

Click [here](#) for production status of specific part numbers.

## MAX16143/MAX16145/ MAX16147/MAX16149

## High-Voltage Supervisors with Manual Reset Input

### General Description

The MAX16143, MAX16145, MAX16147, and MAX16149 are supervisory circuits that monitor their own supply voltages using a factory-set reset threshold that ranges from +2.3V to +11.6V. A manual reset (MR or  $\overline{\text{MR}}$ ) input is included. The RESET (or  $\overline{\text{RESET}}$ ) output has options for active-low, active-high, push-pull, or open-drain. The reset output asserts when the monitored voltage falls below the threshold voltage, and remains asserted until the monitored voltage has exceeded its threshold (plus hysteresis) for a time equal to the factory-set reset timeout period. Available reset timeout periods range from 30 $\mu$ s to 4.2s.

The 5-pin SOT23 and 4-bump wafer-level packages (WLPs) offer compatibility with space-constrained environments. These ICs are fully specified over the -40°C to +125°C temperature range.

### Applications

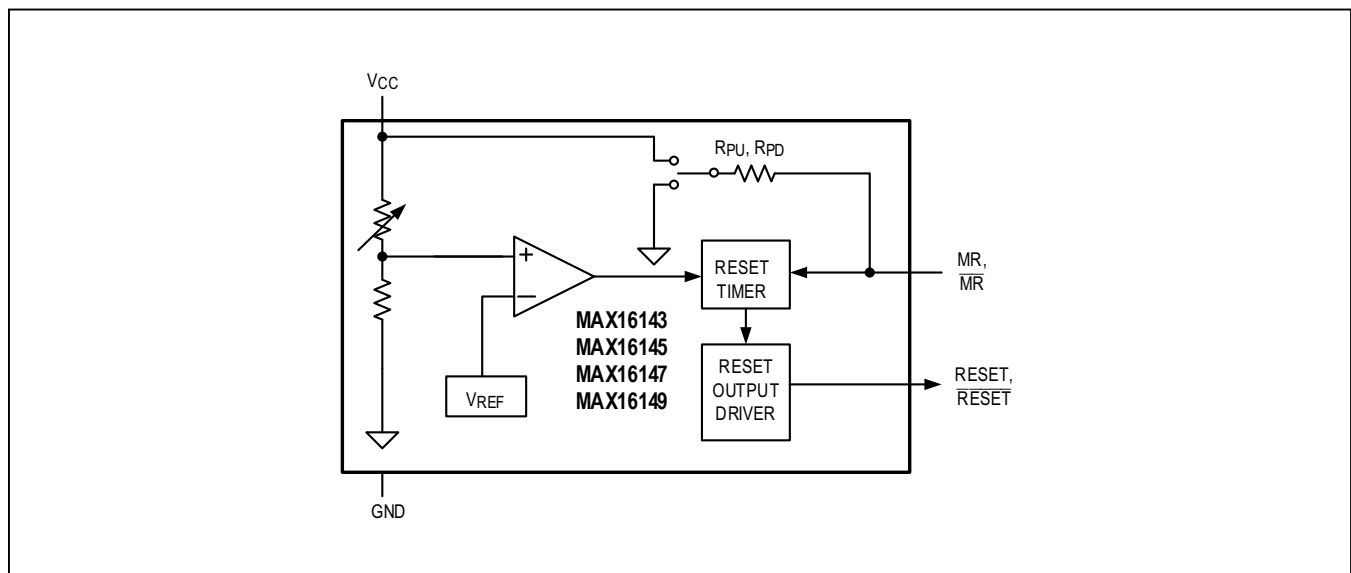
- Servers
- Communications Equipment
- Industrial Equipment

### Benefits and Features

- Factory-Set Reset Threshold Options from +2.3V to +11.6V
- Manual Reset Input
  - Active-High and Active-Low Trigger Options
  - Optional Internal Pullup or Pulldown
  - Fast (45 $\mu$ s) and Slow (50ms) Debounce Time Options
- Guaranteed Reset Valid to  $V_{CC} \geq 1.3V$
- Push-Pull and Open-Drain Reset Output Options
  - MAX16143: Open-Drain, Active-Low
  - MAX16145: Open-Drain, Active-High
  - MAX16147: Push-Pull, Active-Low
  - MAX16149: Push-Pull, Active-High
- Power-Supply Transient Immunity
- -40°C to +125°C Operating Temperature Range
- SOT23-5 Package and 4-Bump WLPs

*Ordering Information* appears at end of data sheet.

### Simplified Block Diagram



### Absolute Maximum Ratings

V<sub>CC</sub> to GND .....-0.3V to +15V  
 MR or  $\overline{\text{MR}}$  to GND.....-0.3V to lower of V<sub>CC</sub> + 0.3 or 6.0 V  
 RESET or  $\overline{\text{RESET}}$  to GND .... -0.3V to lower of V<sub>CC</sub> +0.3 or 6.0V  
 Input/Output Current (All pins) ..... -20mA to +20mA  
 Continuous Power Dissipation (Multilayer Board,  
 SOT23, T<sub>A</sub> = +70°C, derate 3.9mW/°C  
 above +70°C.)..... 312.6mW

Continuous Power Dissipation (Multilayer Board,  
 WLP, T<sub>A</sub> = +70°C, derate 9.7mW/°C above +70°C.).... 776mW  
 Operating Temperature Range..... -40°C to +125°C  
 Storage Temperature Range..... -65°C to +150°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.*

