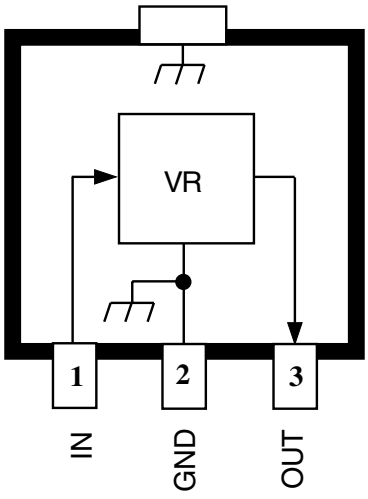
8188

Data Sheet
27468.8

PRELIMINARY INFORMATION
(subject to change without notice)
July 13, 1999

LOW-DROPOUT REGULATORS — HIGH EFFICIENCY

A8188SLT-xx



Dwg. PS-022-2

where "-xx" is the required output voltage in tenths

ABSOLUTE MAXIMUM RATINGS

Input Voltage, V_I . . . . . **10 V**
Peak Output Current,
I_{OM} . . . . . **250 mA***
Enable Input Voltage, V_E . . . . . V_I
Operating Temperature Range,
T_A . . . . . **-20°C to +85°C**
Junction Temperature, T_J . . . . **+150°C**†
Storage Temperature Range,
T_S . . . . . **-40°C to +150°C**

* Output current rating is limited by input voltage, duty cycle, and ambient temperature. Under any set of conditions, do not exceed a junction temperature of +150°C. See following pages.

† Fault conditions that produce excessive junction temperature will activate device thermal shutdown circuitry. These conditions can be tolerated but should be avoided.

Designed specifically to meet the requirement for extended operation of battery-powered equipment such as cordless and cellular telephones, the A8188S— voltage regulators offer the reduced dropout voltage and quiescent current essential for maximum battery life. Applicable also to palmtop computers and personal data assistants, these devices deliver a regulated output at up to 250 mA (transient), which is limited only by package power dissipation. Regulated output voltages between 2.5 V and 3.3 V are trimmed at wafer probe.

A PMOS pass element provides a typical dropout voltage of only 90 mV at 60 mA of load current. The low dropout voltage permits deeper battery discharge before output regulation is lost. Quiescent current does not increase significantly as the dropout voltage is approached, an ideal feature in standby/resume power systems where data integrity is crucial. Regulator accuracy and excellent temperature characteristics are provided by a bandgap reference. The A8188SL-xx includes ENABLE inputs to give the designer complete control over power up, standby, or power down.

These devices are supplied, without the ENABLE function, in a standard 3-lead SOT-89/TO-243AA small-outline plastic transistor package (suffix 'LT'). Dual regulators (A8188SL-xx) are provided in an 8-lead SOIC package. All devices are rated for operation over a temperature range of -20°C to +85°C.

FEATURES AND BENEFITS

- High Efficiency Provides Extended Battery Life
- 90 mV Typical Dropout Voltage at I_O = 60 mA
- 55 µA Typical Quiescent Current
  Less Than 1 µA "Sleep" Current
- 250 mA Peak Output Current
- Improved PSRR and Transient Performance
- Internal Thermal Protection

APPLICATIONS

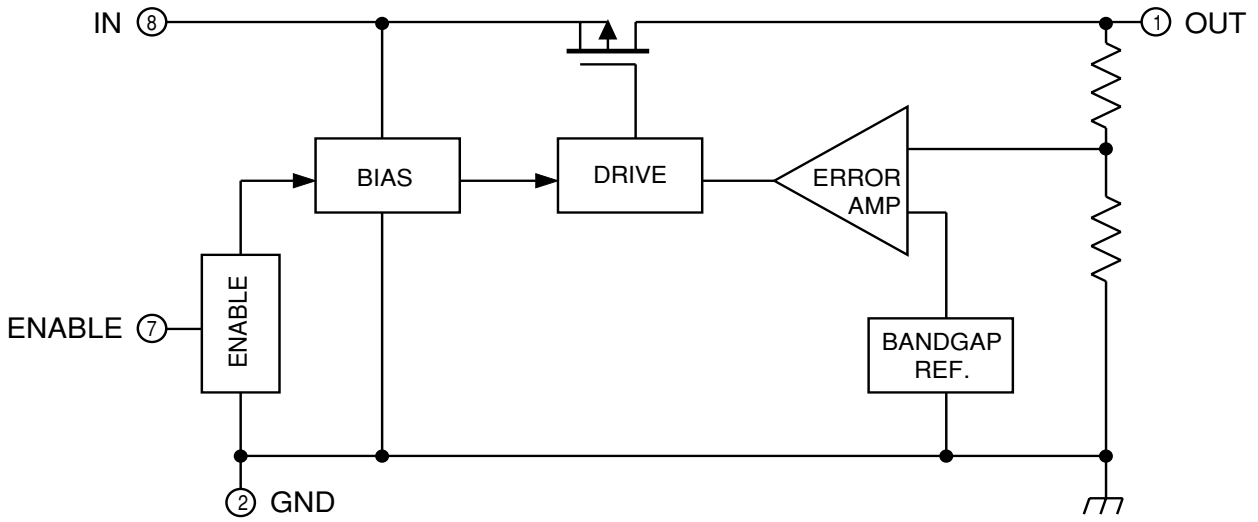
- Cordless and Cellular Telephones
- Personal Data Assistants
- Personal Communicators
- Palmtop Computers

