
LOW VOLTAGE DETECTOR WITH BUILT-IN DELAY CIRCUIT

NO.EA-209-111107

OUTLINE

R3134x Series are CMOS-based voltage detector ICs with built-in delay circuit, high detector threshold accuracy, and ultra low supply current, which can operate at low voltage.

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

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

R3134x Series output "L" at its detect.

Since each of R3134x Series embeds an output delay generator, during a setting 240ms delay time, which is fixed in the IC, this IC keeps the reset condition after they are released. Released conditions will be kept for the delay time from when a supply voltage crosses a setting detector threshold voltage from a low value to a higher value, or from when the manual reset signal is released.

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

Since the packages for these ICs are DFN(PLP)1212-6, SOT-23-5, and SC-88A, high density mounting of the ICs on board is possible.

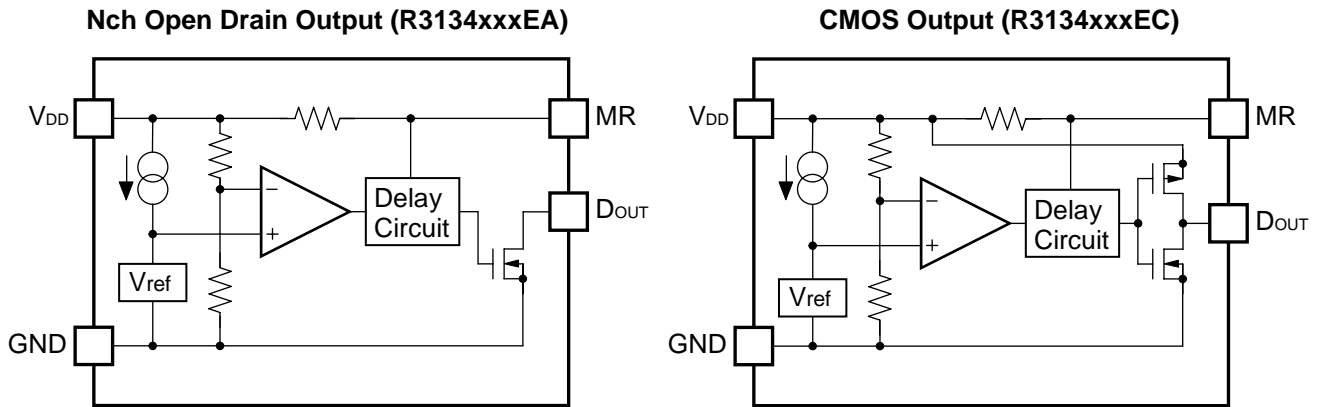
FEATURES

- Supply Current Typ. 0.8 μ A (R3134x27Ex, V_{DD}=3.0V)
- Operating Voltage Range 0.75V to 6.0V (T_{opt}=25°C)
- Detector Threshold Range 1.0V to 5.0V (0.1V steps)
Further, 2.32V, 2.63V, 2.93V, 3.08V, 4.38V, and 4.63V can be provided as standard.
- Detector Threshold Accuracy \pm 1.8%
- Temperature-Drift Coefficient of Detector Threshold Typ. \pm 100ppm/°C
- Built-in Delay Time Circuit Typ. 240ms
- Output Delay Time Accuracy \pm 15%
- Output Types Nch Open Drain and CMOS
- Packages DFN(PLP)1212-6, SC-88A, 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 package type, the detector threshold, the output type and the taping type for the ICs can be selected at the users' request.

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R3134KxxE*(y)-TR	DFN(PLP)1212-6	5,000 pcs	Yes	Yes
R3134QxxE*(y)-TR-FE	SC-88A	3,000 pcs	Yes	Yes
R3134NxxE*(y)-TR-FE	SOT-23-5	3,000 pcs	Yes	Yes

xx: The detector threshold can be designated in the range from 1.0V(10) to 5.0V(50) 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, R3134x26E*3-TR-x

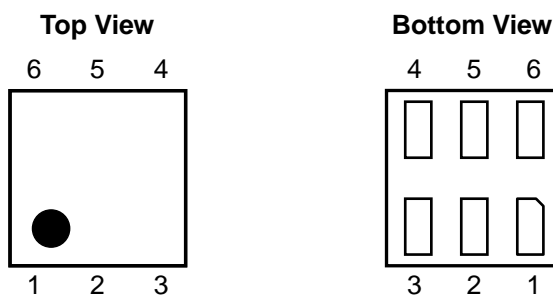
* : Designation of Output Type

(A) Nch Open Drain

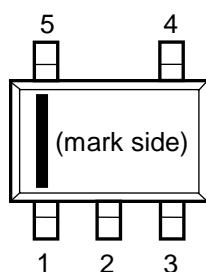
(C) CMOS

PIN CONFIGURATIONS

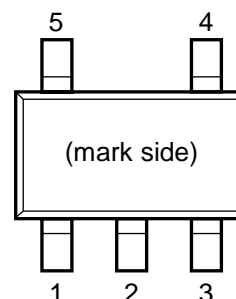
• DFN(PLP)1212-6



• SC-88A



• SOT-23-5



PIN DESCRIPTIONS

• DFN(PLP)1212-6

Pin No.	Symbol	Description
1	V _{DD}	Input Pin
2	NC	No Connection
3	GND	Ground Pin
4	D _{OUT}	Output Pin ("L" at detection)
5	NC	No Connection
6	MR	Manual Reset Input Pin*

• SC-88A

Pin No.	Symbol	Description
1	V _{DD}	Input Pin
2	GND	Ground Pin
3	MR	Manual Reset Input Pin*
4	D _{OUT}	Output Pin ("L" at detection)
5	NC	No Connection

• SOT-23-5

Pin No.	Symbol	Description
1	D _{OUT}	Output Pin ("L" at detection)
2	V _{DD}	Input Pin
3	GND	Ground Pin
4	MR	Manual Reset Input Pin*
5	NC	No Connection

*) MR pin is active at "L" input. Pulled up via 1M Ω (Typ.). If MR pin is not necessary, open this node, or connect it to V_{DD}.

ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V_{DD}	Supply Voltage	6.5	V
V_{OUT}	Output Voltage (Nch Open Drain Output)	$V_{SS}-0.3$ to 6.5	V
	Output Voltage (CMOS Output)	$V_{SS}-0.3$ to $V_{DD}+0.3$	
V_{MR}	Input Voltage	$V_{SS}-0.3$ to $V_{DD}+0.3$	V
I_{OUT}	Output Current	20	mA
P_D	Power Dissipation (DFN(PLP)1212-6)*	400	mW
	Power Dissipation (SC-88A)*	380	
	Power Dissipation (SOT-23-5)*	420	
T_{opt}	Operating Temperature Range	-40 to 85	°C
T_{stg}	Storage Temperature Range	-55 to 125	°C

*) 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

• R3134x

The specification in is checked and guaranteed by design engineering at $-40^{\circ}\text{C} \leq T_{\text{opt}} \leq 85^{\circ}\text{C}$.

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

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit	
V_{DET}	Detector Threshold		$V_{\text{DET}} \times 0.982$		$V_{\text{DET}} \times 1.018$	V	
I_{SS1}	Supply Current1	$V_{\text{DD}}=V_{\text{DET}}-0.1\text{V}$, $I_{\text{OUT}}=0\text{A}$			2.0	μA	
I_{SS2}	Supply Current2	$V_{\text{DD}}=V_{\text{DET}}+0.1\text{V}$, $I_{\text{OUT}}=0\text{A}$			2.0	μA	
I_{SS3}	Supply Current3	$V_{\text{DD}}=6\text{V}$, $I_{\text{OUT}}=0\text{A}$	$V_{\text{DET}} < 1.6\text{V}$			3.6	μA
			$1.6 \leq V_{\text{DET}} < 2.7\text{V}$			3.0	
			$2.7\text{V} \leq V_{\text{DET}}$			2.5	
V_{DD}	Operating Voltage	$T_{\text{opt}}=25^{\circ}\text{C}$	0.75		6.00	V	
		$-40^{\circ}\text{C} \leq T_{\text{opt}} \leq 85^{\circ}\text{C}$	<input type="checkbox"/> 0.85		<input type="checkbox"/> 6.00		
V_{OH}	"H" Output Voltage	Refer to the following table					
V_{OL}	"L" Output Voltage	Refer to the following table					
V_{IH}	MR pin "H" Input Voltage	$V_{\text{DD}} \geq V_{\text{DET}}+0.1\text{V}$	$0.75 \times V_{\text{DD}}$			V	
V_{IL}	MR pin "L" Input Voltage	$V_{\text{DD}} \geq V_{\text{DET}}+0.1\text{V}$			$0.2 \times V_{\text{DD}}$	V	
R_{MR}	MR pin pull-up Resistance	$T_{\text{opt}}=25^{\circ}\text{C}$	0.5	1.0	4.0	$\text{M}\Omega$	
$\frac{\Delta V_{\text{DET}}}{\Delta T_{\text{opt}}}$	Detector Threshold Temperature Coefficient	$-40^{\circ}\text{C} \leq T_{\text{opt}} \leq 85^{\circ}\text{C}$		± 100		ppm/ $^{\circ}\text{C}$	
t_{reset}	Output Delay Time for detect *	$V_{\text{DD}}=V_{\text{DET}} \rightarrow V_{\text{DET}}-0.1\text{V}$		15		μs	
t_{delay}	Output Delay Time for release	$V_{\text{DD}}=0.8\text{V} \rightarrow V_{\text{DET}}+1.0$	204	240	276	ms	

