

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 VPE27PB-15A、原副边 MOSFET 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 20W 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。

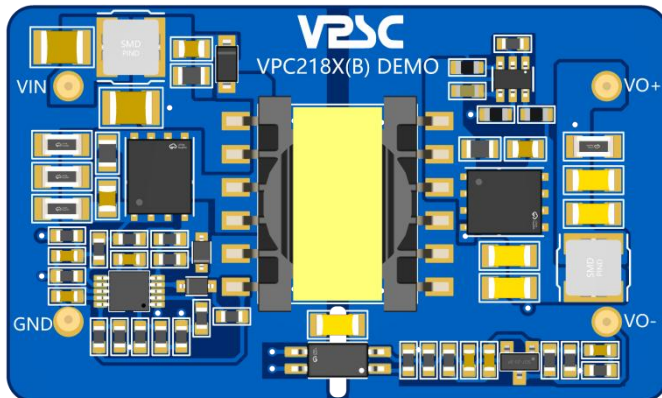
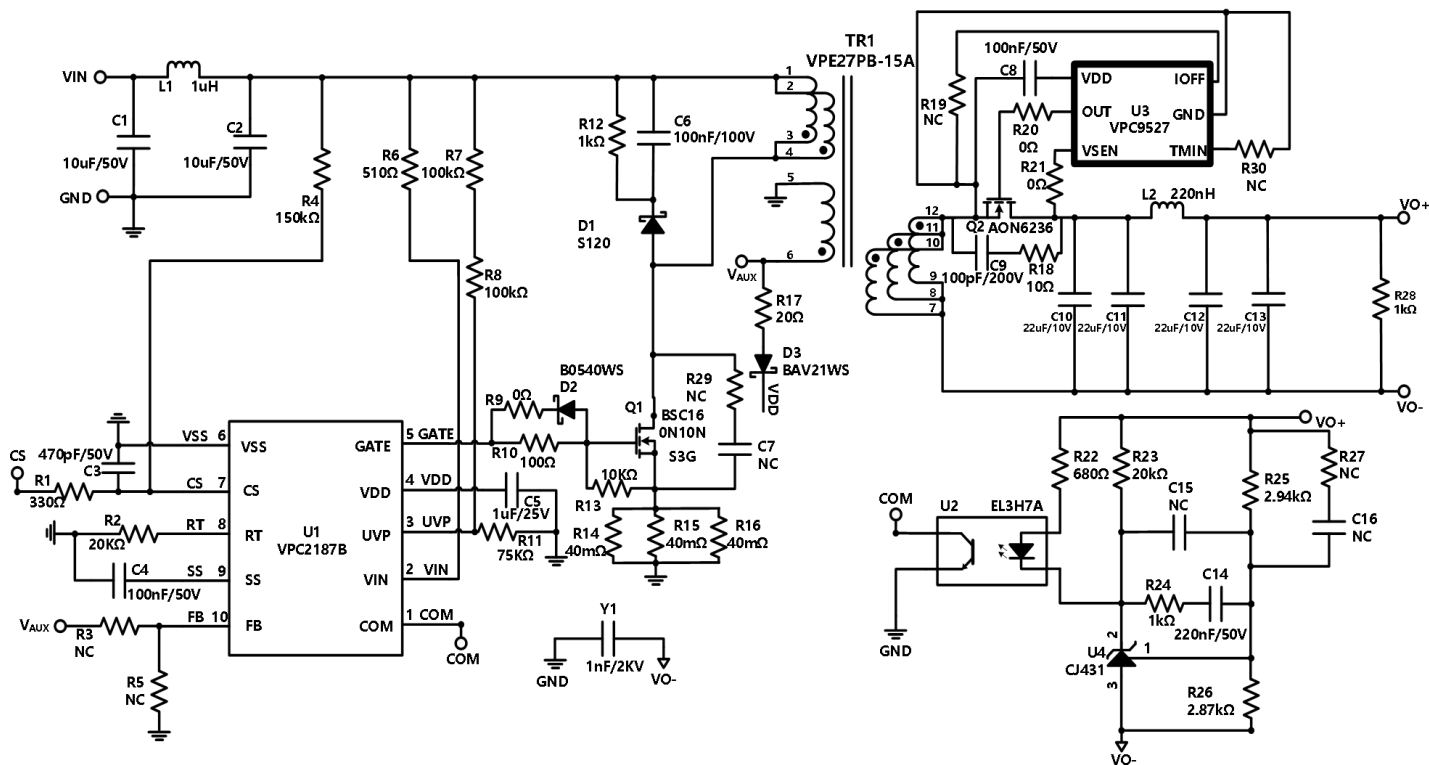


图 1: VPC218X(B) Demo 板(尺寸:50mm*30mm)

关键词: 输入: 9V-36V, 输出 5V/20W, 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

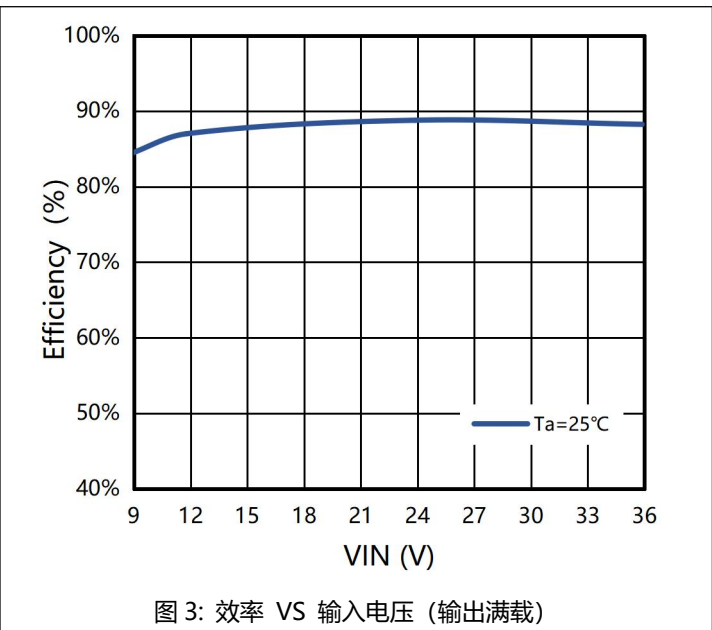
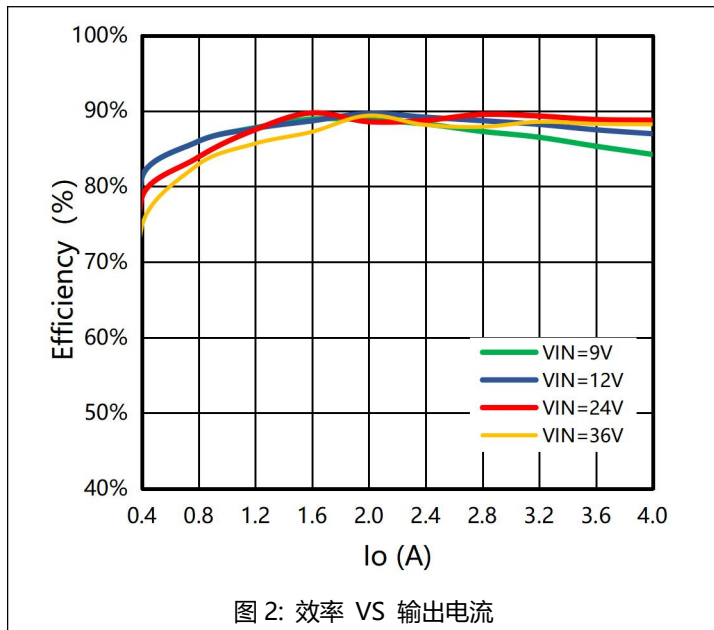
位号	参数	封装	型号	品牌
C1	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C2	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C3	470pF/50V-X7R	0603	CC0603KRX7R9BB471	YAGEO
C4	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C5	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C6	100nF/100V-X7R	0805	CC0805KKX7R0BB104	YAGEO
C7	NC	-	-	-
C8	100nF/50V-X7R	0603	CC0603KRX7R9BB104	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	330Ω±1%	0603	RC0603FR-07330RL	YAGEO
R2	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R3	NC	-	-	-
R4	150KΩ±1%	0603	RC0603FR-07150KL	YAGEO
R5	NC	-	-	-
R6	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R7	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R8	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R9	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R10	100Ω±1%	0603	RC0603FR-07100RL	YAGEO
R11	75KΩ±1%	0603	RC0603FR-0775KL	YAGEO
R12	1KΩ±1%	0805	RC0805FR-071KL	YAGEO
R13	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R14	0.04Ω ±1%	1206	RL1206FR-070R04L	YAGEO
R15	0.04Ω ±1%	1206	RL1206FR-070R04L	YAGEO
R16	0.04Ω ±1%	1206	RL1206FR-070R04L	YAGEO
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	1K Ω ±1%	0603	RC0603FR-071KL	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=7:4:9 Lp=6.86uH	ER14.5	VPE27PB-15A	VPSC
Q1	N 沟道 100V 42A	TDSON-8-EP(5x6)	BSC160N10NS3G	INFINEON
Q2	N 沟道 40V 19A	DFN-8(5.6x5.2)	AON6236	AOS
L1	1uH ±20%	SMD	FNR4020S1R0MT	CJIANG
L2	220nH ±30%	SMD	FNR5020SR22NT	CJIANG
D1	200V/1A	SOD-123	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	YANGJIE
D3	200V/0.2A	SOD-323	BAV21WS	CJ
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

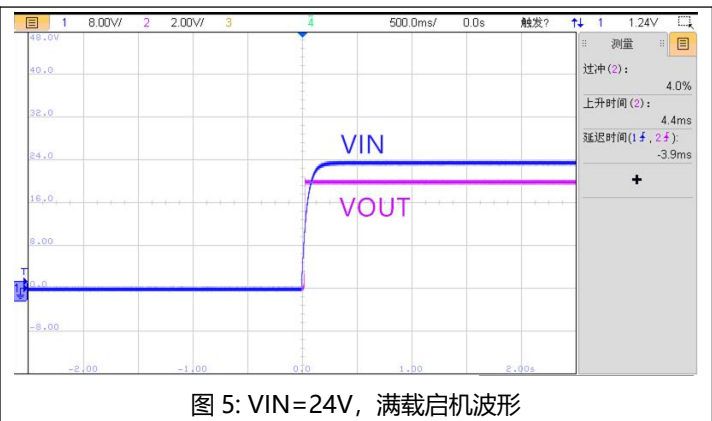
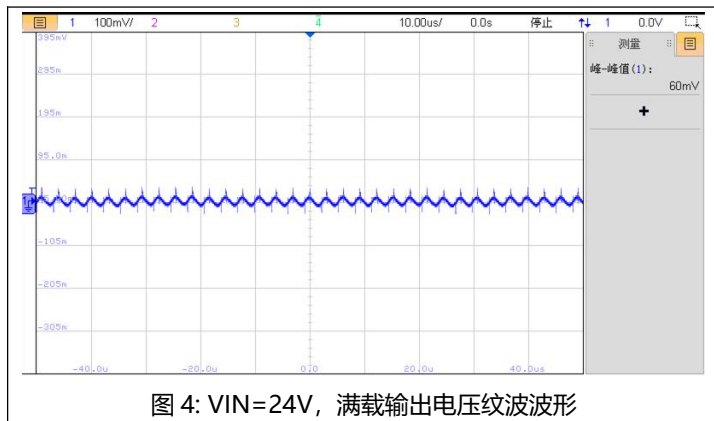
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流 (满载/空载)	VIN=24V	21	---	1950	mA
转换效率	VIN=24V, IO=4A	---	88.78	---	%
纹波&噪声	VIN=24V, IO=4A	---	80	---	mV
输出电压精度	VIN=24V, IO=4A	---	0.2	---	%
线性调节率	VIN=9V-36V, IO=4A	---	0.1	---	%
负载调整率	VIN=24V, IO=4A	---	0.1	---	%
输出过流点系数	VIN=24V, IO=4A	1.3	---	---	倍
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

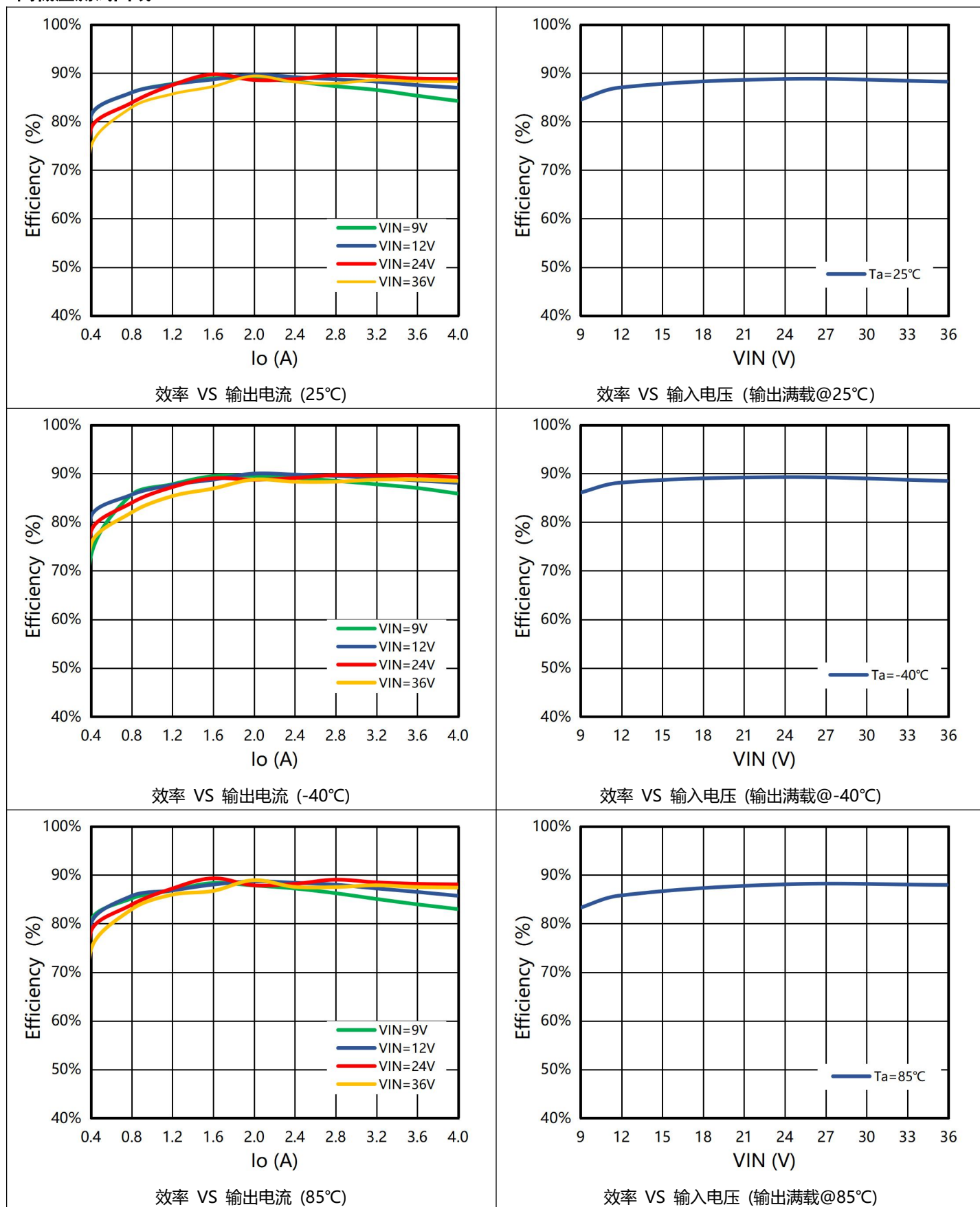


相关波形



详细测试数据

高低温测试曲线



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(%)
23.95	0.014	5.06	0	0%	0.00%
23.95	0.107	5.06	0.396	10%	78.19%
23.94	0.200	5.05	0.795	20%	83.85%
23.93	0.288	5.05	1.194	30%	87.49%
23.92	0.375	5.05	1.594	40%	89.74%
23.92	0.474	5.04	1.993	50%	88.59%
23.91	0.567	5.03	2.392	60%	88.75%
23.9	0.656	5.03	2.791	70%	89.54%
23.89	0.752	5.03	3.191	80%	89.34%
23.89	0.849	5.02	3.591	90%	88.88%
23.88	0.945	5.02	3.991	100%	88.78%

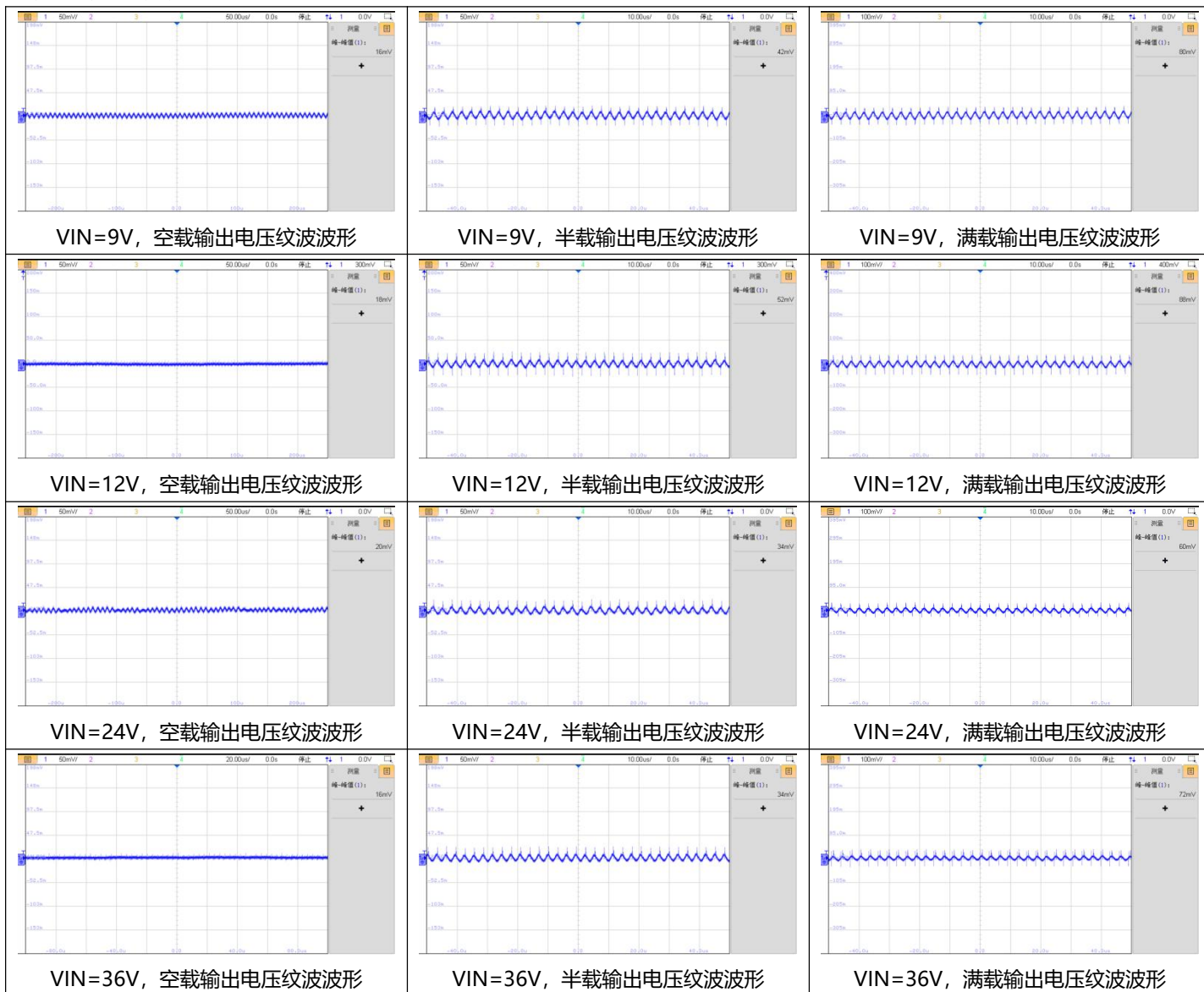
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.96	0.014	5.04	0	0%	0.00%
23.95	0.107	5.03	0.396	10%	77.73%
23.94	0.199	5.03	0.795	20%	83.94%
23.92	0.288	5.03	1.194	30%	87.18%
23.92	0.376	5.02	1.594	40%	89.01%
23.91	0.472	5.02	1.993	50%	88.73%
23.89	0.564	5.02	2.392	60%	89.08%
23.9	0.654	5.02	2.791	70%	89.67%
23.89	0.747	5.01	3.191	80%	89.58%
23.89	0.841	5.01	3.591	90%	89.58%
23.88	0.938	5.01	3.991	100%	89.27%

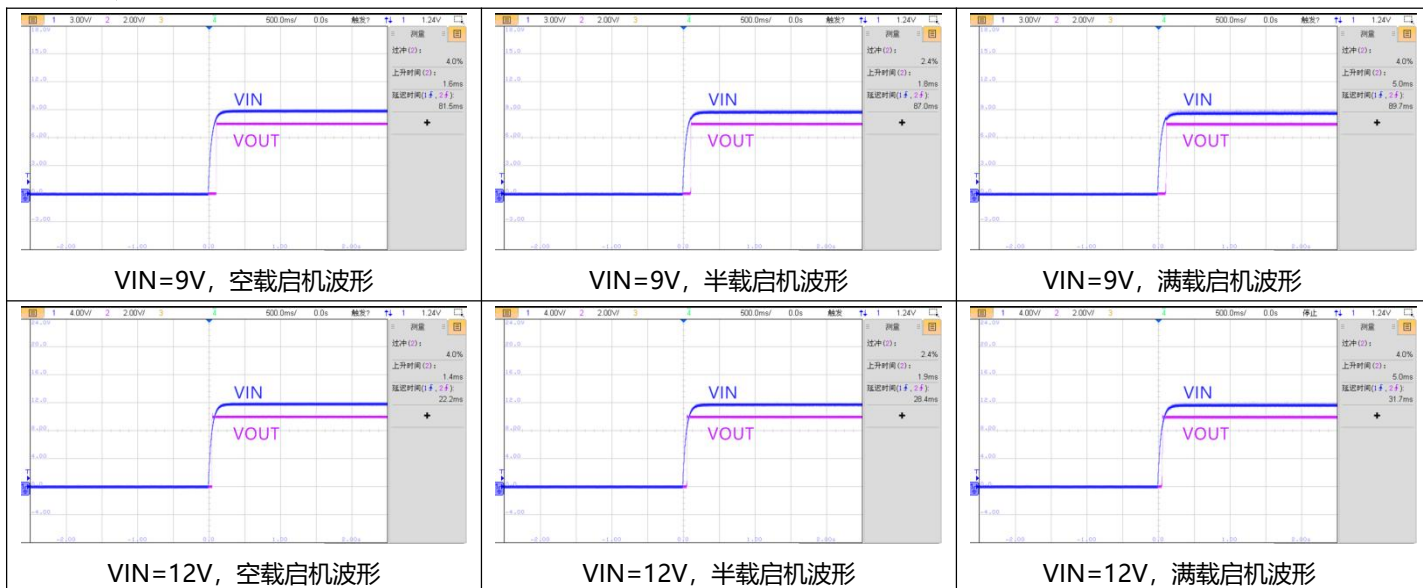
VIN=24V, Ta=85°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
23.96	0.015	5.05	0	0%	0.00%
23.95	0.107	5.05	0.396	10%	78.04%
23.94	0.200	5.05	0.795	20%	83.85%
23.93	0.289	5.05	1.194	30%	87.19%
23.92	0.376	5.04	1.594	40%	89.32%
23.92	0.477	5.03	1.993	50%	87.90%
23.91	0.571	5.03	2.392	60%	88.16%
23.9	0.660	5.03	2.791	70%	89.04%
23.89	0.758	5.02	3.191	80%	88.50%
23.88	0.856	5.02	3.591	90%	88.19%
23.87	0.953	5.02	3.991	100%	88.07%

输出电压纹波波形

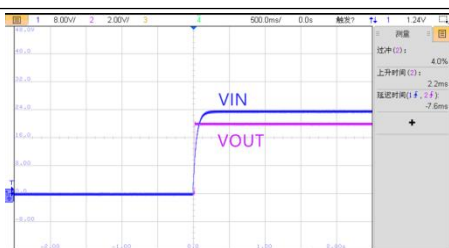


开关机波形

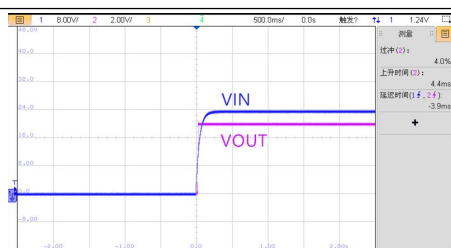




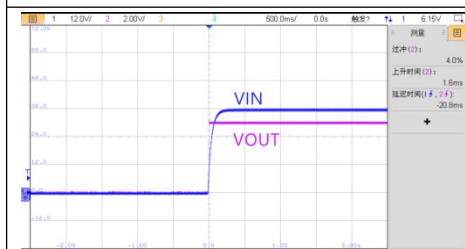
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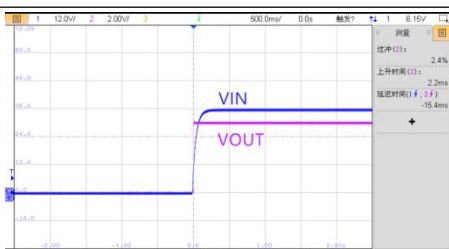
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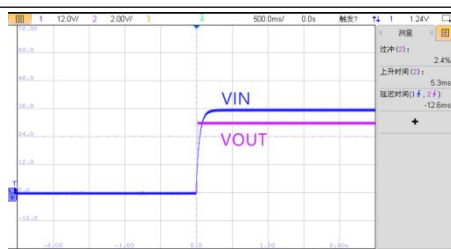
VIN=24V, 满载启机波形



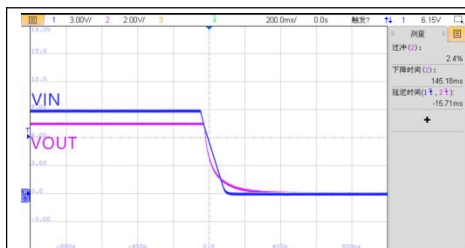
VIN=36V, 空载启机波形



VIN=36V, 半载启机波形



VIN=36V, 满载启机波形



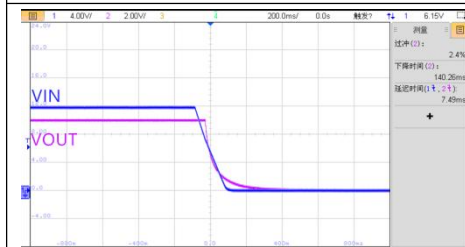
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VIN=9V, 半载关机波形



VIN=9V, 满载关机波形



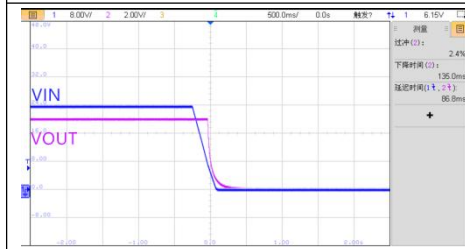
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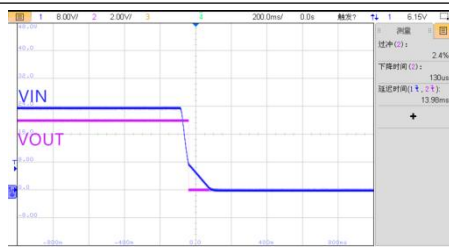
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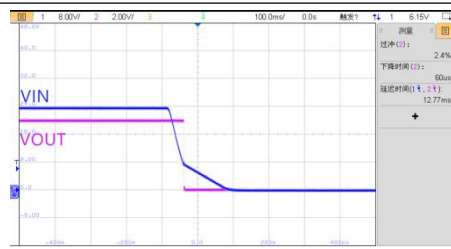
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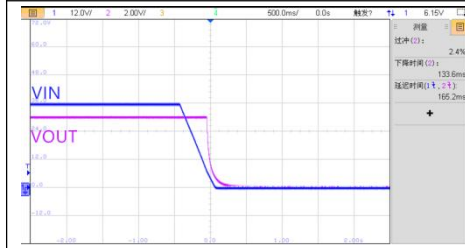
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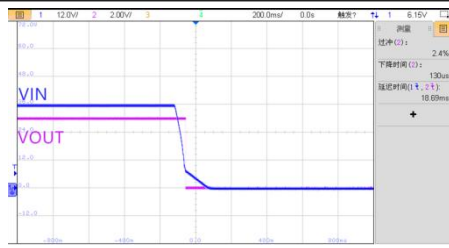
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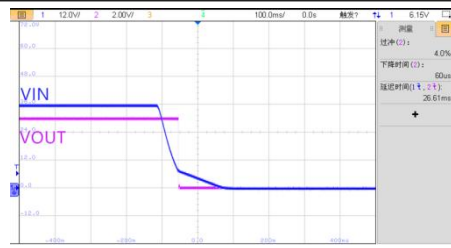
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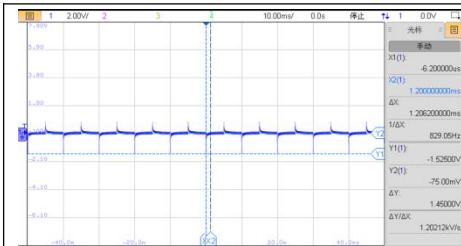


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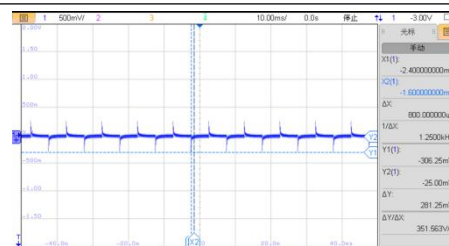


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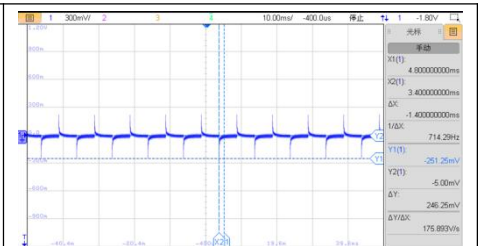
动态波形



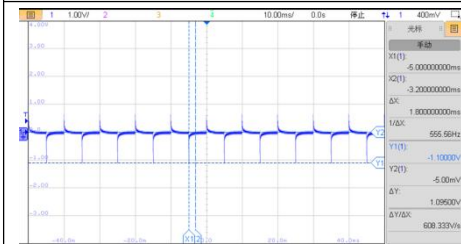
VIN=9V, 100%-10%-100%Io 动态波形



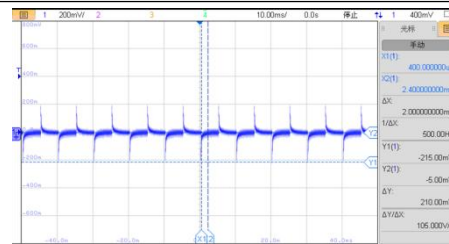
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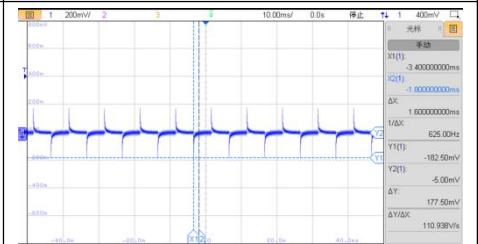
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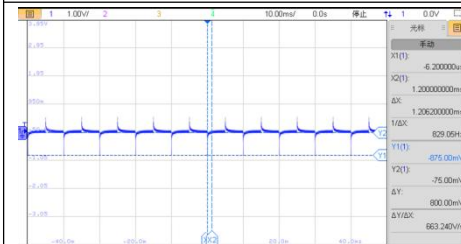
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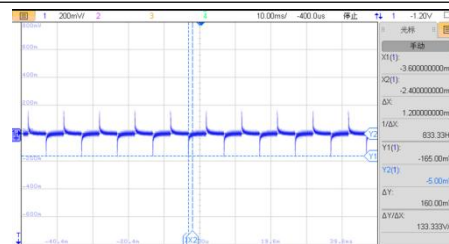
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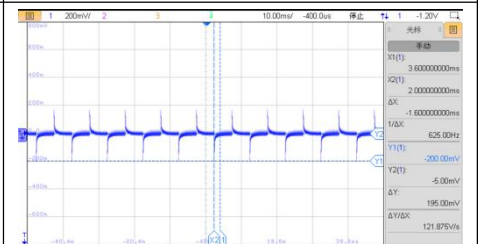
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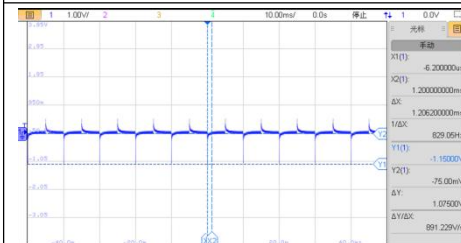
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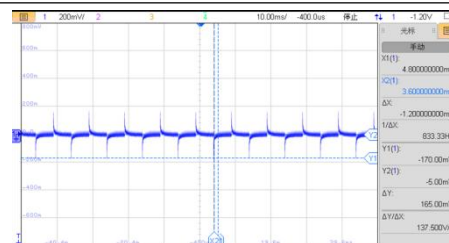
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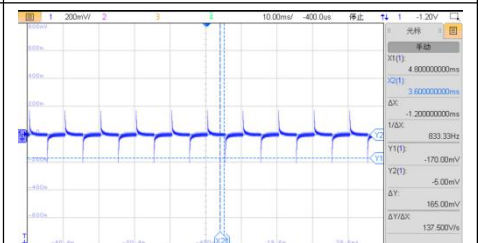
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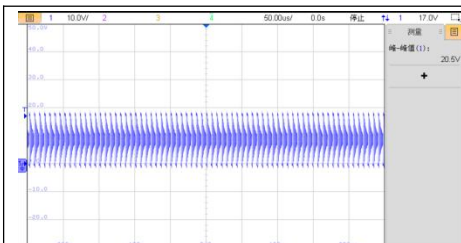


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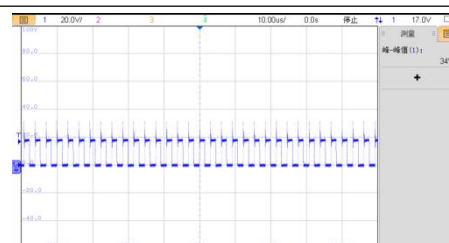


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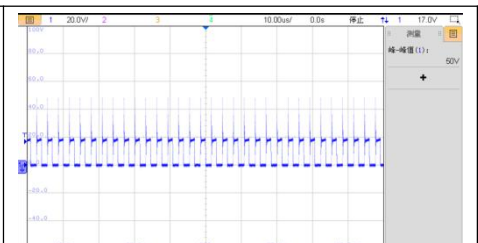
原边 MOS 管 Q1 电压应力波形



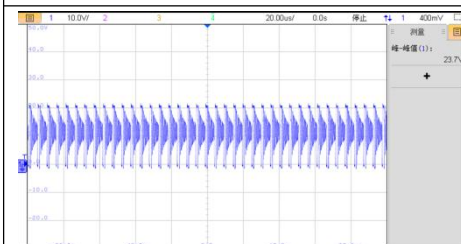
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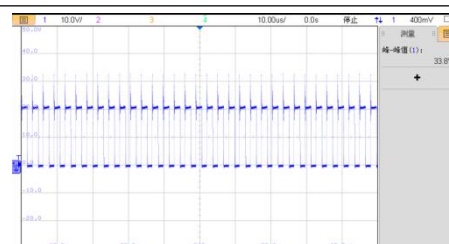
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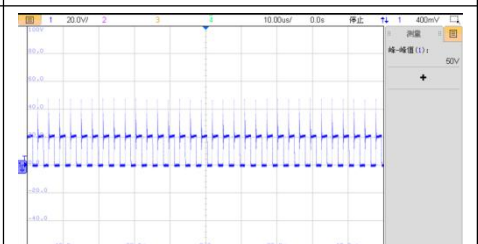
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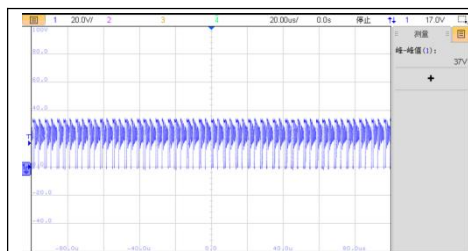
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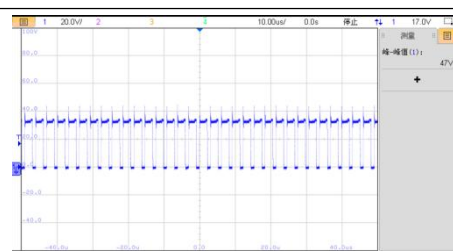
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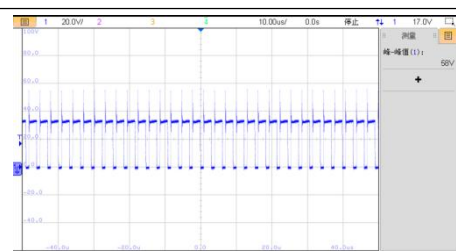
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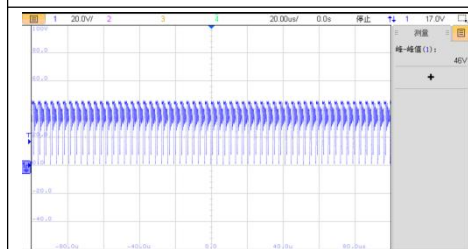
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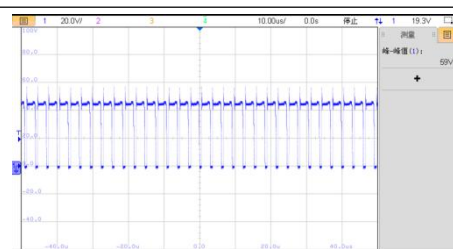
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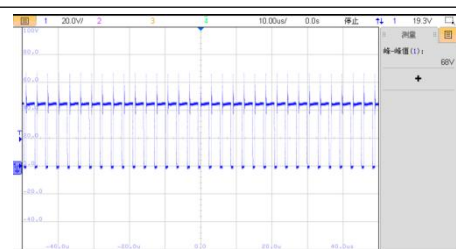
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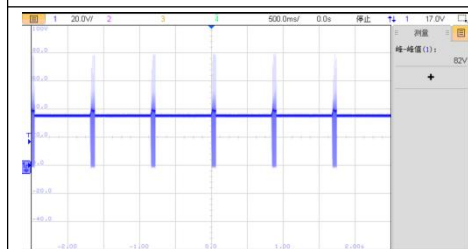
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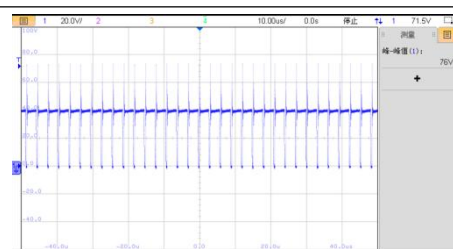
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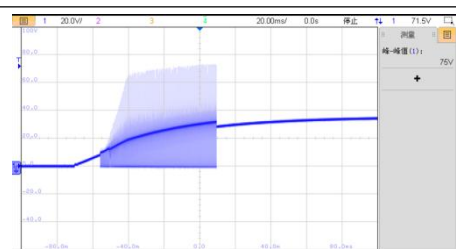
VIN=36V, 满载 VDS 波形



VIN=36V, 短路保护 VDS 波形

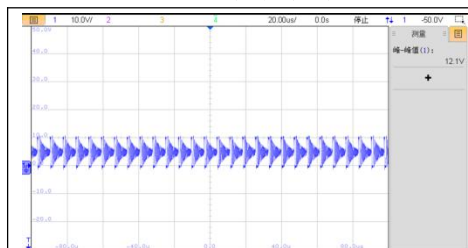


VIN=36V, 短路保护 VDS 展开波形



VIN=36V, 短路启机 VDS 波形

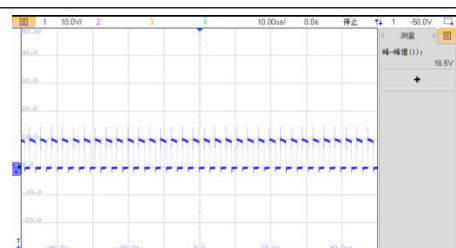
副边 MOS 管 Q2 电压应力波形



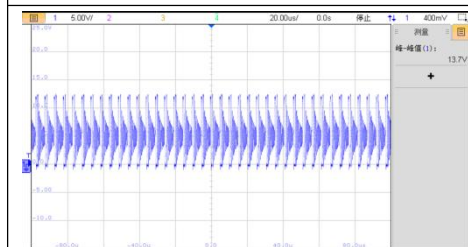
VIN=9V, 空载工作电压波形



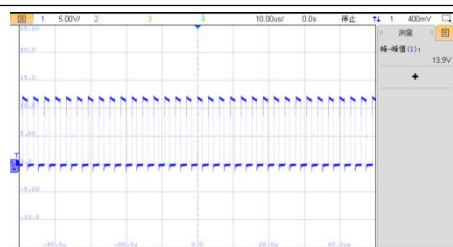
VIN=9V, 半载工作电压波形



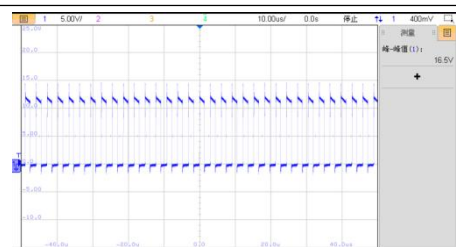
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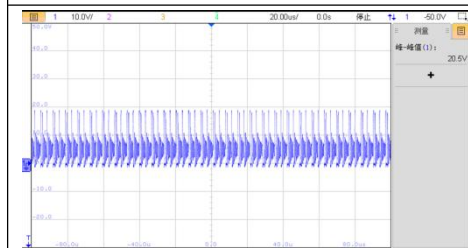
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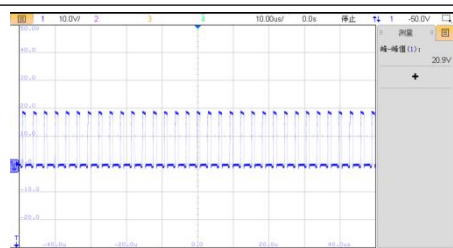
VIN=12V, 半载工作电压波形



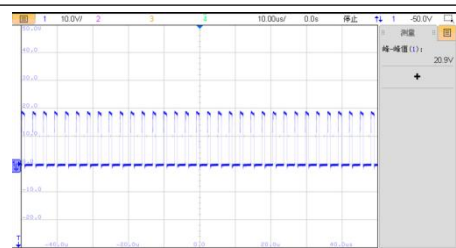
VIN=12V, 满载工作电压波形



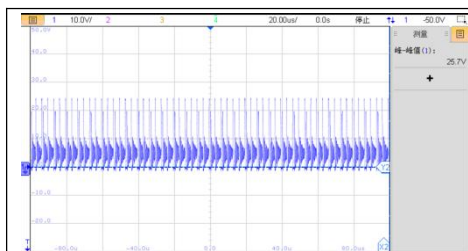
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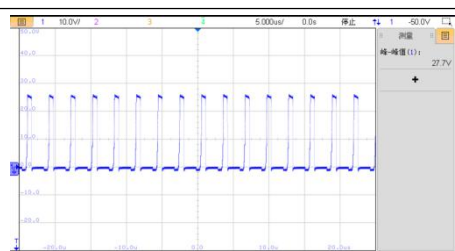
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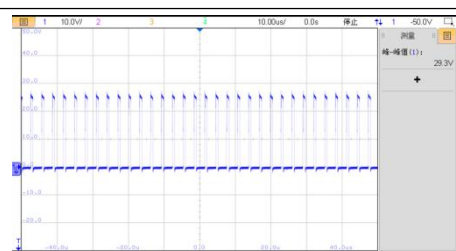
VIN=24V, 满载工作电压波形



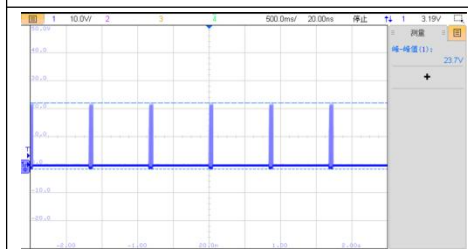
VIN=36V，空载工作电压波形



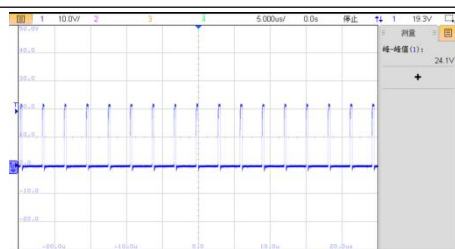
VIN=36V，半载工作电压波形



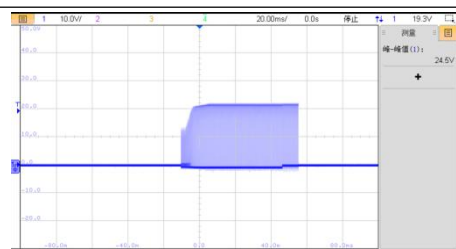
VIN=36V，满载工作电压波形



VIN=36V，短路保护工作电压波形



VIN=36V，短路保护工作电压展开波形



VIN=36V，短路启机电压波形

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