
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.

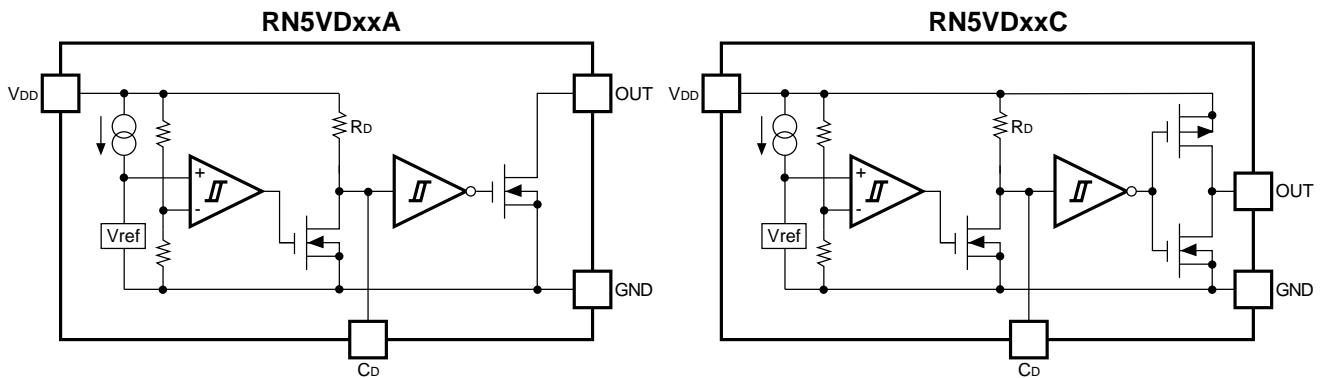
FEATURES

- Built-in Output Delay Circuit..... Typ. 100ms with an external capacitor : 0.15 μ F
- Supply Current..... Typ. 1.0 μ 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

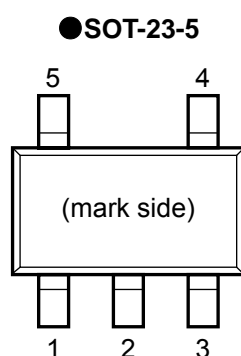
The detector threshold, and the output type for the ICs can be selected at the users' request.

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 _{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
T _{opt}	Operating Temperature Range	-40 to +85		°C
T _{stg}	Storage Temperature Range	-55 to +125		°C
T _{solder}	Lead Temperature (Soldering)	260°C 10s		

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

ABSOLUTE MAXIMUM RATINGS

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

ELECTRICAL CHARACTERISTICS

• RN5VD09A/C

T_{opt}=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)	T _{opt} =25°C		0.55	0.70	V
		-30°C≤T _{opt} ≤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
$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C≤T _{opt} ≤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_{opt}=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)	T _{opt} =25°C -30°C≤T _{opt} ≤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
$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C≤T _{opt} ≤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_{opt}=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)	T _{opt} =25°C -30°C≤T _{opt} ≤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
$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C≤T _{opt} ≤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_{opt}=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)	T _{opt} =25°C -30°C ≤ T _{opt} ≤ 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} =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
$\frac{\Delta -V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C ≤ T _{opt} ≤ 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_{opt}=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)	T _{opt} =25°C -30°C ≤ T _{opt} ≤ 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} =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
$\frac{\Delta -V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C ≤ T _{opt} ≤ 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_{opt}=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)	T _{opt} =25°C -30°C≤T _{opt} ≤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
$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$	Detector Threshold Temperature Coefficient	-30°C≤T _{opt} ≤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	0.9	2.7	Nch	0.01	0.05	Nch	V _{DD} = 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 _{DD} = 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 _{DD} = (-V _{DET}) +2.0V	1.1	3.3	0.05V	0.01	0.05	Nch	V _{DSS} = 0.5V	V _{DD} = 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 _{DD} = (-V _{DET}) -0.13V	1.2	3.6										
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_{opt}=25°CCondition 2 : -30°C ≤ T_{opt} ≤ 85°C

T_{opt}=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)			$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$ (ppm/°C)			
conditions	Min.	Typ.	Typ.	Max.	conditions	Min.	Typ.	Max.	conditions	Min.	Typ.	conditions	Min.	Typ.	Min.	Typ.	Max.	conditions	Typ.	
P _{ch} V _{DS} = -2.1V V _{DD} = 4.5V	1.0	2.0	(Note1) Condition1 0.55	(Note1) Condition1 0.70	conditions V _{DD} = (-V _{DET}) × 1.1V	V _{DDX} 0.3	V _{DDX} 0.5	V _{DDX} 0.7	conditions V _{DS} = 0.1V V _{DD} = 0.7V	Min. 2.0	Typ. 30	conditions V _{DS} = 0.5V V _{DD} = 1.5V	V _{DD} = 0.85V	10	100	0.5	1.0	2.0	conditions -30°C ≤ T _{opt} ≤ 85°C	Typ. ±100
						V _{DD} = 1.0V	50	200												
						V _{DDX} 0.35	V _{DDX} 0.5	V _{DDX} 0.65					V _{DD} = 200	800						
						V _{DDX} 0.4	V _{DDX} 0.5	V _{DDX} 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 _{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	V _{DD} = (-V _{DET}) -0.16V	5.0	10.0	V _{DD} = (-V _{DET}) +2.0V	1.3	3.9	N _{ch} V _{DS} = 0.05V	0.01	0.05	N _{ch} V _{DS} = 0.5V	V _{DD} = 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 _{DD} = (-V _{DET}) -0.20V	6.0	12.0	1.4	4.2								
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		6.5	13.0										
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_{opt}=25°C

Condition 2 : -30°C≤T_{opt}≤85°C

T_{opt}=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)			$\frac{\Delta-V_{DET}}{\Delta T_{opt}}$ (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 _{DD} = (-V _{DET}) ×1.1V	V _{DD} ×	V _{DD} ×	V _{DD} ×	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 ≤ T _{opt} ≤85°C	±100
V _{DS} = -2.1V	1.5	3.0	0.55	0.70		0.4	0.5	0.6V												
V _{DD} = 8.0V			Condition2	Condition2																