### Package Information

#### SOT-23

PACKAGE CODE	U5+1
Outline Number	<a href="#">21-0057</a>
Land Pattern Number	<a href="#">90-0174</a>
<b>Thermal Resistance, Single-Layer Board:</b>	
Junction to Ambient (θ <sub>JA</sub> )	324.3
Junction to Case (θ <sub>JC</sub> )	82
<b>Thermal Resistance, Four-Layer Board:</b>	
Junction to Ambient (θ <sub>JA</sub> )	255.9
Junction to Case (θ <sub>JC</sub> )	81

#### WLP

PACKAGE CODE	W40E0+1
Outline Number	<a href="#">21-100215</a>
Land Pattern Number	<a href="#">See App Note 1891</a>
<b>Thermal Resistance, Four-Layer Board:</b>	
Junction to Ambient (θ <sub>JA</sub> )	103°C/W
Junction to Case (θ <sub>JC</sub> )	N/A

For the latest package outline information and land patterns (footprints), go to [www.maximintegrated.com/packages](http://www.maximintegrated.com/packages). Note that a "+", "#", or "-" in the package code indicates RoHS status only. Package drawings may show a different suffix character, but the drawing pertains to the package regardless of RoHS status.

Package thermal resistances were obtained using the method described in JEDEC specification JESD51-7, using a four-layer board. For detailed information on package thermal considerations, refer to [www.maximintegrated.com/thermal-tutorial](http://www.maximintegrated.com/thermal-tutorial).

## Electrical Characteristics

( $V_{CC} = 2.3V$  to  $14V$ ,  $T_J = T_A = -40^{\circ}C$  to  $+125^{\circ}C$ , Typical values are at  $T_A = 25^{\circ}C$  unless otherwise noted. Limits over the operating temperature range and relevant supply voltage range are guaranteed by design, test, and characterization.)

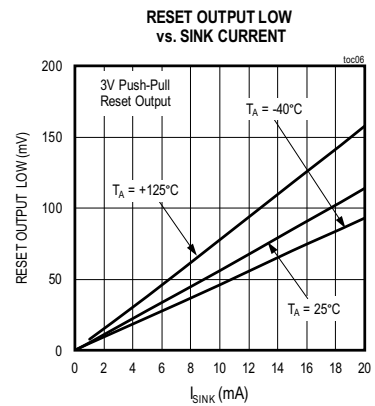
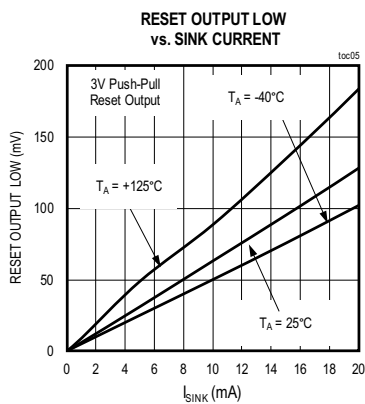
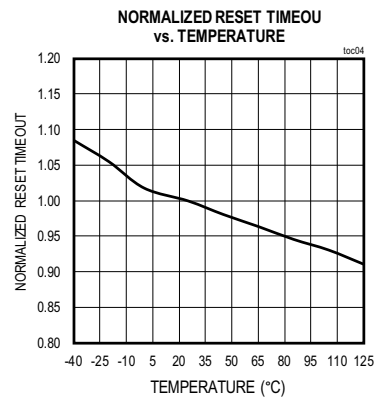
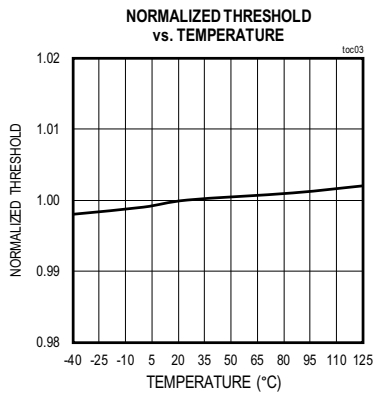
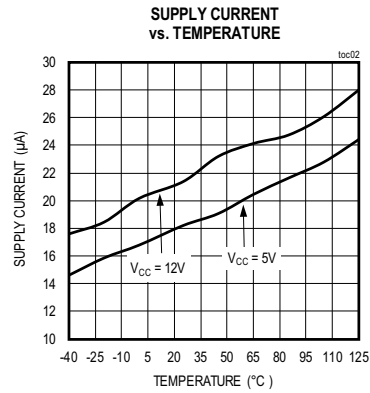
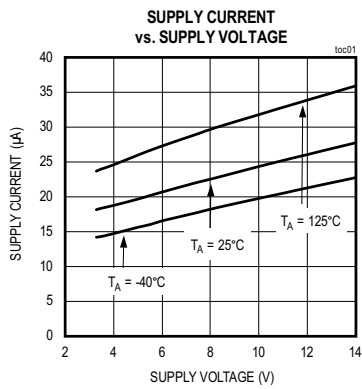
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Operating Voltage Range	$V_{CC}$	Correct threshold detection	3.3		14	V
		MAX16143, MAX16147 (active-low). Correct reset state for supply ramp time $\geq 20\mu s$ . (Note 2)	1.3		14	
		MAX16145, MAX16149 (active-high). Correct reset state for supply ramp time $\geq 1ms$ .	2		14	
Supply Current	$I_{CC}$	$V_{CC} \leq V_{TH} + 150mV$		25	55	$\mu A$
Reset Threshold Accuracy	$V_{TH\_ACC}$		-1.5		+1.5	%
Reset Threshold Hysteresis		Hysteresis option Q, $V_{CC}$ rising		0.5		% $V_{TH}$
		Hysteresis option R, $V_{CC}$ rising		1		
		Hysteresis option S, $V_{CC}$ rising		3		
		Hysteresis option T, $V_{CC}$ rising		5		
$V_{CC}$ to Reset Output Delay	$t_{RD}$	$V_{CC}$ falling at $10mV/\mu s$ from $(V_{CC} + 100mV)$ to $(V_{CC} - 100mV)$		15		$\mu s$
Reset Timeout Period Accuracy (Note 3)		Variation from nominal $t_{RP}$	-25		+25	%
Output Voltage Low	$V_{OL}$	$V_{CC} \geq 1.7V$ , $I_{SINK} = 3.2mA$			0.4	V
		$1.3V \leq V_{CC} < 1.7V$ , $I_{SINK} = 100\mu A$			0.4	
Output Voltage High	$V_{OH}$	MAX16147/MAX16149, $I_{SOURCE} = 10\mu A$	2.4		3.15	V
Output Current	$I_{OH}$	$V_{OH} = 2.5V$	25	50	80	$\mu A$
Open-Drain Output Leakage Current		MAX16143/MAX16145			1	$\mu A$
Manual Reset Debounce Time	$t_{DB}$	Active-low or active-high manual reset		45	70	$\mu s$
				50	70	ms
Manual Reset Minimum Input Pulse Width	$t_{PW}$	Edge-triggered manual reset option.		—		$\mu s$
$\overline{MR}$ Internal Pullup Resistance	$R_{PU}$	MR option F or H		50		k $\Omega$
MR Internal Pulldown Resistance	$R_{PD}$	MR option B or D		50		k $\Omega$
Input Voltage Low	$V_{IL}$	MR, $\overline{MR}$			0.7	V
Input Voltage High	$V_{IH}$	MR, $\overline{MR}$	1.7			V
Input Current		MR, $\overline{MR}$ . Internal pullup resistor not connected.	-150		+150	nA

