

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 VPE17UB-03A、输出整流二极管以及必要的阻容元件，实现 4.5V-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 3W 的输出能力，原副边隔离耐压不小于 1500VDC，同时具备欠压保护、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。

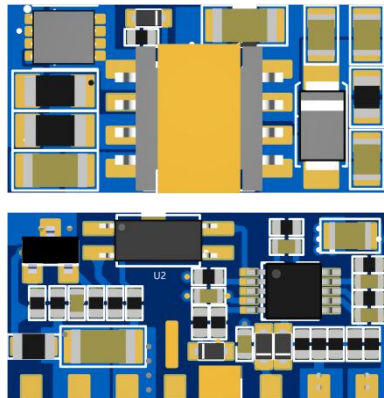
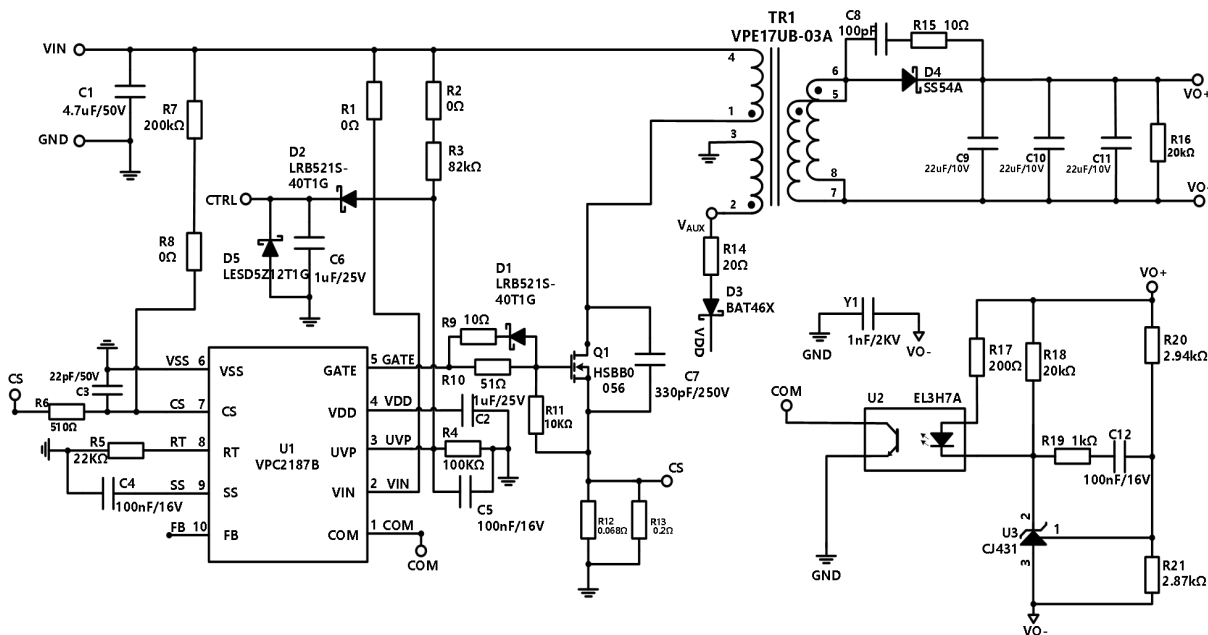


图 1: VPC2187B Demo 板(尺寸:20.3mm*10mm)

关键词：输入：4.5V-36V，输出 5V/3W，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	GND	电源接地端
2	VIN	电源输入端
3	CTRL	电源控制端
4	NC	-
5	VO+	电源输出正
6	VO-	电源输出负
7	NC	-

物料清单

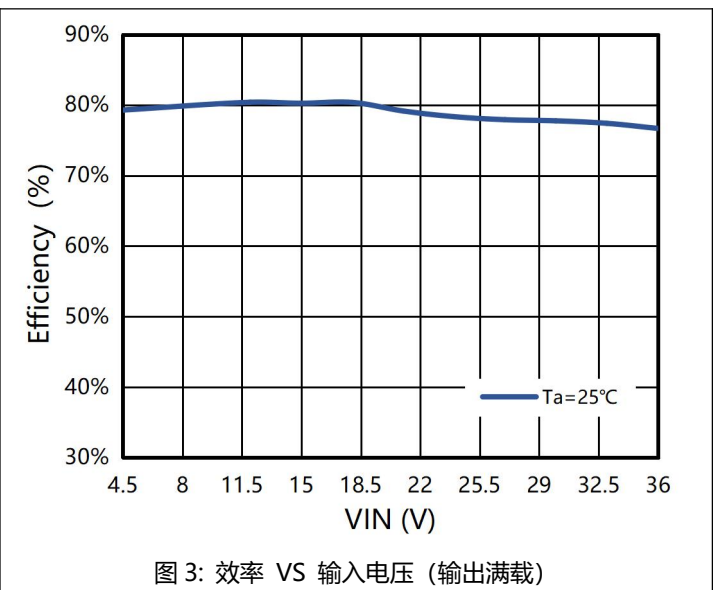
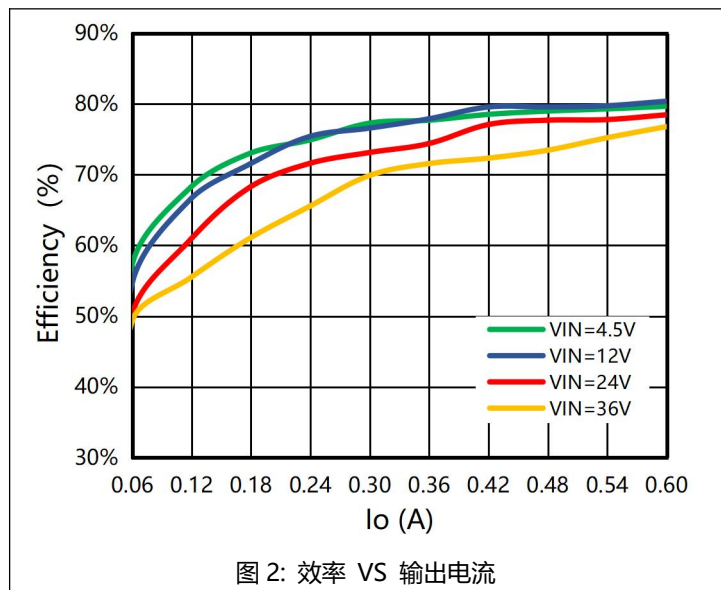
位号	参数	封装	型号	品牌
C1	4.7uF/50V-X7R	1206	CC1206KKX7R9BB475	YAGEO
C2	1uF/25V-X5R	0402	CC0402KRX5R8BB105	YAGEO
C3	22pF/50V-NP0	0402	CC0402FRNP09BN220	YAGEO
C4	100nF/16V-X7R	0402	CC0402JRX7R7BB104	YAGEO
C5	100nF/16V-X7R	0402	CC0402JRX7R7BB104	YAGEO
C6	1uF/25V-X5R	0402	CC0402KRX5R8BB105	YAGEO
C7	330pF/250V-X7R	0805	CC0805KRX7RYBB331	YAGEO
C8	100pF/200V-NP0	0805	CC0805JRNPOABN101	YAGEO
C9	22uF/10V-X5R	0805	CC0805MKX5R6BB226	YAGEO
C10	22uF/10V-X5R	0805	CC0805MKX5R6BB226	YAGEO
C11	22uF/10V-X5R	1206	CC1206KKX5R6BB226	YAGEO
C12	100nF/16V-X7R	0402	CC0402JRX7R7BB104	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	0Ω±1%	0402	RC0402FR-070RL	YAGEO
R2	0Ω±1%	0402	RC0402FR-070RL	YAGEO
R3	82KΩ±1%	0402	RC0402FR-0782KL	YAGEO
R4	100KΩ±1%	0402	RC0402FR-07100KL	YAGEO
R5	22KΩ±1%	0402	RC0402FR-0722KL	YAGEO
R6	510Ω±1%	0402	RC0402FR-07510RL	YAGEO
R7	200KΩ±1%	0402	RC0402FR-07200KL	YAGEO
R8	0Ω±1%	0402	RC0402FR-070RL	YAGEO
R9	10Ω±1%	0402	RC0402FR-0710RL	YAGEO
R10	51Ω±1%	0402	RC0402FR-0751RL	YAGEO
R11	10KΩ±1%	0402	RC0402FR-0710KL	YAGEO
R12	0.068Ω±1%	1206	RL1206FR-070R068L	YAGEO
R13	0.200Ω±1%	1206	RL1206FR-070R2L	YAGEO
R14	20Ω±1%	0402	RC0402FR-0720RL	YAGEO
R15	10Ω±1%	0805	RC0402FR-0710RL	YAGEO
R16	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R17	200Ω±1%	0402	RC0402FR-07200RL	YAGEO
R18	20KΩ±1%	0402	RC0402FR-0720KL	YAGEO
R19	1KΩ±1%	0402	RC0402FR-071KL	YAGEO
R20	2.94KΩ±1%	0402	RC0402FR-072K94L	YAGEO
R21	2.87KΩ±1%	0402	RC0402FR-072K87L	YAGEO
TR1	NP:NS:NA=8:5:15 Lp=6uH	ER7.5	VPE17UB-03A	VPSC
Q1	N 沟道 100V 27A	PRPAK3x3	HSBB0056	HUASHUO
D1	40V/0.2A	SOD-523	LRB521S-40T1G	LRC
D2	40V/0.2A	SOD-523	LRB521S-40T1G	LRC
D3	100V/0.15A	SOD-523	BAT46X	CJ
D4	40V/5A	SMA	SS54A	YANGJIE

D5	反向截止电压 12V	SOD-523	LESD5Z12T1G	LRC
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	SOT23-3	CJ431	CJ

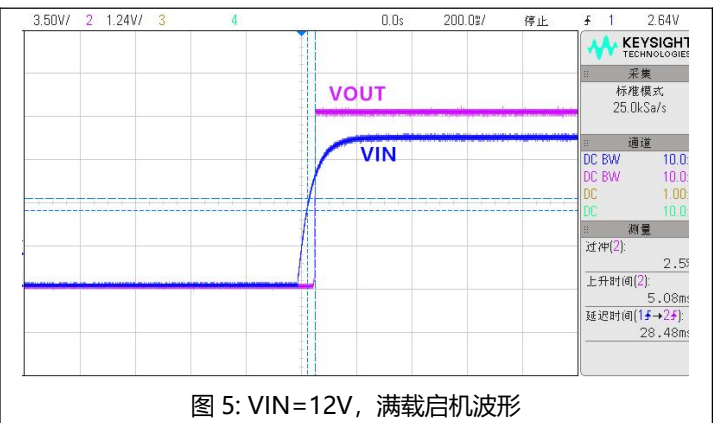
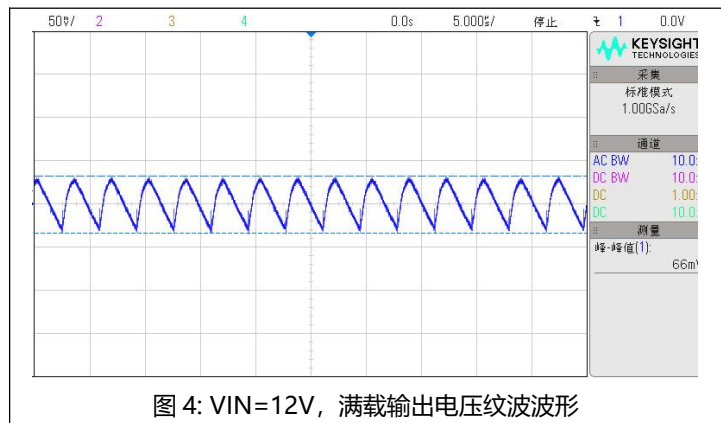
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流 (满载/空载)	VIN=12V	13	---	312	mA
转换效率	VIN=12V, IO=0.6A	---	80.38	---	%
纹波&噪声	VIN=12V, IO=0.6A	---	72	100	mV
输出电压精度	VIN=12V, IO=0.6A	---	0.8	---	%
线性调节率	VIN=4.5V-36V, IO=0.6A	---	0.5	---	%
负载调整率	VIN=12V, IO=0.6A	---	0.5	---	%
输出过流点系数	VIN=36V, IO=0.6A	---	1.31	---	倍
最大容性负载	VIN=36V, IO=0.6A	---	8480	---	uF
输入欠压保护	锁定电压	---	3.7	---	V
	恢复电压	---	4.1	---	V
短路保护	VIN=4.5V-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

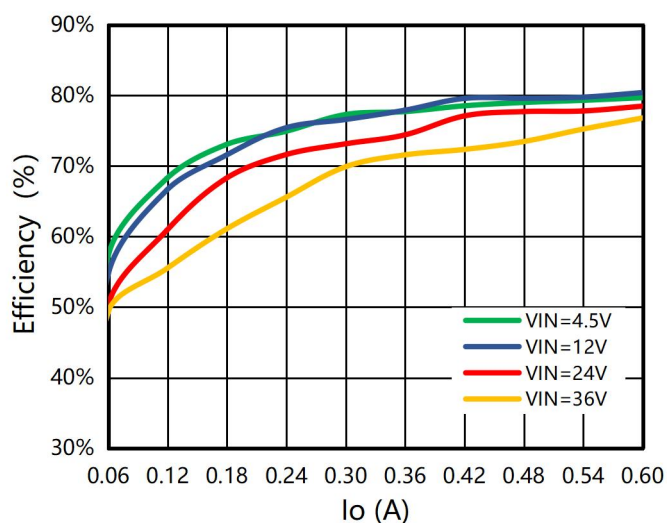


相关波形

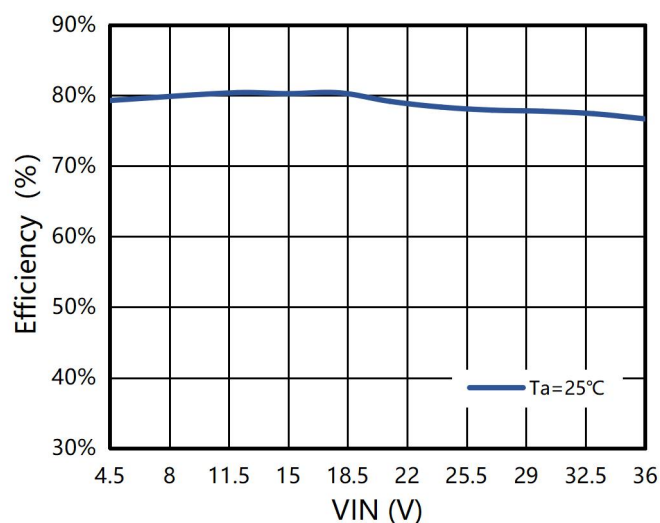


详细测试数据

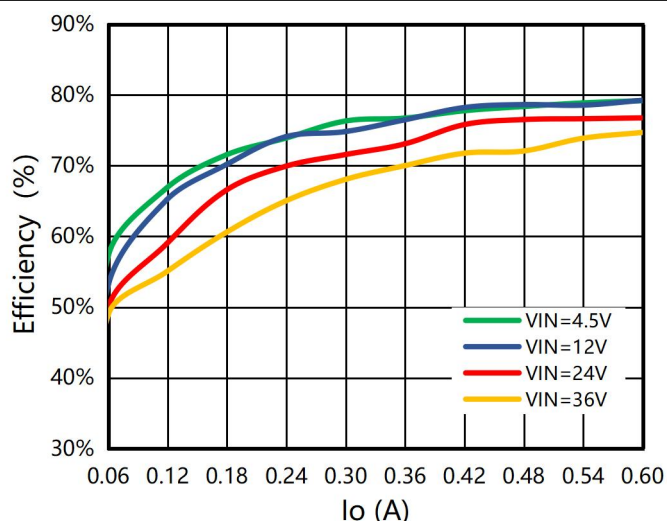
高低温测试曲线



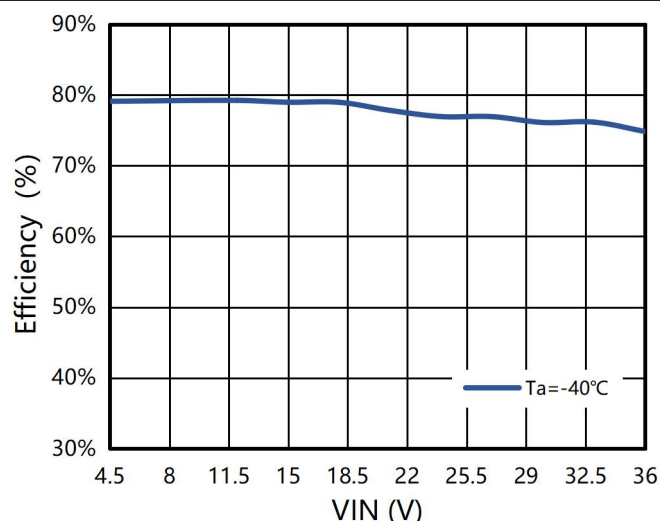
效率 VS 输出电流 (25°C)



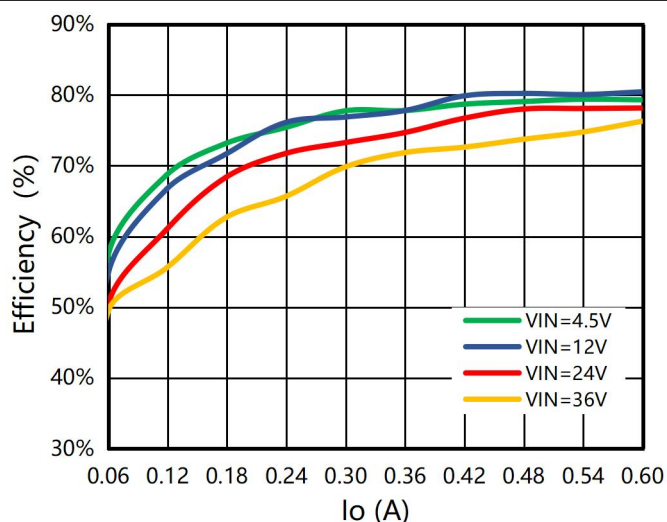
效率 VS 输入电压 (输出满载@25°C)



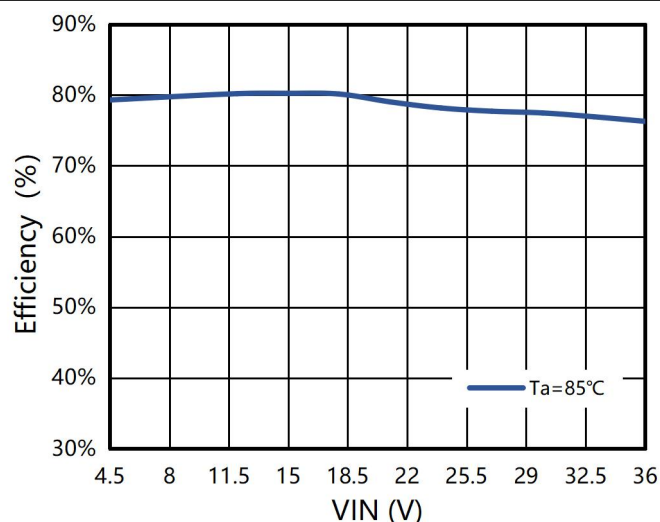
效率 VS 输出电流 (-40°C)



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=12V, Ta=25°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
11.99	0.013	5.03	0.000	0%	0.00%
11.99	0.046	5.03	0.060	10%	54.72%
11.99	0.075	5.03	0.119	20%	66.56%
11.99	0.105	5.03	0.179	30%	71.52%
11.99	0.133	5.03	0.239	40%	75.39%
11.99	0.164	5.02	0.300	50%	76.59%
11.99	0.193	5.02	0.359	60%	77.88%
11.99	0.221	5.02	0.420	70%	79.57%
11.99	0.252	5.02	0.479	80%	79.58%
11.99	0.283	5.02	0.539	90%	79.74%
11.99	0.312	5.02	0.599	100%	80.38%

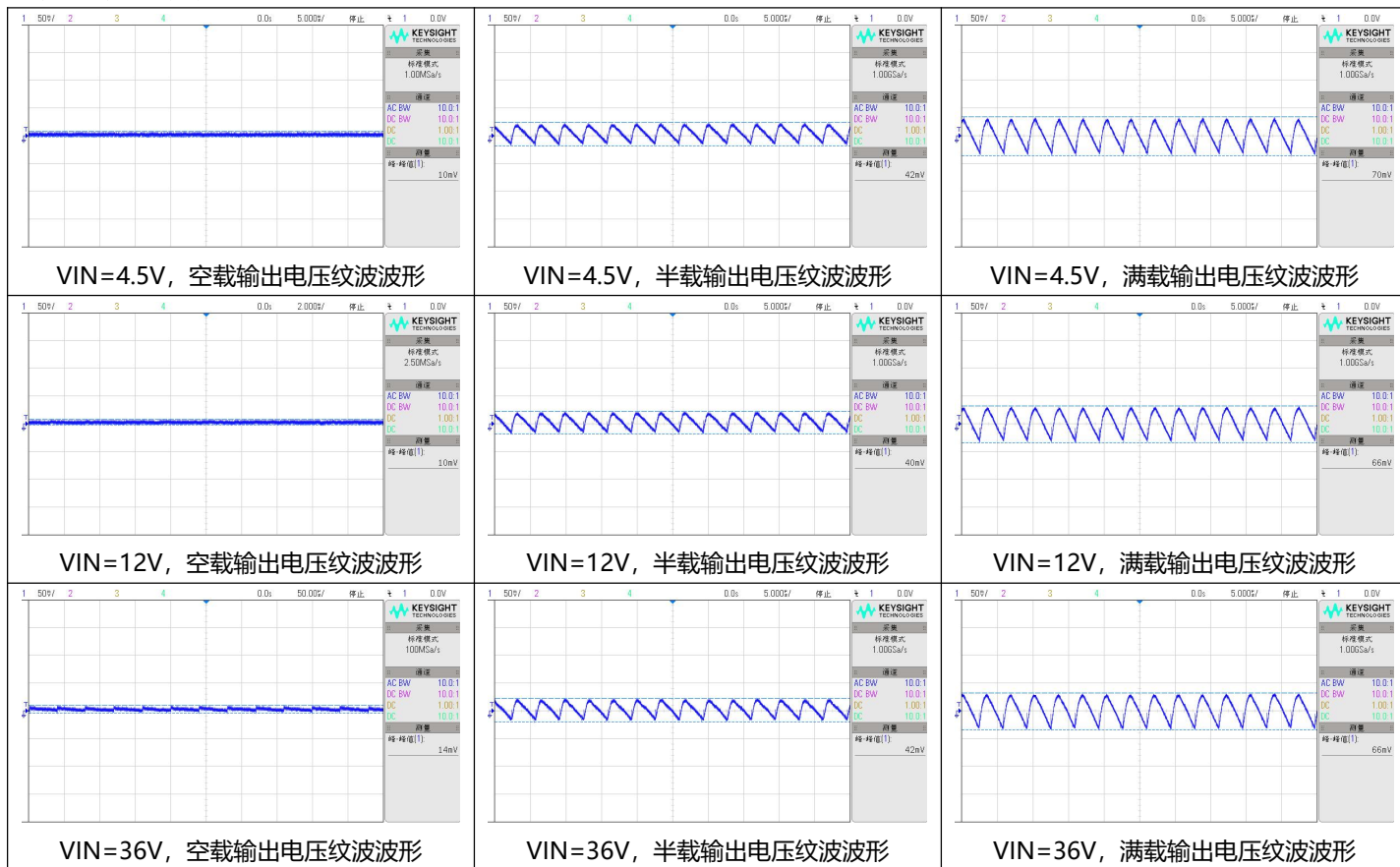
VIN=12V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
11.99	0.013	4.99	0.000	0%	0.00%
11.99	0.047	4.99	0.060	10%	53.13%
11.99	0.076	4.99	0.119	20%	65.17%
11.99	0.106	4.98	0.179	30%	70.14%
11.99	0.134	4.98	0.239	40%	74.08%
11.99	0.166	4.98	0.299	50%	74.81%
11.99	0.195	4.98	0.359	60%	76.47%
11.99	0.223	4.98	0.420	70%	78.23%
11.99	0.253	4.98	0.479	80%	78.64%
11.99	0.285	4.98	0.539	90%	78.55%
11.99	0.314	4.98	0.599	100%	79.23%

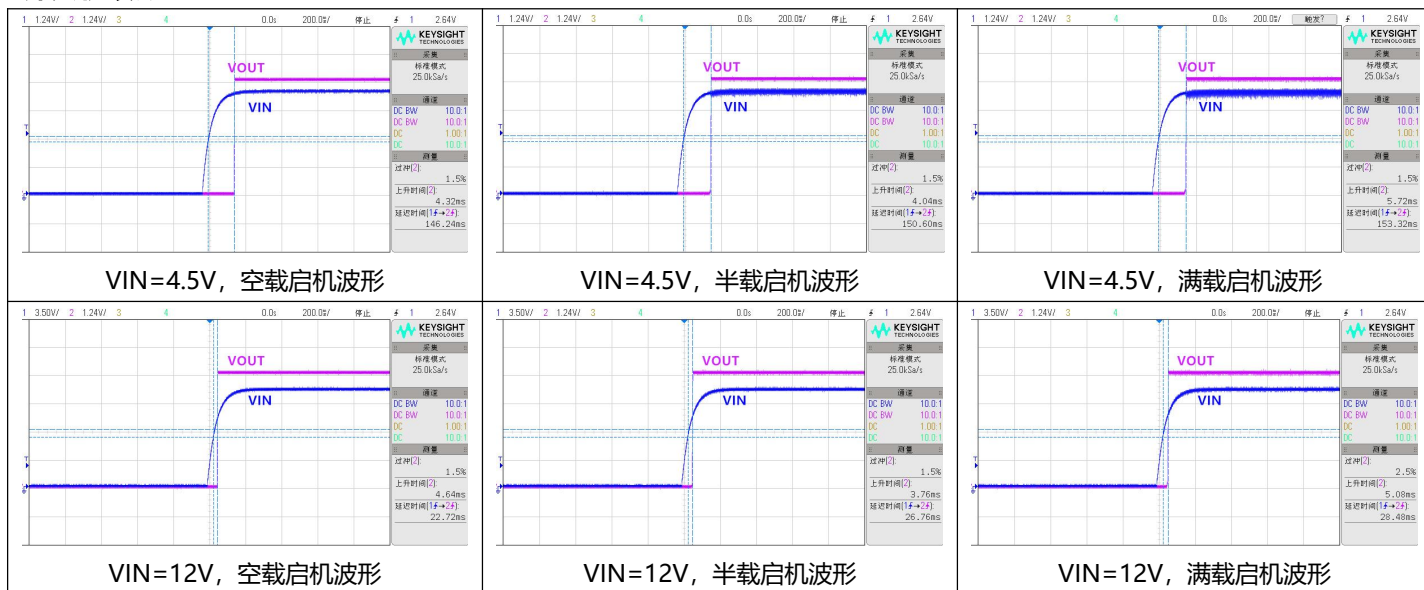
VIN=12V, Ta=85°C, 输入、输出及效率数据:

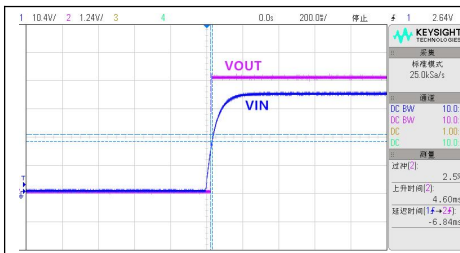
VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
11.99	0.013	5.04	0.000	0%	0.00%
11.99	0.046	5.04	0.060	10%	54.83%
11.99	0.075	5.04	0.119	20%	66.70%
11.99	0.105	5.04	0.179	30%	71.66%
11.99	0.132	5.04	0.239	40%	76.11%
11.99	0.164	5.04	0.300	50%	76.89%
11.99	0.194	5.04	0.359	60%	77.79%
11.99	0.221	5.04	0.420	70%	79.89%
11.99	0.251	5.04	0.479	80%	80.22%
11.99	0.283	5.04	0.539	90%	80.06%
11.99	0.313	5.04	0.599	100%	80.44%

输出电压纹波波形

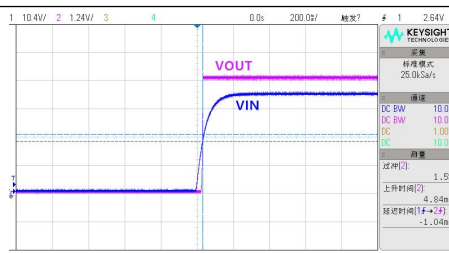


开关机波形

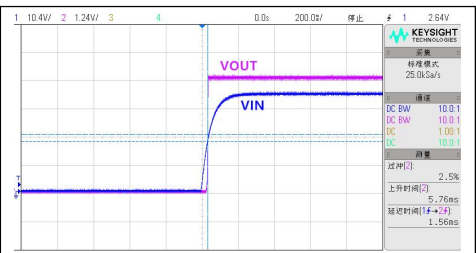




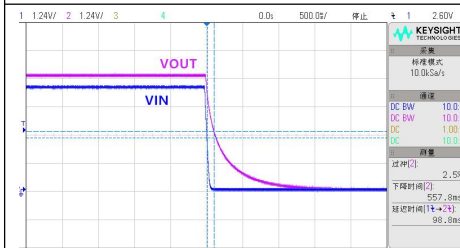
VIN=36V, 空载启机波形



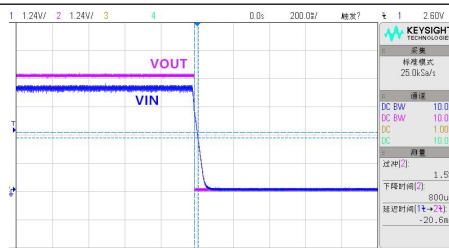
VIN=36V, 半载启机波形



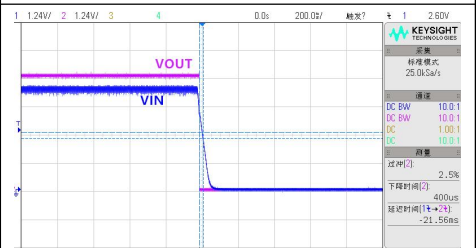
VIN=36V, 满载启机波形



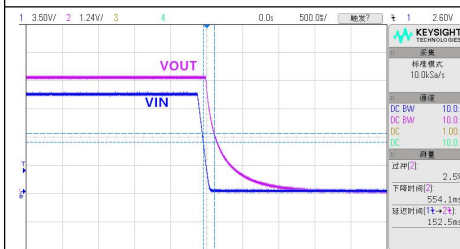
VIN=4.5V, 空载关机波形



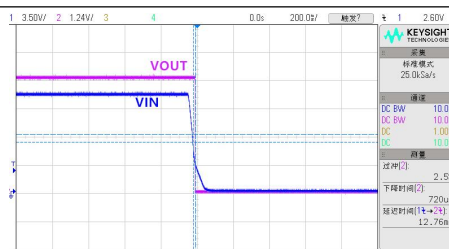
VIN=4.5V, 半载关机波形



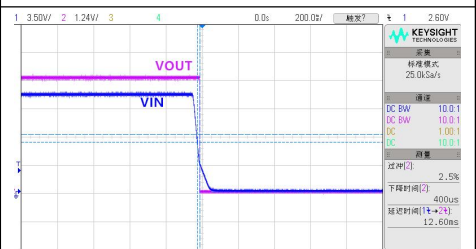
VIN=4.5V, 满载关机波形



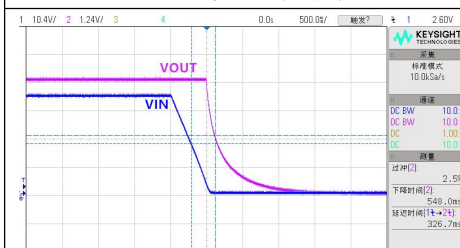
VIN=12V, 空载关机波形



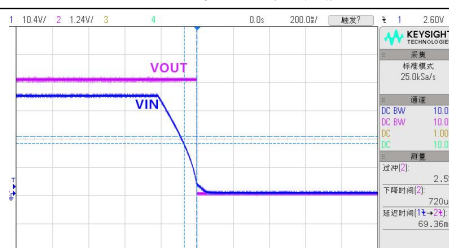
VIN=12V, 半载关机波形



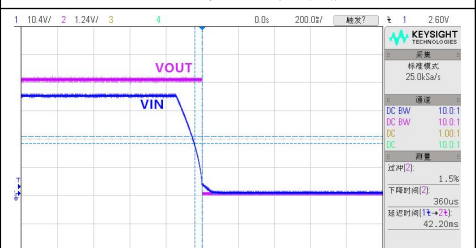
VIN=12V, 满载关机波形



VIN=36V, 空载关机波形

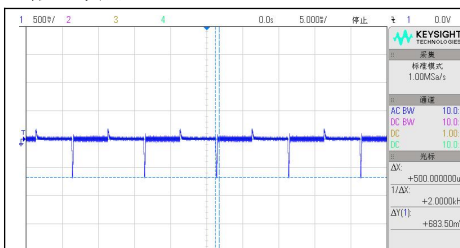


VIN=36V, 半载关机波形

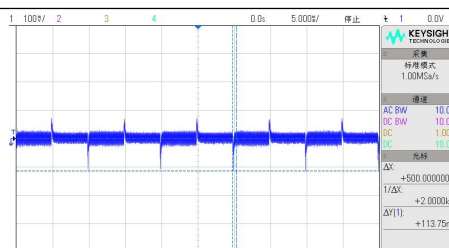


VIN=36V, 满载关机波形

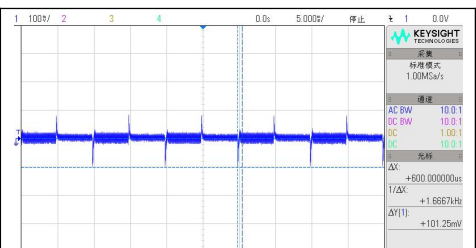
动态波形



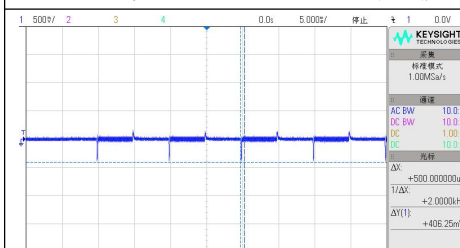
VIN=4.5V, 100%-10%-100%Io 动态波形



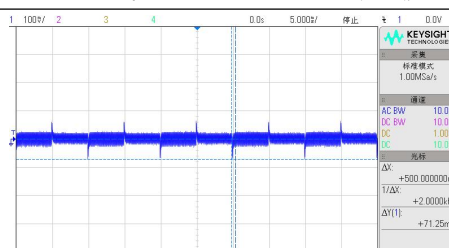
VIN=4.5V, 75%-50%-75%Io 动态波形



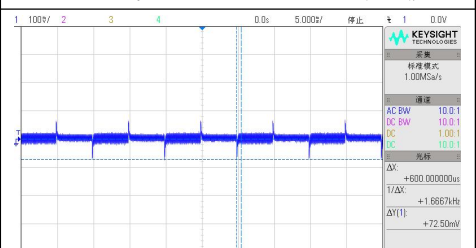
VIN=4.5V, 50%-25%-50%Io 动态波形



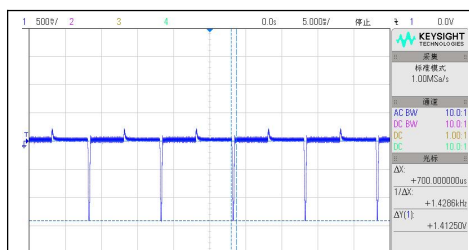
VIN=12V, 100%-10%-100%Io 动态波形



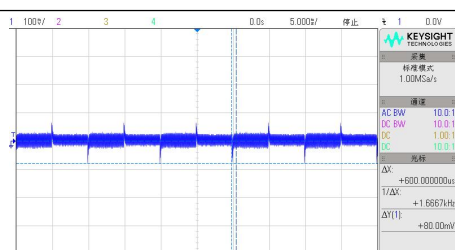
VIN=12V, 75%-50%-75%Io 动态波形



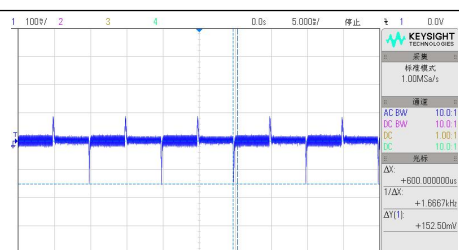
VIN=12V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

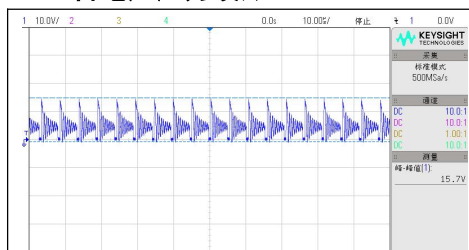


VIN=36V, 75%-50%-75%Io 动态波形

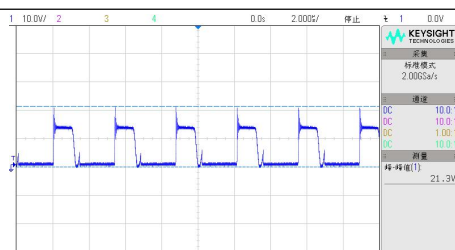


VIN=36V, 50%-25%-50%Io 动态波形

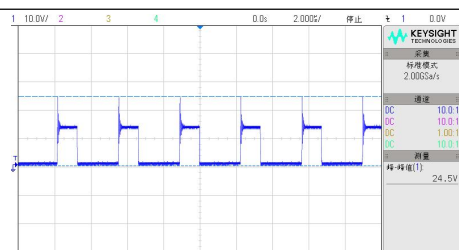
MOS 管电压应力波形



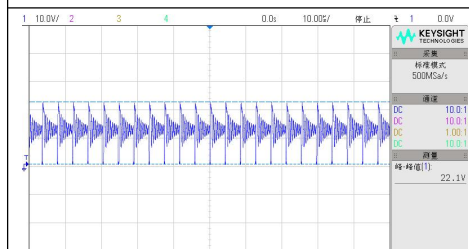
VIN=4.5V, 空载 VDS 波形



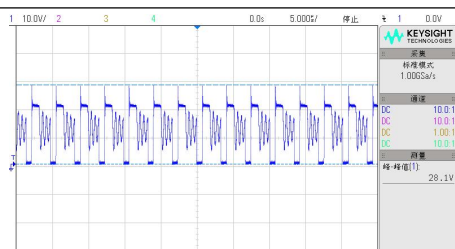
VIN=4.5V, 半载 VDS 波形



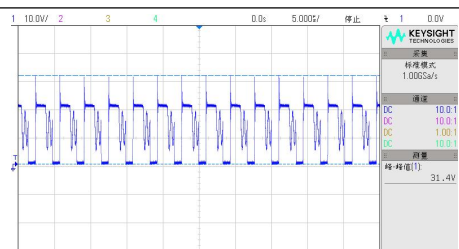
VIN=4.5V, 满载 VDS 波形



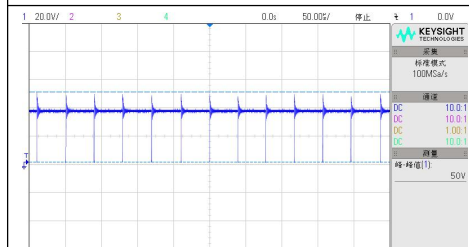
VIN=12V, 空载 VDS 波形



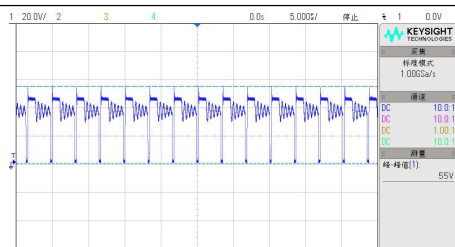
VIN=12V, 半载 VDS 波形



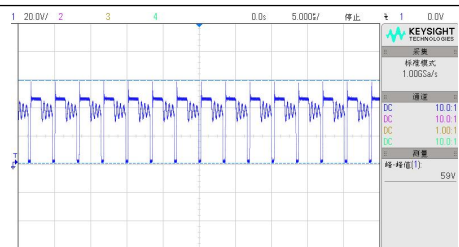
VIN=12V, 满载 VDS 波形



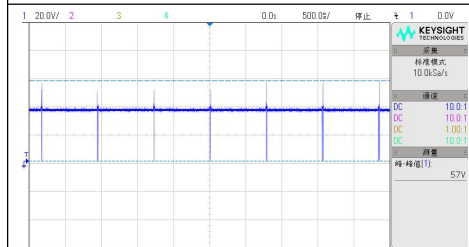
VIN=36V, 空载 VDS 波形



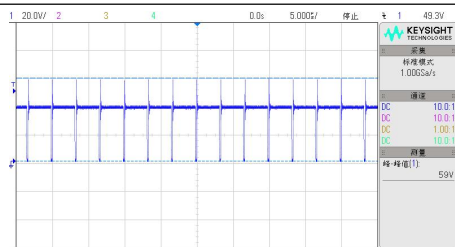
VIN=36V, 半载 VDS 波形



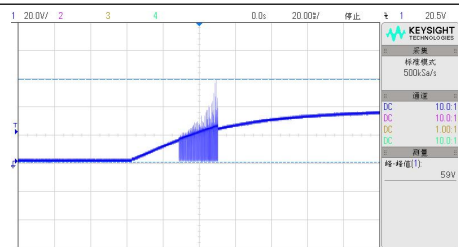
VIN=36V, 满载 VDS 波形



VIN=36V, 短路保护 VDS 波形

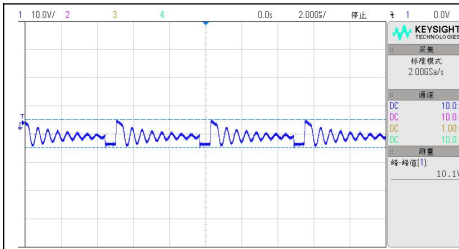


VIN=36V, 短路保护 VDS 展开波形

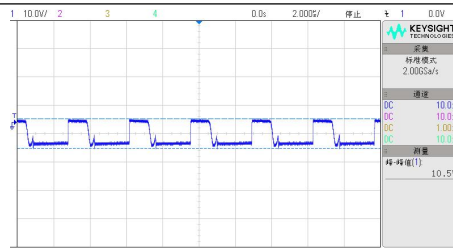


VIN=36V, 短路启机 VDS 波形

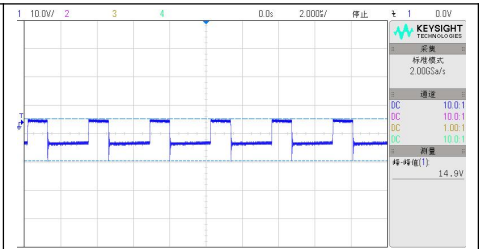
