# ELM97xxxxA VOLTAGE DETECTOR

## ■ GENERAL DESCRIPTION

ELM 97xxxxA Series is a CMOS voltage detector IC for battery-operated portable devices. It consists of a very low-power-consumption reference voltage source, a comparator, an output driver, a hysteresis circuit, and detection voltage setting resistors. Output logic is positive, therefore output level is low when VDD is lower than detection voltage.

It can be used as a reset controller in microcomputer-based systems. And it can be widely applied to the devices, such as battery checkers, switching circuit of back-up power source, power failure detectors, etc. Two output styles are available, N-ch opendrain and CMOS output.

It is available in SOT-89 and SOT-23.

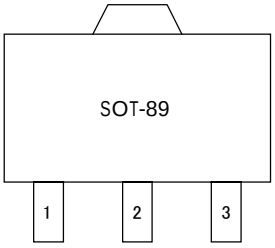
## ■ FEATURES

- Low power operation : TYP. 1.0 μA (VDD = 1.5V)
- Low voltage operation : Reset operation assured at 0.8V
- High accuracy of detection voltage : ±2.5%
- Low temperature coefficient : TYP. −300ppm/℃ (Detection voltage ＜2.0V)
  : TYP. −100ppm/℃ (Detection voltage ≧2.0V)
- Very small package : SOT-89, SOT-23

## ■ APPLICATION

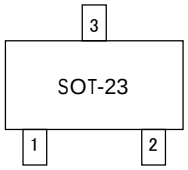
- Reset for microcomputer
- Battery checker
- Power failure detector
- Switching of back-up power source

## ■ PIN CONFIGURATION




( TOP VIEW )

| Pin No. | Pin Name |
|---|---|
| 1 | OUT |
| 2 | VDD |
| 3 | VSS |




( TOP VIEW )

| Pin No. | Pin Name |
|---|---|
| 1 | OUT |
| 2 | VSS |
| 3 | VDD |

## ■ SELECTION GUIDE

| Symbol | | |
|---|---|---|
| a, b | Detection Voltage | Ex 09 : VDETN = 0.9V<br>27 : VDETN = 2.7V<br>45 : VDETN = 4.5V |
| c | Output Form | C : CMOS Output<br>N : N-ch Opendrain Output |
| d | Package | A : SOT-89<br>B : SOT-23 |
| e | Product Version | A : A Version |

ELM97 x x x x A
↑ ↑ ↑ ↑ ↑
a b c d e

## ■ SERIES

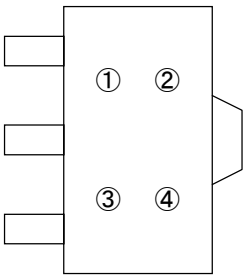
| Model | Detection Voltage | Output Form | Package | Model | Detection Voltage | Output Form | Package |
|---|---|---|---|---|---|---|---|
| ELM9709NBA-S(N) | 0.9V | N-ch | SOT-23 | ELM9727CAA-S(N) | 2.7V | CMOS | SOT-89 |
| ELM9710NBA-S(N) | 1.0V | N-ch | SOT-23 | ELM9730CAA-S(N) | 3.0V | CMOS | SOT-89 |
| ELM9711NBA-S(N) | 1.1V | N-ch | SOT-23 | ELM9732CAA-S(N) | 3.2V | CMOS | SOT-89 |
| ELM9722CAA-S(N) | 2.2V | CMOS | SOT-89 | ELM9734CAA-S(N) | 3.4V | CMOS | SOT-89 |
| ELM9724CAA-S(N) | 2.4V | CMOS | SOT-89 | ELM9745CAA-S(N) | 4.5V | CMOS | SOT-89 |
| ELM9725CAA-S(N) | 2.5V | CMOS | SOT-89 | ELM9748CAA-S(N) | 4.8V | CMOS | SOT-89 |

S type : Standard, N type : Reverse

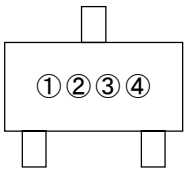
* Available 0.9V～5.0V detection voltage for N-ch output and 2.0V～5.0V detection voltage for CMOS output at 0.1V step as semi-custom-made IC.

