

## OUTLINE

The RN5VD Series are CMOS-based voltage detector ICs with output delay functions and high detector threshold accuracy and ultra-low supply current, which can be operated at an extremely low voltage and is used, for instance, for system reset.

Each of these ICs consists of a voltage reference unit, a comparator, resistors for voltage detection, an output driver, a hysteresis circuit and an output delay generator. The detector threshold is fixed with high accuracy in the IC and requires no adjustment.

The RN5VD Series are operable by a lower voltage than that for the Rx5VL Series, and can be driven by a single battery.

Two output types, Nch open drain type and CMOS type, are available. Since the package for these ICs is SOT-23-5(Mini-mold)package, high density mounting of the ICs on board is possible.

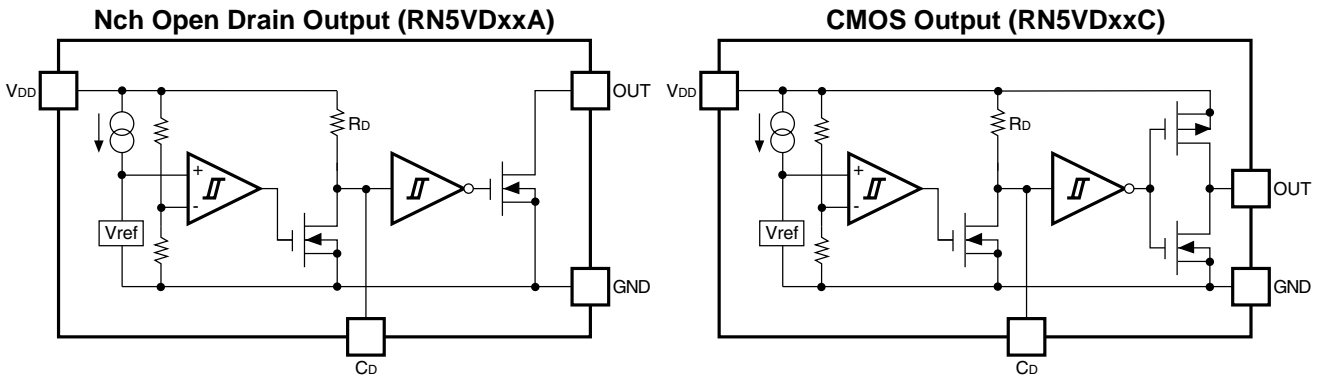
## FEATURES

- Output Delay .....Typ. 100ms with external capacitor : 0.15 $\mu$ F
- Ultra-low Supply Current .....Typ. 1.0 $\mu$ A (RN5VD15x : VDD=3.5V)
- Broad Operating Voltage Range .....0.7V to 10.0V
- Detector Threshold .....Stepwise setting with a step of 0.1V in the range of 0.9V to 6.0V is possible. (refer to Selection Guide) .
- High Accuracy Detector Threshold ..... $\pm 2.5\%$
- Low Temperature-Drift Coefficient of Detector Threshold .....Typ.  $\pm 100$ ppm/ $^{\circ}$ C
- Two Output Types .....Nch Open Drain and CMOS
- Small Package .....SOT-23-5(Mini-mold)

## APPLICATIONS

- CPU & Logic Circuit Reset
- Battery Checker
- Window Comparator
- Wave Shaping Circuit
- Battery Back-Up Circuit
- Power Failure Detector

## BLOCK DIAGRAMS



## SELECTION GUIDE

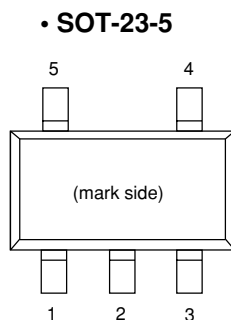
The detector threshold, the output type for the ICs can be selected at the users' request.  
 The selection can be made with designating the part number as shown below;

RN5VD $\overset{\uparrow}{a}$  $\overset{\uparrow}{b}$  $\overset{\uparrow}{c}$  $\overset{\uparrow}{d}$  $\overset{\uparrow}{e}$ xxA-xx-X ← Part Number

Code	Contents
a	Designation of Package Type; N: SOT-23-5
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 Output Type; A: Nch Open Drain C: CMOS
d	Designation of Taping Type; TR (Refer to Taping Specifications; TR type is the standard direction.)
e	Designation of Composition of pin plating -F: Lead free solder plating (SOT-23-5)

For example, the Product with Detector Threshold 4.5V and Output Type Nch Open Drain is designated by Part Number RN5VD45AA-TR-F.

## PIN CONFIGURATION



## PIN DESCRIPTION

Pin No.	Symbol	Description
1	OUT	Output Pin
2	V <sub>DD</sub>	Input and power source for device itself
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	Rating	Unit
V <sub>DD</sub>	Supply Voltage	12	V
V <sub>OUT</sub>	Output Voltage	CNOS	V <sub>SS</sub> -0.3 to V <sub>DD</sub> +0.3
		Nch	V <sub>SS</sub> -0.3 to 12
I <sub>OUT</sub>	Output Current	70	mA
P <sub>D</sub>	Power Dissipation	150	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	

### ABSOLUTE MAXIMUM RATINGS

Absolute Maximum ratings are threshold limit values that must not be exceeded even for an instant under any conditions. Moreover, such values for any two items must not be reached simultaneously. Operation above these absolute maximum ratings may cause degradation or permanent damage to the device. These are stress ratings only and do not necessarily imply functional operation below these limits.