Always order by complete part number, e.g., **A8188SLT-30** .

DISCONTINUED PRODUCT
— FOR REFERENCE ONLY

8188
LOW-DROPOUT REGULATORS

FUNCTIONAL BLOCK DIAGRAM
(1/2 of A8188SL-xx shown)



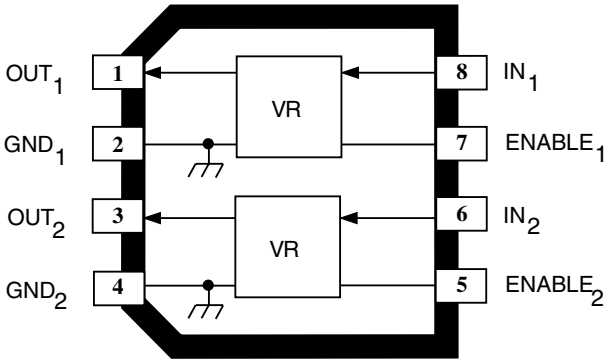
Dwg. FS-012-8

Always order by complete part number:

Part Number	Package	$R_{\theta JA}$
A8188SL-xx	8-Lead SOIC	108°C/W
A8188SLT-xx	3-Lead SOT-89/TO-243AA	258°C/W

where "-xx" is the required output voltage ($V_{O(nom)}$) in tenths (25 through 33), e.g., -30 = 3.0 volts.

A8188SL-xx



Dwg. PS-023

NOTE — There is an indeterminate resistance between terminals 2 and 4. For proper operation, terminals 2 and 4 must be externally connected together.

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A8188SL-xx Maximum Allowable Total Average Output Current* with device mounted on 2.24" x 2.24" (56.9 mm x 56.9 mm) solder-coated copper-clad board in still air.

	Allowable Total Average (10 ms) Output Current in Milliamperes with T_J = 150°C, Duty Cycle = 100%†								
	$V_I - V_O$								
T_A	1.0	1.5	2.0	2.5	3.0	4.0	5 .0	6.0	7.0*
25°C	500	500	500	460	385	285	230	190	165
50°C	500	500	460	370	305	230	185	150	130
70°C	500	490	370	295	245	185	145	120	105
85°C	500	400	300	240	200	150	120	100	85

* Absolute maximum peak output current rating for either output is 250 mA; absolute maximum input voltage is 10 V.

† $I_O = (T_J - T_A)/([V_I - V_O] R_{\theta JA} \text{ x dc}) = (150 - T_A)/([V_I - V_O] \text{ x } 108 \text{ x } 1.00)$

Output current rating can be increased (to 250 mA maximum per output) by additional heat sinking or reducing the duty cycle. Conditions that produce excessive junction temperature will activate device thermal shutdown circuitry. These conditions can be tolerated but should be avoided.

A8188SLT-xx Maximum Allowable Output Current with device mounted on 2.24" x 2.24" (56.9 mm x 56.9 mm) solder-coated copper-clad board in still air.

	Allowable Average (10 ms) Output Current in Milliamperes with T_J = 150°C, Duty Cycle = 100%†								
	$V_I - V_O$								
T_A	1.0	1.5	2.0	2.5	3.0	4.0	5.0	6.0	7.0*
25°C	250	250	240	190	160	120	95	80	65
50°C	250	250	190	155	125	95	75	65	55
70°C	250	205	155	120	100	75	60	50	40
85°C	250	165	125	100	80	60	50	40	35

* Absolute maximum input voltage is 10 V.

