

Low Voltage Detector with Built-in Delay Circuit**Outline:**

BL8509 is a series of high precision voltage detector with ultra low current consumption (500nA typ. at V_{DD}=3.0V) and a built-in delay circuit. It can work at very low voltage, which makes it perfect for system reset.

BL8509 is composed of high precision voltage reference, comparator, delay circuit, output driver and resistor array. Internally preset detect voltage has a low temperature drift and requires no external trimming.

Two type of output, CMOS and N-channel open-drain are available.

BL8509 is available in SOT-23 which is Pb free.

Features:

- High-precision detection Voltage: $\pm 2\%$
- Detection Voltage: 0.9V~6.0V (in 0.1V steps)
- Built-in Power on Reset Delay Time circuit: Refer to Selection Guide
- Operating Voltage range: 0.7V~10V
- Ultra-low current consumption: 500nA typ. (at V_{DD}=3.0V)
- Two Output forms : CMOS and N-channel open-drain (Active Low)

Application:

- Power monitor for portable equipment such as PDA,DSC,Mobile phone,Notebook,MP3
- CPU and Logic Circuit Reset
- Battery Checker
- Battery Back-up Circuit
- Power Failure Detector

Selection Guide:
8509- XXX X X XX

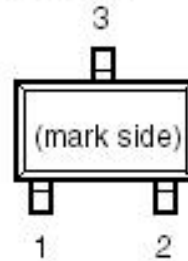
 Package type:
 RM: SOT-23-3

 Output type:
 N: Nch
 C: CMOS

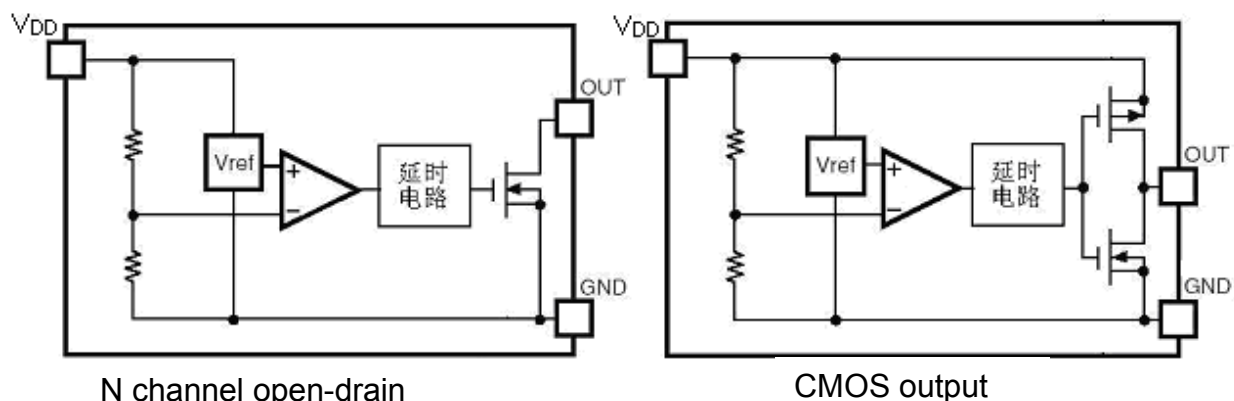
 Delay time:
 A: 50mS
 B: 100mS
 C: 150mS
 D: 200mS
 E: 250mS
 F: 300mS
 G: 400mS

 Detector voltage:
 090 0.9V
 100 1.0V
 263 2.63V
 300 3.0V
 465 4.65V

 600 6.0V
 (In 0.1V step)

Pin Alignment
• SOT-23-3

Pin Description:

PIN Number	PIN Name	Function
1	VSS	GND Pin
2	VOUT	Voltage detection output Pin
3	VDD	Voltage input Pin

Block diagram:

Absolute Maximum Ratings:

Input Voltage range	-----	-0.3V~12V
Output Voltage range	-----	-0.3V~12V
Maximum Output current	-----	70mA
Maximum power dissipation	-----	150mW
Ambient temperature	-----	-40~+70°C
Storage temperature	-----	-40~125°C
Lead temperature and time	-----	260°C,10S

Recommended Work Conditions:

Item	Min	Recommended	Max	unit
Input Voltage range	0.7		10	V
Ambient temperature	-40	25	70	°C

Electrical Characteristics:

- BL8509-090DNRM (0.9V) (T_{opt}=25°C, Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V _{DET}	Detector Threshold		0.882	0.9	0.918	V
I _{SS}	Current consumption	V _{DD} =2.9V		1	1.5	uA
V _{DDH}	Maximum operating voltage				10	V
V _{DDL}	Minimum Operating voltage			0.5		V
I _{OUT}	Output current	Nch V _{DS} =0.05V, V _{DD} =0.7V	0.01	0.05		mA
		V _{DS} =0.50V, V _{DD} =0.8V	0.05	0.50		
		Pch V _{DS} =-2.1V, V _{DD} =4.50V	1.0	2.0		mA

- BL8509-270DNRM (2.7V)

 (T_{opt}=25℃, Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V _{DET}	Detector Threshold		2.646	2.7	2.754	V
I _{SS}	Current consumption	V _{DD} =4.7V		0.5	1	uA
V _{DDH}	Maximum operating voltage				10	V
V _{DDL}	Minimum Operating voltage			0.5		V
I _{OUT}	Output current	Nch V _{DS} =0.05V, V _{DD} =0.70V	0.01	0.05		mA
		Pch V _{DS} =-2.1V, V _{DD} =4.50V	1.0	2.0		mA

- BL8509-300DNRM (3.0V)

 (T_{opt}=25℃, Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V _{DET}	Detector Threshold		2.94	3.0	3.06	V
I _{SS}	Current consumption	V _{DD} =5.0V		0.5	1	uA
V _{DDH}	Maximum operating voltage				10	V
V _{DDL}	Minimum Operating voltage			0.5		V
I _{OUT}	Output current	Nch V _{DS} =0.05V, V _{DD} =0.7V	0.01	0.05		mA
		Pch V _{DS} =-2.1V, V _{DD} =4.50V	1.0	2.0		mA

- BL8509-340DNRM (3.4V)

 (T_{opt}=25℃, Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V _{DET}	Detector Threshold		3.332	3.4	3.468	V
I _{SS}	Current consumption	V _{DD} =5.0V		0.5	1	uA
V _{DDH}	Maximum operating voltage				10	V
V _{DDL}	Minimum Operating voltage			0.5		V
I _{OUT}	Output current	Nch V _{DS} =0.05V, V _{DD} =0.7V	0.01	0.05		mA
		Pch V _{DS} =-2.1V, V _{DD} =4.50V	1.0	2.0		mA

● BL8509-440DNRM (4.4V)

(T_{opt}=25℃, Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V _{DET}	Detector Threshold		4.312	4.4	4.488	V
I _{SS}	Current consumption	V _{DD} =6.4V		0.5	1	uA
V _{DDH}	Maximum operating voltage				10	V
V _{DDL}	Minimum Operating voltage			0.5		V
I _{OUT}	Output current	Nch V _{DS} =0.05V, V _{DD} =0.7V	0.01	0.05		mA
		Pch V _{DS} =-2.1V, V _{DD} =8.0V	1.5	3.0		mA

