500W AC-DC Power Supply with PFC
CFM500S Series
APPLICATION NOTE

Approved By:

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CFM500S Series

Application Note V15

Content

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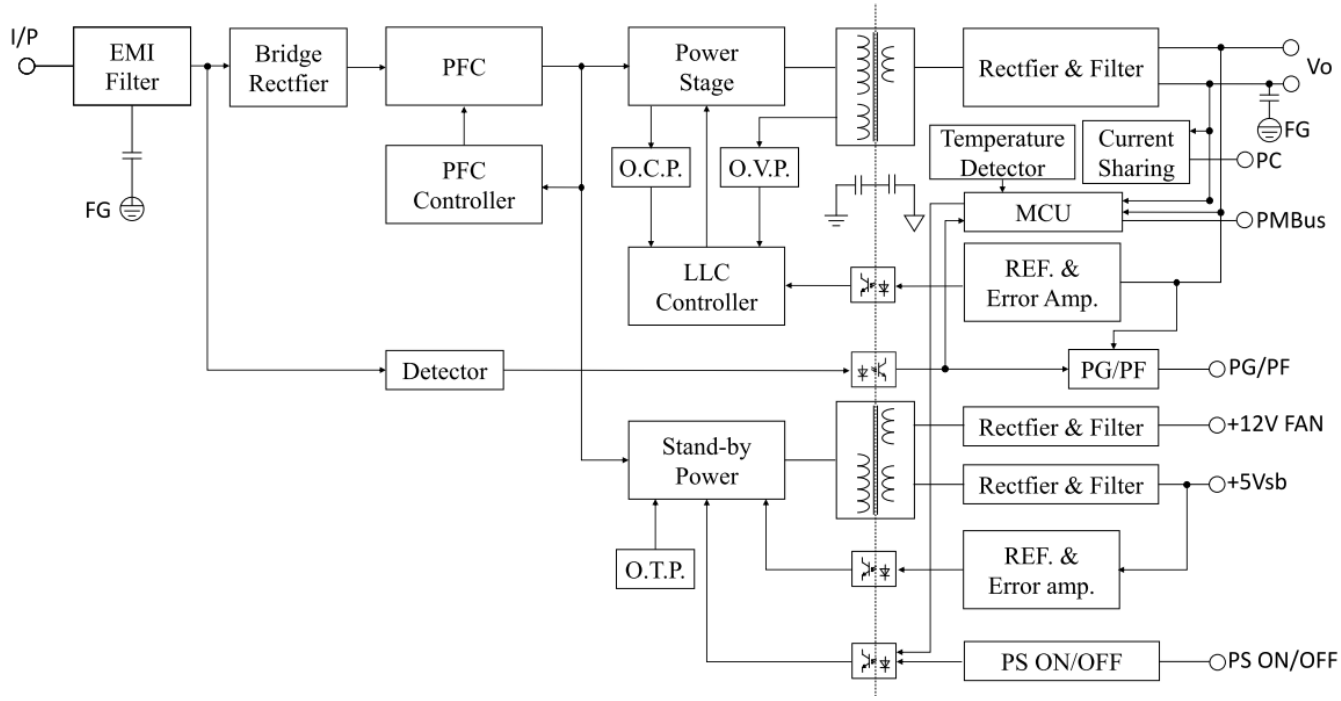
1. Introduction

This application note describes the features and functions of Cincon's CFM500S 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 CFM500S 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 CFM500S series power modules has resulted in their ability to operate within ambient temperature environments from -40°C to 85°C. 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 CFM500S 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:

V_o is output voltage
I_o 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.

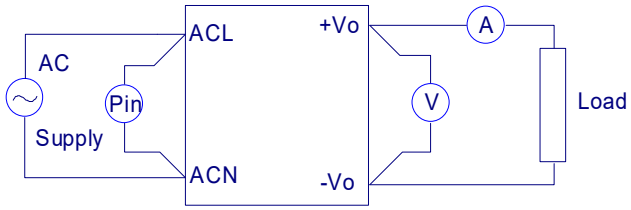


Figure 1. CFM500S Series Test Setup

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.

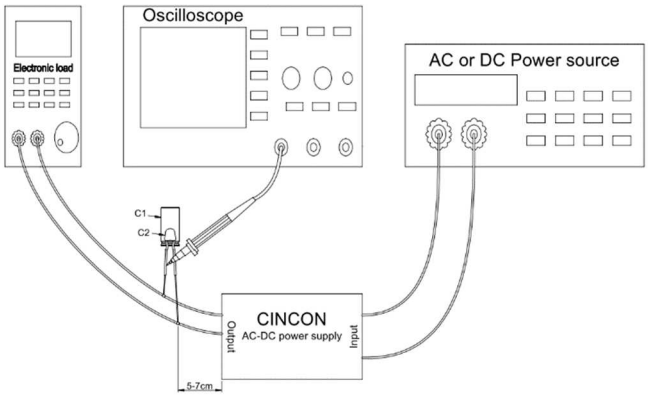
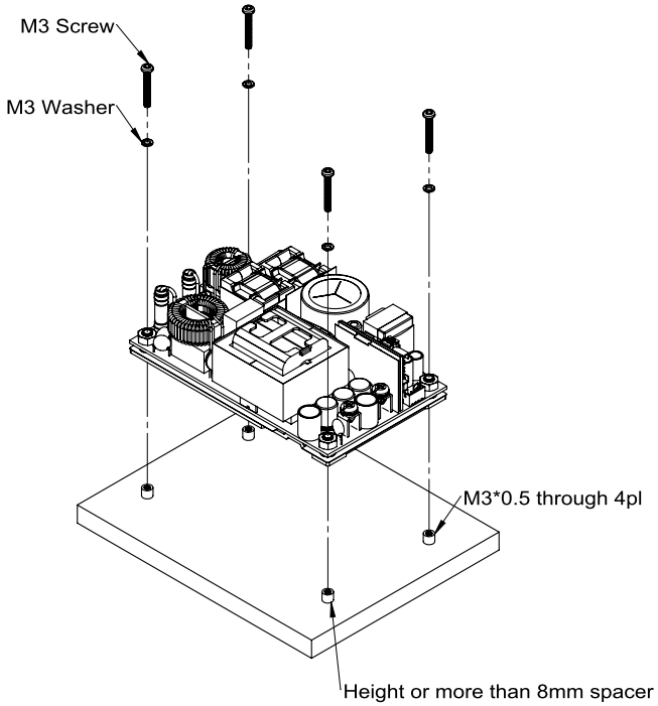


