19-1568; Rev 2; 12/05

6-Pin µP Reset Circuit with Power-Fail Comparator

General Description

The MAX6342–MAX6345 family of microprocessor (µP) supervisory circuits monitors power supplies in digital systems. These devices significantly improve system reliability and accuracy compared to separate ICs or discrete components.

The MAX6342–MAX6345 provide factory-trimmed V_{CC} reset threshold voltages from 2.33V to 4.63V and operate with supply voltages between +1V and +5.5V. A +1.25V threshold detector allows for a power-fail warning, for low-battery detection, or for monitoring another power supply. The MAX6342 contains an $\overline{MR}$ input and an active-low push-pull reset. The MAX6343 and MAX6344 are identical to the MAX6342 except they provide an active-low, open-drain reset and an active-high, push-pull reset, respectively. The MAX6345 provides a second reset output in place of the $\overline{MR}$ input to give it an active-high push-pull reset and an active-low push-pull reset.

All of the devices are packaged in a miniature 6-pin SOT23.

Applications

Portable Computers

Telecom Equipment

Networking Equipment

Portable/Battery-Powered Equipment

Multivoltage Systems

Embedded Control Systems

Typical Operating Circuit appears at end of data sheet.

Selector Guide 1

SUFFIX	RESET THRESHOLD (V)
L	4.63
M	4.38
T	3.08
S	2.93
R	2.63
Z	2.33

Features

- **Small 6-Pin SOT23 Package**
- **Precision Factory-Set V_{CC} Reset Thresholds Between 2.33V and 4.63V**
- **Guaranteed $\overline{RESET}$ Valid to V_{CC} = +1V**
- **100ms min Reset Pulse Width**
- **Debounced CMOS-Compatible Manual-Reset Input**
- **Voltage Monitor for Power-Fail or Low-Battery Warning**

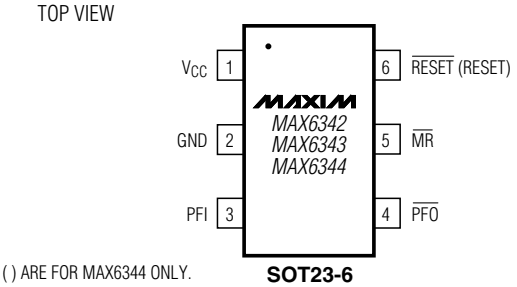
Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX6342_UT-T	-40°C to +125°C	6 SOT23-6
MAX6343_UT-T	-40°C to +125°C	6 SOT23-6
MAX6344_UT-T	-40°C to +125°C	6 SOT23-6
MAX6345_UT-T	-40°C to +125°C	6 SOT23-6

Note: *The MAX6342–MAX6345 are available with factory-set reset thresholds from 2.33V to 4.63V (see Selector Guides 1, 2). Insert the letter corresponding to the desired nominal reset threshold into the blank following the part number. There is a 2500 piece order increment required for the SOT package. SOT Top Marks table appears at end of data sheet.*

Devices are available in both leaded and lead-free packaging. Specify lead-free by replacing "-T" with "+T" when ordering.

Pin Configurations



Pin Configurations continued at end of data sheet.

Selector Guide 2

PART	PUSH-PULL $\overline{RESET}$ OUTPUT	OPEN-DRAIN $\overline{RESET}$ OUTPUT	PUSH-PULL RESET OUTPUT	MANUAL-RESET INPUT
MAX6342	✔	—	—	✔
MAX6343	—	✔	—	✔
MAX6344	—	—	✔	✔
MAX6345	✔	—	✔	—

6-Pin µP Reset Circuit with Power-Fail Comparator

ABSOLUTE MAXIMUM RATINGS

V_{CC} to GND .....-0.3V to +6V
RESET, $\overline{RESET}$
(MAX6342/MAX6344/MAX6345) ..... -0.3V to (V_{CC} + 0.3V)
$\overline{RESET}$ (MAX6343)..... -0.3V to +6V
$\overline{MR}$, PFI, $\overline{PFO}$ .....-0.3V to (V_{CC} + 0.3V)
Input Current, V_{CC} 50mA
Output Current, RESET, $\overline{RESET}$ 50mA

Continuous Power Dissipation (T_A = +70°C)
6-Pin SOT23 (derate 4mW/°C above +70°C).....320mW
Operating Temperature Range .....-40°C to +125°C
Junction Temperature.....+150°C
Storage Temperature Range .....-65°C to +150°C
Lead Temperature Range (soldering, 10s)..... +300°C