## 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.

**• RN5VD45A/C**
 $T_{opt}=25^{\circ}\text{C}$ 

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

(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 470k $\Omega$ , 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	V <sub>DD</sub> = (-V <sub>DET</sub> ) +2.0V	0.9	2.7	Nch V <sub>DS</sub> = 0.05V V <sub>DD</sub> = 0.7V	0.01	0.05	Nch V <sub>DS</sub> = 0.5V V <sub>DD</sub> = 1.5V	V <sub>DD</sub> = 0.85V	0.05	0.50													
RN5VD10A/C	0.975	1.000	1.025	0.030	0.050	0.070														1.8	4.5	2.0	5.0	1.0	3.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.0V	0.2	1.0
RN5VD11A/C	1.073	1.100	1.127	0.033	0.055	0.077																										
RN5VD12A/C	1.170	1.200	1.230	0.036	0.060	0.084		3.0	6.0		4.0	8.0					1.2	3.6	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0							
RN5VD13A/C	1.268	1.300	1.332	0.039	0.065	0.091																				3.5	7.0	5.0	9.0	1.5	4.5	0.01
RN5VD14A/C	1.365	1.400	1.435	0.042	0.070	0.098		4.0	8.0		6.0	10.0					2.0	6.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0							
RN5VD15A/C	1.463	1.500	1.537	0.045	0.075	0.105																				4.5	9.0	7.0	11.0	2.5	7.0	0.01
RN5VD16A/C	1.560	1.600	1.640	0.048	0.080	0.112		5.0	10.0		8.0	12.0					3.0	8.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0							
RN5VD17A/C	1.658	1.700	1.742	0.051	0.085	0.119																				5.5	11.0	9.0	13.0	3.5	9.0	0.01
RN5VD18A/C	1.755	1.800	1.845	0.054	0.090	0.126		6.0	12.0		10.0	14.0					4.0	10.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0							
RN5VD19A/C	1.853	1.900	1.947	0.057	0.095	0.133																				6.5	13.0	11.0	15.0	4.5	11.0	0.01
RN5VD20A/C	1.950	2.000	2.050	0.060	0.100	0.140		7.0	14.0		12.0	16.0					5.0	12.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0							
RN5VD21A/C	2.048	2.100	2.152	0.063	0.105	0.147																				7.5	15.0	13.0	17.0	5.5	13.0	0.01
RN5VD22A/C	2.145	2.200	2.255	0.066	0.110	0.154		8.0	16.0		14.0	18.0					6.0	14.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0							
RN5VD23A/C	2.243	2.300	2.357	0.069	0.115	0.161																				8.5	17.0	15.0	19.0	6.5	15.0	0.01
RN5VD24A/C	2.340	2.400	2.460	0.072	0.120	0.168		9.0	18.0		16.0	20.0					7.0	16.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0							
RN5VD25A/C	2.438	2.500	2.562	0.075	0.125	0.175																				9.5	19.0	17.0	21.0	7.5	17.0	0.01
RN5VD26A/C	2.535	2.600	2.665	0.078	0.130	0.182		10.0	20.0		18.0	22.0					8.0	18.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0							
RN5VD27A/C	2.633	2.700	2.767	0.081	0.135	0.189																				10.5	21.0	19.0	23.0	8.5	19.0	0.01
RN5VD28A/C	2.730	2.800	2.870	0.084	0.140	0.196	11.0	22.0	20.0	24.0	9.0	20.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0													
RN5VD29A/C	2.828	2.900	2.972	0.087	0.145	0.203														11.5	23.0	21.0	25.0	9.5	21.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0
RN5VD30A/C	2.925	3.000	3.075	0.090	0.150	0.210	12.0	24.0	22.0	26.0	10.0	22.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0													
RN5VD31A/C	3.023	3.100	3.177	0.093	0.155	0.217														12.5	25.0	23.0	27.0	10.5	23.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0
RN5VD32A/C	3.120	3.200	3.280	0.096	0.160	0.224	13.0	26.0	24.0	28.0	11.0	24.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0													
RN5VD33A/C	3.218	3.300	3.382	0.099	0.165	0.231														13.5	27.0	25.0	29.0	11.5	25.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0
RN5VD34A/C	3.315	3.400	3.485	0.102	0.170	0.238	14.0	28.0	26.0	30.0	12.0	26.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0													
RN5VD35A/C	3.413	3.500	3.587	0.105	0.175	0.245														14.5	29.0	27.0	31.0	12.5	27.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0
RN5VD36A/C	3.510	3.600	3.690	0.108	0.180	0.252	15.0	30.0	28.0	32.0	13.0	28.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0													
RN5VD37A/C	3.608	3.700	3.792	0.111	0.185	0.259														15.5	31.0	29.0	33.0	13.5	29.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0
RN5VD38A/C	3.705	3.800	3.895	0.114	0.190	0.266	16.0	32.0	30.0	34.0	14.0	30.0	0.01	0.05	Nch	V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 1.5V	1.0	2.0													
RN5VD39A/C	3.803	3.900	3.997	0.117	0.195	0.273																										

(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>DD</sub> = (-V <sub>DET</sub> ) × 1.1V	V <sub>DD</sub> × 0.3	V <sub>DD</sub> × 0.5	V <sub>DD</sub> × 0.7	conditions V <sub>DS</sub> = 0.1V V <sub>DD</sub> = 0.7V	Min. 2.0	Typ. 30	conditions 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	conditions -30°C ≤ T <sub>opt</sub> ≤ 85°C	Typ. ±100
													V <sub>DD</sub> = 1.0V	50	200					
						V <sub>DD</sub> × 0.35	V <sub>DD</sub> × 0.5	V <sub>DD</sub> × 0.65												
						V <sub>DD</sub> × 0.4	V <sub>DD</sub> × 0.5	V <sub>DD</sub> × 0.6												

## 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		5.5	11.0										
RN5VD46A/C	4.485	4.600	4.715	0.138	0.230	0.322													
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	V <sub>DD</sub> = (-V <sub>DET</sub> ) +2.0V	6.0	12.0		1.4	4.2	0.01	0.05	N <sub>ch</sub> V <sub>DS</sub> = 0.5V	V <sub>DD</sub> = 0.7V	1.0	2.0	
RN5VD51A/C	4.973	5.100	5.227	0.153	0.255	0.357													
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		V <sub>DD</sub> = (-V <sub>DET</sub> ) -0.20V	6.5		13.0								
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													
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>DS</sub> = -2.1V	1.5	3.0	0.55	0.70	V <sub>DD</sub> = (-V <sub>DET</sub> ) ×1.1V	V <sub>DD</sub> × 0.4	V <sub>DD</sub> × 0.5	V <sub>DD</sub> × 0.6V	V <sub>DS</sub> = 0.1V	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>DD</sub> = 8.0V			Condition2 0.65	Condition2 0.80					V <sub>DD</sub> = 0.7V											

