

Part II – DC-to-DC Converters

LAMBDA'S P SERIES



The Most Complete Line of Easy-To-Use High-Density DC-DC Modules – At the Lowest Cost

Lambda's new P Series is a revolutionary new family of power converters designed specifically for off-line switching 300VDC and 48VDC input power requirements. It features the highest density (31W/in³) and lowest cost (\$167 qty 100) 300W converter, as well as power factor and harmonic correction modules that current share and operate in a redundant mode.

The P Series features 72 PH Series DC-DC converters, 2 PF Series power factor harmonic correction modules (500W, 1000W), 1 PR Series input rectifier module (500W), 2 PN Series EMI filters (500W, 1000W), heatsinks, thermal pads, PC board sockets, and module evaluation kits.

This is the largest launch of power converters and accompanying accessories ever seen in the worldwide power supply market. Such a complete and broad range of choices affords the design engineer the freedom of immediately tailoring components to his specific power system needs.

P SERIES FEATURES

Low Cost From 55¢/W (Qty 100)	Lambda's low-cost P Series power modules are specifically designed for cost sensitive applications.
Broad Product Range with 48V and 300V Inputs	The P Series is available in 50W, 75W, 100W, 150W, and 300W models, in simple and full function packages, allowing systems to be tailored to specific power requirements.
500W and 1000W PFC Front Ends for N + 1 Operation	Provides a reduction in time to market for medium-high power systems that require power factor correction (IEC 555-2) and increased up-time for redundant power systems.
Input EMI and Rectifier Modules	Designed for off-line switching applications, Lambda's PN and PR Series offer all the necessary components to quickly finalize power solutions.
Fixed Frequency Operation	Simplifies input and output filtering requirements.
Highest Efficiency	High efficiency reduces the size of the heatsink, thereby reducing the effective power supply size. High efficiency reduces hot spot temperatures, thereby increasing overall system reliability.
Standard 2V & 3V Modules to 70% Efficiency	Reduced dissipation in end equipment provides increased reliability for systems using low-voltage logic.
High Density	High density (to 31 W/in ³) combined with high efficiency reduces system power supply volume and frees up valuable printed circuit board real-estate for reduced system size.
- 60% to + 20% Output Voltage Adjustment	Wide range adjustability allows standard full function modules to be used for any desired output voltage, or wide range margining for system diagnostic and testing requirements.
System Interface Signals	AC Power Fail, Auxiliary Power Supply (8V @ 10mA), Inverter Good, and Remote On/Off signals are designed for N, N + 1 redundant, or fault tolerant systems. They reduce the overall design cycle time for low-risk, high-reliability power systems.
Unique Approach to N + 1 Current Sharing	No single module failure or interruption of the current share signal will bring the system down.
Complete Line of Accessories	Heatsinks, thermal pads, PC board sockets and evaluation kits make the P Series even easier to use.
Meets Worldwide Safety Requirements	Safety Agency approvals for UL, CSA, TUV, and BABT make Lambda's P Series ideal for use in worldwide applications.

PH SERIES SPECIFICATIONS

DC Input

200 – 400VDC for 280V modules.
36 – 76VDC for 48V modules.

Efficiency

Package Model	Efficiency						
	2V	3V	5V	12V	15V	24V	28V
PH50S	–	–	81%	83%	85%	85%	85%
PH75S	–	–	81%	83%	85%	85%	85%
PH100S	–	–	82%	85%	85%	88%	88%
PH150S	–	–	82%	85%	85%	88%	88%
PH75F	68%	70%	81%	83%	85%	85%	85%
PH150F	68%	73%	83%	85%	87%	90%	90%
PH300F	68%	73%	83%	85%	87%	90%	90%

DC Output

Full Function Modules2, 3, 5, 12, 15, 24, 28V.
Simple Function Modules . . .5, 12, 15, 24, 28V.

Regulated Voltage

regulation, line0.4% or 20mV (whichever is greater) over entire input range with constant load.
regulation, load0.8% or 40mV (whichever is greater) from no load to full load with constant input line.
temperature coefficient0.02%/°C.
ripple and noise100mV pk-pk on 2V, 3V and 5V models.
150mV pk-pk on 12V and 15V models.
240mV pk-pk on 24V models.
280mV pk-pk at 20MHz on 28V models.

Remote Sensing

Sensing connections are provided to compensate for resistive drops in the output trace/leads. (Not available on the PH50S or PH75S modules.)

Output Voltage Adjustment

The output voltage can be programmed by an external potentiometer or voltage source ($\pm 10\%$ on Simple Function Modules, $+20/-60\%$ ($\pm 20\%$ on 2V and 3V models) on Full Function Modules). Adjustment below the -60% range is possible with the appropriate preload. Consult the factory for further details.

Overtemperature Protection

Inverter shutdown protects the converters against excessive temperatures. Input power must be recycled to restore operation.

Overcurrent Protection

105% – 140% constant current, with automatic recovery.

Overvoltage Protection

2V and 3V models: 165% – 240%.
5V – 28V models: 125% – 145%.
Inverter shutdown.
Input power must be recycled to restore operation.

Remote On/Off Signal

Short terminal CNT to SG to turn on.
Open circuit to turn off.

