

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 VPE17PF-15A、输出整流二极管以及必要的阻容元件，实现 9V-36V 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。

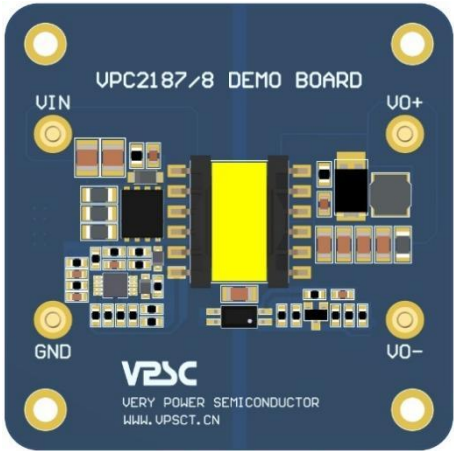
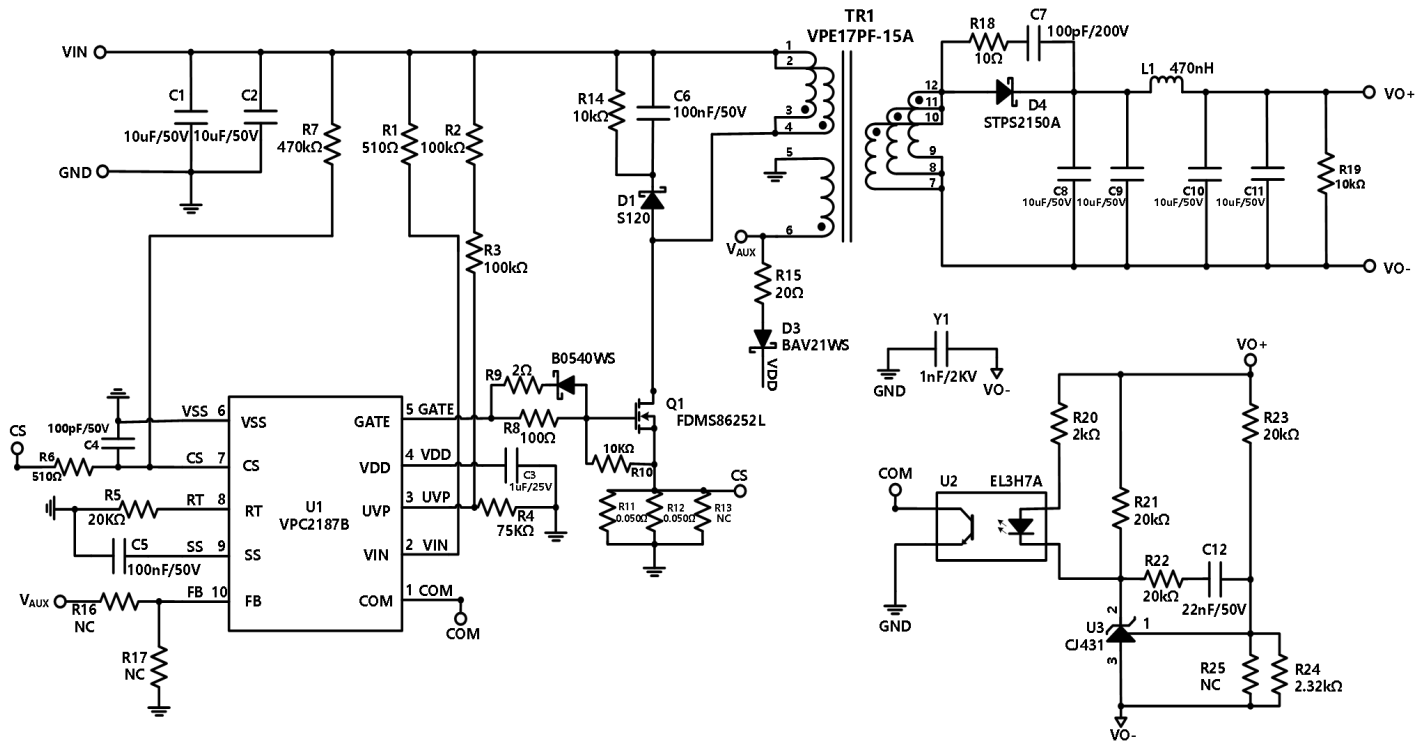


图 1: VPC2187 Demo 板(尺寸:55mm*55mm)

关键词：输入：9V-36V，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

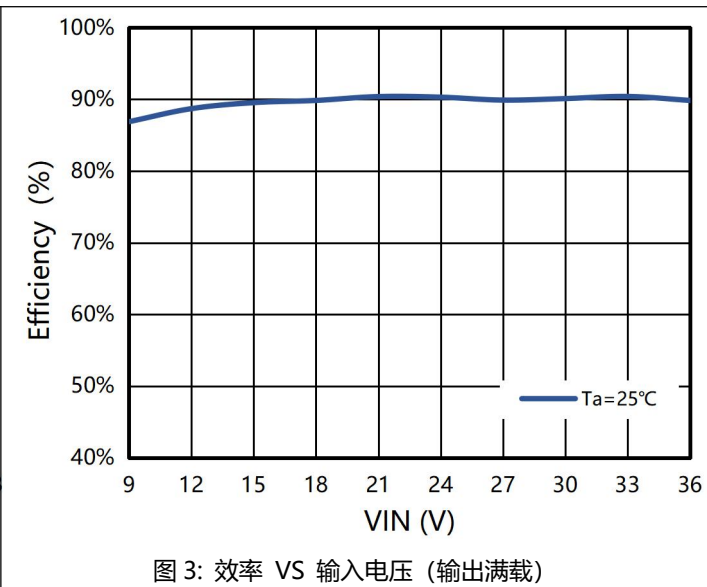
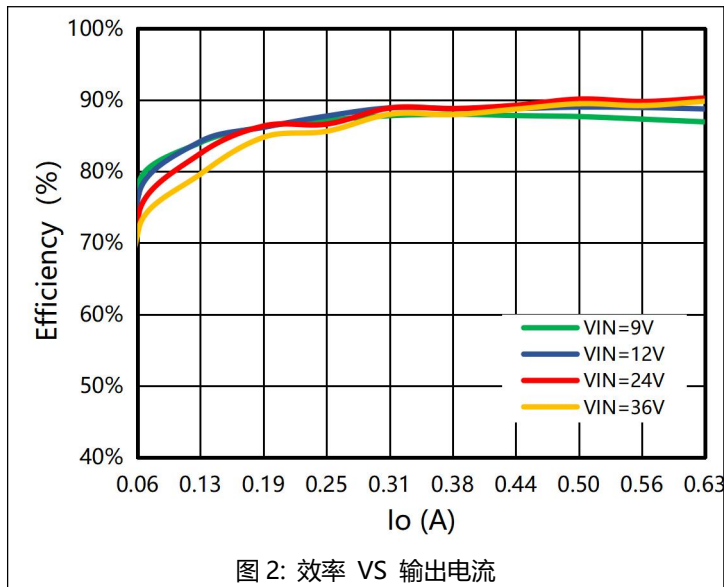
位号	参数	封装	型号	品牌
C1	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C2	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C3	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C4	100pF/50V- X7R	0603	CC0603KRX7R9BB101	YAGEO
C5	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C6	100nF/50V-X7R	0805	CC0805KKX7R0BB104	YAGEO
C7	100pF/200V- NP0	0805	CC0805JRNPOABN101	YAGEO
C8	10uF/50V-X5R	1206	CC1206KKX5R9BB106	YAGEO
C9	10uF/50V-X5R	1206	CC1206KKX5R9BB106	YAGEO
C10	10uF/50V-X5R	1206	CC1206KKX5R9BB106	YAGEO
C11	10uF/50V-X5R	1206	CC1206KKX5R9BB106	YAGEO
C12	22nF/50V-X7R	0603	CC0603KRX7R9BB223	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R2	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R3	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R4	75KΩ±1%	0603	RC0603FR-0775KL	YAGEO
R5	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R6	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R7	470KΩ±1%	0603	RC0603FR-07470KL	YAGEO
R8	100Ω±1%	0603	RC0603FR-07100RL	YAGEO
R9	2Ω±1%	0603	RC0603FR-072RL	YAGEO
R10	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R11	0.050Ω ±1%	1206	RL1206FR-070R050L	YAGEO
R12	0.050Ω ±1%	1206	RL1206FR-070R050L	YAGEO
R13	NC	-	-	-
R14	10KΩ±1%	0805	RC0805FR-0710KL	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	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R23	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R24	2.32KΩ±1%	0603	RC0603FR-072K32L	YAGEO
R25	NC	-	-	-
TR1	NP:NS:NA=7:11:6 Lp=6.86uH	ER14.5	VPE17PF-15A	VPSC

Q1	N 沟道 150V 12A	Power-56-8	FDMS86252L	ONSEMI
L1	470nH $\pm 30\%$	SMD	FNR5020SR47NT	CJIANG
D1	200V/1A	SOD-123	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	CJ
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	150V/2A	SMA	STPS2150A	ST
U1	4-100VIN 电源管理芯片	MSOP-10	VPC2187B	VPSC
U2	CTR=80~160, $V_{iso}=3750VAC$	SSOP-4	EL3H7A	EVERLIGHT
U3	$V_{ref}=2.495V$	SOT23-3	CJ431	CJ

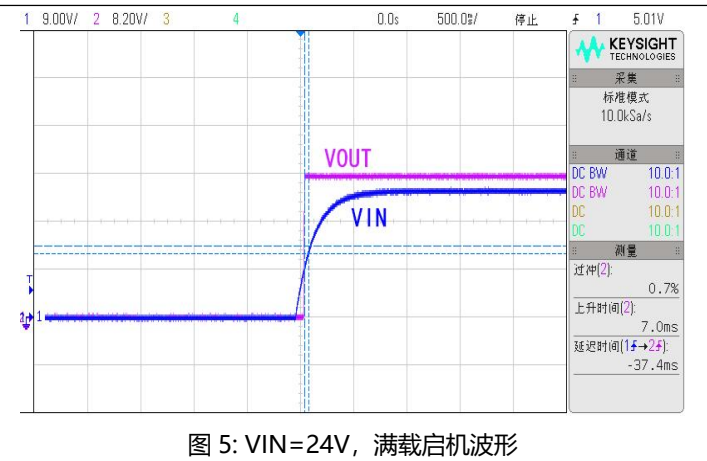
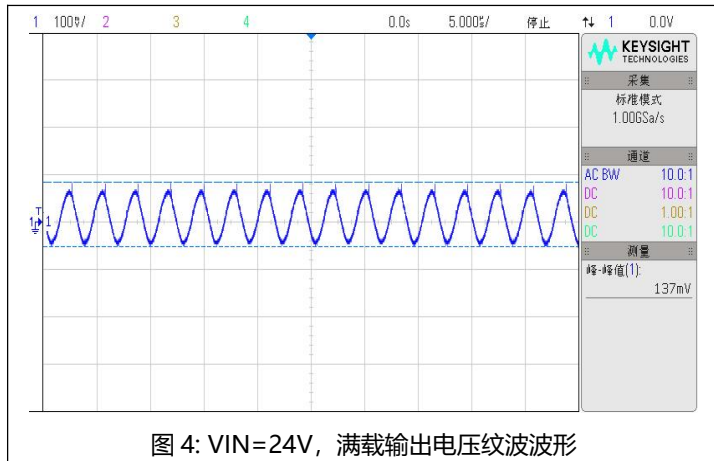
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流 (满载/空载)	VIN=24V	13	---	691	mA
转换效率	VIN=24V, IO=0.625A	---	90.2	---	%
纹波&噪声	VIN=24V, IO=0.625A	---	137	200	mV
输出电压精度	VIN=24V, IO=0.625A	---	0.5	---	%
线性调节率	VIN=9V-36V, IO=0.625A	---	0.1	---	%
负载调整率	VIN=24V, IO=0.625A	---	0.1	---	%
输出过流点系数	VIN=9V, IO=0.625A	---	1.4	---	倍
输入欠压保护	锁定电压	---	7.3	---	V
	恢复电压	---	8.3	---	V
短路保护	VIN=9V-36V	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

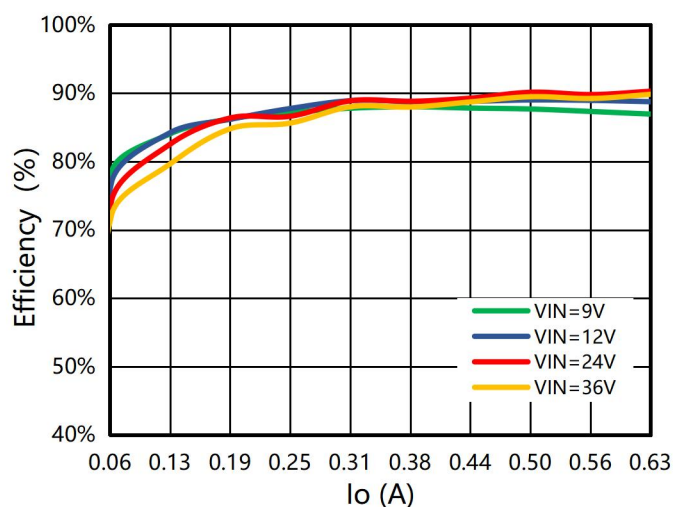


相关波形

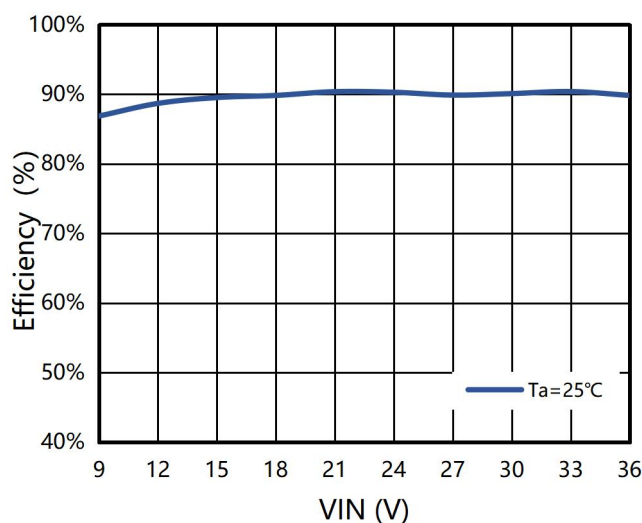


详细测试数据

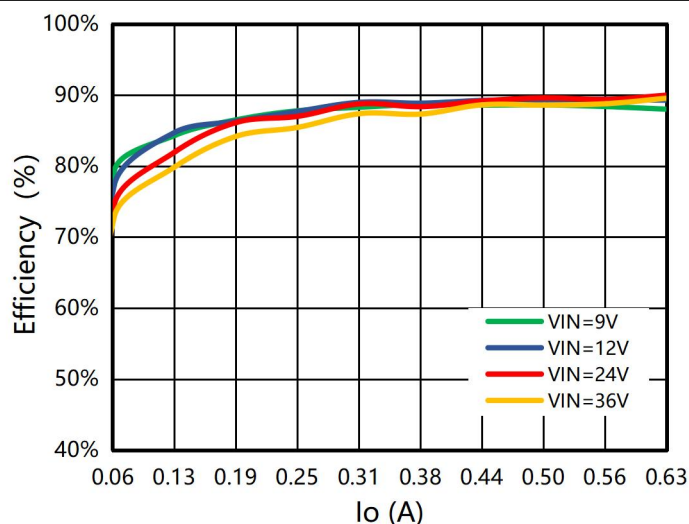
高低温测试曲线



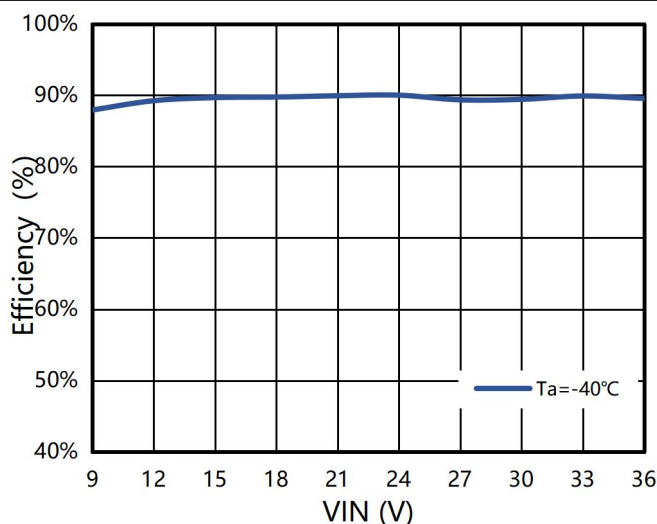
效率 VS 输出电流 (25°C)



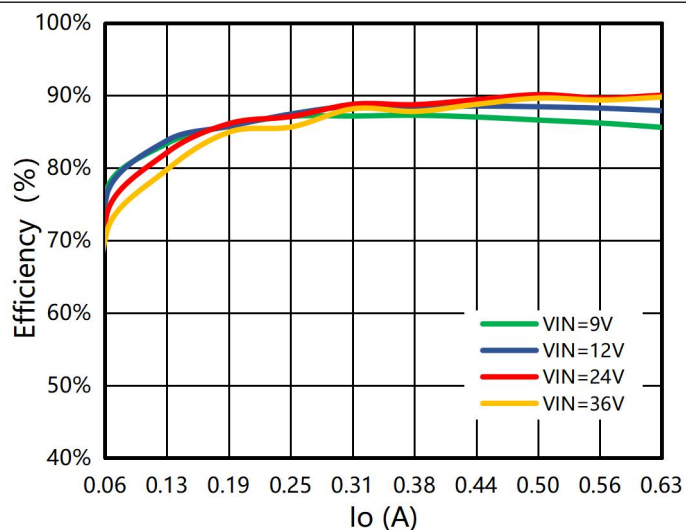
效率 VS 输入电压 (输出满载@25°C)



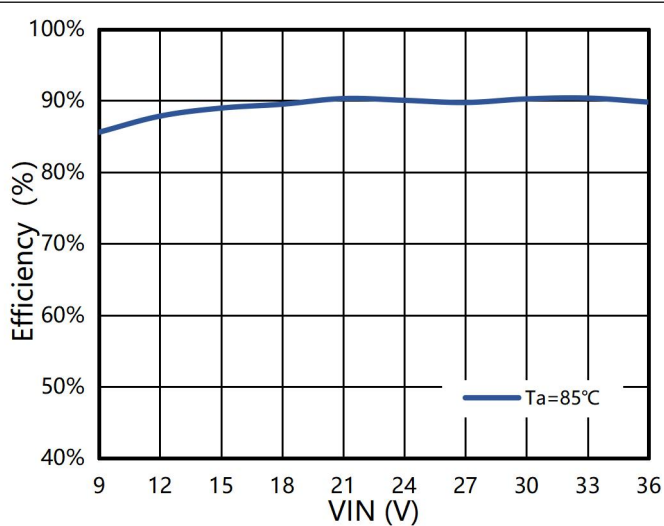
效率 VS 输出电流 (-40°C)



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=24V, Ta=25°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
24	0.013	23.92	0	0%	0.00%
24	0.086	23.92	0.064	10%	74.17%
24	0.152	23.92	0.126	20%	82.62%
24	0.218	23.92	0.189	30%	86.41%
23.97	0.288	23.92	0.250	40%	86.62%
24	0.352	23.92	0.314	50%	88.91%
24	0.422	23.92	0.376	60%	88.80%
24	0.489	23.92	0.438	70%	89.27%
24	0.554	23.92	0.501	80%	90.13%
24	0.626	23.92	0.564	90%	89.80%
24	0.691	23.92	0.626	100%	90.29%

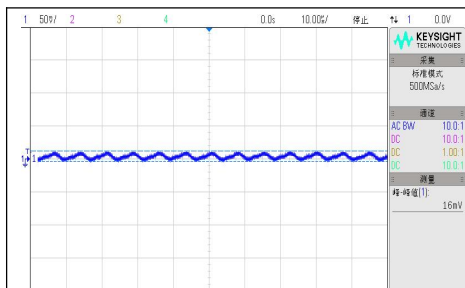
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.99	0.012	23.74	0	0%	0.00%
24	0.085	23.74	0.064	10%	74.48%
24	0.152	23.74	0.126	20%	82.00%
24	0.217	23.74	0.189	30%	86.15%
23.95	0.286	23.74	0.251	40%	86.99%
24	0.350	23.74	0.314	50%	88.74%
24	0.421	23.74	0.376	60%	88.34%
24	0.486	23.74	0.438	70%	89.15%
24	0.553	23.73	0.501	80%	89.58%
24	0.624	23.73	0.564	90%	89.37%
24	0.688	23.73	0.626	100%	89.96%

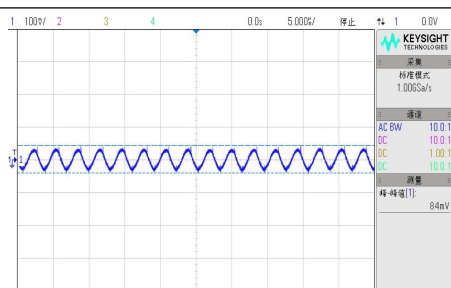
VIN=24V, Ta=85°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
24	0.015	23.96	0	0%	0.00%
24	0.087	23.96	0.064	10%	73.44%
24	0.153	23.96	0.126	20%	82.22%
24	0.219	23.96	0.189	30%	86.16%
23.97	0.288	23.96	0.251	40%	87.12%
24	0.353	23.96	0.314	50%	88.80%
24	0.423	23.96	0.376	60%	88.74%
24	0.490	23.96	0.439	70%	89.44%
24	0.555	23.96	0.501	80%	90.12%
24	0.628	23.96	0.564	90%	89.66%
24	0.694	23.96	0.626	100%	90.05%

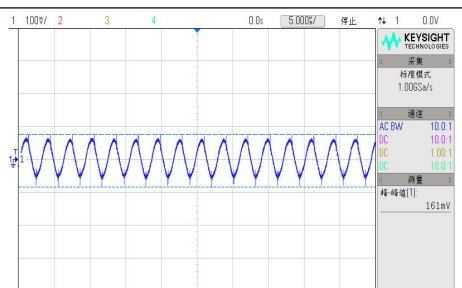
输出电压纹波波形



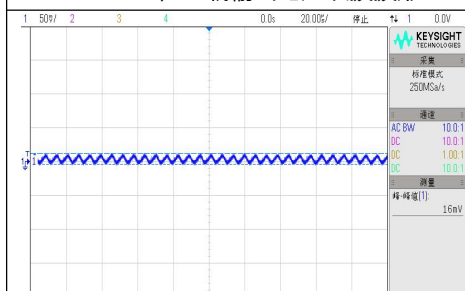
VIN=9V, 空载输出电压纹波波形



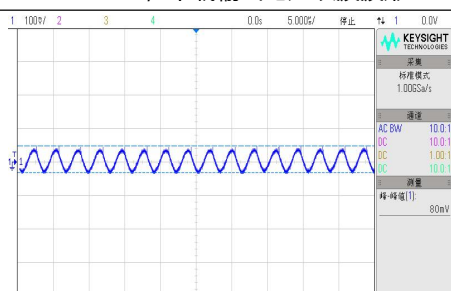
VIN=9V, 半载输出电压纹波波形



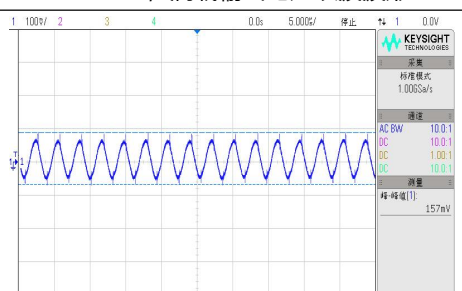
VIN=9V, 满载输出电压纹波波形



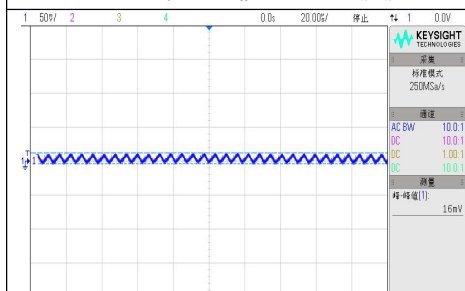
VIN=12V, 空载输出电压纹波波形



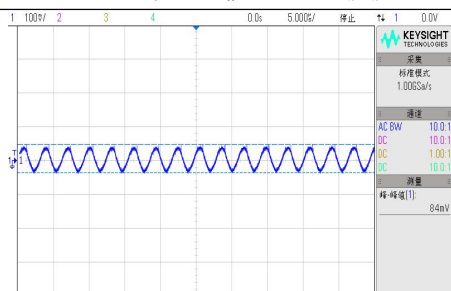
VIN=12V, 半载输出电压纹波波形



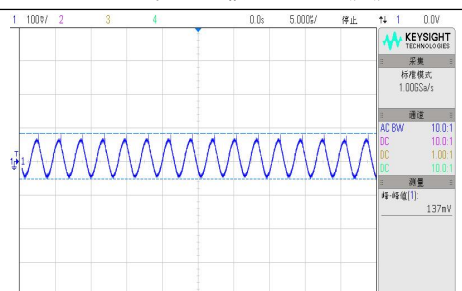
VIN=12V, 满载输出电压纹波波形



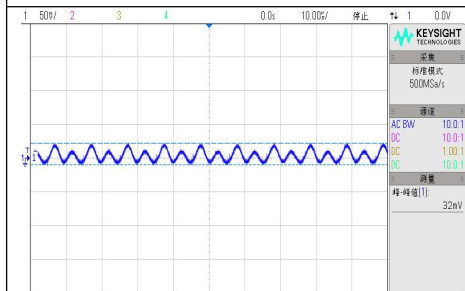
VIN=24V, 空载输出电压纹波波形



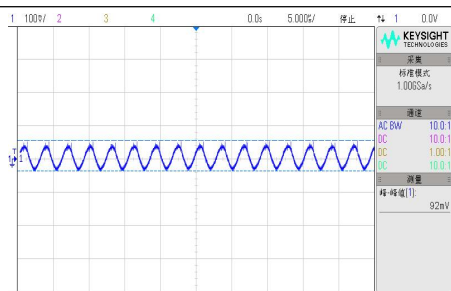
VIN=24V, 半载输出电压纹波波形



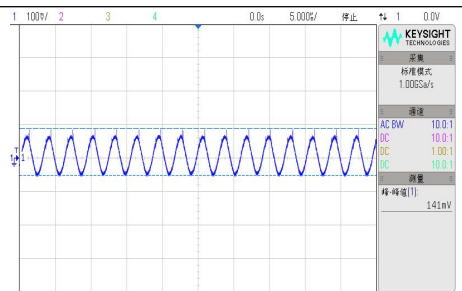
VIN=24V, 满载输出电压纹波波形



VIN=36V, 空载输出电压纹波波形

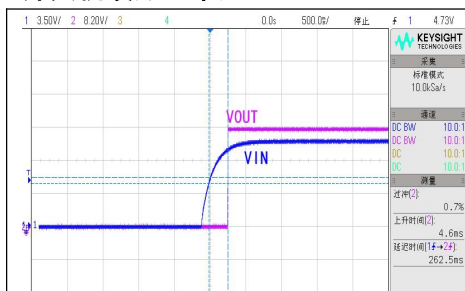


VIN=36V, 半载输出电压纹波波形

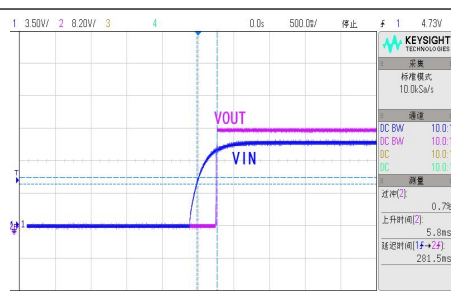


VIN=36V, 满载输出电压纹波波形

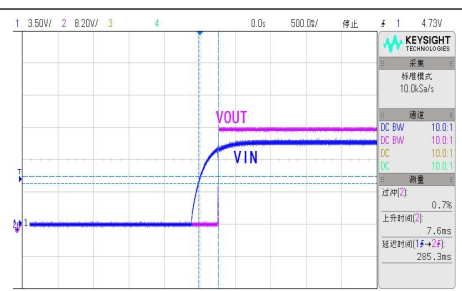
开关机波形 (常温 25°C)



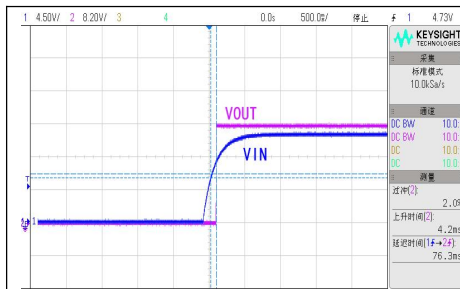
VIN=9V, 空载启机波形



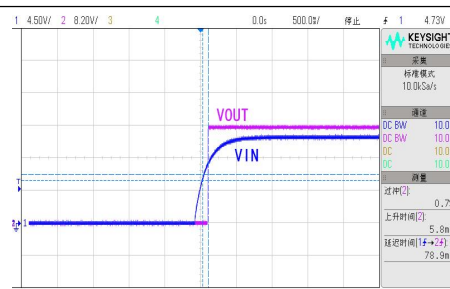
VIN=9V, 半载启机波形



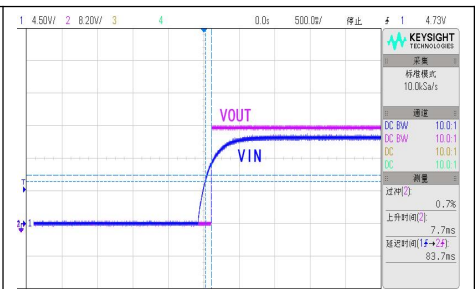
VIN=9V, 满载启机波形



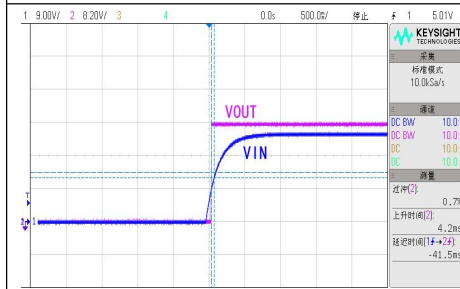
VIN=12V, 空载启机波形



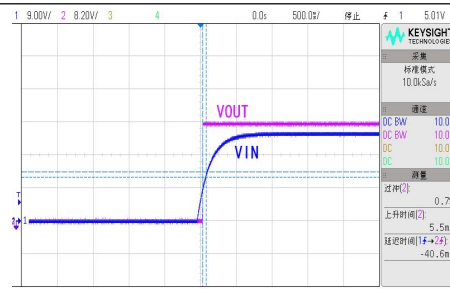
VIN=12V, 半载启机波形



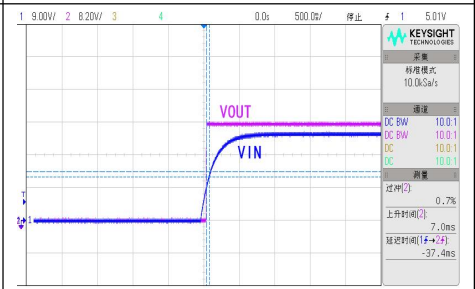
VIN=12V, 满载启机波形



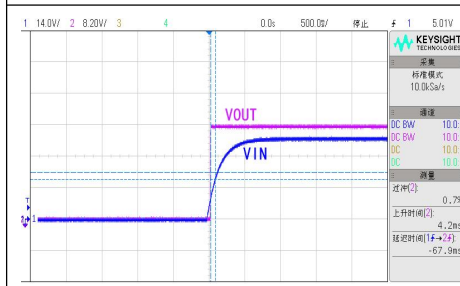
VIN=24V, 空载启机波形



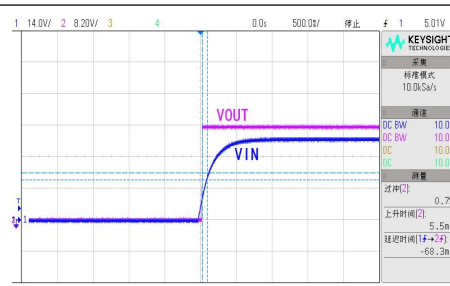
VIN=24V, 半载启机波形



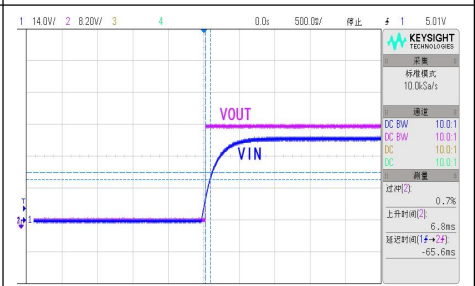
VIN=24V, 满载启机波形



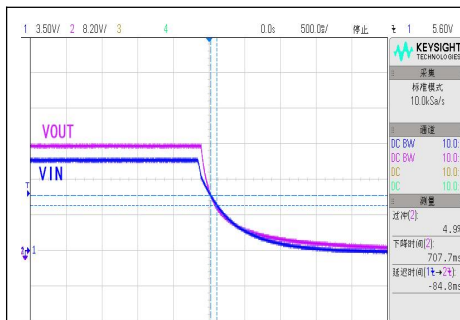
VIN=36V, 空载启机波形



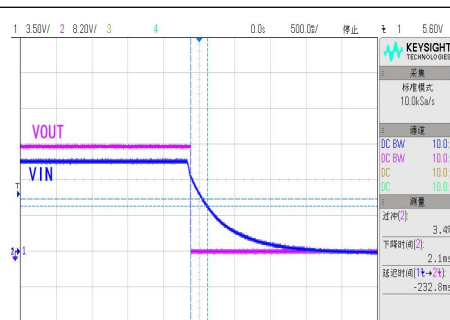
VIN=36V, 半载启机波形



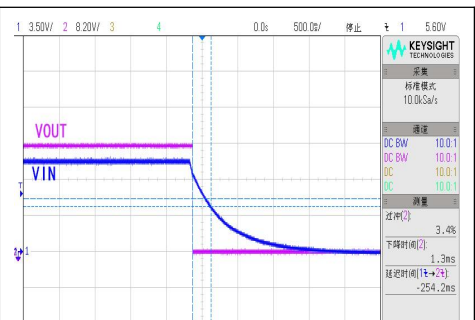
VIN=36V, 满载启机波形



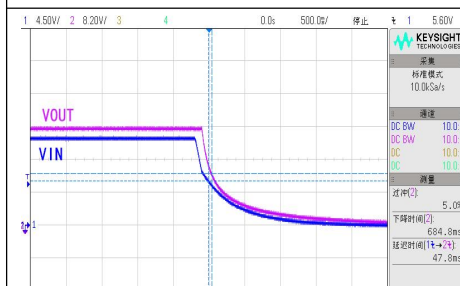
VIN=9V, 空载关机波形



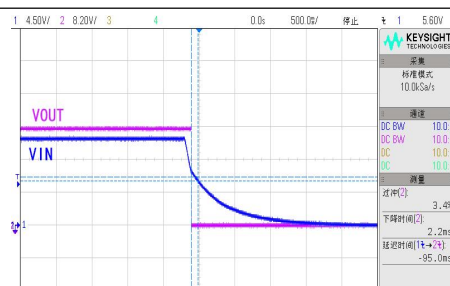
VIN=9V, 半载关机波形



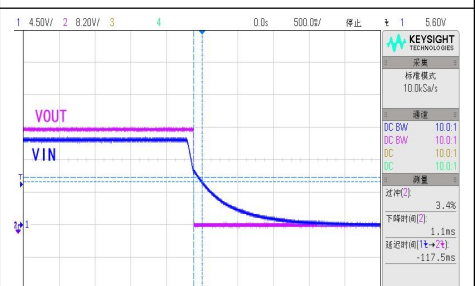
VIN=9V, 满载关机波形



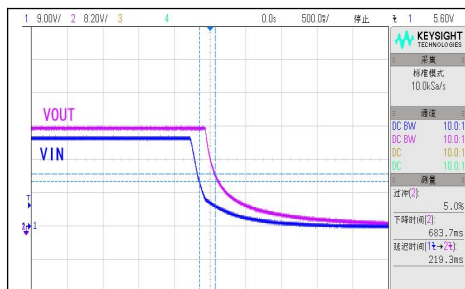
VIN=12V, 空载关机波形



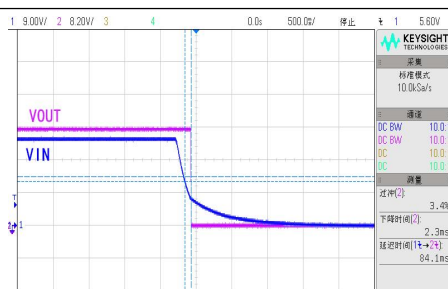
VIN=12V, 半载关机波形



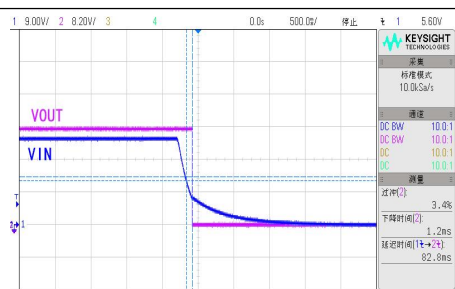
VIN=12V, 满载关机波形



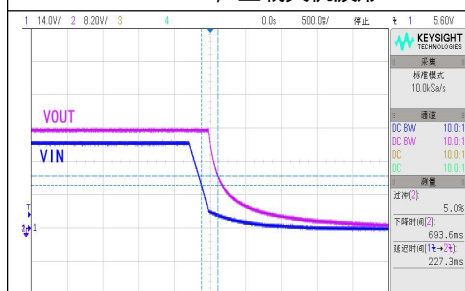
VIN=24V, 空载关机波形



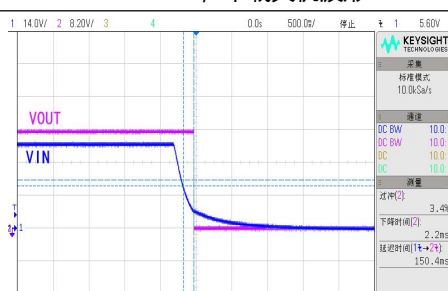
VIN=24V, 半载关机波形



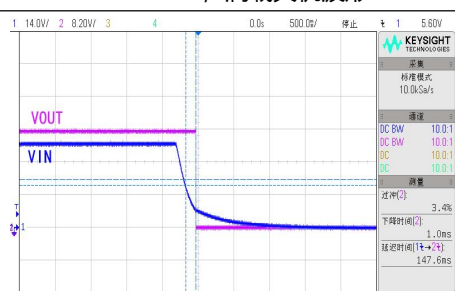
VIN=24V, 满载关机波形



