

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 VPS2109，结合隔离功率变压器 VPE29PBB03A、输出整流二极管以及必要的阻容元件，实现 9V-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 3W 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。

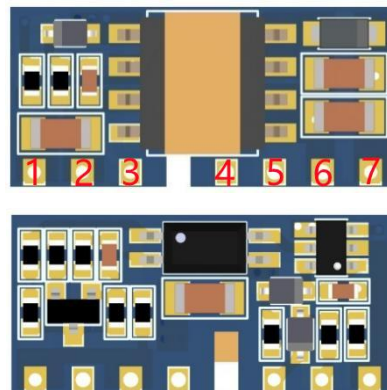
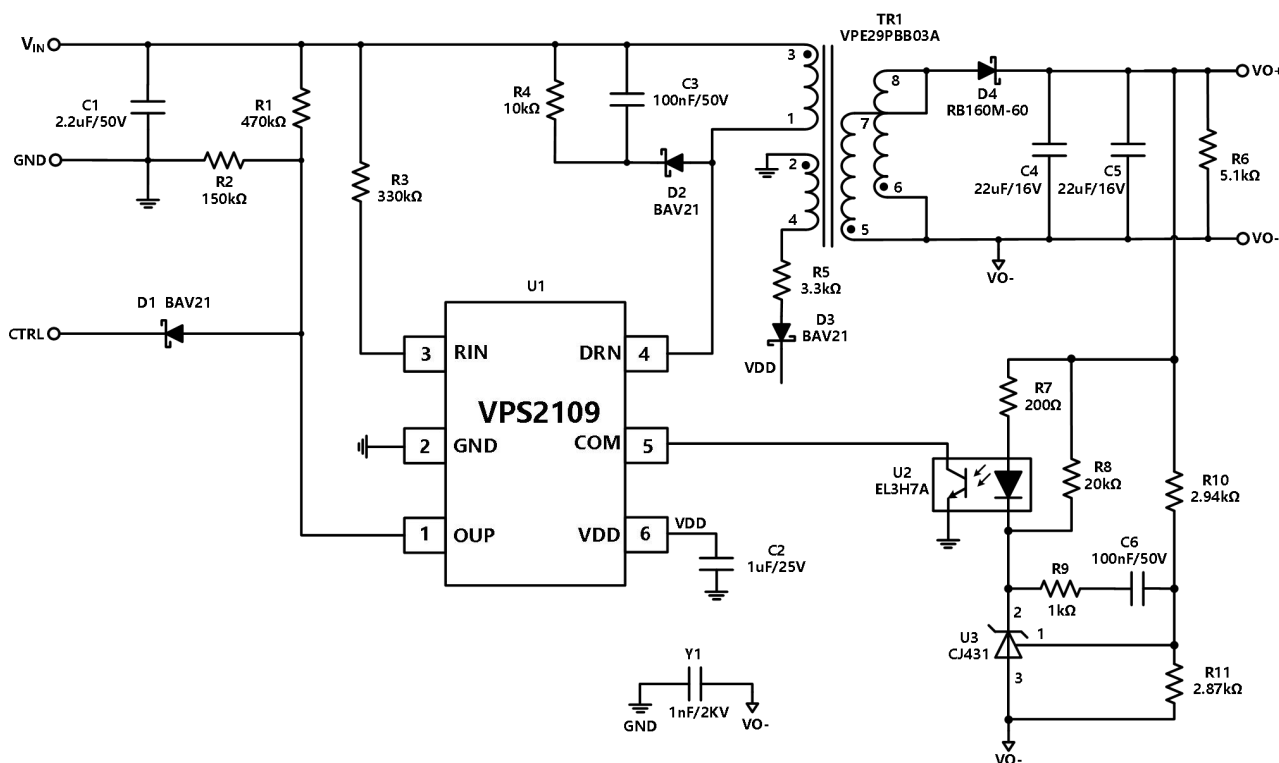


图 1: VPS2109 Demo 板(尺寸:50mm*30mm)

关键词：输入：9V-36V，输出 5V/3W，隔离电压：1500VDC，反馈方式：原边反馈-SSR

原理图



引脚功能说明

编号	功能	功能描述
1	GND	电源接地端
2	VIN	电源输入端
3	CTRL	使能控制引脚
5	VO+	电源输出正
6	VO-	电源输出负
7	VO+	电源输出正

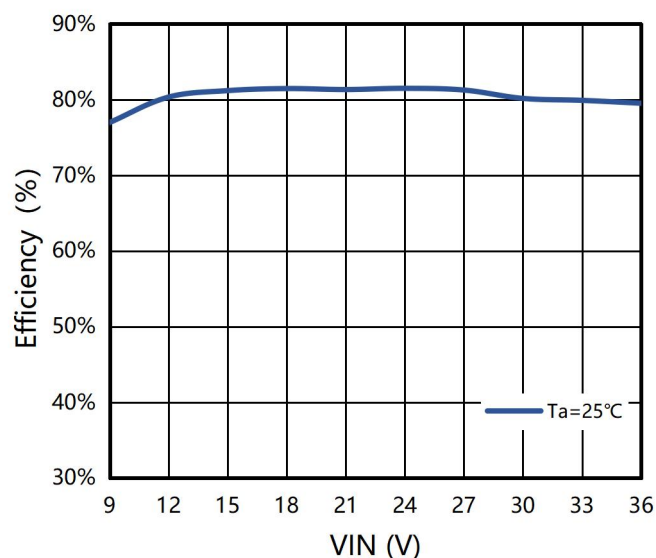
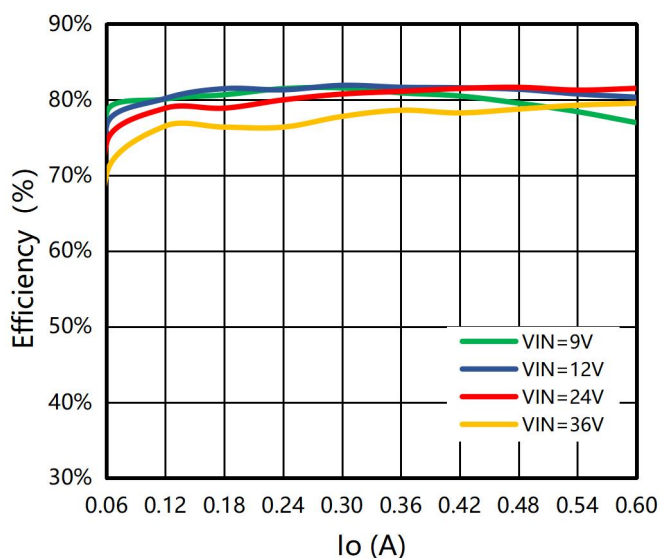
物料清单

