

## 方案简介

本应用方案基于一款高集成度的峰值电流型反激电源控制器 VPS2103，结合隔离功率变压器 VPE24FBB10A、输出整流二极管以及必要的阻容元件，实现 18V-36V 输入，5V 输出的隔离稳压电源方案。本方案可实现全输入电压范围最大功率 10W 的输出能力，原副边隔离耐压不小于 1500VDC，同时具备过欠压保护、过功率保护、可长期短路保护并自恢复等功能。本方案可应用在系统板需要实施电气隔离以达到安全和（或）抗干扰目的相关场合。

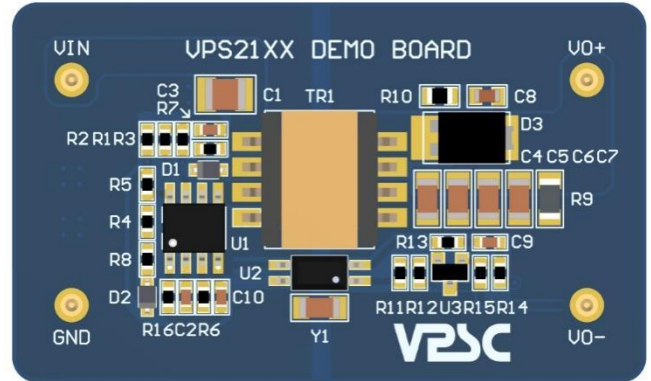
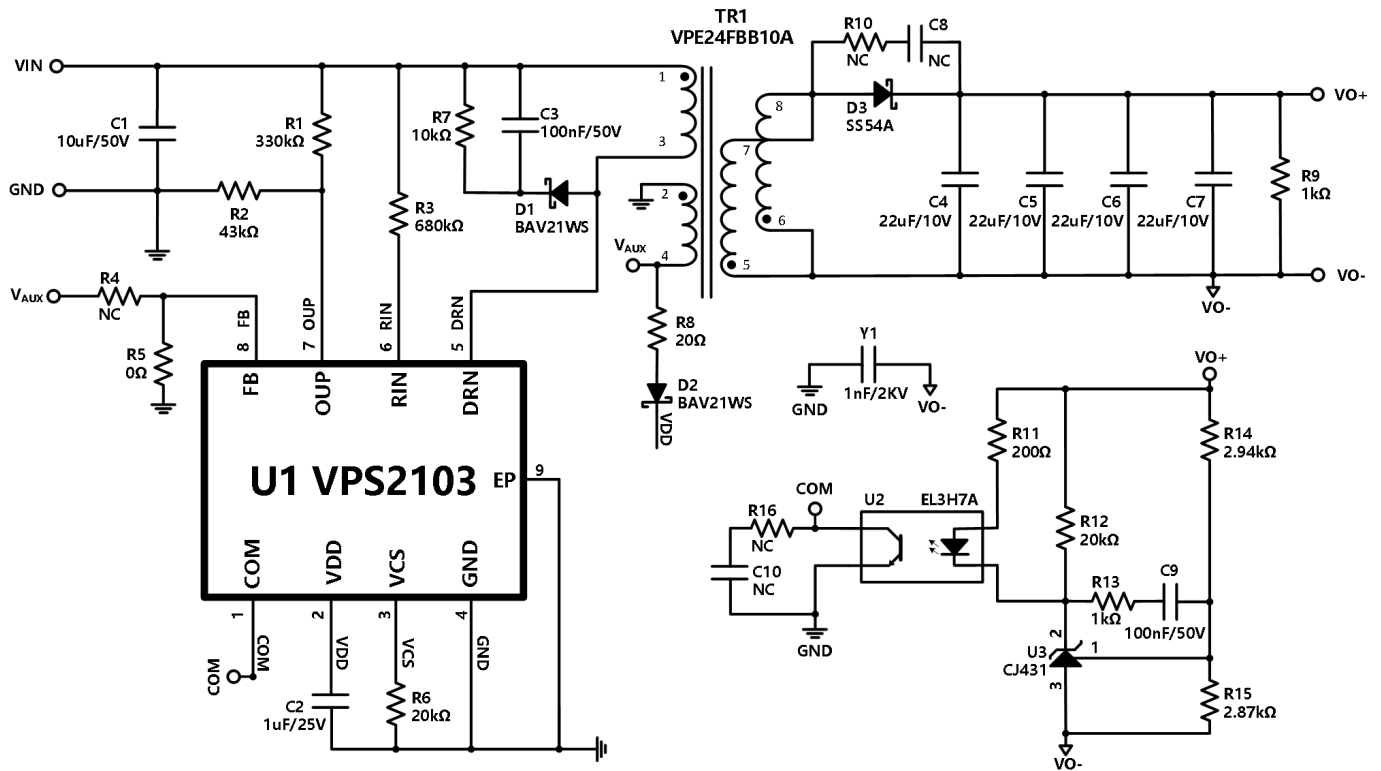


图 1: VPS2103 Demo 板(尺寸:50mm\*30mm)

关键词：输入：18V-36V，输出 5V/10W，隔离电压：1500VDC，反馈方式：副边反馈-SSR

## 原理图



## 引脚功能说明

| 编号 | 功能  | 功能描述  |
|----|-----|-------|
| 1  | VIN | 电源输入端 |
| 2  | GND | 电源接地端 |
| 3  | VO+ | 电源输出正 |
| 4  | VO- | 电源输出负 |

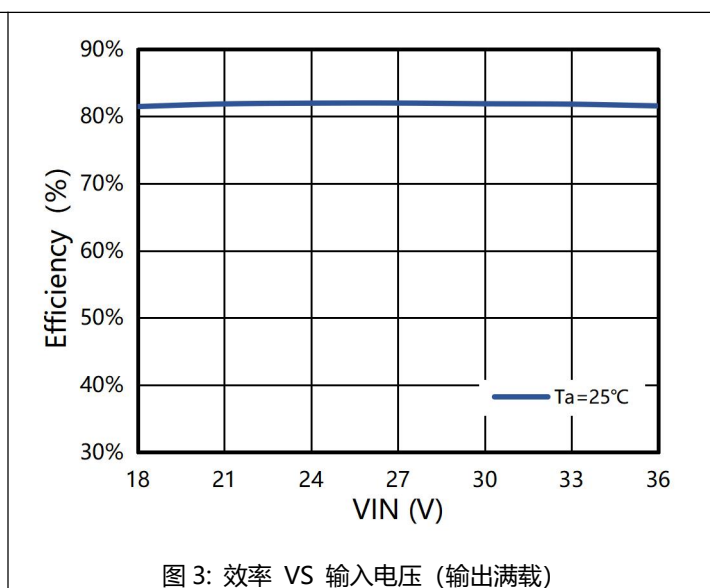
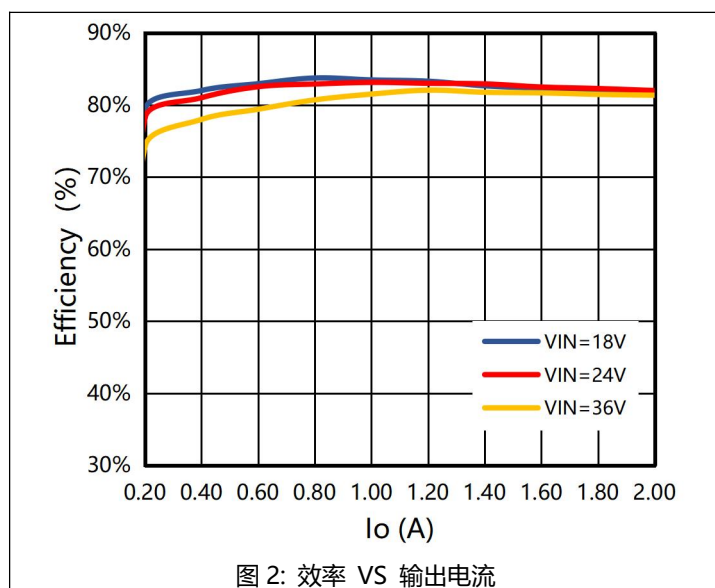
## 物料清单

| 位号  | 参数                                       | 封装      | 型号                | 品牌        |
|-----|------------------------------------------|---------|-------------------|-----------|
| C1  | 10uF/50V-X7R                             | 1210    | CC1210KKX7R9BB106 | YAGEO     |
| C2  | 1uF/25V-X7R                              | 0603    | CC0603KRX7R8BB105 | YAGEO     |
| C3  | 100nF/50V-X7R                            | 0603    | CC0603KRX7R9BB104 | YAGEO     |
| C4  | 22uF/10V-X7R                             | 1206    | CC1206KKX7R6BB226 | YAGEO     |
| C5  | 22uF/10V-X7R                             | 1206    | CC1206KKX7R6BB226 | YAGEO     |
| C6  | 22uF/10V-X7R                             | 1206    | CC1206KKX7R6BB226 | YAGEO     |
| C7  | 22uF/10V-X7R                             | 1206    | CC1206KKX7R6BB226 | YAGEO     |
| C8  | NC                                       | -       | -                 | -         |
| C9  | 100nF/50V-X7R                            | 0603    | CC0603KRX7R9BB104 | YAGEO     |
| C10 | NC                                       | -       | -                 | -         |
| Y1  | 1nF/2KV-X7R                              | 1206    | CC1206KKX7RDBB102 | YAGEO     |
| R1  | 330K $\Omega$ ±1%                        | 0603    | RC0603FR-07330KL  | YAGEO     |
| R2  | 43K $\Omega$ ±1%                         | 0603    | RC0603FR-0743KL   | YAGEO     |
| R3  | 680K $\Omega$ ±1%                        | 0603    | RC0603FR-07680KL  | YAGEO     |
| R4  | NC                                       | -       | -                 | -         |
| R5  | 0 $\Omega$ ±1%                           | 0603    | RC0603FR-070RL    | YAGEO     |
| R6  | 20K $\Omega$ ±1%                         | 0603    | RC0603FR-0720KL   | YAGEO     |
| R7  | 10K $\Omega$ ±1%                         | 0603    | RC0603FR-0710KL   | YAGEO     |
| R8  | 20 $\Omega$ ±1%                          | 0603    | RC0603FR-0720RL   | YAGEO     |
| R9  | 1K $\Omega$ ±1%                          | 1206    | RC1206FR-071KL    | YAGEO     |
| R10 | NC                                       | -       | -                 | -         |
| R11 | 200 $\Omega$ ±1%                         | 0603    | RC0603FR-07200RL  | YAGEO     |
| R12 | 20K $\Omega$ ±1%                         | 0603    | RC0603FR-0720KL   | YAGEO     |
| R13 | 1K $\Omega$ ±1%                          | 0603    | RC0603FR-071KL    | YAGEO     |
| R14 | 2.94K $\Omega$ ±1%                       | 0603    | RC0603FR-072K94L  | YAGEO     |
| R15 | 2.87K $\Omega$ ±1%                       | 0603    | RC0603FR-072K87L  | YAGEO     |
| R16 | NC                                       | -       | -                 | -         |
| TR1 | NP:NS:NA=10:6:6<br>Lp=11uH               | ER11.5  | VPE24FBB10A       | VPSC      |
| D1  | 200V/0.2A                                | SOD-323 | BAV21WS           | CJ        |
| D2  | 200V/0.2A                                | SOD-323 | BAV21WS           | CJ        |
| D3  | 40V/5A                                   | SMA     | SS54A             | YANGJIE   |
| U1  | 4-50VIN/90V/0.1 $\Omega$ 电流模式 PWM<br>控制器 | ESOP-8  | VPS2103           | VPSC      |
| U2  | CTR=80~160, Viso=3750VAC                 | SSOP-4  | EL3H7A            | EVERLIGHT |
| U3  | Vref=2.495V                              | SOT23-3 | CJ431             | CJ        |

## 总体性能一览表

| 性能指标         | 测试条件               | Min        | Typ  | Max | Unit |
|--------------|--------------------|------------|------|-----|------|
| 输入电流 (满载/空载) | VIN=24V            | 5          | ---  | 512 | mA   |
| 转换效率         | VIN=24V, IO=2A     | ---        | 82   | --- | %    |
| 纹波&噪声        | VIN=24V, IO=2A     | ---        | 60   | 90  | mV   |
| 输出电压精度       | VIN=24V, IO=2A     | ---        | 0.6  | --- | %    |
| 线性调节率        | VIN=18V-36V, IO=2A | ---        | 0.1  | --- | %    |
| 负载调整率        | VIN=24, IO=2A      | ---        | 0.2  | --- | %    |
| 输入欠压保护       | 锁定电压               | ---        | 15   | --- | V    |
|              | 恢复电压               | ---        | 17.3 | --- | V    |
| 短路保护         | VIN=18V-36V        | 可长期保护, 自恢复 |      |     |      |
| 工作温度         | 大于 70°C需降额使用       | -40        | ---  | 85  | °C   |
| 绝缘电压         | 原边短接 VS 副边短接       | 1500       | ---  | --- | VDC  |

## 关键性能指标测试结果



## 相关波形

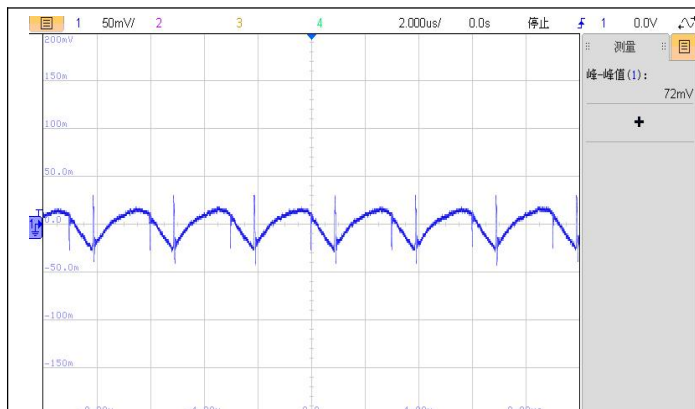


图 4: VIN=24V, 满载输出电压纹波波形

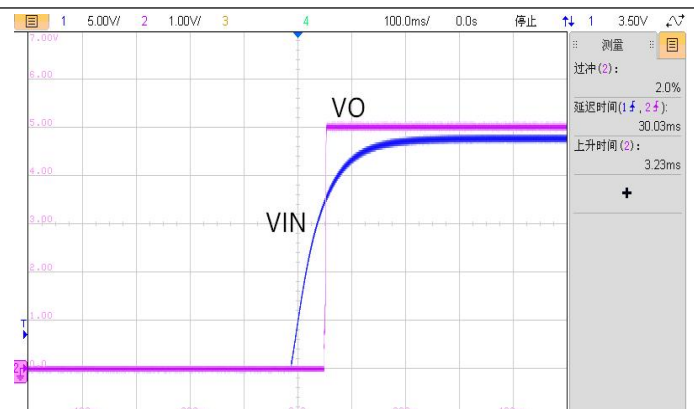
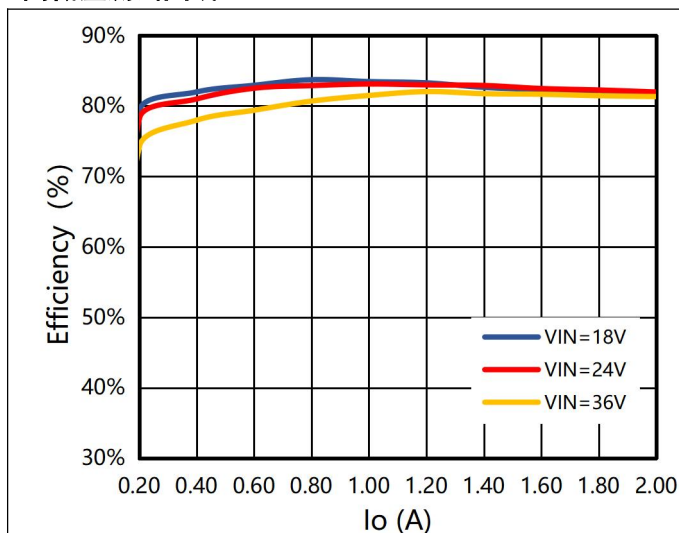


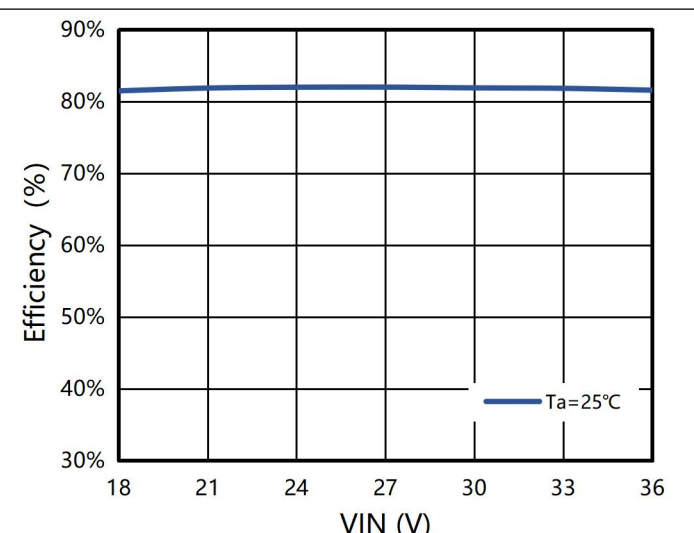
图 5: VIN=24V, 满载启机波形

## 详细测试数据

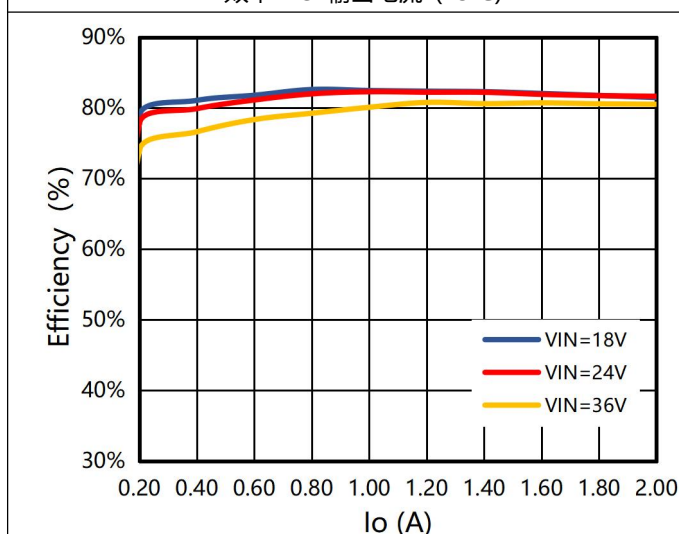
### 高低温测试曲线



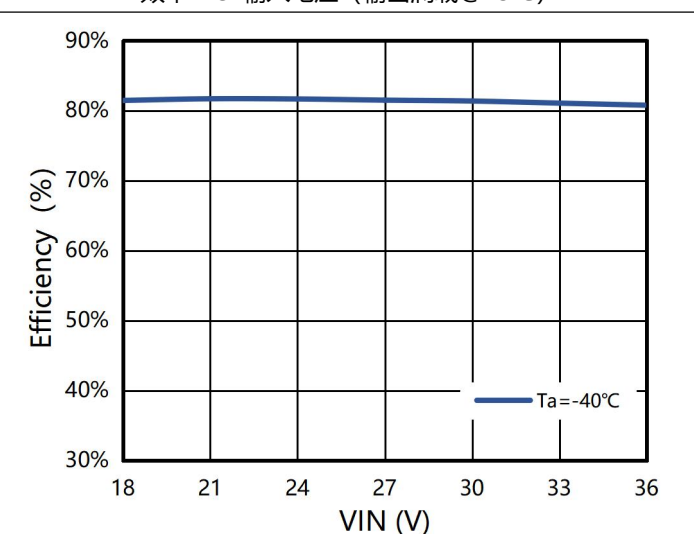
效率 VS 输出电流 (25°C)



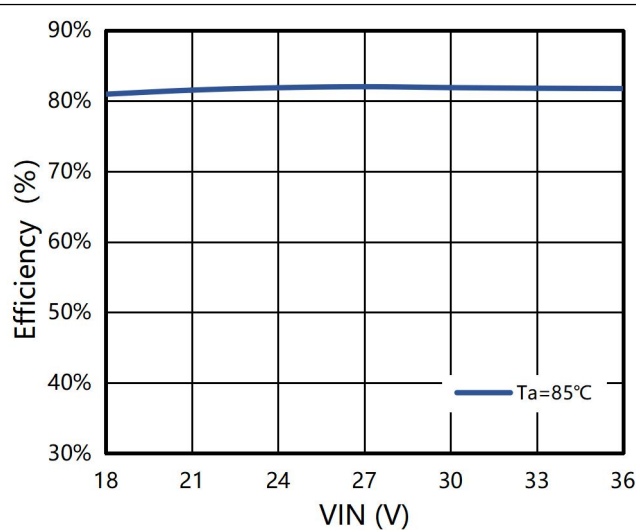
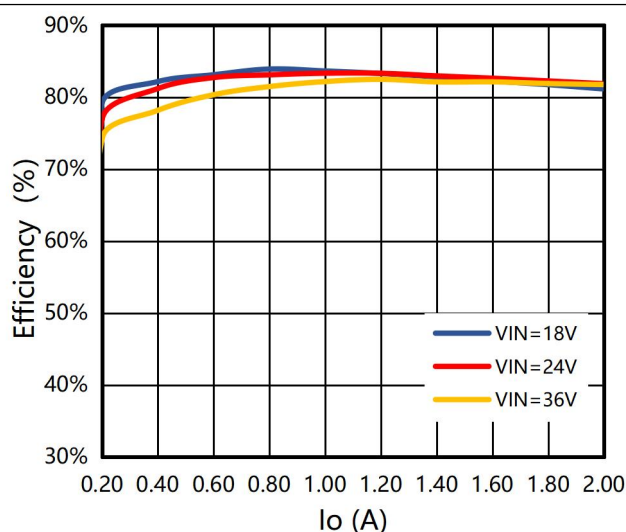
效率 VS 输入电压 (输出满载@25°C)



效率 VS 输出电流 (-40°C)



效率 VS 输入电压 (输出满载@-40°C)



$V_{IN}=24\text{V}$ ,  $T_a=25^{\circ}\text{C}$ , 输入、输出及效率数据:

| $V_{IN}(\text{V})$ | $I_{IN}(\text{A})$ | $V_O(\text{V})$ | $I_O(\text{A})$ | $I_O\text{-max\%}$ | $\eta(\%)$ |
|--------------------|--------------------|-----------------|-----------------|--------------------|------------|
| 23.99              | 0.005              | 5.04            | 0               | 0%                 | 0.00%      |
| 23.99              | 0.054              | 5.04            | 0.201           | 10%                | 78.20%     |
| 23.99              | 0.104              | 5.04            | 0.401           | 20%                | 81.00%     |
| 23.99              | 0.153              | 5.04            | 0.601           | 30%                | 82.52%     |
| 23.99              | 0.203              | 5.04            | 0.801           | 40%                | 82.90%     |
| 23.99              | 0.253              | 5.04            | 1.001           | 50%                | 83.12%     |
| 23.99              | 0.304              | 5.04            | 1.201           | 60%                | 83.00%     |
| 23.99              | 0.355              | 5.04            | 1.401           | 70%                | 82.91%     |
| 23.99              | 0.407              | 5.03            | 1.601           | 80%                | 82.48%     |
| 23.99              | 0.459              | 5.03            | 1.801           | 90%                | 82.27%     |
| 23.99              | 0.512              | 5.03            | 2.002           | 100%               | 81.98%     |

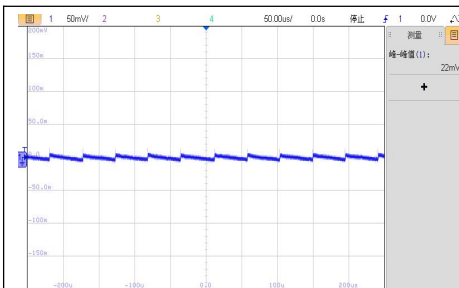
$V_{IN}=24\text{V}$ ,  $T_a=-40^{\circ}\text{C}$ , 输入、输出及效率数据:

| $V_{IN}(\text{V})$ | $I_{IN}(\text{A})$ | $V_O(\text{V})$ | $I_O(\text{A})$ | $I_O\text{-max\%}$ | $\eta(\%)$ |
|--------------------|--------------------|-----------------|-----------------|--------------------|------------|
| 23.98              | 0.004              | 5.02            | 0               | 0%                 | 0.00%      |
| 23.99              | 0.054              | 5.02            | 0.201           | 10%                | 77.89%     |
| 23.99              | 0.105              | 5.02            | 0.401           | 20%                | 79.92%     |
| 23.99              | 0.155              | 5.02            | 0.601           | 30%                | 81.14%     |
| 23.99              | 0.204              | 5.01            | 0.801           | 40%                | 82.00%     |
| 23.99              | 0.254              | 5.01            | 1.001           | 50%                | 82.30%     |
| 23.99              | 0.305              | 5.01            | 1.201           | 60%                | 82.23%     |
| 23.98              | 0.356              | 5.01            | 1.401           | 70%                | 82.22%     |
| 23.98              | 0.408              | 5.01            | 1.600           | 80%                | 81.93%     |
| 23.98              | 0.460              | 5.01            | 1.800           | 90%                | 81.75%     |
| 23.98              | 0.512              | 5.01            | 2.001           | 100%               | 81.65%     |

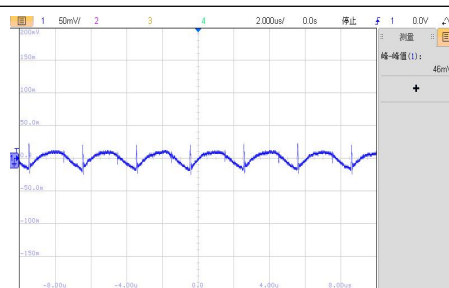
VIN=24V, Ta=85°C, 输入、输出及效率数据:

| VIN(V) | IIN(A) | VO(V) | IO(A) | IO-max% | $\eta$ (%) |
|--------|--------|-------|-------|---------|------------|
| 23.98  | 0.005  | 5.05  | 0     | 0%      | 0.00%      |
| 23.98  | 0.055  | 5.05  | 0.201 | 10%     | 76.96%     |
| 23.98  | 0.104  | 5.05  | 0.401 | 20%     | 81.20%     |
| 23.98  | 0.153  | 5.05  | 0.601 | 30%     | 82.72%     |
| 23.98  | 0.203  | 5.05  | 0.801 | 40%     | 83.10%     |
| 23.98  | 0.253  | 5.05  | 1.001 | 50%     | 83.32%     |
| 23.98  | 0.303  | 5.04  | 1.201 | 60%     | 83.31%     |
| 23.98  | 0.355  | 5.04  | 1.401 | 70%     | 82.95%     |
| 23.98  | 0.407  | 5.04  | 1.600 | 80%     | 82.62%     |
| 23.98  | 0.460  | 5.04  | 1.800 | 90%     | 82.24%     |
| 23.97  | 0.514  | 5.04  | 2.001 | 100%    | 81.86%     |

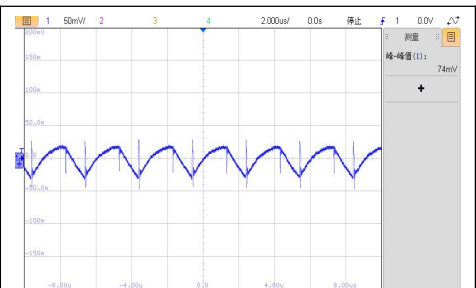
### 输出电压纹波波形



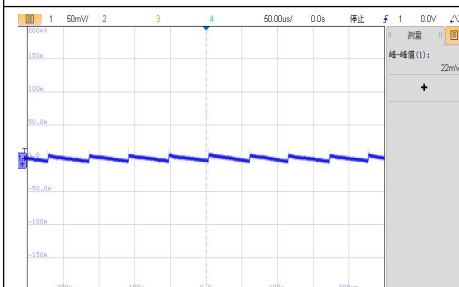
VIN=18V, 空载输出电压纹波波形



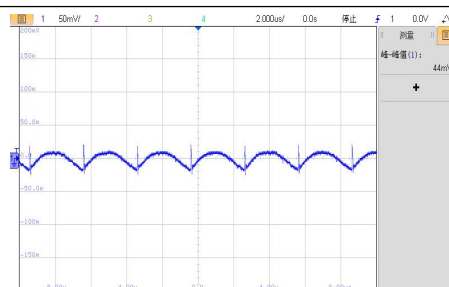
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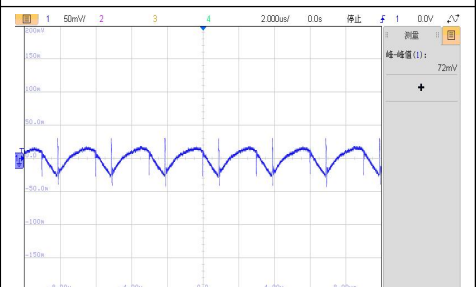
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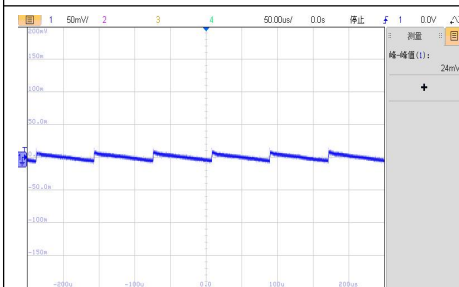
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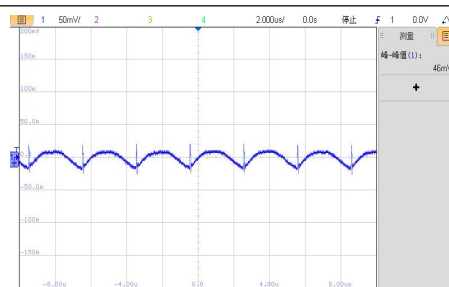
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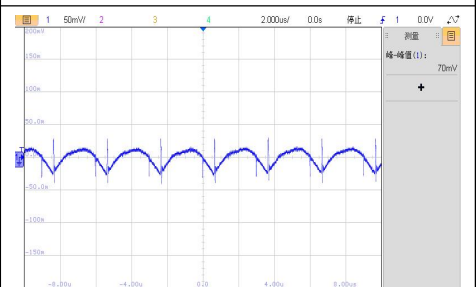
VIN=24V, 满载输出电压纹波波形



VIN=36V, 空载输出电压纹波波形

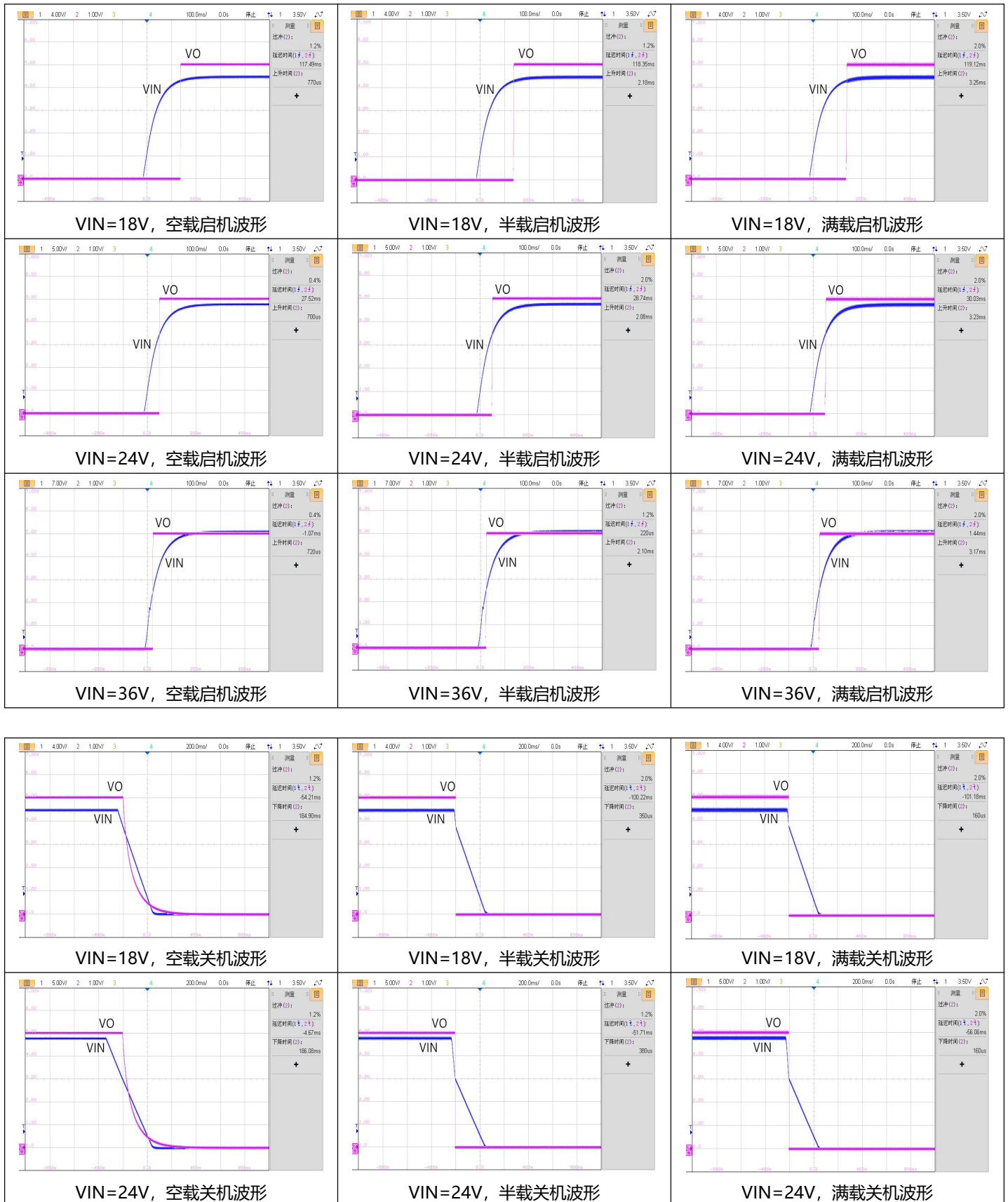


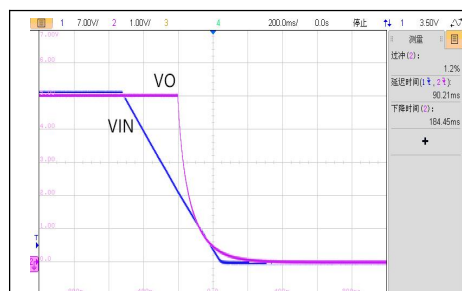
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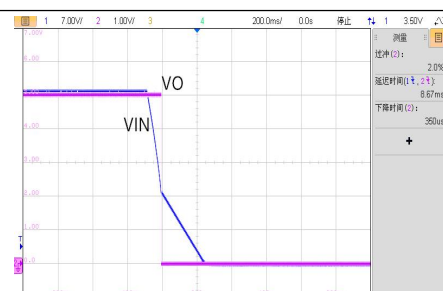
VIN=36V, 满载输出电压纹波波形