VIN=36V, 空载关机波形

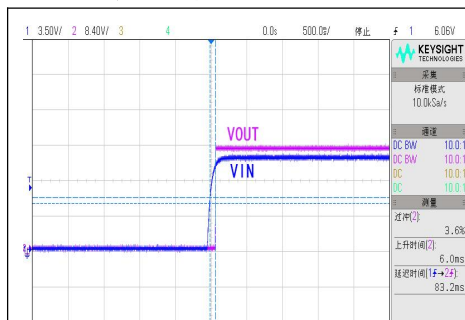


VIN=36V, 半载关机波形

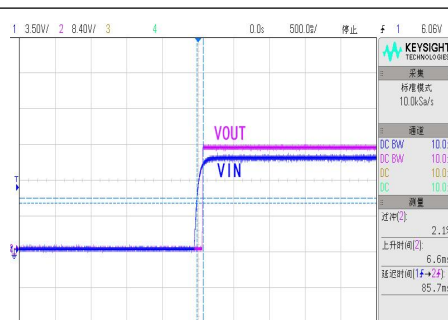


VIN=36V, 满载关机波形

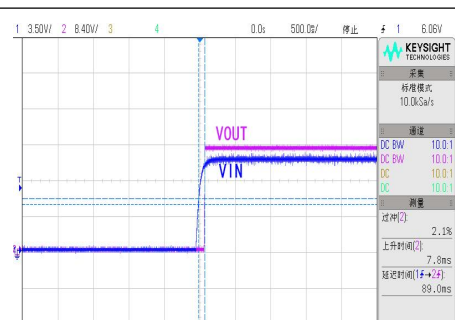
开关机波形（低温-40℃）



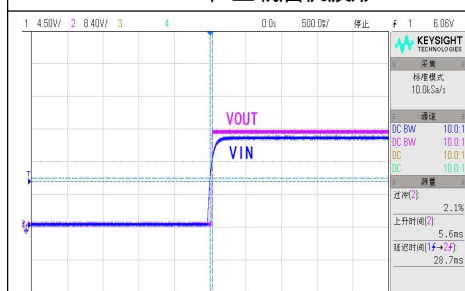
VIN=9V, 空载启机波形



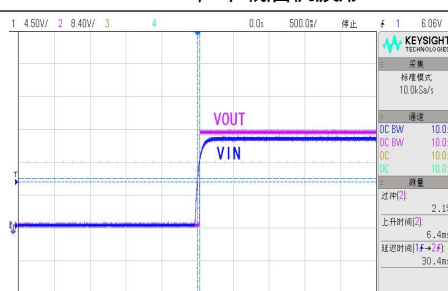
VIN=9V, 半载启机波形



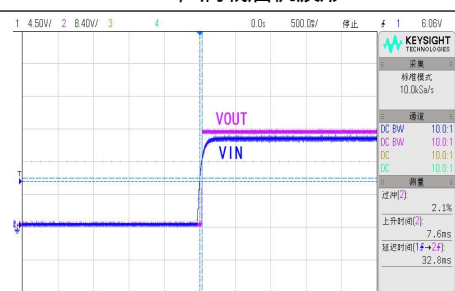
VIN=9V, 满载启机波形



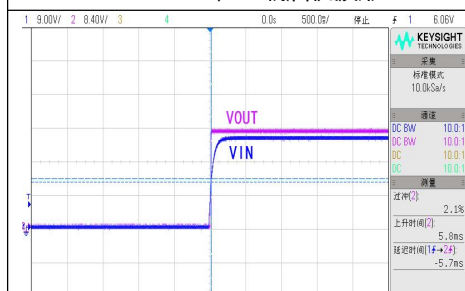
VIN=12V, 空载启机波形



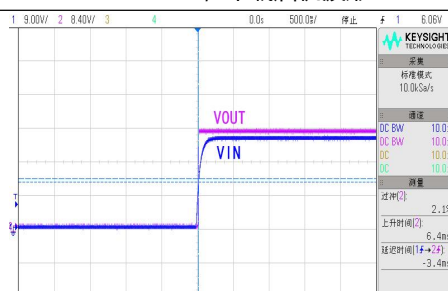
VIN=12V, 半载启机波形



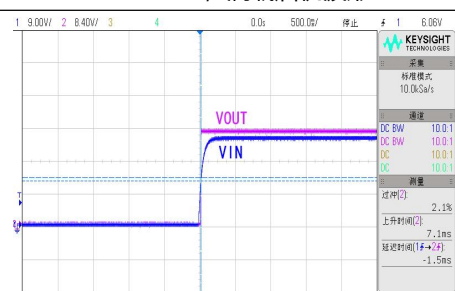
VIN=12V, 满载启机波形



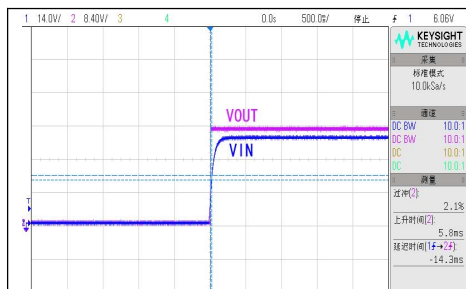
VIN=24V, 空载启机波形



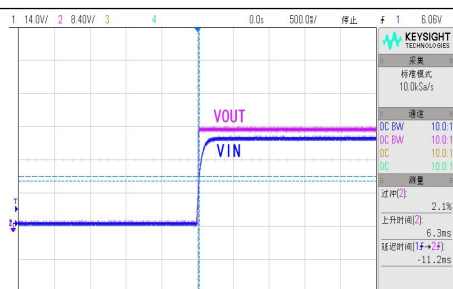
VIN=24V, 半载启机波形



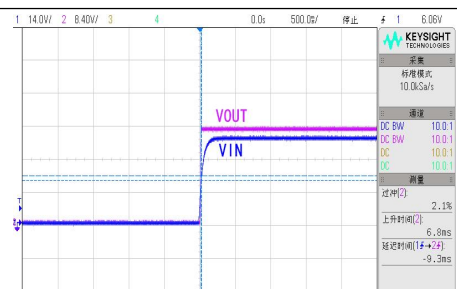
VIN=24V, 满载启机波形



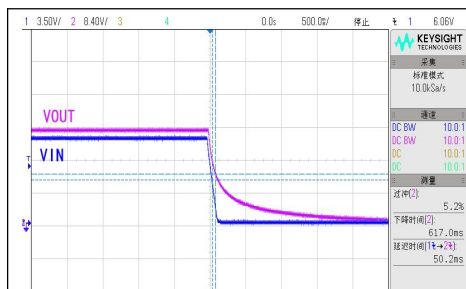
VIN=36V, 空载启机波形



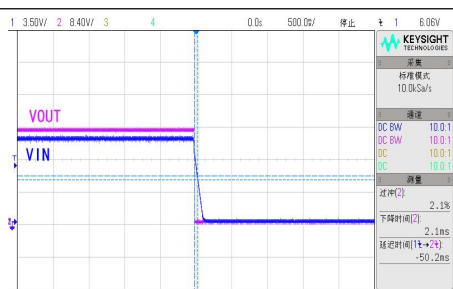
VIN=36V, 半载启机波形



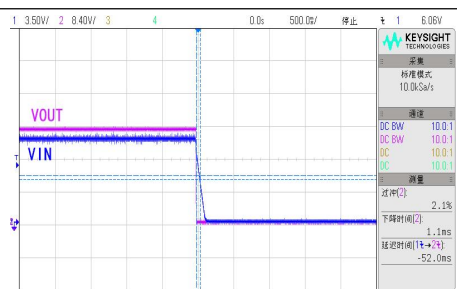
VIN=36V, 满载启机波形



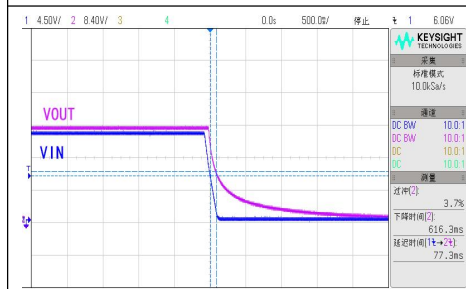
VIN=9V, 空载关机波形



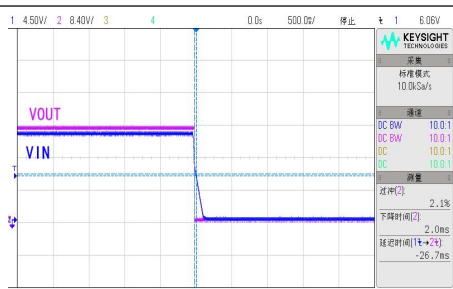
VIN=9V, 半载关机波形



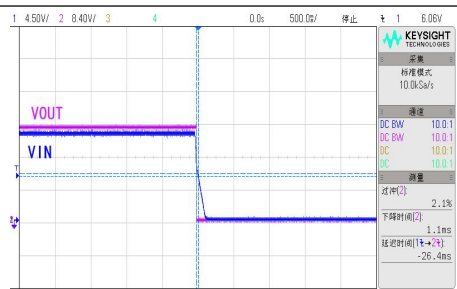
VIN=9V, 满载关机波形



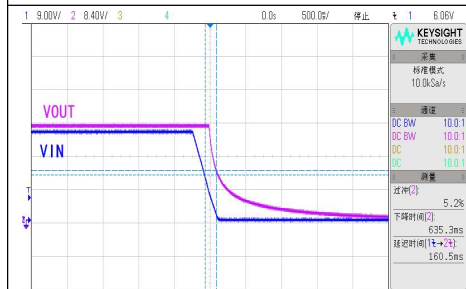
VIN=12V, 空载关机波形



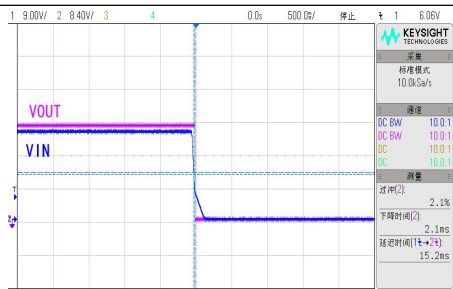
VIN=12V, 半载关机波形



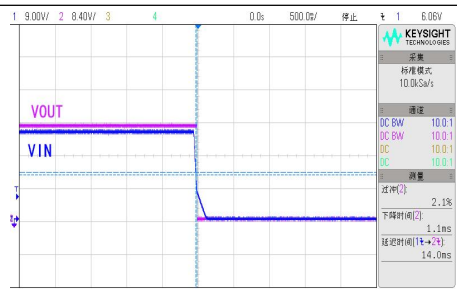
VIN=12V, 满载关机波形



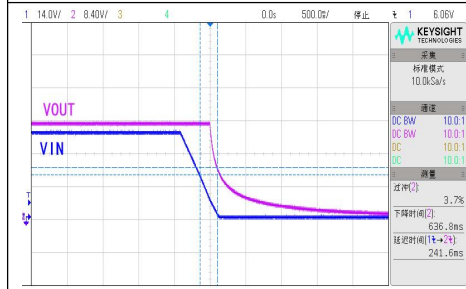
VIN=24V, 空载关机波形



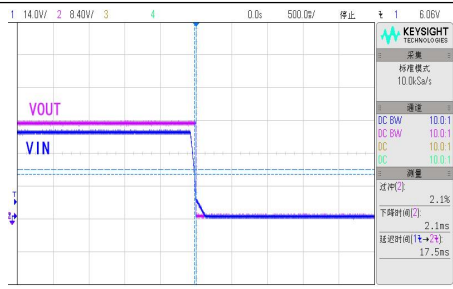
VIN=24V, 半载关机波形



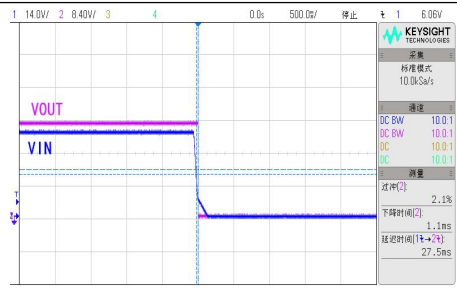
VIN=24V, 满载关机波形



VIN=36V, 空载关机波形

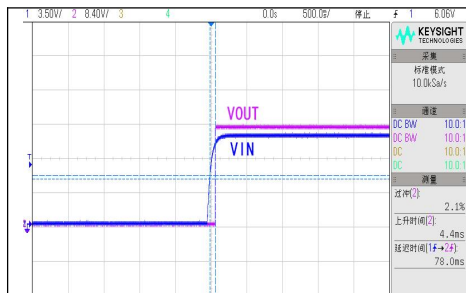


VIN=36V, 半载关机波形

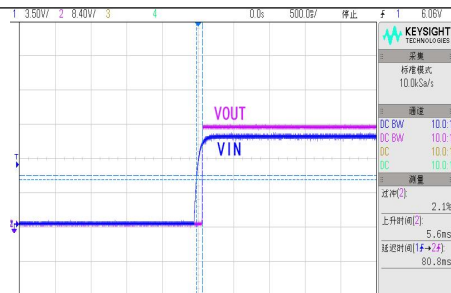


VIN=36V, 满载关机波形

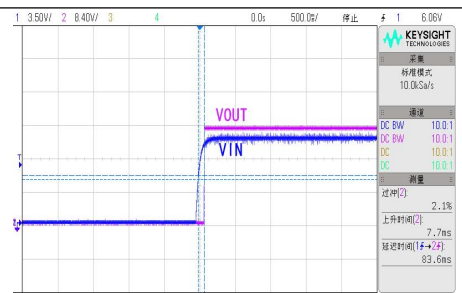
开关机波形（高温 85℃）



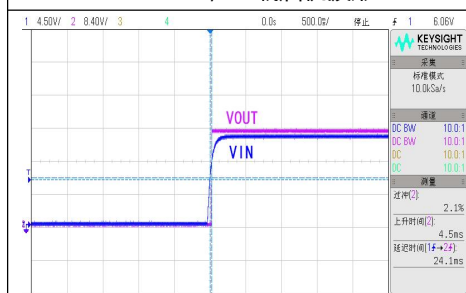
VIN=9V, 空载启机波形



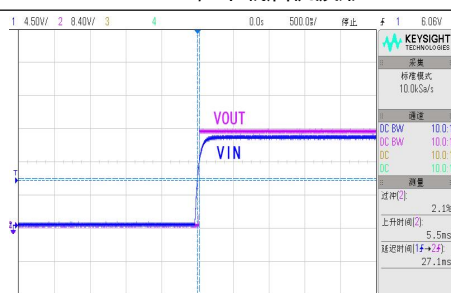
VIN=9V, 半载启机波形



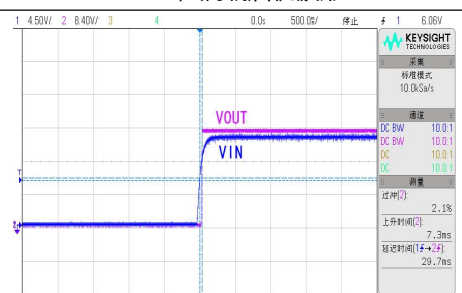
VIN=9V, 满载启机波形



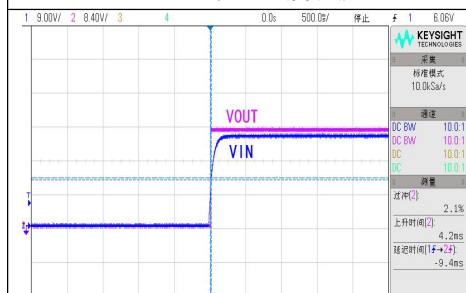
VIN=12V, 空载启机波形



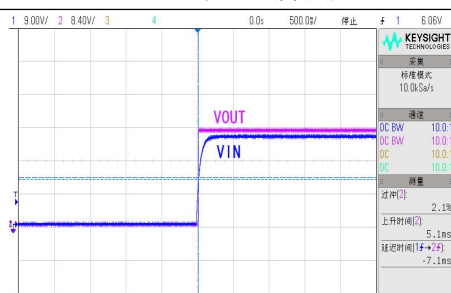
VIN=12V, 半载启机波形



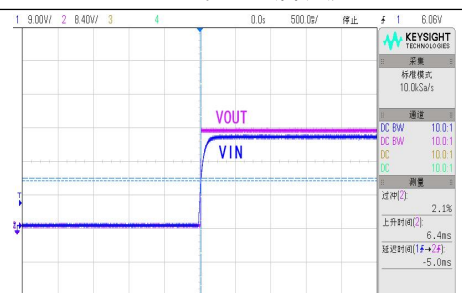
VIN=12V, 满载启机波形



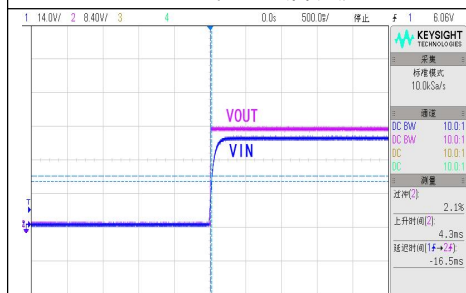
VIN=24V, 空载启机波形



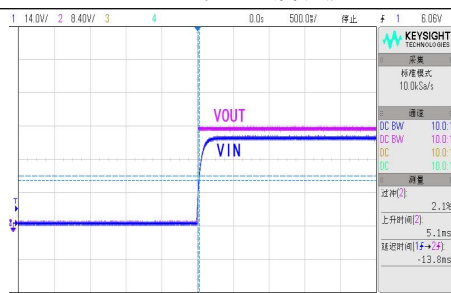
VIN=24V, 半载启机波形



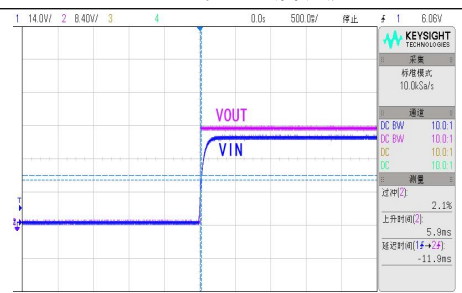
VIN=24V, 满载启机波形



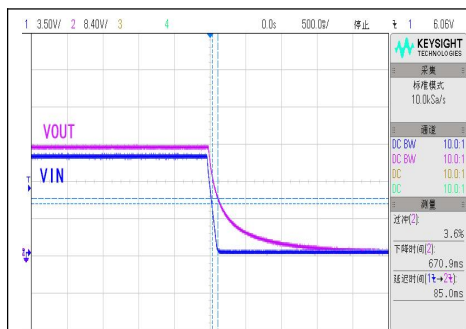
VIN=36V, 空载启机波形



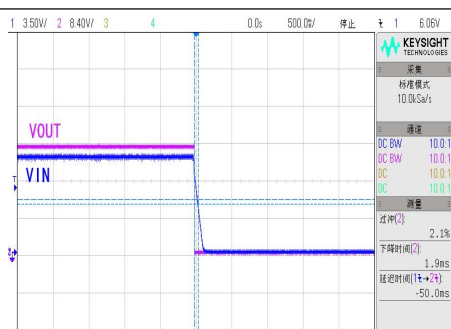
VIN=36V, 半载启机波形



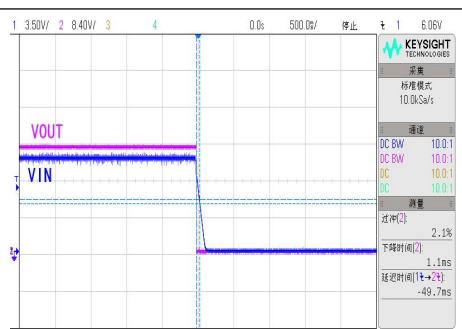
VIN=36V, 满载启机波形



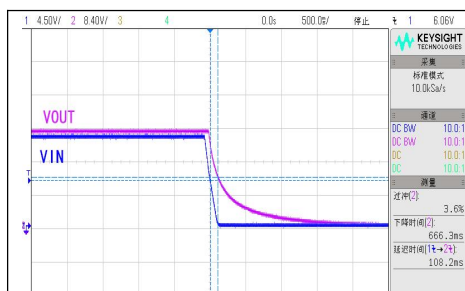
VIN=9V, 空载关机波形



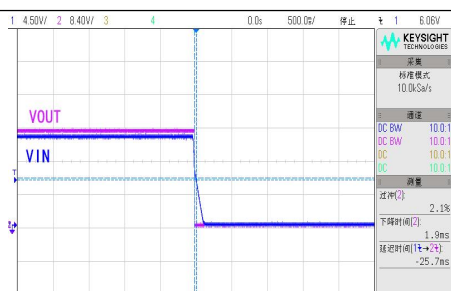
VIN=9V, 半载关机波形



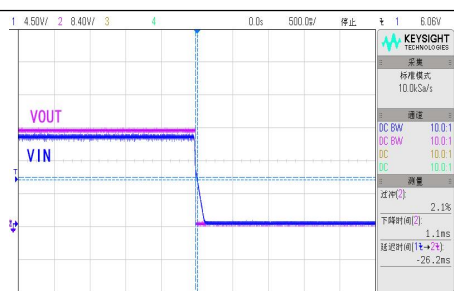
VIN=9V, 满载关机波形



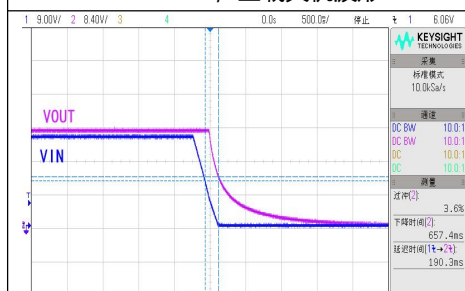
VIN=12V, 空载关机波形



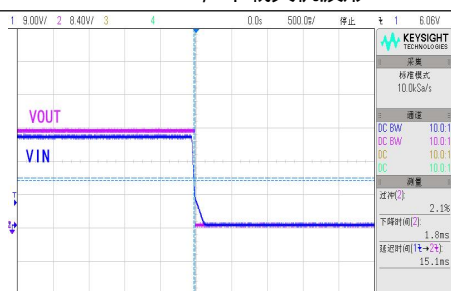
VIN=12V, 半载关机波形



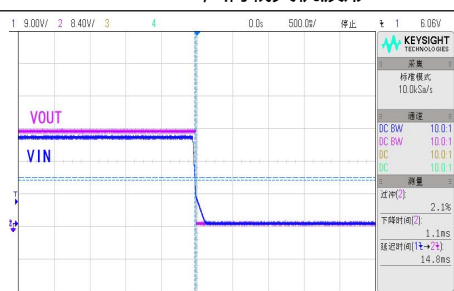
VIN=12V, 满载关机波形



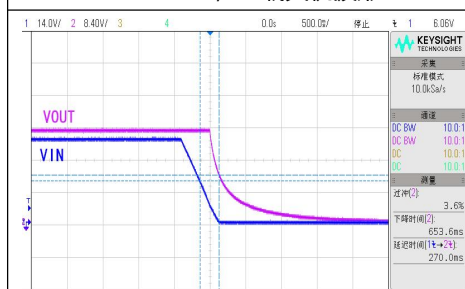
VIN=24V, 空载关机波形



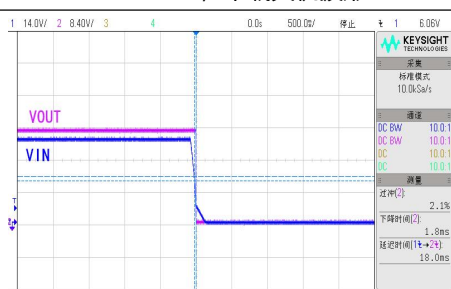
VIN=24V, 半载关机波形



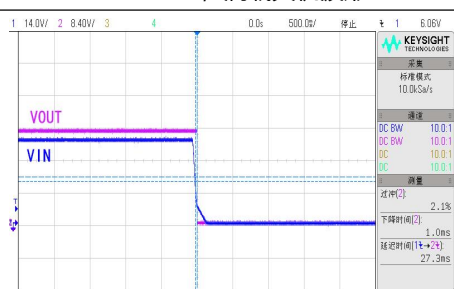
VIN=24V, 满载关机波形



VIN=36V, 空载关机波形

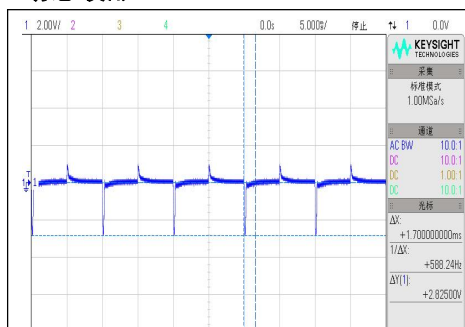


VIN=36V, 半载关机波形

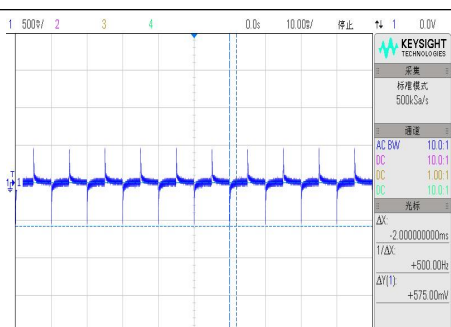


VIN=36V, 满载关机波形

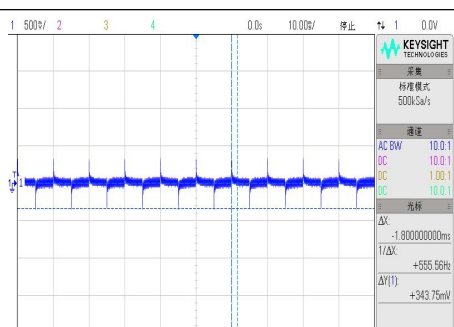
动态波形



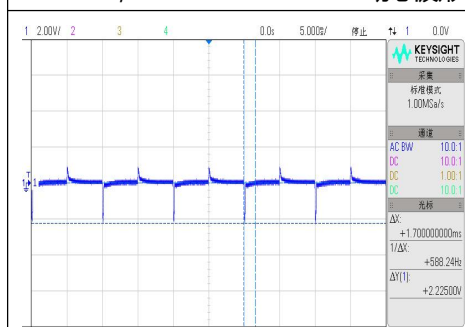
VIN=9V, 100%-10%-100%Io 动态波形



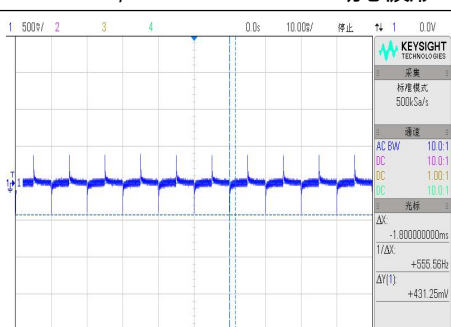
VIN=9V, 75%-50%-75%Io 动态波形



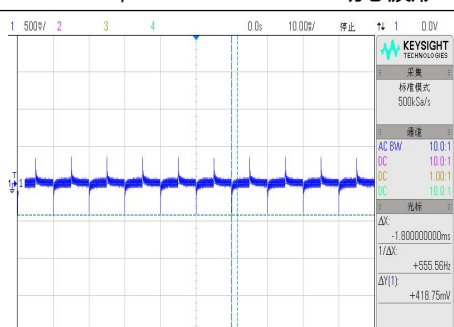
VIN=9V, 50%-25%-50%Io 动态波形



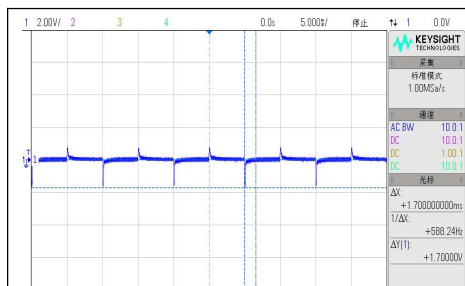
VIN=12V, 100%-10%-100%Io 动态波形



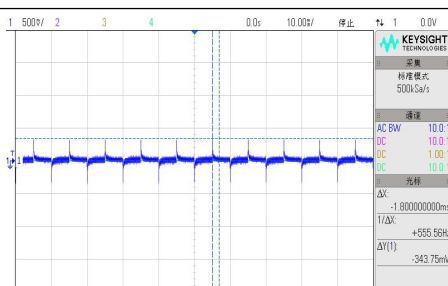
VIN=12V, 75%-50%-75%Io 动态波形



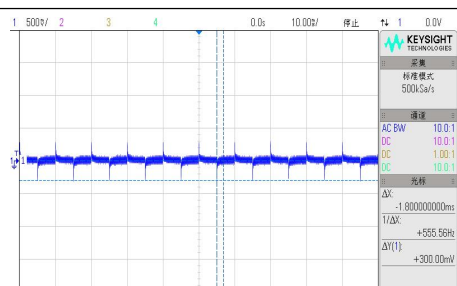
VIN=12V, 50%-25%-50%Io 动态波形



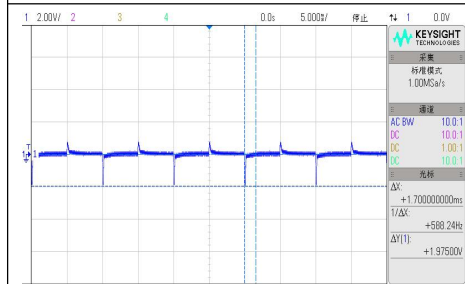
VIN=24V, 100%-10%-100%Io 动态波形



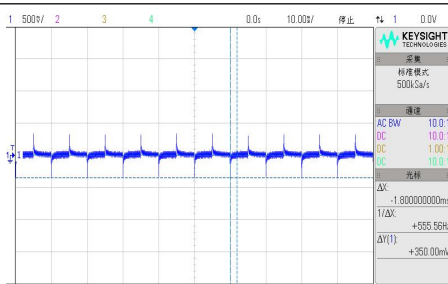
VIN=24V, 75%-50%-75%Io 动态波形



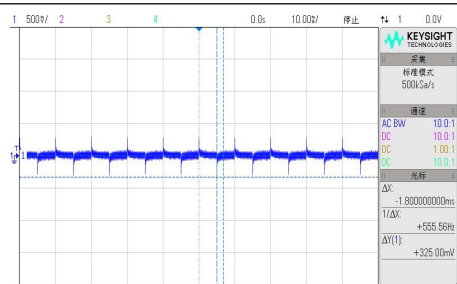
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

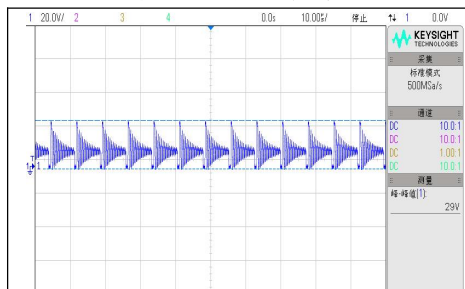


VIN=36V, 75%-50%-75%Io 动态波形

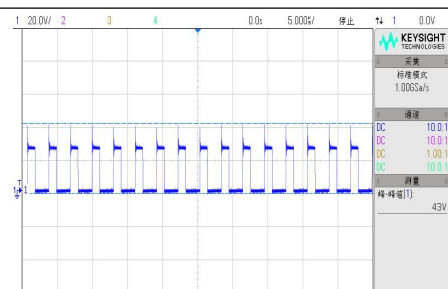


VIN=36V, 50%-25%-50%Io 动态波形

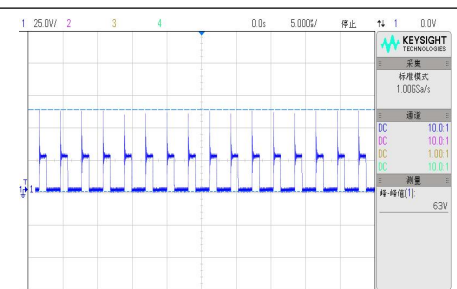
外置 MOS 管 Q1 电压应力波形



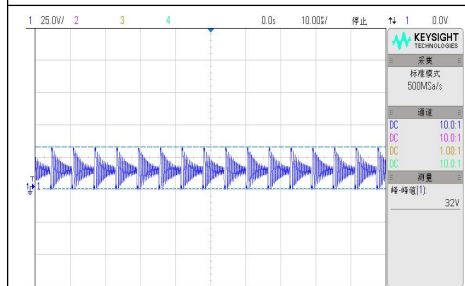
VIN=9V, 空载 VDS 波形



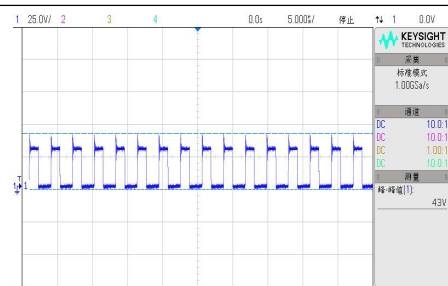
VIN=9V, 半载 VDS 波形



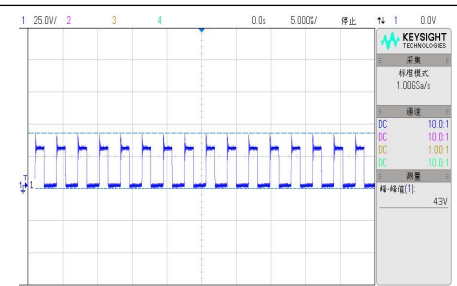
VIN=9V, 满载 VDS 波形



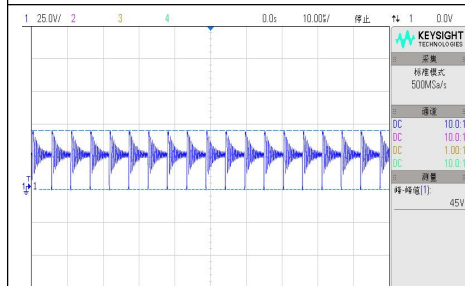
VIN=12V, 空载 VDS 波形



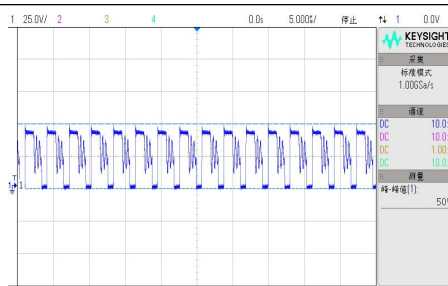
VIN=12V, 半载 VDS 波形



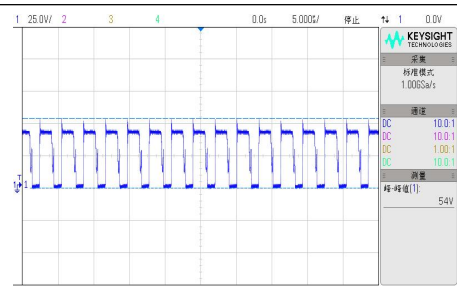
VIN=12V, 满载 VDS 波形



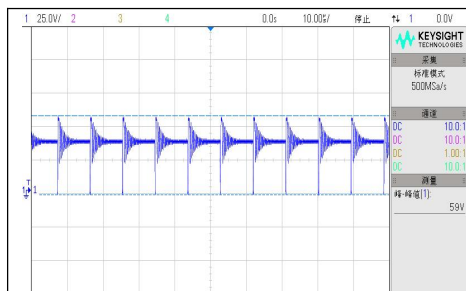
VIN=24V, 空载 VDS 波形



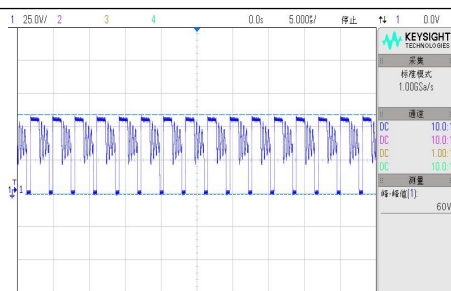
VIN=24V, 半载 VDS 波形



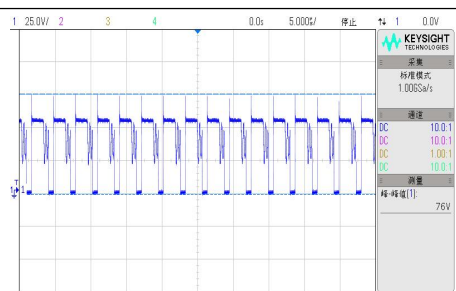
VIN=24V, 满载 VDS 波形



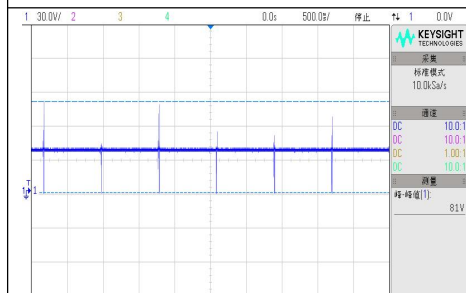
VIN=36V, 空载 VDS 波形



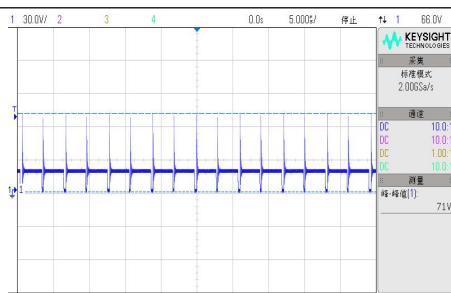
VIN=36V, 半载 VDS 波形



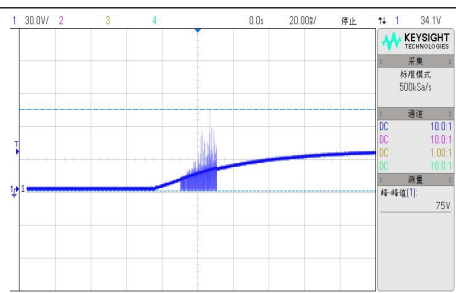
VIN=36V, 满载 VDS 波形



VIN=36V, 短路保护 VDS 波形

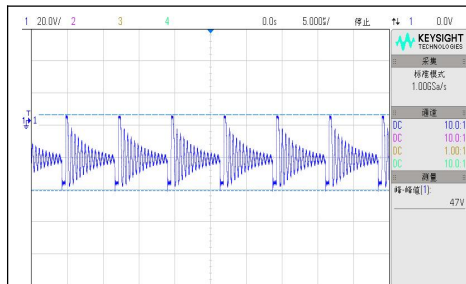


VIN=36V, 短路保护 VDS 展开波形

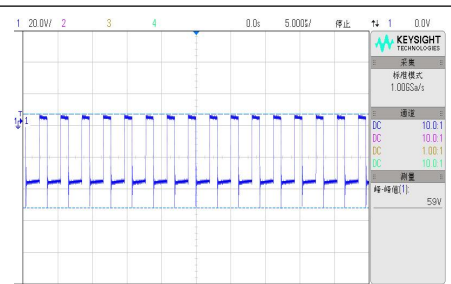


VIN=36V, 短路保护 VDS 启机波形

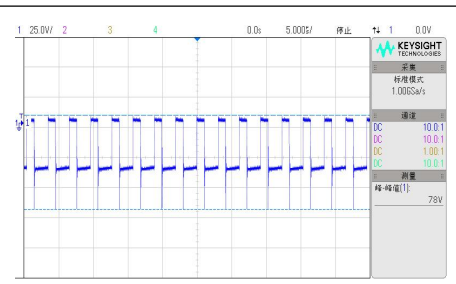
副边输出整流二极管 D4 应力波形



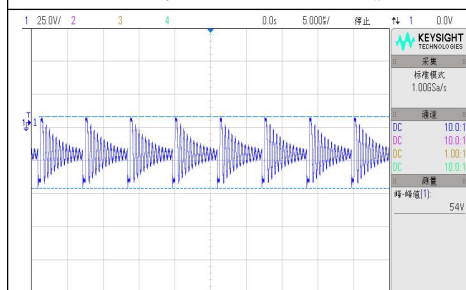
VIN=9V, D4 空载工作电压波形



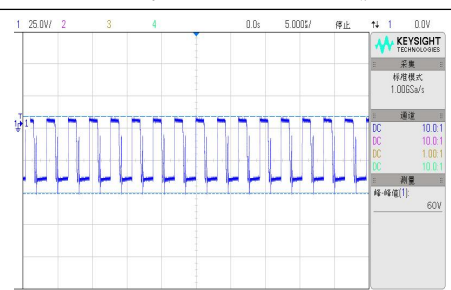
VIN=9V, D4 半载工作电压波形



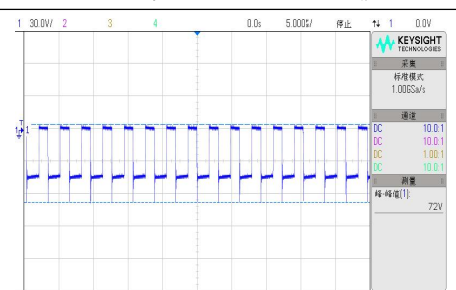
VIN=9V, D4 满载工作电压波形



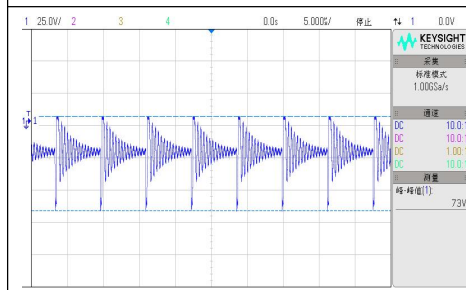
VIN=12V, D4 空载工作电压波形



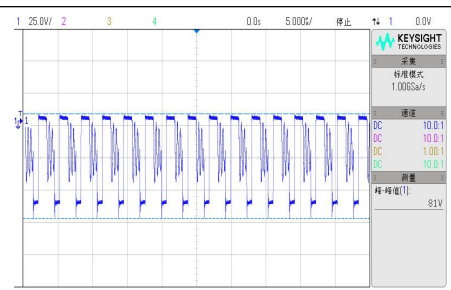
VIN=12V, D4 半载工作电压波形



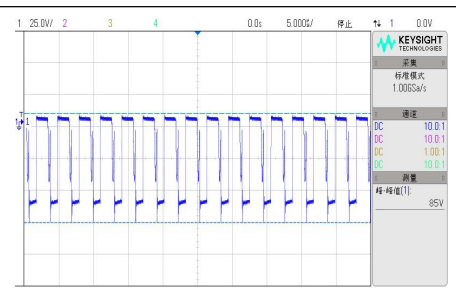
VIN=12V, D4 满载工作电压波形



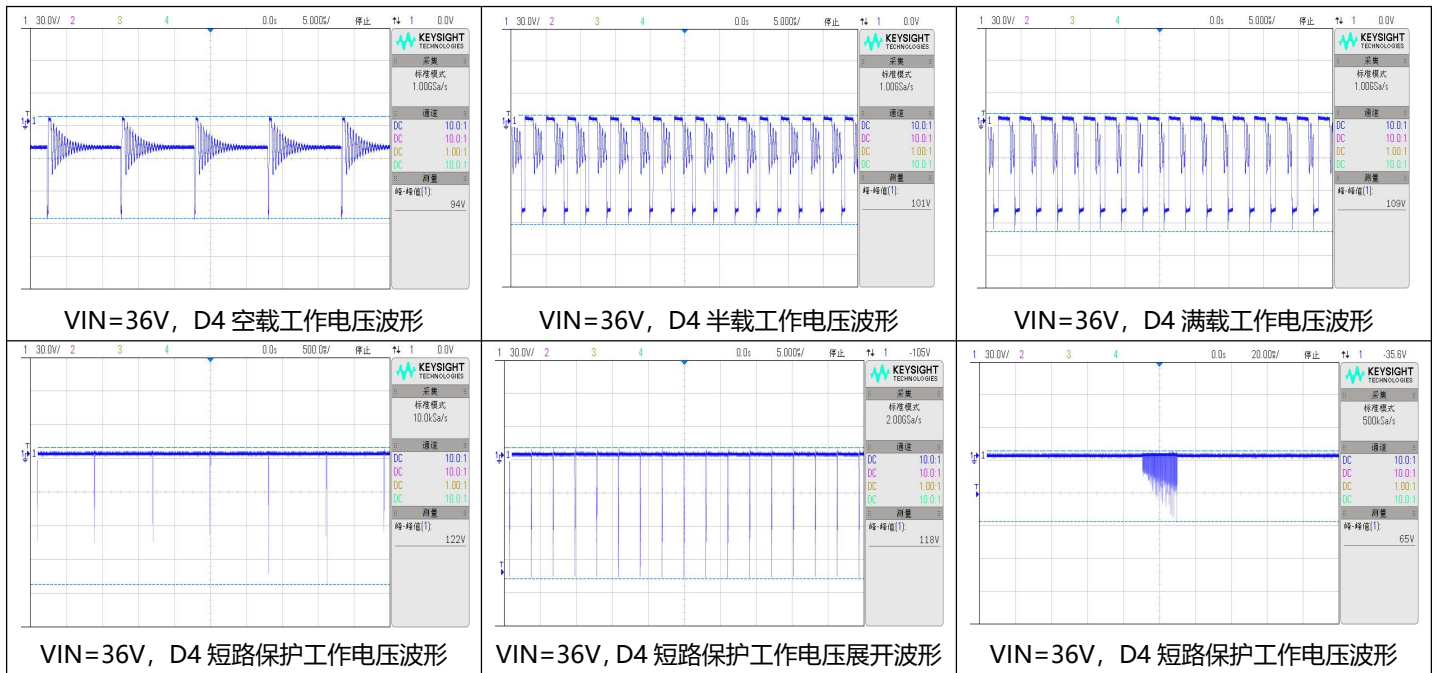
VIN=24V, D4 空载工作电压波形



VIN=24V, D4 半载工作电压波形



VIN=24V, D4 满载工作电压波形



免责声明

本文的主要目的是为了让客户更好地理解与应用源特相关产品。所涉及技术信息提供的所有参数、数值、数据都是基于源特对于部分标准的理解得到的，所提供的信息并不能保证所有假设情况和工作条件。客户在使用源特产品设计开发时，需进行充分的设计验证以确保设计方案能满足特定的应用场合。本文所提供的测试数据是基于有限数量样品测试的典型值，源特不能保证所有数据的准确性和完整性，也不对本文所提供的任何参数、数值、数据、建议、观点的准确性和充分性承担任何责任，不对由本文所造成的直接、间接损失承担任何责任。