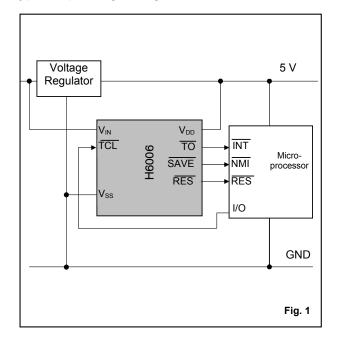
Failsafe Watchdog

Description

The H6006 is a monolithic low power CMOS device combining a programmable digital timer and a series of voltage comparators on the same chip. The device is specially convenient for Watch-Dog functions such as microprocessor and supply voltage monitoring. The watchdog part is designed to be used in all applications where it is important that after the occurrence of a malfunction the microprocessor system is stopped to avoid further damage. The timeout warning signal (\overline{TO}) can be used to try to reactivate the system before halting it. The voltage monitoring part provides double security by combining both unregulated voltage and regulated voltage monitoring simultaneously. The H6006 initializes the poweron reset after V_{IN} reached V_{SH} and V_{DD} raises above 3.5 V. If V_{IN} drops below V_{SL} , the H6006 gives an advanced warning signal for register saving and if the voltage drops further below V_{RL}, RES goes active. The H6006 functions at any supply voltage down to 1.5 V and is therefore particularly suited for start-up and shut-down control of microprocessor systems

Typical Operating Configuration



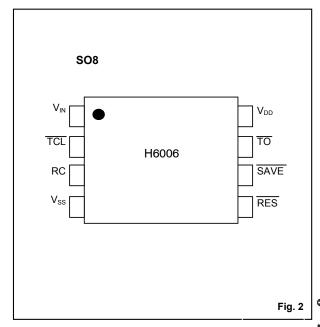
Features

- ☐ Failsafe watchdog function: timeout warning after 1st timeout period, reset after 2nd timeout period, reset remains active to avoid further failures
- ☐ Standard timeout period and power-on reset time (10 ms), externally programmable if required
- V_{IN} monitoring with 3 standard or programmable trigger voltages for: power-on reset initialization, advanced power-fail warning (SAVE), reset at power-down (RES)
- $\hfill \square$ V_{DD} monitoring: power-on reset initialization enabled only if $V_{DD} \geq 3.5 \ V$
- Internal voltage reference
- ☐ Works down to 1.5 V supply voltage
- □ Push-pull or Open drain outputs
- Low current consumption
- Available for normal and extended temperature range
- SO8 package

Applications

- Microprocessor and microcontroller systems
- Point of sales equipment
- □ Telecom products
- Automotive subsystems

Pin Assignment



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Absolute Maximum Ratings

Parameter	Symbol	Conditions
Voltage V _{DD} to V _{SS}	V_{DD}	-0.3 to +8 V
Voltage at any pin to V _{SS}	V_{MIN}	-0.3
Voltage at any pin to V _{DD} (except	V_{MAX}	+0.3
V _{IN})		
Voltage at V _{IN} to V _{SS}	V_{INMAX}	+15 V
Current at any output	I _{MAX}	±10 mA
Storage temperature	T _{STO}	-65 +150 °C

Table 1

Stresses above these listed maximum ratings may cause permanent damage to the device. Exposure beyond specified operating conditions may affect device reliability or cause malfunction.

Handling Procedures

This device has built-in protection against high static voltages or electric fields; however, anti-static precautions must be taken as for any other CMOS component.

Unless otherwise specified, proper operation can only occur when all terminal voltages are kept within the supply voltage range. Unused inputs must always be tied to a defined logic voltage level.

Operating Conditions

Parameter	Symbol	Min.	Тур	Max.	Units
Operating temperature					
Industrial	T_{Al}	-40		+85	°C
Supply voltage	V_{DD}	1.5		5.5	V
Comparator input					
voltage					
Version A2, A3,	V_{IN}	0		V_{DD}	V
B2,B3					
Version B1	V_{IN}	0		12	V
RC-oscillator					
programming					
(see Fig. 15)					
External capacitance	C1			100	nF
External resistance	R1	10			kΩ

