MAS9123

80 mA LDO Voltage Regulator IC

- **Very Low Noise: 9.5 µVrms**
- **Very Short Start-up Time: 20 µs**
- **Excellent Ripple Rejection: 68 dB**
- **Stable with Low-ESR Output Capacitors**
- **Low Minimum Output Capacitance Requirement: 0.23 µF**
- **Regulator Enable/Disable Control**

DESCRIPTION

MAS9123 is a low dropout voltage regulator with an enable/disable pin, which allows device to be turned off or on by pulling control to low or high.

Due to the very low noise level of only 9.5 µVrms MAS9123 is highly suitable for very sensitive circuits, e.g., in portable applications. In addition to the noise level, MAS9123 excels in dropout voltage (95 mV typical at 50 mA) and in start-up time (with bypass capacitor typically 20 µs from start-up to within ±1% of $V_{OUT(NOM)}$). Also its ripple rejection ability of 68 dB at 10 kHz exceed that of competition.

The Equivalent Series Resistance (ESR) range of output capacitors that can be used with MAS9123 is very wide. This ESR range from a few mΩ up to a couple of Ohms combined with no minimum output current requirement makes the usage of MAS9123 easier and low in cost. Also the minimum output capacitance requirement is very low. This combined with very short start-up time makes it possible to switch the regulator off and on even in timing critical and/or noise sensitive applications.

MAS9123 also includes an auto-discharge function, wherein a shutdown transistor turns on and discharges the output capacitor, when MAS9123 is turned off.

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

FEATURES

- Optimized for Fast Start-up
- Very Low Noise
- Internal Thermal Shutdown
- Short Circuit Protection
- Functionally and Pin Compatible with LP2982/LP2985/LP3985
- Small SOT23-5 or Thin TSOT-5 Package
- Output Voltage Options: 2.8, 3.0 and 3.3 V, see Ordering Information p. 13

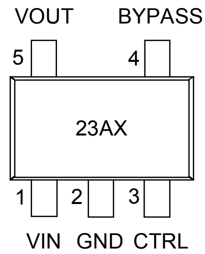
APPLICATIONS

- RF Oscillators
- GPS Systems
- RF Section of Cellular Phones
- RF Section of Wireless Systems
- Oven Oscillators (OCXOs)
- RF Section of Cordless Phones
- Battery Powered Systems
- Portable Systems
- Radio Control Systems

PIN CONFIGURATION

SOT23-5/TSOT-5

Top View

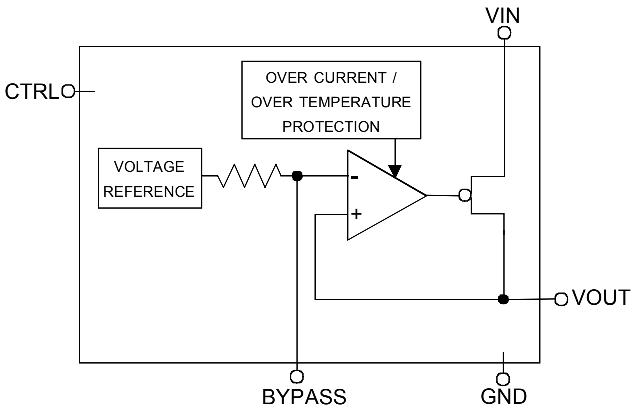


For top marking information see
ordering information p. 13

PIN DESCRIPTION

Pin Name	Pin Number	Type	Function
VIN	1	P	Power Supply Voltage
GND	2	G	Ground
CTRL	3	I	Enable/Disable Pin for Regulator
BYPASS	4	I	Pin for Bypass Capacitor
VOUT	5	O	Output

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
Voltage Range for All Pins			-0.3	V_{IN} + 0.3	V
ESD Rating		HBM		2	kV
Junction Temperature	T_{Jmax}			+175 (limited)	°C
Storage Temperature	T_S		-55	+150	°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.

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Conditions	Min	Max	Unit
Operating Junction Temperature	T_J		-40	+125	°C
Operating Ambient Temperature	T_A		-40	+85	°C
Operating Supply Voltage	V_{IN}		2.5	5.3	V

ELECTRICAL CHARACTERISTICS

◆ Thermal Protection

T_A = -40°C to +85°C, typical values at T_A = +27°C, $V_{IN} = V_{OUT(NOM)}$ + 1.0 V, I_{OUT} = 1.0 mA, C_{IN} = 1.0 μF, C_L = 1.0 μF, C_{BYPASS} = 10 nF, V_{CTRL} = 2.0 V, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Threshold High	T_H		145	160	175	°C
Threshold Low	T_L		135	150	165	°C

The hysteresis of 10°C prevents the device from turning on too soon after thermal shut-down.

◆ Control Terminal Specifications

T_A = -40°C to +85°C, typical values at T_A = +27°C, $V_{IN} = V_{OUT(NOM)}$ + 1.0 V, I_{OUT} = 1.0 mA, C_{IN} = 1.0 μF, C_L = 1.0 μF, C_{BYPASS} = 10 nF, V_{CTRL} = 2.0 V, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Control Voltage OFF State ON State	V_{CTRL}		 –0.3 1.6		 0.55 V_{IN} + 0.3	V
Control Current	I_{CTRL}	 $V_{CTRL} = V_{IN}$ V_{CTRL} = 0 V		 5 0	 15	μA

If CTRL-pin is not connected, MAS9123 is in OFF state (900 kΩ pull-down resistor to ground).

