
LOW VOLTAGE DETECTOR WITH OUTPUT DELAY

NO. EA-027-111103

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.

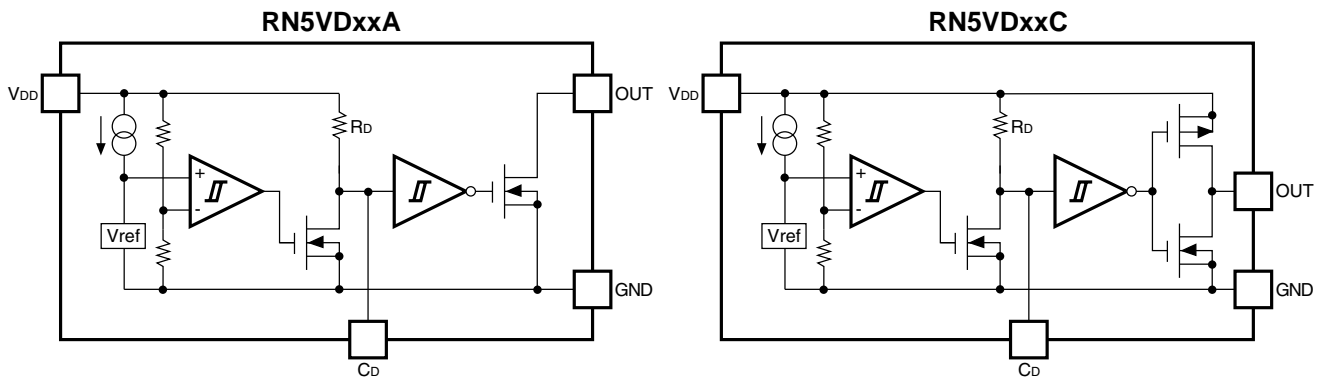
FEATURES

- 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 ThresholdTyp. $\pm 100ppm/^{\circ}C$
- 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

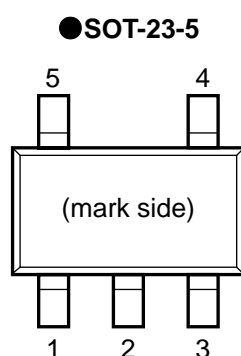
The detector threshold, and the output type for the ICs can be selected at the users' request.

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

$T_{opt}=25^{\circ}\text{C}$

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	μA
		$V_{DD}=6.5\text{V}$		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	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	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	μA	
		$V_{DS}=0.5\text{V}, V_{DD}=1.5\text{V}$	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	$-30^{\circ}\text{C}\leq T_{opt}\leq 85^{\circ}\text{C}$		± 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 Ω , 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	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} = 1.5V	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													
RN5VD12A/C	1.170	1.200	1.230	0.036	0.060	0.084		1.8	4.5										
RN5VD13A/C	1.268	1.300	1.332	0.039	0.065	0.091													
RN5VD14A/C	1.365	1.400	1.435	0.042	0.070	0.098		2.0	5.0		1.0	3.0					V _{DD} = 1.0V	0.2	1.0
RN5VD15A/C	1.463	1.500	1.537	0.045	0.075	0.105													
RN5VD16A/C	1.560	1.600	1.640	0.048	0.080	0.112		2.5	5.0										
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		3.0	6.0										
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		1.1	3.3		V _{DD} = 0.7V	V _{DD} = 1.5V					1.0	2.0	
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		3.5	7.0										
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		4.0	8.0										
RN5VD25A/C	2.438	2.500	2.562	0.075	0.125	0.175													
RN5VD26A/C	2.535	2.600	2.665	0.078	0.130	0.182		1.2	3.6										
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	4.5	9.0											
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	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	4.5	9.0											
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	1.2	3.6											
RN5VD35A/C	3.413	3.500	3.587	0.105	0.175	0.245													
RN5VD36A/C	3.510	3.600	3.690	0.108	0.180	0.252	4.5	9.0											
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	1.2	3.6											
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_{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 _{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 _{DD} × 0.3	V _{DD} × 0.5	V _{DD} × 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 _{DD} × 0.35	V _{DD} × 0.5	V _{DD} × 0.65															
						V _{DD} × 0.4	V _{DD} × 0.5	V _{DD} × 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 V _{DD} = 0.7V	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		5.5	11.0									
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		V _{DD} = (-V _{DET}) -0.20V	6.0		12.0							
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	6.5		13.0									
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												
RN5VD52A/C	5.070	5.200	5.330	0.156	0.260	0.364	6.5		13.0									
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												
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												
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 Tempo.		
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 _{DS} = -2.1V	1.5	3.0	0.55	0.70	V _{DD} = (-V _{DET}) ×1.1V	V _{DD} × 0.4	V _{DD} × 0.5	V _{DD} × 0.6V	V _{DS} = 0.1V	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 _{DD} = 8.0V			Condition2 0.65	Condition2 0.80					V _{DD} = 0.7V											

