Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

ABSOLUTE MAXIMUM RATINGS

V_{CC}, RS+, RS- to GND ....-0.3V to +30V
OUT to GND ....-0.3V to the lesser of (V_{CC} + 0.3V) or +15V
CIN1, CIN2, RESET to GND ....-0.3V to the lesser of (V_{CC} + 0.3V) or +12V
Differential Input Voltage (V_{RS+} - V_{RS-}) ....±0.3V
COUT1, COUT2 to GND.......................................-0.3V to +6.0V
Current into Any Pin...±10mA
Continuous Power Dissipation (T_A = +70°C)
8-Pin µMAX (derate 4.1mW/°C above +70°C) 330mW
8-Pin SO (derate 5.9mW/°C above +70°C)..................471mW
10-Pin µMAX (derate 5.6mW/°C above +70°C) 444mW
14-Pin SO (derate 8.3mW/°C above +70°C)................667mW
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

(V_{CC} = +2.7V to +28V, V_{RS+} = 0 to +28V, V_{SENSE} = 0, $V_{\overline{RESET}}$ = 0, R_{LOAD}= 1MΩ, 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
Operating Voltage Range (Note 2)	V_{CC}		2.7		28	V
Common-Mode Input Range (Note 3)	V_{CMR}		0		28	V
Common-Mode Rejection	CMR	V_{RS+} > 2V		85		dB
Supply Current	I_{CC}	V_{RS+} > 2V, V_{SENSE} = 5mV		50	100	µA
Leakage Current	I_{RS+}, I_{RS-}	V_{CC} = 0		±0.015	±0.5	µA
Input Bias Current	I_{RS+}	V_{RS+} > 2V	0		2.5	µA
		V_{RS+} ≤ 2V	-25		2.0	
	I_{RS-}	V_{RS+} > 2V	0		4	
		V_{RS+} ≤ 2V	-50		4	
Full-Scale Sense Voltage (Note 4)	V_{SENSE}	Gain = +20V/V, +50V/V	150	170		mV
		Gain = +100V/V	100	120		
Input Offset Voltage	V_{OS}	V_{CC} = V_{RS+} = 12V (Note 11), T_A = +25°C		0.1	1	mV
		V_{CC} = V_{RS+} = 12V (Note 11), T_A = T_{MIN} to T_{MAX}			2	
Total OUT Voltage Error (Note 5)	V_{OUT}	V_{SENSE} = 100mV (Note 6), V_{CC} = 12V, V_{RS+} = 12V, T_A = +25°C		±0.30	±2	%
		V_{SENSE} = 100mV (Note 6), V_{CC} = 12V, V_{RS+} = 12V, T_A = T_{MIN} to T_{MAX}			±3	
		V_{SENSE} = 100mV (Note 6), V_{CC} = 28V, V_{RS+} = 28V, T_A = +25°C		±0.35	±2	
		V_{SENSE} = 100mV (Note 6), V_{CC} = 28V, V_{RS+} = 28V, T_A = T_{MIN} to T_{MAX}			±3	
		V_{SENSE} = 100mV (Note 6), V_{CC} = 12V, V_{RS+} = 0.1V		±5.0		
		V_{SENSE} = 6.25mV, V_{CC} = 12V, V_{RS+} = 12V (Note 7)		±5.0		
OUT Voltage Low	V_{OUT}	V_{CC} = 2.7V, I_{OUT} = 10µA		2.5		mV
		V_{CC} = 2.7V, I_{OUT} = 100µA		8.5	65	
OUT Voltage High	V_{CC} - V_{OH}	V_{CC} = 2.7V, I_{OUT} = -500µA			0.25	V

ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +2.7V to +28V, V_{RS+} = 0 to +28V, V_{SENSE} = 0, $V_{\overline{RESET}}$ = 0, R_{LOAD}= 1MΩ, 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
-3dB Bandwidth	BW	V_{RS+} = 12V, V_{CC} = 12V, C_{LOAD} = 10pF	V_{SENSE} = 100mV, Gain = +20V/V		200		kHz
			V_{SENSE} = 100mV, Gain = +50V/V		120		
			V_{SENSE} = 100mV, Gain = +100V/V		110		
			V_{SENSE} = 6.25mV		50		
Gain	A_V	MAX437_T			+20		V/V
		MAX437_F			+50		
		MAX437_H			+100		
Gain Accuracy	ΔA_V	V_{SENSE} = 20mV to 150mV; V_{CC} = 12V; V_{RS+} = 12V; Gain = 20, 50	T_A = +25°C		±0.3	±1.7	%
			T_A = -40°C to +85°C			±2.7	
		V_{SENSE} = 20mV to 100mV, V_{CC} = 12V, V_{RS+} = 12V, Gain = 100	T_A = +25°C		±0.3	±1.7	
			T_A = -40°C to +85°C			±2.7	
OUT Settling Time to 1% of Final Value		Gain = +20V/V, V_{CC} = 12V, V_{RS+} = 12V, C_{LOAD} = 10pF	V_{SENSE} = 6.25mV to 100mV		20		µs
			V_{SENSE} = 100mV to 6.25mV		20		
Capacitive Load Stability		No sustained oscillations			1000		pF
OUT Output Resistance	R_{OUT}	V_{SENSE} = 100mV			1.5		Ω
Power-Supply Rejection	PSR	V_{OUT} = 2V, V_{RS+} > 2V		72	87		dB
Power-Up Time to 1% of Final Value		V_{SENSE} = 100mV, C_{LOAD} = 10pF, V_{CC} = 12V, V_{RS+} = 12V			0.5		ms
Saturation Recovery Time (Note 8)		V_{CC} = 12V, V_{RS+} = 12V, C_{LOAD} = 10pF			0.1		ms
COMPARATOR (Note 9)							
Comparator Threshold	V_{TH}	T_A = +25°C		590	600	610	mV
		T_A = T_{MIN} to T_{MAX}		586		614	
Comparator Hysteresis					-9		mV
Input Bias Current	I_B				±2.2	±15	nA
Propagation Delay		C_L = 10pF, R_L = 10kΩ pull-up to 5V, 5mV of overdrive			4		µs
Output Low Voltage	V_{OL}	I_{SINK} = 1mA				0.6	V

