

MAS9160

2 Outputs LDO Voltage Regulator IC

This is preliminary information on a new product under development. Micro Analog Systems Oy reserves the right to make any changes without notice.

Preliminary

- **Dual Regulator: 2 x 150 mA**
- **Very Low Dropout: 70 mV**
- **High Ripple Rejection: 60 dB**
- **Low Noise: 30 μ Vrms**
- **Very Low Crosstalk**
- **Stable Even with Low-ESR Output Capacitor: min. ESR 0.05 Ω**
- **Regulator Enable/Disable Control**

DESCRIPTION

The MAS9160 is a voltage regulator IC with two low dropout voltage regulators, which both have their own enable/disable pin allowing the regulator to be turned off or on by pulling the particular control to low or high.

Due to the low noise level of only 30 μ Vrms, MAS9160 is suitable for sensitive circuits, e.g., in portable applications. In addition to the noise levels, MAS9160 excels in dropout voltage (70 mV typical at 50 mA) and rise time (16 μ s typical without bypass capacitor). Also its ripple rejection ability of 60 dB at 1 kHz exceeds that of competition.

A very wide range of values of Equivalent Series Resistance (ESR) of output capacitors can be used with MAS9160. This ESR range from a few m Ω up to a couple of Ohms combined with no minimum output current requirement makes the usage of MAS9160 easier and low in cost.

In order to save power the device goes into sleep mode when both regulators are disabled. An internal thermal protection circuit prevents the device from overheating. Also the maximum output current is internally limited.

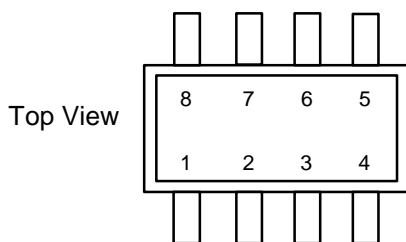
FEATURES

- Output Accuracy $<\pm 2\%$
- Low Noise
- Internal Thermal Shutdown
- Short Circuit Protection
- MSOP-8 Package
- Functionally and Pin Compatible with LP2967
- Output Voltage Options: 3.3 V, 3.0 V, 2.8 V, and 2.5 V (Contact MAS Sales for 1.8 V, and 1.5 V options)

APPLICATION

- Cellular Phones
- Cordless Phones
- Pagers
- Battery Powered Systems
- Portable Systems
- Radio Control Systems
- Low Voltage Systems