OPERATION

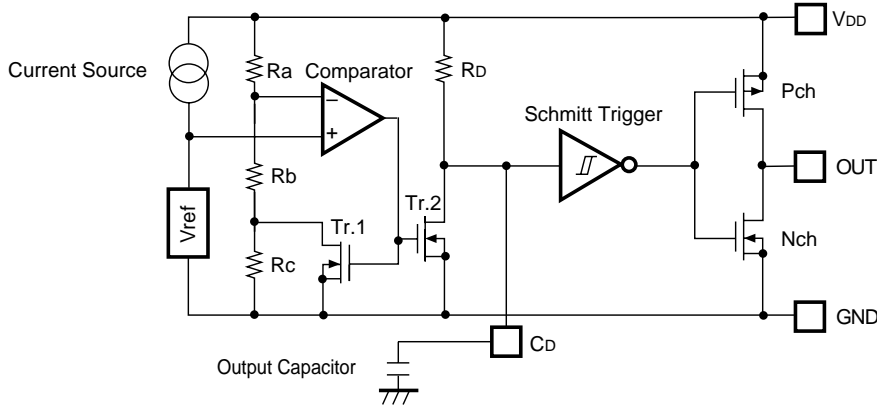


Fig. 1 Block Diagram

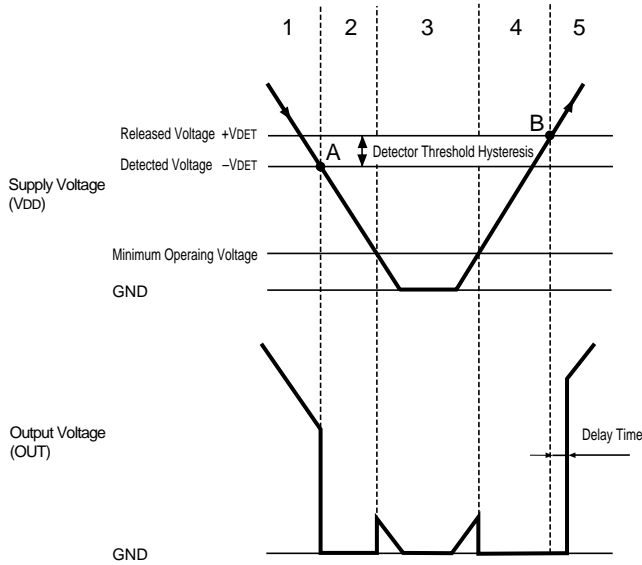


Fig. 2 Operation Diagram

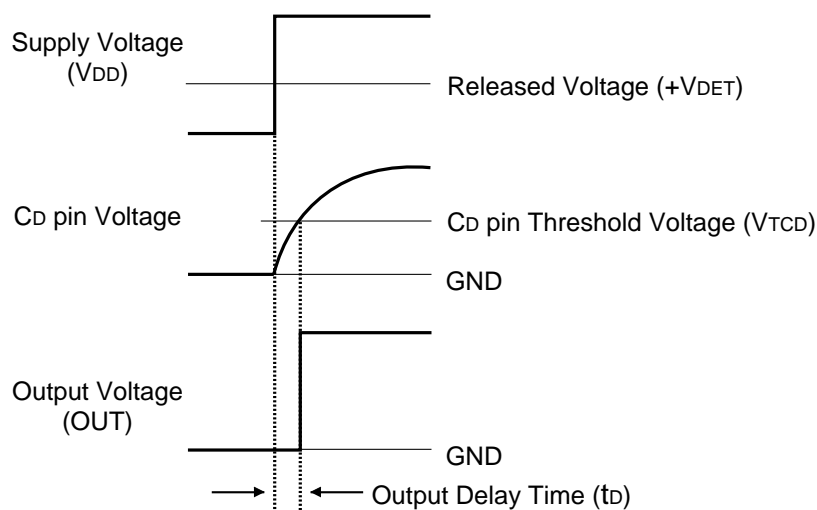
Step	Step 1	Step 2	Step 3	Step 4	Step 5
Comparator (-) Pin Input Voltage	I	II	II	II	I
Comparator Output	L	H	Indefinite	H	L
Tr. 1, 2	OFF	ON	Indefinite	ON	OFF
Output Tr.	Nch	OFF	Indefinite	ON	OFF
	Pch	ON	OFF	Indefinite	OFF

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

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

- Step 1. Output voltage is equal to pull-up voltage.
- Step 2. When input voltage (V_{DD}) 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 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 $V_{ref} \leq V_{DD} \cdot R_b / (R_a + R_b)$ at Point B (Released Voltage $+V_{DET}$), the output of comparator is reversed, and the external capacitor is charged through 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 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 V_{TCD} (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

