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 VPE24PBB06A、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 6W 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。

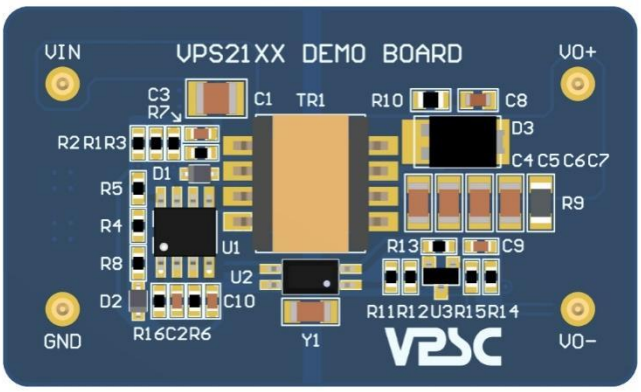
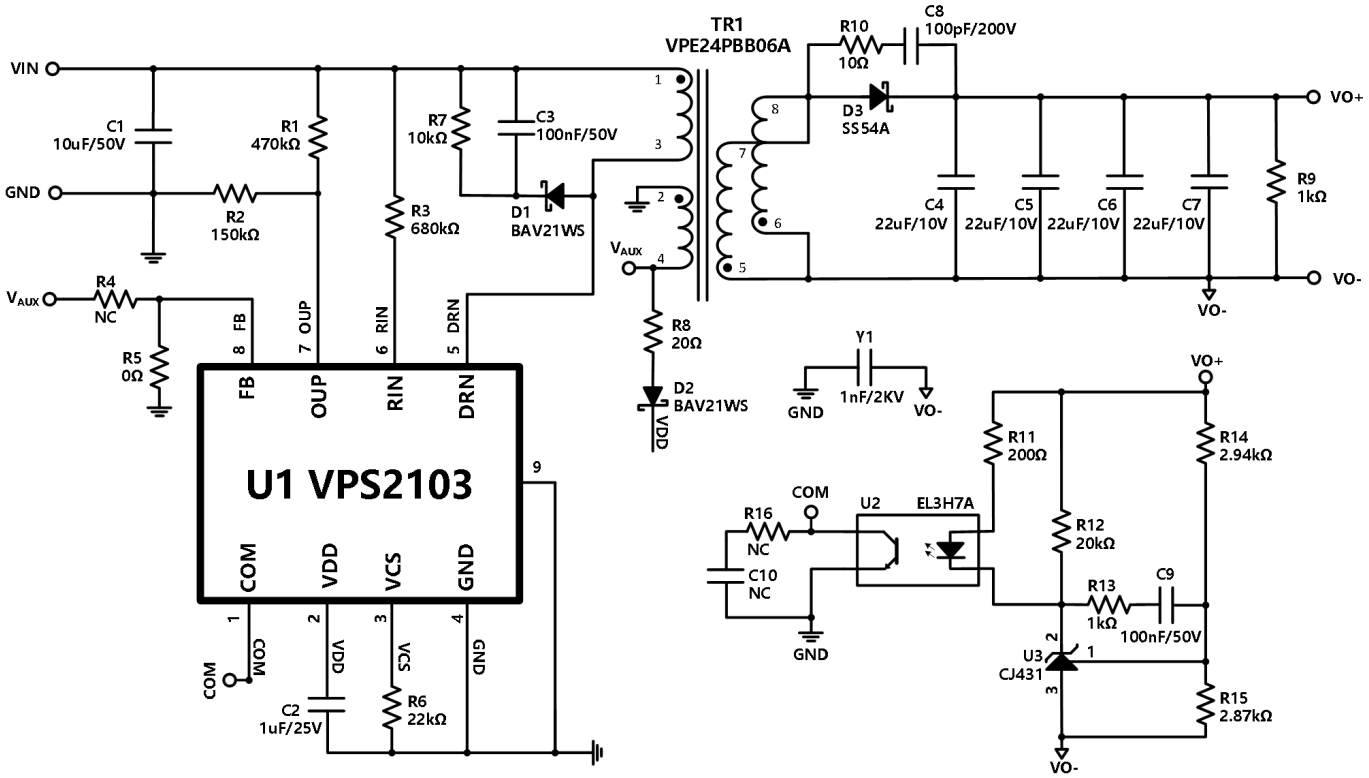


图 1: VPS2103 Demo 板(尺寸:50mm*30mm)

关键词：输入：9V-36V，输出 5V/6W，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	100pF/200V-NP0	0805	CC0805JRNPOABN101	YAGEO
C9	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C10	NC	-	-	-
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	470KΩ±1%	0603	RC0603FR-07470KL	YAGEO
R2	150KΩ±1%	0603	RC0603FR-07150KL	YAGEO
R3	680KΩ±1%	0603	RC0603FR-07680KL	YAGEO
R4	NC	-	-	-
R5	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R6	22KΩ±1%	0603	RC0603FR-0722KL	YAGEO
R7	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R8	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R9	1KΩ±1%	1206	RC1206FR-071KL	YAGEO
R10	10Ω±1%	0805	RC0805FR-0710RL	YAGEO
R11	200Ω±1%	0603	RC0603FR-07200RL	YAGEO
R12	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R13	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R14	2.94KΩ±1%	0603	RC0603FR-072K94L	YAGEO
R15	2.87KΩ±1%	0603	RC0603FR-072K87L	YAGEO
R16	NC	-	-	-
TR1	NP:NS:NA=10:6:6 Lp=15uH	ER11.5	VPE24PBB06A	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/0.1Ω电流模式 PWM 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	4	---	302	mA
转换效率	VIN=24V，IO=1.2A	---	83.5	---	%
纹波&噪声	VIN=24V，IO=1.2A	---	50	80	mV
输出电压精度	VIN=24V，IO=1.2A	---	0.8	---	%
线性调节率	VIN=9V-36V，IO=1.2A	---	0.1	---	%
负载调整率	VIN=24V，IO=1.2A	---	0.2	---	%
输出过流点系数	VIN=9V，IO=1.2A	---	1.45	---	倍
输入欠压保护	锁定电压	---	7.2	---	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℃需降额使用	-40	---	85	℃
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

