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## LOW VOLTAGE DETECTOR WITH OUTPUT DELAY

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NO. EA-027-160309

### OUTLINE

The RN5VD 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, resistor net for detector threshold setting, an output driver, a hysteresis circuit, and an output delay 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.

Since the package for these ICs is SOT-23-5 package, high density mounting of the ICs on board is possible.

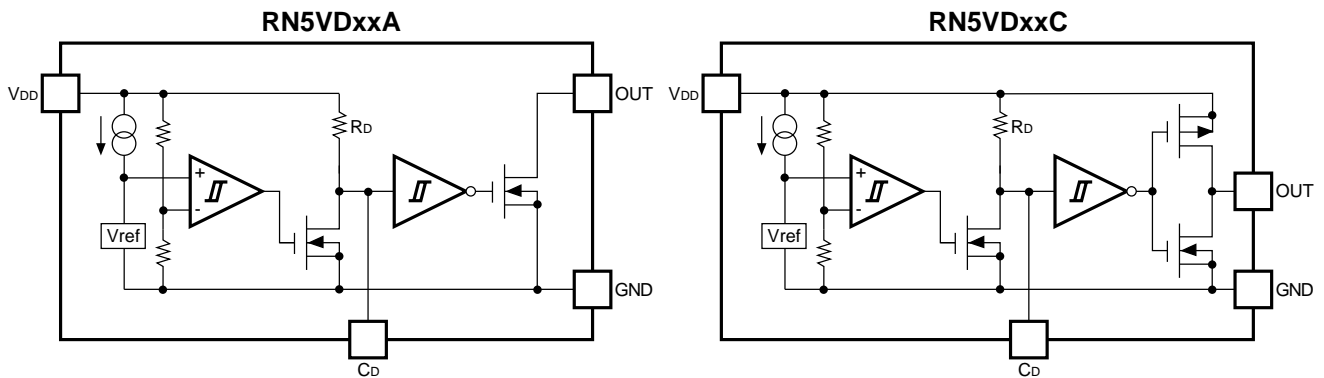
### FEATURES

- Built-in Output Delay Circuit..... Typ. 100ms with an external capacitor : 0.15 $\mu$ F
- Supply Current..... Typ. 1.0 $\mu$ A (RN5VD15x,  $V_{DD}=3.5V$ )
- Operating Voltage Range..... 0.7 to 10.0V ( $T_{opt}=25^{\circ}C$ )
- Detector Threshold Range..... 0.9V to 6.0V (0.1V steps)
- Detector Threshold Accuracy.....  $\pm 2.5\%$
- Temperature-Drift Coefficient of Detector Threshold ..... Typ.  $\pm 100ppm/^{\circ}C$
- Output Types..... Nch Open Drain and CMOS
- Package..... SOT-23-5

### APPLICATIONS

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

## BLOCK DIAGRAMS



## SELECTION GUIDE

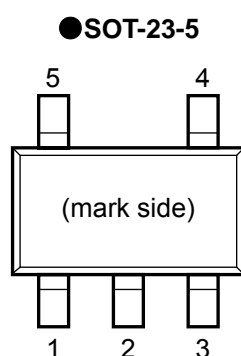
The detector threshold, and the output type for the ICs can be selected at the users' request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RN5VDxx*A-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The detector threshold can be designated in the range from 0.9V(09) to 6.0V(60) in 0.1V steps.

\* : Designation of Output Type  
 (A) Nch Open Drain  
 (C) CMOS

## PIN CONFIGURATION



## PIN DESCRIPTION

Pin No.	Symbol	Pin Description
1	OUT	Output Pin ("L" at Detection)
2	V <sub>DD</sub>	Input Pin
3	GND	Ground Pin
4	NC	No Connection
5	C <sub>D</sub>	Pin for external capacitor ( for setting output delay)

## ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Ratings		Unit
V <sub>DD</sub>	Supply Voltage	12		V
V <sub>OUT</sub>	Output Voltage	CMOS	V <sub>SS</sub> -0.3 to V <sub>DD</sub> +0.3	V
		Nch	V <sub>SS</sub> -0.3~12	
I <sub>OUT</sub>	Output Current	70		mA
P <sub>D</sub>	Power Dissipation (SOT-23-5)*	420		mW
T <sub>opt</sub>	Operating Temperature Range	-40 to +85		°C
T <sub>stg</sub>	Storage Temperature Range	-55 to +125		°C
T <sub>solder</sub>	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.

## ELECTRICAL CHARACTERISTICS

## • RN5VD09A/C

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit.
-V <sub>DET</sub>	Detector Threshold		0.878	0.900	0.922	V
V <sub>HYS</sub>	Detector Threshold Hysteresis		0.027	0.045	0.063	V
I <sub>SS</sub>	Supply Current	V <sub>DD</sub> =0.8V		1.5	3.7	μA
		V <sub>DD</sub> =2.9V		0.9	2.7	
V <sub>DDH</sub>	Maximum Operating Voltage				10	V
V <sub>DDL</sub>	Minimum Operating Voltage (Note 1)	T <sub>opt</sub> =25°C		0.55	0.70	V
		-30°C≤T <sub>opt</sub> ≤85°C		0.65	0.80	
I <sub>OUT</sub>	Output Current	Nch	V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.7V	0.01	0.05	mA
			V <sub>DS</sub> =0.5V, V <sub>DD</sub> =0.85V	0.05	0.50	
		Pch	V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =4.5V	1.0	2.0	mA
V <sub>TCD</sub>	CD pin Threshold Voltage	V <sub>DD</sub> =0.99V	0.297	0.495	0.693	V
I <sub>CD</sub>	CD pin Sink Current	V <sub>DS</sub> =0.1V, V <sub>DD</sub> =0.7V	2.0	30	μA	
		V <sub>DS</sub> =0.5V, V <sub>DD</sub> =0.85V	10.0	100.0		
R <sub>D</sub>	Delay Resistance		0.5	1.0	2.0	MΩ
$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C≤T <sub>opt</sub> ≤85°C		±100		ppm/°C

(Note 1) Minimum Operating Voltage means the value of input voltage when output voltage maintains 0.1V or less, provided that in the case of Nch Open Drain Type Products, the pull-up resistance is set at 470kΩ, and the pull-up voltage is set at 5.0V.

## • RN5VD18A/C

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit.
-V <sub>DET</sub>	Detector Threshold		1.755	1.800	1.845	V
V <sub>HYS</sub>	Detector Threshold Hysteresis		0.054	0.090	0.126	V
I <sub>SS</sub>	Supply Current	V <sub>DD</sub> =1.7V		2.5	5.0	μA
		V <sub>DD</sub> =3.8V		1.0	3.0	
V <sub>DDH</sub>	Maximum Operating Voltage				10	V
V <sub>DDL</sub>	Minimum Operating Voltage (Note 1)	T <sub>opt</sub> =25°C -30°C≤T <sub>opt</sub> ≤85°C		0.55 0.65	0.70 0.80	V
I <sub>OUT</sub>	Output Current	Nch	V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.7V	0.01	0.05	mA
			V <sub>DS</sub> =0.5V, V <sub>DD</sub> =1.5V	1.0	2.0	
		Pch	V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =4.5V	1.0	2.0	mA
V <sub>TCD</sub>	CD pin Threshold Voltage	V <sub>DD</sub> =1.98V	0.693	0.990	1.287	V
I <sub>CD</sub>	CD pin Sink Current	V <sub>DS</sub> =0.1V, V <sub>DD</sub> =0.7V	2.0	30	μA	
		V <sub>DS</sub> =0.5V, V <sub>DD</sub> =1.5V	200.0	800.0		
R <sub>D</sub>	Delay Resistance		0.5	1.0	2.0	MΩ
$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C≤T <sub>opt</sub> ≤85°C		±100		ppm/°C

(Note 1) Minimum Operating Voltage means the value of input voltage when output voltage maintains 0.1V or less, provided that in the case of Nch Open Drain Type Products, the pull-up resistance is set at 470kΩ, and the pull-up voltage is set at 5.0V.

# RN5VD

## • RN5VD27A/C

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit.
-V <sub>DET</sub>	Detector Threshold		2.633	2.700	2.767	V
V <sub>HYS</sub>	Detector Threshold Hysteresis		0.081	0.135	0.189	V
I <sub>SS</sub>	Supply Current	V <sub>DD</sub> =2.6V		3.5	7.0	μA
		V <sub>DD</sub> =4.7V		1.1	3.3	
V <sub>DDH</sub>	Maximum Operating Voltage				10	V
V <sub>DDL</sub>	Minimum Operating Voltage (Note 1)	T <sub>opt</sub> =25°C -30°C ≤ T <sub>opt</sub> ≤ 85°C		0.55 0.65	0.70 0.80	V
I <sub>OUT</sub>	Output Current	Nch	V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.7V	0.01	0.05	mA
			V <sub>DS</sub> =0.5V, V <sub>DD</sub> =1.5V	1.0	2.0	
		Pch	V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =4.5V	1.0	2.0	mA
V <sub>TCD</sub>	CD pin Threshold Voltage	V <sub>DD</sub> =2.97V	1.188	1.485	1.782	V
I <sub>CD</sub>	CD pin Sink Current	V <sub>DS</sub> =0.1V, V <sub>DD</sub> =0.7V	2.0	30	μA	
		V <sub>DS</sub> =0.5V, V <sub>DD</sub> =1.5V	200.0	800.0		
R <sub>D</sub>	Delay Resistance		0.5	1.0	2.0	MΩ
$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C

( Note 1) Minimum Operating Voltage means the value of input voltage when output voltage maintains 0.1V or less, provided that in the case of Nch Open Drain Type Products, the pull-up resistance is set at 470kΩ, and the pull-up voltage is set at 5.0V.

