

450 Watts

- Very high power density 3 x 5"
- 320W Convection / 350W Conduction / 450W Fan cooled
- Medical safety IEC 60601-1 (BF rated) and EMC Immunity EN60601-1-2 4th ed
- Open frame, Covered, Top fan and End fan versions
- Power good, Remote on off and $\pm 8\%$ Voltage adjust
- EN55011 Level B conducted & level A radiated
- 5 Year warranty



The MAH450 series of compact open frame AC-DC PSUs provide 320W convection, 350W conduction and 450W fan cooled power from a 3" x 5" package. The range is approved for use in both IT and medical applications and is available in 12-53V units. The units are fully featured with power good, remote on off and voltage adjust. They are available in four variants; open frame, enclosed, top fan and end fan. All units come with a FiDUS 5 year warranty.



Models & Ratings

INSTALLATION ADVICE PG 8

Model Number ⁽¹⁾⁽²⁾	Output Power	Output voltage	Output Current			Ripple & Noise ⁽⁴⁾	Efficiency ⁽⁵⁾
			Convection	Conduction	21 CFM fan ⁽³⁾		
MAH450US12- <u>Y</u>	450W	12V	20.80A	23.30A	37.50A	250mVp-p	91%
MAH450US15- <u>Y</u>	450W	15V	16.60A	18.60A	30.00A	300mVp-p	92%
MAH450US24- <u>Y</u>	450W	24V	13.30A	14.55A	18.75A	240mVp-p	93%
MAH450US28- <u>Y</u>	450W	28V	11.40A	12.50A	16.10A	280mVp-p	93%
MAH450US36- <u>Y</u>	450W	36V	8.90A	9.72A	12.50A	360mVp-p	93%
MAH450US48- <u>Y</u>	450W	48V	6.65A	7.30A	9.40A	480mVp-p	94%
MAH450US53- <u>Y</u>	450W	53V	6.05A	6.60A	8.55A	530mVp-p	94%

Notes

1. For enclosed type with variable fan output, change A above for E. For example MEH450US12(Y)
2. For fan connector with fixed speed output omit Y. For fixed speed and fan installed, change Y for F1 or F2 for top fan and end fan respectively. For example MEH450US12-F1 for fixed speed top fan (installed fans only possible on enclosed type). Change Y for Y1 or Y2 for variable top fan and end fan respectively. For example MEH450US12-Y2 for variable end fan
3. Fan rating does not also require conduction cooling so is suitable for non conductive installations.
4. Noise is measured with 20MHZ bandwidth and for 12&15V units a 1uF/25V cap, 24-48V units a 1uF/50V cap and for 53V unit 0.1uF/100V cap.
5. Efficiency and all output loads valid at 230VAC, full load and 25°C
6. Loom kits available, see 'Installation Advice' on page 8

Key specifications

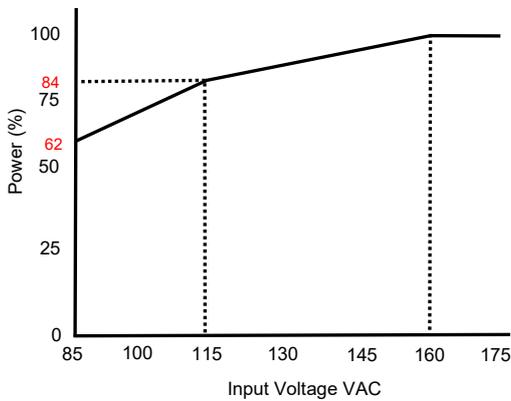
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
AC Input range	85		264	VAC	
Operating temperature	-40		80/85	°C	85°C for <u>Y</u> versions only. See de-raising curves
Efficiency	91		94	%	See models and ratings table above
Dimensions	MAH: 3 x 5 x 1.58" (76.2 x 127 x 40.1mm), MEH: 3.41 x 5 x 1.97" (86.6 x 127 x 50mm), MEH -F1/Y1: 3.41 x 5 x 1.97" (86.6 x 127 x 50mm), MEH -F2/Y2: 3.15 x 5.83 x 1.6" (80 x 148.2 x 40.6mm)				
EMC	EN 55011 / 32 Level B conducted and level A radiated. EN61000-3 and EN61000-4, harmonics, flicker, Surge, EFT, ESD, conducted and radiated. EN 60601-1-2 4th Ed.				
Safety	IEC 60601-1:3.1 edition, ANSI/AAMI/CSA 60601-1: 3rd edition, EN 60601-1: 3.1 edition. IEC 60950-1: 2nd edition, UL/CSA 60950-1: 2nd edition, EN 60950-1: 2nd edition. IEC/EN 62368-1				

