

# MSKSEMI 美森科

SEMICONDUCTOR



ESD



TVS



TSS



MOV



GDT



PLED

## AP2125K-X.XTRG1(MS)

Product specification

## 产品描述

AP2125K-X.XTRG1(MS) 系列是一组低压差 (LDO) 转换器, 具有 1.2V 至 5.5V 宽电压输入范围、低压差、低功耗和小型化封装的等特性。

AP2125K-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。

AP2125K-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 100nA (典型值)。AP2125K-X.XTRG1(MS) 系列支持输出电容采用陶瓷电容器, 在 1.2V 至 5.5V 的宽输入电压范围内和整个输出负载电流 0mA-300mA 范围内稳定工作。

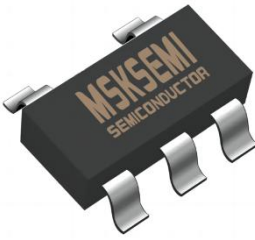
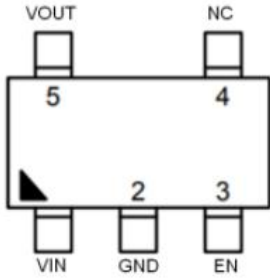
## 产品特性

- 2uA 静态电流 (无负载)
- $\pm 2\%$  输出电压精度
- 300mA 输出电流能力
- 100nA 关断电流 (可选版本)
- 宽范围输入电压: 1.2V 至 5.5V
- 低压差: 0.18V ( $V_o=3.3V/I_o=300mA$  条件下)
- 支持固定输出电压: 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V
- 支持陶瓷电容或者钽电容
- 限流保护
- 过温保护

## 产品应用

- 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

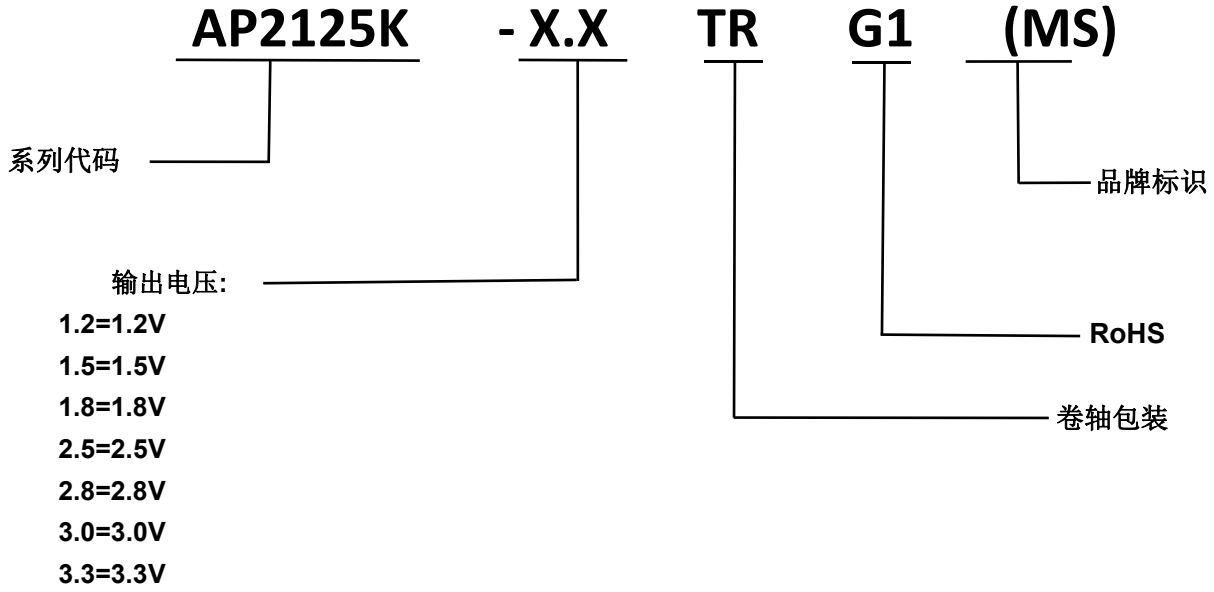
## 封装脚位图

| SOT-23-5  | Pin Configurations   |
|---|--|
|  |  |

## 引脚功能描述

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

## 产品信息



|                     |                     |
|---------------------|---------------------|
| AP2125K-1.2TRG1(MS) | AP2125K-1.5TRG1(MS) |
| <b>AADB</b><br>**** | <b>AADG</b><br>**** |
| AP2125K-1.8TRG1(MS) | AP2125K-2.5TRG1(MS) |
| <b>AABB</b><br>**** | <b>AAET</b><br>**** |
| AP2125K-2.8TRG1(MS) | AP2125K-3.0TRG1(MS) |
| <b>AAC6</b><br>**** | <b>AADC</b><br>**** |
| AP2125K-3.3TRG1(MS) |                     |
| <b>AAC7</b><br>**** |                     |