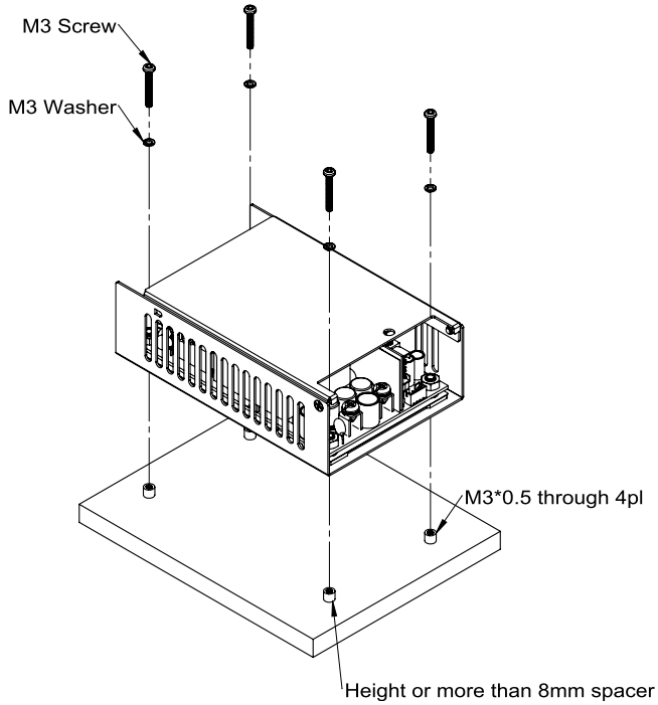
Figure 2. Output Voltage Ripple and Noise Measurement Set-Up

4.3 Installation Instruction

The CFM500S series has four 4mm diameter mounting holes. There are three type installations for CFM500S. Please use the mounting holes as follows:
Insert the spacer (4mm diameter max.) of 8mm height or more to mount the unit.

