

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，5.5V 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）抗干扰目的的相关场合。

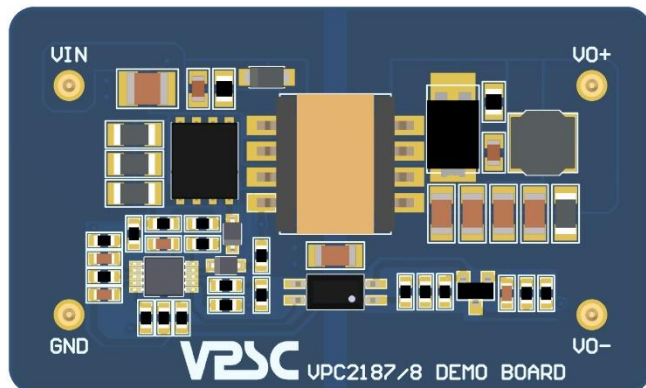
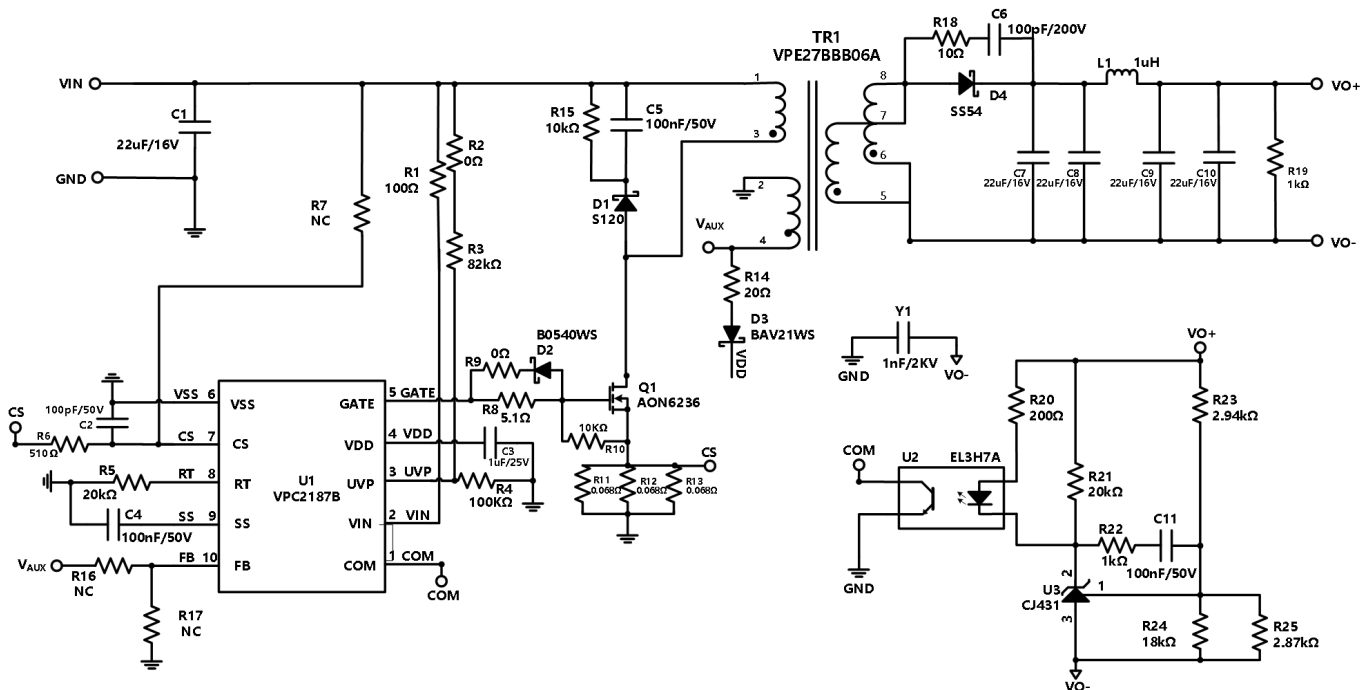


图 1: VPC2187 Demo 板(尺寸:50mm*30mm)

关键词：输入：4.5V-9V，输出 5.5V/6W，隔离电压：1500VDC，反馈方式：副边反馈-SSR，开关频率：330KHz

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

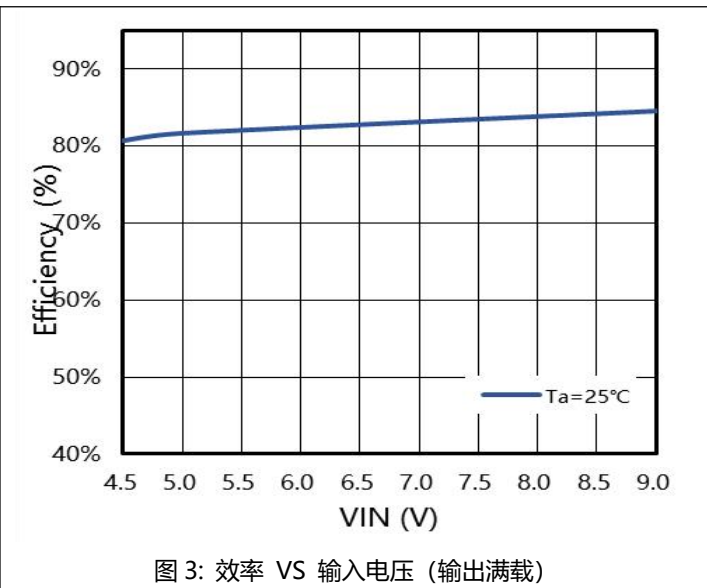
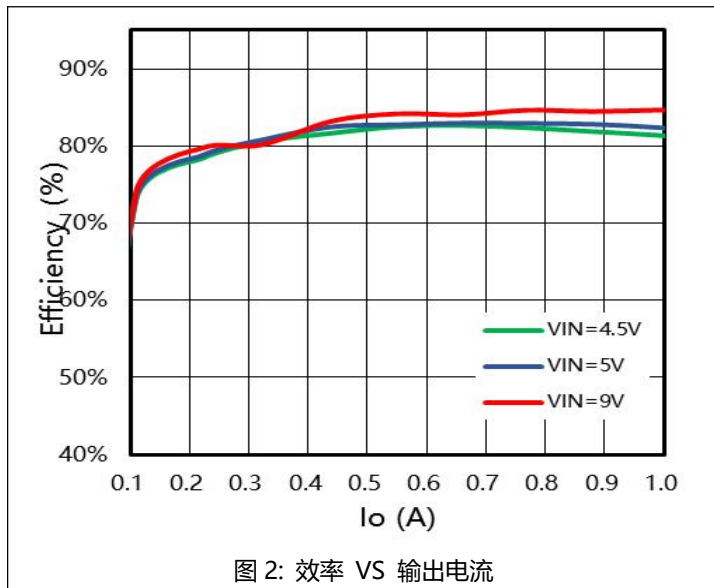
位号	参数	封装	型号	品牌
C1	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C2	100pF/50V-NP0	0603	CC0603JRNPO9BN101	YAGEO
C3	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C4	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C5	100nF/50V-X7R	0805	CC0805KRX7R9BB104	YAGEO
C6	100pF/200V- NP0	0805	CC0805JRNPOABN101	YAGEO
C7	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C8	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C9	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C10	22uF/16V-X5R	1206	CC1206KKX5R7BB226	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	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R10	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R11	0.068Ω±1%	1206	RL1206JR-070R068L	YAGEO
R12	0.068Ω±1%	1206	RL1206JR-070R068L	YAGEO
R13	0.068Ω±1%	1206	RL1206JR-070R068L	YAGEO
R14	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R15	10kΩ±1%	0805	RC0805FR-0710KL	YAGEO
R16	NC	-	-	-
R17	NC	-	-	-
R18	10Ω±1%	0805	RC0805FR-0710RL	YAGEO
R19	1kΩ±1%	1206	RC1206FR-071KL	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	18kΩ±1%	0603	RC0603FR-0718KL	YAGEO
R25	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 40V 19A	DFN-8	AON6236	AOS

