

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 VPS2104，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，同时具备远程控制关断、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。

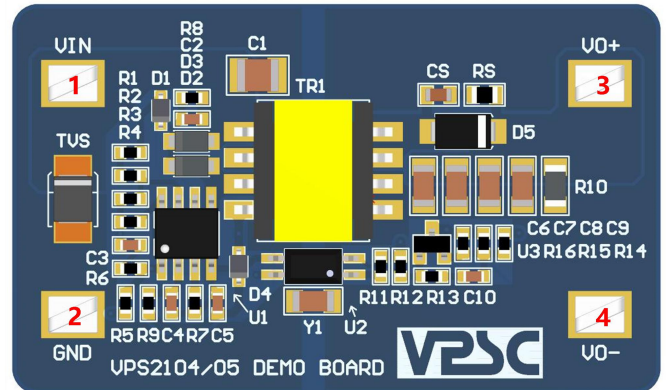
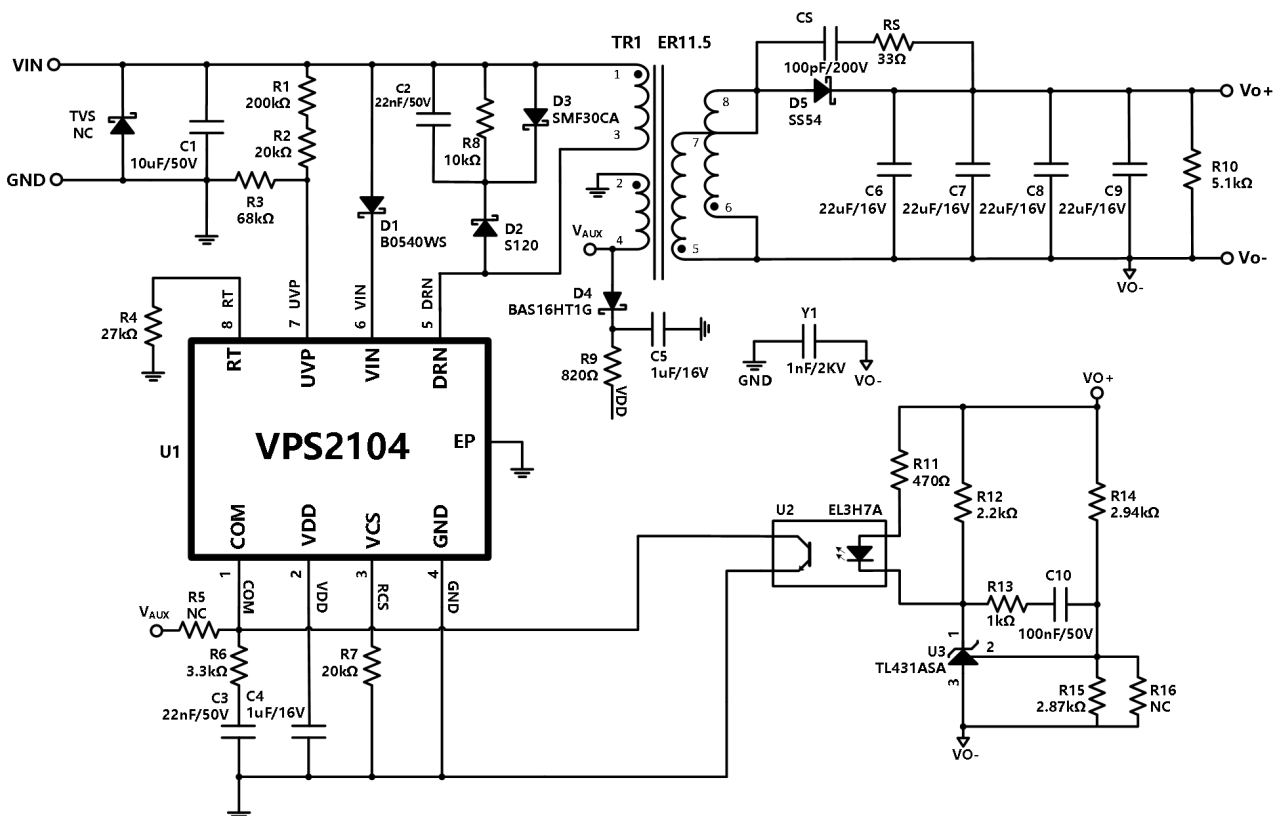


图 1: VPS2104 Demo 板(尺寸:50mm*30mm)

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

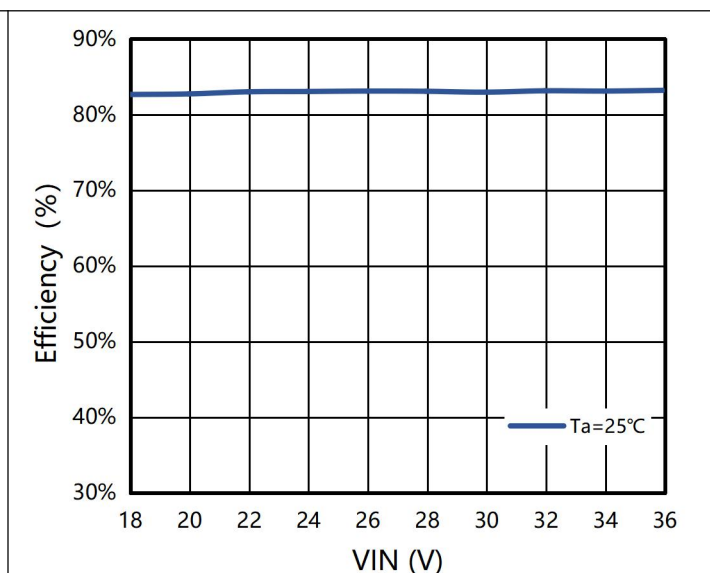
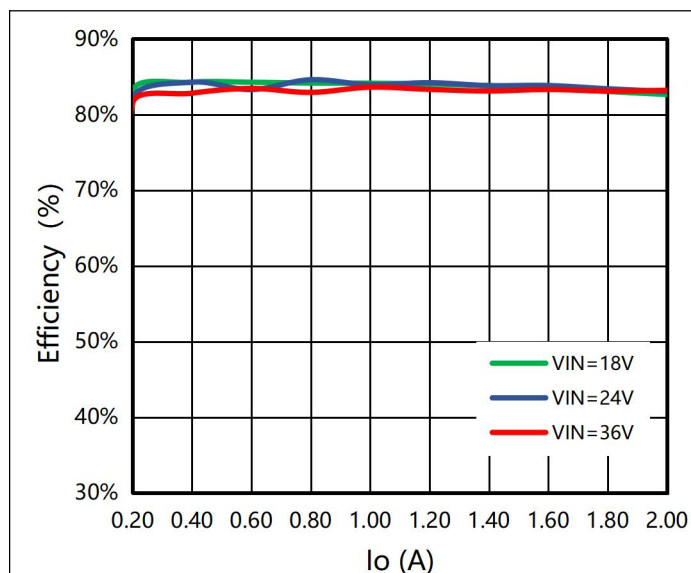
物料清单

