CFM500M SERIES
500 WATT MEDICAL AC-DC POWER SUPPLY WITH PFC

Features

- Universal Input Range 80~264V_{ac}
- High Efficiency up to 94.5%
- 3"x 5" Compact Size
- Class I
- No Load Power Consumption<0.5W
- Approval IEC/EN/UL 60601-1 2 MOPP
- Approval EN 55011, 47 CFR FCC Part 18
- Active PFC Meets EN 61000-3-2
- Meets IEC/EN 60335-1
- Operating Altitude 5000m
- High Power Density up to 21.64W/Inch^3
- 390W Natural, 470 ~ 500W Conduction Convection
- Over Temperature Protection
- PS On/Off Remote Control
- Power Good & Power Fail Signal
- +5V Stand-by, 12V Fan Output
- Low Inrush Current

E252331

MODEL NUMBER	OUTPUT VOLTAGE	OUTPUT CURRENT NOTE1			VOLTAGE ACCURACY NOTE2	RIPPLE &NOISE NOTE3	VOLTAGE ADJ. RANCE	LINE REGULATION NOTE4	LOAD REGULATION NOTE5	%EFF. (Typ.)
		With FAN	Without FAN							
			COVER	OPEN						
CFM500M120	12 V	41.67A	27.5A	25A	±1%	120mV	11.4~12.6 V	±0.5%	±1%	92.5%
CFM500M180	18 V	27.78A	18.33A	16.67A	±1%	150mV	17.1~18.9 V	±0.5%	±1%	93.5%
CFM500M240	24 V	20.83A	17.08A	15.83A	±1%	150mV	22.8~25.2 V	±0.5%	±1%	94.5%
CFM500M360	36 V	13.89A	11.39A	10.56A	±1%	200mV	34.2~37.8 V	±0.5%	±1%	94.5%
CFM500M480	48 V	10.42A	8.54A	7.92A	±1%	250mV	45.6~50.4 V	±0.5%	±1%	94.5%
Stand-by Output Voltage										
All	+5V	1A			±3%	100mV	---	±1%	±5%	---
Fan Output Voltage										
All	+12V	0.5A (NOTE 6)			---	---	---	---	---	---

Note:
1. Forced air convection with 21CFM Fan.
2. Voltage accuracy is set at 100% full load and 25℃ Ta.
3. Add a 0.1uF ceramic capacitor and a 10uF E.L. capacitor to output for ripple & noise measuring @20MHz BW.
4. Line regulation is measured from high line to low line with 100% full load.
5. Load regulation is measured from 10% to 100% full load.
6. Fan output can only operate normal when the stand-by output is above 0.5A.

PART NUMBER

Series	Number of Outputs	Nominal Output Voltage	Type	Output Terminal
CFM500	X	XXX	X (Option)	-X(Option)
CFM500	M：Medical	120：12V 180：18V 240：24V 360：36V 480：48V	None： With Baseplate C： With Cover	None：Vertical R：Horizontal

Part Number Example:
CFM500M120: With Baseplate, 500W, 12Vdc Output, Vertical Type Terminal
CFM500M120C: With Cover, 500W, 12Vdc Output, Vertical Type Terminal
CFM500M120-R: With Baseplate, 500W, 12Vdc Output, Horizontal Type Terminal
CFM500M120C-R: With Cover, 500W, 12Vdc Output, Horizontal Type Terminal

TECHNICAL SPECIFICATIONS

(All specifications are typical at nominal input, full load at 25℃ unless otherwise noted.)

ABSOLUTE MAXIMUM RATINGS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Input Voltage	Safety approvals only to the AC input	All	80		264	V_{ac}
Operating Case Temperature	See Derating Curve	All	-40		85	℃
Storage Temperature		All	-40		85	℃
Operating Altitude		All			5000	m

INPUT CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Operating Voltage Range		All	100		240	V_{ac}
Input Frequency Range		All	47		63	Hz
Maximum Input Current	100% Full Load, V_{in}=100V_{ac}	All			6	A
Power Factor	V_{in}=230V_{ac}	All		0.97		
Leakage Current		All			0.3	mA
Inrush Current	V_{in}=240V_{ac}, Cold start at 25℃	All		8.5		A

OUTPUT CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Output Voltage Set Point	V_{in}=Nominal V_{in}, I_o=Io max., T_c=25℃.	CFM500M120	11.88	12	12.12	V_{dc}
		CFM500M180	17.82	18	18.18	
		CFM500M240	23.76	24	24.24	
		CFM500M360	35.64	36	36.36	
		CFM500M480	47.52	48	48.48	
Operating Output Current Range	Vin=80V_{ac}~264V_{ac}, See Derating Curve	CFM500M120			41.67	A
		CFM500M180			27.78	
		CFM500M240			20.83	
		CFM500M360			13.89	
		CFM500M480			10.42	
Holdup Time	V_{in}=115V_{ac}	All		16		ms
Output Voltage Regulation						
Load Regulation	10% to 100% full load	All			±1.0	%
Line Regulation	V_{in}=High line to low line	All			±0.5	%
Over Voltage Protection	Latch off (AC recycle to reset)	CFM500M120			16	V_{dc}
		CFM500M180			30	
		CFM500M240			35	
		CFM500M360			50	
		CFM500M480			63	
Over Current Protection	Auto recovery	All	120		190	%
Short Circuit Protection	Auto recovery	All				
Over Temperature Protection	Auto recovery	All				
Output Ripple and Noise	1. Add a 0.1uF ceramic capacitor and a 10uF aluminum electrolytic capacitor to output 2. Oscilloscope is 20MHz bandwidth 3. Ambient temperature=25℃	CFM500M120			120	mV
		CFM500M180			150	
		CFM500M240			150	
		CFM500M360			200	
		CFM500M480			250	

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Load Capacitance	1. V_{in}=115V_{ac} and 230V_{ac} 2. Output is 100% full load 3. Ambient temperature=25℃	CFM500M120 CFM500M180 CFM500M240 CFM500M360 CFM500M480			42900 28600 20800 14000 10800	uF
Efficiency	1. V_{in}=230V_{ac} 2. Output is 100% full load 3. Ambient temperature=25℃	CFM500M120 CFM500M180 CFM500M240 CFM500M360 CFM500M480		92.5 93.5 94.5 94.5 94.5		%
PS-On Signal	Power on Power off (PS-ON and GND open)	All	0	4	2	V_{dc}
	Power on (PS-ON and GND short) Power-off (PS-ON and GND open)			10 0		mA
Power Good (PG)	1. Vin=80V_{ac}~264V_{ac} 2. Output is 100% full load 3. The TTL goes high after power set up	All	100		500	ms
Power Fail (PF)	1. Vin=80V_{ac}~264V_{ac} 2. Output is 100% full load 3. The TTL goes low before Vo below 90% rated value	All	1	10		ms

ISOLATION CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Input to Output	1 minute	All			4000	V_{ac}
Isolation Resistance	Input to output	All	100			MΩ

FEATURE CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Switching Frequency	Pout=max. rated power	All		65		kHz
Output Voltage adjustment		All	-5		+5	%

GENERAL SPECIFICATIONS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
MTBF	I_o=100%; T_a=25℃ per MIL-HDBK-217F	All		200		k hours
Humidity	Non-condensing	All			93	% RH
Shock	Meet MIL-STD-810F Table 516.5,Table 516.5-I 10ms, each axis 3 times(±X、±Y、±Z axis)	All		75		g
Vibration	Meet MIL-STD-810F Table 514.5C-VIII,15~2000Hz, X、Y、Z axis, 1 hour (each axis),. Total 3 hrs.	All		4		g
Weight	Baseplate versions Covered versions	All		515 635		g
Dimensions	With baseplate C (with cover)	All	5.000x3.000x1.540 Inches (127.00x76.20x39.10 mm) 5.354x3.425x1.673 Inches (136.00x87.00x42.50 mm)			
Safety	Class I, IEC 60601-1:2005, COR1:2006, COR2:2007, AMD1:2012 EN 60601-1:2006+A11+A1+A12 ANSI/AAMI ES60601-1 (2005/(R)2012+A1:2012, C1:2009/(R)2012+A2:2010/(R)2012)					Ed 3.1
EMC Emission	EN 55011:2009+A1:2010, CISPR 11:2009+A1:2010, Class B, IEC 61000-3-2:2014, IEC 61000-3-3:2013, 47 CFR FCC Part 18					
Conducted Disturbance	EN 55011:2009+A1:2010, CISPR 11:2009+A1:2010, 47 CFR FCC Part 18					Class B
Radiated Disturbance	EN 55011:2009+A1:2010, CISPR 11:2009+A1:2010, 47 CFR FCC Part 18					Class B
Harmonic Current Emissions	IEC 61000-3-2:2014					Class A, C, D

