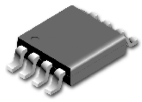
1A Low-Voltage Low-Dropout Regulator LM37102C

FEATURES

- Fixed and adjustable output voltages to 1.24V
- Stable with MLCC and Ceramic Capacitors
- 500mV typical dropout at 1A
  Ideal for 3.0V to 2.5V conversion
  Ideal for 2.5V to 1.8V or 1.5V conversion
- 1A minimum guaranteed output current
- 1% initial accuracy
- Low ground current
- Current limiting and thermal shutdown
- Reversed-battery protection
- Reversed-leakage protection
- Fast transient response
- Moisture Sensitivity Level 3

SOP-8 & SOP-8PP PKG



APPLICATION

- Battery Powered Equipments
- Motherboards and Graphic Cards
- Microprocessor Power Supplies
- Peripheral Cards
- High Efficiency Linear Regulators
- Battery Chargers

ORDERING INFORMATION

Device	Package
LM37102CGD	SOP-8
LM37102CGDP	SOP-8PP

DESCRIPTION

The LM37102C is 1A low-dropout linear voltage regulators that provide low-voltage, high-current output. The LM37102C offers extremely low dropout (typically 500mV at 1A). The LM37102C is adjustable regulators, SOP-8 and SOP-8PP.

The LM37102C is ideal for PC add-in cards that need to convert from standard 5V to 3.3V, 3.3V to 2.5V or 2.5V to1.8V. A guaranteed maximum dropout voltage of 630mV overall operating conditions allows the LM37102C to provide 2.5V from a supply as low as 3.13V and 1.8V from a supply as low as 2.5V. The LM37102C is fully protected with over current limiting, thermal shutdown, and reversed-battery protection.

Absolute Maximum Ratings (Note 1)

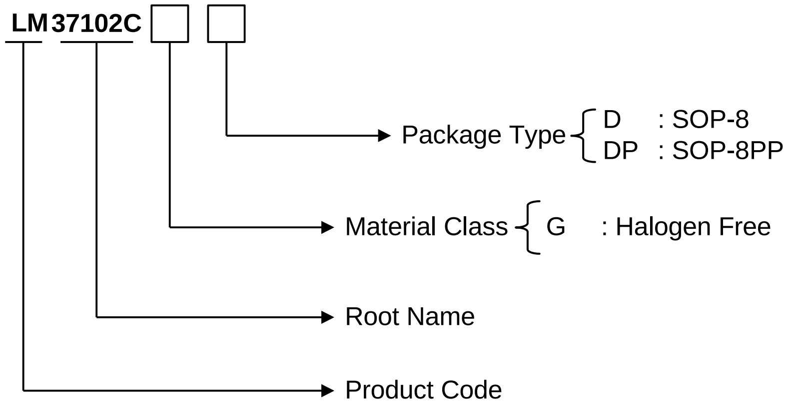
CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Supply Voltage	V_{IN}	- 0.3	+ 20	V
Enable Voltage	V_{EN}	-	+ 20	V
Lead Temperature (Soldering, 5 sec)	T_{SOL}	-	260	℃
Storage Temperature Range	T_{STG}	-65	+ 150	℃

Operating Ratings (Note 2)

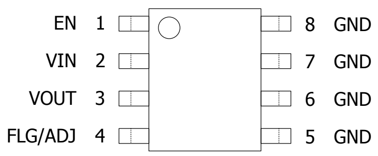
CHARACTERISTIC	SYMBOL	MIN.	MAX.	UNIT
Supply Voltage	V_{IN}	+ 2.5	+ 16	V
Enable Voltage	V_{EN}		+ 16	V
Junction Temperature	T_J	-40	+ 125	℃

Ordering Information

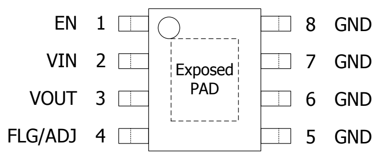
V_{OUT}	Package	Order No.	Description	Supplied As	Status
ADJ	SOP-8	LM37102CGD	1A, Adjustable, Enable	Reel	Active
	SOP-8PP	LM37102CGDP	1A, Adjustable, Enable	Reel	Active



PIN CONFIGURATION



SOP-8

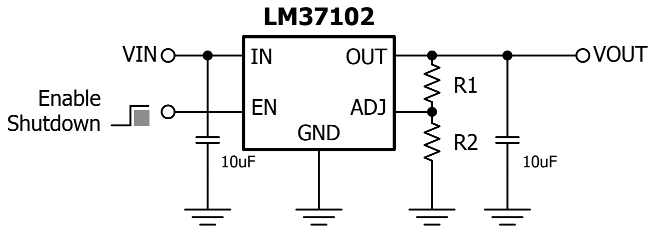


SOP-8PP

PIN DESCRIPTION

Pin No.	SOP-8 PKG	
	Name	Function
1	EN	Chip Enable
2	VIN	Input Supply
3	VOUT	Output Voltage
4	FLG / ADJ	Error Flag Output or Output Adjust
5 / 6 / 7 / 8	GND	Ground
	Thermal Exposed PAD	Connect to Ground.