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ELECTRICAL CHARACTERISTICS (continued)

(V_{CC} = +2.7V to +28V, V_{RS+} = 0 to +28V, V_{SENSE} = 0, $V_{\overline{RESET}}$ = 0, R_{LOAD}= 1MΩ, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 1)

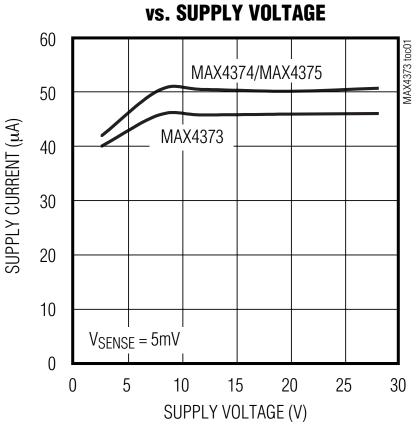
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output High Leakage Current		V_{CC} = 28V, $V_{PULL-UP}$ = 5V (Note 10)			1	µA
$\overline{\text{RESET}}$ Input High Voltage	V_{IH}		2.0			V
$\overline{\text{RESET}}$ Input Low Voltage	V_{IL}				0.8	V
Logic Input Current	I_{IL}, I_{IH}	V_{IL} = 0, V_{IH} = 5.5V, V_{CC} = 28V	-0.5		0.5	µA
Minimum $\overline{\text{RESET}}$ Pulse Width	t_{RPW}			1.5		µs
$\overline{\text{RESET}}$ Propagation Delay	t_{RPD}			3		µs

Note 1: All devices are 100% production tested at T_A = +25°C. All temperature limits are guaranteed by design.
Note 2: Guaranteed by PSR test.
Note 3: Guaranteed by OUT Voltage Error test.
Note 4: Guaranteed by Gain Accuracy test. Output voltage is internally clamped not to exceed 12V.
Note 5: Total OUT Voltage Error and Full-Scale Accuracy are the sum of gain and offset voltage errors.
Note 6: Measured at I_{OUT} = -500µA (R_{LOAD} = 4kΩ for gain of +20V/V, R_{LOAD} = 10kΩ for gain of +50V/V, R_{LOAD} = 20kΩ for gain of +100V/V).
Note 7: +6.25mV = 1/16 of +100mV full-scale voltage.
Note 8: The device will not experience phase reversal when overdriven.
Note 9: All comparator tests are done with V_{RS+} = +12V.
Note 10: $V_{PULL-UP}$ is defined as an externally applied voltage through a resistor to pull up the comparator output.
Note 11: V_{OS} is extrapolated from the gain accuracy test.

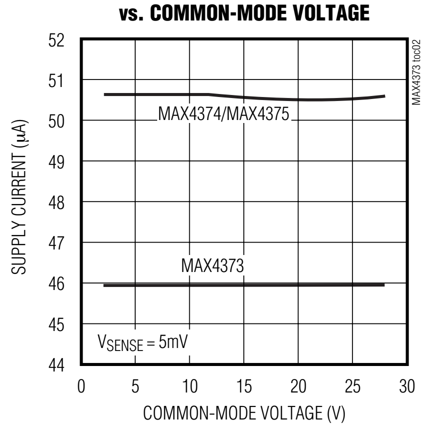
Typical Operating Characteristics

(V_{RS+} = +12V, V_{CC} = +12V, R_{LOAD} = 1MΩ, $V_{\overline{RESET}}$ = 0, V_{SENSE} = 100mV, $V_{PULL-UP}$ = +5V, $R_{PULL-UP}$ = 10kΩ, T_A = +25°C, unless otherwise noted.)

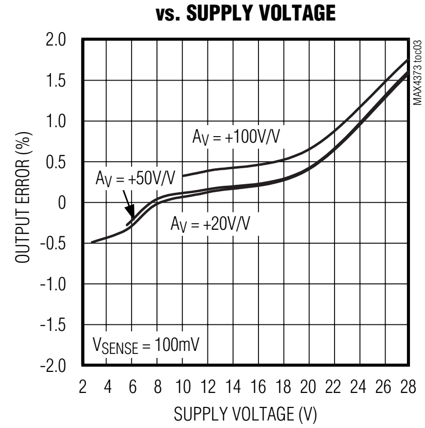
SUPPLY CURRENT vs. SUPPLY VOLTAGE



SUPPLY CURRENT vs. COMMON-MODE VOLTAGE



TOTAL OUTPUT ERROR vs. SUPPLY VOLTAGE

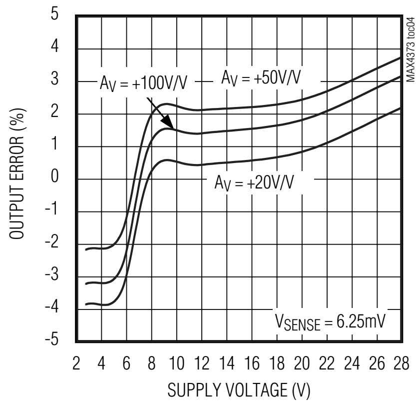


Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

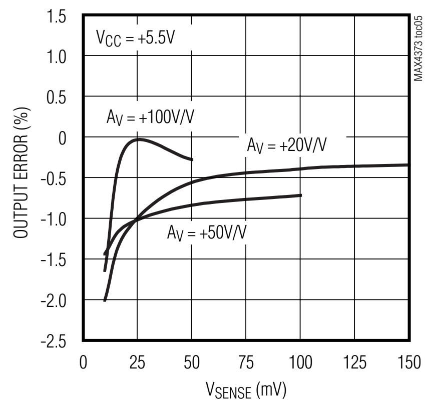
Typical Operating Characteristics (continued)

(V_{RS+} = +12V, V_{CC} = +12V, R_{LOAD} = 1MΩ, $V_{\overline{RESET}}$ = 0, V_{SENSE} = 100mV, $V_{PULL-UP}$ = +5V, $R_{PULL-UP}$ = 10kΩ, T_A = +25°C, unless otherwise noted.)