位号	参数	封装	型号	品牌
C1	2.2uF/50V-X7R	1206	CC1206KKX7R9BB225	YAGEO
C2	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C3	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C4	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C5	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C6	100nF/50V-X7R	1206	CC0603KRX7R9BB104	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	470KΩ±1%	0603	RC0603FR-07470KL	YAGEO
R2	150KΩ±1%	0603	RC0603FR-07150KL	YAGEO
R3	330KΩ±1%	0603	RC0603FR-07330KL	YAGEO
R4	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R5	3.3KΩ±1%	0603	RC0603FR-073K3L	YAGEO
R6	5.1KΩ±1%	0603	RC0603FR-075K1L	YAGEO
R7	200Ω±1%	0603	RC0603FR-07200RL	YAGEO
R8	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R9	1KΩ±1%	1206	RC0603FR-071KL	YAGEO
R10	2.94KΩ±1%	0603	RC0603FR-072K94L	YAGEO
R11	2.87KΩ±1%	0603	RC0603FR-072K87L	YAGEO
TR1	NP:NS:NA=14:9:21 Lp=15.68uH	ER7.5	VPE29PBB03A	VPSC
D1	250V/200mA	SOD-323	BAV21WS	YANGJIE
D2	250V/200mA	SOD-323	BAV21WS	YANGJIE
D3	250V/200mA	SOD-323	BAV21WS	YANGJIE
D4	60V/1A	SOD-123F	RB160M-60TR	ROHM
U1	4-50VIN/90V/0.4Ω电流模式 PWM 控制器	SOT23-6	VPS2109	VPSC
U2	CTR=80~160, Viso=3750VAC	SSOP-4	EL3H7A	EVERLIGHT
U3	Vref=2.495V	SOT23-3	CJ431	CJ

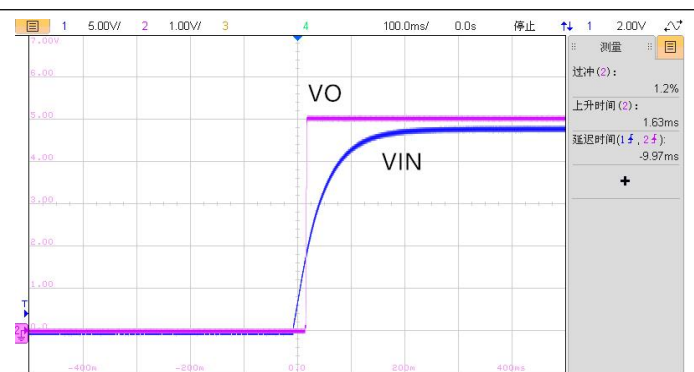
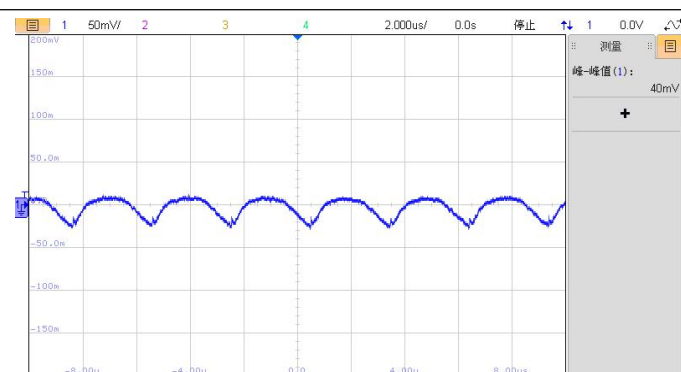
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流 (满载/空载)	VIN=24V	2	---	154	mA
转换效率	VIN=24V, IO=0.6A	---	81	---	%
纹波&噪声	VIN=24V, IO=0.6A	---	50	80	mV
输出电压精度	VIN=24V, IO=0.6A	---	0.4	---	%
线性调节率	VIN=9V-36V, IO=0.6A	---	-0.2	---	%
负载调整率	VIN=24V, IO=0.6A	---	-0.4	---	%
输入欠压保护	锁定电压	---	7.3	---	V
	恢复电压	---	8.3	---	V
短路保护	VIN=9V-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

