



# AP4400AEC

## Ultra Low Power Voltage Detector

### 1. General Description

The AP4400AEC product family is a voltage detector CMOS IC for monitoring battery, power supply and system voltage. The AP4400AEC offers ultra-low power consumption that is 20nA typical.

### 2. Features

- Detection voltage “High” (VDETH) 2.7~4.2V (Options)
- Detection voltage “Low”(VDETL) 2.5~VDETH-0.2V (Options)
- Hysteresis voltage of detector 0.2 ~ 1.7 V
- Operating Power VDDIN = 1.2 ~ 5.5V
- Power consumption 20nA typical (@VDDIN=3.4V)
- Operation temperature Ta = -15 ~ 85 °C
- Package WLCSP 4- pin

**3. Table of Contents**

1.	General Description.....	1
2.	Features.....	1
3.	Table of Contents.....	2
4.	Block Diagram.....	3
	■ Block Diagram.....	3
5.	Pin Configuration and Function.....	4
	■ Pin Configuration .....	4
	■ Function .....	4
6.	Absolute Maximum Ratings .....	5
7.	Recommended Operating Conditions.....	5
8.	Electrical Characteristics .....	6
9.	Function Description .....	7
10.	Example Application .....	8
11.	Package.....	9
	■ Outline Dimensions .....	9
	■ Marking .....	9
12.	Revision History .....	10
	IMPORTANT NOTICE .....	11

## 4. Block Diagram

### ■ Block Diagram

AP4400AEC : CMOS output (Active "High" )

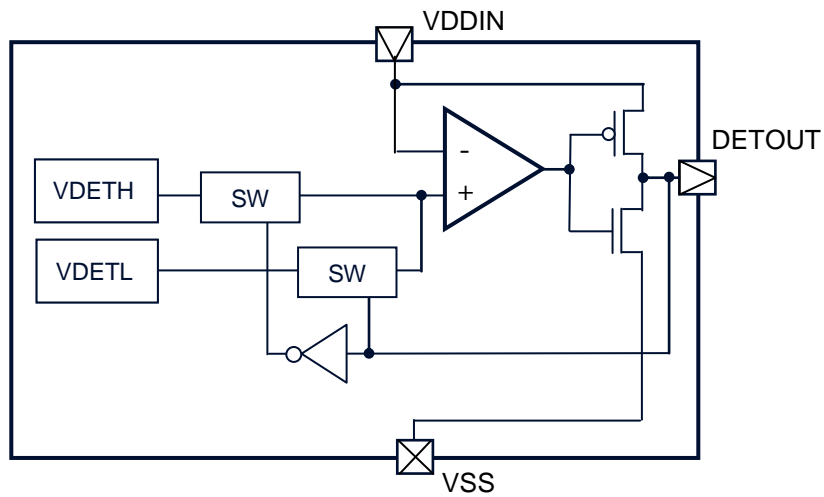
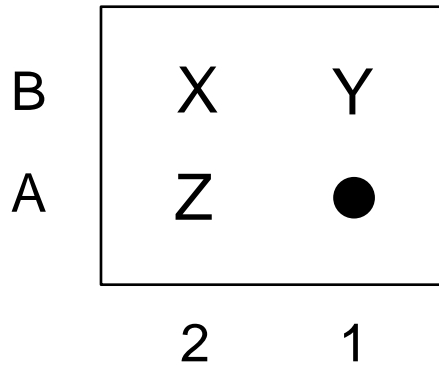


Figure 1. Block Diagram

**5. Pin Configuration and Function**

**■ Pin Configuration**

WLCSP 4-pin



**■ Function**

Pin No	Pin Name	I/O (Note1)	Function
A1	VSS	Ground	Ground
A2	DETOUT	Output	Dectction voltage output(CMOS Output)
B1	NC	-	Non connect
B2	VDDIN	Power	Power supply

Note 1. Power : Power supply pin (VDDIN)

## 6. Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Power Supply Voltage (Note 2)	VDDIN	-0.3	6.5	V
Output Voltage(Note 2)	V <sub>out</sub>	VSS-0.3	VDDIN + 0.3	V
Output Current	I <sub>out</sub>	-10	+10	mA
Storage Temperature	T <sub>stg</sub>	-55	150	°C

Note 2. All voltages are with reference to VSS = 0 V

WARNING: Stresses exceeding Maximum Ratings may damage the device. Normal operation is not guarantee if the condition exceeds the maximum rating.