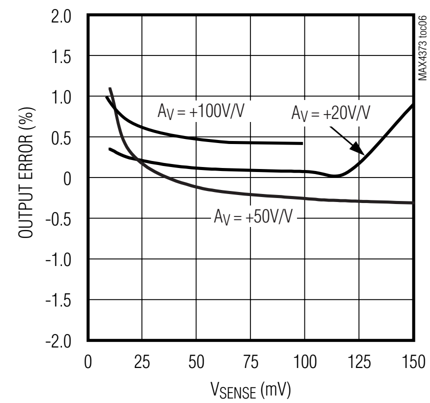
TOTAL OUTPUT ERROR vs. SUPPLY VOLTAGE



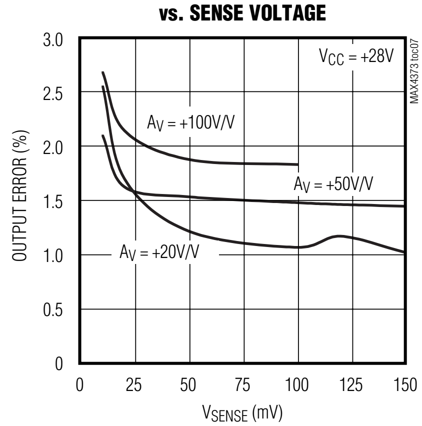
TOTAL OUTPUT ERROR vs. SENSE VOLTAGE



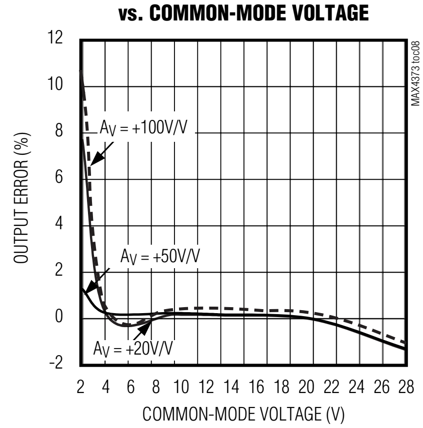
TOTAL OUTPUT ERROR vs. SENSE VOLTAGE



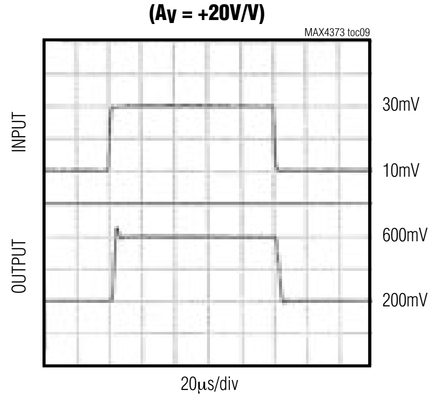
TOTAL OUTPUT ERROR vs. SENSE VOLTAGE



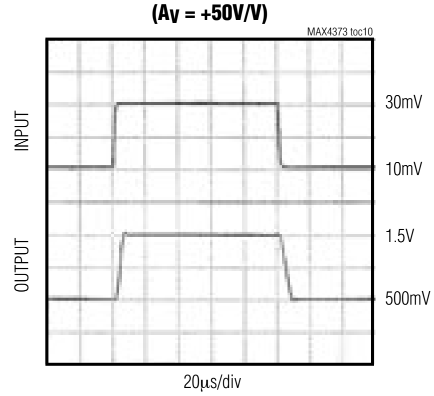
TOTAL OUTPUT ERROR vs. COMMON-MODE VOLTAGE



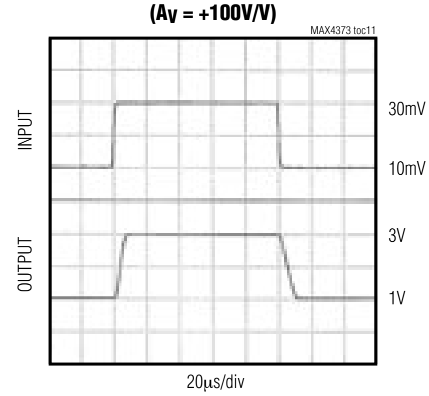
SMALL-SIGNAL PULSE RESPONSE (A_V = +20V/V)



SMALL-SIGNAL PULSE RESPONSE (A_V = +50V/V)



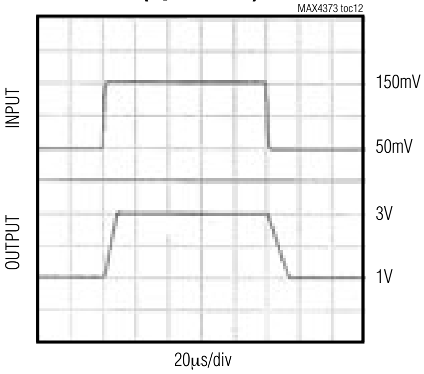
SMALL-SIGNAL PULSE RESPONSE (A_V = +100V/V)



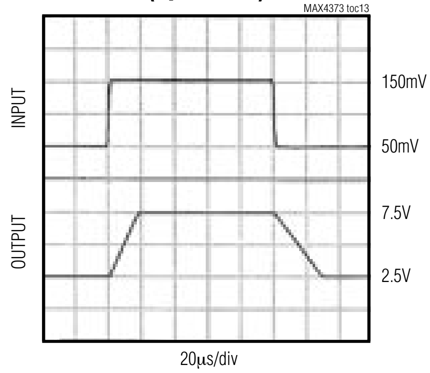
Typical Operating Characteristics (continued)

(V_{RS+} = +12V, V_{CC} = +12V, R_{LOAD} = 1MΩ, $V_{\overline{RESET}}$ = 0, V_{SENSE} = 100mV, $V_{PULL\text{-}UP}$ = +5V, $R_{PULL\text{-}UP}$ = 10kΩ, T_A = +25°C, unless otherwise noted.)