**Note 2:** Correct reset output voltage is guaranteed down to  $V_{CC} = 1.3V$ .

**Note 3:** During power-up, the internal regulator takes 2ms. Power-up time must be added to reset timeout period.

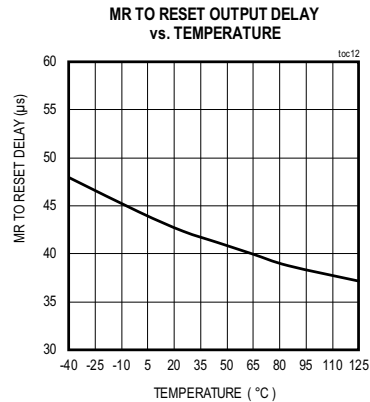
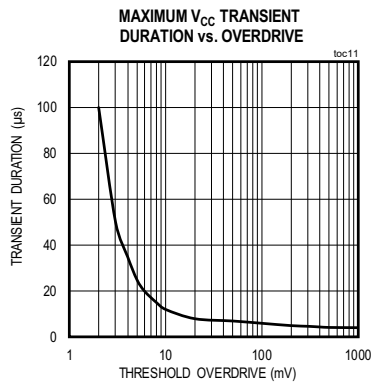
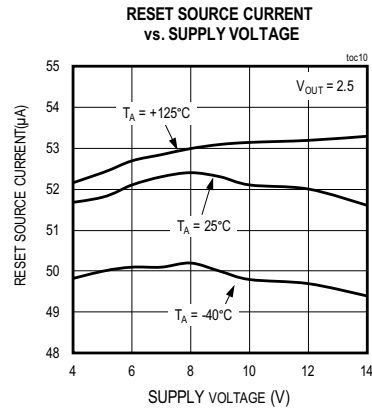
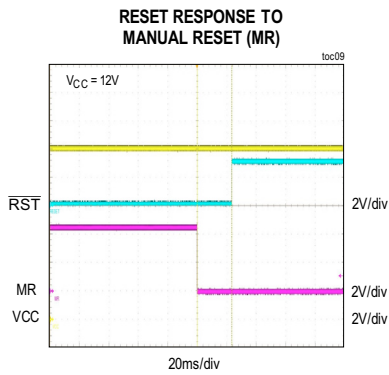
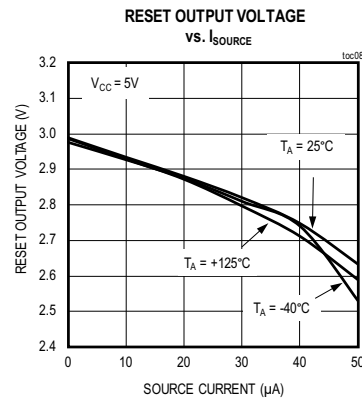
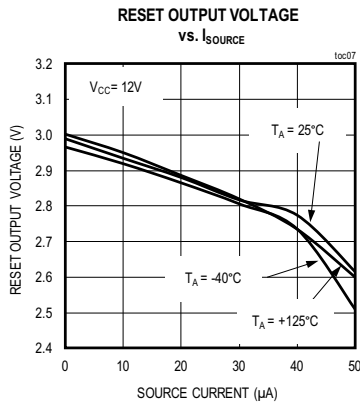
Typical Operating Characteristics

( $T_A = 25^\circ\text{C}$  unless otherwise noted.)



