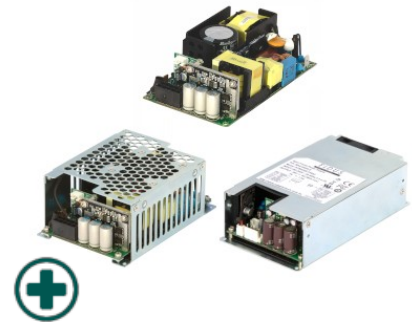


MAC450 Series

450 Watts

- 250W Convection cooled 450W with 13.8 CFM
- Latest Medical and ITE safety approvals IEC 60601-1 (3.1) & BF rated, IEC 62368-1
- 4th ed. Medical EMC IEC 60601-1-2 (2014)
- 5V 1A Standby, 12V 0.6A fan out and Remote on/off
- EN55011 Level B conducted & radiated
- Latest UL/IEC 62368-1 approvals
- 5 Year warranty



The MAC450 series of open frame power dense AC-DC power modules offer 250W convection and 450W of power with fan cooling in a 3 x 5" package. The units are designed for use in medical and ITE applications, are very efficient and have low emissions, meeting EN55011 Level B and 4th edition EMC immunity EN60601-1-2. They have an operating temperature range from -20 to +70°C operating from 85 to 264VAC. Outputs are available from 12 to 56V with 5V 1A stand by and 12V 0.6A fan rail.

Dimensions:

Open: 3 x 5 x 1.3" (76 x 127 x 34mm)
Covered / top fan: 3.4 x 5 x 2" (87 x 127 x 50mm)
End fan: 3.2 x 5.9 x 1.6" (80 x 148.2 x 40.6mm)

Models & Ratings

INSTALLATION ADVICE PG5

Model Number ⁽¹⁾	Output voltage	Output Power		Output Current		Efficiency ⁽²⁾
		Convection	13.8 CFM	Convection	13.8 CFM	
MAC45012	12V	250W	450W	20.8A	37.5A	91%
MAC45015	15V	250W	450W	16.6A	30.0A	92%
MAC45019	19V	250W	450W	13.0A	23.7A	93%
MAC45024	24V	250W	450W	10.4A	18.8A	93%
MAC45036	36V	250W	450W	6.9A	12.5A	93%
MAC45048	48V	250W	450W	5.2A	9.4A	93%
MAC45054	54V	250W	450W	4.6A	8.3A	94%
MAC45056	56V	250W	450W	4.5A	8.0A	94%

Notes

1. For covered add -C, for top fan -T and end fan -E
2. Efficiency taken at full load and high line voltage. 12V / 5V no load
3. 5V standby 1A max
4. 12V system fan out 0.6A max
5. 36-56V units have remote sense (CN4)

Key specifications

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
AC Input range	90		264	VAC	100% at 100VAC derating to 90% at 90VAC
Operating temperature	-20		70	°C	Derate linearly from 100% load at 50°C to 50% load at 70°C. See derating curve on page 3
Efficiency	91		94	%	Full load at high line, 12V and 5V no load
Dimensions	Open: 3 x 5 x 1.3" (76 x 127 x 34mm), Covered / top fan: 3.4 x 5 x 2" (87 x 127 x 50mm), End fan: 3.2 x 5.9 x 1.6" (80 x 148.2 x 40.6mm)				
EMC	EN55011 Level B conducted and radiated. EN61000-3 and EN61000-4, harmonics, flicker, Surge, EFT, ESD, conducted and radiated. IEC60601-1-2 (4th Edition)				
Safety	IEC60601-1 2006/A1:2013, ES60601-1:2005 (R2012), CSA-C22.2 No. 60601-1:14, EN60601-1:2006/A1:2013, IEC/EN/UL 62368-1				

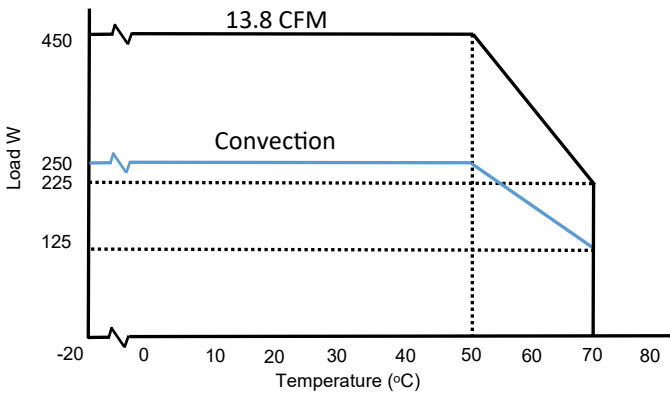
Input					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Input voltage	90		264	VAC	100% at 100VAC derating to 90% at 90VAC
Input frequency	47		63	Hz	
Power factor	0.9				EN61000-3-2 class A compliant
Input current (rms)			5.3	A	Low line. At 115VAC
			2.2		High line. At 240VAC
Inrush current			100	A	230VAC cold start at 25°C
Touch current			100	uA	240VAC 60Hz
No load power			0.21	W	