## 7. Recommended Operating Conditions

Parameter	Symbol	min	typ	max	Unit	Condition
Operation Temperature	T <sub>a</sub>	-15	-	85	°C	
Power Supply Voltage (Note 3)	VDDIN	1.2		5.5	V	

Note 3. The output voltage is indefinite if the power supply voltage is less than the minimum value.

## 8. Electrical Characteristics

Ta= -15 to 85°C, DETOUT=open unless otherwise specified.

Parameter	Symbol	min	typ	max	Unit	Condition
Detection Voltage (Note 4)						
Detection Voltage "High" (VDETH)	VDETH	2.9	3.0	3.1	V	Ta=25°C VDDIN="L"→"H" VDDIN="H"→"L"
Detection Voltage "Low" (VDETL)	VDETL	2.4	2.5	2.6	V	
Detection voltage temperature coefficient	$\Delta V_{DET}/\Delta T_a$	-	0.75	-	mV/°C	Design guarantee value (Note 5)
Power Consumption (Note 6)						
Upper threshold detection	IDDH	-	20	50	nA	Ta=25°C VDDIN=VDETH+0.1V VDDIN=VDETL-0.1V
Lower threshold detection	IDDL	-	20	50	nA	
Power Consumption (Note 6)						
Upper threshold detection	IDDH	-	20	200	nA	VDDIN=VDETH+0.1V VDDIN=VDETL-0.1V
Lower threshold detection	IDDL	-	20	200	nA	
IOL (Note 7)	I <sub>OL</sub>	0.2	-	-	mA	VDDIN=VDETL-0.1V, VDDIN-VDETOUT=0.5V
IOH (Note 7)	I <sub>OH</sub>	0.15	-	-	mA	VDDIN=VDETH+0.1V, VDETOUT-VSS=0.5V
Response Time 1 (Note 4)	tPLH	-	0.5	1.0	ms	No-load condition Ta=25°C VDDIN= VDETH-0.1V→VDETH+0.1V VDDIN= VDETL+0.1V→VDETL-0.1V
	tPHL	-	4.0	10	ms	
Response Time 2 (Note 4)	tPLH	-	-	1.0	ms	No-load condition VDDIN= VDETH-0.1V→VDETH+0.1V VDDIN= VDETL+0.1V→VDETL-0.1V
	tPHL	-	-	30	ms	

Note 4. This specification is for VDETH=3.0V and VDETL=2.5V.

Note 5. Not tested

Note 6. Output drive is not included.

Note 7. Output current depends on VDDIN.

IOL shows N-Channel pull current when AP4400AEC DETOUT outputs low.

IOH shows P-Channel push current when AP4400AEC DETOUT outputs high.

### 9. Function Description

• **Input voltage VDDIN becomes greater than the detection voltage “High”(VDETH)**

The DETOUT will be in an undefined state when VDDIN voltage is from VSS to AP4400AEC minimum operating voltage. The DETOUT outputs VSS when VDDIN voltage exceeds minimum operating voltage. The DETOUT outputs VDDIN when VDDIN voltage is larger than detection voltage “High”(VDETH).

• **Input voltage VDDIN falls smaller than the detection voltage “Low”(VDETL)**

The DETOUT outputs VDDIN when VDDIN voltage is larger than detection voltage “High”(VDETH). The DETOUT outputs VSS when VDDIN voltage falls smaller than detection voltage “Low”(VDETL). The DETOUT will be in an undefined state when VDDIN voltage is below AP4400AEC minimum operating voltage.