## 典型应用电路

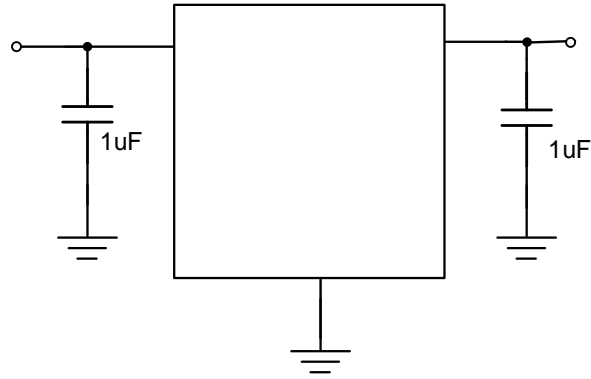


图 1: 固定输出应用电路

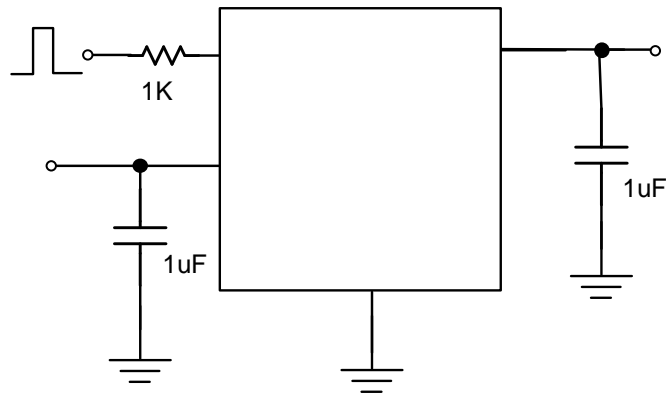


图 2: 带使能脚的固定输出应用电路

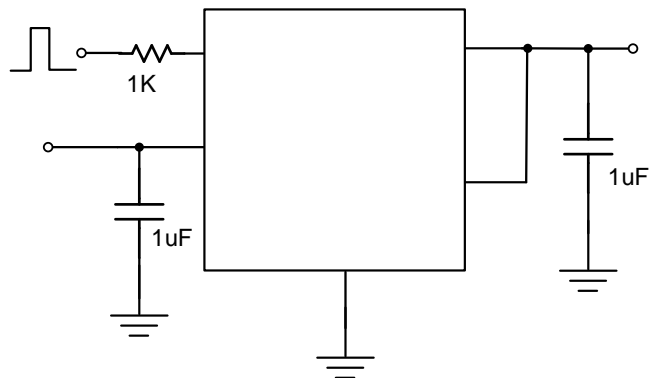


图 3: 固定输出带使能功能和输出电压检测功能之应用电路

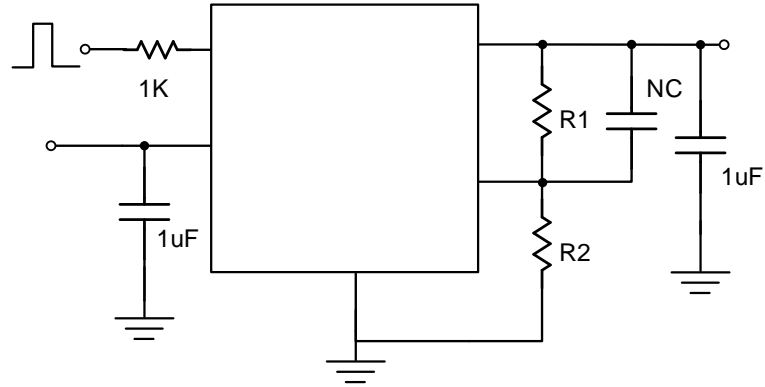
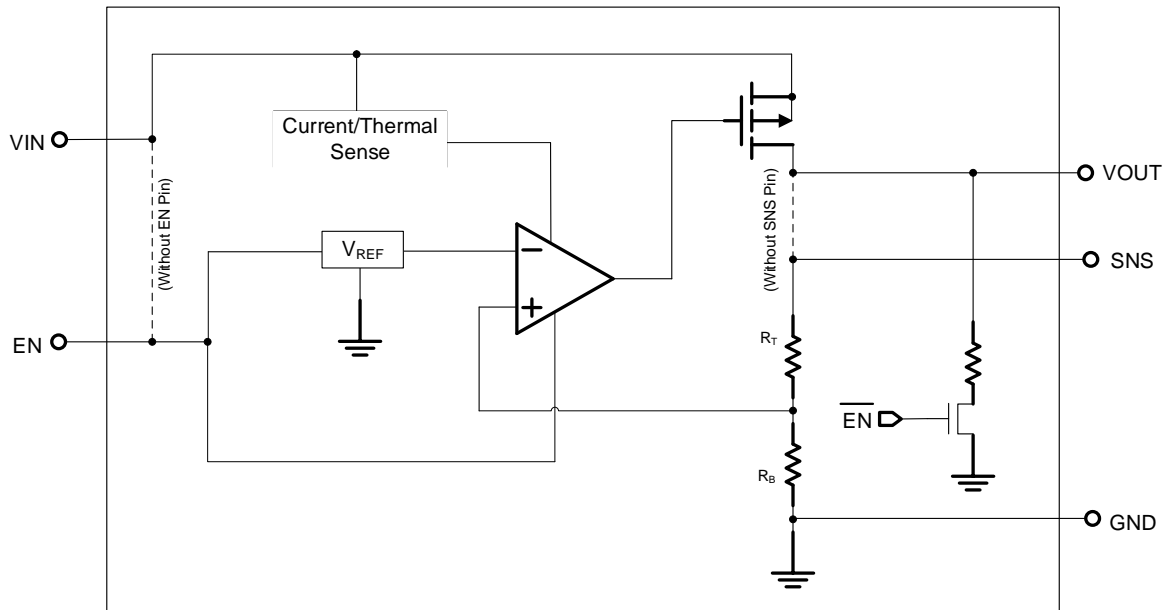


图 4: 带使能脚和输出电压检测可调电压输出应用电路

**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 °C /W        |
| 引脚焊锡温度 (Soldering, 10 sec.) | ----- | 260 °C           |
| 结点温度                        | ----- | 150 °C           |
| 存储温度范围                      | ----- | -60 °C to 150 °C |
| ESD 静电                      |       |                  |
| HBM                         | ----- | 2KV              |
| MM                          | ----- | 200V             |
| CDM                         | ----- | 2KV              |

**建议应用条件**

|          |       |                  |
|----------|-------|------------------|
| 输入电压 VIN | ----- | 1.2V to 5.5V     |
| 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)

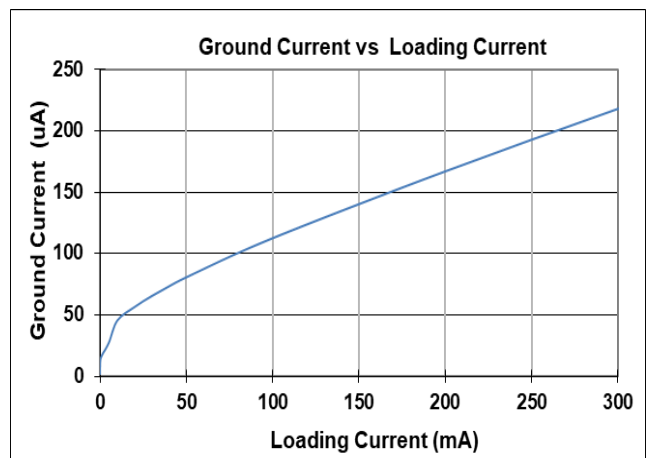
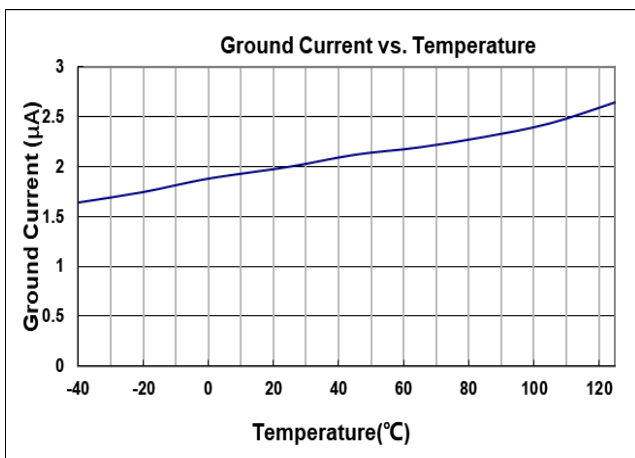
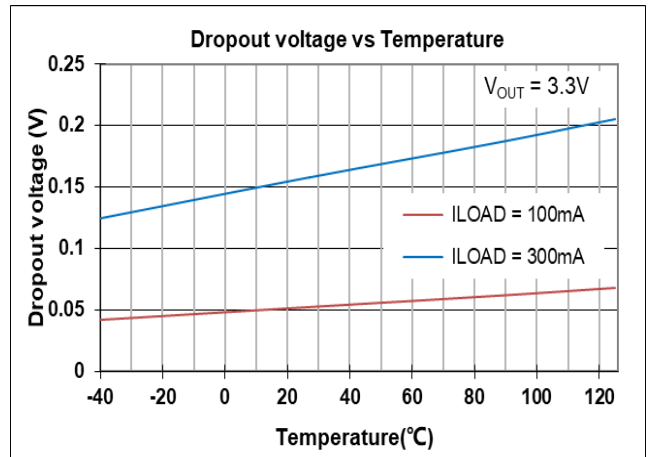
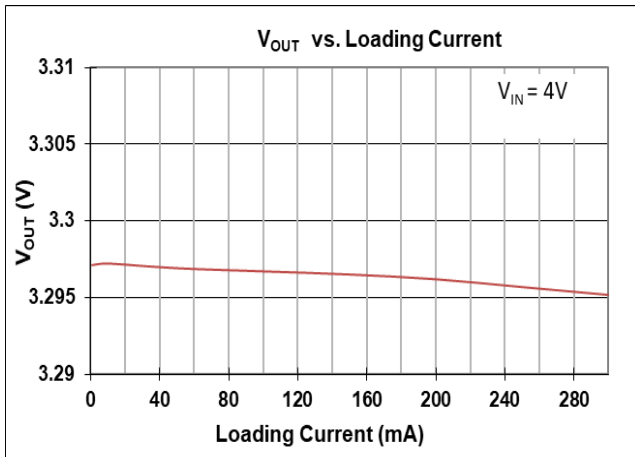
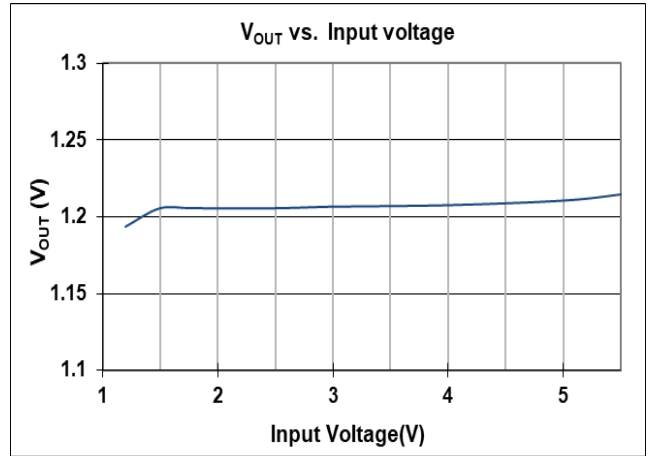
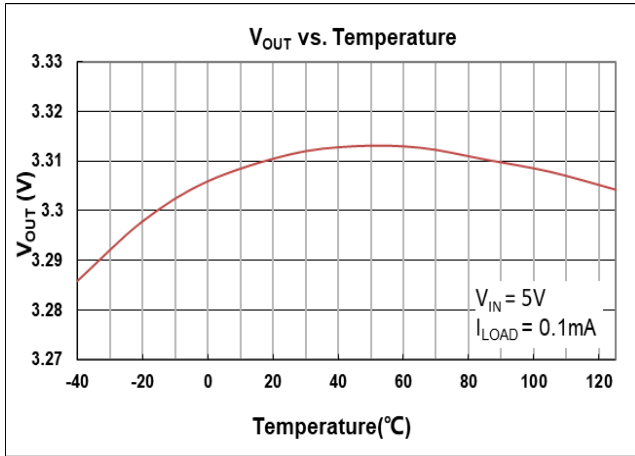
| 参数  | 符号               | 测试条件   | 最小值              | 典型值  | 最大值 | 单位       |               |
|---|------------------|--|------------------|------|-----|----------|---------------|
| 输入电压  | $V_{IN}$         |  | 1.2              | --   | 5.5 | V        |               |
| 输出电压精准度   |                  | $I_{LOAD} = 0.1mA$   | -2               |      | 2   | %        |               |
| SNS 输入电流  | $I_{SNS}$        | $SNS = V_{OUT}$  |                  | 0.5  |     | $\mu A$  |               |
| Dropout 电压 ( $I_{LOAD} = 300mA$ )<br>(Note 3)               | $V_{DROP\_3V}$   | $V_{OUT} \geq 3V$  |                  | 0.18 |     | V        |               |
|   | $V_{DROP\_2.8V}$ | $V_{OUT} = 2.8V$   |                  | 0.23 |     |          |               |
|   | $V_{DROP\_2.5V}$ | $V_{OUT} = 2.5V$   |                  | 0.23 |     |          |               |
|   | $V_{DROP\_1.8V}$ | $V_{OUT} = 1.8V$   |                  | 0.28 |     |          |               |
|   | $V_{DROP\_1.5V}$ | $V_{OUT} = 1.5V$   |                  | 0.36 |     |          |               |
|   | $V_{DROP\_1.2V}$ | $V_{OUT} = 1.2V$   |                  | 0.45 |     |          |               |
| 静态电流  | $I_Q$            | $I_{LOAD} = 0mA$   |                  | 2    |     | $\mu A$  |               |
| 关闭电流  | $I_{SD}$         | $V_{EN} = 0V$ , $V_{OUT} = 0V$   |                  | 0.1  | 0.5 | $\mu A$  |               |
| 使能电压阈值  | $V_{IH}$         | EN Rising  | 1.0              |      |     | V        |               |
|   | $V_{IL}$         | EN Falling   |                  |      | 0.4 |          |               |
| EN 输入电流   | $I_{EN}$         | $V_{EN} = 5V$  |                  | 10   | 100 | nA       |               |
| 输入电压调整率   | $\Delta LINE$    | $I_{LOAD} = 30mA$ ,<br>$1.5V \leq V_{IN} \leq 5.5V$ or<br>$(V_{OUT} + 0.2V) \leq V_{IN} \leq 5.5V$ |                  | 0.2  |     | %        |               |
| 负载电压调整率   | $\Delta LOAD$    | $10mA \leq I_{LOAD} \leq 0.3A$   |                  | 0.2  |     | %        |               |
| 输出电流限流值   | $I_{LIM}$        | $V_{OUT} = 0V$   | 301              | 600  |     | mA       |               |
| 电源抑制比<br>( $I_{LOAD} = 5mA$ )                               | PSRR             | $V_{OUT} = 1.2V$ ,<br>$V_{IN} = 2V$  | $f = 100Hz$      | --   | 80  | --       | dB            |
|   |                  |  | $f = 1kHz$       | --   | 75  | --       |               |
| 输出电流噪声<br>( $BW = 10Hz$ to $100kHz$ , $C_{OUT} = 1\mu F$ .) |                  | $V_{IN} = 3.5V$<br>$I_{LOAD} = 0.1A$   | $V_{OUT} = 1.2V$ | --   | 80  | --       | $\mu V_{RMS}$ |
|   |                  |  | $V_{OUT} = 2.8V$ | --   | 120 | --       |               |
| 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  | $R_{DC}$         | $EN = 0V$ , $V_{OUT} = 0.1V$   | --               | 30   | --  | $\Omega$ |               |