# OPERATION

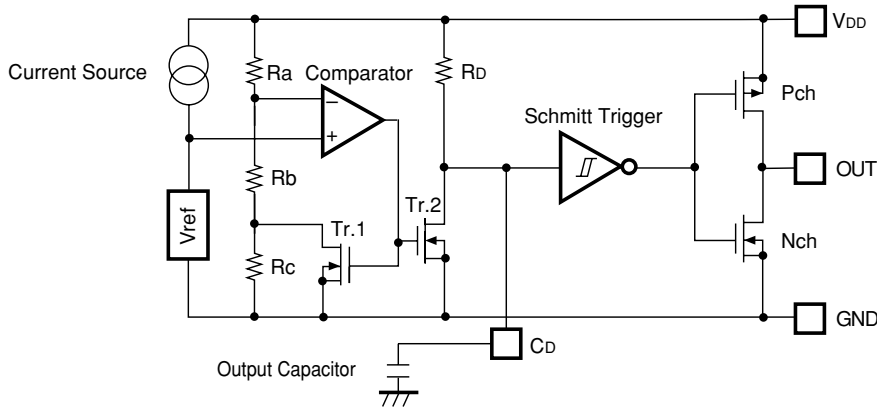


Fig. 1 Block Diagram

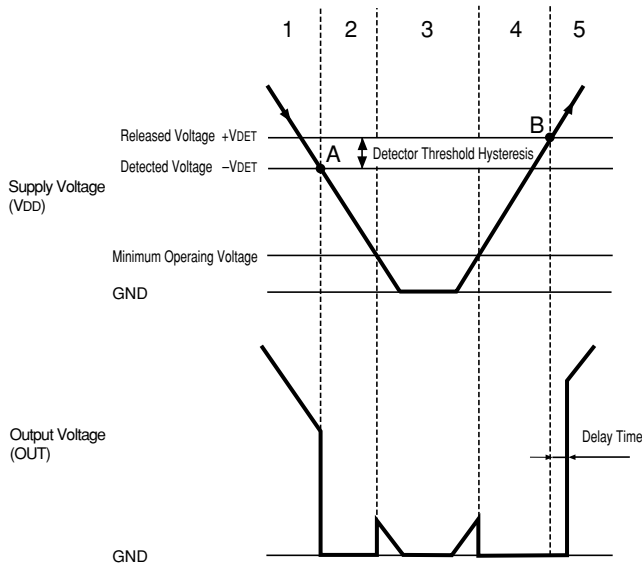


Fig. 2 Operation Diagram

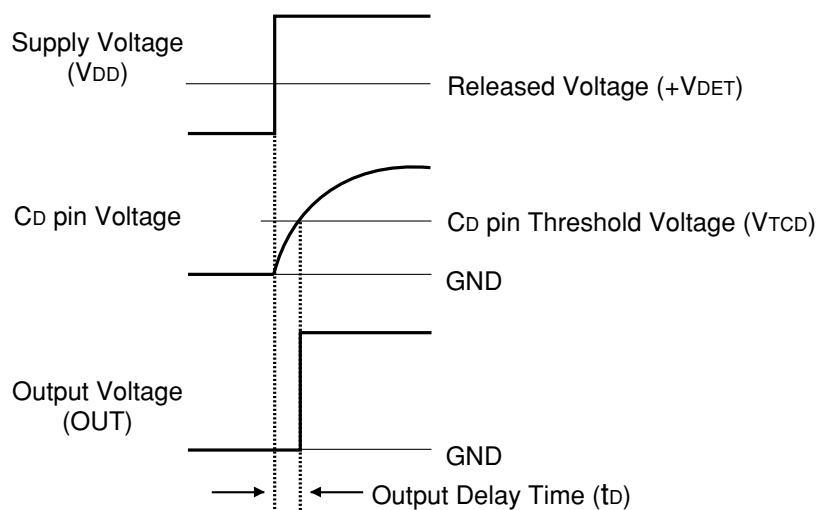
Step	Step 1	Step 2	Step 3	Step 4	Step 5
Comparator (-) Pin Input Voltage	I	II	II	II	I
Comparator Output	L	H	Indefinite	H	L
Tr. 1, 2	OFF	ON	Indefinite	ON	OFF
Output Tr.	Nch	OFF	Indefinite	ON	OFF
	Pch	ON	OFF	Indefinite	OFF

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

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

- 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 (+VDET) from a low value to a value higher than the released voltage (+VDET), the CD pin voltage starts to increase (starts to charge the external capacitor).

The output voltage is maintained at “L” level until the CD pin voltage reaches to VTCD (CD 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

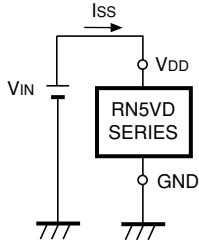


Fig. 3 Supply Current test Circuit

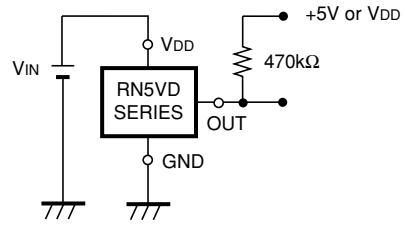


Fig. 4 Detector Threshold Test Circuit

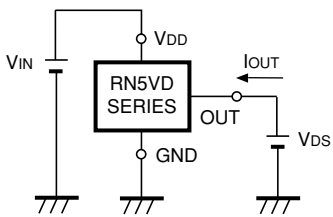


Fig. 5 Nch Driver Output Current Test Circuit

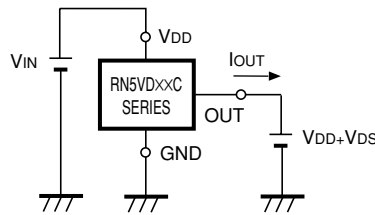


Fig. 6 Pch Driver Output Current Test Circuit

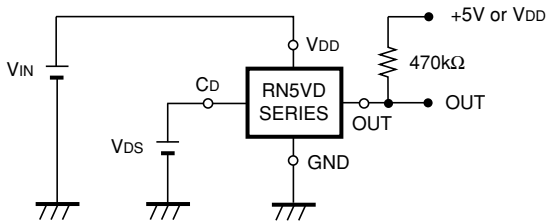


Fig. 7 Cd pin Threshold Voltage Test Circuit

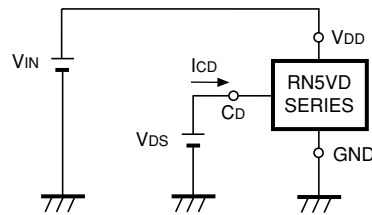


Fig. 8 Cd pin Sink Current Test Circuit

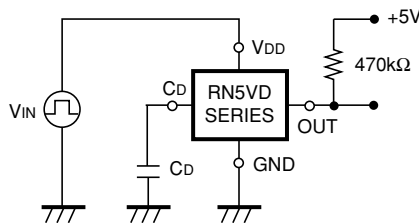
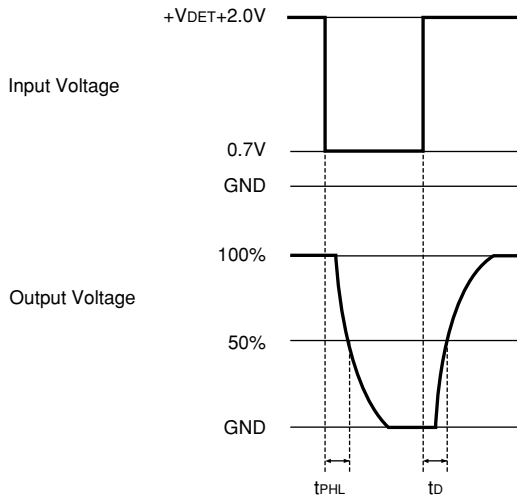


