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SEMICONDUCTOR



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**AP2112K-X.XTRG1(MS)**

产品手册

**静态电流 2μA, 输出电流 600mA 低压降线性降压转换器**

**概述**

AP2112K-X.XTRG1(MS) 系列是一组低压差(LDO) 转换器, 具有 1.2V至6V宽电压输入范围、低压差、低功耗和小型化封装的等特性。

AP2112K-X.XTRG1(MS) 低至 2uA 低静态电流特性, 特别适合用于电池供电、长时间待机系统设备应用, 能帮助降低系统设备的待机功耗, 有效延长待机时间和电池使用寿命。AP2112K-X.XTRG1(MS) 有带 EN 使能引脚的版本可选, 将 EN 脚拉低可进入关断模式, 此关断模式下静态电流可降至仅10nA (典型值)。

AP2112K-X.XTRG1(MS) 系列支持输出电容采用陶瓷电容器, 在 1.2V 至 6V 的宽输入电压范围内和整个输出负载电流 0mA- 600mA 范围内稳定工作。

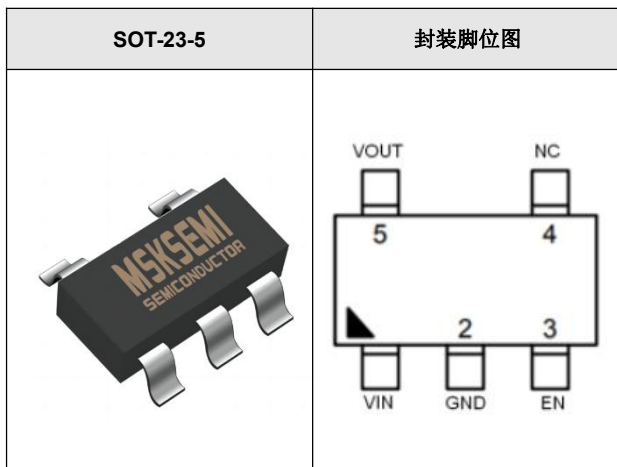
**产品特性**

- 2uA 静态电流 (无负载)
- ±2%输出电压精度
- 600mA 输出电流能力
- 10nA 关断电流(可选版本)
- 宽范围输入电压: 1.2V 至 6V
- 低压差: 0.32V (Vo=3.3V/Io=600mA 条件下)
- 支持固定输出电压: 1.2V, 1.8V, 2.5V, 3.0V, 3.3V
- 支持陶瓷电容或者钽电容
- 限流保护
- 过温保护
- 提供 SOT-23-5封装