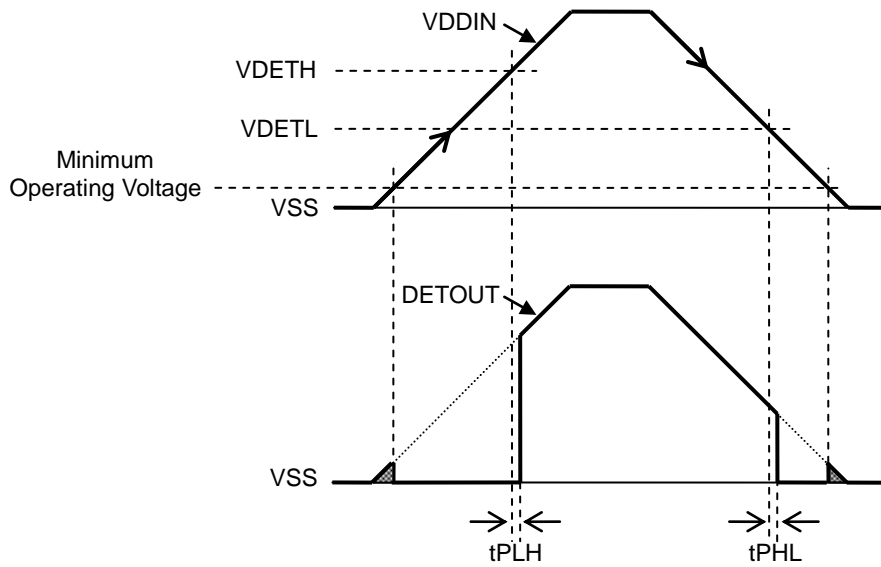


Figure 2. Operation

10. Example Application

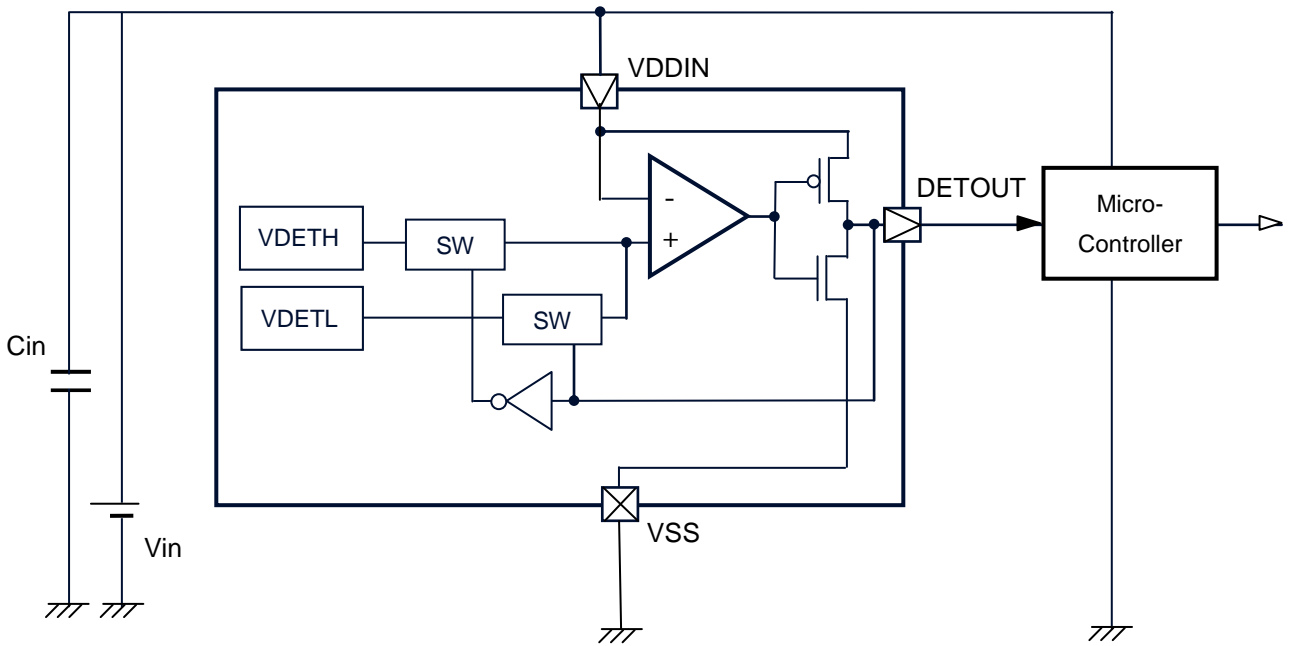


Figure 3. Microprocessor Reset Circuit

Note 8. When a user control  $VDDIN$  falling voltage using  $DETOUT$  turnover timing, please add  $C_{in}$  near  $VDDIN$  pin and  $VSS$  pin depends on load condition.