**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。

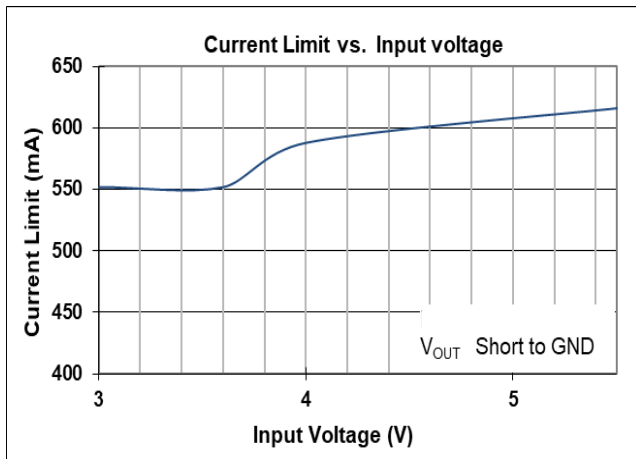
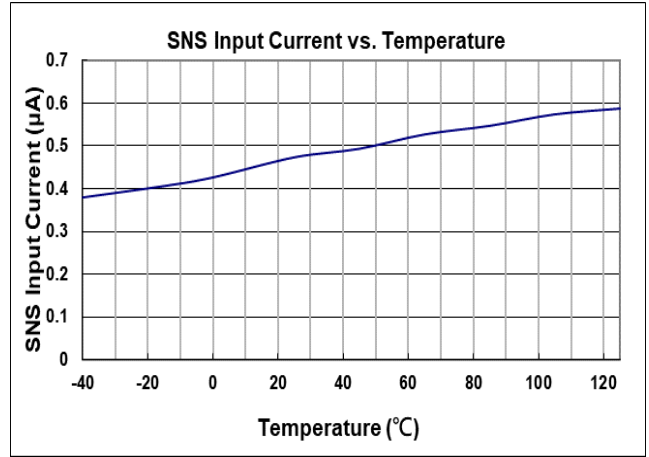
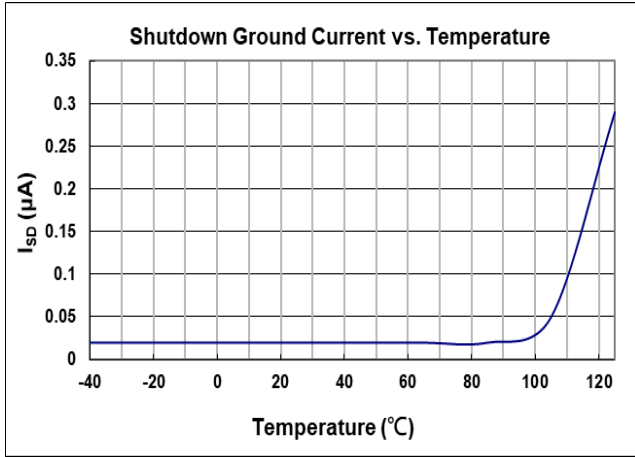
**Note 2.**  $\theta_{JA}$  测量条件： $T_A = 25^\circ C$ ，使用 EVB 板。