**产品用途**

- 手持式、电池供电设备
- 低功耗微处理器
- 笔记本电脑、掌上型电脑和 PDA
- 无线通讯设备
- 音频/视频设备
- 车载导航系统

**产品信息**

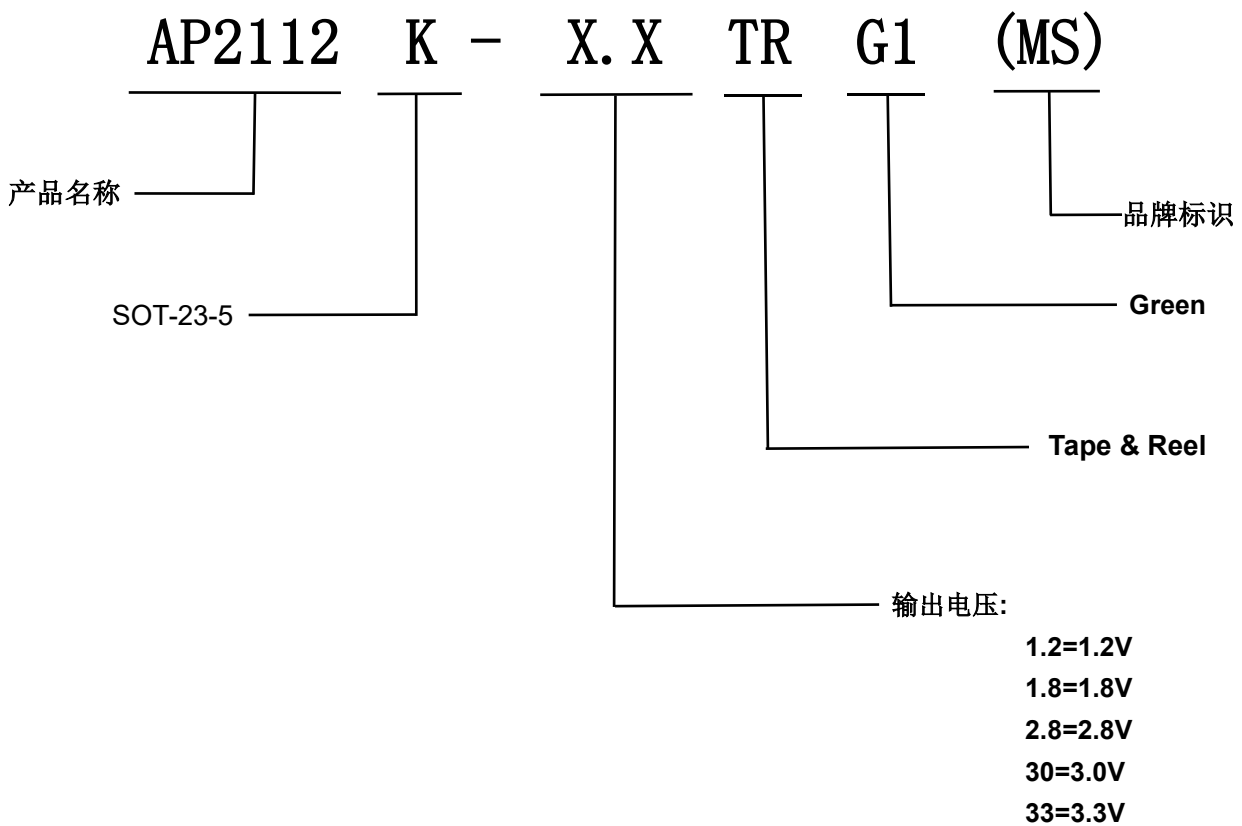


AP2112K-1.2TRG1(MS)	AP2112K-1.8TRG1(MS)
<b>AABS</b> ****	<b>AABT</b> ****
AP2112K-2.8TRG1(MS)	AP2112K-3.0TRG1(MS)
<b>AABU</b> ****	<b>AAAX</b> ****
AP2112K-3.3TRG1(MS)	
<b>AAAA</b> ****	

注: \*\*\*\*代表生产编码

引脚功能描述

脚位号	名称	功能描述
2	GND	接地
5	VOUT	电源输出端口
1	VIN	电源输入端口
3	EN	使能控制
4	NC	浮空脚



订购信息

型号	输出电压	封装	最小包装
AP2112K-1.2TRG1(MS)	1.2V	SOT-23-5	3000/7II/Tape & Reel
AP2112K-1.8TRG1(MS)	1.8V	SOT-23-5	3000/7II/Tape & Reel
AP2112K-2.8TRG1(MS)	2.8V	SOT-23-5	3000/7II/Tape & Reel
AP2112K-3.0TRG1(MS)	3.0V	SOT-23-5	3000/7II/Tape & Reel
AP2112K-3.3TRG1(MS)	3.3V	SOT-23-5	3000/7II/Tape & Reel