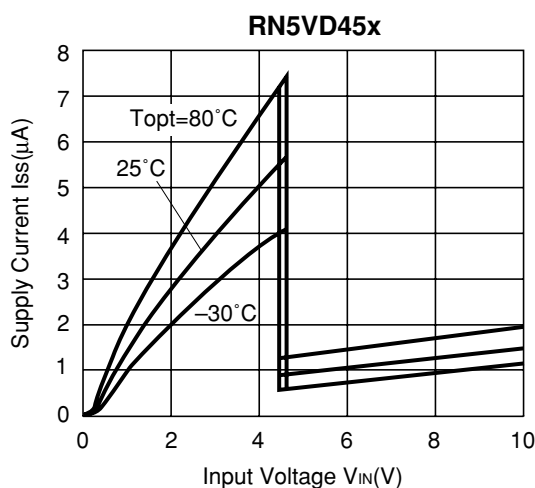
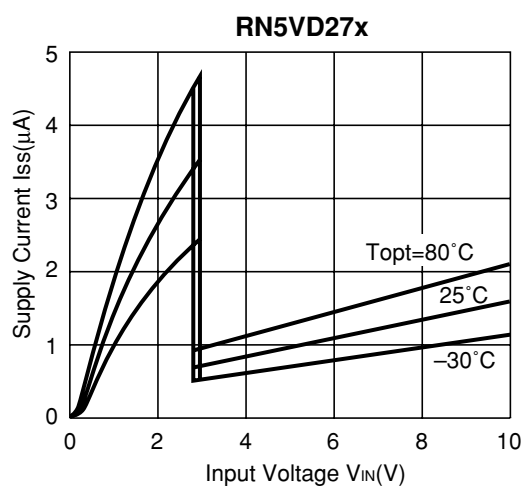
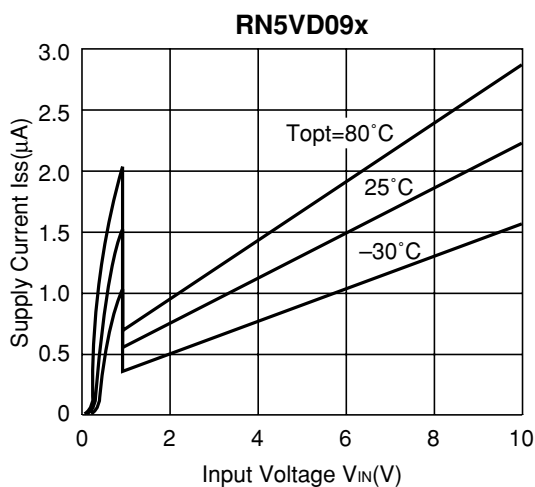
Fig. 9 Output Delay Time Test Circuit

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

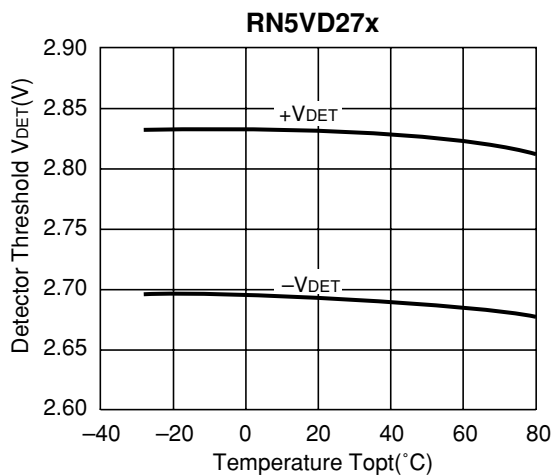
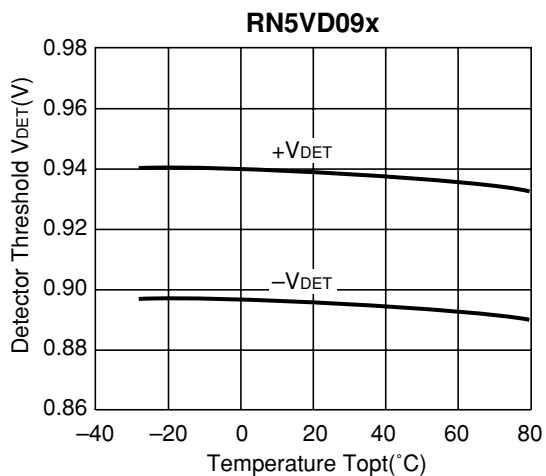


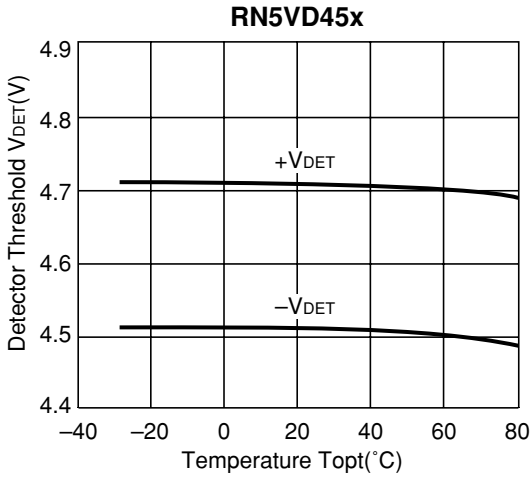
# TYPICAL CHARACTERISTICS

## 1) Supply Current vs. Input Voltage

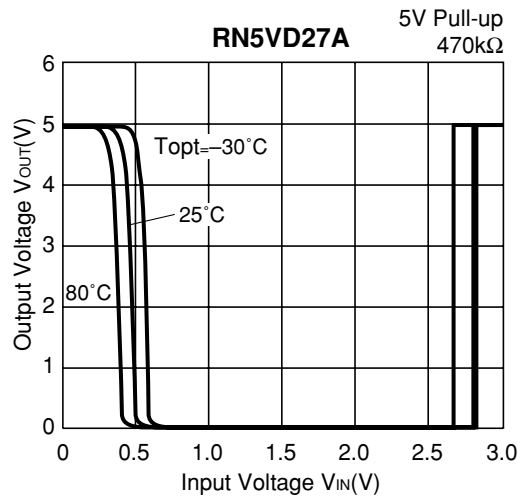
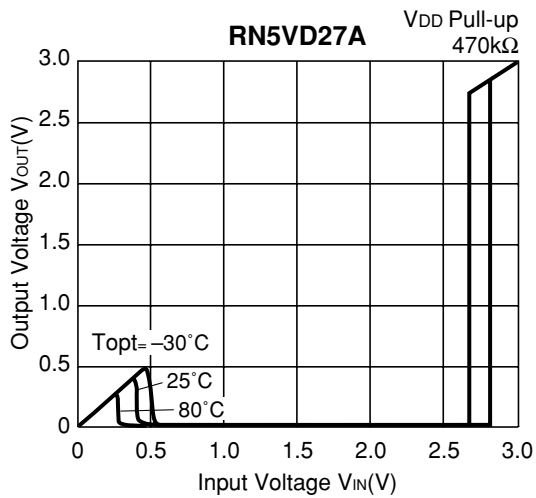
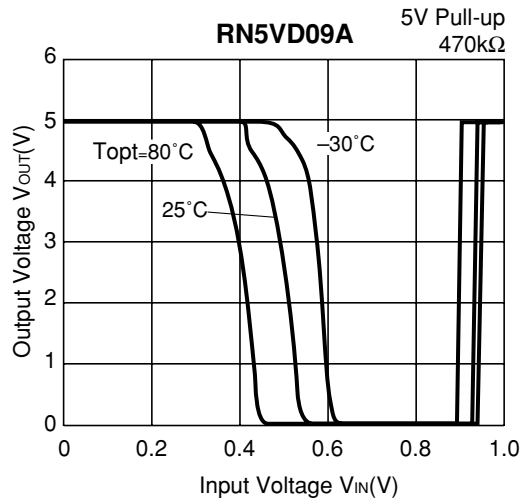
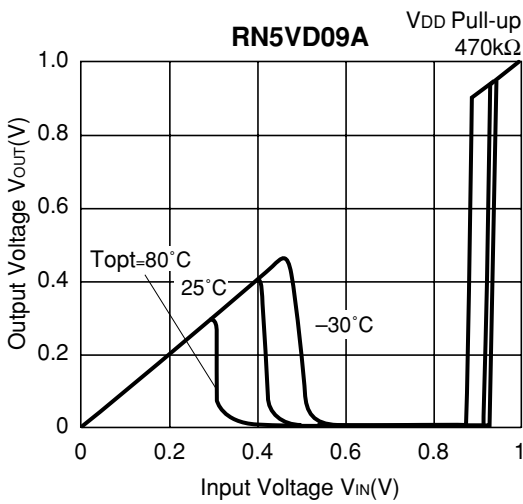


