Low-Voltage, Precision, Single/Dual/Triple/ Quad-Voltage µP Supervisors

MAX16132–MAX16135

General Description

The MAX16132–MAX16135 are low-voltage, ±1% accurate, single, dual, triple, and quad-voltage µP supervisors that monitor up to 4 system-supply voltages for undervoltage and overvoltage faults. The MAX16132–MAX16134 feature independent reset outputs, while the MAX16135 features dual reset outputs. For the MAX16132– MAX16134, a reset output asserts when the voltage at its corresponding input falls outside a factory-trimmed undervoltage and overvoltage window threshold. The reset is maintained for a minimum timeout period after voltage at the input falls within the factory-set window threshold. For the MAX16135, a reset output asserts when either, or both, of the corresponding inputs fall outside the factory-trimmed undervoltage and overvoltage window thresholds. See the *Selector Guide* for available options. These integrated supervisory circuits significantly improve system reliability and reduce size compared to separate ICs or discrete components.

The MAX16132–MAX16135 are fixed-threshold devices. The nominal input voltage for any input is factory-programmable from 1.0V to 5.0V, providing a wide range of threshold selections. The window threshold levels are factory programmable from ±4% to ±11%, with ±1% resolution and 0.25% or 0.50% hysteresis. The ±1% threshold accuracy over temperature and window threshold monitoring make these devices ideal for automotive ADAS applications.

The reset outputs are active-low, open-drain, and are guaranteed to be in the correct reset output logic state when V_{DD} remains greater than 1.07V. All devices are offered with 23 reset timeout periods ranging from 20µs (min) to 1200ms (min). All reset outputs share the same factory-set reset timeout period.

The MAX16132–MAX16135 are available in a small 8-pin SOT23 package and specified over the automotive temperature range of -40°C to +125°C.

Applications

- ADAS
- Multivoltage ASICs
- Storage Equipment
- Servers

Benefits and Features

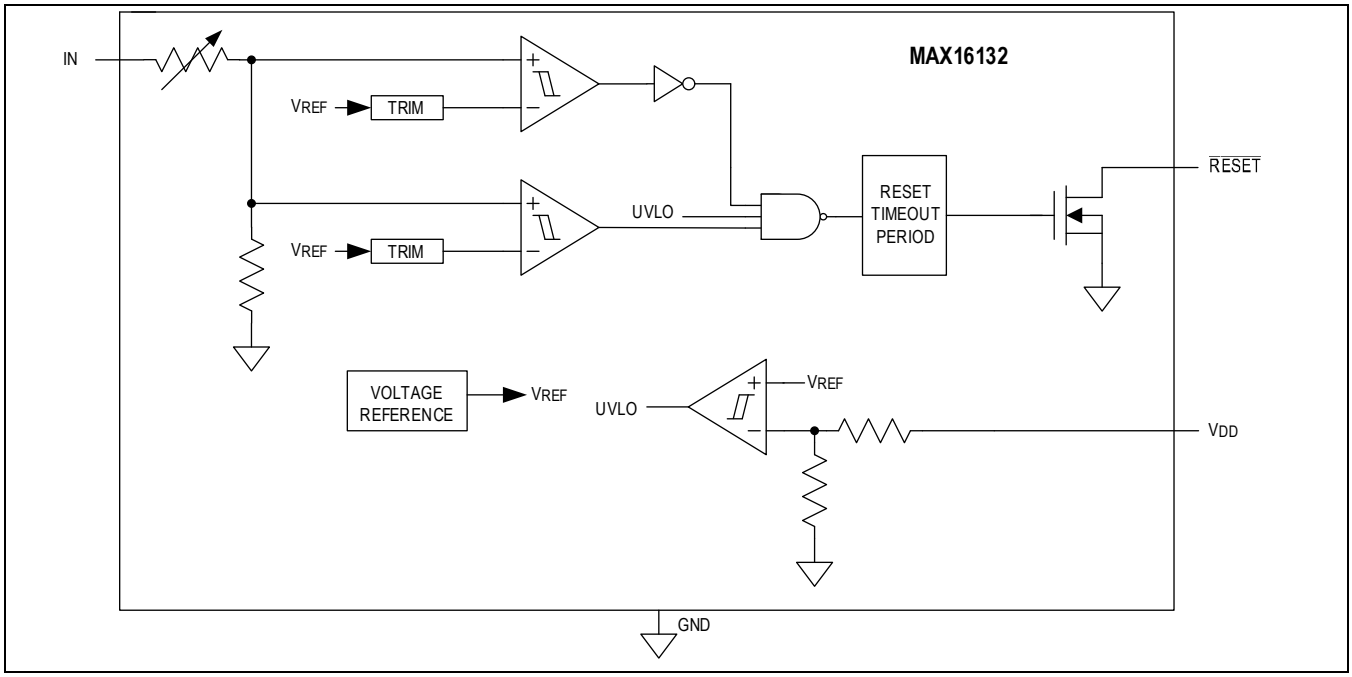
- High Precision
  - ±1% Threshold Accuracy over Temperature
- Programmable OV Threshold: 104% to 111%
- Programmable UV Threshold: 89% to 96%
- Programmable Input Voltage from 1.0V to 5.0V
- Low 15µA Supply Current
- Quad-Input Monitor
- 23 Programmable Reset Timeout Periods
- Immune to Short Monitored Supply Transients
- Guaranteed Correct Logic State Down to V_{DD} = 1.07V
- Open-Drain Outputs
- Enables Functional Safety at System Level
- Small SOT23 Package
- -40°C to +125°C Automotive Operating Temperature Range
- AEC-Q100 Qualified (/V Part Numbers, See *Ordering Information*)

Ordering Information appears at end of data sheet.

19-8708; Rev 26; 10/24

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Simplified Block Diagram



Absolute Maximum Ratings

V_{DD} to GND ..... -0.3V to +6V

V_{IN1}, V_{IN2}, V_{IN3}, V_{IN4} to GND..... -0.3V to +6V

$V_{\overline{RESET1}}$, $V_{\overline{RESET2}}$, $V_{\overline{RESET3}}$ to GND..... -0.3V to +6V

Maximum Input/Output Current (all pins)..... ±20mA

Continuous Power Dissipation (T_A = +70°C)..... 408mW

Operating Temperature Range..... -40°C to +125°C

Junction Temperature.....+150°C

Soldering Temperature (Reflow) .....+260°C

Storage Temperature Range..... -65°C to +150°C

Lead Temperature .....+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.

Package Information

8 SOT23

8 SOT23 Package Drawing Link

Package Code	K8+5/K8+5A
Outline Number	*21-0078*
Land Pattern Number	*90-0176*
Thermal Resistance, Four Layer Board:	
Junction-to-Ambient (θ_{JA})	196
Junction-to-Case (θ_{JC})	70

For the latest package outline information and land patterns (footprints), go to *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*.

Electrical Characteristics

(V_{DD} = 1.71V to 5.5V, T_A = T_A = T_J = -40°C to +125°C. Typical values are at T_A = +25°C, unless otherwise noted. (*Note 1*))

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SUPPLY VOLTAGE						
Operating Voltage Range	V_{DD}		1.71		5.5	V
Undervoltage-Lockout Threshold	V_{UVLO}	V_{DD} rising	1.35	1.50	1.65	V
Undervoltage-Lockout Threshold Hysteresis	V_{UVLO_HYS}	V_{DD} falling		47		mV
SUPPLY CURRENT						
Supply Current	I_{DD}	$\overline{RESET_}$ not asserted	5	12.5	30	µA
INPUT VOLTAGE						
Nominal Input Voltage Programming Range	V_{IN_NOM}	(*Note 2*)	1		5.0	V
Tolerance Programming Range	TOL	Reset occurs when V_{IN_NOM} falls outside of V_{IN_NOM} x (1 ± TOL%)	4		11	%
Tolerance Programming Resolution	TOL_{RES}			1		% V_{IN_NOM}
Undervoltage/Overvoltage Threshold Hysteresis		(*Note 3*) (*Note 4*)	0.04	0.25	0.47	% V_{IN_NOM}
		(*Note 3*)	0.20	0.50	0.80	

(V_{DD} = 1.71V to 5.5V, T_A = T_A = T_J = -40°C to +125°C. Typical values are at T_A = +25°C, unless otherwise noted. (*Note 1*))

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Undervoltage Threshold Accuracy	$V_{UV_TH_AC}$	V_{IN_NOM} falling, V_{UV_TH} = V_{IN_NOM} x (1 - TOL%)	-1	V_{UV_TH}	+1	%
Overvoltage Threshold Accuracy	OV_{TH_AC}	V_{IN_NOM} rising, V_{OV_TH} = V_{IN_NOM} x (1 + TOL%)	-1	V_{OV_TH}	+1	%
IN_ Input Current	$I_{IN_}$	$V_{IN_}$ = V_{IN_NOM}		1.30	2	µA
RESET OUTPUTS (*Note 3*)						
Reset Output Voltage Low	V_{OL}	V_{DD} = 5V, I_{SINK} = 3mA, $\overline{RESET_}$ asserted		0.1	0.3	V
		V_{DD} = 1V, I_{SINK} = 8µA, $\overline{RESET_}$ asserted		0.1	0.3	
Reset Output Leakage Current		$V_{\overline{RESET_}}$ = 5.5V, T_A = +25°C		0.001		µA
		$V_{\overline{RESET_}}$ = 5.5V, T_A = +125°C		0.01	1	
Reset Timeout Period	t_{RP}		-40	t_{RP}	+30	%
IN_ to RESET_Propagation Delay	t_D	(V_{UV_TH}+1%) to (V_{UV_TH}-1%)		15		µs
		(V_{OV_TH} -1%) to (V_{OV_TH}+1%)		15		

Note 1: Devices are tested at T_A = +25°C and guaranteed by design for T_A = -40°C to +125°C.

Note 2: The sum of nominal input voltage, tolerance percentage, and threshold accuracy percentage must not exceed 5.5V.

