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 VPE25PEE06A、输出整流二极管以及必要的阻容元件，实现 9V-36V 输入，15V 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。

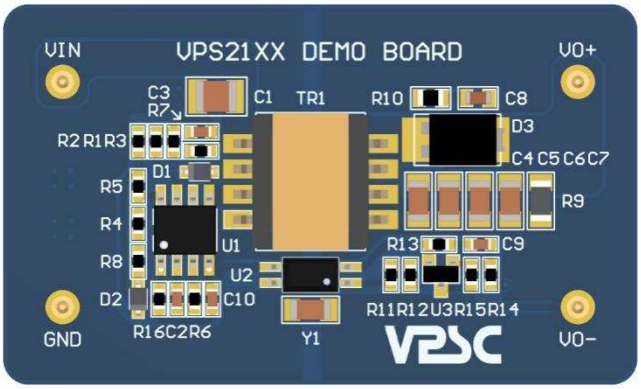
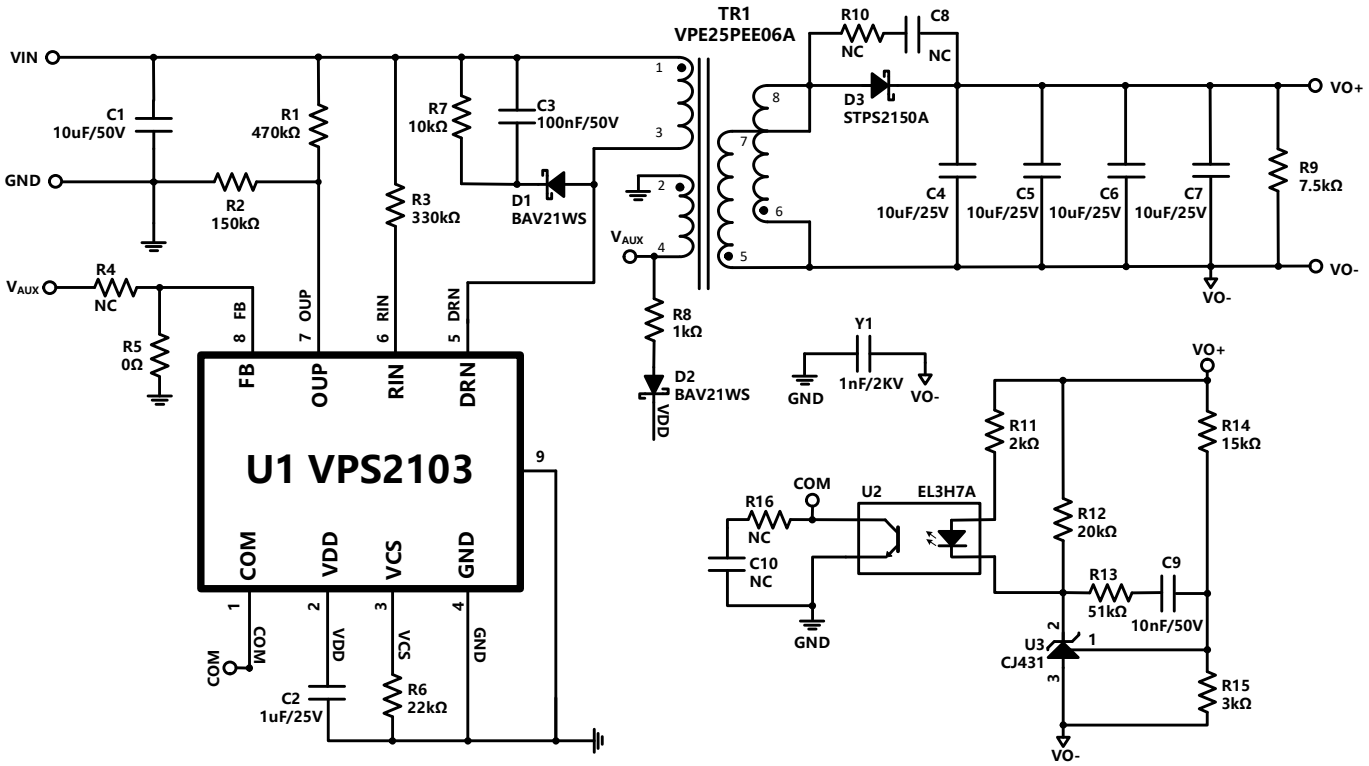


图 1: VPS2103 Demo 板(尺寸:50mm*30mm)

关键词：输入：9V-36V，输出 15V/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	10uF/25V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C5	10uF/25V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C6	10uF/25V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C7	10uF/25V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C8	NC	-	-	-
C9	10nF/50V-X7R	0603	CC0603KRX7R9BB103	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	330KΩ±1%	0603	RC0603FR-07330KL	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	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R9	7.5KΩ±1%	1206	RC1206FR-077K5L	YAGEO
R10	NC	-	-	-
R11	2KΩ±1%	0603	RC0603FR-072KL	YAGEO
R12	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R13	51KΩ±1%	0603	RC0603FR-0751KL	YAGEO
R14	15KΩ±1%	0603	RC0603FR-0715KL	YAGEO
R15	3KΩ±1%	0603	RC0603FR-073KL	YAGEO
R16	NC	-	-	-
TR1	NP:NS:NA=10:16:13 Lp=11uH	ER11.5	VPE25PEE06A	VPSC
D1	200V/0.2A	SOD-323	BAV21WS	CJ
D2	200V/0.2A	SOD-323	BAV21WS	CJ
D3	150V/2A	SMA	STPS2150A	ST
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	5	---	288	mA
转换效率	VIN=24V，IO=0.4A	---	86	---	%
纹波&噪声	VIN=24V，IO=0.4A	---	50	80	mV
输出电压精度	VIN=24V，IO=0.4A	---	-0.4	---	%
线性调节率	VIN=9V-36V，IO=0.4A	---	0	---	%
负载调整率	VIN=24V，IO=0.4A	---	0	---	%
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