† $I_O = (T_J - T_A)/([V_I - V_O] R_{\theta JA} \text{ x dc}) = (150 - T_A)/([V_I - V_O] \text{ x } 258 \text{ x } 1.00)$

Output current rating can be increased (to 250 mA maximum) by additional heat sinking or reducing the duty cycle. Conditions that produce excessive junction temperature will activate device thermal shutdown circuitry. These conditions can be tolerated but should be avoided.

ELECTRICAL CHARACTERISTICS at T_A = +25°C (unless otherwise noted).

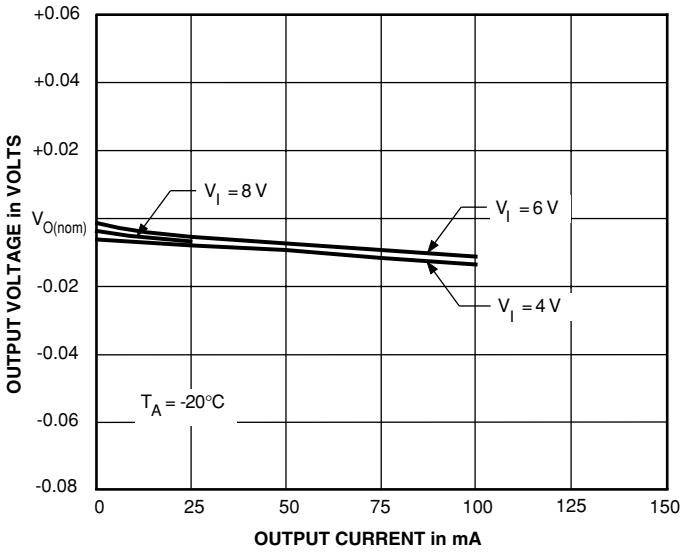
Characteristic	Symbol	Test Conditions	Limits			
			Min.	Typ.	Max.	Units
Output Voltage (reference specified $V_{O(nom)}$)	V_O	4 V ≤ V_I ≤ 8 V, 10 µA ≤ I_O ≤ 100 mA*	-0.05	0.00	+0.05	V
		V_I = $V_{O(nom)}$, I_O = 60 mA	-0.30	—	—	V
Output Volt. Temp. Coeff.	a_{VO}	V_I = 6 V, I_O = 10 mA, T_J ≤ 125°C	—	-0.30	—	mV/°C
Line Regulation	$\Delta V_{O(\Delta VI)}$	4 V ≤ V_I ≤ 8 V, I_O = 1 mA	—	—	10	mV
Load Regulation	$\Delta V_{O(\Delta IO)}$	1 mA ≤ I_O ≤ 100 mA*, V_I = 8 V	—	—	40	mV
		1 mA ≤ I_O ≤ 100 mA*, V_I = 6 V	—	—	40	mV
		1 mA ≤ I_O ≤ 100 mA*, V_I = 4 V	—	—	40	mV
Dropout Voltage	$V_I$min – V_O	I_O = 60 mA	—	90	150	mV
		I_O = 125 mA*	—	190	300	mV
Quiescent Current (GND terminal current)	I_Q	V_I = 8 V, I_O ≤ 1 mA, V_E ≥ 2.0 V	—	55	70	µA
		V_I = 8 V, I_O ≤ 100 mA*, V_E ≥ 2.0 V	—	70	85	µA
		V_I = $V_{O(nom)}$, I_O = 60 mA	—	200	—	µA
	$I_{Q(off)}$	4 V ≤ V_I ≤ 8 V, V_E ≤ 0.8 V	—	—	1.0	µA
ENABLE Input Voltage	V_{EH}	4 V ≤ V_I ≤ 8 V, Output ON	2.0	—	—	V
	V_{EL}	4 V ≤ V_I ≤ 8 V, Output OFF	—	—	0.8	V
ENABLE Input Current	I_E	V_E = V_I = 8 V	—	—	±1.0	µA
Thermal Shutdown Temp.	T_J		150	—	—	°C
Rejection Ratio	PSRR	V_I = $V_{O(nom)}$ + 1.5 V, V_i = 100 mV, I_O = 10 mA:				
		f = 1 kHz	—	60	—	dB
		f = 10 kHz	–	50	—	dB
Noise	e_n	10 Hz ≤ f ≤ 100 kHz, I_O = 10 mA, C_O = 10 µF	—	2.0	—	µV/√Hz

Typical values are at T_A = +25°C and are given for circuit design information only.

* Pulse test (≤20 ms). See previous page for duty cycle limitations.