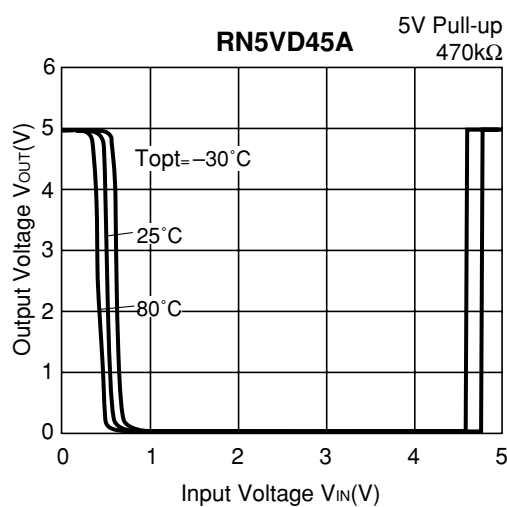
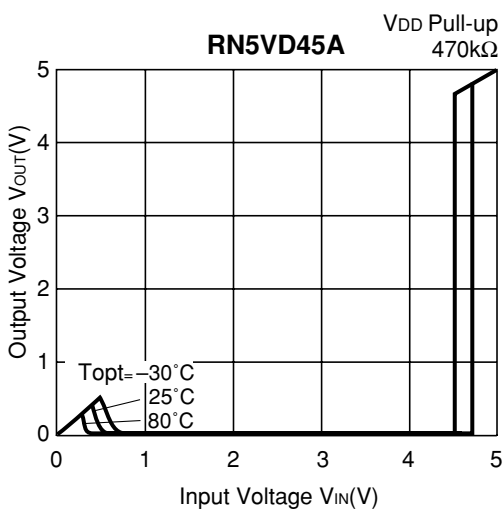
## 2) Detector Threshold vs. Temperature



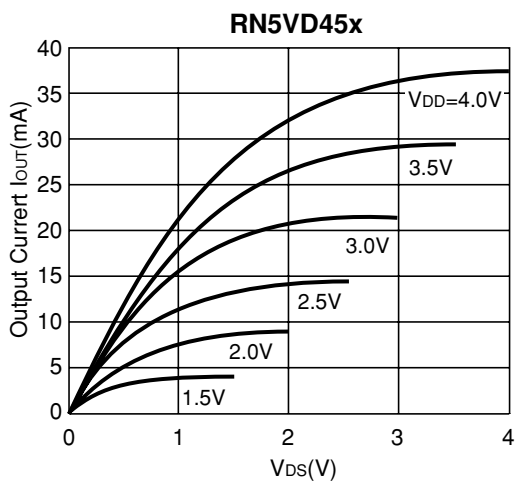
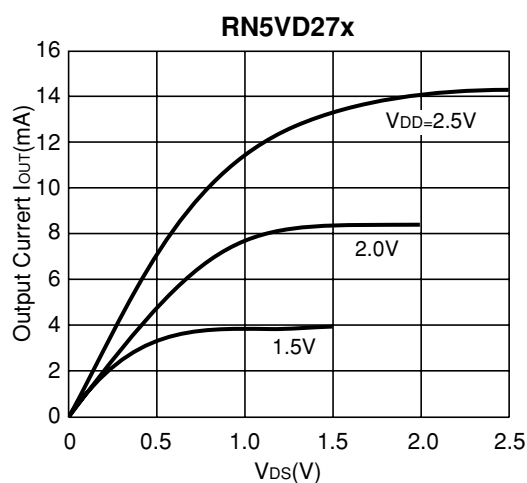
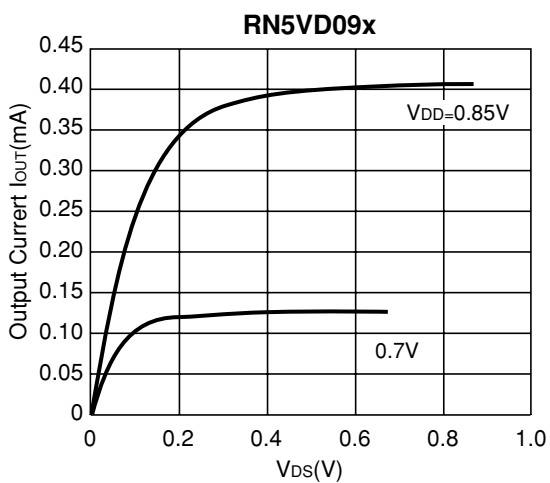