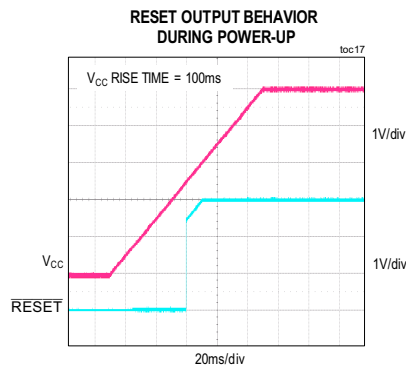
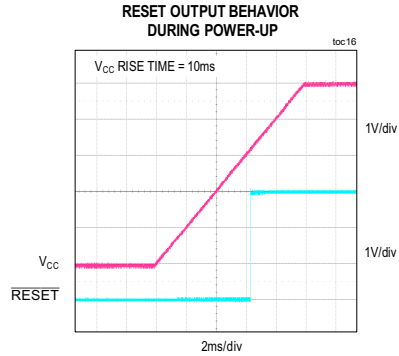
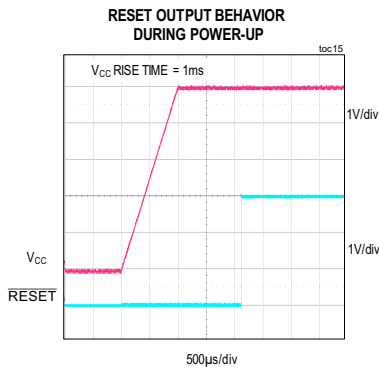
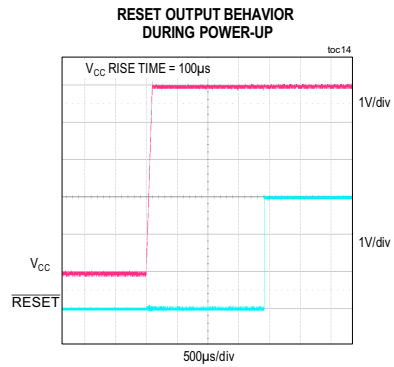
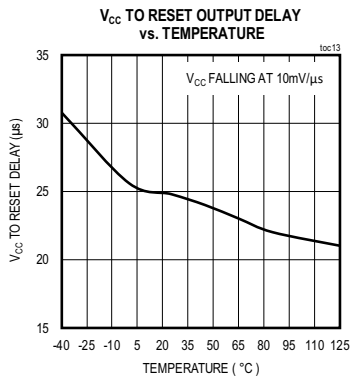
Typical Operating Characteristics (continued)

( $T_A = 25^\circ\text{C}$  unless otherwise noted.)



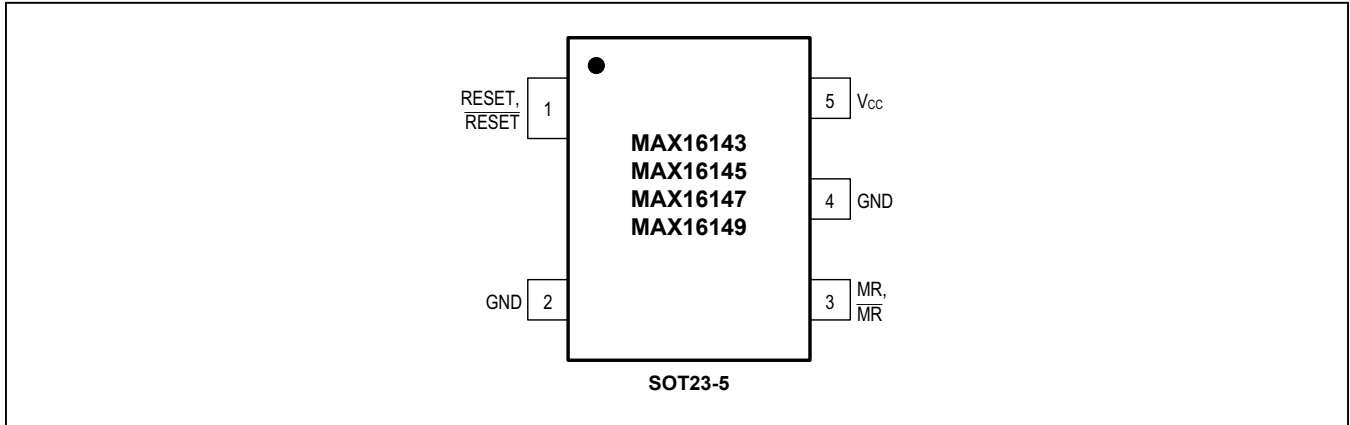
Typical Operating Characteristics (continued)