PIN CONFIGURATION AND DESCRIPTION

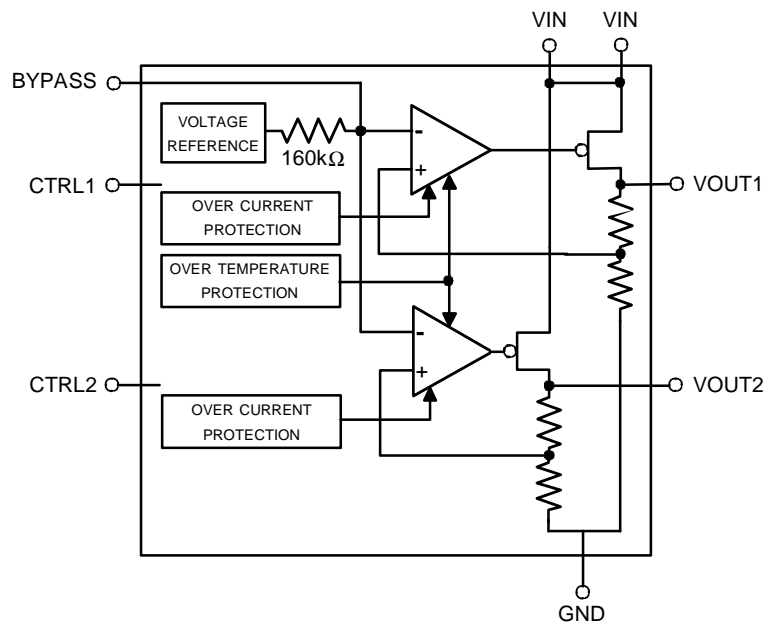


For Top Marking Information see p. 8 Ordering Information

Pin Name	Pin	Type	Function
VIN	1, 8	P	Power Supply Voltage for both regulators.
GND	4	G	Ground
CTRL1	6	I	Enable/Disable Pin for the first regulator
CTRL2	3	I	Enable/Disable Pin for the second regulator
BYPASS	5	I	Pin for Bypass Capacitor
VOUT1	7	O	Output voltage of the first Regulator.
VOUT2	2	O	Output voltage of the Second regulator.

G = Ground, I = Input, O = Output, P = Power

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

All voltages with respect to ground.

Parameter	Symbol	Conditions	Min	Max	Unit
Supply Voltage	V_{IN}		-0.3	6	V
ESD Rating		HBM (note 1)		2	kV
Junction Temperature	T_{Jmax}			+175 (limited)	°C
Operating Junction Temperature	T_J		- 40	+125	°C
Storage Temperature	T_S		-55	+150	°C
Operating Ambient Temperature	T_A		-40	+85	°C

Stresses beyond those listed may cause permanent damage to the device. The device may not operate under these conditions, but it will not be destroyed.

Note 1. ESD Rating 1.0 kV for BYPASS- and CTRL-pins.

ELECTRICAL CHARACTERISTICS

$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$, typical values at $T_A = +27^\circ\text{C}$, $V_{IN} = V_{NOM} + 1.0\text{ V}$, $I_{OUT} = 1.0\text{ mA}$, $C_{IN} = 1.0\ \mu\text{F}$, $C_L = 1.0\ \mu\text{F}$, $V_{CTRL} = 3.8\text{ V}$, unless otherwise specified

◆ Thermal protection

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Threshold High	T_H		145	160	175	$^\circ\text{C}$
Threshold Low	T_L		135	150	165	$^\circ\text{C}$

A hysteresis of 10°C prevents oscillation in case of thermal shutdown. After the regulator temperature has dropped by this value, it will turn on again automatically.

◆ Control Terminal Specifications

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Control Voltage OFF State ON State	V_{CTRL}		1.6		0.55	V
Control Current, one control input	I_{CTRL}	$V_{CTRL} = V_{IN}$ $V_{CTRL} = 0\text{ V}$		5 0	10	μA

◆ Voltage Parameters

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage Tolerance	V_{OUT}	$I_{OUT} = 0\text{ mA}$ $I_{OUT} = 150\text{ mA}$	- 1.7 - 3.5		+ 1.7 + 1.7	$\%V_{NOM}$
Operating Supply Voltage	V_{IN}		V_{NOM} + 0.3		5.3	V
Dropout Voltage	V_{DROP}	$I_{OUT} = 1\text{ mA}$ $I_{OUT} = 50\text{ mA}$ $I_{OUT} = 150\text{ mA}$		2 70 200		mV

◆ Current Parameters

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Continuous Output Current	I_{OUT}			150		mA
Short Circuit Current	I_{MAX}	$R_L = 0\ \Omega$		450		mA
Peak Output Current	I_{PK}	$V_{OUT} > 95\% * V_{NOM}$		410		mA
Ground Pin Current, one regulator on	I_{GND}	$I_{OUT} = 0\text{ mA}$ $I_{OUT} = 10\text{ mA}$ $I_{OUT} = 50\text{ mA}$ $I_{OUT} = 150\text{ mA}$		140 145 170 235		μA
Ground Pin Current, both regulators on	I_{GND}	$I_{OUT} = 0\text{ mA}$ $I_{OUT} = 10\text{ mA}$ $I_{OUT} = 50\text{ mA}$ $I_{OUT} = 150\text{ mA}$		215 230 280 410		μA
Ground Pin Current, Power off	I_{GND}	$V_{CTRL} < 0.3\text{ V}$				μA
			$T=25^\circ\text{C}$	0.03	1.0	
			$T=85^\circ\text{C}$	0.5	5.0	

