4-Pin, Ultra-Low-Voltage, Low-Power µP Reset Circuits with Manual Reset

MAX6335/MAX6336/MAX6337

General Description

The MAX6335/MAX6336/MAX6337 microprocessor (µP) supervisory circuits monitor the power supplies in 1.8V to 3.3V µP and digital systems. They increase circuit reliability and reduce cost by eliminating external components and adjustments. They also feature a debounced manual-reset input.

These devices perform a single function: they assert a reset signal whenever the V_{CC} supply voltage declines below a preset threshold or whenever manual reset is asserted. Reset remains asserted for a preset timeout period after V_{CC} has risen above the reset threshold or after manual reset is deasserted. The only difference among the three devices is their output. The MAX6336 (push/pull) and MAX6337 (open-drain) have an active-low $\overline{RESET}$ output, while the MAX6335 (push/pull) has an active-high RESET output. The MAX6335/MAX6336 are guaranteed to be in the correct state for V_{CC} down to 0.7V. The MAX6337 is guaranteed to be in the correct state for V_{CC} down to 1.0V.

The reset comparator in these ICs is designed to ignore fast transients on V_{CC}. Reset thresholds are factory-trimmable between 1.6V and 2.5V, in approximately 100mV increments. There are 15 standard versions available (2500 piece minimum-order quantity); contact the factory for availability of nonstandard versions (10,000 piece minimum-order quantity). For space-critical applications, the MAX6335/MAX6336/MAX6337 come packaged in a 4-pin SOT143.

Applications

- Pentium II™ Computers
- Computers
- Controllers
- Intelligent Instruments
- Critical µP/µC Power Monitoring
- Portable/Battery-Powered Equipment
- Automotive

Typical Operating Circuit and Pin Configuration appear at end of data sheet.

Features

- Ultra-Low 0.7V Operating Supply Voltage
- Low 3.3µA Supply Current
- Precision Monitoring of 1.8V and 2.5V Power-Supply Voltages
- Reset Thresholds Available from 1.6V to 2.5V, in Approximately 100mV Increments
- Debounced Manual Reset
- Fully Specified over Temperature
- Three Power-On Reset Pulse Widths Available (1ms min, 20ms min, 100ms min)
- Low Cost
- Three Available Output Structures: Push/Pull $\overline{RESET}$, Push/Pull RESET, Open-Drain $\overline{RESET}$
- Guaranteed RESET/$\overline{RESET}$ Valid to V_{CC} = 0.7V (MAX6335/MAX6336)
- Power-Supply Transient Immunity
- No External Components
- 4-Pin SOT143 Package
- Pin Compatible with MAX811/MAX812 and MAX6314/MAX6315

***Ordering Information** appears at end of data sheet.*

Pentium II is a trademark of Intel Corp.

19-1412; Rev 3; 9/24

Absolute Maximum Ratings

Terminal Voltage (with respect to GND)
- V_{CC} ..... -0.3V to +6V
- Push/Pull RESET or $\overline{RESET}$, $\overline{MR}$ ..... -0.3V to (V_{CC} + 0.3V)
- Open-Drain $\overline{RESET}$ ..... -0.3V to +6V

Input Current (V_{CC}) 20mA
Output Current (RESET, $\overline{RESET}$) 20mA

Continuous Power Dissipation (T_A = +70°C)
- SOT143 (derate 4mW/°C above +70°C) 320mW

Operating Temperature Range ..... -40°C to +125°C
Storage Temperature Range ..... -65°C to +160°C
Lead Temperature (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