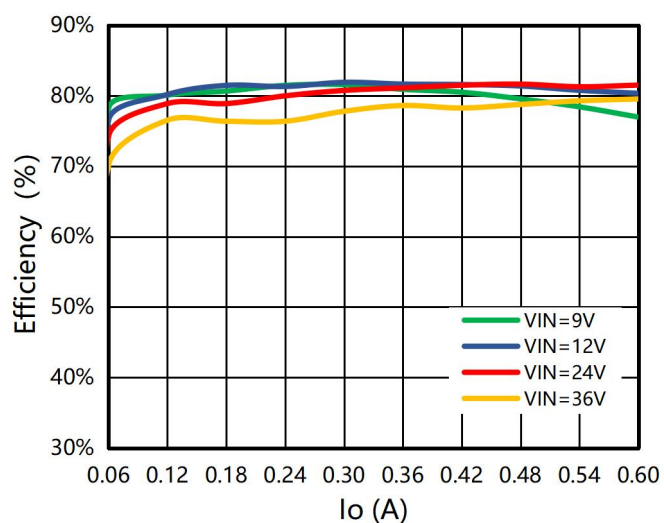


相关波形

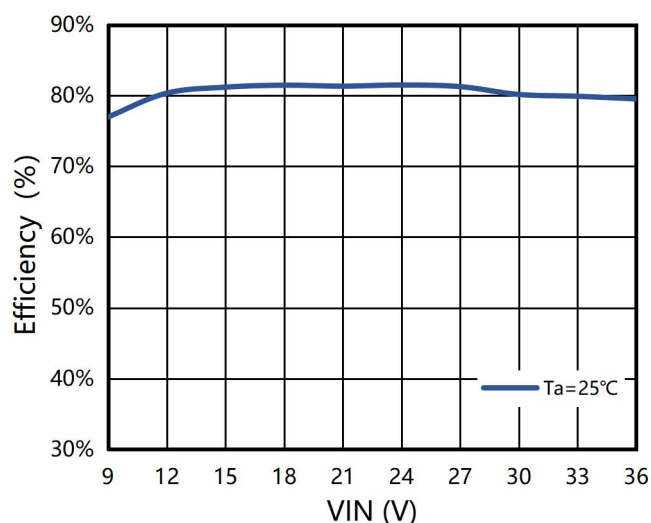


详细测试数据

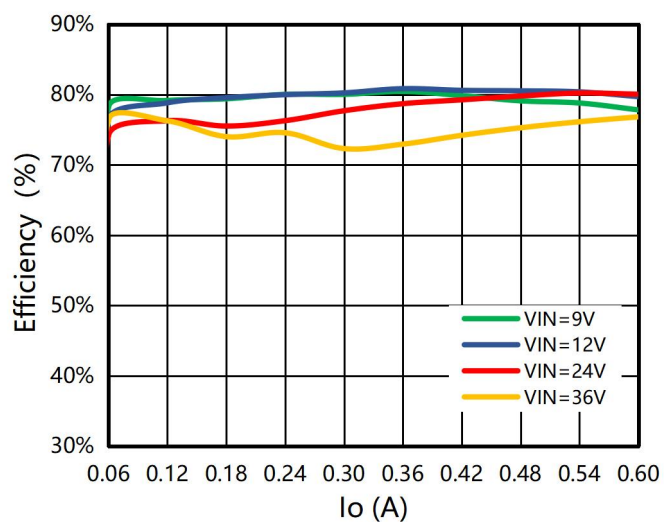
高低温测试曲线



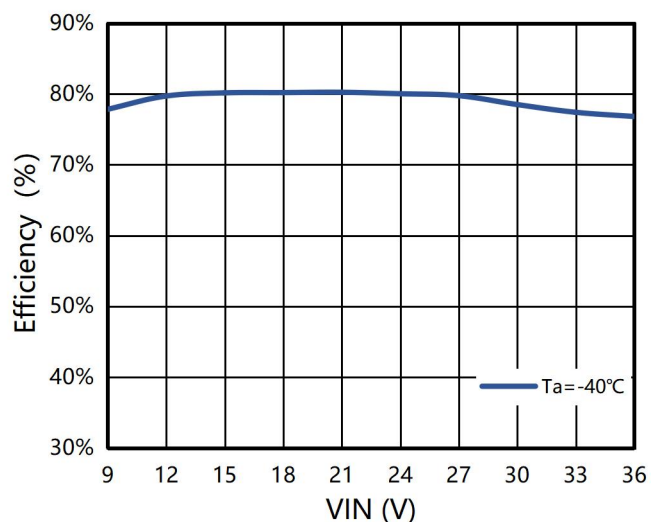
效率 VS 输出电流(25°C)



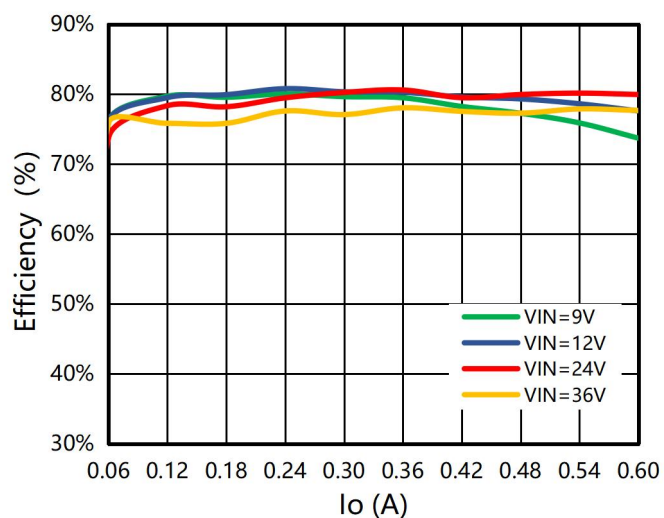
效率 VS 输入电压 (输出满载@25°C)



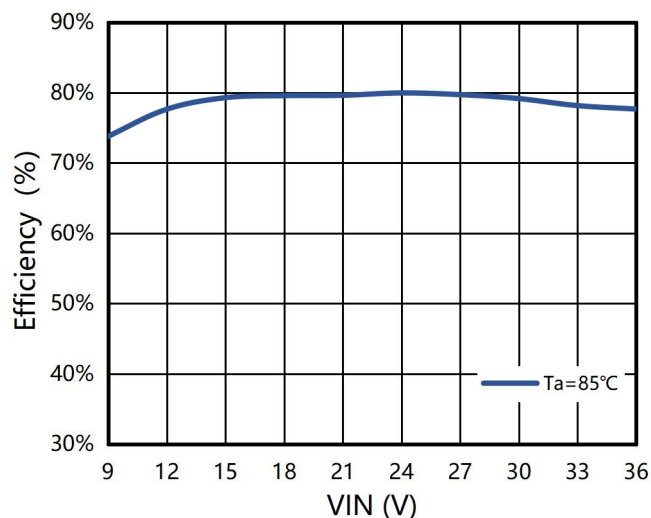
效率 VS 输出电流(-40°C)



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(%)
24.01	0.002	5.05	0	0%	0.00%
24.01	0.017	5.05	0.060	10%	74.23%
24.01	0.032	5.05	0.120	20%	78.87%
24.01	0.048	5.05	0.180	30%	78.87%
24.01	0.063	5.04	0.240	40%	79.97%
24.01	0.078	5.04	0.300	50%	80.74%
24.01	0.093	5.03	0.360	60%	81.10%
24.01	0.108	5.03	0.420	70%	81.47%
24	0.123	5.02	0.480	80%	81.63%
24	0.139	5.02	0.540	90%	81.26%
24	0.154	5.02	0.600	100%	81.49%

