

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 VPE17BD-06B、输出整流二极管以及必要的阻容元件，实现 4.5V-9V 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 6W 的输出能力，原副边隔离耐压不小于 3000VDC，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。

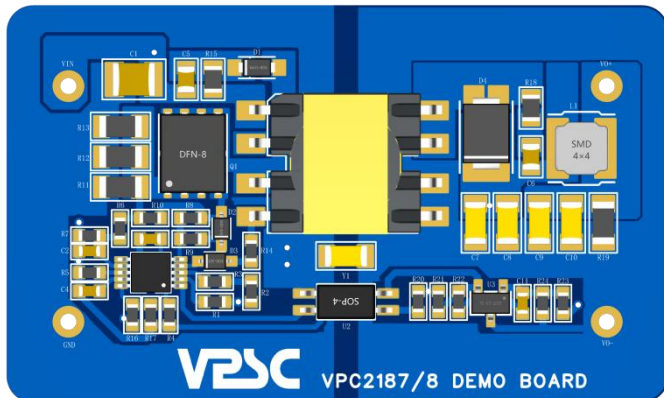
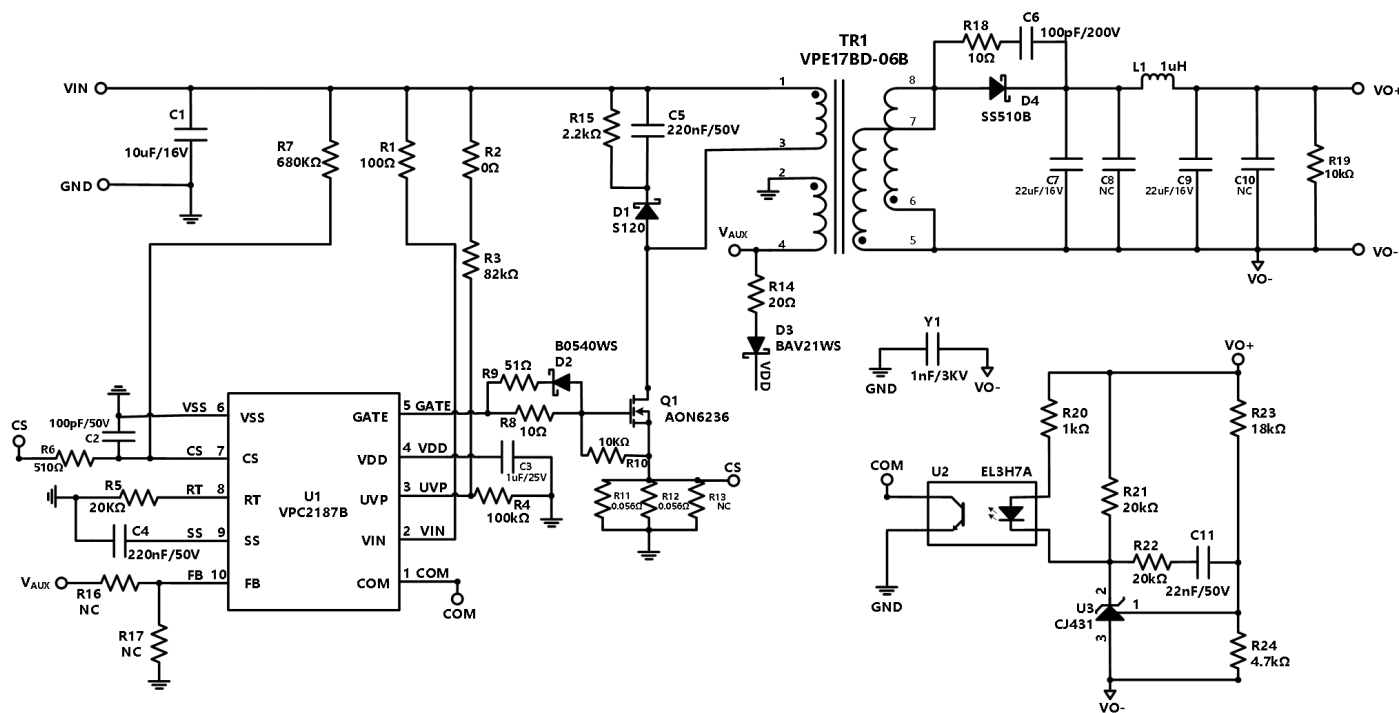


图 1: VPC2187 Demo 板(尺寸:50mm*30mm)

关键词：输入：4.5V-9V，输出 12V/6W，隔离电压：3000VDC，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

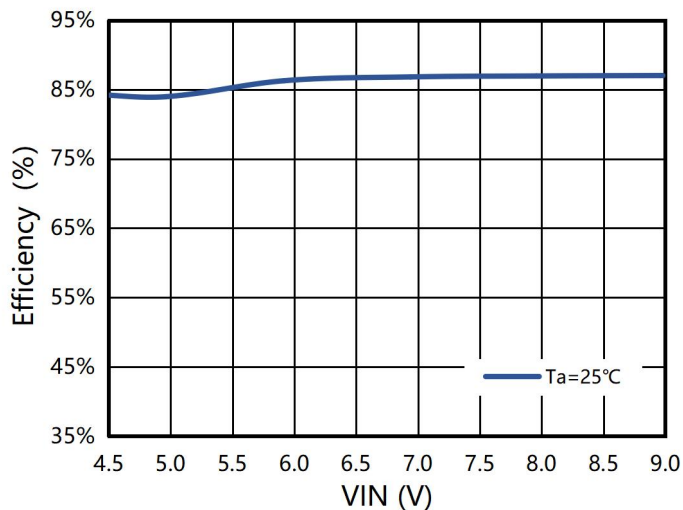
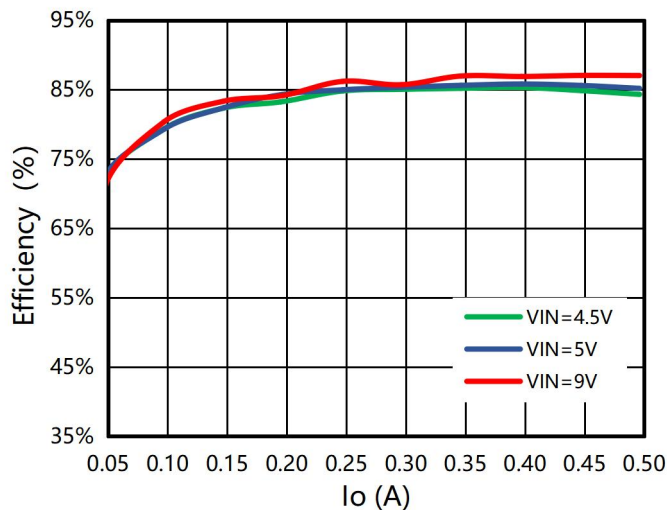
位号	参数	封装	型号	品牌
C1	10uF/16V-X7R	1206	CC1206KKX7R7BB106	YAGEO
C2	100pF/50V- NP0	0603	CC0603JRNPO9BN101	YAGEO
C3	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C4	220nF/50V-X7R	0603	CC0603KRX7R9BB224	YAGEO
C5	220nF/50V-X7R	0805	CC0805KKX7R9BB224	YAGEO
C6	100pF/200V- NP0	0805	CC0805JRNPOABN101	YAGEO
C7	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C8	NC	-	-	-
C9	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C10	NC	-	-	-
C11	22nF/50V-X7R	0603	CC0603KRX7R9BB223	YAGEO
Y1	1nF/3KV-X7R	1808	CC1808KKX7REBB102	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	680KΩ±1%	0603	RC0603FR-07680KL	YAGEO
R8	10Ω±1%	0603	RC0603FR-0710RL	YAGEO
R9	51Ω±1%	0603	RC0603FR-0751RL	YAGEO
R10	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R11	0.056Ω ±1%	1206	RL1206FR-070R056L	YAGEO
R12	0.056Ω ±1%	1206	RL1206FR-070R056L	YAGEO
R13	NC	-	-	-
R14	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R15	2.2KΩ±1%	0805	RC0805FR-072K2L	YAGEO
R16	NC	-	-	-
R17	NC	-	-	-
R18	10Ω±1%	0805	RC0805FR-0710RL	YAGEO
R19	10KΩ±1%	1206	RC1206FR-0710KL	YAGEO
R20	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R21	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R22	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R23	18KΩ±1%	0603	RC0603FR-0718KL	YAGEO
R24	4.7KΩ±1%	0603	RC0603FR-074K7L	YAGEO
TR1	NP:NS:NA=5:10:10 Lp=3.75uH	ER11.5L	VPE17BD-06B	VPSC
Q1	N 沟道 40V 19A	DFN-8(5.6x5.2)	AON6236	AOS
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	SMB	SS510B	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