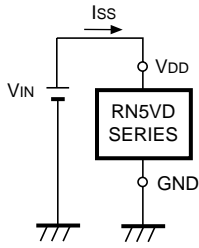


Fig. 3 Supply Current test Circuit

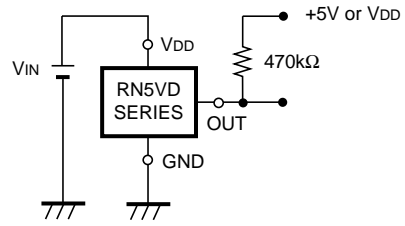


Fig. 4 Detector Threshold Test Circuit

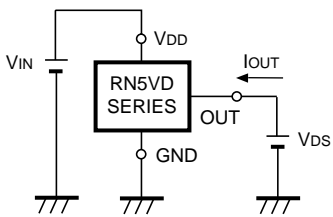


Fig. 5 Nch Driver Output Current Test Circuit

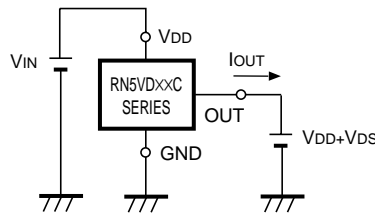


Fig. 6 Pch Driver Output Current Test Circuit

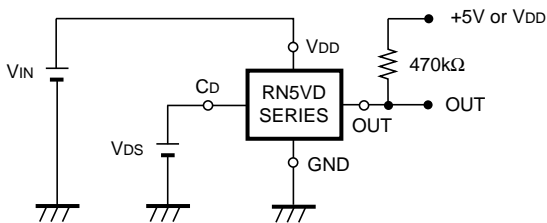


Fig. 7 Cd pin Threshold Voltage Test Circuit

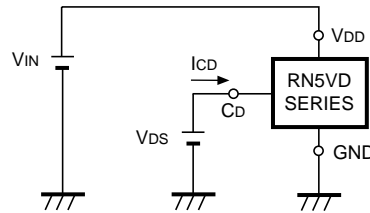


Fig. 8 Cd pin Sink Current Test Circuit

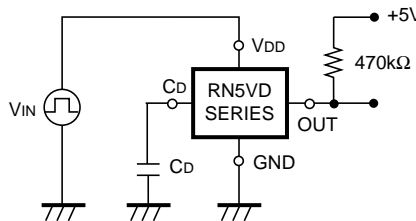
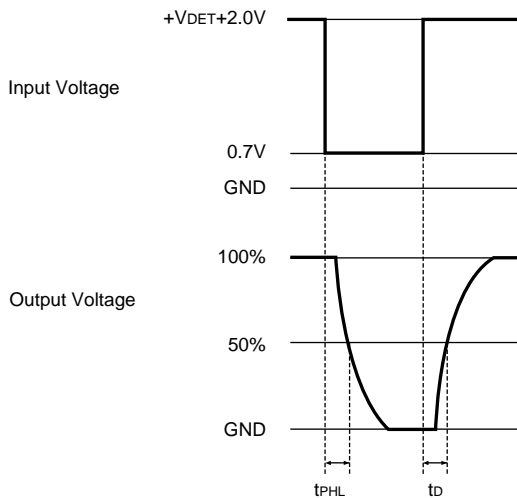
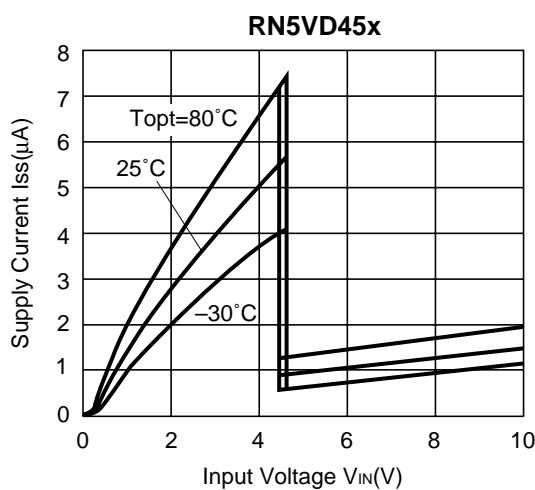
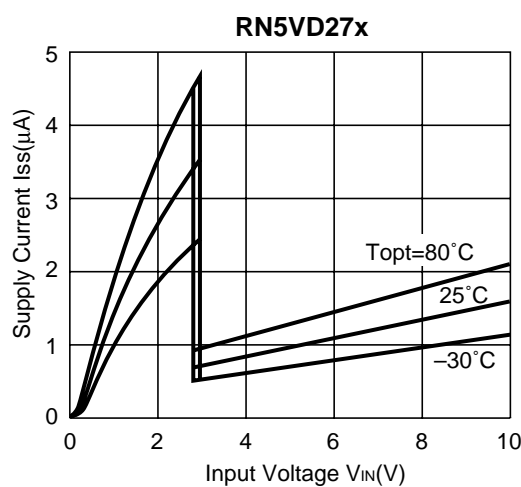
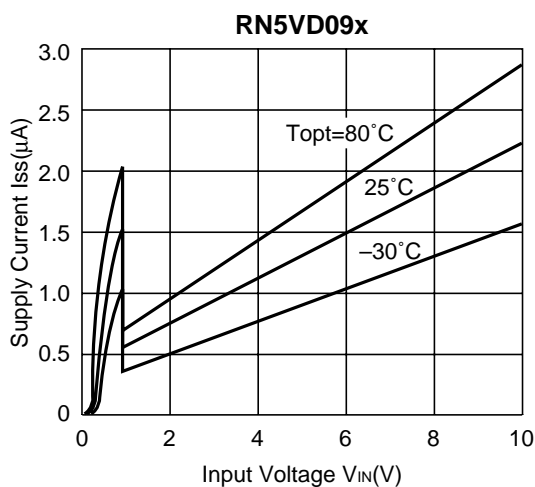


Fig. 9 Output Delay Time Test Circuit

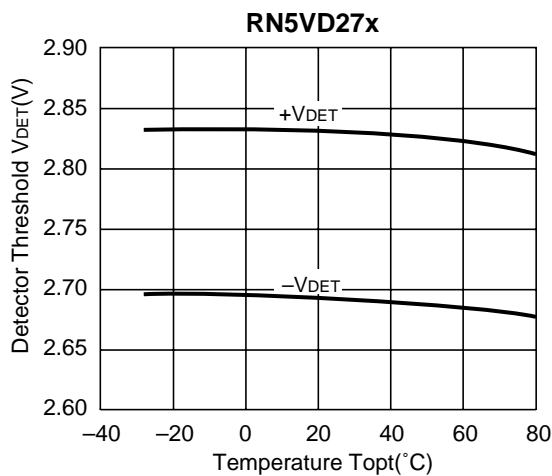
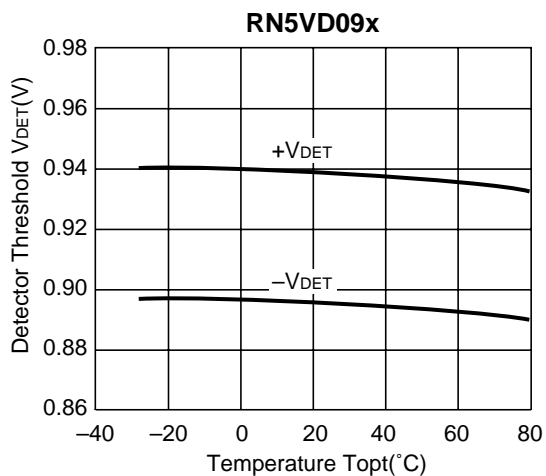
*) at Fig.4,7,9. CMOS Output Type does not need a pull-up resistor.

