

Voltage Detector

FEATURES

- Precise Detection Thresholds Standard.....  $\pm 2.5\%$
- Low Current Drain Typ.....  $1\mu\text{A}$
- Voltage Detection Range..... 0.9V to 6.0V
- Operating Voltage Range..... 0.7V to 10.0V
- Offered in SOT-23, SOT-89, & TO-92 Package

APPLICATIONS

- Microprocessor Reset
- Battery Status Indicator
- Level Discriminator
- Power-failure Detector
- Switching Circuit in Battery Backup
- Waveform Shaping Circuit

PRODUCT DESCRIPTION

The ALPHA Semiconductor's AS440 is a CMOS Voltage Detector, designed for battery-powered applications, due to ultra low  $1\mu\text{A}$  operating current and package size. This device is laser trimmed to threshold voltage in the range between 0.9V to 6.0V, in 0.1V increments.

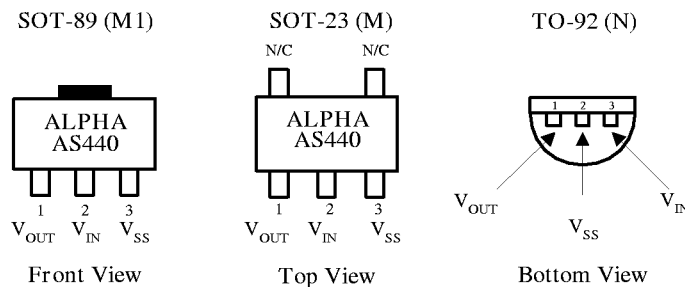
The AS440 contains a comparator, low-current high-precision reference, laser-trimmed divider, hysteresis circuit and output driver. This device is available in either an open-drain or complementary ("CMOS") configuration.

The AS440 output ( $V_{\text{OUT}}$ ) remains in the logic HIGH state as long as  $V_{\text{IN}}$  is greater than the specified threshold voltage ( $-V_{\text{DET}}$ ). When  $V_{\text{IN}}$  falls below  $-V_{\text{DET}}$ , the output is driven to a logic LOW.  $V_{\text{OUT}}$  remains LOW until  $V_{\text{IN}}$  rises above  $-V_{\text{DET}}$  by an amount  $V_{\text{hyst}}$ , whereupon it resets to a logic HIGH. The AS440 is offered in SOT-23, SOT-89, & TO-92 package.

ORDERING INFORMATION

TYPE	SOT-23-5	SOT-89-3	TO-92	Oper. Temp. Range
Nch Open Drain	AS440NM-X	AS440NM1-X	AS440NN-X	-40°C to 85°C
CMOS Output	AS440CM-X	AS440CM1-X	AS440CN-X	-40°C to 85°C

PIN CONNECTIONS



## ABSOLUTE MAXIMUM RATINGS

Supply Voltage  $V_{IN}$  ..... 12V  
 Output Voltage: CMOS ..... ( $V_{SS} - 0.3$ ) to ( $V_{IN} + 0.3$ )  
                   Open Drain ..... 12V  
 Output Current ..... 70mA  
 Operating Temperature..... -40°C to +85°C

Power Dissipation: SOT-23 .....150mW  
                           SOT-89 .....300mW  
                           TO-92 .....300mW  
 Storage Temperature ..... -65°C to +150°C  
 Soldering Temperature ..... 260°C, 10 seconds

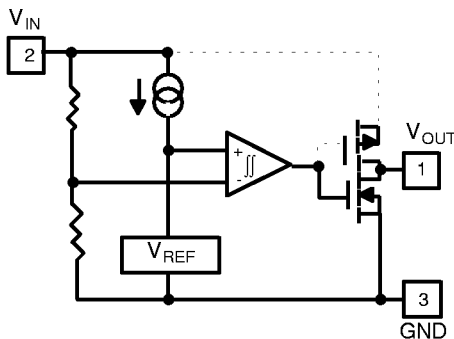
## ELECTRICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$ , unless otherwise specified.

