

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 VPE17QD-15A、输出整流二极管以及必要的阻容元件，实现 18V-72V 输入，12V 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。

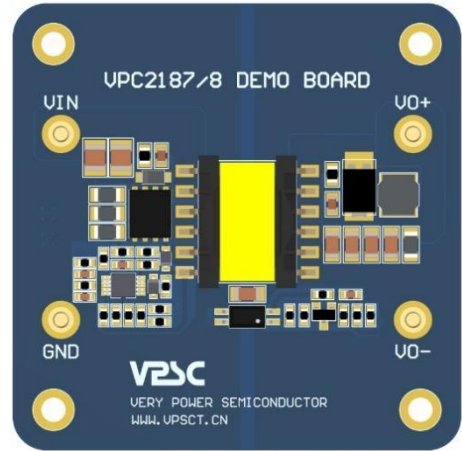
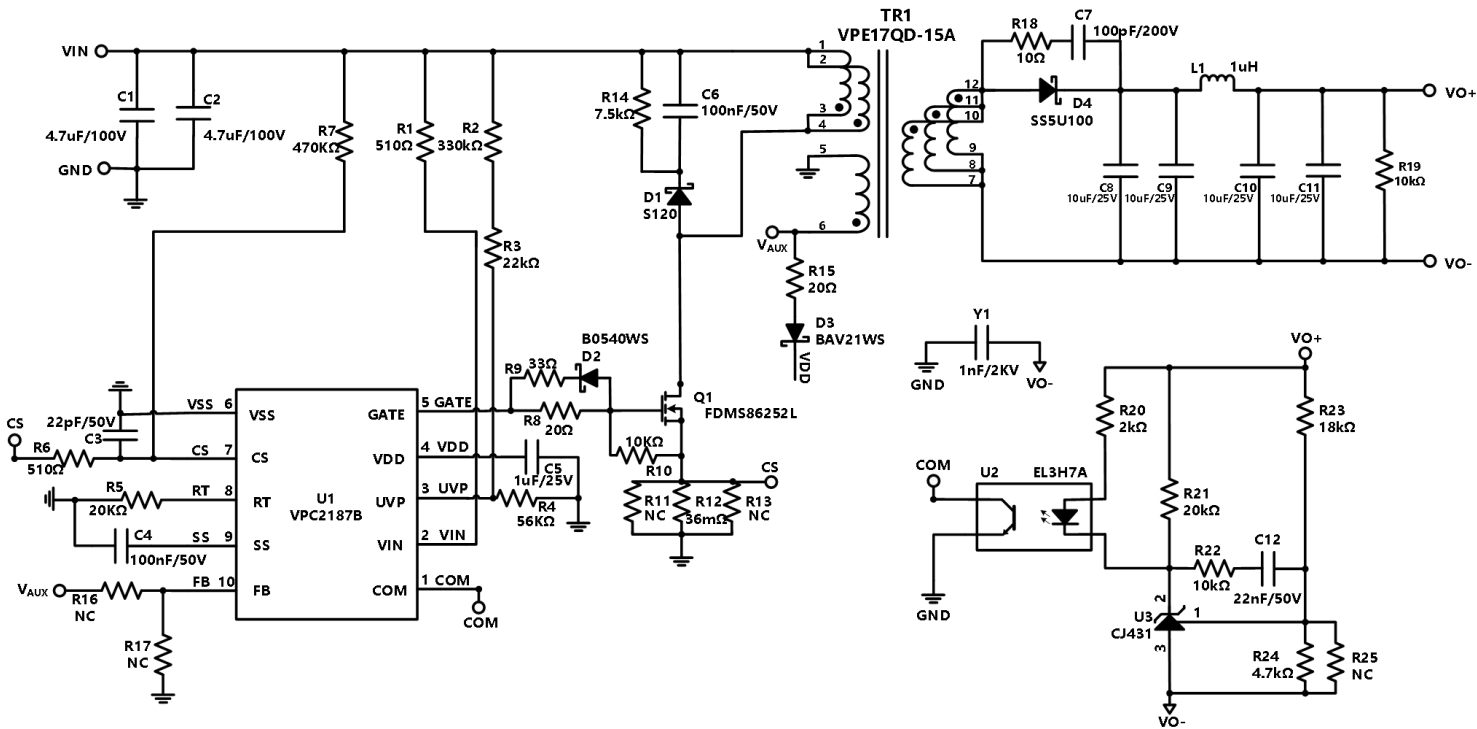


图 1: VPC2187 Demo 板(尺寸:55mm*55mm)

关键词：输入：18V-72V，输出 12V/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
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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	22pF/50V- NP0	0603	CC0603KRNPO9BN220	YAGEO
C4	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C5	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C6	100nF/50V-X7R	0805	CC0805KKX7R0BB104	YAGEO
C7	100pF/200V- NP0	0805	CC0805JRNPOABN101	YAGEO
C8	10uF/25V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C9	10uF/25V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C10	10uF/25V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C11	10uF/25V-X7R	1206	CC1206KKX7R8BB106	YAGEO
C12	22nF/50V-X7R	0603	CC0603KRX7R9BB223	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R2	330KΩ±1%	0603	RC0603FR-07330KL	YAGEO
R3	22KΩ±1%	0603	RC0603FR-0722KL	YAGEO
R4	56KΩ±1%	0603	RC0603FR-0756KL	YAGEO
R5	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R6	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R7	470K±1%	0603	RC0603FR-07470KL	YAGEO
R8	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R9	33Ω±1%	0603	RC0603FR-0733RL	YAGEO
R10	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R11	NC	-	-	-
R12	0.036Ω ±1%	1206	RL1206FR-070R036L	YAGEO
R13	NC	-	-	-
R14	7.5KΩ±1%	0805	RC0805FR-077K5L	YAGEO
R15	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R16	NC	-	-	-
R17	NC	-	-	-
R18	10Ω±1%	0805	RC0805FR-0710RL	YAGEO
R19	10KΩ±1%	1206	RC1206FR-0710KL	YAGEO
R20	2KΩ±1%	0603	RC0603FR-072KL	YAGEO
R21	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R22	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R23	18KΩ±1%	0603	RC0603FR-0718KL	YAGEO
R24	4.7KΩ±1%	0603	RC0603FR-074K7L	YAGEO
TR1	NP:NS:NA= 14:7:7	ER14.5	VPE17QD-15A	VPSC

