

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 VPPSGUB-15A、输出整流二极管以及必要的阻容元件，实现 7V-50V 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。

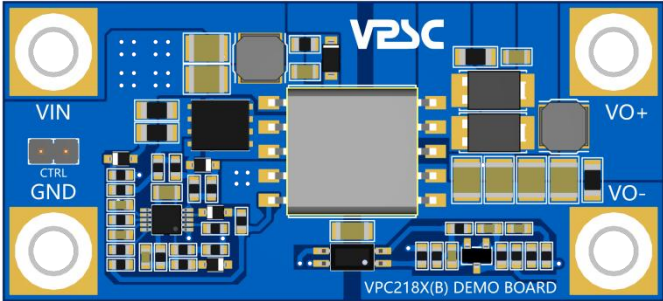
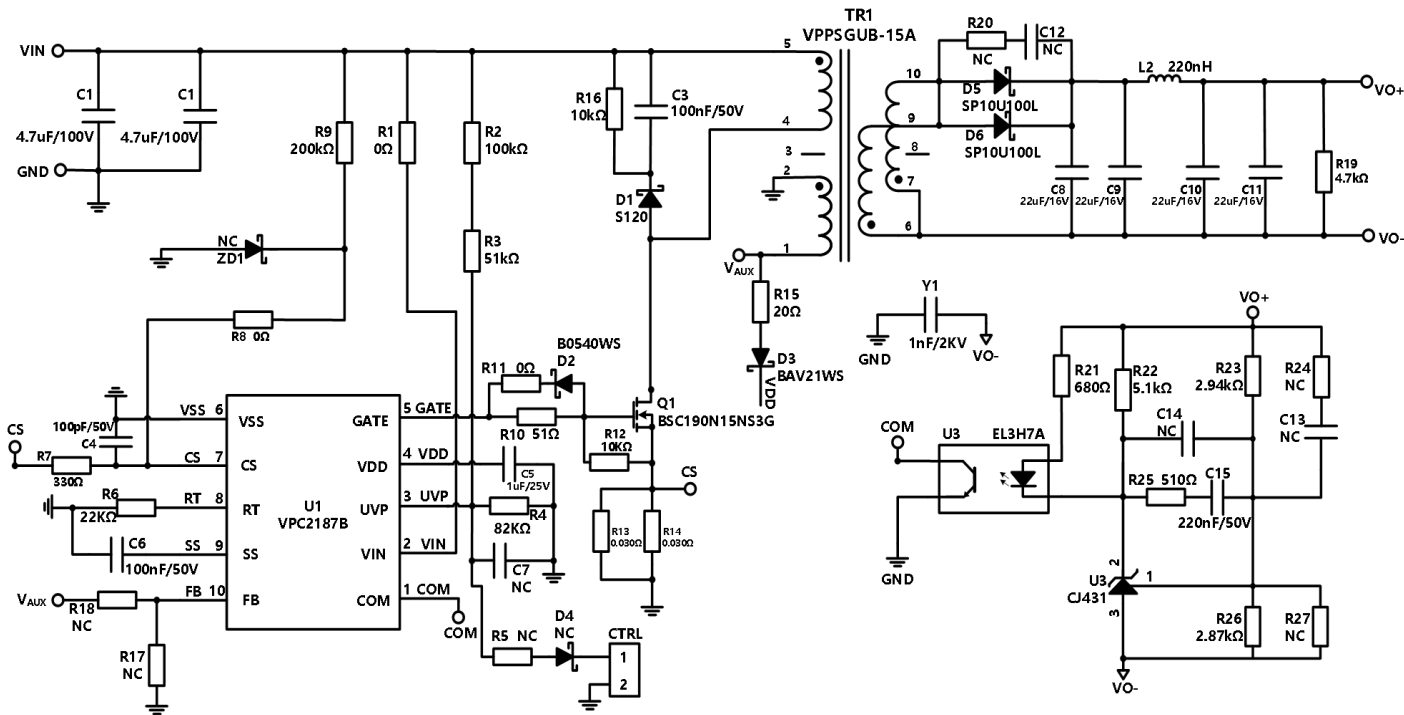


图 1: VPC2187B Demo 板(尺寸:50mm*30mm)

