



**Features**

- Designed for Medical equipment (meet MOOP and MOPP)
- High efficiency up to 90% at 230Vac full load
- Universal AC input voltage range: 90-264 VAC
- Active power factor correction
- Over temperature, output over voltage, over current and short circuit protection
- Input over voltage, under voltage protection
- Low conducted and radiated EMI (EN 55011 class A 6db margin)
- Safety approval to UL 60601-1 3<sup>rd</sup>, CSA60601-1 3<sup>rd</sup> and IEC60950-1 3<sup>rd</sup>
- High power density design: 11.2 W/in<sup>3</sup>
- Compact size: 3.0 (W) x 1.5 (H) x 5.0 (L) inch
- ROHS compliant

**Applications**

- Medical, Telecom, Datacom, Industrial equipment

**Description**

This is a compact and efficient series of AC-DC power supplies suited for medical and many other applications. This family meets the international information technology safety standards. Their high efficiency allows a very minimal power loss in end equipment, resulting in higher reliability, ease of thermal management, and regulatory approvals for an environmentally friendly end product. With approval to Means of Patient Protection (MOPP), the MBC250 is suitable for use in body floating (BF) applications wherein equipment may come in direct contact with the patient, such as blood pressure monitors or ultrasound equipment.

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## 1 ORDERING INFORMATION

Product Family	Output Power	Dash	# Outputs	Standard: 0 S-Type: 1-9	Vo-Voltage	RoHS compliant
MBC250-10XX	250W	-	1	0	12VDC / 24VDC / 48VDC	G

## 2 OVERVIEW

The MBC250-10XXG is a high efficiency and high power density AC to DC power supply. It use single phase transition mode PFC converter and well proven two-FET forward converter with output diode rectifiers, providing increased system reliability and high efficiency. With around 1 m/s system air cooling, MBC250-1012G can

delivery up to 228W continuous output power and 252W for MBC250-1024G and MBC250-1048G .

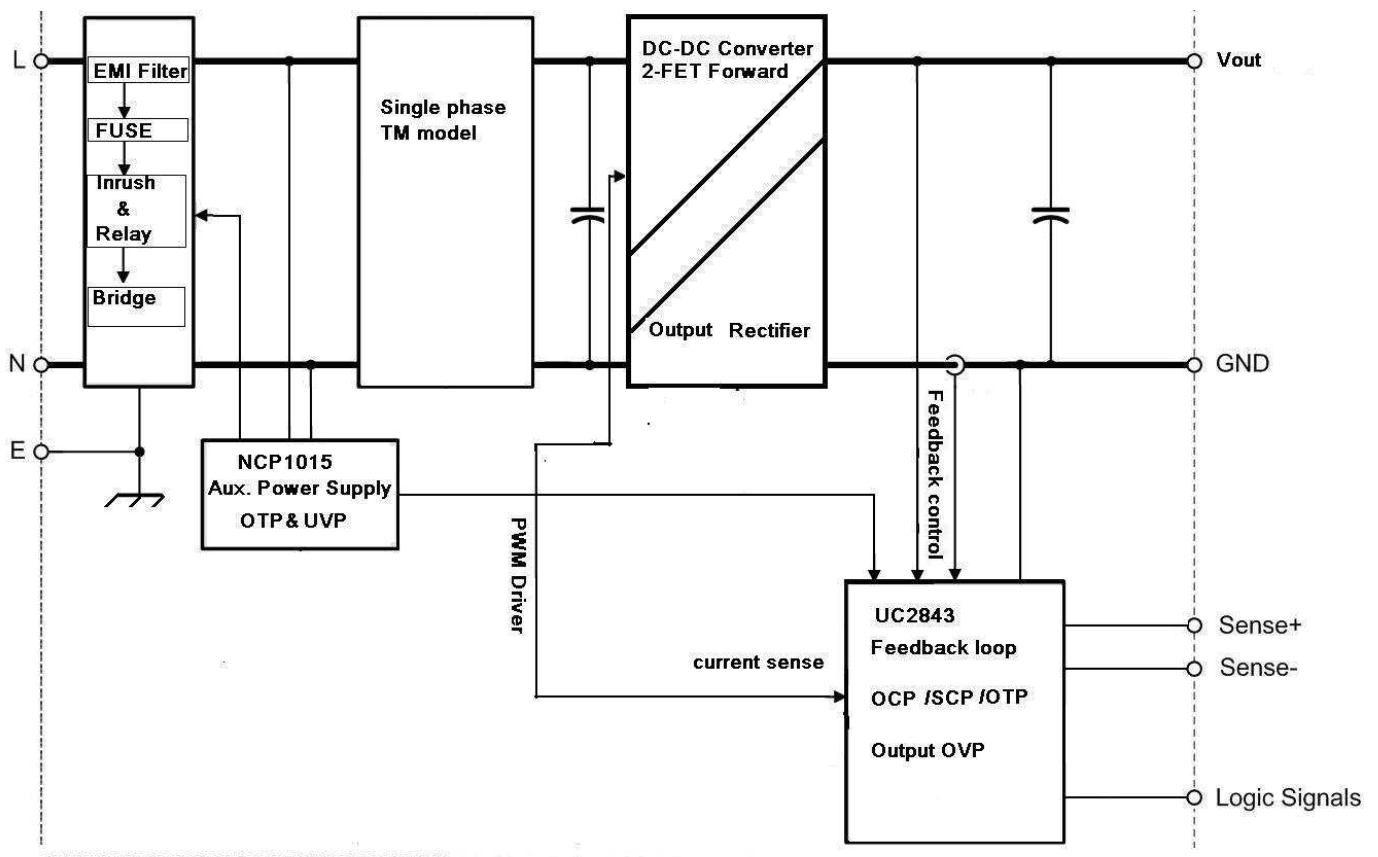


Figure 1: MBC250-10XXG block diagram

### 3 ABSOLUTE MAXIMUM RATINGS

Stresses in excess of the absolute maximum ratings may cause performance degradation, adversely affect long-term reliability, and cause permanent damage to the supply.