Inverter Good Signal

Full function modules provide an inverter good status at the IOG terminal when the module is healthy.

Parallel Operation

Single star point connection of PC terminal enables modules to share current. Available on full function modules only.

Series Operation

The P Series can be operated in series. Refer to the Instruction Manual for detailed requirements.

Auxiliary Supply

Full function modules have an auxiliary bias supply (8V at 10mA) which can be used to power interface circuits (i.e., optocouplers).

Isolation Rating

Input to output: 3000VAC.
Input to baseplate: 2500VAC.
Output to baseplate: 100M Ω at 500VDC 70% RH.

Cooling

All models are conduction cooled.
Contact the factory for heatsink recommendations.

Operating Temperature Range

Operation from -20°C to $+85^{\circ}\text{C}$ baseplate.

Storage Temperature Range

Storage from -40°C to $+85^{\circ}\text{C}$.

Accessories

Heatsink, thermal pads, evaluation kits, PC board sockets, application notes. Contact the factory for further information.

Safety Agency Approvals

The PH Series is under evaluation for UL, CSA, VDE, BABT.

Physical Data

Package Model	Weight (grams)	Dimensions (inches)
PH50S	100	3.38 x 1.61 x 0.5
PH75S	100	3.38 x 1.61 x 0.5
PH100S	150	3.38 x 2.44 x 0.5
PH150S	150	3.38 x 2.83 x 0.5
PH75F	150	3.38 x 2.44 x 0.5
PH150F	180	3.38 x 3.27 x 0.5
PH300F	250	3.38 x 5.75 x 0.5

Guarantee

One year guarantee includes labor as well as parts.
Guarantee applies to operation within published specifications and recommended application data at the end of one year.

DC-to-DC Converters

Industrial Converter Ratings Table – Single Output

MAX CURRENT (AMPS) AT BASEPLATE TEMPERATURE OF 85°C	MAX POWER (WATTS) AT AMBIENT TEMPERATURE OF 85°C	V _{out} ADJ. RANGE	COMPLETE ELEC. SPEC. PG.	UNIT PRICE PER DELIVERED QUANTITY				MODEL	
				1	10	25	100	48V INPUT	280V INPUT
SIMPLE FUNCTION!									
5V OUTPUT									
10.0	50.0	4.5-5.5	111	\$ 69	\$ 66	\$ 62	\$ 56	PH50S48-5	PH50S280-5
15.0	75.0	4.5-5.5	111	76	72	69	62	PH75S48-5	PH75S280-5
20.0	100.0	4.5-5.5	111	92	87	83	75	PH100S48-5	PH100S280-5
30.0	150.0	4.5-5.5	111	105	100	95	85	PH150S48-5	PH150S280-5
12V OUTPUT									
4.2	50.0	10.8-13.2	111	69	66	62	56	PH50S48-12	PH50S280-12
6.3	75.0	10.8-13.2	111	76	72	69	62	PH75S48-12	PH75S280-12
8.4	100.0	10.8-13.2	111	92	87	83	75	PH100S48-12	PH100S280-12
12.5	150.0	10.8-13.2	111	105	100	95	85	PH150S48-12	PH150S280-12
15V OUTPUT									
3.4	50.0	13.5-16.5	111	69	66	62	56	PH50S48-15	PH50S280-15
5.0	75.0	13.5-16.5	111	76	72	69	62	PH75S48-15	PH75S280-15
6.7	100.0	13.5-16.5	111	92	87	83	75	PH100S48-15	PH100S280-15
10.0	150.0	13.5-16.5	111	105	100	95	85	PH150S48-15	PH150S280-15
24V OUTPUT									
2.1	50.0	21.6-26.4	111	69	66	62	56	PH50S48-24	PH50S280-24
3.2	75.0	21.6-26.4	111	76	72	69	62	PH75S48-24	PH75S280-24
4.2	100.0	21.6-26.4	111	92	87	83	75	PH100S48-24	PH100S280-24
6.3	150.0	21.6-26.4	111	105	100	95	85	PH150S48-24	PH150S280-24
28V OUTPUT									
1.8	50.0	25.2-30.8	111	69	66	62	56	PH50S48-28	PH50S280-28
2.7	75.0	25.2-30.8	111	76	72	69	62	PH75S48-28	PH75S280-28
3.6	100.0	25.2-30.8	111	92	87	83	75	PH100S48-28	PH100S280-28
5.4	150.0	25.2-30.8	111	105	100	95	85	PH150S48-28	PH150S280-28

NOTES: 1Simple Function P Series modules feature $\pm 10\%$ adjustability.