## • RN5VD36A/C

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit.
-V <sub>DET</sub>	Detector Threshold		3.510	3.600	3.690	V
V <sub>HYS</sub>	Detector Threshold Hysteresis		0.108	0.180	0.252	V
I <sub>SS</sub>	Supply Current	V <sub>DD</sub> =3.47V		4.5	9.0	μA
		V <sub>DD</sub> =5.6V		1.2	3.6	
V <sub>DDH</sub>	Maximum Operating Voltage				10	V
V <sub>DDL</sub>	Minimum Operating Voltage (Note 1)	T <sub>opt</sub> =25°C -30°C ≤ T <sub>opt</sub> ≤ 85°C		0.55 0.65	0.70 0.80	V
I <sub>OUT</sub>	Output Current	Nch	V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.7V	0.01	0.05	mA
			V <sub>DS</sub> =0.5V, V <sub>DD</sub> =1.5V	1.0	2.0	
		Pch	V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =4.5V	1.0	2.0	mA
V <sub>TCD</sub>	CD pin Threshold Voltage	V <sub>DD</sub> =3.96V	1.584	1.980	2.376	V
I <sub>CD</sub>	CD pin Sink Current	V <sub>DS</sub> =0.1V, V <sub>DD</sub> =0.7V	2.0	30	μA	
		V <sub>DS</sub> =0.5V, V <sub>DD</sub> =1.5V	200.0	800.0		
R <sub>D</sub>	Delay Resistance		0.5	1.0	2.0	MΩ
$\frac{\Delta -V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C

(Note 1) Minimum Operating Voltage means the value of input voltage when output voltage maintains 0.1V or less, provided that in the case of Nch Open Drain Type Products, the pull-up resistance is set at 470kΩ, and the pull-up voltage is set at 5.0V.

## RN5VD

### • RN5VD45A/C

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit.
-V <sub>DET</sub>	Detector Threshold		4.388	4.500	4.612	V
V <sub>HYS</sub>	Detector Threshold Hysteresis		0.135	0.225	0.315	V
I <sub>SS</sub>	Supply Current	V <sub>DD</sub> =4.34V		5.5	11.0	μA
		V <sub>DD</sub> =6.5V		1.3	3.9	
V <sub>DDH</sub>	Maximum Operating Voltage				10	V
V <sub>DDL</sub>	Minimum Operating Voltage (Note 1)	T <sub>opt</sub> =25°C -30°C ≤ T <sub>opt</sub> ≤ 85°C		0.55 0.65	0.70 0.80	V
I <sub>OUT</sub>	Output Current	Nch	V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.7V	0.01	0.05	mA
			V <sub>DS</sub> =0.5V, V <sub>DD</sub> =1.5V	1.0	2.0	
		Pch	V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =8.0V	1.5	3.0	mA
V <sub>TCD</sub>	CD pin Threshold Voltage	V <sub>DD</sub> =4.95V	1.980	2.475	2.970	V
I <sub>CD</sub>	CD pin Sink Current	V <sub>DS</sub> =0.1V, V <sub>DD</sub> =0.7V	2.0	30	μA	
		V <sub>DS</sub> =0.5V, V <sub>DD</sub> =1.5V	200.0	800.0		
R <sub>D</sub>	Delay Resistance		0.5	1.0	2.0	MΩ
$\frac{\Delta -V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C ≤ T <sub>opt</sub> ≤ 85°C		±100		ppm/°C

(Note 1) Minimum Operating Voltage means the value of input voltage when output voltage maintains 0.1V or less, provided that in the case of Nch Open Drain Type Products, the pull-up resistance is set at 470kΩ, and the pull-up voltage is set at 5.0V.



## • RN5VD54A/C

T<sub>opt</sub>=25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit.
-V <sub>DET</sub>	Detector Threshold		5.265	5.400	5.535	V
V <sub>HYS</sub>	Detector Threshold Hysteresis		0.162	0.270	0.378	V
I <sub>SS</sub>	Supply Current	V <sub>DD</sub> =5.2V		6.0	12.0	μA
		V <sub>DD</sub> =7.4V		1.4	4.2	
V <sub>DDH</sub>	Maximum Operating Voltage				10	V
V <sub>DDL</sub>	Minimum Operating Voltage (Note 1)	T <sub>opt</sub> =25°C -30°C≤T <sub>opt</sub> ≤85°C		0.55 0.65	0.70 0.80	V
I <sub>OUT</sub>	Output Current	Nch	V <sub>DS</sub> =0.05V, V <sub>DD</sub> =0.7V	0.01	0.05	mA
			V <sub>DS</sub> =0.5V, V <sub>DD</sub> =1.5V	1.0	2.0	
		Pch	V <sub>DS</sub> =-2.1V, V <sub>DD</sub> =8.0V	1.5	3.0	mA
V <sub>TCD</sub>	CD pin Threshold Voltage	V <sub>DD</sub> =5.94V	2.376	2.970	3.564	V
I <sub>CD</sub>	CD pin Sink Current	V <sub>DS</sub> =0.1V, V <sub>DD</sub> =0.7V	2.0	30	μA	
		V <sub>DS</sub> =0.5V, V <sub>DD</sub> =1.5V	200.0	800.0		
R <sub>D</sub>	Delay Resistance		0.5	1.0	2.0	MΩ
$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C≤T <sub>opt</sub> ≤85°C		±100		ppm/°C

(Note 1) Minimum Operating Voltage means the value of input voltage when output voltage maintains 0.1V or less, provided that in the case of Nch Open Drain Type Products, the pull-up resistance is set at 470kΩ, and the pull-up voltage is set at 5.0V.

# ELECTRICAL CHARACTERISTICS BY DETECTOR THRESHOLD

• RN5VD09A/C to RN5VD39A/C

Part Number.	Detector Threshold			Hysteresis			Supply Current 1			Supply Current 2			Output Current 1			Output Current 2															
	-V <sub>DET</sub> (V)			V <sub>HYS</sub> (V)			I <sub>SS1</sub> (μA)			I <sub>SS2</sub> (μA)			I <sub>OUT1</sub> (mA)			I <sub>OUT2</sub> (mA)															
	Min.	Typ.	Max.	Min.	Typ.	Max.	conditions	Typ.	Max.	conditions	Typ.	Max.	conditions	Min.	Typ.	conditions	Min.	Typ.													
RN5VD09A/C	0.878	0.900	0.922	0.027	0.045	0.063	V <sub>DD</sub> = (-V <sub>DET</sub> ) -0.10V	1.5	3.7	0.9	2.7	Nch	0.01	0.05	Nch	V <sub>DD</sub> = 0.85V	0.05	0.50													
RN5VD10A/C	0.975	1.000	1.025	0.030	0.050	0.070																									
RN5VD11A/C	1.073	1.100	1.127	0.033	0.055	0.077													1.8	4.5											
RN5VD12A/C	1.170	1.200	1.230	0.036	0.060	0.084																									
RN5VD13A/C	1.268	1.300	1.332	0.039	0.065	0.091													2.0	5.0	1.0	3.0	V <sub>DD</sub> = 1.0V	0.2	1.0						
RN5VD14A/C	1.365	1.400	1.435	0.042	0.070	0.098																									
RN5VD15A/C	1.463	1.500	1.537	0.045	0.075	0.105													2.5	5.0											
RN5VD16A/C	1.560	1.600	1.640	0.048	0.080	0.112																									
RN5VD17A/C	1.658	1.700	1.742	0.051	0.085	0.119													3.0	6.0	V <sub>DD</sub> = (-V <sub>DET</sub> ) +2.0V	1.1	3.3	0.05V	0.01	0.05	Nch	V <sub>DSS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0
RN5VD18A/C	1.755	1.800	1.845	0.054	0.090	0.126																									
RN5VD19A/C	1.853	1.900	1.947	0.057	0.095	0.133													3.5	7.0											
RN5VD20A/C	1.950	2.000	2.050	0.060	0.100	0.140																									
RN5VD21A/C	2.048	2.100	2.152	0.063	0.105	0.147													4.0	8.0	1.2	3.6									
RN5VD22A/C	2.145	2.200	2.255	0.066	0.110	0.154																									
RN5VD23A/C	2.243	2.300	2.357	0.069	0.115	0.161													4.5	9.0											
RN5VD24A/C	2.340	2.400	2.460	0.072	0.120	0.168																									
RN5VD25A/C	2.438	2.500	2.562	0.075	0.125	0.175													V <sub>DD</sub> = (-V <sub>DET</sub> ) -0.13V	4.5	9.0										
RN5VD26A/C	2.535	2.600	2.665	0.078	0.130	0.182																									
RN5VD27A/C	2.633	2.700	2.767	0.081	0.135	0.189													4.5	9.0											
RN5VD28A/C	2.730	2.800	2.870	0.084	0.140	0.196																									
RN5VD29A/C	2.828	2.900	2.972	0.087	0.145	0.203	4.5	9.0																							
RN5VD30A/C	2.925	3.000	3.075	0.090	0.150	0.210																									
RN5VD31A/C	3.023	3.100	3.177	0.093	0.155	0.217	4.5	9.0																							
RN5VD32A/C	3.120	3.200	3.280	0.096	0.160	0.224																									
RN5VD33A/C	3.218	3.300	3.382	0.099	0.165	0.231	4.5	9.0																							
RN5VD34A/C	3.315	3.400	3.485	0.102	0.170	0.238																									
RN5VD35A/C	3.413	3.500	3.587	0.105	0.175	0.245	4.5	9.0																							
RN5VD36A/C	3.510	3.600	3.690	0.108	0.180	0.252																									
RN5VD37A/C	3.608	3.700	3.792	0.111	0.185	0.259	4.5	9.0																							
RN5VD38A/C	3.705	3.800	3.895	0.114	0.190	0.266																									
RN5VD39A/C	3.803	3.900	3.997	0.117	0.195	0.273	4.5	9.0																							