	Lp=27.44uH			
Q1	N 沟道 150V 12A	Power-56-8	FDMS86252L	onsemi
L1	1uH ±20%	SMD	SWPA4030S1R0MT	SUNLORD
D1	200V/1A	SOD-123	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	CJ
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	100V/5A	TO-277	SS5U100	YANGJIE
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	SOT-23	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	3	---	346	mA
转换效率	VIN=48V, IO=1.25A	---	90.44	---	%
纹波&噪声	VIN=48V, IO=1.25A	---	70	88	mV
输出电压精度	VIN=48V, IO=1.25A	---	0.06	---	%
线性调节率	VIN=18V-72V, IO=1.25A	---	0.5	---	%
负载调整率	VIN=48V, IO=1.25A	---	0.5	---	%
最大容性负载	VIN=18V, IO=1.25A	---	7020	---	uF
输出过流点系数	VIN=18V, IO=1.25A	---	1.31	---	倍
输入欠压保护	锁定电压	---	14.6	---	V
	恢复电压	---	16.2	---	V
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

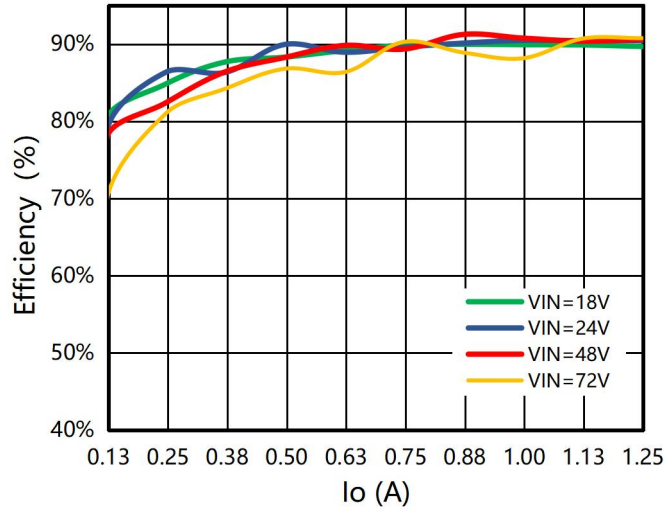


图 2: 效率 VS 输出电流

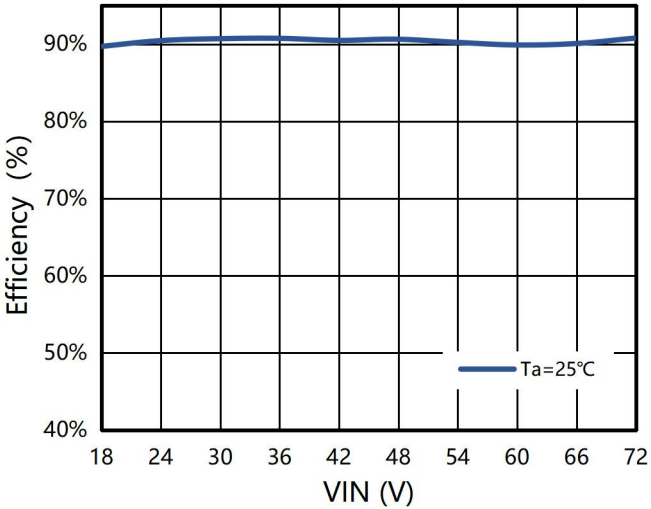
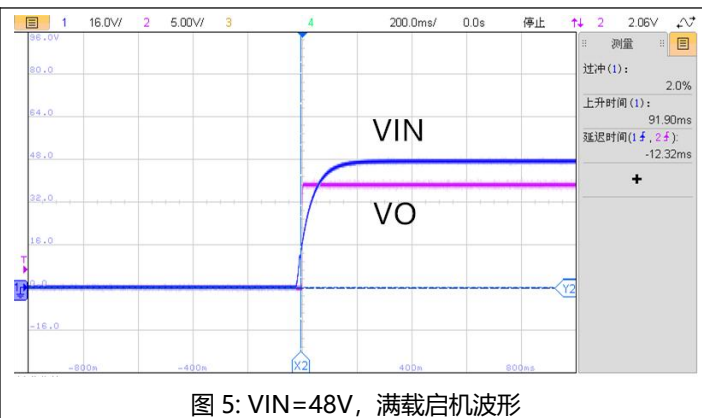
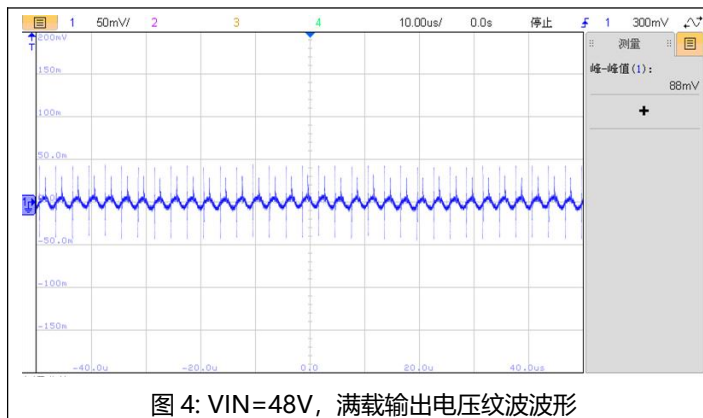


