LOW VOLTAGE DETECTOR WITH OUTPUT DELAY

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

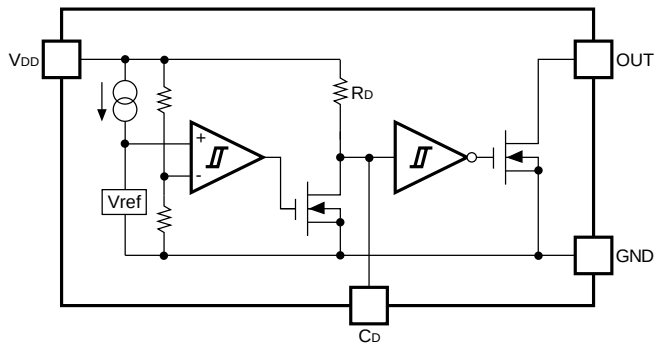
- Built-in Output Delay Circuit ..... Typ. 100ms with an external capacitor : 0.15μF
- Supply Current ..... Typ. 1.0μA (RN5VD15x, V_{DD}=3.5V)
- Operating Voltage Range ..... 0.7 to 10.0V (Topt=25°C)
- Detector Threshold Range ..... 0.9V to 6.0V (0.1V steps)
- Detector Threshold Accuracy ..... ±2.5%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

APPLICATIONS

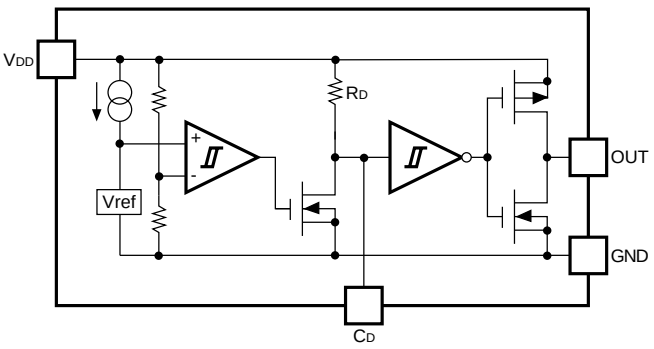
- CPU and Logic Circuit Reset
- Battery Checker
- Window Comparator
- Wave Shaping Circuit
- Battery Back-up Circuit
- Power Failure Detector

BLOCK DIAGRAMS

RN5VDxxA



RN5VDxxC



SELECTION GUIDE

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

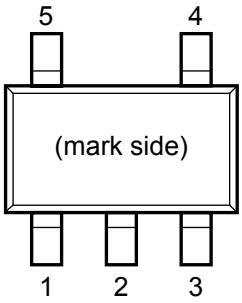
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
RN5VDxx∗A-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

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

●SOT-23-5



PIN DESCRIPTION

Pin No.	Symbol	Pin Description
1	OUT	Output Pin（"L" at Detection）
2	V_{DD}	Input Pin
3	GND	Ground Pin
4	NC	No Connection
5	C_D	Pin for external capacitor (for setting output delay)

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Ratings		Unit
V_{DD}	Supply Voltage	12		V
V_{OUT}	Output Voltage	CMOS	V_{SS} −0.3 to V_{DD}+0.3	V
		Nch	V_{SS} −0.3～12	
I_{OUT}	Output Current	70		mA
P_D	Power Dissipation (SOT-23-5)*	420		mW
Topt	Operating Temperature Range	−40 to +85		°C
Tstg	Storage Temperature Range	−55 to +125		°C
Tsolder	Lead Temperature (Soldering)	260°C 10s		

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

ABSOLUTE MAXIMUM RATINGS

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

ELECTRICAL CHARACTERISTICS

• RN5VD09A/C

Topt=25°C

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

Topt=25°C

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

• **RN5VD27A/C**

Topt=25°C

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

Topt=25°C

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

Topt=25°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}=4.34V			5.5	11.0	µA
		V_{DD}=6.5V			1.3	3.9	
V_{DDH}	Maximum Operating Voltage					10	V
V_{DDL}	Minimum Operating Voltage (Note 1)	Topt=25°C			0.55	0.70	V
		–30°C≤Topt≤85°C			0.65	0.80	
I_{OUT}	Output Current	Nch	V_{DS}=0.05V, V_{DD}=0.7V	0.01	0.05		mA
			V_{DS}=0.5V, V_{DD}=1.5V	1.0	2.0		
		Pch	V_{DS}=–2.1V, V_{DD}=8.0V	1.5	3.0		mA
V_{TCD}	CD pin Threshold Voltage	V_{DD}=4.95V		1.980	2.475	2.970	V
I_{CD}	CD pin Sink Current	V_{DS}=0.1V, V_{DD}=0.7V		2.0	30		µA
		V_{DS}=0.5V, V_{DD}=1.5V		200.0	800.0		
R_D	Delay Resistance			0.5	1.0	2.0	MΩ
$\frac{\Delta -V_{DET}}{\Delta Topt}$	Detector Threshold Temperature Coefficient	–30°C≤Topt≤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

Topt=25°C

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit.
$-V_{DET}$	Detector Threshold			5.265	5.400	5.535	V
V_{HYS}	Detector Threshold Hysteresis			0.162	0.270	0.378	V
I_{SS}	Supply Current	V_{DD}=5.2V			6.0	12.0	µA
		V_{DD}=7.4V			1.4	4.2	
V_{DDH}	Maximum Operating Voltage					10	V
V_{DDL}	Minimum Operating Voltage (Note 1)	Topt=25°C –30°C≤Topt≤85°C			0.55 0.65	0.70 0.80	V
I_{OUT}	Output Current	Nch	V_{DS}=0.05V, V_{DD}=0.7V	0.01	0.05		mA
			V_{DS}=0.5V, V_{DD}=1.5V	1.0	2.0		
		Pch	V_{DS}=–2.1V, V_{DD}=8.0V	1.5	3.0		mA
V_{TCD}	CD pin Threshold Voltage	V_{DD}=5.94V		2.376	2.970	3.564	V
I_{CD}	CD pin Sink Current	V_{DS}=0.1V, V_{DD}=0.7V		2.0	30		µA
		V_{DS}=0.5V, V_{DD}=1.5V		200.0	800.0		
R_D	Delay Resistance			0.5	1.0	2.0	MΩ
$\frac{\Delta -V_{DET}}{\Delta Topt}$	Detector Threshold Temperature Coefficient	–30°C≤Topt≤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			
	$-V_{DET}$ (V)			V_{HYS} (V)			I_{SS1} (µA)			I_{SS2} (µA)			I_{OUT1} (mA)			I_{OUT2} (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_{DD}= ($-V_{DET}$) –0.10V	1.5	3.7	V_{DD}= ($-V_{DET}$) +2.0V	0.9	2.7	Nch V_{DS}= 0.05V V_{DD}= 0.7V	0.01	0.05	Nch V_{DS}= 0.5V	V_{DD}= 0.85V	0.05	0.50
RN5VD10A/C	0.975	1.000	1.025	0.030	0.050	0.070					1.0	3.0							
RN5VD11A/C	1.073	1.100	1.127	0.033	0.055	0.077		1.8	4.5								V_{DD}= 1.0V	0.2	1.0
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										
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								V_{DD}= 1.5V	1.0	2.0
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													
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													
RN5VD20A/C	1.950	2.000	2.050	0.060	0.100	0.140		3.0	6.0		1.1	3.3							
RN5VD21A/C	2.048	2.100	2.152	0.063	0.105	0.147													
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													
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		3.5	7.0										
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													
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													
RN5VD30A/C	2.925	3.000	3.075	0.090	0.150	0.210	V_{DD}= ($-V_{DET}$) –0.13V	4.0	8.0		1.2	3.6							
RN5VD31A/C	3.023	3.100	3.177	0.093	0.155	0.217													
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													
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													
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													

