Precision, Micropower, Low-Dropout, SC70 Series Voltage Reference

ABSOLUTE MAXIMUM RATINGS

(Voltages Referenced to GND)
IN ....-0.3V to +6.0V
OUT ....-0.3V to (V_{IN} + 0.3V)
Output Short Circuit to GND or IN ....Continuous
Continuous Power Dissipation (T_A = +70°C)
3-Pin SC70 (derate 2.9mW/°C above +70°C)............235mW
Operating Temperature Range ....-40°C to +85°C
Junction Temperature ....+150°C
Storage Temperature Range ....-65°C to +150°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–MAX6034_21 (V_{OUT} = 2.048V)

(V_{IN} = 2.7V, I_{OUT} = 0, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
OUTPUT							
Output Voltage	V_{OUT}	T_A = +25°C	MAX6034A_21 (±0.2%)	2.044	2.048	2.052	V
			MAX6034B_21 (±0.4%)	2.040	2.048	2.056	
Output Voltage Temperature Coefficient (Note 2)	TCV_{OUT}	MAX6034A_21			7	30	ppm/°C
		MAX6034B_21			7	75	
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	2.5V ≤ V_{IN} ≤ 5.5V			33	220	µV/V
Load Regulation	$\Delta V_{OUT}/\Delta I_{OUT}$	Sourcing: 0 ≤ I_{OUT} ≤ 1mA			0.25	1.0	mV/mA
		Sinking: 0 ≤ I_{OUT} ≤ 200µA			2.1	62	
OUT Short-Circuit Current	I_{SC}	Short to GND			12		mA
		Short to IN			4		
Temperature Hysteresis	ΔV_{OUT}/cycle	(Note 3)			100		ppm
Long-Term Stability	ΔV_{OUT}/time	1000hr at T_A = +25°C			90		ppm/1000hr
DYNAMIC							
Noise Voltage	e_{OUT}	f = 0.1Hz to 10Hz			45		$µV_{P-P}$
		f = 10Hz to 10kHz			46		$µV_{RMS}$
Ripple Rejection	$\Delta V_{OUT}/\Delta V_{IN}$	V_{IN} = 2.7V ±100mV, f = 120Hz			80		dB
Turn-On Settling Time	t_R	To V_{OUT} = 0.1% of final value, C_{OUT} = 50pF			85		µs
Capacitive-Load Stability Range	C_{OUT}	(Note 4)		0		1	µF
INPUT							
Supply Voltage Range	V_{IN}	Guaranteed by line-regulation test		2.5		5.5	V
Quiescent Supply Current	I_{IN}				85	115	µA
Change in Supply Current Per Change in Input Voltage	$\Delta I_{IN}/\Delta V_{IN}$	2.5V ≤ V_{IN} ≤ 5.5V			4.1	16	µA/V

ELECTRICAL CHARACTERISTICS–MAX6034_25 (V_{OUT} = 2.500V)

(V_{IN} = 2.7V, I_{OUT} = 0, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
OUTPUT							
Output Voltage	V_{OUT}	T_A = +25°C	MAX6034A_25 (±0.2%)	2.495	2.500	2.505	V
			MAX6034B_25 (±0.4%)	2.490	2.500	2.510	
Output Voltage Temperature Coefficient (Note 2)	TCV_{OUT}	MAX6034A_25			7	30	ppm/°C
		MAX6034B_25			7	75	
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	(V_{OUT} + 200mV) ≤ V_{IN} ≤ 5.5V			40	250	µV/V
Load Regulation	$\Delta V_{OUT}/\Delta I_{OUT}$	Sourcing: 0 ≤ I_{OUT} ≤ 1mA			0.22	1.0	mV/mA
		Sinking: 0 ≤ I_{OUT} ≤ 200µA			2.5	8	
OUT Short-Circuit Current	I_{SC}	Short to GND			12		mA
		Short to IN			4		
Dropout Voltage	V_{IN} - V_{OUT}	I_{OUT} = 1mA (Note 5)			70	200	mV
Temperature Hysteresis	ΔV_{OUT}/cycle	(Note 3)			100		ppm
Long-Term Stability	ΔV_{OUT}/time	1000hr at T_A = +25°C			90		ppm/1000hr
DYNAMIC							
Noise Voltage	e_{OUT}	f = 0.1Hz to 10Hz			55		$µV_{P-P}$
		f = 10Hz to 10kHz			64		$µV_{RMS}$
Ripple Rejection	$\Delta V_{OUT}/\Delta V_{IN}$	V_{IN} = 2.7V ±100mV, f = 120Hz			80		dB
Turn-On Settling Time	t_R	To V_{OUT} = 0.1% of final value, C_{OUT} = 50pF			140		µs
Capacitive-Load Stability Range	C_{OUT}	(Note 4)		0		1	µF
INPUT							
Supply Voltage Range	V_{IN}	Guaranteed by line-regulation test		V_{OUT} + 0.2		5.5	V
Quiescent Supply Current	I_{IN}				85	115	µA
Change in Supply Current Per Change in Input Voltage	$\Delta I_{IN}/\Delta V_{IN}$	(V_{OUT} + 200mV) ≤ V_{IN} ≤ 5.5V			4.2	16	µA/V

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ELECTRICAL CHARACTERISTICS–MAX6034_30 (V_{OUT} = 3.000V)