*) Guaranteed by design, not mass production tested.

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.

• "H" Output Voltage (V_{OH}) table

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

Products	Detector Threshold V_{DET} (V)	"H" Output Voltage V_{OH} (V)			
		Conditions	Min.	Typ.	Max.
R3134xxxEC	$V_{DET} < 1.2V$	$V_{DD}=V_{DET}+0.1V, I_{OH}=50\mu A$	0.8× V_{DD}		
	$1.2V \leq V_{DET} < 2.0V$	$V_{DD}=V_{DET}+0.1V, I_{OH}=150\mu A$			
	$2.0V \leq V_{DET} < 3.1V$	$V_{DD}=V_{DET}+0.1V, I_{OH}=500\mu A$			
	$3.1V \leq V_{DET}$	$V_{DD}=V_{DET}+0.1V, I_{OH}=800\mu A$			

V_{DET} is a set value.

• "L" Output Voltage (V_{OL}) table

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

Products	Detector Threshold V_{DET} (V)	"L" Output Voltage V_{OL} (V)			
		Conditions	Min.	Typ.	Max.
R3134xxxEx	$V_{DET} < 1.2V$	$V_{DD}=V_{DET}-0.1V, I_{OL}=200\mu A$			0.04
	$1.2V \leq V_{DET} < 2.0V$	$V_{DD}=V_{DET}-0.1V, I_{OL}=750\mu A$			0.06
	$2.0V \leq V_{DET} < 3.1V$	$V_{DD}=V_{DET}-0.1V, I_{OL}=1.2mA$			0.05
	$3.1V \leq V_{DET}$	$V_{DD}=V_{DET}-0.1V, I_{OL}=3.2mA$			0.06

V_{DET} is a set value.

DETECTOR THRESHOLD SPECIFICATIONS BY PART NUMBER

• R3134x

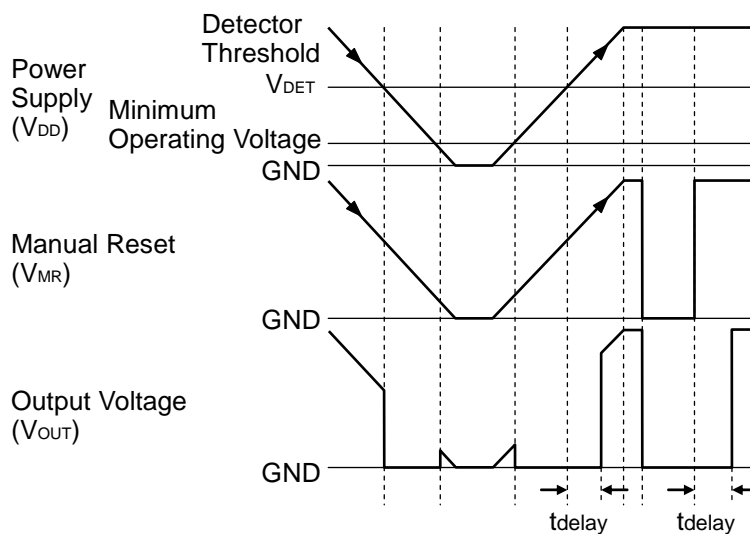
Part Number	Operating Voltage				Detector Threshold			Supply Current 1		
	VDD [V]				VDET [V]			ISS1 [μA]		
	Conditions	Min.	Conditions	Min.	Min.	Typ.	Max.	Conditions	Typ.	Max.
R3134x23Ex2	Topt=25°C	0.75	-40°C ≤ Topt ≤ 85°C	0.85	2.278	2.320	2.362	VDD=VDET-0.1V IOUT=0A	0.8	2.0
R3134x26Ex3					2.583	2.630	2.677			
R3134x29Ex3					2.877	2.930	2.983			
R3134x30Ex8					3.025	3.080	3.135			
R3134x43Ex8					4.301	4.380	4.459			
R3134x46Ex3					4.547	4.630	4.713			
R3134x10Ex	Topt=25°C	0.75	-40°C ≤ Topt ≤ 85°C	0.85	0.982	1.000	1.018	VDD=VDET-0.1V IOUT=0A	0.8	2.0
R3134x11Ex					1.080	1.100	1.120			
R3134x12Ex					1.178	1.200	1.222			
R3134x13Ex					1.277	1.300	1.323			
R3134x14Ex					1.375	1.400	1.425			
R3134x15Ex					1.473	1.500	1.527			
R3134x16Ex					1.571	1.600	1.629			
R3134x17Ex					1.669	1.700	1.731			
R3134x18Ex					1.768	1.800	1.832			
R3134x19Ex					1.866	1.900	1.934			
R3134x20Ex					1.964	2.000	2.036			
R3134x21Ex					2.062	2.100	2.138			
R3134x22Ex					2.160	2.200	2.240			
R3134x23Ex					2.259	2.300	2.341			
R3134x24Ex					2.357	2.400	2.443			
R3134x25Ex					2.455	2.500	2.545			
R3134x26Ex					2.553	2.600	2.647			
R3134x27Ex					2.651	2.700	2.749			
R3134x28Ex					2.750	2.800	2.850			
R3134x29Ex					2.848	2.900	2.952			
R3134x30Ex					2.946	3.000	3.054			
R3134x31Ex					3.044	3.100	3.156			
R3134x32Ex					3.142	3.200	3.258			
R3134x33Ex					3.241	3.300	3.359			
R3134x34Ex					3.339	3.400	3.461			
R3134x35Ex					3.437	3.500	3.563			
R3134x36Ex					3.535	3.600	3.665			
R3134x37Ex					3.633	3.700	3.767			
R3134x38Ex					3.732	3.800	3.868			
R3134x39Ex					3.830	3.900	3.970			
R3134x40Ex	3.928	4.000	4.072							
R3134x41Ex	4.026	4.100	4.174							
R3134x42Ex	4.124	4.200	4.276							
R3134x43Ex	4.223	4.300	4.377							
R3134x44Ex	4.321	4.400	4.479							
R3134x45Ex	4.419	4.500	4.581							
R3134x46Ex	4.517	4.600	4.683							
R3134x47Ex	4.615	4.700	4.785							
R3134x48Ex	4.714	4.800	4.886							
R3134x49Ex	4.812	4.900	4.988							
R3134x50Ex	4.910	5.000	5.090							
								0.9		

Supply Current 2			Supply Current 3			"H" Output Voltage	
Iss2 [μ A]			Iss3 [μ A]			Voh [V]	
Conditions	Typ.	Max.	Conditions	Typ.	Max.	Conditions	Min.
VDD=VDET+0.1V IOUT=0A	0.8	2.0	VDD=6.0V IOUT=0A	1.2	3.0	VDD=VDET+0.1V IOH=500 μ A	0.8 \times VDD
				1.0	2.5	VDD=VDET+0.1V IOH=800 μ A	
VDD=VDET+0.1V IOUT=0A	0.8	2.0	VDD=6.0V IOUT=0A	1.4	3.6	VDD=VDET+0.1V IOH=50 μ A	0.8 \times VDD
						VDD=VDET+0.1V IOH=150 μ A	
				1.2	3.0	VDD=VDET+0.1V IOH=500 μ A	
						VDD=VDET+0.1V IOH=800 μ A	
				1.0	2.5		
0.8							

