

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。

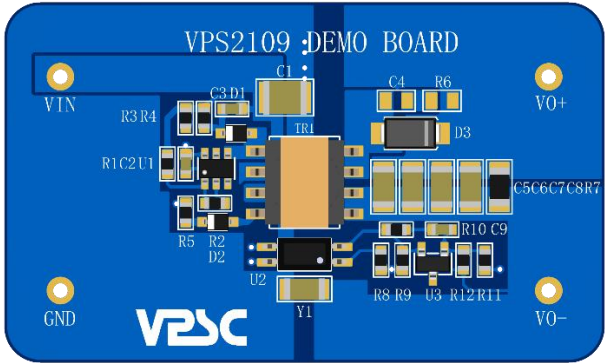
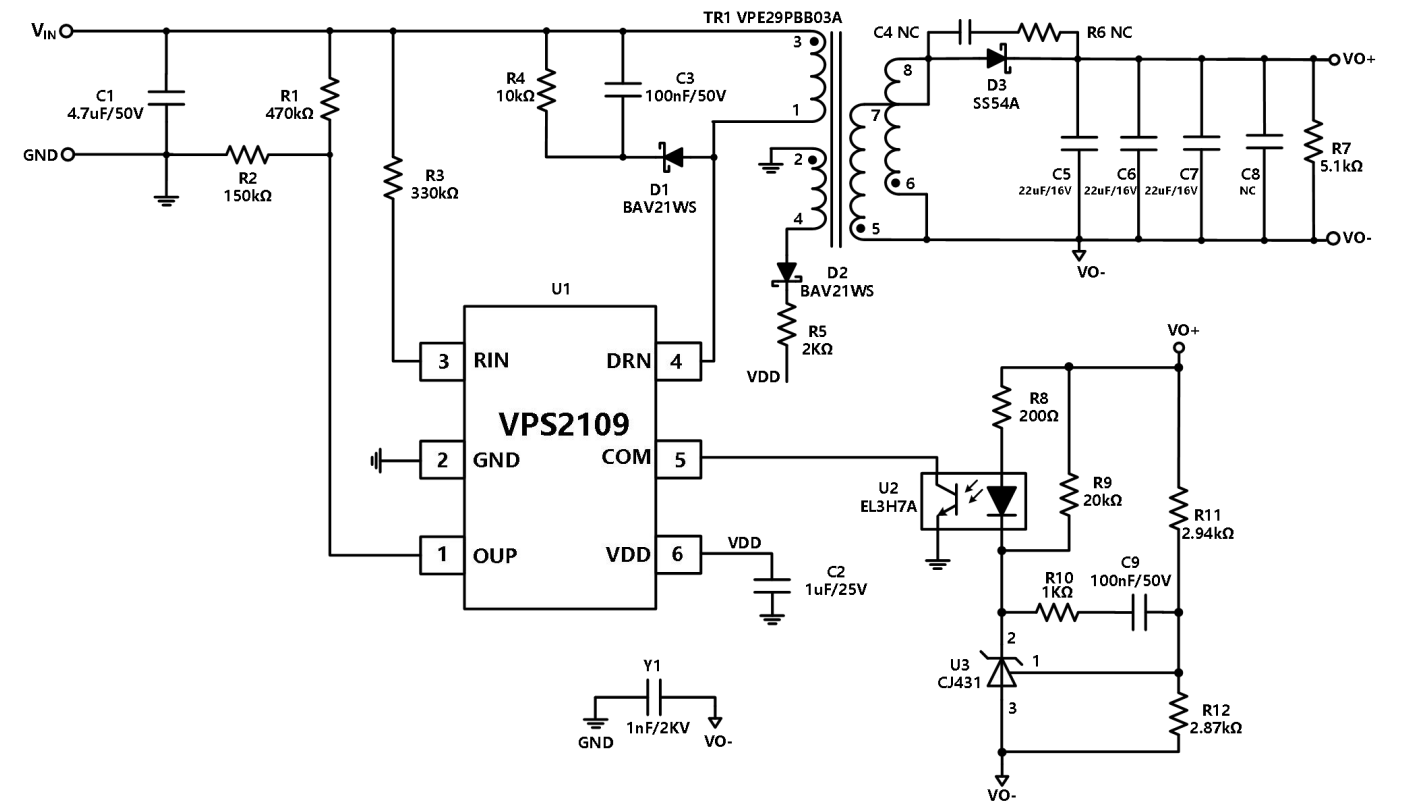


图 1: VPS2109 Demo 板(尺寸:50mm*30mm)