关键词：输入：7V-50V，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

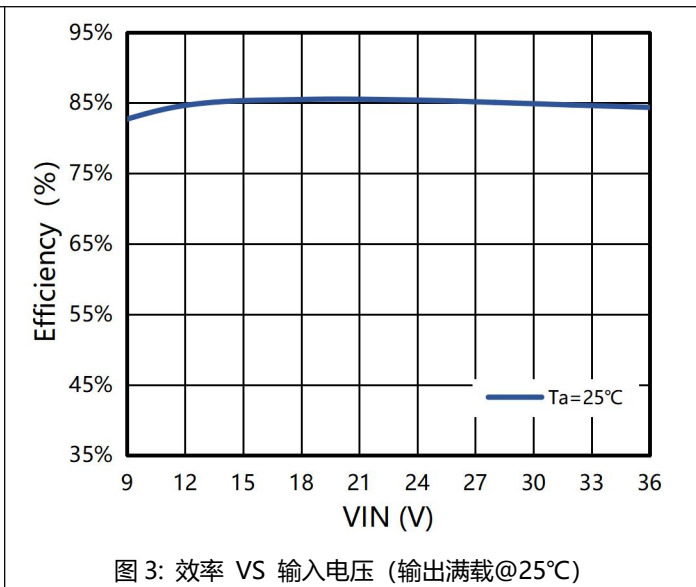
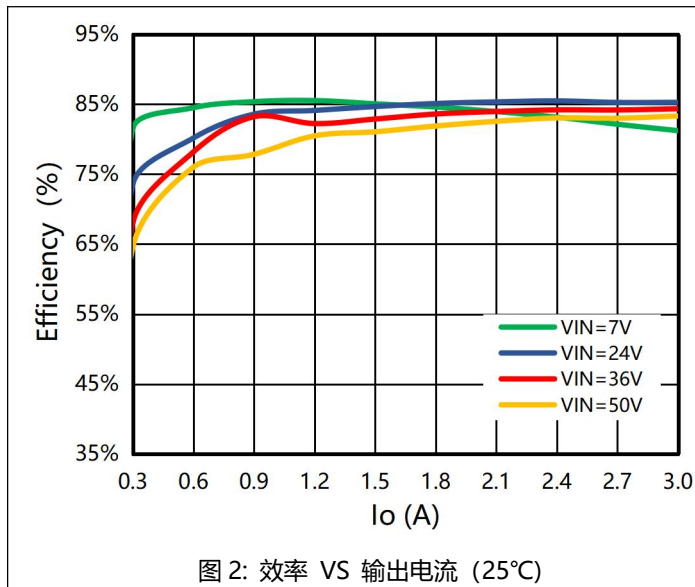
位号	参数	封装	型号	品牌
C1	4.7uF/100V-X7R	1210	FS32X475K101EGG	PSA
C2	4.7uF/100V-X7R	1210	FS32X475K101EGG	PSA
C3	100nF/50V-X7R	0805	CC0805KRX7R0BB104	YAGEO
C4	100pF/50V- NP0	0603	CC0603JRNPO9BN101	YAGEO
C5	1uF/50V-X7R	0805	CC0805KKX7R9BB105	YAGEO
C6	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C7	NC	-	-	-
C8	22uF/10V-X7R	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	NC	-	-	-
C13	NC	-	-	-
C14	NC	-	-	-
C15	220nF/50V-X7R	0603	CC0603KRX7R9BB224	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R2	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R3	51KΩ±1%	0603	RC0603FR-0751KL	YAGEO
R4	82KΩ±1%	0603	RC0603FR-0782KL	YAGEO
R5	NC	-	-	-
R6	22KΩ±1%	0603	RC0603FR-0722KL	YAGEO
R7	330Ω±1%	0603	RC0603FR-07330RL	YAGEO
R8	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R9	200KΩ±1%	0603	RC0603FR-07200KL	YAGEO
R10	51Ω±1%	0603	RC0603FR-0751RL	YAGEO
R11	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R12	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R13	0.030Ω ±1%	1206	RL1206JR-070R030L	YAGEO
R14	0.030Ω ±1%	1206	RL1206JR-070R030L	YAGEO
R15	20Ω±1%	0603	RC0603FR-0720RL	YAGEO
R16	10KΩ±1%	0805	RC0805FR-0710KL	YAGEO
R17	NC	-	-	-
R18	NC	-	-	-
R19	4.7KΩ±1%	1206	RC1206FR-074K7L	YAGEO
R20	NC	-	-	-
R21	680Ω±1%	0603	RC0603FR-07680RL	YAGEO
R22	5.1KΩ±1%	0603	RC0603FR-075K1L	YAGEO
R23	2.94KΩ±1%	0603	RC0603FR-072K94L	YAGEO
R24	NC	-	-	-

R25	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R26	2.87KΩ±1%	0603	RC0603FR-072K87L	YAGEO
R27	NC	-	-	-
TR1	NP:NS:NA=10:8:18 Lp=7.8uH	EPD13	VPPSGUB-15A	VPSC
Q1	N 沟道 150V 50A	TDSON-8	BSC190N15NS3G	onsemi
L2	220nH ±20%	SMD	SWPA5020SR22MT	Sunlord
ZD1	NC	-	-	-
D1	200V/1A	SOD-123	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	CJ
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	NC	-	-	-
D6	100V/10A	TO-277	SP10U100L	XCH
D7	100V/10A	TO-277	SP10U100L	XCH
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

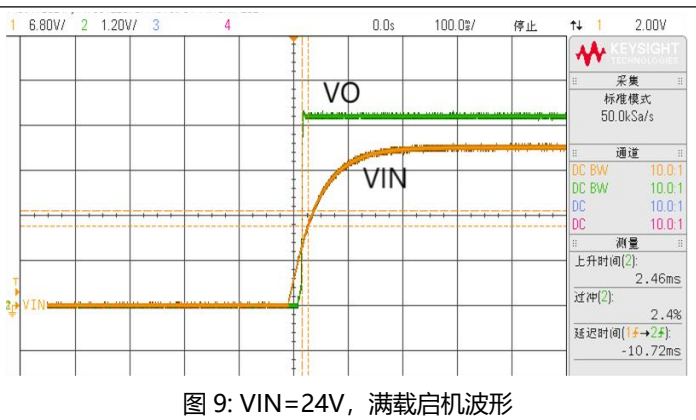
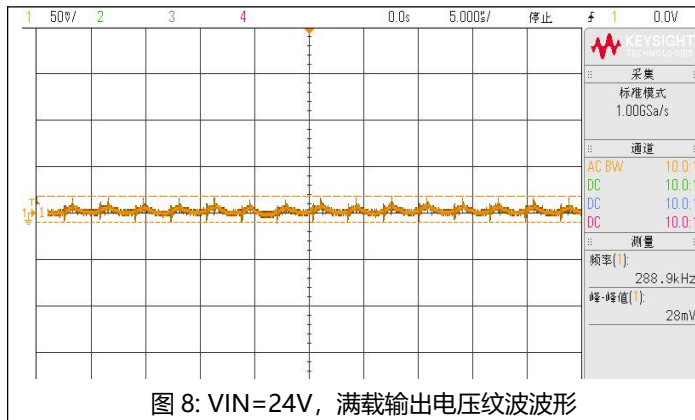
总体性能一览表

性能指标	测试条件	Min	Typ	Max	Unit
输入电流 (满载/空载)	VIN=24V	5	---	739	mA
转换效率	VIN=24V, IO=3A	---	85.28	---	%
纹波&噪声	VIN=24V, IO=3A	---	28	90	mV
输出电压精度	VIN=24V, IO=3A	---	1	---	%
线性调节率	VIN=7V-50V, IO=3A	---	0.5	---	%
负载调整率	VIN=24V, IO=3A	---	0.5	---	%
输出过流点系数	VIN=50V, IO=3A	---	1.46	---	倍
输入欠压保护	锁定电压	---	5.7	---	V
	恢复电压	---	6.4	---	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

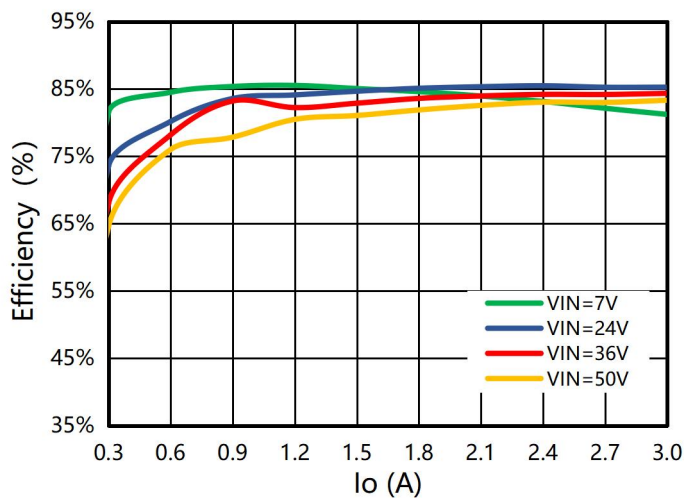


图 2: 效率 VS 输出电流 (25°C)

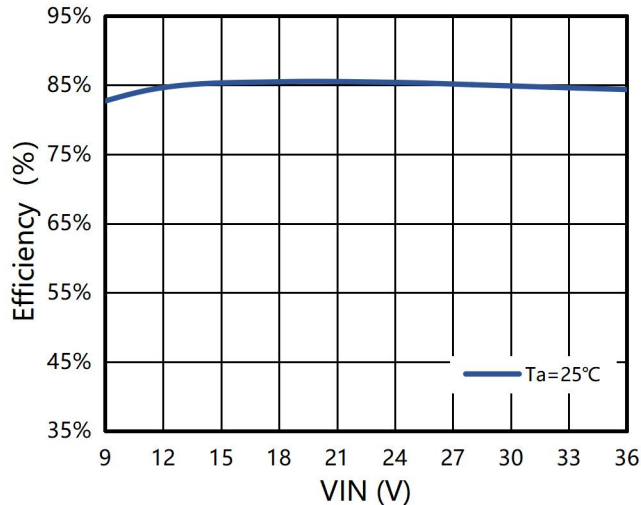


图 3: 效率 VS 输入电压 (输出满载@25°C)

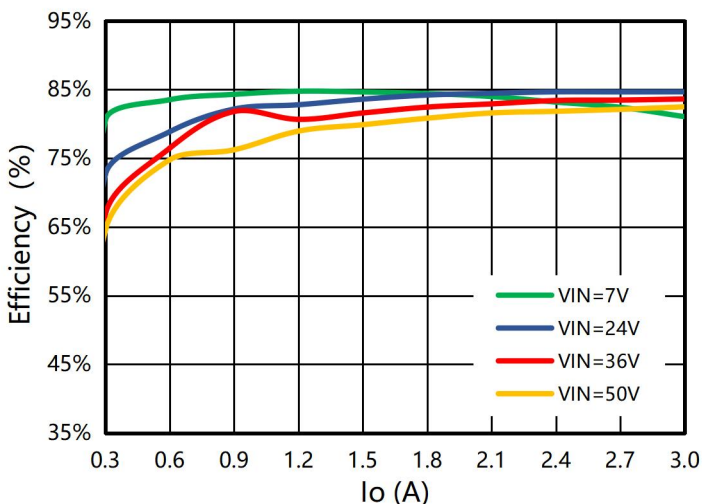


图 4: 效率 VS 输出电流 (-40°C)

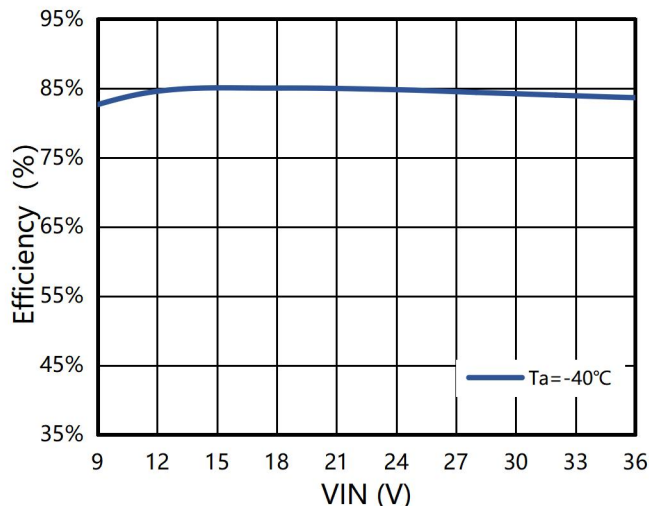


图 5: 效率 VS 输入电压 (输出满载@-40°C)

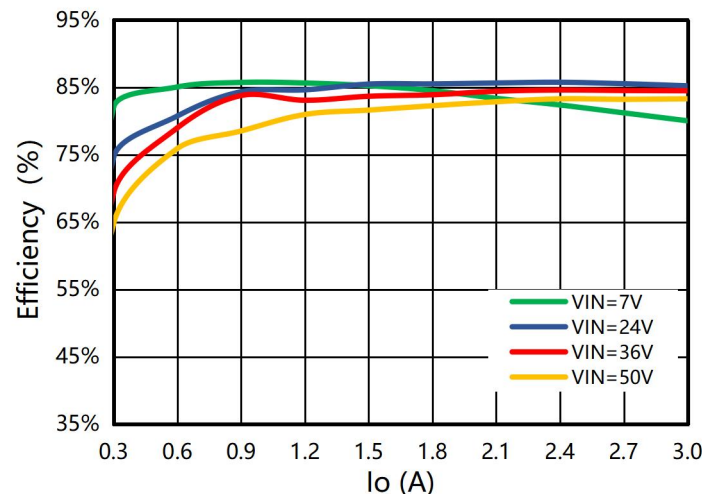


图 6: 效率 VS 输出电流 (85°C)

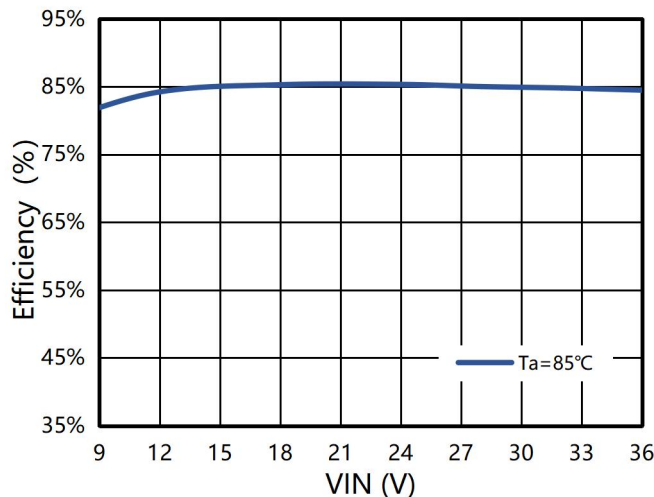


图 7: 效率 VS 输入电压 (输出满载@85°C)

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	0.005	5.06	0	0%	0.00%
24	0.086	5.06	0.300	10%	73.55%
24	0.158	5.06	0.601	20%	80.20%
24	0.227	5.06	0.900	30%	83.59%
24	0.301	5.06	1.201	40%	84.12%
24	0.373	5.05	1.501	50%	84.67%
24	0.445	5.05	1.800	60%	85.11%
24	0.518	5.05	2.101	70%	85.34%
24	0.591	5.05	2.401	80%	85.48%
24	0.665	5.04	2.700	90%	85.26%
24	0.739	5.04	3.001	100%	85.28%

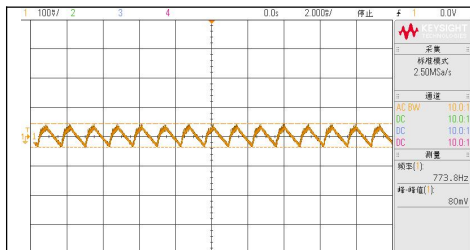
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
24	0.005	5.04	0	0%	0.00%
24	0.087	5.04	0.301	10%	72.66%
24	0.160	5.04	0.601	20%	78.88%
24	0.230	5.04	0.900	30%	82.17%
24	0.304	5.03	1.201	40%	82.80%
24	0.376	5.03	1.500	50%	83.61%
24	0.448	5.03	1.800	60%	84.21%
24	0.521	5.03	2.100	70%	84.48%
24	0.594	5.03	2.400	80%	84.68%
24	0.667	5.02	2.700	90%	84.67%
24	0.741	5.02	3.000	100%	84.68%

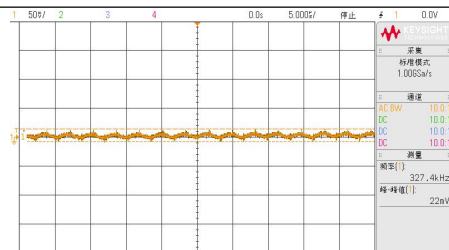
VIN=24V, Ta=85°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
24	0.006	5.07	0	0%	0.00%
24	0.085	5.07	0.3	10%	74.56%
24	0.157	5.07	0.600	20%	80.73%
24	0.225	5.06	0.900	30%	84.33%
24	0.299	5.06	1.200	40%	84.62%
24	0.370	5.06	1.500	50%	85.47%
24	0.443	5.05	1.800	60%	85.50%
24	0.516	5.05	2.100	70%	85.63%
24	0.589	5.05	2.400	80%	85.74%
24.01	0.664	5.05	2.700	90%	85.53%
24.01	0.739	5.04	3.000	100%	85.21%

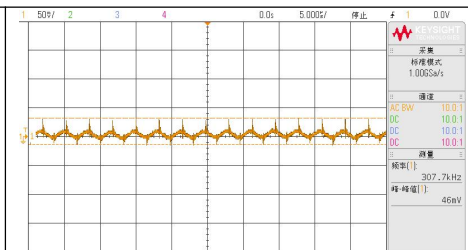
输出电压纹波波形



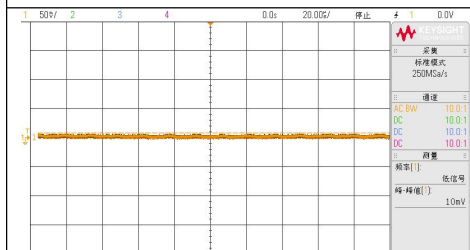
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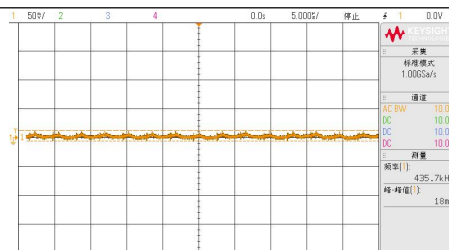
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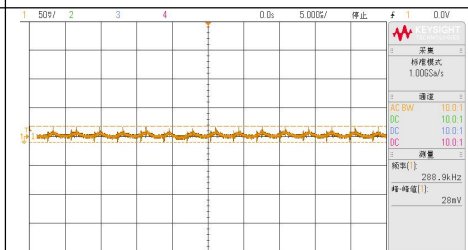
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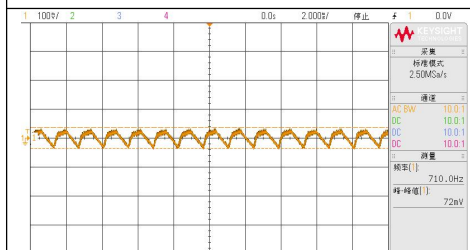
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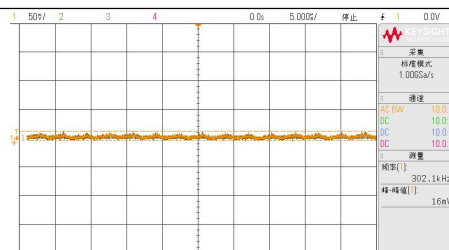
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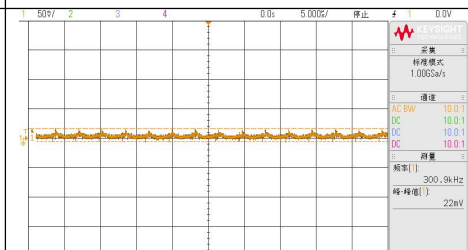
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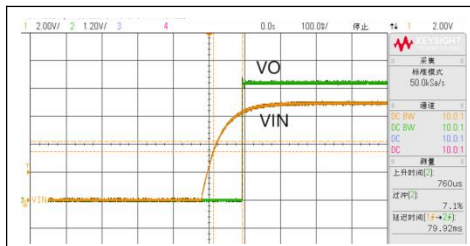


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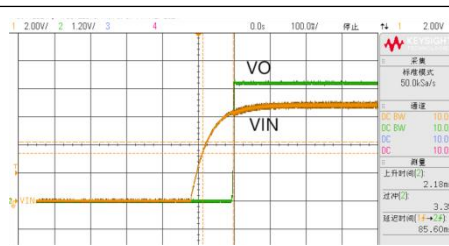


VIN=50V, 满载输出电压纹波波形

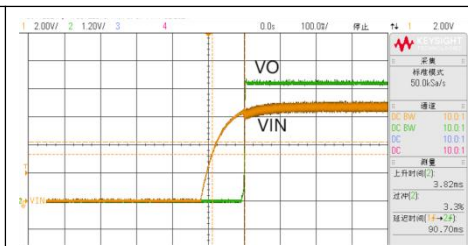
开关机波形



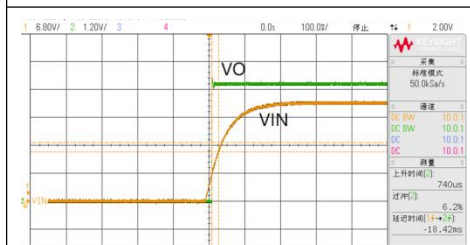
VIN=7V, 空载启机波形



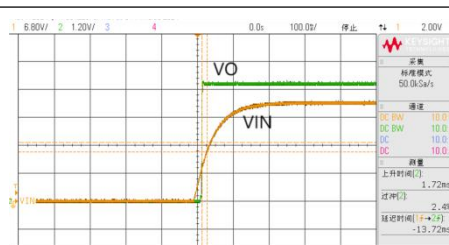
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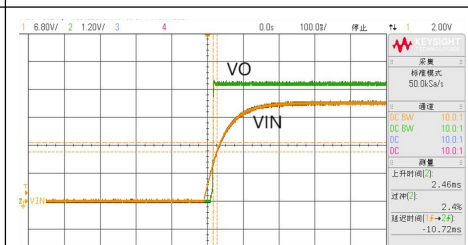
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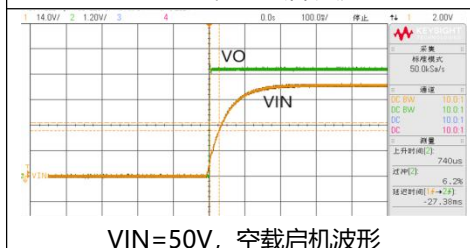
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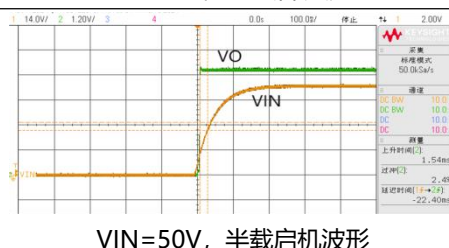
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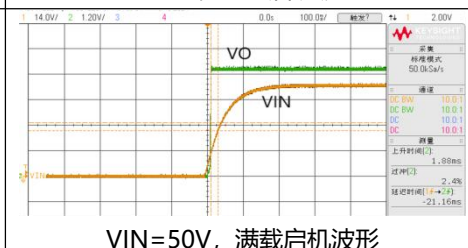
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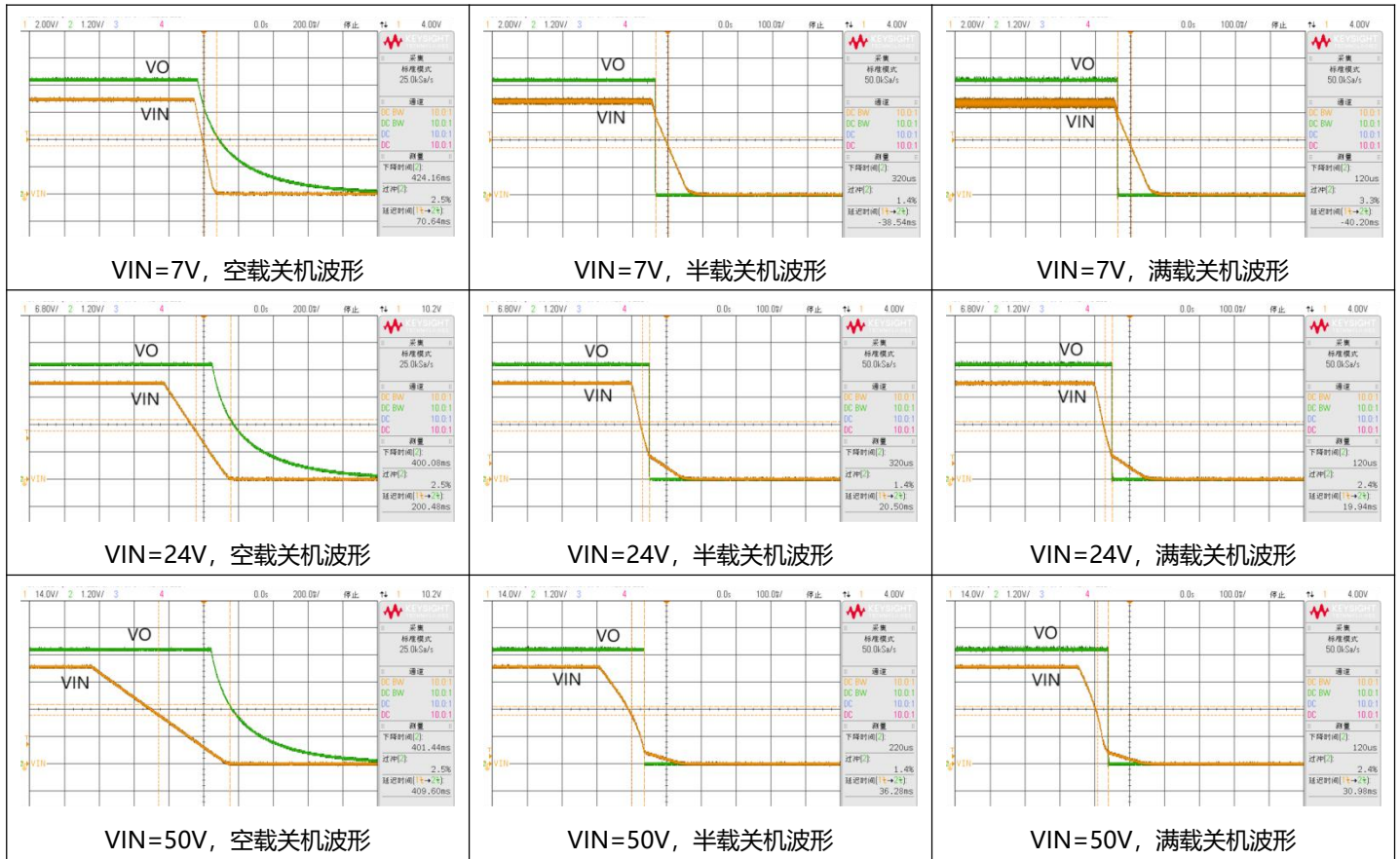
VIN=50V, 空载启机波形



VIN=50V, 半载启机波形



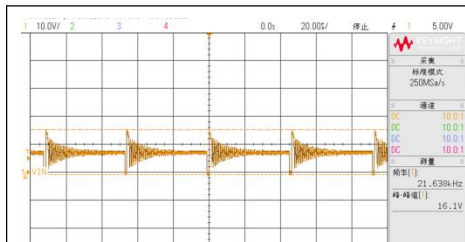
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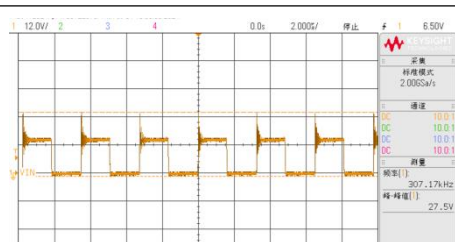
动态波形



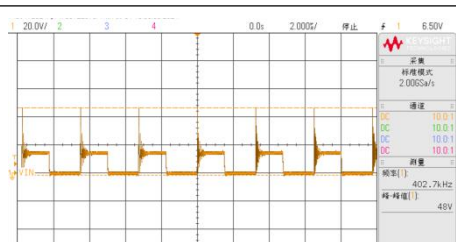
外置 MOS 管 Q1 电压应力波形



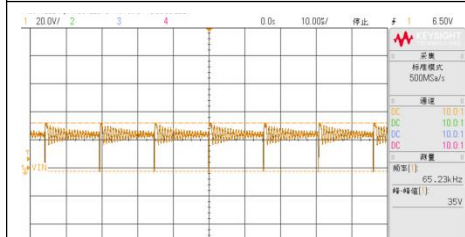
VIN=7V, 空载 VDS 波形



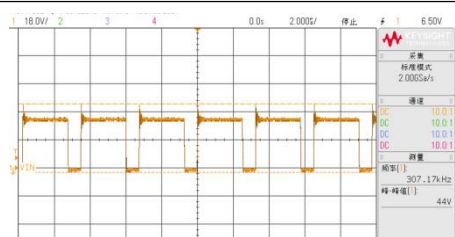
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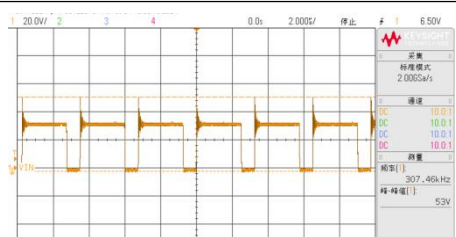
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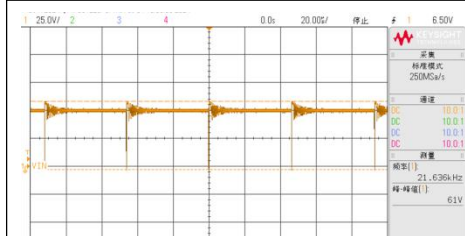
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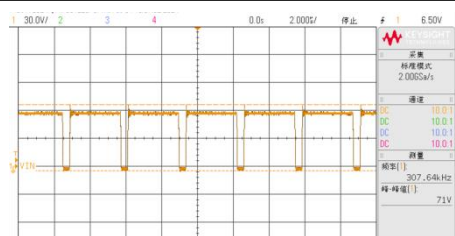
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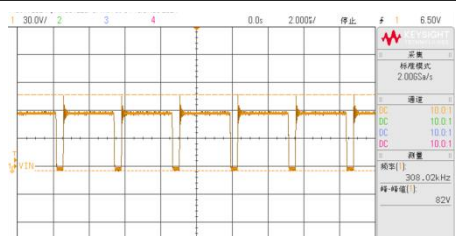
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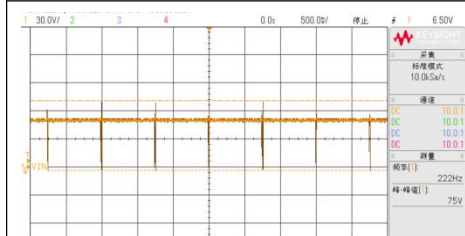
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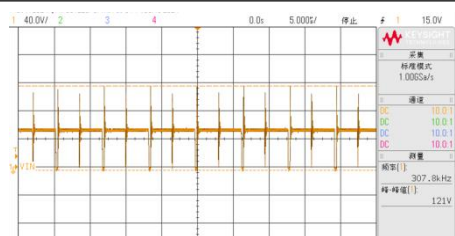
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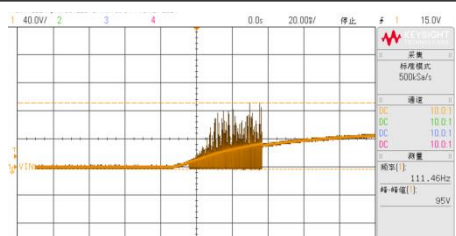
VIN=50V, 满载 VDS 波形



VIN=50V, 短路保护 VDS 波形

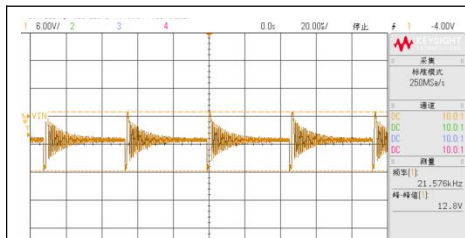


VIN=50V, 短路保护 VDS 展开波形

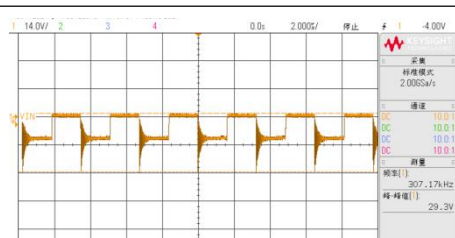


VIN=50V, 短路启机 VDS 波形

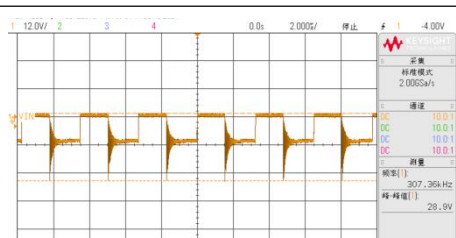
副边输出整流二极管 D6、D7 应力波形



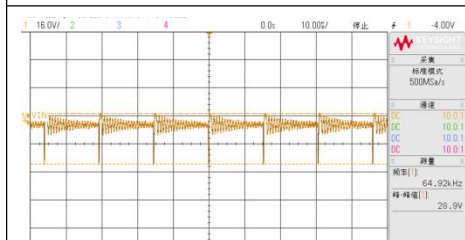
VIN=7V, D6、D7 空载工作电压波形



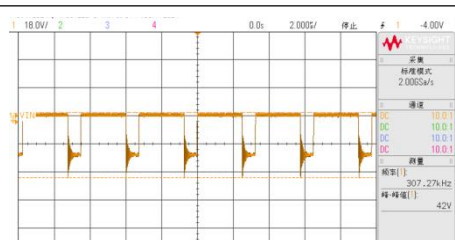
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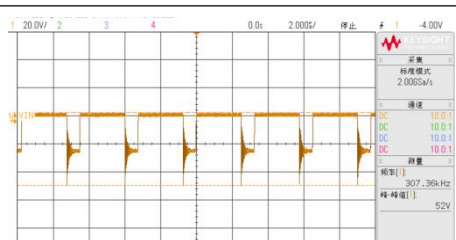
VIN=7V, D6、D7 满载工作电压波形



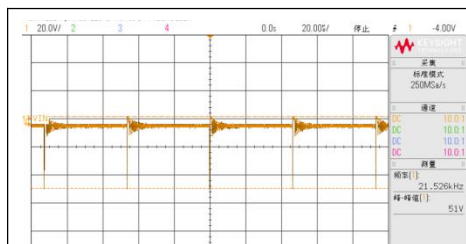
VIN=24V, D6、D7 空载工作电压波形



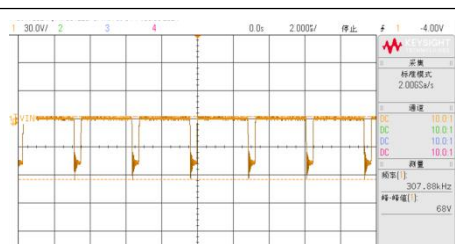
VIN=24V, D6、D7 半载工作电压波形



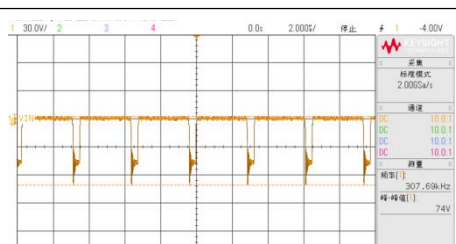
VIN=24V, D6、D7 满载工作电压波形



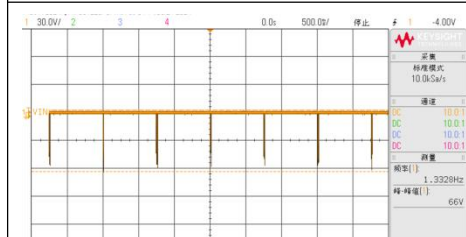
VIN=50V, D6、D7 空载工作电压波形



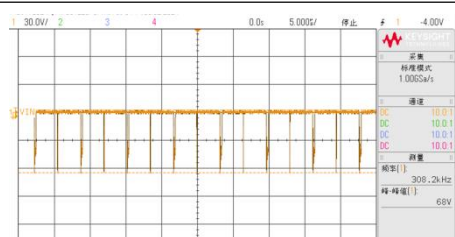
VIN=50V, D6、D7 半载工作电压波形



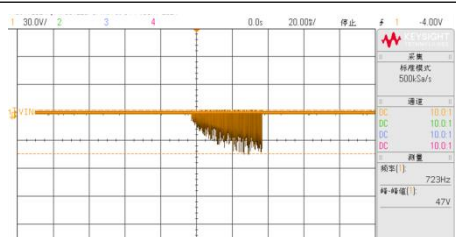
VIN=50V, D6、D7 满载工作电压波形



VIN=50V, D6、D7 短路保护工作电压波形



VIN=50V, D6、D7 短路保护工作电压展开波形



VIN=50V, D6、D7 短路启机电压波形

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