LOW VOLTAGE DETECTOR WITH BUILT-IN DELAY CIRCUIT

NO.EA-093-160314

OUTLINE

R3132x/R3133x Series are CMOS-based low 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.

R3132x Series output “L” at its detect, while R3133x Series output “H”.

Since each of R3132x/R3133x 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 are the case when a supply voltage crosses a setting detector threshold voltage from a low value to a higher value, or when this IC is released from manual reset.

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

Since the package for these ICs are ultra small SC-82AB package and SON1612-6, high density mounting of the ICs on board is possible.

FEATURES

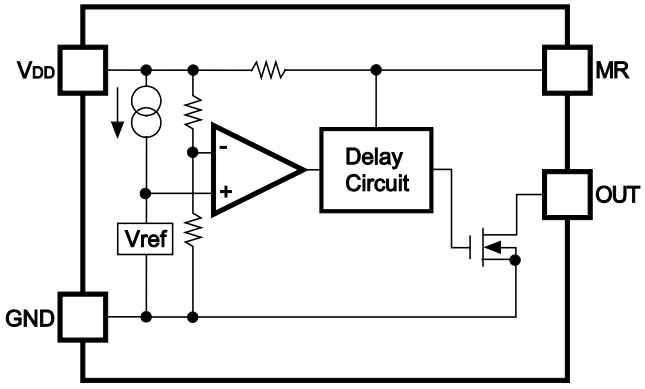
- Supply current ..... Typ. 0.8μA (R313xx27x: V_{DD}=3.0V)
- Operating Voltage Range ..... 0.8V to 6.0V (Topt=25°C)
- Detector Threshold ..... Setting with a step of 0.1V in the range of 1.0V to 5.0V is possible. Further, 2.32V, 2.63V, 2.93V, 3.08V, 4.38V, and 4.63V can be provided as standard.
- Embedded Power on Reset Delay Time Circuit ..... Typ. 240ms
- Detector Threshold Accuracy ..... ±2.0%
- Released Delay Time Accuracy ..... ±15.0%
- Temperature-Drift Coefficient of Detector Threshold ..... Typ. ±100ppm/°C
- Output Types ..... Nch Open Drain and CMOS
- Packages SC-82AB, SON1612-6

APPLICATIONS

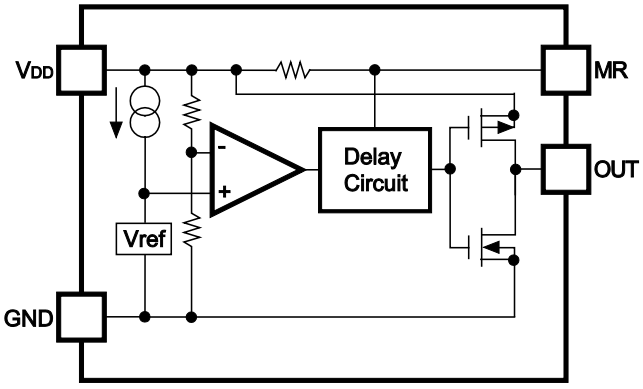
- CPU and Logic Circuit Reset
- Battery Checker
- Window Comparator
- Wave Shaping Circuit
- Battery Back-up Circuit
- Power Failure Detector

BLOCK DIAGRAMS

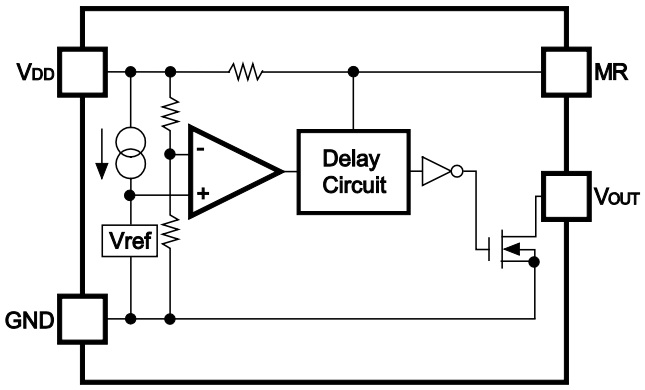
R3132xxxEA Nch Open Drain Output



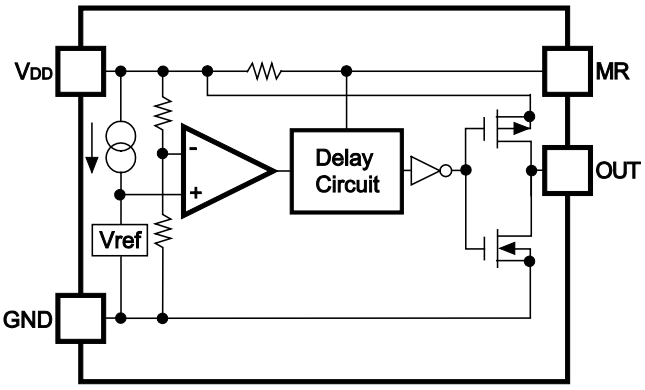
R3132xxxEC CMOS Output



R3133xxxEA Nch Open Drain Output



R3133xxxEC CMOS Output



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.

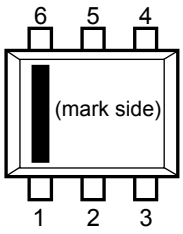
Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R3132DxxE∗(y)-TR-FE R3133DxxE∗(y)-TR-FE	SON1612-6	4,000 pcs	Yes	Yes
R3132QxxE∗(y)-TR-FE R3133QxxE∗(y)-TR-FE	SC-82AB	3,000 pcs	Yes	Yes

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.
(2.32V, 2.63V, 2.93V, 3.08V, 4.38V, 4.63V)
Ex. If the detector threshold is 2.63V, R3132x26E∗3-TR-FE.

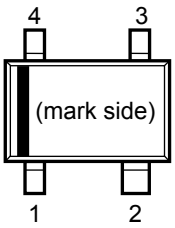
∗ : Designation of Output Type
(A) Nch Open Drain
(C) CMOS

PIN CONFIGURATIONS

● **SON1612-6**



● **SC-82AB**



PIN DESCRIPTIONS

● **SON1612-6**

Pin No	Symbol	Pin Description
1	V_{DD}	Input Pin
2	GND	Ground Pin
3	MR	Manual Reset Input Pin Active at “L” input. Pulled up via 1MΩ. If MR pin is not necessary, open this node, or connect to V_{DD}.
4	OUT	Output Pin R3132D Series:"L" at detection R3133D Series:"H" at detection
5	GND	Ground Pin
6	NC	No Connection

● **SC-82AB**

Pin No	Symbol	Pin Description
1	GND	Ground Pin
2	OUT	Output Pin R3132Q Series :"L" at detection R3133Q Series :"H" at detection
3	MR	Manual Reset Input Pin Active at "L" input. Pulled up via 1MΩ. If MR pin is not necessary, open this node, or connect to V_{DD}.
4	V_{DD}	Input Pin

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 (SON1612-6)*1, *2	500	mW
	Power Dissipation (SC-82AB)*2	380	
Topt	Operating Temperature Range	–40 to 85	°C
Tstg	Storage Temperature Range	–55 to 125	°C
Tsolder	Soldering Temperature	260°C, 10s	

∗1) This specification is at mounted on board.
P_D depends on conditions of mounting on board. This specification is based on the measurement at the condition below:
∗Measurement Conditions
Environment: Mounted on board (Wind velocity 0m/s)
Board Material: FR-4 (2-layer)
Board dimensions : 40mm x 40mm x t1.6mm
Copper Area : 50%

∗2) 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

Topt=25°C

Symbol	Item	Test Conditions		Min.	Typ.	Max.	Unit
V_{DD}	Operating Voltage	R3132	Topt=25°C	0.75		6.0	V
			−40°C≤Topt≤85°C	0.85		6.0	
		R3133	Topt=25°C	0.80		6.0	
			−40°C≤Topt≤85°C	0.90		6.0	
V_{DET}	Detector Threshold			$V_{DET}\times$ 0.98		$V_{DET}\times$ 1.02	V
I_{SS1}	Supply Current1	$V_{DD}=V_{DET}-0.1V$, $I_{OUT}=0A$				2.0	μA
I_{SS2}	Supply Current2	$V_{DD}=V_{DET}+0.1V$, $I_{OUT}=0A$				2.0	μA
I_{SS3}	Supply Current3	V_{DD}=6.0V, I_{OUT}=0A	V_{DET}<1.6V			3.6	μA
			1.6V≤V_{DET}<2.7V			3.0	
			2.7V≤V_{DET}			2.5	
V_{OH}	“H” Output Voltage	Refer to the following table.					
V_{OL}	“L” Output Voltage	Refer to the following table.					
R_{MR}	MR pin pull-up resistance	Topt=25°C		0.5	1.0	4.0	MΩ
T_{rst}*	Output Delay Time for detect	$V_{DD}=V_{DET}$ to $V_{DET}-0.1V$			15		μs
Tdelay	Output Delay Time for release	V_{DD}=0.8V to $V_{DET}+1.0V$		204	240	276	ms
$\Delta V_{DET}/\Delta Topt$	Detector Threshold Temperature Coefficient	−40°C≤Topt≤85°C			±100		ppm/°C