开关机波形

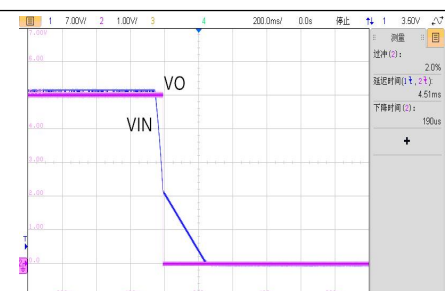




VIN=36V, 空载关机波形

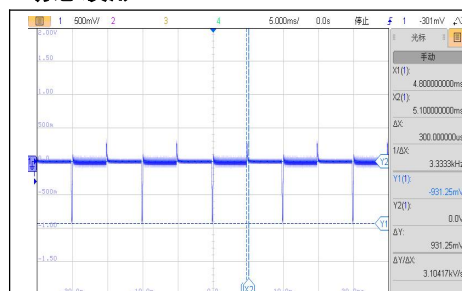


VIN=36V, 半载关机波形

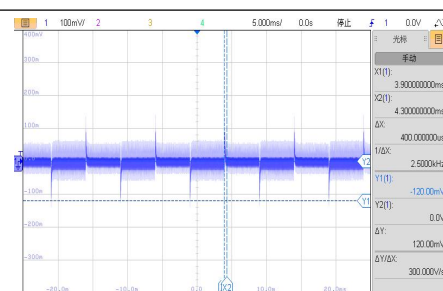


VIN=36V, 满载关机波形

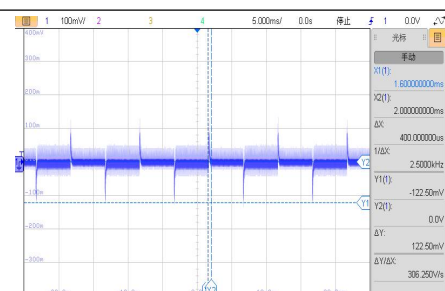
## 动态波形



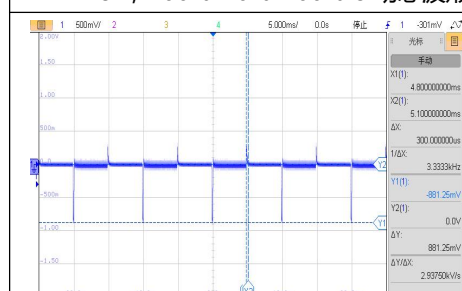
VIN=18V, 100%-10%-100%Io 动态波形



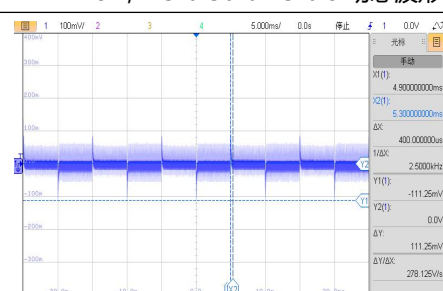
VIN=18V, 75%-50%-75%Io 动态波形



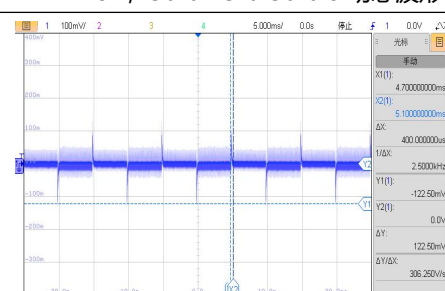
VIN=18V, 50%-25%-50%Io 动态波形



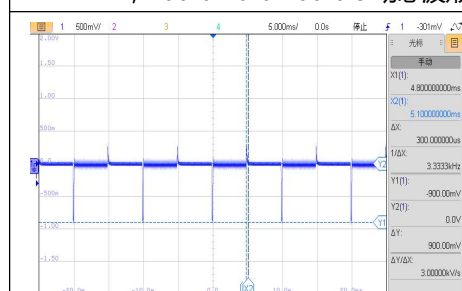
VIN=24V, 100%-10%-100%Io 动态波形



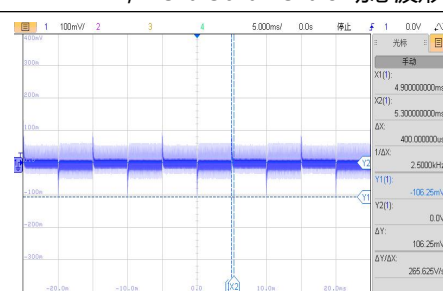
VIN=24V, 75%-50%-75%Io 动态波形



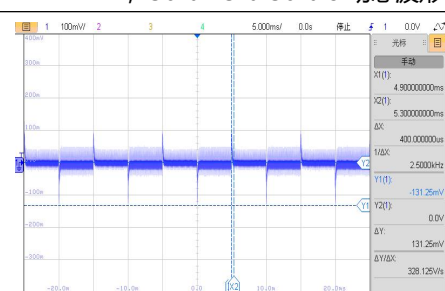
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

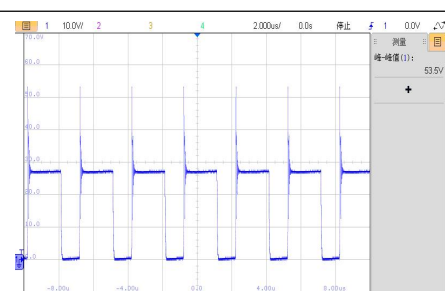
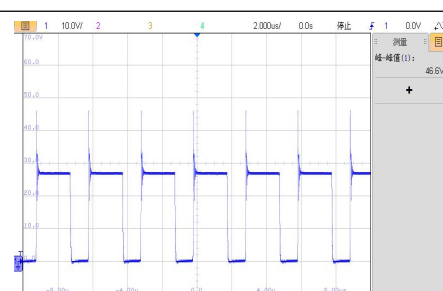
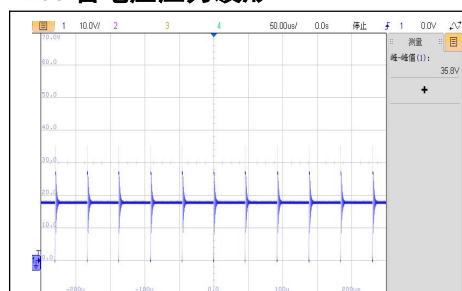