(V_{IN} = 5V, I_{OUT} = 0, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
OUTPUT							
Output Voltage	V_{OUT}	T_A = +25°C	MAX6034A_30 (±0.2%)	2.994	3.000	3.006	V
			MAX6034B_30 (±0.4%)	2.988	3.000	3.012	
Output Voltage Temperature Coefficient (Note 2)	TCV_{OUT}	MAX6034A_30			7	30	ppm/°C
		MAX6034B_30			7	75	
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	(V_{OUT} + 200mV) ≤ V_{IN} ≤ 5.5V			43	280	µV/V
Load Regulation	$\Delta V_{OUT}/\Delta I_{OUT}$	Sourcing: 0 ≤ I_{OUT} ≤ 1mA			0.30	1.3	mV/mA
		Sinking: 0 ≤ I_{OUT} ≤ 200µA			2.6	8	
OUT Short-Circuit Current	I_{SC}	Short to GND			13		mA
		Short to IN			4		
Dropout Voltage	V_{IN} - V_{OUT}	I_{OUT} = 1mA (Note 5)			70	200	mV
Temperature Hysteresis	ΔV_{OUT}/cycle	(Note 3)			100		ppm
Long-Term Stability	ΔV_{OUT}/time	1000hr at T_A = +25°C			90		ppm/1000hr
DYNAMIC							
Noise Voltage	e_{OUT}	f = 0.1Hz to 10Hz			66		$µV_{P-P}$
		f = 10Hz to 10kHz			80		$µV_{RMS}$
Ripple Rejection	$\Delta V_{OUT}/\Delta V_{IN}$	V_{IN} = 5V ±100mV, f = 120Hz			76		dB
Turn-On Settling Time	t_R	To V_{OUT} = 0.1% of final value, C_{OUT} = 50pF			165		µs
Capacitive-Load Stability Range	C_{OUT}	(Note 4)		0		1	µF
INPUT							
Supply Voltage Range	V_{IN}	Guaranteed by line-regulation test		V_{OUT} + 0.2		5.5	V
Quiescent Supply Current	I_{IN}				95	125	µA
Change in Supply Current Per Change in Input Voltage	$\Delta I_{IN}/\Delta V_{IN}$	(V_{OUT} + 200mV) ≤ V_{IN} ≤ 5.5V			4.5	16	µA/V

ELECTRICAL CHARACTERISTICS–MAX6034_33 (V_{OUT} = 3.300V)

(V_{IN} = 5V, I_{OUT} = 0, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
OUTPUT							
Output Voltage	V_{OUT}	T_A = +25°C	MAX6034A_33 (±0.2%)	3.293	3.300	3.307	V
			MAX6034B_33 (±0.4%)	3.287	3.300	3.313	
Output Voltage Temperature Coefficient (Note 2)	TCV_{OUT}	MAX6034A_33			7	30	ppm/°C
		MAX6034B_33			7	75	
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	(V_{OUT} + 200mV) ≤ V_{IN} ≤ 5.5V			45	300	µV/V
Load Regulation	$\Delta V_{OUT}/\Delta I_{OUT}$	Sourcing: 0 ≤ I_{OUT} ≤ 1mA			0.3	1.3	mV/mA
		Sinking: 0 ≤ I_{OUT} ≤ 200µA			3	8.6	
OUT Short-Circuit Current	I_{SC}	Short to GND			13		mA
		Short to IN			4		
Dropout Voltage	V_{IN} - V_{OUT}	I_{OUT} = 1mA (Note 5)			70	200	mV
Temperature Hysteresis	ΔV_{OUT}/cycle	(Note 3)			100		ppm
Long-Term Stability	ΔV_{OUT}/time	1000hr at T_A = +25°C			90		ppm/1000hr
DYNAMIC							
Noise Voltage	e_{OUT}	f = 0.1Hz to 10Hz			73		$µV_{P-P}$
		f = 10Hz to 10kHz			88		$µV_{RMS}$
Ripple Rejection	$\Delta V_{OUT}/\Delta V_{IN}$	V_{IN} = 5V ±100mV, f = 120Hz			76		dB
Turn-On Settling Time	t_R	To V_{OUT} = 0.1% of final value, C_{OUT} = 50pF			200		µs
Capacitive-Load Stability Range	C_{OUT}	(Note 4)		0		1	µF
INPUT							
Supply Voltage Range	V_{IN}	Guaranteed by line-regulation test		V_{OUT} + 0.2		5.5	V
Quiescent Supply Current	I_{IN}				95	125	µA
Change in Supply Current Per Change in Input Voltage	$\Delta I_{IN}/\Delta V_{IN}$	(V_{OUT} + 200mV) ≤ V_{IN} ≤ 5.5V			3.8	16	µA/V

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ELECTRICAL CHARACTERISTICS–MAX6034_41 (V_{OUT} = 4.096V)