DC to DC Converters

Industrial Converter Ratings Table – Single Output

MAX CURRENT (AMPS) AT BASEPLATE TEMPERATURE OF 85°C	MAX POWER (WATTS) AT AMBIENT TEMPERATURE OF 85°C	V _{out} ADJ. RANGE	COMPLETE ELEC. SPEC. PG.	UNIT PRICE PER DELIVERED QUANTITY				MODEL	
				1	10	25	100	48V INPUT	280V INPUT
FULL FUNCTION!									
2V OUTPUT									
15.0	30.0	1.60-2.40	111	\$ 95	\$ 90	\$ 86	\$ 77	PH75F48-2	PH75F280-2
30.0	60.0	1.60-2.40	111	130	124	117	106	PH150F48-2	PH150F280-2
60.0	120.0	1.60-2.40	111	205	195	185	167	PH300F48-2	PH300F280-2
3V OUTPUT									
15.0	45.0	2.40-3.60	111	95	90	86	77	PH75F48-3	PH75F280-3
30.0	90.0	2.40-3.60	111	130	124	117	106	PH150F48-3	PH150F280-3
60.0	180.0	2.40-3.60	111	205	195	185	167	PH300F48-3	PH300F280-3
5V OUTPUT									
15.0	75.0	2.00-6.00	111	95	90	86	77	PH75F48-5	PH75F280-5
30.0	150.0	2.00-6.00	111	130	124	117	106	PH150F48-5	PH150F280-5
60.0	300.0	2.00-6.00	111	205	195	185	167	PH300F48-5	PH300F280-5
12V OUTPUT									
6.3	75.0	4.80-14.40	111	95	90	86	77	PH75F48-12	PH75F280-12
12.5	150.0	4.80-14.40	111	130	124	117	106	PH150F48-12	PH150F280-12
25.0	300.0	4.80-14.40	111	205	195	185	167	PH300F48-12	PH300F280-12
15V OUTPUT									
5.0	75.0	6.00-18.00	111	95	90	86	77	PH75F48-15	PH75F280-15
10.0	150.0	6.00-18.00	111	130	124	117	106	PH150F48-15	PH150F280-15
20.0	300.0	6.00-18.00	111	205	195	185	167	PH300F48-15	PH300F280-15
24V OUTPUT									
3.2	75.0	9.60-28.80	111	95	90	86	77	PH75F48-24	PH75F280-24
6.3	150.0	9.60-28.80	111	130	124	117	106	PH150F48-24	PH150F280-24
12.6	300.0	9.60-28.80	111	205	195	185	167	PH300F48-24	PH300F280-24
28V OUTPUT									
2.7	75.0	11.20-33.60	111	95	90	86	77	PH75F48-28	PH75F280-28
5.4	150.0	11.20-33.60	111	130	124	117	106	PH150F48-28	PH150F280-28
10.8	300.0	11.20-33.60	111	205	195	185	167	PH300F48-28	PH300F280-28

NOTES: 1 Full Function P Series modules are designed with the following standard features: Current Sharing Operation, N + 1 Redundancy; Inverter Good and Remote on/off System Interface Signals; Wide Range Output Adjustment of - 60% to ± 20%.

INDUSTRIAL CONVERTER ACCESSORIES

PF SERIES Power Factor/Harmonic Correction Modules

- 0.95 Power Factor – IEC555-2 Compliant
- Aux. Power Supply/System Interface Signals
- N + 1 Redundant Operation

PR SERIES Rectifier Modules

- Low Profile of 0.5"
- Conduction Cooled
- System Interface Signals

PN SERIES EMI Filters

- Reduces Conducted EMI
- Low Leakage < 1mA
- Low Profile/Conduction Cooled

MODEL	OUTPUT		COMPLETE ELEC. SPEC. PG.	UNIT PRICE PER DELIVERED QUANTITY		
	85-265 VAC	187-265 VAC		1	10	100
PF SERIES POWER FACTOR/HARMONIC CORRECTION MODULES						
PF500F-360	504W	756W	110	\$125	\$119	\$102
PF1000-360	1008W	1512W	110	175	166	142
PR SERIES RECTIFIER MODULES						
PR500-280	500W	750W	110	45	43	37
PN SERIES EMI FILTERS						
PN3207	7A	—	110	34	32	28
PN3215	15A	—	110	45	43	37

MODEL	HEIGHT (mm)	WIDTH (mm)	FIN DIRECTION	FOR USE WITH THESE MODELS	UNIT PRICE PER DELIVERED QUANTITY
					1-25
PAH SERIES HEATSINKS KITS					
PAH41L12	12	41	Lengthwise	PH50S, PH75S	\$15
PAH62L12	12	62	Lengthwise	PH75F, PH100S, PN3207	16
PAH72L12	12	72	Lengthwise	PH150S	18
PAH83L12	12	83	Lengthwise	PH150F, PF500, PN3215, PR500	18
PAH146L12	12	146	Lengthwise	PH300F, PF1000	21
PAH146W12	12	146	Widthwise	PH300F, PF1000	21
PAH41L23	23	41	Lengthwise	PH50S, PH75S	17
PAH62L23	23	62	Lengthwise	PH75F, PH100S, PN3207	18
PAH72L23	23	72	Lengthwise	PH150S	20
PAH83L23	23	83	Lengthwise	PH150F, PF500, PN3215, PR500	20
PAH146L23	23	146	Lengthwise	PH300F, PF1000	25

*Kit includes heatsink, thermal pad, mounting hardware

MODEL	WIDTH (mm)	FOR USE WITH THESE MODELS	PACKAGE PRICE PER DELIVERED QUANTITY*
			1-25
PATP SERIES THERMAL PADS			
PATP41	41	PH50S, PH75S	\$18
PATP62	62	PH75F, PH100S	20
PATP72	72	PH150S	21
PATP83	83	PH150F, PF500	22
PATP146	146	PH300F, PF1000	28

*10 per package

MODEL	DESCRIPTION	PACKAGE PRICE PER DELIVERED QUANTITY*
		1-25
PAS SERIES PIN SOCKETS		
PASHC	HIGH CURRENT PIN SOCKET	\$24
PASLC	LOW CURRENT PIN SOCKET	18

*10 per package

Part II – DC-to-DC Converters

PR, PF, PN SERIES SPECIFICATIONS

PF Series – Power Factor/Harmonic Correction Modules

PR Series – Rectifier Modules

PN Series – EMI Filters

AC Input

line 85-265VAC on PF modules.
85-132VAC or 170-265VAC manual
selectable on PR module.
47-63Hz.

Efficiency

Package Model	100VAC	Efficiency	200VAC
PF500-360	90%		94%
PF1000-360	90%		94%
PR500-280	95%		95%

Output Voltage

PR modules are unregulated.
regulation, line 5V typical with constant load on PF
modules.
regulation, load 10V typical with constant line on PF
modules.
temperature coefficient 0.02%/°C (–10°C to +60°C).
ripple and noise Dependent on the output capacitor.

Output Power

Package Model	85-132VAC		85-265VAC		170-265VAC	
	Power (W)	Current (A)	Power (W)	Current (A)	Power (W)	Current (A)
PF500-360	–	–	504	1.4	756	2.1
PF1000-360	–	–	1008	2.8	1512	4.2
PR500-280	500	2.1	–	–	750	3.1

Output Current

7A on the PN3207.
15A on the PN3215.

Power Factor

95% minimum at full load on PF modules.

Harmonic Correction

The PF modules are compliant to IEC 555-2 and EN60555-2.

Overshoot Protection

390-400VDC on PF modules. Inverter shutdown. Input power must be recycled to restore operation.

Overcurrent Protection

Inverter shutdown on PF modules limits the current to a safe level.

Overtemperature Protection

Inverter shutdown on PF modules protects against excessive temperatures. Input power must be recycled to restore operation.

In-rush Current Limiting

Value programmable using an external resistor.

Parallel Operation

Single star point connection of PC terminal enables modules to current and stress share on PF modules.

Inverter Good Signal

PF Series provides an inverter good status at the IOG terminal when the module is operational.

Enable Output Signal

The ENA terminal is provided to control the DC-DC converters during start-up and guarantee proper start-up when power is applied.

DC Output Good

Low voltage sense is provided on PR modules to monitor the DC output voltage.

AC Power Fail

ACF terminal is provided on PR modules for AC fail detection.

Auxiliary Supply

The PF Series has an auxiliary bias supply (15V at 10mA), which can be used to power interface circuits (i.e., optocouplers).

Isolation Rating

Input to output: Not isolated.
Input to baseplate: 3000VAC.
Input and output to baseplate: 1000MΩ at 500VDC 70% RH.

Cooling

Conduction cooled, no fans or blowers needed.
Contact the factory for heat sinking recommendations.

Operating Temperature Range

Operation from –20°C to +85°C baseplate.

Storage Temperature Range

–40°C to +85°C.

External Components Required

Application notes are available to guide selection of external components.

Hold-up Capacitors: External hold-up capacitors are required. Capacitors may be selected to meet individual hold-up requirements and specific form factors.

In-rush Limiting Resistor: In-rush current value can be programmed using an external resistor.

Fuse, EMI Filter: An input fuse is essential. The EMI filter is recommended but optional.

Safety Agency Approvals

The PR, PF and PN Series are presently under evaluation for UL, CSA, VDE, BABT.

Accessories

Heat sink, thermal pads, evaluation kits, PC board sockets, application notes. Contact the factory for further information.

Physical Data

Package Model	Weight (grams)	Dimensions (inches)
PF500-360	130	3.38 x 3.27 x 0.5
PF1000-360	200	3.38 x 5.75 x 0.5
PR500-280	140	3.38 x 3.27 x 0.5
PN3207	100	3.38 x 2.44 x 0.5
PN3215	140	3.38 x 3.27 x 0.5

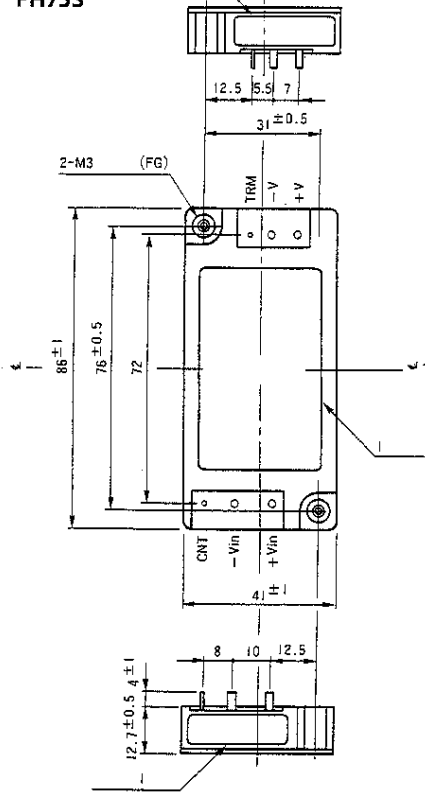
Guarantee

One year guarantee includes labor as well as parts. Guarantee applies to operation within published specifications and recommended application data at the end of one year.