∗) 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**

Topt=25°C

Products	Test Conditions		Min.	Typ.	Max.	Unit
R3132xxxEC	V_{DET}<1.2V	V_{DD}=V_{DET}+0.1V, I_{OH}=−50μA	0.8×V_{DD}			V
	1.2V≤V_{DET}<2.0V	V_{DD}=V_{DET}+0.1V, I_{OH}=−150μA				
	2.0V≤V_{DET}<3.1V	V_{DD}=V_{DET}+0.1V, I_{OH}=−500μA				
	3.1V≤V_{DET}	V_{DD}=V_{DET}+0.1V, I_{OH}=−800μA				
R3133xxxEC	V_{DET}<1.2V	V_{DD}=V_{DET}−0.1V, I_{OH}=−10μA	0.8×V_{DD}			V
	1.2V≤V_{DET}<2.0V	V_{DD}=V_{DET}−0.1V, I_{OH}=−100μA				
	2.0V≤V_{DET}<3.1V	V_{DD}=V_{DET}−0.1V, I_{OH}=−500μA				
	3.1V≤V_{DET}	V_{DD}=V_{DET}−0.1V, I_{OH}=−800μA				

V_{DET} is a set value.

- **"L" Output Voltage (V_{OL}) table**

Topt=25°C

Symbol	Item	Test Conditions	Min.	Typ.	Max.	Unit
R3132xxxEx	V_{DET}<1.2V	V_{DD}=V_{DET}−0.1V, I_{OL}=20μA			0.3	V
	1.2V≤V_{DET}<1.6V	V_{DD}=V_{DET}−0.1V, I_{OL}=750μA				
	1.6V≤V_{DET}<3.1V	V_{DD}=V_{DET}−0.1V, I_{OL}=1.2mA				
	3.1V≤V_{DET}	V_{DD}=V_{DET}−0.1V, I_{OL}=3.2mA			0.4	V
R3133xxxEx	V_{DET}<1.2V	V_{DD}=V_{DET}+0.1V, I_{OL}=20μA			0.3	V
	1.2V≤V_{DET}<1.6V	V_{DD}=V_{DET}+0.1V, I_{OL}=750μA				
	1.6V≤V_{DET}<3.1V	V_{DD}=V_{DET}+0.1V, I_{OL}=1.2mA				
	3.1V≤V_{DET}	V_{DD}=V_{DET}+0.1V, I_{OL}=3.2mA			0.4	V

V_{DET} is a set value.

DETECTOR THRESHOLD SPECIFICATIONS BY PART NUMBER

- **R3132x**

Part Number	Operating Voltage				Detector Threshold			Supply Current 1		
	V_{DD}[V]				V_{DET}[V]			I_{SS1}[µA]		
	Conditions	Min.	Conditions	Min.	Min.	Typ.	Max.	Conditions	Typ.	Max.
R3132x23Ex2	Topt=25°C	0.75	−40°C≤Topt≤85°C	0.85	2.274	2.320	2.366	V_{DD}=V_{DET}−0.1V I_{OUT}=0A	0.8	2.0
R3132x26Ex3					2.578	2.630	2.682			
R3132x29Ex3					2.872	2.930	2.988		0.9	
R3132x30Ex8					3.019	3.080	3.141			
R3132x43Ex8					4.293	4.380	4.467			
R3132x46Ex3					4.538	4.630	4.722			
R3132x10Ex	Topt=25°C	0.75	−40°C≤Topt≤85°C	0.85	0.980	1.000	1.020	V_{DD}=V_{DET}−0.1V I_{OUT}=0A	0.8	2.0
R3132x11Ex					1.078	1.100	1.122			
R3132x12Ex					1.176	1.200	1.224			
R3132x13Ex					1.274	1.300	1.326			
R3132x14Ex					1.372	1.400	1.428			
R3132x15Ex					1.470	1.500	1.530			
R3132x16Ex					1.568	1.600	1.632			
R3132x17Ex					1.666	1.700	1.734			
R3132x18Ex					1.764	1.800	1.836			
R3132x19Ex					1.862	1.900	1.938			
R3132x20Ex					1.960	2.000	2.040			
R3132x21Ex					2.058	2.100	2.142			
R3132x22Ex					2.156	2.200	2.244			
R3132x23Ex					2.254	2.300	2.346			
R3132x24Ex					2.352	2.400	2.448			
R3132x25Ex					2.450	2.500	2.550			
R3132x26Ex					2.548	2.600	2.652			
R3132x27Ex					2.646	2.700	2.754		0.9	
R3132x28Ex					2.744	2.800	2.856			
R3132x29Ex					2.842	2.900	2.958			
R3132x30Ex					2.940	3.000	3.060			
R3132x31Ex					3.038	3.100	3.162			
R3132x32Ex					3.136	3.200	3.264			
R3132x33Ex					3.234	3.300	3.366			
R3132x34Ex					3.332	3.400	3.468			
R3132x35Ex					3.430	3.500	3.570			
R3132x36Ex					3.528	3.600	3.672			
R3132x37Ex					3.626	3.700	3.774			
R3132x38Ex					3.724	3.800	3.876			
R3132x39Ex					3.822	3.900	3.978			
R3132x40Ex					3.920	4.000	4.080			
R3132x41Ex					4.018	4.100	4.182			
R3132x42Ex					4.116	4.200	4.284			
R3132x43Ex					4.214	4.300	4.386			
R3132x44Ex					4.312	4.400	4.488			
R3132x45Ex					4.410	4.500	4.590			
R3132x46Ex					4.508	4.600	4.692			
R3132x47Ex					4.606	4.700	4.794			
R3132x48Ex					4.704	4.800	4.896			
R3132x49Ex					4.802	4.900	4.998			
R3132x50Ex					4.900	5.000	5.100			

Supply Current 2			Supply Current 3			"H" Output Voltage	
I_{SS2}[μA]			I_{SS3}[μA]			V_{OH}[V]	
Conditions	Typ.	Max.	Conditions	Typ.	Max.	Conditions	Min.
$V_{DD}=V_{DET}+0.1V$ $I_{OUT}=0A$	0.8	2.0	$V_{DD}=6.0V$ $I_{OUT}=0A$	1.2	3.0	$V_{DD}=V_{DET}+0.1V$ $I_{OH}=-500\mu A$	0.8× V_{DD}
				1.0	2.5	$V_{DD}=V_{DET}+0.1V$ $I_{OH}=-800\mu A$	
$V_{DD}=V_{DET}+0.1V$ $I_{OUT}=0A$	0.8	2.0	$V_{DD}=6.0V$ $I_{OUT}=0A$	1.4	3.6	$V_{DD}=V_{DET}+0.1V$ $I_{OH}=-50\mu A$	0.8× V_{DD}
						$V_{DD}=V_{DET}+0.1V$ $I_{OH}=-150\mu A$	
				1.2	3.0	$V_{DD}=V_{DET}+0.1V$ $I_{OH}=-500\mu A$	
				1.0	2.5	$V_{DD}=V_{DET}+0.1V$ $I_{OH}=-800\mu A$	
				0.8			

Part Number	"L" Output Voltage		MR pin "H" Input Voltage		MR pin "L" Input Voltage		MR pin pull-up resistance			
	V_{OL}[V]		V_{IH}[V]		V_{IL}[V]		R_{MR}[MΩ]			
	Conditions	Max.	Conditions	Min.	Conditions	Max.	Conditions	Min.	Typ.	Max.
R3132x23Ex2	V_{DD}=V_{DET}−0.1V I_{OL}=+1.2mA	0.3	V_{DD}≥V_{DET}+0.1	0.75×V_{DD}	V_{DD}≥V_{DET}+0.1	0.2×V_{DD}	Topt=25°C	0.5	1.0	4.0
R3132x26Ex3										
R3132x29Ex3										
R3132x30Ex8										
R3132x43Ex8	V_{DD}=V_{DET}−0.1V I_{OL}=+3.2mA	0.4								
R3132x46Ex3										
R3132x10Ex	V_{DD}=V_{DET}−0.1V I_{OL}=+20μA	0.3	V_{DD}≥V_{DET}+0.1	0.75×V_{DD}	V_{DD}≥V_{DET}+0.1	0.2×V_{DD}	Topt=25°C	0.5	1.0	4.0
R3132x11Ex										
R3132x12Ex	V_{DD}=V_{DET}−0.1V I_{OL}=+750μA									
R3132x13Ex										
R3132x14Ex										
R3132x15Ex										
R3132x16Ex	V_{DD}=V_{DET}−0.1V I_{OL}=+1.2mA									
R3132x17Ex										
R3132x18Ex										
R3132x19Ex										
R3132x20Ex										
R3132x21Ex										
R3132x22Ex										
R3132x23Ex										
R3132x24Ex										
R3132x25Ex										
R3132x26Ex										
R3132x27Ex										
R3132x28Ex										
R3132x29Ex										
R3132x30Ex										
R3132x31Ex	V_{DD}=V_{DET}−0.1V I_{OL}=+3.2mA	0.4								
R3132x32Ex										
R3132x33Ex										
R3132x34Ex										
R3132x35Ex										
R3132x36Ex										
R3132x37Ex										
R3132x38Ex										
R3132x39Ex										
R3132x40Ex										
R3132x41Ex										
R3132x42Ex										
R3132x43Ex										
R3132x44Ex										
R3132x45Ex										
R3132x46Ex										
R3132x47Ex										
R3132x48Ex										
R3132x49Ex										
R3132x50Ex										