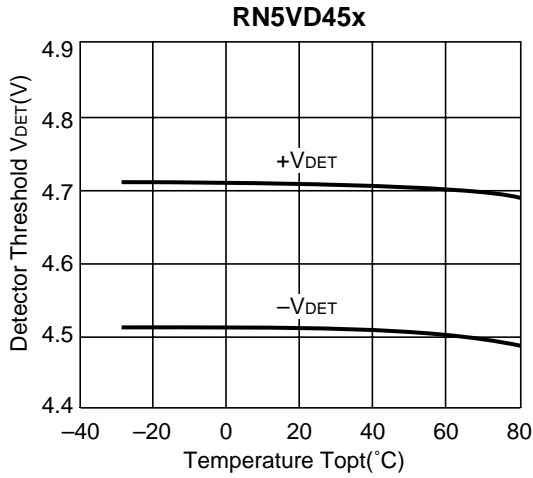
TYPICAL CHARACTERISTICS

1) Supply Current vs. Input Voltage

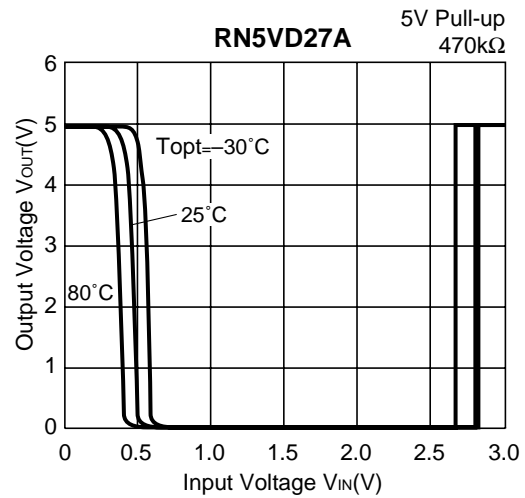
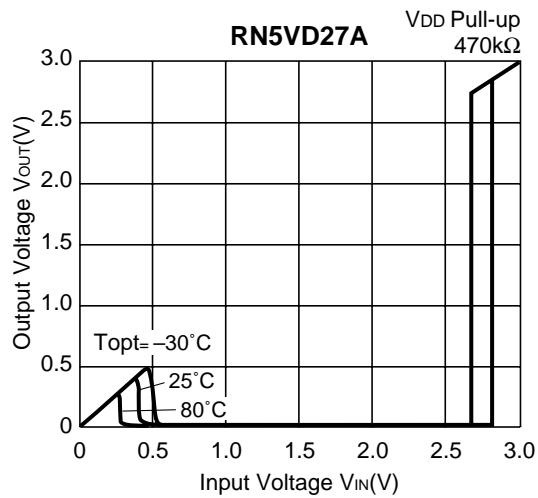
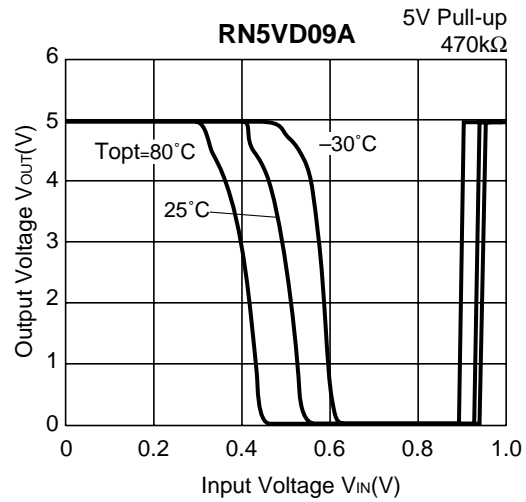
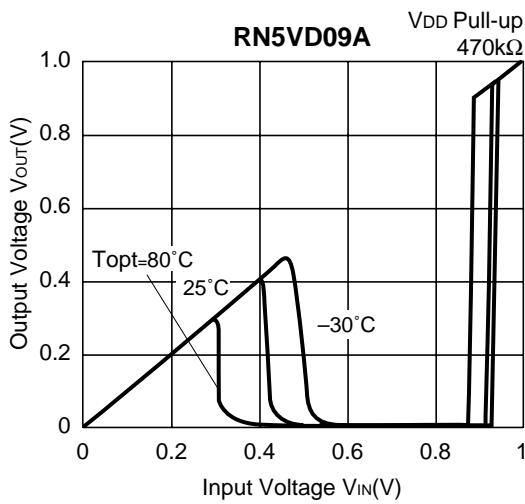


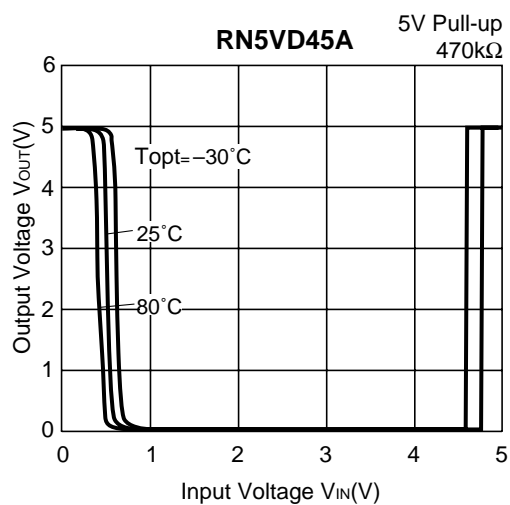
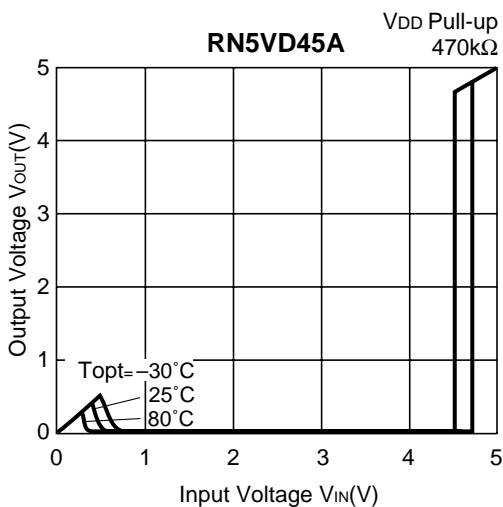
2) Detector Threshold vs. Temperature