L1	1uH ±30%	SMD	SWPA4030S1R0NT	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	40V /5A	SMA(DO-214AC)	SS54	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	SOT-23	CJ431	CJ

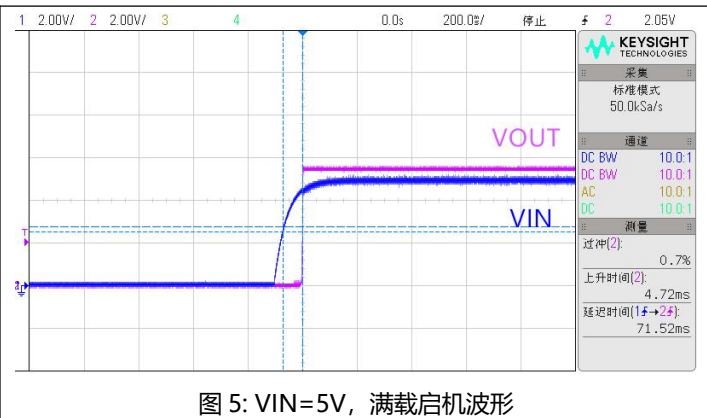
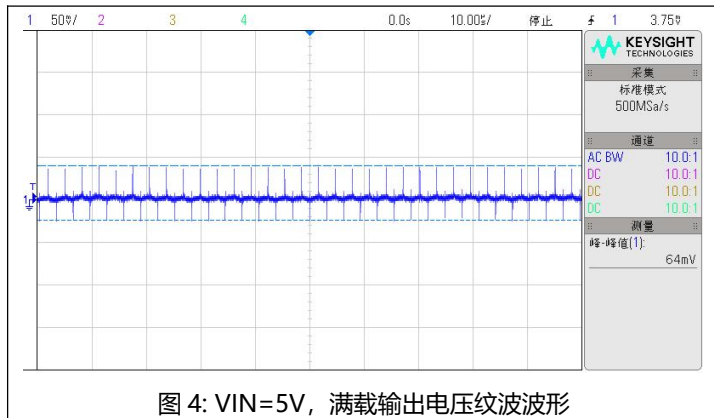
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流（满载/空载）	VIN=5V	18	---	1483	mA
转换效率	VIN=5V, IO=1A	---	81.64	---	%
纹波&噪声	VIN=5V, IO=1A	---	64	84	mV
输出电压精度	VIN=5V, IO=1A	---	1	---	%
线性调节率	VIN=4.5V-9V, IO=1A	---	0.5	---	%
负载调整率	VIN=5V, IO=1A	---	0.5	---	%
输入欠压保护	锁定电压	---	3.96	---	V
	恢复电压	---	4.38	---	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

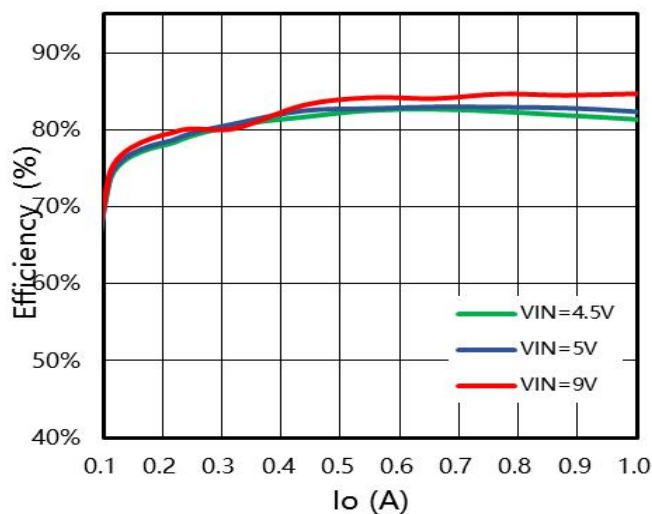


相关波形

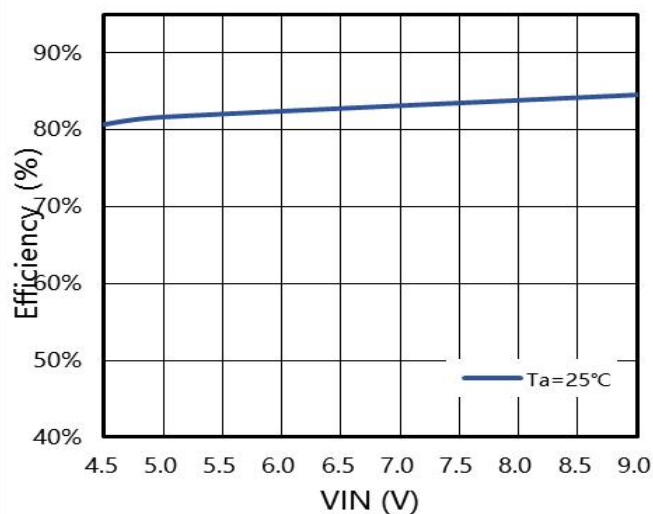


详细测试数据

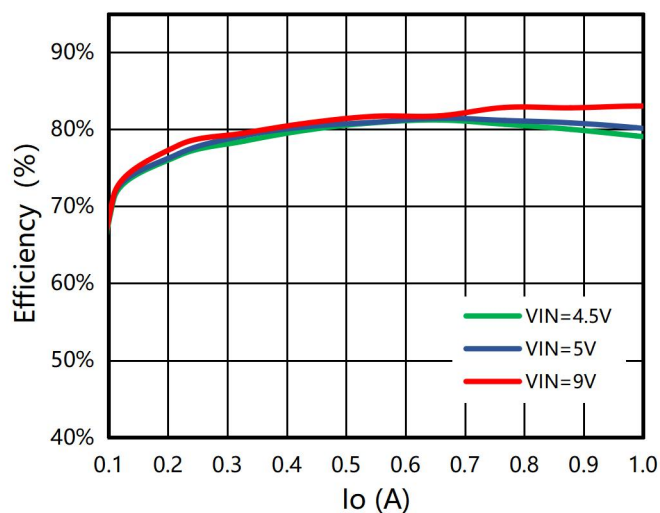
高低温测试曲线



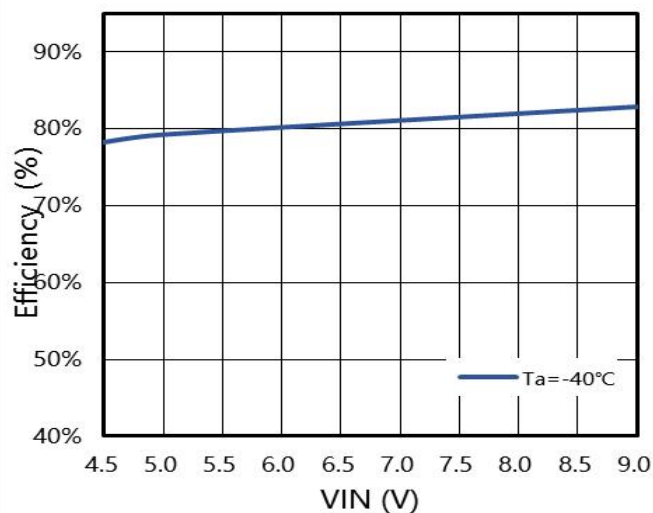
效率 VS 输出电流 (25°C)



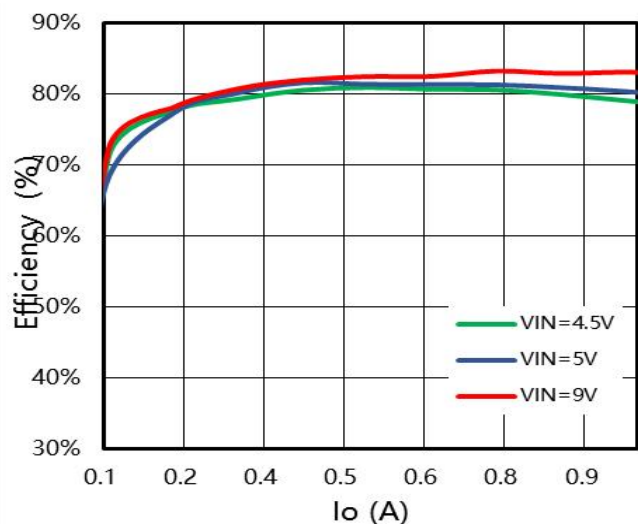
效率 VS 输入电压 (输出满载@25°C)