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

(V_{CC} = +1.0V to +5.5V, T_A = -40°C to +125°C, unless otherwise noted. Typical values are at T_A = +25°C and V_{CC} = +3V.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{CC}	T_A = 0°C to +70°C		1.0		5.5	V
		T_A = -40°C to +125°C		1.2		5.5	
Supply Current	I_{CC}	No load	V_{CC} = 3V, TA = -40° to +85°C		25	40	µA
			V_{CC} = 5.5V, TA = -40° to +85°C		30	50	
			V_{CC} = 3V, TA = -40° to +125°C		25	50	
			V_{CC} = 5.5V, TA = -40° to +125°C		30	60	
Reset Threshold	V_{TH}	MAX634_L	T_A = +25°C	4.56	4.63	4.70	V
			T_A = -40°C to +85°C	4.50		4.75	
			T_A = -40°C to +125°C	4.40		4.86	
		MAX634_M	T_A = +25°C	4.31	4.38	4.45	
			T_A = -40°C to +85°C	4.25		4.50	
			T_A = -40°C to +125°C	4.16		4.56	
		MAX634_T	T_A = +25°C	3.03	3.08	3.13	
			T_A = -40°C to +85°C	3.00		3.15	
			T_A = -40°C to +125°C	2.92		3.23	
		MAX634_S	T_A = +25°C	2.89	2.93	2.97	
			T_A = -40°C to +85°C	2.85		3.00	
			T_A = -40°C to +125°C	2.78		3.08	
		MAX634_R	T_A = +25°C	2.59	2.63	2.67	
			T_A = -40°C to +85°C	2.55		2.70	
			T_A = -40°C to +125°C	2.50		2.76	
		MAX634_Z	T_A = +25°C	2.30	2.33	2.36	
			T_A = -40°C to +85°C	2.25		2.38	
			T_A = -40°C to +125°C	2.21		2.45	
V_{CC} to Reset Delay		V_{CC} = V_{TH} to (V_{TH} - 100mV)			20		µs
$\overline{RESET}$ and RESET Outputs Drive Capability (Note 2)	V_{OL}	V_{CC} > 1.2V, I_{SINK} = 100µA				0.4	V
		V_{CC} > 2.7V, I_{SINK} = 1.2mA				0.3	
		V_{CC} > 4.5V, I_{SINK} = 3.2mA				0.4	
	V_{OH}	V_{CC} > 1.2V, I_{SOURCE} = 50µA		0.8 × V_{CC}			V
		V_{CC} > 2.7V, I_{SOURCE} = 500µA (MAX6342/MAX6345 only)		0.8 × V_{CC}			
		V_{CC} > 4.5V, I_{SOURCE} = 800µA (MAX6342/MAX6345 only)		0.8 × V_{CC}			

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +1.0V to +5.5V, T_A = -40°C to +125°C, unless otherwise noted. Typical values are at T_A = +25°C and V_{CC} = +3V.) (Note 1)

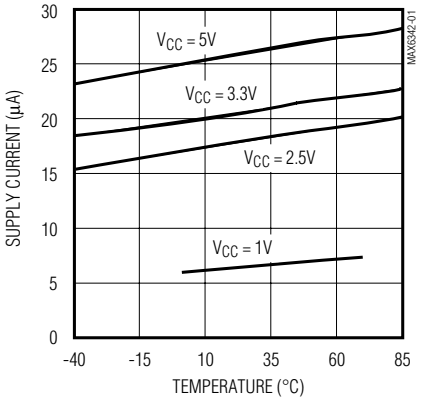
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Reset Timeout Period	t_{RP}	T_A = -40°C to +85°C	100	180	280	ms
		T_A = -40°C to +125°C	80		360	
Open-Drain $\overline{RESET}$ Output Leakage Current (Note 3)	I_{LKG}	MAX6343 only, $V_{CC} > V_{TH(MAX)}$			1	µA
$\overline{MR}$ Input Low	V_{IL}				0.3 × VCC	V
$\overline{MR}$ Input High	V_{IH}		0.7 × VCC			V
$\overline{MR}$ Pull-Up Resistance			60			kΩ
$\overline{MR}$ Minimum Pulse Width			1			µs
$\overline{MR}$ Glitch Rejection				0.1		µs
$\overline{MR}$ to Reset Delay				0.2		µs
PFI Input Threshold		T_A = -40°C to +85°C	1.2	1.25	1.3	V
		T_A = -40°C to +125°C	1.15		1.35	
PFI Leakage Current (Note 3)		T_A = -40°C to +85°C		±0.01	±25	nA
		T_A = -85°C to +125°C			±100	
$\overline{PFO}$ Output Voltage	V_{OL}	V_{CC} = 4.5V, I_{SINK} = 3.2mA			0.4	V
$\overline{PFO}$ Output Voltage	V_{OH}	V_{CC} = 4.5V, I_{SOURCE} = 800µA	0.8 × VCC			V
$\overline{PFO}$ Output Short-Circuit Current		Output sink current		20		mA
		Output source current		5		
PFI to $\overline{PFO}$ Delay		$V_{OVERDRIVE}$ = 15mV		3		µs

