Low VD with Individual SENSE Pin and Delay Function for Automotive Applications

No. EC-242-211026

OUTLINE

The R3118x is a voltage detector IC with individual sense pin, high detector threshold accuracy and delay time, and ultra-low supply current, which can be operated at an extremely low voltage and is used for system reset as an example. Each of the IC consists of a voltage reference unit, a hysteresis comparator, resistors net for detector threshold setting, an output driver transistor, and a delay circuit.

V_{DD} supply pin for the IC and voltage supervisory sense pin are individual, therefore the output pin can keep "L" level even if the sense pin voltage is going down to 0 V, or there is no indefinite range for the sense pin.

Since a delay circuit is built-in, by connecting an external capacitor, any output delay time can be set. In the R3118x, detector released delay time can be set, and detector delay time is not influenced by the external capacitor for the delay time.

The detector threshold is fixed with high accuracy internally and does not require any adjustment. The tolerance of the detector threshold is ±22.5 mV ($-V_{DET_S}$ < 1.6 V) or ±1.5% ($-V_{DET_S}$ ≥ 1.6 V).

Minimum detector threshold voltage is 0.6 V, ultra-low voltage detector threshold can be set. Output delay time for the detector release can be set with high accuracy. The tolerance of the IC side is ±30%. Two output types, Nch. open drain type and CMOS type are available. If the sense pin voltage becomes to equal or lower than the detector threshold voltage, the output voltage becomes "L", and if the sense pin voltage becomes to released voltage, the output voltage becomes "H" after the set delay time.

The R3118x supports SOT-23-5 package.

FEATURES (1)

- Operating Voltage Range (Maximum Rating) ..... 1.0 V to 6.0 V (7.0 V)
- Supply Current(2) ..... Typ. 0.4 μA (V_{SENSE} ≥ +V_{DET}, V_{DD} = 6 V)
- Operating Temperature Range ..... R3118Nxxxx-AE: −40°C to 85°C
  R3118Nxxxx-KE: −40°C to 125°C
- Detector Threshold Range ..... 0.6 V to 5.0 V (0.1 V step)
- Accuracy Detector Threshold ..... ±1.5% ($-V_{DET_S}$ ≥ 1.6 V), ±22.5 mV ($-V_{DET_S}$ < 1.6 V)
- Temperature-Drift Coefficient of Detector Threshold ..... Typ. ±30 ppm/°C
- Accuracy Detector Released ..... ±30%
- Temperature-Drift Coefficient of Detector Released ..... Typ. ±0.16 ppm/°C
- Output Types ..... Nch Open Drain and CMOS
- Packages SOT-23-5

APPLICATIONS

- Voltage monitoring for electronic control units such as EV inverter and battery charge control unit

(1) Ta = 25°C, unless otherwise specified.
(2) Consumption current through SENSE pin is not included.

SELECTION GUIDE

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

Selection Guide

Product Name	Package	Quantity per Reel	Pb Free	Halogen Free
R3118Nxx1∗-TR-#E	SOT-23-5	3,000 pcs	Yes	Yes

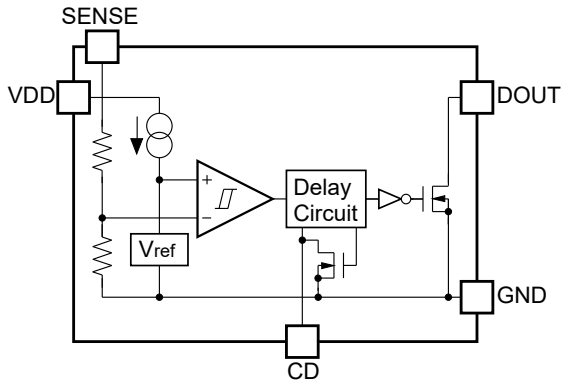
xx: The detector threshold can be designated in the range from 0.6 V(06) to 5.0 V(50) in 0.1 V step.

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

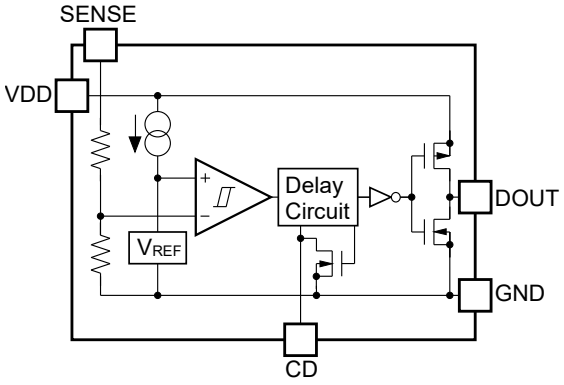
: Quality Class

#	Operating Temperature Range	Test Temperature
A	−40°C to 85°C	25°C, High
K	−40°C to 125°C	Low, 25°C, High

BLOCK DIAGRAMS

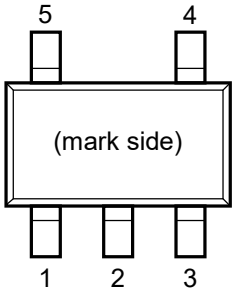


**R3118xxxxA (Nch. Open Drain Output)
Block Diagram**



**R3118xxxxC (CMOS Output)
Block Diagram**

PIN DESCRIPTIONS



SOT-23-5 Pin Configuration

SOT-23-5 Pin Description

Pin No.	Symbol	Description
1	DOUT	Output Pin ("L" at detection)
2	VDD	Input Pin
3	GND	Ground Pin
4	CD	Pin for External Capacitor (for setting output delay)
5	SENSE	Voltage Detector Voltage Sense Pin

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings

Symbol	Item	Rating	Unit
V_{DD}	Supply Voltage	−0.3 to 7.0	V
V_{SENSE}	SENSE Pin Voltage	−0.3 to 7.0	V
V_{DOUT}	Output Voltage (R3118NxxxA)	−0.3 to 7.0	V
	Output Voltage (R3118NxxxC)	−0.3 to V_{DD} + 0.3	
I_{DOUT}	Output Current Nch. Driver (Sink Current)	20	mA
	Output Current Pch. Driver (Source Current)	−5	
P_D	Power Dissipation(1) (SOT-23-5, JEDEC STD.51-7)	660	mW
Tj	Junction Temperature Range	−40 to 125	°C
Tstg	Storage Temperature Range	−55 to 125	°C

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage and may degrade the lifetime 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

Recommended Operating Conditions

Symbol	Item		Rating	Unit
V_{DD}	Supply Voltage		1.0 to 6.0	V
Ta	Operating Temperature Range	R3118Nxxxx-AE	−40 to 85	°C
		R3118Nxxxx-KE	−40 to 125	

RECOMMENDED OPERATING CONDITIONS

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 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.

(1) Refer to *POWER DISSIPATION* for detailed information.

ELECTRICAL CHARACTERISTICS

V_{DD} = 1 V to 6 V, unless otherwise specified.
The specifications surrounded by [ ] are guaranteed by design engineering at −40°C ≤ Ta ≤ 85°C.

R3118NxxxA/C (-AE) Electrical Characteristics **(Ta = 25°C)**

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold	$-V_{DET_S}$(1) < 1.6 V	Ta = 25°C	$-V_{DET_S}$ −0.0225	$-V_{DET_S}$	$-V_{DET_S}$ +0.0225	V
			−40°C ≤ Ta ≤ 85°C	[$-V_{DET_S}$ −0.0375]	$-V_{DET_S}$	[$-V_{DET_S}$ +0.0375]	
		$-V_{DET_S}$ ≥ 1.6 V	Ta = 25°C	$-V_{DET_S}$ × 0.985	$-V_{DET_S}$	$-V_{DET_S}$ × 1.015	
			−40°C ≤ Ta ≤ 85°C	[$-V_{DET_S}$ × 0.975]	$-V_{DET_S}$	[$-V_{DET_S}$ × 1.025]	
V_{HYS}	Detector threshold Hysteresis	Ta = 25°C		$-V_{DET_S}$ × 0.040	$-V_{DET_S}$ × 0.055	$-V_{DET_S}$ × 0.070	V
		−40°C ≤ Ta ≤ 85°C		[$-V_{DET_S}$ × 0.035]	$-V_{DET_S}$ × 0.055	[$-V_{DET_S}$ × 0.075]	
I_{SS}	Supply Current(2)	V_{SENSE} = 0 V, V_{DD} = 6 V			0.480	[1.450]	μA
		V_{SENSE} = 6 V, V_{DD} = 6 V			0.400	[1.200]	
R_{SENSE}	Sense Resistor	V_{SENSE} = 6 V, V_{DD} = 6 V		[9]	34	[58]	MΩ
I_{DOUT}	Output Current (Driver Output Pin)	Nch. V_{SENSE} = 0 V	V_{DD} = 1 V, V_{DOUT} = 0.1 V	[0.150]			mA
			V_{DD} = 3 V, V_{DOUT} = 0.1 V	[0.550]			
			V_{DD} = 5 V, V_{DOUT} = 0.1 V	[0.850]			
			V_{DD} = 1 V, V_{DOUT} = 0.4 V	[0.400]			
			V_{DD} = 3 V, V_{DOUT} = 0.4 V	[2.100]			
			V_{DD} = 5 V, V_{DOUT} = 0.4 V	[3.300]			
		Pch V_{SENSE} = 6 V (R3118NxxxC)	V_{DD} = 1 V, V_{DOUT} = 0.9 V	[6]			μA
			V_{DD} = 3 V, V_{DOUT} = 2.9 V	[30]			
			V_{DD} = 5 V, V_{DOUT} = 4.9 V	[45]			
I_{LEAK}	Nch Driver Leakage Current (R3118NxxxA)	V_{SENSE} = 6 V, V_{DD} = 6 V, V_{DOUT} = 6 V				[80]	nA
R_{DIS}	C_D pin Discharge Tr. On Resistance	V_{SENSE} = 6 V, V_{DD} = 1 V, V_{CD} = 0.4 V		[2.200]		[6.200]	kΩ
		V_{SENSE} = 6 V, V_{DD} = 3 V, V_{CD} = 0.4 V		[0.400]		[1.250]	
		V_{SENSE} = 6 V, V_{DD} = 5 V, V_{CD} = 0.4 V		[0.250]		[0.800]	

(1) $-V_{DET_S}$: Set Detector Threshold
(2) Consumption current through SENSE pin is not included.

ELECTRICAL CHARACTERISTICS (continued)

V_{DD} = 1 V to 6 V, unless otherwise specified.
The specifications surrounded by [ ] are guaranteed by design engineering at −40°C ≤ Ta ≤ 85°C.

R3118NxxxA/C (-AE) Electrical Characteristics **(Ta = 25°C)**

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
t_{RESET}	Detect Output Delay Time(1)	Ta = 25°C		80		μs
t_{DELAY}	Release Output Delay Time(2)	Ta = 25°C	70	100	130	ms
		−40°C ≤ Ta ≤ 85°C	[65]	100	[145]	

All of unit are tested and specified under load conditions such that Tj ≈ Ta = 25°C except for Detector Output Delay Time and Release Output Delay Time.

(1) **R3118NxxxC:** In the case that a 0.022 μF capacitor is connected to the CD pin, the time interval from forcing pulsive voltage between $-V_{DET_S} \times 1.155$ V and $-V_{DET_S} \times 0.9$ V to SENSE pin, to when the output voltage of the DOUT pin will reach from "H" to $V_{DD}/2$.
R3118NxxxA: In the case that a 0.022 μF capacitor is connected to the CD pin and the DOUT pin is pulled up to 5 V with 470 kΩ, the time interval from forcing pulsive voltage between $-V_{DET_S} \times 1.155$ V and $-V_{DET_S} \times 0.9$ V to SENSE pin, to when the output voltage reaches from "H" to 2.5V.

