Advanced Monolithic Systems

AMS112

150mA LOW DROPOUT VOLTAGE REGULATOR WITH ON/OFF SWITCH

PRELIMINARY INFORMATION

FEATURES

- **3.3V and 5V Voltage Available***
- **Active High On/Off Control**
- **Output Current of 150mA**
- **Very Low Quiescent Current**
- **Low Dropout Voltage of 80mV at 30mA**
- **Very Low Noise**
- **Short Circuit Protection**
- **Internal Thermal Shutdown**
- **Space Saving 5 Lead SOT-23 Package**

APPLICATIONS

- **Battery Powered Systems**
- **Portable Consumer Equipment**
- **Cordless Telephones**
- **Portable (Notebook) Computers**
- **Portable Instrumentation**
- **Radio Control Systems**
- **Personal Communication Equipment**
- **Toys**
- **Low Voltage Systems**

GENERAL DESCRIPTION

The AMS112 series consists of positive fixed voltage regulators featuring an internal electronic switch controlled by TTL or CMOS logic levels. When the Control pin is pulled to a logic high level, the device is in the ON state. If the control function is not used, the control terminal should be connected to a logic high level or V_{IN}, therefore allowing the regulator to be ON. The regulator will be ON when the control terminal voltage is grater than 1.8V. To lower the output noise level to $30\mu V_{rms}$, an external capacitor can be connected to the noise bypass pin. These devices feature very low quiescent current of 1mA when supplying 30mA loads (180µA at no load). This unique characteristic and the low standby current (typ. 100nA) make the AMS112 ideal to use for standby power systems. Like other regulators the AMS112 series also includes internal current limiting and thermal shutdown.

The AMS112 is offered in 3.3V and 5.0V output voltages, and is available in the 5-pin SOT-23 surface mount package.

ORDERING INFORMATION

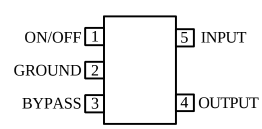
PACKAGE TYPE	**OPERATING TEMP. RANGE**
5L SOT-23	
AMS112M1-X	IND

X =3.3V or 5V

*For additional available fixed voltages contact factory

PIN CONNECTIONS

5 Lead SOT-23 (M1)



Bottom View

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ABSOLUTE MAXIMUM RATINGS (Note 1)

Input Voltage	16V
Power Dissipation	400mW
Operating Temperature Range	-30°C to +80°C
Maximum Junction Temperature	+150°C
Storage Temperature	-55°C to +150°C
Lead Temperature (Soldering 10 sec)	230°C

ELECTRICAL CHARACTERISTICS

Electrical Characteristics at T_A=25°C, V_{IN} =V_{OUT} +1V, C_P = 0.1µF unless otherwise noted.

PARAMETER	CONDITIONS (Note 2)	AMS112-X Min.	Typ.	Max.	Units
Output Voltage	V_{IN} = V_{OUT}+1V	-3		+3	%
Quiescent Current	I_O = 0 mA, Except I_{CONT}		170	350	µA
Standby Current	V_{IN} = 8V, at output off			0.1	µA
Line Regulation	V_{IN} = V_{OUT}+1V to V_{OUT}+6V		3	20	mV
Load Regulation	5mA ≤I_O ≤ 60 mA		10	50	mV
Dropout Voltage	I_O = 60 mA I_O = 150 mA		160 290	260 400	mV mV
Output Current		180	240		mA
Ripple Rejection	100mV_{rms}, I_O=10mA		55		dB
Output Noise Voltage	10Hz < f < 80kHz, I_O=30mA		30		µVrms
Temperature Coefficient	I_O=10mA, -20°C≤T_A≤+75°C		0.2		mV/°C
Noise Bypass Terminal Voltage			1.25		V
Control Terminal Specifications					
On/Off Current	Output On		12	30	µA
On/Off Voltage	Output On Output Off	1.8		 0.6	V V
Output Rise Time	I_O = 30 mA, V_{CONT} = 0V to 1.8V		0.3		ms

Note 1: Absolute Maximum Ratings are limits beyond which damage to the device may occur. For guaranteed performance limits and associated test conditions, see the Electrical Characteristics tables.

Note 2: To ensure constant junction temperature, low duty cycle pulse testing is used.