位号	参数	封装	型号	品牌
C1	10uF/50V-X7R	1210	CL31B106KBHNNNE	SAMSUNG
C2	22nF/50V-X7R	0603	CC0603JRX7R9BB223	YAGEO
C3	22nF/50V-X7R	0603	CC0603JRX7R9BB223	YAGEO
C4	1uF/16V-X7R	0603	CC0603KRX7R7BB105	YAGEO
C5	1uF/16V-X7R	0603	CC0603KRX7R7BB105	YAGEO
C6	22uF/16V-X7R	1206	1206B226K160NT	FH
C7	22uF/16V-X7R	1206	1206B226K160NT	FH
C8	22uF/16V-X7R	1206	1206B226K160NT	FH
C9	22uF/16V-X7R	1206	1206B226K160NT	FH
C10	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
CS	100pF/200V-NP0	0805	CC0805JRNPOABN101	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	200K Ω ±1%	0603	RC0603FR-07200KL	YAGEO
R2	20K Ω ±1%	0603	RC0603JR-0720KL	YAGEO
R3	68K Ω ±1%	0603	RC0603FR-0768KL	YAGEO
R4	27K Ω ±1%	0603	RC0603FR-0727KL	YAGEO
R5	NC	-	-	-
R6	3.3K Ω ±1%	0603	RC0603FR-073K3L	YAGEO
R7	20K Ω ±1%	0603	RC0603JR-0720KL	YAGEO
R8	10K Ω ±1%	0603	RC0603FR-0710KL	YAGEO
R9	820 Ω ±1%	0603	RC0603FR-07820RL	YAGEO
R10	5.1K Ω ±1%	1206	RC1206FR-075K1L	YAGEO
R11	470 Ω ±1%	0603	RC0603FR-07470RL	YAGEO
R12	2.2K Ω ±1%	0603	RC0603FR-072K2L	YAGEO
R13	1K Ω ±1%	0603	RC0603FR-071KL	YAGEO
R14	2.94K Ω ±1%	0603	RC0603FR-072K94L	YAGEO
R15	2.87K Ω ±1%	0603	RC0603FR-072K87L	YAGEO
R16	NC	-	-	-
RS	33 Ω ±1%	0805	RC0805FR-0733RL	YAGEO
TR1	Np:Ns:Na=10:6:6 Lp=11uH	ER11.5	VPE24FBB10A	VPSC
TVS	NC	-	-	-
D1	40V/0.5A	SOD-323	B0540WS	YANGJIE
D2	200V/1A	SOD-123	S120	YANGJIE
D3	30V/8.3A	SOD-123	SMF30CA	MDD
D4	85V/200mA	SOD-323	BAS16HT1G	ON
D5	40V/5A	SMA	SS54	MDD
U1	4-100Vin/120V/0.1 Ω 小功率反激电源控制器	ESOP-8	VPS2104	VPSC
U2	CTR=80~160,Viso=3750VAC	SSOP-4	EL3H7A	EVERLIGHT
U3	Vref=2.495V	TL431	TL431ASA	DIODES

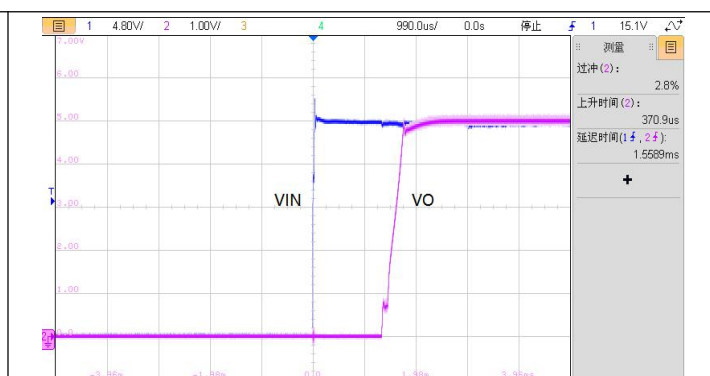
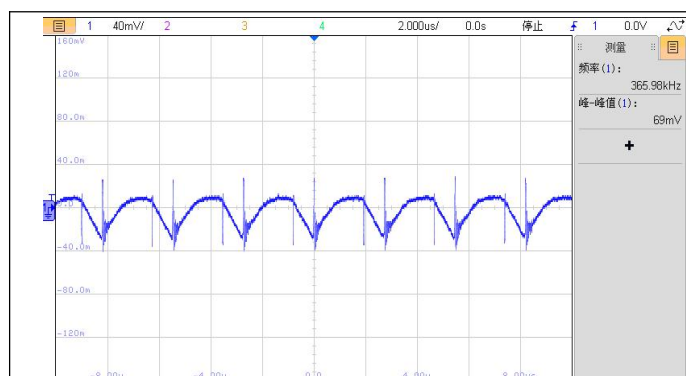
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流 (满载/空载)	VIN=24V	2.09	---	502	mA
转换效率	VIN=24V, IO=2A	---	83	---	%
纹波&噪声	VIN=24V; IO=2A	---	50	100	mV
线性调节率	VIN=18V-36V, IO=2A	---	0	---	%
负载调整率	VIN=24V; IO=2A	---	0	---	%
输入欠压保护	锁定电压	---	15.5	---	V
	恢复电压	---	17.2	---	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

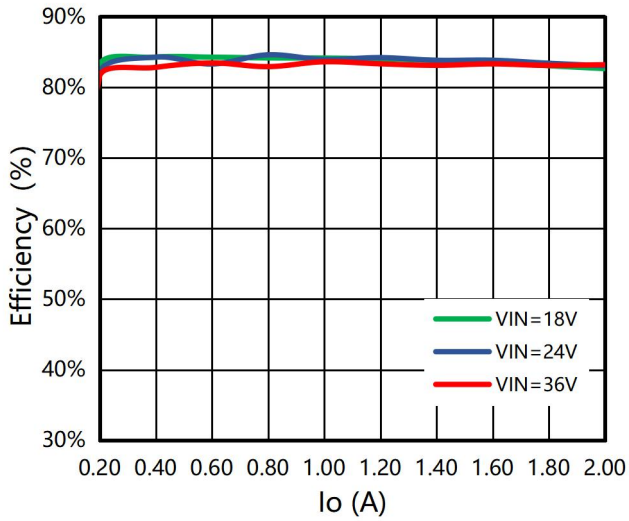


相关波形

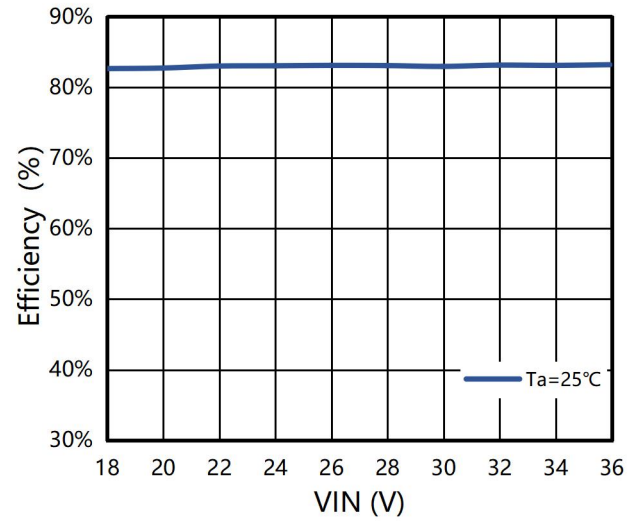


详细测试数据

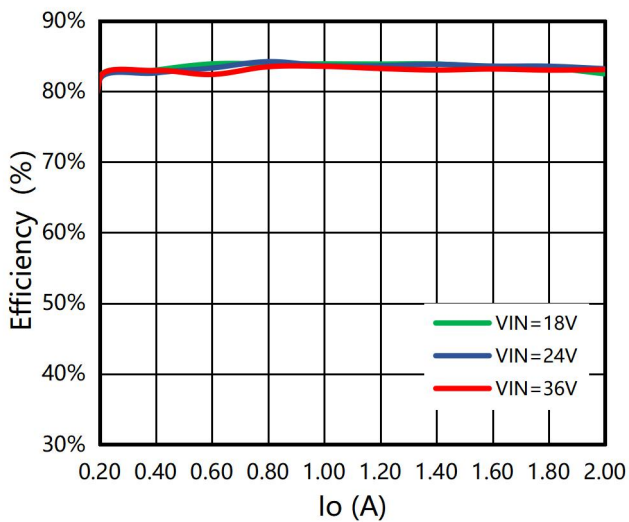
高低温测试曲线



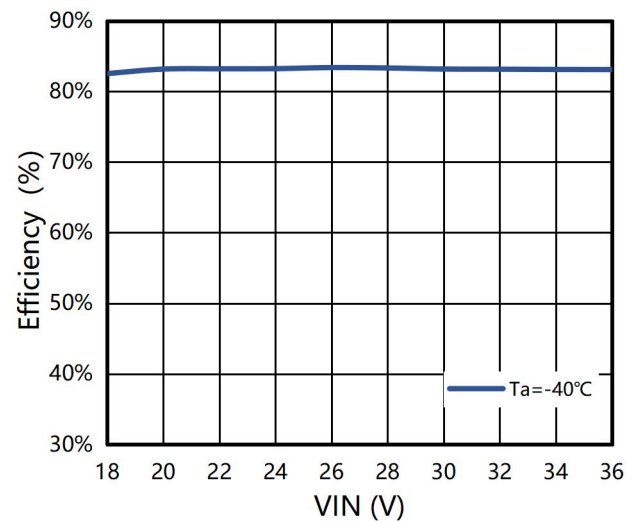
效率 VS 输出电流(25°C)



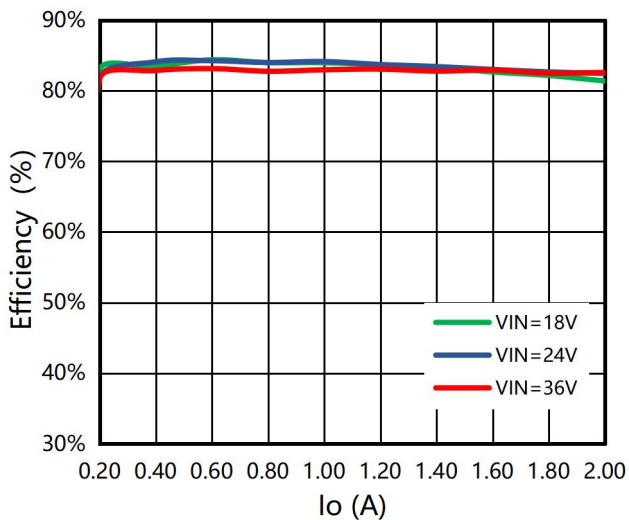
效率 VS 输入电压 (输出满载@25°C)



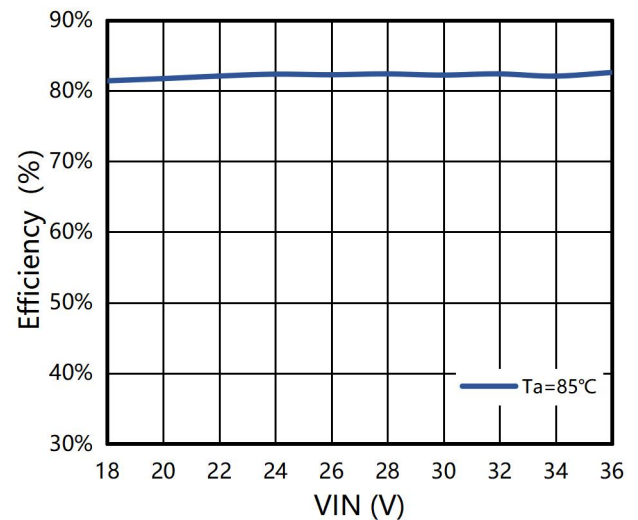
效率 VS 输出电流(-40°C)



效率 VS 输入电压(输出满载@-40°C)



效率 VS 输出电流(85°C)



效率 VS 输入电压(输出满载@85°C)

VIN=24V, Ta=25°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.97	0.001	5	0	0%	0.00%
23.97	0.051	5.01	0.200	10%	81.97%
23.97	0.099	5	0.400	20%	84.28%
23.97	0.150	5	0.599	30%	83.30%
23.97	0.197	5	0.799	40%	84.60%
23.97	0.248	5	0.998	50%	83.94%
23.97	0.297	5	1.199	60%	84.21%
23.96	0.348	5	1.398	70%	83.83%
23.96	0.398	5	1.599	80%	83.84%
23.95	0.450	5	1.798	90%	83.41%
23.95	0.502	5	1.997	100%	83.05%

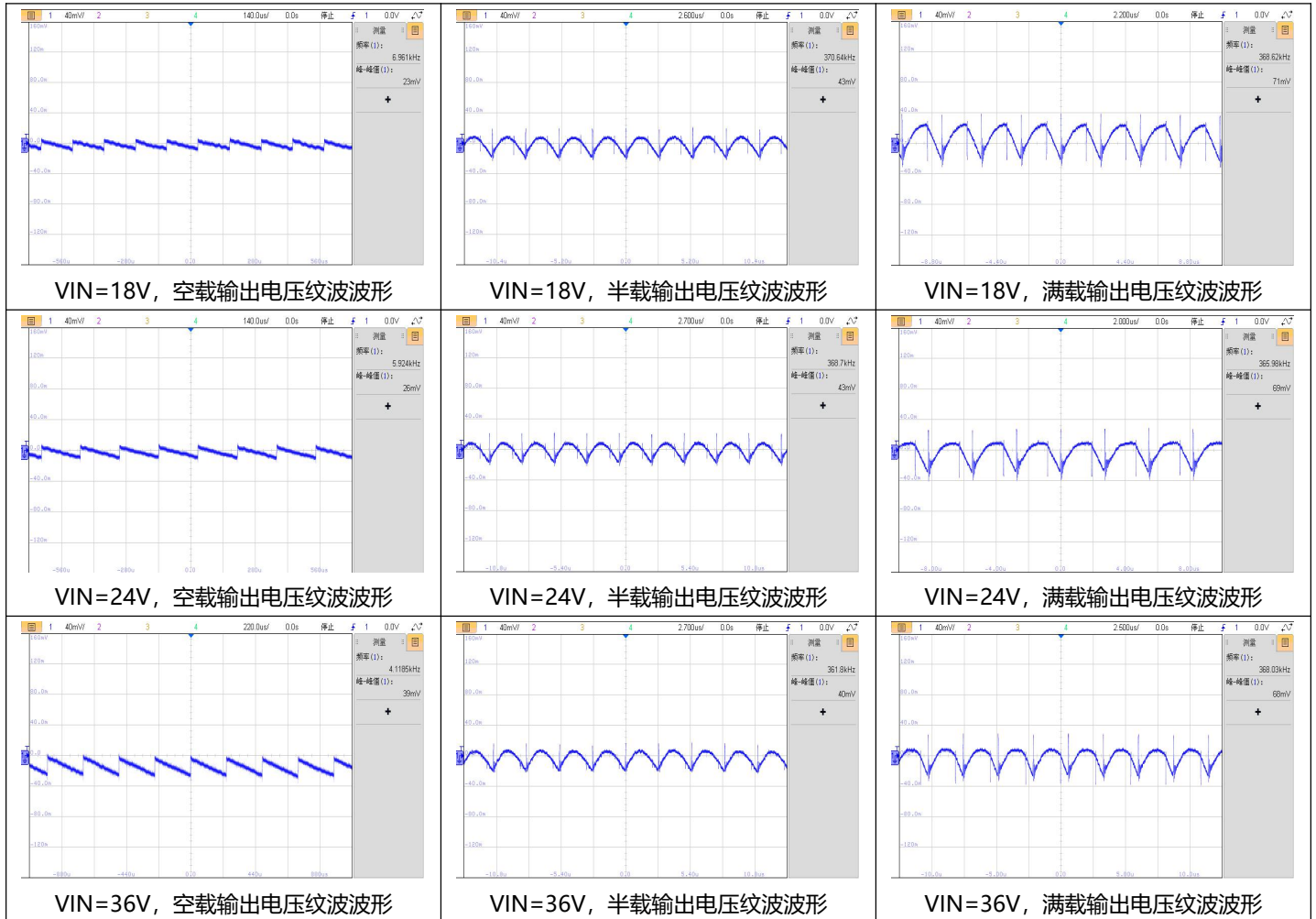
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.97	0.001	5	0	0%	0.00%
23.97	0.051	5	0.199	10%	81.39%
23.97	0.101	5	0.400	20%	82.61%
23.97	0.150	5	0.599	30%	83.30%
23.96	0.198	5	0.799	40%	84.21%
23.96	0.249	5	0.998	50%	83.64%
23.96	0.299	5	1.198	60%	83.61%
23.96	0.348	5	1.398	70%	83.83%
23.96	0.399	5	1.598	80%	83.58%
23.96	0.449	5	1.798	90%	83.57%
23.95	0.501	5	1.997	100%	83.22%

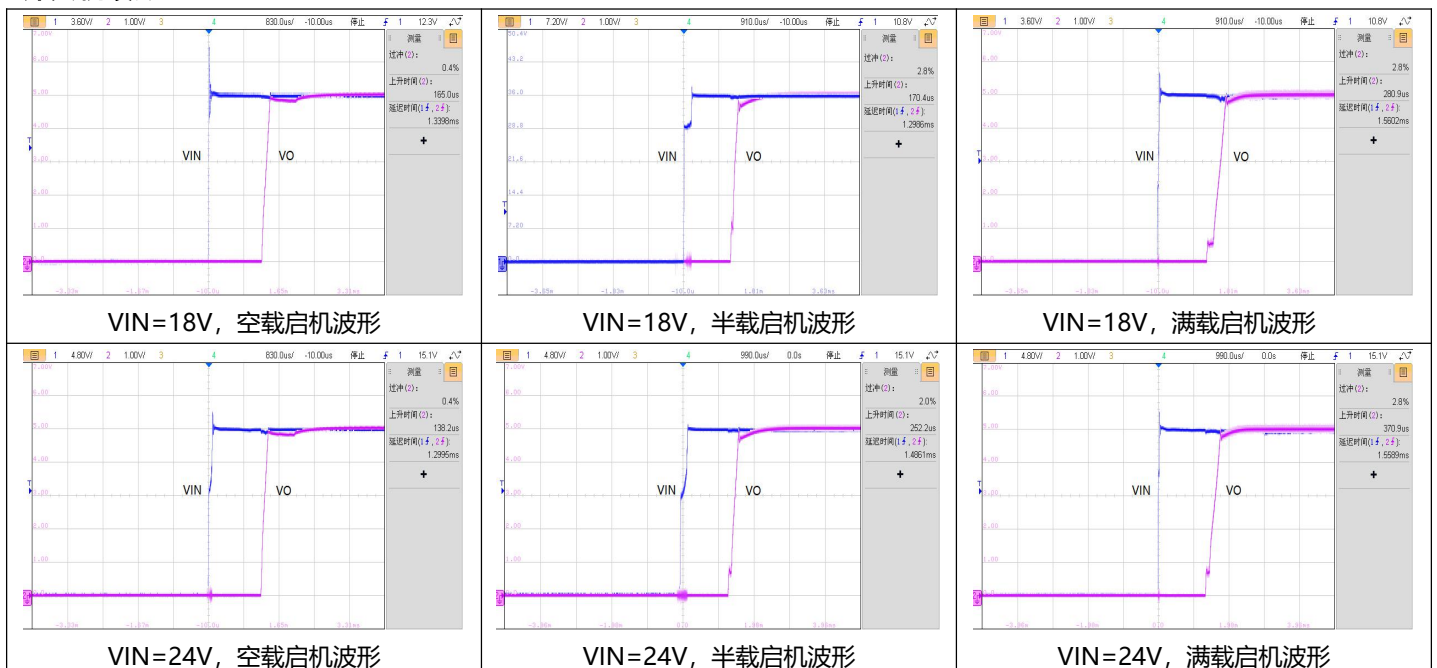
VIN=24V, Ta=85°C, 输入、输出及效率数据:

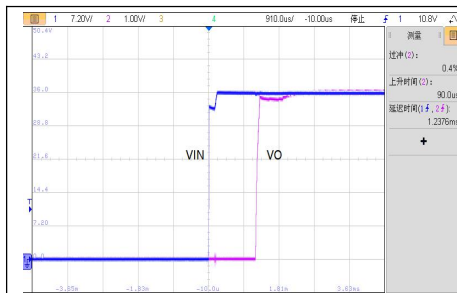
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.97	0.001	4.99	0	0%	0.00%
23.97	0.051	4.99	0.200	10%	81.64%
23.97	0.099	4.99	0.400	20%	84.11%
23.97	0.148	4.99	0.599	30%	84.26%
23.97	0.198	4.99	0.799	40%	84.01%
23.96	0.247	4.99	0.998	50%	84.15%
23.96	0.298	4.99	1.198	60%	83.72%
23.96	0.348	4.98	1.397	70%	83.44%
23.96	0.400	4.98	1.598	80%	83.03%
23.96	0.452	4.98	1.798	90%	82.68%
23.93	0.504	4.98	1.997	100%	82.46%

输出电压纹波波形



开关机波形

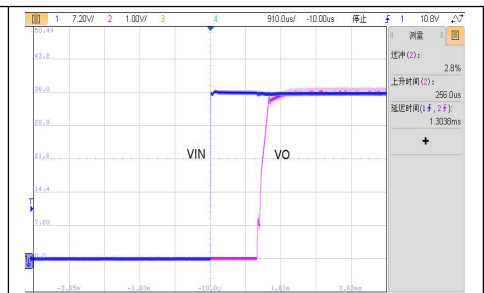




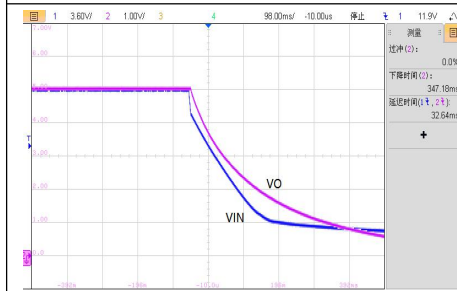
VIN=36V, 空载启机波形



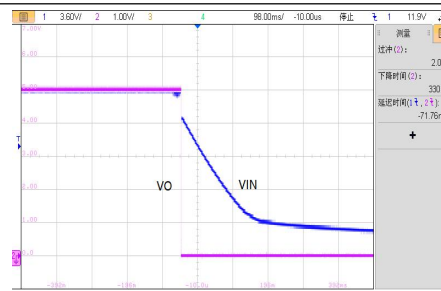
VIN=36V, 半载启机波形



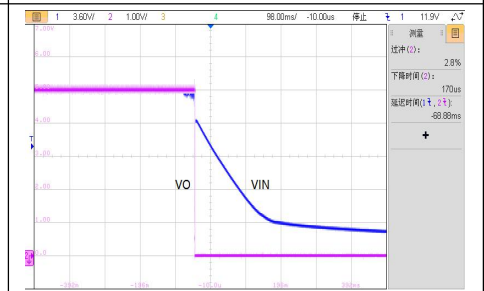
VIN=36V, 满载启机波形



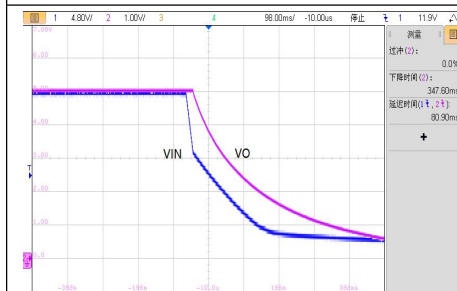
VIN=18V, 空载关机波形



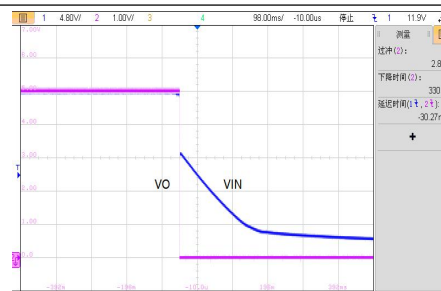
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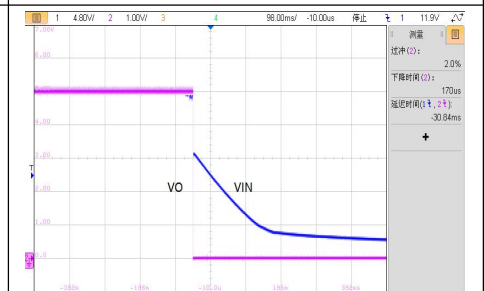
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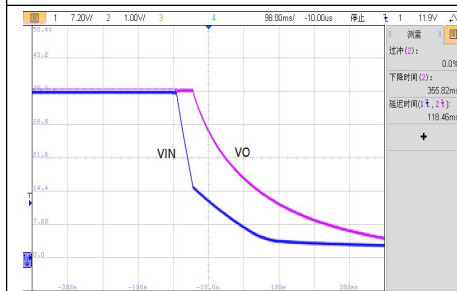
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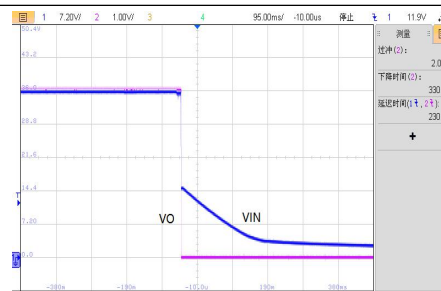
VIN=24V, 半载关机波形