◆ Voltage Parameters

T_A = -40°C to +85°C, typical values at T_A = +27°C, $V_{IN} = V_{OUT(NOM)}$ + 1.0 V, I_{OUT} = 1.0 mA, C_{IN} = 1.0 μF, C_L = 1.0 μF, C_{BYPASS} = 10 nF, V_{CTRL} = 2.0 V, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Voltage Tolerance	V_{OUT}	 I_{OUT} = 0 mA I_{OUT} = 50 mA	 $V_{OUT(NOM)}$ – 0.05 $V_{OUT(NOM)}$ – 0.10		 $V_{OUT(NOM)}$ + 0.05 $V_{OUT(NOM)}$ + 0.05	V
Dropout Voltage	V_{DROP}	 I_{OUT} = 1 mA I_{OUT} = 10 mA I_{OUT} = 50 mA		 46 51 95		mV

◆ Current Parameters

T_A = -40°C to +85°C, typical values at T_A = +27°C, $V_{IN} = V_{OUT(NOM)}$ + 1.0 V, I_{OUT} = 1.0 mA, C_{IN} = 1.0 μF, C_L = 1.0 μF, C_{BYPASS} = 10 nF, V_{CTRL} = 2.0 V, unless otherwise specified.

Parameter	Symbol	Conditions		Min	Typ	Max	Unit
Continuous Output Current	I_{OUT}			0		80	mA
Short Circuit Current	I_{MAX}	R_L = 0 Ω			230		mA
Peak Output Current	I_{PK}	V_{OUT} > 95% * $V_{OUT(NOM)}$			180		mA
Ground Pin Current	I_{GND}	 I_{OUT} = 0 mA I_{OUT} = 10 mA I_{OUT} = 50 mA			 170 210 250		μA
Ground Pin Current, Sleep mode	I_{GND}	V_{CTRL} = 0 V	T_A = 27°C		0.02	0.5	μA
			T_A = 85°C		0.2	2	

◆ Power Dissipation

T_A = -40°C to +85°C, typical values at T_A = +27°C, $V_{IN} = V_{OUT(NOM)}$ + 1.0 V, I_{OUT} = 1.0 mA, C_{IN} = 1.0 µF, C_L = 1.0 µF, C_{BYPASS} = 10 nF, V_{CTRL} = 2.0 V, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Thermal Resistance (Junction-to-Air)	R_{JA}	thermal test board according to JESD51-7 (4 layers), SOT23-5 package TSOT-5 package		191 207		°C/W
Maximum Power Dissipation	P_d	any ambient temperature	$P_{dMAX} = \frac{T_{J(MAX)} - T_A}{R_{JA}}$ Note 1			W

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

◆ Line and Load Regulation

T_A = -40°C to +85°C, typical values at T_A = +27°C, $V_{IN} = V_{OUT(NOM)}$ + 1.0 V, I_{OUT} = 1.0 mA, C_{IN} = 1.0 µF, C_L = 1.0 µF, C_{BYPASS} = 10 nF, V_{CTRL} = 2.0 V, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Line Regulation		$V_{OUT(NOM)} + 1\ V < V_{IN} < 5.3\ V$, I_{OUT} = 50 mA		0.75	2	mV
Load Regulation		I_{OUT} = 1.0 to 50 mA		13.5	25	mV

◆ Noise and Ripple Rejection

T_A = -40°C to +85°C, typical values at T_A = +27°C, $V_{IN} = V_{OUT(NOM)}$ + 1.0 V, I_{OUT} = 1.0 mA, C_{IN} = 1.0 µF, C_L = 1.0 µF, C_{BYPASS} = 10 nF, V_{CTRL} = 2.0 V, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Noise Voltage	V_{RMS}	10 Hz < f < 100 kHz		9.5		µVrms
Noise Density	V_N	I_{OUT} = 50 mA, f = 10 kHz		24		$nV/\sqrt{Hz}$
PSRR		f = 1 kHz f = 10 kHz f = 100 kHz		70 68 58		dB

◆ Dynamic Parameters

T_A = -40°C to +85°C, typical values at T_A = +27°C, $V_{IN} = V_{OUT(NOM)}$ + 1.0 V, I_{OUT} = 1.0 mA, C_{IN} = 1.0 µF, C_L = 1.0 µF, C_{BYPASS} = 10 nF, V_{CTRL} = 2.0 V, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Start-up Delay (from start-up to 80% of $V_{OUT(NOM)}$)		V_{CTRL} = 0 to 2.4 V, I_{OUT} = 50 mA, $C_L \leq$ 1.0 µF		7.5		µs
Overshoot		V_{CTRL} = 0 to 2.4 V		1.0	8.0	%
Start-up Time (settling time of voltage transient from start-up to within ±1% of $V_{OUT(NOM)}$)		V_{CTRL} = 0 to 2.4 V, I_{OUT} = 50 mA $C_L \leq$ 1.0 µF		20		µs

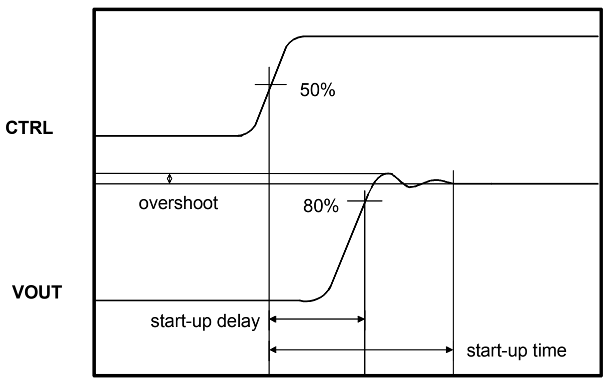


Figure1. Definitions of start-up delay, overshoot and start-up time.