**3) Output Voltage vs. Input Voltage**

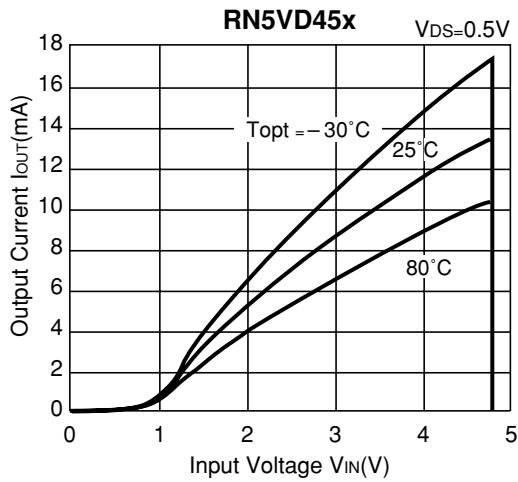
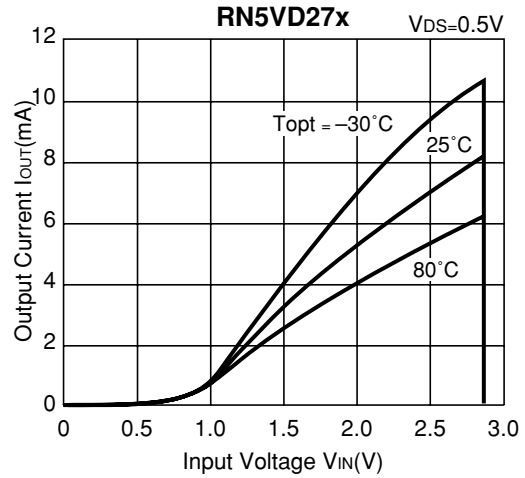
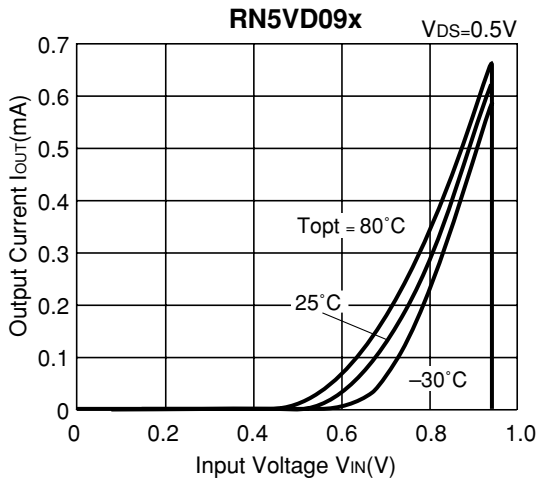




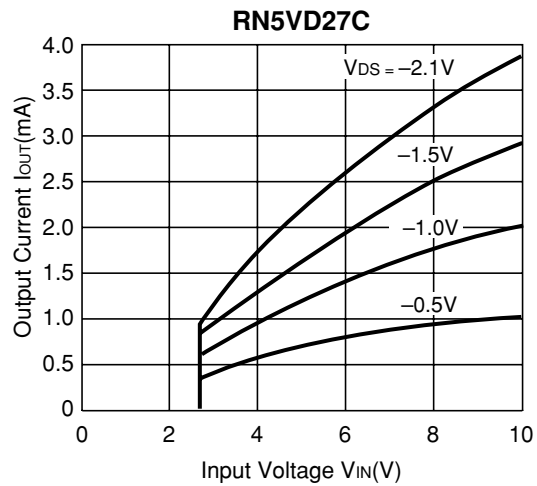
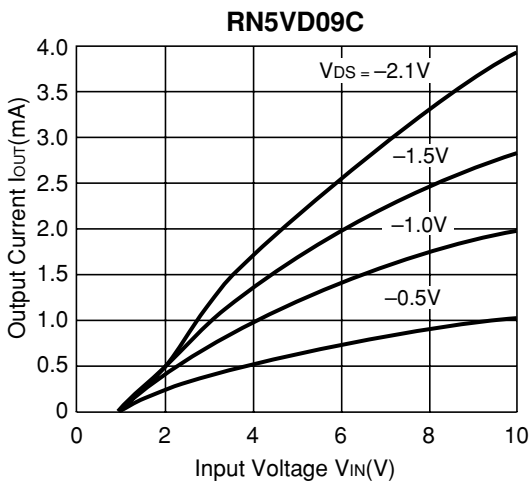
4) Nch Driver Output Current vs. V<sub>DS</sub>

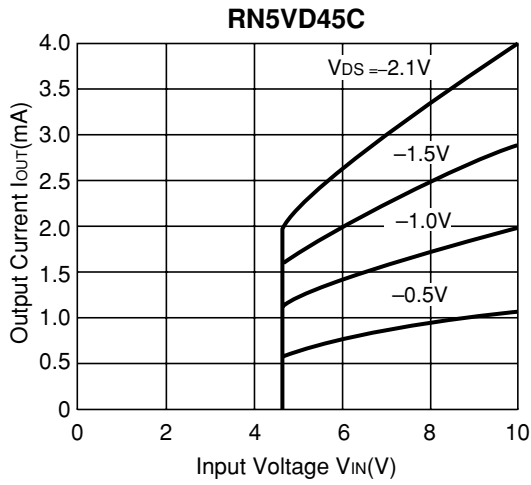


**5) Nch Driver Output Current vs. Input Voltage**

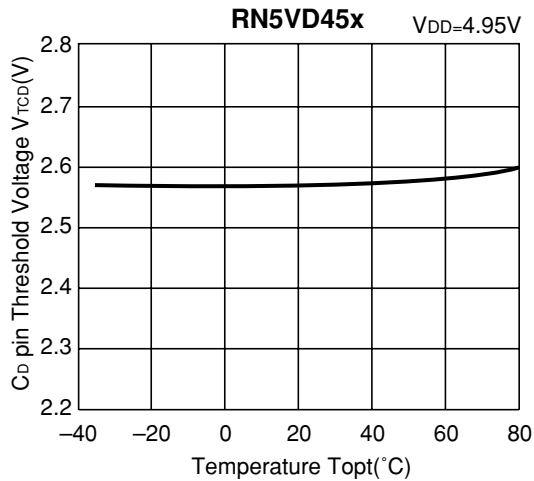
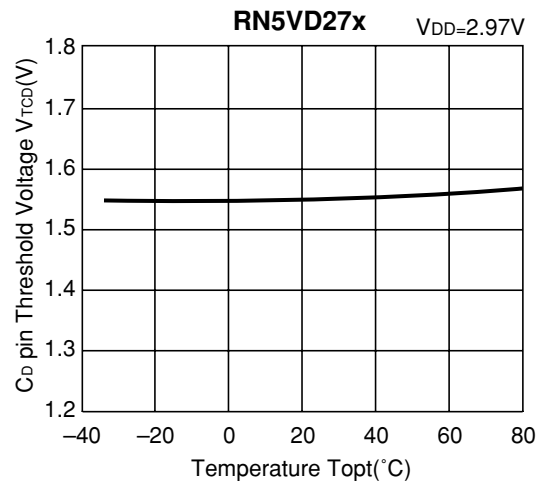
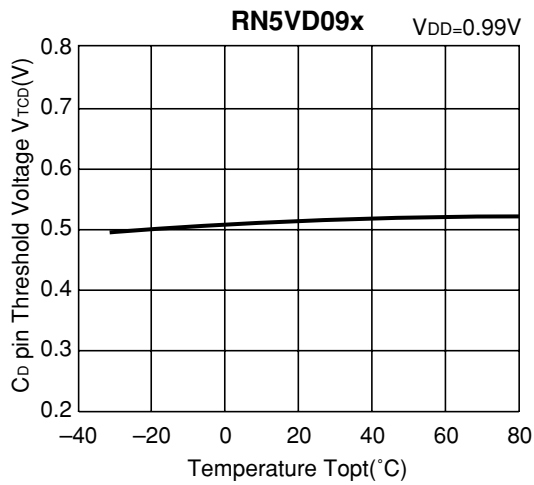


