

SM72240

SolarMagic 5-Pin Microprocessor Reset Circuit

General Description

The SM72240 microprocessor supervisory circuit monitors the power supplies in microprocessor and digital systems. It provides a reset to the microprocessor during power-up, power-down, brown-out conditions, and manual reset.

The SM72240 asserts a reset signal whenever the supply decreases below the factory-programmed reset threshold. Reset will be asserted for at least 100ms even after V_{CC} rises above the reset threshold.

The SM72240 has an active-low open-drain \overline{RESET} output. The SM72240 is suitable for monitoring 5V. With a low supply current of only 6 μ A, the SM72240 is ideal for use in portable equipment. The SM72240 is available in the 5-pin SOT23 package.

Features

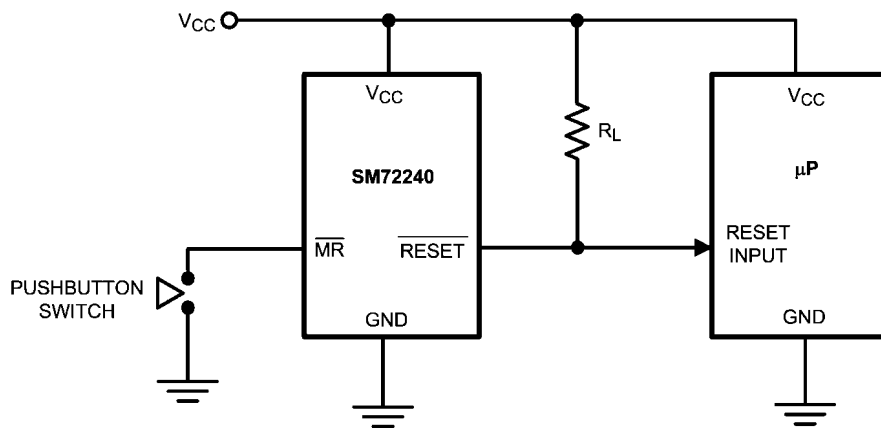
- Renewable Energy Grade
- Precise monitoring of 5V supply voltages
- Fully specified over temperature
-40°C to +125°C
- 100 ms minimum Power-On Reset pulse width, 190 ms typical:
 - Active-Low \overline{RESET} Open Drain Output
- Guaranteed \overline{RESET} Output valid for $V_{CC} \geq 1V$
- Low Supply Current, 6 μ A typical
- Power supply transient immunity
- Compatible with MAX811/812 applications

Applications

- Microprocessor Systems
- Computers
- Controllers
- Intelligent Instruments
- Portable/Battery-Powered Equipment

