

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 VPS2103，结合隔离功率变压器 VPE23PBD06B、输出整流二极管以及必要的阻容元件，实现 9V-36V 输入，5V (1A) 和 12V (0.1A) 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 6W 的输出能力，原副边隔离耐压不小于 3000VDC，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。

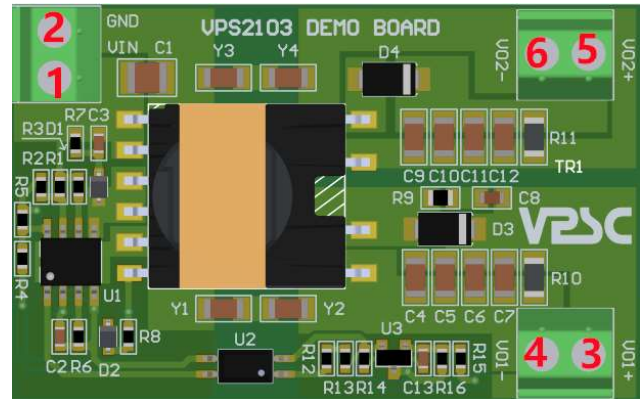
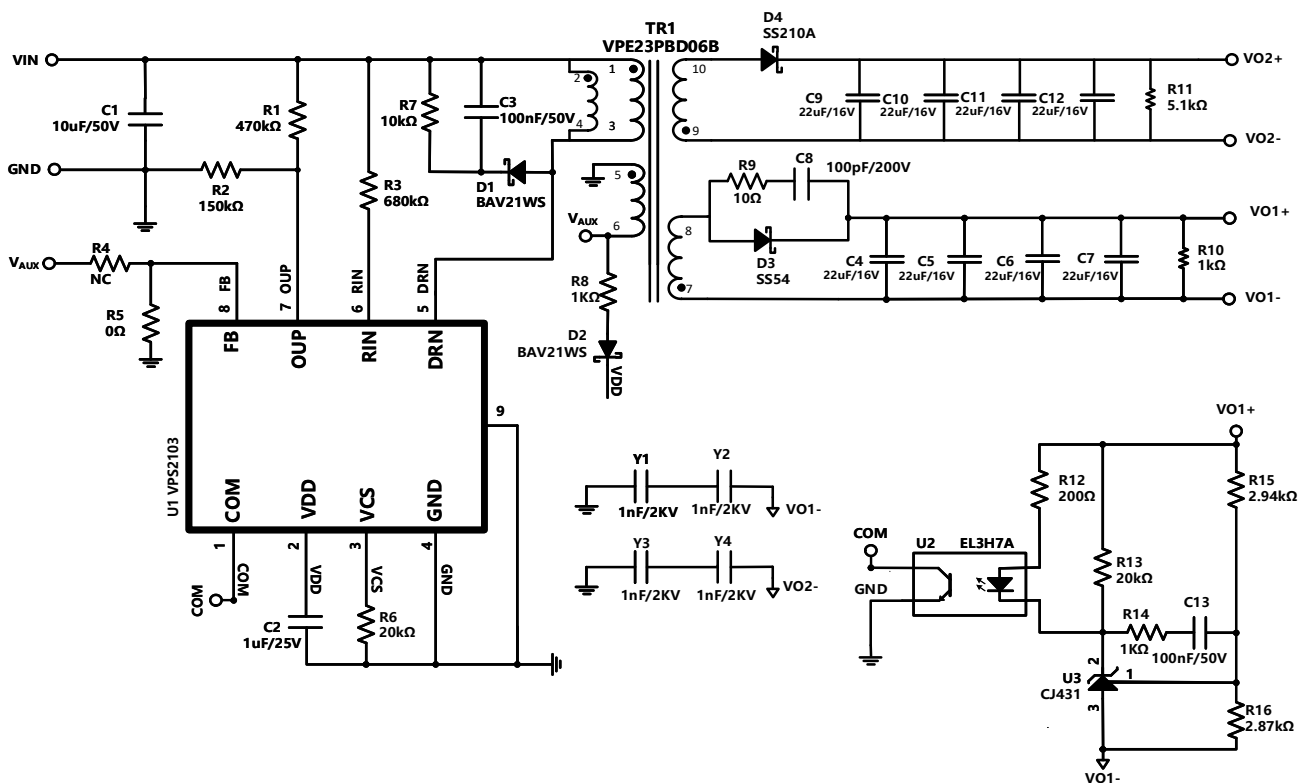


图 1: VPS2103 Demo 板(尺寸:51mm*32mm)

关键词：输入：9V-36V，输出：(5V/12V)/6W，隔离电压：3000VDC，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	VO1+	电源主路输出正
4	VO1-	电源主路输出负
5	VO2+	电源辅路输出正
6	VO2-	电源辅路输出负

物料清单

位号	参数	封装	型号	品牌
C1	10uF/50V-X7R	1210	CC1210KKX7R9BB106	YAGEO
C2	1uF/25V-X7R	0603	CC0603KRX7R8BB105	YAGEO
C3	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
C4	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C5	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C6	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C7	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C8	100pF/200V-NPO	0805	CC0805JRNPOABN101	YAGEO
C9	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C10	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C11	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C12	22uF/16V-X5R	1206	CC1206KKX5R7BB226	YAGEO
C13	100nF/50V-X7R	0603	CC0603KRX7R9BB104	YAGEO
Y1	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
Y2	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
Y3	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
Y4	1nF/2KV-X7R	1206	CC1206KKX7RDBB102	YAGEO
R1	470KΩ±1%	0603	RC0603FR-07470KL	YAGEO
R2	150KΩ±1%	0603	RC0603FR-07150KL	YAGEO
R3	680KΩ±1%	0603	RC0603FR-07680KL	YAGEO
R4	NC	-	-	-
R5	0Ω±1%	0603	RC0603FR-070RL	YAGEO
R6	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R7	10KΩ±1%	0603	RC0603FR-0710KL	YAGEO
R8	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R9	10Ω±1%	0805	RC0805FR-0710RL	YAGEO
R10	1KΩ±1%	1206	RC1206FR-071KL	YAGEO
R11	5.1KΩ±1%	1206	RC1206FR-075K1L	YAGEO
R12	200Ω±1%	0603	RC0603FR-07200RL	YAGEO
R13	20KΩ±1%	0603	RC0603FR-0720KL	YAGEO
R14	1KΩ±1%	0603	RC0603FR-071KL	YAGEO
R15	2.94KΩ±1%	0603	RC0603FR-072K94L	YAGEO
R16	2.87KΩ±1%	0603	RC0603FR-072K87L	YAGEO
TR1	NP:NS1:NS2:NA=7:4:9:9 Lp=6.86uH	ER14.5L	VPE23PBD06B	VPSC
D1	200V/0.2A	SOD-323	BAV21WS	CJ
D2	200V/0.2A	SOD-323	BAV21WS	CJ
D3	40V/5A	SMA	SS54	MDD
D4	100V/2A	SMA	SS210A	YANGJIE
U1	4-50VIN/90V/0.1Ω 电流模式 PWM 控制器	ESOP8	VPS2103	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, IO1=1A, IO2=0.1A	4	---	315	mA
转换效率	VIN=24V, IO1=1A, IO2=0.1A	---	82.2	---	%
纹波&噪声	VIN=24V, IO1=1A, IO2=0.1A	---	60	100	mV
线性调节率	VIN=9V-36V, IO1=1A, IO2=0.1A 主路	---	0.1	---	%
负载调整率	VIN=24V, IO1=1A, IO2=0.1A 主路	---	0.1	---	%
输出电压	VIN=24V, IO1=1A, IO2=0.01A 主路	---	5.03	---	V
	VIN=24V, IO1=1A, IO2=0.01A 辅路	---	14.38	---	V
	VIN=24V, IO1=0.1A, IO2=0.1A 主路	---	5.04	---	V
	VIN=24V, IO1=0.1A, IO2=0.1A 辅路	---	11.33	---	V
输入欠压保护	锁定电压	---	7.2	---	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	3000	---	---	VDC