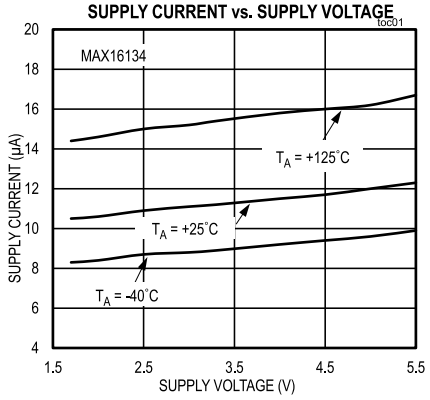
Note 3: Contact factory for the desired option.

Note 4: Guaranteed by characterization.

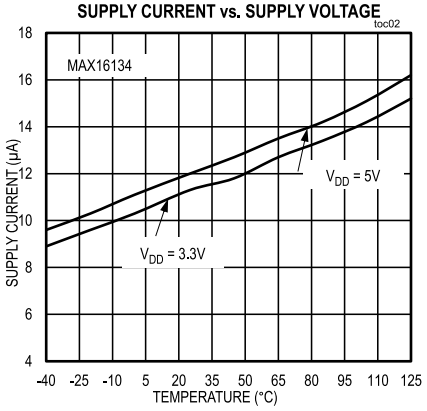
Typical Operating Characteristics

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

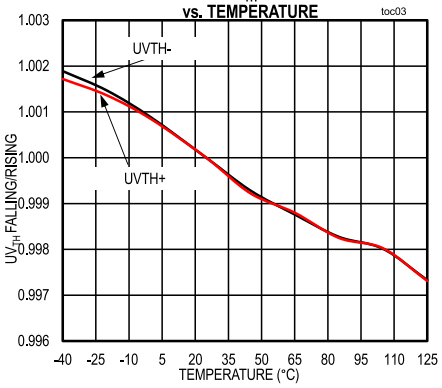
SUPPLY CURRENT vs. SUPPLY VOLTAGE



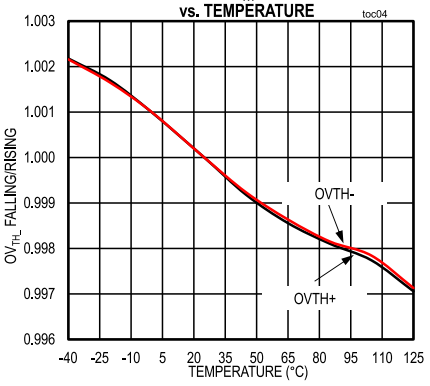
SUPPLY CURRENT vs. SUPPLY VOLTAGE



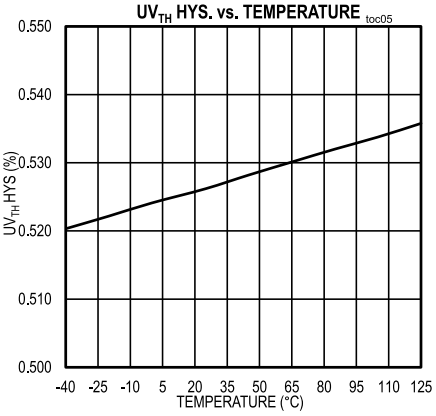
NORMALIZED UV_{TH} FALLING/RISING vs. TEMPERATURE



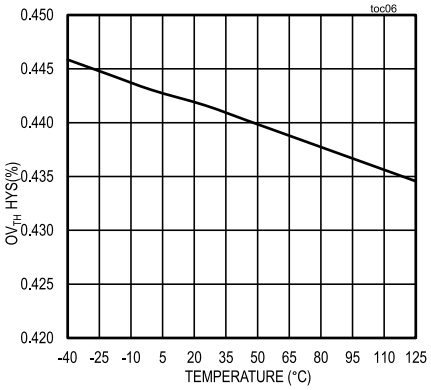
NORMALIZED OV_{TH} FALLING/RISING vs. TEMPERATURE



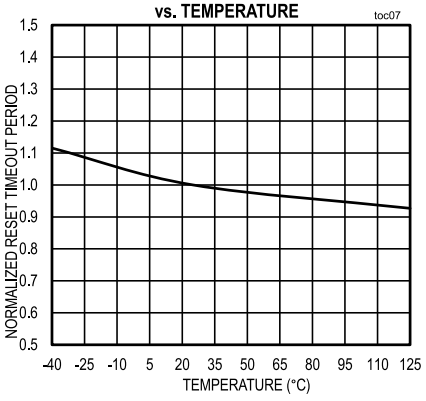
UV_{TH} HYS. vs. TEMPERATURE



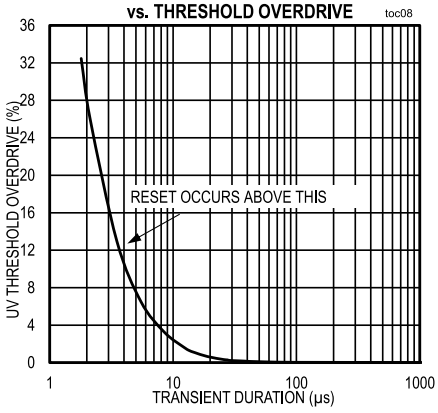
OV_{TH} HYS. vs. TEMPERATURE



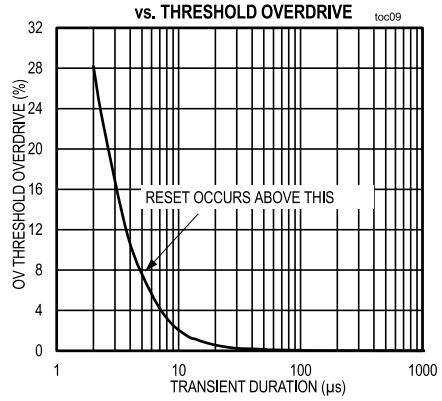
NORMALIZED RESET TIMEOUT vs. TEMPERATURE



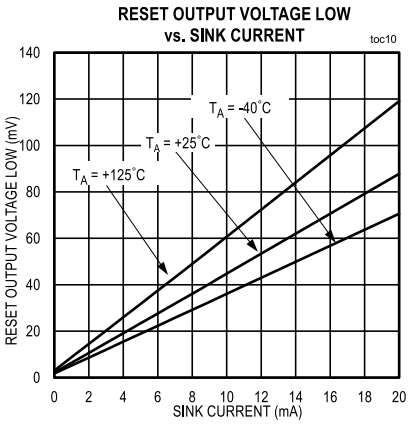
UV TRANSIENT DURATION vs. THRESHOLD OVERDRIVE



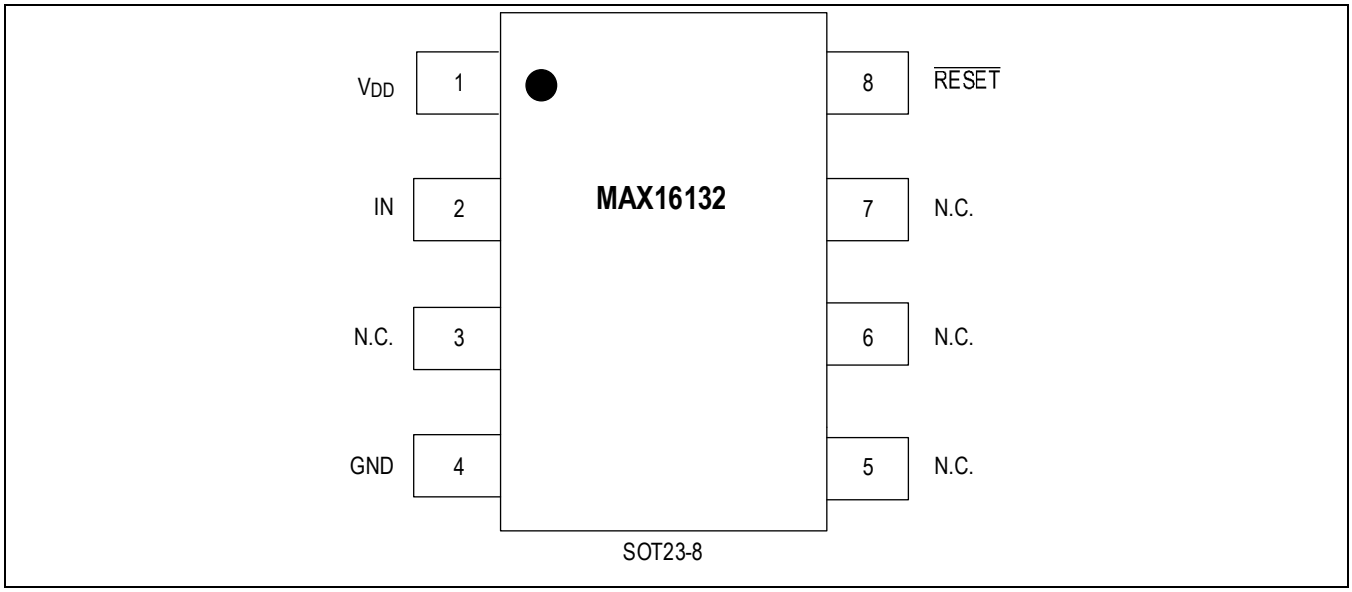
OV TRANSIENT DURATION vs. THRESHOLD OVERDRIVE