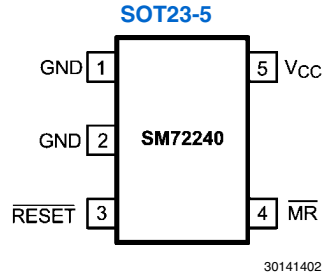


Typical Application Circuit



30141437

Connection Diagram



Pin Descriptions

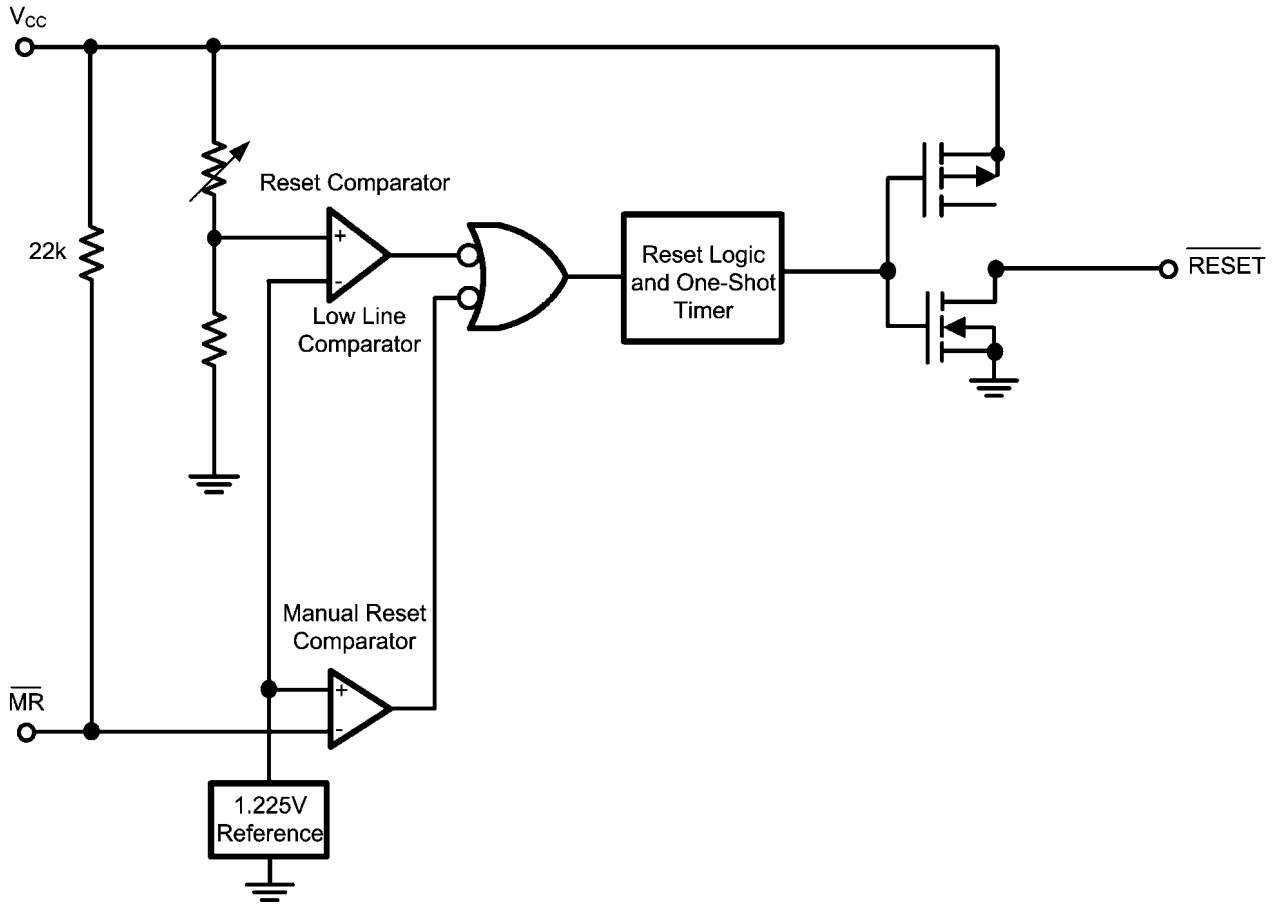
Pin	Name	Function
1	GND	Ground reference
2	GND	Ground reference, device substrate, connect to ground.
3	$\overline{\text{RESET}}$	Active-low output. $\overline{\text{RESET}}$ remains low while V_{CC} is below the reset threshold voltage, and for 190 ms after V_{CC} rises above the reset threshold voltage.
4	$\overline{\text{MR}}$	Active-low input. Reset is asserted whenever this pin is pulled low and remains asserted for 190 ms after the $\overline{\text{MR}}$ pin goes high. May be left open.
5	V_{CC}	Supply Voltage (+5V, nominal)

Ordering Information

Reset Threshold (V)	Supplied as 250 units, tape & reel	Supplied as 1000 units, tape & reel	Supplied as 3000 units, tape & reel	Package Type	Package Top Mark	NSC Package
4.63	SM72240MFE-4.63	SM72240MF-4.63	SM72240MFX-4.63	SOT23-5	2240	MF05A
3.08	SM72240MFE-3.08	SM72240MF-3.08	SM72240MFX-3.08	SOT23-5	R133	MF05A