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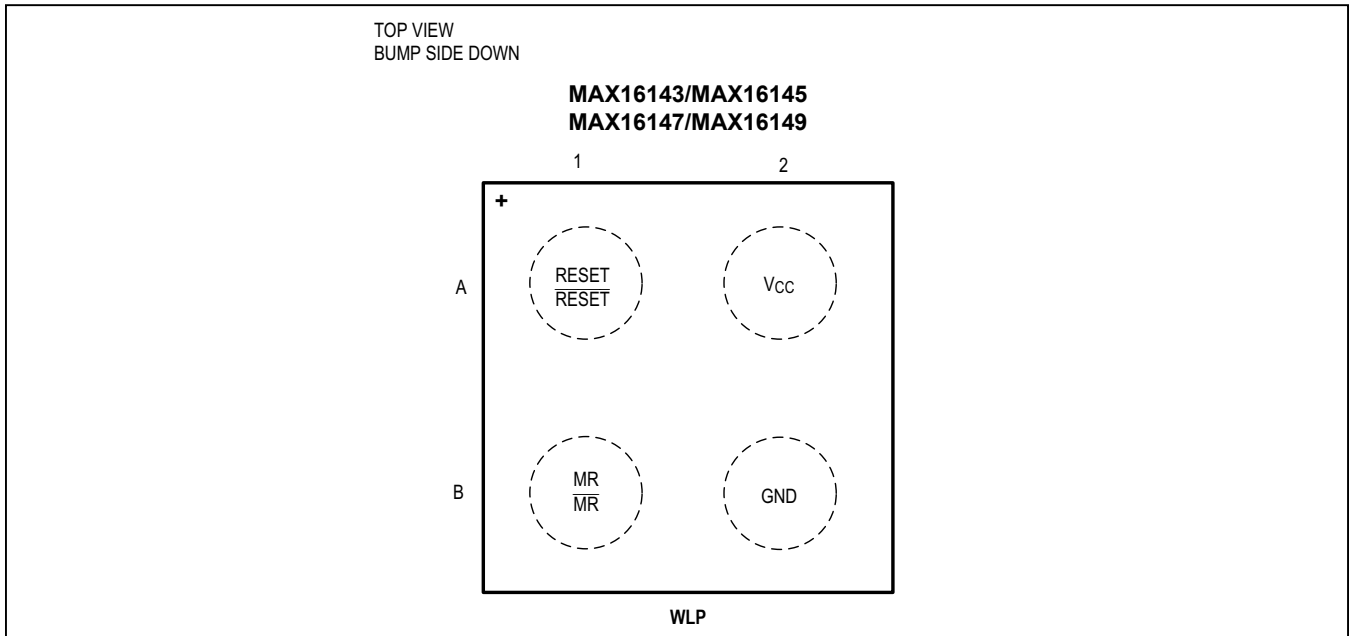


## Pin Configuration

### SOT23



### WLP



## Pin Description

PIN		NAME	FUNCTION
SOT23	WLP		
1	A1	RESET, $\overline{\text{RESET}}$	Reset Output. RESET asserts when $V_{CC}$ falls below the factory-set threshold or when the manual reset is triggered. RESET deasserts after the factory-set reset timeout when $V_{CC}$ goes above its set threshold or when MR is released.
2, 4	B2	GND	Ground
3	B1	MR, $\overline{\text{MR}}$	Manual Reset Input. See <a href="#">Manual Reset Input</a> section for more detail.
5	A2	$V_{CC}$	Supply Voltage Input. Bypass $V_{CC}$ to ground with a 0.1 $\mu$ F capacitor.

### Detailed Description

The MAX16143/MAX16145/MAX16147/MAX16149 are supervisory circuits that monitor their  $V_{CC}$  voltage from +2.3V to +11.6V using factory-set reset threshold and offer manual reset capability. The MAX16143/MAX16145 feature an open-drain reset output, while the MAX16147/MAX16149 feature a push-pull reset output. The reset output asserts and remains asserted for the reset timeout after the  $V_{CC}$  voltage exceeds its threshold. All devices are offered with reset timeout periods ranging from 30 $\mu$ s to 4200ms. See [Table 1](#) for available options. The reset output is guaranteed to be in valid logic state down to  $V_{CC} = 1.3V$ .

### VCC Threshold

The MAX16143/MAX16145/MAX16147/MAX16149 operate with a  $V_{CC}$  supply voltage from +3.3V to +14V, with monitoring range of +2.3V to +11.6V.  $V_{CC}$  has a rising threshold of  $V_{TH} + V_{HYST}$  and a falling threshold of  $V_{TH}$ . See [Tables 2 and 3](#) for available threshold and hysteresis options. When  $V_{CC}$  rises above  $V_{TH} + V_{HYST}$  and the manual reset input is in an inactive state, RESET deasserts after the reset timeout period ( $t_{RP}$ ). See the timing diagram in [Figure 1](#). When  $V_{CC}$  falls below  $V_{TH}$ , the reset output asserts low after a fixed delay ( $t_{RD}$ ).

**Table 1. Reset Timeout Options**

SUFFIX	RESET TIMEOUT PERIOD			UNIT
	T <sub>A</sub> = 25°C	T <sub>A</sub> = -40°C to +125°C		
		TYP	MIN	
A	30	—	—	$\mu$ s
B	1.50	1.125	1.875	ms
C	3	2.25	3.75	ms
D	6	4.5	7.5	ms
E	12	9	15	ms
F	24	18	30	ms
G	50	37.5	62.5	ms
H	100	75	125	ms
I	150	112.5	187.5	ms
J	225	168.8	281.3	ms
K	300	225	375	ms
L	450	337.5	562.5	ms
M	600	450	750	ms
N	1000	740	1250	ms
O	2000	1500	2500	ms
P	4200	3150	5250	ms

**Table 2. VCC Threshold Options**

SUFFIX	1.5%			UNIT
	TYP	MIN	MAX	
Y6	11.484	11.600	11.716	V
Y5	11.385	11.500	11.615	V
Y4	11.286	11.400	11.514	V
Y3	11.187	11.300	11.413	V
Y2	11.088	11.200	11.312	V
Y1	10.989	11.100	11.211	V
Y0	10.89	11.000	11.11	V
X7	10.593	10.700	10.807	V
X6	10.494	10.600	107.06	V
X5	10.395	10.500	10.605	V
00	9.9	10.000	10.1	V
95	9.405	9.500	9.595	V
90	8.91	9.000	9.09	V
85	8.415	8.500	8.585	V
80	7.92	8.000	8.08	V
75	7.425	7.500	7.575	V
70	6.93	7.000	7.07	V
65	6.435	6.500	6.565	V
60	5.94	6.000	6.06	V
55	5.445	5.500	5.555	V
48	4.752	4.800	4.848	V
47	4.653	4.700	4.747	V
46	4.554	4.600	4.646	V
45	4.455	4.500	4.545	V
44	4.356	4.400	4.444	V
43	4.257	4.300	4.343	V
42	4.158	4.200	4.242	V
41	4.059	4.100	4.141	V
40	3.960	4.000	4.040	V
39	3.861	3.900	3.939	V
38	3.762	3.800	3.838	V
37	3.663	3.700	3.737	V
36	3.564	3.600	3.636	V
35	3.465	3.500	3.535	V
34	3.366	3.400	3.434	V
33	3.267	3.300	3.333	V
32	3.168	3.200	3.232	V
31	3.069	3.100	3.131	V
30	2.970	3.000	3.030	V
29	2.871	2.900	2.929	V



