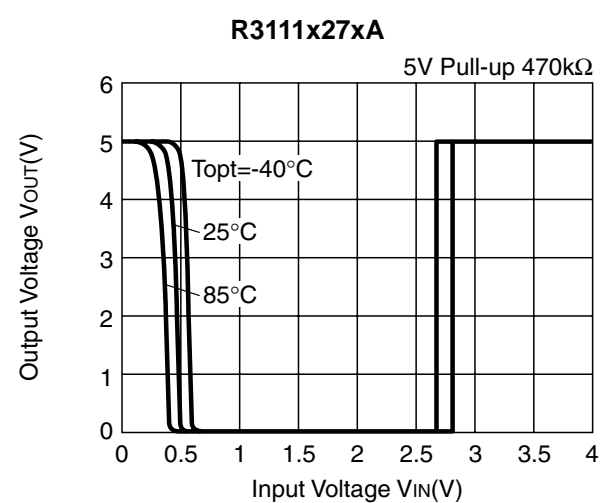
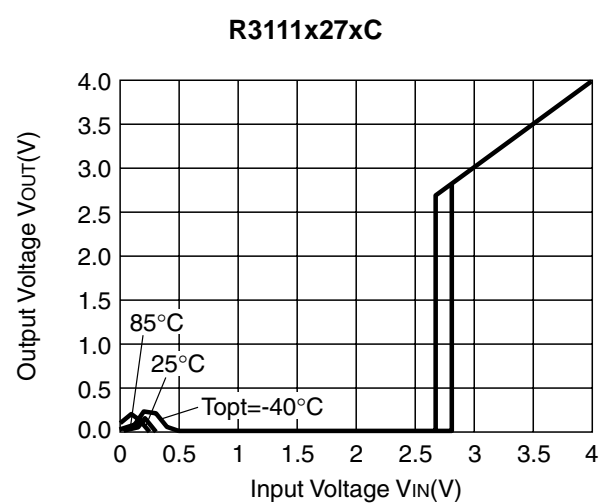
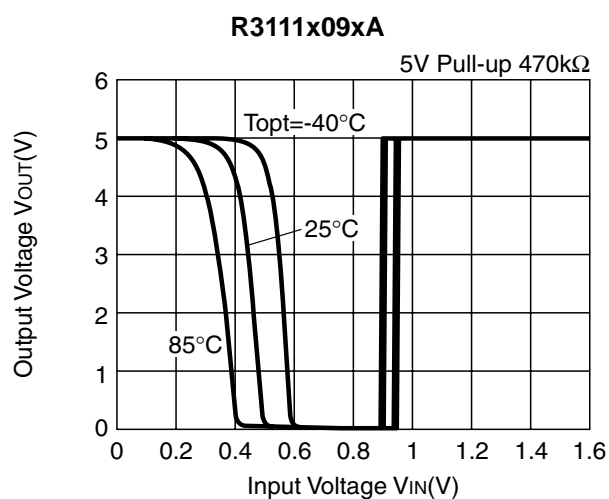
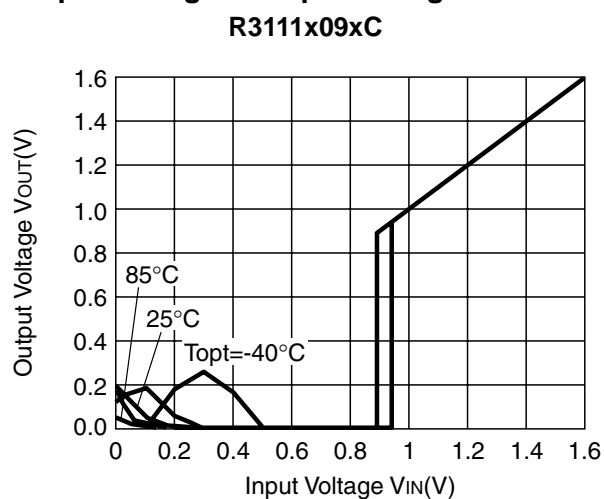


