

方案简介

本应用方案基于一款高集成度的电流型反激式电源控制器 VPC2187B，结合隔离功率变压器 VPP17FF-30A、输出整流二极管以及必要的阻容元件，实现 18V-36V 输入，24V 输出 30W 的隔离稳压电源方案，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。

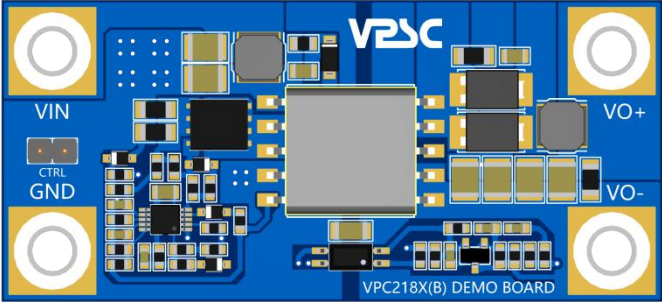


图 1: VPC218X(B) Demo 板(尺寸:67.5mm*30.7mm)

关键词：输入：18V-36V，输出 24V/30W，隔离电压：1500VDC，反馈方式：副边反馈-SSR，开关频率：330kHz

原理图

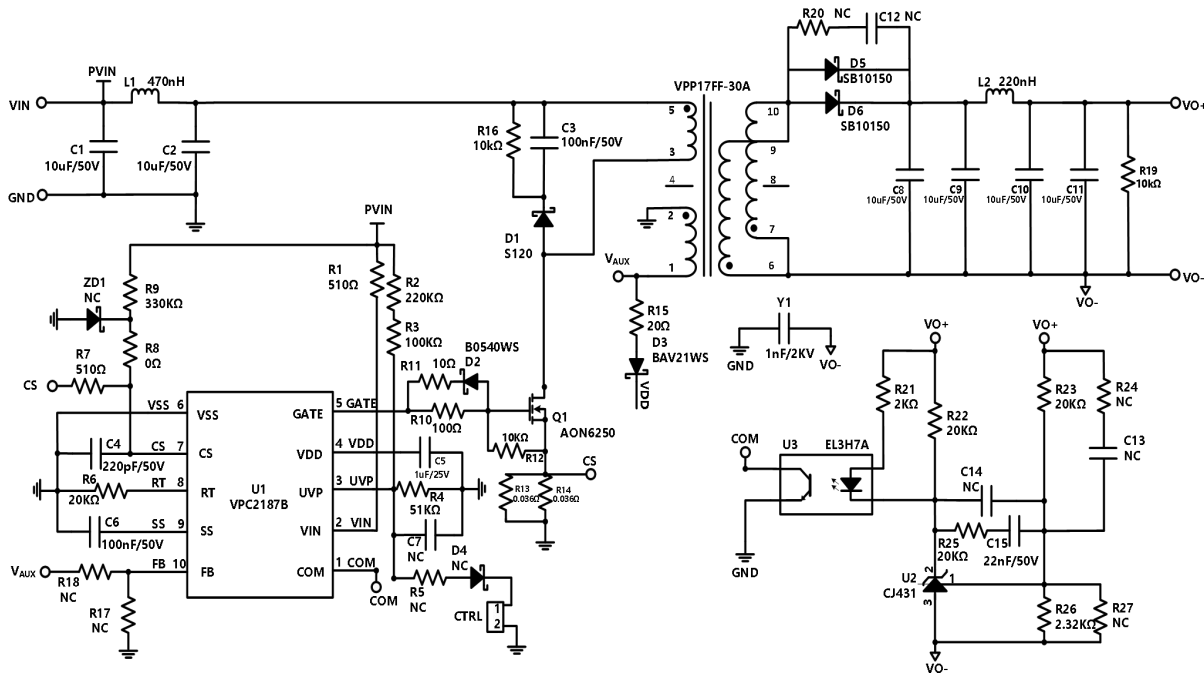


图 2: VPC2187B 24V/30W 原理图

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	100nF/50V-X7R	0805	CC0805KRX7R9BB104	YAGEO
C4	220pF/50V- NP0	0603	CC0603JRNPO9BN221	YAGEO
C5	1uF/25V-X5R	0805	CC0805MKX5R8BB105	YAGEO
C6	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C7	NC	-	-	-
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	NC	-	-	-
C13	NC	-	-	-
C14	NC	-	-	-
C15	22nF/50V-X7R	0603	CC0603KRX7R9BB223	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R2	220KΩ±1%	0603	RC0603FR-07220KL	YAGEO
R3	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R4	51KΩ±1%	0603	RC0603FR-0751KL	YAGEO
R5	NC	-	-	-
R6	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R7	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R8	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R9	330KΩ±1%	0603	RC0603FR-07330KL	YAGEO
R10	100Ω±1%	0603	RC0603FR-07100RL	YAGEO
R11	10Ω±1%	0603	RC0603FR-0710RL	YAGEO
R12	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R13	0.036Ω ±1%	1206	RL1206FR-070R036L	YAGEO
R14	0.036Ω ±1%	1206	RL1206FR-070R036L	YAGEO
R15	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R16	10KΩ±1%	0805	RC0805FR-0710KL	YAGEO
R17	NC	-	-	-
R18	NC	-	-	-
R19	10KΩ±1%	1206	RC1206FR-0710KL	YAGEO
R20	NC	-	-	-
R21	2KΩ±1%	0603	RC0603FR-072KL	YAGEO
R22	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R23	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R24	NC	-	-	-

R25	20K Ω ±1%	0603	RC0603FR-0720KL	YAGEO
R26	2.32K Ω ±1%	0603	RC0603FR-072K32L	YAGEO
R27	NC	-	-	-
TR1	NP:NS:NA=12:16:8 Lp=14.4uH	EPD13	VPP17FF-30A	VPSC
Q1	N 沟道 150V 52A	PDFN-8(5.8x4.9)	AON6250	AOS
L1	470nH ±30%	SMD	SWPA5020SR47NT	SUNLORD
L2	220nH ±20%	SMD	SWPA5020SR22MT	SUNLORD
D1	200V/1A	SOD-123	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	YANGJIE
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	NC	-	-	-
D5	150V/10A	TO-277	SB10150	GOODWORK
D6	150V/10A	TO-277	SB10150	GOODWORK
ZD1	NC	-	-	-
U1	4-100VIN 电源管理芯片	MSOP-10	VPC2187B	VPSC
U2	Vref=2.495V	SOT-23	CJ431	CJ
U3	CTR=80~160, Viso=3750VAC	SSOP-4	EL3H7A	EVERLIGHT

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	21	---	1405	mA
转换效率	VIN=24V, IO=1.25A	---	88.9	---	%
纹波&噪声	VIN=24V, IO=1.25A	---	109	180	mV
输出电压精度	VIN=24V, IO=1.25A	---	0.45	---	%
线性调节率	VIN=18V-36V, IO=1.25A	---	0.1	---	%
负载调整率	VIN=24V, IO=1.25A	---	0.1	---	%
输出过流点系数	VIN=18V, IO=1.25A	---	1.58	---	倍
输入欠压保护	锁定电压	---	14.9	---	V
	恢复电压	---	16.1	---	V
短路保护	VIN=18V-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

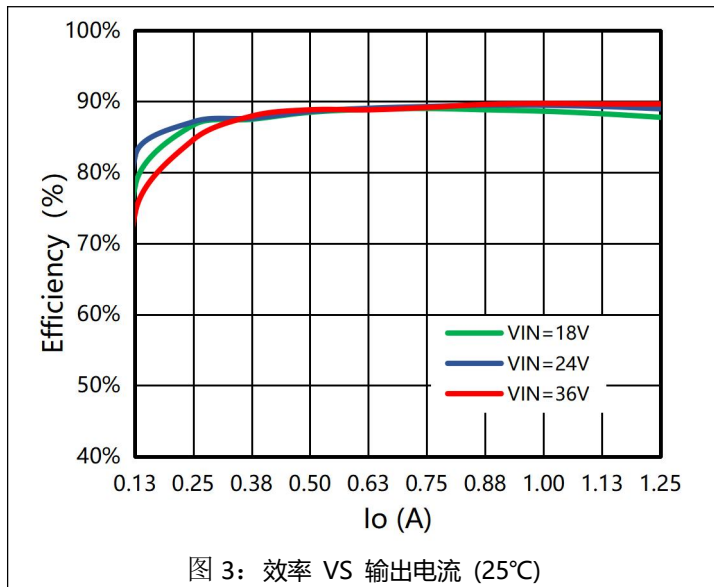


图 3: 效率 VS 输出电流 (25°C)

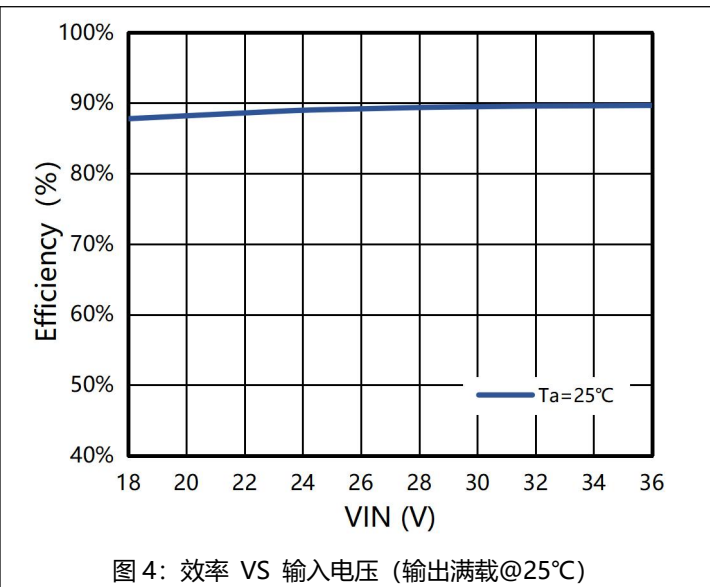


图 4: 效率 VS 输入电压 (输出满载@25°C)

相关波形

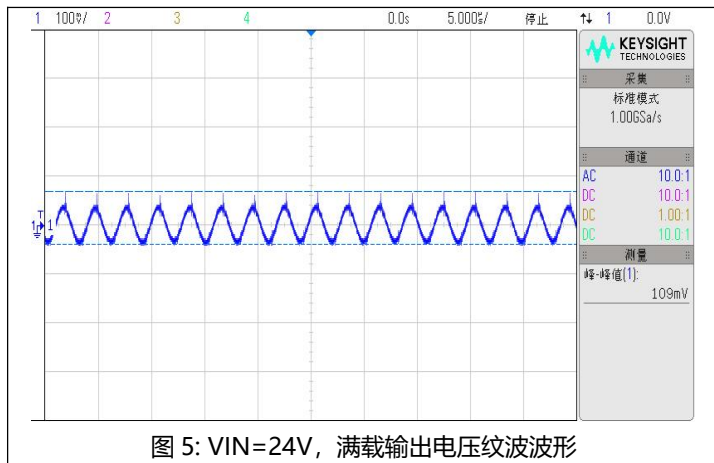


图 5: VIN=24V, 满载输出电压纹波波形

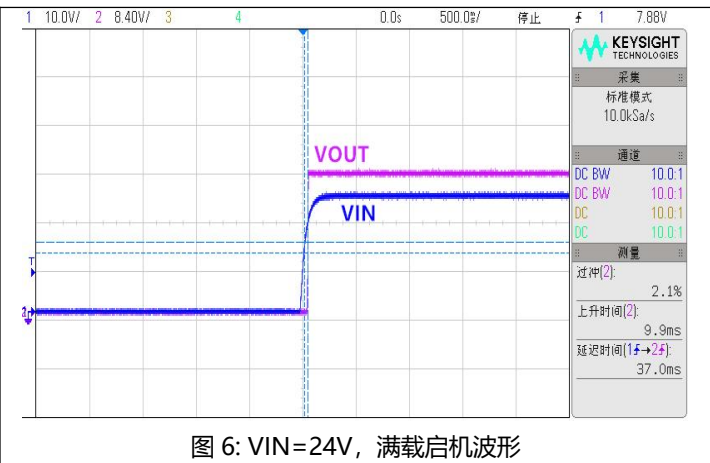
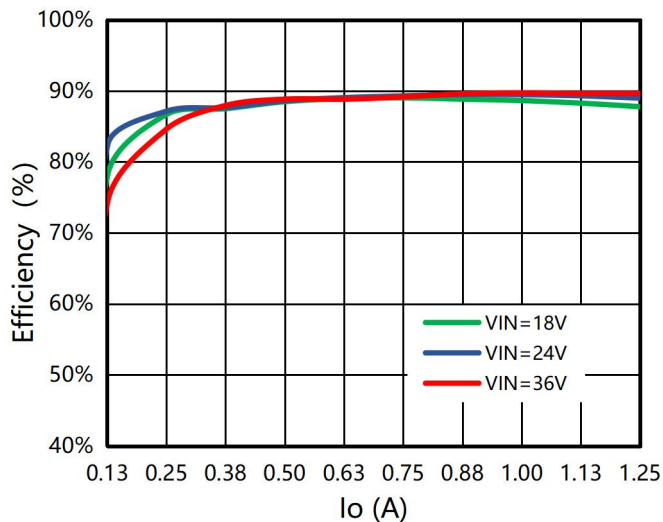


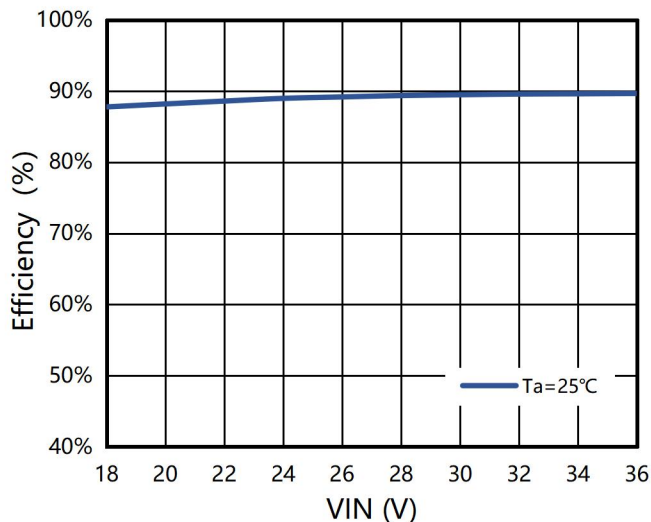
图 6: VIN=24V, 满载启机波形

详细测试数据

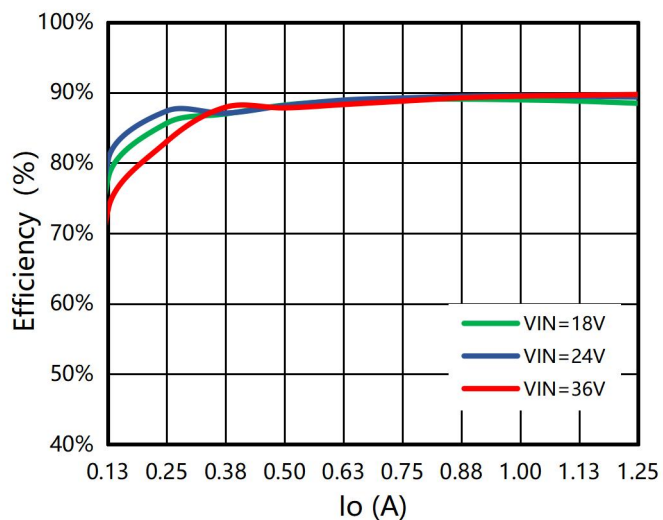
高低温测试曲线



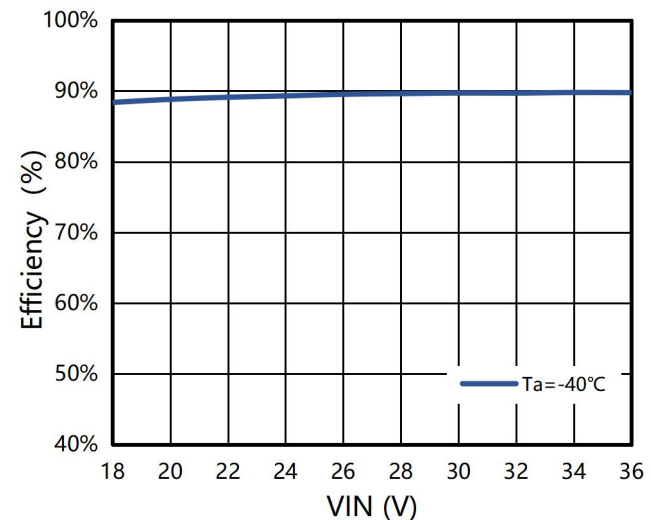
效率 VS 输出电流 (25°C)



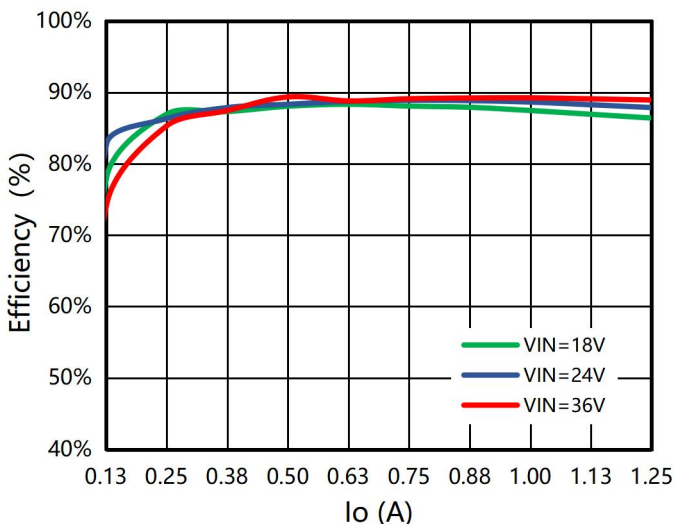
效率 VS 输入电压 (输出满载@25°C)



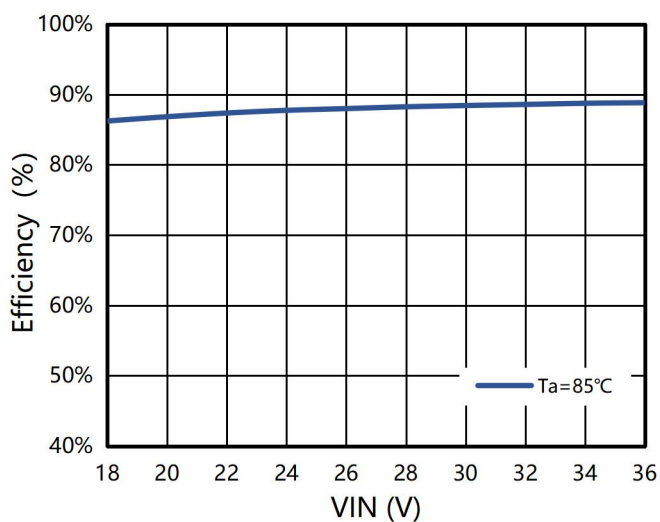
效率 VS 输出电流 (-40°C)



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	0.021	24	0	0%	0.00%
24	0.153	24	0.126	10%	82.35%
24	0.288	24	0.251	20%	87.15%
24	0.429	24	0.376	30%	87.65%
24	0.565	24	0.501	40%	88.60%
24	0.703	24	0.626	50%	89.05%
24	0.840	24	0.750	60%	89.29%
24	0.979	24	0.876	70%	89.48%
24	1.119	24	1.001	80%	89.45%
24	1.261	24	1.126	90%	89.29%
24	1.405	24	1.250	100%	88.97%

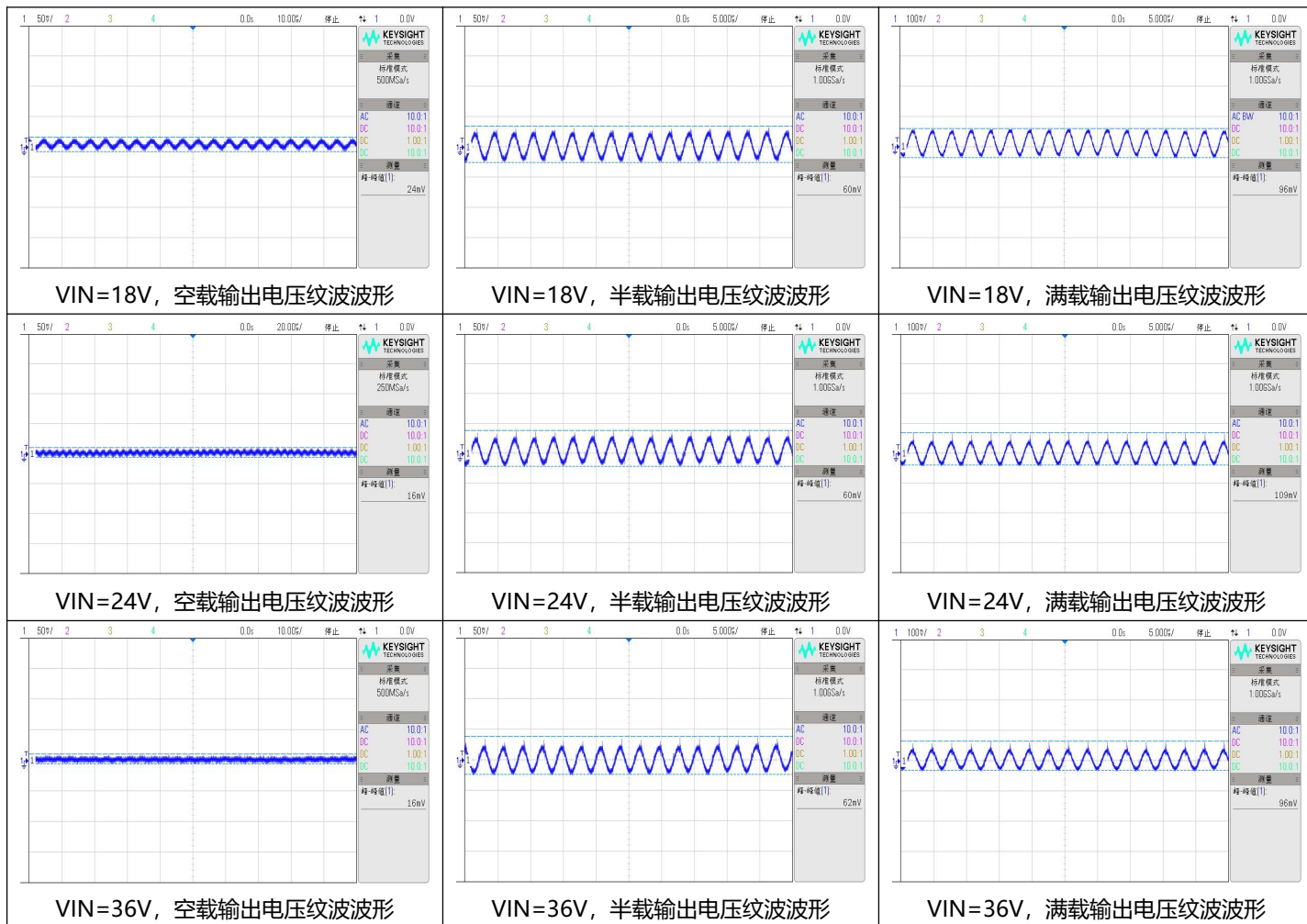
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.99	0.022	23.9	0	0%	0.00%
24	0.156	23.9	0.126	10%	80.43%
24	0.286	23.9	0.251	20%	87.40%
24	0.430	23.9	0.376	30%	87.08%
24	0.566	23.9	0.501	40%	88.15%
24	0.701	23.9	0.626	50%	88.93%
24	0.837	23.9	0.750	60%	89.23%
24	0.975	23.9	0.876	70%	89.47%
24	1.113	23.9	1.001	80%	89.56%
24	1.252	23.9	1.125	90%	89.48%
24	1.393	23.9	1.250	100%	89.36%

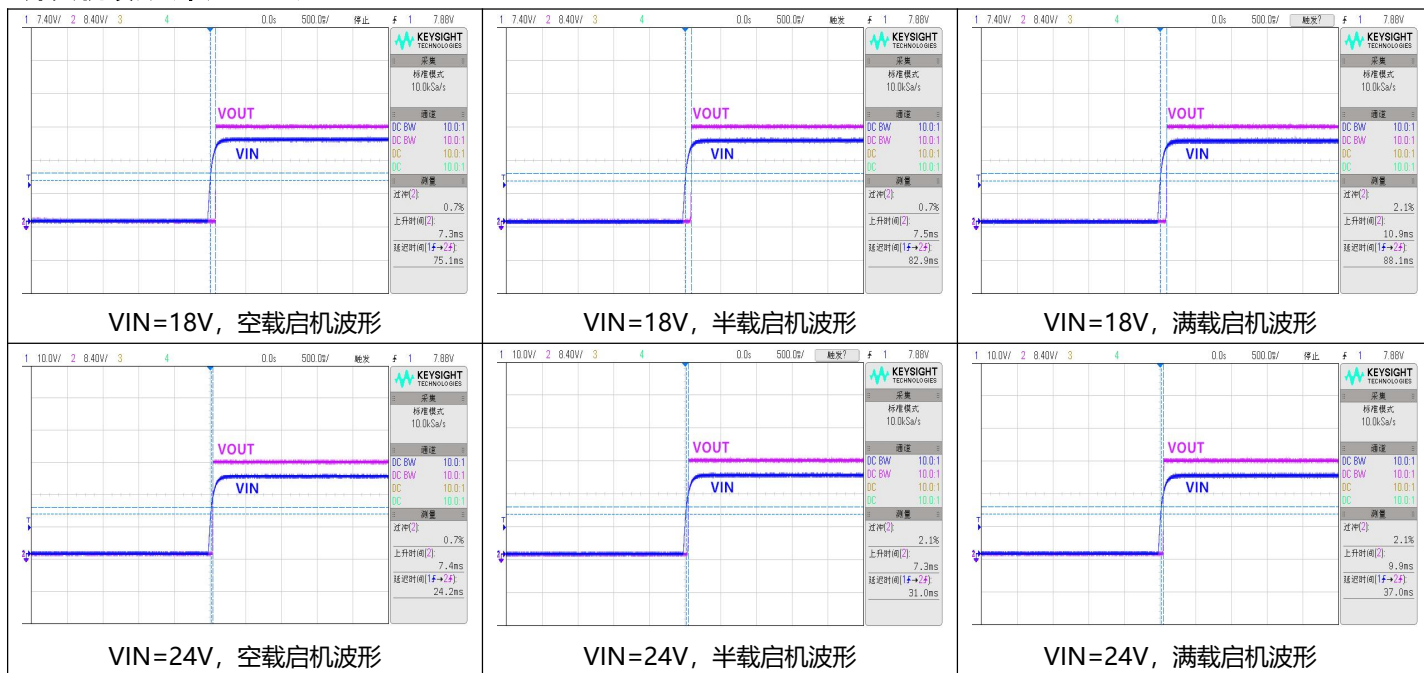
VIN=24V, Ta=85°C, 输入、输出及效率数据:

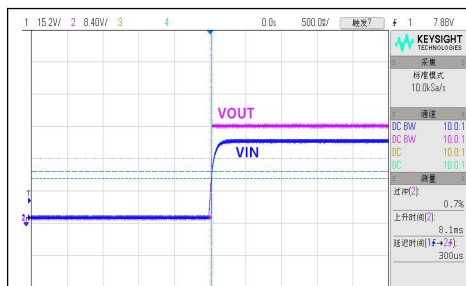
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
24	0.021	23.95	0	0%	0.00%
24	0.152	23.95	0.126	10%	82.72%
24	0.289	23.95	0.250	20%	86.32%
24	0.427	23.95	0.376	30%	87.87%
24	0.566	23.95	0.501	40%	88.33%
24	0.704	23.95	0.626	50%	88.74%
24	0.842	23.95	0.750	60%	88.89%
24	0.984	23.95	0.876	70%	88.84%
24	1.127	23.95	1.001	80%	88.63%
24	1.272	23.95	1.125	90%	88.26%
24	1.419	23.94	1.250	100%	87.87%

输出电压纹波波形

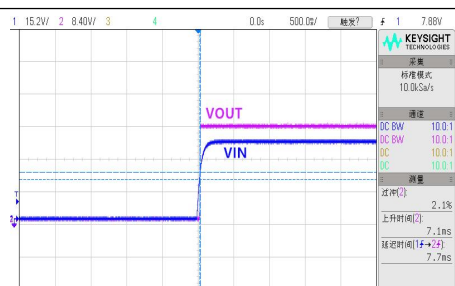


开关机波形 (常温 25°C)

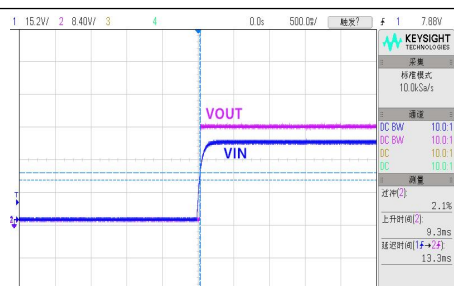




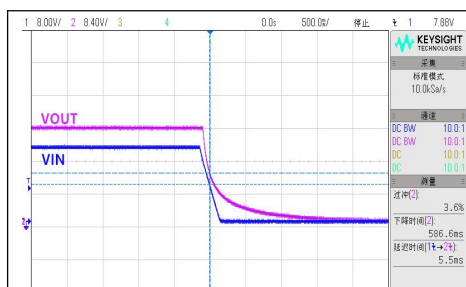
VIN=36V, 空载启机波形



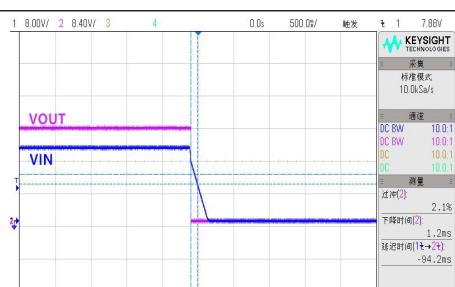
VIN=36V, 半载启机波形



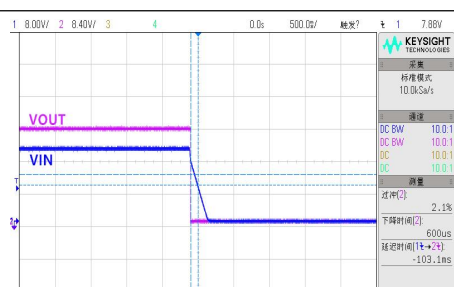
VIN=36V, 满载启机波形



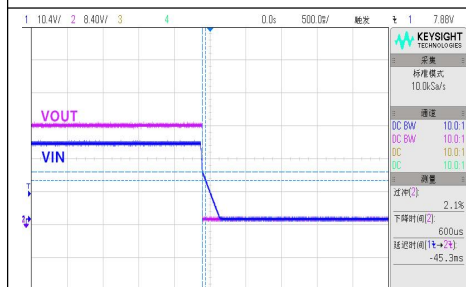
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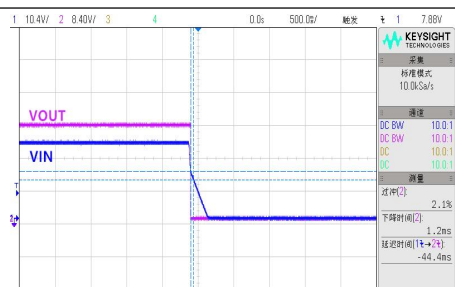
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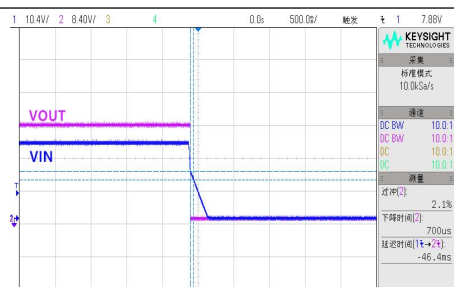
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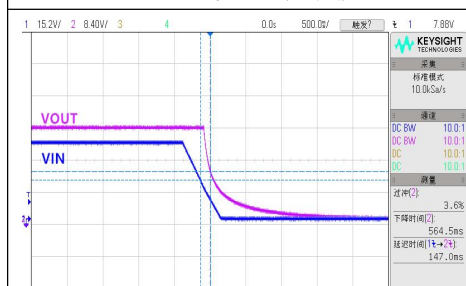
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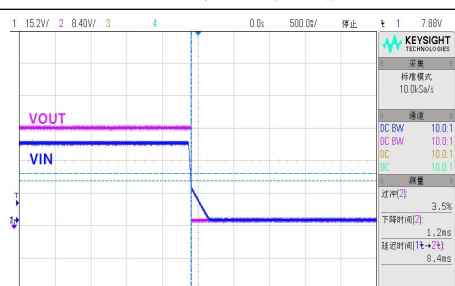
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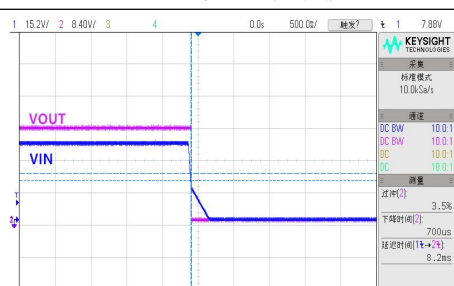
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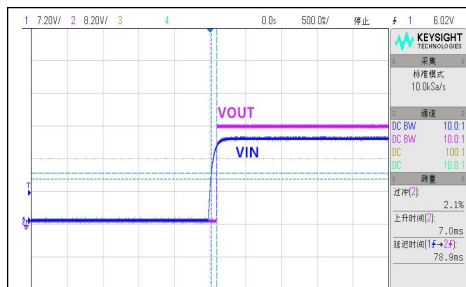


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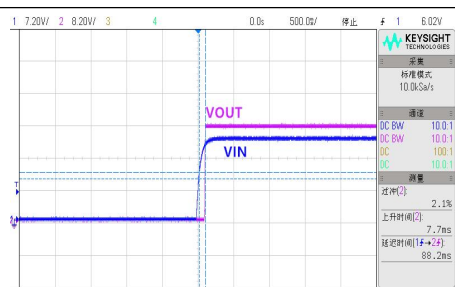


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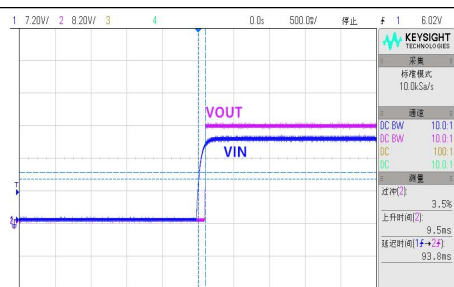
开关机波形(低温-40℃)



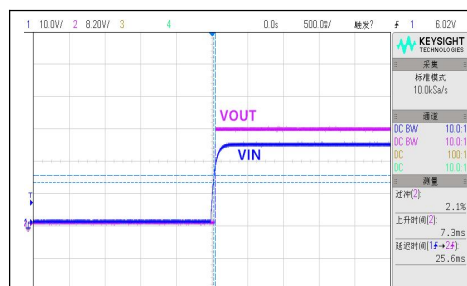
VIN=18V, 空载启机波形



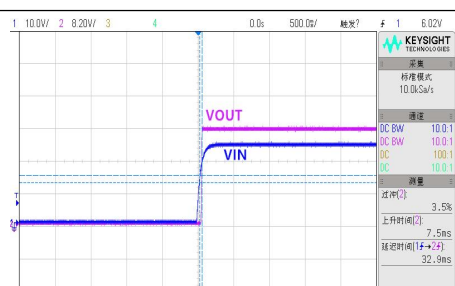
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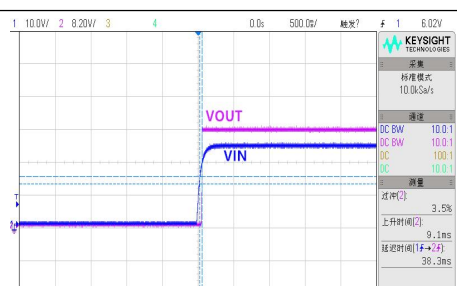
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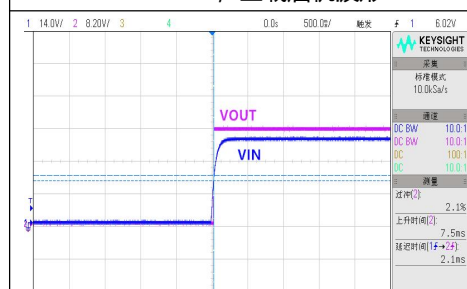
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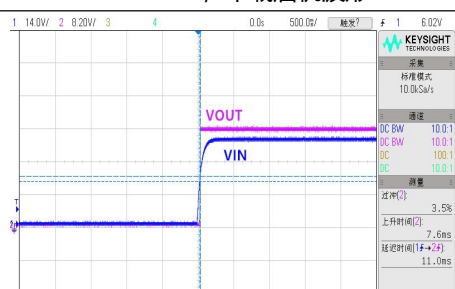
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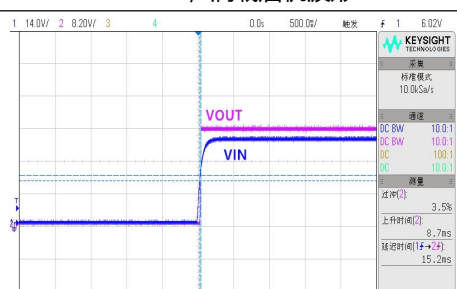
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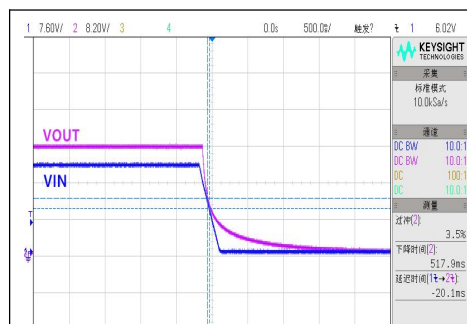
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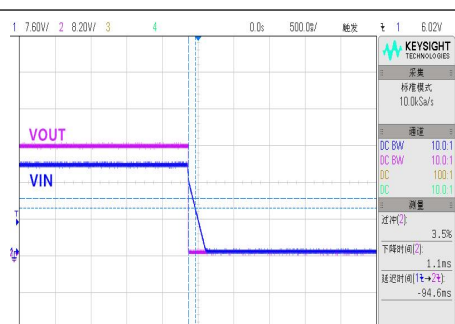
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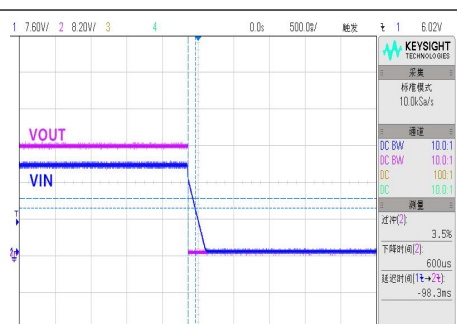
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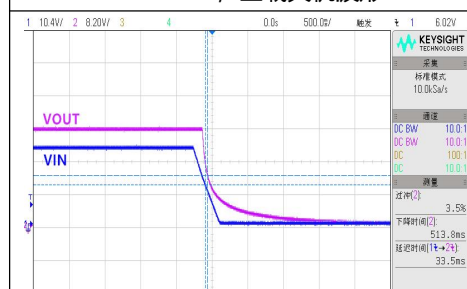
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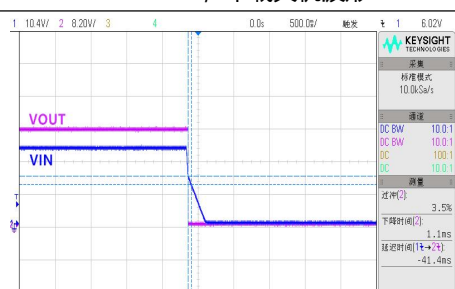
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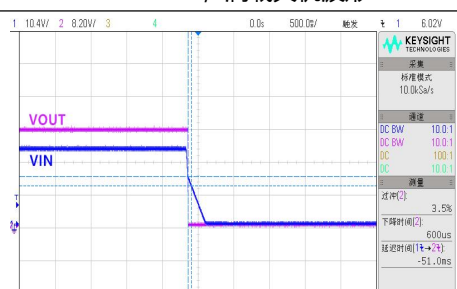
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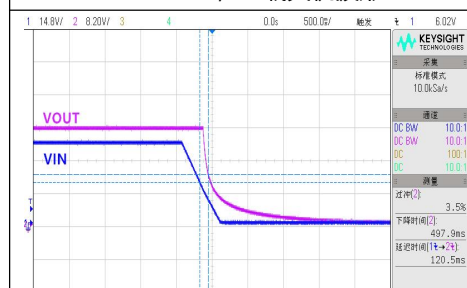
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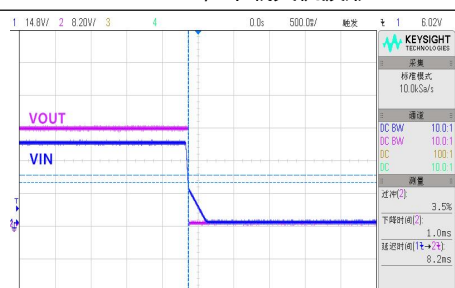
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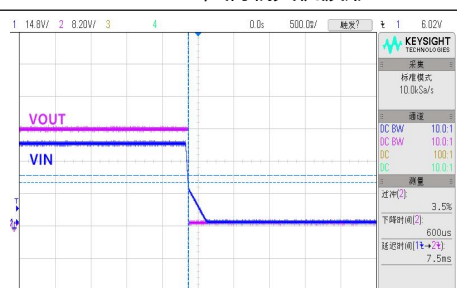
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VIN=36V, 空载关机波形



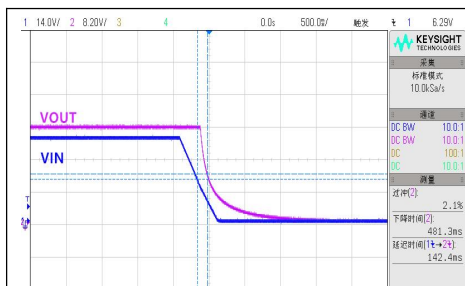
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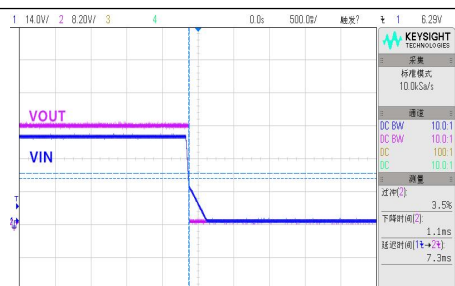
VIN=36V, 满载关机波形

开关机波形 (高温 85°C)

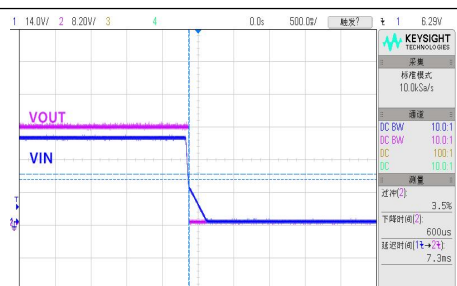




VIN=36V, 空载关机波形

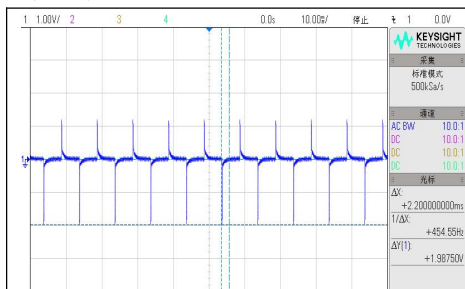


VIN=36V, 半载关机波形

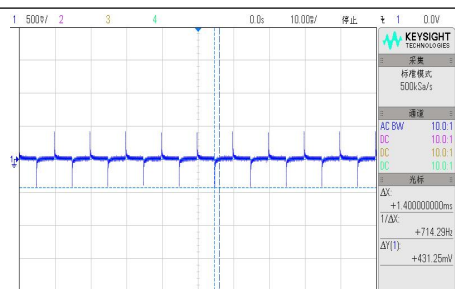


VIN=36V, 满载关机波形

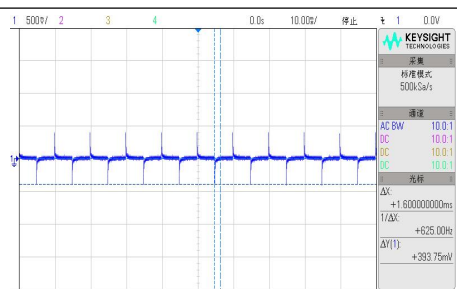
动态波形



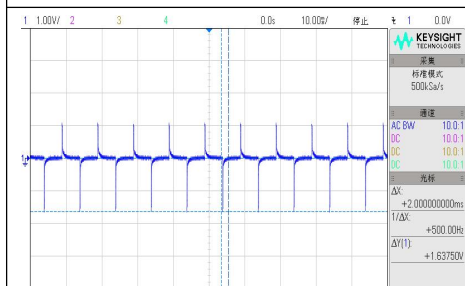
VIN=18V, 100%-10%-100%Io 动态波形



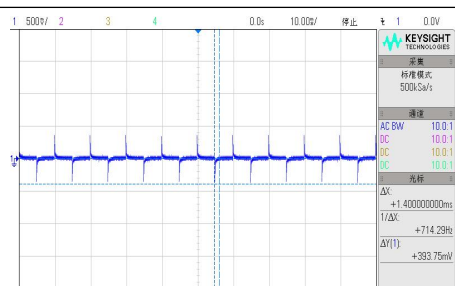
VIN=18V, 75%-50%-75%Io 动态波形



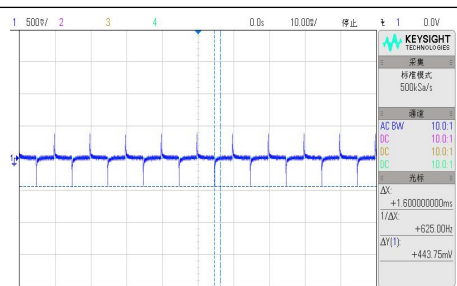
VIN=18V, 50%-25%-50%Io 动态波形



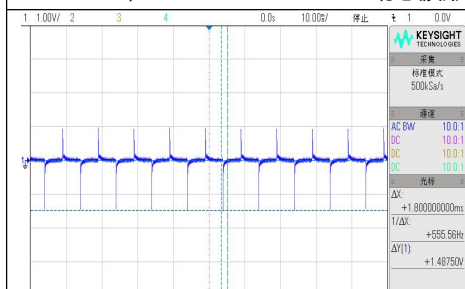
VIN=24V, 100%-10%-100%Io 动态波形



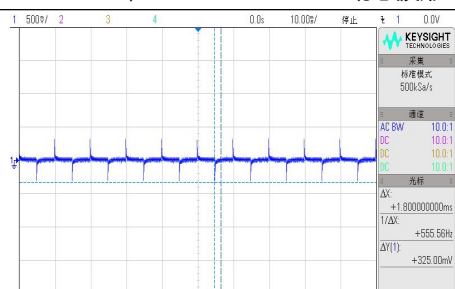
VIN=24V, 75%-50%-75%Io 动态波形



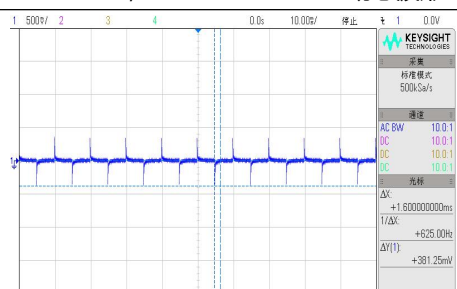
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

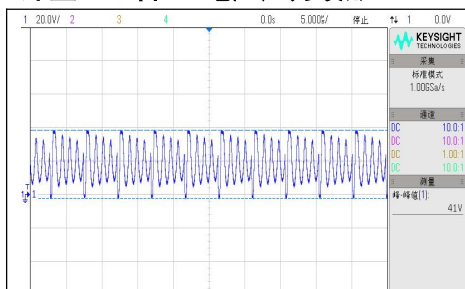


VIN=36V, 75%-50%-75%Io 动态波形

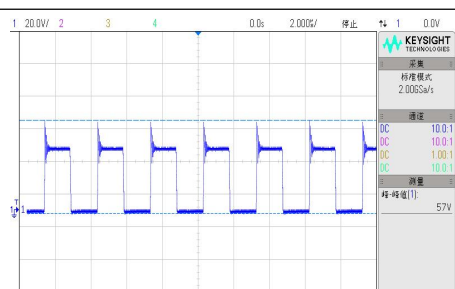


VIN=36V, 50%-25%-50%Io 动态波形

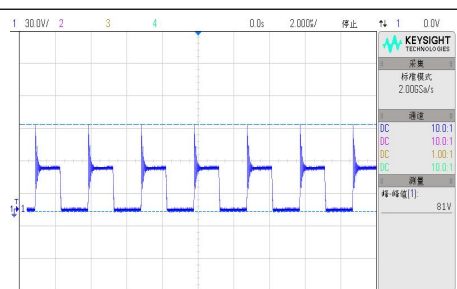
外置 MOS 管 Q1 电压应力波形



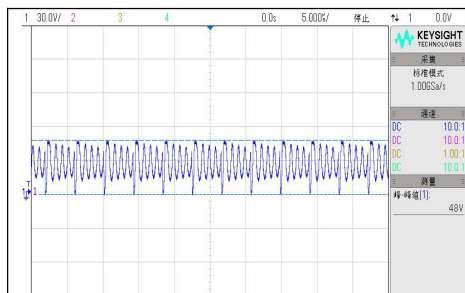
VIN=18V, 空载 VDS 波形



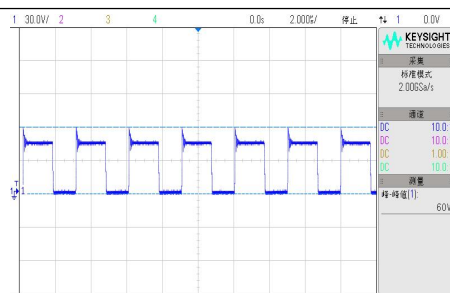
VIN=18V, 半载 VDS 波形



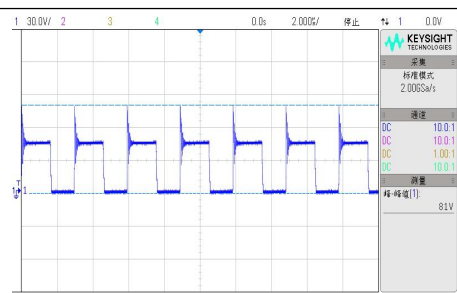
VIN=18V, 满载 VDS 波形



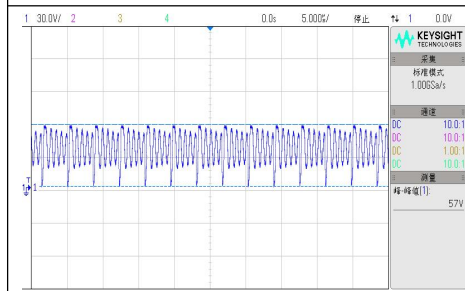
VIN=24V, 空载 VDS 波形



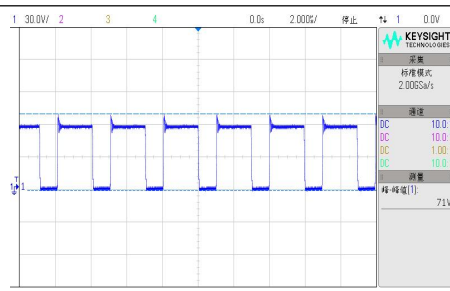
VIN=24V, 半载 VDS 波形



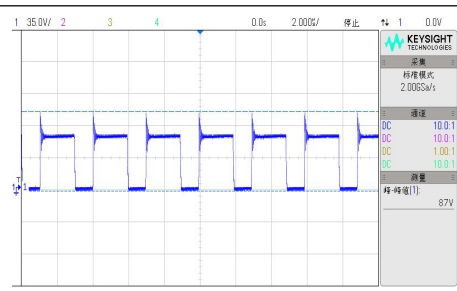
VIN=24V, 满载 VDS 波形



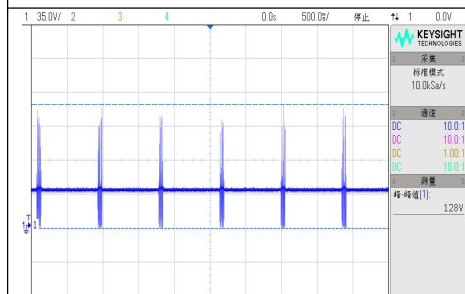
VIN=36V, 空载 VDS 波形



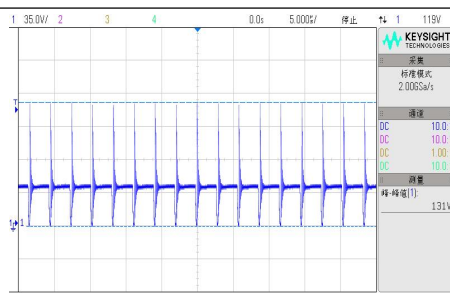
VIN=36V, 半载 VDS 波形



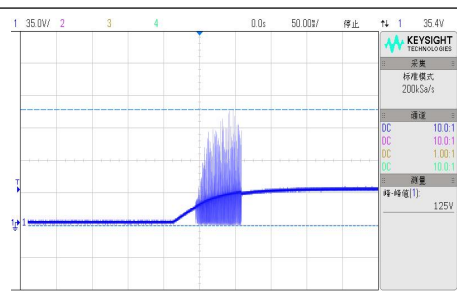
VIN=36V, 满载 VDS 波形



VIN=36V, 短路保护 VDS 波形

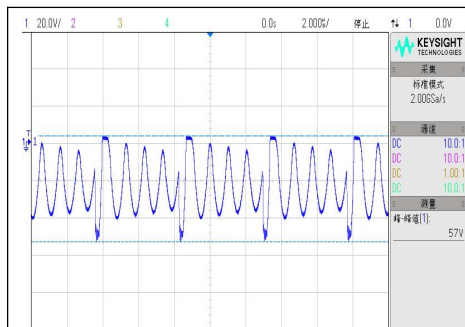


VIN=36V, 短路保护 VDS 展开波形

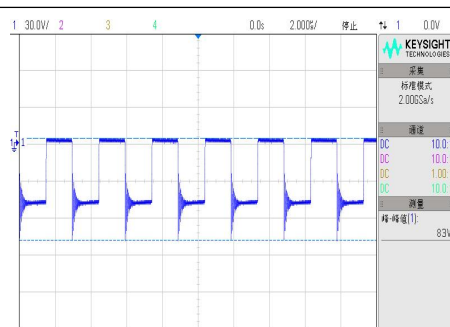


VIN=36V, 短路保护 VDS 启机波形

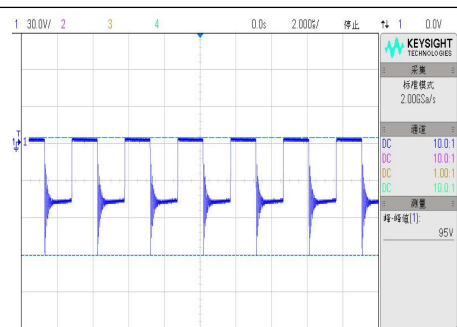
副边输出整流二极管 D5/D6 应力波形



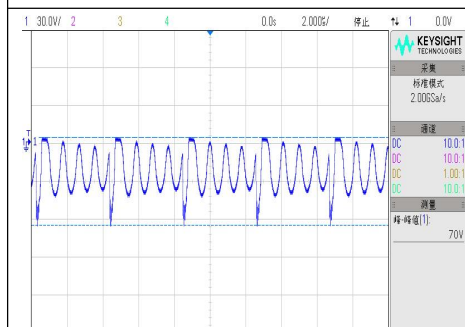
VIN=18V, D4 空载工作电压波形



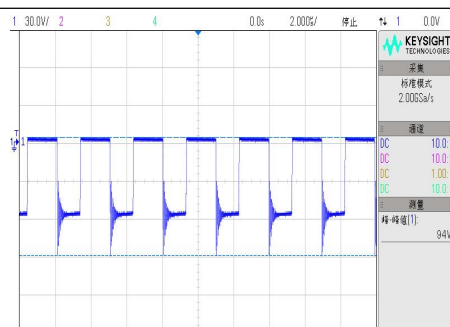
VIN=18V, D4 半载工作电压波形



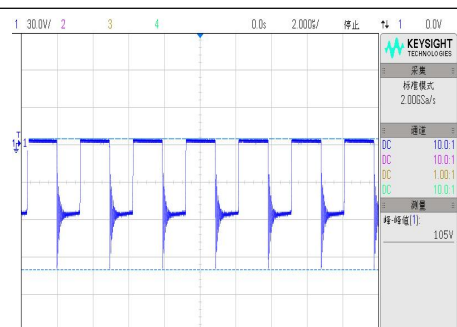
VIN=18V, D4 满载工作电压波形



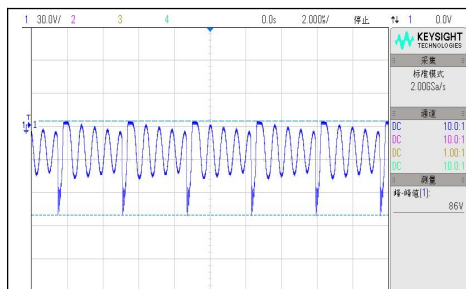
VIN=24V, D4 空载工作电压波形



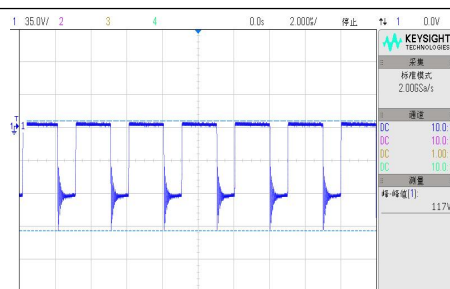
VIN=24V, D4 半载工作电压波形



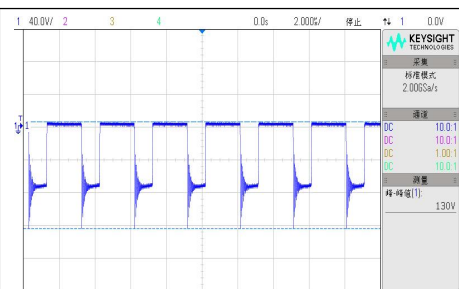
VIN=24V, D4 满载工作电压波形



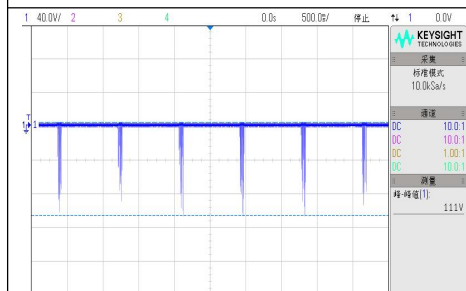
VIN=36V, D4 空载工作电压波形



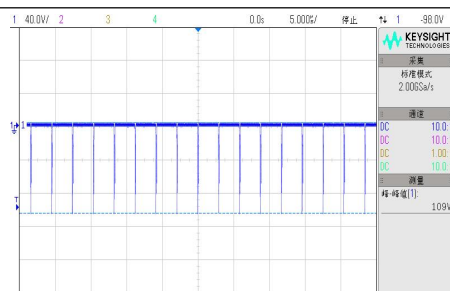
VIN=36V, D4 半载工作电压波形



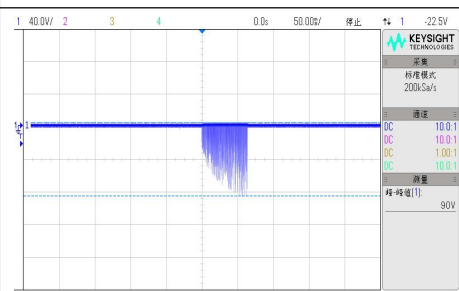
VIN=36V, D4 满载工作电压波形



VIN=36V, D4 短路保护工作电压波形



VIN=36V, D4 短路保护工作电压展开波形



VIN=36V, D4 短路保护工作电压启机波形

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