(Note) Refer to the previously defined “Minimum Operating Voltage”.
Condition 1 : Topt=25˚C
Condition 2 : –30˚C≤Topt≤85˚C

Topt=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_{OUT3} (mA)			V_{DDL} (V)		V_{TCD} (V)				I_{CD1} (μA)			I_{CD2} (μA)				R_D (MΩ)			$\frac{\Delta -V_{DET}}{\Delta Topt}$ (ppm/°C)	
conditions	Min.	Typ.	Typ.	Max.	conditions	Min.	Typ.	Max.	conditions	Min.	Typ.	conditions		Min.	Typ.	Min.	Typ.	Max.	conditions	Typ.
Pch V_{DS}= -2.1V V_{DD}= 4.5V	1.0	2.0	(Note1) Condition1 0.55 Condition2 0.65	(Note1) Condition1 0.70 Condition2 0.80	V_{DD}= (-V_{DET}) × 1.1V	V_{DD}× 0.3	V_{DD}× 0.5	V_{DD}× 0.7	V_{DS}= 0.1V V_{DD}= 0.7V	2.0	30	V_{DS}= 0.5V	V_{DD}= 0.85V	10	100	0.5	1.0	2.0	-30°C≤ Topt ≤85°C	±100
						V_{DD}× 0.35	V_{DD}× 0.5	V_{DD}× 0.65					V_{DD}= 1.0V	50	200					
						V_{DD}× 0.4	V_{DD}× 0.5	V_{DD}× 0.6					V_{DD}= 1.5V	200	800					

• RN5VD40A/C to RN5VD60A/C

Part Number.	Detector Threshold			Hysteresis			Supply Current 1			Supply Current 2			Output Current 1			Output Current 2			
	$-V_{DET}$ (V)			V_{HYS} (V)			I_{SS1} (µA)			I_{SS2} (µA)			I_{OUT1} (mA)			I_{OUT2} (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													
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		5.0	10.0										
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	$V_{DD}=(-V_{DET})-0.16V$				1.3	3.9							
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													
RN5VD47A/C	4.583	4.700	4.817	0.141	0.235	0.329		5.5	11.0										
RN5VD48A/C	4.680	4.800	4.920	0.144	0.240	0.336							Nch						
RN5VD49A/C	4.778	4.900	5.022	0.147	0.245	0.343				$V_{DD}=(-V_{DET})+2.0V$			$V_{DS}=0.05V$	0.01	0.05	Nch	$V_{DD}=1.5V$	1.0	2.0
RN5VD50A/C	4.875	5.000	5.125	0.150	0.250	0.350							$V_{DD}=0.7V$			$V_{DS}=0.5V$			
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		6.0	12.0										
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	$V_{DD}=(-V_{DET})-0.20V$				1.4	4.2							
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 : Topt=25˚C
Condition 2 : –30˚C≤Topt≤85˚C

Topt=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_{OUT3} (mA)			V_{DDL} (V)		V_{TCD} (V)				I_{CD1} (μA)			I_{OUT1} (mA)				I_{OUT2} (mA)			$\frac{\Delta -V_{DET}}{\Delta Topt}$ (ppm/°C)	
conditions	Min.	Typ.	Typ.	Max.	conditions	Min.	Typ.	Max.	conditions	Min.	Typ.	conditions		Min.	Typ.	conditions	Typ.	Max.	conditions	Typ.
Pch V_{DS}= −2.1V V_{DD}= 8.0V	1.5	3.0	(Note1) Condition1 0.55 Condition2 0.65	(Note1) Condition1 0.70 Condition2 0.80	V_{DD}= (−V_{DET}) ×1.1V	V_{DD}× 0.4	V_{DD}× 0.5	V_{DD}× 0.6V	V_{DS}= 0.1V V_{DD}= 0.7V	2.0	30	V_{DS}= 0.5V	V_{DD}= 1.5V	200	800	0.5	1.0	2.0	−30°C≤ Topt ≤85°C	±100

OPERATION

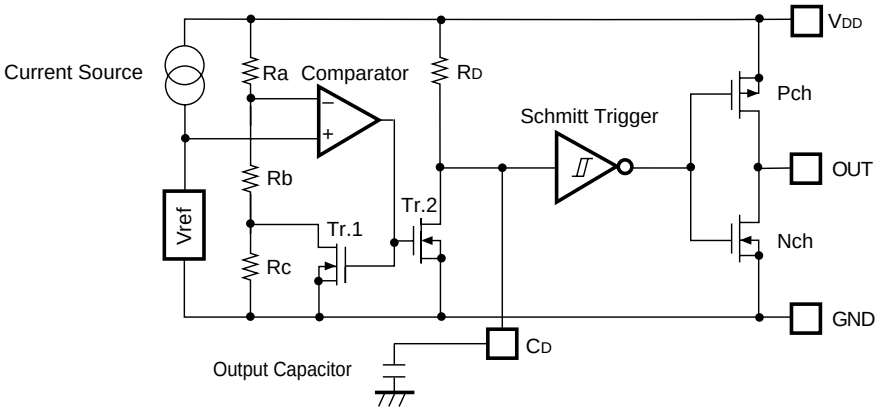


Fig. 1 Block Diagram

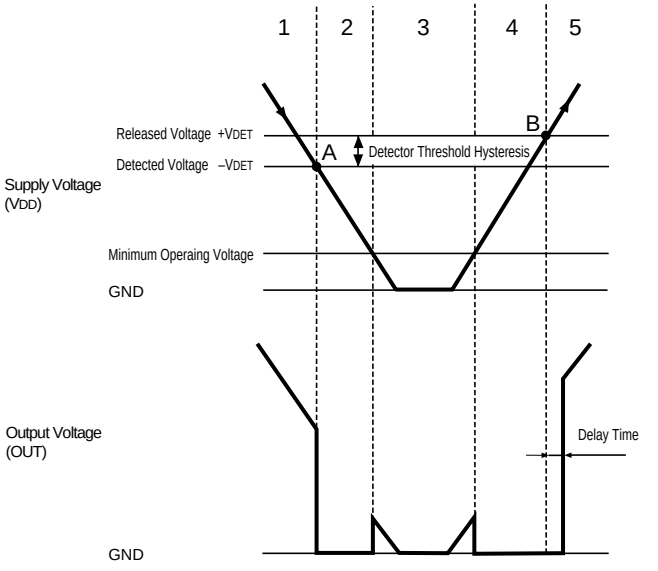


Fig. 2 Operation Diagram

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	ON	Indefinite	ON	OFF
	Pch	ON	OFF	Indefinite	OFF	ON

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

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

Step 1. Output voltage is equal to pull-up voltage.

