

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 VPC2188B，结合隔离功率变压器 VPD18PB-30A、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 30W 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）抗干扰目的的相关场合。

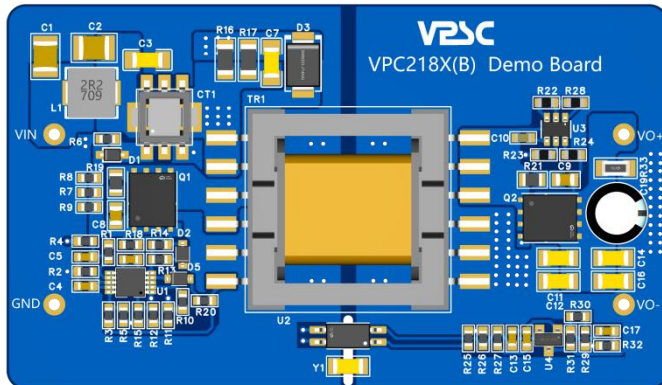
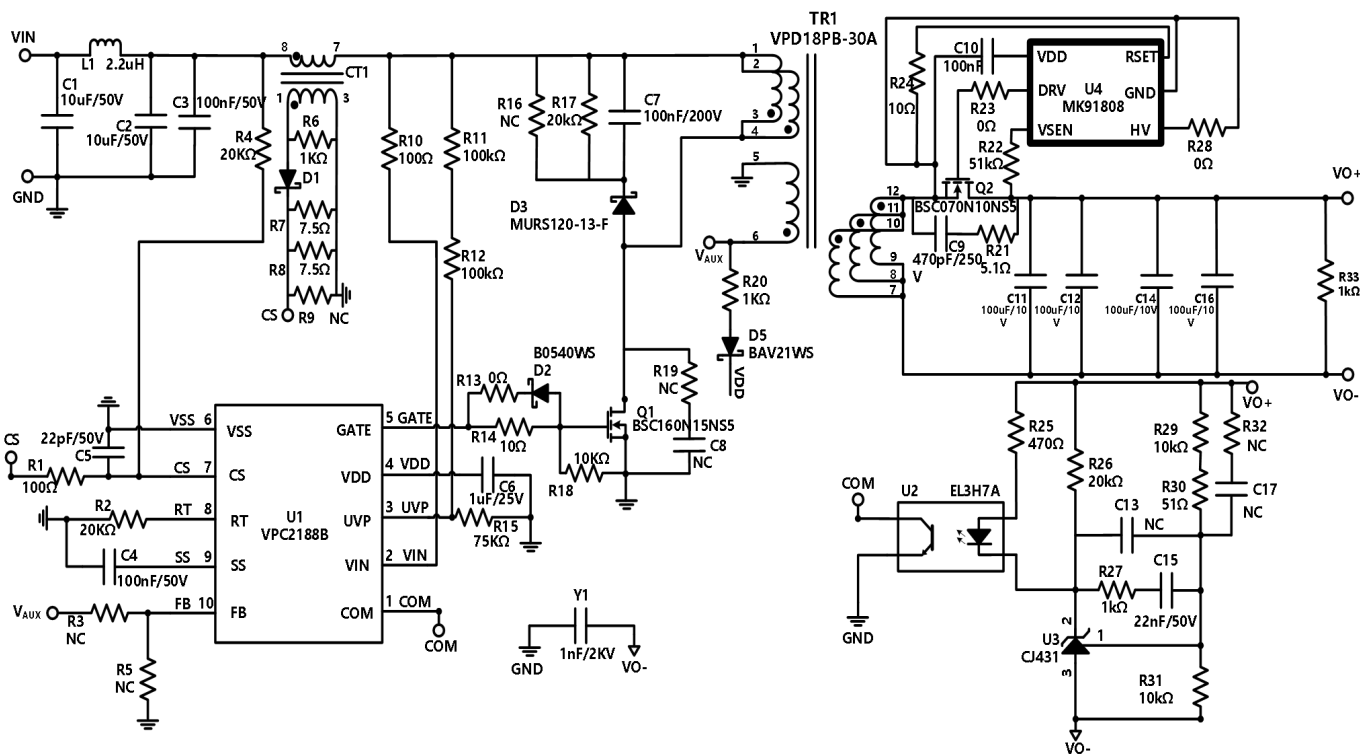


图 1: VPC2188B Demo 板(尺寸:69mm*40mm)

关键词：输入：9V-36V，输出 5V/30W，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

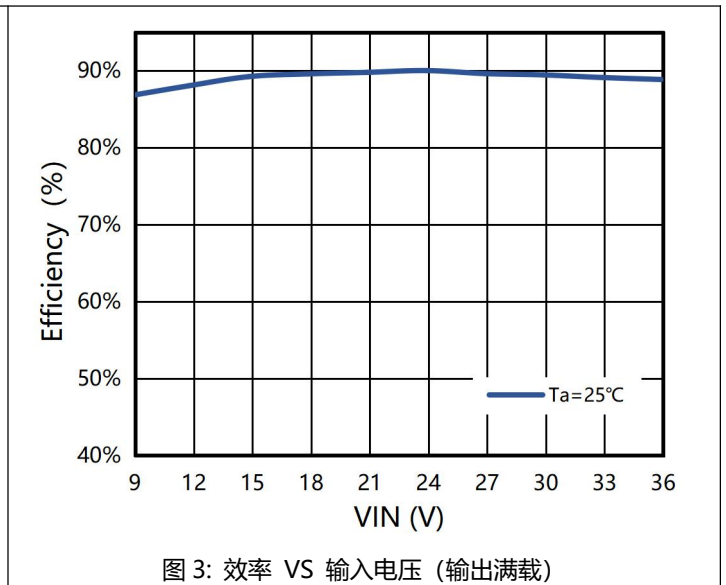
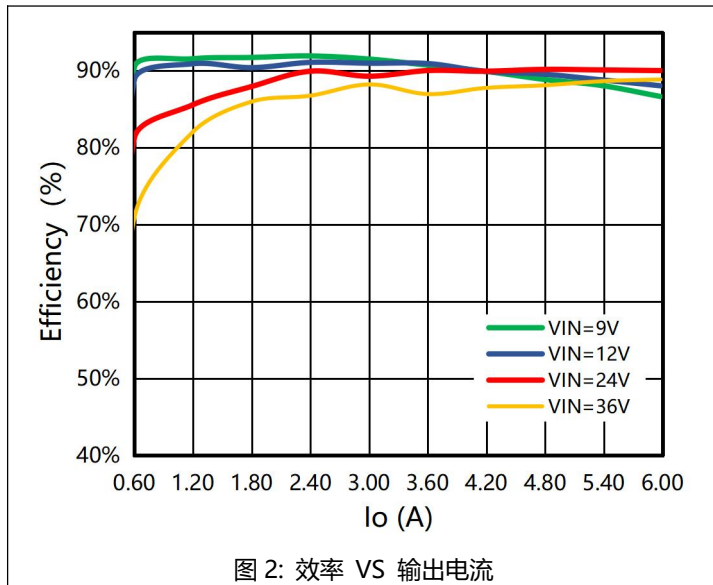
位号	参数	封装	型号	品牌
C1	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C2	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C3	100nF/50V-X7R	1206	CC1206KRX7R9BB104	YAGEO
C4	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C5	22pF/50V- NP0	0603	CC0603JRNPO9BN220	YAGEO
C6	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C7	100nF/200V-X7R	1206	CC1206KKX7RABB104	YAGEO
C8	NC			
C9	470pF/250V-C0G	0805	AC0805JRNPOYBN471	YAGEO
C10	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C11	100uF/10V-X5R	1206	GRM31CR61A107ME05L	MURATA
C12	100uF/10V-X5R	1206	GRM31CR61A107ME05L	MURATA
C13	NC			
C14	100uF/10V-X5R	1206	GRM31CR61A107ME05L	MURATA
C15	22nF/50V-X7R	0603	CC0603KRX7R9BB223	YAGEO
C16	100uF/10V-X5R	1206	GRM31CR61A107ME05L	MURATA
C17	NC			
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	100Ω±1%	0603	RC0603FR-07100RL	YAGEO
R2	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R3	NC			
R4	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R5	NC			
R6	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R7	7.5Ω±1%	0603	RC0603FR-077R5L	YAGEO
R8	7.5Ω±1%	0603	RC0603FR-077R5L	YAGEO
R9	NC			
R10	100Ω±1%	0603	RC0603FR-07100RL	YAGEO
R11	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R12	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R13	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R14	10Ω±1%	0603	RC0603FR-0710RL	YAGEO
R15	75KΩ±1%	0603	RC0603FR-0775KL	YAGEO
R16	NC	-	-	-
R17	20KΩ±1%	1206	RC1206FR-0720KL	YAGEO
R18	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R19	NC			
R20	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R21	5.1Ω±1%	0805	RC0805FR-075R1L	YAGEO
R22	51KΩ±1%	0603	RC0603FR-0751KL	YAGEO

R23	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R24	10Ω±1%	0603	RC0603FR-0710RL	YAGEO
R25	470Ω±1%	0603	RC0603FR-07470RL	YAGEO
R26	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R27	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R28	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R29	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R30	51Ω±1%	0603	RC0603FR-0751RL	YAGEO
R31	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R32	NC			
R33	1KΩ±1%	1206	RC1206FR-071KL	YAGEO
TR1	NP:NS:NA=5:3:7 Lp=4uH	EFD20	VPD18PB-30A	VPSC
Q1	N 沟道 150V 56A	DFN-8	BSC160N15NS5	INFINEON
Q2	N 沟道 100V 80A	DFN-8	BSC070N10NS5	INFINEON
L1	2.2uH ±20%	SMD	FXL0530-2R2-M	CJIANG
D1	40V/0.5A	SOD-323	B0540WS	CJ
D2	40V/0.5A	SOD-323	B0540WS	CJ
D3	200V/1A	SMB	MURS120-13-F	DIODES
D5	200V/0.2A	SOD-323	BAV21WS	CJ
U1	4-100VIN 电源管理芯片	MSOP-10	VPC2188B	VPSC
U2	CTR=80~160, Viso=3750VAC	SSOP-4	EL3H7A	EVERLIGHT
U3	Vref=2.495V	SOT23-3	CJ431	CJ
U4	快速关断同步整流控制器	SOT23-6	MK91808	MERAKI

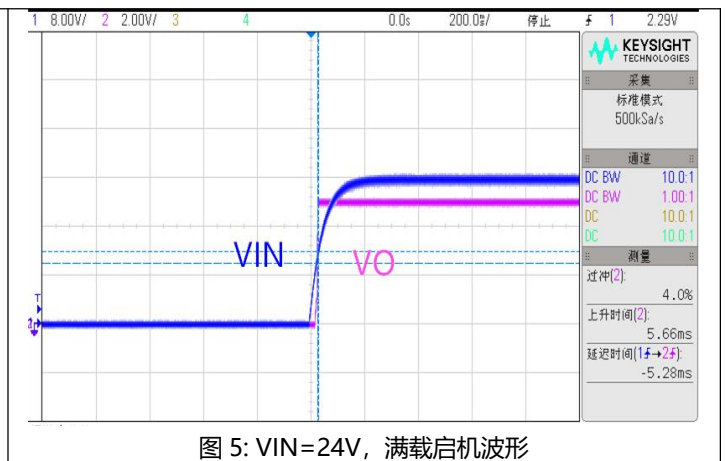
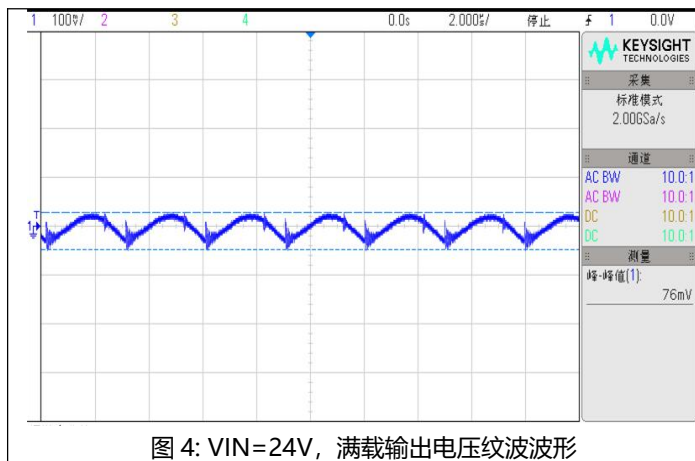
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流（满载/空载）	VIN=24V	5	---	1372	mA
转换效率	VIN=24V, IO=6A	---	90.17	---	%
纹波&噪声	VIN=24V, IO=6A	---	76	100	mV
输出电压精度	VIN=24V, IO=6A	---	1.5	---	%
线性调节率	VIN=9V-36V, IO=6A	---	0.6	---	%
负载调整率	VIN=24V, IO=6A	---	-0.1	---	%
最大容性负载	VIN=9V-36V, IO=6A	---	---	4700	uF
输出过流点系数	VIN=9V, IO=6A	---	142	---	%
输入欠压保护	锁定电压	---	7.4	---	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 45°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

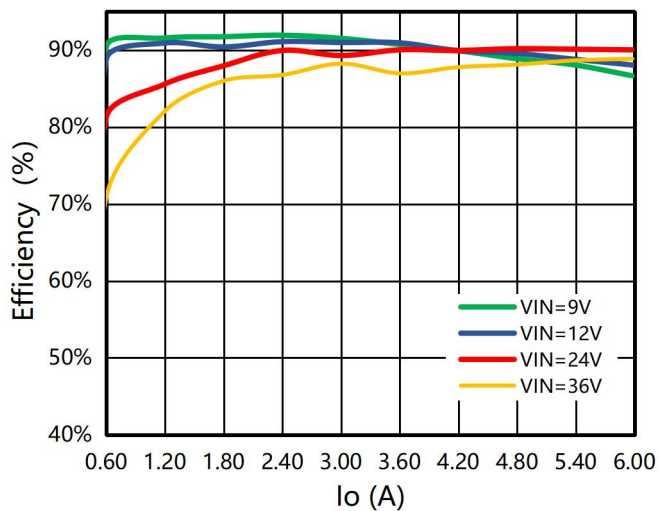


相关波形

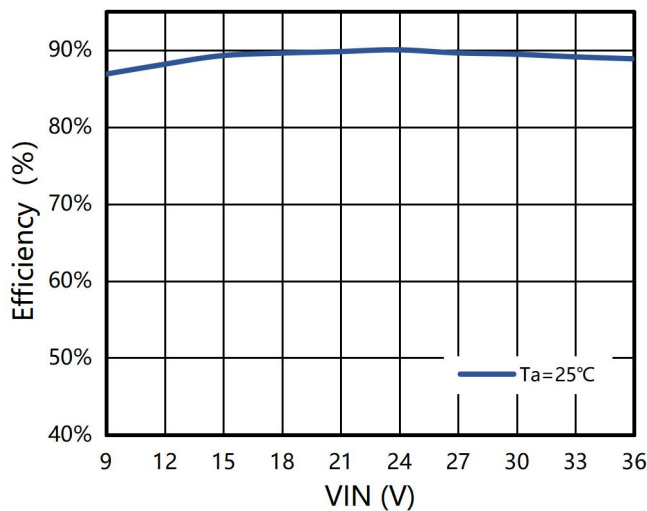


详细测试数据

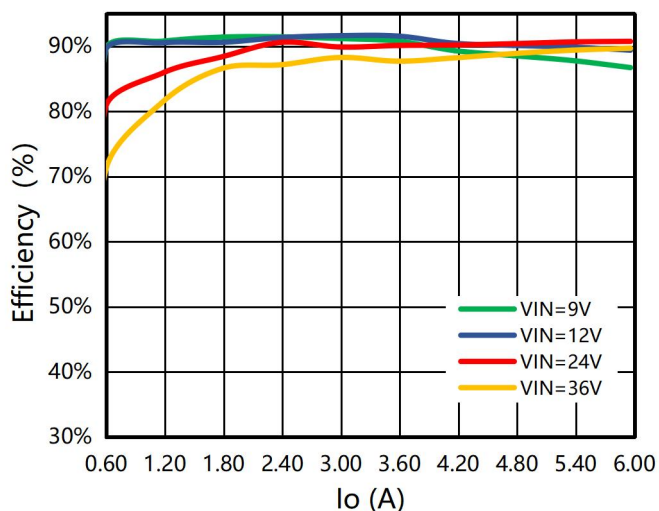
高低温测试曲线



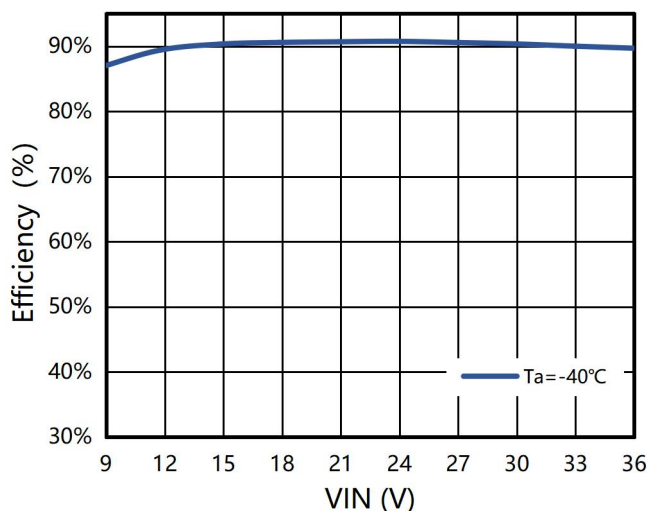
效率 VS 输出电流 (25°C)



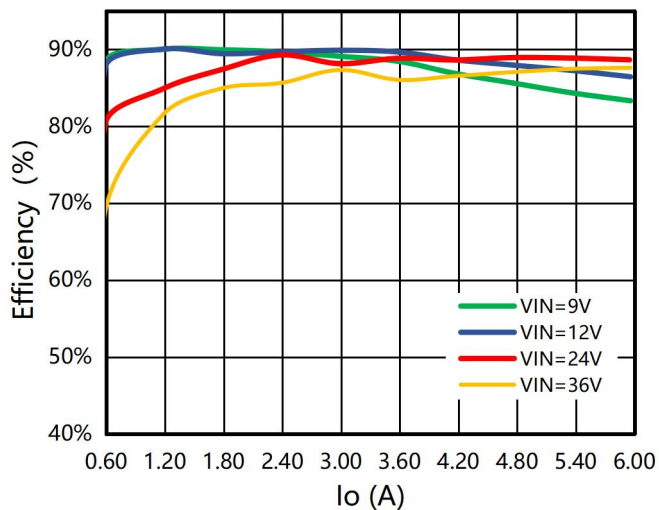
效率 VS 输入电压 (输出满载@25°C)



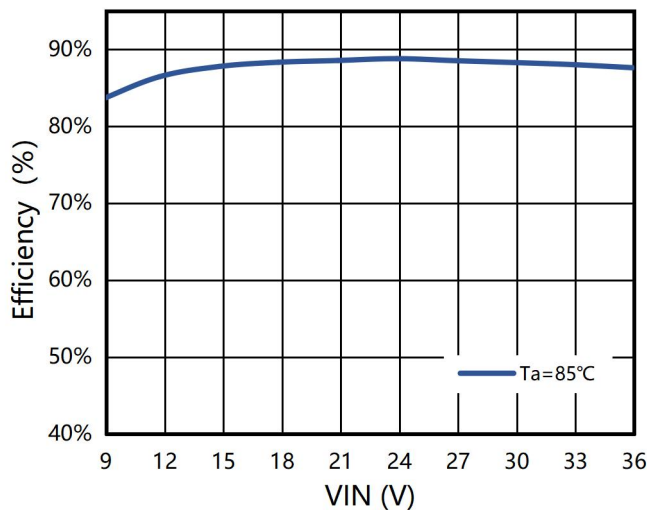
效率 VS 输出电流 (-40°C)



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)	IO-max%	η (%)
23.98	0.005	4.97	0	0%	0.00%
23.97	0.153	4.97	0.599	10%	81.18%
23.96	0.290	4.96	1.199	20%	85.59%
23.95	0.424	4.96	1.801	30%	87.97%
23.95	0.553	4.96	2.402	40%	89.95%
23.93	0.695	4.96	3.003	50%	89.56%
23.92	0.830	4.96	3.604	60%	90.04%
23.91	0.964	4.96	4.180	70%	89.95%
23.9	1.100	4.95	4.790	80%	90.19%
23.89	1.237	4.95	5.380	90%	90.12%
23.88	1.372	4.94	5.980	100%	90.17%

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 (%)
24.01	0.005	4.98	0	0%	0.00%
24	0.155	4.97	0.597	10%	79.76%
23.97	0.287	4.97	1.190	20%	85.97%
23.96	0.420	4.97	1.790	30%	88.40%
23.94	0.547	4.97	2.387	40%	90.59%
23.93	0.699	4.96	2.992	50%	88.72%
23.92	0.822	4.94	3.587	60%	90.12%
23.91	0.953	4.94	4.160	70%	90.19%
23.91	1.096	4.95	4.760	80%	89.91%
23.9	1.222	4.94	5.360	90%	90.66%
23.89	1.365	4.94	5.960	100%	90.29%

VIN=24V, Ta=85°C, 输入、输出及效率数据:

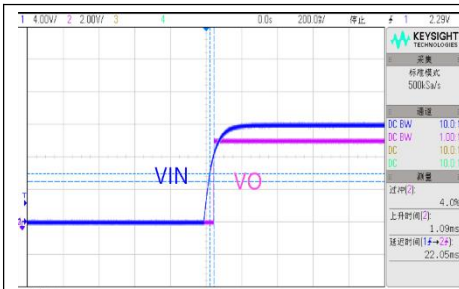
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η (%)
23.99	0.006	4.98	0	0%	0.00%
23.98	0.152	4.97	0.597	10%	81.40%
23.97	0.290	4.96	1.190	20%	84.91%
23.96	0.424	4.96	1.790	30%	87.39%
23.94	0.553	4.95	2.387	40%	89.25%
23.92	0.695	4.95	2.993	50%	89.12%
23.92	0.834	4.94	3.587	60%	88.82%
23.91	0.970	4.94	4.160	70%	88.61%
23.89	1.104	4.94	4.760	80%	89.16%
23.88	1.248	4.94	5.360	90%	88.85%
23.87	1.385	4.94	5.950	100%	88.91%

VIN	Load Condition	Peak-to-Peak Ripple [V]
9V	空载	72mV
9V	半载	88mV
9V	满载	141mV
12V	空载	24mV
12V	半载	84mV
12V	满载	125mV
24V	空载	76mV
24V	半载	88mV
24V	满载	76mV
36V	空载	84mV
36V	半载	56mV
36V	满载	96mV