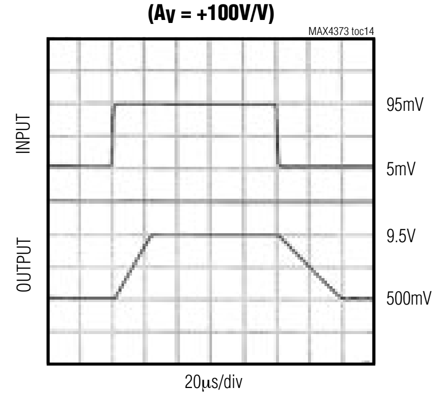
LARGE-SIGNAL PULSE RESPONSE (A_V = +20V/V)



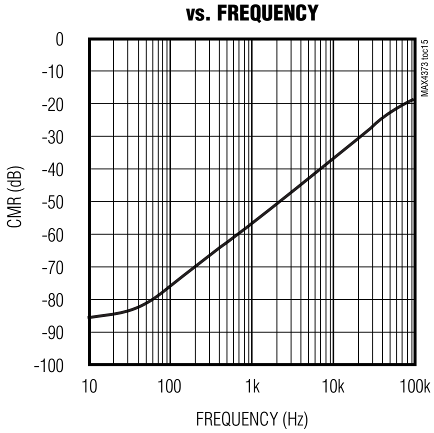
LARGE-SIGNAL PULSE RESPONSE (A_V = +50V/V)



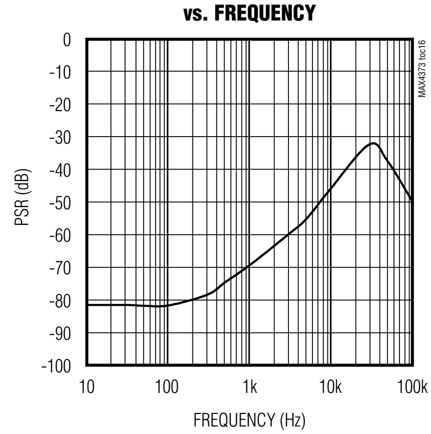
LARGE-SIGNAL PULSE RESPONSE (A_V = +100V/V)



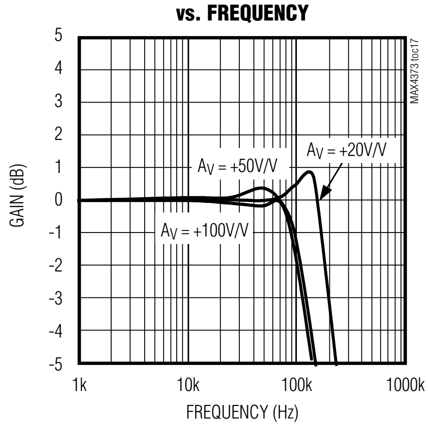
COMMON-MODE REJECTION vs. FREQUENCY



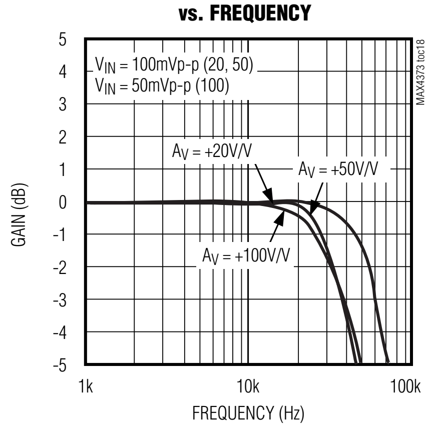
POWER-SUPPLY REJECTION vs. FREQUENCY



SMALL-SIGNAL GAIN vs. FREQUENCY

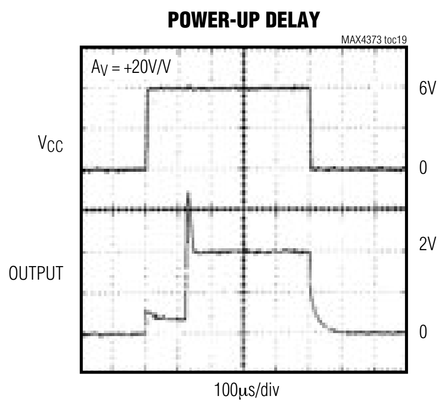


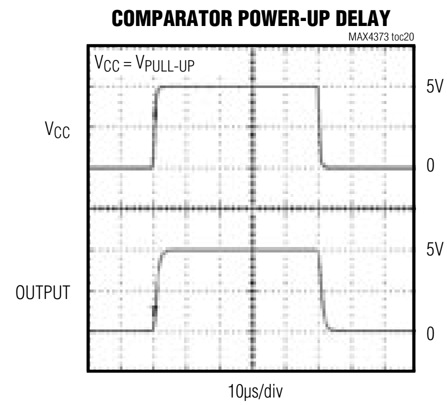
LARGE-SIGNAL GAIN vs. FREQUENCY

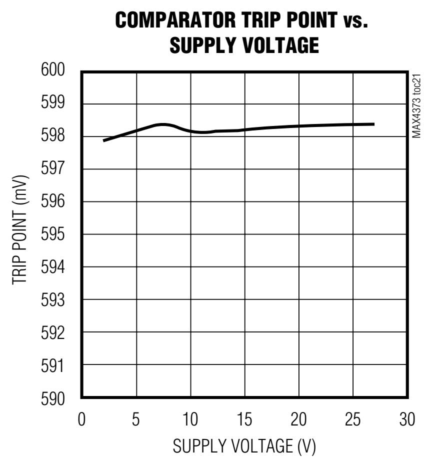


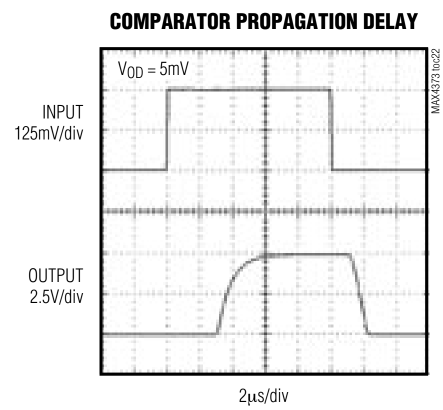
Typical Operating Characteristics (continued)

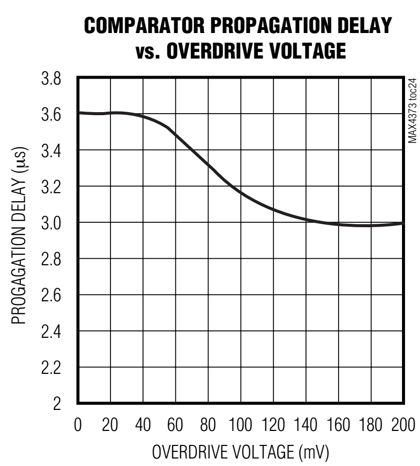
(V_{RS+} = +12V, V_{CC} = +12V, R_{LOAD} = 1MΩ, $V_{\overline{RESET}}$ = 0, V_{SENSE} = 100mV, $V_{PULL-UP}$ = +5V, $R_{PULL-UP}$ = 10kΩ, T_A = +25°C, unless otherwise noted.)

