



BL8509

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.

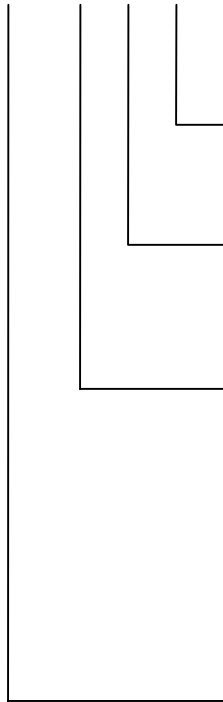
Features:

- 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

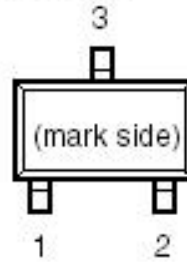
 Delay time:
 A: 50mS
 B: 100mS
 C: 150mS
 D: 200mS
 E: 250mS
 F: 300mS
 G: 400mS

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

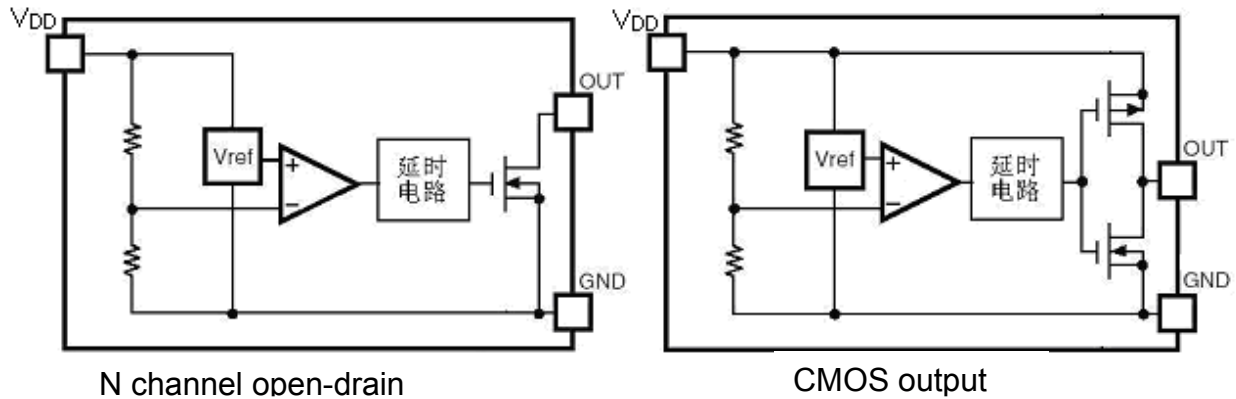
 600 6.0V
 (In 0.1V step)

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) (Topt=25°C, Unless otherwise specified.)

| Symbol | Parameter | Conditions | Reference data | | | Unit |
|------------------|---------------------------|---|----------------|------|-------|------|
| | | | Min. | Typ. | Max. | |
| -VDET | 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) (Topt=25°C, 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) (Topt=25°C, 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) (Topt=25°C, 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°C, 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

