

## DESCRIPTION

The MFA160-USR-2/3 is a series of high efficiency, small form factor AC-DC power supplies for use in Class II medical applications.

Offering up to 160 W of regulated DC power from an open-frame 2 x 4 x 1" standard form factor, the MFA160-USR-2/3 series make easier its integration into space constrained systems.

Thanks to its creepage and clearance greater than 8 mm, it can be operated over 4000 m of altitude without de-rating.

By converting energy at 91% typical efficiency, the MFA160-USR-2/3 series generate less heat facilitating thermal management.

The series is available in four different output voltages: 5, 12, 24 and 48 V, and is equipped with an auxiliary low power 12 V.

The MFA160-USR-2/3 range comply with the 3<sup>rd</sup> edition of the IEC 60601-1 and ANSI/AAMI ES60601-1 safety standards for Class II medical equipment.

The series meets the EN 55022 EMC limits of Class B for conducted and Class A for radiated emissions as well as the IEC/EN 61000-3 and IEC/EN 61000-4 EMC standards.



## KEY FEATURES

- Universal input voltage range
- 160 W active PFC power supply
- Low leakage current (< 100  $\mu$ A)
- Very small form factor (2 x 4 x 1) in
- High efficiency (91% typical)
- 5, 12, 24 and 48V standard output variants
- Class II isolation
- Over temperature protection
- Output over-voltage protection
- Over current, and short circuit protections
- Auxiliary fan + 12 V output
- 4000 m altitude operation
- IEC/EN 60601-1 3<sup>rd</sup> ed., ANSI/AAMI ES60601-1
- RoHS-6 compliant (EU directive 2011/65/EU)

## MARKET SEGMENT AND APPLICATIONS

- Class II medical electronics
- Class II dental electronics
- Laboratory equipment
- Healthcare diagnostic

## MODELS CODING AND OUTPUT RATINGS

Model Number	V1 [V]	I1 <sup>1</sup> Convection [A]	I1 <sup>1</sup> Forced air [A]	V1 <sup>2</sup> Ripple [mV]	V2 [V]	I2 <sup>1</sup> Rated [A]	V2 <sup>2</sup> Ripple [mV]
MFA160-US05-2/3	5	14.00	20.00	50	12	0.5	240
MFA160-US12-2/3	12	8.30	13.33	120	12	0.5	240
MFA160-US24-2/3	24	4.16	6.66	240	12	0.5	240
MFA160-US48-2/3	48	2.08	3.33	480	12	0.5	240

<sup>1</sup> The combined output power of V1 and V2 must not exceed 70 W for the 5V model or 100 W for the 12, 24 and 48 V when natural convection cooled, and 100 W and 160 W respectively when forced air cooled at 500 LFM, up to 50 °C ambient. Above 50 °C output de-rating applies (see details on the output specifications).

<sup>2</sup> Peak-to-Peak measured at 20 MHz Bandwidth.

## INPUT SPECIFICATIONS

Specification	Test Conditions / Notes	Min.	Nominal	Max.	Units
AC Input Voltage	PS starts and operates at 90 V <sub>AC</sub> at all load conditions	90	100/240	264	V <sub>AC</sub>
Input Frequency		47	50/60	63	Hz
DC Input Voltage		170	-	370	V <sub>DC</sub>
Input Current	RMS at 90 V <sub>AC</sub> , maximum load	-	-	2.3	A
Inrush Current	No damage at 230 V <sub>AC</sub> , cold start/hot start.				
Fusing	2.5 A, Time Lag, 250 V on L and N	-	2.5	-	A
Efficiency	5V, 12, 24, 48V, 115 V <sub>AC</sub> 12, 24, 48V, 230 V <sub>AC</sub>	-	85 90 91	-	%
No load Power Consumption	115 V <sub>AC</sub> 230 V <sub>AC</sub>	-	2.5 2.3	-	W
Power Factor	At full rated load, 115 V <sub>AC</sub> , 60 Hz 230 V <sub>AC</sub> , 50 Hz	0.99 0.89	- -	- -	
Harmonic Current	Complies with EN-61000-3-2 Class D at 230 V <sub>AC</sub> 50 Hz.				
Fluctuations and Flicker	Complies with EN-61000-3-3 at nominal voltages and full load.				
Leakage Current	264 V <sub>AC</sub> , 60 Hz, normal condition	-	-	100	μA