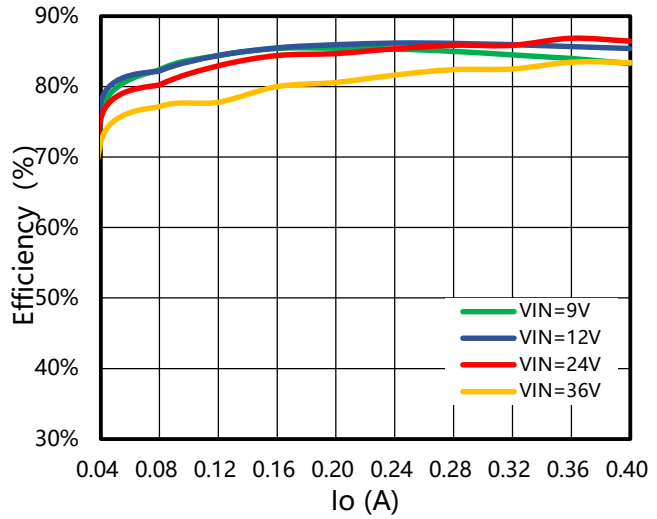


图 2: 效率 VS 输出电流

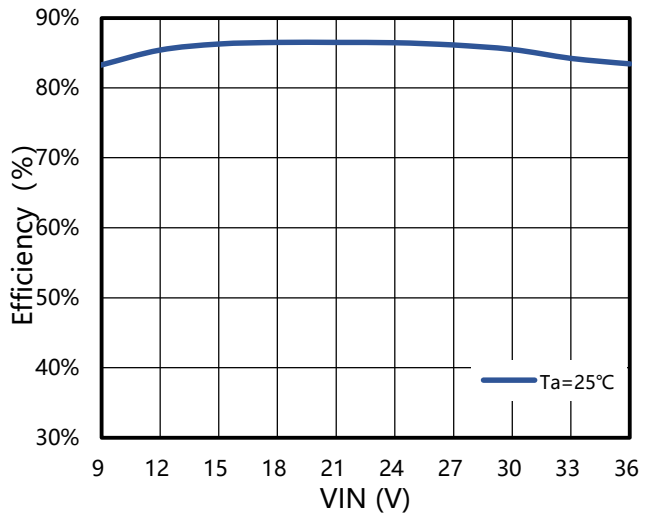


图 3: 效率 VS 输入电压（输出满载）

相关波形

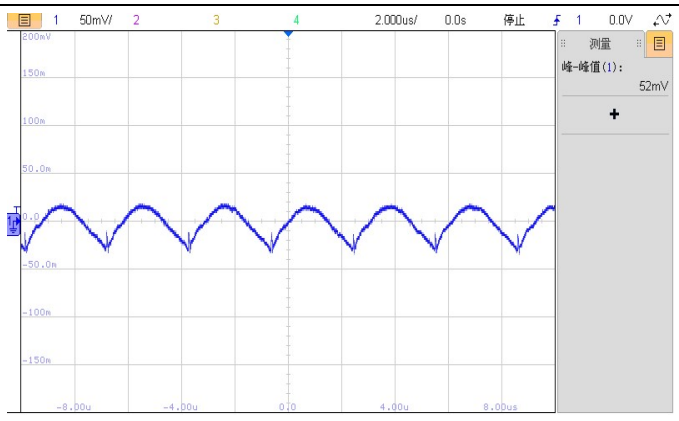


图 4: VIN=24V，满载输出电压纹波波形

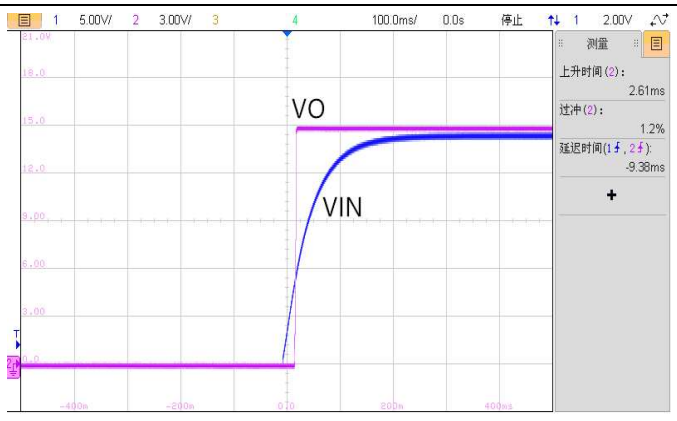
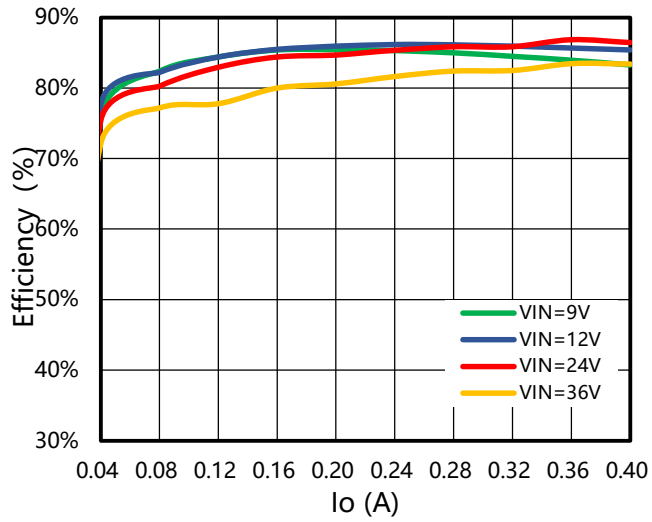