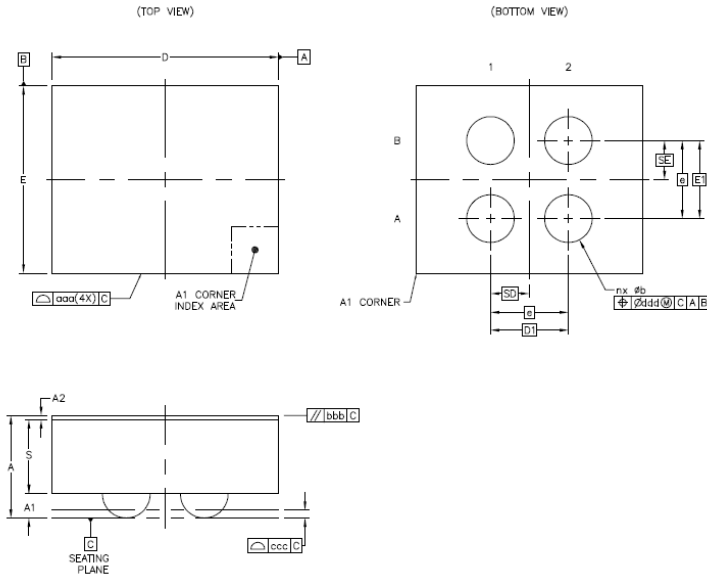


**11. Package**

**■ Outline Dimensions**

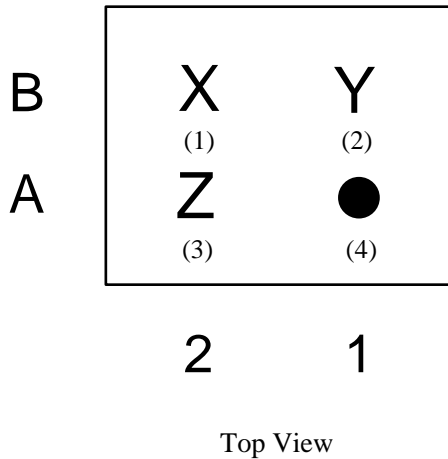
WLCSP 4-pin (Unit : mm)

When the IC is exposed to light, it might affect the electrical characteristics of the IC due to the light sensitivity of WLCSP package structures.



	SYMBOL	COMMON DIMENSIONS
TOTAL THICKNESS	A	0.525 ± 0.031
WAFER THICKNESS	S	0.378 ± 0.012
STAND OFF	A1	0.11 ~ 0.14
FILM THICKNESS	A2	0.022 ± 0.004
BODY SIZE	X	D 1.16
	Y	E 0.96
BALL/BUMP PITCH	X	SD 0.2 BSC
	Y	SE 0.2 BSC
EDGE BALL CENTER TO CENTER	X	D1 0.4 BSC
	Y	E1 0.4 BSC
PITCH	e	0.4 BSC
BALL DIAMETER (SIZE)		0.2
BALL/BUMP WIDTH	b	0.215 ~ 0.275
BALL/BUMP COUNT	n	4
PACKAGE EDGE TOLERANCE	aaa	0.05
WAFER FLATNESS	bbb	0.1
COPLANARITY	ccc	0.04
BALL/BUMP OFFSET (PACKAGE)	ddd	0.15

**■ Marking**



- (1) X: Year code (last 1 digit)  
\*If (2) LOT number is occupied, 1 to 9 and 0, and then A to K and L to U and V will be numbered
- (2) Y: LOT number  
\*numbered 1 to 9 by LOT and then A to Z
- (3) Z: Part number code
- (4) 1 pin Indication

**12. Revision History**

Date (YY/MM/DD)	Revision	Page	Contents
2016/07/21	00	-	First Edition

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