典型应用电路

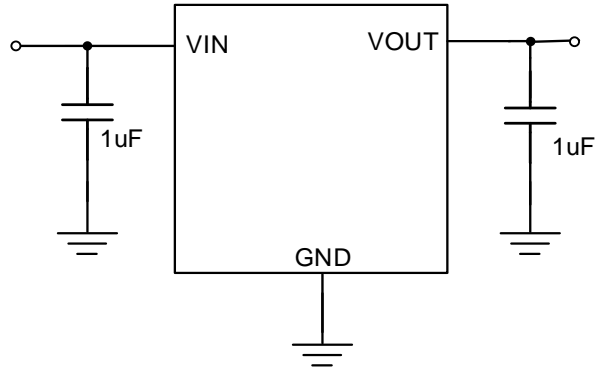


图 1: 固定输出应用电路

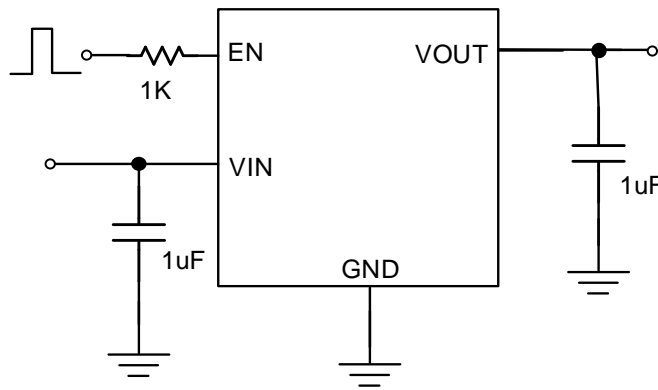


图 2: 带使能脚的固定输出应用电路

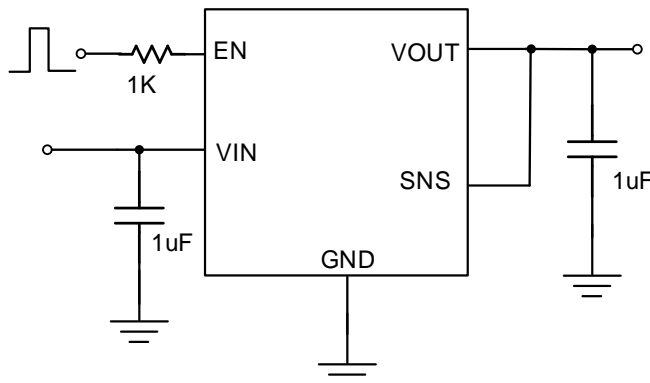


图 3: 固定输出带使能功能和输出电压检测功能之应用电路

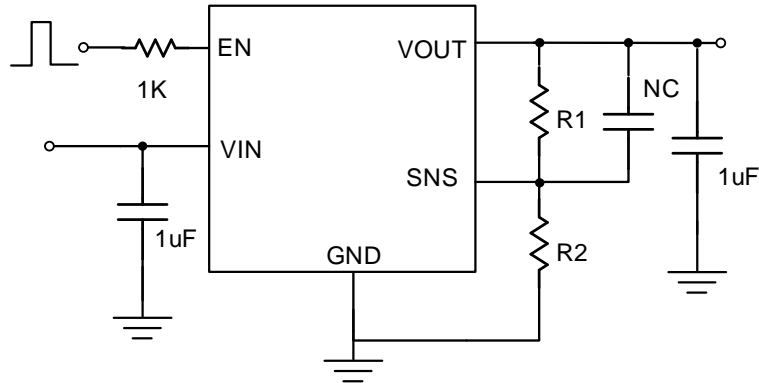
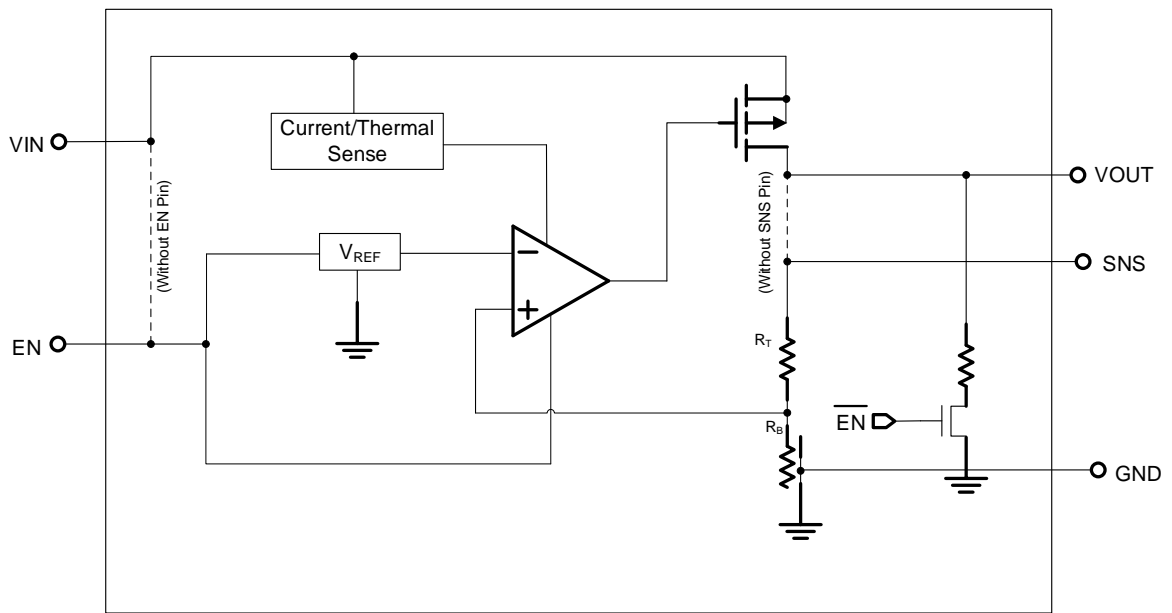


图 4: 带使能脚和输出电压检测可调电压输出应用电路

**产品功能框图**



**最大耐压值** (Note 1)

VIN 至 GND -----	-0.3V to 7V
VOUT, EN 至 GND -----	-0.3V to 6V
VOUT 至 VIN -----	-6V to 0.3V

封装热阻 (Note 2)

$\theta_{JA}$ -----	200	/W
引脚焊锡温度 (Soldering, 10 sec.) -----	260	
结点温度 -----	150	

存储温度范围 -----	-60 °C to 150 °C
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ESD 静电

HBM -----	2KV
MM -----	200V
CDM -----	2KV

**建议应用条件**

输入电压 VIN -----	1.2V to 6V
应用结温范围 -----	-40 °C to 125 °C
应用环温范围 -----	-40 °C to 85 °C

## 电气特性

( $V_{IN}=5V$ ,  $V_{EN}=5V$   $T_A=25^{\circ}C$  除另有说明外)