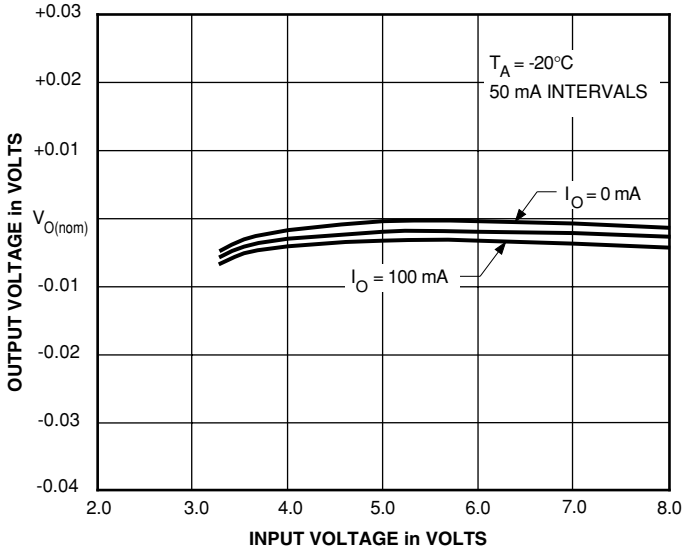
TYPICAL CHARACTERISTICS

LOAD REGULATION

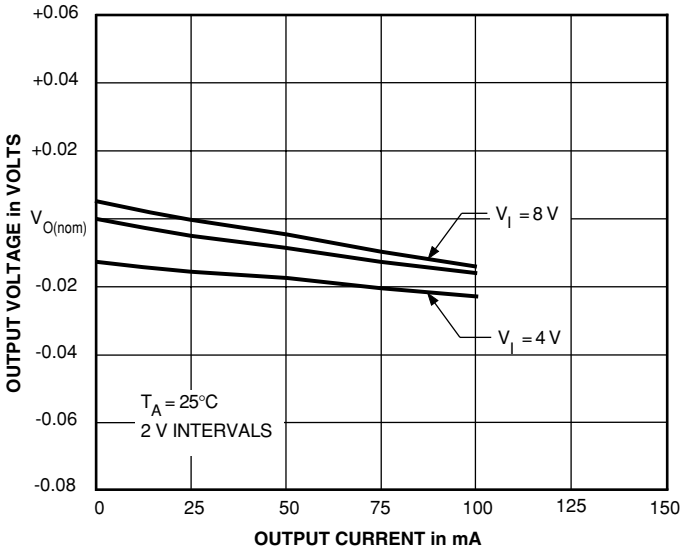


Dwg. GP-052-13

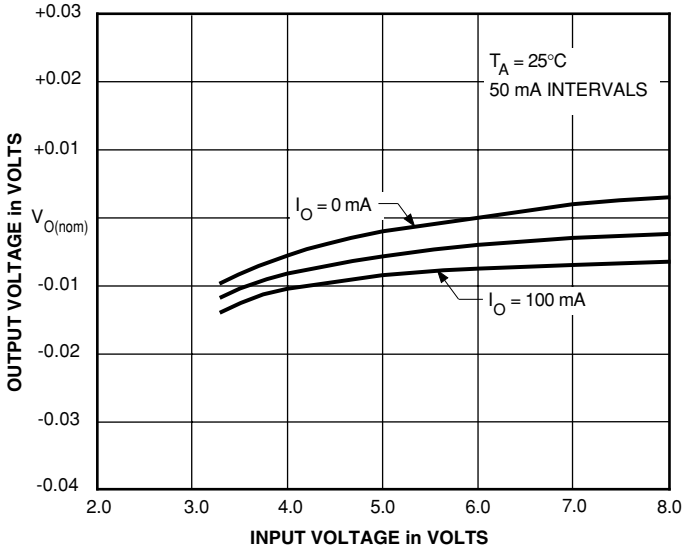
LINE REGULATION



Dwg. GP-053-13



Dwg. GP-052-14

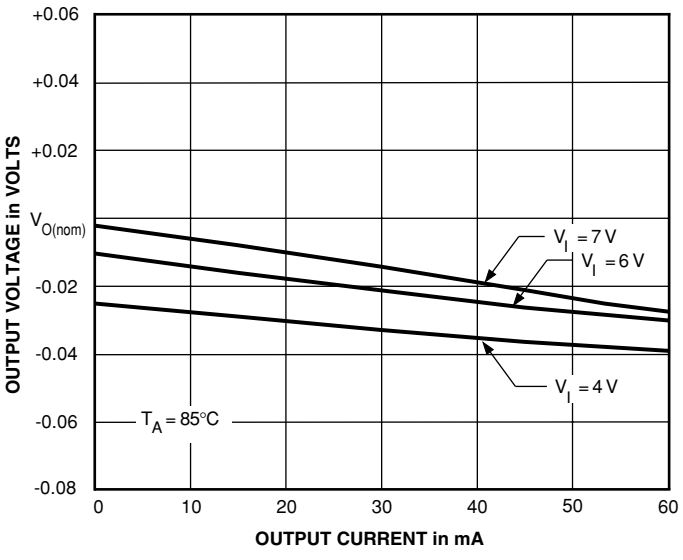


Dwg. GP-053-14

CAUTION: Maximum allowable duty cycle will be significantly less than 100% at high temperatures, at high input voltages, or at high output currents. See appropriate Maximum Allowable Output Current table.

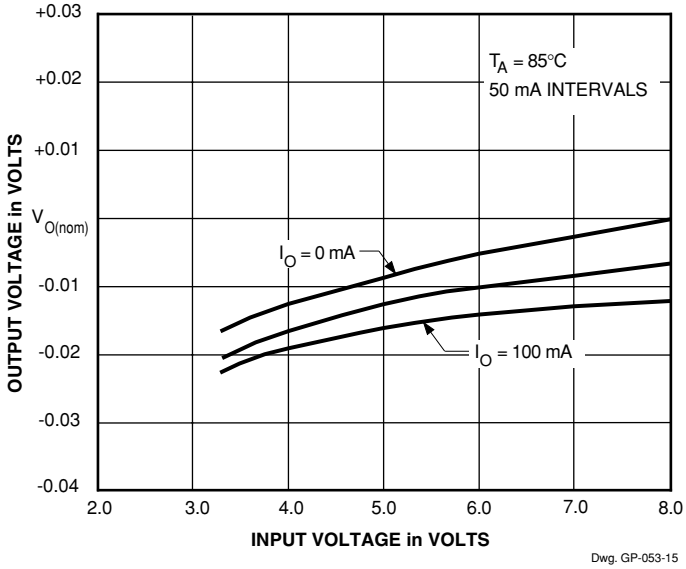
TYPICAL CHARACTERISTICS (cont'd)

