

方案简介

本应用方案基于一款高集成度的电流型反激式电源控制器 VPC2187B，结合隔离功率变压器、输出整流二极管以及必要的阻容元件，实现 9V-36V 输入，18V 输出 23.4W 的隔离稳压电源方案，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。

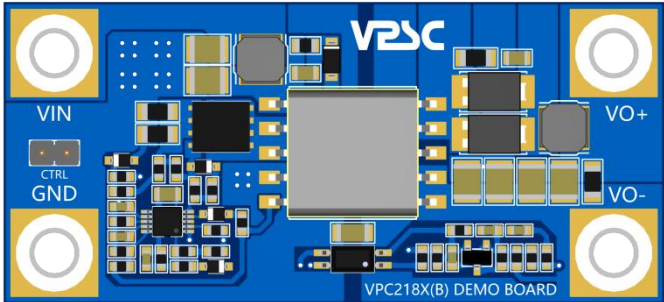


图 1: VPC2187B Demo 板(尺寸:67.5mm*30.7mm)

关键词：输入：9V-36V，输出 18V/23.4W，隔离电压：1500VDC，反馈方式：副边反馈-SSR，开关频率：330kHz

原理图

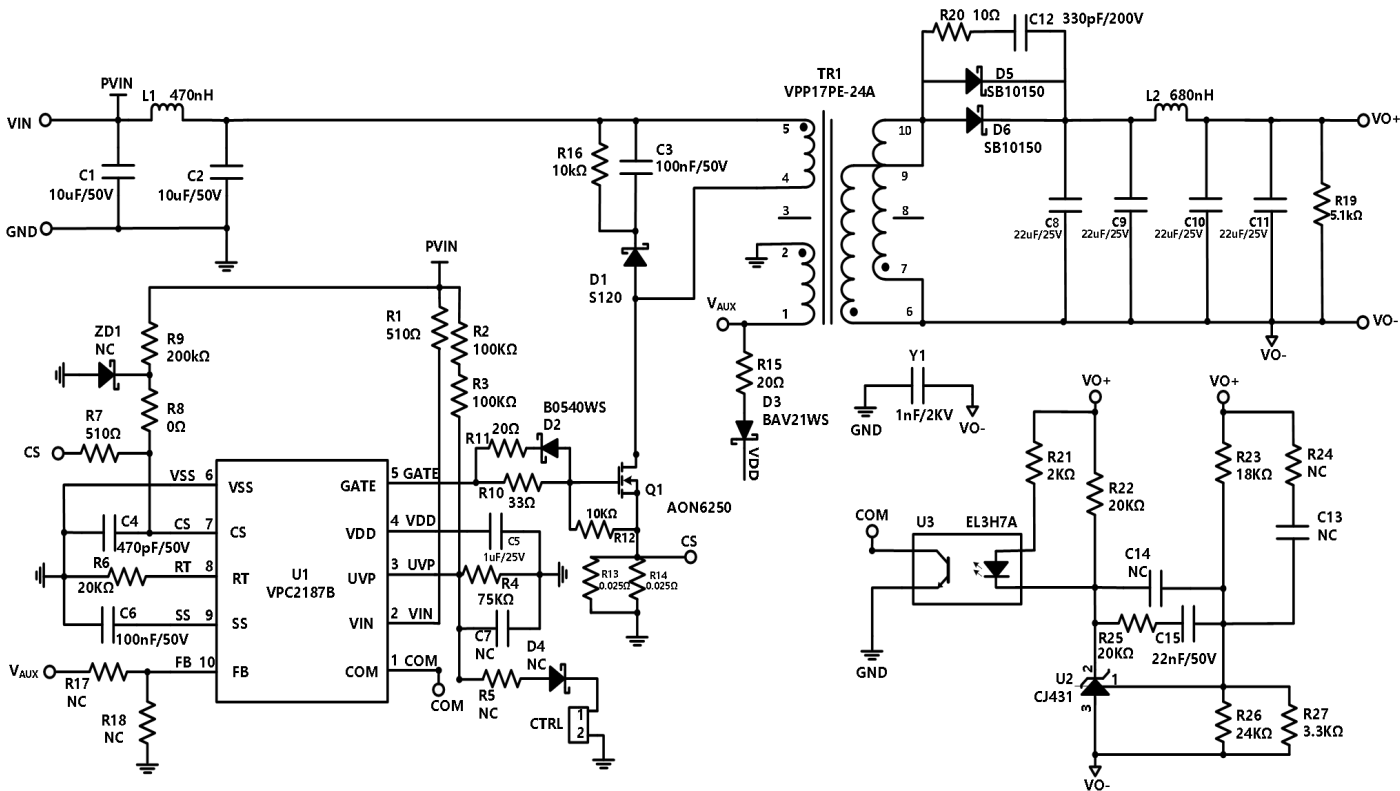


图 2: VP2187B 18V/23.4W 原理图

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	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C3	100nF/50V-X7R	0805	CC0805KRX7R9BB104	YAGEO
C4	470pF/50V-X7R	0603	CC0603KRX7R9BB474	YAGEO
C5	1uF/25V-X7R	0805	CC0805KKX7R8BB105	YAGEO
C6	100nF/25V-X7R	0603	CC0603KKX7R0BB104	YAGEO
C7	NC	-	-	-
C8	22uF/25V-X5R	1206	CC1206KKX5R8BB226	YAGEO
C9	22uF/25V-X5R	1206	CC1206KKX5R8BB226	YAGEO
C10	22uF/25V-X5R	1206	CC1206KKX5R8BB226	YAGEO
C11	22uF/25V-X5R	1206	CC1206KKX5R8BB226	YAGEO
C12	330pF/200V- NP0	0805	CC0805JRNPOABN331	YAGEO
C13	NC	-	-	-
C14	NC	-	-	-
C15	22nF/50V-X7R	0603	CC0603KRX7R9BB223	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R2	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R3	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R4	75KΩ±1%	0603	RC0603FR-0775KL	YAGEO
R5	NC	-	-	-
R6	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R7	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R8	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R9	200KΩ±1%	0603	RC0603FR-07200KL	YAGEO
R10	33Ω±1%	0603	RC0603FR-0733RL	YAGEO
R11	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R12	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R13	0.025Ω ±1%	1206	RL1206FR-070R025L	YAGEO
R14	0.025Ω ±1%	1206	RL1206FR-070R025L	YAGEO
R15	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R16	10KΩ±1%	0805	RC0805FR-0710KL	YAGEO
R17	NC	-	-	-
R18	NC	-	-	-
R19	5.1KΩ±1%	1206	RC1206FR-075K1L	YAGEO
R20	10Ω±1%	1206	RC1206FR-0710RL	YAGEO
R21	2KΩ±1%	0603	RC0603FR-072KL	YAGEO
R22	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R23	18KΩ±1%	0603	RC0603FR-0718KL	YAGEO
R24	NC	-	-	-