2) Detector Threshold Hysteresis vs. Temperature

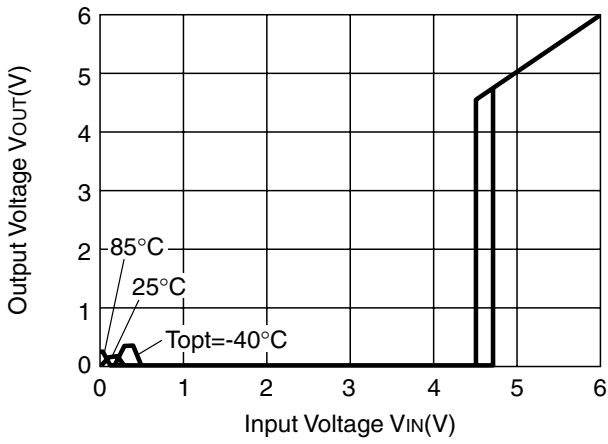




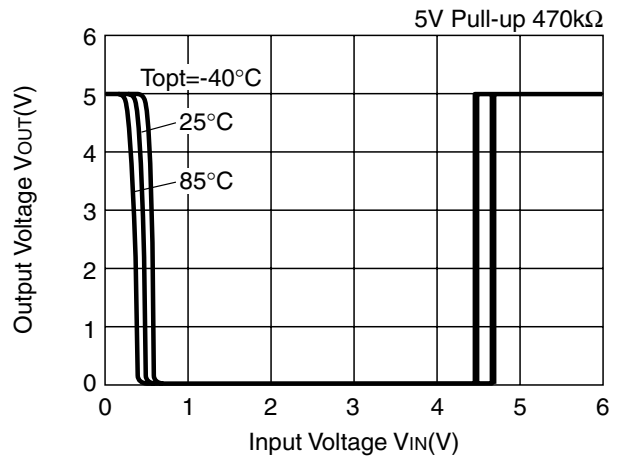
3) Output Voltage vs. Input Voltage



R3111x45xC

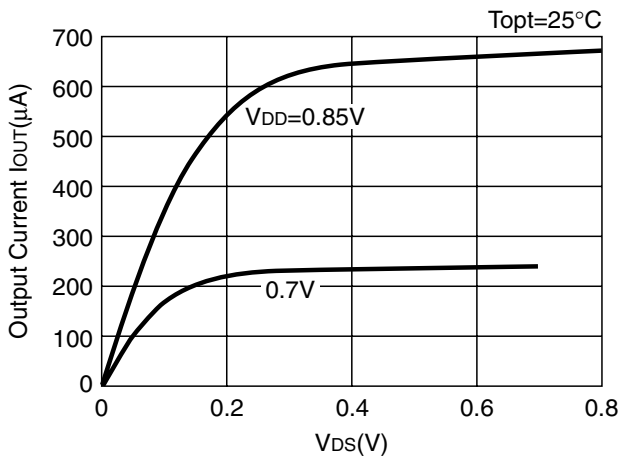


R3111x45xA

