

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 VPE24FFF10A、输出整流二极管以及必要的阻容元件，实现 9V-36V 输入，12V 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。

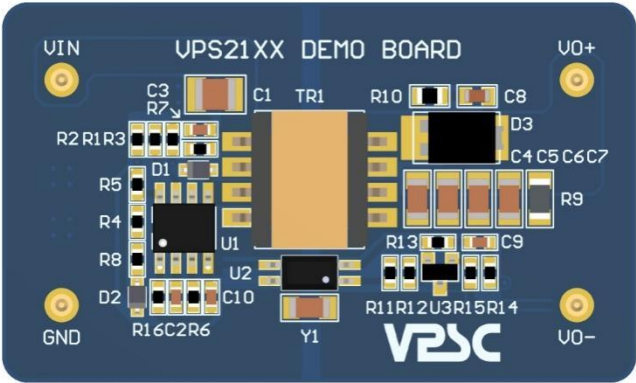
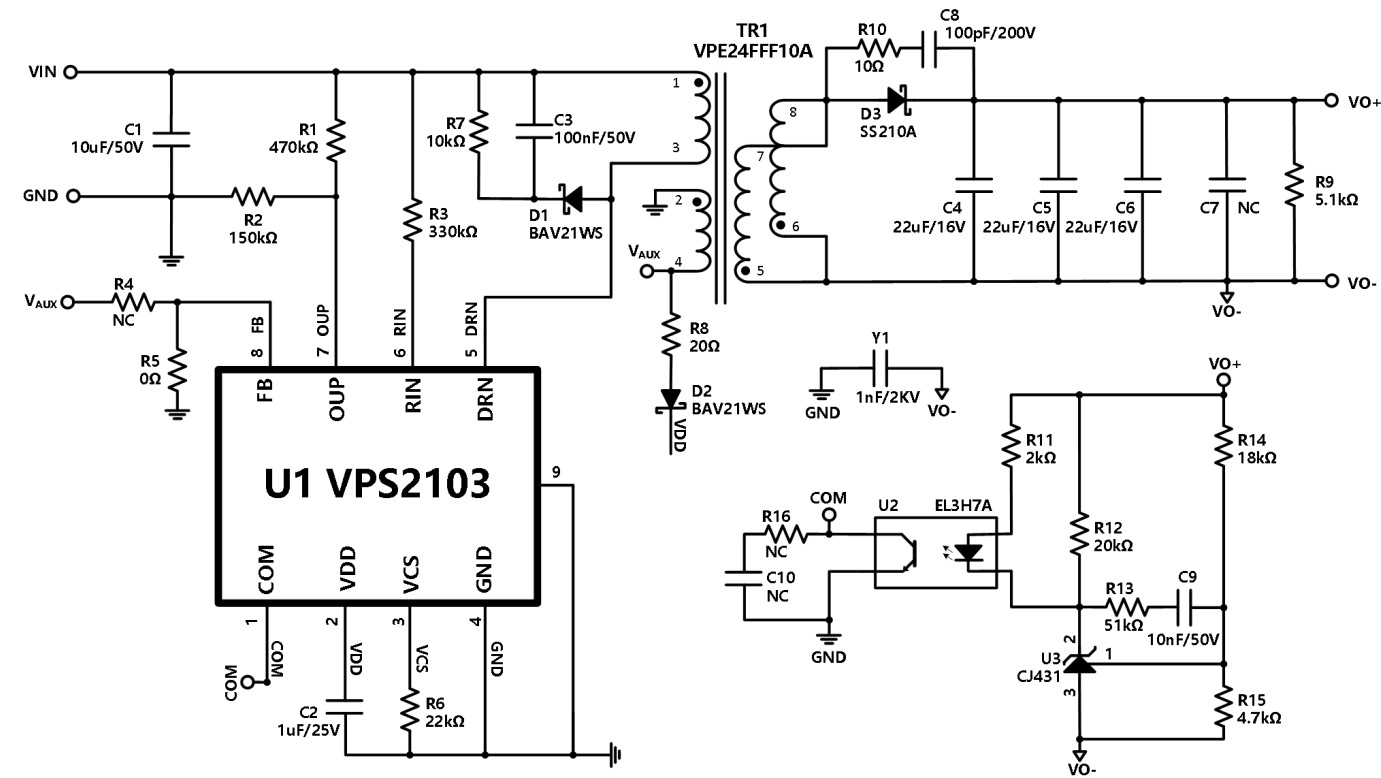


图 1: VPS2103 Demo 板(尺寸:50mm*30mm)

关键词：输入：9V-36V，输出 12V/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

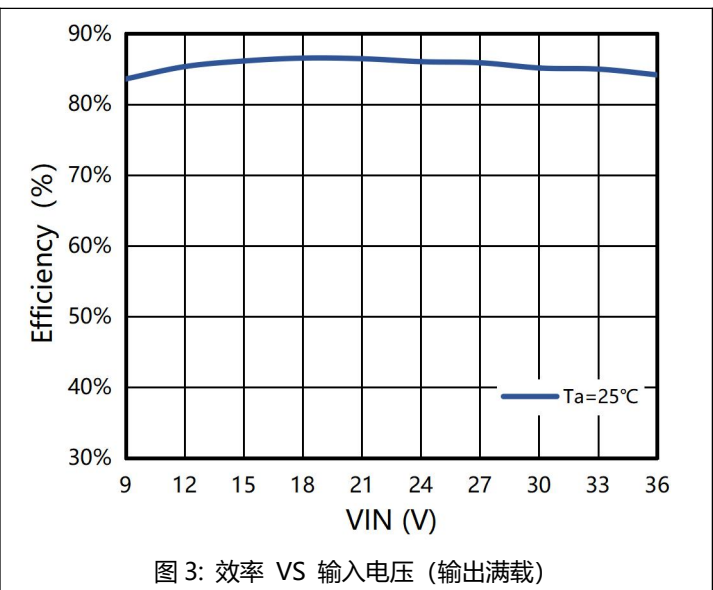
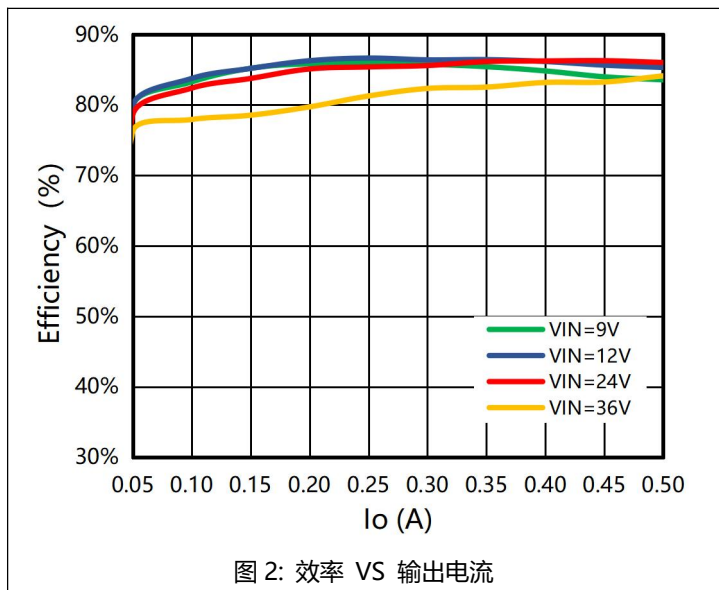
物料清单