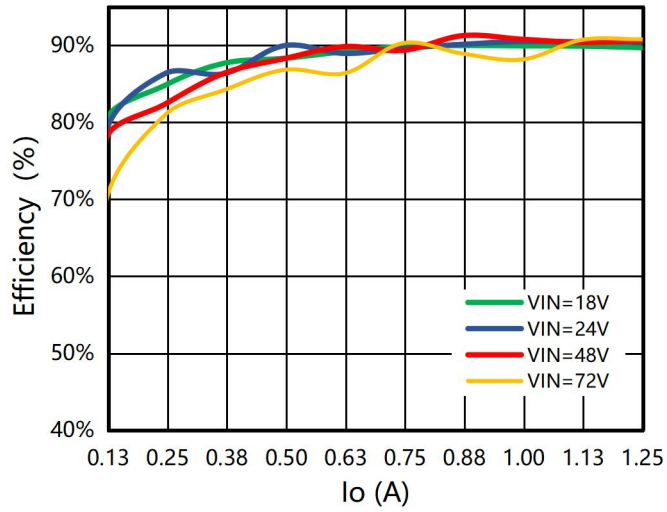
图 3: 效率 VS 输入电压（输出满载）

相关波形

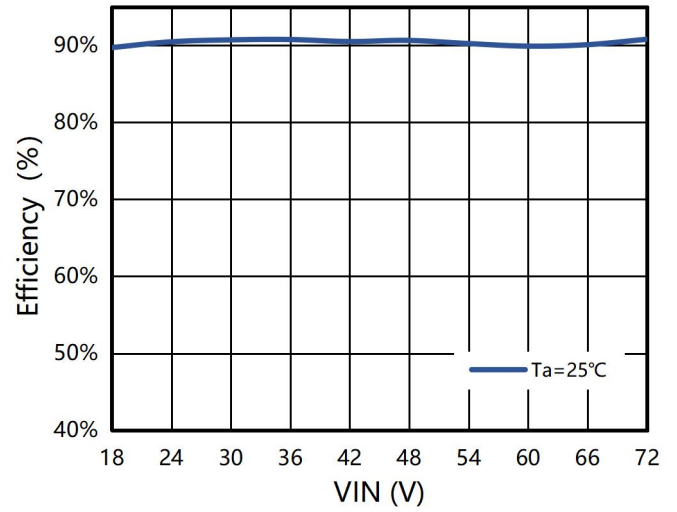


详细测试数据

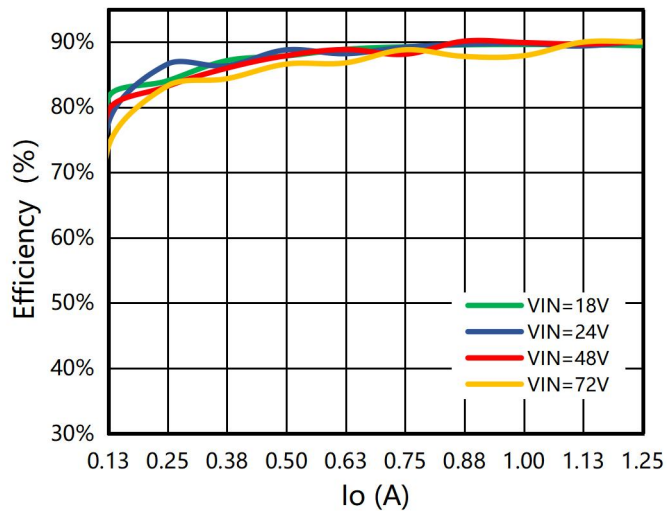
高低温测试曲线



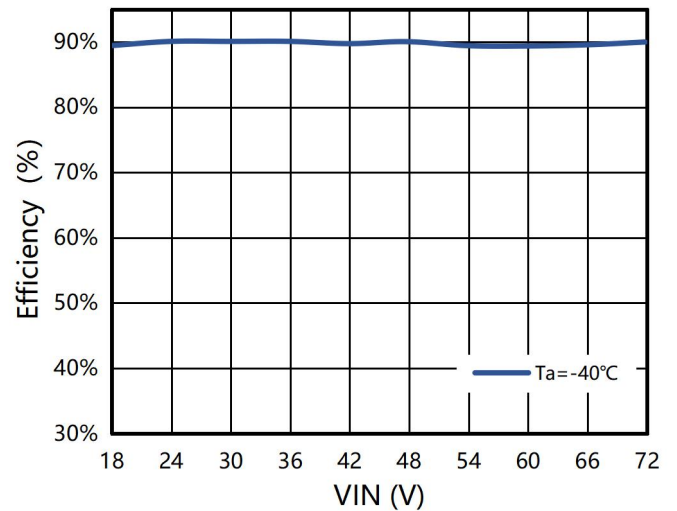
效率 VS 输出电流 (25°C)



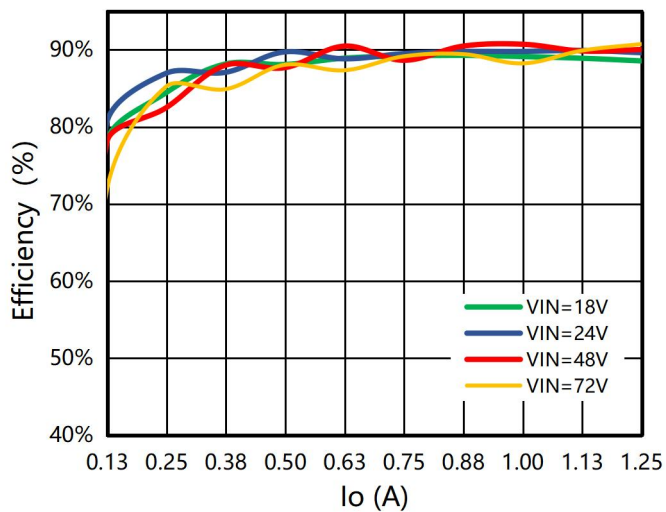
效率 VS 输入电压 (输出满载@25°C)