Note 1: Overtemperature limits are guaranteed by design and not production tested.
Note 2: Apply to each part in accordance with threshold voltage, output configuration, and manual reset status selected.
Note 3: Leakage parameters are guaranteed by design and not production tested.

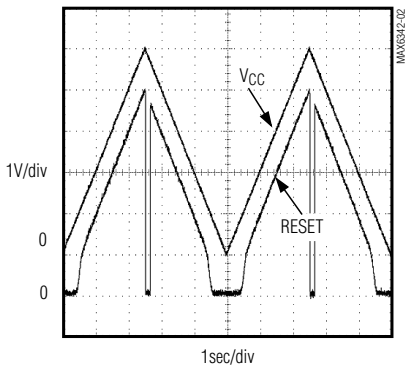
Typical Operating Characteristics

(V_{PFI} = V_{CC} = +5V, T_A = +25°C, unless otherwise noted.)

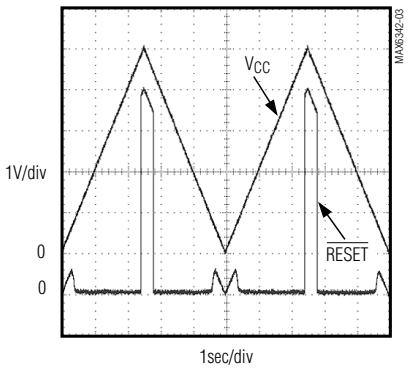
SUPPLY CURRENT vs. SUPPLY VOLTAGE AND TEMPERATURE



MAX6344L/MAX6345L RESET OUTPUT VOLTAGE vs. SUPPLY VOLTAGE



MAX6342M/MAX6345M $\overline{RESET}$ OUTPUT VOLTAGE vs. SUPPLY VOLTAGE

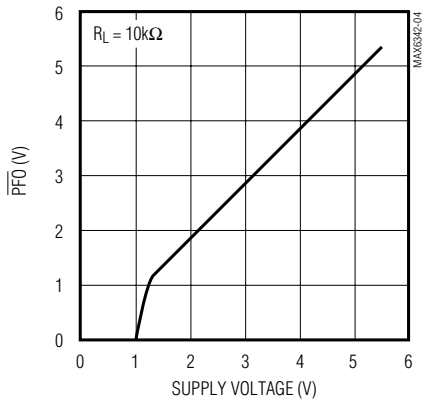


6-Pin µP Reset Circuit with Power-Fail Comparator

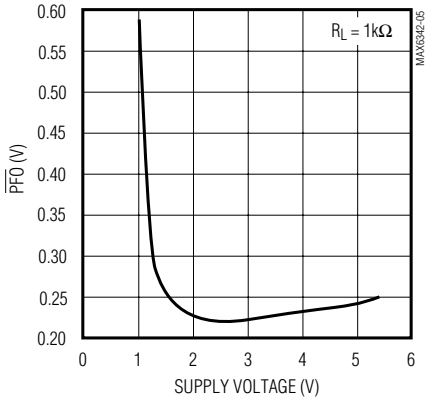
Typical Operating Characteristics (continued)

(V_{PFI} = V_{CC} = +5V, T_A = +25°C, unless otherwise noted.)