Output					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Output voltage	12		56	VDC	See Model & Ratings table
Set point tolerance			±5	%	
Total regulation		±6		%	
Transient response		0.5		ms	50% load change
Minimum load	0			%	
Ripple & Noise		2%		V(Vp-p)	All models measured with 0.1 and 0.47uF capacitor and 20 MHz bandwidth.
Hold up time	10			ms	Max load
Overload protection			130	%	Trip and restart. Automatic recovery
Short circuit protection					Trip and restart. Automatic recovery
Overvoltage protection			150	%	Shutdown and latch off. AC recycle to reset.

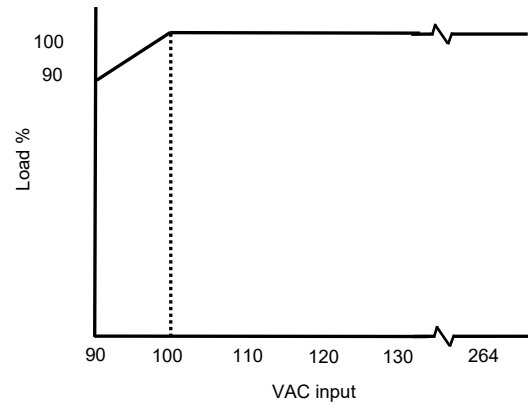
General					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency	91		94	%	See models and ratings table
Isolation: Input to Output	4000			VAC	2 x MOPP (BF rated)
	Input to Ground	1500		VAC	
Isolation resistance		10		MΩ	500VDC
Power density		23.08		W/In ³	
MTBF	300			kHrs	As per Telcordia SR-332
Weight	390	570	660	g	

Environmental					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating temperature	-20		70	°C	Derate linearly from 100% load at 50°C to 50% load at 70°C. See derating curve on page 3
Storage temperature	-20		80	°C	10-90% RH
Cooling					Convection cooled / fan cooled
Humidity	20		80	% RH	Non condensing
Operating altitude			5000	m	
Vibration			5	g	10-500hz, 10min/cycle in each axis x, y and z

Derating curve



AC Derating curve



EMC: Emissions

	Standard	Test level	Criteria	Notes & Conditions
Conducted	EN55011	B		
Radiated	EN55011	B		
Harmonic current	EN61000-3-2	Class A		
Voltage flicker	EN61000-3-3			

EMC: Immunity

	Standard	Test level	Criteria	Notes & Conditions
ESD	EN61000-4-2	4	A	±8kV contact, ±15 air
Radiated	EN61000-4-3	3	A	10V/m 80% AM (1kHz) 80-2700MHz (6V for ISM & amateur radio frequencies)
EFT	EN61000-4-4	3	A	±2kV (100V and 240V 50Hz)
Surges	EN61000-4-5	Installation Class 3	A	±2kV L/N to PE, ±1kV L-N
Conducted	EN61000-4-6	3/6Vrms	A	80% AM (1kHz)
Magnetic Fields	EN61000-4-8	30A/m	A	50/60Hz 1 min
Voltage Dips	EN61000-4-11	100% for 0.5 cycles, 60% 5 cycles, 30% for 25/30 cycles, interrupt 250/300 cycles and 1 sec - performance criteria A,A,B		