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

原理图



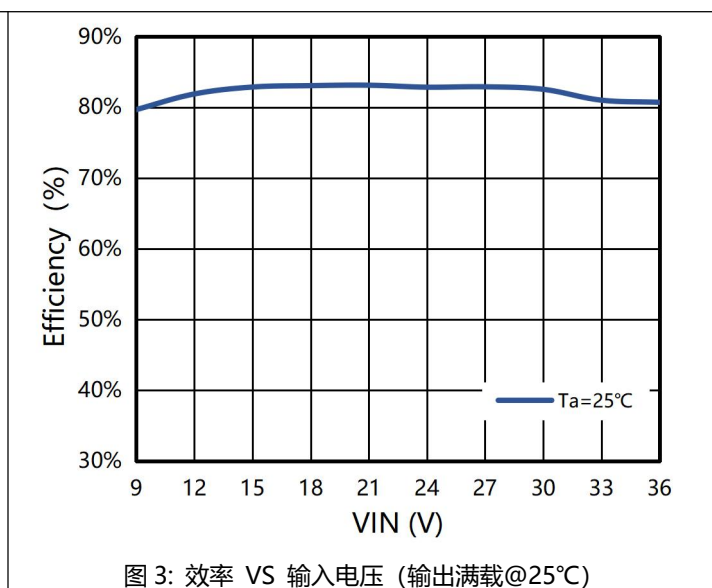
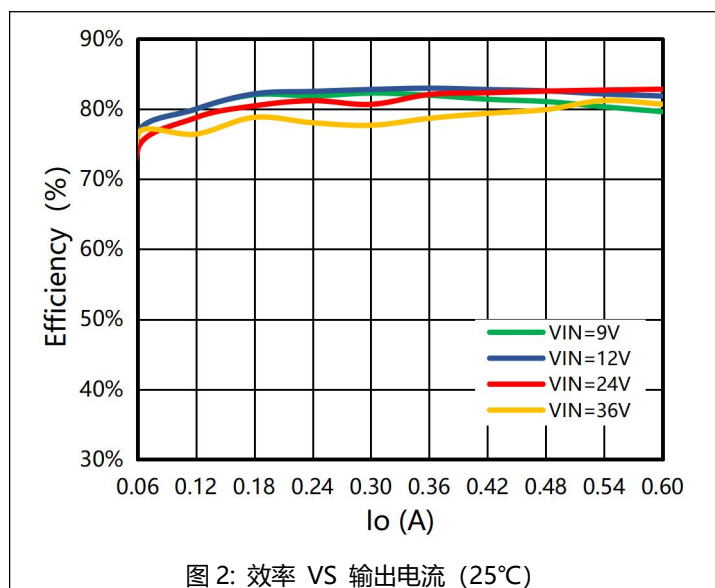
物料清单

位号	参数	封装	型号	品牌
C1	4.7uF/50V-X7R	1206	CC1206KKX7R9BB475	YAGEO
C2	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C3	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C4	NC	-	-	-
C5	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C6	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C7	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C8	NC	-	-	-
C9	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
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	10K Ω ±1%	0603	RC0603FR-0710KL	YAGEO
R5	2K Ω ±1%	0603	RC0603FR-072KL	YAGEO
R6	NC	-	-	-
R7	5.1K Ω ±1%	1206	RC1206FR-075K1L	YAGEO
R8	200 Ω ±1%	0603	RC0603FR-07200RL	YAGEO
R9	20K Ω ±1%	0603	RC0603FR-0720KL	YAGEO
R10	1K Ω ±1%	0603	RC0603FR-071KL	YAGEO
R11	2.94K Ω ±1%	0603	RC0603FR-072K94L	YAGEO
R12	2.87K Ω ±1%	0603	RC0603FR-072K87L	YAGEO
TR1	NP:NS:NA=14:9:21 Lp=15.68uH	ER7.5	VPE29PBB03A	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/0.4 Ω 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

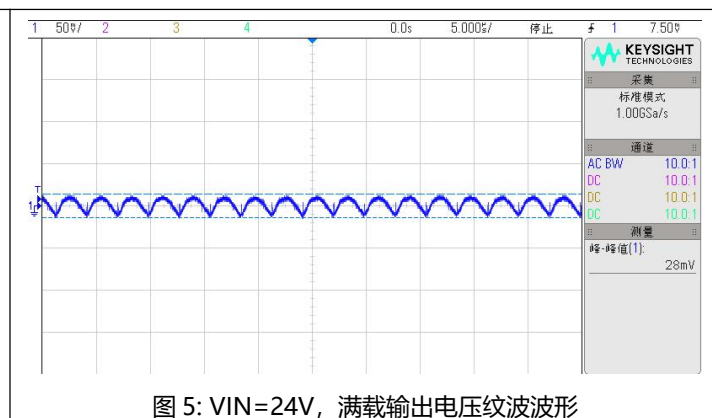
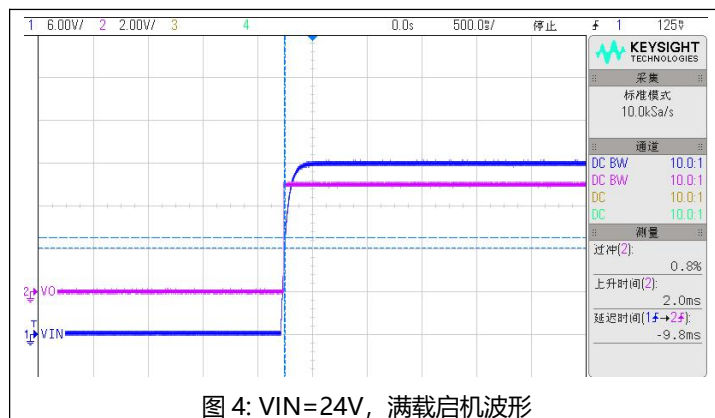
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流 (满载/空载)	VIN=24V	3	---	152	mA
转换效率	VIN=24V, IO=0.6A	---	82.8	---	%
纹波&噪声	VIN=24V, IO=0.6A	---	40	80	mV
输出电压精度	VIN=24V, IO=0.6A	---	0.1	---	%
线性调节率	VIN=9V-36V, IO=0.6A	---	0.1	---	%
负载调整率	VIN=24V, IO=0.6A	---	0.1	---	%
输出过流点系数	VIN=9V, IO=0.6A	---	1.56	---	倍
输入欠压保护	锁定电压	---	7.4	---	V
	恢复电压	---	8.4	---	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