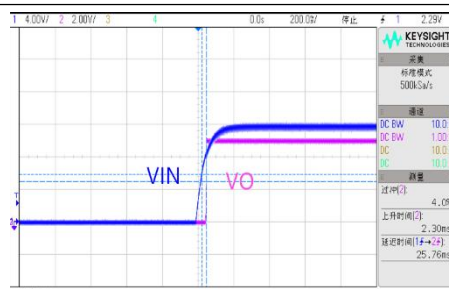
VIN=9V, 空载启机波形

VIN=9V, 半载启机波形

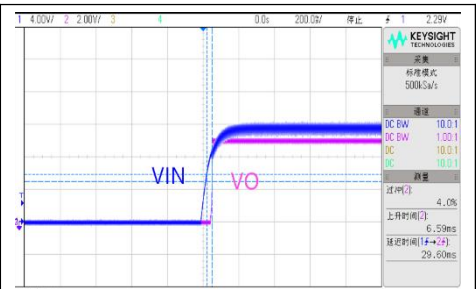
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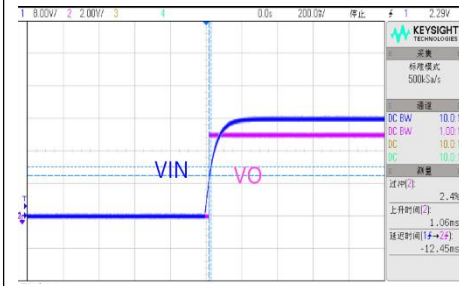
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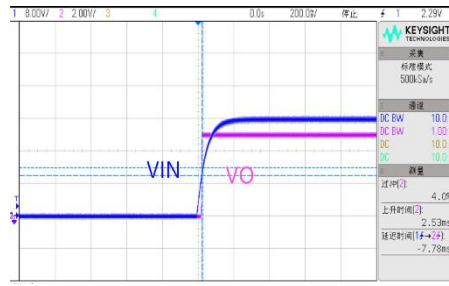
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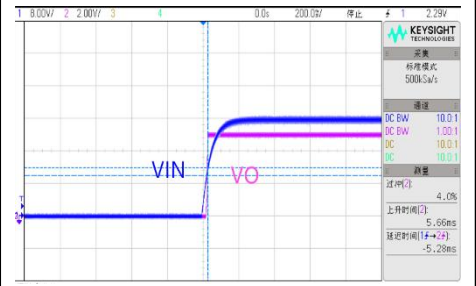
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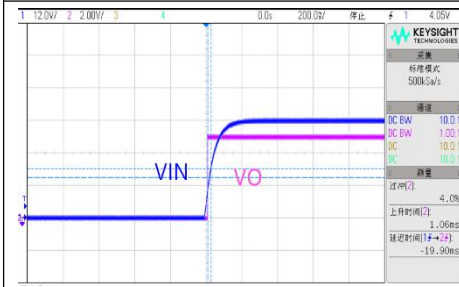
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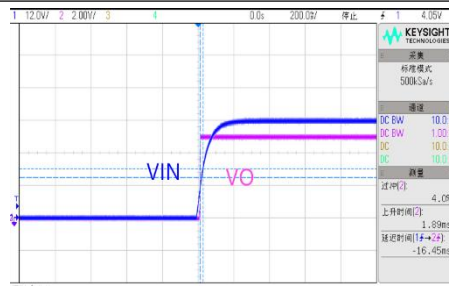
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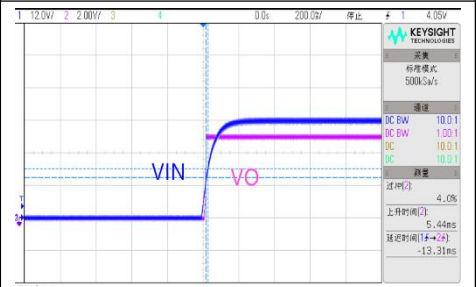
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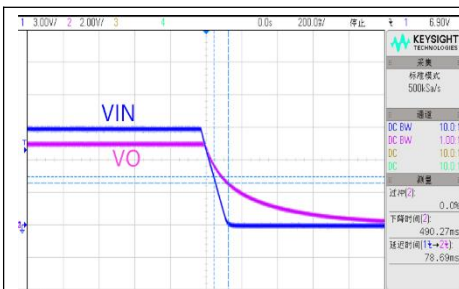
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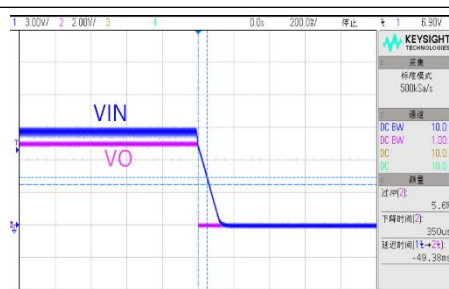
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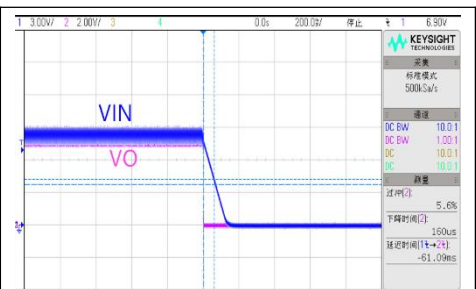
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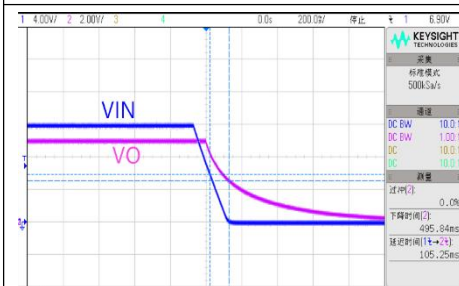
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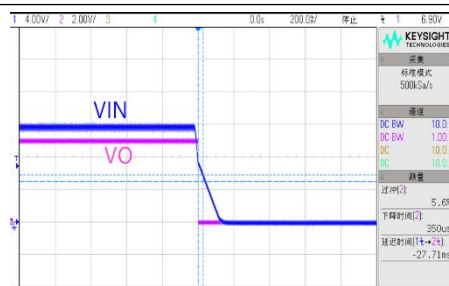
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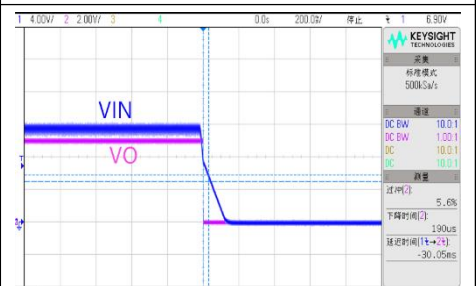
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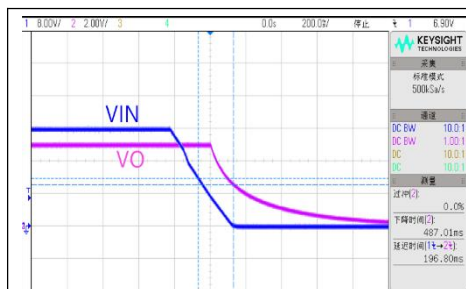
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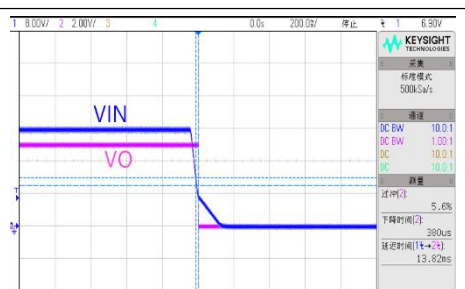
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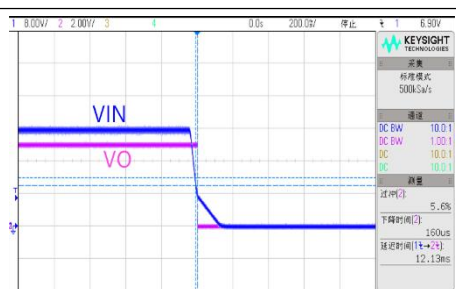
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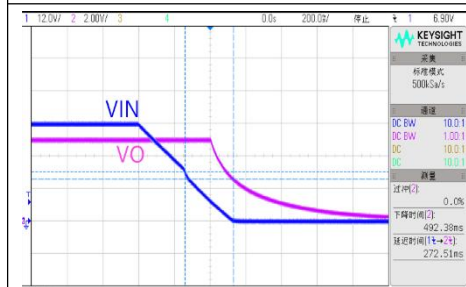
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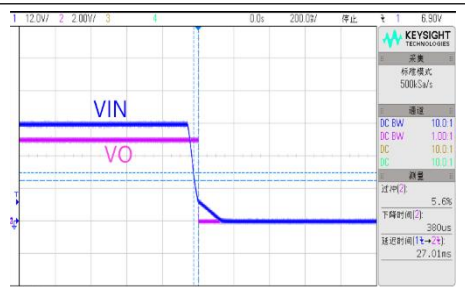
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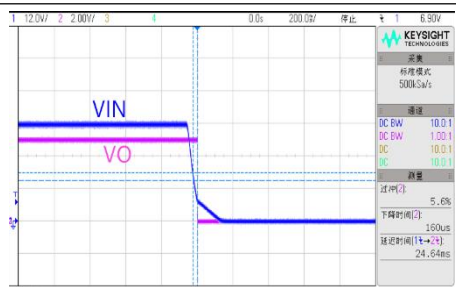
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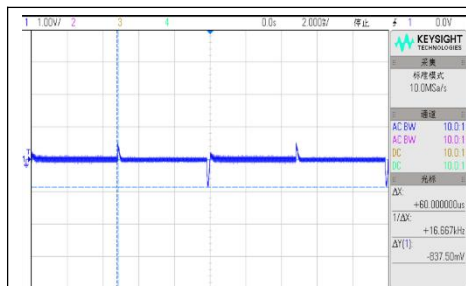


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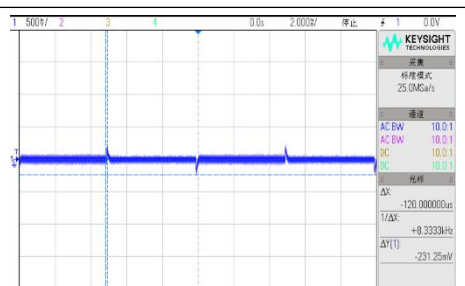