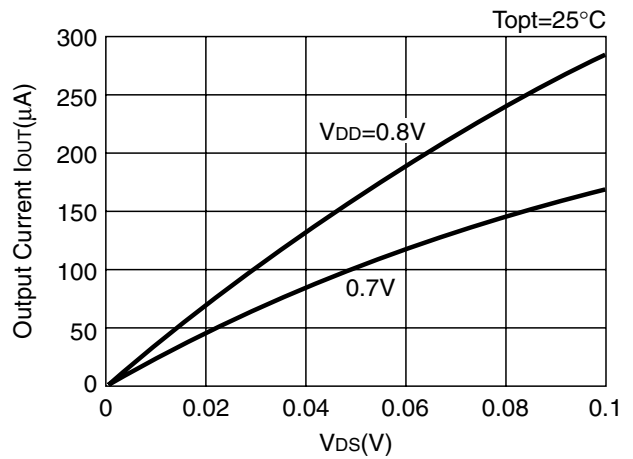


4) Nch Driver Output Current vs. V_{DS}

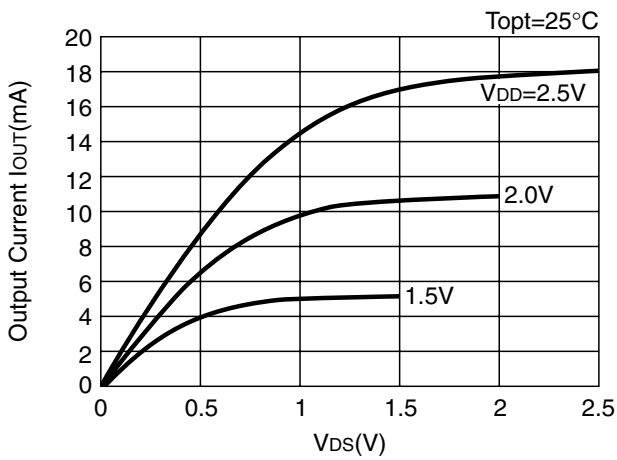
R3111x09xC



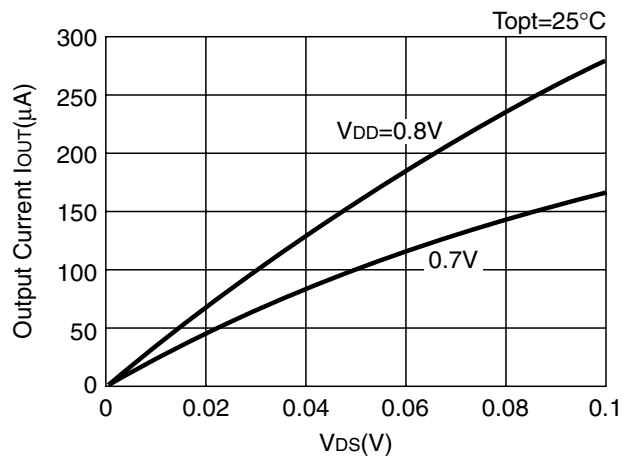
R3111x09xA

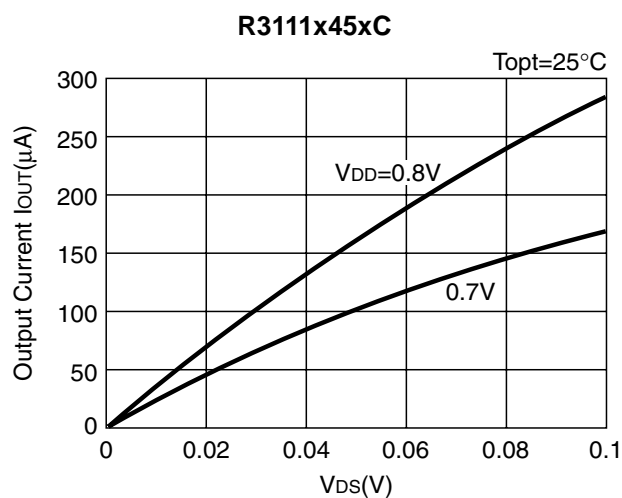
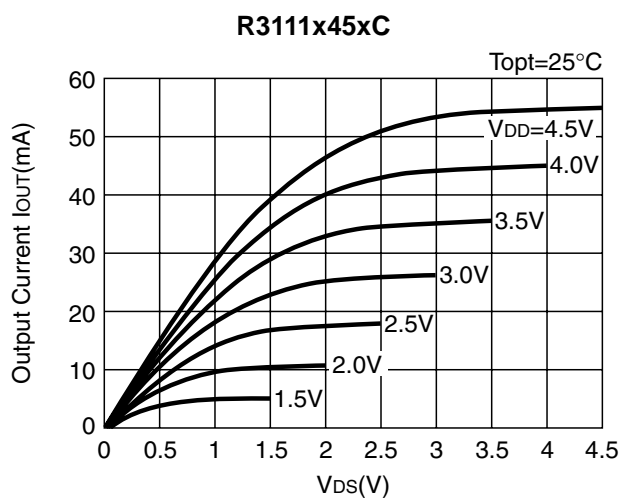