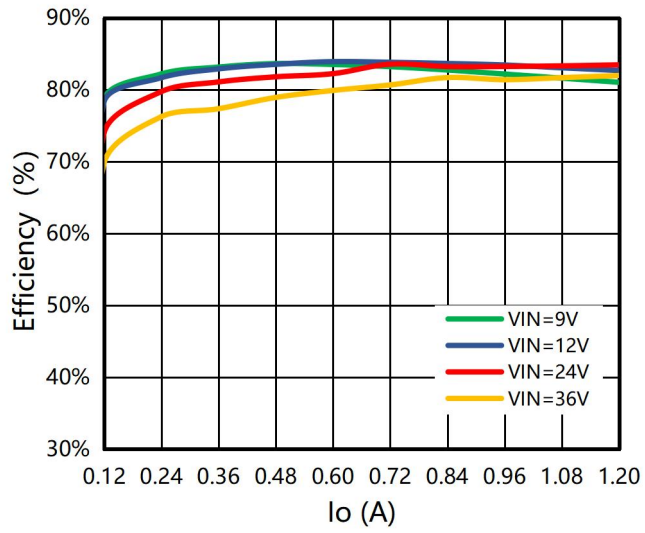


图 2: 效率 VS 输出电流

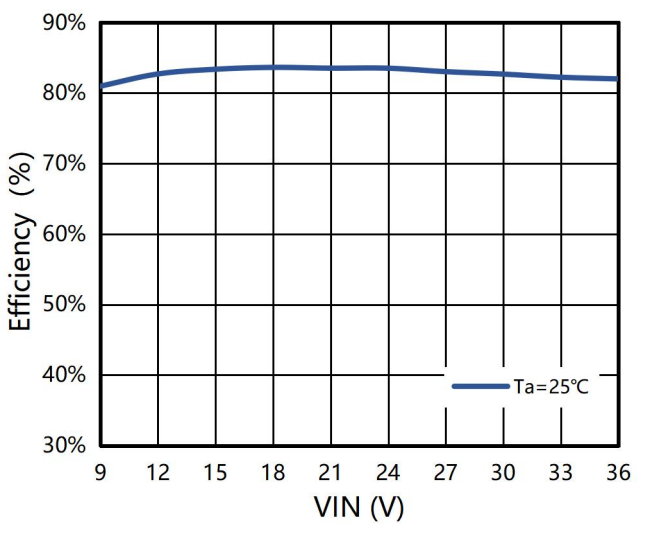


图 3: 效率 VS 输入电压（输出满载）

相关波形

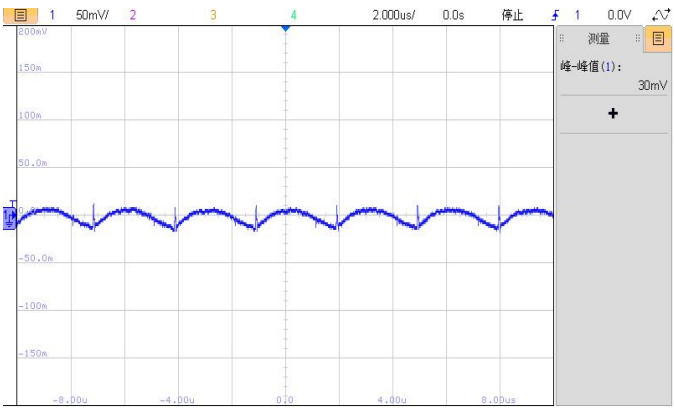


图 4: VIN=24V，满载输出电压纹波波形

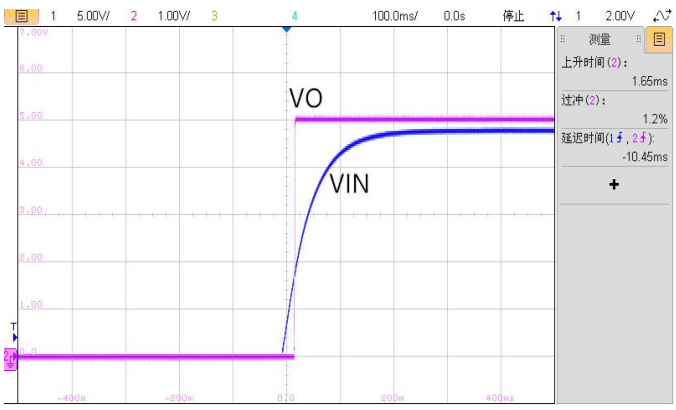
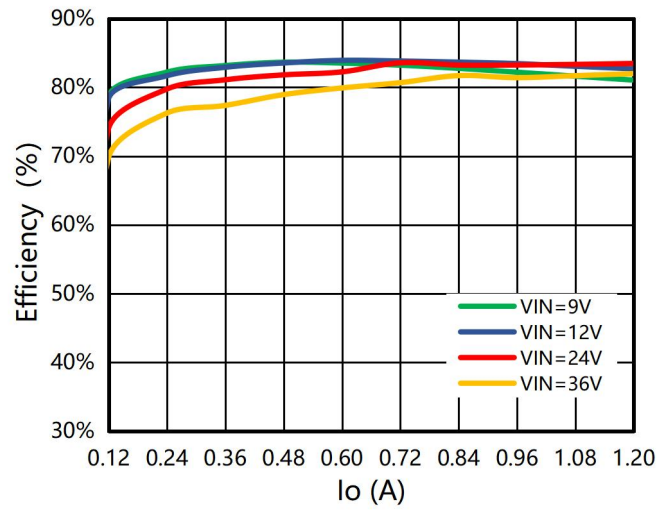


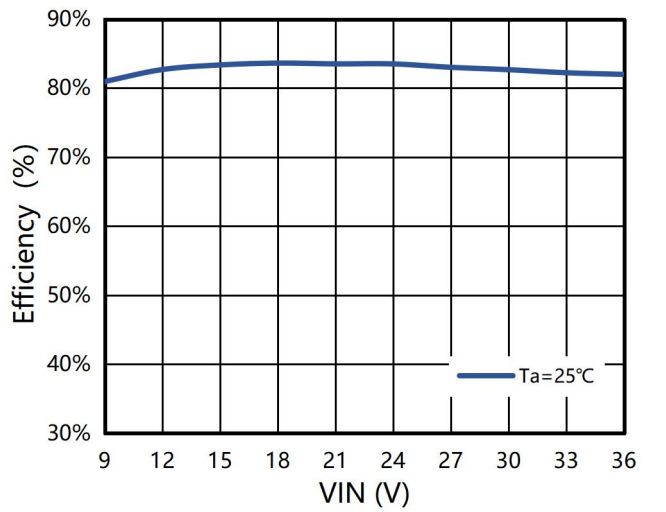
图 5: VIN=24V，满载启机波形

详细测试数据

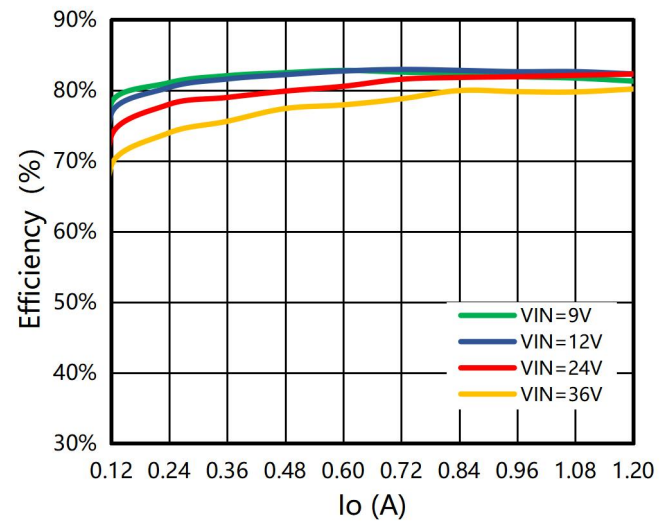
高低温测试曲线



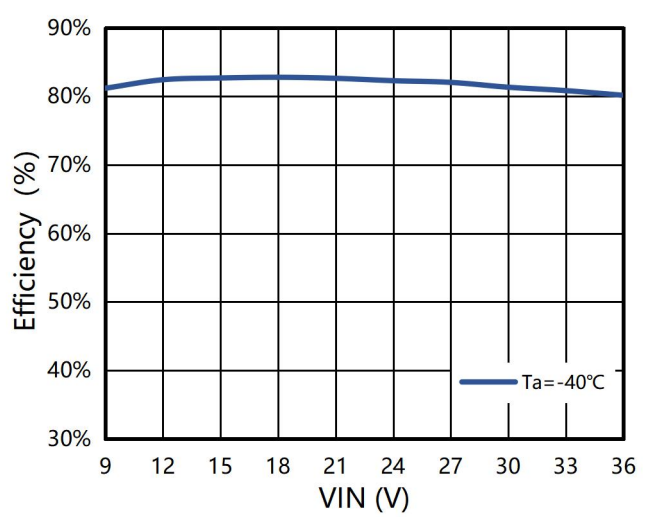
效率 VS 输出电流 (25℃)