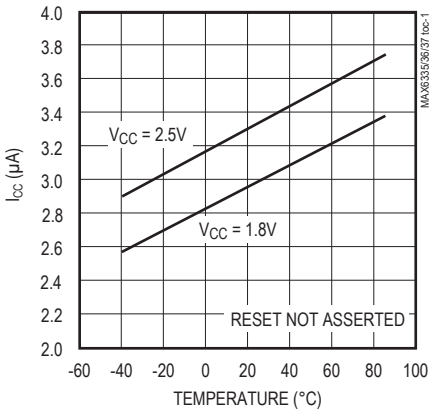
(V_{CC} = full range, $\overline{MR}$ = V_{CC} or unconnected, T_A = -40°C to +125°C, unless otherwise noted. Typical values are at T_A = +25°C and V_{CC} = 3V, reset not asserted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Voltage Range	V_{CC}	T_A = 0°C to +85°C	MAX6335/MAX6336	0.7		5.5	V
			MAX6337	1.0		5.5	
		T_A = -40°C to +85°C	MAX6335/MAX6336	0.78		5.5	
			MAX6337	1.2		5.5	
		T_A = -40°C to +125°C	MAX6335/MAX6336	1.2		5.5	
			MAX6337				
Supply Current	I_{CC}	No load	V_{CC} = 1.8V		3.0	6.0	µA
			V_{CC} = 2.5V		3.3	7.0	
Reset Threshold	V_{TH}	MAX633_US__D_-T, Table 1	T_A = +25°C	V_{TH} – 1.8%	V_{TH}	V_{TH} – 1.8%	V
			T_A = -40°C to +125°C	V_{TH} – 3%	V_{TH}	V_{TH} – 3%	
V_{CC} Falling Reset Delay		V_{CC} falling at 10V/ms			24		µs
Reset Active Timeout Period	t_{RP}	MAX633_US__D1+T		1	1.5	2	ms
		MAX633_US__D2+T		20	30	40	
		MAX633_US__D3+T		100	150	200	
$\overline{RESET}$ Output Low Voltage (MAX6336/MAX6337)	V_{OL}	Reset asserted	I_{SINK} = 50µA, V_{CC} ≥ 1.0V			0.4	V
			I_{SINK} = 500µA, V_{CC} ≥ 1.8V			0.3	
$\overline{RESET}$ Output High Voltage (MAX6336)	V_{OH}	Reset not asserted	I_{SOURCE} = 200µA, V_{CC} ≥ 1.8V	0.8V_{CC}			V
			I_{SOURCE} = 500µA, V_{CC} ≥ 2.7V	0.8V_{CC}			
RESET Output Voltage (MAX6335)	V_{OH}	Reset asserted	I_{SOURCE} = 1µA, V_{CC} ≥ 1.0V	0.8V_{CC}			V
			I_{SOURCE} = 200µA, V_{CC} ≥ 1.8V	0.8V_{CC}			
	V_{OL}	Reset not asserted	I_{SINK} = 500µA, V_{CC} ≥ 1.8V			0.3	V
			I_{SINK} = 1.2mA, V_{CC} ≥ 2.7V			0.3	
$\overline{MR}$ Minimum Pulse Width				1			µs
$\overline{MR}$ Glitch Immunity		V_{CC} = 2.6V			160		ns
$\overline{MR}$ Reset Delay		V_{CC} = 2.6V			0.42		µs
$\overline{MR}$ Threshold	$V_{\overline{MR}}$			0.3V_{CC}		0.7V_{CC}	V
$\overline{MR}$ Pull-Up Resistance				12	20	30	kΩ
$\overline{RESET}$ Output Leakage Current (MAX6337)		V_{CC} > V_{TH}, $\overline{RESET}$ deasserted				0.5	µA

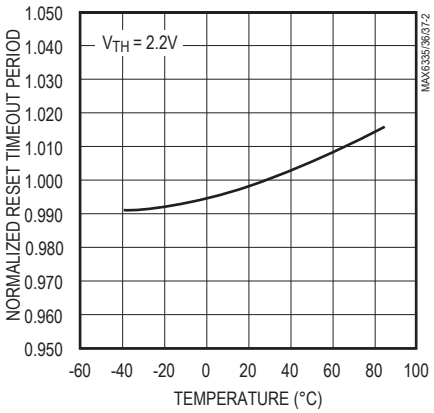
Typical Operating Characteristics

(Reset not asserted, T_A = +25°C, unless otherwise noted.)