(2) **R3118NxxxC:** In the case that a 0.022 μF capacitor is connected to the CD pin, the time interval from forcing pulsive voltage between $-V_{DET_S} \times 0.9$ V and $-V_{DET_S} \times 1.155$ V to SENSE pin, to when the output voltage of the DOUT pin will reach from "L" to $V_{DD}/2$.
R3118NxxxA: In the case that a 0.022 μF capacitor is connected to the CD pin and the DOUT pin is pulled up to 5 V with 470 kΩ, the time interval from forcing pulsive voltage between $-V_{DET_S} \times 0.9$ V and $-V_{DET_S}$ x1.155 V to SENSE pin, to when the output voltage reaches from "L" to 2.5 V.

ELECTRICAL CHARACTERISTICS (continued)

The specifications surrounded by [ ] are guaranteed by design engineering at −40°C ≤ Ta ≤ 85°C.

R3118NxxxA/C (-AE) Product-specific Electrical Characteristics

Product Name	$-V_{DET}$ [V]						$-V_{HYS}$ [V]					
	Ta = 25°C			-40°C ≤ Ta ≤ 85°C			Ta = 25°C			-40°C ≤ Ta ≤ 85°C		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
R3118N061x	0.5775	0.6000	0.6225	0.5625	0.6000	0.6375	0.0240	0.0330	0.0420	0.0210	0.0330	0.0450
R3118N071x	0.6775	0.7000	0.7225	0.6625	0.7000	0.7375	0.0280	0.0385	0.0490	0.0245	0.0385	0.0525
R3118N081x	0.7775	0.8000	0.8225	0.7625	0.8000	0.8375	0.0320	0.0440	0.0560	0.0280	0.0440	0.0600
R3118N091x	0.8775	0.9000	0.9225	0.8625	0.9000	0.9375	0.0360	0.0495	0.0630	0.0315	0.0495	0.0675
R3118N101x	0.9775	1.0000	1.0225	0.9625	1.0000	1.0375	0.0400	0.0550	0.0700	0.0350	0.0550	0.0750
R3118N111x	1.0775	1.1000	1.1225	1.0625	1.1000	1.1375	0.0440	0.0605	0.0770	0.0385	0.0605	0.0825
R3118N121x	1.1775	1.2000	1.2225	1.1625	1.2000	1.2375	0.0480	0.0660	0.0840	0.0420	0.0660	0.0900
R3118N131x	1.2775	1.3000	1.3225	1.2625	1.3000	1.3375	0.0520	0.0715	0.0910	0.0455	0.0715	0.0975
R3118N141x	1.3775	1.4000	1.4225	1.3625	1.4000	1.4375	0.0560	0.0770	0.0980	0.0490	0.0770	0.1050
R3118N151x	1.4775	1.5000	1.5225	1.4625	1.5000	1.5375	0.0600	0.0825	0.1050	0.0525	0.0825	0.1125
R3118N161x	1.5760	1.6000	1.6240	1.5600	1.6000	1.6400	0.0640	0.0880	0.1120	0.0560	0.0880	0.1200
R3118N171x	1.6745	1.7000	1.7255	1.6575	1.7000	1.7425	0.0680	0.0935	0.1190	0.0595	0.0935	0.1275
R3118N181x	1.7730	1.8000	1.8270	1.7550	1.8000	1.8450	0.0720	0.0990	0.1260	0.0630	0.0990	0.1350
R3118N191x	1.8715	1.9000	1.9285	1.8525	1.9000	1.9475	0.0760	0.1045	0.1330	0.0665	0.1045	0.1425
R3118N201x	1.9700	2.0000	2.0300	1.9500	2.0000	2.0500	0.0800	0.1100	0.1400	0.0700	0.1100	0.1500
R3118N211x	2.0685	2.1000	2.1315	2.0475	2.1000	2.1525	0.0840	0.1155	0.1470	0.0735	0.1155	0.1575
R3118N221x	2.1670	2.2000	2.2330	2.1450	2.2000	2.2550	0.0880	0.1210	0.1540	0.0770	0.1210	0.1650
R3118N231x	2.2655	2.3000	2.3345	2.2425	2.3000	2.3575	0.0920	0.1265	0.1610	0.0805	0.1265	0.1725
R3118N241x	2.3640	2.4000	2.4360	2.3400	2.4000	2.4600	0.0960	0.1320	0.1680	0.0840	0.1320	0.1800
R3118N251x	2.4625	2.5000	2.5375	2.4375	2.5000	2.5625	0.1000	0.1375	0.1750	0.0875	0.1375	0.1875
R3118N261x	2.5610	2.6000	2.6390	2.5350	2.6000	2.6650	0.1040	0.1430	0.1820	0.0910	0.1430	0.1950
R3118N271x	2.6595	2.7000	2.7405	2.6325	2.7000	2.7675	0.1080	0.1485	0.1890	0.0945	0.1485	0.2025
R3118N281x	2.7580	2.8000	2.8420	2.7300	2.8000	2.8700	0.1120	0.1540	0.1960	0.0980	0.1540	0.2100
R3118N291x	2.8565	2.9000	2.9435	2.8275	2.9000	2.9725	0.1160	0.1595	0.2030	0.1015	0.1595	0.2175
R3118N301x	2.9550	3.0000	3.0450	2.9250	3.0000	3.0750	0.1200	0.1650	0.2100	0.1050	0.1650	0.2250
R3118N311x	3.0535	3.1000	3.1465	3.0225	3.1000	3.1775	0.1240	0.1705	0.2170	0.1085	0.1705	0.2325
R3118N321x	3.1520	3.2000	3.2480	3.1200	3.2000	3.2800	0.1280	0.1760	0.2240	0.1120	0.1760	0.2400
R3118N331x	3.2505	3.3000	3.3495	3.2175	3.3000	3.3825	0.1320	0.1815	0.2310	0.1155	0.1815	0.2475
R3118N341x	3.3490	3.4000	3.4510	3.3150	3.4000	3.4850	0.1360	0.1870	0.2380	0.1190	0.1870	0.2550
R3118N351x	3.4475	3.5000	3.5525	3.4125	3.5000	3.5875	0.1400	0.1925	0.2450	0.1225	0.1925	0.2625
R3118N361x	3.5460	3.6000	3.6540	3.5100	3.6000	3.6900	0.1440	0.1980	0.2520	0.1260	0.1980	0.2700
R3118N371x	3.6445	3.7000	3.7555	3.6075	3.7000	3.7925	0.1480	0.2035	0.2590	0.1295	0.2035	0.2775
R3118N381x	3.7430	3.8000	3.8570	3.7050	3.8000	3.8950	0.1520	0.2090	0.2660	0.1330	0.2090	0.2850
R3118N391x	3.8415	3.9000	3.9585	3.8025	3.9000	3.9975	0.1560	0.2145	0.2730	0.1365	0.2145	0.2925
R3118N401x	3.9400	4.0000	4.0600	3.9000	4.0000	4.1000	0.1600	0.2200	0.2800	0.1400	0.2200	0.3000
R3118N411x	4.0385	4.1000	4.1615	3.9975	4.1000	4.2025	0.1640	0.2255	0.2870	0.1435	0.2255	0.3075
R3118N421x	4.1370	4.2000	4.2630	4.0950	4.2000	4.3050	0.1680	0.2310	0.2940	0.1470	0.2310	0.3150
R3118N431x	4.2355	4.3000	4.3645	4.1925	4.3000	4.4075	0.1720	0.2365	0.3010	0.1505	0.2365	0.3225
R3118N441x	4.3340	4.4000	4.4660	4.2900	4.4000	4.5100	0.1760	0.2420	0.3080	0.1540	0.2420	0.3300
R3118N451x	4.4325	4.5000	4.5675	4.3875	4.5000	4.6125	0.1800	0.2475	0.3150	0.1575	0.2475	0.3375
R3118N461x	4.5310	4.6000	4.6690	4.4850	4.6000	4.7150	0.1840	0.2530	0.3220	0.1610	0.2530	0.3450
R3118N471x	4.6295	4.7000	4.7705	4.5825	4.7000	4.8175	0.1880	0.2585	0.3290	0.1645	0.2585	0.3525
R3118N481x	4.7280	4.8000	4.8720	4.6800	4.8000	4.9200	0.1920	0.2640	0.3360	0.1680	0.2640	0.3600
R3118N491x	4.8265	4.9000	4.9735	4.7775	4.9000	5.0225	0.1960	0.2695	0.3430	0.1715	0.2695	0.3675
R3118N501x	4.9250	5.0000	5.0750	4.8750	5.0000	5.1250	0.2000	0.2750	0.3500	0.1750	0.2750	0.3750

ELECTRICAL CHARACTERISTICS (continued)

V_{DD} = 1 V to 6 V, unless otherwise specified.

R3118NxxxA/C (-KE) Electrical Characteristics **(−40°C ≤ Ta ≤ 125°C)**

Symbol	Item	Conditions		Min.	Typ.	Max.	Unit
$-V_{DET}$	Detector Threshold	$-V_{DET_S}$(1) < 1.6 V	Ta = 25°C	$-V_{DET_S}$ −0.0225	$-V_{DET_S}$	$-V_{DET_S}$ +0.0225	V
			−40°C ≤ Ta ≤ 125°C	$-V_{DET_S}$ −0.0375	$-V_{DET_S}$	$-V_{DET_S}$ +0.0375	
		$-V_{DET_S}$ ≥ 1.6 V	Ta = 25°C	$-V_{DET_S}$ × 0.985	$-V_{DET_S}$	$-V_{DET_S}$ × 1.015	
			−40°C ≤ Ta ≤ 125°C	$-V_{DET_S}$ × 0.975	$-V_{DET_S}$	$-V_{DET_S}$ × 1.025	
V_{HYS}	Detector threshold Hysteresis	Ta = 25°C		$-V_{DET_S}$ × 0.040	$-V_{DET_S}$ × 0.055	$-V_{DET_S}$ × 0.070	V
		−40°C ≤ Ta ≤ 125°C		$-V_{DET_S}$ × 0.035	$-V_{DET_S}$ × 0.055	$-V_{DET_S}$ × 0.075	
I_{SS}	Supply Current(2)	V_{SENSE} = 0 V, V_{DD} = 6 V			0.480	1.700	µA
		V_{SENSE} = 6 V, V_{DD} = 6 V			0.400	1.700	
R_{SENSE}	Sense Resistor	V_{SENSE} = 6 V, V_{DD} = 6 V		9	34	58	MΩ
I_{DOUT}	Output Current (Driver Output Pin)	Nch. V_{SENSE} = 0 V	V_{DD} = 1 V, V_{DOUT} = 0.1 V	0.130			mA
			V_{DD} = 3 V, V_{DOUT} = 0.1 V	0.480			
			V_{DD} = 5 V, V_{DOUT} = 0.1 V	0.730			
			V_{DD} = 1 V, V_{DOUT} = 0.4 V	0.380			
			V_{DD} = 3 V, V_{DOUT} = 0.4 V	1.800			
			V_{DD} = 5 V, V_{DOUT} = 0.4 V	2.800			
		Pch. V_{SENSE} = 6 V (R3118NxxxC)	V_{DD} = 1 V, V_{DOUT} = 0.9 V	6			µA
			V_{DD} = 3 V, V_{DOUT} = 2.9 V	28			
			V_{DD} = 5 V, V_{DOUT} = 4.9 V	43			
I_{LEAK}	Nch Driver Leakage Current (R3118NxxxA)	V_{SENSE} = 6 V, V_{DD} = 6 V, V_{DOUT} = 6 V				80	nA

(1) $-V_{DET_S}$: Set Detector Threshold

(2) Consumption current through SENSE pin is not included.