Electrical Characteristics By Detector Threshold

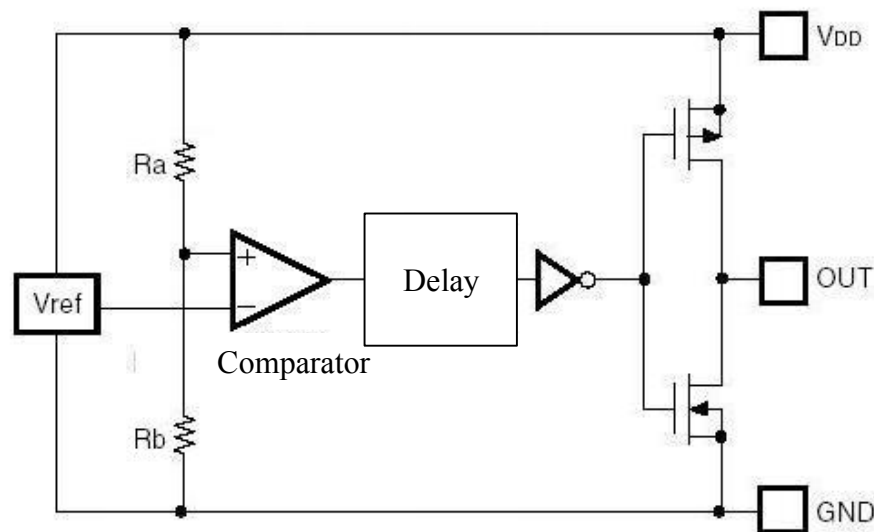
Part Number	Detector Threshold			Supply Current1			Supply Current2		
	-Vdet[V]			Iss1[μ A]			Iss2[μ A]		
	Min.	Typ.	Max.	Condition	Typ.	Max.	Condition	Typ.	Max.
BL8509-0900XXXX	0.882	0.900	0.918	Vdd= (-Vdet) +0.1V	0.5	1.0	Vdd= (-Vdet) +2V	1.0	1.5
BL8509-1000XXXX	0.980	1.000	1.020						
BL8509-1100XXXX	1.078	1.100	1.122						
BL8509-1200XXXX	1.176	1.200	1.224						
BL8509-1300XXXX	1.274	1.300	1.326						
BL8509-1400XXXX	1.372	1.400	1.428						
BL8509-1500XXXX	1.470	1.500	1.530						
BL8509-1600XXXX	1.568	1.600	1.632						
BL8509-170XXXX	1.666	1.700	1.734						
BL8509-180XXXX	1.764	1.800	1.836						
BL8509-190XXXX	1.862	1.900	1.938						
BL8509-200XXXX	1.960	2.000	2.040						
BL8509-210XXXX	2.058	2.100	2.142						
BL8509-220XXXX	2.156	2.200	2.244						
BL8509-230XXXX	2.254	2.300	2.346						
BL8509-240XXXX	2.352	2.400	2.448						
BL8509-250XXXX	2.450	2.500	2.550						
BL8509-260XXXX	2.548	2.600	2.652						
BL8509-270XXXX	2.646	2.700	2.754						
BL8509-280XXXX	2.744	2.800	2.856						
BL8509-290XXXX	2.842	2.900	2.958						
BL8509-300XXXX	2.940	3.000	3.060						
BL8509-310XXXX	3.038	3.100	3.162						
BL8509-320XXXX	3.136	3.200	3.264						
BL8509-330XXXX	3.234	3.300	3.366						
BL8509-340XXXX	3.332	3.400	3.468						
BL8509-350XXXX	3.430	3.500	3.570						
BL8509-360XXXX	3.528	3.600	3.672						
BL8509-370XXXX	3.626	3.700	3.774						
BL8509-380XXXX	3.724	3.800	3.876						
BL8509-390XXXX	3.822	3.900	3.978						
BL8509-400XXXX	3.920	4.000	4.080				0.5	1.0	1.0
BL8509-410XXXX	4.018	4.100	4.182						
BL8509-420XXXX	4.116	4.200	4.284						
BL8509-430XXXX	4.214	4.300	4.386						
BL8509-440XXXX	4.312	4.400	4.488						
BL8509-450XXXX	4.410	4.500	4.590						
BL8509-460XXXX	4.508	4.600	4.692						
BL8509-470XXXX	4.606	4.700	4.794						
BL8509-480XXXX	4.704	4.800	4.896						
BL8509-490XXXX	4.802	4.900	4.998						
BL8509-500XXXX	4.900	5.000	5.100						
BL8509-510XXXX	4.998	5.100	5.202						
BL8509-520XXXX	5.096	5.200	5.304						
BL8509-530XXXX	5.194	5.300	5.406						
BL8509-540XXXX	5.292	5.400	5.508						
BL8509-550XXXX	5.390	5.500	5.610						
BL8509-560XXXX	5.488	5.600	5.712						
BL8509-570XXXX	5.586	5.700	5.814						
BL8509-580XXXX	5.684	5.800	5.916						
BL8509-590XXXX	5.782	5.900	6.018						
BL8509-600XXXX	5.880	6.000	6.120						

Output Current1			Output Current2				Minimum Operating Voltage		Detector Threshold Temperature Coefficient	
Iout1[mA]			Iout2[mA]				VDDL[V]		-VDET/	Tppm/°C
Condition	Min.	Typ.	Condition		Min.	Typ.	Typ.	Max.	Condition	Typ.
NCH, V _{DS} =0.05V , V _{DD} =0.7V	0.01	0.05	NCH, V _{DS} =0.5V V _{DD} =1.5V	Vdd=0.8 5V	0.1	0.5	0.5	0.7	-40 °C T _{opt} 85 °C	100
				Vdd=1.0V	0.2	1.0				
					1.0	2.0				