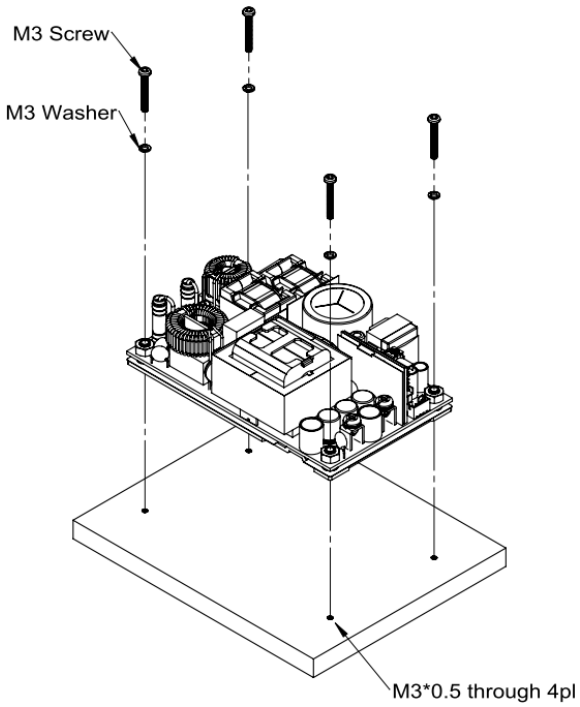


CFM500SXXX Installation Diagram

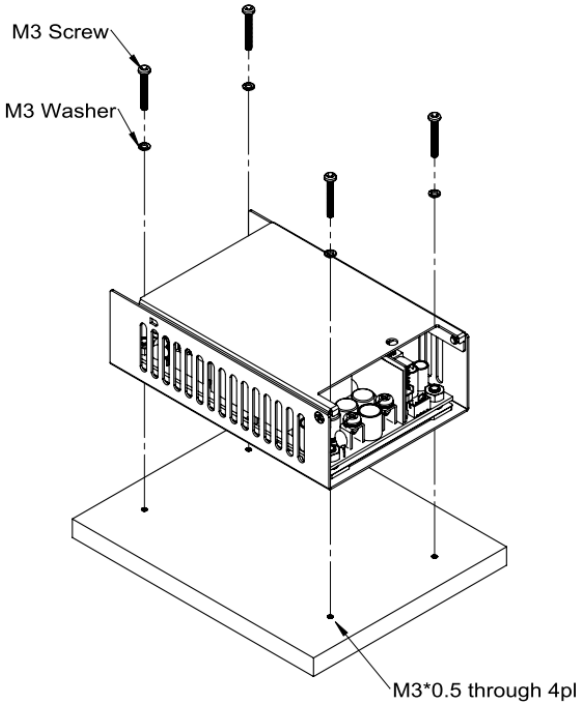


CFM500SXXXC Installation Diagram

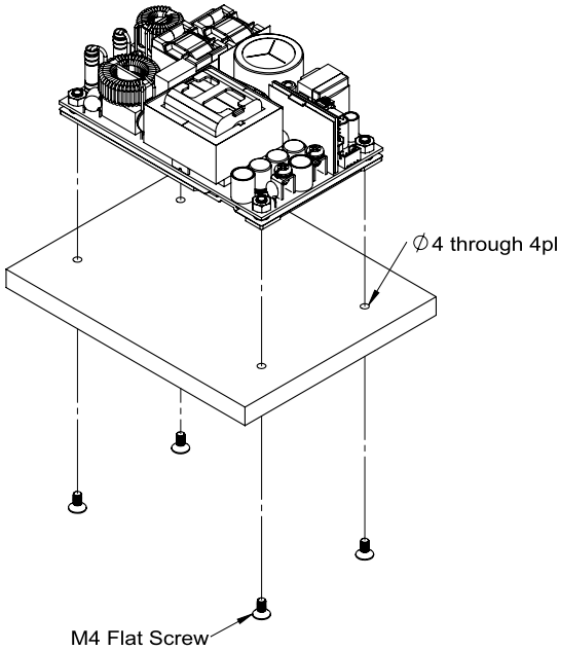
The CFM500S series provide the baseplate cooling for customer to increasing heat dissipation. Please refer to the following figure for installation.



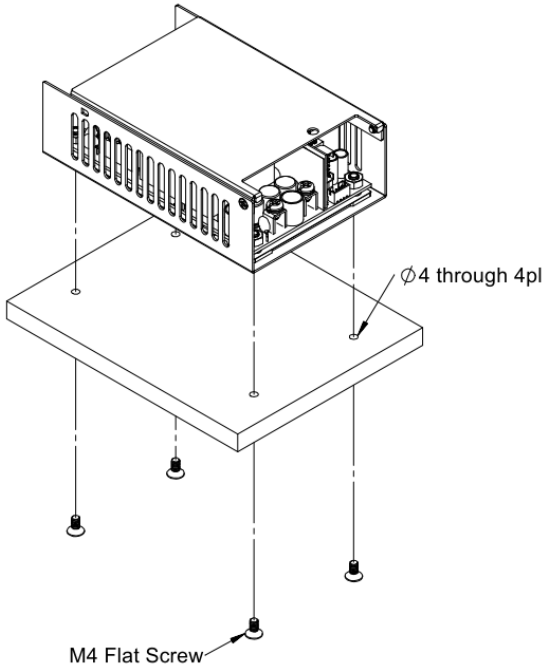
CFM500SXXX Installation Diagram



CFM500SXXXC Installation Diagram



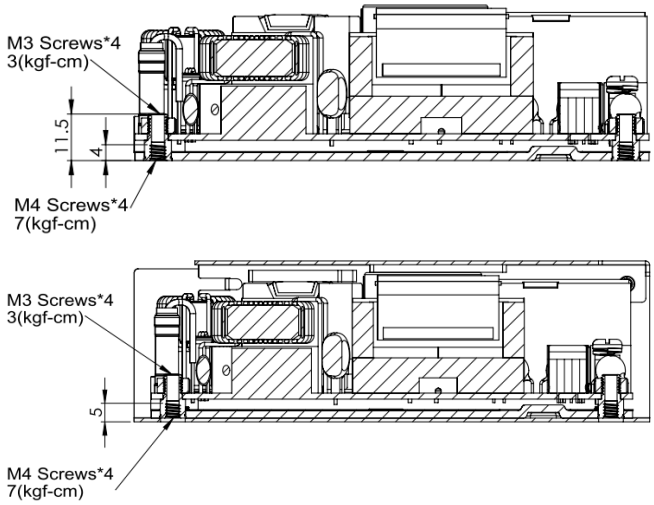
CFM500SXXX Installation Diagram



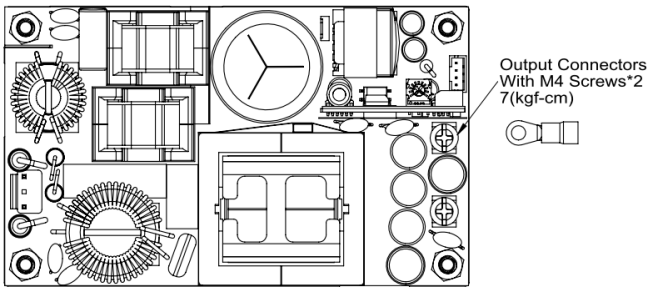
CFM500SXXXC Installation Diagram

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

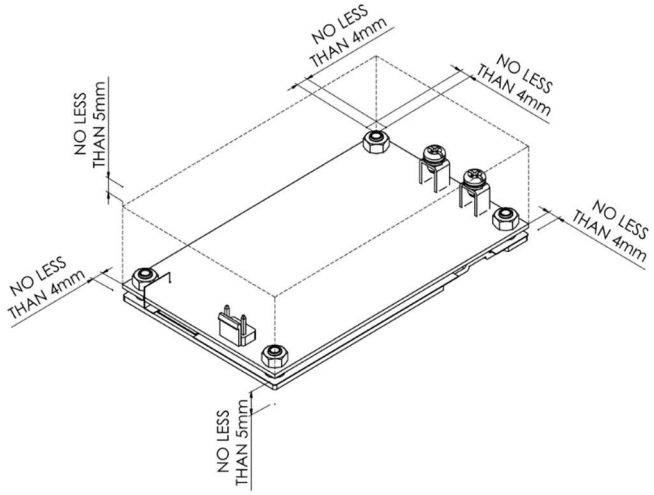
The torque of CFM500S series as follows:



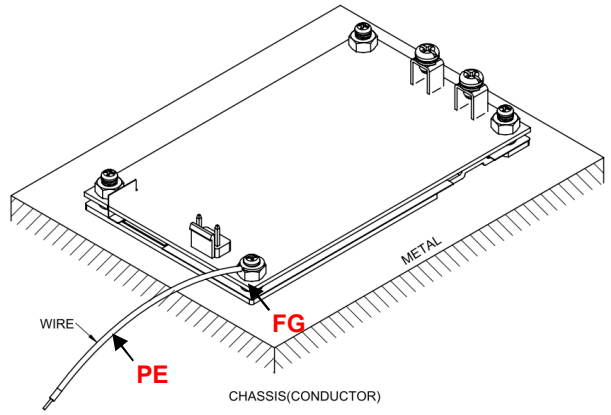
The torque of M3 screws are 3kgf-cm and M4 screws are 7kgf-cm. The torque of output connectors are 7kgf-cm and the connectors mate with round terminal. The maximum outer diameter of the terminal is 8.0mm and the maximum inner diameter is 4.3mm. When locking the round terminal or Y terminal to output connectors, the terminals should not touch other parts to avoid short.

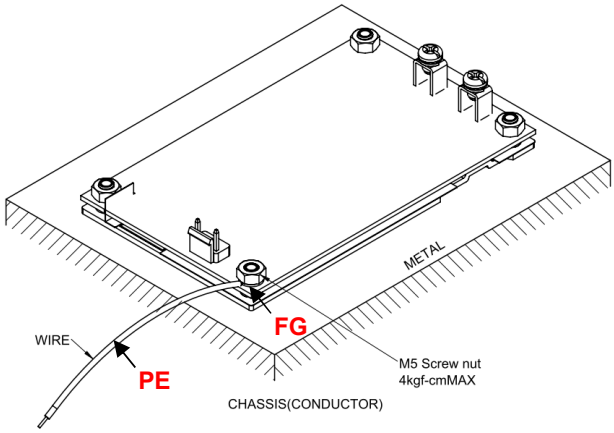


Please allow 4mm side clearance from the components and all side of the PCB. Allow 5mm clearance above the highest parts on the PCB. Be especially careful to allow 5mm between the solder side of the PCB and the mounting surface. If the clearances are not sufficient the specifications for isolation and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



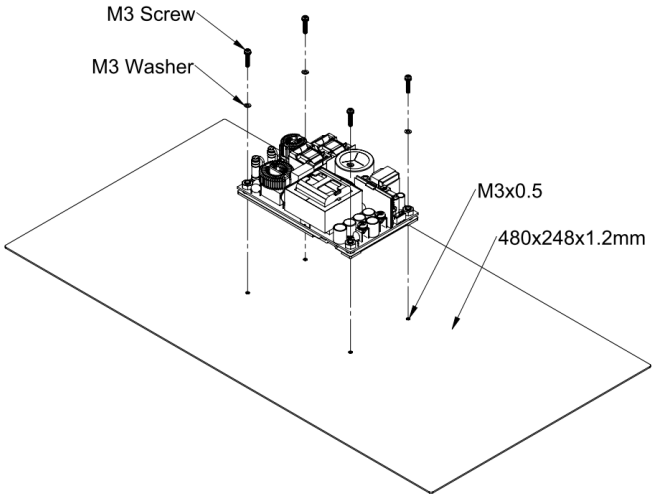


The torque of M5 screw nut is 4kgf-cm.

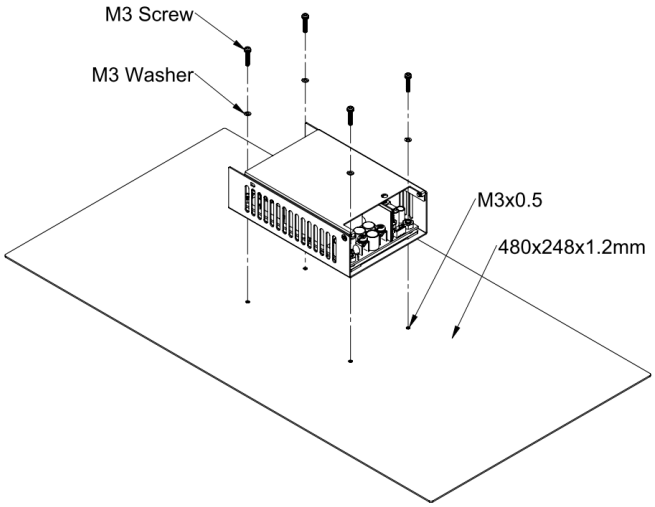
4.4 External Baseplate Cooling

The CFM500S series provide the baseplate cooling for customer to increasing heat dissipation. For example, adding a 480mm*248mm*1.2mm heatsink at the bottom of CFM500S, between the heatsink and CFM500S with thermal grease to help heating ability.

Please refer to the following figure for installation. When the CFM500S series uses an external baseplate cooling solution, it can be used at 470 ~ 500W. Please refer to the power derating curve in the specification.