GENERAL SPECIFICATIONS

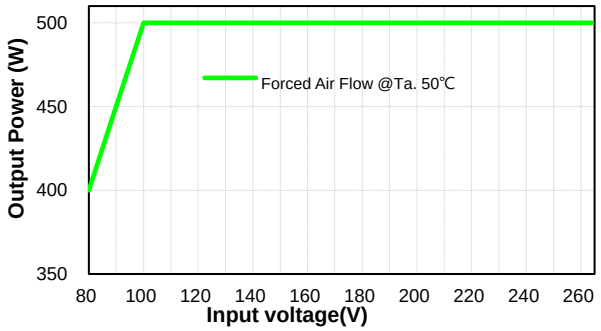
Voltage Fluctuations & Flicker	IEC 61000-3-3:2013	
EMC Immunity	EN 60601-1-2:2015, IEC 61000-4-2,3,4,5,6,8,11	Ed 4.0
Electrostatic Discharge (ESD)	IEC 61000-4-2:2008, Air Discharge: ±15kV, Contact Discharge: ±8kV	Criterion A
Radio-Frequency, Continuous Radiated Disturbance	IEC 61000-4-3:2006+A1:2007+A2:2010	Criterion A
Electrical Fast Transient (EFT)	IEC 61000-4-4:2012, ±2kV	Criterion A
Surge	IEC 61000-4-5:2014+A1:2017, L-N: ±0.5kV, ±1kV, L-E(Ground): ±0.5kV, ±1kV, ±2kV	Criterion A
Conducted Disturbances, Induced by RF Fields	IEC 61000-4-6:2013+COR1:2015	Criterion A
Power Frequency Magnetic Field	IEC 61000-4-8:2009	Criterion A
Voltage Dips	IEC 61000-4-11:2004+A1:2017, Dip: 30% Reduction, Dip >95% Reduction	Criterion A
Voltage Interruptions	IEC 61000-4-11:2004+A1:2017, >95% Reduction	Criterion B
Application Note Link	CFM500M Series App Notes	