(V_{IN} = 5V, I_{OUT} = 0, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
OUTPUT							
Output Voltage	V_{OUT}	T_A = +25°C	MAX6034A_41 (±0.2%)	4.088	4.096	4.104	V
			MAX6034B_41 (±0.4%)	4.080	4.096	4.112	
Output Voltage Temperature Coefficient (Note 2)	TCV_{OUT}	MAX6034A_41			7	30	ppm/°C
		MAX6034B_41			7	75	
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	(V_{OUT} + 200mV) ≤ V_{IN} ≤ 5.5V			50	350	µV/V
Load Regulation	$\Delta V_{OUT}/\Delta I_{OUT}$	Sourcing: 0 ≤ I_{OUT} ≤ 1mA			0.35	1.5	mV/mA
		Sinking: 0 ≤ I_{OUT} ≤ 200µA			3.4	9.8	
OUT Short-Circuit Current	I_{SC}	Short to GND			13		mA
		Short to IN			7		
Dropout Voltage	V_{IN} - V_{OUT}	I_{OUT} = 1mA (Note 5)			70	200	mV
Temperature Hysteresis	ΔV_{OUT}/cycle	(Note 3)			100		ppm
Long-Term Stability	ΔV_{OUT}/time	1000hr at T_A = +25°C			90		ppm/1000hr
DYNAMIC							
Noise Voltage	e_{OUT}	f = 0.1Hz to 10Hz			90		$µV_{P-P}$
		f = 10Hz to 10kHz			105		$µV_{RMS}$
Ripple Rejection	$\Delta V_{OUT}/\Delta V_{IN}$	V_{IN} = 5V ±100mV, f = 120Hz			73		dB
Turn-On Settling Time	t_R	To V_{OUT} = 0.1% of final value, C_{OUT} = 50pF			260		µs
Capacitive-Load Stability Range	C_{OUT}	(Note 4)		0		1	µF
INPUT							
Supply Voltage Range	V_{IN}	Guaranteed by line-regulation test		V_{OUT} + 0.2		5.5	V
Quiescent Supply Current	I_{IN}				95	125	µA
Change in Supply Current Per Change in Input Voltage	$\Delta I_{IN}/\Delta V_{IN}$	(V_{OUT} + 200mV) ≤ V_{IN} ≤ 5.5V			4.7	16	µA/V

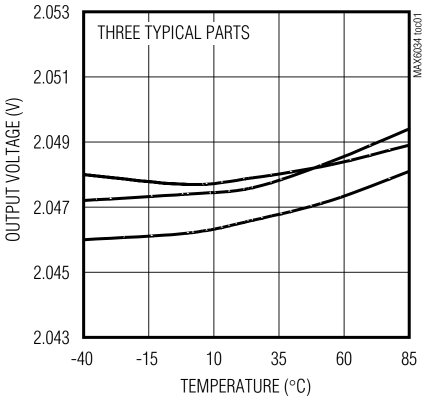
Note 1: All devices are 100% production tested at T_A = +25°C and are guaranteed by design for T_A = T_{MIN} to T_{MAX} as specified.
Note 2: Temperature coefficient is measured by the "box" method, i.e. the maximum ΔV_{OUT} / V_{OUT} is divided by the maximum ΔT.
Note 3: Temperature hysteresis is defined as the change in +25°C output voltage after cycling the device from T_{MIN} to T_{MAX}.
Note 4: Not production tested. Guaranteed by design.
Note 5: Dropout voltage is defined as the minimum differential voltage (V_{IN} - V_{OUT}) at which V_{OUT} decreases by 0.2% from its original value at V_{IN} = 5.0V (V_{IN} = 2.7V for MAX6034_25).

Precision, Micropower, Low-Dropout, SC70 Series Voltage Reference

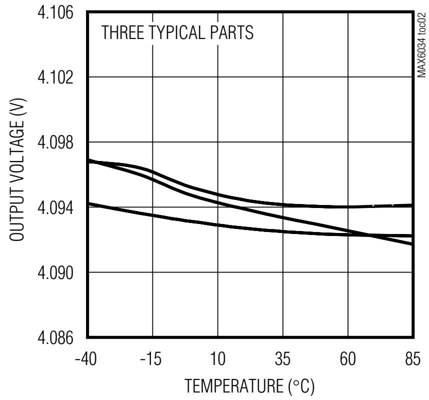
Typical Operating Characteristics

(V_{IN} = 2.7V for MAX6034_21/25, V_{IN} = 5V for MAX6034_30/33/41, I_{OUT} = 0, T_A = +25°C, unless otherwise noted.) (Note 6)

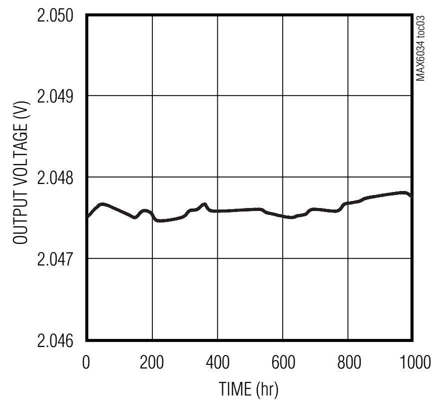
MAX6034_21
OUTPUT VOLTAGE TEMPERATURE DRIFT
(V_{OUT} = 2.048V)



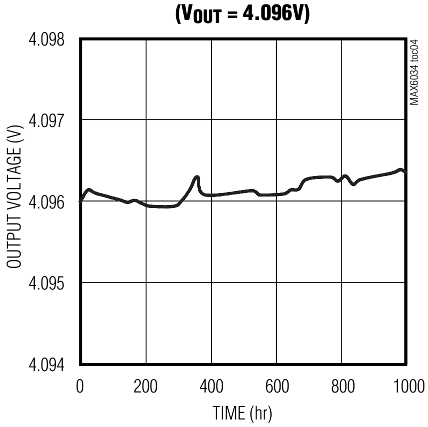
MAX6034_41
OUTPUT VOLTAGE TEMPERATURE DRIFT
(V_{OUT} = 4.096V)