**6) Pch Driver Output Current vs. Input Voltage**

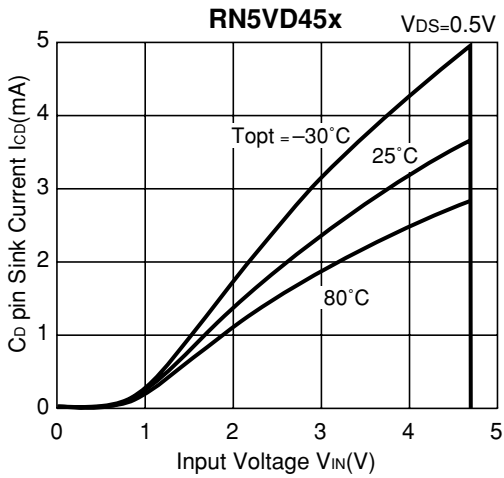
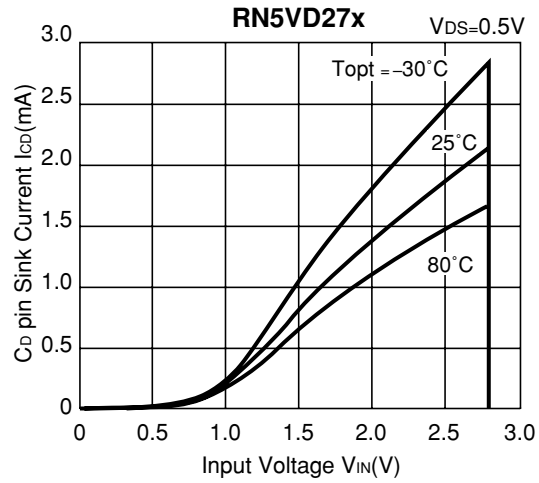
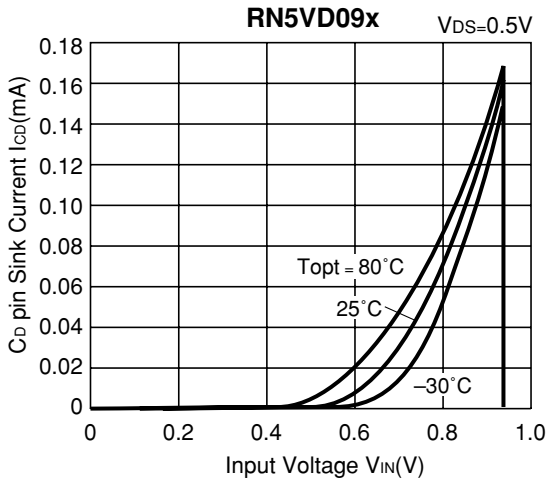




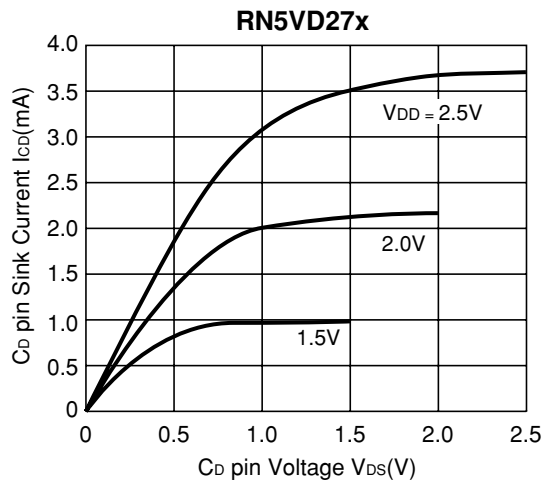
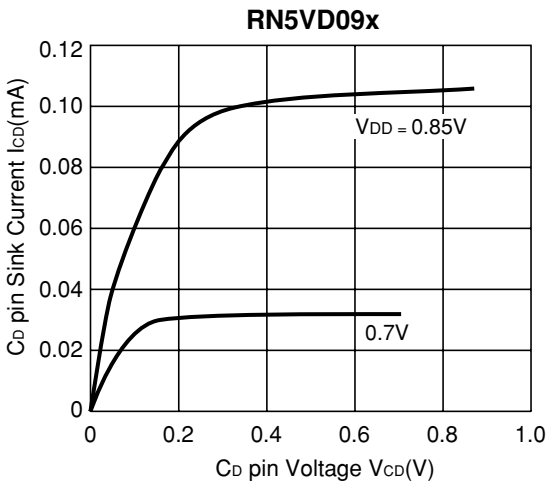
7) Cd pin Threshold Voltage vs. Temperature

