



<b>90-286V</b> Input Voltage	<b>30V</b> Output Voltage	<b>17A</b> Output Current	<b>510W</b> Max Power	<b>AC-DC</b> Converter
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The FM500 series is an independently regulated single output converter that uses the industry standard FULL brick package size. The very high efficiency is a result of ENARGY CORP patented topology that uses synchronous rectification and an innovative construction design to minimize heat dissipation and allow extremely high power densities. The power dissipated by the converter is so low that a heat sink is not required, which saves cost, weight, height, and application effort. All of the power and control components are mounted to the multi-layer PCB substrate with highyield surface mount technology, resulting in a more reliable product.

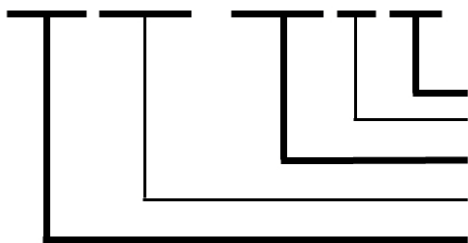
Key Features	
⊖	Output power: 510W
⊖	Wide input range: 90-286 Vac
⊖	High conversion efficiency: Up to 92%
⊖	Line regulation to $\pm 0.2\%$
⊖	Load regulation to $\pm 0.5\%$
⊖	Isolation Voltage :3000Vac
⊖	Input over voltage protection
⊖	Input under voltage lock-out
⊖	Enable (On/Off) Control
⊖	Output over-load protection
⊖	Hiccup mode short circuit protection
⊖	Over-temperature protection
⊖	Input under-voltage lock-out

Applications	
⊖	Industry control
⊖	Railway
⊖	Computing
⊖	Networking

Certification & Safety	
⊖	UL94V-0 flame-retarded rating
⊖	RoHS compliant

### Model Numbering System

# FM 500 - 220 S 30



- Output Voltage: "30" = 30V
- # of Outputs: "S" = Single
- Input Voltage Range: "220" = 90-284Vac
- Output Power Rating: "500" = 510W
- Product Family

## Electrical Characteristics

### Input Characteristics

Parameter	Min	Typ	Max	Units	Notes
Input voltage range	90		286	Vac	
Rated input voltage range		220		Vac	
Rated input voltage		115/230		Vac	
Input frequency range	46		66	Hz	
Rated AC input frequency		50/60		Hz	
Max. input current			6.5	A	Min. input voltage, full load
Input inrush current			40	A	Input 220Vac, 25°C, cold start
Enable Voltage Enable Source Current	-0.3		12	Vdc	
			3	mA	
Enable (On/Off Control) Positive Logic	2.4		12	Vdc	Off-Control, Logic high
	-0.3		0.7	Vdc	On-Control, Logic low or floating
Power factor		95		%	Full load
BC capacitance	330	440		μF	Low ESR electrolytic capacitors, Pressure ≥ 450V
	1			μF	Polypropylene capacitors

### Output Characteristics

Parameter	Min	Typ	Max	Units	Notes
Output voltage range	29.1	30	30.9	Vdc	
Output current range	0		17	A	
Line regulation		0.2		%	
Load regulation		0.5		%	
Temperature coefficient		±0.02		%/°C	
Ripple & Noise		350		mV	Typical input, full load, 20MHz bandwidth, 0.1μF ceramic capacitor and 10μF electrolytic capacitor
Dynamic response deviation			5	%	50% to 75% to 50% lout max, 0.1A/us
Dynamic response settling time			200	us	



Turn-on rise time	5	20	200	mS	Full load,10%~90% Vout
Turn-on delay time			5	S	90Vac, full load
Output voltage overshoot		0	5	%	
Output capacitance	470	3300	5000	μF	
Efficiency	90		92	%	Input=220Vac, full load ,Ta=25°C
Primary side auxiliary Vcc	11.5		14.5	Vdc	Source current limited 50mA
Secondary auxiliary Vdd	9		12	Vdc	Source current limited 20mA
Trim	Trim-up		≤+10	%	
	Trim-down		≤-20	%	