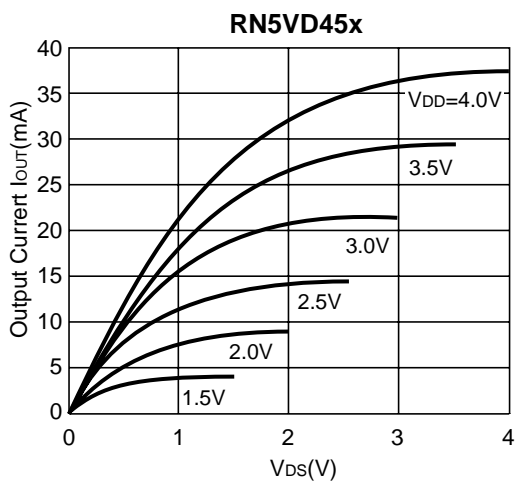
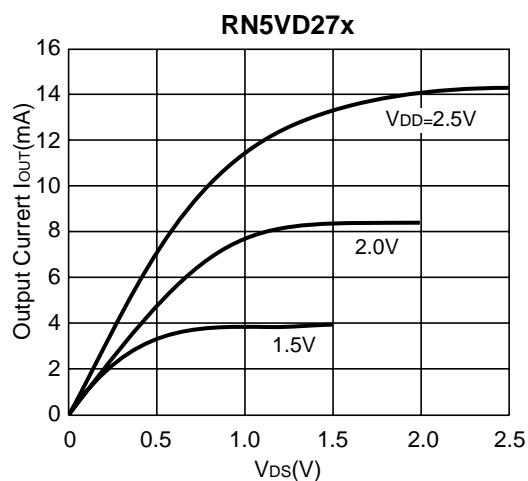
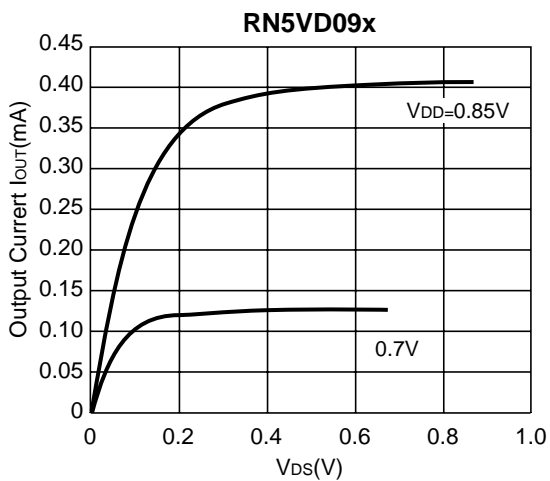


3) Output Voltage vs. Input Voltage

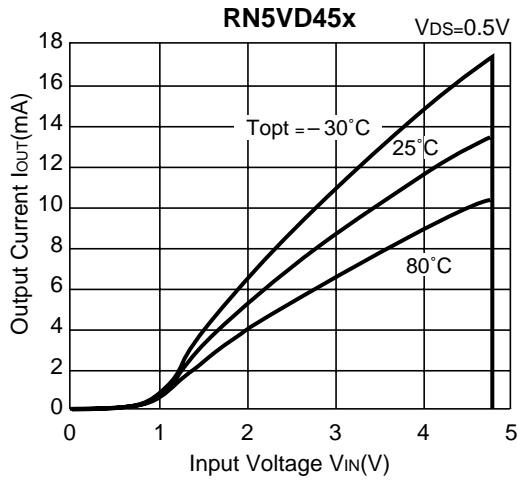
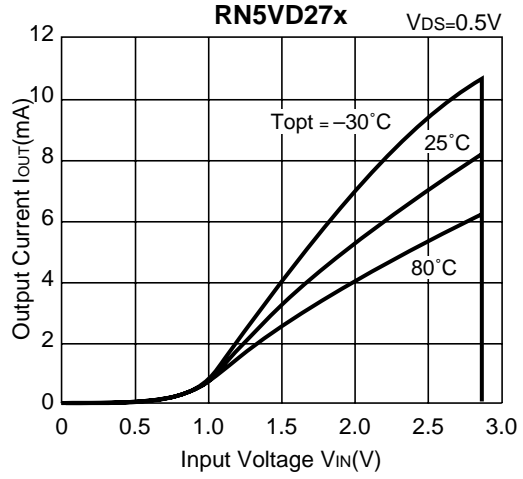
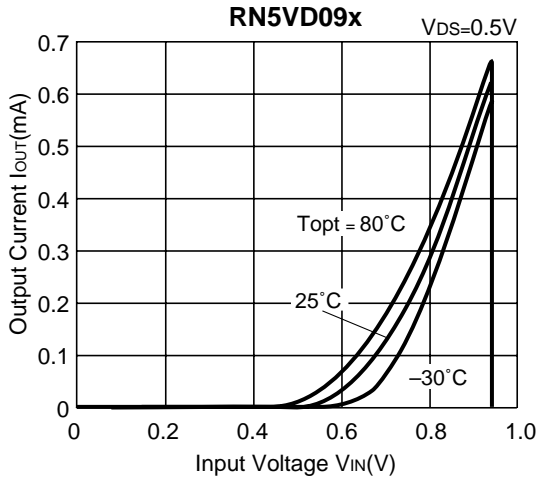




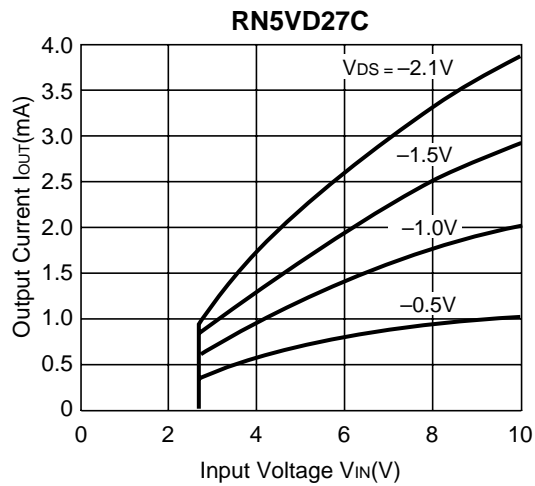
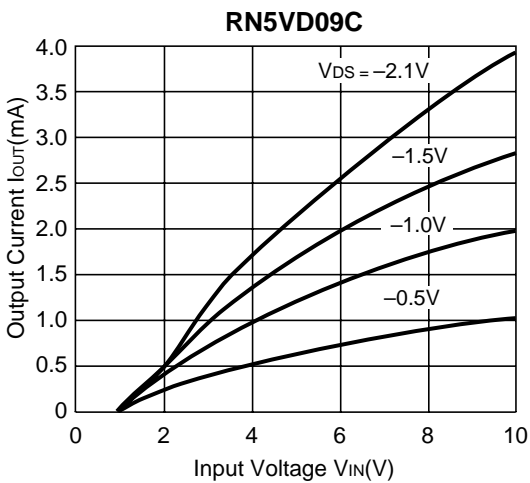
4) Nch Driver Output Current vs. V_{DS}