OPERATION

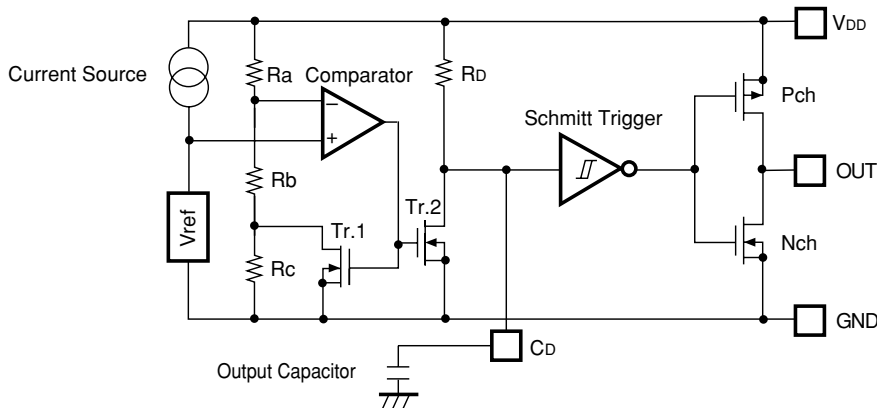


Fig. 1 Block Diagram

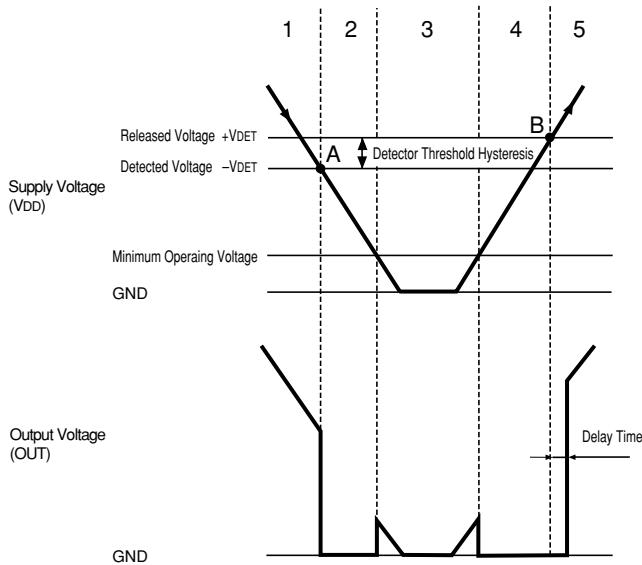


Fig. 2 Operation Diagram

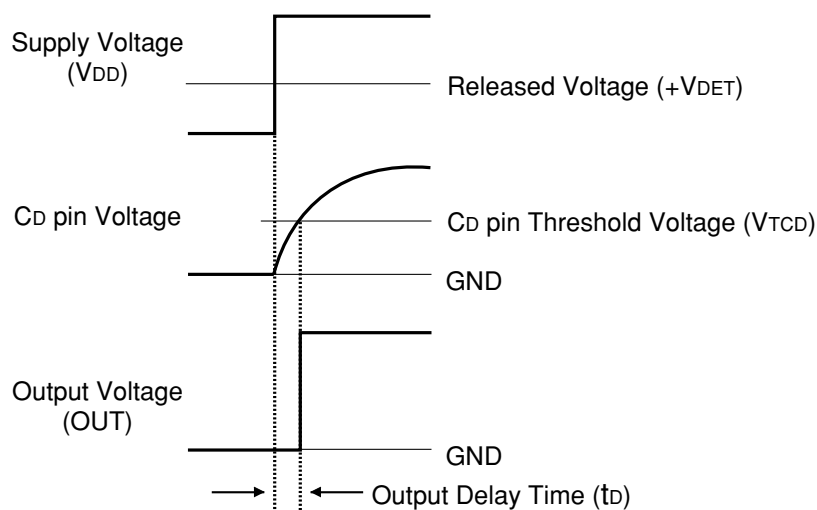
Step	Step 1	Step 2	Step 3	Step 4	Step 5
Comparator (-) Pin Input Voltage	I	II	II	II	I
Comparator Output	L	H	Indefinite	H	L
Tr. 1, 2	OFF	ON	Indefinite	ON	OFF
Output Tr.	Nch	OFF	Indefinite	ON	OFF
	Pch	ON	OFF	Indefinite	OFF

