

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 VPE27PB-15A、输出整流二极管以及必要的阻容元件，实现 9V-36V 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）抗干扰目的的相关场合。

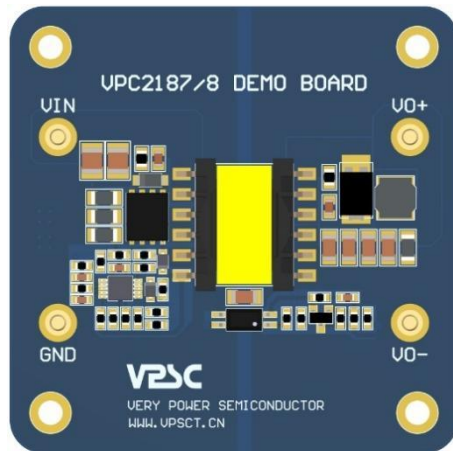
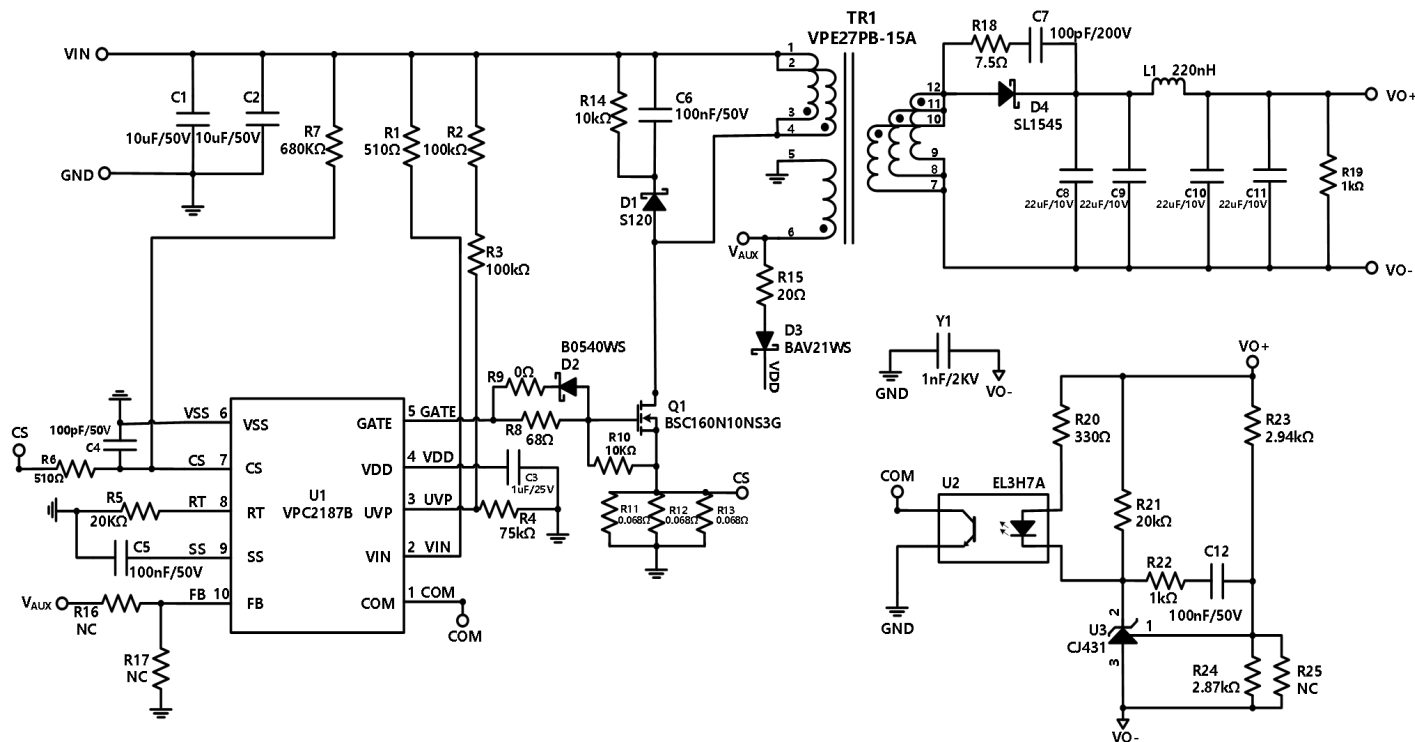


图 1: VPC2187B Demo 板(尺寸:55mm*55mm)

关键词：输入：9V-36V，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

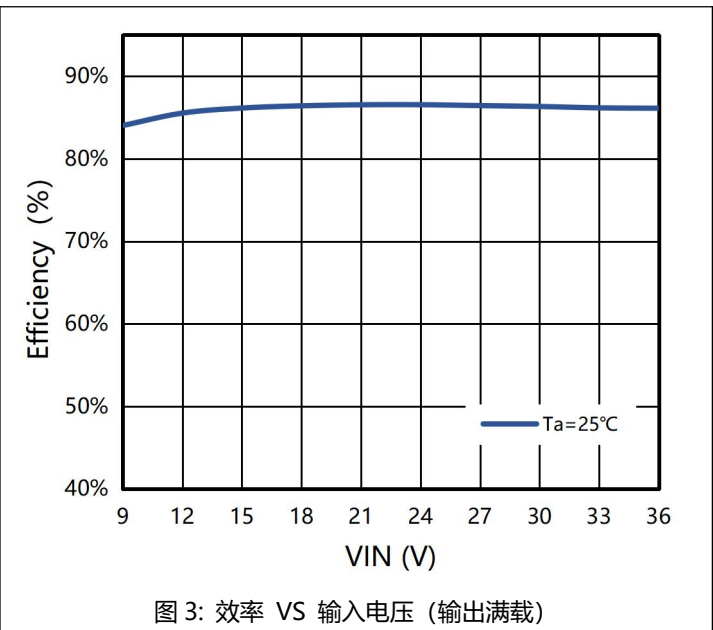
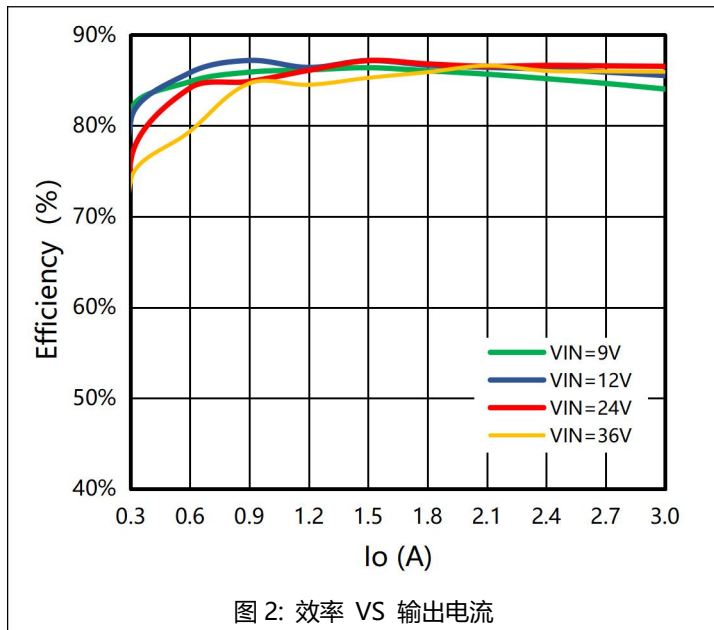
位号	参数	封装	型号	品牌
C1	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C2	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C3	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C4	100pF/50V- NP0	0603	CC0603JRNPO9BN101	YAGEO
C5	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C6	100nF/50V-X7R	0805	CC0805KKX7R0BB104	YAGEO
C7	100pF/200V- NP0	0805	CC0805JRNPOABN101	YAGEO
C8	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C9	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C10	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C11	22uF/10V-X7R	1206	CC1206KKX7R6BB226	YAGEO
C12	100nF/50V-X7R	0603	CC0603KRX7R9BB104	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	680KΩ±1%	0603	RC0603FR-07680KL	YAGEO
R8	68Ω±1%	0603	RC0603FR-0768RL	YAGEO
R9	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R10	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R11	0.068Ω ±1%	1206	RL1206JR-070R068L	YAGEO
R12	0.068Ω ±1%	1206	RL1206JR-070R068L	YAGEO
R13	0.068Ω ±1%	1206	RL1206JR-070R068L	YAGEO
R14	10KΩ±1%	0805	RC0805FR-0710KL	YAGEO
R15	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R16	NC	-	-	-
R17	NC	-	-	-
R18	7.5Ω±1%	0805	RC0805FR-077R5L	YAGEO
R19	1KΩ±1%	1206	RC1206FR-071KL	YAGEO
R20	330Ω±1%	0603	RC0603FR-07330RL	YAGEO
R21	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R22	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R23	2.94KΩ±1%	0603	RC0603FR-072K94L	YAGEO
R24	2.87KΩ±1%	0805	RC0603FR-072K87L	YAGEO
R25	NC	-	-	-
TR1	NP:NS:NA=7:4:9 Lp=6.86uH	ER14.5	VPE27PB-15A	VPSC

Q1	N 沟道 100V 42A	PG-TDSON-8	BSC160N10NS3G	INFINEON
L1	220nH $\pm 30\%$	SMD	MWSA0402S-R22MT	Sunlord
D1	200V/1A	SOD-123	S120	YANGJIE
D2	85V/0.2A	SOD-323	B0540WS	CJ
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	45V/15A	TO-277	SL1545	MDD
U1	4-100VIN 电源管理芯片	MSOP-10	VPC2187B	VPSC
U2	CTR=80~160, $V_{iso}=3750VAC$	SSOP-4	EL3H7A	EVERLIGHT
U3	$V_{ref}=2.495V$	SOT23-3	CJ431	CJ

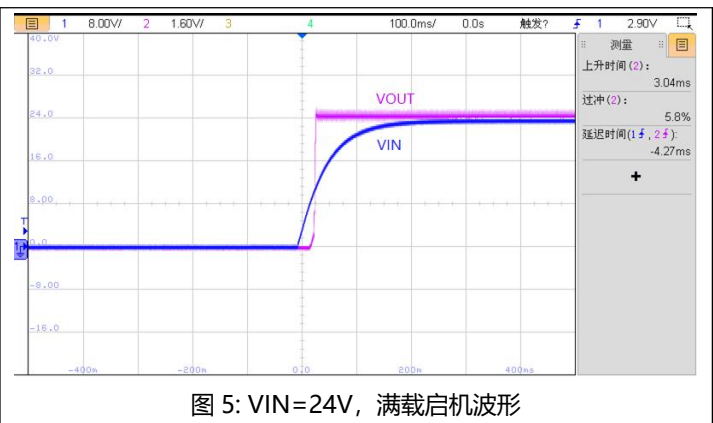
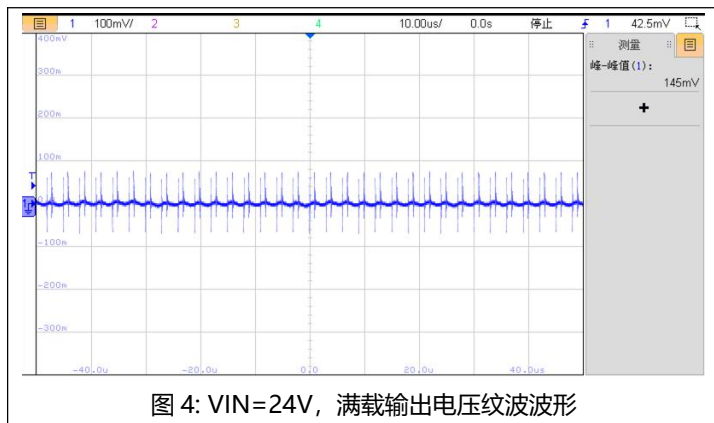
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流（满载/空载）	VIN=24V	6	---	727	mA
转换效率	VIN=24V, IO=3A	---	86.55	---	%
纹波&噪声	VIN=24V, IO=3A	---	130	160	mV
输出电压精度	VIN=24V, IO=3A	---	0.1	---	%
线性调节率	VIN=9V-36V, IO=3A	---	0	---	%
负载调整率	VIN=24V, IO=3A	---	0.1	---	%
输入欠压保护	锁定电压	---	7.6	---	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

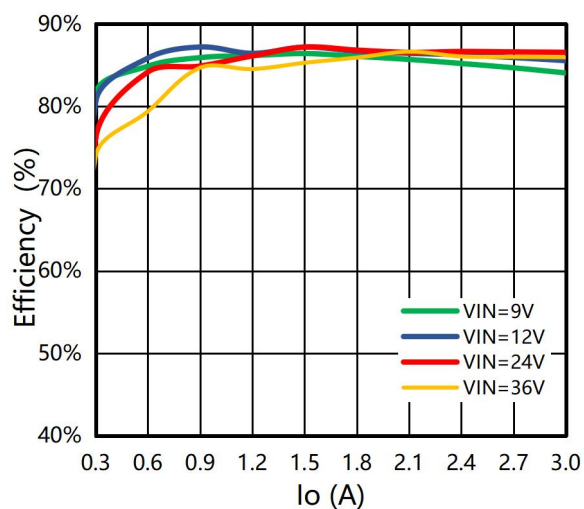


相关波形

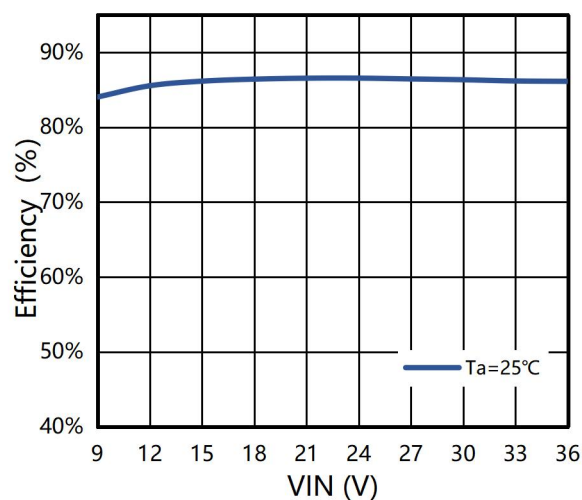


详细测试数据

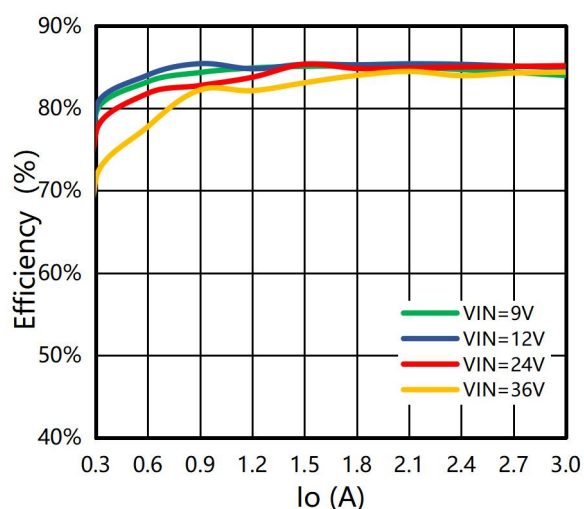
高低温测试曲线



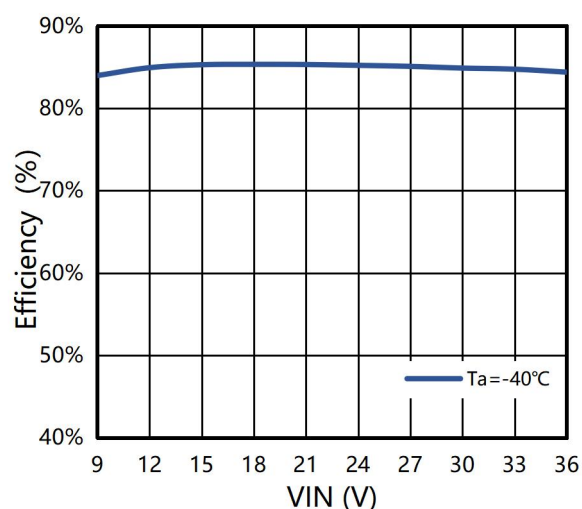
效率 VS 输出电流 (25°C)



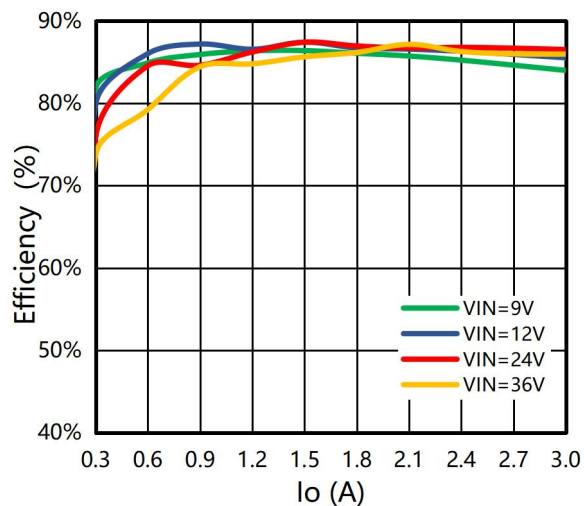
效率 VS 输入电压 (输出满载@25°C)



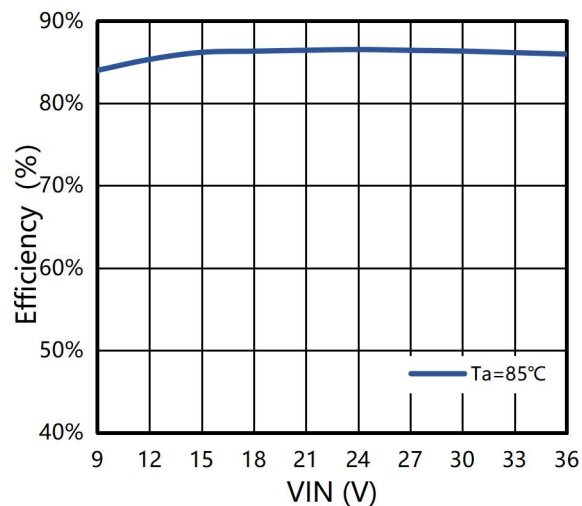
效率 VS 输出电流 (-40°C)



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(%)
23.99	0.006	5.04	0	0%	0.00%
23.99	0.083	5.04	0.301	10%	76.19%
23.99	0.150	5.04	0.601	20%	84.18%
23.99	0.223	5.04	0.901	30%	84.88%
23.99	0.293	5.04	1.201	40%	86.11%
23.99	0.361	5.03	1.501	50%	87.18%
23.99	0.435	5.03	1.801	60%	86.81%
23.99	0.509	5.03	2.101	70%	86.55%
23.99	0.581	5.03	2.401	80%	86.65%
23.99	0.654	5.03	2.701	90%	86.59%
23.99	0.727	5.03	3.001	100%	86.55%

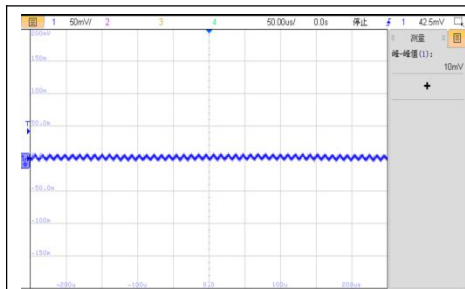
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.99	0.005	5.03	0	0%	0.00%
23.99	0.082	5.03	0.301	10%	76.96%
23.99	0.154	5.03	0.601	20%	81.83%
23.99	0.228	5.03	0.900	30%	82.76%
23.99	0.300	5.02	1.201	40%	83.77%
23.99	0.368	5.02	1.501	50%	85.35%
23.99	0.444	5.02	1.800	60%	84.83%
23.99	0.518	5.02	2.101	70%	84.87%
23.99	0.591	5.02	2.401	80%	85.01%
23.99	0.664	5.02	2.700	90%	85.09%
23.99	0.737	5.02	3.000	100%	85.18%

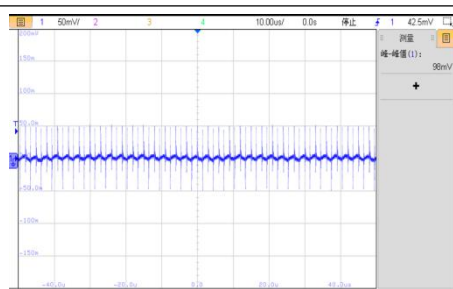
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VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.98	0.006	5.03	0	0%	0.00%
23.99	0.083	5.03	0.301	10%	76.04%
23.99	0.149	5.03	0.601	20%	84.57%
23.99	0.223	5.03	0.900	30%	84.62%
23.99	0.292	5.03	1.201	40%	86.24%
23.99	0.360	5.03	1.501	50%	87.42%
23.99	0.434	5.03	1.800	60%	86.96%
23.99	0.508	5.03	2.101	70%	86.72%
23.99	0.580	5.03	2.401	80%	86.80%
23.99	0.653	5.03	2.700	90%	86.69%
23.98	0.726	5.02	3.001	100%	86.53%

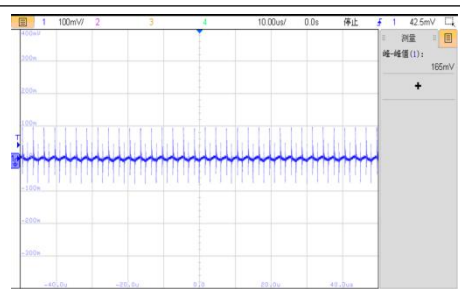
输出电压纹波波形



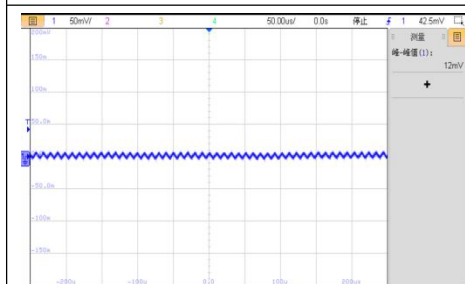
VIN=9V, 空载输出电压纹波波形



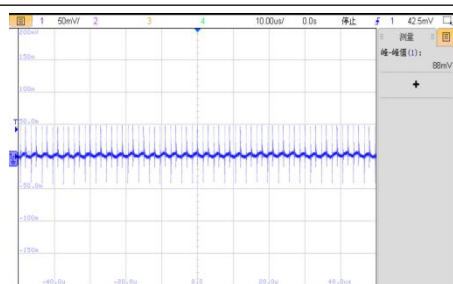
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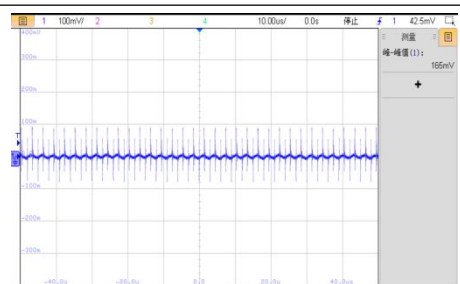
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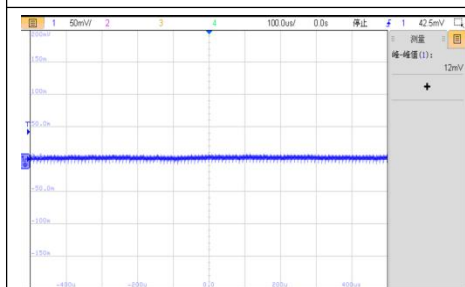
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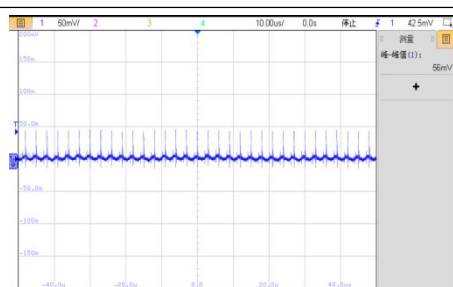
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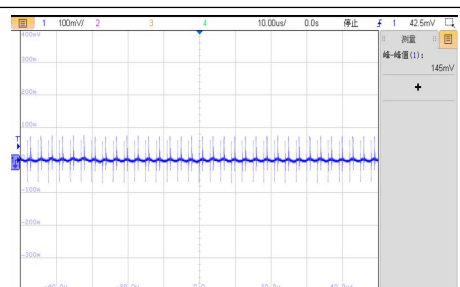
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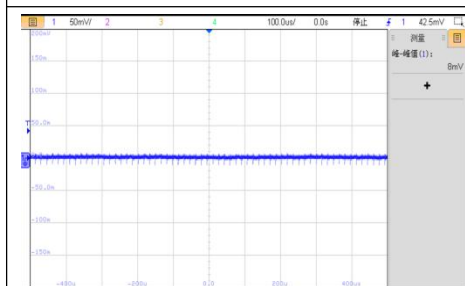
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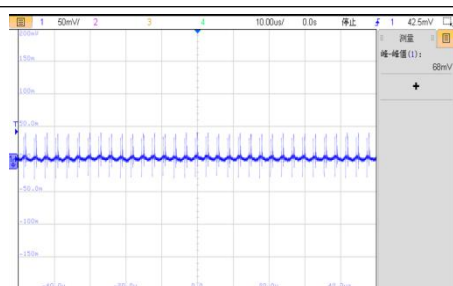
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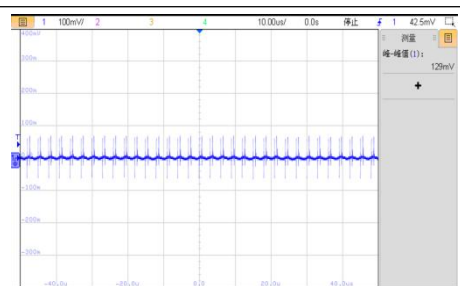
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VIN=36V, 空载输出电压纹波波形

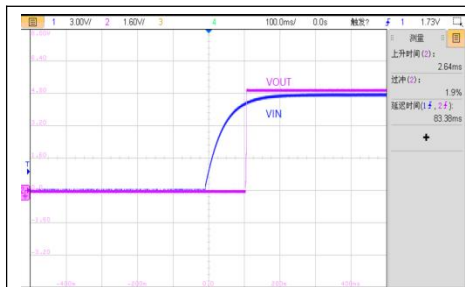


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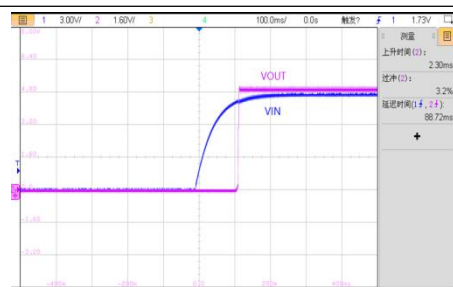


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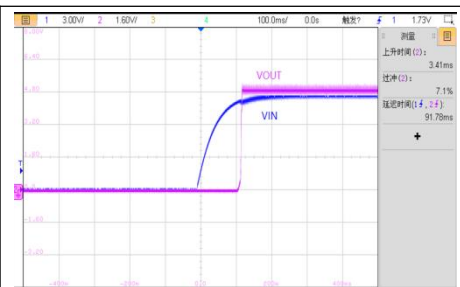
开关机波形



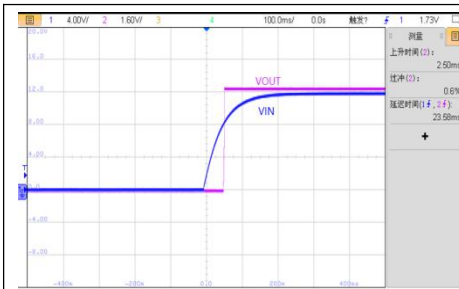
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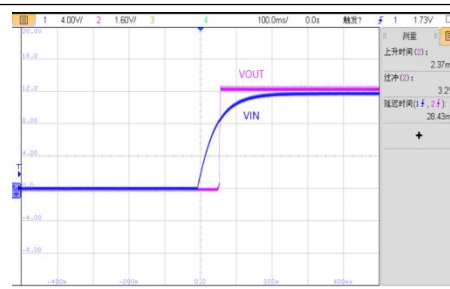
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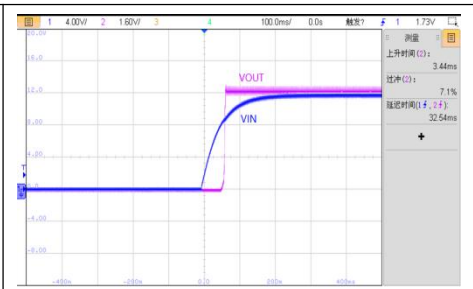
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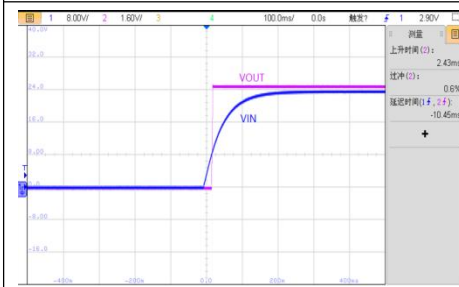
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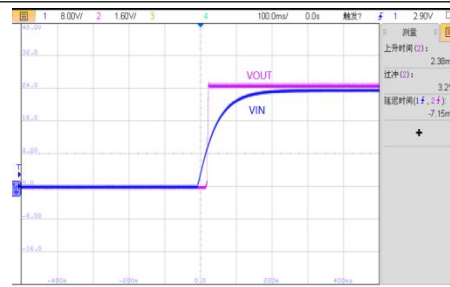
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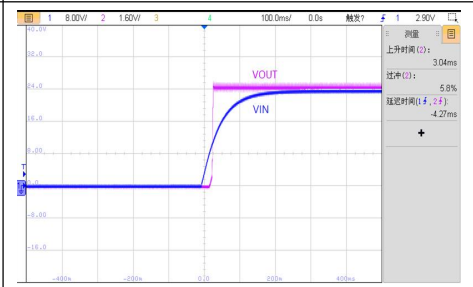
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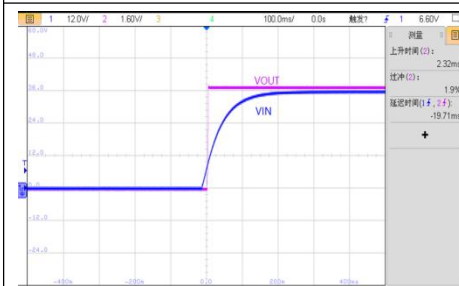
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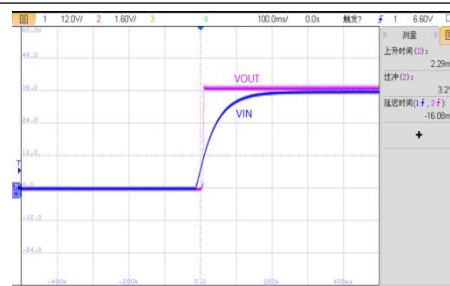
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VIN=24V, 满载启机波形



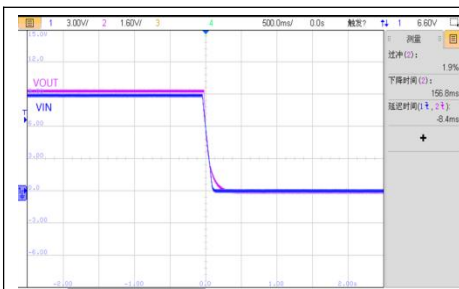
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VIN=36V, 半载启机波形



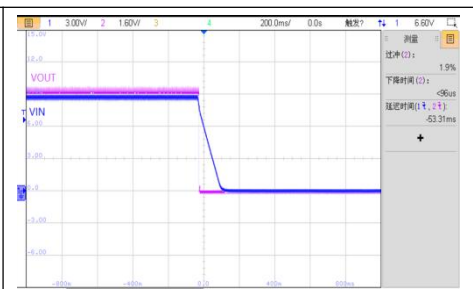
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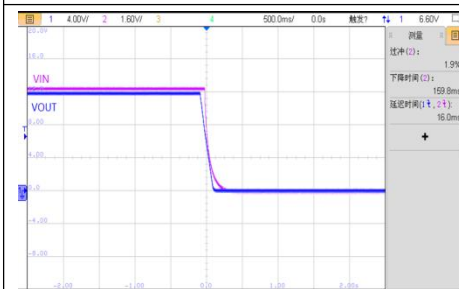
VIN=9V, 空载关机波形



VIN=9V, 半载关机波形



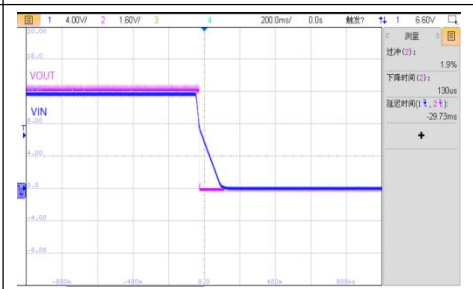
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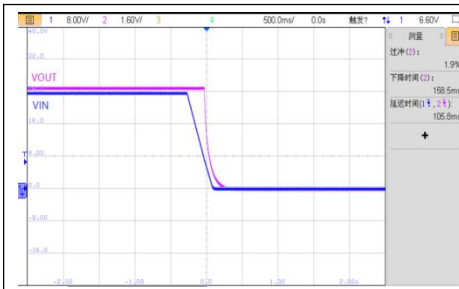
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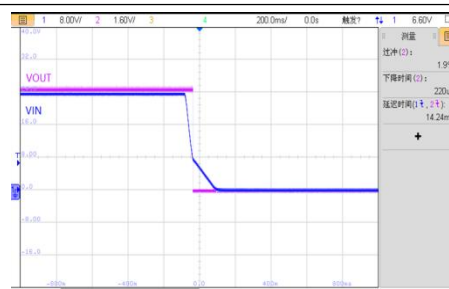
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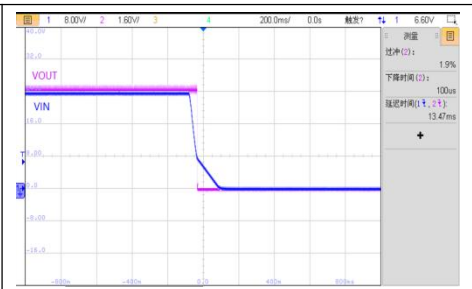
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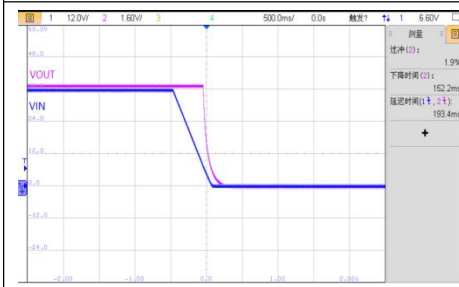
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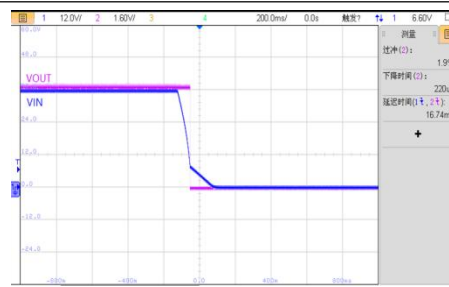
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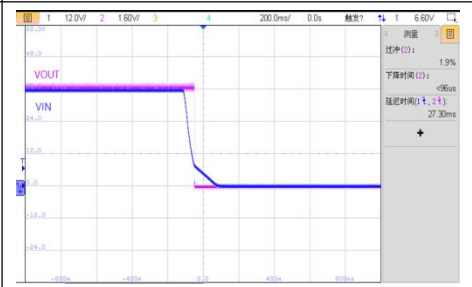
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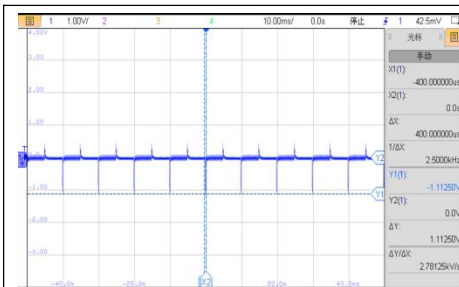


VIN=36V, 半载关机波形

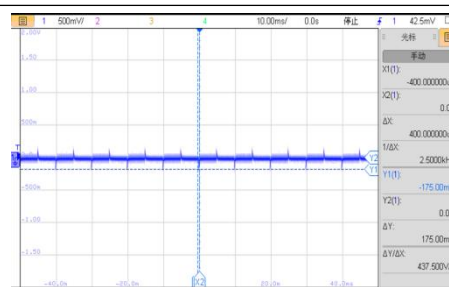


VIN=36V, 满载关机波形

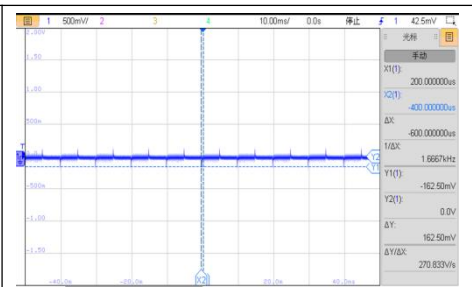
动态波形



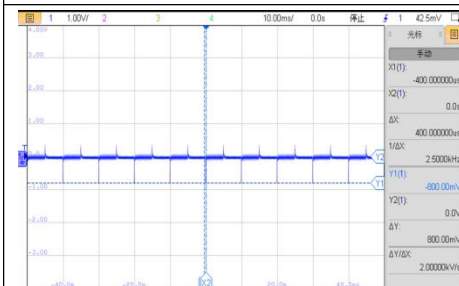
VIN=9V, 100%-10%-100%Io 动态波形



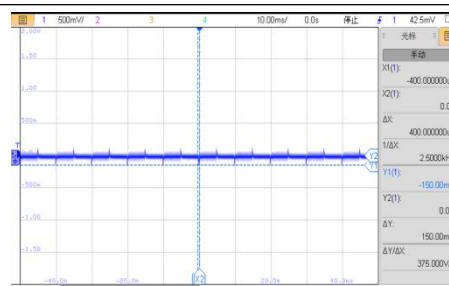
VIN=9V, 75%-50%-75%Io 动态波形



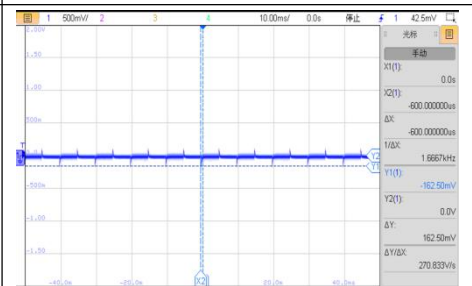
VIN=9V, 50%-25%-50%Io 动态波形



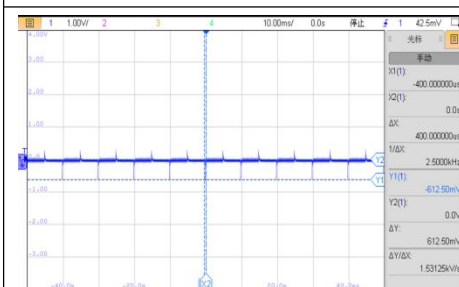
VIN=12V, 100%-10%-100%Io 动态波形



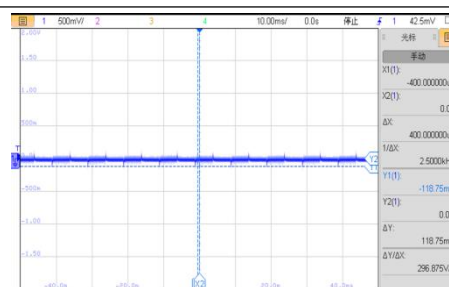
VIN=12V, 75%-50%-75%Io 动态波形



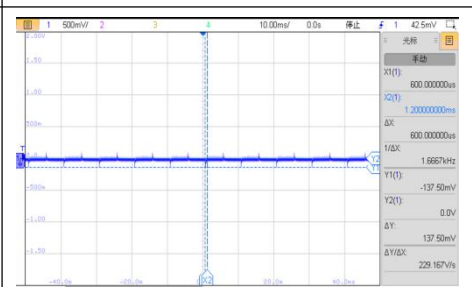
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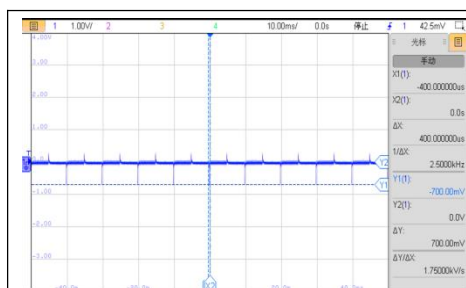
VIN=24V, 100%-10%-100%Io 动态波形



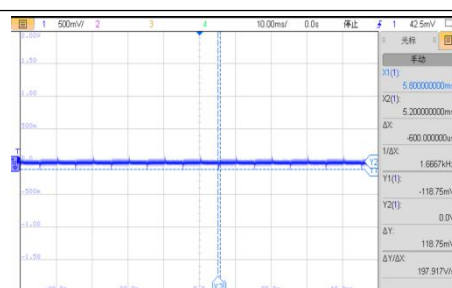
VIN=24V, 75%-50%-75%Io 动态波形



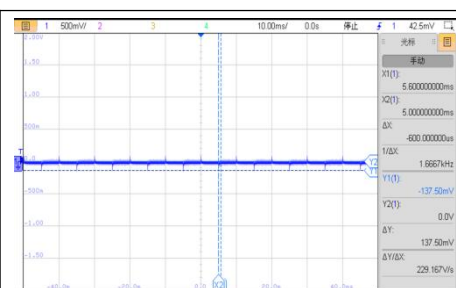
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

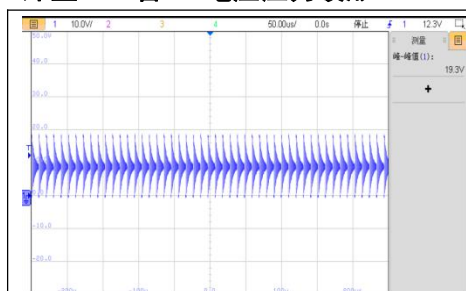


VIN=36V, 75%-50%-75%Io 动态波形

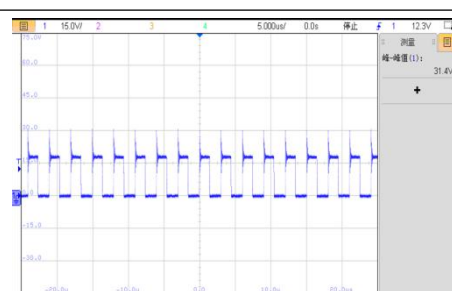


VIN=36V, 50%-25%-50%Io 动态波形

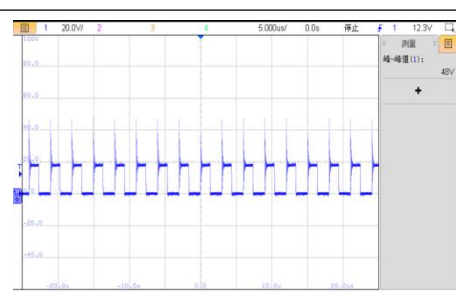
外置 MOS 管 Q1 电压应力波形



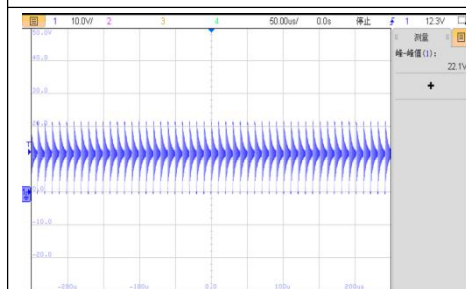
VIN=9V, 空载 VDS 波形



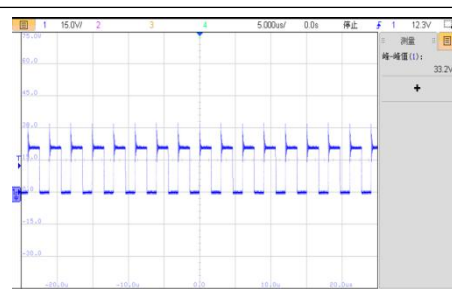
VIN=9V, 半载 VDS 波形



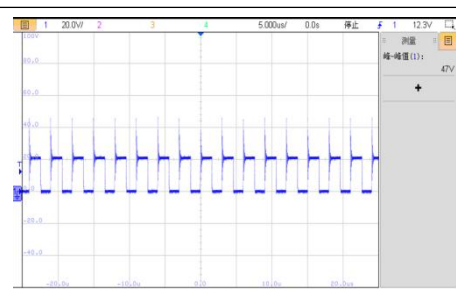
VIN=9V, 满载 VDS 波形



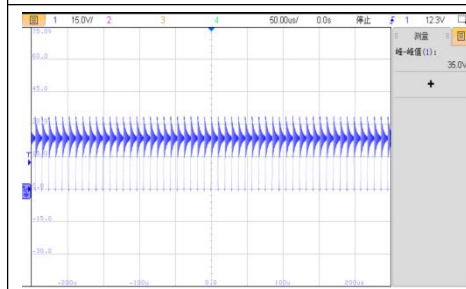
VIN=12V, 空载 VDS 波形



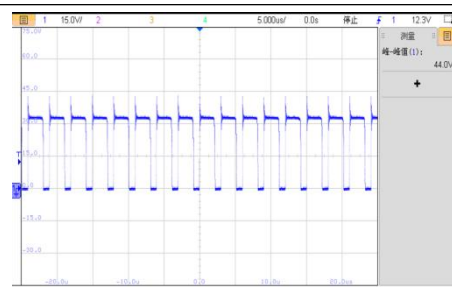
VIN=12V, 半载 VDS 波形



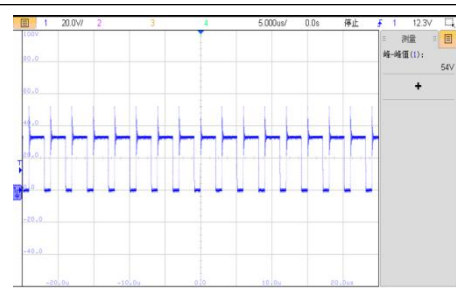
VIN=12V, 满载 VDS 波形



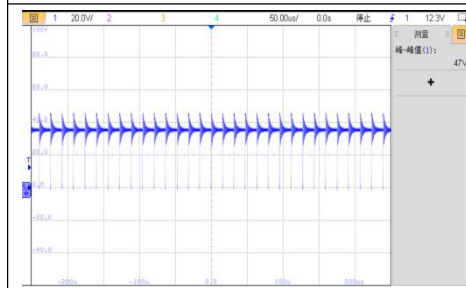
VIN=24V, 空载 VDS 波形



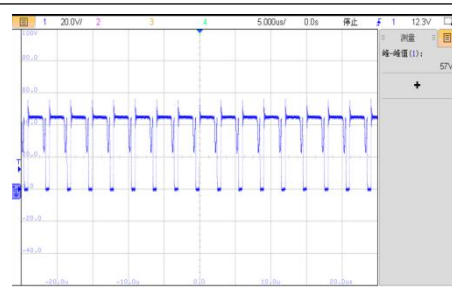
VIN=24V, 半载 VDS 波形



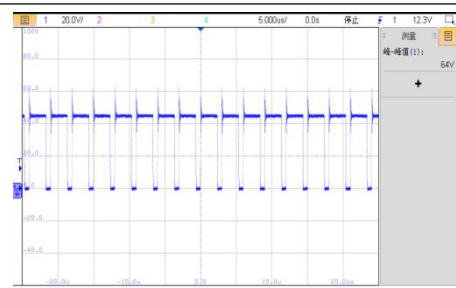
VIN=24V, 满载 VDS 波形



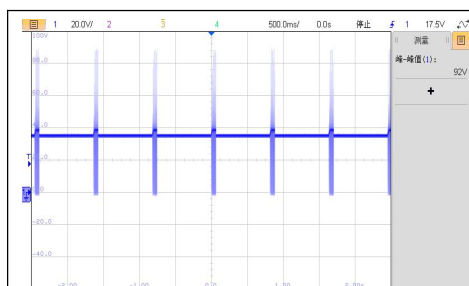
VIN=36V, 空载 VDS 波形



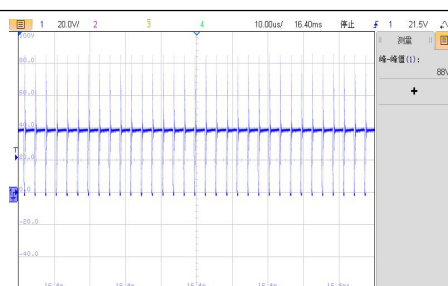
VIN=36V, 半载 VDS 波形



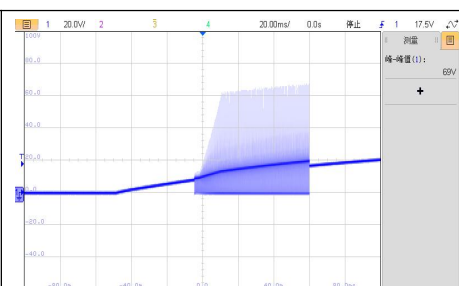
VIN=36V, 满载 VDS 波形



VIN=36V, 短路保护 VDS 波形

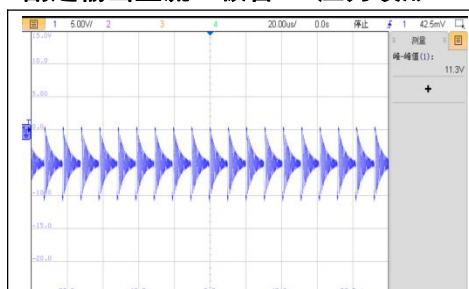


VIN=36V, 短路保护 VDS 展开波形

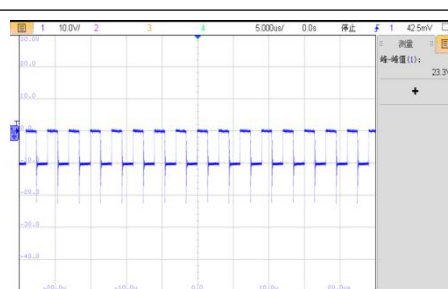


VIN=36V, 短路保护 VDS 展开波形

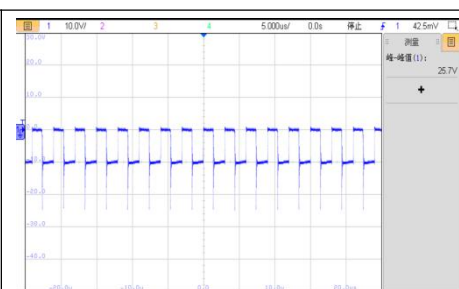
副边输出整流二极管 D4 应力波形



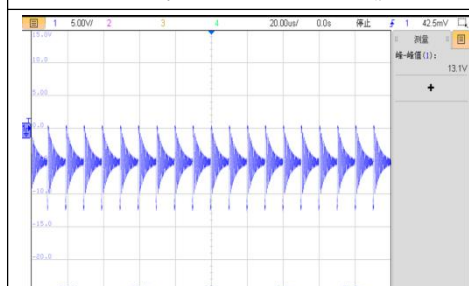
VIN=9V, D4 空载工作电压波形



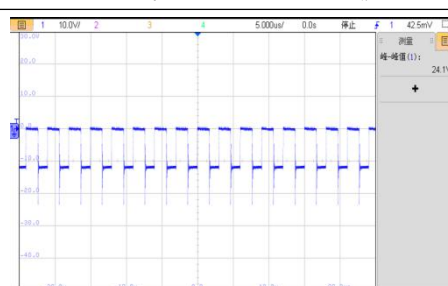
VIN=9V, D4 半载工作电压波形



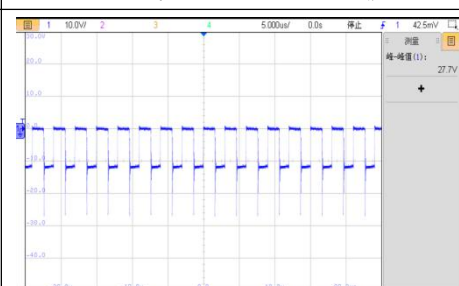
VIN=9V, D4 满载工作电压波形



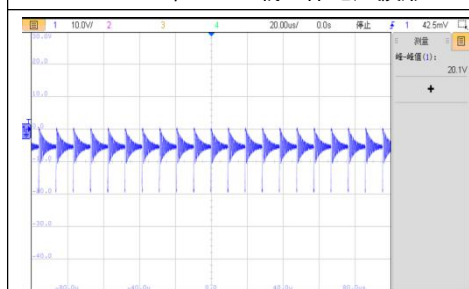
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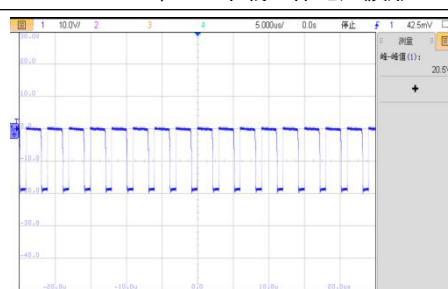
VIN=12V, D4 半载工作电压波形



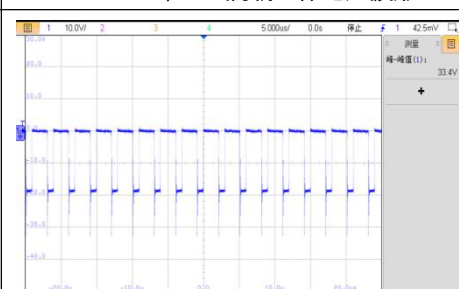
VIN=12V, D4 满载工作电压波形



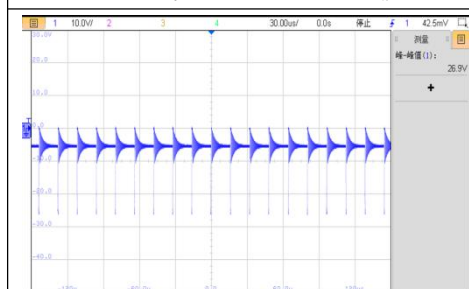
VIN=24V, D4 空载工作电压波形



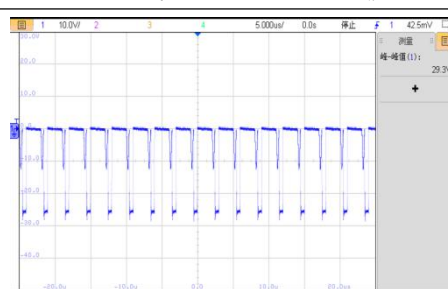
VIN=24V, D4 半载工作电压波形



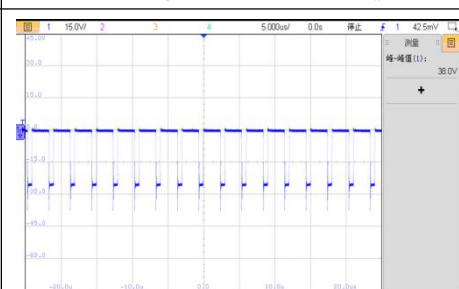
VIN=24V, D4 满载工作电压波形



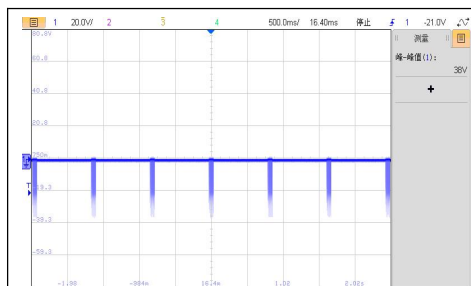
VIN=36V, D4 空载工作电压波形



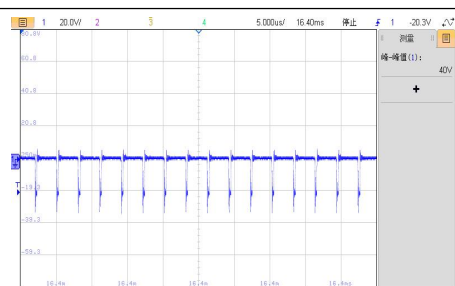
VIN=36V, D4 半载工作电压波形



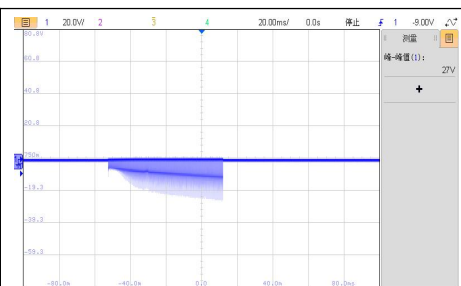
VIN=36V, D4 满载工作电压波形



VIN=36V, D4 短路保护工作电压波形



VIN=36V, D4 短路保护工作电压展开波形



VIN=36V, D4 短路启机电压波形

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