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 VPP27QD-30A、输出整流二极管以及必要的阻容元件，实现 18V-72V 输入，12V 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。

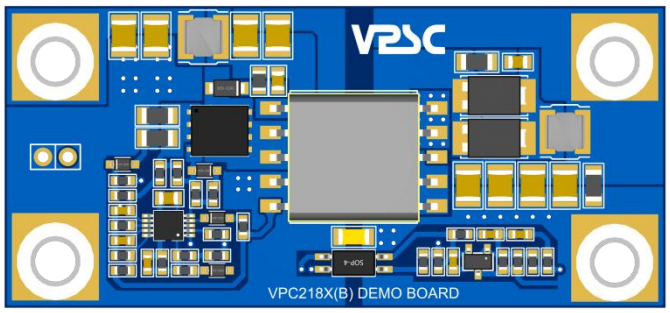


图 1: VPC2187B Demo 板(尺寸:67.5mm*30.7m)

关键词：输入：18V-72V，输出 12V/30W，隔离电压：1500VDC，反馈方式：副边反馈-SSR，开关频率：330kHz

原理图

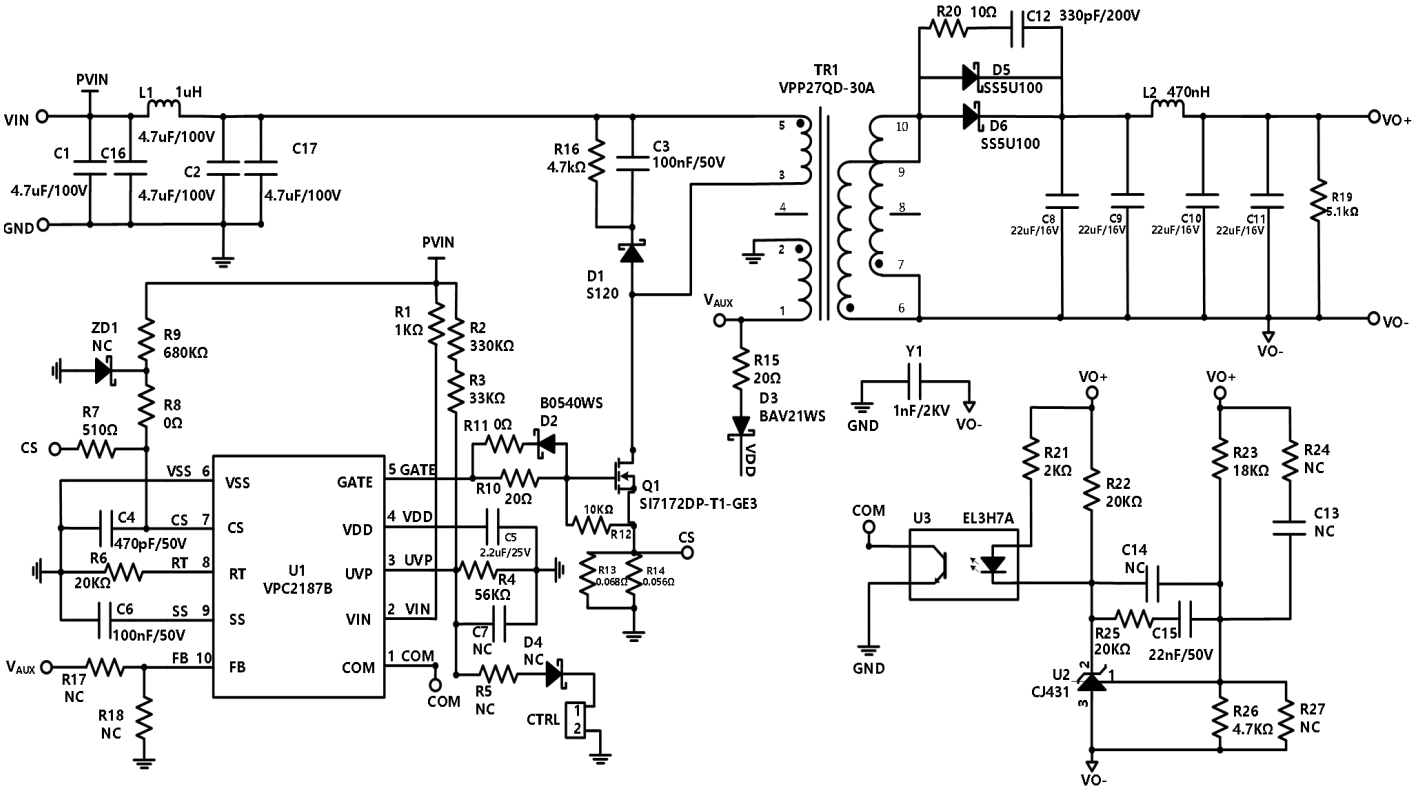


图 2：VPC2187B 12V/30W 原理图

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	4.7uF/100V-X5R	1210	1210X475K101NT	FH(风华)
C2	4.7uF/100V-X5R	1210	1210X475K101NT	FH(风华)
C3	100nF/50V-X7R	0805	CC0805KRX7R9BB104	YAGEO
C4	470pF/50V-X7R	0603	CC0603KKX7R0BB471	YAGEO
C5	2.2uF/25V-X7R	0805	CC0805KRX7R8BB225	YAGEO
C6	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C7	NC	-	-	-
C8	22uF/16V-X5R	1206	CC1206KKX5R9BB226	YAGEO
C9	22uF/16V-X5R	1206	CC1206KKX5R9BB226	YAGEO
C10	22uF/16V-X5R	1206	CC1206KKX5R9BB226	YAGEO
C11	22uF/16V-X5R	1206	CC1206KKX5R9BB226	YAGEO
C12	330pF/200V- NP0	0805	CC0805JRNPOABN331	YAGEO
C13	NC	-	-	-
C14	NC	-	-	-
C15	22nF/50V-X7R	0603	CC0603KRX7R9BB223	YAGEO
C16	4.7uF/100V-X5R	1210	1210X475K101NT	FH(风华)
C17	4.7uF/100V-X5R	1210	1210X475K101NT	FH(风华)
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R2	330KΩ±1%	0603	RC0603FR-07330KL	YAGEO
R3	33KΩ±1%	0603	RC0603FR-0733KL	YAGEO
R4	56KΩ±1%	0603	RC0603FR-0756KL	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	680KΩ±1%	0603	RC0603FR-07680KL	YAGEO
R10	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R11	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R12	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R13	0.068Ω ±1%	1206	RL1206FR-070R068L	YAGEO
R14	0.056Ω ±1%	1206	RL1206FR-070R056L	YAGEO
R15	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R16	4.7KΩ±1%	0805	RC0805FR-074K7L	YAGEO
R17	NC	-	-	-
R18	NC	-	-	-
R19	5.1KΩ±1%	1206	RC1206FR-075K1L	YAGEO
R20	10Ω±1%	1206	RC1206FR-0710RL	YAGEO
R21	2KΩ±1%	0603	RC0603FR-072KL	YAGEO

R22	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R23	18KΩ±1%	0603	RC0603FR-0718KL	YAGEO
R24	NC	-	-	-
R25	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R26	4.7KΩ±1%	0603	RC0603FR-074K7L	YAGEO
R27	NC	-	-	-
TR1	NP:NS:NA=12:6:6 Lp=21.6uH	EPD13	VPP27QD-30A	VPSC
Q1	N 沟道 200V 25A	PowerPAK-SO-8	SI7172DP-T1-GE3	VISHAY
L1	1uH ±20%	SMD	SWPA5020SR1UT	SUNLORD
L2	470nH ±20%	SMD	SWPA5020SR47NT	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	100V/5A	SMA	SS5U100	YANGJIE
D6	100V/5A	SMA	SS5U100	YANGJIE
ZD1	NC	-	-	-
U1	4-100VIN 电源管理芯片	MSOP-10	VPC2187B	VPSC
U2	Vref=2.495V	SOT23-3	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=48V	8	---	703	mA
转换效率	VIN=48V，IO=2.5A	---	90.1	---	%
纹波&噪声	VIN=48V，IO=2.5A	---	47	85	mV
输出电压精度	VIN=48V，IO=2.5A	---	0.5	---	%
线性调节率	VIN=18V-72V，IO=2.5A	---	0.5	---	%
负载调整率	VIN=48V，IO=2.5A	---	0.5	---	%
输入欠压保护	锁定电压	---	15	---	V
	恢复电压	---	17	---	V
短路保护	VIN=18V-72V	可长期保护，自恢复			
工作温度	大于 70℃需降额使用	-40	---	85	℃
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

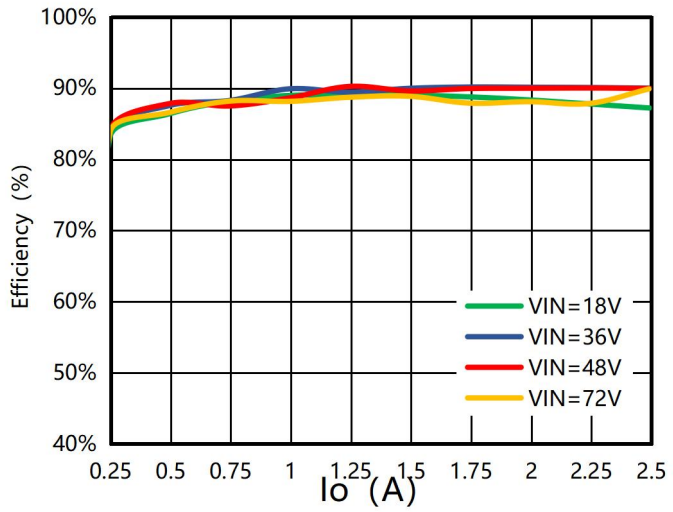


图 3：效率 VS 输出电流（25℃）

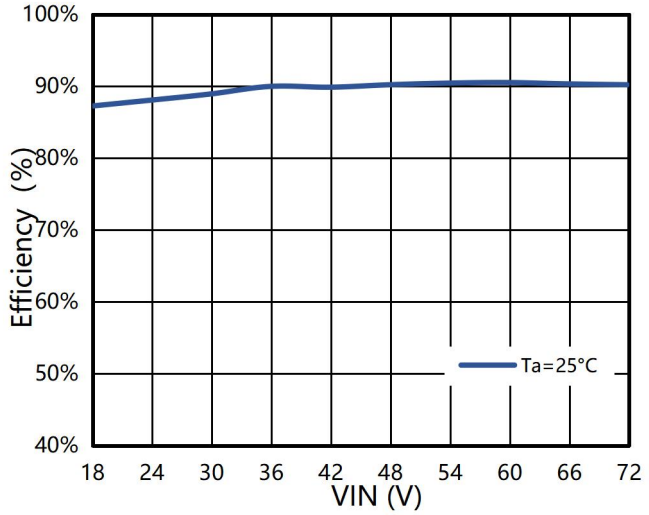
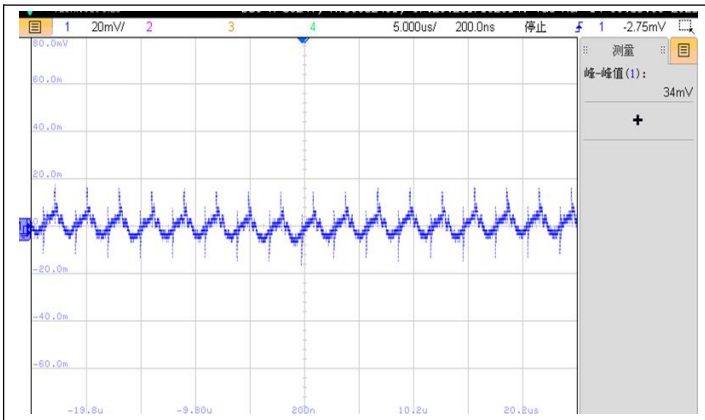


图 4：效率 VS 输入电压（输出满载@25℃）

相关波形



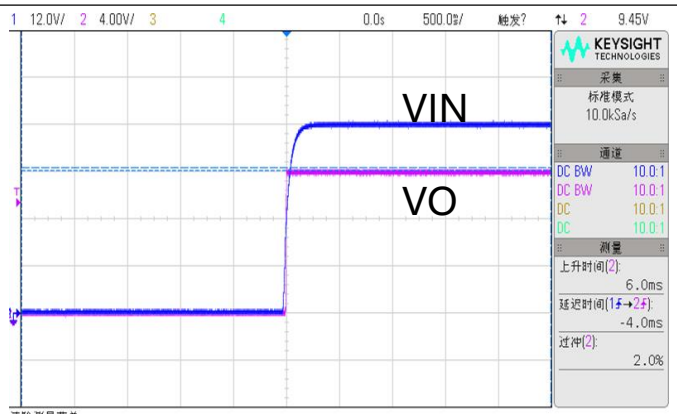
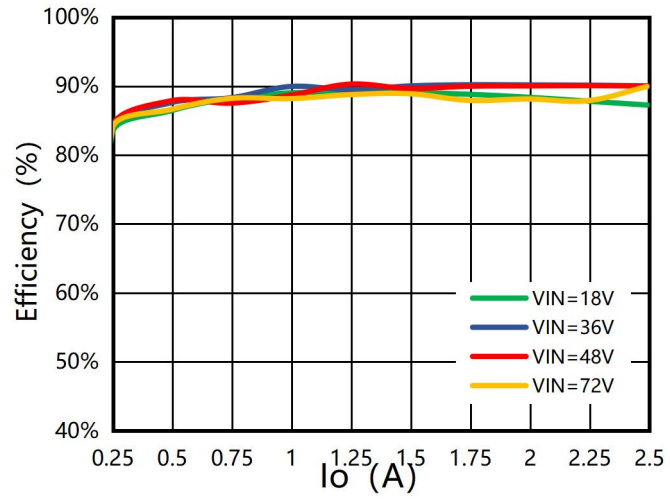


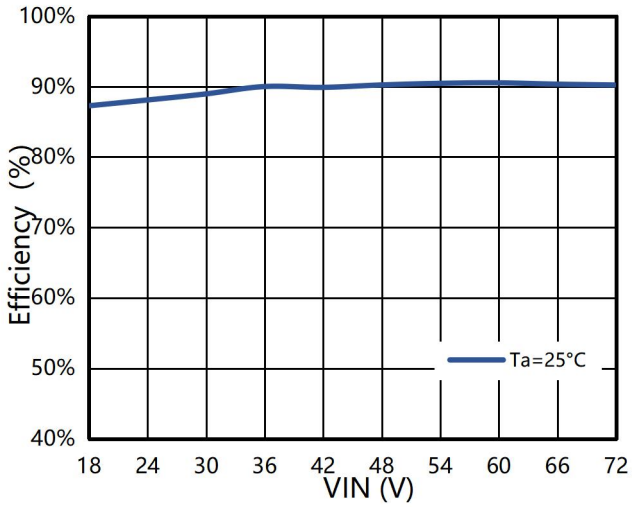
图 5: VIN=48V，满载输出电压纹波波形	图 6: VIN=48V，满载启机波形

详细测试数据

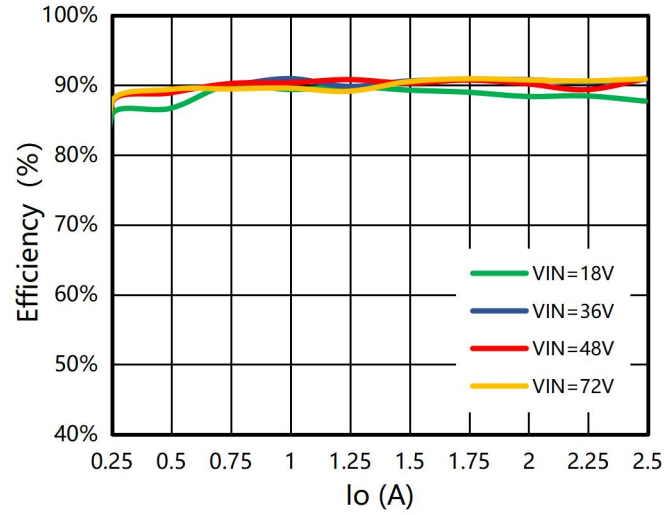
高低温测试曲线



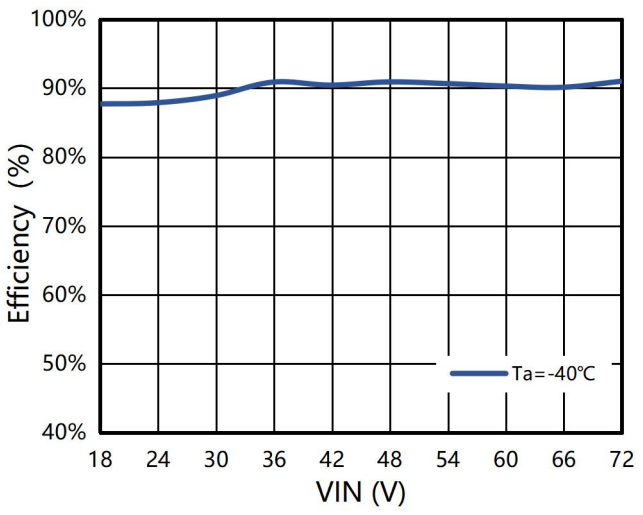
效率 VS 输出电流（25℃）



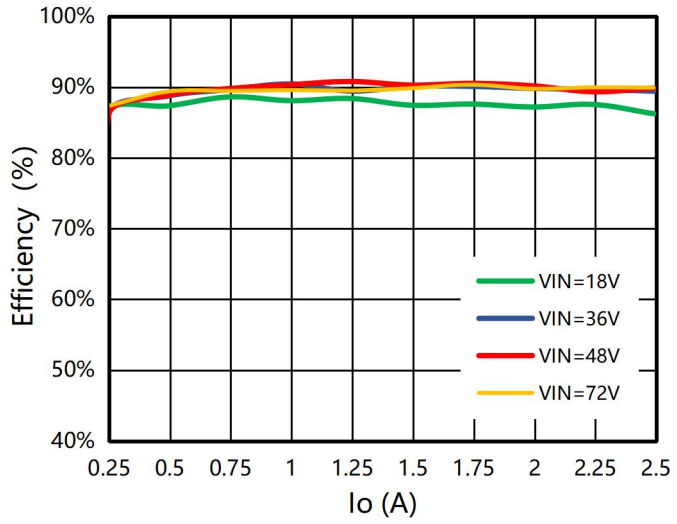
效率 VS 输入电压（输出满载@25℃）



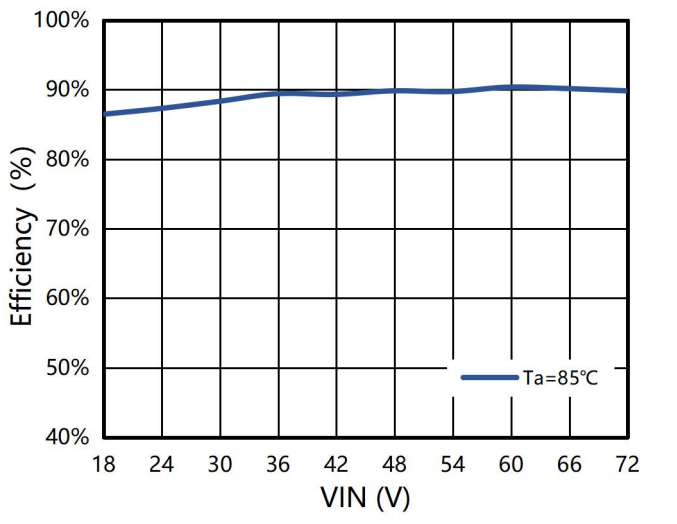
效率 VS 输出电流（-40℃）



效率 VS 输入电压（输出满载@-40℃）



效率 VS 输出电流 (85℃)



效率 VS 输入电压 (输出满载@85℃)

VIN=48V，Ta=25℃，输入、输出及效率数据：

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
47.9	0.008	12.07	0	0%	0.00%
47.9	0.073	12.07	0.25	10%	86.31%
47.8	0.144	12.07	0.50	20%	87.87%
47.8	0.217	12.07	0.75	30%	87.53%
47.8	0.286	12.07	1.00	40%	88.67%
47.8	0.350	12.07	1.25	50%	90.27%
47.8	0.423	12.07	1.50	60%	89.64%
47.8	0.492	12.07	1.75	70%	89.98%
47.8	0.562	12.07	2.00	80%	90.02%
47.8	0.632	12.07	2.25	90%	90.06%
47.8	0.703	12.07	2.50	100%	89.98%

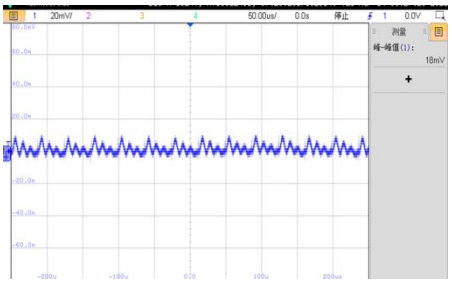
VIN=48V，Ta=-40℃，输入、输出及效率数据：

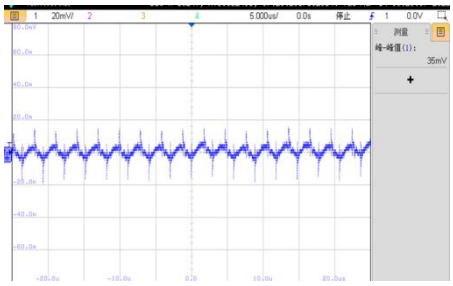
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
47.9	0.008	12.07	0	0%	0.00%
47.9	0.072	12.07	0.25	10%	87.30%
47.8	0.142	12.07	0.50	20%	88.89%
47.8	0.210	12.07	0.75	30%	90.22%
47.8	0.280	12.07	1.00	40%	90.34%
47.8	0.348	12.07	1.25	50%	90.79%
47.8	0.420	12.07	1.50	60%	90.28%
47.8	0.488	12.07	1.75	70%	90.71%
47.8	0.561	12.07	2.00	80%	90.18%
47.8	0.637	12.07	2.25	90%	89.35%
47.8	0.696	12.07	2.50	100%	90.90%

VIN=48V，Ta=85℃，输入、输出及效率数据：

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
47.9	0.008	12.07	0	0%	0.00%
47.9	0.075	12.07	0.25	10%	83.81%
47.8	0.142	12.07	0.50	20%	88.89%
47.8	0.211	12.07	0.75	30%	89.79%
47.8	0.280	12.07	1.00	40%	90.34%
47.8	0.348	12.07	1.25	50%	90.79%
47.8	0.420	12.07	1.50	60%	90.28%
47.8	0.489	12.07	1.75	70%	90.53%
47.8	0.565	12.07	2.00	80%	89.54%
47.8	0.642	12.07	2.25	90%	88.65%
47.8	0.708	12.07	2.50	100%	89.36%

输出电压纹波波形


VIN=18V，空载输出电压纹波波形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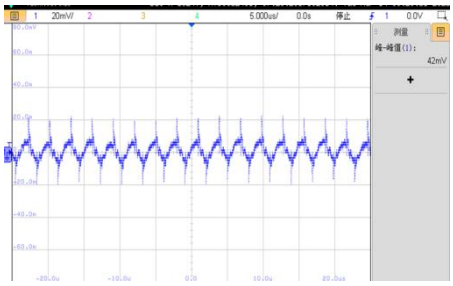
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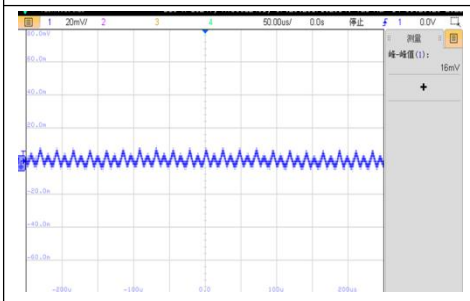
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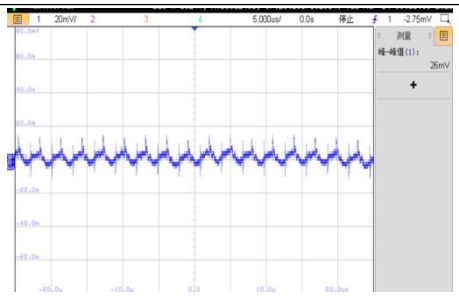
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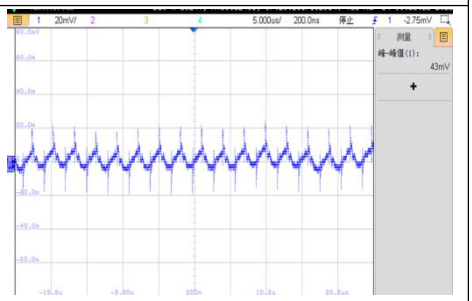
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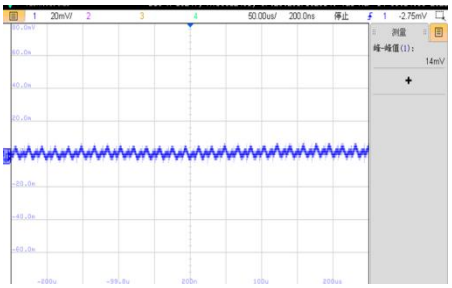
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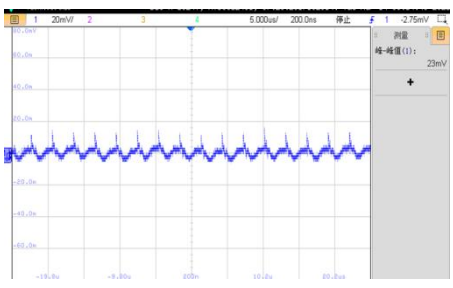
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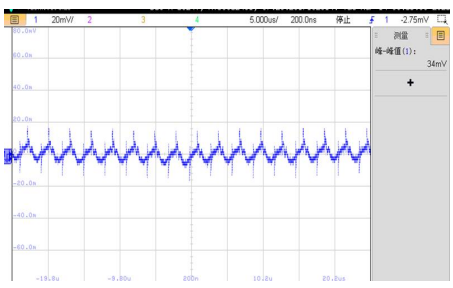
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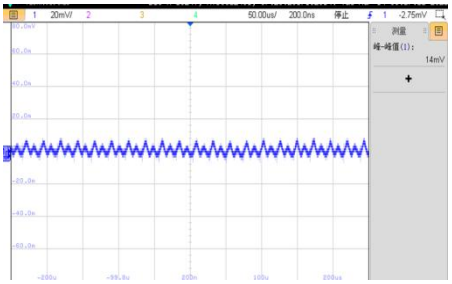
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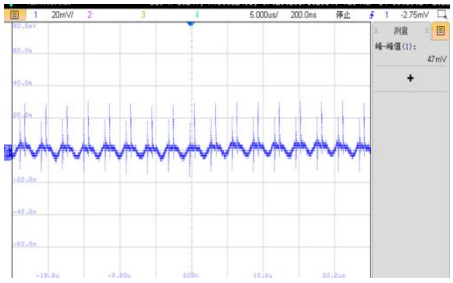
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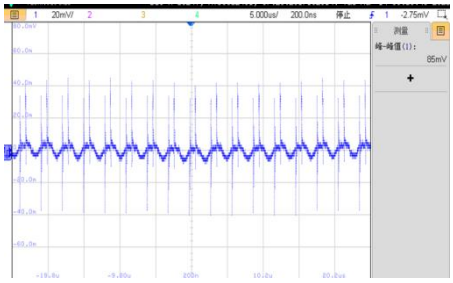
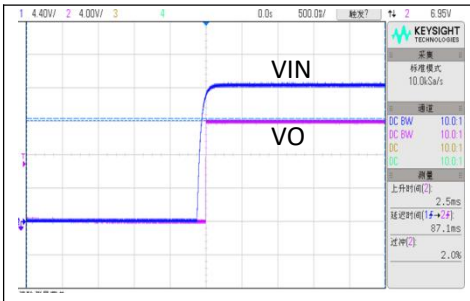
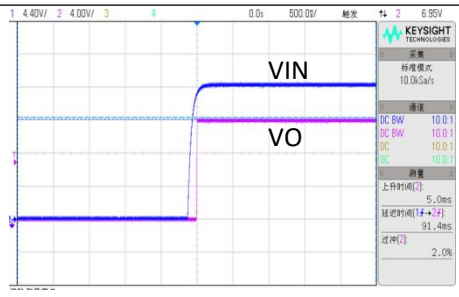

VIN=72V，满载输出电压纹波波形

开关机波形（常温-程控开关）



VIN=18V，空载启机波形



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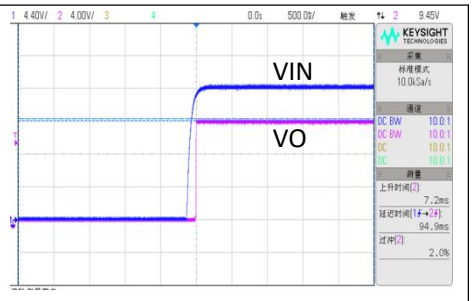

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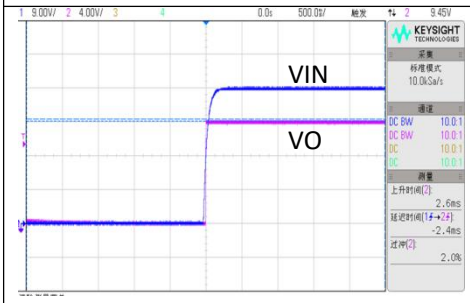

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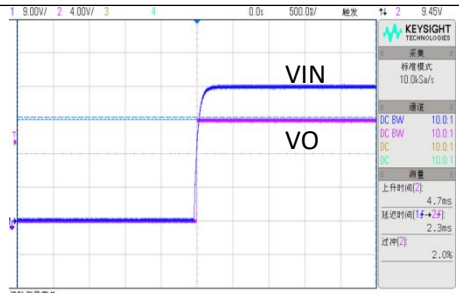

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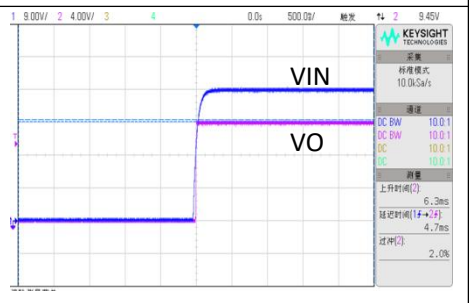
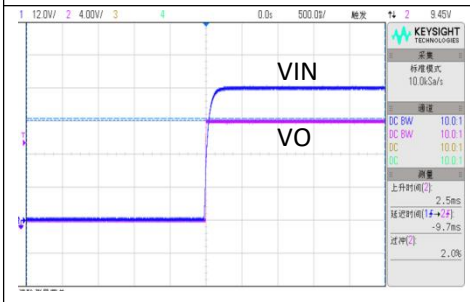
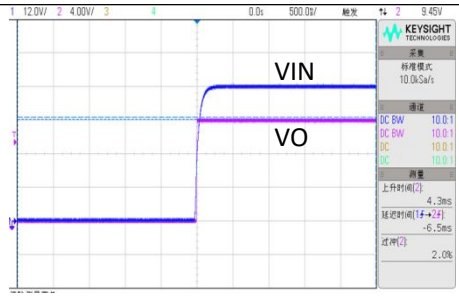


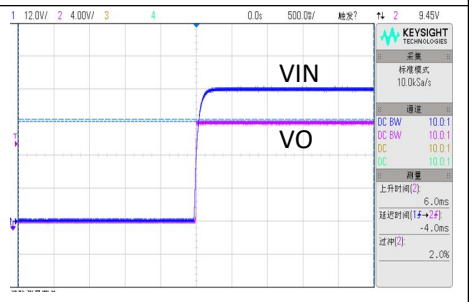
VIN=36V，满载启机波形



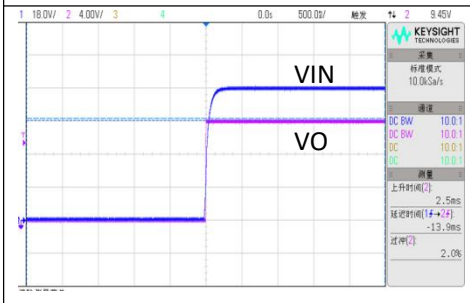
VIN=48V，空载启机波形



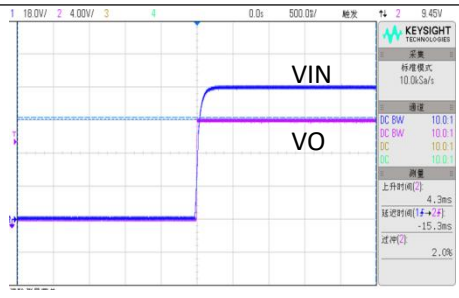
VIN=48V，半载启机波形



VIN=48V，满载启机波形



VIN=72V，空载启机波形



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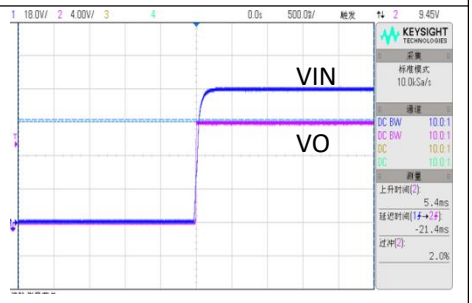
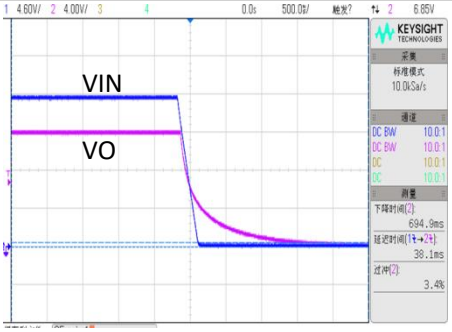
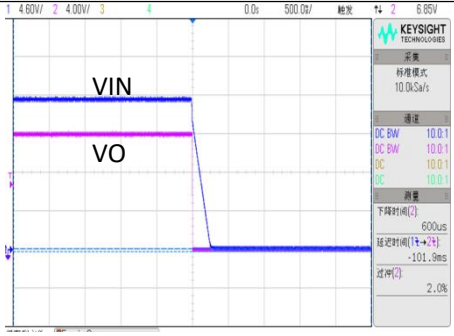


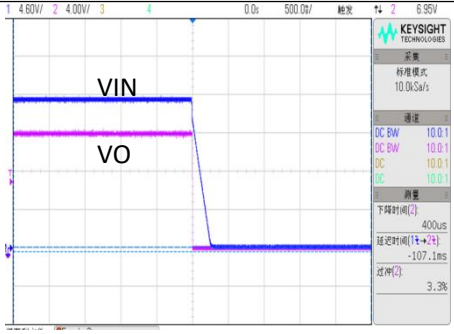
VIN=72V，满载启机波形



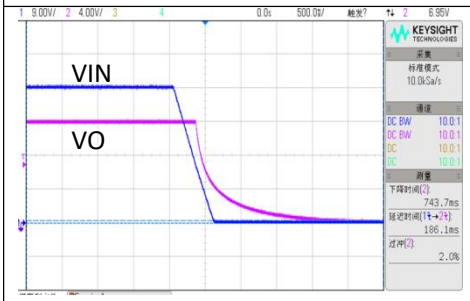
VIN=18V，空载关机波形



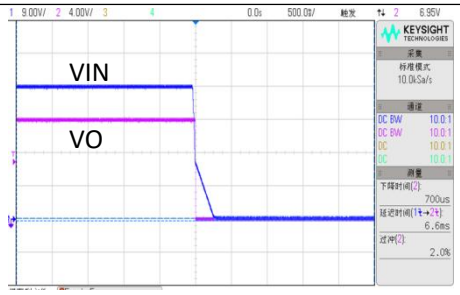
VIN=18V，半载关机波形



VIN=18V，满载关机波形



VIN=36V，空载关机波形



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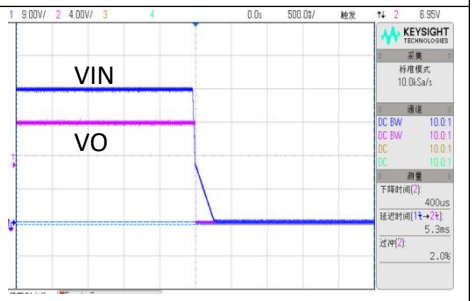
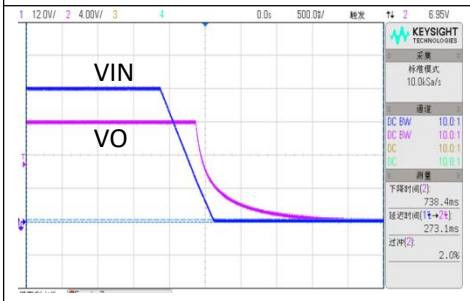
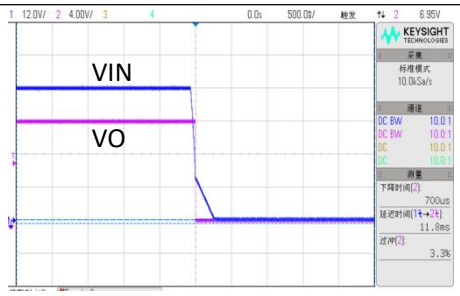


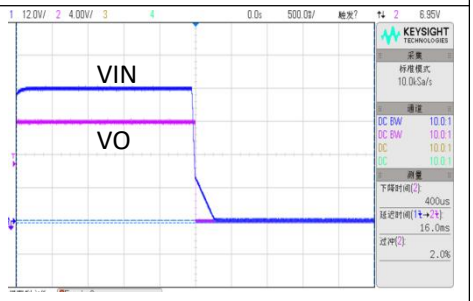
VIN=36V，满载关机波形



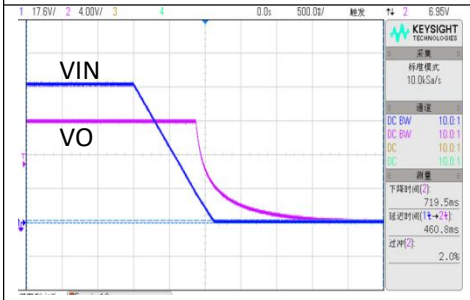
VIN=48V，空载关机波形



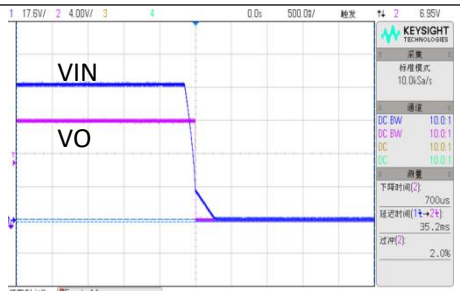
VIN=48V，半载关机波形



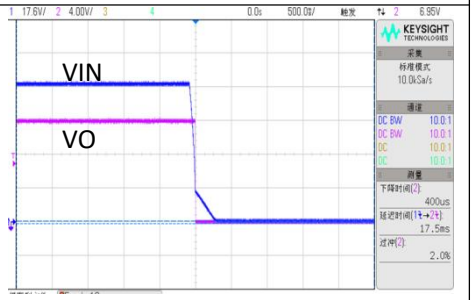
VIN=48V，满载关机波形



VIN=72V，空载关机波形

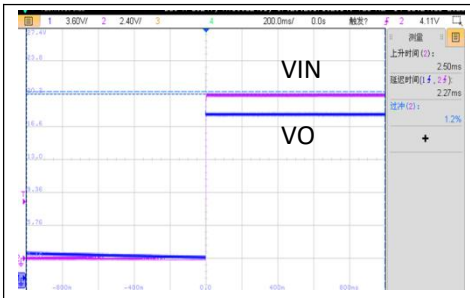


VIN=72V，半载关机波形

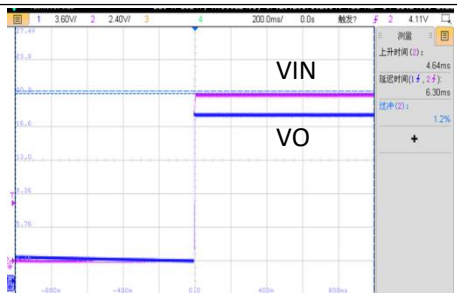


VIN=72V，满载关机波形

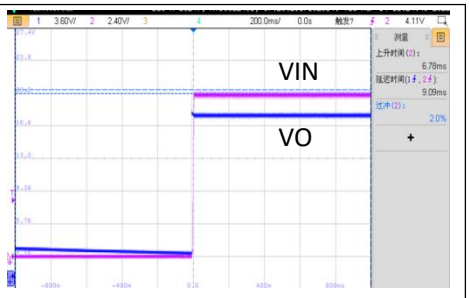
开关机波形（常温-空气开关）



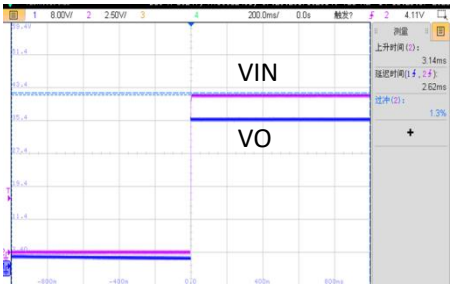
VIN=18V，空载启机波形



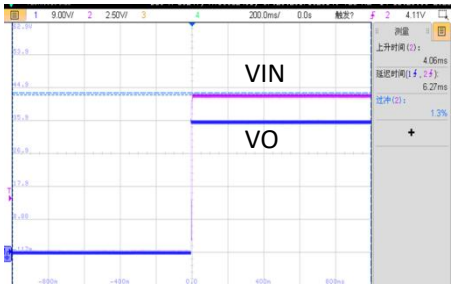
VIN=18V，半载启机波形



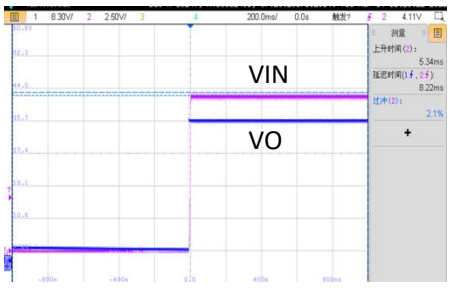
VIN=18V，满载启机波形



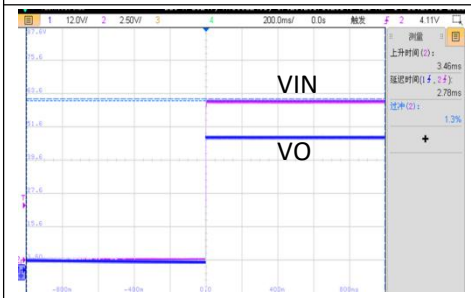
VIN=36V，空载启机波形



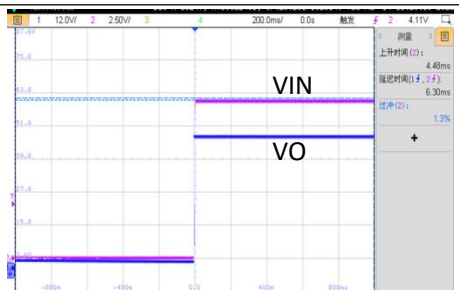
VIN=36V，半载启机波形



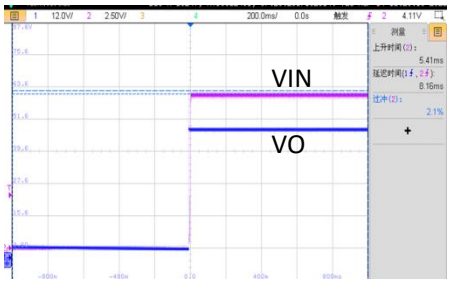
VIN=36V，满载启机波形



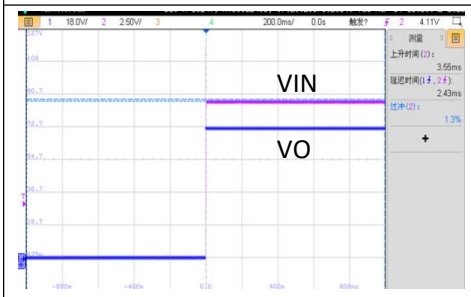
VIN=48V，空载启机波形



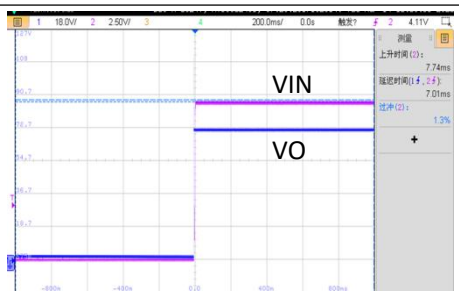
VIN=48V，半载启机波形



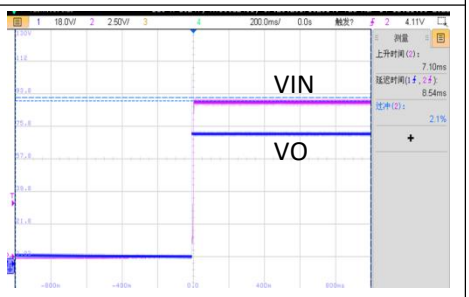
VIN=48V，满载启机波形



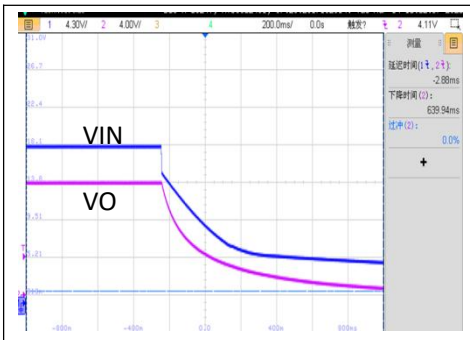
VIN=72V，空载启机波形



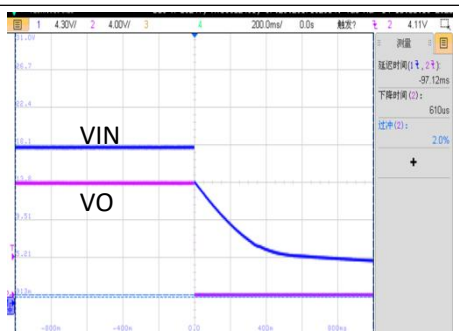
VIN=72V，半载启机波形



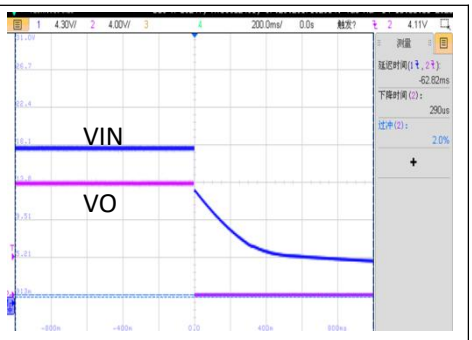
VIN=72V，满载启机波形



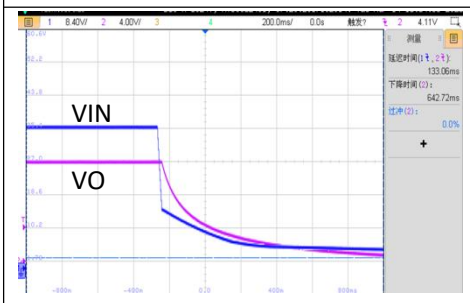
VIN=18V，空载关机波形



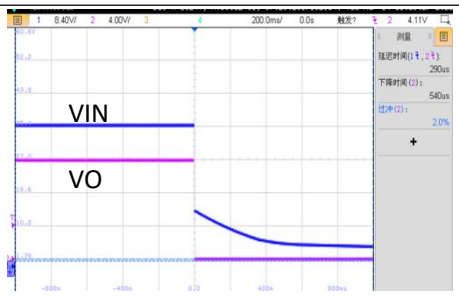
VIN=18V，半载关机波形



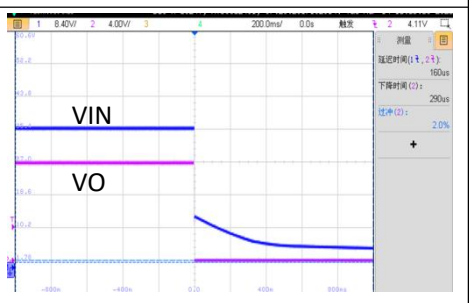
VIN=18V，满载关机波形



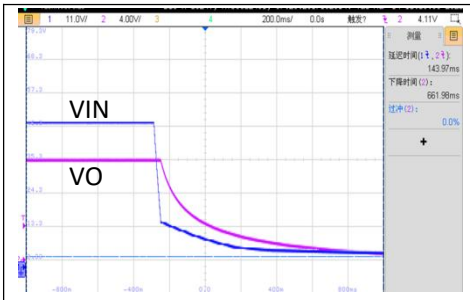
VIN=36V，空载关机波形



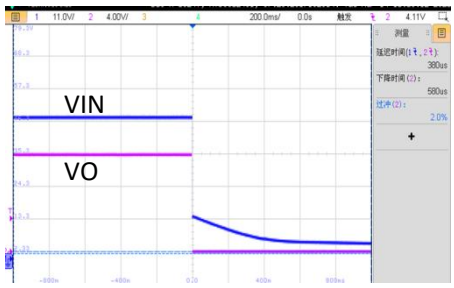
VIN=36V，半载关机波形



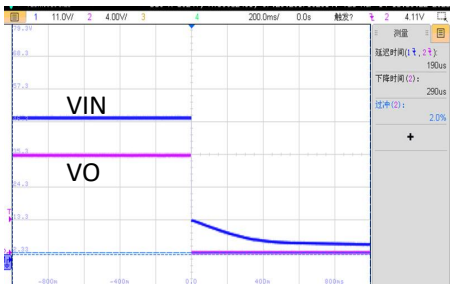
VIN=36V，满载关机波形



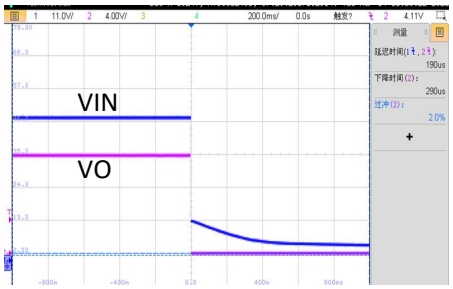
VIN=48V，空载关机波形



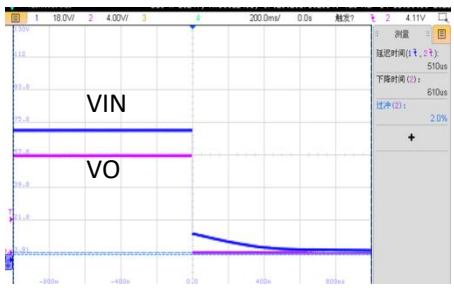
VIN=48V，半载关机波形



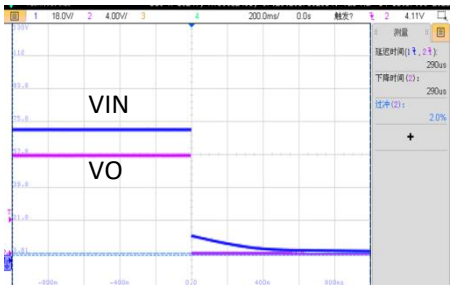
VIN=48V，满载关机波形



VIN=72V，空载关机波形

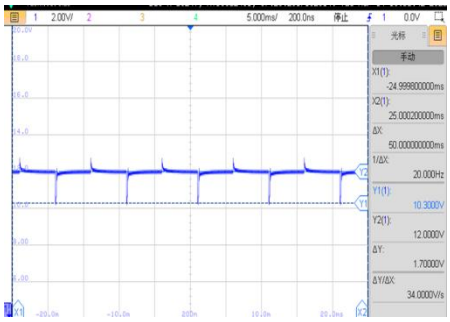


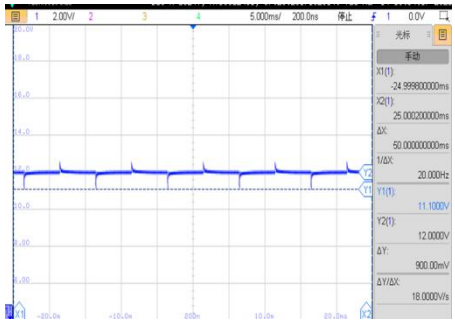
VIN=72V，半载关机波形

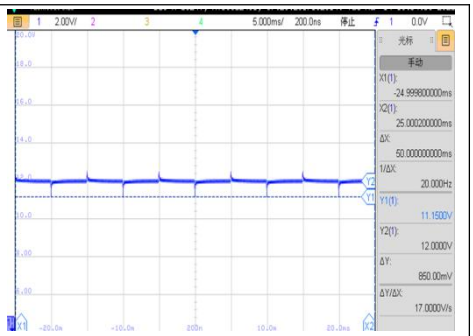


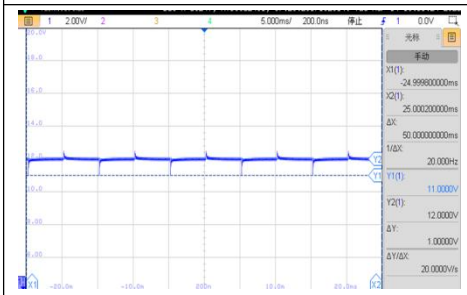
VIN=72V，满载关机波形

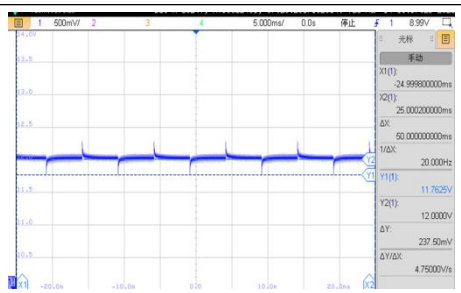
动态波形

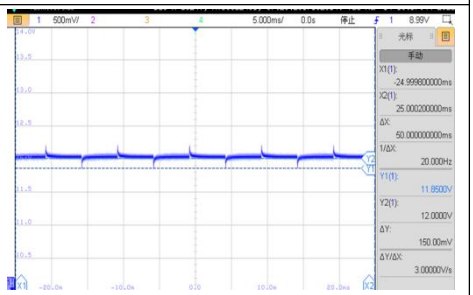

VIN=18V，100%-10%-100%Io 动态波形

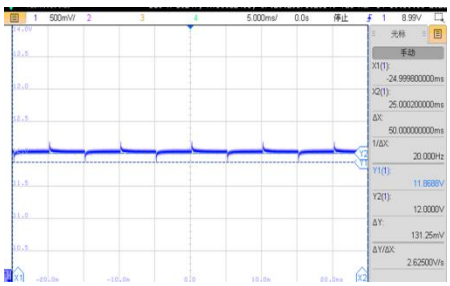

VIN=18V，75%-50%-75%Io 动态波形

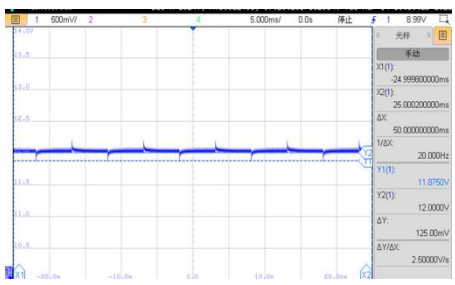

VIN=18V，50%-25%-50%Io 动态波形

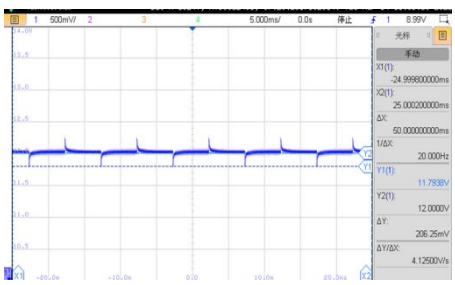

VIN=36V，100%-10%-100%Io 动态波形

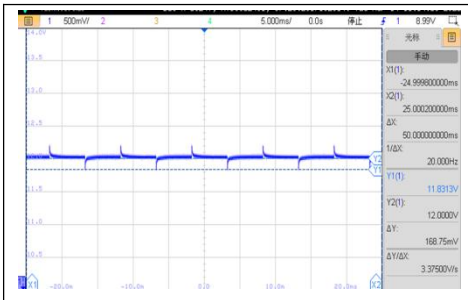

VIN=36V，75%-50%-75%Io 动态波形

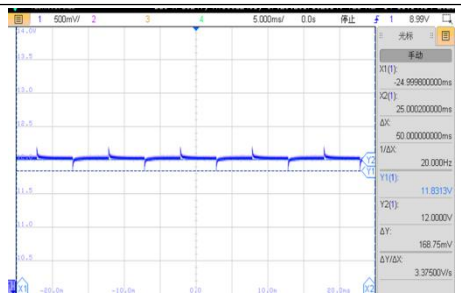

VIN=36V，50%-25%-50%Io 动态波形

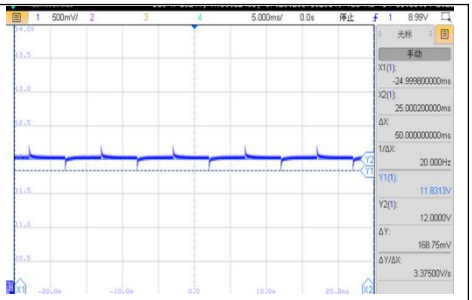

VIN=48V，100%-10%-100%Io 动态波形


VIN=48V，75%-50%-75%Io 动态波形

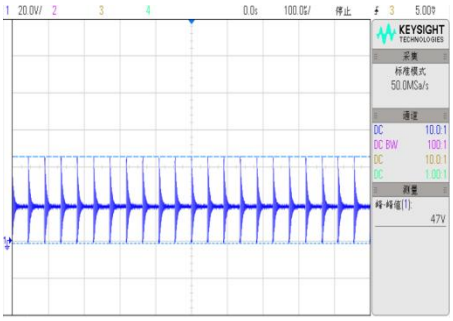

VIN=48V，50%-25%-50%Io 动态波形

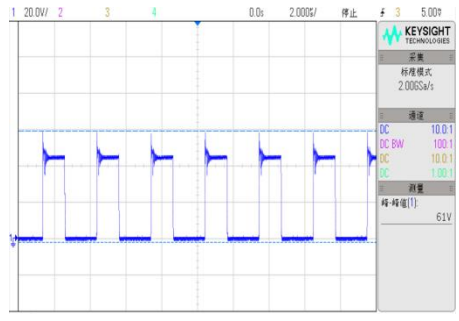

VIN=72V，100%-10%-100%Io 动态波形

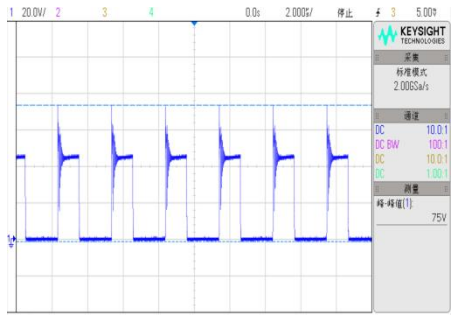

VIN=72V，75%-50%-75%Io 动态波形

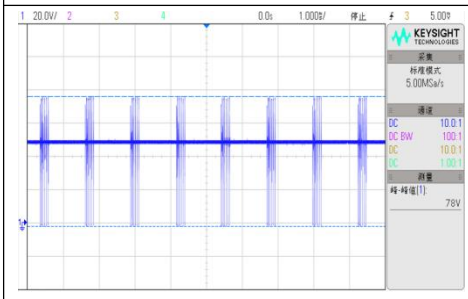

VIN=72V，50%-25%-50%Io 动态波形

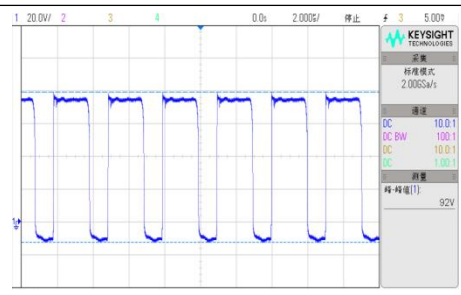
外置 MOS 管 Q1 电压应力波形

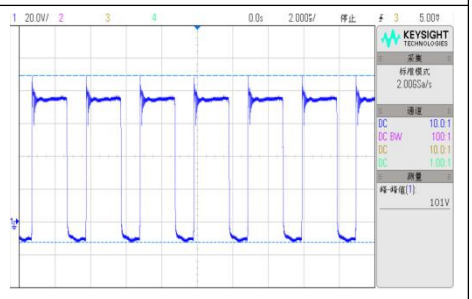

VIN=18V，空载 VDS 波形

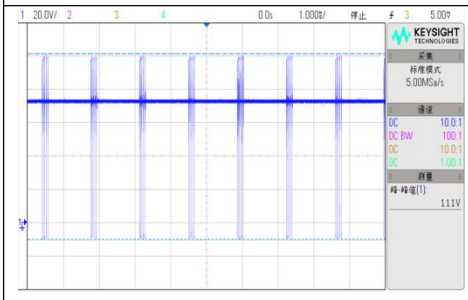

VIN=18V，半载 VDS 波形

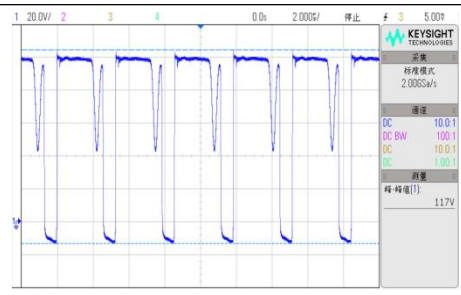

VIN=18V，满载 VDS 波形

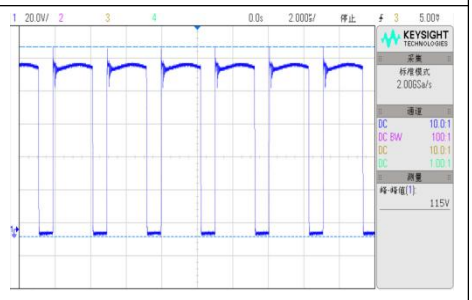

VIN=48V，空载 VDS 波形

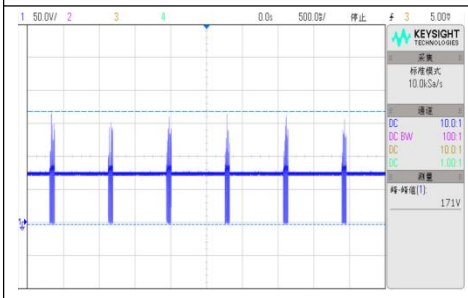

VIN=48V，半载 VDS 波形

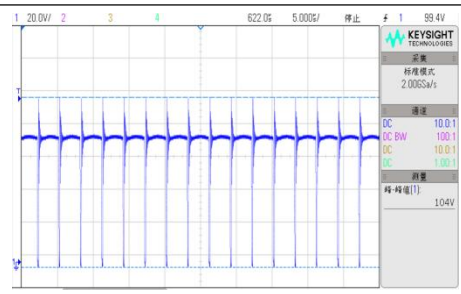

VIN=48V，满载 VDS 波形


VIN=72V，空载 VDS 波形

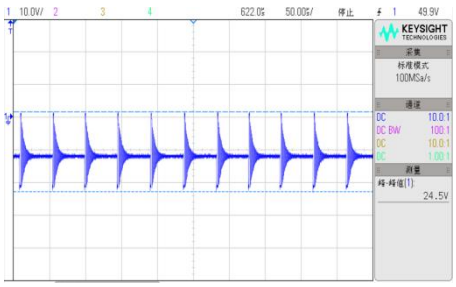

VIN=72V，半载 VDS 波形

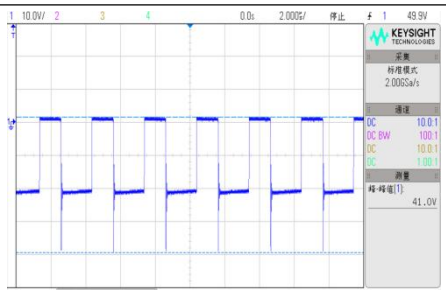

VIN=72V，满载 VDS 波形


VIN=72V，短路保护 VDS 波形


VIN=72V，短路保护 VDS 展开波形

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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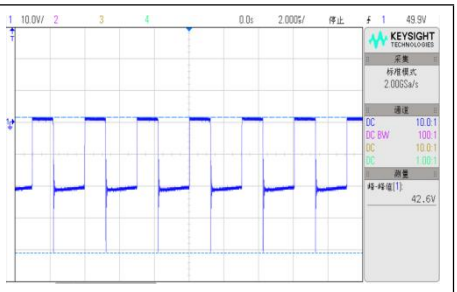
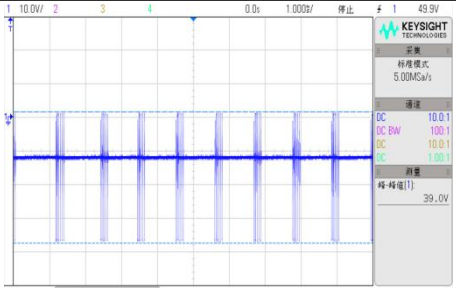
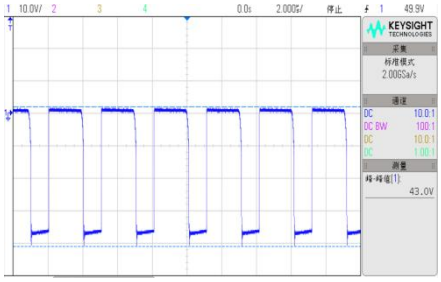
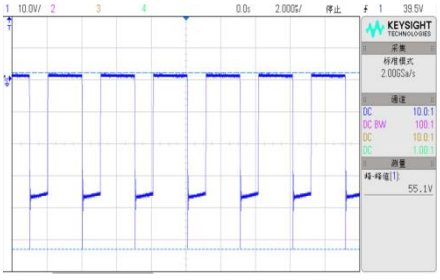

VIN=18V，D4 满载工作电压波形


VIN=48V，D4 空载工作电压波形


VIN=48V，D4 半载工作电压波形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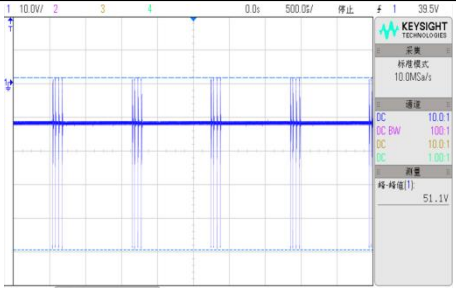
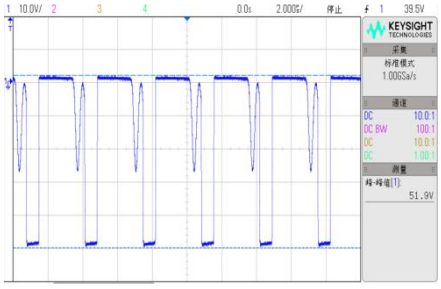
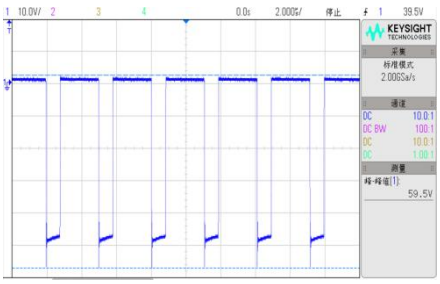

VIN=72V，D4 空载工作电压波形


VIN=72V，D4 半载工作电压波形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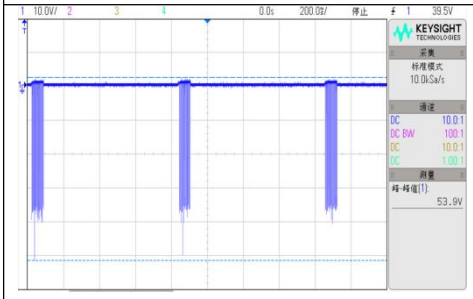
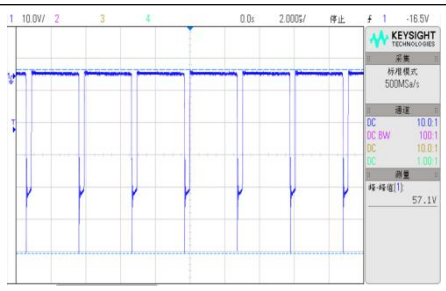
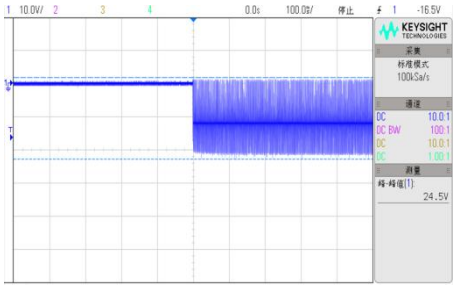
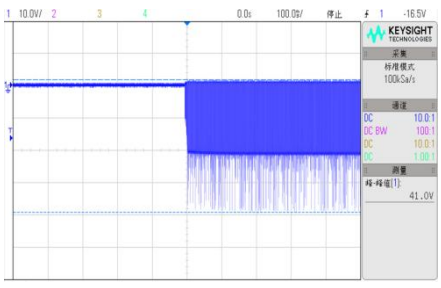
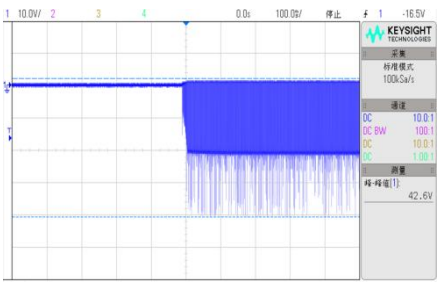

VIN=72V，D4 短路保护工作电压波形

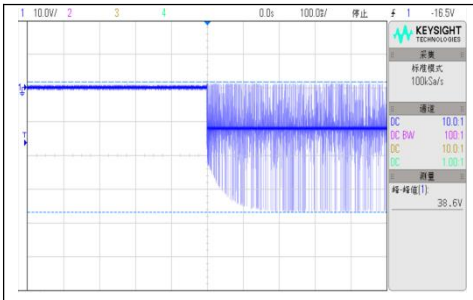

VIN=72V，D4 短路保护工作电压展开波形

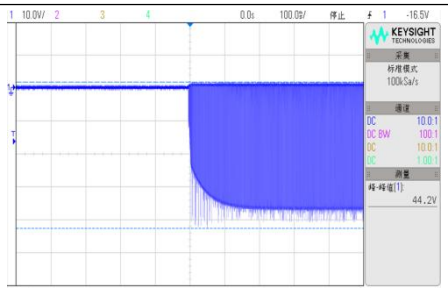
副边输出整流二极管 D5/D6 启机波形

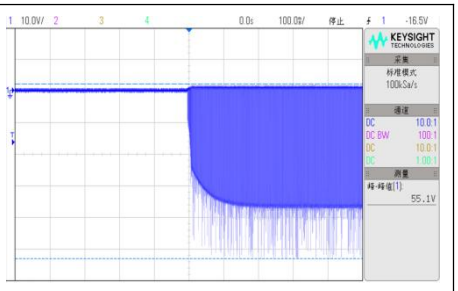

VIN=18V，D4 空载启机波形

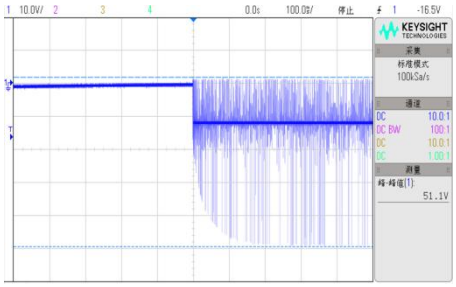

VIN=18V，D4 半载启机波形


VIN=18V，D4 满载启机波形


VIN=48V，D4 空载启机波形


VIN=48V，D4 半载启机波形


VIN=48V，D4 满载启机波形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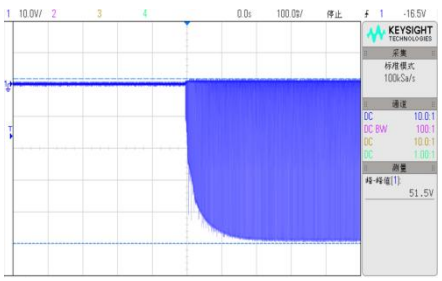
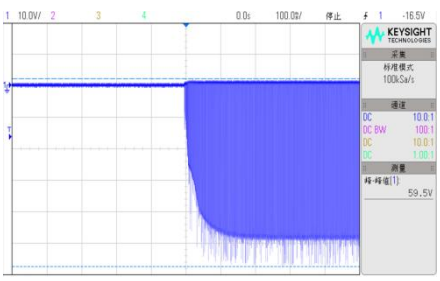
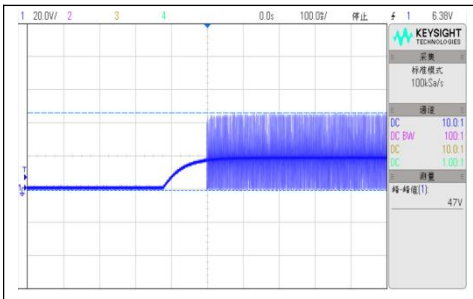
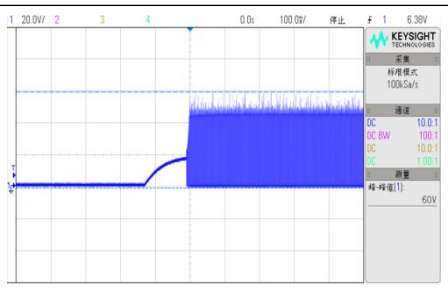
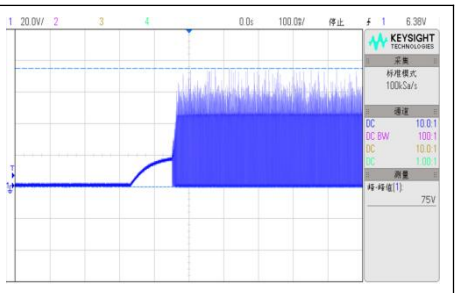

VIN=72V，D4 半载启机波形

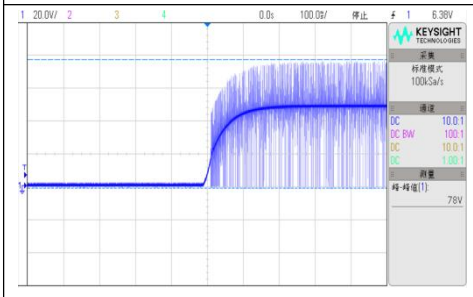

VIN=72V，D4 满载启机波形

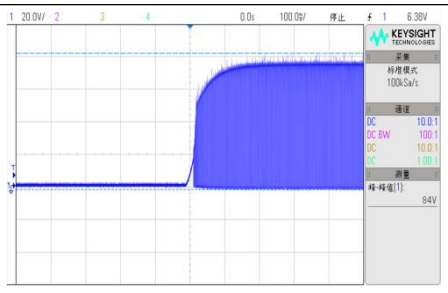
外置 MOS 管启机波形

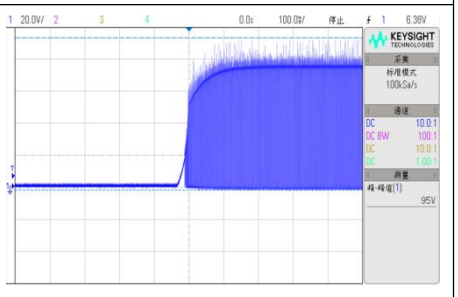

VIN=18V，空载启机 Vds 波形

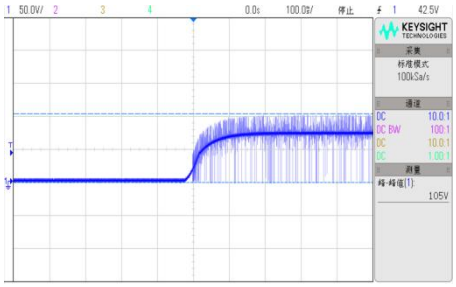

VIN=18V，半载启机 Vds 波形

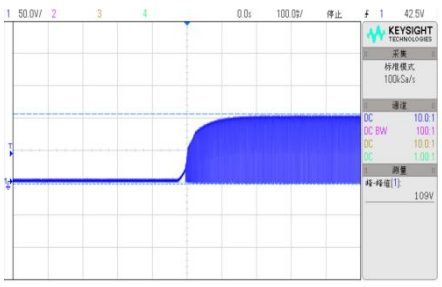

VIN=18V，满载启机 Vds 波形

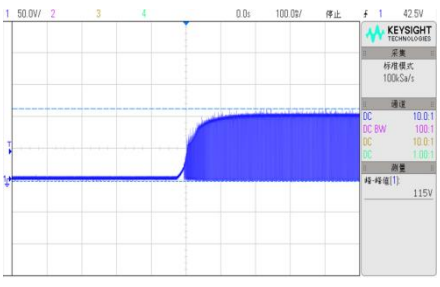

VIN=48V，空载启机 Vds 波形


VIN=48V，半载启机 Vds 波形

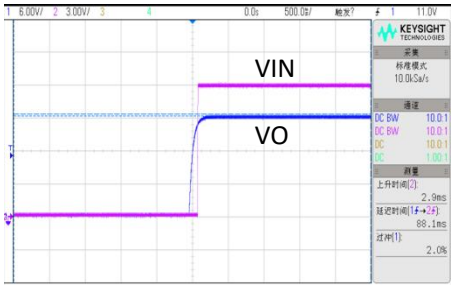

VIN=48V，满载启机 Vds 波形


VIN=72V，空载启机 Vds 波形

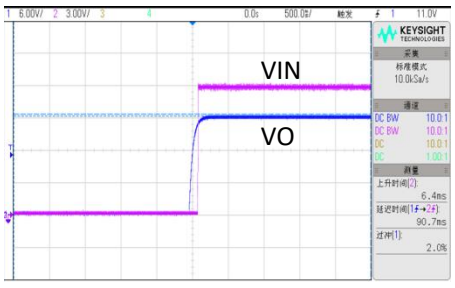

VIN=72V，半载启机 Vds 波形


VIN=72V，满载启机 Vds 波形

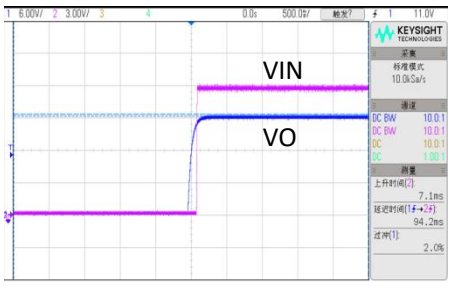
开关机波形（低温-40℃-程控开关）



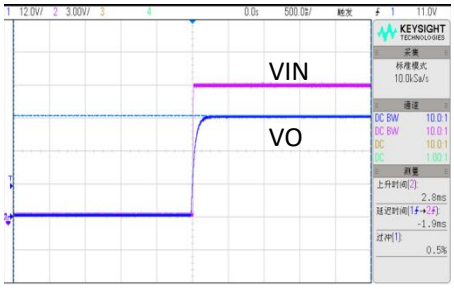
VIN=18V，空载启机波形



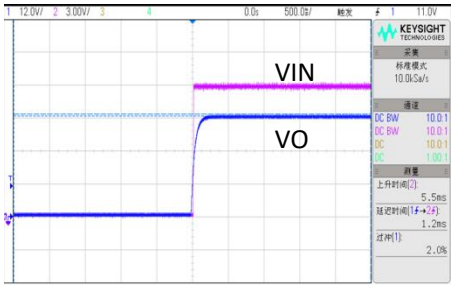
VIN=18V，半载启机波形



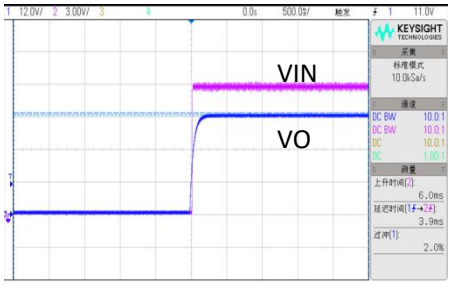
VIN=18V，满载启机波形



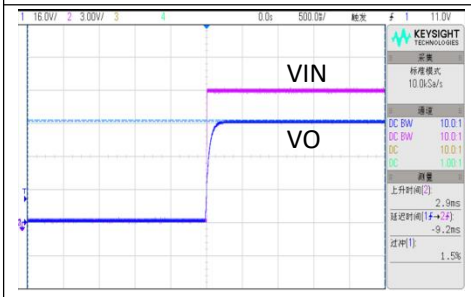
VIN=36V，空载启机波形



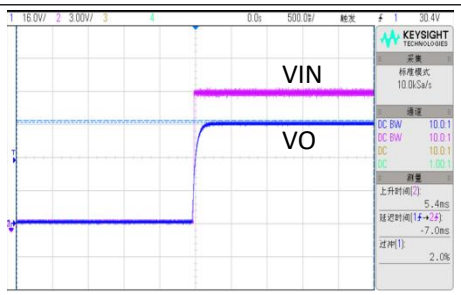
VIN=36V，半载启机波形



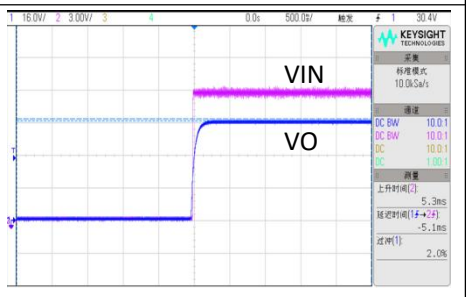
VIN=36V，满载启机波形



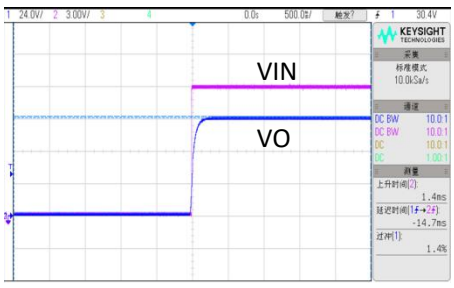
VIN=48V，空载启机波形



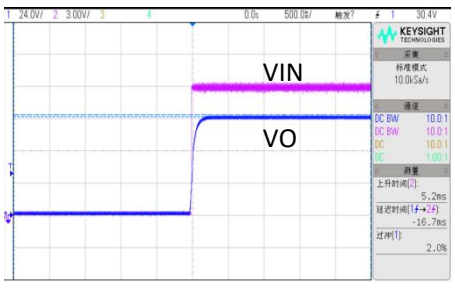
VIN=48V，半载启机波形



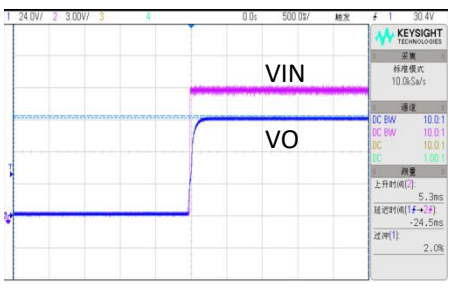
VIN=48V，满载启机波形



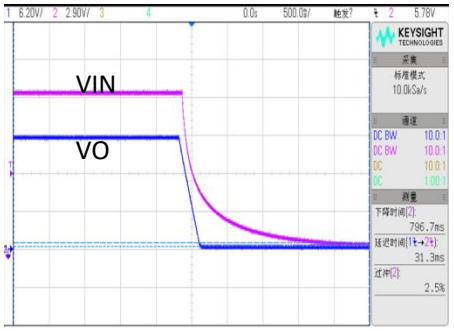
VIN=72V，空载启机波形

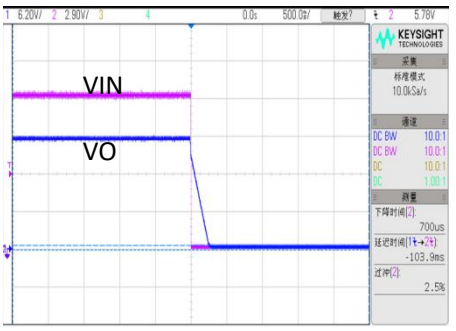


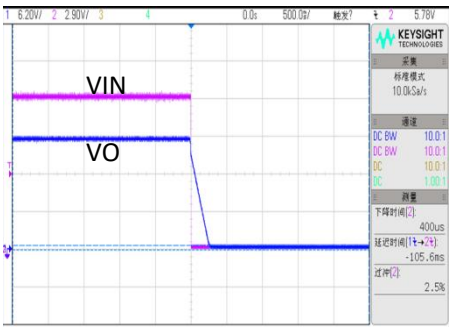
VIN=72V，半载启机波形

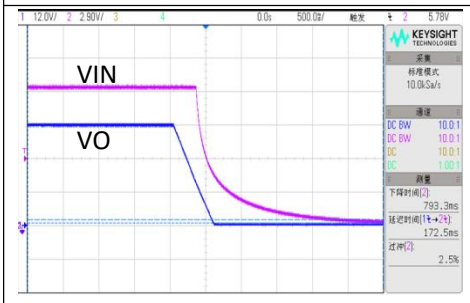
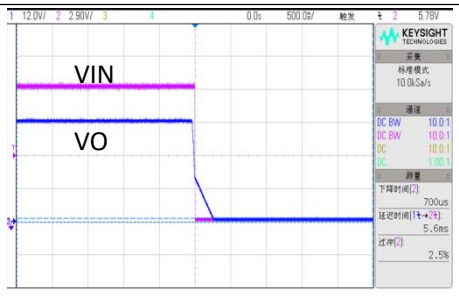
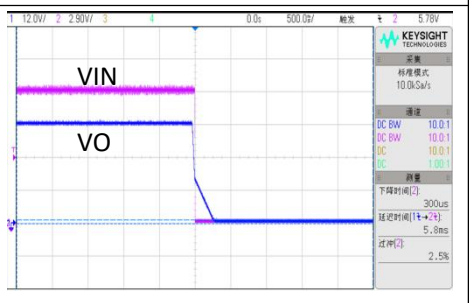
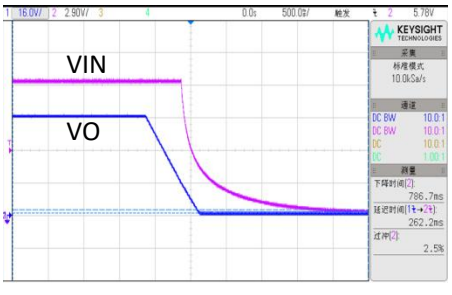
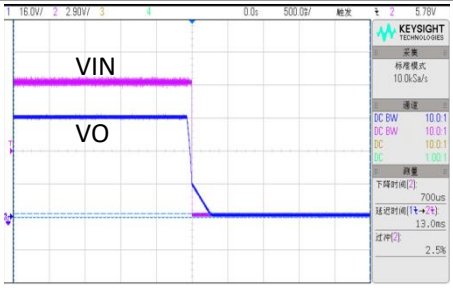
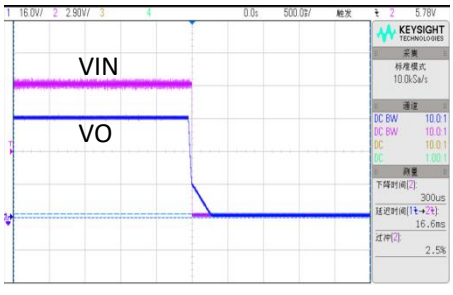
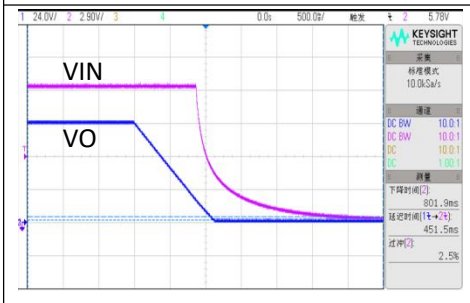
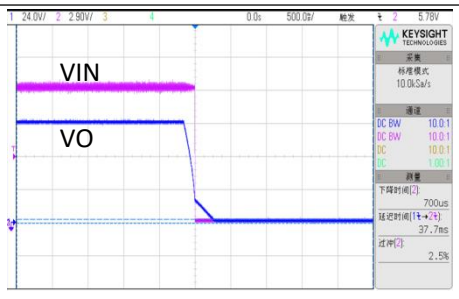
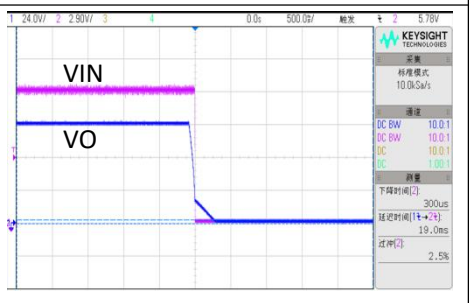


VIN=72V，满载启机波形

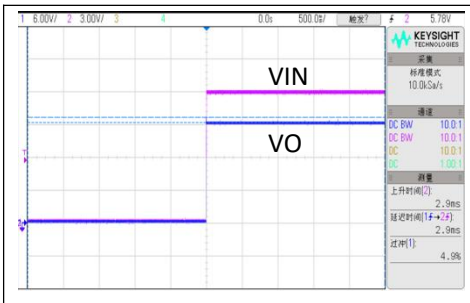
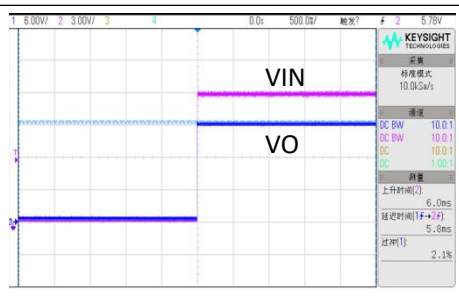
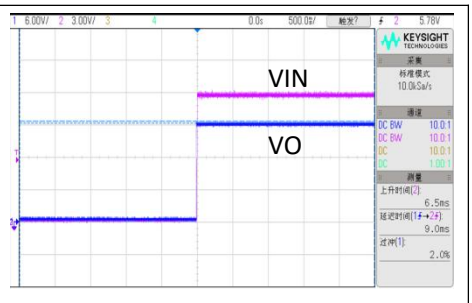
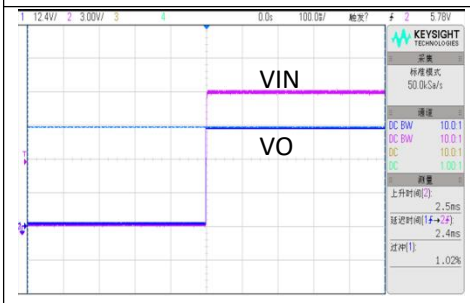
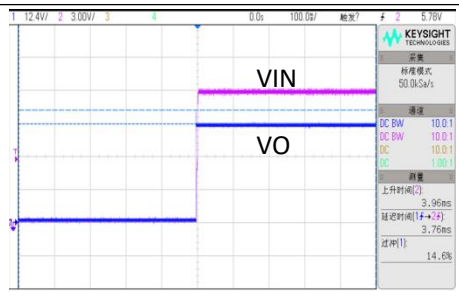
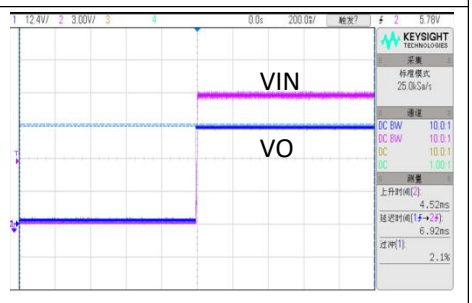


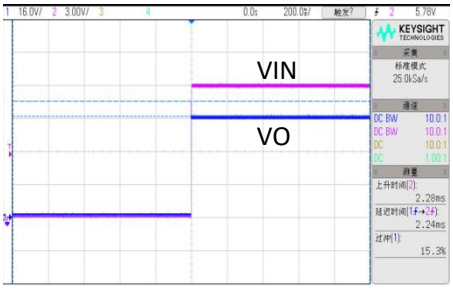




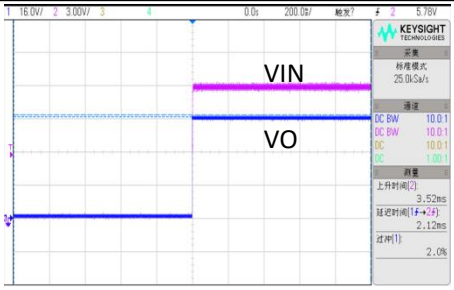
VIN=18V，空载关机波形	VIN=18V，半载关机波形	VIN=18V，满载关机波形
		
VIN=36V，空载关机波形	VIN=36V，半载关机波形	VIN=36V，满载关机波形
		
VIN=48V，空载关机波形	VIN=48V，半载关机波形	VIN=48V，满载关机波形
		
VIN=72V，空载关机波形	VIN=72V，半载关机波形	VIN=72V，满载关机波形

开关机波形（低温-40℃-空气开关）

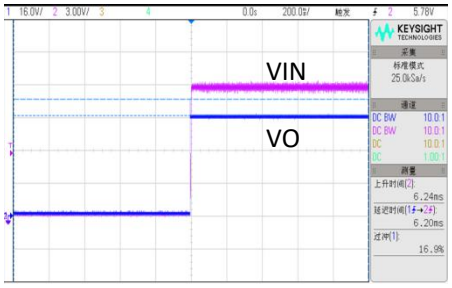
VIN=18V，空载启机波形	VIN=18V，半载启机波形	VIN=18V，满载启机波形
		
VIN=36V，空载启机波形	VIN=36V，半载启机波形	VIN=36V，满载启机波形
		



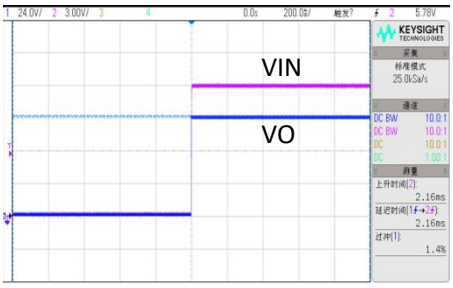
VIN=48V，空载启机波形



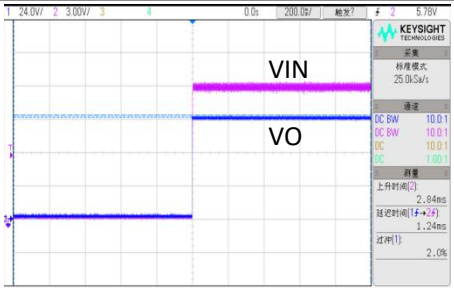
VIN=48V，半载启机波形



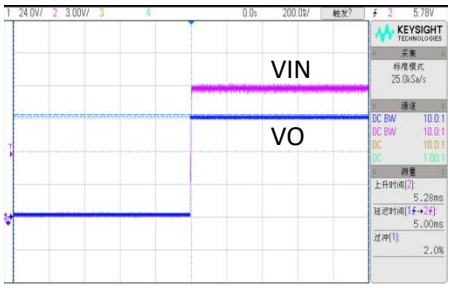
VIN=48V，满载启机波形



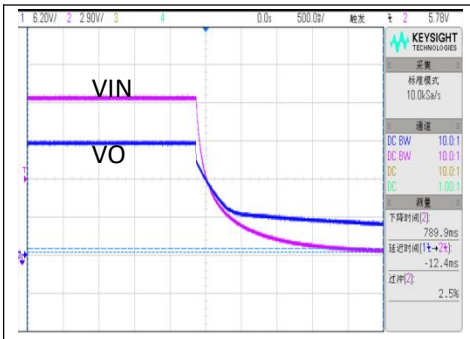
VIN=72V，空载启机波形



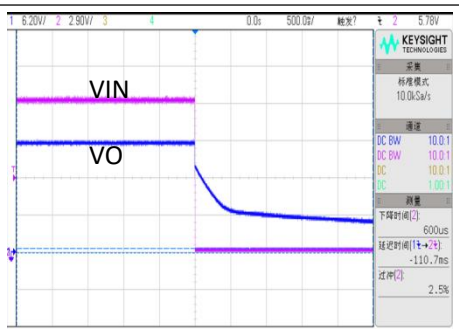
VIN=72V，半载启机波形



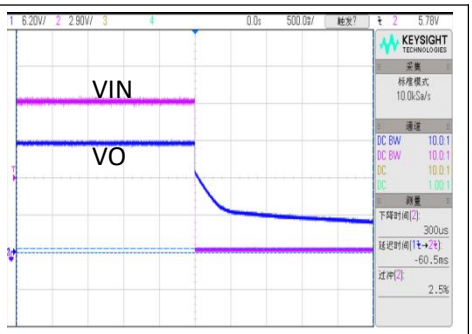
VIN=72V，满载启机波形



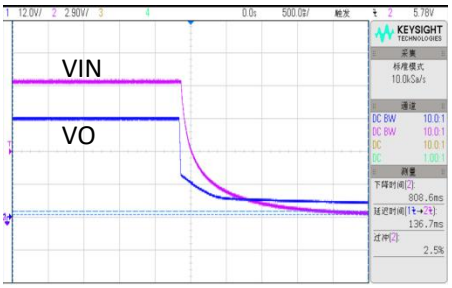
VIN=18V，空载关机波形



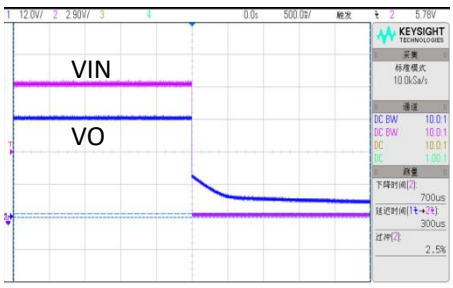
VIN=18V，半载关机波形



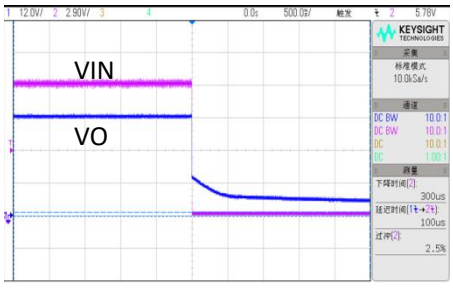
VIN=18V，满载关机波形



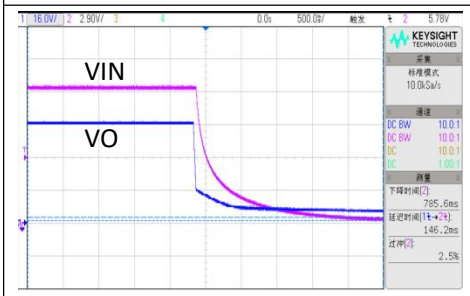
VIN=36V，空载关机波形



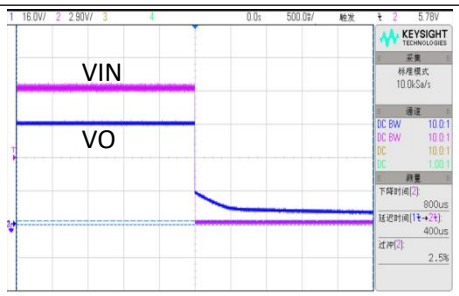
VIN=36V，半载关机波形



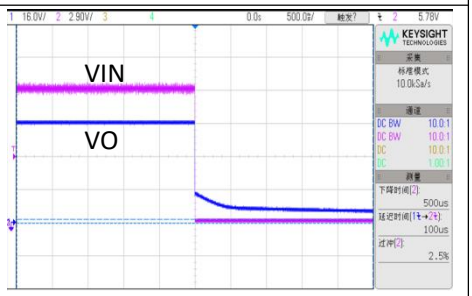
VIN=36V，满载关机波形



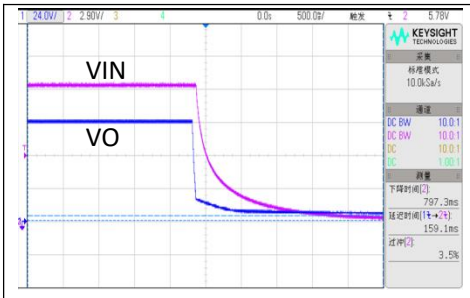
VIN=48V，空载关机波形



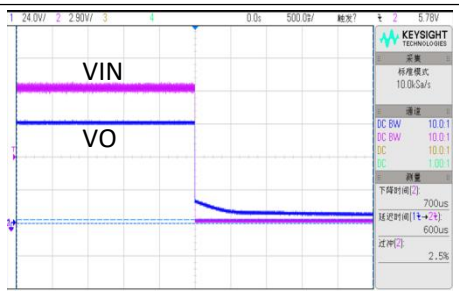
VIN=48V，半载关机波形



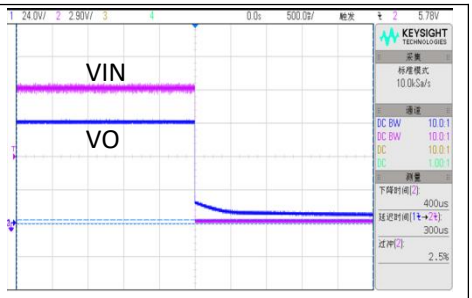
VIN=48V，满载关机波形



VIN=72V，空载关机波形

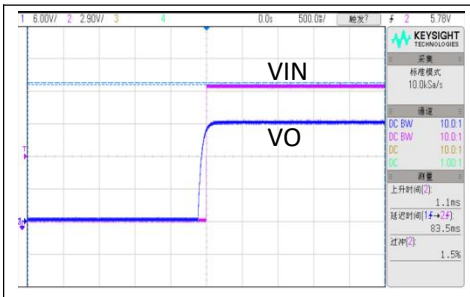


VIN=72V，半载关机波形

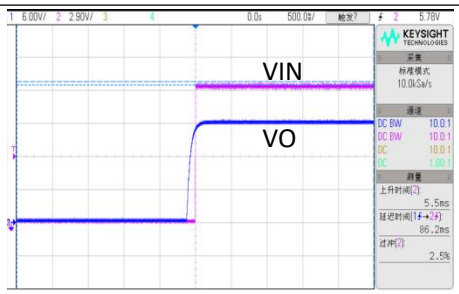


VIN=72V，满载关机波形

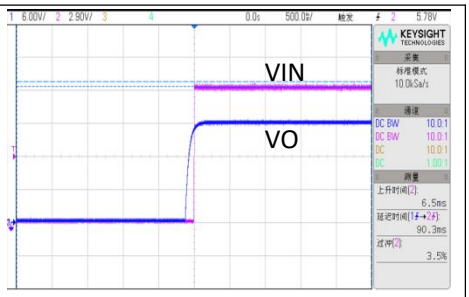
开关机波形（高温 85℃-程控开关）



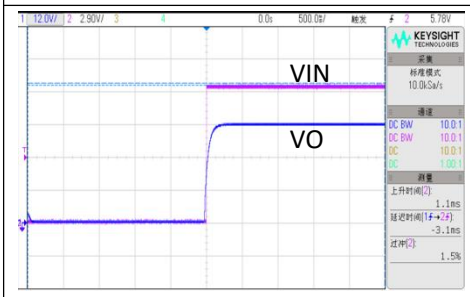
VIN=18V，空载启机波形



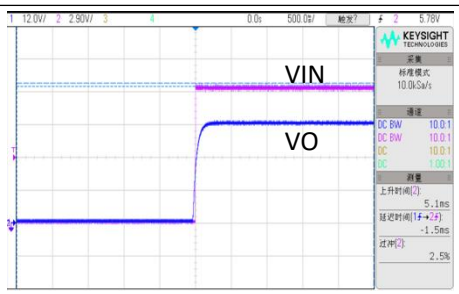
VIN=18V，半载启机波形



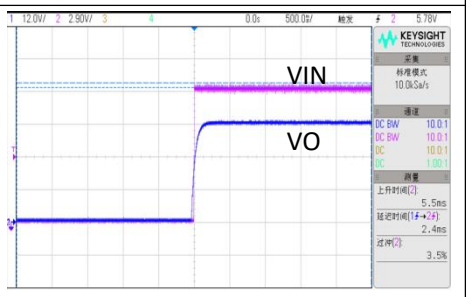
VIN=18V，满载启机波形



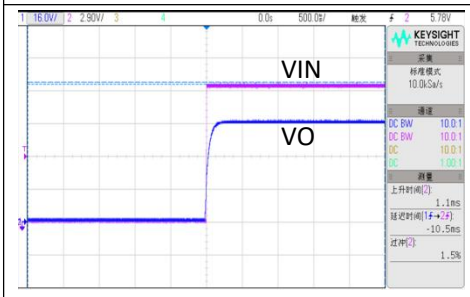
VIN=36V，空载启机波形



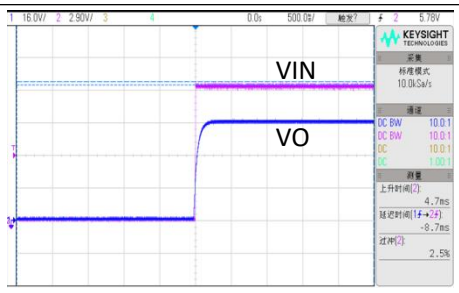
VIN=36V，半载启机波形



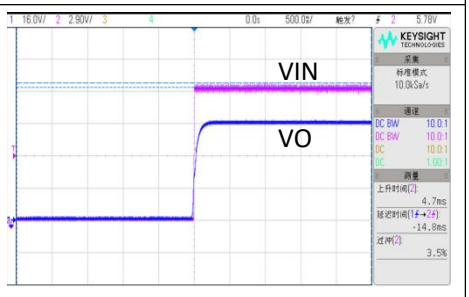
VIN=36V，满载启机波形



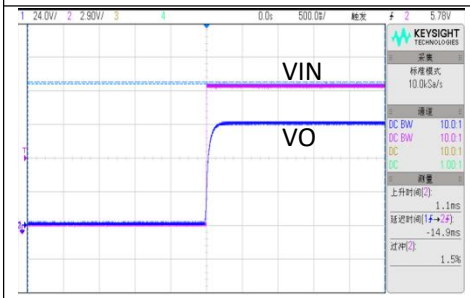
VIN=48V，空载启机波形



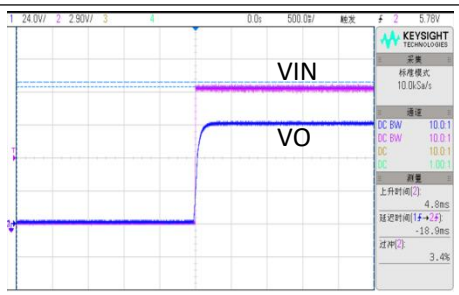
VIN=48V，半载启机波形



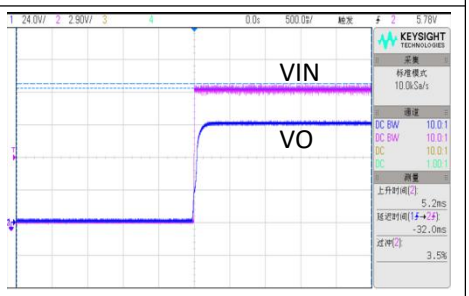
VIN=48V，满载启机波形



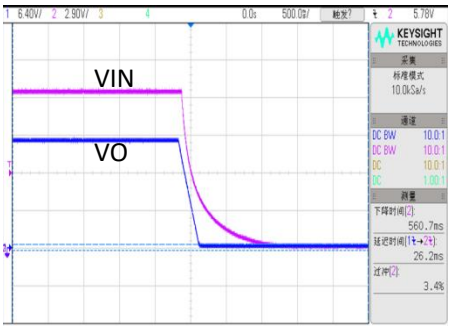
VIN=72V，空载启机波形



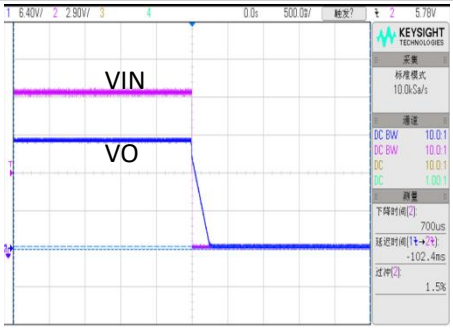
VIN=72V，半载启机波形



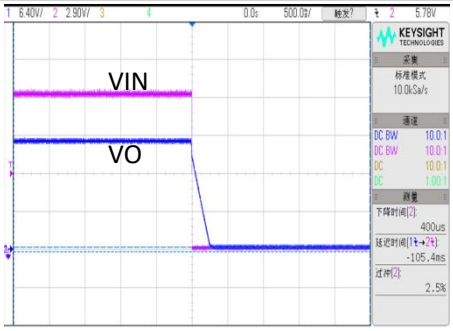
VIN=72V，满载启机波形



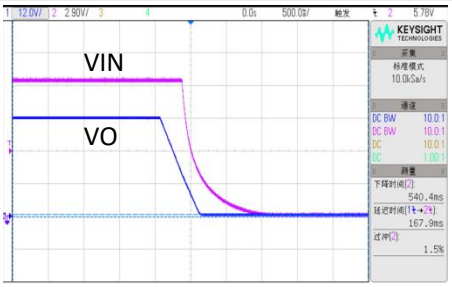
VIN=18V，空载关机波形



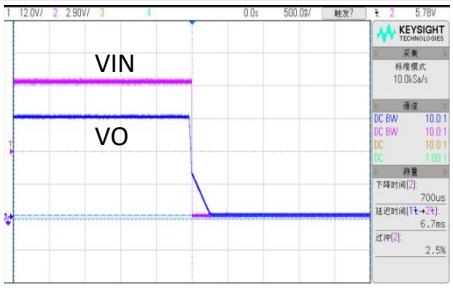
VIN=18V，半载关机波形



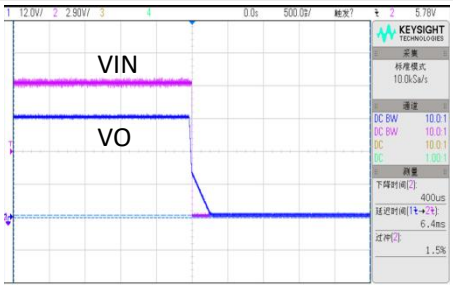