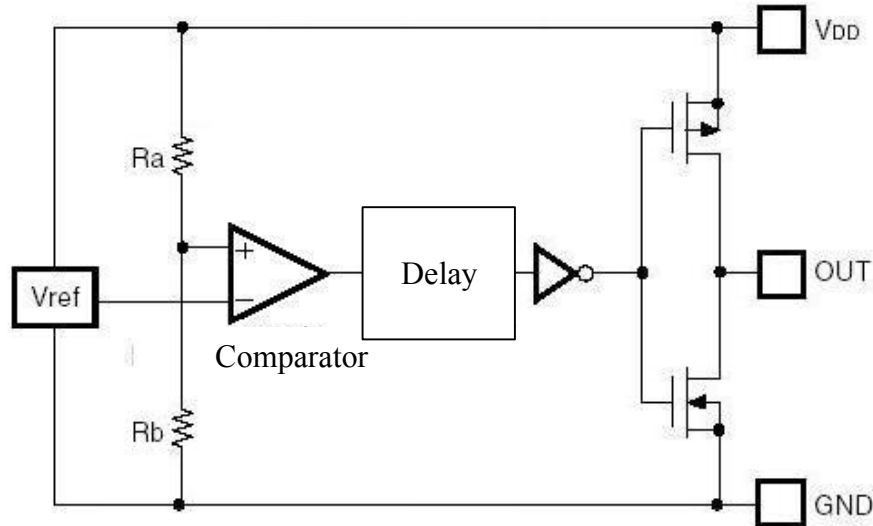
| Part Number | Detector Threshold | | | Supply Current1 | | | Supply Current2 | | |
|-----------------|--------------------|-------|-------|--------------------------|------|------|------------------------|------|------|
| | -Vdet[V] | | | Iss1[μ A] | | | Iss2[μ A] | | |
| | Min. | Typ. | Max. | Condition | 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 | | | | | | |
| BL8509-1700XXXX | 1.666 | 1.700 | 1.734 | | | | | | |
| BL8509-1800XXXX | 1.764 | 1.800 | 1.836 | | | | | | |
| BL8509-1900XXXX | 1.862 | 1.900 | 1.938 | | | | | | |
| BL8509-2000XXXX | 1.960 | 2.000 | 2.040 | | | | | | |
| BL8509-2100XXXX | 2.058 | 2.100 | 2.142 | | | | | | |
| BL8509-2200XXXX | 2.156 | 2.200 | 2.244 | | | | | | |
| BL8509-2300XXXX | 2.254 | 2.300 | 2.346 | | | | | | |
| BL8509-2400XXXX | 2.352 | 2.400 | 2.448 | | | | | | |
| BL8509-2500XXXX | 2.450 | 2.500 | 2.550 | | | | | | |
| BL8509-2600XXXX | 2.548 | 2.600 | 2.652 | | | | | | |
| BL8509-2700XXXX | 2.646 | 2.700 | 2.754 | | | | | | |
| BL8509-2800XXXX | 2.744 | 2.800 | 2.856 | | | | | | |
| BL8509-2900XXXX | 2.842 | 2.900 | 2.958 | | | | | | |
| BL8509-3000XXXX | 2.940 | 3.000 | 3.060 | | | | | | |
| BL8509-3100XXXX | 3.038 | 3.100 | 3.162 | | | | | | |
| BL8509-3200XXXX | 3.136 | 3.200 | 3.264 | | | | | | |
| BL8509-3300XXXX | 3.234 | 3.300 | 3.366 | | | | | | |
| BL8509-3400XXXX | 3.332 | 3.400 | 3.468 | | | | | | |
| BL8509-3500XXXX | 3.430 | 3.500 | 3.570 | | | | | | |
| BL8509-3600XXXX | 3.528 | 3.600 | 3.672 | | | | | | |
| BL8509-3700XXXX | 3.626 | 3.700 | 3.774 | | | | | | |
| BL8509-3800XXXX | 3.724 | 3.800 | 3.876 | | | | | | |
| BL8509-3900XXXX | 3.822 | 3.900 | 3.978 | | | | | | |
| BL8509-4000XXXX | 3.920 | 4.000 | 4.080 | | | | | | |
| BL8509-4100XXXX | 4.018 | 4.100 | 4.182 | | | | | | |
| BL8509-4200XXXX | 4.116 | 4.200 | 4.284 | | | | | | |
| BL8509-4300XXXX | 4.214 | 4.300 | 4.386 | | | | | | |
| BL8509-4400XXXX | 4.312 | 4.400 | 4.488 | | | | | | |
| BL8509-4500XXXX | 4.410 | 4.500 | 4.590 | | | | | | |
| BL8509-4600XXXX | 4.508 | 4.600 | 4.692 | | | | | | |
| BL8509-4700XXXX | 4.606 | 4.700 | 4.794 | | | | | | |
| BL8509-4800XXXX | 4.704 | 4.800 | 4.896 | | | | | | |
| BL8509-4900XXXX | 4.802 | 4.900 | 4.998 | | | | | | |
| BL8509-5000XXXX | 4.900 | 5.000 | 5.100 | | | | | | |
| BL8509-5100XXXX | 4.998 | 5.100 | 5.202 | | | | | | |
| BL8509-5200XXXX | 5.096 | 5.200 | 5.304 | | | | | | |
| BL8509-5300XXXX | 5.194 | 5.300 | 5.406 | | | | | | |
| BL8509-5400XXXX | 5.292 | 5.400 | 5.508 | | | | | | |
| BL8509-5500XXXX | 5.390 | 5.500 | 5.610 | | | | | | |
| BL8509-5600XXXX | 5.488 | 5.600 | 5.712 | | | | | | |
| BL8509-5700XXXX | 5.586 | 5.700 | 5.814 | | | | | | |
| BL8509-5800XXXX | 5.684 | 5.800 | 5.916 | | | | | | |
| BL8509-5900XXXX | 5.782 | 5.900 | 6.018 | | | | | | |
| BL8509-6000XXXX | 5.880 | 6.000 | 6.120 | | | | | | |
| | | | | | | | 0.5 | 1.0 | |