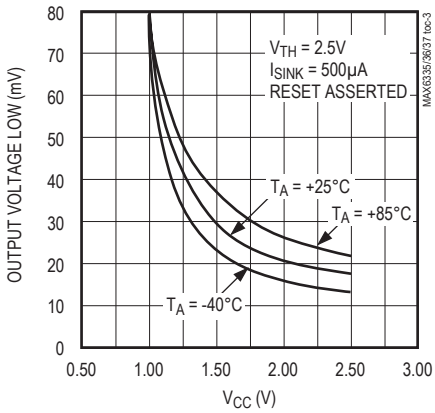
SUPPLY CURRENT vs. TEMPERATURE



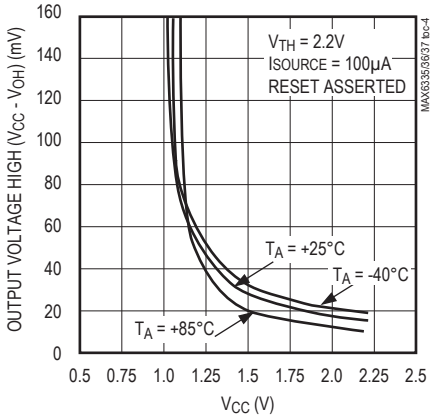
NORMALIZED RESET TIMEOUT PERIOD vs. TEMPERATURE



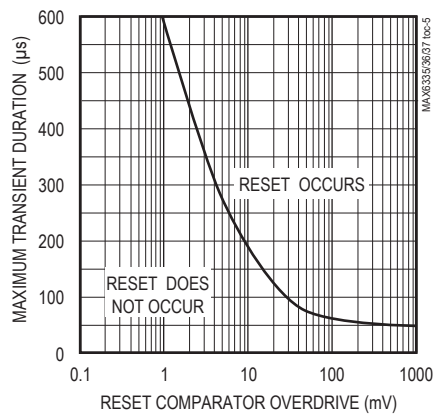
OUTPUT VOLTAGE LOW vs. SUPPLY VOLTAGE



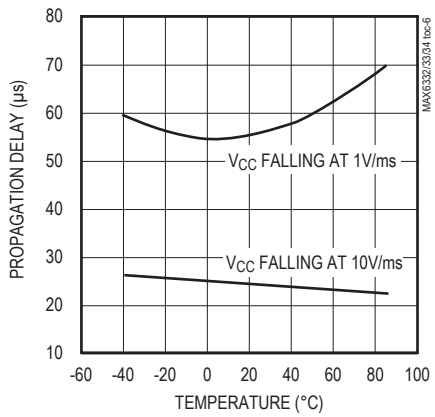
OUTPUT VOLTAGE HIGH vs. SUPPLY VOLTAGE



MAXIMUM TRANSIENT DURATION vs. RESET COMPARATOR OVERDRIVE



VCC FALLING PROPAGATION DELAY vs. TEMPERATURE



Pin Description

PIN		NAME	FUNCTION
MAX6335	MAX6336 MAX6337		
1	1	GND	Ground
—	2	$\overline{\text{RESET}}$	Active-Low Reset Output. $\overline{\text{RESET}}$ remains low while V_{CC} is below the reset threshold, or $\overline{\text{MR}}$ is asserted and for a reset timeout period (t_{RP}) after V_{CC} rises above the reset threshold, or $\overline{\text{MR}}$ is deasserted. $\overline{\text{RESET}}$ on the MAX6337 is open-drain.
2	—	RESET	Active-High Reset Output. RESET remains high while V_{CC} is below the reset threshold, or $\overline{\text{MR}}$ is asserted and for a reset timeout period (t_{RP}) after V_{CC} rises above the reset threshold, or $\overline{\text{MR}}$ is deasserted. RESET also asserts when $\overline{\text{MR}}$ is low.
3	3	$\overline{\text{MR}}$	Manual-Reset Input. A logic low on $\overline{\text{MR}}$ asserts reset. Reset remains asserted as long as $\overline{\text{MR}}$ is low, and for the reset timeout period (t_{RP}) after $\overline{\text{MR}}$ goes high. Leave unconnected or connect to V_{CC} if not used.
4	4	V_{CC}	Supply Voltage (0.7V to 5.5V)