R3111x27xC

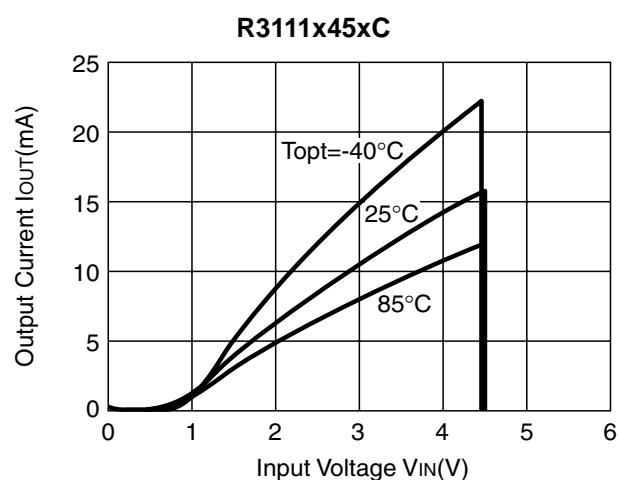
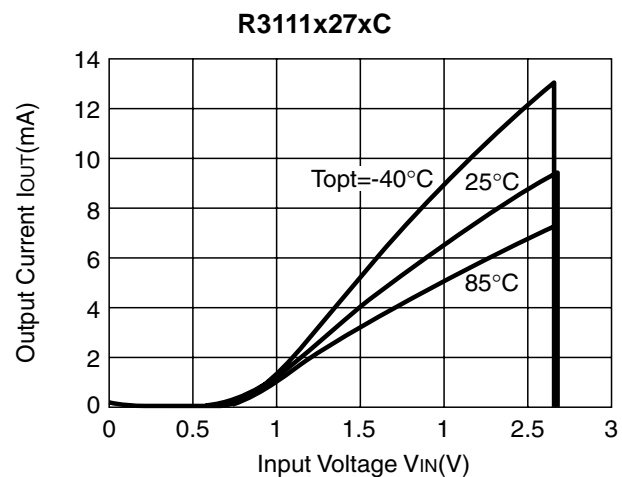
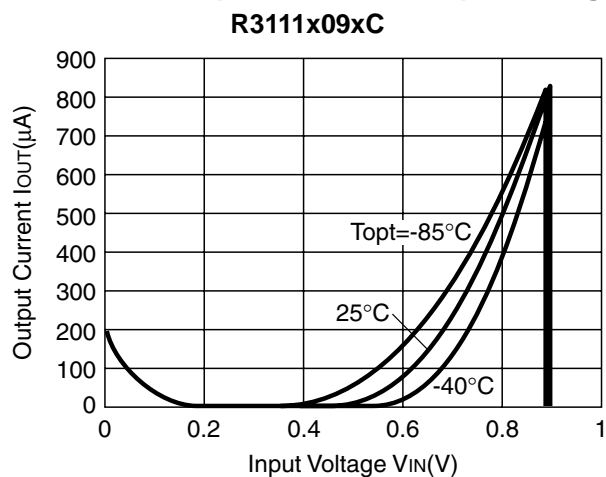