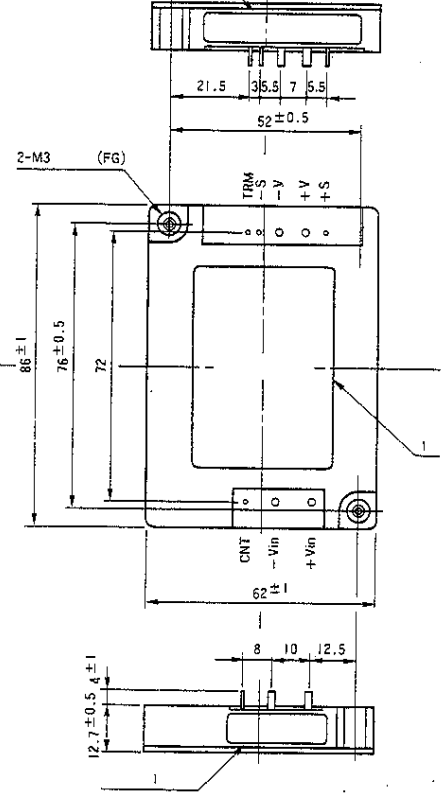
Part II – DC-to-DC Converters

P SERIES MECHANICAL DRAWINGS

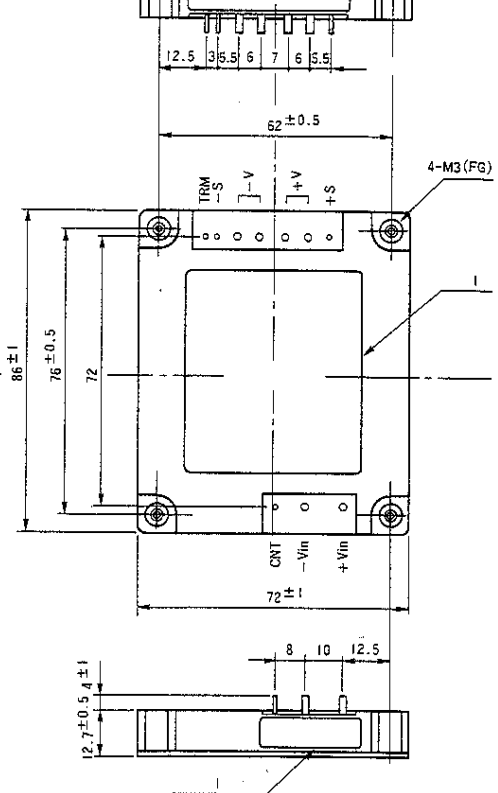
PH50S
PH75S



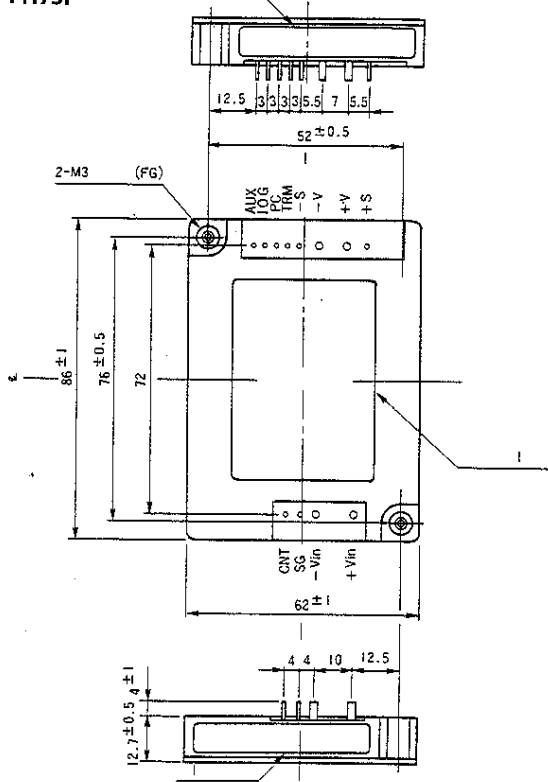
PH100S



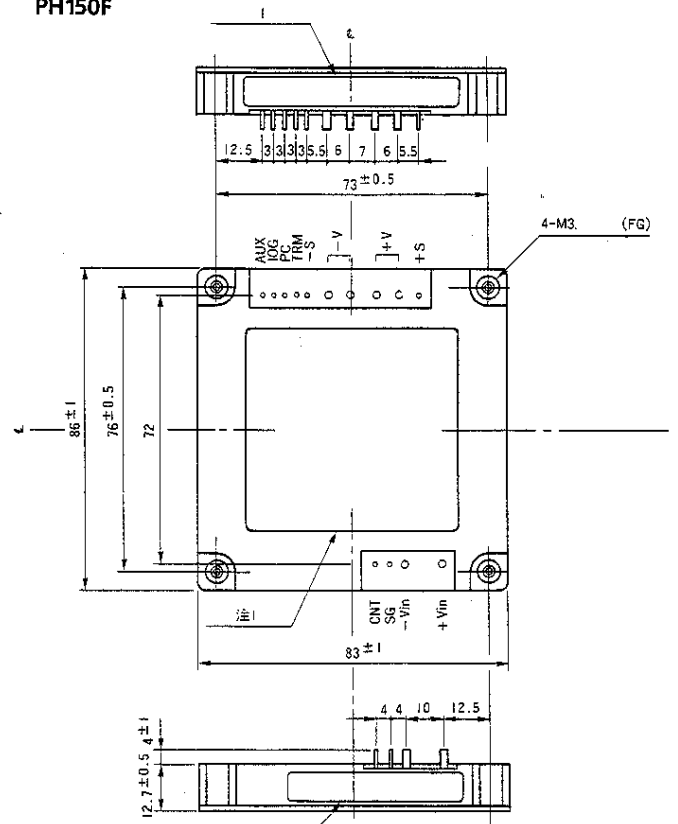