Parameter	Conditions	AS440			Units
		Min	Typ	Max	
Threshold Voltage ( $-V_{DET}$ )		$(-V_{DET})$ $\times 0.975$		$(-V_{DET})$ $\times 1.025$	V
Hysteresis Range ( $V_{hsyt}$ )		$(-V_{DET})$ $\times 0.03$	$(-V_{DET})$ $\times 0.05$	$(-V_{DET})$ $\times 0.07$	V
Quiescent Current ( $I_Q$ )	$V_{IN} = 1\text{V}$ (Output - ON)		1.0	(note 1)	$\mu\text{A}$
Operating Voltage ( $V_{IN}$ )		0.7		10.0	V
Output Current ( $I_{OUT}$ )	N-Channel $V_{DS} = 0.5\text{V}$ $-V_{DET} = 4.5\text{V}$ 2.7V 0.9V	$V_{IN} = 4.0\text{V}$		12.0	mA
		$V_{IN} = 2.5\text{V}$		7.2	
		$V_{IN} = 0.8\text{V}$		0.45	
	P-Channel $V_{DS} = 0.5\text{V}$ $-V_{DET} = 4.5\text{V}$ 2.7V 0.9V	$V_{IN} = 5.0\text{V}$		0.6	mA
		$V_{IN} = 3.0\text{V}$		0.4	
		$V_{IN} = 1.0\text{V}$		0.05	
Tempco of ( $-V_{DET}$ )			$\pm 100$		ppm/ $^\circ\text{C}$

Note 1: When  $V_{IN}$  drops to 1.5 volts or less,  $I_{SS}$  is approximately 0.5 - 1.0 $\mu\text{A}$ . at  $(-V_{DET}) \pm 1\text{V}$ , it is approximately 1.5 $\mu\text{A}$ . For  $I_{SS}$  at higher values of  $V_{IN}$  or over temperature, see the appropriate curves.

Note 2: These are average values for devices in the "ON" condition ( $V_{IN}$  lower than  $-V_{DET}$  for the N-Channel output, and  $V_{IN}$  higher than  $-V_{DET}$  for the P-Channel output).

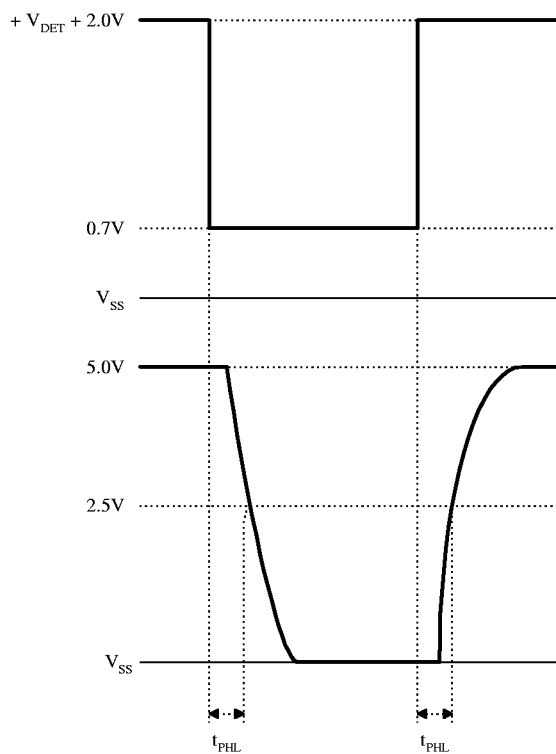
## FUNCTIONAL BLOCK DIAGRAM



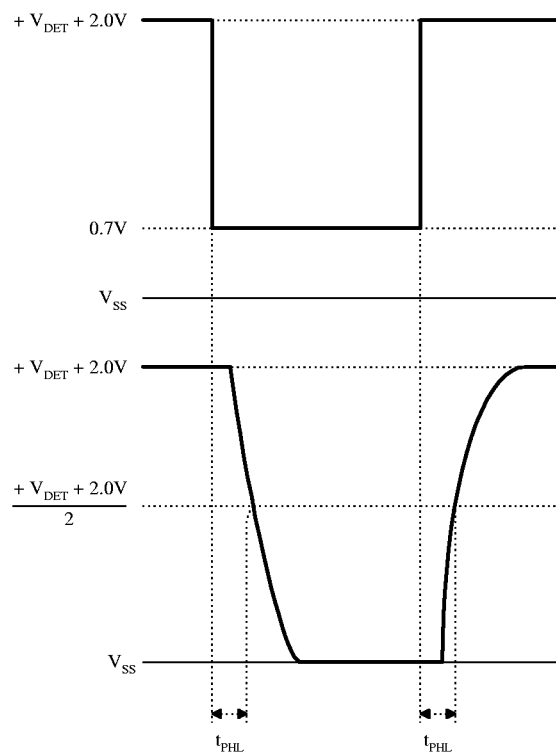
Open-Drain version (N) has only an N-Channel output transistor. (Ordering code N).