R3111x27xA



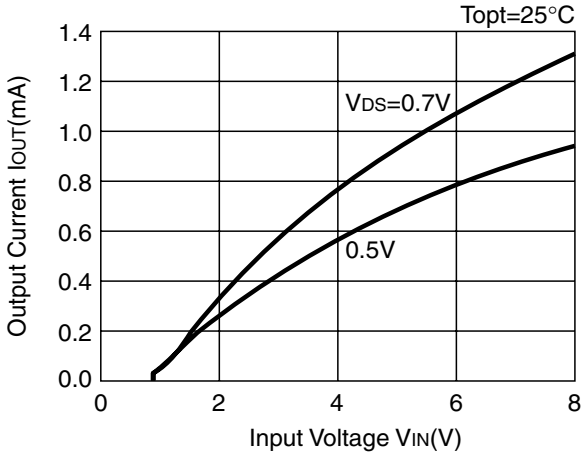


5) Nch Driver Output Current vs. Input Voltage

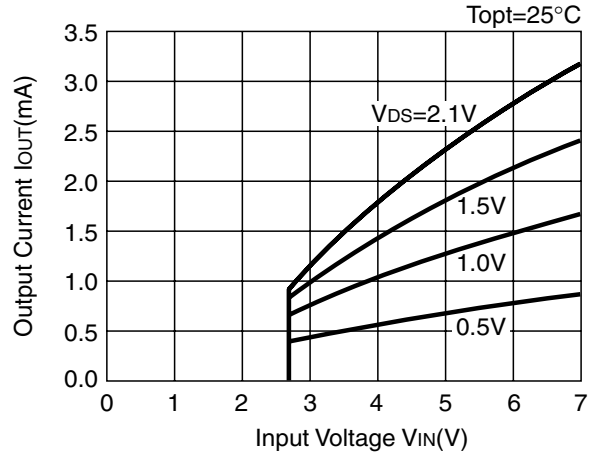


6) Pch Driver Output Current vs. Input Voltage

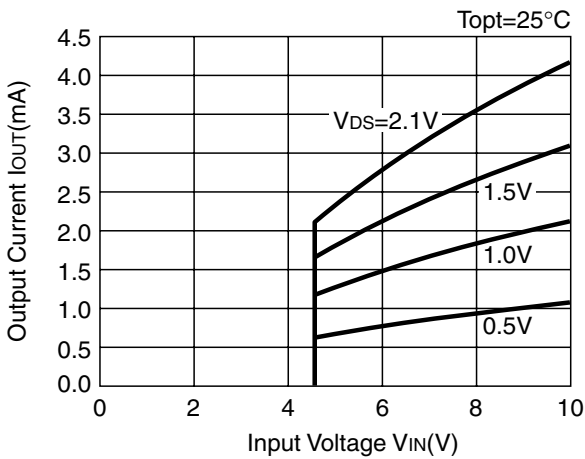
R3111x09xC



R3111x27xC

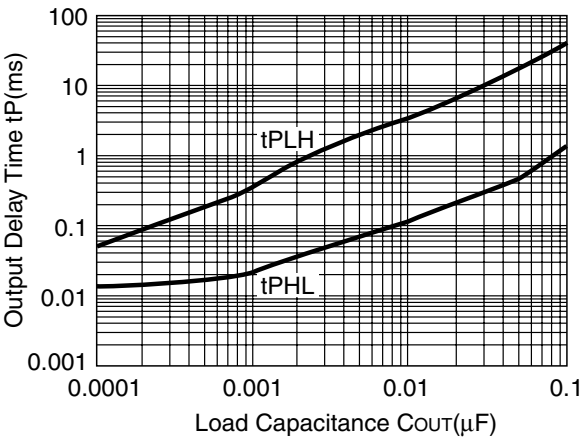


