∗ R3130NxxB/D/H (SOT23-3) are the limited products and R3131N (SOT-23-3) is the discontinued product as of March, 2016.

NISSHINBO

R3130N/R3131N SERIES

Low Voltage Detector with Built-in Delay Circuit

NO.EA-073-160315

OUTLINE

R3130N/R3131N Series are CMOS-based low voltage detector ICs with built-in delay circuit, high Detector Threshold accuracy and ultra low supply current which can be operated at low voltage.

These ICs can be used as system reset generator, and each of these ICs consists of a voltage reference, a comparator, resistors for setting voltage detector threshold, an output driver transistor, and an output delay generator.

Detector threshold is fixed internally with high accuracy and requires no adjustment. When Supply Voltage crosses a setting detector threshold voltage from a high value to a lower value, this IC generates reset signal.

R3130N Series output “L” at detection mode, while R3131N Series output “H”.

Further, each of R3130N/R3131N Series embeds an output delay generator, when Supply Voltage crosses a setting detector threshold voltage from a low value to a higher value, during a setting delay time which is fixed in the IC, this IC keeps the reset condition. Output Delay Time can be selected. (Typ. 240ms is standard.)

Two output types, Nch open drain type and CMOS type, are available.

Since the package for these ICs is SOT23-3 (Mini-mold) package, high density mounting of the ICs on board is possible.

FEATURES

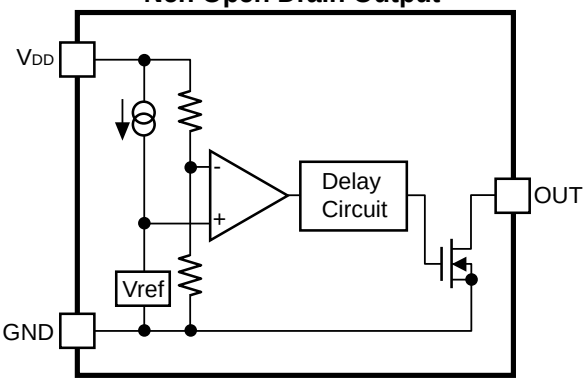
- Pin to Pin compatible with MAX 809/810 (R3130Nxxxx: MAX 809, R3131Nxxxx: MAX 810)
- Ultra-low supply Current ..... Typ. 1.25μA (R313xN27xx: V_{DD}=3.0V)
- Operating Voltage Range ..... 1.0V to 6.0V (Topt=25°C)
- Detector Threshold..... Setting with a step of 0.1V in the range of 1.6V to 4.8V is possible.
- Embedded Power on Reset Delay Time Circuit ..... Delay Time can be designated. Refer to Selection Guide.
- High Accuracy Detector Threshold ..... ±1.5%
- High Accuracy Output Delay Time ..... ±10.0%
- Low Temperature-Drift Coefficient of Detector Threshold... Typ. ±100ppm/°C
- Two Output Types ..... Nch Open Drain and CMOS
- Small Package SOT-23-3

APPLICATIONS

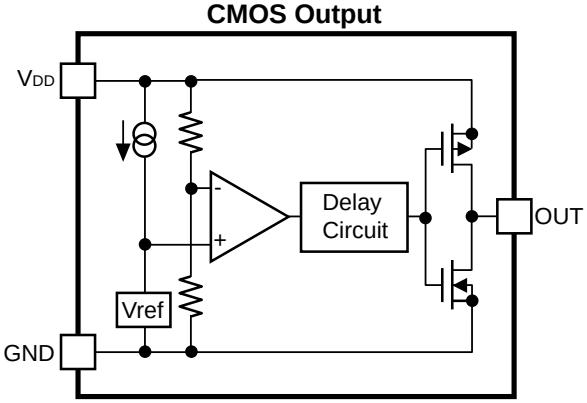
- CPU & Logic Circuit Reset
- Battery Checker
- Window Comparator
- Wave Shaping Circuit
- Battery Back-Up Circuit
- Power Failure Detector

BLOCK DIAGRAMS

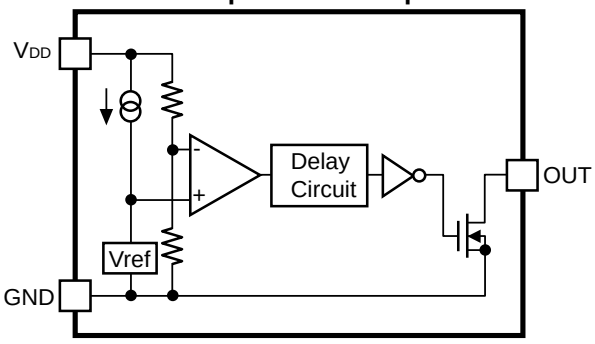
R3130NxxxA
Nch Open Drain Output



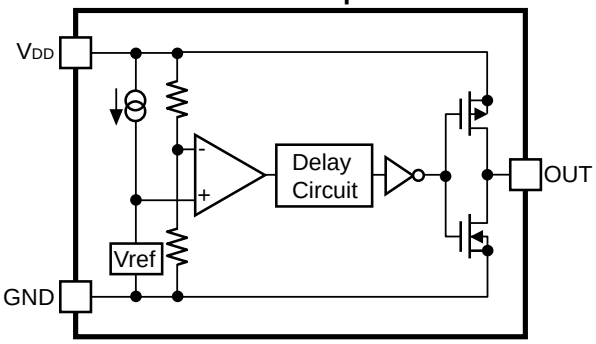
R3130NxxxC
CMOS Output



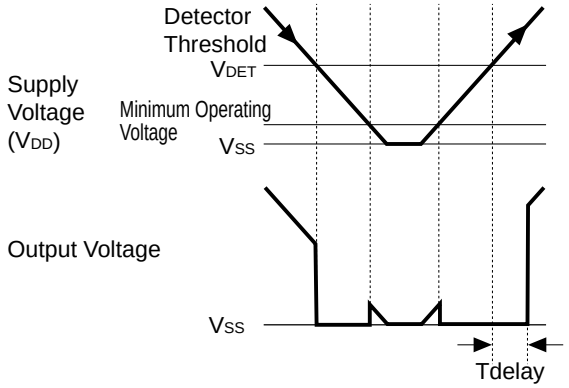
R3131NxxxA
Nch Open Drain Output



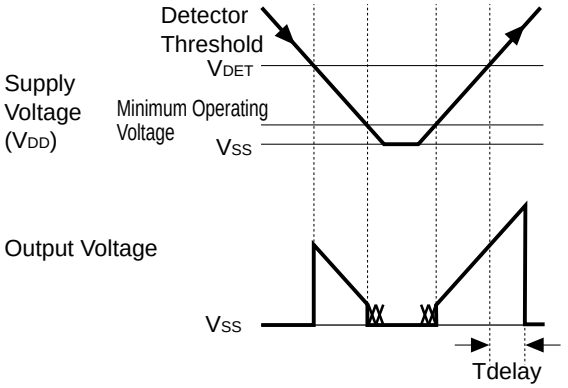
R3131NxxxC
CMOS Output



TIMING CHART



R3130N Operation Diagram



R3131N Operation Diagram

• Output Delay Operation

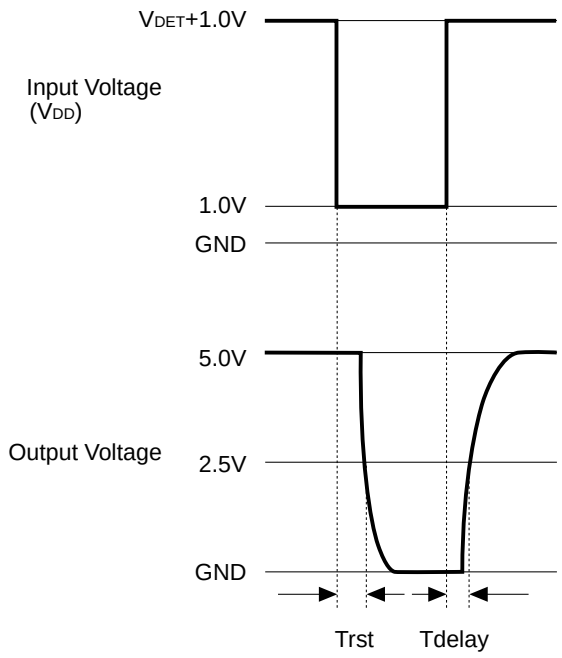
Output Delay Time, or Tdelay is specified as follows:

1. In the case of Nch open drain output:

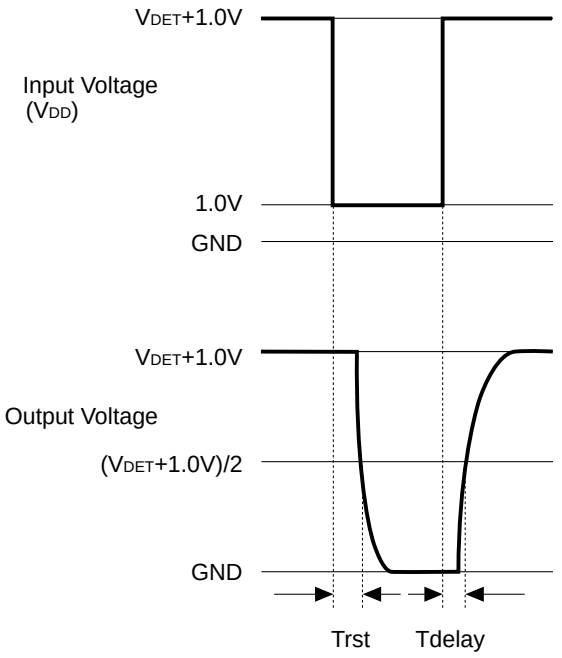
The time interval from rising edge of V_{DD} pulse (1.0V→(V_{DET})+1.0V) to the time at which the output reaches 2.5V under the condition that the output pin (OUT) is pulled up to 5V through a 470kΩ resistor.

2. In the case of CMOS output

The time interval from rising edge of V_{DD} pulse (1.0V→(V_{DET})+1.0V) to the time at which the output reaches V_{DD}/2.



Nch Open Drain Output



CMOS Output

∗ R3130NxxB/D/H (SOT23-3) are the limited products and R3131N (SOT-23-3) is the discontinued product as of March, 2016.

SELECTION GUIDE

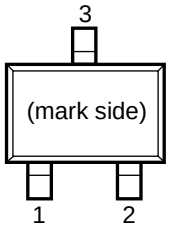
The detector threshold, the output type for the ICs can be selected at the users' request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R3130Nxx$∗(y)-TR-FE	SOT-23-3	3,000 pcs	Yes	Yes
R3131Nxx$∗(y)-TR-FE	SOT-23-3	3,000 pcs	Yes	Yes

xx: The detector threshold can be designated in the range from 1.6V(16) to 4.8V(48) in 0.1V steps.
y: If the detector threshold includes the 3rd digit, indicate the digit of 0.01V.
(Example) If the detector threshold is 2.63V, R3130N26$∗3-TR-FE
The following 6 kinds of voltage are standard products. 2.63V, 2.93V, 3.08V, 4.0V, 4.4V, 4.65V.
$: Designation of Output Delay Time
(A) 50ms (Only for standard products)
(B) 100ms
(D) 200ms
(E) 240ms
(H) 400ms
∗ : Designation of Output Type
(A) Nch Open Drain
(C) CMOS

PIN CONFIGURATION

● **SOT-23-3**



PIN DESCRIPTION

Pin No	Symbol	Description
1	GND	Ground Pin
2	OUT	Output Pin R3130N : Output "L" at detection mode, Output "H" at release mode R3131N : Output "H" at detection mode, Output "L" at release mode
3	V_{DD}	Input Pin

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating		Unit
V_{DD}	Supply Voltage	6.5		V
V_{OUT}	Output Voltage	CMOS	V_{SS}–0.3 to V_{DD}+0.3	V
		Nch	V_{SS}–0.3 to 6.5	V
I_{OUT}	Output Current	20		mA
P_D	Power Dissipation	150		mW
Topt	Operating Temperature Range	–40 to +85		°C
Tstg	Storage Temperature Range	–55 to +125		°C
Tsolder	Soldering Temperature	260°C, 10s		

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.