TYPICAL PERFORMANCE CHARACTERISTICS

T_A = +27°C, V_{IN} = $V_{OUT(NOM)}$ + 1.0 V, I_{OUT} = 50 mA, C_{IN} = 1.0 µF, C_L = 1.0 µF, C_{BYPASS} = 10 nF, V_{CTRL} = 2.0 V, unless otherwise specified.

Start-up
MAS9123 start-up is optimized for bypass capacitor values of 3 to 20 nF. When values are lower than 3 nF the start-up settling might be unstable for about 20 µs after the start-up. The rise time increases if bypass capacitor values are bigger than 20 nF.

Start-up settling
Typically 20 µs after the start-up the output voltage drops about 10 to 20 mV in 250 µs time (figure 4). The value of this voltage drop depends on the parasitic components of the bypass capacitor. After the voltage drop the output voltage rises slowly to the final value (figure 5).

Noise reduction
MAS9123 has typically 9.5 µV_{RMS} output noise voltage with 10 nF bypass capacitor. By increasing the capacitance value, the output noise will slightly decrease, but the start-up time increases.

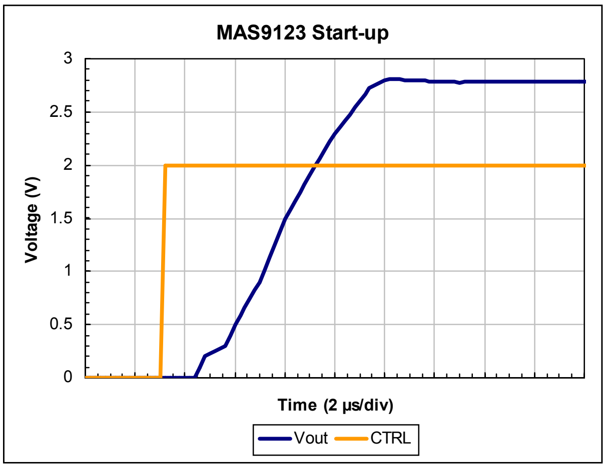


Figure 2. Typical start-up.

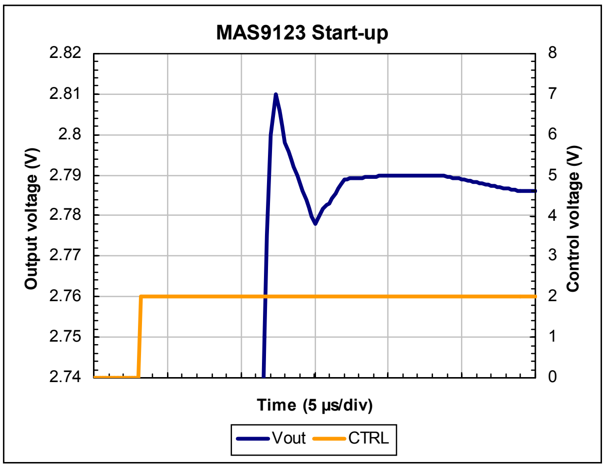


Figure 3. Typical start-up.

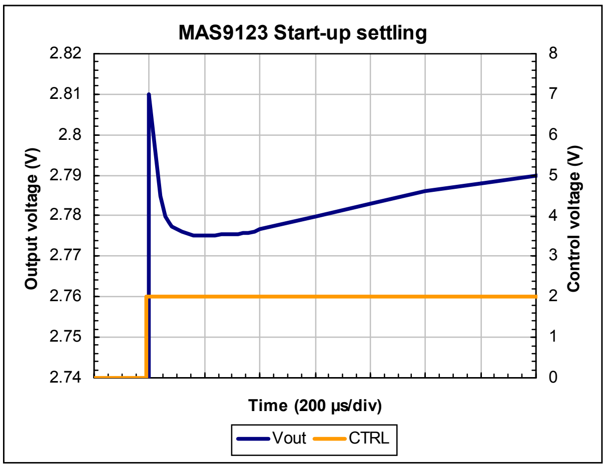


Figure 4. Typical start-up settling.

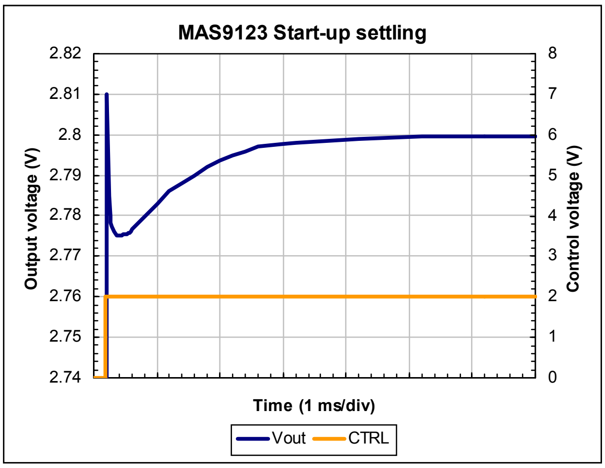


Figure 5. Typical start-up settling.