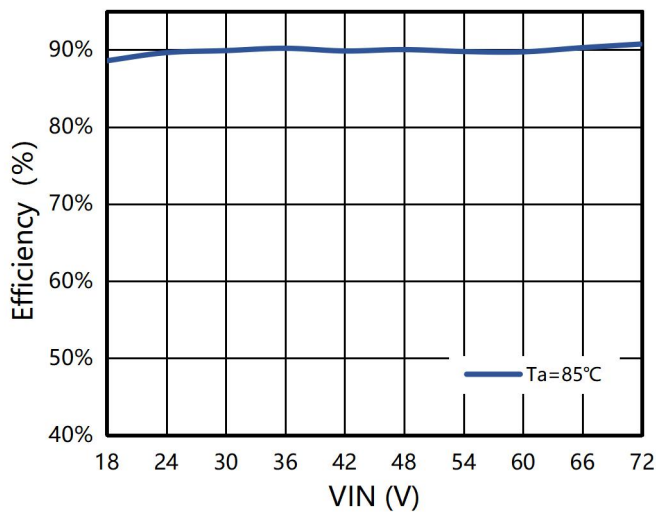
效率 VS 输出电流 (-40°C)



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=25°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
47.9	0.003	12.09	0	0%	0.00%
47.9	0.039	12.09	0.120	10%	77.66%
47.9	0.075	12.08	0.245	20%	82.38%
47.9	0.108	12.08	0.370	30%	86.40%
47.8	0.142	12.08	0.496	40%	88.27%
47.8	0.175	12.08	0.622	50%	89.82%
47.8	0.211	12.08	0.746	60%	89.35%
47.9	0.241	12.08	0.872	70%	91.25%
47.9	0.277	12.08	0.997	80%	90.77%
47.8	0.314	12.08	1.123	90%	90.38%
47.8	0.348	12.08	1.248	100%	90.63%

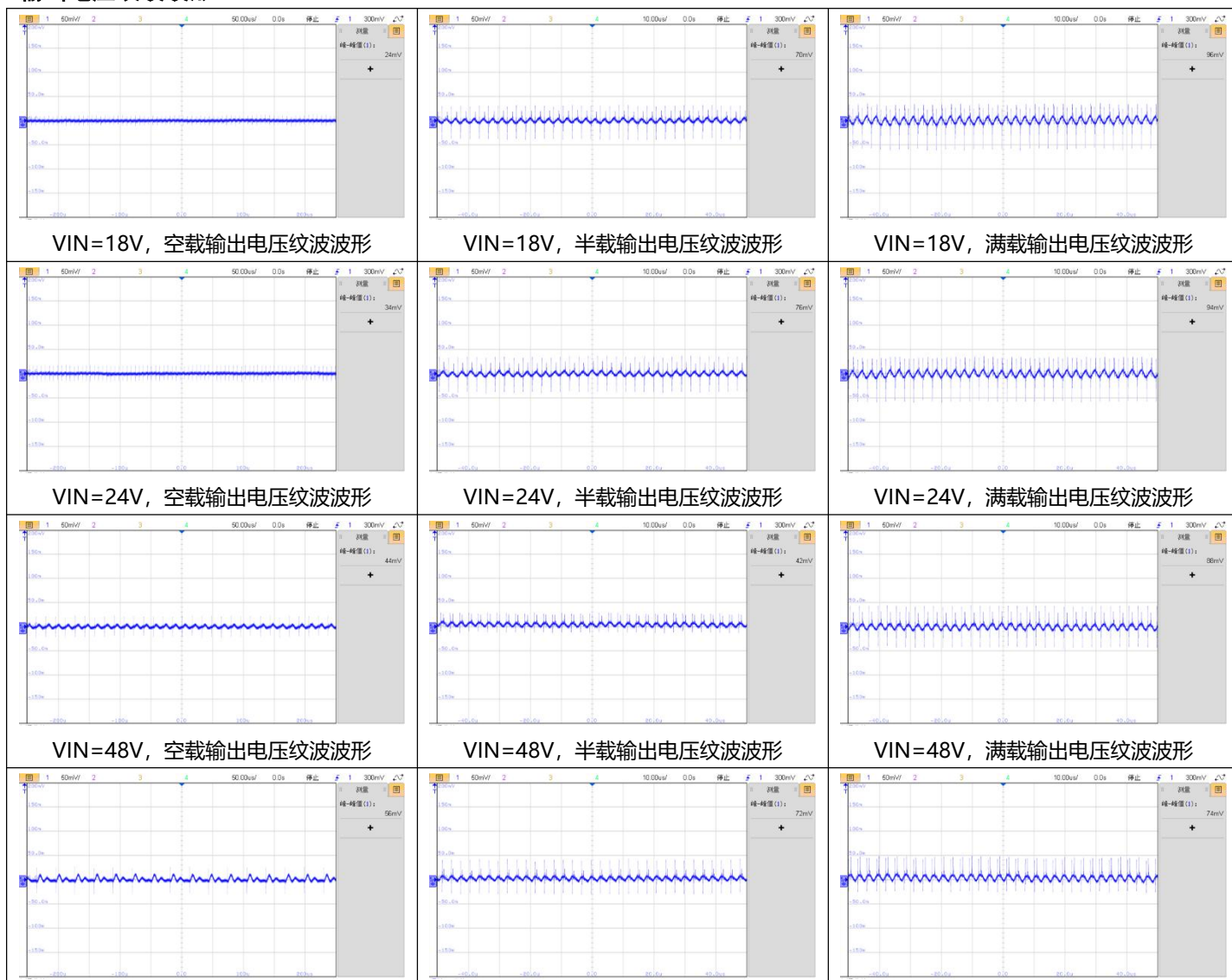
VIN=48V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
47.9	0.003	12	0	0%	0.00%
47.9	0.039	12	0.123	10%	79.01%
47.9	0.075	12	0.249	20%	83.17%
47.9	0.109	12	0.374	30%	85.96%
47.9	0.142	12	0.498	40%	87.86%
47.9	0.176	12	0.624	50%	88.82%
47.9	0.213	12	0.749	60%	88.09%
47.9	0.243	12	0.874	70%	90.11%
47.8	0.279	12	0.999	80%	89.89%
47.8	0.315	12	1.125	90%	89.66%
47.7	0.349	12	1.249	100%	90.03%

VIN=48V, Ta=85°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
47.9	0.003	12.06	0	0%	0.00%
47.9	0.040	12.05	0.124	10%	77.99%
47.9	0.076	12.06	0.249	20%	82.49%
47.9	0.107	12.06	0.374	30%	88.00%
47.9	0.143	12.06	0.498	40%	87.68%
47.8	0.174	12.06	0.624	50%	90.48%
47.8	0.213	12.05	0.749	60%	88.65%
47.9	0.243	12.05	0.874	70%	90.48%
47.9	0.277	12.05	0.999	80%	90.73%
47.9	0.315	12.05	1.125	90%	89.84%
47.9	0.349	12.05	1.249	100%	90.03%

输出电压纹波波形

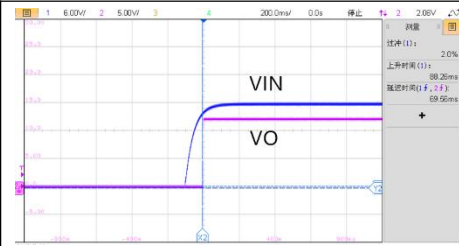


VIN=72V, 空载输出电压纹波波形

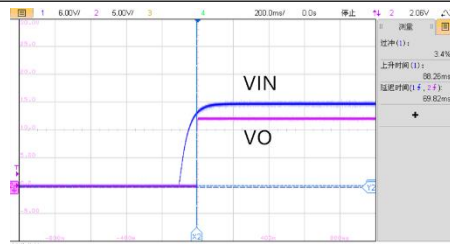
VIN=72V, 半载输出电压纹波波形

VIN=72V, 满载输出电压纹波波形

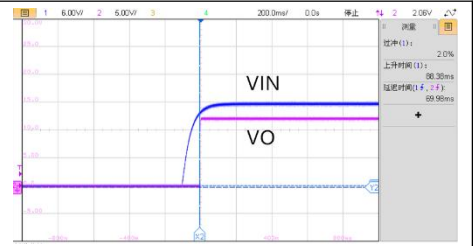
开关机波形



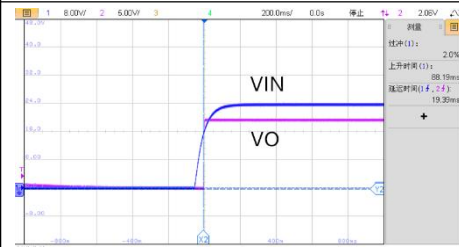
VIN=18V, 空载启机波形



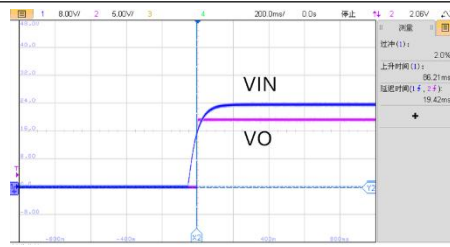
VIN=18V, 半载启机波形



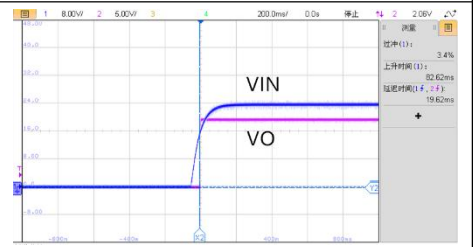
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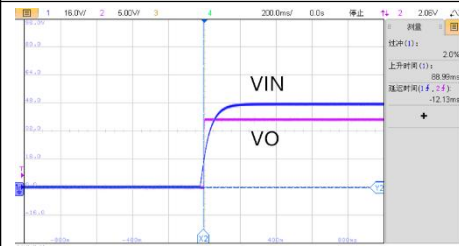
VIN=24V, 空载启机波形



VIN=24V, 半载启机波形



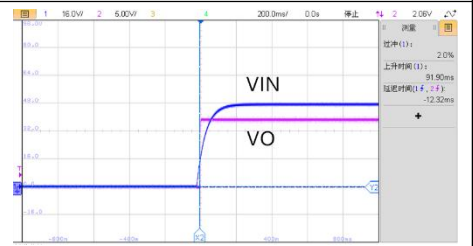
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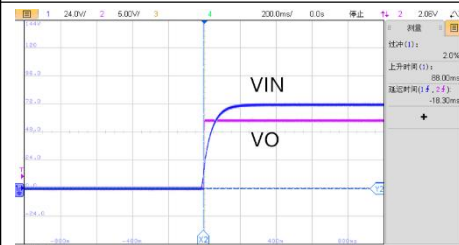
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VIN=48V, 半载启机波形



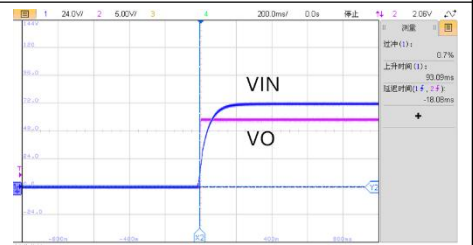
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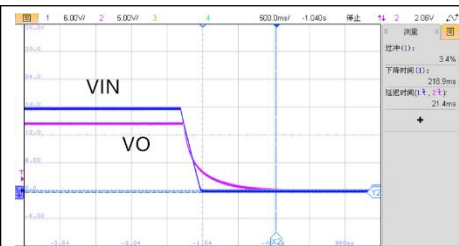
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VIN=72V, 半载启机波形



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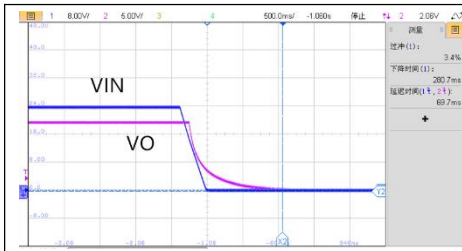
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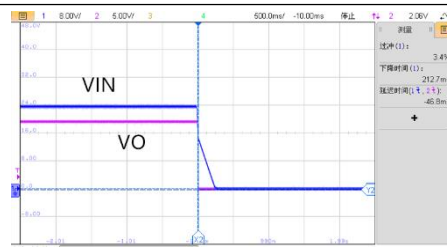
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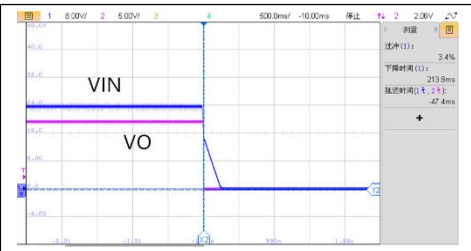
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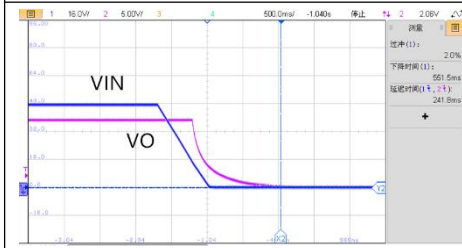
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VIN=24V, 半载关机波形



