

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、输出整流二极管以及必要的阻容元件，实现 9V-36V 输入，12V 输出 24W 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）抗干扰目的的相关场合。

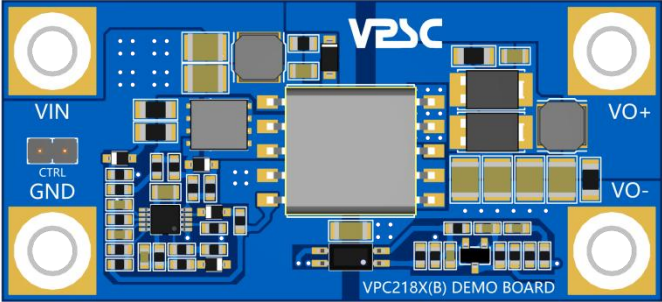


图 1: VPC218X(B) Demo 板(尺寸:67.5mm*30.7mm)

关键词：输入：9V-36V，输出 12V/24W，隔离电压：1500VDC，反馈方式：副边反馈-SSR，开关频率：330kHz

原理图

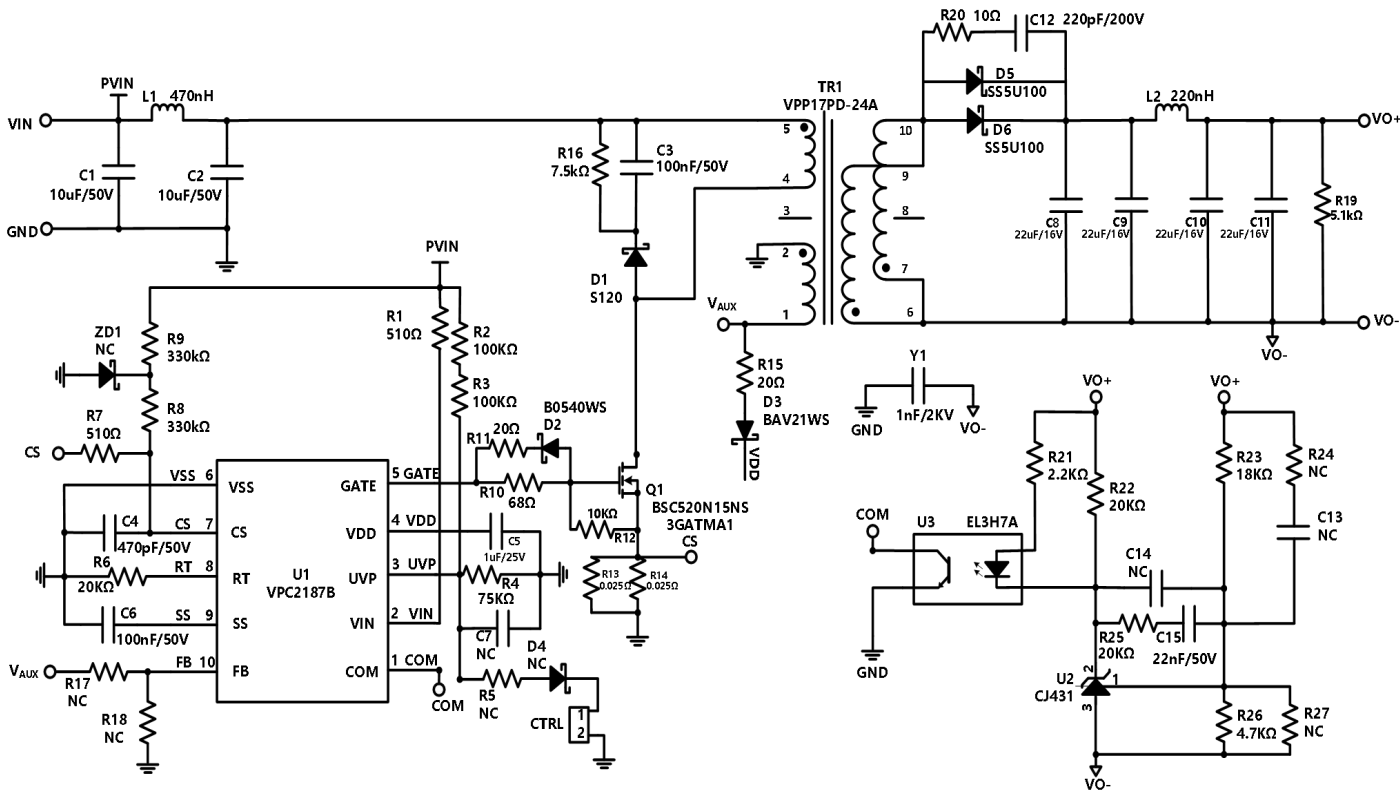


图 2: VPC2187B 12V/24W 原理图

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
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物料清单

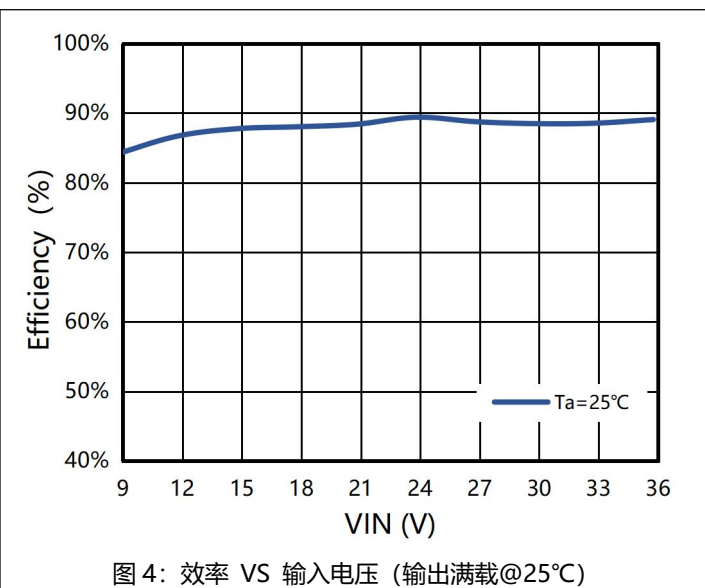
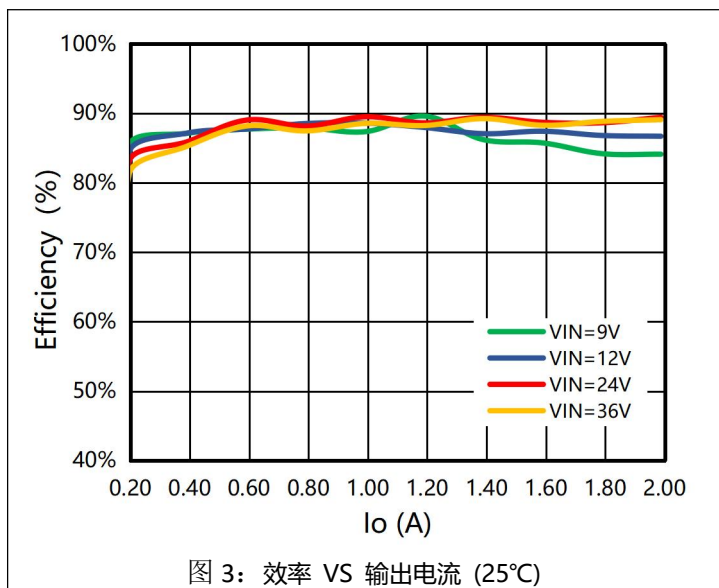
位号	参数	封装	型号	品牌
C1	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C2	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C3	100nF/50V-X7R	0805	CC0805KRX7R9BB104	YAGEO
C4	470pF/50V-X7R	0603	CC0603JRNPO9BN471	YAGEO
C5	1uF/25V-X7R	0805	CC0805KKX7R8BB105	YAGEO
C6	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C7	NC	-	-	-
C8	22uF/16V-X5R	1206	CC1206MKX5R7BB226	YAGEO
C9	22uF/16V-X5R	1206	CC1206MKX5R7BB226	YAGEO
C10	22uF/16V-X5R	1206	CC1206MKX5R7BB226	YAGEO
C11	22uF/16V-X5R	1206	CC1206MKX5R7BB226	YAGEO
C12	220pF/200V- X7R	0805	CC0805KRX7RABB221	YAGEO
C13	NC	-	-	-
C14	NC	-	-	-
C15	22nF/50V-X7R	0603	CC0603KRX7R9BB223	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R2	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R3	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R4	75KΩ±1%	0603	RC0603FR-0775KL	YAGEO
R5	NC	-	-	-
R6	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R7	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R8	330KΩ±1%	0603	RC0603FR-07330KL	YAGEO
R9	330KΩ±1%	0603	RC0603FR-07330KL	YAGEO
R10	68Ω±1%	0603	RC0603FR-0768RL	YAGEO
R11	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R12	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R13	0.025Ω ±1%	1206	RL1206FR-070R025L	YAGEO
R14	0.025Ω ±1%	1206	RL1206FR-070R025L	YAGEO
R15	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R16	7.5KΩ±1%	0805	RC0805FR-077K5L	YAGEO
R17	NC	-	-	-
R18	NC	-	-	-
R19	5.1KΩ±1%	1206	RC1206FR-075K1L	YAGEO
R20	10Ω±1%	1206	RC1206FR-0710RL	YAGEO
R21	2.2KΩ±1%	0603	RC0603FR-072K2L	YAGEO
R22	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO

R23	18K Ω ±1%	0603	RC0603FR-0718KL	YAGEO
R24	NC	-	-	-
R25	20K Ω ±1%	0603	RC0603FR-0720KL	YAGEO
R26	4.7K Ω ±1%	0603	RC0603FR-074K7L	YAGEO
R27	NC	-	-	-
TR1	NP:NS:NA=6:6:6 Lp=3.6uH	EPD13	VPP17PD-24A	VPSC
Q1	N 沟道 150V 21A	TDSON-8	BSC520N15NS3GATMA1	INFINEON
L1	470nH ±30%	SMD	SWPA5020SR47NT	SUNLORD
L2	220nH ±20%	SMD	WPN4020HR22MT	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	TO-277	SS5U100	YANGJIE
D6	100V/5A	TO-277	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=24V	4	---	1118	mA
转换效率	VIN=24V, IO=2A	---	89.8	---	%
纹波&噪声	VIN=24V, IO=2A	---	72	220	mV
输出电压精度	VIN=24V, IO=2A	---	0.4	---	%
线性调节率	VIN=9V-36V, IO=2A	---	0.1	---	%
负载调整率	VIN=24V, IO=2A	---	0.2	---	%
输出过流点系数	VIN=9V, IO=2A	---	1.5	---	倍
输入欠压保护	锁定电压	---	7.3	---	V
	恢复电压	---	8.3	---	V
短路保护	VIN=9V-36V	可长期保护，自恢复			
工作温度	大于 70°C需降额使用	-40	---	85	°C
绝缘电压	原边短接 VS 副边短接	1500	---	---	VDC

关键性能指标测试结果



相关波形

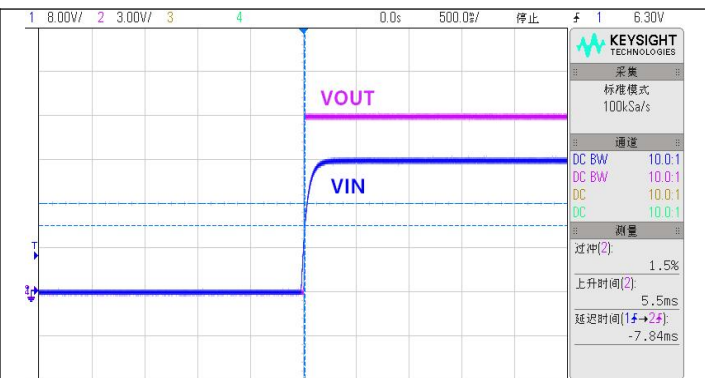
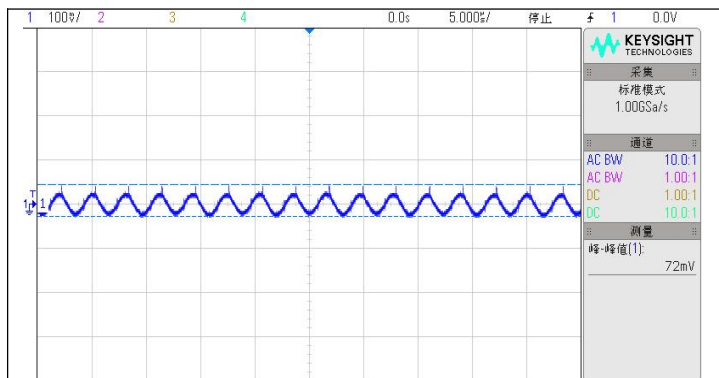
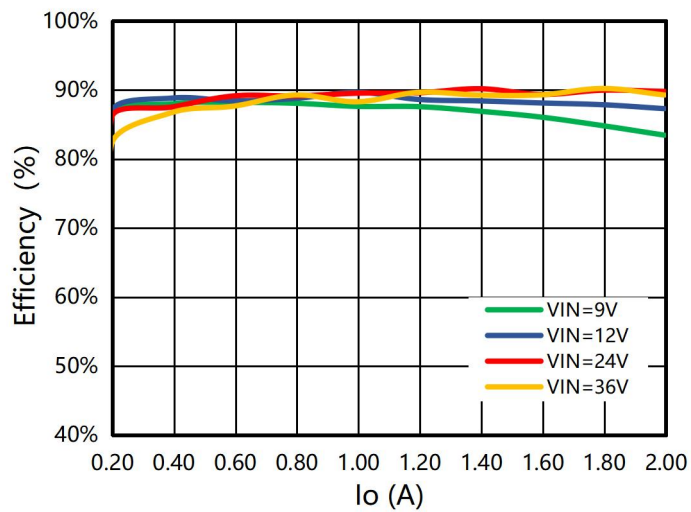


图 5: VIN=24V, 满载输出电压纹波波形

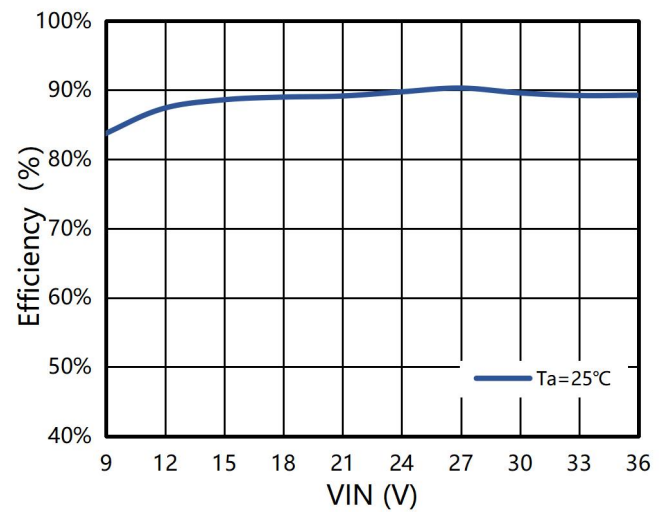
图 6: VIN=24V, 满载启机波形

详细测试数据

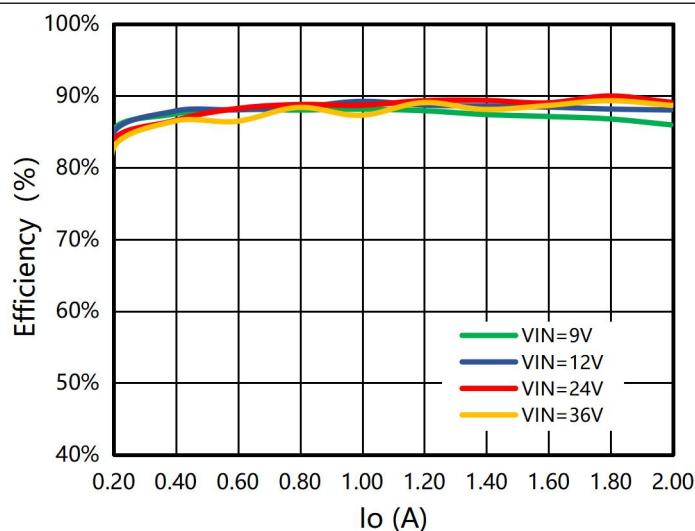
高低温测试曲线



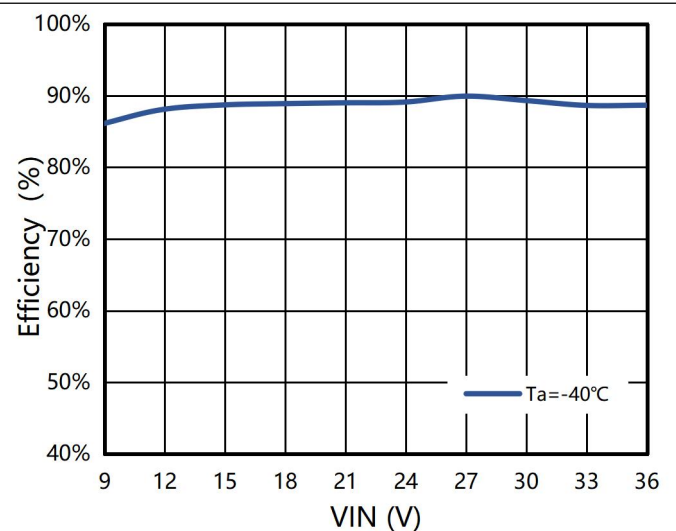
效率 VS 输出电流 (25°C)



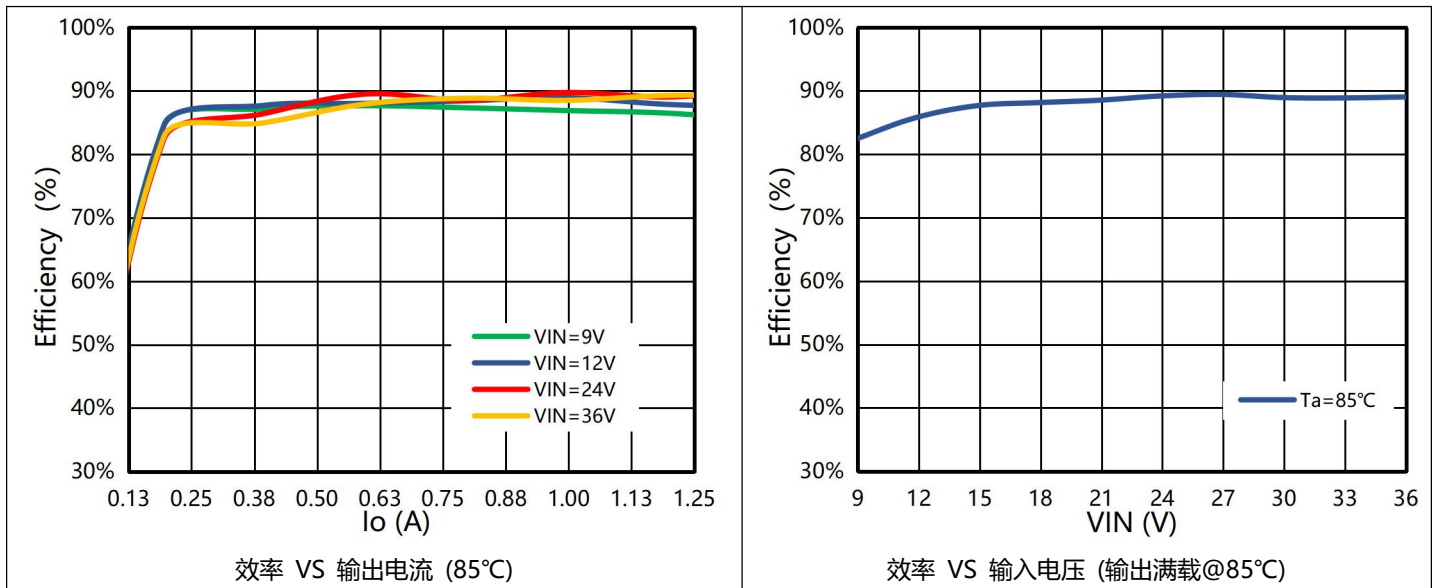
效率 VS 输入电压 (输出满载@25°C)



效率 VS 输出电流 (-40°C)



效率 VS 输入电压 (输出满载@-40°C)



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(%)
24.01	0.004	12.05	0	0%	0.00%
24.01	0.115	12.05	0.197	10%	85.97%
23.99	0.227	12.04	0.396	20%	87.55%
23.99	0.335	12.04	0.595	30%	89.14%
23.97	0.448	12.04	0.795	40%	89.13%
23.98	0.558	12.04	0.995	50%	89.53%
23.97	0.670	12.04	1.195	60%	89.59%
23.97	0.777	12.04	1.395	70%	90.18%
23.96	0.897	12.04	1.595	80%	89.35%
23.95	1.003	12.04	1.795	90%	89.97%
23.94	1.118	12.04	1.996	100%	89.79%

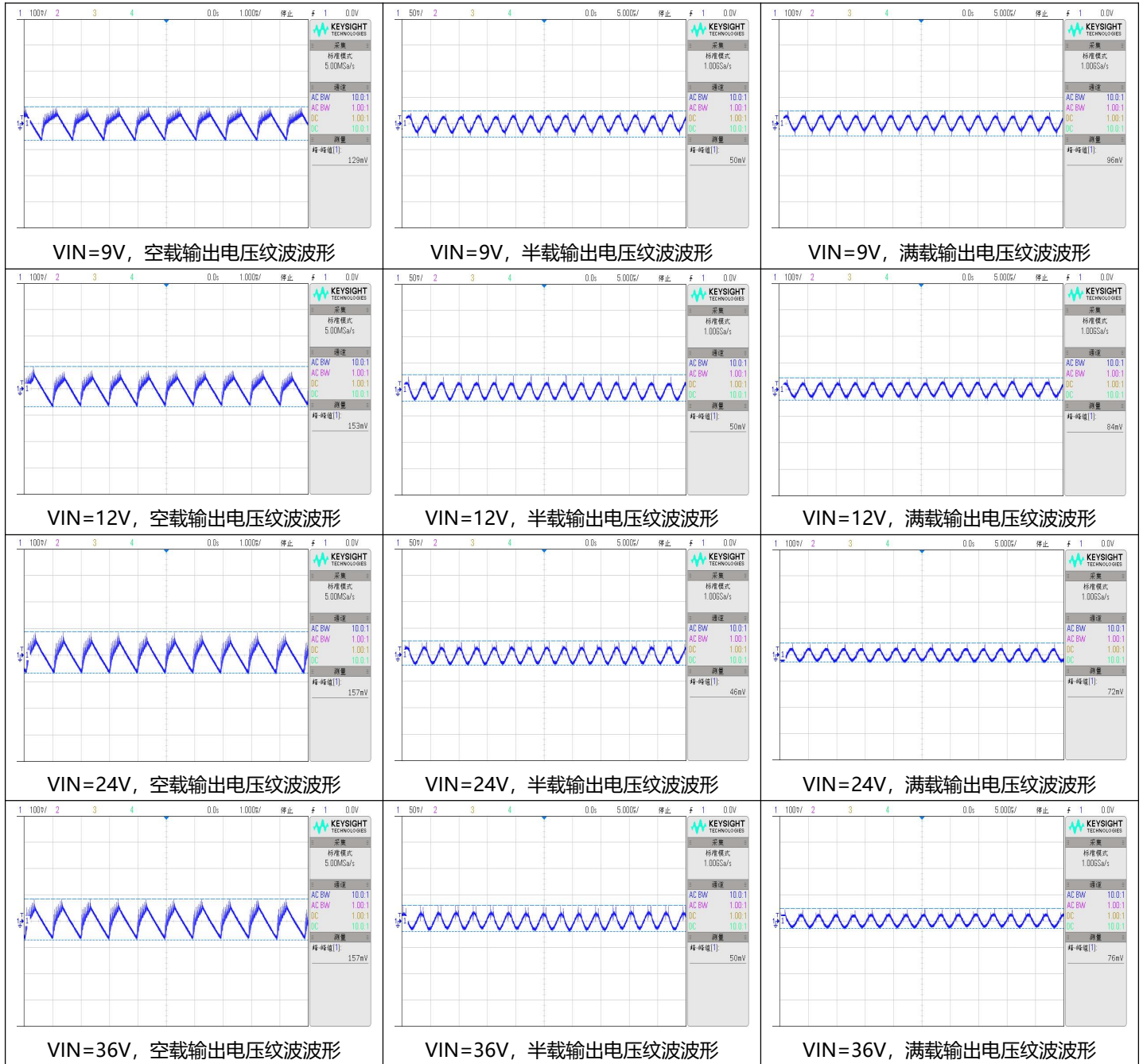
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
24.01	0.004	11.99	0	0%	0.00%
24.01	0.117	11.99	0.195	10%	83.23%
23.98	0.228	11.98	0.395	20%	86.55%
23.98	0.337	11.98	0.595	30%	88.21%
23.97	0.447	11.98	0.794	40%	88.78%
23.98	0.560	11.98	0.994	50%	88.68%
23.96	0.669	11.98	1.195	60%	89.31%
23.97	0.779	11.97	1.394	70%	89.36%
23.94	0.896	11.97	1.595	80%	89.01%
23.93	0.998	11.97	1.795	90%	89.97%
23.93	1.118	11.96	1.993	100%	89.10%

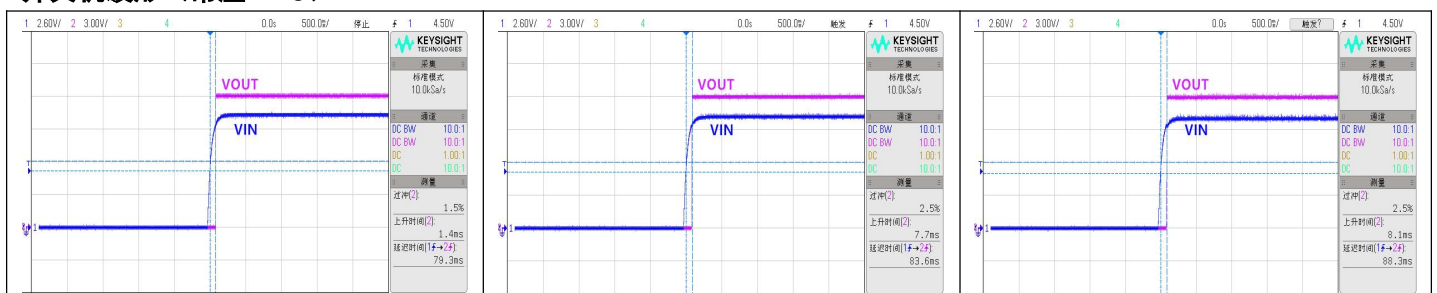
VIN=24V, Ta=85°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
24.02	0.004	12.08	0	0%	0.00%
24.02	0.119	12.08	0.195	10%	82.41%
24.00	0.230	12.08	0.395	20%	86.44%
24.01	0.335	12.08	0.596	30%	89.51%
23.98	0.452	12.07	0.795	40%	88.53%
23.98	0.558	12.07	0.995	50%	89.75%
23.96	0.676	12.07	1.195	60%	89.05%
23.96	0.780	12.07	1.394	70%	90.03%
23.95	0.905	12.06	1.595	80%	88.75%
23.94	1.013	12.06	1.794	90%	89.21%
23.92	1.127	12.06	1.994	100%	89.20%

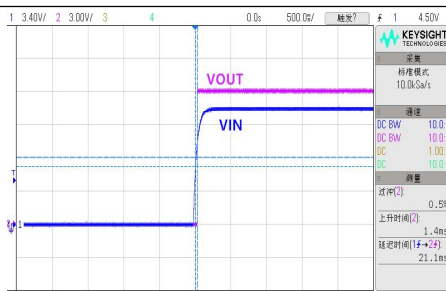
输出电压纹波波形



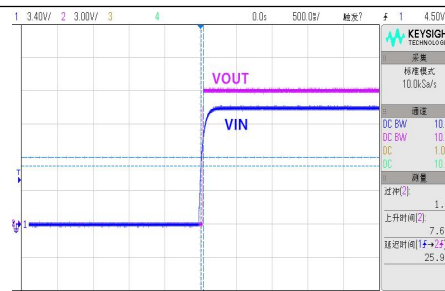
开关机波形 (常温 25°C)



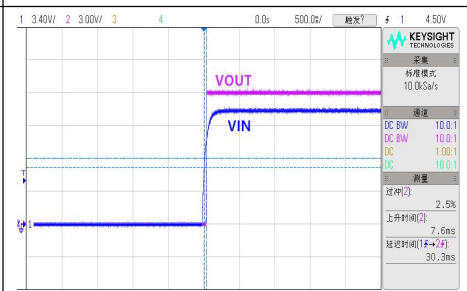
VIN=9V, 空载启机波形



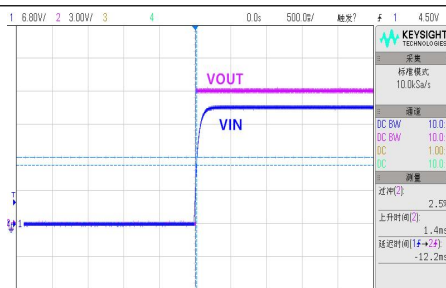
VIN=9V, 半载启机波形



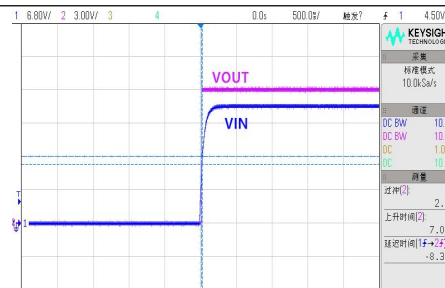
VIN=9V, 满载启机波形



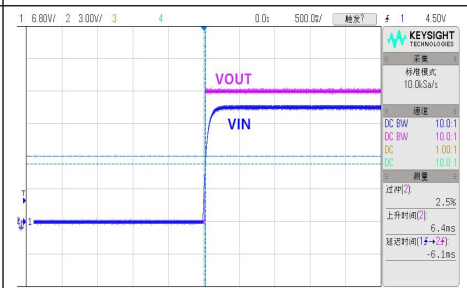
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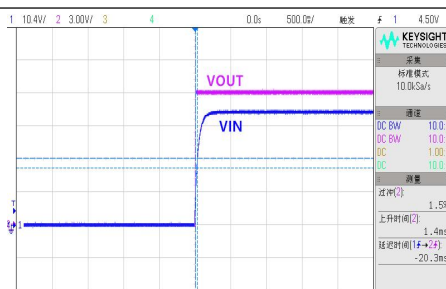
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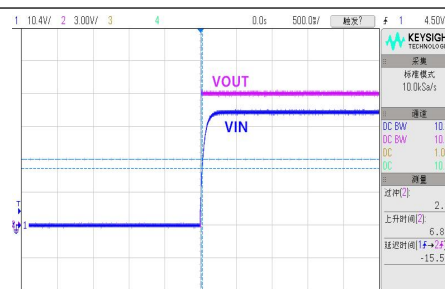
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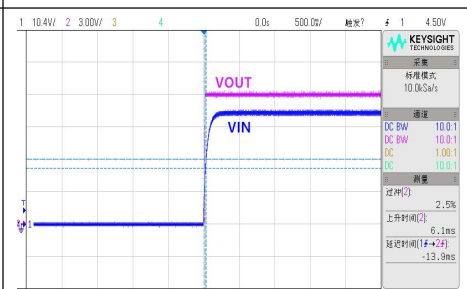
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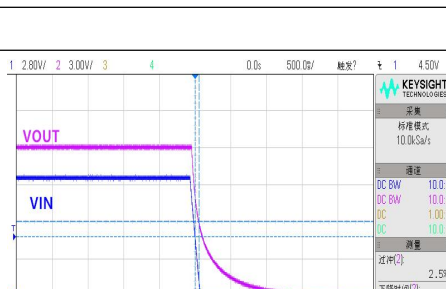
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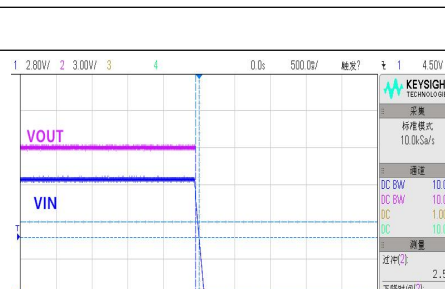
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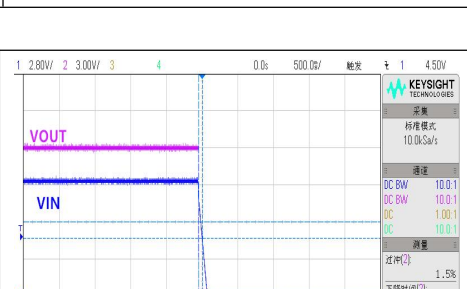
VIN=36V, 空载启机波形



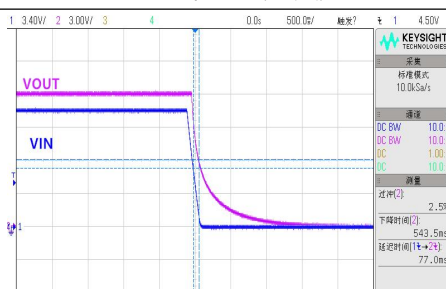
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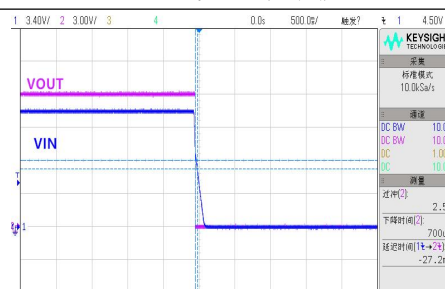
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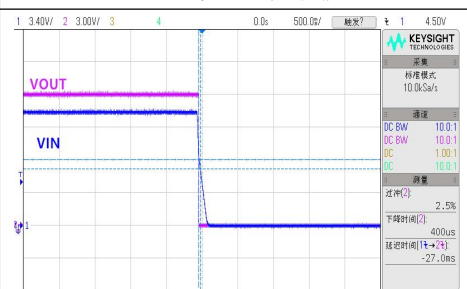
VIN=9V, 空载关机波形



VIN=9V, 半载关机波形



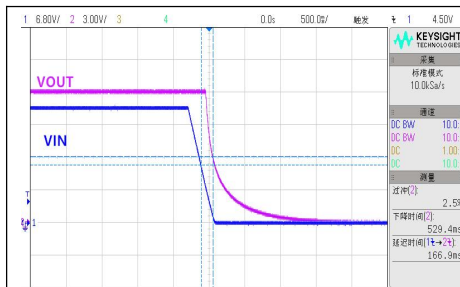
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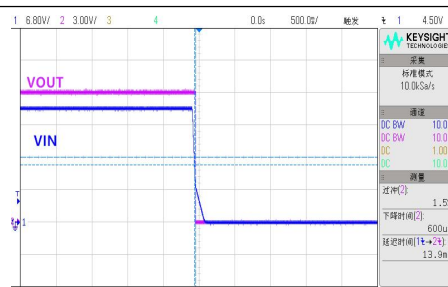
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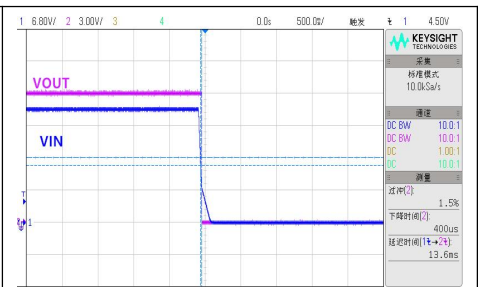
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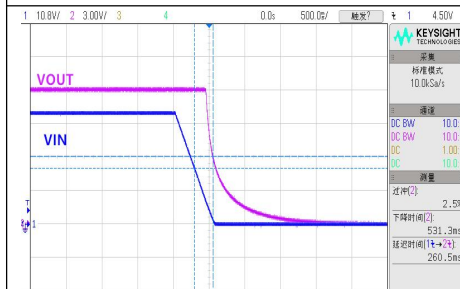
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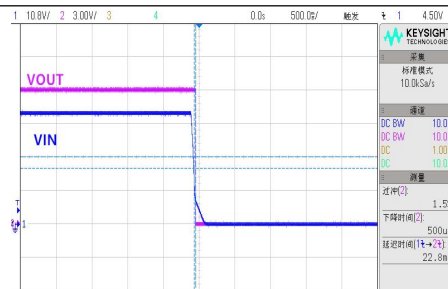
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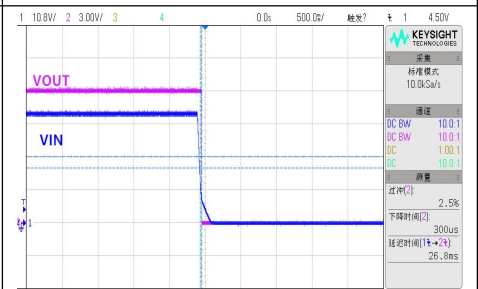
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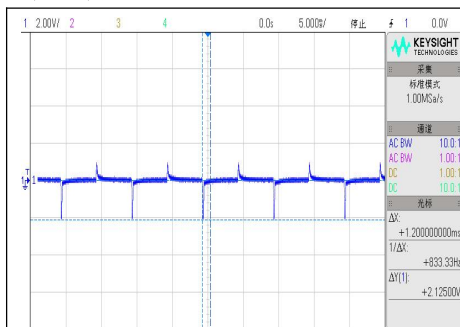


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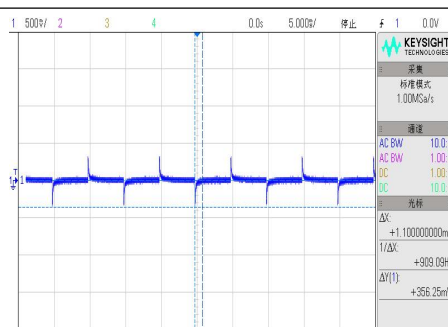


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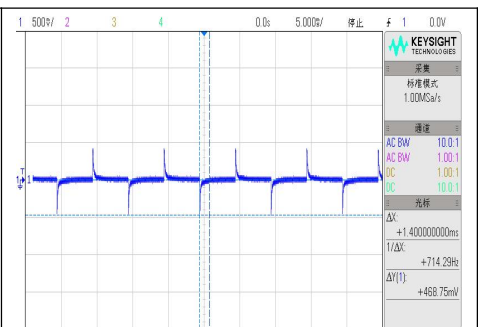
动态波形



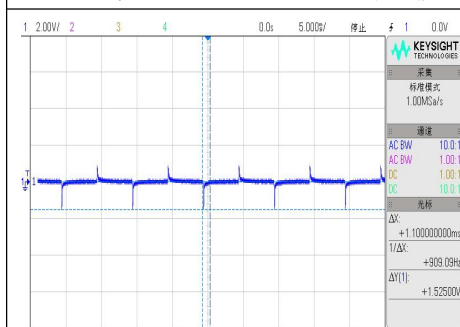
VIN=9V, 100%-10%-100%Io 动态波形



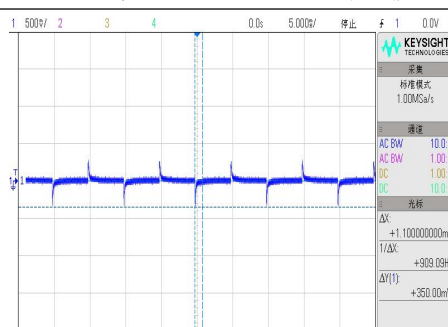
VIN=9V, 75%-50%-75%Io 动态波形



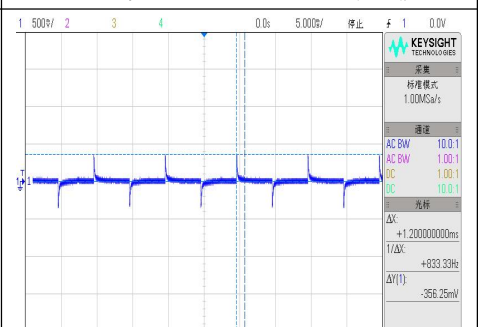
VIN=9V, 50%-25%-50%Io 动态波形



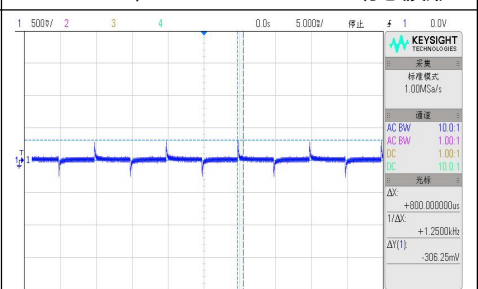
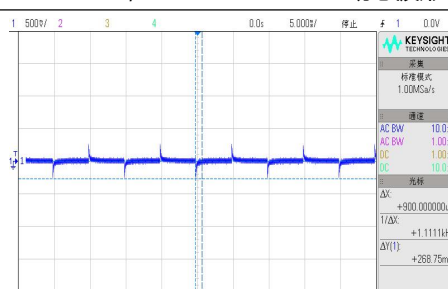
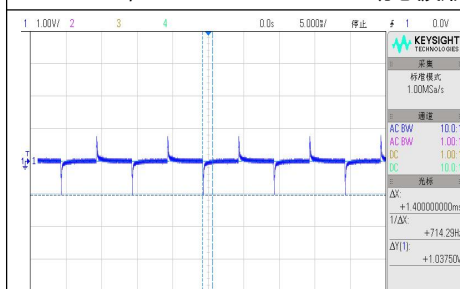
VIN=12V, 100%-10%-100%Io 动态波形