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

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

- 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

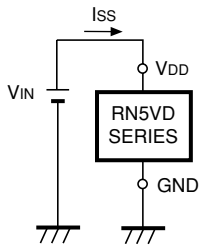


Fig. 3 Supply Current test Circuit

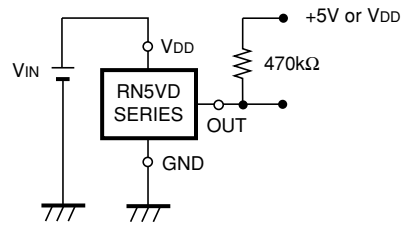


Fig. 4 Detector Threshold Test Circuit

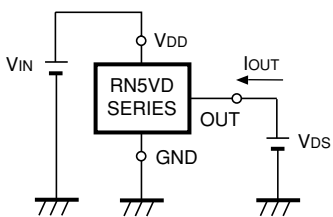


Fig. 5 Nch Driver Output Current Test Circuit

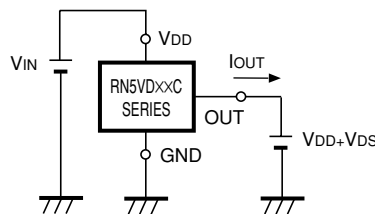


Fig. 6 Pch Driver Output Current Test Circuit

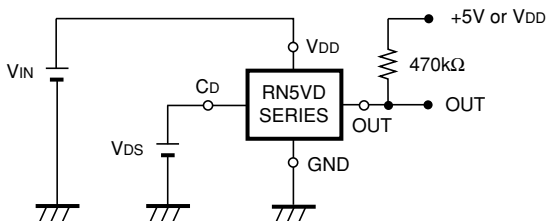


Fig. 7 Cd pin Threshold Voltage Test Circuit

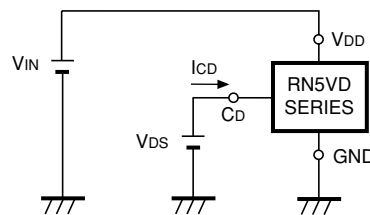


Fig. 8 Cd pin Sink Current Test Circuit

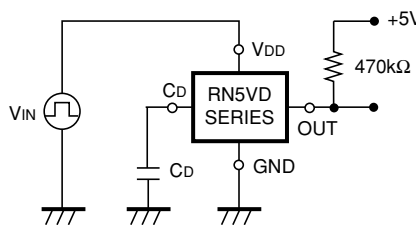
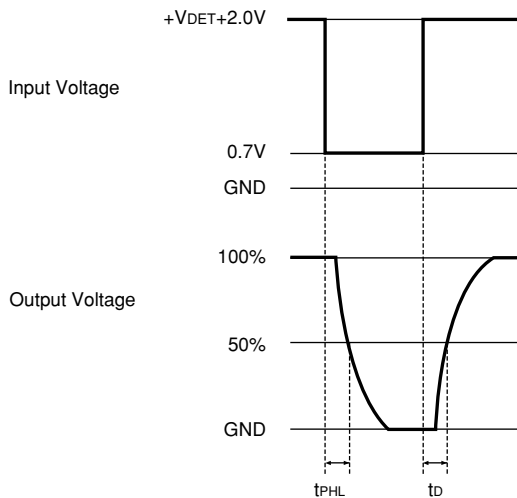
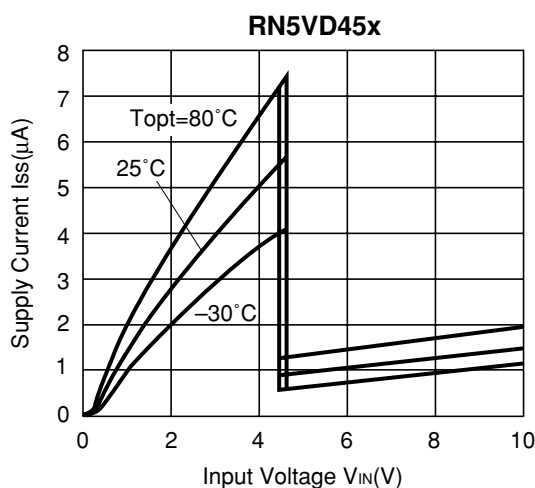
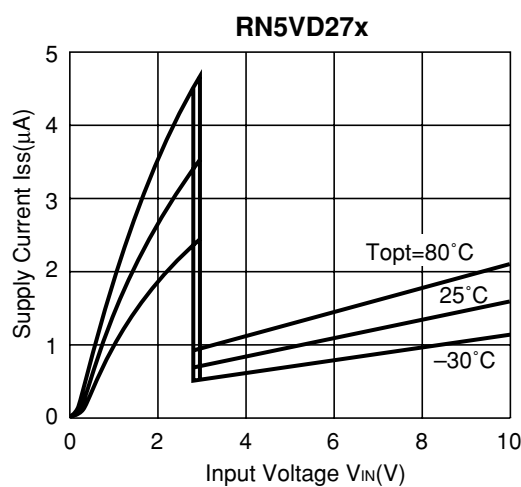
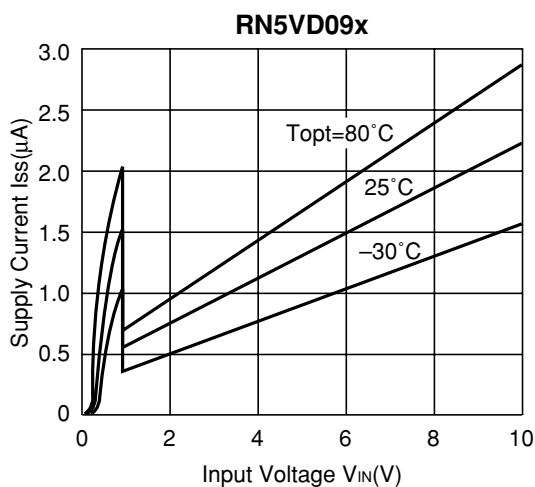


Fig. 9 Output Delay Time Test Circuit

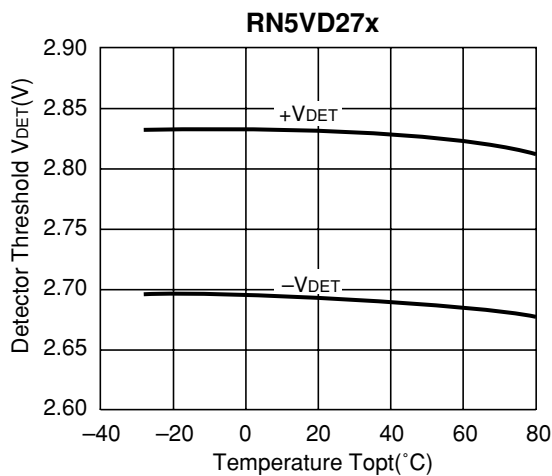
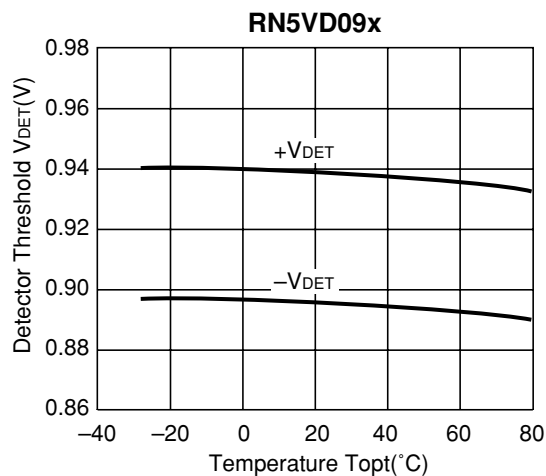
*) at Fig.4,7,9. CMOS Output Type does not need a pull-up resistor.