Parameter		Conditions / Description	Min	Nom	Max	Unit
$V_{i\ max}$	Max continuous input	Continuous			264	VAC

### 4 ENVIRONMENTAL AND MECHANICAL

Parameter		Conditions / Description	Min	Nom	Max	Unit
$T_A$	Ambient temperature	$V_{i\ min}$ to $V_{i\ max}$ , $I_{1\ nom}$ ,	-10		+50	°C
$T_{A\ ext}$	Extended temp range	Derated output	+50		+70	°C
$T_S$	Storage temperature	Non-operational	-40		+85	°C
	Dimensions	Width		76.2		mm
		Height		38.1		mm
		Depth		127.0		mm
$M$	Weight		0.5		kg	

### 5 INPUT SPECIFICATIONS

General Condition:  $T_A = -10... 50$  °C unless otherwise noted.

Active fan air cooling required: 200 LFM (1 m/s)

Parameter		Conditions / Description	Min	Nom	Max	Unit
$V_{i\ nom}$	Nominal input voltage		100		240	VAC
$V_i$	Input voltage ranges	Normal operating ( $V_{i\ min}$ to $V_{i\ max}$ )	90		264	VAC
$I_{i\ max}$	Max input current				3.5	$A_{rms}$
$I_{i\ p}$	Inrush current limitation	$V_{i\ nom}=115VAC$ , $T=25^\circ C$ (see Figure 2) $V_{i\ nom}=230VAC$ , $T=25^\circ C$ (see Figure 3)			30 60	$A_p$
$F_i$	Input frequency		47	50/60	63	Hz
PF	Power factor	$V_{i\ nom}=264VAC$ , $> 0.5 I_{o\ nom}$	0.9			WVA
$V_{i\ on}$	Turn-on input voltage <sup>1)</sup>	Ramping up	82		89	VAC
$V_{i\ off}$	Turn-off input voltage <sup>1)</sup>	Ramping down	78		85	VAC
$\eta$	Efficiency	$V_{i\ nom}=230VAC$ , $0.5 \cdot I_{o\ nom}$ , $V_{o\ nom}$ , $T_A = 25^\circ C$	88 <sup>2)</sup>			%
		$V_{i\ nom}=230VAC$ , $1.0 \cdot I_{o\ nom}$ , $V_{o\ nom}$ , $T_A = 25^\circ C$	90			
$T_{hold}$	Hold-up Time	After last AC zero point, $V_o$ within regulation, $V_i = 115 VAC$ , $P_{o\ nom}$	12	18		ms
$Li$	Earth leakage current	264Vac at 60Hz			300	$\mu A$

1) The power supply is provided with a minimum hysteresis of 2 V during turn-on and turn-off within the ranges.

2) For MBC250-1012G/1048G half load minimum efficiency is 87.5%.

## INPUT FUSE

Double fusing with 5A slow-blow type (5 × 20 mm), in series with Live and neutral line inside of the power supply protects against severe defects. The fuses and a VDR form together with the input filter an effective protection against high input transients.

## 5.1 INRUSH CURRENT

The AC-DC power supply exhibits an X-capacitance of only 2.0  $\mu$ F, resulting in a low and short peak current, when the supply is connected to the mains. The internal bulk capacitor will be charged through an power resistor which will limit the inrush current (see Figure 2 and 3).

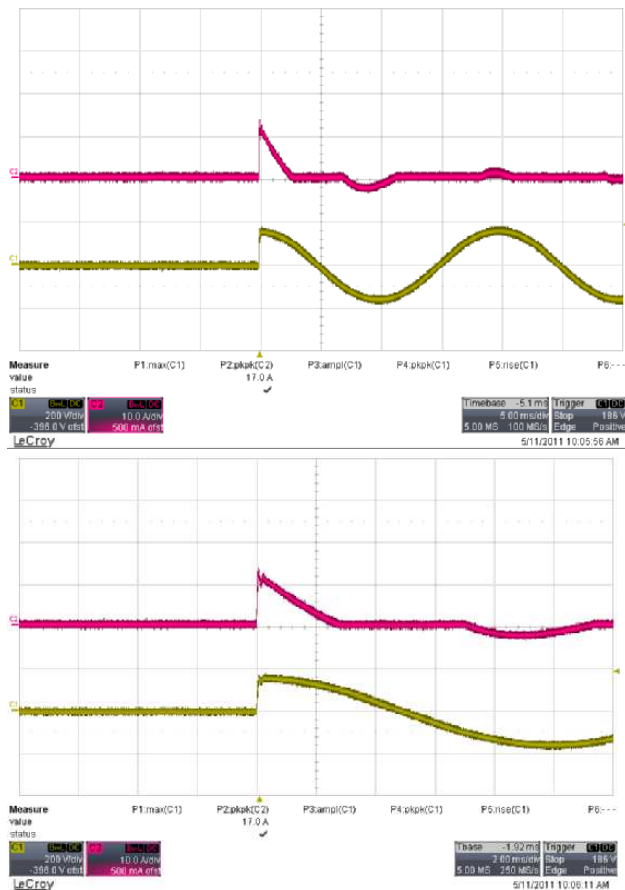


Figure 2: Inrush current,  $V_{in} = 115VAC$ , Phase=90°  
CH1:  $V_{in}$  (200V/div), CH2:  $I_{in}$  (10A/div)  
Test data: the inrush current is 13A at 115VAC input.

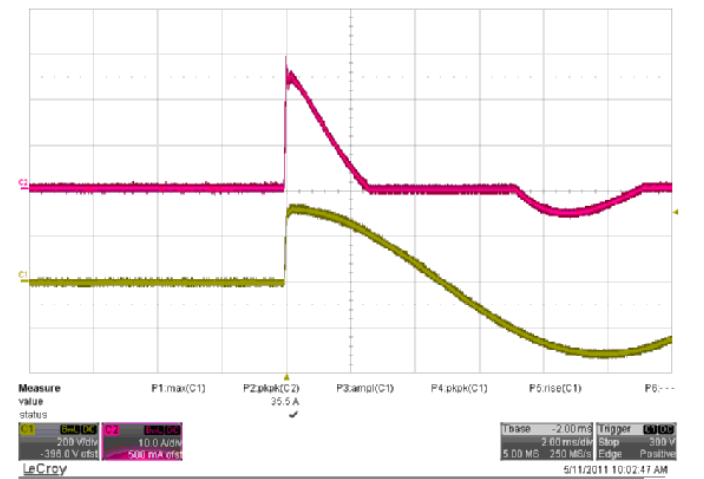
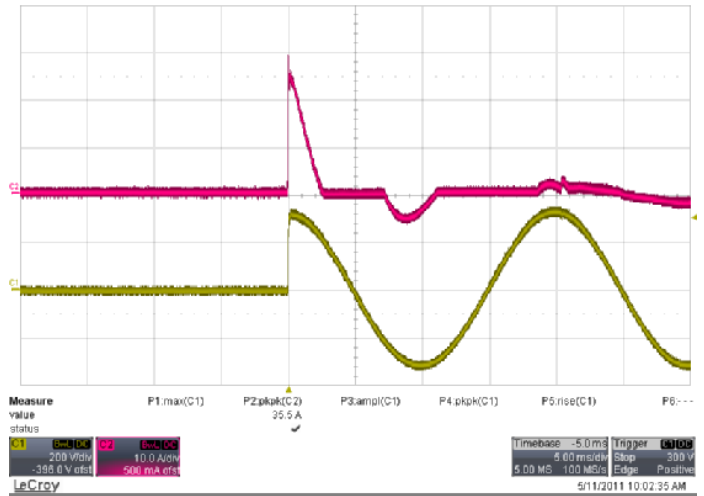


Figure 3: Inrush current,  $V_{in} = 230VAC$ , Phase=90°  
CH1:  $V_{in}$  (200V/div), CH2:  $I_{in}$  (10A/div)  
Test data: the inrush current is 30A at 230VAC input.

## 5.2 INPUT UNDER-VOLTAGE

If the sinusoidal input voltage stays below the input under voltage lockout threshold  $V_{i on}$ , the supply will be inhibited. Once the input voltage returns within the normal operating range, the supply will return to normal operation again.

## 5.3 POWER FACTOR CORRECTION

Power factor correction (PFC) is achieved by controlling the input current waveform synchronously with the input voltage. A specified PFC controller is implemented in single phase transition mode topology giving outstanding PFC

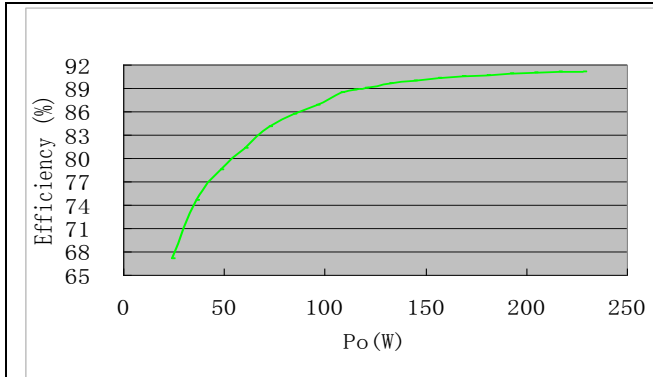
results over a wide input voltage and load ranges. The input current will follow the shape of the input voltage.

**5.4 EFFICIENCY**

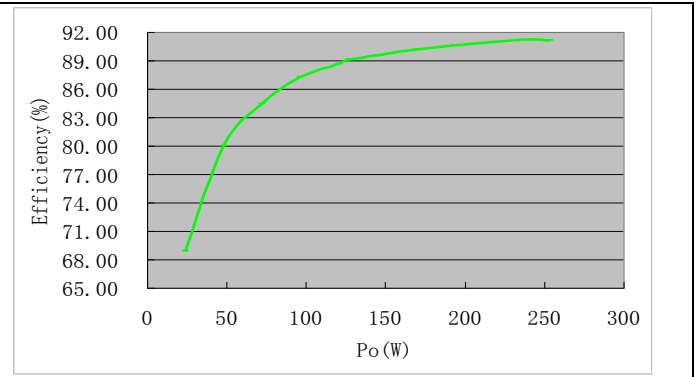
The high efficiency (see **Figure 4, 5 and 6**) is achieved by using state-of-the-art silicon power devices in conjunction with transition mode PFC topology minimizing switching

losses. Synchronous rectifiers on the output reduce the losses in the high current output path for MBC250-1012G .

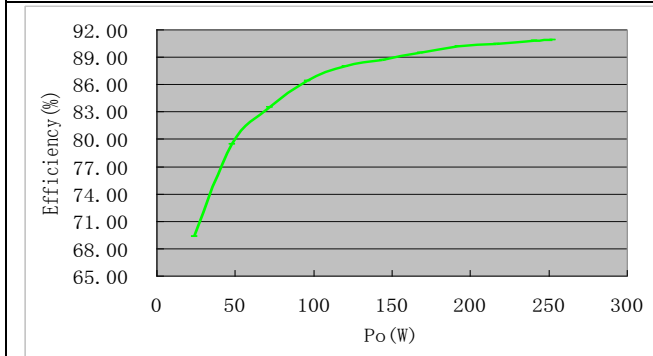
Schottky diode and ultra fast diode are used as rectifiers for MBC250-1024G and MBC250-1048G separately due to the high output voltage level.



**Figure 4:** Efficiency vs. Output Power at 230VAC, MBC250-1012G



**Figure 5:** Efficiency vs. Output Power at 230VAC, MBC250-1024G



**Figure 6:** Efficiency vs. Output Power at 230VAC, MBC250-1048G

**6 OUTPUT SPECIFICATIONS**

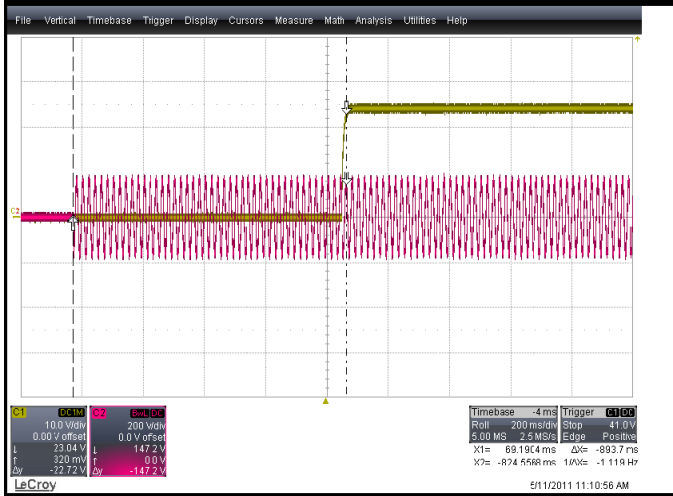
General Condition:  $T_A = -10 \dots +50 \text{ }^\circ\text{C}$  unless otherwise noted. Active fan air cooling required: 200 LFM (1 m/s)

Parameter	Conditions / Description		Min	Nom	Max	Unit	
<b>Main Output <math>V_o</math></b>							
$V_o$	Nominal output voltage	$0.5 \cdot I_o, T_{amb} = 25 \text{ }^\circ\text{C}$	MBC250-1012G		12.0		VDC
			MBC250-1024G		24.0		VDC
			MBC250-1048G		48.0		VDC
$V_{o\text{set}}$	Output set point accuracy	$0.5 \cdot I_o, T_{amb} = 25 \text{ }^\circ\text{C}$	MBC250-1012G	-50		50	mV
			MBC250-1024G	-75		75	mV
			MBC250-1048G	-150		150	mV
$P_{o\text{nom}}$	Nominal output power		MBC250-1012G	0		228	W
			MBC250-1024G	0		252	W
			MBC250-1048G	0		252	W
$I_{o\text{nom}}$	Nominal output current		MBC250-1012G	0		19*	A
			MBC250-1024G	0		10.5**	A
			MBC250-1048G	0		5.25***	A
$V_{o\text{p-p}}$	Output ripple voltage	$V_{o\text{nom}}, I_{o\text{nom}}, 20 \text{ MHz BW}$	MBC250-1012G		60	120	mVpp
			MBC250-1024G		80	240	mVpp
			MBC250-1048G		150	480	mVpp
$dV_{o\text{Load}}$	Load regulation	$V_i = V_{i\text{nom}}, 0 - 100 \% I_{o\text{nom}}$	MBC250-1012G	-360	50	360	mV
			MBC250-1024G	-720	80	720	mV
			MBC250-1048G	-1440	130	1440	mV
$dV_{o\text{Line}}$	Line regulation	$V_i = V_{i\text{min}} \dots V_{i\text{max}}$	MBC250-1012G	-120	80	120	mV
			MBC250-1024G	-120	80	120	mV
			MBC250-1048G	-120	80	120	mV
$dV_{\text{dyn}}$	Dynamic regulation load	$\Delta I_o = 50\% I_{o\text{nom}}, I_o = 50 \dots 100\% I_{o\text{nom}}, dI_o/dt = 1 \text{ A}/\mu\text{s}, \text{ recovery within } 5\% \text{ of } V_{o\text{nom}}$	MBC250-1012G	-0.6	0.25	0.6	V
			MBC250-1024G	-1.2	0.45	1.2	V
			MBC250-1048G	-2.4	0.7	2.4	V
$t_{\text{rec}}$	Recovery time				2	ms	
$t_{\text{delay}}$	Turn-on Delay	Time required for output within regulation after initial application of AC input @90 Vac	0.3	1	2	Sec	
$t_{\text{rise}}$	Turn on Rise time	$V_o = 10 \dots 90\% V_{o\text{nom}}$		10	20	ms	
$C_{\text{Load}}$	Capacitive loading	$T_{amb} = 25 \text{ }^\circ\text{C}$	MBC250-1012G			4200	$\mu\text{F}$
			MBC250-1024G			2300	$\mu\text{F}$
			MBC250-1048G			1150	$\mu\text{F}$

\* For convection cooling condition, the maximum output current is 10A for MBC250-1012G;

\*\* For convection cooling condition, the maximum output current is 5A for MBC250-1024G;

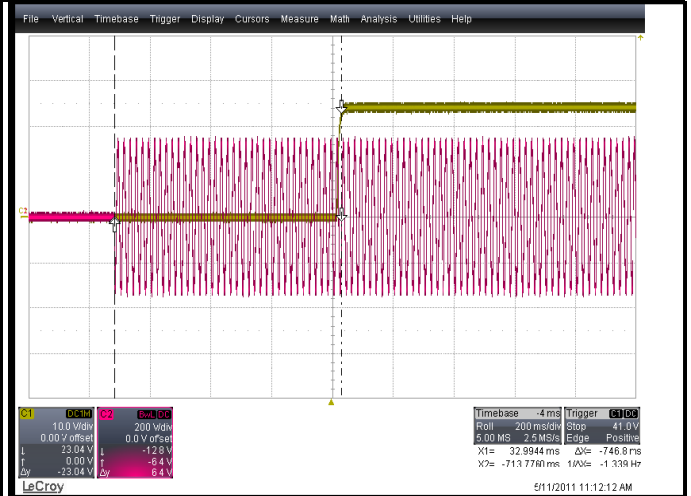
\*\*\* For convection cooling condition, the maximum output current is 2A for MBC250-1048G.



CH1:Vo (10V/div)

CH2:Vin (200V/div)

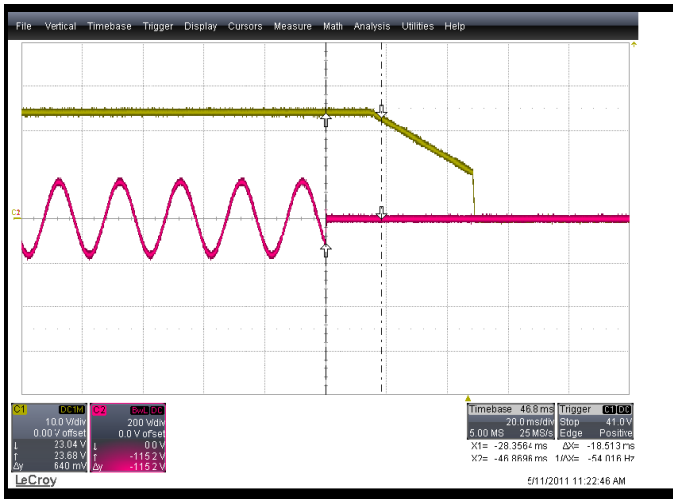
Figure5:Turn on AC line 115VAC,full load (200ms/div)



CH1:Vo (10V/div)

CH2:Vin (200V/div)

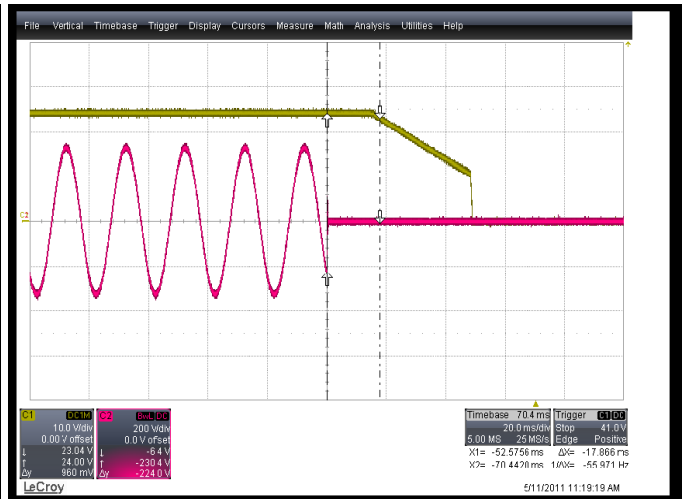
Figure6:Turn on AC line 230VAC,full load (200ms/div)



CH1:Vo (10V/div)

CH2:Vin (200V/div)

Figure7:Turn off AC line at 115VAC,full load (20ms/div)

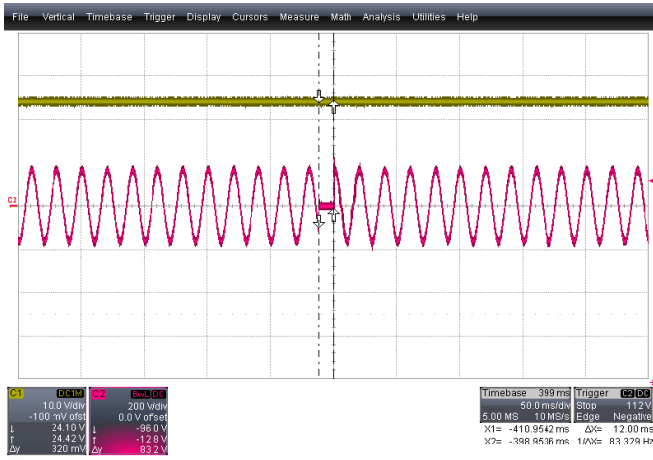


CH1:Vo (10V/div)

CH2:Vin (200V/div)

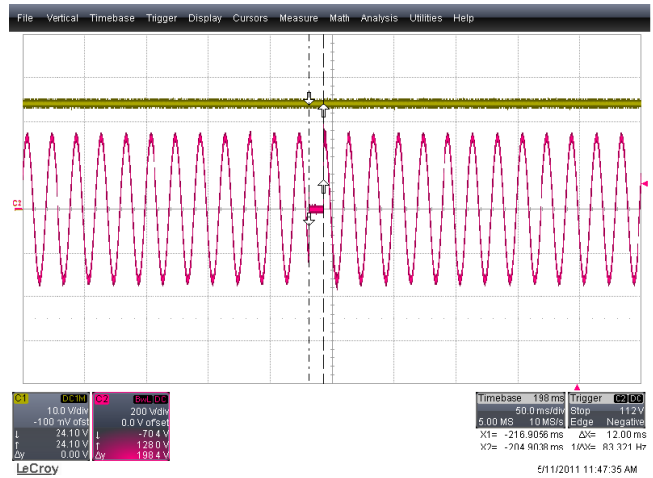
Figure8:Turn off AC line at 230VAC,full load (20ms/div)





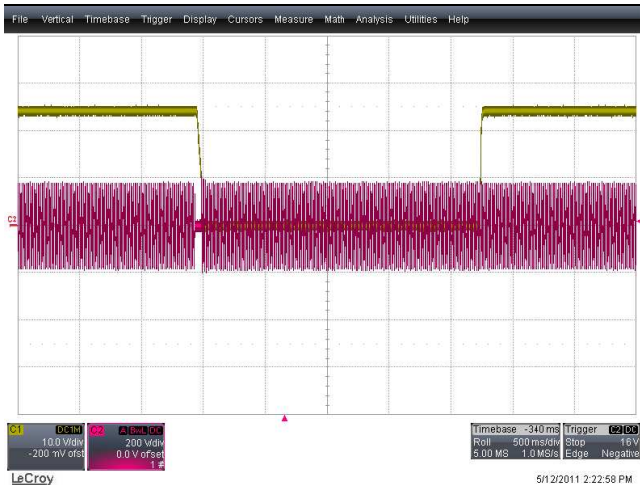
CH1:Vo (10V/div)      CH2:Vin (200V/div)

Figure 9: AC drop out 12ms at 115VAC (50 ms/div)



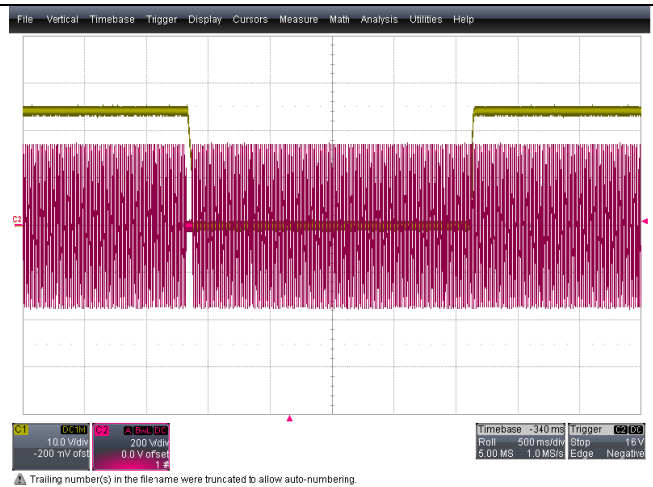
CH1:Vo (10V/div)      CH2:Vin (200V/div)