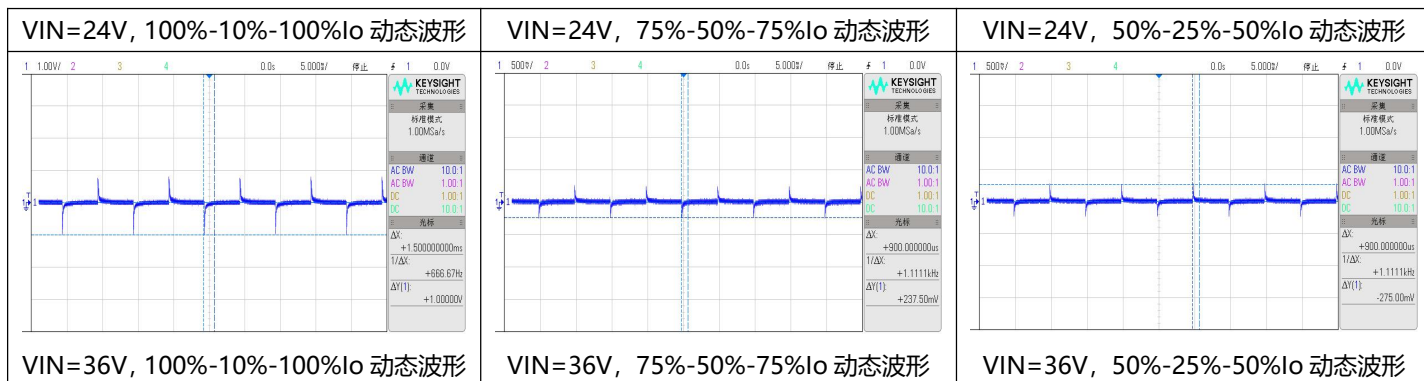


VIN=12V, 75%-50%-75%Io 动态波形

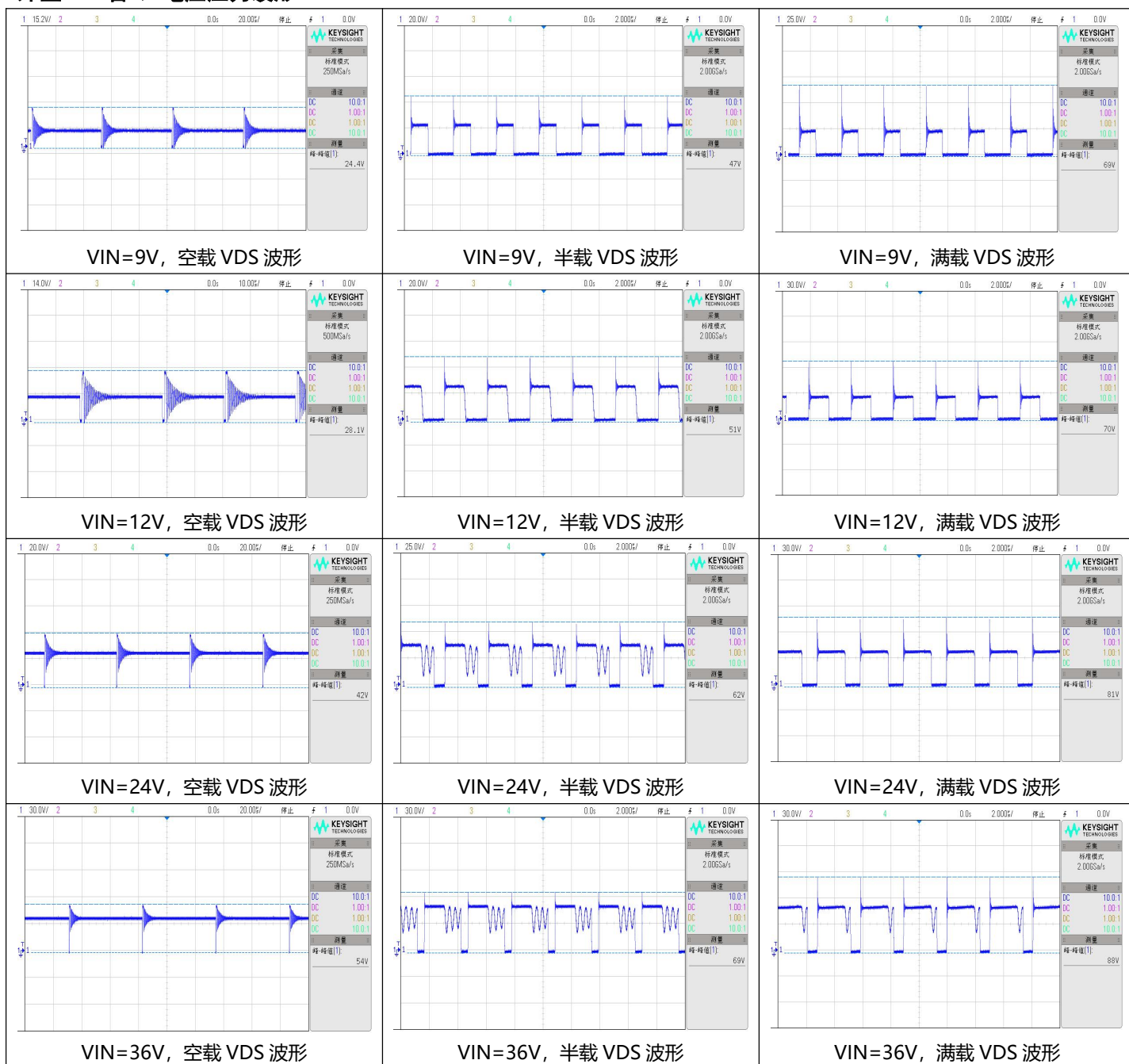


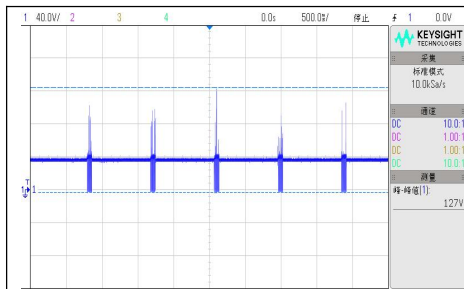
VIN=12V, 50%-25%-50%Io 动态波形



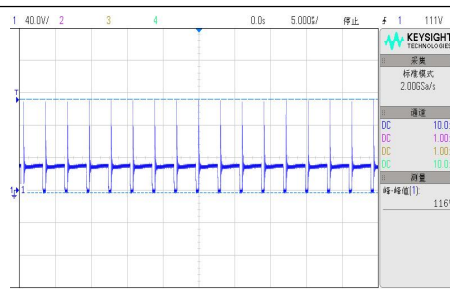


外置 MOS 管 Q1 电压应力波形

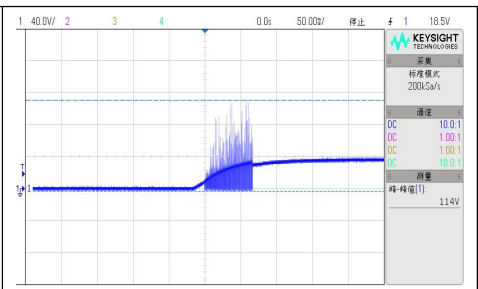




VIN=36V, 短路保护 VDS 波形

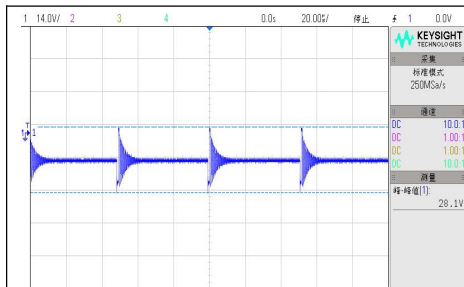


VIN=36V, 短路保护 VDS 展开波形

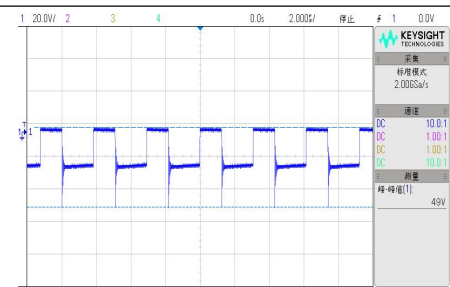


VIN=36V, 短路保护 VDS 启机波形

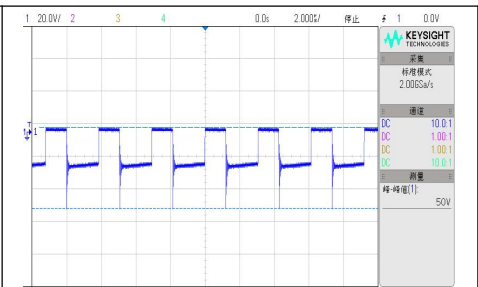
副边输出整流二极管 D5 应力波形



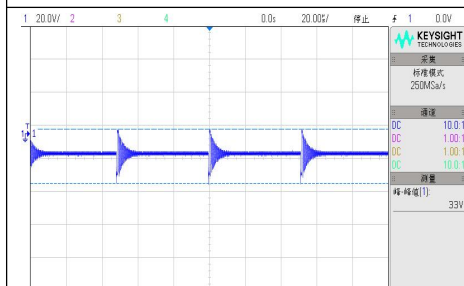
VIN=9V, D5 空载工作电压波形



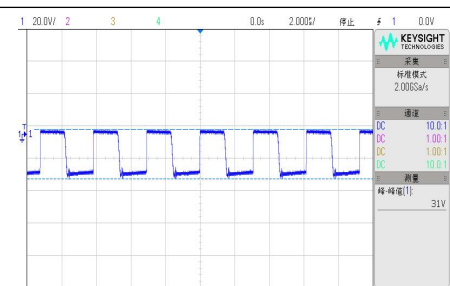
VIN=9V, D5 半载工作电压波形



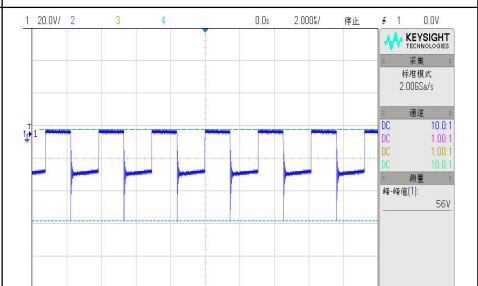
VIN=9V, D5 满载工作电压波形



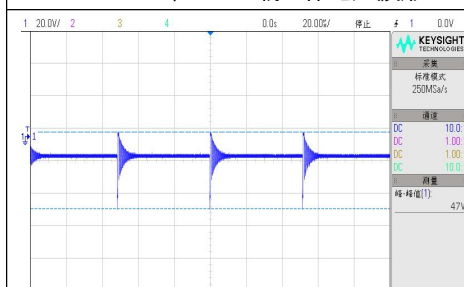
VIN=12V, D5 空载工作电压波形



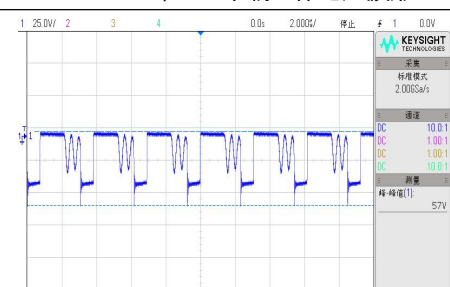
VIN=12V, D5 半载工作电压波形



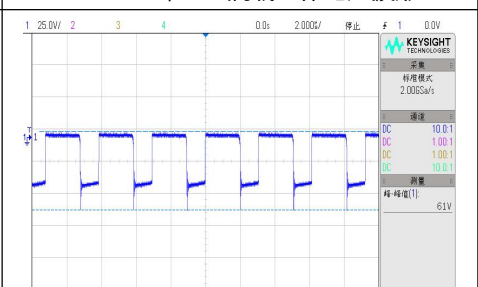
VIN=12V, D5 满载工作电压波形



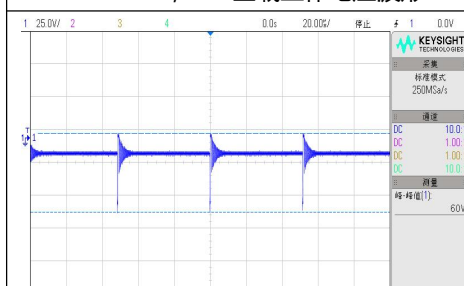
VIN=24V, D5 空载工作电压波形



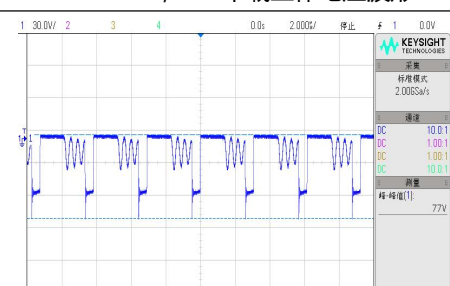
VIN=24V, D5 半载工作电压波形



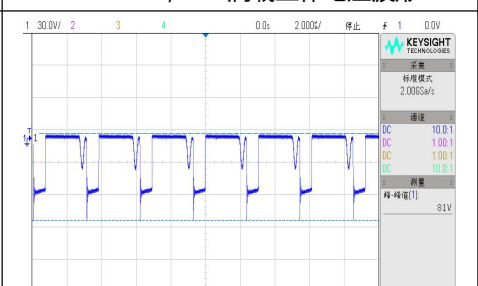
VIN=24V, D5 满载工作电压波形



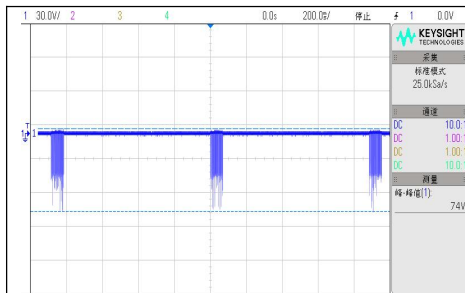
VIN=36V, D5 空载工作电压波形



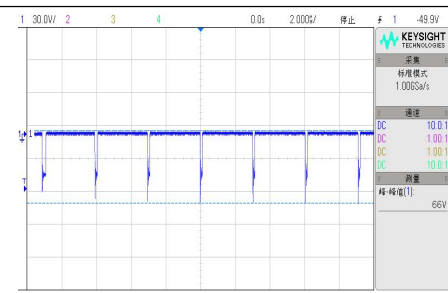
VIN=36V, D5 半载工作电压波形



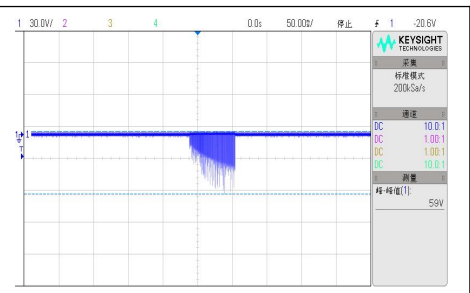
VIN=36V, D5 满载工作电压波形



VIN=36V, D5 短路保护工作电压波形

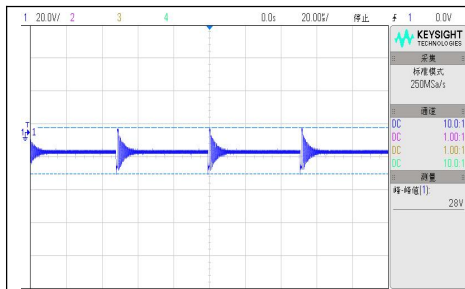


VIN=36V, D5 短路保护工作电压展开波形

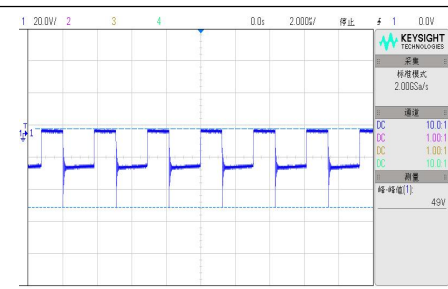


VIN=36V, D5 短路保护 VDS 启机波形

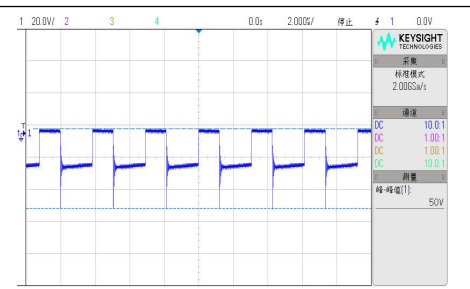
副边输出整流二极管 D6 应力波形



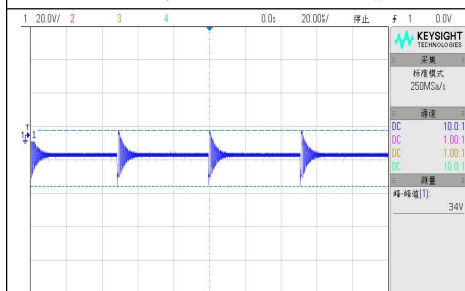
VIN=9V, D6 空载工作电压波形



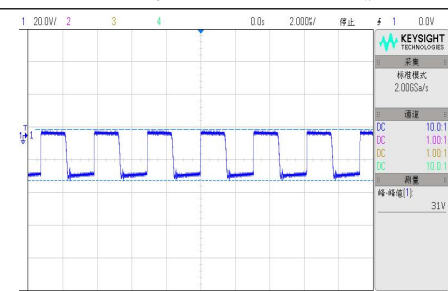
VIN=9V, D6 半载工作电压波形



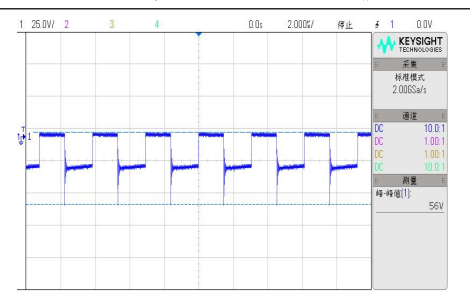
VIN=9V, D6 满载工作电压波形



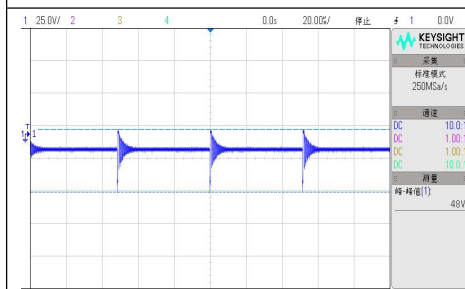
VIN=12V, D6 空载工作电压波形



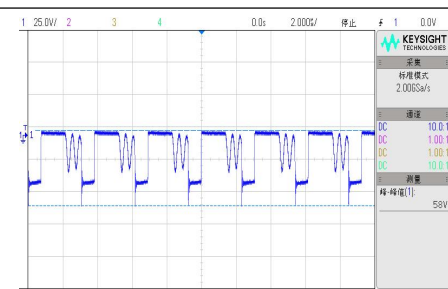
VIN=12V, D6 半载工作电压波形



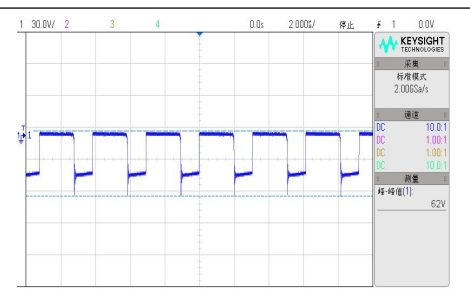
VIN=12V, D6 满载工作电压波形



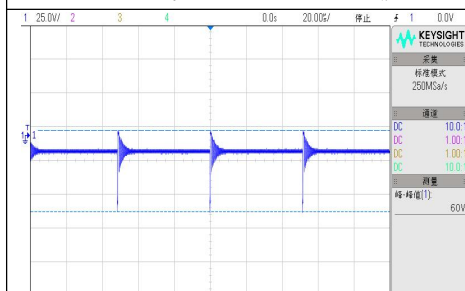
VIN=24V, D6 空载工作电压波形



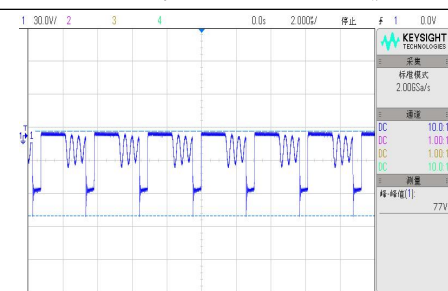
VIN=24V, D6 半载工作电压波形



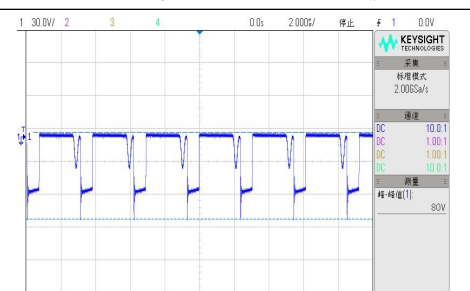
VIN=24V, D6 满载工作电压波形



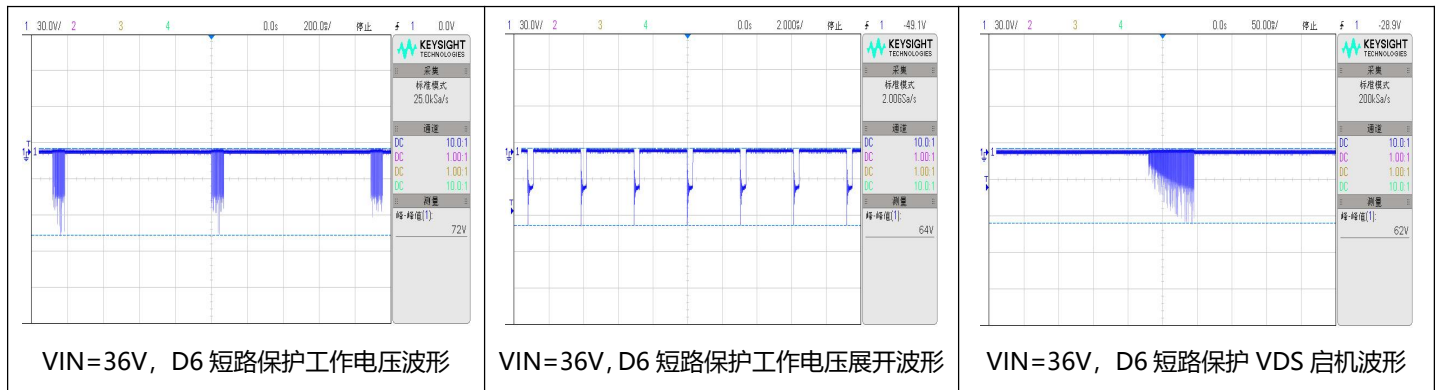
VIN=36V, D6 空载工作电压波形



VIN=36V, D6 半载工作电压波形



VIN=36V, D6 满载工作电压波形



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