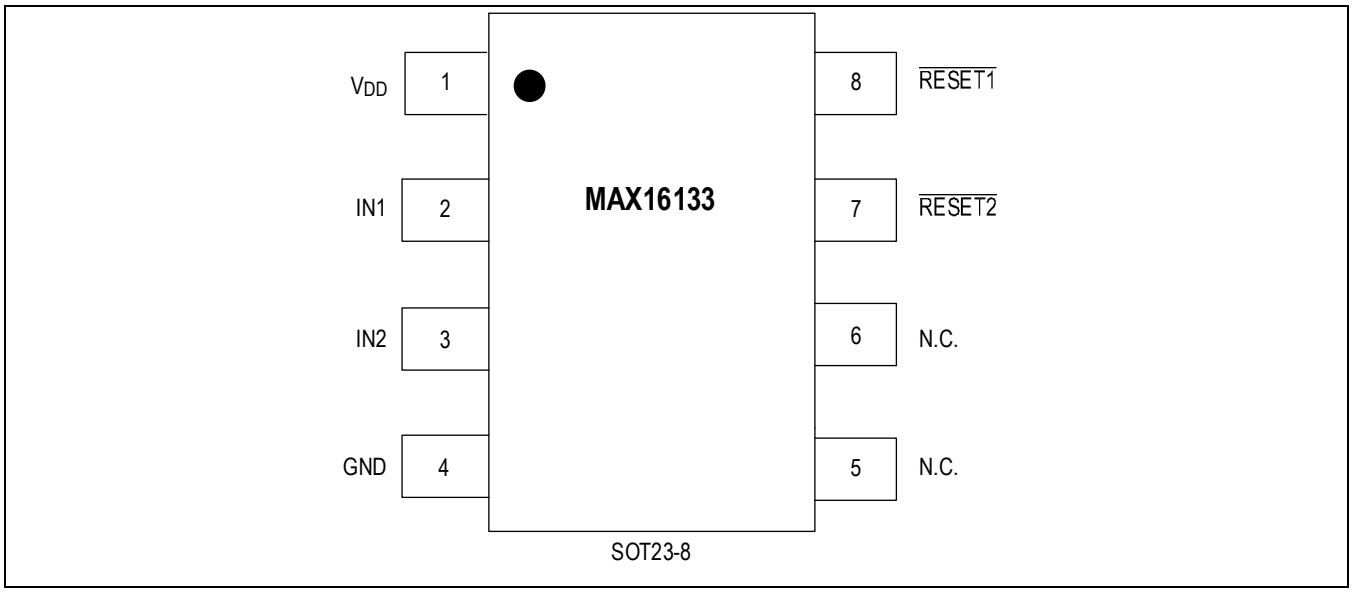


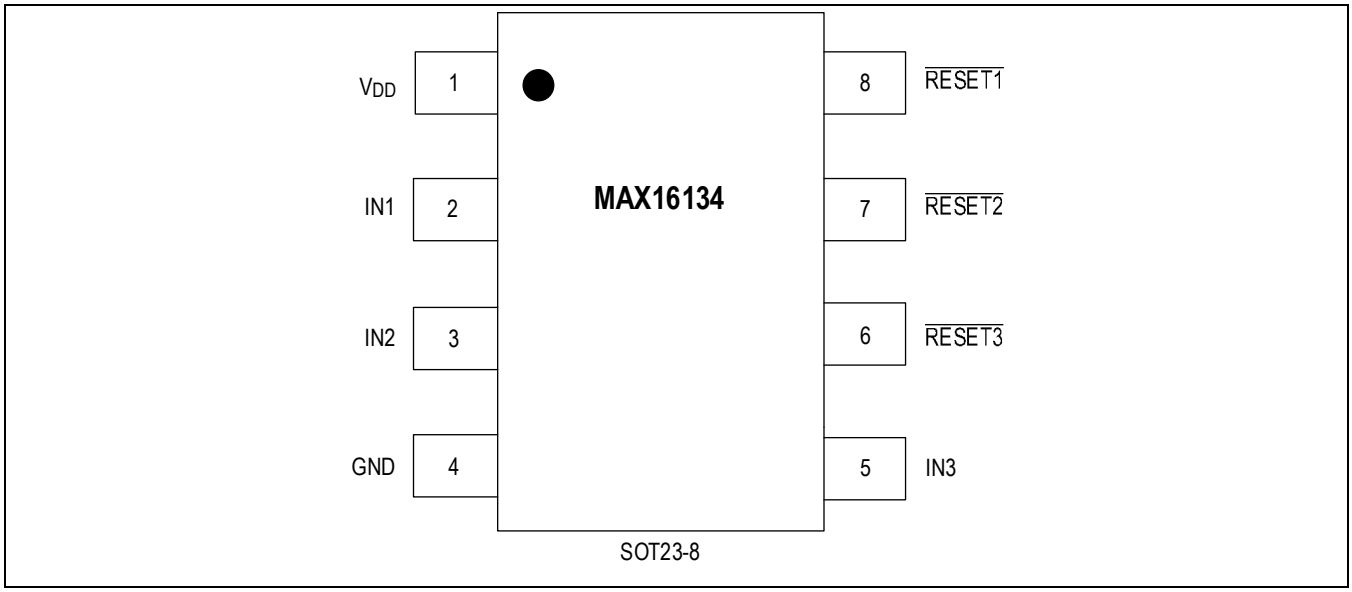
(V_{DD} = 5V, T_A = +25°C, unless otherwise noted.)