Table 2

Electrical Characteristics

 V_{DD} = 5.0 V, T_A = -40 to +85 °C, unless otherwise specified

Parameter	Symbol	Test Conditions	Min.	Тур.	Max.	Units
V _{DD} activation threshold	V _{ON}	T _A = 25 °C	3		3.5	V
V _{DD} deactivation threshold	V_{OFF}	T _A = 25 °C		V _{ON} - 1.5		V
Supply current	I_{DD}	RC open, TCL= 5 V, V _{IN} = 0 V		50	140	μΑ
Input V _{IN} ,, TCL						
Leakage current	I _{IP}	$V_{SS} \leq V_{IP} \leq V_{DD};$				
		T _A = 85 °C		0.005	1	μΑ
Input current on pin V _{IN}	I _{IN}	Version B1; V _{IN} = 10 V		100	180	μΑ
TCL input low level	V_{IL}				8.0	V
TCL input high level	V_{IH}		2.4			V
TO, RES. SAVE Outputs						
Leakage current	I _{OLK}	Versions A2, A3;				
-		$V_{OUT} = V_{DD}$		0 .05	1	μΑ
Drive currents (all versions)	l _{OL}	$V_{OL} = 0.4 V$	3.2	8		mA
	I _{OL}	$V_{DD} = 3.5 \text{ V}; V_{OL} = 0.4 \text{ V}$	2			mA
	I _{OL}	$V_{DD} = 1.6 \text{ V}; V_{OL} = 0.4 \text{ V}$	80			μΑ
Drive currents	I _{OH}	V _{OH} = 4.0 V	3.2	8		mA
(versions B1, B2, B3) ¹⁾	I _{OH}	$V_{DD} = 3.5 \text{ V}; V_{OH} \ge 2.8 \text{ V}$	2			mA
	I _{OH}	$V_{DD} = 1.6 \text{ V}; V_{OH} = V_{DD} - 0.4$	80			μΑ

¹⁾Versions: An = open drain outputs; Bn = push-pull outputs

Table 3

V_{IN} Surveillance

Voltage thresholds at T_A = 25 °C

Version ¹⁾	Comparator Reference	Input Resistance R _{VIN}	Thresholds	Threshold Tolerance	Ratio Tolerance ³⁾
B1	V_{DD}	100kΩ	9.00 8.00 7.00 ²⁾	± 5%	+2%
A2, B2	V_{DD}	~100MΩ	2.25 2.00 1.75 ²⁾	± 5%	+2%
A3, B3	Band-gap reference	~100MΩ	2.00 1.95 1.90	± 10%	+2%

¹⁾ Versions: An = open drain outputs; Bn = push-pull outputs

Table 4

 $^{^{2)}}$ at V_{DD} = 5 V

 $^{^{3)}}$ Threshold ratio as $V_{\text{SH}}/V_{\text{SL}}$ or $V_{\text{SL}}/V_{\text{RL}}$



Timing Characteristics

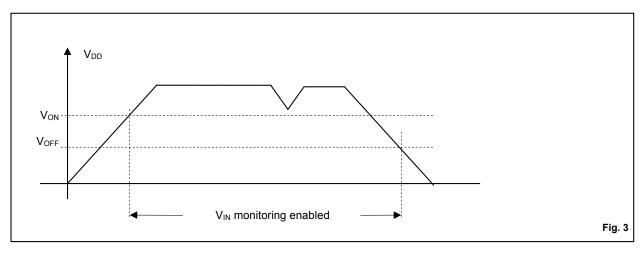
 V_{DD} = 5.0 V, T_A = -40 °C to +85 °C, unless otherwise specified

Parameter	Symbol	Test Conditions	Min.	Тур.	Max.	Units
Propagation delays						
TCL to output pins	T_{DIDO}			250	500	ns
V _{IN} to output pins	T _{AIDO}	Excluding debounce time T _{DB}		4	10	μS
Logic transition times on all output pins	T _{TR}	Load 10 kΩ, 100 pF		30	100	ns
Timeout period	T _{TO}	RC open, unshielded , T _A =25 °C	6	10	16	ms
·	T _{TO}	RC open, unshielded (not tested)	4.5		20	ms
T _{TCL} input pulse width	T _{TCL}		150			ns
Power-on reset debounce	T_DB			T _{TO/32}		ms