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

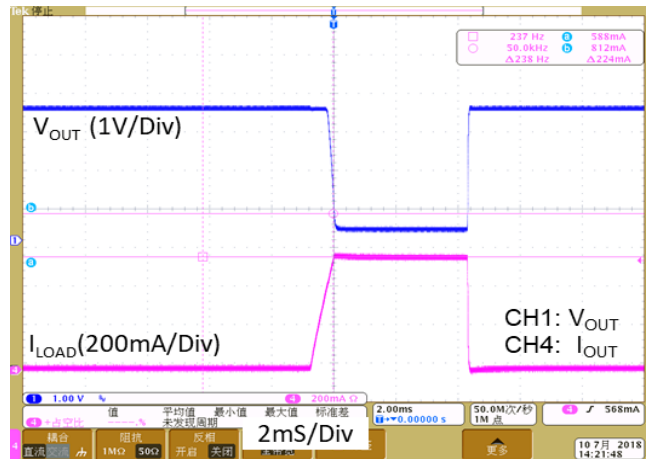
典型电气特性



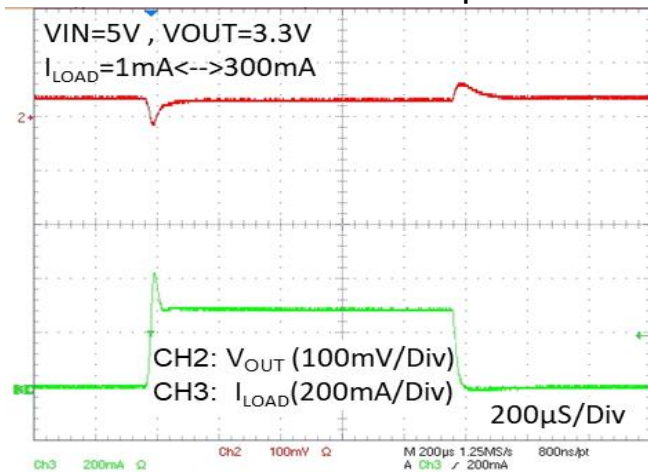




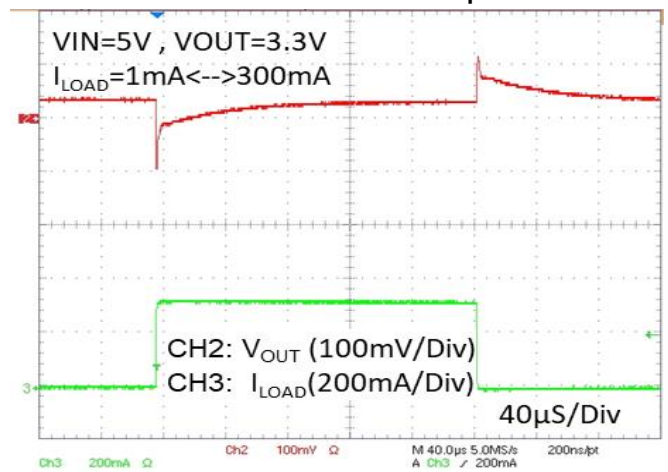
### Current Limit Response



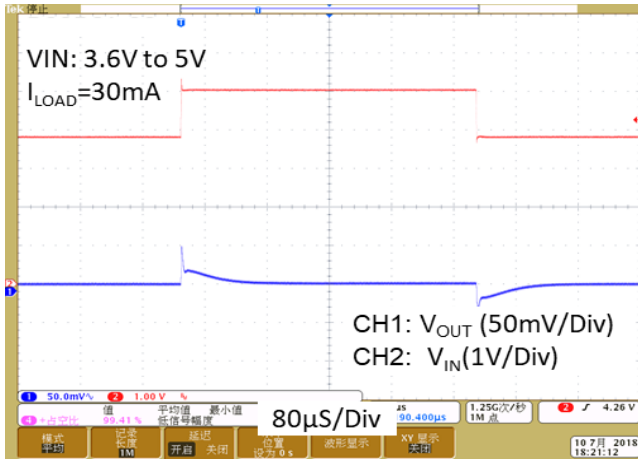
### Load Transient Response I



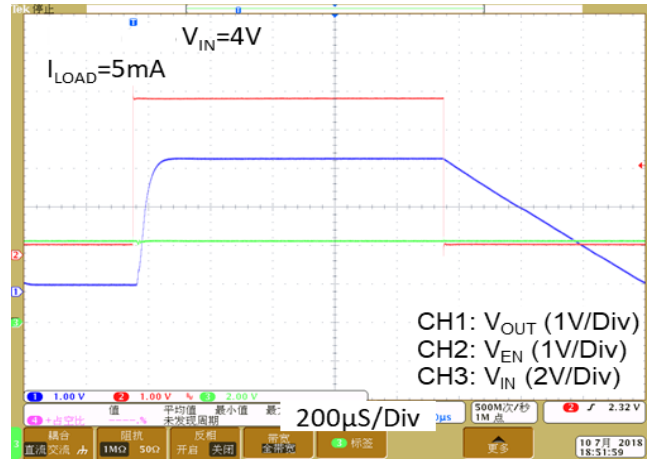
### Load Transient Response II



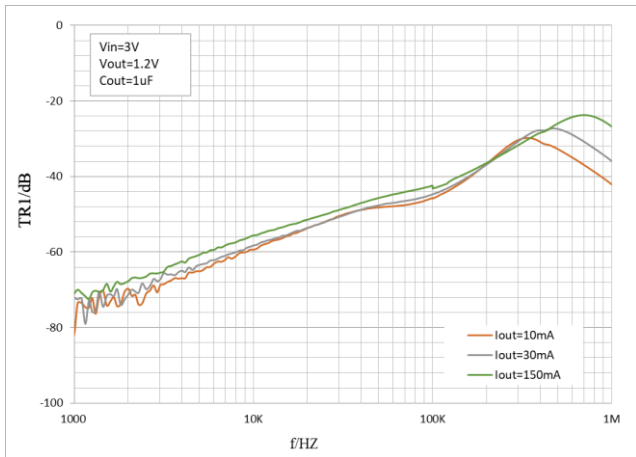
## Line Transient Response



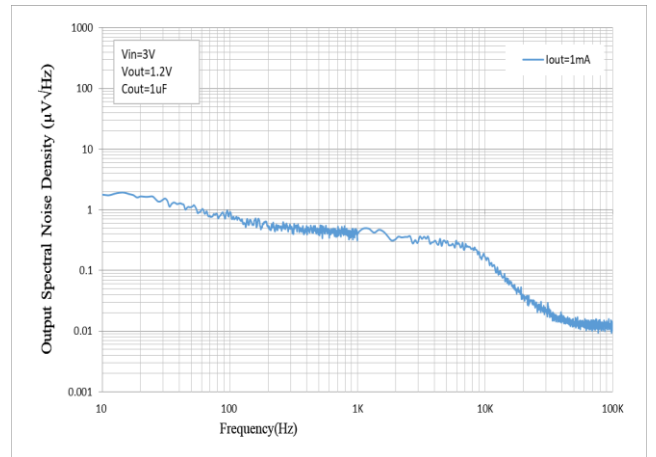
## V<sub>OUT</sub> Turn On/Off by EN



## PSRR vs. Frequency



## Noise Density Spectrum



## 应用指导

### 输入和输出电容

AP2125K-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 GNDpin 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。

### Dropout 电压

AP2125K-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>DRO P</sub> 和输出电流近似成比例, 和其他线性电压转换器一样, AP2125K-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。

## 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 AP2125K-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。

### 电流限制功能

AP2125K-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 600mA (典型值)。限流功能确保输出可以短路至地, 器件不会损坏。