## ■ MARKING

SOT-89




SOT-23




### Rule 1

①: Represents the integer digit of the detection voltage

| Symbol | Detection Voltage | Symbol | Detection Voltage |
|---|---|---|---|
| A | 0.*V (N-ch) | P | 2.*V (CMOS) |
| B | 1.*V (N-ch) | R | 3.*V (CMOS) |
| C | 2.*V (N-ch) | S | 4.*V (CMOS) |
| D | 3.*V (N-ch) | T | 5.*V (CMOS) |
| E | 4.*V (N-ch) | | |
| F | 5.*V (N-ch) | | |

②: Represents the decimal digit of the detection voltage

| Symbol | Detection Voltage | Symbol | Detection Voltage |
|---|---|---|---|
| 0 | *.0V | 5 | *.5V |
| 1 | *.1V | 6 | *.6V |
| 2 | *.2V | 7 | *.7V |
| 3 | *.3V | 8 | *.8V |
| 4 | *.4V | 9 | *.9V |

③ : Represents the assembly lot number

A ～ Z repeated (I,O,X excepted)

④ : Represents the assembly lot number

0 ～ 9 repeated

### Rule 2

①: Represents the ELM97xxxxA series

ELM97xxxxA series = A

②: Represents the integer digit of the detection voltage

| Symbol | Detection Voltage | Symbol | Detection Voltage |
|---|---|---|---|
| 0 | 0.*V (N-ch) | Y | 2.*V (CMOS) |
| 1 | 1.*V (N-ch) | W | 3.*V (CMOS) |
| 2 | 2.*V (N-ch) | U | 4.*V (CMOS) |
| 3 | 3.*V (N-ch) | V | 5.*V (CMOS) |
| 4 | 4.*V (N-ch) | | |
| 5 | 5.*V (N-ch) | | |

③ : Represents the decimal digit of the detection voltage

| Symbol | Detection Voltage | Symbol | Detection Voltage |
|---|---|---|---|
| 0 | *.0V | 5 | *.5V |
| 1 | *.1V | 6 | *.6V |
| 2 | *.2V | 7 | *.7V |
| 3 | *.3V | 8 | *.8V |
| 4 | *.4V | 9 | *.9V |

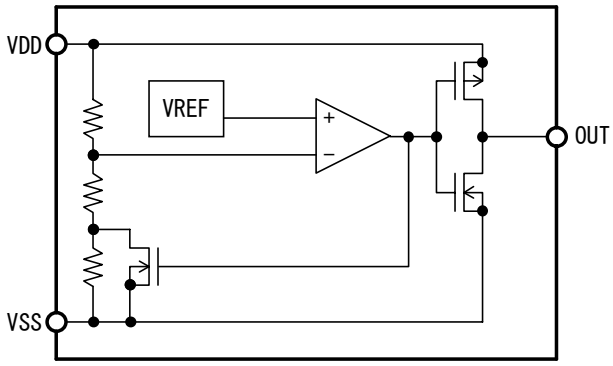
④ : Represents the assembly lot number

0 ～ 9, A ～ Z repeated (I,O,X excepted)

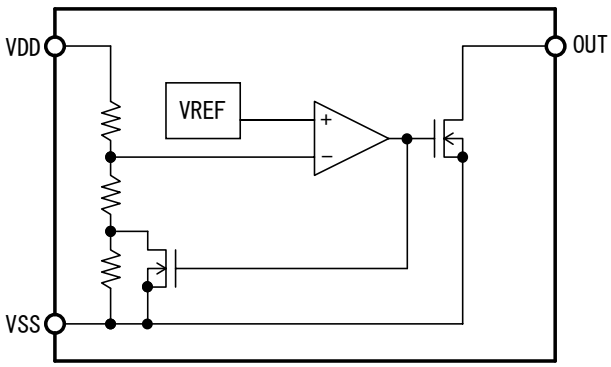
*Remarks --- ELM97xxxxA series have two kind of mraking rules each package.