Applications Information

Manual-Reset Inputs

Many µP-based products require manual-reset capability, allowing the operator, a test technician, or external logic circuitry to initiate a reset. A logic low on $\overline{\text{MR}}$ asserts reset. Reset remains asserted while $\overline{\text{MR}}$ is low, and for the reset active timeout period after $\overline{\text{MR}}$ returns high. $\overline{\text{MR}}$ has an internal 20kΩ pull-up resistor, so it can be left unconnected if not used. Connect a normally open momentary switch from $\overline{\text{MR}}$ to GND to create a manual-reset function; external debounce circuitry is not required.

Interfacing to µPs with Bidirectional Reset Pins

Since the $\overline{\text{RESET}}$ output on the MAX6337 is open-drain, this device interfaces easily with µPs that have bidirectional reset pins, such as the Motorola 68HC11. Connecting the µP supervisor's $\overline{\text{RESET}}$ output directly to the microcontroller's (µC's) $\overline{\text{RESET}}$ pin with a single pull-up resistor allows either device to assert reset (Figure 1).

Negative-Going V_{CC} Transients

In addition to issuing a reset to the µP during power-up, power-down, and brownout conditions, these devices are relatively immune to short-duration, negative-going V_{CC} transients (glitches). The *Typical Operating Characteristics* show the Maximum Transient Duration vs. Reset Comparator Overdrive graph. The graph shows the maximum pulse width that a negative-going V_{CC} transient may typically have without issuing a reset signal. As the amplitude of the transient increases, the maximum allowable pulse width decreases.

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

When V_{CC} falls below 1V and approaches the minimum operating voltage of 0.7V, push/pull-structured reset sinking (or sourcing) capabilities decrease drastically. High-impedance CMOS-logic inputs connected to the $\overline{\text{RESET}}$ pin can drift to indeterminate voltages. This does not present a problem in most cases, since most µPs and circuitry do not operate at V_{CC} below 1V. For the MAX6336, where $\overline{\text{RESET}}$ must be valid down to 0, adding a pull-down resistor between $\overline{\text{RESET}}$ and GND removes stray leakage currents, holding $\overline{\text{RESET}}$ low