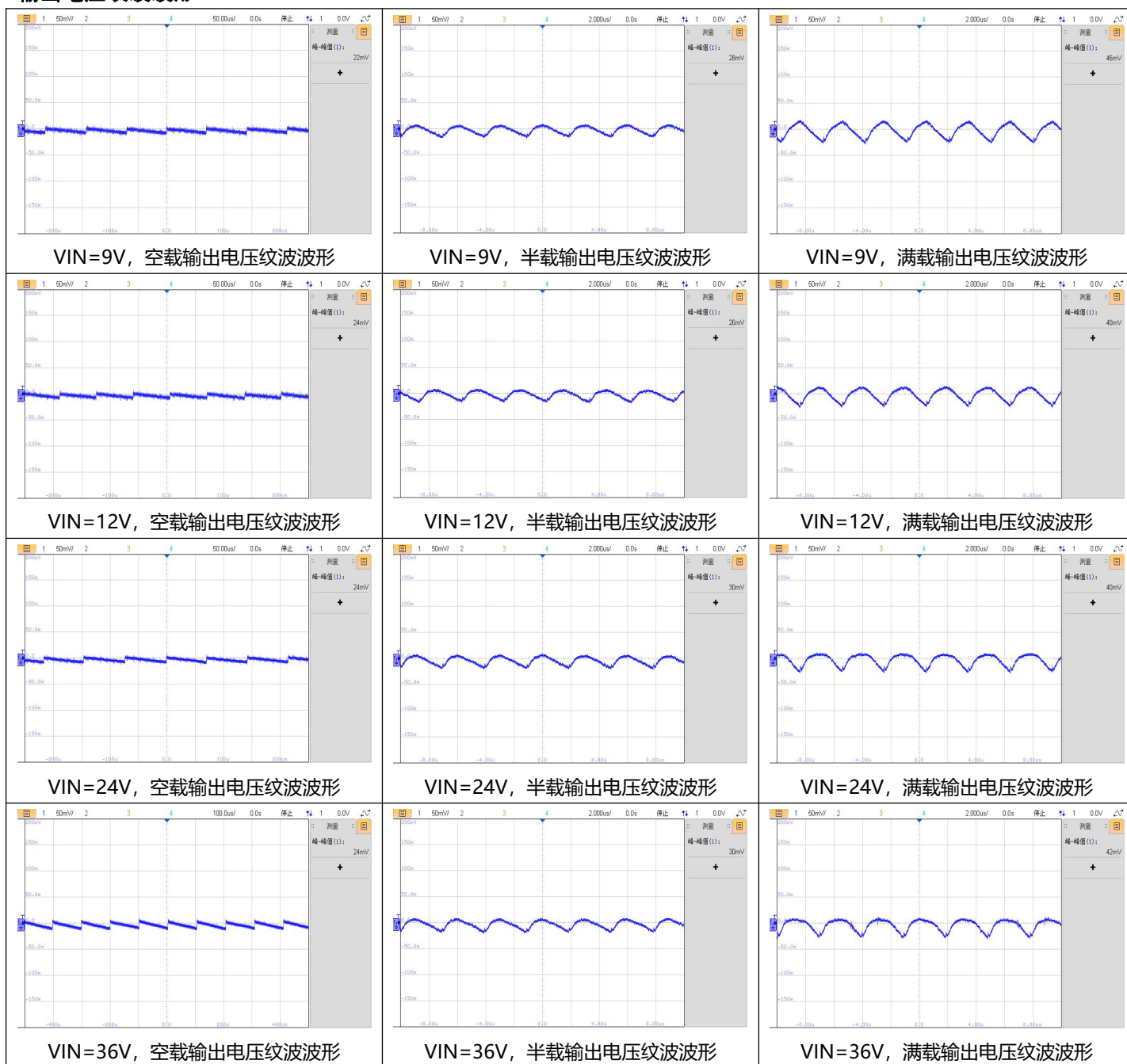
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.98	0.002	5.04	0	0%	0.00%
23.98	0.017	5.04	0.060	10%	74.18%
23.98	0.033	5.03	0.120	20%	76.28%
23.98	0.050	5.03	0.180	30%	75.51%
23.98	0.066	5.03	0.240	40%	76.28%
23.98	0.081	5.03	0.300	50%	77.69%
23.97	0.096	5.03	0.360	60%	78.69%
23.97	0.111	5.02	0.420	70%	79.24%
23.97	0.126	5.02	0.480	80%	79.78%
23.97	0.141	5.02	0.540	90%	80.21%
23.97	0.157	5.02	0.600	100%	80.04%

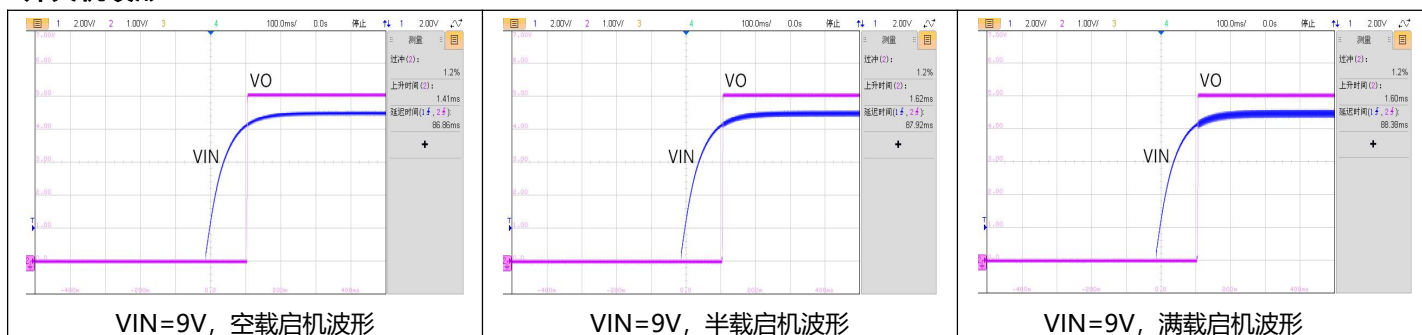
VIN=24V, Ta=85°C, 输入、输出及效率数据:

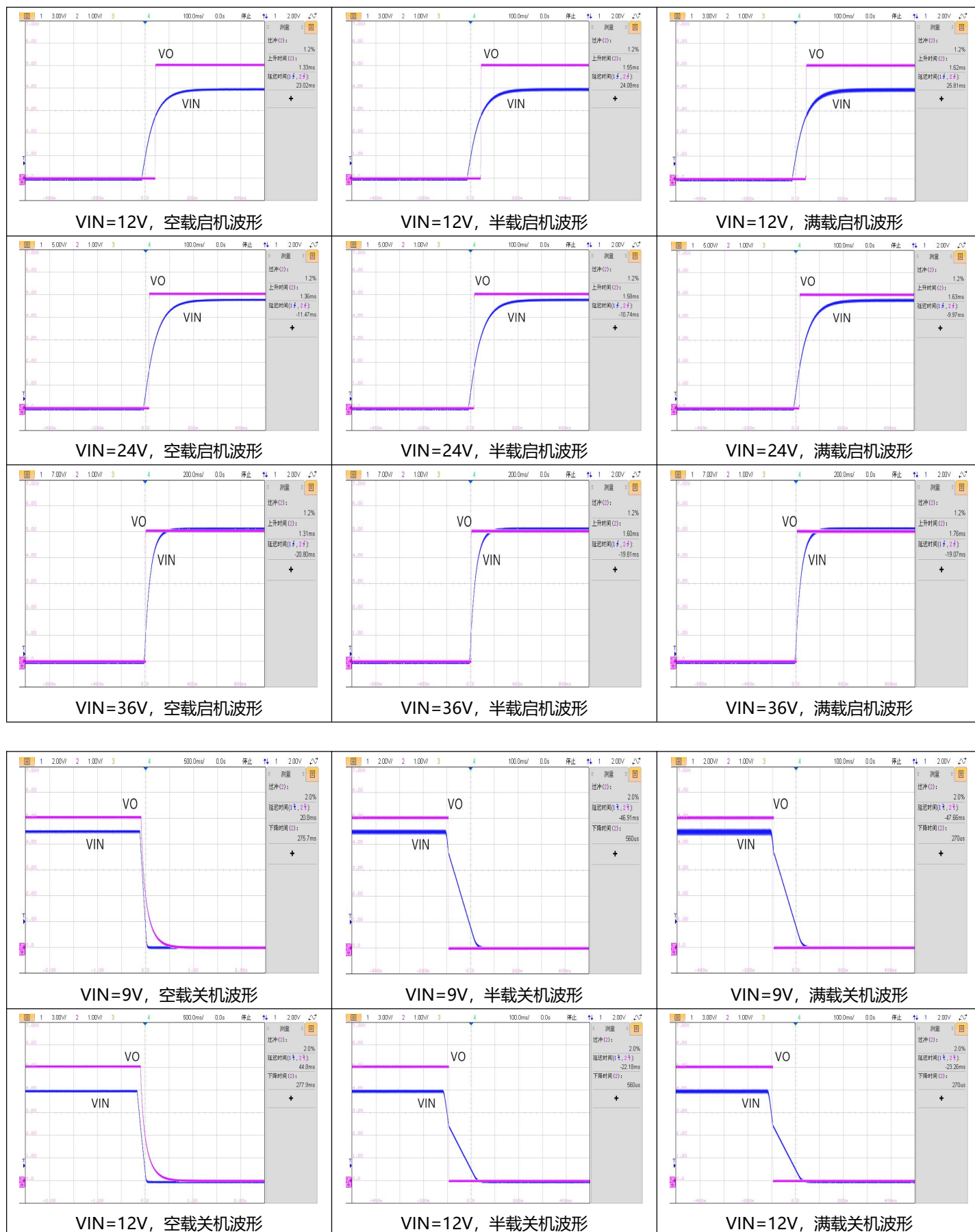
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.98	0.003	5.01	0	0%	0.00%
23.98	0.017	5.01	0.060	10%	73.74%
23.98	0.032	5.01	0.120	20%	78.35%
23.98	0.048	5	0.180	30%	78.19%
23.97	0.063	5	0.240	40%	79.46%
23.97	0.078	5	0.300	50%	80.23%
23.97	0.093	4.99	0.360	60%	80.58%
23.97	0.110	4.99	0.420	70%	79.49%
23.97	0.125	4.99	0.480	80%	79.94%
23.97	0.140	4.98	0.540	90%	80.14%
23.96	0.156	4.98	0.600	100%	79.94%