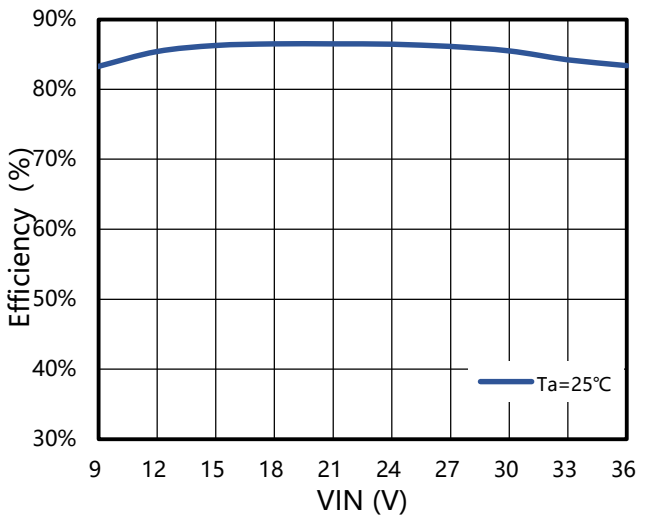
图 5: VIN=24V，满载启机波形

详细测试数据

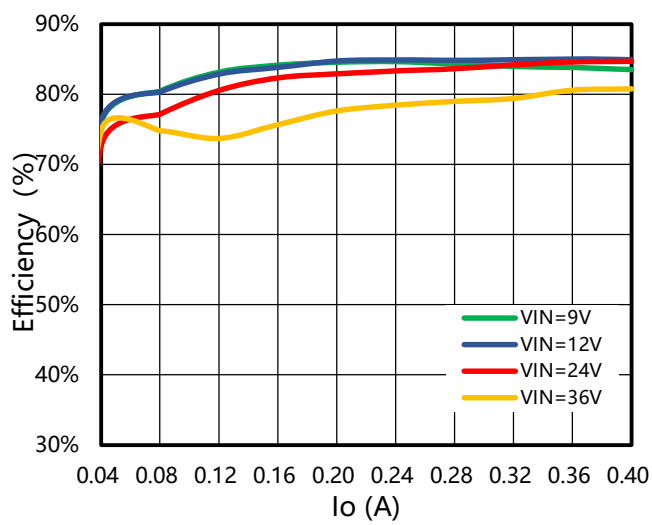
高低温测试曲线



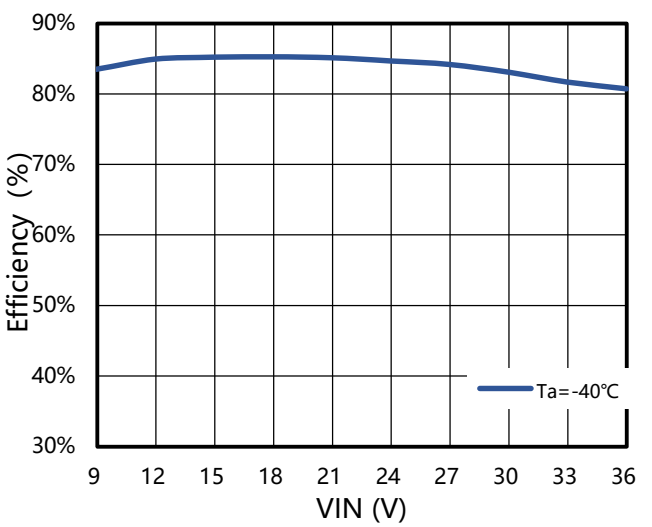
效率 VS 输出电流 (25℃)



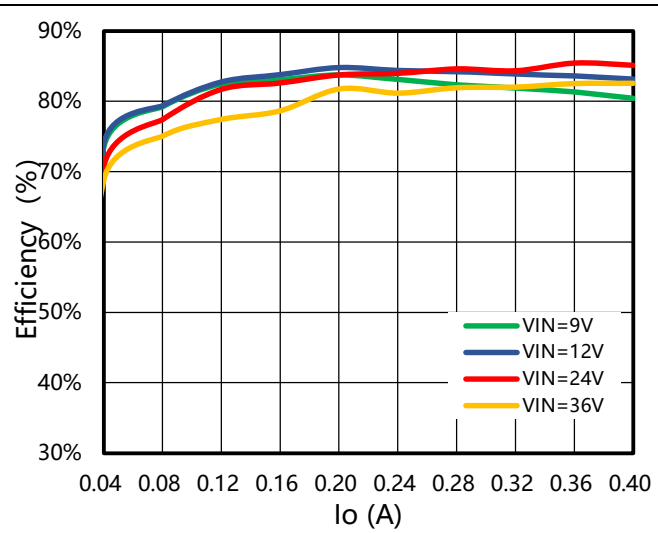
效率 VS 输入电压 (输出满载@25℃)



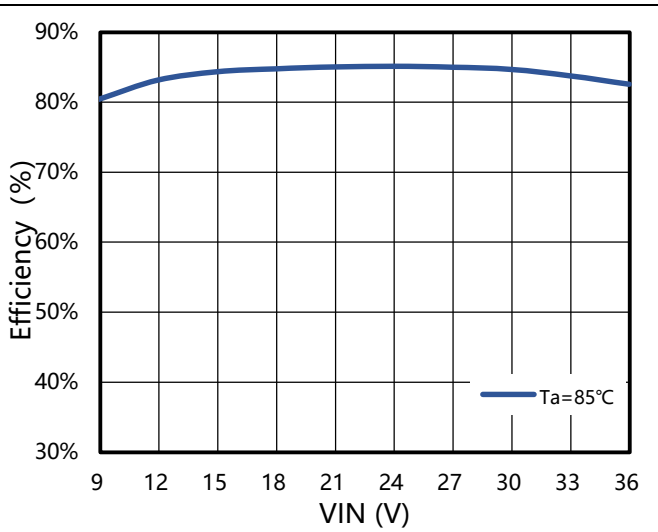
效率 VS 输出电流 (-40℃)



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(%)
24.01	0.005	14.94	0	0%	0.00%
24.01	0.033	14.94	0.040	10%	75.42%
24.01	0.062	14.94	0.080	20%	80.29%
24.01	0.090	14.94	0.120	30%	82.97%
24	0.118	14.94	0.160	40%	84.41%
24	0.147	14.94	0.200	50%	84.69%
24	0.175	14.94	0.240	60%	85.37%
24	0.203	14.94	0.280	70%	85.86%
24	0.232	14.94	0.320	80%	85.86%
24	0.258	14.94	0.360	90%	86.86%
24	0.288	14.94	0.400	100%	86.46%

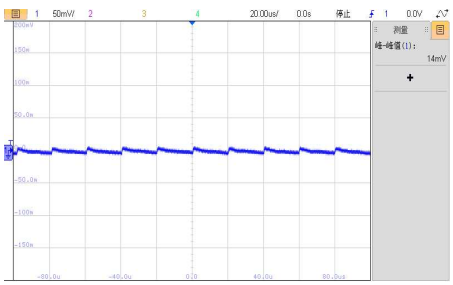
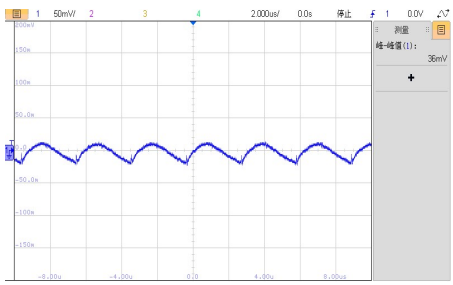
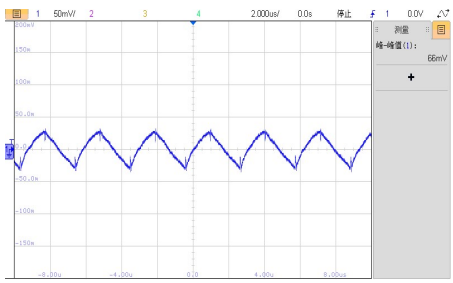
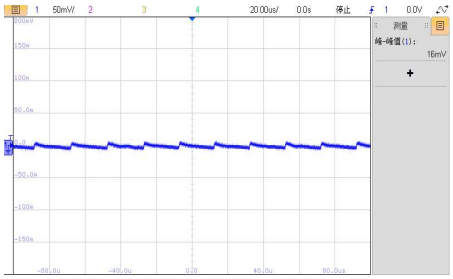
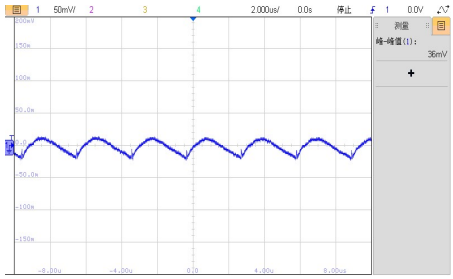
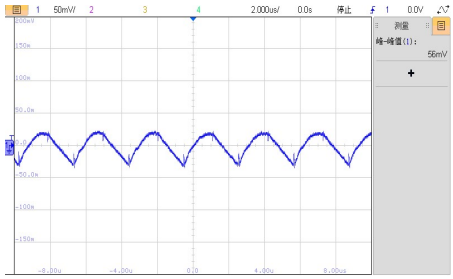
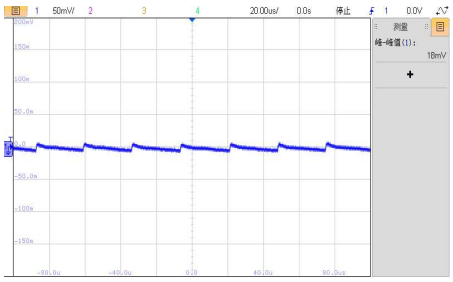
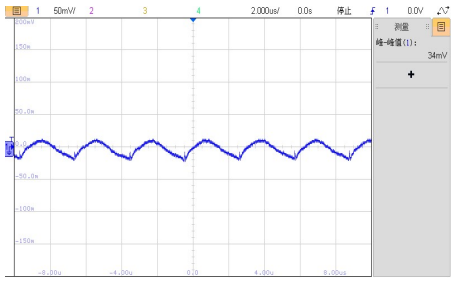
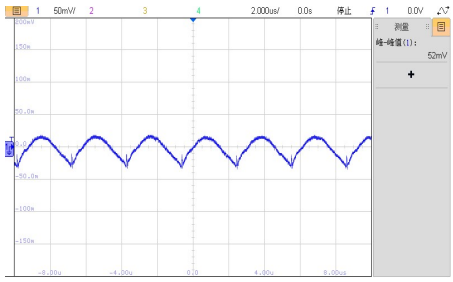
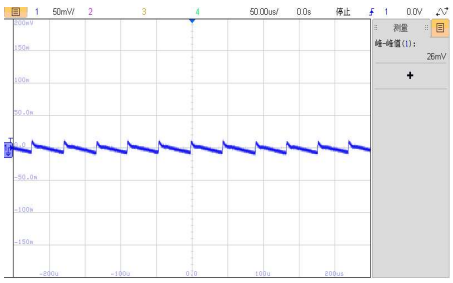
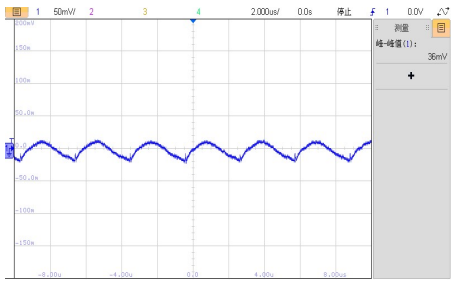
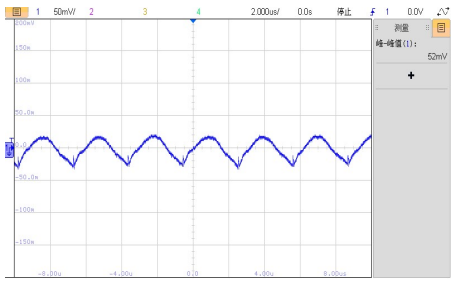
VIN=24V，Ta=-40℃，输入、输出及效率数据：

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.99	0.005	14.81	0	0%	0.00%
23.99	0.034	14.81	0.040	10%	72.63%
23.99	0.064	14.81	0.080	20%	77.17%
23.98	0.092	14.81	0.120	30%	80.56%
23.98	0.120	14.81	0.160	40%	82.35%
23.98	0.149	14.81	0.200	50%	82.90%
23.98	0.178	14.82	0.240	60%	83.33%
23.97	0.207	14.82	0.280	70%	83.63%
23.97	0.235	14.82	0.320	80%	84.19%
23.97	0.263	14.82	0.360	90%	84.63%
23.97	0.292	14.82	0.400	100%	84.69%

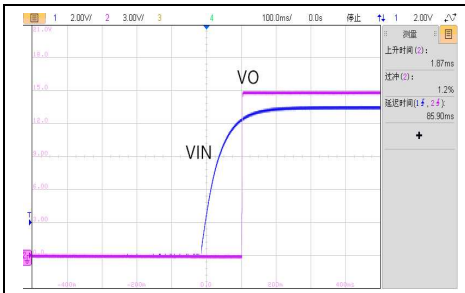
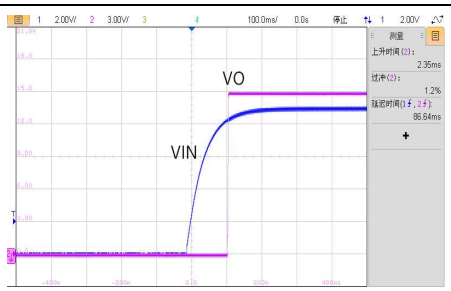
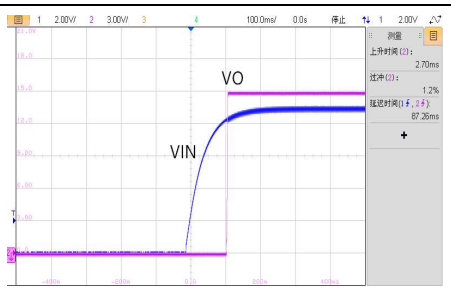
VIN=24V，Ta=85℃，输入、输出及效率数据：

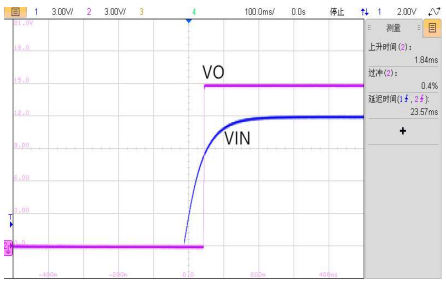
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.98	0.006	14.86	0	0%	0.00%
23.98	0.035	14.86	0.040	10%	70.82%
23.98	0.064	14.86	0.080	20%	77.46%
23.98	0.091	14.86	0.120	30%	81.72%
23.98	0.120	14.86	0.160	40%	82.62%
23.97	0.148	14.86	0.200	50%	83.78%
23.97	0.177	14.85	0.240	60%	84.00%
23.97	0.205	14.85	0.280	70%	84.62%
23.97	0.235	14.85	0.320	80%	84.36%
23.97	0.261	14.85	0.360	90%	85.45%
23.97	0.291	14.85	0.400	100%	85.16%

输出电压纹波波形

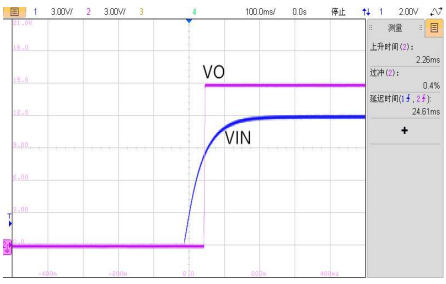
		
VIN=9V，空载输出电压纹波波形	VIN=9V，半载输出电压纹波波形	VIN=9V，满载输出电压纹波波形
		
VIN=12V，空载输出电压纹波波形	VIN=12V，半载输出电压纹波波形	VIN=12V，满载输出电压纹波波形
		
VIN=24V，空载输出电压纹波波形	VIN=24V，半载输出电压纹波波形	VIN=24V，满载输出电压纹波波形
		
VIN=36V，空载输出电压纹波波形	VIN=36V，半载输出电压纹波波形	VIN=36V，满载输出电压纹波波形

开关机波形

		
VIN=9V，空载启机波形	VIN=9V，半载启机波形	VIN=9V，满载启机波形



VIN=12V，空载启机波形



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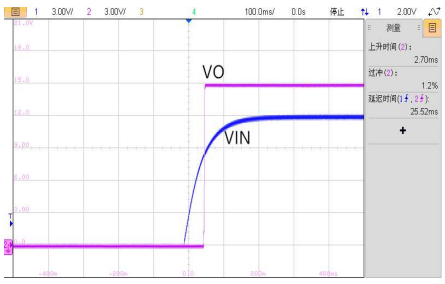

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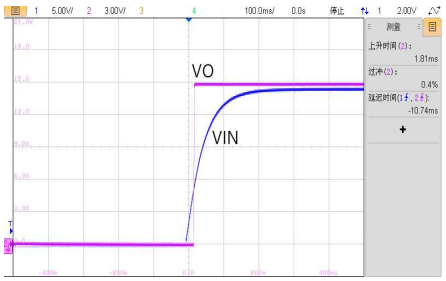

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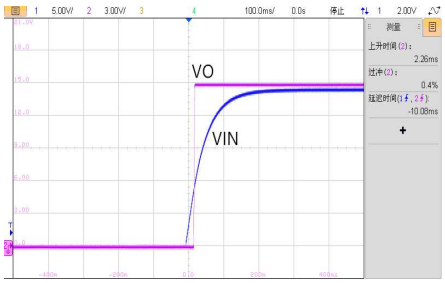

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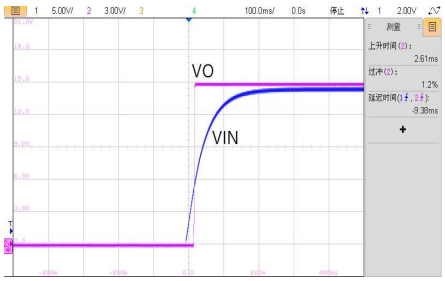
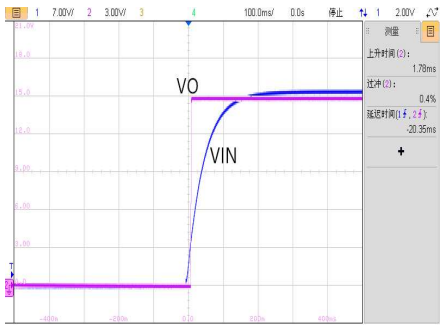


VIN=24V，满载启机波形



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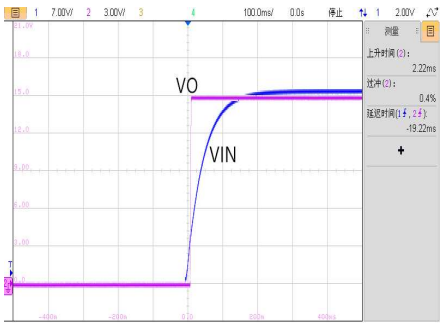
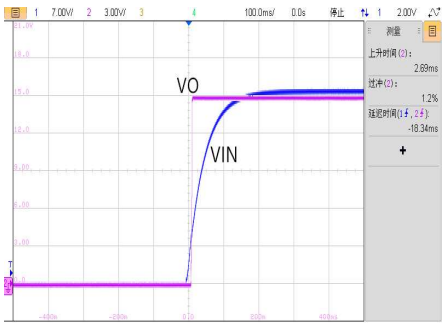
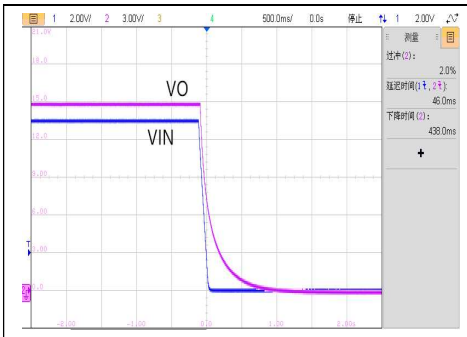