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/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C5	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C6	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C7	NC	-	-	-
C8	100pF/200V-NP0	0805	CC0805JRNPOABN101	YAGEO
C9	10nF/50V-X7R	0603	CC0603KRX7R9BB103	YAGEO
C10	NC	-	-	-
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	470K Ω ±1%	0603	RC0603FR-07470KL	YAGEO
R2	150K Ω ±1%	0603	RC0603FR-07150KL	YAGEO
R3	330K Ω ±1%	0603	RC0603FR-07330KL	YAGEO
R4	NC	-	-	-
R5	0 Ω ±1%	0603	RC0603FR-070RL	YAGEO
R6	22K Ω ±1%	0603	RC0603FR-0722KL	YAGEO
R7	10K Ω ±1%	0603	RC0603FR-0710KL	YAGEO
R8	20 Ω ±1%	0603	RC0603FR-0720RL	YAGEO
R9	5.1K Ω ±1%	1206	RC1206FR-075K1L	YAGEO
R10	10 Ω ±1%	0805	RC0805FR-0710RL	YAGEO
R11	2K Ω ±1%	0603	RC0603FR-072KL	YAGEO
R12	20K Ω ±1%	0603	RC0603FR-0720KL	YAGEO
R13	51K Ω ±1%	0603	RC0603FR-0751KL	YAGEO
R14	18K Ω ±1%	0603	RC0603FR-0718KL	YAGEO
R15	4.7K Ω ±1%	0603	RC0603FR-074K7L	YAGEO
R16	NC	-	-	-
TR1	NP:NS:NA=10:14:7 Lp=11uH	ER11.5	VPE24FFF10A	VPSC
D1	200V/0.2A	SOD-323	BAV21WS	CJ
D2	200V/0.2A	SOD-323	BAV21WS	CJ
D3	100V/2A	SMA	SS210A	YANGJIE
U1	4-50VIN/90V/0.1 Ω 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	---	292	mA
转换效率	VIN=24V, IO=0.5A	---	86	---	%
纹波&噪声	VIN=24V, IO=0.5A	---	50	90	mV
输出电压精度	VIN=24V, IO=0.5A	---	0.7	---	%
线性调节率	VIN=9V-36V, IO=0.5A	---	0	---	%
负载调整率	VIN=24V, IO=0.5A	---	0.1	---	%
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°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

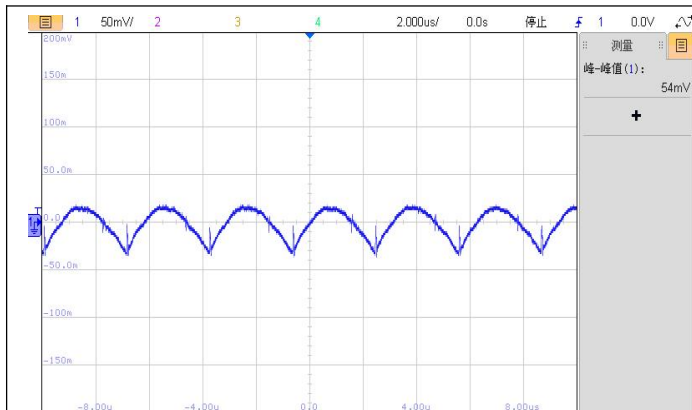


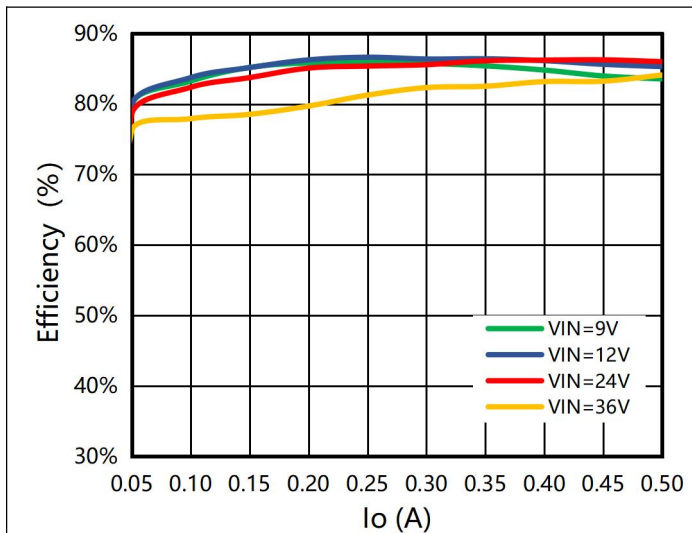
图 4: VIN=24V, 满载输出电压纹波波形



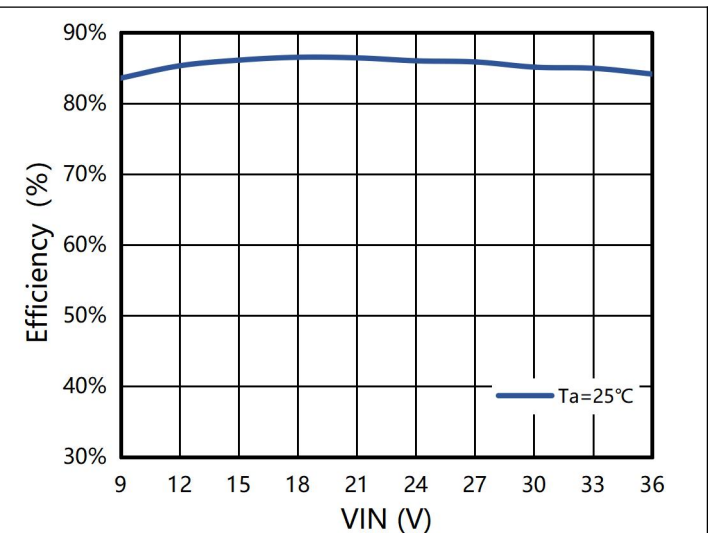
图 5: VIN=24V, 满载启机波形

详细测试数据

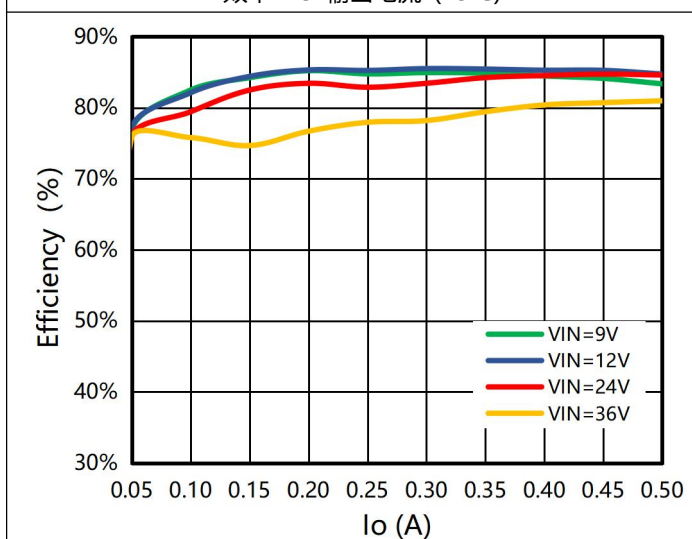
高低温测试曲线



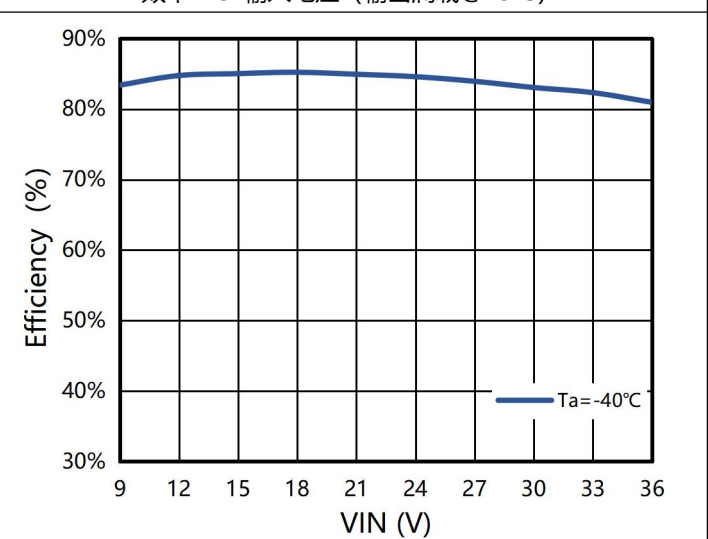
效率 VS 输出电流 (25°C)



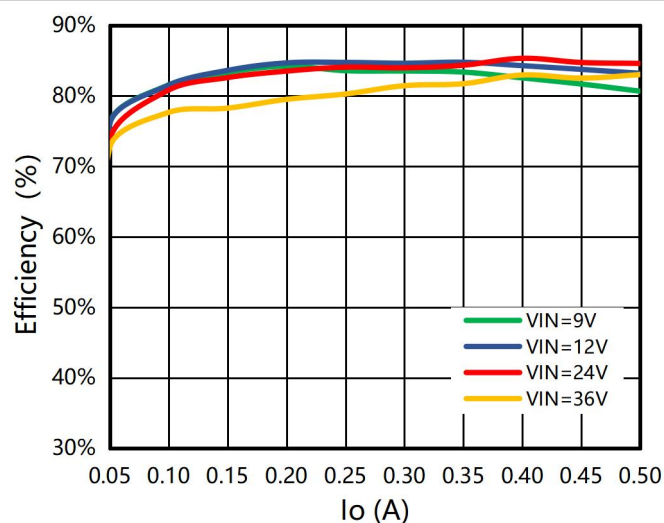
效率 VS 输入电压 (输出满载@25°C)



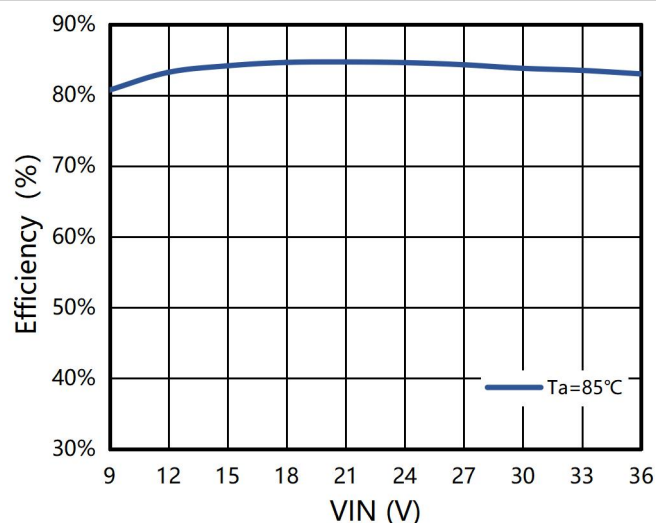
效率 VS 输出电流 (-40°C)



效率 VS 输入电压 (输出满载@-40°C)



效率 VS 输出电流 (85°C)



效率 VS 输入电压 (输出满载@85°C)

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

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η (%)
24.06	0.004	12.09	0	0%	0.00%
24.06	0.032	12.09	0.050	10%	78.51%
24.06	0.061	12.09	0.100	20%	82.38%
24.06	0.090	12.09	0.150	30%	83.75%
24.06	0.118	12.08	0.200	40%	85.10%
24.06	0.147	12.08	0.250	50%	85.39%
24.06	0.176	12.08	0.300	60%	85.58%
24.06	0.204	12.08	0.350	70%	86.14%
24.05	0.233	12.08	0.400	80%	86.23%
24.05	0.262	12.08	0.450	90%	86.27%
24.05	0.292	12.08	0.500	100%	86.01%

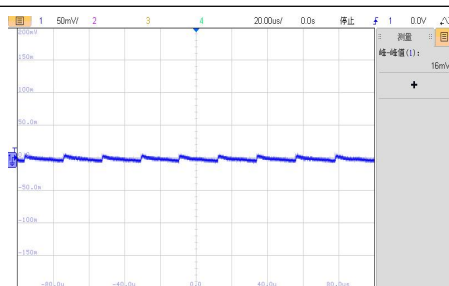
VIN=24V, $T_a=-40^{\circ}\text{C}$, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η (%)
23.98	0.004	12	0	0%	0.00%
23.98	0.033	12	0.050	10%	75.82%
23.98	0.063	12	0.100	20%	79.43%
23.98	0.091	12	0.150	30%	82.49%
23.97	0.120	12	0.200	40%	83.44%
23.97	0.151	12	0.250	50%	82.89%
23.97	0.180	12	0.300	60%	83.44%
23.97	0.208	12	0.350	70%	84.24%
23.96	0.237	12	0.400	80%	84.53%
23.96	0.266	12	0.450	90%	84.73%
23.96	0.296	12	0.500	100%	84.60%

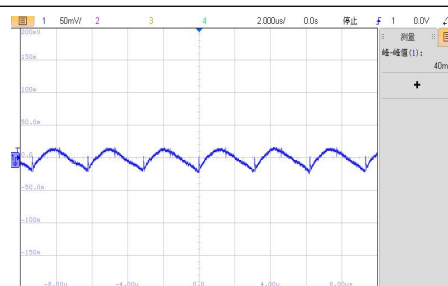
VIN=24V, Ta=85°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η (%)
23.97	0.005	12.02	0	0%	0.00%
23.97	0.034	12.01	0.050	10%	73.68%
23.97	0.062	12.01	0.100	20%	80.81%
23.97	0.091	12.01	0.150	30%	82.59%
23.97	0.120	12.01	0.200	40%	83.51%
23.97	0.149	12.01	0.250	50%	84.07%
23.97	0.179	12.01	0.300	60%	83.97%
23.96	0.208	12.01	0.350	70%	84.35%
23.96	0.235	12.01	0.400	80%	85.32%
23.96	0.266	12	0.450	90%	84.73%
23.96	0.296	12	0.500	100%	84.60%

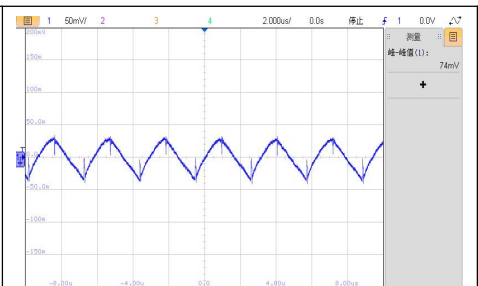
输出电压纹波波形



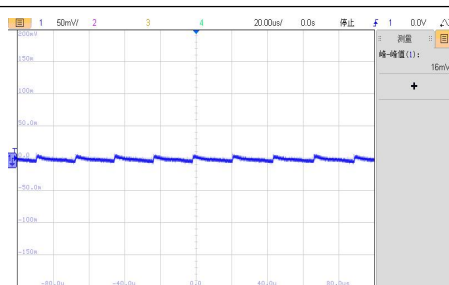
VIN=9V, 空载输出电压纹波波形



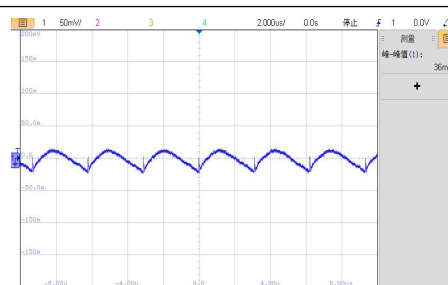
VIN=9V, 半载输出电压纹波波形



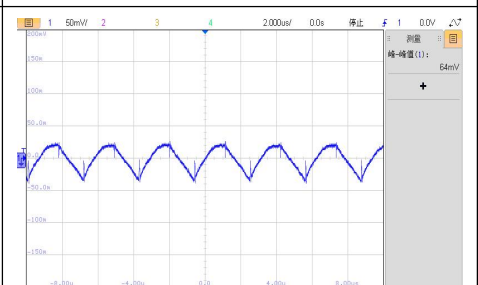
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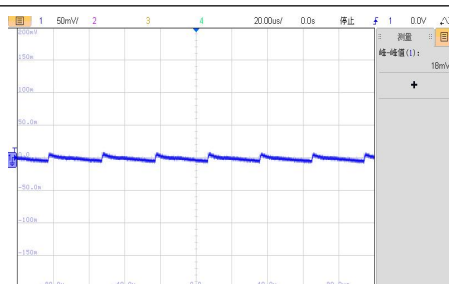
VIN=12V, 空载输出电压纹波波形