**Protection Characteristics**

Parameter		Min	Typ	Max	Units	Notes
Input under voltage lock out	Turn-on voltage threshold	80	85	90	Vac	Full load, Ta=25°C
	Turn-off voltage threshold	70	75	80	Vac	
Input over voltage protection	Protect voltage	300	310	315	Vac	
	Recovery voltage	285	290	295	Vac	
Output over voltage protection		35		40	Vdc	
Output over load protection		19		25	A	Hiccup
Short – Circuit Protection				10	mΩ	Hiccup
Over-temperature protection	Shutdown	100	105	120	°C	Auto recovery
	Hysteresis		10		°C	

**General Characteristics**

Parameter	Min	Typ	Max	Units	Notes
MTBF	1			MHrs	Rated input, full load,25°C
Weight		205		g	

### Environmental Characteristics

Parameter	Min	Typ	Max	Units	Notes
Operating temperature	-40		+85	°C	Figure 1
Storage temperature	-55		+125	°C	
Relative humidity	20		90	%	
Storage humidity	10		95	%	non-condensing
Altitude			5000	m	

### Safety Characteristics

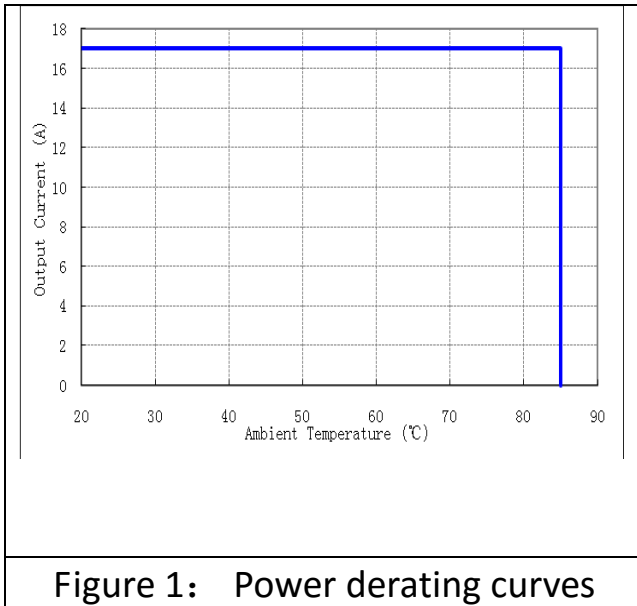
Parameter	Min	Typ	Max	Units	Notes
Isolation voltage	Input to output		3000Vac	Vac	5mA/1min, No arcing and breakdown
	Input to ground		2500Vac	Vac	
	Output to ground		500Vdc	Vdc	5mA/1min, No arcing and breakdown
Isolation resistance	Input to output		10	MΩ	500Vdc/1min, normal atmospheric pressure, 90% humidity
Leakage current	Output to ground		0.2	mA	

### EMC Characteristics

Item	Standards	Conditions	Notes
CE	EN55022	Class A	Pass system test
RE	EN55022	Class A	Pass system test

### Standards compliance

Parameter	Notes
UL/UL60950	
IEC60601-1	
IEC/EN62368-1	
GB4943	
IEC 695-2-2	Needle flame test, test on entire assembly, board&plastic components UL94V-0 compliant



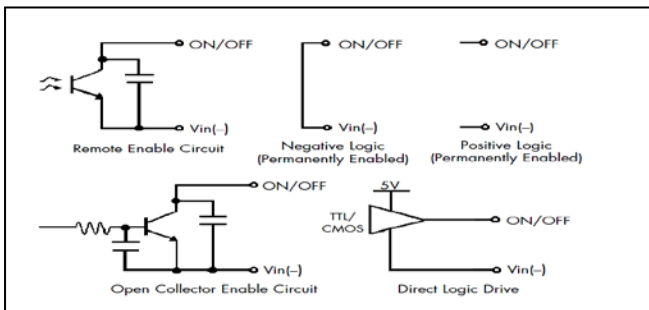
## Function Specifications

### Enable (ON/OFF) Control (Pin 12):

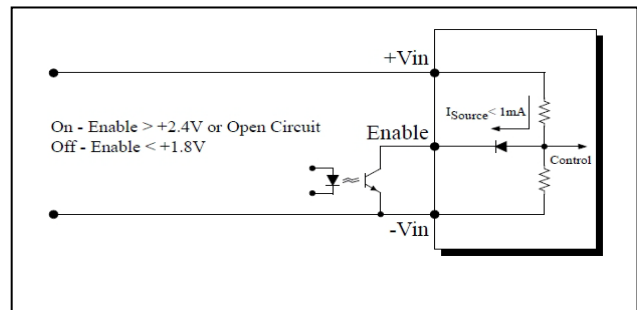
The Enable pin allows the power module to be switched on and off electronically. The Enable (On/Off) function is useful for conserving battery power, for pulsed power application or for power up sequencing.

The Enable pin is referenced to the -Vin. It is pulled up internally, so no external voltage source is required. An open collector (or open drain) switch is recommended for the control of the Enable pin.

When using the Enable pin, make sure that the reference is really the -Vin pin, not ahead of EMI filtering or remotely from the unit. Optically coupling the control signal and locating the opto coupler directly at the module will avoid any of these problems. If the Enable pin is not used, it can be left floating (positive logic) or connected to the -Vin pin (negative logic). **Figure A** details five possible circuits for driving the ON/OFF pin. **Figure B** is a detailed look of the internal ON/OFF circuitry.



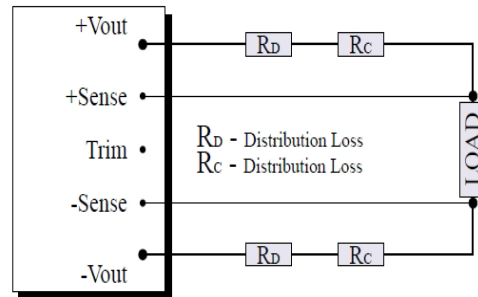
**Figure A:** Various circuits for driving the ON/OFF pin.



**Figure B:** Internal ON/OFF pin circuitry

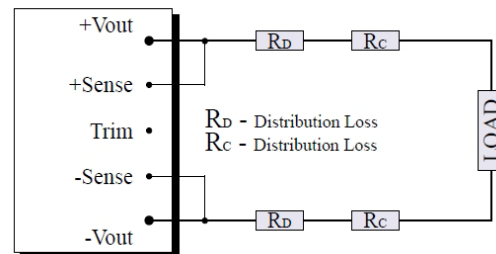
## Remote Sensing (Pins 8 and 9)

Remote sensing allows the converter to sense the output voltage directly at the point of load and thus automatically compensates the load conductor distribution & contact losses (Figure C). There is one sense lead for each output terminal, designated +Sense and -Sense. These leads carry very low current compared with the load leads. Internally a resistor is connected between sense terminal and power output terminal. If the remote sense is not used, the sense leads need to be shorted to their respective output leads (Figure D).



**Figure C:** Remote Sense Connection

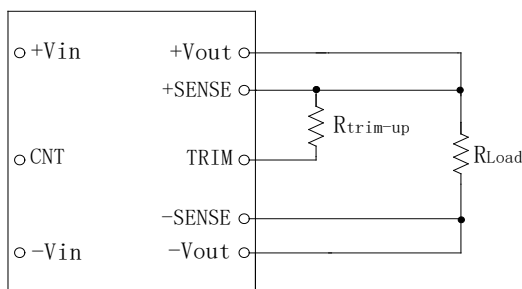
Care has to be taken when making output connections. If the output terminals should disconnect before the sense lines, the full load current will flow down the sense lines and damage the internal sensing resistors. Be sure to always power down the converter before making any output connections. The maximum compensation voltage for line drop is up to 107% Vout



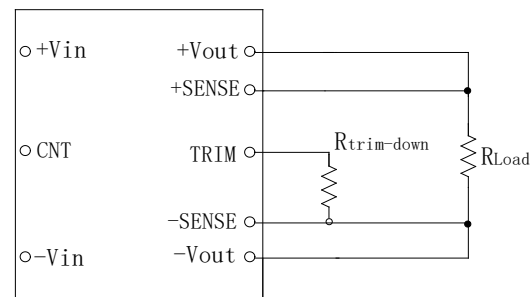
**Figure D:** Remote Sense is not used

## Voltage Trim (Pin 7)

Output voltage can be adjusted up or down with an external resistor. There are positive trim logic and negative trim logic available. For positive logic, the output voltage will increase when an external trimming resistor is connected between the Trim and +Vout/+Sense pin. The output voltage will decrease when an external trimming resistor is connected between Trim and -Vout/-Sense pin. A multi-turn 20K  $\Omega$  trim pot can also be used to adjust the output voltage up or down (Figure E & F). output voltage in 66.6% – 107% Vout confine



**Figure E:** Trim-Up



**Figure F:** Trim-Down

## Protection Features

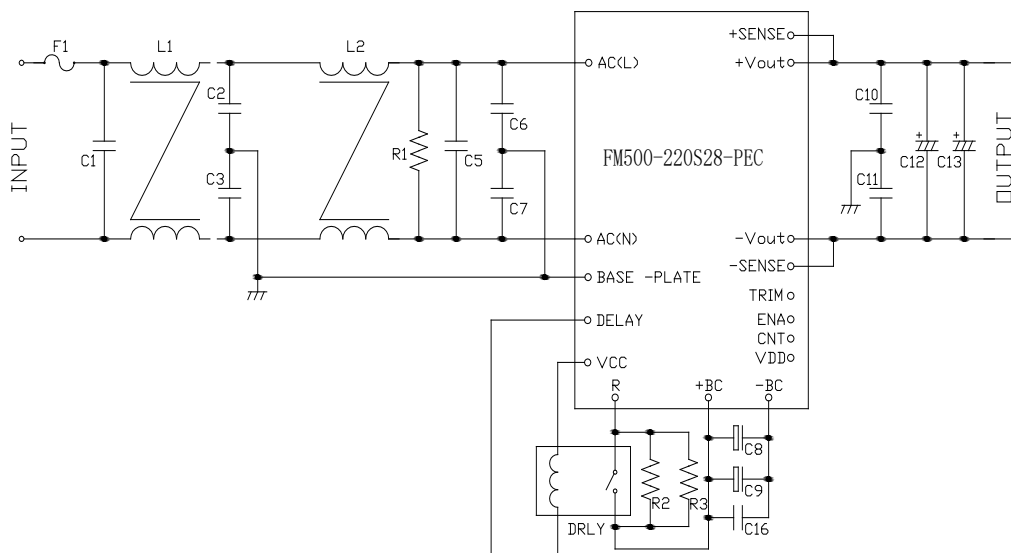
- **Input Under-Voltage Lockout:** The converter is designed to turn off when the input voltage is too low, helping avoid an input system instability problem. The lockout circuitry is a comparator with DC hysteresis. When the input voltage is rising, it must exceed the typical Turn-On Voltage Threshold value (listed on the specification page) before the converter will turn on. Once the converter is on, the input voltage must fall below the typical Turn-Off Voltage Threshold value before the converter will turn off.

- **Output Current Limit:** The maximum current limit remains constant as the output voltage drops. However, once the impedance of the short across the output is small enough to make the output voltage drop below the specified Output DC Current-Limit Shutdown Voltage, the converter enters hiccup mode indefinite short circuit protection state until the short circuit condition is removed. This prevents excessive heating of the converter or the load board.

- **Over-Temperature Shutdown:** A temperature sensor on the converter senses the average temperature of the module. The thermal shutdown circuit is designed to turn the converter off when the temperature at the sensed location reaches the Over-Temperature Shutdown value. It will allow the converter to turn on again when the temperature of the sensed location falls by the amount of the Over-Temperature Shutdown Restart Hysteresis value.