Electrical Characteristics by Output Delay Time

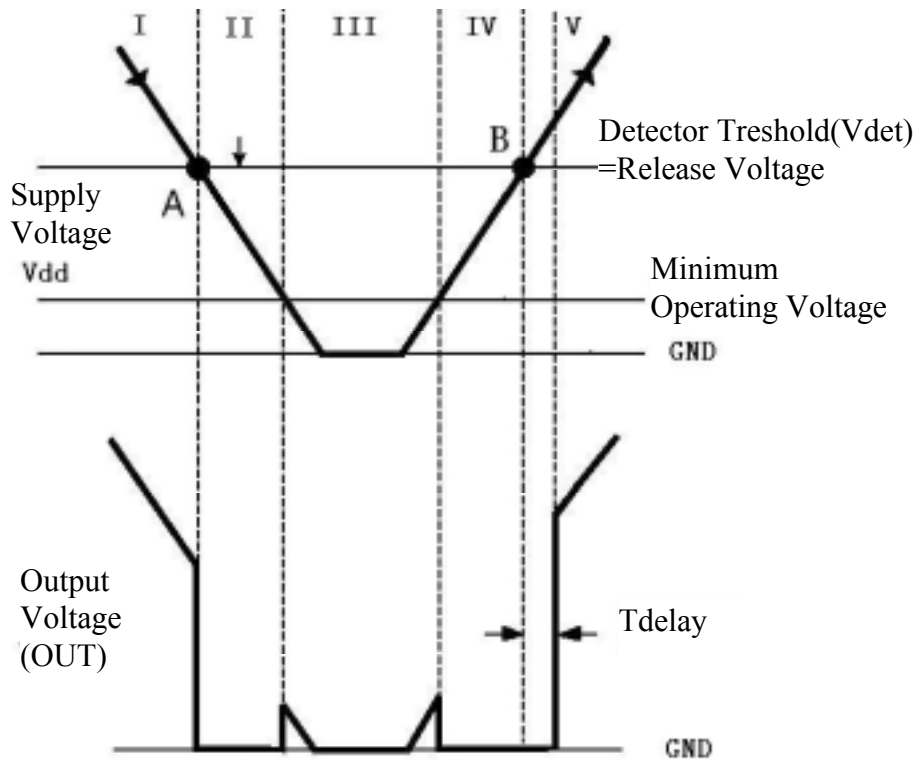
Part Number	Test Condition	Output Delay Time			Unit
		Min.	Typ.	Max.	
8509-xxxAxxx	VDD=1.0V to Vdet+1.0V	45	50	55	ms
8509-xxxBxxx		90	100	110	
8509-xxxCxxx		135	150	165	
8509-xxxDxxx		180	200	220	
8509-xxxExxx		225	250	275	
8509-xxxFxxx		270	300	330	
8509-xxxGxxx		360	400	440	

Function description:



High precision low temperature co-efficiency reference voltage is applied to the negative input of a comparator. Input voltage, divided by resistor array of Ra and Rb, is applied to the positive input of the comparator. Output of the comparator passes a delay circuit and a series of buffer to drive the output CMOS pair.

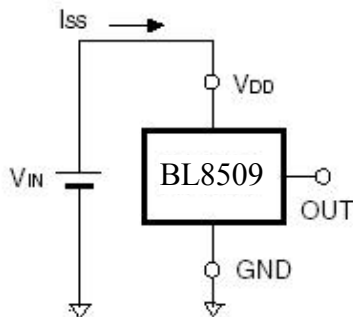
$$V_{DET} = V_{REF} * (1 + R_a/R_b)$$



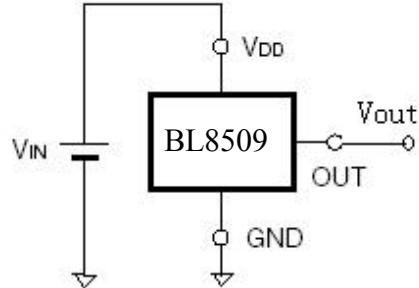
No.	Operation status	Output status
I	$V_{DD} > V_{det}$	Output voltage is equal to the supply voltage
II	V_{DD} drops below V_{det}	Output voltage equals to GND level
III	V_{DD} drops further below V_{DDL}	Output voltage is undefined
IV	V_{DD} rises above V_{DDL}	Output voltage equals to GND level
V	V_{DD} rises above V_{det}	Output voltage equals to supply voltage after T_{delay}

Test circuits:

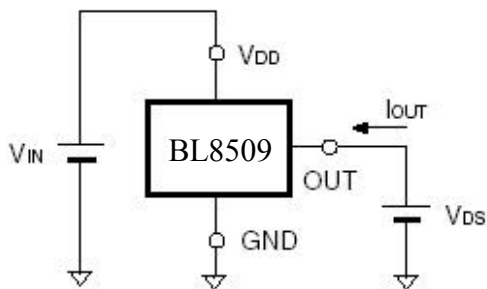
(1) Supply current test circuit



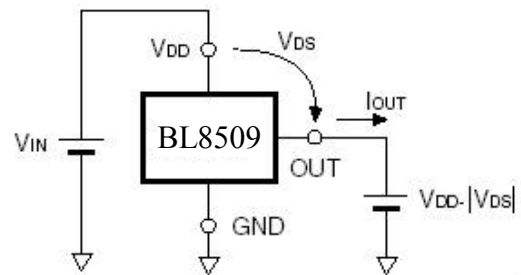
(2) Detector threshold test circuit



(3) NCH Drive Output Current Test Circuit



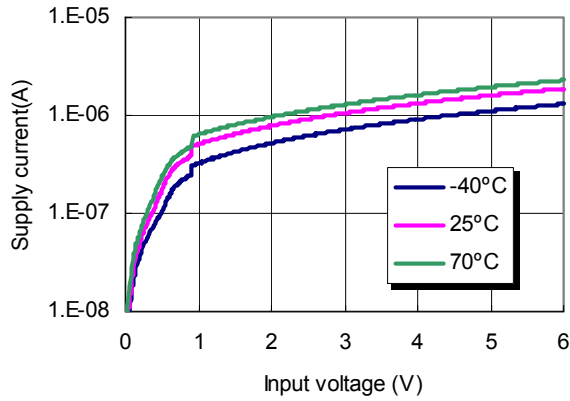
(4) PCH Drive Output Current Test Circuit



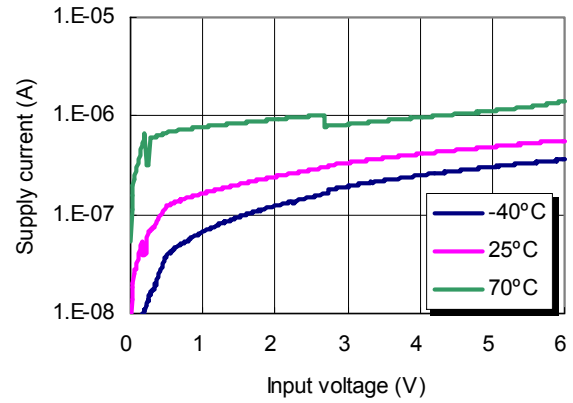
Typical Performance Characteristics:

1) Supply current VS. Input voltage

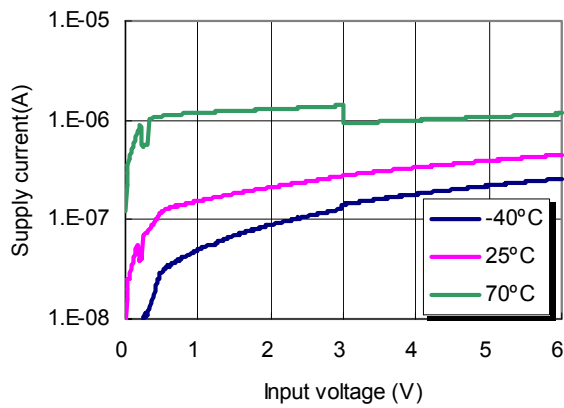
Detector threshold= 0.9V



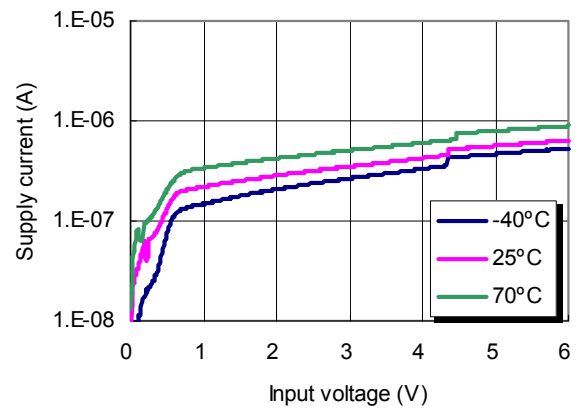
Detector threshold=2.7V



Detector threshold=3.0V

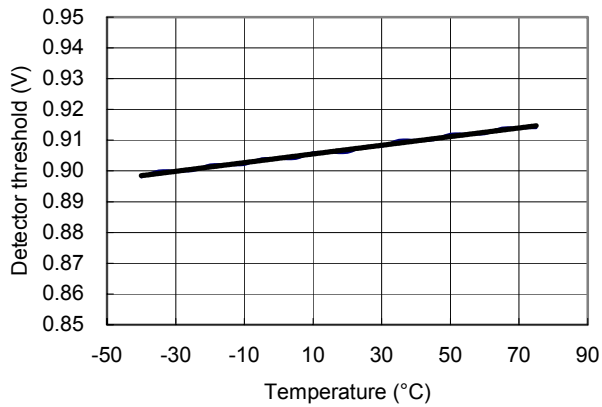


Detector threshold=4.4V

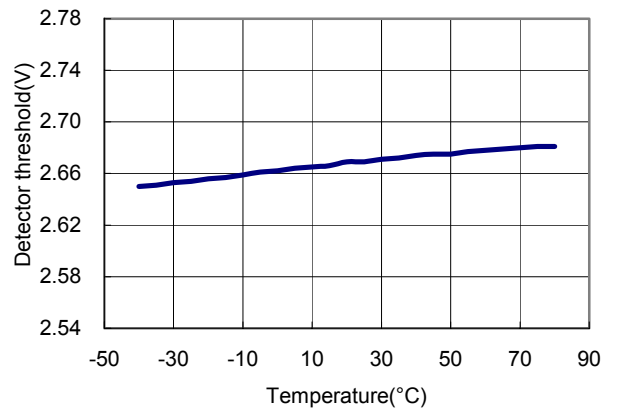


2) Detector Threshold VS. Temperature

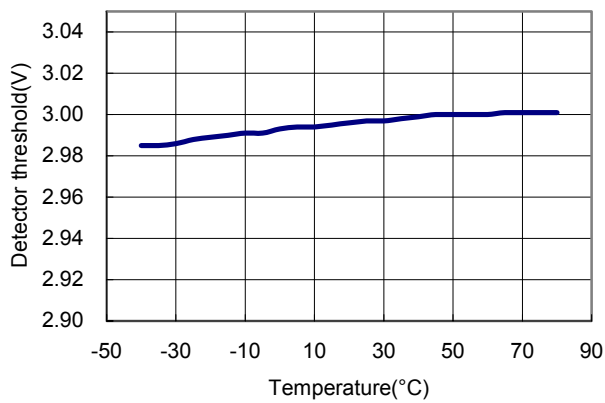
Detector threshold= 0.9V



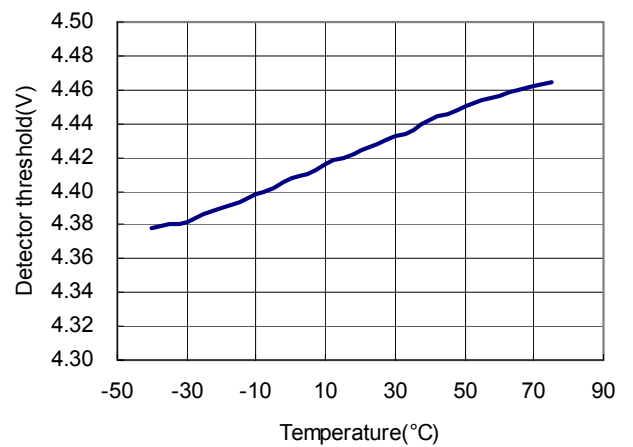
Detector threshold=2.7V



Detector threshold=3.0V

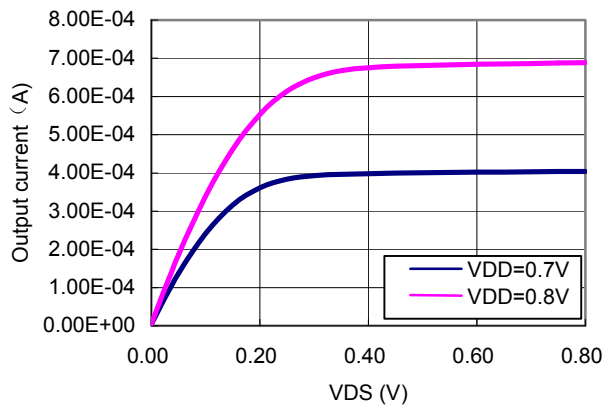


Detector threshold=4.4V

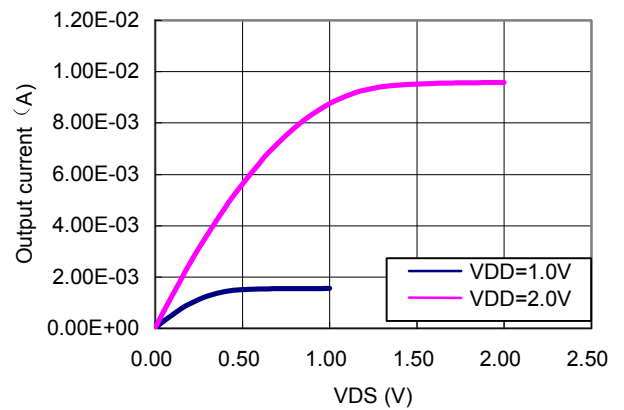


3) Nch Driver Output Current VS. V_{DS}

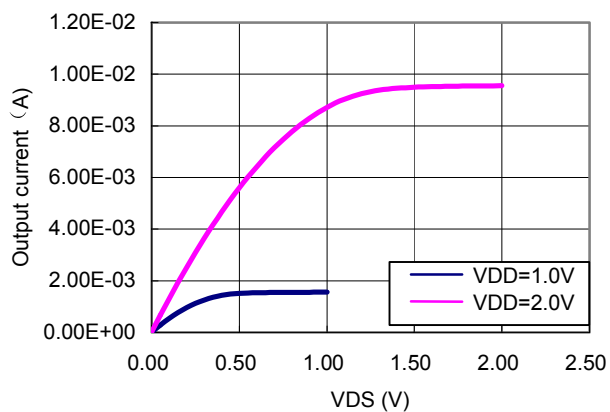
BL8509-090xxx



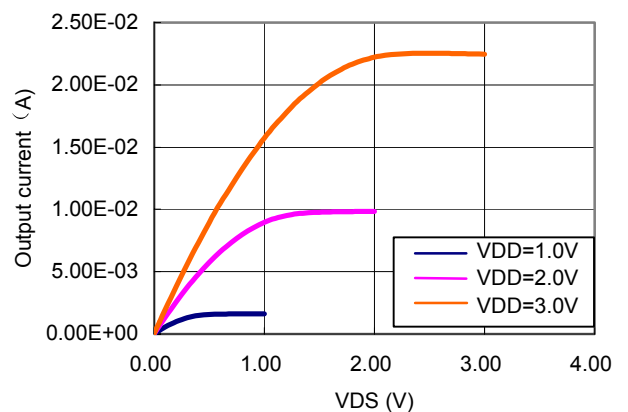
BL8509-270xxx



BL8509-300xxx

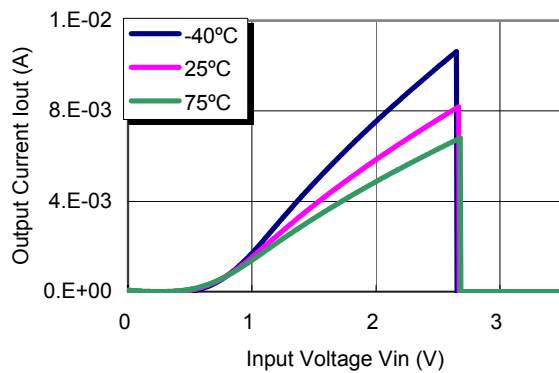


BL8509-440xxx

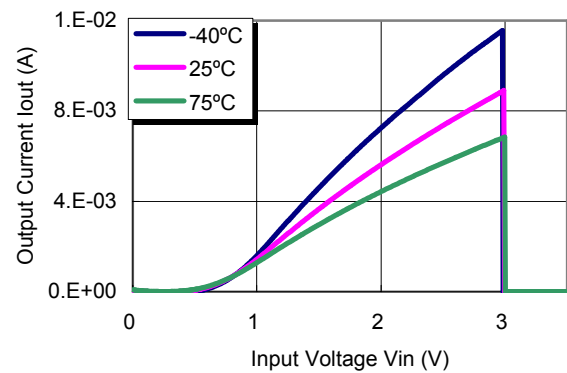


4) NCH Driver Output Current vs. Input Voltage

Detector threshold=2.7V

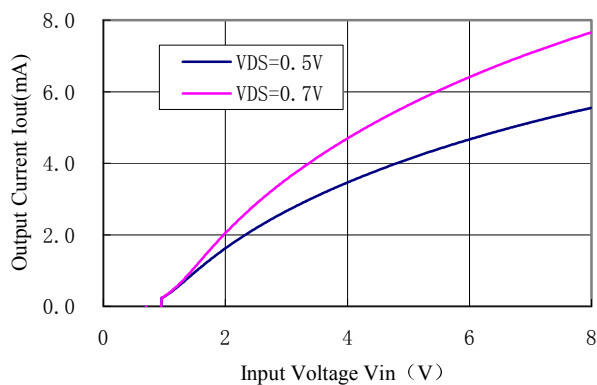


Detector threshold=3.0V