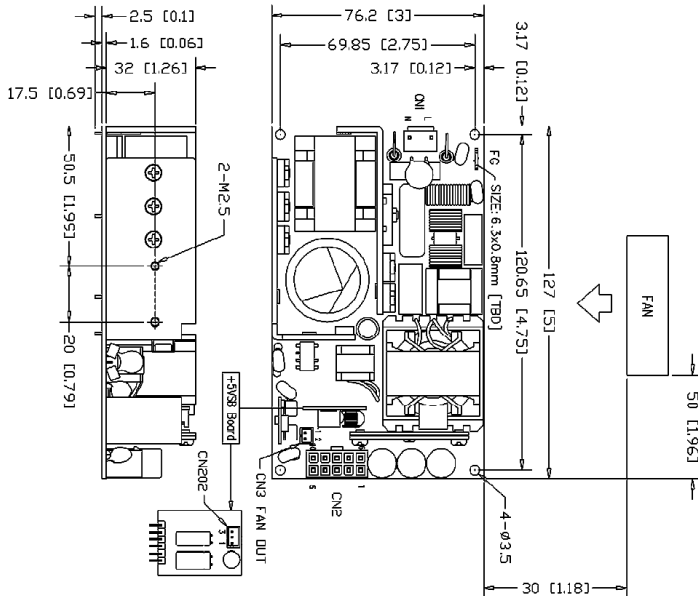
Safety Approvals

	Safety standard	Notes & Conditions
UL	ES 60601-1:2005 (R2012), CSA-C22.2 No 60601-1:14 UL 62368-1: 2014	
CB	IEC 60601-1 2005 + A1 (Ed 3.1) IEC 62368-1 :2014	
TUV	EN 60601-1:2006 + A1: 2013 EN 62368-1: 2014	
CE		2015/863/EU RoHS Directive and 2014/35/EU Low voltage directive
Means of patient protection	Input to Output: 2 x MOPP Input to Ground: 1 x MOPP Output to Ground: 1 x MOPP	
Equipment protection class		Class I

MAC450 Series

Mechanical Details

Open frame 12-24V



Notes

1. All dimensions shown in millimetres [Inches]
2. Earth connection via Faston 6.3 x 0.8mm

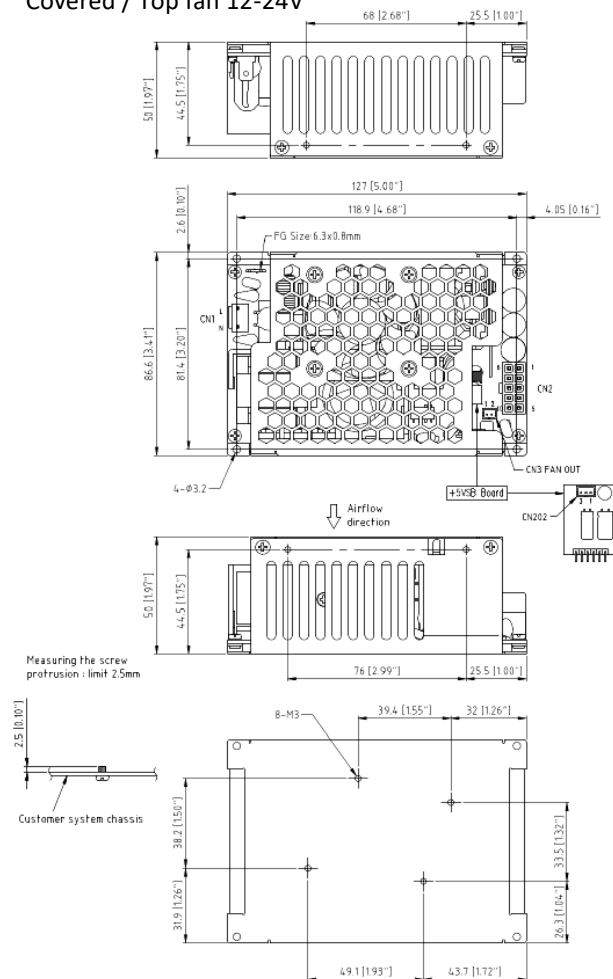
CN1 JST B3P-2-VH mates with VHR-3N	
Pin	Function
1	Neutral
2	NC
3	Line

CN2 Pin Connections Molex mini fit 39-28-1103 mates with 39-01-2100	
Pin	Function
1	+DC
2	+DC
3	+DC
4	RTN
5	RTN
6	+DC
7	+DC
8	RTN
9	RTN
10	RTN