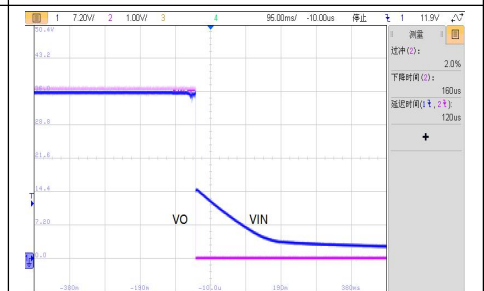
VIN=24V, 满载关机波形



VIN=36V, 空载关机波形

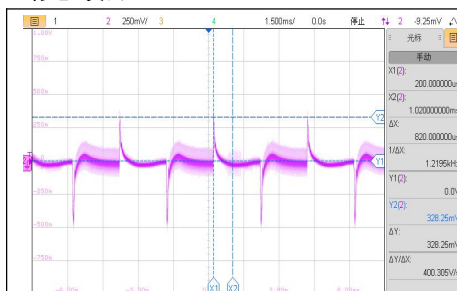


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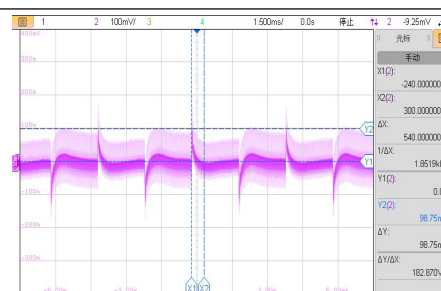


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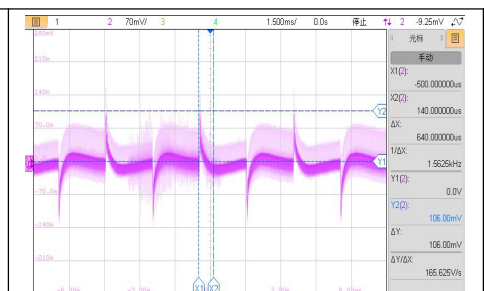
动态波形



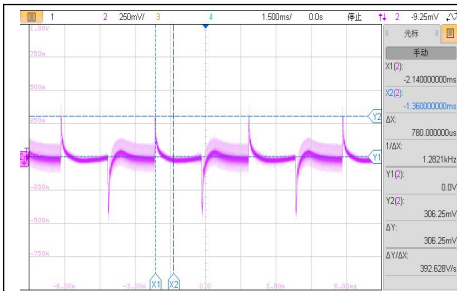
VIN=18V, 100%-10%-100%Io 动态波形



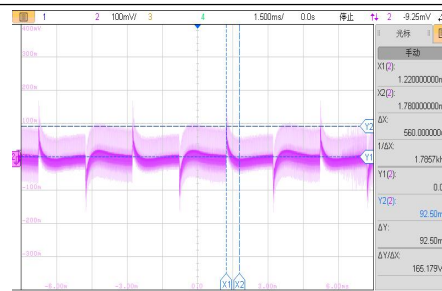
VIN=18V, 75%-50%-75%Io 动态波形



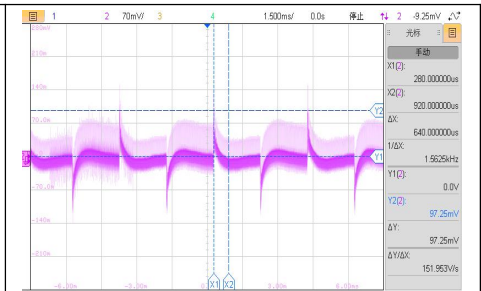
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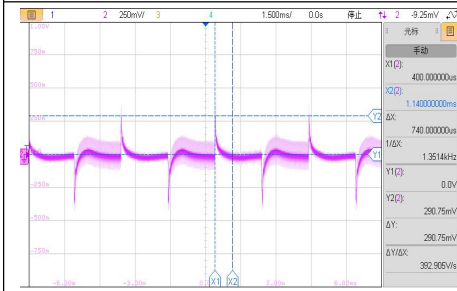
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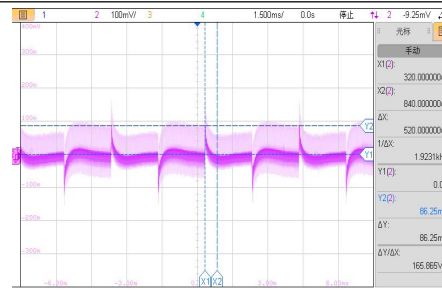
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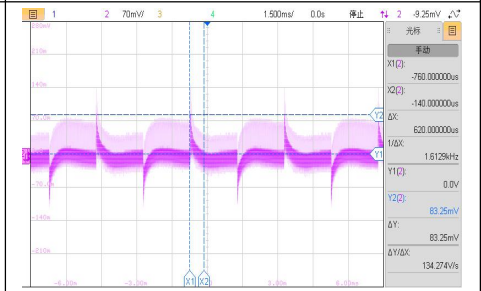
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