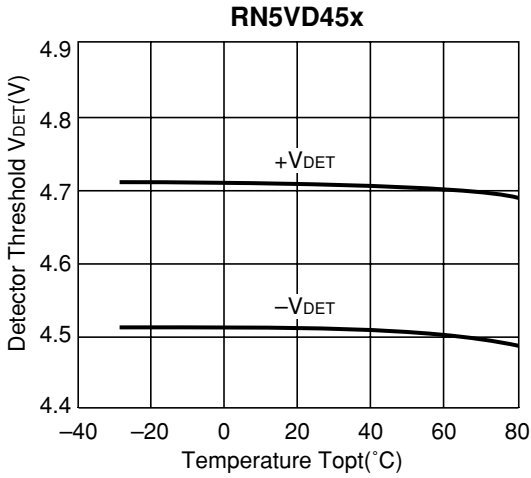
TYPICAL CHARACTERISTICS

1) Supply Current vs. Input Voltage

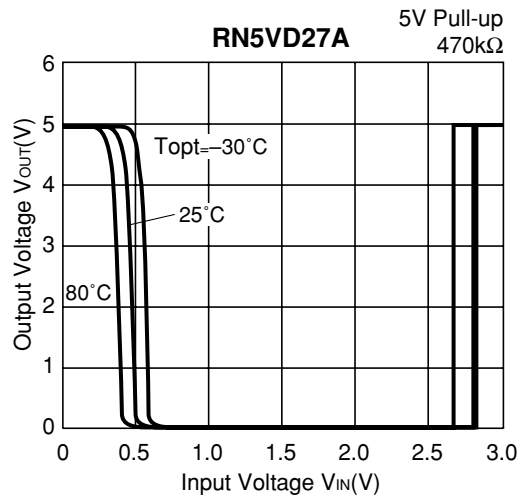
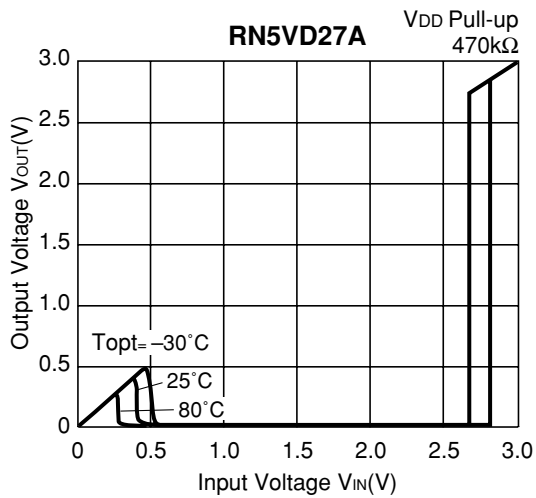
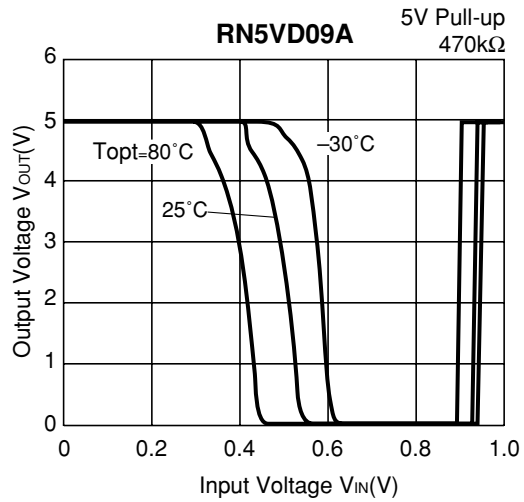
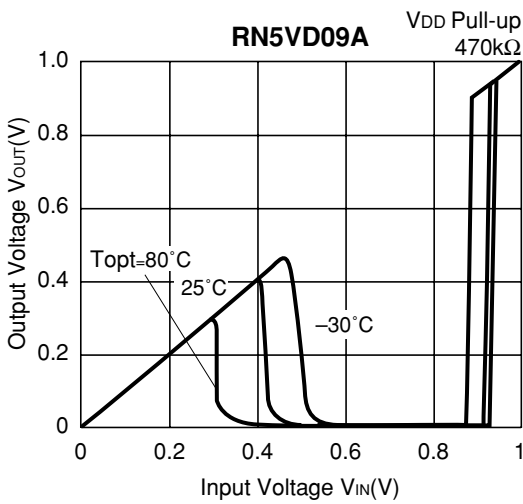