CHARACTERISTIC CURVE

Power Derating Curve

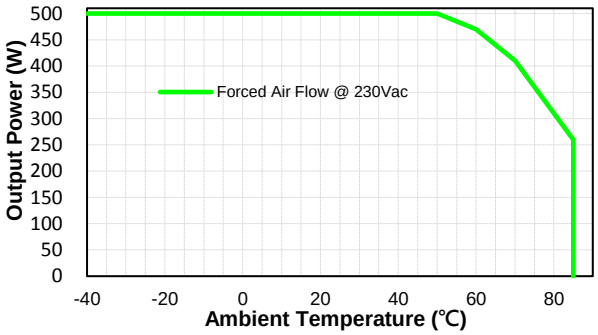
Forced Air Flow

Output power & Input voltage



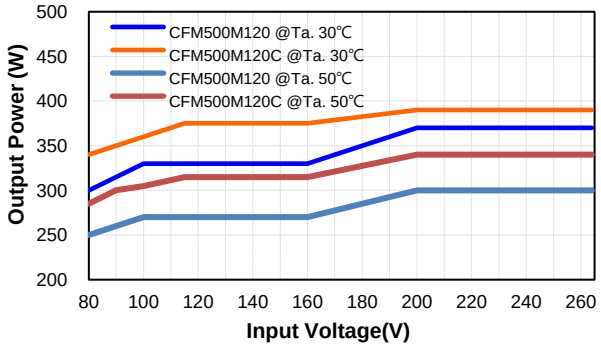
Forced Air Flow

Output power vs Ambient Temperature



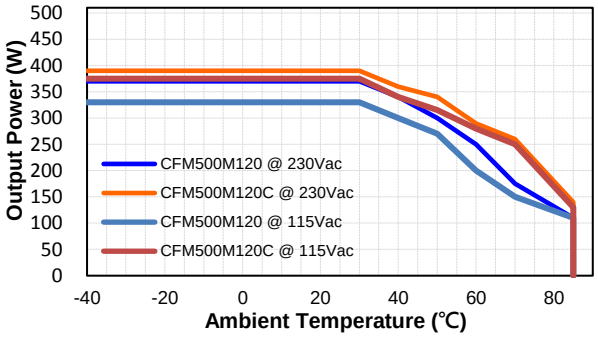
Natural Convection

Output power & Input Voltage

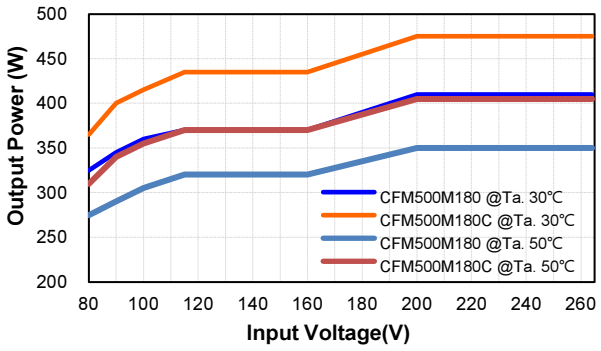


Natural Convection

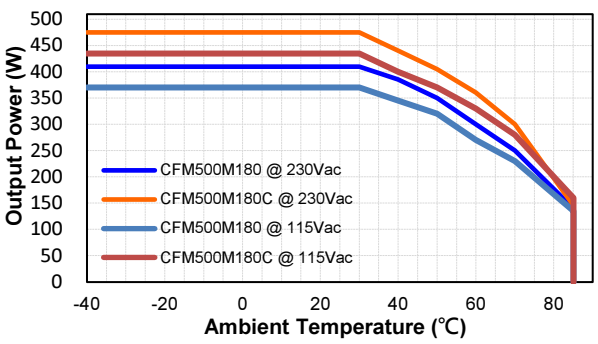
Output power vs Ambient Temperature



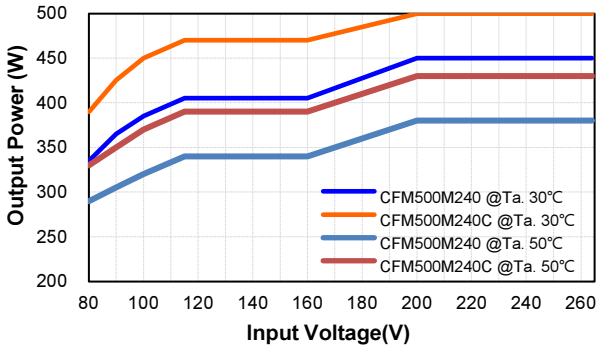
Output power & Input Voltage



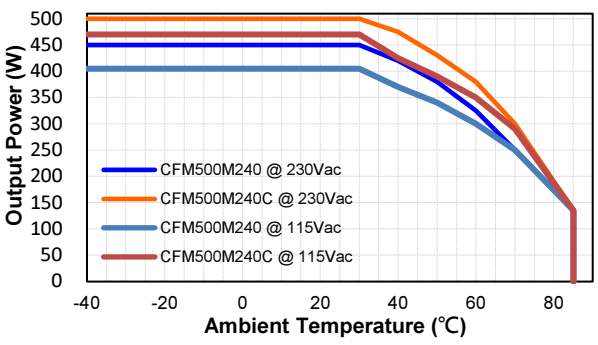
Output power vs Ambient Temperature



Output power & Input Voltage



Output power vs Ambient Temperature



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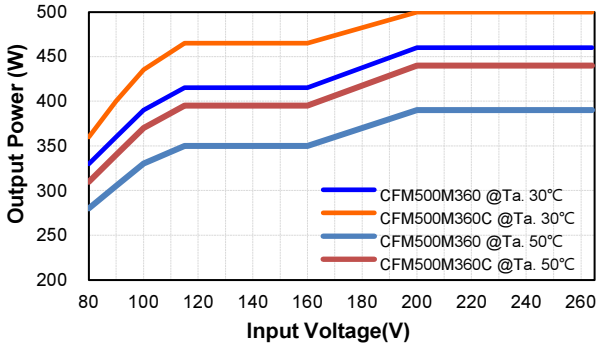
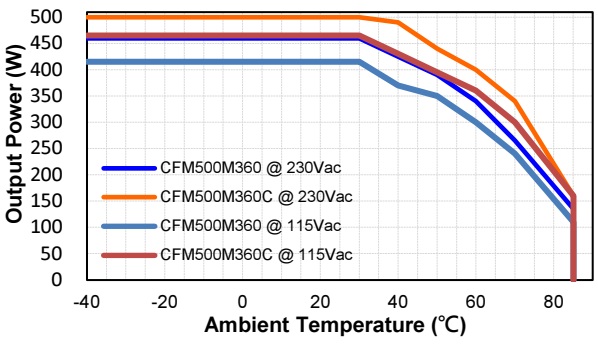
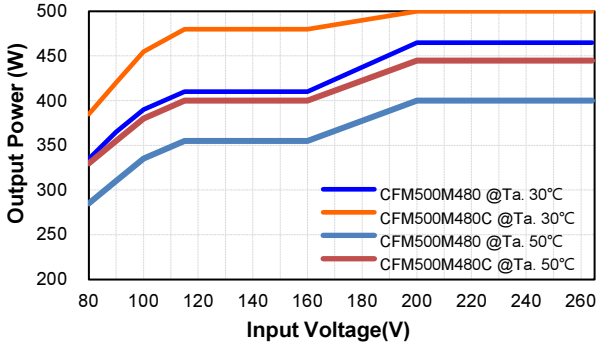


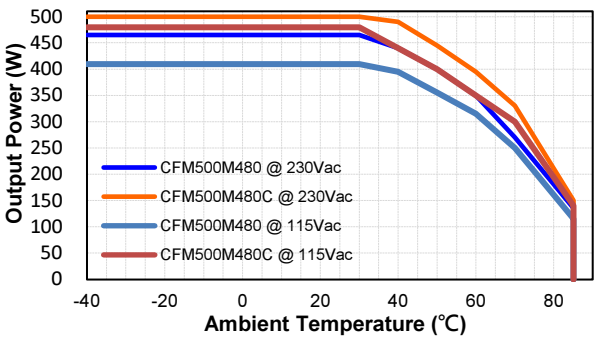
Output power vs Ambient Temperature



Output power & Input Voltage

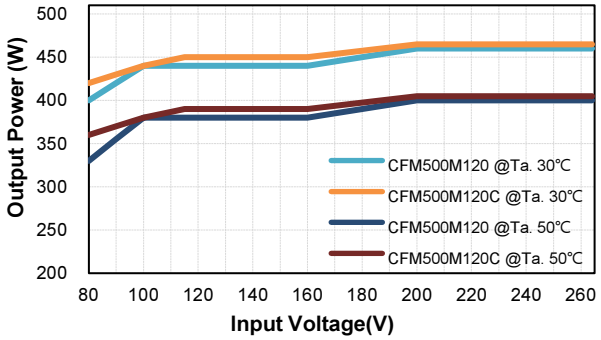


Output power vs Ambient Temperature



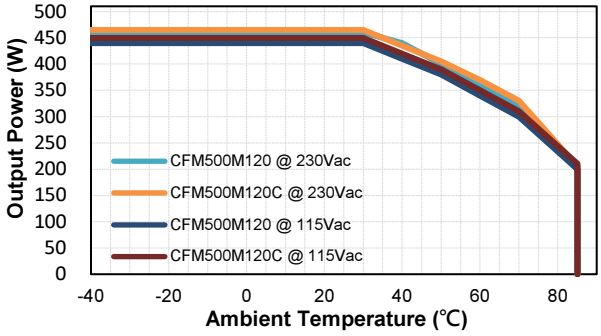
Conduction Convection with External Baseplate (48x24.8x0.12cm)

Output power & Input Voltage

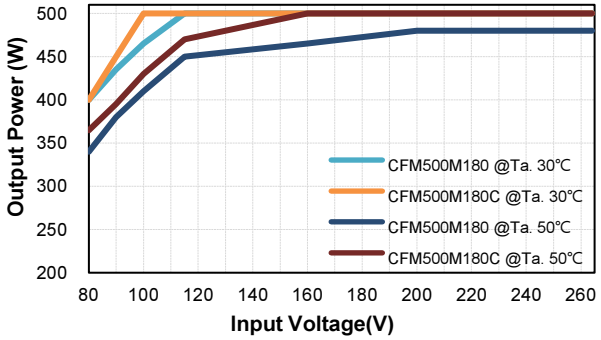


Conduction Convection with External Baseplate (48x24.8x0.12cm)

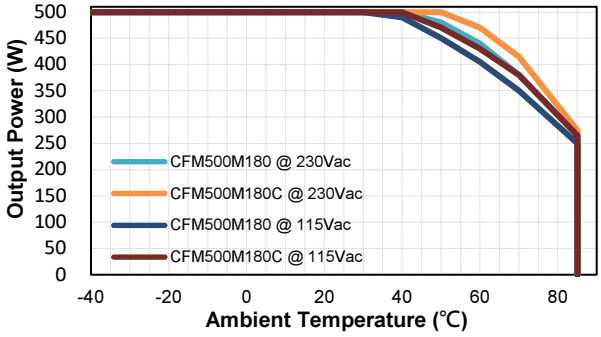
Output power vs Ambient Temperature



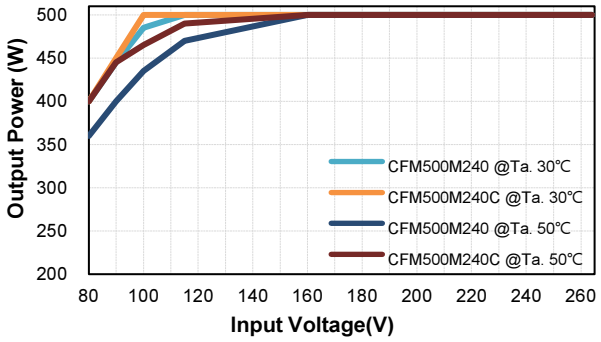
Output power & Input Voltage



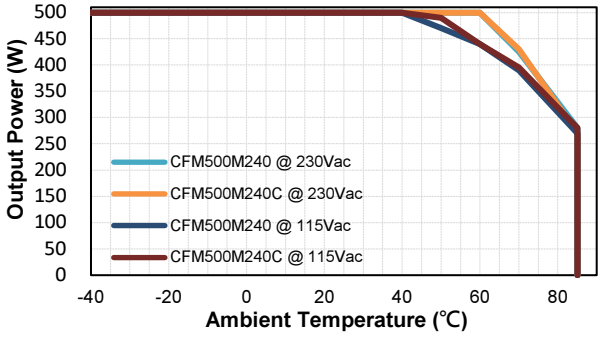
Output power vs Ambient Temperature



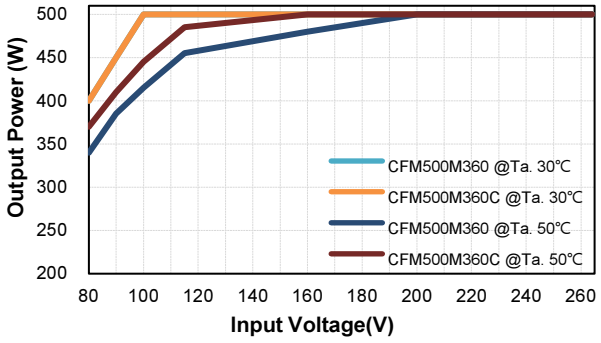
Output power & Input Voltage



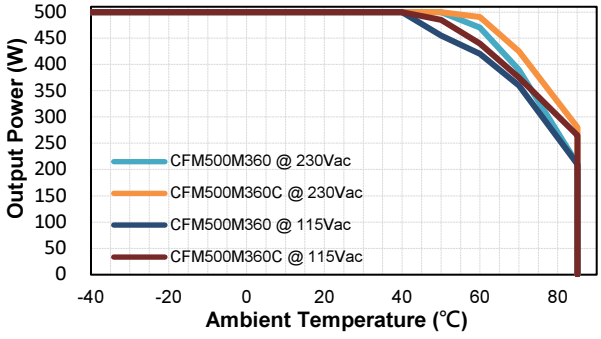
Output power vs Ambient Temperature



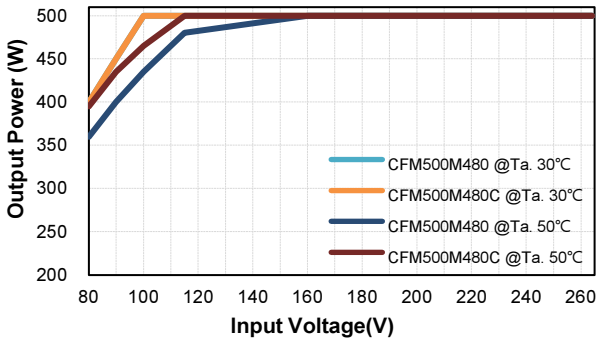
Output power & Input Voltage



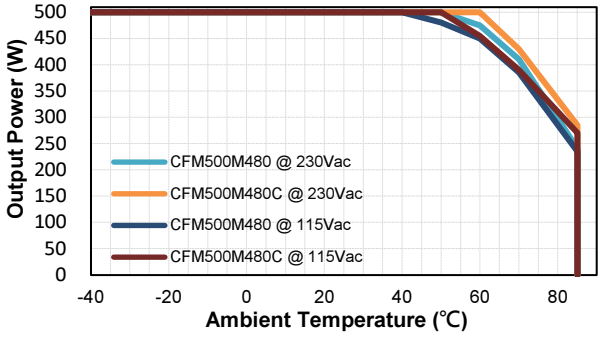
Output power vs Ambient Temperature



Output power & Input Voltage

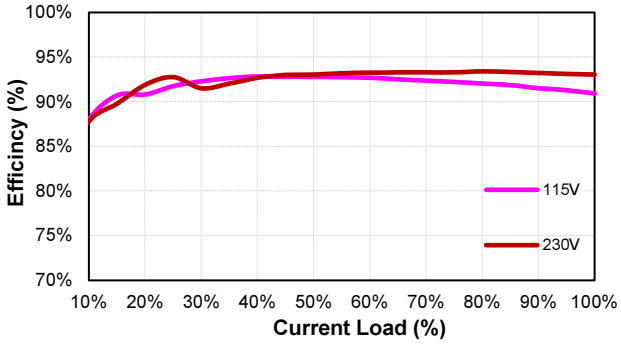


Output power vs Ambient Temperature

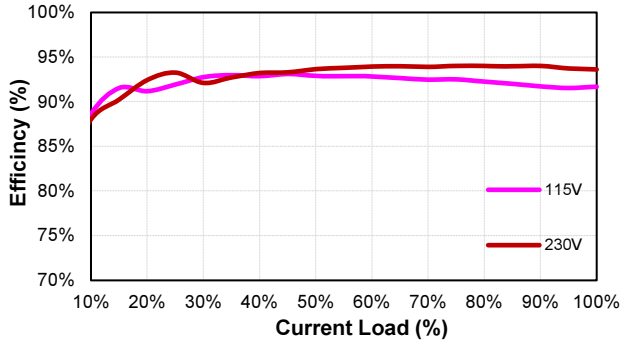


Performance Data

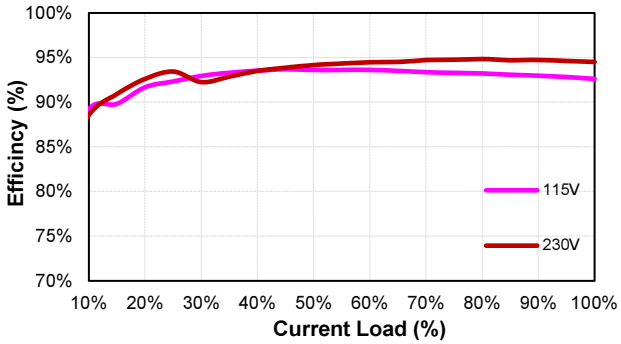
CFM500M120 (Eff Vs Io)



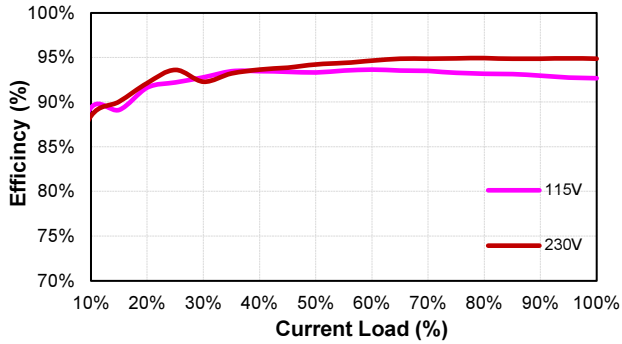
CFM500M180 (Eff Vs Io)



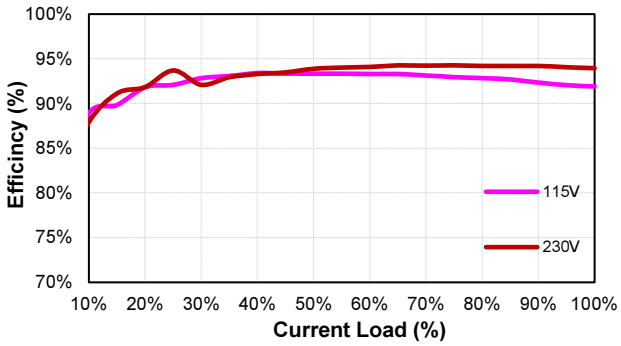
CFM500M240 (Eff Vs Io)



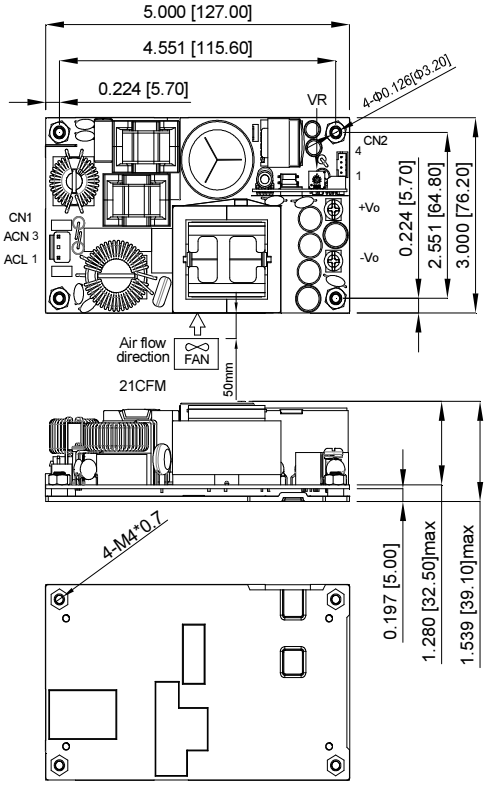
CFM500M360 (Eff Vs Io)

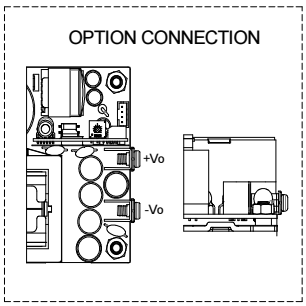


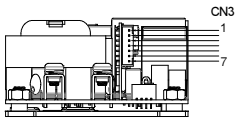
CFM500M480 (Eff Vs Io)



MECHANICAL SPECIFICATION







CN1:
PIN CONNECTION

Pin	Function
1	ACL
2	-
3	ACN

CN2:
PIN CONNECTION

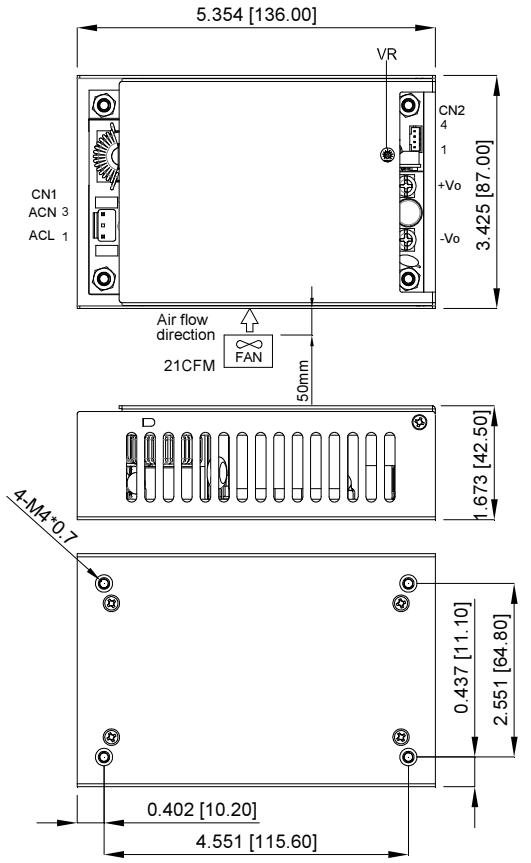
Pin	Function
1	GND
2	+5VSB
3	GND
4	+12V-FAN

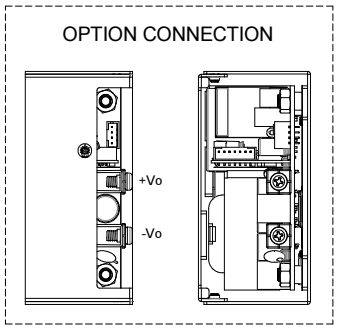
CN3:
PIN CONNECTION

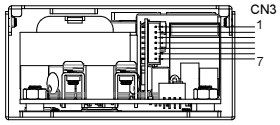
Pin	Function
1	GND
2	PF
3	FAN-EN
4	PS-ON
5	-Sense
6	+Sense
7	OPTION

All Dimensions In Inches[mm]
Tolerance Inches:x.xxx= ± 0.02
Millimeters: x.xx = ± 0.5

CFM500MXXX







CN1:
PIN CONNECTION

Pin	Function
1	ACL
2	-
3	ACN

CN2:
PIN CONNECTION

Pin	Function
1	GND
2	+5VSB
3	GND
4	+12V-FAN

CN3:
PIN CONNECTION

Pin	Function
1	GND
2	PF
3	FAN-EN
4	PS-ON
5	-Sense
6	+Sense
7	OPTION

All Dimensions In Inches[mm]
Tolerance Inches:x.xxx= ± 0.02
Millimeters: x.xx = ± 0.5

CFM500MXXXC

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500W AC-DC Power Supply with PFC
CFM500M Series
APPLICATION NOTE

Approved By:

Department	Approved By	Checked By	Written By
Research and Development Department	Enoch	Yang Ovid	Henry
Quality Assurance Department	Ryan	Benny	

CFM500M Series

Application Note V10

Content

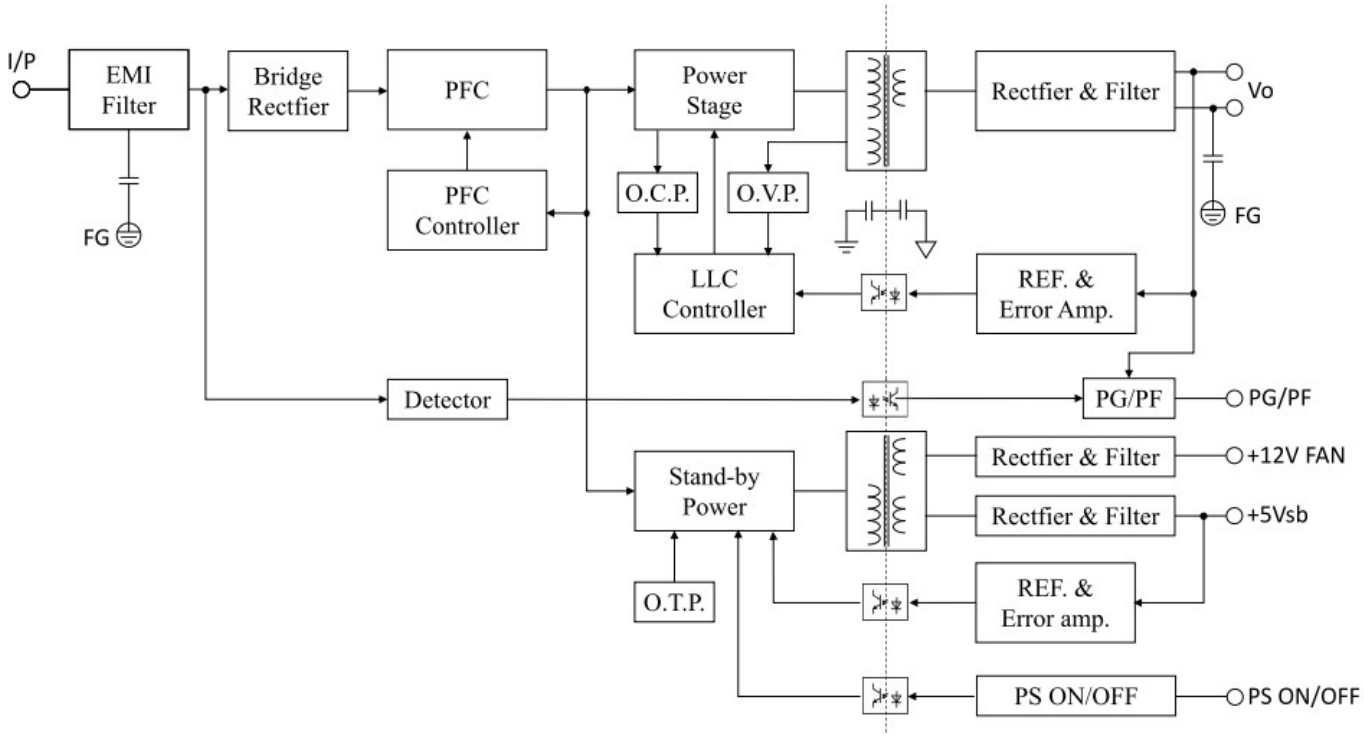
CFM500M Series

Application Note V10

1. Introduction

This application note describes the features and functions of Cincon's CFM500M series of open frame, switching AC-DC power module. These are highly efficient, reliable, compact, high power density, single output AC/DC power modules. The module is fully protected against short circuit and over-voltage conditions. Cincon's world class automated manufacturing methods, together with an extensive testing and qualification program, ensure that the CFM500M series power module is extremely reliable.

2. Electrical Block Diagram



3. Main Features and Functions

3.1 Operating Temperature Range

The highly efficient design of Cincon's CFM500M series power modules has resulted in their ability to operate within ambient temperature environments from -40℃ to 85℃. Due consideration must be given to the de-rating curves when ascertaining the maximum power that can be drawn from the module. The maximum power which can be drawn is influenced by a number of factors, such as

- Input voltage range
- Permissible Output load (per derating curve)
- Effective heat sinks

3.2 Output Protection (Over Current Protection)

The power modules provide full continuous short-circuit protection. The unit will auto recover once the short circuit is removed. To provide protection in a fault condition, the unit is equipped with internal over-current protection. The unit will operate normally once the fault condition is removed. The power module will go to hiccup mode if the output current is set from 110% to 180% of rated current.

4. Applications

4.1 Test Set-Up

The basic test set-up to measure parameters such as efficiency and load regulation is shown in Figure 1. When testing the Cincon's CFM500M series under any transient conditions, please ensure that the transient response of the source is sufficient to power the equipment under test. We can calculate the

- Efficiency
- Load regulation and line regulation.

The value of efficiency is defined as:

$$\eta = \frac{Vo \times Io}{Pin} \times 100\%$$

Where:

Vo is output voltage

Io is output current

Pin is input power

The value of load regulation is defined as:

$$Load\ reg. = \frac{V_{FL} - V_{NL}}{V_{NL}} \times 100\%$$

Where:

V_{FL} is the output voltage at full load

V_{NL} is the output voltage at 10% load

The value of line regulation is defined as:

$$Line\ reg. = \frac{V_{HL} - V_{LL}}{V_{LL}} \times 100\%$$

Where:

V_{HL} is the output voltage of maximum input voltage at full load.

V_{LL} is the output voltage of minimum input voltage at full load.

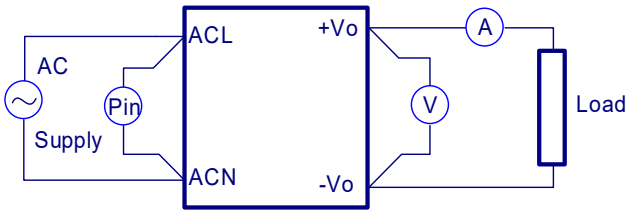


Figure 1. CFM500M Series Test Setup

4.2 Output Ripple and Noise Measurement

The test set-up for noise and ripple measurements is shown in Figure 2. Measured method:
Add a C2=0.1uF ceramic capacitor and a C1=10uF electrolytic capacitor to output at 20 MHz Band Width.

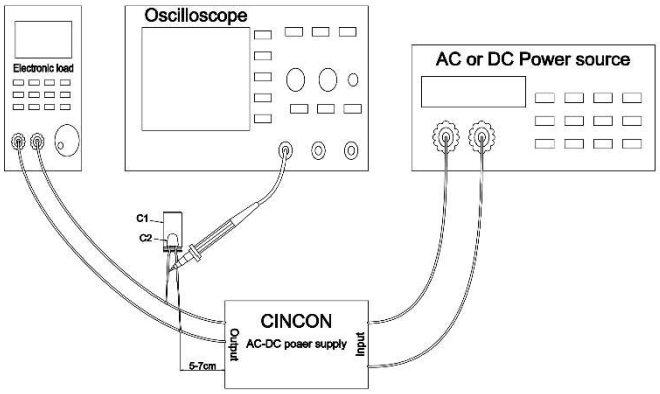
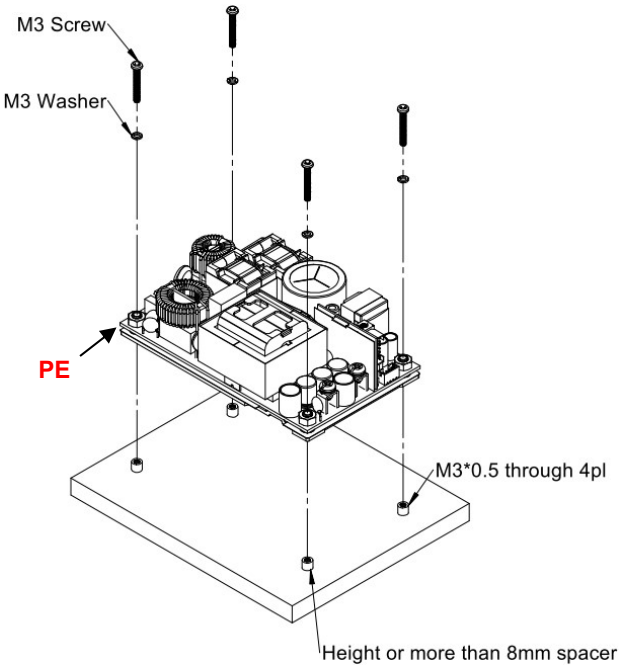


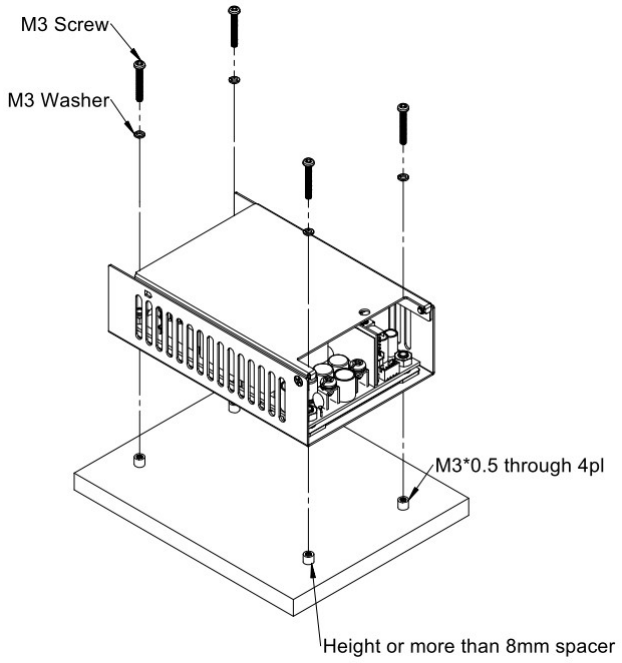
Figure 2. Output Voltage Ripple and Noise Measurement Set-Up

4.3 Installation Instruction

The CFM500M series has four 4mm diameter mounting holes. There are three type installations for CFM500M. Please use the mounting holes as follows:
Insert the spacer (4mm diameter max.) of 8mm height or more to mount the unit.

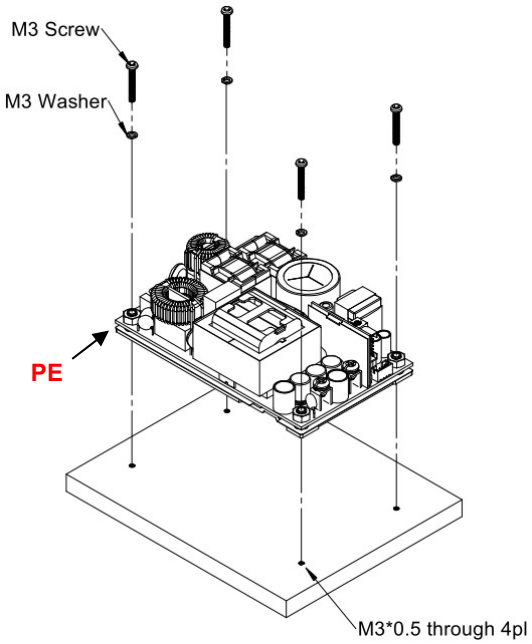


CFM500MXXX Installation Diagram

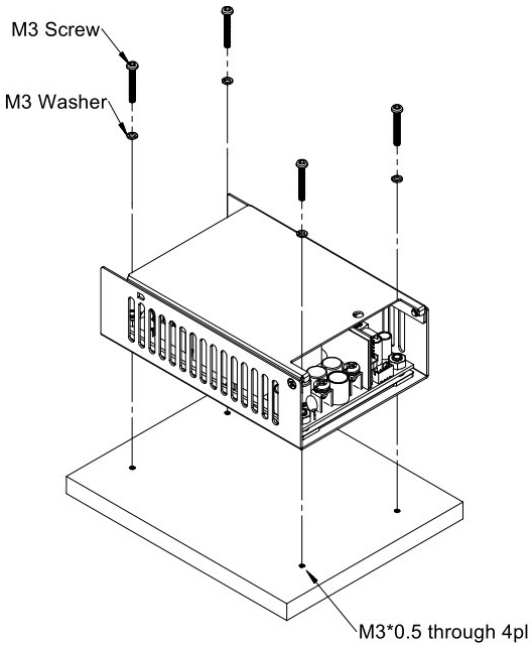


CFM500MXXXC Installation Diagram

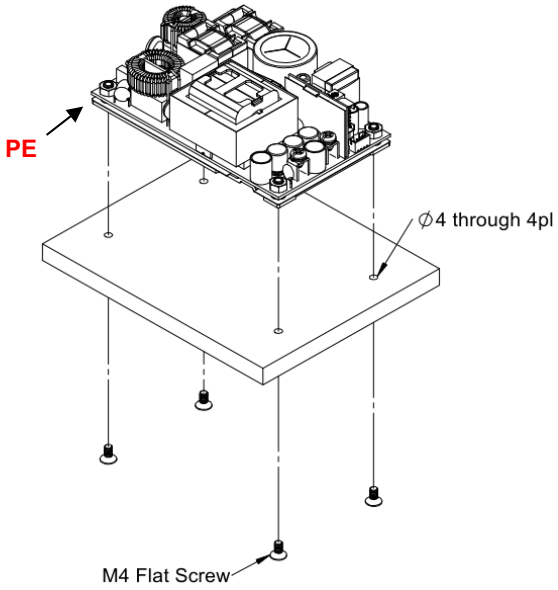
The CFM500M series provide the baseplate cooling for customer to increasing heat dissipation. Please refer to the following figure for installation.



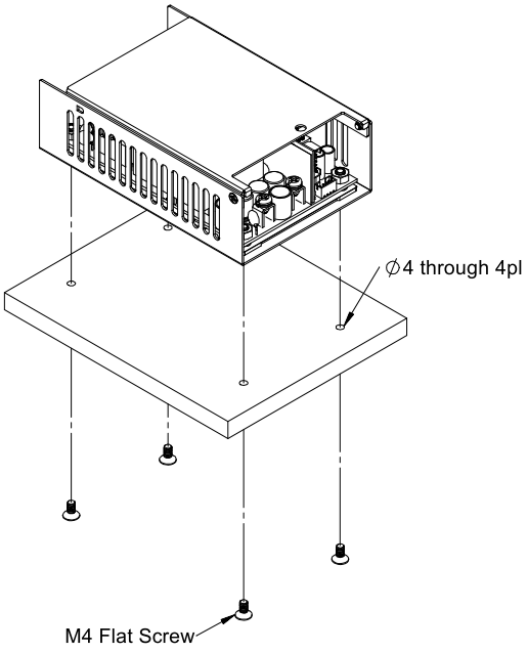
CFM500MXXX installation diagram



CFM500MXXXC installation diagram



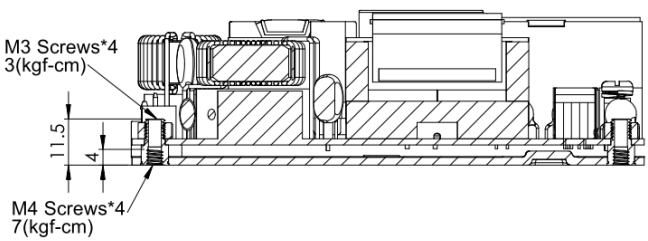
CFM500MXXX installation diagram

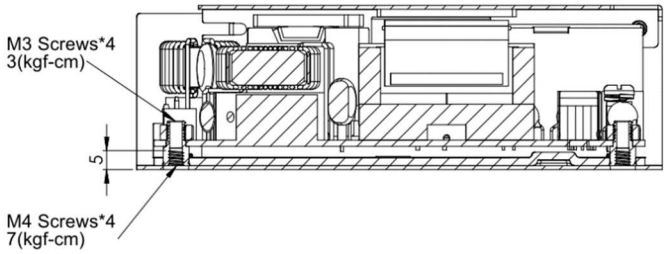


CFM500MXXXC installation diagram

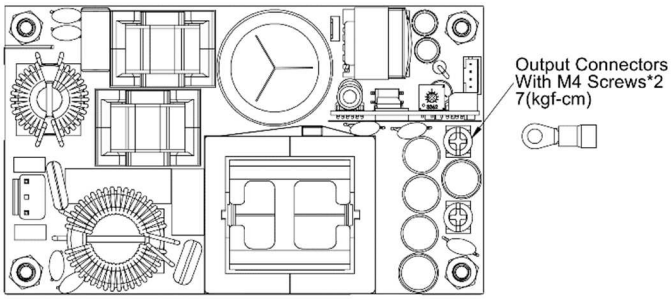
Note: M3 & M4 screw head and washer diameter shall not exceed 5.5mm.

The torque of CFM500M series as follows:

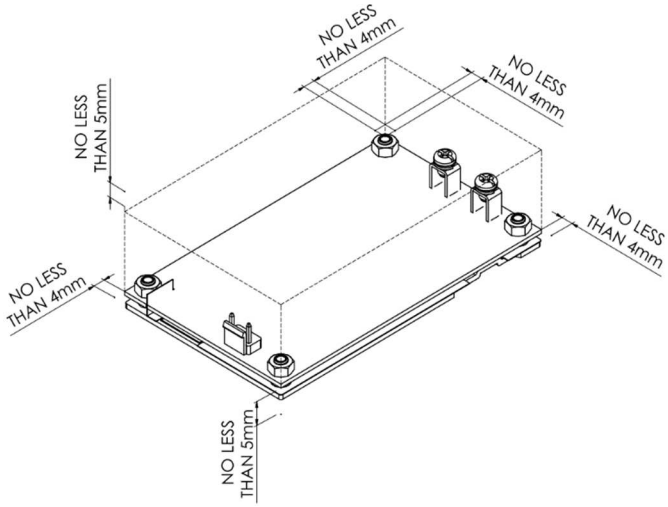




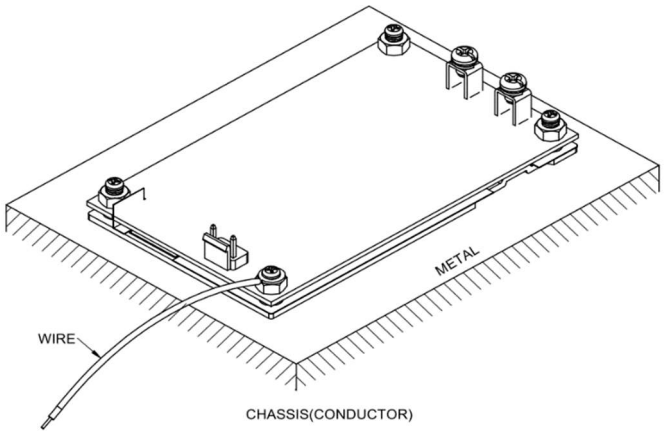
The torque of output connectors are 7kgf-cm and the connectors mate with round terminal. The maximum outer diameter of the terminal is 8.0mm and the maximum inner diameter is 4.3mm. When locking the round terminal or Y terminal to output connectors, the terminals should not touch other parts to avoid short.



Please allow 4mm side clearance from the components and all side of the PCB. Allow 5mm clearance above the highest parts on the PCB. Be especially careful to allow 5mm between the solder side of the PCB and the mounting surface. If the clearances are not sufficient the specifications for isolation and withstand will not be valid.

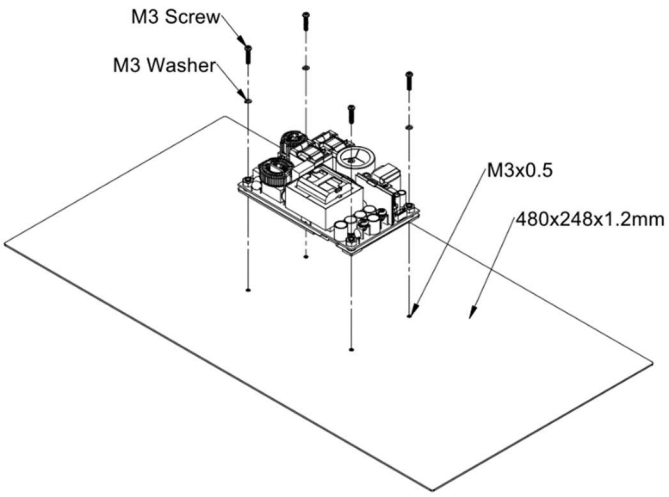


FG should be connected to the earth (ground) terminal of the apparatus. If not the conducted noise and output noise will increase.

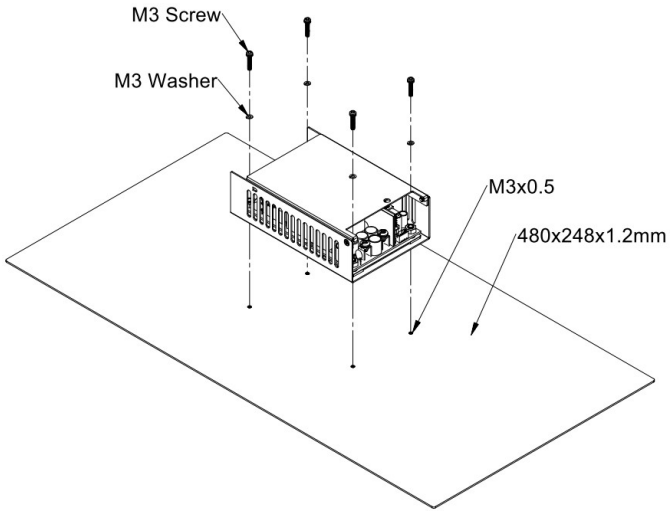


4.4 External Baseplate Cooling

The CFM500M series provide the baseplate cooling for customer to increasing heat dissipation. For example, adding a 480mm*248mm*1.2mm heatsink at the bottom of CFM500M, between the heatsink and CFM500M with thermal grease to help heating ability.
Please refer to the following figure for installation. When the CFM500M series uses an external baseplate cooling solution, it can be used at 470 ~ 500W. Please refer to the power derating curve in the specification.