## Typical Application and Design Consideration

### Typical application circuit



**Figure G:** Typical application circuit



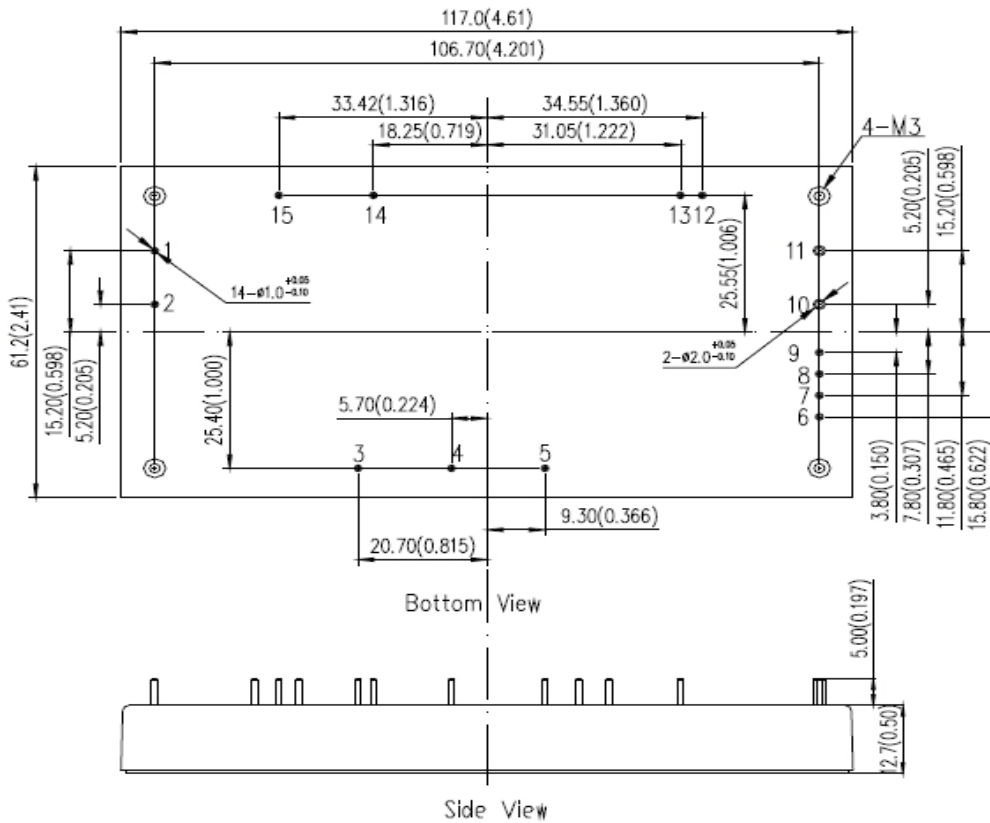
Outside the component

F1	AC250V 10A fuse	C12	470uF 63V capacitor
C1	AC250V 1uF X2 capacitor	C13	0.1uF 63V capacitor
C2、C3	2200pF 250VAC Y2 capacitor	C16	1 uF 630V capacitor
C5	AC250V 1uF X2 capacitor	R1	2W 470K Resistance
C6、C7	2200pF 250VAC Y2 capacitor	R2, R3	330R/3W Resistance
C8、C9	450V 220uF capacitor	L1、L2	6.0mH Common mode inductor
C10、C11	4700pF 250VAC Y2 capacitor	DRLY	12VDC, 10A/250VAC relay

Physical Information

Mechanical Outline

Length×width×height: (4.61×2.41×0.50) (inch)



注：未标尺寸公差：X.X mm = ±0.5 mm (X.XX in = ±0.02 in)  
 X.XX mm = ±0.25 mm (X.XXX in = ±0.010 in)



**Pin Designations**

Pin No.	Name	Function
1	AC (N)	AC Input N line
2	AC (L)	AC Input L line
3	R	PFC BOOST OUTPUT
4	+BC	Positive high pressure DC
5	-BC	Negative high pressure DC
6	ENA	Power OK
7	TRIM	Output voltage trim. Leave TRIM pin open for nominal output voltage.
8	+S	Positive remote sense. SENSE(+) may be connected to Vout(+) or left open.
9	-S	Negative remote sense. SENSE(-) may be connected to Vout(-) or left open.
10	+V	Positive output voltage
11	-V	Negative output voltage
12	CNT	TTL input to turn converter on and off, referenced to Vin(-), with internal pull up.
13	+VDD	Auxiliary power supply
14	DELAY	Relay control terminal
15	VCC	Auxiliary power supply

**Notes:**

- Specifications subject to change without notice.
- All dimensions in mm(inches), tolerance is  $\pm 0.5\text{mm}(\pm 0.02")$ .
- Warranty: 2 years.
- Specifications are for convection rating at factory settings at 230Vac input, 25°C unless otherwise stated.

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