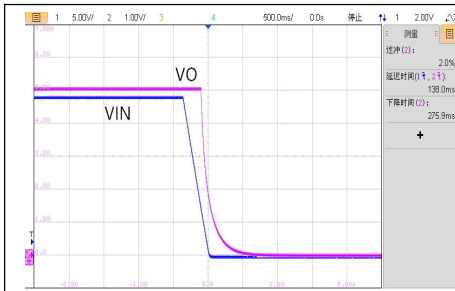
输出电压纹波波形



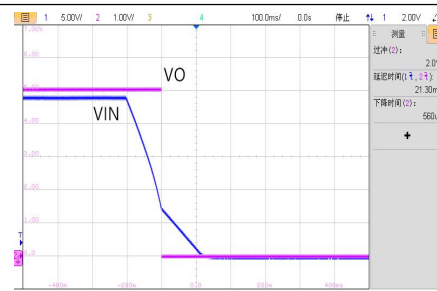
开关机波形



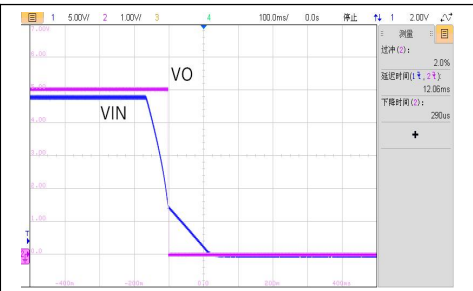




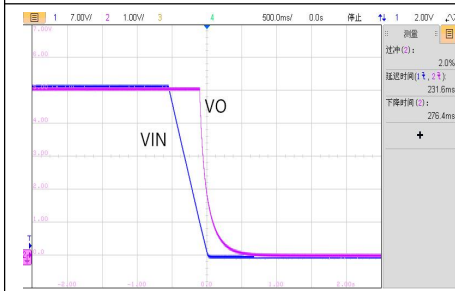
VIN=24V, 空载关机波形



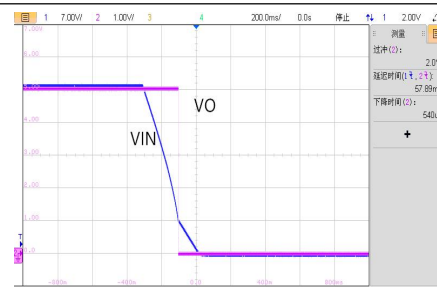
VIN=24V, 半载关机波形



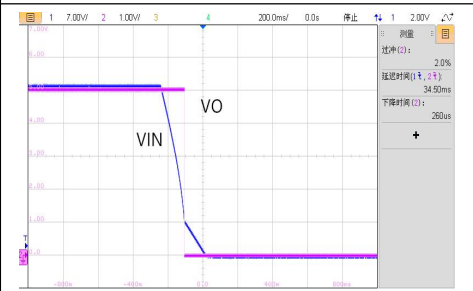
VIN=24V, 满载关机波形



VIN=36V, 空载关机波形

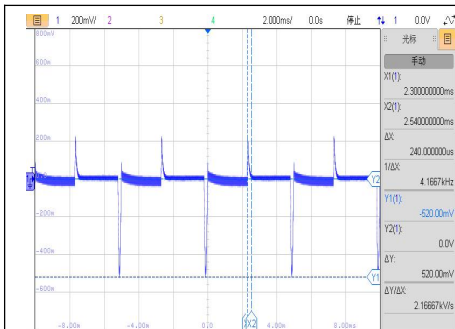


VIN=36V, 半载关机波形

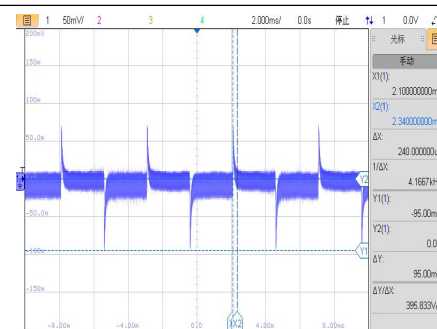


VIN=36V, 满载关机波形

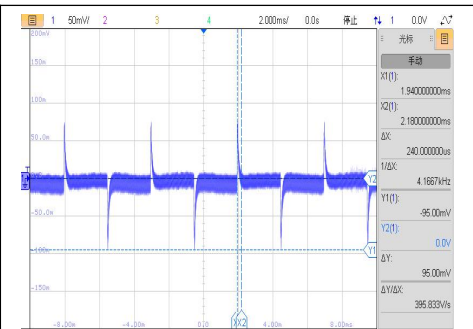
动态波形



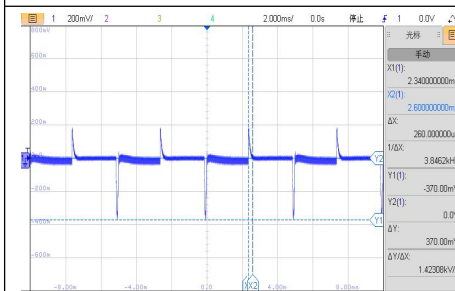
VIN=9V, 100%-10%-100%Io 动态波形



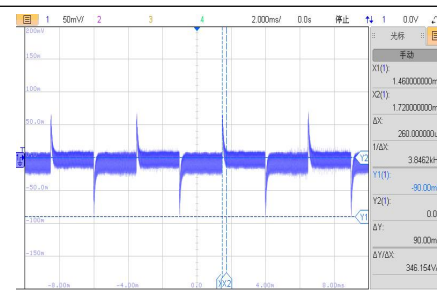
VIN=9V, 75%-50%-75%Io 动态波形



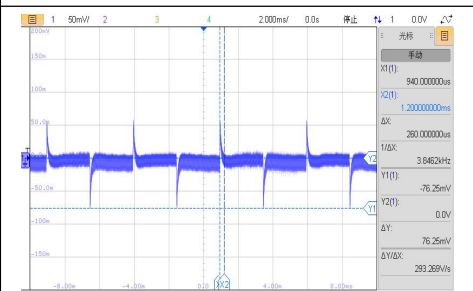
VIN=9V, 50%-25%-50%Io 动态波形



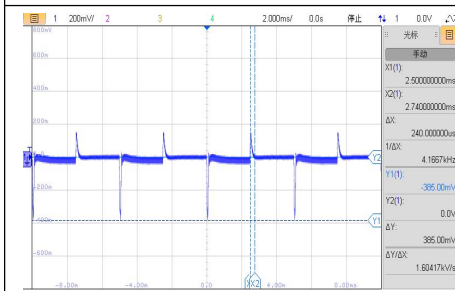
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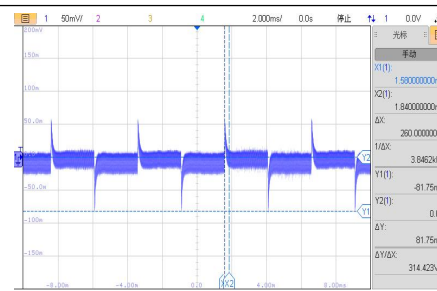
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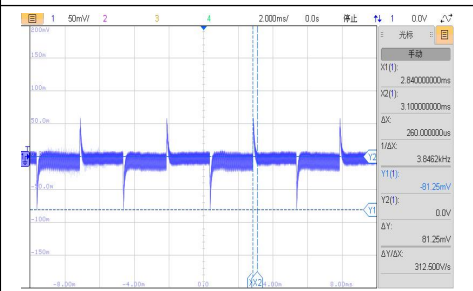
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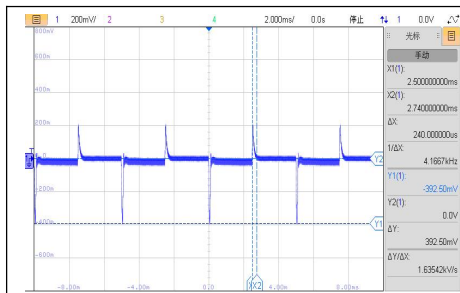
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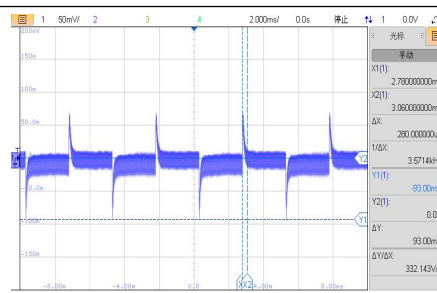
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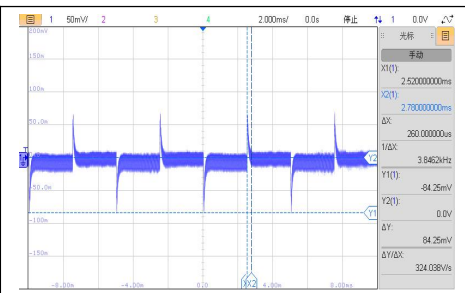
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

