

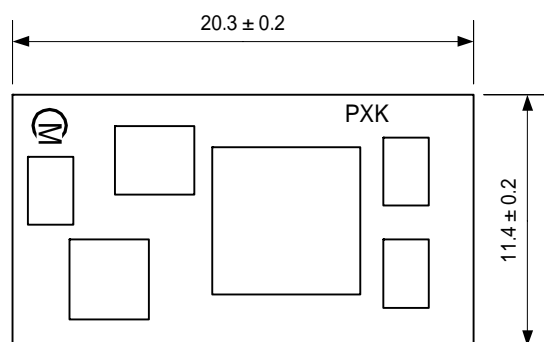
# DC-DC Converter Application Manual

## MPDTY413S

### 1. Features

- Up to 6A output current, non-isolated POL.
- Wide adjustable output voltage range by connecting external resistance (0.7525V to 5.5V).
- Wide operating temperature ( -40 °C to +85 °C ) .
- UVLO function / ON/OFF function, Over-current function and Over temperature function are built in.

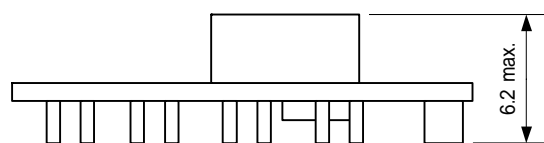
### 2. Appearance, Dimensions




( )...reference value

P=2.54 ± 0.2mm

Tolerance is not accumulated.



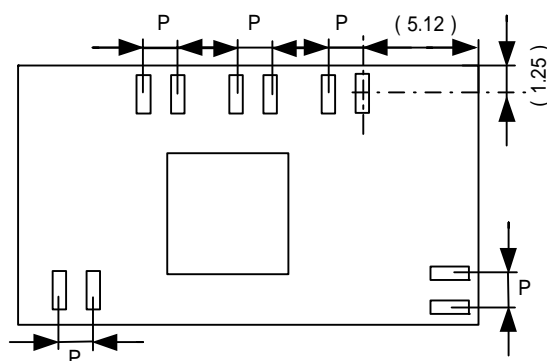
#### Marking

- (1) Pin No.1 Marking / MFG ID 
- (2) Parts No. PXX
- (3) Lot No.

Production Factory

Production Year

Production Month ( 1,2,3,...9,O,N,D )



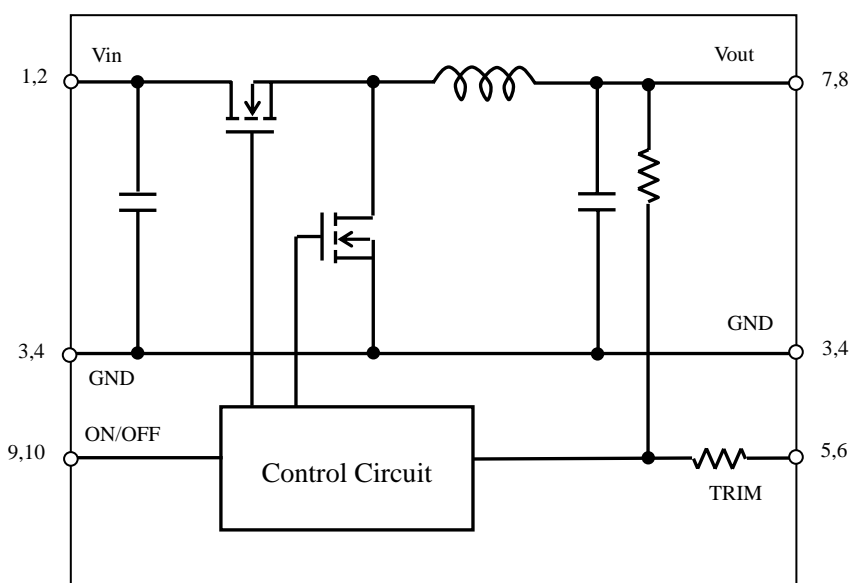
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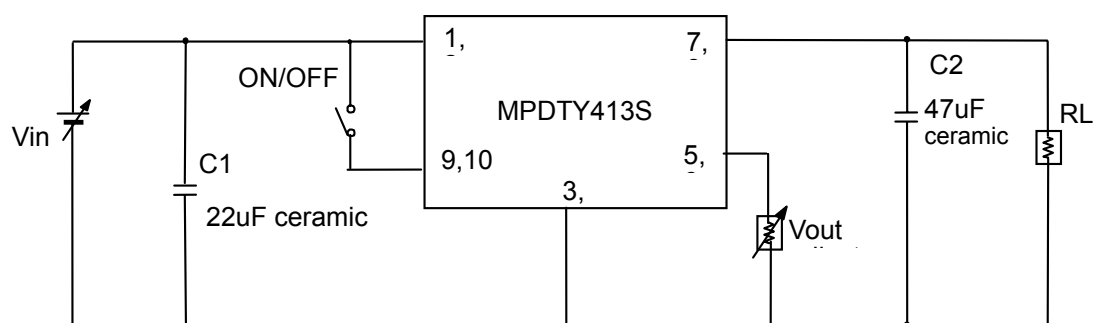
## Pin Number and Function