VIN=36V, 满载关机波形

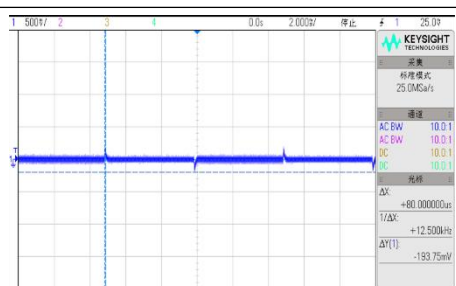
动态波形



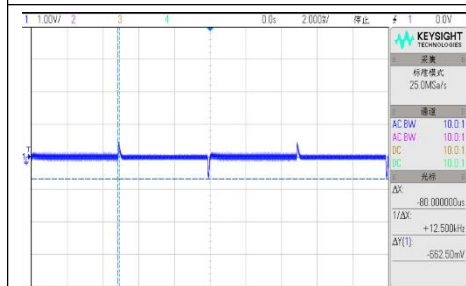
VIN=9V, 100%-10%-100%Io 动态波形



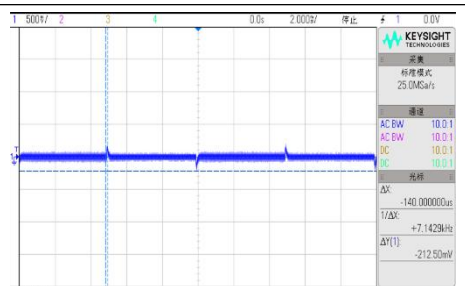
VIN=9V, 75%-50%-75%Io 动态波形



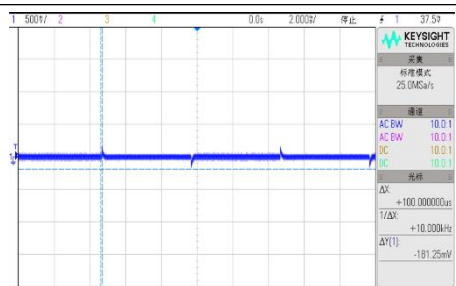
VIN=9V, 50%-25%-50%Io 动态波形



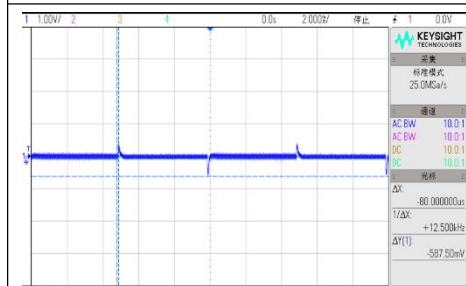
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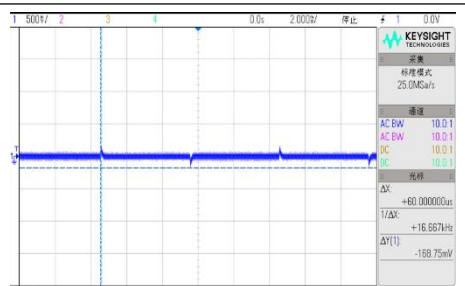
VIN=12V, 75%-50%-75%Io 动态波形



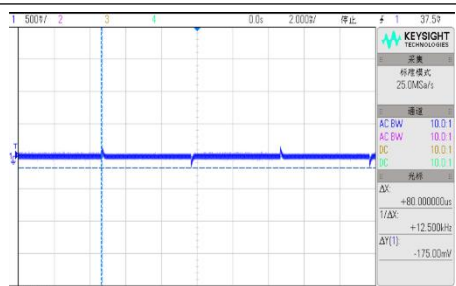
VIN=12V, 50%-25%-50%Io 动态波形



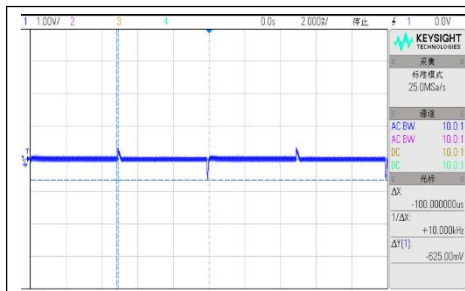
VIN=24V, 100%-10%-100%Io 动态波形



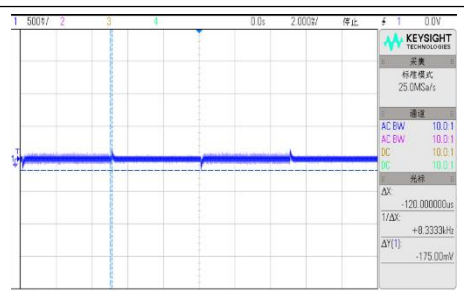
VIN=24V, 75%-50%-75%Io 动态波形



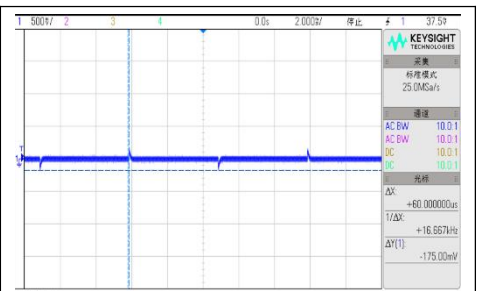
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

