使用 XL4301 和 NT6008 设计的兼容 Quick Charge 3.0 的车载充电器

描述

本文介绍的是使用 XL4301 和 NT6008 设计的 Quick Charge 3.0 的车载充电器演示板(同时兼容 Quick Charge 2.0)，输出电压 3.6-12V，以 200mV 每档步进，最大输出电流 2.4A 的车载快充应用，最高转换效率可以达到 95%以上。

XL4301 是开关降压型 DC-DC 转换芯片，内部集成功率 MOSFET；固定开关频率 180KHz，可减小外部元器件尺寸。芯片具有出色的线性调整率与负载调整率，输入电压最高可达 40V。芯片内部集成过流保护、过温保护、短路保护等可靠性模块。

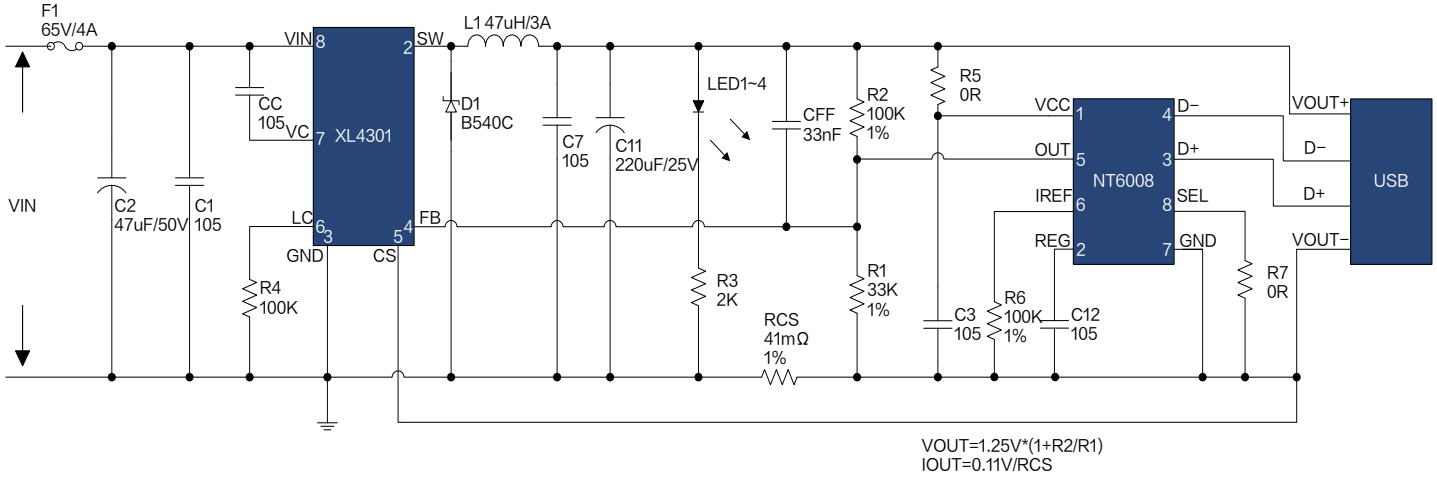
此方案默认输出电压为 5V，可通过负载结合 NT6008 进行逻辑判断，自动调整输出电压；可支持苹果、安卓、BC1.2 和 YD/T 1591 等充电协议。

XL4301 为 SOP8-EP 封装，采用标准外部元器件，应用灵活。

电源规格

说明		符号	最小值	典型值	最大值	单位	备注
输入	输入电压	VIN	10		40	VDC	
输出	输出电压 1	VOUT1		5		V	
	输出电流 1	IOUT1			2.4	A	
	输出纹波电压 1	VRIPPLE1		66		mVPP	20MHz 带宽
	输出电压 2	VOUT2		9		V	
	输出电流 2	IOUT2			1.8	A	
	输出纹波电压 2	VRIPPLE2		50		mVPP	20MHz 带宽
	输出电压 3	VOUT3		12		V	输入电压大于 13V
	输出电流 3	IOUT3			1.8	A	
	输出纹波电压 3	VRIPPLE3		56		mVPP	20MHz 带宽
效率	VOUT=5V	η		89		%	VIN=12V，满载
	VOUT=9V			94			VIN=12V，满载
	VOUT=12V			96			VIN=14V，满载

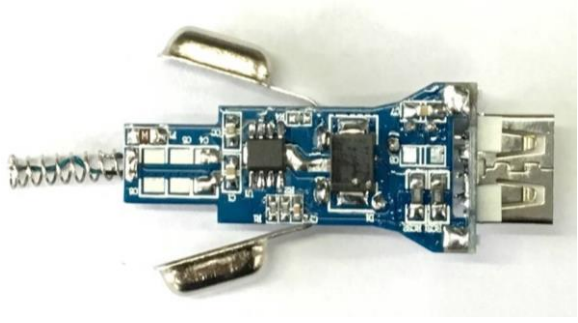
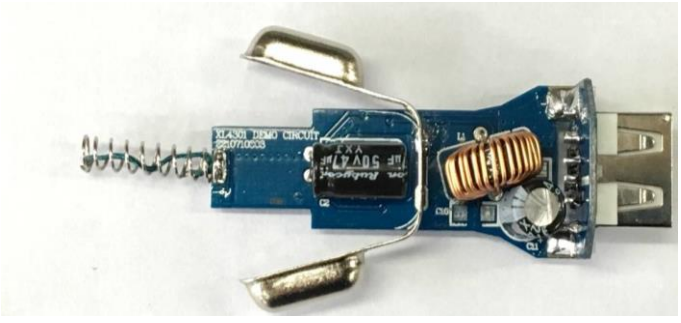
电路原理图



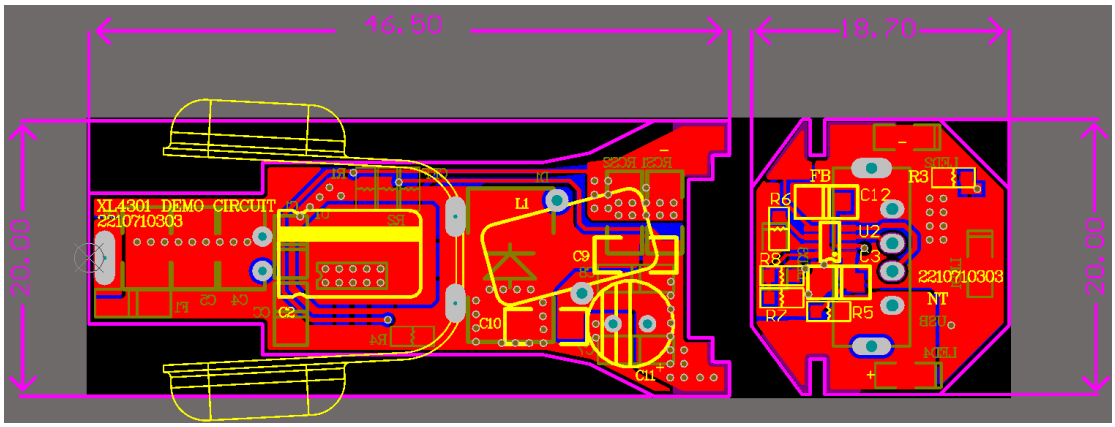
物料清单

序号	数量	参考位号	说明	生产商型号	生产商
1	5	C1,C3,C7,C12,CC	1uF,50V,Ceramic,X7R,0805	C2012X7R1H105K	TDK
2	1	C2	47uF,50V,Electrolytic,(6.3*11)	YXJ-50V-47uF	Rubycon
3	1	C11	220uF,25V,Electrolytic,(6.3*11)	YXJ-25V-220uF	Rubycon
4	1	CFF	33nF,50V,Ceramic,X7R,0603	C1608X7R1H333K	TDK
5	1	D1	40V,5A,Schottky Barrier Rectifier,SMC	B540C	DIODES
6	1	F1	4A,65V,Fast acting,1206	F1206F4.00TM	DEEP
7	1	L1	47uH,3A,(13*7)	-	-
8	4	LED1-4	Blue,0805,SMD	-	-
9	1	R1	33KΩ,1%,1/16W,Thick Film,0603	RC0603XR-073302L	Yageo
10	3	R2,R4,R6	100KΩ,1%,1/16W,Thick Film,0603	RC0603XR-071003L	Yageo
11	1	R3	2KΩ,1%,1/16W,Thick Film,0603	RC0603XR-072001L	Yageo
12	2	R5,R7	0Ω,1%,1/16W,Thick Film,0603	-	Yageo
13	2	RCS1,RCS2	0.082Ω,1%,1/4W,Thick Film,1206	RC1206XR-07R082L	Yageo
14	1	U1	40V,3A,180K,BUCK,DC-DC Converter,SOP8-EP	XL4301	XLSEMI
15	1	U2	Charger Interface Physical Layer IC,TSOT23-8L	NT6008	EOSMEM
16	1	USB	DIP		

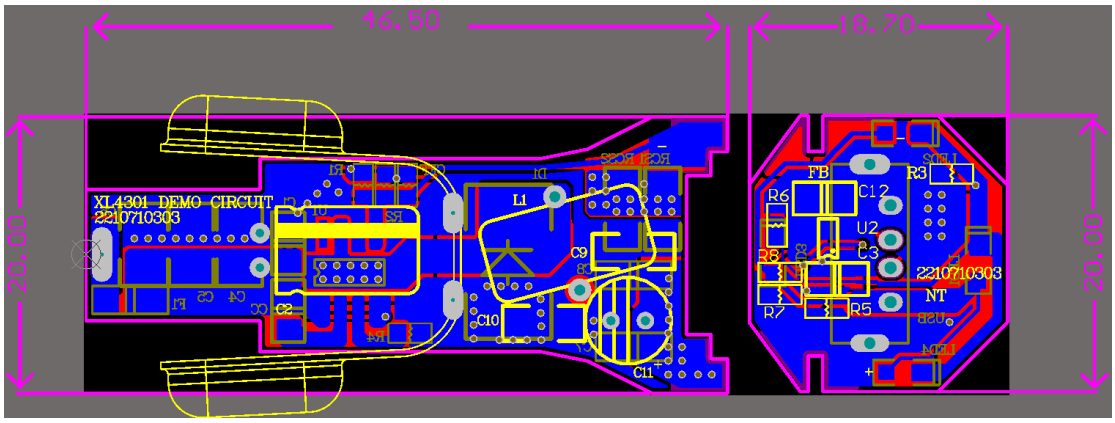
电路板实物图

顶层	底层
	

PCB 布局


16.50
18.70
20.00
20.00
XL4301 DEMO CIRCUIT
2210710303
L1
C9
C10
C11
C2
FB
R3
R6
C12
U2
R8
C3
R7
R5
NT
2210710303

顶层

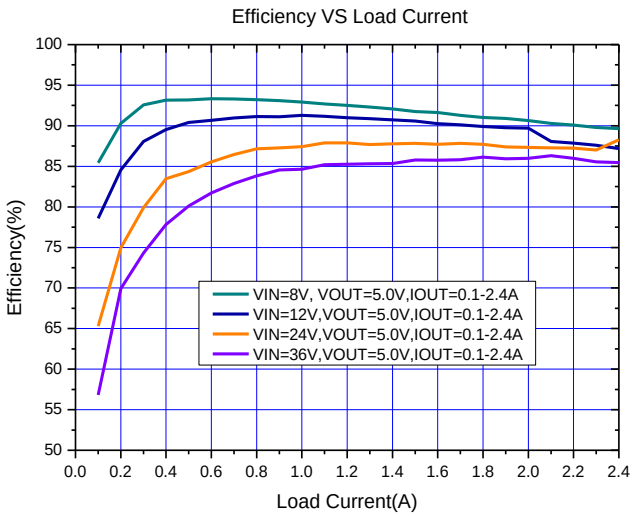

16.50
18.70
20.00
20.00
XL4301 DEMO CIRCUIT
2210710303
L1
C9
C10
C11
C2
FB
R3
R6
C12
U2
R8
C3
R7
R5
NT
2210710303

底层

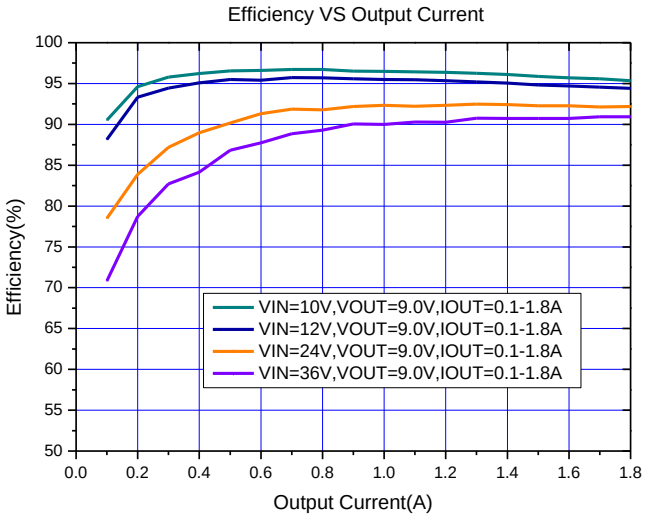
性能数据

转换效率

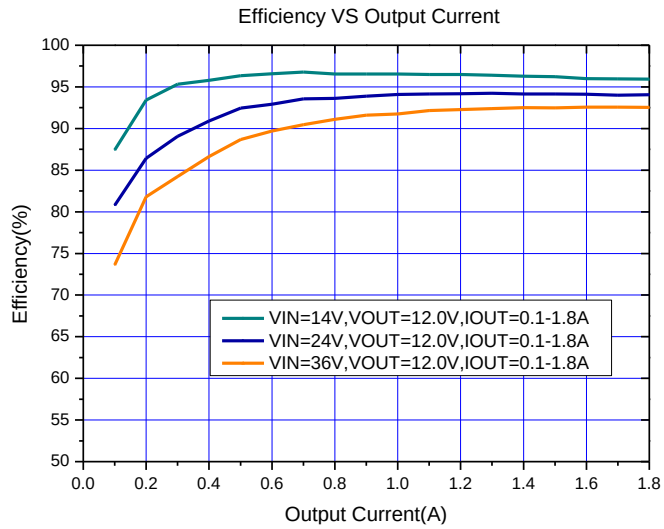
VOUT=5V



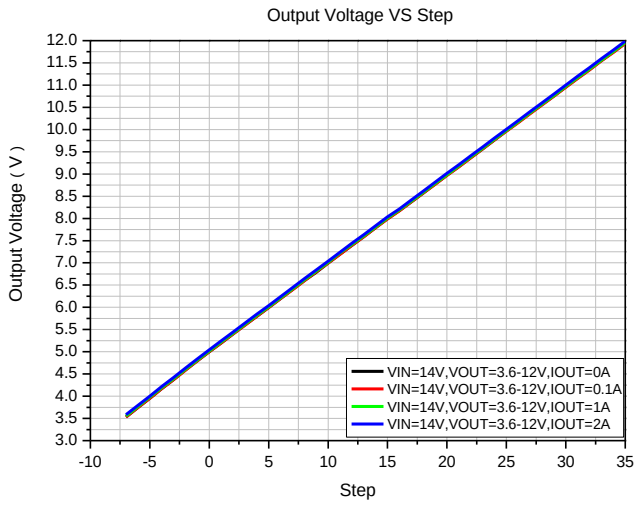
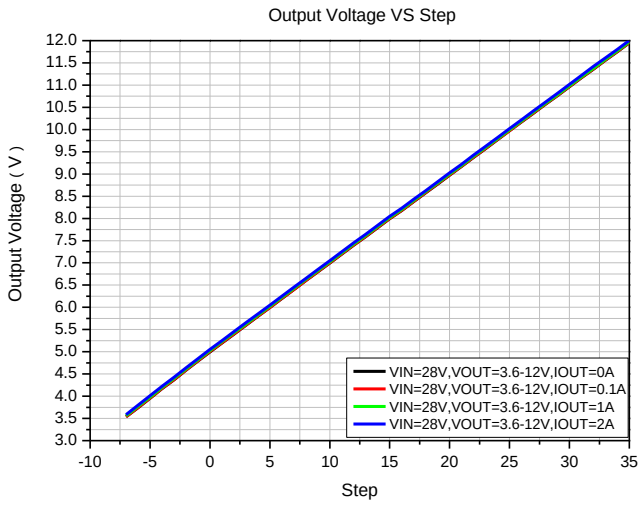
VOUT=9V



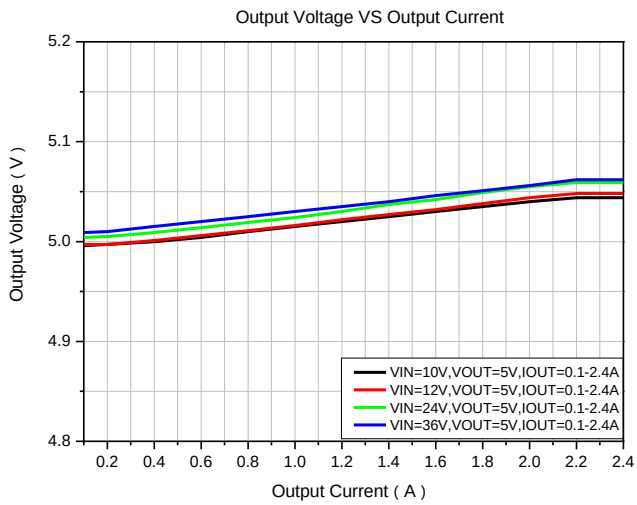
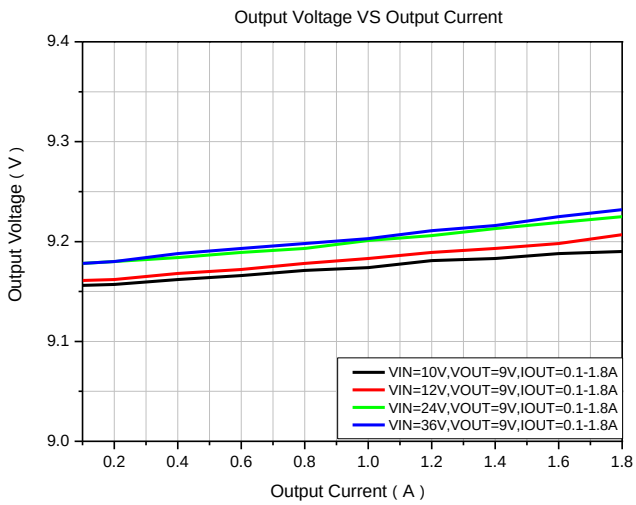
VOUT=12V



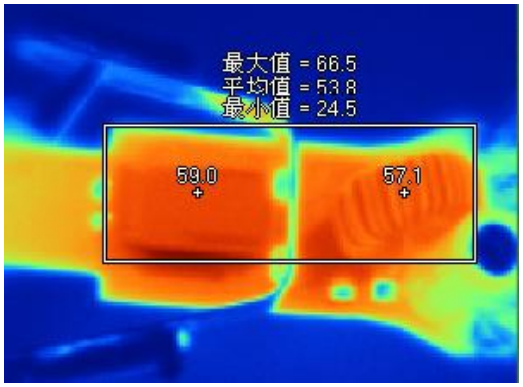
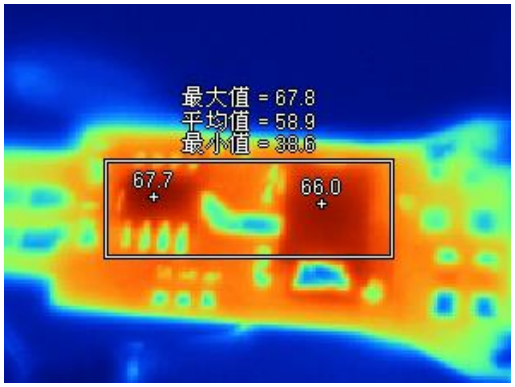
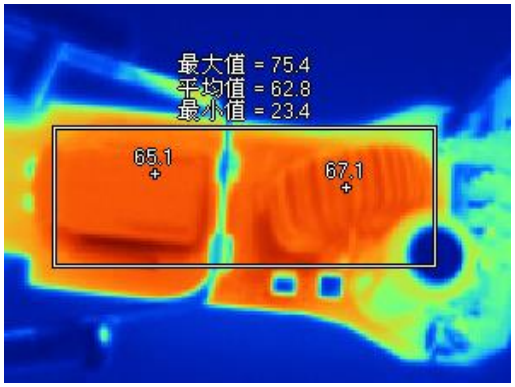
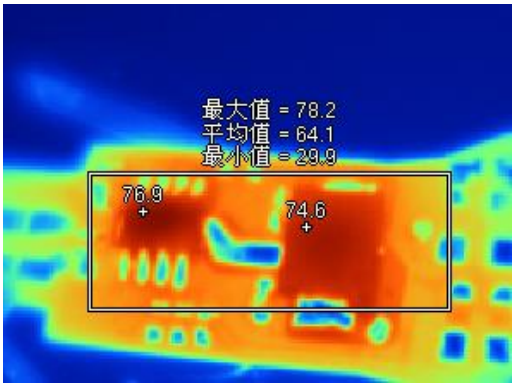
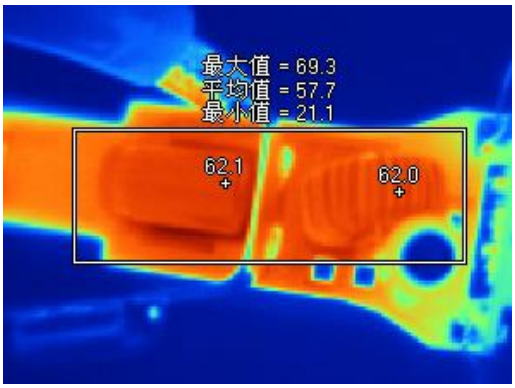
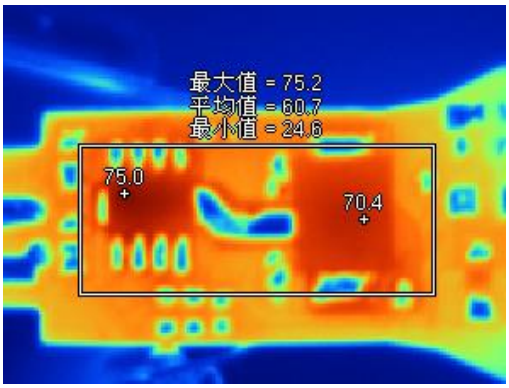
输出电压步进（VOUT=5V 为步长参考 0 点）