Output Delay Time for Release				Detector Threshold Temperature Coefficient	
Tdelay[ms]				$\Delta V_{DET}/\Delta Topt$[ppm/°C]	
Conditions	Min.	Typ.	Max.	Conditions	Typ.
V_{DD}=0.8V→ V_{DET}+1.0V Topt=25°C	204	240	276	−40°C≤Topt≤85°C	±100
V_{DD}=0.8V→ V_{DET}+1.0V Topt=25°C	204	240	276	−40°C≤Topt≤85°C	±100

- **R3133x**

Part Number	Operating Voltage				Detector Threshold			Supply Current 1		
	V_{DD}[V]				V_{DET}[V]			I_{SS1}[μA]		
	Conditions	Min.	Conditions	Min.	Min.	Typ.	Max.	Conditions	Typ.	Max.
R3133x23Ex2	Topt=25°C	0.80	−40°C≤Topt≤85°C	0.90	2.274	2.320	2.366	V_{DD}=V_{DET}−0.1V I_{OUT}=0A	0.8	2.0
R3133x26Ex3					2.578	2.630	2.682			
R3133x29Ex3					2.872	2.930	2.988		0.9	
R3133x30Ex8					3.019	3.080	3.141			
R3133x43Ex8					4.293	4.380	4.467			
R3133x46Ex3					4.538	4.630	4.722			
R3133x10Ex	Topt=25°C	0.80	−40°C≤Topt≤85°C	0.90	0.980	1.000	1.020	V_{DD}=V_{DET}−0.1V I_{OUT}=0A	0.8	2.0
R3133x11Ex					1.078	1.100	1.122			
R3133x12Ex					1.176	1.200	1.224			
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R3133x14Ex					1.372	1.400	1.428			
R3133x15Ex					1.470	1.500	1.530			
R3133x16Ex					1.568	1.600	1.632			
R3133x17Ex					1.666	1.700	1.734			
R3133x18Ex					1.764	1.800	1.836			
R3133x19Ex					1.862	1.900	1.938			
R3133x20Ex					1.960	2.000	2.040			
R3133x21Ex					2.058	2.100	2.142			
R3133x22Ex					2.156	2.200	2.244			
R3133x23Ex					2.254	2.300	2.346			
R3133x24Ex					2.352	2.400	2.448			
R3133x25Ex					2.450	2.500	2.550			
R3133x26Ex					2.548	2.600	2.652			
R3133x27Ex					2.646	2.700	2.754		0.9	
R3133x28Ex					2.744	2.800	2.856			
R3133x29Ex					2.842	2.900	2.958			
R3133x30Ex					2.940	3.000	3.060			
R3133x31Ex					3.038	3.100	3.162			
R3133x32Ex					3.136	3.200	3.264			
R3133x33Ex					3.234	3.300	3.366			
R3133x34Ex					3.332	3.400	3.468			
R3133x35Ex					3.430	3.500	3.570			
R3133x36Ex					3.528	3.600	3.672			
R3133x37Ex					3.626	3.700	3.774			
R3133x38Ex					3.724	3.800	3.876			
R3133x39Ex					3.822	3.900	3.978			
R3133x40Ex					3.920	4.000	4.080			
R3133x41Ex					4.018	4.100	4.182			
R3133x42Ex					4.116	4.200	4.284			
R3133x43Ex					4.214	4.300	4.386			
R3133x44Ex					4.312	4.400	4.488			
R3133x45Ex					4.410	4.500	4.590			
R3133x46Ex					4.508	4.600	4.692			
R3133x47Ex					4.606	4.700	4.794			
R3133x48Ex					4.704	4.800	4.896			
R3133x49Ex					4.802	4.900	4.998			
R3133x50Ex					4.900	5.000	5.100			

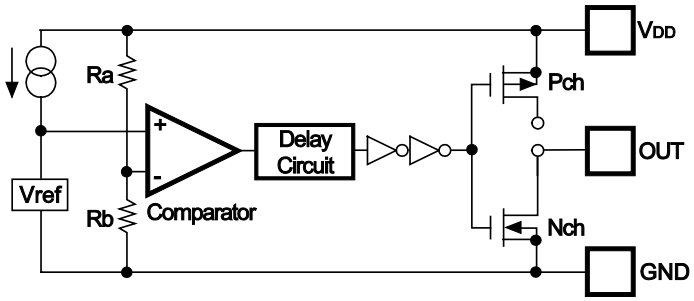
Supply Current 2			Supply Current 3			"H" Output Voltage	
I_{SS2}[μA]			I_{SS3}[μA]			V_{OH}[V]	
Conditions	Typ.	Max.	Conditions	Typ.	Max.	Conditions	Min.
$V_{DD}=V_{DET}+0.1V$ $I_{OUT}=0A$	0.8	2.0	$V_{DD}=6.0V$ $I_{OUT}=0A$	1.2	3.0	$V_{DD}=V_{DET}-0.1V$ $I_{OH}=-500\mu A$	0.8× V_{DD}
				1.0	2.5	$V_{DD}=V_{DET}-0.1V$ $I_{OH}=-800\mu A$	
$V_{DD}=V_{DET}+0.1V$ $I_{OUT}=0A$	0.8	2.0	$V_{DD}=6.0V$ $I_{OUT}=0A$	1.4	3.6	$V_{DD}=V_{DET}-0.1V$ $I_{OH}=-10\mu A$	0.8× V_{DD}
						$V_{DD}=V_{DET}-0.1V$ $I_{OH}=-100\mu A$	
				1.2	3.0	$V_{DD}=V_{DET}-0.1V$ $I_{OH}=-500\mu A$	
				1.0	2.5	$V_{DD}=V_{DET}-0.1V$ $I_{OH}=-800\mu A$	
				0.8			

Part Number	"L" Output Voltage		MR pin "H" Input Voltage		MR pin "L" Input Voltage		MR pin pull-up resistance			
	V_{OL}[V]		V_{IH}[V]		V_{IL}[V]		R_{MR}[MΩ]			
	Conditions	Max.	Conditions	Min.	Conditions	Max.	Conditions	Min.	Typ.	Max.
R3133x23Ex2	V_{DD}=V_{DET}+0.1V I_{OL}=+1.2mA	0.3	V_{DD}≥V_{DET}+0.1	0.75×V_{DD}	V_{DD}≥V_{DET}+0.1	0.2×V_{DD}	Topt=25°C	0.5	1.0	4.0
R3133x26Ex3										
R3133x29Ex3										
R3133x30Ex8										
R3133x43Ex8	V_{DD}=V_{DET}+0.1V I_{OL}=+3.2mA	0.4								
R3133x46Ex3										
R3133x10Ex	V_{DD}=V_{DET}+0.1V I_{OL}=+20μA	0.3	V_{DD}≥V_{DET}+0.1	0.75×V_{DD}	V_{DD}≥V_{DET}+0.1	0.2×V_{DD}	Topt=25°C	0.5	1.0	4.0
R3133x11Ex										
R3133x12Ex	V_{DD}=V_{DET}+0.1V I_{OL}=+750μA									
R3133x13Ex										
R3133x14Ex										
R3133x15Ex										
R3133x16Ex	V_{DD}=V_{DET}+0.1V I_{OL}=+1.2mA									
R3133x17Ex										
R3133x18Ex										
R3133x19Ex										
R3133x20Ex										
R3133x21Ex										
R3133x22Ex										
R3133x23Ex										
R3133x24Ex										
R3133x25Ex										
R3133x26Ex										
R3133x27Ex										
R3133x28Ex										
R3133x29Ex										
R3133x30Ex										
R3133x31Ex	V_{DD}=V_{DET}+0.1V I_{OL}=+3.2mA	0.4								
R3133x32Ex										
R3133x33Ex										
R3133x34Ex										
R3133x35Ex										
R3133x36Ex										
R3133x37Ex										
R3133x38Ex										
R3133x39Ex										
R3133x40Ex										
R3133x41Ex										
R3133x42Ex										
R3133x43Ex										
R3133x44Ex										
R3133x45Ex										
R3133x46Ex										
R3133x47Ex										
R3133x48Ex										
R3133x49Ex										
R3133x50Ex										