TYPICAL APPLICATION



1.5V / 1A Adjustable Regulator

ELECTRICAL CHARACTERISTICS

T_J = 25°C, **bold** values indicate -40°C ≤ T_J ≤ +125°C; unless noted otherwise.

Symbol	Parameters	Condition	Min.	Typ.	Max.	Unit
V_{OUT}	Output Voltage	10mA 10mA ≤ I_{OUT} ≤ 1A, V_{OUT}+1V ≤ V_{IN} ≤16V	-1 **-2**		1 **2**	% %
V_{ADJ}	Adjustable Pin Voltage		1.228 **1.215**	1.24	1.252 **1.265**	V
		(Note 8)	**1.203**		**1.277**	
I_{ADJ}	Adjust Pin Bias Current			3	**20**	uA
	Line Regulation	I_{OUT}=1mA, V_{OUT} +1V ≤ V_{IN} ≤ 16V		0.06	0.5	%
	Load Regulation	V_{IN}= V_{OUT} +1V, 1mA ≤ I_{OUT} ≤ 1A		0.2	1	%
V_{DO}	Dropout Voltage (Note 5)	I_{OUT}=100mA, ΔV_{OUT} = -1%		100	**250**	mV mV
		I_{OUT}=1A, ΔV_{OUT} = -1%		500	**630**	mV mV
I_{GND}	Ground Current (Note 6)	I_{OUT}=100mA, V_{IN}= V_{OUT}+1V		3.8		mA
		I_{OUT}=1A, V_{IN}= V_{OUT}+1V		25		mA
$I_{OUT(lim)}$	Current Limit	V_{OUT}=0V, V_{IN}=V_{OUT}+1V		1.4	2.5	A
$\Delta V_{OUT}/\Delta T$	Output Voltage Temp. Coefficient (Note 4)				**100**	ppm/ °C
V_{EN}	Enable Input Voltage	logic low (off)			**0.25**	V
		logic high (on)	**2.0**			V
I_{EN}	Enable Input Current	V_{EN}=16V		3	30 **75**	μA μA
		V_{EN}=0.0V		0.01	1 **4**	μA μA
T_{EN}	Delay time to Nominal Output Voltage (Note 7)	I_{OUT} =10mA, V_{IN} =V_{OUT} +1V, V_{EN} =0V to V_{IN}		50		μs
		I_{OUT} =500mA, V_{IN} =V_{OUT} +1V, V_{EN} =0V to V_{IN}		250		
		I_{OUT} =1.0A, V_{IN} =V_{OUT} +1V, V_{EN} =0V to V_{IN}		350		

Note 1. Exceeding the absolute maximum ratings may damage the device.

Note 2. The device is not guaranteed to function outside its operating rating.

Note 3. PD (max)= ($T_{J\ (max)}$ - T_A) ÷ θ_{JA}, where θ_{JA} -junction-to-ambient thermal resistance.

Note 4. Output voltage temperature coefficient is ΔV_{OUT} (worst case) ÷ ($T_{J(max)}$ - $T_{J(min)}$) where $T_{J(max)}$ is +125°C and $T_{J(min)}$ is 0°C.

Note 5. V_{DO} = V_{IN} - V_{OUT} when V_{OUT} decreases to 99% of its nominal output voltage with V_{IN} = V_{OUT} + 1V. For output voltages below 2.5V, dropout voltage is the input-to-output voltage differential with the minimum input voltage being 2.5V. Minimum input operating voltage is 2.5V.

Note 6. I_{GND} is the quiescent current. I_{IN} = I_{GND} + $I_{OUT.}$

Note 7. Delay time is measured after V_{EN}=V_{IN}. C_{IN}=C_{OUT}=10μF.

Note 8. V_{ADJ} ≤ V_{OUT} ≤ (V_{IN} - 1V), 2.5V ≤ V_{IN} ≤ 16V, 10mA ≤ I_L ≤ 1 A.

APPLICATION INFORMATION

Output Capacitor

The LM37102C regulators are designed to be stable with a wide range of output capacitors. The ESR of the output capacitor affects stability, most notably with small capacitors. A minimum output capacitor of 2.2uF is recommended to prevent oscillations. Larger values of output capacitance can decrease the peak deviations and provide improved transient response for larger load current changes. Bypass capacitors, used to decouple individual components powered by the LM37102C, will increase the effective output capacitor value.
Extra consideration must be given to the use of ceramic capacitors. Ceramic capacitors are manufactured with a variety of dielectrics, each with different behavior over temperature and applied voltage.
X7R-type capacitors change capacitance by 15% over their operating temperature range and are the most stable type of ceramic capacitors. Z5U and Y5V dielectric capacitors change value by as much as 50% and 60% respectively over their operating temperature ranges. To use a ceramic chip capacitor with Y5V dielectric, the value must be much higher than an X7R ceramic capacitor to ensure the same minimum capacitance over the equivalent operating temperature range.