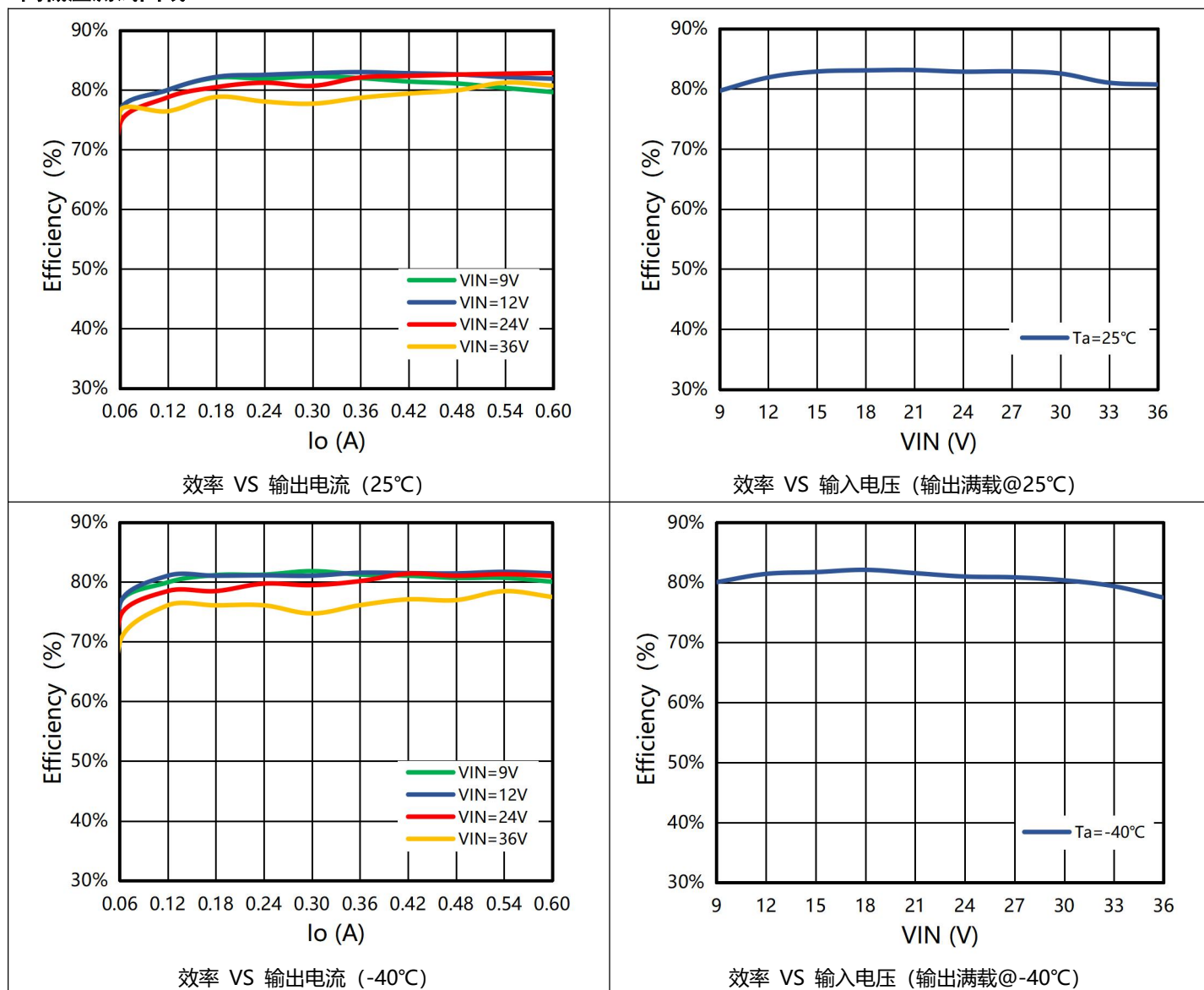


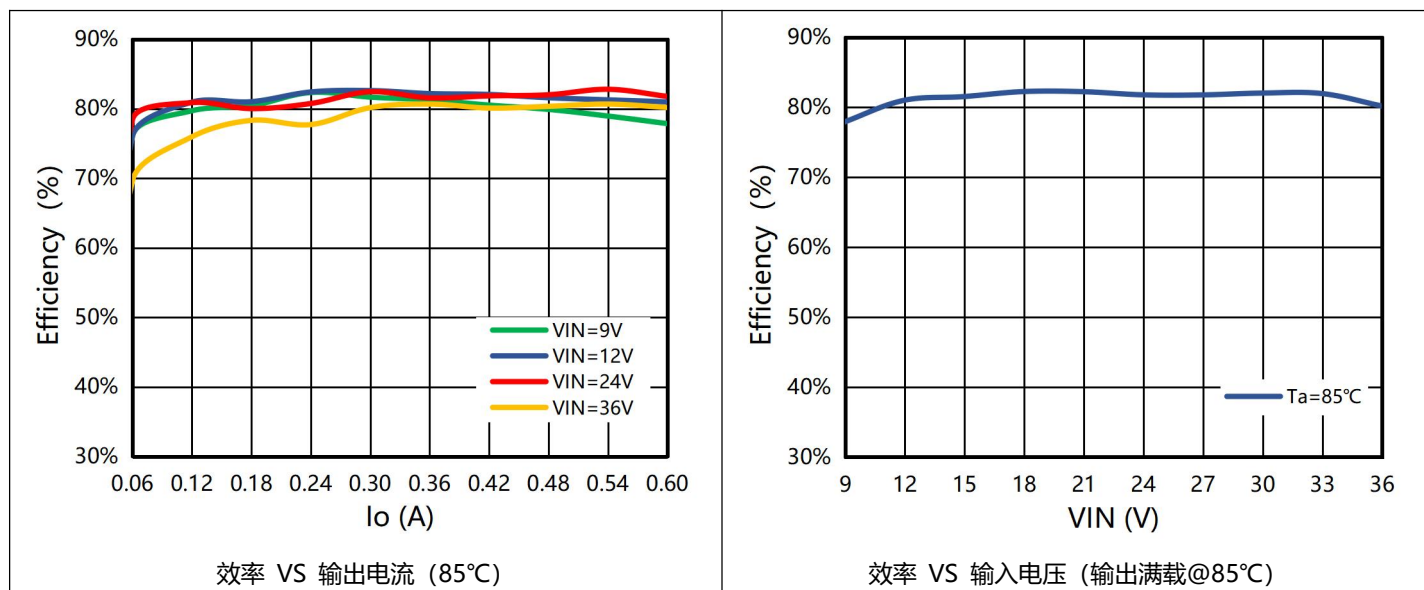
相关波形



详细测试数据

高低温测试曲线





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(%)
23.99	0.003	5.04	0	0%	0.00%
23.99	0.017	5.04	0.060	10%	74.15%
23.99	0.032	5.04	0.120	20%	78.78%
23.99	0.047	5.04	0.180	30%	80.46%
23.98	0.062	5.03	0.240	40%	81.20%
23.98	0.078	5.03	0.300	50%	80.68%
23.98	0.092	5.03	0.360	60%	82.08%
23.98	0.107	5.03	0.420	70%	82.33%
23.97	0.122	5.03	0.480	80%	82.56%
23.97	0.137	5.03	0.540	90%	82.71%
23.97	0.152	5.03	0.600	100%	82.83%

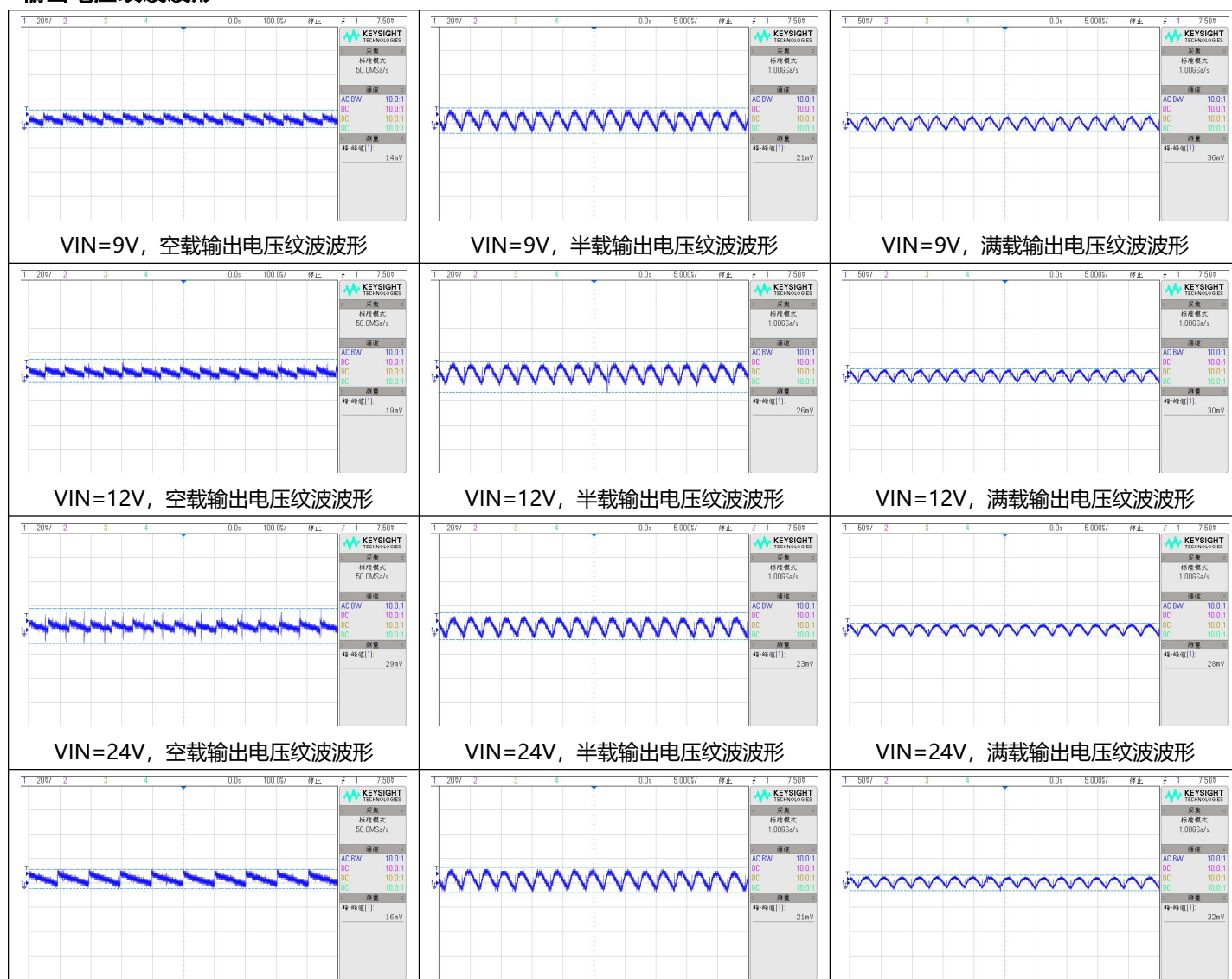
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.99	0.001	5.02	0	0%	0.00%
23.99	0.017	5.02	0.060	10%	73.85%
23.99	0.032	5.02	0.120	20%	78.47%
23.99	0.048	5.02	0.180	30%	78.47%
23.99	0.063	5.02	0.240	40%	79.72%
23.99	0.079	5.02	0.300	50%	79.46%
23.99	0.094	5.02	0.360	60%	80.14%
23.99	0.108	5.02	0.420	70%	81.38%
23.98	0.124	5.02	0.480	80%	81.04%
23.99	0.139	5.02	0.540	90%	81.29%
23.99	0.155	5.02	0.600	100%	81.00%

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(%)
23.99	0.001	5.01	0	0%	0.00%
23.97	0.016	5.01	0.060	10%	78.38%
23.98	0.031	5.01	0.120	20%	80.87%
23.98	0.047	5.01	0.180	24%	80.01%
23.97	0.062	5	0.240	40%	80.75%
23.99	0.076	5.01	0.300	50%	82.44%
23.99	0.092	5	0.360	60%	81.56%
23.98	0.107	5	0.420	70%	81.84%
23.99	0.122	5	0.480	80%	82.00%
23.98	0.136	5	0.540	90%	82.79%
23.98	0.153	5	0.600	100%	81.77%

输出电压纹波波形

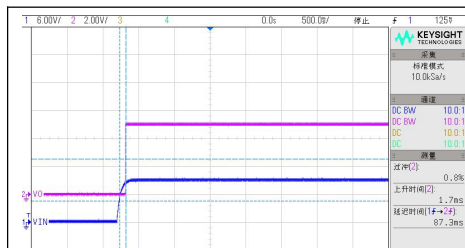


VIN=36V，空载输出电压纹波波形

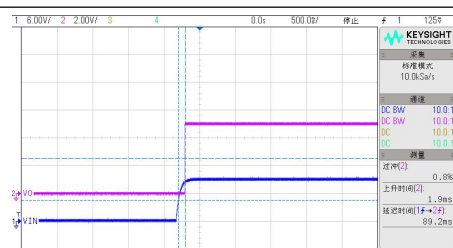
VIN=36V，半载输出电压纹波波形

VIN=36V，满载输出电压纹波波形

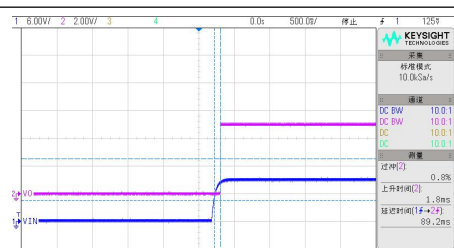
开关机波形



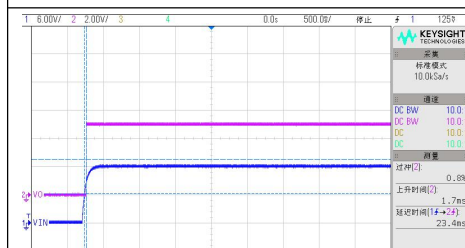
VIN=9V，空载启机波形



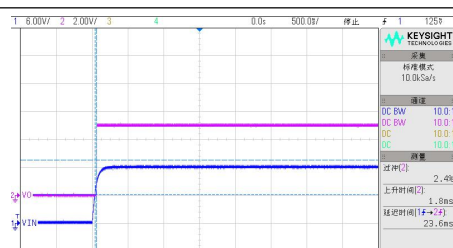
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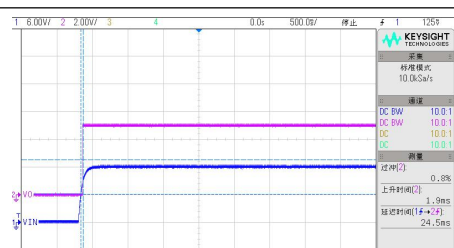
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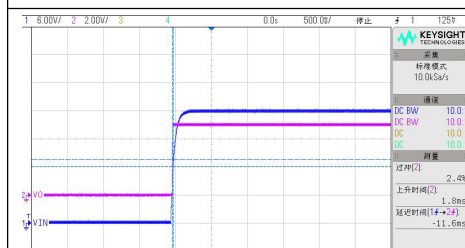
VIN=12V，空载启机波形