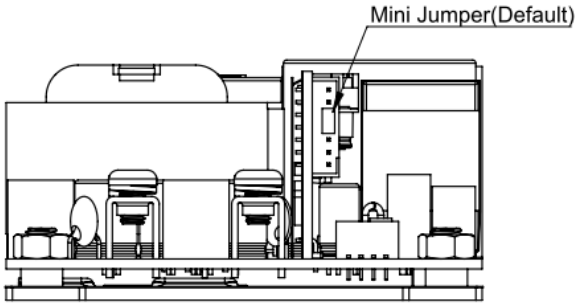
CFM500SXXX Installation Diagram



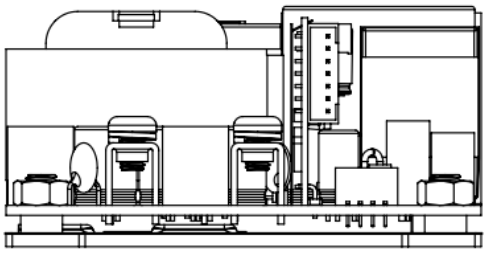
CFM500SXXXC Installation Diagram

4.5 PS On/Off Remote Control and Fan Control

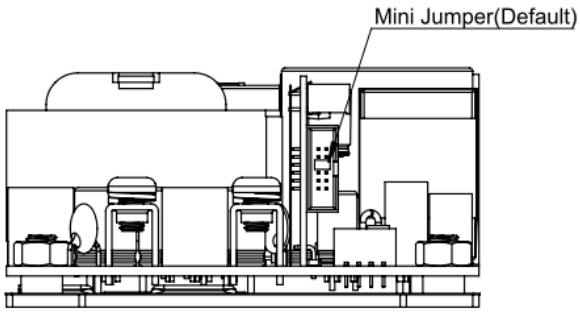
The PS-ON and FAN-EN of CFM500SXXX are connected through the default Mini Jumper for normal operation of the unit.



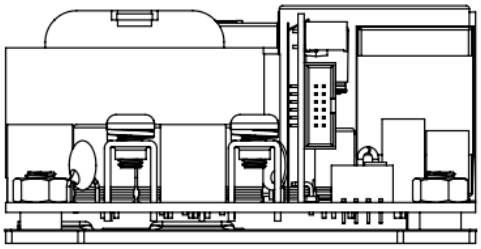
When using the PS-ON remote control and Fan Control function of CFM500SXXX, remove the Mini Jumper on PS-ON and FAN-EN.



The PS-ON and GND of CFM500SXXX-PM are connected through the default Mini Jumper for normal operation of the unit.



When using the PS-ON remote control and PMBus remote on/off function of CFM500SXXX-PM, remove the Mini Jumper on PS-ON and GND.

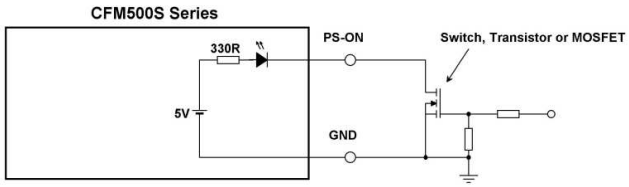


The PS-ON remote control of CFM500SXXX is provided in CN3 pin 4.
The PS-ON remote control of CFM500SXXX-PM is provided in CN3 pin 7.

The diagram and control function are shown as follow:

Power On: $V_{PS-ON} \leqq 2V$, $I_{PS-ON} \geqq 10mA$ (PS-ON and GND short, $I_{PS-ON}=10mA$ typical)

Power Off: Open circuit, $V_{PS-ON}=4V$

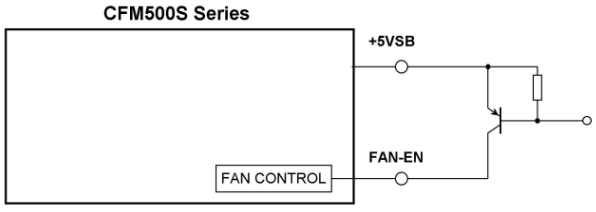


The fan control of CFM500SXXX is provided in CN3 pin 3.

CFM500SXXX-PM is not provided fan control.
The control function and diagram are shown as follow:

Fan On: $V_{FAN-EN} \geqq 1V$

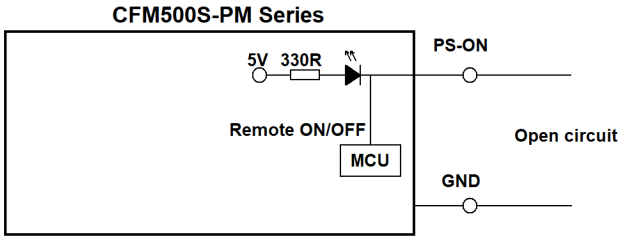
Fan Off: Open circuit, $V_{FAN-EN}=0V$



When the PS-ON and GND of CFM500SXXX-PM are open circuit.
The Remote ON/OFF control logic is selectable via PMBus:

Power On: Write 0x80 to Command Code 01h

Power Off: Write 0x00 to Command Code 01h

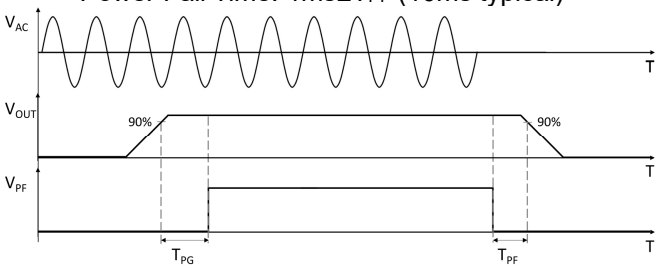


4.6 Power Good (PG) and Power Fail (PF)

The PF remote control is provided in CN3 pin2. The signal time sequence is shown as follow:

Power Good Time: 100ms≦T_{PG}≦500ms

Power Fail Time: 1ms≦T_{PF} (10ms typical)

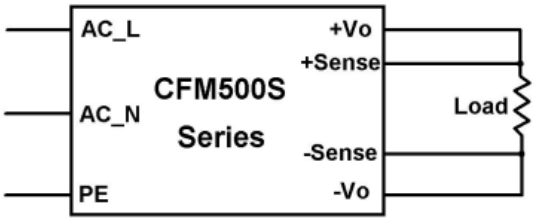


4.7 Output Remote Sensing

The CFM500S 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 CFM500S 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 $V_{o\_nominal}$

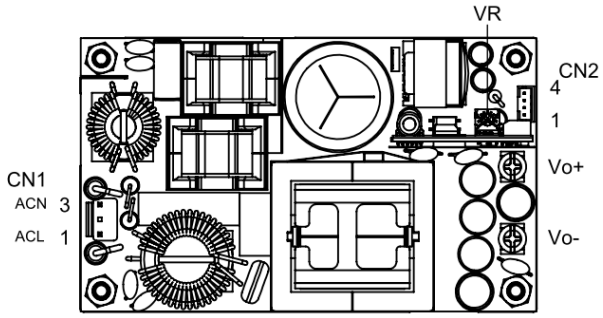
A Remote Sensing is provided in CN3. This is shown in the schematic as below.



4.8 EMI Test

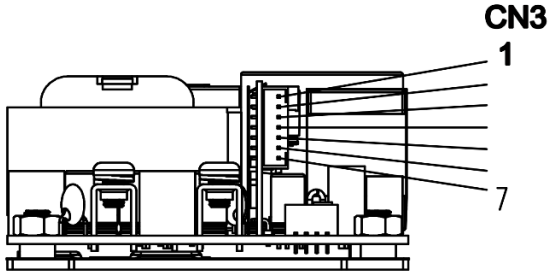
The CFM500S series Conductive EMI meets EN 55032, FCC Part 15 Class B when test condition is Class I.

4.9 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 PHR 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.

The CN3 of CFM500SXXX is shown in figure as below.

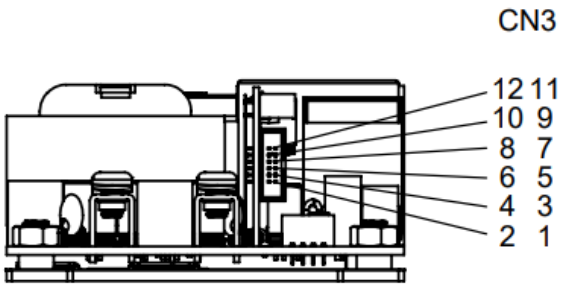


- CN3:
  Output connector wafer with JST PH series and mate with JST housing PHR series or equivalent.

DC Output Connector(CN3):TKP P110L-07 or equivalent

Pin	Function	Mating Housing	Terminal
1	GND	JST PHR-7 or equivalent	JST SPH-002T-P0.5L or equivalent
2	PF		
3	FAN-EN		
4	PS-ON		
5	-Sense		
6	+Sense		
7	PC(Option)		

The CN3 of CFM500SXXX-PM is shown in figure as below.



●CN3:

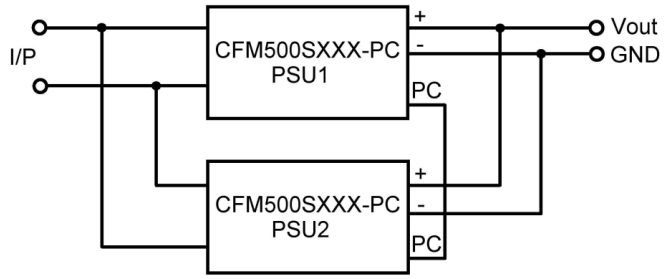
Output connector wafer with B304F-12RGF-104-LH series and mate with Samtec FFSD-06-01-N series or equivalent.

DC Output Connector(CN3):Townes B304F-12RGF-104-LH or equivalent

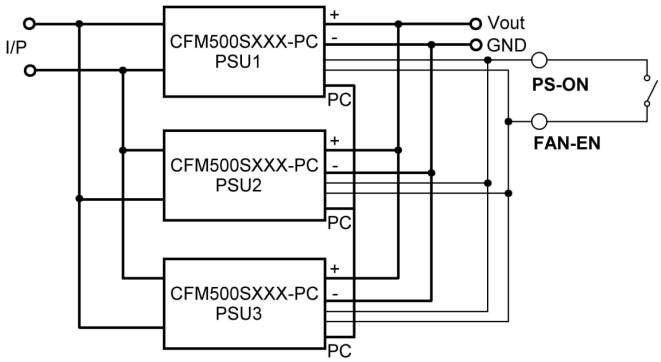
Pin	Function	Mating Housing
1	SGND	Samtec FFSD-06-01-N or equivalent
2	PMBus Clock	
3	PMBus Data	
4	PMBus Alert	
5	PMBus Addr2	
6	PMBus Addr1	
7	PS ON/OFF	
8	GND	
9	PG	
10	NA	
11	Vsns-	
12	Vsns+	

4.10 Parallel Operation Function (Option)

The parallel connection is shown in figure as below. The function of current sharing in parallel is connected by CN3 Pin7 (PC).



Connect the Pin4 (PS-ON) of CN3 of all PSUs to operate in parallel and start / stop at the same time.



- When the PSU is operating in parallel, the remote sense feature could not be used.
- Only PSUs with the same output voltage are allowed for parallel operation and ensure the output voltage at no-load is within 0.2V.
- The maximum of total power can't exceed 90% of rated total power. The value of total output current is defined as:

$$I_{o\_total} = I_{o\_rated} \times N \times 0.9$$

Where:

N is number of PSU

- T o ensure the parallel operation function is effective, it is suggested to use the remote on/off to control the PSUs synchronously while more than two PSUs.