TYPICAL PERFORMANCE CHARACTERISTICS

T_A = +27°C, V_{IN} = $V_{OUT(NOM)}$ + 1.0 V, I_{OUT} = 50 mA, C_{IN} = 1.0 µF, C_L = 1.0 µF, C_{BYPASS} = 10 nF, V_{CTRL} = 2.0 V, unless otherwise specified.

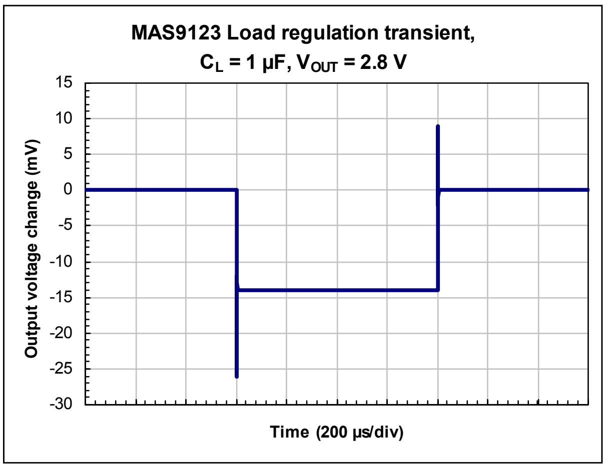


Figure 6. Typical load regulation transient. C_L = 1 µF, I_{OUT} = 0.5 mA … 50 mA in 2 µs.

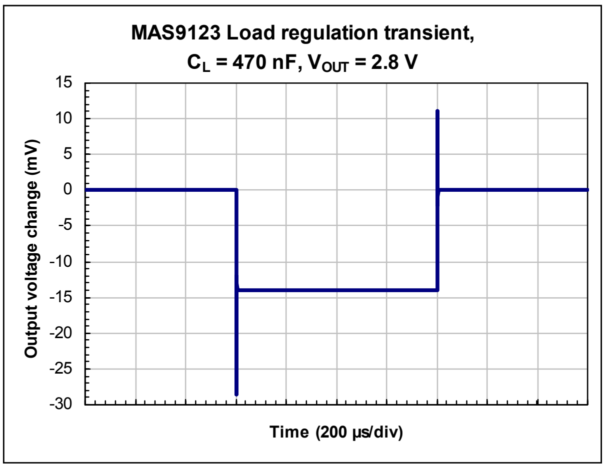


Figure 7. Typical load regulation transient. C_L = 470 nF, I_{OUT} = 0.5 mA … 50 mA in 2 µs.

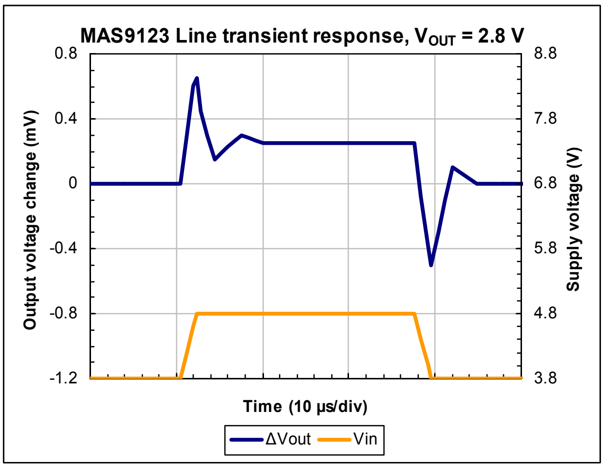


Figure 8. Line transient response. C_L = 1 µF, I_{OUT} = 10 mA.

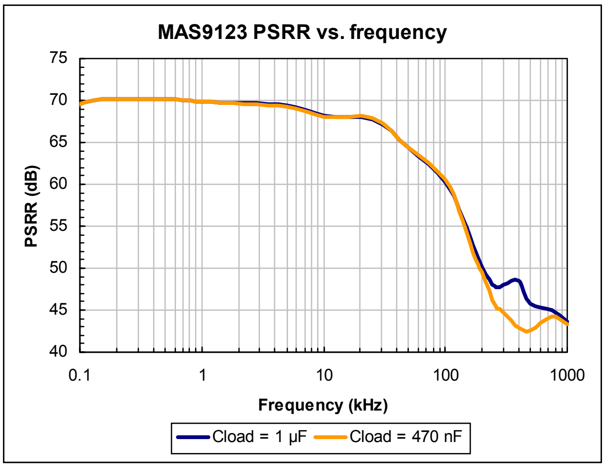


Figure 9. PSRR vs. frequency.

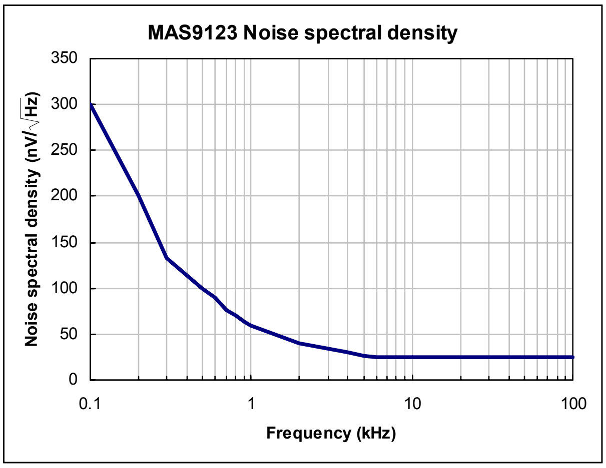


Figure 10. Noise spectral density vs. frequency.