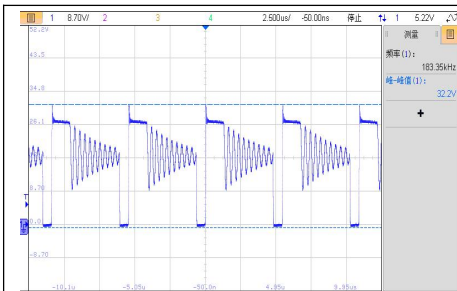


VIN=36V, 75%-50%-75%Io 动态波形

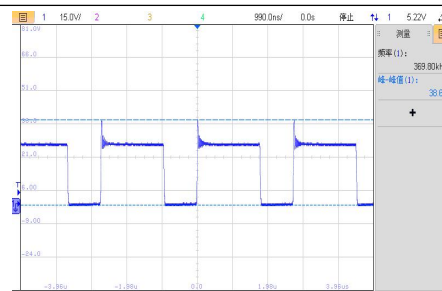


VIN=36V, 50%-25%-50%Io 动态波形

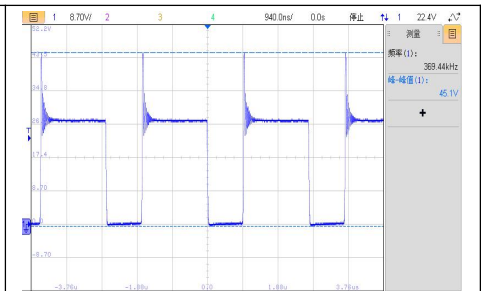
MOS 管电压应力波形



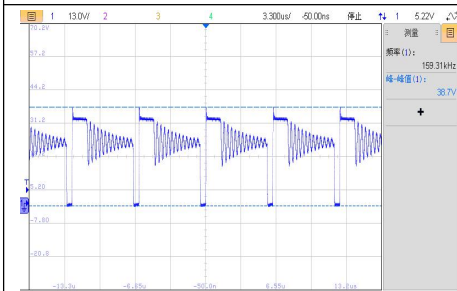
VIN=18V, 轻载 VDS 波形



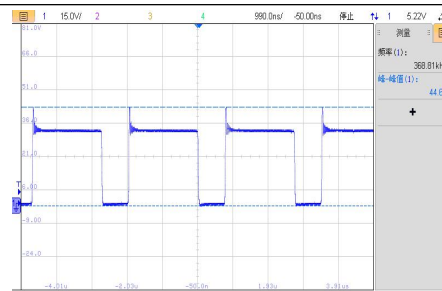
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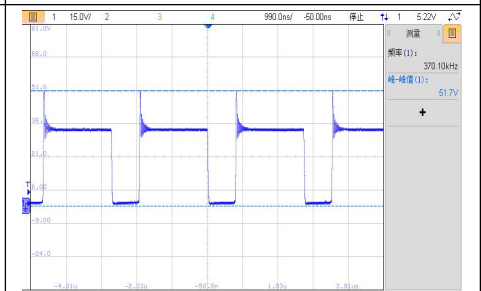
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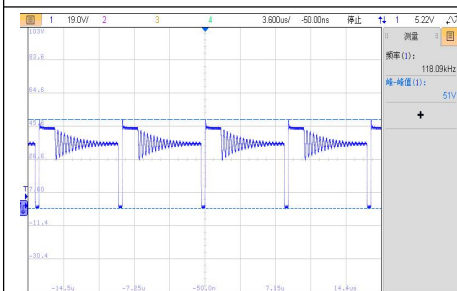
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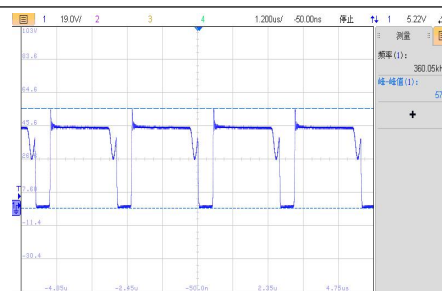
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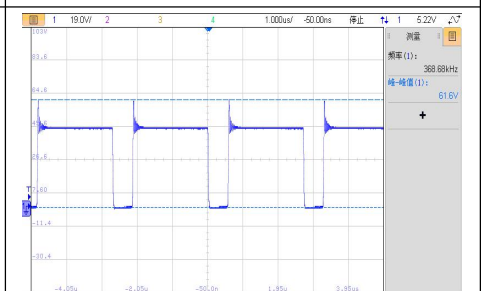
VIN=24V, 满载 VDS 波形