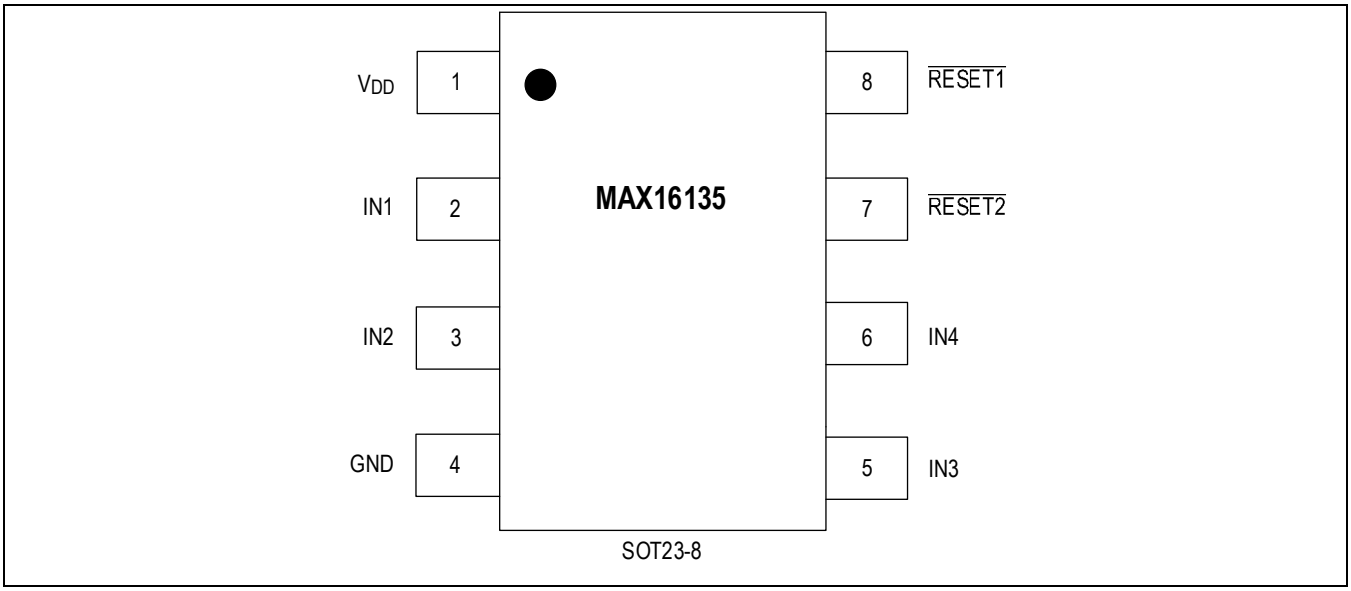


Pin Configurations




VDD
1
IN1
2
IN2
3
GND
4
MAX16133
8
RESET1
7
RESET2
6
N.C.
5
N.C.
SOT23-8


VDD
1
IN1
2
IN2
3
GND
4
MAX16134
8
RESET1
7
RESET2
6
RESET3
5
IN3
SOT23-8



Pin Descriptions

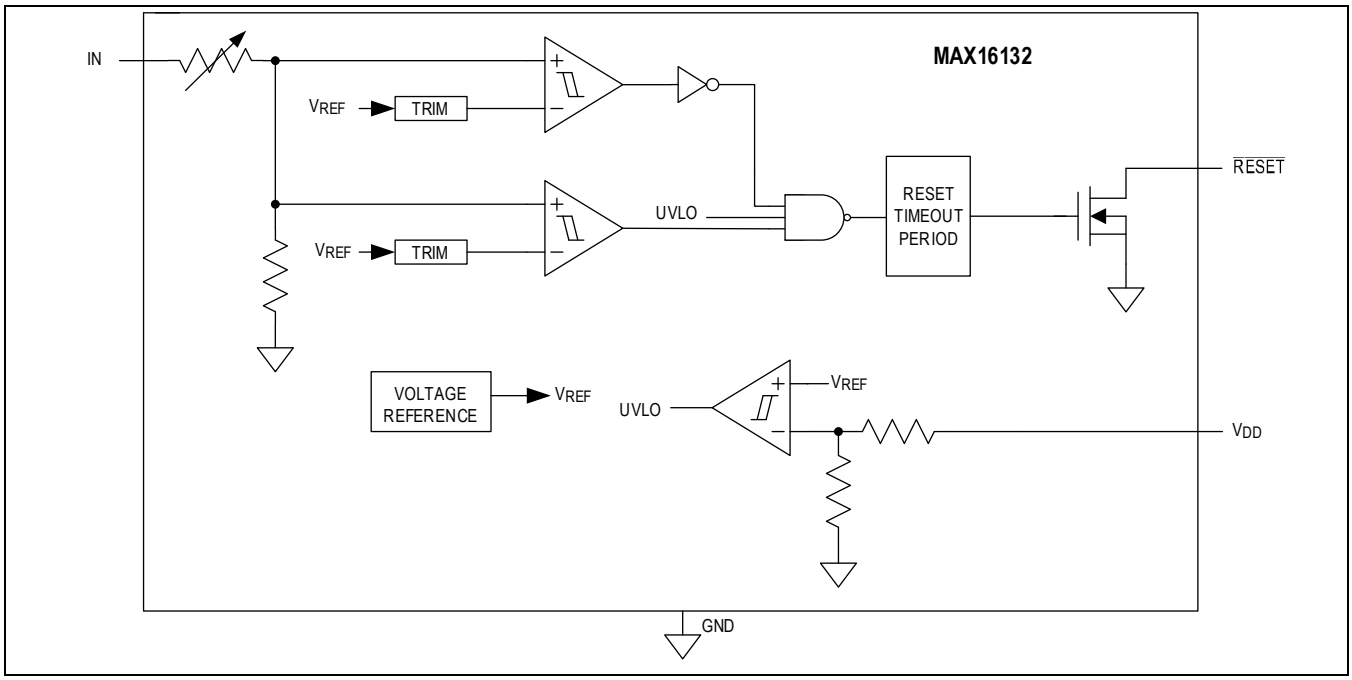
Pin Descriptions

PIN				NAME	FUNCTION
MAX16132	MAX16133	MAX16134	MAX16135		
1	1	1	1	V_{DD}	Supply Input. Bypass with a 0.1µF capacitor to GND.
2	—	—	—	IN	Monitoring Input. Connect IN to its nominal input voltage. When V_{IN} falls outside overvoltage/ undervoltage window threshold, $\overline{RESET}$ asserts.
3, 5, 6, 7	5, 6	—	—	N.C.	No Connect. Connect to ground.
4	4	4	4	GND	Ground
8	—	—	—	$\overline{RESET}$	Active-Low, Open-Drain Reset Output. $\overline{RESET}$ asserts when V_{IN} falls outside of the undervoltage/overvoltage window threshold. $\overline{RESET}$ stays asserted for the reset timeout period after V_{IN} fall within the undervoltage/ overvoltage window threshold. $\overline{RESET}$ requires a pullup resistor.
—	2	2	2	IN1	Monitoring Input 1. Connect IN1 to its nominal input voltage. When V_{IN1} falls outside the undervoltage/overvoltage window threshold, $\overline{RESET1}$ asserts. For the quad input, (MAX16135), $\overline{RESET1}$ asserts when either IN1 and/or IN2 falls outside the undervoltage/ overvoltage window threshold.
—	3	3	3	IN2	Monitoring Input 2. Connect IN2 to its nominal input voltage. When VIN2 falls outside the undervoltage/overvoltage window threshold, RESET2 asserts. For the quad input (MAX16135), RESET1 asserts when either IN2 and/or IN1 falls outside the undervoltage/ overvoltage window threshold.

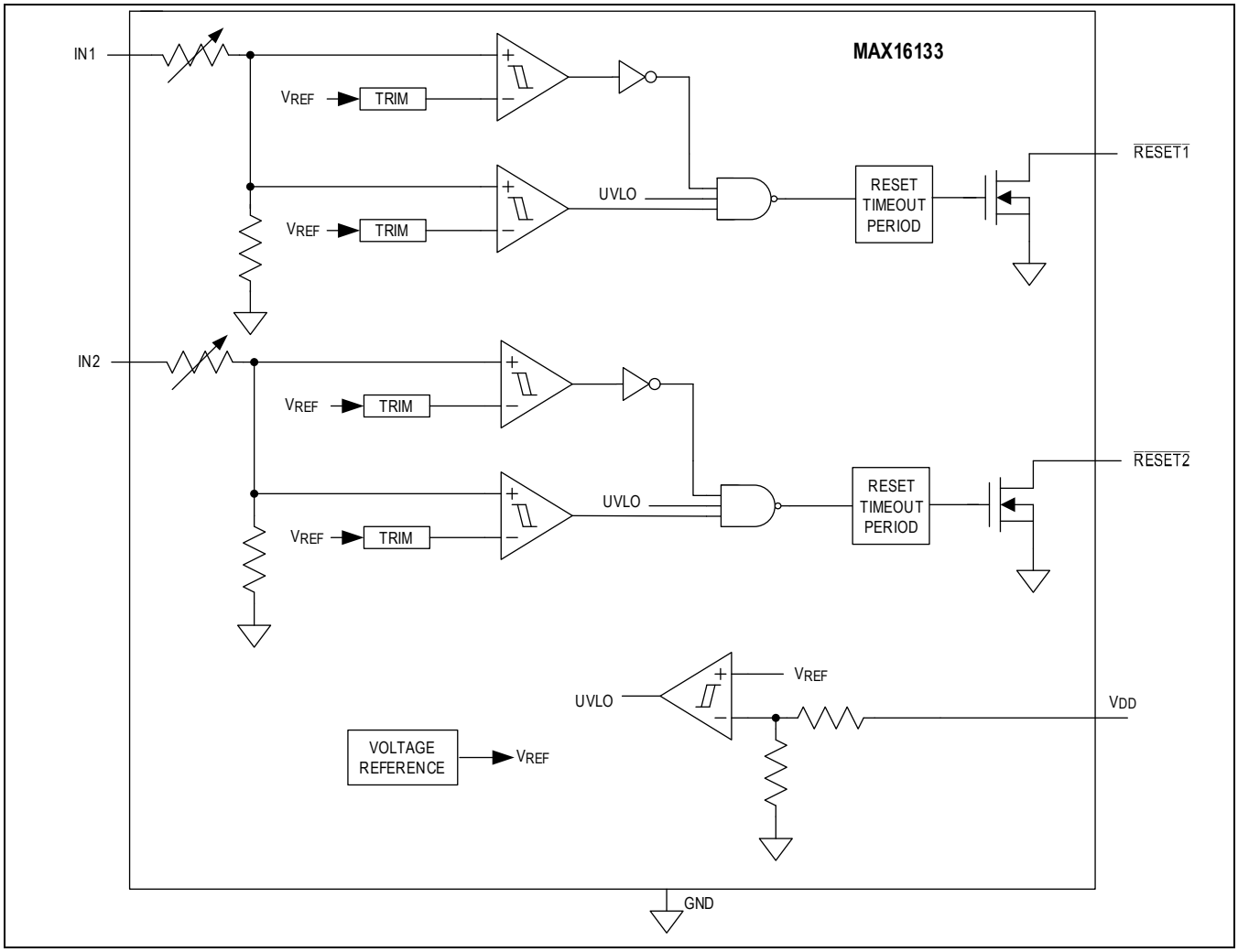
PIN				NAME	FUNCTION
MAX16132	MAX16133	MAX16134	MAX16135		
—	7	7	7	$\overline{\text{RESET2}}$	Active-Low, Open-Drain Reset Output 2. $\overline{\text{RESET2}}$ asserts when V_{IN2} falls outside the undervoltage/ overvoltage window threshold. $\overline{\text{RESET2}}$ stays asserted for the reset timeout period after V_{IN2} falls within the undervoltage/overvoltage window threshold. $\overline{\text{RESET2}}$ requires a pullup resistor. For the MAX16135, $\overline{\text{RESET2}}$ asserts when either IN3 and/or IN4 falls outside the undervoltage/ overvoltage window threshold.
—	8	8	8	$\overline{\text{RESET1}}$	Active-Low, Open-Drain Reset Output 1. $\overline{\text{RESET1}}$ asserts when V_{IN1} falls outside the undervoltage/ overvoltage window threshold. $\overline{\text{RESET1}}$ stays asserted for the reset timeout period after V_{IN1} falls within the undervoltage/overvoltage window threshold. $\overline{\text{RESET1}}$ requires a pullup resistor. For the MAX16135, $\overline{\text{RESET1}}$ asserts when either IN1 and/or IN2 falls outside the undervoltage/ overvoltage window threshold.
—	—	5	5	IN3	Monitoring Input 3. Connect IN3 to its nominal input voltage. When V_{IN3} falls outside overvoltage/undervoltage window threshold, $\overline{\text{RESET3}}$ asserts. For the MAX16135, $\overline{\text{RESET2}}$ asserts when either IN3 and/or IN4 falls outside the undervoltage/overvoltage window threshold.
—	—	6	—	$\overline{\text{RESET3}}$	Active-Low, Open-Drain Reset Output 3. $\overline{\text{RESET3}}$ asserts when V_{IN3} falls outside the undervoltage/ overvoltage window threshold. $\overline{\text{RESET3}}$ stays asserted for the reset timeout period after the V_{IN3} falls within the undervoltage/overvoltage window threshold. $\overline{\text{RESET3}}$ requires a pullup resistor.
—	—	—	6	IN4	Monitoring Input 4. Connect IN4 to its nominal input voltage. When V_{IN4} falls outside the overvoltage/undervoltage window threshold, $\overline{\text{RESET2}}$ asserts, $\overline{\text{RESET2}}$ asserts when either IN4 and/or IN3 falls outside the undervoltage/ overvoltage window threshold.