RECOMMENDED OPERATING CONDITIONS (ELECTRICAL CHARACTERISTICS)

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if when they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

- **R3130N26xx3-TR**

[Topt=25°C]

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage				6.0	V
V_{DDL} *1	Minimum Operating Voltage	I_{OL}=50µA		0.75	1.00	V
V_{DET}	Detector Threshold		2.591	2.630	2.669	V
I_{SS1}	Supply Current1	V_{DD}=6.00V		1.40	5.00	µA
I_{SS2}	Supply Current2	V_{DD}=2.73V		1.25	4.00	µA
I_{SS3}	Supply Current3	V_{DD}=2.53V		1.10	3.50	µA
V_{OH}	“H” Output Voltage	V_{DD}=2.73V, I_{OUT}=–500µA	0.8×V_{DD}	0.93×V_{DD}		V
V_{OL}	“L” Output Voltage	V_{DD}=2.53V, I_{OUT}=1.2Ma		0.16	0.30	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release				
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	–40°C ≦ Topt ≦ 85°C		±100		ppm/°C

∗ R3130NxxB/D/H (SOT23-3) are the limited products and R3131N (SOT-23-3) is the discontinued product as of March, 2016.

- **R3130N29xx3-TR**

[Topt=25°C]

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage				6.0	V
V_{DDL} *1	Minimum Operating Voltage	I_{OL}=50μA		0.75	1.00	V
V_{DET}	Detector Threshold		2.887	2.930	2.973	V
I_{SS1}	Supply Current1	V_{DD}=6.00V		1.40	5.00	μA
I_{SS2}	Supply Current2	V_{DD}=3.03V		1.25	4.00	μA
I_{SS3}	Supply Current3	V_{DD}=2.83V		1.10	3.50	μA
V_{OH}	"H" Output Voltage	V_{DD}=3.03V, I_{OUT}=−500μA	0.8×V_{DD}	0.93×V_{DD}		V
V_{OL}	"L" Output Voltage	V_{DD}=2.83V, I_{OUT}=1.2mA		0.16	0.30	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release				
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±100		ppm/°C

- **R3130N30xx8-TR**

[Topt=25°C]

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage				6.0	V
V_{DDL} *1	Minimum Operating Voltage	I_{OL}=50μA		0.75	1.00	V
V_{DET}	Detector Threshold		3.034	3.080	3.126	V
I_{SS1}	Supply Current1	V_{DD}=6.00V		1.40	5.00	μA
I_{SS2}	Supply Current2	V_{DD}=3.18V		1.25	4.00	μA
I_{SS3}	Supply Current3	V_{DD}=2.98V		1.10	3.50	μA
V_{OH}	"H" Output Voltage	V_{DD}=3.18V, I_{OUT}=−500μA	0.8×V_{DD}	0.93×V_{DD}		V
V_{OL}	"L" Output Voltage	V_{DD}=2.98V, I_{OUT}=1.2mA		0.16	0.30	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release				
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±100		ppm/°C

- **R3130N40xx-TR**

[Topt=25°C]

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage				6.0	V
V_{DDL} *1	Minimum Operating Voltage	I_{OL}=50μA		0.75	1.00	V
V_{DET}	Detector Threshold		3.940	4.000	4.060	V
I_{SS1}	Supply Current1	V_{DD}=6.00V		1.40	5.00	μA
I_{SS2}	Supply Current2	V_{DD}=4.10V		1.30	4.00	μA
I_{SS3}	Supply Current3	V_{DD}=3.90V		1.15	3.50	μA
V_{OH}	"H" Output Voltage	V_{DD}=4.10V, I_{OUT}=−800μA	0.8×V_{DD}	0.95×V_{DD}		V
V_{OL}	"L" Output Voltage	V_{DD}=3.90V, I_{OUT}=3.2mA		0.18	0.40	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release				
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±100		ppm/°C

- **R3130N44xx-TR**

[Topt=25°C]

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage				6.0	V
V_{DDL} *1	Minimum Operating Voltage	I_{OL}=50μA		0.75	1.00	V
V_{DET}	Detector Threshold		4.334	4.400	4.466	V
I_{SS1}	Supply Current1	V_{DD}=6.00V		1.40	5.00	μA
I_{SS2}	Supply Current2	V_{DD}=4.50V		1.30	4.00	μA
I_{SS3}	Supply Current3	V_{DD}=4.30V		1.15	3.50	μA
V_{OH}	"H" Output Voltage	V_{DD}=4.50V, I_{OUT}=−800μA	0.8×V_{DD}	0.95×V_{DD}		V
V_{OL}	"L" Output Voltage	V_{DD}=4.30V, I_{OUT}=3.2mA		0.18	0.40	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release				
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±100		ppm/°C

∗ R3130NxxB/D/H (SOT23-3) are the limited products and R3131N (SOT-23-3) is the discontinued product as of March, 2016.

- **R3130N46xx5-TR**

[Topt=25°C]

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage				6.0	V
V_{DDL} *1	Minimum Operating Voltage	I_{OL}=50μA		0.75	1.00	V
V_{DET}	Detector Threshold		4.581	4.650	4.719	V
I_{SS1}	Supply Current1	V_{DD}=6.00V		1.40	5.00	μA
I_{SS2}	Supply Current2	V_{DD}=4.75V		1.30	4.00	μA
I_{SS3}	Supply Current3	V_{DD}=4.55V		1.15	3.50	μA
V_{OH}	“H” Output Voltage	V_{DD}=4.75V, I_{OUT}=−800μA	0.8×V_{DD}	0.95×V_{DD}		V
V_{OL}	“L” Output Voltage	V_{DD}=4.55V, I_{OUT}=3.2mA		0.18	0.40	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release				
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C		±100		ppm/°C

- **R3131N26xx3-TR**

[Topt=25°C]

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage					6.0	V
V_{DDL} *3	Minimum Operating Voltage	CMOS Output	I_{OH}=−10μA		0.90	1.00	V
		Nch Open Drain Output	V_{DS}=6.5V				
V_{DET}	Detector Threshold			2.591	2.630	2.669	V
I_{SS1}	Supply Current1	V_{DD}=6.00V			1.40	5.00	μA
I_{SS2}	Supply Current2	V_{DD}=2.73V			1.25	4.00	μA
I_{SS3}	Supply Current3	V_{DD}=2.53V			1.10	3.50	μA
V_{OH}	“H” Output Voltage	V_{DD}=2.73V, I_{OUT}=−500μA		0.8×V_{DD}	0.93×V_{DD}		V
V_{OL}	“L” Output Voltage	V_{DD}=2.53V, I_{OUT}=1.2mA			0.16	0.30	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release					
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±100		ppm/°C

- **R3131N29xx3-TR**

[Topt=25°C]

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage					6.0	V
V_{DDL} *3	Minimum Operating Voltage	CMOS Output	I_{OH}=−10μA		0.90	1.00	V
		Nch Open Drain Output	V_{DS}=6.5V				
V_{DET}	Detector Threshold			2.887	2.930	2.973	V
I_{SS1}	Supply Current1	V_{DD}=6.00V			1.40	5.00	μA
I_{SS2}	Supply Current2	V_{DD}=3.03V			1.25	4.00	μA
I_{SS3}	Supply Current3	V_{DD}=2.83V			1.10	3.50	μA
V_{OH}	“H” Output Voltage	V_{DD}=2.83V, I_{OUT}=−500μA		0.8×V_{DD}	0.93×V_{DD}		V
V_{OL}	“L” Output Voltage	V_{DD}=3.03V, I_{OUT}=1.2mA			0.16	0.30	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release					
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±100		ppm/°C

- **R3131N30xx8-TR**

[Topt=25°C]

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage					6.0	V
V_{DDL} *3	Minimum Operating Voltage	CMOS Output	I_{OH}=−10μA		0.90	1.00	V
		Nch Open Drain Output	V_{DS}=6.5V				
V_{DET}	Detector Threshold			3.034	3.080	3.126	V
I_{SS1}	Supply Current1	V_{DD}=6.00V			1.40	5.00	μA
I_{SS2}	Supply Current2	V_{DD}=3.18V			1.25	4.00	μA
I_{SS3}	Supply Current3	V_{DD}=2.98V			1.10	3.50	μA
V_{OH}	“H” Output Voltage	V_{DD}=2.98V, I_{OUT}=−500μA		0.8×V_{DD}	0.93×V_{DD}		V
V_{OL}	“L” Output Voltage	V_{DD}=3.18V, I_{OUT}=1.2mA			0.16	0.30	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release					
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±100		ppm/°C

- **R3131N40xx-TR**

[Topt=25°C]

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage					6.0	V
V_{DDL} *3	Minimum Operating Voltage	CMOS Output	I_{OH}=−10μA		0.90	1.00	V
		Nch Open Drain Output	V_{DS}=6.5V				
V_{DET}	Detector Threshold			3.940	4.000	4.060	V
I_{SS1}	Supply Current1	V_{DD}=6.00V			1.40	5.00	μA
I_{SS2}	Supply Current2	V_{DD}=3.90V			1.30	4.00	μA
I_{SS3}	Supply Current3	V_{DD}=4.10V			1.15	3.50	μA
V_{OH}	“H” Output Voltag	V_{DD}=3.90V, I_{OUT}=−800μA		0.8×V_{DD}	0.95×V_{DD}		V
V_{OL}	“L” Output Voltage	V_{DD}=4.10V, I_{OUT}=3.2mA			0.18	0.40	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release					
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±100		ppm/°C

- **R3131N44xx-TR**

[Topt=25°C]

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage					6.0	V
V_{DDL} *3	Minimum Operating Voltage	CMOS Output	I_{OH}=−10μA		0.90	1.00	V
		Nch Open Drain Output	V_{DS}=6.5V				
V_{DET}	Detector Threshold			4.334	4.400	4.466	V
I_{SS1}	Supply Current1	V_{DD}=6.00V			1.40	5.00	μA
I_{SS2}	Supply Current2	V_{DD}=4.50V			1.30	4.00	μA
I_{SS3}	Supply Current3	V_{DD}=4.30V			1.15	3.50	μA
V_{OH}	“H” Output Voltage	V_{DD}=4.30V, I_{OUT}=−800μA		0.8×V_{DD}	0.95×V_{DD}		V
V_{OL}	“L” Output Voltage	V_{DD}=4.50V, I_{OUT}=3.2mA			0.18	0.40	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release					
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±100		ppm/°C

- **R3131N46xx5-TR**

[Topt=25°C]

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
V_{DDH}	Maximum Operating Voltage					6.0	V
V_{DDL} *3	Minimum Operating Voltag	CMOS Output	I_{OH}=−10μA		0.90	1.00	V
		Nch Open Drain Output	V_{DS}=6.5V				
V_{DET}	Detector Threshold			4.581	4.650	4.719	V
I_{SS1}	Supply Current1	V_{DD}=6.00V			1.40	5.00	μA
I_{SS2}	Supply Current2	V_{DD}=4.75V			1.30	4.00	μA
I_{SS3}	Supply Current3	V_{DD}=4.55V			1.15	3.50	μA
V_{OH}	“H” Output Voltage	V_{DD}=4.55V, I_{OUT}=−800μA		0.8×V_{DD}	0.95×V_{DD}		V
V_{OL}	“L” Output Voltage	V_{DD}=4.75V, I_{OUT}=3.2mA			0.18	0.40	V
Tdelay *2	Output Delay Time for release	Refer to electrical characteristics by Output Delay Time for release					
ΔV_{DET}/ ΔTopt	Detector Threshold Temperature Coefficient	−40°C ≦ Topt ≦ 85°C			±100		ppm/°C

∗1) Supply Voltage when Output Voltage becomes equal or less than 0.3V. (As for Nch Open Drain Output type, pull-up resistor is 470kΩ, pull-up voltage is 5.0V.