**Table 2. V<sub>CC</sub> Threshold Options (continued)**

SUFFIX	1.5%			UNIT
	TYP	MIN	MAX	
28*	2.772	2.800	2.828	V
27	2.673	2.700	2.727	V
26*	2.574	2.600	2.626	V
25	2.475	2.500	2.525	V
24	2.376	2.400	2.424	V
23	2.277	2.300	2.323	V

**Table 3. V<sub>CC</sub> Threshold Hysteresis Options**

SUFFIX	HYSTERSIS
Q	0.5%
R	1%
S	3%
T	5%

**Table 4. MAX16143/MAX16145 Manual Reset Configuration Options**

SUFFIX	LEVEL HIGH/LOW	DEBOUNCE TIME (NA = EDGE TRIGGER)	PULLUP/PULLDOWN
A	H	45µs	NOT CONNECTED
B	H	45µs	PULLDOWN
C	H	50ms	NOT CONNECTED
D	H	50ms	PULLDOWN
E	L	45µs	NOT CONNECTED
F	L	45µs	PULLUP
G	L	50ms	NOT CONNECTED
H	L	50ms	PULLUP
J	H	N/A	NOT CONNECT
K	H	N/A	PULLDOWN
L	L	N/A	NOT CONNECTED
M	L	N/A	PULL UP

### Reset Output

The MAX16143/MAX16145 feature open-drain reset outputs, while the MAX16147/MAX16149 feature push-pull reset outputs. For proper operation, connect the reset output of the MAX16143 and the MAX16145 to V<sub>CC</sub>, or external voltage with a pullup resistor. The reset output of the MAX16147 and the MAX16149 are internally connected to a 2.5V or 3V regulator.

### Manual Reset Input

The MAX16143/MAX16145/MAX16147/MAX16149 include a manual reset input (MR,  $\overline{\text{MR}}$ ) that allows initiating system reset using external signal or push-button switch. The manual reset input is available in active-low, active-high or edge-triggered option. The active-low ( $\overline{\text{MR}}$ ) and active-high (MR) inputs feature either 45µs or 50ms debounce timing option to help filter out noise during manual reset transitioning from inactive to active state. In addition, the manual reset input is factory-programmable to have a pull up/pull down resistor or be left floating. See [Table 4](#) and [Table 5](#) for available options.

**Table 5. MAX16147/MAX16149 Manual Reset and RESET Configuration Options**

SUFFIX	LEVEL HIGH/LOW	DEBOUNCE TIME (NA = EDGE TRIGGER)	MR/ $\overline{\text{MR}}$ PULLUP/PULLDOWN	RESET PULLUP VOLTAGE
A	H	45 $\mu$ s	NOT CONNECTED	3V
B	H	45 $\mu$ s	PULLDOWN	3V
C	H	50ms	NOT CONNECTED	3V
D	H	50ms	PULLDOWN	3V
E	L	45 $\mu$ s	NOT CONNECTED	3V
F	L	45 $\mu$ s	PULLUP	3V
G	L	50ms	NOT CONNECTED	3V
H	L	50ms	PULLUP	3V
J	H	N/A	NOT CONNECTED	2.5V
K	H	N/A	PULLDOWN	2.5V
L	H	N/A	NOT CONNECTED	2.5V
M	H	N/A	PULLUP	2.5V
N	L	45 $\mu$ s	NOT CONNECTED	2.5V
O	L	45 $\mu$ s	PULLUP	2.5V
P	L	50ms	NOT CONNECTED	2.5V
Q	L	50ms	PULLUP	2.5V
R	H	N/A	NOT CONNECTED	3V
S	H	N/A	PULLDOWN	3V
T	L	N/A	NOT CONNECTED	3V
U	L	N/A	PULLUP	3V
V	H	N/A	NOT CONNECTED	2.5V
W	H	N/A	PULLDOWN	2.5V
X	L	N/A	NOT CONNECTED	2.5V
Y	L	N/A	PULLUP	2.5V

## Applications Information

### Reset Output

The MAX16143/MAX16145/MAX16147/MAX16149 are microprocessor supervisory circuits that assert a reset to prevent code-execution errors during power-up, power-down, and brownout conditions. The reset output asserts when the  $V_{CC}$  voltage falls below the factory-set threshold,  $V_{TH}$ . The reset output de-asserts after the reset timeout ( $t_{RP}$ ) when  $V_{CC}$  voltage rises above the reset threshold plus the hysteresis voltage, ( $V_{TH} + V_{HYS}$ ). The reset output is guaranteed to be at the correct logic voltage for  $V_{CC}$  voltage down to 1.3V. See [Figure 1](#) for details.

### Manual Reset Input (MR)

Many systems require manual reset capability, allowing the operator, a test technician, or external logic circuitry to initiate a reset. The MAX16143/MAX16145/MAX16147/MAX16149 provide this capability by featuring an manual reset input (MR). When a manual reset is initiated, the reset output asserts and remain asserted as long as the manual reset input is in active state. Reset deasserts after reset timeout when the manual reset input is released. [Figure 1](#) shows the behavior of the manual reset configured as active-low, with 50k $\Omega$  pull ( $\overline{MR}$ ). See [Selector Guide](#) for available options.