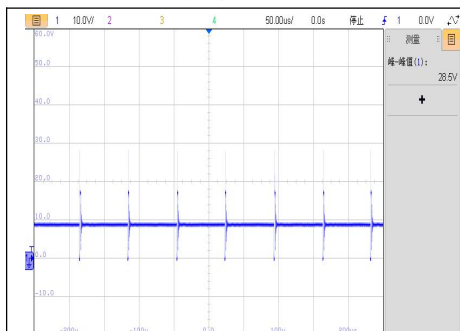


VIN=36V, 75%-50%-75%Io 动态波形

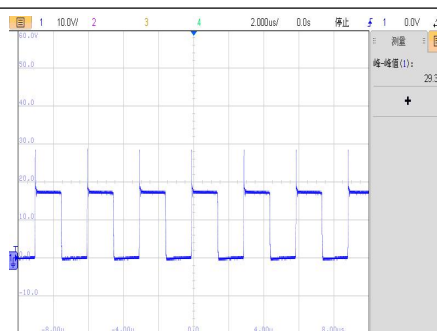


VIN=36V, 50%-25%-50%Io 动态波形

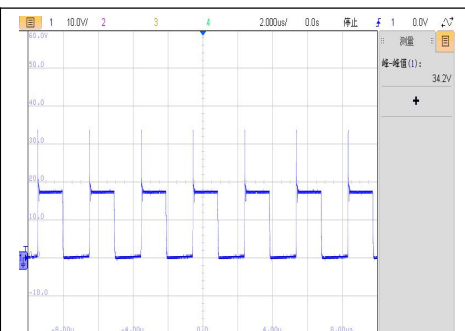
MOS 管电压应力波形



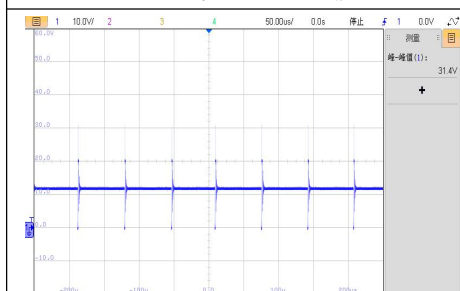
VIN=9V, 空载 VDS 波形



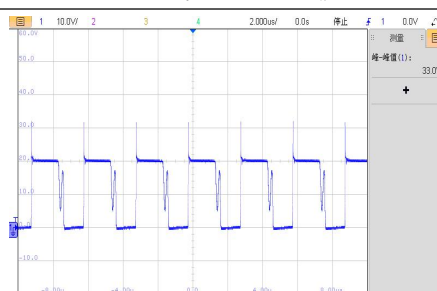
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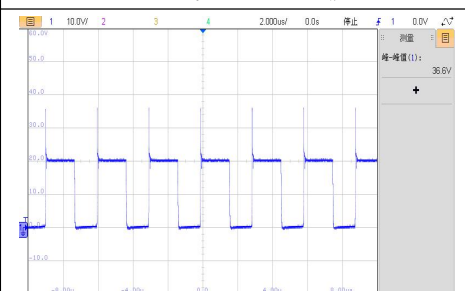
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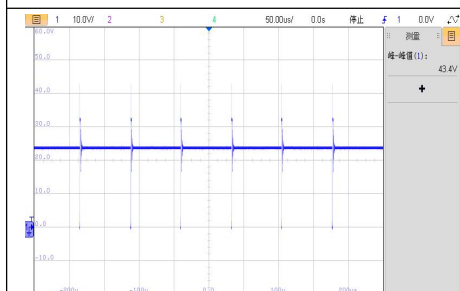
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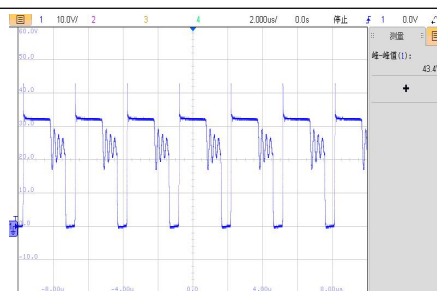
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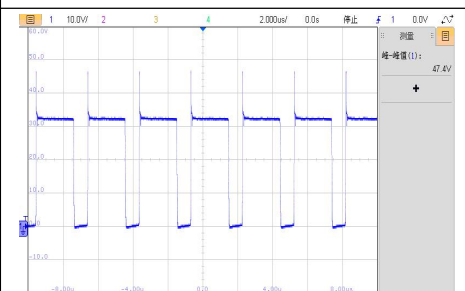
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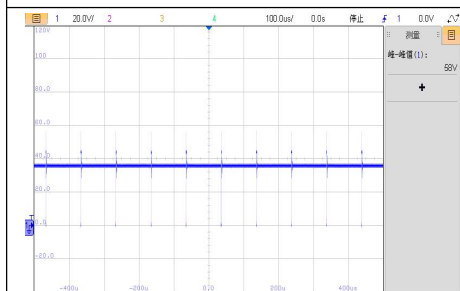
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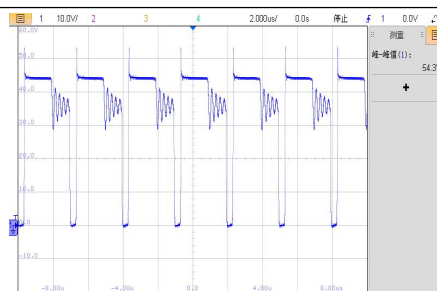
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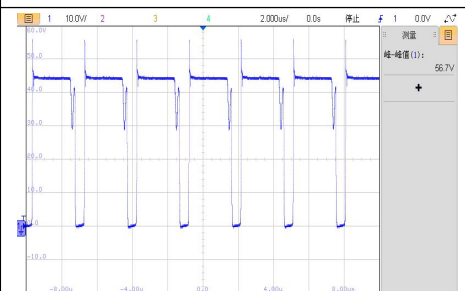
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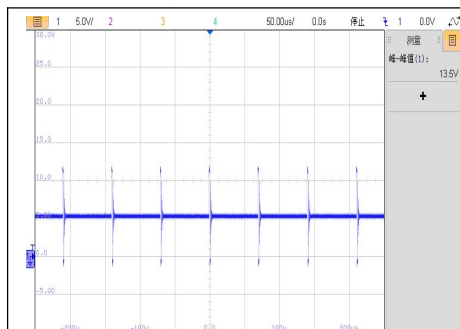