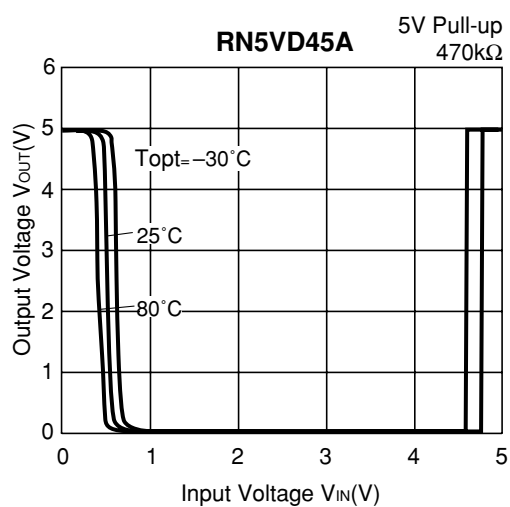
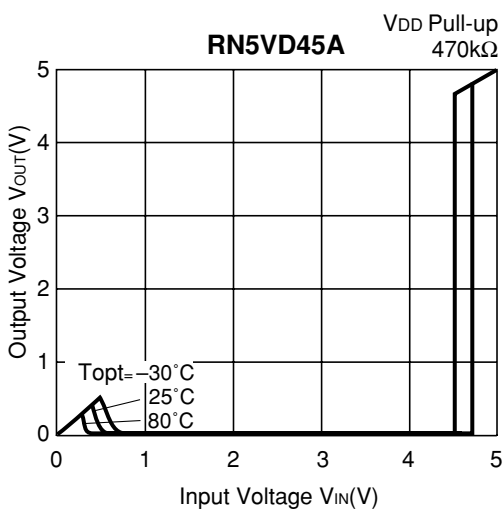
2) Detector Threshold vs. Temperature



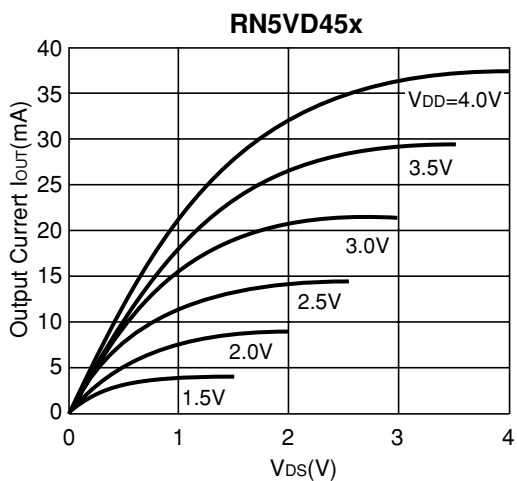
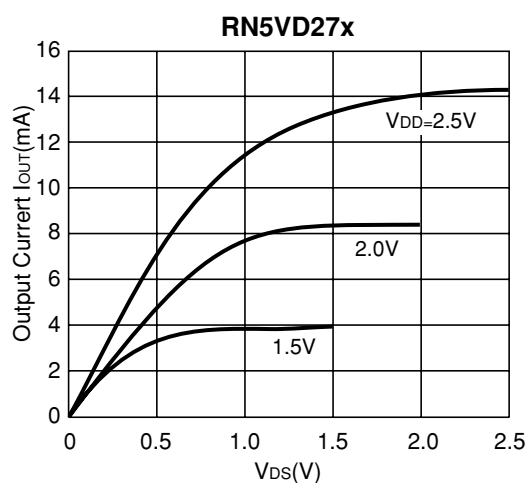
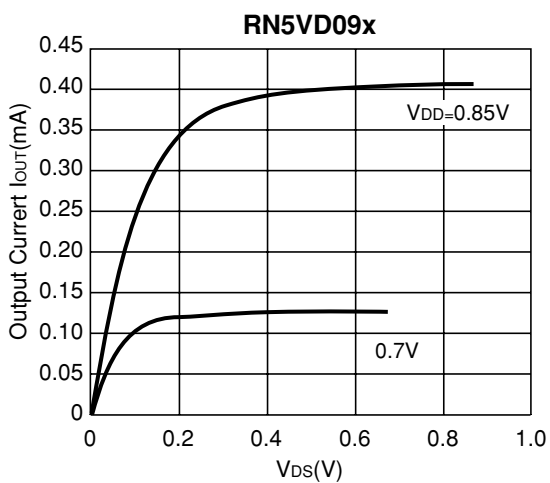


3) Output Voltage vs. Input Voltage

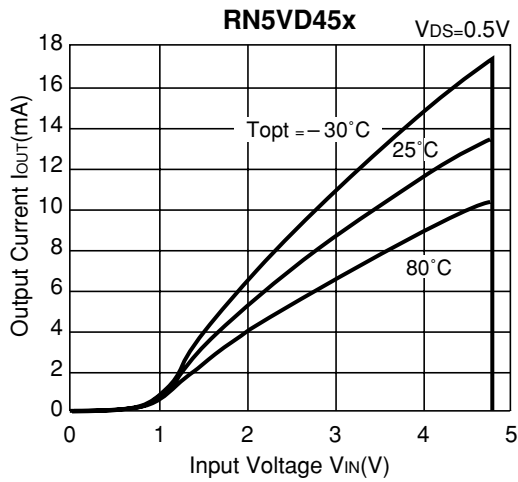
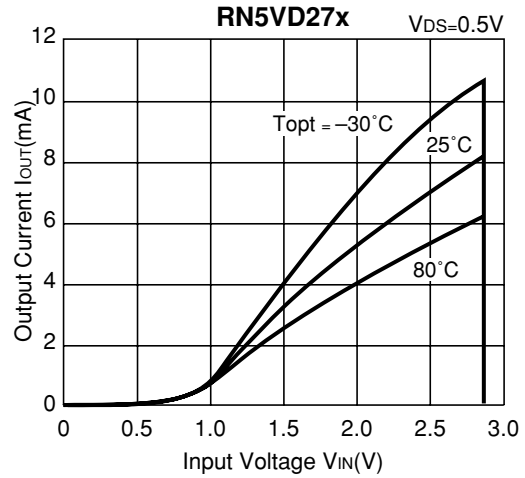
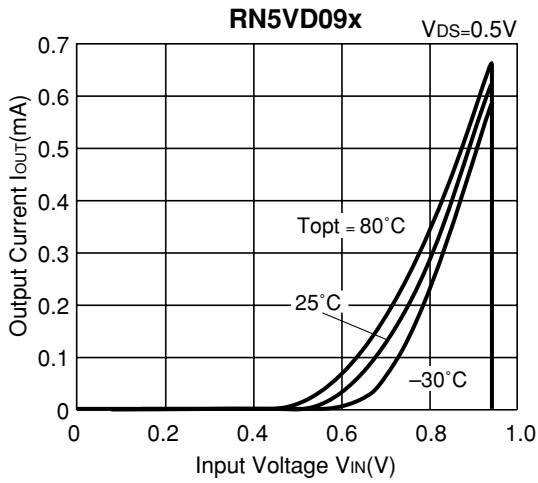