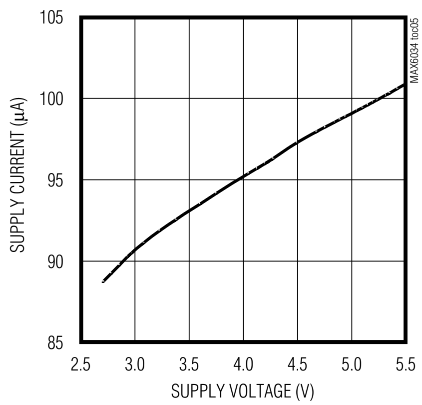
MAX6034_21
LONG-TERM DRIFT
(V_{OUT} = 2.048V)



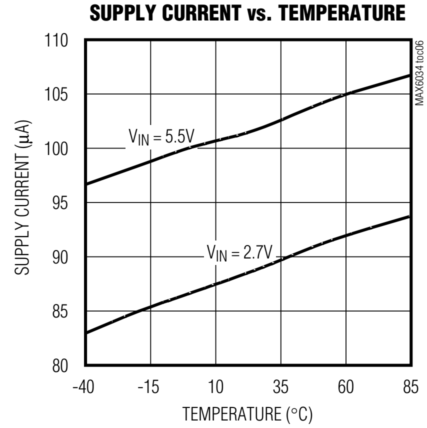
MAX6034_41
LONG-TERM DRIFT
(V_{OUT} = 4.096V)



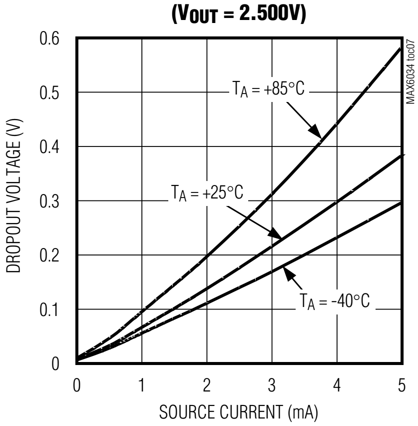
SUPPLY CURRENT
vs. SUPPLY VOLTAGE



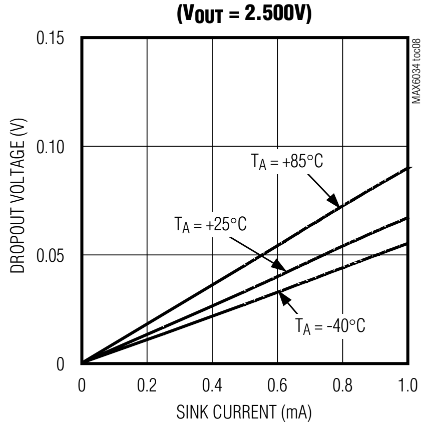
SUPPLY CURRENT vs. TEMPERATURE



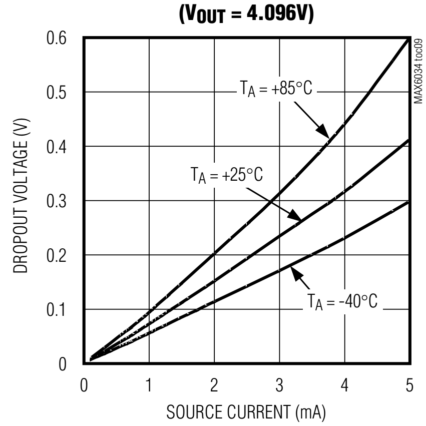
MAX6034_25
DROPOUT VOLTAGE vs. SOURCE CURRENT
(V_{OUT} = 2.500V)



MAX6034_25
DROPOUT VOLTAGE vs. SINK CURRENT
(V_{OUT} = 2.500V)



MAX6034_41
DROPOUT VOLTAGE vs. SOURCE CURRENT
(V_{OUT} = 4.096V)

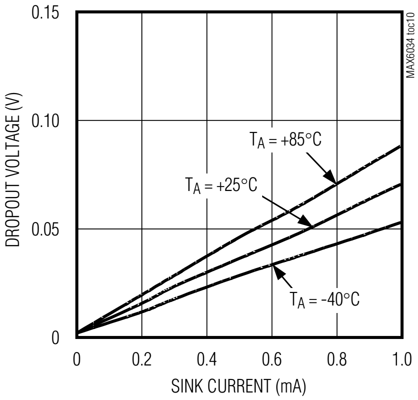


Precision, Micropower, Low-Dropout, SC70 Series Voltage Reference

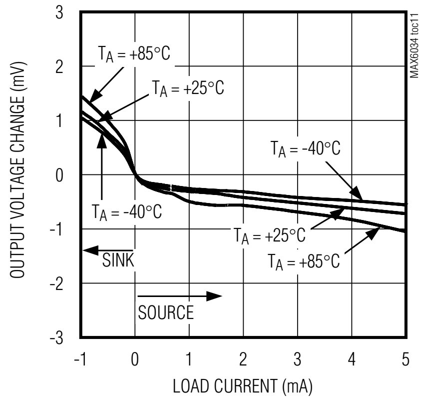
Typical Operating Characteristics (continued)