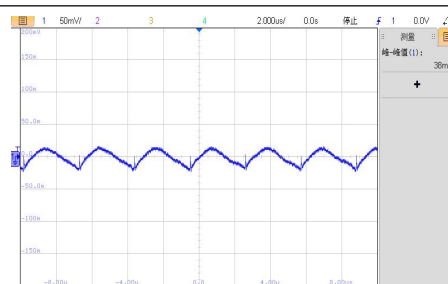
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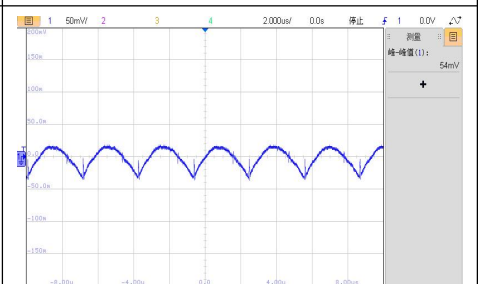
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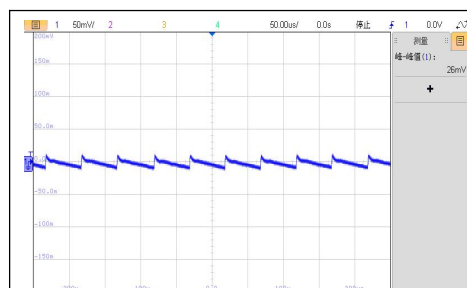
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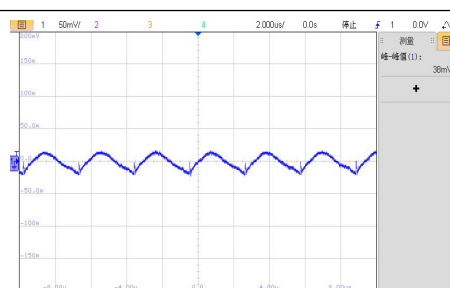
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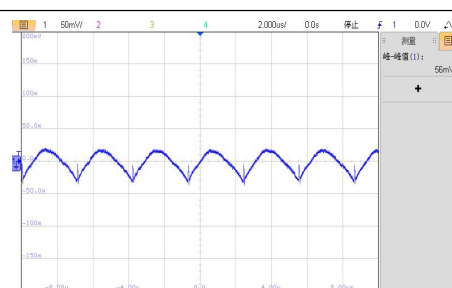
VIN=24V, 满载输出电压纹波波形



VIN=36V, 空载输出电压纹波波形



VIN=36V, 半载输出电压纹波波形

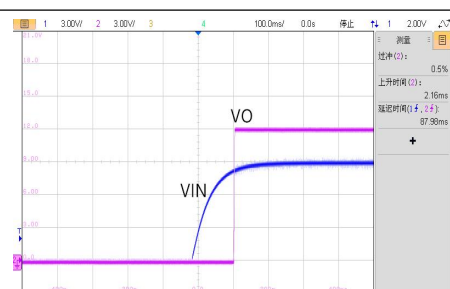


VIN=36V, 满载输出电压纹波波形

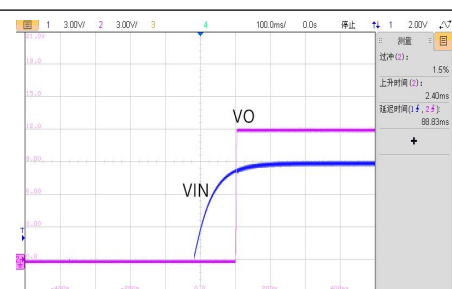
开关机波形



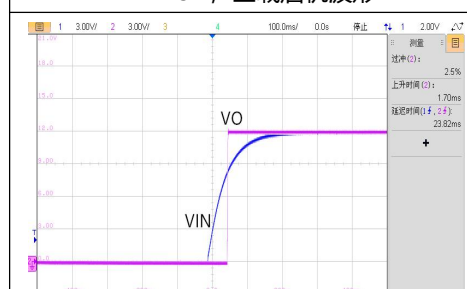
VIN=9V, 空载启机波形



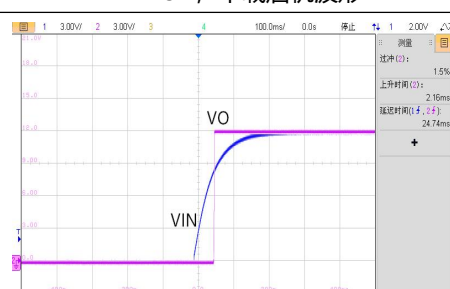
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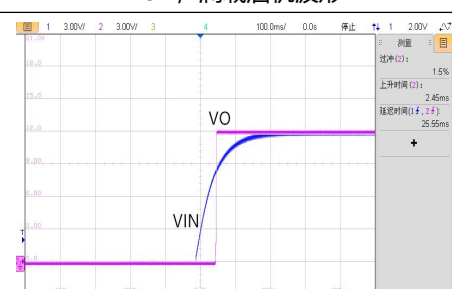
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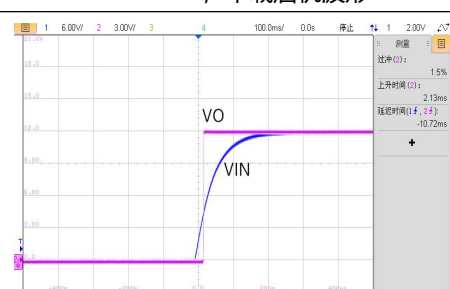
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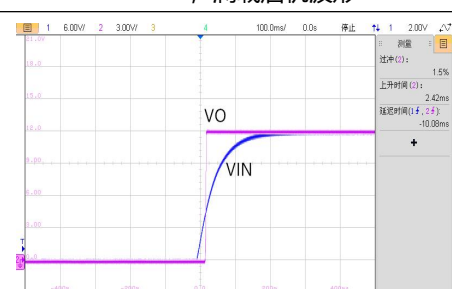
VIN=12V, 满载启机波形