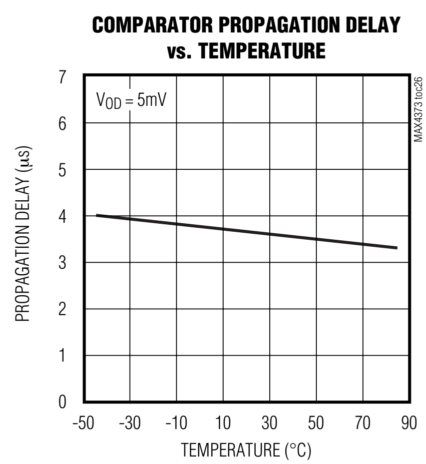










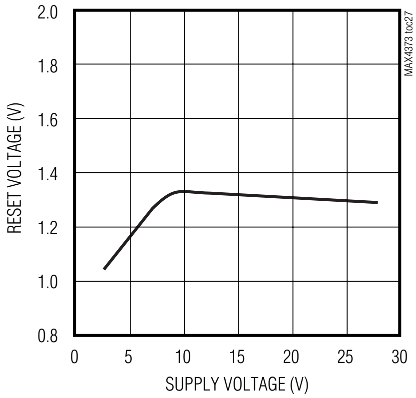


Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

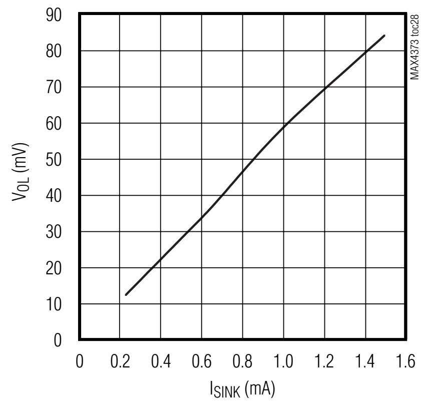
Typical Operating Characteristics (continued)

(V_{RS+} = +12V, V_{CC} = +12V, R_{LOAD} = 1MΩ, $V_{\overline{RESET}}$ = 0, V_{SENSE} = 100mV, $V_{PULL-UP}$ = +5V, $R_{PULL-UP}$ = 10kΩ, T_A = +25°C, unless otherwise noted.)

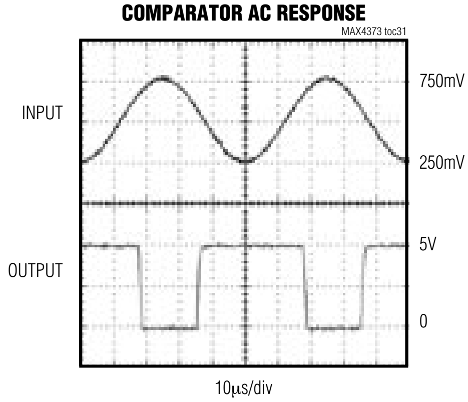
COMPARATOR RESET VOLTAGE vs. SUPPLY VOLTAGE