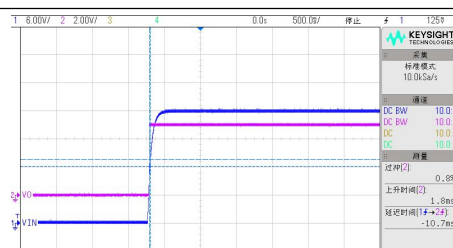
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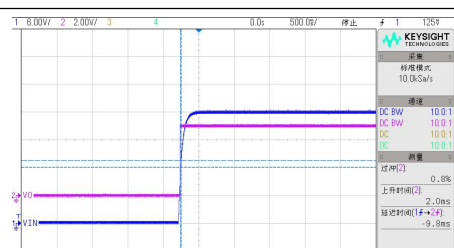
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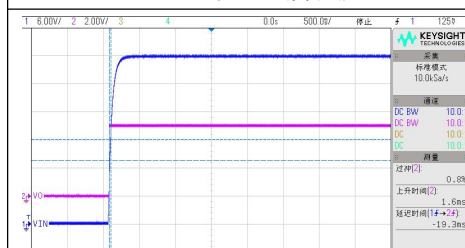
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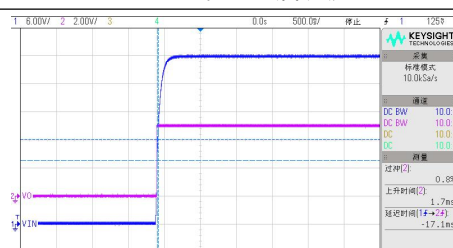
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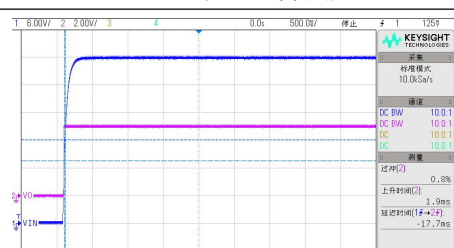
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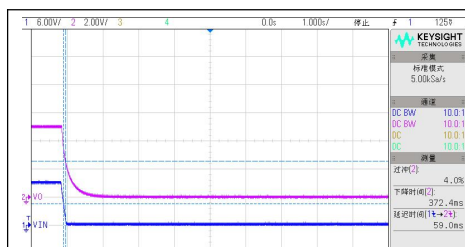
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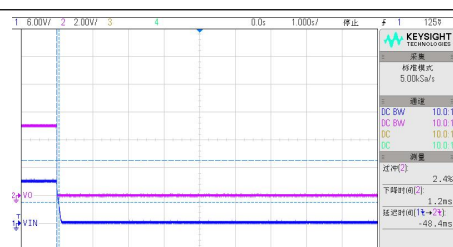
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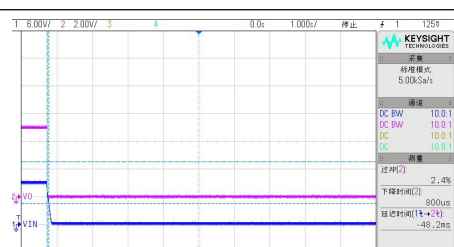
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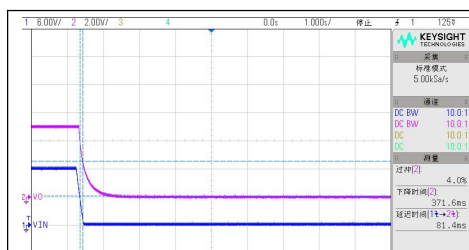
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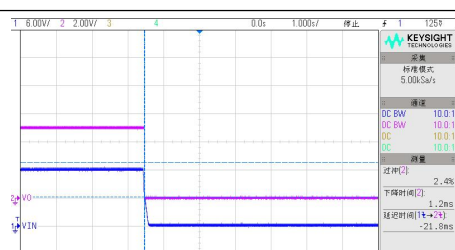
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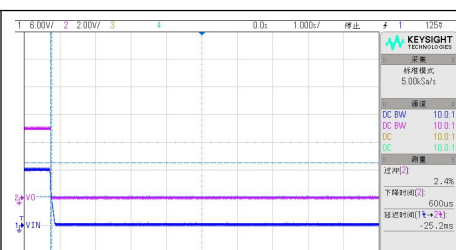
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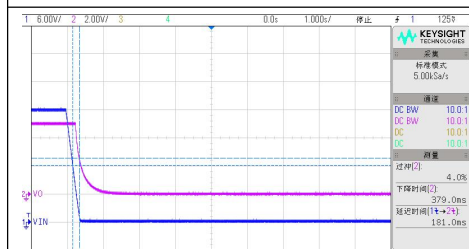
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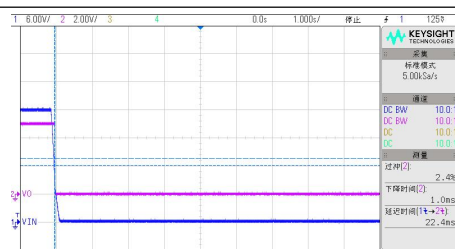
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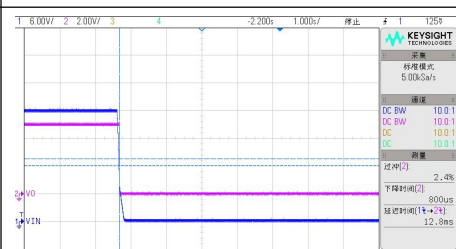
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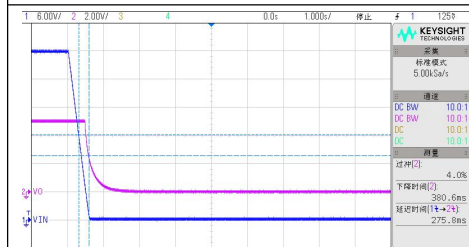
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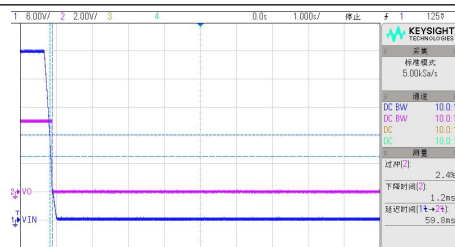
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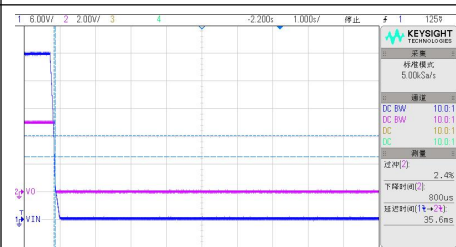
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VIN=36V, 空载关机波形