(Note) Refer to the previously defined "Minimum Operating Voltage".

Condition 1 : T<sub>opt</sub>=25°C

Condition 2 : -30°C ≤ T<sub>opt</sub> ≤ 85°C

T<sub>opt</sub>=25°C

Output Current 3			Minimum Operating Voltage		CD Pin Threshold Voltage			CD Pin Output Current 1			CD Pin Output Current 2			Delay Resistance			Detector Threshold Tempco.			
I <sub>OUT3</sub> (mA)			V <sub>DDL</sub> (V)		V <sub>TCD</sub> (V)			I <sub>CD1</sub> (μA)			I <sub>CD2</sub> (μA)			R <sub>D</sub> (MΩ)			$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$ (ppm/°C)			
conditions	Min.	Typ.	Typ.	Max.	conditions	Min.	Typ.	Max.	conditions	Min.	Typ.	conditions	Min.	Typ.	Min.	Typ.	Max.	conditions	Typ.	
P <sub>ch</sub> V <sub>DS</sub> = -2.1V V <sub>DD</sub> = 4.5V	1.0	2.0	(Note1) Condition1 0.55	(Note1) Condition1 0.70	conditions	V <sub>DDX</sub>	V <sub>DDX</sub>	V <sub>DDX</sub>	V <sub>DS</sub> = 0.1V V <sub>DD</sub> = 0.7V	2.0	30	V <sub>DS</sub> = 0.5V V <sub>DD</sub> = 1.5V	V <sub>DD</sub> = 0.85V	10	100	0.5	1.0	2.0	-30°C ≤ T <sub>opt</sub> ≤ 85°C	±100
													V <sub>DD</sub> = 1.0V	50	200					
						V <sub>DDX</sub>	V <sub>DDX</sub>	V <sub>DDX</sub>												
						V <sub>DDX</sub>	V <sub>DDX</sub>	V <sub>DDX</sub>												
			Condition2 0.65	Condition2 0.80	V <sub>DD</sub> = (-V <sub>DET</sub> ) × 1.1V	V <sub>DDX</sub>	V <sub>DDX</sub>	V <sub>DDX</sub>												
						V <sub>DDX</sub>	V <sub>DDX</sub>	V <sub>DDX</sub>												
						V <sub>DDX</sub>	V <sub>DDX</sub>	V <sub>DDX</sub>												
						V <sub>DDX</sub>	V <sub>DDX</sub>	V <sub>DDX</sub>												

## RN5VD

### • RN5VD40A/C to RN5VD60A/C

Part Number.	Detector Threshold			Hysteresis			Supply Current 1			Supply Current 2			Output Current 1			Output Current 2				
	-V <sub>DET</sub> (V)			V <sub>HYS</sub> (V)			I <sub>SS1</sub> (μA)			I <sub>SS2</sub> (μA)			I <sub>OUT1</sub> (mA)			I <sub>OUT2</sub> (mA)				
	Min.	Typ.	Max.	Min.	Typ.	Max.	conditions	Typ.	Max.	conditions	Typ.	Max.	conditions	Min.	Typ.	conditions	Min.	Typ.		
RN5VD40A/C	3.900	4.000	4.100	0.120	0.200	0.280	V <sub>DD</sub> = (-V <sub>DET</sub> ) -0.16V	5.0	10.0			1.3	3.9	N <sub>ch</sub> V <sub>DS</sub> = 0.05V	0.01	0.05	N <sub>ch</sub> V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0
RN5VD41A/C	3.998	4.100	4.202	0.123	0.205	0.287														
RN5VD42A/C	4.095	4.200	4.305	0.126	0.210	0.294														
RN5VD43A/C	4.193	4.300	4.407	0.129	0.215	0.301														
RN5VD44A/C	4.290	4.400	4.510	0.132	0.220	0.308														
RN5VD45A/C	4.388	4.500	4.612	0.135	0.225	0.315														
RN5VD46A/C	4.485	4.600	4.715	0.138	0.230	0.322		5.5	11.0											
RN5VD47A/C	4.583	4.700	4.817	0.141	0.235	0.329														
RN5VD48A/C	4.680	4.800	4.920	0.144	0.240	0.336														
RN5VD49A/C	4.778	4.900	5.022	0.147	0.245	0.343														
RN5VD50A/C	4.875	5.000	5.125	0.150	0.250	0.350														
RN5VD51A/C	4.973	5.100	5.227	0.153	0.255	0.357	V <sub>DD</sub> = (-V <sub>DET</sub> ) +2.0V	6.0	12.0				0.01	0.05	N <sub>ch</sub> V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 0.7V	1.0	2.0		
RN5VD52A/C	5.070	5.200	5.330	0.156	0.260	0.364														
RN5VD53A/C	5.168	5.300	5.432	0.159	0.265	0.371														
RN5VD54A/C	5.265	5.400	5.535	0.162	0.270	0.378														
RN5VD55A/C	5.363	5.500	5.637	0.165	0.275	0.385														
RN5VD56A/C	5.460	5.600	5.740	0.168	0.280	0.392														
RN5VD57A/C	5.558	5.700	5.842	0.171	0.285	0.399		6.5	13.0											
RN5VD58A/C	5.655	5.800	5.945	0.174	0.290	0.406														
RN5VD59A/C	5.753	5.900	6.047	0.177	0.295	0.413														
RN5VD60A/C	5.850	6.000	6.150	0.180	0.300	0.420														

(Note) Refer to the previously defined "Minimum Operating Voltage".

Condition 1 : T<sub>opt</sub>=25°C

Condition 2 : -30°C≤T<sub>opt</sub>≤85°C

T<sub>opt</sub>=25°C

Output Current 3			Minimum Operating Voltage		CD Pin Threshold Voltage				CD Pin Output Current 1			CD Pin Output Current 2			Delay Resistance			Detector Threshold Tempo.		
I <sub>OUT3</sub> (mA)			V <sub>DDL</sub> (V)		V <sub>TCD</sub> (V)				I <sub>CD1</sub> (μA)			I <sub>OUT1</sub> (mA)			I <sub>OUT2</sub> (mA)			$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$ (ppm/°C)		
conditions	Min.	Typ.	Typ.	Max.	conditions	Min.	Typ.	Max.	conditions	Min.	Typ.	conditions	Min.	Typ.	conditions	Typ.	Max.	conditions	Typ.	
Pch			(Note1) Condition1	(Note1) Condition1	V <sub>DD</sub> = (-V <sub>DET</sub> ) ×1.1V	V <sub>DD</sub> ×	V <sub>DD</sub> ×	V <sub>DD</sub> ×	V <sub>DS</sub> = 0.1V V <sub>DD</sub> = 0.7V	2.0	30	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	200	800	0.5	1.0	2.0	-30°C ≤ T <sub>opt</sub> ≤85°C	±100
V <sub>DS</sub> = -2.1V	1.5	3.0	0.55	0.70		0.4	0.5	0.6V												
V <sub>DD</sub> = 8.0V			Condition2	Condition2																