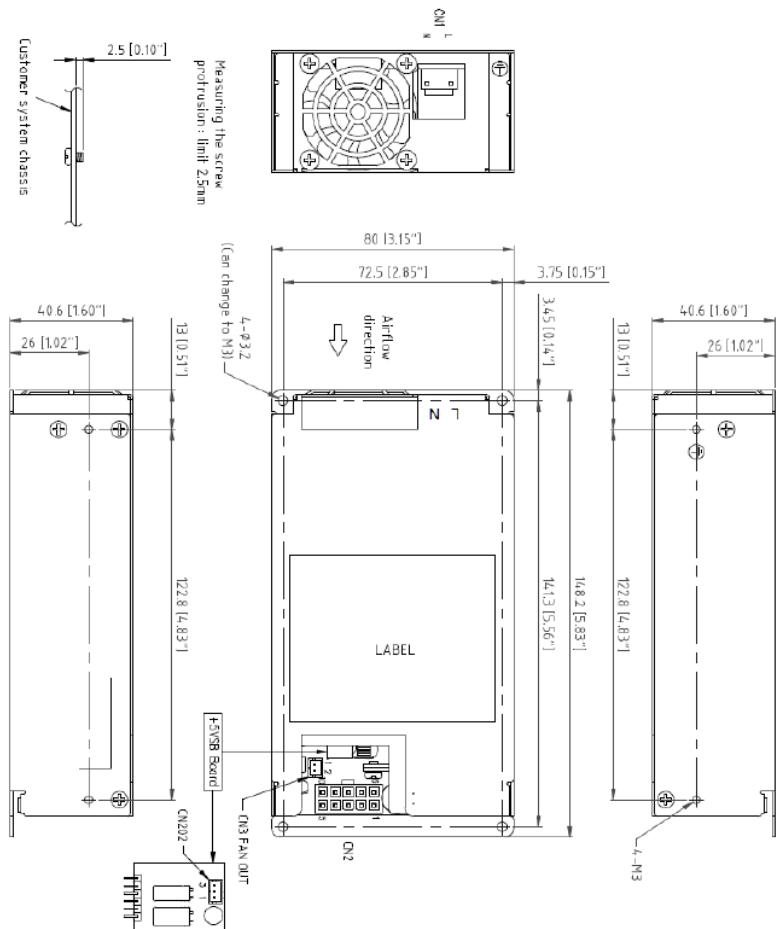
CN202 mates with JST, PHR-3 . Short to GND for off	
Pin	Function
1	+5V Standby
2	GND
3	Ctrl