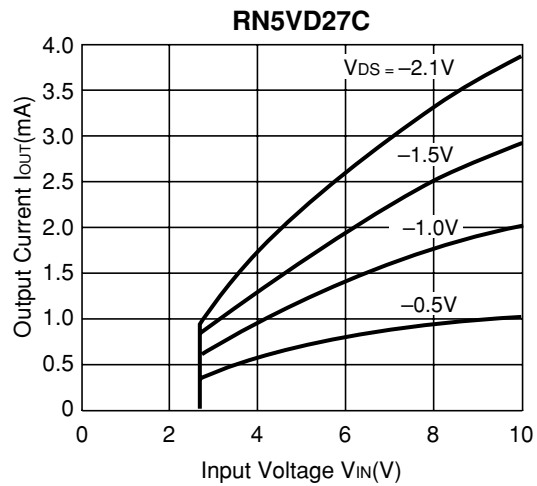
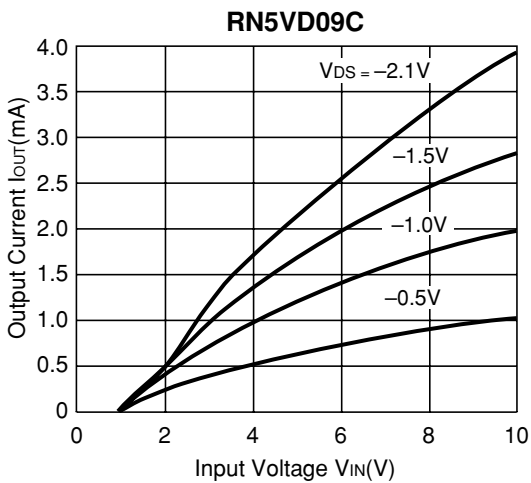
4) Nch Driver Output Current vs. V_{DS}

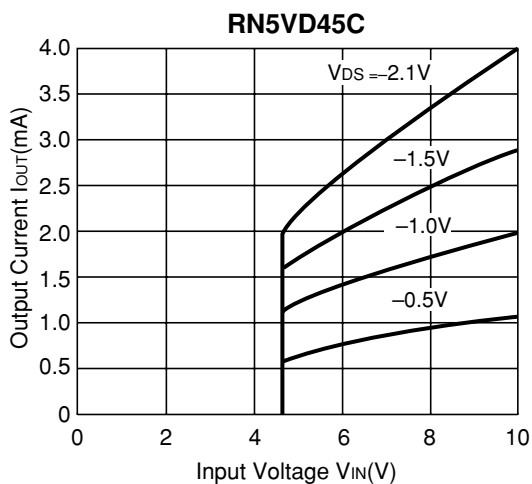


5) Nch Driver Output Current vs. Input Voltage

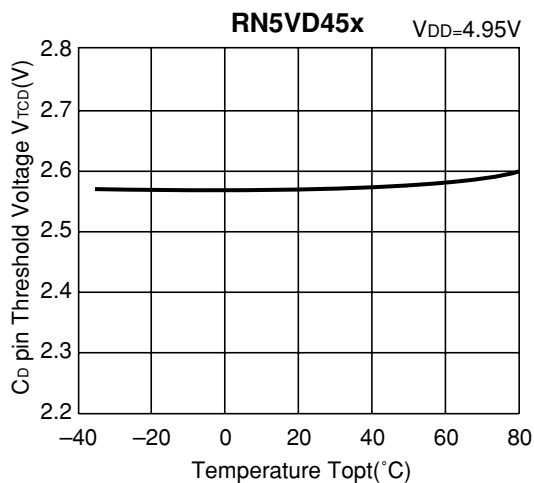
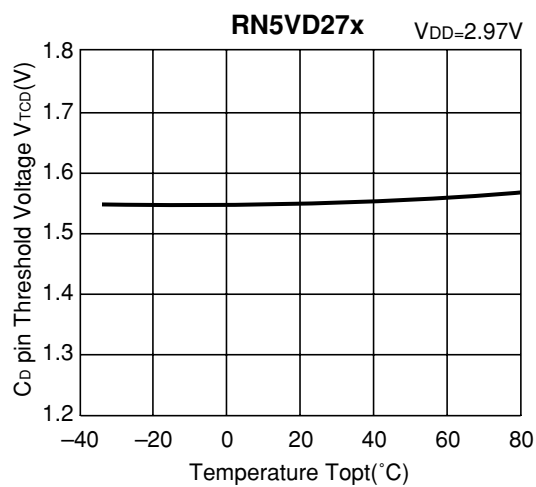
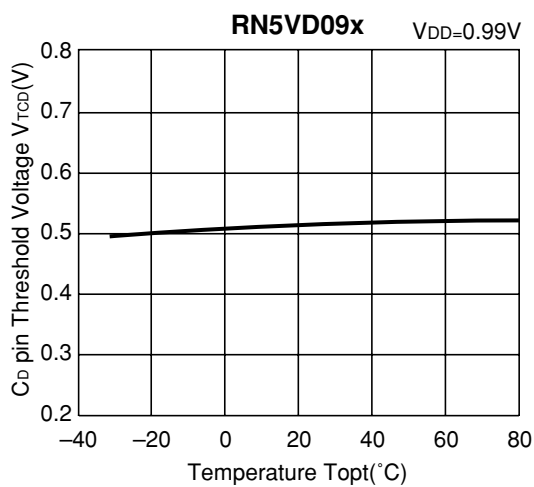