| 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

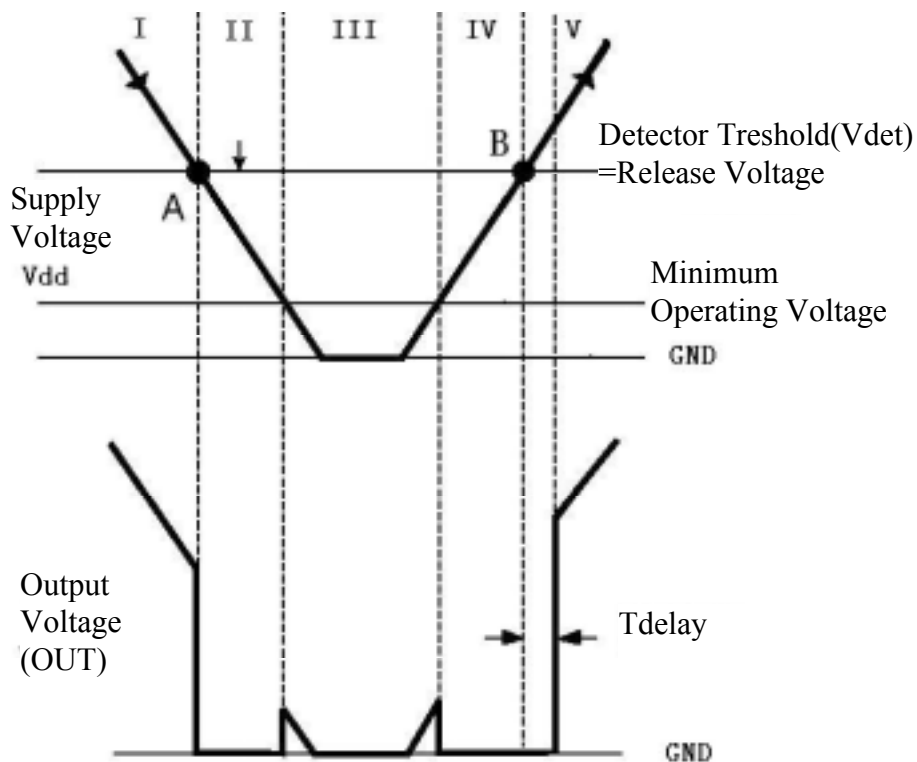
| Part Number | Test Condition | Output Delay Time | | | Unit |
|--------------|-----------------------|-------------------|------|------|------|
| | | Min. | Typ. | Max. | |
| 8509-xxxAxxx | VDD=1.0V to Vdet+1.0V | 45 | 50 | 55 | ms |
| 8509-xxxBxxx | | 90 | 100 | 110 | |
| 8509-xxxCxxx | | 135 | 150 | 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.

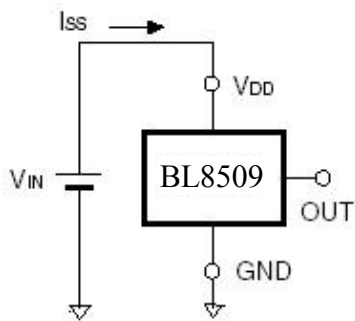
$$V_{DET} = V_{REF} * (1 + R_a/R_b)$$



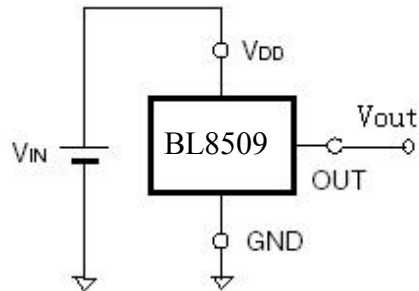
| No. | Operation status | Output status |
|-----|--|---|
| I | $V_{DD} > V_{det}$ | Output voltage is equal to the supply voltage |
| II | V_{DD} drops below V_{det} | Output voltage equals to GND level |
| III | V_{DD} drops further below V_{DDL} | Output voltage is undefined |
| IV | V_{DD} rises 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:

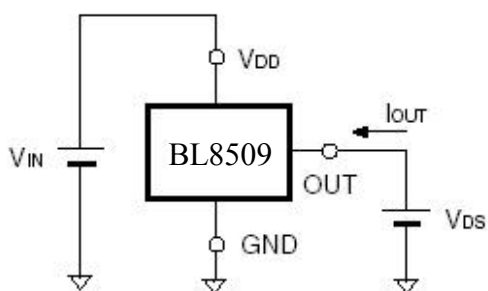
(1) Supply current test circuit



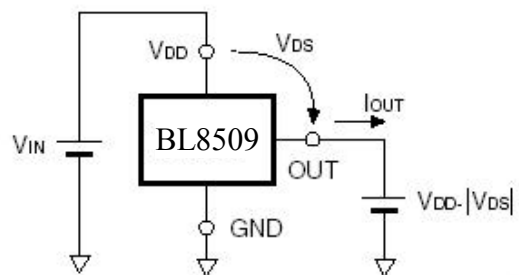
(2) Detector threshold test circuit



(3) NCH Drive Output Current Test Circuit

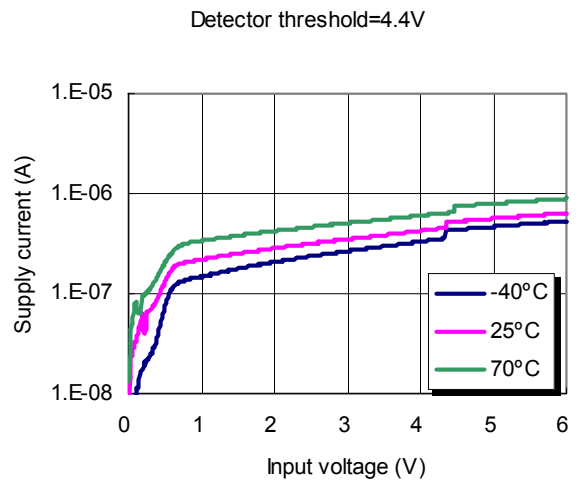
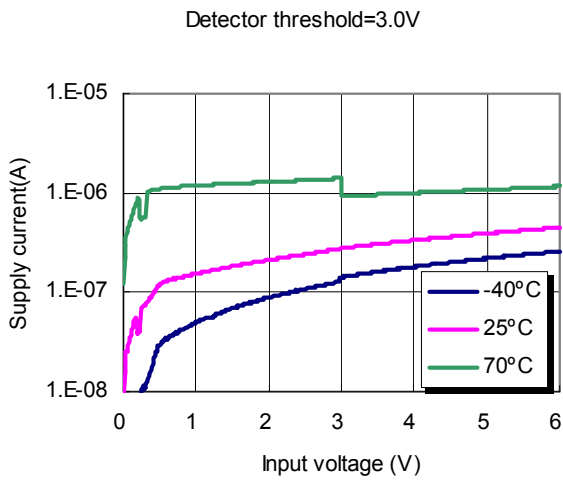
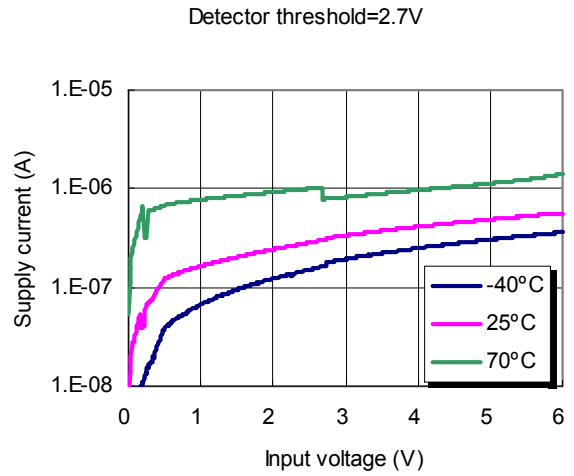
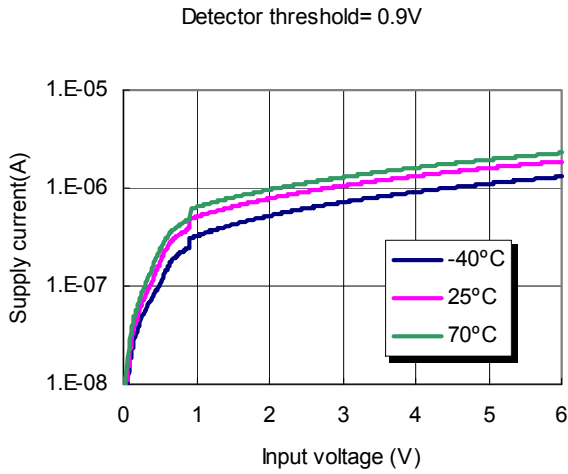