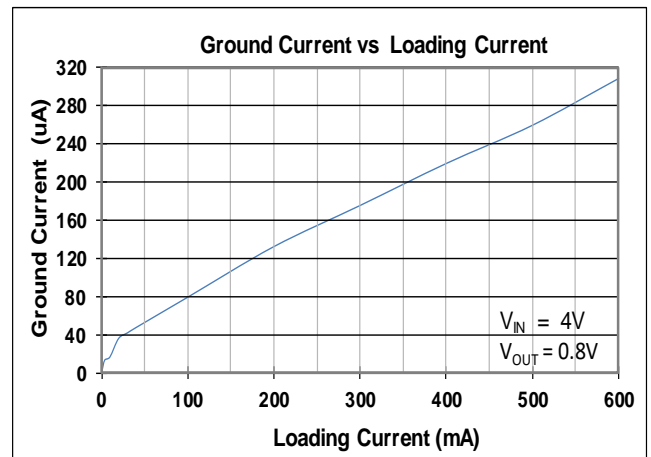
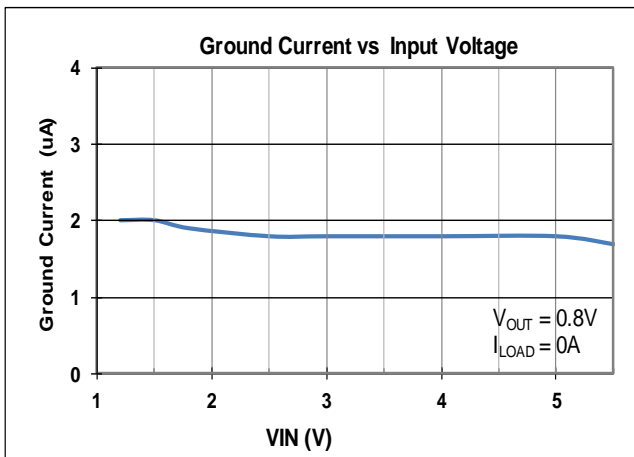
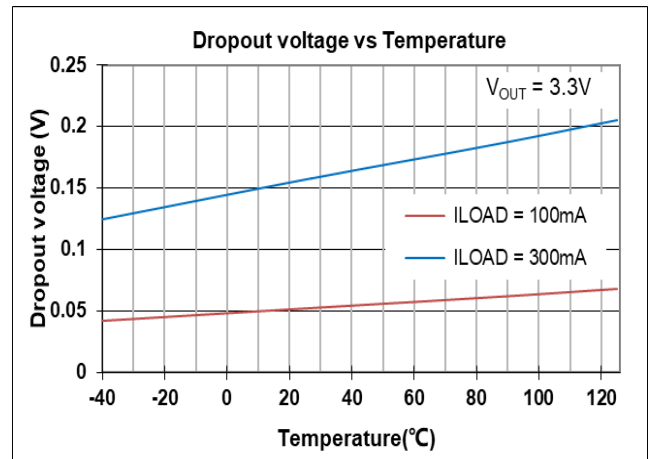
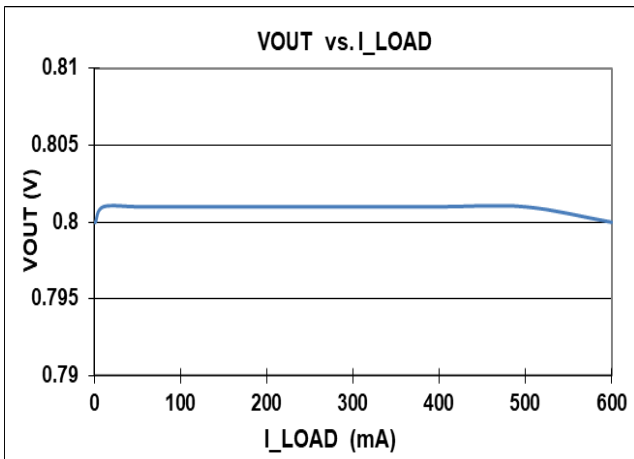
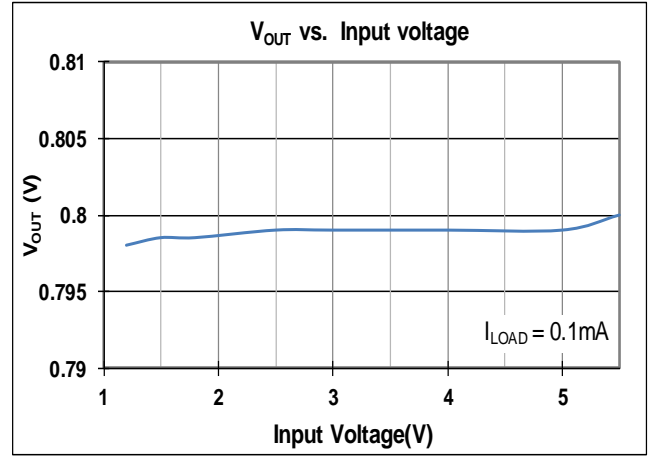
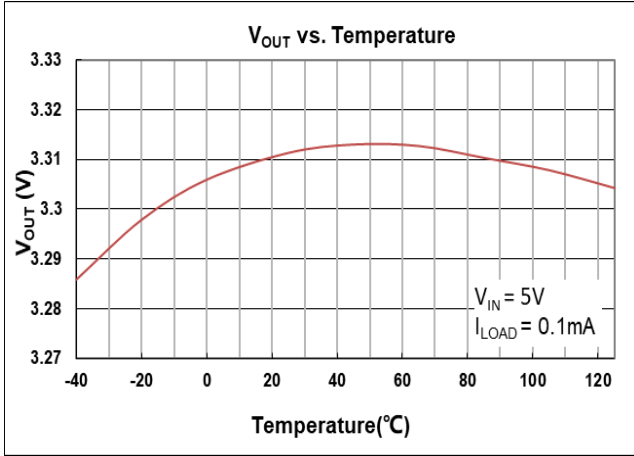
参数	符号	测试条件	最小值	典型值	最大值	单位	
输入电压	$V_{IN}$		1.2	--	6.0	V	
输出电压精度		$I_{LOAD}=0.1mA$	-2		2	%	
SNS 输入电流	$I_{SNS}$	$SNS = V_{OUT}$		0.7		$\mu A$	
Dropout 电压 ( $I_{LOAD}=600mA$ ) (Note 3)	$V_{DROP\_3.3V}$	$V_{OUT} \geq 3.3V$		0.32		V	
	$V_{DROP\_3V}$	$V_{OUT} \geq 3V$		0.32			
	$V_{DROP\_2.8V}$	$V_{OUT} = 2.8V$		0.36			
	$V_{DROP\_1.8V}$	$V_{OUT} = 1.8V$		0.57			
	$V_{DROP\_1.2V}$	$V_{OUT} = 1.2V$		0.8			
静态电流	$I_Q$	$I_{LOAD} = 0mA$		2		$\mu A$	
关闭电流	$I_{SD}$	$V_{EN} = 0V, V_{OUT} = 0V$		0.01	0.5	$\mu A$	