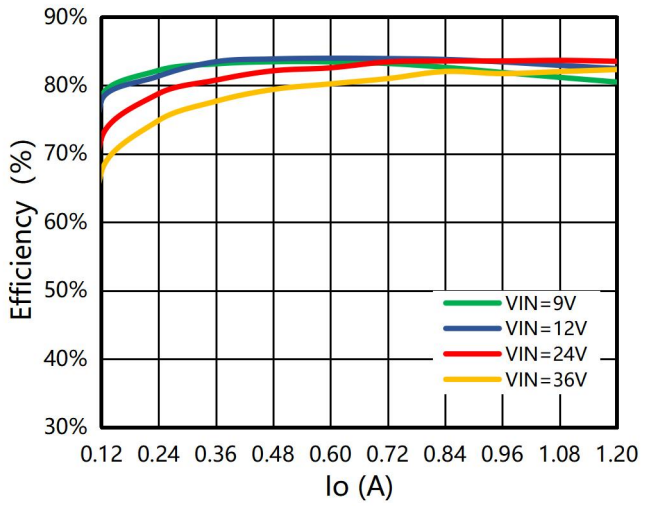
效率 VS 输入电压 (输出满载@25℃)



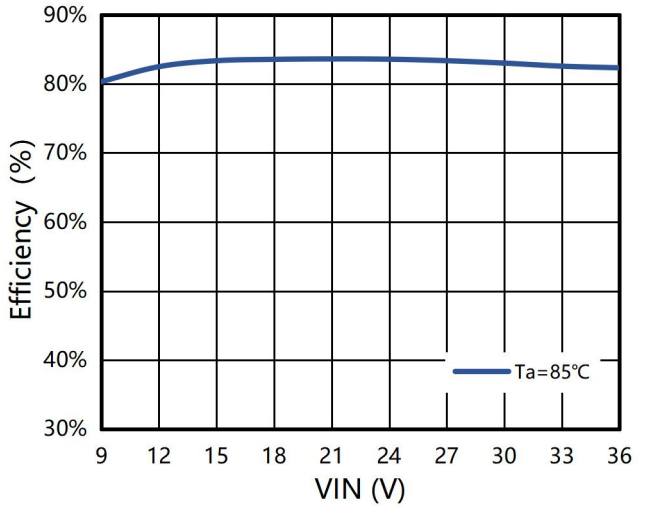
效率 VS 输出电流 (-40℃)



效率 VS 输入电压 (输出满载@-40℃)



效率 VS 输出电流 (85℃)



效率 VS 输入电压 (输出满载@85℃)

VIN=24V，Ta=25℃，输入、输出及效率数据：

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.98	0.004	5.05	0.000	0%	0.00%
23.95	0.034	5.05	0.119	10%	73.80%
23.98	0.063	5.04	0.239	20%	79.73%
23.99	0.093	5.04	0.359	30%	81.10%
23.99	0.123	5.04	0.479	40%	81.81%
23.99	0.153	5.04	0.599	50%	82.25%
23.99	0.181	5.04	0.720	60%	83.57%
23.99	0.212	5.04	0.840	70%	83.24%
23.99	0.242	5.04	0.959	80%	83.25%
23.99	0.272	5.04	1.079	90%	83.34%
23.99	0.302	5.04	1.200	100%	83.48%

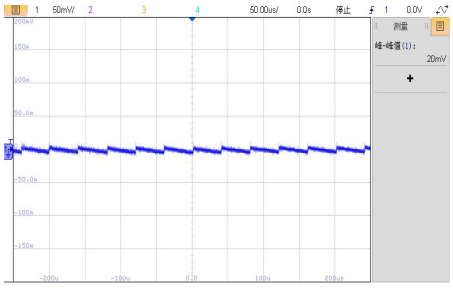
VIN=24V，Ta=-40℃，输入、输出及效率数据：

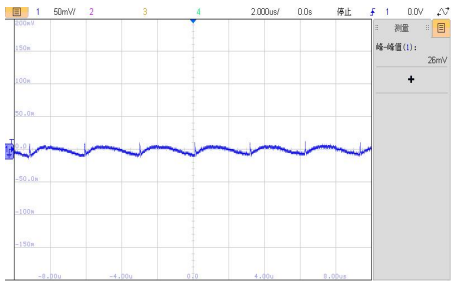
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.98	0.004	5.01	0.000	0%	0.00%
23.96	0.034	5.01	0.119	10%	73.18%
23.99	0.064	5.01	0.239	20%	77.99%
23.99	0.095	5.00	0.360	30%	78.98%
23.99	0.125	5.00	0.479	40%	79.87%
23.99	0.155	5.00	0.599	50%	80.54%
23.99	0.184	5.00	0.720	60%	81.56%
23.99	0.214	5.00	0.840	70%	81.81%
23.99	0.244	5.00	0.959	80%	81.92%
23.98	0.274	5.00	1.079	90%	82.11%
23.98	0.304	5.00	1.200	100%	82.31%

VIN=24V，Ta=85℃，输入、输出及效率数据：

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.98	0.005	5.07	0.000	0%	0.00%
23.96	0.035	5.07	0.119	10%	71.94%
23.99	0.064	5.06	0.239	20%	78.77%
23.99	0.094	5.06	0.360	30%	80.78%
23.99	0.123	5.06	0.479	40%	82.14%
23.99	0.153	5.06	0.599	50%	82.58%
23.99	0.182	5.06	0.720	60%	83.44%
23.99	0.212	5.06	0.840	70%	83.57%
23.99	0.242	5.06	0.959	80%	83.58%
23.99	0.272	5.06	1.079	90%	83.67%
23.99	0.303	5.06	1.200	100%	83.53%