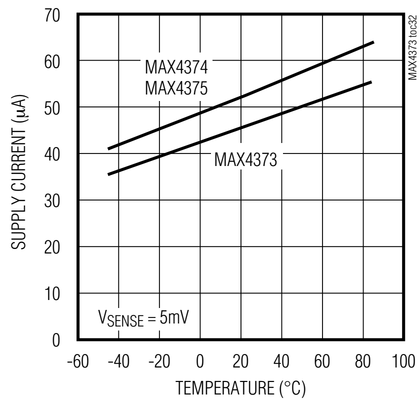
COMPARATOR V_{OL} vs. I_{SINK}



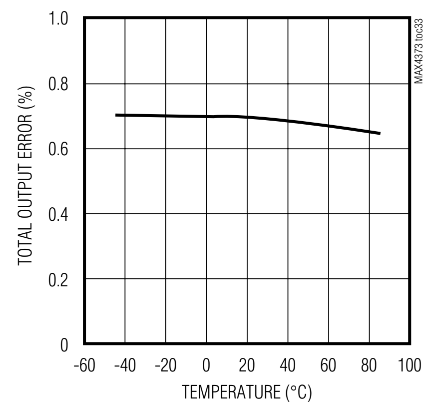
COMPARATOR AC RESPONSE



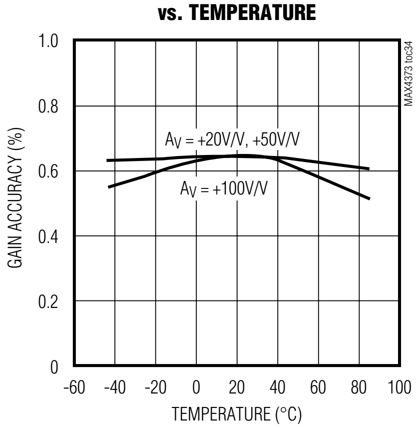
SUPPLY CURRENT vs. TEMPERATURE



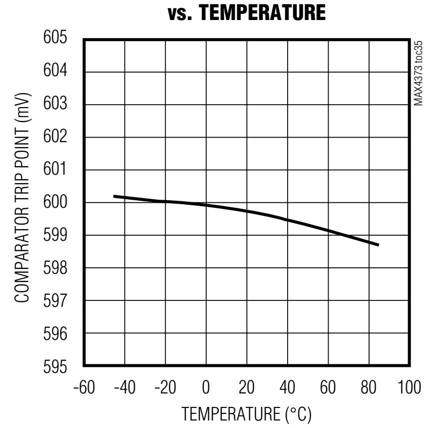
TOTAL OUTPUT ERROR vs. TEMPERATURE



GAIN ACCURACY vs. TEMPERATURE



COMPARATOR TRIP POINT vs. TEMPERATURE



Pin Description

PIN			NAME	FUNCTION
MAX4373	MAX4374/MAX4375			
μMAX/SO	μMAX	SO		
1	1	1	V_{CC}	Supply Voltage Input
2	2	2	OUT	Voltage Output. V_{OUT} is proportional to V_{SENSE} (V_{RS+} - V_{RS-}).
3	3	4	CIN1	Comparator Input 1. Positive input of an internal comparator. The negative terminal is connected to a 0.6V internal reference.
—	4	5	CIN2	Comparator Input 2. Terminal of a second internal comparator. The positive terminal for the MAX4374 and the negative terminal for the MAX4375. The other terminal is connected to a 0.6V internal reference.
4	5	7	GND	Ground
5	6	8	$\overline{\text{RESET}}$	Reset Input. Resets the output latch of the comparator at CIN1.
6	8	11	COUT1	Open-Drain Comparator Output. Latching output of the comparator controlled by CIN1. Connect $\overline{\text{RESET}}$ to GND to disable the latch.
—	7	10	COUT2	Open-Drain Comparator Output. Output of the second unlatched internal comparator.
7	9	13	RS-	Load-Side Connection for the External Sense Resistor
8	10	14	RS+	Power Connection to the External Sense Resistor
—	—	3, 6, 9, 12	N.C.	No Connection. Not internally connected.

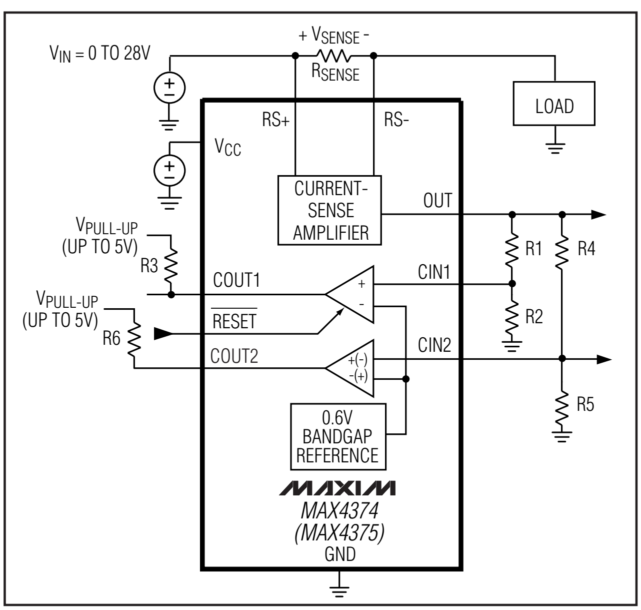


Figure 1. Functional Diagram

Detailed Description

The MAX4373 high-side current-sense supervisor features a high-side current-sense amplifier, bandgap reference, and comparator with latching output to monitor a supply for an overcurrent condition (Figure 1). The latching output allows the comparator to shut down a power supply without oscillations. The MAX4374/MAX4375 offer an additional comparator to allow window detection of the current.

Current-Sense Amplifier

The internal current-sense amplifier features a 0V to +28V input common-mode range that is independent of the supply voltage. With this feature, the device can monitor the output current of a battery in deep discharge and also high-side current-sensing voltages exceeding V_{CC}.

The current-sense amplifier is also suitable for low-side current sensing. However, the total output voltage error will increase when V_{RS+} falls below 2V, as shown in the *Electrical Characteristics* and *Typical Operating Characteristics*.

Internal Comparator(s)

The MAX4373/MAX4374/MAX4375 contain an open-drain output comparator for current limiting. The comparator's negative terminal is connected to the internal 600mV reference. The positive terminal is accessible at CIN1. When $\overline{\text{RESET}}$ is high, the internal latch is active, and once CIN1 rises above 600mV, the output latches into the open state. Pulsing $\overline{\text{RESET}}$ low for 1.5µs resets the latch, and holding $\overline{\text{RESET}}$ low makes the latch transparent. See *$\overline{\text{RESET}}$ at Power-Up* section

The MAX4374/MAX4375 contain an additional open-drain comparator. The negative terminal of the MAX4374's additional comparator and the positive terminal of the MAX4375's additional comparator are connected to the internal 600mV reference as shown in Figure 1. The positive terminal of the MAX4374's additional comparator and the negative terminal of the MAX4375's additional comparator are accessible at CIN2.

Applications Information

Recommended Component Values

Ideally, the maximum load current will develop the full-scale sense voltage across the current-sense resistor. Choose the gain version needed to yield the maximum output voltage required for the application:

$$V_{OUT} = V_{SENSE} \times A_V$$

where V_{SENSE} is the full-scale sense voltage, 150mV for gains of +20V/V and +50V/V or 100mV for a gain of +100V/V. A_V is the gain of the device. The minimum supply voltage is V_{OUT} + 0.25V. Note that the output for the gain of +100V/V is internally clamped at 12V. Calculate the maximum value for R_{SENSE} so that the differential voltage across RS+ and RS- does not exceed the full-scale sense voltage:

$$R_{SENSE(MAX)} = \frac{V_{SENSE(MAX)}}{I_{LOAD}}$$

Choose the highest value resistance possible to maximize V_{SENSE} and thus minimize total output error.

In applications monitoring high current, ensure that R_{SENSE} is able to dissipate its own I^2R loss. If the resistor's power dissipation is exceeded, its value may drift or it may fail altogether, causing a differential voltage across the terminals in excess of the absolute maximum ratings. Use resistors specified for current-sensing applications.