使能电压阈值	$V_{IH}$	EN Rising	1.7			V	
	$V_{IL}$	EN Falling			0.6		
EN 输入电流	$I_{EN}$	$V_{EN} = 5V$		10	100	nA	
输入电压调整率	$\Delta LINE$	$I_{LOAD} = 30mA$ , $1.5V \leq V_{IN} \leq 5.5V$ or $(V_{OUT} + 0.2V) \leq V_{IN} \leq 5.5V$		0.2		%	
负载电压调整率	$\Delta LOAD$	$10mA \leq I_{LOAD} \leq 0.3A$		0.2		%	
输出电流限值	$I_{LIM}$	$V_{OUT} = 0V$	601	1100		mA	
电源抑制比 ( $I_{LOAD} = 5mA$ )	PSRR	$V_{OUT} = 1.2V$ , $V_{IN} = 2V$	$f = 100Hz$	--	80	--	dB
			$f = 1kHz$	--	75	--	
输出电流噪声 ( $BW = 10Hz$ to $100kHz$ , $C_{OUT} = 1\mu F$ )		$V_{IN} = 3.5V$ $I_{LOAD} = 0.1A$	$V_{OUT} = 0.9V$	--	40	--	$\mu V_{RMS}$
			$V_{OUT} = 2.8V$	--	70	--	
过温度关断温度	$T_{SD}$	$I_{LOAD} = 10mA$		--	155	--	$^{\circ}C$
过温度关断迟滞	$\Delta T_{SD}$			--	15	--	$^{\circ}C$
放电电阻	$R_{DC}$	$EN = 0V, V_{OUT} = 0.1V$	--	80	--	$\Omega$	