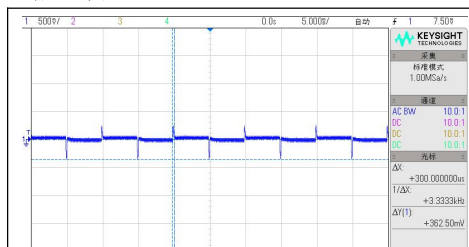


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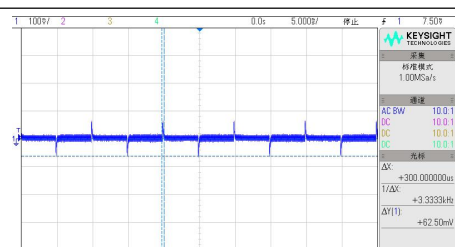


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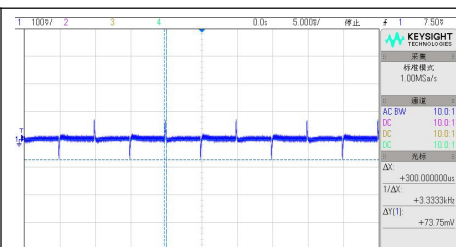
动态波形



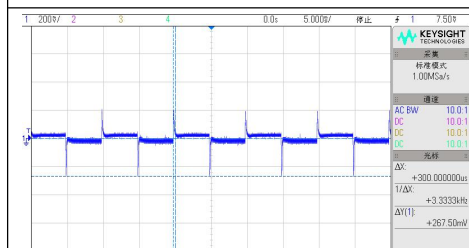
VIN=9V, 100%-10%-100%lo 动态波形



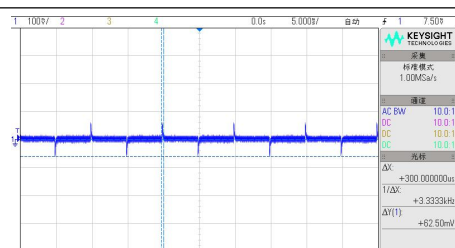
VIN=9V, 75%-50%-75%lo 动态波形



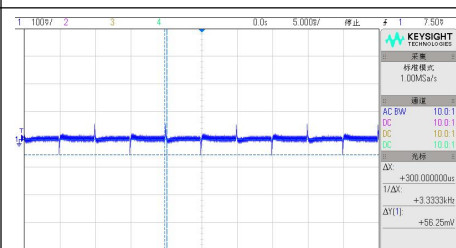
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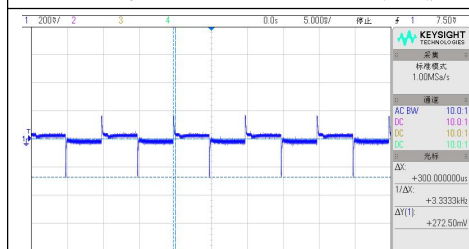
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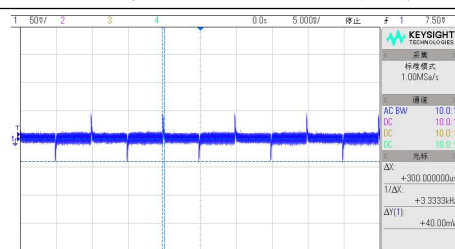
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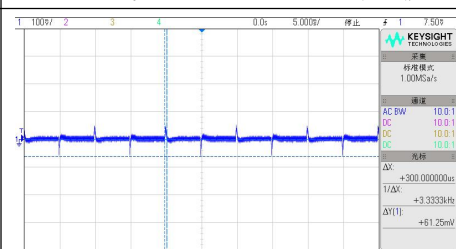
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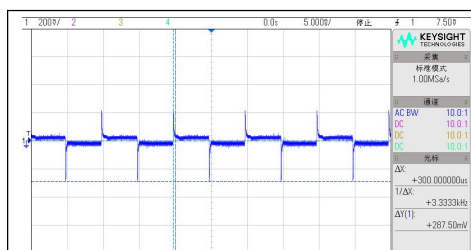
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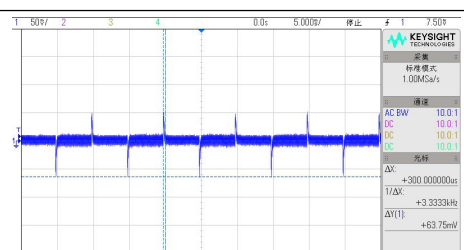
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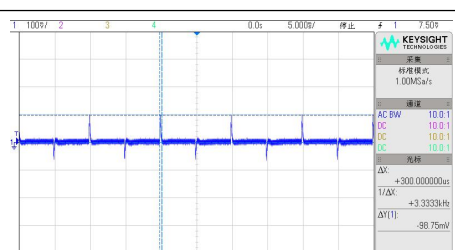
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VIN=36V, 100%-10%-100%Io 动态波形