(V_{IN} = 2.7V for MAX6034_21/25, V_{IN} = 5V for MAX6034_30/33/41, I_{OUT} = 0, T_A = +25°C, unless otherwise noted.) (Note 6)

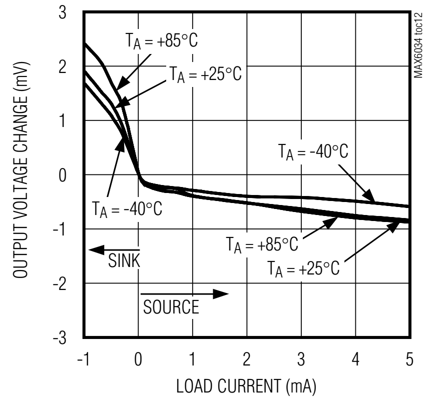
MAX6034_41
DROPOUT VOLTAGE vs. SINK CURRENT
(V_{OUT} = 4.096V)



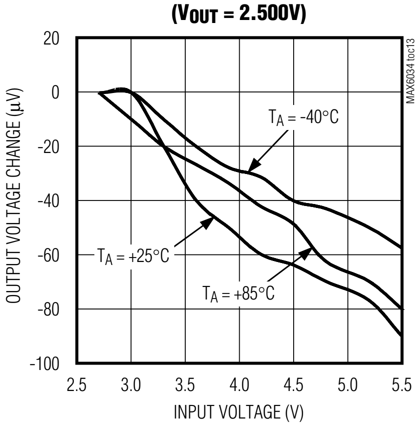
MAX6034_21
LOAD REGULATION
(V_{OUT} = 2.048V)



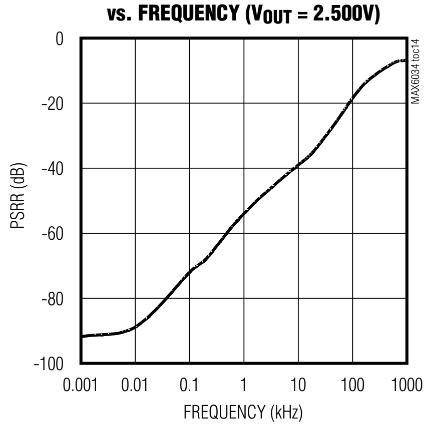
MAX6034_41
LOAD REGULATION
(V_{OUT} = 4.096V)



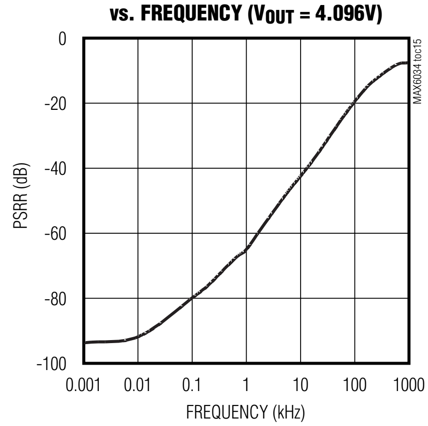
MAX6034_25
LINE REGULATION
(V_{OUT} = 2.500V)



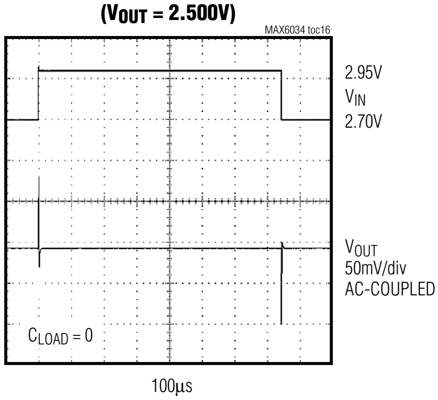
MAX6034_25
POWER-SUPPLY REJECTION RATIO
vs. FREQUENCY (V_{OUT} = 2.500V)



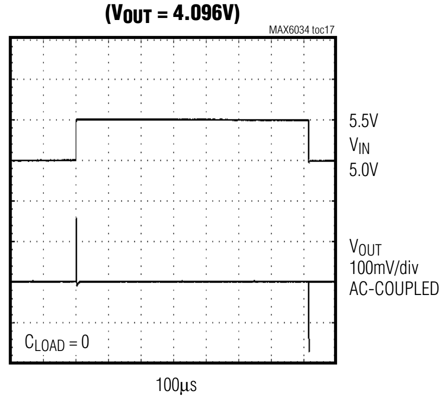
MAX6034_41
POWER-SUPPLY REJECTION RATIO
vs. FREQUENCY (V_{OUT} = 4.096V)



MAX6034_25
LINE TRANSIENT
(V_{OUT} = 2.500V)



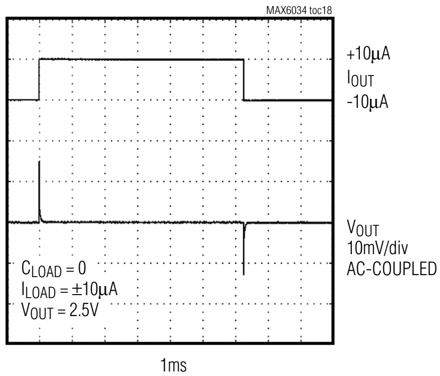
MAX6034_41
LINE TRANSIENT
(V_{OUT} = 4.096V)