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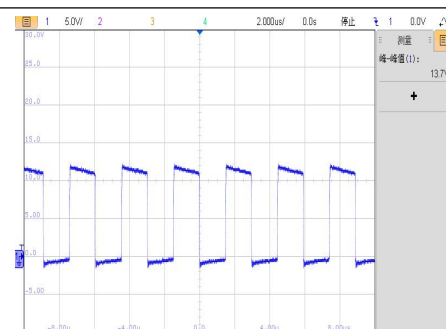


VIN=36V, 满载 VDS 波形

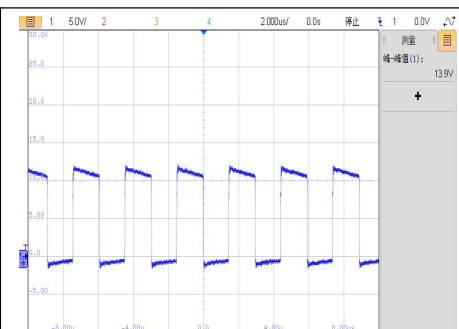
副边输出整流二极管 D4 应力波形



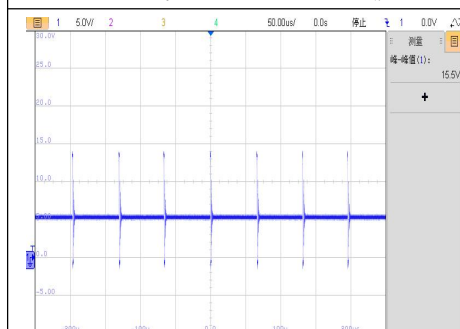
VIN=9V, D4 空载工作电压波形



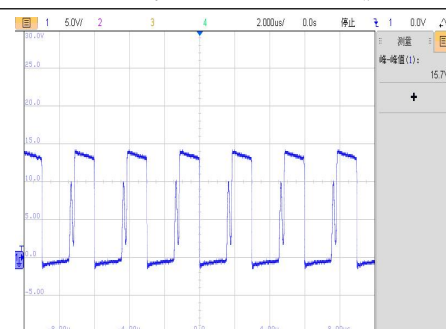
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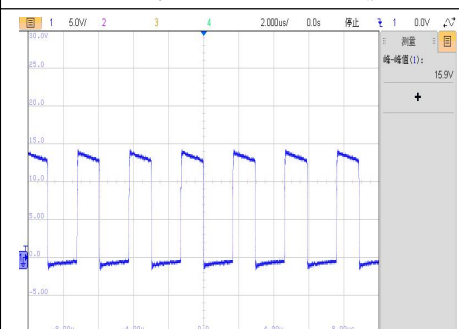
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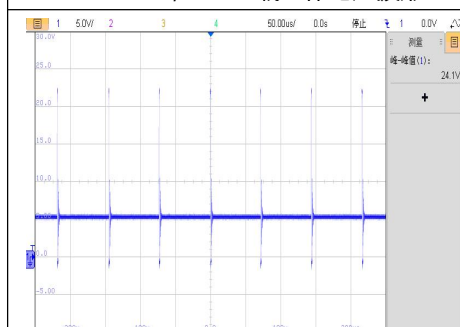
VIN=12V, D4 空载工作电压波形



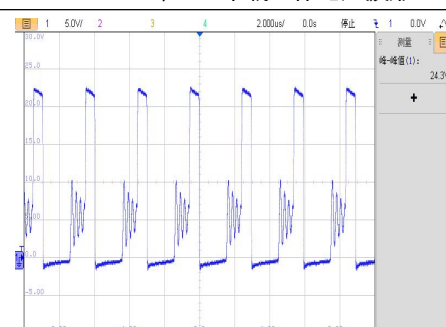
VIN=12V, D4 半载工作电压波形



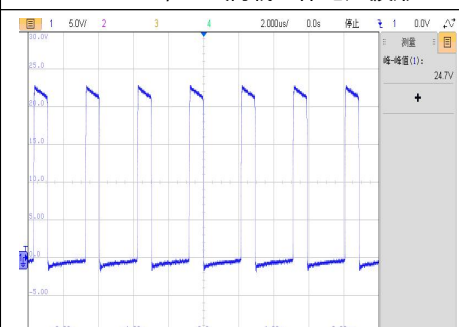
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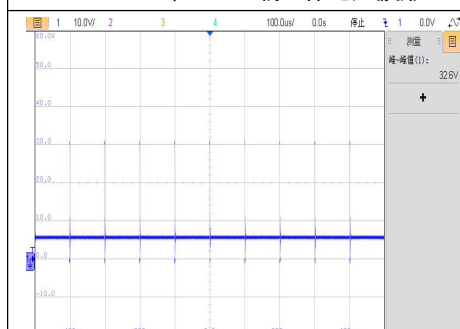
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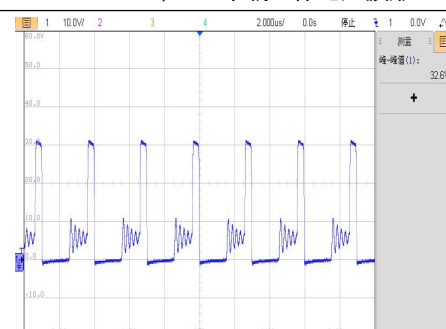
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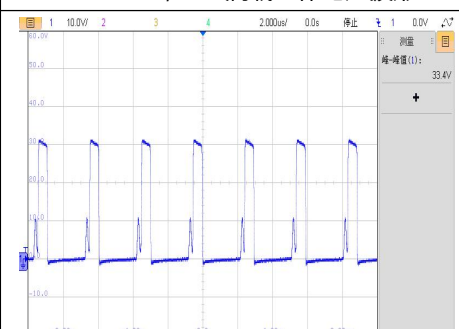
VIN=24V, D4 满载工作电压波形



VIN=36V, D4 空载工作电压波形



VIN=36V, D4 半载工作电压波形



VIN=36V, D4 满载工作电压波形

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