Functional Diagrams

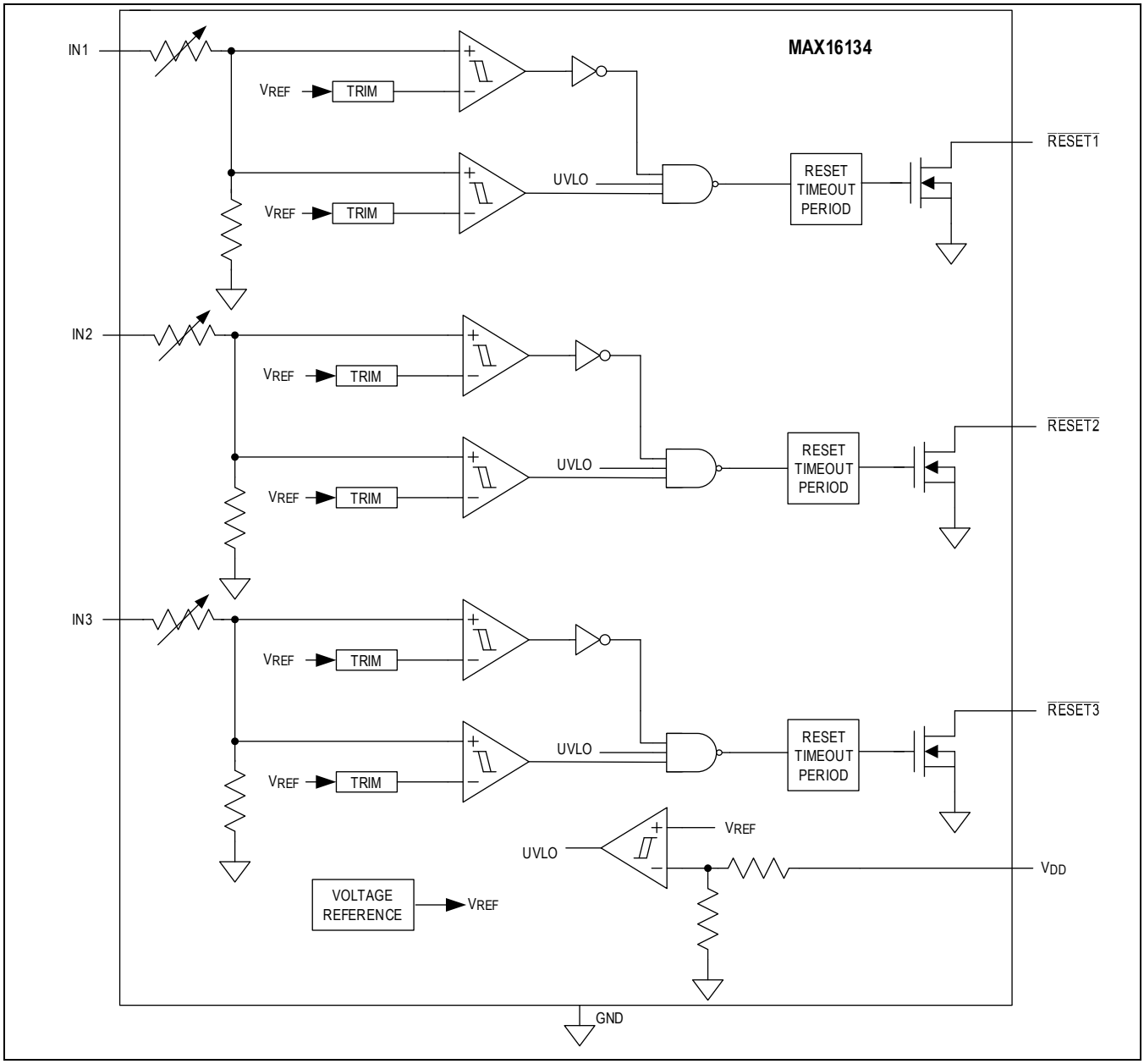
Single-Input Functional Block Diagram



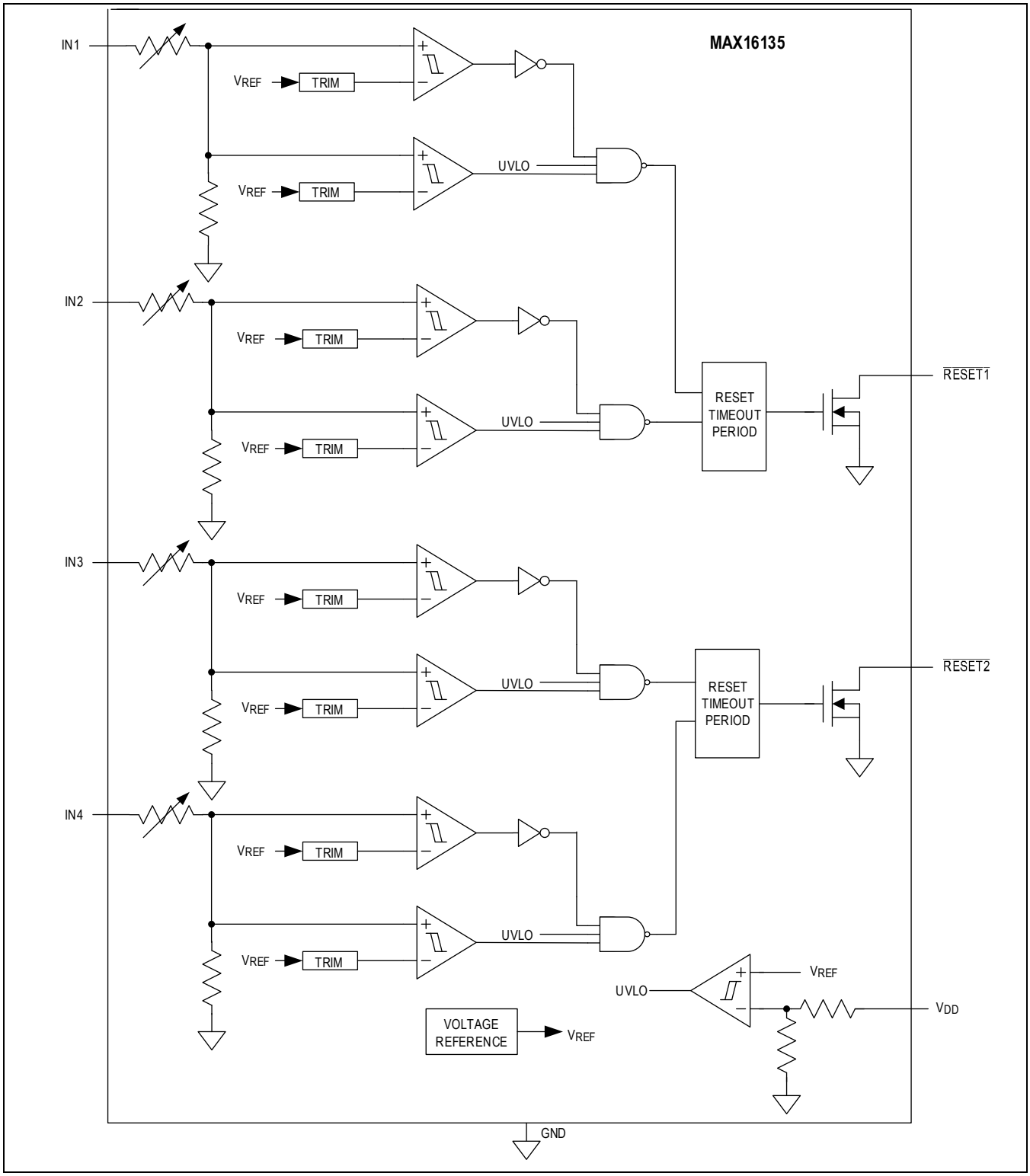
Dual-Input Functional Block Diagram



Triple-Input Functional Block Diagram



Quad-Input Functional Block Diagram



Detailed Description

Detailed Description

The MAX16132–MAX16135 are single, dual, triple, and quad-voltage µP supervisors designed to maintain system integrity in multi-supply systems. These devices offer undervoltage and overvoltage window threshold monitoring within ±1% accuracy over temperature.

Input Voltage

The MAX16132–MAX16135 feature factory-programmable input-voltage-level options from 1.0V to 5V. See *Table 1* thru *Table 4*, as well as the *Selector Guide* for standard voltage options. The selection of nominal input voltage does not set the voltage threshold levels. For the MAX16132–MAX16135, the undervoltage and overvoltage thresholds are determined by the selection of input tolerance. See the *Electrical Characteristics* table and *Input Tolerance/Hysteresis* section for more detail.

Input Tolerance/Hysteresis

The MAX16132–MAX1635 are designed to offer eight factory-programmable input tolerance levels from ±4% to ±11% in ±1% increment. The input tolerance level sets the undervoltage and overvoltage threshold levels with respect to the selected nominal input voltage. See *Table 5* thru *Table 8* for hysteresis and tolerance values. The MAX16132–MAX16135 are immune to short IN_ transients. Each of the internal comparators are factory-set to either 0.5% or 0.25% hysteresis with respect to the selected nominal input voltage. Hysteresis provides input immunity to ambient noise without significantly reducing the input threshold accuracy. See the Maximum IN_ Transient Duration vs. Reset Threshold Overdrive graph in the *Typical Operating Characteristics* section.

Reset Outputs

The MAX16132–MAX16134 feature independent, active-low, open-drain reset outputs, while the MAX16135 features dual reset outputs. For the MAX16132–MAX16134, when an input voltage falls outside the set window threshold, the corresponding reset outputs asserts. The reset output deasserts after the reset timeout period when the input voltage falls within the window threshold. See *Figure 1* below for more detail.

The MAX16135 feature dual reset outputs. $\overline{RESET1}$ asserts when V_{IN1} and/or V_{IN2} falls outside the set window threshold. $\overline{RESET2}$ asserts when V_{IN3} and/or V_{IN4} falls outside the set window threshold. $\overline{RESET1}$ and $\overline{RESET2}$ deassert after the reset timeout period when their corresponding input voltages are within the set window threshold. At power-up, resets stay asserted for the reset timeout period once V_{DD} is above the UVLO. All reset outputs require a pullup resistor to V_{DD}.

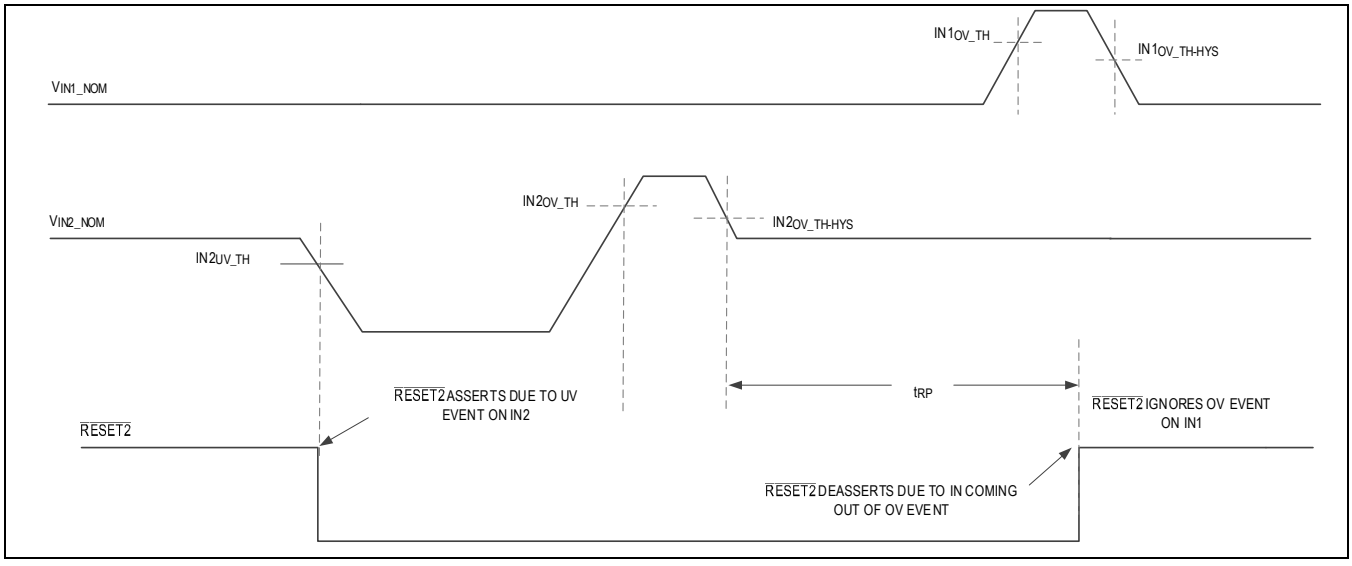


Figure 1. Independent Reset Output Timing Diagram (MAX16133/MAX16134)

Reset Timeout Period

The MAX16132–MAX16135 offer 23 factory-set reset timeout periods. All reset outputs share the same reset timeout period. See *Table 9* for reset timeout period selection.