## ■ BLOCK DIAGRAM

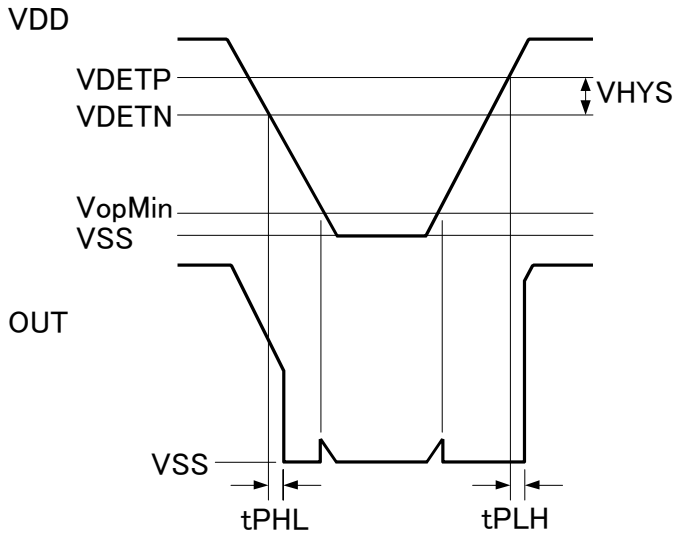
1. CMOS Output




2. N-ch Opendrain Output




## ■ TIMING CHART




## ■ MAXIMUM ABSOLUTE RATINGS

(VSS=0V)

| Parameter | Symbol | | Limits | Units |
|---|---|---|---|---|
| Power Supply Voltage | VDD | | 10 | V |
| Output Voltage | VOUT | CMOS | VSS-0.3～VDD+0.3 | V |
| | | N-ch | VSS-0.3～+10 | |
| Output Current | IOUT | | 50 | mA |
| Power Dissipation | Pd | SOT-89 | 300 | mW |
| | | SOT-23 | 200 | |
| Operating Temperature | Top | | -30～+80 | ℃ |
| Storage Temperature | Tstg | | -40～+125 | |

## ■ ELECTRICAL CHARACTERISTICS

### ELM9709NBA

(Top=25℃)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 0.878 | 0.900 | 0.922 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=1.5V | - | 1.0 | 3.0 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=0.8V, VDS=0.5V | 0.02 | 0.1 | - | mA | 3 |
| Delay Time | tPHL | | | 2.0 | | mS | 5 |
| Temperature Characteristics of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.27 | - | mV/℃ | - |

Remarks ) Test circuit No.

### ELM9710NBA

(Top=25℃)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 0.975 | 1.000 | 1.025 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=1.5V | - | 1.0 | 3.0 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=0.8V, VDS=0.5V | 0.02 | 0.1 | - | mA | 3 |
| Delay Time | tPHL | | | 2.0 | | mS | 5 |
| Temperature Characteristic of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.30 | - | mV/℃ | - |

Remarks ) Test circuit No.

### ELM9711NBA

(Top=25℃)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 1.073 | 1.100 | 1.127 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=1.5V | - | 1.0 | 3.0 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=0.8V, VDS=0.5V | 0.02 | 0.1 | - | mA | 3 |
| Delay Time | tPHL | | | 2.0 | | mS | 5 |
| Temperature Characteristic of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.33 | - | mV/℃ | - |

Remarks ) Test circuit No.