Input					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
AC Input voltage	85		264	VAC	
DC Input voltage	120		370	VDC	
Input frequency	47		63	Hz	
Power factor	0.95				EN61000-3-2 class A and D compliant
Input current			2.4/5.8	A	2.4A at 240VAC, 5.8A at 100VAC
Inrush current			100	A	230VAC cold start at 25°C
Leakage current			100	uA	At 264VAC. BF rated
Start up time		2		S	
Rise time		30		mS	
No load input power		0.3		W	230VAC Open and enclosed (without fan) 12V units
		0.5		W	230VAC Open and enclosed (without fan) other units
		0.5		W	230VAC Open and enclosed (with fan) 12V units
		0.8		W	230VAC Open and enclosed (with fan) other units

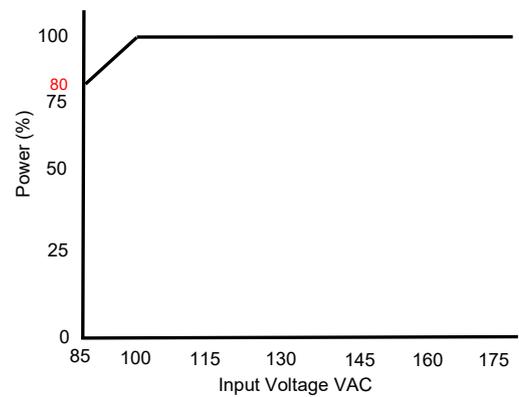
Output					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Output voltage	12		53	VDC	See Model & Ratings table
Set point accuracy			±1	%	
Line regulation			±0.2	%	
Load regulation			±0.4	%	10% to 90% load change
Voltage adjust			±8	%	
Minimum load	0			%	
Transient response			3	%	Recovery within 1% within 600 μs for 50-75% step at 2.5A/us
Hold up time		14		mS	At full load and 115VAC
Overload protection	115		155		Trip & restart. Automatic recovery
Overvoltage protection	110		135		Latch off. AC reset required,
Short circuit protection					Automatic recovery, for high current latch off
Over temperature protection	110		125	°C	Latch off. AC reset required,
Standby power		5		V	2A
Fan power		12		V	500mA

Environmental					
Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating temperature	-40		80/85	°C	80°C for fan versions and 85°C for non fan versions. See derating curves, different models vary
Storage temperature	-40		80/85	°C	80°C for fan versions and 85°C for non fan versions.
Cooling					Fan cooled (requires 21CFM), conduction (430x248x12mm plate) or convection cooled
Temperature coefficient			±0.02	%/°C	
Humidity	5		95	%RH	Non-condensing
Operating altitude			5000	M	
Thermal Shock					MIL-STD-810F
Vibration					IEC60068-2-6
Shock					IEC60068-2-27

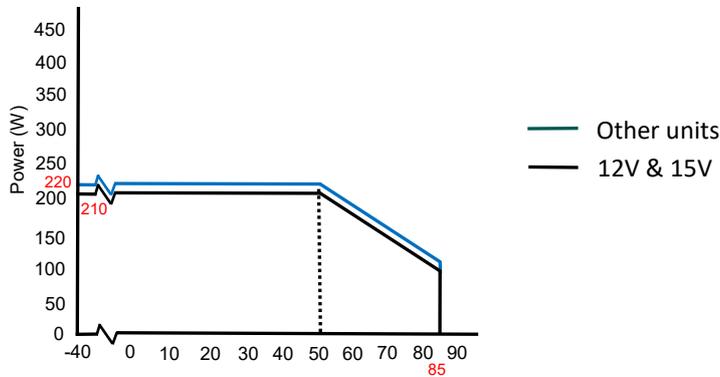
AC input derating curve Natural convection 50°C