∗2) Time interval of rising edge of V_{DD} which is set from 1.0V to V_{DET}+1.0V, and the point of which Output voltage reaches to 50% of final voltage.

∗3) CMOS Output type; Supply Voltage when Output Voltage becomes equal or more than 0.8×V_{DD}.
Nch Open Drain type; Supply Voltage when off leakage current becomes equal or less than 0.1μA.

ELECTRICAL CHARACTERISTICS BY OUTPUT DELAY TIME

[Topt=25°C]

Part Number	Test Condition	Output Delay Time (Tdelay)			Unit
		Min.	Typ.	Max.	
R313xNxxAx	V_{DD}=1.0V to V_{DET}+1.0V	45	50	55	ms
R313xNxxBx		90	100	110	
R313xNxxDx		180	200	220	
R313xNxxEx		216	240	264	
R313xNxxHx		360	400	440	

ELECTRICAL CHARACTERISTICS BY DETECTOR THRESHOLD

- **R3130N16EA/C to R3130N48EA/C**

Part Number	Detector Threshold			Supply Current 1			Supply Current 2			Supply Current 3		
	V_{DET} (V)			I_{SS1} (µA)			I_{SS2} (µA)			I_{SS3} (µA)		
	Min.	Typ.	Max.	Condition	Typ.	Max.	Condition	Typ.	Max.	Condition	Typ.	Max.
R3130N16EA/C	1.576	1.600	1.624	V_{DD}=6.0V	1.40	5.00	V_{DD}=V_{DET} +0.1V	1.20	4.00	V_{DD}=V_{DET} −0.1V	1.00	3.50
R3130N17EA/C	1.675	1.700	1.725									
R3130N18EA/C	1.773	1.800	1.827									
R3130N19EA/C	1.872	1.900	1.928									
R3130N20EA/C	1.970	2.000	2.030									
R3130N21EA/C	2.069	2.100	2.131									
R3130N22EA/C	2.167	2.200	2.233									
R3130N23EA/C	2.266	2.300	2.334									
R3130N24EA/C	2.364	2.400	2.436					1.25			1.10	
R3130N25EA/C	2.463	2.500	2.537									
R3130N26EA/C	2.561	2.600	2.639									
R3130N27EA/C	2.660	2.700	2.740									
R3130N28EA/C	2.758	2.800	2.842									
R3130N29EA/C	2.857	2.900	2.943									
R3130N30EA/C	2.955	3.000	3.045									
R3130N31EA/C	3.054	3.100	3.146									
R3130N32EA/C	3.152	3.200	3.248									
R3130N33EA/C	3.251	3.300	3.349									
R3130N34EA/C	3.349	3.400	3.451									
R3130N35EA/C	3.448	3.500	3.552									
R3130N36EA/C	3.546	3.600	3.654					1.30			1.15	
R3130N37EA/C	3.645	3.700	3.755									
R3130N38EA/C	3.743	3.800	3.857									
R3130N39EA/C	3.842	3.900	3.958									
R3130N40EA/C	3.940	4.000	4.060									
R3130N41EA/C	4.039	4.100	4.161									
R3130N42EA/C	4.137	4.200	4.263									
R3130N43EA/C	4.236	4.300	4.364									
R3130N44EA/C	4.334	4.400	4.466									
R3130N45EA/C	4.433	4.500	4.567									
R3130N46EA/C	4.531	4.600	4.669									
R3130N47EA/C	4.630	4.700	4.770									
R3130N48EA/C	4.728	4.800	4.872									

Topt=25°C

"H" Output Voltage			"L" Output Voltage			Minimum Operating Voltage		Output Delay Time			Detector Threshold Temperature Coefficient	
V_{OH} (V)			V_{OL} (V)			V_{DDL} (V)		Tdelay (ms)			$\Delta V_{DET}/\Delta Topt$ (ppm/°C)	
Condition	Min.	Typ.	Condition	Typ.	Max.	Typ.	Max.	Min.	Typ.	Max.	Condition	Typ.
$V_{DD}=V_{DET}$ +0.1V I_{OH}= −150μA	0.80× V_{DD}	0.95× V_{DD}	$V_{DD}=V_{DET}$ −0.1V, I_{OL}=1.2mA	0.16	0.30	∗1 0.75	∗1 1.00	216	240	264	−40°C ≦ Topt ≦ 85°C	±100
$V_{DD}=V_{DET}$ +0.1V I_{OH}= −500μA	0.80× V_{DD}	0.93× V_{DD}										
$V_{DD}=V_{DET}$ +0.1V I_{OH}= −800μA	0.80× V_{DD}	0.95× V_{DD}	$V_{DD}=V_{DET}$ −0.1V, I_{OL}=3.2mA	0.18	0.40							

∗1describes V_{DD} Voltage when Output Voltage becomes equal or less than 0.3V.

● R3131N16EA/C to R3131N48EA/C

Part Number	Detector Threshold			Supply Current 1			Supply Current 2			Supply Current 3		
	V_{DET} (V)			I_{SS1} (µA)			I_{SS2} (µA)			I_{SS3} (µA)		
	Min.	Typ.	Max.	Condition	Typ.	Max.	Condition	Typ.	Max.	Condition	Typ.	Max.
R3131N16EA/C	1.576	1.600	1.624	V_{DD}=6.0V	1.40	5.00	V_{DD}=V_{DET} +0.1V	1.20	4.00	V_{DD}=V_{DET} −0.1V	1.00	3.50
R3131N17EA/C	1.675	1.700	1.725									
R3131N18EA/C	1.773	1.800	1.827									
R3131N19EA/C	1.872	1.900	1.928									
R3131N20EA/C	1.970	2.000	2.030									
R3131N21EA/C	2.069	2.100	2.131									
R3131N22EA/C	2.167	2.200	2.233									
R3131N23EA/C	2.266	2.300	2.334									
R3131N24EA/C	2.364	2.400	2.436					1.25			1.10	
R3131N25EA/C	2.463	2.500	2.537									
R3131N26EA/C	2.561	2.600	2.639									
R3131N27EA/C	2.660	2.700	2.740									
R3131N28EA/C	2.758	2.800	2.842									
R3131N29EA/C	2.857	2.900	2.943									
R3131N30EA/C	2.955	3.000	3.045									
R3131N31EA/C	3.054	3.100	3.146									
R3131N32EA/C	3.152	3.200	3.248									
R3131N33EA/C	3.251	3.300	3.349									
R3131N34EA/C	3.349	3.400	3.451									
R3131N35EA/C	3.448	3.500	3.552									
R3131N36EA/C	3.546	3.600	3.654					1.30			1.15	
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R3131N39EA/C	3.842	3.900	3.958									
R3131N40EA/C	3.940	4.000	4.060									
R3131N41EA/C	4.039	4.100	4.161									
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R3131N44EA/C	4.334	4.400	4.466									
R3131N45EA/C	4.433	4.500	4.567									
R3131N46EA/C	4.531	4.600	4.669									
R3131N47EA/C	4.630	4.700	4.770									
R3131N48EA/C	4.728	4.800	4.872									

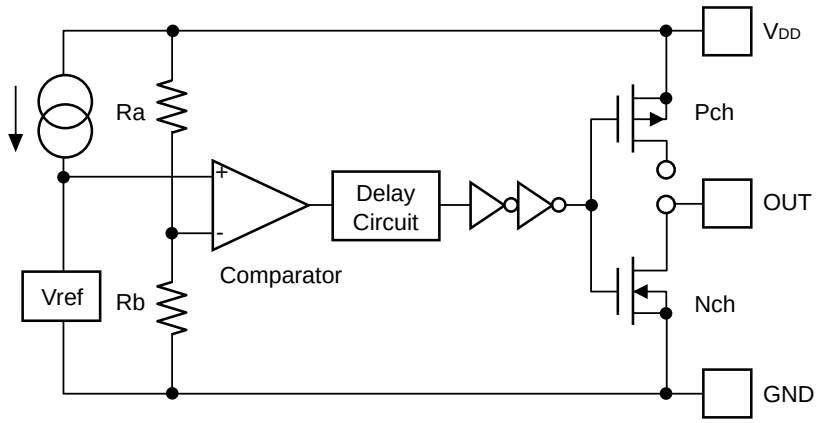
Topt=25°C

"H" Output Voltage			"L" Output Voltage			Minimum Operating Voltage		Output Delay Time			Detector Threshold Temperature Coefficient	
V_{OH} (V)			V_{OL} (V)			V_{DDL} (V)		Tdelay (ms)			$\Delta V_{DET}/\Delta Topt$ (ppm/°C)	
Condition	Min.	Typ.	Condition	Typ.	Max.	Typ.	Max.	Min.	Typ.	Max.	Condition	Typ
$V_{DD}=V_{DET}-0.1V$ $I_{OH}=-150\mu A$	0.80×V_{DD}	0.95×V_{DD}	$V_{DD}=V_{DET}+0.1V$, $I_{OL}=1.2mA$	0.16	0.30	∗2 0.90	∗2 1.00	216	240	264	−40°C ≦ Topt ≦ 85°C	±100
$V_{DD}=V_{DET}-0.1V$ $I_{OH}=-500\mu A$	0.80×V_{DD}	0.93×V_{DD}										
$V_{DD}=V_{DET}-0.1V$ $I_{OH}=-800\mu A$	0.80×V_{DD}	0.95×V_{DD}	$V_{DD}=V_{DET}+0.1V$, $I_{OL}=3.2mA$	0.18	0.40							

∗2 CMOS Output Type; describes V_{DD} voltage when Output Voltage becomes equal or more than $V_{DD}\times 0.8V$
Nch Open Drain Output Type; describes V_{DD} voltage when Off-leakage Current becomes equal or less than 0.1μA.