ELECTRICAL CHARACTERISTICS (continued)

V_{DD} = 1 V to 6 V, unless otherwise specified.

R3118NxxxA/C (-KE) Electrical Characteristics **(−40°C ≤ Ta ≤ 125°C)**

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
R_{DIS}	CD pin Discharge Tr. On Resistance	V_{SENSE} = 6 V, V_{DD} = 1 V, V_{CD} = 0.4 V	2.200		6.300	kΩ
		V_{SENSE} = 6 V, V_{DD} = 3 V, V_{CD} = 0.4 V	0.400		1.400	
		V_{SENSE} = 6 V, V_{DD} = 5 V, V_{CD} = 0.4 V	0.250		0.880	
t_{RESET}	Detect Output Delay Time(1)	Ta = 25°C		80		μs
t_{DELAY}	Release Output Delay Time(2)	Ta = 25°C	70	100	130	ms
		−40°C ≤ Ta ≤ 125°C	65	100	155	

(1) **R3118NxxxC:** In the case that a 0.022 μF capacitor is connected to the CD pin, the time interval from forcing pulsive voltage between -V_{DET_S} ×1.155 V and -V_{DET_S} ×0.9 V to SENSE pin, to when the output voltage of the DOUT pin will reach from "H" to V_{DD}/2.
R3118NxxxA: In the case that a 0.022 μF capacitor is connected to the CD pin and the DOUT pin is pulled up to 5 V with 470 kΩ, the time interval from forcing pulsive voltage between –V_{DET_S}×1.155 V and -V_{DET_S}×0.9 V to SENSE pin, to when the output voltage reaches from "H" to 2.5 V.

(2) **R3118NxxxC:** In the case that a 0.022 μF capacitor is connected to the CD pin, the time interval from forcing pulsive voltage between -V_{DET_S}×0.9 V and -V_{DET_S}×1.155 V to SENSE pin, to when the output voltage of the DOUT pin will reach from "L" to V_{DD}/2.
R3118NxxxA: In the case that a 0.022 μF capacitor is connected to the CD pin and the DOUT pin is pulled up to 5 V with 470 kΩ, the time interval from forcing pulsive voltage between -V_{DET_S} ×0.9 V and -V_{DET_S} x1.155 V to SENSE pin, to when the output voltage reaches from "L" to 2.5 V.

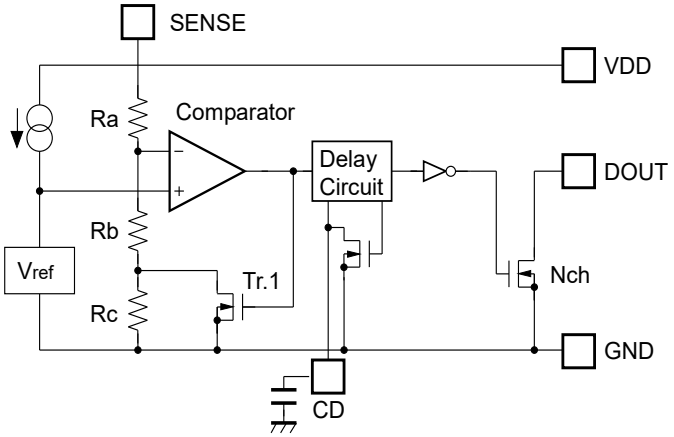
ELECTRICAL CHARACTERISTICS (continued)

R3118NxxxA/C (-KE) Product-specific Electrical Characteristics

Product Name	$-V_{DET}$ [V]						$-V_{HYS}$ [V]					
	Ta = 25°C			-40°C ≤ Ta ≤ 125°C			Ta = 25°C			-40°C ≤ Ta ≤ 125°C		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
R3118N061x	0.5775	0.6000	0.6225	0.5625	0.6000	0.6375	0.0240	0.0330	0.0420	0.0210	0.0330	0.0450
R3118N071x	0.6775	0.7000	0.7225	0.6625	0.7000	0.7375	0.0280	0.0385	0.0490	0.0245	0.0385	0.0525
R3118N081x	0.7775	0.8000	0.8225	0.7625	0.8000	0.8375	0.0320	0.0440	0.0560	0.0280	0.0440	0.0600
R3118N091x	0.8775	0.9000	0.9225	0.8625	0.9000	0.9375	0.0360	0.0495	0.0630	0.0315	0.0495	0.0675
R3118N101x	0.9775	1.0000	1.0225	0.9625	1.0000	1.0375	0.0400	0.0550	0.0700	0.0350	0.0550	0.0750
R3118N111x	1.0775	1.1000	1.1225	1.0625	1.1000	1.1375	0.0440	0.0605	0.0770	0.0385	0.0605	0.0825
R3118N121x	1.1775	1.2000	1.2225	1.1625	1.2000	1.2375	0.0480	0.0660	0.0840	0.0420	0.0660	0.0900
R3118N131x	1.2775	1.3000	1.3225	1.2625	1.3000	1.3375	0.0520	0.0715	0.0910	0.0455	0.0715	0.0975
R3118N141x	1.3775	1.4000	1.4225	1.3625	1.4000	1.4375	0.0560	0.0770	0.0980	0.0490	0.0770	0.1050
R3118N151x	1.4775	1.5000	1.5225	1.4625	1.5000	1.5375	0.0600	0.0825	0.1050	0.0525	0.0825	0.1125
R3118N161x	1.5760	1.6000	1.6240	1.5600	1.6000	1.6400	0.0640	0.0880	0.1120	0.0560	0.0880	0.1200
R3118N171x	1.6745	1.7000	1.7255	1.6575	1.7000	1.7425	0.0680	0.0935	0.1190	0.0595	0.0935	0.1275
R3118N181x	1.7730	1.8000	1.8270	1.7550	1.8000	1.8450	0.0720	0.0990	0.1260	0.0630	0.0990	0.1350
R3118N191x	1.8715	1.9000	1.9285	1.8525	1.9000	1.9475	0.0760	0.1045	0.1330	0.0665	0.1045	0.1425
R3118N201x	1.9700	2.0000	2.0300	1.9500	2.0000	2.0500	0.0800	0.1100	0.1400	0.0700	0.1100	0.1500
R3118N211x	2.0685	2.1000	2.1315	2.0475	2.1000	2.1525	0.0840	0.1155	0.1470	0.0735	0.1155	0.1575
R3118N221x	2.1670	2.2000	2.2330	2.1450	2.2000	2.2550	0.0880	0.1210	0.1540	0.0770	0.1210	0.1650
R3118N231x	2.2655	2.3000	2.3345	2.2425	2.3000	2.3575	0.0920	0.1265	0.1610	0.0805	0.1265	0.1725
R3118N241x	2.3640	2.4000	2.4360	2.3400	2.4000	2.4600	0.0960	0.1320	0.1680	0.0840	0.1320	0.1800
R3118N251x	2.4625	2.5000	2.5375	2.4375	2.5000	2.5625	0.1000	0.1375	0.1750	0.0875	0.1375	0.1875
R3118N261x	2.5610	2.6000	2.6390	2.5350	2.6000	2.6650	0.1040	0.1430	0.1820	0.0910	0.1430	0.1950
R3118N271x	2.6595	2.7000	2.7405	2.6325	2.7000	2.7675	0.1080	0.1485	0.1890	0.0945	0.1485	0.2025
R3118N281x	2.7580	2.8000	2.8420	2.7300	2.8000	2.8700	0.1120	0.1540	0.1960	0.0980	0.1540	0.2100
R3118N291x	2.8565	2.9000	2.9435	2.8275	2.9000	2.9725	0.1160	0.1595	0.2030	0.1015	0.1595	0.2175
R3118N301x	2.9550	3.0000	3.0450	2.9250	3.0000	3.0750	0.1200	0.1650	0.2100	0.1050	0.1650	0.2250
R3118N311x	3.0535	3.1000	3.1465	3.0225	3.1000	3.1775	0.1240	0.1705	0.2170	0.1085	0.1705	0.2325
R3118N321x	3.1520	3.2000	3.2480	3.1200	3.2000	3.2800	0.1280	0.1760	0.2240	0.1120	0.1760	0.2400
R3118N331x	3.2505	3.3000	3.3495	3.2175	3.3000	3.3825	0.1320	0.1815	0.2310	0.1155	0.1815	0.2475
R3118N341x	3.3490	3.4000	3.4510	3.3150	3.4000	3.4850	0.1360	0.1870	0.2380	0.1190	0.1870	0.2550
R3118N351x	3.4475	3.5000	3.5525	3.4125	3.5000	3.5875	0.1400	0.1925	0.2450	0.1225	0.1925	0.2625
R3118N361x	3.5460	3.6000	3.6540	3.5100	3.6000	3.6900	0.1440	0.1980	0.2520	0.1260	0.1980	0.2700
R3118N371x	3.6445	3.7000	3.7555	3.6075	3.7000	3.7925	0.1480	0.2035	0.2590	0.1295	0.2035	0.2775
R3118N381x	3.7430	3.8000	3.8570	3.7050	3.8000	3.8950	0.1520	0.2090	0.2660	0.1330	0.2090	0.2850
R3118N391x	3.8415	3.9000	3.9585	3.8025	3.9000	3.9975	0.1560	0.2145	0.2730	0.1365	0.2145	0.2925
R3118N401x	3.9400	4.0000	4.0600	3.9000	4.0000	4.1000	0.1600	0.2200	0.2800	0.1400	0.2200	0.3000
R3118N411x	4.0385	4.1000	4.1615	3.9975	4.1000	4.2025	0.1640	0.2255	0.2870	0.1435	0.2255	0.3075
R3118N421x	4.1370	4.2000	4.2630	4.0950	4.2000	4.3050	0.1680	0.2310	0.2940	0.1470	0.2310	0.3150
R3118N431x	4.2355	4.3000	4.3645	4.1925	4.3000	4.4075	0.1720	0.2365	0.3010	0.1505	0.2365	0.3225
R3118N441x	4.3340	4.4000	4.4660	4.2900	4.4000	4.5100	0.1760	0.2420	0.3080	0.1540	0.2420	0.3300
R3118N451x	4.4325	4.5000	4.5675	4.3875	4.5000	4.6125	0.1800	0.2475	0.3150	0.1575	0.2475	0.3375
R3118N461x	4.5310	4.6000	4.6690	4.4850	4.6000	4.7150	0.1840	0.2530	0.3220	0.1610	0.2530	0.3450
R3118N471x	4.6295	4.7000	4.7705	4.5825	4.7000	4.8175	0.1880	0.2585	0.3290	0.1645	0.2585	0.3525
R3118N481x	4.7280	4.8000	4.8720	4.6800	4.8000	4.9200	0.1920	0.2640	0.3360	0.1680	0.2640	0.3600
R3118N491x	4.8265	4.9000	4.9735	4.7775	4.9000	5.0225	0.1960	0.2695	0.3430	0.1715	0.2695	0.3675
R3118N501x	4.9250	5.0000	5.0750	4.8750	5.0000	5.1250	0.2000	0.2750	0.3500	0.1750	0.2750	0.3750

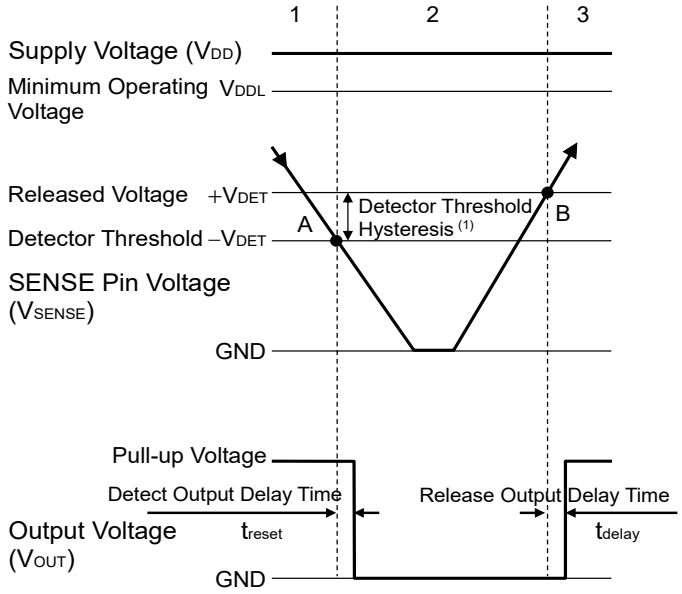
THEORY OF OPERATION

R3118xxxxA (Nch. OPEN-DRAIN OUTPUT)



*) DOUT pin should be pulled-up to VDD or an external voltage level.