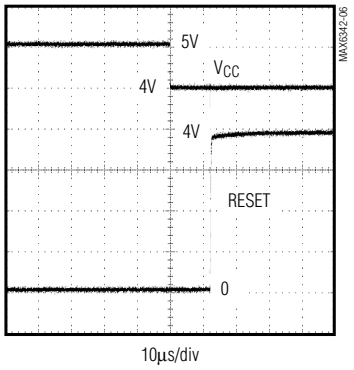
$\overline{PFO}$ OUTPUT-VOLTAGE HIGH vs. SUPPLY VOLTAGE



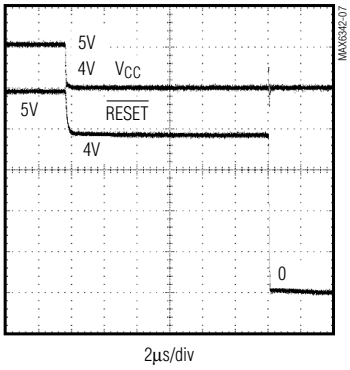
$\overline{PFO}$ OUTPUT-VOLTAGE LOW vs. SUPPLY VOLTAGE



MAX6344/MAX6345 RESET RESPONSE TIME



MAX6342/MAX6345 $\overline{RESET}$ RESPONSE TIME



Pin Description

PIN				NAME	FUNCTION
MAX6342	MAX6343	MAX6344	MAX6345		
1	1	1	1	V_{CC}	Supply Voltage
2	2	2	2	GND	Ground
3	3	3	3	PFI	Power-Fail Voltage Monitor Input. When PFI is < 1.25V, $\overline{PFO}$ goes low. Connect PFI to GND or V_{CC} when not used.
4	4	4	4	$\overline{PFO}$	Power-Fail Voltage Monitor Output

6-Pin µP Reset Circuit with Power-Fail Comparator

Pin Description (continued)

PIN				NAME	FUNCTION
MAX6342	MAX6343	MAX6344	MAX6345		
5	5	5	—	$\overline{MR}$	Manual-Reset Input. Pull low to force a reset. $\overline{RESET}$ or RESET remains active as long as $\overline{MR}$ is low and for the reset timeout period after $\overline{MR}$ goes high. Leave unconnected or connect to V_{CC} if unused.
6	6	—	5	$\overline{RESET}$	Active-Low Reset Output. Push-pull for MAX6342/MAX6345. Open-drain for MAX6343. It remains low for 180ms after V_{CC} rises above the reset threshold or $\overline{MR}$ goes from low to high.
—	—	6	6	RESET	Active-High Push-Pull Reset Output. It remains high for 180ms after V_{CC} rises above the reset threshold or $\overline{MR}$ goes from low to high.

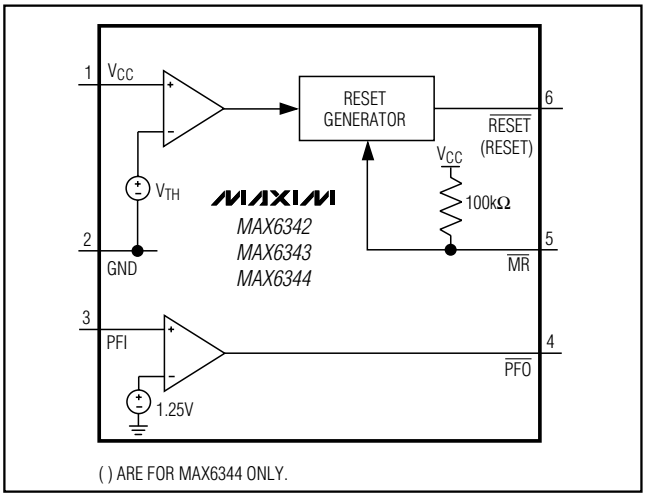


Figure 1. MAX6342/MAX6343/MAX6344 Functional Diagram

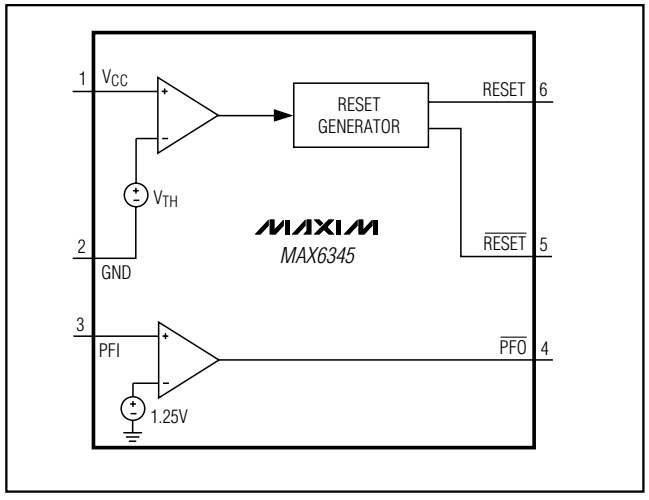


Figure 2. MAX6345 Functional Diagram

Detailed Description

Reset Output

A µP's reset input starts the µP in a known state. These µP supervisory circuits assert reset to prevent code-execution errors during power-up, power-down, or brownout conditions.