输出电压纹波波形


VIN=9V，空载输出电压纹波波形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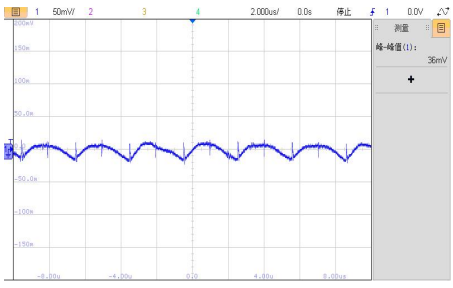
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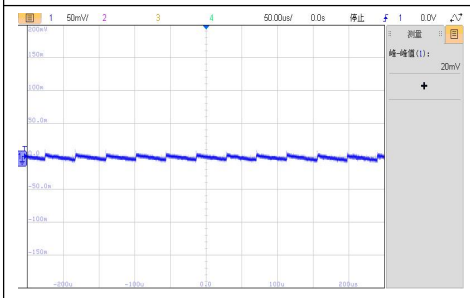
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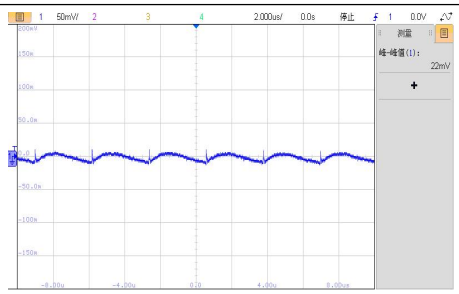
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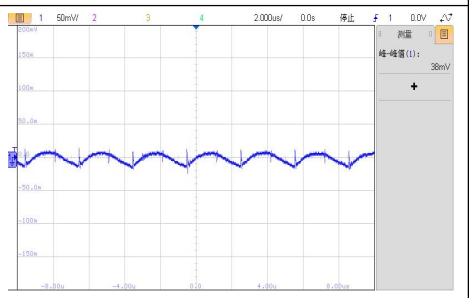
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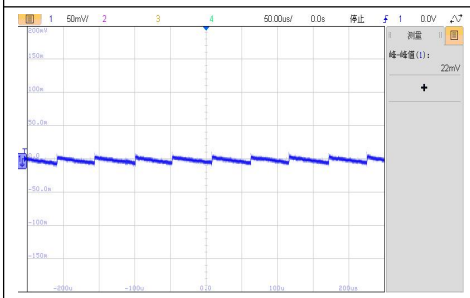
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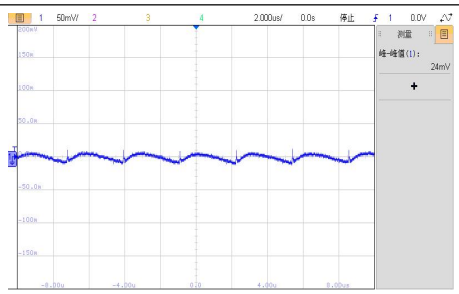
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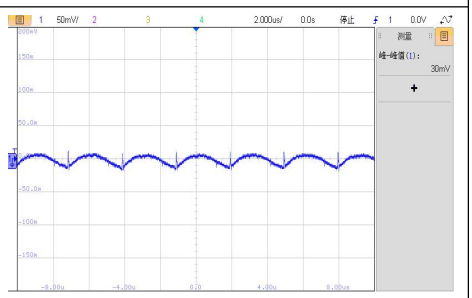
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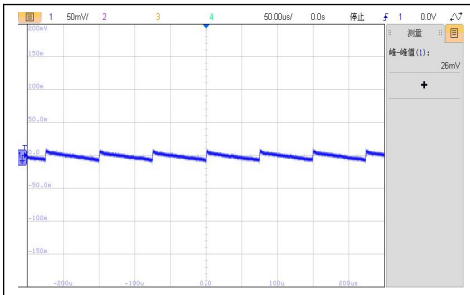
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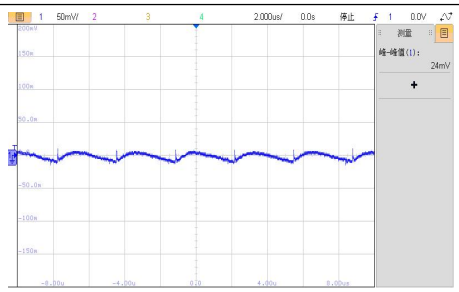
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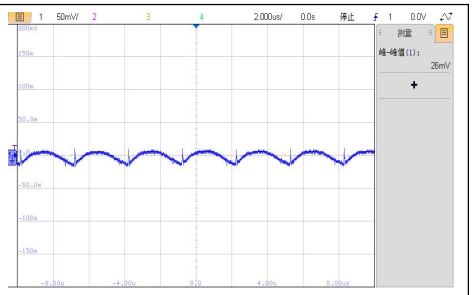
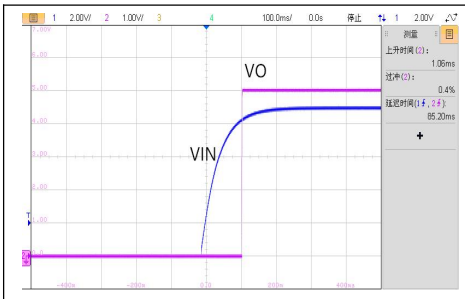

VIN=36V，满载输出电压纹波波形

开关机波形



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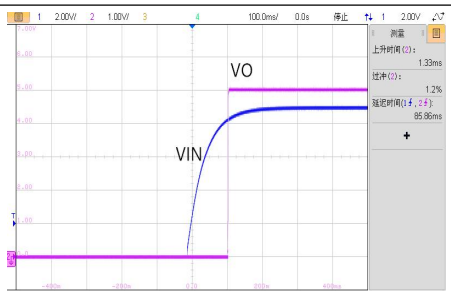

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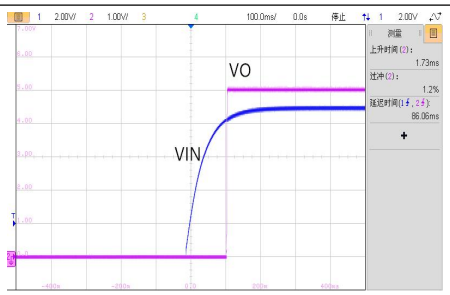
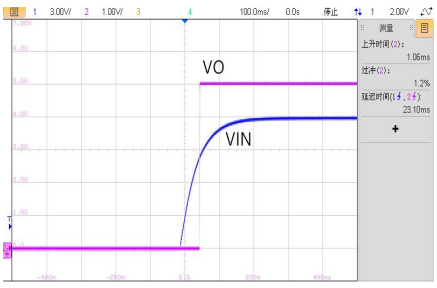


VIN=9V，满载启机波形



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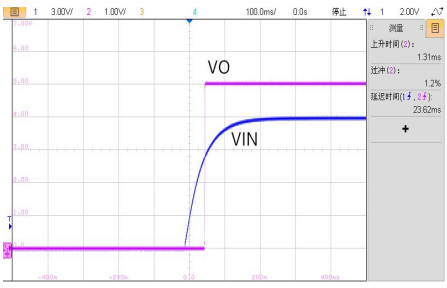

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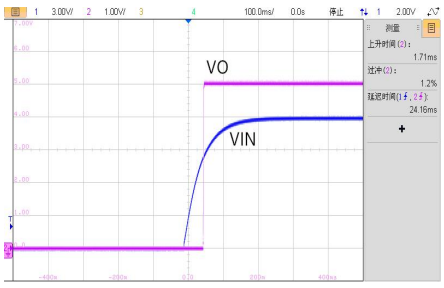