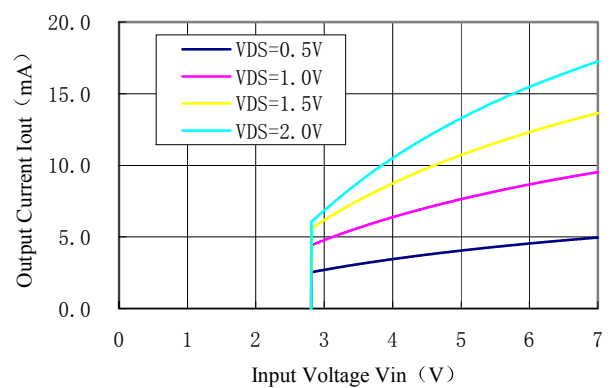


5) PCH Driver Output Current vs. Input Current

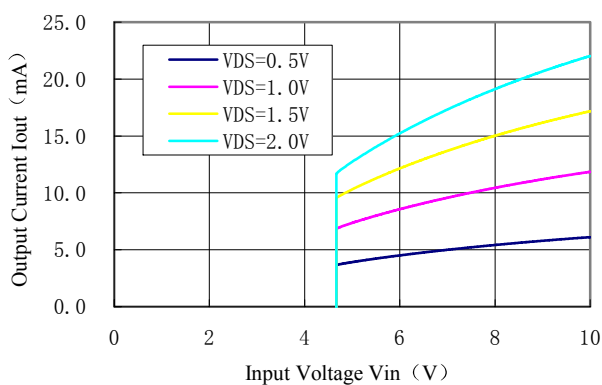
Detector threshold=0.9V



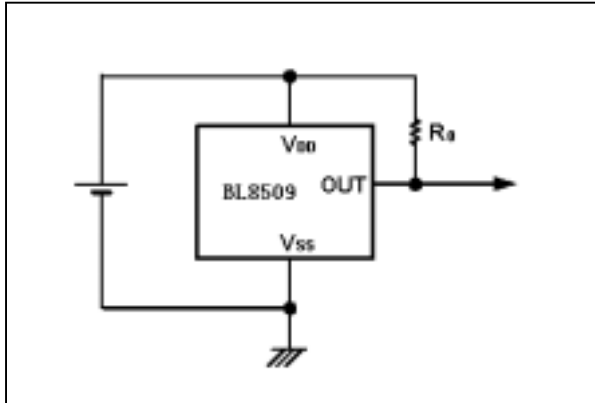
Detector threshold=2.7V



Detector threshold=4.4V



Typical applications:



Note:

1. R_0 is unnecessary for CMOS output products.
2. The value of R_0 need to be selected in different application, Typical value is $470k\ \Omega$

Package Outline:

SOT-23-3:

Package	SOT-23-3	Devices per reel	3000	Unit	mm
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Package dimension:

The drawing shows the mechanical dimensions of the SOT-23-3 package. The top view shows a rectangular body with a width of 2.9 ± 0.2 mm and a length of 1.9 ± 0.2 mm. The distance between the two side leads (1 and 2) is 0.95 mm, and the distance between the side lead (1) and the top lead (3) is 0.4 ± 0.1 mm. The height of the package is 2.8 ± 0.3 mm. The side view shows a maximum height of 1.4 mm, a lead height of $1.1^{+0.2}_{-0.1}$ mm, a lead thickness of 0.8 mm, and a minimum lead thickness of 0.2 mm. The bottom view shows a width of 1.6 ± 0.2 mm and a length of 1.9 ± 0.2 mm. The distance between the two side leads (1 and 2) is 0.95 mm, and the distance between the side lead (1) and the top lead (3) is 0.4 ± 0.1 mm.

Taping Specification:

The drawing shows the taping specification for the SOT-23-3 package. The top view shows a rectangular body with a width of 2.0 mm (maximum) and a length of 4.0 ± 0.1 mm. The distance between the two side leads (1 and 2) is 0.3 ± 0.1 mm. The distance between the side lead (1) and the top lead (3) is 0.4 ± 0.1 mm. The height of the package is 1.75 ± 0.1 mm. The side view shows a maximum height of 1.4 mm, a lead height of $1.1^{+0.2}_{-0.1}$ mm, a lead thickness of 0.8 mm, and a minimum lead thickness of 0.2 mm. The bottom view shows a width of 1.6 ± 0.2 mm and a length of 1.9 ± 0.2 mm. The distance between the two side leads (1 and 2) is 0.95 mm, and the distance between the side lead (1) and the top lead (3) is 0.4 ± 0.1 mm.

Taping reel dimension:

