

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 VPE27BBB06A、输出整流二极管以及必要的阻容元件，实现 4.5V-9V 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 6W 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）抗干扰目的相关场合。

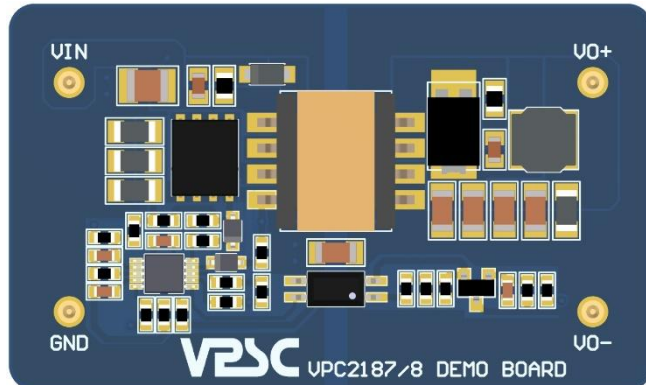
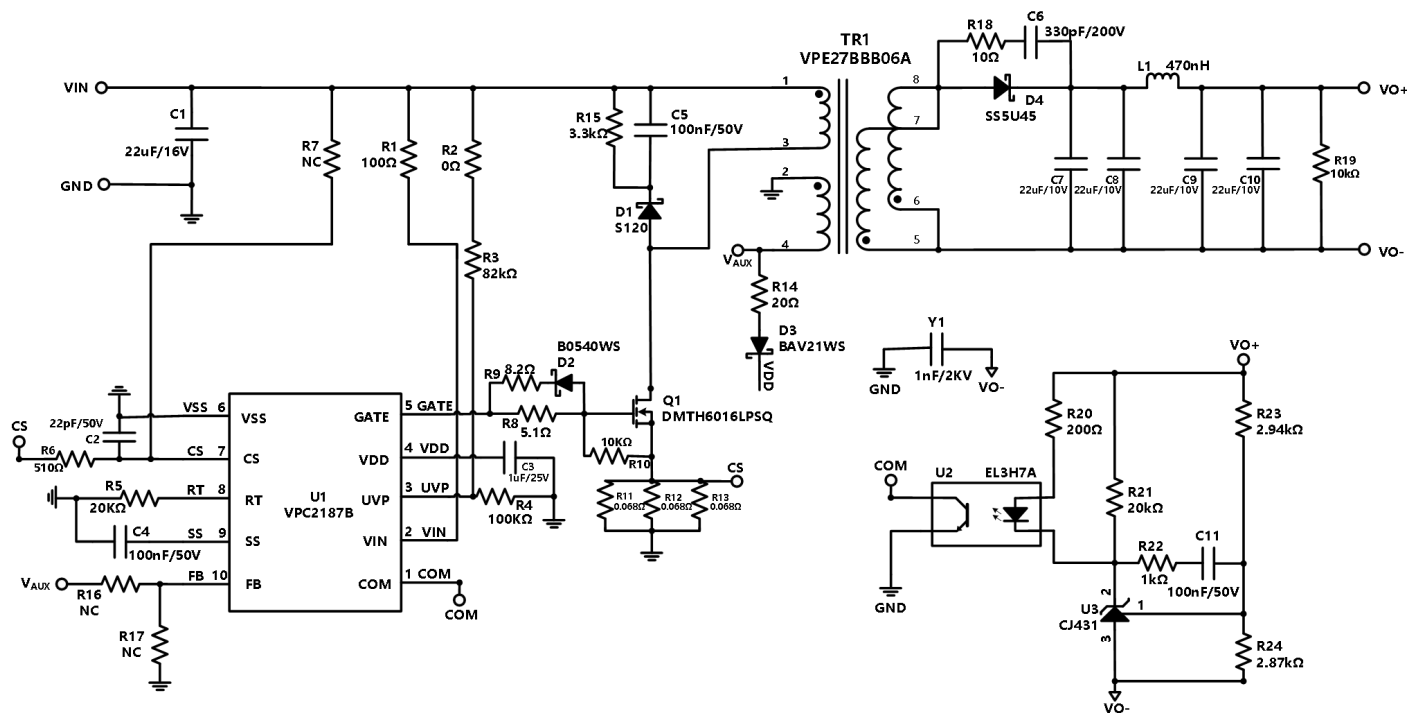


图 1: VPC2187 Demo 板(尺寸:50mm*30mm)

关键词：输入：4.5V-9V，输出 5V/6W，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

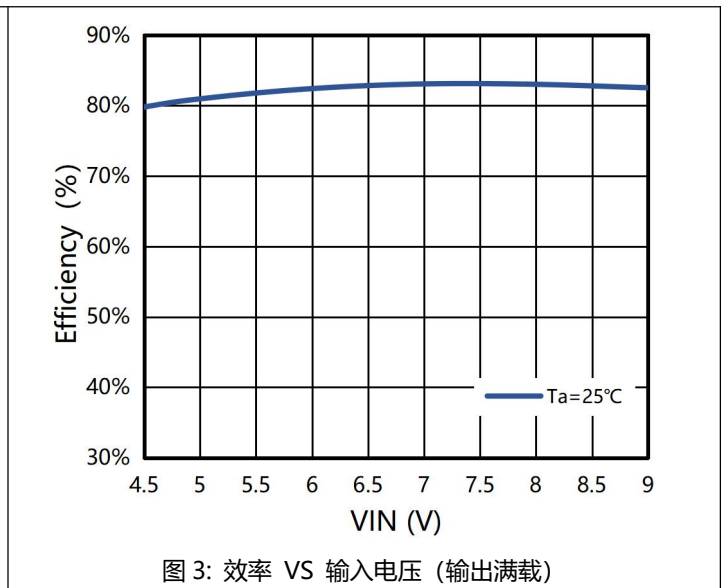
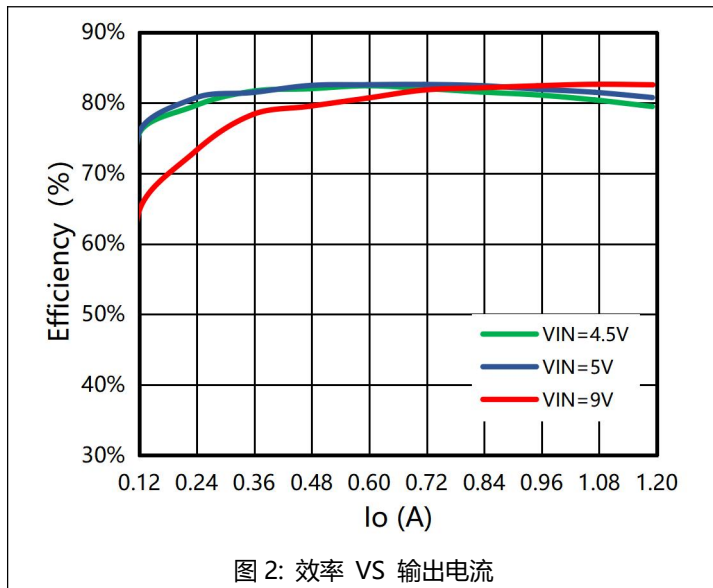
位号	参数	封装	型号	品牌
C1	22uF/16V-X5R	1210	CC1210KKX5R7BB226	YAGEO
C2	22pF/50V- NP0	0603	CC0603KRNPO9BN220	YAGEO
C3	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C4	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C5	100nF/50V-X7R	0805	CC0805KKX7R0BB104	YAGEO
C6	330pF/200V- NP0	0805	CC0805JRNPO9BN331	YAGEO
C7	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C8	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C9	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C10	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C11	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	100Ω±1%	0603	RC0603FR-07100RL	YAGEO
R2	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R3	82KΩ±1%	0603	RC0603FR-0782KL	YAGEO
R4	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R5	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R6	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R7	NC	-	-	-
R8	5.1Ω±1%	0603	RC0603FR-075R1L	YAGEO
R9	8.2Ω±1%	0603	RC0603FR-078R2L	YAGEO
R10	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R11	0.068Ω ±1%	1206	RL1206FR-070R068L	YAGEO
R12	0.068Ω ±1%	1206	RL1206FR-070R068L	YAGEO
R13	0.068Ω ±1%	1206	RL1206FR-070R068L	YAGEO
R14	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R15	3.3KΩ±1%	0805	RC0805FR-073K3L	YAGEO
R16	NC	-	-	-
R17	NC	-	-	-
R18	10Ω±1%	0805	RC0805FR-0710RL	YAGEO
R19	10KΩ±1%	1206	RC1206FR-0710KL	YAGEO
R20	200Ω±1%	0603	RC0603FR-07200RL	YAGEO
R21	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R22	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R23	2.94KΩ±1%	0603	RC0603FR-072K94L	YAGEO
R24	2.87KΩ±1%	0603	RC0603FR-072K87L	YAGEO
TR1	NP:NS:NA=5:6:13 Lp=2.75uH	ER11.5	VPE27BBB06A	VPSC
Q1	N 沟道 60V 9.8A	PowerDI5060-8	DMTH6016LPSQ	DIODES
L1	470nH ±30%	SMD	FNR5020SR47NT	CJIANG

D1	200V/1A	SOD-123	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	DIODES
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	45V/5A	TO-277	SS5U45	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	SOT23-3	CJ431	CJ

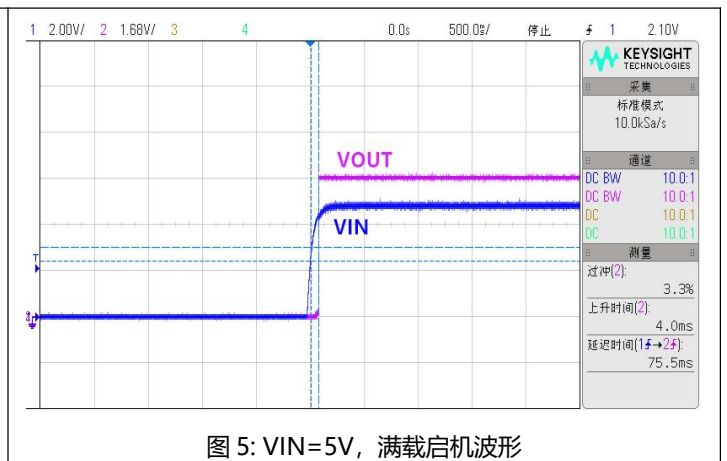
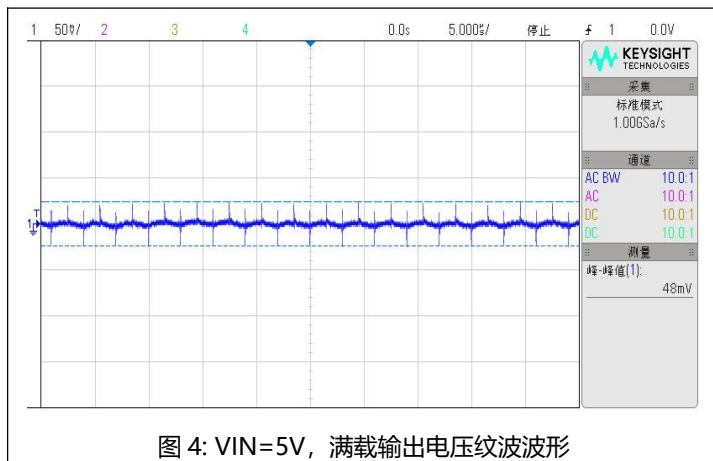
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流（满载/空载）	VIN=5V	12	---	1526	mA
转换效率	VIN=5V, IO=1.2A	---	80.7	---	%
纹波&噪声	VIN=5V, IO=1.2A	---	48	90	mV
输出电压精度	VIN=5V, IO=1.2A	---	1.2	---	%
线性调节率	VIN=4.5V-9V, IO=1.2A	---	0.5	---	%
负载调整率	VIN=5V, IO=1.2A	---	0.5	---	%
输入欠压保护	锁定电压	---	3.6	---	V
	恢复电压	---	4.0	---	V
短路保护	VIN=4.5V-9V	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

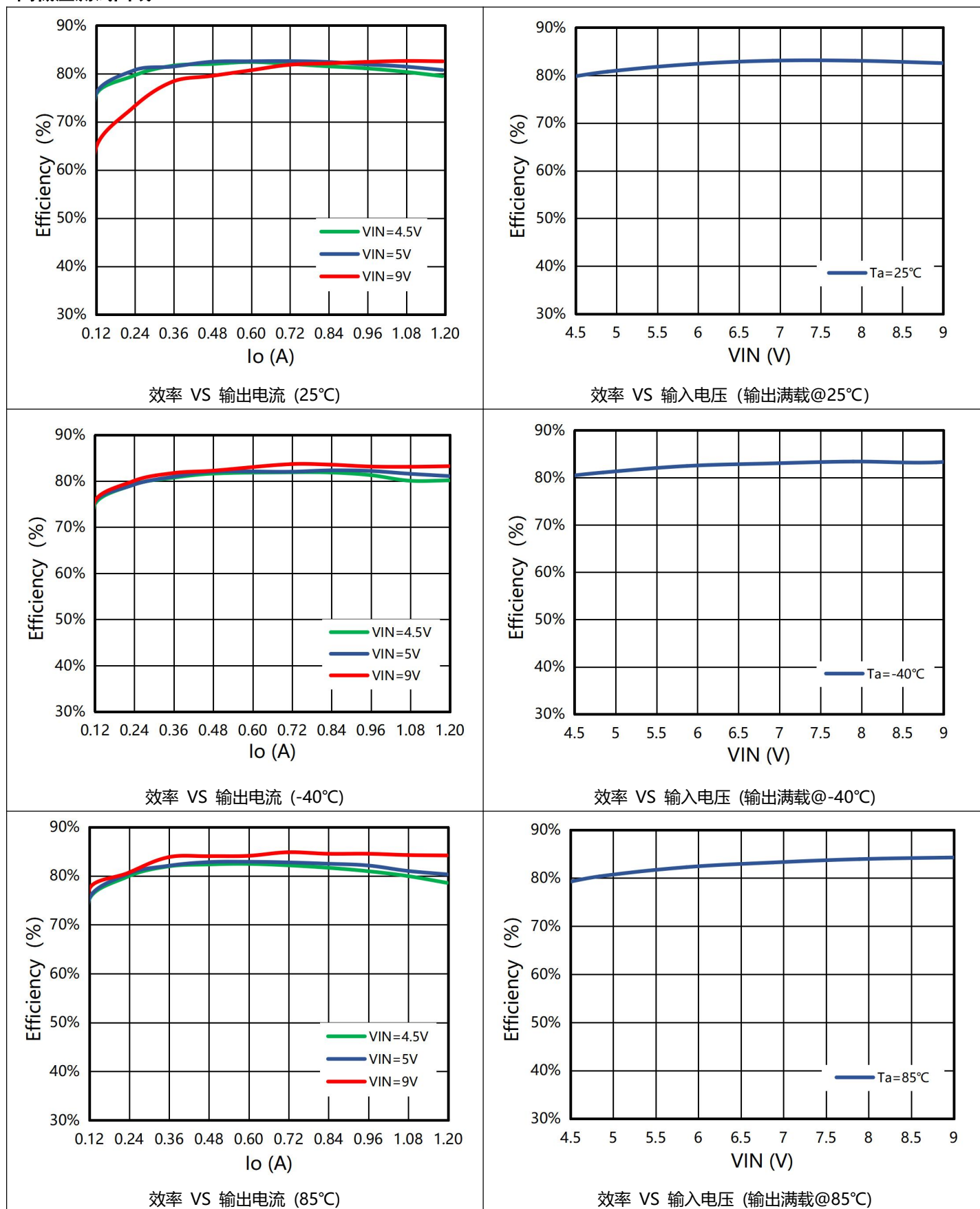


相关波形



详细测试数据

高低温测试曲线



VIN=5V, Ta=25°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
4.99	0.012	5.06	0	0%	0.00%
4.98	0.158	5.06	0.117	10%	75.24%
4.97	0.299	5.06	0.237	20%	80.70%
4.96	0.447	5.06	0.357	30%	81.48%
4.95	0.590	5.06	0.476	40%	82.47%
4.94	0.738	5.06	0.595	50%	82.58%
4.93	0.887	5.06	0.714	60%	82.62%
4.92	1.039	5.06	0.833	70%	82.45%
4.91	1.196	5.06	0.951	80%	81.94%
4.9	1.357	5.06	1.071	90%	81.50%
4.89	1.526	5.06	1.191	100%	80.76%

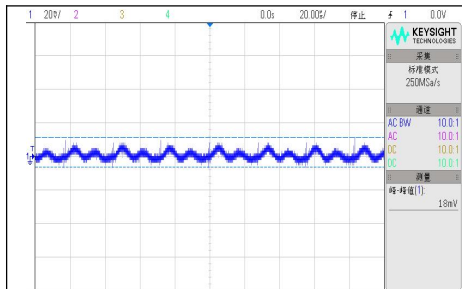
VIN=5V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
4.98	0.011	5.04	0	0%	0.00%
4.95	0.158	5.04	0.116	10%	74.75%
4.94	0.303	5.04	0.235	20%	79.13%
4.93	0.451	5.04	0.357	30%	80.92%
4.91	0.597	5.04	0.477	40%	82.01%
4.9	0.896	5.03	0.716	60%	82.03%
4.88	1.048	5.03	0.837	70%	82.32%
4.86	1.205	5.03	0.957	80%	82.20%
4.86	1.365	5.03	1.076	90%	81.59%
4.85	1.531	5.03	1.197	100%	81.09%

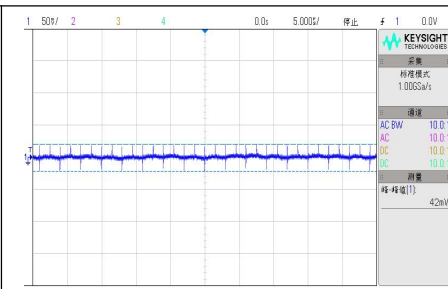
VIN=5V, Ta=85°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
4.99	0.013	5.04	0	0%	0.00%
4.98	0.158	5.03	0.117	10%	74.79%
4.94	0.300	5.03	0.237	20%	80.44%
4.93	0.445	5.03	0.358	30%	82.08%
4.92	0.590	5.03	0.478	40%	82.83%
4.91	0.739	5.03	0.598	50%	82.90%
4.89	0.891	5.03	0.717	60%	82.78%
4.88	1.047	5.03	0.838	70%	82.50%
4.86	1.207	5.03	0.958	80%	82.15%
4.85	1.377	5.02	1.078	90%	81.03%
4.84	1.547	5.02	1.198	100%	80.32%

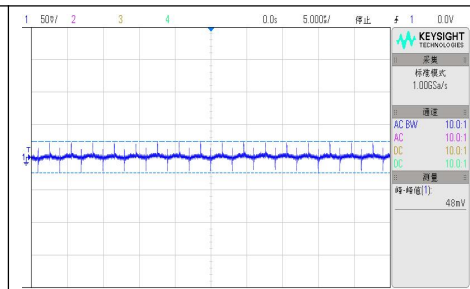
输出电压纹波波形



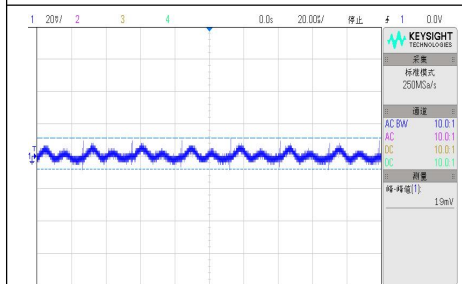
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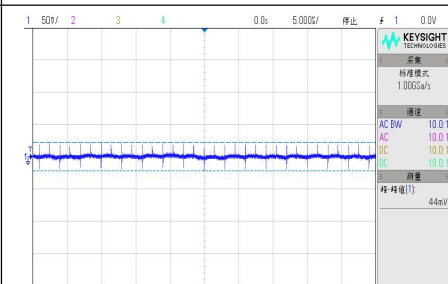
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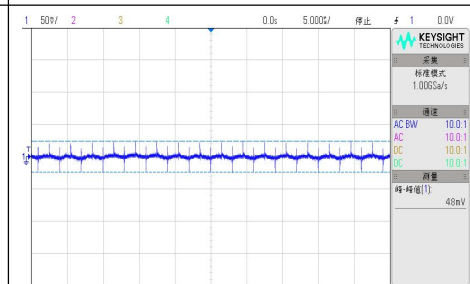
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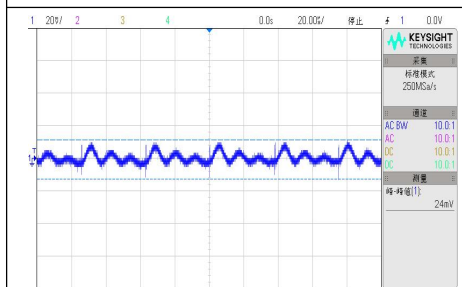
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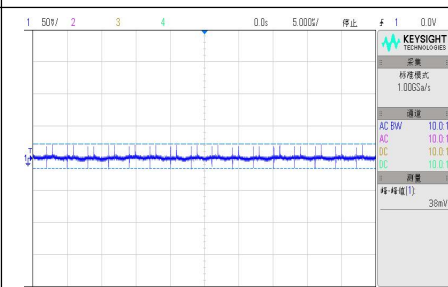
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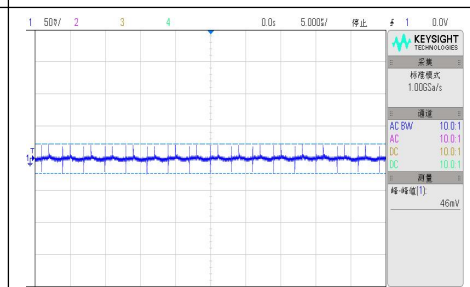
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VIN=9V，空载输出电压纹波波形

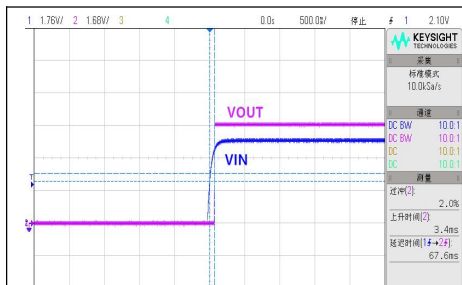


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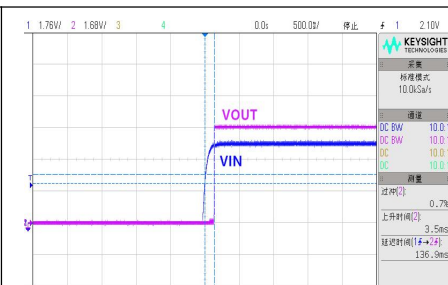


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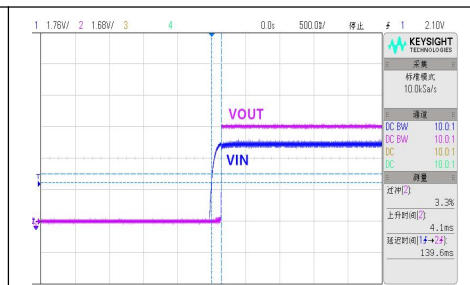
开关机波形（常温 25℃）



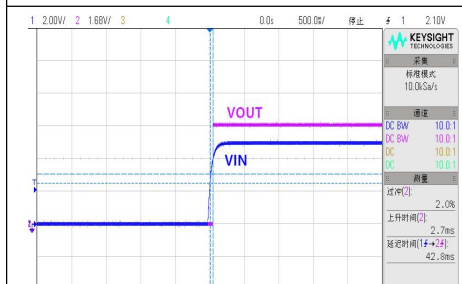
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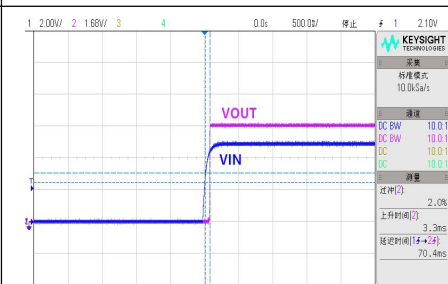
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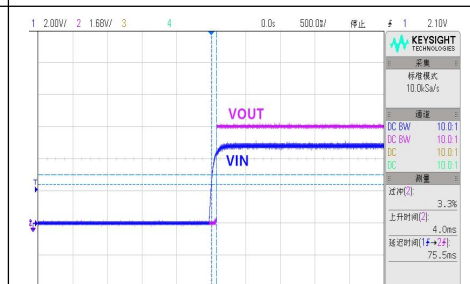
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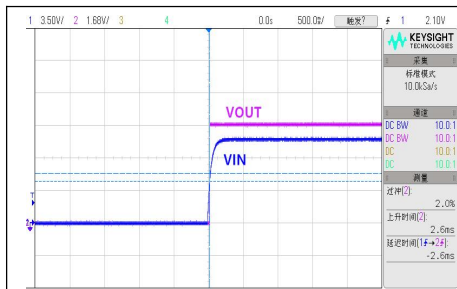
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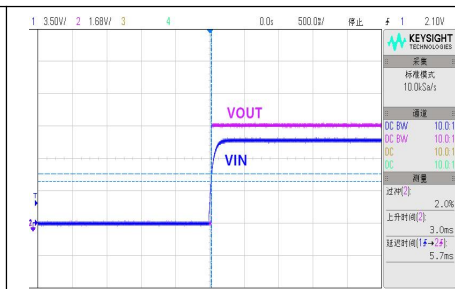
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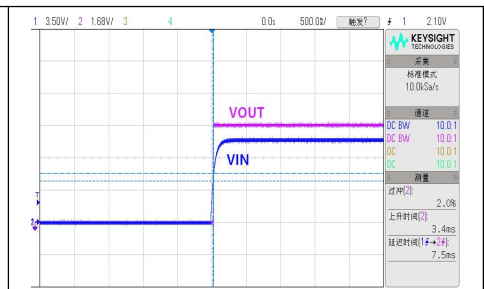
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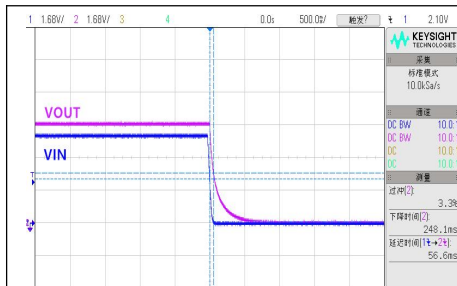
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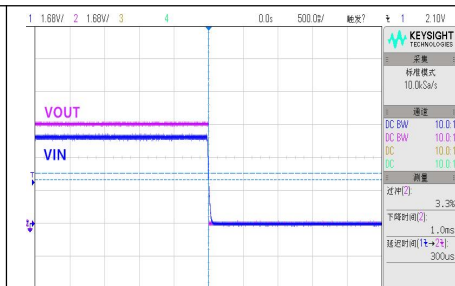
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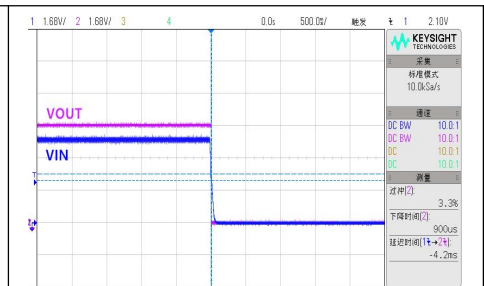
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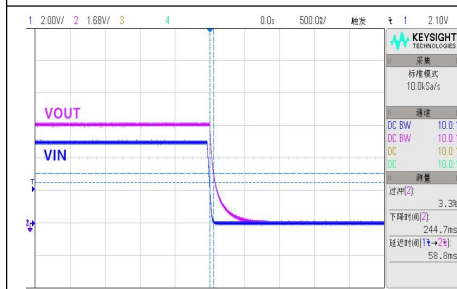
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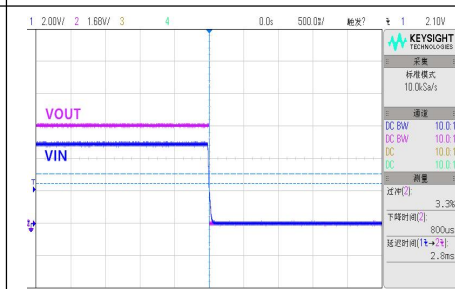
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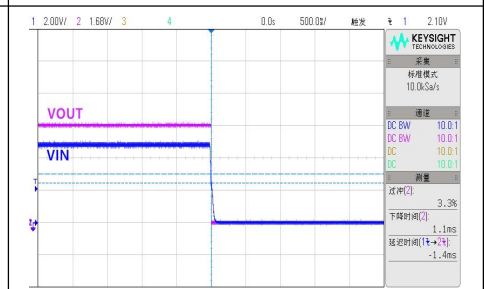
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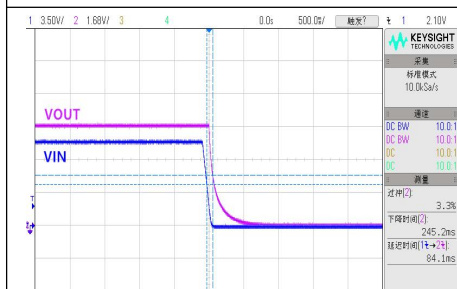
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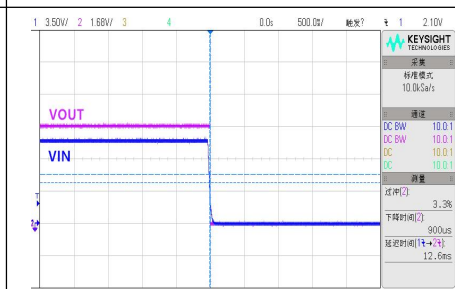
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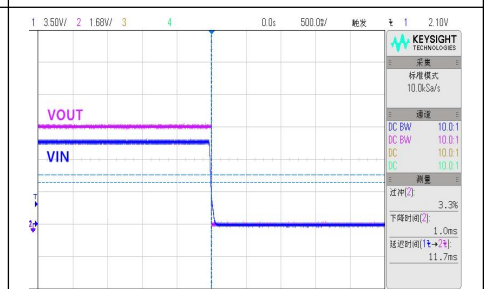
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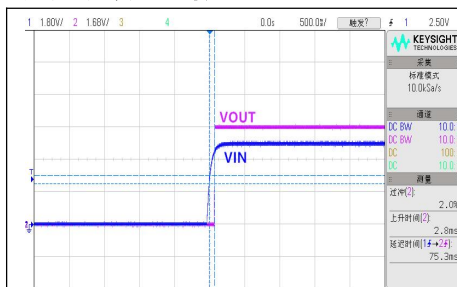


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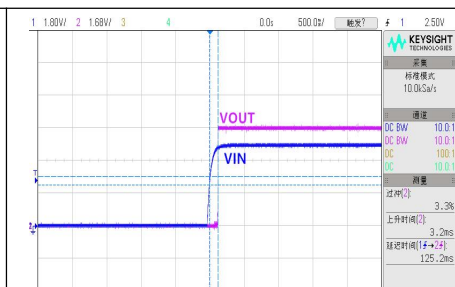


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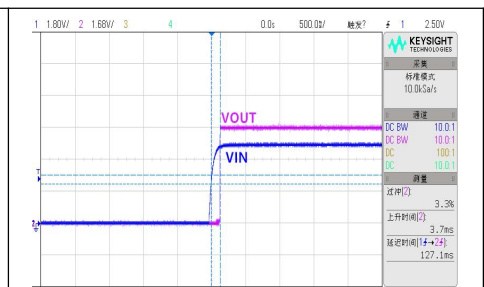
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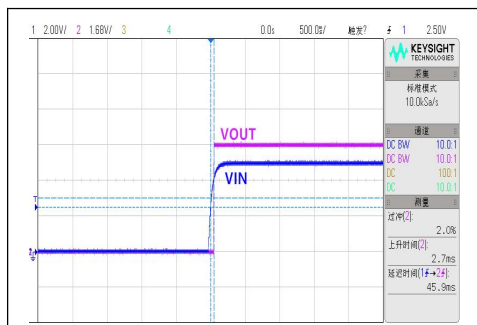
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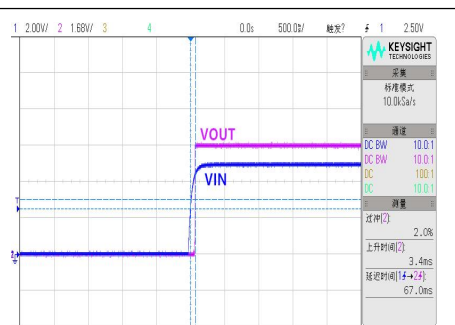
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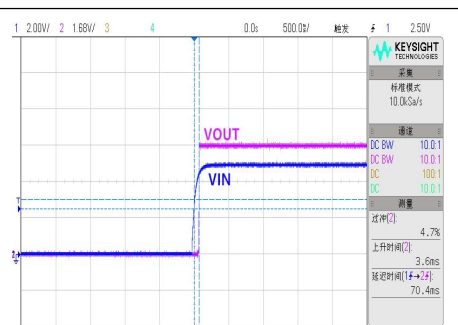
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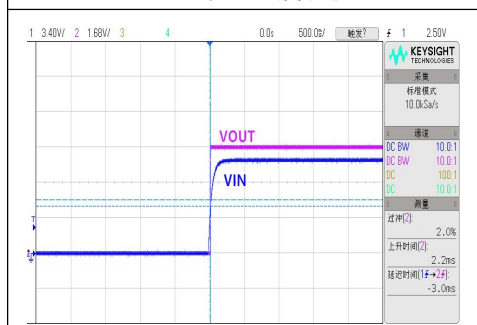
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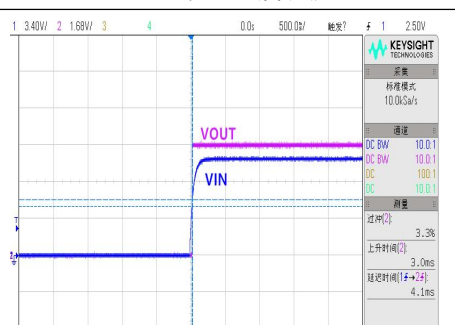
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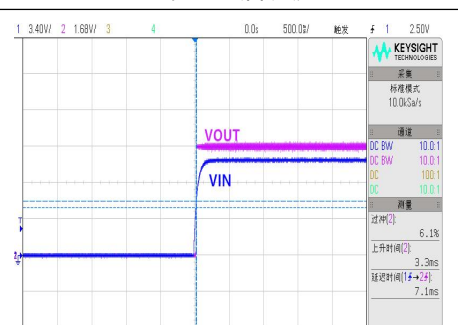
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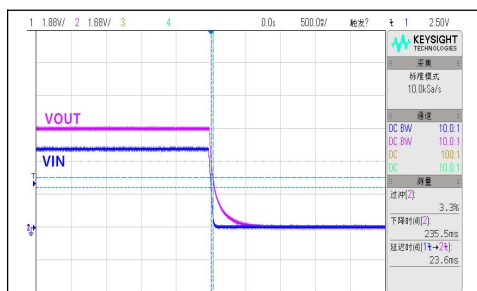
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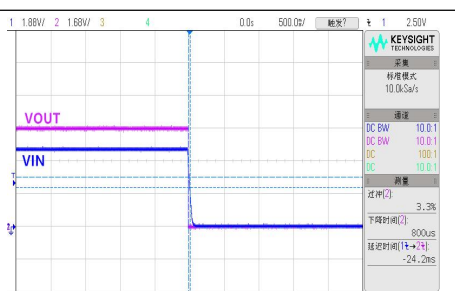
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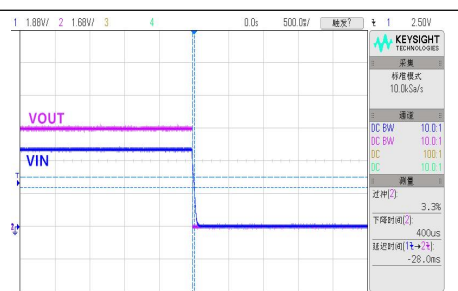
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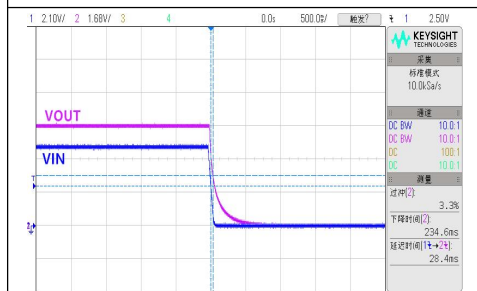
VIN=4.5V, 空载关机波形



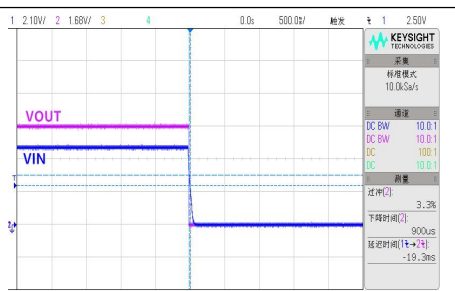
VIN=4.5V, 半载关机波形



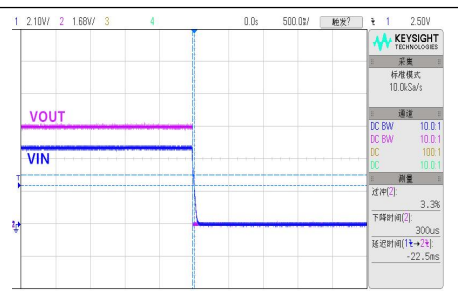
VIN=9V, 满载关机波形



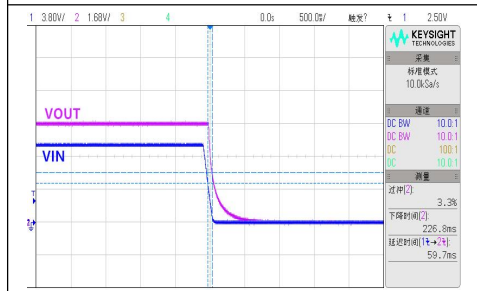
VIN=5V, 空载关机波形



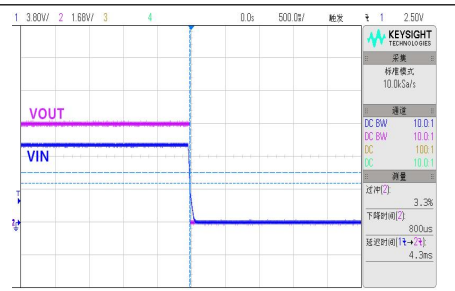
VIN=5V, 半载关机波形



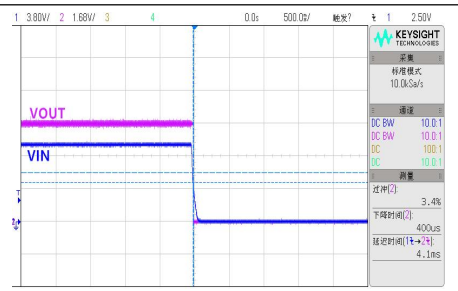
VIN=5V, 满载关机波形



VIN=9V, 空载关机波形

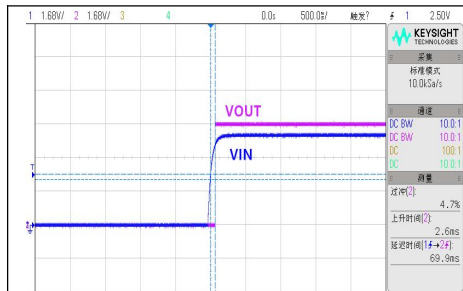


VIN=9V, 半载关机波形

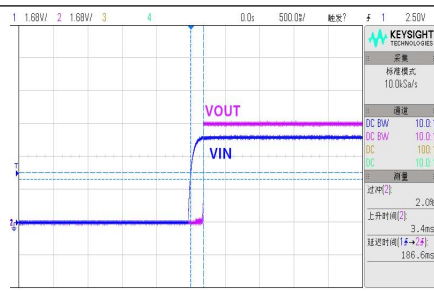


VIN=9V, 满载关机波形

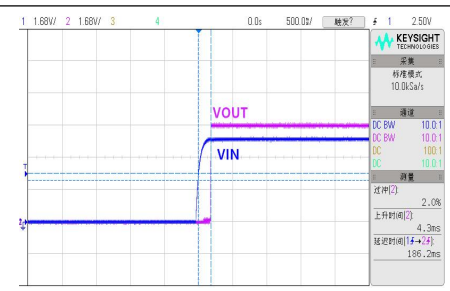
开关机波形 (高温 85°C)



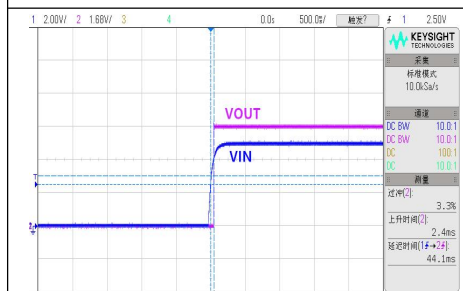
VIN=4.5V, 空载启机波形



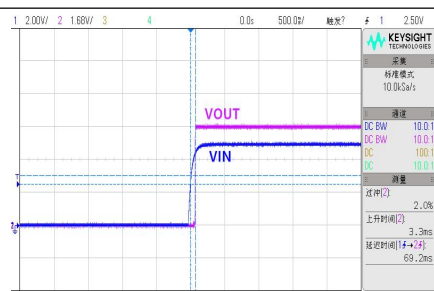
VIN=4.5V, 半载启机波形



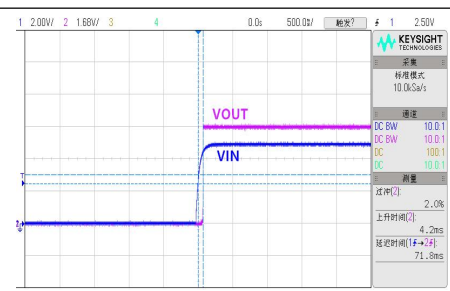
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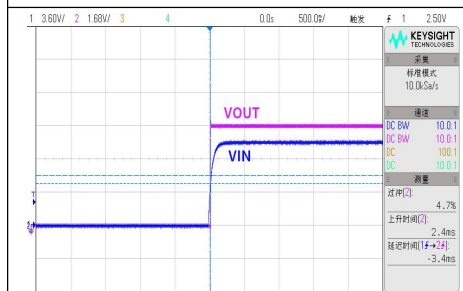
VIN=5V, 空载启机波形



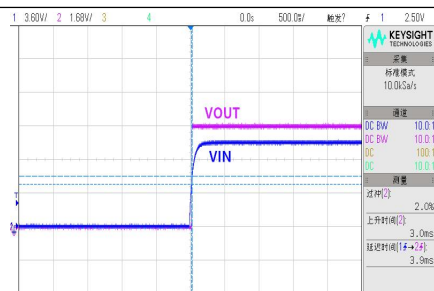
VIN=5V, 半载启机波形



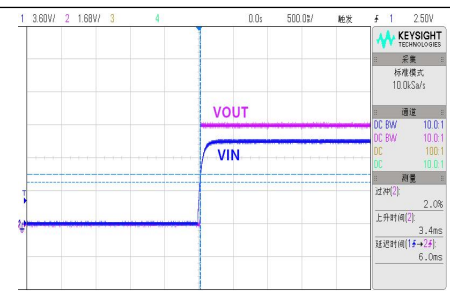
VIN=5V, 满载启机波形



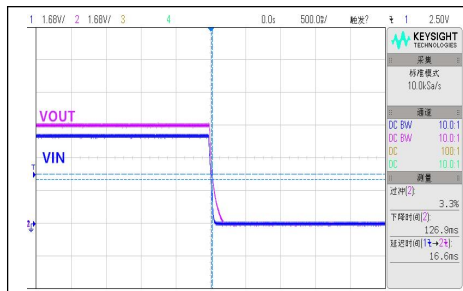
VIN=9V, 空载启机波形



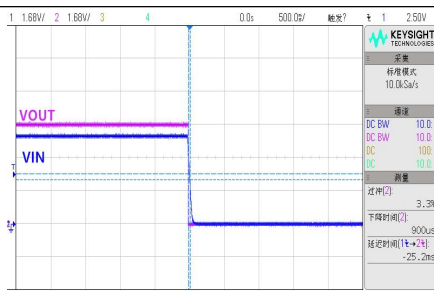
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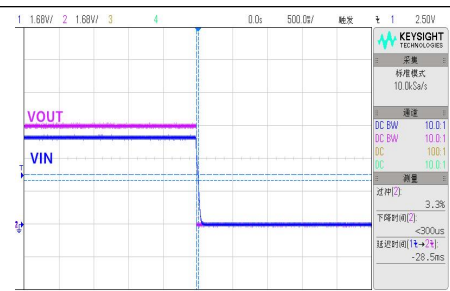
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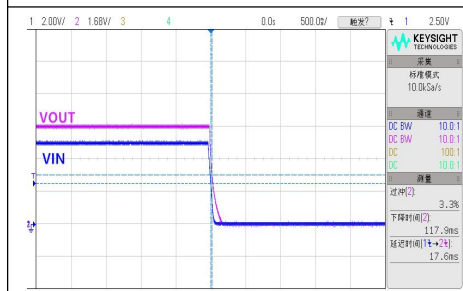
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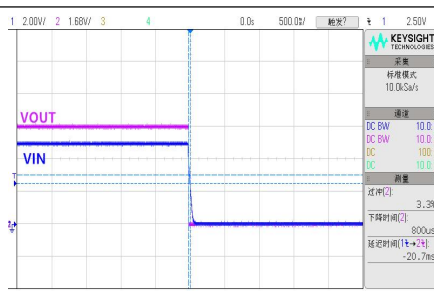
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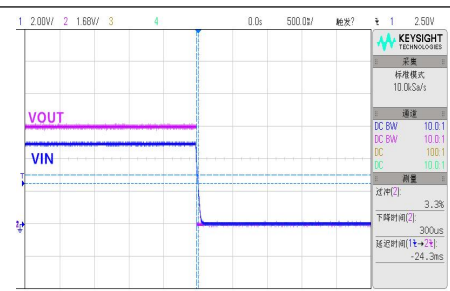
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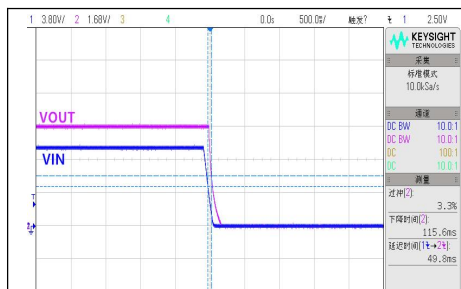
VIN=5V, 空载关机波形



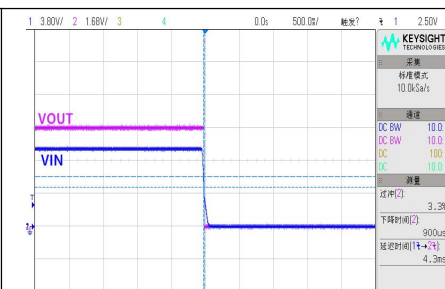
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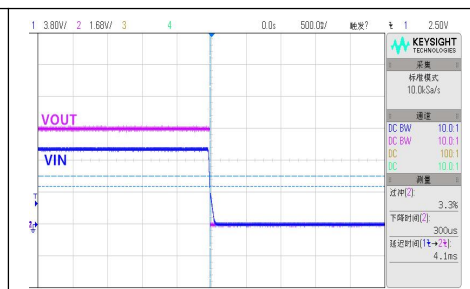
VIN=5V, 满载关机波形



VIN=9V, 空载关机波形

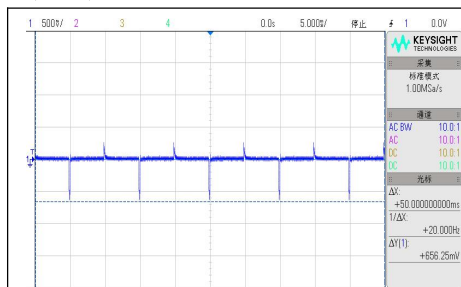


VIN=9V, 半载关机波形

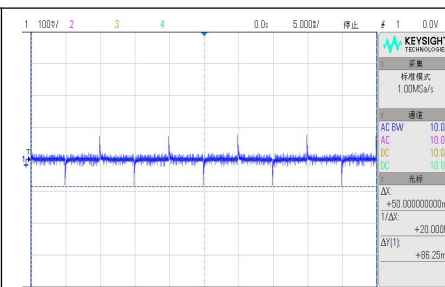


VIN=9V, 满载关机波形

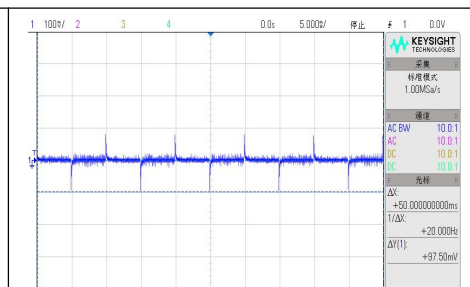
动态波形



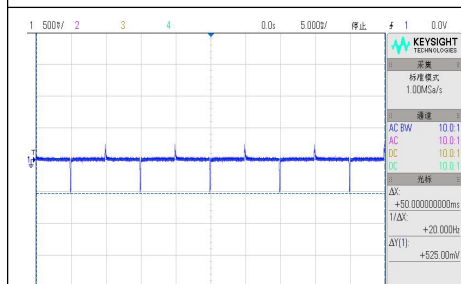
VIN=4.5V, 100%-10%-100%Io 动态波形



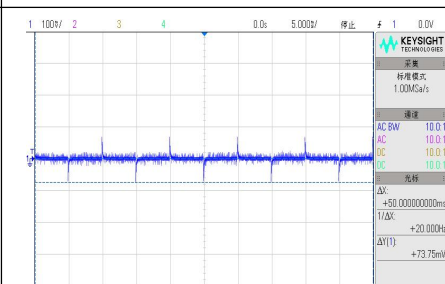
VIN=4.5V, 75%-50%-75%Io 动态波形



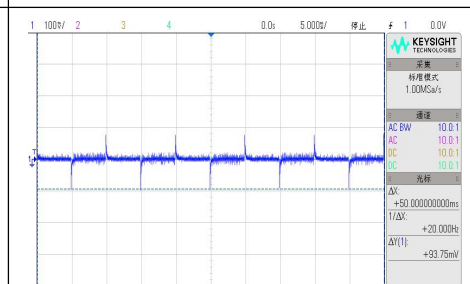
VIN=4.5V, 50%-25%-50%Io 动态波形



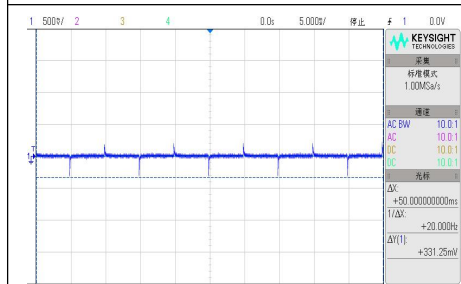
VIN=5V, 100%-10%-100%Io 动态波形



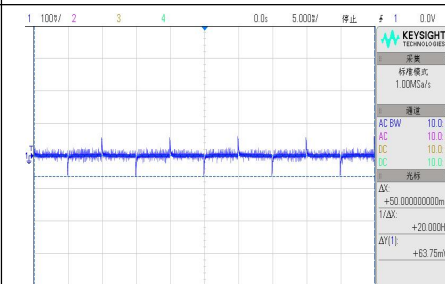
VIN=5V, 75%-50%-75%Io 动态波形