Figure 10: AC drop out 12ms at 230VAC (50 ms/div)



CH1:Vo (10V/div)      CH2:Vin (200V/div)

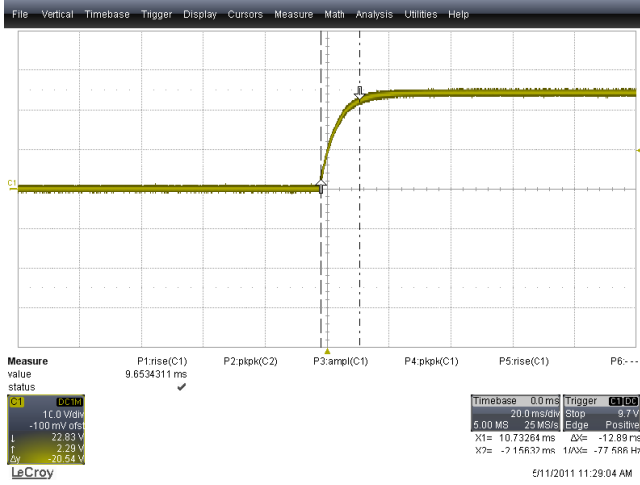
Figure 11: AC drop out 50ms@115VAC (50 ms/div) ,Vo restart.



CH1:Vo (10V/div)      CH2:Vin (200V/div)

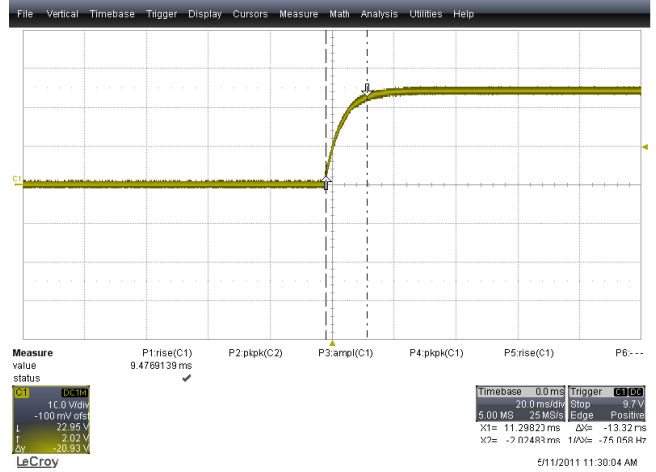
Figure 12: AC drop out 50ms@230VAC (50 ms/div) ,Vo restart.





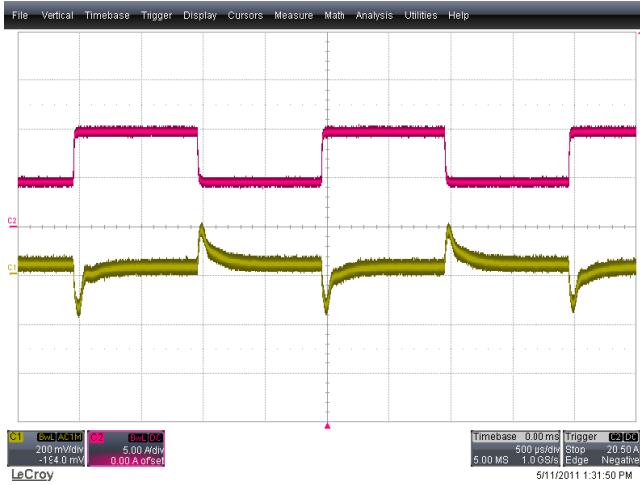
CH1:Vo (10V/div)

Figure 13: Vo rise time at 115VAC (20 ms/div)



CH1:Vo (10V/div)

Figure 14: Vo rise time at 230VAC (20 ms/div)



CH1: Vo (200mV/div) CH2: I<sub>1</sub> (5 A/div)

Figure 15: Load transient Vo, 5.25A <-> 10.5A (0.5 ms/div), 2A/μs



CH1: Vo (200 mV/div) CH2: I<sub>1</sub> (5 A/div)

Figure 16: Load transient Vo, 5.25A <-> 10.5A (1 ms/div), 2A/μs

**7 PROTECTION**

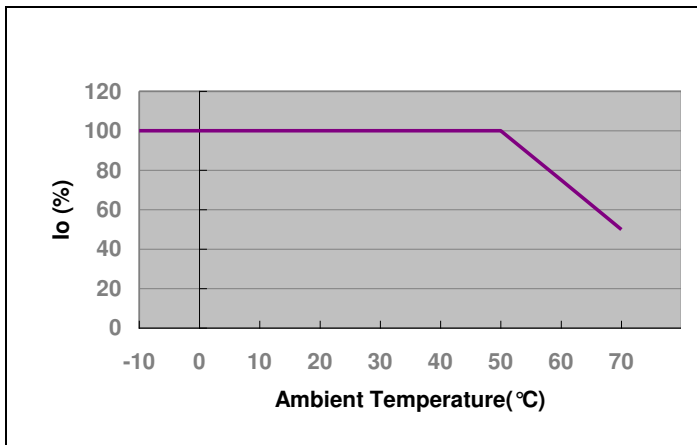
Parameter		Conditions / Description	Min	Nom	Max	Unit	
F	Input fuses (L and N)	Not user accessible, time lag characteristic		5.0		A	
Vo ov	OV threshold	MBC250-1012G	14.0		16.0	VDC	
		MBC250-1024G	28.0		32.0	VDC	
		MBC250-1048G	53		57	VDC	
Io lim	Current limit	$V_i > 90 \text{ VAC}, T_a < 50 \text{ }^\circ\text{C}$	MBC250-1012G	21	22.5	25	A
		MBC250-1024G	11.5	12.6	13.7	A	
		MBC250-1048G	5.8	6.4	6.8	A	
TSD	Over temperature on heat sinks	Automatic shut-down	91	96	101	$^\circ\text{C}$	

**7.1 OVERVOLTAGE PROTECTION**

The AC-DC power supply provides a fixed threshold overvoltage (OV) protection implemented with a HW comparator. Once an OV condition has been triggered, the supply will shut down and latch the fault condition. The latch can be unlocked by disconnecting the supply from the AC mains only.

**7.2 CURRENT LIMITATION**

The main output current limitation will decrease with linear derating to 50% at 70  $^\circ\text{C}$  if the ambient (inlet) temperature increases beyond 50  $^\circ\text{C}$  (see **Figure 17** ).

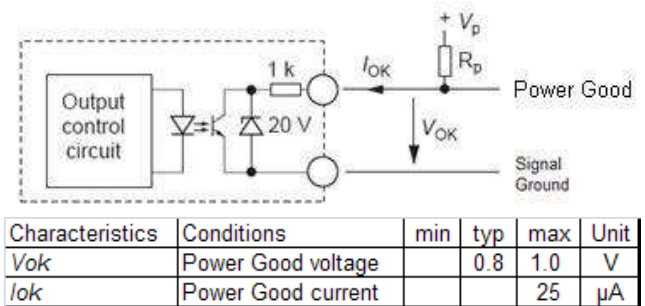


**Figure 17:** Output Current Limitation Curve

## 8 POWER GOOD SIGNAL

The Out-OK output gives a status indication of the converter and the output voltages. It can be used for control functions such as data protection, central system monitoring or as a part of a self-testing system. Connecting the Out-OK as shown in **Figure 18**,  $V_{OK} < 1.0$  V indicates that the output voltage(s) of the converter are within the range.

Note: Using the potentiometer, the monitor level tracks the programmed output voltage. In an error condition, if the output voltage is out of range due to overload or an external overvoltage,  $V_{OK}$  will approach  $V_p$ . The output is formed by an NPN transistor. The signal is isolated from the output.



**Figure 18:** Power Good signal

## 9 ELECTROMAGNETIC COMPATIBILITY

### 9.1 IMMUNITY

**Note:** Most of the immunity requirements are derived from EN 61000-6-1:2007.

Test	Standard / Description	Criteria
ESD Contact Discharge	EN 61000-4-2, Level 2	A
RF Susceptibility	EN 61000-4-3, Level 3	A
Fast Transient/Burst	EN 61000-4-4, Level 3	B
Surge	EN 61000-4-5, Class 3	B
RF Conducted Immunity	EN 61000-4-6, Class 3	A
Magnetic Fields	EN 61000-4-8	A
Voltage Dips and Interruptions	EN 61000-4-11	C

### 9.2 EMISSION

Test	Standard / Description	Criteria
Conducted Emission	EN55011: 0.15 ... 30 MHz, QP and AVG, single unit	Class A 6 dB Margin
Radiated Emission	EN55011 : 30 MHz ... 1 GHz, QP, single unit	Class A 6 dB Margin
Harmonic Emissions	IEC61000-3-2, $V_{in} = 100$ VAC/ 60 Hz, 100% Load	Class A
	IEC61000-3-2, $V_{in} = 240$ VAC/ 50 Hz, 100% Load	Class A
Voltage Fluctuation and Flicker	EN61000-3-3	PASS
Rules for Unintentional Radiations	FCC Part 15, Sub Part-B	PASS

**10 SAFETY / APPROVALS**

Maximum electric strength testing is performed in the factory according to IEC 60950-1, Input-to-output electric strength tests should not be repeated in the field. Power-One will not honor any warranty claims resulting from electric strength field tests.

Parameter		Description / Conditions	Min	Nom	Max	Unit
	Agency Approvals	UL60601-1 3rd CSA60601-1 3rd IEC 60950-1 3rd	Approved by independent body (see CE Declaration)			
	Insulation Safety Rating	Input / Case	Basic			
		Input / Output	Reinforced			
		Output / Case	Basic			
<i>dc</i>	Creepage / clearance	Primary (L/N) to protective earth (PE)	According to safety standard			mm
		Primary to secondary				mm
	Electrical strength test	Input to case	2.3			KVDC
		Input to output	4.0			KVAC
		Output and Signals to case	1.5			KVAC

**11 MECHANICAL**

**11.1 DIMENSIONS**

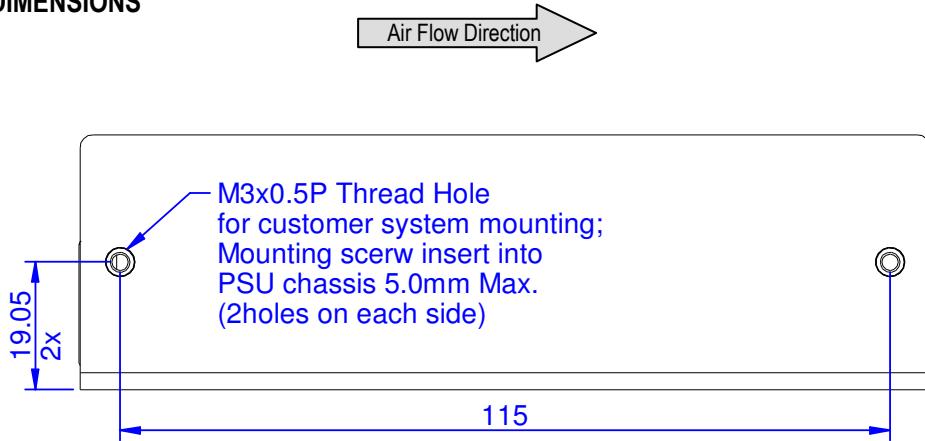
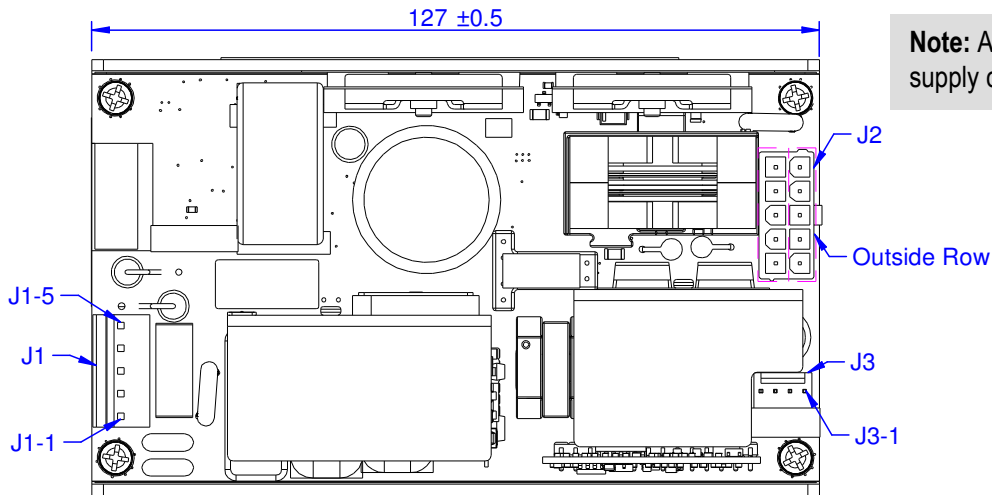


Figure 19: Side view 1



**Note:** A 3D step file of the power supply casing is available on request.

Figure 20: Top view

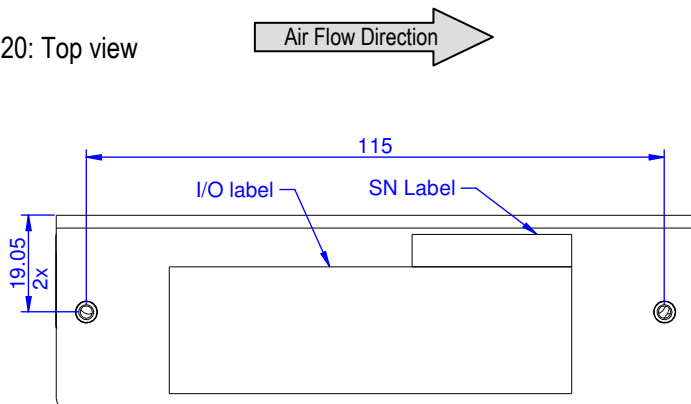


Figure 21: Side view 2

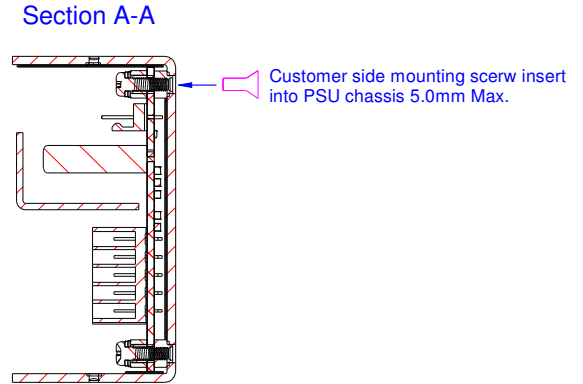
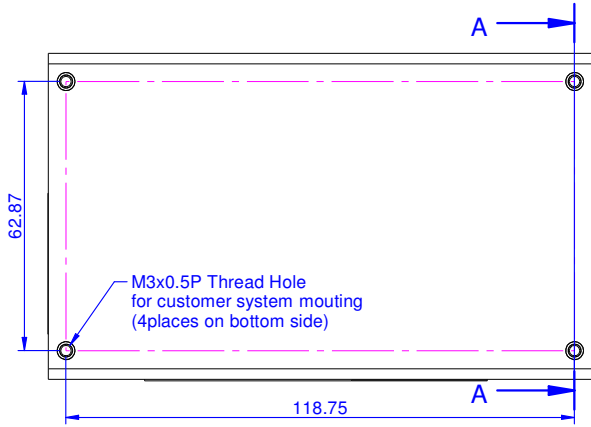


Figure 22: Bottom view 2

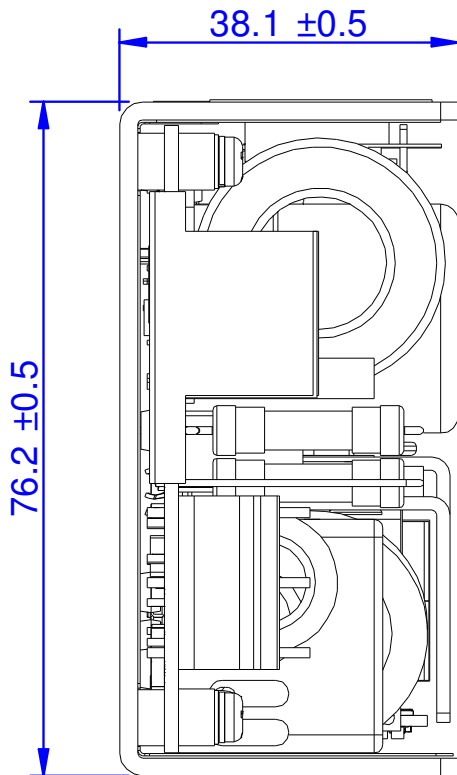


Figure 23: Front view

**11.2 CONNECTIONS**

**Connector Pin Assignment:**

PIN	CONNECTION
1	Earth
2	Not fitted
3	Neutral
4	Note fitted
5	Line

J1

PIN	CONNECTION
Inside Row (Pin 1-5)	-Vo
Outside Row (Pin 6- 10)	+Vo

J2

PIN	CONNECTION
1	Vb Sense -
2	Vb Sense +
3	Power Good
4	Power Good Return

J3

**Mating parts( Molex or equivalent):**

CONNECTOR	HOUSING	CRIMP TERMINAL	WIRE GAUGE
J1	09-50-3051	08-50-0105	AWG # 18
J2	39-01-2105	44476-3112	AWG # 16
J3	22-01-3047	08-50-0113	AWG # 22-30

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