$\overline{RESET}$ and RESET are guaranteed to be asserted at a valid logic level for V_{CC} > +1V (see the *Electrical Characteristics* table). Once RESET asserts, it remains asserted for at least 100ms (t_{RP}) after V_{CC} rises above its threshold value or after $\overline{MR}$ returns high (Figures 1 and 2).

Open-Drain $\overline{RESET}$ Output

The MAX6343 has an active-low, open-drain reset output. This output sinks current when $\overline{RESET}$ is asserted. Connect a pull-up resistor from $\overline{RESET}$ to any positive supply voltage up to +5.5V (Figure 3). Select a resistor value large enough to register a logic low (see the *Electrical Characteristics* table), and small enough to register a logic high while supplying all input current and leakage paths connected to the $\overline{RESET}$ line. A 10kΩ pull-up is sufficient in most applications.

Manual Reset

The MAX6342/MAX6343/MAX6344s' manual-reset input ($\overline{MR}$) allows reset to be triggered by a pushbutton switch. The switch is effectively debounced by the 1µs min reset pulse width. $\overline{MR}$ is CMOS-logic compatible.

6-Pin µP Reset Circuit with Power-Fail Comparator

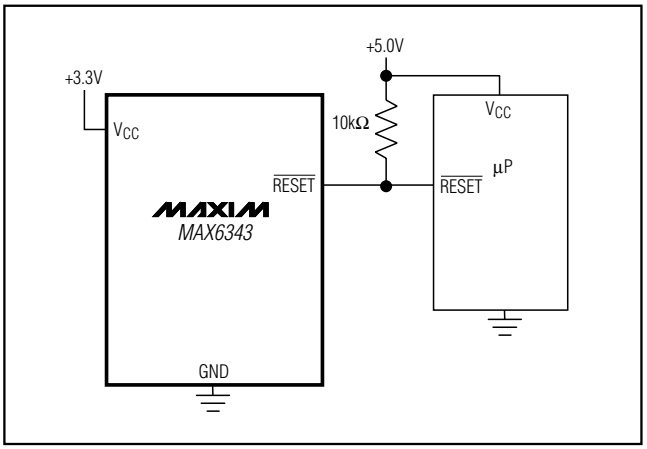


Figure 3. Open-Drain $\overline{RESET}$ Output Allows Use with Multiple Supplies

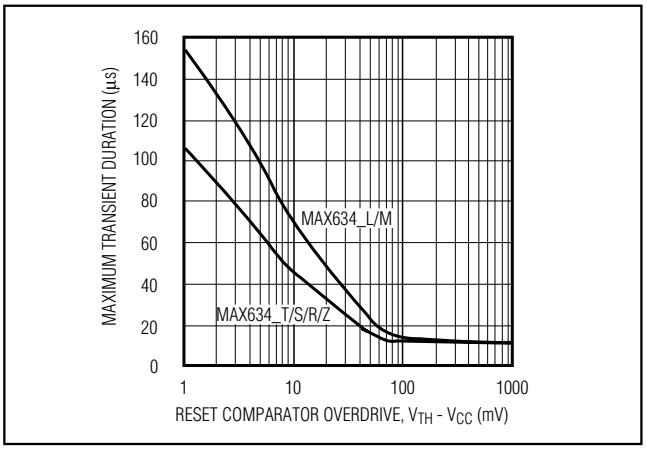


Figure 4. Maximum Transient Duration Magnitude Rejection

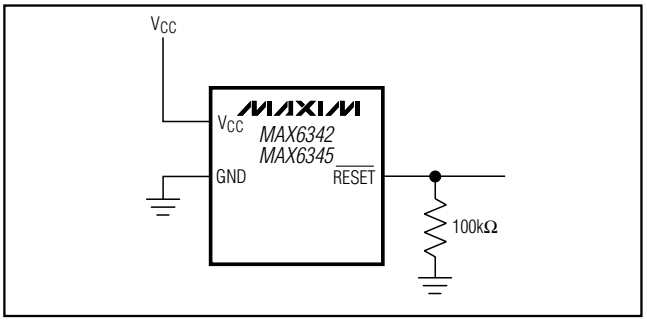


Figure 5. Ensuring $\overline{RESET}$ Valid to V_{CC} = 0 on Active-Low Push-Pull Outputs