OPERATION

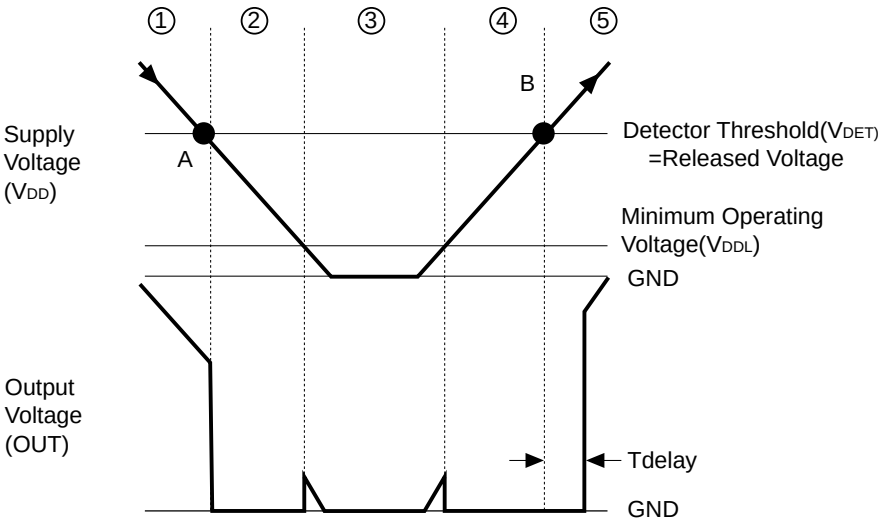
● Operation of R3130N Series



Block Diagram

・CMOS output type
OUT pin is connected to the drain of Nch Tr. and Pch Tr. in this IC.

・Nch open drain output type
OUT pin is connected to the drain of Nch Tr. in this IC. (OUT pin should be pulled up to V_{DD} or an external voltage level.)



Operating Diagram

In the above diagram,

① Output voltage becomes equal to supply voltage (Nch open drain output Type; equal to pull-up Voltage).

②When supply voltage is down to the detector threshold level (Point A), Vref ≧ V_{DD}× Rb/(Ra+Rb) is true. Then, Output of the comparator is reversed, thus output voltage becomes equal to GND level.

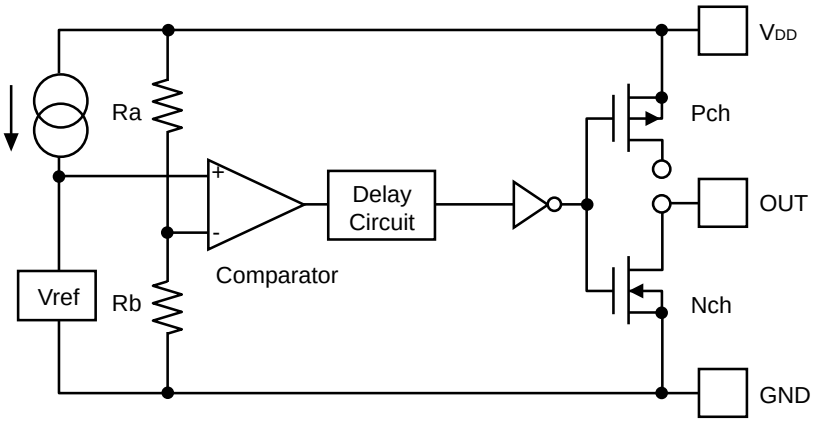
③ When supply voltage is lower than minimum operating voltage, output of transistor is indefinite, therefore output is also indefinite.

④ Output voltage is equal to GND level.

⑤ When supply voltage is higher than released voltage (Point B), Vref ≦ V_{DD}× Rb/(Ra+Rb) is true. Then output of the comparator is reversed, thus output voltage becomes equal to supply voltage (Nch open drain output type; equal to pull-up voltage).

∗ There is no hysteresis range between detector threshold and released voltage.

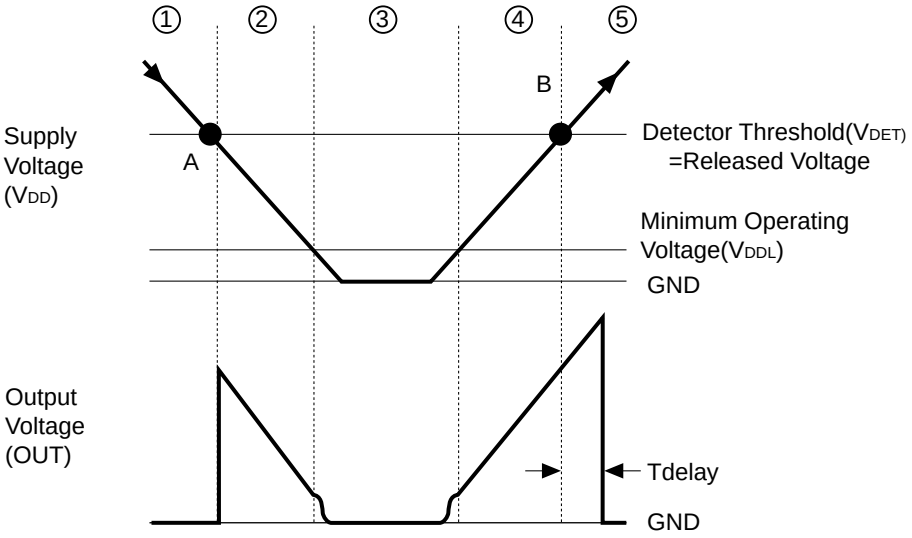
● Operation of R3131N Series



Block Diagram

・CMOS output type
OUT pin is connected to the drain of Nch Tr. and Pch Tr. in this IC.

・Nch open drain output type: I
OUT pin is connected to the drain of Nch Tr. in this IC. (OUT pin should be pulled up to V_{DD} or an external voltage level.)



Operation Diagram

In the above diagram,

① Output voltage becomes equal to GND level.

②When supply voltage is down to the detector threshold level (Point A), Vref ≧ V_{DD}× Rb/(Ra+Rb) is true. Then, output of the comparator is reversed, thus output voltage becomes equal to supply voltage (Nch open drain output type; equal to pull-up Voltage).

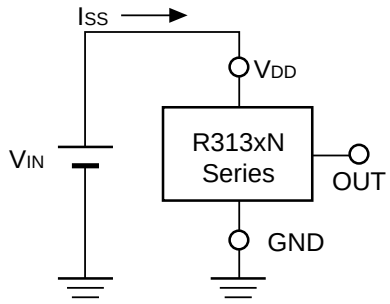
③ When supply voltage is lower than minimum operating voltage, Output of transistor is indefinite, therefore output is also indefinite.(Nch open drain output type; Output voltage level is equal to pull-up voltage.)

④ Output voltage is equal to supply voltage. (Nch open drain output type; equal to pull-up voltage.)

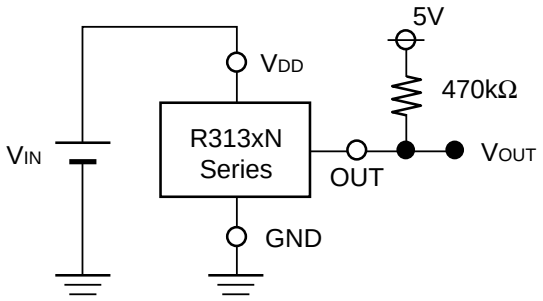
⑤ When supply voltage is higher than released voltage (Point B), Vref ≦ V_{DD}× Rb/(Ra+Rb) is true. Then output of the comparator is reversed, thus output voltage becomes equal to GND level after the output delay time.

* There is no hysteresis range between detector threshold and released voltage.

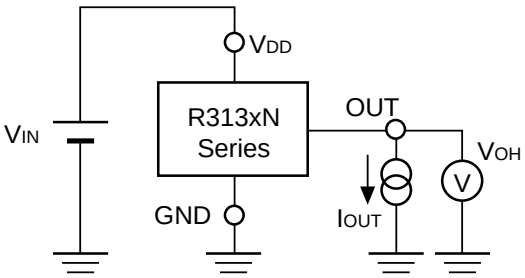
TEST CIRCUITS



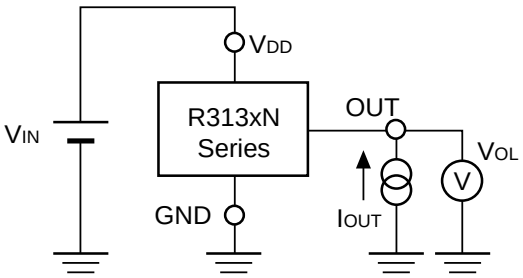
Test Circuit for Supply Current



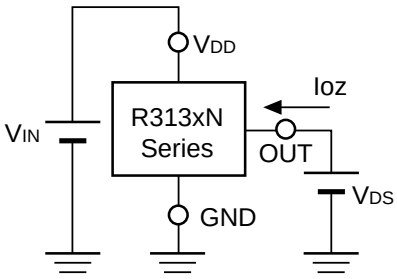
Test Circuit for Detector Threshold
(CMOS Output type; pull-up part is not necessary.)



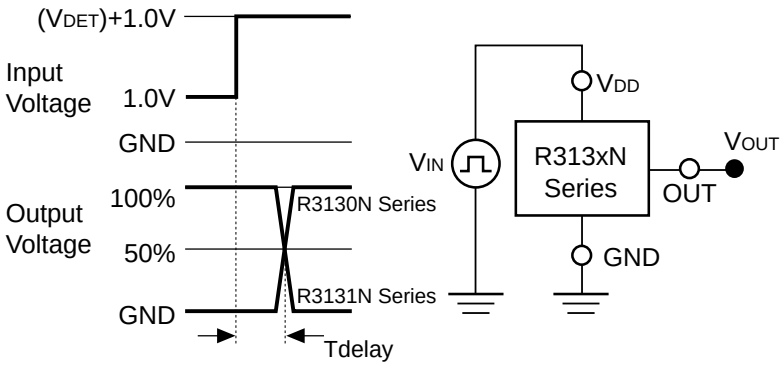
Test Circuit for "H" Output Voltage
(CMOS Output Type only)



Test Circuit for "L" Output Voltage



Test Circuit for Off Leakage Current

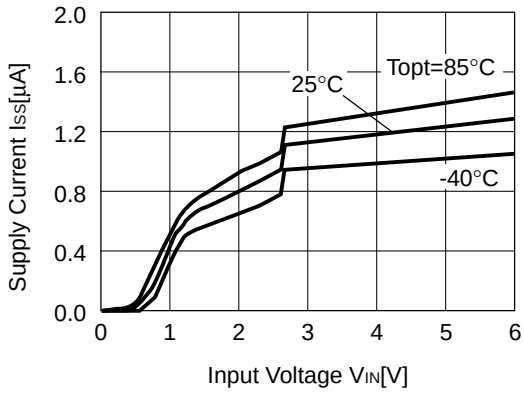


Test Circuit for Output Delay Time
(CMOS Output type; pull-up is not necessary.)