LOAD REGULATION



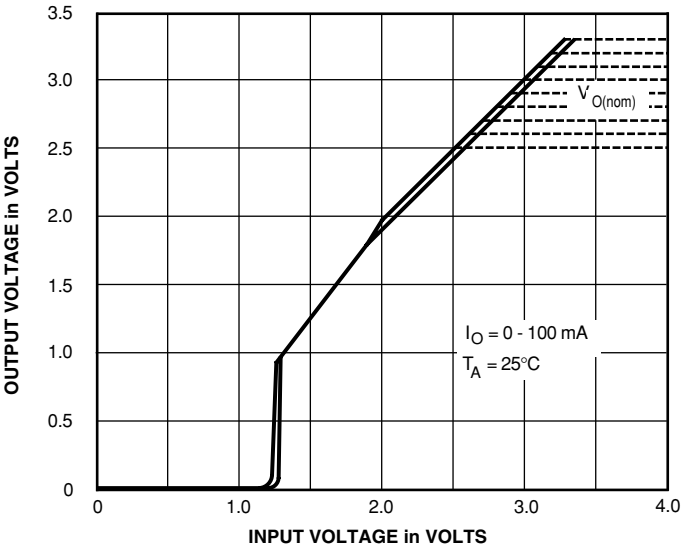
Dwg. GP-052-15

LINE REGULATION

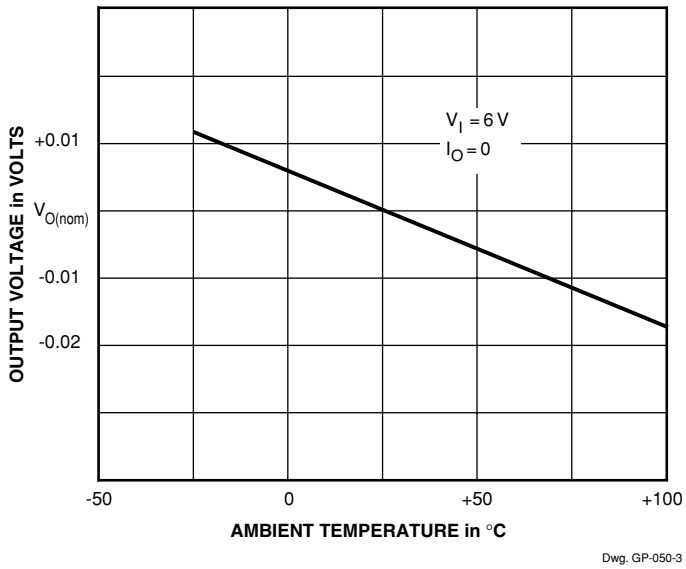


Dwg. GP-053-15

OUTPUT VOLTAGE



Dwg. GP-059-2

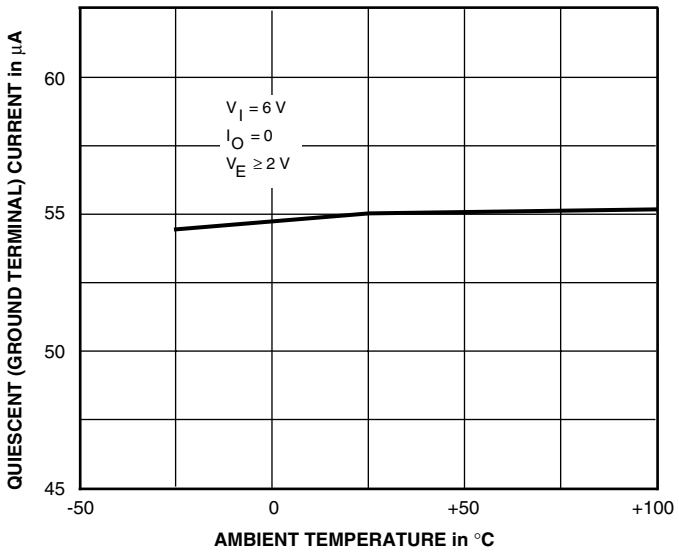


Dwg. GP-050-3

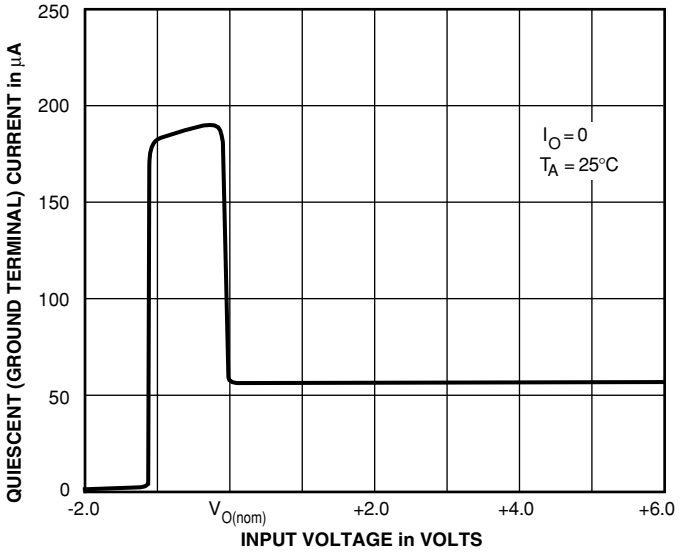
CAUTION: Maximum allowable duty cycle will be significantly less than 100% at high temperatures, at high input voltages, or at high output currents. See appropriate Maximum Allowable Output Current table.

TYPICAL CHARACTERISTICS (cont'd)