R3118xxxxA Block Diagram with External Capacitor



Step		1	2	3
Comparator (–) Pin Input Voltage		I	II	I
Comparator Output		L	H	L
Tr.1		OFF	ON	OFF
Output Tr.	Nch	OFF	ON	OFF

$$\text{I} \quad \frac{Rb+Rc}{Ra+Rb+Rc} \times V_{SENSE}$$

$$\text{II} \quad \frac{Rb}{Ra+Rb} \times V_{SENSE}$$

Operation Diagram

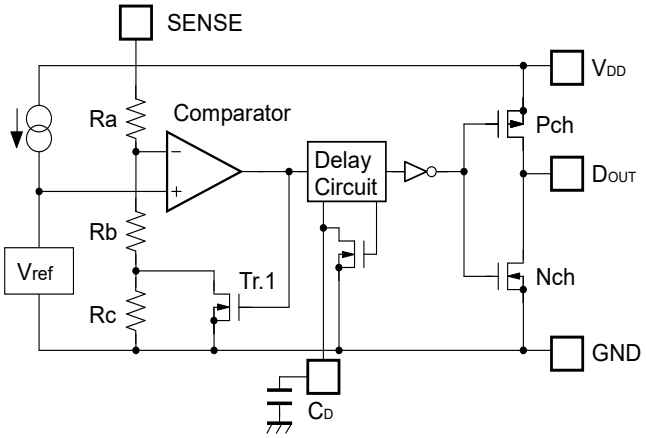
Step 1. The output voltage is equal to the pull-up voltage.

Step 2. At Point "A", $V_{REF} \leq V_{SENSE} \times (Rb+Rc)/(Ra+Rb+Rc)$ 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 ($-V_{DET}$). (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 GND level.)

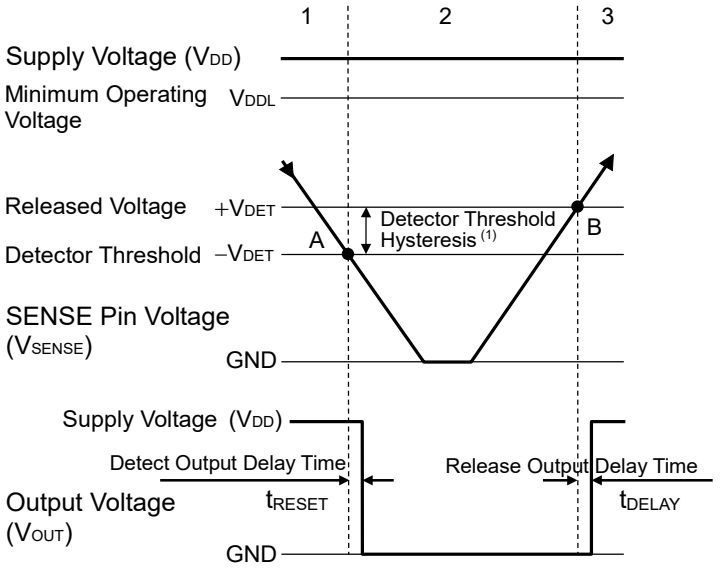
Step 3. At Point "B", $V_{REF} \leq V_{SENSE} \times Rb/(Ra+Rb)$ is true, as a result, the output of comparator is reversed from "H" to "L", then the output voltage is equal to the pull-up voltage. The voltage level of Point B means a released voltage ($+V_{DET}$).

(1) The difference between a released voltage and a detector threshold voltage is a detector threshold hysteresis.

R3118xxxxC (CMOS OUTPUT)



R3118xxxC Block Diagram with External Capacitor



Step		1	2	3
Comparator (−) Pin Input Voltage		I	II	I
Comparator Output		L	H	L
Tr.1		OFF	ON	OFF
Output Tr.	Pch	ON	OFF	ON
	Nch	OFF	ON	OFF

$$\text{I} \quad \frac{Rb+Rc}{Ra+Rb+Rc} \times V_{SENSE}$$

$$\text{II} \quad \frac{Rb}{Ra+Rb} \times V_{SENSE}$$

Operation Diagram

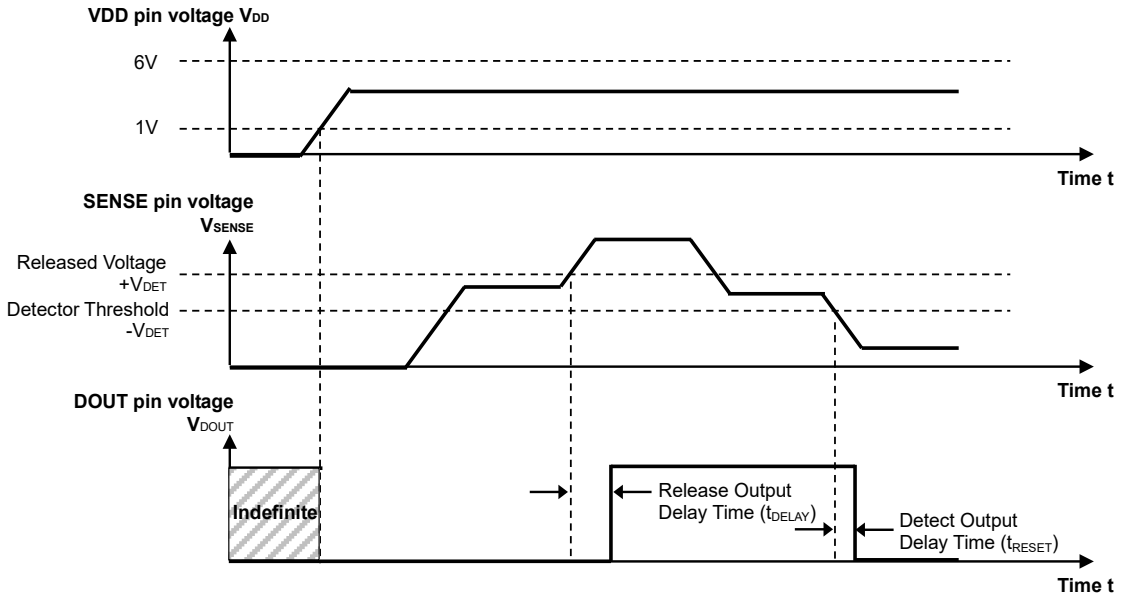
Step 1. The output voltage is equal to the supply voltage (V_{DD}).

Step 2. At Point "A", $V_{REF} \geq V_{SENSE} \times (Rb+Rc)/(Ra+Rb+Rc)$ 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 ($-V_{DET}$). (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 GND level.)

Step 3. At Point "B", $V_{REF} \leq V_{SENSE} \times Rb/(Ra+Rb)$ 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 ($+V_{DET}$).

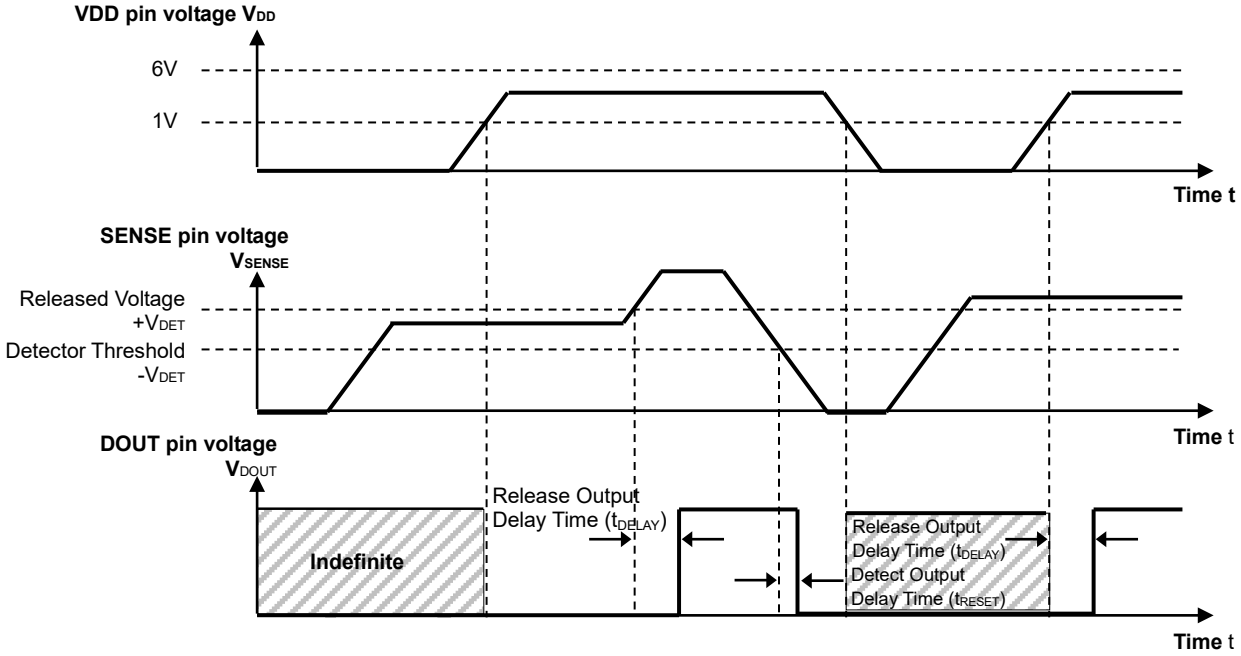
(1) The difference between a released voltage and a detector threshold voltage is a detector threshold hysteresis.

WHEN POWER TO SENSE PIN TURNING-ON AFTER VDD PIN'S POWER-ON



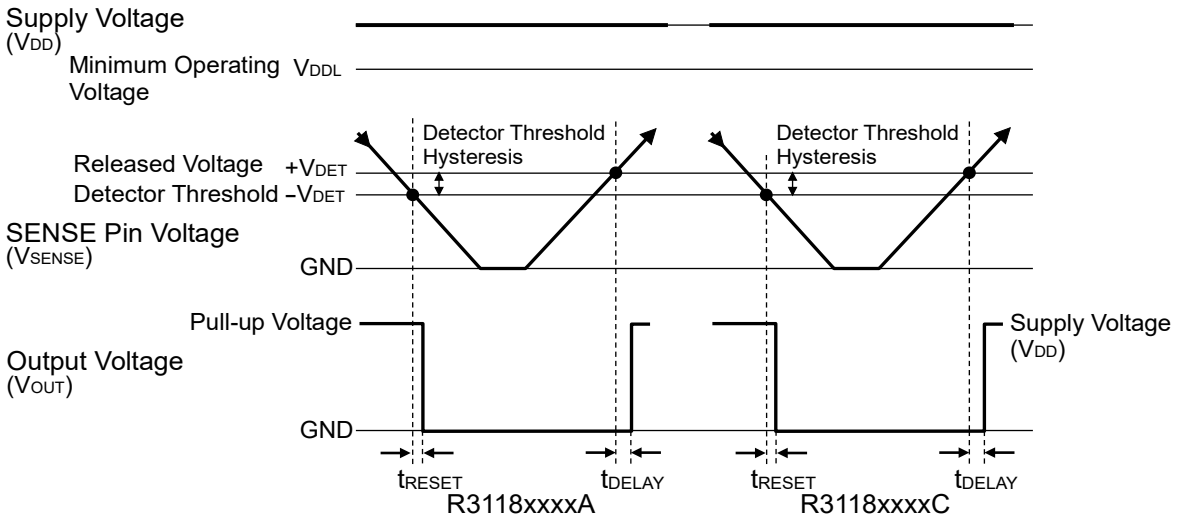
If a voltage is applied to SENSE pin after a power (in the range from 1 V to 6 V) is applied to VDD pin, DOUT pin becomes "L" when the SENSE pin voltage is less than released voltage $+V_{DET}$, ,and DOUT pin becomes "H" when the SENSE pin voltage is equal or more than the released voltage $+V_{DET}$.