Block Diagram

SM72240 Block Diagram



30141435

Absolute Maximum Ratings *(Note 1)*

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

V_{CC} , \overline{MR}	-0.3V to 6.0V
RESET, \overline{RESET}	-0.3V to ($V_{CC} + 0.3V$)
Input Current, V_{CC} Pin	20mA
Output Current, RESET, \overline{RESET} Pin	20mA

ESD Rating *(Note 2)*

2kV

Continuous Power Dissipation ($T_A = +70^\circ\text{C}$)

SOT-23 *(Note 3)*

320mW

Operating Temperature Range

-40°C to +125°C

Maximum Junction Temperature

125°C

Storage Temperature Range

-65°C to +160°C

Lead Temperature

(soldering, 10sec)

+300°C

Electrical Characteristics

Typical values are at $T_A = +25^\circ\text{C}$. Limits with standard typeface are for $T_A = +25^\circ\text{C}$, and limits in boldface type apply for the operating temperature range -40°C to +125°C, unless otherwise noted. *(Note 4)*

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{CC}	V_{CC} Range		1.0		5.5	V
I_{CC}	Supply Current ($I_{LOAD} = 0A$)	SM72240-4.63 $V_{CC} = 5.5V$		8	15	μA
		SM72240-3.08 $V_{CC} = 3.6V$		7	10	
V_{TH}	Reset Threshold	SM72240-4.63	4.54 4.50	4.63	4.72 4.75	V
		SM72240-3.08	3.03 3.00	3.08	3.14 3.15	
V_{TH} Tempco	Reset Threshold Temperature Coefficient			30		ppm/°C
t_{RD}	V_{CC} to Reset Delay <i>(Note 5)</i>	$V_{CC} = V_{TH}$ to ($V_{TH} - 100mV$)		20		μs
t_{RP}	Reset Active Timeout Period		100	190	560	ms
t_{MR}	\overline{MR} Minimum Pulse Width		10			μs
t_{MD}	\overline{MR} to Reset Propagation Delay			2		μs
		\overline{MR} Glitch Immunity <i>(Note 6)</i>		100		
V_{IH} V_{IL}	\overline{MR} Input Threshold	$V_{CC} > V_{TH(MAX)}$	2.3			V
					0.8	
	\overline{MR} Pull-Up Resistance			22		k Ω
V_{OL}	\overline{RESET} Output Voltage Low	$V_{CC} = V_{TH}$ min, $I_{SINK} = 3.2$ mA			0.4	V
		$V_{CC} > 1V$, $I_{SINK} = 50\mu A$			0.3	
I_{IN}	\overline{RESET} Output Leakage Current (SM72240)	$V_{CC} > V_{TH}$, $\overline{RESET} = 5.5V$			0.5	μA

Note 1: Absolute Maximum Ratings are limits beyond which damage to the device may occur. Operating Ratings are conditions under which the device operates correctly. Operating ratings do not imply guaranteed performance limits. For guaranteed performance limits and associated test conditions, see the Electrical Characteristics.

Note 2: The human body model is a 100pF capacitor discharged through a 1.5k Ω resistor into each pin.

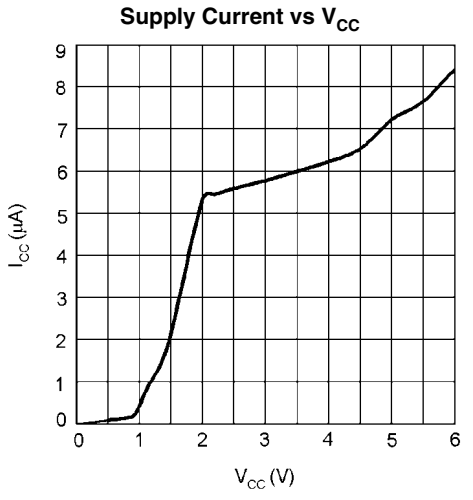
Note 3: At elevated temperatures, devices must be derated based on package thermal resistance. The device must be derated at 4.5mW/°C at ambient temperatures above 70°C. The device has internal thermal protection.