(4) PCH Drive Output Current Test Circuit



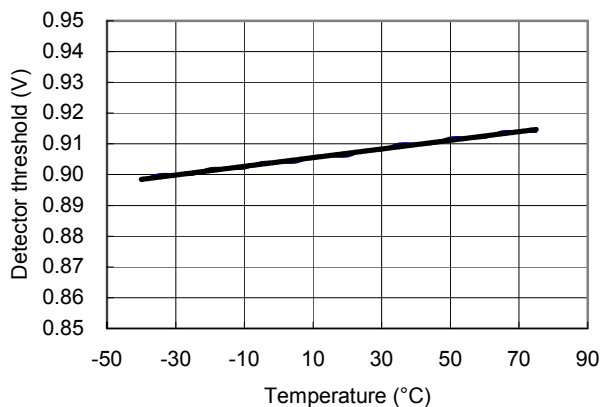
Typical Performance Characteristics:

1) Supply current VS. Input voltage

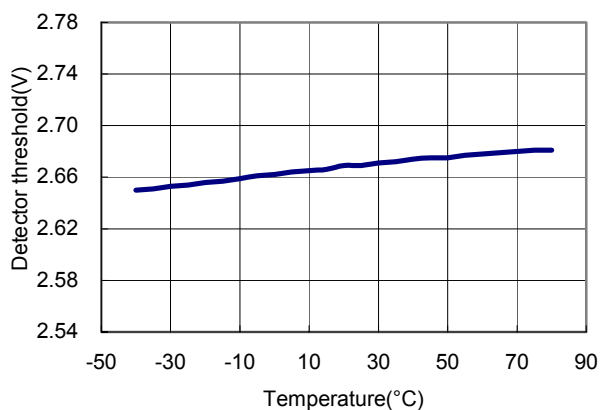


2) Detector Threshold VS. Temperature

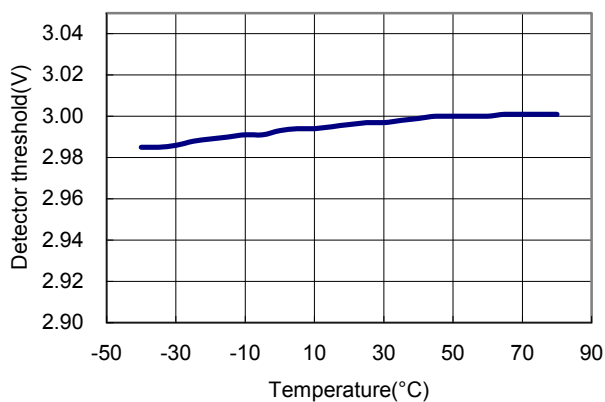
Detector threshold= 0.9V



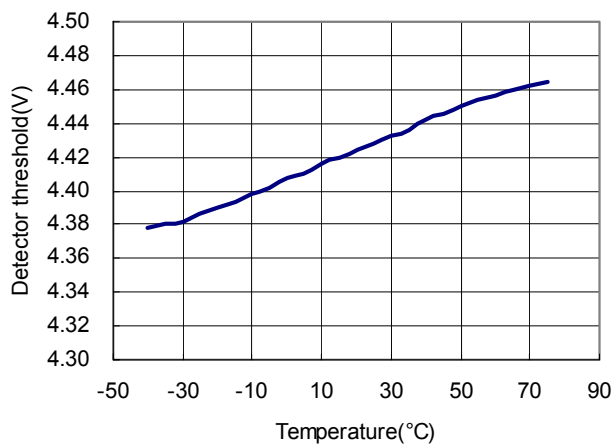
Detector threshold=2.7V