Pin No.	Symbol	Function
1,2	Vin	Input Voltage
3,4	GND	GND
5,6	TRIM	Output Voltage Adjustment
7,8	Vout	Output Voltage
9,10	ON/OFF	Remote ON/OFF

## 3. Block Diagram



## 4. Test Circuit



C1 : 22 $\mu$ F / 25V Ceramic Capacitor

C2 : 47 $\mu$ F / 10V Ceramic Capacitor

Please make sure to place C1 and C2 nearby input and output terminal of DC-DC converter.

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## 5. Characteristics

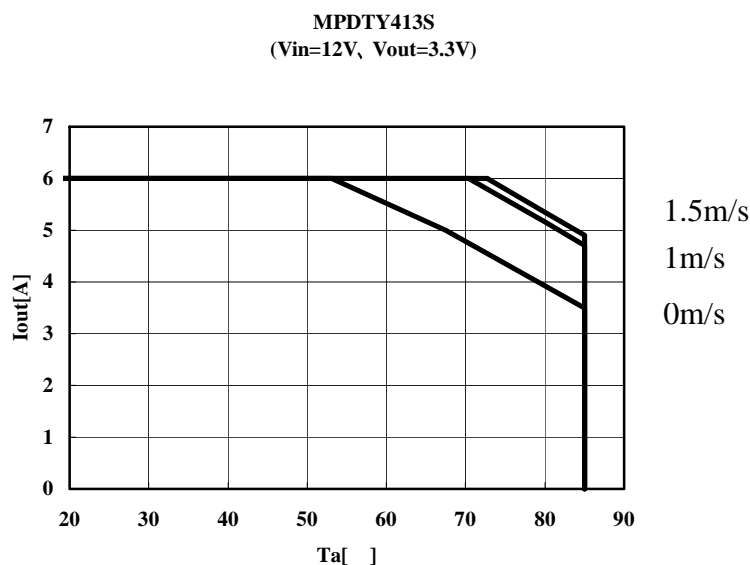
## 5. 1 Electrical Characteristics (Ta=25 °C)

Item	Symbol	Condition	Value			Unit	
			Min.	Typ.	Max.		
Input Voltage Range	Vin		10.0	12.0	14.0	V	
UVLO Threshold	UVLO		-	9.4	-	V	
Output Voltage Adjustable Range	Vout		0.7525	-	5.5	V	
Output Voltage Tolerance	Vo tol	Vin=10 ~ 14V Iout=0 ~ 6A	Vout=1.2 V	1.164	1.2	1.236	V
			Vout=5.0 V	4.85	5.0	5.15	
Output Current	Iout	See the thermal derating curve in section 5.2.	0	-	6	A	
Ripple Voltage	Vrpl	Vin =12V, Vout=2.5V, Iout=6A, BW=20MHz	-	35	70	mV(pp)	
Efficiency	EFF	Vin =12V, Iout=6A	Vout=2.5 V	-	90	-	%
			Vout=3.3 V	-	94	-	
Operating Frequency	Frq		-	400	-	kHz	
ON/OFF pin High Voltage	VIH	If ON/OFF pin is connected to Vin, the DC-DC converter shall be "OFF".	OFF	Vin-0.3	-	Vin	V
ON/OFF pin Low Voltage	VIL	If ON/OFF pin is connected to GND, the DC-DC Converter shall be "ON".	ON	0	-	0.3	V
Short Circuit Protection	SCP	If output is shorted to GND, DC-DC converter shall be operated in a hiccup mode. After the short circuit event has cleared, the output is automatically brought back into regulation.					
External Output Capacitor	Cout	When input voltage is ideal voltage source	47	-	1000	μF	
Output Rise Time	Tr	Vo=10% ~ 90%	-	4	-	msec	
Rising Overshoot	Vover		-	-	+10	%	
Output Delay	Td	Vin High :ON/OFF High→Low Vo=10%	-	5	-	msec	

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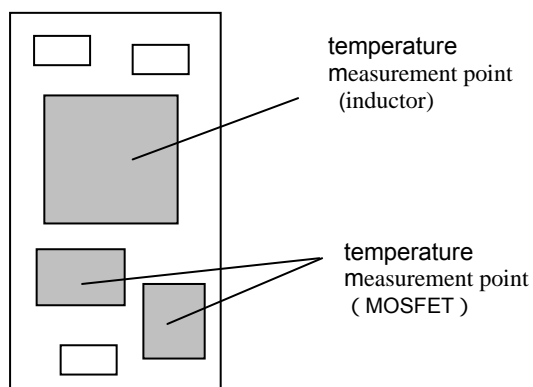
## 5. 2 Thermal Derating



When using this product at the ambient air temperature of 55°C more, it is used by the following temperature derating.

But when any other heat generating parts are close to this product, it may be over heated.

Please confirm that the MOSFET temperature is below 120°C, the inductor temperature is below 106°C to secure operation reliability(see following fig).



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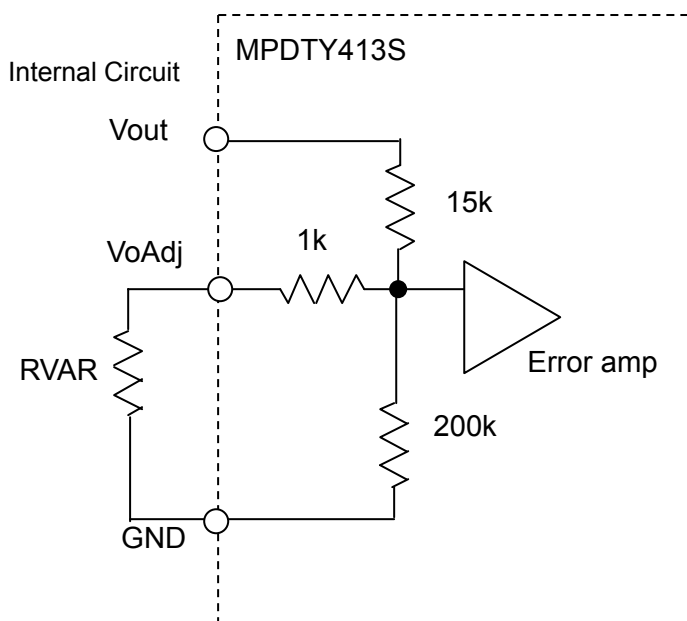
## 6. Pin Description

### 6.1. Adjusting the Output Voltage

The output voltage can be adjusted from 0.7525V to 5.5V by connecting resistors between TRIM-pin(5,6Pin) to GND-pin.

The following equation gives the required external-resistor values to adjust the output voltage to the required Vout.

It is highly recommended that evaluation of the characteristics of this DC-DC converter's operation under your board conditions be thoroughly conducted.



$$RVAR = \frac{10500}{Voadj[V] - 0.7525[V]} - 1000 \quad [ \Omega ]$$

<RVAR Calculation Example>

Voadj [V]	Calculated RVAR[Ω]	RVAR example
5	1472	1.47 kΩ + 2Ω
3.3	3122	3kΩ + 120Ω
2.5	5009	4.99kΩ + 20Ω
1.8	9024	8.2kΩ + 820Ω
1.5	13047	13kΩ+47Ω
1.2	22464	22kΩ + 470Ω
0.7525	∞	Open

### 6.2. ON/OFF Control

#### ON/OFF function

Using the ON/OFF feature, the operation of this product can be disabled without removal of the input voltage. Sequencing of a power supply system and power-saving control can be easily achieved using this function.

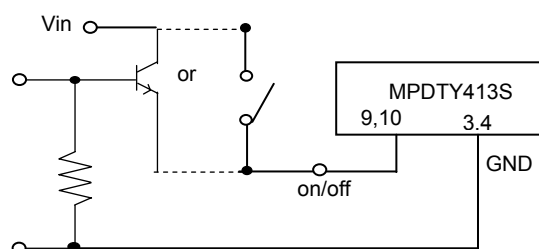
#### ON/OFF Control Operation

When ON/OFF-pin(9,10pin)are left open

..... Output Voltage =ON

When ON/OFF-pin(9,10pin) is connected to Vin

..... Output Voltage =OFF



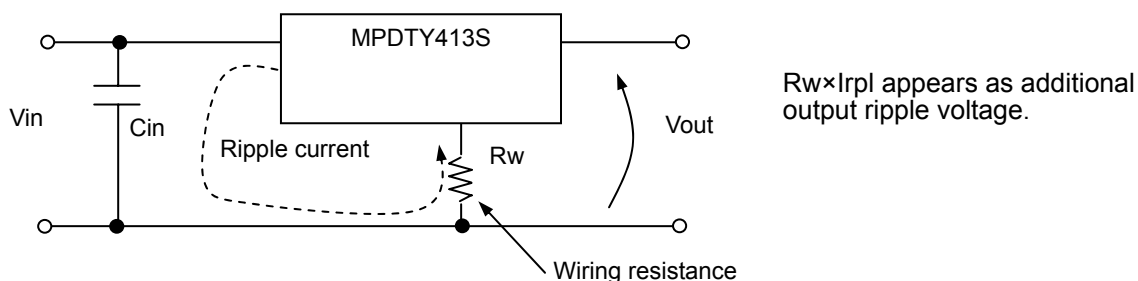
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#### 6.4. Input External capacitor

It is recommended to connect a low-impedance electrolytic capacitor of 22 $\mu$ F or more at Vin terminal. Smaller input capacitor may leads to an unstable operation of this product caused by input voltage fluctuation. Please check the proper operation of it on your product when smaller input capacitor is used.

Using ceramic capacitors as input capacitor may cause an increase of output voltage, because input ripple current flows through the external input capacitor and wiring resistance. This phenomenon is affected by the position of external capacitors, the value of external capacitors and voltage difference between Vin and Vout. Using low-impedance electrolytic capacitor will ease this problem. Please check the proper operation of it on your product when ceramic input capacitor is used.



#### 6.5. Output External capacitor

Ceramic capacitors are recommended as output external capacitor. Using ceramic capacitors, small output variation and small ripple voltage are realized.

Output capacitor should be within 47 $\mu$ F to 1000 $\mu$ F. Output capacitor shall be placed near the output terminal. When using plural capacitors, please make sure to place a capacitor of at least 47 $\mu$ F near the output terminal, and place other capacitors near the load.

When using LC output filter, please make sure to place a capacitor of at least 47 $\mu$ F near the output terminal.

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## 7. Typical Characteristics Data

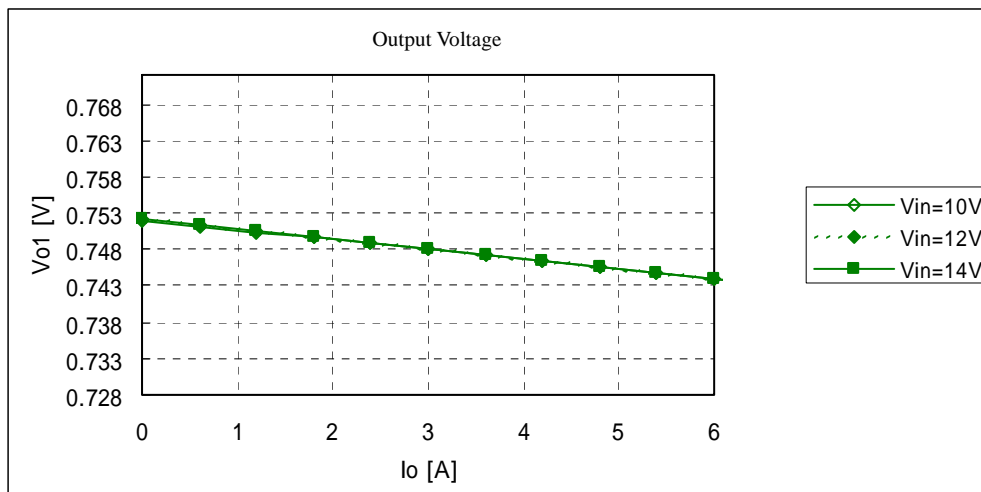
7.1.  $V_{out}=0.7525V$ 

Fig.7-1-1. Output Voltage v.s. Output Current

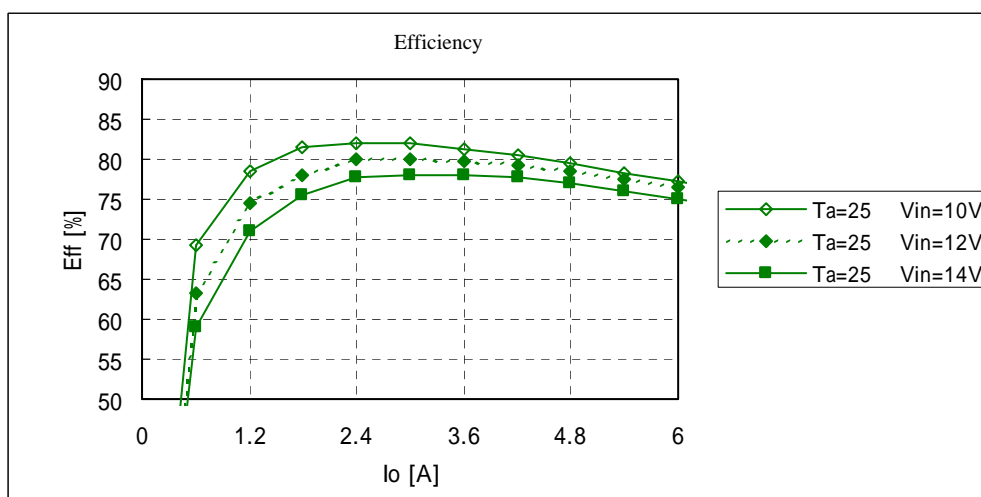


Fig.7-1-2. Efficiency v. s. Output Current

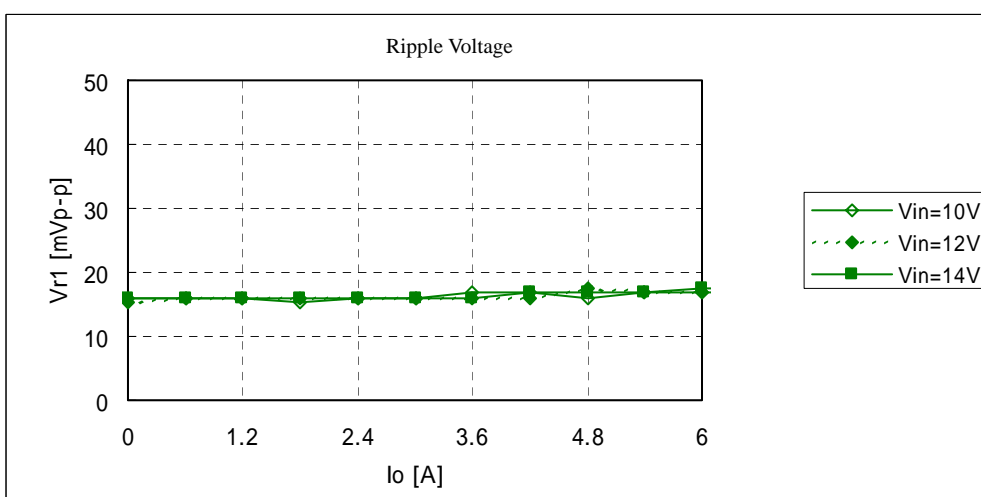


Fig.7-1-3. Ripple Voltage v. s. Output Current

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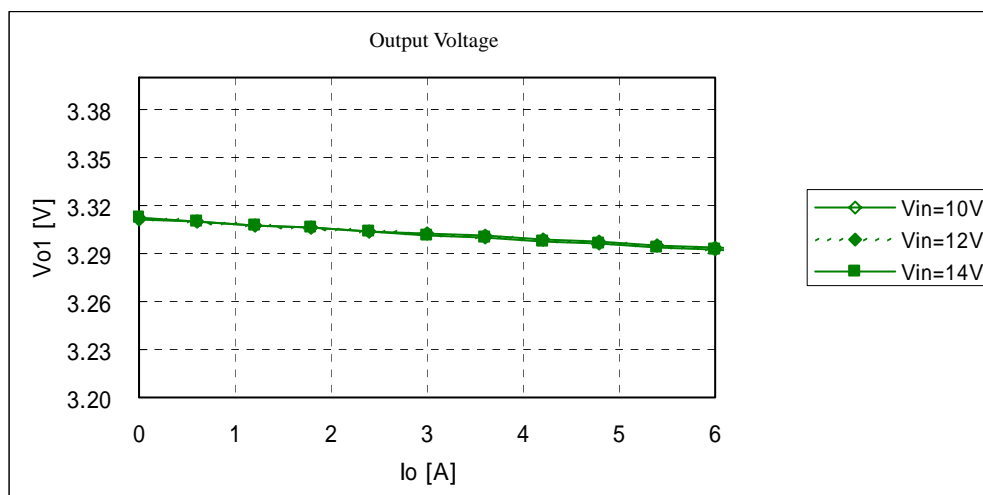
7.2.  $V_{out}=3.3V$ 

Fig.7-2-1. Output Voltage v.s. Output Current

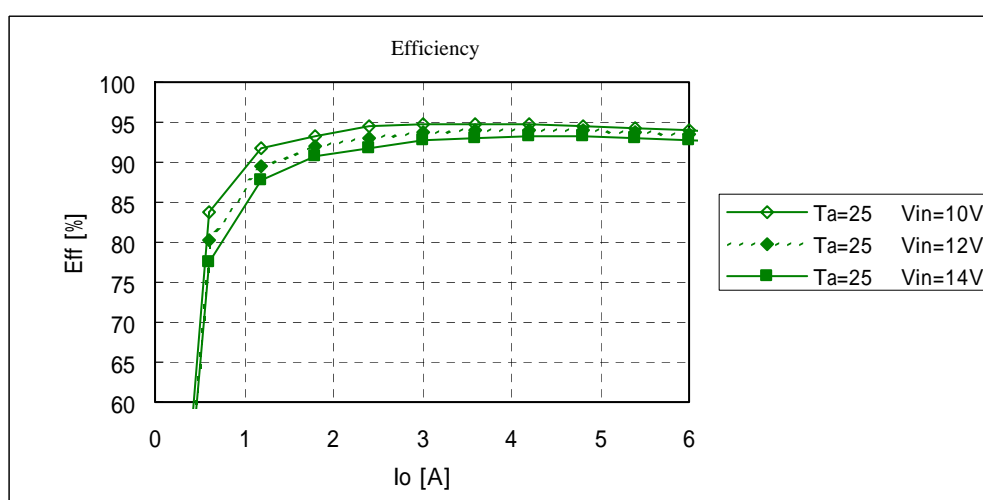


Fig.7-2-2. Efficiency v. s. Output Current

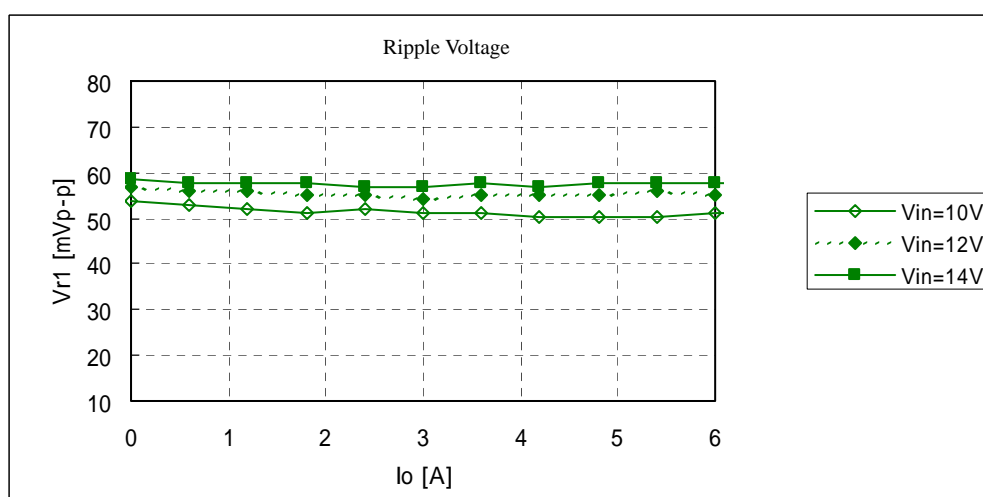


Fig.7-2-3. Ripple Voltage v. s. Output Current

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## 7.3. Vout=5.5V

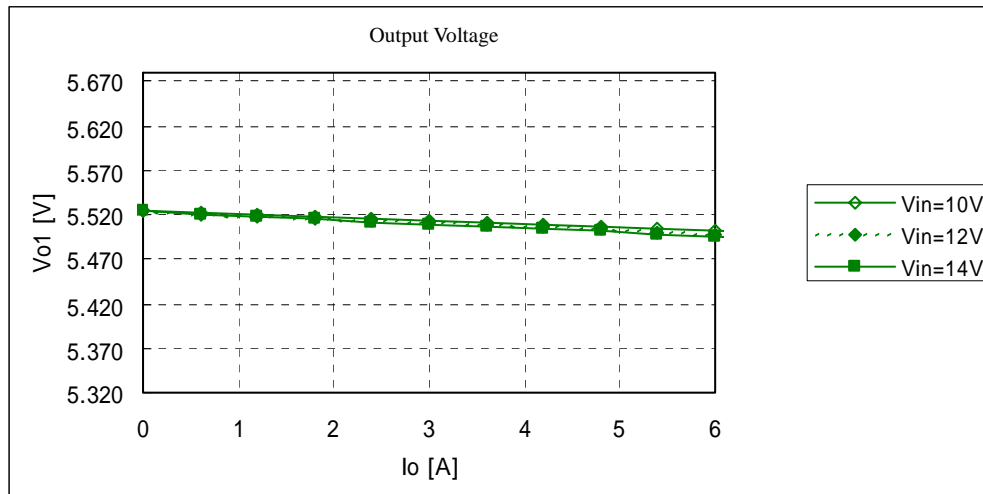


Fig.7-3-1. Output Voltage v.s. Output Current

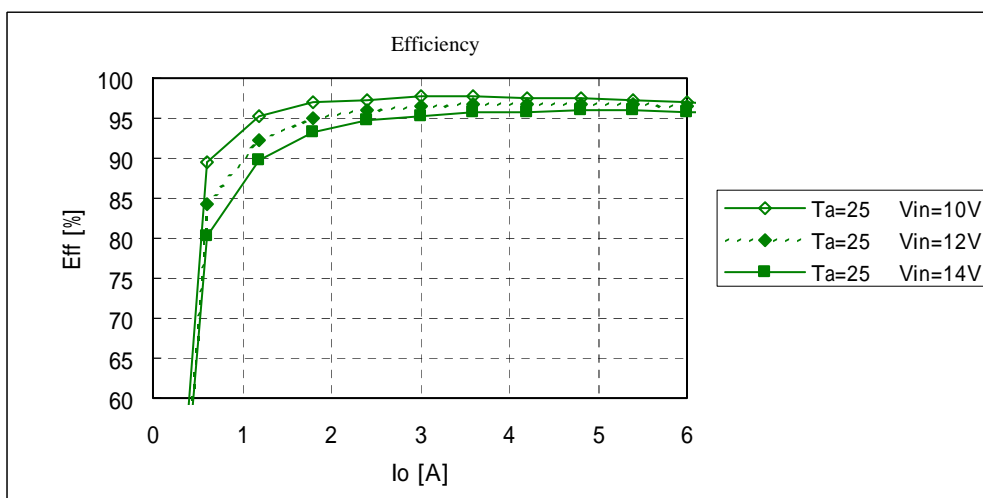


Fig.7-3-2. Efficiency v. s. Output Current

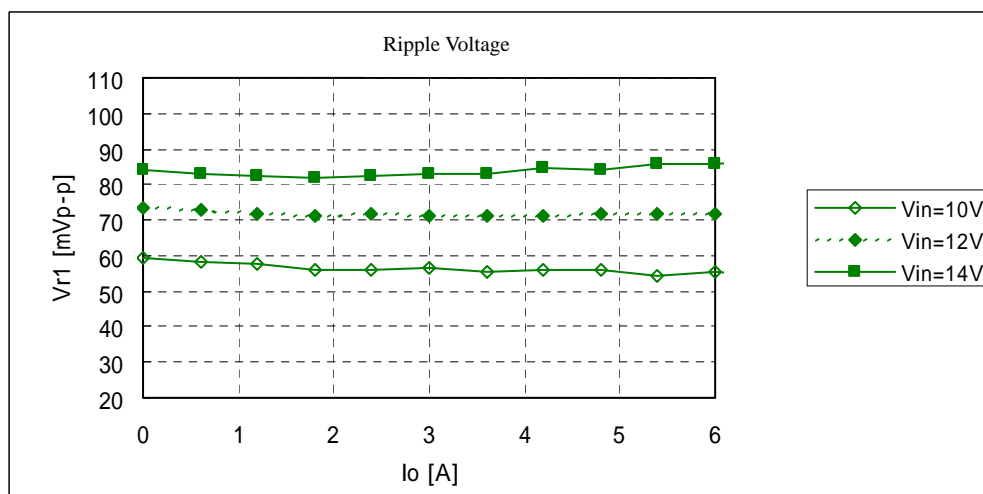


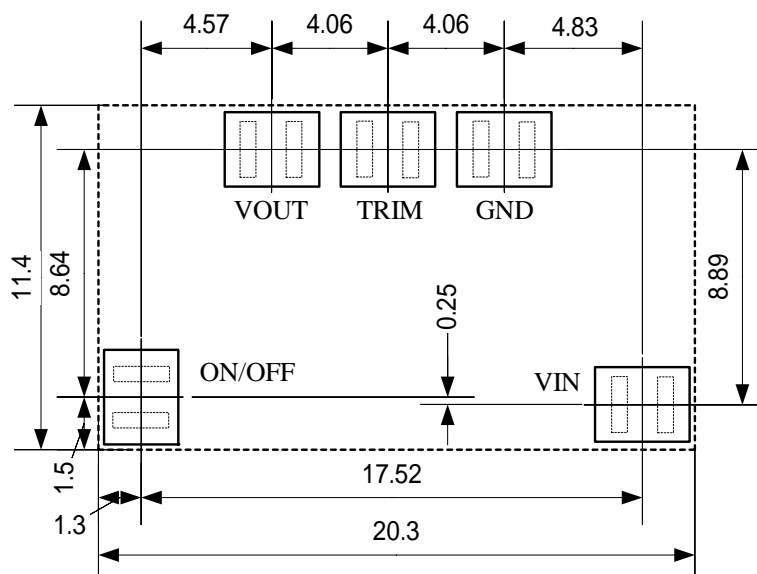
Fig.7-3-3. Ripple Voltage v. s. Output Current

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## 8. Mounting Condition

## 8.1. PCB Land Pattern Recommendation



Recommendable Land Size 3.3mm × 2.2 mm

There are wiring coppers or through-hole via at the bottom side of the DC-DC converter. When you design your PCBs, please be careful not to short the circuit of the DC-DC converter or PCBs.

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## 8.2. Recommended Soldering Conditions

### Reflow Soldering

This product is RoHS compliant. The following profile is recommended for the reflow of this product using Pb-free solder paste (Sn-Ag-Cu).