Note 4: Production testing done at $T_A = +25^\circ\text{C}$. Limits over the operating temperature range are guaranteed through correlation using Statistical Quality Control (SQC) methods.

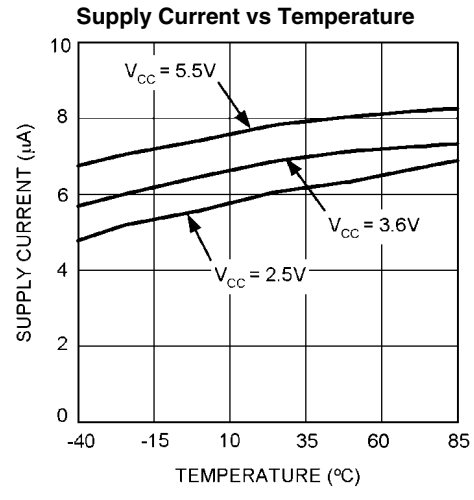
Note 5: \overline{RESET} Output.

Note 6: Glitches of 100 ns or less typically will not generate a reset pulse.

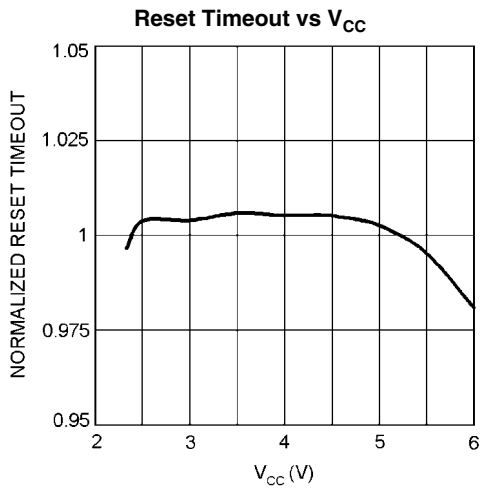
Typical Performance Characteristics



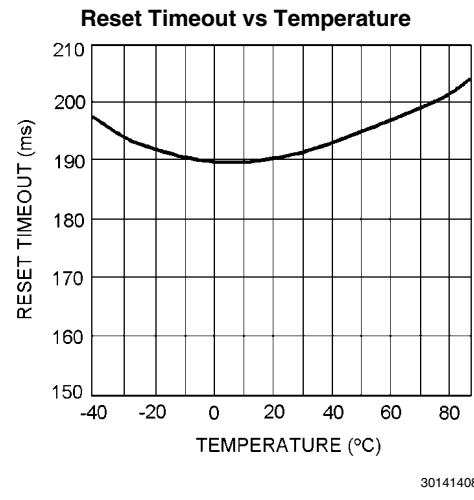
30141403



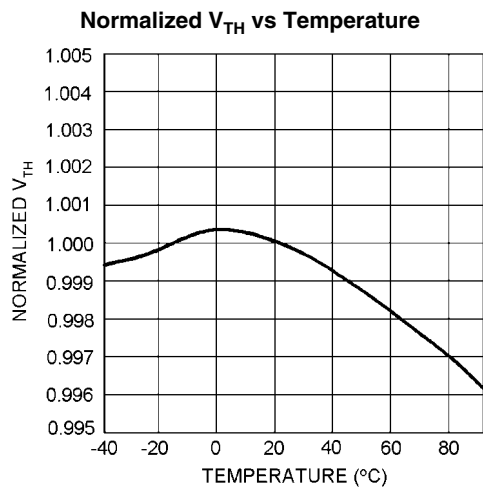
30141407



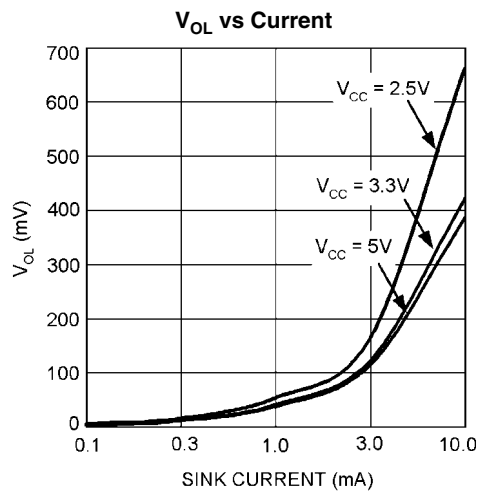
30141404



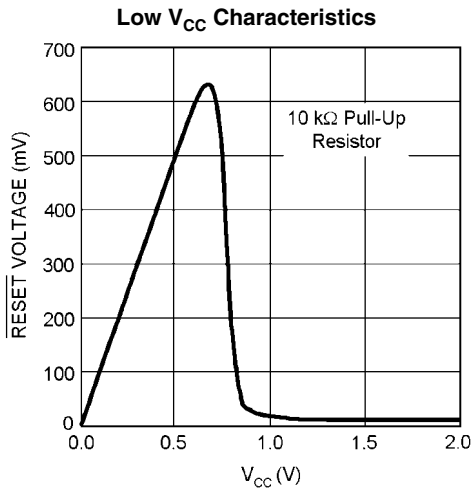
30141408



30141416

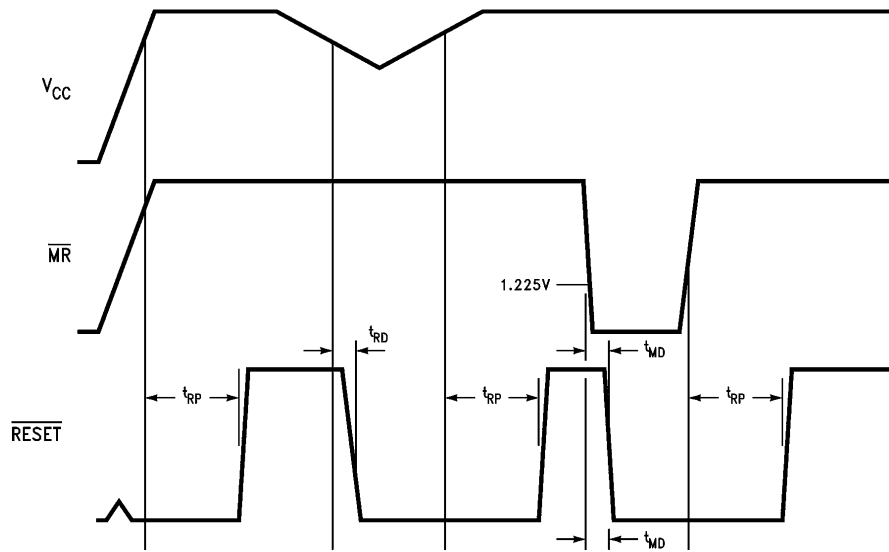


30141405



30141406

Timing Diagram



30141412

Circuit Information

RESET OUTPUT

The reset input of a μP initializes the device into a known state. The SM72240 microprocessor voltage monitoring circuit asserts a forced reset output to prevent code execution errors during power-up, power-down, and brownout conditions.

$\overline{\text{RESET}}$ is guaranteed valid for $V_{\text{CC}} \geq 1\text{V}$. Once V_{CC} exceeds the reset threshold, an internal timer maintains the output for the reset timeout period. After this interval, reset goes high and the microprocessor initializes itself into a known state. $\overline{\text{RESET}}$ is active low.

As V_{CC} drops below the reset threshold (such as during a brownout), the reset activates (see the *Negative-Going V_{CC} Transients* section). When V_{CC} again rises above the reset threshold, the internal timer starts. Reset holds until V_{CC} exceeds the reset threshold for longer than the reset timeout period. After this time, reset releases.