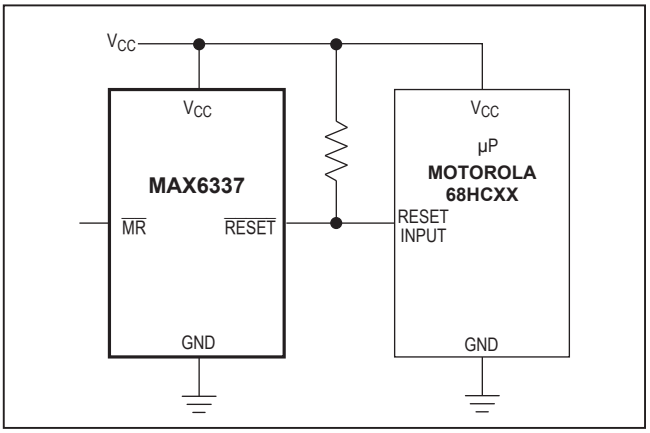


Figure 1. Interfacing to µPs with Bidirectional Reset Pins

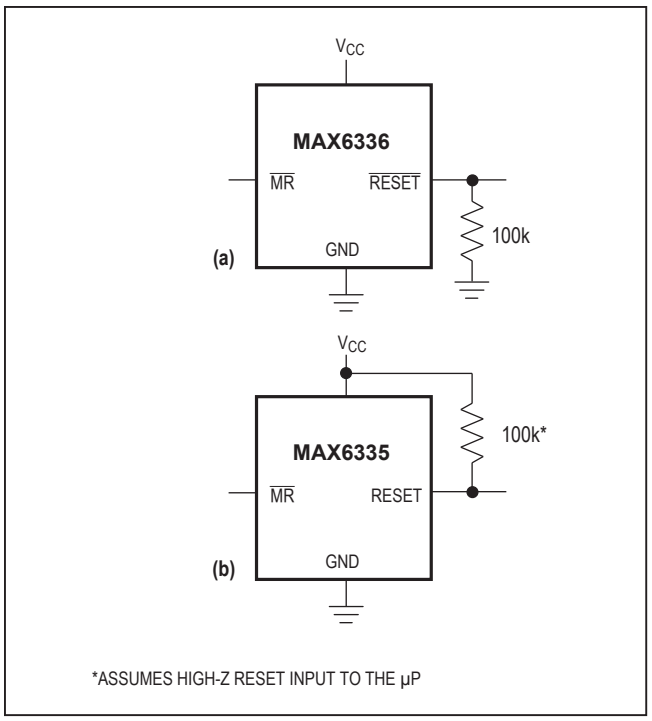


Figure 2. Ensuring Reset Valid down to V_{CC} = 0

(Figure 2a). The pull-down resistor value is not critical; 100kΩ is large enough not to load $\overline{RESET}$, and small enough to pull it low. For the MAX6335, where RESET must be valid to V_{CC} = 0, a 100kΩ pull-up resistor between RESET and V_{CC} will hold RESET high when V_{CC} falls below 0.7V (Figure 2b).

Since the MAX6337 has an open-drain, active-low output, it typically uses a pull-up resistor. With this device, RESET will most likely not maintain an active condition, but will drift to a non-active level due to the pull-up resistor and the reduced sinking capability of the opendrain device. Therefore, this device is not recommended for applications where the $\overline{RESET}$ pin is required to be valid down to V_{CC} = 0.

Table 1. Factory-Trimmed Reset Thresholds*

RESET THRESHOLD SUFFIX	T_A = +25°C			T_A = -40°C to +125°C	
	MIN	TYP	MAX	MIN	MAX
MAX633_US25D_	2.46	2.50	2.55	2.43	2.58
MAX633_US24D_	2.36	2.40	2.44	2.33	2.47
MAX633_US23D_	2.26	2.30	2.34	2.23	2.37
MAX633_US22D_	2.16	2.20	2.24	2.13	2.27
MAX633_US21D_	2.06	2.10	2.14	2.04	2.16
MAX633_US20D_	1.96	2.00	2.04	1.94	2.06
MAX633_US19D_	1.87	1.90	1.93	1.84	1.96
MAX633_US18D_	1.77	1.80	1.83	1.75	1.85
MAX633_US17D_	1.67	1.70	1.73	1.65	1.75
MAX633_US16D_	1.57	1.60	1.63	1.55	1.65

** Factory-trimmed reset thresholds are available in approximately 100mV increments, with a ±1.8% room-temperature variance.*

Selector Guide

The MAX6335/MAX6336/MAX6337 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.

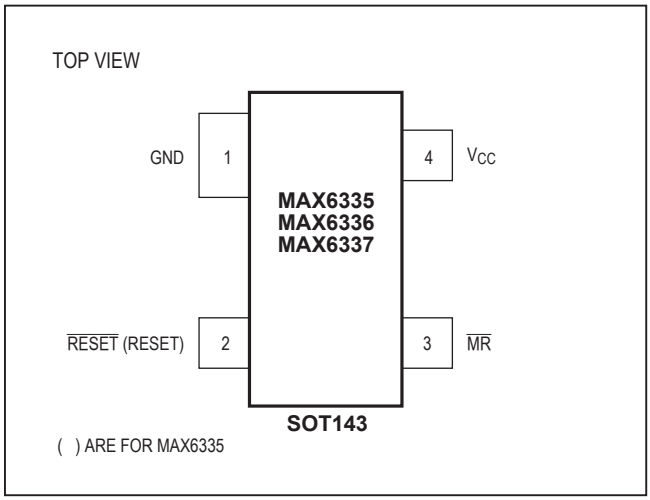
MAX633 US D +T

SUF	OUTPUT STAGE
5	PUSH-PULL $\overline{\text{RESET}}$
6	PUSH-PULL $\overline{\text{RESET}}$
7	OPEN-DRAIN $\overline{\text{RESET}}$

