

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 VPE27POE01A、输出整流二极管以及必要的阻容元件，实现 6V-60V 输入，12V 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 24W 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。

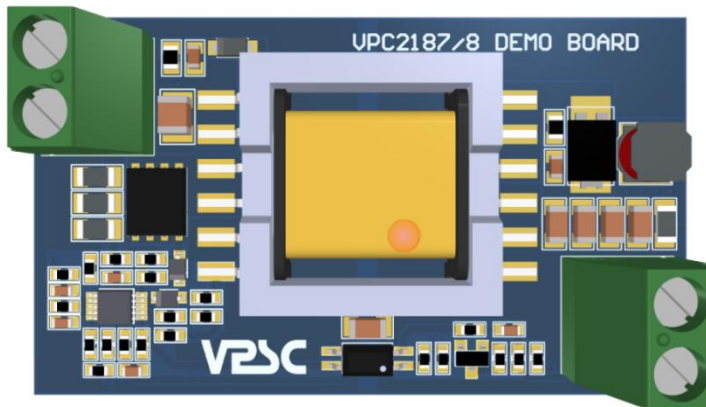
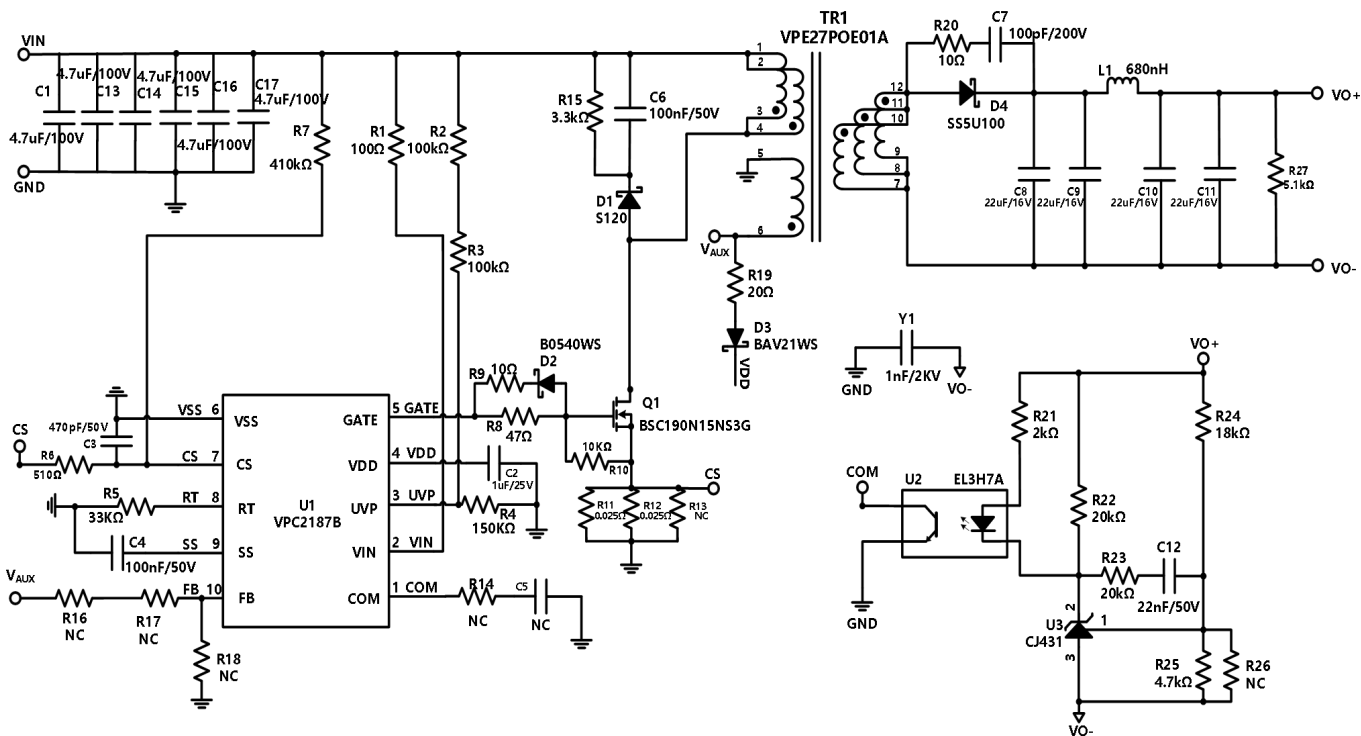


图 1: VPC218x Demo 板(尺寸:16mm*9.5mm)

关键词：输入：6V-60V，输出 12V/24W，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	1210	1210B475K101NT	FH(风华)
C2	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C3	470pF/50V-NP0	0603	CC0603JRX7R9BB471	YAGEO
C4	100nF/50V-NP0	0603	CC0603KRX7R9BB104	YAGEO
C5	NC	-	-	-
C6	100nF/50V-X7R	0805	CC0805KKX7R0BB104	YAGEO
C7	100pF/200V- NP0	0805	CC0805JRNPOABN101	YAGEO
C8	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C9	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C10	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C11	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C12	22nF/50V-X7R	0603	CC0603KRX7R9BB223	YAGEO
C13	4.7uF/100V	1210	1210B475K101NT	FH(风华)
C14	4.7uF/100V	1210	1210B475K101NT	FH(风华)
C15	4.7uF/100V	1210	1210B475K101NT	FH(风华)
C16	4.7uF/100V	1210	1210B475K101NT	FH(风华)
C17	4.7uF/100V	1210	1210B475K101NT	FH(风华)
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	100Ω±1%	0603	AF0603FR-07100RL	YAGEO
R2	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R3	100KΩ±1%	0603	RC0603FR-07100KL	YAGEO
R4	150KΩ±1%	0603	RT0603BRD07150KL	YAGEO
R5	33KΩ±1%	0603	AC0603FR-0733KL	YAGEO
R6	510Ω±1%	0603	RC0603FR-07510RL	YAGEO
R7	820KΩ±1%并联 820KΩ±1%	0603	RC0603FR-07820KL	YAGEO
R8	47Ω±1%	0603	RC0603FR-0747RL	YAGEO
R9	10Ω±1%	0603	AC0603FR-0710RL	YAGEO
R10	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R11	0.025Ω ±1%	1206	RL1206FR-070R025L	YAGEO
R12	0.025Ω ±1%	1206	RL1206FR-070R025L	YAGEO
R13	NC	-	-	-
R14	NC	-	-	-
R15	3.3KΩ±1%	0805	RC0805FR-073K3L	YAGEO
R16	NC	-	-	-
R17	NC	-	-	-
R18	NC	-	-	-
R19	20Ω±1%	0603	AC0603FR-0720RL	YAGEO
R20	10Ω±1%	0805	AC0805FR-0710RL	YAGEO
R21	2KΩ±1%	0603	RC0603FR-072KL	YAGEO
R22	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO

R23	20K Ω ±1%	0603	RC0603FR-0720KL	YAGEO
R24	18K Ω ±1%	0603	RC0603FR-0718KL	YAGEO
R25	4.7K Ω ±1%	0603	RC0603FR-074K7L	YAGEO
R26	NC	-	-	-
R27	5.1K Ω ±1%	1206	RV1206FR-075K1L	YAGEO
TR1	NP:NS:NA=7:5:5 Lp=10uH	EFD20	VPE27POE01A	VPSC
Q1	N 沟道 150V 50A	PG-TDSON-8	BSC190N15NS3G	INFINEON
L1	680nH ±20%	SMD-5.0mm* 3.0mm	MWSA0503S-R68MT	Sunlord
D1	200V/1A	SOD-123	S120	YANGJIE
D2	40V/0.5A	SOD-323	B0540WS	DIDDOES
D3	200V/0.2A	SOD-323	BAV21WS	CJ
D4	100V/10A	TO-277	SS5U100	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	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	5	---	568	mA
转换效率	VIN=48V, IO=2A	---	88.27	---	%
纹波&噪声	VIN=48V, IO=2A	---	84	94	mV
输出电压精度	VIN=48V, IO=2A	---	0.42	---	%
线性调节率	VIN=6V-60V, IO=2A	---	0	---	%
负载调整率	VIN=48V, IO=2A	---	0.3	---	%
短路保护	VIN=6V-60V	可长期保护, 自恢复			
工作温度		-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

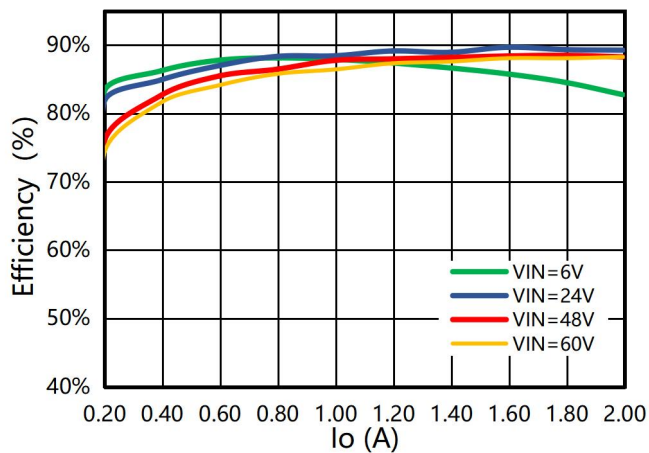


图 2: 效率 VS 输出电流

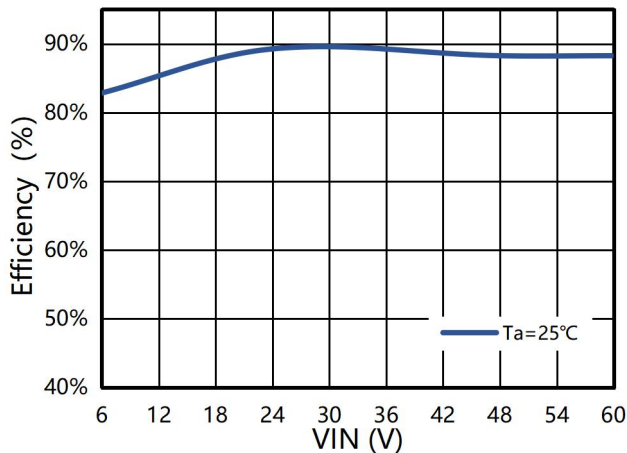


图 3: 效率 VS 输入电压 (输出满载)

相关波形

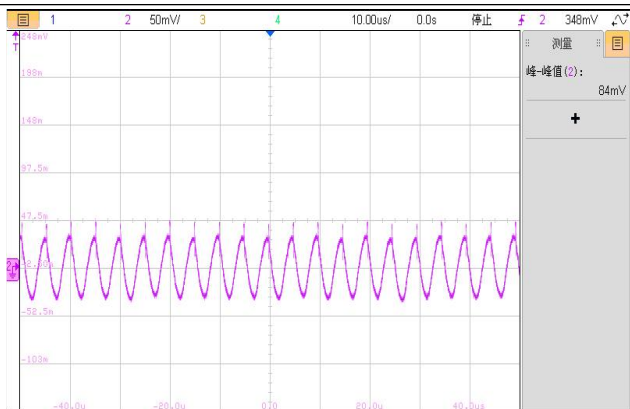


图 4: VIN=48V, 满载输出电压纹波波形

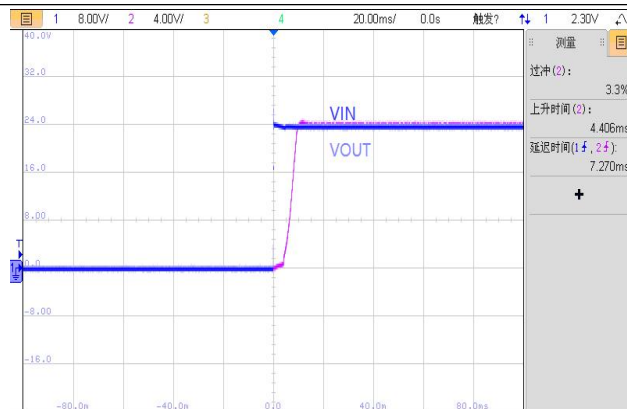


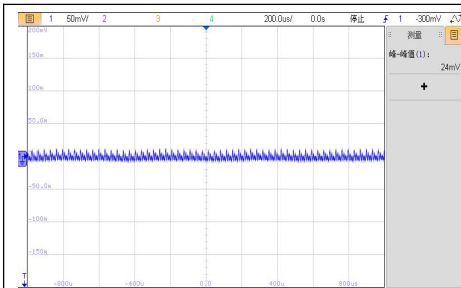
图 5: VIN=48V, 满载启机波形

详细测试数据

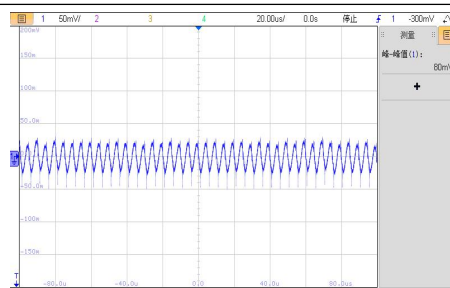
VIN=48V, Ta=25°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO(V)	IO(A)	IO-max%	η(%)
47.9	0.005	12.08	0	0%	0%
47.9	0.066	12.08	0.198	10%	75.66%
47.9	0.121	12.07	0.397	20%	82.68%
47.9	0.176	12.07	0.597	30%	85.47%
47.9	0.232	12.07	0.796	40%	86.46%
47.9	0.286	12.07	0.996	50%	87.75%
47.9	0.342	12.06	1.195	60%	87.97%
47.9	0.398	12.06	1.394	70%	88.18%
47.9	0.454	12.06	1.594	80%	88.40%
47.9	0.510	12.05	1.794	90%	88.49%
47.9	0.568	12.05	1.993	100%	88.27%

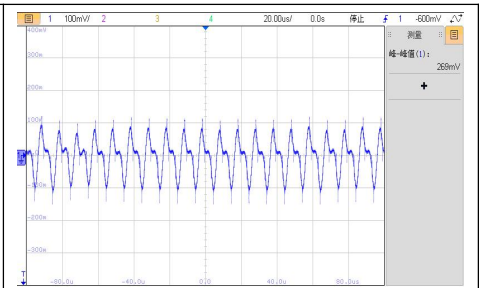
输出电压纹波波形



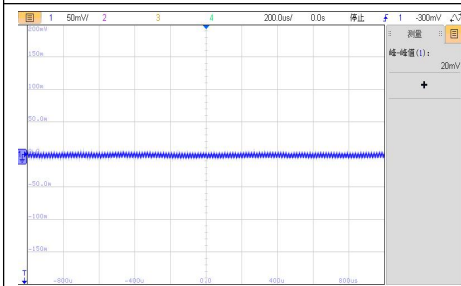
VIN=6V, 空载输出电压纹波波形



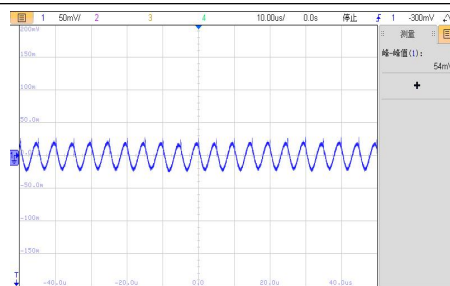
VIN=6V, 半载输出电压纹波波形



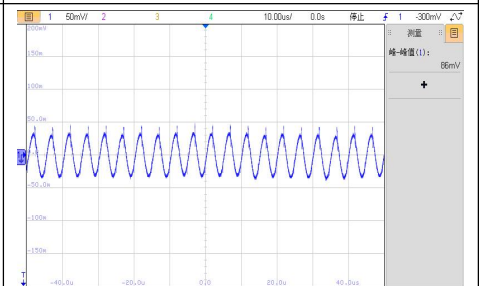
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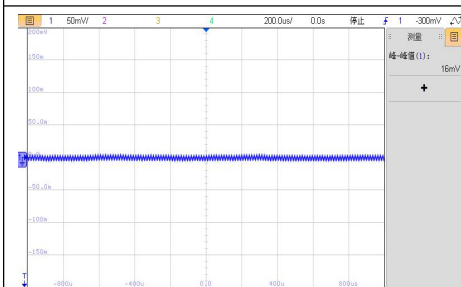
VIN=24V, 空载输出电压纹波波形



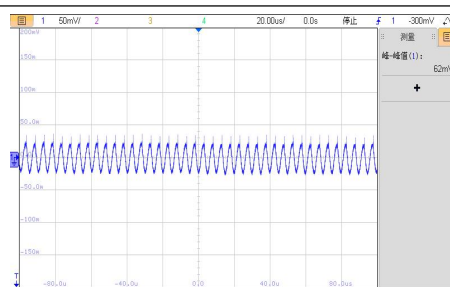
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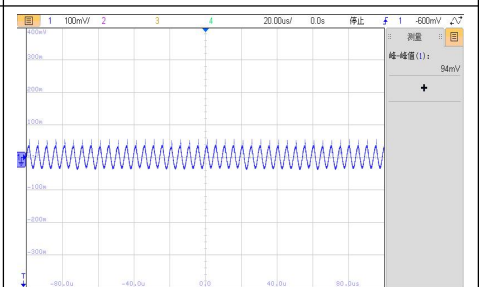
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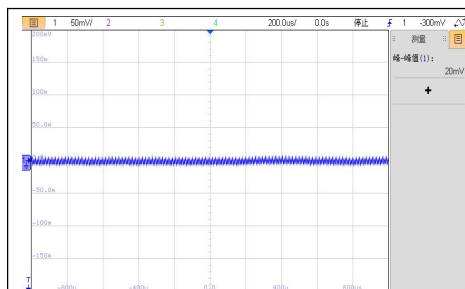
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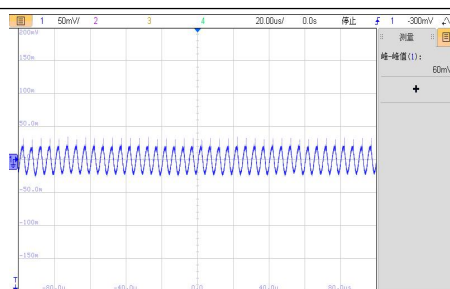
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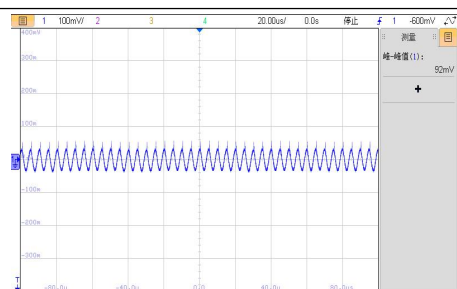
VIN=48V, 满载输出电压纹波波形



VIN=60V, 空载输出电压纹波波形



VIN=60V, 半载输出电压纹波波形

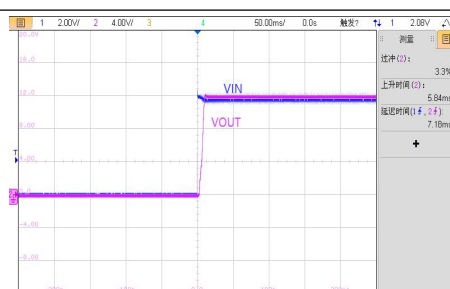


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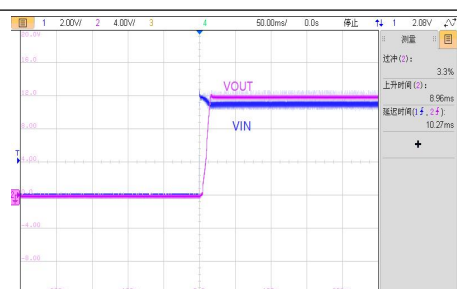
开关机波形



VIN=6V, 空载启机波形



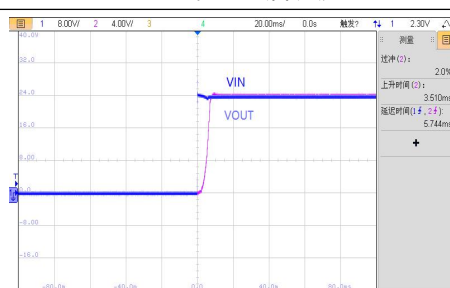
VIN=6V, 半载启机波形



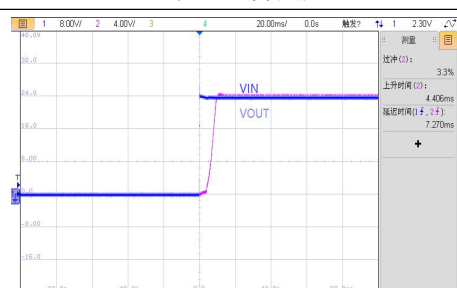
VIN=6V, 满载启机波形



VIN=24V, 空载启机波形



VIN=24V, 半载启机波形



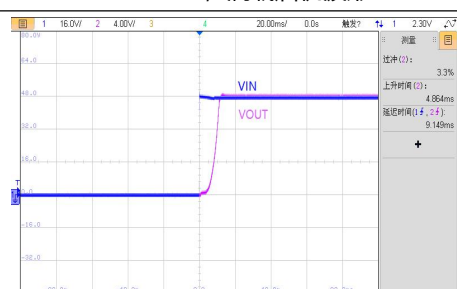
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VIN=48V, 空载启机波形