**Note 1.** 任何超过“最大耐压值”的应用可能会导致芯片遭受永久性损坏。这些是额定最大耐压值，仅表示在这个范围内芯片不会损伤，但不保证所有性能指标都正常，在任何超过“最大耐压值”的场合使用，都可能导致芯片永久性损坏。在接近或等于最大耐压值情况下使用，可能会影响产品可靠性。

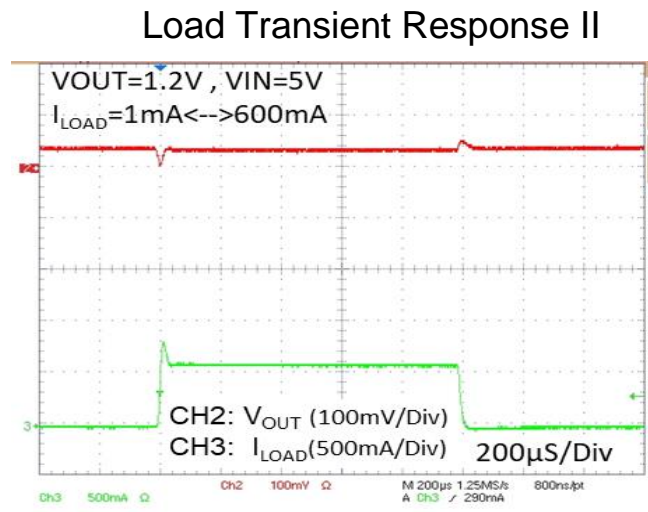
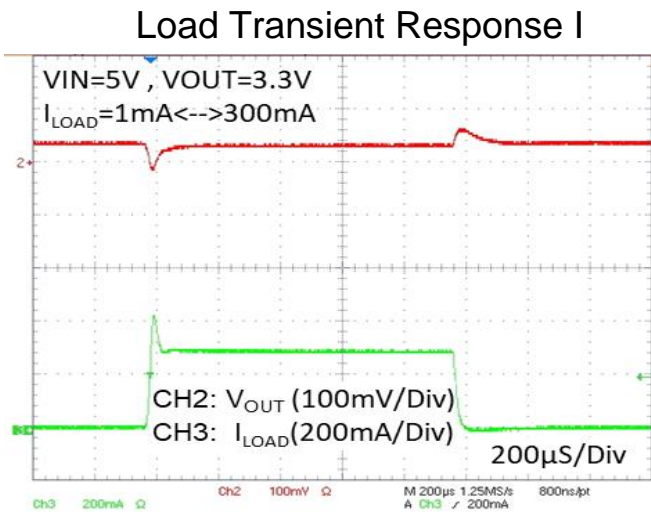
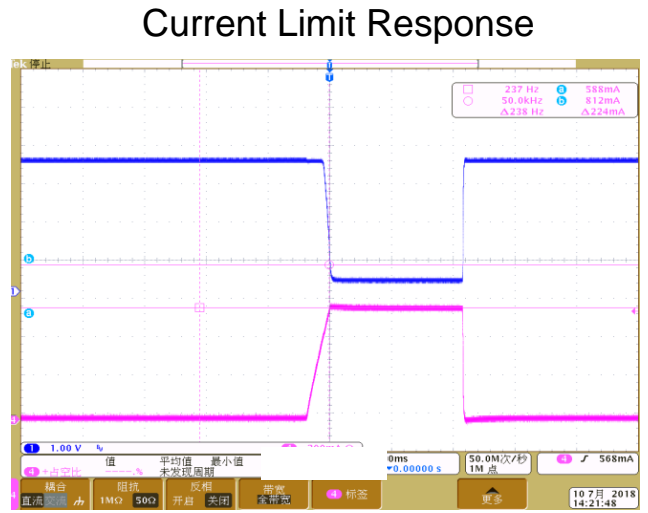
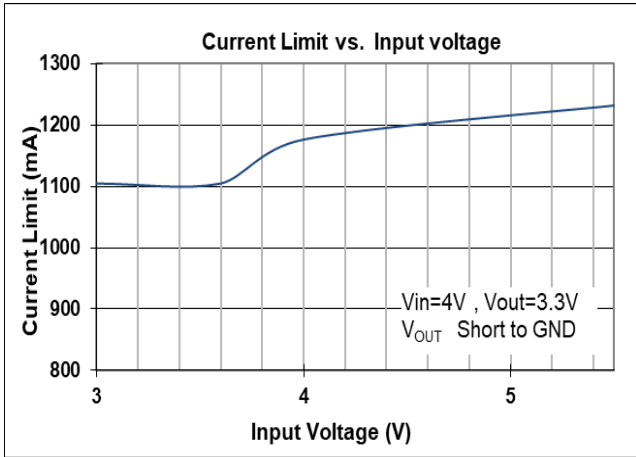
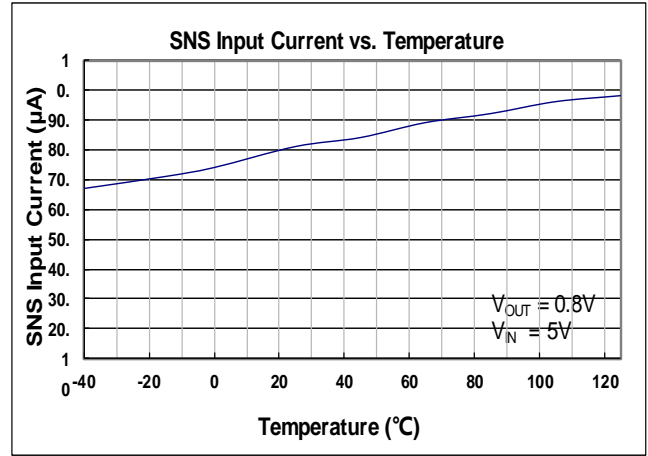
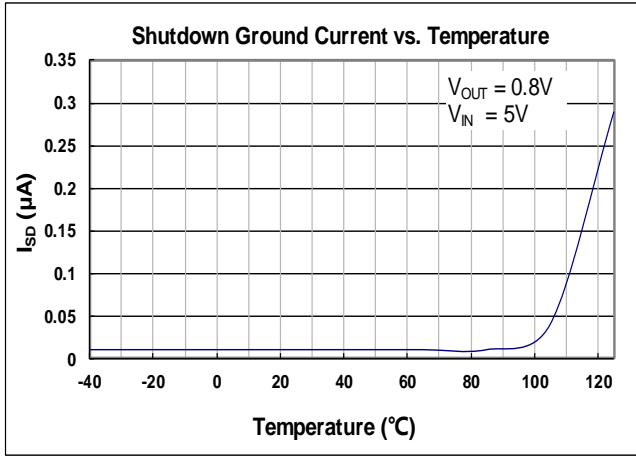
**Note 2.**  $\theta_{JA}$  测量条件： $T_A = 25^{\circ}C$ ，使用 EVB 板。