Part Number	"L" Output Voltage		MR pin "H" Input Voltage		MR pin "L" Input Voltage		MR pin pull-up resistance											
	VoL [V]		VIH [V]		VIL [V]		RMR [MΩ]											
	Conditions	Max.	Conditions	Min.	Conditions	Max.	Conditions	Min.	Typ.	Max.								
R3134x23Ex2	VDD=VDET-0.1V IOL=1.2mA	0.05	VDD ≥ VDET+0.1	0.75× VDD	VDD ≥ VDET+0.1	0.2× VDD	Topt=25°C	0.5	1.0	4.0								
R3134x26Ex3																		
R3134x29Ex3																		
R3134x30Ex8																		
R3134x43Ex8	VDD=VDET-0.1V IOL=3.2mA	0.06	VDD ≥ VDET+0.1	0.75× VDD	VDD ≥ VDET+0.1	0.2× VDD	Topt=25°C	0.5	1.0	4.0								
R3134x46Ex3																		
R3134x10Ex	VDD=VDET-0.1V IOL=200μA	0.04									VDD ≥ VDET+0.1	0.75× VDD	VDD ≥ VDET+0.1	0.2× VDD	Topt=25°C	0.5	1.0	4.0
R3134x11Ex																		
R3134x12Ex	VDD=VDET-0.1V IOL=750μA	0.06	VDD ≥ VDET+0.1	0.75× VDD	VDD ≥ VDET+0.1	0.2× VDD	Topt=25°C	0.5	1.0	4.0								
R3134x13Ex																		
R3134x14Ex																		
R3134x15Ex																		
R3134x16Ex																		
R3134x17Ex																		
R3134x18Ex																		
R3134x19Ex	VDD=VDET-0.1V IOL=1.2mA	0.05	VDD ≥ VDET+0.1	0.75× VDD	VDD ≥ VDET+0.1	0.2× VDD	Topt=25°C	0.5	1.0	4.0								
R3134x20Ex																		
R3134x21Ex																		
R3134x22Ex																		
R3134x23Ex																		
R3134x24Ex																		
R3134x25Ex																		
R3134x26Ex																		
R3134x27Ex																		
R3134x28Ex																		
R3134x29Ex	VDD=VDET-0.1V IOL=3.2mA	0.06	VDD ≥ VDET+0.1	0.75× VDD	VDD ≥ VDET+0.1	0.2× VDD	Topt=25°C	0.5	1.0	4.0								
R3134x30Ex																		
R3134x31Ex																		
R3134x32Ex																		
R3134x33Ex																		
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R3134x49Ex																		
R3134x50Ex																		

Output Delay Time for Release				Detector Threshold Temperature Coefficient	
tdelay [ms]				$\Delta V_{DET}/\Delta T_{opt}$ [ppm/°C]	
Conditions	Min.	Typ.	Max.	Conditions	Typ.
$V_{DD}=0.8V \rightarrow$ $V_{DET}=1.0V$ $T_{opt}=25^{\circ}C$	204	240	276	$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$	± 100
$V_{DD}=0.8V \rightarrow$ $V_{DET}=1.0V$ $T_{opt}=25^{\circ}C$	204	240	276	$-40^{\circ}C \leq T_{opt} \leq 85^{\circ}C$	± 100

TIMING CHART



R3134x Operating Diagram

DEFINITION OF OUTPUT DELAY TIME

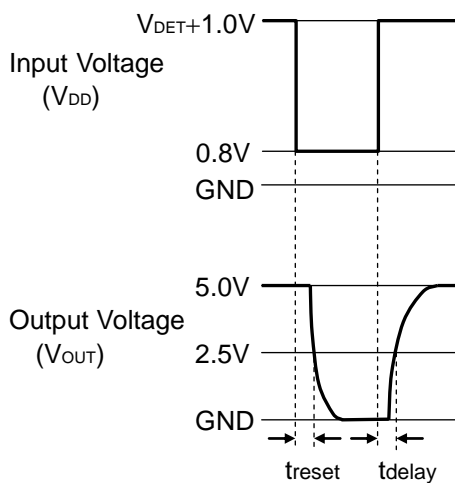
Output Delay Time (t_{delay}) is specified as follows:

1. In the case of Nch Open Drain Output:

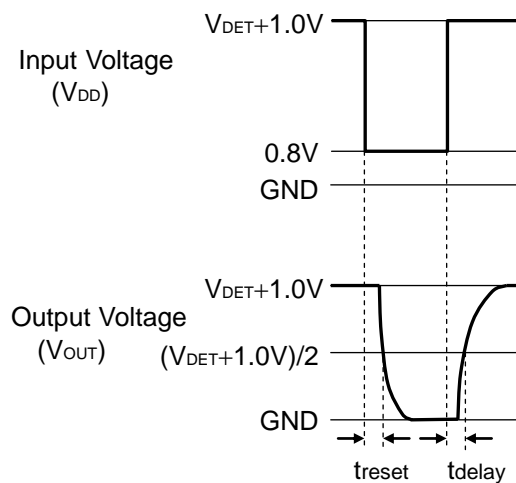
The time interval from rising edge of V_{DD} pulse 0.8V to $V_{DET}+1.0V$ to the time at which the output reaches 2.5V under the condition that the output pin (D_{OUT}) is pulled up to 5V through a 470k Ω resistor.

2. In the case of CMOS Output:

The time interval from rising edge of V_{DD} pulse 0.8V to $V_{DET}+1.0V$ to the time at the output reaches $(V_{DET}+1.0V)/2$.



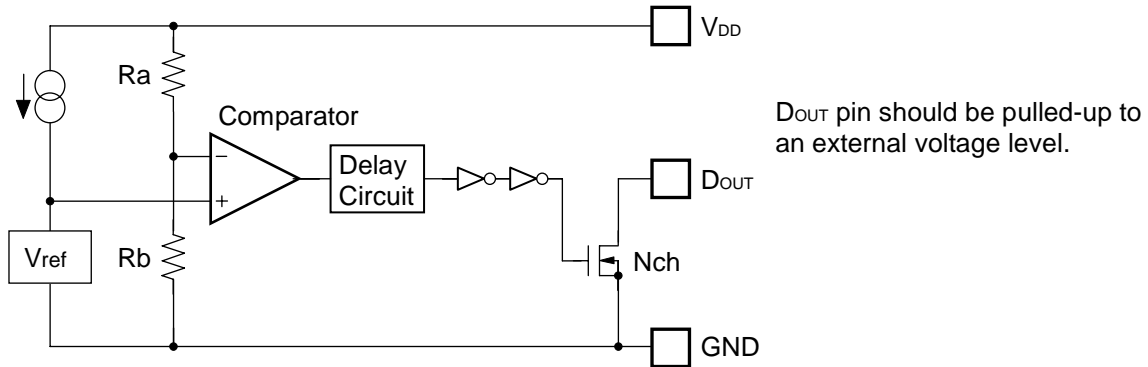
Nch Open Drain Output
(R3134xxxEA)



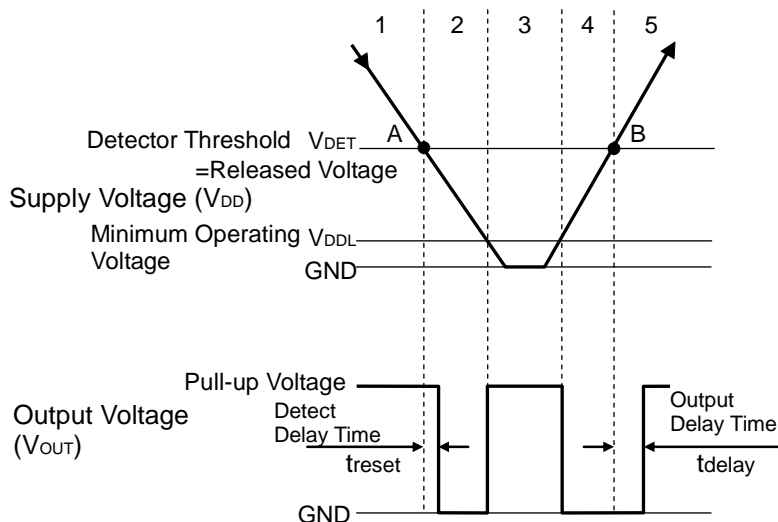
CMOS Output
(R3134xxxEC)

OPERATION

• Operation of R3134xxxEA



Block Diagram



Operation Diagram

• Explanation of operation

Step 1. The output voltage is equal to the pull-up voltage.