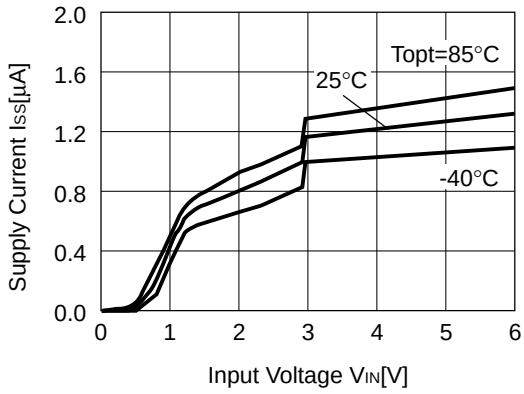
TYPICAL CHARACTERISTICS

1) Supply Current vs. Input Voltage

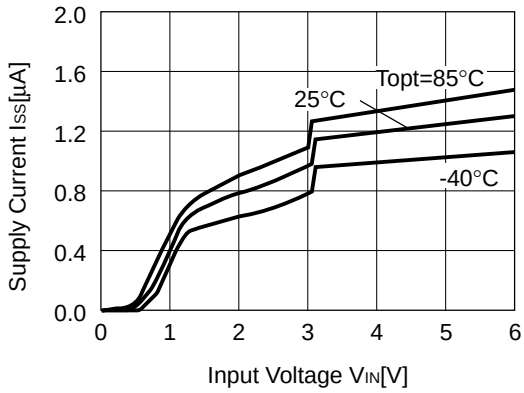
R3131N26xx3



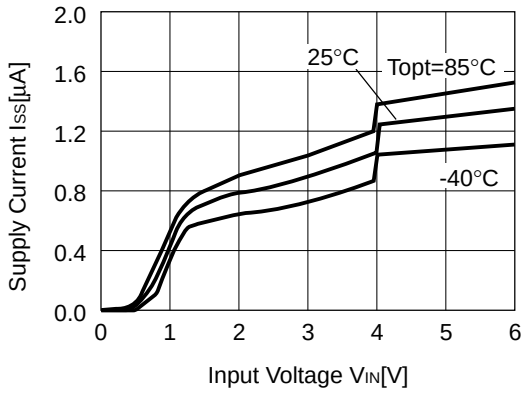
R3131N29xx3



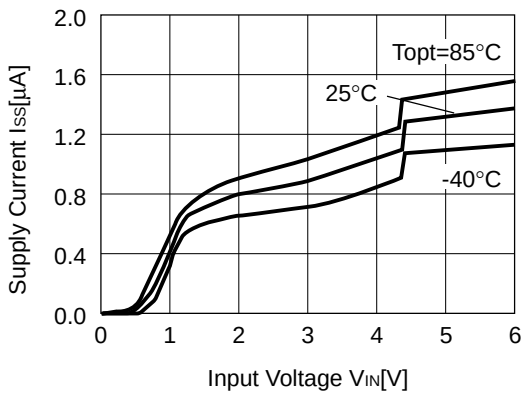
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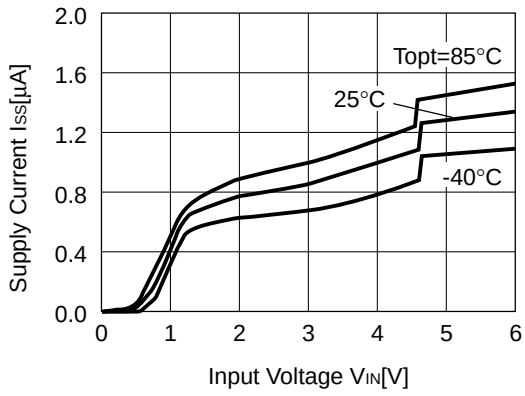
R3131N40xx



R3131N44xx

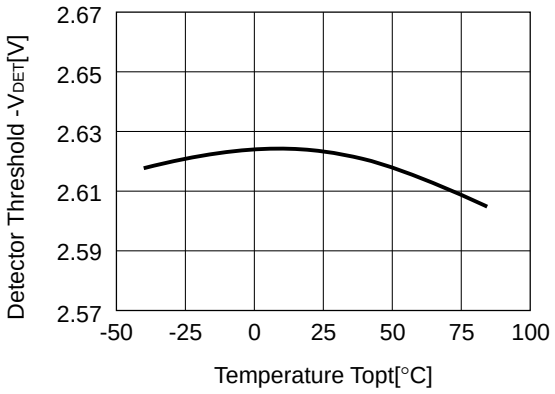


R3131N46xx5

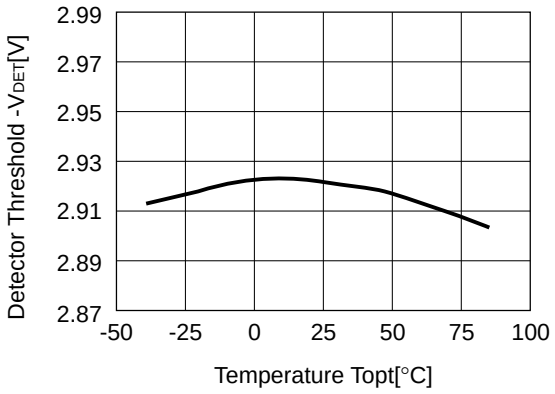


2) Detector Threshold vs. Temperature

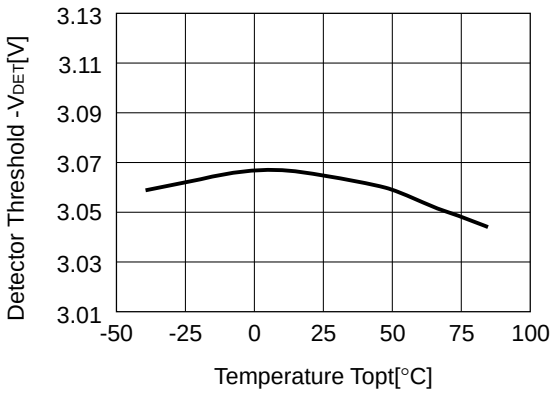
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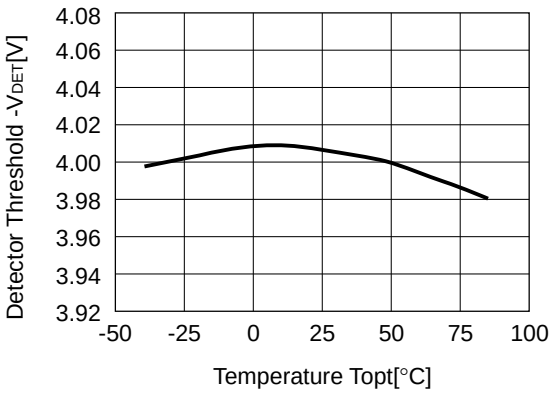
R3130N29xx3