Detector threshold=3.0V

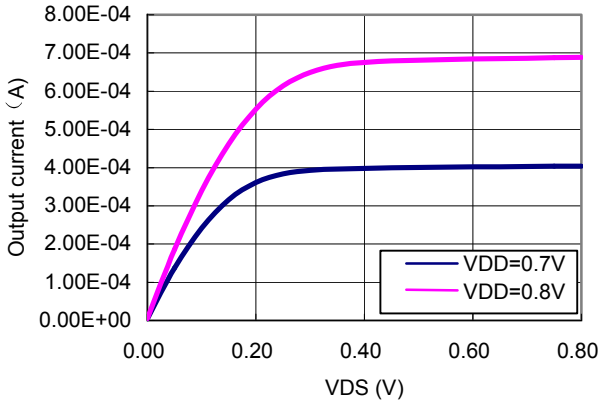


Detector threshold=4.4V

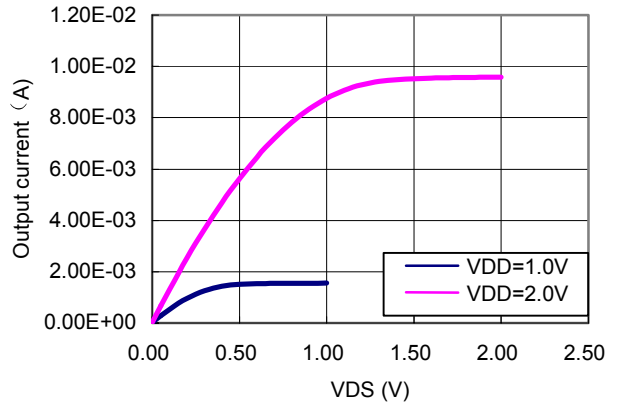


3) Nch Driver Output Current VS. V_{DS}

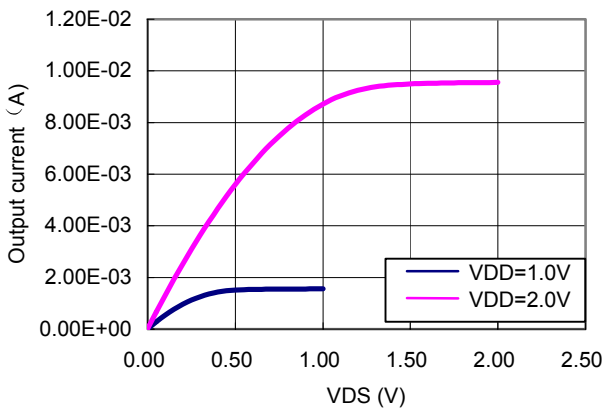
BL8509-090xxx



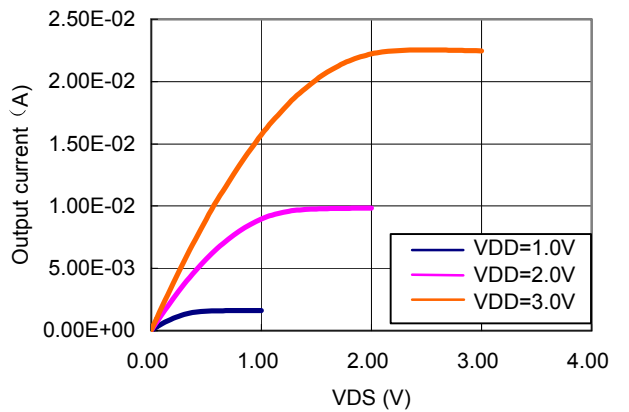
BL8509-270xxx



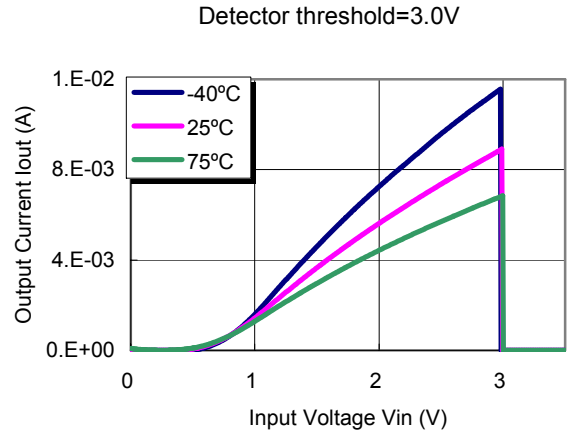
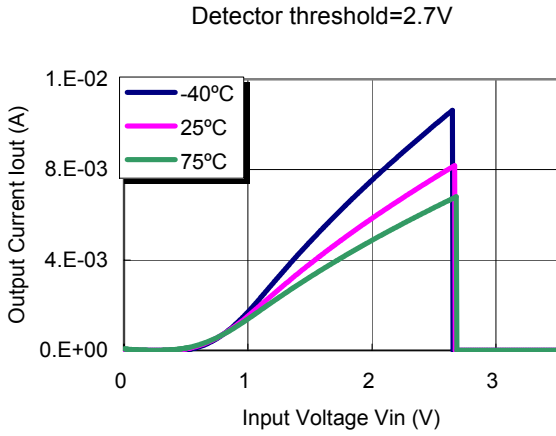
BL8509-300xxx