VIN=24V, 满载关机波形



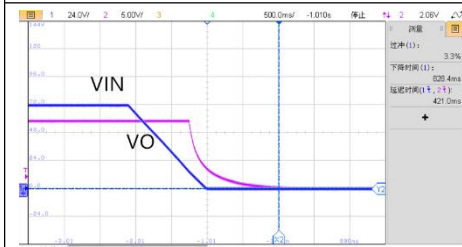
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VIN=48V, 半载关机波形



VIN=48V, 满载关机波形



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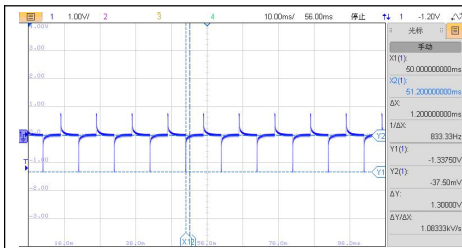


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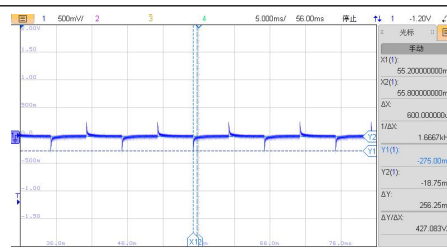


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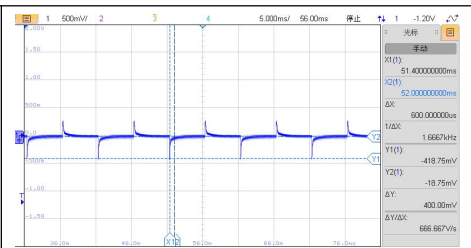
动态波形



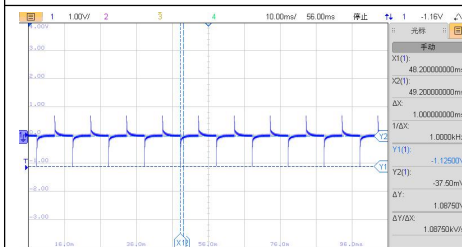
VIN=18V, 100%-10%-100%Io 动态波形



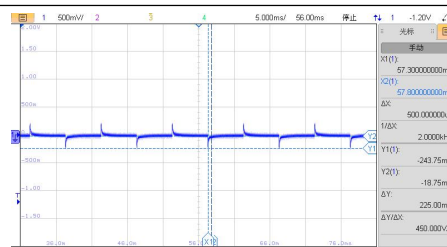
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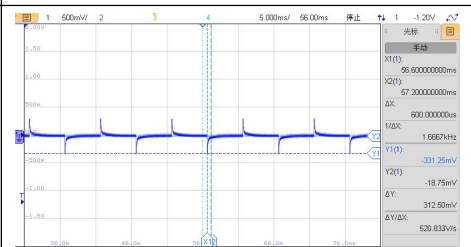
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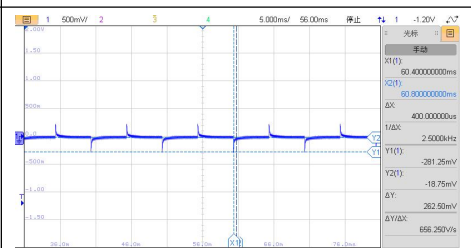
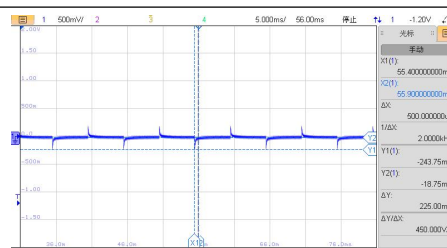
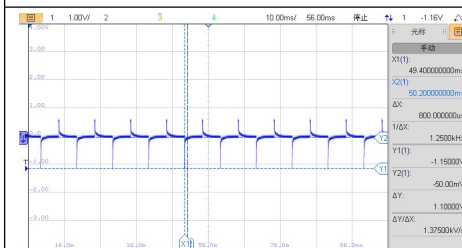
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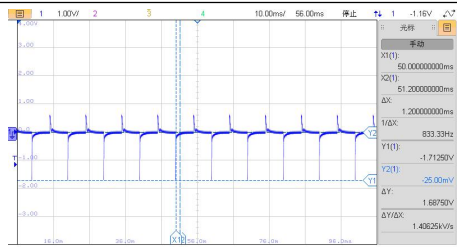
VIN=24V, 75%-50%-75%Io 动态波形



VIN=24V, 50%-25%-50%Io 动态波形

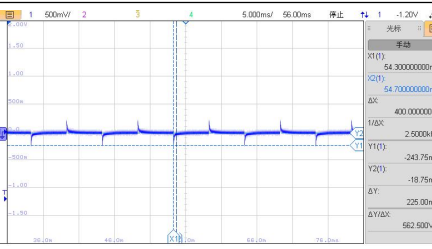


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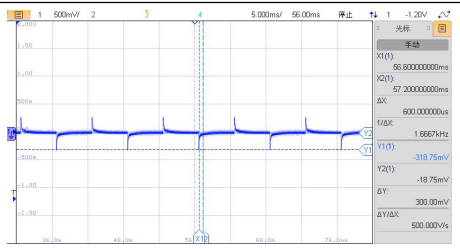
VIN=72V, 100%-10%-100%Io 动态波形