6) Pch Driver Output Current vs. Input Voltage

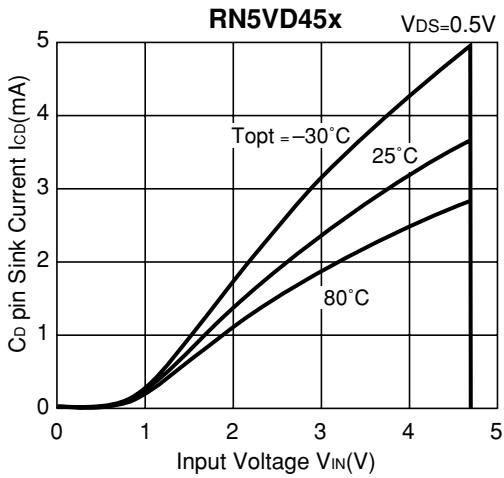
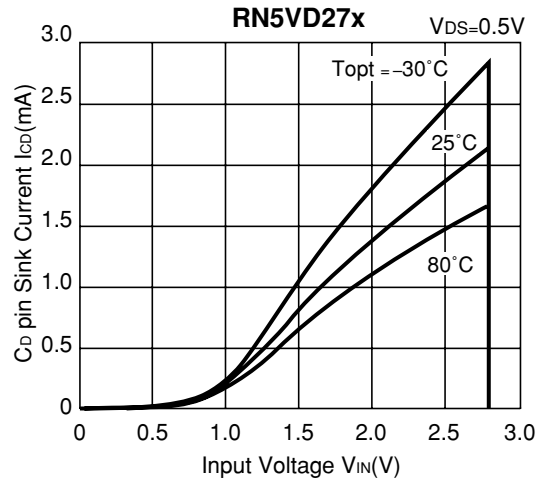
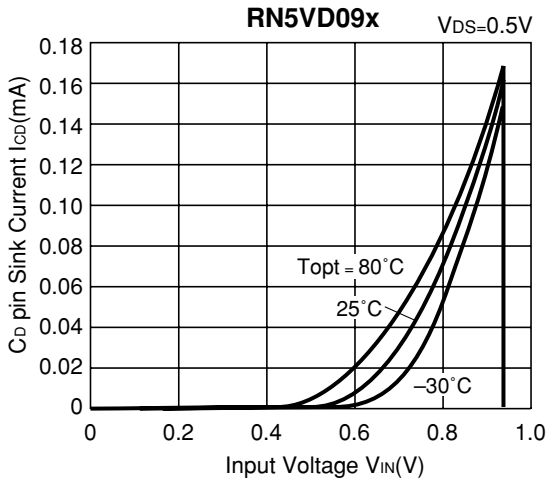




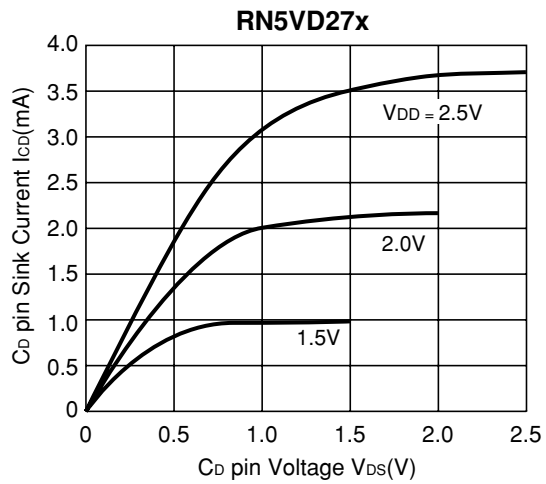
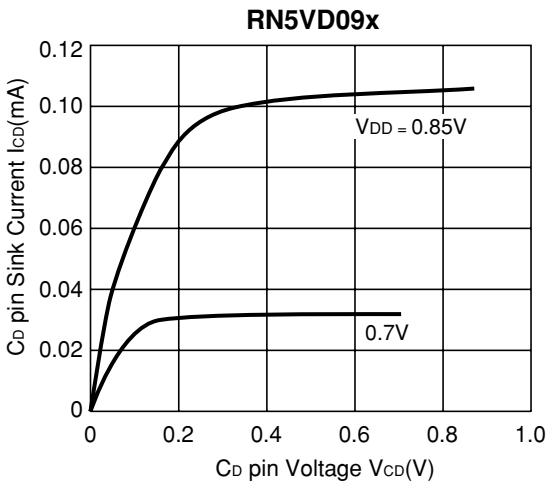
7) Cd pin Threshold Voltage vs. Temperature