# OPERATION

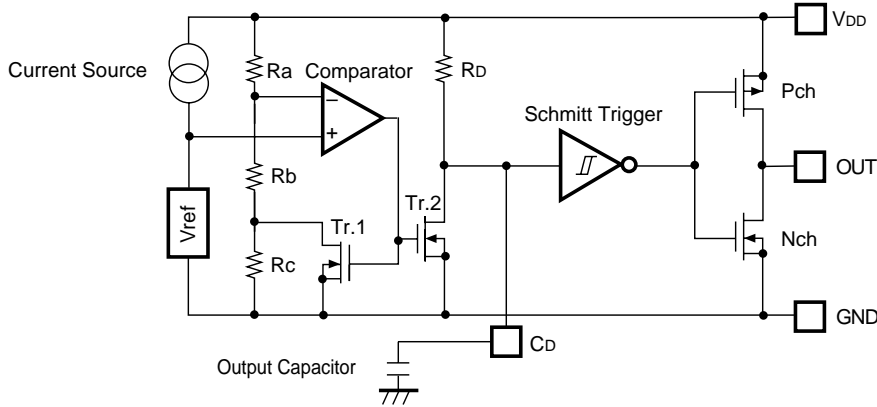


Fig. 1 Block Diagram

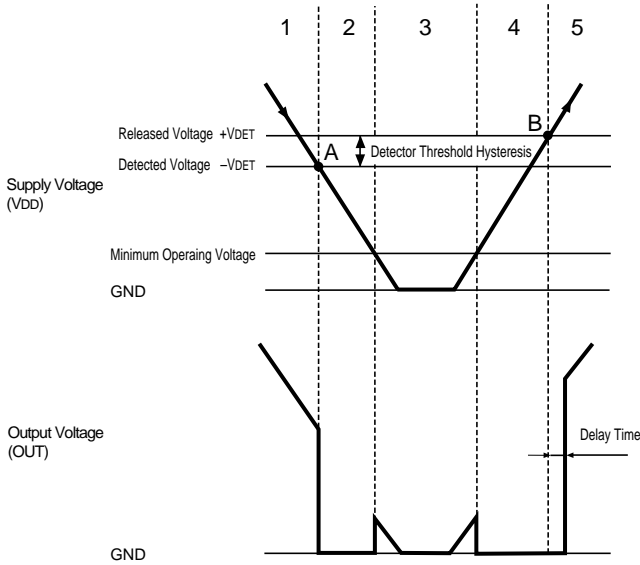


Fig. 2 Operation Diagram

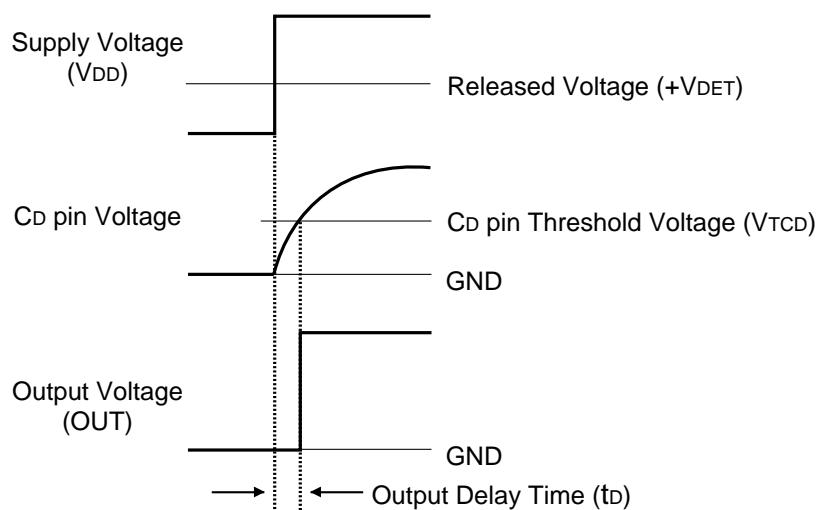
Step	Step 1	Step 2	Step 3	Step 4	Step 5
Comparator (-) Pin Input Voltage	I	II	II	II	I
Comparator Output	L	H	Indefinite	H	L
Tr. 1, 2	OFF	ON	Indefinite	ON	OFF
Output Tr.	Nch	OFF	Indefinite	ON	OFF
	Pch	ON	OFF	Indefinite	OFF

$$I. \frac{R_b + R_c}{R_a + R_b + R_c} \cdot V_{DD}$$

$$II. \frac{R_b}{R_a + R_b} \cdot V_{DD}$$

- Step 1. Output voltage is equal to pull-up voltage.
- Step 2. When input voltage (VDD) reaches the state of  $V_{ref} \geq V_{DD} \cdot (R_b + R_c) / (R_a + R_b + R_c)$  at point A (Detected Voltage  $-V_{DET}$ ), the output of comparator is reversed, so that output voltage becomes GND. Discharging is performed from Cd pin connected to an external capacitor. No delay time is generated.
- Step 3. Output voltage becomes indefinite when power source voltage (VDD) is smaller than minimum operating voltage. When the output is pulled up, VDD is output.
- Step 4. Output voltage becomes equal to GND.
- Step 5. When input voltage (VDD) reaches the state of  $V_{ref} \leq V_{DD} \cdot R_b / (R_a + R_b)$  at Point B (Released Voltage  $+V_{DET}$ ), the output of comparator is reversed, and the external capacitor is charged through Cd pin, so that output voltage becomes equal to pulled-up voltage after a delay time  $t_D (=0.69 \times 10^6 \times C_D)$ .

### • Output Delay Operation



When the supply voltage crosses the released voltage (+ $V_{DET}$ ) from a low value to a value higher than the released voltage (+ $V_{DET}$ ), the  $C_D$  pin voltage starts to increase (starts to charge the external capacitor).

The output voltage is maintained at “L” level until the  $C_D$  pin voltage reaches to  $V_{TCD}$  ( $C_D$  pin threshold voltage) after that the output voltage is reversed to “H”.

The time period from beginning of charging capacitor to output voltage reversing represents the output delay ( $t_D$ ).

### • Output Delay Time

Delay time ( $t_D$ ) can be set accordance with the capacitance  $C_D$  of external capacitor as below

$$t_D = 0.69 \times 10^6 \times C_D \text{ (s)}$$

# TEST CIRCUITS

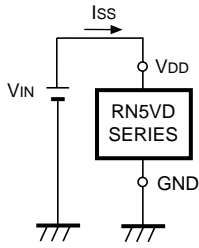


Fig. 3 Supply Current test Circuit

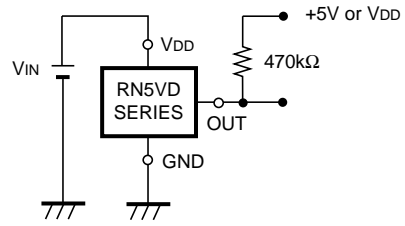


Fig. 4 Detector Threshold Test Circuit

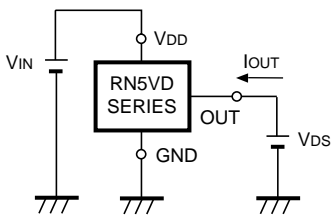


Fig. 5 Nch Driver Output Current Test Circuit

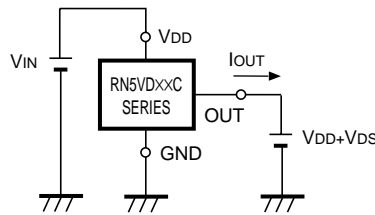


Fig. 6 Pch Driver Output Current Test Circuit

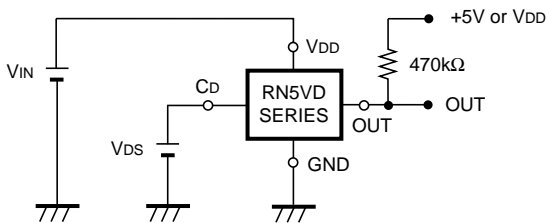


Fig. 7 Cd pin Threshold Voltage Test Circuit

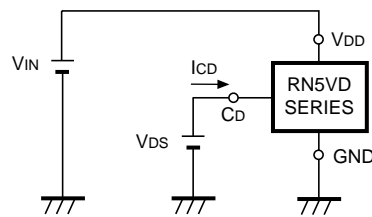


Fig. 8 Cd pin Sink Current Test Circuit

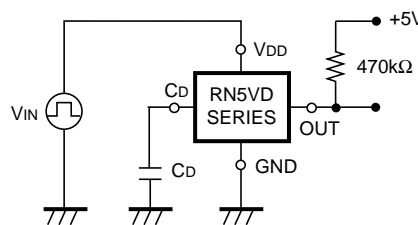
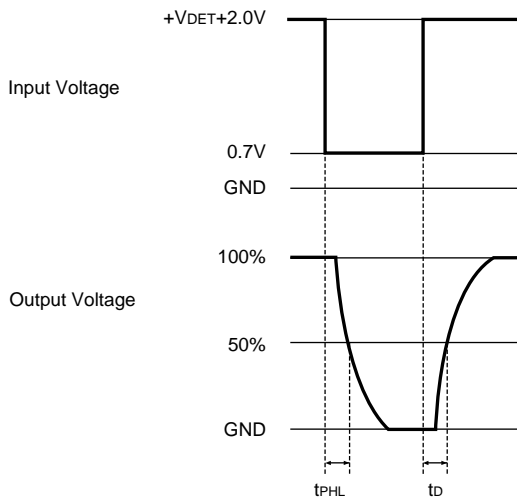