**Note 3.**  $V_{DROP} = V_{IN} - V_{OUT}$  ( $V_{OUT}$  达到 98%标准值)。

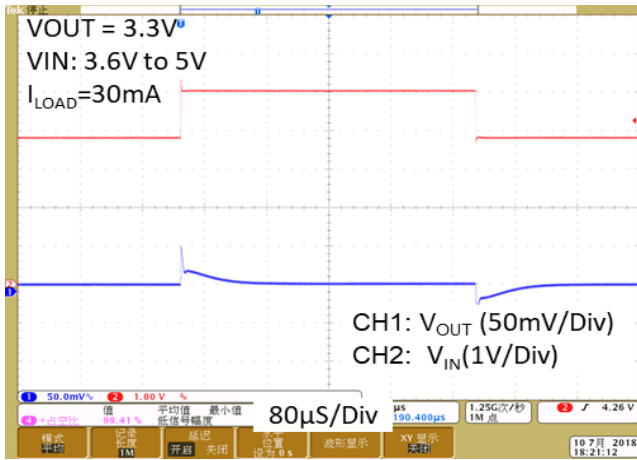
典型电气特性



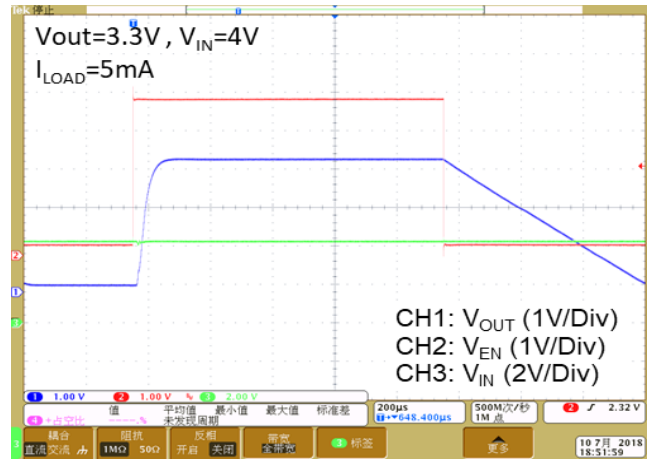




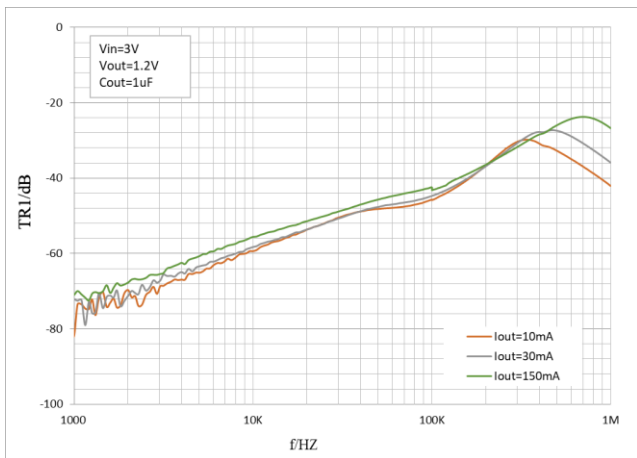
Line Transient Response



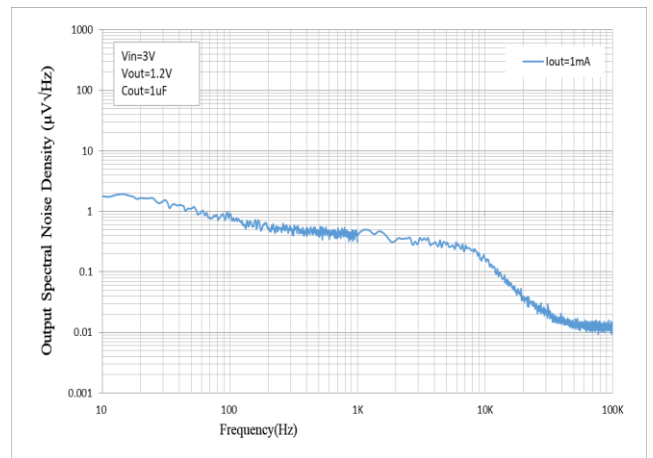
V<sub>OUT</sub> Turn On/Off by EN



PSRR vs. Frequency



Noise Density Spectrum



## 应用指导

### 输入和输出电容

AP2112K-X.XTRG1(MS)系列产品应用，需要选择合适的输入电容和输出电容，以确保产品应用获得稳定可靠的性能。使用 1uF 或者更大容值的输入电容，并将其靠近 IC 的 VIN 和 GND pin 脚摆放。输出电容可选用 1mΩ 以上 ESR (等效串联阻抗)，有效容值 1uF 至 22uF 的电容。并将输出电容靠近 IC 的 V<sub>OUT</sub> 和 GND 脚摆放。增加输出电容的容值和降低 ESR 能够提升电路的 PSRR 和瞬态响应能力。

### 电流限制功能

AP2112K-X.XTRG1(MS)系列产品内部的电流限制器可持续监控及控制输出功率晶体管，将输出电流限制至 1100mA (典型值)。限流功能确保输出可以短路至地，器件不会损坏。