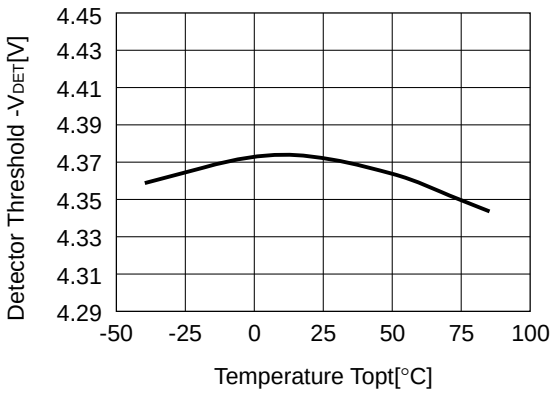
R3130N30xx8



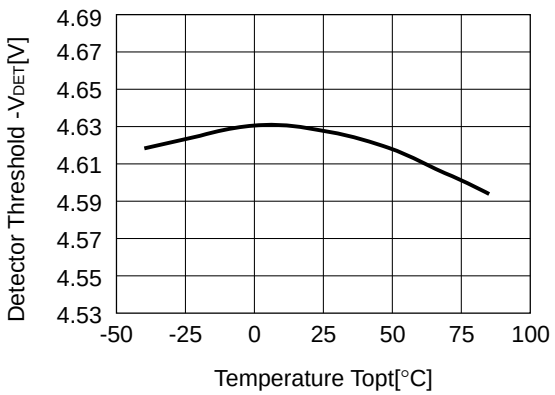
R3130N40xx



R3130N44xx

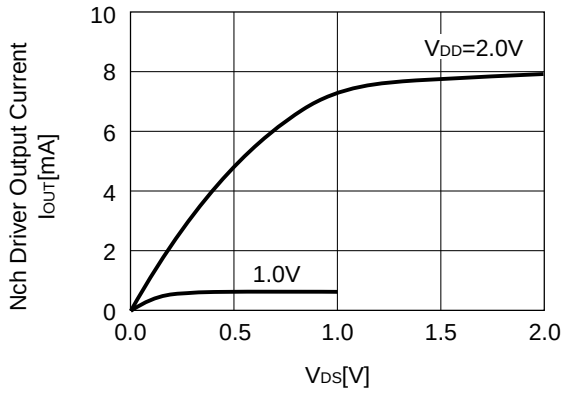


R3130N46xx5

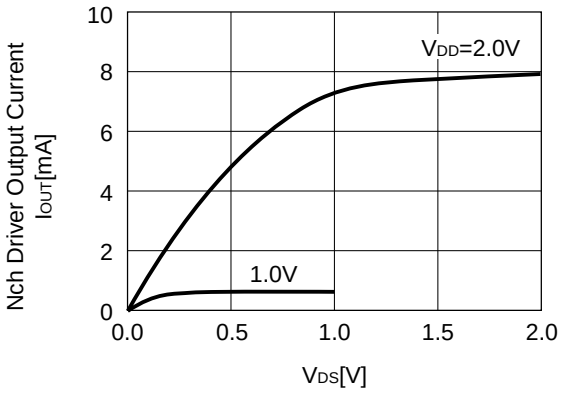


3) Nch Driver Output Current vs. V_{DS}

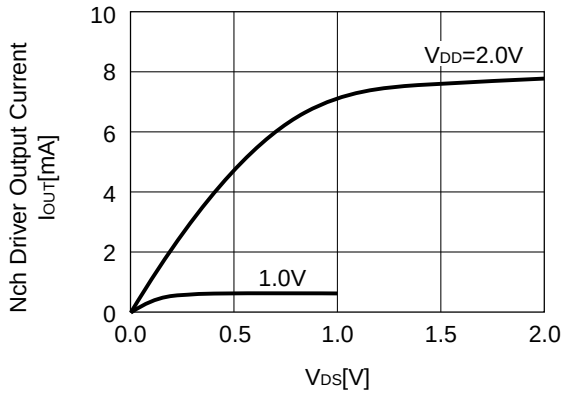
R3130N26xx3



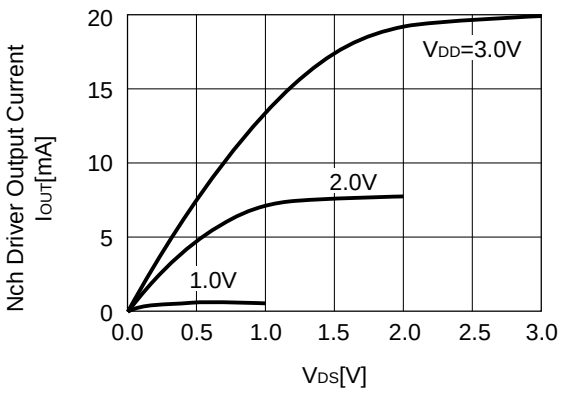
R3130N29xx3



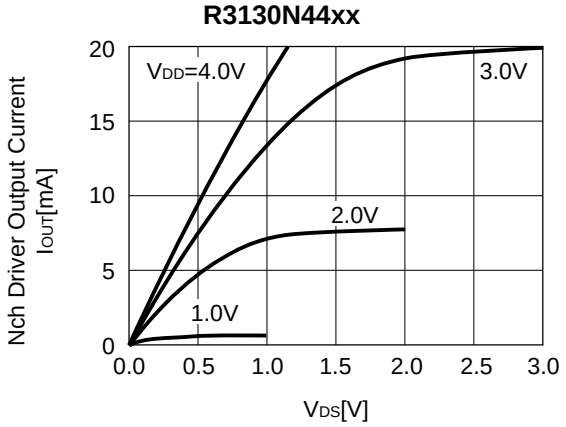
R3130N30xx8



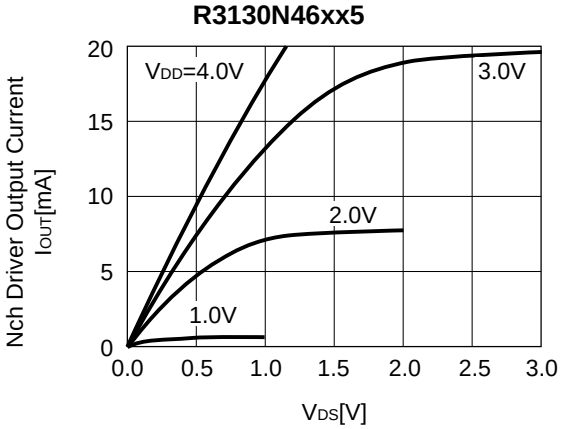
R3130N40xx



R3130N44xx

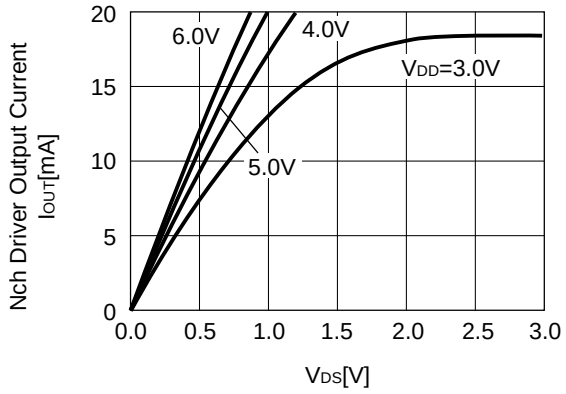


R3130N46xx5

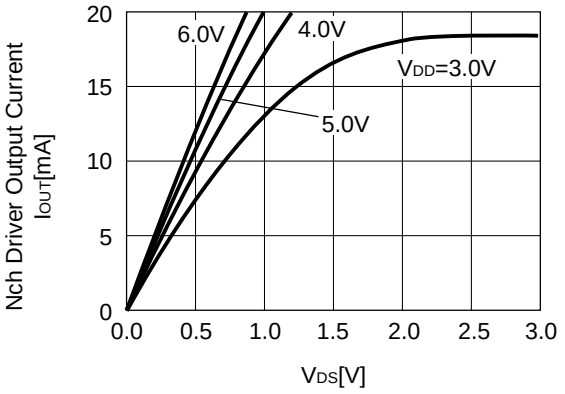


∗ R3130NxxB/D/H (SOT23-3) are the limited products and R3131N (SOT-23-3) is the discontinued product as of March, 2016.

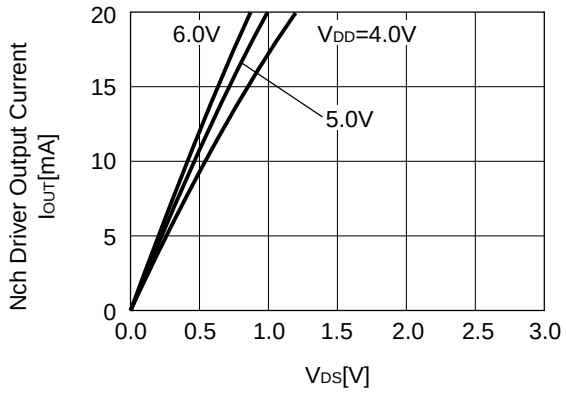
R3131N26xx3



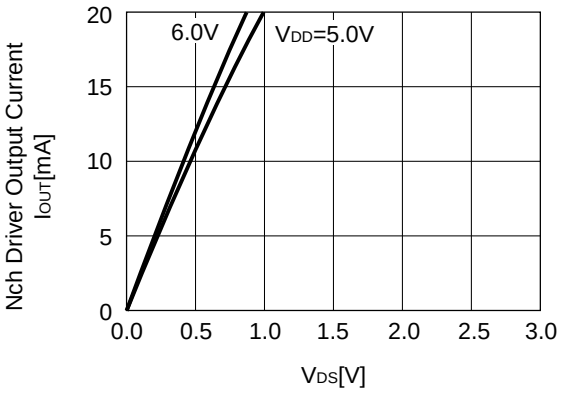
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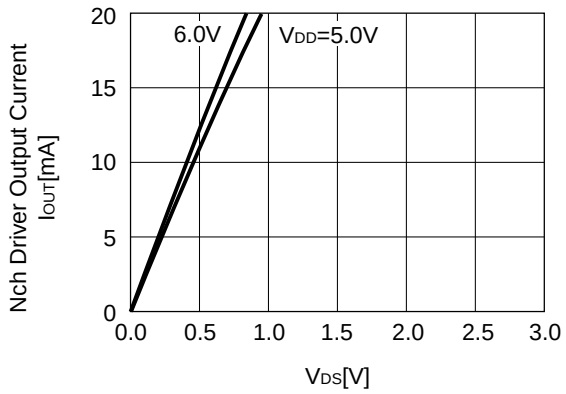
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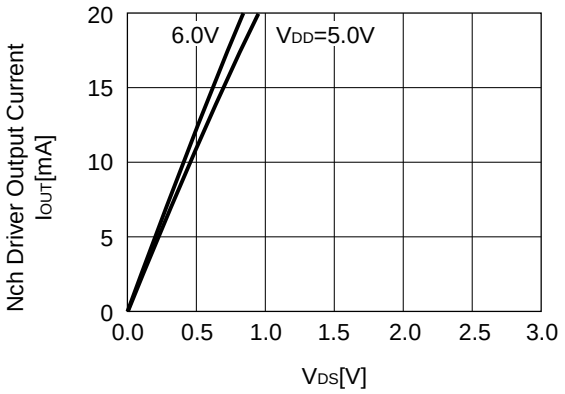
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R3131N44xx

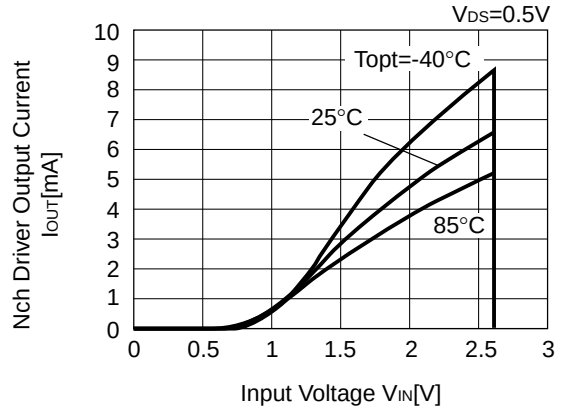


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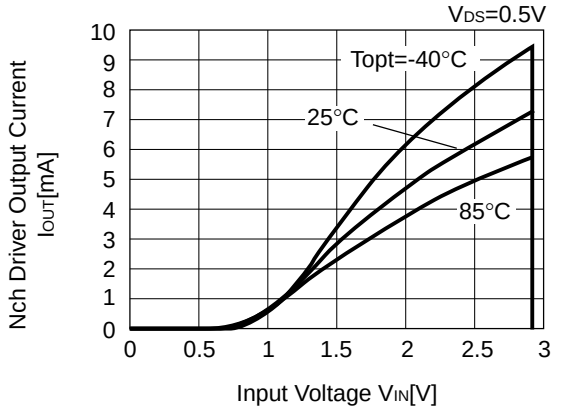


4) Nch Driver Output Current vs. Input Voltage

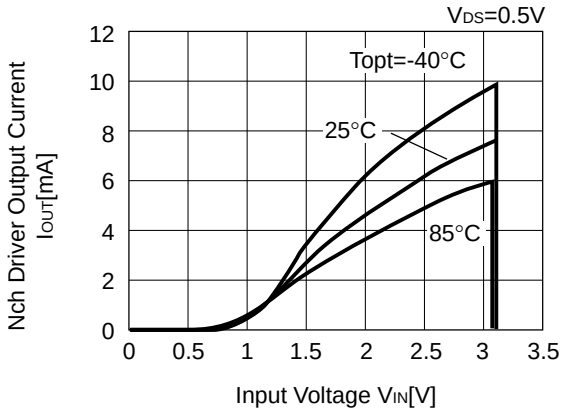
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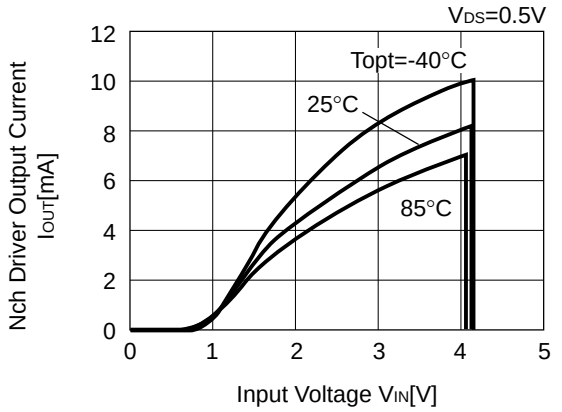
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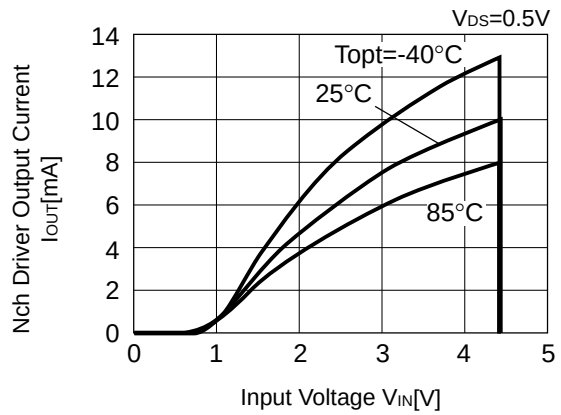
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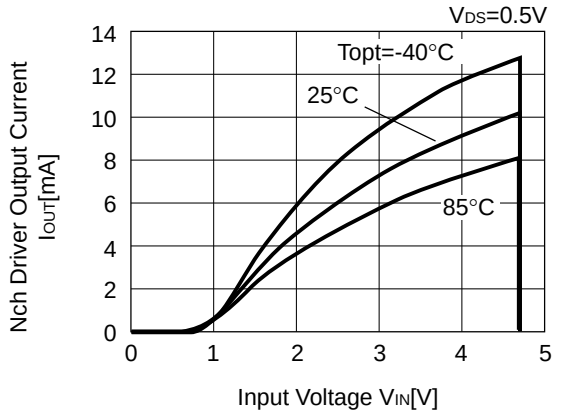
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R3130N44xx

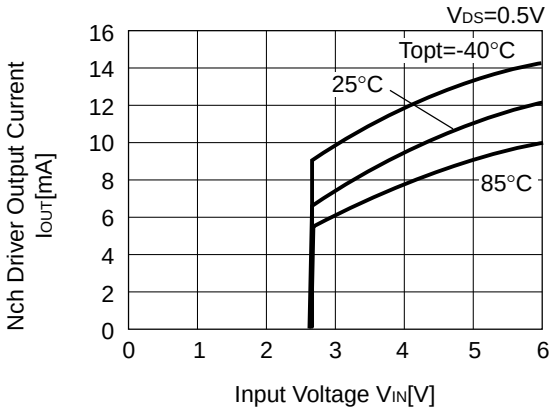


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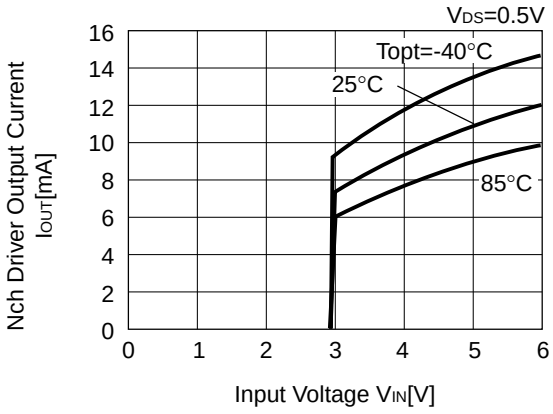


∗ R3130NxxB/D/H (SOT23-3) are the limited products and R3131N (SOT-23-3) is the discontinued product as of March, 2016.