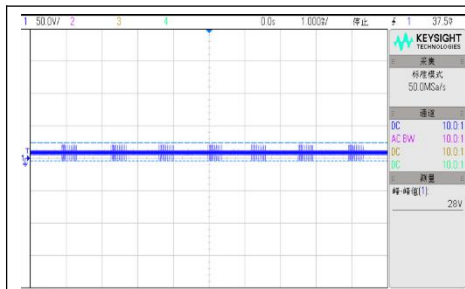


VIN=36V, 75%-50%-75%Io 动态波形

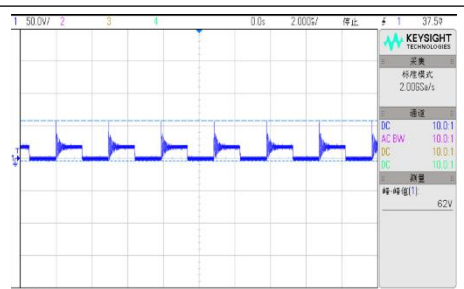


VIN=36V, 50%-25%-50%Io 动态波形

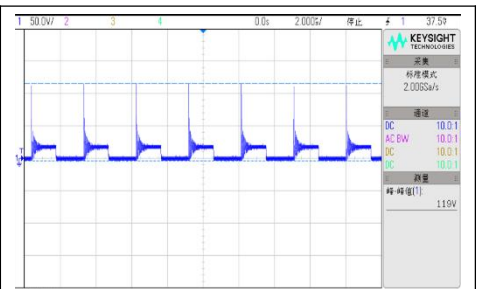
外置 MOS 管 Q1 电压应力波形



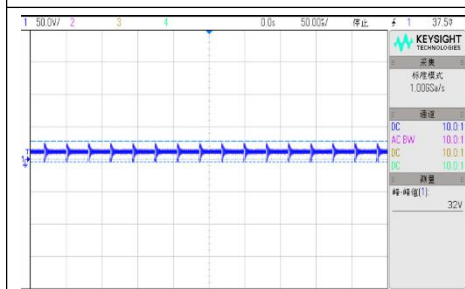
VIN=9V, 空载 VDS 波形



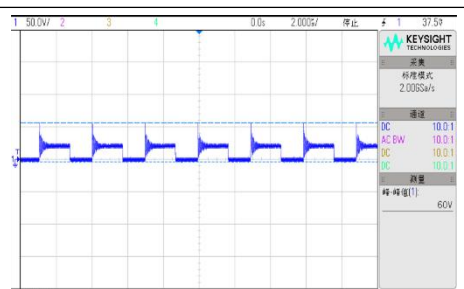
VIN=9V, 半载 VDS 波形



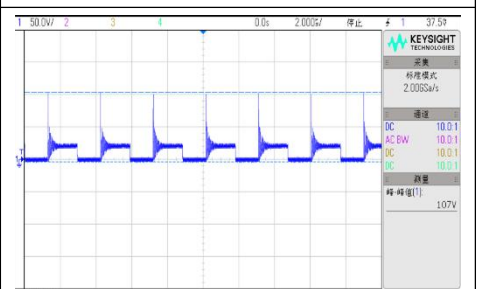
VIN=9V, 满载 VDS 波形



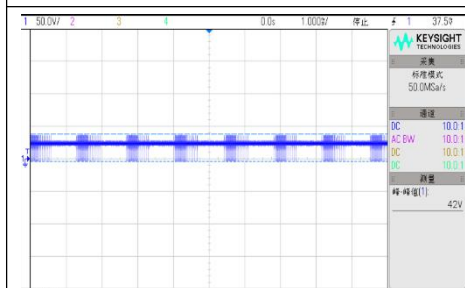
VIN=12V, 空载 VDS 波形



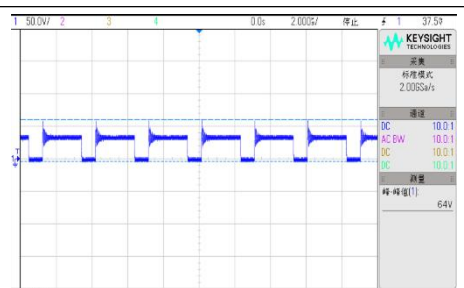
VIN=12V, 半载 VDS 波形



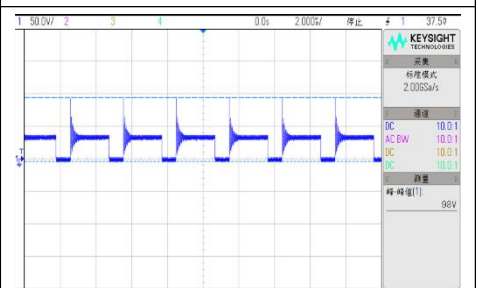
VIN=12V, 满载 VDS 波形



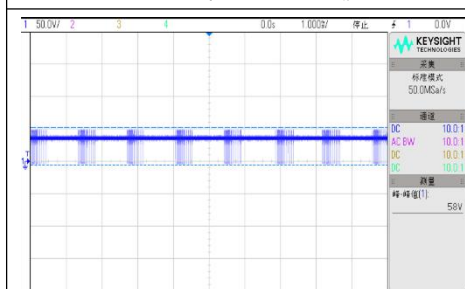
VIN=24V, 空载 VDS 波形



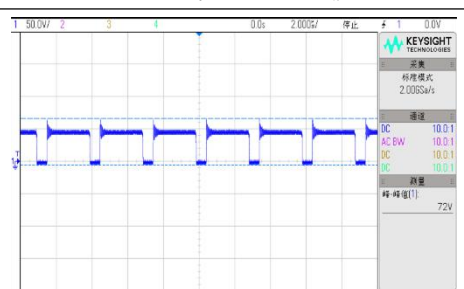
VIN=24V, 半载 VDS 波形



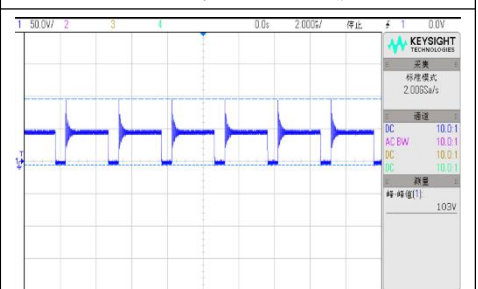
VIN=24V, 满载 VDS 波形



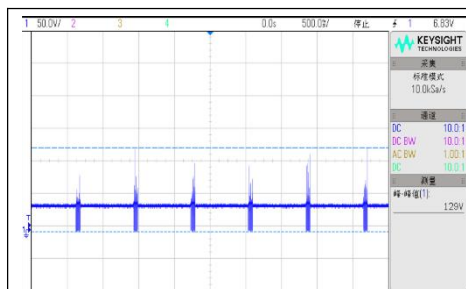
VIN=36V, 空载 VDS 波形



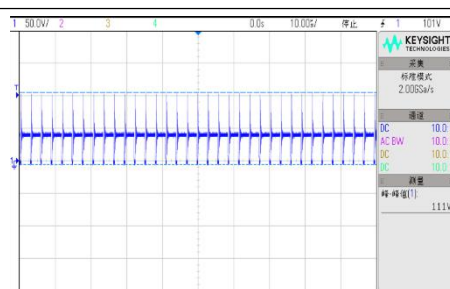
VIN=36V, 半载 VDS 波形



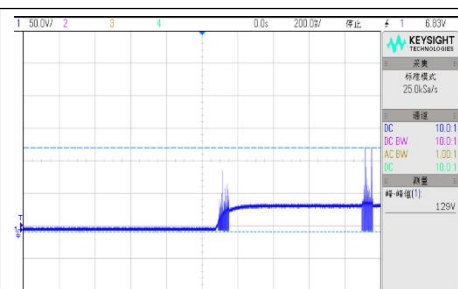
VIN=36V, 满载 VDS 波形



VIN=36V, 短路保护 VDS 波形

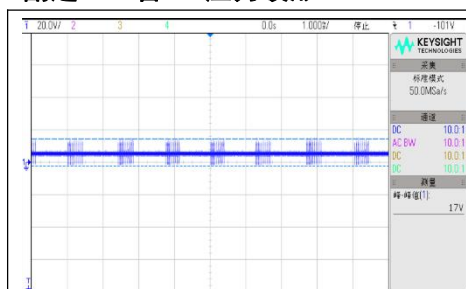


VIN=36V, 短路保护 VDS 展开波形