## ELM9722CAA

(Top=25℃)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 2.145 | 2.200 | 2.255 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=3.0V | - | 1.5 | 4.5 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=1.5V, VDS=0.5V | 1.0 | 2.0 | - | mA | 3 |
| | IOUTP | VDD=4.5V, VDS=2.1V | 0.5 | 1.5 | - | mA | 4 |
| Delay Time | tPHL | | | 0.1 | | mS | 5 |
| Temperature Characteristic of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.22 | - | mV/℃ | - |

Remarks ) Test circuit No.

## ELM9724CAA

(Top=25℃)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 2.340 | 2.400 | 2.460 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=3.0V | - | 1.5 | 4.5 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=1.5V, VDS=0.5V | 1.0 | 2.0 | - | mA | 3 |
| | IOUTP | VDD=4.5V, VDS=2.1V | 0.5 | 1.5 | - | mA | 4 |
| Delay Time | tPHL | | | 0.1 | | mS | 5 |
| Temperature Characteristic of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.24 | - | mV/℃ | - |

Remarks ) Test circuit No.

## ELM9725CAA

(Top=25℃)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 2.438 | 2.500 | 2.562 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=3.0V | - | 1.5 | 4.5 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=1.5V, VDS=0.5V | 1.0 | 2.0 | - | mA | 3 |
| | IOUTP | VDD=4.5V, VDS=2.1V | 0.5 | 1.5 | - | mA | 4 |
| Delay Time | tPHL | | | 0.1 | | mS | 5 |
| Temperature Characteristic of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.25 | - | mV/℃ | - |

Remarks ) Test circuit No.

## ELM9727CAA

(Top=25℃)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 2.633 | 2.700 | 2.767 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=4.5V | - | 1.5 | 4.5 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=1.5V, VDS=0.5V | 1.0 | 2.0 | - | mA | 3 |
| | IOUTP | VDD=4.5V, VDS=2.1V | 0.5 | 1.5 | - | mA | 4 |
| Delay Time | tPHL | | | 0.1 | | mS | 5 |
| Temperature Characteristic of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.27 | - | mV/℃ | - |

Remarks ) Test circuit No.

## ELM9730CAA

(Top=25℃)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 2.925 | 3.000 | 3.075 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=4.5V | - | 1.5 | 4.5 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=1.5V, VDS=0.5V | 1.0 | 2.0 | - | mA | 3 |
| | IOUTP | VDD=4.5V, VDS=2.1V | 0.5 | 1.5 | - | mA | 4 |
| Delay Time | tPHL | | | 0.1 | | mS | 5 |
| Temperature Characteristic of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.30 | - | mV/℃ | - |

Remarks ) Test circuit No.

## ELM9732CAA

(Top=25℃)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 3.120 | 3.200 | 3.280 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=4.5V | - | 1.5 | 4.5 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=1.5V, VDS=0.5V | 1.0 | 2.0 | - | mA | 3 |
| | IOUTP | VDD=4.5V, VDS=2.1V | 0.5 | 1.5 | - | mA | 4 |
| Delay Time | tPHL | | | 0.1 | | mS | 5 |
| Temperature Characteristic of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.32 | - | mV/℃ | - |

Remarks ) Test circuit No.

## ELM9734CAA

(Top=25℃)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 3.315 | 3.400 | 3.485 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=4.5V | - | 1.5 | 4.5 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=1.5V, VDS=0.5V | 1.0 | 2.0 | - | mA | 3 |
| | IOUTP | VDD=4.5V, VDS=2.1V | 0.5 | 1.5 | - | mA | 4 |
| Delay Time | tPHL | | | 0.1 | | mS | 5 |
| Temperature Characteristic of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.34 | - | mV/℃ | - |

Remarks ) Test circuit No.

## ELM9745CAA

(Top=25℃)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 4.388 | 4.500 | 4.612 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=6.0V | - | 1.5 | 4.5 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=1.5V, VDS=0.5V | 1.0 | 2.0 | - | mA | 3 |
| | IOUTP | VDD=6.0V, VDS=2.1V | 0.5 | 2.0 | - | mA | 4 |
| Delay Time | tPHL | | | 0.1 | | mS | 5 |
| Temperature Characteristic of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.45 | - | mV/℃ | - |

Remarks ) Test circuit No.