Step 2. At Point "A", $V_{ref} \geq V_{DD} \times R_b / (R_a + R_b)$ is true, as a result, the output of comparator is reversed from "L" to "H", therefore the output voltage becomes the GND level. The voltage level of Point A means a detector threshold voltage (V_{DET}).

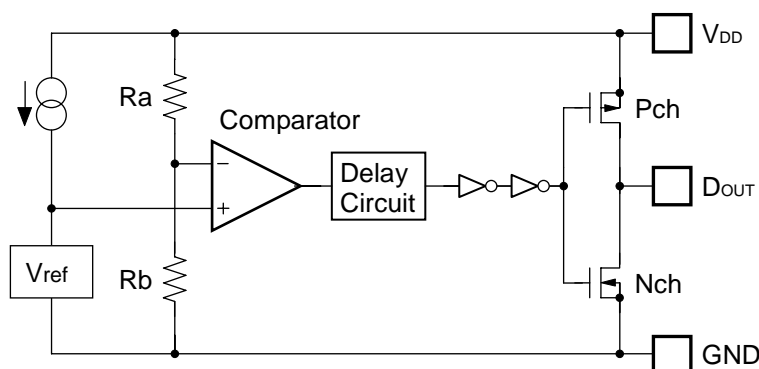
Step 3. When the supply voltage is lower than the minimum operating voltage, the operation of the output transistor becomes indefinite. The output voltage is equal to the pull-up voltage.

Step 4. The output voltage is equal to the GND level.

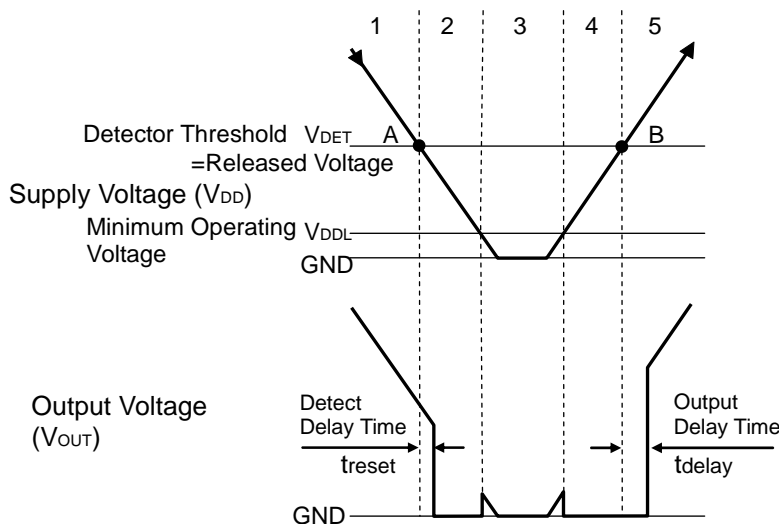
Step 5. At Point "B", $V_{ref} \leq V_{DD} \times R_b / (R_a + R_b)$ is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the pull-up voltage. The voltage level of Point B means a released voltage (V_{DET}).

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

• Operation of R3134xxxEC



Block Diagram



Operation Diagram

• Explanation of operation

Step 1. The output voltage is equal to the supply voltage (V_{DD}).

Step 2. At Point "A", $V_{ref} \geq V_{DD} \times R_b / (R_a + R_b)$ is true, as a result, the output of comparator is reversed from "L" to "H", therefore the output voltage becomes the GND level. The voltage level of Point A means a detector threshold voltage (V_{DET}).

Step 3. When the supply voltage is lower than the minimum operating voltage, the operation of the output transistor becomes indefinite.

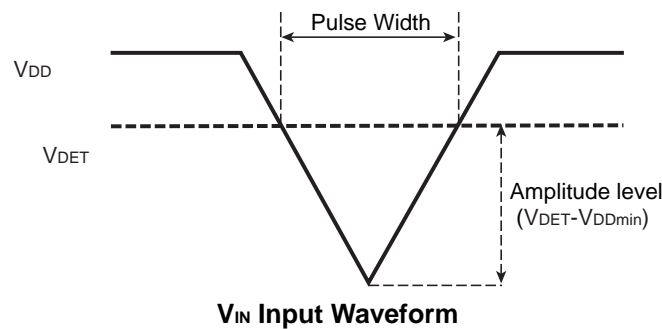
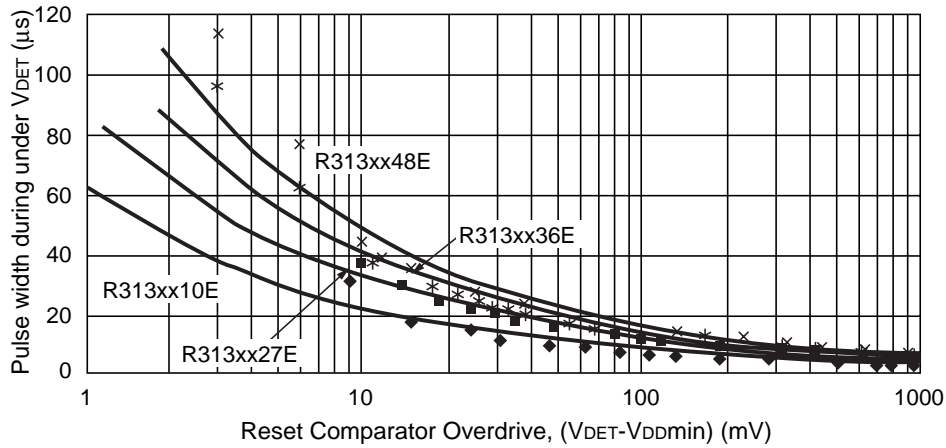
Step 4. The output voltage is equal to the GND level.

Step 5. At Point "B", $V_{ref} \leq V_{DD} \times R_b / (R_a + R_b)$ is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the supply voltage (V_{DD}). The voltage level of Point B means a released voltage (V_{DET}).

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

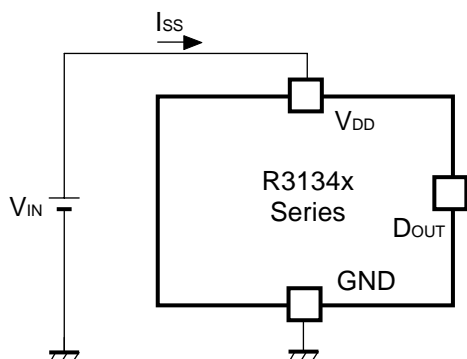
Detector Operation vs. glitch input voltage to the V_{DD} pin

When the IC is released and a large pulse (glitch) crosses the detector threshold is forced, the IC may not maintain the released condition. The amplitude of the pulse ($V_{DET}-V_{DDmin}$) and the pulse width the IC can maintain the released level is described in the graph as follows:

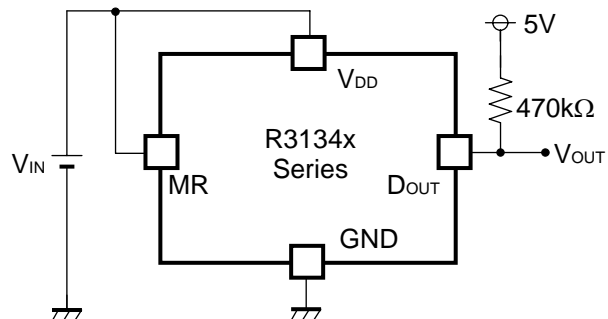


The graph above shows the condition for the maximum transient duration without generating a reset. If the larger amplitude or larger pulse width noise than the graph may be on the V_{DD} , the reset signal may be generated.