◆ Power Dissipation

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Junction to Case Thermal Resistance	R_{JC}			39.0		°C/W
Junction to Ambient Thermal Resistance	R_{JA}	typical PC board mounting, still air		206.0		°C/W
Maximum Power Dissipation	P_d	any ambient temperature	$P_{dMAX} = \frac{T_{J(MAX)} - T_A}{R_{JA}}$ Note 1			mW

Note 1: $T_{J(MAX)}$ denotes maximum operating junction temperature (+125°C), T_A ambient temperature, and R_{JA} junction-to-ambient thermal resistance (+206.0°C/W).

◆ Line and Load Regulation

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Line Regulation		$V_{OUT} + 1 V < V_{IN} < 5.3 V$ $I_{OUT} = 60 mA$		1.0		mV
Load Regulation		$I_{OUT} = 1.0$ to 50 mA $I_{OUT} = 1.0$ to 150 mA		9 24	20 45	mV

◆ Noise and Ripple Rejection

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Noise Voltage	V_{RMS}	300Hz < f < 50kHz, $C_{BYPASS} = 10 nF$		30		μV_{rms}
Noise Density	V_N	$C_{BYPASS} = 10 nF$, $I_{OUT} = 50 mA$, $f = 1.0 kHz$		150		$\frac{nV}{\sqrt{Hz}}$
PSRR		$C_{BYPASS} = 10 nF$, $I_{OUT} = 50 mA$ $f = 1kHz$ $f = 10 kHz$ $f = 100 kHz$		60 50 30		dB

◆ Dynamic Parameters

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Rise Time (10%...90%)		$V_{CTRL} = 0$ to 2.4 V, $I_{OUT} = 30mA$ $C_{BYPASS} = 10 nF$ w/o C_{BYPASS}		4 16		ms μs
Overshoot		$V_{CTRL} = 0$ to 2.4 V w/o C_{BYPASS}		3	5	%
Start-up Delay		From CTRL signal to 90% * V_{NOM} , one regulator on		26		μs

DETAILED DESCRIPTION

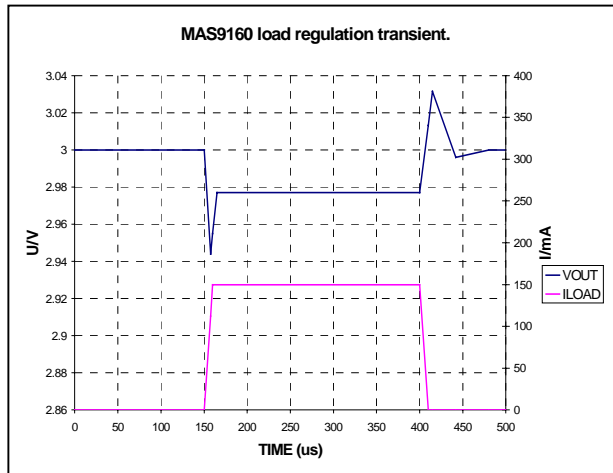


Figure 1. Typical load regulation transient.
 $I_{OUT} = 0 \dots 150 \text{ mA}$ at $10 \mu\text{s}$.