APPLICATION HINTS

Package Power Dissipation

The package power dissipation is the level at which the thermal sensor monitoring the junction temperature is activated. The AMS112 shuts down when the junction temperature exceeds the limit of 150°C. The junction temperature rises as the difference between the input power and output power increases. The mounting pad configuration on the PCB, the board material, as well as the ambient temperature affect the rate of temperature rise. The junction temperature will be low, even if the power dissipation is high, when the mounting of the device has good thermal conductivity. When mounted on the recommended mounting pad the power dissipation for the SOT-23 package is 400mW. For operation above 25°C derate the power dissipation at 3.2 mW/°C. To determine the power dissipation for shutdown when mounted, attach the device on the PCB and increase the input-to-output voltage until the thermal protection circuit is activated. Calculate the power dissipation of the device by subtracting the output voltage from the input voltage and multiply by the output current. The measurements should allow for the ambient temperature of the PCB. The value obtained from P_D/ (150°C - T_A) is the derating factor. The PCB mounting pad should provide maximum thermal conductivity in order to maintain low device temperatures. As a general rule, the lower the temperature, the better the reliability of the device.
The thermal resistance when the device is mounted is equal to:

$$T_J = \theta_{JA} \times P_D + T_A$$

The internal limit for junction temperature is 150°C. If the ambient temperature is 25°C, then:

$$150°C = \theta_{JA} \times P_D + 25°C$$

$$\theta_{JA} = 125°C/ P_D$$

A simple way to determine P_D is to calculate $V_{IN} \times I_{IN}$ when the output is shorted. As the temperature rises, the input gradually will decrease. The P_D value obtained when the thermal equilibrium is reached, is the value that should be used.

The range of usable currents can be found from the graph in figure 2.

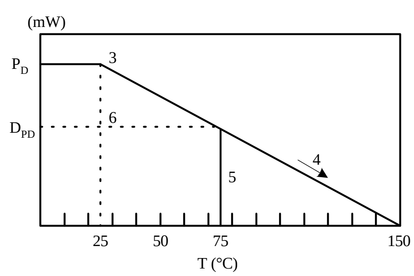


Figure 2

Procedure:
1. Find P_D.
2. P_{D1} is calculated as P_D x (0.8 - 0.9).
3. Plot P_{D1} against 25°C.
4. Connect P_{D1} to the point corresponding to the 150°C.
5. Take a vertical line from the maximum operating temperature (75°C) to the derating curve.
6. Read the value of P_D at the point where the vertical line intersects the derating curve. This is the maximum power dissipation, D_{PD}.

The maximum operating current is:

$$I_{OUT} = (D_{PD}/ (V_{IN(MAX)} - V_O)$$

External Capacitors

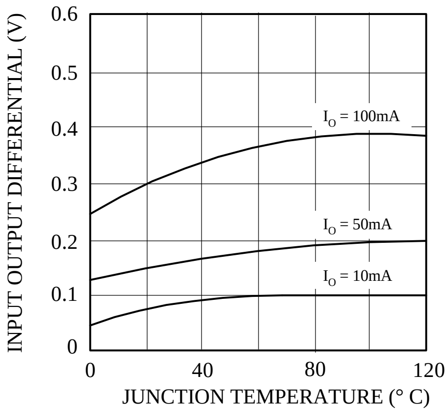
The AMS112 series require input and output decoupling capacitors. The required value of these capacitors depends on the application circuit and other factors.
Because high frequency characteristics of electrolytic capacitors depend greatly on the type and even the manufacturer, the value of capacitance that works well with AMS112 for one brand or type may not necessary be sufficient with an electrolytic of different origin. Sometimes actual bench testing will be the only means to determine the proper capacitor type and value. To obtain stability in all general applications a high quality 4.7μF aluminum electrolytic or a 2.2μF tantalum electrolytic can be used.
A critical characteristic of the electrolytic capacitors is their performance over temperature. The AMS112 is designed to operate to -30°C, but some electrolytics will freeze around -30°C therefore becoming ineffective. In such case the result is oscillation at the regulator output. For all application circuits where cold operation is necessary, the output capacitor must be rated to operate at the minimum temperature.
In order to determine the minimum value of the output capacitor, for an application circuit, the entire circuit including the capacitor should be bench tested at minimum operating temperatures and maximum operating currents. After the minimum capacitance value has been found, the value should be doubled for actual use to cover for production variations both in the regulator and the capacitor. The recommended minimum capacitance for AMS112 is 2.2μF. As a general rule, with higher output voltages the value of the output capacitance decreases, since the internal loop gain is reduced.