Configuration Tables

Table 1. Single-Input Nominal Voltage Options (Typ)

SUFFIX	IN_NOM (V)	SUFFIX	IN_NOM (V)
—	—	28	2.800
—	—	29	2.900
—	—	30	3.000
—	—	31	3.100
—	—	32	3.200
04	1.240	—	—
10	1.00	33	3.300
11	1.100	34	3.400
12	1.200	35	3.500
13	1.300	36	3.600
14	1.400	37	3.700
15	1.500	38	3.800
16	1.600	39	3.900
17	1.700	40	4.000
18	1.800	41	4.100
19	1.900	42	4.200
20	2.000	43	4.300
21	2.100	44	4.400
22	2.200	45	4.500
23	2.300	46	4.600
24	2.400	47	4.700
25	2.500	48	4.800
26	2.600	49	4.900
27	2.700	50	5.000

Table 2. Dual-Input Nominal Voltage Options (Typ)

SUFFIX	IN1_NOM (V)	IN2_NOM (V)
A	5.000	3.300
B	5.000	1.800
C	5.000	1.200
D	5.000	1.000
E	3.300	1.800
F	3.300	1.200
G	3.300	1.000
H	2.500	1.200
I	2.500	1.160
J	1.800	1.500
K	1.800	1.200
L	1.800	1.000

M	1.500	1.200
N	1.500	1.000
O	1.200	1.000
P	2.500	1.140
Q	1.25	1.25

Table 3. Triple-Input Nominal Voltage Options (Typ)

SUFFIX	IN1_ NOM (V)	IN2_NOM (V)	IN3_NOM (V)
A	5.000	3.300	1.800
B	5.000	3.300	1.200
C	5.000	3.300	1.000
D	4.800	3.000	1.800
E	4.800	3.000	1.200
F	4.800	1.800	1.200
G	4.800	1.800	1.000
H	4.500	3.300	1.800
I	4.500	3.300	1.200
J	4.500	3.300	1.000
K	3.300	1.800	1.200
L	3.300	1.800	1.000
M	3.000	1.800	1.200
N	3.000	1.800	1.000
O	2.500	1.800	1.200
P	2.500	1.800	1.000
Q	3.300	2.500	1.160
R	3.300	3.300	1.200
S	3.300	1.800	1.080

Table 4. Quad-Input Nominal Voltage Options (Typ)

SUFFIX	IN1_NOM (V)	IN2_NOM (V)	IN3_NOM (V)	IN4_NOM (V)
A	5.000	3.300	2.500	1.500
B	5.000	3.300	1.800	1.200
C	5.000	3.300	1.200	1.000
D	4.800	3.300	1.800	1.200
E	4.800	2.500	1.800	1.200
F	4.800	3.00	1.500	1.000
G	4.500	3.300	2.500	1.800
H	4.500	3.000	1.800	1.200
I	3.300	2.500	1.800	1.500
J	3.300	2.500	1.800	1.200
K	3.300	1.800	1.200	1.000

L	3.000	2.500	1.500	1.200
M	3.000	1.800	1.200	1.000
N	2.500	1.800	1.200	1.000
O	2.300	1.800	1.500	1.200
P	2.300	1.500	1.200	1.000
Q	3.300	1.800	1.160	1.160
R	5.000	3.240	1.220	1.800
S	1.800	1.500	1.360	1.200
T	3.300	1.000	1.000	3.300

Table 5. Single-Input HYS/TOL Options (Typ)

SUFFIX	IN HYS (%)/TOL (±%))
A	0.5/4
B	0.25/4
C	0.5/5
D	0.25/5
E	0.5/6
F	0.25/6
G	0.5/7
H	0.25/7
I	0.5/8
J	0.25/8
K	0.5/9
L	0.25/9
M	0.5/10
N	0.25/10
O	0.5/11
P	0.25/11

Table 6. Dual-Input HYS/TOL Options (Typ)

SUFFIX	IN1 HYS (%)/TOL (±%)	IN2 HYS (%)/TOL (±%)
A	0.5/4	0.5/4
B	0.25/4	0.25/4
C	0.5/5	0.5/5
D	0.25/5	0.25/5
E	0.5/6	0.5/6
F	0.25/6	0.25/6
G	0.5/7	0.5/7
H	0.25/7	0.25/7
I	0.5/8	0.5/8
J	0.25/8	0.25/8

K	0.5/9	0.5/9
L	0.25/9	0.25/9
M	0.5/10	0.5/10
N	0.25/10	0.25/10
O	0.5/11	0.5/11
P	0.25/11	0.25/11

Table 7. Triple-Input HYS/TOL Options (Typ)

SUFFIX	IN1 HYS (%)/TOL (±%)	IN2 HYS (%)/TOL (±%)	IN3 HYS (%)/TOL (±%)
A	0.5/4	0.5/4	0.5/4
B	0.25/4	0.25/4	0.25/4
C	0.5/5	0.5/5	0.5/5
D	0.25/5	0.25/5	0.25/5
E	0.5/6	0.5/6	0.5/6
F	0.25/6	0.25/6	0.25/6
G	0.5/7	0.5/7	0.5/7
H	0.25/7	0.25/7	0.25/7
I	0.5/8	0.5/8	0.5/8
J	0.25/8	0.25/8	0.25/8
K	0.5/9	0.5/9	0.5/9
L	0.25/9	0.25/9	0.25/9
M	0.5/10	0.5/10	0.5/10
N	0.25/10	0.25/10	0.25/10
O	0.5/11	0.5/11	0.5/11
P	0.25/11	0.25/11	0.25/11
Q	0.25/4	0.25/4	0.25/7

Table 8. Quad-Input HYS/TOL Options (Typ)

SUFFIX	IN1 HYS (%)/TOL (±%)	IN2 HYS (%)/TOL (±%)	IN3 HYS (%)/TOL (±%)	IN4 HYS (%)/TOL (±%)
A	0.5/4	0.5/4	0.5/4	0.5/4
B	0.25/4	0.25/4	0.25/4	0.25/4
C	0.5/5	0.5/5	0.5/5	0.5/5
D	0.25/5	0.25/5	0.25/5	0.25/5
E	0.5/6	0.5/6	0.5/6	0.5/6
F	0.25/6	0.25/6	0.25/6	0.25/6
G	0.5/7	0.5/7	0.5/7	0.5/7
H	0.25/7	0.25/7	0.25/7	0.25/7
I	0.5/8	0.5/8	0.5/8	0.5/8
J	0.25/8	0.25/8	0.25/8	0.25/8
K	0.5/9	0.5/9	0.5/9	0.5/9
L	0.25/9	0.25/9	0.25/9	0.25/9

M	0.5/10	0.5/10	0.5/10	0.5/10
N	0.25/10	0.25/10	0.25/10	0.25/10
O	0.5/11	0.5/11	0.5/11	0.5/11
P	0.25/11	0.25/11	0.25/11	0.25/11
Q	0.25/11	0.25/4	0.5/11	0.5/4
R	0.25/8	0.25/5	0.25/5	0.25/4
S	0.5/8	0.5/4	0.5/6	0.5/6

Table 9. Reset Timeout (Min)

SUFFIX	TRP	SUFFIX	TRP
A	20µs	M	70ms
B	1ms	N	100ms
C	2ms	O	140ms
D	3ms	P	150ms
E	5ms	Q	200ms
F	10ms	R	280ms
G	15ms	S	400ms
H	20ms	T	560ms
I	25ms	U	800ms
J	35ms	V	1120ms
K	40ms	W	1200ms
L	50ms	—	—

Applications Information

Unused Inputs

The MAX16132–MAX16135 are capable of monitoring inputs for undervoltage and overvoltage events within a very narrow voltage window. Connect any unused IN_ input to its nominal voltage setting.

Setting Input Thresholds

The MAX16132–MAX16135 reset devices that monitor input within a window threshold set by the input tolerance selection. Tolerance setting determines the boundary for undervoltage and overvoltage thresholds. The selected nominal input voltage must stay within the window threshold for the MAX16132–MAX16135 not to issue a reset signal. See below for threshold calculation for 2.5V nominal input voltage and ±10% input tolerance:

$$V_{INNOM} = 2.5V$$

$$TOL = \pm 10\%$$

$$V_{UVTH} = V_{INNOM}(1 - 10\%) = 2.5V(1 - 0.1) = 2.5V - 0.250V = 2.250V$$

$$V_{OVTH} = V_{INNOM}(1 + 10\%) = 2.5V(1 + 0.1) = 2.5V + 0.250V = 2.750V$$

Where V_{INNOM} is the selected nominal input voltage, TOL is the input tolerance, V_{UVTH} is undervoltage threshold voltage and V_{OVTH} is the overvoltage threshold voltage.