## ELM9748CAA

(Top=25℃)

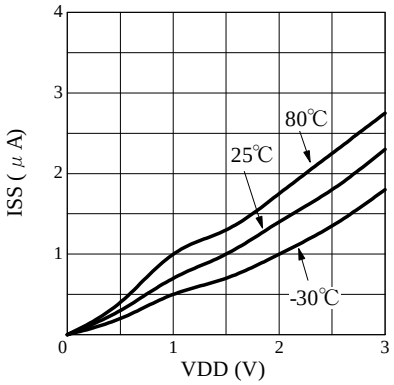
| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Units | Remarks |
|---|---|---|---|---|---|---|---|
| Detection Voltage | VDETN | | 4.680 | 4.800 | 4.920 | V | 2 |
| Hysteresis width | VHYS | | VDETN ×0.02 | - | VDETN ×0.08 | V | 2 |
| Current Consumption | ISS | VDD=6.0V | - | 1.5 | 4.5 | μA | 1 |
| Operating Voltage | VDD | | 0.8 | - | 6.0 | V | 2 |
| Output Current | IOUTN | VDD=1.5V, VDS=0.5V | 1.0 | 2.0 | - | mA | 3 |
| | IOUTP | VDD=6.0V, VDS=2.1V | 0.5 | 2.0 | - | mA | 4 |
| Delay Time | tPHL | | | 0.1 | | mS | 5 |
| Temperature Characteristic of VDETN | $\frac{\triangle VDETN}{\triangle Top}$ | Top=-30～+80℃ | - | -0.48 | - | mV/℃ | - |

Remarks ) Test circuit No.

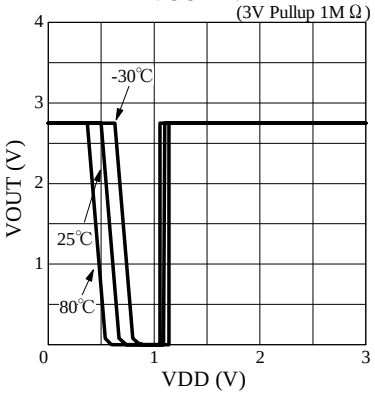
## ■ TYPICAL CHARACTERISTICS

● ELM9711NxA

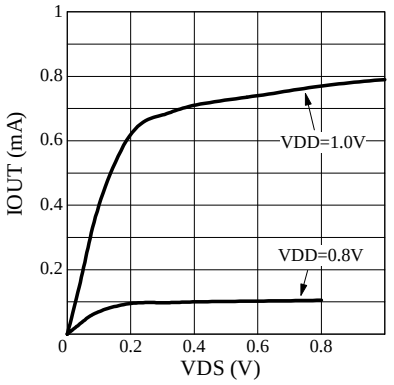
ISS - VDD



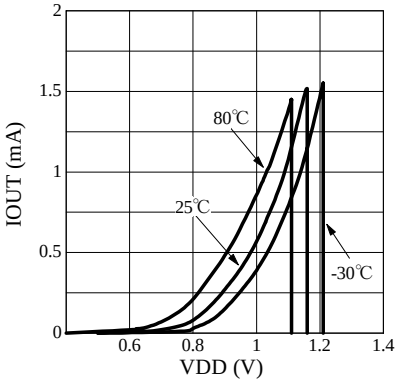

VOUT - VDD (3V Pullup 1M Ω)