VIN=36V, 轻载 VDS 波形

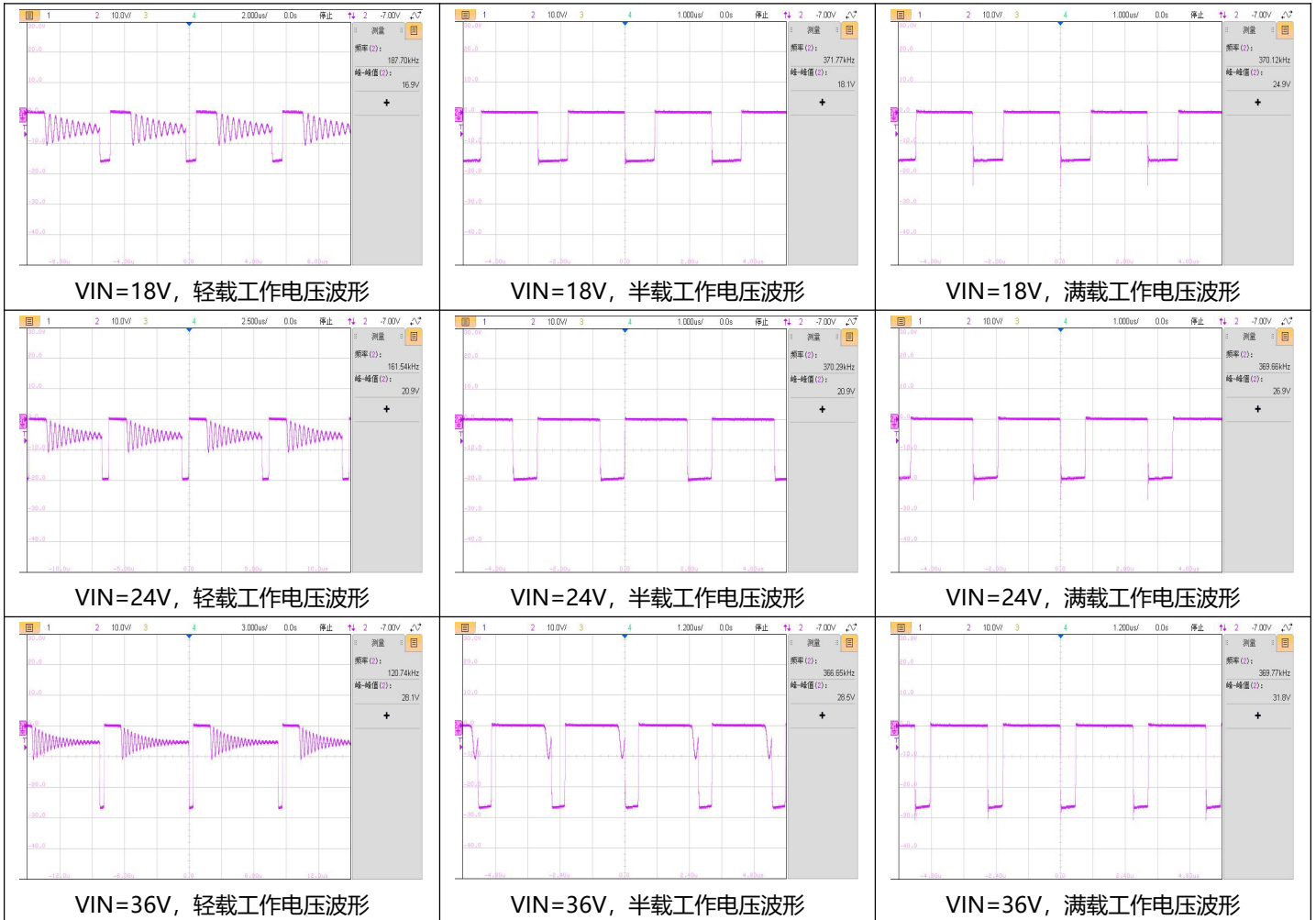


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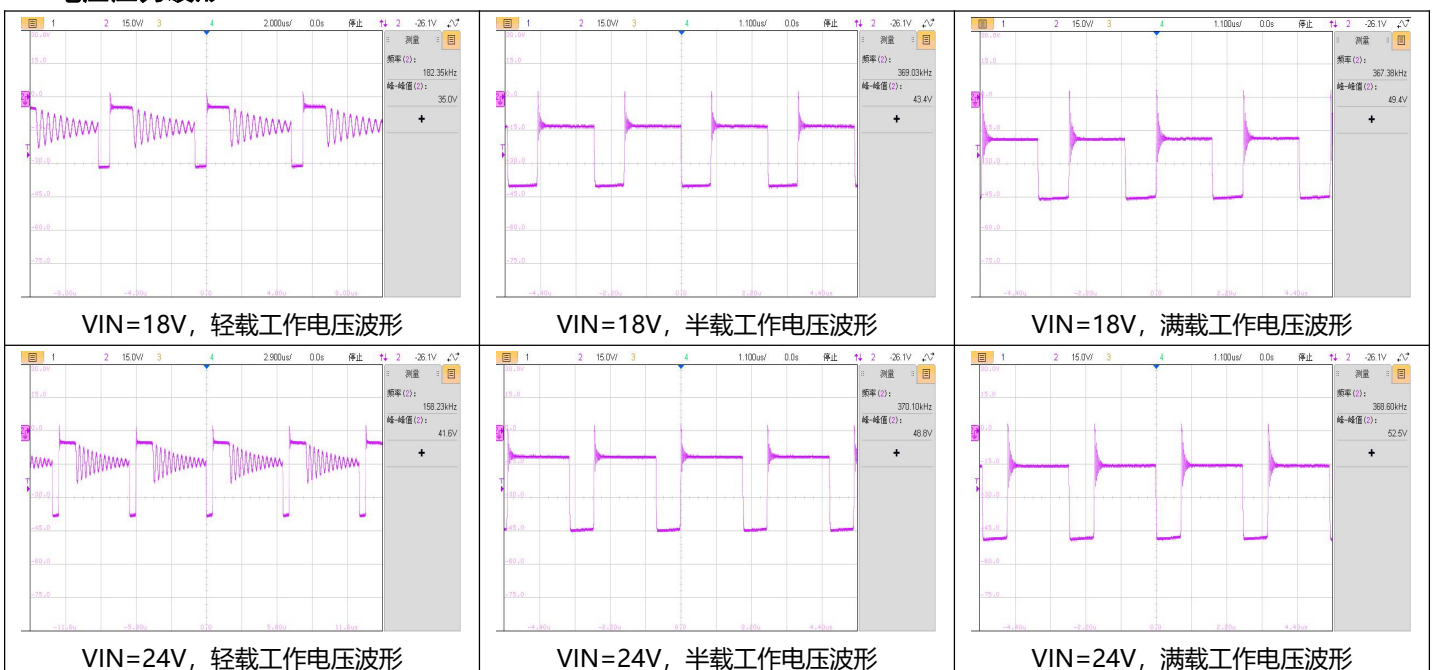