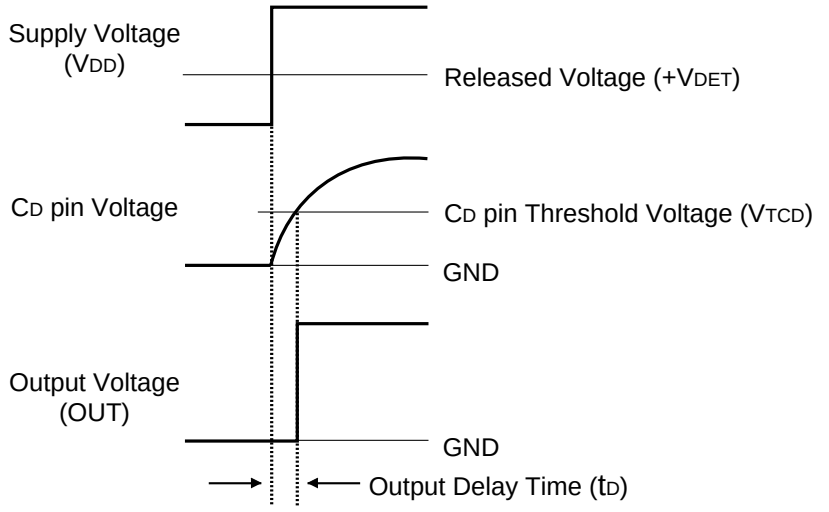
Step 2. When input voltage (V_{DD}) reaches the state of $V_{ref} \geq V_{DD} \cdot (Rb+Rc) / (Ra+Rb+Rc)$ at point A (Detected Voltage $-V_{DET}$), the output of comparator is reversed, so that output voltage becomes GND. Discharging is performed from C_D pin connected to an external capacitor. No delay time is generated.

Step 3. Output voltage becomes indefinite when power source voltage (V_{DD}) is smaller than minimum operating voltage. When the output is pulled up, V_{DD} is output.

Step 4. Output voltage becomes equal to GND.

Step 5. When input voltage (V_{DD}) reaches the state of $V_{ref} \leq V_{DD} \cdot Rb / (Ra+Rb)$ at Point B (Released Voltage $+V_{DET}$), the output of comparator is reversed, and the external capacitor is charged through C_D 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

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

TEST CIRCUITS

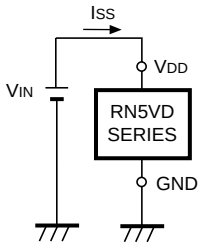


Fig. 3 Supply Current test Circuit

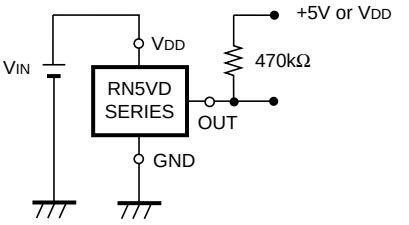


Fig. 4 Detector Threshold Test Circuit

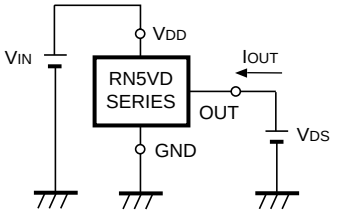


Fig. 5 Nch Driver Output Current Test Circuit

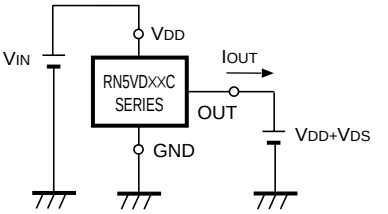


Fig. 6 Pch Driver Output Current Test Circuit

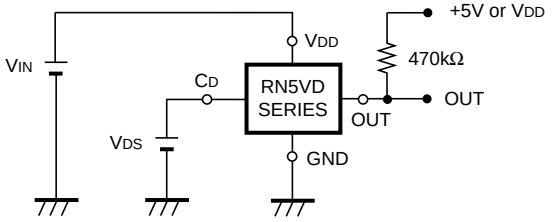


Fig. 7 C_D pin Threshold Voltage Test Circuit

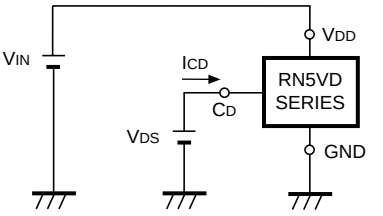
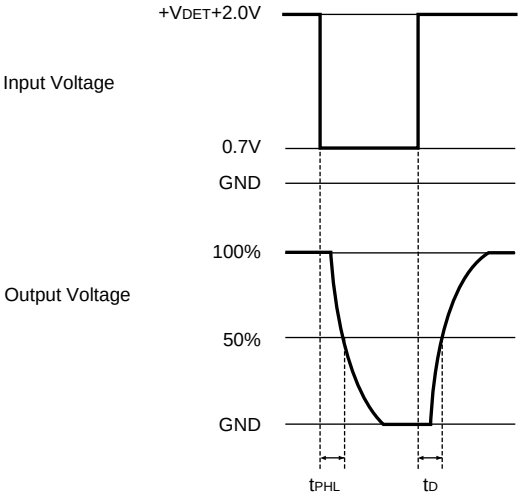