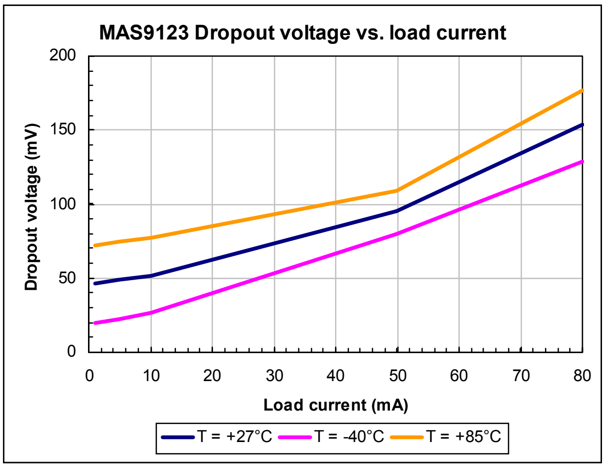
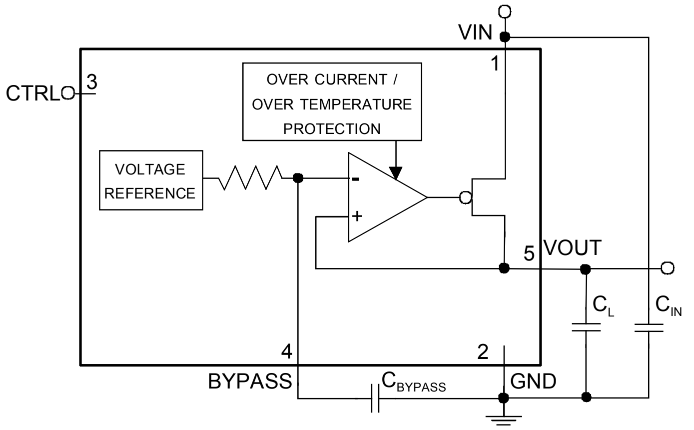


Figure 11. Dropout voltage vs. load current.

APPLICATION INFORMATION

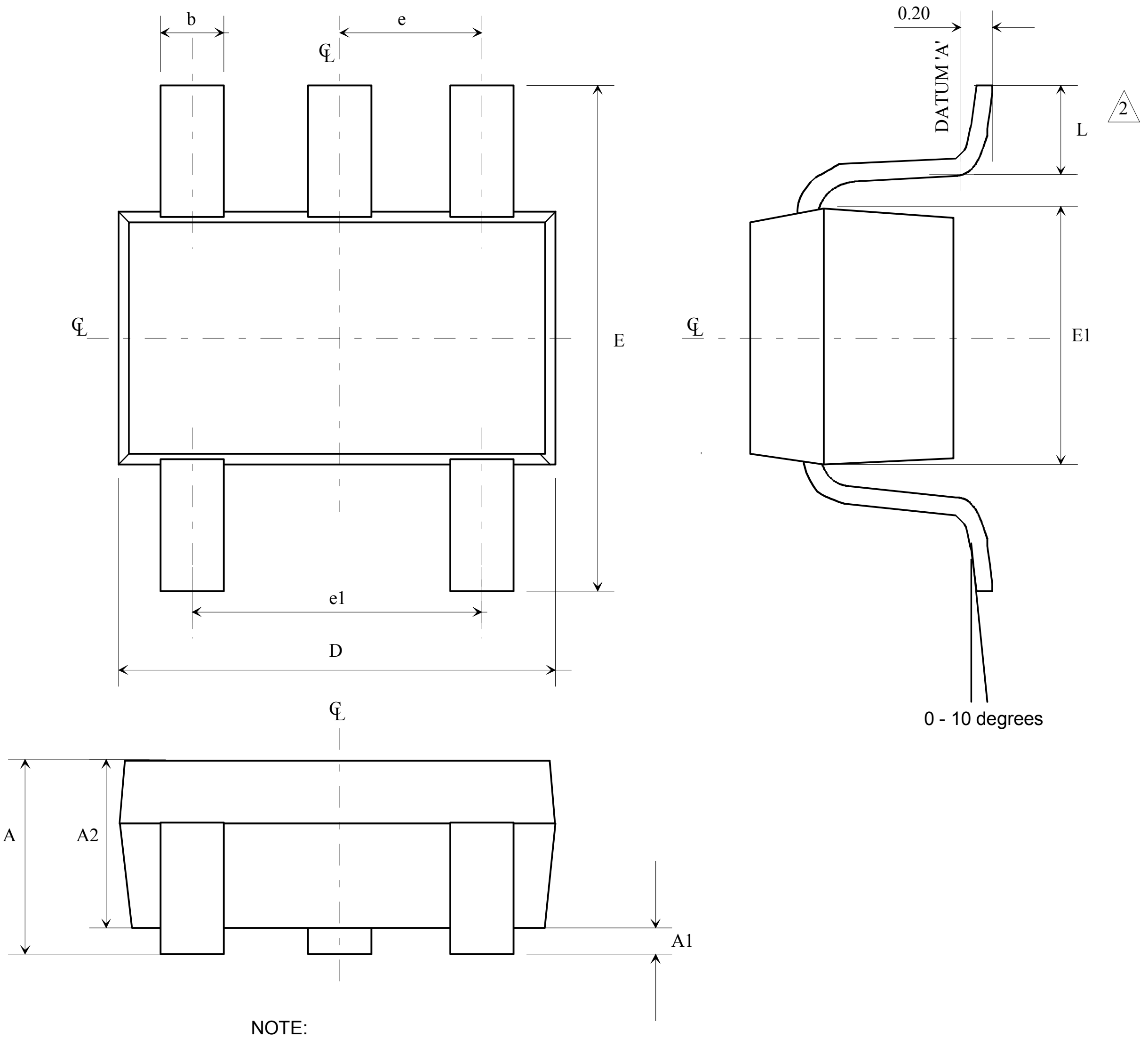


Auto-Discharge Function
MAS9123 has a shutdown transistor that turns on, when the device is disabled, and discharges the output capacitor.