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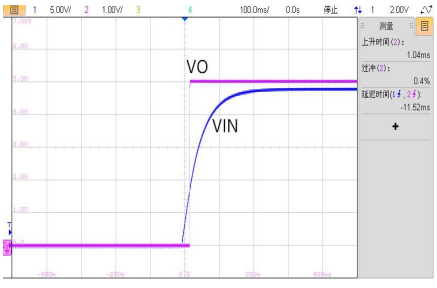

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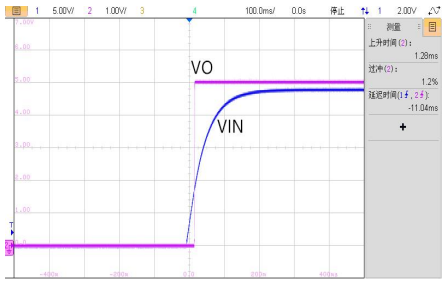

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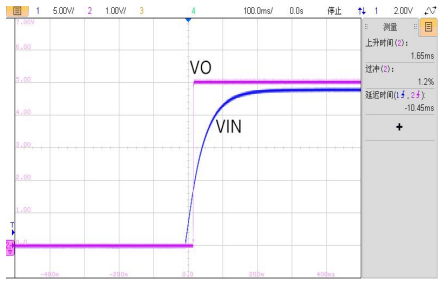

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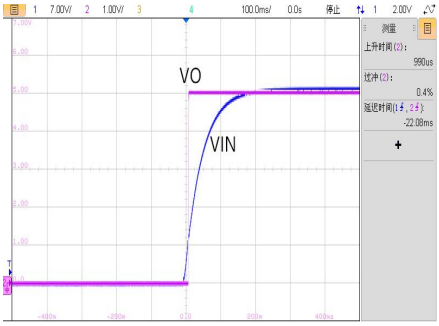
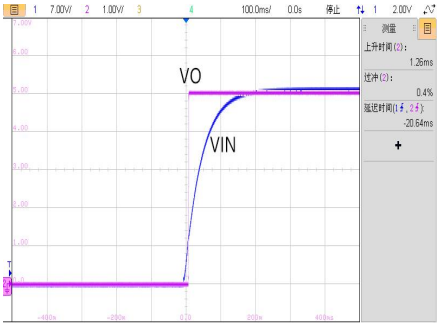
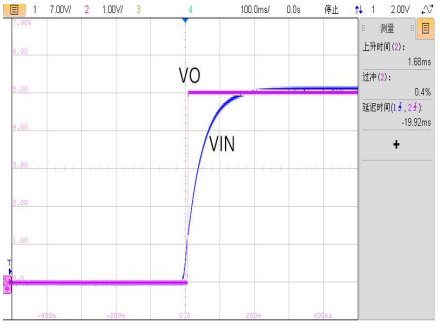