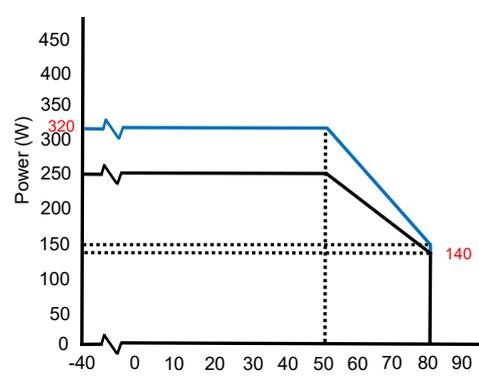
AC input derating curve forced air cooling 40°C



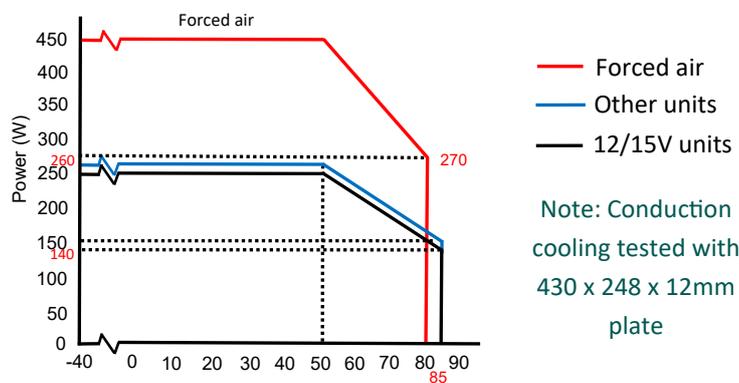
Thermal derating curve 115VAC convection



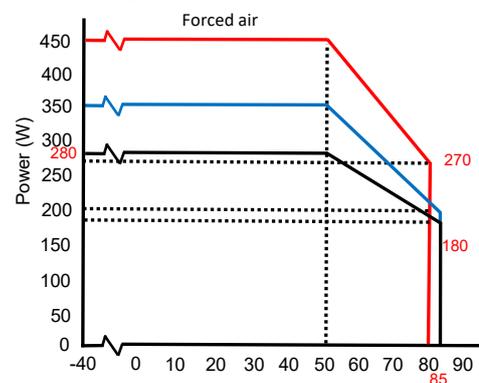
Thermal derating curve 230VAC convection



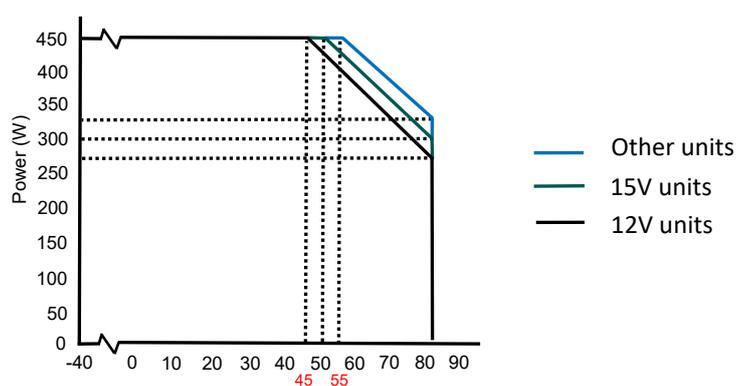
Thermal derating curve 115VAC conduction



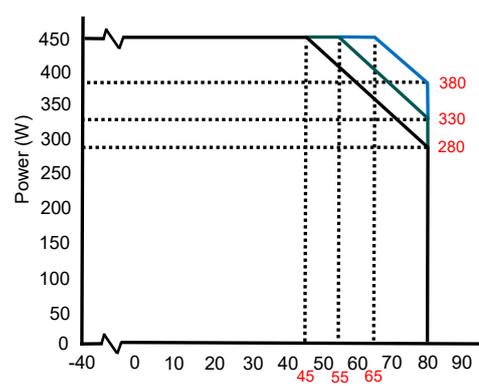
Thermal derating curve 230VAC conduction



Thermal derating curve 115VAC internal fan



Thermal derating curve 230VAC internal fan



General

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency	91		94	%	See models & Ratings table
Isolation: Input to Output	4000			VAC	2 x MOPP
Input to Ground	2500			VAC	
Output to Ground	2500			VAC	
Isolation resistance	1000			MΩ	
Power density			18.98	W/ln ³	
Switching frequency	65		75	KHz	Full load. 75KHz for 15V units 65KHz for others
MTBF		409		Khrs	MIL-HDBK-217F 25°C
Weight	462		552	g	462g open frame, 504g enclosed, 524g top fan and 552g end fan