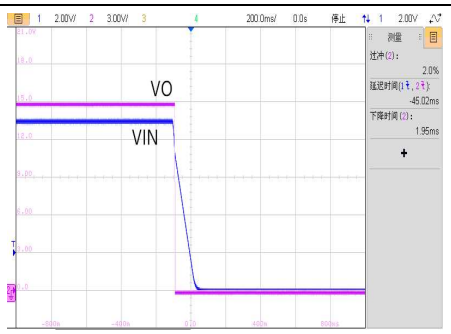
VIN=36V，半载启机波形



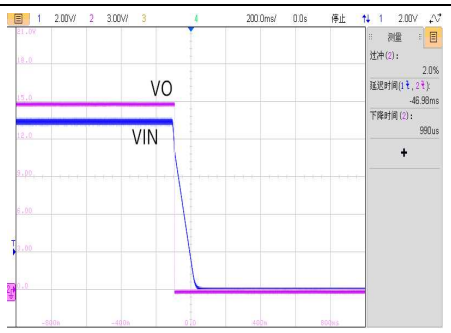
VIN=36V，满载启机波形



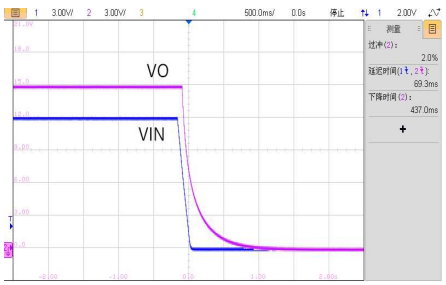
VIN=9V，空载关机波形



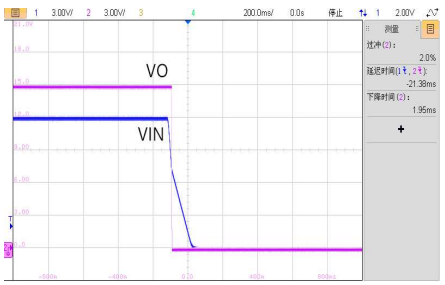
VIN=9V，半载关机波形



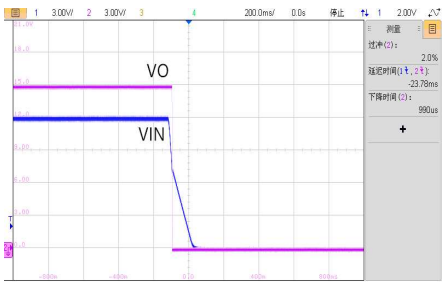
VIN=9V，满载关机波形



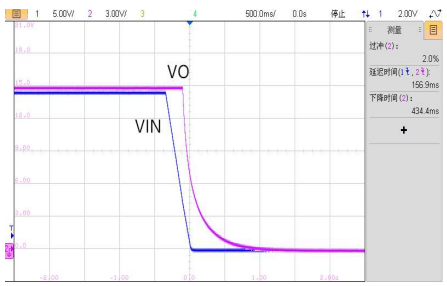
VIN=12V，空载关机波形



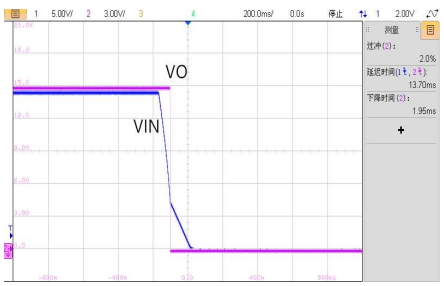
VIN=12V，半载关机波形



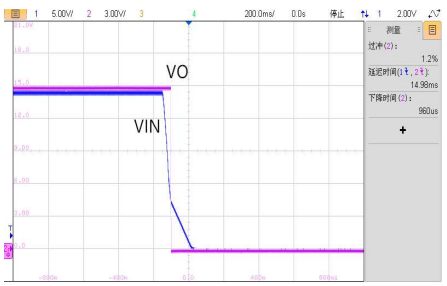
VIN=12V，满载关机波形



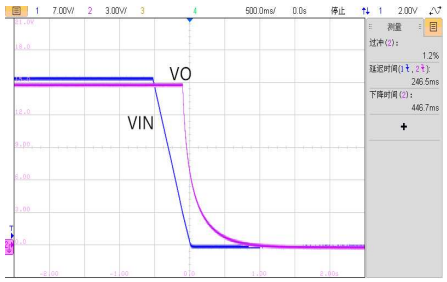
VIN=24V，空载关机波形



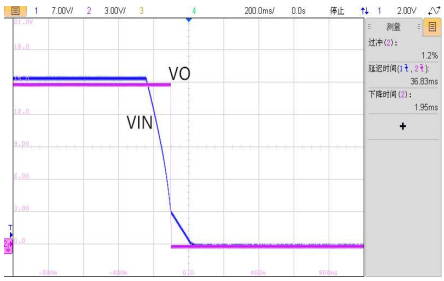
VIN=24V，半载关机波形



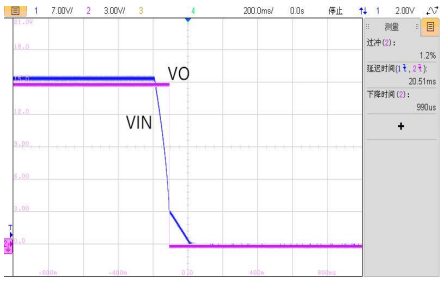
VIN=24V，满载关机波形



VIN=36V，空载关机波形

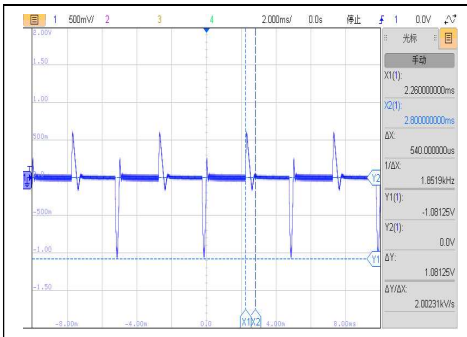


VIN=36V，半载关机波形

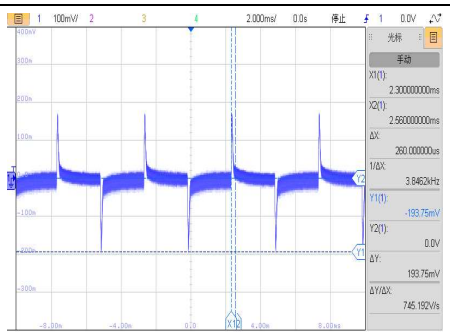


VIN=36V，满载关机波形

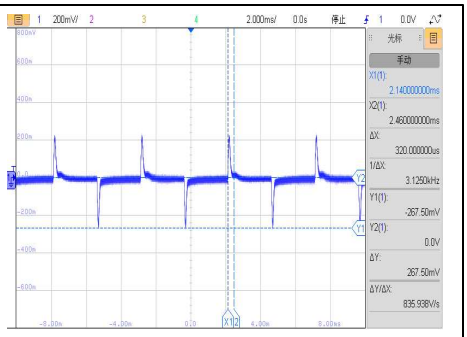
动态波形



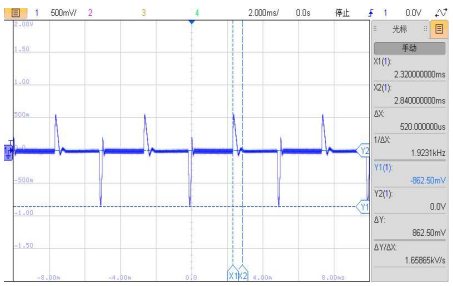
VIN=9V，100%-10%-100%Io 动态波形



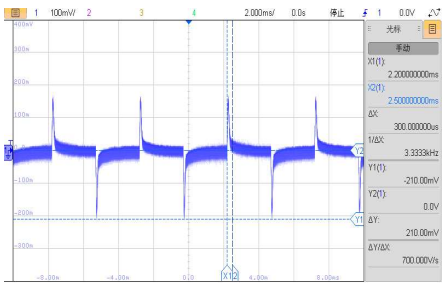
VIN=9V，75%-50%-75%Io 动态波形



