



芯高科技  
HIGH TECH  
TECHNOLOGY LIMITED

**HT6020**

## *Characterization Report*

Version 01

# Car Charger\_HT6020 (20W + 20W) 演示板測試

雙輸出車載充電器 (DB02)

測試單元: 20030601

2020/12/17

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# 報告大綱

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# 1. 摘要

操作模式:	單通道	雙通道
輸入電壓範圍	12V to 24V	
主要支持的快速充電協議	QC 3.0**	
輸出電壓和電流範圍 (最大輸出功率是 20W + 20W)	(5V 3A), (9V 2A), (12V 1.5A), (20V – 1A)	雙通道的最大總輸出電流為 5A
沒有快充協議時的輸出電壓和電流範圍	5V 3A	雙通道的最大總輸出電流為 5A
尺寸	64mm(長) X 37mm(闊) X 14mm(高)	
最大輸出功率	20W	40W
負載調節(Load Regulation)準確度	輸出電壓在不同負載下準確度達 99% (Vin=24V)	
最大功率轉換效率	96%	97%
短路(Short Circuit)測試	✓	

\*\* QC3.0: Based on QUALCOMM webpage: Charge up to 4 times faster than conventional 5W chargers.  
(<https://www.qualcomm.com/news/onq/2015/09/14/introducing-quick-charge-30-next-generation-fast-charging-technology>)

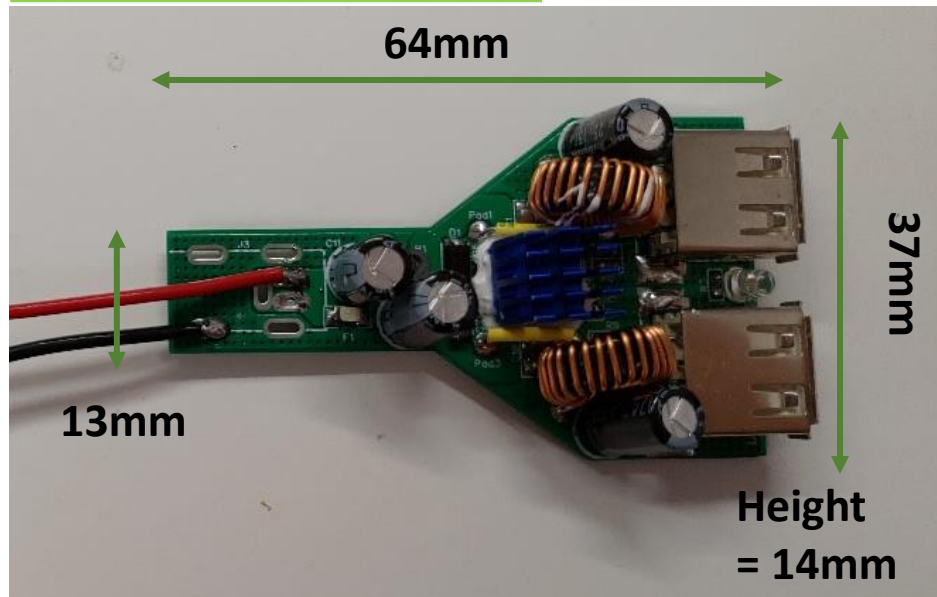
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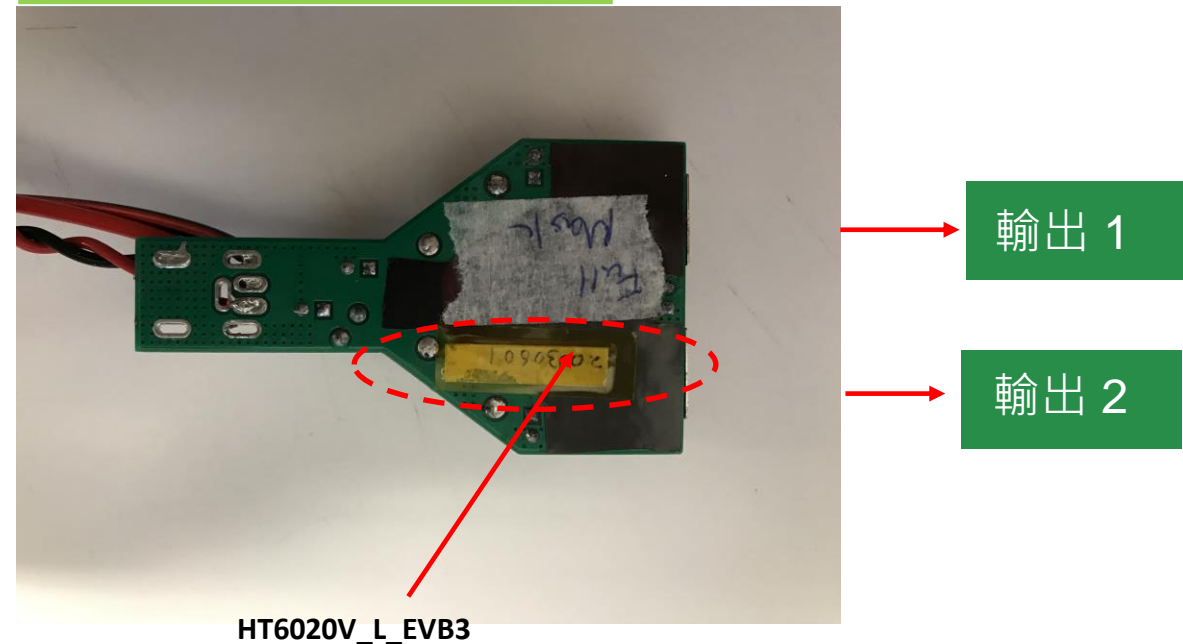
## 2. 演示板介紹

- 演示板 (測試單元: 20062202)
- 尺寸: 64mm(長) x 37mm(闊) x 14mm(高)

演示板 (頂視圖)



演示板 (底視圖)

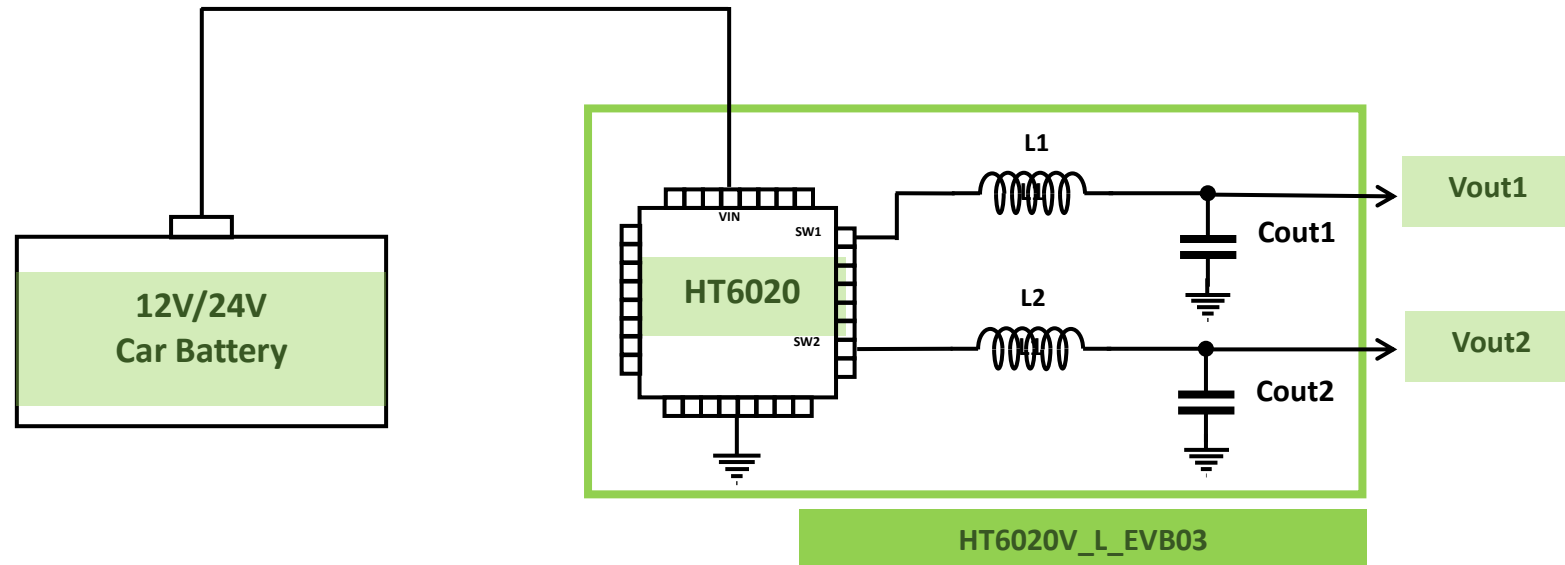


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## 2. 演示板介紹

### 設計簡約\*



\* 有關完整的電路圖，請參見附錄I。

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# 3. 測試規格

## 輸入電壓

12 V, 13 V, 24 V

## 輸出電壓和電流

- 5 V, 0 – 3A (15 W)
- 9 V, 0 – 2 A (18 W)
- 12 V, 0 – 1.5 A (18 W)
- 20 V, 0 – 1 A (20 W) (只適用於 $V_{in} = 24V$ )

## 雙路輸出的總輸出電流及功率

- 最大總輸出電流為 5 A
- 總功率最高為40 W {20W (20V, 1A) + 20W (20V, 1A)}

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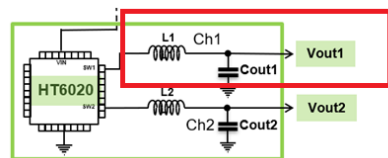
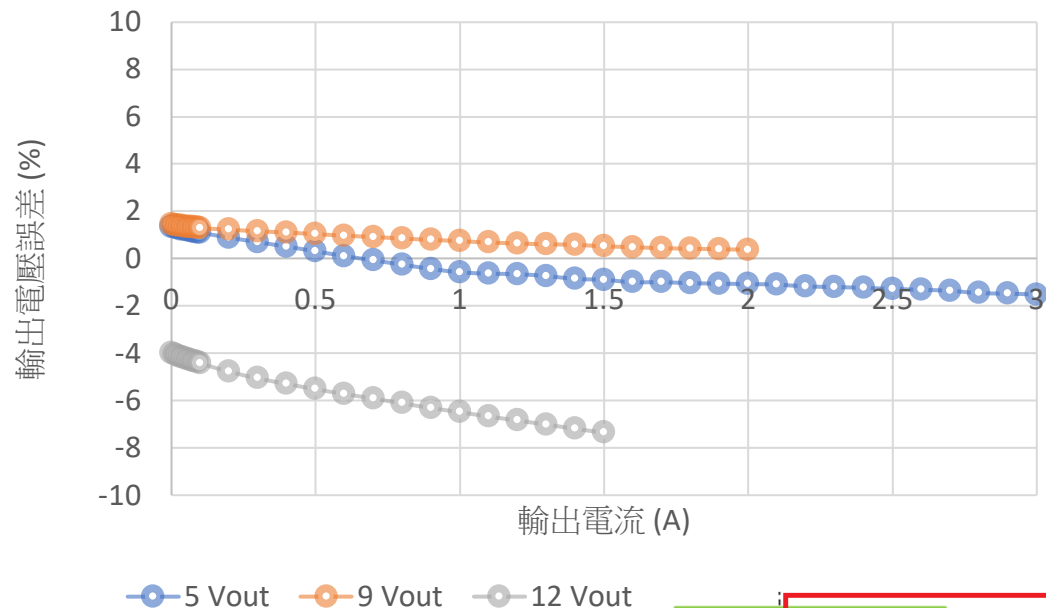
# 4. 負載調節 Load Regulation ( $V_{in} = 12V$ )

輸出電壓準確度 >98%,  $V_{out} = 5 - 9V @ I_{out} = 0 - 3A$

輸出電壓準確度 >91%,  $V_{out} = 12V @ I_{out} = 0 - 3A$

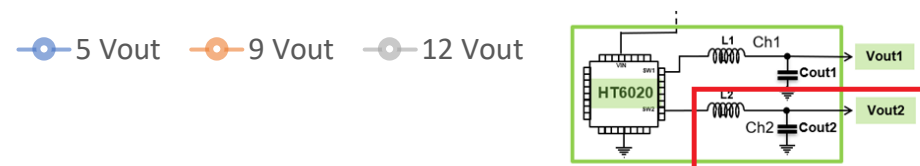
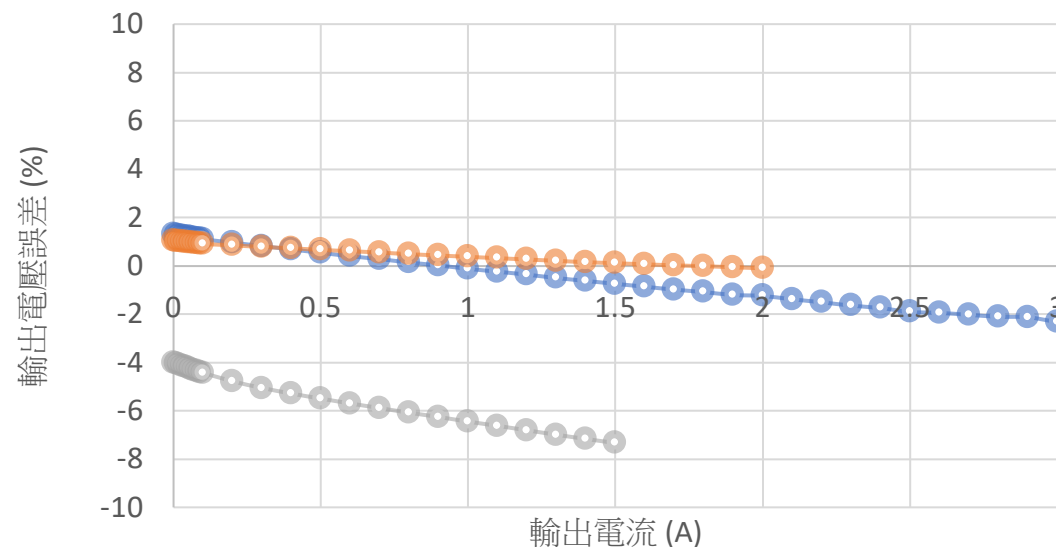
## Ch1 (通道1), (Ch 2 No Load)

負載調節 @  $V_{in} = 12V$



## Ch2 (通道2), (Ch1 No Load)

負載調節 @  $V_{in} = 12V$



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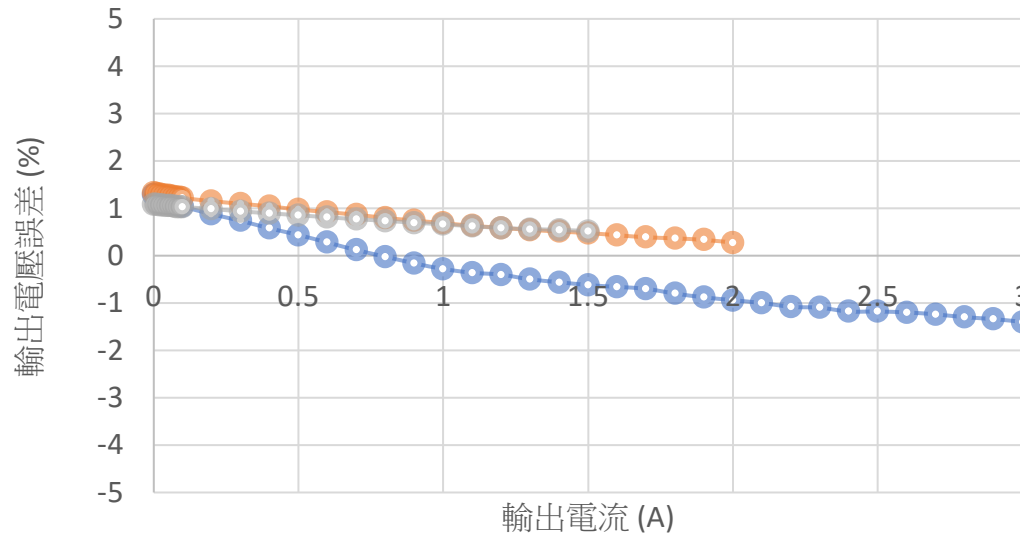
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# 4. 負載調節 ( $V_{in} = 13V$ )

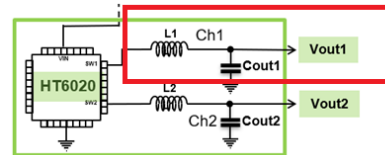
輸出電壓準確度 >98%,  $V_{out} = 5 - 12V @ I_{out} = 0 - 3A$

## Ch1, (Ch2 No Load)

負載調節 @  $V_{in} = 13V$

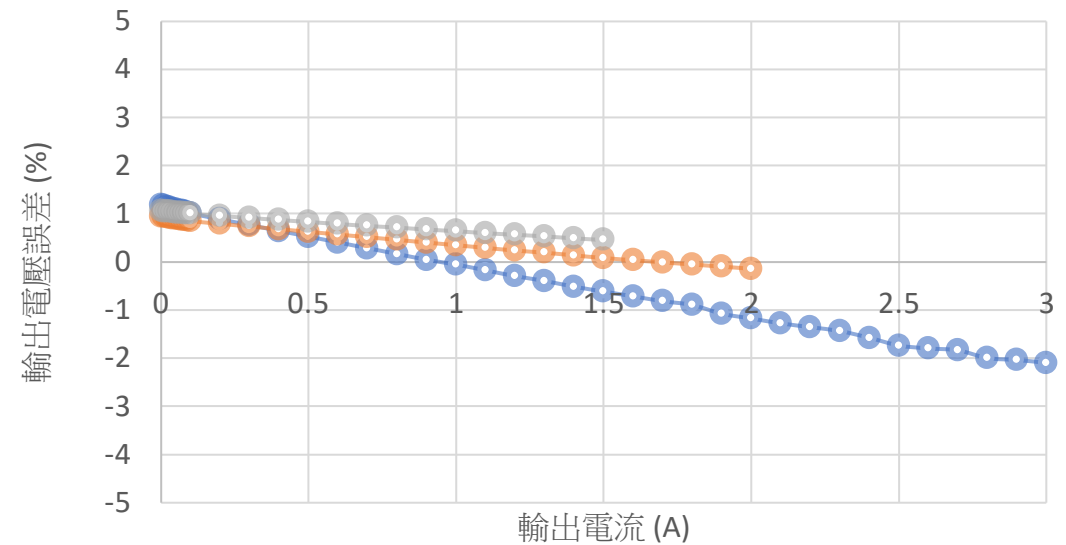


● 5 Vout ● 9 Vout ● 12 Vout

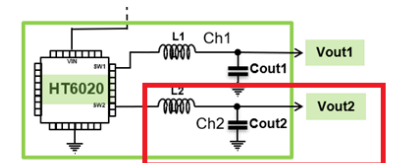


## Ch2, (Ch1 No Load)

負載調節 @  $V_{in} = 13V$



● 5 Vout ● 9 Vout ● 12 Vout



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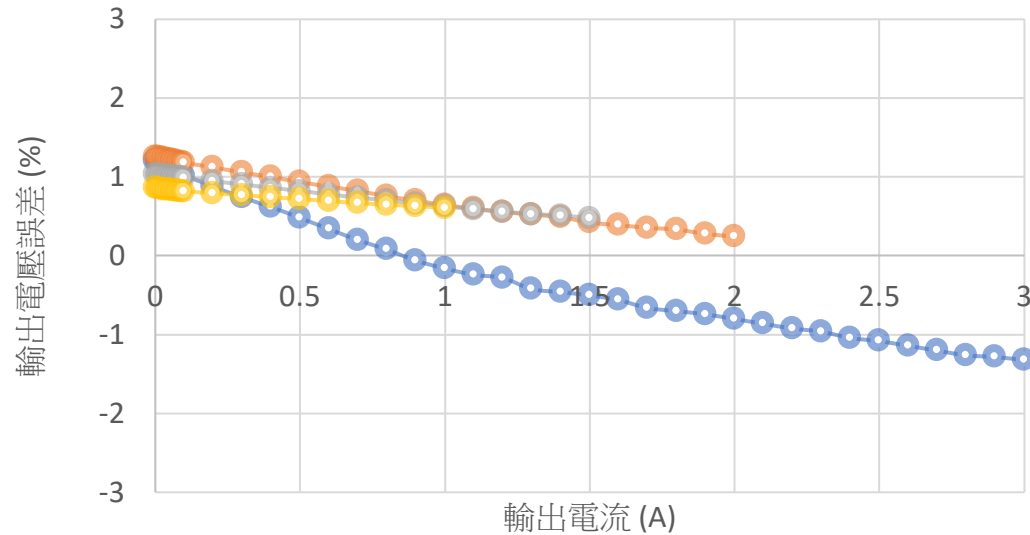


# 4. 負載調節 ( $V_{in} = 24V$ )

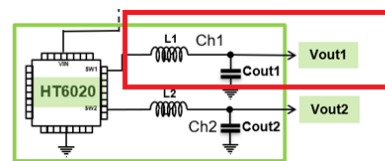
輸出電壓準確度 >98%,  $V_{out} = 5 - 20V @ I_{out} = 0 - 3A$

## Ch1, (Ch2 No Load)

負載調節 @  $V_{in} = 24V$

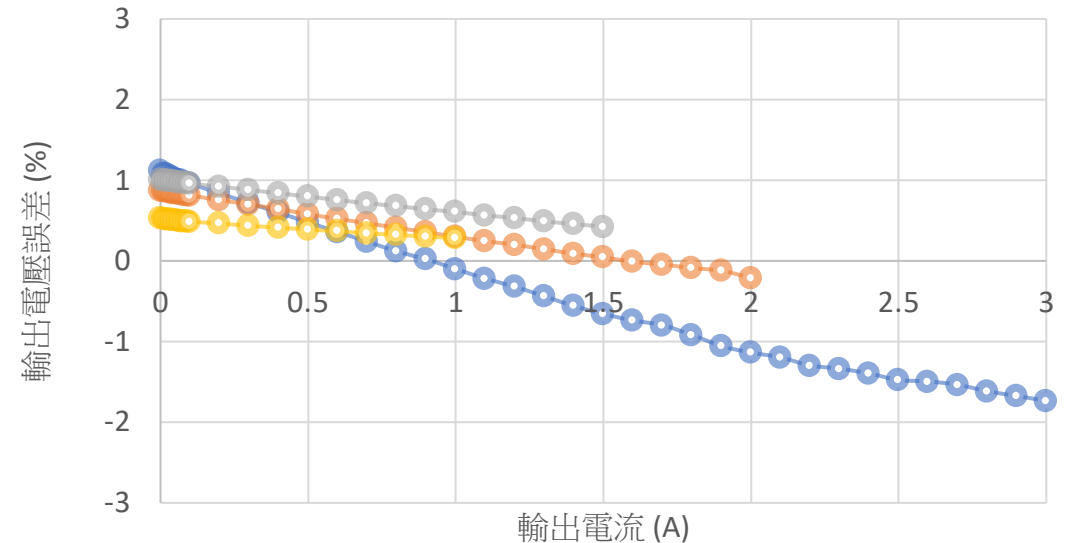


● 5 Vout ● 9 Vout ● 12 Vout ● 20 Vout

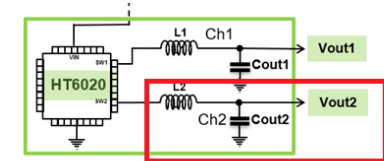


## Ch2, (Ch1 No Load)

負載調節 @  $V_{in} = 24V$



● 5 Vout ● 9 Vout ● 12 Vout ● 20 Vout

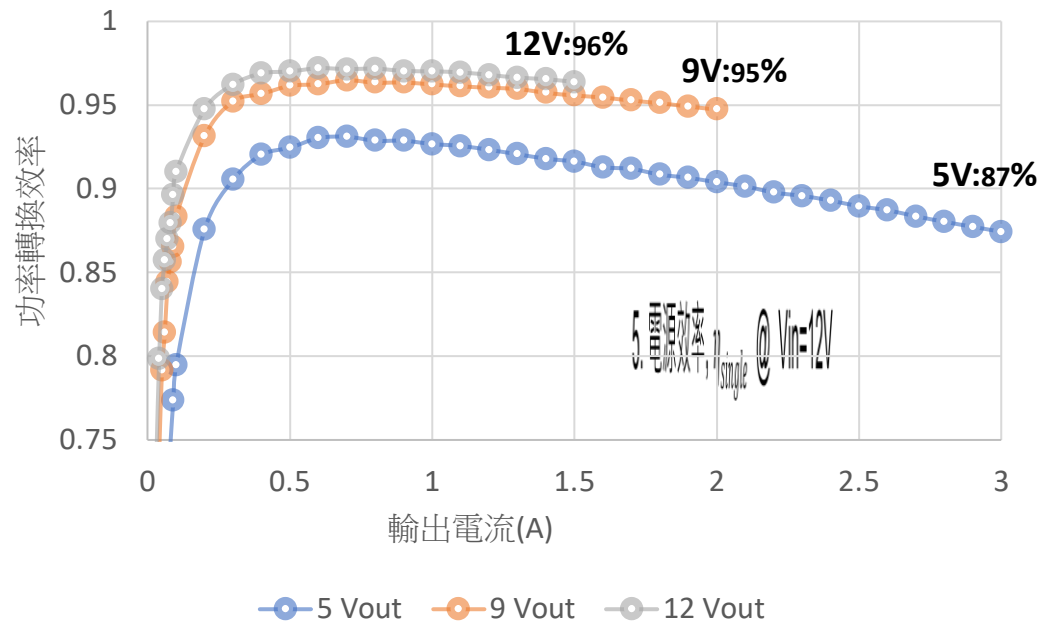


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# 5. 電源效率, $\eta_{single}$ @ $V_{in}=12V$

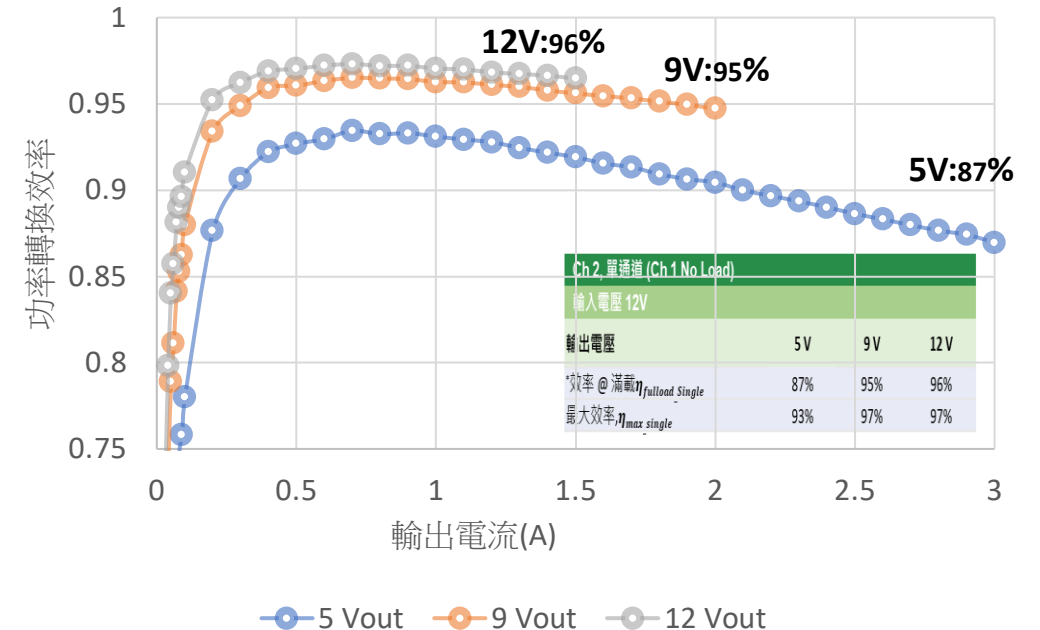
## Ch1 功率轉換效率@ $V_{in} = 12V$



Ch 1, 單通道 (Ch 2 No Load)			
輸入電壓 12V			
輸出電壓	5 V	9 V	12 V
*效率 @ 滿載 $\eta_{fullload\_Single}$	87%	95%	96%
最大效率, $\eta_{max\_single}$	93%	96%	97%

\* 滿載 Full load conditions (5V, 3A), (9V,2A), (12V,1.5A)

## Ch2 功率轉換效率@ $V_{in} = 12V$



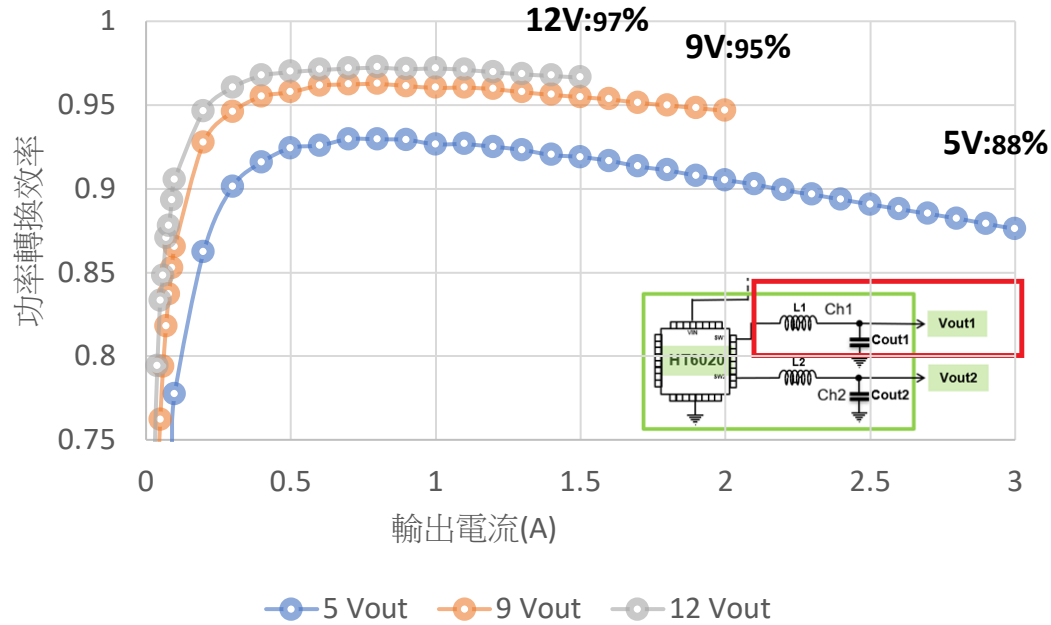
Ch 2, 單通道 (Ch 1 No Load)			
輸入電壓 12V			
輸出電壓	5 V	9 V	12 V
*效率 @ 滿載 $\eta_{fullload\_Single}$	87%	95%	96%
最大效率, $\eta_{max\_single}$	93%	97%	97%