EMC: Emissions

	Standard	Test level	Criteria	Notes & Conditions
Conducted	EN55011/32	B		
Radiated	EN55011/32	A		
Harmonic current	EN61000-3-2	Class A		Also meets Class D requirements.
Voltage flicker	EN61000-3-3			

EMC: Immunity

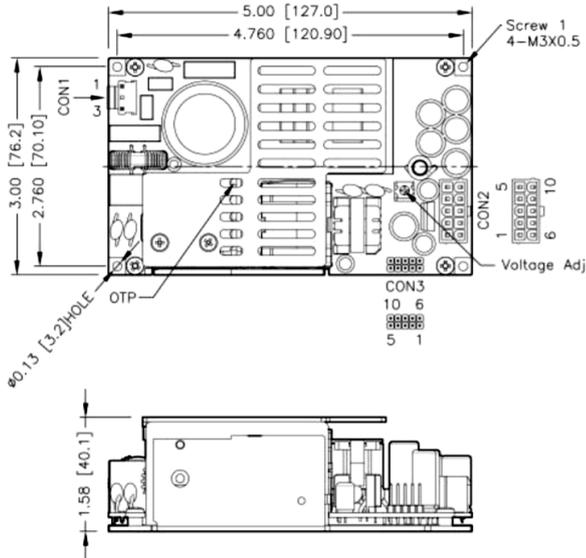
	Standard	Test level	Criteria	Notes & Conditions
ESD	EN61000-4-2	4	A	±8kV contact, ±15kV air
Radiated	EN61000-4-3	3	A	3V/m
EFT	EN61000-4-4	3	A	±2KV
Surges	EN61000-4-5	Installation Class 3	A	±2KV line—neutral, ±1KV line/neutral—earth
Conducted	EN61000-4-6	3	A	20Vrms
PFMF	EN61000-4-8	3	A	30A/rm
Dips and interruptions	EN61000-4-11		A	For all conditions

Safety Approvals

	Safety standard	Notes & Conditions
UL	UL 60950-1: 2nd edition UL 62368-1 ANSI/AAMI/ 60601-1: 3.1 edition	UL: E360199 (Medical) , E193009 (ITE)
CB	IEC 60950-1: 2nd edition IEC 62368-1 IEC 60601-1: 3.1 edition	
TUV	EN 60950-1: 2nd edition EN 62368-1 EN 60601-1: 3.1 edition	
CE		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

Mechanical Details

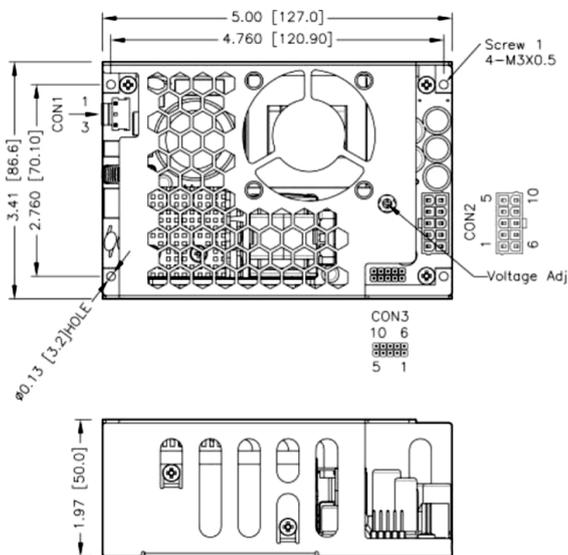
Open Frame



Pin Connections—Input (CON) ⁽⁴⁾	
Pin	Function
1	Live
2	N/C
3	Neutral

Pin Connections—AUX Output (CON2) ⁽⁵⁾	
Pin	Function
1	+Vout
2	+Vout
3	+Vout
4	+Vout
5	+Vout
6	-Vout
7	-Vout
8	-Vout
9	-Vout
10	-Vout