Fig. 8 C_D pin Sink Current Test Circuit



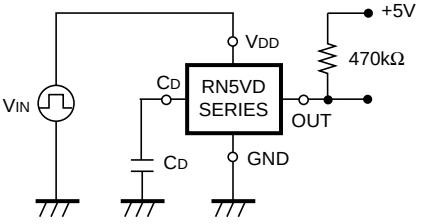


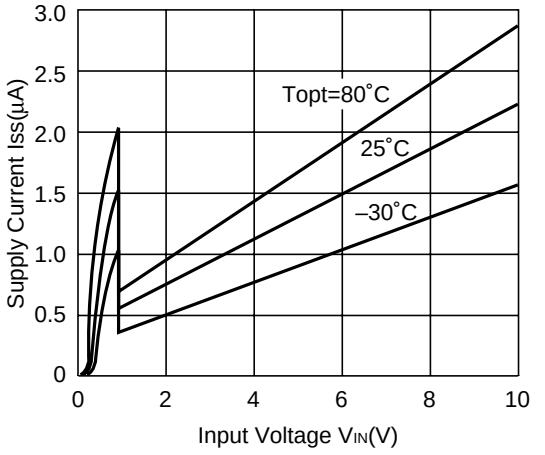
Fig. 9 Output Delay Time Test Circuit

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

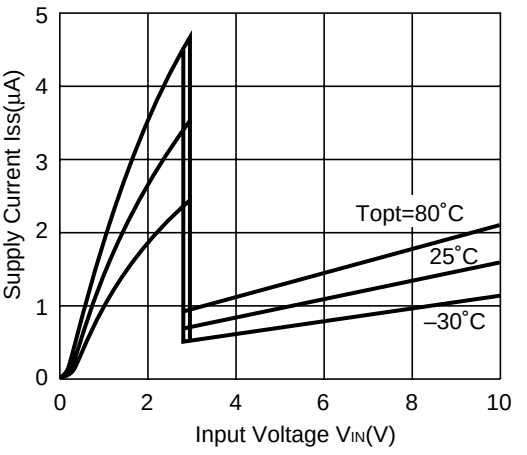
TYPICAL CHARACTERISTICS

1) Supply Current vs. Input Voltage

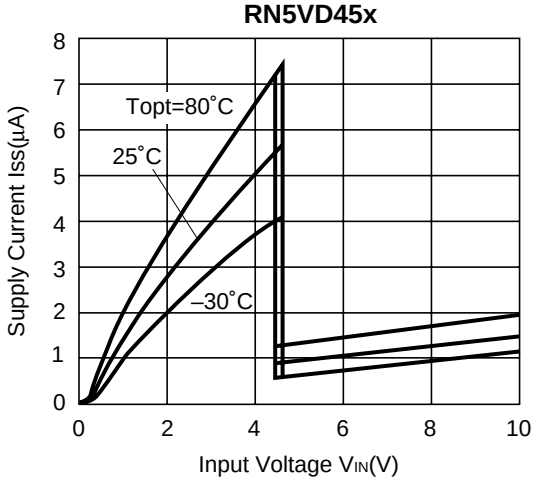
RN5VD09x



RN5VD27x

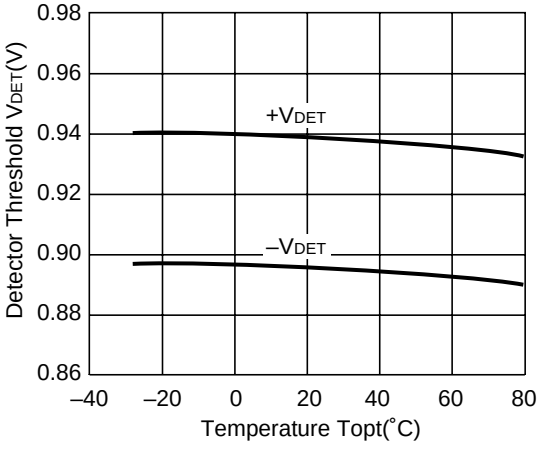


RN5VD45x

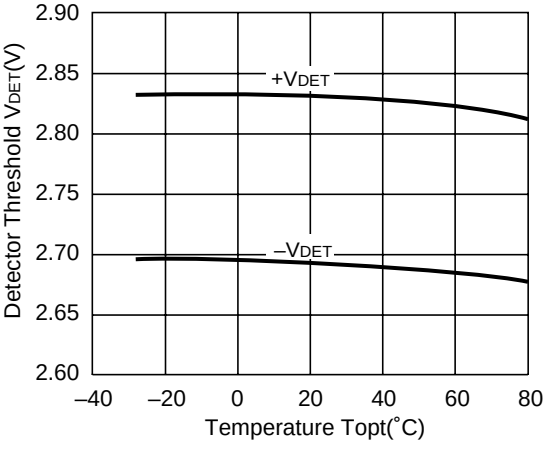


2) Detector Threshold vs. Temperature

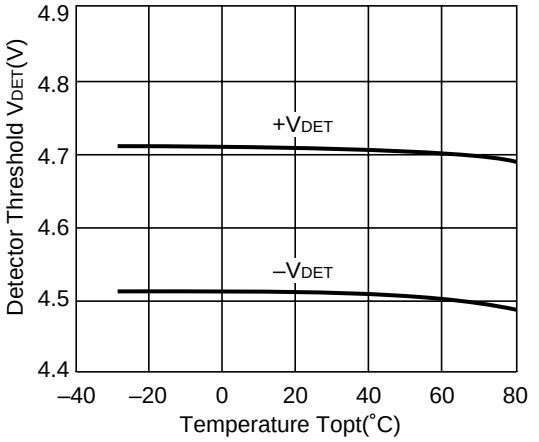
RN5VD09x