Complementary ("CMOS") version includes a P-Channel output transistor (dottedlines). (Ordering code C).

DEFINITION OF OUTPUT DELAY TIME

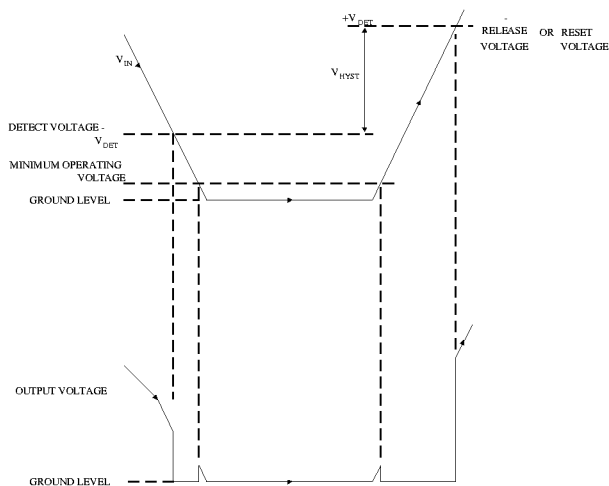


Nch OPEN DRAIN



CMOS

TIMING CHART

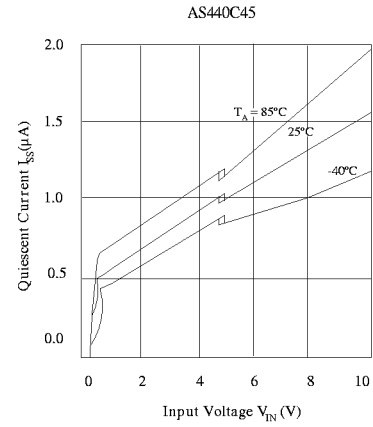
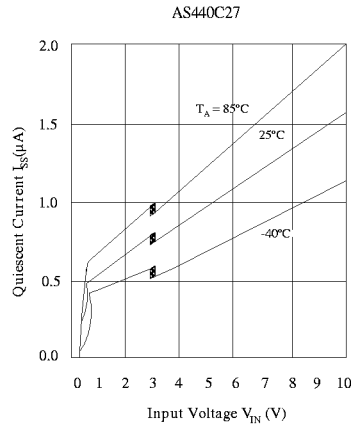
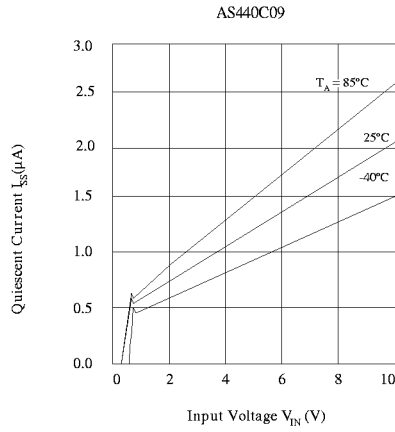