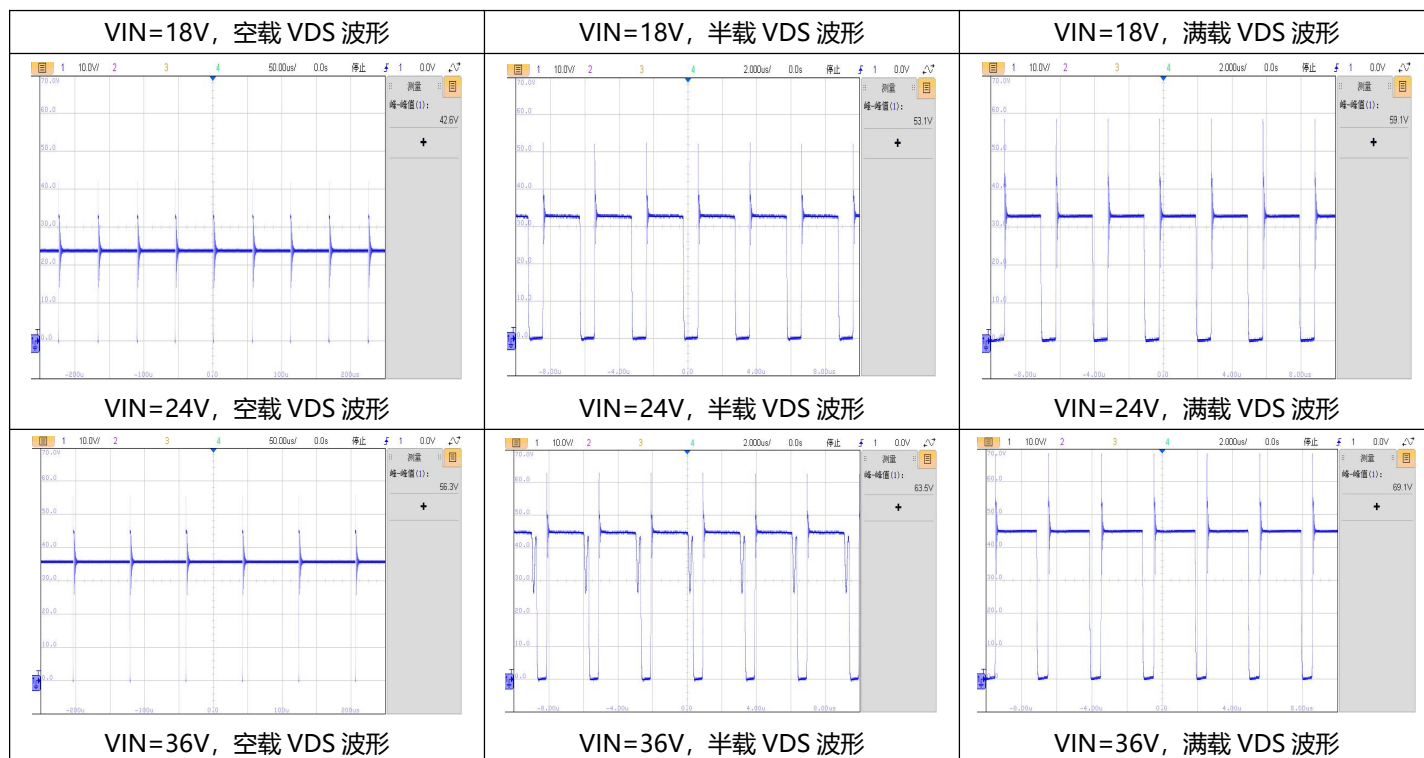
VIN=36V, 75%-50%-75%Io 动态波形



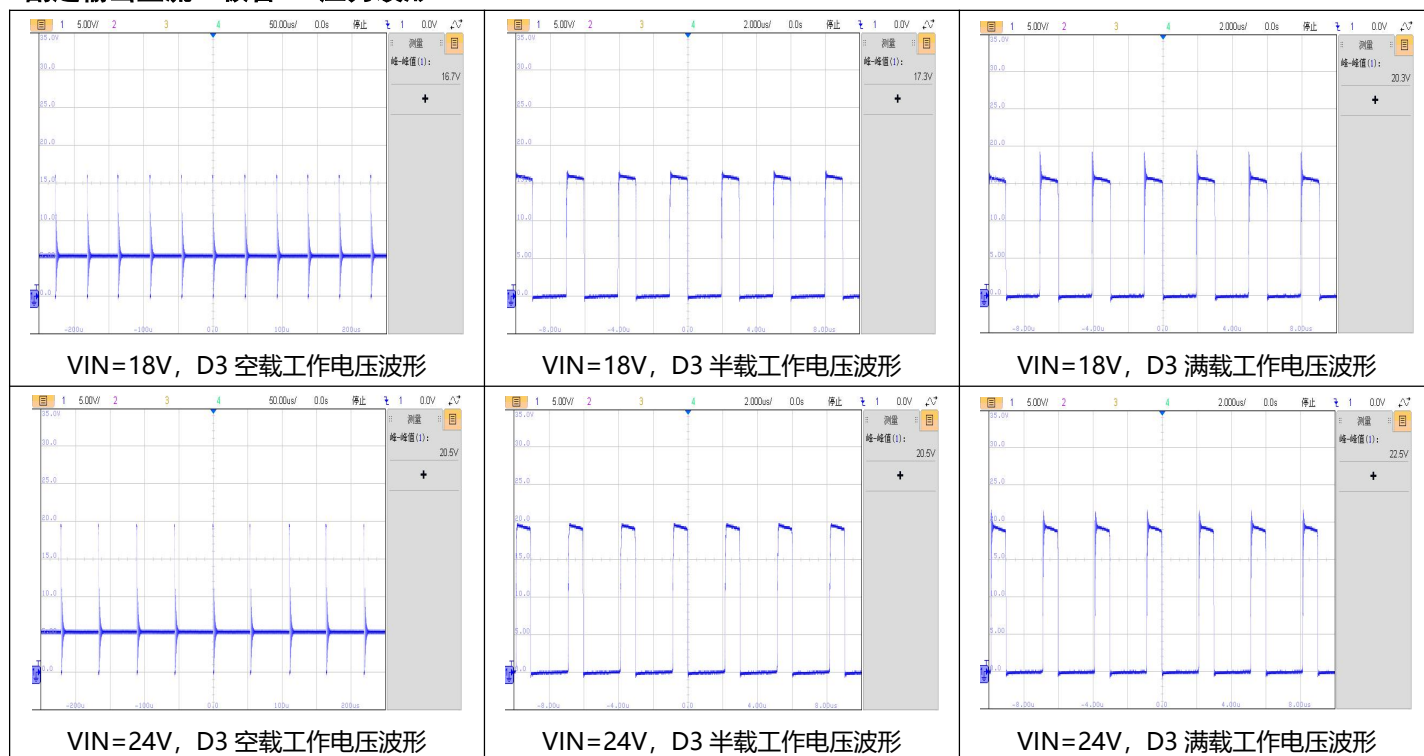
VIN=36V, 50%-25%-50%Io 动态波形

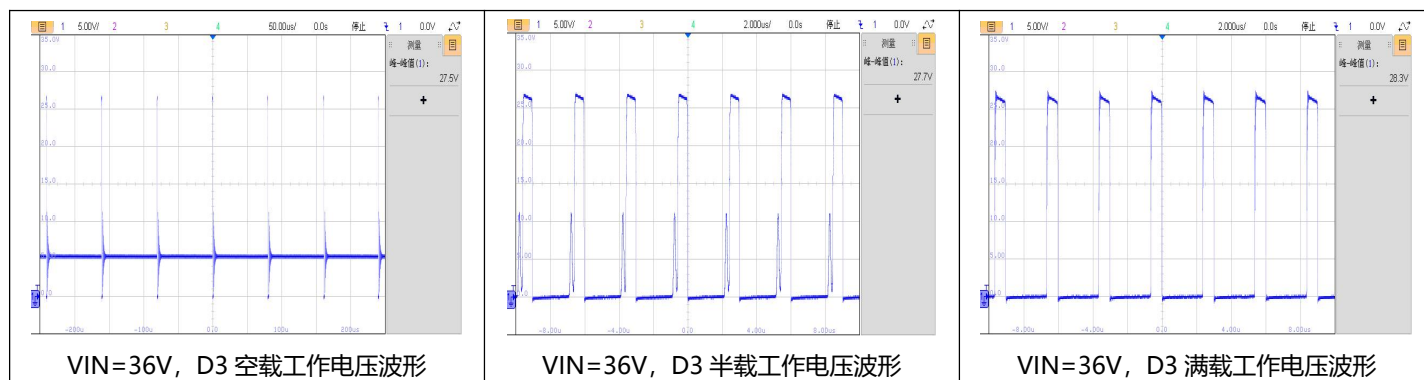
## MOS 管电压应力波形





副边输出整流二极管 D3 应力波形





### 免责声明

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