QUIESCENT (GROUND TERMINAL) CURRENT

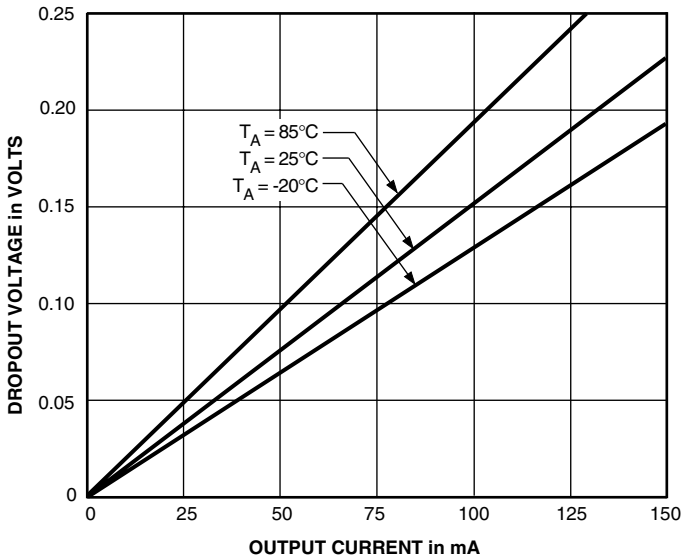


Dwg. GP-051-3



Dwg. GP-058-1

DROPOUT VOLTAGE



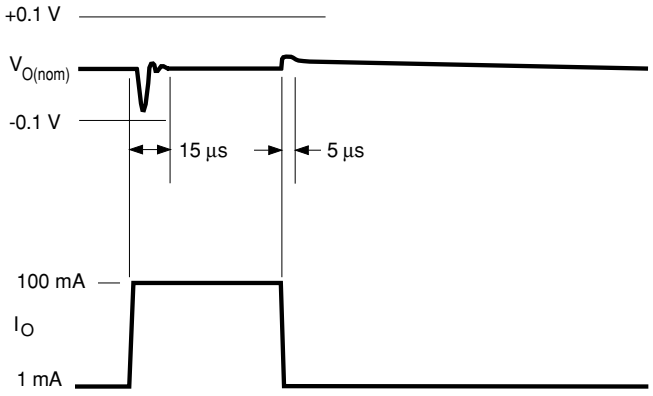
Dwg. GP-054-2

CAUTION: Maximum allowable duty cycle will be significantly less than 100% at high temperatures, at high input voltages, or at high output currents. See appropriate Maximum Allowable Output Current table.

TYPICAL CHARACTERISTICS (concluded)

LOAD TRANSIENT PERFORMANCE

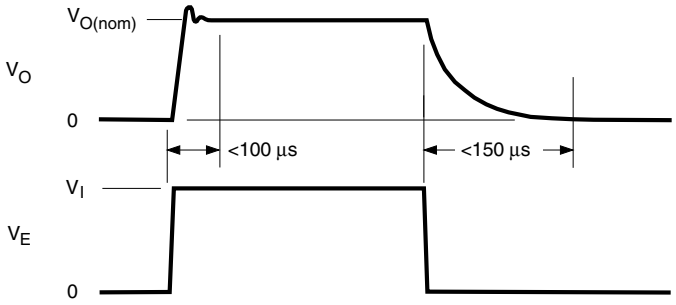
V_I = 3.2 V to 6.2 V, C_O = 4.7 µF, T_A = 25°C



Dwg. WP-028-2

ENABLE TRANSIENT PERFORMANCE

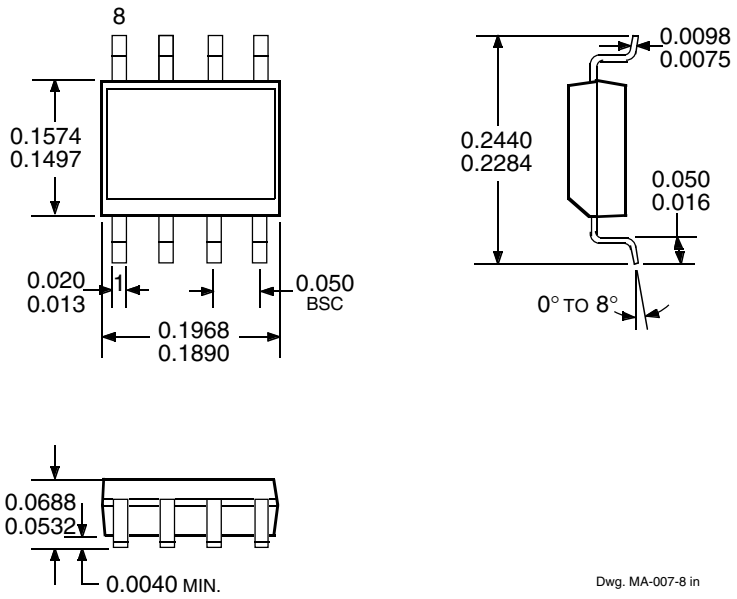
V_I = 3.2 V to 6.2 V, C_O = 1 µF, T_A = 25°C