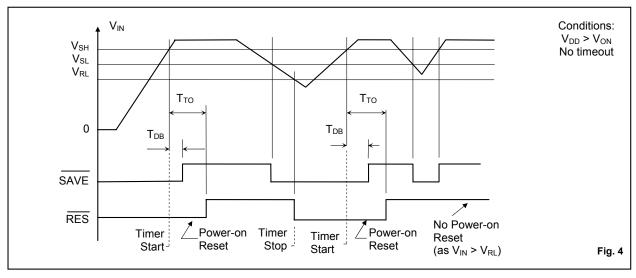
Table 5

Timing Waveforms

Voltage Reaction: V_{DD} Monitoring

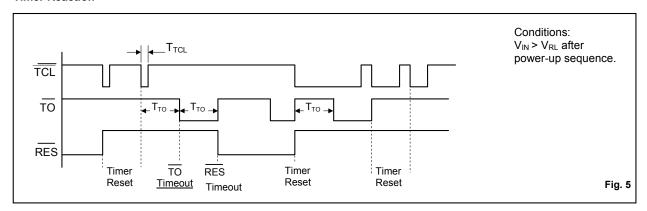


Voltage Reaction: V_{IN} Monitoring

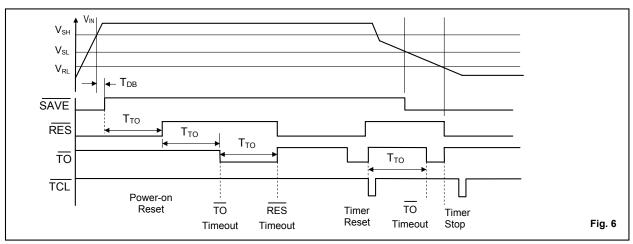




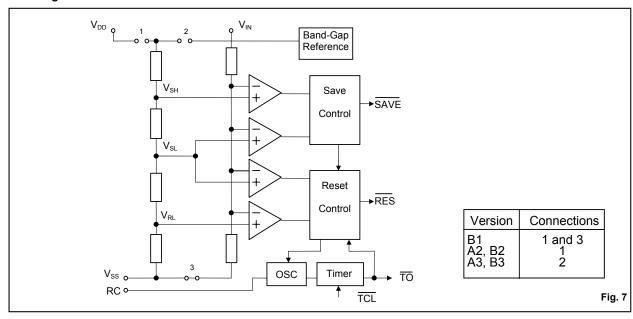
Timer Reaction



Combined Voltage and Timer Reaction



Block Diagram





Pin Description

Pin	Name	Function
1	V_{IN}	Voltage monitoring input
2	TCL	Timer clear input signal
3	RC	RC oscillator tuning input
4	V_{SS}	GND terminal
5	RES	Reset output
6	SAVE	Save output
7	TO	Timer output signal
8	V_{DD}	Positive supply voltage terminal

Table 6

Functional Description

Supply Lines

The circuit is powered through the V_{DD} and V_{SS} pins. It monitors both its own V_{DD} supply and a voltage applied to the V_{IN} input.

V_{DD} Monitoring

During power-up the V_{IN} monitoring is disabled and \overline{RES} and \overline{SAVE} stay active low as long as V_{DD} is below V_{ON} (3.5 V). As soon as V_{DD} reaches the V_{ON} level, the state of the outputs depend on the watchdog timer and the volt-age at V_{IN} relative to the thresholds (see Fig. 3 and 4). If the supply voltage V_{DD} falls back below V_{OFF} (1.5 V) the watchdog timer and the V_{IN} monitoring are disabled and the outputs \overline{SAVE} and \overline{RES} are active low. The V_{DD} line should be free of spikes.

VIN Monitoring

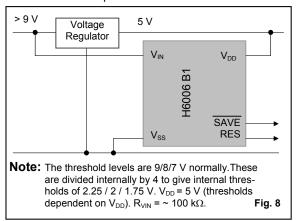
The analog voltage comparators compare the voltage applied to V_{IN} (typically connected to the input of the voltage regulator) with the stabilized supply voltage V_{DD} (versions B1, A2, B2) or with the bandgap voltage (versions A3, B3) (see Fig. 7). At power-up, when V_{DD} reached V_{ON} and V_{IN} reaches the V_{SH} level, the SAVE output goes high, and the timer starts running, setting $\overline{RES}\,$ high after the time T_{TO} (see Fig. 4). If V_{IN} falls below V_{SL} , the \overline{SAVE} output goes low and stays low until V_{IN} rises again above V_{SH} . If V_{IN} falls below the voltage V_{RL} , the RES output will go low and the on-chip timer will stop. When V_{IN} rises again above V_{SH}, the timer will initiate a power-up sequence. The RES output may however be influenced independently of the voltage V_{IN} by the timer action, see section "Combined Voltage and Timer Action". Monitoring the rough DC side of the regulator as shown in Fig. 12 is the only way to have advanced warning at power-down. Spikes on VIN should be filtered if they are likely to drop below V_{SL}

The combination of V_{IN} and V_{DD} monitoring provide high system security: if V_{IN} rises much faster than V_{DD} , then the device starts the power-on sequence only when V_{DD} reached V_{ON} (Fig. 3). Short circuits on the regulated supply voltage can be detected.