RN5VD27x

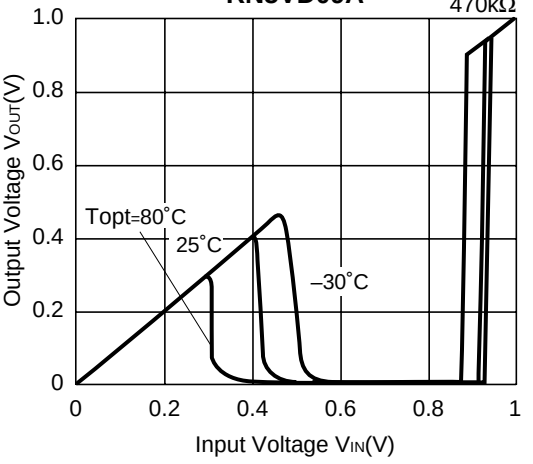


RN5VD45x

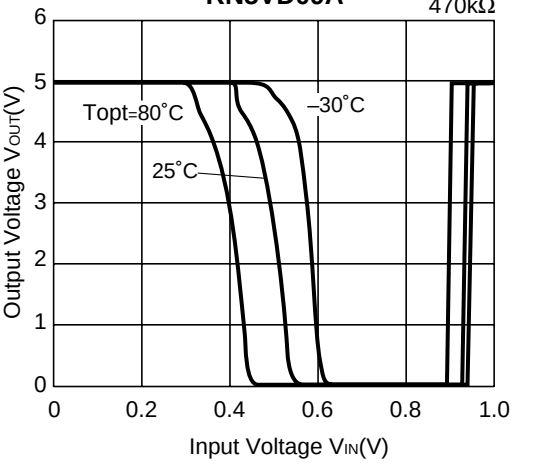


3) Output Voltage vs. Input Voltage

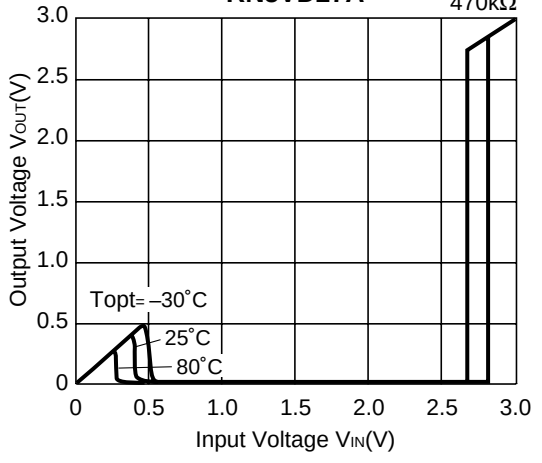
RN5VD09A VDD Pull-up 470kΩ



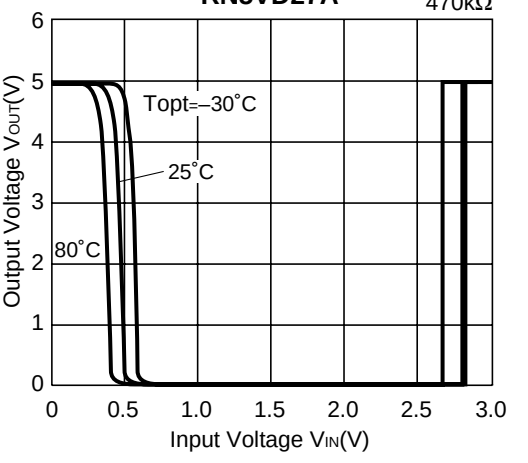
RN5VD09A 5V Pull-up 470kΩ

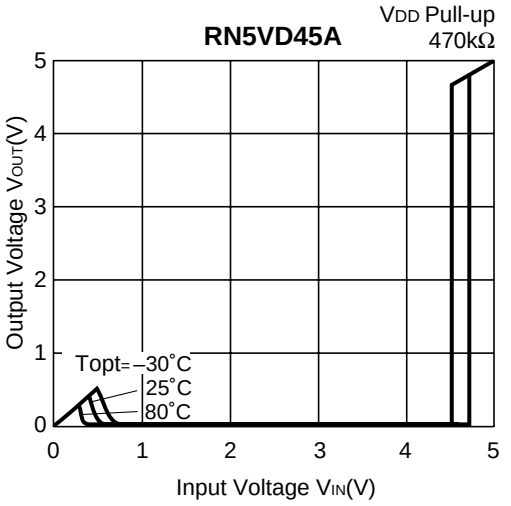


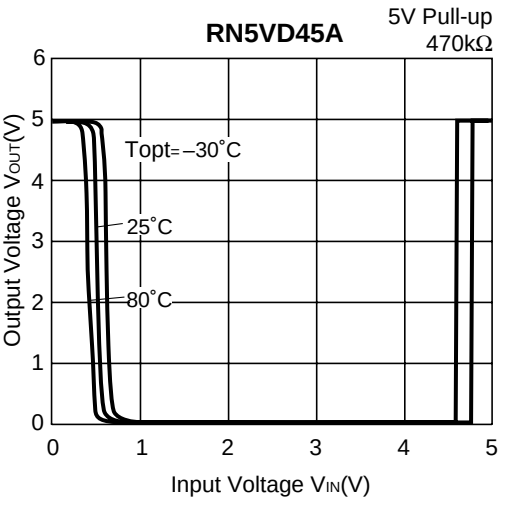
RN5VD27A VDD Pull-up 470kΩ



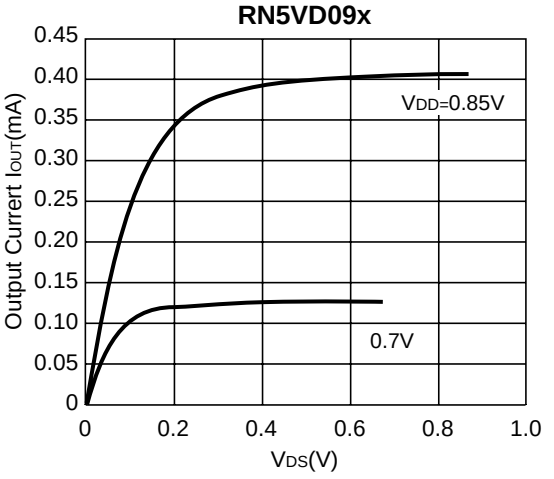
RN5VD27A 5V Pull-up 470kΩ

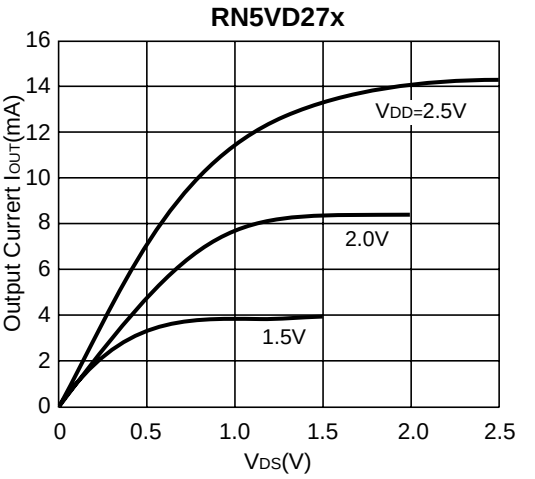


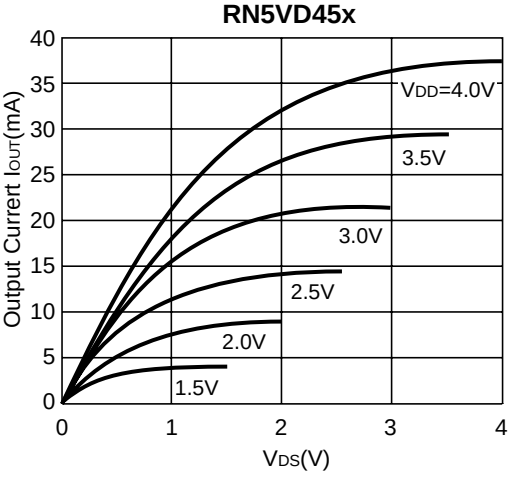




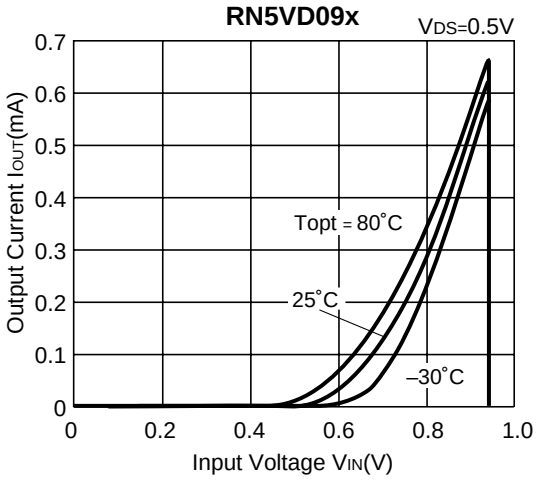