VIN=18V，满载关机波形



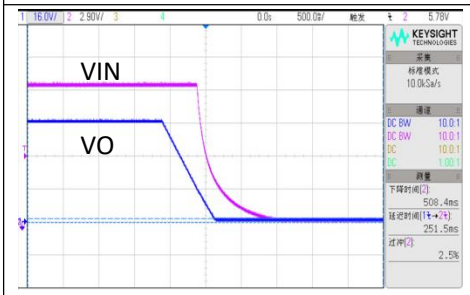
VIN=36V，空载关机波形



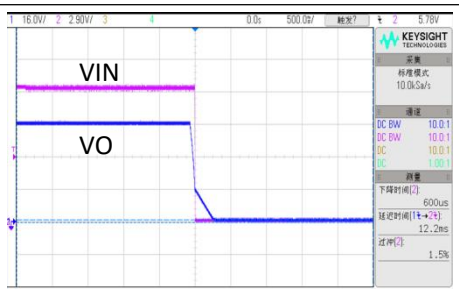
VIN=36V，半载关机波形



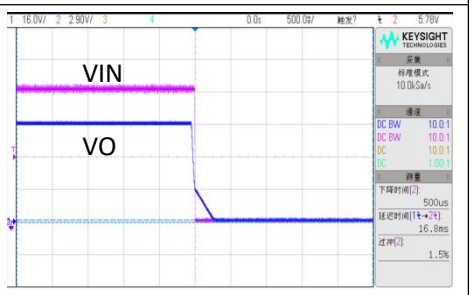
VIN=36V，满载关机波形



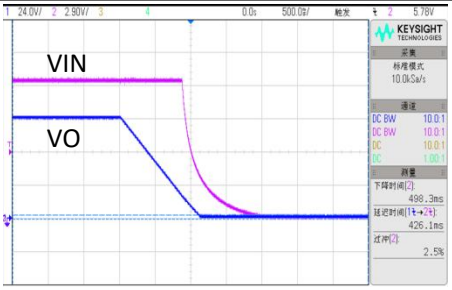
VIN=48V，空载关机波形



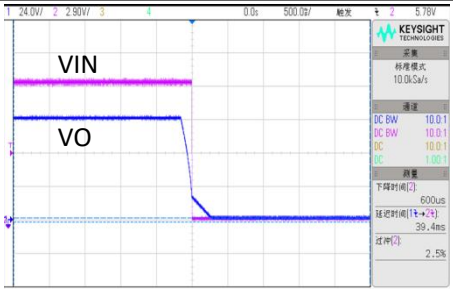
VIN=48V，半载关机波形



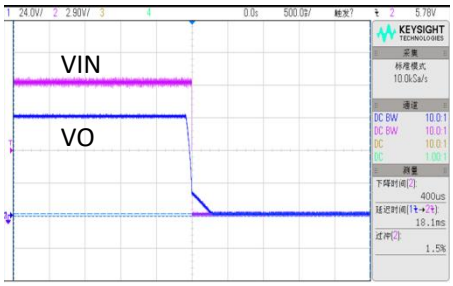
VIN=48V，满载关机波形



VIN=72V，空载关机波形

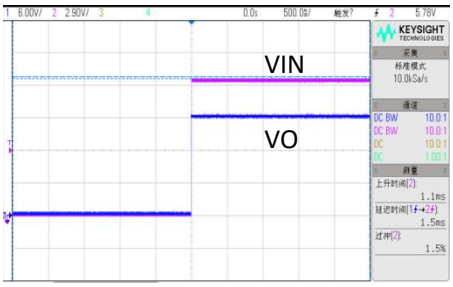


VIN=72V，半载关机波形

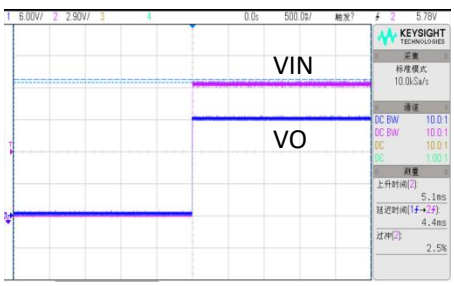


VIN=72V，满载关机波形

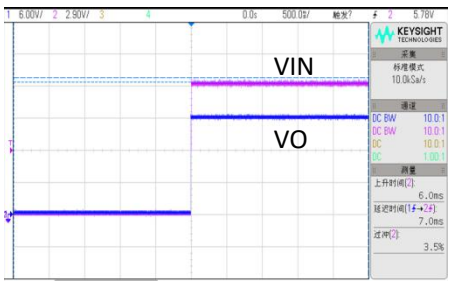
开关机波形（高温 85℃-空气开关）



VIN=18V，空载启机波形



VIN=18V，半载启机波形



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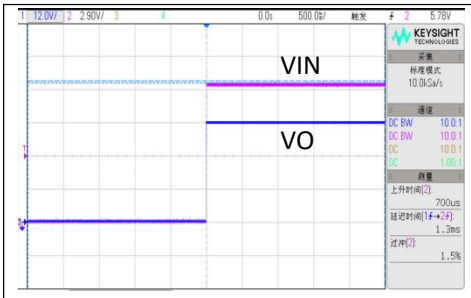
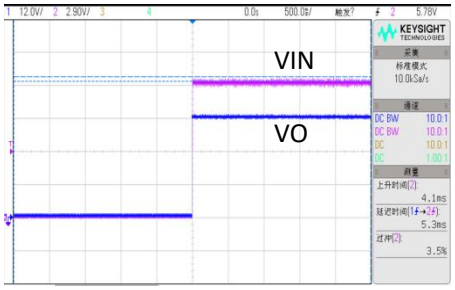
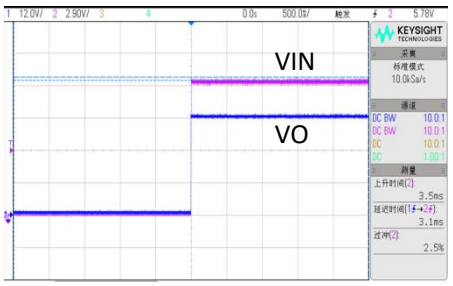


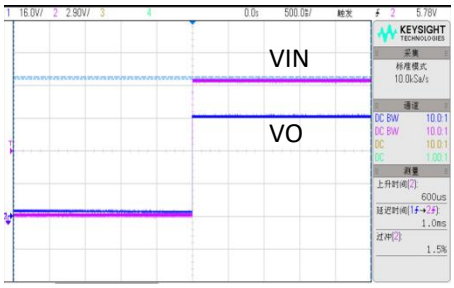
VIN=36V，空载启机波形



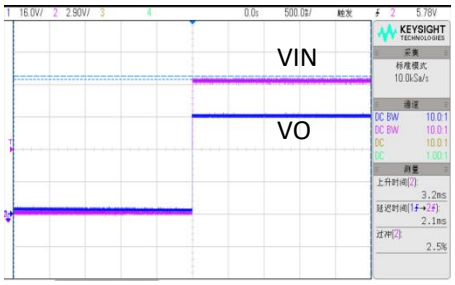
VIN=36V，半载启机波形



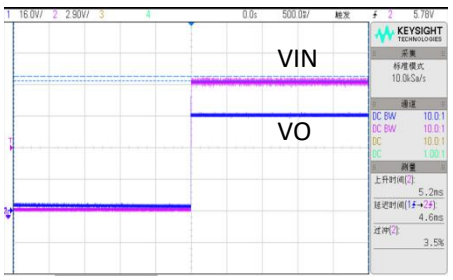
VIN=36V，满载启机波形



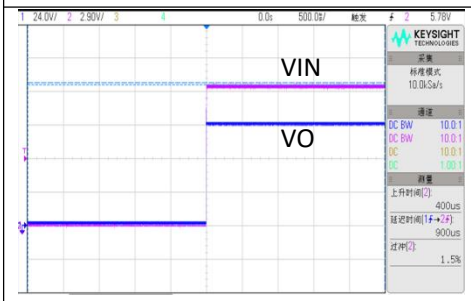
VIN=48V，空载启机波形



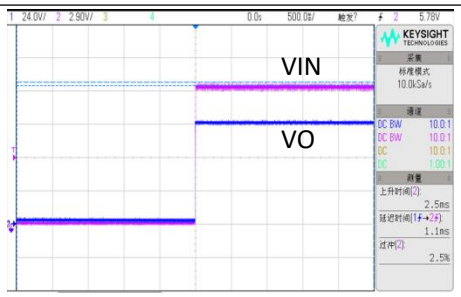
VIN=48V，半载启机波形



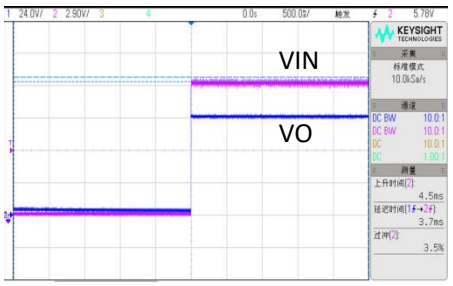
VIN=48V，满载启机波形



VIN=72V，空载启机波形



VIN=72V，半载启机波形



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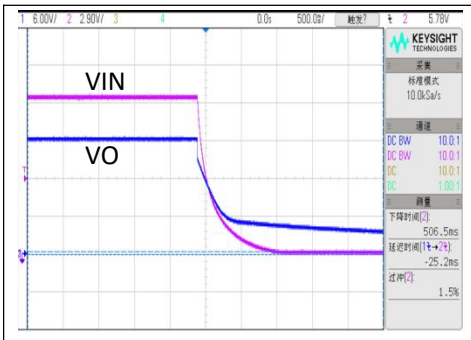
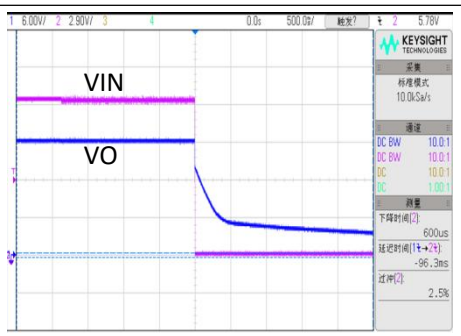
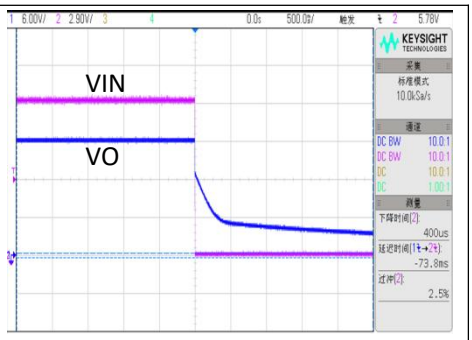


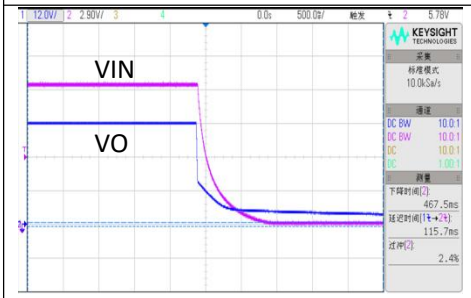
VIN=18V，空载关机波形



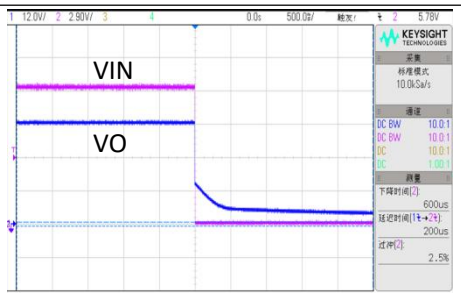
VIN=18V，半载关机波形



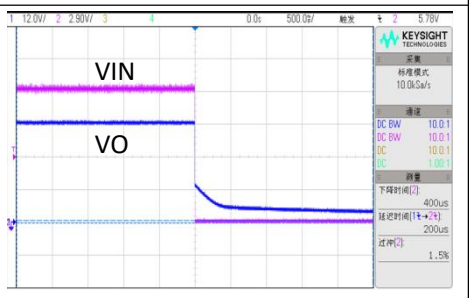
VIN=18V，满载关机波形



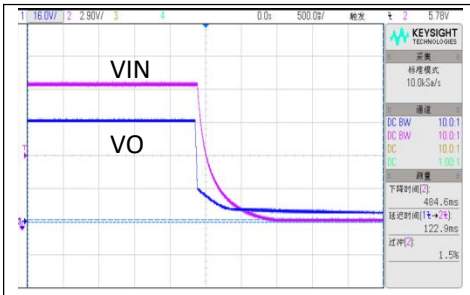
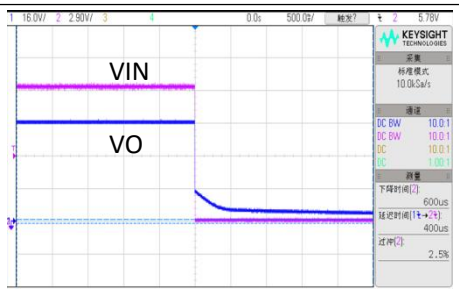
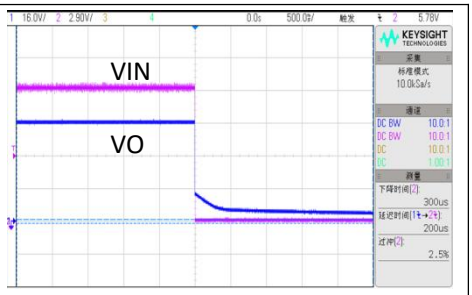
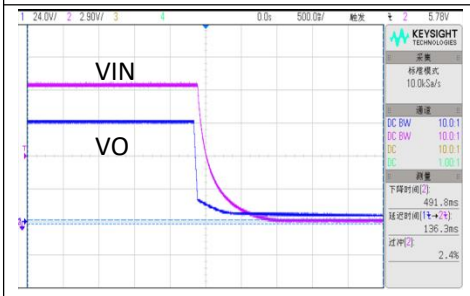
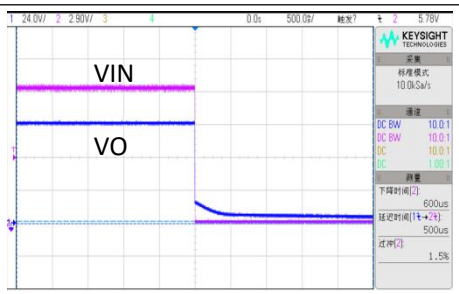
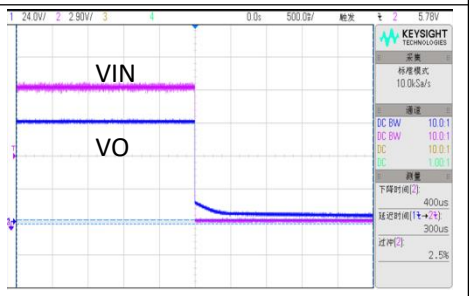
VIN=36V，空载关机波形



VIN=36V，半载关机波形



VIN=36V，满载关机波形

		
VIN=48V，空载关机波形	VIN=48V，半载关机波形	VIN=48V，满载关机波形
		
VIN=72V，空载关机波形	VIN=72V，半载关机波形	VIN=72V，满载关机波形

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