Enclosed



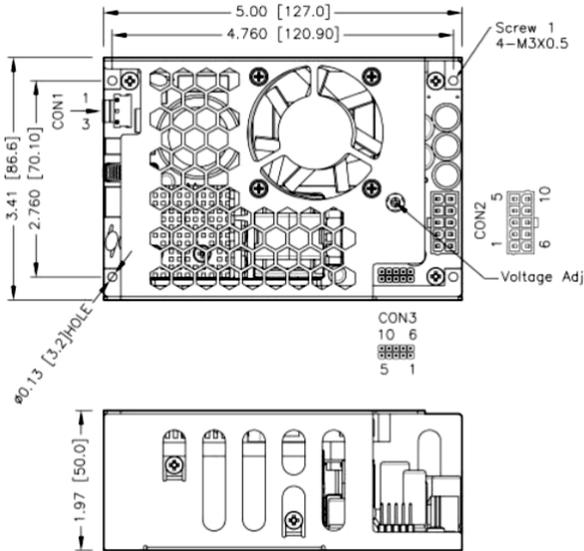
CON3: Pin Connections ⁽⁶⁾	
Pin	Function
1	+ FAN
2	+V Sense
3	+ Control
4	+ PG
5	+ Standby
6	- FAN
7	- V Sense
8	- Control
9	N/P
10	- Standby

Notes

- All dimensions in inches (mm)
- Mounting screws not to exceed 5.2Kgf-cm / 0.51Nm
- Any mounting hole can be used for PE connection
- TB1: AC input header mates with Molex 09-50-8031
- TB2: DC output header mates with Molex 39-01-2105
- TB3: AUX output connector mates with: Molex 90143-0008
- Tolerance: 2DP $\pm 0.02''$ [$\pm 0.5\text{mm}$]
3DP $\pm 0.01''$ [$\pm 0.25\text{mm}$]

Mechanical Details

Top Fan

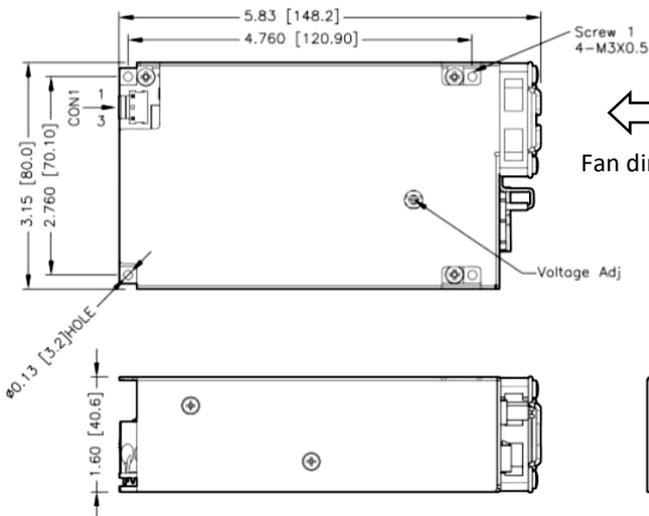


Fan blowing in from the top

Pin Connections—Input (CON) ⁽⁴⁾	
Pin	Function
1	Live
2	N/C
3	Neutral

Pin Connections—AUX Output (CON2) ⁽⁵⁾	
Pin	Function
1	+Vout
2	+Vout
3	+Vout
4	+Vout
5	+Vout
6	-Vout
7	-Vout
8	-Vout
9	-Vout
10	-Vout

End Fan



Fan direction

CON3: Pin Connections ⁽⁶⁾	
Pin	Function
1	+ FAN
2	+V Sense
3	+ Control
4	+ PG
5	+ Standby
6	- FAN
7	- V Sense
8	- Control
9	N/P
10	- Standby

Notes

- All dimensions in inches (mm)
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- TB1: AC input header mates with Molex 09-50-8031
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- TB3: AUX output connector mates with: Molex 90143-0008
- Tolerance: 2DP ± 0.02 " [± 0.5 mm]
3DP ± 0.01 " [± 0.25 mm]

Application note:

Output sensing function can be applied via connecting wires on CON3. Initially, Pin 7 and Pin 8 are shorted by a jumper set as default, shown as Fig. 1.