WHEN POWER TO VDD PIN TURNING-ON AFTER SENSE PIN'S POWER-ON

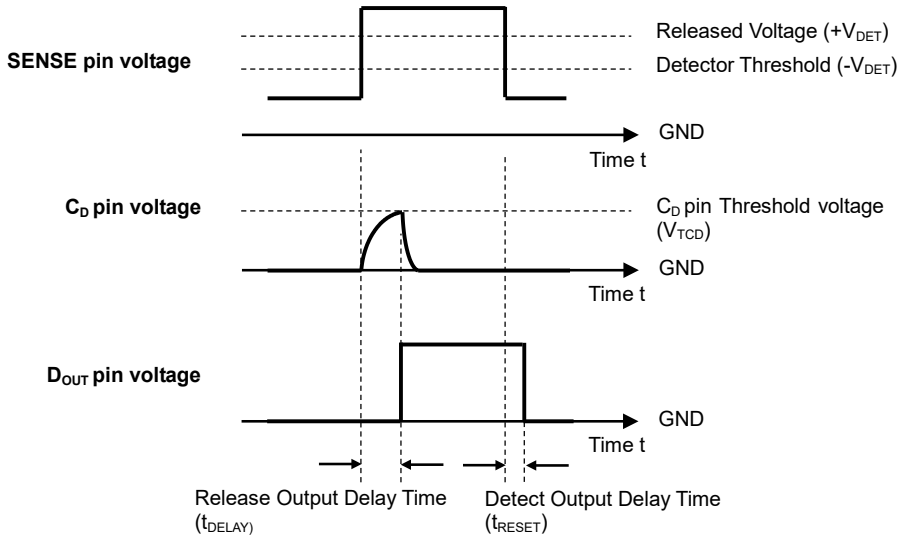


In the case of the SENSE pin voltage is less than released voltage $+V_{DET}$, when the V_{DD} pin voltage becomes to 1 V or more, "L" output of D_{OUT} is determined. In case of the SENSE pin voltage is equal or more than the released voltage $+V_{DET}$, when the V_{DD} pin voltage becomes to 1 V or more, "H" output of D_{OUT} is determined.
If the turn on speed of the supply voltage of the VDD pin up to 1 V is slower than the1 V/s, connect 0.001 μF or more capacitor to CD pin, otherwise, powering-up of the VDD pin with the SENSE pin output voltage of $-V_{DET} < V_{SENSE} < +V_{DET}$ may result in an unstable DOUT pin output, "H" or "L", at the point where the VDD pin voltage exceeds 1 V.

TIMING CHART



OUTPUT DELAY OPERATION



Output Delay Operation Diagram

A higher voltage than the released voltage is forced to the SENSE pin, charge to the capacitor connected to CD pin is started, then the CD pin voltage increases. Until CD pin voltage reaches to CD pin threshold voltage, the output of DOUT pin voltage keeps "L", then when CD pin voltage is higher than CD pin threshold voltage, the DOUT pin voltage changes from "L" to "H". The released output delay time means the time interval from when the released voltage threshold or more voltage level is forced to SENSE pin to when DOUT voltage changes from "L" to "H".

When the voltage of DOUT pin reverses from "L" to "H", the discharge of the external capacitor connected to CD pin starts. Therefore, the time interval from when the voltage lower than the detector threshold is forced to SENSE pin, to when the output voltage reverses from "H" to "L", or detector output delay time is constant and independent from the external capacitance value. However, after the DOUT pin voltage reverses from "L" to "H", if a voltage lower than the detector threshold is forced to SENSE pin before the capacitor connected to CD pin is discharged, delay time will increase. The time interval (t_{DIS}) from when the capacitor connected to CD pin is discharged completely to when the capacitor is charged to a certain CD pin voltage (described as V_{CD} herein) can be calculated by power supply voltage (V_{DD}), external capacitance (C_D), on resistance of the CD pin discharge transistor (R_{DIS}) as in the next formula:

$$t_{DIS} = -R_{DIS} \times C_D \times \ln(V_{CD} / (V_{DD} \times 0.45))$$

RELEASED OUTPUT DELAY TIME

The release output delay time (t_{DELAY}) can be calculated as in the next formula with an external capacitance value (C_D):

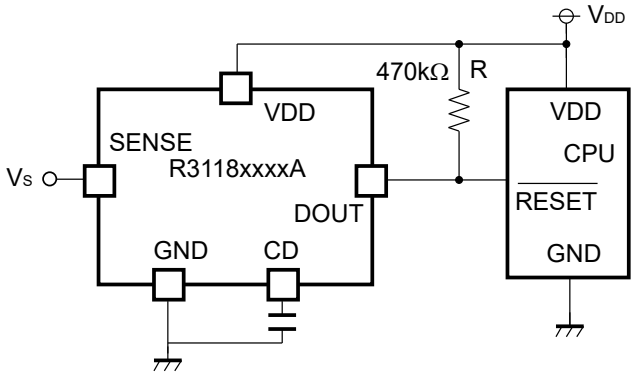
$$t_{DELAY}(s) = 4.545 \times 10^6 \times C_D(F)$$

During the released delay operation, only a small current will charge the external capacitor connected to CD pin. If the leakage current between CD pin and GND is large, the released delay time may increase or the detector may not be released. And, if the VDD pin voltage varies, the released output delay time will be also shift.

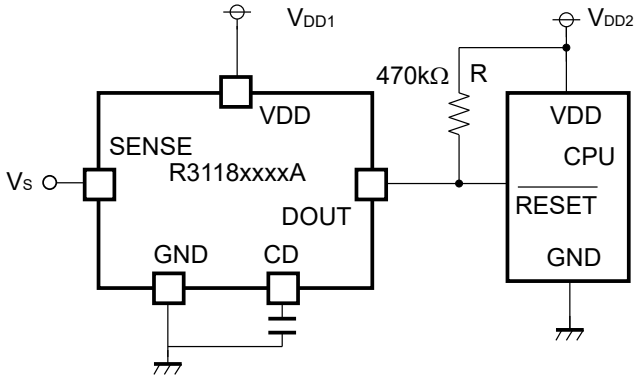
APPLICATION INFORMATION

TYPICAL APPLICATION

R3118xxxxA (Nch. Open-drain Output) CPU Reset Circuit

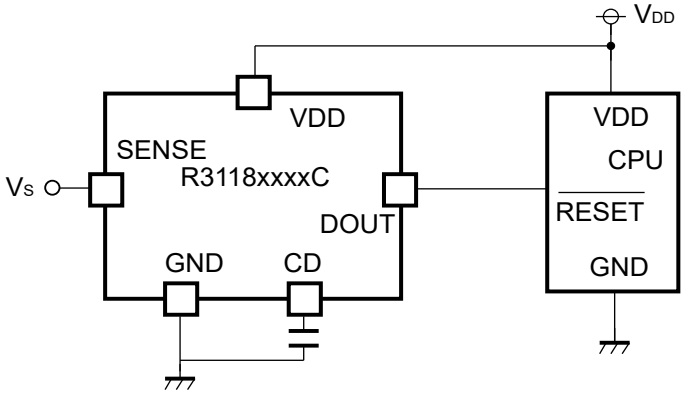


When using a shared input voltage between R3118N and CPU



When using different input voltages between R3118N and CPU

R3118xxxxC (CMOS Output) CPU Reset Circuit

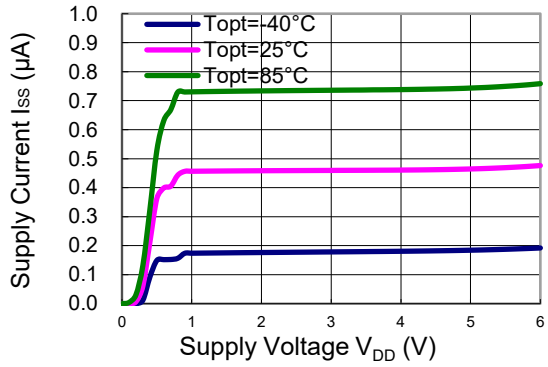


TYPICAL CHARACTERISTICS

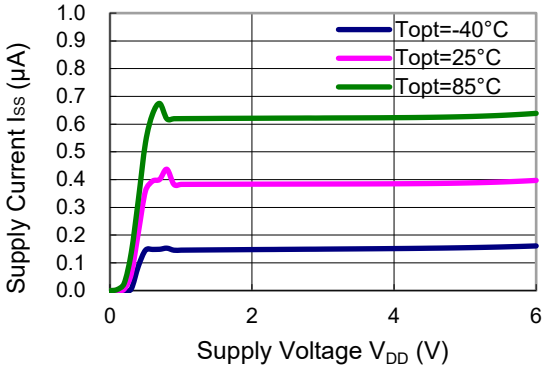
Note: Typical Characteristics are intended to be used as reference data; they are not guaranteed.

1) Supply Current vs. Supply Voltage

R3118xxxxA/C (V_{SENSE} = 0 V)

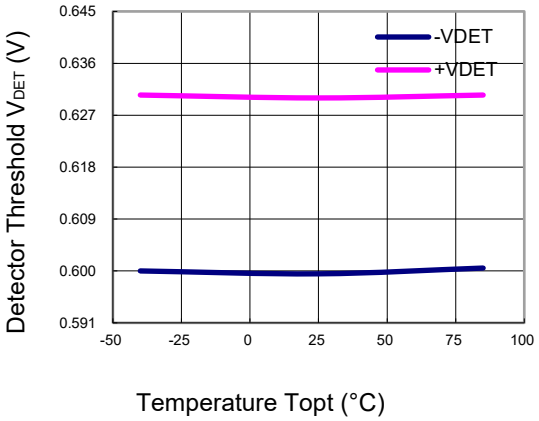


R3118xxxxA/C (V_{SENSE} = 6 V)

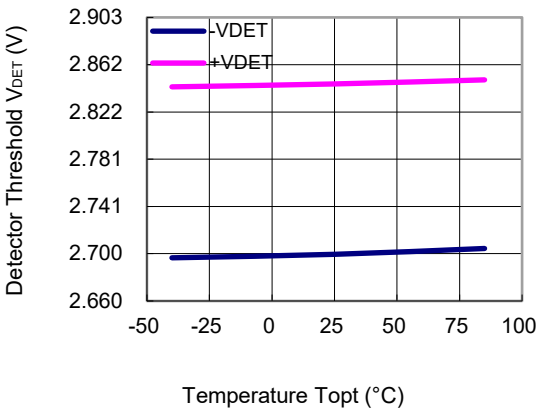


2) Detector Threshold vs. Temperature

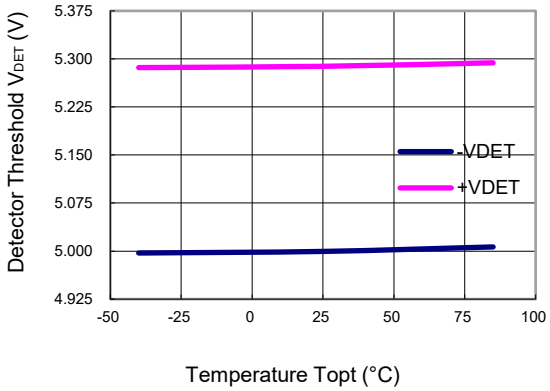
R3118x06xA/C (V_{DD} = 5.3 V)



