

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, 同步整流控制器 VPC9527, 结合隔离功率变压器 VPE17QB-15A、原副边 MOSFET 以及必要的阻容元件, 实现 18V-75V 输入, 5V 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) 抗干扰目的相关场合。

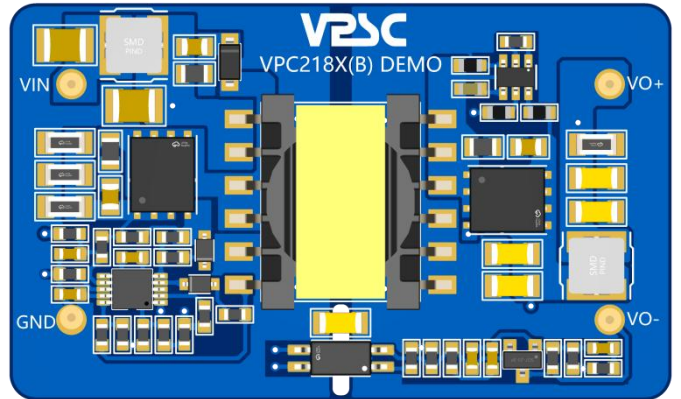
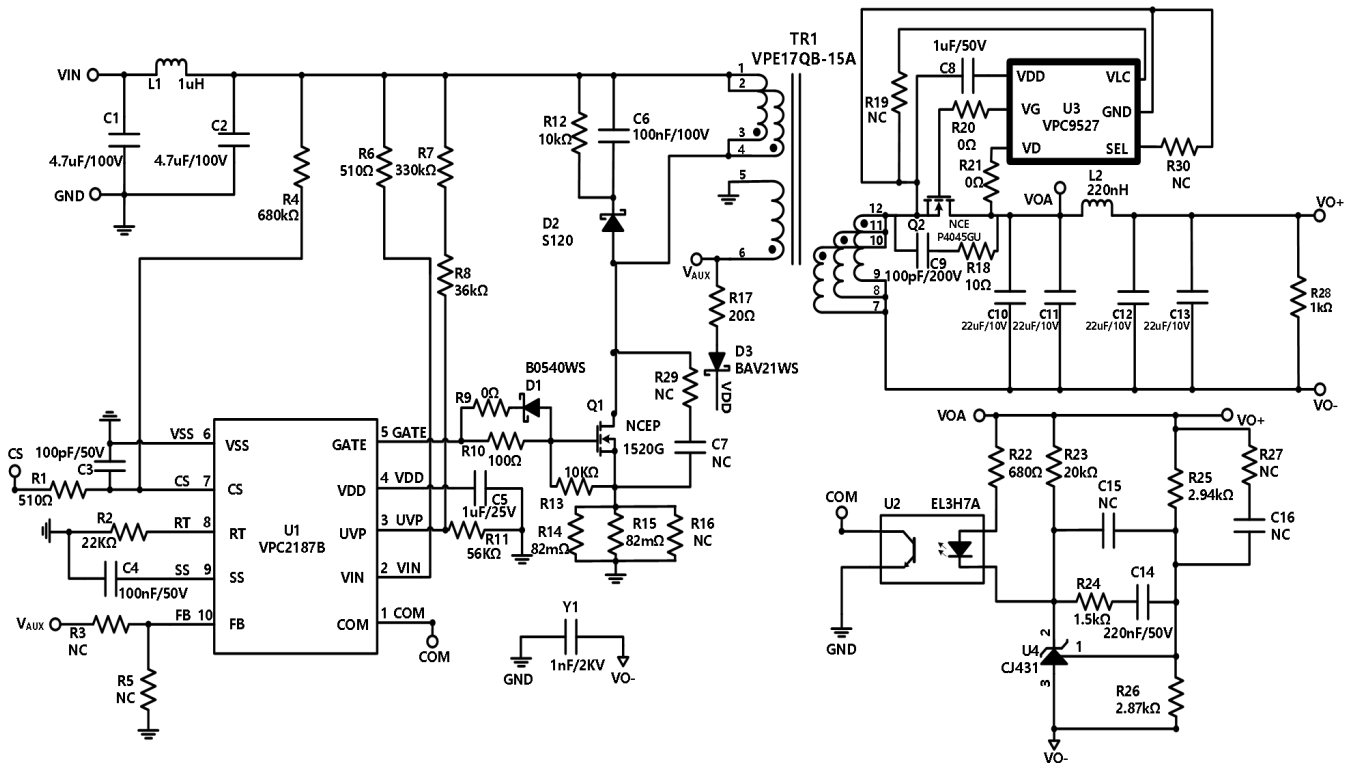


图 1: VPC218X(B) Demo 板(尺寸:50mm*30mm)

关键词: 输入: 18V-75V, 输出 5V/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

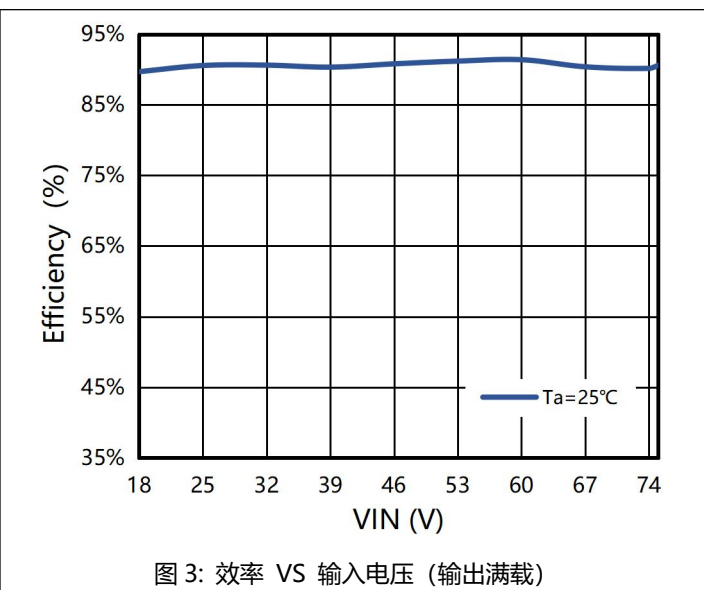
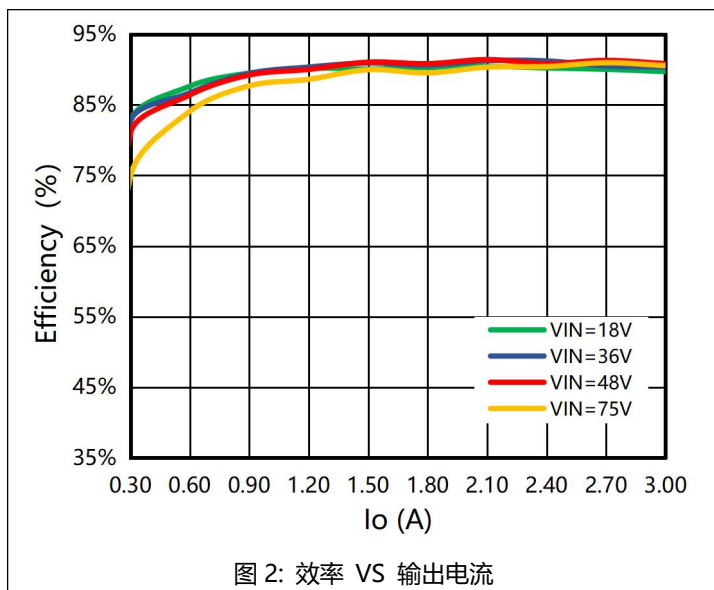
位号	参数	封装	型号	品牌
C1	4.7uF/100V-X7R	1210	1210B475K101NT	FH
C2	4.7uF/100V-X7R	1210	1210B475K101NT	FH
C3	100pF/50V-X7R	0603	CC0603KRX7R9BB101	YAGEO
C4	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C5	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C6	100nF/100V-X7R	0805	CC0805KKX7R0BB104	YAGEO
C7	NC	-	-	-
C8	1uF/50V-X7R	0603	CC0603KRX7R9BB105	YAGEO
C9	100pF/200V- NP0	0805	CC0805JRNPOABN101	YAGEO
C10	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C11	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C12	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C13	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C14	220nF/50V-X7R	0603	CC0603KRX7R9BB224	YAGEO
C15	NC	-	-	-
C16	NC	-	-	-
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R2	22KΩ±1%	0603	RC0603FR-0722KL	YAGEO
R3	NC	-	-	-
R4	680KΩ±1%	0603	RC0603FR-07680KL	YAGEO
R5	NC	-	-	-
R6	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R7	330KΩ±1%	0603	RC0603FR-07330KL	YAGEO
R8	36KΩ±1%	0603	RC0603FR-0736KL	YAGEO
R9	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R10	100Ω±1%	0603	RC0603FR-07100RL	YAGEO
R11	56KΩ±1%	0603	RC0603FR-0756KL	YAGEO
R12	10KΩ±1%	0805	RC0805FR-0710KL	YAGEO
R13	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R14	0.082Ω ±1%	1206	RL1206FR-070R082L	YAGEO
R15	0.082Ω ±1%	1206	RL1206FR-070R082L	YAGEO
R16	NC	-	-	-
R17	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R18	10Ω±1%	0805	RC0805FR-0710RL	YAGEO
R19	NC	-	-	-
R20	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R21	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R22	680Ω±1%	0603	RC0603FR-07680RL	YAGEO
R23	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO

R24	1.5K Ω ±1%	0603	RC0603FR-071K5L	YAGEO
R25	2.94K Ω ±1%	0603	RC0603FR-072K94L	YAGEO
R26	2.87K Ω ±1%	0805	RC0603FR-072K87L	YAGEO
R27	NC	-	-	-
R28	1K Ω ±1%	1206	RC1206FR-071KL	YAGEO
R29	NC	-	-	-
R30	NC	-	-	-
TR1	NP:NS:NA=13:3:7 Lp=23.66uH	ER14.5	VPE17QB-15A	VPSC
Q1	N 沟道 150V 20A	DFN5X6-8L	NCEP1520G	NCE
Q2	N 沟道 40V 45A	DFN5x6-8L	NCEP4045GU	NCE
L1	1uH ±20%	SMD	MWSA0402S-1R0MT	Sunlord
L2	220nH ±30%	SMD	WPN4020HR22MT	Sunlord
D1	40V/0.5A	SOD-323	B0540WS	CJ
D2	200V/1A	SOD-123	S120	YANGJIE
D3	200V/0.2A	SOD-323	BAV21WS	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	快速关断同步整流控制器	SOT23-6	VPC9527	VPSC
U4	Vref=2.495V	SOT23-3	CJ431	CJ

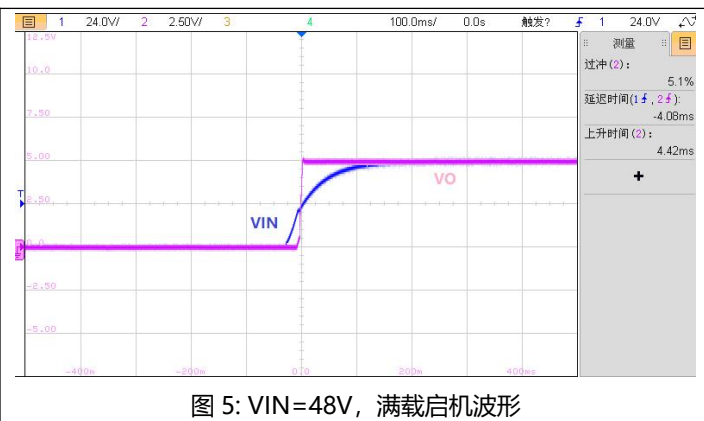
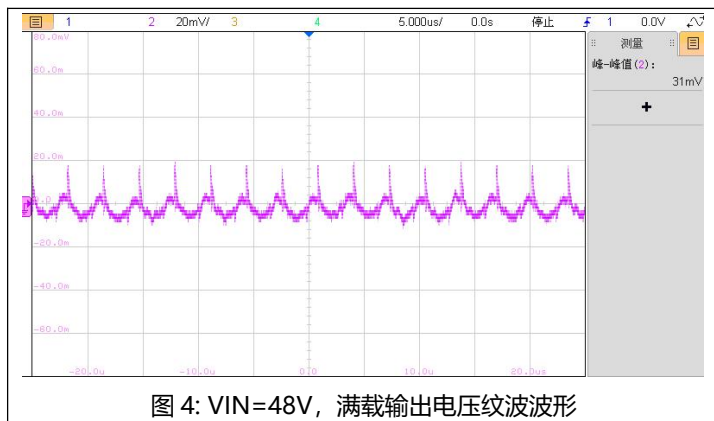
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流（满载/空载）	VIN=48V	3	---	347	mA
转换效率	VIN=48V, IO=3A	---	90.8	---	%
纹波&噪声	VIN=48V, IO=3A	---	40	80	mV
输出电压精度	VIN=48V, IO=3A	---	0.52	---	%
线性调节率	VIN=18V-75V, IO=3A	---	0.1	---	%
负载调整率	VIN=48V, IO=3A	---	0.26	---	%
输出过流点系数	VIN=18V, IO=3A	1.47	---	---	倍
最大容性负载	VIN=18V, IO=3A	---	6800	---	uF
输入欠压保护	锁定电压	---	15.3	---	V
	恢复电压	---	16.6	---	V
短路保护	VIN=18V-75V	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

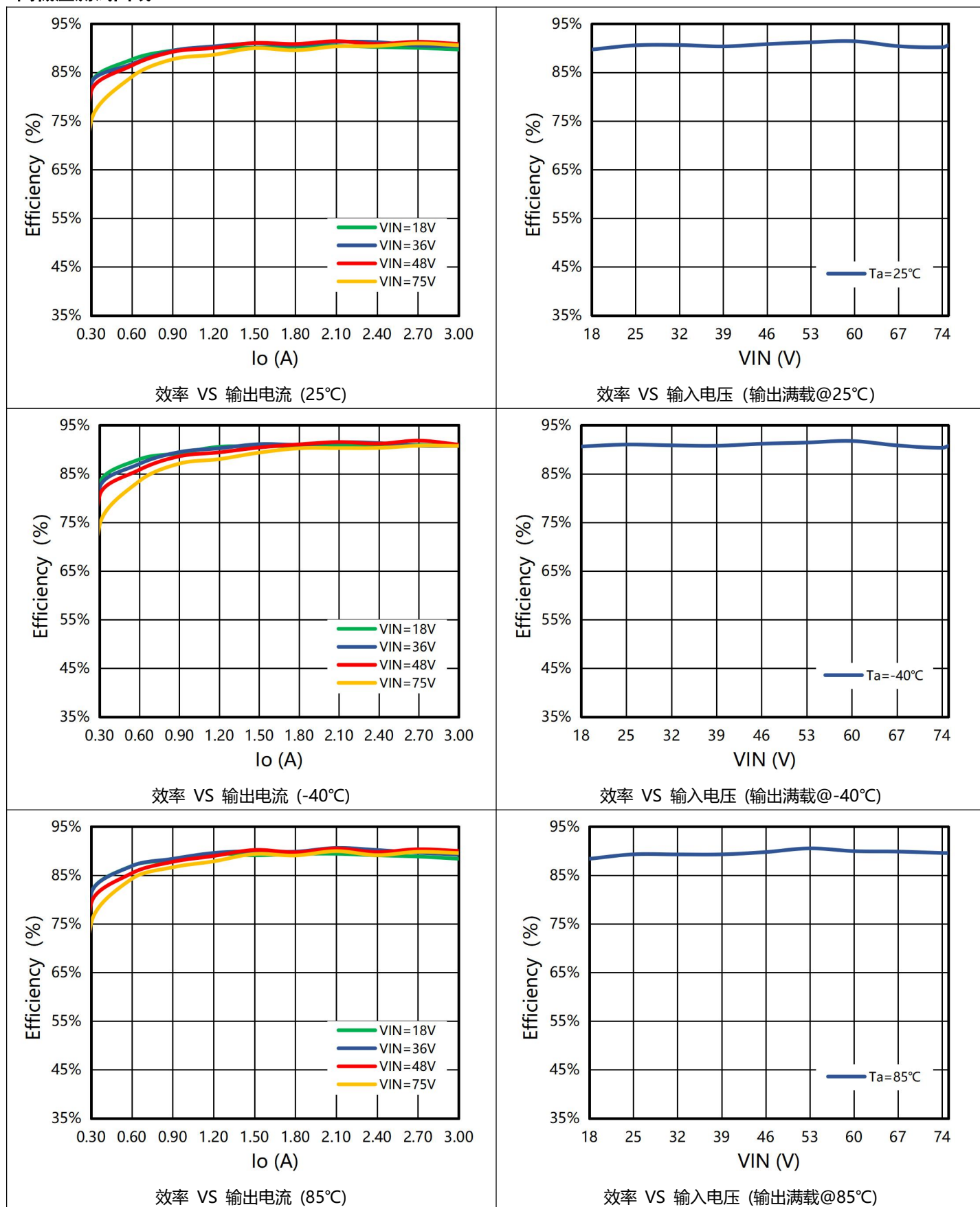


相关波形



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(%)
48.00	0.003	5.05	0.000	0%	0.00%
48.00	0.039	5.05	0.300	10%	80.90%
47.99	0.073	5.05	0.600	20%	86.40%
47.99	0.106	5.04	0.900	30%	89.22%
47.99	0.140	5.04	1.200	40%	90.02%
47.98	0.173	5.04	1.500	50%	91.04%
47.98	0.208	5.04	1.800	60%	90.83%
47.98	0.241	5.03	2.100	70%	91.40%
47.98	0.277	5.03	2.400	80%	90.85%
47.97	0.310	5.03	2.700	90%	91.29%
47.97	0.346	5.03	3.000	100%	90.84%

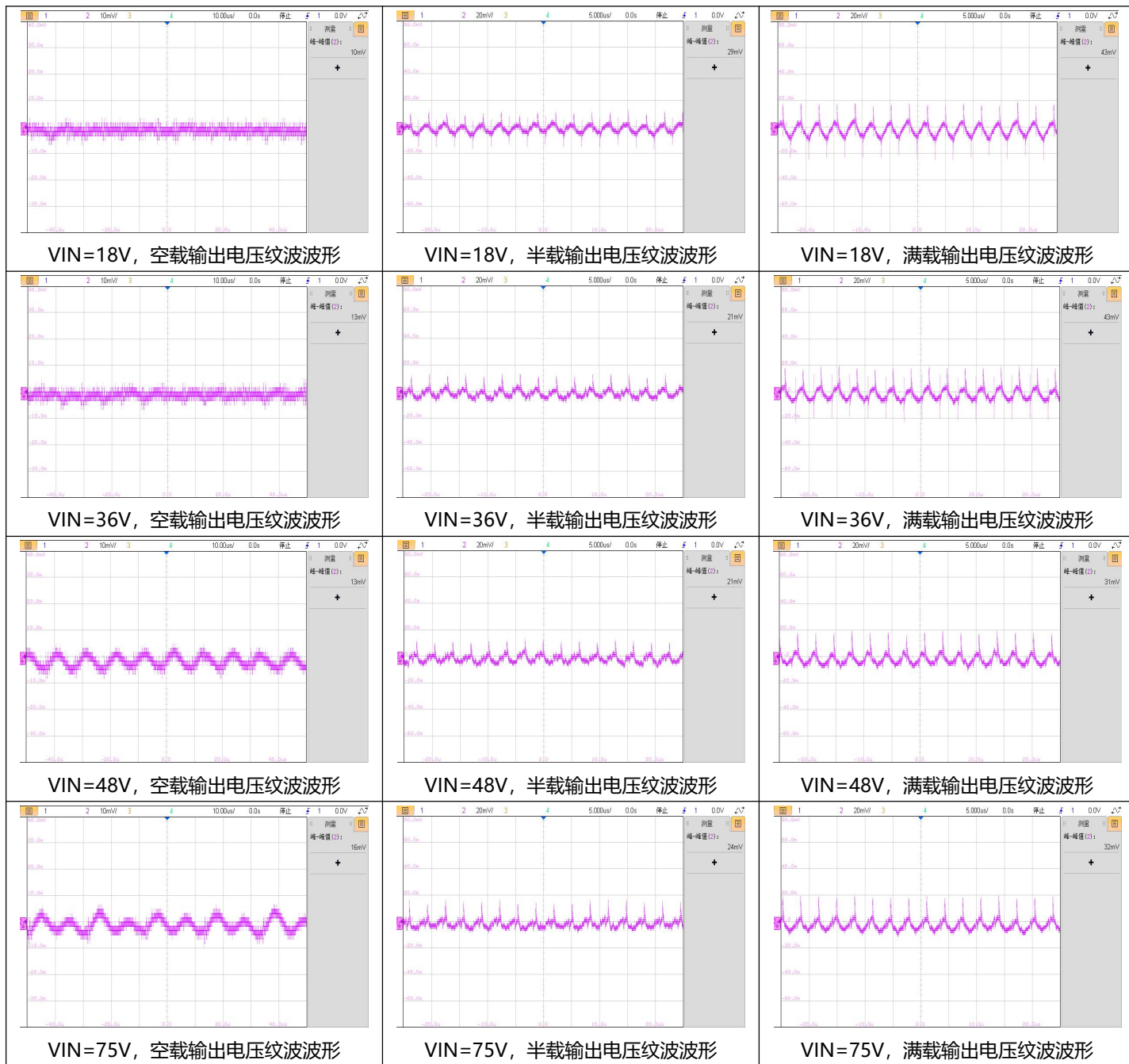
VIN=48V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
48.00	0.002	5.02	0.000	0%	0.00%
48.00	0.039	5.02	0.300	10%	80.37%
48.00	0.073	5.01	0.600	20%	85.82%
48.00	0.106	5.01	0.900	30%	88.60%
47.99	0.140	5.01	1.200	40%	89.41%
47.99	0.173	5.00	1.500	50%	90.41%
47.99	0.206	5.00	1.800	60%	91.06%
47.98	0.239	5.00	2.100	70%	91.53%
47.98	0.274	5.00	2.400	80%	91.21%
47.98	0.306	4.99	2.700	90%	91.82%
47.97	0.343	4.99	3.000	100%	91.00%

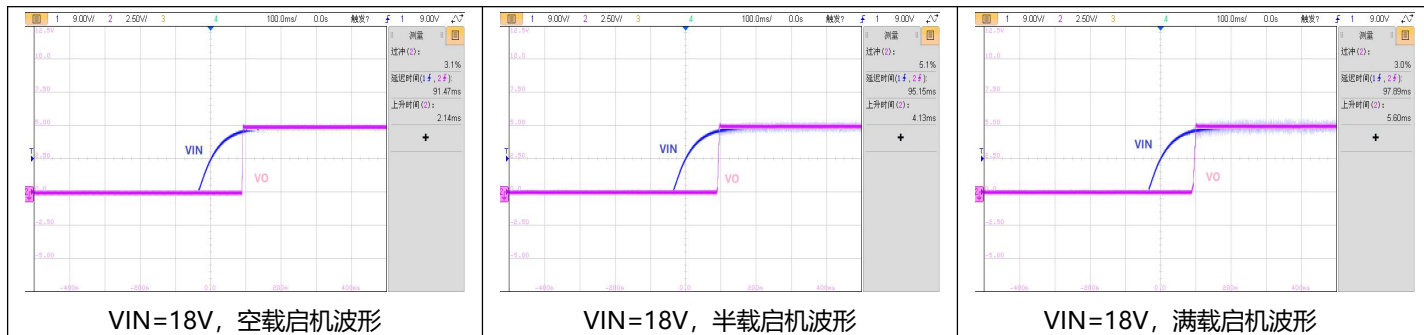
VIN=48V, Ta=85°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
48.00	0.003	5.06	0.000	0%	0.00%
48.00	0.040	5.06	0.300	10%	79.03%
47.99	0.074	5.06	0.600	20%	85.42%
47.99	0.108	5.05	0.900	30%	87.76%
47.99	0.142	5.05	1.200	40%	88.96%
47.98	0.175	5.05	1.500	50%	90.20%
47.98	0.211	5.05	1.800	60%	89.74%
47.98	0.244	5.04	2.100	70%	90.48%
47.97	0.281	5.04	2.400	80%	89.77%
47.97	0.314	5.04	2.700	90%	90.34%
47.97	0.350	5.04	3.000	100%	90.02%

输出电压纹波波形

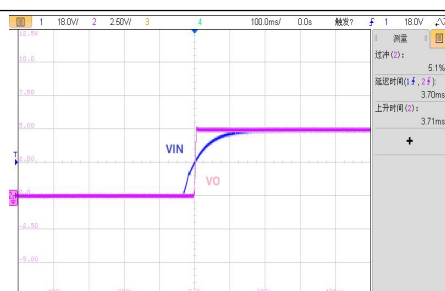


开关机波形

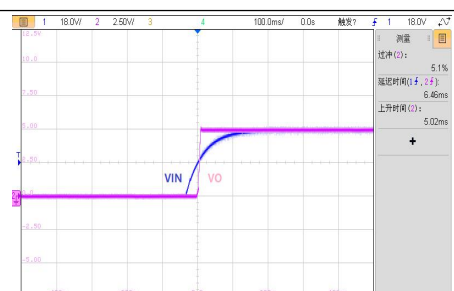




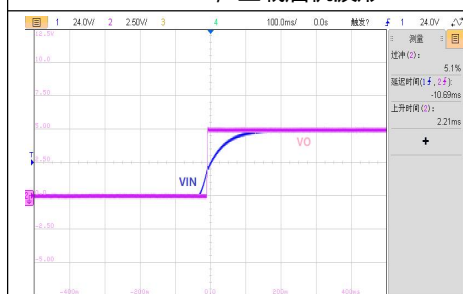
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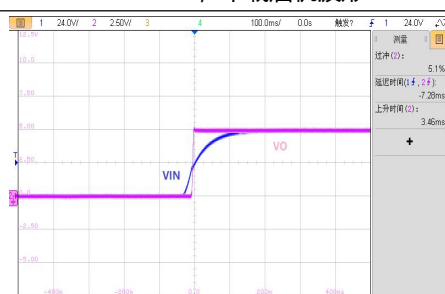
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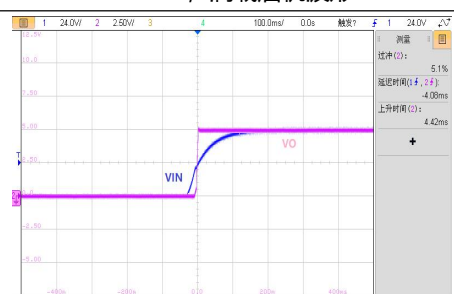
VIN=36V, 满载启机波形



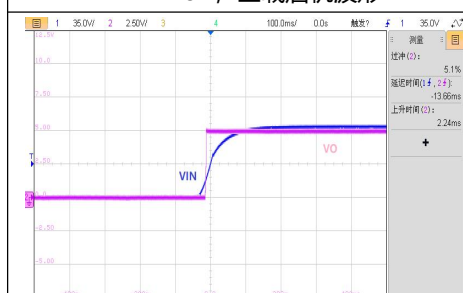
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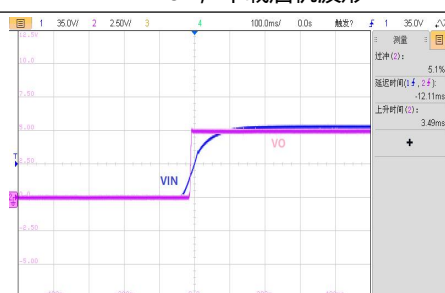
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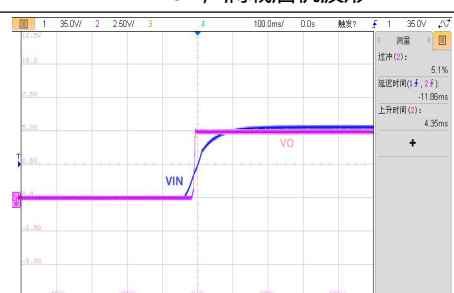
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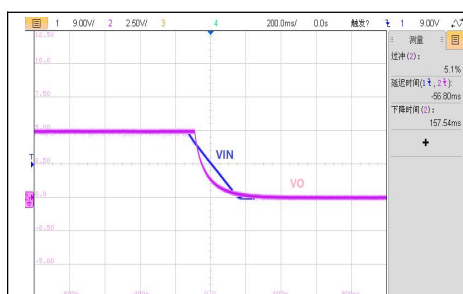
VIN=75V, 空载启机波形



VIN=75V, 半载启机波形



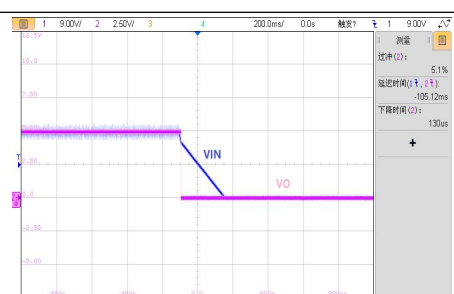
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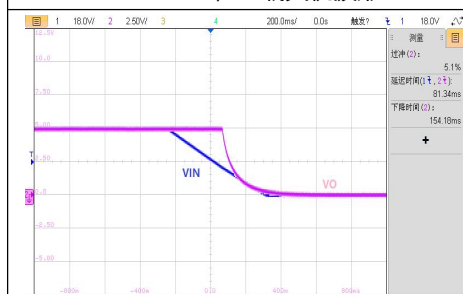
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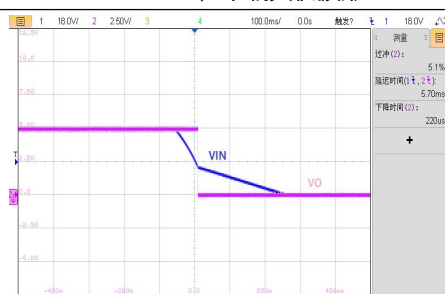
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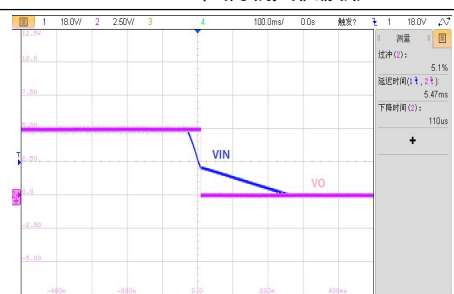
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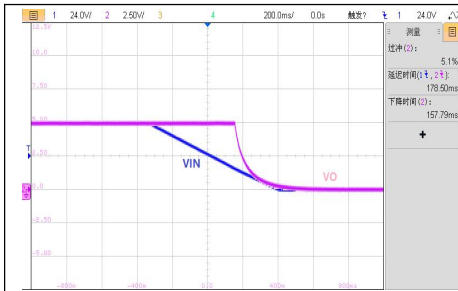
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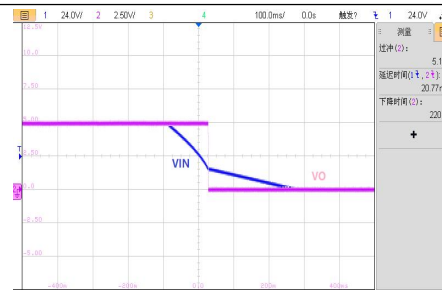
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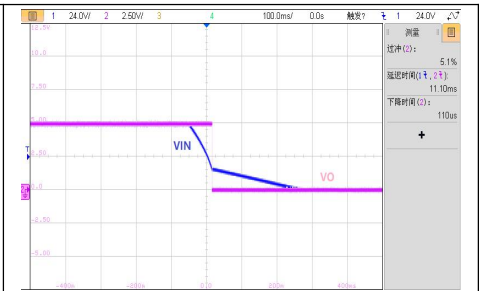
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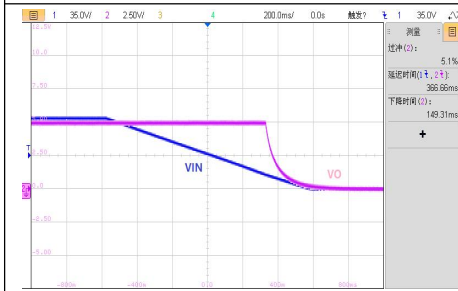
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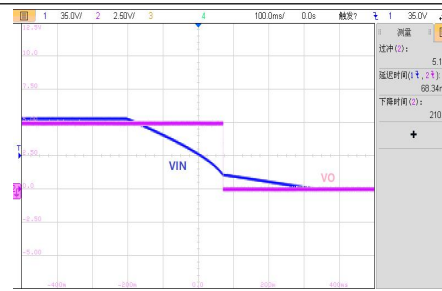
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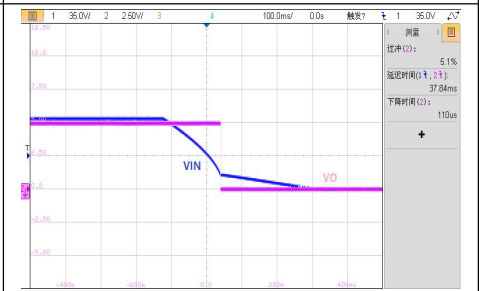
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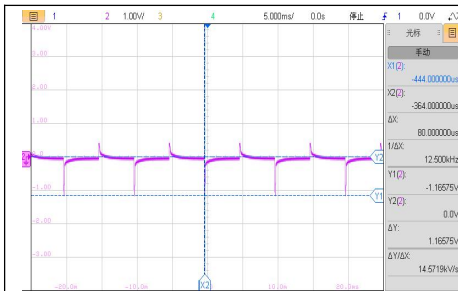


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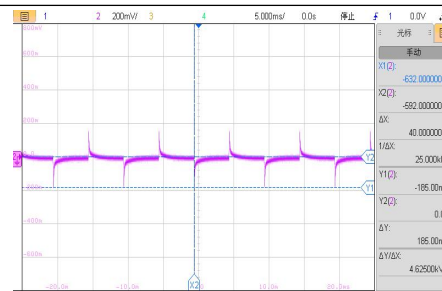


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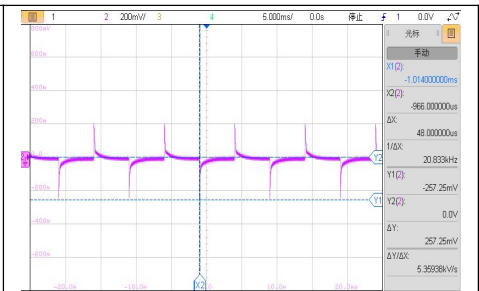
动态波形



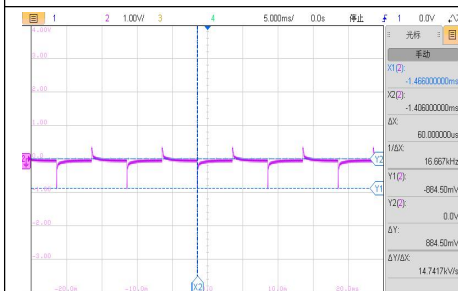
VIN=18V, 100%-10%-100%Io 动态波形



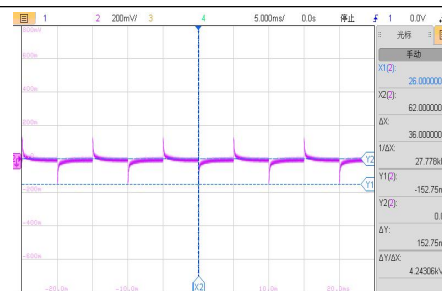
VIN=18V, 75%-50%-75%Io 动态波形



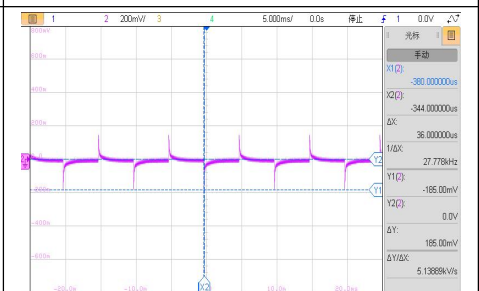
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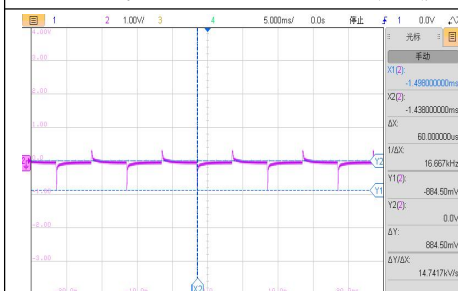
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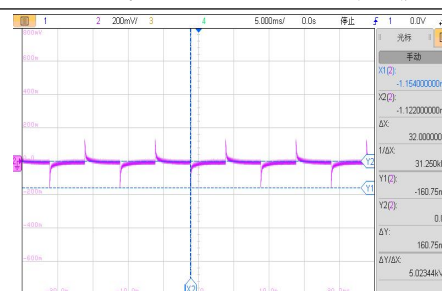
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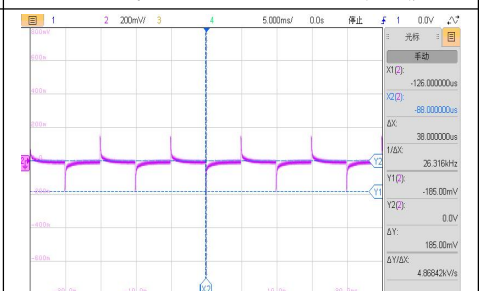
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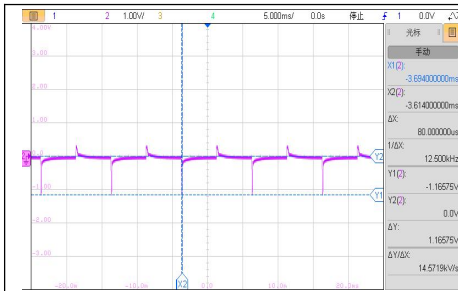
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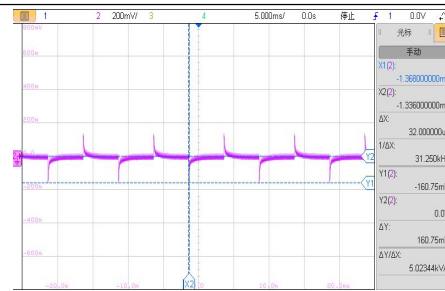
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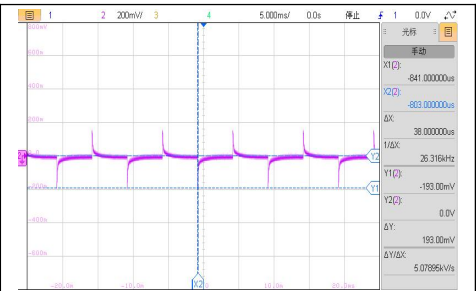
VIN=48V, 50%-25%-50%Io 动态波形



VIN=75V, 100%-10%-100%Io 动态波形

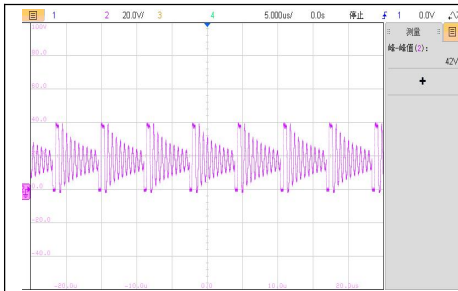


VIN=75V, 75%-50%-75%Io 动态波形

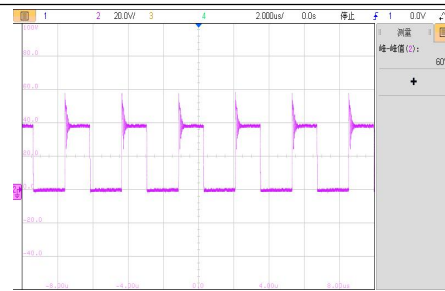


VIN=75V, 50%-25%-50%Io 动态波形

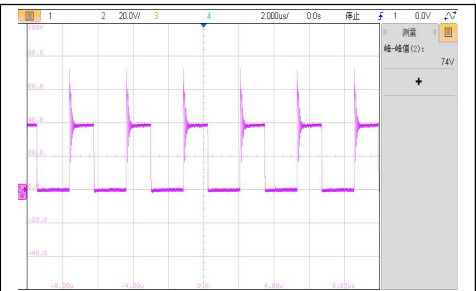
原边 MOS 管 Q1 电压应力波形



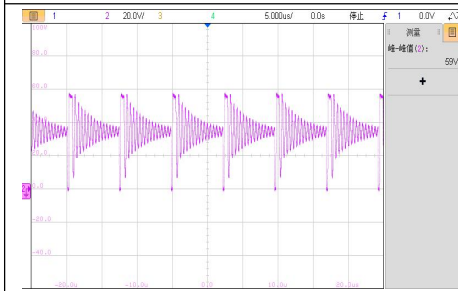
VIN=18V, 空载 VDS 波形



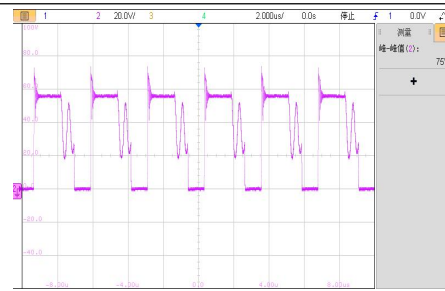
VIN=18V, 半载 VDS 波形



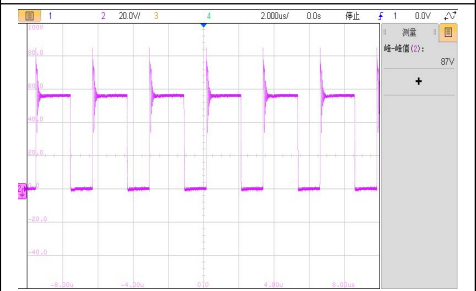
VIN=18V, 满载 VDS 波形



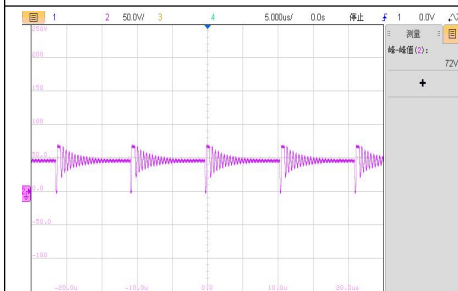
VIN=36V, 空载 VDS 波形



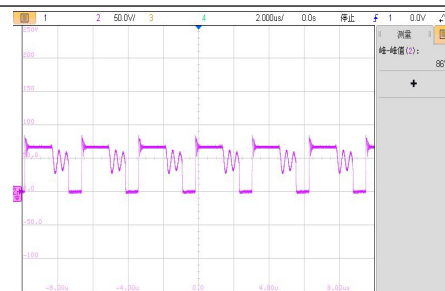
VIN=36V, 半载 VDS 波形



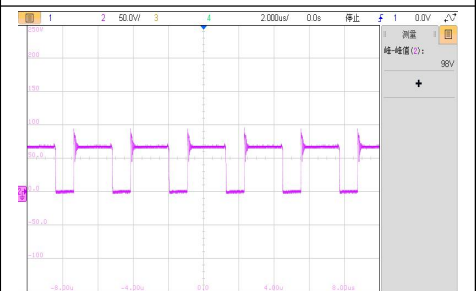
VIN=36V, 满载 VDS 波形



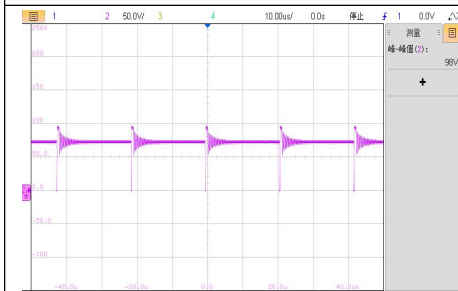
VIN=48V, 空载 VDS 波形



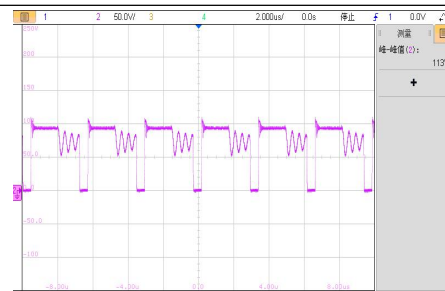
VIN=48V, 半载 VDS 波形



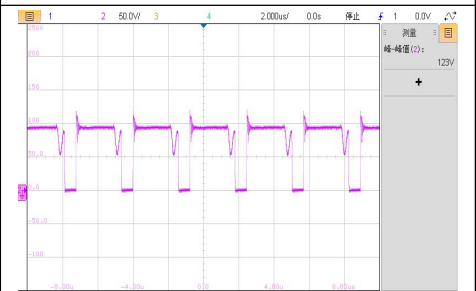
VIN=48V, 满载 VDS 波形



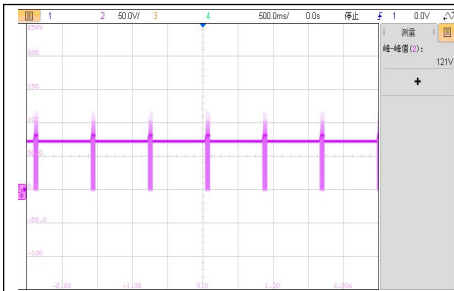
VIN=75V, 空载 VDS 波形



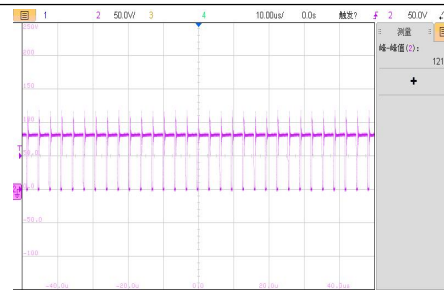
VIN=75V, 半载 VDS 波形



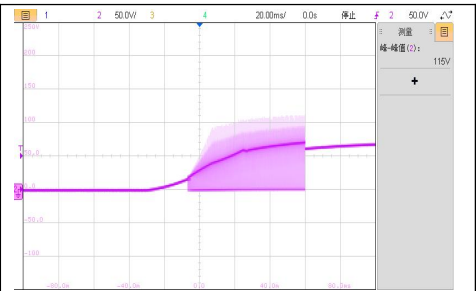
VIN=75V, 满载 VDS 波形



VIN=75V, 短路保护 VDS 波形

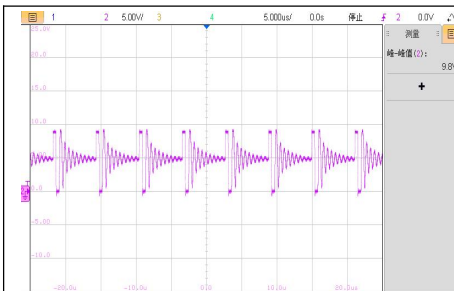


VIN=75V, 短路保护 VDS 展开波形

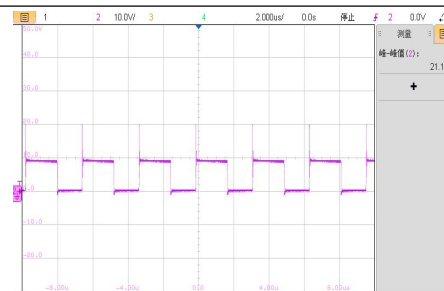


VIN=75, 短路启机 VDS 波形

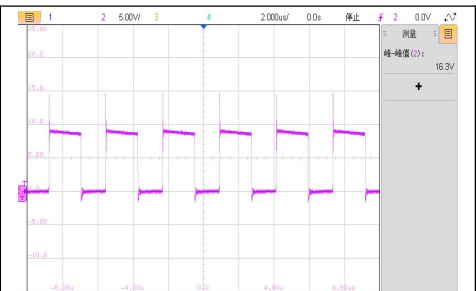
副边 MOS 管 Q2 电压应力波形



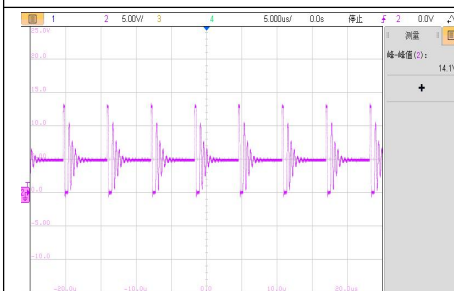
VIN=18V, 空载工作电压波形



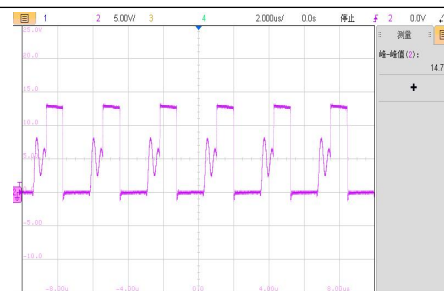
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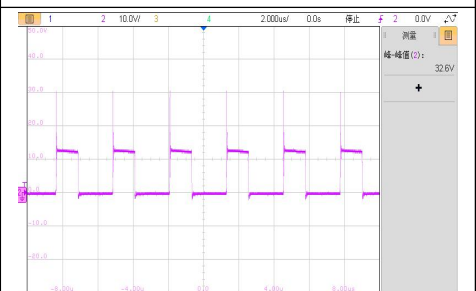
VIN=18V, 满载工作电压波形



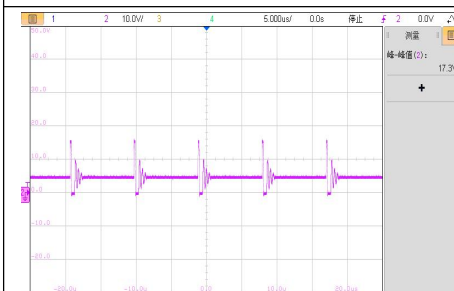
VIN=36V, 空载工作电压波形



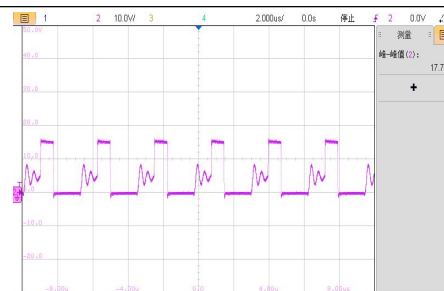
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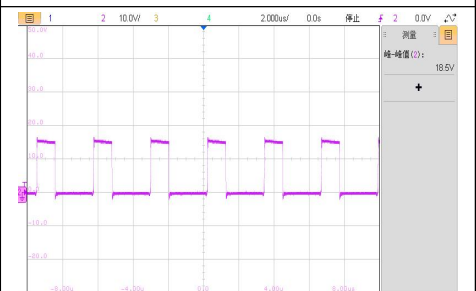
VIN=36V, 满载工作电压波形



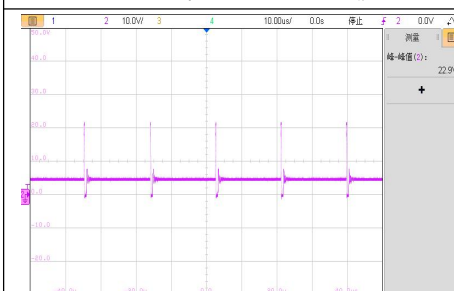
VIN=48V, 空载工作电压波形



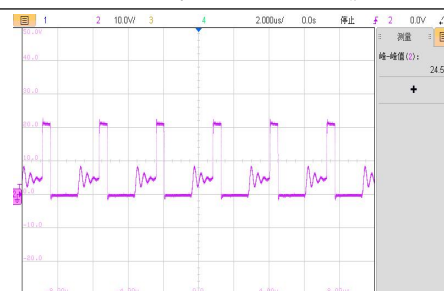
VIN=48V, 半载工作电压波形



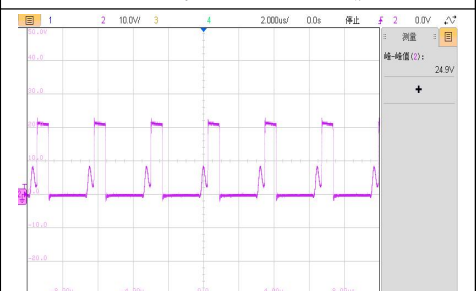
VIN=48V, 满载工作电压波形



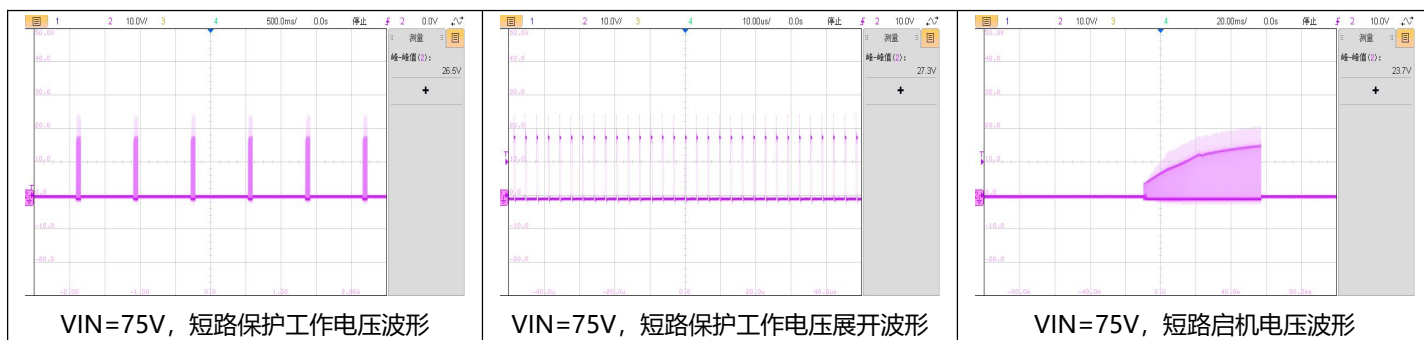
VIN=75V, 空载工作电压波形



VIN=75V, 半载工作电压波形



VIN=75V, 满载工作电压波形



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