

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 VPC2187B，结合隔离功率变压器 VPE17QF-15A、输出整流二极管以及必要的阻容元件，实现 18V-72V 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 15W 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。

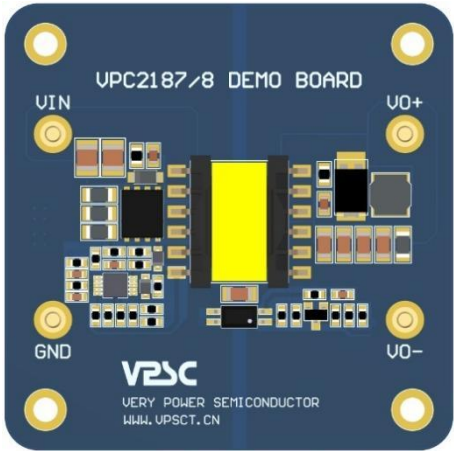
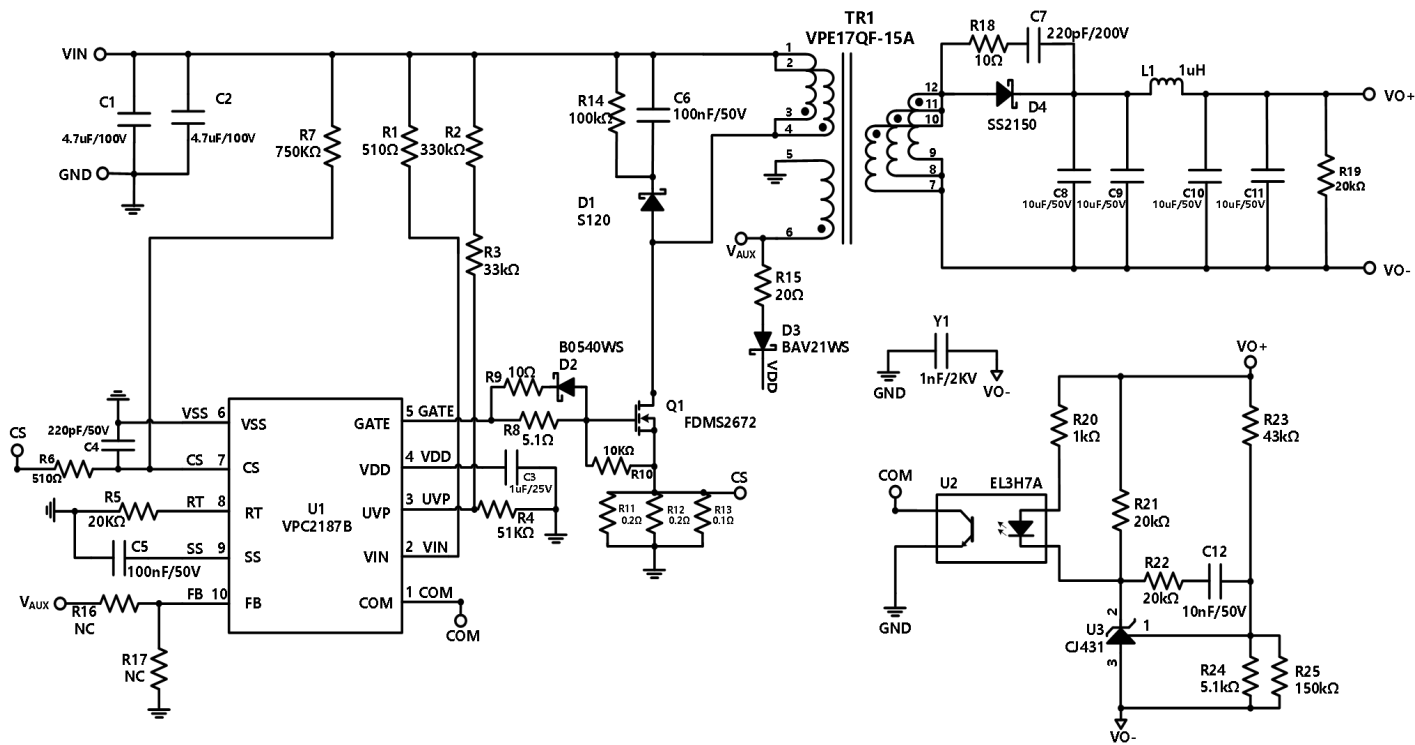


图 1: VPC2187B Demo 板(尺寸:55mm*55mm)

关键词：输入：18V-72V，输出 24V/15W，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

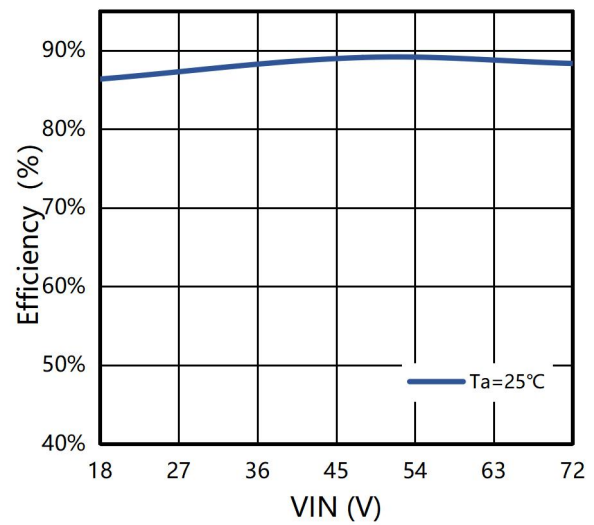
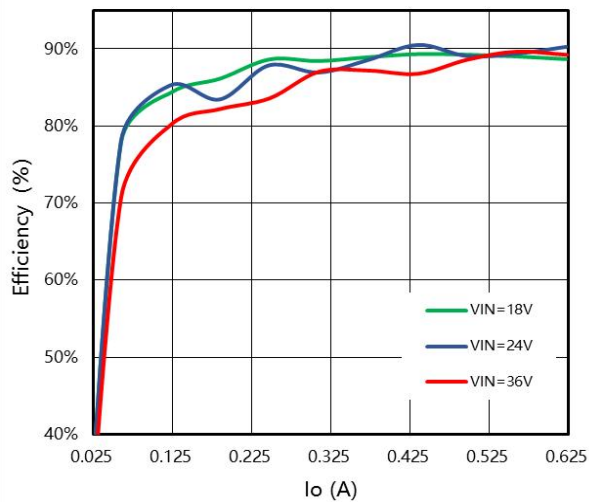
位号	参数	封装	型号	品牌
C1	4.7uF/100V-X7R	1210	1210X475K101NT	FH (风华)
C2	4.7uF/100V-X7R	1210	1210X475K101NT	FH (风华)
C3	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C4	220pF/50V- NP0	0603	CC0603JRNPO9BN221	YAGEO
C5	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C6	100nF/50V-X7R	0805	CC0805KKX7R0BB104	YAGEO
C7	220pF/200V- NP0	0805	CC0805JRNPOABN221	YAGEO
C8	10uF/50V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C9	10uF/50V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C10	10uF/50V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C11	10uF/50V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C12	10nF/50V-X7R	0603	CC0603KRX7R9BB103	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R2	330KΩ±1%	0603	RC0603FR-07330KL	YAGEO
R3	33KΩ±1%	0603	RC0603FR-0733KL	YAGEO
R4	51KΩ±1%	0603	RC0603FR-0751KL	YAGEO
R5	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R6	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R7	750KΩ±1%	0603	RC0603FR-07750KL	YAGEO
R8	5.1Ω±1%	0603	RC0603FR-075R1L	YAGEO
R9	10Ω±1%	0603	RC0603FR-0710RL	YAGEO
R10	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R11	0.2Ω ±1%	1206	RL1206FR-070R2L	YAGEO
R12	0.2Ω ±1%	1206	RL1206FR-070R2L	YAGEO
R13	0.1Ω ±1%	1206	RL1206FR-070R1L	YAGEO
R14	100KΩ±1%	0805	RC0805FR-07100KL	YAGEO
R15	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R16	NC	-	-	-
R17	NC	-	-	-
R18	10Ω±1%	0805	RC0805FR-0710RL	YAGEO
R19	20KΩ±1%	1206	RC1206FR-0720KL	YAGEO
R20	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R21	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R22	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R23	43KΩ±1%	0603	RC0603FR-0743KL	YAGEO
R24	5.1KΩ±1%	0603	RC0603FR-075K3L	YAGEO
R25	150KΩ±1%	0603	RC0603FR-07150KL	YAGEO
TR1	NP:NS:NA= 13:11:6 Lp=23.66uH	ER14.5	VPE17QF-15A	VPSC
Q1	N 沟道 200V 20A	PDFN-8(5x6)	FDMS2672	onsemi

L1	1uH ±20%	SMD	FXL0420	CJ
D1	200V/1A	SOD-123	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	DIODES
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	150V/2A	SMA	SS2150	MDD
U1	4-100VIN 电源管理芯片	MSOP-10	VPC2187B	VPSC
U2	CTR=80~160, Viso=3750VAC	SSOP-4	EL3H7A	EVERLIGHT
U3	Vref=2.495V	SOT23-3	CJ431	CJ

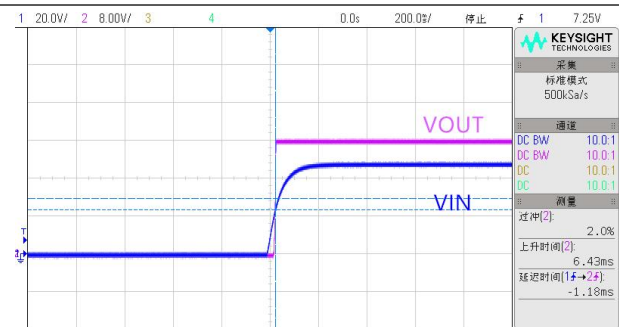
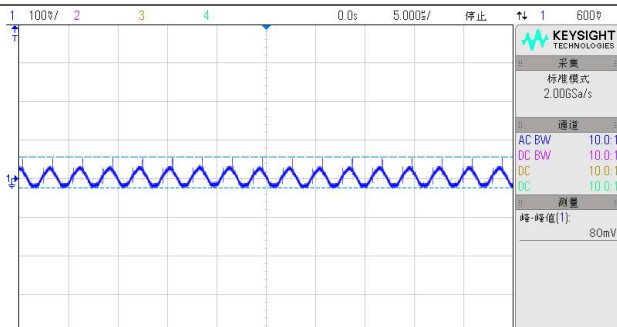
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流 (满载/空载)	VIN=48V	2	---	344	mA
转换效率	VIN=48V, IO=0.625A	---	89.09%	---	%
纹波&噪声	VIN=48V, IO=0.625A	---	---	80	mV
输出电压精度	VIN=48V, IO=0.625A	---	1	---	%
线性调节率	VIN=18V-72V, IO=0.625A	---	0.04	---	%
负载调整率	VIN=48V, IO=0.625A	---	1	---	%
输入欠压保护	锁定电压	---	14.7	---	V
	恢复电压	---	15.9	---	V
最大容性负载	VIN=18V, IO=0.625A	---	1000	---	uF
输出过流点系数	VIN=18V, IO=0.625A	---	1.31	---	倍
短路保护	VIN=18V-72V	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

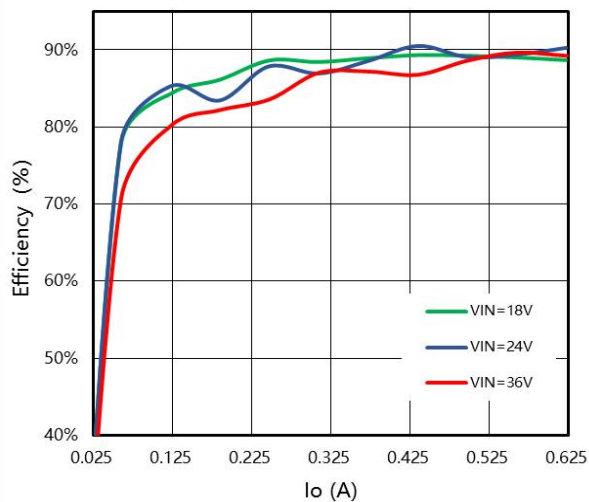


相关波形

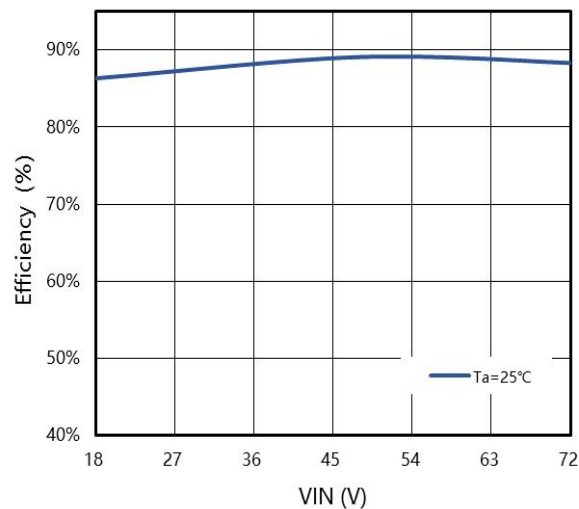


详细测试数据

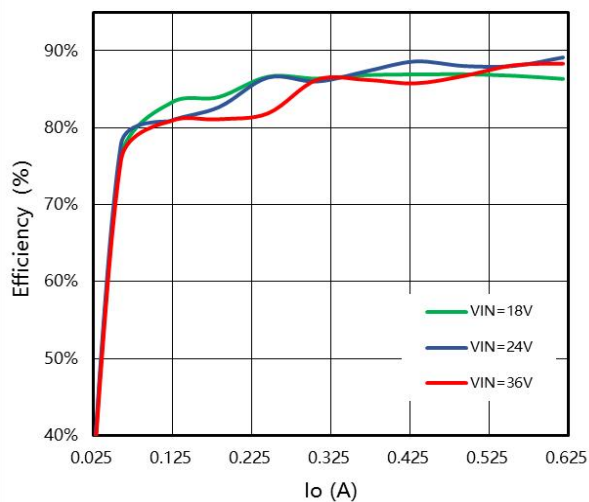
高低温测试曲线



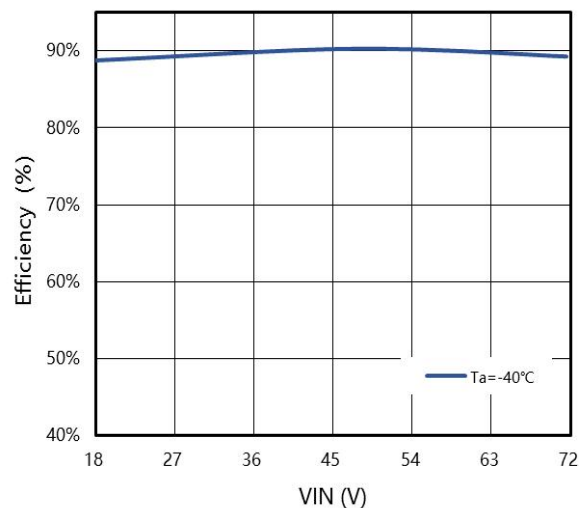
效率 VS 输出电流 (25°C)



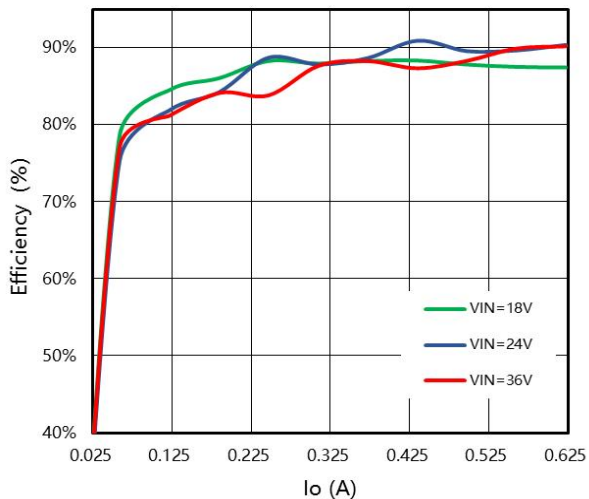
效率 VS 输入电压 (输出满载@25°C)



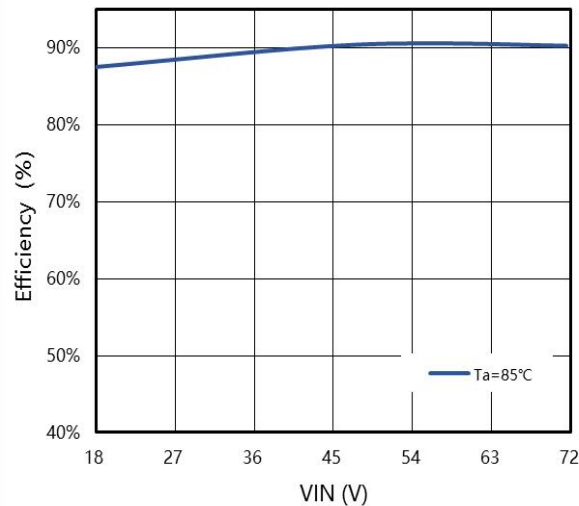
效率 VS 输出电流 (-40°C)



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=48V, Ta=-40℃, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η (%)
48	0.003	24.06	0	0%	0.00%
48	0.038	24.05	0.059	10%	77.79%
48	0.075	24.05	0.121	20%	80.83%
48	0.111	24.06	0.183	30%	82.64%
48	0.142	24.06	0.245	40%	86.48%
48	0.179	24.06	0.307	50%	85.97%
48	0.212	24.07	0.369	60%	87.28%
48	0.244	24.07	0.431	70%	88.58%
48	0.281	24.07	0.493	80%	87.98%
48	0.317	24.08	0.556	90%	87.99%
48	0.348	24.08	0.618	100%	89.09%

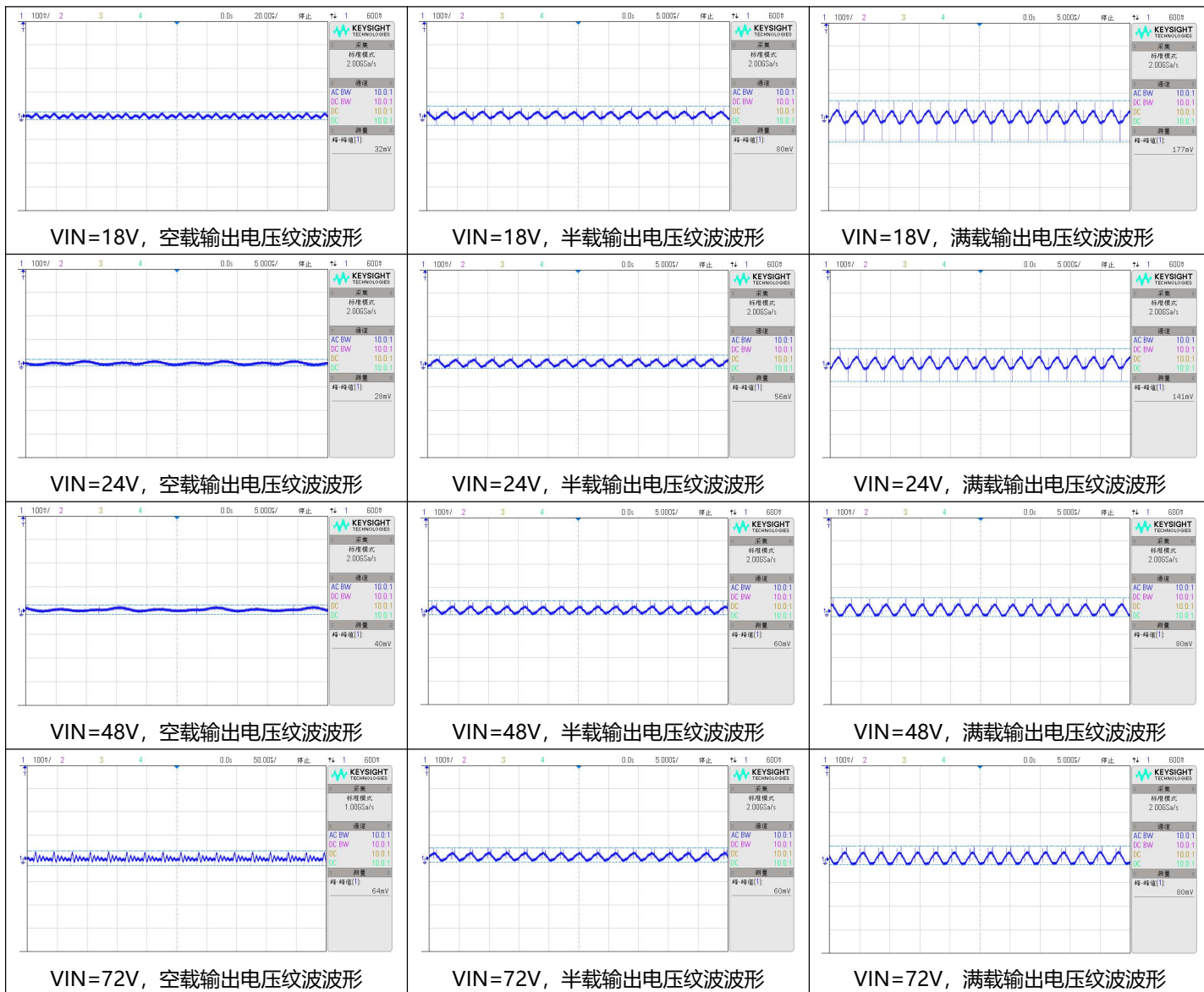
VIN=48V, Ta=25℃, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η (%)
47.7	0.002	23.95	0	0%	0.00%
47.7	0.038	23.95	0.059	10%	77.96%
47.6	0.072	23.95	0.122	20%	85.26%
47.6	0.111	23.95	0.184	30%	83.41%
47.6	0.141	23.96	0.246	40%	87.82%
47.6	0.179	23.96	0.309	50%	86.89%
47.6	0.211	23.96	0.371	60%	88.51%
47.6	0.242	23.96	0.435	70%	90.48%
47.6	0.281	23.96	0.497	80%	89.03%
47.6	0.315	23.96	0.559	90%	89.33%
47.6	0.347	23.96	0.622	100%	90.23%

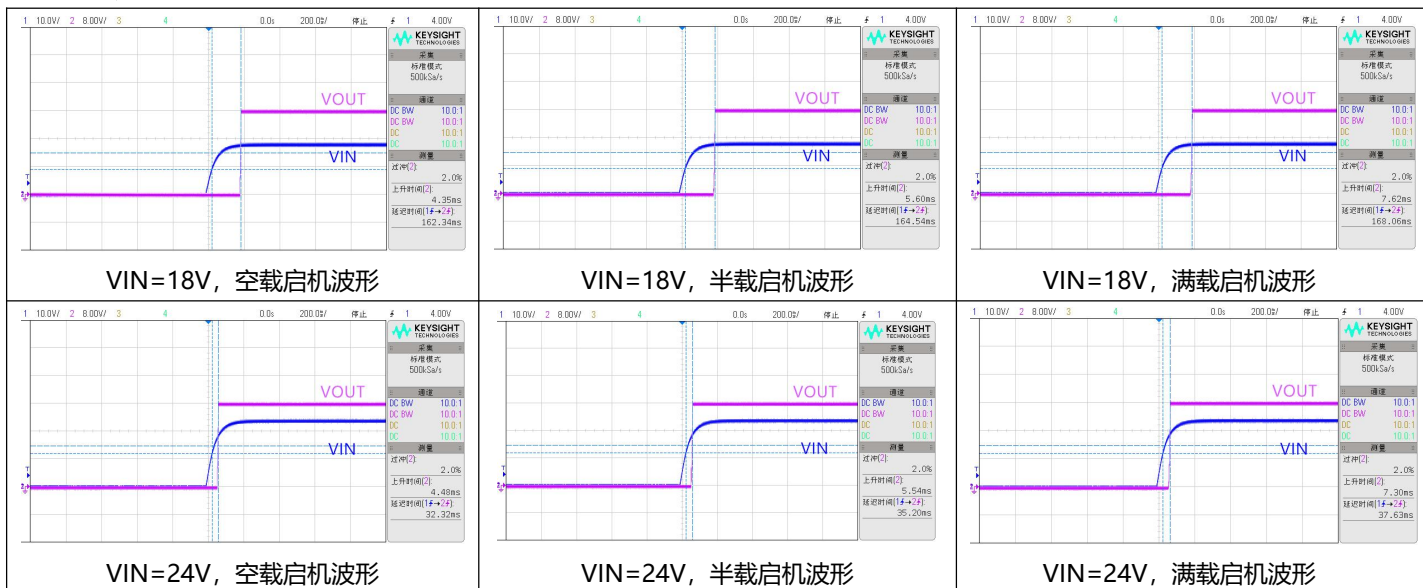
VIN=48V, Ta=85℃, 输入、输出及效率数据:

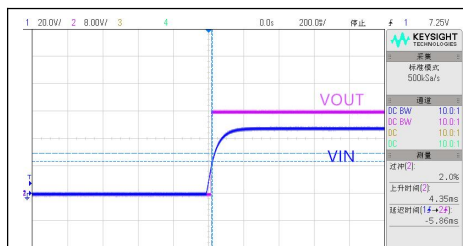
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η (%)
47.6	0.003	24.16	0	0%	0.00%
47.6	0.04	24.26	0.059	10%	75.18%
47.6	0.076	24.26	0.122	20%	81.81%
47.6	0.112	24.26	0.185	30%	84.19%
47.6	0.142	24.26	0.247	40%	88.65%
47.6	0.180	24.26	0.310	50%	87.78%
47.6	0.214	24.26	0.372	60%	88.60%
47.6	0.244	24.26	0.435	70%	90.86%
47.6	0.283	24.26	0.497	80%	89.51%
47.6	0.318	24.26	0.559	90%	89.59%
47.6	0.351	24.26	0.622	100%	90.32%

输出电压纹波波形

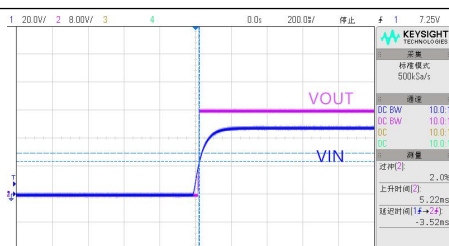


开关机波形

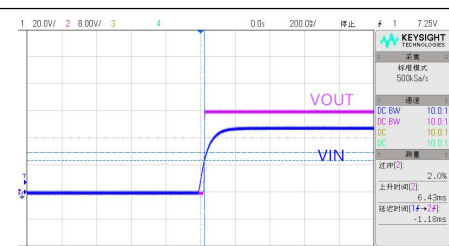




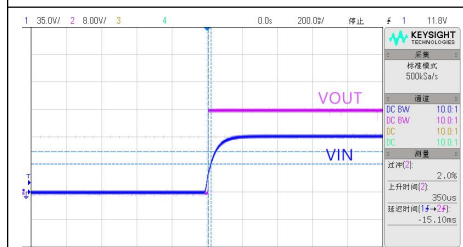
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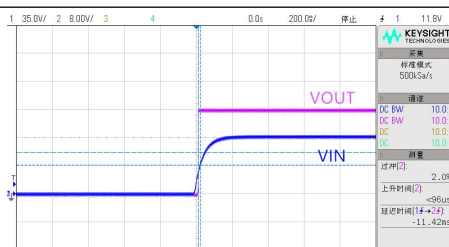
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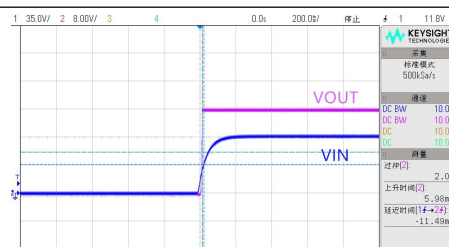
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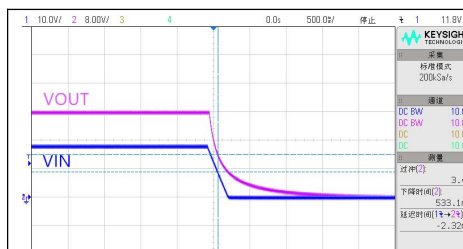
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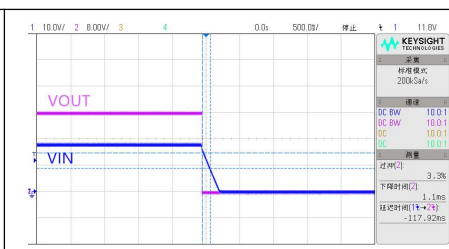
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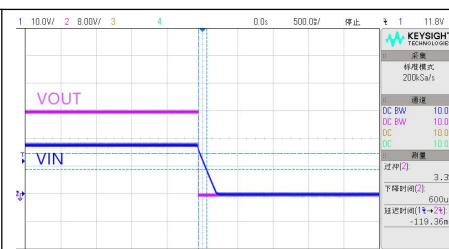
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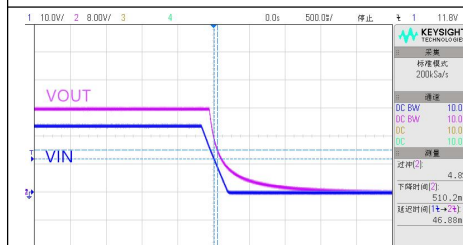
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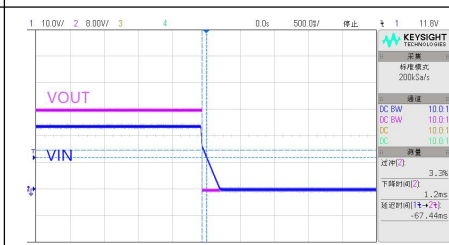
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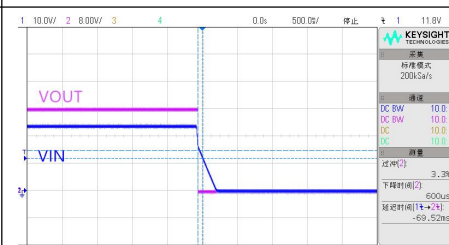
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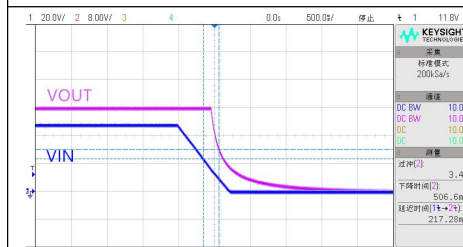
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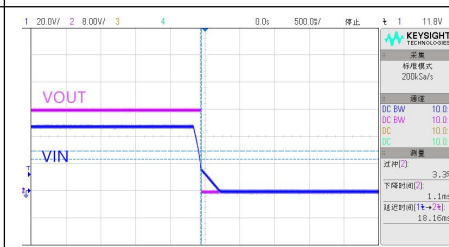
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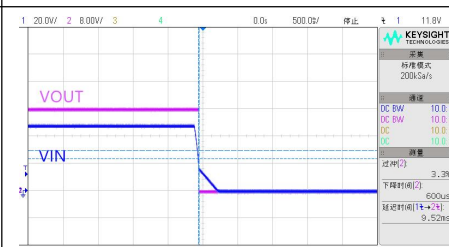
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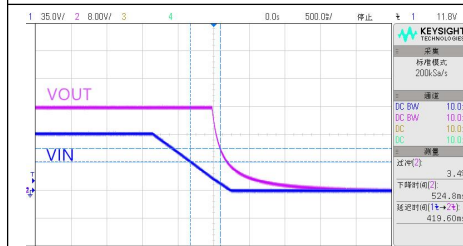
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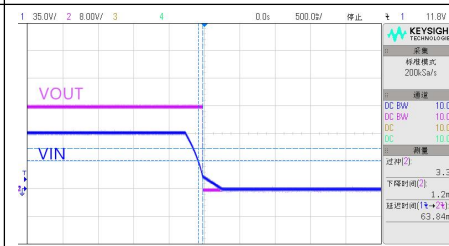
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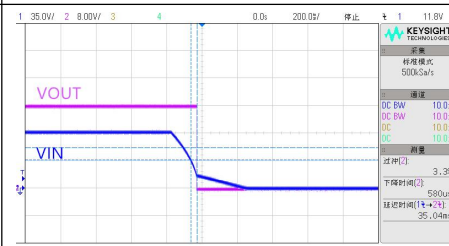
VIN=48V, 满载关机波形