R3111x45xC

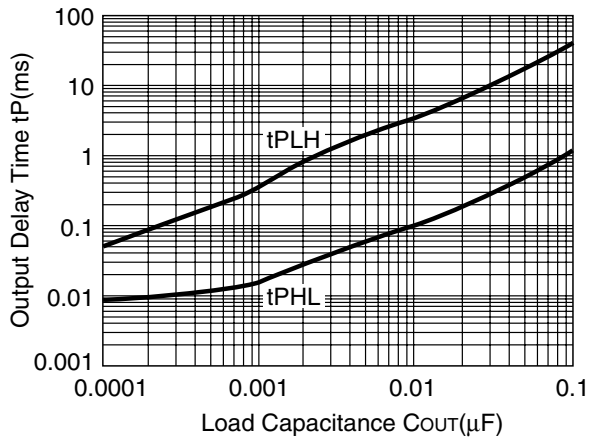


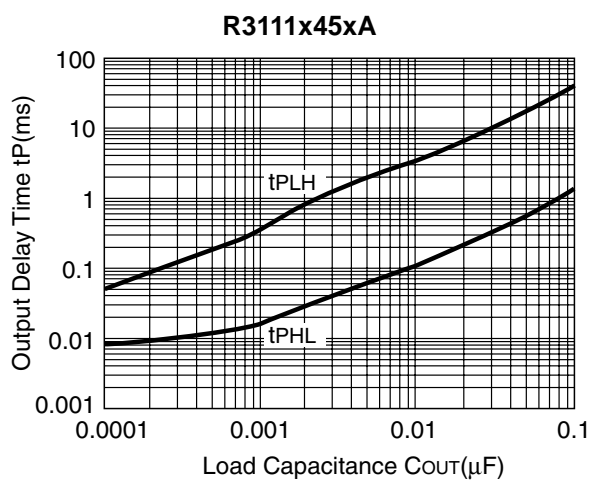
7) Output Delay Time vs. Load Capacitance (Topt=25°C)

R3111x09xA

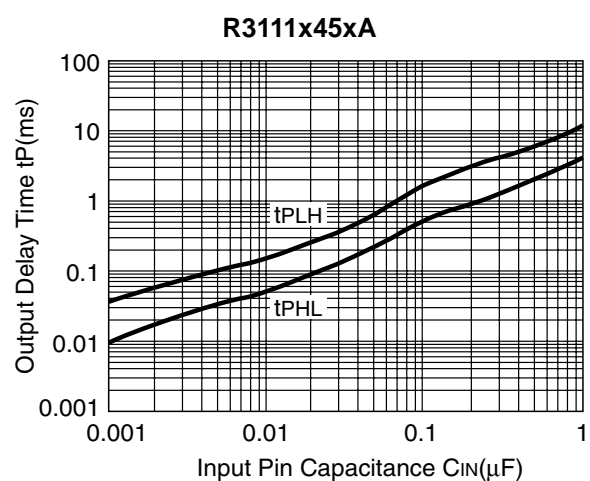
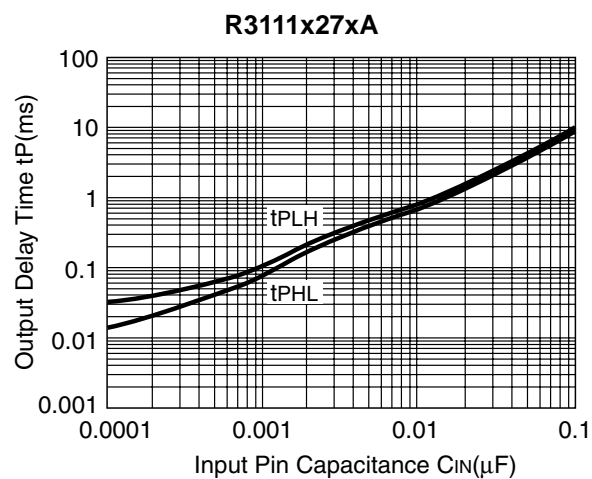
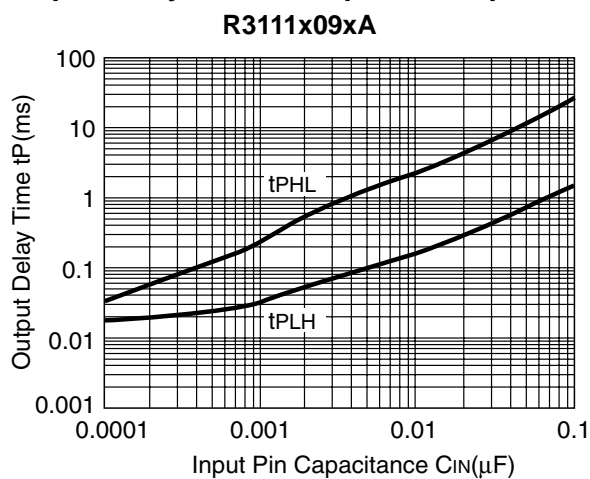