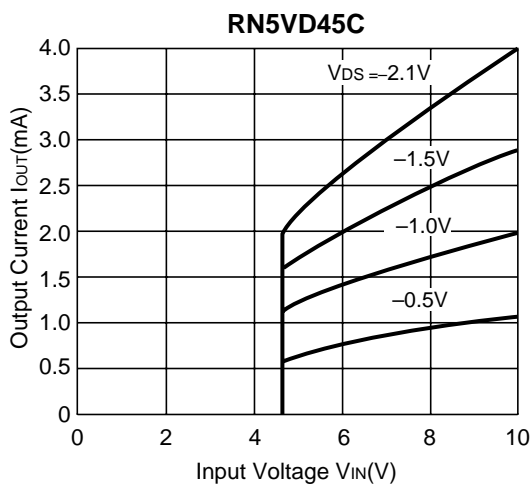


5) Nch Driver Output Current vs. Input Voltage

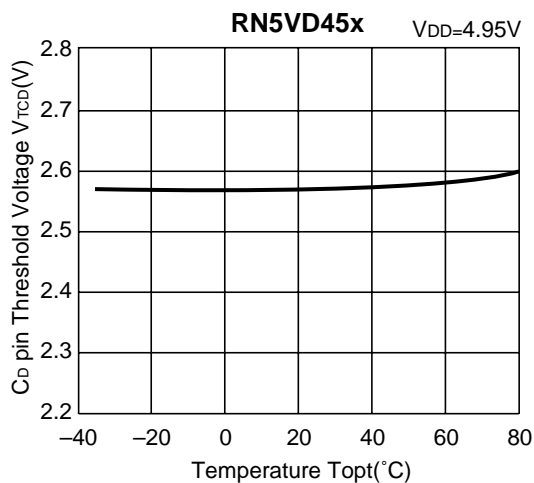
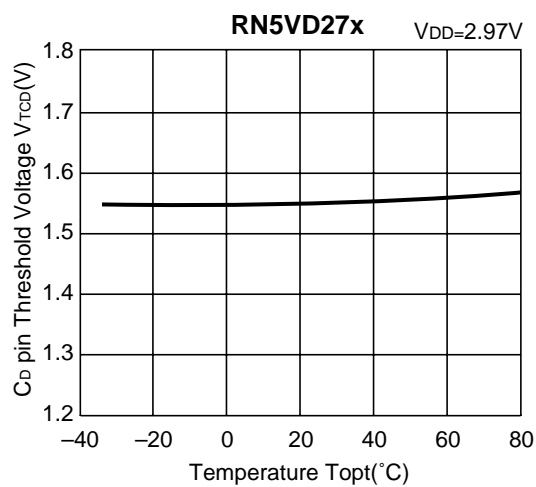
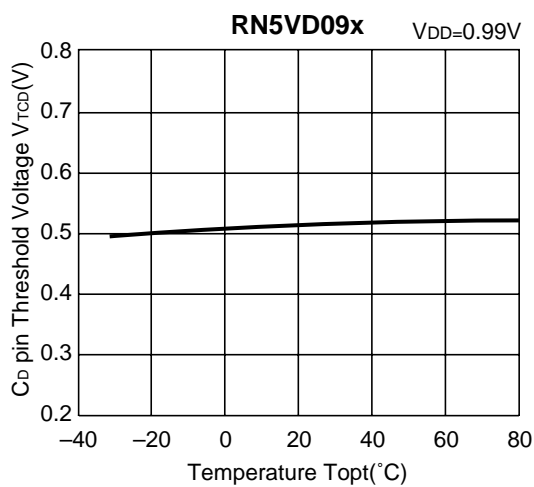


6) Pch Driver Output Current vs. Input Voltage

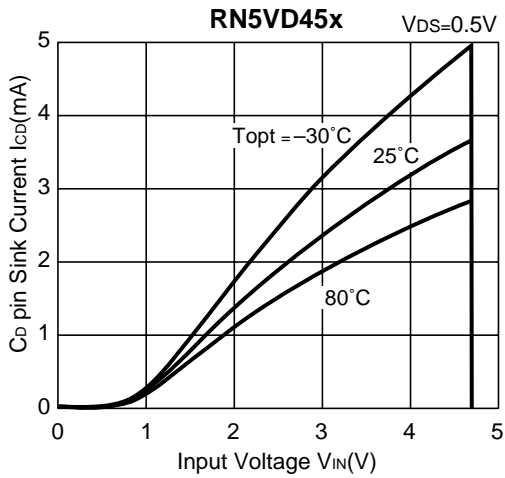
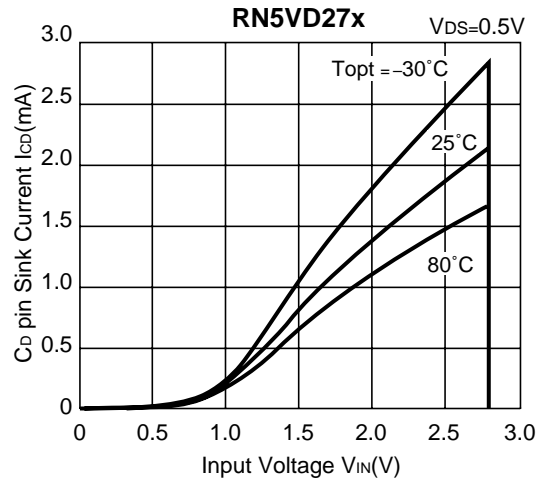
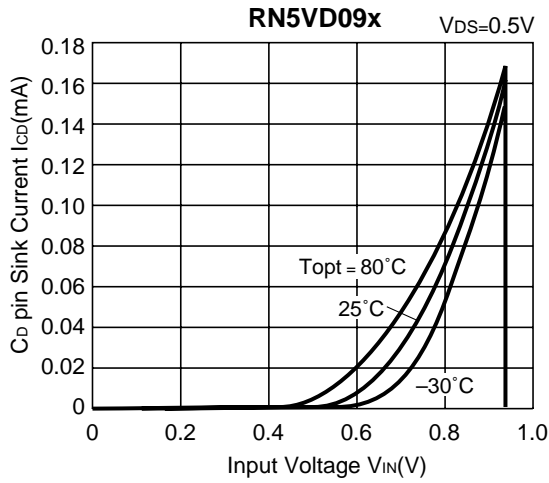