VIN=72V, 空载关机波形

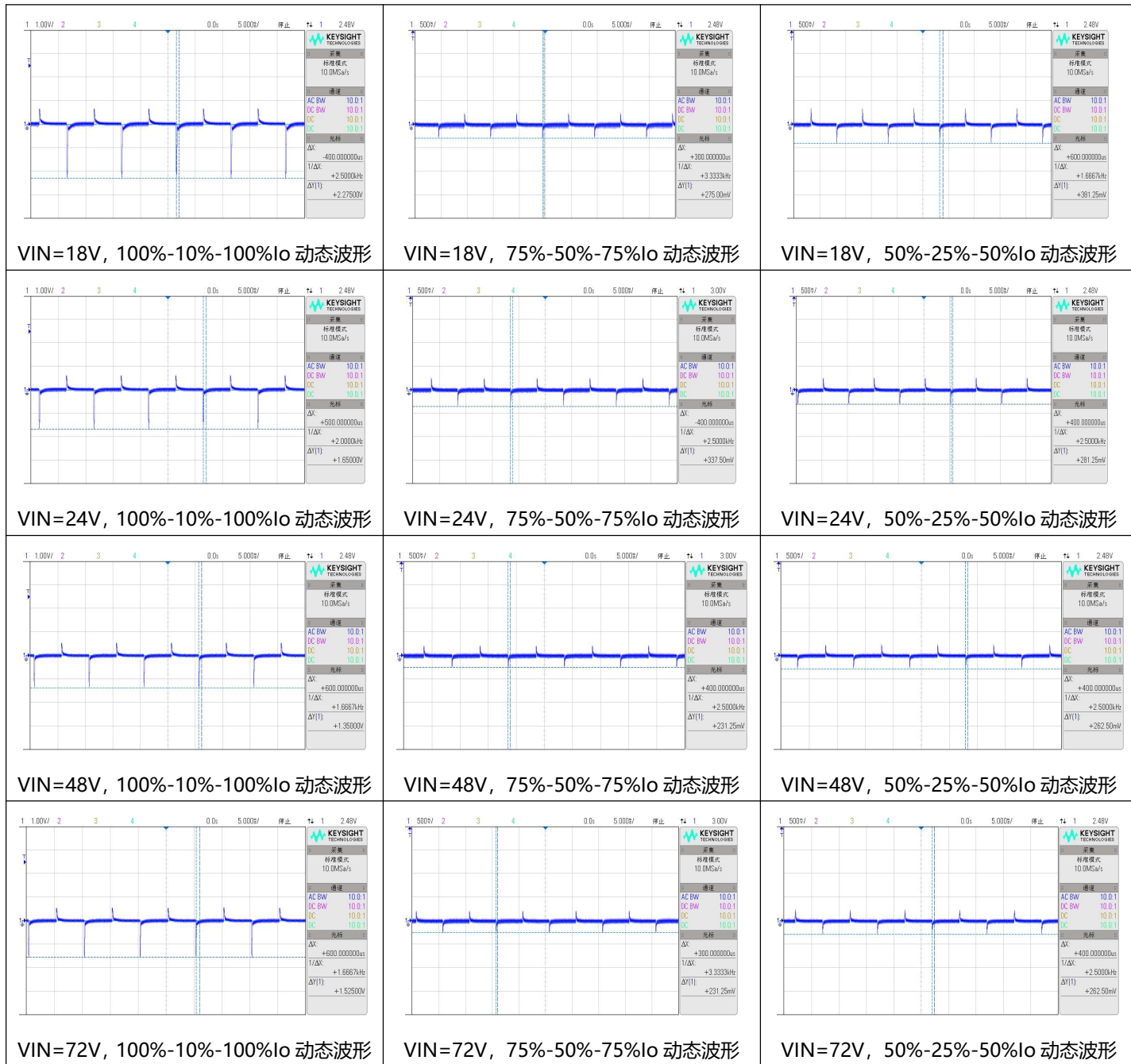


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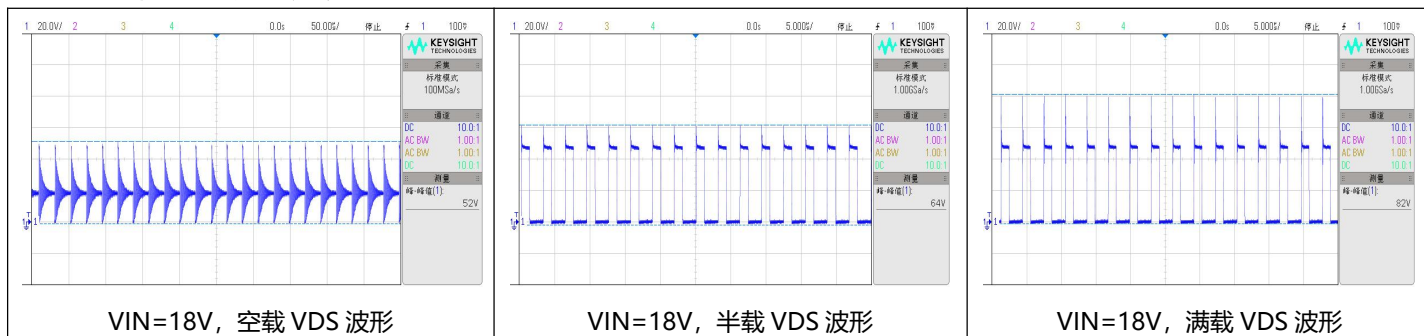