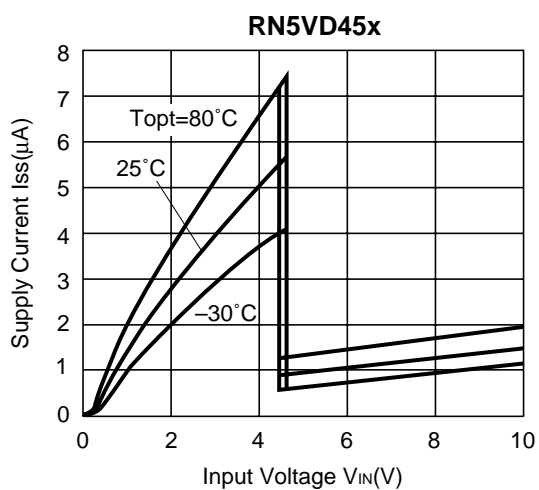
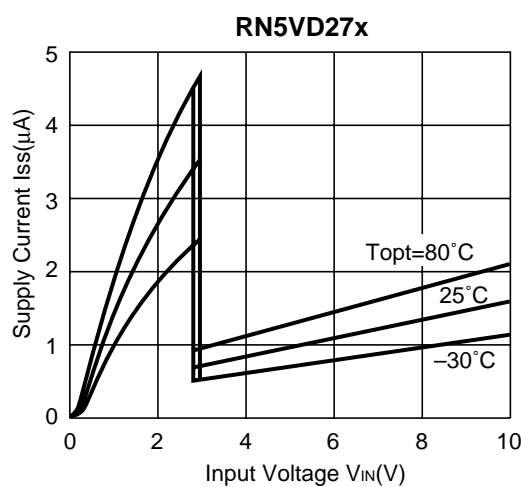
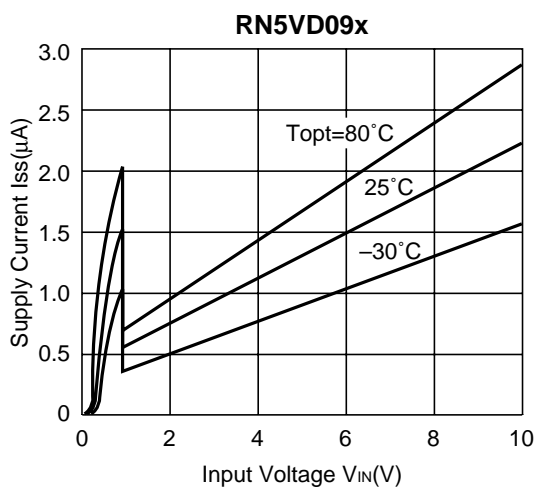
Fig. 9 Output Delay Time Test Circuit

\*) at Fig.4,7,9. CMOS Output Type does not need a pull-up resistor.

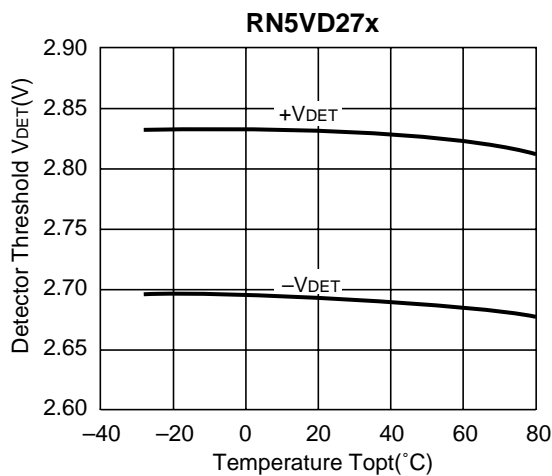
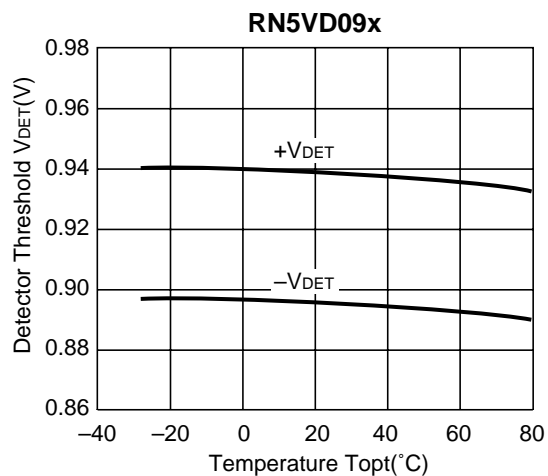


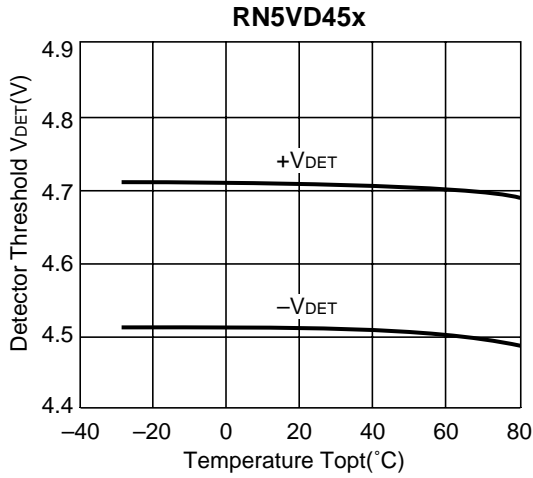
# TYPICAL CHARACTERISTICS

## 1) Supply Current vs. Input Voltage

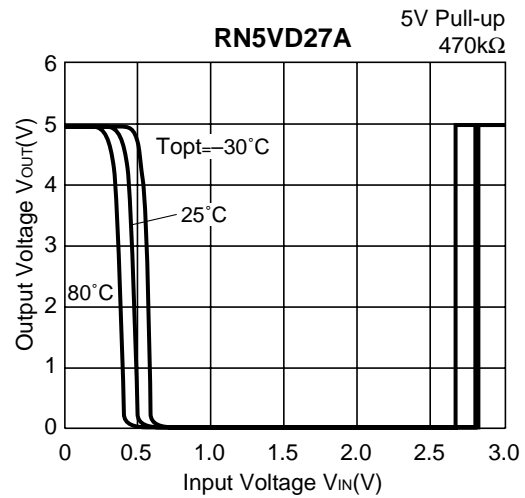
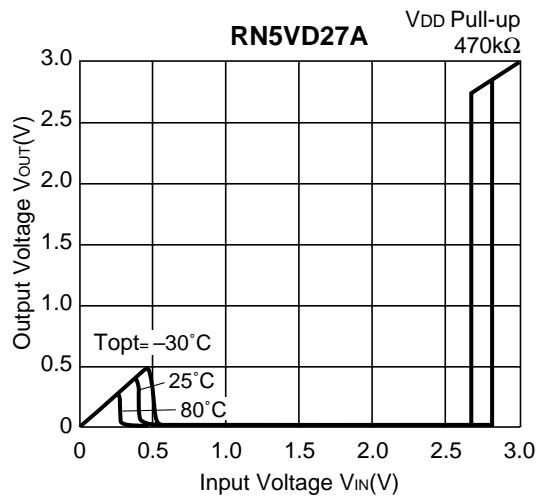
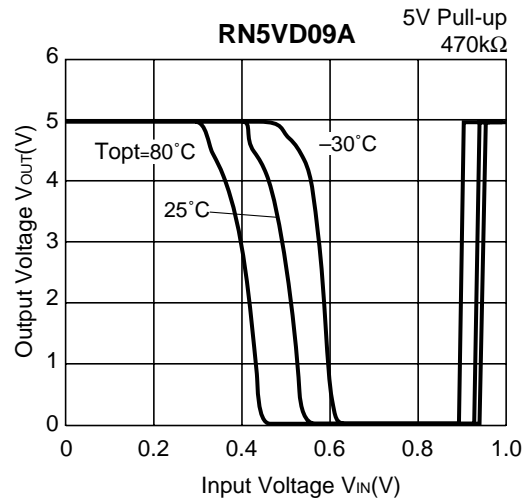
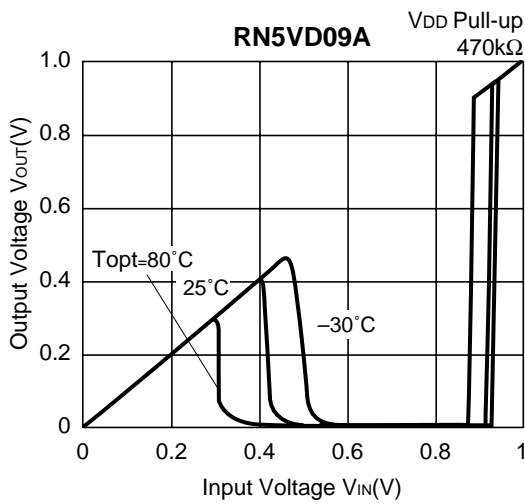