Parameter	Symbol	Min	Typ	Max	Unit	Note
Output Capacitance	C_L	0.23	1.0		μF	1. Ceramic and film capacitors can be used. 2. The value of C_L should be smaller than or equal to the value of C_{IN}.
Effective Series Resistance	ESR	0.01		2	Ω	1. When within this range stable with all I_{OUT} = 0 mA…80 mA values.
Bypass Capacitance	C_{BYPASS}	3	10		nF	1. 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}	0.5			μF	1. A big enough input capacitance is needed to prevent possible impedance interactions between the supply and MAS9123. 2. Ceramic, tantalum, and film capacitors can be used. If a tantalum capacitor is used, it should be checked that the surge current rating is sufficient for the application. 3. In the case that the inductance between a **battery** and MAS9123 is very small (< 0.1 μH), a 0.47 μF input capacitor is sufficient. 4. The value of C_{IN} should not be smaller than the value of C_L.

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.**

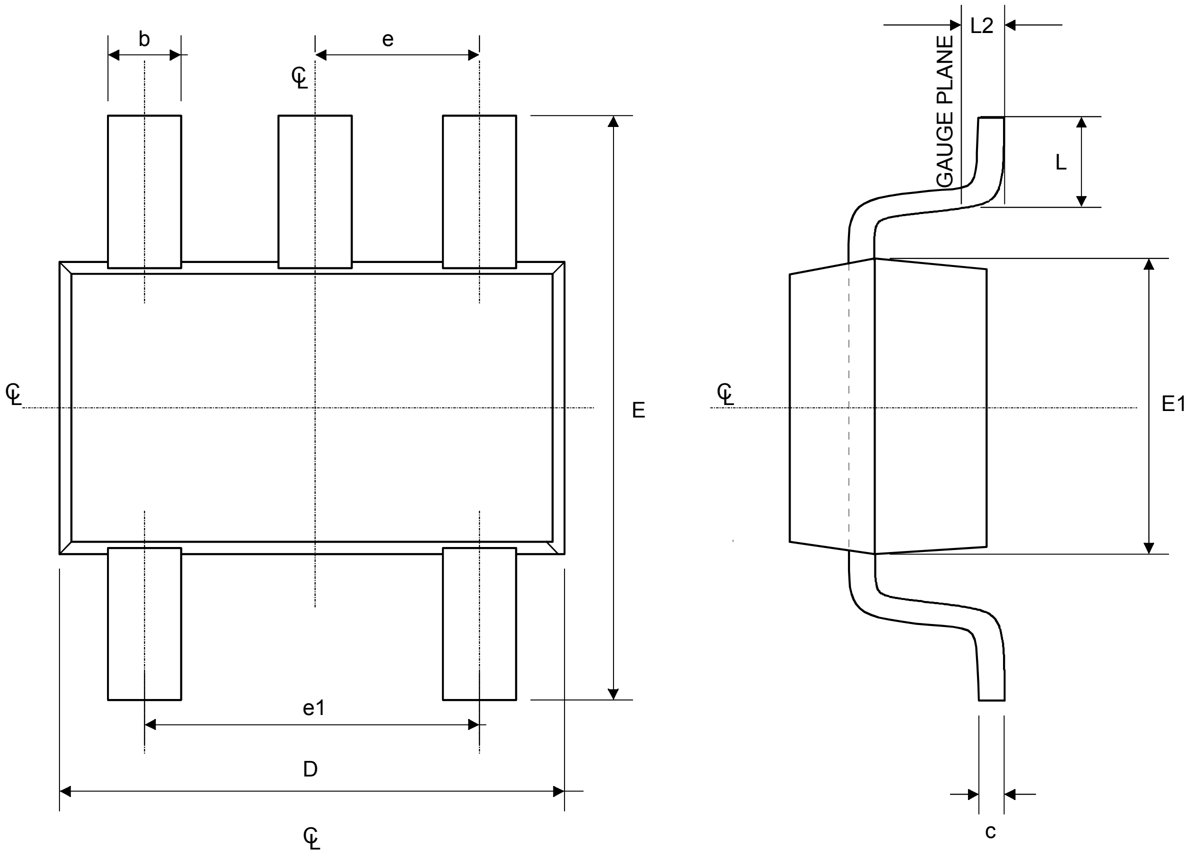
PACKAGE (SOT23-5) OUTLINE

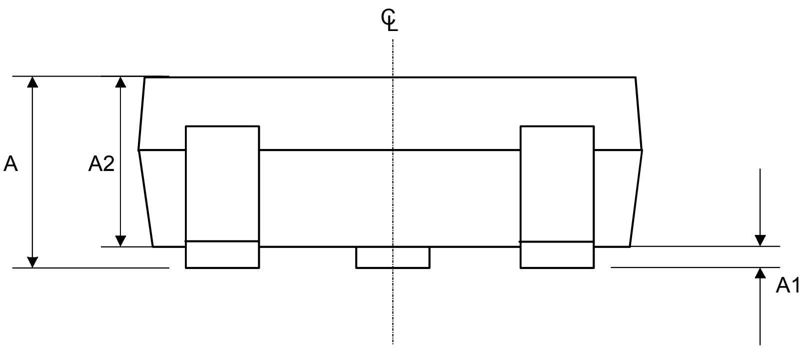


NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS
2. FOOT LENGHT MEASURED AT INTERCEPT POINT BETWEEN DATUM A & LEAD SURFACE.
3. PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH & METAL BURR
4. PACKAGE OUTLINE INCLUSIVE OF SOLDER PLATING.
5. COMPLY TO EIAJ SC74