Additionally, the Manual Reset input ($\overline{\text{MR}}$) will initiate a forced reset. See the *Manual Reset Input* section.

The SM72240 reset output ignores short duration glitches on V_{CC} and $\overline{\text{MR}}$. See the *Applications Information* section for details.

RESET THRESHOLD

The SM72240 is available with a reset voltage of 4.63V or 3.08V which are suitable for monitoring 5.0V or 3.3V supplies respectively.

MANUAL RESET INPUT ($\overline{\text{MR}}$)

Many μP -based products require a manual reset capability, allowing the operator to initiate a reset. The $\overline{\text{MR}}$ input is fully debounced and provides an internal 22 k Ω pull-up. When the $\overline{\text{MR}}$ input is pulled below V_{IL} ($0.25V_{\text{CC}}$) for more than 100 ns, reset is asserted after a typical delay of 2 μs . Reset remains active as long as $\overline{\text{MR}}$ is held low, and releases after $\overline{\text{MR}}$ rises above V_{IH} and the reset timeout period expires. Use $\overline{\text{MR}}$ with digital logic to assert reset or to daisy chain supervisory circuits.

Applications Information

BENEFITS OF PRECISION RESET THRESHOLDS

A microprocessor supply supervisor must provide a reset output within a predictable range of the supply voltage. A common threshold range is between 5% and 10% below the nominal supply voltage. The SM72240 uses highly accurate

circuitry to ensure that the reset threshold occurs only within this range (for 5.0V and 3.3V supplies). *Table 1* shows how the standard reset threshold applies to 5.0V and 3.3V nominal supply voltages.

TABLE 1. Monitored Tolerance Table

Reset Threshold	Supply Voltage	
	3.3V	5.0V
4.63 \pm %		90.8-94.4%
3.08 \pm %	91.8-95.2%	

ENSURING A VALID RESET OUTPUT DOWN TO $V_{\text{CC}} = 0\text{V}$

When V_{CC} falls below 1V, the SM72240 $\overline{\text{RESET}}$ output is unable to sink the rated current. A high-impedance CMOS logic input connected to $\overline{\text{RESET}}$ can therefore drift to undetermined voltages. To prevent this situation, a 100k Ω resistor should be connected from the $\overline{\text{RESET}}$ output to ground, as shown in *Figure 1*.

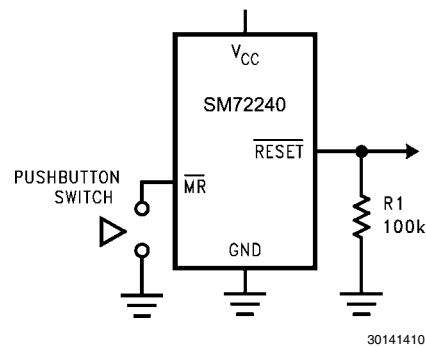


FIGURE 1. Circuit for $\overline{\text{RESET}}$ Valid from $V_{\text{CC}} = 0\text{V}$

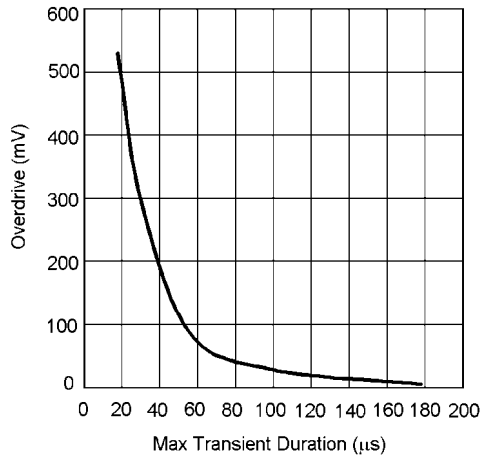
OPEN DRAIN OUTPUT

An open drain output allows easy paralleling of multiple microprocessor reset circuits without requiring additional logic gates. Open drain outputs also allow interfacing devices of differing logic levels or families, since the output pull-up resistor may be connected to any supply voltage up to 5.5V, regardless of V_{CC} .