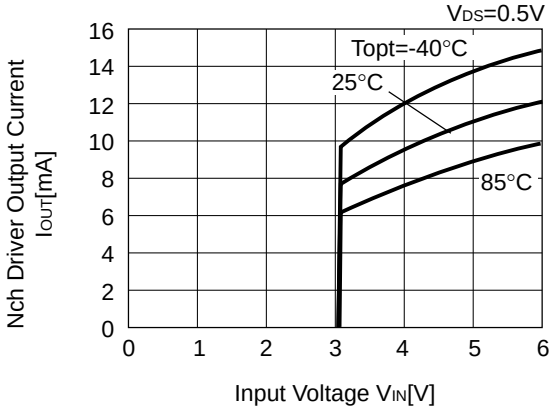
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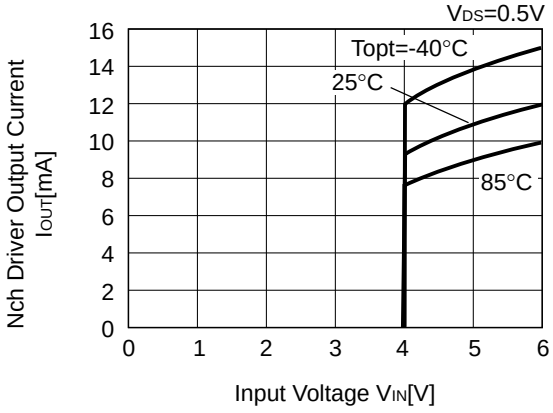
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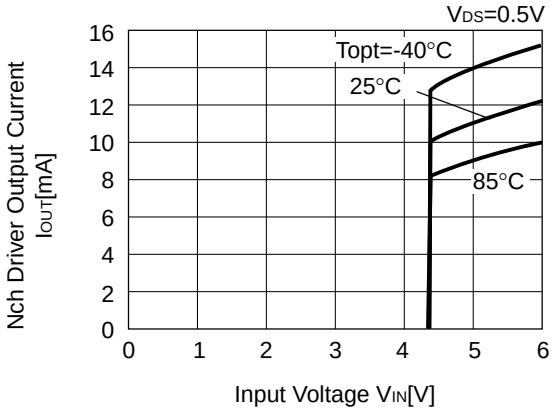
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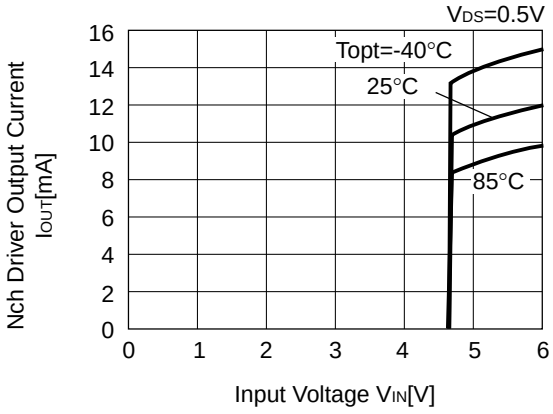
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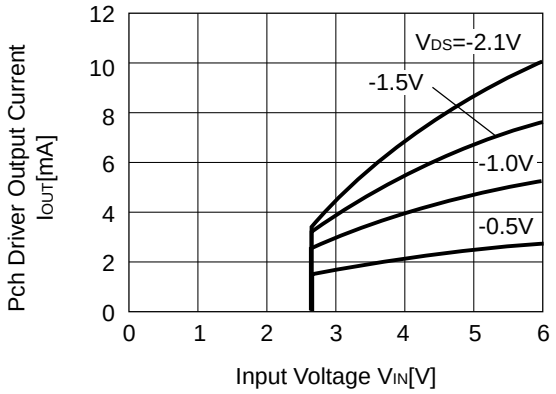


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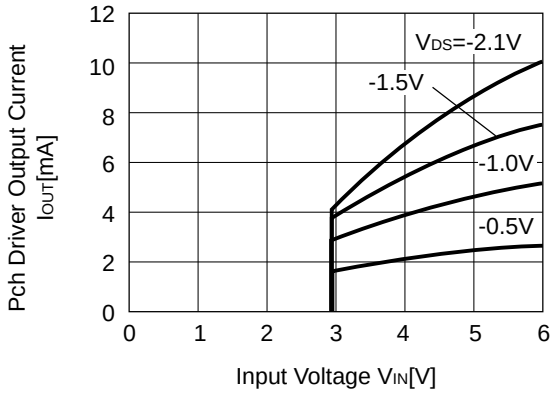


5) Pch Driver Output Current vs. Input Voltage

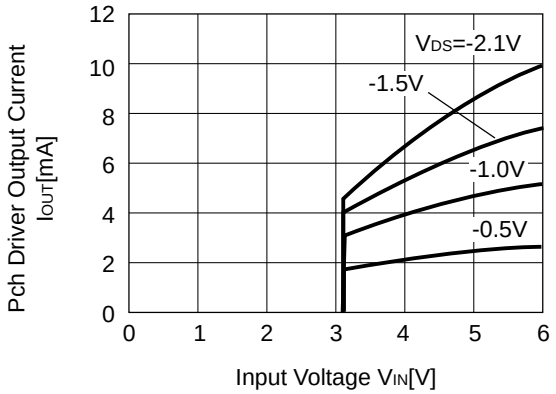
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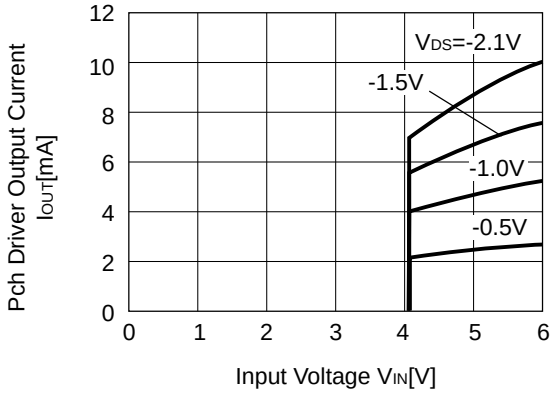
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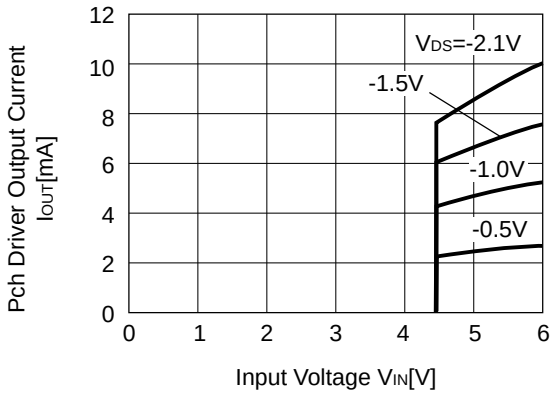
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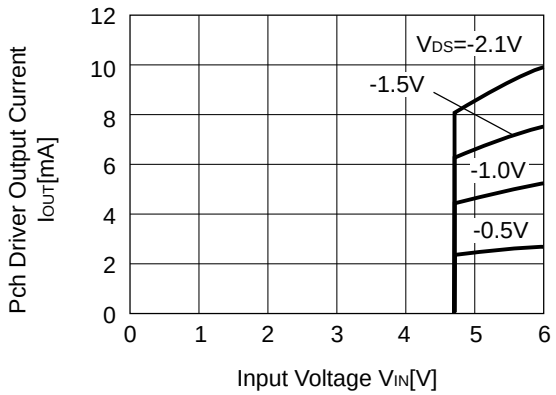
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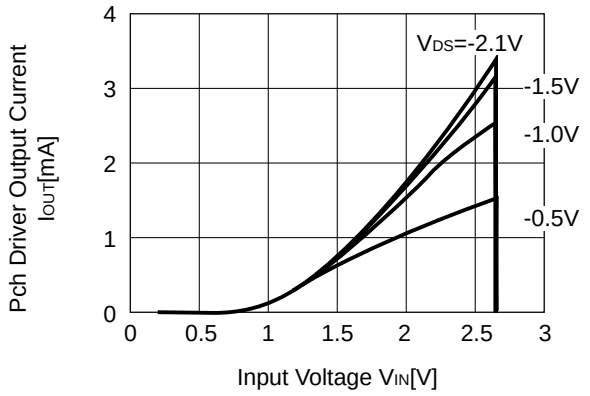
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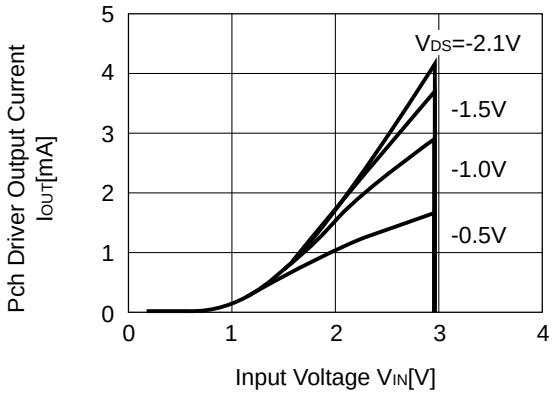
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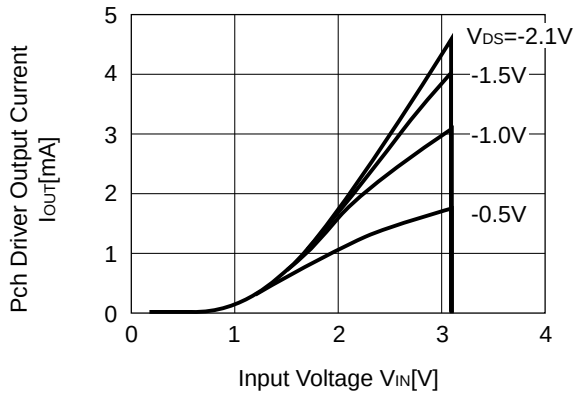
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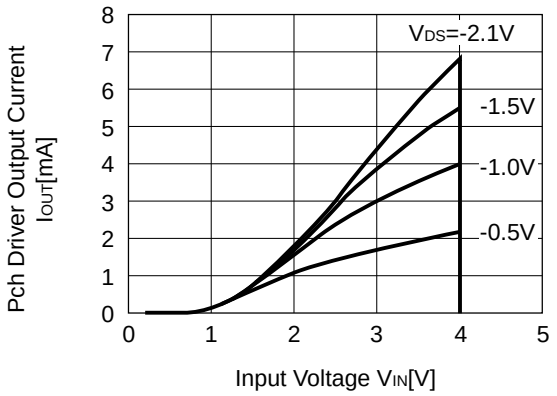
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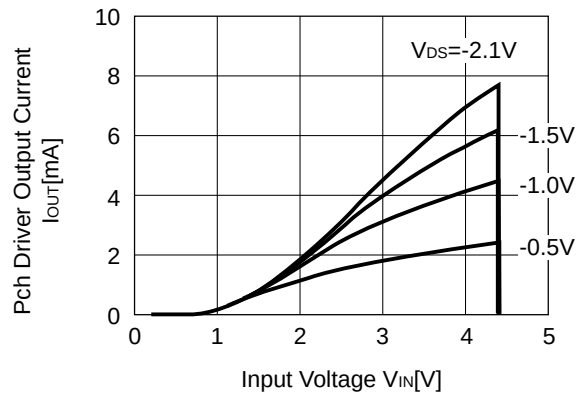
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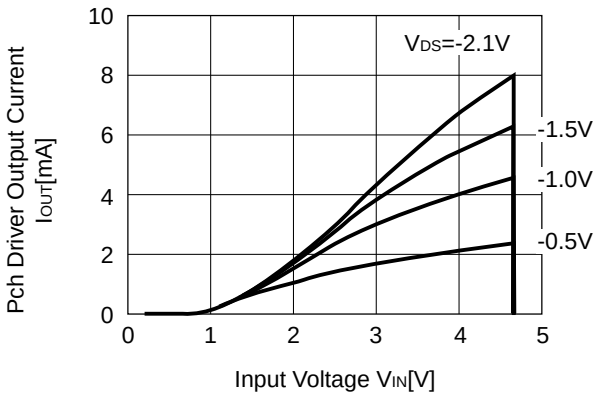
R3131N40xx