R3118x27xA/C (V_{DD} = 5.3 V)

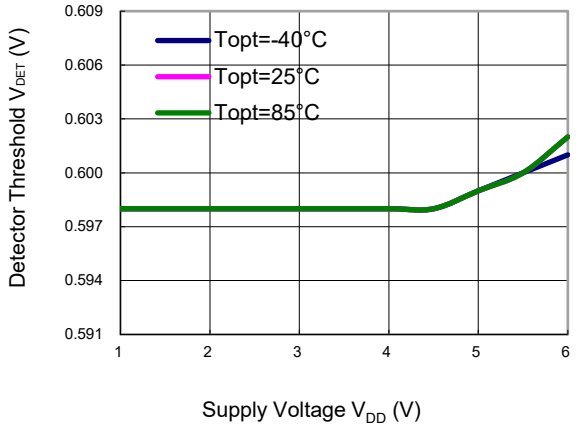


R3118x50xA/C (V_{DD} = 5.3 V)

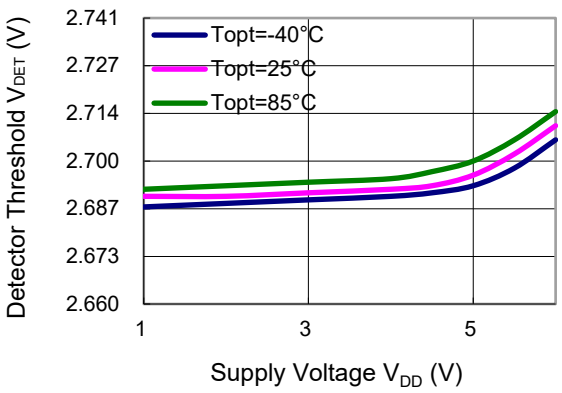


3) Detector Threshold vs. Supply Voltage

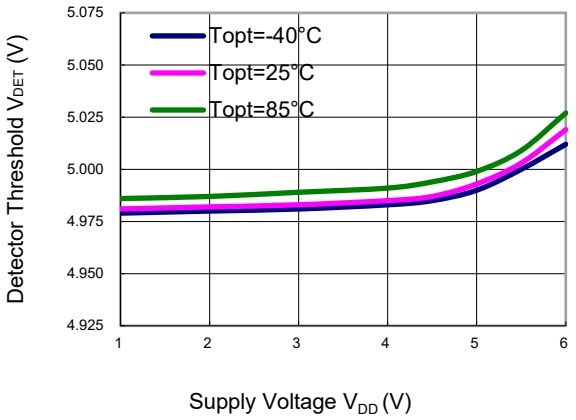
R3118x06xA/C



R3118x27xA/C

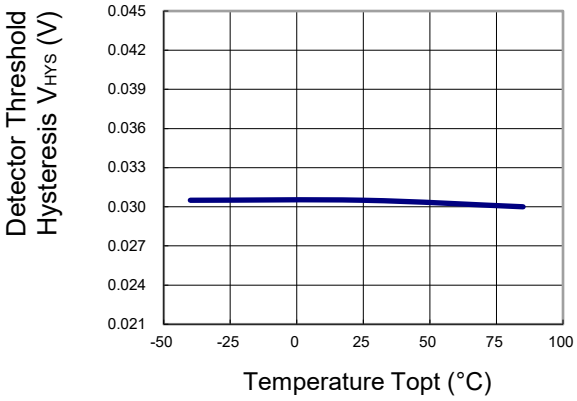


R3118x50xA/C

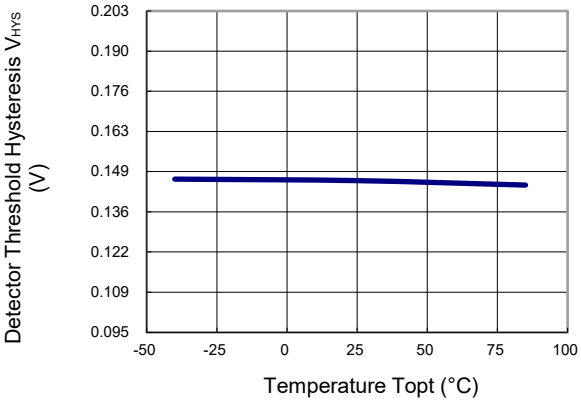


4) Hysteresis vs. Temperature

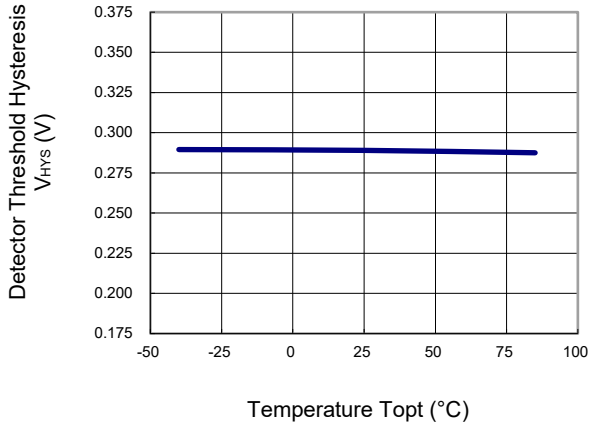
R3118x06xA/C (V_{DD} = 5.3 V)



R3118x27xA/C (V_{DD} = 5.3 V)

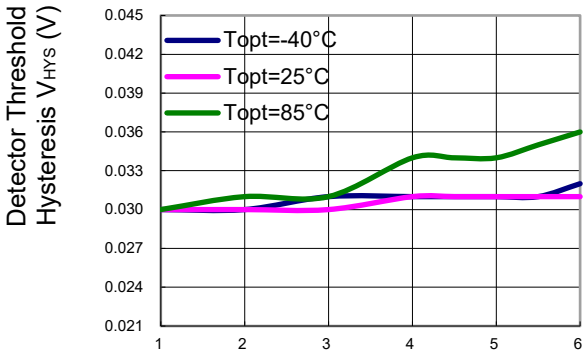


R3118x50xA/C (V_{DD} = 5.3 V)

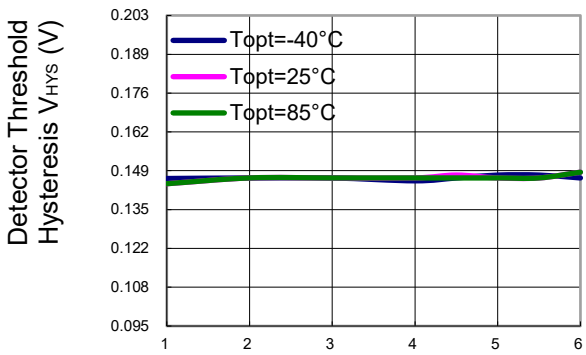


5) Hysteresis vs. Supply Voltage

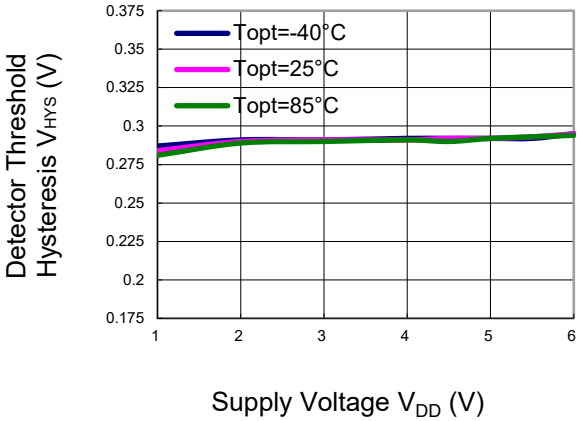
R3118x06xA/C



R3118x27xA/C

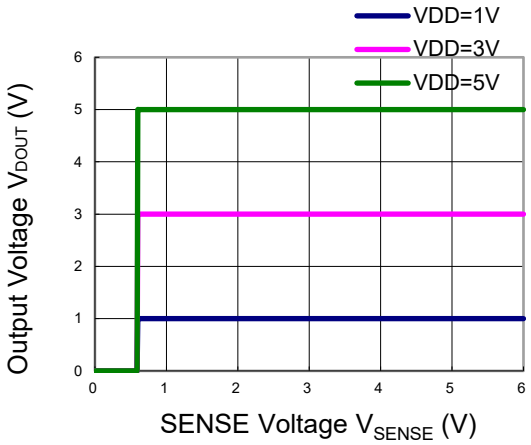


R3118x50xA/C

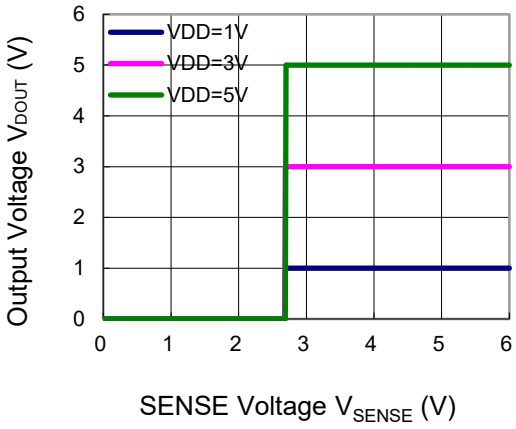


6) Output Voltage vs. SENSE Voltage (DOUT pin is pulled up to VDD pin via 470 kΩ)

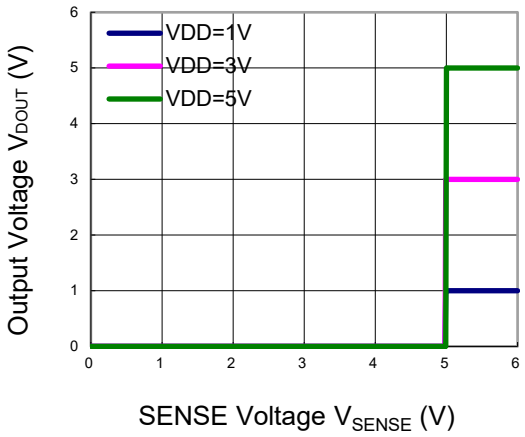
R3118x06xA/C



R3118x27xA/C

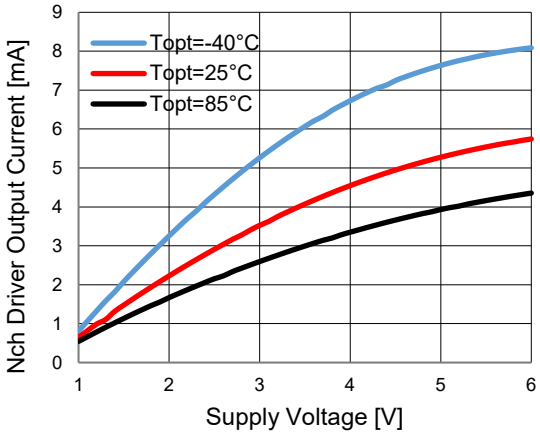


R3118x50xA/C



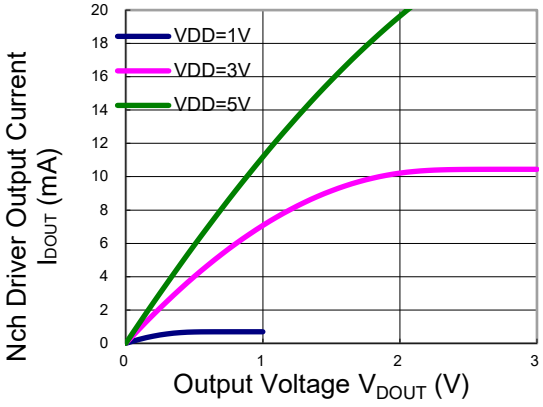
7) Nch. Driver Output Current vs. Supply Voltage