Output Delay Time for Release				Detector Threshold Temperature Coefficient	
Tdelay[ms]				ΔVDET/ΔTopt[ppm/°C]	
Conditions	Min.	Typ.	Max.	Conditions	Typ.
VDD=0.8V→ VDET+1.0V Topt=25°C	204	240	276	−40°C≤Topt≤85°C	±100
VDD=0.8V→ VDET+1.0V Topt=25°C	204	240	276	−40°C≤Topt≤85°C	±100

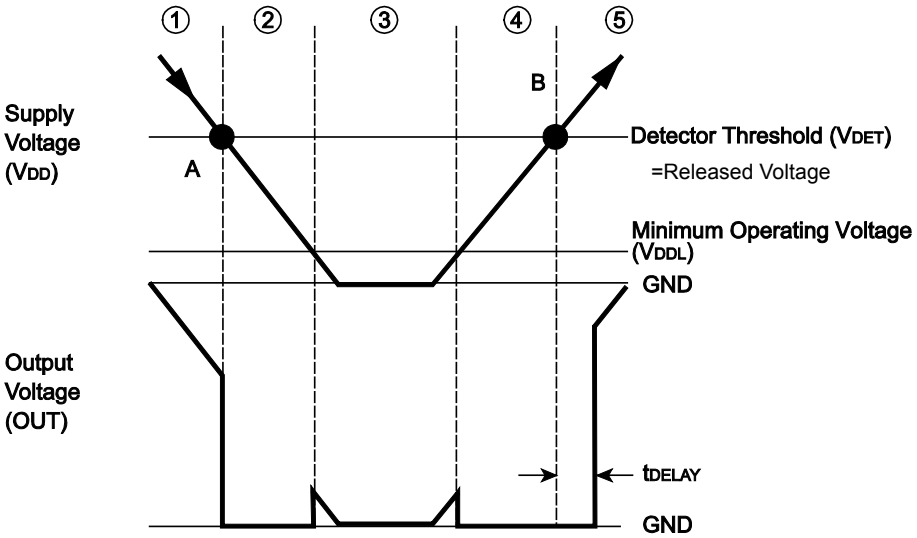
OPERATION

• Operation of R3132x 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).

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

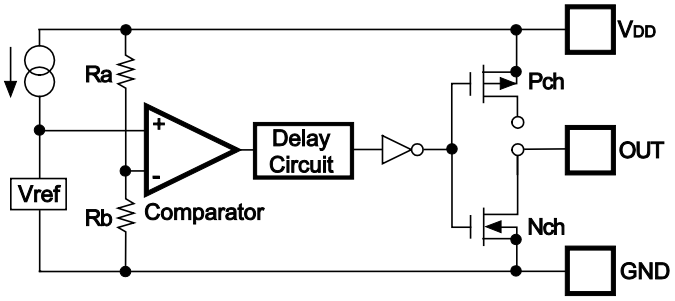
③ When the supply voltage is lower than minimum operating voltage, the output of transistor is indefinite, therefore the output is also indefinite.

④ Output voltage is equal to GND level.

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

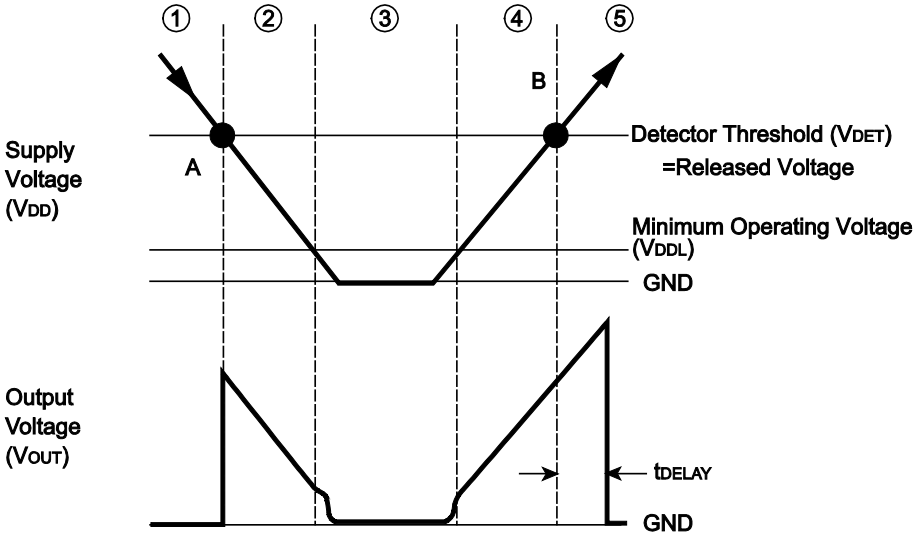
∗ There is no hysteresis range between the detector threshold and the released voltage.

• Operation of R3133x 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.)



Operation Diagram

In the above diagram,

① Output voltage becomes equal to GND level.

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

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

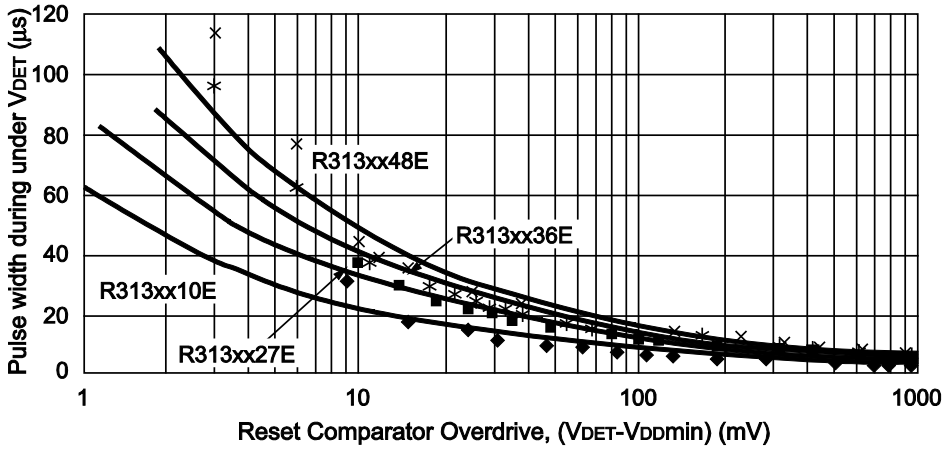
④ Output voltage is equal to the supply voltage. (Nch open drain output type; equal to pull-up Voltage.)

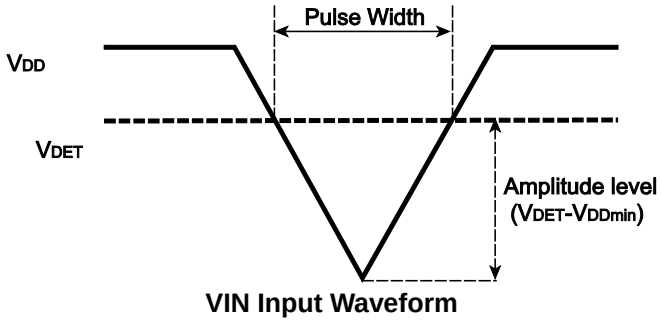
⑤ When the supply voltage is higher than the released voltage (Point B), Vref≤V_{DD} × Rb / (Ra+Rb) is true. Then the output of the comparator is reversed, thus the output voltage becomes equal to GND level after the output delay time.

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

TECHNICAL NOTES

When the IC is released, if a large pulse (glitch) which crosses the detector threshold voltage is in, the IC may not maintain the released condition. The amplitude of the pulse (V_{DET}–V_{DD}min) and the pulse width the IC can maintain the released level is described in the graph as follows:





VIN Input Waveform

Notes:

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.

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.

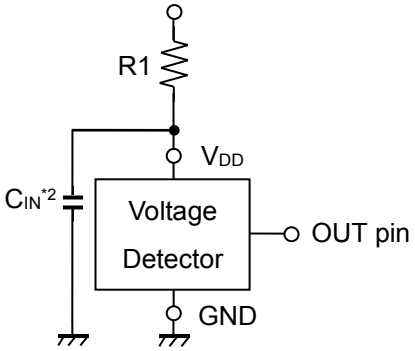


Figure A

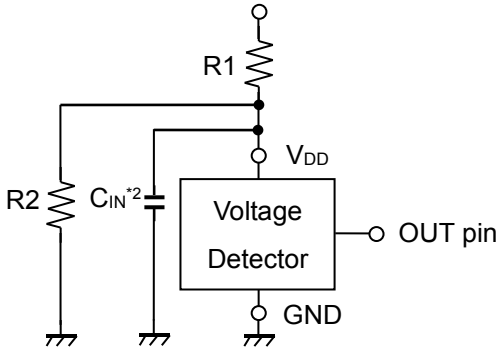
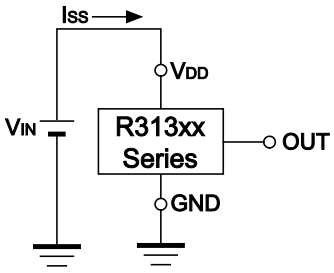


Figure B

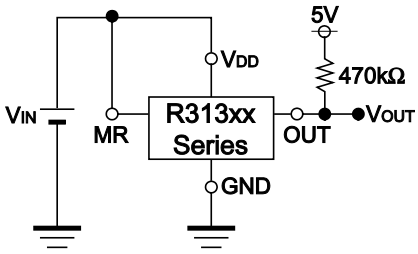
*1 In the CMOS output type, a charging current for OUT pin is included.