Depending on the application, the manual reset input is factory-programmable to have either an internal pullup resistor, pulldown resistor of 50k $\Omega$  (typ), or be left floating.

The pullup resistor allows the manual reset input to be left unconnected if not used. An external pullup resistor is required if the manual reset input option chosen does not have an internal pullup resistor. The maximum input voltage on  $\overline{MR}$  is 5.5V.

An alternative is to use a normally open momentary switch connected from  $\overline{MR}$  (active-low) to GND, or from MR (active-high) to a logic-high voltage to create a manual-reset function. If a Long Debounce version is used, external debounce circuitry is not required, but an external pullup or pulldown will be required if a version without an internal resistor is used. If the manual reset input is driven from long cables, or the IC is used in a noisy environment, connect a 0.1 $\mu$ F capacitor from  $\overline{MR}$ /MR to GND in order to provide additional noise immunity.

### Negative-Going $V_{CC}$ Transients Protection

These supervisory circuits are relatively immune to short-duration, negative-going  $V_{CC}$  transients (glitches). The Maximum Transient Duration vs. Reset Threshold Overdrive graph (in the [Typical Operating Characteristics](#) section) shows the typical transient pulse width and amplitude required to trigger a reset. The reset threshold overdrive specifies how far the pulse falls below the actual reset threshold, and the maximum transient duration specifies the width of the pulse as it crosses the reset threshold. If a pulse occurs in the region above the curve, a reset triggers. If a pulse occurs in the region below the curve, a reset does not trigger.