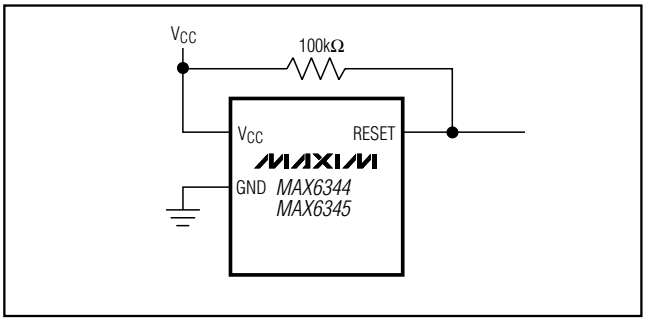


Figure 6. Ensuring $\overline{RESET}$ Valid to V_{CC} = 0 on Active-High Push-Pull Outputs

Power-Fail Comparator

The power-fail comparator is useful for various purposes because the power-fail output ($\overline{PFO}$) is independent of the reset output. The inverting input is internally connected to a +1.25V reference.

To build an early-warning circuit for power failure, connect the PFI pin to a voltage divider (see the *Typical Oper-ating Circuit*). Choose the voltage-divider ratio so that the voltage at PFI falls below +1.25V just before the +5V regulator drops out. Use $\overline{PFO}$ to interrupt the µP to prepare for an orderly shutdown.

Applications Information

Negative-Going V_{CC} Transients

The MAX6342–MAX6345 supervisors are immune to short-duration, negative-going V_{CC} transients (glitches) that usually do not require the entire system to shut down.

Figure 4 shows typical transient duration vs. reset comparator overdrive, for which the MAX6342–MAX6345 do not generate a reset pulse. The graph was generated using a negative-going pulse applied to V_{CC}, starting 0.5V above the actual reset threshold and ending below it by the magnitude indicated (reset comparator overdrive). The graph indicates the maximum pulse width a negative-going V_{CC} transient can have without causing a reset pulse. As the magnitude of the transient increases (goes further below the reset threshold), the maximum allowable pulse width decreases.

Typically, a V_{CC} transient that goes 100mV below the reset threshold and lasts 12µs or less will not cause a reset pulse. A 1µF bypass capacitor mounted as close as possible to the V_{CC} pin provides additional transient immunity.

Ensuring a Valid Reset Output Down to V_{CC} = 0

The MAX6342–MAX6345 are guaranteed to operate properly down to V_{CC} = +1V. In applications that require valid reset levels down to V_{CC} = 0, a pulldown resistor to active-low outputs (MAX6342/MAX6345) and a pullup resistor to active-high outputs (MAX6344/MAX6345) ensure that the reset line is valid when the reset output is no longer sinking or sourcing current (Figures 5 and 6).