PH150S



PH75F



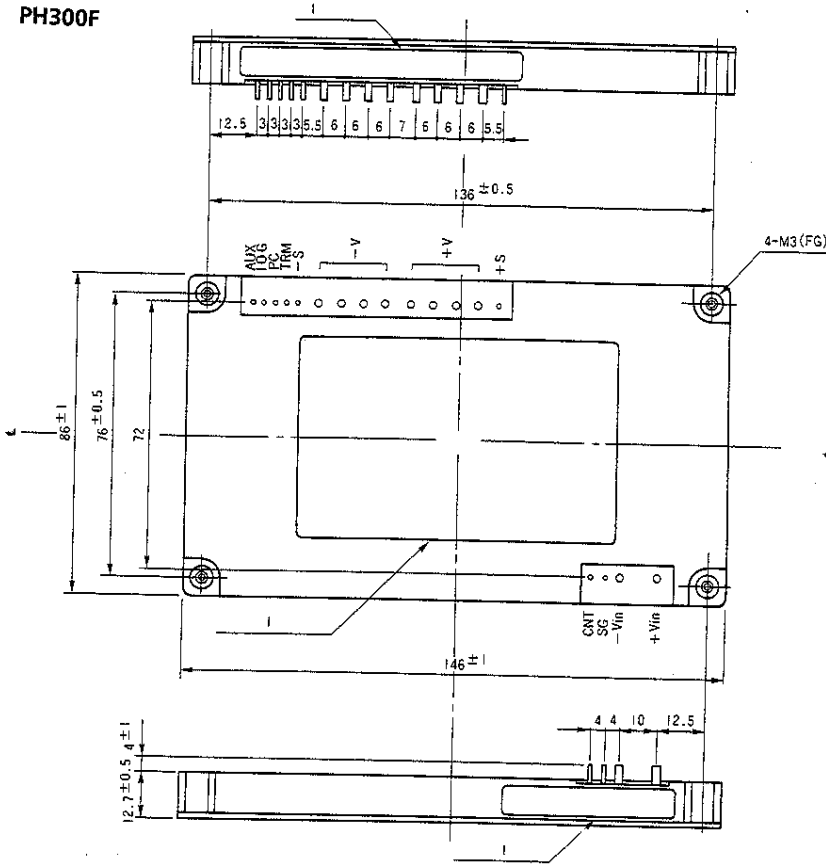
PH150F



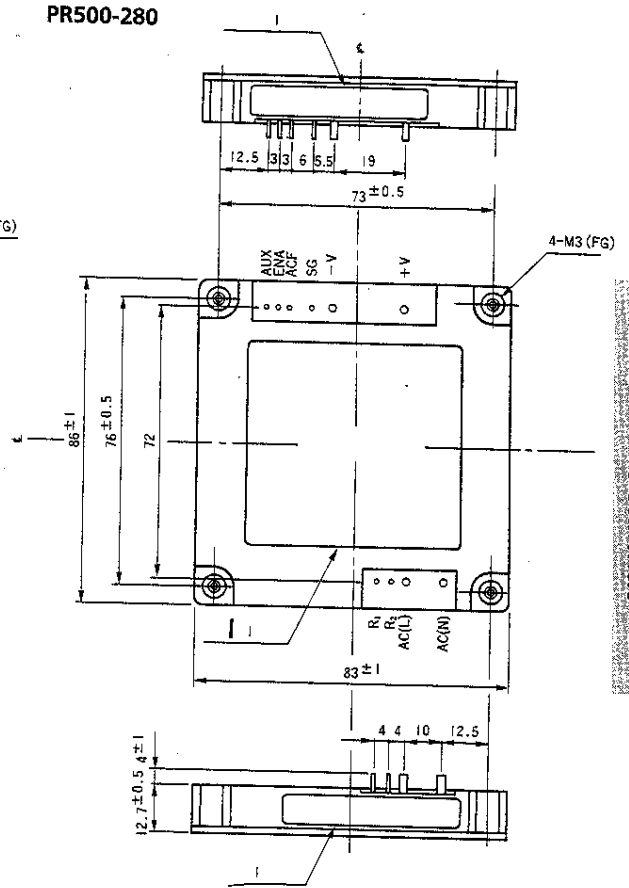
- Notes:
 1. Model number and Pin Labeling.
 2. Small Pins 0.6mm
 Large Pins 2.0mm
 3. All Dimensions are in mm.