CN3 JST B2B-PH mates with PHR-2	
Pin	Function
1	12V fan
2	RTN

Covered / Top fan 12-24V

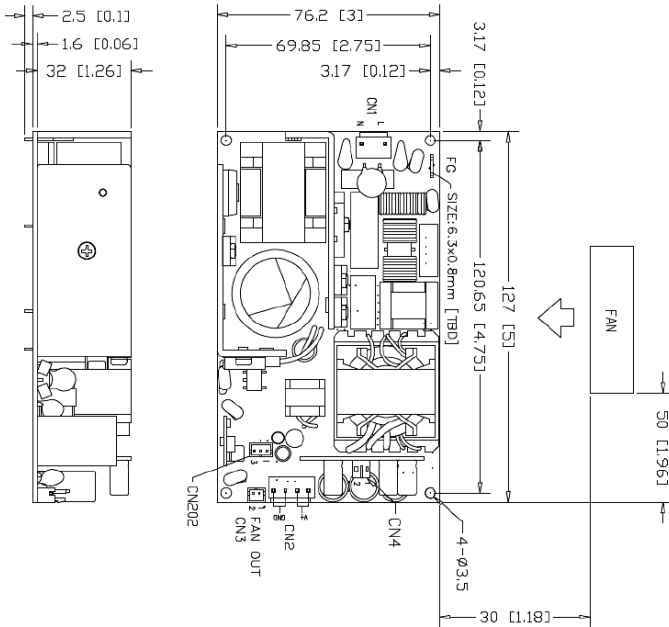


End fan 12-24V



Mechanical Details

Open frame 36-56V



Notes

1. All dimensions shown in millimetres [Inches]
2. Earth connection via Faston 6.3 x 0.8mm

CN1 JST B3P-2-VH mates with VHR-3N	
Pin	Function
1	Neutral
2	NC
3	Line

CN2 JST B4P-VH mates with VHR-4N	
Pin	Function
1	+DC
2	+DC
3	RTN
4	RTN

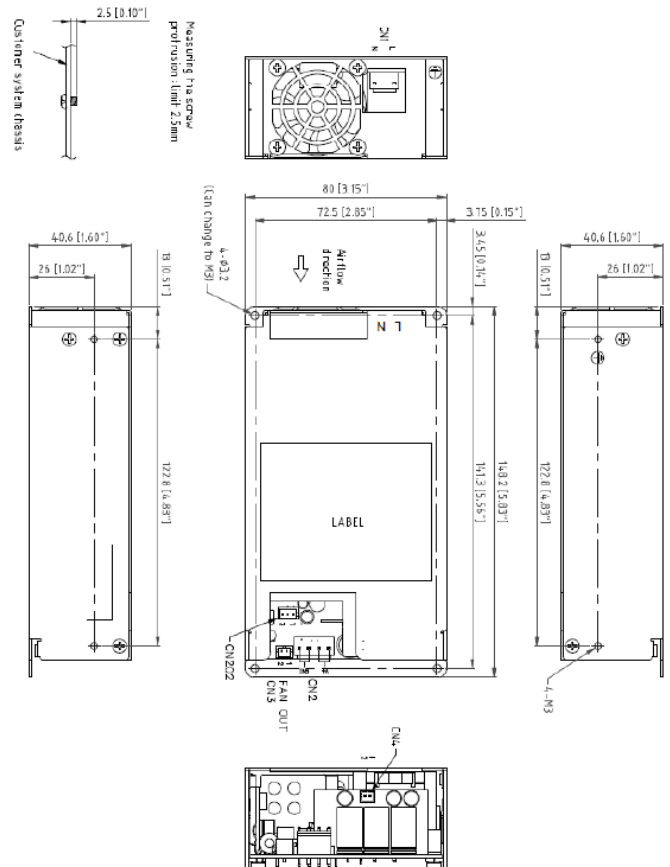
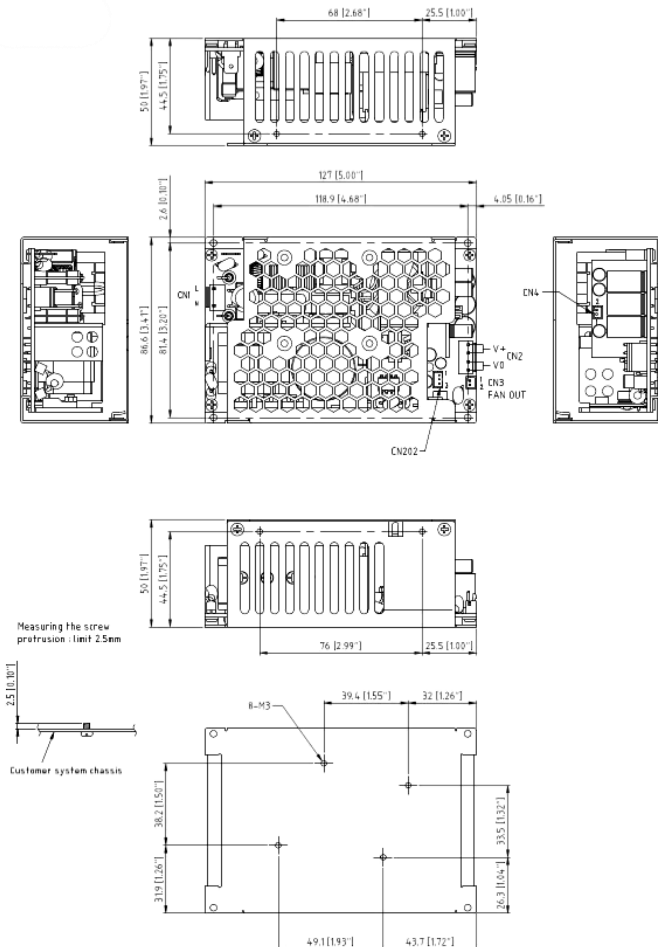
CN202 JST B3B-PH mates with PHR-3. Short to GND for off	
Pin	Function
1	+5V Standby
2	GND
3	Ctrl

CN3 JST B2B-PH mates with PHR-2	
Pin	Function
1	12V fan
2	RTN

CN4 JST B2B-PH mates with PHR-2	
Pin	Function
1	+ Sense
2	- Sense

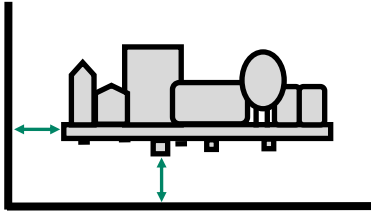
Covered / Top fan 36-56V

End fan 36-56V



Installation Advice

Safety



On installation customers must consider the required creepage and clearance distances between the PSU and the end-equipment enclosure. These distances vary depending on the installation class and safety standard requirements.