DESCRIPTION OF OPERATION

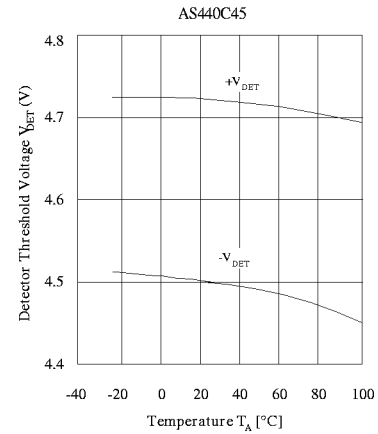
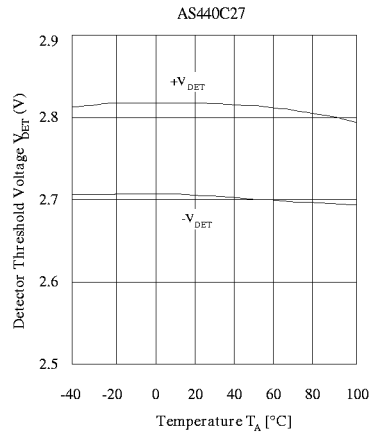
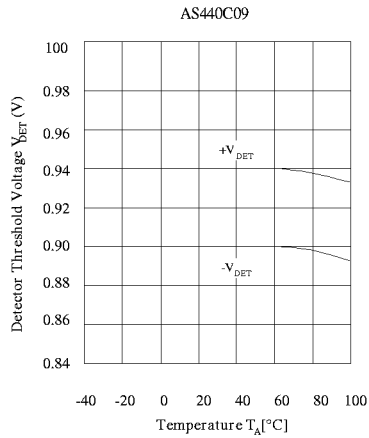
- When an input voltage ( $V_{IN}$ ) is larger than the detected voltage ( $-V_{DET}$ ),  $V_{IN}$  will equal  $V_{OUT}$  (OFF mode in Nch OPEN DRAIN).
- When  $V_{IN}$  is lower than  $-V_{DET}$ ,  $V_{OUT}$  will equal  $V_{SS}$ .
- When  $V_{IN}$  drops below the minimum operating voltage ( $V_{MIN}$ ),  $V_{OUT}$  will be undefined.
- When  $V_{IN}$  rises from ground potential (GND), the output will be undefined when  $V_{IN}$  is between GND and  $V_{MIN}$ .  $V_{OUT}$  will be equal to  $V_{SS}$  when  $V_{IN}$  is between  $V_{MIN}$  and the release voltage ( $+V_{DET}$ ).
- The difference between  $+V_{DET}$  and  $-V_{DET}$  is  $V_{HYST}$ .

## TYPICAL PERFORMANCE CHARACTERISTICS

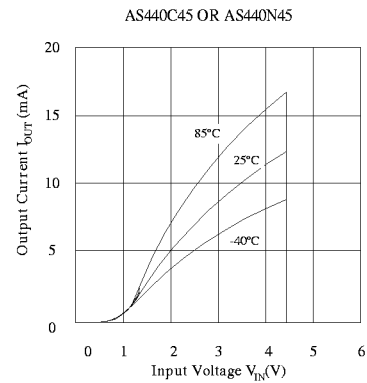
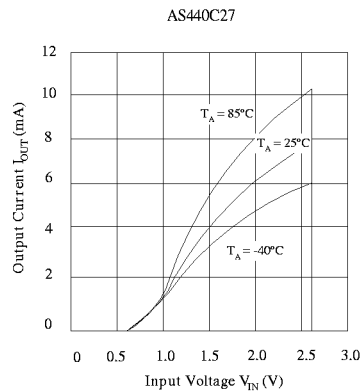
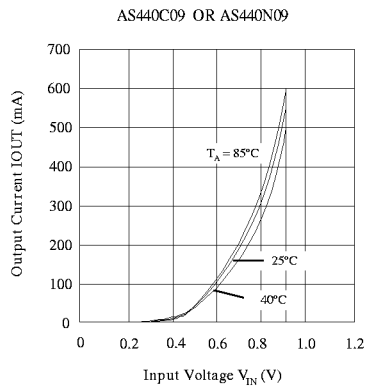
### 1) Quiescent Current vs. Input Voltage