关键性能指标测试结果

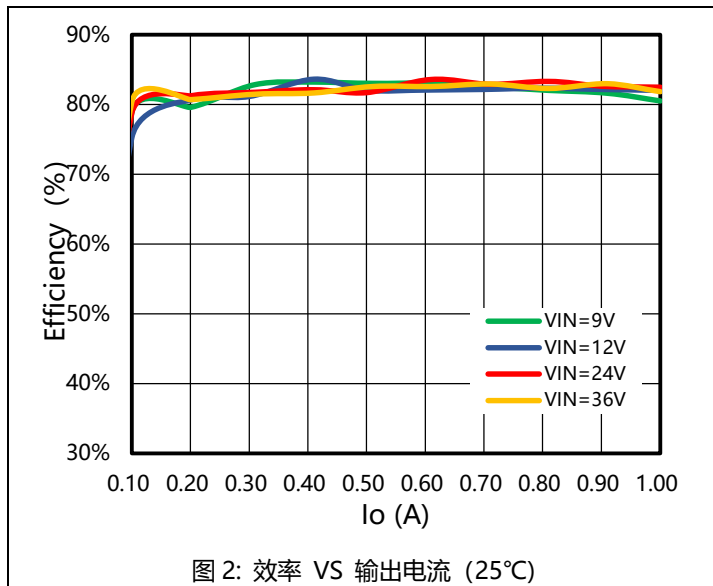


图 2: 效率 VS 输出电流 (25°C)

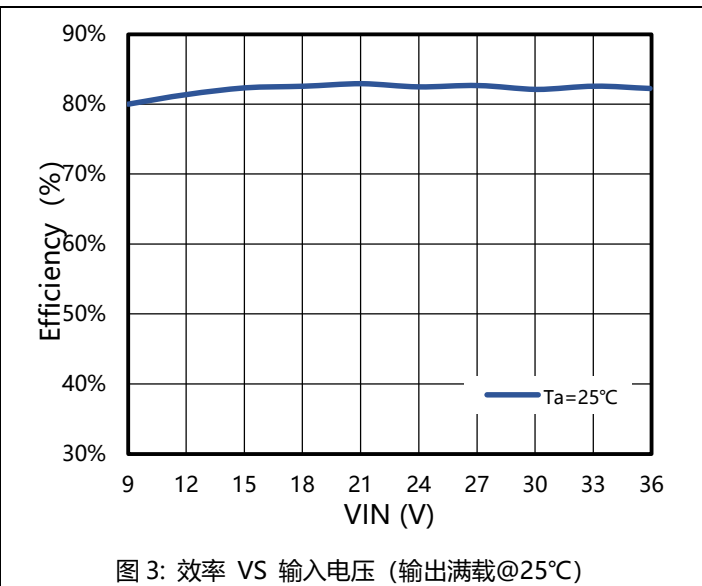


图 3: 效率 VS 输入电压 (输出满载@25°C)

相关波形（辅路带相同比例负载）

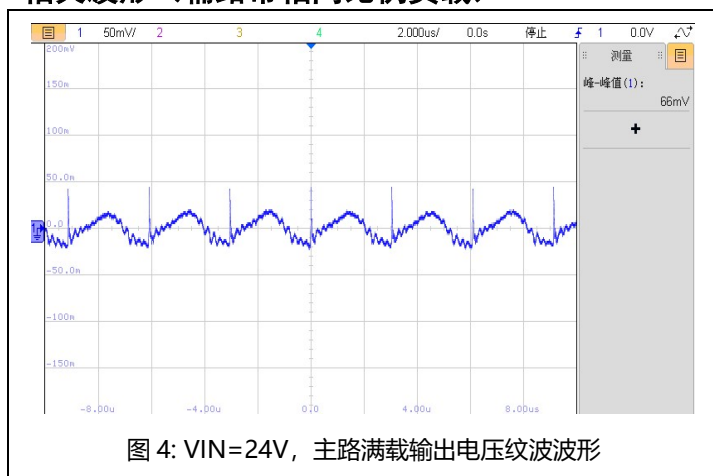


图 4: VIN=24V, 主路满载输出电压纹波波形

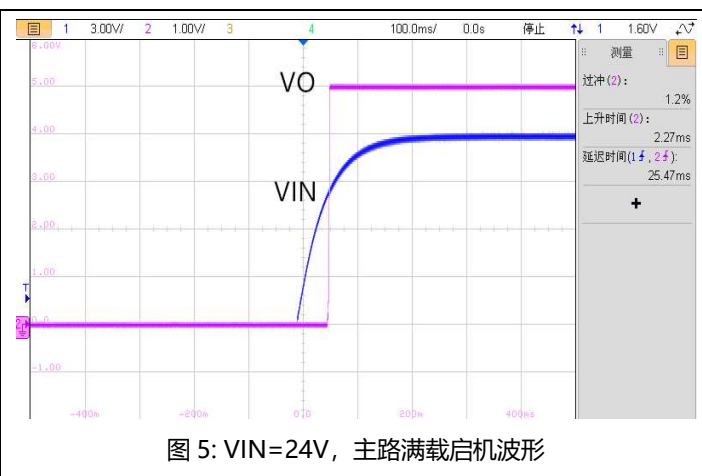
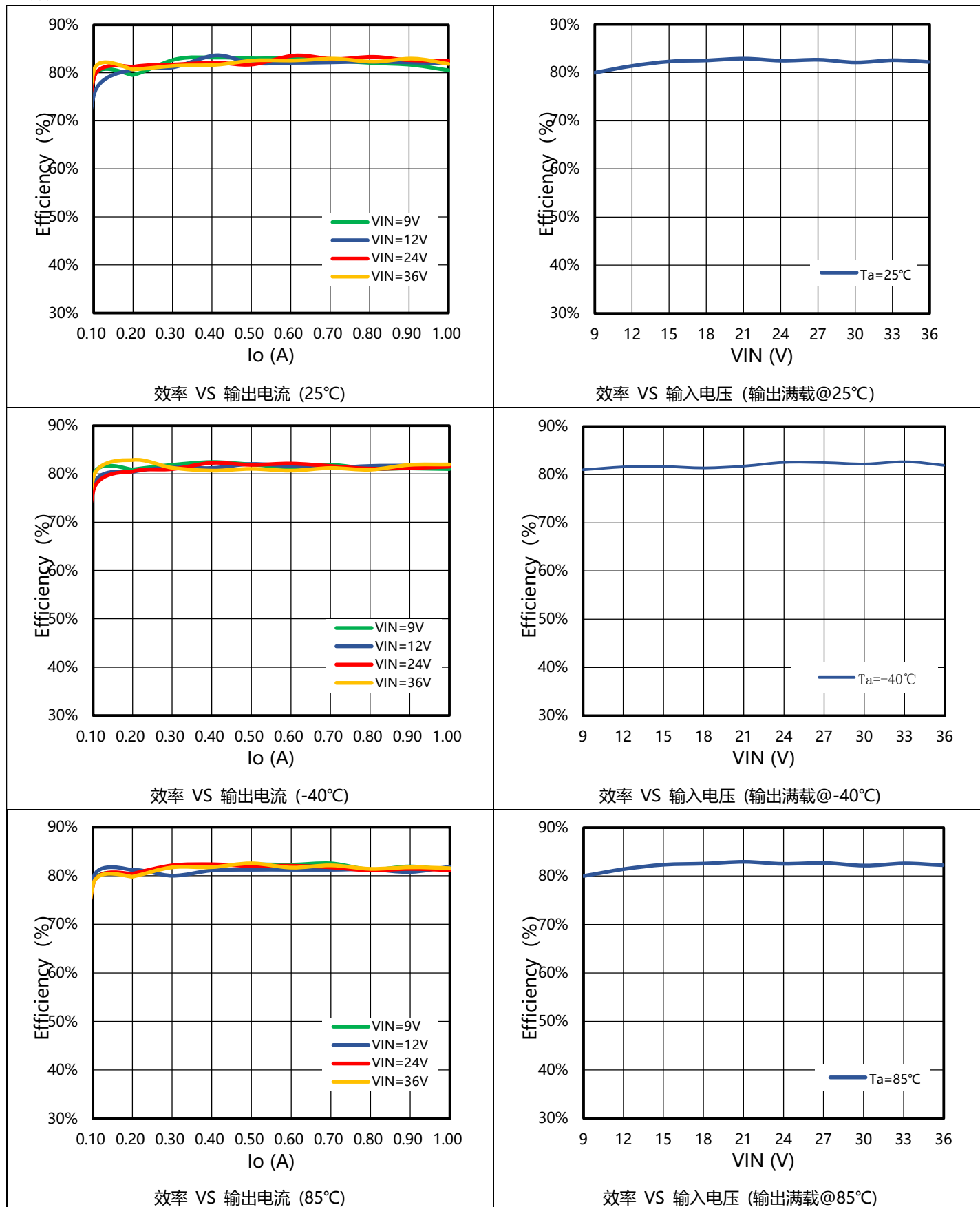


图 5: VIN=24V, 主路满载启机波形

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)	VO1(V)	IO1(A)	VO2(V)	IO2(A)	IO-max%	η(%)
24.00	0.004	5.04	0.00	11.71	0.00	0%	0.00
24.00	0.035	5.04	0.10	11.98	0.01	10%	74.26
24.00	0.066	5.04	0.20	12.00	0.02	20%	78.79
24.00	0.098	5.04	0.30	12.02	0.03	30%	81.76
24.00	0.129	5.03	0.40	12.02	0.04	40%	82.14
23.98	0.157	5.03	0.50	12.02	0.05	50%	83.08
23.98	0.188	5.03	0.60	12.02	0.06	60%	82.94
23.98	0.222	5.03	0.70	12.02	0.07	70%	82.89
23.98	0.254	5.03	0.80	12.02	0.08	80%	82.68
23.98	0.284	5.03	0.90	12.02	0.09	90%	82.36
23.98	0.316	5.03	1.00	12.02	0.10	100%	82.24

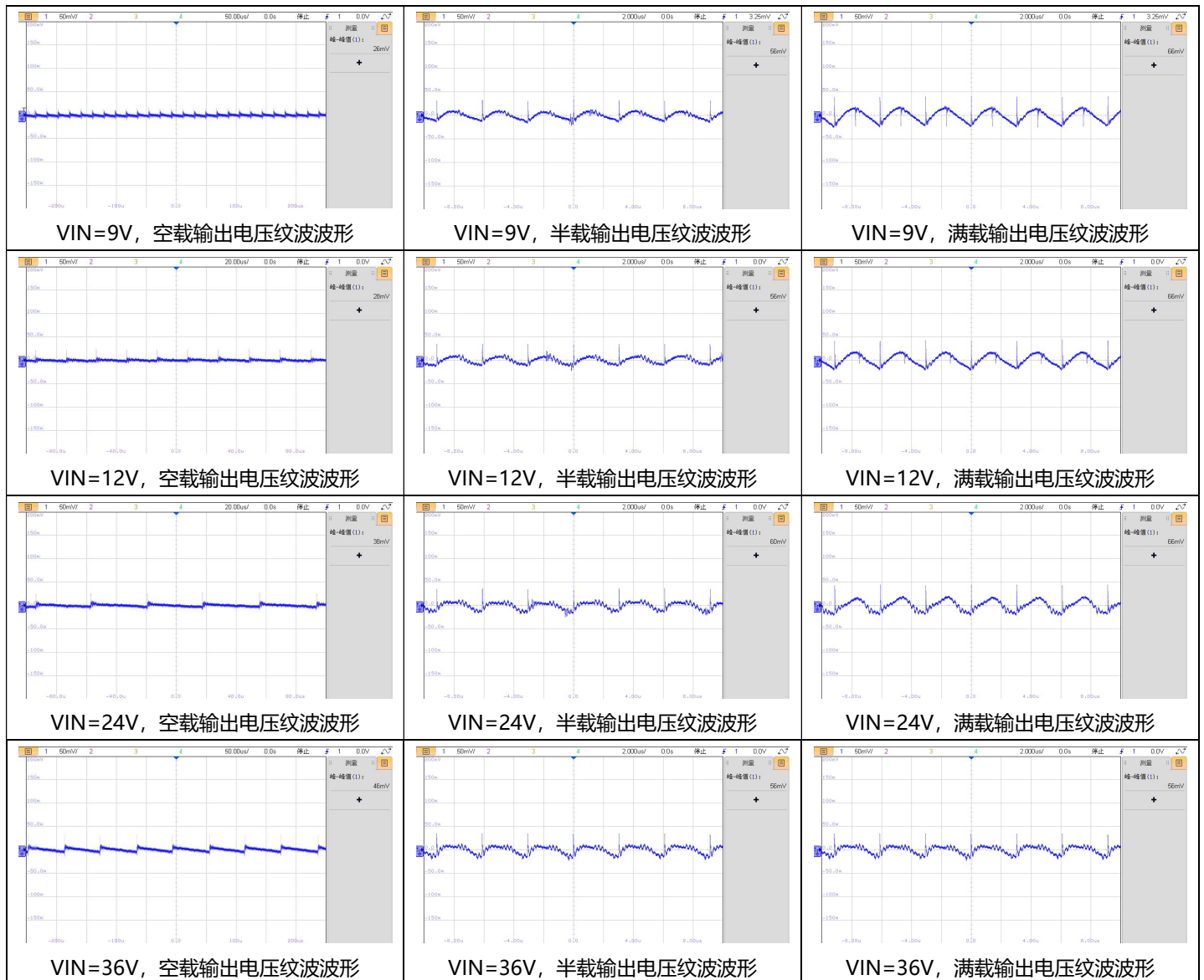
VIN=24V, Ta=-40°C, 输入、输出及效率数据:

VIN(V)	IIN(A)	VO1(V)	IO1(A)	VO2(V)	IO2(A)	IO-max%	η(%)
24.00	0.006	5.05	0.00	11.79	0.00	0%	0.00
24.00	0.038	5.05	0.10	12.09	0.01	10%	68.52
24.00	0.070	5.05	0.20	12.09	0.02	20%	77.27
24.00	0.102	5.05	0.30	12.09	0.03	30%	79.01
24.00	0.133	5.05	0.40	12.09	0.04	40%	80.14
24.00	0.163	5.04	0.50	12.09	0.05	50%	81.21
24.00	0.193	5.04	0.60	12.09	0.06	60%	81.77
23.99	0.225	5.04	0.70	12.09	0.07	70%	80.78
23.99	0.255	5.04	0.80	12.09	0.08	80%	81.33
23.98	0.286	5.04	0.90	12.09	0.09	90%	81.48
23.98	0.317	5.04	1.00	12.09	0.10	100%	81.68

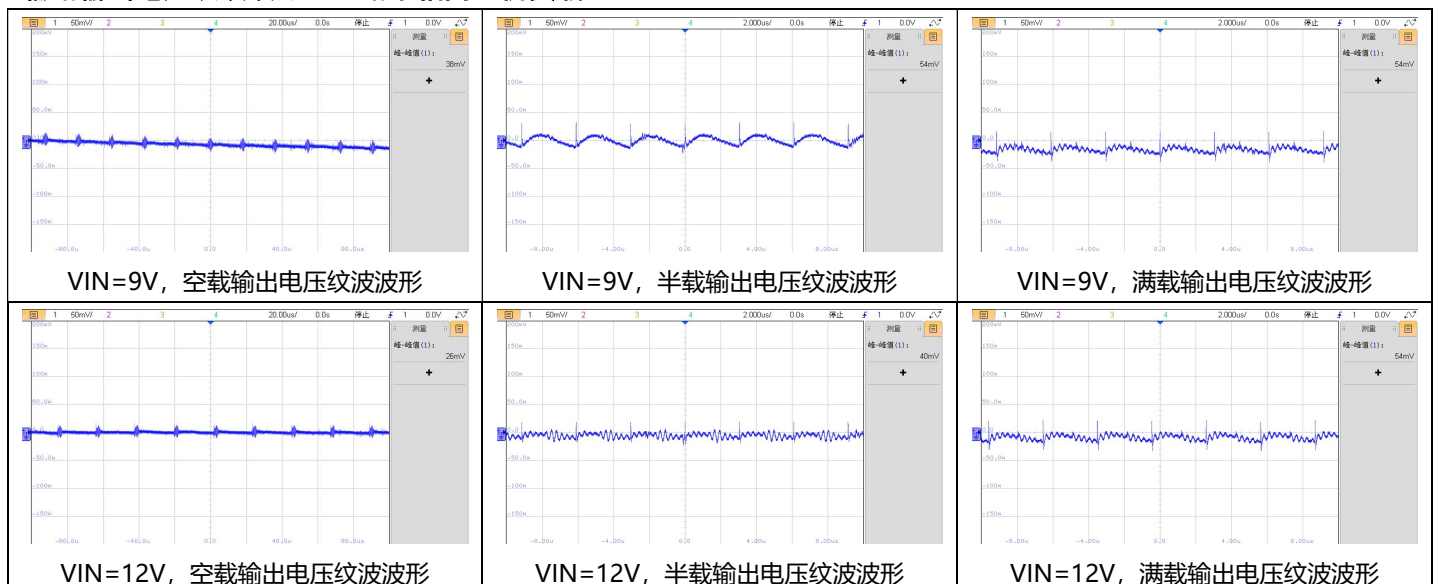
VIN=24V, Ta=85°C, 输入、输出及效率数据:

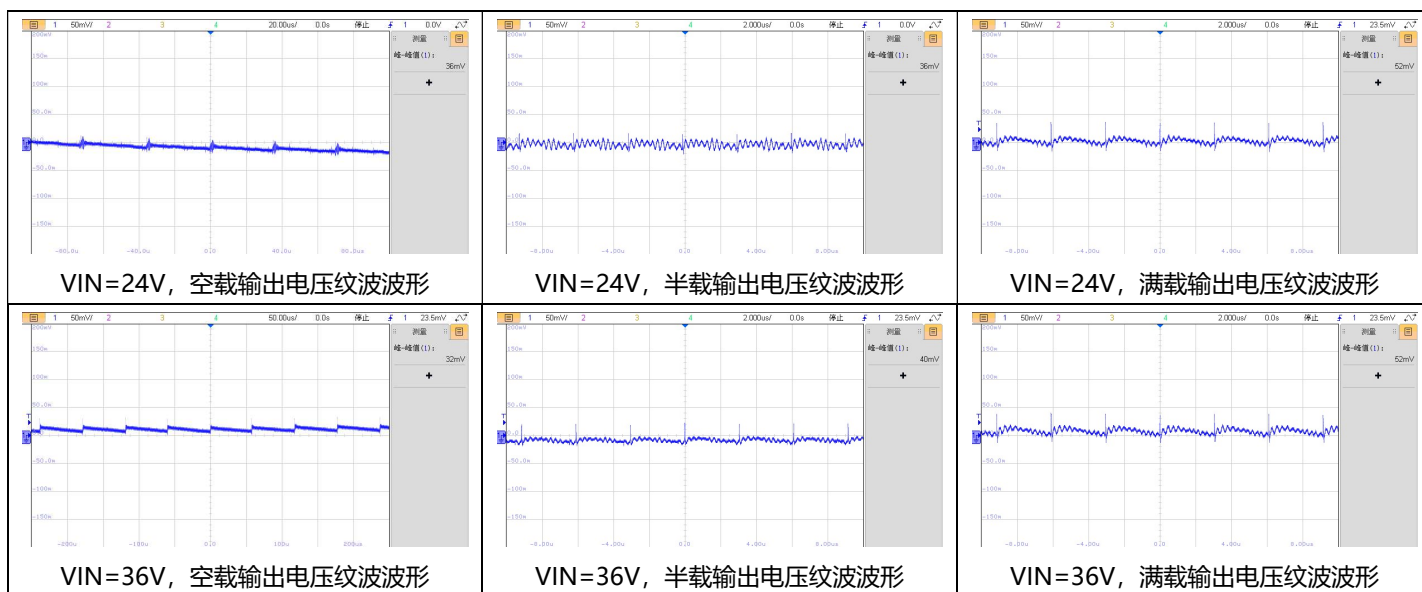
VIN(V)	IIN(A)	VO1(V)	IO1(A)	VO2(V)	IO2(A)	IO-max%	η(%)
24.00	0.006	5.02	0.00	11.62	0	0%	0
24.00	0.037	5.02	0.10	11.91	0.01	10%	76.81
24.00	0.068	5.02	0.20	11.92	0.02	20%	78.95
24.00	0.099	5.02	0.30	11.93	0.03	30%	80.30
24.00	0.129	5.02	0.40	11.94	0.04	40%	81.64
24.00	0.160	5.02	0.50	11.94	0.05	50%	81.98
24.00	0.191	5.02	0.60	11.95	0.061	60%	82.34
24.00	0.222	5.02	0.70	11.96	0.071	70%	82.35
24.00	0.253	5.02	0.80	11.98	0.08	80%	82.11
24.00	0.283	5.02	0.90	11.99	0.09	90%	82.36
24.00	0.315	5.01	1.00	11.99	0.10	100%	81.35

主路输出电压纹波波形（辅路带相同比例负载）

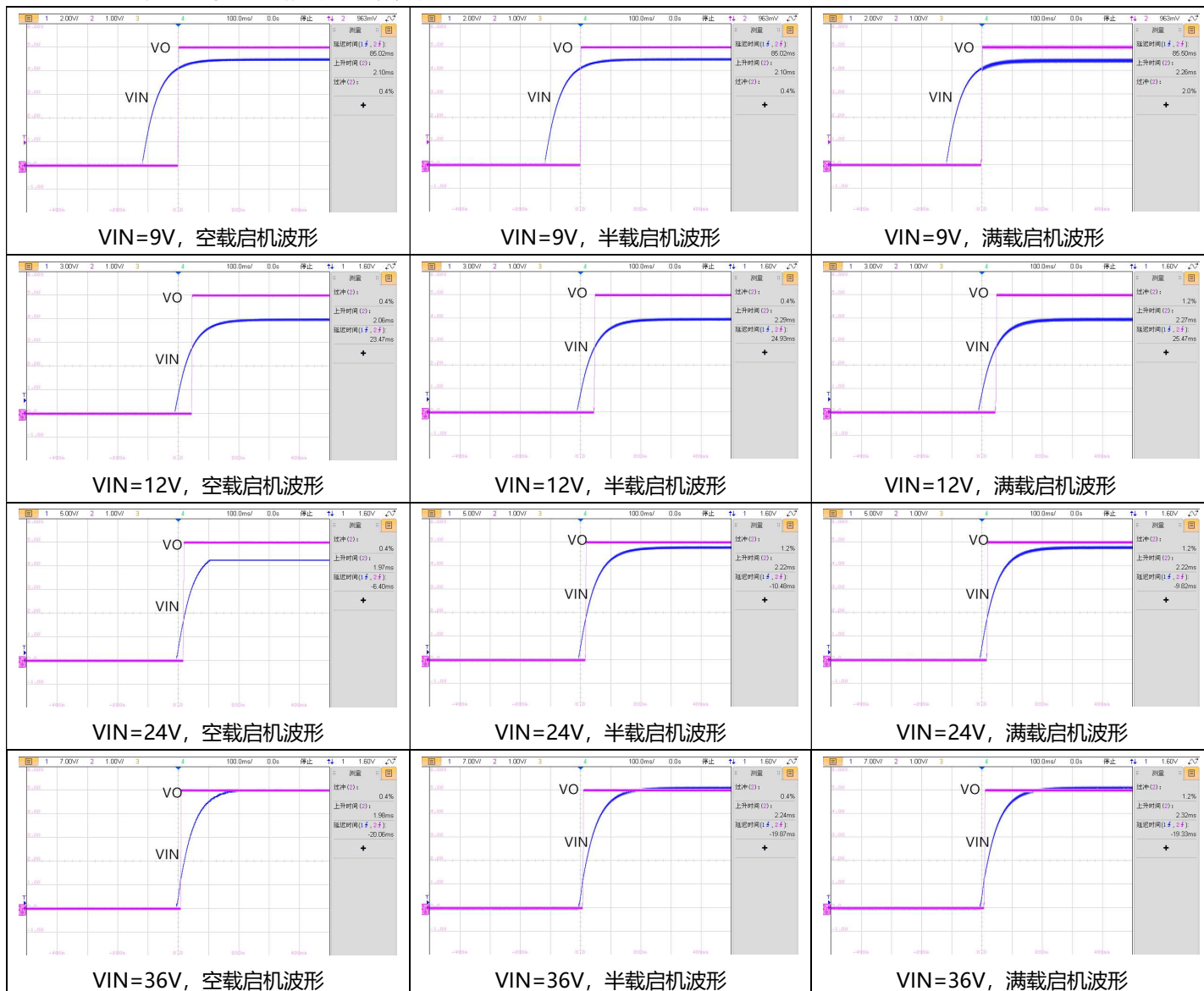


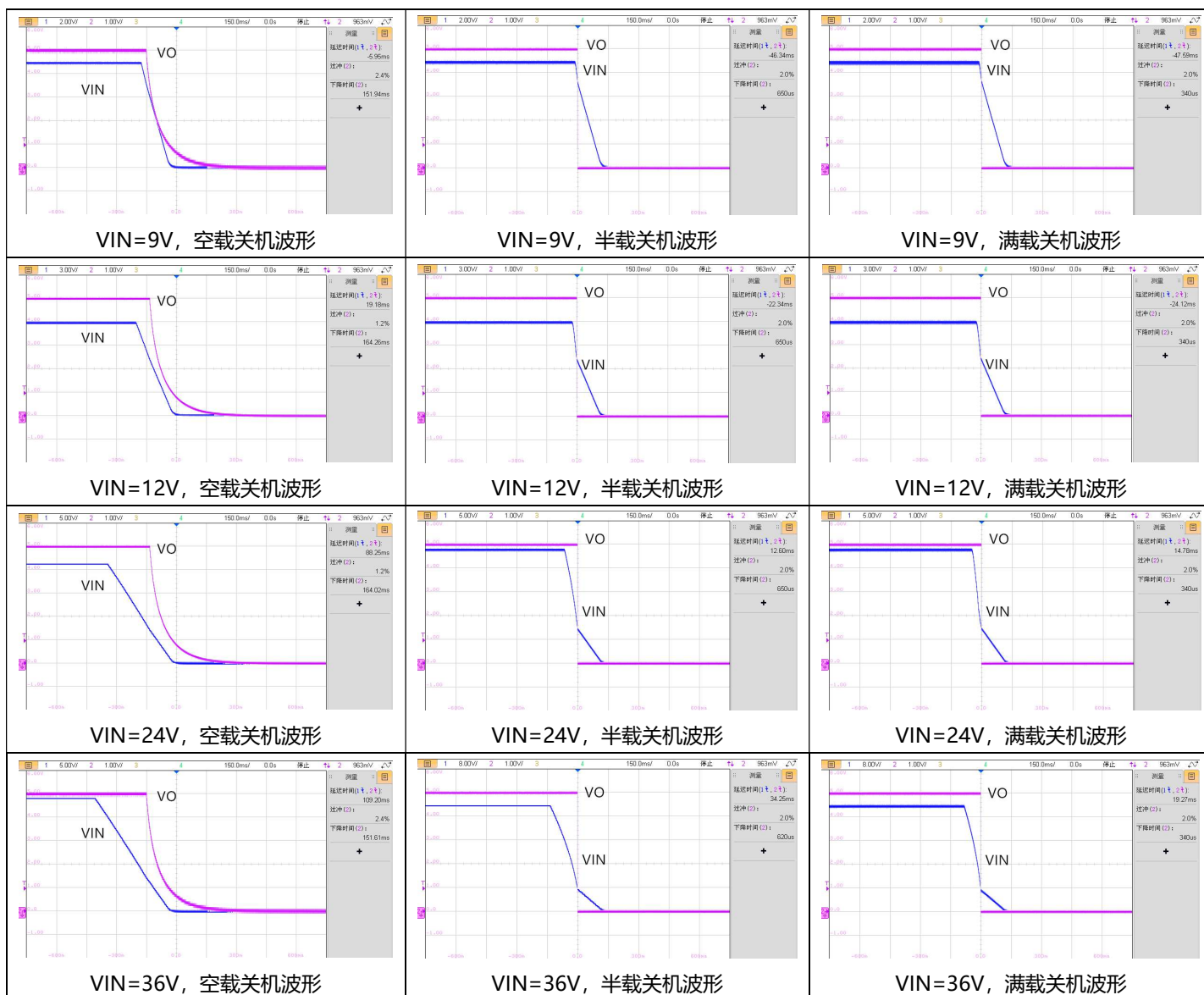
辅路输出电压纹波波形（主路带相同比例负载）



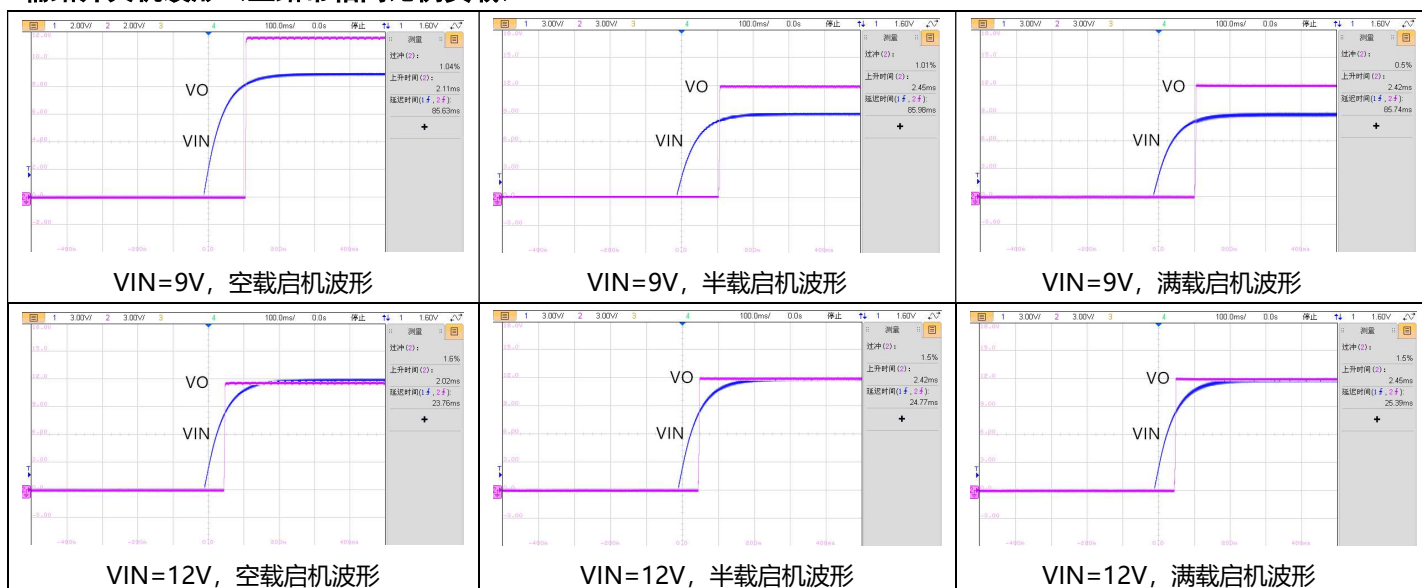


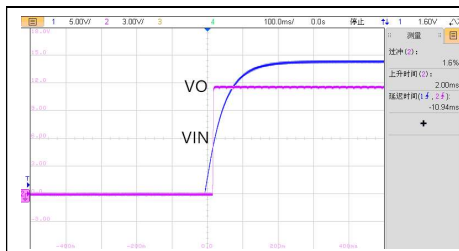
主路开关机波形（辅路带相同比例负载）



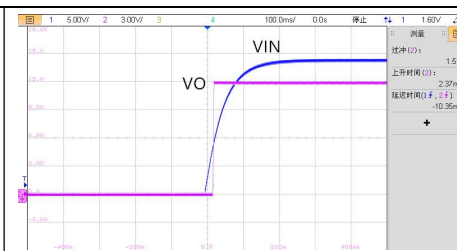


辅路开关机波形 (主路带相同比例负载)

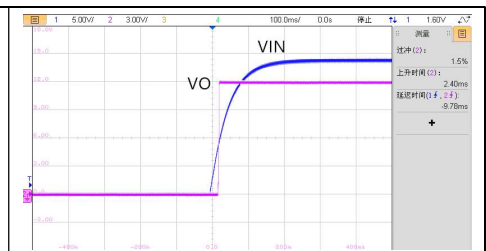




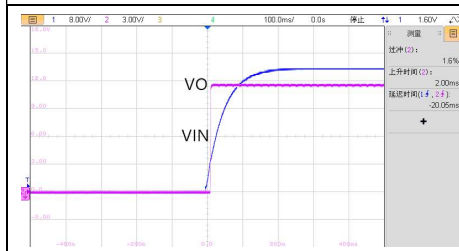
VIN=24V, 空载启机波形



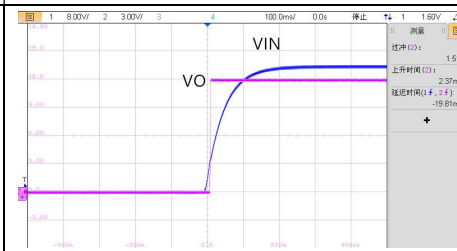
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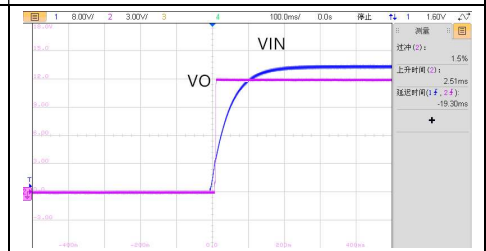
VIN=24V, 满载启机波形



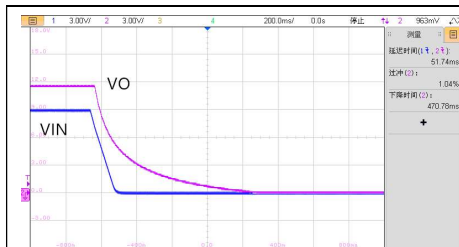
VIN=36V, 空载启机波形



VIN=36V, 半载启机波形



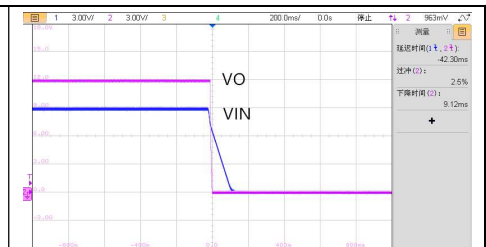
VIN=36V, 满载启机波形



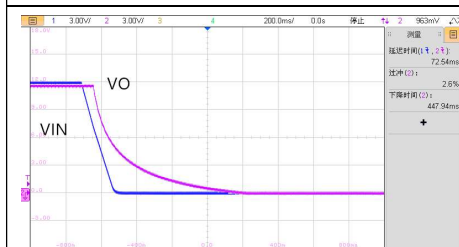
VIN=9V, 空载关机波形



VIN=9V, 半载关机波形



VIN=9V, 满载关机波形



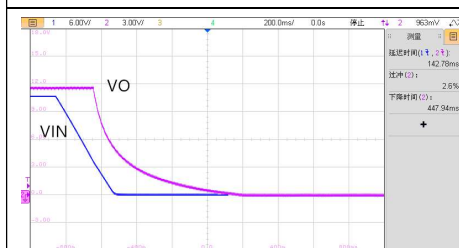
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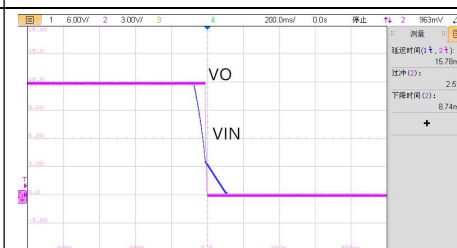
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VIN=12V, 满载关机波形



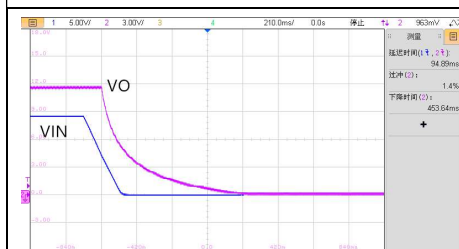
VIN=24V, 空载关机波形



VIN=24V, 半载关机波形



VIN=24V, 满载关机波形



VIN=36V, 空载关机波形

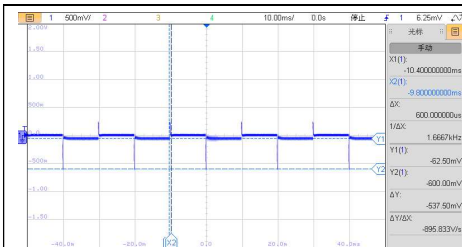


VIN=36V, 半载关机波形

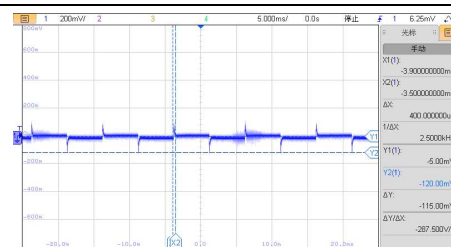


VIN=36V, 满载关机波形

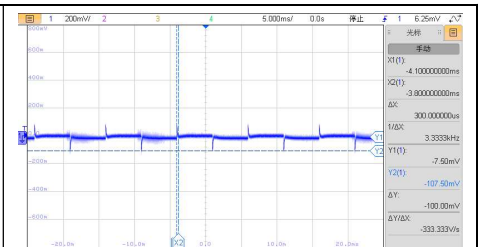
主路动态波形（主路带总功率范围测试）



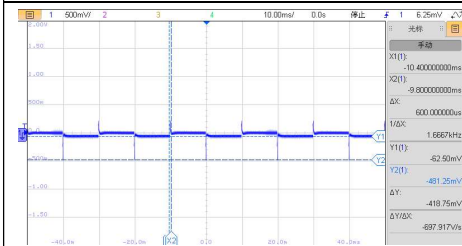
VIN=9V, 100%-10%-100%Io 动态波形



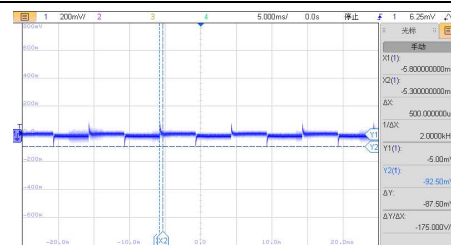
VIN=9V, 75%-50%-75%Io 动态波形



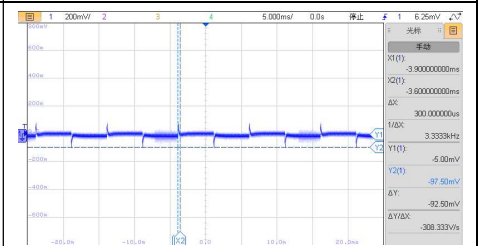
VIN=9V, 50%-25%-50%Io 动态波形



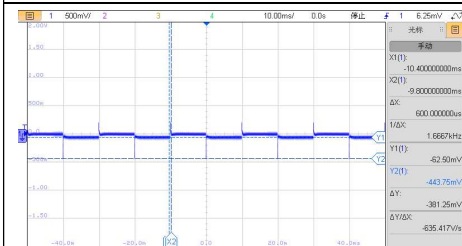
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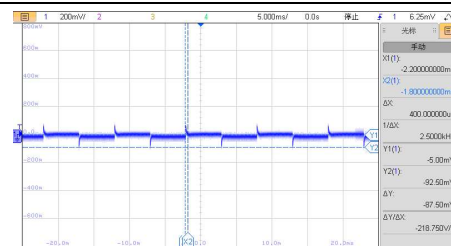
VIN=12V, 75%-50%-75%Io 动态波形



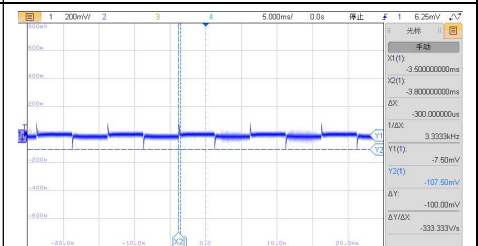
VIN=12V, 50%-25%-50%Io 动态波形



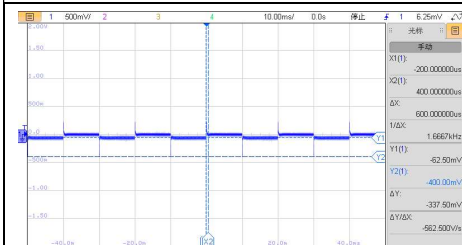
VIN=24V, 100%-10%-100%Io 动态波形



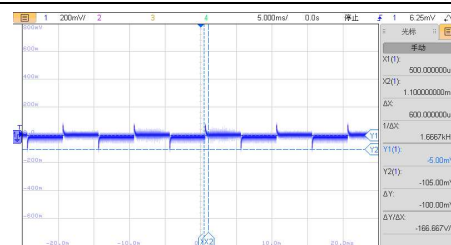
VIN=24V, 75%-50%-75%Io 动态波形



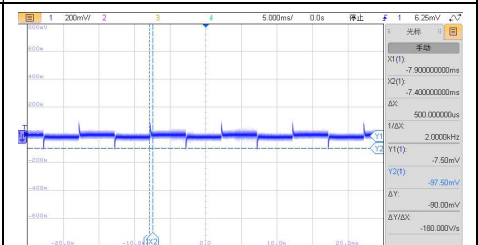
VIN=24V, 50%-25%-50%Io 动态波形



VIN=36V, 100%-10%-100%Io 动态波形

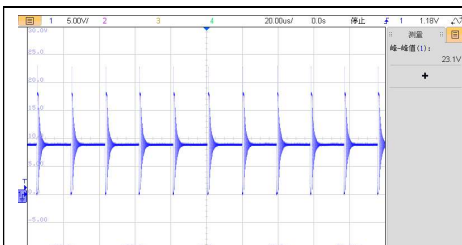


VIN=36V, 75%-50%-75%Io 动态波形

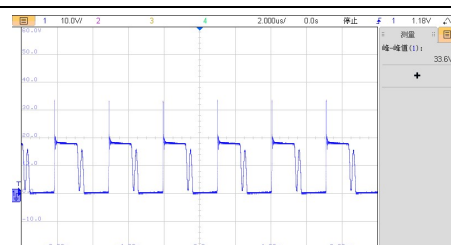


VIN=36V, 50%-25%-50%Io 动态波形

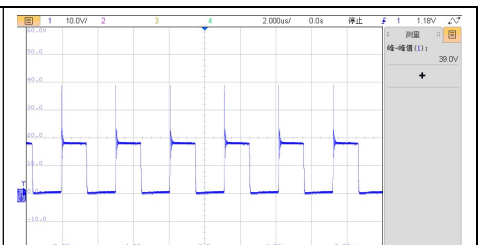
MOS 管电压应力波形（输出端带相同比例负载）



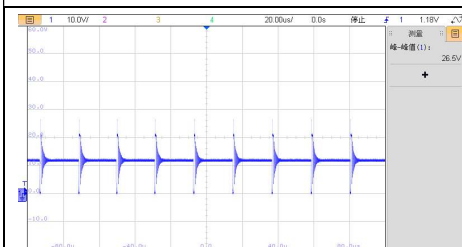
VIN=9V, 空载 VDS 波形



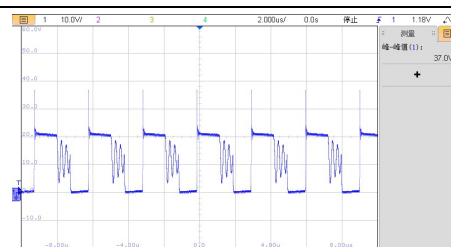
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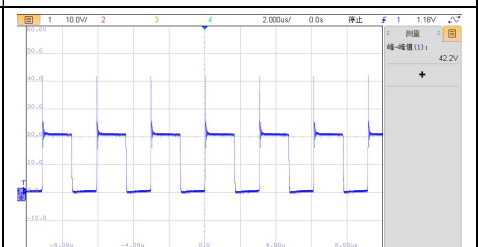
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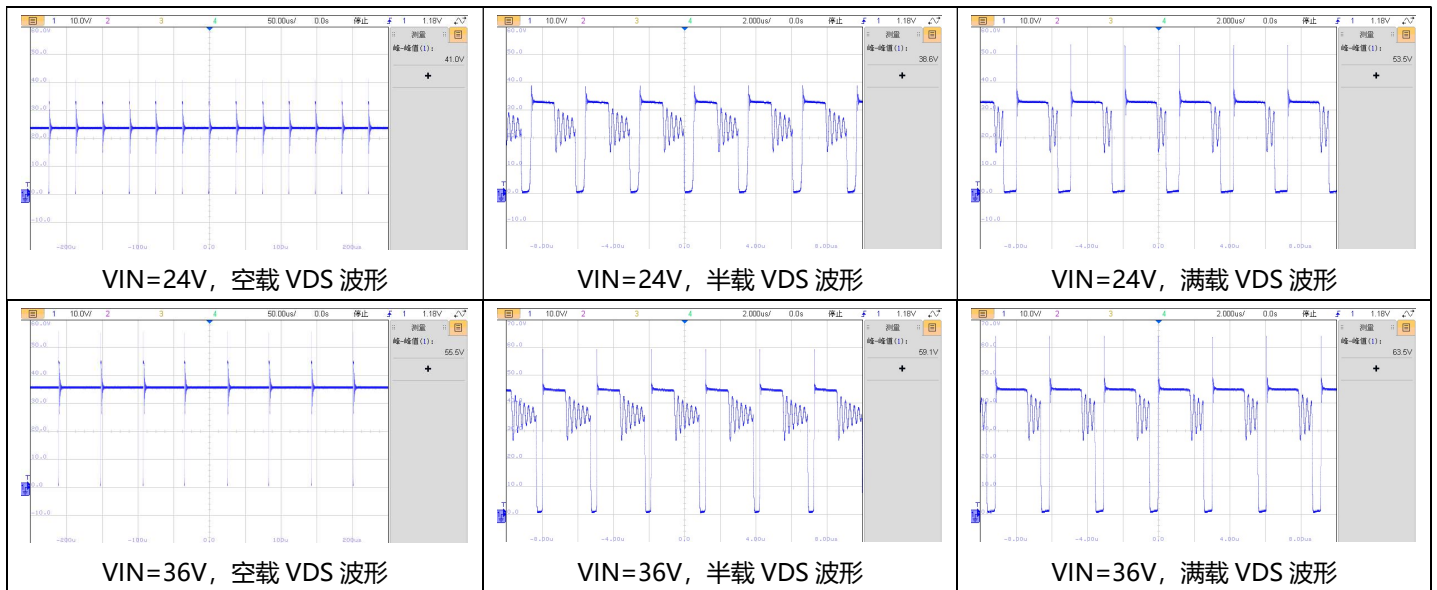
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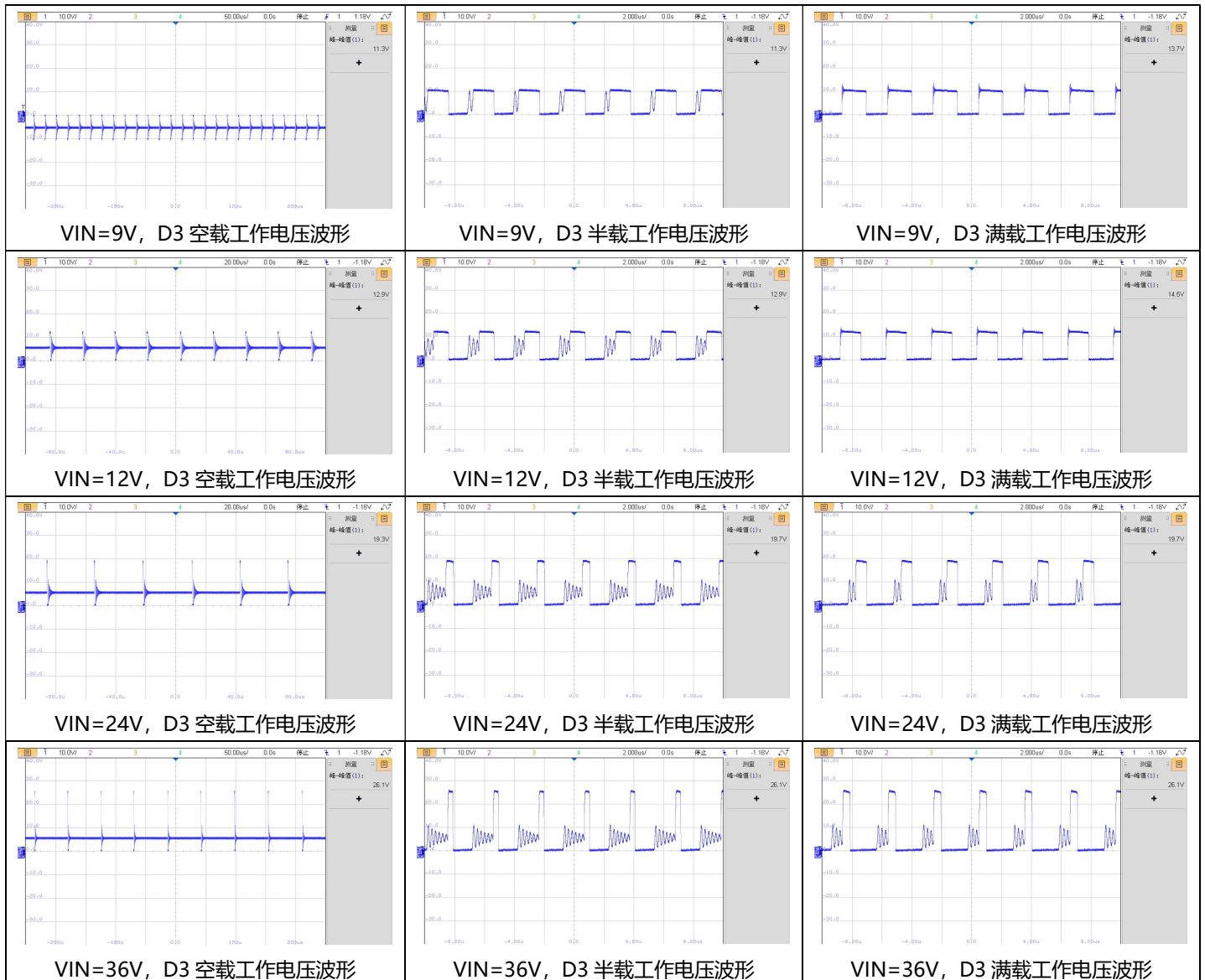
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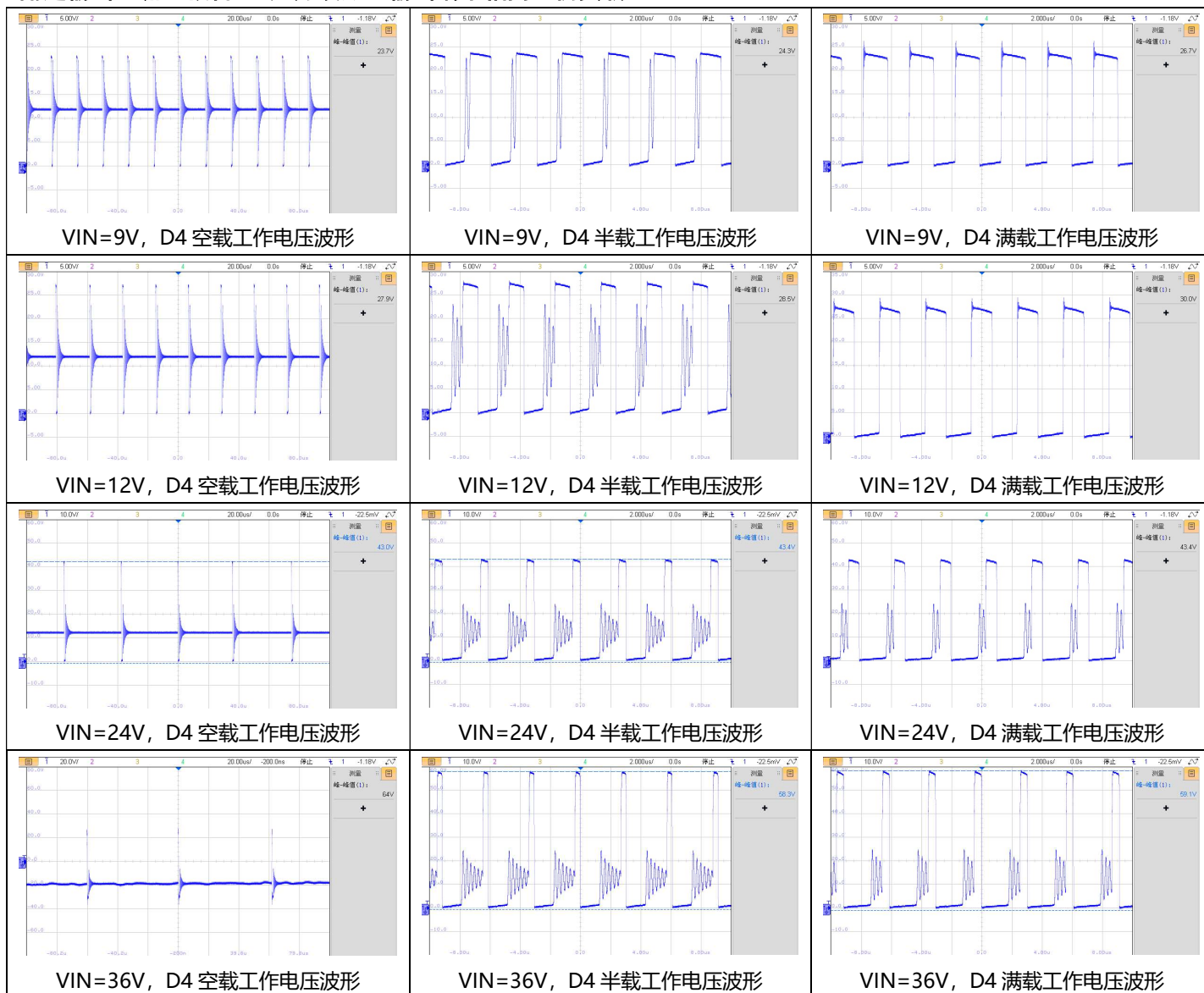
VIN=12V, 满载 VDS 波形



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