4) Nch Driver Output Current vs. V_{DS}

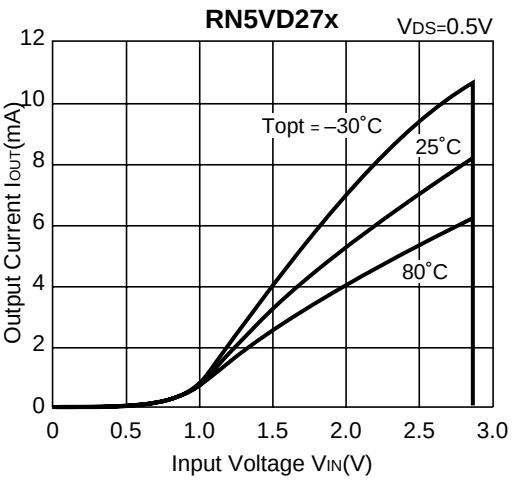


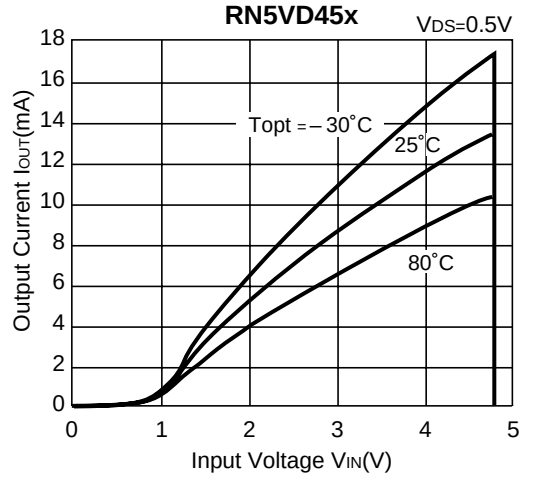




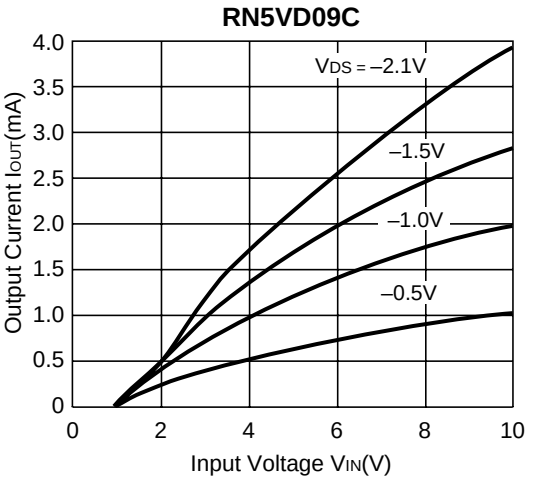
5) Nch Driver Output Current vs. Input Voltage

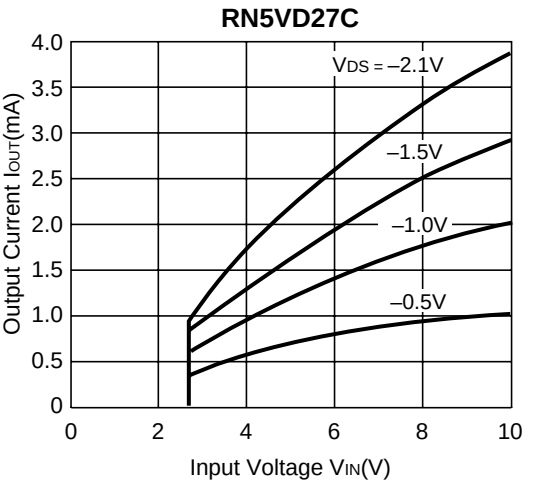


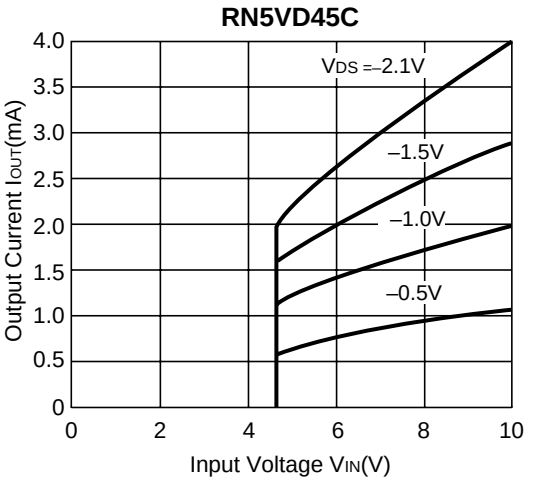




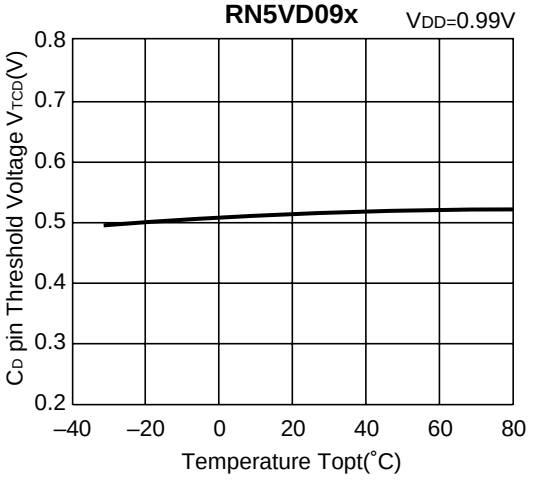
6) Pch Driver Output Current vs. Input Voltage

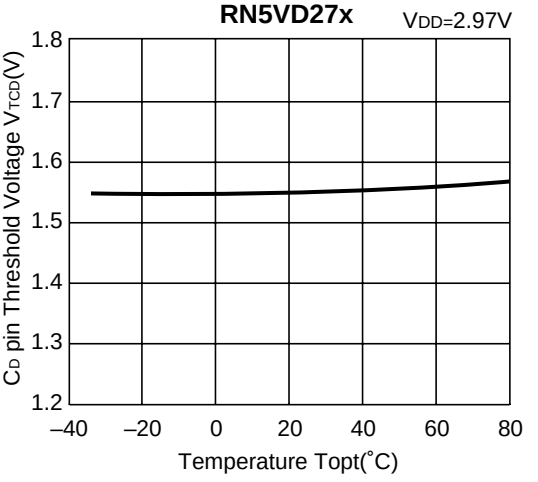


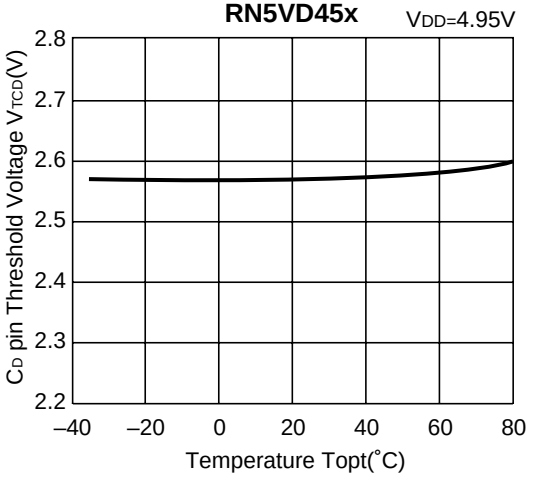




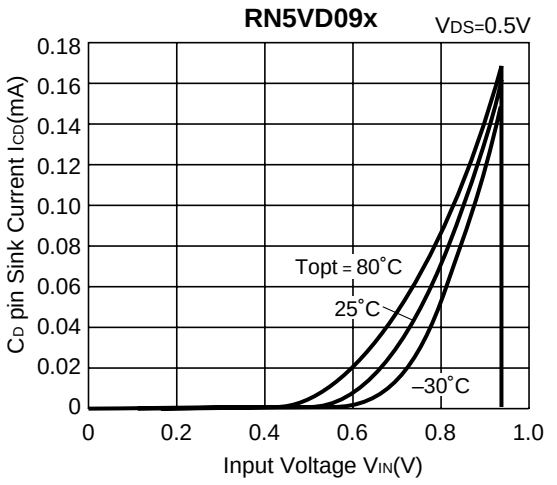
7) C_D pin Threshold Voltage vs. Temperature