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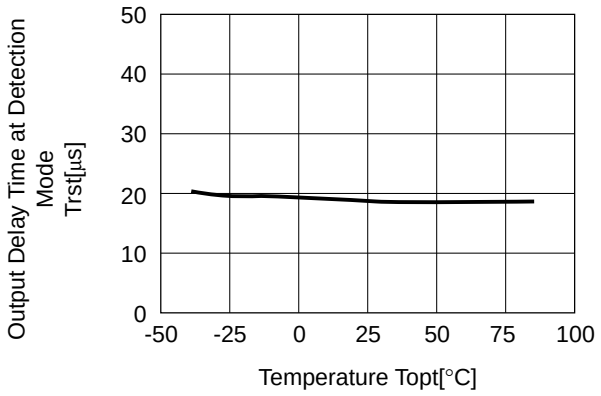


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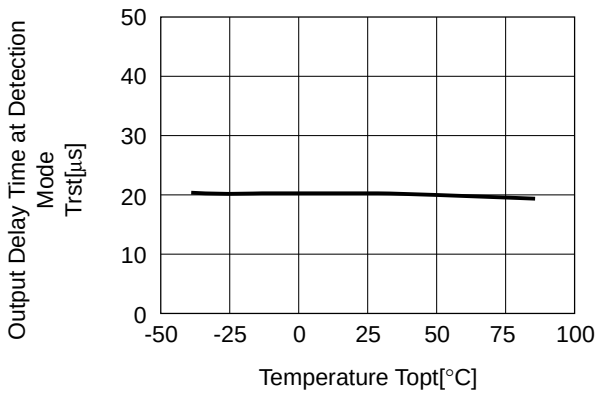


6) Output Delay Time at Detection Mode vs. Temperature

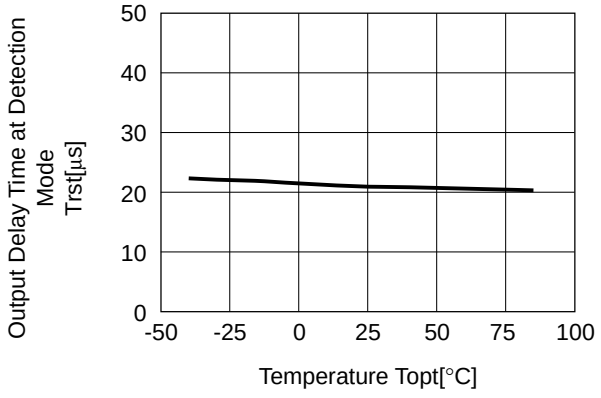
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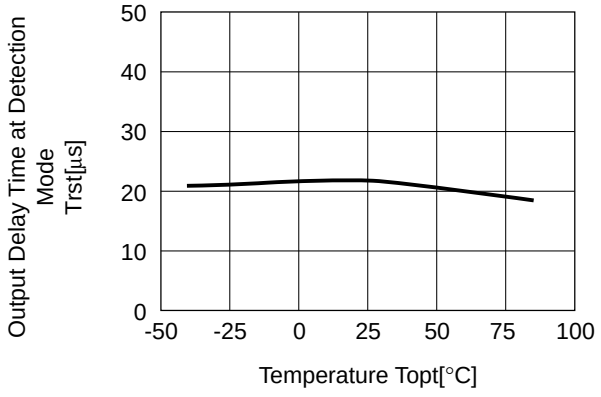
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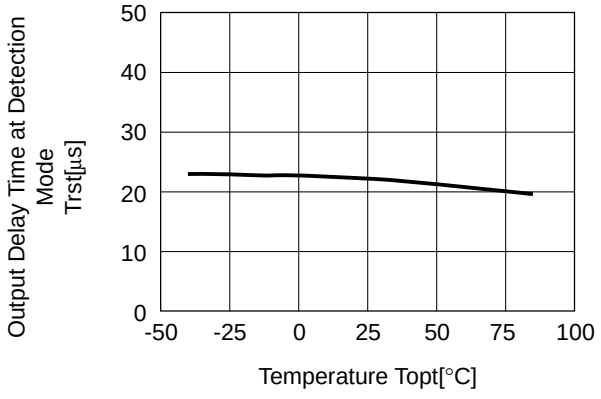
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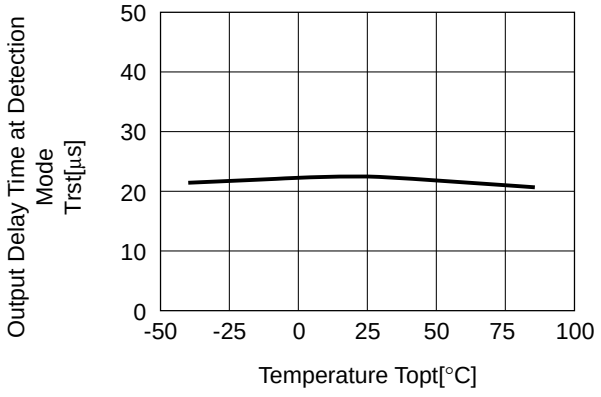
R3131N40xx



R3131N44xx

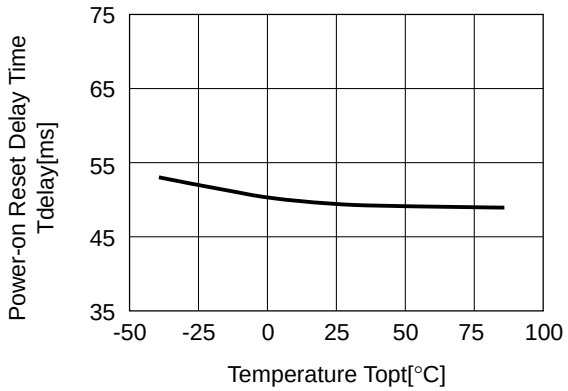


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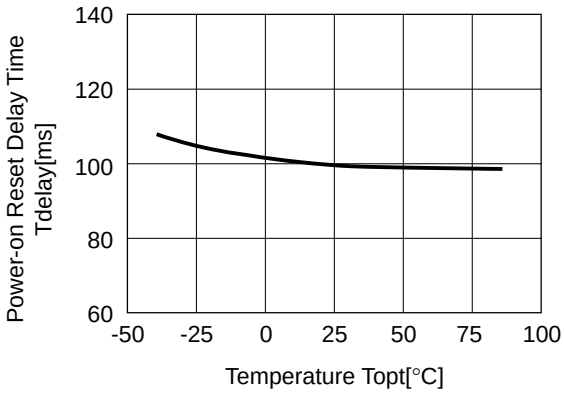


7) Power-on Reset Delay Time vs. Temperature

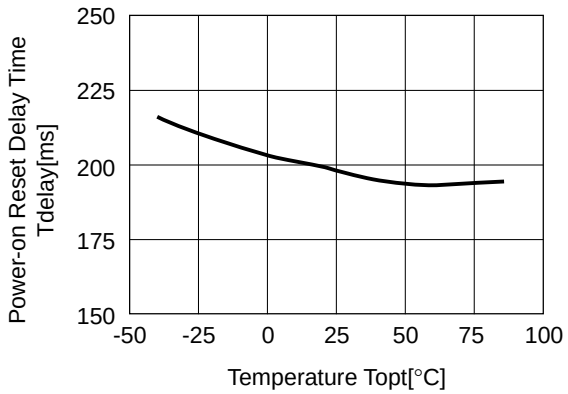
R3131NxxAx



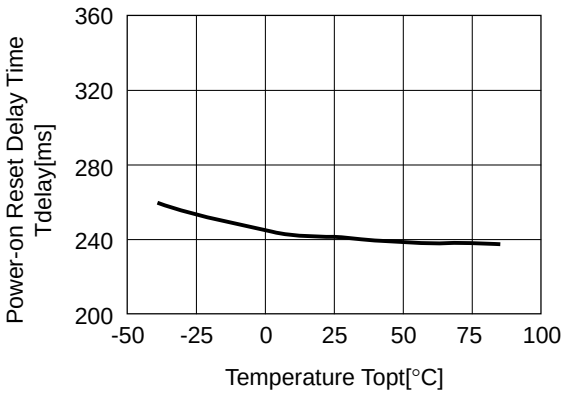
R3131NxxBx



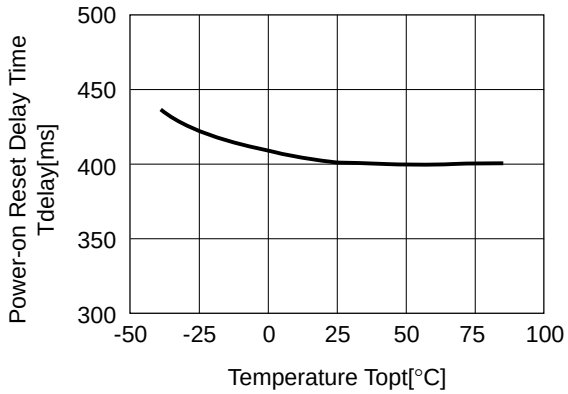
R3131NxxDx



R3131NxxEx



R3131NxxHx



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.

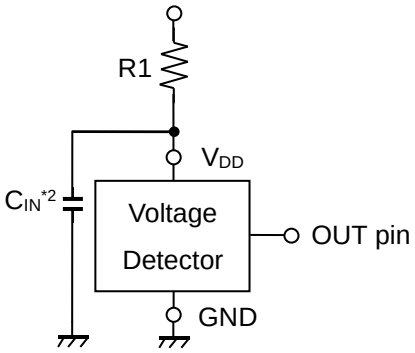


Figure A

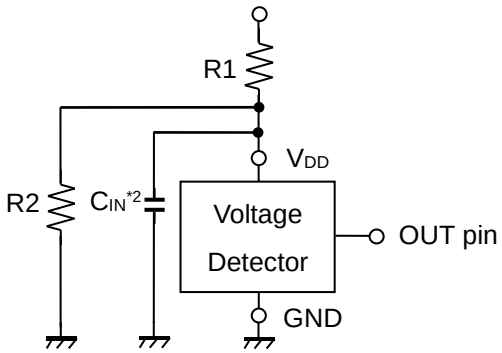


Figure B

*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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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 our sales or our distributor before attempting to use AOI.
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