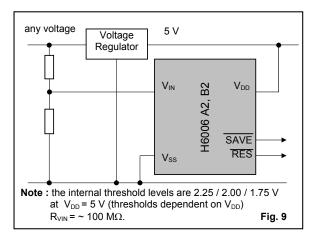
Voltage Thresholds on VIN

The H6006 is available with 3 different sets of thresholds:

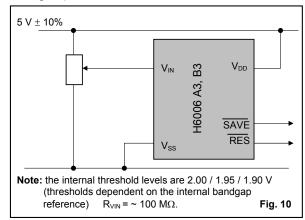
Version B1: with internal voltage divider, resulting in thresholds for direct monitoring of the unregulated voltage without external components.



Version A2, B2: for monitoring of all unregulated voltage, where custom programming is required. Fixed resistor values can be used for programming.



Version A3, B3: for monitoring of regulated voltage, where no unregulated voltage is available (the tolerance is ± 10 %, see Table 4. For tighter tolerances, trimming can be used, see Fig. 10).





Monitoring of the unregulated voltage require versions B1, A2 and B2. The versions are based on the principle that V_{DD} rises with V_{IN} on power-up and V_{DD} holds up for a certain time after V_{IN} starts dropping on power-down. The version B1 has a 100 k Ω nominal resistance from V_{IN} to V_{SS} (internal voltage divider). The versions A2, B2, A3 and B3 have high impedance V_{IN} inputs (see Fig. 7 and Table 4) for external threshold voltage programming by a voltage divider on pin V_{IN} . The levels obtained are proportional to the internal levels V_{SH} , V_{SL} and V_{RL} on the chip itself (see Electrical Specifications).

Timer Programming

With pin RC unconnected, the on-chip RC oscillator together with its divider chain give a timeout T_{TO} of typically 10 ms. For programming a different T_{TO} , an approximation for calculating component values is given by the formula:

$$T_{TO} = \begin{bmatrix} 0.75 + \frac{(32 + C_1) \cdot 1.6}{5.5 + \frac{V_{DD} - 0.8}{R_1}} \end{bmatrix} \cdot 1.024$$

 $R_1\,min.$ = 10 k $\Omega,\,C_{1\,max}.$ = 1 μF If R_1 is in $M\Omega$ and C_1 in pF, T_{TO} will be in ms.

Thus, a resistor decreases and a capacitor increases the interval to timeout. By using both external components, excellent temperature stability of T_{TO} can be achieved. With \overline{TCL} tied to either V_{DD} or $V_{SS,}$ a precise square wave of period 2 x T_{TO} is generated at the output \overline{TO} . The oscillator and watchdog timer run so long as the chip is powered with at least the minimum positive supply voltage specified $(V_{ON}),$ and so long as V_{IN} remains above the level V_{RL} after a power-up sequence. If the timer function is not required, input \overline{TCL} should be tied to output \overline{TO} to give a simple voltage monitor (see Fig. 14).

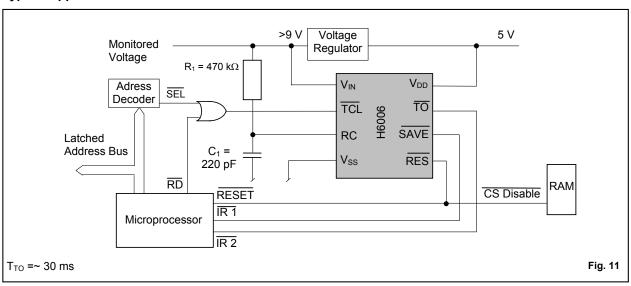
Timer Clearing and RES Action

A negative edge or a negative pulse at the \overline{TCL} input longer than 150 ns will reset the timer and set \overline{TO} high. If a further \overline{TCL} signal edge or pulse is applied before T_{TO} timeout, \overline{TO} will stay high and the timer will again be reset to zero (see Fig. 5). If no \overline{TCL} signal is applied before the T_{TO} timeout, \overline{TO} will start to generate a square wave of period 2 x T_{TO} starting with a low state. If no \overline{TCL} signal is applied during the first low state of \overline{TO} , then the \overline{RES} output will go low and stay low until the next \overline{TCL} signal, or until a fresh power-up sequence.