CFM500MXXX installation diagram

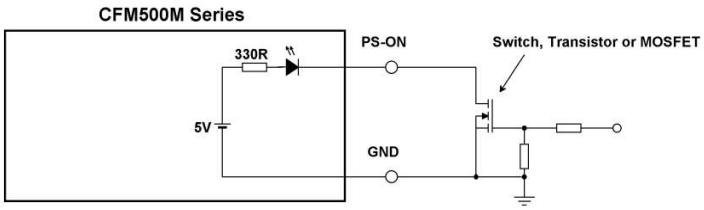


CFM500MXXXC installation diagram

4.5 PS On/Off Remote Control and Fan Control

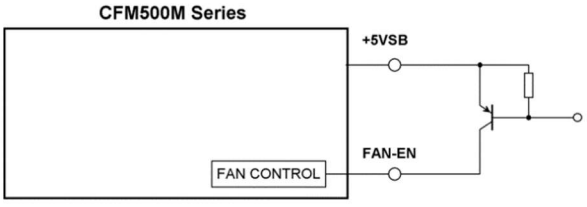
The PS-ON remote control is provided in CN3 pin 4. The diagram and control function are shown as follow:

Power On: VPS-ON≦2V, IPS-ON≧10mA (PS-ON and GND short, IPS-ON =10 mA typical).
Power Off: Open circuit, VPS-ON =4V.

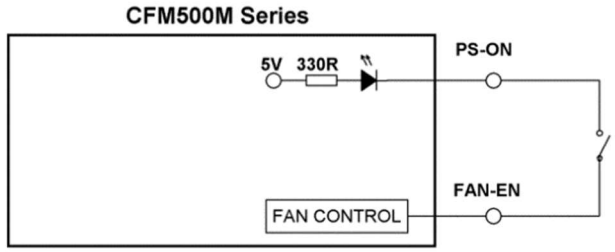


The fan control is provided in CN3 pin 3. The control function and diagram are shown as follow:

Fan On: V_{FAN-EN} ≧ 1V.
Fan Off: Open circuit, V_{FAN-EN} =0V.



When the PS On/Off remote-control function is not used, connect a short circuit between the pin PS-ON and FAN-EN.

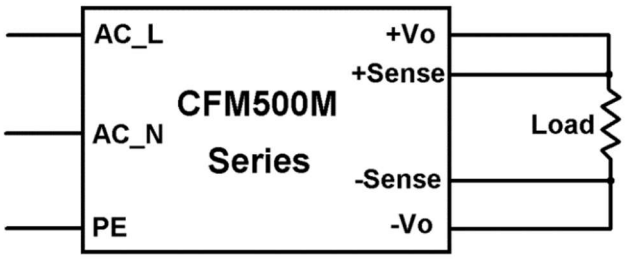


4.6 Output Remote Sensing

The CFM500M SERIES converter has the capability to remotely sense both lines of its output. This feature moves the effective output voltage regulation point from the output of the unit to the point of connection of the remote sense pins. This feature automatically adjusts the real output voltage of the CFM500M series in order to compensate for voltage drops in distribution and maintain a regulated voltage at the point of load. The remote-sense voltage range is:

$[(+V_{out}) - (-V_{out})] - [(+Sense) - (-Sense)] \leqq 5\%$ of $V_{o\_nominal}$

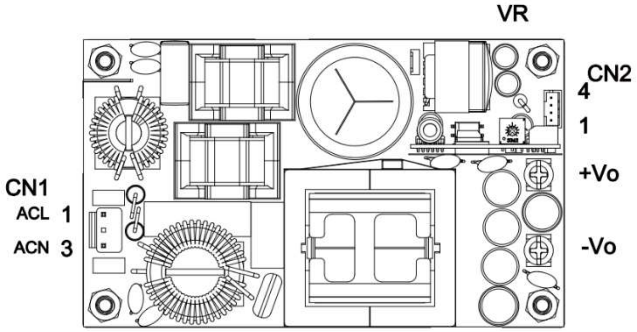
If the remote sense feature is not to be used, the sense pins should be connected locally. The +Sense pin should be connected to the +Vout pin at the module and the -Sense pin should be connected to the -Vout pin at the module. A Remote Sensing is provided in CN3. This is shown in the schematic as below.

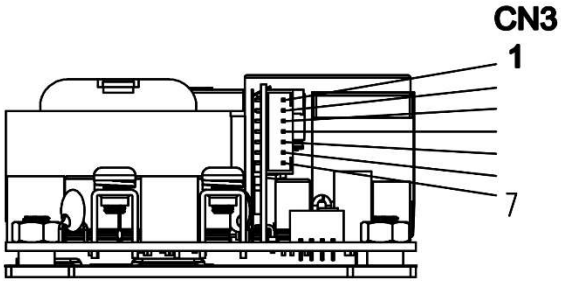


4.7 EMI Test

The CFM500M series Conductive EMI meets EN55011, FCC Part 15 Class B when test condition is Class I.

4.8 Mating Connectors

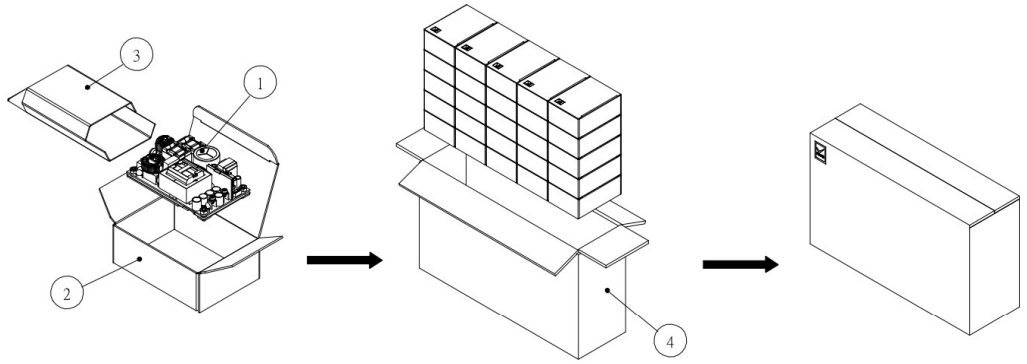




- CN1: Input connector wafer with JST VH series and mate with JST housing VHR series or equivalent. Optional Input connector wafer with LONG CHU P3161 series and mate with LONG CHU H3060 series or equivalent.
- CN2: Output connector wafer with TAIWAN KING PIN TERMINAL P110I series and mate with JST housing PH series or equivalent.
- CN3: Output connector wafer with JST PH series and mate with JST housing PH series or equivalent.
- Vo+ & Vo-: Output connectors mate with round terminal and round terminal of the max outer diameter is 8.0mm, max inner diameter is 4.3mm.

5. Packing Information

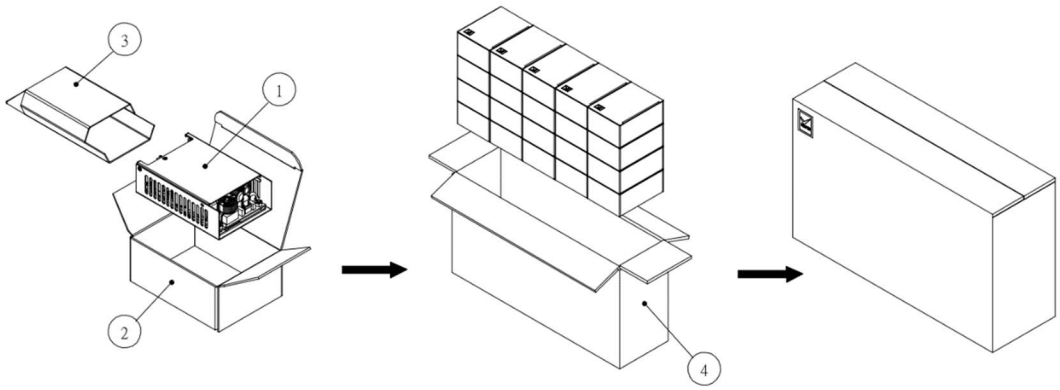
The packing information for CFM500MXXX is showing as follows:



ITEM	PART NO.	NAME	OUTSIDE DIM(mm)	PCS
1		CFM500MXXX Product	127x76.2x39.1	25
2	G64205245	Inner Box	140x100x55	25
3	G64F00005	Antistatic Bag	(110+60)x165	25
4	G64112325	No.146 Cardboard Box	525x155x300	1

Each Box Packaging 25 PCS Products
Gross weight Ref. 14.5 Kg

The packing information for CFM500MXXXC is showing as follows:



ITEM	PART NO.	NAME	OUTSIDE DIM(mm)	PCS
1		CFM500MXXXC Product	136x87x42.5	20
2	G64205247	Inner Box	145x105x65	20
3	G64F00007	Antistatic Bag	(230+80)x150	20
4	G64112326	No.147 Cardboard Box	550x160x285	1

Each Box Packaging 20 PCS Products
Gross weight Ref. 14.6 Kg

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