R3118xxxxA/C (V_{DOUT} = 0.4 V)



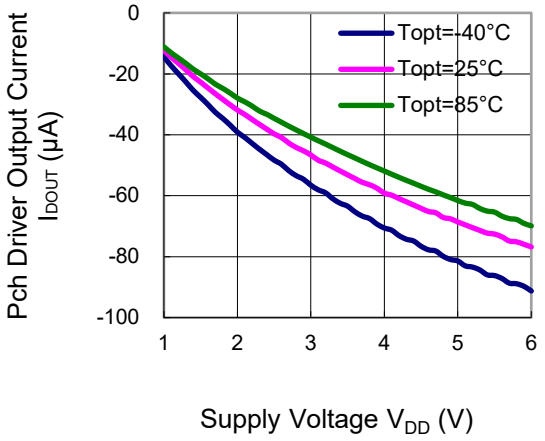
8) Nch. Driver Output Current vs. Output Voltage

R3118xxxxA/C



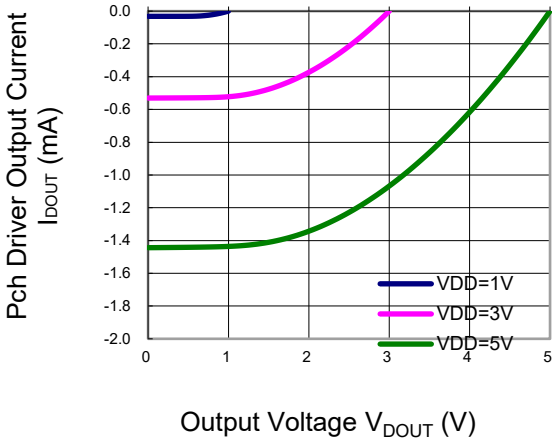
9) Pch. Driver Output Current vs. Supply Voltage

R3118xxxxA/C (V_{DOUT} = V_{DD} - 0.1 V)



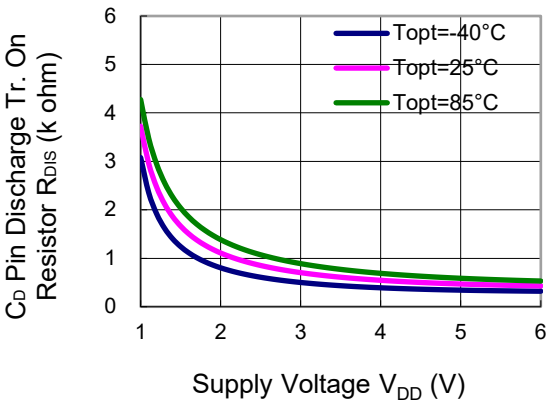
10) Pch Driver Output current vs. Output voltage

R3118xxxxA/C



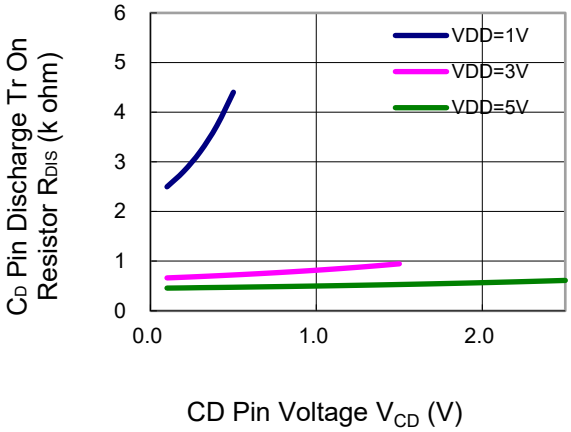
11) CD pin Discharge Tr. On Resistance vs. Supply Voltage

R3118xxxxA/C (V_{CD} = 0.4 V)



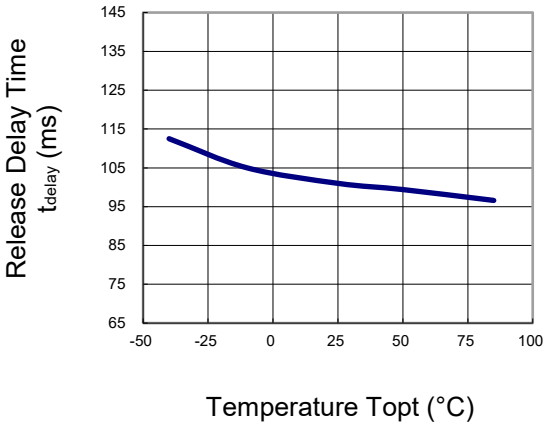
12) CD pin Discharge Transistor On Resistance vs. CD pin Voltage

R3118xxxxA/C



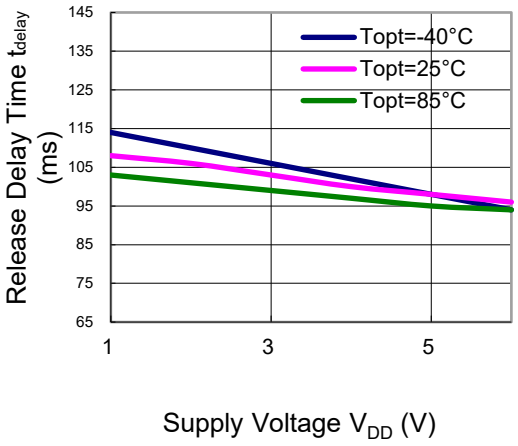
13) Release Output Delay Time vs. Temperature

R3118xxxxA/C (V_{DD} = 4 V, C_D = 0.022 µF)



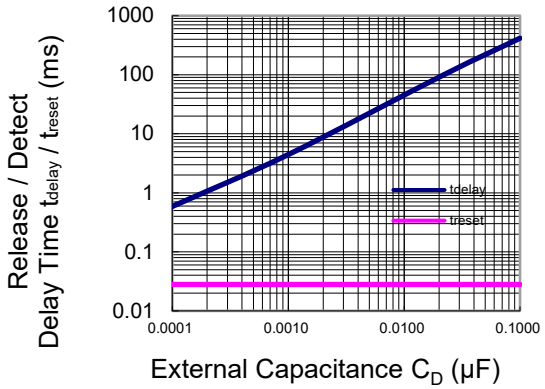
14) Release Output Delay Time vs. Supply Voltage

R3118xxxxA/C (C_D = 0.022 µF)



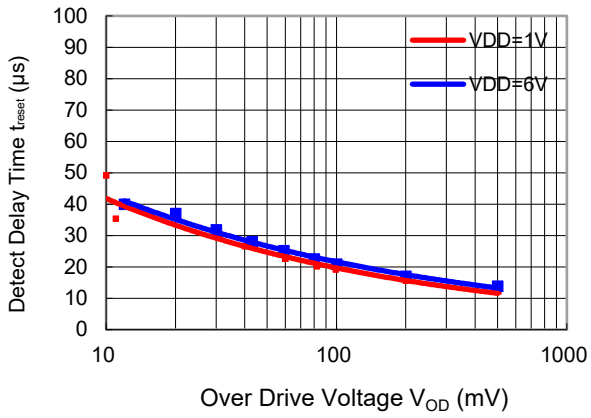
15) Detect Output Delay Time/Release Output Delay Time vs. CD pin External Capacitance

R3118xxxxA/C (V_{DD} = 4 V)

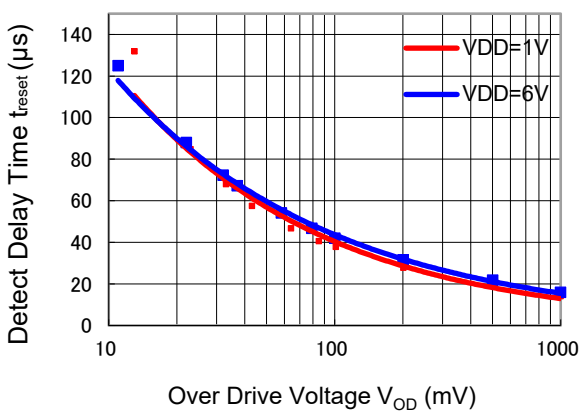


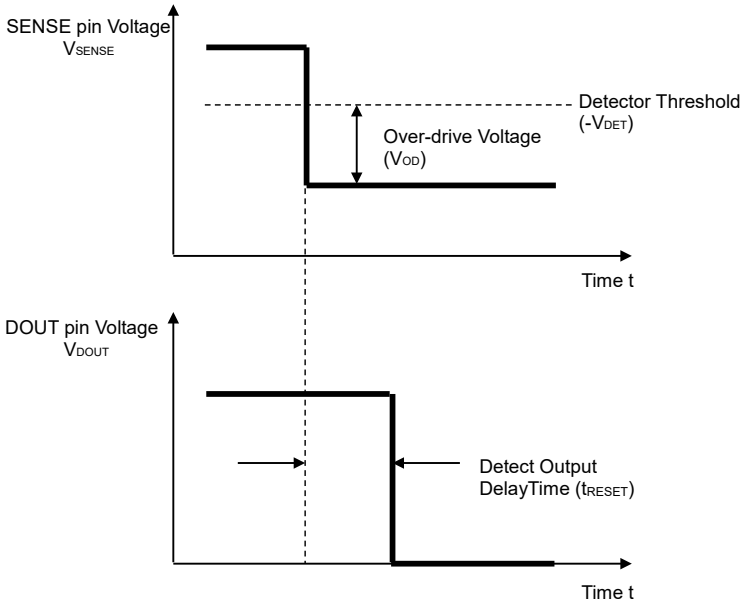
16) Detect Output Delay time vs. Over-drive Voltage

R3118x06xA/C (C_D = none)



R3118x50xA/C (C_D = none)

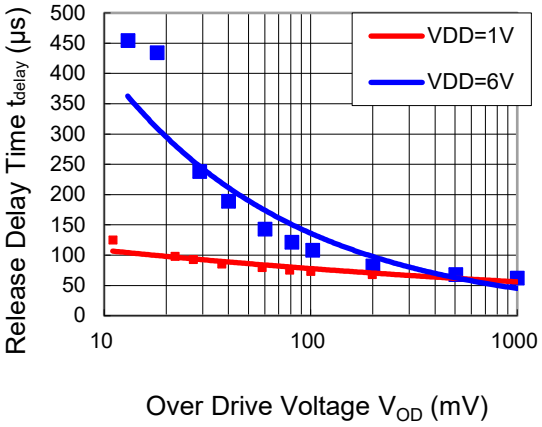




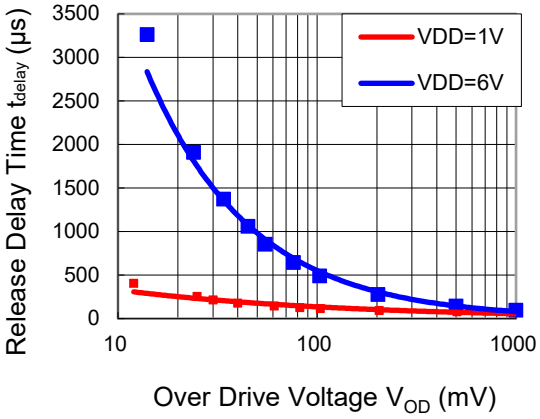
Note: The pulse shorter than the detect output delay time cannot be detected, and "L" does not output from DOUT pin.