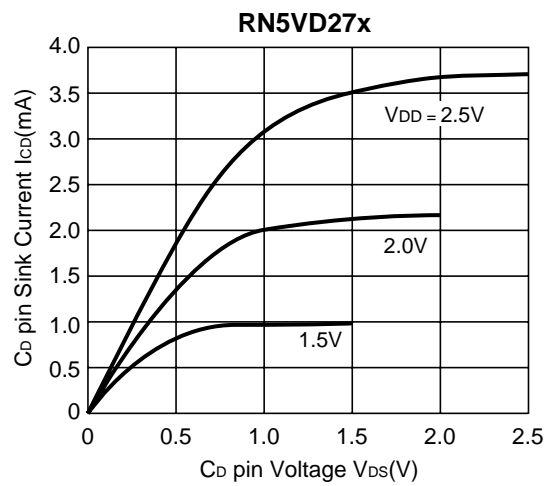
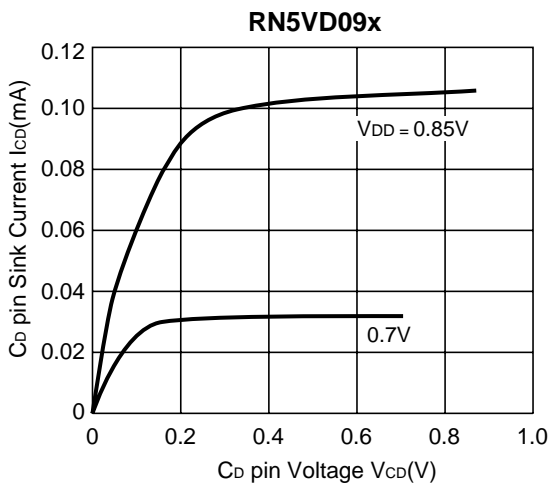
7) Cd pin Threshold Voltage vs. Temperature

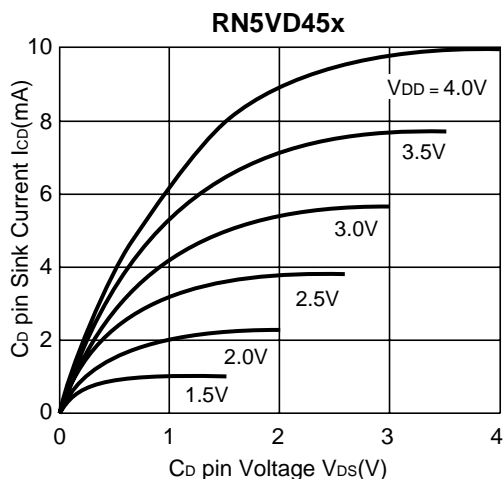


8) CD pin Sink Current vs. Input Voltage

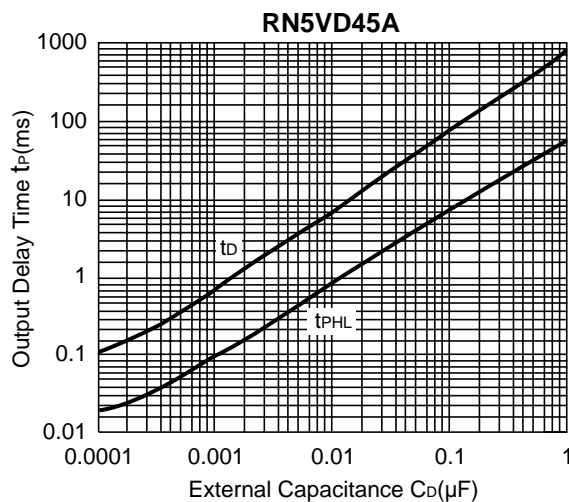
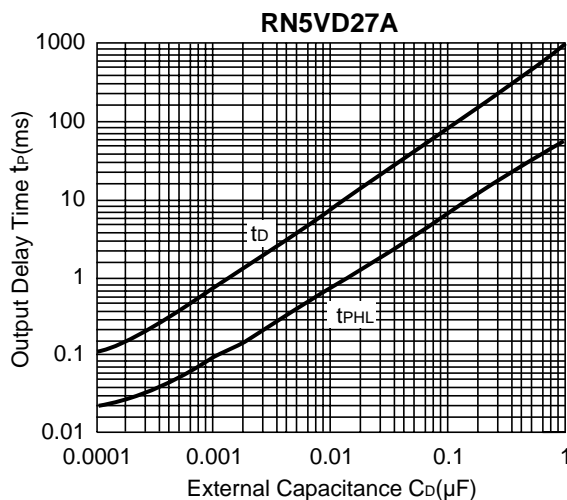
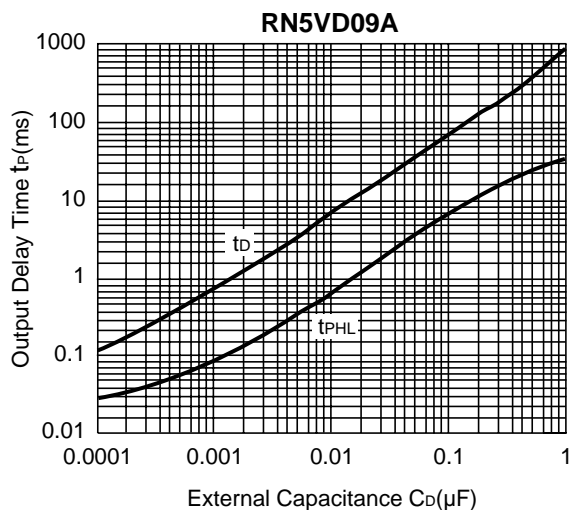


9) CD pin Sink Current vs. CD pin Voltage

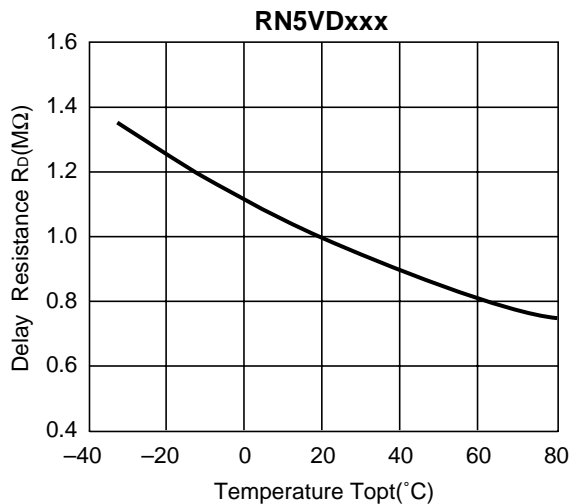




10) Output delay Time vs. External Capacitance



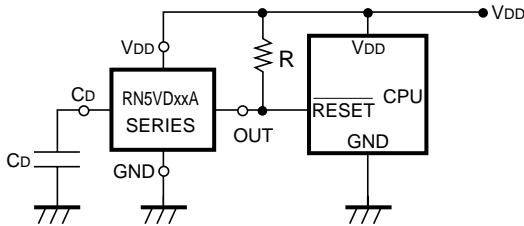
11) Delay Resistance vs. Temperature



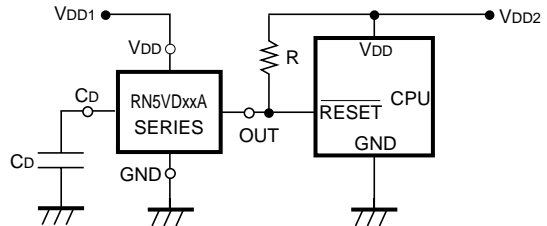
TYPICAL APPLICATIONS

• RN5VDxxA CPU Reset Circuit (Nch Open Drain Output)