TEST CIRCUITS

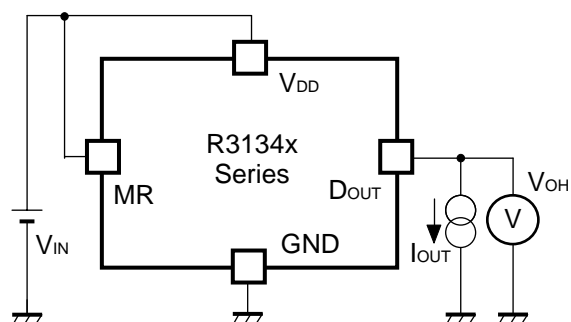


Supply Current Test Circuit



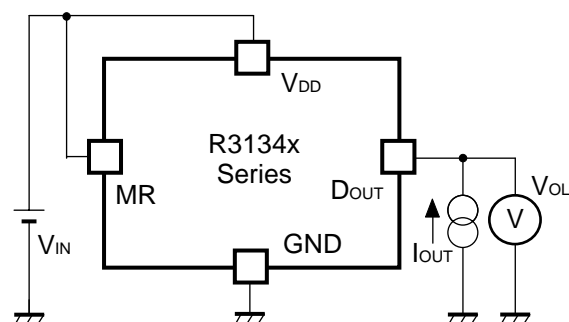
Detector Threshold Test Circuit

(Pull-up circuit is not necessary for CMOS Output type.)

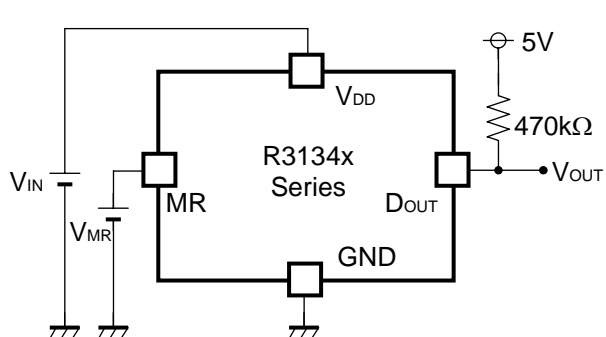


"H" Output Voltage Test Circuit

(CMOS Output Type only)

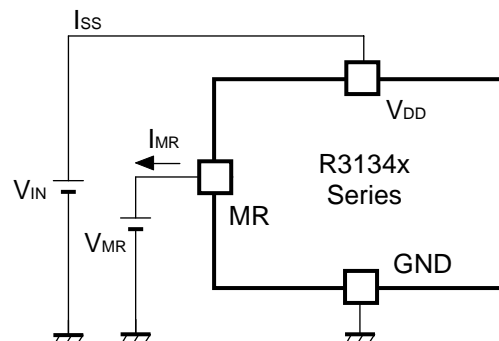


"L" Output Voltage Test Circuit

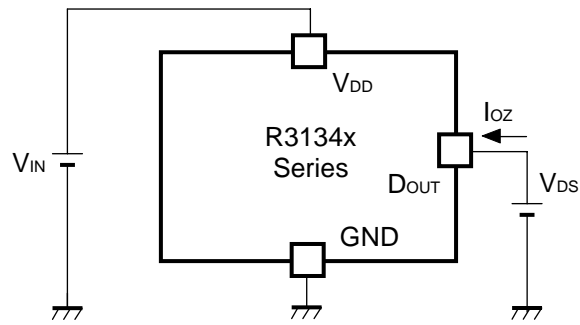


MR pin Input Voltage Test Circuit

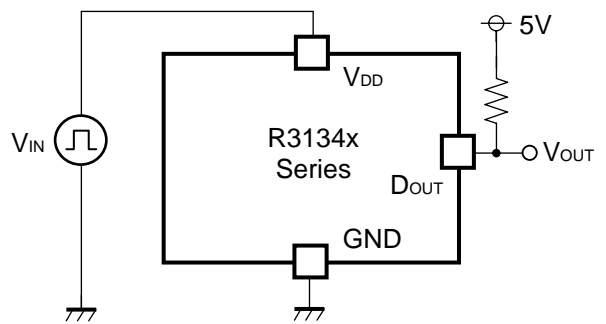
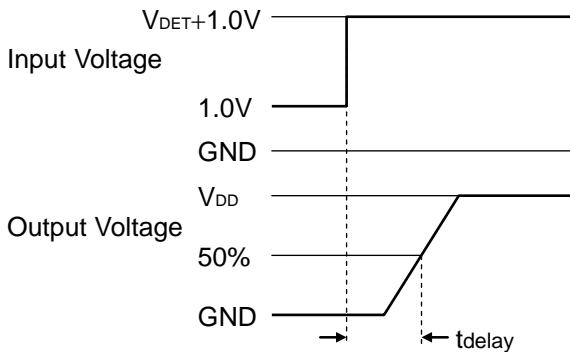
(Pull-up circuit is not necessary for CMOS Output type.)



MR pin Pull-up Resistance Test Circuit



Off Leakage Current Test Circuit

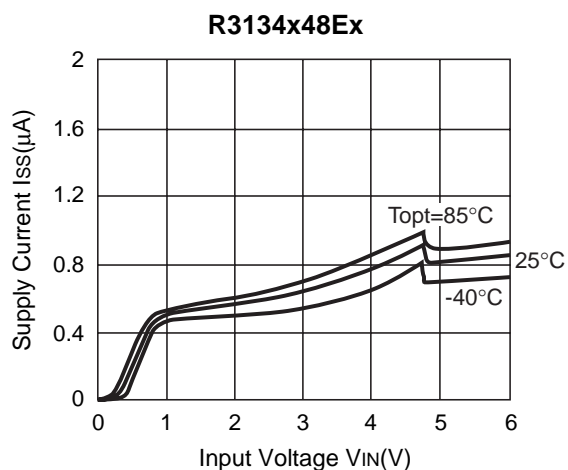
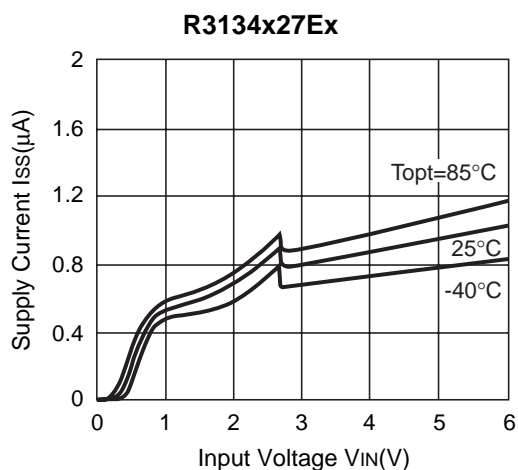
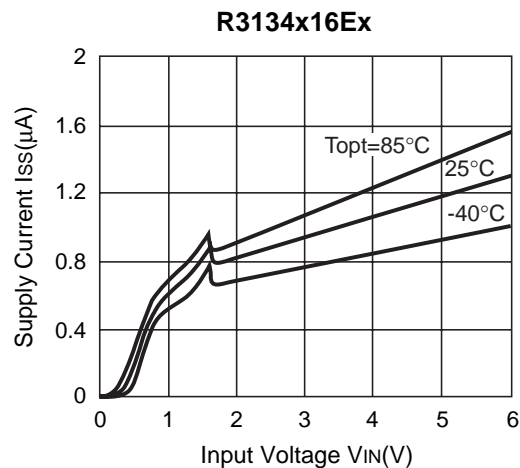
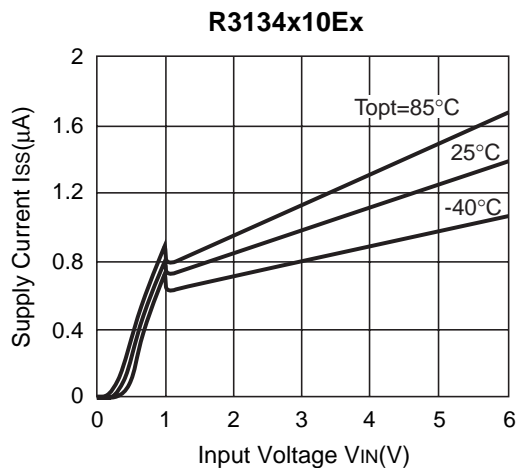