Noise Bypass Capacitor

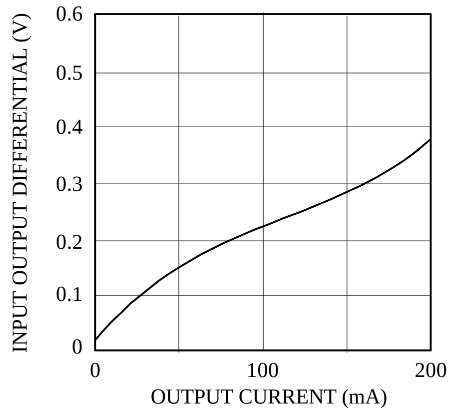
The noise bypass capacitor should be connected as close as possible to pin 3 and ground. The recommended value for this capacitor is 0.01μF. The noise bypass terminal is susceptible to external noise, and oscillation can occur when the bypass capacitor is not used and the solder pad for this pin is too large. Because of the high impedance of the noise bypass terminal, care should be taken if the bypass capacitor is not used.

TYPICAL PERFORMANCE CHARACTERISTICS

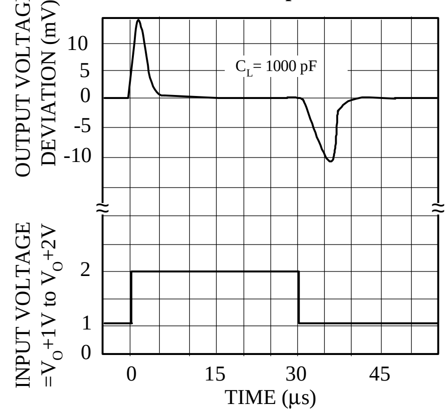
Dropout Voltage



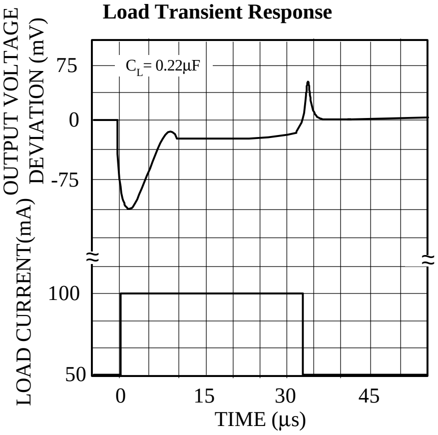
Dropout Voltage



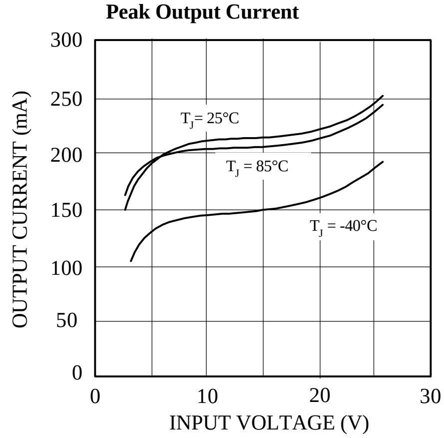
Line Transient Response



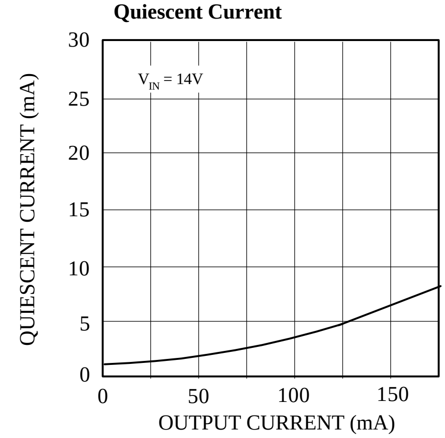
Load Transient Response



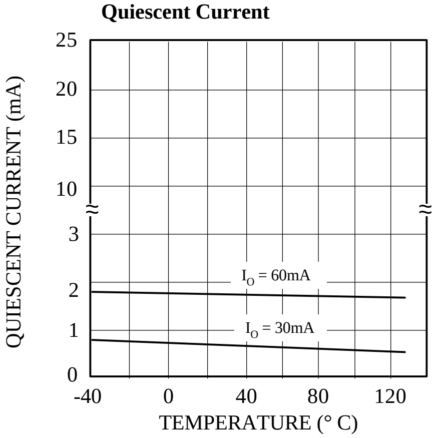
Peak Output Current



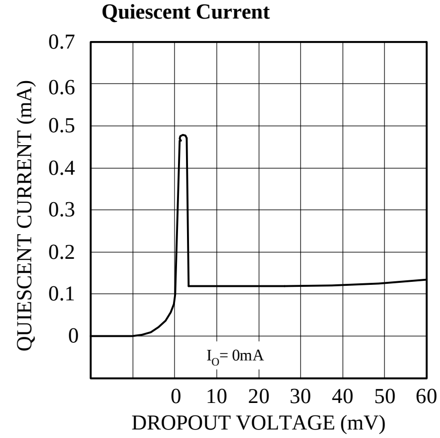
Quiescent Current



Quiescent Current



Quiescent Current



Ripple Rejection