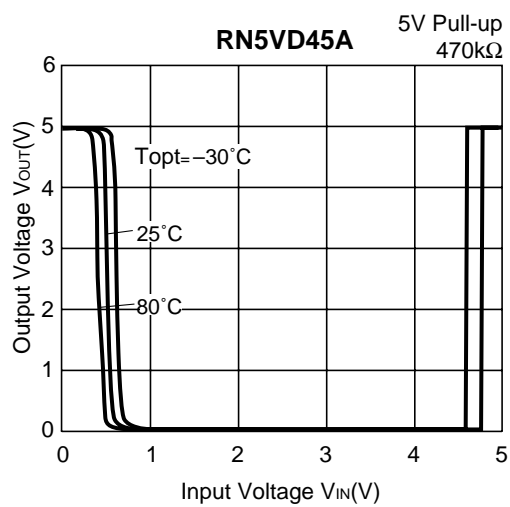
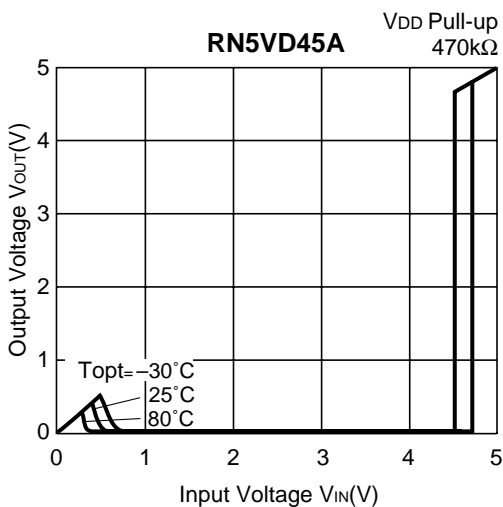
## 2) Detector Threshold vs. Temperature



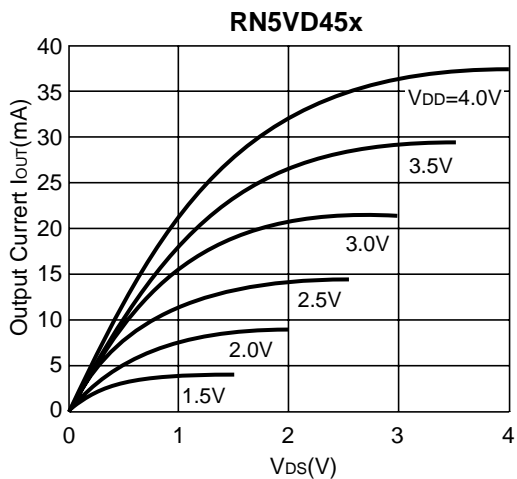
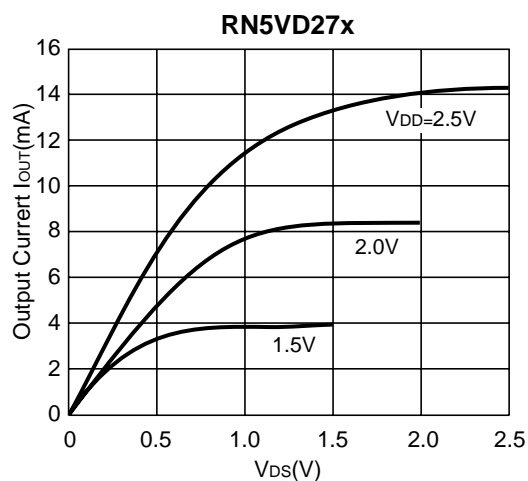
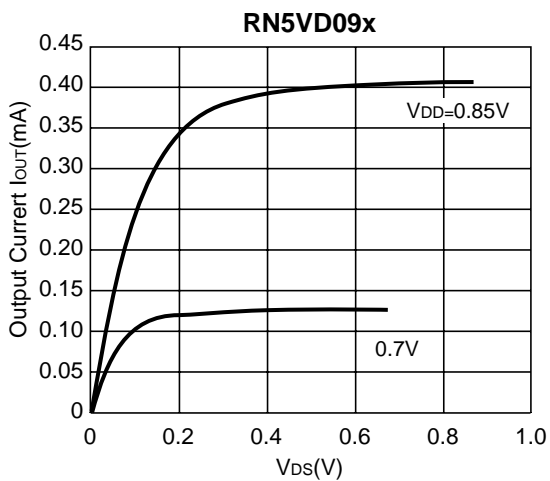


**3) Output Voltage vs. Input Voltage**

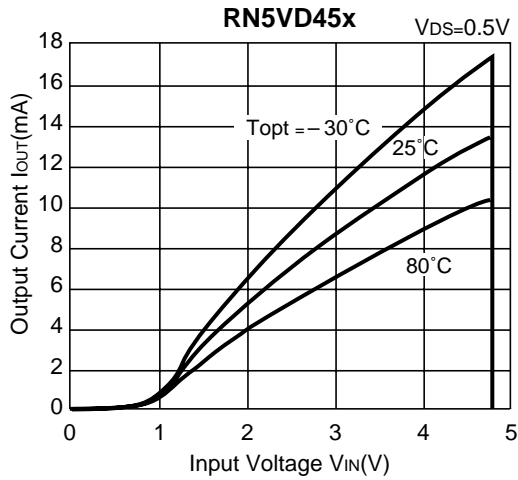
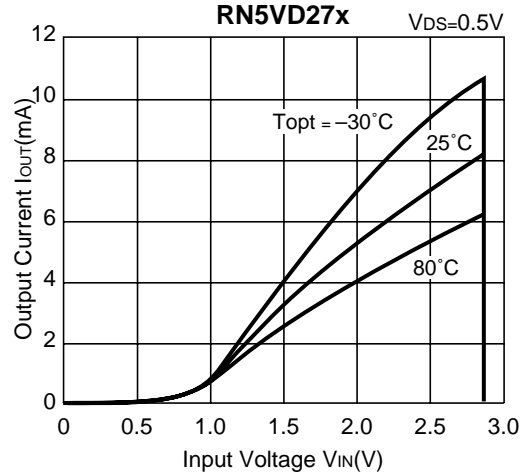
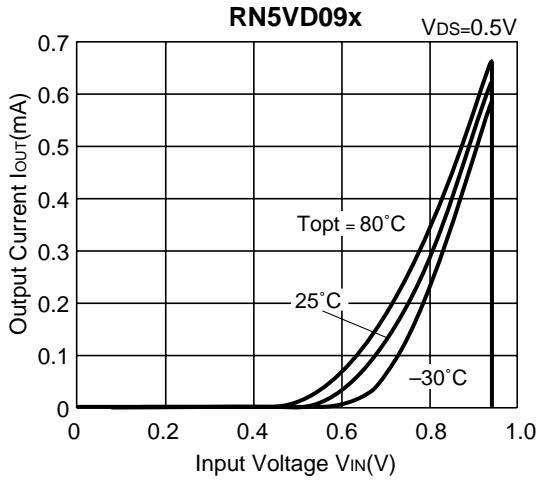




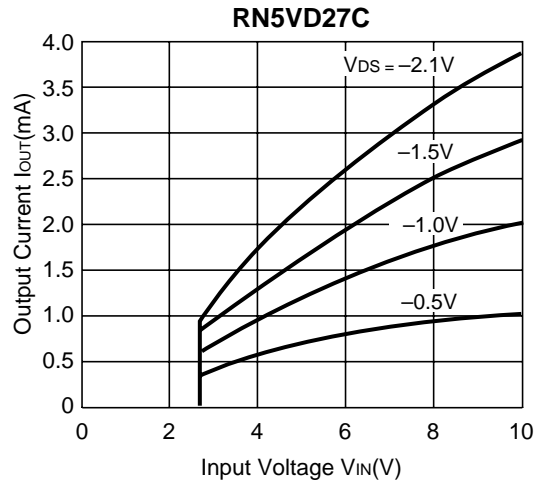
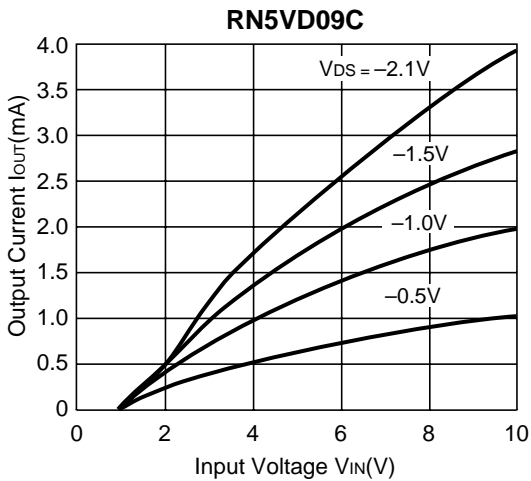
4) Nch Driver Output Current vs. V<sub>DS</sub>