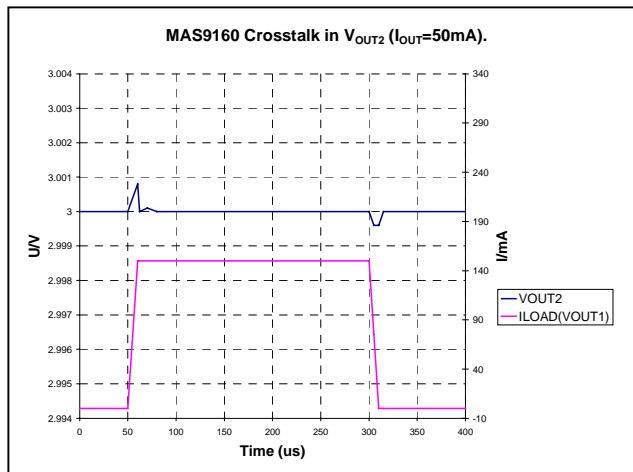
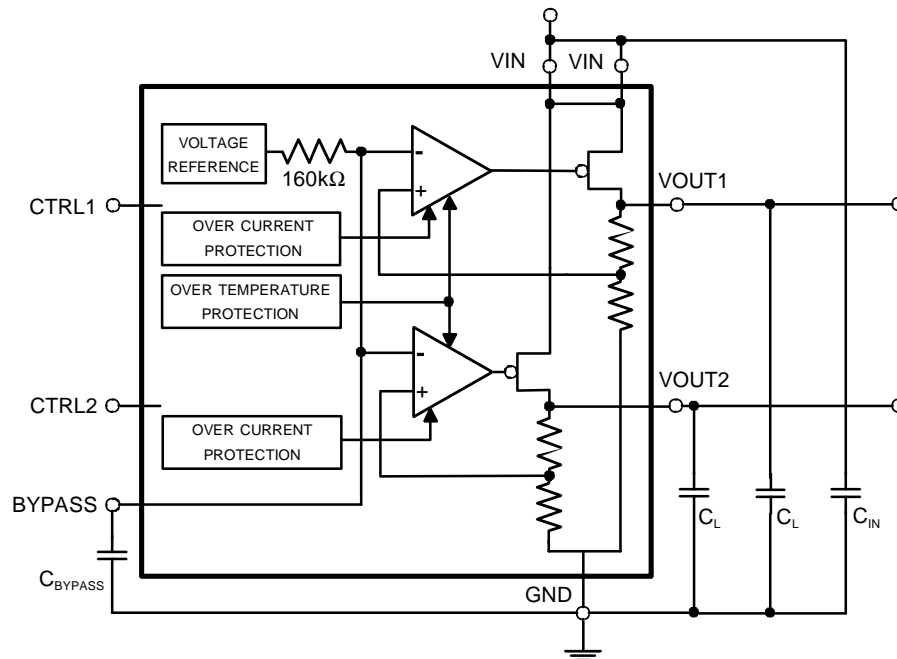
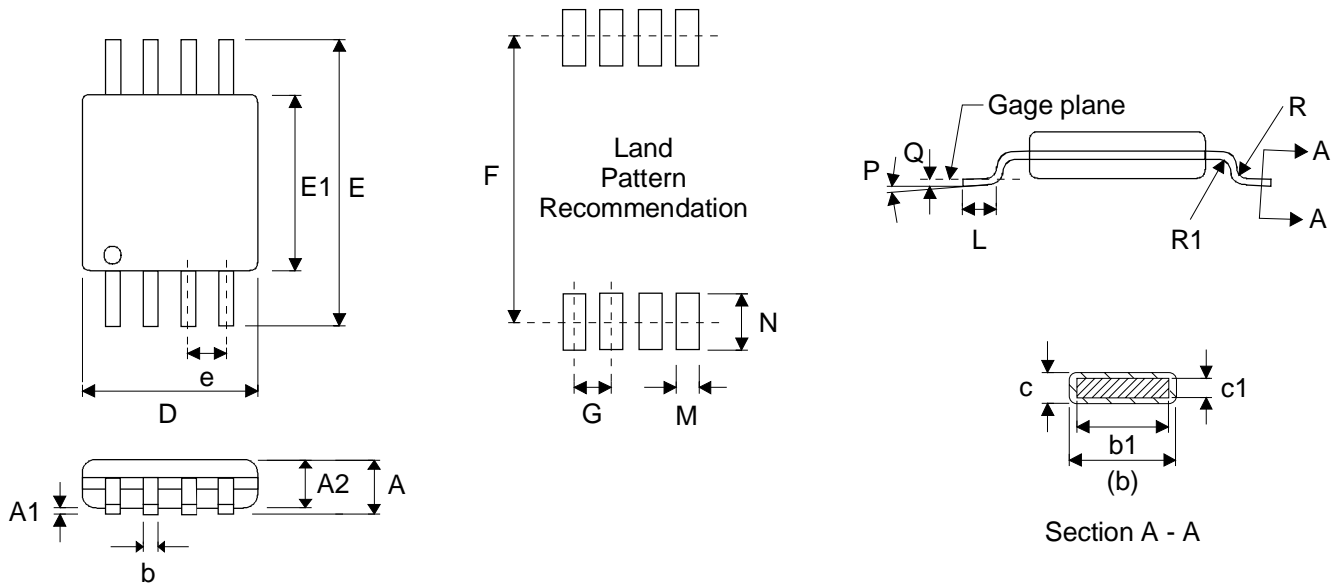