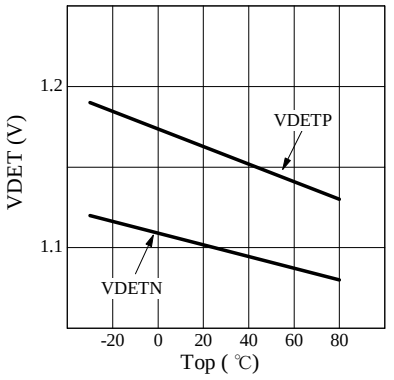

IOUT - VDS



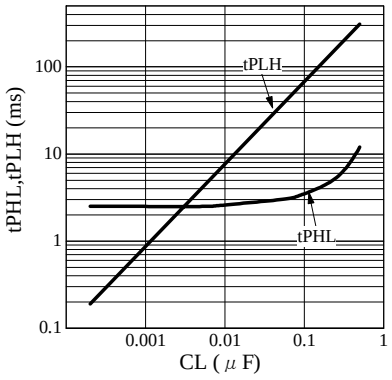

IOUT - VDD




VDET - Top

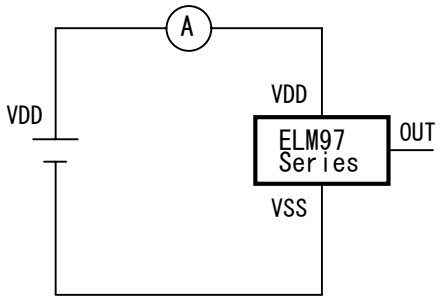



tPHL,tPLH - VDD

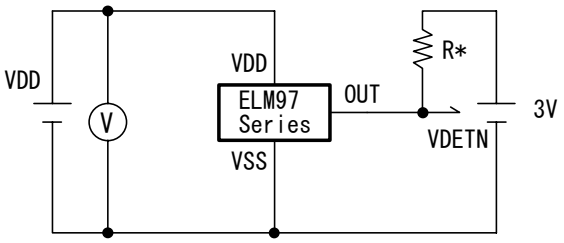


## ■ TEST CIRCUITS

1. Current Consumption

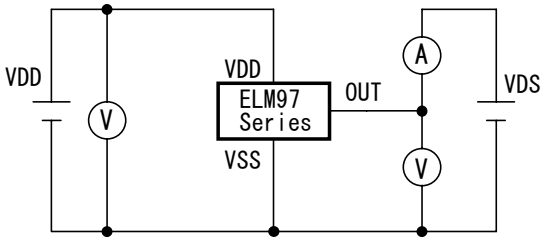



2. Detection Voltage

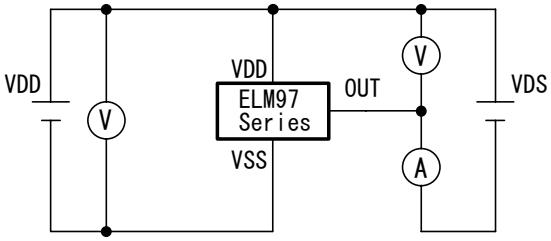



＊ R=1MΩ

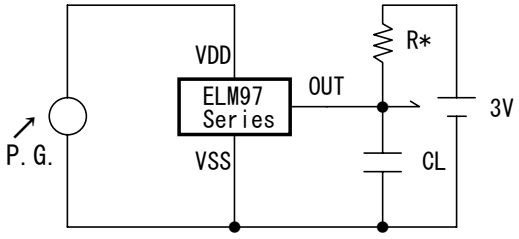
3. Output Current (N-ch)



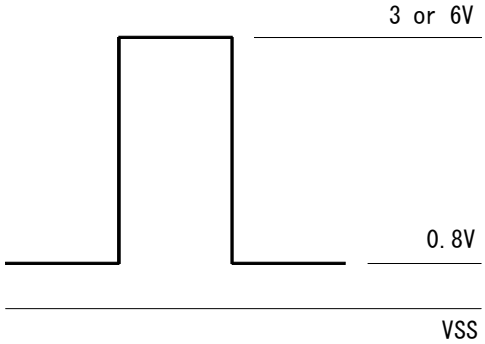

4. Output Current (P-ch)




5. Delay Time




Input Pulse




＊ R=1MΩ
R is unnecessary for CMOS output products.