R25	20K Ω ±1%	0603	RC0603FR-0720KL	YAGEO
R26	24K Ω ±1%	0603	RC0603FR-0724KL	YAGEO
R27	3.3K Ω ±1%	0603	RC0603FR-073K3L	YAGEO
TR1	NP:NS:NA=9:12:8 Lp=8.1uH	EPD13	VPP17PE-24A	VPSC
Q1	N 沟道 150V 52A	DFN-8(5.8x4.9)	AON6250	AOS
L1	470nH ±30%	SMD	SWPA5020SR47NT	SUNLORD
L2	680nH ±20%	SMD	MWSA0503S-R68MT	SUNLORD
D1	200V/1A	SOD-123	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	YANGJIE
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	NC	-	-	-
D5	150V/10A	TO-277	SB10150	GOODWORK
D6	150V/10A	TO-277	SB10150	GOODWORK
ZD1	NC	-	-	-
U1	4-100VIN 电源管理芯片	MSOP-10	VPC2187B	VPSC
U2	Vref=2.495V	SOT23-3	CJ431	CJ
U3	CTR=80~160, Viso=3750VAC	SSOP-4	EL3H7A	EVERLIGHT

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	17	---	1085	mA
转换效率	VIN=24V, IO=1.3A	---	89.98	---	%
纹波&噪声	VIN=24V, IO=1.3A	---	30	140	mV
输出电压精度	VIN=24V, IO=1.3A	---	0.4	---	%
线性调节率	VIN=9V-36V, IO=1.3A	---	0.2	---	%
负载调整率	VIN=24V, IO=1.3A	---	0.2	---	%
输出过流点系数	VIN=9V, IO=1.3A	---	1.69	---	倍
输入欠压保护	锁定电压	---	7.3	---	V
	恢复电压	---	8.2	---	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

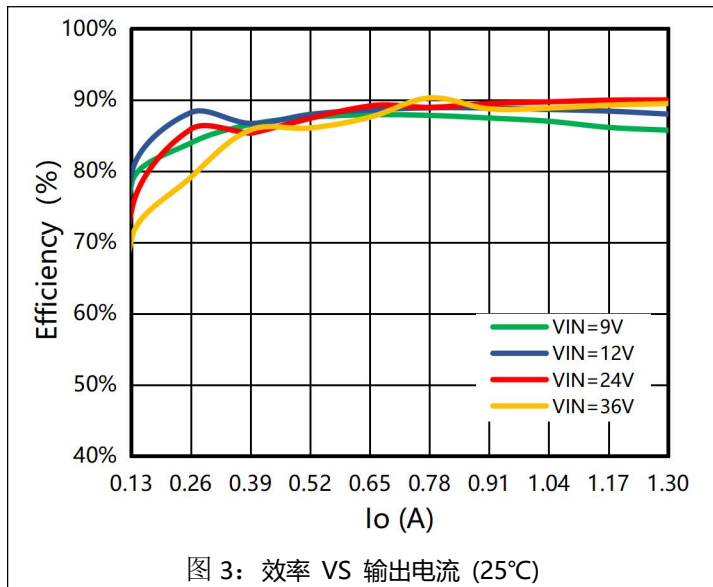


图 3: 效率 VS 输出电流 (25°C)

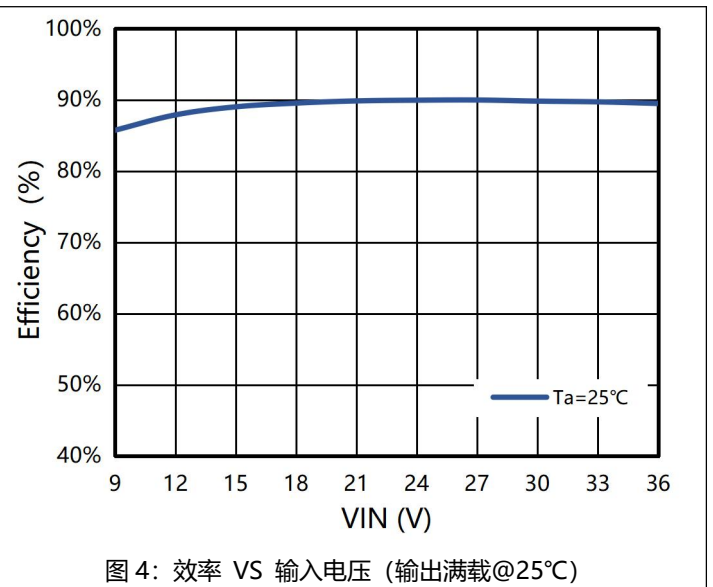


图 4: 效率 VS 输入电压 (输出满载@25°C)

相关波形

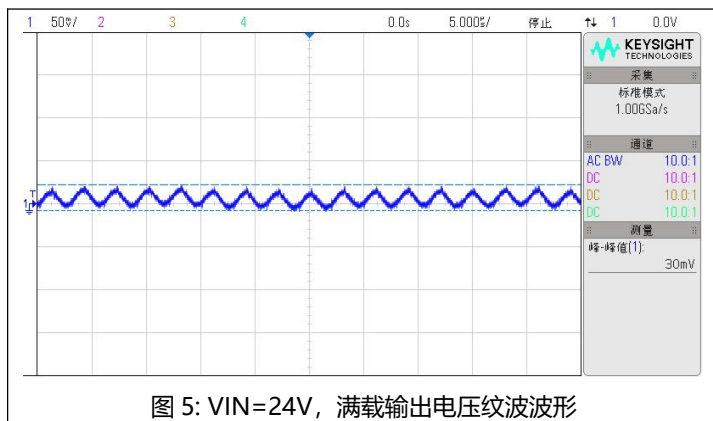


图 5: VIN=24V, 满载输出电压纹波波形

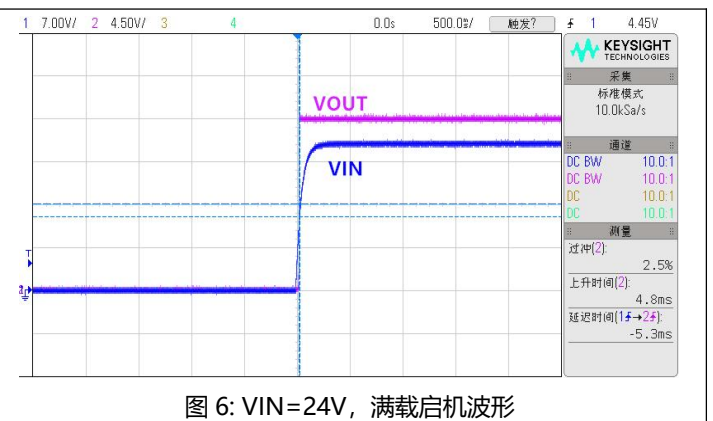
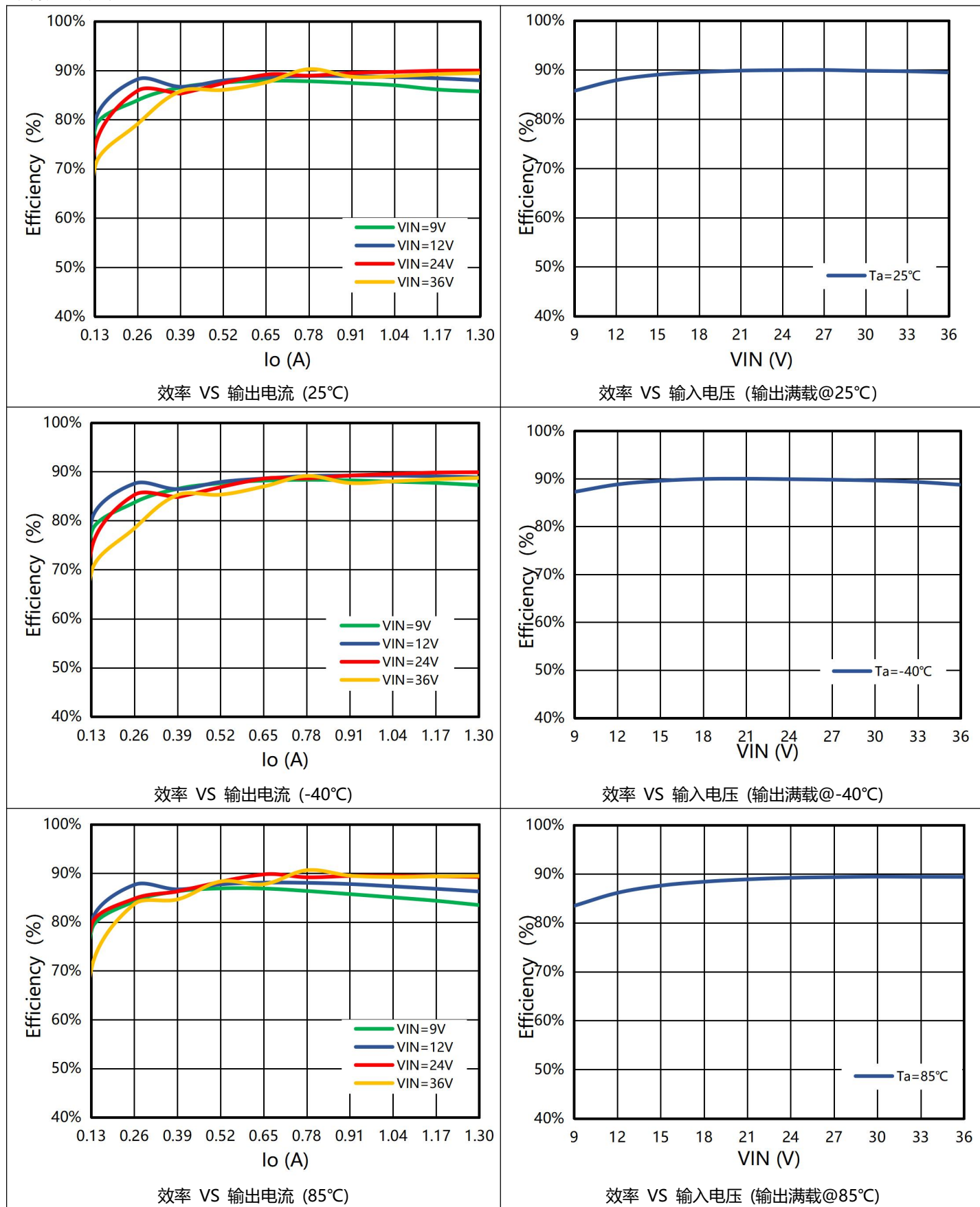


图 6: VIN=24V, 满载启机波形

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	0.017	18.02	0	0%	0.00%
24	0.132	18.02	0.131	10%	74.51%
24	0.228	18.01	0.261	20%	85.90%
24	0.344	18.01	0.391	30%	85.29%
24	0.344	18.01	0.391	40%	85.29%
24	0.548	18.01	0.651	50%	89.15%
24	0.659	18.01	0.781	60%	88.93%
24	0.764	18.01	0.911	70%	89.48%
24	0.870	18.01	1.040	80%	89.70%
24	0.977	18.01	1.171	90%	89.94%
24	1.085	18.01	1.301	100%	89.98%

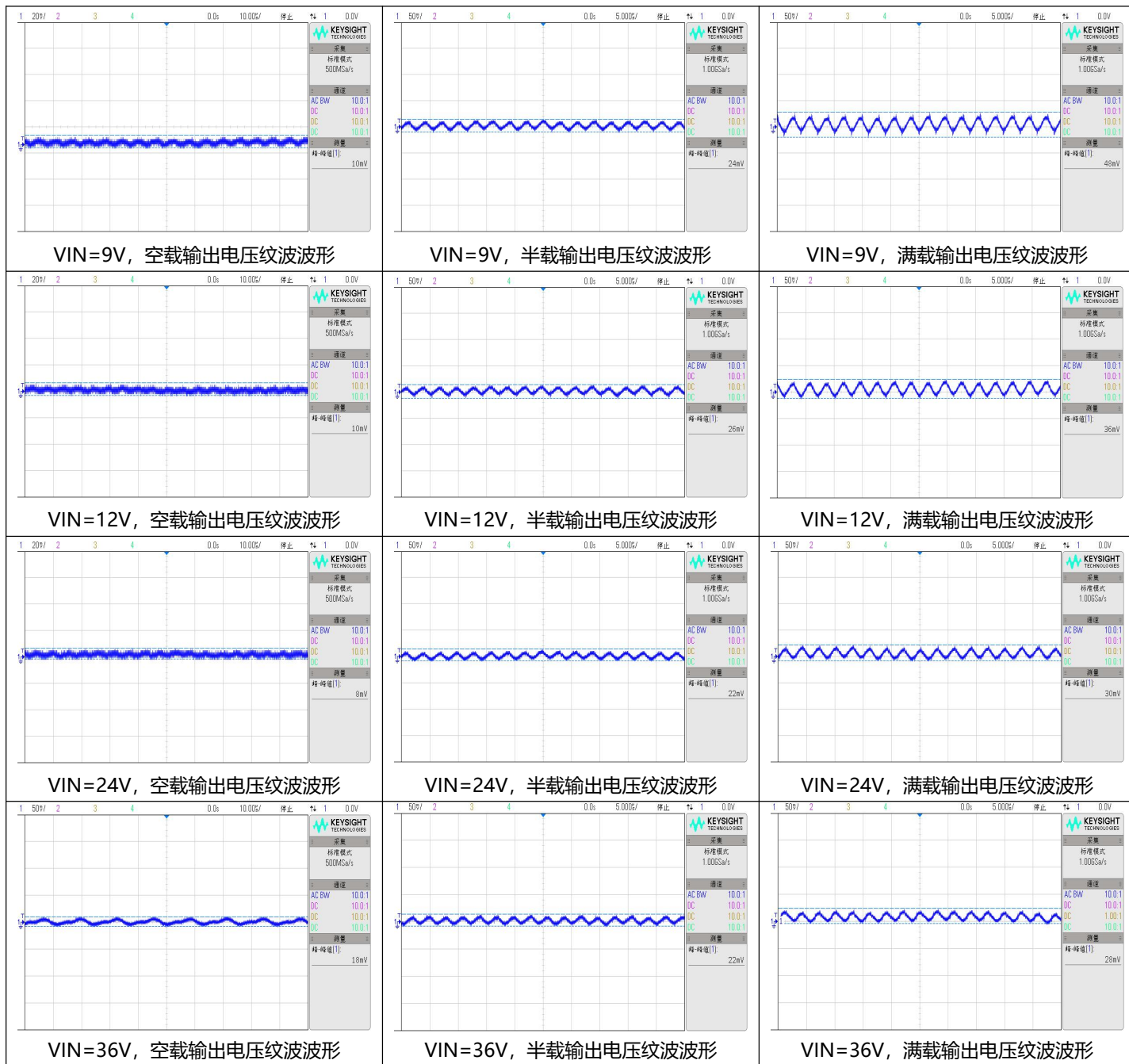
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.99	0.016	17.97	0	0%	0.00%
24	0.132	17.96	0.131	10%	74.27%
24	0.229	17.96	0.261	20%	85.29%
24	0.345	17.96	0.391	30%	84.81%
24	0.345	17.96	0.391	40%	84.81%
24	0.550	17.96	0.651	50%	88.58%
23.87	0.663	17.96	0.781	60%	88.63%
23.91	0.767	17.96	0.911	70%	89.22%
23.95	0.871	17.96	1.040	80%	89.54%
23.97	0.976	17.96	1.170	90%	89.82%
23.97	1.083	17.95	1.300	100%	89.89%

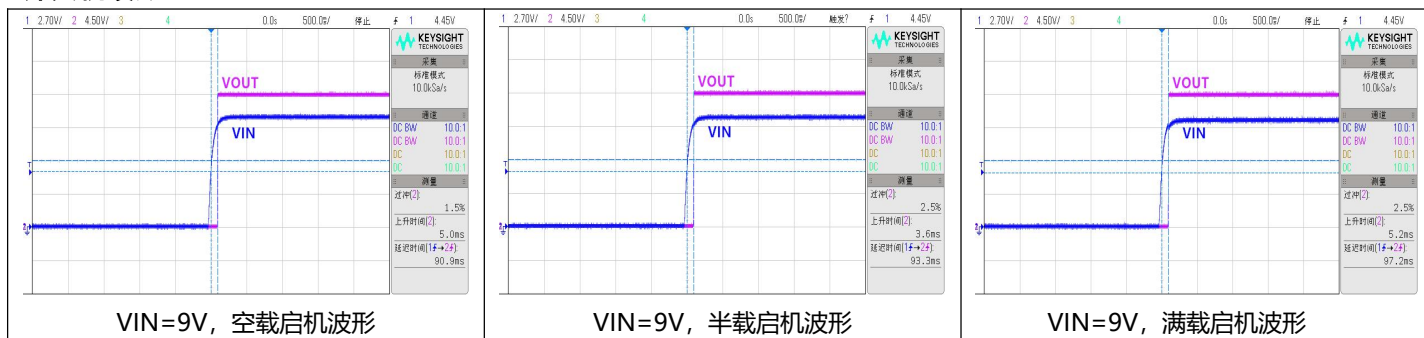
VIN=24V, Ta=85°C, 输入、输出及效率数据:

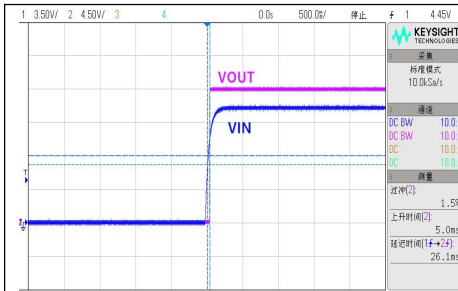
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.99	0.018	18.01	0	0%	0.00%
24	0.124	18.01	0.131	10%	79.28%
24	0.231	18.01	0.261	20%	84.79%
24	0.340	18	0.391	30%	86.25%
24	0.340	18.01	0.391	40%	86.30%
24	0.544	18	0.651	50%	89.75%
24	0.657	18	0.781	60%	89.16%
24	0.764	18	0.911	70%	89.43%
24	0.872	18	1.040	80%	89.45%
24	0.982	18	1.170	90%	89.36%
24	1.092	17.99	1.300	100%	89.24%

输出电压纹波波形

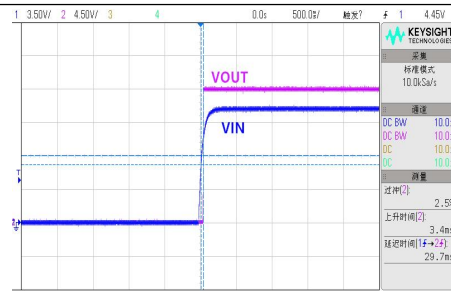


开关机波形

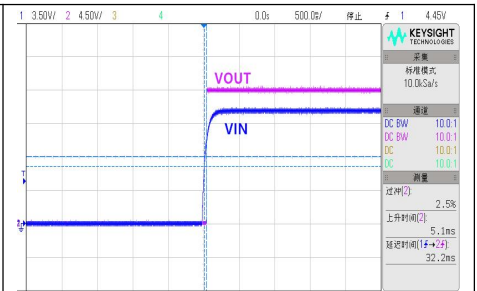




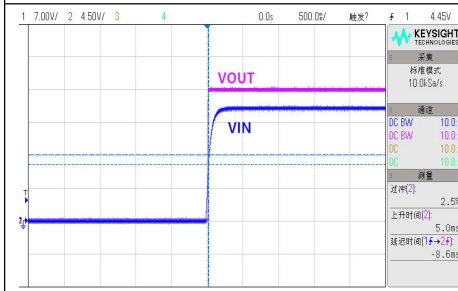
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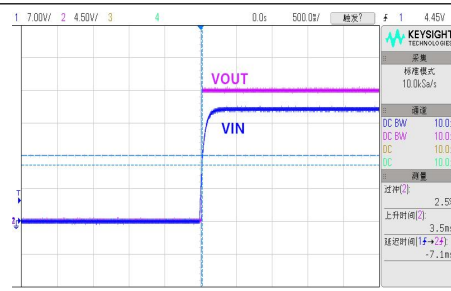
VIN=12V, 半载启机波形



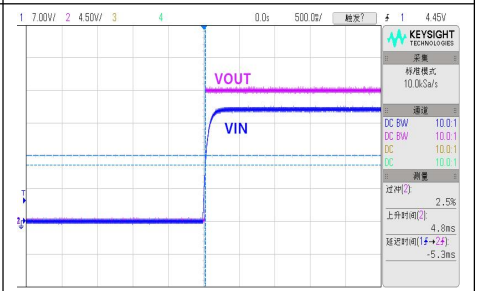
VIN=12V, 满载启机波形



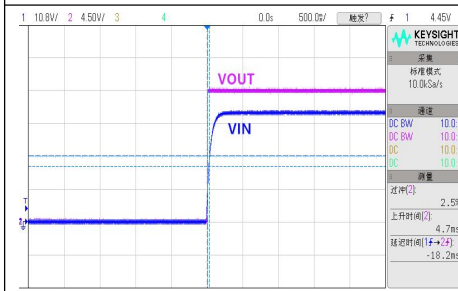
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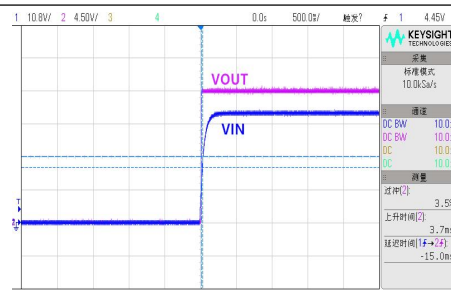
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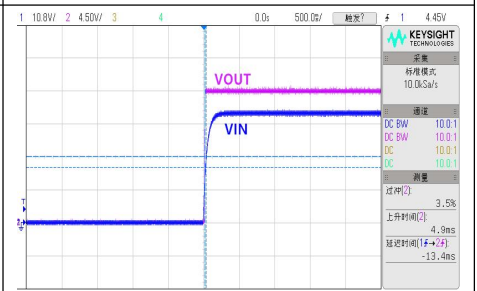
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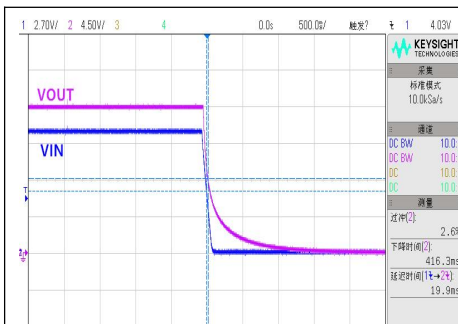
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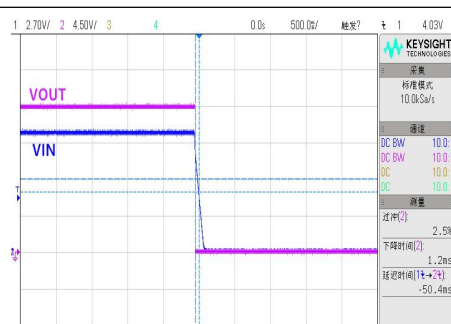
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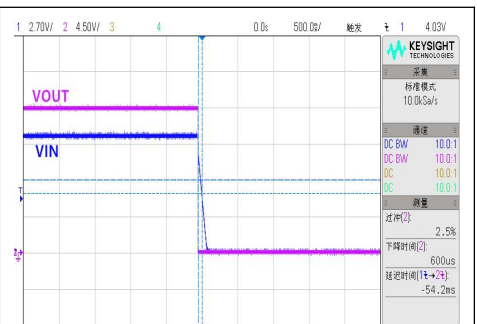
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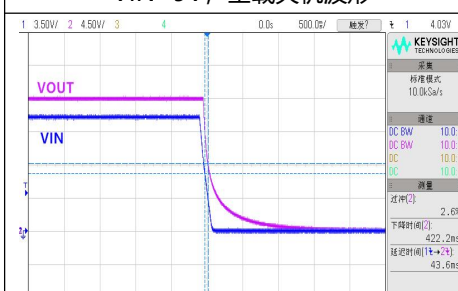
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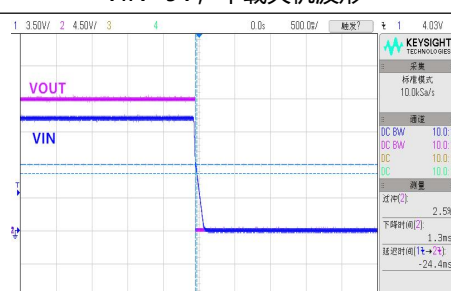
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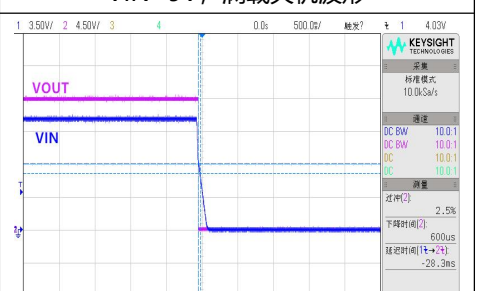
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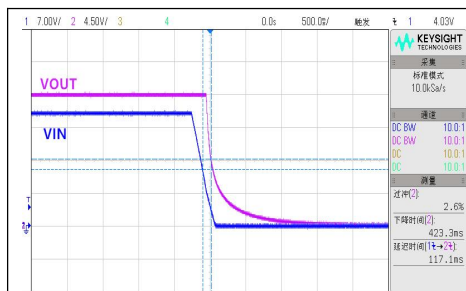
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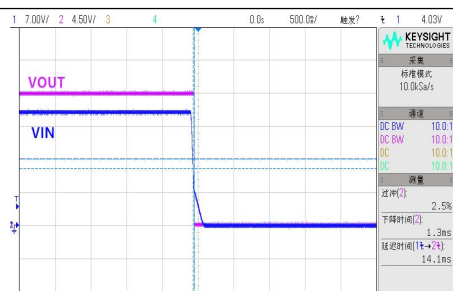
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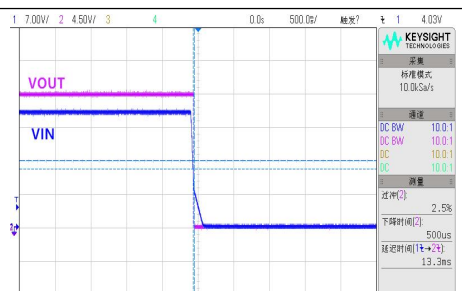
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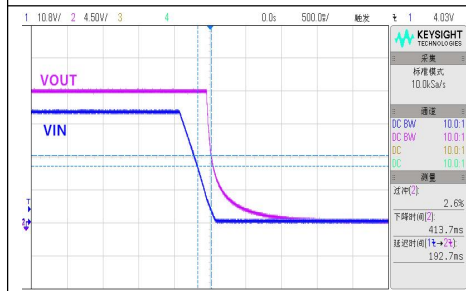
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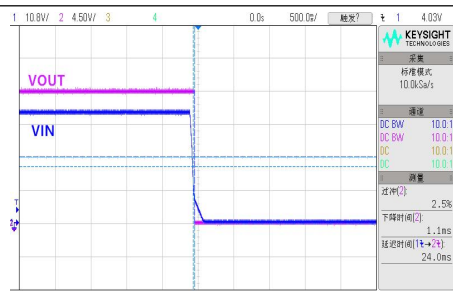
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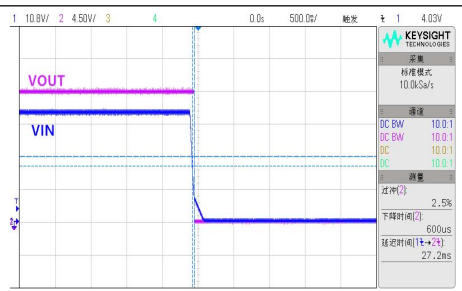
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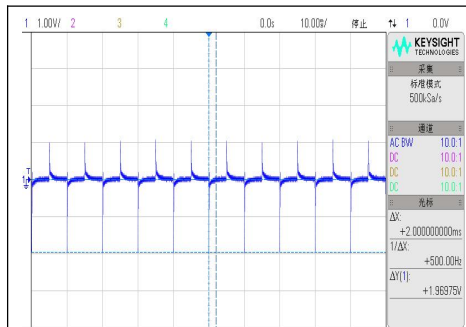


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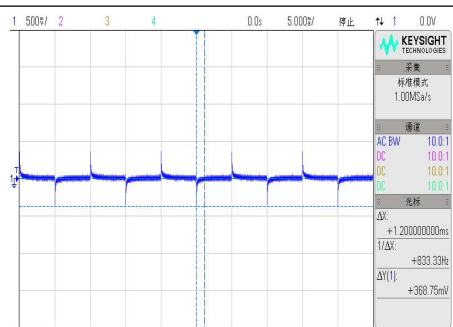


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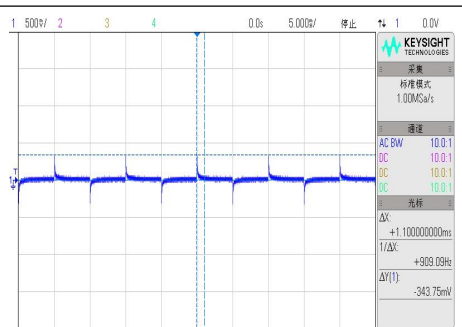
动态波形



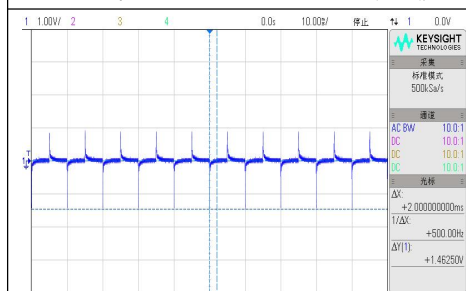
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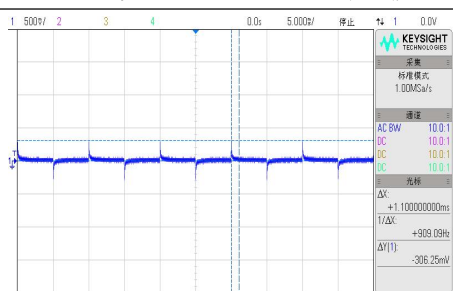
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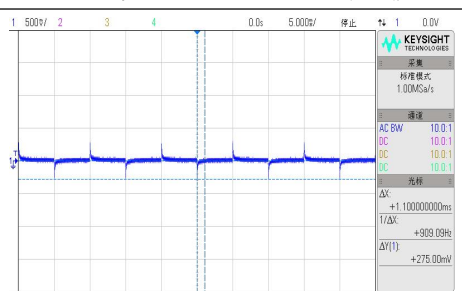
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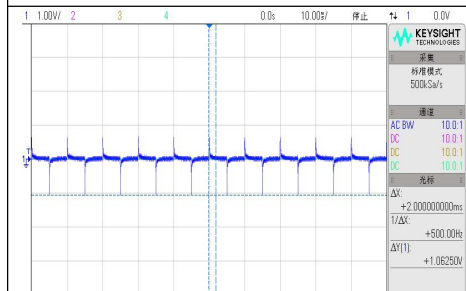
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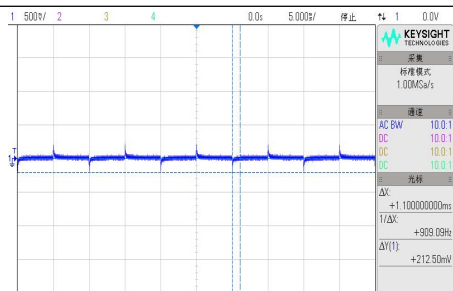
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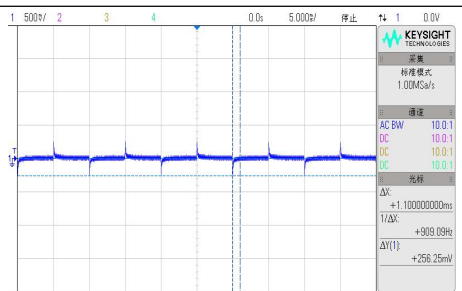
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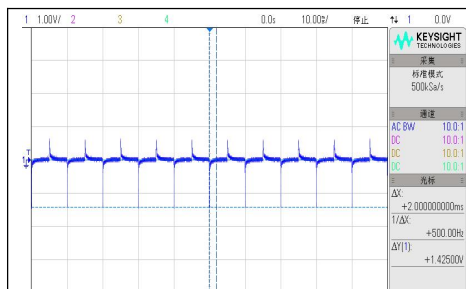
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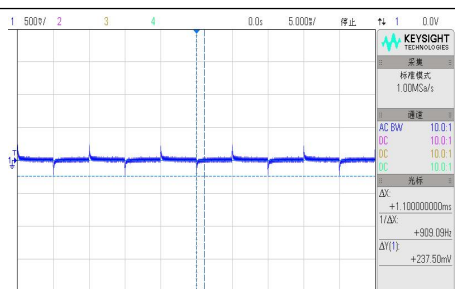
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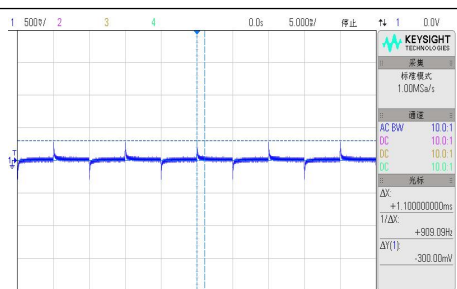
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VIN=36V, 100%-10%-100%Io 动态波形

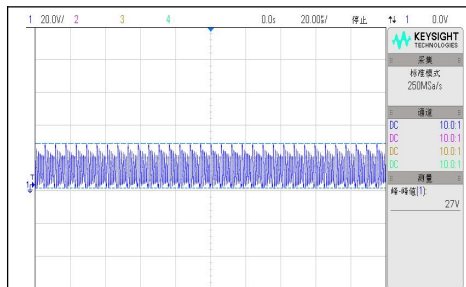


VIN=36V, 75%-50%-75%Io 动态波形

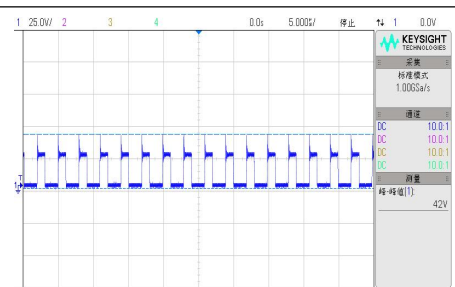


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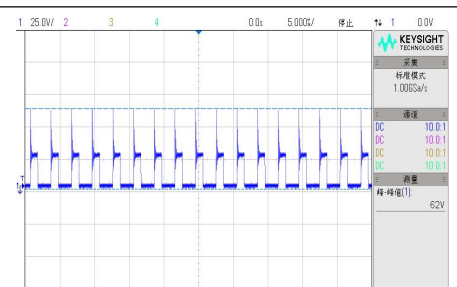
外置 MOS 管 Q1 电压应力波形