The pull up resistor is calculated so that maximum current flow into $\overline{\text{RESET}}$ is less than 10 mA when activated. The resistor must be small enough so that the leakage current of all connected devices does not create an excessive voltage drop when the output is not activated. A resistor value of 100 k Ω will generally suffice.

NEGATIVE-GOING V_{CC} TRANSIENTS

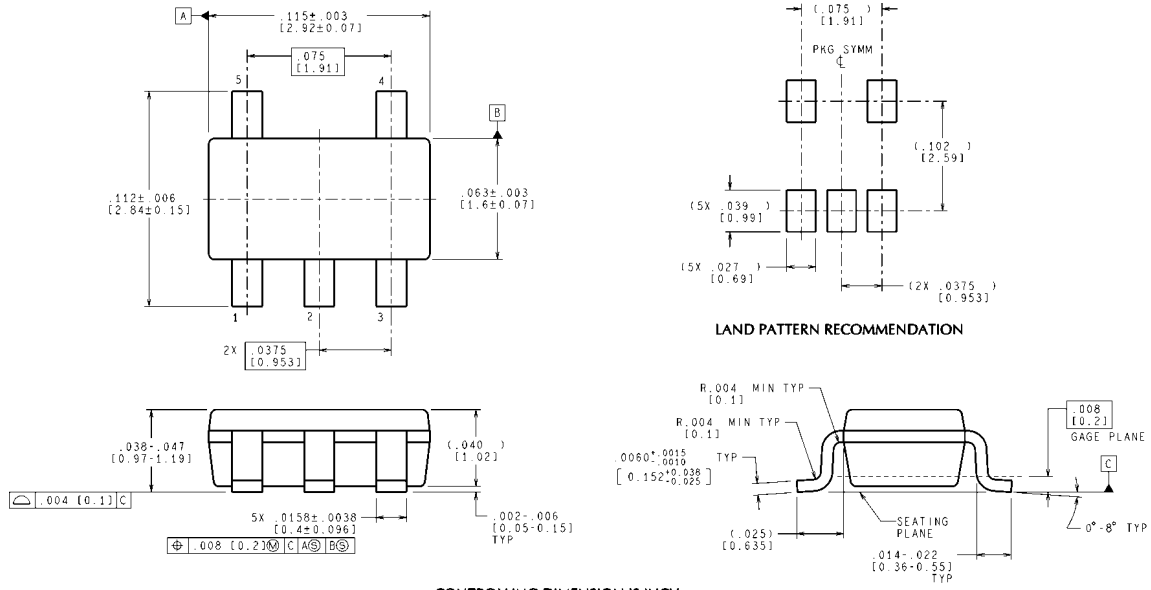
The SM72240 is relatively immune to short negative-going transients or glitches on V_{CC} . *Figure 2* shows the maximum pulse width a negative-going V_{CC} transient can have without causing a reset pulse. In general, as the magnitude of the transient increases, going further below the threshold, the maximum allowable pulse width decreases. Typically, a V_{CC} transient that goes 125 mV below the reset threshold and lasts 40 μs or less will not cause a reset pulse. A 0.1 μF bypass capacitor mounted as close as possible to the V_{CC} pin will provide additional transient rejection.