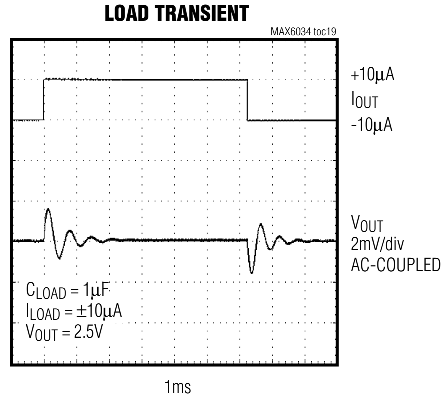
Typical Operating Characteristics (continued)

(V_{IN} = 2.7V for MAX6034_21/25, V_{IN} = 5V for MAX6034_30/33/41, I_{OUT} = 0, T_A = +25°C, unless otherwise noted.) (Note 6)

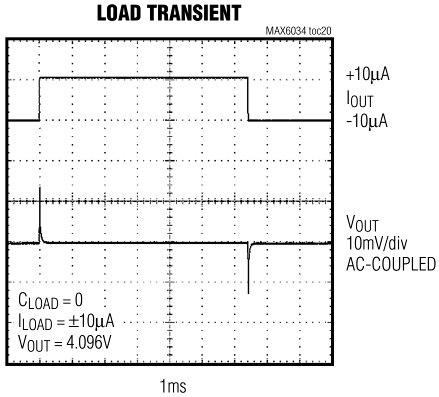
MAX6034_25
LOAD TRANSIENT



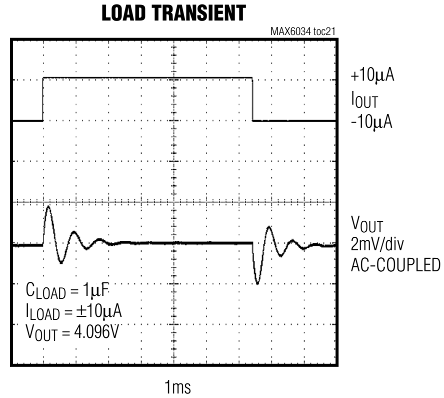
MAX6034_25
LOAD TRANSIENT



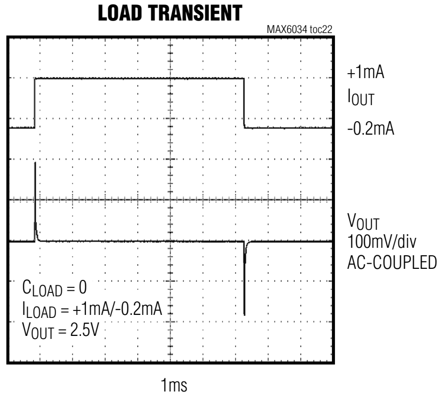
MAX6034_41
LOAD TRANSIENT



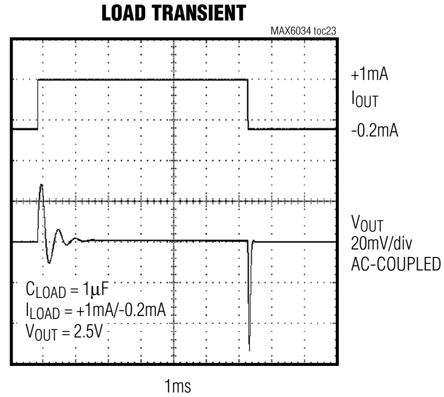
MAX6034_41
LOAD TRANSIENT



MAX6034_25
LOAD TRANSIENT



MAX6034_25
LOAD TRANSIENT

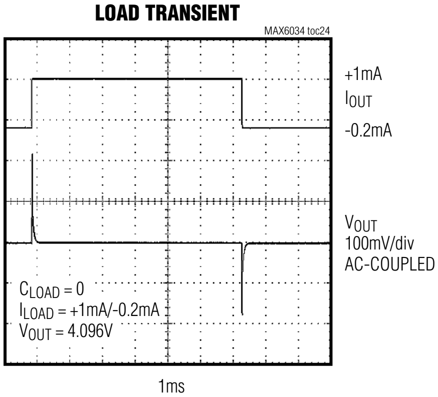


Precision, Micropower, Low-Dropout, SC70 Series Voltage Reference

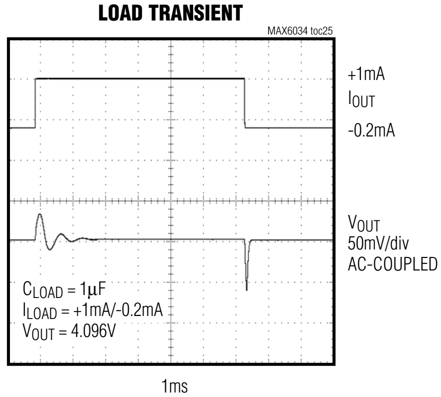
Typical Operating Characteristics (continued)

(V_{IN} = 2.7V for MAX6034_21/25, V_{IN} = 5V for MAX6034_30/33/41, I_{OUT} = 0, T_A = +25°C, unless otherwise noted.) (Note 6)