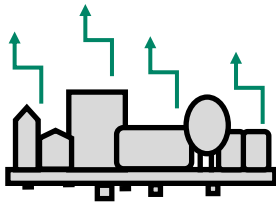
For **Class I** installations there should be 3-4mm between any part of the PSU and any earthed metal part of the enclosure. 3mm is acceptable for IT applications, 4mm required for medical applications. In Class I installations the PSU earth point must be connected to system safety ground.

For **Class II** installations distances may need to be increased if being installed into a surrounding metal enclosure.

Ensure consideration of components on the underside of the PCB or low lying spills when measuring clearance distances between the PSU and the end-equipment. Also top surface especially in tight enclosures such as 1U boxes. An insulation material can be used between PSU and metal if smaller gap required.

FiDUS recommends installing the PSU on 6mm stand offs typically, but check the distances.

EMC

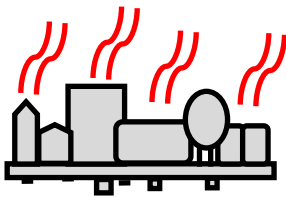


Conducted and radiated emissions compliance is a common application consideration. It is important to remember that even when using a properly filtered PSU, an application may still not achieve compliance if it is not designed to minimise emissions. That being said, there are a number of things that can be done to optimise EMC performance either as best practice, or if you are struggling for compliance:

- 1) Connect all marked EMI ground points to earth. Often these are combined with the safety earth point (in class I installations), but on some power supplies there may be additional earth tags or mounting points.
- 2) Minimise the length of input/output wiring where possible and try to maintain max distance of the conductors from the PSU, to prevent noise pick up. Avoid bundling input and output cables together. A common component to avoid placing wiring near is the PFC inductor in power factor corrected power supplies.
- 3) Apply additional filtering before the PSU input (ensure consideration of which frequencies there are issues with before selecting a filter).
- 4) When using an open frame PSU, mount the supply on a metal plate and connect EMI mounting points.
- 5) In multi circuit systems, decouple the circuits locally.
- 6) Ferrites added between the PSU and system input connector and/or the DC output cables can help in reducing radiated noise issues in systems. If seen, issues are commonly in the 30-150MHz area.

For more detailed assistance, if you still have any concerns with compliance, please get in contact with our Engineering department who are on hand to assist with any queries.

Thermal

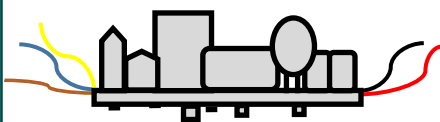


Thermal management is an important consideration when thinking about equipment service life. Electrolytic capacitors within the PSU wear with time and are typically the first end-of-life failure. Keeping the operation temperature of key components within the PSU, such as the electrolytic capacitors, as low as possible is paramount. As a general rule, for every 10°C drop in the operating temperature of the electrolytic capacitors you double their lifetime, and thus the lifetime of the power supply. When looking at thermal performance it is helpful to test under a worst-case set of conditions, to ensure component temperatures are in an acceptable range for the required service life. Then consider the impact of operational time, load and temperature profile to estimate a more realistic lifetime for your PSU.

Also, many FiDUS power supplies offer a *Peak Power* rating to provide for customers with pulsing loads. When using a peak power capability customers must consider:

- 1) Peak duration rating: the maximum length of time the peak can be drawn for
- 2) Duty cycle: the frequency with which the peak can be drawn. (e.g. 10% duty cycle, 1 second on:9 seconds off)
- 3) Average power value: datasheets will state the maximum average power acceptable with peak power PSUs. If any of these elements are exceeded the supply may overheat, with performance and lifetime suffering as a result.

Connectivity



All FiDUS Power engineering samples requested will arrive with a free of charge loom kit for ease of testing.

The loom kit connects to the input/output terminals of the PSU and provides the customer with bare wire ends to connect with.

The loom kits can also prove advantageous for ease of installation in production. Please contact sales if you are interested in including the loom kit in your quotation. Alternatively the input/output connector and mating part details can be found in the attached table.

	Part Number	Mating Part Number
Input	B3P-VH	VHR-3N
Output	Molex 39-28-1103 / JST B4P-VH	39-01-2100 / JST VHR-4N
Loom Kit	MAC450 12-24 LK / MAC450 36-46V LK	