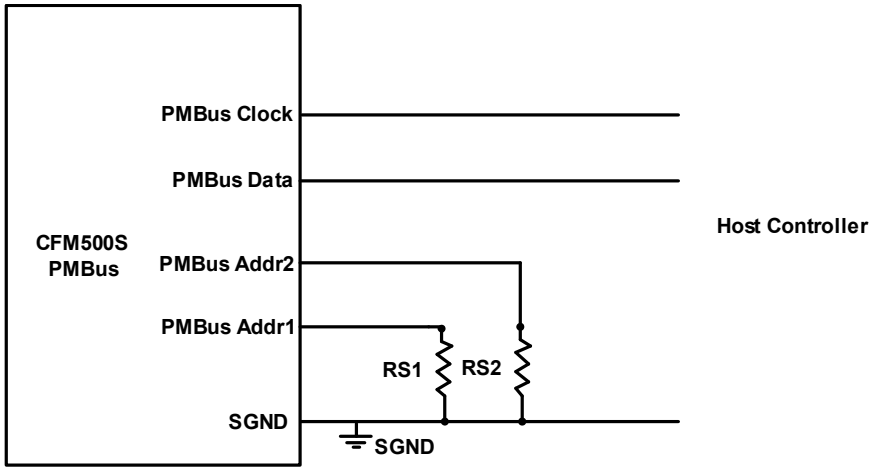
4.11 PMBus Function Commands (Option)

The table below lists the PMBus Function Commands.

Command Code	Command Name	Data Type	Number Of Data Bytes	Data Format	n	Instruction
01h	OPERATION	Write_Byte/ Read_Byte	1	Byte	---	turn the unit on and off in conjunction with the input from the CONTROL pin (Section 4.5)
19h	CAPABILITY	Read_Byte	1	Byte	---	provides a way for a host system to determine some key capabilities of a PMBus device
20h	VOUT_MODE	Read_Byte	1	Byte	---	whether the device uses the Linear, VID or Direct modes for output voltage related commands
88h	READ_VIN	Read_Word	2	Linear11	-10	returns the input voltage in volts
8Bh	READ_VOUT	Read_Word	2	Linear16	Vout_Mode	returns the actual, measured (not commanded) output voltage in the same format as set by the VOUT_MODE command
8Ch	READ_IOUT	Read_Word	2	Linear11	-10	returns the measured output current in amperes
8Dh	READ_TEMPERATURE_1	Read_Word	2	Int16	0	returns the temperature in degree Celsius
96h	READ_POUT	Read_Word	2	Linear11	---	returns the output power in watts
98h	PMBUS_REVISION	Read_Byte	1	Byte	---	stores or reads the revision of the PMBus to which the device is compliant
9Ah	MFR_MODEL	Block_Read	13	Byte	---	reads the manufacturer's model number.
C5h	MFR_PROGRAM_VER_0xC5	Read_Word	2	Int16	---	reads the manufacturer's revision number.

4.12 PMBus Address Selection(Option)

The PMBus connection is shown in figure as below.



The address for the PMBus is set using external resistors connected to the Addr pins.
The table below lists the resistor values for each PMBus address.

Address	Addr2(Ω)	Addr1(Ω)	Address	Addr2(Ω)	Addr1(Ω)	Address	Addr2(Ω)	Addr1(Ω)	Address	Addr2(Ω)	Addr1(Ω)
0*	-	-	25	6800	22000	50	22000	0	75*	-	-
1*	-	-	26	6800	30000	51	22000	3900	76	43000	30000
2*	-	-	27	6800	43000	52	22000	6800	77	43000	43000
3*	-	-	28	6800	62000	53	22000	11000	78	43000	62000
4*	-	-	29	6800	Open	54	22000	16000	79	43000	Open
5*	-	-	30	11000	0	55	22000	22000	80	62000	0
6*	-	-	31	11000	3900	56	22000	30000	81	62000	3900
7*	-	-	32	11000	6800	57	22000	43000	82	62000	6800
8*	-	-	33	11000	11000	58	22000	62000	83	62000	11000
9*	-	-	34	11000	16000	59	22000	Open	84	62000	16000
10*	-	-	35	11000	22000	60	30000	0	85	62000	22000
11*	-	-	36	11000	30000	61	30000	3900	86	62000	30000
12*	-	-	37	11000	43000	62	30000	6800	87	62000	43000
13	3900	11000	38	11000	62000	63	30000	11000	88	62000	62000
14	3900	16000	39	11000	Open	64*	-	-	89	62000	Open
15	3900	22000	40*	-	-	65*	-	-	90	Open	0
16	3900	30000	41	16000	3900	66*	-	-	91	Open	3900
17	3900	43000	42	16000	6800	67*	-	-	92	Open	6800
18	3900	62000	43	16000	11000	68*	-	-	93	Open	11000
19	3900	Open	44*	-	-	69	30000	Open	94	Open	16000
20	6800	0	45*	-	-	70	43000	0	95	Open	22000
21	6800	3900	46	16000	30000	71	43000	3900	96	Open	30000
22	6800	6800	47	16000	43000	72*	-	-	97*	-	-
23	6800	11000	48	16000	62000	73*	-	-	98	Open	62000
24	6800	16000	49	16000	Open	74*	-	-	99	Open	Open

Note:

1. All resistors should be 1% tolerance or better
2. (*) These addresses are reserved by the SMBus specification and cannot be used
3. If using reserved addresses (*), it will be assigned to address 127

4.13 PMBus Data Range and Tolerance(Option)

(All specifications are typical at 25℃ Ambient temperature unless otherwise noted.)