Figure 2. Typical cross-coupling at load regulation transient. V_{OUT1} : $I_{OUT} = 0 \dots 150 \text{ mA}$ at $10 \mu\text{s}$ (Figure 1).

APPLICATION INFORMATION


Parameter	Symbol	Min	Max	Unit	Note
Output Capacitance	C_L	0.22		μF	Ceramic and film capacitors can be used. When within this range, stable with all $I_{OUT} = 0 \text{ mA} \dots 150 \text{ mA}$ values
Effective Series Resistance	ESR	0.05	3	Ohm	
Bypass Capacitance	C_{BYPASS}	Typically 0.01		μF	Ceramic and film capacitors are best suited. For maximum output voltage accuracy DC leakage current through capacitor should be kept as low as possible. In any case DC leakage current must be below 100 nA.
Input Capacitance	C_{IN}	1		μF	Ceramic, tantalum, and film capacitors can be used. If using a tantalum capacitor, it should be checked that the surge current rating is sufficient for the application.

Values given on the table are minimum requirements unless otherwise specified. When selecting capacitors, tolerance and temperature coefficient must be considered to make sure that the requirement is met in all potential operating conditions.

PACKAGE (MSOP-8) OUTLINE


Symbol	Min	Nom	Max	Unit
A			1.10	mm
A1	0		0.15	mm
A2	0.75	0.85	0.95	mm
b	0.22		0.38	mm
b1	0.22	0.30	0.33	mm
c	0.08		0.23	mm
c1	0.08		0.18	mm
D		3.00 BSC		mm
E		4.90 BSC		mm
E1		3.00 BSC		mm
e		0.65 BSC		mm
F		4.8		mm
G		0.65		mm
L	0.40	0.60	0.80	mm
(Terminal length for soldering)				
M		0.41		mm
N		1.02		mm
P	0°		8°	
Q		0.25 BSC		mm
R	0.07			mm
R1	0.07			mm

Dimensions do not include mold or interlead flash, protrusions or gate burrs.
 All measurement according to JEDEC standard MO-187.

ORDERING INFORMATION

Product Code	Product	Top Marking	Package	Comments
MAS9160ASM1-T	3.3 V Voltage Regulator IC	60A1	MSOP-8	Tape and Reel
MAS9160ASM2-T	2.8 V Voltage Regulator IC	60A2	MSOP-8	Tape and Reel
MAS9160ASM3-T	2.5 V Voltage Regulator IC	60A3	MSOP-8	Tape and Reel
MAS9160ASM4-T	1.8 V Voltage Regulator IC	60A4	MSOP-8	Tape and Reel
MAS9160ASM5-T	1.5 V Voltage Regulator IC	60A5	MSOP-8	Tape and Reel
MAS9160ASM6-T	3.0 V Voltage Regulator IC	60A6	MSOP-8	Tape and Reel

LOCAL DISTRIBUTOR

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