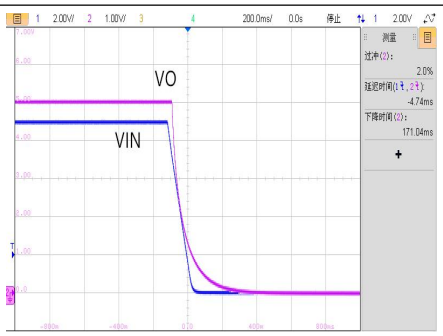
VIN=36V，空载启机波形



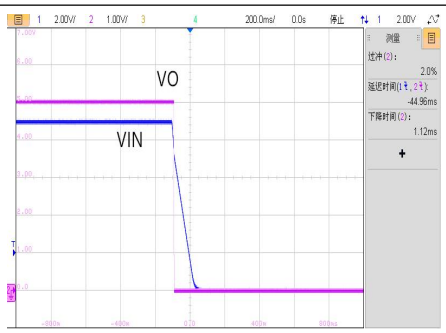
VIN=36V，半载启机波形



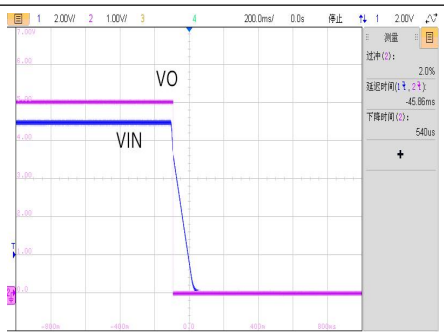
VIN=36V，满载启机波形



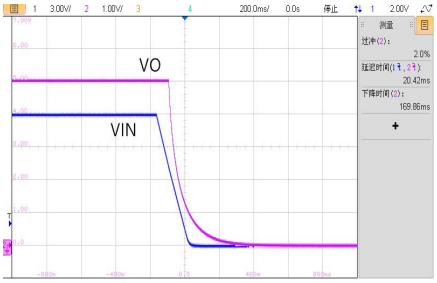
VIN=9V，空载关机波形



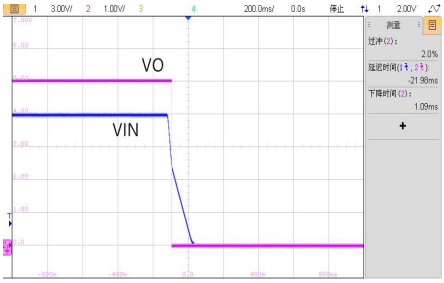
VIN=9V，半载关机波形



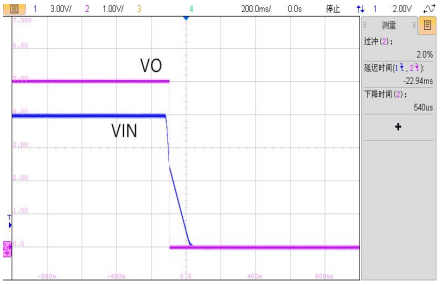
VIN=9V，满载关机波形



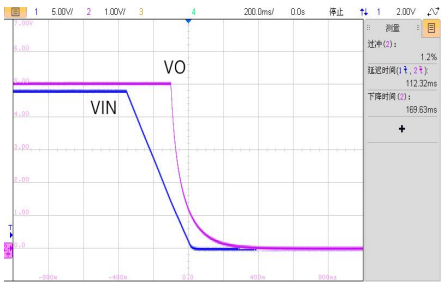
VIN=12V，空载关机波形



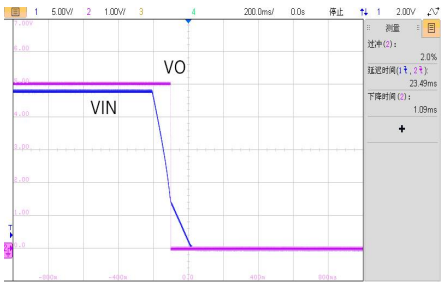
VIN=12V，半载关机波形



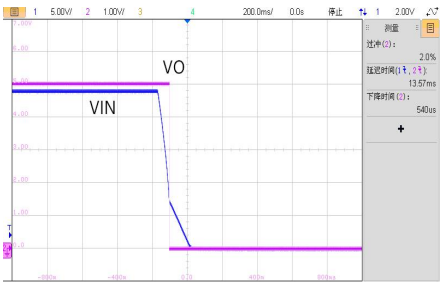
VIN=12V，满载关机波形



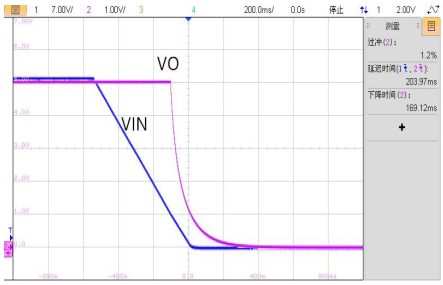
VIN=24V，空载关机波形



VIN=24V，半载关机波形

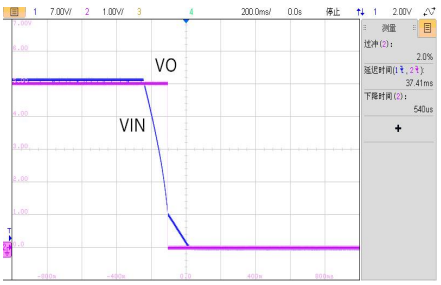


VIN=24V，满载关机波形



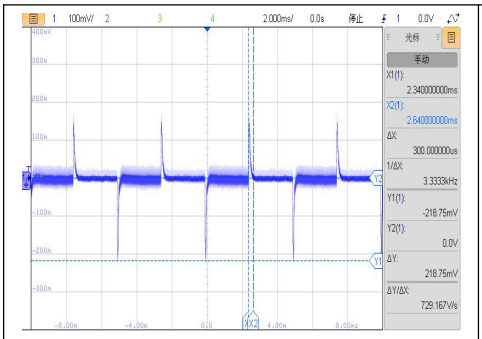
VIN=36V，空载关机波形

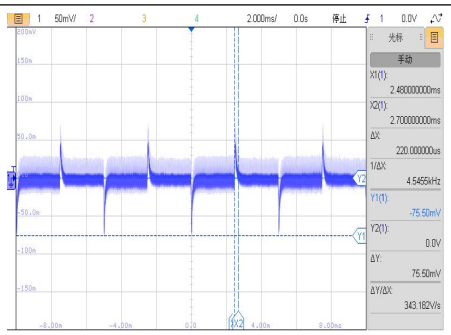
VIN=36V，半载关机波形

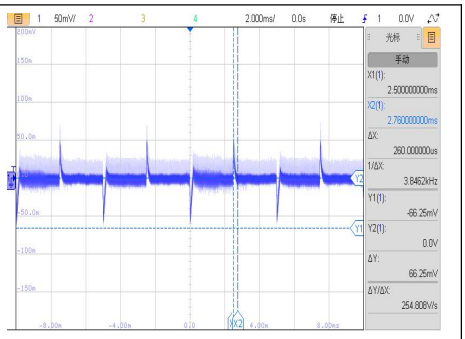


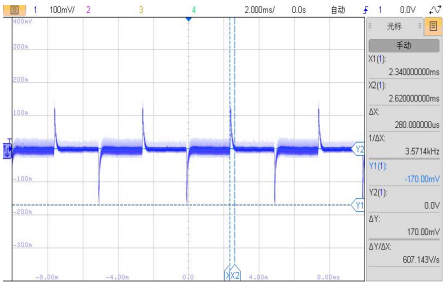
VIN=36V，满载关机波形

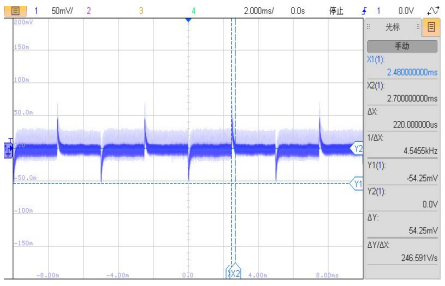
动态波形

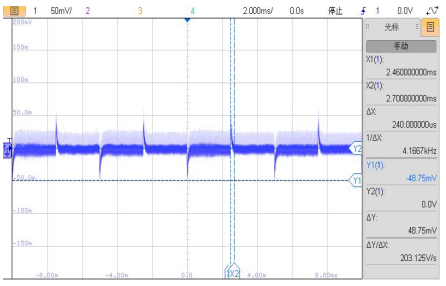

VIN=9V，100%-10%-100%Io 动态波形

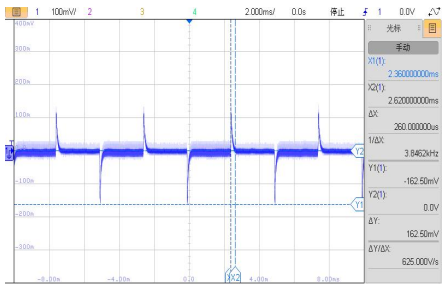

VIN=9V，75%-50%-75%Io 动态波形

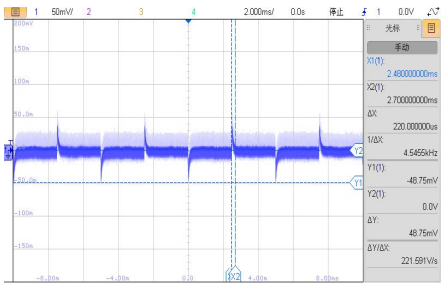