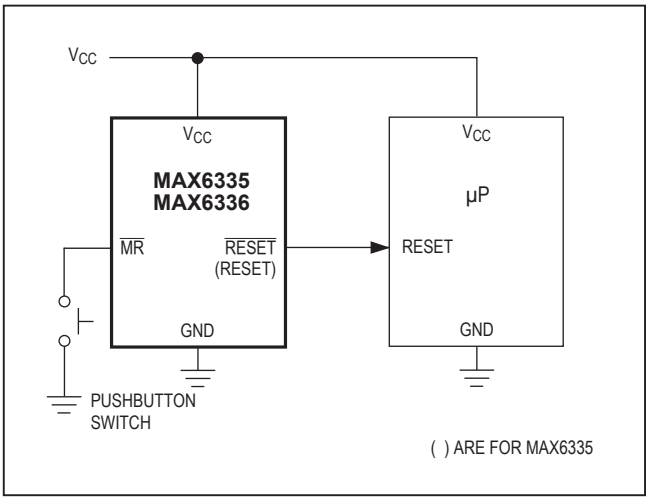
SUF	NOMINAL V_{TH} (TYP) (V)
16	1.60
17	1.70
18	1.80
19	1.90
20	2.00
21	2.10
22	2.20
23	2.30
24	2.40
25	2.50

SUF	RESET TIMEOUT PERIOD (TYP) (ms)
1	1.5
2	30
3	150

Pin Configuration



Typical Operating Circuit



Ordering Information

PART*	TEMP. RANGE	PIN-PACKAGE
MAX6335US16D3+T	-40°C to +125°C	4 SOT143
MAX6336US24D1+T	-40°C to +125°C	4 SOT143
MAX6336US23D3+T	-40°C to +125°C	4 SOT143
MAX6336US20D3+T	-40°C to +125°C	4 SOT143
MAX6336US18D3+T	-40°C to +125°C	4 SOT143
MAX6336US16D3+T	-40°C to +125°C	4 SOT143
MAX6337US23D3+T	-40°C to +125°C	4 SOT143
MAX6337US20D3+T	-40°C to +125°C	4 SOT143
MAX6337US17D3+T	-40°C to +125°C	4 SOT143
MAX6337US16D3+T	-40°C to +125°C	4 SOT143

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

T = Tape and reel.