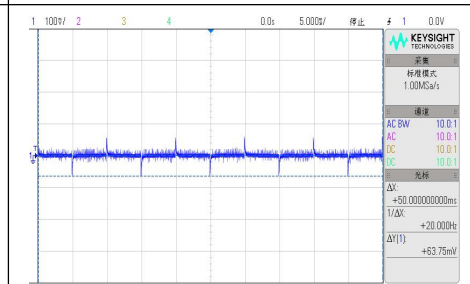
VIN=5V, 50%-25%-50%Io 动态波形



VIN=9V, 100%-10%-100%Io 动态波形

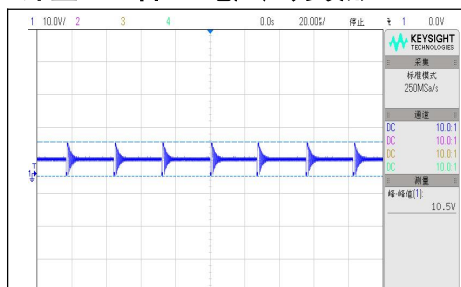


VIN=9V, 75%-50%-75%Io 动态波形

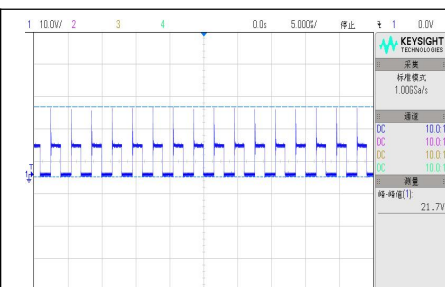


VIN=9V, 50%-25%-50%Io 动态波形

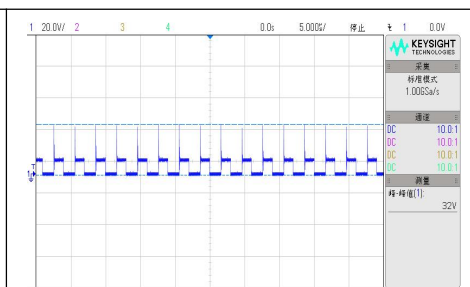
外置 MOS 管 Q1 电压应力波形



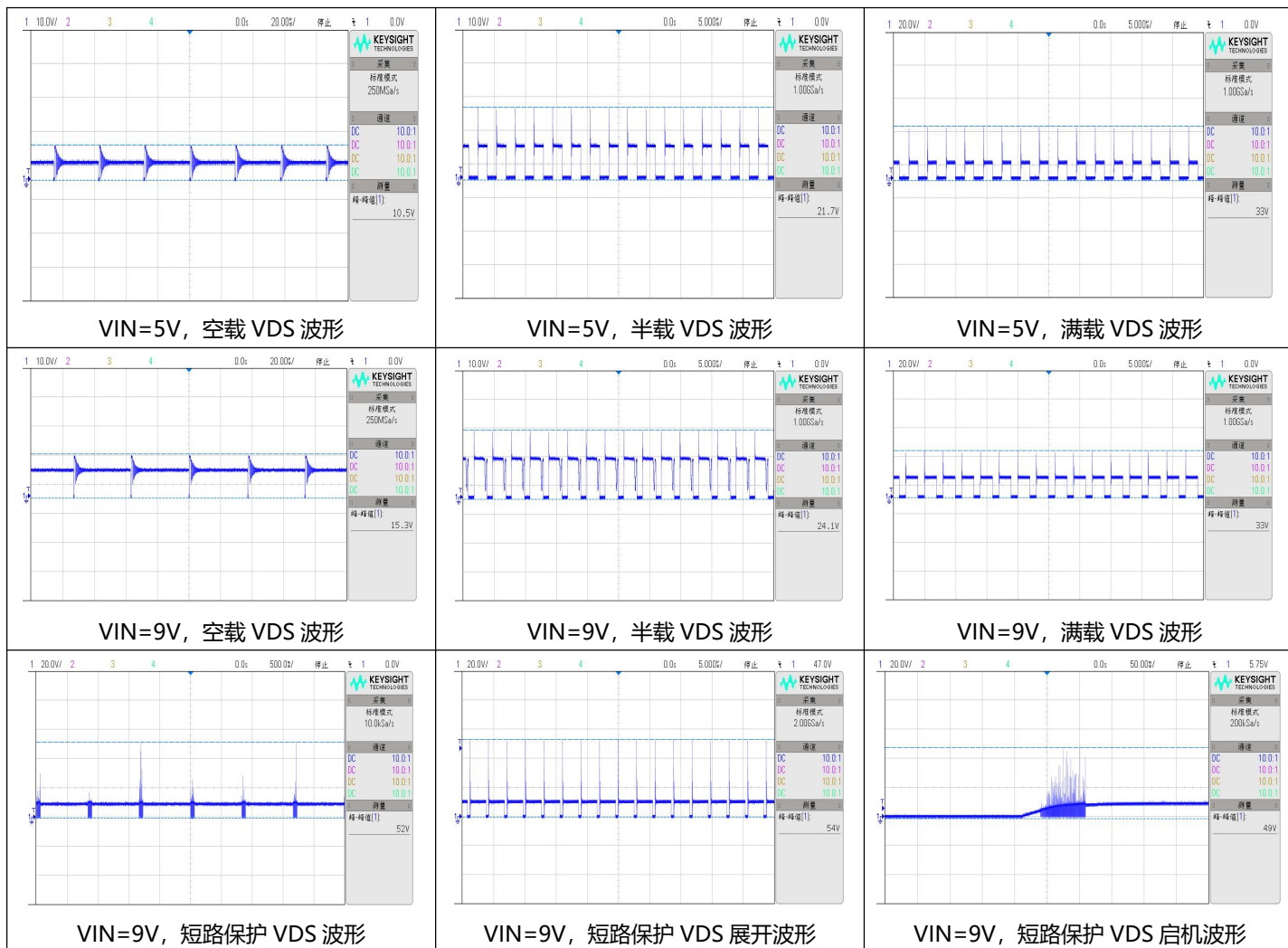
VIN=4.5V, 空载 VDS 波形



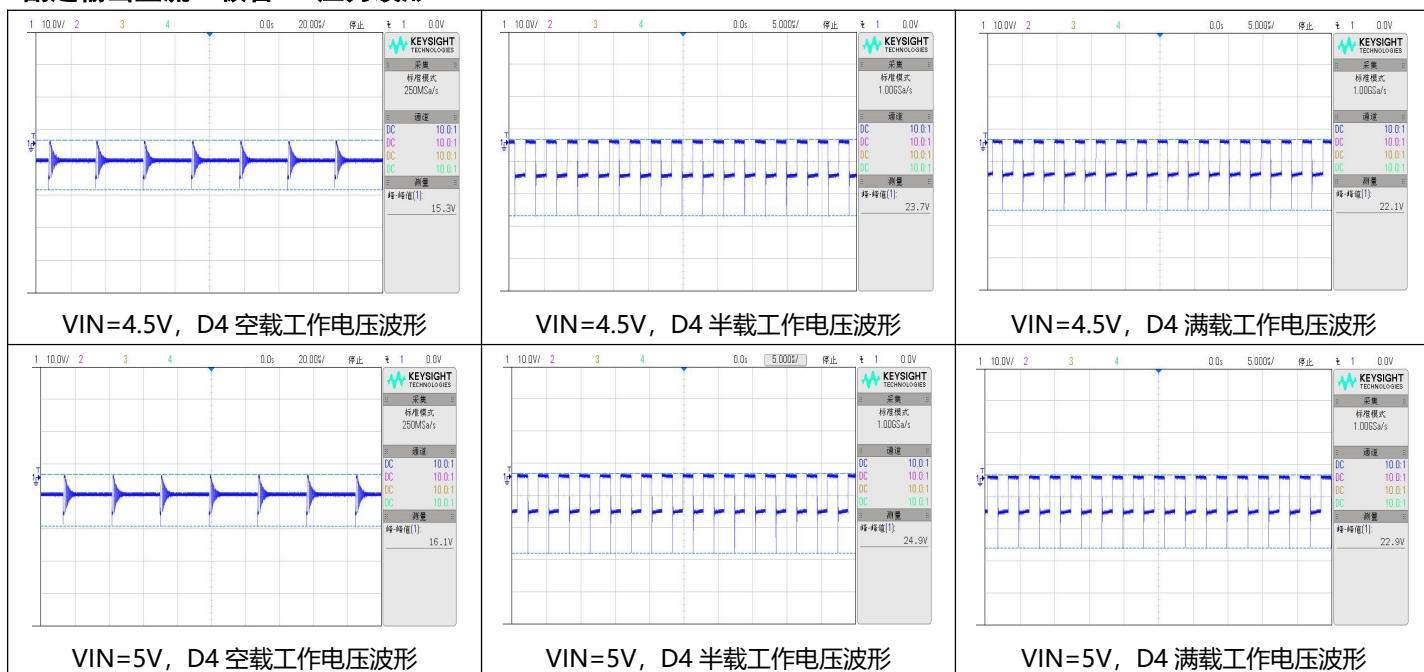
VIN=4.5V, 半载 VDS 波形

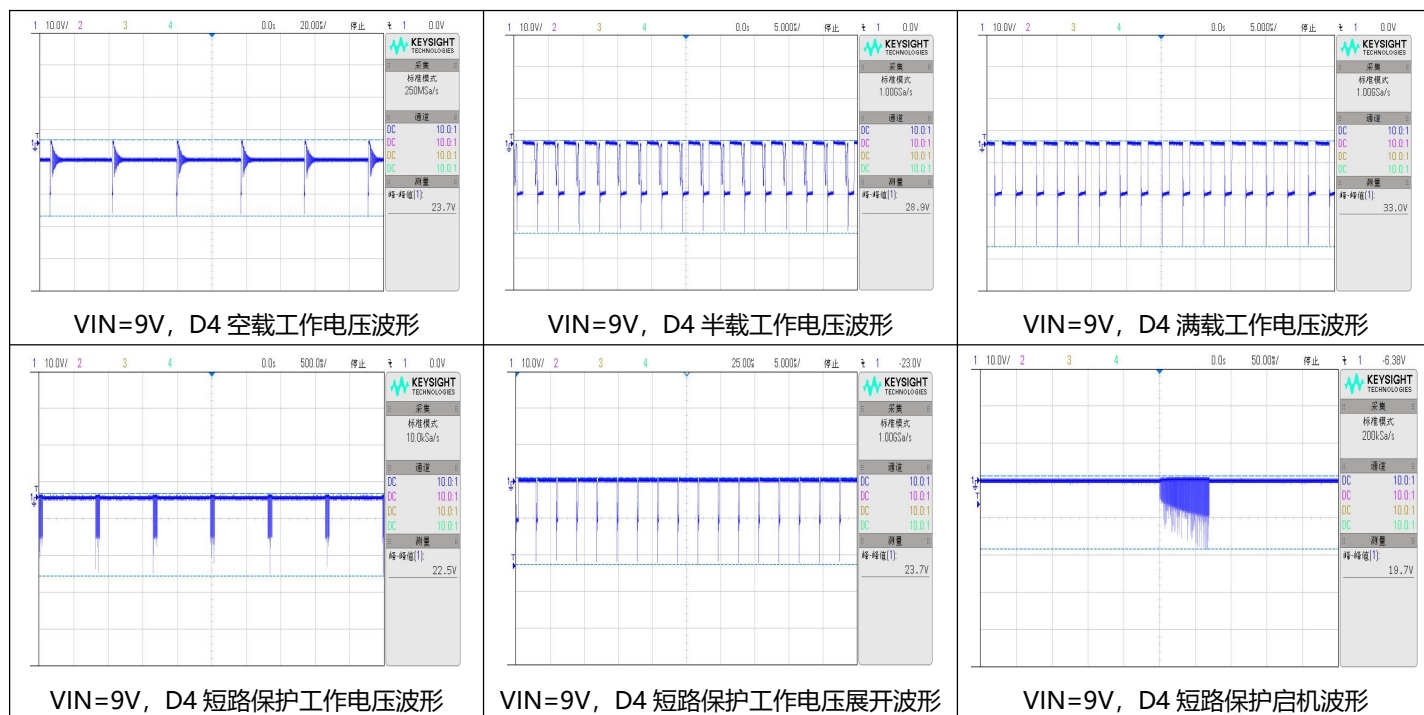


VIN=4.5V, 满载 VDS 波形



副边输出整流二极管 D4 应力波形





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