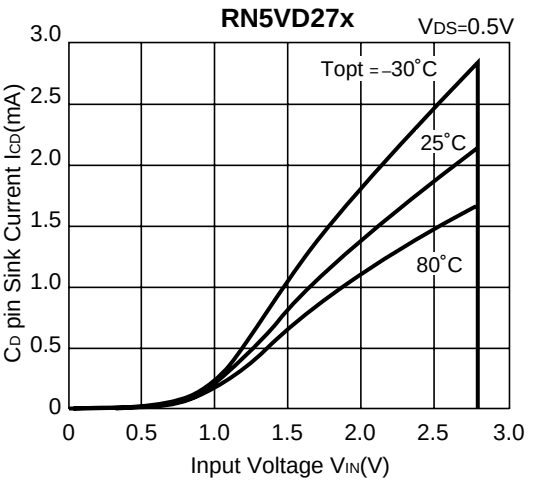


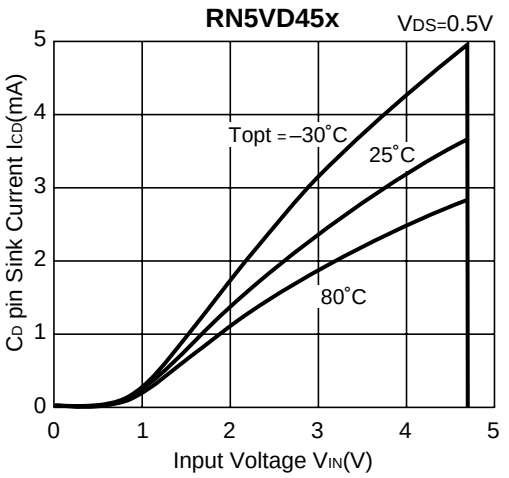




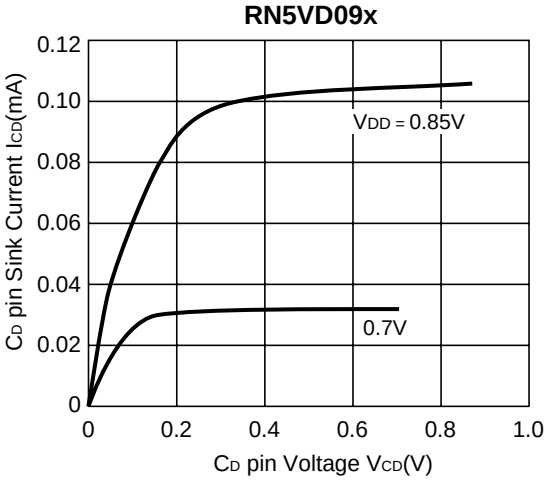
8) CD pin Sink Current vs. Input Voltage

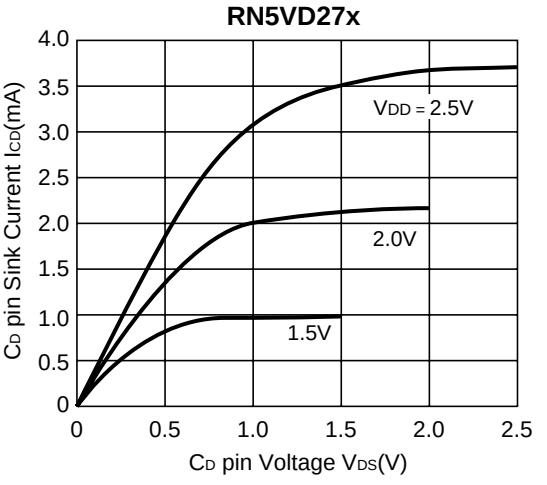


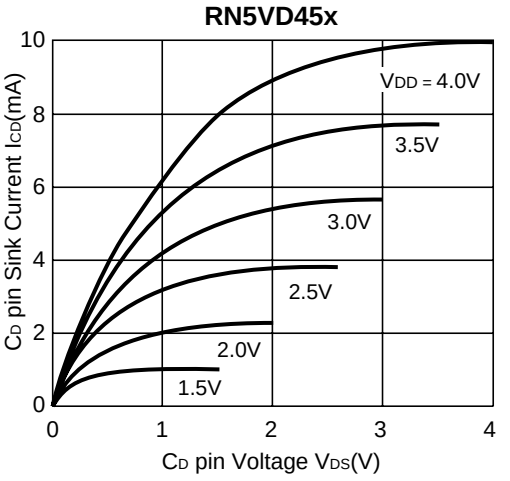




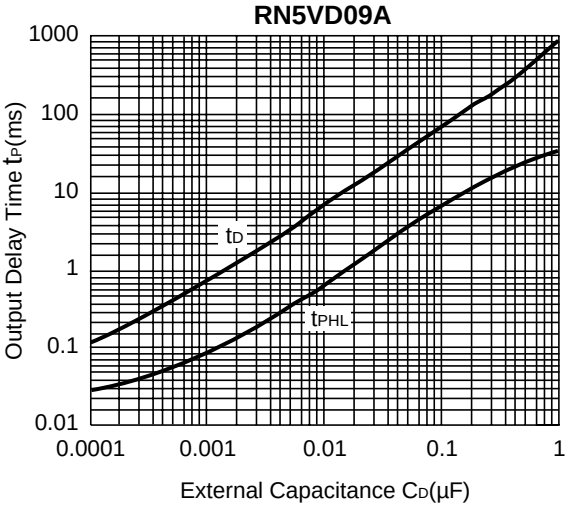
9) CD pin Sink Current vs. CD pin Voltage