VIN=48V, 75%-50%-75%Io 动态波形



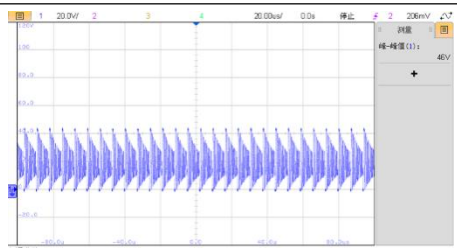
VIN=72V, 75%-50%-75%Io 动态波形

VIN=48V, 50%-25%-50%Io 动态波形

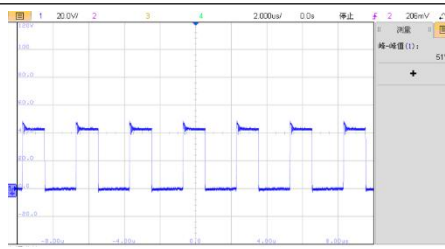


VIN=72V, 50%-25%-50%Io 动态波形

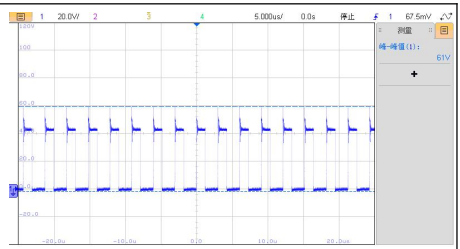
外置 MOS 管 Q1 电压应力波形



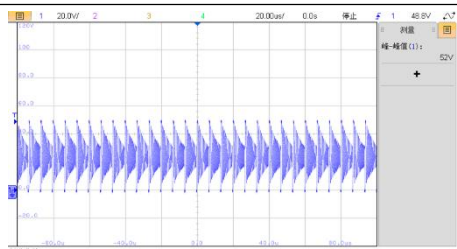
VIN=18V, 空载 VDS 波形



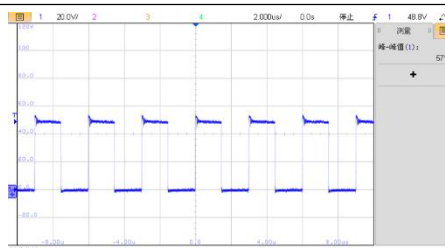
VIN=18V, 半载 VDS 波形



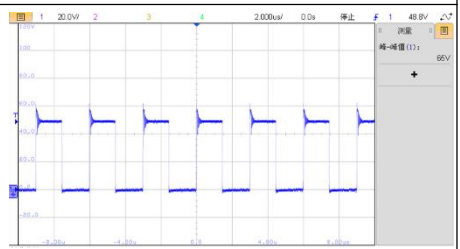
VIN=18V, 满载 VDS 波形



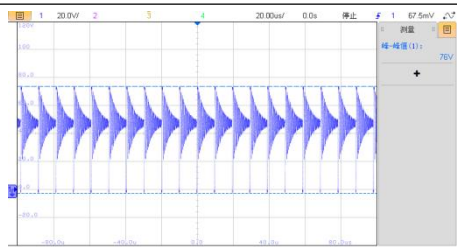
VIN=24V, 空载 VDS 波形



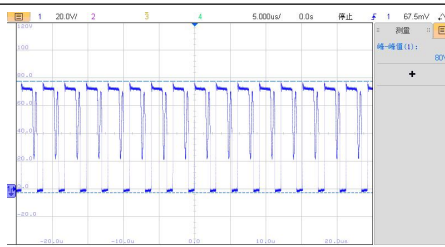
VIN=24V, 半载 VDS 波形



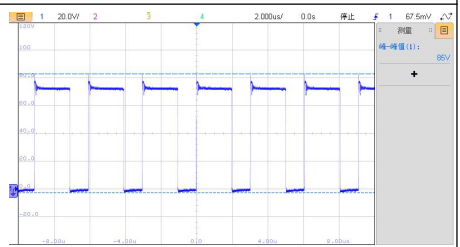
VIN=24V, 满载 VDS 波形



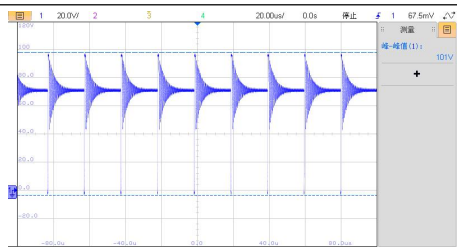
VIN=48V, 空载 VDS 波形



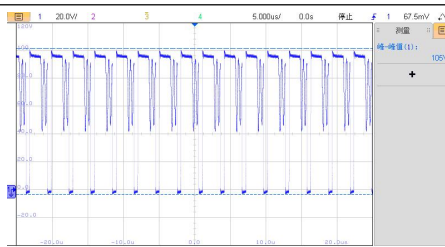
VIN=48V, 半载 VDS 波形



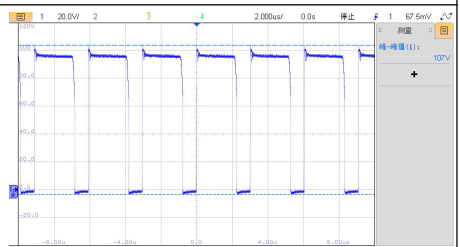
VIN=48V, 满载 VDS 波形



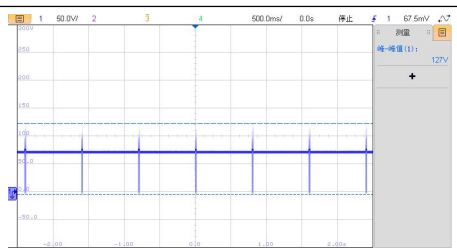
VIN=72V, 空载 VDS 波形



VIN=72V, 半载 VDS 波形



VIN=72V, 满载 VDS 波形

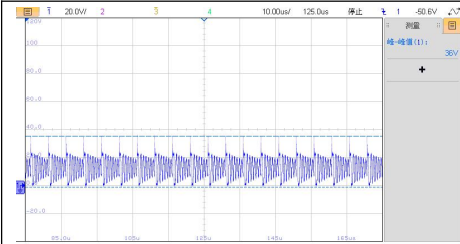


VIN=72V，短路保护 VDS 波形