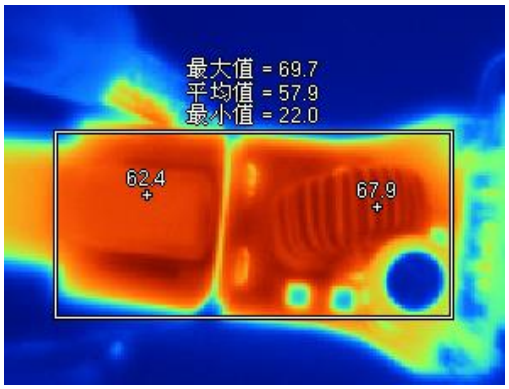
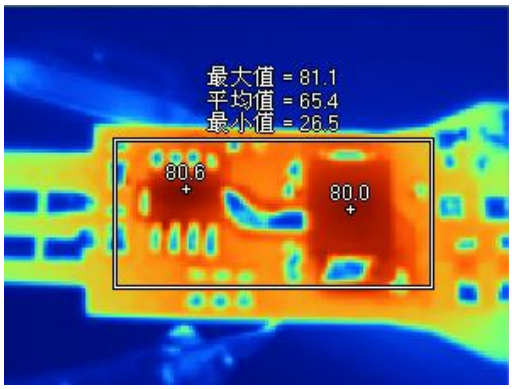
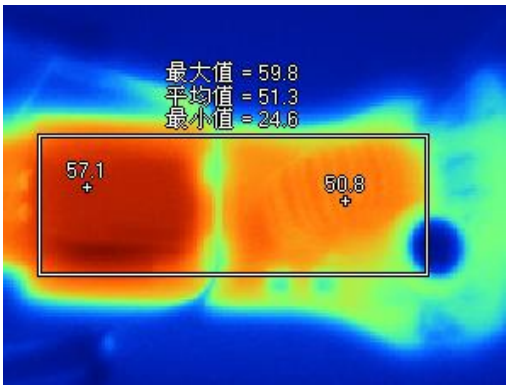
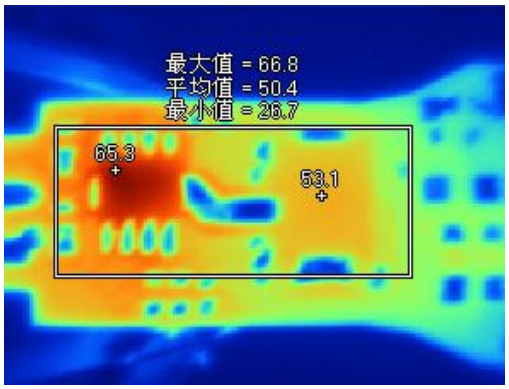
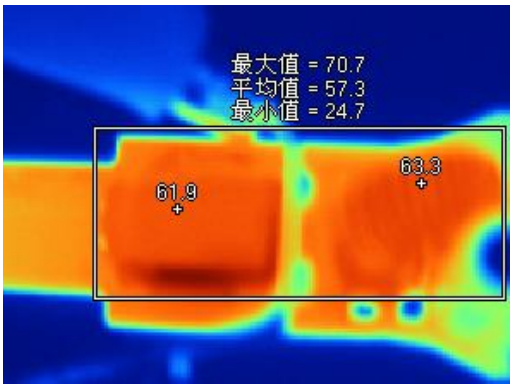
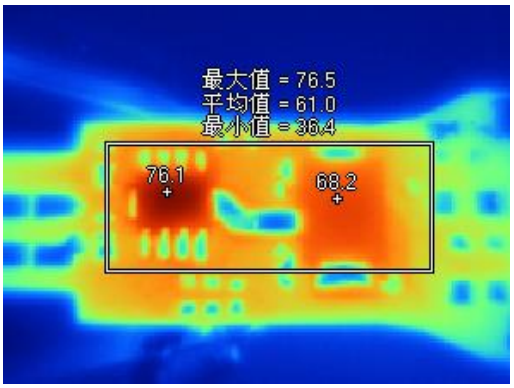
VIN=14V , VOUT=3.6-12V	VIN=28V , VOUT=3.6-12V
	

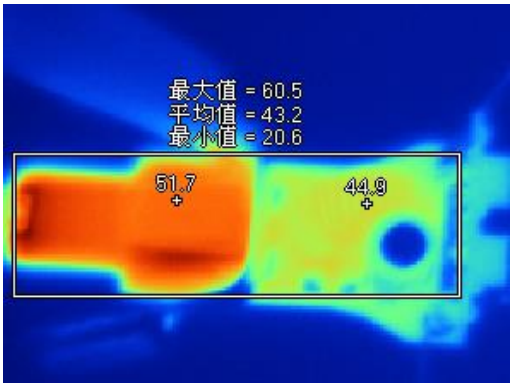
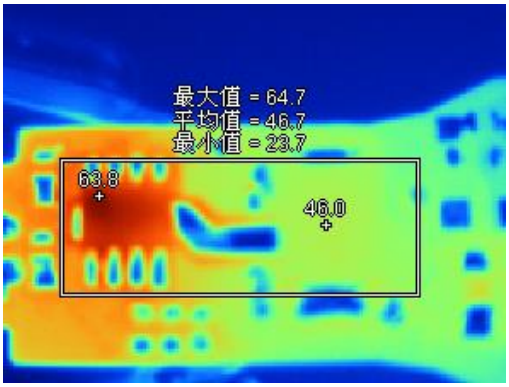
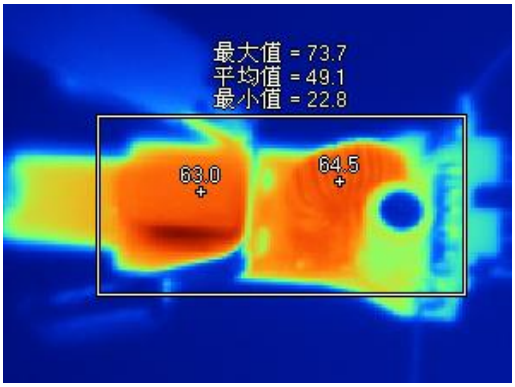
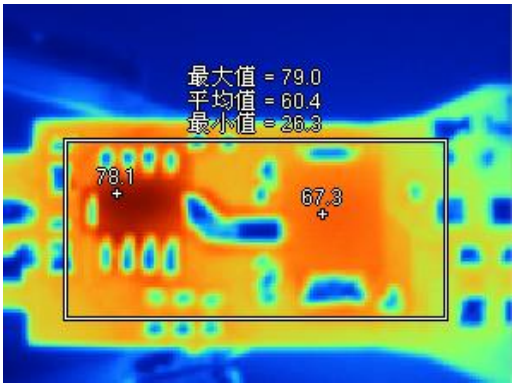
线性调整率与负载调整率

VOUT=5V	VOUT=9V
	

热性能

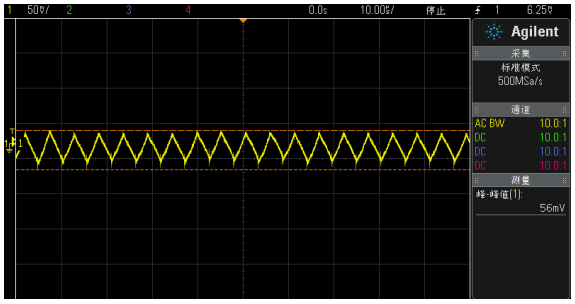
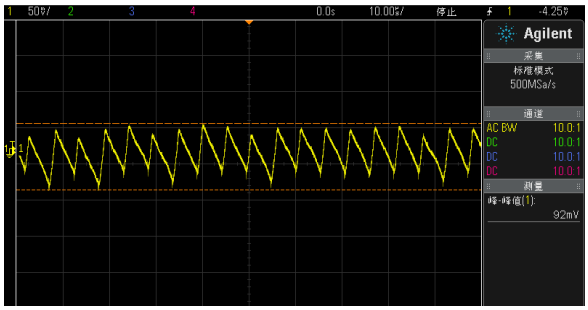
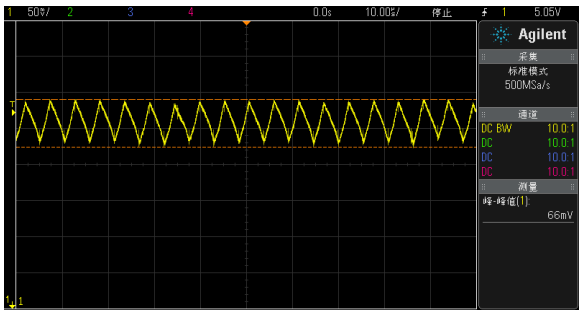
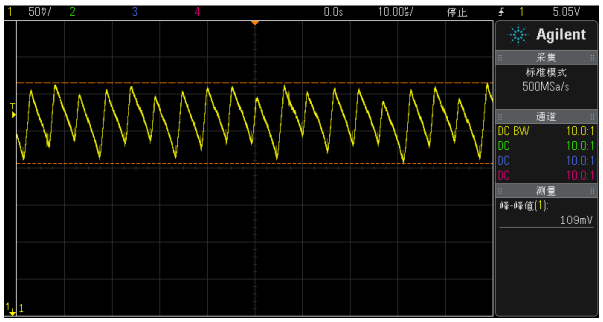
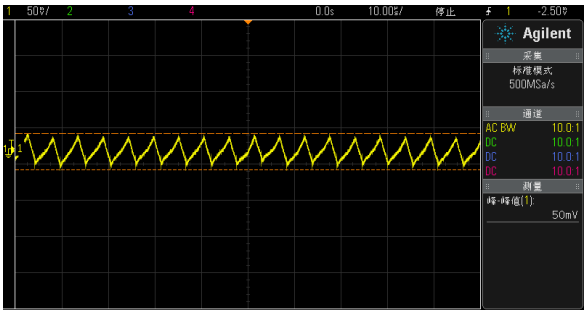
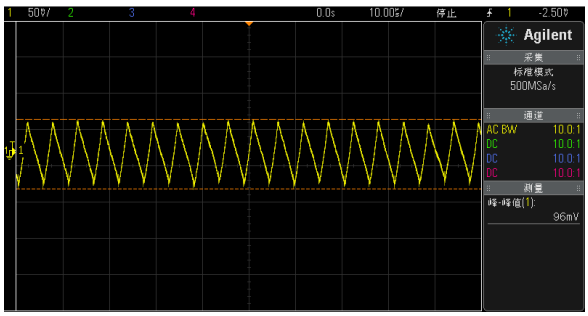
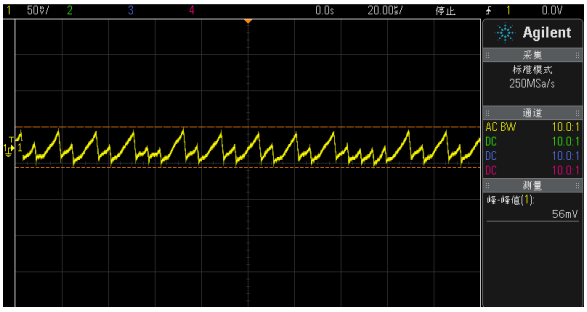
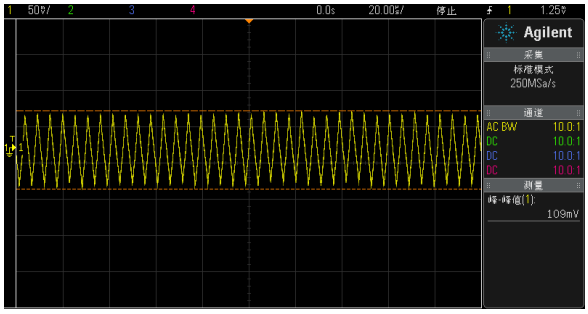
测试条件	顶层	底层
VIN=14V VOUT=5V IOUT=2.1A TA=15℃		
VIN=28V VOUT=5V IOUT=2.1A TA=15℃		
VIN=14V VOUT=5V IOUT=2.4A TA=15℃		

VIN=28V VOUT=5V IOUT=2.4A TA=15℃		
VIN=14V VOUT=9V IOUT=1.8A TA=15℃		
VIN=28V VOUT=9V IOUT=1.8A TA=15℃		

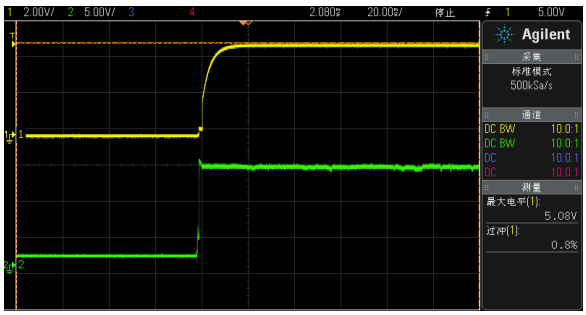
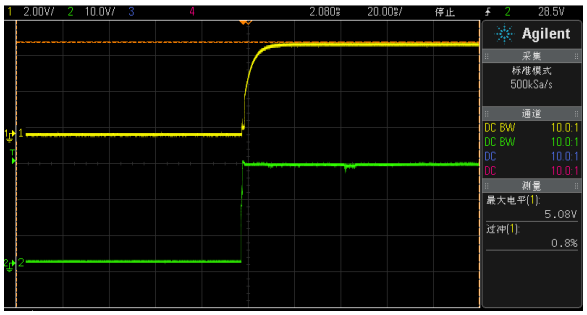
VIN=14V VOUT=12V IOUT=1.8A TA=15℃		
VIN=28V VOUT=12V IOUT=1.8A TA=15℃		

波形

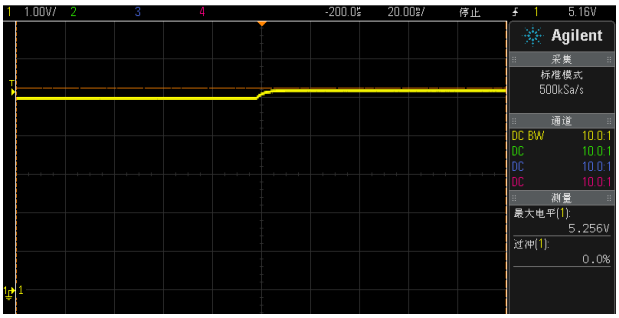
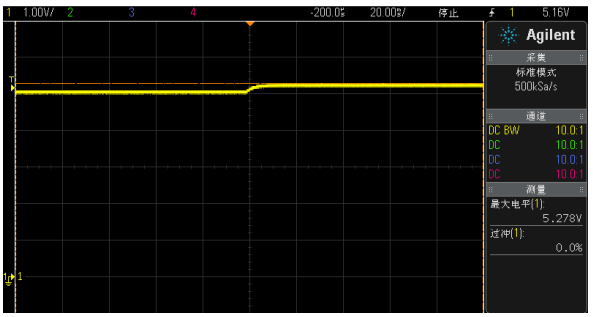
输出纹波电压

测试条件	VIN=14V	VIN=28V
VOUT=5V IOUT=2.1A		
VOUT=5V IOUT=2.4A		
VOUT=9V IOUT=1.8A		
VOUT=12V IOUT=1.8A		

输出电压

测试条件	VIN=14V	VIN=28V
VOUT=5V IOUT=2.1A		
备注	黄色通道为输出电压波形，绿色通道为输入电压波形	

输出电压切换

测试条件	VIN=14V	VIN=28V
IOUT=2A VOUT: 5V->5.2V		
测试条件	VIN=14V	VIN=28V
IOUT=2A VOUT: 5V->4.8V