Symbol	Min	Max	Unit
A	0.90	1.45	mm
A1	0.00	0.15	mm
A2	0.90	1.30	mm
b	0.25	0.50	mm
C	0.09	0.20	mm
D	2.80	3.10	mm
E	2.60	3.00	mm
E1	1.50	1.75	mm
L	0.35	0.55	mm
e	0.95ref		mm
e1	1.90ref		mm

PACKAGE (TSOT-5) OUTLINE





1) PACKAGE OUTLINE DIMENSIONS INCLUSIVE OF METAL BURR & SOLDER PLATING

2) PACKAGE OUTLINE EXCLUSIVE OF MOLD FLASH

3) ALL SPECIFICATIONS COMPLY TO JEDEC MO193

4) Q REFERS TO ALL PACKAGE DRAFT ANGLES

Symbol	Min	Nom	Max	Unit
A	--	--	1.00	mm
A1	0.01	0.05	0.10	mm
A2	0.84	0.87	0.90	mm
b	0.30	--	0.45	mm
c	0.12	0.127	0.20	mm
D		2.90BSC		mm
E		2.80BSC		mm
E1		1.60BSC		mm
e		0.95BSC		mm
e1		1.90BSC		mm
L	0.30	0.40	0.50	mm
L2		0.25BSC		mm
Q	4°	10°	12°	

SOLDERING INFORMATION

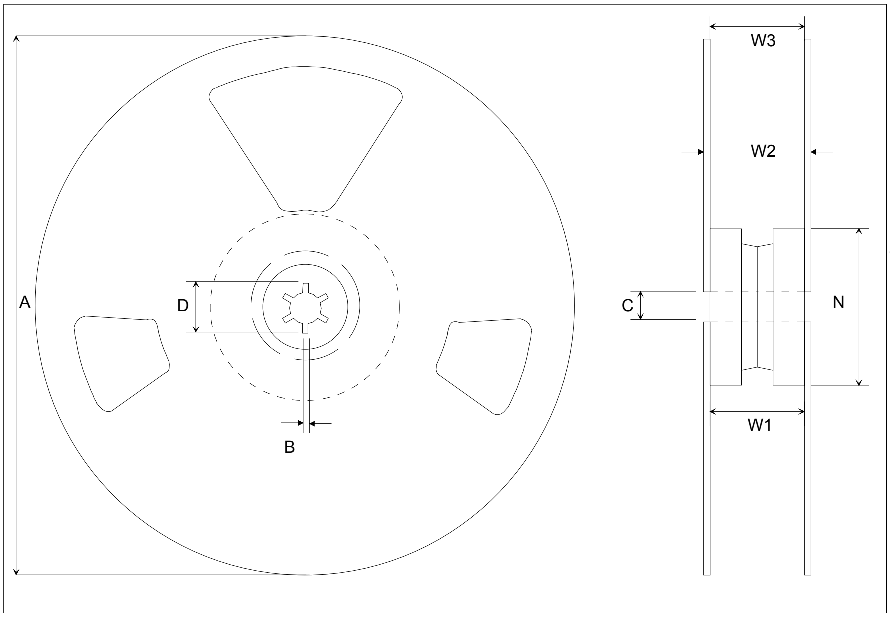
◆ For Eutectic Sn/Pb SOT23-5

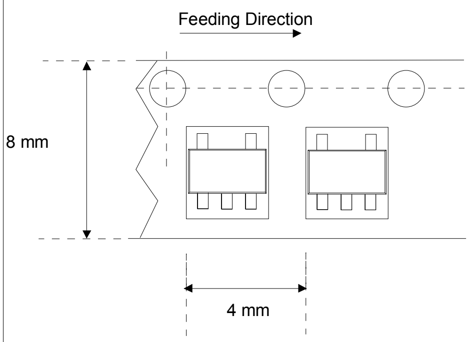
Resistance to Soldering Heat	According to RSH test IEC 68-2-58/20 2*220°C
Maximum Temperature	240°C
Maximum Number of Reflow Cycles	3
Reflow profile	Thermal profile parameters stated in JESD22-A113 should not be exceeded. http://www.jedec.org
Seating Plane Co-planarity	max 0.08 mm
Lead Finish	Solder plate 7.62 - 25.4 µm, material Sn 85% Pb 15%

◆ For Lead-Free, RoHS Compliant TSOT-5

Resistance to Soldering Heat	According to RSH test IEC 68-2-58/20
Maximum Temperature	260°C
Maximum Number of Reflow Cycles	3
Reflow profile	Thermal profile parameters stated in IPC/JEDEC J-STD-020 should not be exceeded. http://www.jedec.org
Seating Plane Co-planarity	max 0.08 mm
Lead Finish	Solder plate 7.62 - 25.4 µm, material Matte Tin

TAPE & REEL SPECIFICATIONS (SOT23-5/TSOT-5)





Other Dimensions according to EIA-481 Standard.