R3111x27xA





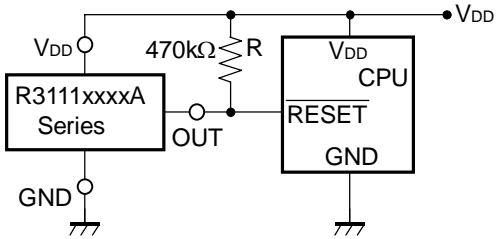
8) Output Delay Time vs. Input Pin Capacitance



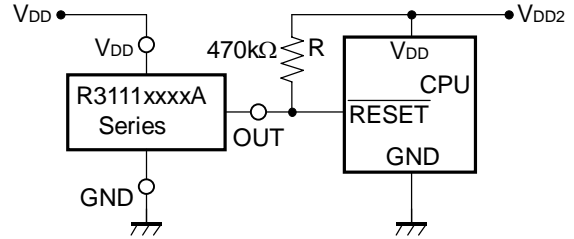
TYPICAL APPLICATION

• R3111xxxxA CPU Reset Circuit (Nch Open Drain Output)

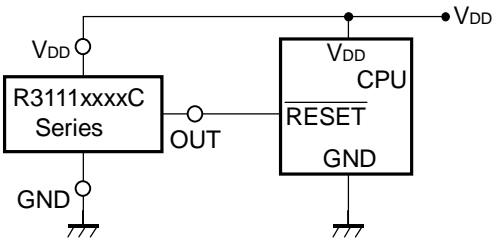
Case 1. Input Voltage to R3111xxxxA is equal to Input Voltage to CPU



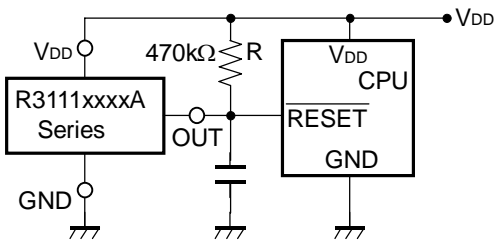
Case 2. Input Voltage to R3111xxxxA is unequal to Input Voltage to CPU



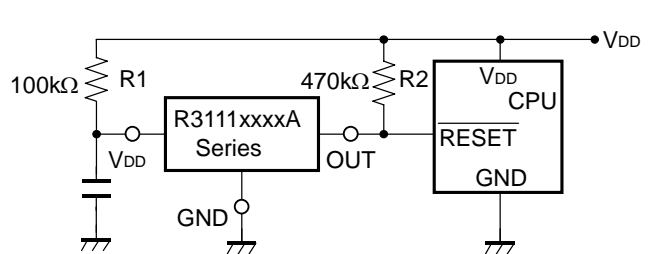
• R3111xxxxC CPU Reset Circuit (CMOS Output)



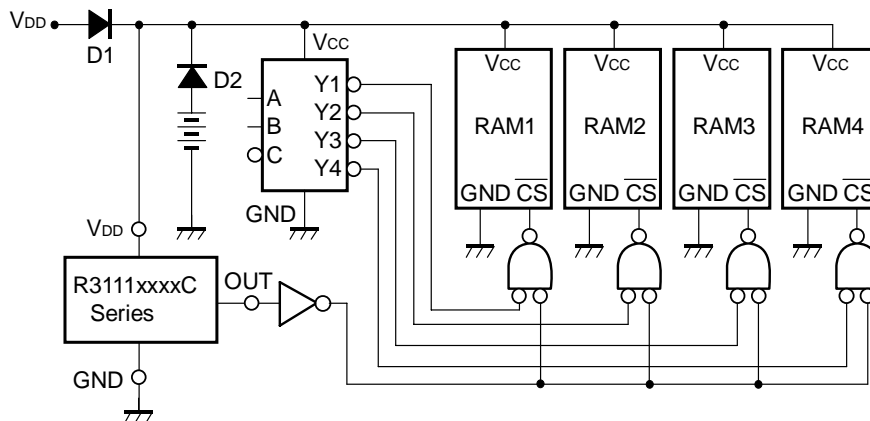
• R3111xxxxA Output Delay Time Circuit 1 (Nch Open Drain Output)