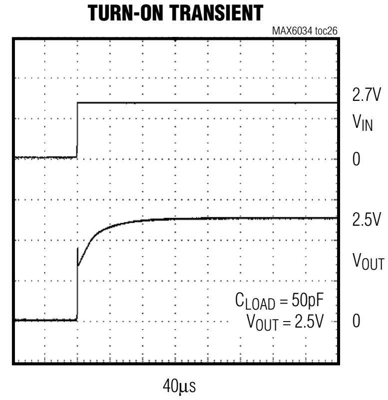
MAX6034_41
LOAD TRANSIENT



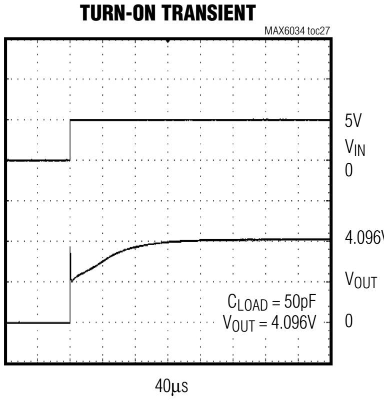
MAX6034_41
LOAD TRANSIENT



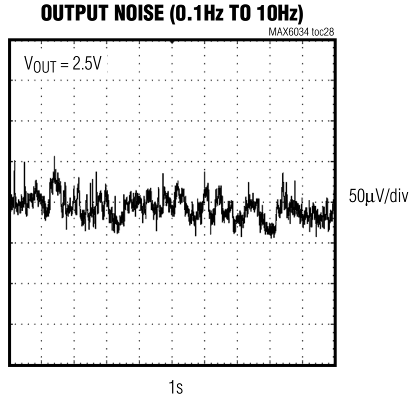
MAX6034_25
TURN-ON TRANSIENT



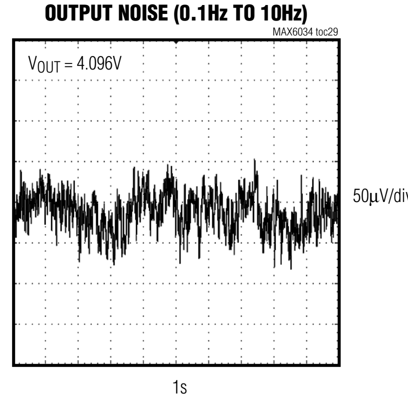
MAX6034_41
TURN-ON TRANSIENT



MAX6034_25
OUTPUT NOISE (0.1Hz TO 10Hz)



MAX6034_41
OUTPUT NOISE (0.1Hz TO 10Hz)



Note 6: Many of the MAX6034 family *Typical Operating Characteristics* are extremely similar. The extremes of these characteristics are found in the MAX6034_21 (2.048V output) and the MAX6034_41 (4.096V output). The *Typical Operating Characteristics* of the remainder of the MAX6034 family typically lie between those two extremes and can be estimated based on their output voltages.

Pin Description

PIN	NAME	FUNCTION
1	IN	Supply Voltage Input
2	OUT	Reference Voltage Output
3	GND	Ground

Detailed Description

The MAX6034 family of precision bandgap references use a proprietary temperature coefficient curvature-correction circuit and laser-trimmed, thin-film resistors, resulting in a low temperature coefficient of less than 30ppm/°C and initial accuracy of better than 0.2%. These devices can source up to 1mA and sink up to 200µA with less than 200mV of dropout voltage, making them attractive for use in low-voltage applications.

Applications Information

Input Bypassing

For the best line-transient performance, decouple the input with a 0.1µF ceramic capacitor as shown in the *Typical Operating Circuit*. Locate the capacitor as close to IN as possible.

Output/Load Capacitance

Devices in the MAX6034 family do not require an output capacitor for frequency stability. They are stable for capacitive loads from 0 to 1µF. However, in applications where the load or the supply can experience step changes, an output capacitor reduces the amount of overshoot (or undershoot) and improves the circuit's transient response. Many applications do not need an external capacitor, and the MAX6034 can offer a significant advantage in these applications when board space is critical.

Supply Current

The quiescent supply current of the series-mode MAX6034 family is typically 90µA and is virtually independent of the supply voltage, with only a 16µA/V (max) variation with supply voltage.

When the supply voltage is below the minimum-specified input voltage (as during turn-on), the device can draw up to 50µA beyond the nominal supply current. The input-voltage source must be capable of providing this current to ensure reliable turn-on.

Output Voltage Hysteresis

Output voltage hysteresis is the change in the output voltage at T_A = +25°C before and after the device is cycled over its entire operating temperature range. Hysteresis is caused by differential package stress appearing across the bandgap core transistors. The typical temperature hysteresis value for the MAX6034 family is 100ppm.

Turn-On Time

These devices typically turn on and settle to within 0.1% of their final value in 85µs to 260µs depending on the device. The turn-on time can increase up to 1.25ms with the device operating at the minimum dropout voltage and the maximum load.

Temperature Coefficient vs. Operating Temperature Range for a 1LSB Maximum Error

In a data converter application, the reference voltage of the converter must stay within a certain limit to keep the error in the data converter smaller than the resolution limit through the operating temperature range. Figure 1 shows the maximum allowable reference voltage temperature coefficient to keep the conversion error to less than 1LSB, as a function of the operating temperature range (T_{MAX} - T_{MIN}) with the converter resolution as a parameter. The graph assumes the reference-voltage temperature coefficient as the only parameter affecting accuracy.