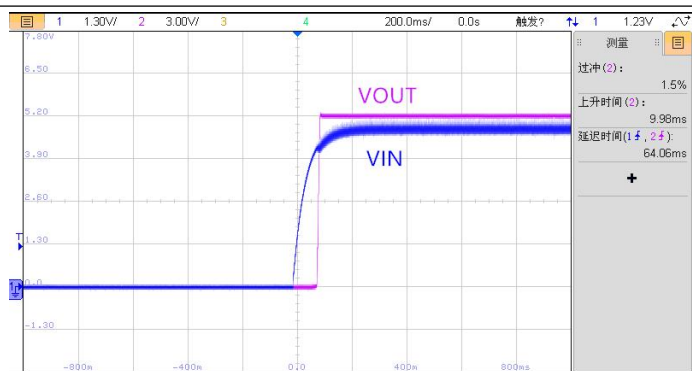
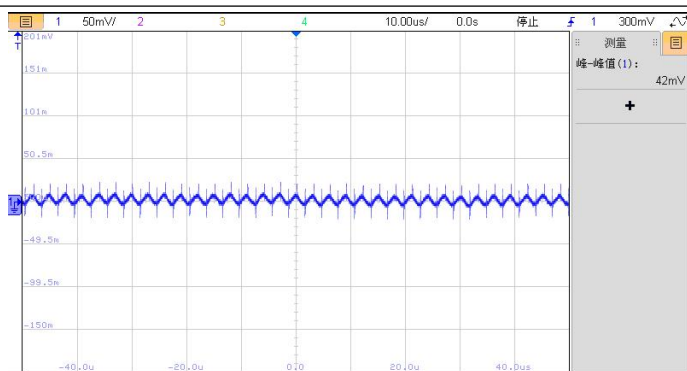
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流 (满载/空载)	VIN=5V	19	---	1441	mA
转换效率	VIN=5V, IO=0.5A	---	85.17	---	%
纹波&噪声	VIN=5V, IO=0.5A	---	42	90	mV
输出电压精度	VIN=5V, IO=0.5A	---	0.8	---	%
线性调节率	VIN=4.5V-9V, IO=0.5A	---	0.5	---	%
负载调整率	VIN=5V, IO=0.5A	---	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	3000	---	---	VDC

关键性能指标测试结果

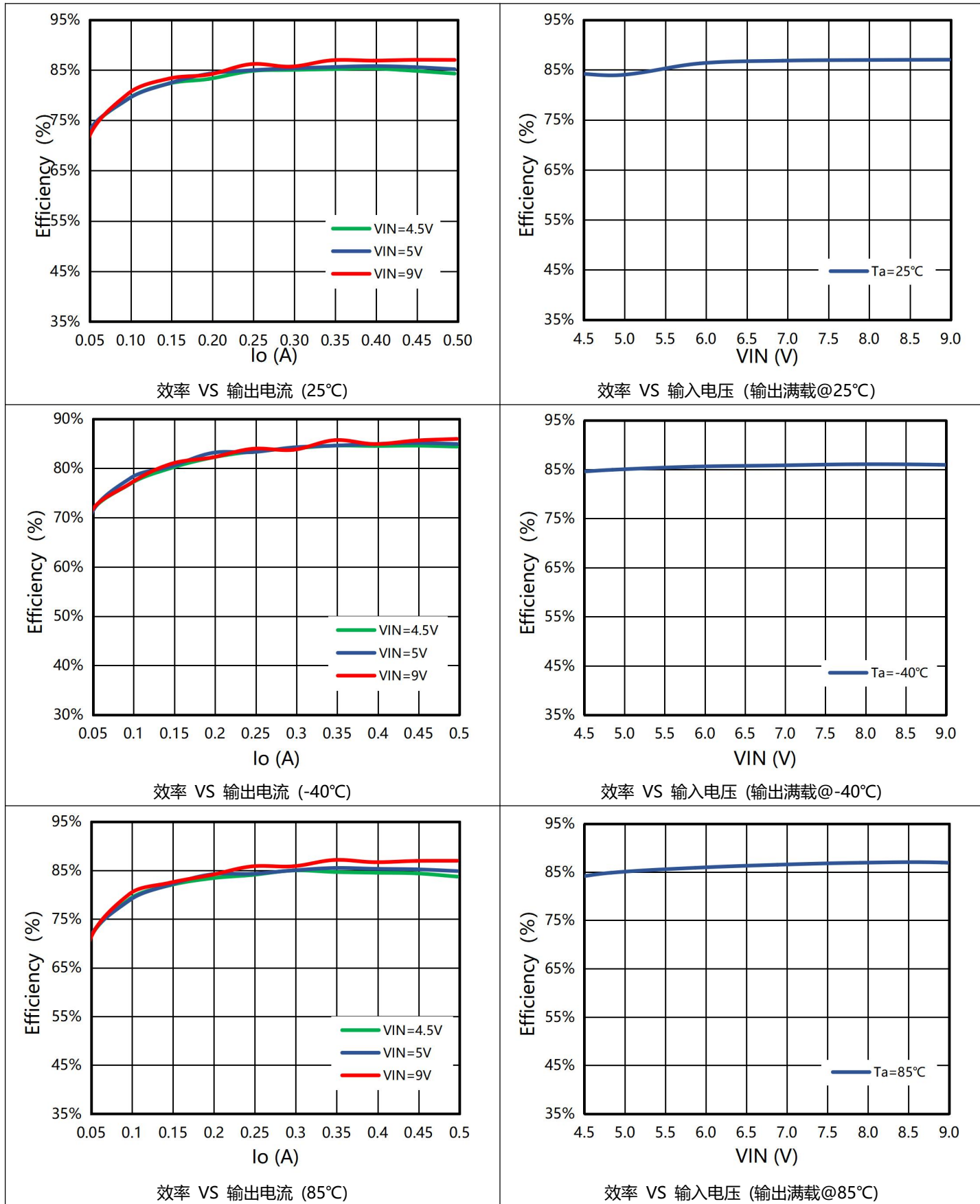


相关波形



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(%)
5.01	0.019	12.09	0	0%	0.00%
4.99	0.156	12.09	0.046	10%	71.44%
4.98	0.297	12.09	0.097	20%	79.29%
4.96	0.435	12.09	0.147	30%	82.37%
4.95	0.568	12.09	0.196	40%	84.28%
4.95	0.710	12.09	0.247	50%	84.97%
4.94	0.849	12.09	0.296	60%	85.33%
4.93	0.992	12.1	0.346	70%	85.61%
4.92	1.138	12.1	0.397	80%	85.80%
4.91	1.287	12.1	0.447	90%	85.59%
4.89	1.441	12.1	0.496	100%	85.17%

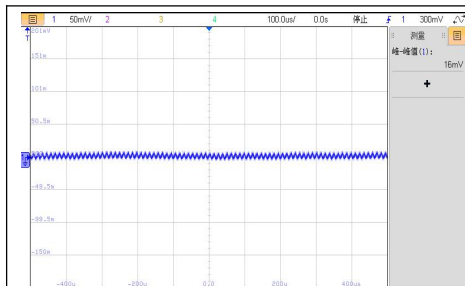
VIN=5V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
4.98	0.018	12.05	0	0%	0.00%
4.98	0.160	12.05	0.046	10%	69.57%
4.94	0.303	12.05	0.097	20%	78.09%
4.93	0.444	12.05	0.146	30%	80.37%
4.89	0.584	12.05	0.197	40%	83.12%
4.91	0.725	12.05	0.246	50%	83.27%
4.89	0.866	12.05	0.296	60%	84.23%
4.89	1.008	12.05	0.346	70%	84.59%
4.87	1.154	12.05	0.396	80%	84.91%
4.86	1.302	12.05	0.447	90%	85.12%
4.85	1.454	12.05	0.497	100%	84.93%

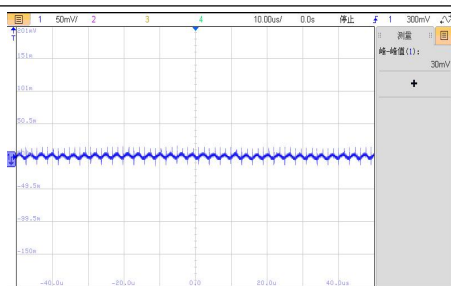
VIN=5V, Ta=85°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
4.98	0.021	12.13	0	0%	0.00%
4.96	0.161	12.13	0.046	10%	69.87%
4.94	0.302	12.13	0.097	20%	78.87%
4.93	0.438	12.13	0.146	30%	82.01%
4.92	0.577	12.13	0.197	40%	84.18%
4.91	0.721	12.13	0.246	50%	84.29%
4.89	0.864	12.13	0.296	60%	84.98%
4.88	1.009	12.13	0.347	70%	85.48%
4.87	1.159	12.13	0.397	80%	85.32%
4.85	1.312	12.13	0.447	90%	85.21%
4.83	1.471	12.13	0.497	100%	84.85%

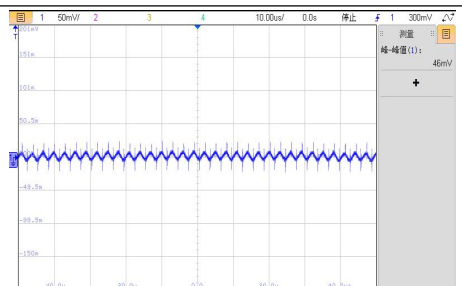
输出电压纹波波形



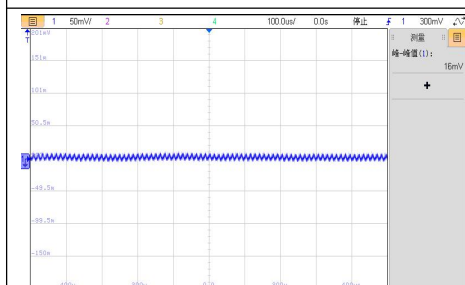
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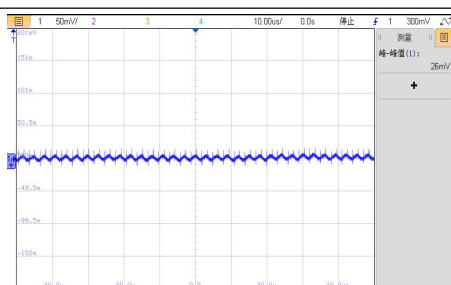
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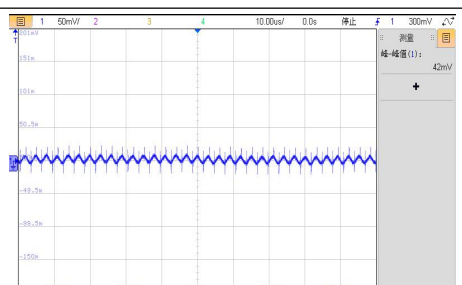
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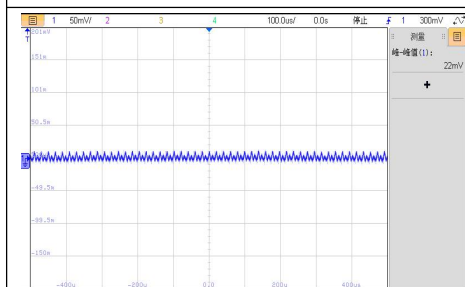
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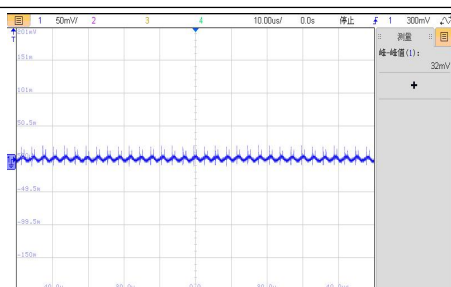
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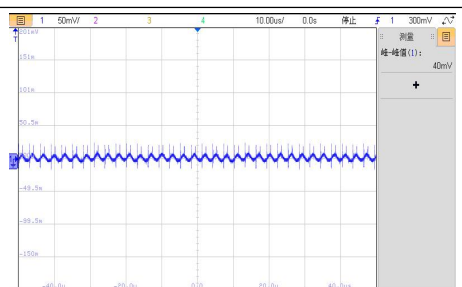
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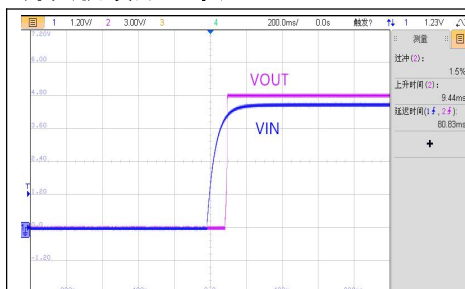


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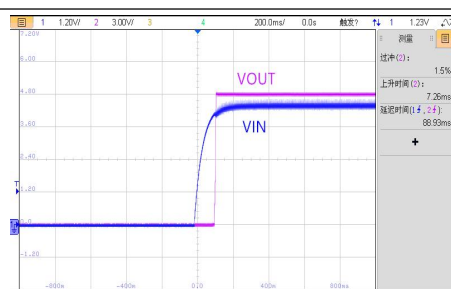


VIN=9V，满载输出电压纹波波形

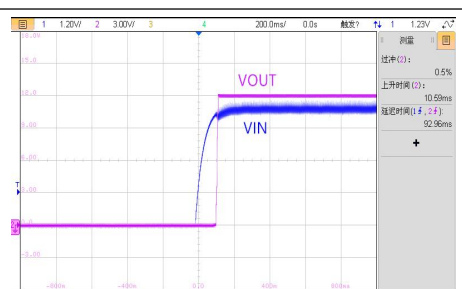
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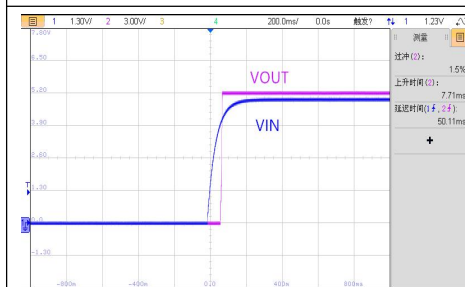
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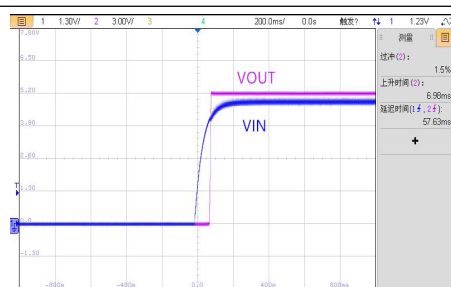
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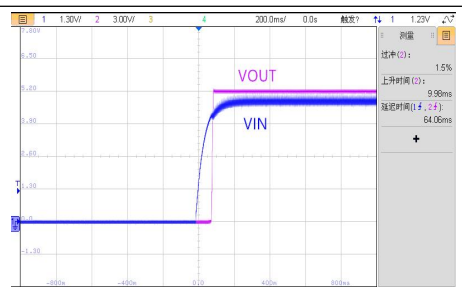
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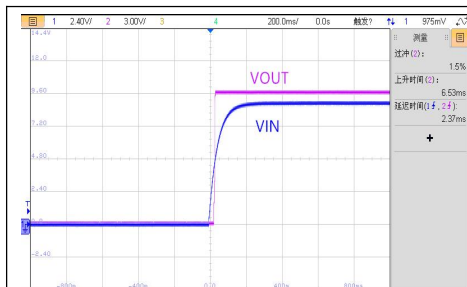
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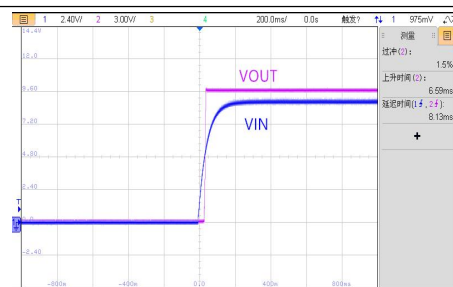
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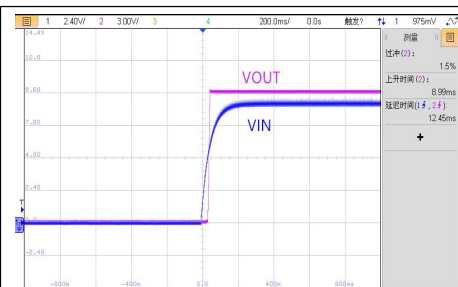
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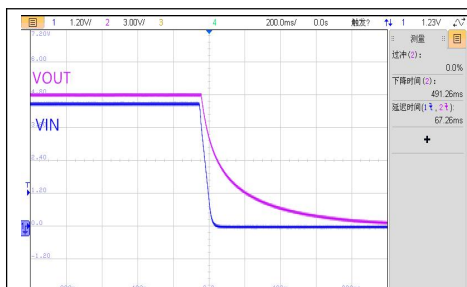
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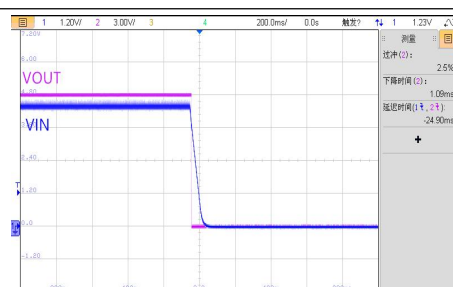
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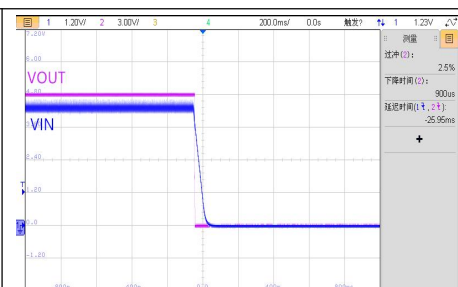
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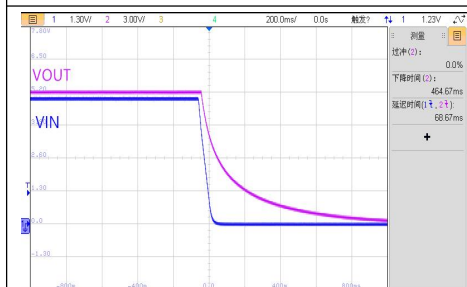
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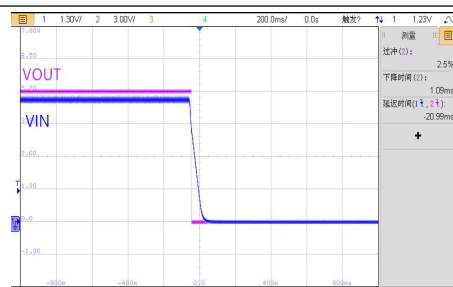
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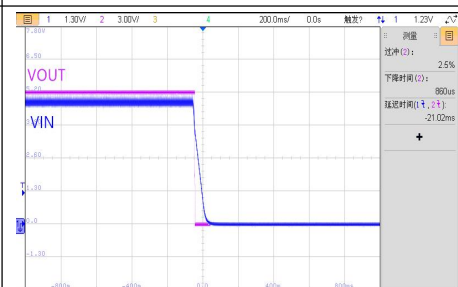
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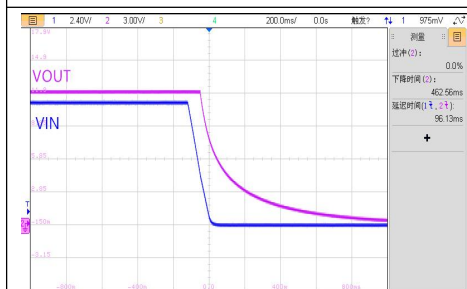
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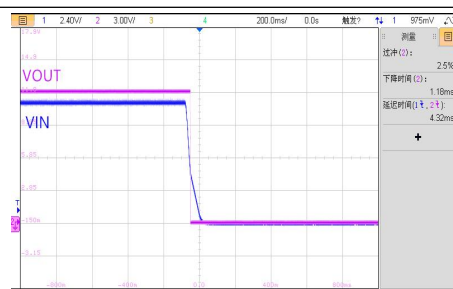
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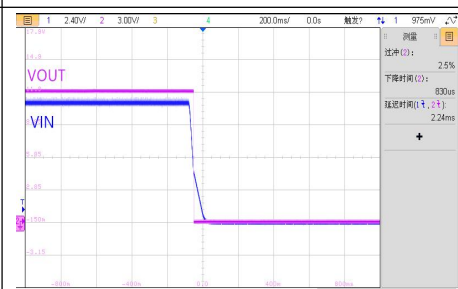
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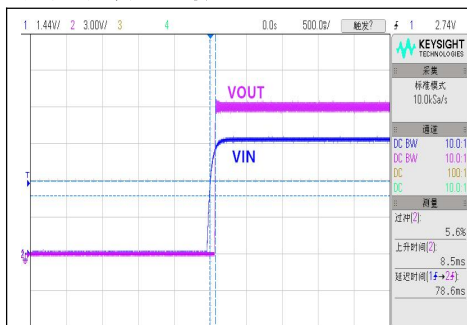


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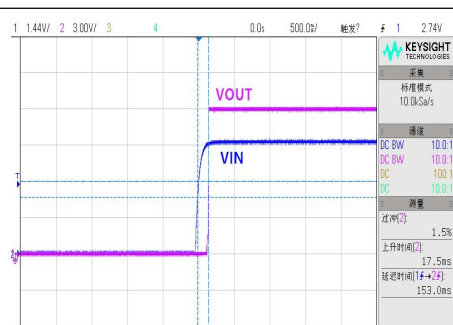


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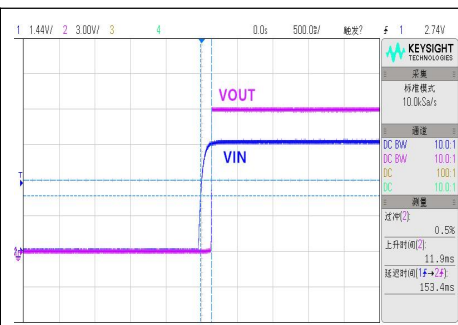
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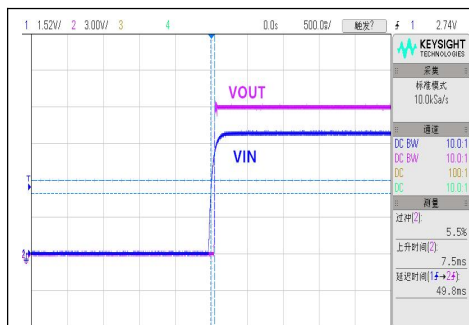
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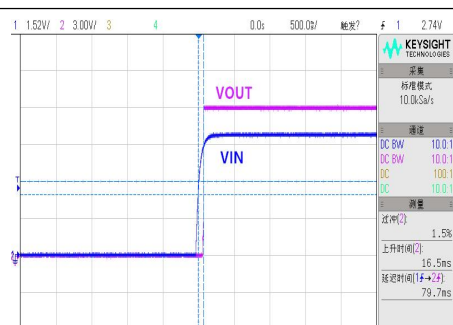
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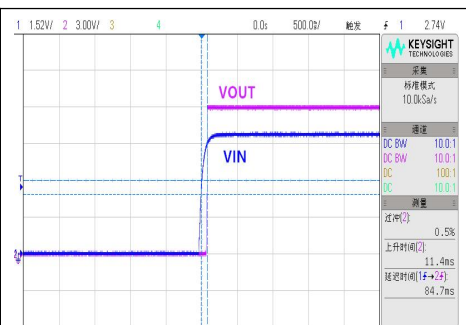
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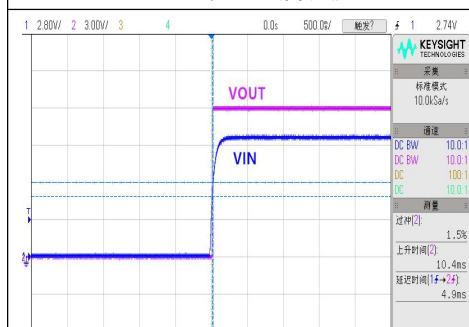
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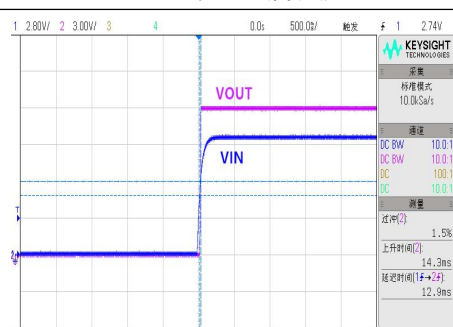
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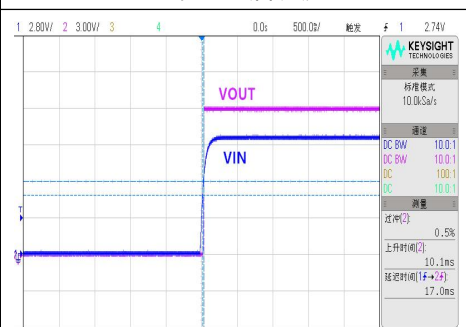
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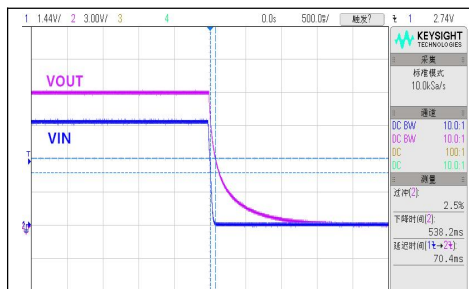
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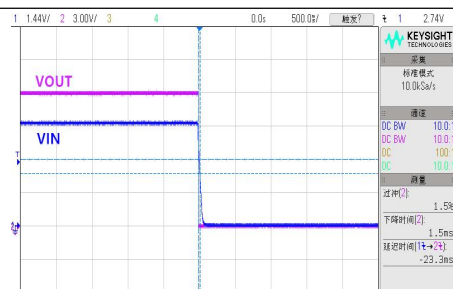
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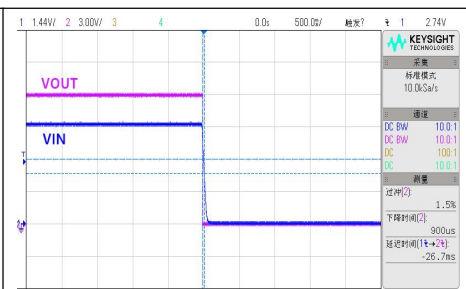
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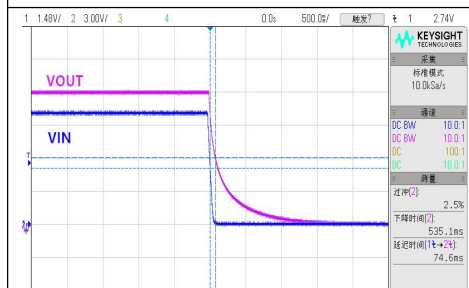
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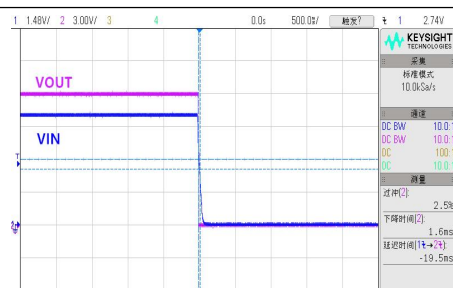
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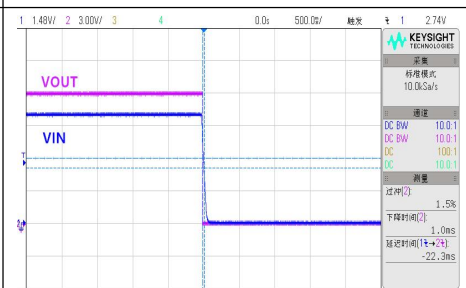
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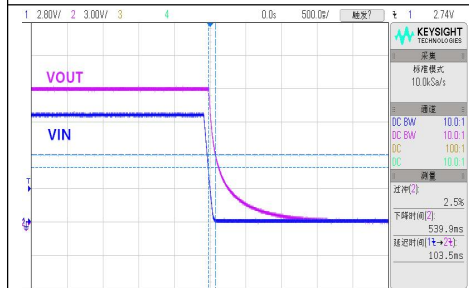
VIN=5V, 空载关机波形



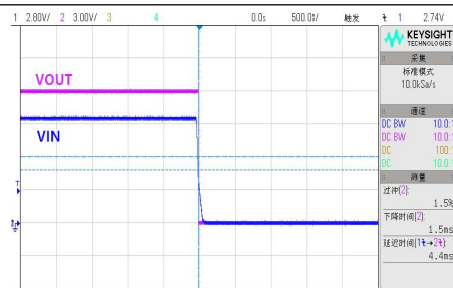
VIN=5V, 半载关机波形



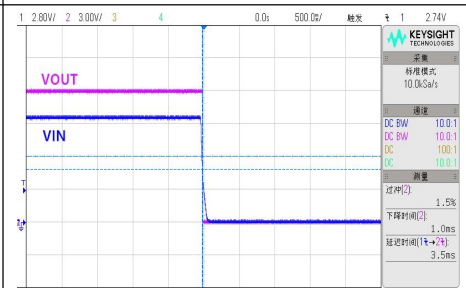
VIN=5V, 满载关机波形



VIN=9V, 空载关机波形

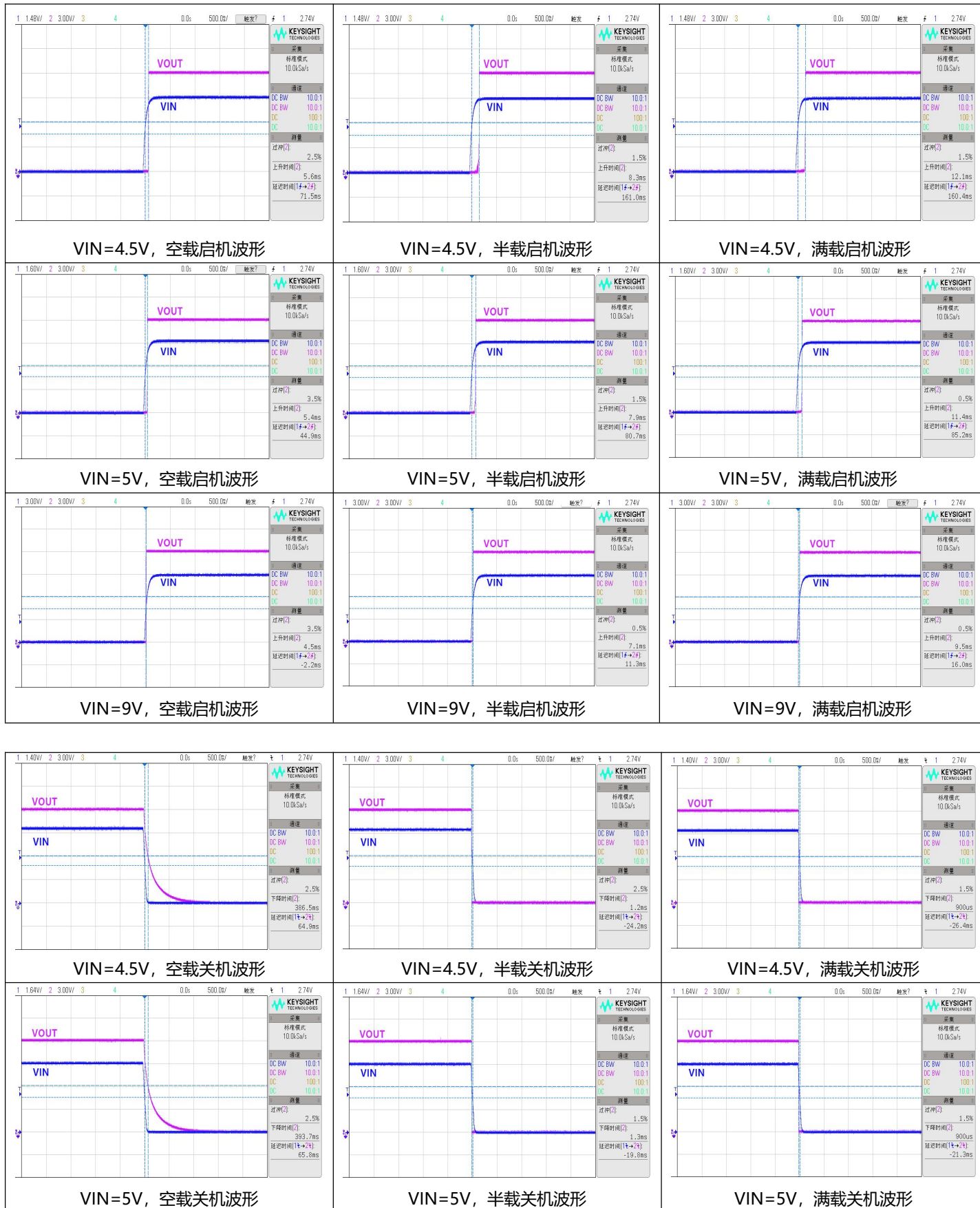


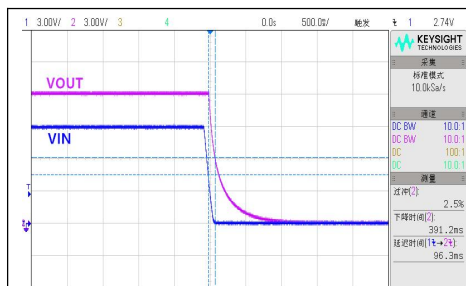
VIN=9V, 半载关机波形



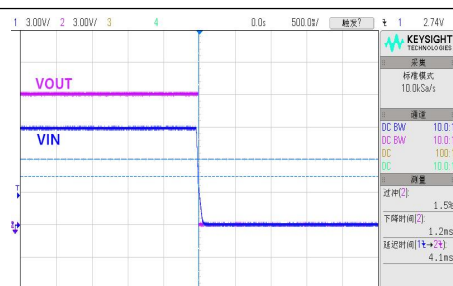
VIN=9V, 满载关机波形

开关机波形（高温 85℃）

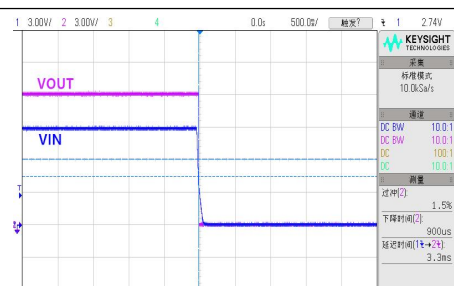




VIN=9V, 空载关机波形

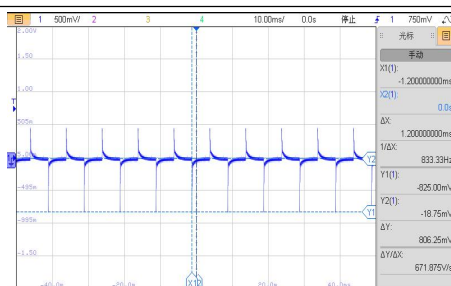


VIN=9V, 半载关机波形

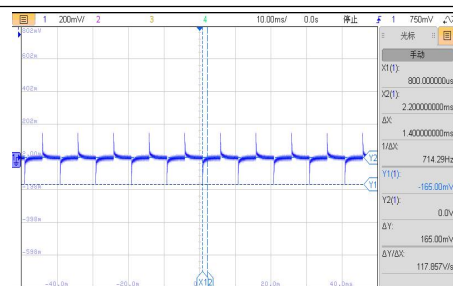


VIN=9V, 满载关机波形

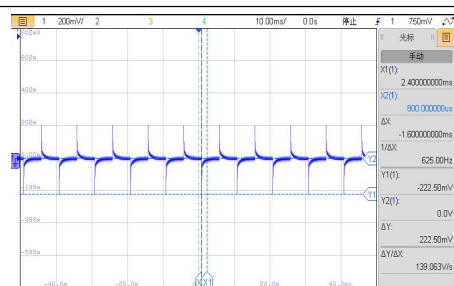
动态波形



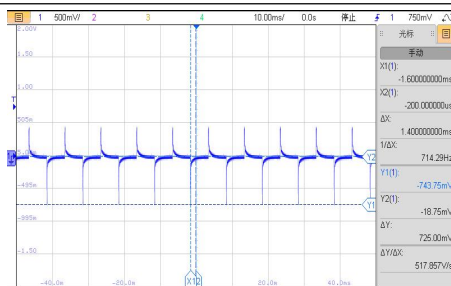
VIN=4.5V, 100%-10%-100%Io 动态波形



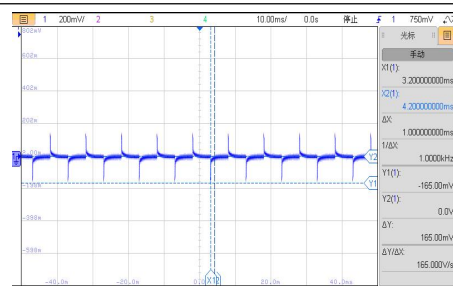
VIN=4.5V, 75%-50%-75%Io 动态波形



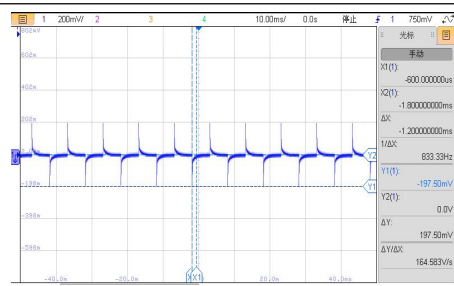
VIN=4.5V, 50%-25%-50%Io 动态波形



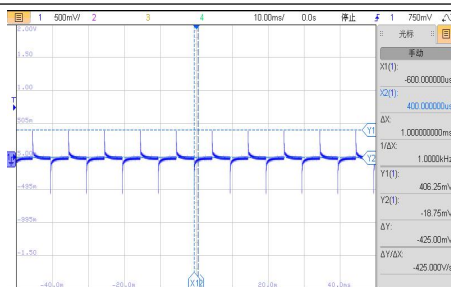
VIN=5V, 100%-10%-100%Io 动态波形



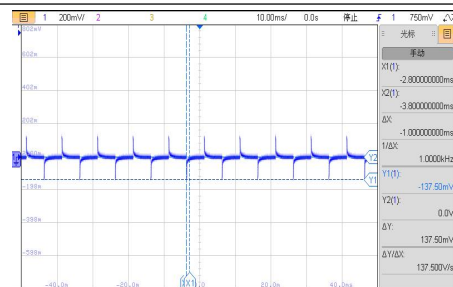
VIN=5V, 75%-50%-75%Io 动态波形



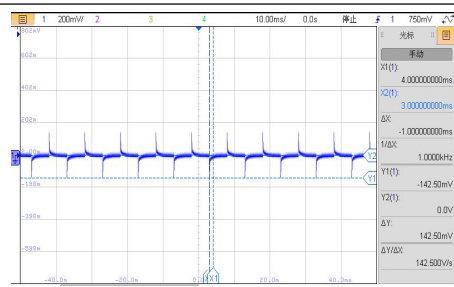
VIN=5V, 50%-25%-50%Io 动态波形



VIN=9V, 100%-10%-100%Io 动态波形

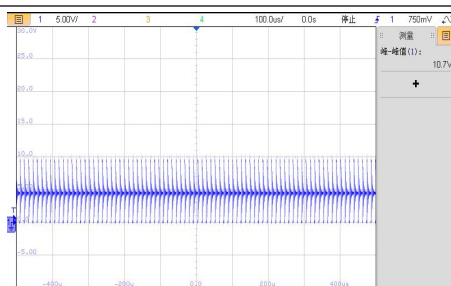


VIN=9V, 75%-50%-75%Io 动态波形

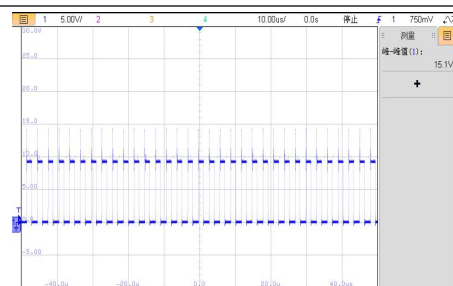


VIN=9V, 50%-25%-50%Io 动态波形

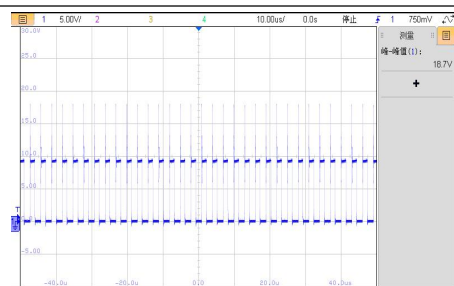
外置 MOS 管 Q1 电压应力波形



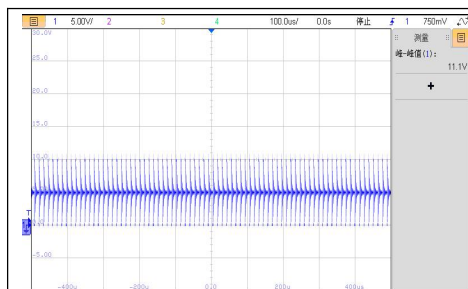
VIN=4.5V, 空载 VDS 波形



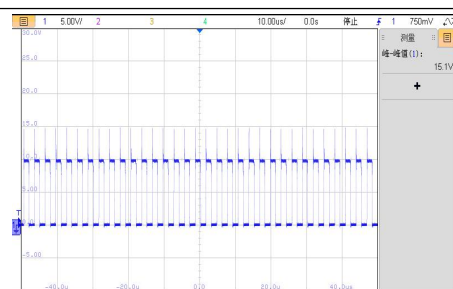
VIN=4.5V, 半载 VDS 波形



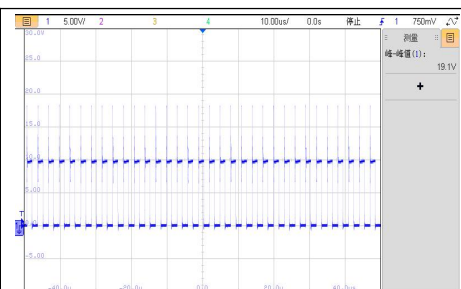
VIN=4.5V, 满载 VDS 波形



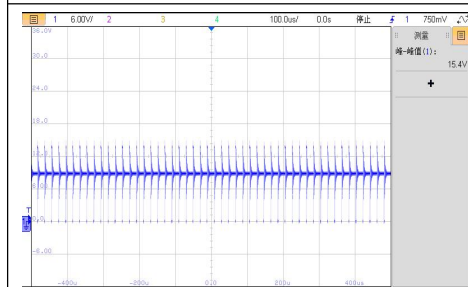
VIN=5V, 空载 VDS 波形



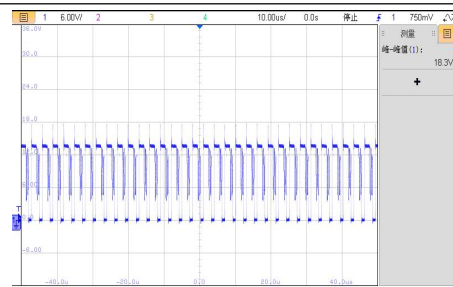
VIN=5V, 半载 VDS 波形



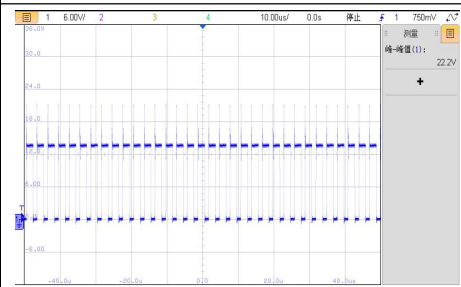
VIN=5V, 满载 VDS 波形



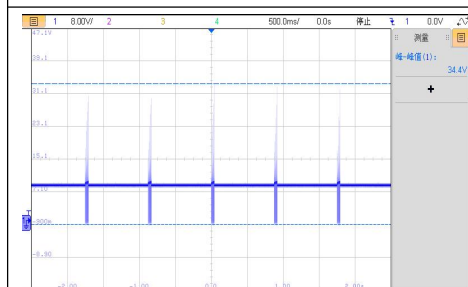
VIN=9V, 空载 VDS 波形



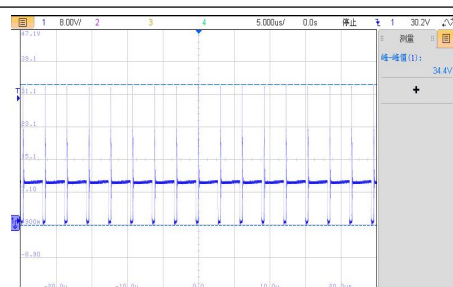
VIN=9V, 半载 VDS 波形



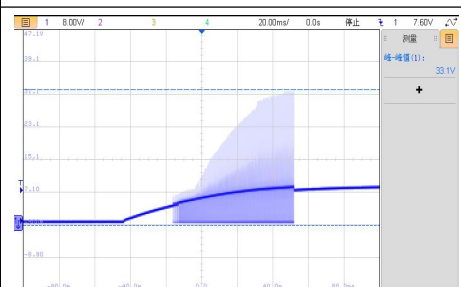
VIN=9V, 满载 VDS 波形



VIN=9V, 短路保护 VDS 波形

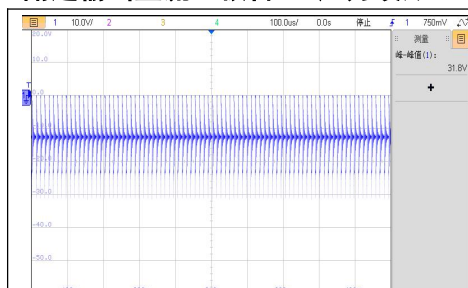


VIN=9V, 短路保护 VDS 展开波形

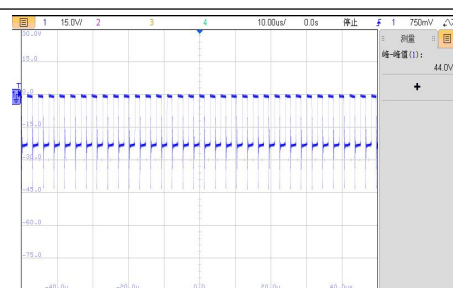


VIN=9V, 短路启动 VDS 波形

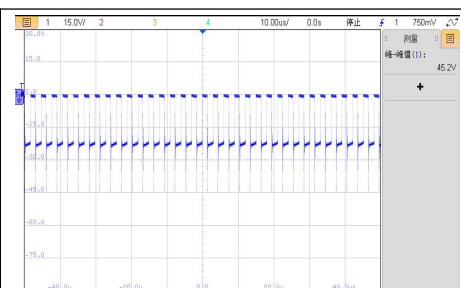
副边输出整流二极管 D4 应力波形



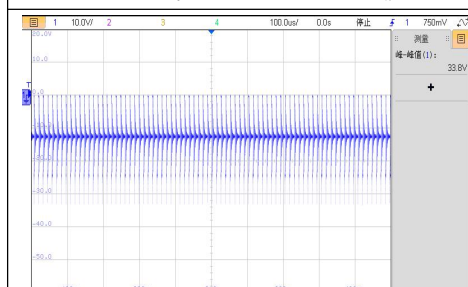
VIN=4.5V, D4 空载工作电压波形



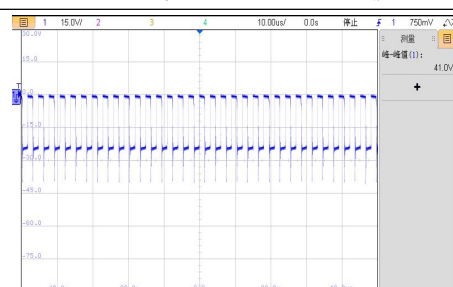
VIN=4.5V, D4 半载工作电压波形



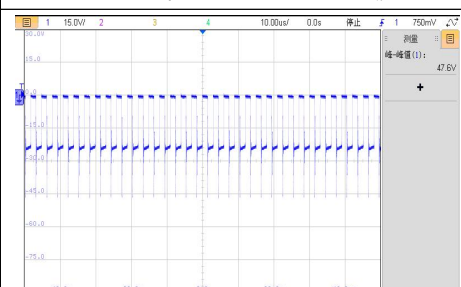
VIN=4.5V, D4 满载工作电压波形



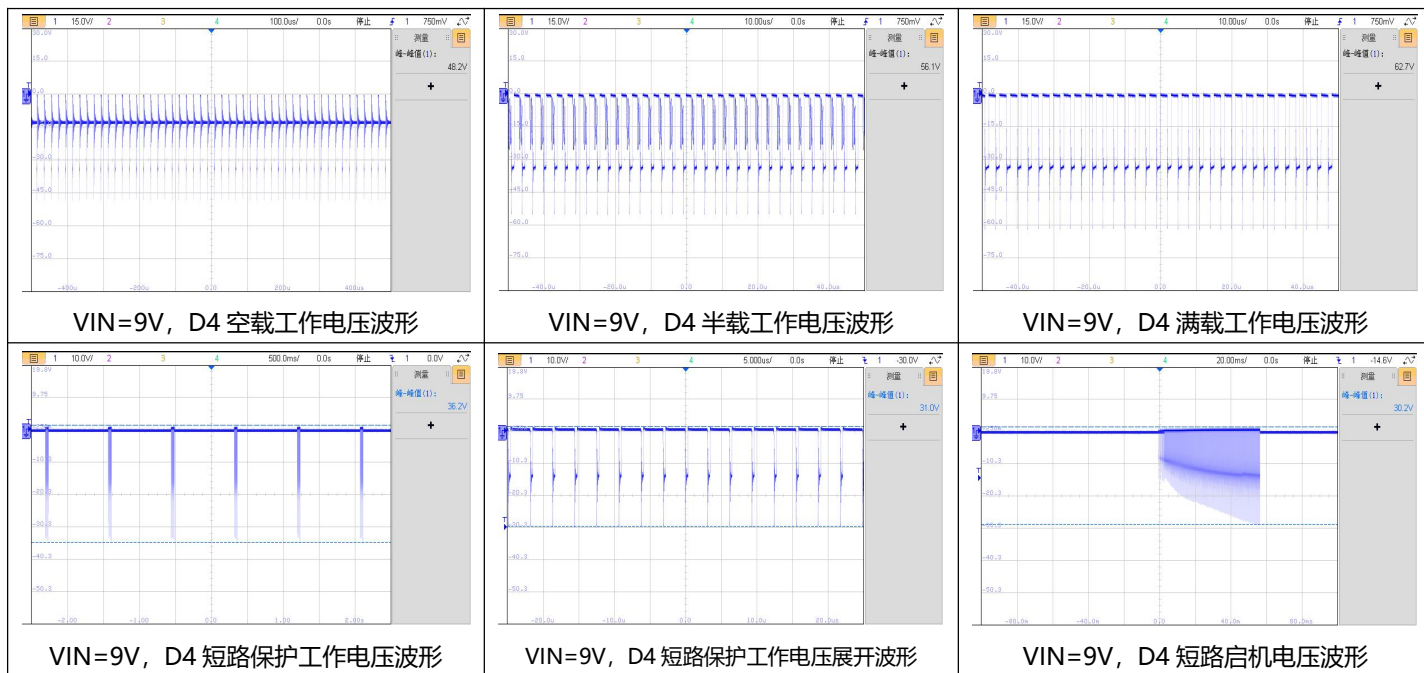
VIN=5V, D4 空载工作电压波形



VIN=5V, D4 半载工作电压波形



VIN=5V, D4 满载工作电压波形



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