VIN=24V, 空载启机波形



VIN=24V, 半载启机波形



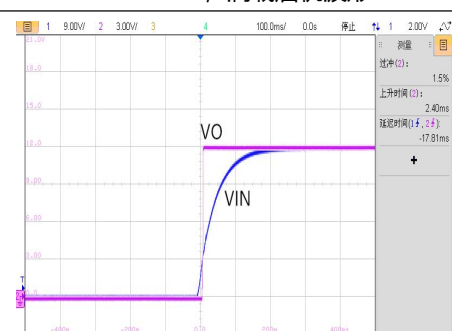
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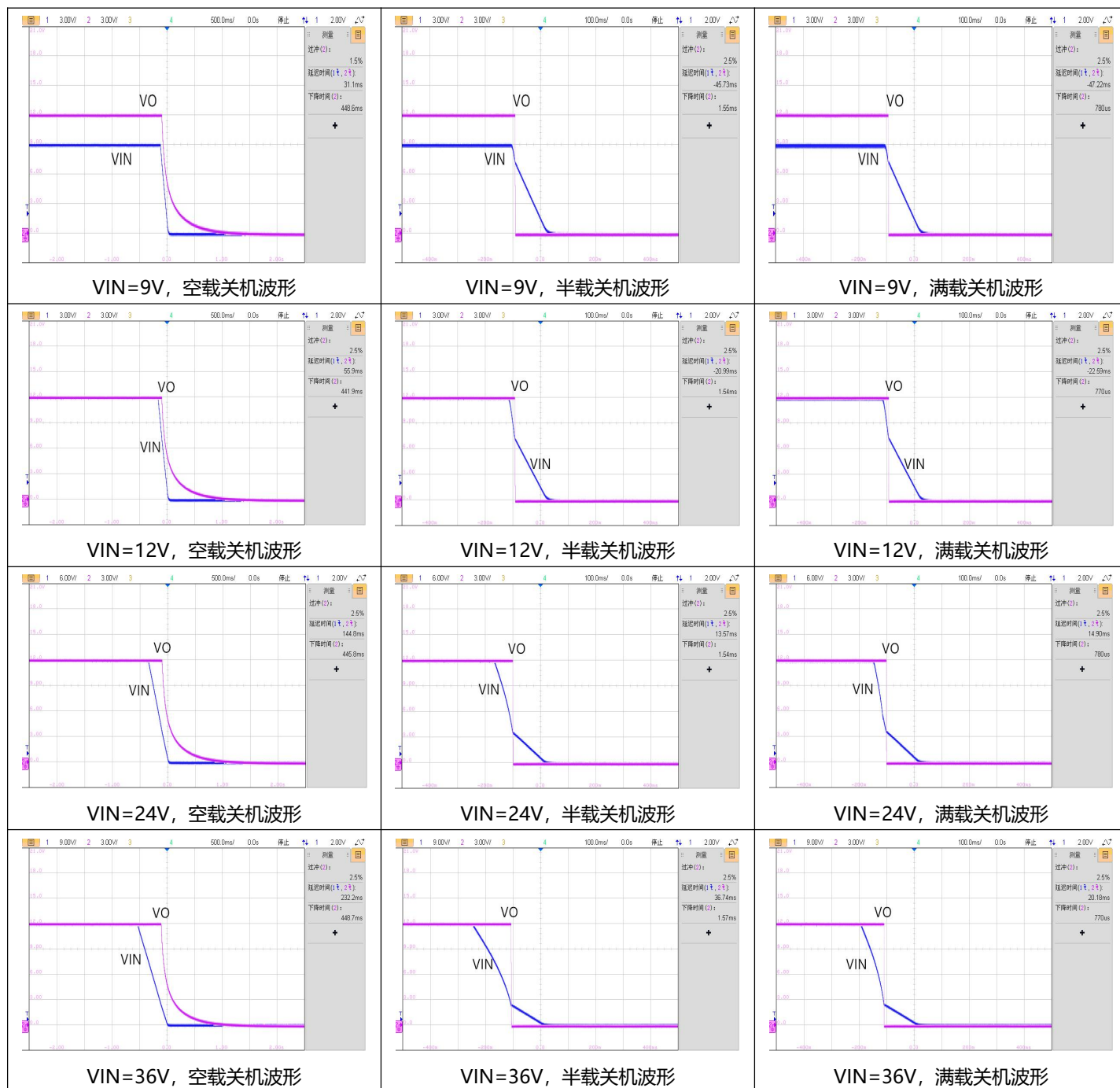
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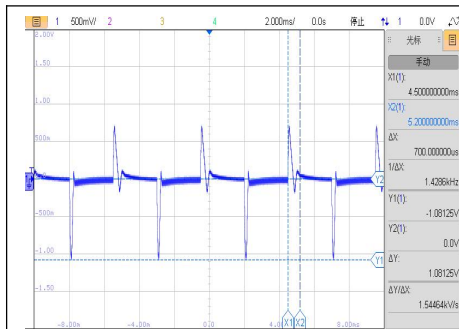
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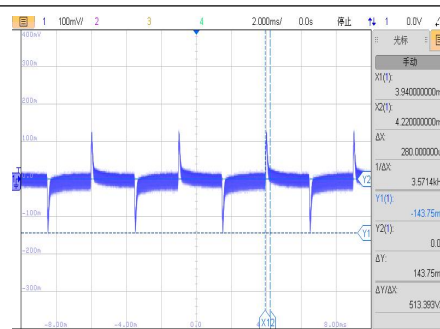
VIN=36V, 满载启机波形



