

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 VPE17PE-15A、输出整流二极管以及必要的阻容元件，实现 9V-36V 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。

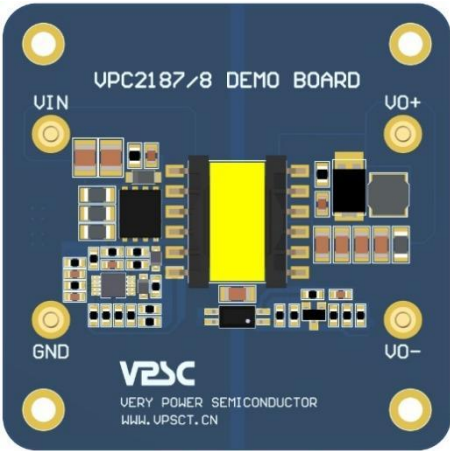
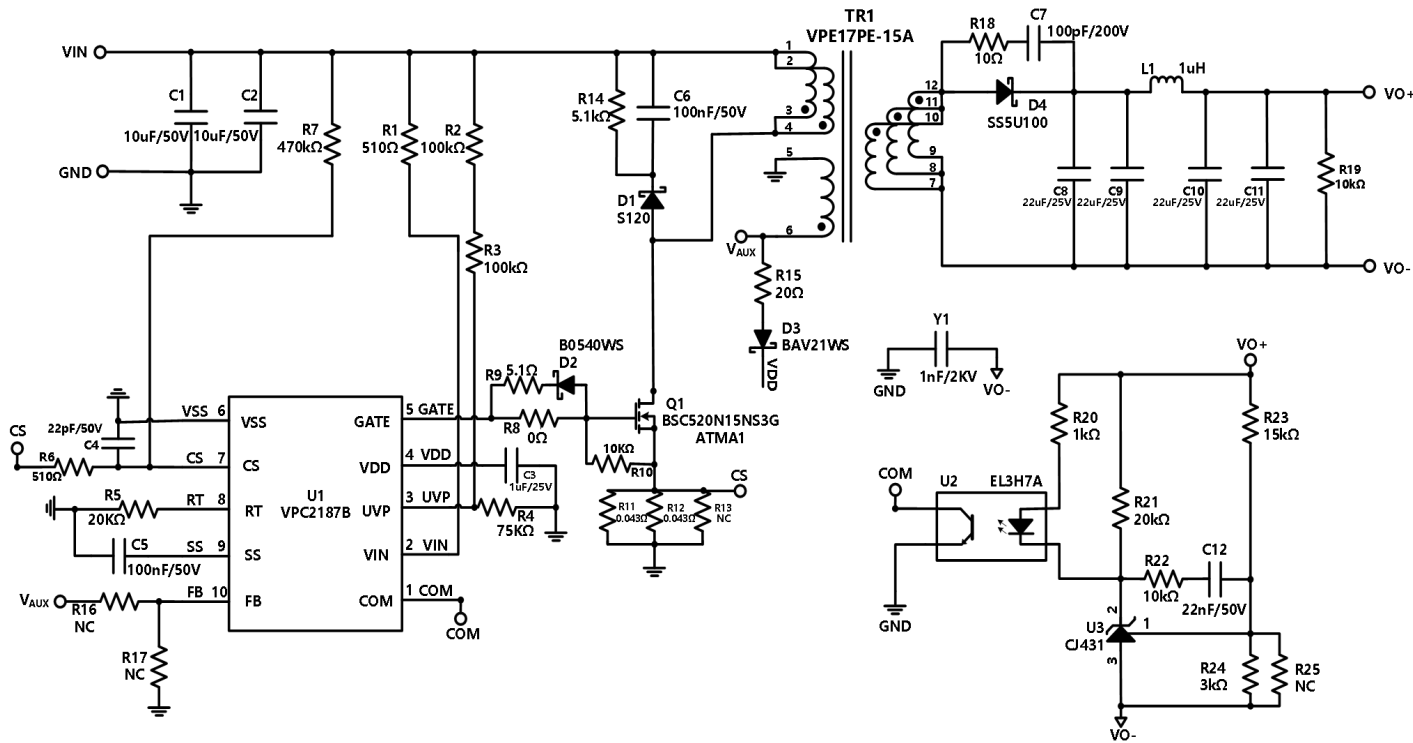


图 1: VPC2187 Demo 板(尺寸:55mm*55mm)

关键词：输入：9V-36V，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

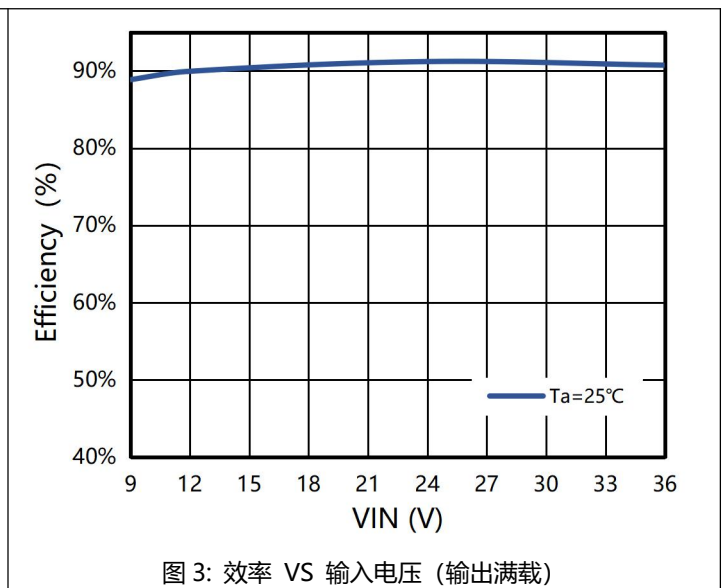
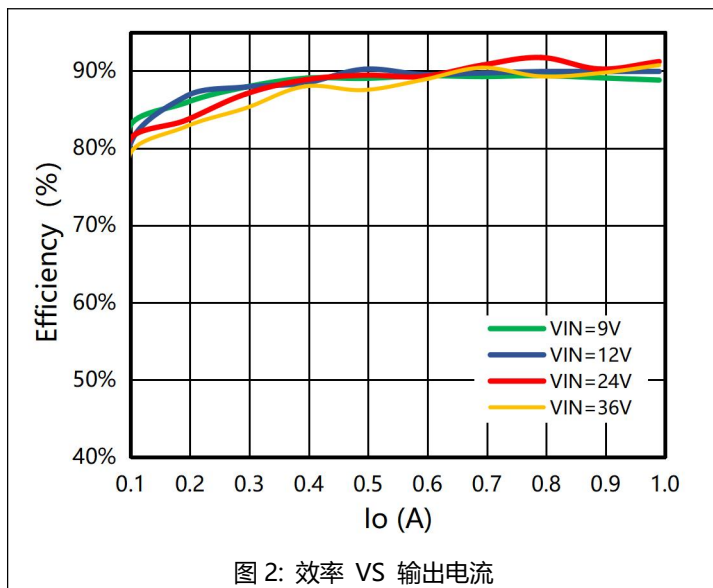
位号	参数	封装	型号	品牌
C1	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C2	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C3	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C4	22pF/50V- NP0	0603	CC0603KRNPO9BN220	YAGEO
C5	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C6	100nF/50V-X7R	0805	CC0805KKX7R0BB104	YAGEO
C7	100pF/200V- 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
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R2	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R3	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R4	75KΩ±1%	0603	RC0603FR-0775KL	YAGEO
R5	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R6	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R7	470kΩ±1%	0603	RC0603FR-07470KL	YAGEO
R8	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R9	5.1Ω±1%	0603	RC0603FR-075K1L	YAGEO
R10	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R11	0.043Ω ±1%	1206	RL1206FR-070R043L	YAGEO
R12	0.043Ω ±1%	1206	RL1206FR-070R043L	YAGEO
R13	NC	-	-	-
R14	5.1KΩ±1%	0805	RC0805FR-075K1L	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=7:7:6 Lp=6.86uH	ER14.5	VPE17PE-15A	VPSC

Q1	N 沟道 150V 21A	TDSON-8	BSC520N15NS3GATMA1	INFINEON
L1	1uH ±20%	SMD	WPN4020H1R0MT	Sunlord(顺络)
D1	200V/1A	SOD-123	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	CJ
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	100V/5A	SMB	SS510B	YANGJIE
U1	4-100VIN 电源管理芯片	MSOP-10	VPC2187B	VPSC
U2	CTR=80~160, Viso=3750VAC	SSOP-4	EL3H7A	EVERLIGHT
U3	Vref=2.495V	SOT-23	CJ431	CJ

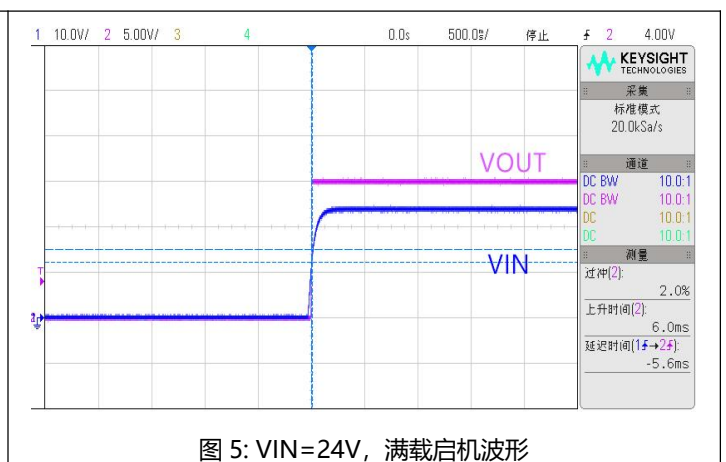
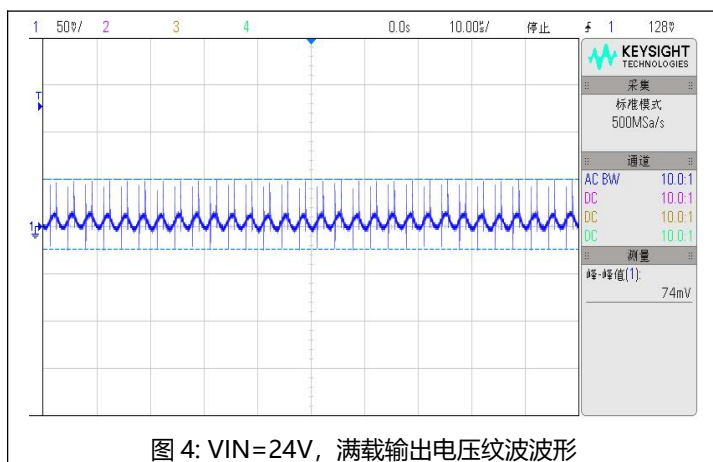
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流（满载/空载）	VIN=24V	5	---	698	mA
转换效率	VIN=24V, IO=1A	---	91.22	---	%
纹波&噪声	VIN=24V, IO=1A	---	70	110	mV
输出电压精度	VIN=24V, IO=1A	---	0.1	---	%
线性调节率	VIN=9V-36V, IO=1A	---	0.1	---	%
负载调整率	VIN=24V, IO=1A	---	-0.1	---	%
输入欠压保护	锁定电压	---	7.5	---	V
	恢复电压	---	8.1	---	V
短路保护	VIN=9V-36V	可长期保护，自恢复			
工作温度	大于 70°C需降额使用	-40	---	85	°C
绝缘电压	原边短接 VS 副边短接	1500	---	---	VDC

关键性能指标测试结果

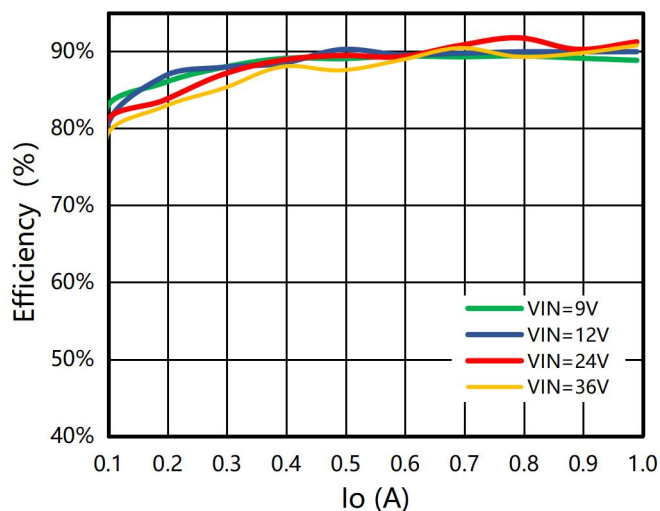


相关波形

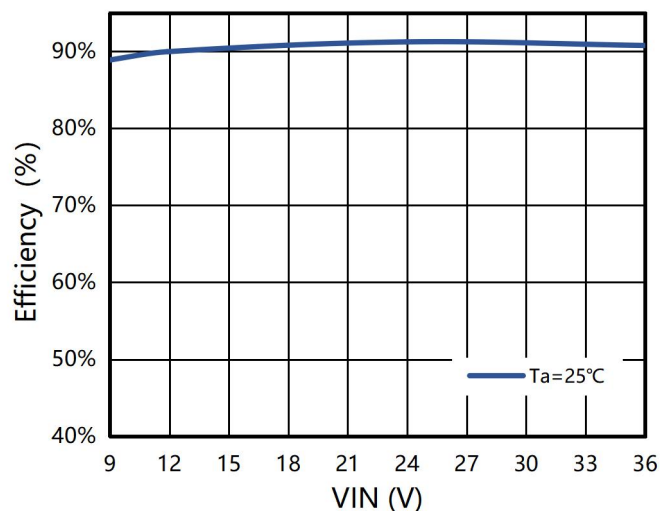


详细测试数据

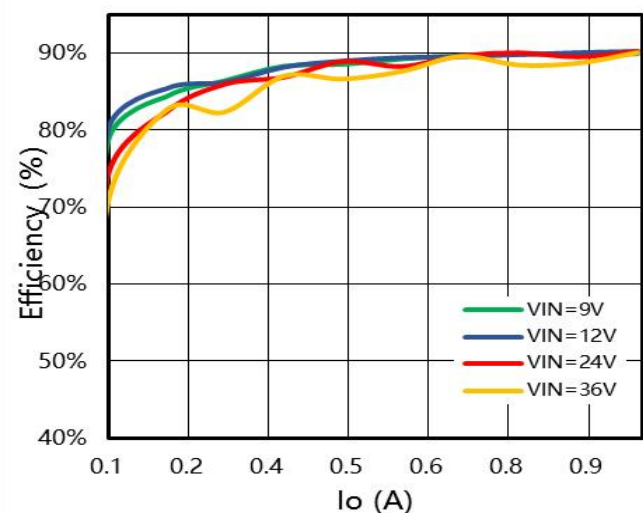
高低温测试曲线



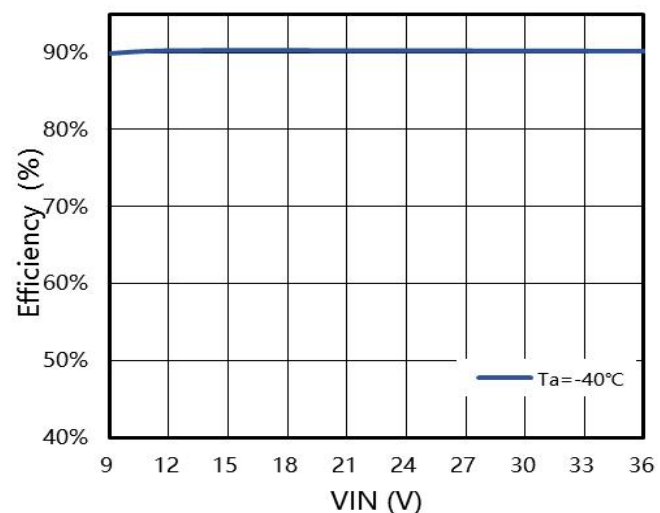
效率 VS 输出电流 (25°C)



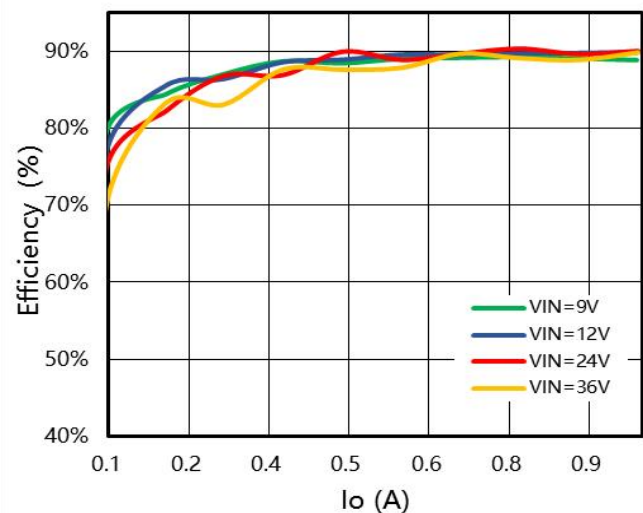
效率 VS 输入电压 (输出满载@25°C)



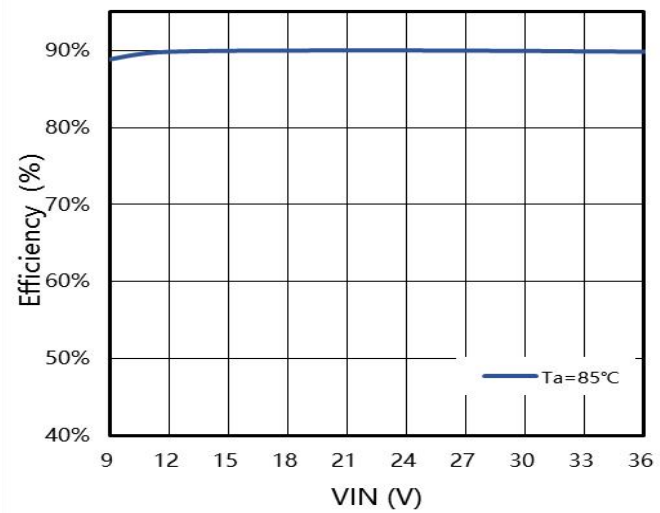
效率 VS 输出电流 (-40°C)



效率 VS 输入电压 (输出满载@-40°C)



效率 VS 输出电流 (85°C)



效率 VS 输入电压 (输出满载@85°C)

VIN=24V, Ta=25°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
24.03	0.006	14.93	0	0%	0.00%
24.03	0.074	14.92	0.096	10%	80.55%
24.03	0.144	14.92	0.194	20%	83.65%
24.02	0.210	14.93	0.294	30%	87.02%
24.00	0.275	14.92	0.393	40%	88.84%
23.99	0.343	14.93	0.493	50%	89.45%
24.01	0.412	14.92	0.592	60%	89.29%
24.00	0.474	14.92	0.692	70%	90.76%
24.00	0.536	14.92	0.791	80%	91.74%
23.99	0.614	14.92	0.891	90%	90.25%
23.97	0.676	14.93	0.990	100%	91.22%

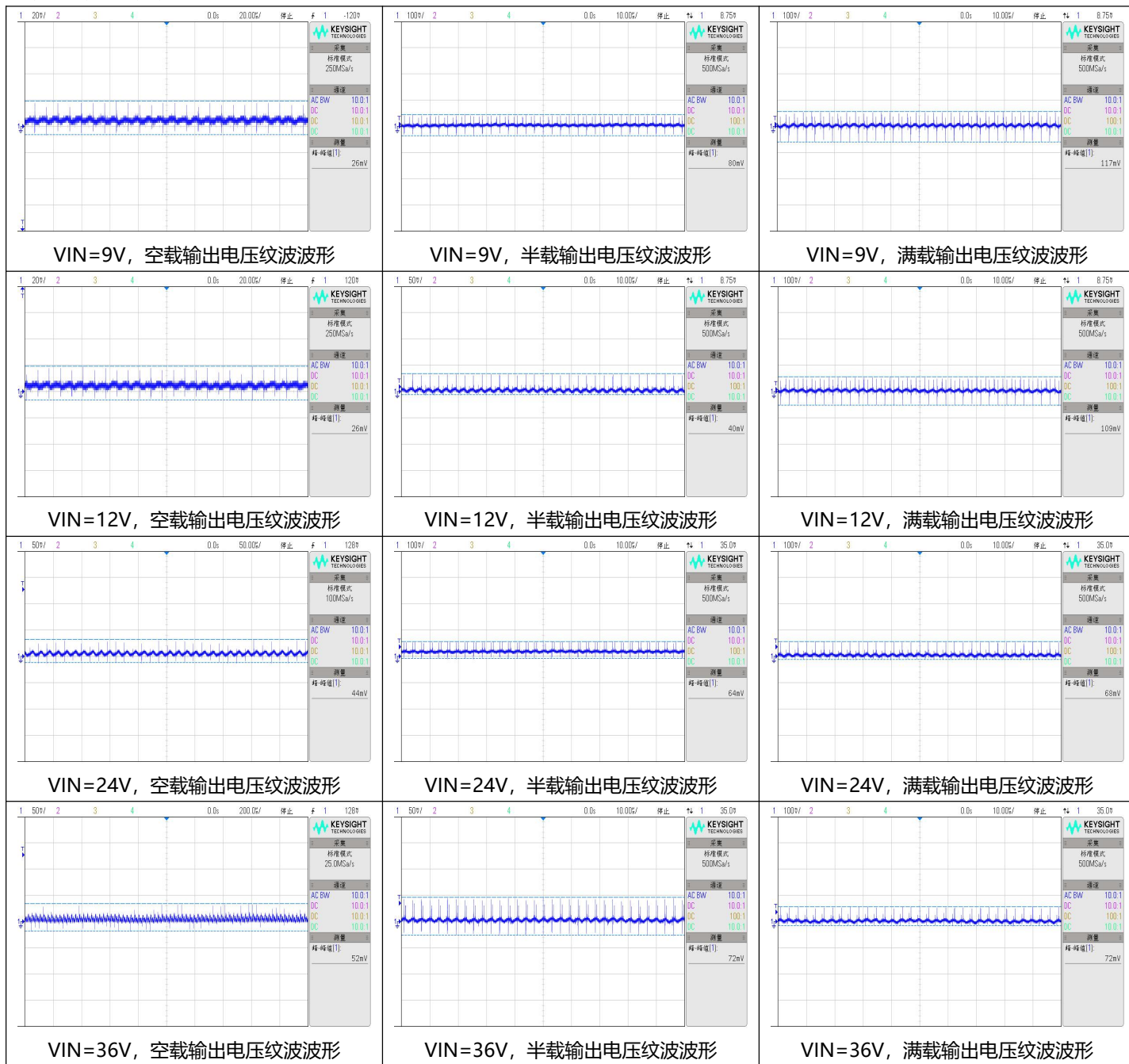
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
24.08	0.006	15.08	0	0%	0.00%
24.07	0.081	15.08	0.095	10%	73.48%
24.07	0.149	15.07	0.196	20%	82.36%
24.07	0.215	15.08	0.295	30%	85.96%
24.06	0.285	15.08	0.395	40%	86.87%
24.06	0.348	15.07	0.494	50%	88.91%
24.05	0.422	15.08	0.594	60%	88.26%
24.04	0.485	15.08	0.693	70%	89.63%
24.03	0.552	15.08	0.792	80%	90.04%
24.03	0.625	15.07	0.892	90%	89.50%
24.02	0.691	15.08	0.993	100%	90.22%

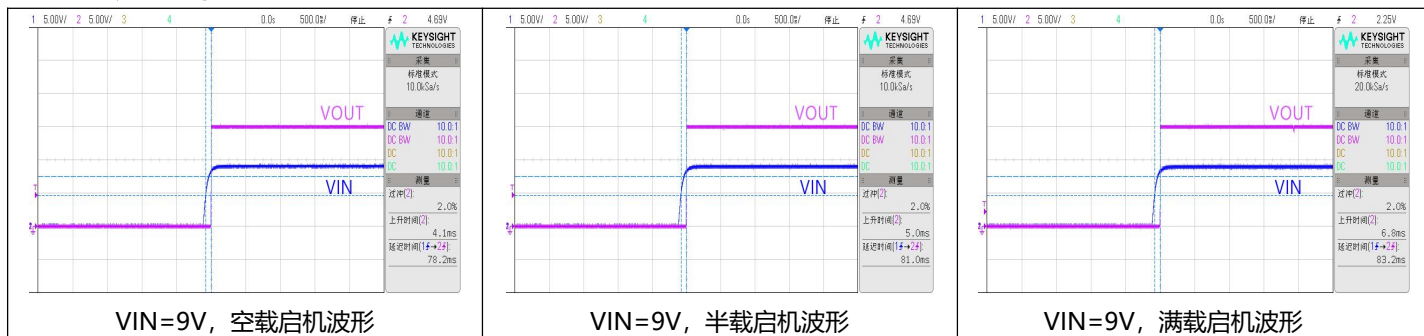
VIN=24V, Ta=85°C, 输入、输出及效率数据:

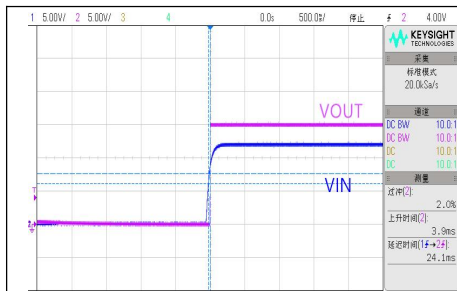
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
24.07	0.008	15.1	0	0%	0.00%
24.07	0.080	15.11	0.095	10%	74.55%
24.07	0.149	15.11	0.195	20%	82.16%
24.06	0.212	15.11	0.293	30%	86.80%
24.06	0.284	15.11	0.393	40%	86.90%
24.05	0.345	15.11	0.494	50%	89.96%
24.04	0.420	15.11	0.594	60%	88.89%
24.04	0.485	15.11	0.692	70%	89.68%
24.04	0.551	15.11	0.792	80%	90.34%
24.03	0.625	15.11	0.891	90%	89.64%
24.02	0.693	15.11	0.992	100%	90.05%

输出电压纹波波形

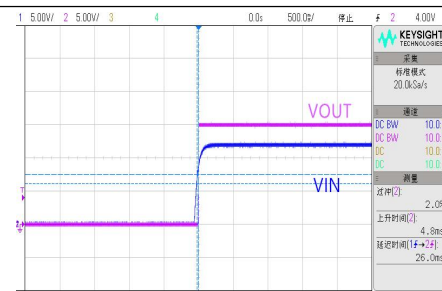


开关机波形（常温 25℃）

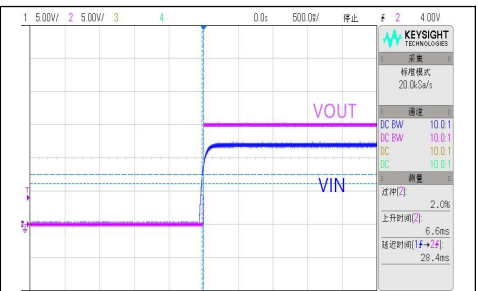




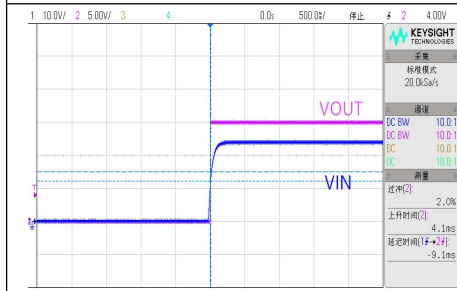
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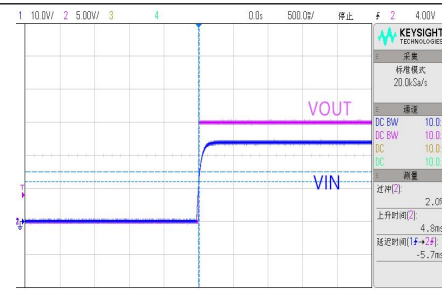
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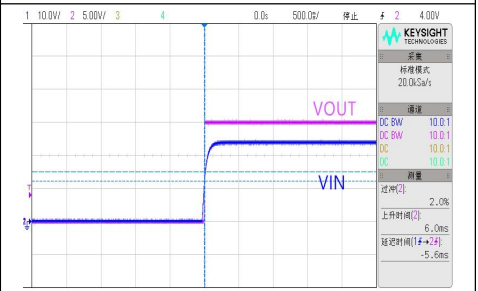
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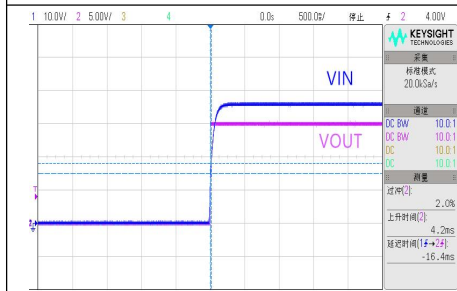
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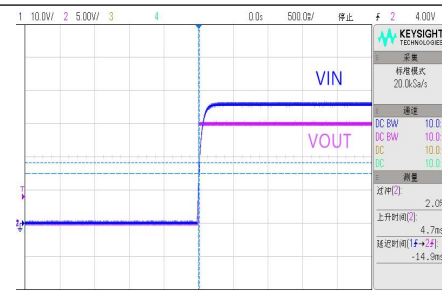
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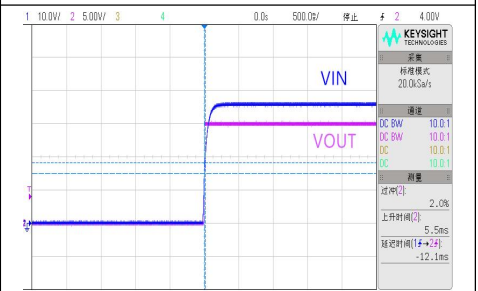
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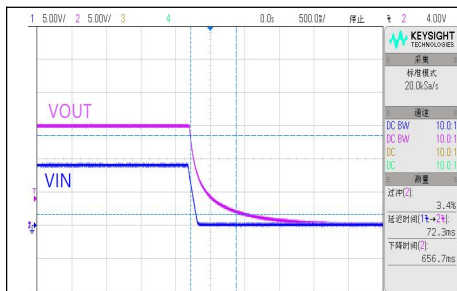
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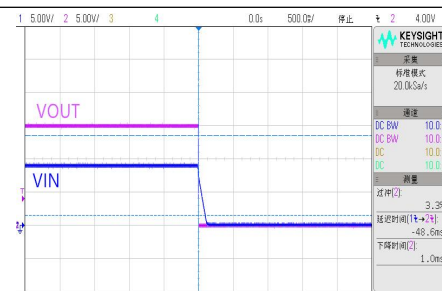
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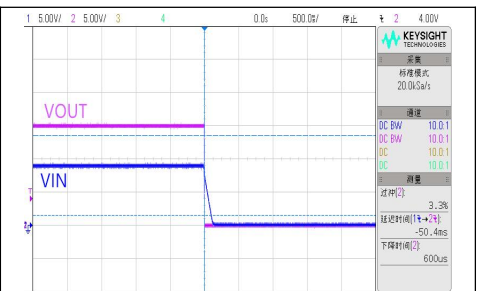
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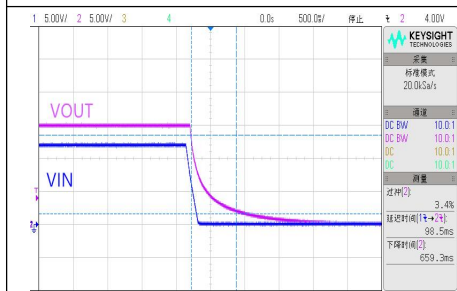
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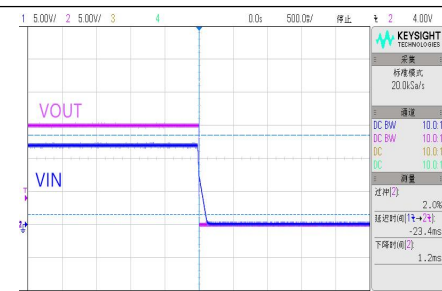
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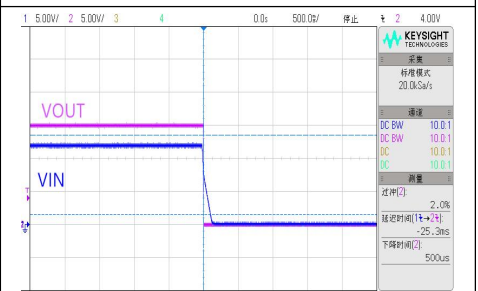
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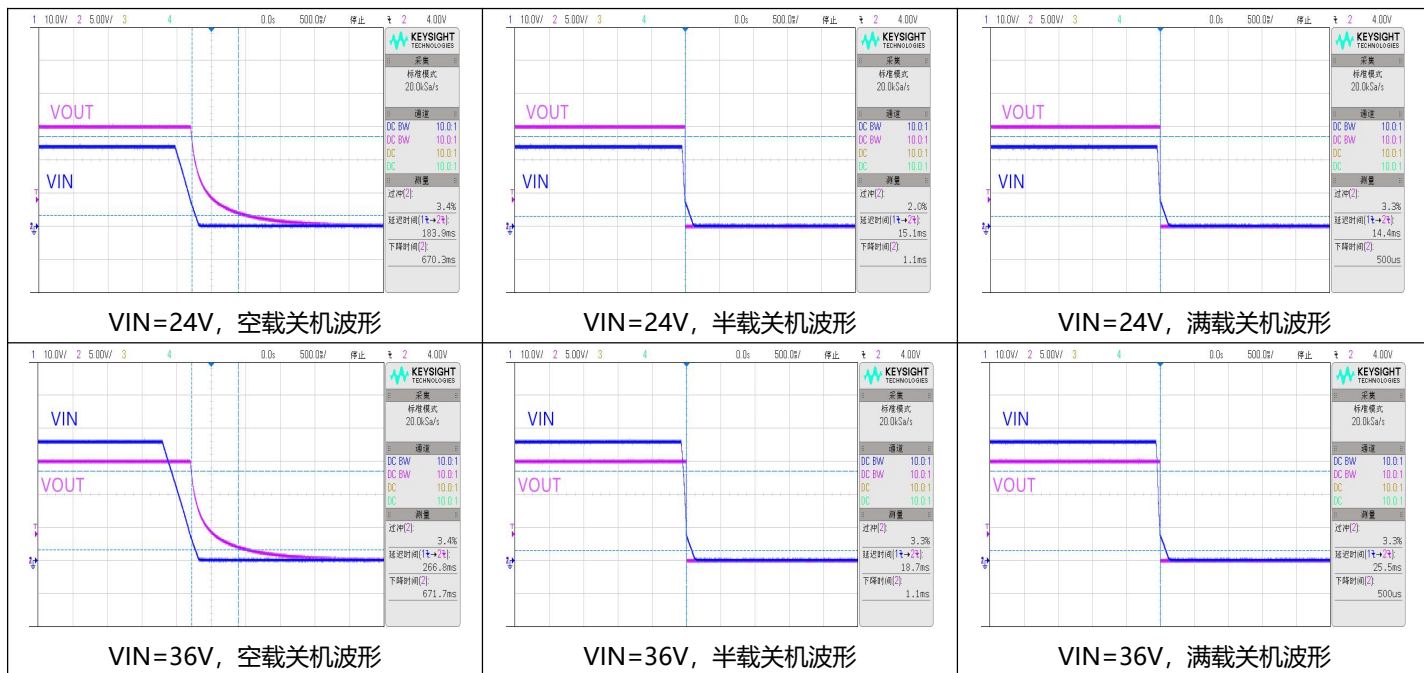
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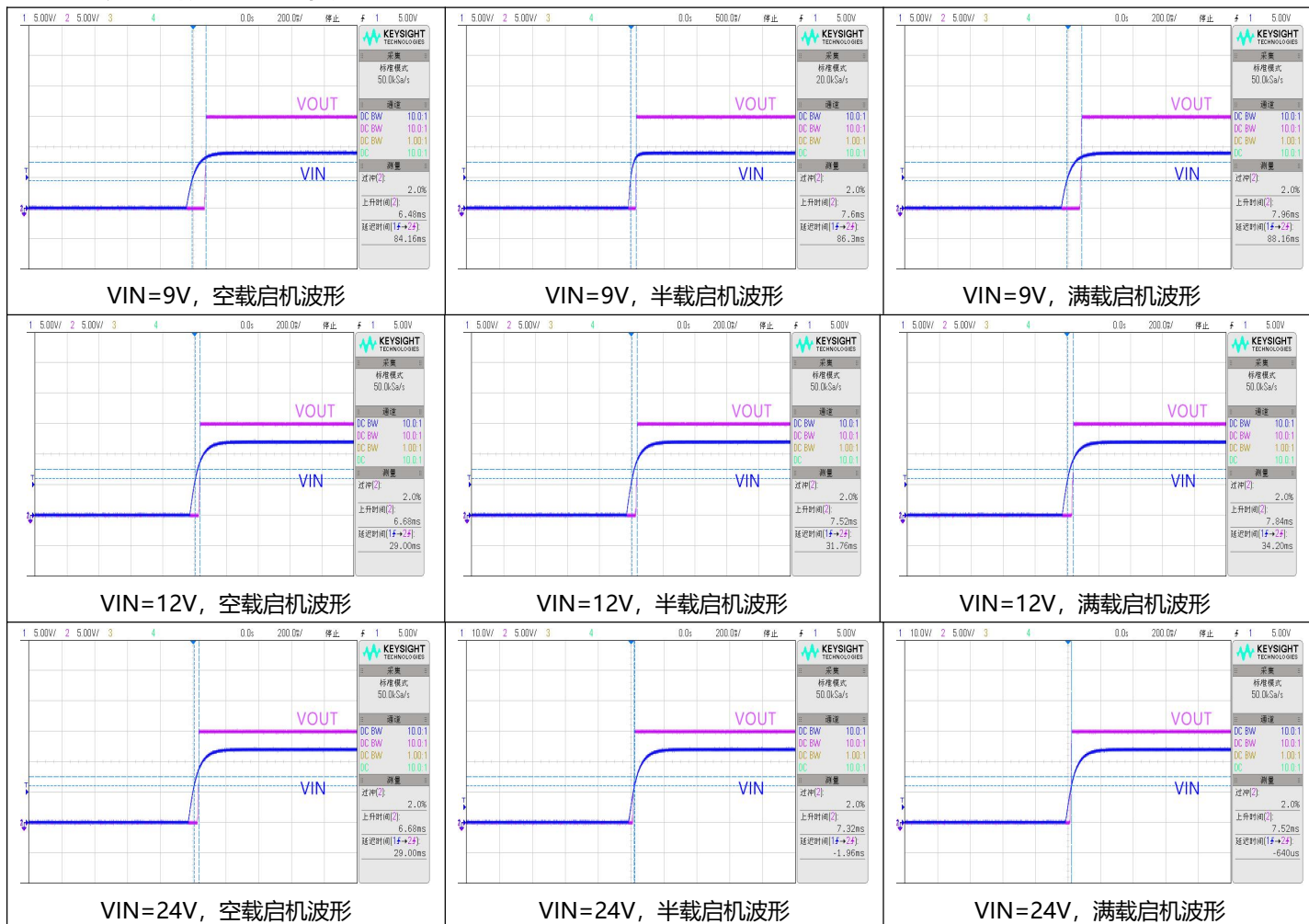
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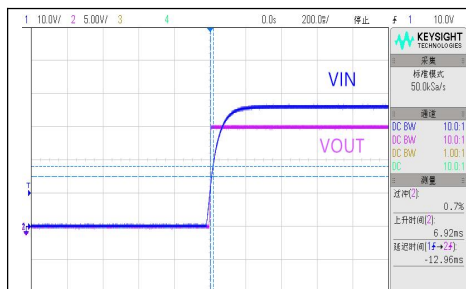


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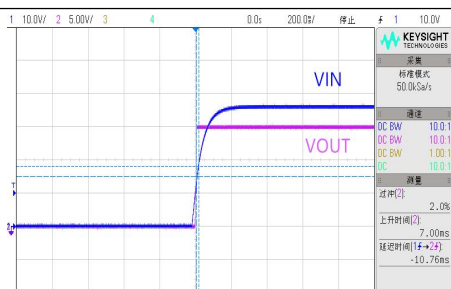


开关机波形（低温-40℃-程控开关）

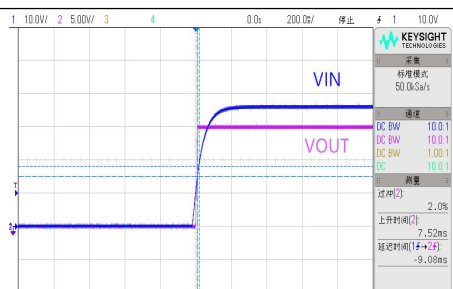




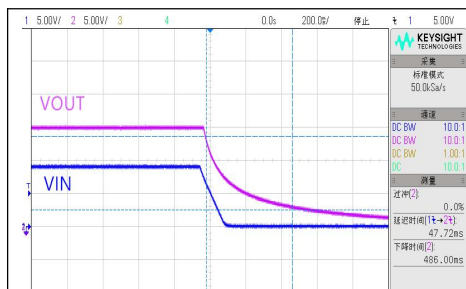
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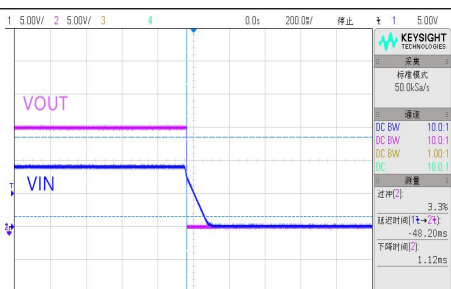
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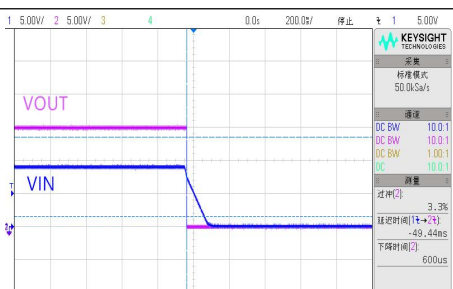
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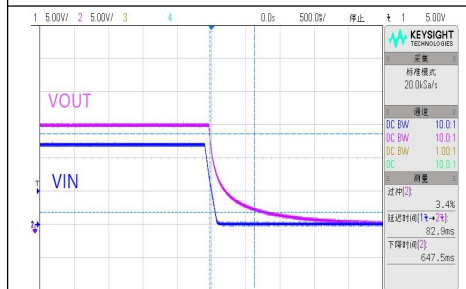
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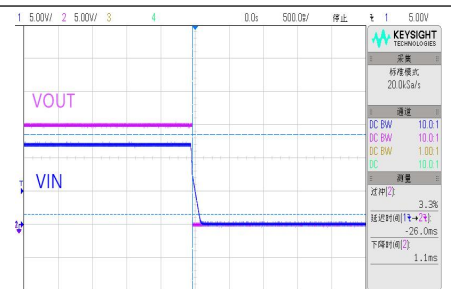
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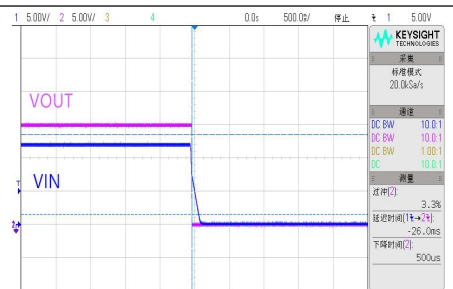
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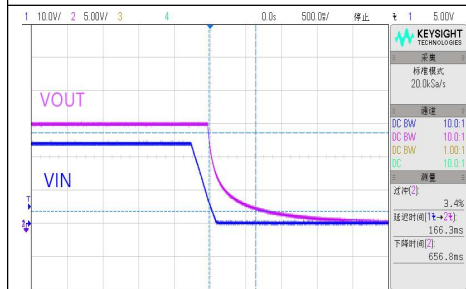
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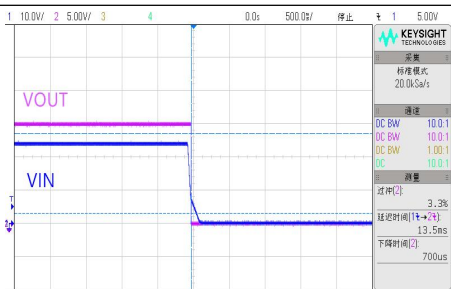
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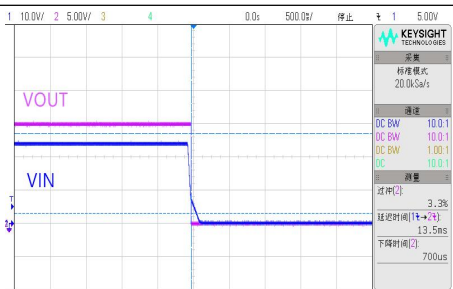
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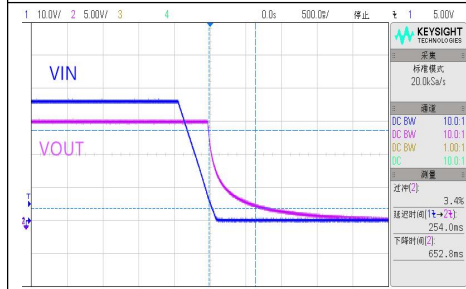
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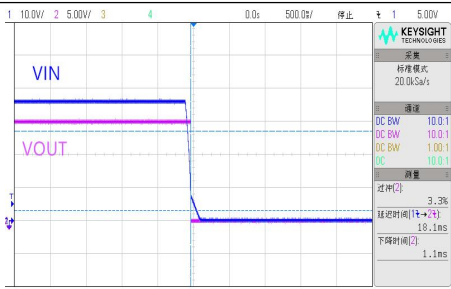
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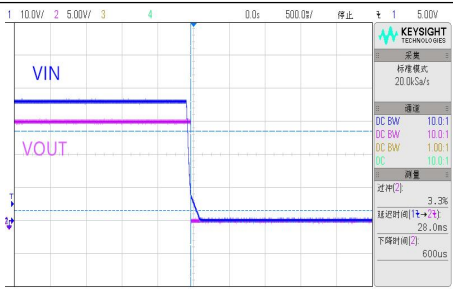
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VIN=36V, 空载关机波形



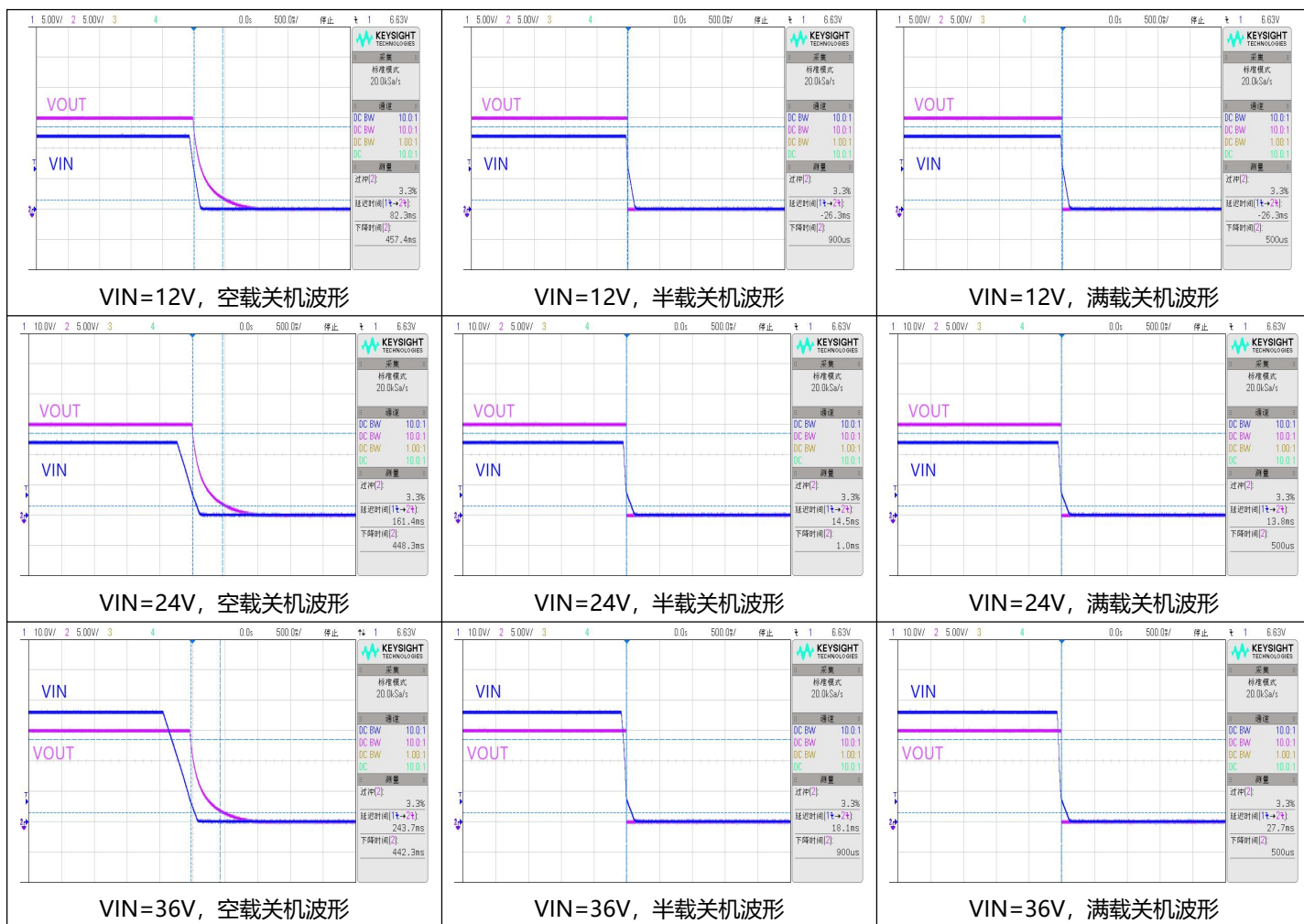
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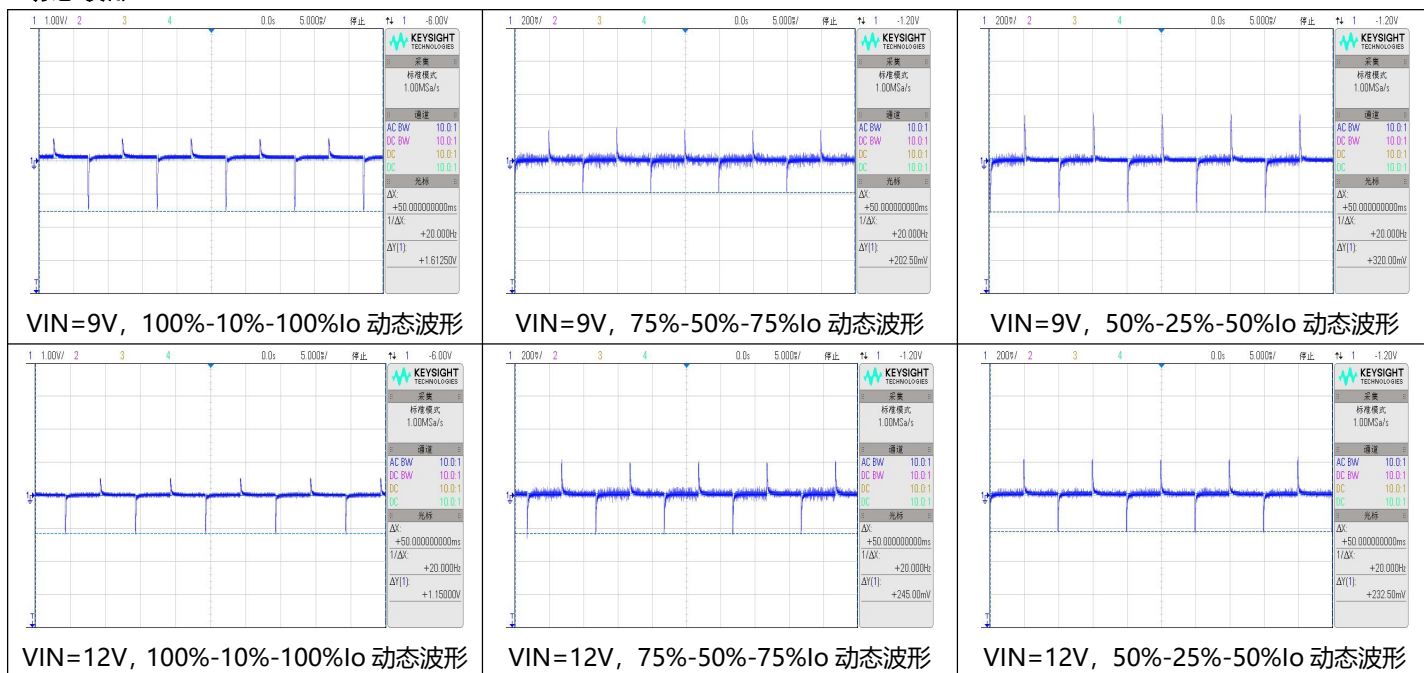
VIN=36V, 满载关机波形

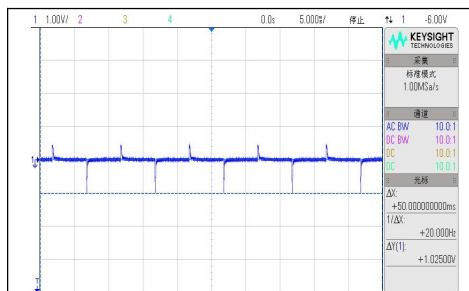
开关机波形（高温 85℃）



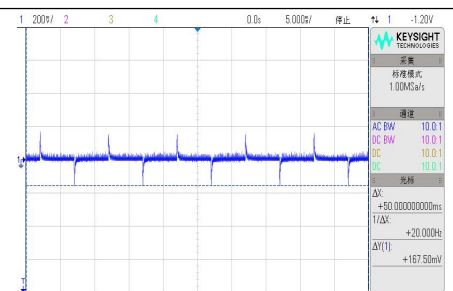


动态波形

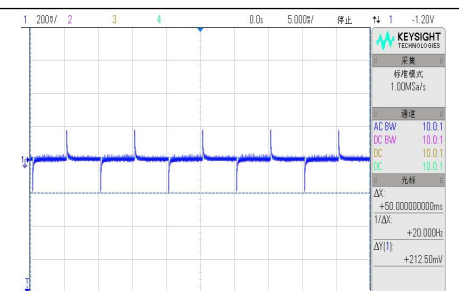




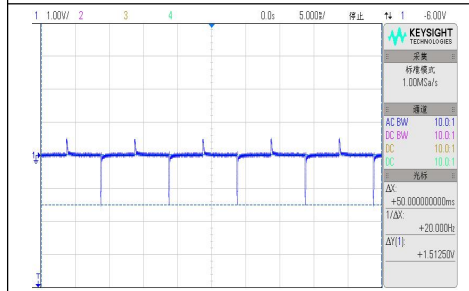
VIN=24V, 100%-10%-100%Io 动态波形



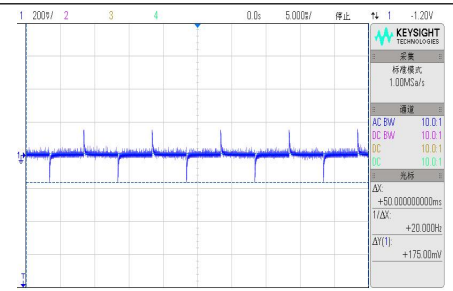
VIN=24V, 75%-50%-75%Io 动态波形



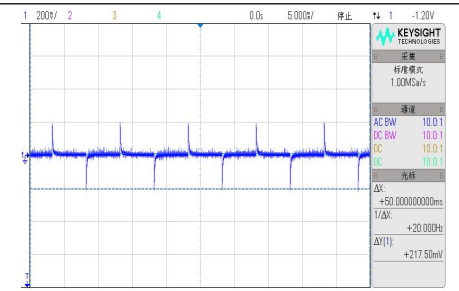
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

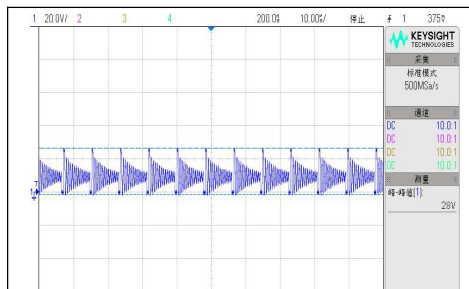


VIN=36V, 75%-50%-75%Io 动态波形

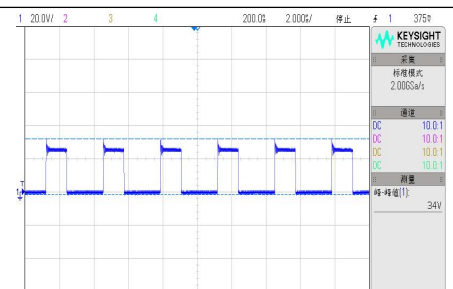


VIN=36V, 50%-25%-50%Io 动态波形

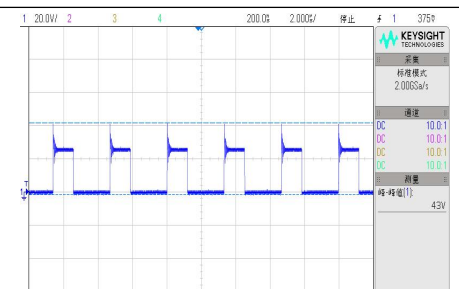
外置 MOS 管 Q1 电压应力波形



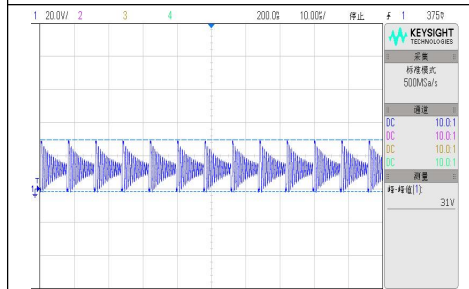
VIN=9V, 空载 VDS 波形



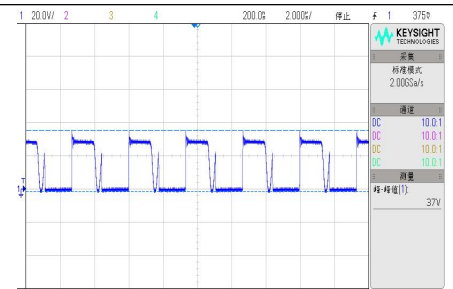
VIN=9V, 半载 VDS 波形



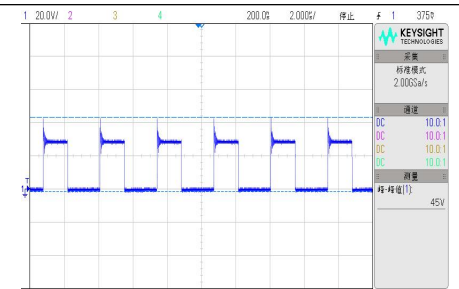
VIN=9V, 满载 VDS 波形



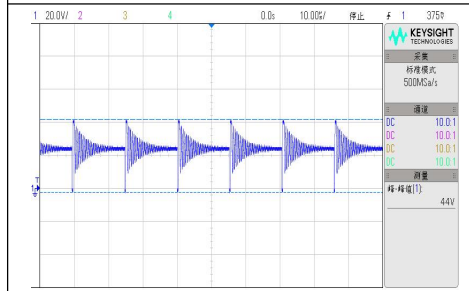
VIN=12V, 空载 VDS 波形



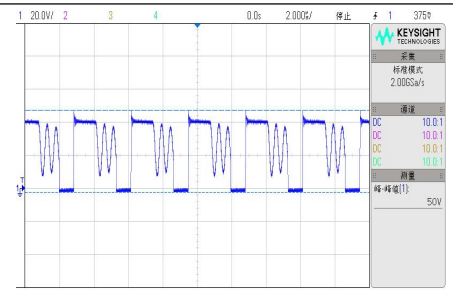
VIN=12V, 半载 VDS 波形



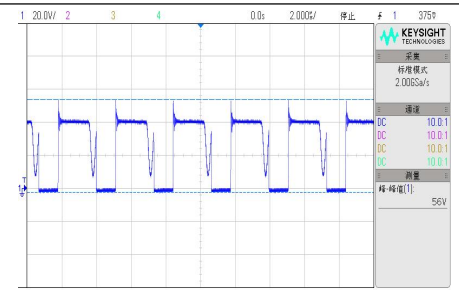
VIN=12V, 满载 VDS 波形



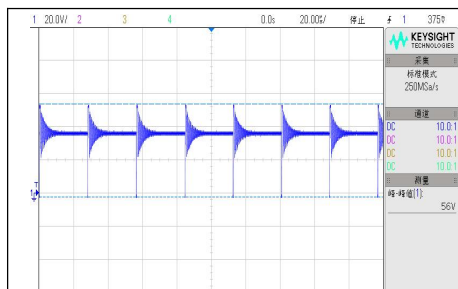
VIN=24V, 空载 VDS 波形



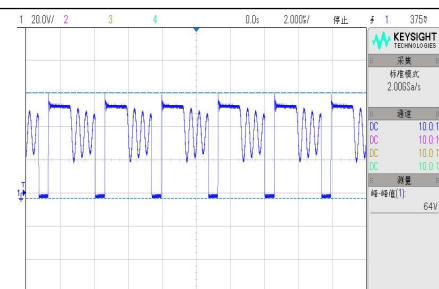
VIN=24V, 半载 VDS 波形



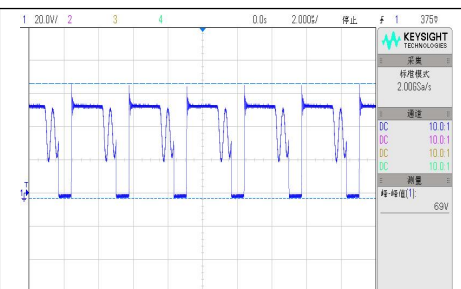
VIN=24V, 满载 VDS 波形



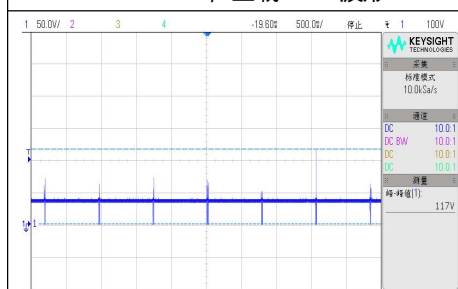
VIN=36V, 空载 VDS 波形



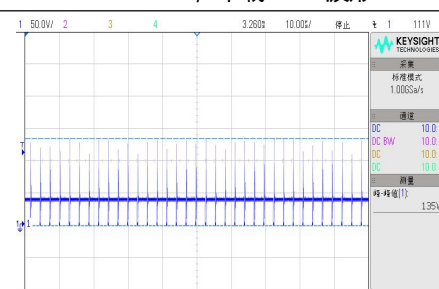
VIN=36V, 半载 VDS 波形



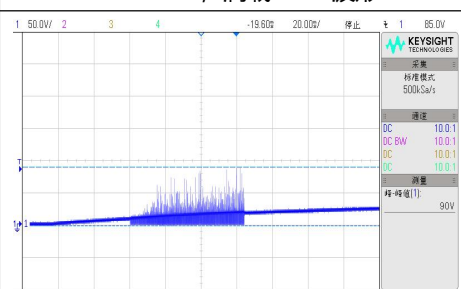
VIN=36V, 满载 VDS 波形



VIN=36V, 短路保护 VDS 波形

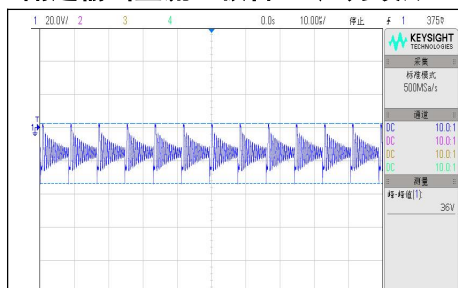


VIN=36V, 短路保护 VDS 展开波形

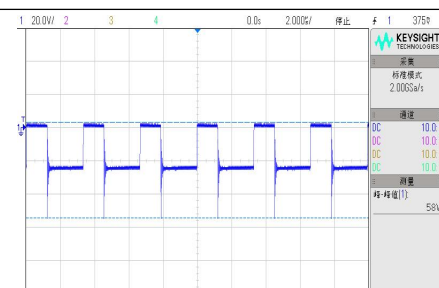


VIN=36V, 短路保护 VDS 启机波形

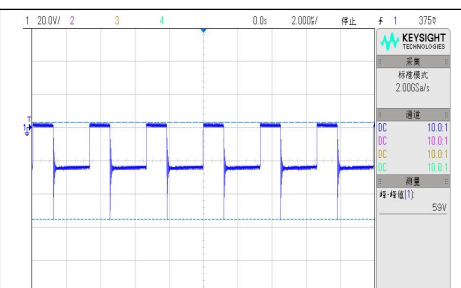
副边输出整流二极管 D4 应力波形



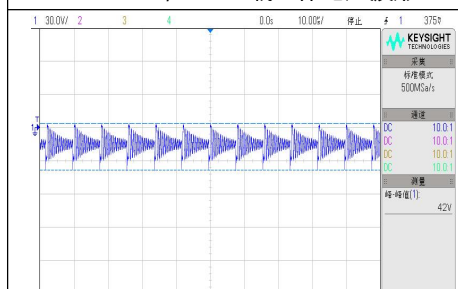
VIN=9V, D4 空载工作电压波形



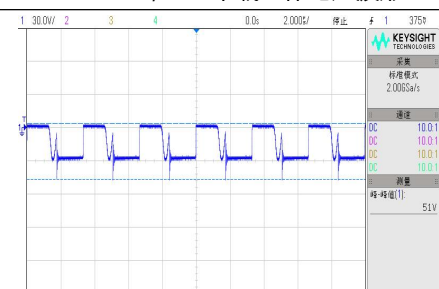
VIN=9V, D4 半载工作电压波形



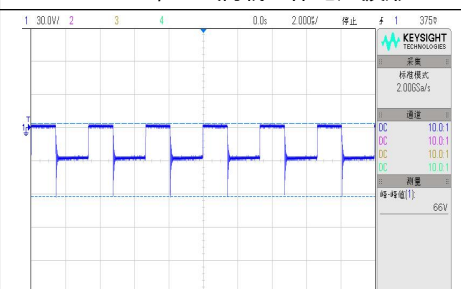
VIN=9V, D4 满载工作电压波形



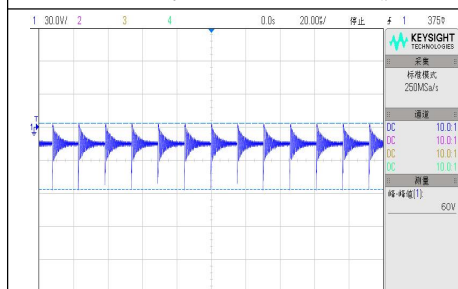
VIN=12V, D4 空载工作电压波形



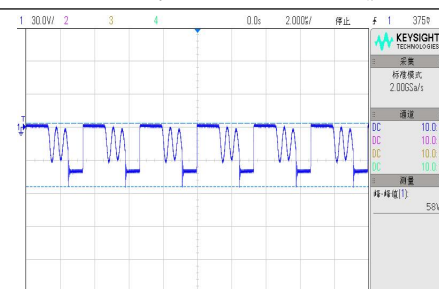
VIN=12V, D4 半载工作电压波形



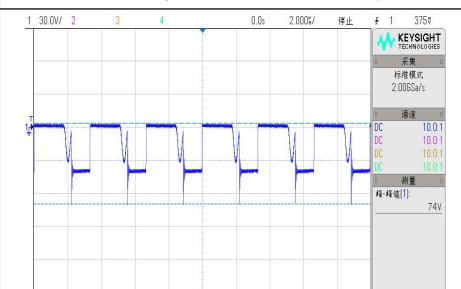
VIN=12V, D4 满载工作电压波形



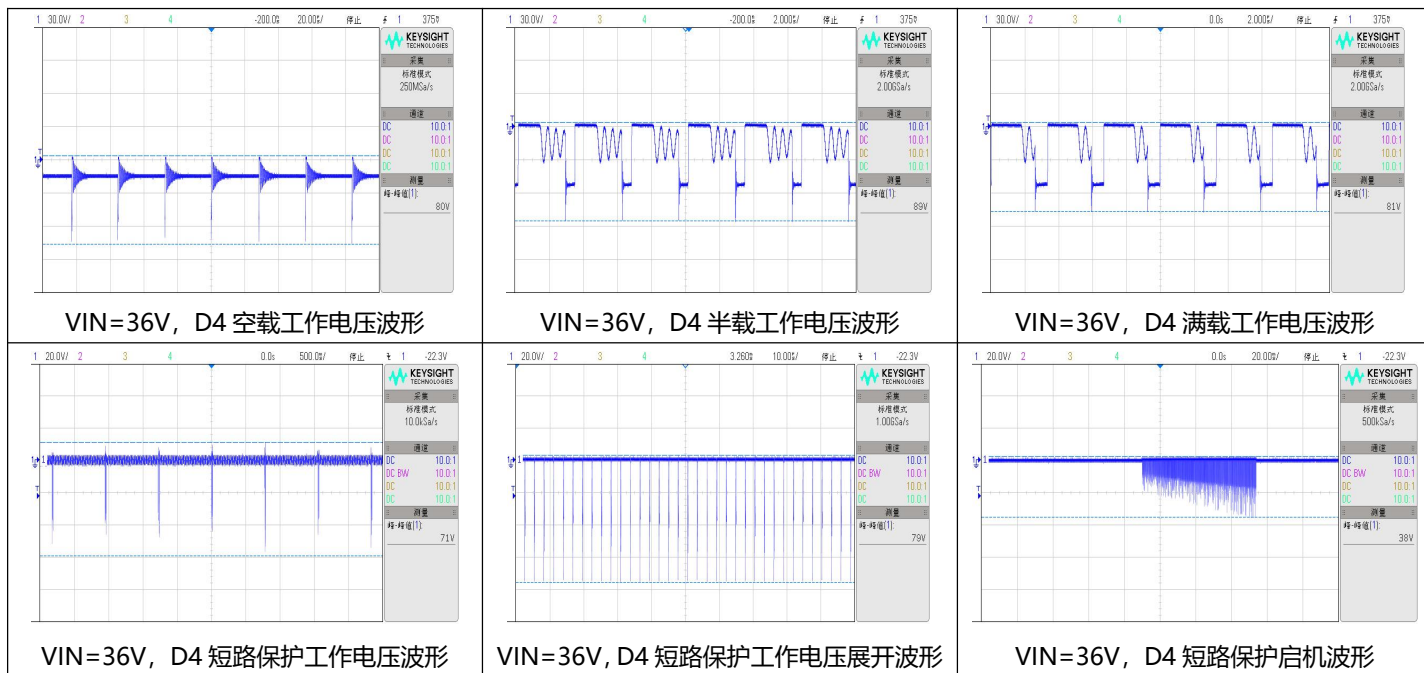
VIN=24V, D4 空载工作电压波形



VIN=24V, D4 半载工作电压波形



VIN=24V, D4 满载工作电压波形



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