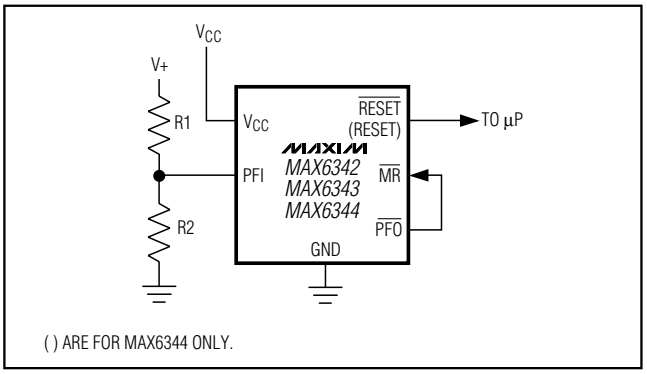


Figure 7. Monitoring Two Supplies

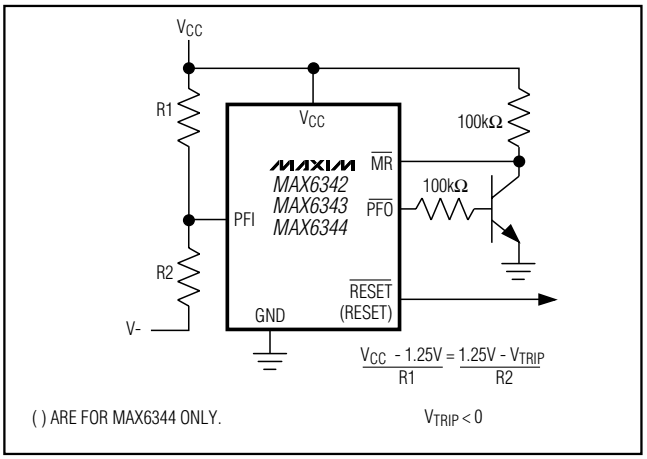


Figure 8. Monitoring a Negative Voltage

Note that this method does not work with the open-drain output of the MAX6343. The resistor value used is not critical, but it must be large enough not to load the reset output when V_{CC} is above the reset threshold. For most applications, 100kΩ is adequate.

Monitoring Two Supplies

Monitor another voltage by connecting a resistor-divider to PFI as shown in Figure 7. The threshold voltage will then be given by:

$$V_{TH(PFI)} = 1.25[(R1 + R2) / R2]$$

where $V_{TH(PFI)}$ is the threshold at which the monitored voltage will trip $\overline{PFO}$.

A good rule of thumb for selecting the resistors is to choose R2 between 250kΩ and 500kΩ and solve for R1. Connect $\overline{PFO}$ to $\overline{MR}$ in applications that require reset to assert when the second voltage falls below its threshold.

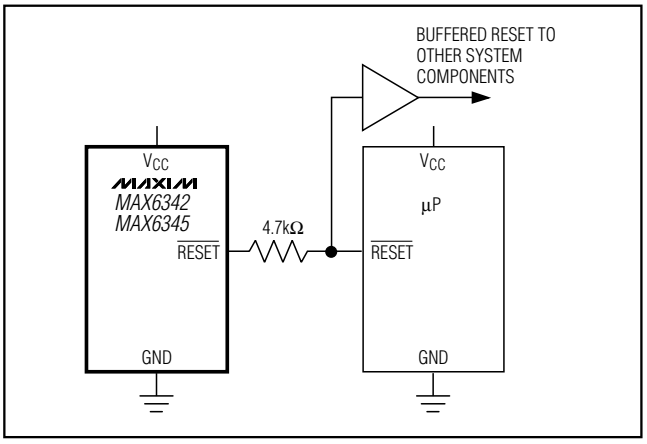


Figure 9. Interfacing to µPs with Bidirectional Reset I/O

Monitoring a Negative Voltage

Connect the circuit as shown in Figure 8 to use the power-fail comparator to monitor a negative supply rail. $\overline{PFO}$ stays low when V- is good. When V- rises to cause PFI to be above +1.25V, $\overline{PFO}$ goes high. By adding the resistors and transistor as shown, a high $\overline{PFO}$ triggers reset. As long as $\overline{PFO}$ remains high, the MAX6342/MAX6343/MAX6344 will keep reset asserted. Note that the accuracy of this circuit depends on the PFI threshold tolerance, the V_{CC} line voltage, and the resistors. Also, ensure that the voltage at PFI remains above GND.

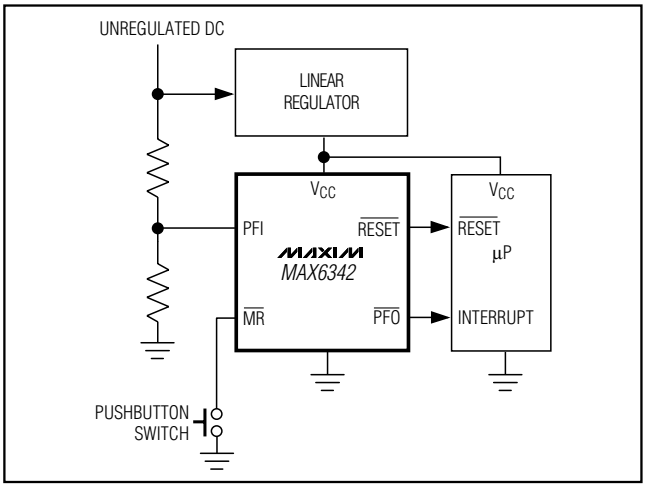
Interfacing to µPs with Bidirectional Reset Pins