Method : Full convection reflow soldering

### Reflow Soldering Profile

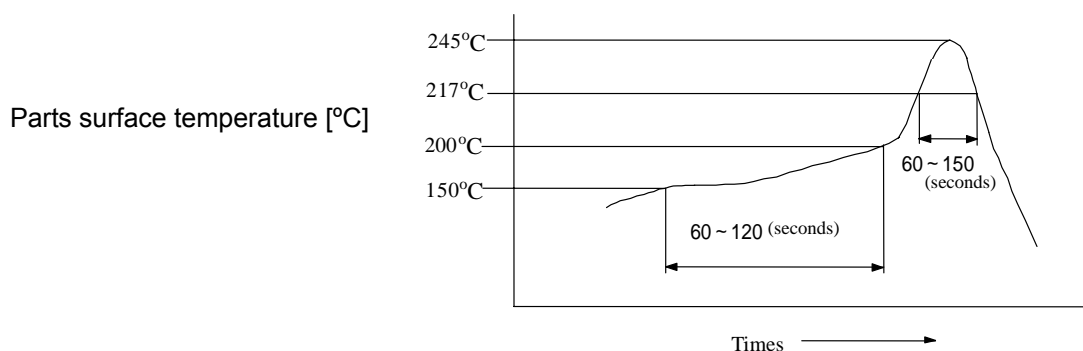
JEDEC IPC/JEDEC J-STD-020D

Table 5-2 Classification Reflow Profile

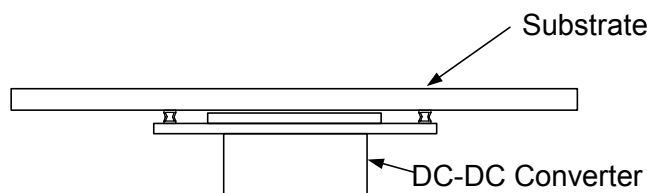
Pb-Free Assembly Large Body

### Profile details

Soldering temperature : 245°C+0/-5°C  
 Soldering time : 30 seconds, 240 to 245°C  
 Heating time : 60 to 150 seconds, over 217°C  
 Preheating time : 60 to 120 seconds, 150 to 200°C  
 Programming rate : 3°C/ sec. Max., 217 to 245°C  
 Descending rate : 6°C/ sec. Max.  
 Total soldering time : 8 minutes Max., 25 to 245°C  
 Times : 1 time



Elimination of any additional vibration applied to this device during reflow is highly recommended. Careful regulation of temperature is recommended to avoid the separation of mounted components from this device during reflow.



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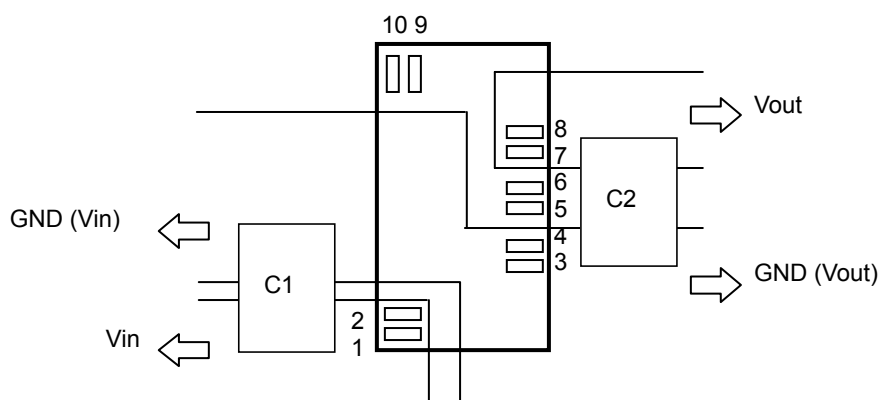
## 9. Notice

### Input / Output capacitor

Both input-side and output side, please make the wiring loop between plus and minus as small as possible. The influence of a leakage inductance can be reduced.

Please make the power line pattern as wide and short as possible.

The Following figure is an example of recommendable PCB design.



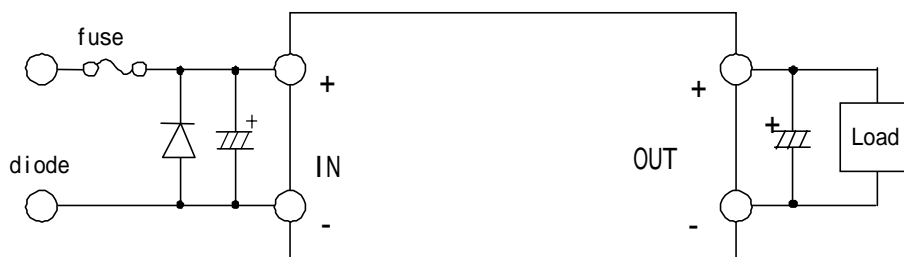
This product should not be operated in parallel or in series.

Please do not use a connector or a socket to connect this product to your product. The electric characteristics may be deteriorated by the influence of contact resistance.

Be sure to provide an appropriate fail-safe function on your product to prevent secondary damage that may be caused due to abnormal functional or failure of this product.

Inrush current protection is not a feature of this product.

Please connect the input terminals with the correct polarity. If an error in polarity connection is made this product may be damaged. If this product is damaged internally, an elevated input current may flow, and so this product may exhibit an abnormal temperature rise, or your product may be damaged. Please add a diode and fuse per the following diagram to protect them.



Please select diode and fuse after confirming the operation of your product.

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Aerospace equipment  
Undersea equipment  
Power plant control equipment  
Medical equipment  
Transportation equipment (vehicles, trains, ships, etc.)  
Traffic signal equipment  
Disaster prevention /crime prevention equipment  
Data-processing equipment  
Application of similar complexity and/or reliability requirements to the applications listed in the above.

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