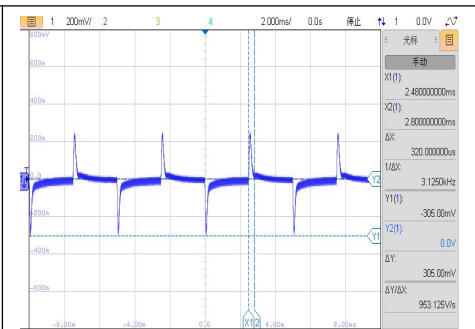
动态波形



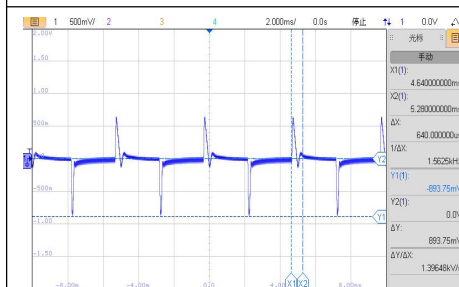
VIN=9V, 100%-10%-100%Io 动态波形



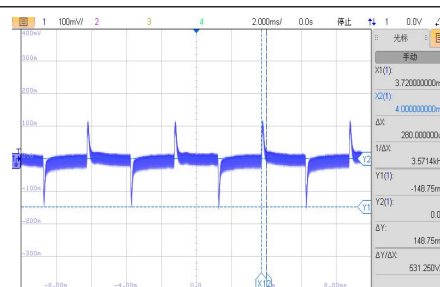
VIN=9V, 75%-50%-75%Io 动态波形



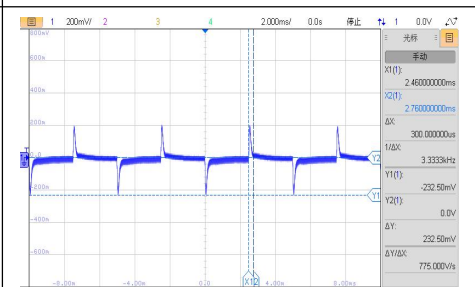
VIN=9V, 50%-25%-50%Io 动态波形



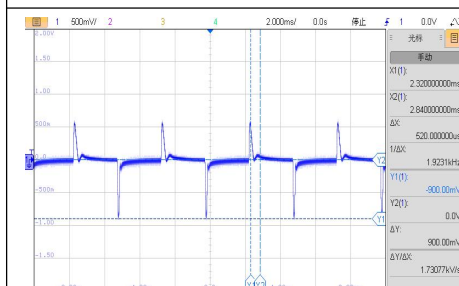
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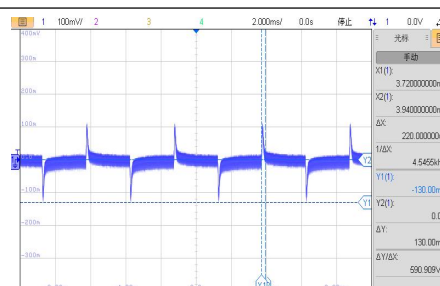
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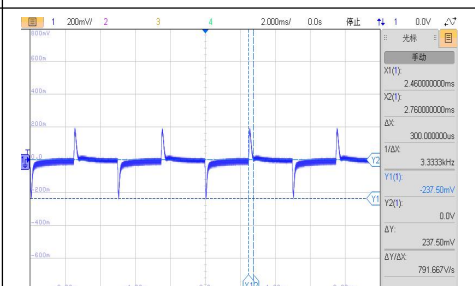
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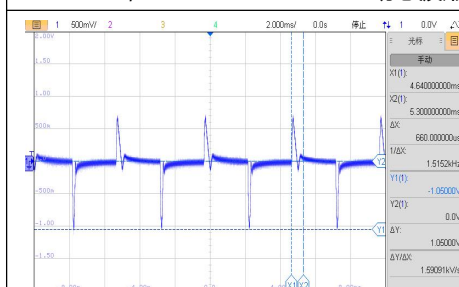
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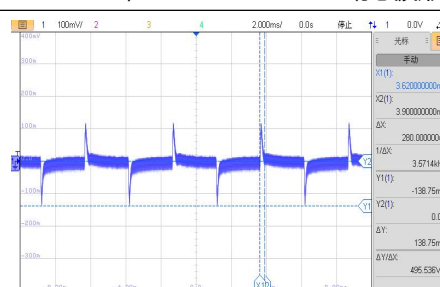
VIN=24V, 75%-50%-75%Io 动态波形



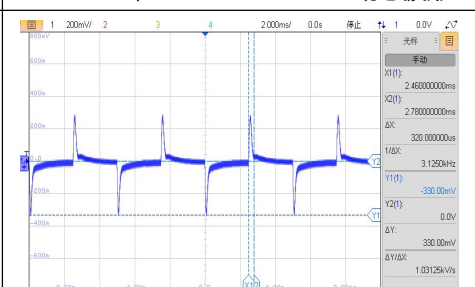
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

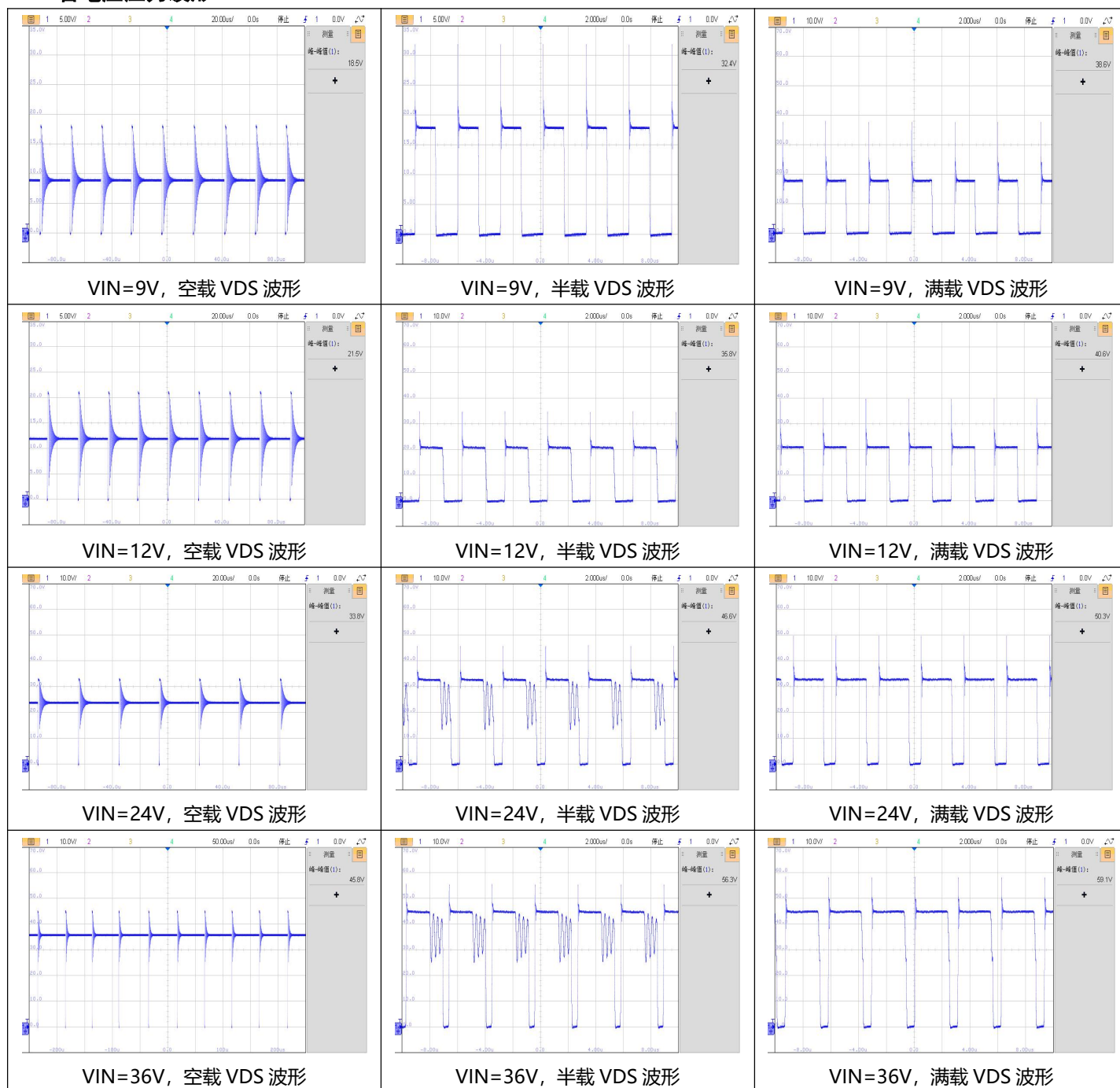


VIN=36V, 75%-50%-75%Io 动态波形

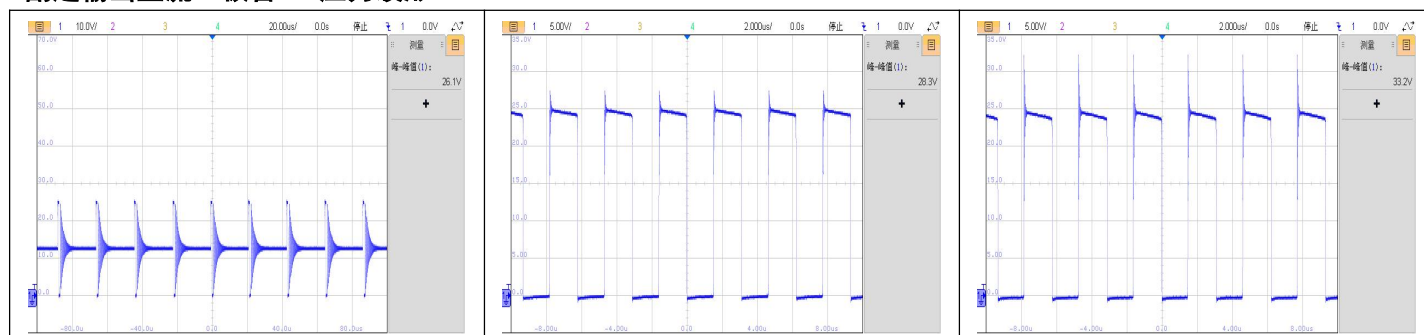


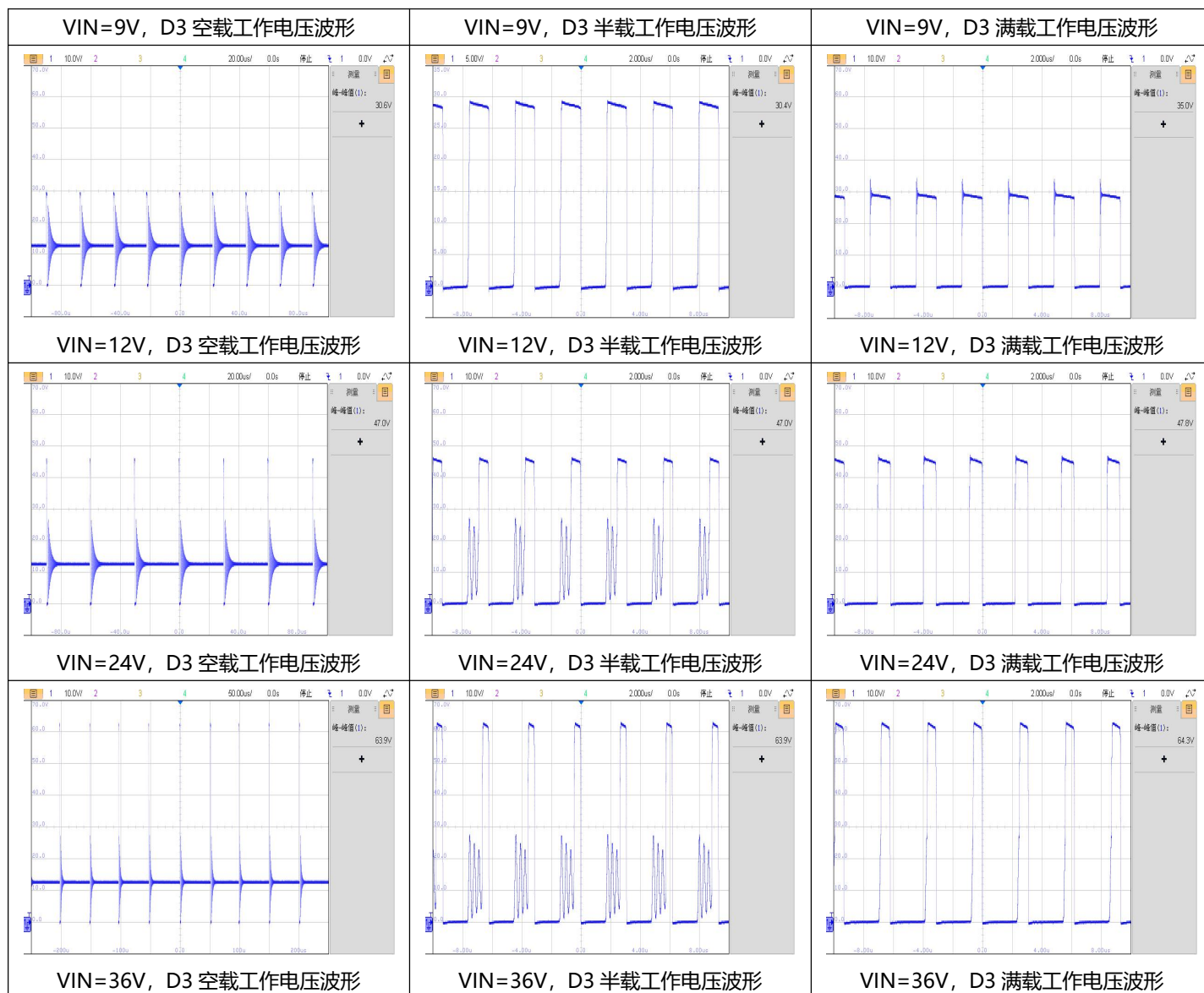
VIN=36V, 50%-25%-50%Io 动态波形

MOS 管电压应力波形



副边输出整流二极管 D3 应力波形





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