*2 Note the bias dependence of capacitors.

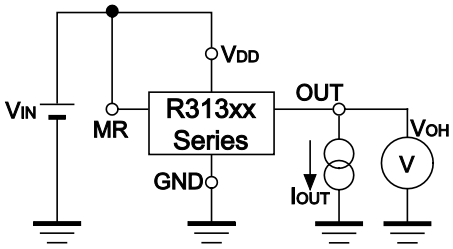
TEST CIRCUITS



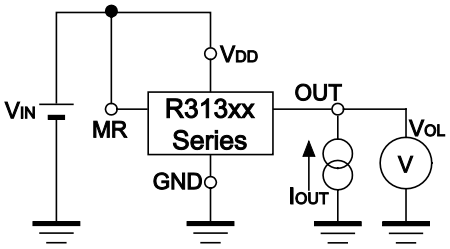
Supply Current Test Circuit



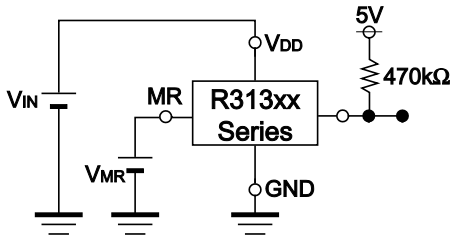
Detector Threshold Test Circuit
(CMOS Output type; pull-up part is not necessary.)



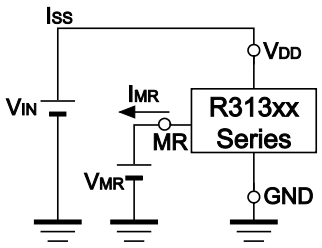
"H" Output Voltage Test Circuit
(CMOS Output Type only)



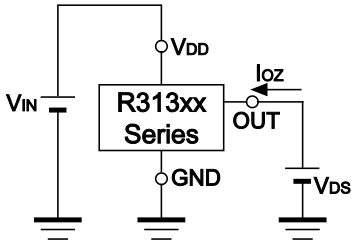
"L" Output Voltage Test Circuit



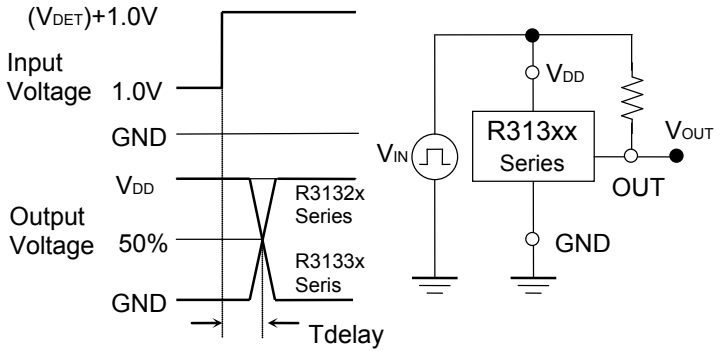
MR pin Input Voltage Test Circuit
(CMOS Output type; pull-up part is not necessary.)



MR pin Pull-up Resistance Test Circuit



Off Leakage Current Test Circuit

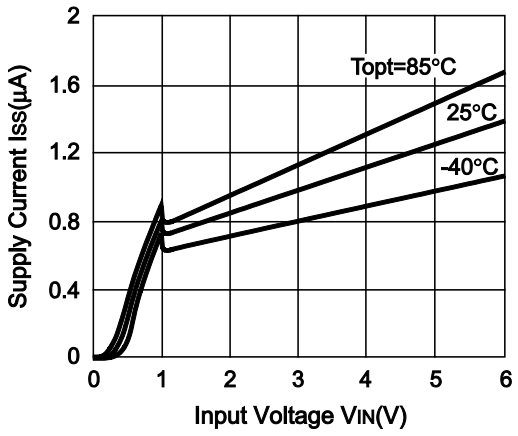


Output Delay Time Test Circuit
(CMOS Output type; pull-up is not necessary.)