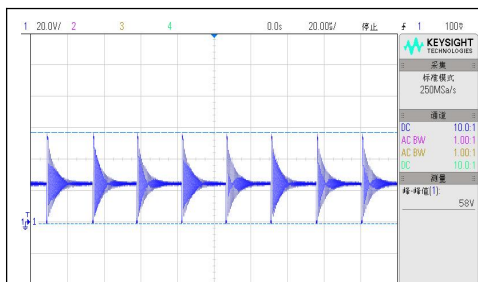
VIN=72V, 满载关机波形

动态波形

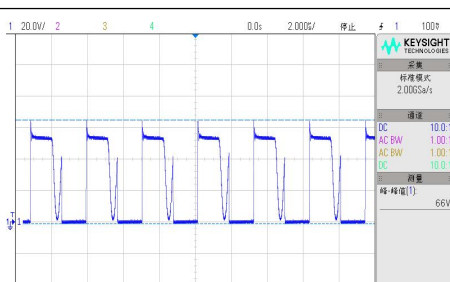


外置 MOS 管 Q1 电压应力波形

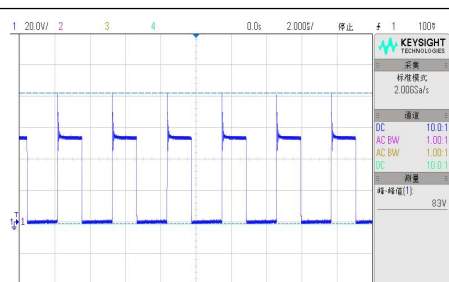




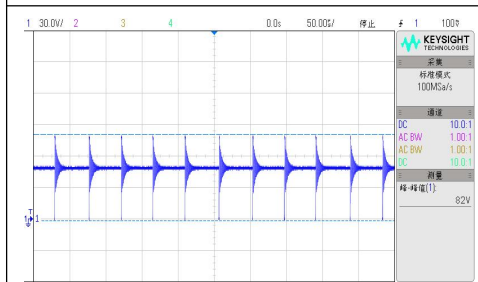
VIN=24V, 空载 VDS 波形



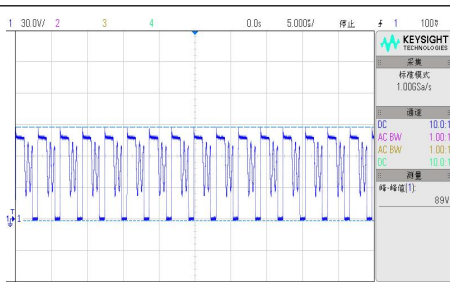
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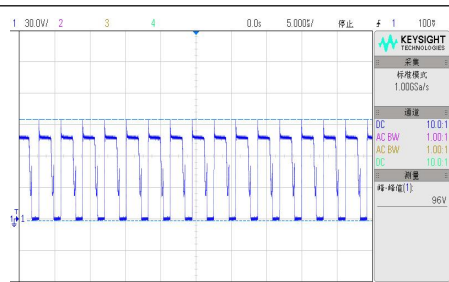
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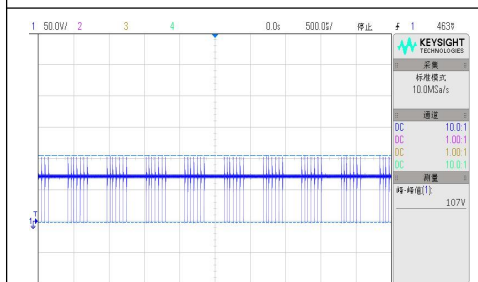
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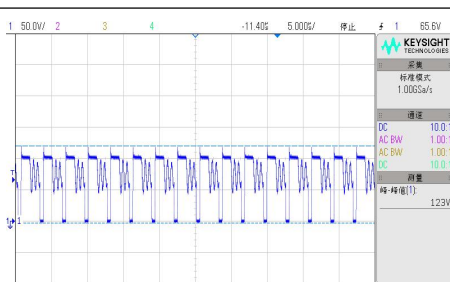
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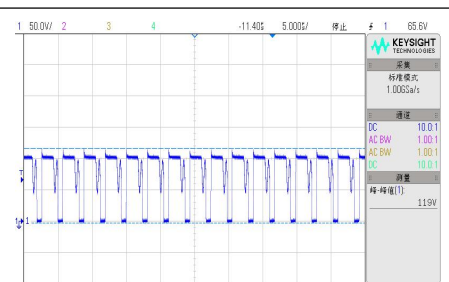
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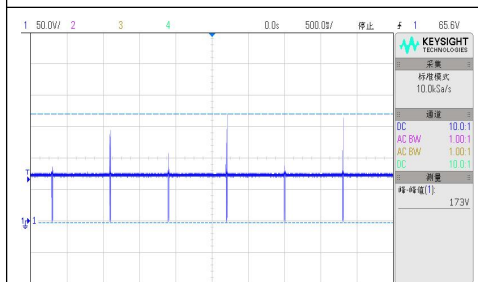
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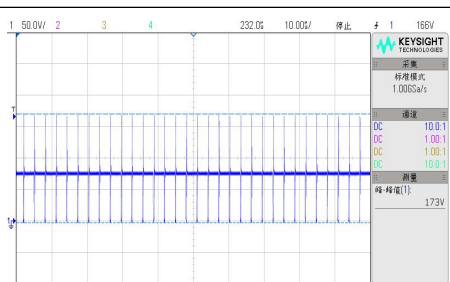
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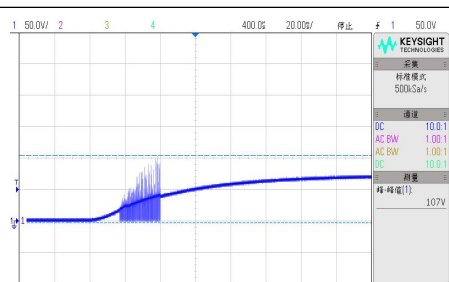
VIN=72V, 满载 VDS 波形