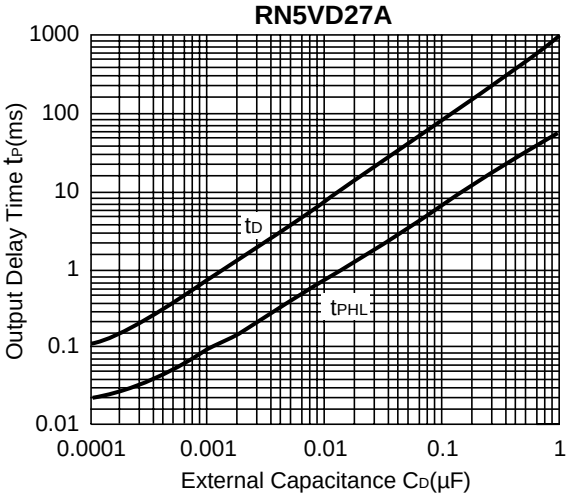


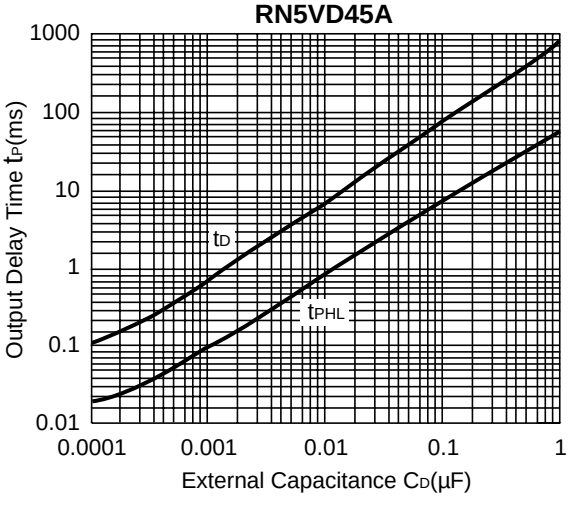




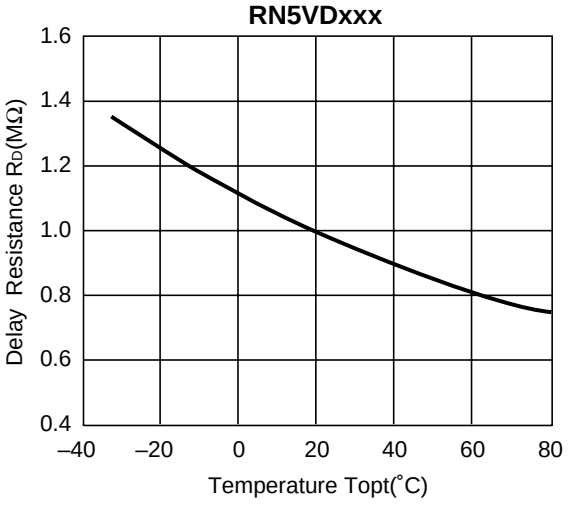
10) Output delay Time vs. External Capacitance







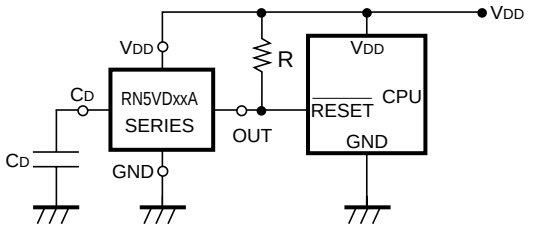
11) Delay Resistance vs. Temperature



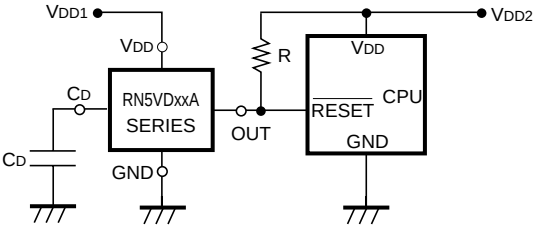
TYPICAL APPLICATIONS

• RN5VDxxA CPU Reset Circuit (Nch Open Drain Output)

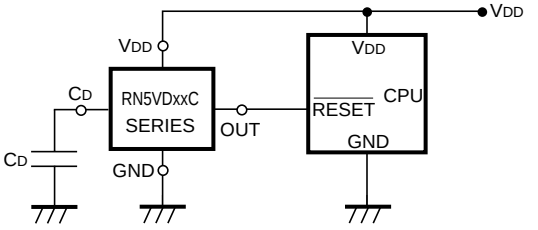
(1) Input Voltage to RN5VDxxA is the same as the input voltage to CPU.



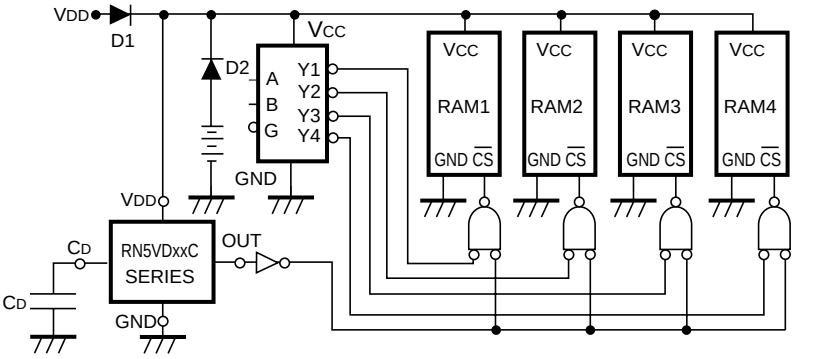
(2) Input Voltage to RN5VDxxA is different from the input voltage to CPU.



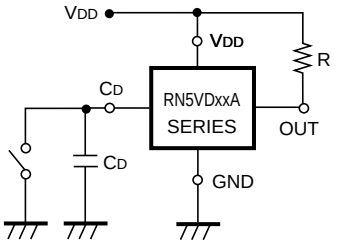
• RN5VDxxC CPU Reset Circuit (CMOS Output)

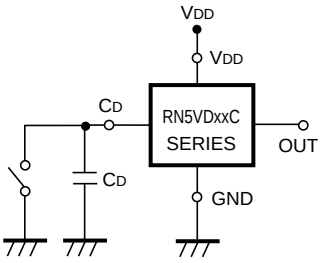


• Memory Back-up Circuit



• **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*1, 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_{IN} 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.

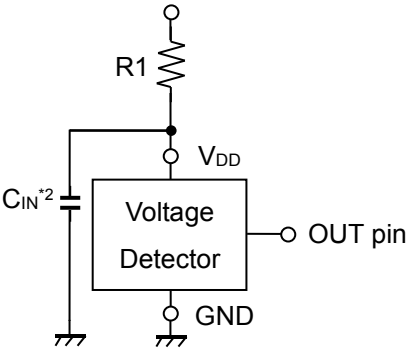


Figure A

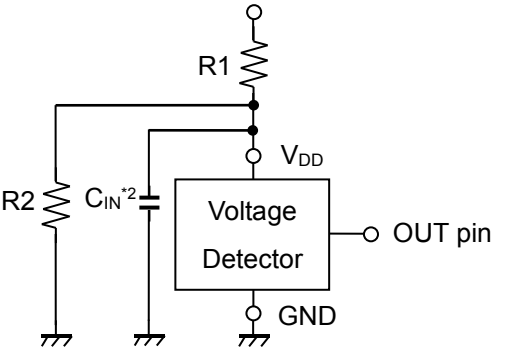


Figure B

*1 In the CMOS output type, a charging current for OUT pin is included.

*2 Note the bias dependence of capacitors.

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