副边输出整流二极管 D4 应力波形



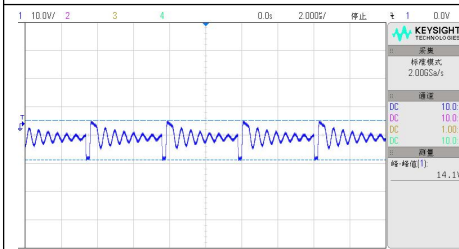
VIN=4.5V, D4 空载工作电压波形



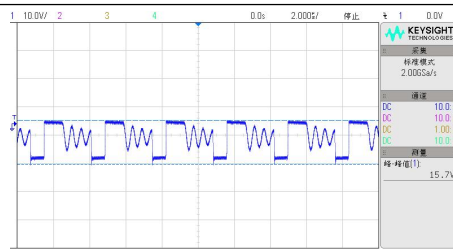
VIN=4.5V, D4 半载工作电压波形



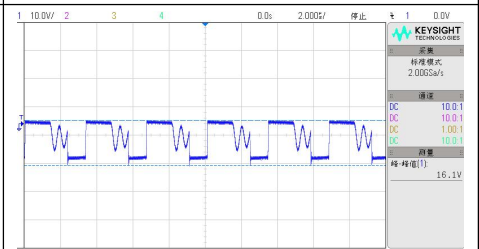
VIN=4.5V, D4 满载工作电压波形



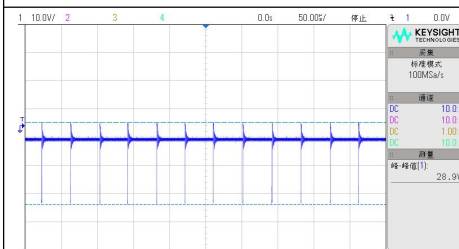
VIN=12V, D4 空载工作电压波形



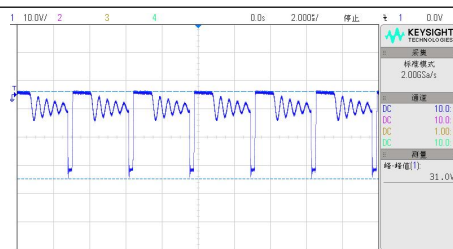
VIN=12V, D4 半载工作电压波形



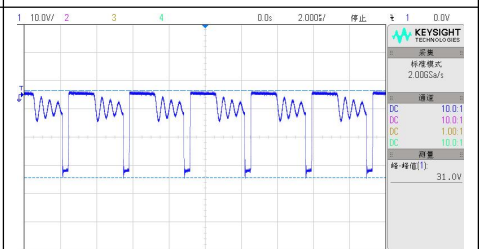
VIN=12V, D4 满载工作电压波形



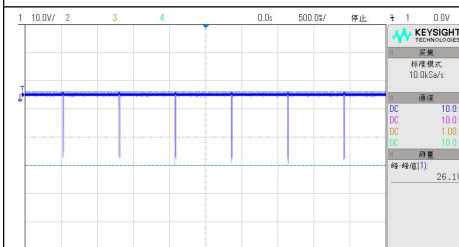
VIN=36V, D4 空载工作电压波形



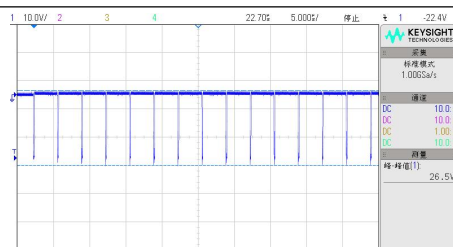
VIN=36V, D4 半载工作电压波形



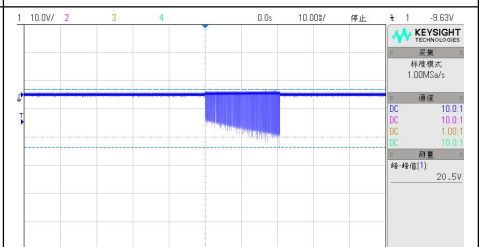
VIN=36V, D4 满载工作电压波形



VIN=36V, D4 短路保护电压波形



VIN=36V, D4 短路保护电压展开波形



VIN=36V, D4 短路启机电压波形

免责声明

本文的主要目的是为了让客户更好地理解与应用源特相关产品。所涉及技术信息提供的所有参数、数值、数据都是基于源特对于部分标准的理解得到的, 所提供的信息并不能保证所有假设情况和工作条件。客户在使用源特产品设计开发时, 需进行充分的设计验证以确保设计方案能满足特定的应用场合。本文所提供的测试数据是基于有限数量样品测试的典型值, 源特不能保证所有数据的准确性和完整性, 也不对本文所提供的任何参数、数值、数据、建议、观点的准确性和充分性承担任何责任, 不对由本文所造成的直接、间接损失承担任何责任。