Output Delay Time Test Circuit

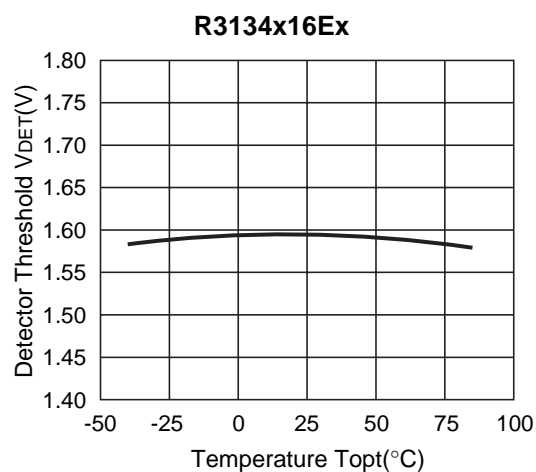
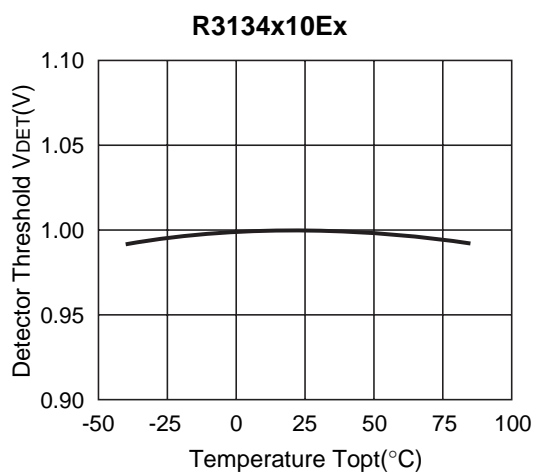
(Pull-up circuit is not necessary for CMOS Output type.)

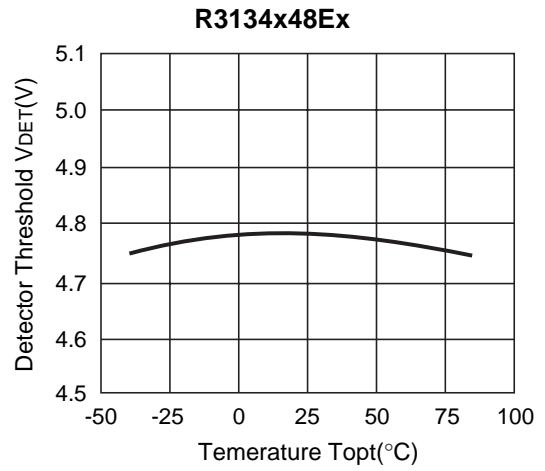
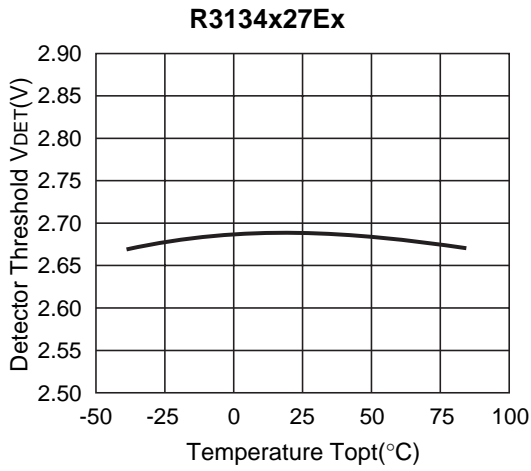
TYPICAL CHARACTERISTICS

1) Supply Current vs. Input Voltage

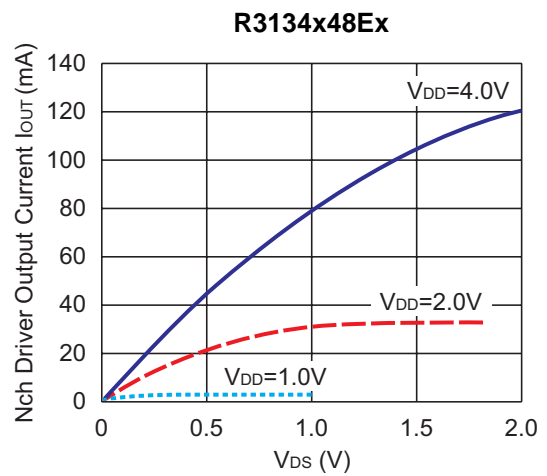
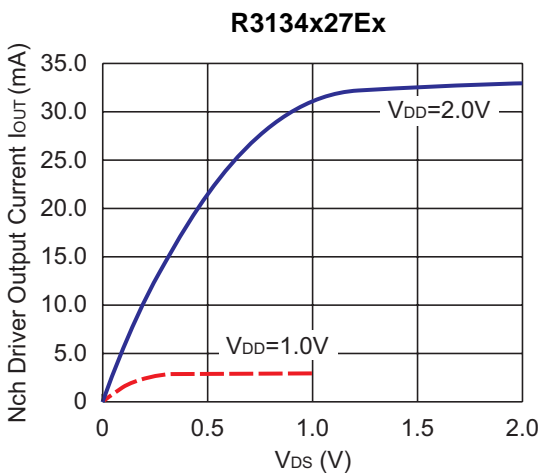
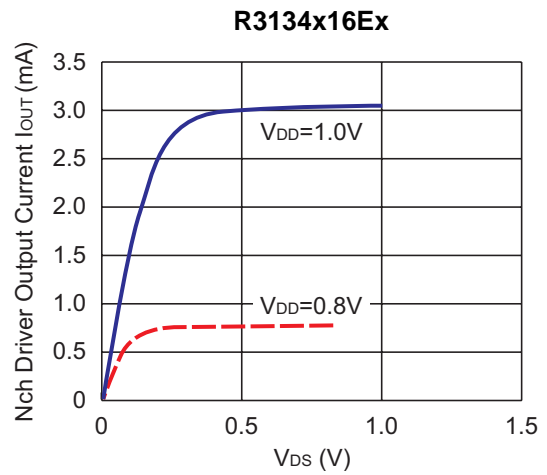
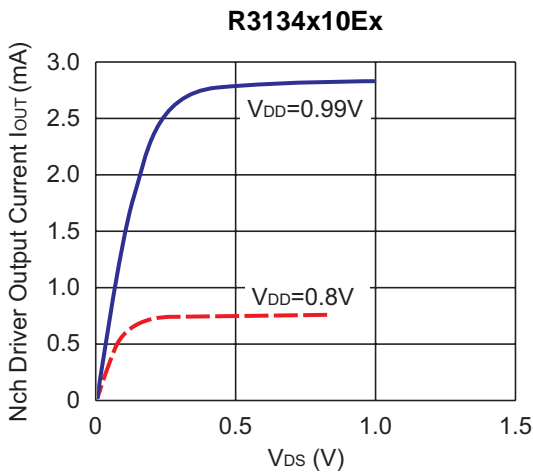


2) Detector Threshold vs. Temperature

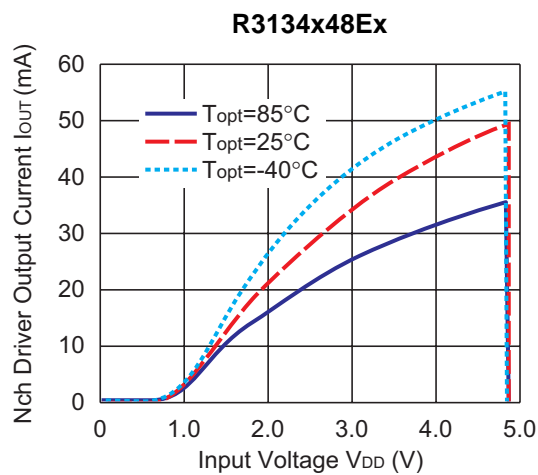
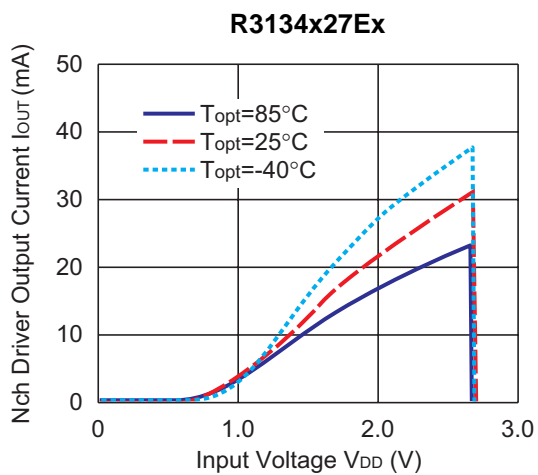
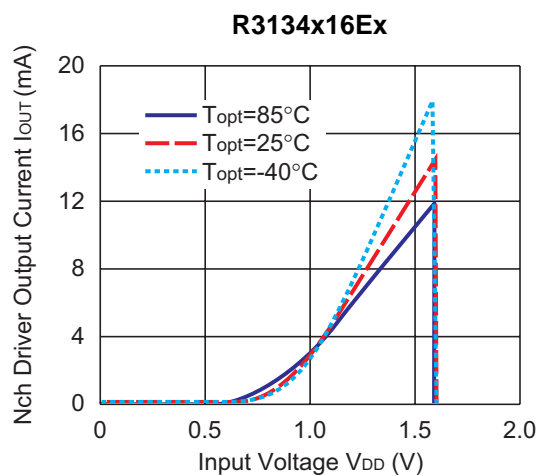
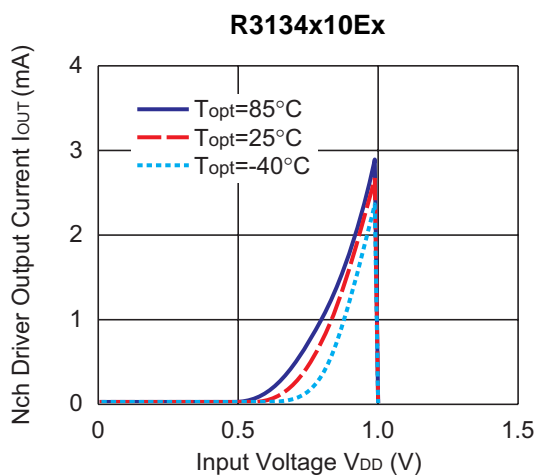