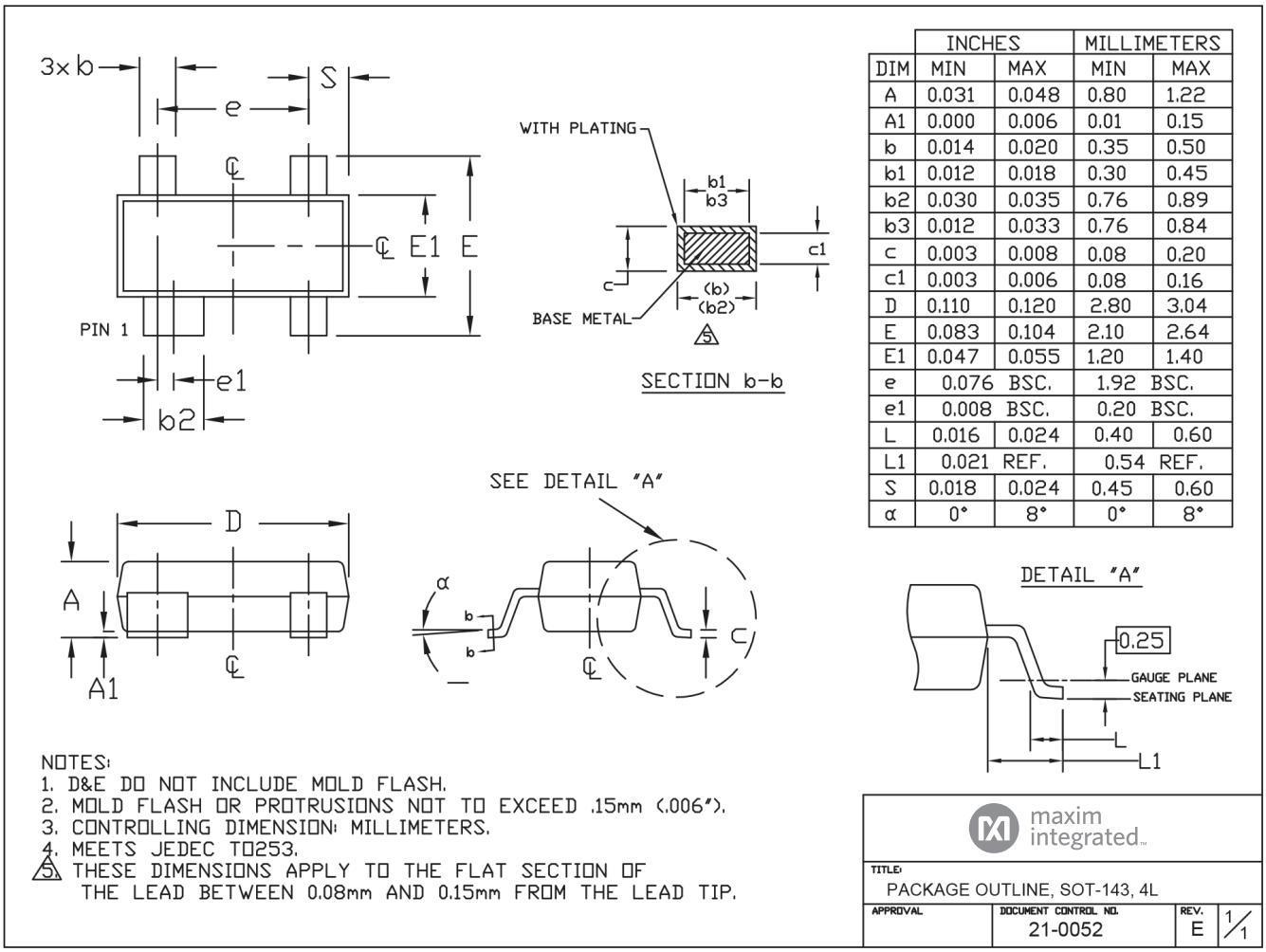
***Note:** See Selector Guide for Output Stage, Nominal Input Voltage, and Reset Timeout Period.*

Chip Information

TRANSISTOR COUNT: 505

Package Information

For the latest package outline information and land patterns (footprints), go to https://www.analog.com/en/resources/packaging-quality-symbols-footprints/package-index.html. 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.



	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.031	0.048	0.80	1.22
A1	0.000	0.006	0.01	0.15
b	0.014	0.020	0.35	0.50
b1	0.012	0.018	0.30	0.45
b2	0.030	0.035	0.76	0.89
b3	0.012	0.033	0.76	0.84
c	0.003	0.008	0.08	0.20
c1	0.003	0.006	0.08	0.16
D	0.110	0.120	2.80	3.04
E	0.083	0.104	2.10	2.64
E1	0.047	0.055	1.20	1.40
e	0.076 BSC.		1.92 BSC.	
e1	0.008 BSC.		0.20 BSC.	
L	0.016	0.024	0.40	0.60
L1	0.021 REF.		0.54 REF.	
S	0.018	0.024	0.45	0.60
α	0°	8°	0°	8°

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC TO253.
5. THESE DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN 0.08mm AND 0.15mm FROM THE LEAD TIP.

maxim integrated

TITLE: PACKAGE OUTLINE, SOT-143, 4L

APPROVAL	DOCUMENT CONTROL NO.	REV.	
	21-0052	E	1/1

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
1	12/98	Initial release	—
2	12/05	Added lead free option to Ordering Information	1
3	9/24	Updated Selector Guide and Ordering Information Table	6, 7