### 2) Detector Threshold vs. Temperature

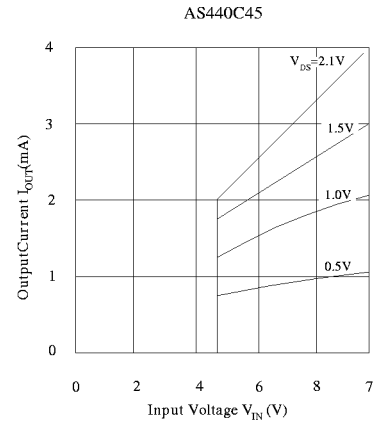
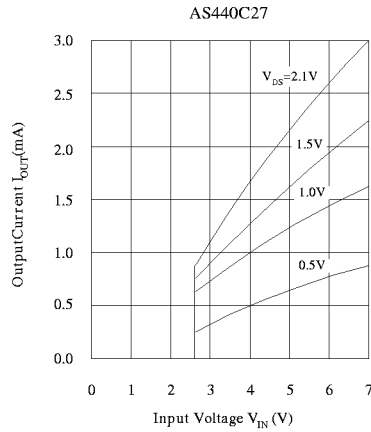
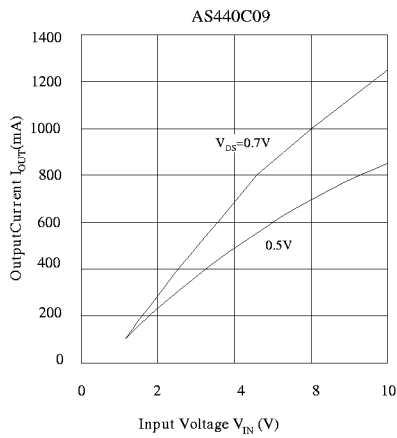


### 3) Nch Driver Output Current vs. Input Voltage

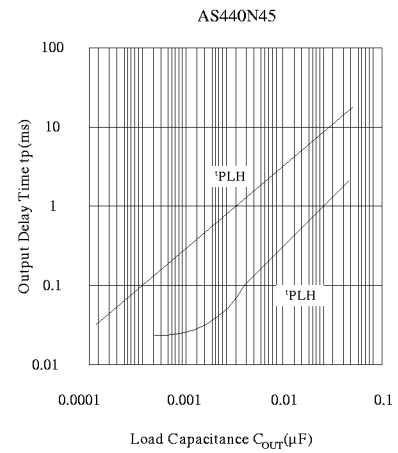
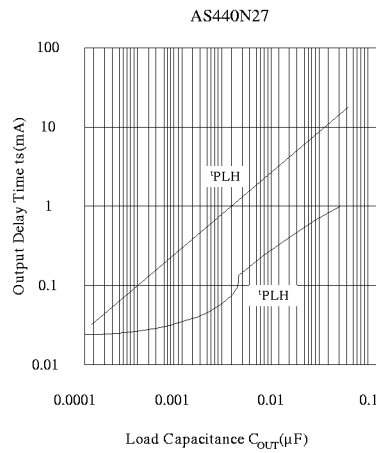
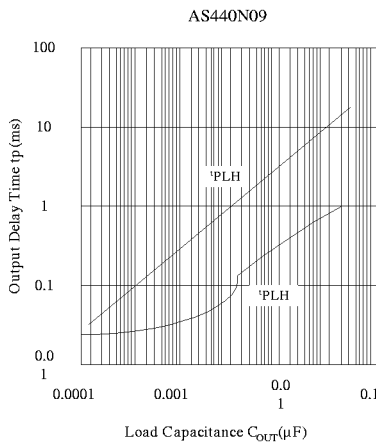