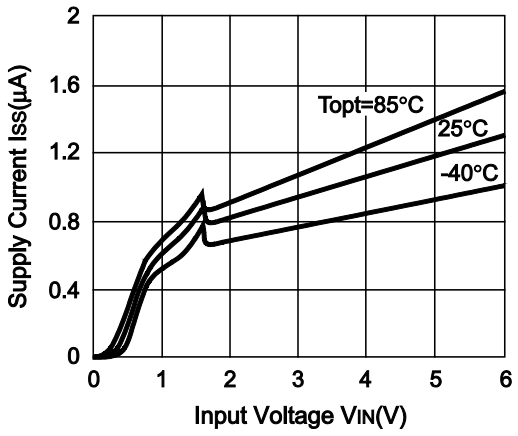
TYPICAL CHARACTERISTICS

1) Supply Current vs. Input Voltage

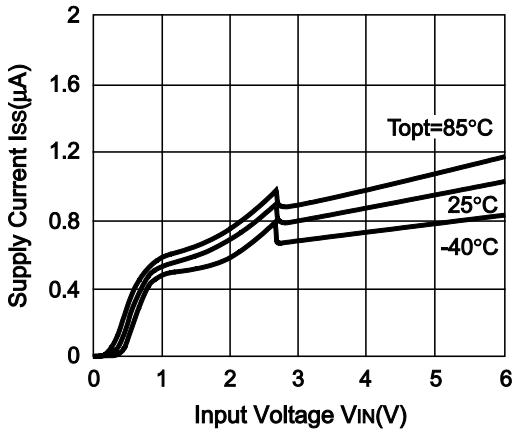
R3132x10Ex/R3133x10Ex



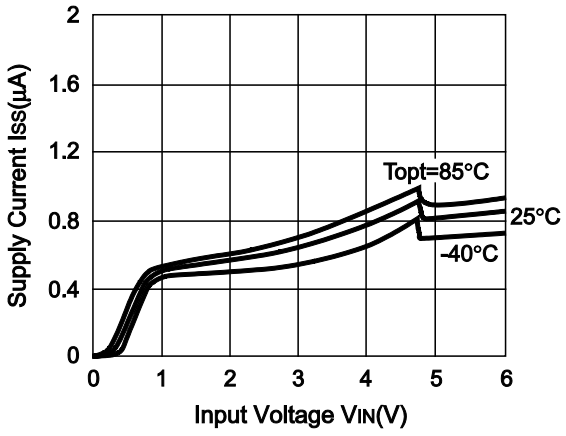
R3132x16Ex/R3133x16Ex



R3132x27Ex/R3133x27Ex

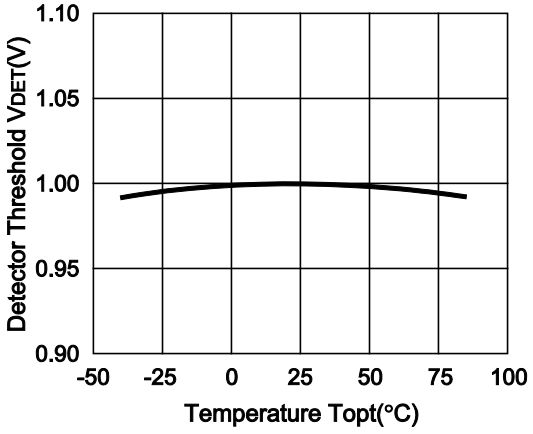


R3132x48Ex/R3133x48Ex

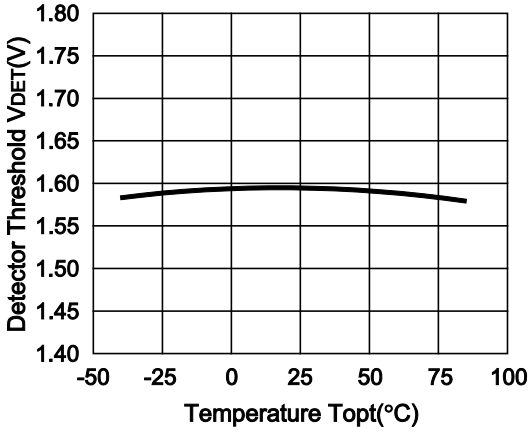


2) Detector Threshold vs. Temperature

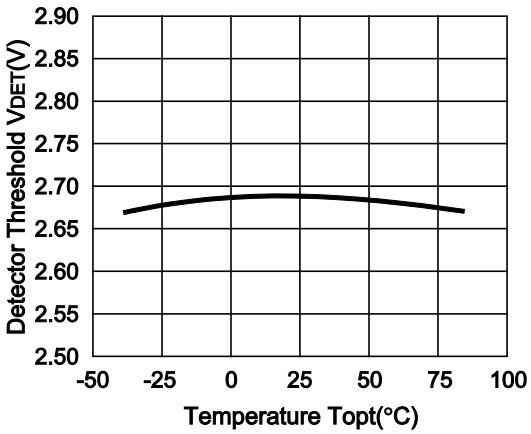
R3132x10Ex/R3133x10Ex



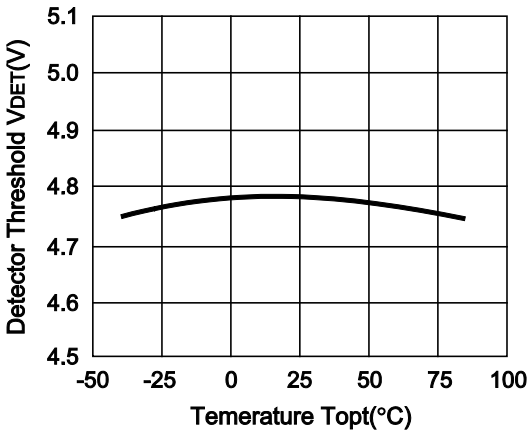
R3132x16Ex/R3133x16Ex



R3132x27Ex/R3133x27Ex

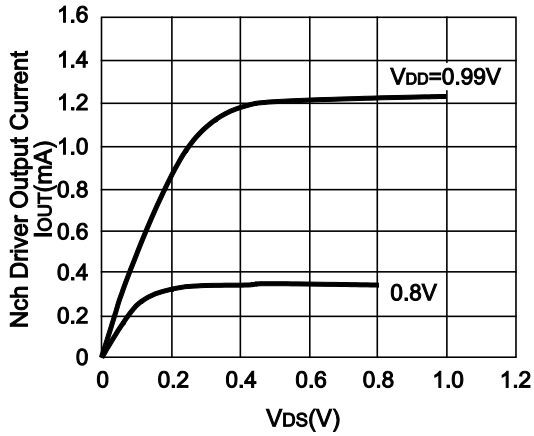


R3132x48Ex/R3133x48Ex

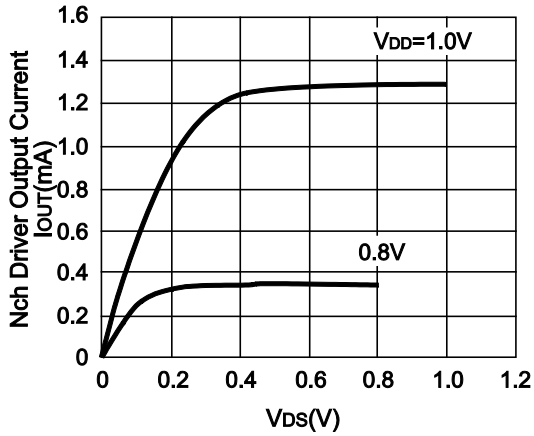


3) Nch Driver Output Current vs. V_{DS} (Topt=25°C)

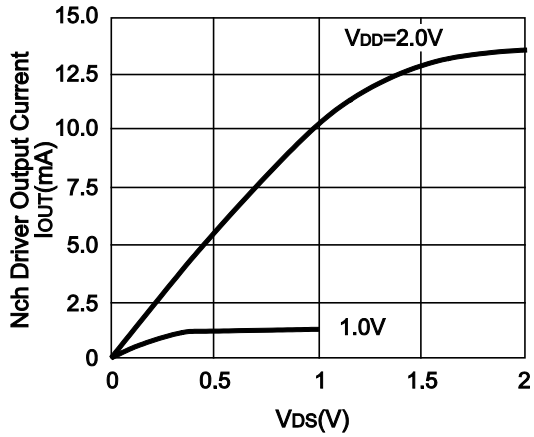
R3132x10Ex



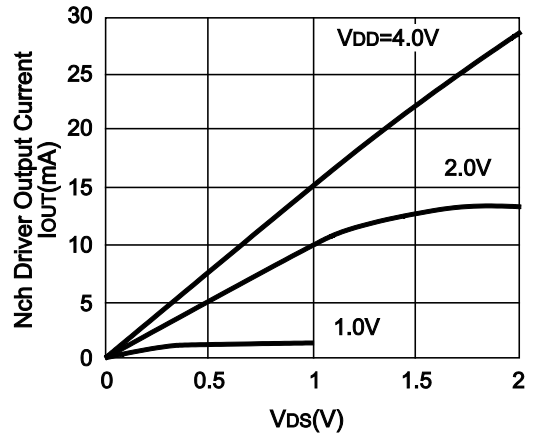
R3132x16Ex



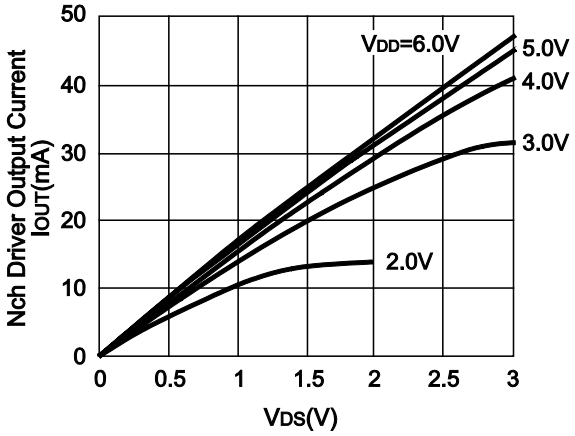
R3132x27Ex



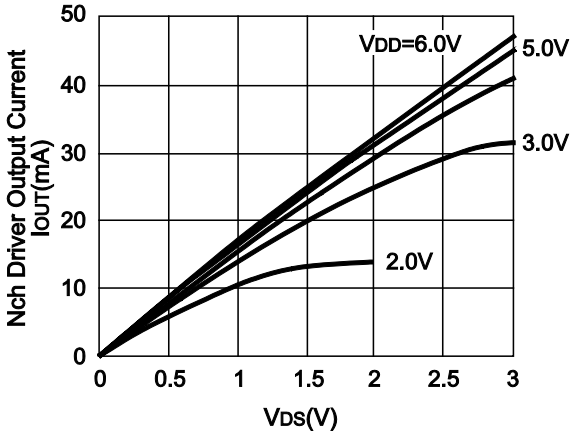
R3132x48Ex



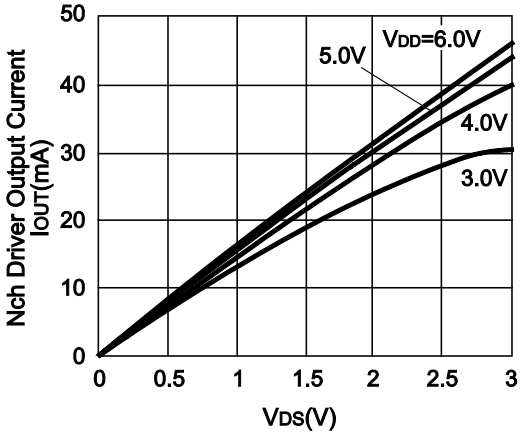
R3133x10Ex



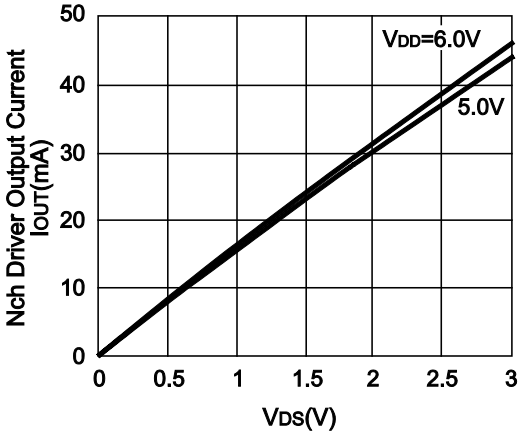
R3133x16Ex



R3133x27Ex

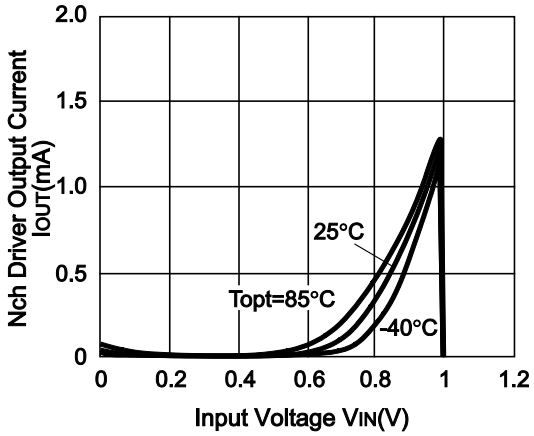


R3133x48Ex

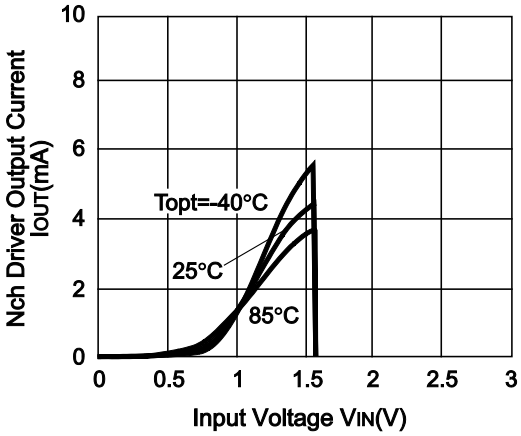


4) Nch Driver Output Current vs. Input Voltage (V_{DS}=0.5V)