VIN=48V, 半载启机波形



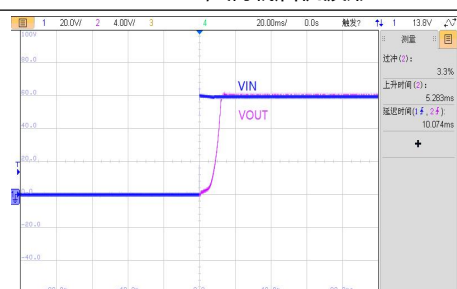
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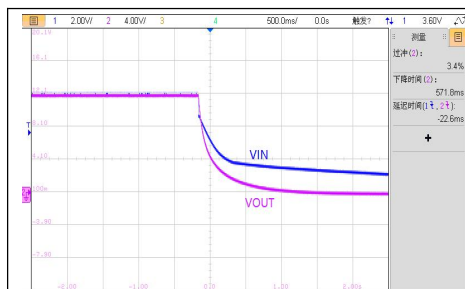
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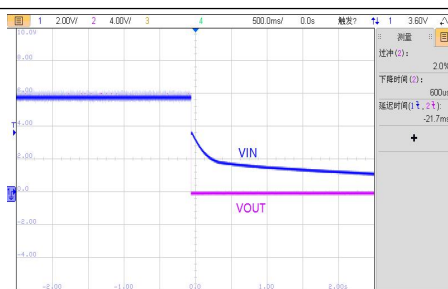
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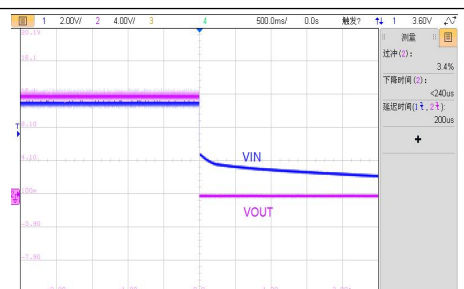
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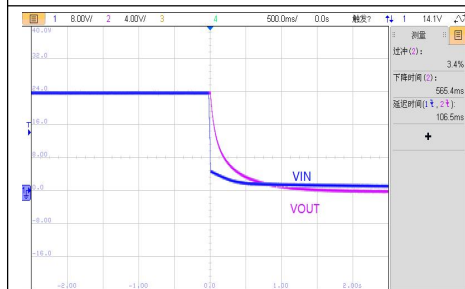
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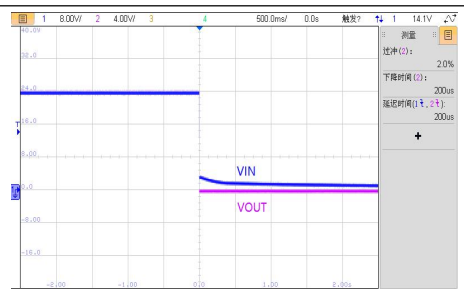
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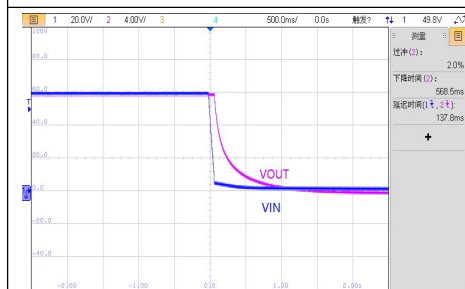
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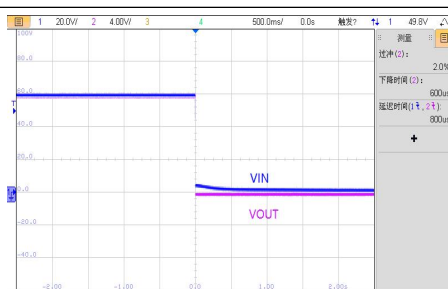
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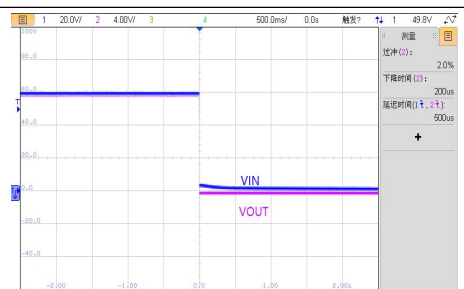
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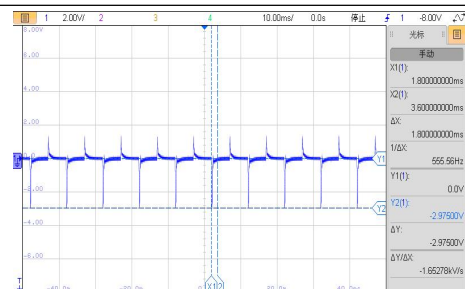


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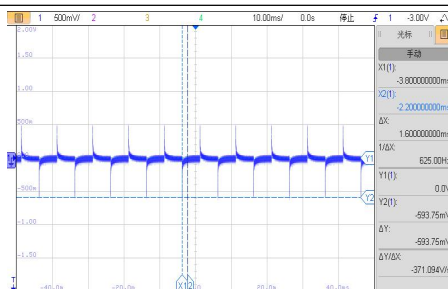


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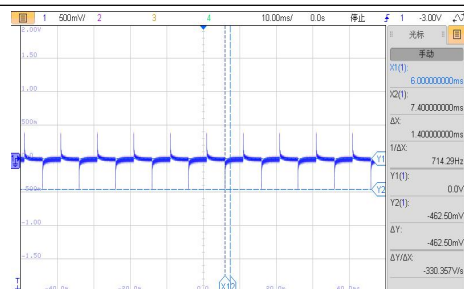
动态波形



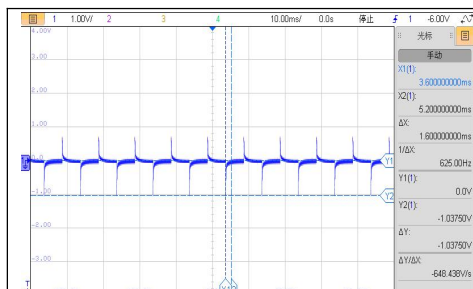
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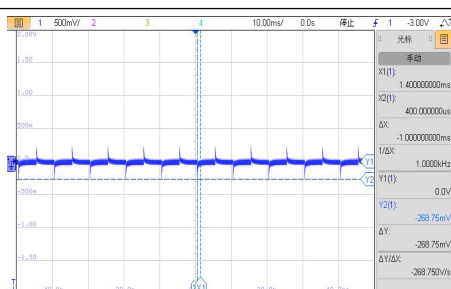
VIN=6V, 75%-50%-75%lo 动态波形



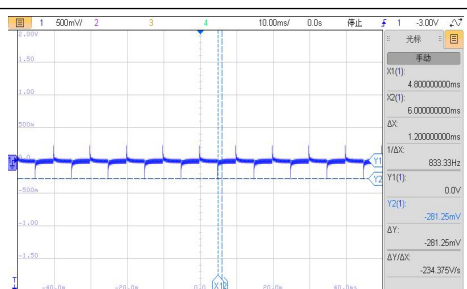
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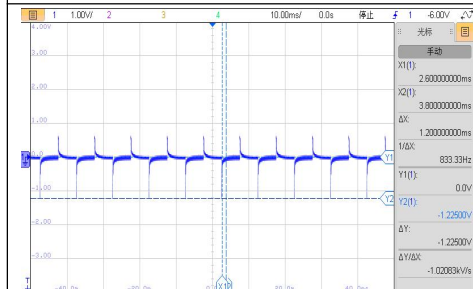
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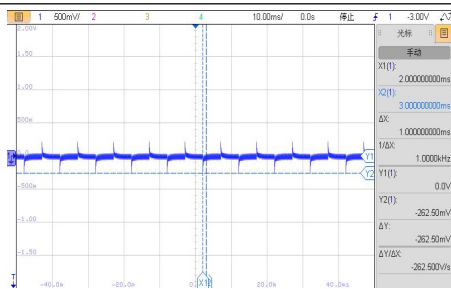
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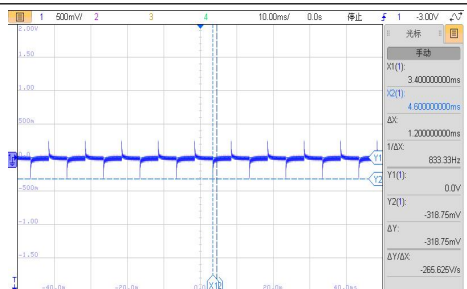
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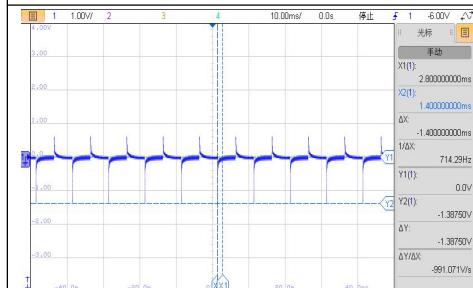
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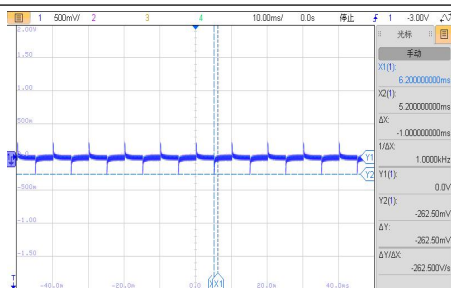
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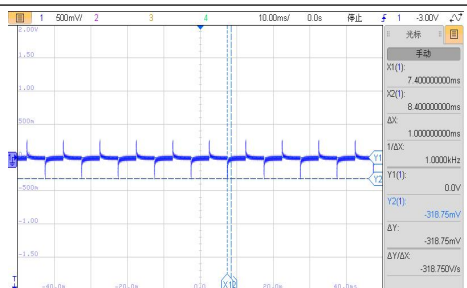
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VIN=60V, 100%-10%-100%Io 动态波形

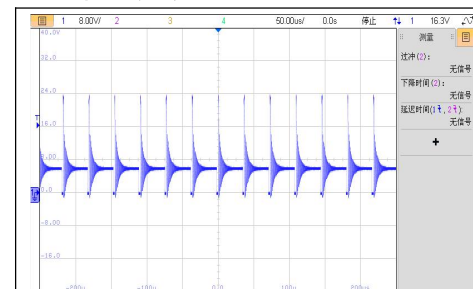


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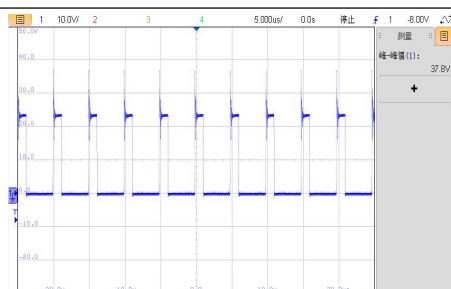


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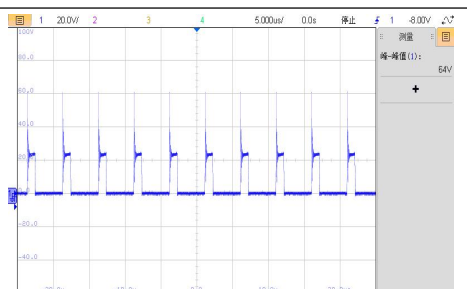
MOS 管应力波形



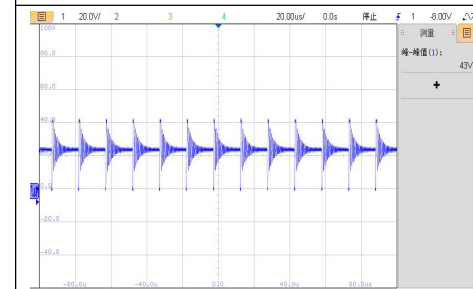
VIN=6V, 空载 VDS 波形



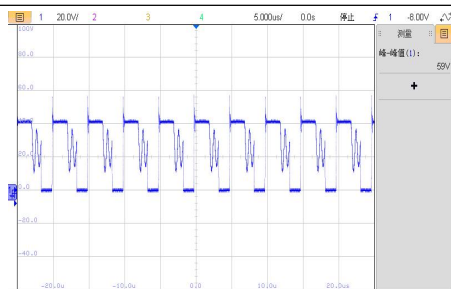
VIN=6V, 半载 VDS 波形



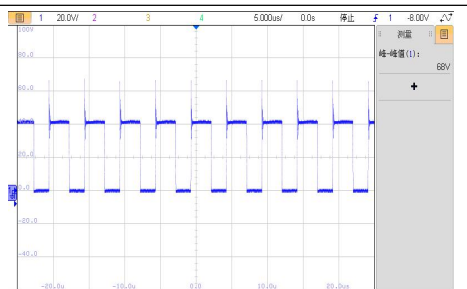
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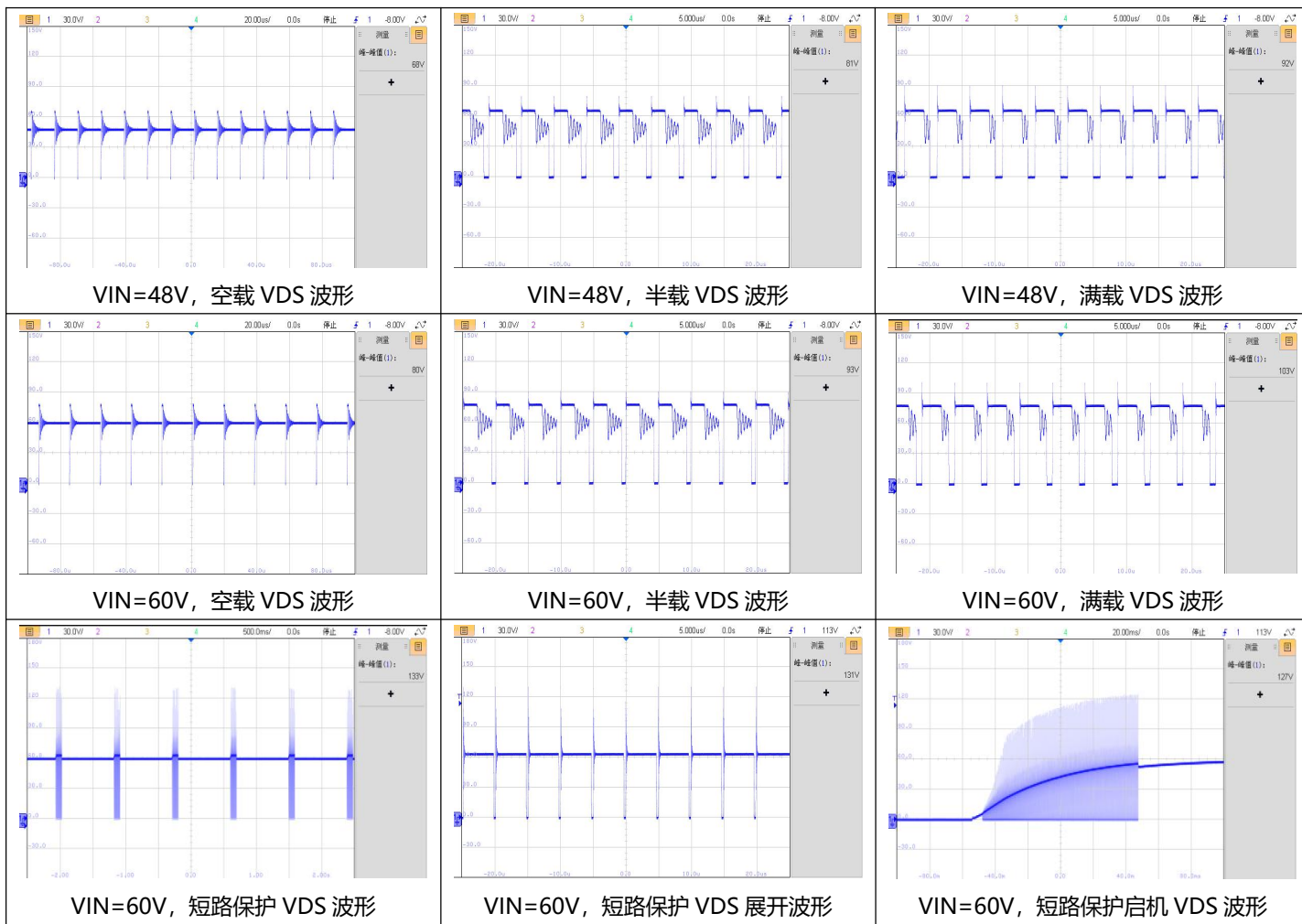
VIN=24V, 空载 VDS 波形



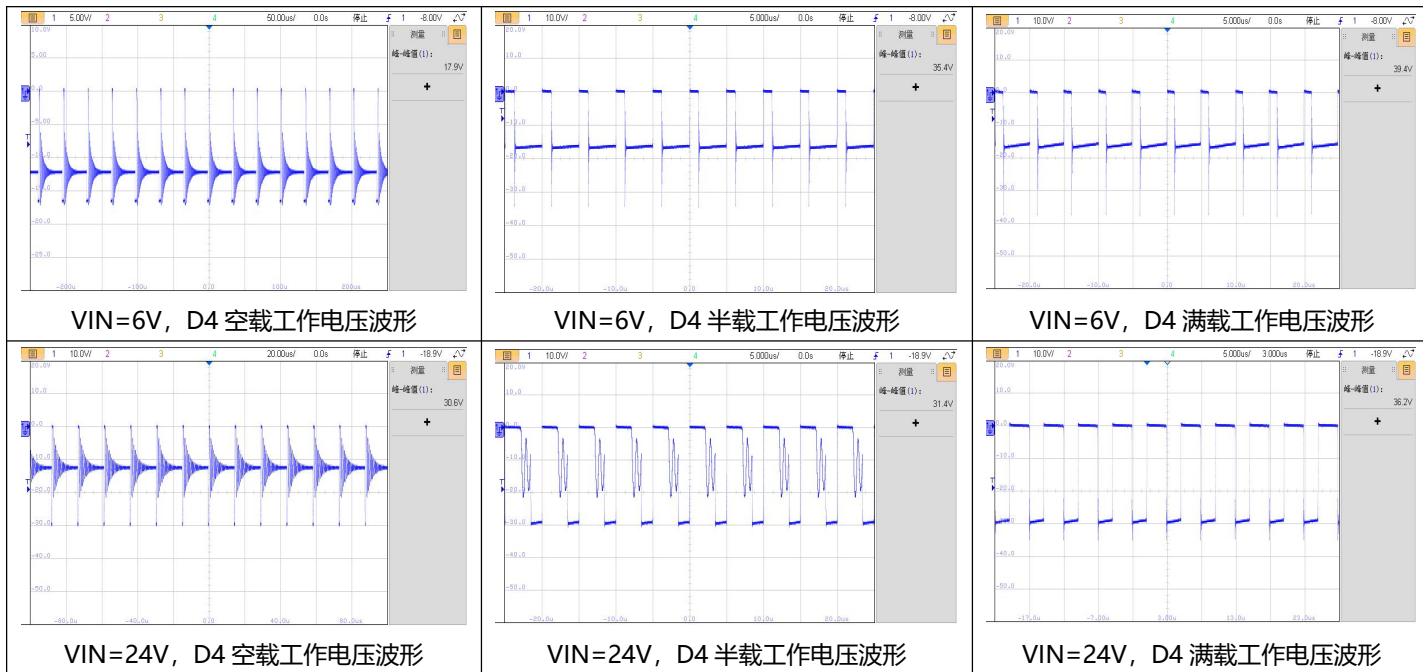
VIN=24V, 半载 VDS 波形

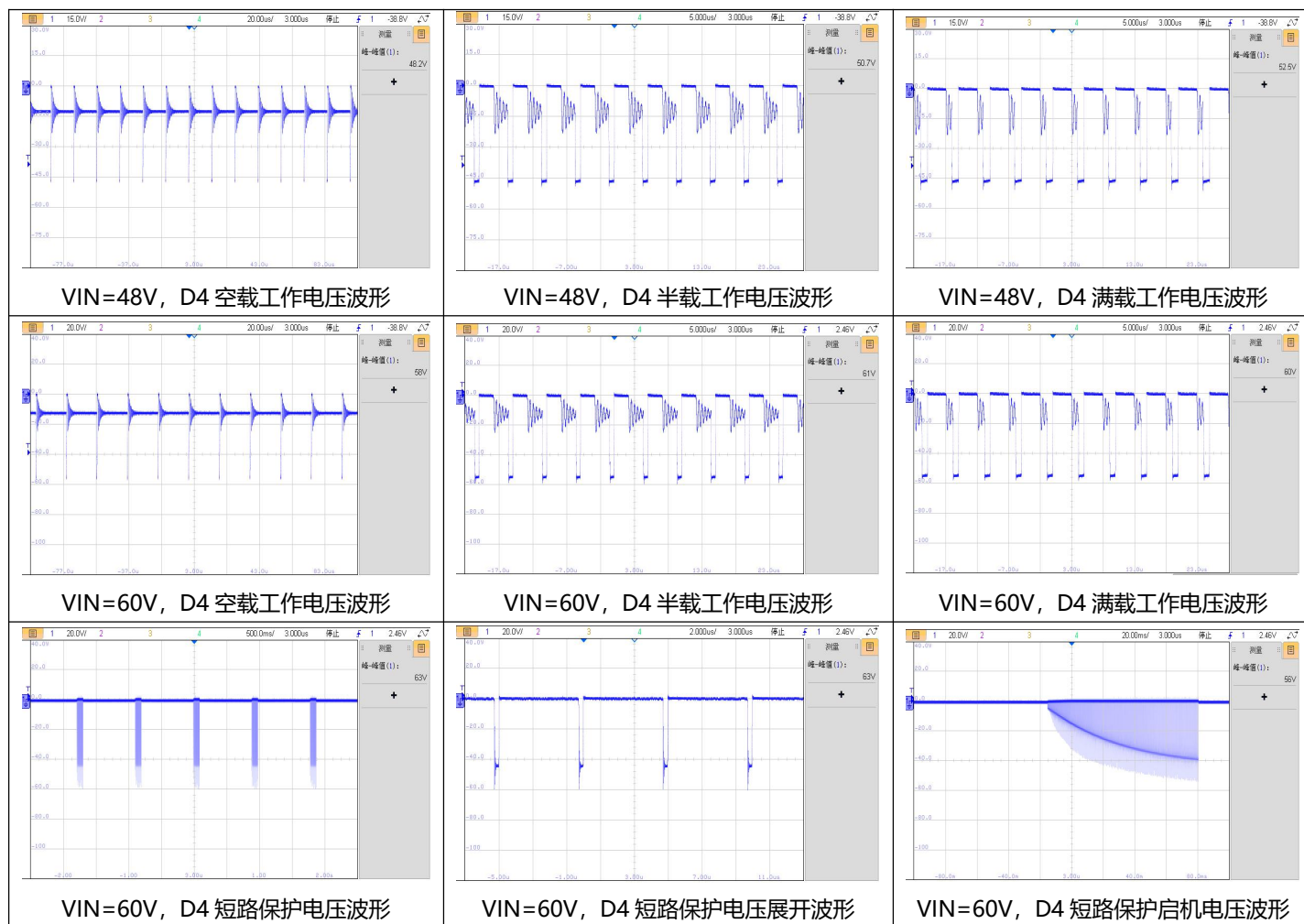


VIN=24V, 满载 VDS 波形



副边输出整流二极管 D4 应力波形





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