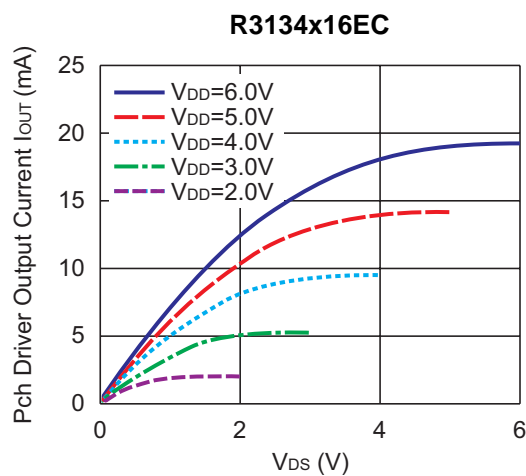
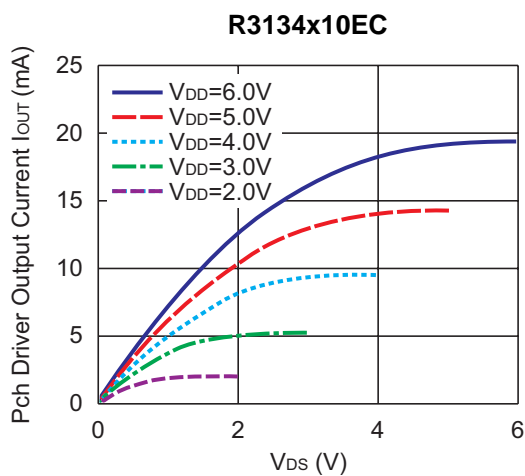
3) Nch Driver Output Current vs. V_{DS} (T_{opt}=25°C)

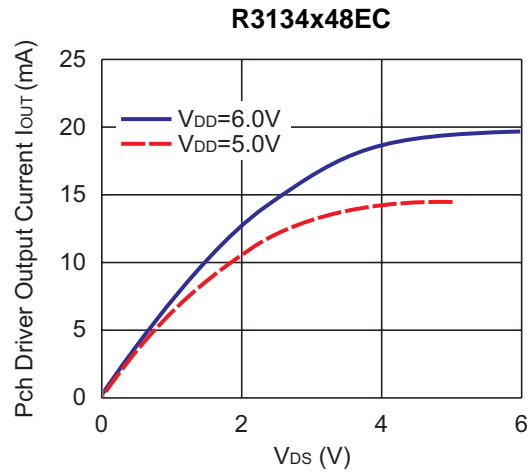
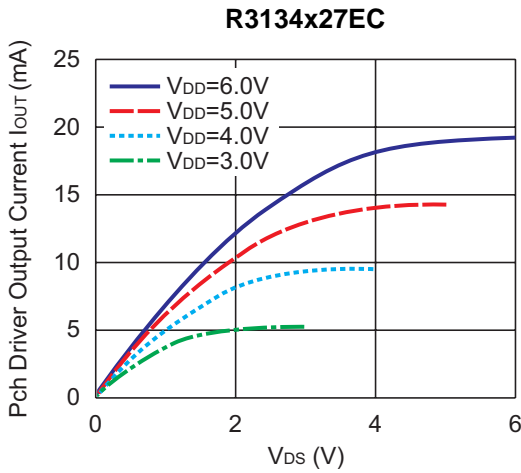


4) Nch Driver Output Current vs. Input Voltage

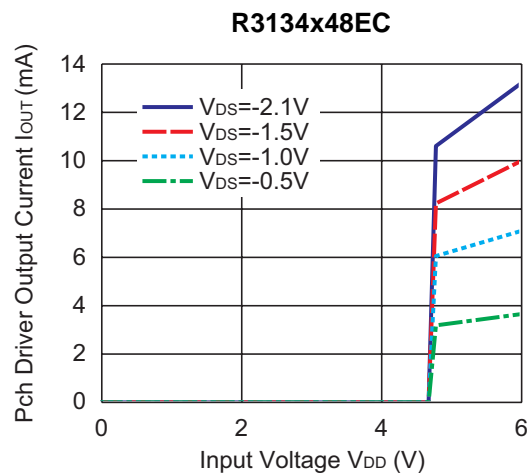
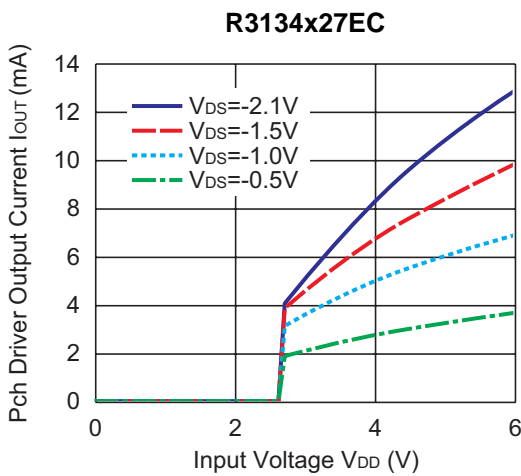
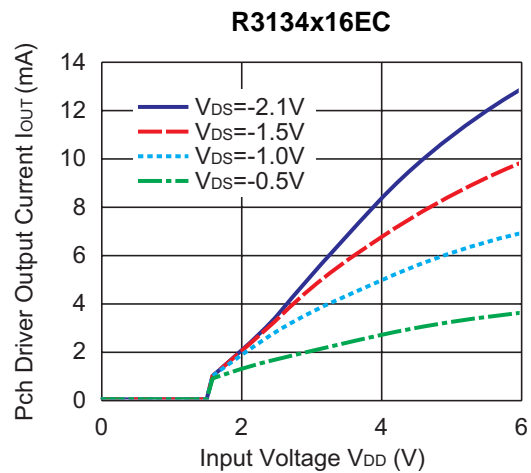
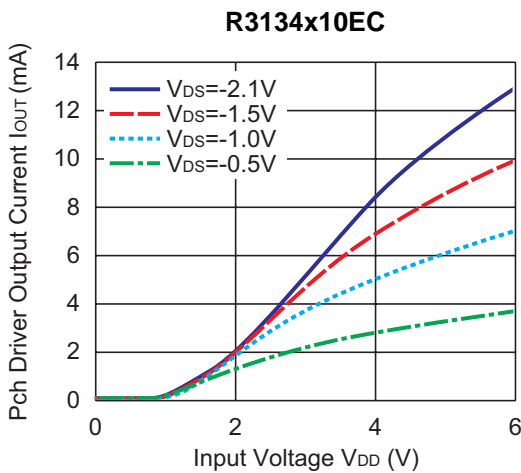


