

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 VPE17QE-15A、输出整流二极管以及必要的阻容元件，实现 18V-72V 输入，15V 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。

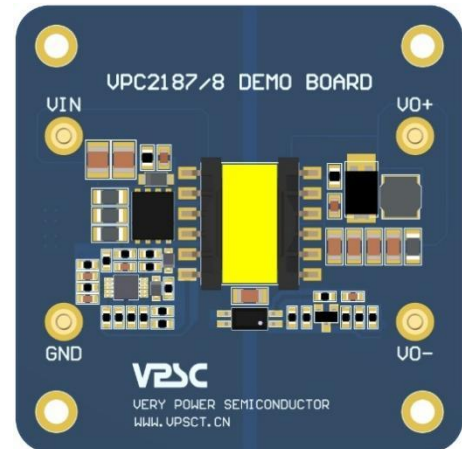
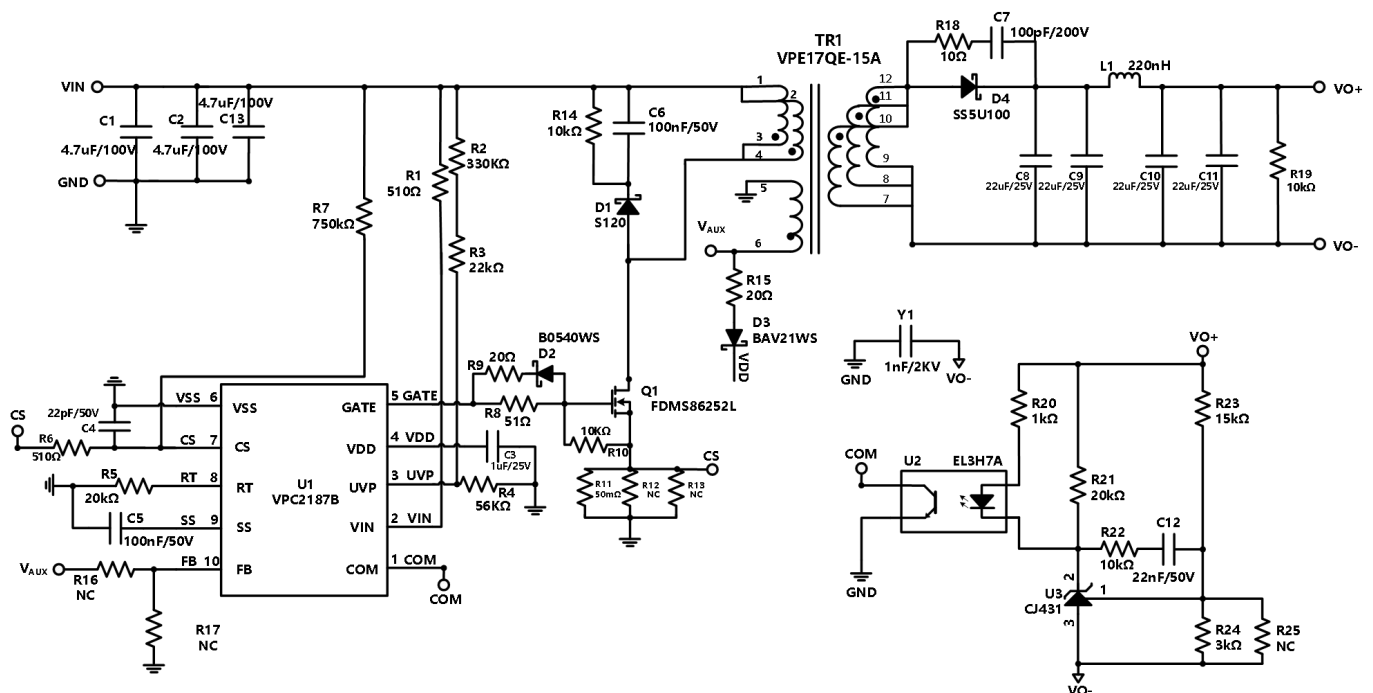


图 1: VPC2187 Demo 板(尺寸:55mm*55mm)

关键词：输入：18V-72V，输出 15V/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

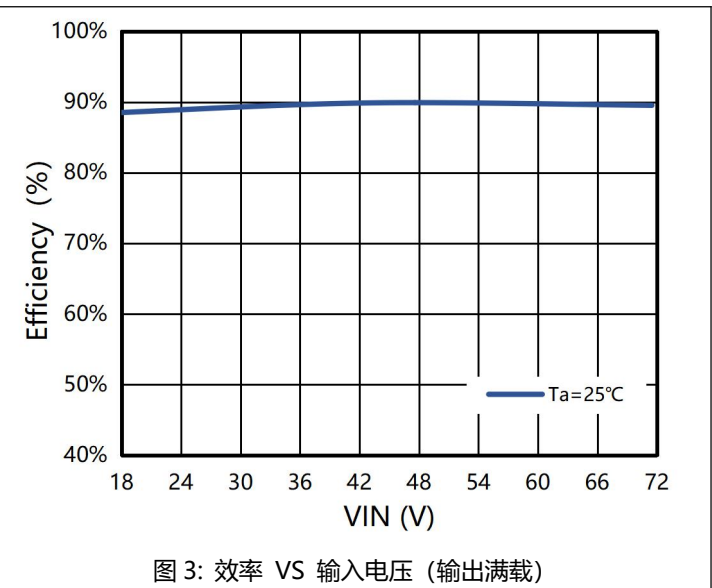
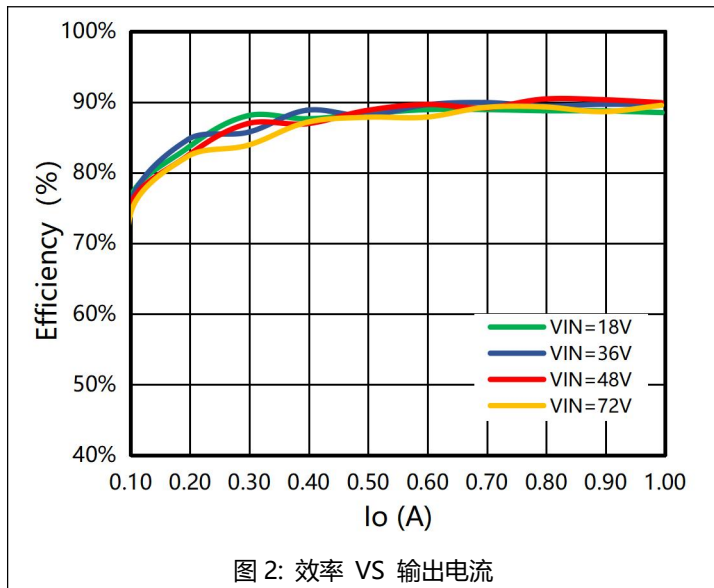
位号	参数	封装	型号	品牌
C1	4.7uF/100V-X5R	1210	1210X475K101NT	FH(风华)
C2	4.7uF/100V-X5R	1210	1210X475K101NT	FH(风华)
C3	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C4	22pF/50V-NP0	0603	CC0603JRNPO9BN220	YAGEO
C5	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C6	100nF/50V-X7R	0805	CC0805KKX7R0BB104	YAGEO
C7	100pF/200V- NP0	0805	CC0805JRNPOABN101	YAGEO
C8	22uF/25V-X5R	1206	CC1206KKX5R8BB226	YAGEO
C9	22uF/25V-X5R	1206	CC1206KKX5R8BB226	YAGEO
C10	22uF/25V-X5R	1206	CC1206KKX5R8BB226	YAGEO
C11	22uF/25V-X5R	1206	CC1206KKX5R8BB226	YAGEO
C12	22nF/50V-X7R	0603	CC0603KRX7R9BB223	YAGEO
C13	4.7uF/100V-X5R	1210	1210X475K101NT	FH(风华)
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R2	330kΩ±1%	0603	RC0603FR-07330KL	YAGEO
R3	22kΩ±1%	0603	RC0603FR-0722KL	YAGEO
R4	56kΩ±1%	0603	RC0603FR-0756KL	YAGEO
R5	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R6	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R7	750kΩ±1%	0603	RC0603FR-07750KL	YAGEO
R8	51Ω±1%	0603	RC0603FR-0751RL	YAGEO
R9	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R10	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R11	0.05Ω ±1%	1206	RL1206FR-070R05L	YAGEO
R12	NC	-	-	-
R13	NC	-	-	-
R14	10KΩ±1%	0805	AC0805FR-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	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R21	20kΩ±1%	0603	RC0603FR-0720KL	YAGEO
R22	10kΩ±1%	0603	RC0603FR-0710KL	YAGEO
R23	15kΩ±1%	0603	RC0603FR-0715KL	YAGEO
R24	3kΩ±1%	0603	RC0603FR-073KL	YAGEO
R25	NC	-	-	-
TR1	NP:NS:NA=14:8:7	ER14.5	VPE17QE-15A	VPSC

	Lp=27.44uH			
Q1	N 沟道 150V 12A	Power-56-8	FDMS86252L	onsemi
L1	220nH ±20%	SMD(5x5x2mm)	SWPA5020SR22MT	SUNLORD
D1	200V/1A	SOD-123	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	CJ
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	100V /5A	TO-277	SS5U100	YANGJIE
U1	4-100VIN 电源管理芯片	MSOP-10	VPC2187B	VPSC
U2	CTR=80~160, Viso=3750VAC	SSOP-4	EL3H7A	EVERLIGHT
U3	Vref=2.495V	SOT-23	CJ431	CJ

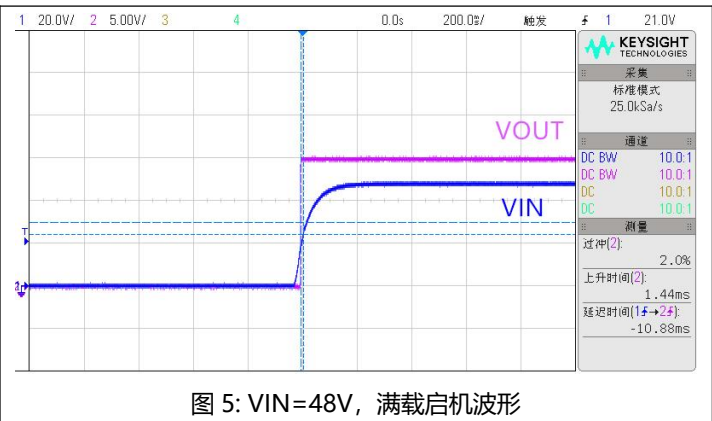
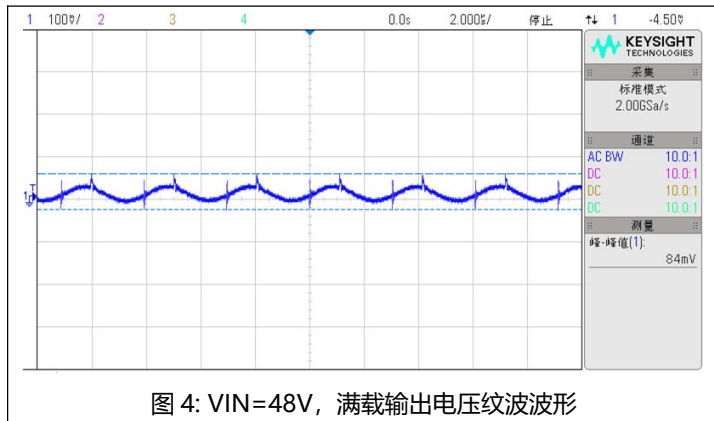
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流（满载/空载）	VIN=48V	4	---	347	mA
转换效率	VIN=48V, IO=1A	---	89.91	---	%
纹波&噪声	VIN=48V, IO=1A	---	84	114	mV
输出电压精度	VIN=48V, IO=1A	---	1	---	%
线性调节率	VIN=18V-72V, IO=1A	---	0.5	---	%
负载调整率	VIN=48V, IO=1A	---	0.5	---	%
输入欠压保护	锁定电压	---	14.8	---	V
	恢复电压	---	16.1	---	V
短路保护	VIN=18V-72V	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

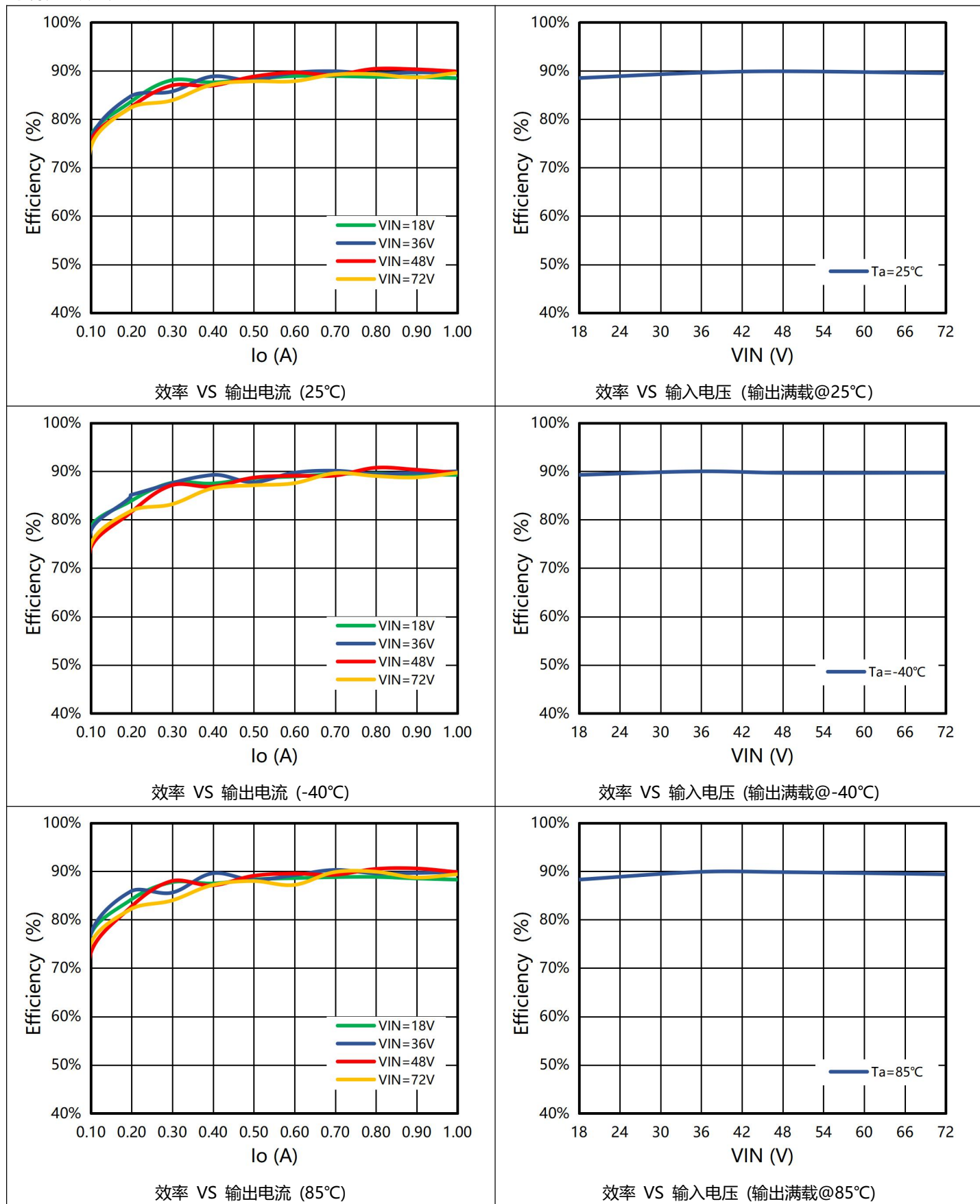


相关波形



详细测试数据

高低温测试曲线



VIN=48V, Ta=25°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
47.6	0.004	14.94	0	0%	0.00%
47.7	0.041	14.94	0.098	10%	74.86%
47.6	0.075	14.94	0.197	20%	82.44%
47.7	0.107	14.94	0.297	30%	86.94%
47.6	0.143	14.94	0.396	40%	86.92%
47.7	0.175	14.94	0.496	50%	88.77%
47.6	0.209	14.94	0.597	60%	89.65%
47.6	0.245	14.94	0.696	70%	89.16%
47.6	0.276	14.94	0.795	80%	90.41%
47.6	0.311	14.94	0.895	90%	90.32%
47.6	0.347	14.94	0.994	100%	89.91%

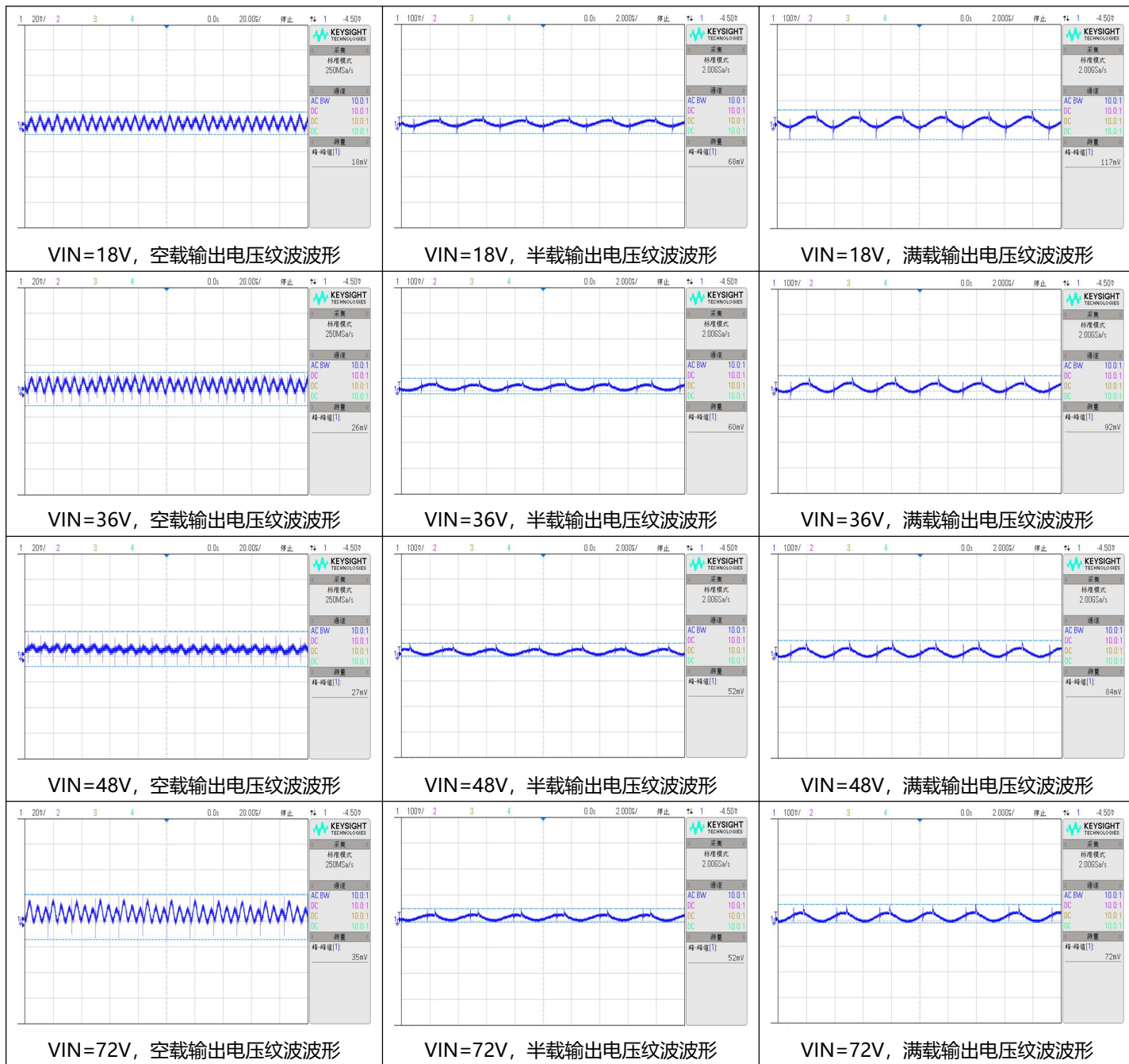
VIN=48V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
47.9	0.004	14.85	0	0%	0.00%
47.9	0.041	14.85	0.097	10%	73.35%
47.9	0.075	14.85	0.197	20%	81.43%
47.9	0.106	14.84	0.298	30%	87.10%
47.9	0.142	14.84	0.398	40%	86.83%
47.9	0.174	14.84	0.498	50%	88.67%
47.9	0.208	14.84	0.598	60%	89.07%
47.9	0.243	14.84	0.699	70%	89.12%
47.9	0.273	14.85	0.799	80%	90.74%
47.9	0.308	14.84	0.898	90%	90.33%
47.9	0.345	14.85	0.998	100%	89.68%

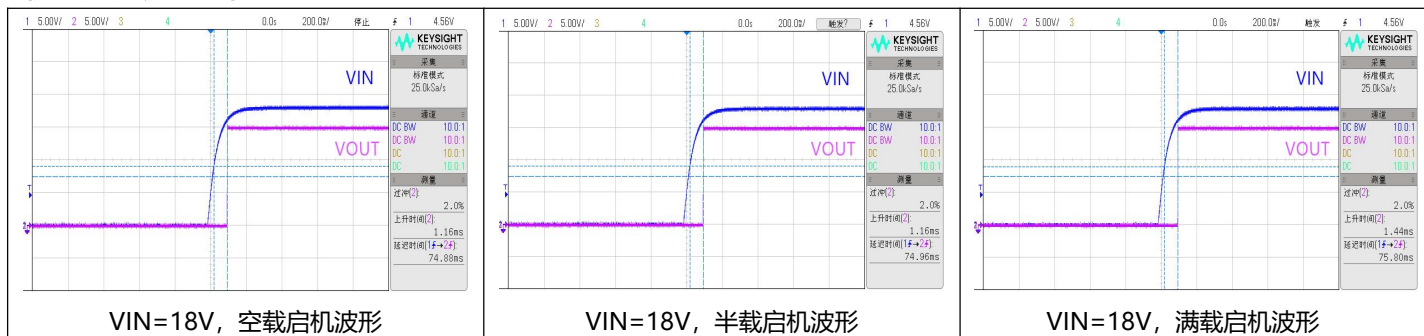
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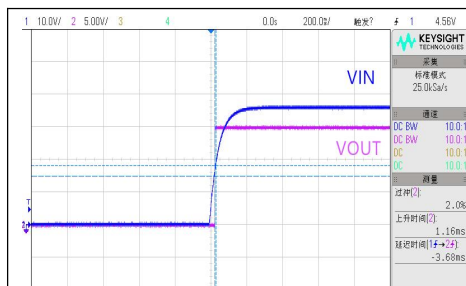
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
47.9	0.005	14.99	0	0%	0.00%
47.9	0.042	14.99	0.097	10%	72.28%
47.9	0.075	14.99	0.198	20%	82.62%
47.9	0.106	14.99	0.298	30%	87.98%
47.9	0.143	14.99	0.398	40%	87.10%
47.9	0.175	14.99	0.498	50%	89.05%
47.9	0.209	14.99	0.598	60%	89.54%
47.9	0.245	14.99	0.699	70%	89.28%
47.9	0.276	14.99	0.798	80%	90.48%
47.9	0.310	14.98	0.898	90%	90.59%
47.9	0.348	14.99	0.999	100%	89.84%

输出电压纹波波形

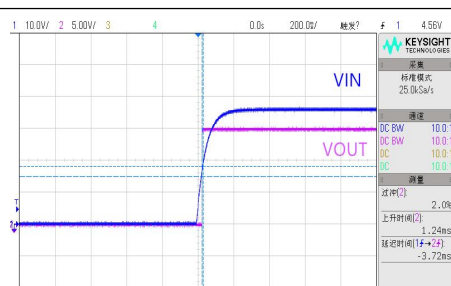


软开关机波形 (常温)

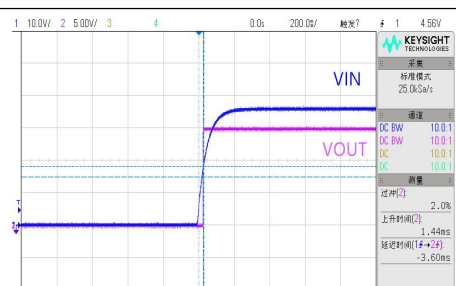




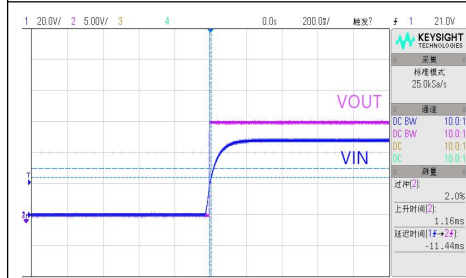
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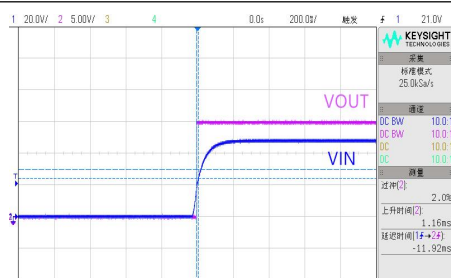
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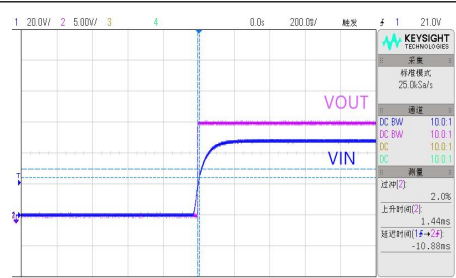
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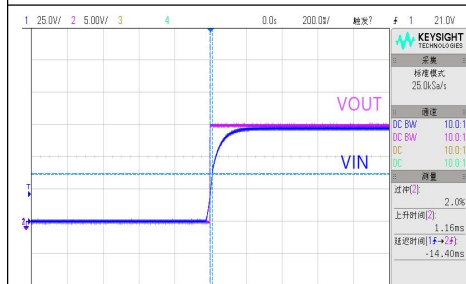
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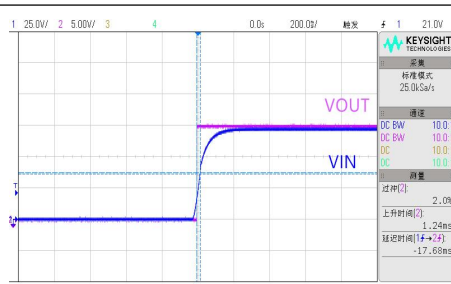
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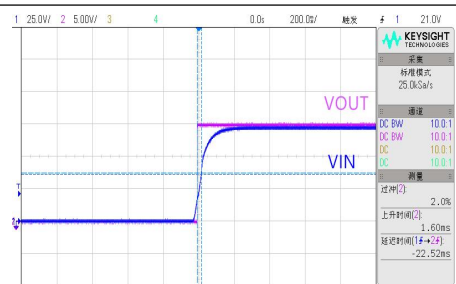
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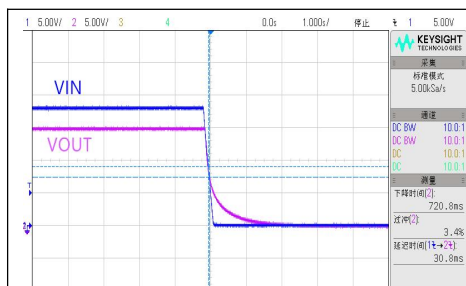
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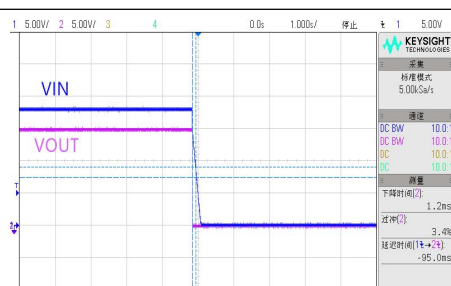
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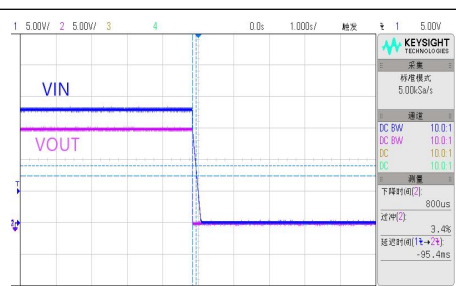
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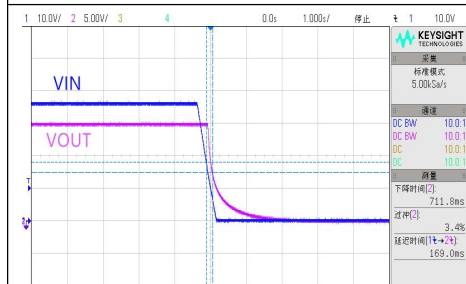
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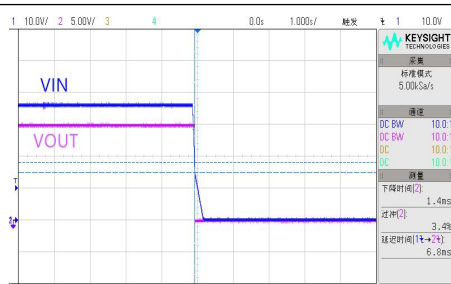
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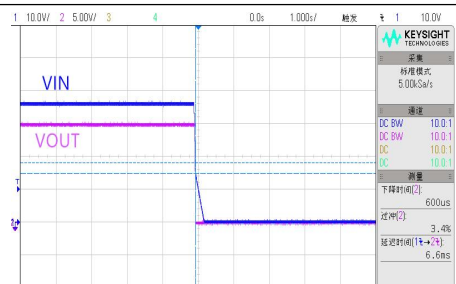
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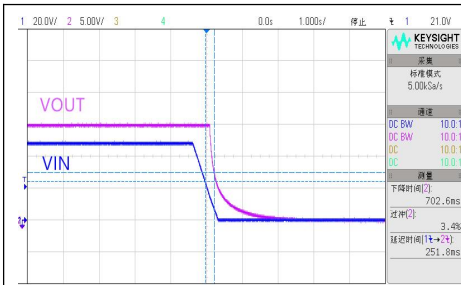
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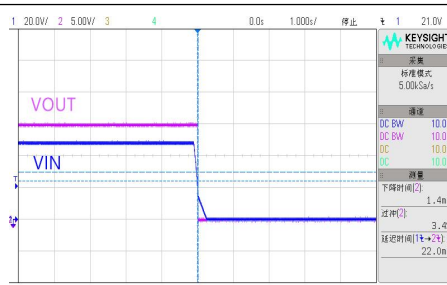
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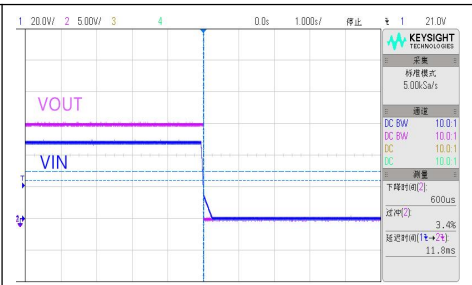
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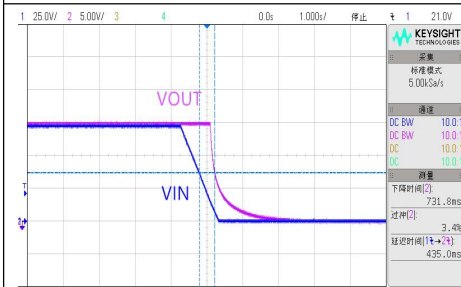
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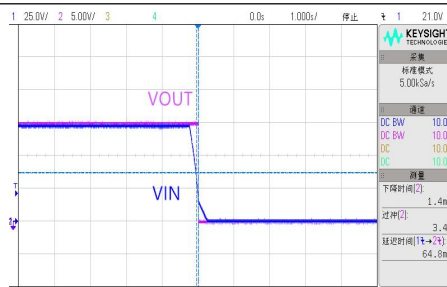
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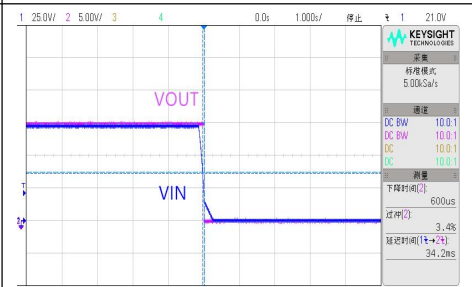
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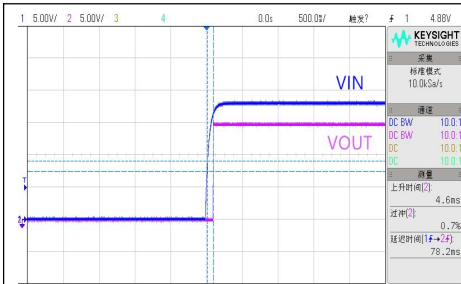


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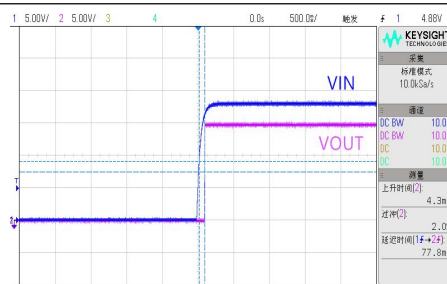


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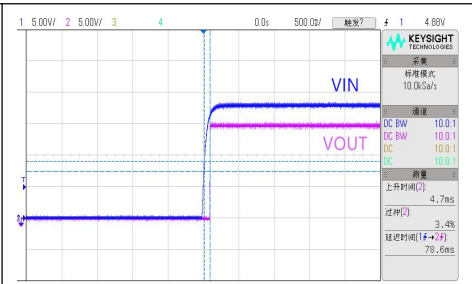
软开关机波形（低温-40℃）



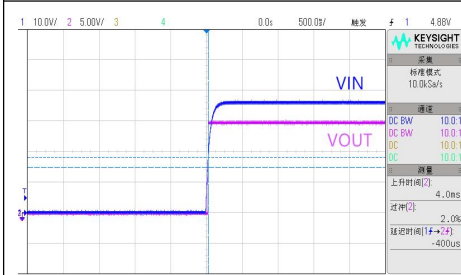
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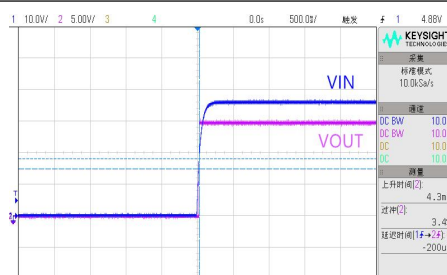
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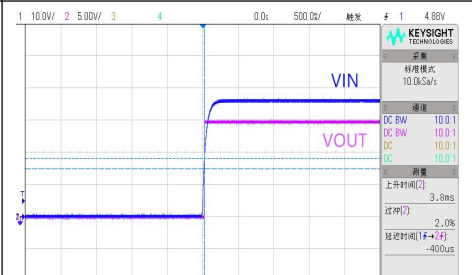
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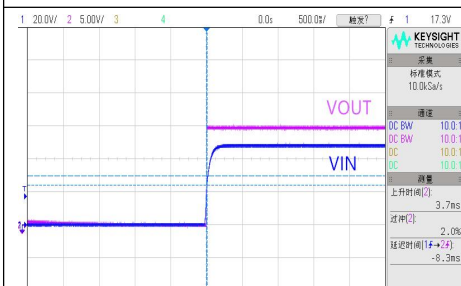
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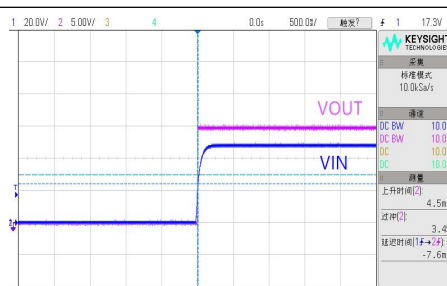
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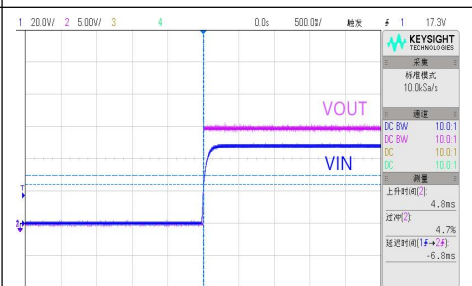
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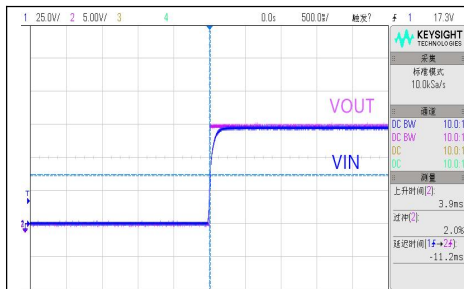
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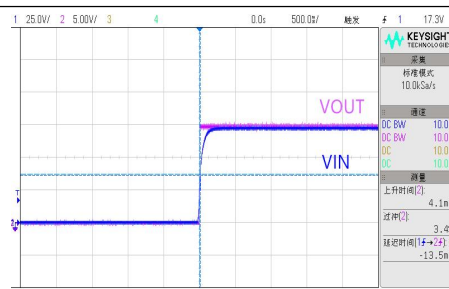
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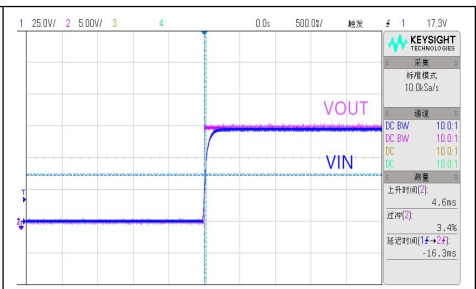
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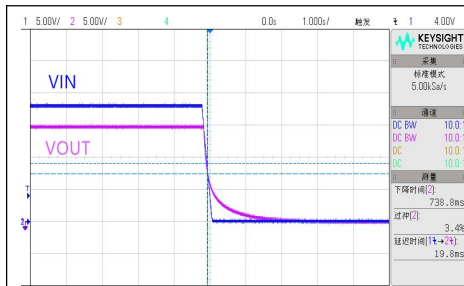
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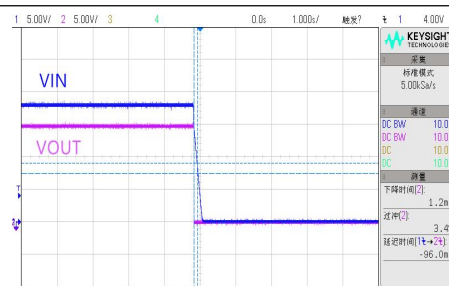
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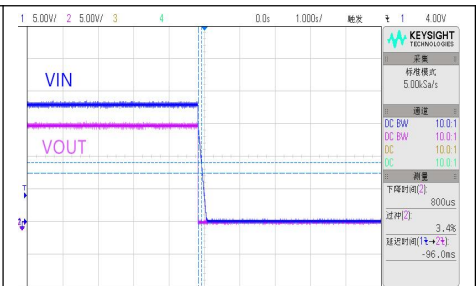
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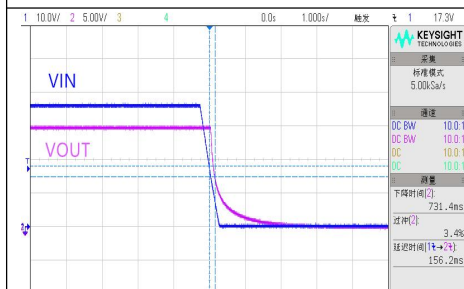
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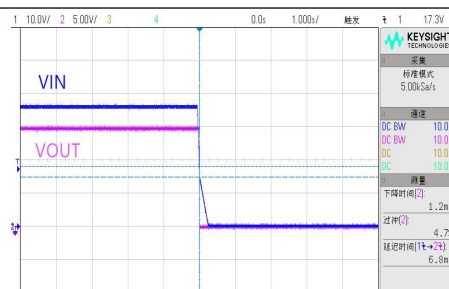
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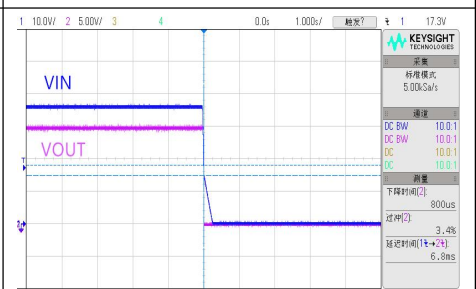
VIN=18V, 满载关机波形



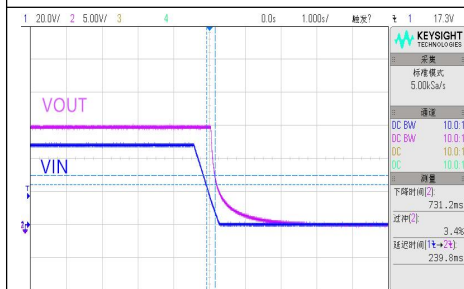
VIN=36V, 空载关机波形



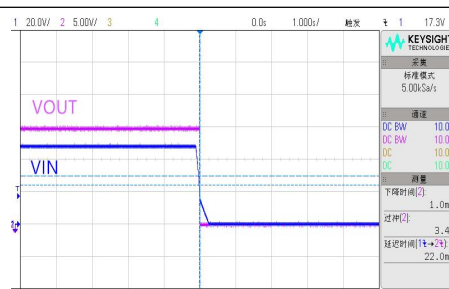
VIN=36V, 半载关机波形



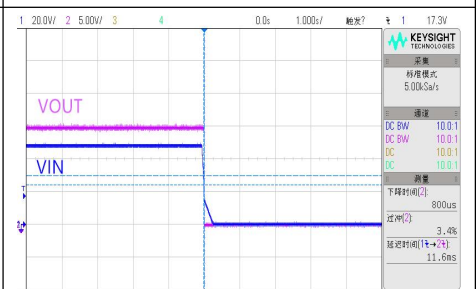
VIN=36V, 满载关机波形



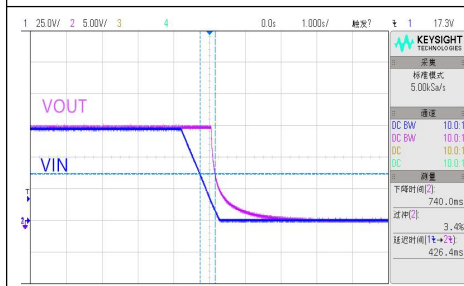
VIN=48V, 空载关机波形



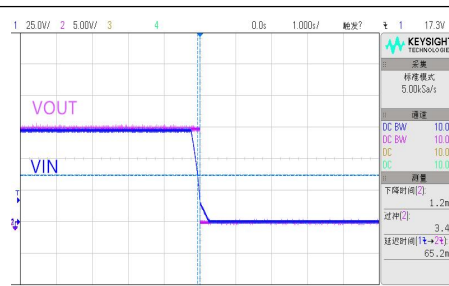
VIN=48V, 半载关机波形



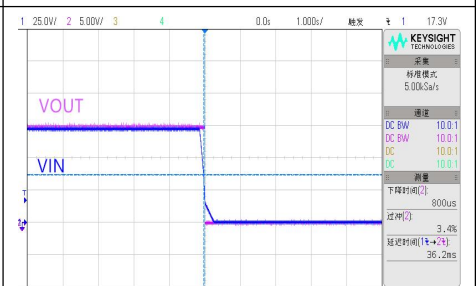
VIN=48V, 满载关机波形



VIN=72V, 空载关机波形

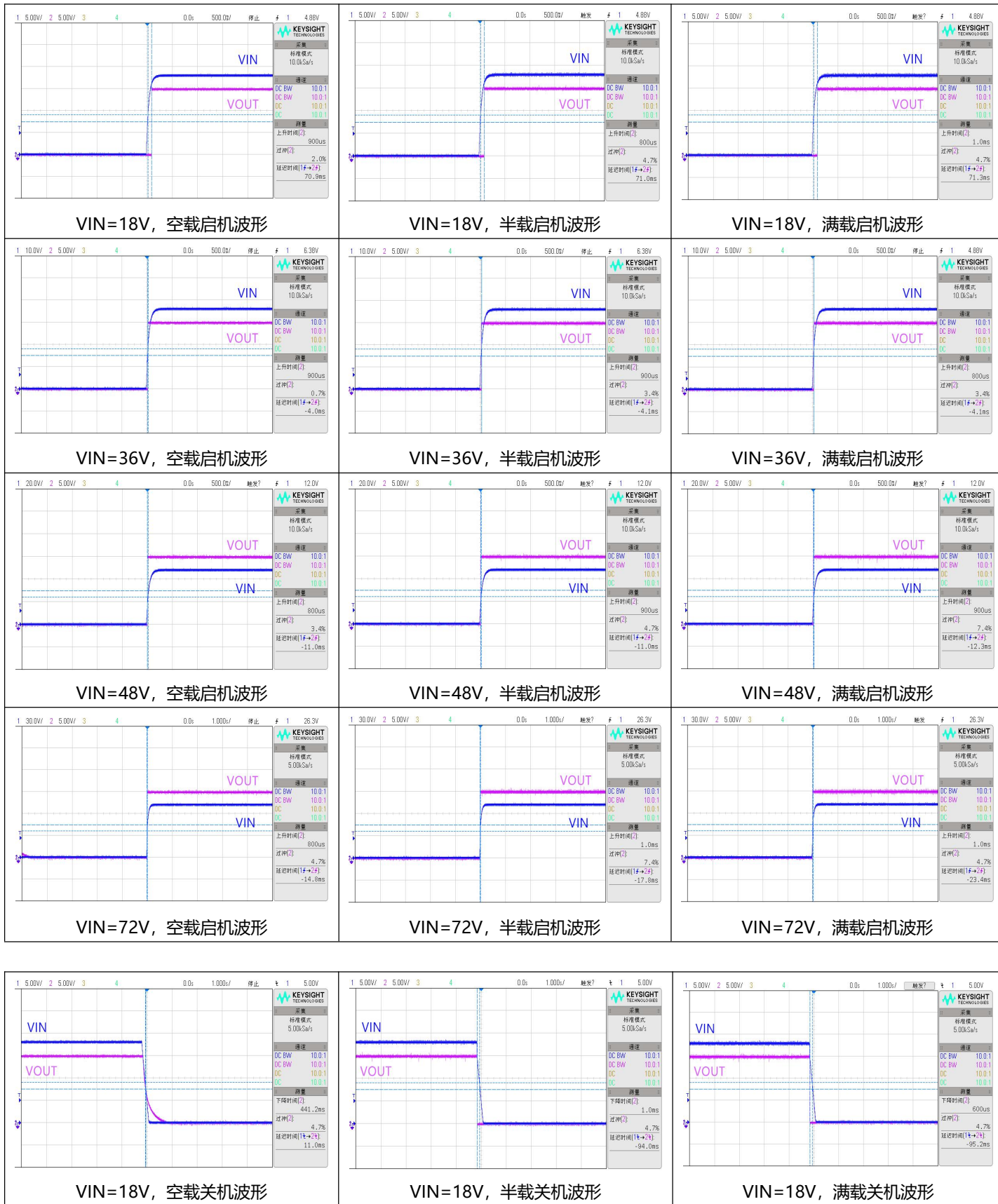


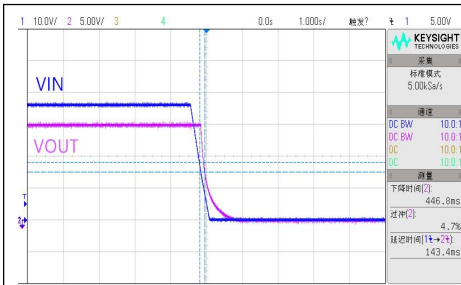
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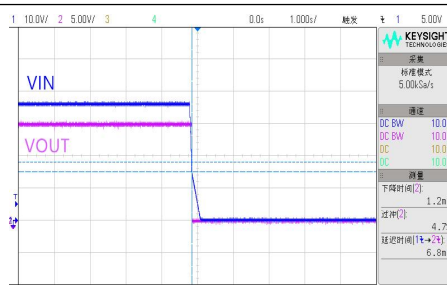
VIN=72V, 满载关机波形

软开关机波形（高温 85℃）

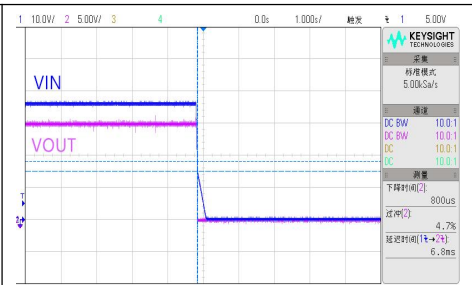




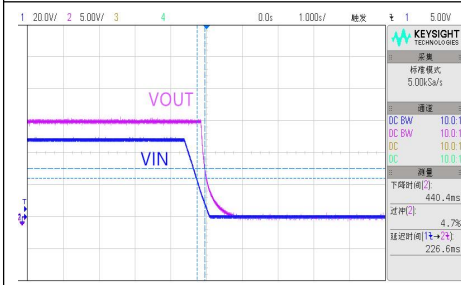
VIN=36V, 空载关机波形



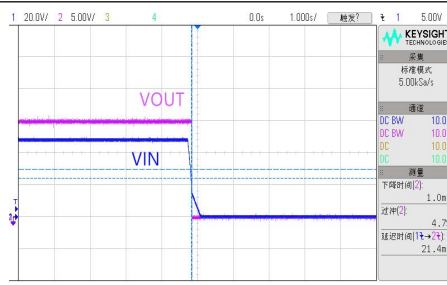
VIN=36V, 半载关机波形



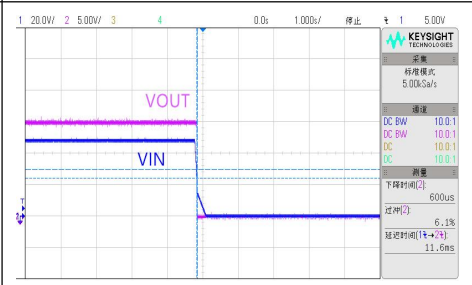
VIN=36V, 满载关机波形



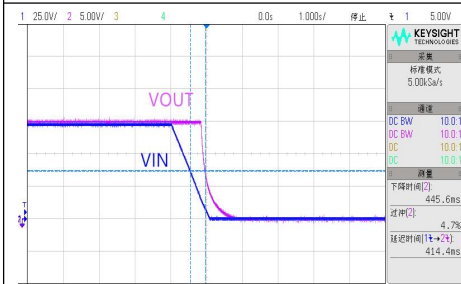
VIN=48V, 空载关机波形



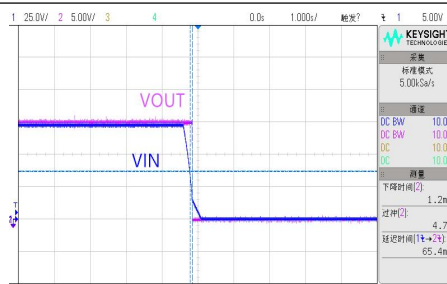
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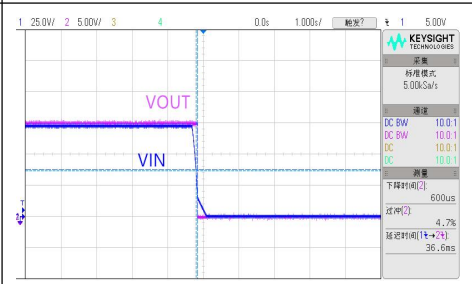
VIN=48V, 满载关机波形



VIN=72V, 空载关机波形

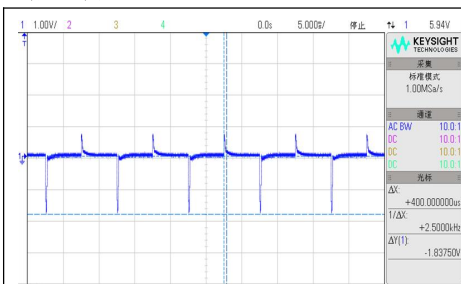


VIN=72V, 半载关机波形

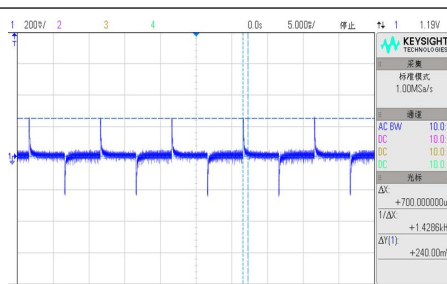


VIN=72V, 满载关机波形

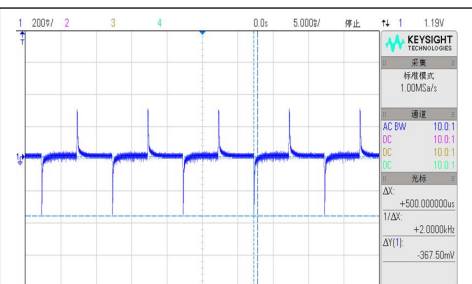
动态波形



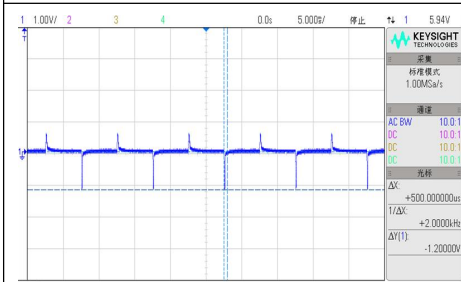
VIN=18V, 100%-10%-100%Io 动态波形



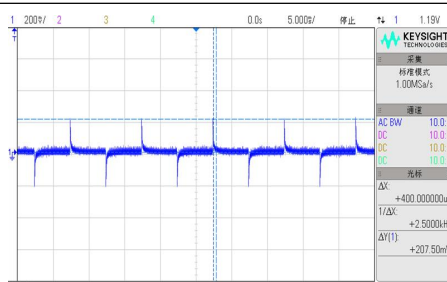
VIN=18V, 75%-50%-75%Io 动态波形



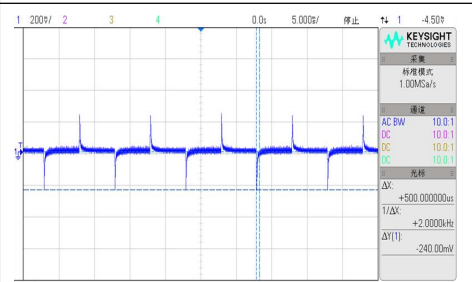
VIN=18V, 50%-25%-50%Io 动态波形



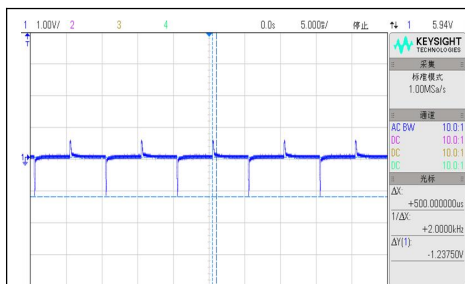
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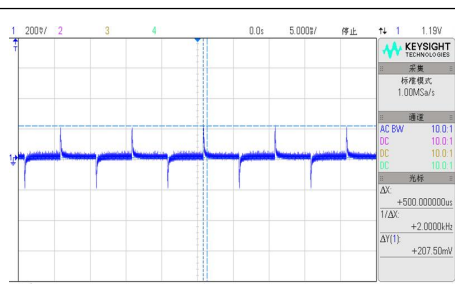
VIN=36V, 75%-50%-75%Io 动态波形



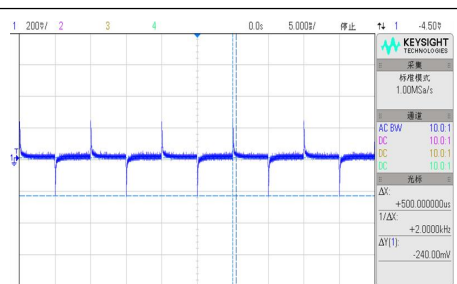
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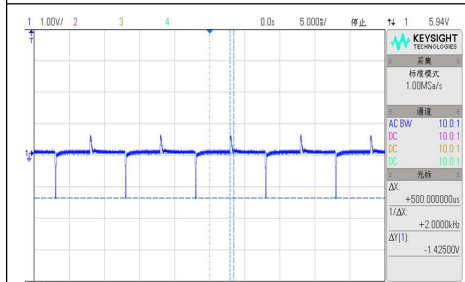
VIN=48V, 100%-10%-100%Io 动态波形



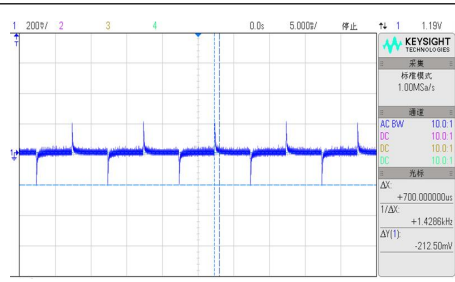
VIN=48V, 75%-50%-75%Io 动态波形



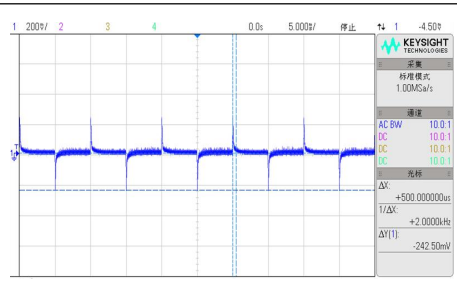
VIN=48V, 50%-25%-50%Io 动态波形



VIN=72V, 100%-10%-100%Io 动态波形

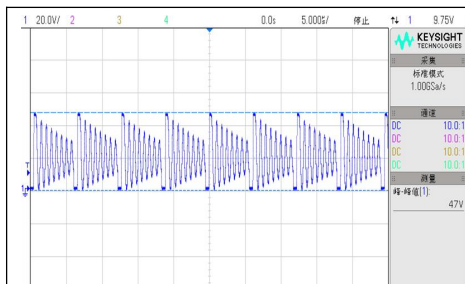


VIN=72V, 75%-50%-75%Io 动态波形

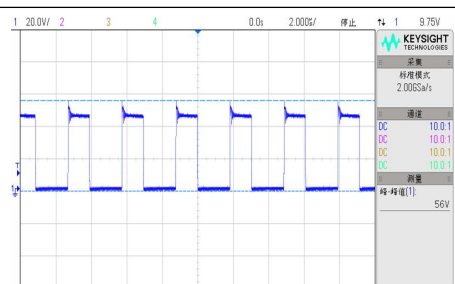


VIN=72V, 50%-25%-50%Io 动态波形

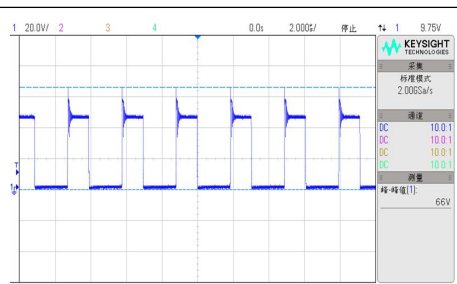
外置 MOS 管 Q1 电压应力波形



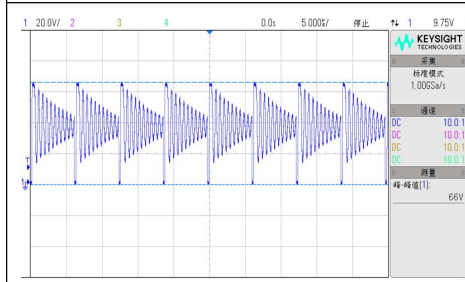
VIN=18V, 空载 VDS 波形



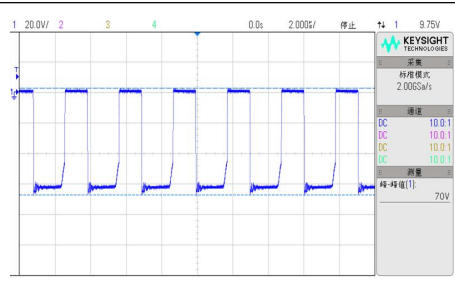
VIN=18V, 半载 VDS 波形



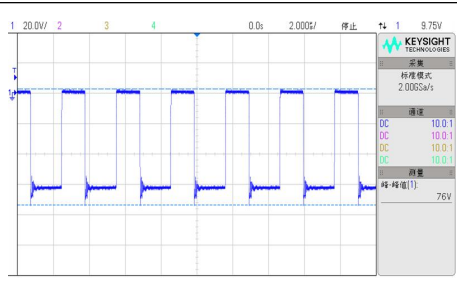
VIN=18V, 满载 VDS 波形



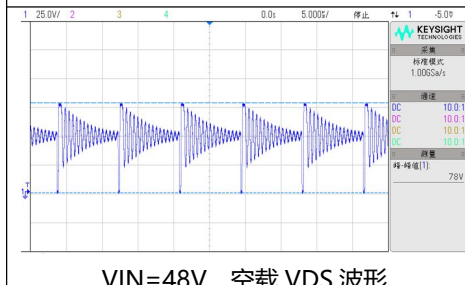
VIN=36V, 空载 VDS 波形



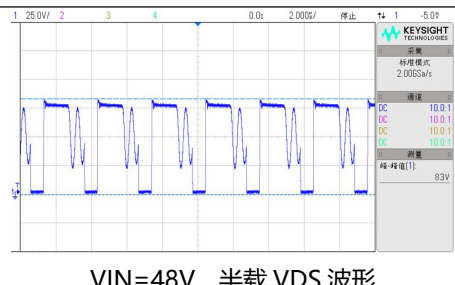
VIN=36V, 半载 VDS 波形



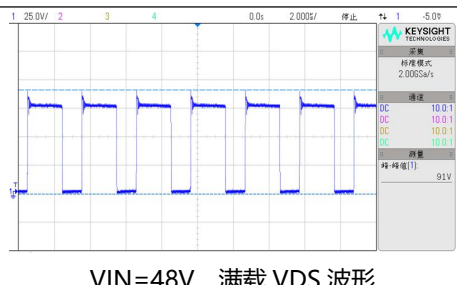
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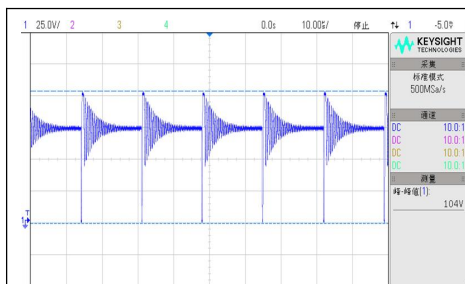
VIN=48V, 空载 VDS 波形



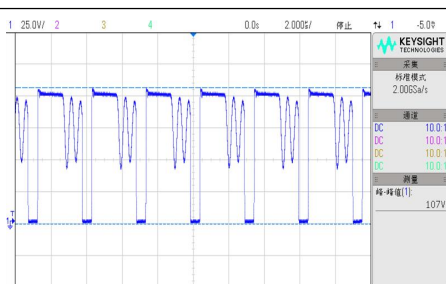
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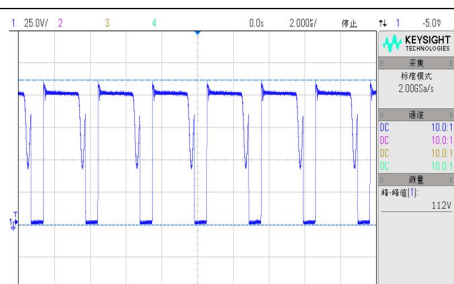
VIN=48V, 满载 VDS 波形



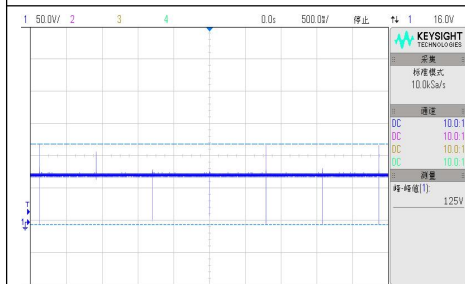
VIN=72V, 空载 VDS 波形



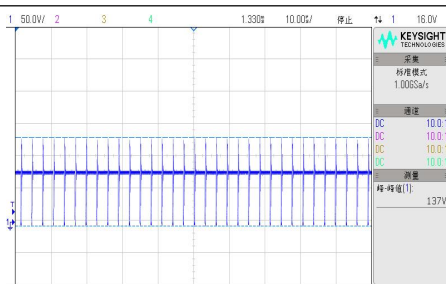
VIN=72V, 半载 VDS 波形



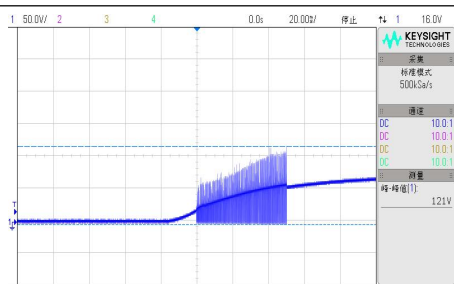
VIN=72V, 满载 VDS 波形



VIN=72V, VDS 短路保护工作电压波形

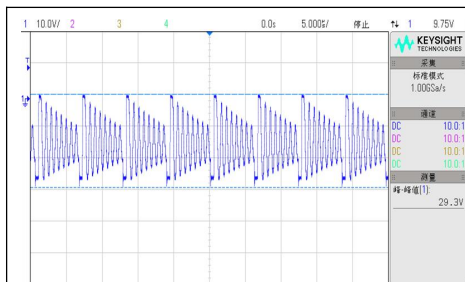


VIN=72V, VDS 短路保护工作电压展开形

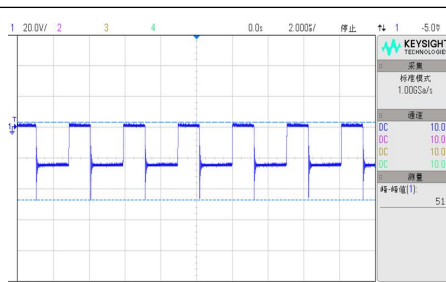


VIN=72V, VDS 短路保护工作启机波形

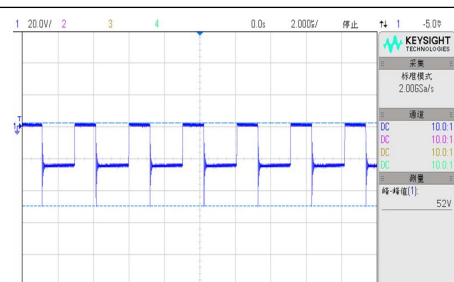
副边输出整流二极管 D4 应力波形



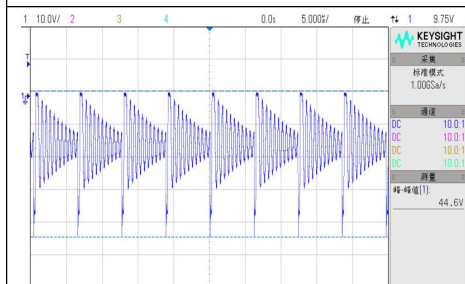
VIN=18V, D4 空载工作电压波形



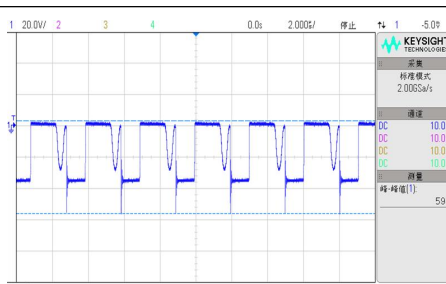
VIN=18V, D4 半载工作电压波形



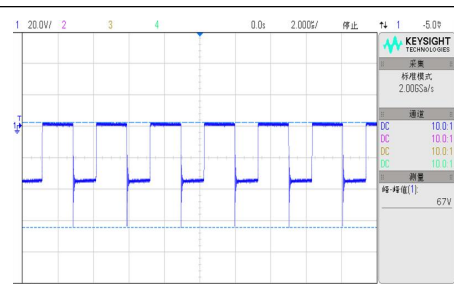
VIN=18V, D4 满载工作电压波形



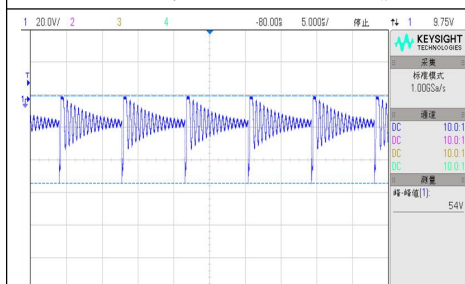
VIN=36V, D4 空载工作电压波形



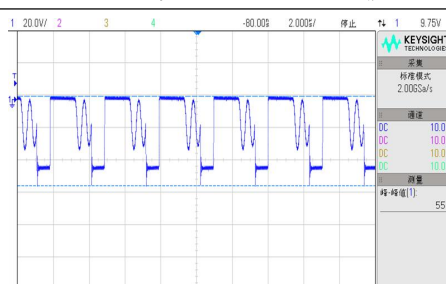
VIN=36V, D4 半载工作电压波形



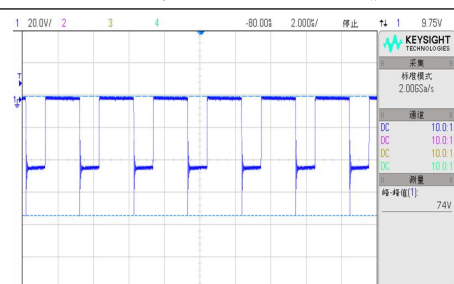
VIN=36V, D4 满载工作电压波形



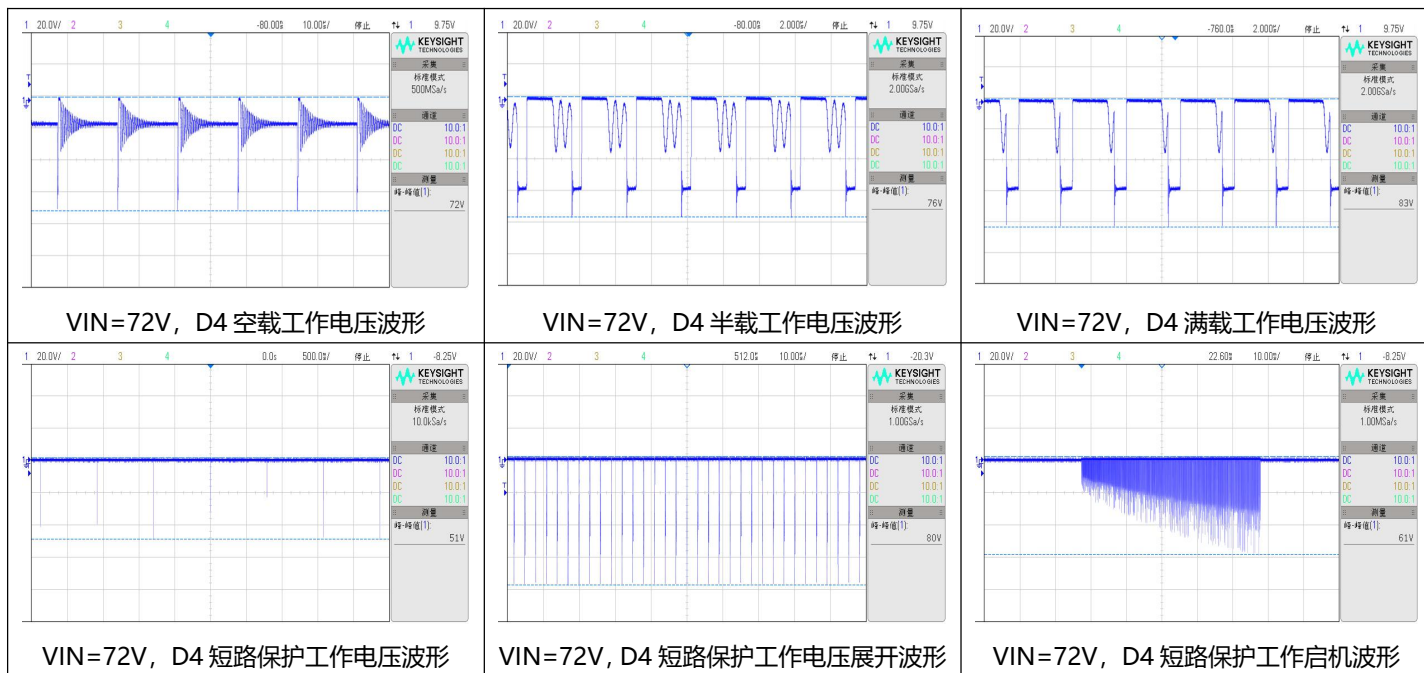
VIN=48V, D4 空载工作电压波形



VIN=48V, D4 半载工作电压波形



VIN=48V, D4 满载工作电压波形



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