R3132x10Ex

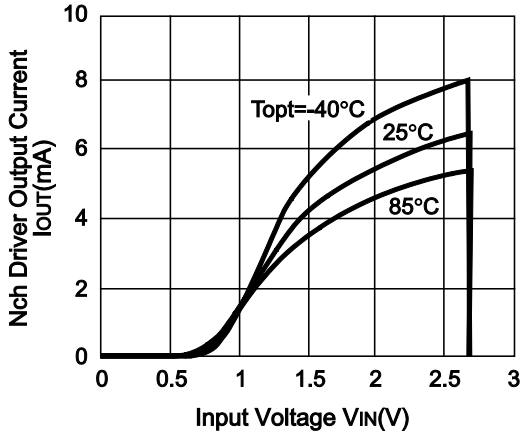


R3132x16Ex

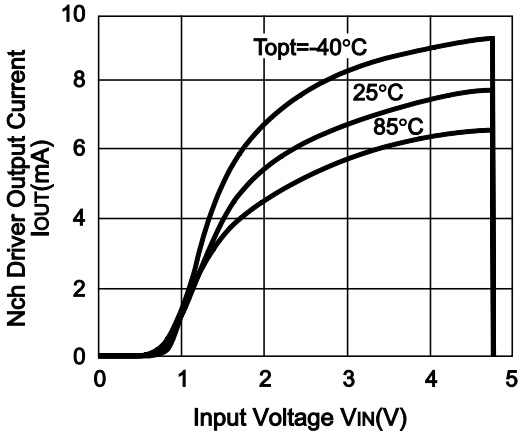


R3132x/R3133x

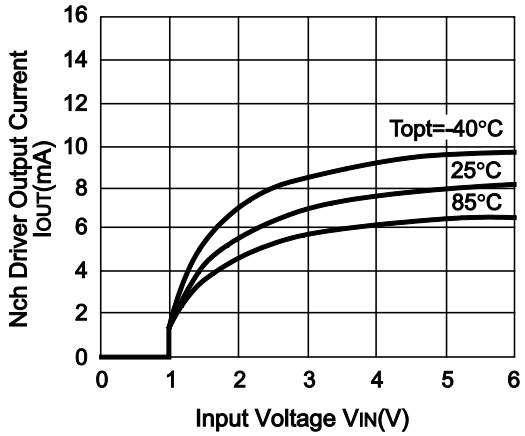
R3132x27Ex



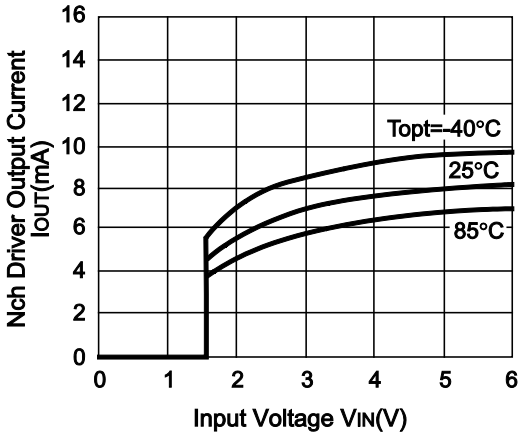
R3132x48Ex



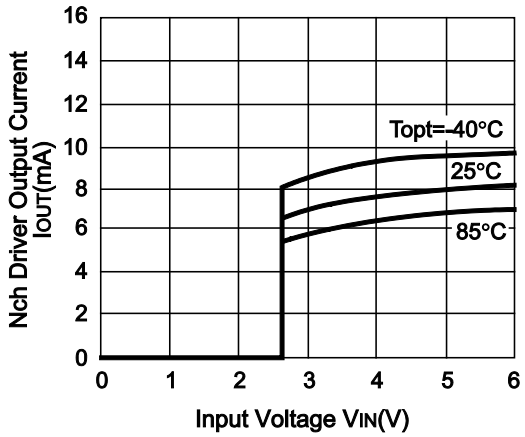
R3133x10Ex



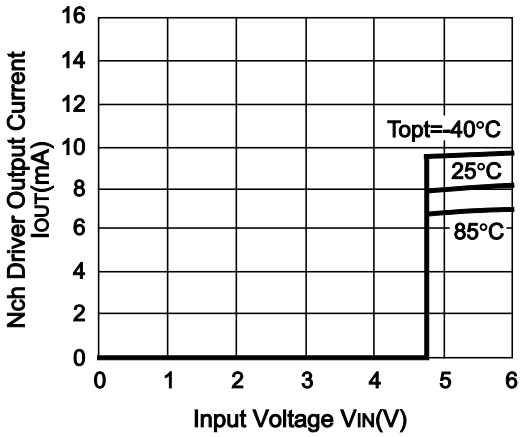
R3133x16Ex



R3133x27Ex

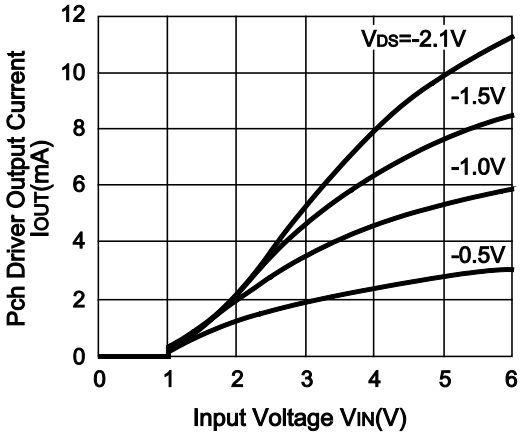


R3133x48Ex

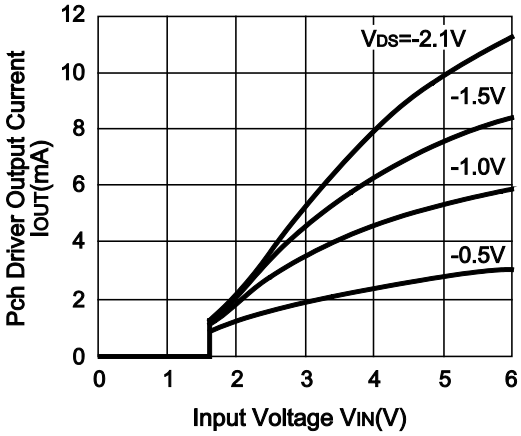


5) Pch Driver Output Current vs. Input Voltage

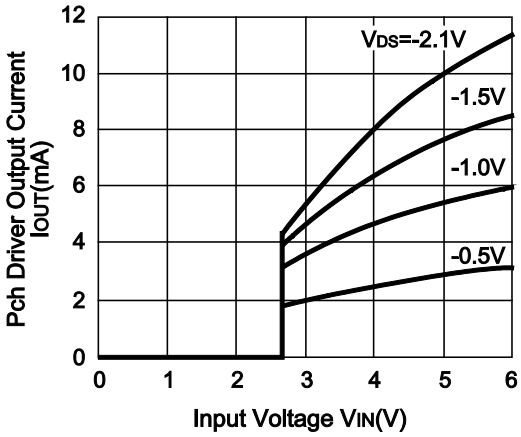
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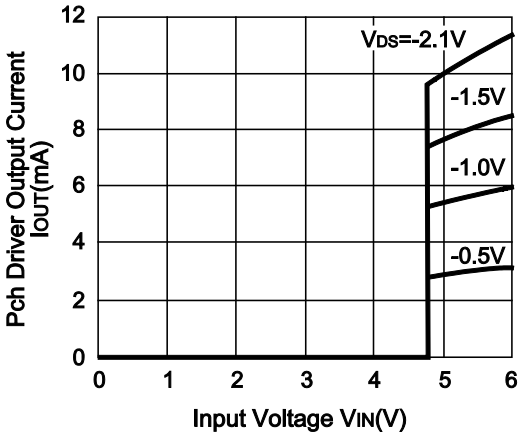
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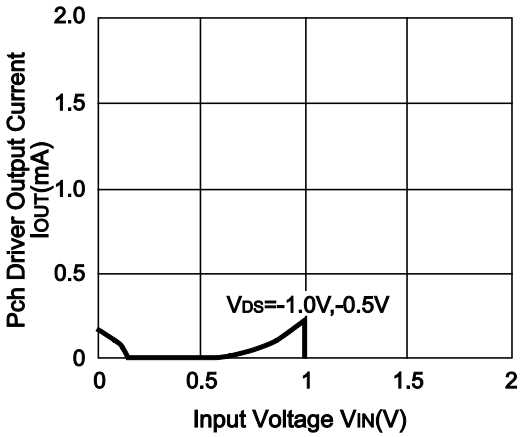
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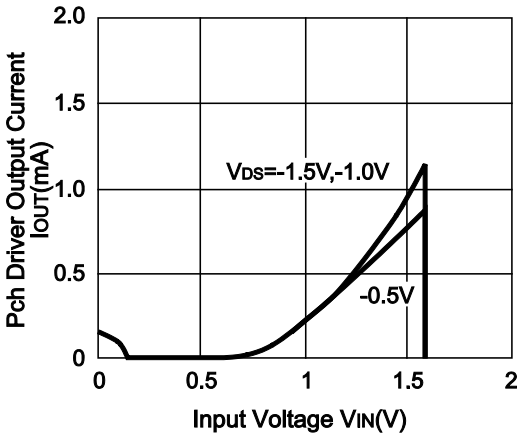
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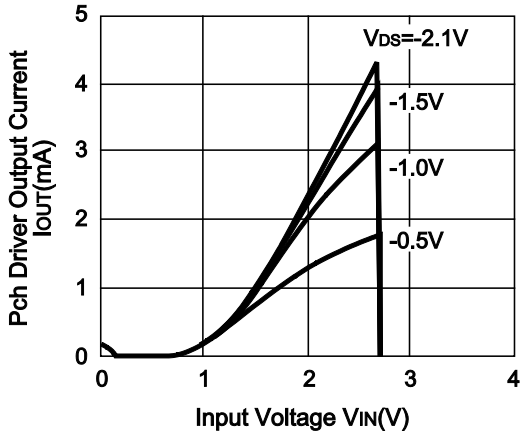
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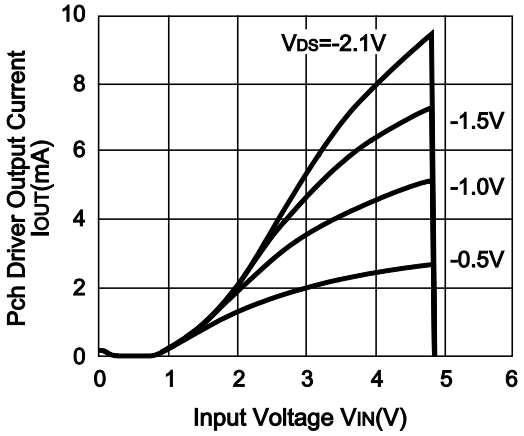