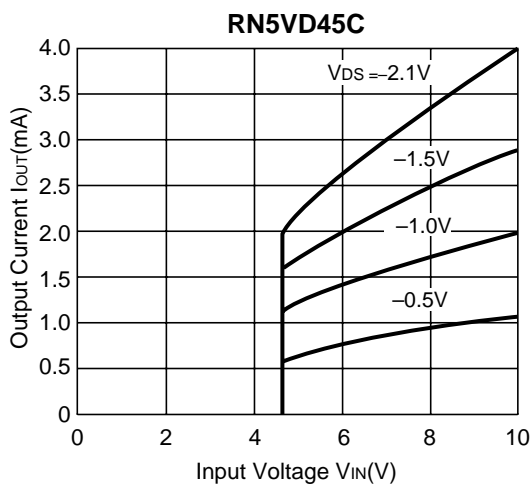


**5) Nch Driver Output Current vs. Input Voltage**

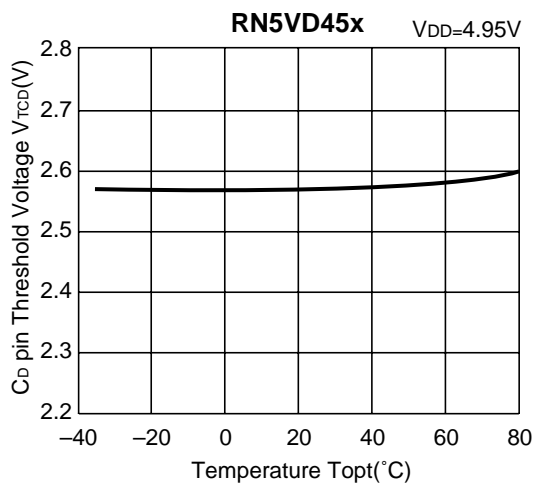
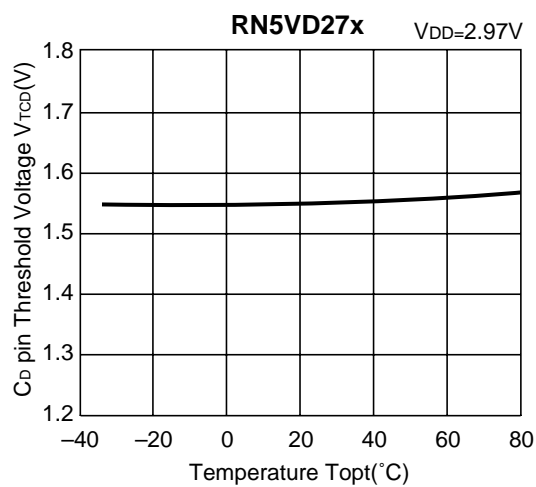
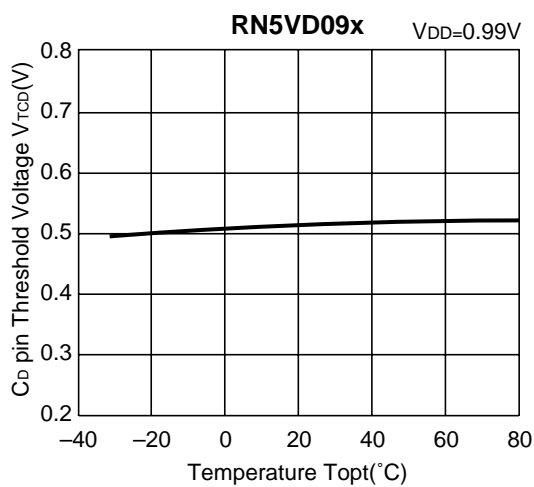


**6) Pch Driver Output Current vs. Input Voltage**

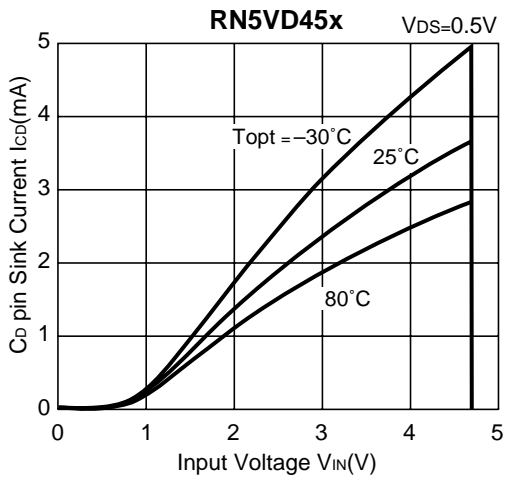
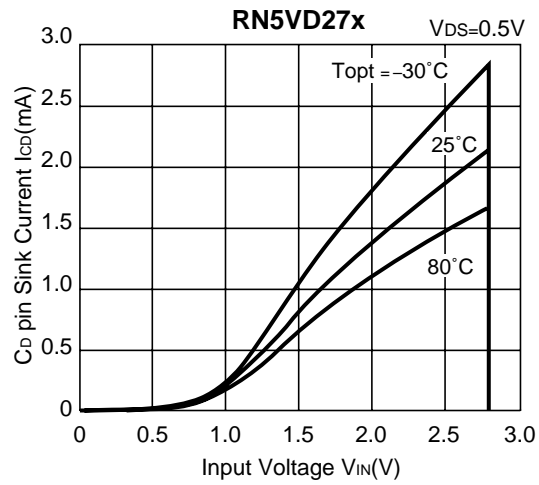
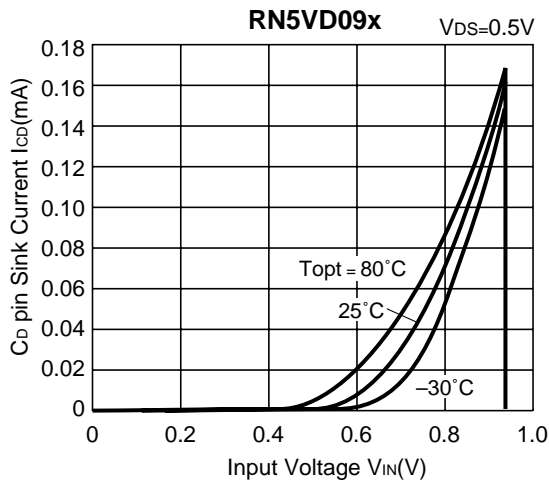




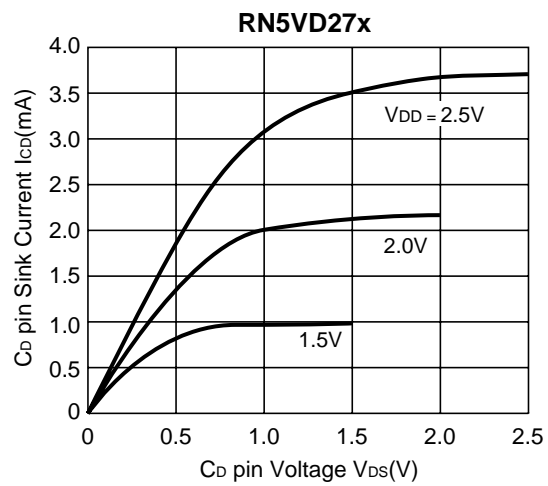
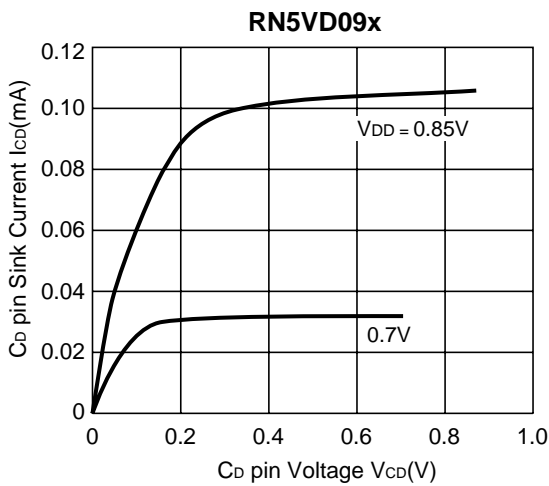
7)  $C_D$  pin Threshold Voltage vs. Temperature