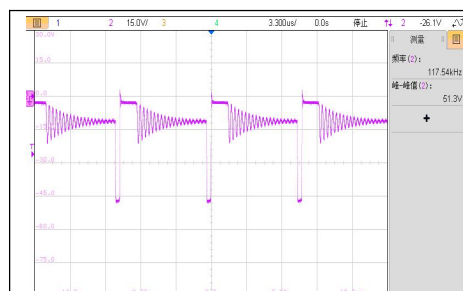
VIN=36V, 满载 VDS 波形

副边输出整流二极管 D5 应力波形

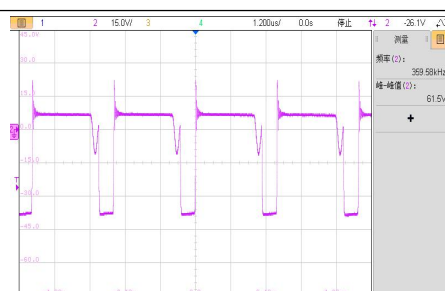


D2 电压应力波形

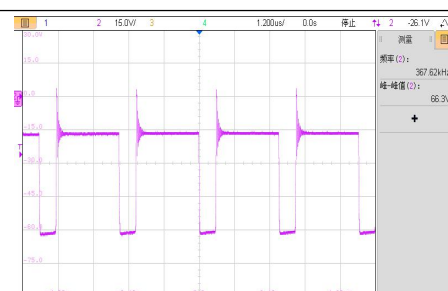




VIN=36V, 轻载工作电压波形

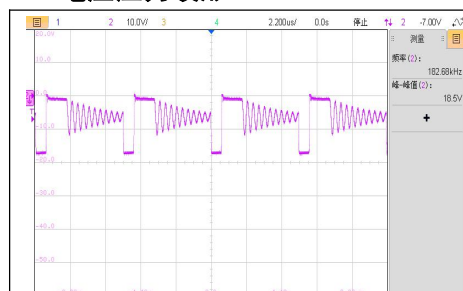


VIN=36V, 半载工作电压波形

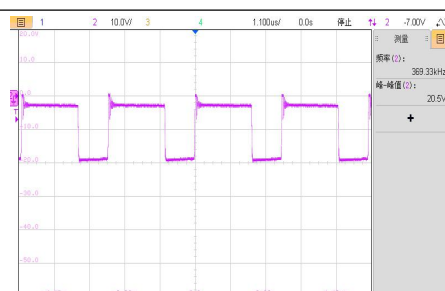


VIN=36V, 满载工作电压波形

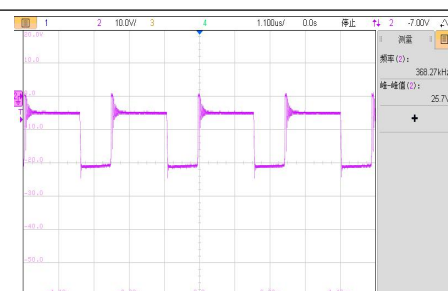
D4 电压应力波形



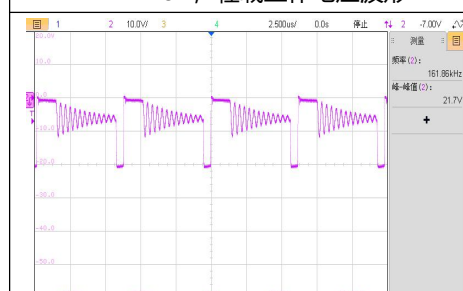
VIN=18V, 轻载工作电压波形



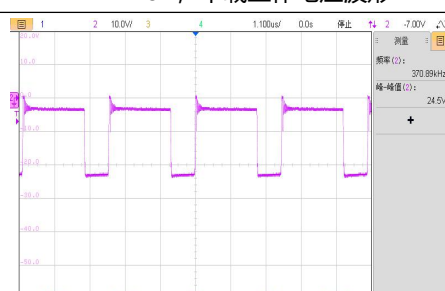
VIN=18V, 半载工作电压波形



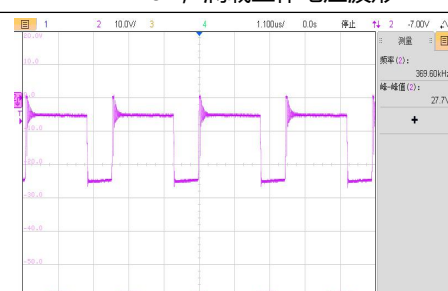
VIN=18V, 满载工作电压波形



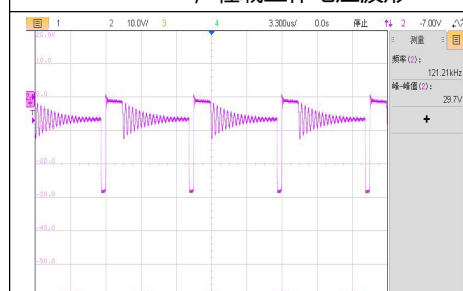
VIN=24V, 轻载工作电压波形



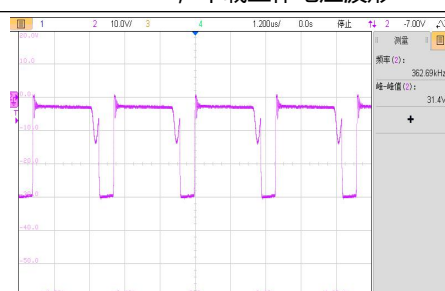
VIN=24V, 半载工作电压波形



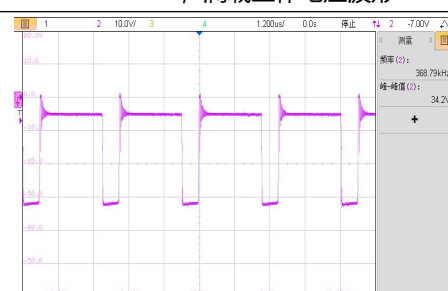
VIN=24V, 满载工作电压波形



VIN=36V, 轻载工作电压波形



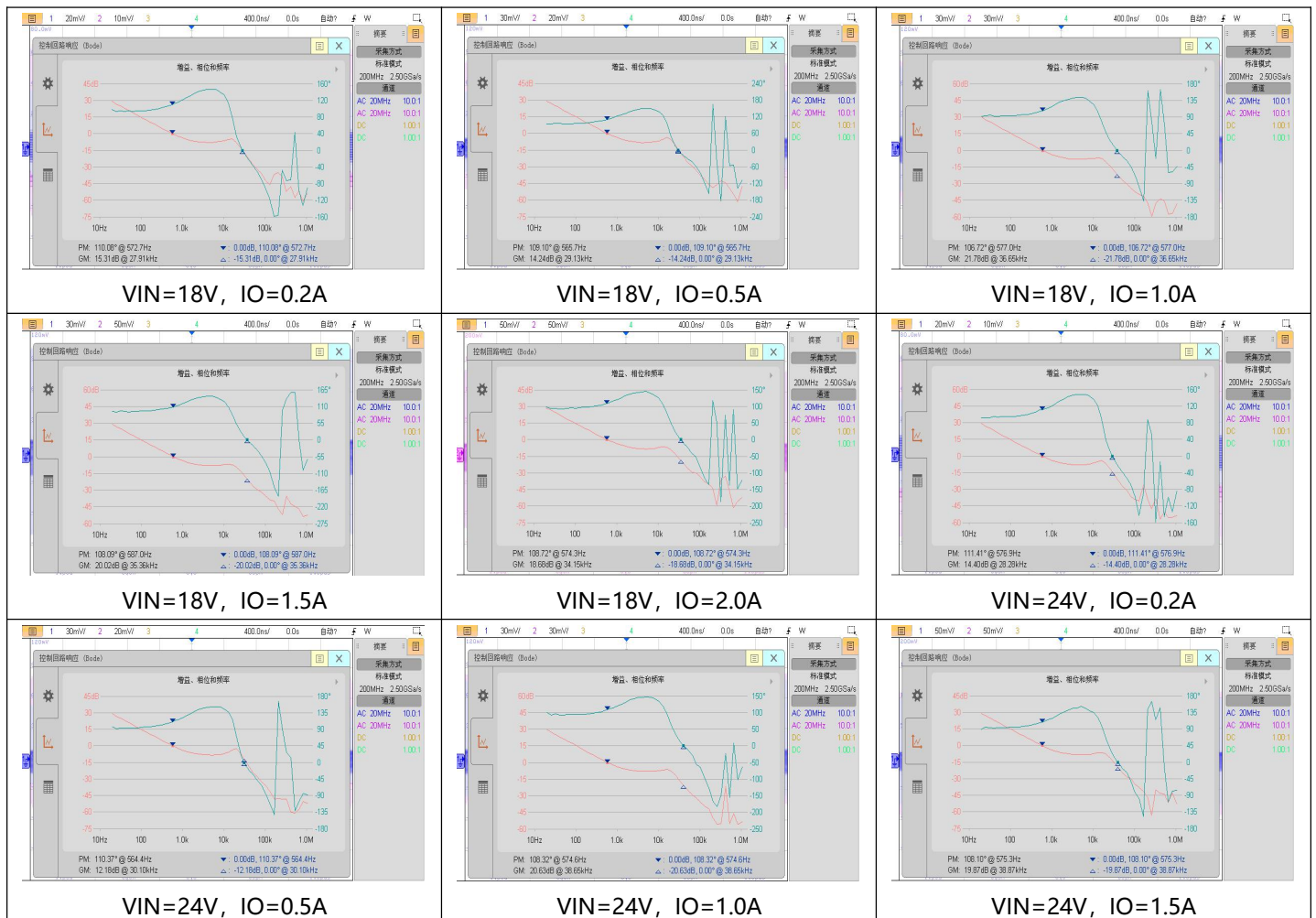
VIN=36V, 半载工作电压波形

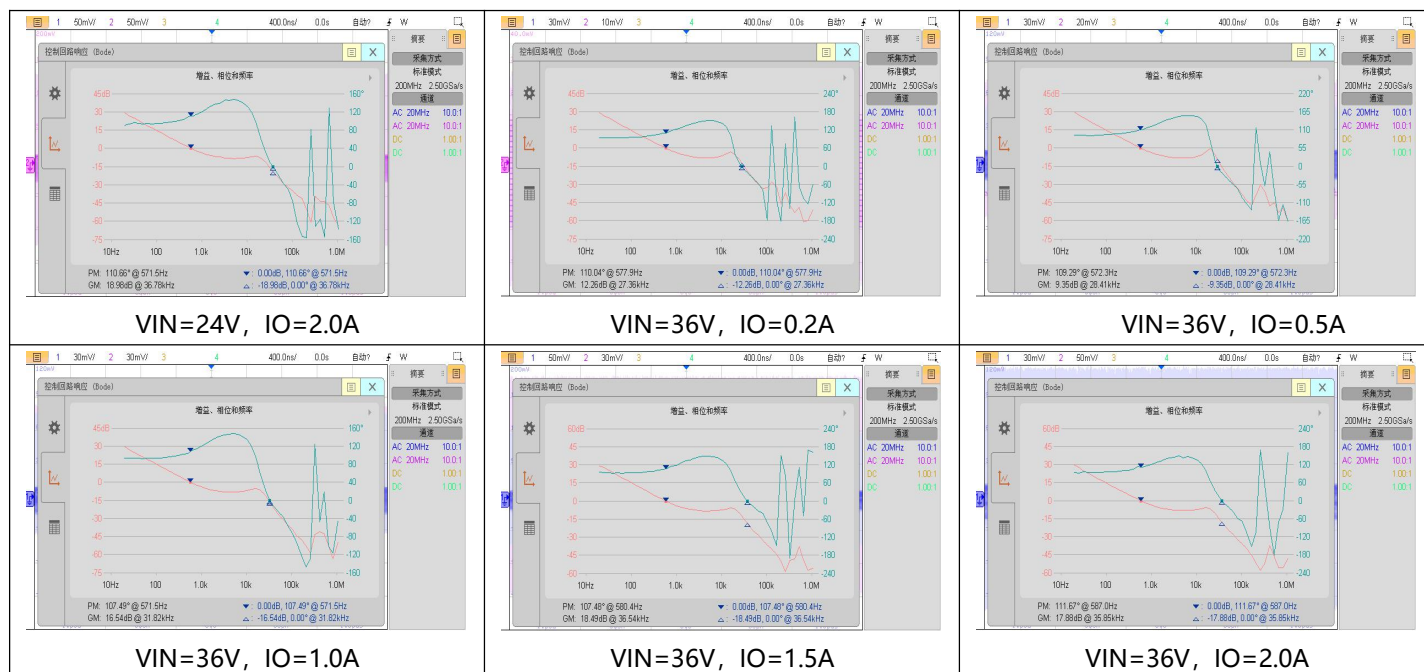


VIN=36V, 满载工作电压波形

环路稳定性测试

测试条件		PM	GM
IO=0.2A	VIN=18V	110.08°@572.7Hz	15.31dB@27.9KHz
	VIN=24V	111.41°@576.9Hz	14.40dB@28.28Hz
	VIN=36V	110.04°@577.9Hz	12.26dB@27.36Hz
IO=0.5A	VIN=18V	109.10°@565.7Hz	14.24dB@29.13Hz
	VIN=24V	110.37°@564.4Hz	12.18dB@30.10Hz
	VIN=36V	109.29°@572.3Hz	9.35dB@28.41Hz
IO=1.0A	VIN=18V	106.72°@577.0Hz	21.78dB@36.65Hz
	VIN=24V	108.32°@574.6Hz	20.63dB@38.65Hz
	VIN=36V	107.49°@571.5Hz	16.54dB@31.82Hz
IO=1.5A	VIN=18V	108.09°@587.0Hz	20.02dB@35.36Hz
	VIN=24V	108.10°@575.3Hz	38.87dB@35.36Hz
	VIN=36V	107.48°@580.4Hz	18.49dB@36.54Hz
IO=2.0A	VIN=18V	108.72°@574.3Hz	18.68dB@34.15Hz
	VIN=24V	110.66°@571.5Hz	18.98dB@36.78Hz
	VIN=36V	111.67°@587.0Hz	17.88dB@35.85Hz





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