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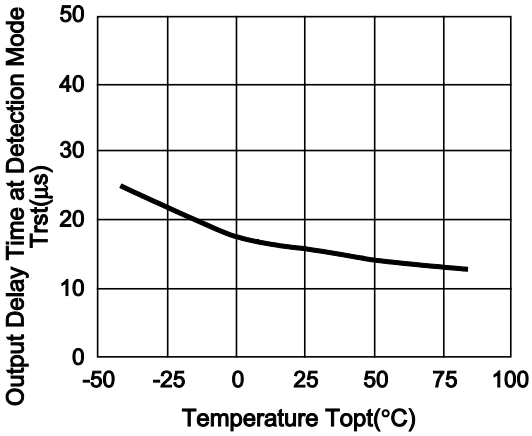


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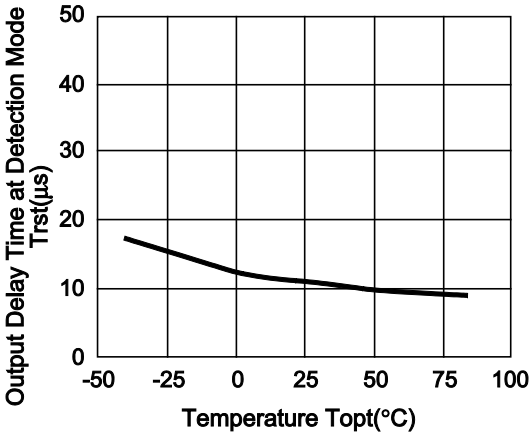


6) Output Delay Time at Detection Mode vs. Temperature

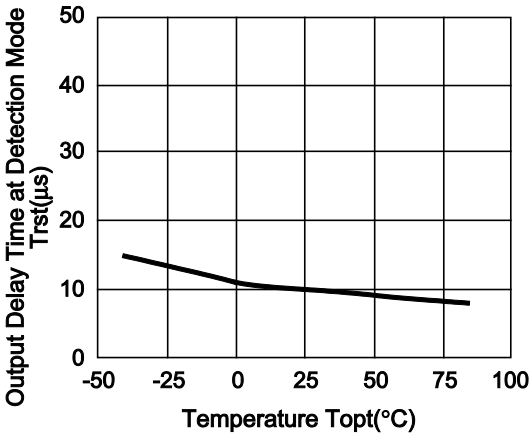
R3132x10Ex/R3133x10Ex



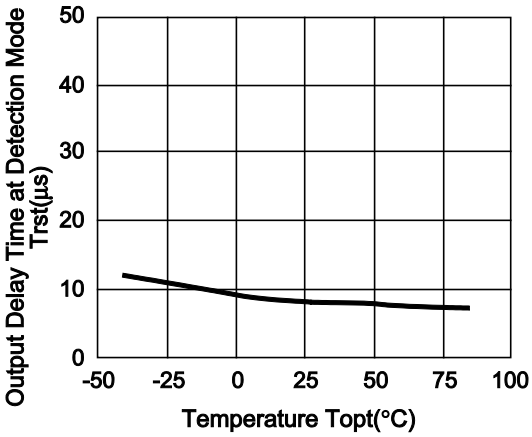
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R3132x27Ex/R3133x27Ex

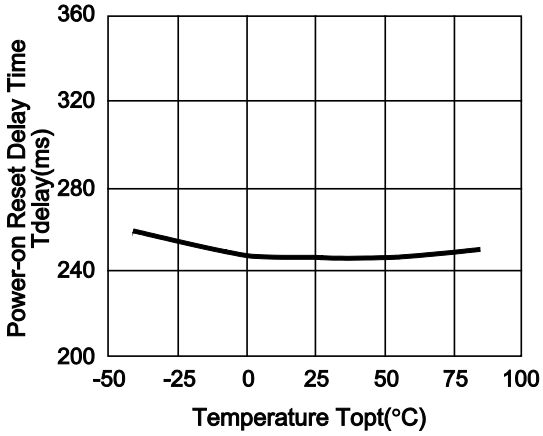


R3132x48Ex/R3133x48Ex

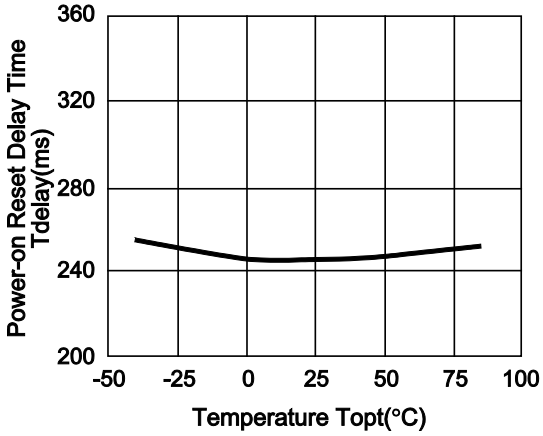


7) Power-on Reset Delay Time vs. Temperature

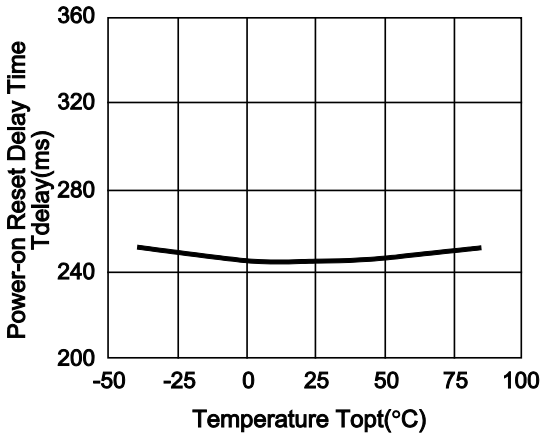
R3132x10Ex/R3133x10Ex



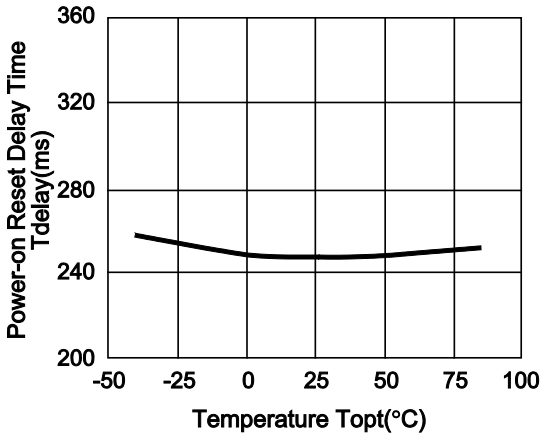
R3132x16Ex/R3133x16Ex



R3132x27Ex/R3133x27Ex



R3132x48Ex/R3133x48Ex



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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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