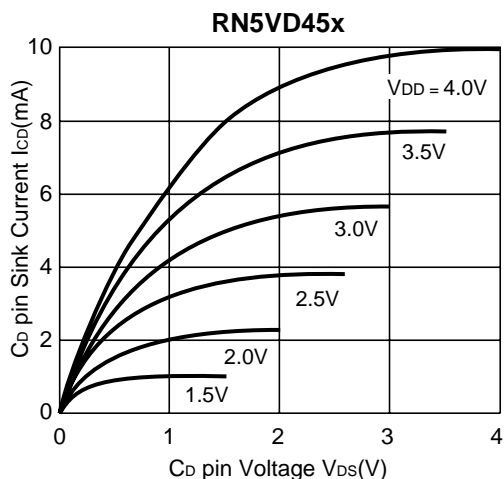


**8) CD pin Sink Current vs. Input Voltage**

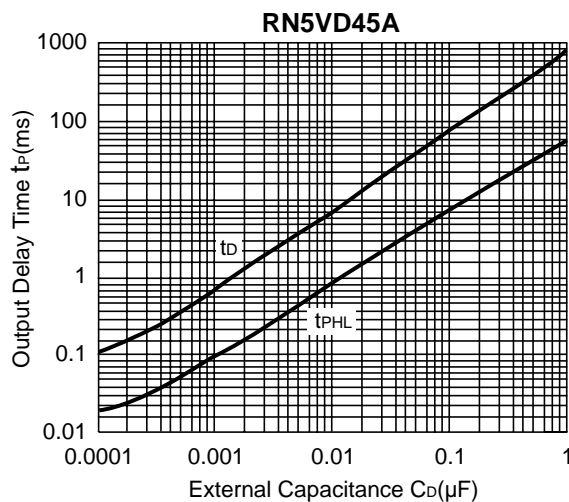
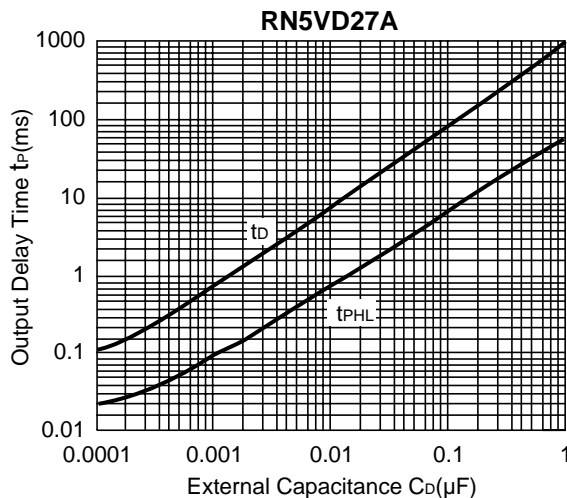
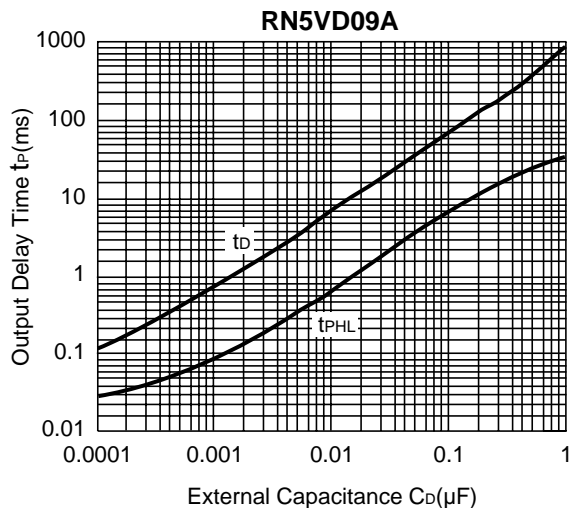


**9) CD pin Sink Current vs. CD pin Voltage**

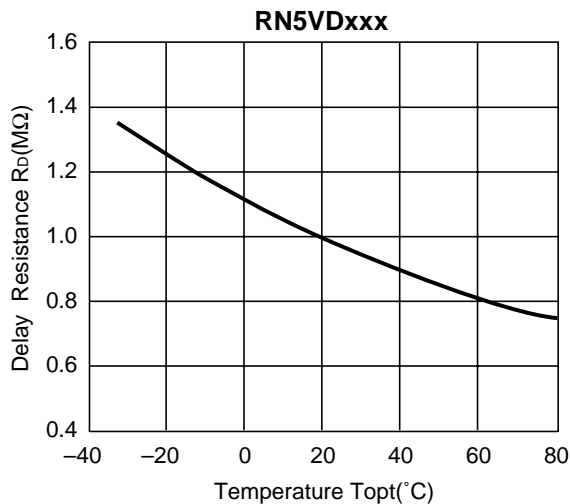




10) Output delay Time vs. External Capacitance



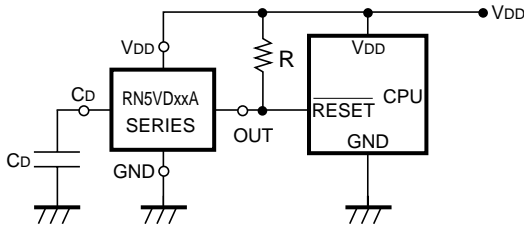
11) Delay Resistance vs. Temperature



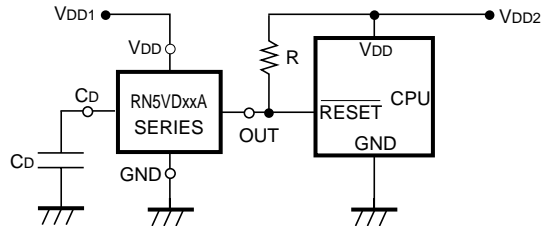
## TYPICAL APPLICATIONS

### • RN5VDxxA CPU Reset Circuit (Nch Open Drain Output)

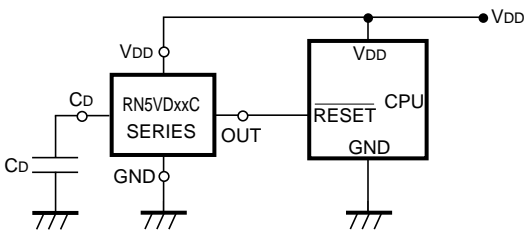
(1) Input Voltage to RN5VDxxA is the same as the input voltage to CPU.



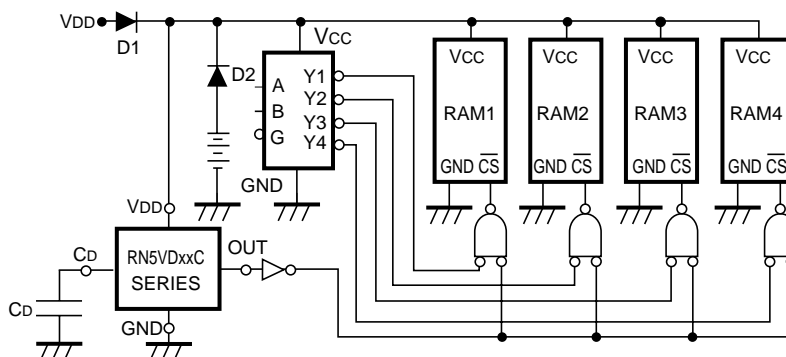
(2) Input Voltage to RN5VDxxA is different from the input voltage to CPU.



### • RN5VDxxC CPU Reset Circuit (CMOS Output)



### • Memory Back-up Circuit





### • Manual Reset Circuit



## TECHNICAL NOTES

### When connecting resistors to the device's input pin

When connecting a resistor (R1) to an input of this device, the input voltage decreases by [Device's Consumption Current] x [Resistance Value] only. And, the cross conduction current\*<sup>1</sup>, which occurs when changing from the detecting state to the release state, is decreased the input voltage by [Cross Conduction Current] x [Resistance Value] only. And then, this device will enter the re-detecting state if the input voltage reduction is larger than the difference between the detector voltage and the released voltage.

When the input resistance value is large and the VDD is gone up at mildly in the vicinity of the released voltage, repeating the above operation may result in the occurrence of output.

As shown in Figure A/B, set R1 to become 100 kΩ or less as a guide, and connect C<sub>IN</sub> of 0.1 μF and more to between the input pin and GND. Besides, make evaluations including temperature properties under the actual usage condition, with using the evaluation board like this way. As a result, make sure that the cross conduction current has no problem.

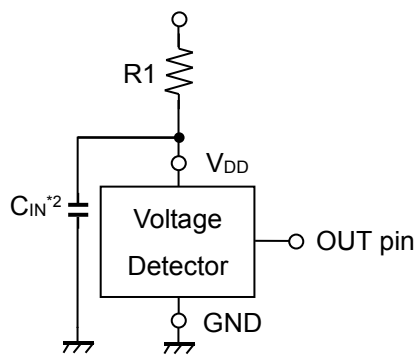


Figure A

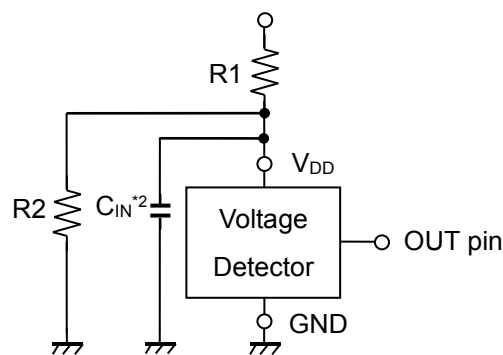


Figure B

\*<sup>1</sup> In the CMOS output type, a charging current for OUT pin is included.

\*<sup>2</sup> Note the bias dependence of capacitors.



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