Input Capacitor

An input capacitor of 1μF or greater is recommended when the device is more than 4 inches away from the bulk ac supply capacitance or when the supply is a battery. Small, surface-mount, ceramic chip capacitors can be used for the bypassing. Larger values will help improving the ripple rejection by bypassing the input to the regulator, further improving the integrity of the output voltage.

Enable Input

The LM37102C features an active-high enable input (EN) that allows on-off control of the regulator. Current drain reduces to “zero” when the device is shutdown, with only micro amperes of leakage current. The EN input has TTL/CMOS compatible thresholds for simple logic interfacing. EN may be directly tied to V_{IN} and pulled up to the maximum supply voltage.

Minimum Load Current

The LM37102C regulator is specified between finite loads. If the output current is too small, leakage currents dominate and the output voltage rises. A 10mA minimum load current is necessary for proper regulation.

Adjustable Regulator Design

The LM37102C allows programming the output voltage any-where between 1.24V and the 16V maximum operating rating of the family. Two resistors are used. Resistors can be quite large, up to 1MΩ, because of the very high input impedance and low bias current of the sense comparator: The resistor values are calculated by : R1=R2(Vout/1.240-1) Where Vout is the desired output voltage. Figure 1 shows component definition. Applications with widely varying load currents may scale the resistors to draw the minimum load current required for proper operation (see below). The current consumed by feedback resisters R1 and R2 is calculated by: I_{res} = Vout / (R1+ R2).

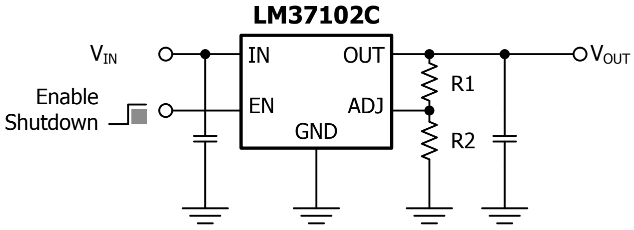


Figure 1. Adjustable Regulator with Resistors

Maximum Output Current Capability

The LM37102C can deliver a continuous current of 1A over the full operating junction temperature range. However, the output current is limited by the restriction of power dissipation which differs from packages. A heat sink may be required depending on the maximum power dissipation and maximum ambient temperature of application. With respect to the applied package, the maximum output current of 1A may be still undeliverable due to the restriction of the power dissipation of LM37102C. Under all possible conditions, the junction temperature must be within the range specified under operating conditions. The temperatures over the device are given by:

$$T_C = T_A + P_D \times \theta_{CA} \; / \quad T_J = T_C + P_D \times \theta_{JC} \; / \quad T_J = T_A + P_D \times \theta_{JA}$$

where T_J is the junction temperature, T_C is the case temperature, T_A is the ambient temperature, P_D is the total power dissipation of the device, θ_{CA} is the thermal resistance of case-to-ambient, θ_{JC} is the thermal resistance of junction-to-case, and θ_{JA} is the thermal resistance of junction to ambient. The total power dissipation of the device is given by:

$$P_D = P_{IN} - P_{OUT} = (V_{IN} \times I_{IN}) - (V_{OUT} \times I_{OUT})$$
$$= (V_{IN} \times (I_{OUT} + I_{GND})) - (V_{OUT} \times I_{OUT}) = (V_{IN} - V_{OUT}) \times I_{OUT} + V_{IN} \times I_{GND}$$

where I_{GND} is the operating ground current of the device which is specified at the Electrical Characteristics. The maximum allowable temperature rise (T_{Rmax}) depends on the maximum ambient temperature (T_{Amax}) of the application, and the maximum allowable junction temperature (T_{Jmax}):

$$T_{Rmax} = T_{Jmax} - T_{Amax}$$

The maximum allowable value for junction-to-ambient thermal resistance, θ_{JA}, can be calculated using the formula:

$$\theta_{JA} = T_{Rmax} / P_D = (T_{Jmax} - T_{Amax}) / P_D$$

LM37102C is available in SOP-8 and SOP-8PP package. The thermal resistance depends on amount of copper area or heat sink, and on air flow. If the maximum allowable value of θ_{JA} calculated above is over 75°C/W for SOP-8PP package and 130°C/W for SOP-8, no heat sink is needed since the package can dissipate enough heat to satisfy these requirements. If the value for allowable θ_{JA} falls near or below these limits, a heat sink or proper area of copper plane is required. In summary, the absolute maximum ratings of thermal resistances are as follow:

Absolute Maximum Ratings of Thermal Resistance

Characteristic	Symbol	Rating	Unit
Thermal Resistance Junction-To-Ambient / SOP-8	$\theta_{JA\text{-}SOP\text{-}8}$	130	°C/W
Thermal Resistance Junction-To-Ambient / SOP-8PP	$\theta_{JA\text{-}SOT\text{-}8PP}$	75	°C/W

No heat sink / No air flow / No adjacent heat source / 20 mm^2 copper area. (T_A=25°C)

REVISION NOTICE

The description in this datasheet can be revised without any notice to describe its electrical characteristics properly.