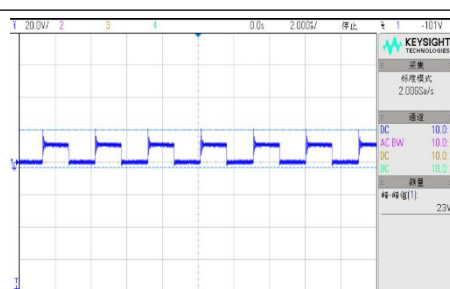


VIN=36V, 短路开机保护 VDS 展开波形

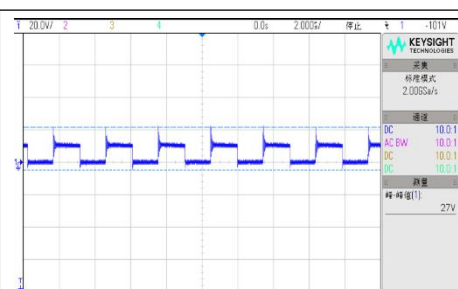
副边 MOS 管 Q2 应力波形



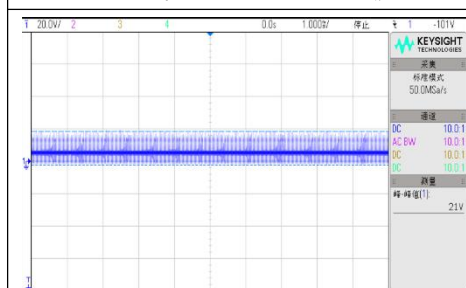
VIN=9V, Q2 空载工作电压波形



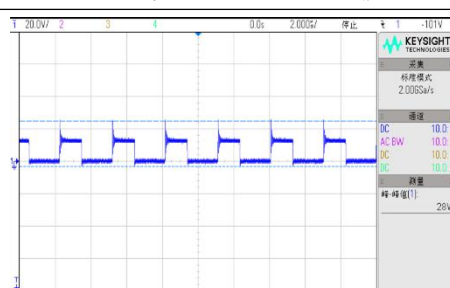
VIN=9V, Q2 半载工作电压波形



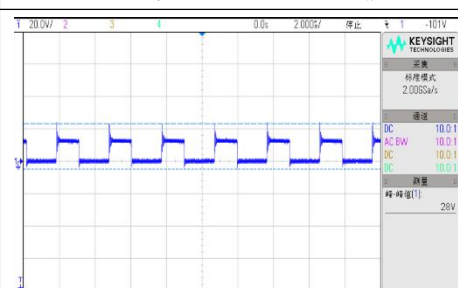
VIN=9V, Q2 满载工作电压波形



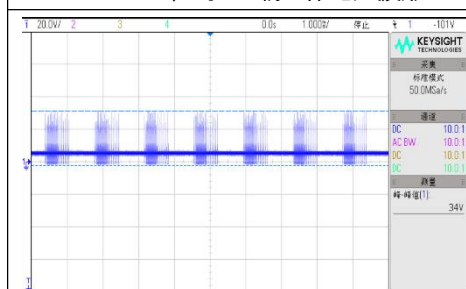
VIN=12V, Q2 空载工作电压波形



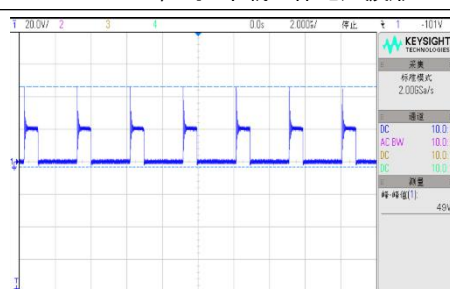
VIN=12V, Q2 半载工作电压波形



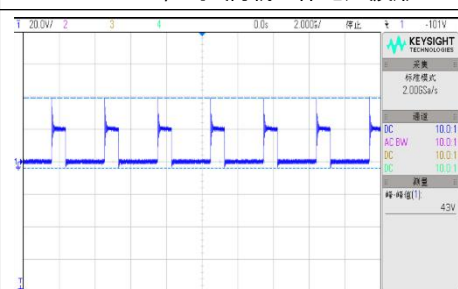
VIN=12V, Q2 满载工作电压波形



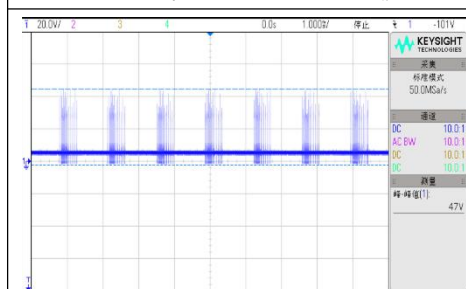
VIN=24V, Q2 空载工作电压波形



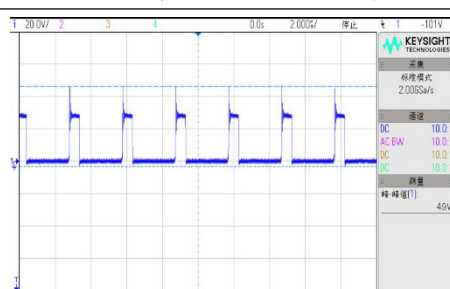
VIN=24V, Q2 半载工作电压波形



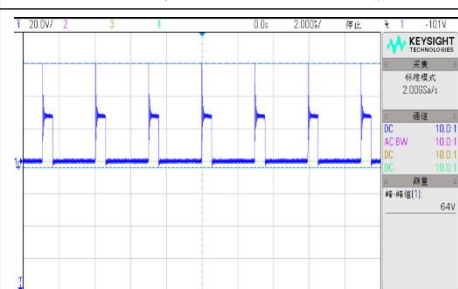
VIN=24V, Q2 满载工作电压波形



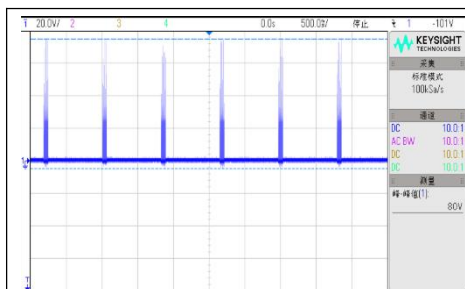
VIN=36V, Q2 空载工作电压波形



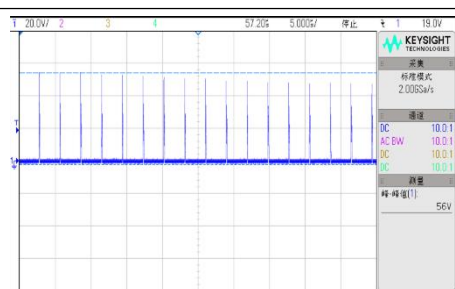
VIN=36V, Q2 半载工作电压波形



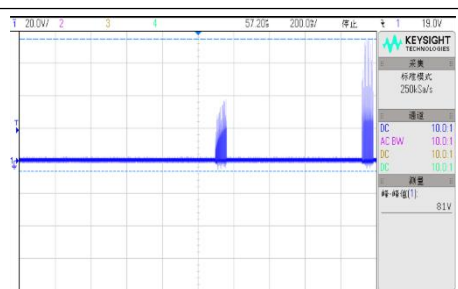
VIN=36V, Q2 满载工作电压波形



VIN=36V, Q2 短路保护工作电压波形



VIN=36V, Q2 短路保护工作电压展开波形



VIN=36V, Q2 短路开机保护工作电压波形

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