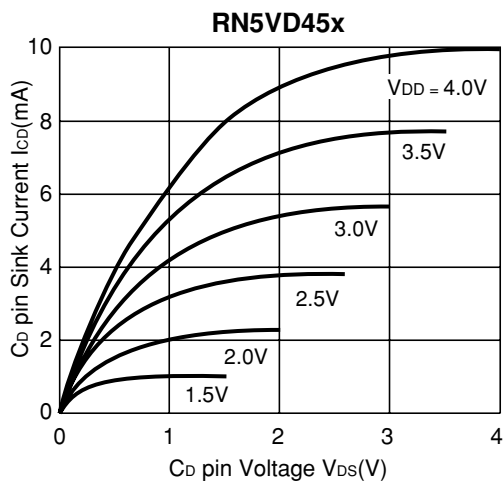


8) CD pin Sink Current vs. Input Voltage

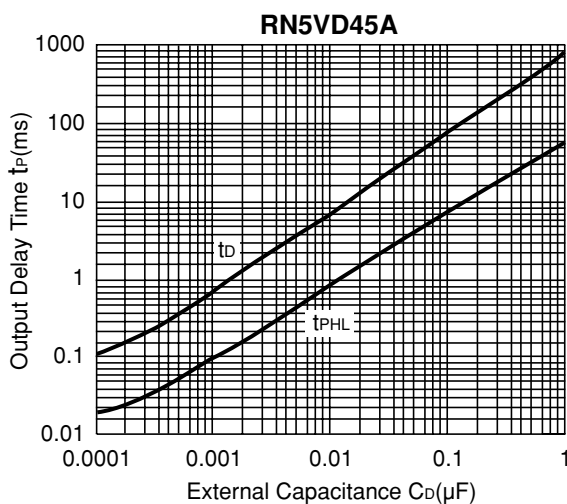
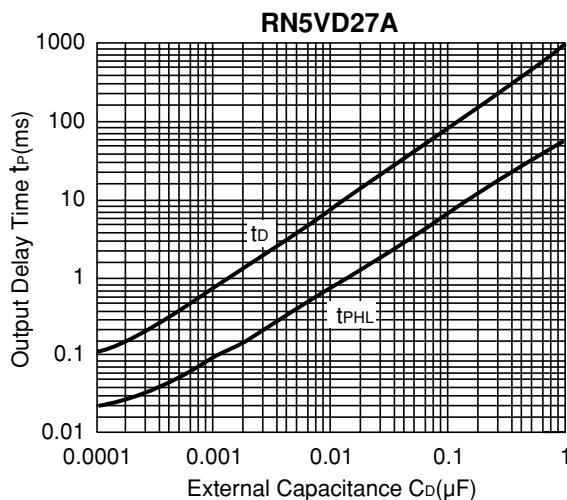
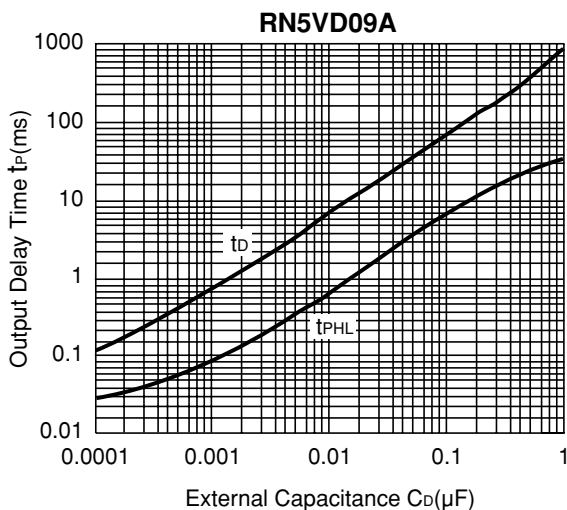


9) CD pin Sink Current vs. CD pin Voltage

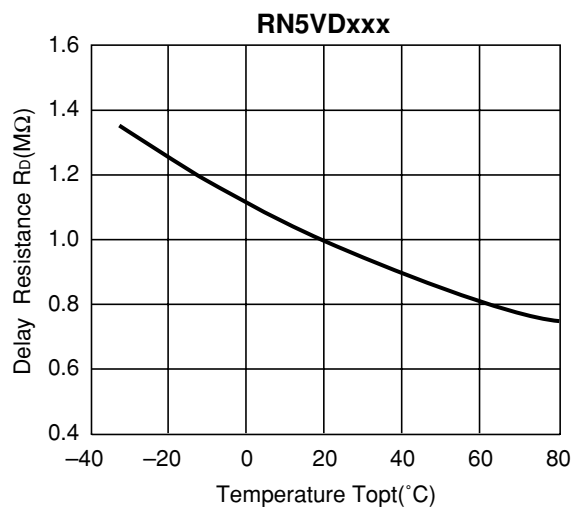




10) Output delay Time vs. External Capacitance



11) Delay Resistance vs. Temperature



• Manual Reset Circuit



APPLICATION HINTS

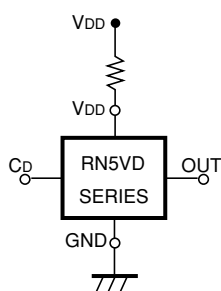


Fig.10

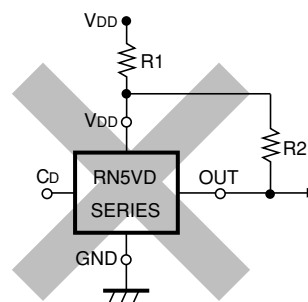


Fig.11

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)



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