Dwg. WP-027-3

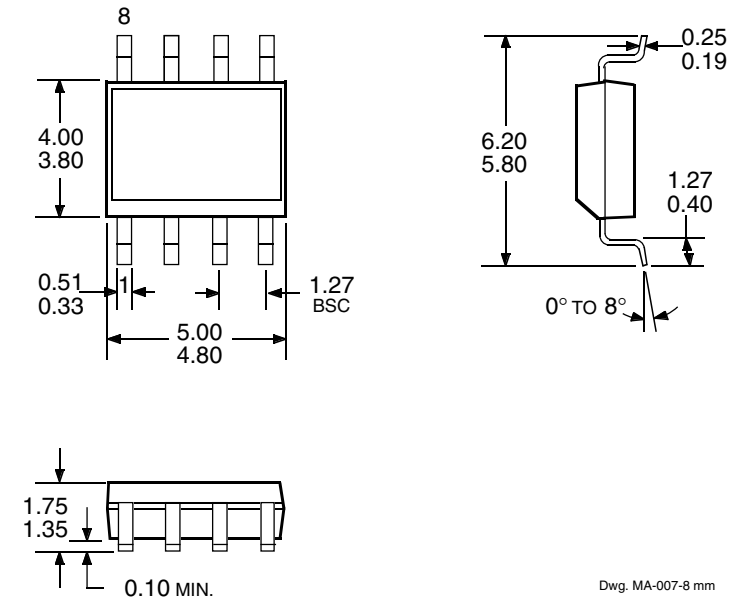
A8188SL-xx

Dimensions in Inches
(for reference only)



Dwg. MA-007-8 in

Dimensions in Millimeters
(controlling dimensions)



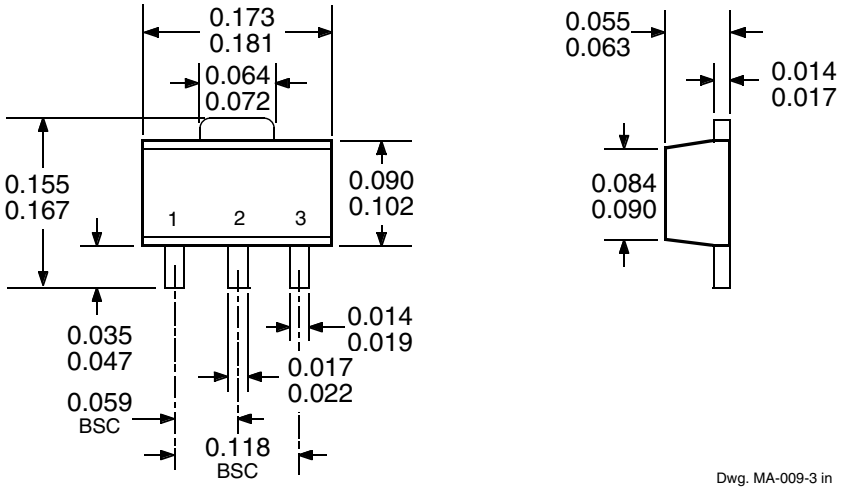
Dwg. MA-007-8 mm

NOTES: 1. Lead spacing tolerance is non-cumulative.

2. Exact body and lead configuration at vendor's option within limits shown.

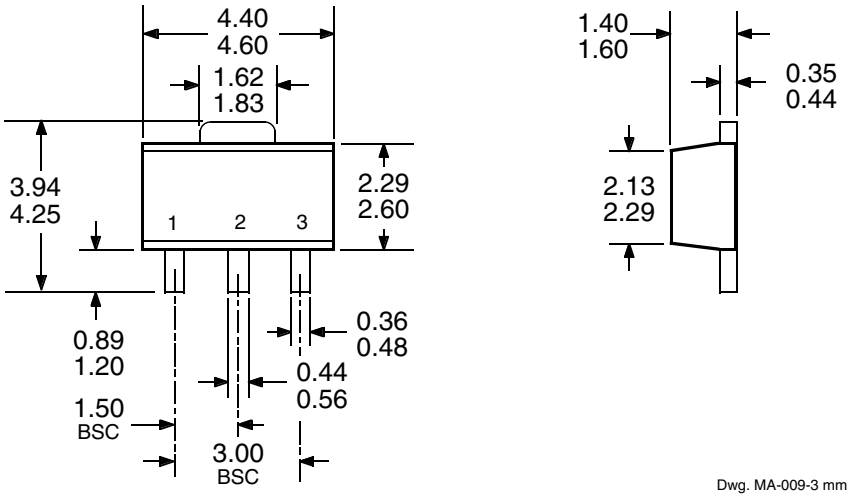
A8188SLT-xx

Dimensions in Inches
(for reference only)



Dwg. MA-009-3 in

Dimensions in Millimeters
(controlling dimensions)



Dwg. MA-009-3 mm

NOTES: 1. Lead spacing tolerance is non-cumulative.

2. Exact body and lead configuration at vendor's option within limits shown.

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LOW-DROPOUT REGULATORS

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