ACBEL POLYTECH INC.

Engineering Spec

Model No: DC9011-000G

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AcBel Product Specification

Acbel Part No.	DC9011-000G
Model Name	A2DM500W-12V
Description	AC-DC Converter 85~265Vac Input, 12Vdc Output, 500W Output Power,
Revision	Rev 3.4
Date Issued	2015/12/18

High Output Power, High Efficiency AC-DC Converter,

DC9011-000G A2DM500W-12V

Module: 85Vac to 265Vac Input,

12Vdc Output, Maximum Output Power 500W.

World's Most Advanced Ultra High Power Density AC-DC Converters.

DESCRIPTION:

AC to DC Converter A2DM500W-12V modules are high power density and high efficiency AC-DC converters designed for uses in telecom and other centralized modular and distributed power applications. All use metal baseplates, planar transformers, and surface mount construction to produce up to 500W maximum.

FEATURES:

- Miniature Size: 116.8mmx 61mmx 12.7mm (4.59in. x 2.40in. x 0.50in.)
- High Efficiency: 88.2% at 110Vac, 90.2% at 230Vac
- Low Output Noise
- Industry-Standard Size
- Metal Baseplate
- Thermal Protection
- Over Voltage Protection
- Current Limit/Short Circuit Protection
- Adjustable Output Voltage: 65% to 120% of Vo,set
- Remote Sense
- Power On Signal (ENA)Open Collector (10mA sink current).Low (ON) when output is present.
- Stand off type: Thread hole

Safety compliance:

- Meets safety standards UL60950-1 2nd edition and IEC/EN 60950-1
- Approved by UL and TUV
- CE mark meets 2006/95/EC directives

SPECIFICATIONS:

ABSOLUTE MAXIMUM RATINGS

PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
Input Voltage AC(L) to AC(N)	85		265	Vac	
Input Power With No Damage			312	Vac	
Power Factor Correction	0.95				Vin=85~264Vac@ Full Load
Storage Temperature	-55		+125	°C	
Storage Humidity	10		95	%	
Operating Temperature	-40		+100	°C	Temperature measure shall be taken from the baseplate (Tb). Refer to Fig.3 for location defini-tion
Operating Humidity	20		95	%	

INPUT SPECIFICATIONS:

PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
Operation Input Voltage (Vi)	85		265	Vac	
Input Frequency	47		63	Hz	
Maximum Input Current (Ii,max)			6.2	A	Vi=100Vac, Io =Io,max
Inrush Current			40	A	Vi=264Vac Turn On, External components are needed for opera-tion. Refer to Fig.4 for appli-cation circuit.

OUTPUT SPECIFICATIONS:

PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
Output Voltage Accuracy (12V)	11.76	12.0	12.24	V	Io,max
Output Voltage Adjustment Range	7.7	12.0	14.4	V	Vo>=12V, Po=504W. Vo<=12V, Output current should be <=42A.
Line Regulation		48		mV	Vi= Vi,min to Vi,max.
Load Regulation		48		mV	Io= Io,min to Io,max.
Output Ripple and Noise Voltage Peak to Peak			120	mVp-p	Bandwidth 5Hz to 20MHz and with filter 4.7 nF MLCC series 50 ohm Min. Output Capacitor: 1000uF *2, Tc>= -20℃ 1000uF *4, Tc<= -20℃
Output Current (Io,max)			42	A	At Vo<=12V, if Vo>12V Output Power (Po) should be <=504W
Output Current limit	105		140	%Io,max	Current limit inception point Vo=90% of Vo,set @Tb=25°C; Auto - recovery
Output Over Voltage Protection	125		145	%Vo,set	Io=0.5A; Inverter shut-down method.

OUTPUT SPECIFICATIONS (CONTINUED):

PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
Efficiency		88.2 90.2		% %	Vi=110Vac, Vi=230Vac, Vo=12V, Io= 100%Io,max @Tb=25°C
Dynamic Response: Peak Deviation Settling Time		3	300	%Vo,set us	25% - 50% -75% load, 0.25 A/us; With Cap. 2000uF/25V Tb=25 °C, Vi=200Vac
External Capacitance	2000			uF	Tb=25 °C

CONTROL SPECIFICATIONS:

PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
Turn-On Time			3	Sec	Io= Io,max, Vo with 90% Vo,set
Output Voltage Adjustment Output Voltage Trim Range	65		120	%Vo,set	With Cap. 2000uF/25V, @Tb=25 °C
Over Temperature Protection Shutdown Recovery	90	110		°C °C	Auto - recovery
Hold On Time	20			mSec	With Cap. 780uF(C10 + C11 in Fig.3)

ISOLATION SPECIFICATIONS:

PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
Input to Output		3000		Vac	60 seconds
Input to Case		2500		Vac	60 seconds
Output to Case		1500		Vdc	60 seconds
Input to Output Capacitance		2000		pF	
Isolation Resistance	100			Mohm	at Tb=25°C and 70%RH, Output to Baseplate - 500VDC

(Input refer to pin AC(L), AC(N), R, +BC, -BC. Output refer to pin +OUT, -OUT, +S, -S, TRIM, ENA)

STRUCTURAL DYNAMICS:

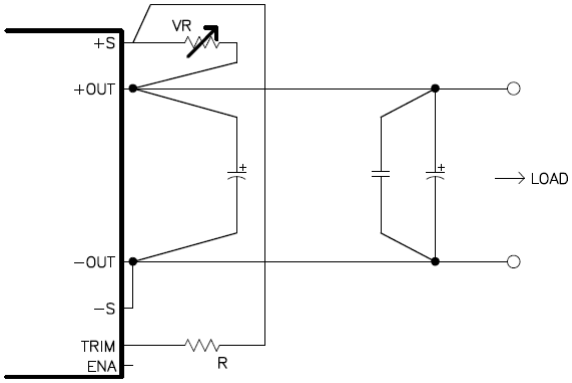
PARAMETER	CONDITIONS
Vibration	Sine Wave, 10-55Hz (Sweep for 1 min.), Amplitude 0.825mm Constant (Maximum 0.5g) X,Y,Z 1 Hour each, At No Operating,
Shock	196.1m/S^2

GENERAL SPECIFICATIONS:

PARAMETER	MIN	TYP	MAX	UNITS	CONDITIONS
MTBF		1.6		Mhrs	Tb=40 °C, Io=80% Io,max, Vi=220V
Weight		206		g	
Size (WxHxD)		116.8x12.7x61		mm	

TRIM CIRCUIT:

Output Voltage Adjusted by using external resistor and/or variable resistor:



Assign R = 12.7 KΩ

$VR = 1.103Vo - 8.488$ (VR unit : KΩ , Vo unit : V)

Fig.1 Output voltage adjusted by using external resistor and/or variable resistor

BASEPLATE MEASURE POINT:

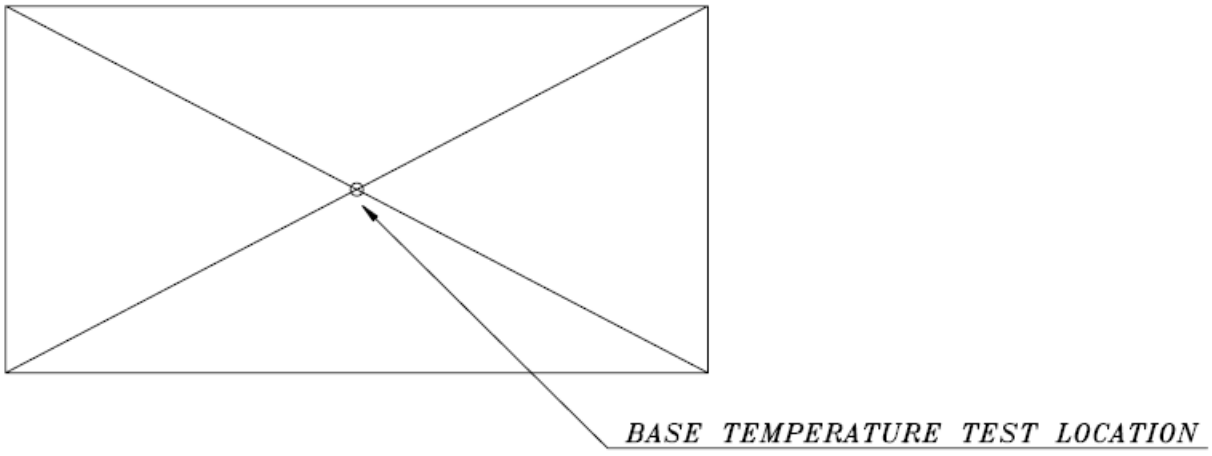
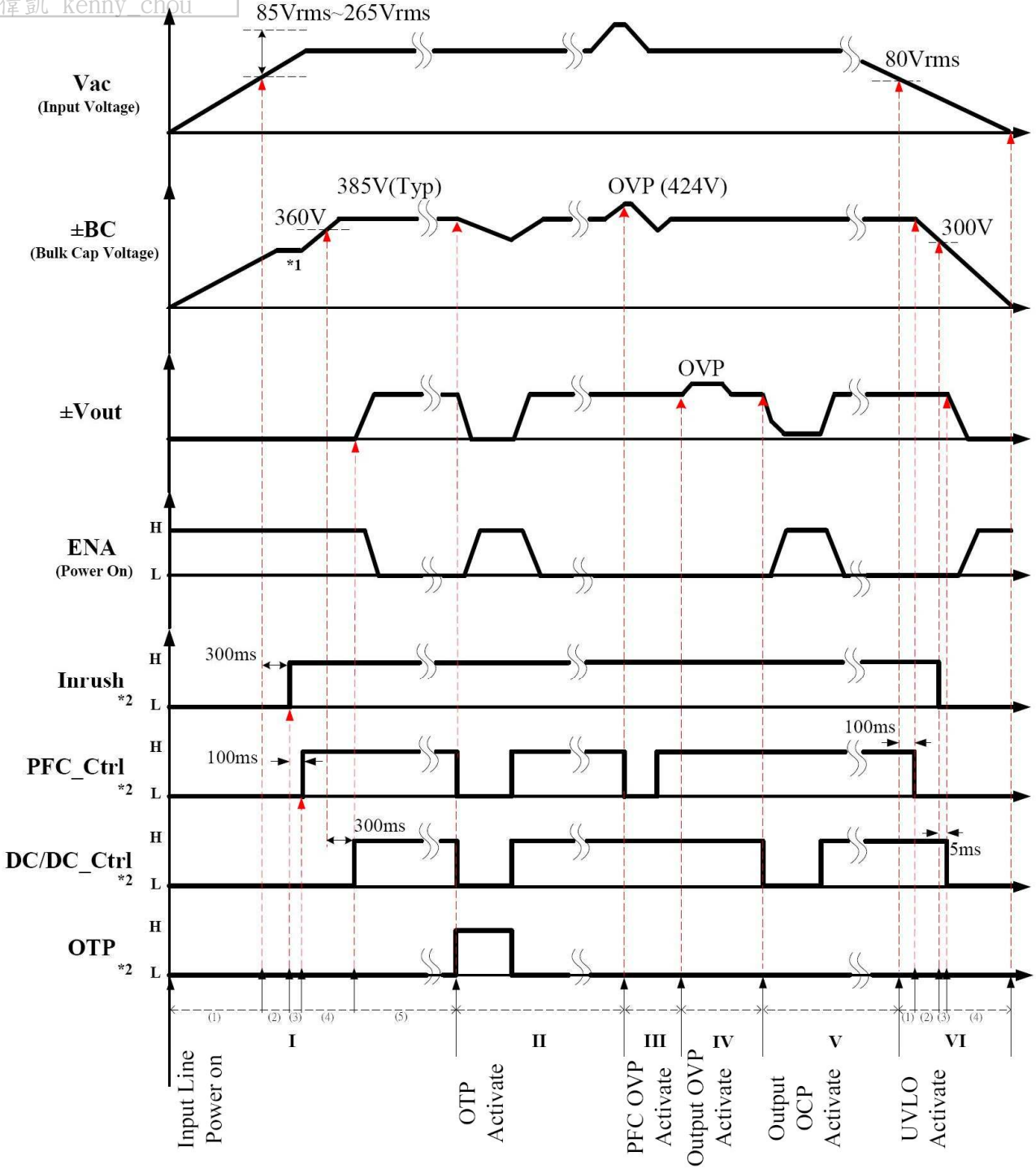


Fig.2 Baseplate Temperature Measure Point

AC/DC Block Sequence Time Chart :



Note:

***1: The voltage of bulk capacitor should be more than the rectification of 95% input voltage before inrush is high. The twenty times of RC time constant must be less than 300mS. Otherwise internal transistor of the unit could be damaged by inrush current. The time constant is equal to the product of the bulk capacitor and the external resistor.**

***2: It is the internal signal of unit.**
Inrush: Bypass signal for external resistor. Please refer to the description of each region.
PFC_Ctrl: Turn on/off signal. When signal is high, the PFC converter turns on. If it is low, the converter turns off.
DC/DC_Ctrl: Turn on/off signal. When signal is high, the DC/DC converter turns on. If it is low, the converter turns off.
OTP: Turn on/off signal. When signal is high, the over temperature protection is action.

The Description For Each Region Of Time Sequence：

◆ **Region I**：

(1) The input voltage is under 85Vrms, so the unit has no output and the ENA signal is high (open collector).

(2) Input under voltage lockout (UVLO) action. The unit starts the turn on sequence. When the input voltage reaches 85Vac and it delays 300mS, the inrush signal changes from low to high.

When the inrush signal is low, the internal transistor of the unit between R terminal and +BC terminal is open. Therefore, the inrush current can be suppressed by external resistor. When the inrush signal is high, the internal transistor of unit is short. Therefore, the external resistor is bypassed by internal transistor.

The voltage of bulk capacitors (±BC) should be more than 95% of the rectification input voltage before inrush signal changes to high. If not, the unit could be damaged by inrush current.

(3) When the inrush signal is high and then delays 100mS, the PFC_Ctrl signal changes from low to high. Which means the PFC converter turns on and the ±BC will be boosted to 385Vdc (Typ).

(4) When the PFC_Ctrl is high as well as ±BC reaches 360V and then delays 300mS, the DC/DC_Ctrl signal will change from low to high. After the steps mentioned the output voltage of unit starts to increase to specified voltage level.

(5) When the output voltage of DC9011-000G reaches 6.3V (Typ) at start up, the ENA signal is pulled low to indicate that unit finished the turn on sequence.
The unit finished the turn on sequence through the steps above.

◆ **Region II**：The over temperature protection (OTP) action. When the baseplate temperature (refer to spec. figure 2) of the unit rises to 110℃(Typ), both PFC and DC/DC converters turns off and the output shuts down. When the baseplate temperature decreases to 90℃(Min), the output auto-recovers.

◆ **Region III**：PFC output over voltage protection (OVP) action. When ±BC is over 424V (Typ), the PFC converter turns off. The PFC output voltage auto-recovers, if the failure is removed.

◆ **Region IV**：Output OVP action. The output OVP mode is clamp.

◆ **Region V**：Output over current protection (OCP) action. When the output current of the unit is over limitation, the output voltage steps down. If the failure mode is removed, the output voltage auto-recovers.

◆ **Region VI** :

(1) Input UVLO action. When the input voltage is under 80Vac (Typ) and it keeps 100mS, the PFC_Ctrl signal changes from high to low, which means that the PFC converter turns off.

The delay time (100mS) and suitable bulk capacitance can reduce the effect of input voltage dropout and meet the requirement of hold-up time. So the output voltage is stable during input voltage dropout. The recommended bulk capacitance can be referred to application circuit.

The requirement of hold up time will be reduced if the bulk capacitance is lower than the recommended and the unit is under high output power, it would trigger region VI-(2) before the end of region VI-(1).

(2) When ±BC reduces to 300V, the inrush signal changes from high to low at the same time.

(3) When the inrush is low and delays 5mS, the DC/DC_Ctrl changes from high to low, which means the DC/DC converter turns off.

(4) When the output voltage of DC9011-000G decreases to 6.3V (Typ), the ENA signal changes from low to high.

The unit turns off through the steps of region VI.

APPLICATION CIRCUIT AND COMPONENT SELECTION::

For EMI application circuit, please contact with supplier

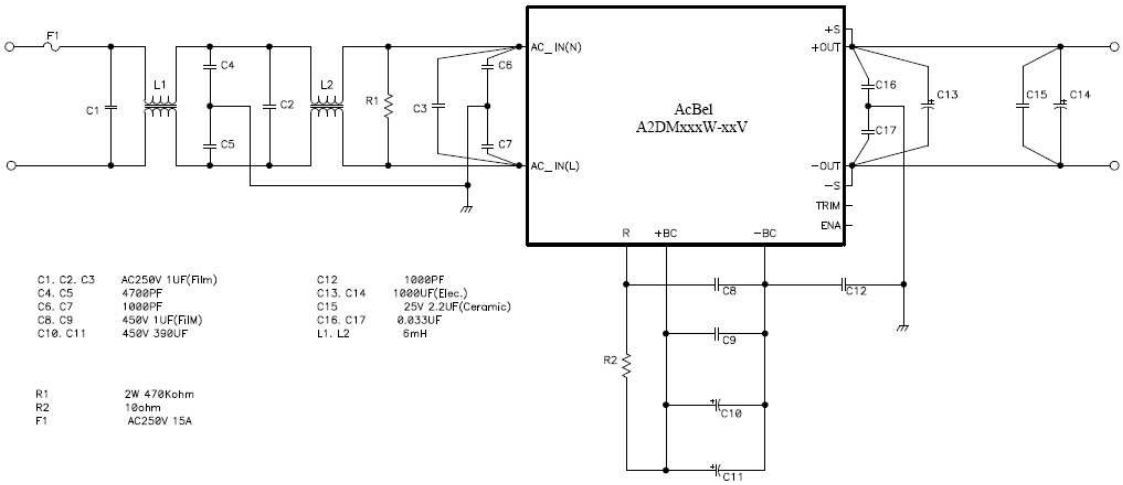


Fig.3 Application Circuit

F1: Use external fuse to meet safety standard and improve safety. Current rating of fuse must higher than application with margin. Also check the I^2t rating during inrush, transient and surge.

L1 L2: CM choke. Part of EMI filter

C1~C3: Part of EMI filter. Choose safety approved X-cap.

C4~C7: Part of EMI filter. Choose safety approved Y-cap. Check leakage current requirement for application.

R1: Bleeding resistor for safety requirement. Voltage rating and power rating should higher than application.

C8 C9: Filter cap. Check current rating and the rating should higher than application.

C10 C11: Bulk cap. The minimum required capacitance is 450V 390uF*2 for 500W output, -40degC operation and suggest to use Nippon Chemi-Con LXQ series or equal component. The figure below shows minimum required current ripple rating for bulk cap vs. output load. Make sure the selected bulk cap ripple current rating is suitable for application. Bulk cap selection also depends on input allowable dropout time. Please see section " Input voltage dropout transient immunity" for detail.

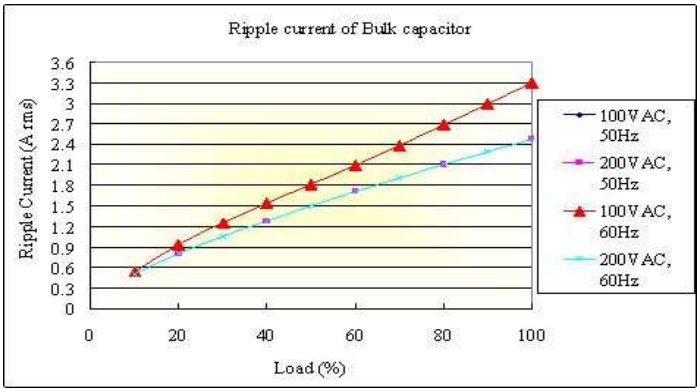


Fig.4 Bulk cap ripple current requirement vs. Output load

R2: Inrush current limit. Resistance can be calculated by formula below. Suggest to choose resistance >10ohm.

$$R = \frac{Vin_{rms} * \sqrt{2}}{Ir, pk}$$

Vin_{rms}: Input voltage

Ir,pk: Inrush current peak value.

Sufficient inrush energy withstand capacity is required. Required energy capacity can be calculated below and suggest having some design margin.

$$\frac{1}{2} C_{bulk} * (\sqrt{2} Vin_{rms})^2$$

$Cbulk$: Bulk capacitance (C10&C11)

Vin_{rms}: Input voltage.

The selected inrush resistor R2 have to meet the formula below, if the resistor value over the limitation may cause the brick damage.

$$R < \frac{300mS}{20 * C_{bulk}}$$

$Cbulk$: Bulk capacitance (C10&C11)

C12: Part of EMI filter. Choose safety approved Y-cap.

C13 C14: E-cap to reduce output ripple and ensure stability. Choose low ESR part and check the ripple current rating higher than application. Suggest at least 470uF*2 if Tb>-20℃ and 470uF*4 if -40℃<Tb<-20℃.

C15: Connect ceramic capacitor near output terminal to reduce output noise.

C16 C17: Ceramic or film capacitor for EMI filtering. High voltage rating is required for isolation requirement.

INPUT VOLTAGE DROPOUT TRANSIENT IMMUNITY:

The output voltage should immune input voltage dropout. The allowable dropout time is related to output power and bulk capacitance (C10&C11) and Vo. Dropout time is longer with higher capacitance or lower output power. But the maximum allowable dropout time is **60mS** regardless of capacitance and output power. The formula of allowable dropout time is shown below.

$$C_{bulk} = \frac{2(P_o * T_{holdup}) * 1000}{(385^2 - 320^2) * 0.92}$$ For Vo≦ 12V

$$C_{bulk} = \frac{2(P_o * T_{holdup}) * 1000}{(385^2 - (320 * Vo/12)^2) * 0.92}$$ For Vo>12V

$Cbulk$: Bulk capacitance (uF)

Po: Output power (W)

$Tholdup$: Allowable dropout time (mS)

For example, if required dropout time is 20mS at Po=500W, Vo=12V, the Cbulk capacitance must higher than 475uF, Note that capacitance tolerance need to take into account and must fulfill the minimum capacitance 390 uF *2 requirement for -40degC operation. Note that the maximum allowable dropout time is 60mS even the calculation result over 60mS.

EFFICIENCY CURVE:

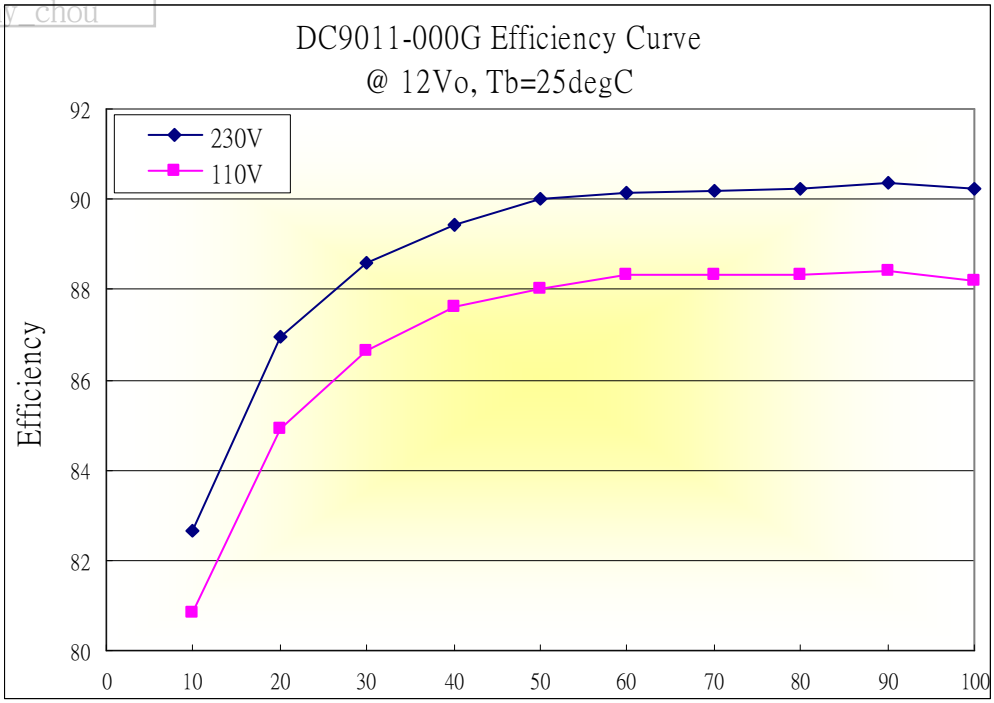


Fig.5 Efficiency curve

OUTLINE DRAWING:

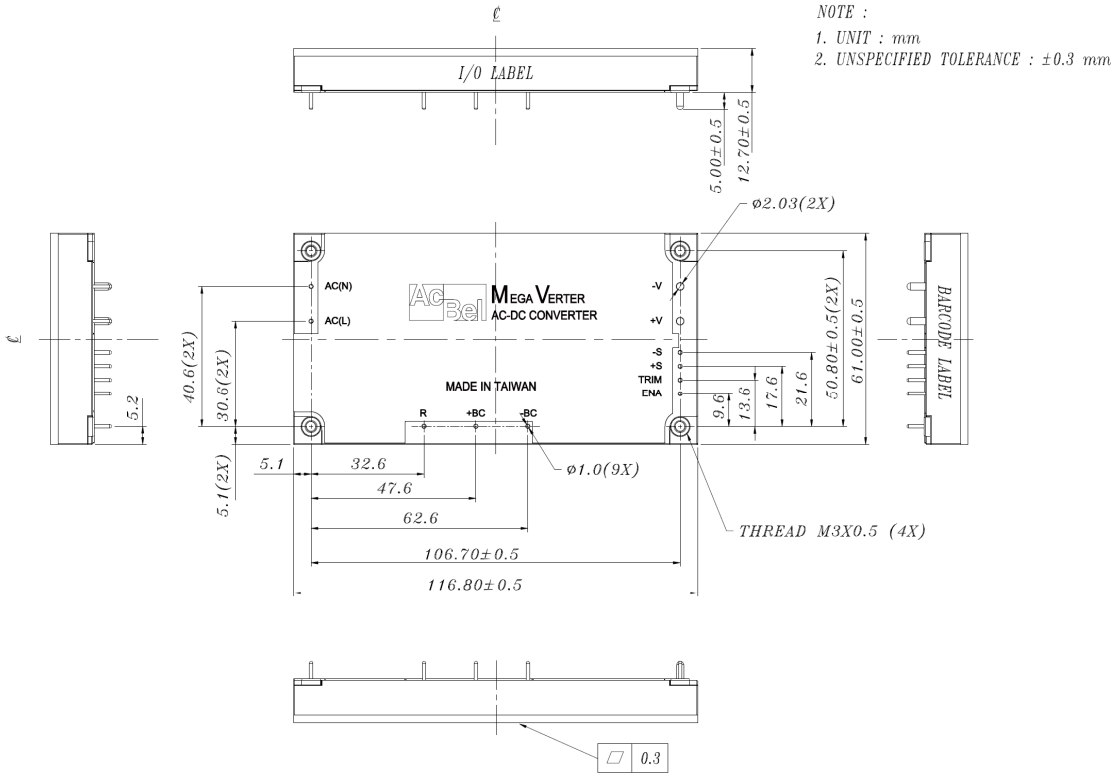


Fig.5 Outline drawing