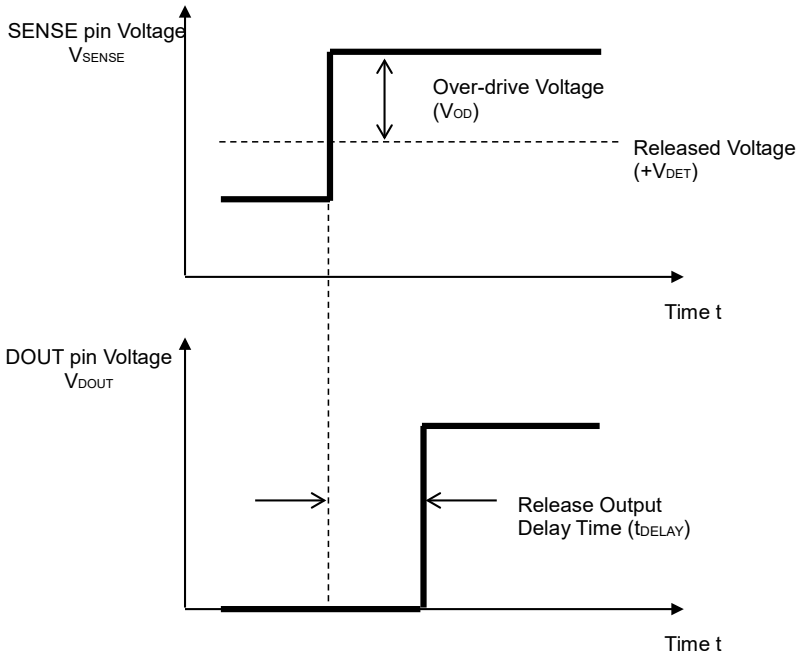
17) Release Output Delay time vs. Over-drive Voltage

R3118x06xA/C (C_D = none)



R3118x50xA/C (C_D = none)





Notes:

- If the pulse is shorter than the output release delay time, the R3118x cannot be released and "H" does not output from DOUT pin.
- If the attachment capacitor for CD pin for setting a delay time is too small and the difference between the released voltage threshold and the actual released voltage is too small or the slope for rising voltage of the SENSE pin is too slow, the output delay time tolerance will be worse.
  Ex. Attachment capacitor = 0.0001 µF, Released voltage threshold = 4.725 V, Actual released voltage = 4.75 V. In this case, the calculated delay time = 0.4545 ms, however, over-drive voltage is only 25 mV. Therefore, the actual delay time will be approximately 2.4545 ms. If the attachment capacitor = 0.001 µF and other conditions are same as above, the calculated delay time = 4.545 ms, and the actual delay time will be approximately 6.545 ms. If the attachment capacitor = 0.01 µF and other conditions are same as above, the calculated delay time = 45.45 ms, and the actual delay time will be approximately 47.45 ms.

Ver. A

The power dissipation of the package is dependent on PCB material, layout, and environmental conditions. The following measurement conditions are based on JEDEC STD. 51-7.

Measurement Conditions

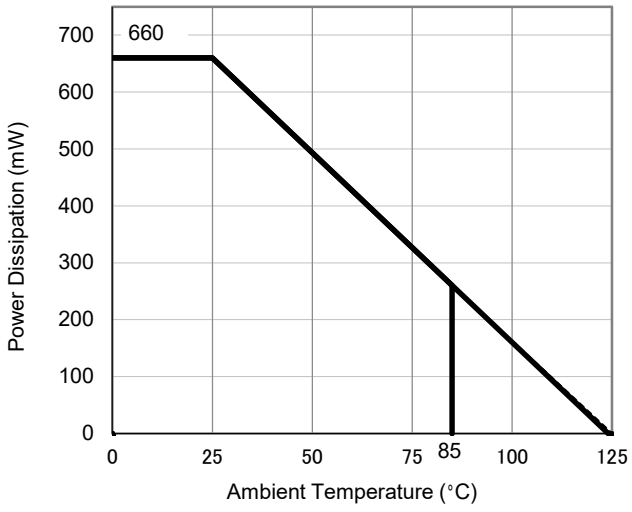
Item	Measurement Conditions
Environment	Mounting on Board (Wind Velocity = 0 m/s)
Board Material	Glass Cloth Epoxy Plastic (Four-Layer Board)
Board Dimensions	76.2 mm × 114.3 mm × 0.8 mm
Copper Ratio	Outer Layer (First Layer): Less than 95% of 50 mm Square Inner Layers (Second and Third Layers): Approx. 100% of 50 mm Square Outer Layer (Fourth Layer): Approx. 100% of 50 mm Square
Through-holes	ϕ 0.3 mm × 7 pcs

Measurement Result (Ta = 25°C, Tjmax = 125°C)

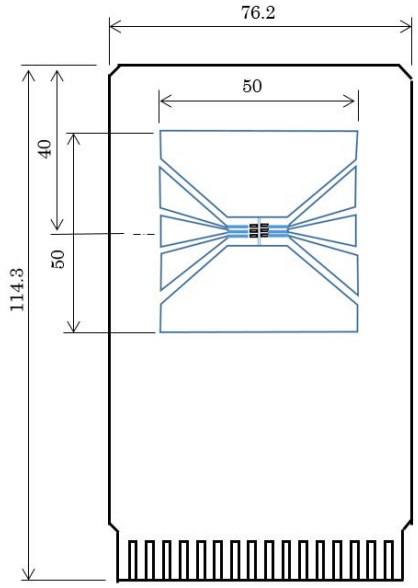
Item	Measurement Result
Power Dissipation	660 mW
Thermal Resistance (θja)	θja = 150°C/W
Thermal Characterization Parameter (ψjt)	ψjt = 51°C/W

θja: Junction-to-Ambient Thermal Resistance

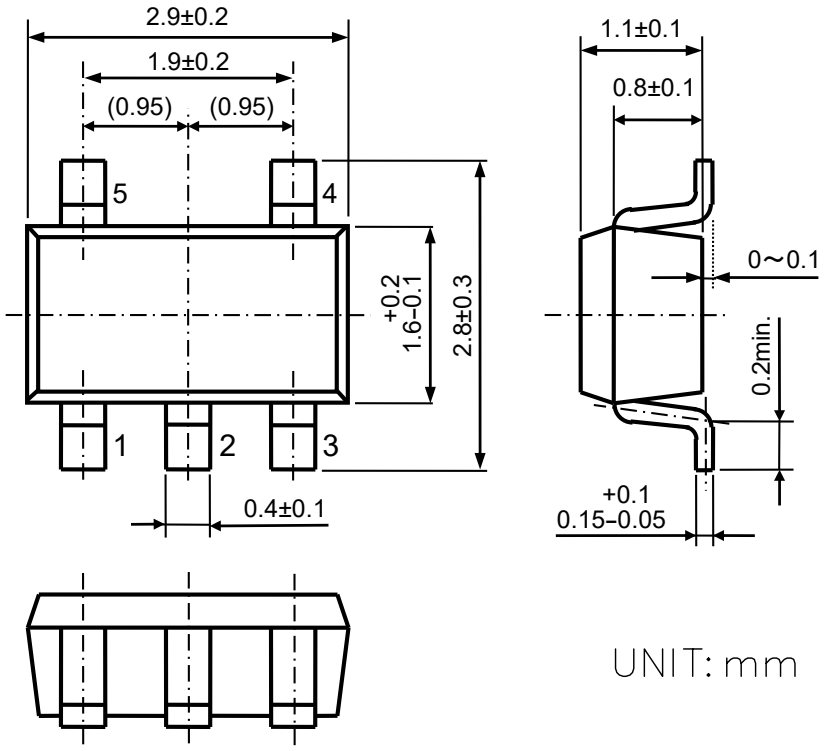
ψjt: Junction-to-Top Thermal Characterization Parameter



Power Dissipation vs. Ambient Temperature



Measurement Board Pattern



SOT-23-5 Package Dimensions

1. The products and the product specifications described in this document are subject to change or discontinuation of production without notice for reasons such as improvement. Therefore, before deciding to use the products, please refer to our sales representatives for the latest information thereon.
2. The materials in this document may not be copied or otherwise reproduced in whole or in part without the prior written consent of us.
3. This product and any technical information relating thereto are subject to complementary export controls (so-called KNOW controls) under the Foreign Exchange and Foreign Trade Law, and related politics ministerial ordinance of the law. (Note that the complementary export controls are inapplicable to any application-specific products, except rockets and pilotless aircraft, that are insusceptible to design or program changes.) Accordingly, when exporting or carrying abroad this product, follow the Foreign Exchange and Foreign Trade Control Law and its related regulations with respect to the complementary export controls.
4. The technical information described in this document shows typical characteristics and example application circuits for the products. The release of such information is not to be construed as a warranty of or a grant of license under our or any third party's intellectual property rights or any other rights.
5. The products listed in this document are intended and designed for automotive applications. Those customers intending to use a product in an application requiring extreme quality and reliability, for example, in a highly specific application where the failure or misoperation of the product could result in human injury or death should first contact us.
    - Aerospace Equipment
    - Equipment Used in the Deep Sea
    - Power Generator Control Equipment (nuclear, steam, hydraulic, etc.)
    - Life Maintenance Medical Equipment
    - Fire Alarms / Intruder Detectors
    - Vehicle Control Equipment (airplane, railroad, ship, etc.)
    - Various Safety Devices
    - Traffic control system
    - Combustion equipment

    In case your company desires to use this product for any applications other than general electronic equipment mentioned above, make sure to contact our company in advance. Note that the important requirements mentioned in this section are not applicable to cases where operation requirements such as application conditions are confirmed by our company in writing after consultation with your company.
6. We are making our continuous effort to improve the quality and reliability of our products, but semiconductor products are likely to fail with certain probability. In order to prevent any injury to persons or damages to property resulting from such failure, customers should be careful enough to incorporate safety measures in their design, such as redundancy feature, fire containment feature and fail-safe feature. We do not assume any liability or responsibility for any loss or damage arising from misuse or inappropriate use of the products.
7. The products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. We shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products.
8. Quality Warranty

    8-1. Quality Warranty Period

    In the case of a product purchased through an authorized distributor or directly from us, the warranty period for this product shall be one (1) year after delivery to your company. For defective products that occurred during this period, we will take the quality warranty measures described in section 8-2. However, if there is an agreement on the warranty period in the basic transaction agreement, quality assurance agreement, delivery specifications, etc., it shall be followed.

    8-2. Quality Warranty Remedies

    When it has been proved defective due to manufacturing factors as a result of defect analysis by us, we will either deliver a substitute for the defective product or refund the purchase price of the defective product.
    Note that such delivery or refund is sole and exclusive remedies to your company for the defective product.

    8-3. Remedies after Quality Warranty Period

    With respect to any defect of this product found after the quality warranty period, the defect will be analyzed by us. On the basis of the defect analysis results, the scope and amounts of damage shall be determined by mutual agreement of both parties. Then we will deal with upper limit in Section 8-2. This provision is not intended to limit any legal rights of your company.
9. Anti-radiation design is not implemented in the products described in this document.
10. The X-ray exposure can influence functions and characteristics of the products. Confirm the product functions and characteristics in the evaluation stage.
11. WLCSP products should be used in light shielded environments. The light exposure can influence functions and characteristics of the products under operation or storage.
12. Warning for handling Gallium and Arsenic (GaAs) products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.
13. Please contact our sales representatives should you have any questions or comments concerning the products or the technical information.

NISSHINBO

Nisshinbo Micro Devices Inc.

Official website
https://www.nisshinbo-microdevices.co.jp/en/

Purchase information
https://www.nisshinbo-microdevices.co.jp/en/buy/