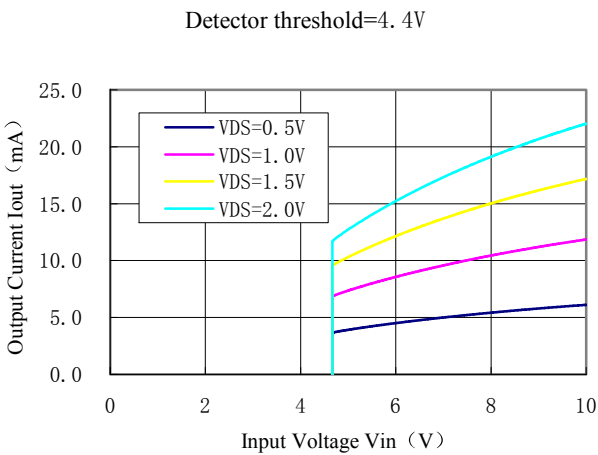
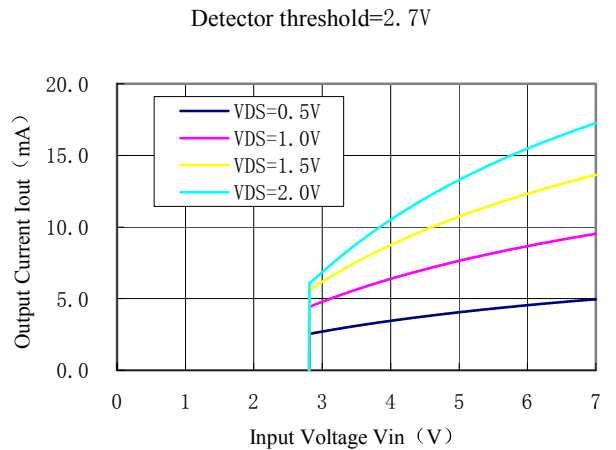
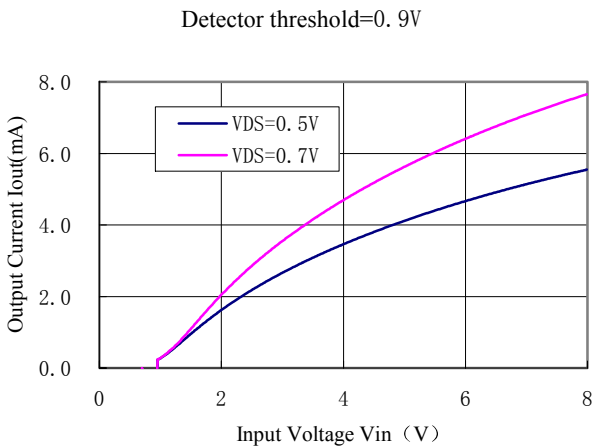
BL8509-440xxx



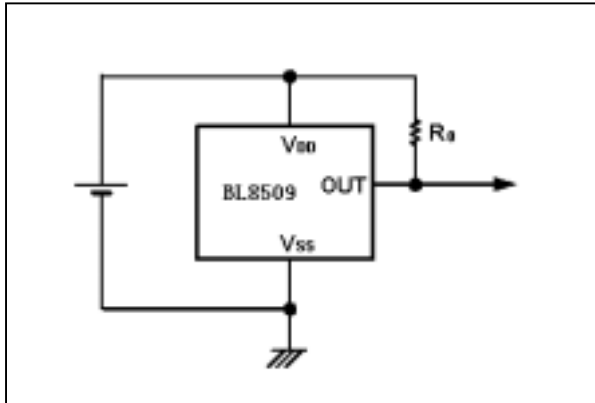
4) NCH Driver Output Current vs. Input Voltage



5) PCH Driver Output Current vs. Input Current



Typical applications:



Note:

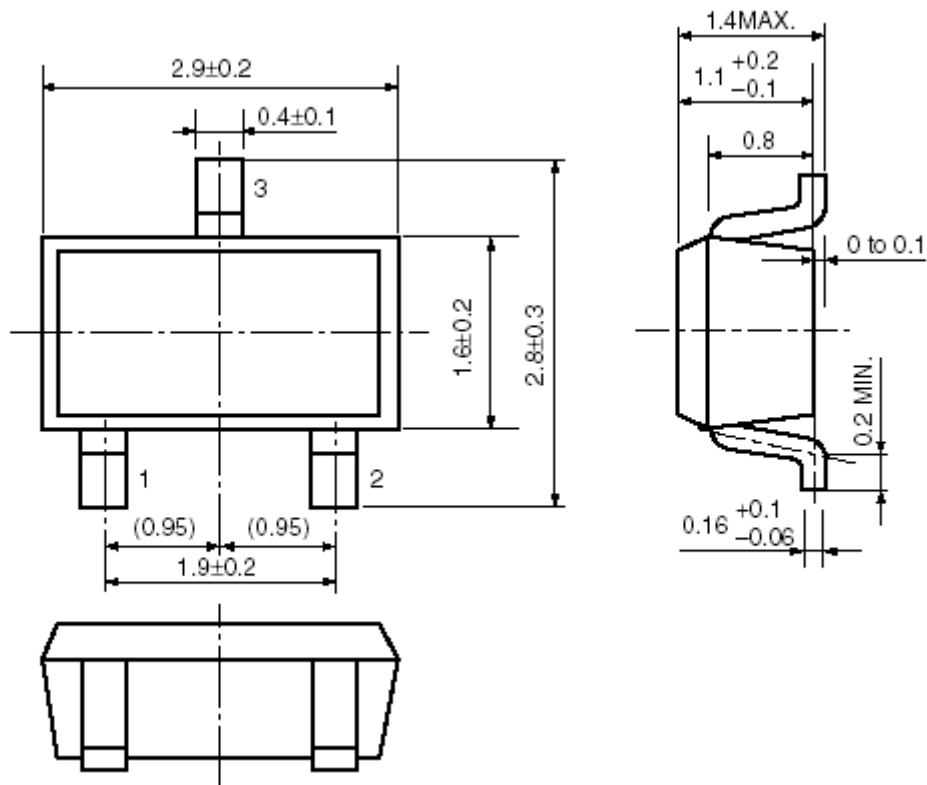
1. R₀ is unnecessary for CMOS output products.
2. The value of R₀ need to be selected in different application, Typical value is 470k Ω

Package Outline:

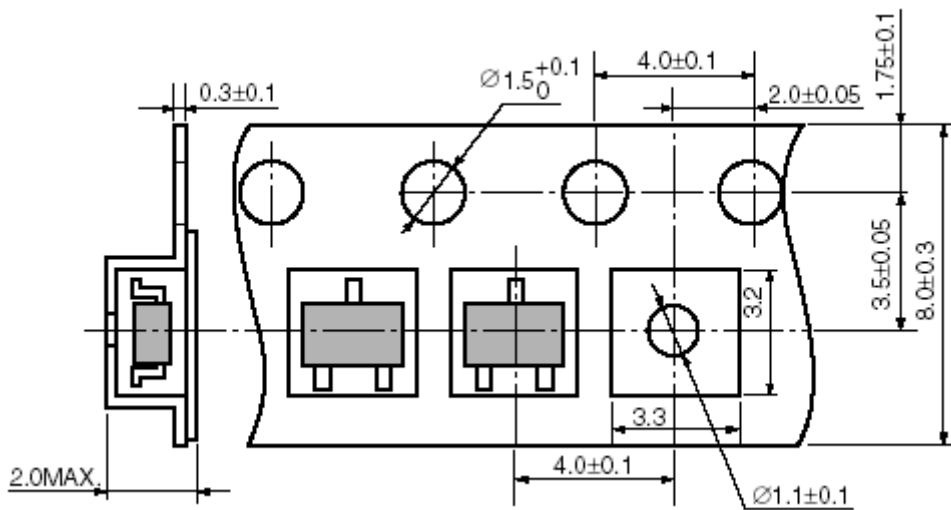
SOT-23-3:

| Package | SOT-23-3 | Devices per reel | 3000 | Unit | mm |
|---------|----------|------------------|------|------|----|
|---------|----------|------------------|------|------|----|

Package dimension:



Taping Specification:



Taping reel dimension:

