

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 VPE24FFF10A、输出整流二极管以及必要的阻容元件，实现 18-36V 输入，24V 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。

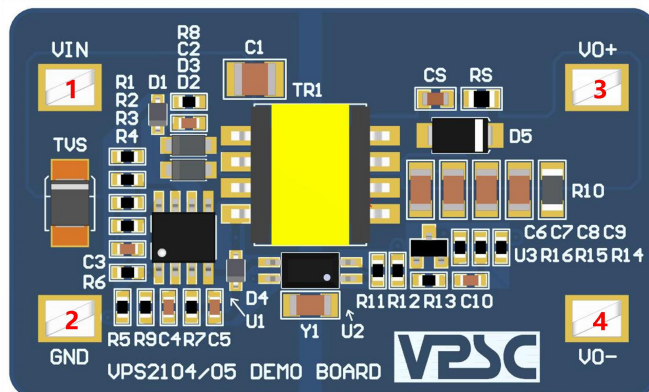
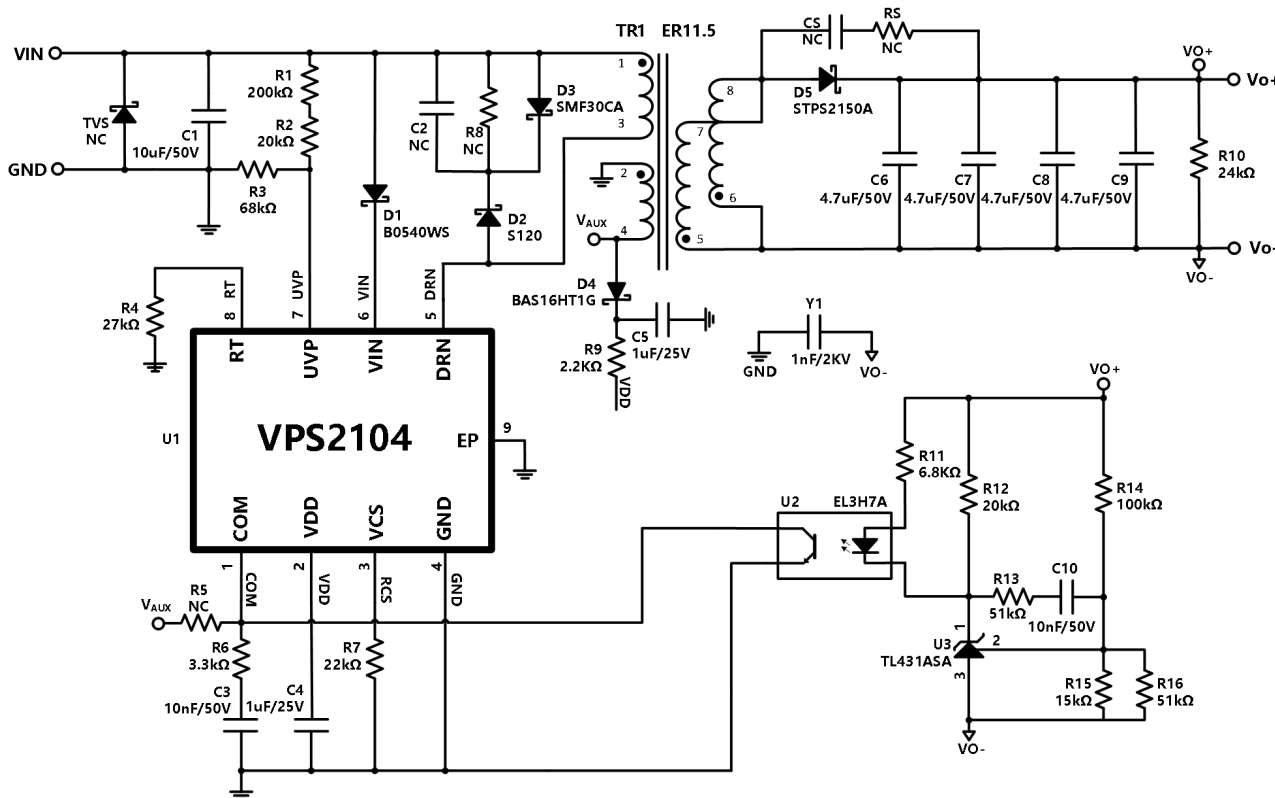


图 1: VPS2104 Demo 板(尺寸:50mm*30mm)

关键词：输入：18V-36V，输出 24V/10W，隔离电压：1500VDC，反馈方式：副边反馈-SSR

原理图



引脚功能说明

功能	功能描述
VIN	电源输入端
GND	电源接地端
VO+	电源输出正
VO-	电源输出负

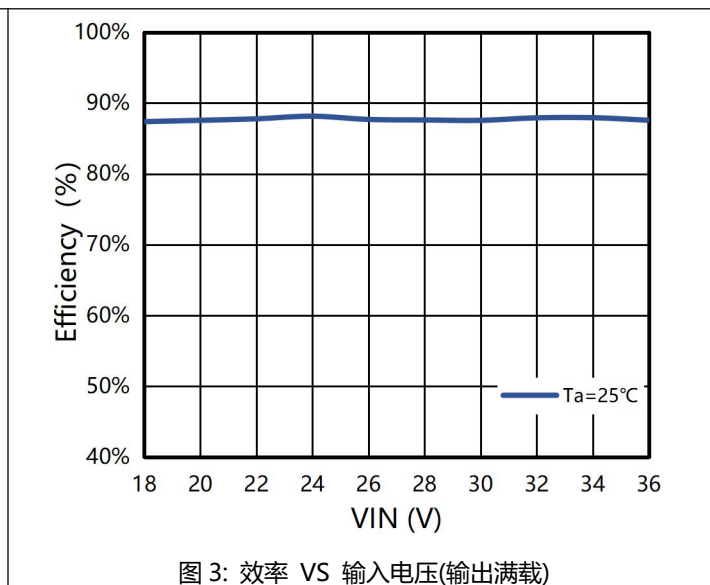
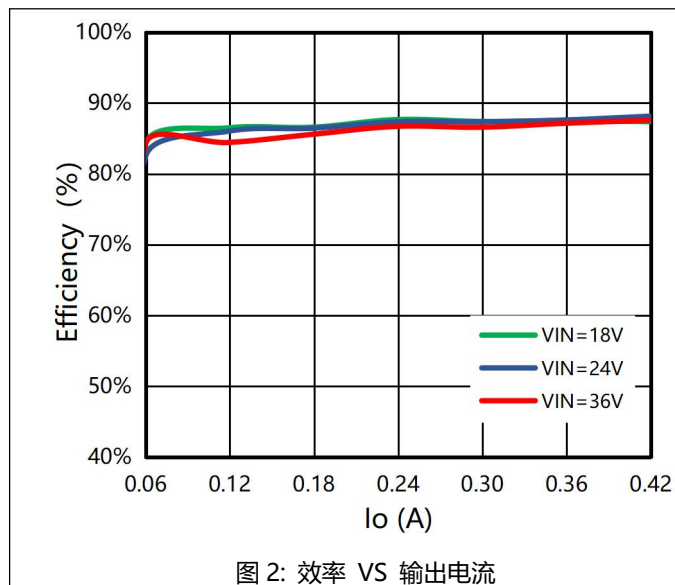
物料清单

位号	参数	封装	型号	品牌
C1	10uF/50V-X7R	1210	CL31B106KBHNNNE	SAMSUNG
C2	NC	-	-	-
C3	10nF/50V-X7R	0603	CC0603KRX7R9BB103	YAGEO
C4	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C5	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C6	4.7uF/50V-X7R	1206	CC1206KKX7R9BB475	YAGEO
C7	4.7uF/50V-X7R	1206	CC1206KKX7R9BB475	YAGEO
C8	4.7uF/50V-X7R	1206	CC1206KKX7R9BB475	YAGEO
C9	4.7uF/50V-X7R	1206	CC1206KKX7R9BB475	YAGEO
C10	10nF/50V-X7R	0603	CC0603KRX7R9BB103	YAGEO
CS	NC	-	-	-
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	200K Ω ±1%	0603	RC0603FR-07200KL	YAGEO
R2	20K Ω ±1%	0603	RC0603FR-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	22K Ω ±1%	0603	RC0603FR-0722KL	YAGEO
R8	NC	-	-	-
R9	2.2K Ω ±1%	0603	RC0603FR-072K2L	YAGEO
R10	24K Ω ±1%	1206	RC1206FR-0724KL	YAGEO
R11	6.8K Ω ±1%	0603	RC0603FR-076K8L	YAGEO
R12	20K Ω ±1%	0603	RC0603FR-0720KL	YAGEO
R13	51K Ω ±1%	0603	RC0603FR-0751KL	YAGEO
R14	100K Ω ±1%	0603	RC0603FR-07100KL	YAGEO
R15	15K Ω ±1%	0603	RC0603FR-0715KL	YAGEO
R16	51K Ω ±1%	0603	RC0603FR-0751KL	YAGEO
RS	NC	-	-	-
D1	40V/0.5A	SOD-323	B0540WS	YANGJIE
D2	200V/1A	SOD-123	S120	YANGJIE
D3	30V/8.3A TVS	SOD-123	SMF30CA	MDD
D4	85V/200mA	SOD-323	BAS16HT1G	ON
D5	150V/2A	SMA	STPS2150A	ST
TVS	NC	-	-	-
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	SOT23-3	TL431ASA	DIODES
TR1	Np:Ns:Na=10:14:7 Lp=11uH	ER11.5	VPE24FFF10A	VPSC

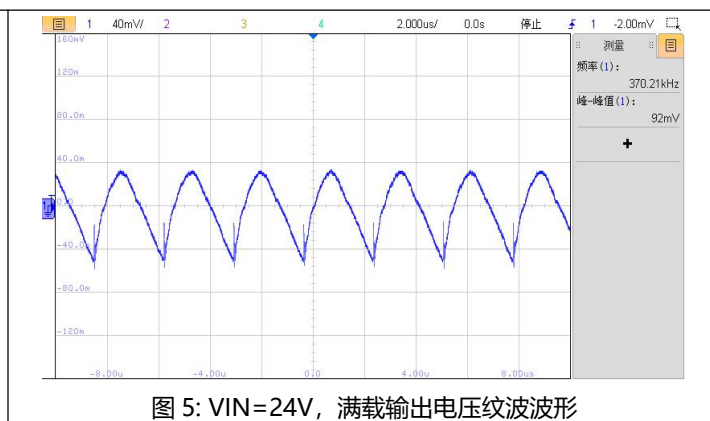
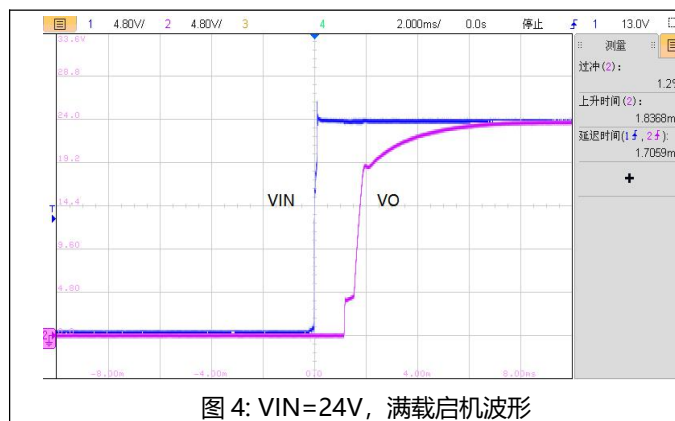
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流 (满载/空载)	VIN=24V	3	---	472	mA
转换效率	VIN=24V, IO=0.42A	---	88	---	%
纹波&噪声	VIN=24V; IO=0.42A	---	90	120	mV
线性调节率	VIN=18V-36V, IO=0.42A	---	0.02	---	%
负载调整率	VIN=24V; IO=0.42A	---	0.02	---	%
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

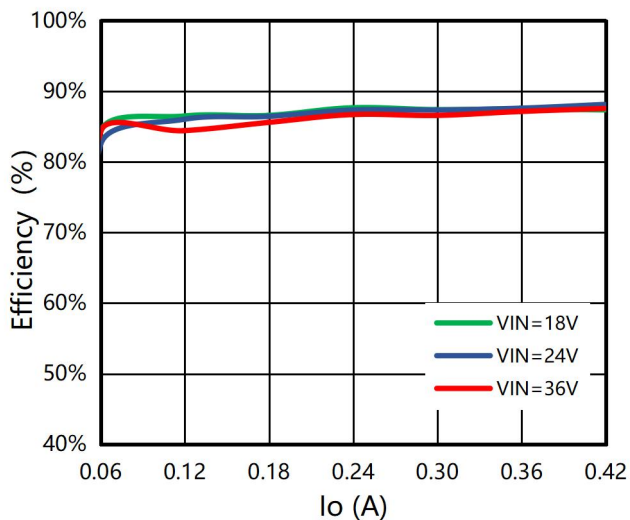


相关波形

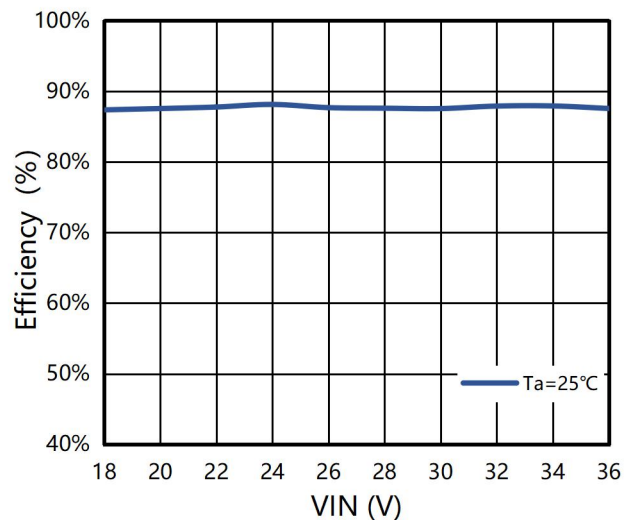


详细测试数据

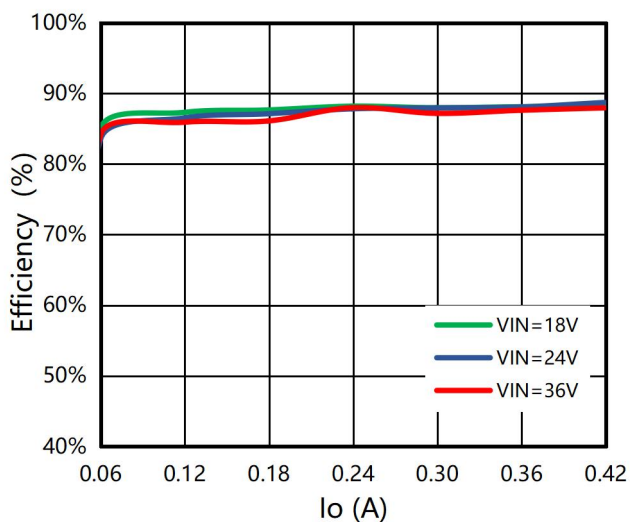
高低温测试曲线



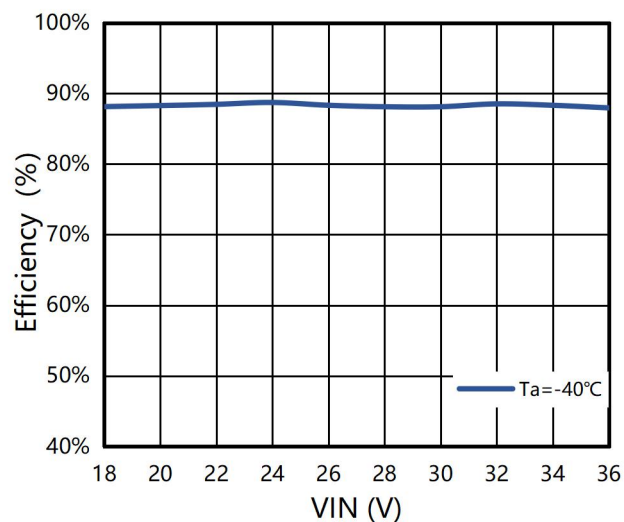
效率 VS 输出电流(25°C)



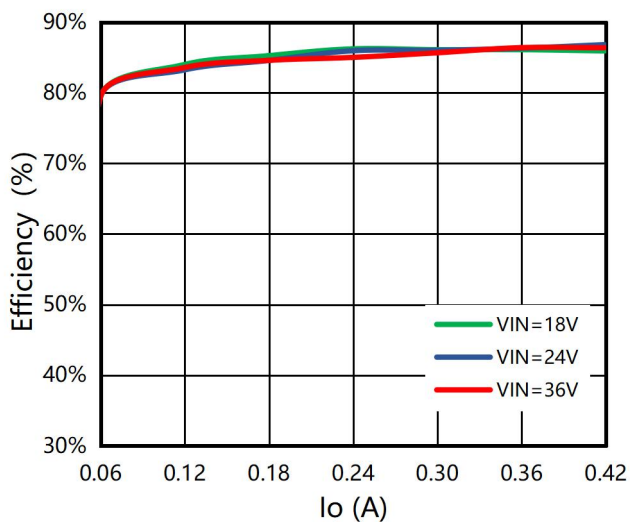
效率 VS 输入电压(输出满载@25°C)



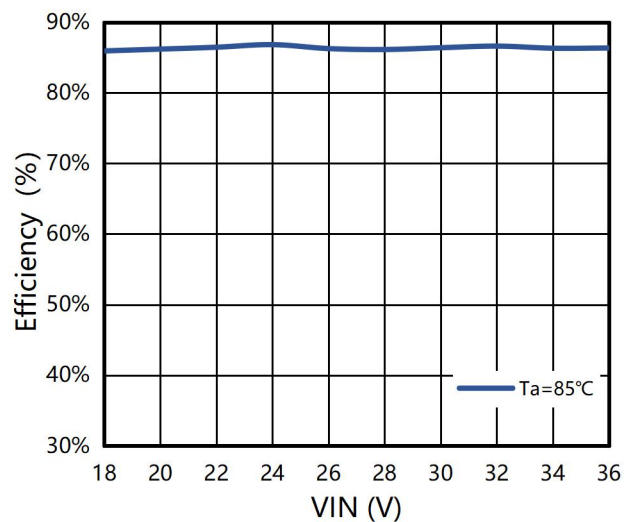
效率 VS 输出电流(-40°C)



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)	η(%)
24.02	0.003	23.77	0	0.00%
24.02	0.072	23.76	0.060	82.43%
24.01	0.138	23.76	0.120	86.05%
24.01	0.205	23.77	0.179	86.44%
24	0.271	23.77	0.239	87.35%
24	0.339	23.77	0.299	87.36%
23.99	0.406	23.77	0.359	87.61%
23.99	0.471	23.77	0.419	88.14%

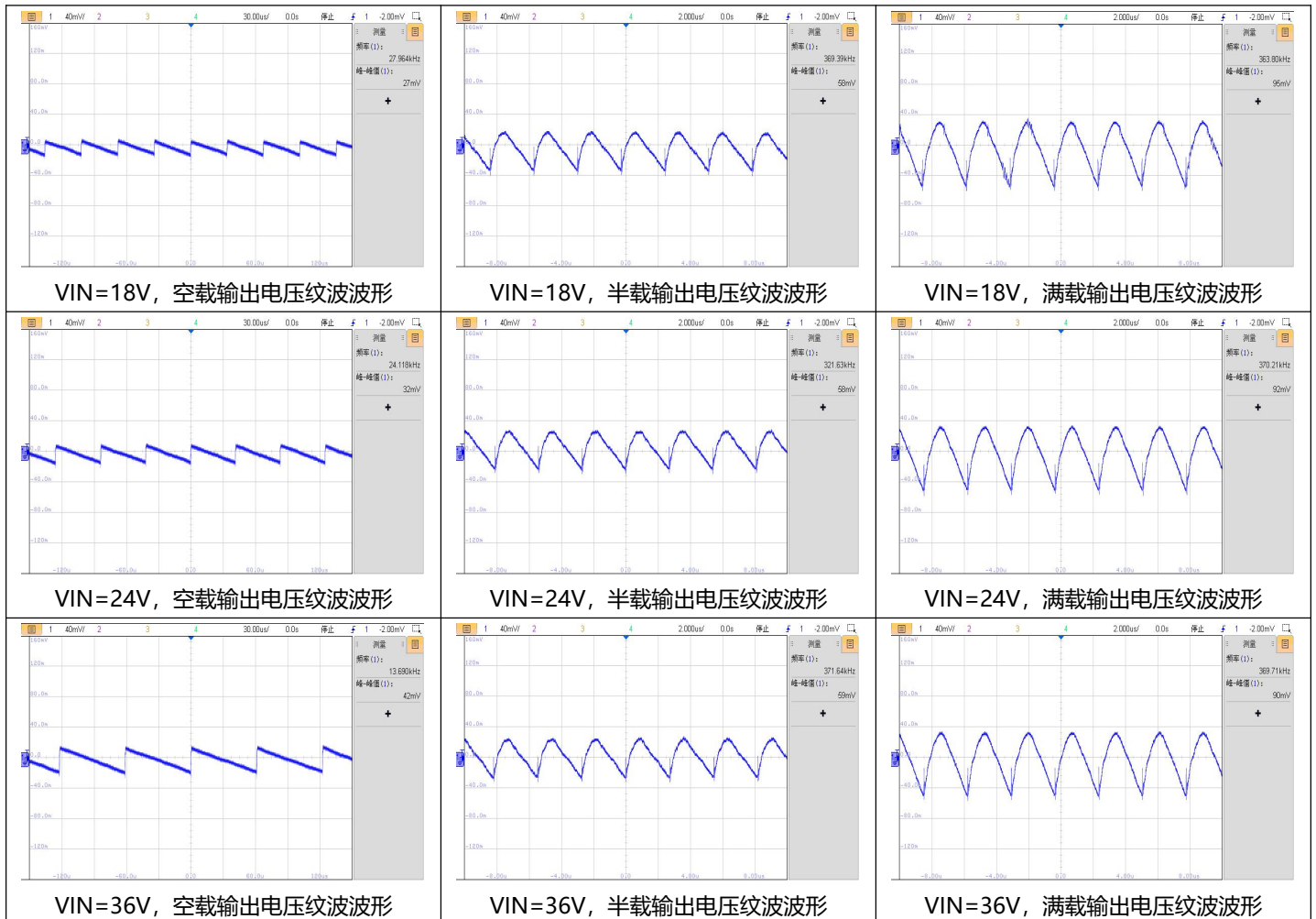
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	η(%)
24.01	0.003	23.72	0	0.00%
24.01	0.071	23.72	0.060	83.49%
24.01	0.137	23.72	0.120	86.53%
24.01	0.203	23.72	0.179	87.11%
24	0.269	23.72	0.239	87.81%
24	0.336	23.72	0.299	87.95%
23.99	0.403	23.72	0.359	88.08%
23.99	0.467	23.72	0.419	88.71%

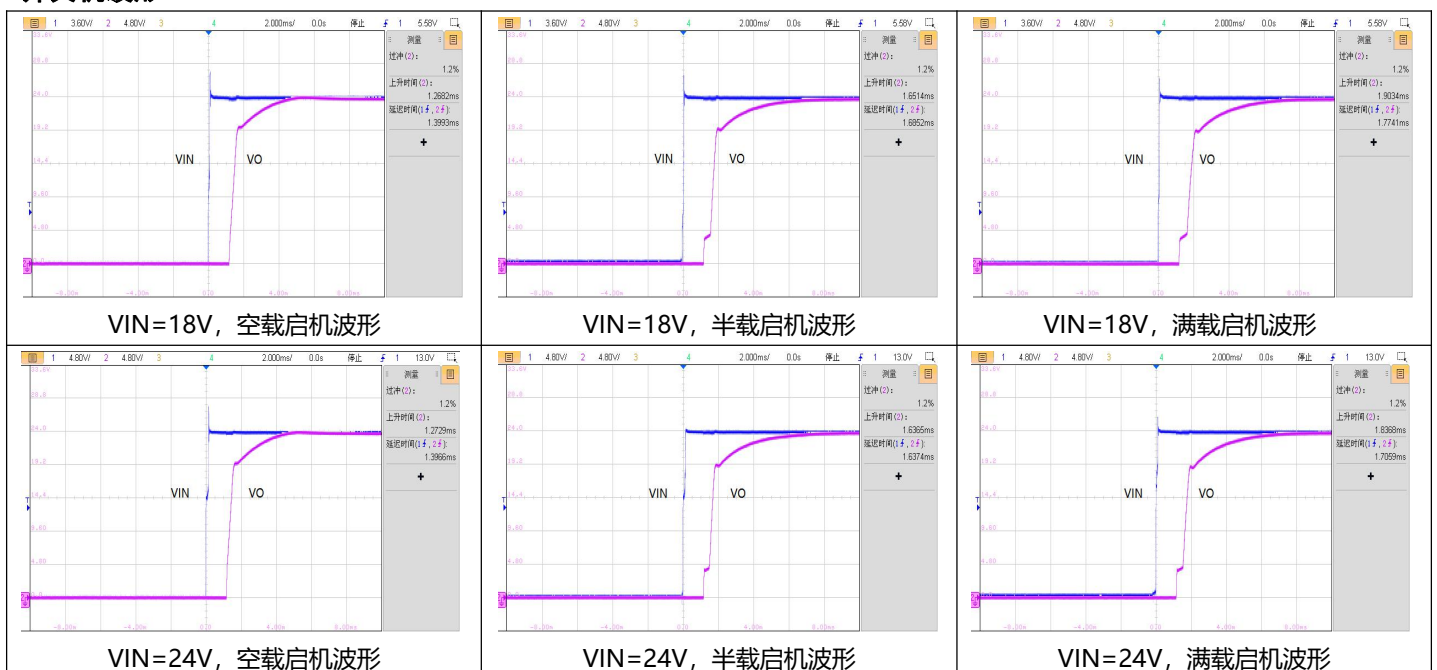
VIN=24V, Ta=85°C, 输入、输出及效率数据:

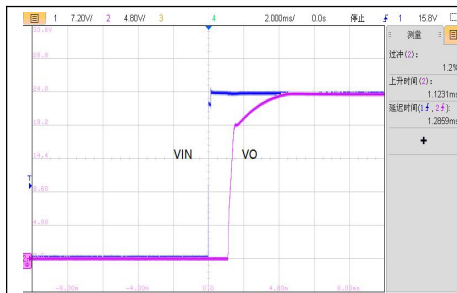
VIN(V)	IIN(A)	VO(V)	IO(A)	η(%)
24.02	0.005	23.85	0	0.00%
24.02	0.075	23.84	0.060	79.40%
24.02	0.143	23.83	0.120	83.25%
24.02	0.210	23.83	0.179	84.56%
24.01	0.276	23.83	0.239	85.95%
24.01	0.345	23.83	0.299	86.02%
24	0.413	23.83	0.359	86.31%
24	0.479	23.82	0.419	86.82%

输出电压纹波波形

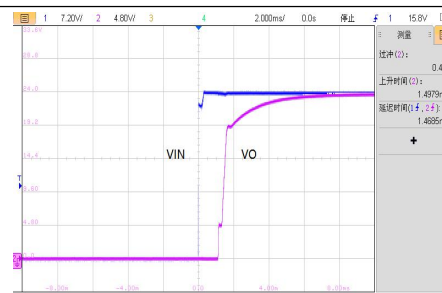


开关机波形

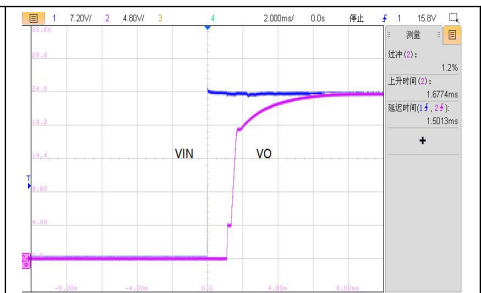




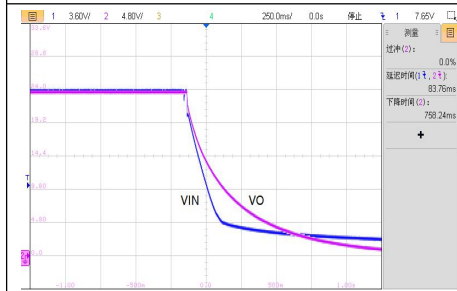
VIN=36V, 空载启机波形



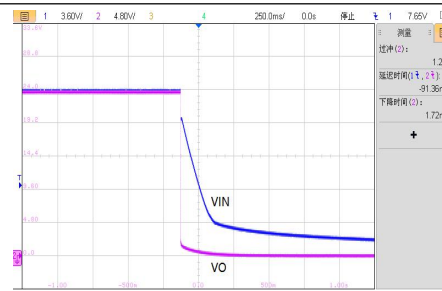
VIN=36V, 半载启机波形



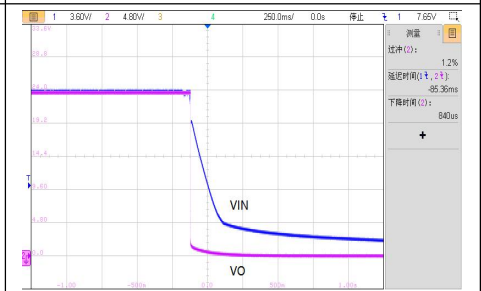
VIN=36V, 满载启机波形



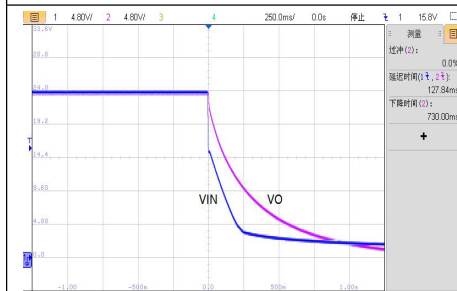
VIN=18V, 空载关机波形



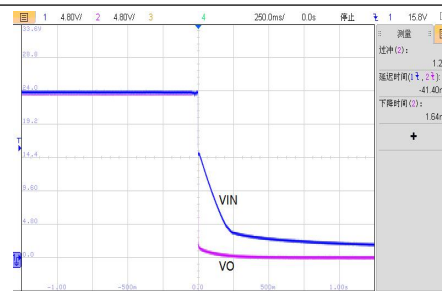
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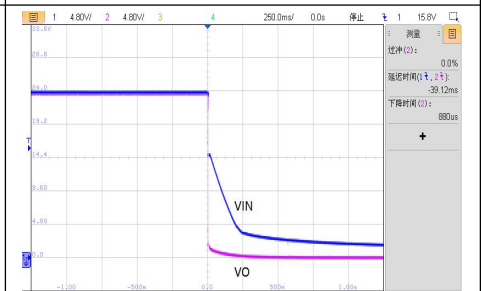
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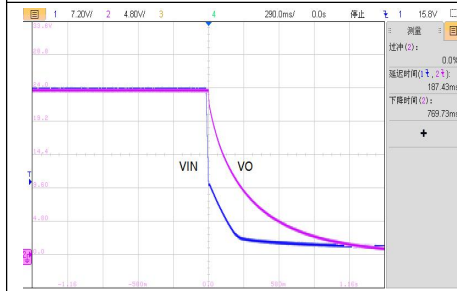
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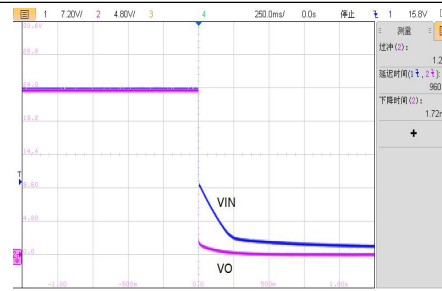
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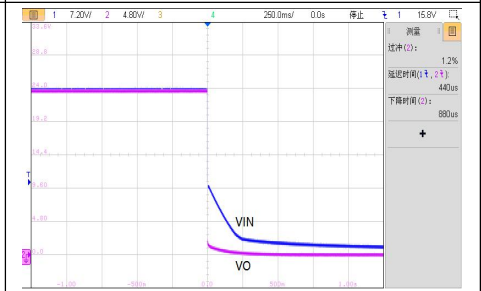
VIN=24V, 满载关机波形



VIN=36V, 空载关机波形

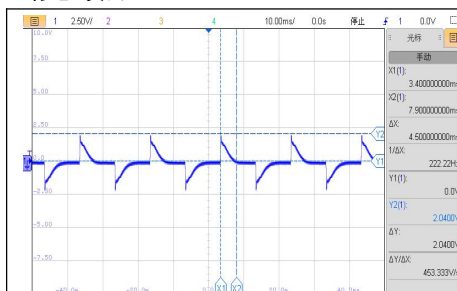


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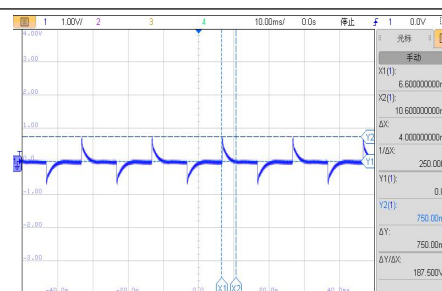


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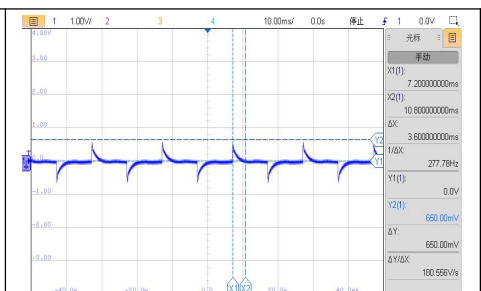
动态波形



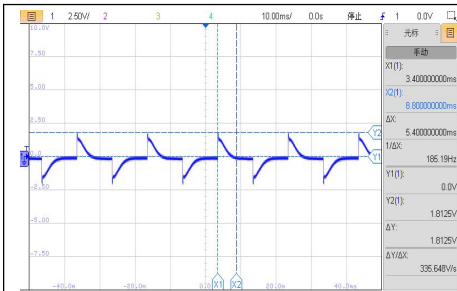
VIN=18V, 100%-10%-100%Io 动态波形



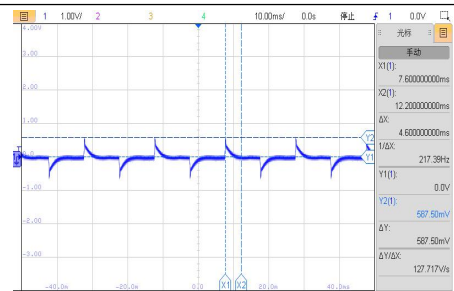
VIN=18V, 75%-50%-75%Io 动态波形



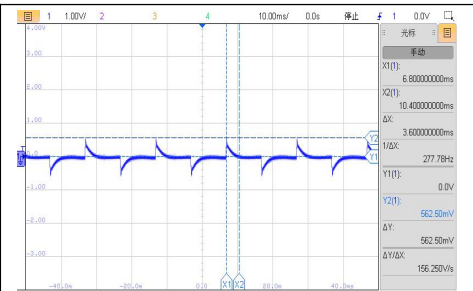
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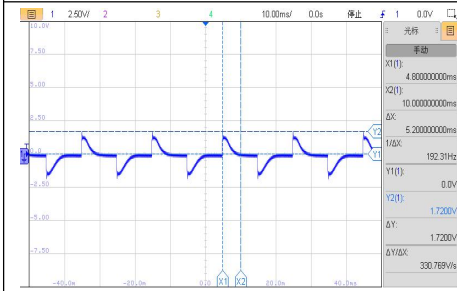
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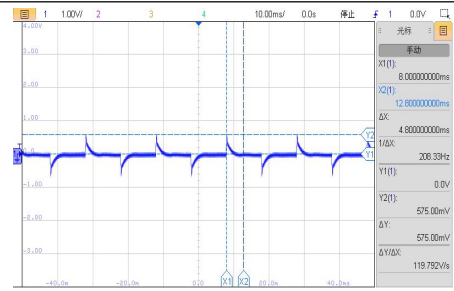
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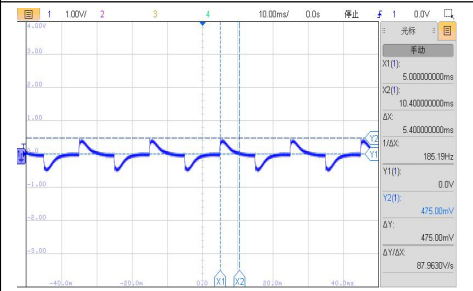
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

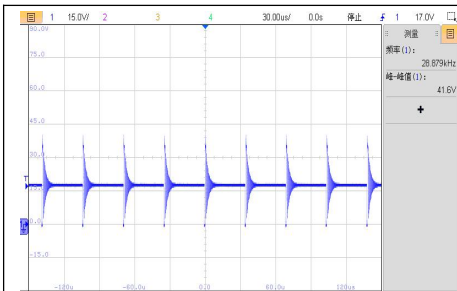


VIN=36V, 75%-50%-75%Io 动态波形

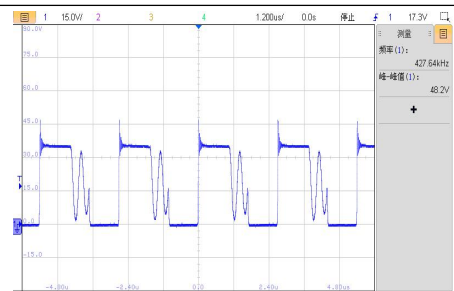


VIN=36V, 50%-25%-50%Io 动态波形

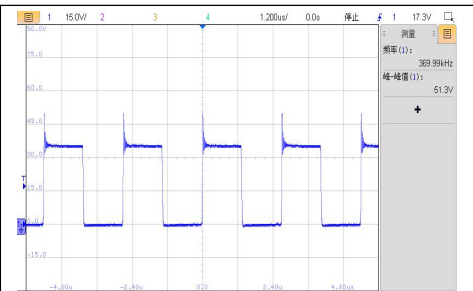
MOS 管电压应力波形



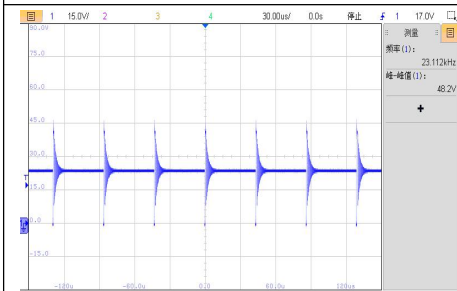
VIN=18V, 空载 VDS 波形



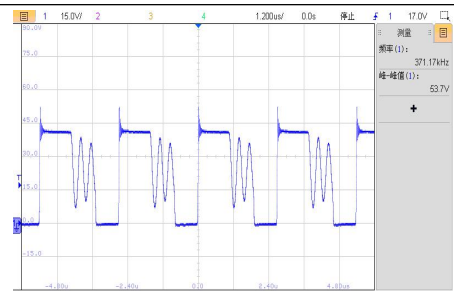
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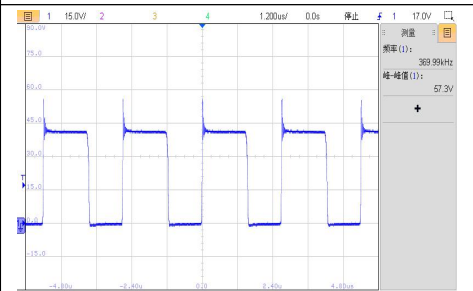
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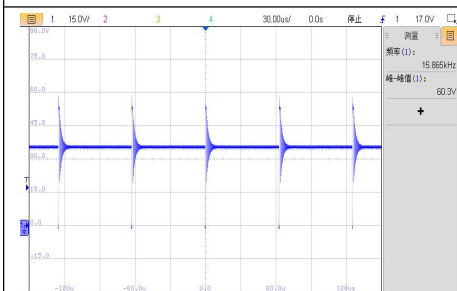
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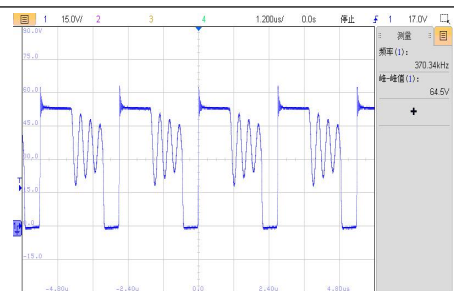
VIN=24V, 半载 VDS 波形



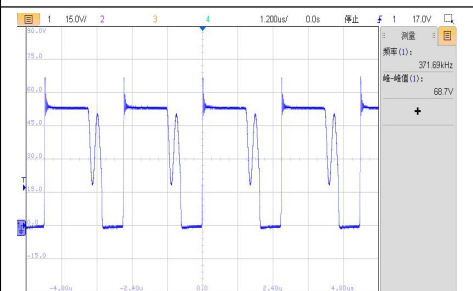
VIN=24V, 满载 VDS 波形



VIN=36V, 空载 VDS 波形

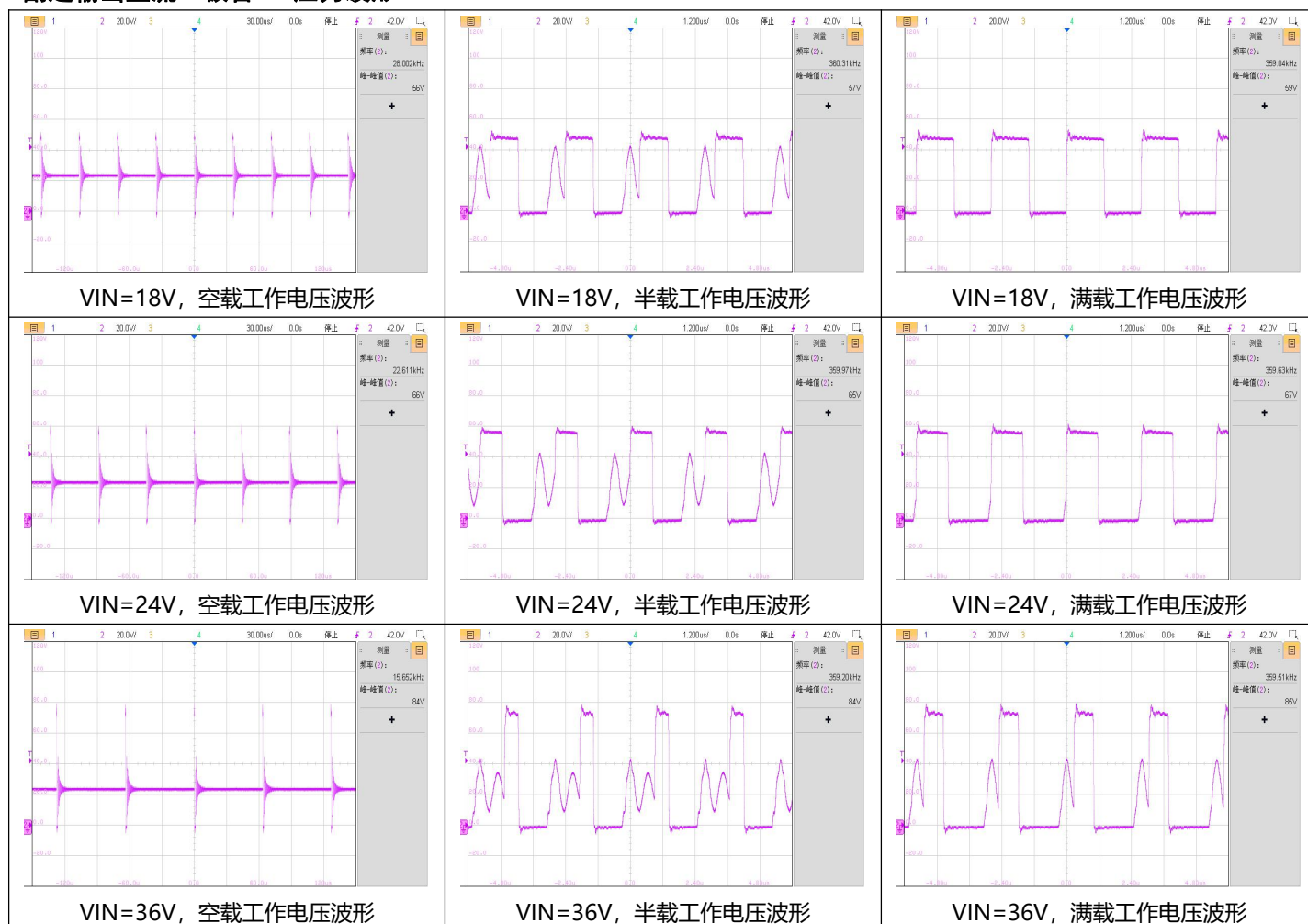


VIN=36V, 半载 VDS 波形

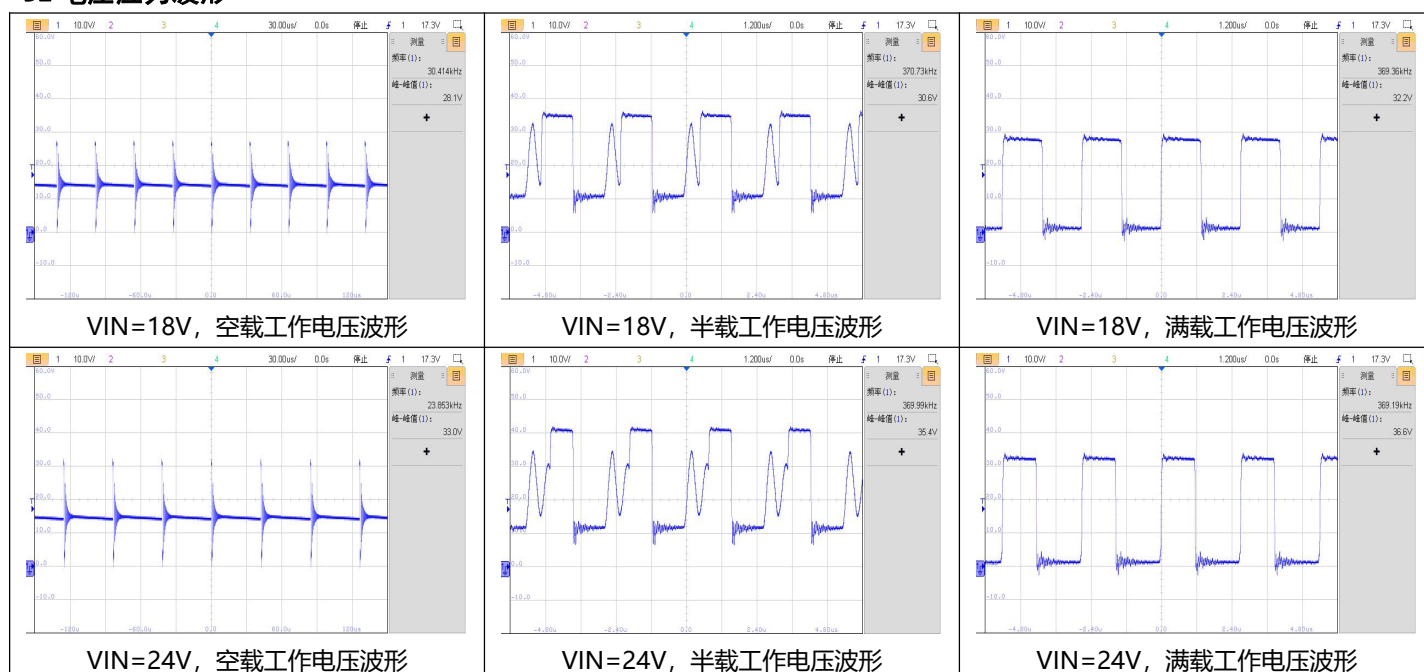


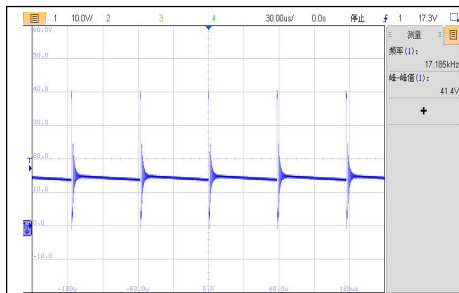
VIN=36V, 满载 VDS 波形

副边输出整流二极管 D5 应力波形

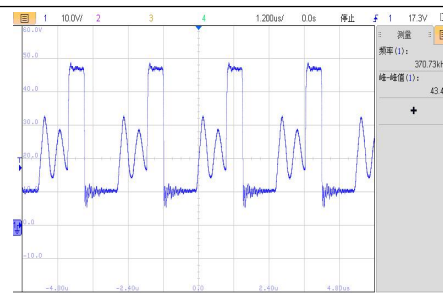


D2 电压应力波形

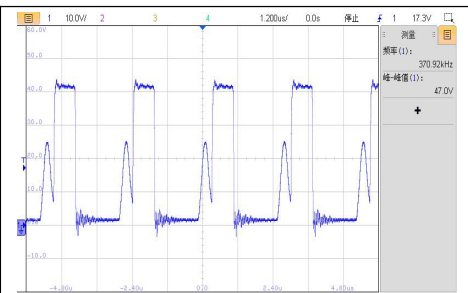




VIN=36V, 空载工作电压波形

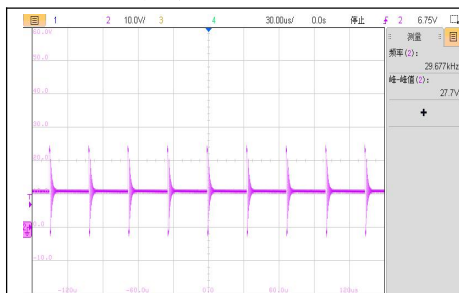


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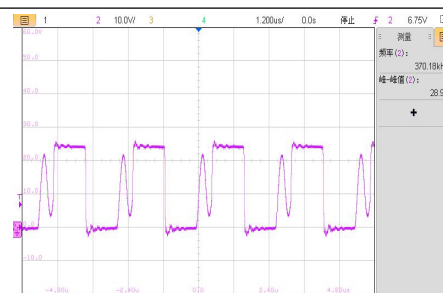


VIN=36V, 满载工作电压波形

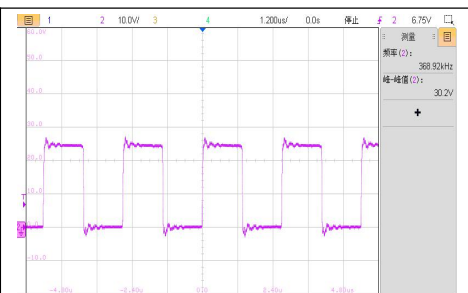
D4 电压应力波形



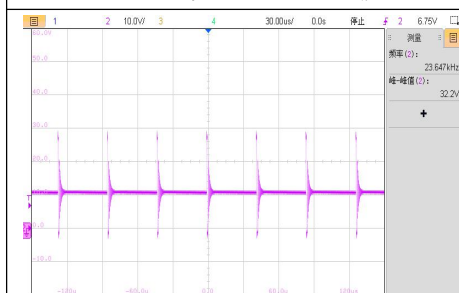
VIN=18V, 空载工作电压波形



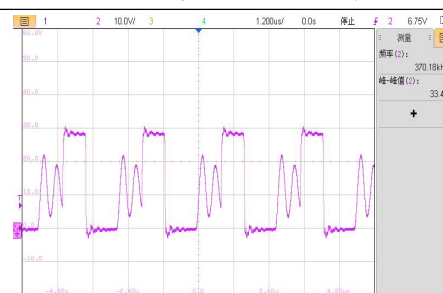
VIN=18V, 半载工作电压波形



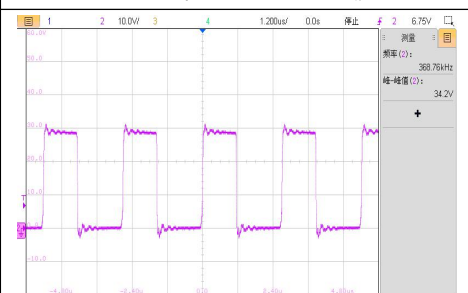
VIN=18V, 满载工作电压波形



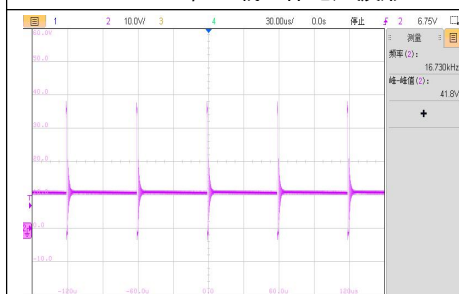
VIN=24V, 空载工作电压波形



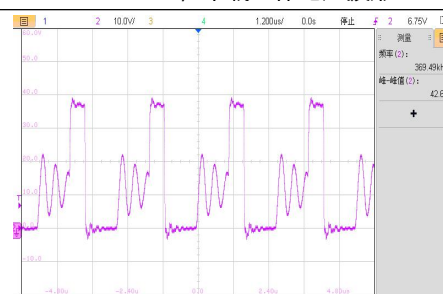
VIN=24V, 半载工作电压波形



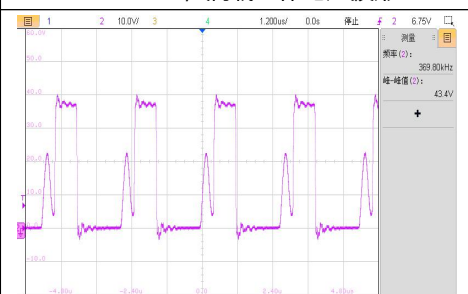
VIN=24V, 满载工作电压波形



VIN=36V, 空载工作电压波形



VIN=36V, 半载工作电压波形



VIN=36V, 满载工作电压波形

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