The MAX16132–MAX16135 feature ±1% threshold accuracy over temperature. This excursion must be added to the calculated undervoltage and overvoltage threshold settings to account for the threshold variation as shown below:

$$V_{UVTH_EXC} = V_{UVTH}(1 \pm 1\,\%) = 2.250V(1 \pm 0.01) = 2.250V \pm 0.0225V$$

$$V_{OVTH_EXC} = V_{OVTH}(1 \pm 1\,\%) = 2.750V(1 \pm 0.01) = 2.750V \pm 0.0275V$$

Where V_{UVTH_EXC} is the undervoltage threshold variation and V_{OVTH_EXC} is the overvoltage threshold variation.

Undervoltage/Overvoltage-Detection Circuit

The open-drain outputs of the MAX16132–MAX16135 can be configured to detect an undervoltage/overvoltage condition. *Figure 2* shows the MAX16132 reset output deriving an LED when there is an overvoltage/undervoltage event on IN.

Note: The value for the current-limiting resistor R must be chosen such that it does not violate the absolute maximum ratings of the reset pin.

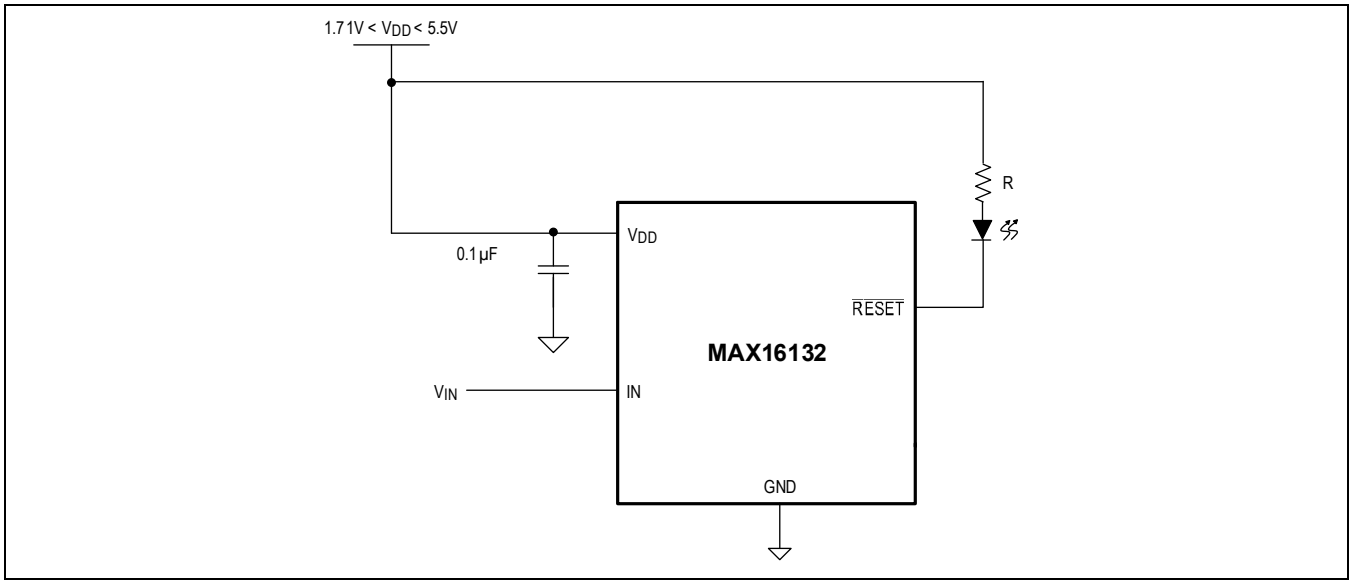


Figure 2. Undervoltage/Overvoltage Detection Circuit with LED Indicator

Power-Supply Bypassing and Grounding

The MAX16132–MAX16135 operate from a 1.71V to 5.5V supply. An undervoltage lockout ensures that the outputs are in the correct states when the UVLO is exceeded. Bypass V_{DD} to ground with a 0.1µF capacitor as close to the device

as possible. Additional capacitor improves transient immunity. For fast transients with large voltage excursion, a filter resistor in series with the bypass capacitor is recommended for proper device operation. See *Figure 3* below for more detail.

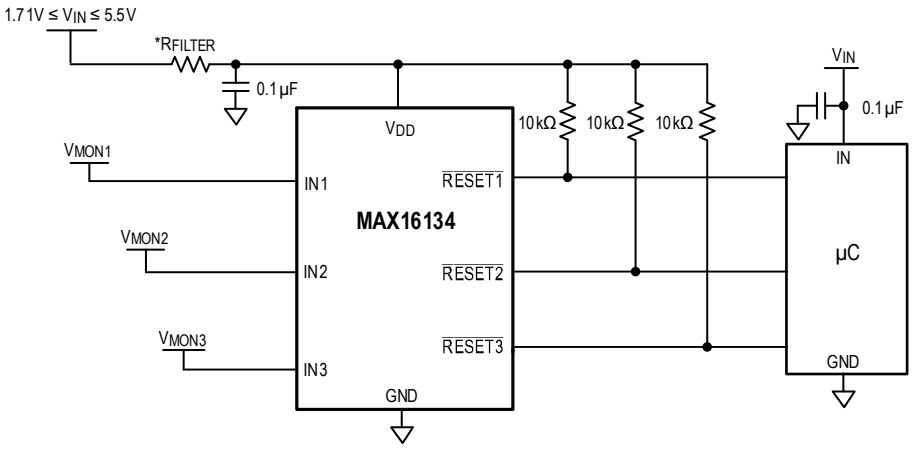


Figure 3. Power Supply Bypassing/Input Filter

Selector Guide

The MAX16132–MAX16135 include different variants or device options; however, not all options are released for sale. Released variants are called standard models and are listed in the *Ordering Information*. For the most up-to-date list of standard models, refer to the product page's Sample & Buy section. Contact an Analog Devices sales representative for information on nonstandard models and be aware that samples and production units may have long lead times.

MAX161____+T

SUF	# OF CHANNELS
32	SINGLE
33	DUAL
34	TRIPLE
35	QUAD

RESET TIMEOUT (min)	
A	20µs
B	1ms
C	2ms
D	3ms
E	5ms
F	10ms
G	15ms
H	20ms
I	25ms
J	35ms
K	40ms
L	50ms
M	70ms
N	100ms
O	140ms
P	150ms
Q	200ms
R	280ms
S	400ms
T	560ms
U	800ms
V	1120ms
W	1200ms

SINGLE NOMINAL INPUT (typ)			
SUF	V_{IN_NOM} (V)	SUF	V_{IN_NOM} (V)
–	–	28	2.800
–	–	29	2.900
–	–	30	3.000
–	–	31	3.100
–	–	32	3.200
10	1.000	33	3.300
11	1.100	34	3.400
12	1.200	35	3.500
13	1.300	36	3.600
04	1.240	–	–
14	1.400	37	3.700
15	1.500	38	3.800
16	1.600	39	3.900
17	1.700	40	4.000
18	1.800	41	4.100
19	1.900	42	4.200
20	2.000	43	4.300
21	2.100	44	4.400
22	2.200	45	4.500
23	2.300	46	4.600
24	2.400	47	4.700
25	2.500	48	4.800
26	2.600	49	4.900
27	2.700	50	5.000

DUAL NOMINAL INPUT (typ)		
SUF	V_{IN1_NOM} (V)	V_{IN2_NOM} (V)
A	5.000	3.300
B	5.000	1.800
C	5.000	1.200
D	5.000	1.00
E	3.300	1.800
F	3.300	1.200
G	3.300	1.000
H	2.500	1.200
I	2.500	1.160
J	1.800	1.500
K	1.800	1.200
L	1.800	1.000
M	1.500	1.200
N	1.500	1.100
O	1.250	1.000
P	2.500	1.140
Q	1.250	1.250

TRIPLE NOMINAL INPUT (typ)			
SUF	V_{IN1_NOM} (V)	V_{IN2_NOM} (V)	V_{IN3_NOM} (V)
A	5.000	3.300	1.800
B	5.000	3.300	1.200
C	5.000	3.300	1.000
D	4.800	3.000	1.800
E	4.800	3.000	1.200
F	4.800	1.800	1.200
G	4.800	1.800	1.000
H	4.500	3.300	1.800
I	4.500	3.300	1.200
J	4.500	3.300	1.000
K	3.300	1.800	1.200
L	3.300	1.800	1.000
M	3.000	1.800	1.200
N	3.000	1.800	1.000
O	2.500	1.800	1.200
P	2.500	1.800	1.000
Q	3.300	2.500	1.160
R	3.300	3.300	1.200
S	3.300	1.800	1.080

QUAD-NOMINAL INPUT (typ)				
SUF	V_{IN1_NOM} (V)	V_{IN2_NOM} (V)	V_{IN3_NOM} (V)	V_{IN4_NOM} (V)
A	5.000	3.300	2.500	1.500
B	5.000	3.300	1.800	1.200
C	5.000	3.300	1.200	1.000
D	4.800	3.300	1.800	1.200
E	4.800	2.500	1.800	1.200
F	4.800	3.000	1.500	1.000
G	4.500	3.300	2.500	1.800
H	4.500	3.000	1.800	1.200
I	3.300	2.500	1.800	1.500
J	3.300	2.500	1.800	1.200
K	3.300	1.800	1.200	1.000
L	3.000	2.500	1.500	1.200
M	3.000	1.800	1.200	1.000
N	2.500	1.800	1.200	1.000
O	2.300	1.800	1.500	1.200
P	2.300	1.500	1.200	1.000
Q	3.300	1.800	1.160	1.160
R	5.000	3.240	1.220	1.800
S	1.800	1.500	1.360	1.200
T	3.300	1.000	1.000	3.300