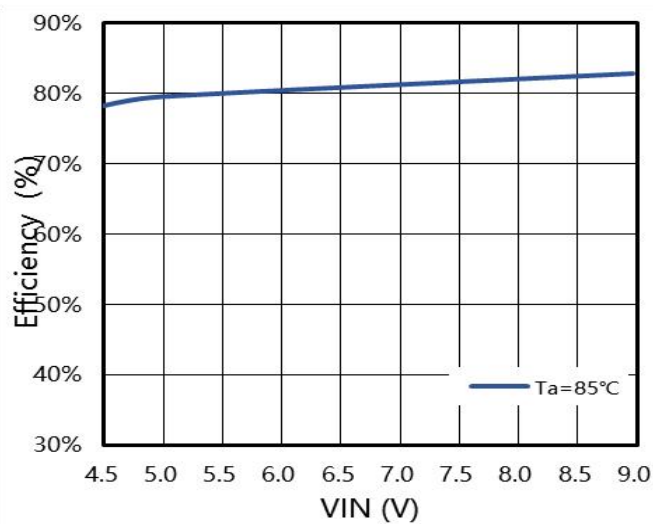
效率 VS 输出电流 (-40°C)



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=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	0.018	5.49	0	0%	0.00%
4.98	0.164	5.49	0.109	10%	73.27%
4.97	0.306	5.49	0.218	20%	78.70%
4.96	0.448	5.48	0.328	30%	80.89%
4.95	0.589	5.49	0.438	40%	82.48%
4.94	0.736	5.48	0.549	50%	82.75%
4.99	0.871	5.48	0.658	60%	82.96%
4.98	1.019	5.48	0.768	70%	82.94%
4.98	1.168	5.48	0.879	80%	82.81%
4.98	1.321	5.48	0.989	90%	82.38%
4.97	1.483	5.48	1.098	100%	81.64%

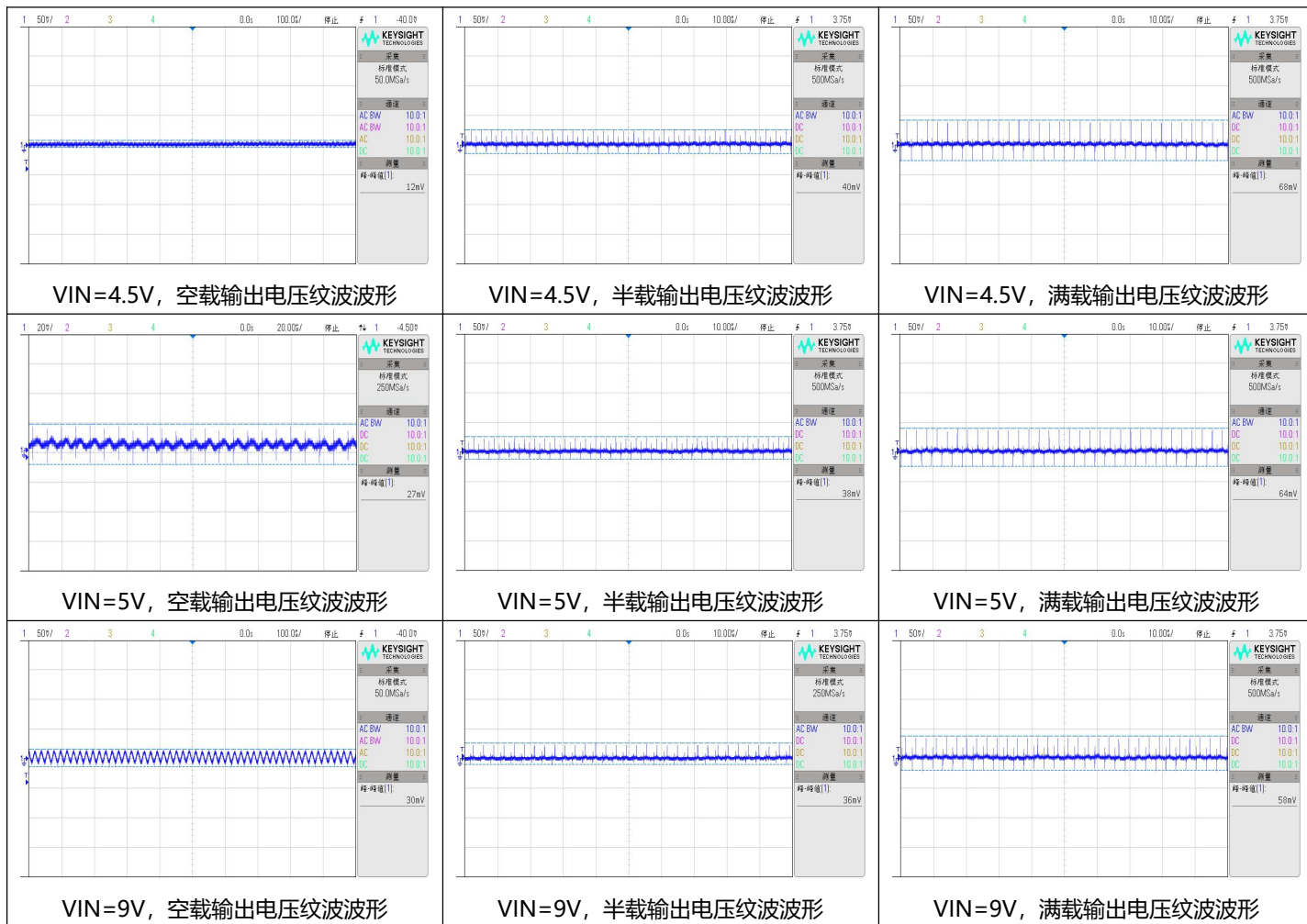
VIN=5V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
4.99	0.017	5.47	0	0%	0.00%
5.00	0.166	5.47	0.108	10%	71.18%
4.99	0.311	5.47	0.218	20%	76.84%
4.97	0.456	5.47	0.328	30%	79.17%
4.96	0.601	5.47	0.438	40%	80.37%
4.99	0.741	5.47	0.547	50%	80.92%
4.98	0.886	5.47	0.657	60%	81.45%
5.00	1.034	5.47	0.767	70%	81.15%
4.98	1.193	5.47	0.878	80%	80.84%
4.98	1.353	5.47	0.988	90%	80.21%
4.99	1.514	5.46	1.097	100%	79.28%

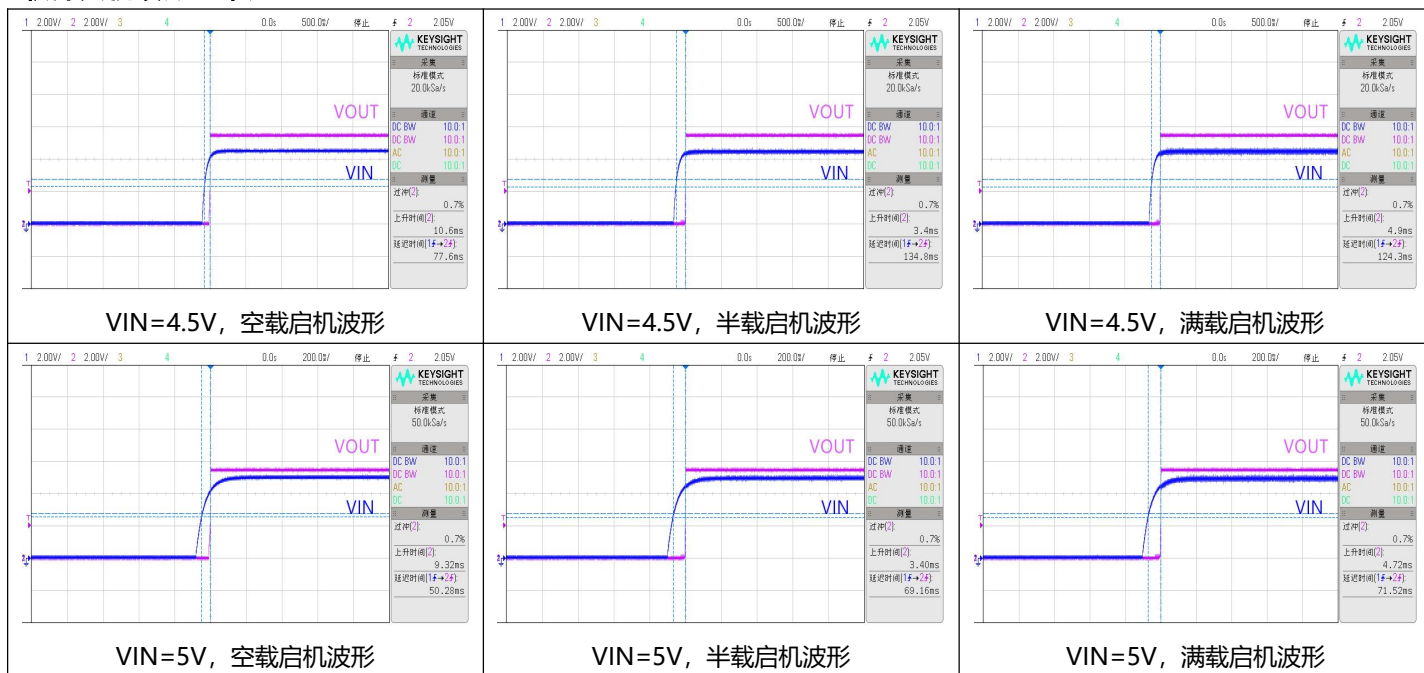
VIN=5V, Ta=85°C, 输入、输出及效率数据:

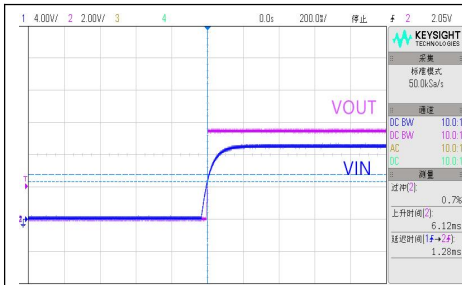
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
4.99	0.02	5.46	0	0%	0.00%
4.98	0.166	5.46	0.100	10%	66.05%
4.97	0.309	5.46	0.217	20%	77.15%
5.02	0.443	5.46	0.326	30%	80.04%
5.00	0.583	5.46	0.435	40%	81.48%
4.99	0.731	5.45	0.544	50%	81.28%
4.99	0.878	5.45	0.653	60%	81.23%
4.98	1.027	5.45	0.762	70%	81.20%
4.97	1.182	5.45	0.871	80%	80.81%
4.99	1.332	5.45	0.979	90%	80.27%
4.98	1.496	5.44	1.089	100%	79.52%

输出电压纹波波形

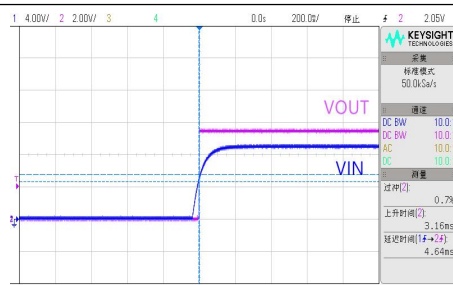


软开关机波形（常温）

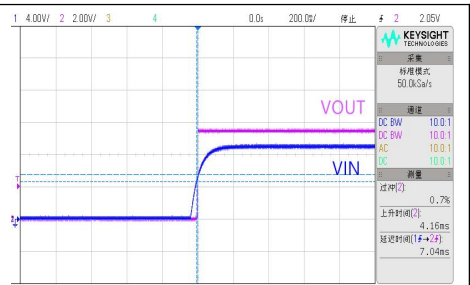




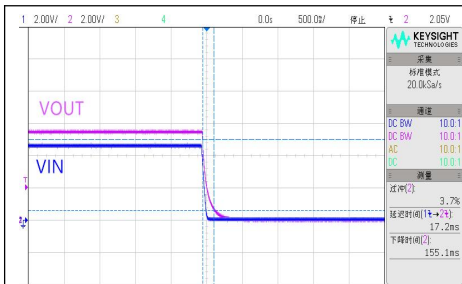
VIN=9V, 空载启机波形



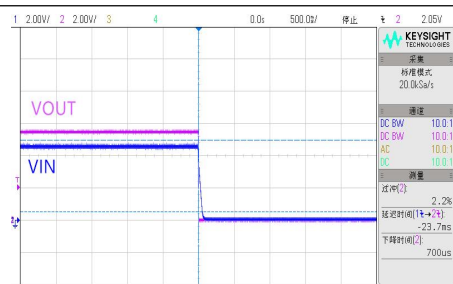
VIN=9V, 半载启机波形



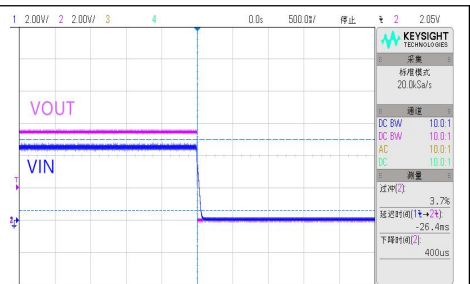
VIN=9V, 满载启机波形



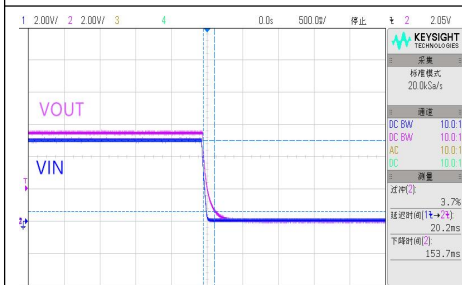
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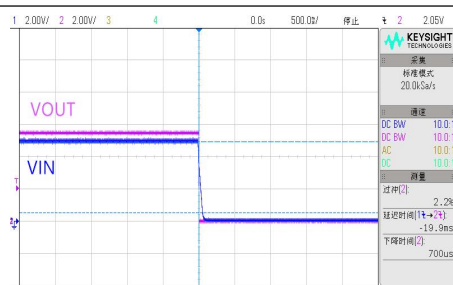
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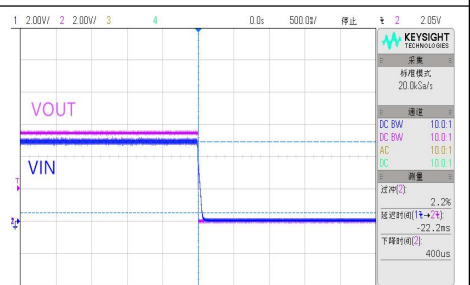
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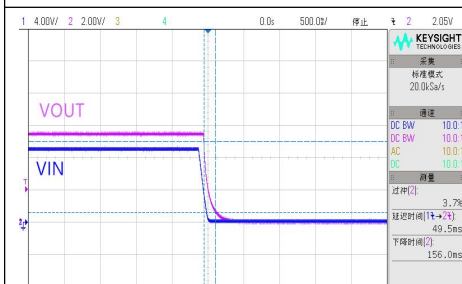
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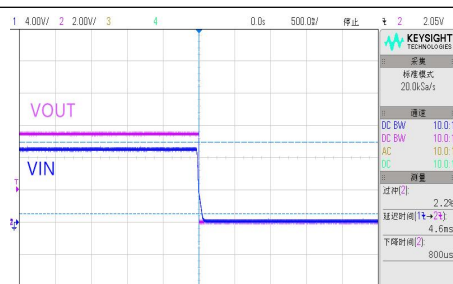
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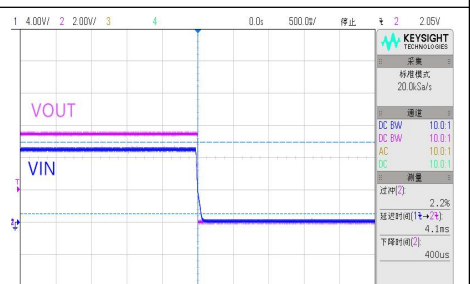
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VIN=9V, 空载关机波形

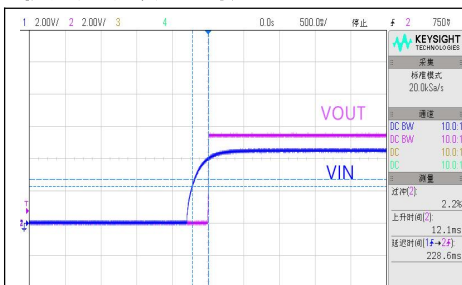


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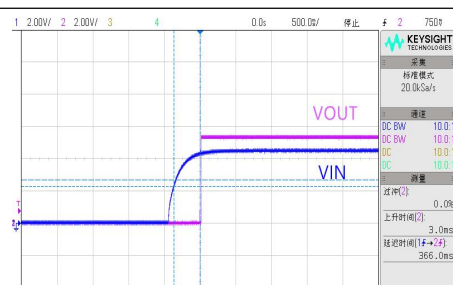


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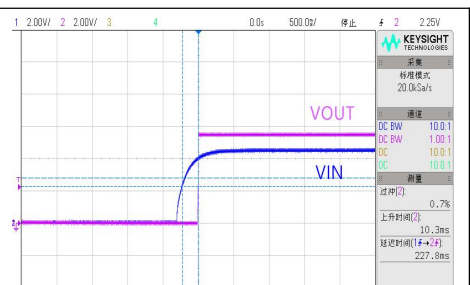
软开关机波形 (低温-40℃)



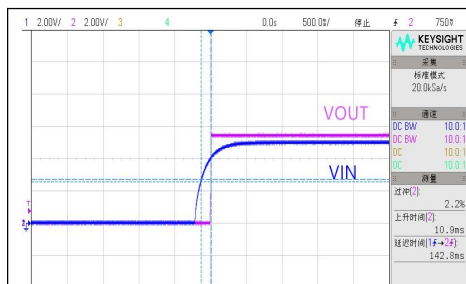
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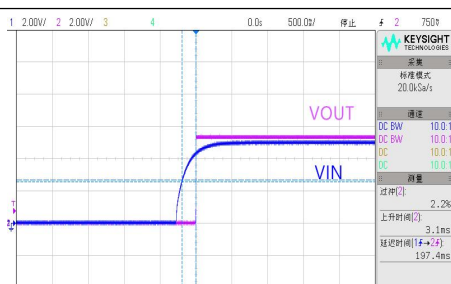
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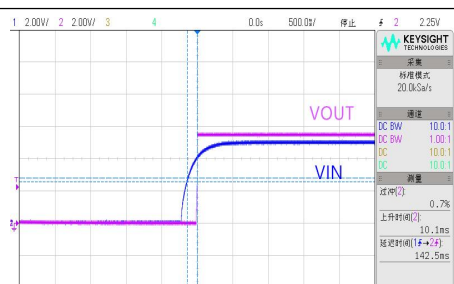
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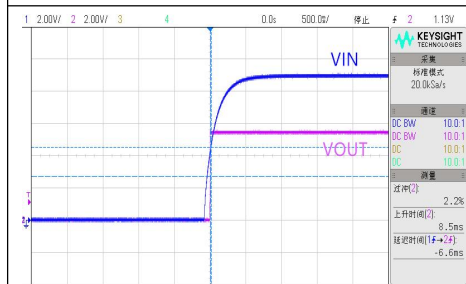
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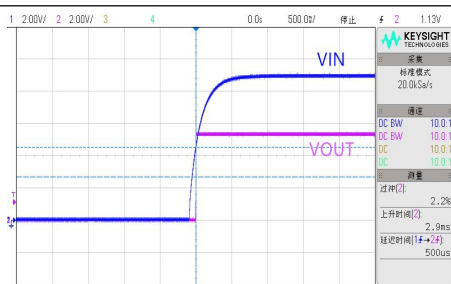
VIN=5V, 半载启机波形



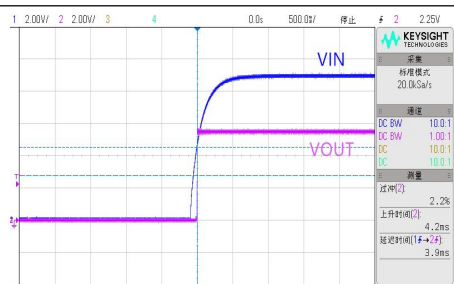
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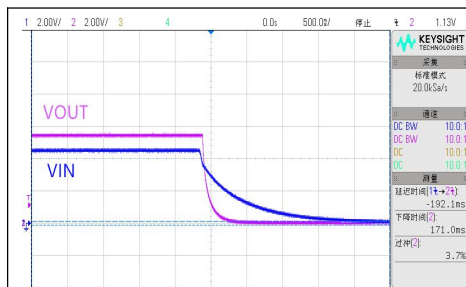
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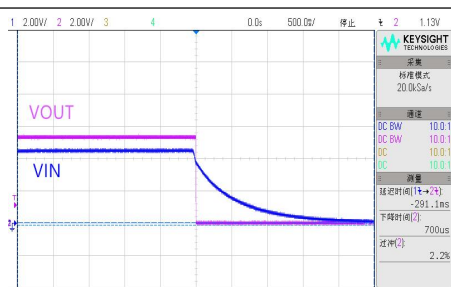
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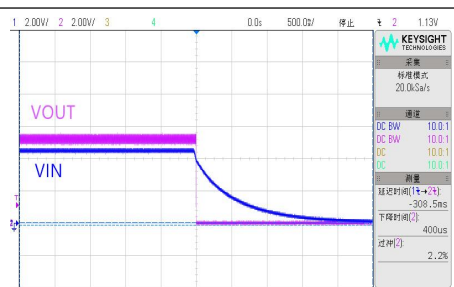
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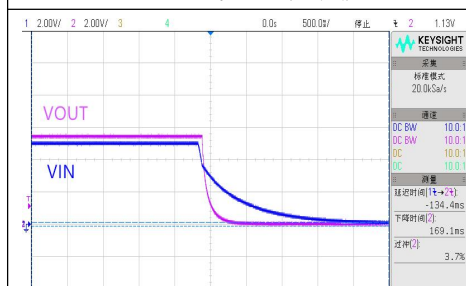
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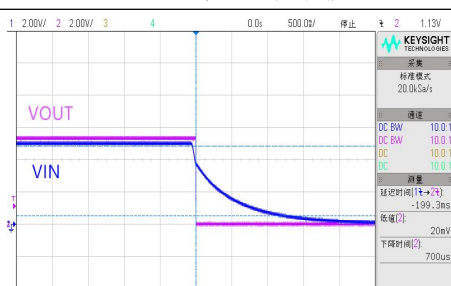
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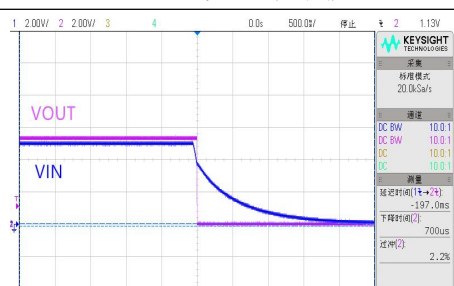
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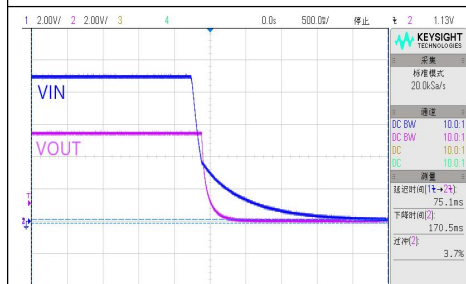
VIN=5V, 空载关机波形



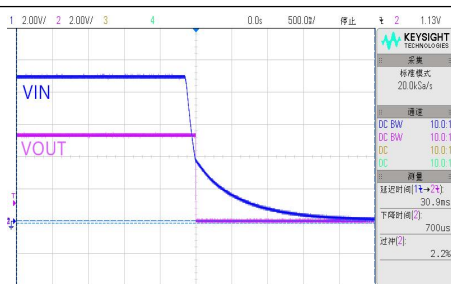
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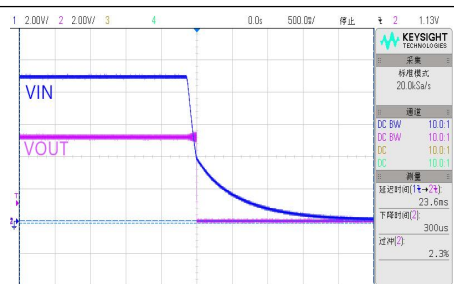
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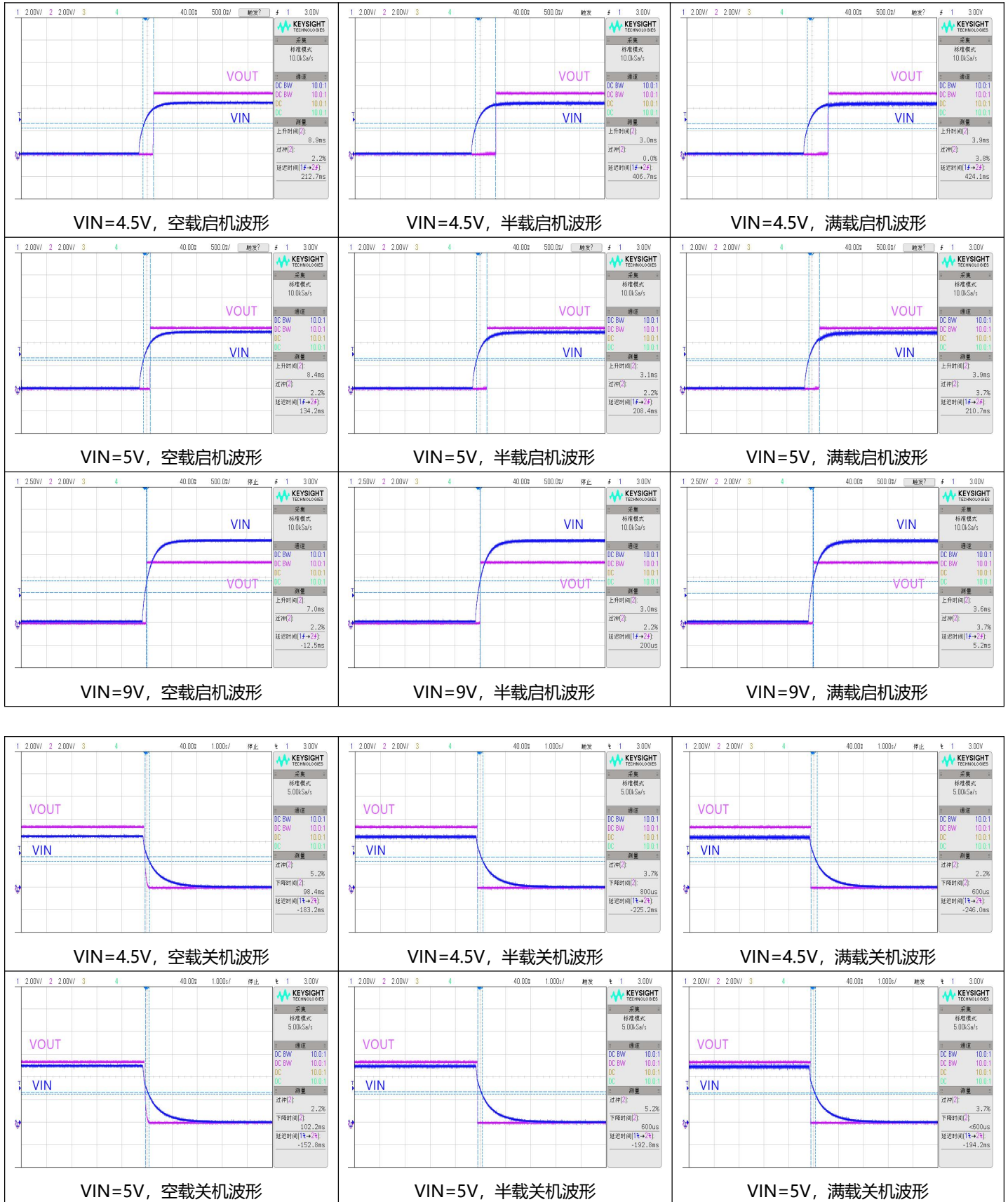


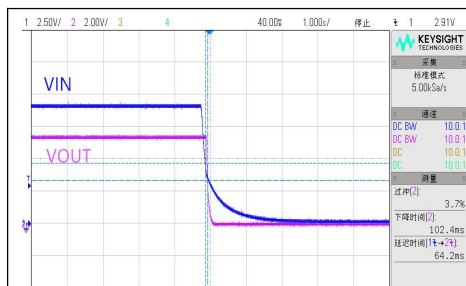
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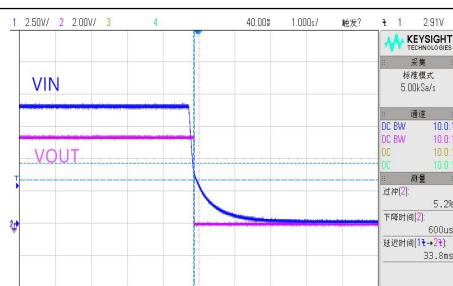
VIN=9V, 满载关机波形

软开关机波形（高温 85℃）

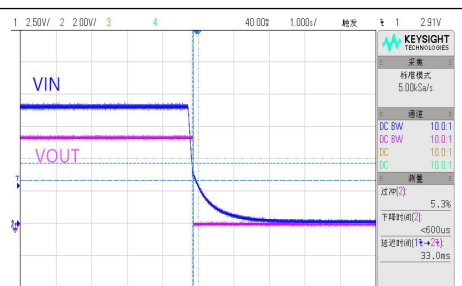




VIN=9V, 空载关机波形

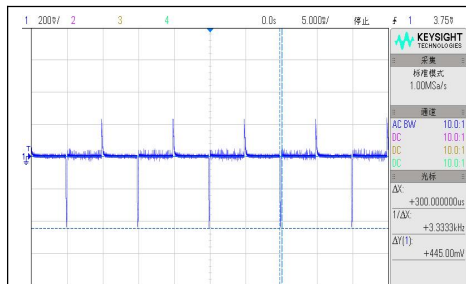


VIN=9V, 半载关机波形

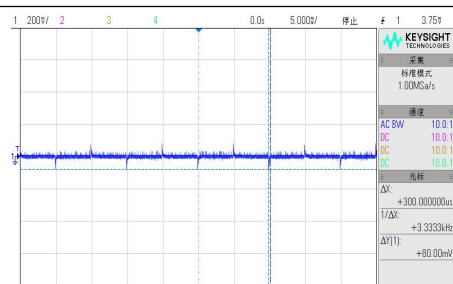


VIN=9V, 满载关机波形

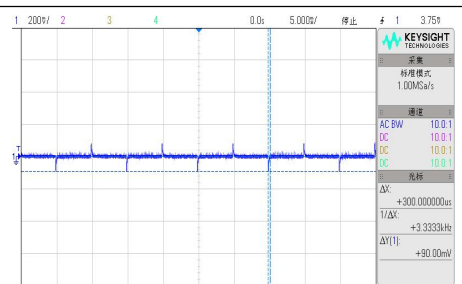
动态波形



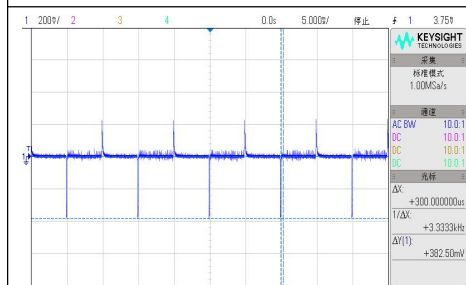
VIN=4.5V, 100%-10%-100%Io 动态波形



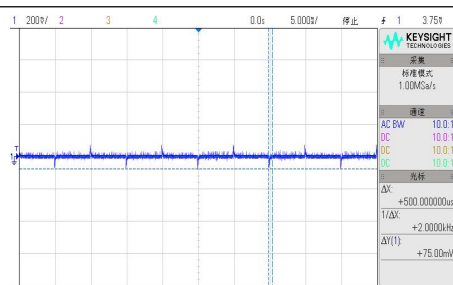
VIN=4.5V, 75%-50%-75%Io 动态波形



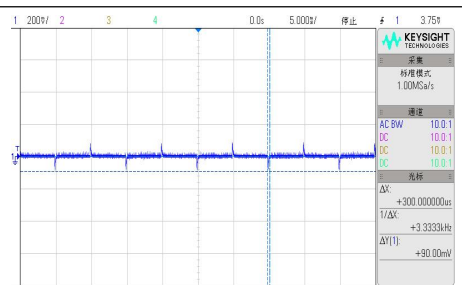
VIN=4.5V, 50%-25%-50%Io 动态波形



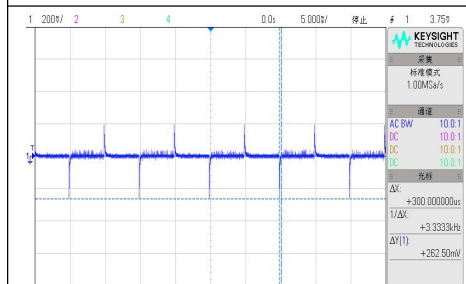
VIN=5V, 100%-10%-100%Io 动态波形



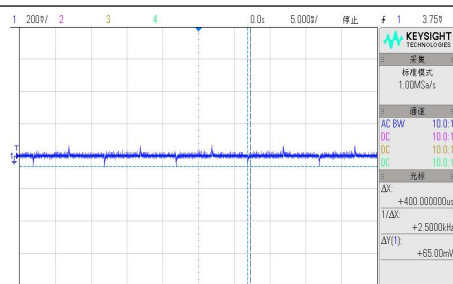
VIN=5V, 75%-50%-75%Io 动态波形



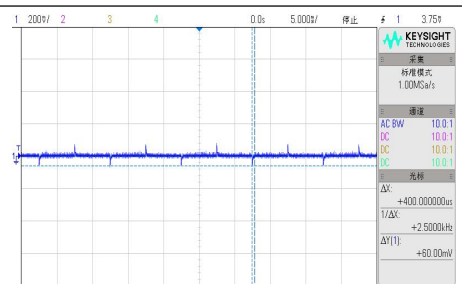
VIN=5V, 50%-25%-50%Io 动态波形



VIN=9V, 100%-10%-100%Io 动态波形

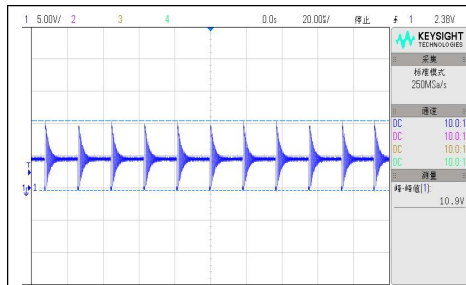


VIN=9V, 75%-50%-75%Io 动态波形

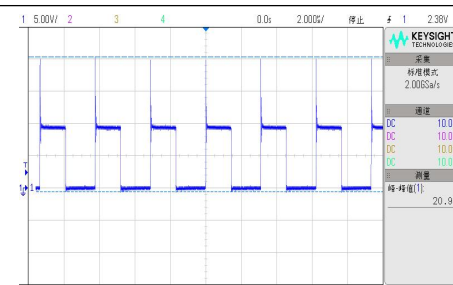


VIN=9V, 50%-25%-50%Io 动态波形

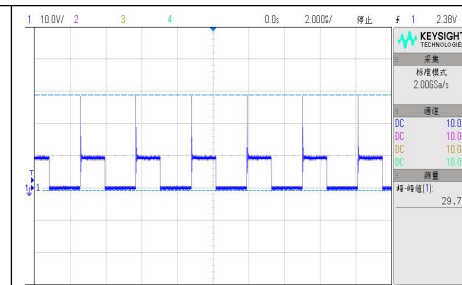
外置 MOS 管 Q1 电压应力波形



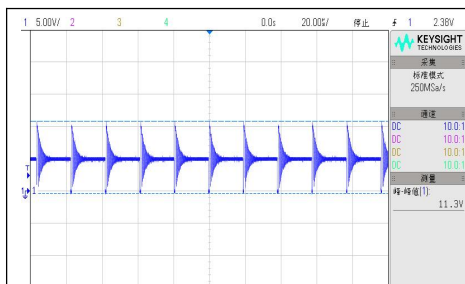
VIN=4.5V, 空载 VDS 波形



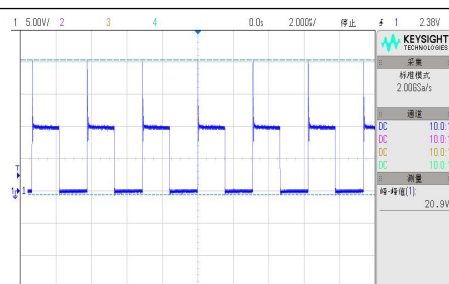
VIN=4.5V, 半载 VDS 波形



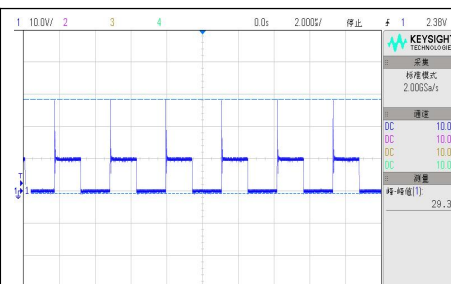
VIN=4.5V, 满载 VDS 波形



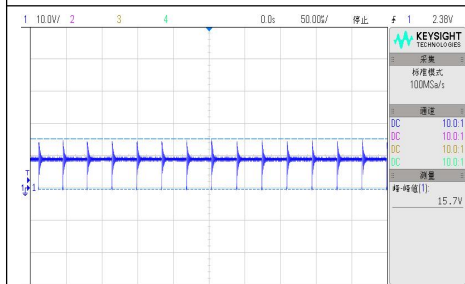
VIN=5V, 空载 VDS 波形



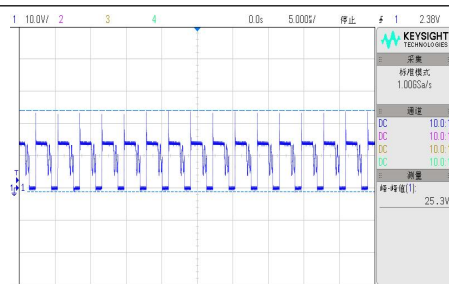
VIN=5V, 半载 VDS 波形



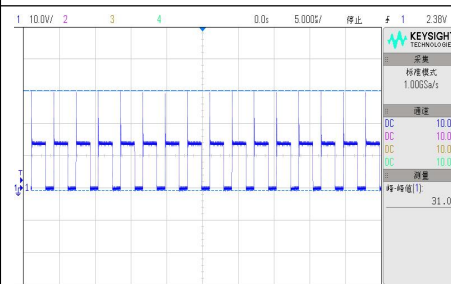
VIN=5V, 满载 VDS 波形



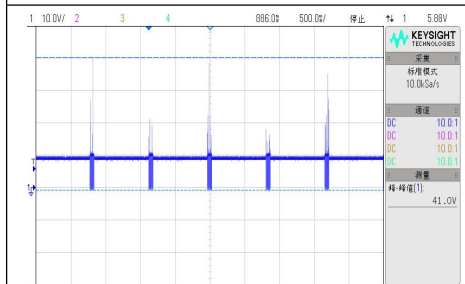
VIN=9V, 空载 VDS 波形



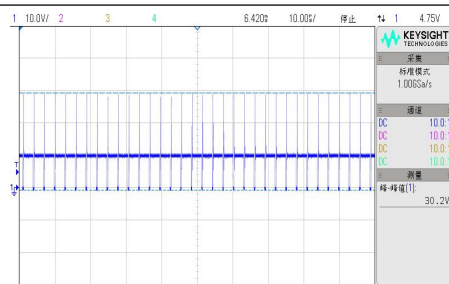
VIN=9V, 半载 VDS 波形



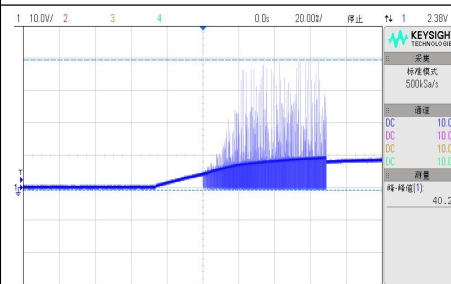
VIN=9V, 满载 VDS 波形



VIN=9V, VDS 短路保护工作电压波形

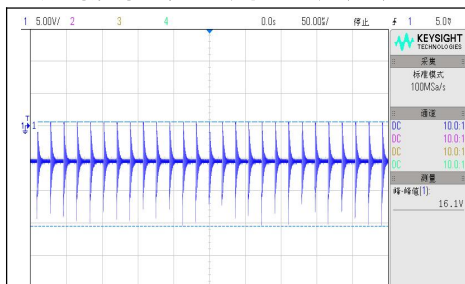


VIN=9V, VDS 短路保护工作电压展开波形

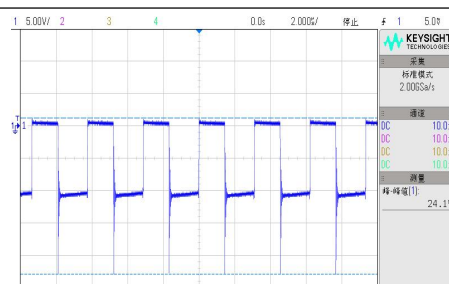


VIN=9V, VDS 短路保护工作启机波形

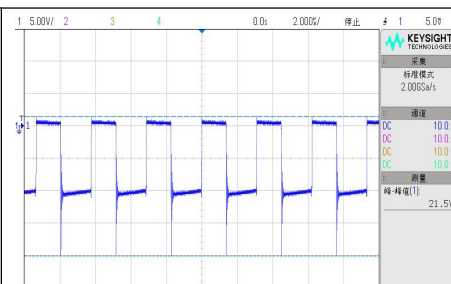
副边输出整流二极管 D4 应力波形



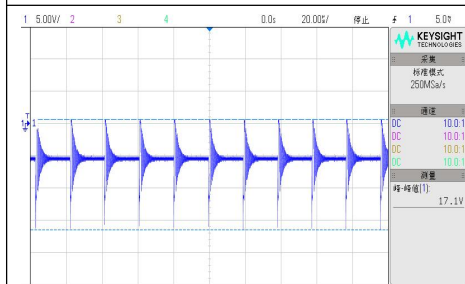
VIN=4.5V, D4 空载工作电压波形



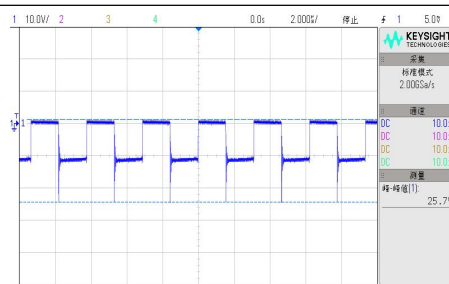
VIN=4.5V, D4 半载工作电压波形



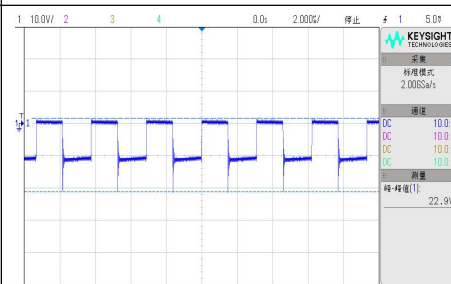
VIN=4.5V, D4 满载工作电压波形



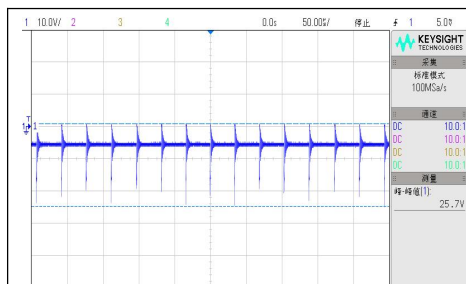
VIN=5V, D4 空载工作电压波形



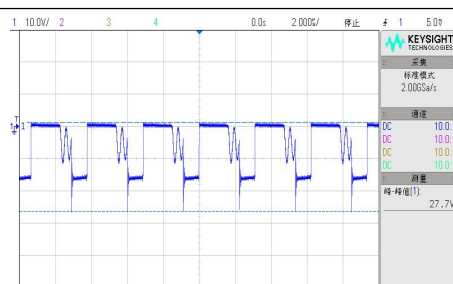
VIN=5V, D4 半载工作电压波形



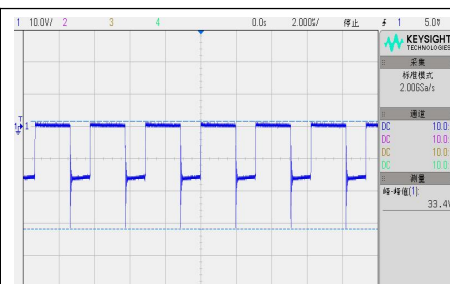
VIN=5V, D4 满载工作电压波形



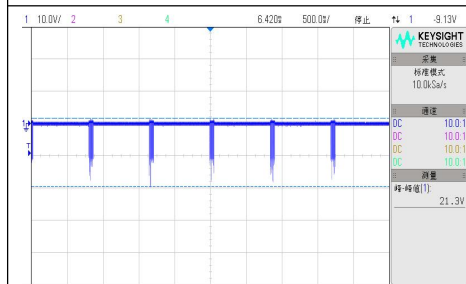
VIN=9V, D4 空载工作电压波形



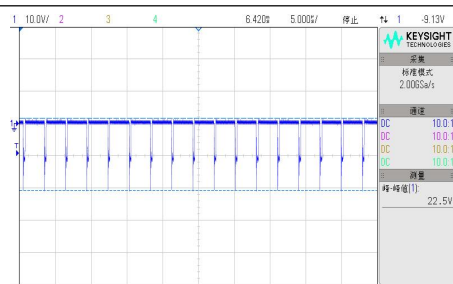
VIN=9V, D4 半载工作电压波形



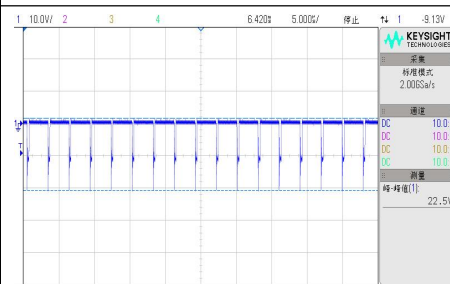
VIN=9V, D4 满载工作电压波形



VIN=9V, D4 短路保护工作电压波形



VIN=9V, D4 短路保护工作电压展开波形



VIN=9V, D4 短路保护工作启机波形

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