Display parameters

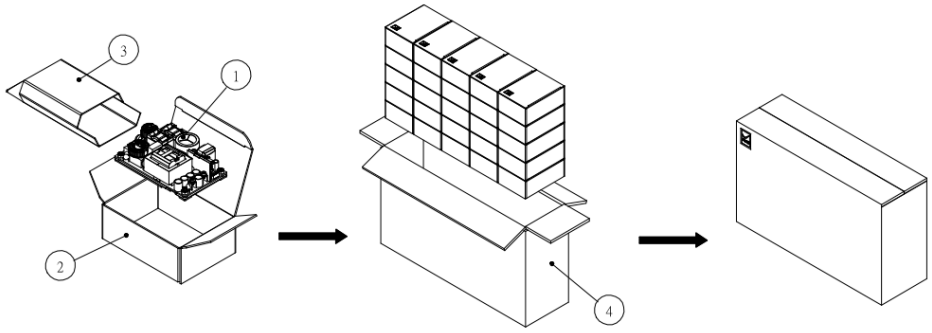
Command Code	Command Name	Model	Range	Tolerance
88h	READ_VIN	All	75~270V	±5V
8Bh	READ_VOUT	12V	0~16V	±0.12V
		18V	0~22.5V	±0.18V
		24V	0~30V	±0.24V
		28V	0~35V	±0.28V
		30V	0~35V	±0.3V
		36V	0~45V	±0.36V
		48V	0~60V	±0.48V
8Ch	READ_IOUT	12V	0~4.16A	±0.416A
			4.16~50A	
		18V	0~2.77A	±0.277A
			2.77~33.3A	
		24V	0~2.08A	±0.208A
			2.08~25A	
		28V	0~1.78A	±0.178A
			1.78~21.42A	
		30V	0~1.66A	±0.166A
			1.66~20A	
		36V	0~1.38A	±0.138A
			1.38~16.6A	
		48V	0~1.04A	±0.104A
			1.04~12.5A	
8Dh	READ_TEMPERATURE_1	All	-40~125℃	±5℃

Control Parameters

Command Code	Command Name	Model	Adjustable range	Default
01h	OPERATION	All	00h(OFF) / 80h(ON)	00h (OFF)
98h	PMBUS_REVISION	All	--	22h (Rev. 1.2)
C5h	MFR_PROGRAM_VER_0xC5	All	--	01h (V1.0)
9Ah	MFR_MODEL	12V	--	CFM500S120-PM
		18V		CFM500S180-PM
		24V		CFM500S240-PM
		28V		CFM500S280-PM
		30V		CFM500S300-PM
		36V		CFM500S360-PM
		48V		CFM500S480-PM

5. Packing Information

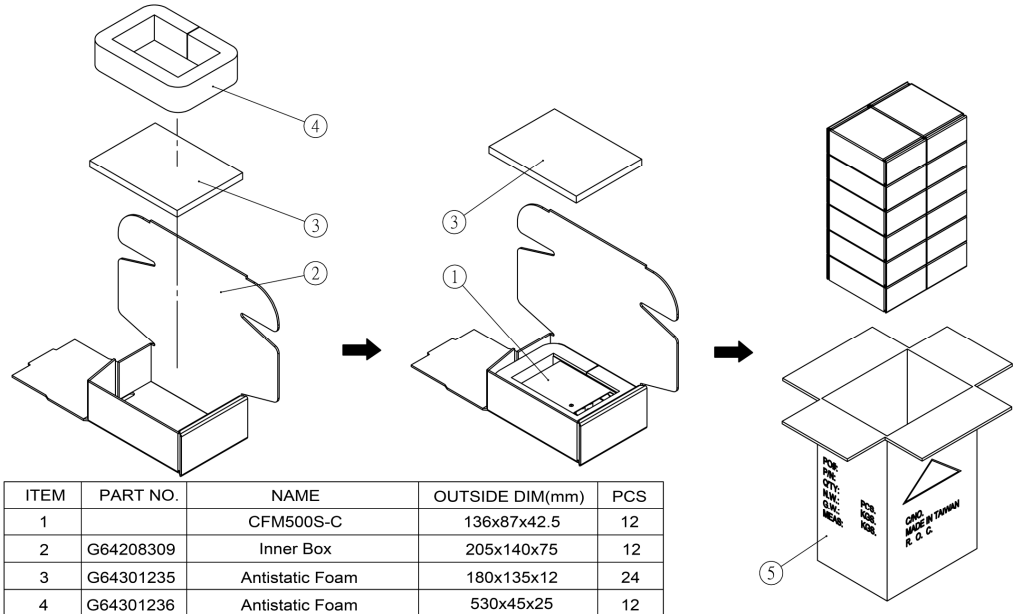
The packing information for CFM500SXXX is showing as follows:



ITEM	PART NO.	NAME	OUTSIDE DIM(mm)	PCS
1		CFM500SXXX 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 CFM500SXXXC is showing as follows:



ITEM	PART NO.	NAME	OUTSIDE DIM(mm)	PCS
1		CFM500S-C	136x87x42.5	12
2	G64208309	Inner Box	205x140x75	12
3	G64301235	Antistatic Foam	180x135x12	24
4	G64301236	Antistatic Foam	530x45x25	12
5	G64100141	No.47 Cardboard Box	309.1x239.4x475.7	1

Each Box Packaging 12 PCS Products
Gross weight Ref. 10 Kg

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