Combined Voltage and Timer Action

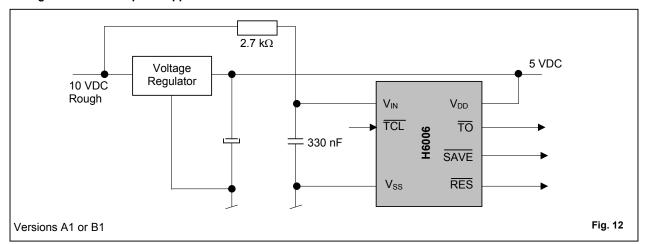
The combination of voltage and timer action is illustrated by the sequence of events shown in Fig. 6. One timeout period after V_{IN} reached $V_{\text{SH}},$ during power-up, $\overline{\text{RES}}\,$ goes inactive high. No TCL pulse will have any effect until this power-on reset delay is completed. After completing the power-up sequence the watchdog timer starts acting. If no TCL pulse occurs, the timeout warning TO goes active low after one timeout period T_{TO}. After each subsequent timeout period without a timer clear pulse \overline{TCL} , \overline{TO} changes its polarity providing a square wave signal. RES activates at the end of the first low state of the TO signal. A TCL pulse clears the watchdog timer and resets the TO and RES output inactive high again. A voltage drop below the V_{RL} level overrides the timer and immediately forces RES and SAVE active low and disables TO. Any further TCL pulse has no effect until the next power-up sequence has complete

Typical Applications

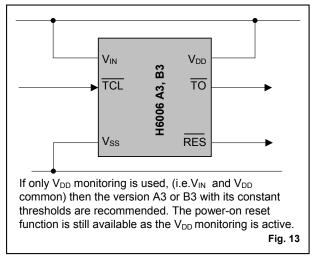




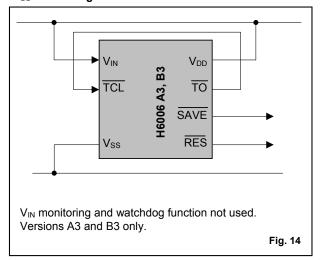
Voltage Monitor with Spike Suppression



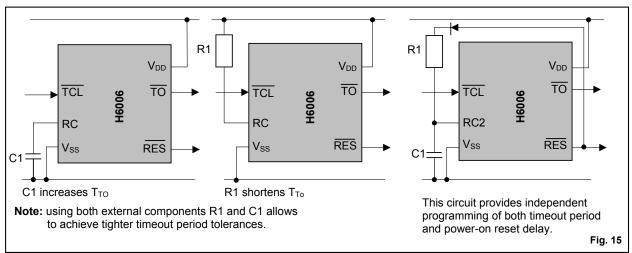
Watchdog and Power-On Reset



V_{DD} Monitoring and Power-On Reset



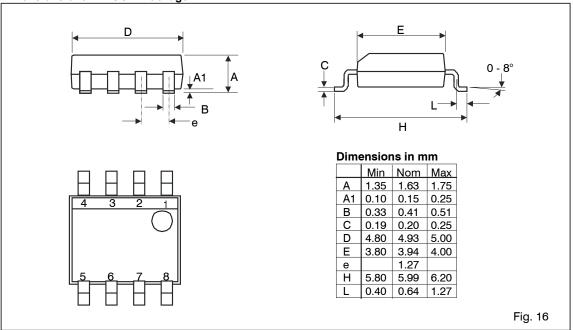
External Programming of RC Oscillator





Package Information





Ordering Information

When ordering, please specify the complete Part Number

Part Number	Version	Threshol d (see Table 4)	Outpu t Type	Package	Delivery Form	Package Marking (first line)	Temperature Range	
H6006A2SO8A	A2	2.00		8-pin SOIC	Stick	6006A2		
H6006A2SO8B	72	2.00	Open	8-pin SOIC	Tape & Reel	6006A2		
H6006A3SO8A*	A3	1.95	drain	8-pin SOIC	Stick	6006A3		
H6006A3SO8B*	AS	1.95		8-pin SOIC	Tape & Reel	6006A3		
H6006B1SO8A	D1	B1	8.00		8-pin SOIC	Stick	6006B1	-40 to +85 °C
H6006B1SO8B*	ы	6.00		8-pin SOIC	Tape & Reel	6006B1	-40 to 103 C	
H6006B2SO8A	B2	2.00	Push-	8-pin SOIC	Stick	6006B2		
H6006B2SO8B	DZ	2.00	pull	8-pin SOIC	Tape & Reel	6006B2		
H6006B3SO8A	D2	B3 1.95		8-pin SOIC	Stick	6006B3		
H6006B3SO8B	۵۵	1.95		8-pin SOIC	Tape & Reel	6006B3		

^{* =} non stock item. Might be available on request and upon minimum order quantity (please contact EM Microelectronic).

Note: Other versions are no longer available

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