5) Pch Driver Output Current vs. V_{DS}

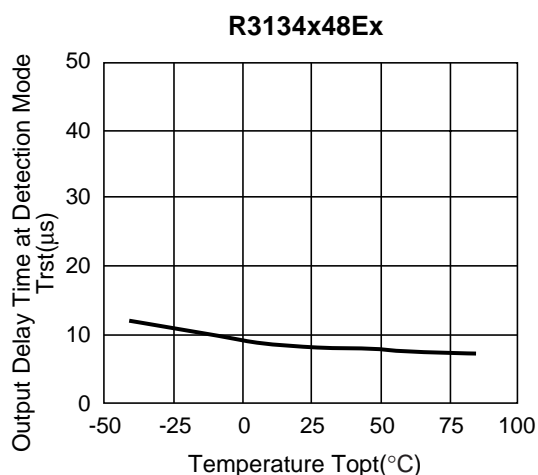
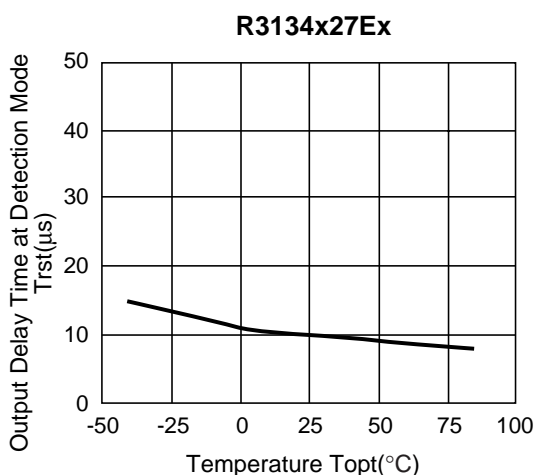
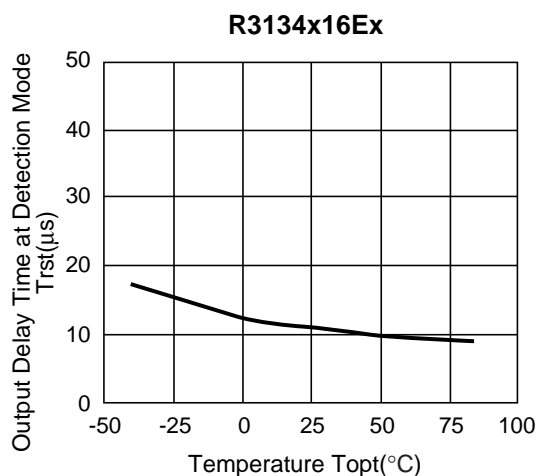
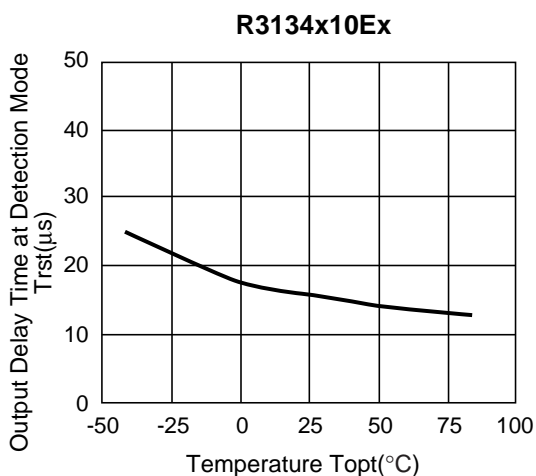




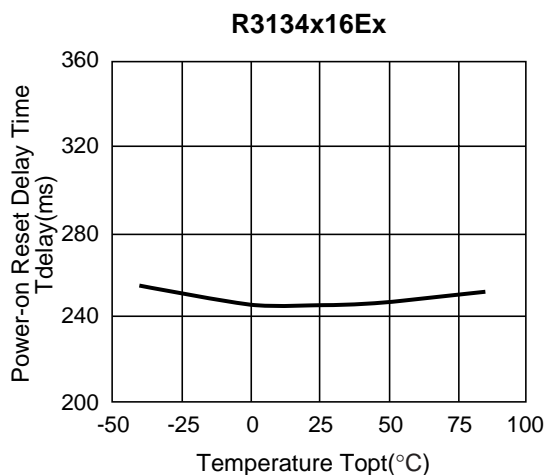
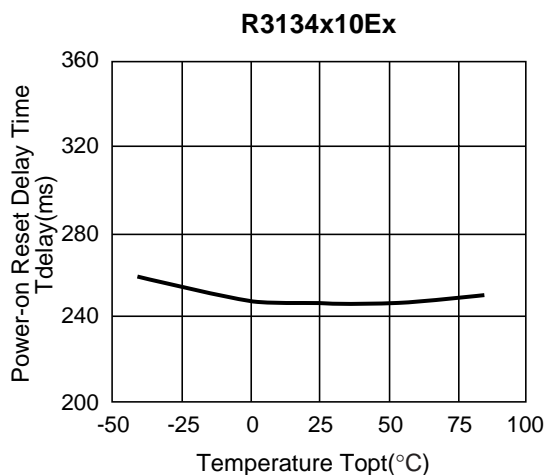
6) Pch Driver Output Current vs. Input Voltage

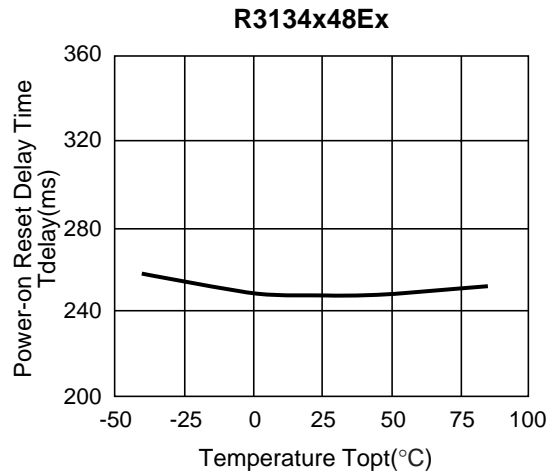
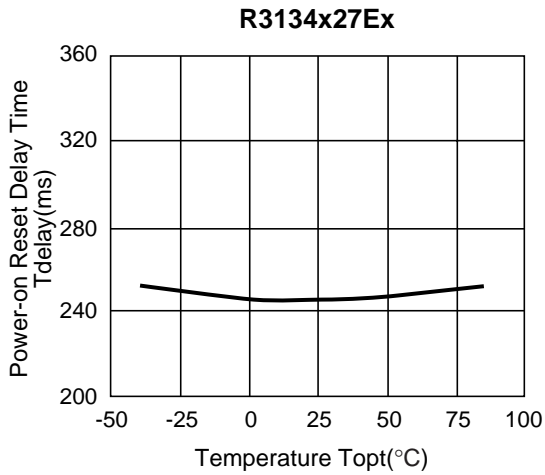


7) Output Delay Time at Detection Mode vs. Temperature



8) Power-on Reset Delay Time vs. Temperature





TECHNICAL NOTES

The connection such as Figure A and Figure B may cause the loop oscillation because of the cross conduction current. Not only that, these types connection may make shift the detector threshold level because of the voltage dropout with consumption current of the IC itself.

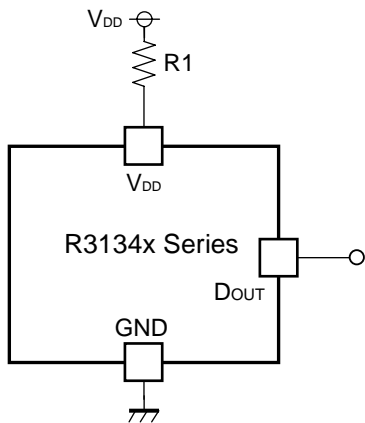


Figure A

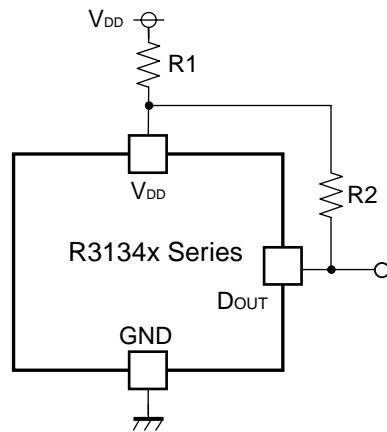


Figure B



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