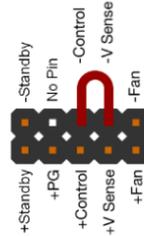
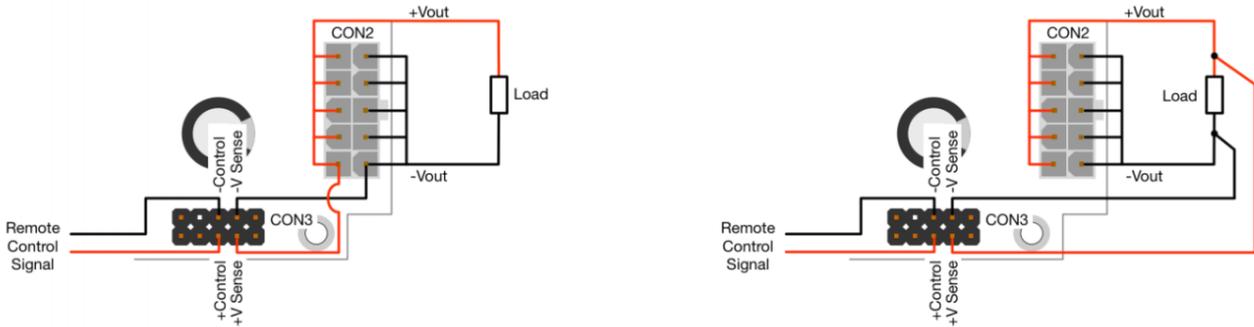


Fig. 1 Default connection

But if remote control function is to be used, the jumper on Pin 7 and Pin 8 should be removed. Since sense pins could not be left open for module stability, please follow the connections as below (Fig. 2).



(a) Sense pins connect to corresponding polarity of Vout pin

(b) Sense pins connect to corresponding polarity terminal of load.

Fig. 2 Recommended output sensing connections

Notes

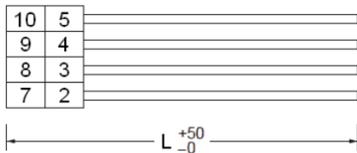
1. Remote control: Positive logic; Power on: open or 3-12VDC
Power off: Short or 0-1.2VDC

2. Power good signal ref GND; Power good: output low
Power off: open collector

(Current draw 0.5-1mA)

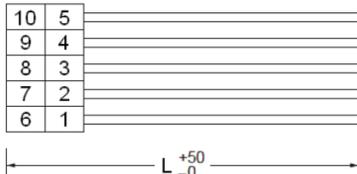
Optional Parts:

7N-0265-F :



Length L = 500mm Typical

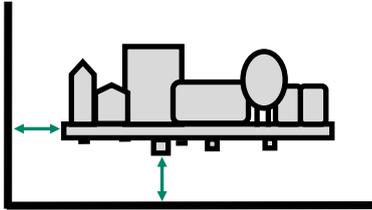
7N-0266-F :



Pin Connections			
Pin	Function	Colour	AWG
1	+ FAN	Yellow	26
2	+V Sense	Grey	26
3	+ Control	Orange	26
4	+ PG	Blue	26
5	+ Standby	Red	22
6	- FAN	Brown	26
7	- V Sense	Green	26
8	- Control	Brown	26
9	N/P	N/P	N/P
10	- Standby	Black	22

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.

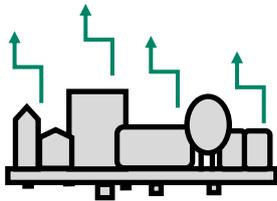
For **Class I** installations there should be 3-4mm between any part of the PSU and any earthed metal part of the enclosure. 3mm is acceptable for IT applications, 4mm required for medical applications. In Class I installations the PSU earth point must be connected to system safety ground.

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

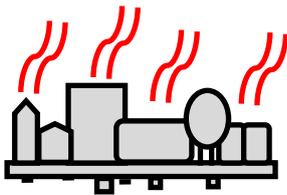


Conducted and radiated emissions compliance is a common application consideration. It is important to remember that even when using a properly filtered PSU, an application may still not achieve compliance if it is not designed to minimise emissions. That being said, there are a number of things that 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

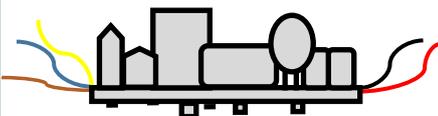


Thermal management is an important consideration when thinking about equipment service life. Electrolytic capacitors within the PSU wear with time and are typically the first end-of-life failure. Keeping the operation temperature of key components within the PSU, such as the electrolytic capacitors, 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.

	Mating Part Number
Input	Molex 09-50-8031
Output	Molex 39-01-2105
Loom Kit	MAH450 LK