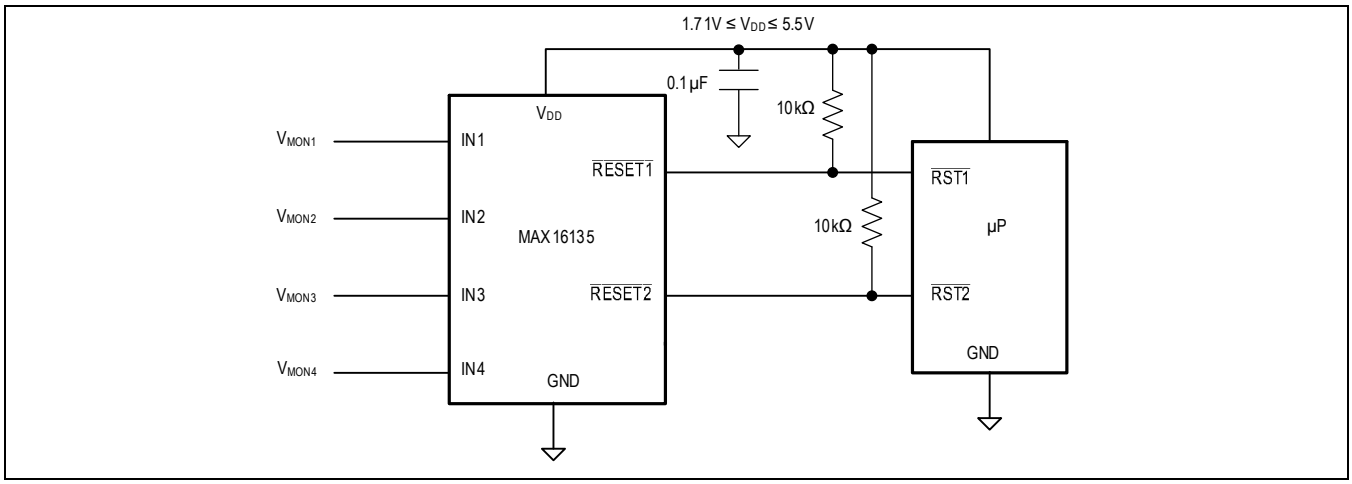
SINGLE-INPUT HYS/TOL	
SUF	IN HYS (%)/ TOL (%)
A	0.5/4
B	0.25/4
C	0.5/5
D	0.25/5
E	0.5/6
F	0.25/6
G	0.5/7
H	0.25/7
I	0.5/8
J	0.25/8
K	0.5/9
L	0.25/9
M	0.5/10
N	0.25/10
O	0.5/11
P	0.25/11

DUAL-INPUT HYS/TOL (typ)		
SUF	IN1 HYS (%)/ TOL (%)	IN2 HYS (%)/ TOL (%)
A	0.5/4	0.5/4
B	0.25/4	0.25/4
C	0.5/5	0.5/5
D	0.25/5	0.25/5
E	0.5/6	0.5/6
F	0.25/6	0.25/6
G	0.5/7	0.5/7
H	0.25/7	0.25/7
I	0.5/8	0.5/8
J	0.25/8	0.25/8
K	0.5/9	0.5/9
L	0.25/9	0.25/9
M	0.5/10	0.5/10
N	0.25/10	0.25/10
O	0.5/11	0.5/11
P	0.25/11	0.25/11

TRIPLE-INPUT HYS/TOL (typ)			
SUF	IN1 HYS (%)/ TOL (%)	IN2 HYS (%)/ TOL (%)	IN3 HYS (%)/ TOL (%)
A	0.5/4	0.5/4	0.5/4
B	0.25/4	0.25/4	0.25/4
C	0.5/5	0.5/5	0.5/5
D	0.25/5	0.25/5	0.25/5
E	0.5/6	0.5/6	0.5/6
F	0.25/6	0.25/6	0.25/6
G	0.5/7	0.5/7	0.5/7
H	0.25/7	0.25/7	0.25/7
I	0.5/8	0.5/8	0.5/8
J	0.25/8	0.25/8	0.25/8
K	0.5/9	0.5/9	0.5/9
L	0.25/9	0.25/9	0.25/9
M	0.5/10	0.5/10	0.5/10
N	0.25/10	0.25/10	0.25/10
O	0.5/11	0.5/11	0.5/11
P	0.25/11	0.25/11	0.25/11
Q	0.25/4	0.25/4	0.25/7

QUAD-INPUT HYS/TOL (typ)				
SUF	IN1 HYS (%)/ TOL (%)	IN2 HYS (%)/ TOL (%)	IN3 HYS (%)/ TOL (%)	IN4 HYS (%)/ TOL (%)
A	0.5/4	0.5/4	0.5/4	0.5/4
B	0.25/4	0.25/4	0.25/4	0.25/4
C	0.5/5	0.5/5	0.5/5	0.5/5
D	0.25/5	0.25/5	0.25/5	0.25/5
E	0.5/6	0.5/6	0.5/6	0.5/6
F	0.25/6	0.25/6	0.25/6	0.25/6
G	0.5/7	0.5/7	0.5/7	0.5/7
H	0.25/7	0.25/7	0.25/7	0.25/7
I	0.5/8	0.5/8	0.5/8	0.5/8
J	0.25/8	0.25/8	0.25/8	0.25/8
K	0.5/9	0.5/9	0.5/9	0.5/9
L	0.25/9	0.25/9	0.25/9	0.25/9
M	0.5/10	0.5/10	0.5/10	0.5/10
N	0.25/10	0.25/10	0.25/10	0.25/10
O	0.5/11	0.5/11	0.5/11	0.5/11
P	0.25/11	0.25/11	0.25/11	0.25/11
Q	0.25/11	0.25/4	0.5/11	0.5/4
R	0.25/8	0.25/5	0.25/5	0.25/4

Typical Operating Circuit



Ordering Information

PART NUMBER	TEMP RANGE	PIN-PACKAGE
MAX16132B11A/V+T	-40°C to +125°C	8 SOT23
MAX16132B33A+T	-40°C to +125°C	8 SOT23
MAX16132B33F/V+T	-40°C to +125°C	8 SOT23
MAX16132E33B/V+T	-40°C to +125°C	8 SOT23
MAX16132F04E/V+T	-40°C to +125°C	8 SOT23
MAX16132F33G/V+T	-40°C to +125°C	8 SOT23
MAX16132G04D+T	-40°C to +125°C	8 SOT23
MAX16132G04D/V+T	-40°C to +125°C	8 SOT23
MAX16132H10B+T	-40°C to +125°C	8 SOT23
MAX16132H10B/V+T	-40°C to +125°C	8 SOT23
MAX16133AEG/V+T	-40ºC to +125ºC	8 SOT23
MAX16133BFM+T	-40°C to +125°C	8 SOT23
MAX16133BFM/V+T	-40°C to +125°C	8 SOT23
MAX16133BHA+T	-40°C to +125°C	8 SOT23
MAX16133EEM/V+T	-40°C to +125°C	8 SOT23
MAX16133FQP/V+T	-40°C to +125°C	8 SOT23
MAX16133HPB/V+	-40°C to +125°C	8 SOT23
MAX16133HPB+T	-40°C to +125°C	8 SOT23
MAX16133HIB/V+T	-40°C to +125°C	8 SOT23
MAX16133LFM/V+T	-40°C to +125°C	8 SOT23
MAX16133LFM+T	-40°C to +125°C	8 SOT23
MAX16134ERO/V+T	-40°C to +125°C	8 SOT23
MAX16134ESC+T	-40°C to +125°C	8 SOT23
MAX16134MLG+T	-40°C to +125°C	8 SOT23
MAX16134NKQ/V+T	-40°C to +125°C	8 SOT23
MAX16134QAA+T	-40°C to +125°C	8 SOT23
MAX16134QLA+T	-40°C to +125°C	8 SOT23
MAX16135ATI+T	-40°C to +125°C	8 SOT23
MAX16135GQS/V+T	-40°C to +125°C	8 SOT23
MAX16135HRB+T	-40°C to +125°C	8 SOT23
MAX16135HRB/V+T	-40°C to +125°C	8 SOT23
MAX16135HRR/V+T	-40°C to +125°C	8 SOT23

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

T = Tape and reel.

/V denotes an automotive qualified part.

***Note:** See the Selector Guide for Reset Timeout Period, Nominal Input Voltages, and Hysteresis/Tolerance options.*

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	11/16	Initial release	—
1	1/17	Corrected part numbers in Figure 3 and Typical Application Circuit	20
2	2/17	Updated Selector Guide	21
3	6/17	Updated Electrical Characteristics table, Selector Guide, and Ordering Information table	6, 16–18, 21, 22
4	8/17	Updated Ordering Information table	22
5	11/17	Added released part numbers to Ordering Information table and AEC-Q100 statement to Benefits and Features section	1, 22
6	12/17	Updated Electrical Characteristics table and Ordering Information	6, 22
7	1/18	Updated Ordering Information	22
8	2/18	Updated Ordering Information	22
9	3/18	Updated the General Description, Benefits and Features, and Input Voltage sections, Electrical Characteristics table, Table 1 and Table 4, and Selector Guide.	1, 6, 15–17, 21
10	7/18	Updated Ordering Information table	22
11	7/18	Updated Absolute Maximum Ratings and Ordering Information	5, 22
12	10/18	Updated Electrical Characteristics table and Applications Information	6, 19
13	12/18	Updated Ordering Information table	22
14	2/19	Updated Ordering Information table	22
15	10/19	Updated Table 2, Selector Guide, and Ordering Information	14, 19, 20
16	10/19	Updated Pin Description and Applications Information	8, 17
17	11/19	Updated Table 2, Selector Guide, and Ordering Information	14, 19, 20
18	12/19	Updated Table 1–9, Selector Guide, and Ordering Information	14–16, 19, 20
19	2/20	Updated General Description, Benefits and Features, and Package Information	1, 3
20	4/20	Updated Typical Operating Characteristics, Pin Description table, Detailed Description, Applications Information, Selector Guide, and Ordering Information table	5, 8, 9, 13–15, 17, 19, 20
21	9/20	Updated Ordering Information table	25
22	3/21	Updated Electrical Characteristics table, Ordering Information table	3, 4, 24
23	6/21	Updated Ordering Information table	24
24	8/21	Updated Ordering Information table, Configuration Tables, and Selector Guide	15, 17, 19, 22, 24
25	12/21	Updated Ordering Information table	24
26	10/24	Updated Benefits and Features section, Configuration tables, Selector Guide, and Ordering Information table	1, 16, 22, 24

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