3000 Components on Each Reel.

Dimension	Min	Max	Unit
A		178	mm
B	1.5		mm
C	12.80	13.50	mm
D	20.2		mm
N	50		mm
W_1 (measured at hub)	8.4	9.9	mm
W_2 (measured at hub)		14.4	mm
W_3 (includes flange distortion at outer edge)	7.9	10.9	mm
Trailer	160		mm
Leader	390, of which minimum 160 mm of empty carrier tape sealed with cover tape		mm

ORDERING INFORMATION

Product Code	Output Voltage	Top Marking	Package	Comments
MAS9123AST2-T	2.80 V	23A2	SOT23-5	Tape and Reel
MAS9123A2GC06	2.80 V	23A2 (G in the bottom marking to indicate lead-free, RoHS compliant)	TSOT-5 lead-free, RoHS compliant	Tape and Reel
MAS9123AST6-T	3.00 V	23A6	SOT23-5	Tape and Reel
MAS9123A6GC06	3.00 V	23A6 (G in the bottom marking to indicate lead-free, RoHS compliant)	TSOT-5 lead-free, RoHS compliant	Tape and Reel
MAS9123AST1-T	3.30 V	23A1	SOT23-5	Tape and Reel
MAS9123A1GC06	3.30 V	23A1 (G in the bottom marking to indicate lead-free, RoHS compliant)	TSOT-5 lead-free, RoHS compliant	Tape and Reel

For more voltage options contact Micro Analog Systems Oy.

LOCAL DISTRIBUTOR

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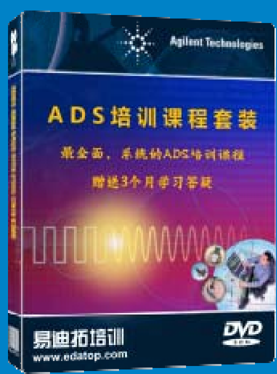
课程网址：http://www.edatop.com/peixun/rfe/110.html

ADS 学习培训课程套装

该套装是迄今国内最全面、最权威的 ADS 培训教程，共包含 10 门 ADS 学习培训课程。课程是由具有多年 ADS 使用经验的微波射频与通信系统设计领域资深专家讲解，并多结合设计实例，由浅入深、详细而又全面地讲解了 ADS 在微波射频电路设计、通信系统设计和电磁仿真设计方面的内容。能让您在最短的时间内学会使用 ADS，迅速提升个人技术能力，把 ADS 真正应用到实际研发工作中去，成为 ADS 设计专家...

课程网址： http://www.edatop.com/peixun/ads/13.html

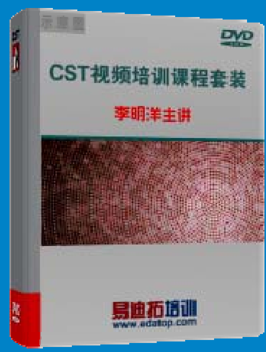


HFSS 学习培训课程套装

该套课程套装包含了本站全部 HFSS 培训课程，是迄今国内最全面、最专业的HFSS培训教程套装，可以帮助您从零开始，全面深入学习HFSS的各项功能和在多个方面的工程应用。购买套装，更可超值赠送 3 个月免费学习答疑，随时解答您学习过程中遇到的棘手问题，让您的 HFSS 学习更加轻松顺畅…

课程网址：http://www.edatop.com/peixun/hfss/11.html

CST 学习培训课程套装



该培训套装由易迪拓培训联合微波 EDA 网共同推出，是最全面、系统、专业的 CST 微波工作室培训课程套装，所有课程都由经验丰富的专家授课，视频教学，可以帮助您从零开始，全面系统地学习 CST 微波工作的各项功能及其在微波射频、天线设计等领域的设计应用。且购买该套装，还可超值赠送 3 个月免费学习答疑…

课程网址：http://www.edatop.com/peixun/cst/24.html

HFSS 天线设计培训课程套装

套装包含 6 门视频课程和 1 本图书，课程从基础讲起，内容由浅入深，理论介绍和实际操作讲解相结合，全面系统的讲解了 HFSS 天线设计的全过程。是国内最全面、最专业的 HFSS 天线设计课程，可以帮助您快速学习掌握如何使用 HFSS 设计天线，让天线设计不再难…

课程网址：http://www.edatop.com/peixun/hfss/122.html

13.56MHz NFC/RFID 线圈天线设计培训课程套装

套装包含 4 门视频培训课程，培训将 13.56MHz 线圈天线设计原理和仿真设计实践相结合，全面系统地讲解了 13.56MHz 线圈天线的工作原理、设计方法、设计考量以及使用 HFSS 和 CST 仿真分析线圈天线的具体操作，同时还介绍了 13.56MHz 线圈天线匹配电路的设计和调试。通过该套课程的学习，可以帮助您快速学习掌握 13.56MHz 线圈天线及其匹配电路的原理、设计和调试…

详情浏览：http://www.edatop.com/peixun/antenna/116.html

我们的课程优势：

※ 成立于 2004 年，10 多年丰富的行业经验，

※ 一直致力并专注于微波射频和天线设计工程师的培养，更了解该行业对人才的要求

※ 经验丰富的一线资深工程师讲授，结合实际工程案例，直观、实用、易学

联系我们：

※ 易迪拓培训官网：http://www.edatop.com

※ 微波 EDA 网：http://www.mweda.com

※ 官方淘宝店：http://shop36920890.taobao.com