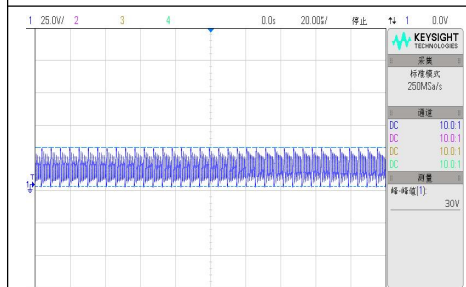
VIN=9V, 空载 VDS 波形



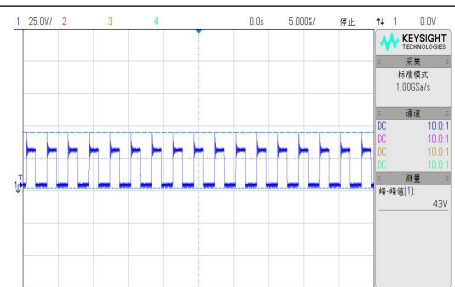
VIN=9V, 半载 VDS 波形



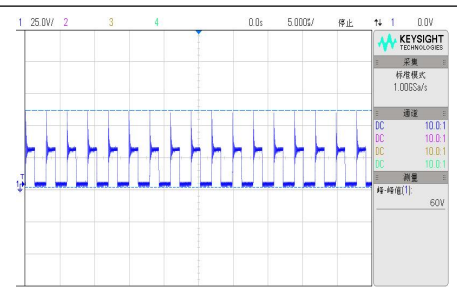
VIN=9V, 满载 VDS 波形



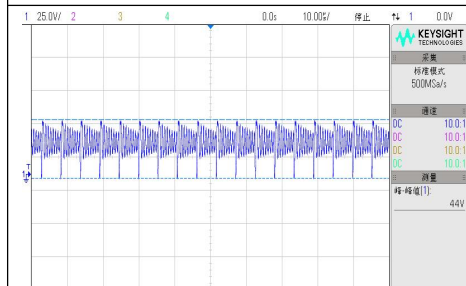
VIN=12V, 空载 VDS 波形



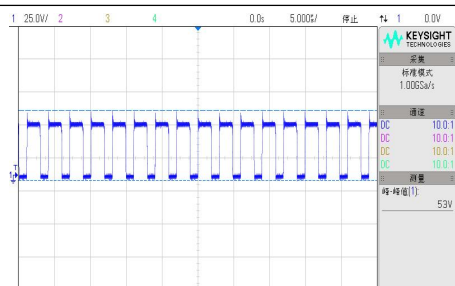
VIN=12V, 半载 VDS 波形



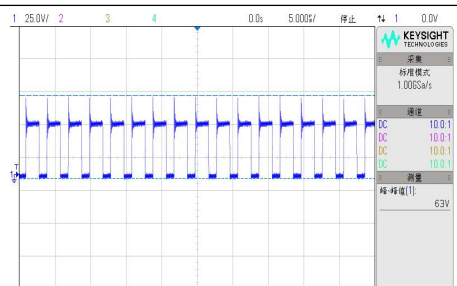
VIN=12V, 满载 VDS 波形



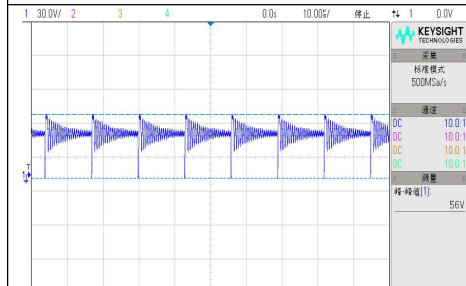
VIN=24V, 空载 VDS 波形



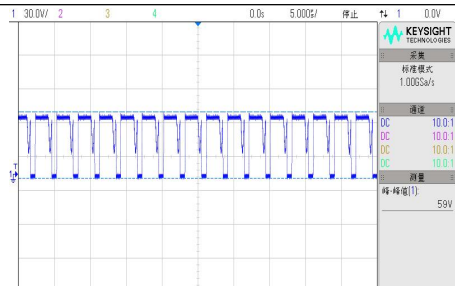
VIN=24V, 半载 VDS 波形



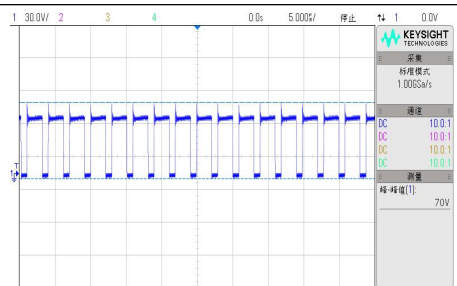
VIN=24V, 满载 VDS 波形



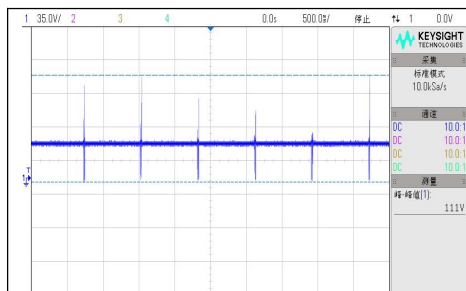
VIN=36V, 空载 VDS 波形



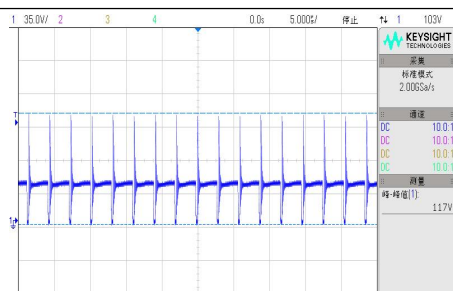
VIN=36V, 半载 VDS 波形



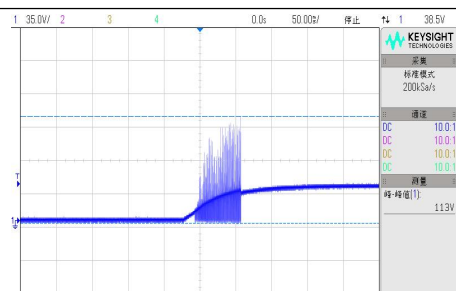
VIN=36V, 满载 VDS 波形



VIN=36V, 短路保护 VDS 波形

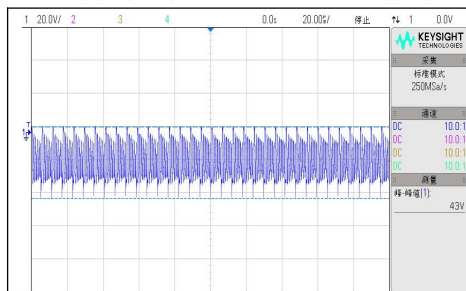


VIN=36V, 短路保护 VDS 展开波形

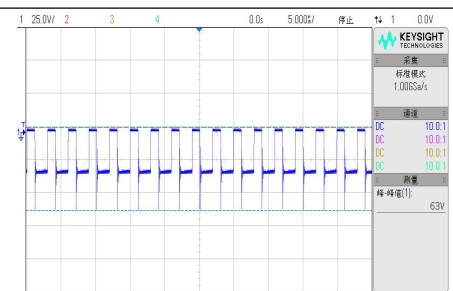


VIN=36V, 短路保护 VDS 启机波形

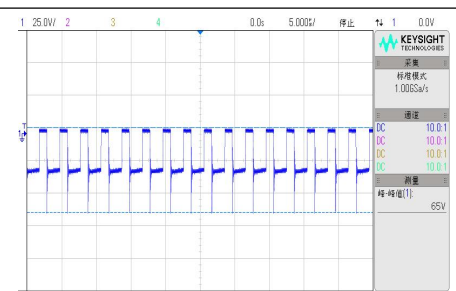