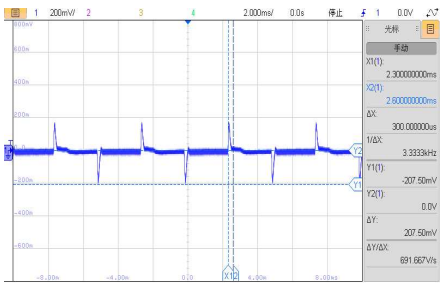
VIN=9V，50%-25%-50%Io 动态波形



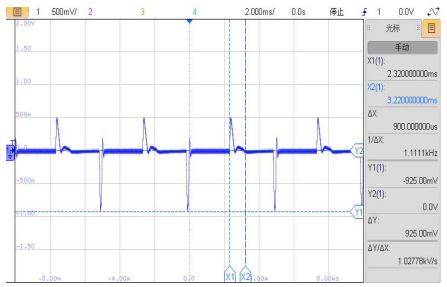
VIN=12V，100%-10%-100%Io 动态波形



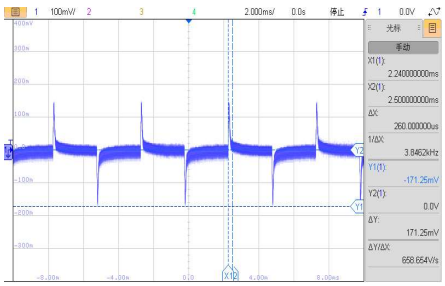
VIN=12V，75%-50%-75%Io 动态波形



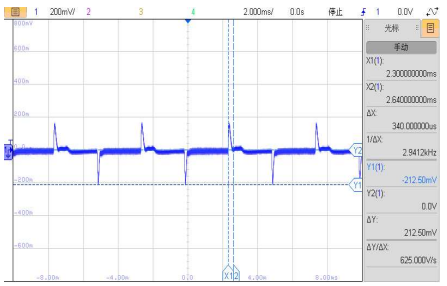
VIN=12V，50%-25%-50%Io 动态波形



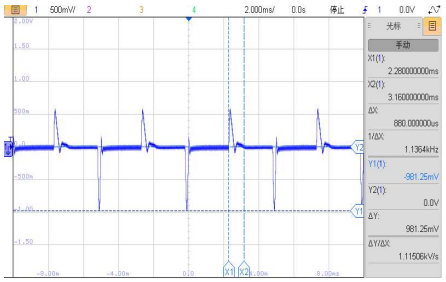
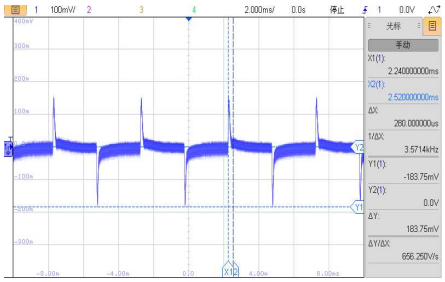
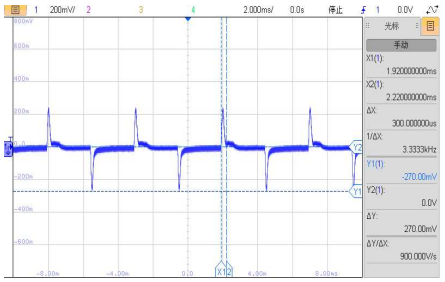
VIN=24V，100%-10%-100%Io 动态波形



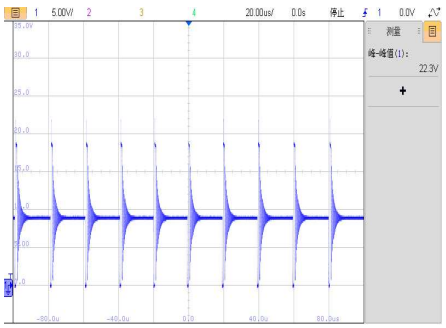
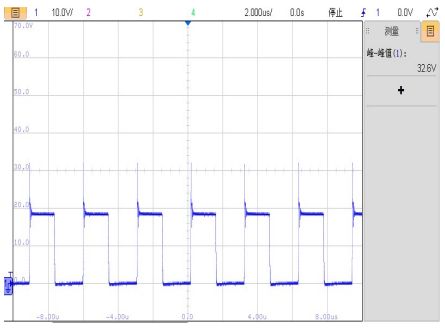
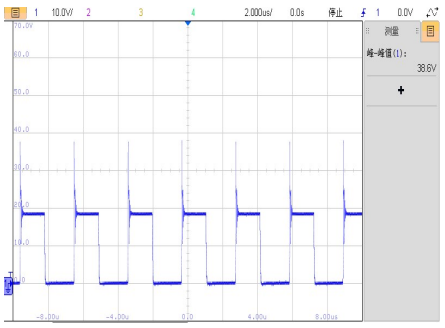
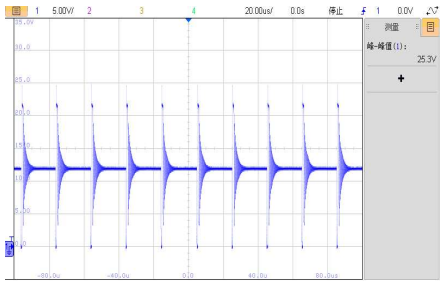
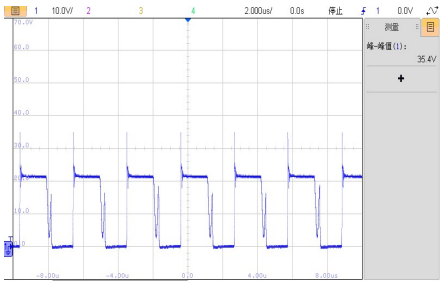
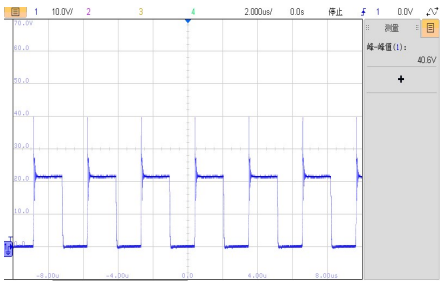
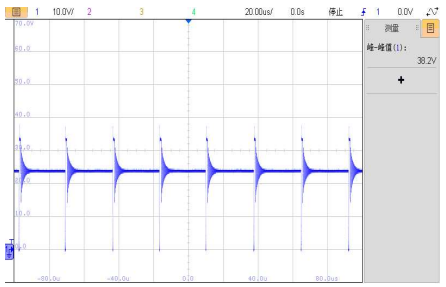
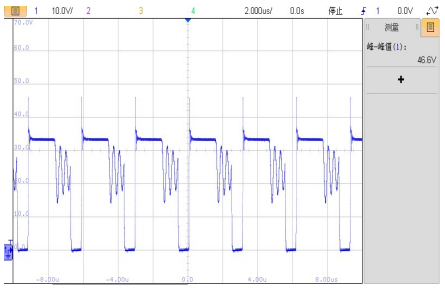
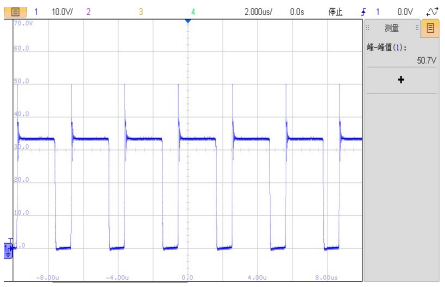
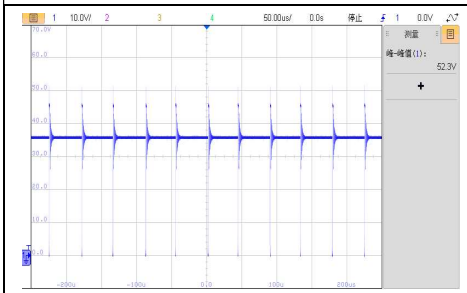
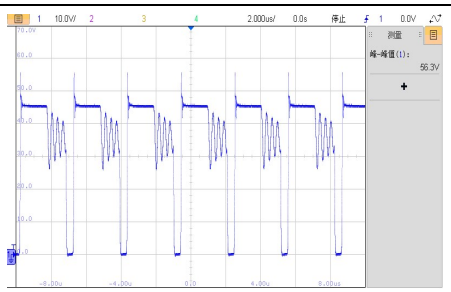
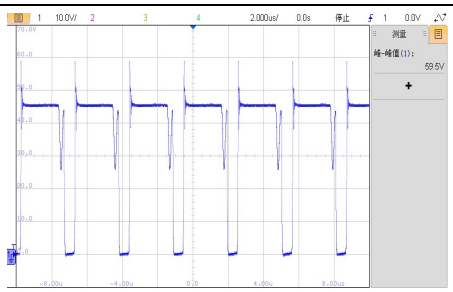
VIN=24V，75%-50%-75%Io 动态波形