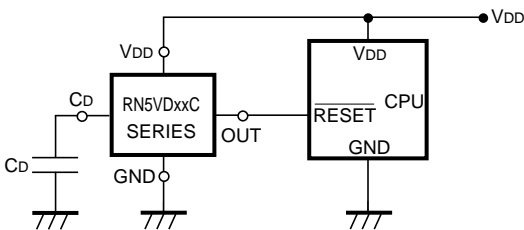
(1) Input Voltage to RN5VDxxA is the same as the input voltage to CPU.



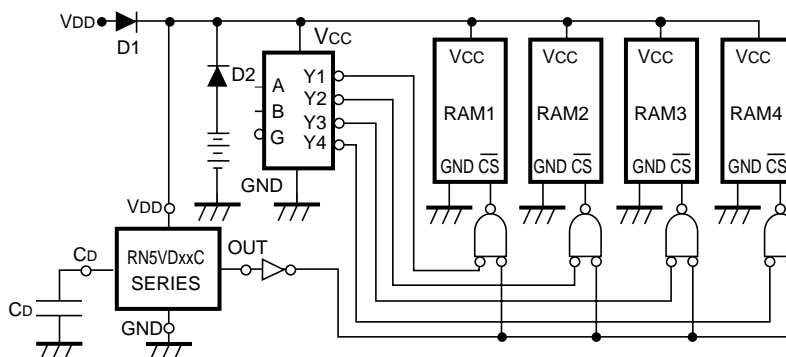
(2) Input Voltage to RN5VDxxA is different from the input voltage to CPU.



• RN5VDxxC CPU Reset Circuit (CMOS Output)



• Memory Back-up Circuit



• Manual Reset Circuit



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.

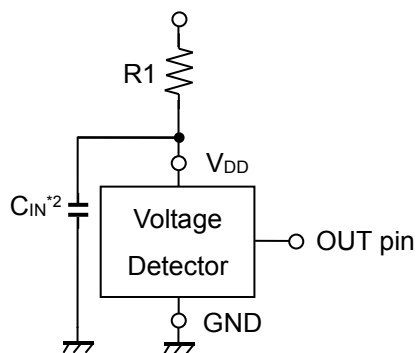


Figure A

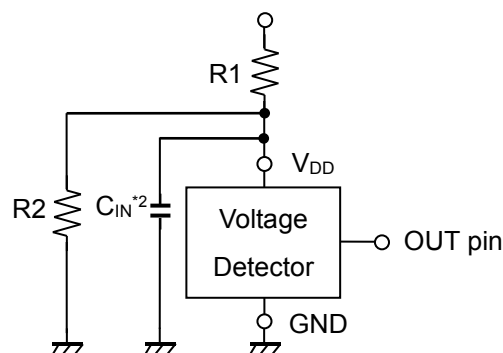


Figure B

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

*² Note the bias dependence of capacitors.



1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to Ricoh sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without prior written consent of Ricoh.
3. Please be sure to take any necessary formalities under relevant laws or regulations before exporting or otherwise taking out of your country the products or the technical information described herein.
4. The technical information described in this document shows typical characteristics of and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under Ricoh's or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for use as general electronic components in standard applications (office equipment, telecommunication equipment, measuring instruments, consumer electronic products, amusement equipment etc.). Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death (aircraft, spacevehicle, nuclear reactor control system, traffic control system, automotive and transportation equipment, combustion equipment, safety devices, life support system etc.) should first contact us.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. Anti-radiation design is not implemented in the products described in this document.
8. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
9. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
10. There can be variation in the marking when different AOI (Automated Optical Inspection) equipment is used. In the case of recognizing the marking characteristic with AOI, please contact Ricoh sales or our distributor before attempting to use AOI.
11. Please contact Ricoh sales representatives should you have any questions or comments concerning the products or the technical information.



Ricoh is committed to reducing the environmental loading materials in electrical devices with a view to contributing to the protection of human health and the environment.

Ricoh has been providing RoHS compliant products since April 1, 2006 and Halogen-free products since April 1, 2012.

RICOH RICOH ELECTRONIC DEVICES CO., LTD.

<http://www.e-devices.ricoh.co.jp/en/>

Sales & Support Offices

RICOH ELECTRONIC DEVICES CO., LTD.

Higashi-Shinagawa Office (International Sales)
3-32-3, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8655, Japan
Phone: +81-3-5479-2857 Fax: +81-3-5479-0502

RICOH EUROPE (NETHERLANDS) B.V.

Semiconductor Support Centre
Prof. W.H. Keesomlaan 1, 1183 DJ Amstelveen, The Netherlands
Phone: +31-20-5474-309

RICOH INTERNATIONAL B.V. - German Branch

Semiconductor Sales and Support Centre
Oberrather Strasse 6, 40472 Düsseldorf, Germany
Phone: +49-211-6546-0

RICOH ELECTRONIC DEVICES KOREA CO., LTD.

3F, Haesung Bldg, 504, Teheran-ro, Gangnam-gu, Seoul, 135-725, Korea
Phone: +82-2-2135-5700 Fax: +82-2-2051-5713

RICOH ELECTRONIC DEVICES SHANGHAI CO., LTD.

Room 403, No.2 Building, No.690 Bibo Road, Pu Dong New District, Shanghai 201203, People's Republic of China
Phone: +86-21-5027-3200 Fax: +86-21-5027-3299

RICOH ELECTRONIC DEVICES CO., LTD.

Taipei office
Room 109, 10F-1, No.51, Hengyang Rd., Taipei City, Taiwan (R.O.C.)
Phone: +886-2-2313-1621/1622 Fax: +886-2-2313-1623