VIN=72V, 短路保护 VDS 波形

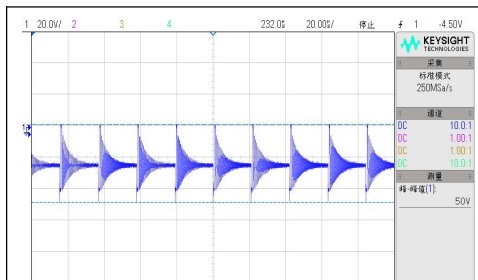


VIN=72V, 短路保护 VDS 展开波形

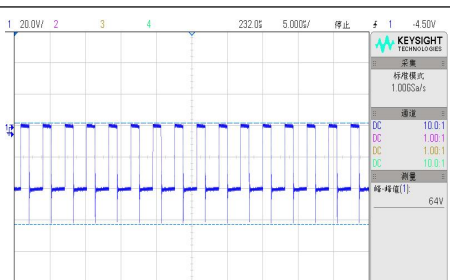


VIN=72V, 短路保护 VDS 开机波形

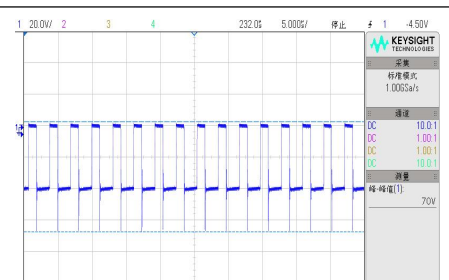
副边输出整流二极管 D4 应力波形



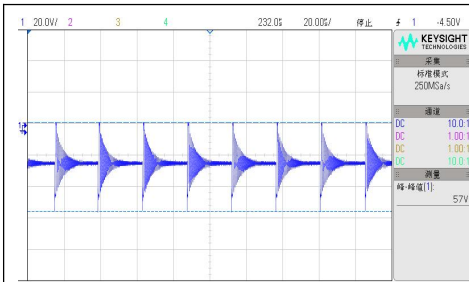
VIN=18V, D4 空载工作电压波形



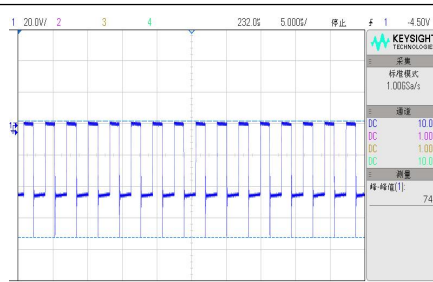
VIN=18V, D4 半载工作电压波形



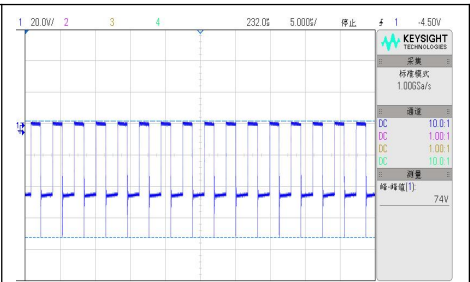
VIN=18V, D4 满载工作电压波形



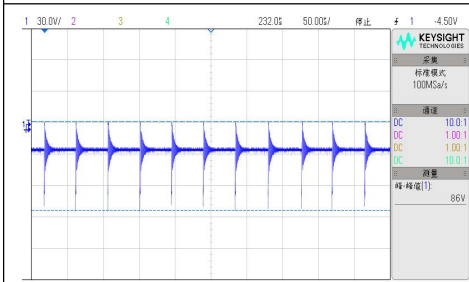
VIN=24V, D4 空载工作电压波形



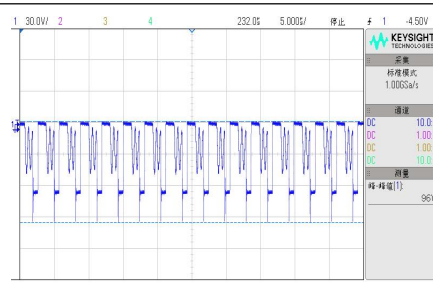
VIN=24V, D4 半载工作电压波形



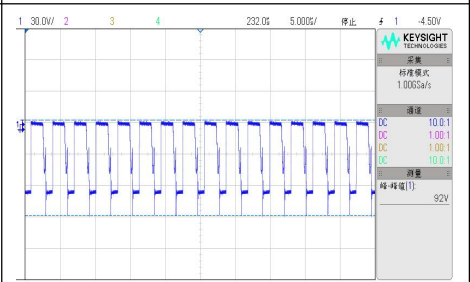
VIN=24V, D4 满载工作电压波形



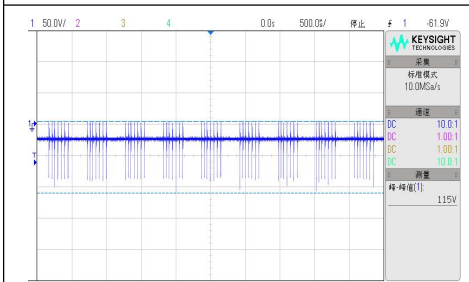
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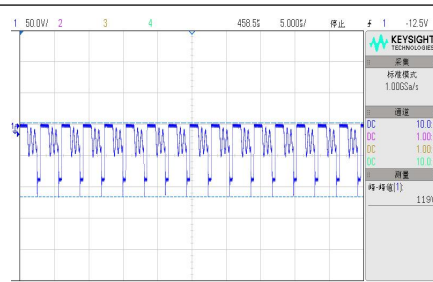
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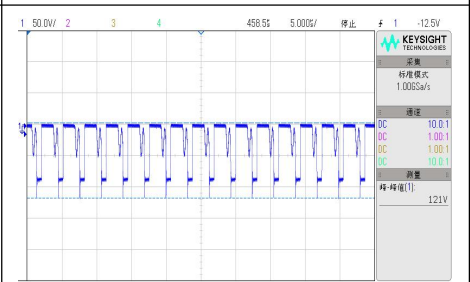
VIN=48V, D4 满载工作电压波形



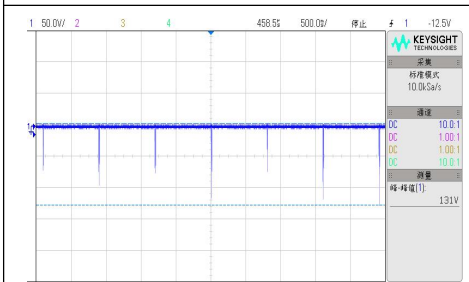
VIN=72V, D4 空载工作电压波形



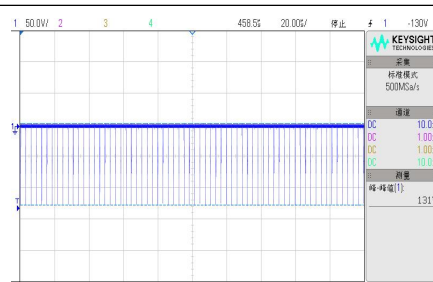
VIN=72V, D4 半载工作电压波形



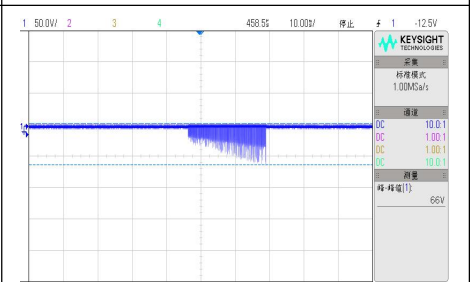
VIN=72V, D4 满载工作电压波形



VIN=72V, D4 短路保护工作电压波形



VIN=72V, D4 短路保护工作电压展开波形



VIN=72V, 短路保护 VDS 开机波形

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