VIN=9V，50%-25%-50%Io 动态波形

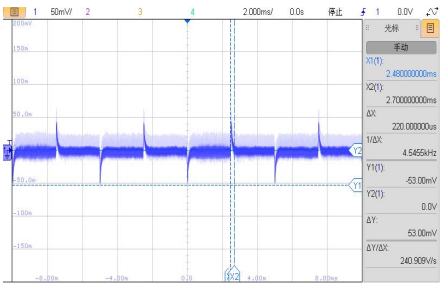

VIN=12V，100%-10%-100%Io 动态波形

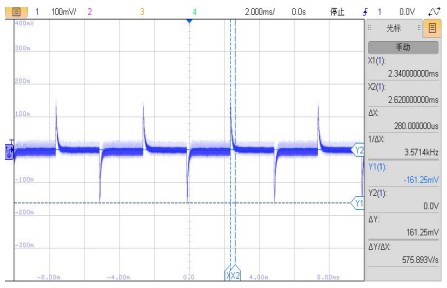

VIN=12V，75%-50%-75%Io 动态波形

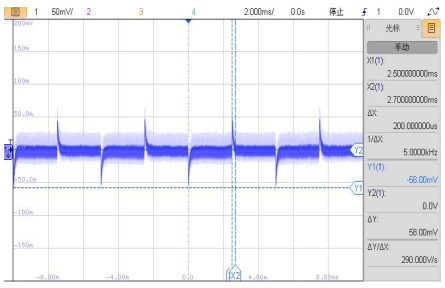

VIN=12V，50%-25%-50%Io 动态波形

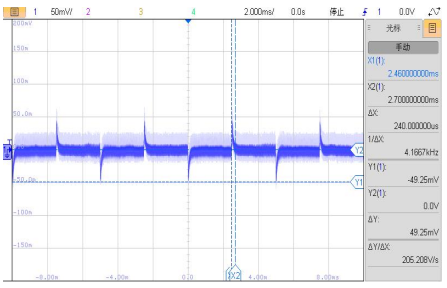

VIN=24V，100%-10%-100%Io 动态波形


VIN=24V，75%-50%-75%Io 动态波形

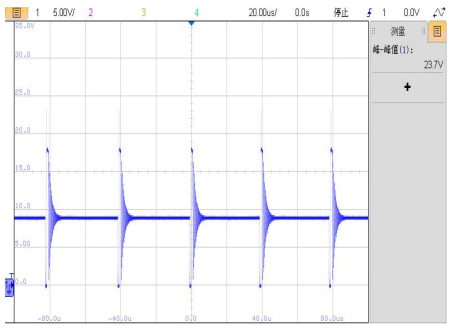

VIN=24V，50%-25%-50%Io 动态波形


VIN=36V，100%-10%-100%Io 动态波形

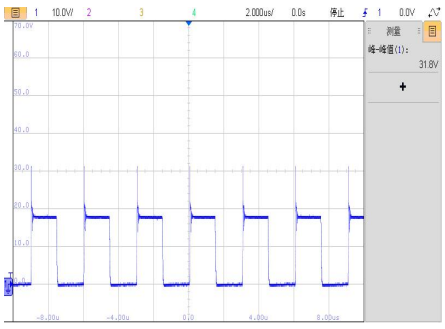

VIN=36V，75%-50%-75%Io 动态波形


VIN=36V，50%-25%-50%Io 动态波形

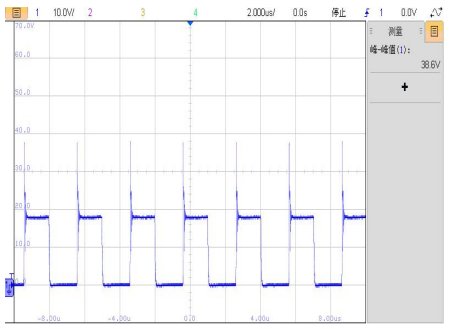
MOS 管电压应力波形



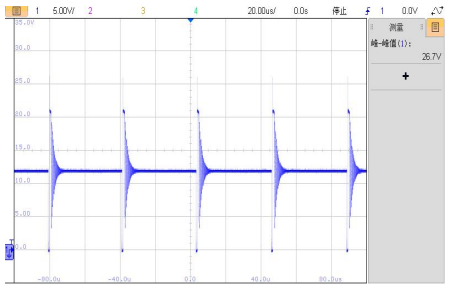
VIN=9V，空载 VDS 波形



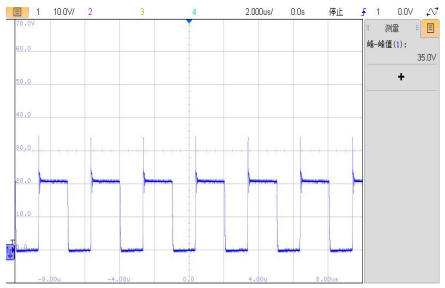
VIN=9V，半载 VDS 波形



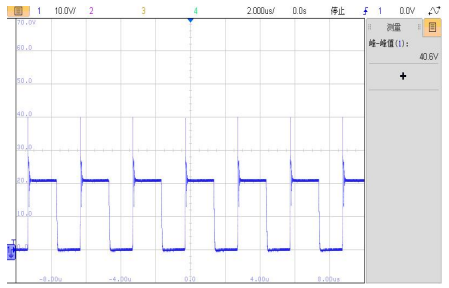
VIN=9V，满载 VDS 波形



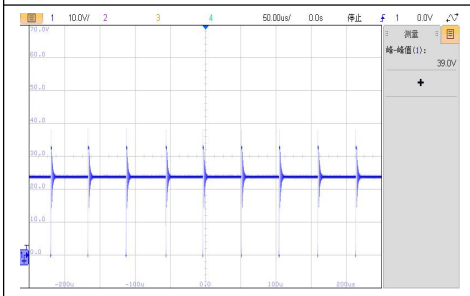
VIN=12V，空载 VDS 波形



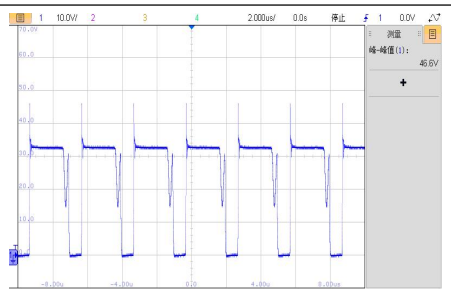
VIN=12V，半载 VDS 波形



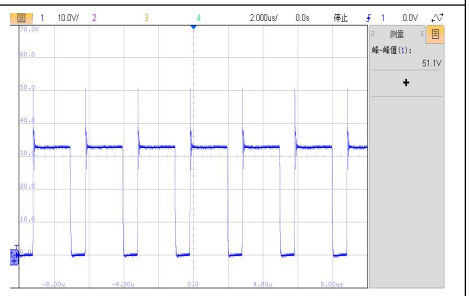
VIN=12V，满载 VDS 波形



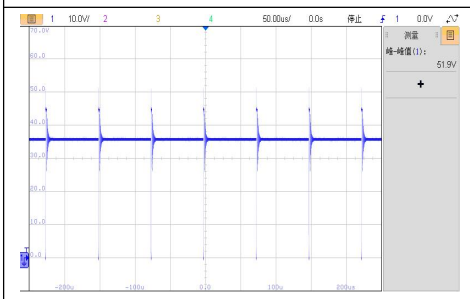
VIN=24V，空载 VDS 波形



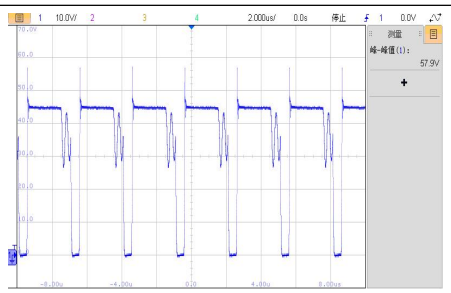