P SERIES MECHANICAL DRAWINGS

PH300F

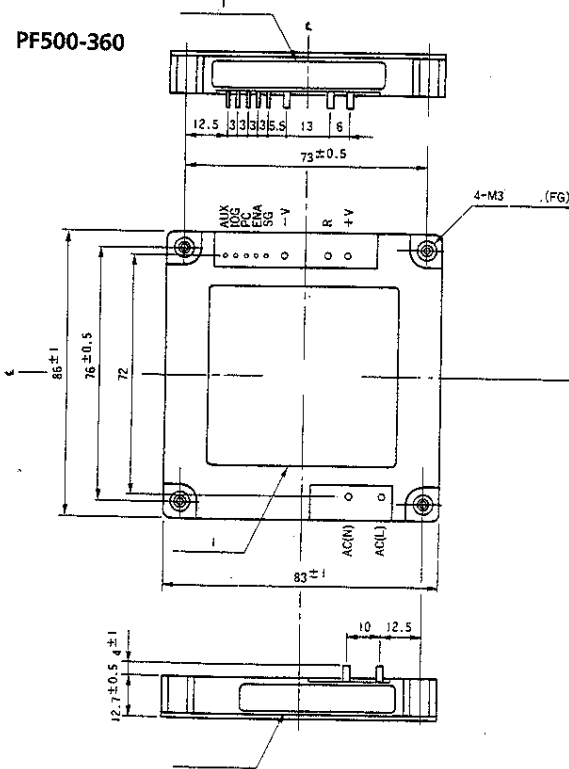


PR500-280

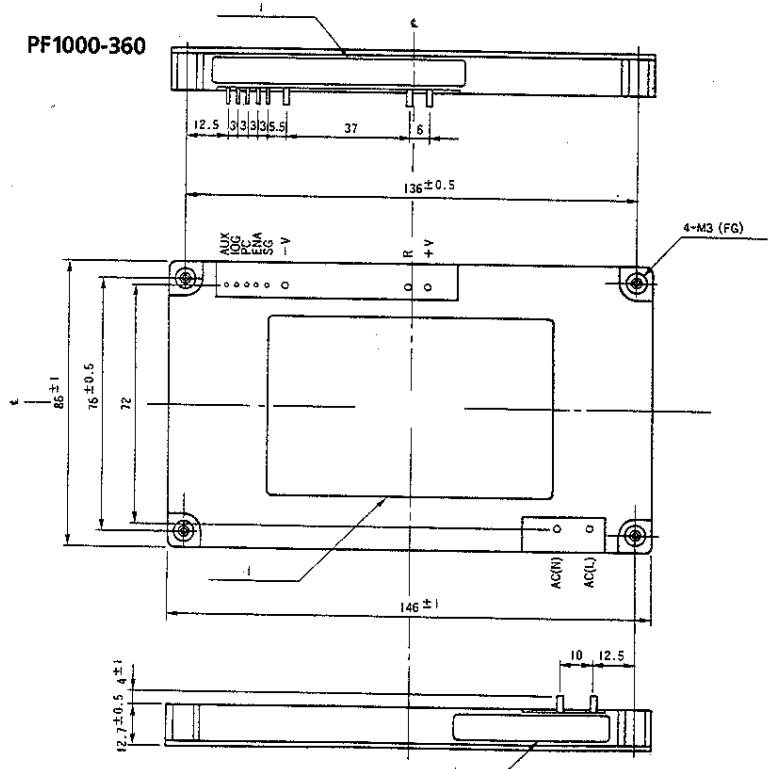


DC-to-DC Converters

PF500-360



PF1000-360

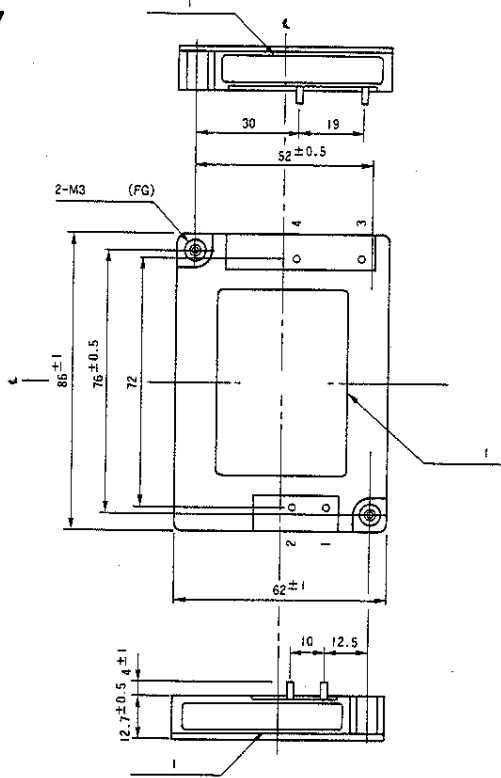


- Notes:
1. Model number and Pin Labeling.
 2. Small Pins 0.6mm
Large Pins 2.0mm
 3. All Dimensions are in mm.