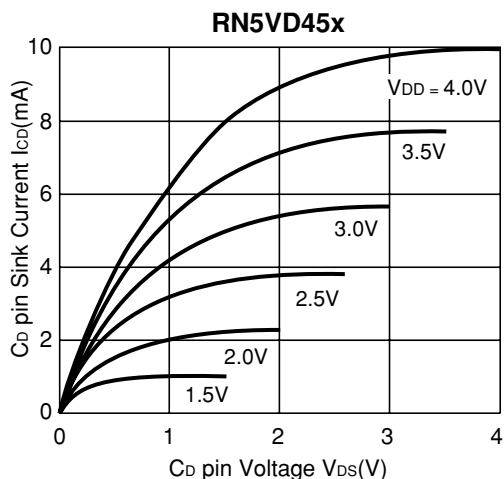


**8) CD pin Sink Current vs. Input Voltage**

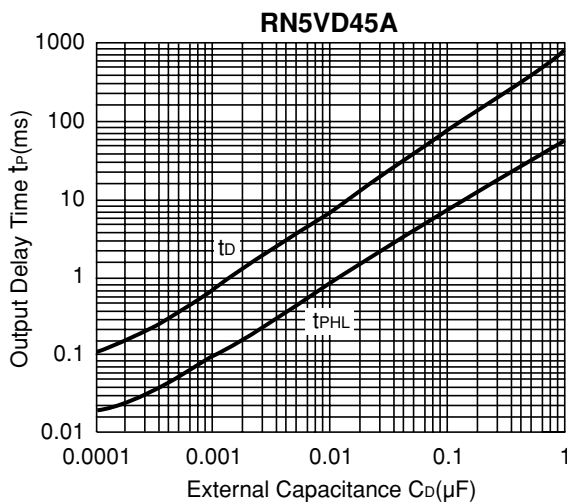
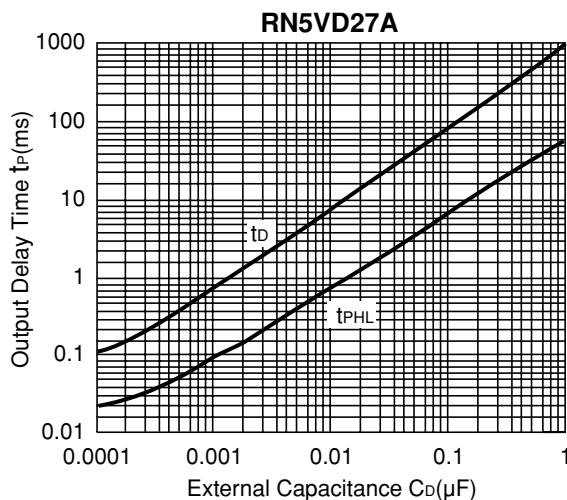
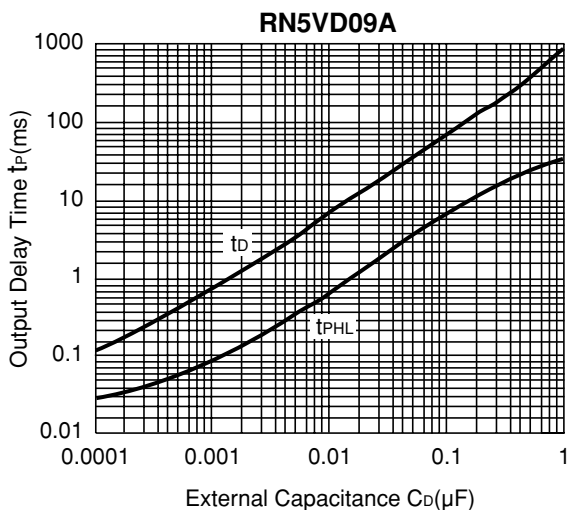


**9) CD pin Sink Current vs. CD pin Voltage**

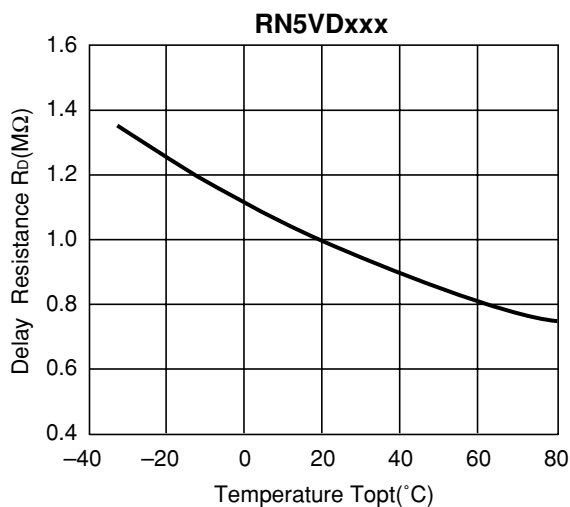




10) Output delay Time vs. External Capacitance



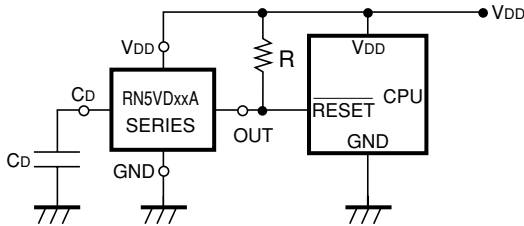
11) Delay Resistance vs. Temperature



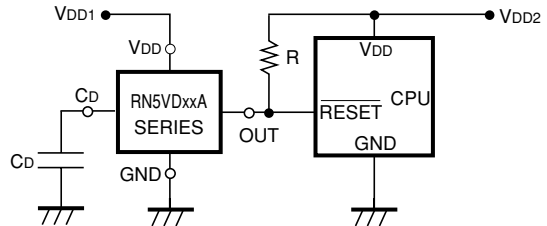
## TYPICAL APPLICATIONS

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

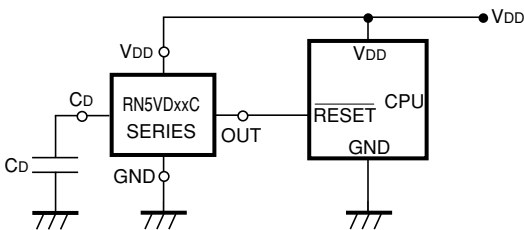
(1) Input Voltage to RN5VDxxA is the same as the input voltage to CPU.



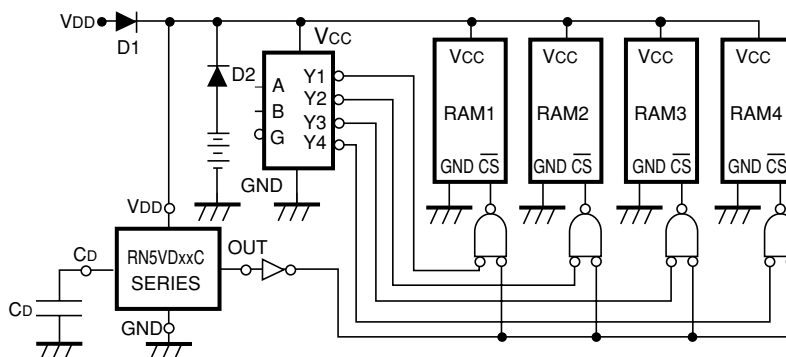
(2) Input Voltage to RN5VDxxA is different from the input voltage to CPU.



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



### • Memory Back-up Circuit





### • Manual Reset Circuit



### APPLICATION HINTS

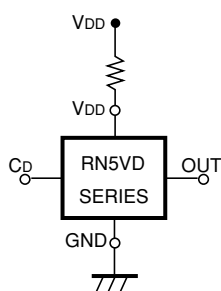


Fig.10

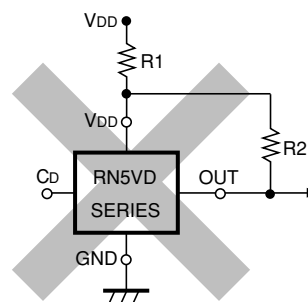


Fig.11

1. When RN5VDxxC (CMOS Output) is used in Fig.10, this IC may oscillate by cross conduction current at the detection when impedance is connected between Power Source VDD and RN5VD VDD Pin. When RN5VDxxA (Nch Open Drain Output) is used in Fig.10, and R becomes excessively large, Detector Threshold may be varied because of the voltage drop of the supply current in the IC itself.
2. The connection as shown in Fig. 11 may cause the oscillation in both RN5VDxxC (CMOS Output) and RN5VDxxA (Nch Open Drain Output)