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# 5. 電源效率, $\eta_{single}$ @ $V_{in}=13V$

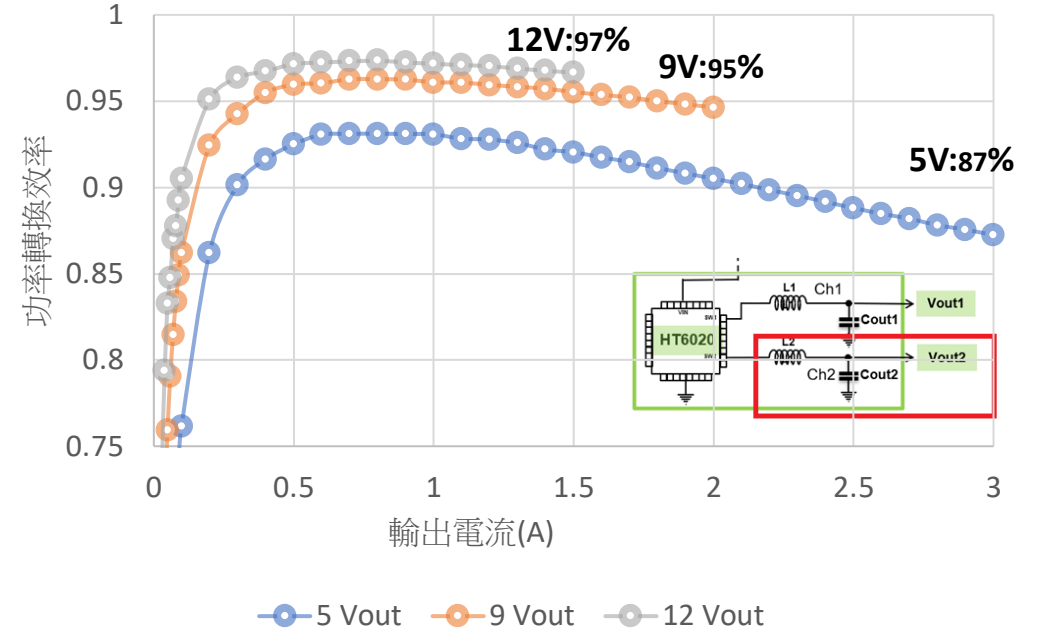
Ch1 功率轉換效率@  $V_{in} = 13V$



Ch 1, 單通道 (Ch 2 No Load)			
輸入電壓 13 V			
輸出電壓	5 V	9 V	12 V
*效率 @ 滿載 $\eta_{fullload\_Single}$	88%	95%	97%
最大效率, $\eta_{max\_single}$	93%	96%	97%

\* 滿載 Full load conditions (5V, 3A), (9V,2A), (12V,1.5A)

Ch2 功率轉換效率@  $V_{in} = 13V$



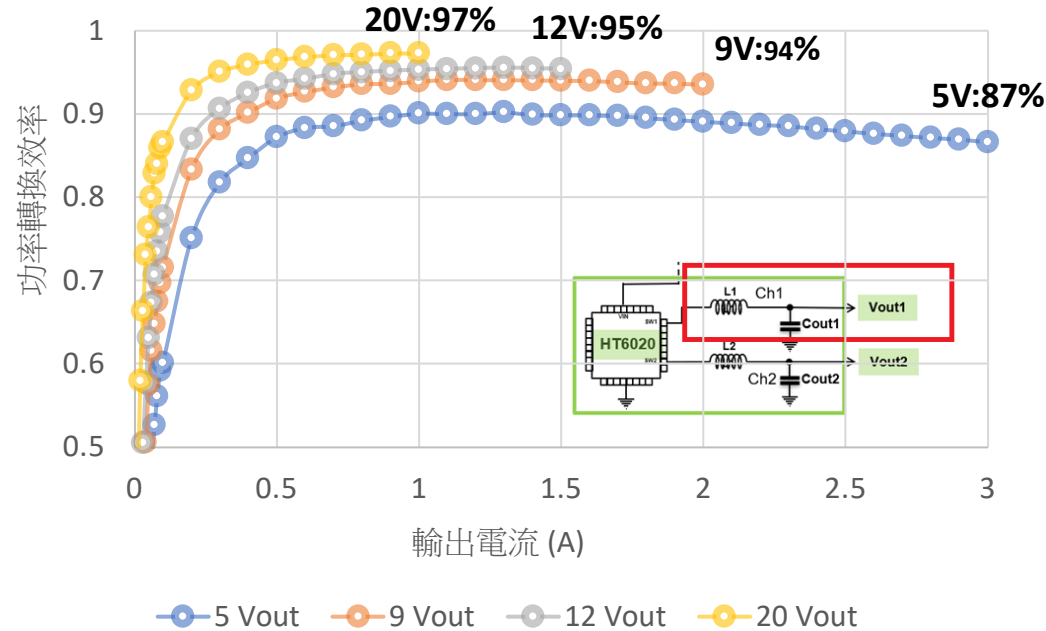
Ch 2, 單通道 (Ch 1 No Load)			
輸入電壓 13 V			
輸出電壓	5 V	9 V	12 V
*效率 @ 滿載 $\eta_{fullload\_Single}$	87%	95%	97%
最大效率, $\eta_{max\_single}$	93%	96%	97%

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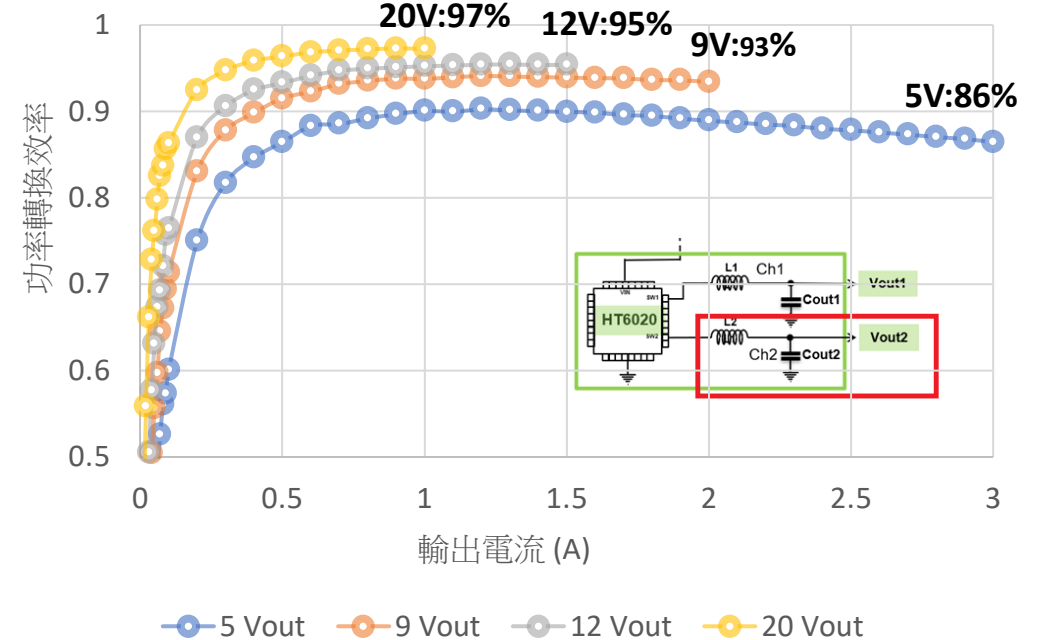
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# 5. 電源效率, $\eta_{single}$ @ $V_{in}=24V$

Ch1 功率轉換效率@  $V_{in} = 24V$



Ch2 功率轉換效率@  $V_{in} = 24V$



## Ch 1, 單通道 (Ch 2 No Load)

輸入電壓 24 V

輸出電壓	5 V	9 V	12 V	20 V
*效率 @ 滿載 $\eta_{fullload\_Single}$	87%	94%	95%	97%
最大效率, $\eta_{max\_single}$	90%	94%	96%	97%

\* 滿載 Full load conditions (5V, 3A), (9V,2A), (12V,1.5A) & (20V,1A)

## Ch 2, 單通道 (Ch 1 No Load)

輸入電壓 24 V

輸出電壓	5 V	9 V	12 V	20 V
*效率 @ 滿載 $\eta_{fullload\_Single}$	86%	93%	95%	97%
最大效率, $\eta_{max\_single}$	90%	94%	95%	97%

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## 5. 功率轉換效率 (雙通道), $\eta_{fulload\_Dual}$

- 總結

**Vin 12V, 13V & 24V**

滿載效率範圍\*,  $\eta_{fulload\_Dual}$

86% - 97%

\*In various combination of full load conditions: (5V, 3A), (9V,2A), (12V,1.5A) & (20V,1A)

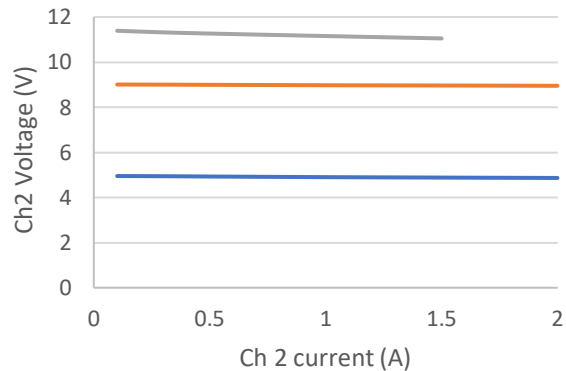
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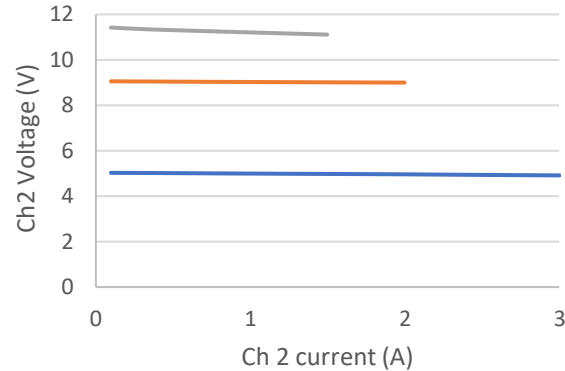
# 6. 雙通道輸出性能

## Ch2 在不同Ch1設定下的情況 @ $V_{IN}=12V$

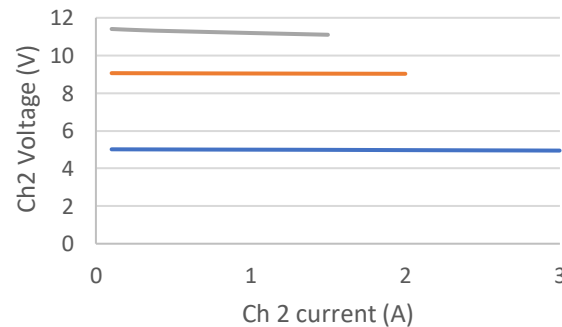
- Ch1 : 運作於 5 V, 3A
- Ch2 :  $V_o$  vs  $I_o$  @  $V_{in} = 12V$



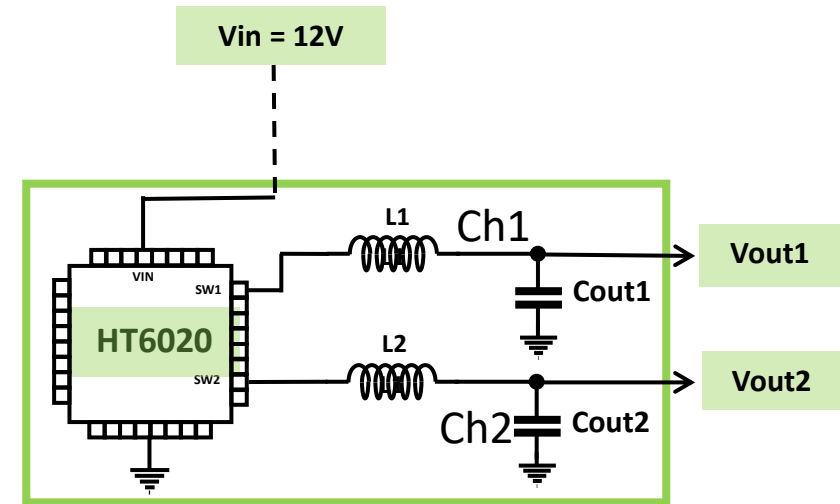
- Ch1 : 運作於 9 V, 2A
- Ch2 :  $V_o$  vs  $I_o$  @  $V_{in} = 12V$



- Ch1 : 運作於 12 V, 1.5A
- Ch2 :  $V_o$  vs  $I_o$  @  $V_{in} = 12V$



— 5V — 9V — 12V



### 摘要

- 當Vout1固定時，Vout2 在5V及9V輸出電壓下準確度達96%；在12V輸出電壓下準確度達91%。
- 當兩個通道同時運作時，最大輸出電流為5A。
- 最大輸出功率是 40W (20 W + 20 W)

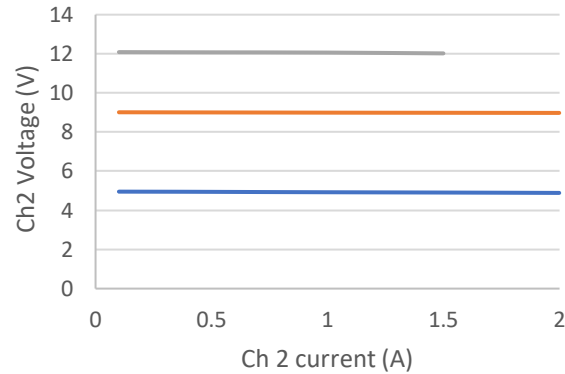
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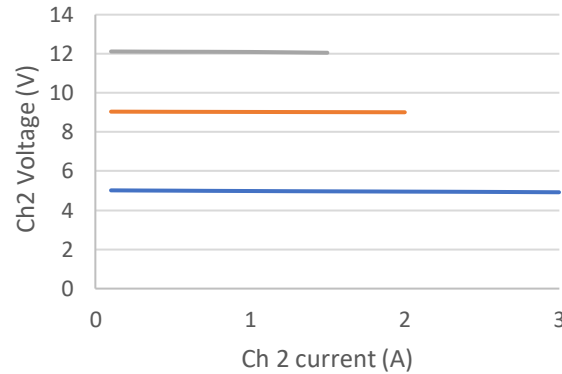
# 6. 雙通道輸出性能

## Ch2 在不同Ch1設定下的情況 @ $V_{IN}=13V$

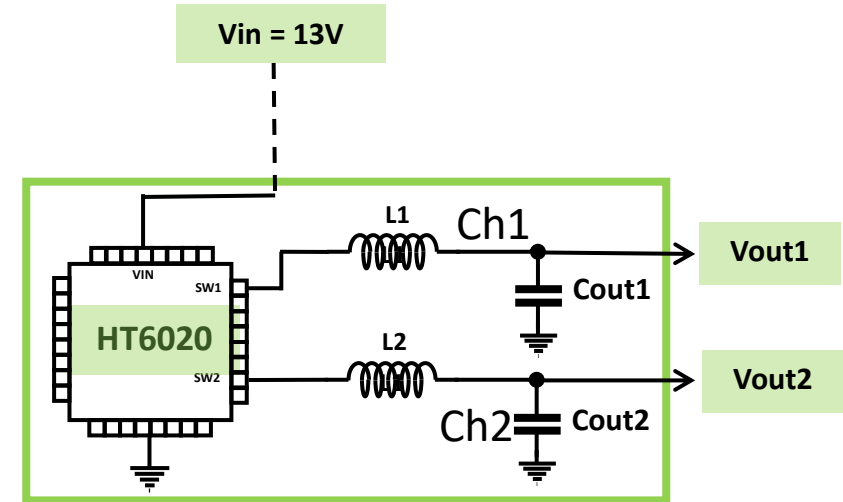
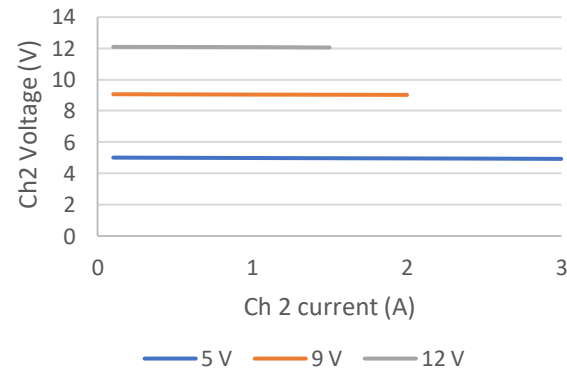
- Ch1 : 運作於 **5 V, 3A**
- Ch2 :  $V_o$  vs  $I_o$  @  $V_{in} = 13V$



- Ch1 : 運作於 **9 V, 2A**
- Ch2 :  $V_o$  vs  $I_o$  @  $V_{in} = 13V$



- Ch1 : 運作於 **12 V, 1.5A**
- Ch2 :  $V_o$  vs  $I_o$  @  $V_{in} = 13V$



### 摘要

- 當Vout1固定時，Vout2 在不同的輸出電壓下準確度達97%。
- 當兩個通道同時運作時，最大輸出電流為5A。
- 最大輸出功率是 40W (20 W + 20 W)

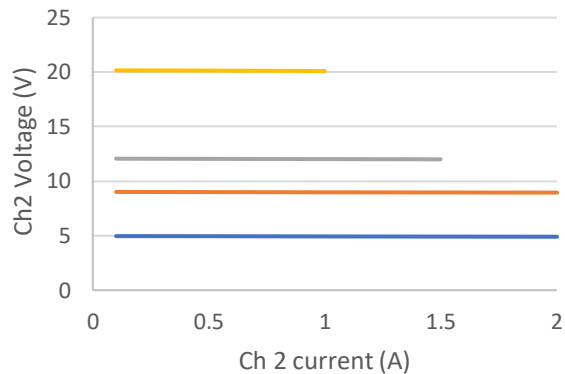
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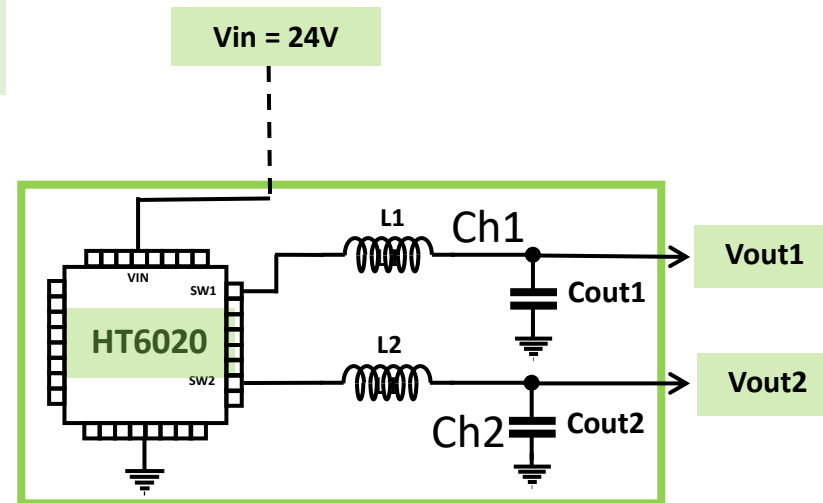
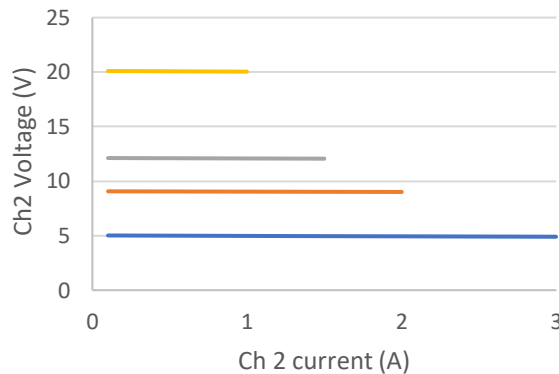
# 6. 雙通道輸出性能

## ch2 在不同Ch1設定下的情況 @ $V_{IN}=24V$

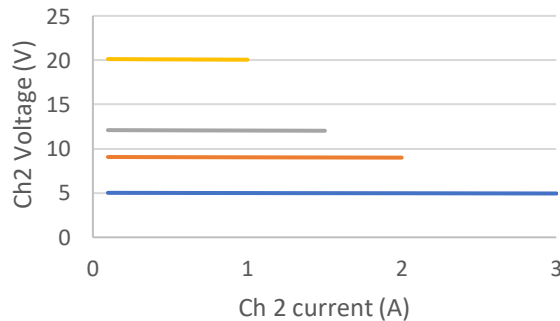
- Ch1 : 運作於 5 V, 3A
- Ch2 :  $V_o$  vs  $I_o$  @  $V_{in} = 24V$



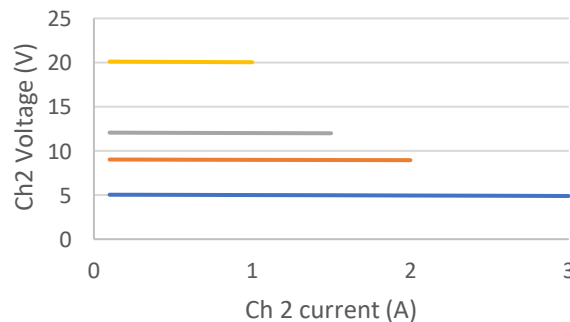
- Ch1 : 運作於 9 V, 2A
- Ch2 :  $V_o$  vs  $I_o$  @  $V_{in} = 24V$



- Ch1 : 運作於 12 V, 1.5A
- Ch2 :  $V_o$  vs  $I_o$  @  $V_{in} = 24V$



- Ch1 : 運作於 20 V, 1A
- Ch2 :  $V_o$  vs  $I_o$  @  $V_{in} = 24V$



### 摘要

- 當Vout1固定時，Vout2 在不同的輸出電壓下準確度達97%。
- 當兩個通道同時運作時，最大輸出電流為5A。
- 最大輸出功率是 40W (20 W + 20 W)

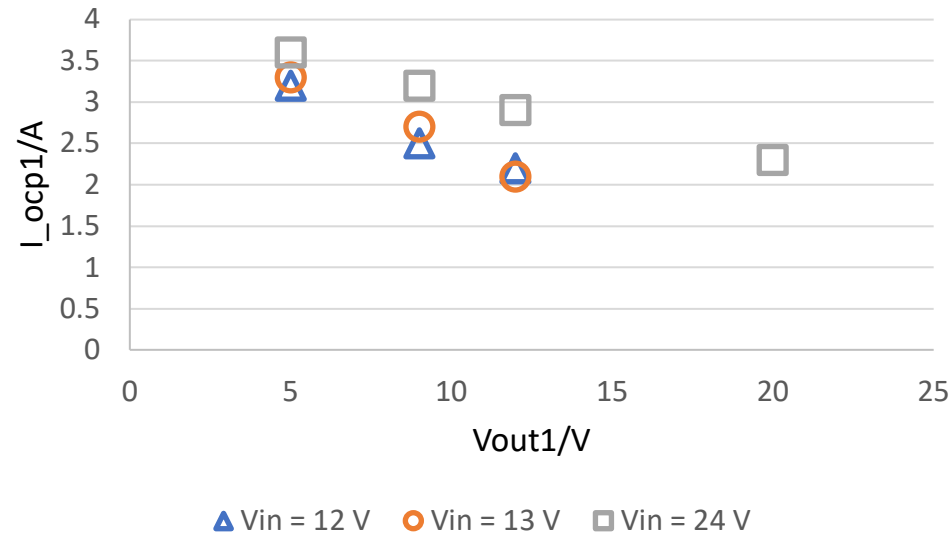
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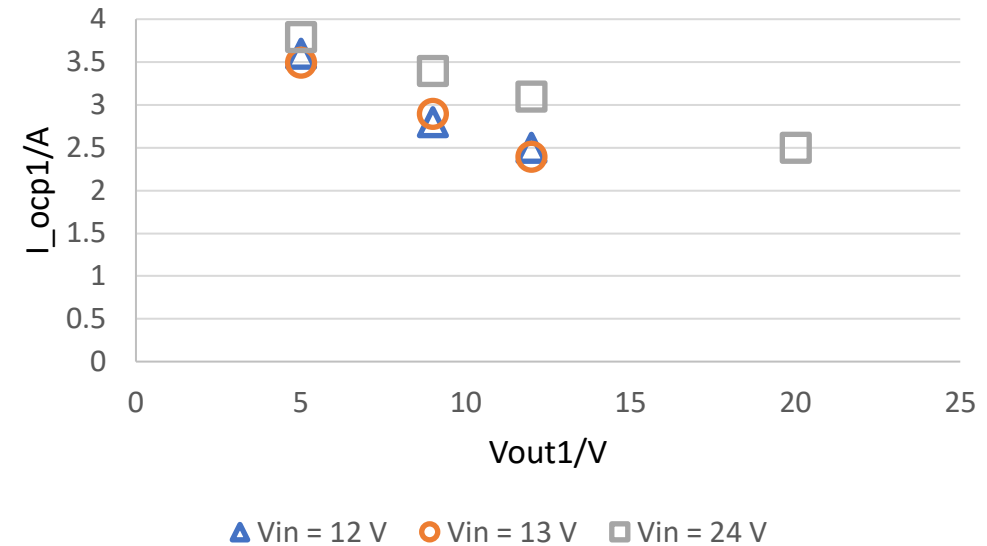


# 7. 過流保護 Over-Current Protection

### Ch1 的過流保護



### Ch2 的過流保護

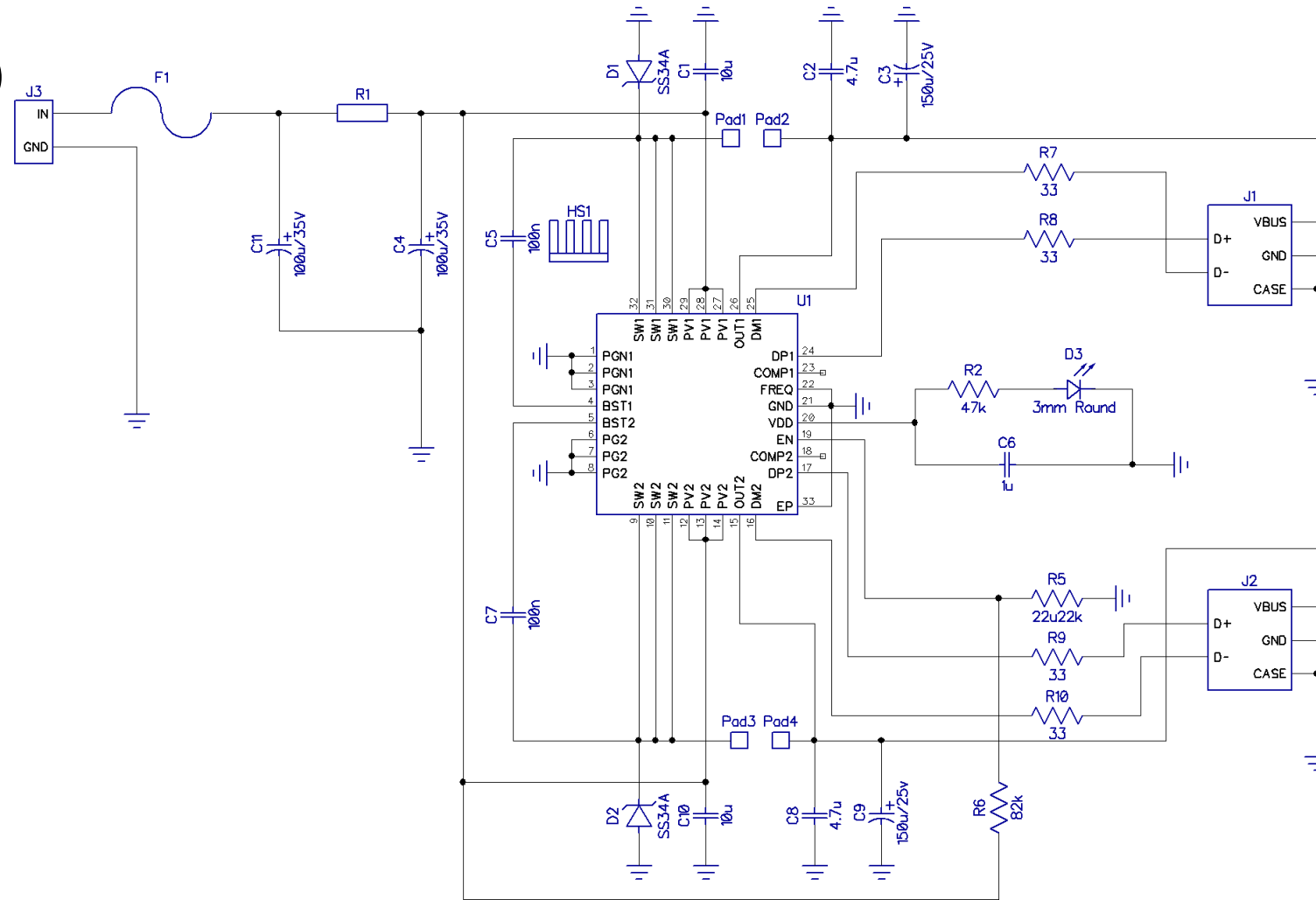


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# 8. 附錄 I

- 演示板原理圖  
(物料清單詳見附錄II)



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## 8. 附錄 II



### • 演示板物料

RefDes	NAME	VALUE
C1	CAP_1206	10u
C2	CAP_0805	4.7u
C3	E-Cap 2.5/6.3	150u/25V
C4	E-Cap 2.5/6.3	100u/35V
C5	CAP_0603	100n
C6	CAP_0603	1u
C7	CAP_0603	100n
C8	CAP_0805	4.7u
C9	E-Cap 2.5/6.3	150u/25v
C10	CAP_1206	10u
C11	E-Cap 2.5/6.3	100u/35V
D1	SMA	SS34A
D2	SMA	SS34A
D3	LED-3R_Red	3mm Round
F1	FUSE	7A 1206
HS1	HS_9*9*10	Heat Sink

RefDes	NAME	VALUE
J1	USB_F	Connector
J2	USB_F	Connector
J3	Car_Charger_H	Connector/Wire
Pad1	Pad_2.5/1.6	Inductor 47uH,9mm
Pad2	Pad_2.5/1.6	Inductor 47uH,9mm
Pad3	Pad_2.5/1.6	Inductor 47uH,9mm
Pad4	Pad_2.5/1.6	Inductor 47uH,9mm
R1	Ferrite Bead	
R2	RES_0603	47k
R5	RES_0603	22k
R6	RES_0603	82k
R7	RES_0603	33
R8	RES_0603	33
R9	RES_0603	33
R10	RES_0603	33
U1	HT6020V-LRC	

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