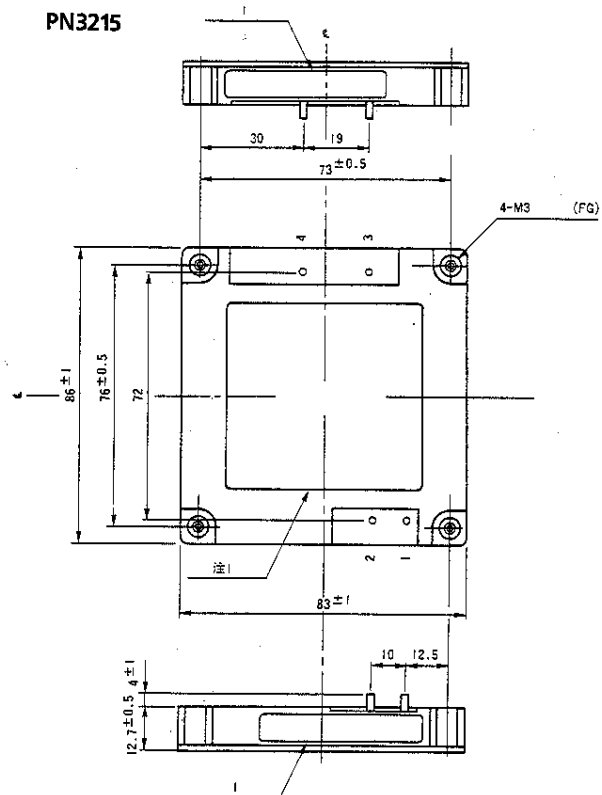
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P SERIES MECHANICAL DRAWINGS

PN3207



PN3215



- Notes:
 1. Model number and Pin Labeling.
 2. Small Pins 0.6mm
 Large Pins 2.0mm
 3. All Dimensions are in mm.

PAH Series

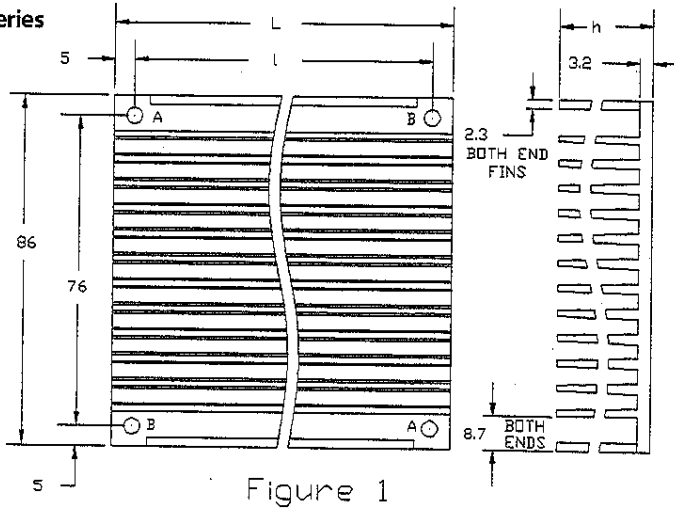


Figure 1

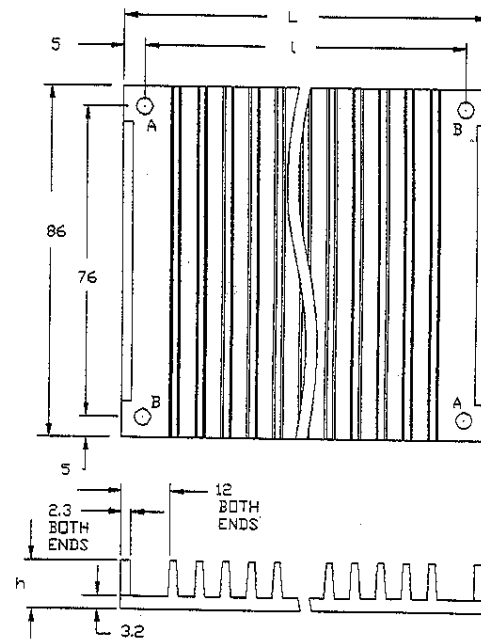


Figure 2

Heatsink Kit Number	Dimensions (mm)			Hole Size (mm)		Figure
	L	l	h	A	B	
PAH146L23	146	136	23	3.5	3.5	1
PAH146L12	146	136	12	3.5	3.5	1
PAH83L23	146	136	12	3.5	3.5	2
PAH146V12	83	73	23	3.5	3.5	1
PAH83L12	83	73	12	3.5	3.5	1
PAH72L23	72	62	23	3.5	3.5	1
PAH72L12	72	62	12	3.5	3.5	1
PAH62L23	62	52	23	3.5	-	1
PAH62L12	62	52	12	3.5	-	1
PAH41L23	41	31	23	3.5	-	1
PAH41L12	41	31	12	3.5	-	1