30141414

FIGURE 2. Maximum Transient Duration without Causing a Reset Pulse vs. Reset Comparator Overdrive

Physical Dimensions inches (millimeters) unless otherwise noted



CONTROLLING DIMENSION IS INCH
 VALUES IN [] ARE MILLIMETERS
 DIMENSIONS IN () FOR REFERENCE ONLY

MF05A (Rev D)

5-Lead SOT23-5
For Ordering, refer to Ordering Information table
NS Package Number MF05A

Notes

For more National Semiconductor product information and proven design tools, visit the following Web sites at:
www.national.com

Products		Design Support	
Amplifiers	www.national.com/amplifiers	WEBENCH® Tools	www.national.com/webench
Audio	www.national.com/audio	App Notes	www.national.com/appnotes
Clock and Timing	www.national.com/timing	Reference Designs	www.national.com/refdesigns
Data Converters	www.national.com/adc	Samples	www.national.com/samples
Interface	www.national.com/interface	Eval Boards	www.national.com/evalboards
LVDS	www.national.com/lvds	Packaging	www.national.com/packaging
Power Management	www.national.com/power	Green Compliance	www.national.com/quality/green
Switching Regulators	www.national.com/switchers	Distributors	www.national.com/contacts
LDOs	www.national.com/lido	Quality and Reliability	www.national.com/quality
LED Lighting	www.national.com/led	Feedback/Support	www.national.com/feedback
Voltage References	www.national.com/vref	Design Made Easy	www.national.com/easy
PowerWise® Solutions	www.national.com/powerwise	Applications & Markets	www.national.com/solutions
Serial Digital Interface (SDI)	www.national.com/sdi	Mil/Aero	www.national.com/milaero
Temperature Sensors	www.national.com/tempensors	SolarMagic™	www.national.com/solarmagic
PLL/VCO	www.national.com/wireless	PowerWise® Design University	www.national.com/training

THE CONTENTS OF THIS DOCUMENT ARE PROVIDED IN CONNECTION WITH NATIONAL SEMICONDUCTOR CORPORATION ("NATIONAL") PRODUCTS. NATIONAL MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS PUBLICATION AND RESERVES THE RIGHT TO MAKE CHANGES TO SPECIFICATIONS AND PRODUCT DESCRIPTIONS AT ANY TIME WITHOUT NOTICE. NO LICENSE, WHETHER EXPRESS, IMPLIED, ARISING BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT.

TESTING AND OTHER QUALITY CONTROLS ARE USED TO THE EXTENT NATIONAL DEEMS NECESSARY TO SUPPORT NATIONAL'S PRODUCT WARRANTY. EXCEPT WHERE MANDATED BY GOVERNMENT REQUIREMENTS, TESTING OF ALL PARAMETERS OF EACH PRODUCT IS NOT NECESSARILY PERFORMED. NATIONAL ASSUMES NO LIABILITY FOR APPLICATIONS ASSISTANCE OR BUYER PRODUCT DESIGN. BUYERS ARE RESPONSIBLE FOR THEIR PRODUCTS AND APPLICATIONS USING NATIONAL COMPONENTS. PRIOR TO USING OR DISTRIBUTING ANY PRODUCTS THAT INCLUDE NATIONAL COMPONENTS, BUYERS SHOULD PROVIDE ADEQUATE DESIGN, TESTING AND OPERATING SAFEGUARDS.

EXCEPT AS PROVIDED IN NATIONAL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, NATIONAL ASSUMES NO LIABILITY WHATSOEVER, AND NATIONAL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY RELATING TO THE SALE AND/OR USE OF NATIONAL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS PRIOR WRITTEN APPROVAL OF THE CHIEF EXECUTIVE OFFICER AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

Life support devices or systems are devices which (a) are intended for surgical implant into the body, or (b) support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in a significant injury to the user. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system or to affect its safety or effectiveness.

National Semiconductor and the National Semiconductor logo are registered trademarks of National Semiconductor Corporation. All other brand or product names may be trademarks or registered trademarks of their respective holders.

Copyright© 2011 National Semiconductor Corporation

For the most current product information visit us at www.national.com



**National Semiconductor
Americas Technical
Support Center**
Email: support@nsc.com
Tel: 1-800-272-9959

**National Semiconductor Europe
Technical Support Center**
Email: europe.support@nsc.com

**National Semiconductor Asia
Pacific Technical Support Center**
Email: ap.support@nsc.com

**National Semiconductor Japan
Technical Support Center**
Email: jpn.feedback@nsc.com