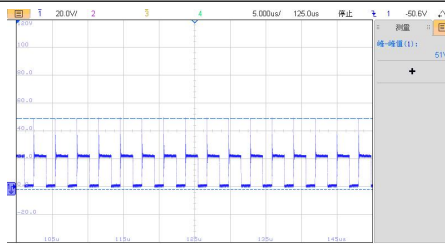
VIN=72V，短路保护 VDS 展开波形

VIN=72V，短路保护 VDS 启机波形

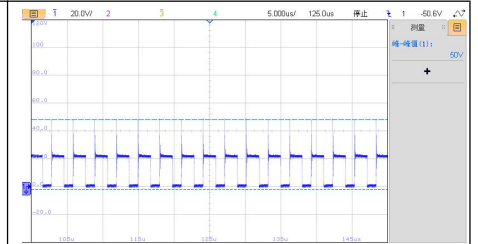
副边输出整流二极管 D4 应力波形



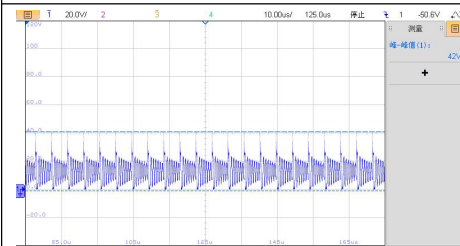
VIN=18V，D4 空载工作电压波形



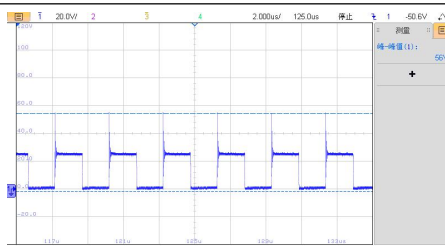
VIN=18V，D4 半载工作电压波形



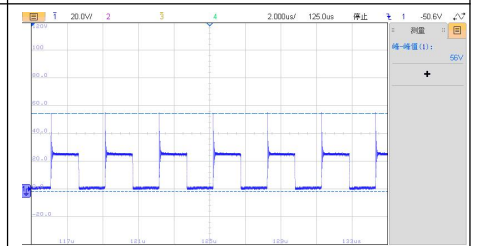
VIN=18V，D4 满载工作电压波形



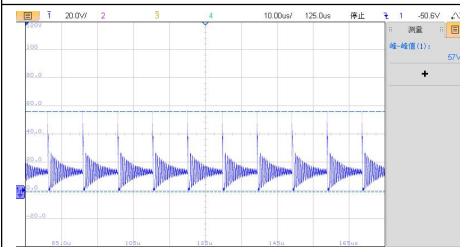
VIN=24V，D4 空载工作电压波形



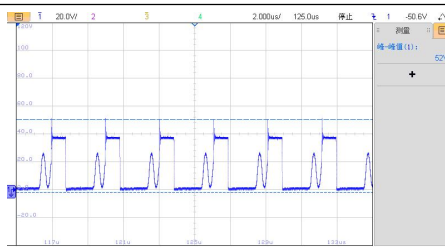
VIN=24V，D4 半载工作电压波形



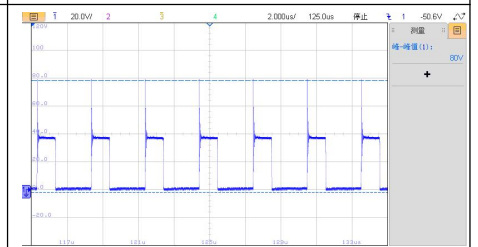
VIN=24V，D4 满载工作电压波形



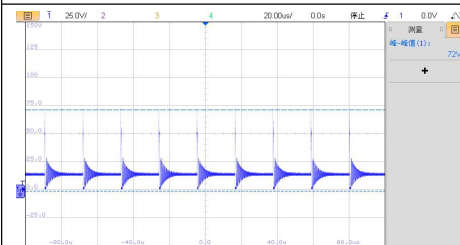
VIN=48V，D4 空载工作电压波形



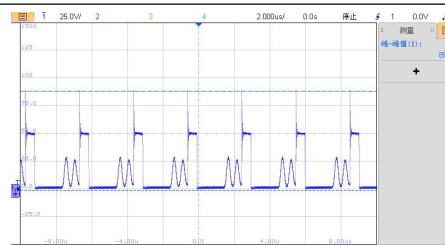
VIN=48V，D4 半载工作电压波形



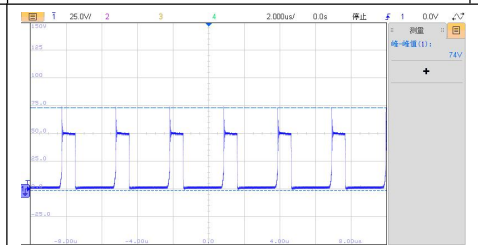
VIN=48V，D4 满载工作电压波形



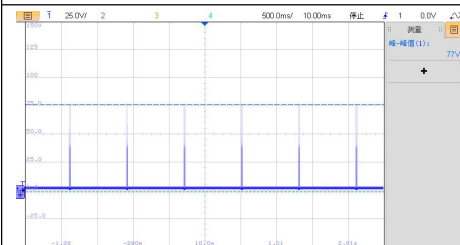
VIN=72V，D4 空载工作电压波形



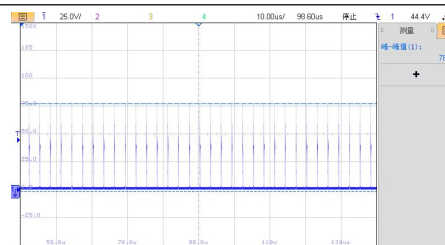
VIN=72V，D4 半载工作电压波形



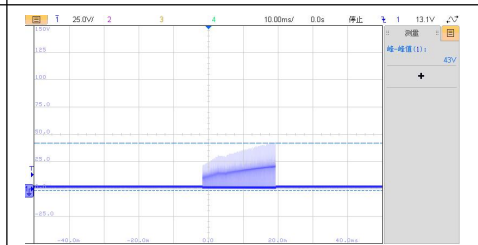
VIN=72V，D4 满载工作电压波形



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，D4 短路保护工作电压启机波形

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