### Dropout 电压

AP2112K-X.XTRG1(MS)系列采用 PMOS 传输晶体管来实现低压差。当 (V<sub>IN</sub> - V<sub>OUT</sub>) 小于 (V<sub>DROP</sub>) 时，PMOS 晶体管处于线性工作区域，输入至输出阻抗即为 PMOS 的 R<sub>DS(ON)</sub>，在此状态下，PMOS 等效于一颗电阻，V<sub>DROP</sub> 和输出电流近似成比例。和其他线性电压转换器一样，AP2112K-X.XTRG1(MS)系列的 PSRR 和瞬态响应能力会随着 (V<sub>IN</sub> - V<sub>OUT</sub>) 压差接近 V<sub>DROP</sub> 而下降。

### 可调输出电压应用

AP2112K-X.XTRG1(MS)带 SNS Pin 版本可同时作为可调输出电压 LDO。图 4 是可调输出电压典型应用电路。从 V<sub>OUT</sub> 到 SNS 的分压电阻网络设定输出电压，输出电压值由 R1 和 R2 的值决定。为确保输出电压的输出精度，需要合理选择 R1 和 R2 的值，以减少 SNS 脚处输入电流的温度影响。为了满足上述要求，建议流过分压电阻器的电流大于 50uA。可调输出电压计算公式如下：

$$V_{OUT} = \frac{R1+R2}{R2} \times V_{SNS} \quad (1)$$

V<sub>SNS</sub> 取决于选用的产品型号 AP2112K-X.XTRG1(MS)，V<sub>SNS</sub> 值为 0.8V。由于可调输出分压电阻最小 50uA 电流的要求，整个降压电路的静态电流不再是 2uA。

### OTP (过温度保护)

当产品的结点温度超过 155°C (典型值) 时，AP2112K-X.XTRG1(MS)会关闭 P-MOS 关闭输出。当结点温度往回降大约 15°C 时，AP2112K-X.XTRG1(MS)会重新自动重启工作。

### 热散功率

持续工作时，IC 的结点温度不应超过其额定值。最大的热散功率取决于 IC 封装的热阻、PCB 布图、周围气流速率以及结点和环境温度的差异。最大热散功率计算如下：

热散功率(PD)等于输出电流和 LDO 上的压降的乘积，计算公式如下：

$$PD = (VIN - VOUT) \times IOUT$$

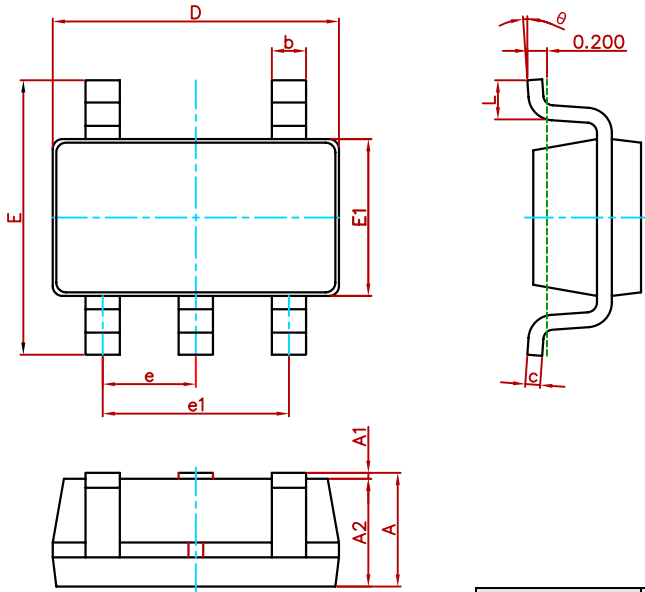
环温  $T_A=25^{\circ}\text{C}$ , 使用 PCB,

$$PD(\text{Max}) = (125^{\circ}\text{C} - 25^{\circ}\text{C}) / (200^{\circ}\text{C}/\text{W}) = 0.5\text{W}$$

### Layout 注意事项

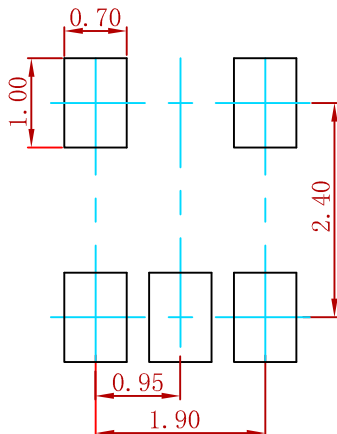
将输入电容、输出电容和 LDO 放置在 PCB 的同一面，并尽量将电容器靠近 IC 的输入输出脚摆放，可实现电路最佳性能。输入电容和输出电容的接地连接必须拉回到 AP2112K-X.XTRG1(MS)的接地引脚，并使用短而粗的铺线连接。避免使用长走线、窄走线、或者通过过孔走线，这些会增加寄生电感和电阻，导致电路性能变差，特别是在瞬态工作条件下。

**Package Outline Dimensions**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	2.650	2.950	0.104	0.116
E1	1.500	1.700	0.059	0.067
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

**Suggested Pad Layout**



- Note:
1. Controlling dimension: in millimeters.
  2. General tolerance:  $\pm 0.05\text{mm}$ .
  3. The pad layout is for reference purposes only.

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