副边输出整流二极管 D4/D5 应力波形



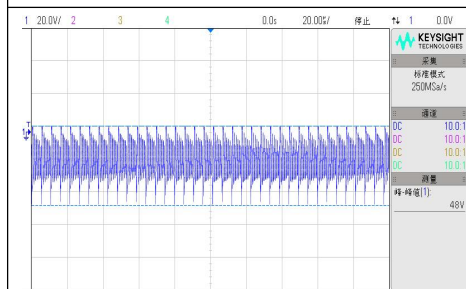
VIN=9V, D4 空载工作电压波形



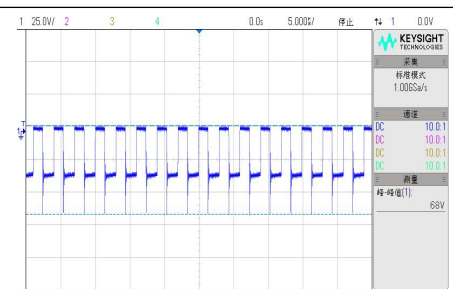
VIN=9V, D4 半载工作电压波形



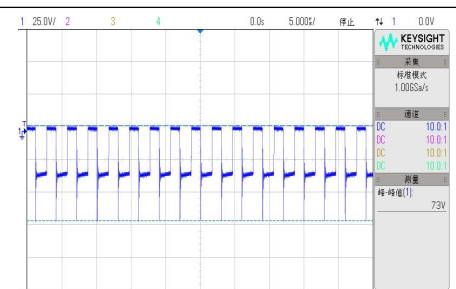
VIN=9V, D4 满载工作电压波形



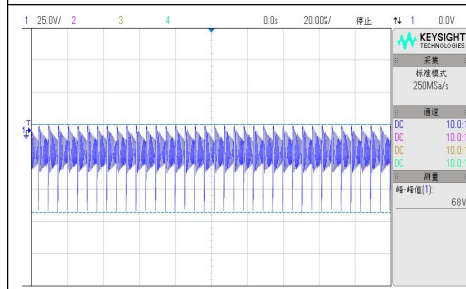
VIN=12V, D4 空载工作电压波形



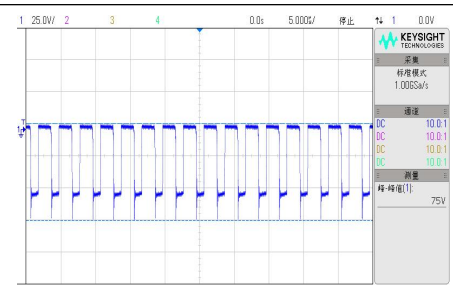
VIN=12V, D4 半载工作电压波形



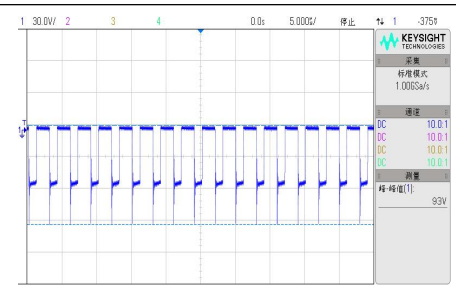
VIN=12V, D4 满载工作电压波形



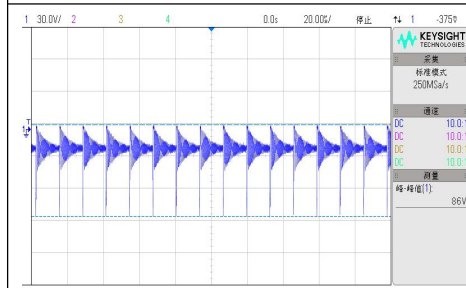
VIN=24V, D4 空载工作电压波形



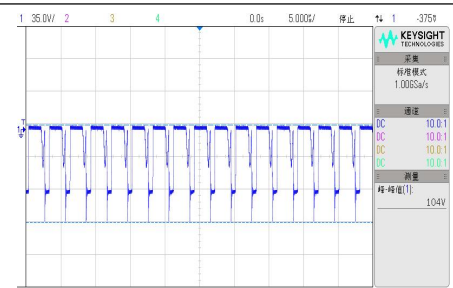
VIN=24V, D4 半载工作电压波形



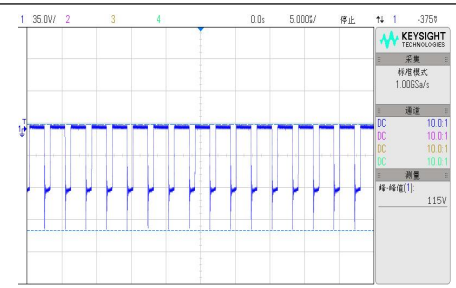
VIN=24V, D4 满载工作电压波形



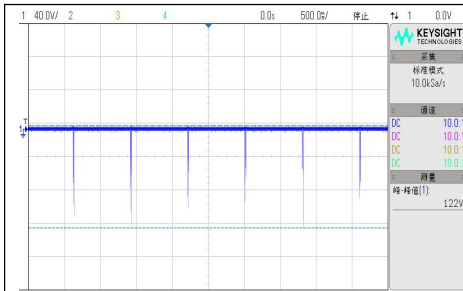
VIN=36V, D4 空载工作电压波形



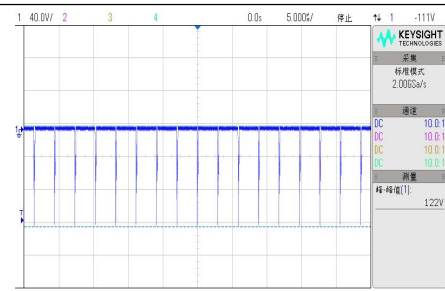
VIN=36V, D4 半载工作电压波形



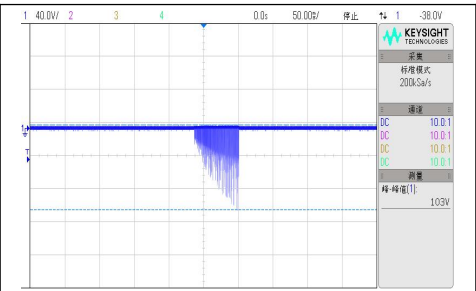
VIN=36V, D4 满载工作电压波形



VIN=36V, D4 短路保护工作电压波形



VIN=36V, D4 短路保护工作电压展开波形



VIN=36V, D4 短路保护 VDS 启机波形

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