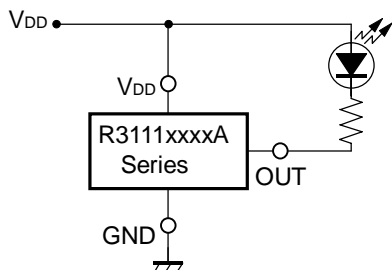
• R3111xxxxA Output Delay Time Circuit 2 (Nch Open Drain Output)



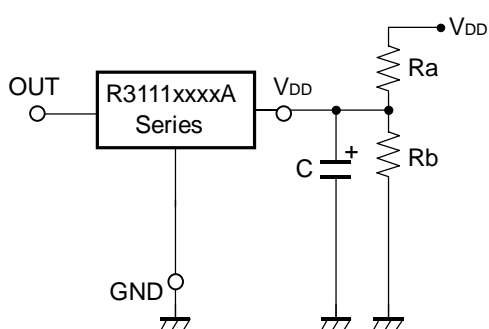
• Memory Back-up Circuit



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



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

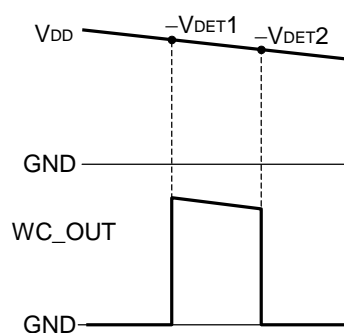
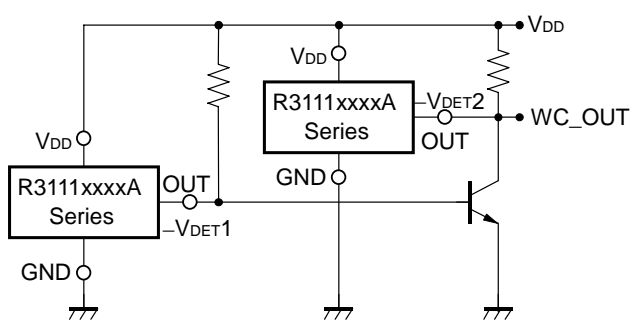


Adjusted Detector Threshold
 $= (-V_{DET}) \times (Ra + Rb) / Rb$

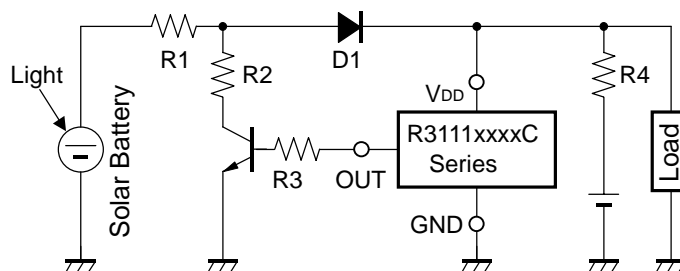
Hysteresis Voltage
 $= (V_{HYS}) \times (Ra + Rb) / Rb$

*) 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.

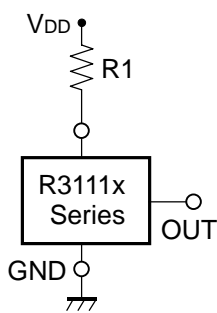


Figure A

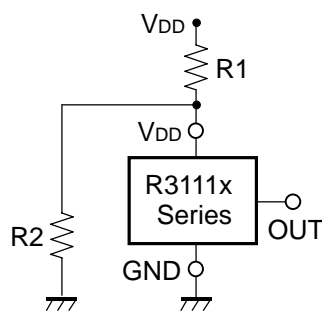


Figure B

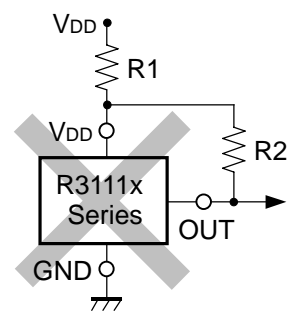


Figure C



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