## TYPICAL PERFORMANCE CHARACTERISTICS (CONT)

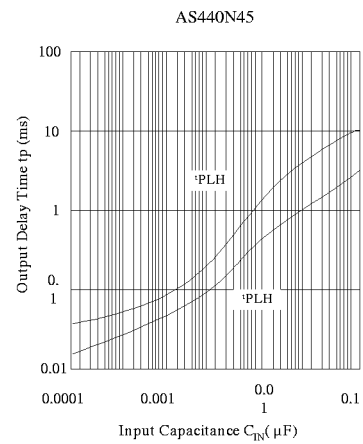
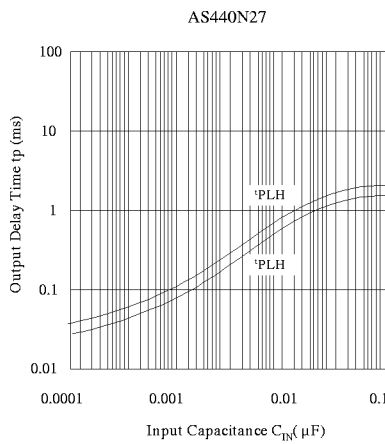
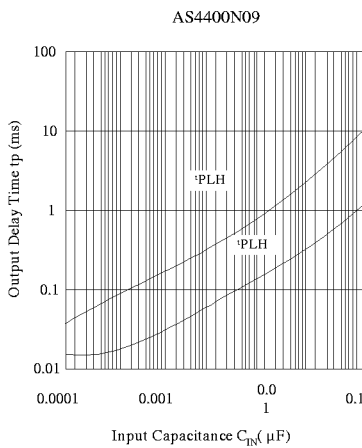
4) Pch Driver Output Current vs. Input Voltage ( $T_A=25^\circ\text{C}$ )



5) Output Delay vs. Load Capacitance ( $T_A=25^\circ\text{C}$ )

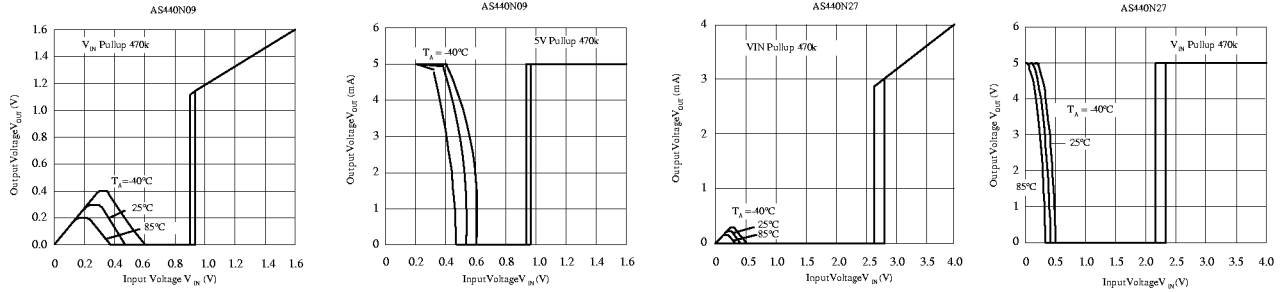


6) Output Delay vs. Input Capacitance (External)

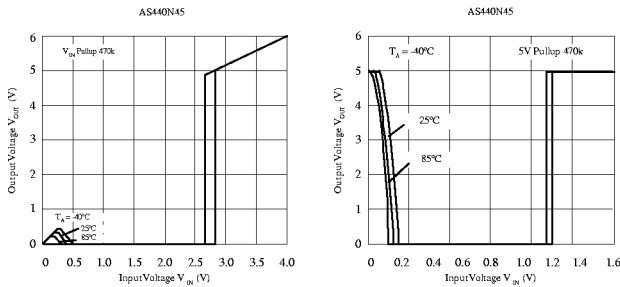


## TYPICAL CHARACTERISTICS PERFORMANCE

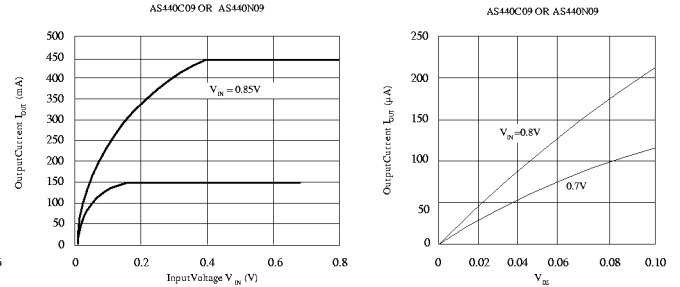
### OUTPUT VOLTAGE VS. TYPICAL VOLTAGE



### OUTPUT VOLTAGE VS. TYPICAL VOLTAGE



### Nch DRIVER OUTPUT CURRENT VS. $V_{DS}$ ( $T_A = 25^\circ\text{C}$ )



### Nch DRIVER OUTPUT CURRENT VS. $V_{DS}$ ( $T_A = 25^\circ\text{C}$ )