In reality, the absolute static accuracy of a data converter is dependent on the combination of many parameters such as integral nonlinearity, differential nonlinearity, offset error, gain error, as well as voltage reference changes.

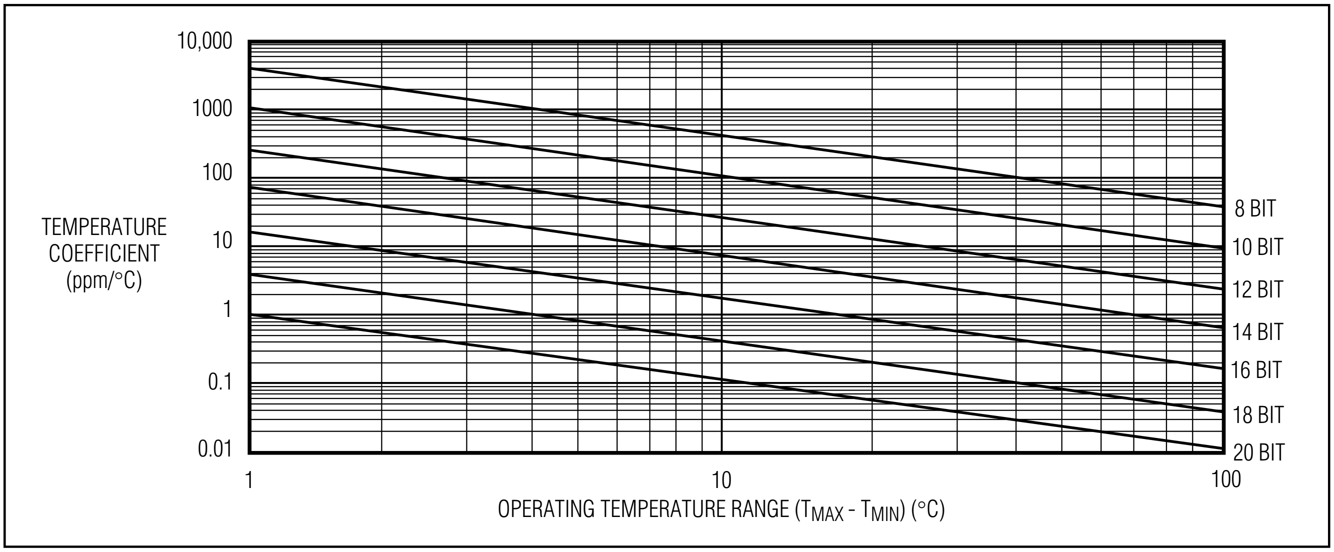


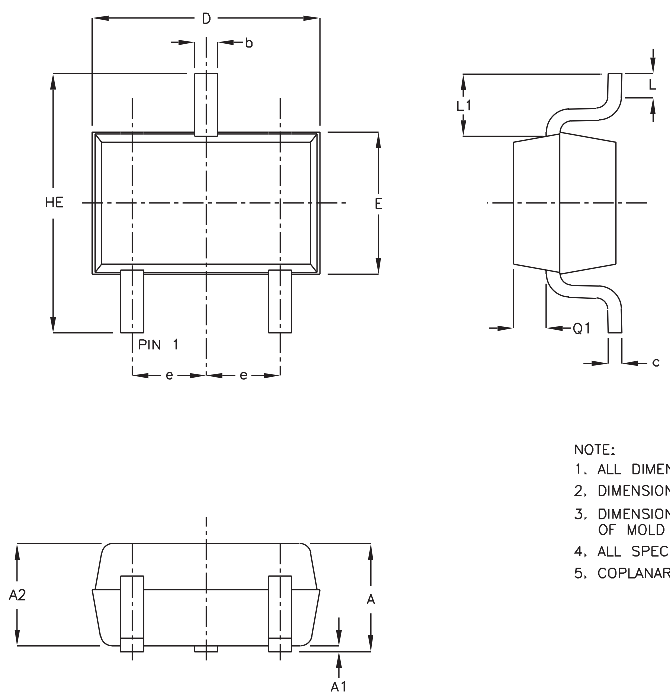
Figure 1. Temperature Coefficient vs. Operating Temperature Range for a 1LSB Maximum Error

Chip Information

TRANSISTOR COUNT: 113

PROCESS: BiCMOS

Package Information



SC70, 3L.EPS

SYMBOL	MIN	MAX
e	0.65 BSC	
D	1.80	2.20
b	0.25	0.40
E	1.15	1.35
HE	1.80	2.40
Q1	0.10	0.40
A2	0.80	1.00
A1	0.00	0.10
A	0.80	1.10
c	0.10	0.18
L	0.10	0.30
L1	0.425 TYP.	

NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. DIMENSIONS ARE INCLUSIVE OF PLATING
3. DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH & METAL BURR
4. ALL SPECIFICATIONS COMPLY TO EIAJ SC70
5. COPLANARITY 4 MILS. MAX.

MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, SC70, 3L
APPROVAL | DOCUMENT CONTROL NO. 21-0075 | REV B | 1/1

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