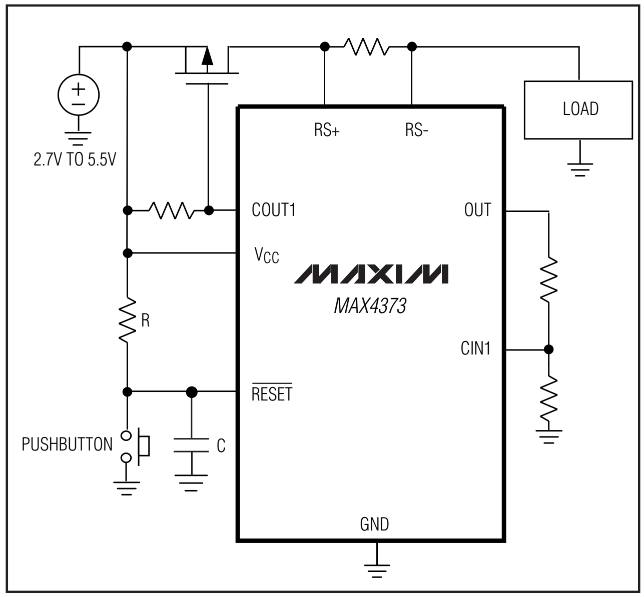


Figure 2. MAX4373 Overcurrent Protection Circuit

Overcurrent Protection Circuit

The overcurrent protection circuit, shown in Figure 2, uses the MAX4373 to control an external P-channel MOSFET. The MOSFET controlled by the MAX4373 opens the current path under overload conditions. The latched output of the MAX4373's comparator prevents the circuit from oscillating, and the pushbutton resets the current path after an overcurrent condition.

Window Detection Circuit

Figure 3 shows a simple circuit suitable for window detection. Let I_{OVER} be the minimum load current

$$I_{UNDER} = \frac{V_{REF}}{R_{SENSE} \times A_V}\left(\frac{R4 + R5}{R5}\right)$$

and

$$I_{OVER} = \frac{V_{REF}}{R_{SENSE} \times A_V}\left(\frac{R1 + R2}{R2}\right)$$

(I_{LOAD}) required to cause a low state at COUT2, and let I_{UNDER} be the maximum load current required to cause a high state at COUT1:

where A_V is the gain of the device and V_{REF} is the internal reference voltage (0.6V typ).

Connect COUT1 and COUT2; the resulting comparator output will be high when the current is inside the current window and low when the current is outside the window. The window is defined as load currents less than I_{OVER} and greater than I_{UNDER}.

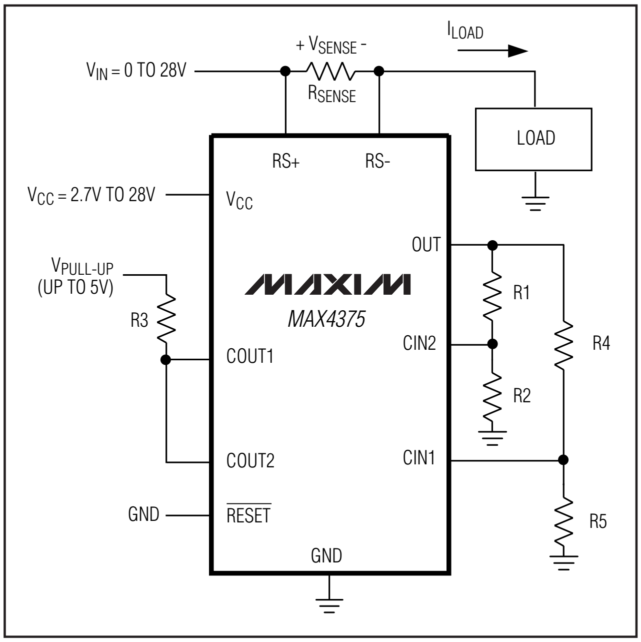


Figure 3. MAX4375 Window Detector

Power-Supply Bypassing

It is recommended that V_{CC} be bypassed to GND with at least a 0.1µF ceramic capacitor to isolate the IC from supply voltage transients. It is possible that plugging in/out a battery or AC adapter/charger could cause large, fast line transients (>5V/µs) at V_{CC}. The simplest solution is to run V_{CC} from a better regulated supply (+5V for example), since V_{CC} and RS+ (or RS-) do not have to be connected together.

For high-speed V_{CC} transients, another solution is to add a resistor in series with the V_{CC} pin and a 0.1µF capacitor to create an RC time constant to slow the rise time of the transient. Since these current-sense amplifiers consume less than 100µA, even a 2.5kΩ resistor only drops an extra 250mV at V_{CC}. For most applications with fast transients, 1kΩ in conjunction with a 0.1µF bypass capacitor works well.

$\overline{\text{RESET}}$ at Power-Up

The $\overline{\text{RESET}}$ pin is used to control the latch function of comparator 1. Holding $\overline{\text{RESET}}$ low (<0.8V) makes the latch transparent and COUT1 will respond to changes at CIN1, above and below the internal 600mV reference threshold voltage. When $\overline{\text{RESET}}$ is high (>2.0V), once CIN1 rises above 600mV, COUT1 latches into the open-drain OFF state and remains in this state even if CIN1 drops below 600mV. Pulsing $\overline{\text{RESET}}$ low for at least 1.5µs resets the latch.

There is no internal circuitry to control the reset function during power-up. To prevent false latching, $\overline{\text{RESET}}$ must be held low until the V_{CC} power has risen above the 2.7V minimum operating supply voltage. This is easily accomplished when $\overline{\text{RESET}}$ is driven under µC or logic gate control. However, if $\overline{\text{RESET}}$ is to be always connected high, add an RC between V_{CC}, $\overline{\text{RESET}}$ and GND (see Figure 2). Note that $\overline{\text{RESET}}$ cannot exceed V_{CC} + 0.3V or +12V, whichever is less.

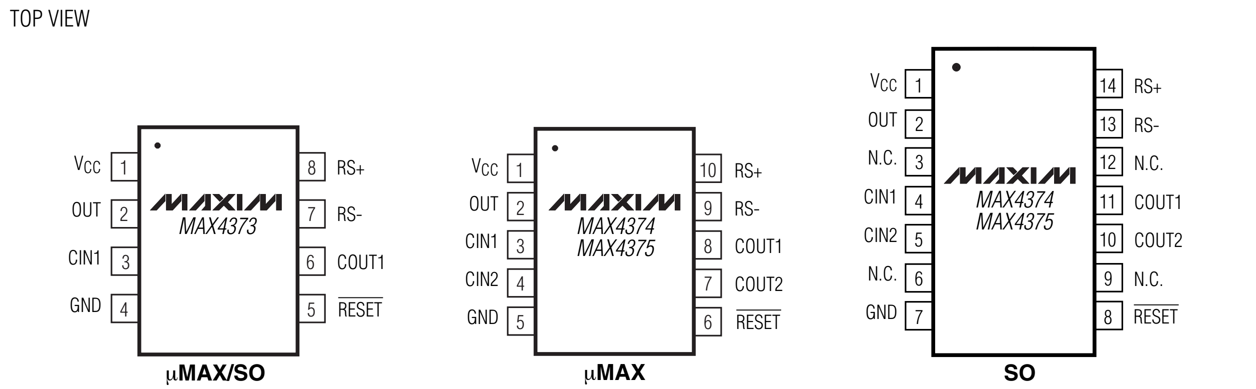
The following formula can be used to determine the appropriate RC value.