VIN=24V，半载 VDS 波形



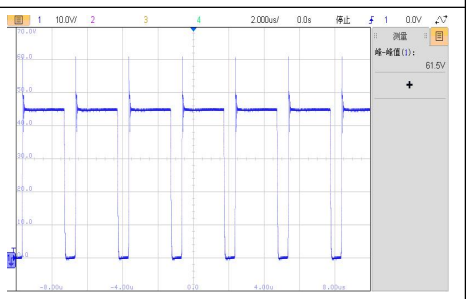
VIN=24V，满载 VDS 波形



VIN=36V，空载 VDS 波形

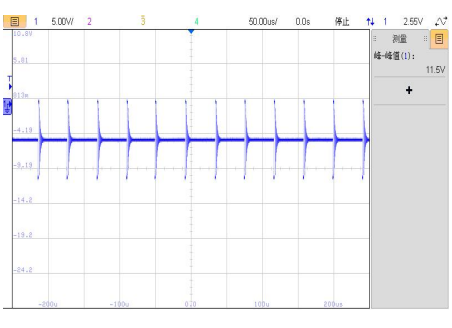


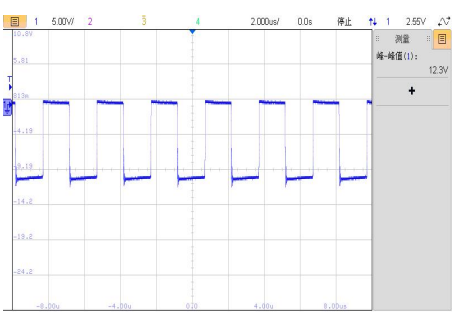
VIN=36V，半载 VDS 波形

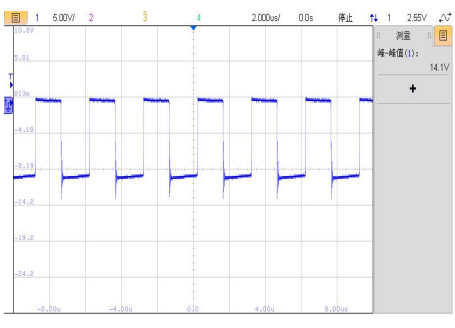


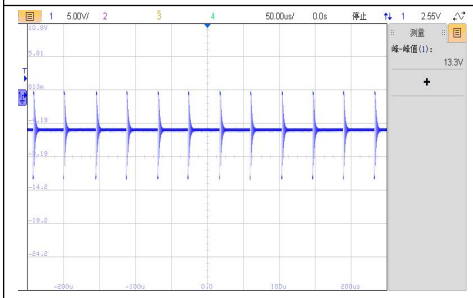
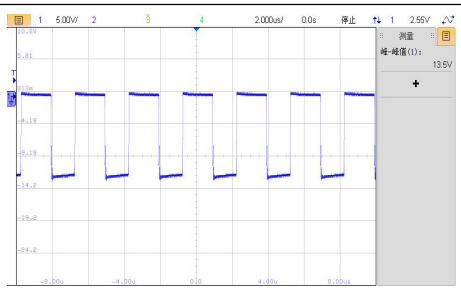
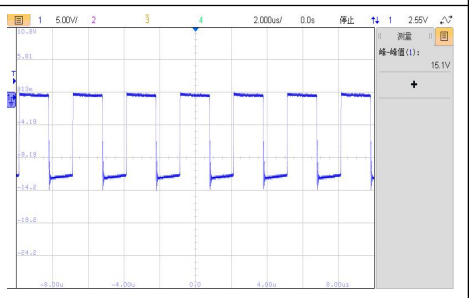
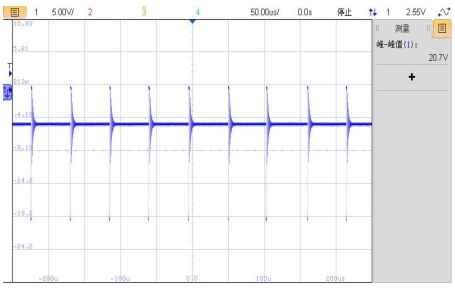
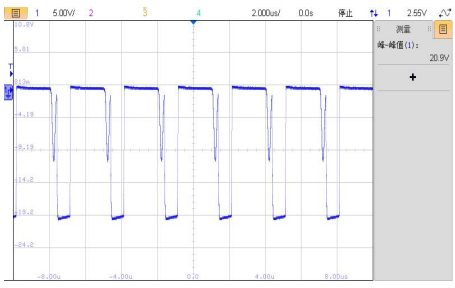
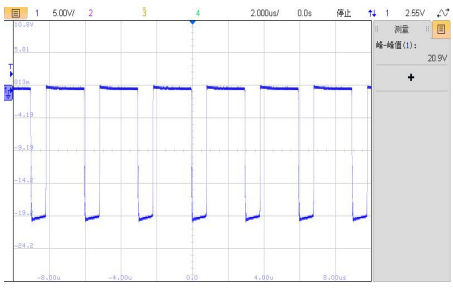
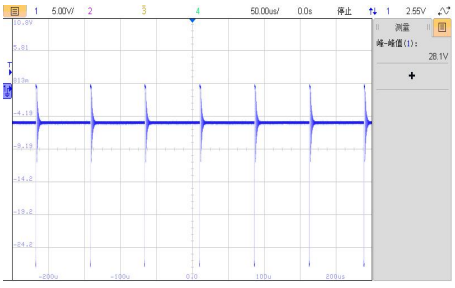
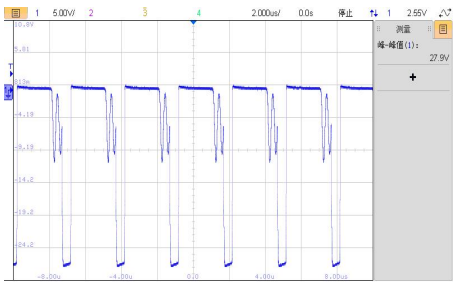
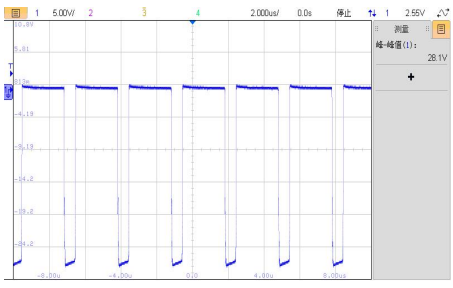
VIN=36V，满载 VDS 波形

副边输出整流二极管 D3 应力波形

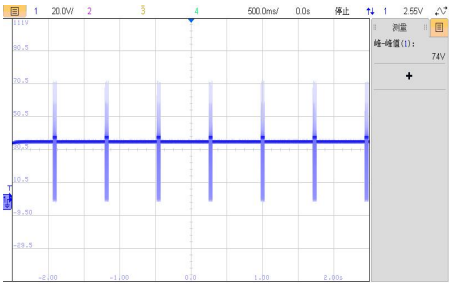
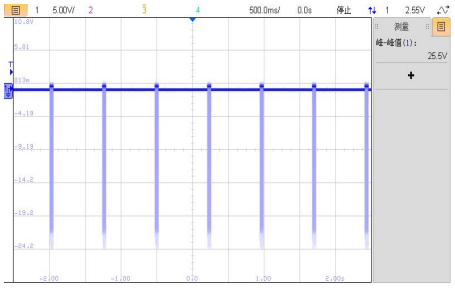






VIN=9V，D3 空载工作电压波形	VIN=9V，D3 半载工作电压波形	VIN=9V，D3 满载工作电压波形
		
VIN=12V，D3 空载工作电压波形	VIN=12V，D3 半载工作电压波形	VIN=12V，D3 满载工作电压波形
		
VIN=24V，D3 空载工作电压波形	VIN=24V，D3 半载工作电压波形	VIN=24V，D3 满载工作电压波形
		
VIN=36V，D3 空载工作电压波形	VIN=36V，D3 半载工作电压波形	VIN=36V，D3 满载工作电压波形

短路应力波形

VIN=36V，VDS 短路工作电压波形	VIN=36V，D3 短路工作电压波形
	

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