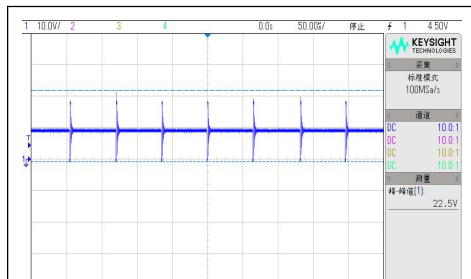


VIN=36V, 75%-50%-75%Io 动态波形

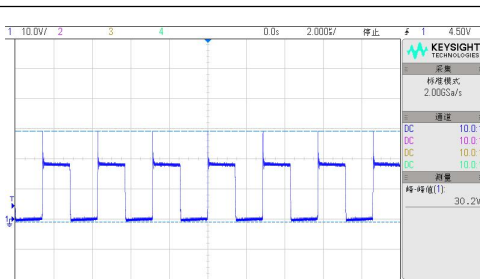


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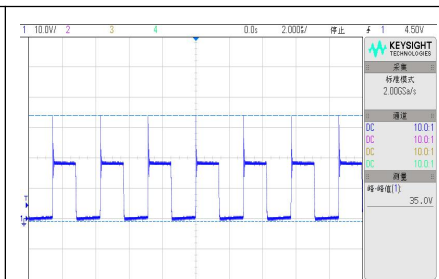
MOS 管电压应力波形



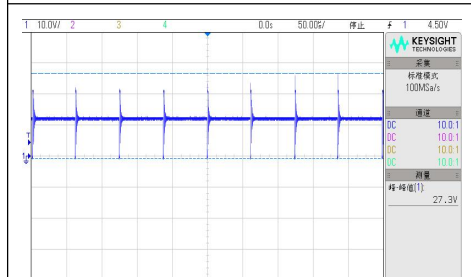
VIN=9V, 空载 VDS 波形



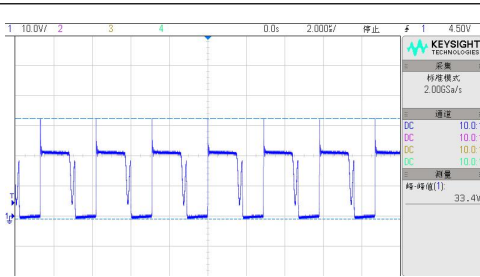
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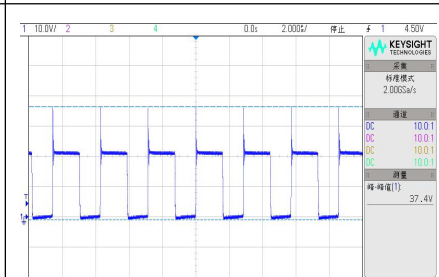
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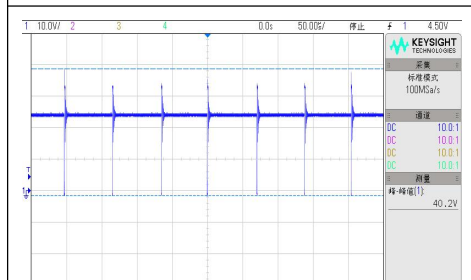
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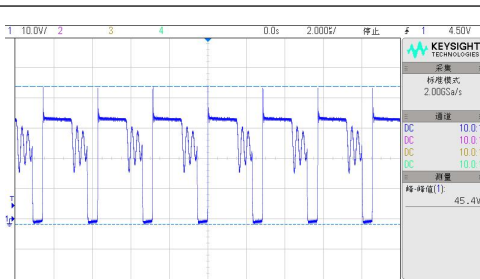
VIN=12V, 半载 VDS 波形



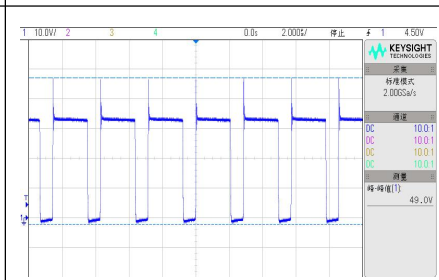
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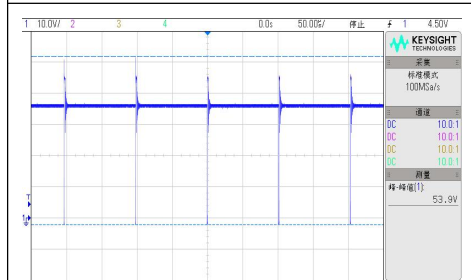
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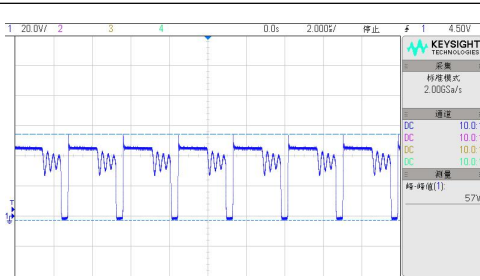
VIN=24V, 半载 VDS 波形



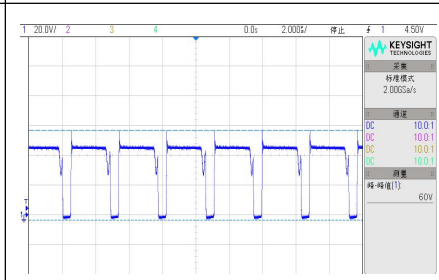
VIN=24V, 满载 VDS 波形



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 D3 应力波形



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