SOT Top Marks

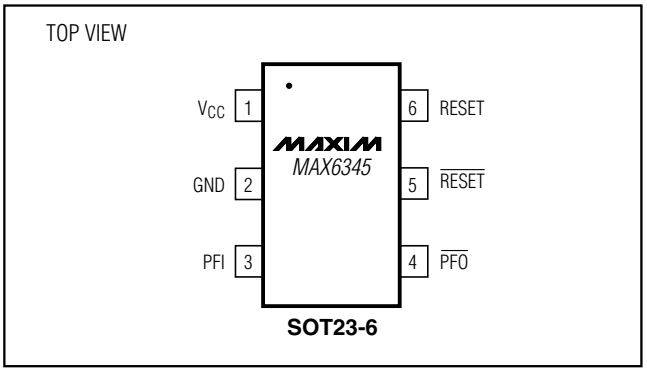
PART	SOT TOP MARK	PART	SOT TOP MARK
MAX6342LUT-T	AACP	MAX6344LUT-T	AADQ
MAX6342MUT-T	AACQ	MAX6344MUT-T	AADR
MAX6342TUT-T	AACR	MAX6344TUT-T	AADS
MAX6342SUT-T	AACS	MAX6344SUT-T	AADT
MAX6342RUT-T	AACT	MAX6344RUT-T	AADU
MAX6342ZUT-T	AACU	MAX6344ZUT-T	AADV
MAX6343LUT-T	AACV	MAX6345LUT-T	AADW
MAX6343MUT-T	AACW	MAX6345MUT-T	AADX
MAX6343TUT-T	AACX	MAX6345TUT-T	AADY
MAX6343SUT-T	AACY	MAX6345SUT-T	AADZ
MAX6343RUT-T	AACZ	MAX6345RUT-T	AAEA
MAX6343ZUT-T	AADA	MAX6345ZUT-T	AAEB

6-Pin µP Reset Circuit with Power-Fail Comparator

Typical Operating Circuit



Pin Configurations (continued)

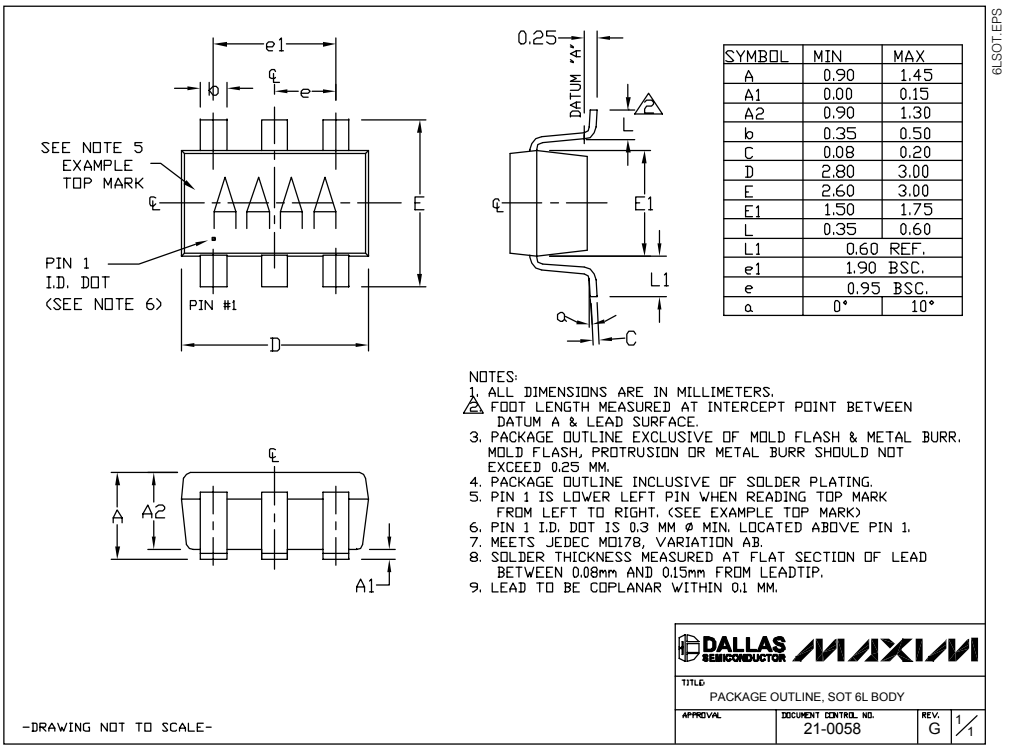


Chip Information

TRANSISTOR COUNT: 403

Package Information

(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to **www.maxim-ic.com/packages**.)



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