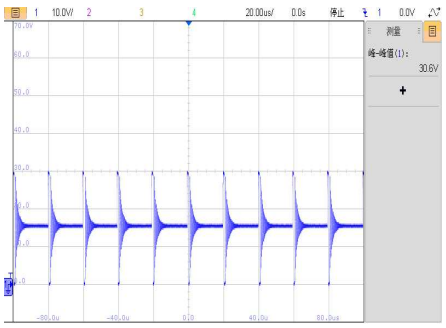
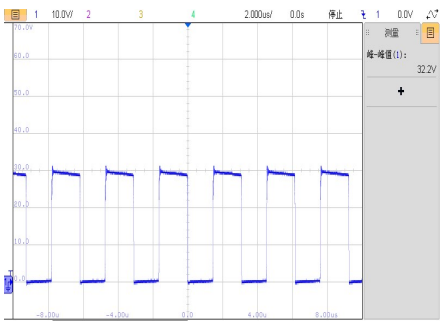
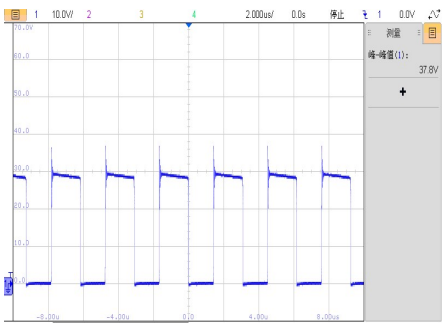
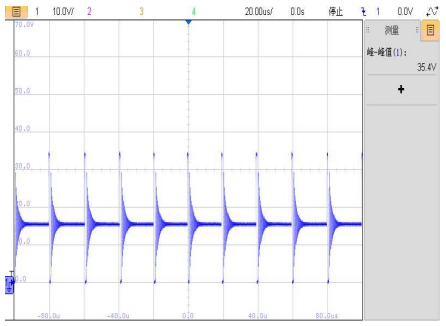
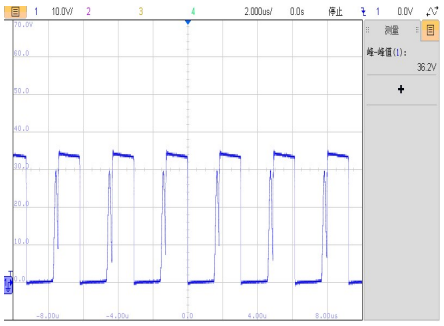
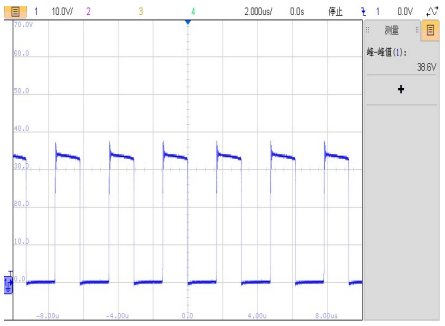
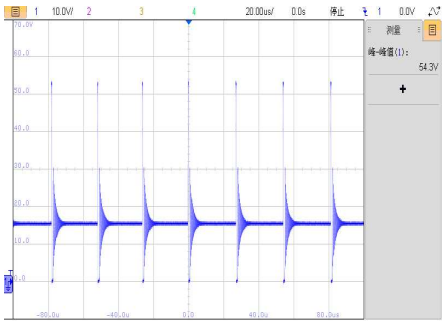
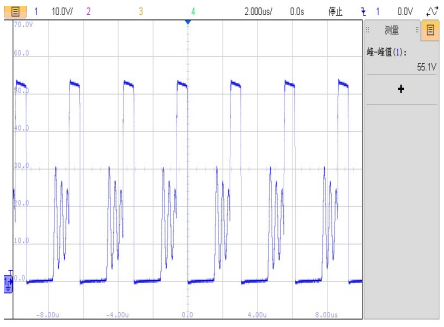
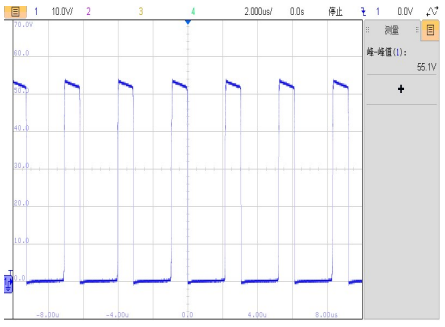
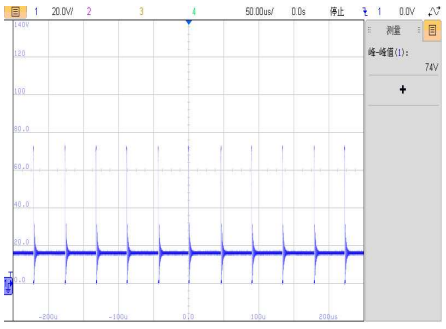
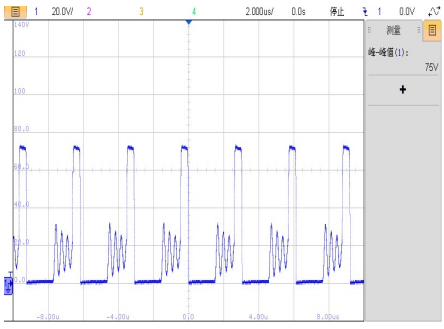
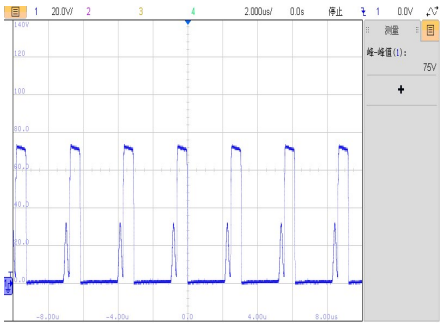
VIN=24V，50%-25%-50%Io 动态波形

		
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

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