$$RC = \frac{T}{\ln\left(2.7V/(2.7V - 0.8V)\right)} = \frac{T}{0.3514}$$

where T is the maximum time for V_{CC} to reach 2.7V and 0.8V is the maximum $\overline{\text{RESET}}$ logic low voltage. For example, a 470kΩ resistor and 0.22µF capacitor will keep $\overline{\text{RESET}}$ low during a power-up time of up to 36ms. A faster power-up time is also safe with the calculated R and C since the capacitor will have even less time to charge.

Low-Cost, Micropower, High-Side Current-Sense Amplifier + Comparator + Reference ICs

Pin Configurations



Ordering Information (continued)

PART	TEMP RANGE	PIN-PACKAGE	GAIN (V/V)
MAX4374TEUB	-40°C to +85°C	10 µMAX	+20
MAX4374TESD	-40°C to +85°C	14 SO	+20
MAX4374FEUB	-40°C to +85°C	10 µMAX	+50
MAX4374FESD	-40°C to +85°C	14 SO	+50
MAX4374HEUB	-40°C to +85°C	10 µMAX	+100
MAX4374HESD	-40°C to +85°C	14 SO	+100
MAX4375TEUB	-40°C to +85°C	10 µMAX	+20
MAX4375TESD	-40°C to +85°C	14 SO	+20
MAX4375FEUB	-40°C to +85°C	10 µMAX	+50
MAX4375FESD	-40°C to +85°C	14 SO	+50
MAX4375HEUB	-40°C to +85°C	10 µMAX	+100
MAX4375HESD	-40°C to +85°C	14 SO	+100

Chip Information

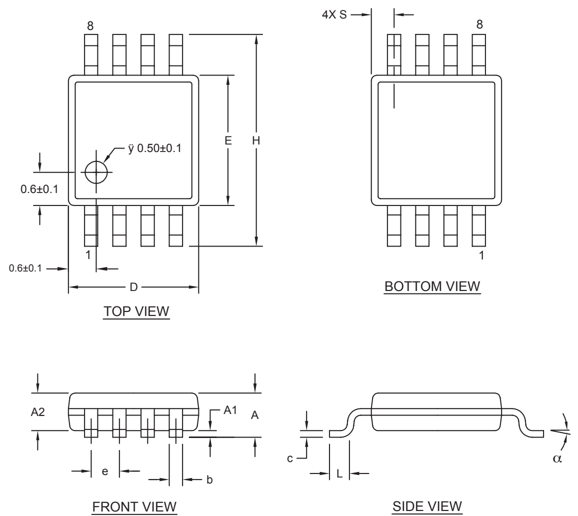
TRANSISTOR COUNT: 390

SUBSTRATE CONNECTED TO GND

Package Information

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

8LUMAXD.EPS



DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	-	0.043	-	1.10
A1	0.002	0.006	0.05	0.15
A2	0.030	0.037	0.75	0.95
b	0.010	0.014	0.25	0.36
c	0.005	0.007	0.13	0.18
D	0.116	0.120	2.95	3.05
e	0.0256 BSC		0.65 BSC	
E	0.116	0.120	2.95	3.05
H	0.188	0.198	4.78	5.03
L	0.016	0.026	0.41	0.66
α	0∞	6∞	0∞	6∞
S	0.0207 BSC		0.5250 BSC	

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15MM (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC MO-187C-AA.

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, 8L uMAX/uSOP
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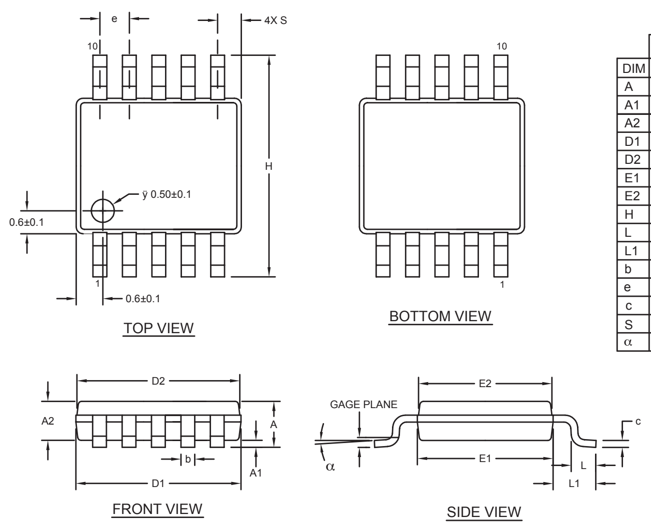
10LUMAX.EPS



DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	-	0.043	-	1.10
A1	0.002	0.006	0.05	0.15
A2	0.030	0.037	0.75	0.95
D1	0.116	0.120	2.95	3.05
D2	0.114	0.118	2.89	3.00
E1	0.116	0.120	2.95	3.05
E2	0.114	0.118	2.89	3.00
H	0.187	0.199	4.75	5.05
L	0.0157	0.0275	0.40	0.70
L1	0.037 REF		0.940 REF	
b	0.007	0.0106	0.177	0.270
e	0.0197 BSC		0.500 BSC	
c	0.0035	0.0078	0.090	0.200
S	0.0196 REF		0.498 REF	
α	0∞	6∞	0∞	6∞

NOTES:
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm (.006").
3. CONTROLLING DIMENSION: MILLIMETERS.
4. MEETS JEDEC MO-187C-BA.

DALLAS SEMICONDUCTOR MAXIM
PROPRIETARY INFORMATION
TITLE: PACKAGE OUTLINE, 10L uMAX/uSOP
APPROVAL | DOCUMENT CONTROL NO. 21-0061 | REV. I | 1/1

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