### OTP (过温度保护)

当产品的结点温度超过 155°C (典型值) 时, AP2125K-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, AP2125K-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:

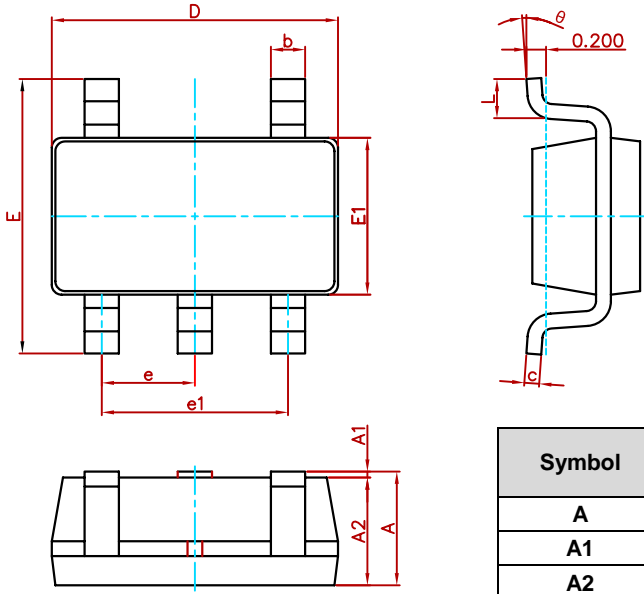
环温 T<sub>A</sub>=25°C, 使用 MSKSEMI PCB,

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

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:

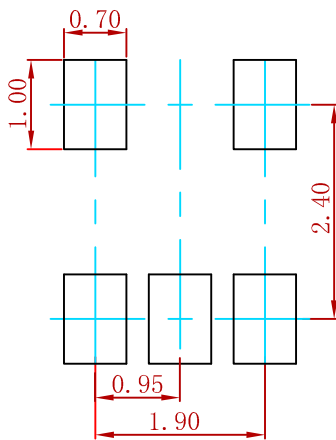
$$PD = (V_{IN} - V_{OUT}) \times I_{OUT}$$

**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.

## 订购信息

| 订单型号                | 封装形式     | 包装/数量      |
|---------------------|----------|------------|
| AP2125K-1.2TRG1(MS) | SOT-23-5 | 盘装/3000pcs |
| AP2125K-1.5TRG1(MS) | SOT-23-5 | 盘装/3000pcs |
| AP2125K-1.8TRG1(MS) | SOT-23-5 | 盘装/3000pcs |
| AP2125K-2.5TRG1(MS) | SOT-23-5 | 盘装/3000pcs |
| AP2125K-2.8TRG1(MS) | SOT-23-5 | 盘装/3000pcs |
| AP2125K-3.0TRG1(MS) | SOT-23-5 | 盘装/3000pcs |
| AP2125K-3.3TRG1(MS) | SOT-23-5 | 盘装/3000pcs |

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