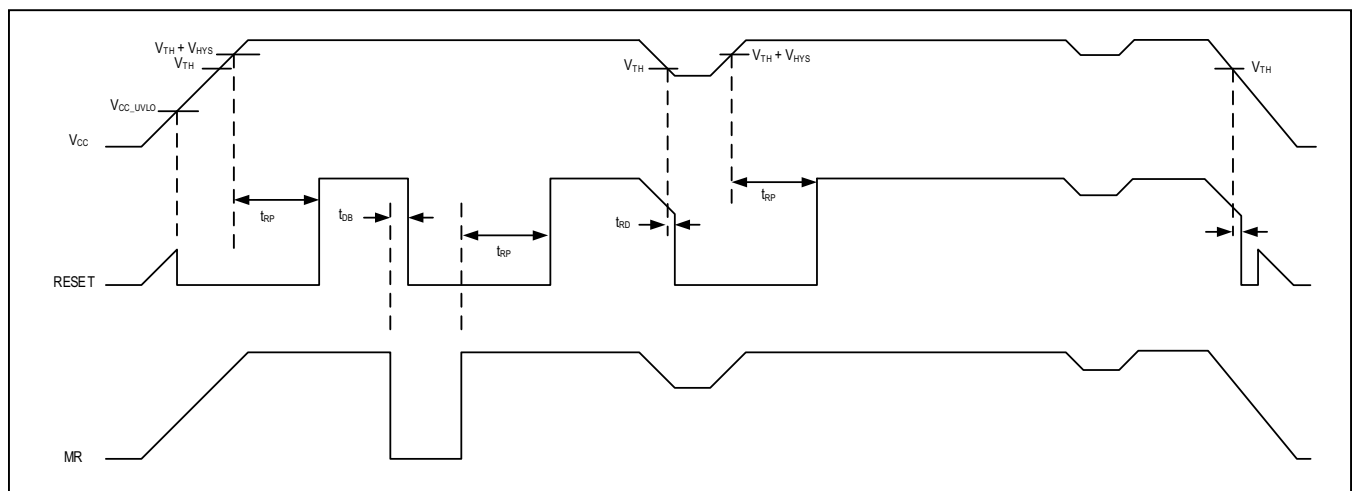
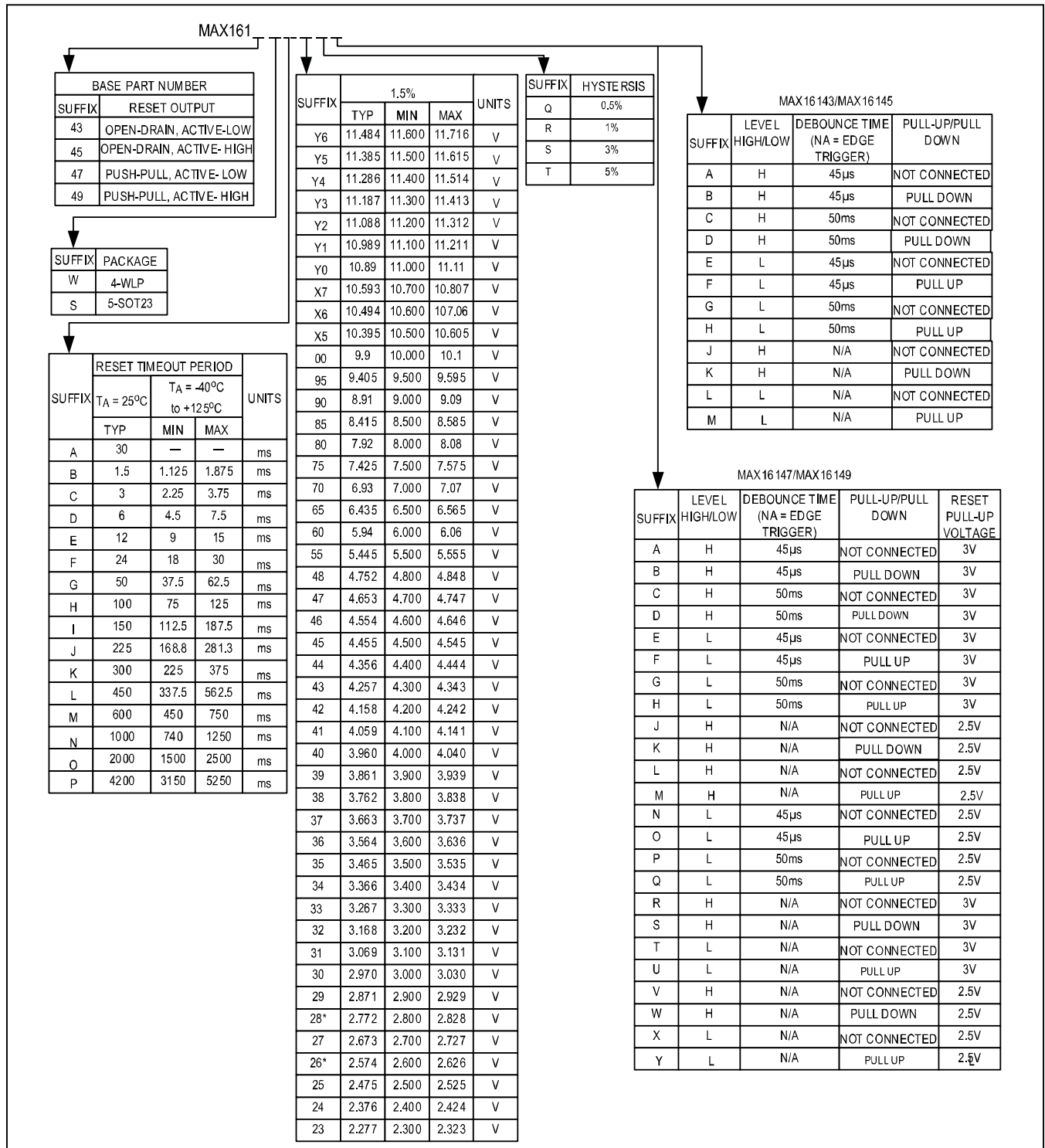
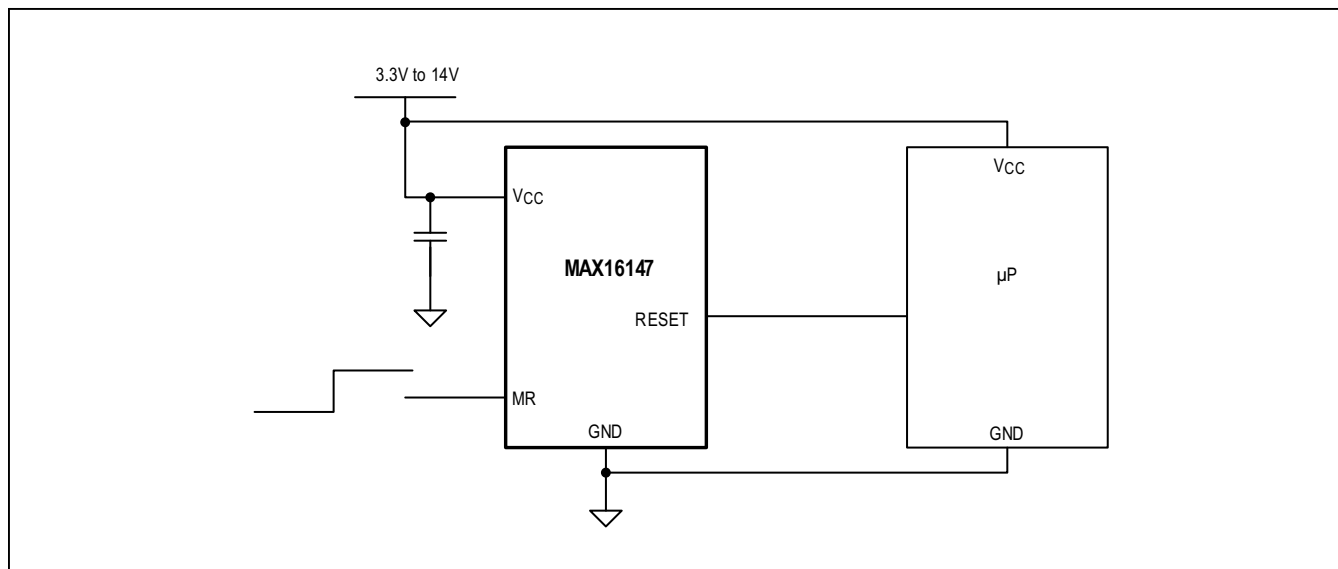


Figure 1. RESET and MR Timing Diagram

Selector Guide



### Typical Application Circuit



### Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
MAX16143_____+T*	-40°C to +125°C	4 WLP
MAX16145_____T*	-40°C to +125°C	4 WLP
MAX16147WM75SA+T	-40°C to +125°C	4 WLP
MAX16149_____T*	-40°C to +125°C	4 WLP

\*Future product—Contact factory for availability.

+ Denotes a lead(Pb)-free/RoHS-compliant package.

T Denotes tape-and-reel.

## Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	6/18	Initial release	—
1	6/18	Updated <i>Simplified Block Diagram</i> and <i>Ordering Information</i> table	1, 13

For pricing, delivery, and ordering information, please contact Maxim Direct at 1-888-629-4642, or visit Maxim Integrated's website at [www.maximintegrated.com](http://www.maximintegrated.com).

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