## OUTPUT SPECIFICATIONS

Specification	Test Conditions / Notes	Min.	Nom.	Max.	Units
V1 Set Point Accuracy			± 1	-	%
V1 Output Power Rating	5V, natural convection 5V, at 500 LFM forced air 12, 24, 48V, natural convection 12, 24, 48V, at 500 LFM forced air	- - - -	- - - -	70 100 100 160	W
V2 Output Voltage	All models (15% accuracy)	10.2	12	13.8	V
V2 Output Current	All models	-	-	0.5	A
V1 Voltage Adjustment Range		-	-	± 5	% V1
Load Regulation	V <sub>AC</sub> : nominal voltages V1 Load: 0 – 100% rated V2 Load: 0 – 0.5 A	- - -	- - -	± 1 ± 5	% V1 % V2
Load-Line Cross Regulation	V <sub>AC</sub> : 90 – 264 V <sub>RMS</sub> V1: 0 – 100% load (V2 at 50% load) V2: 0 – 0.5 A load (V1 at 50% load)	- - -	- - -	± 1 ± 15	% V1 % V2
V1 Line Regulation	V <sub>AC</sub> : 90 – 264 V <sub>RMS</sub>	-	-	± 0.1	% V1
V1 Transient Response (Voltage Deviation)	50% load changes at 0.1 A/μs Recovery to regulation band within 1 ms	-	-	± 5	% V1
V1 Ripple and Noise	All models, Peak-to-peak, 20 MHz BW. 470 pF ceramic and 22 μF tantalum caps at the load (resistive).	-	-	1	% V1
Start-up Rise Time	90 < V <sub>IN</sub> < 264, any load conditions.	0.2	-	20	ms
Start-up Delay	V1 in regulation after AC is applied	-	-	1000	ms
Turn-on Overshoot		-	10 20	- -	% V1 % V2
Hold-up Time	At nominal V <sub>IN</sub> , rated load, all models	16	-	-	ms
Minimum Load	All models; V1, V2	0	-	-	A
Temperature Drift		-	± 1.2	-	mV/°C

## PROTECTION FEATURES

Specification	Test Conditions / Notes	Min.	Nominal	Max.	Units
Input Under Voltage Lockout	No damage, auto recovery	60	75	-	V <sub>AC</sub>
Input Fuse	Time Lag 2.5 A, 250 V on L and N				
Over Current	Hiccup mode, auto-recovery	110	-	150	% I <sub>1 MAX</sub>
Short Circuit	Hiccup mode, auto-recovery				
Over Voltage	Shut down, latch off mode	110	-	130	% V <sub>NOM</sub>
Over Temperature	Shut-down, auto-recovery				
I-O isolation	Reinforced	4000	-	-	V <sub>AC</sub>
Isolation V1/ V2		100	-	-	V <sub>DC</sub>
Creepage and Clearance		8	-	-	mm

## ENVIRONMENTAL SPECIFICATIONS

Specification	Test Conditions / Notes	Min	Nominal	Max	Units
<b>Operating Temperature</b>	No de-rating up to 50 °C Linearly de-rate above 50 °C	-20	-	70	°C
<b>Storage Temperature Range</b>		-40	-	80	°C
<b>Humidity</b>	RH, Non-condensing Operating Non-operating	-	-	90 95	% %
<b>Operating Altitude</b>		-	-	4000	m
<b>Shock</b>	Operating: 10 g, 11 ms, half sine, one shock input in each axes				
<b>Vibration</b>	Operating, sinusoidal: 0.5 g peak-to-peak, 10-300 Hz, 3 axes				
<b>MTBF</b>	> 220000 hours (5V variant) at 75% Full Load, Nominal V <sub>AC</sub> , 25 °C ambient MIL-HDBK-217-E-1				
<b>Cooling</b>	Natural convection Forced air cooling	10 500	- -	- -	LFM

## ELECTROMAGNETIC COMPATIBILITY (EMC) - EMISSIONS

Phenomenon	Conditions / Notes	Standard	Equipment/ Performance Class
<b>Conducted</b>	115 V <sub>RMS</sub> , 230 V <sub>RMS</sub> . Maximum load. 4 dB minimum margin	EN 55022 EN 60601-1-2	B
<b>Radiated</b>	At 10 m distance	EN 55022	A
<b>Line Voltage Fluctuation and Flicker</b>	At 20%, 50% and 100% maximum load. Nominal input voltages.	EN 61000-3-3	
<b>Harmonic Current Emission</b>	Nominal input voltages. All load conditions.	EN 61000-3-2	D

## ELECTROMAGNETIC COMPATIBILITY (EMC) - IMMUNITY

Phenomenon	Conditions / Notes	Standard	Test Level	Performance criteria
	<b>Reference standard for the medical version</b>	<b>EN 60601-1-2</b>		
<b>ESD</b>	15 kV air discharge, 8 kV contact, at any point of the system.	EN 61000-4-2	4	A
<b>Radiated Field</b>	3 V/m, 80-1000 MHz, 1 KHz/2 Hz 80% AM. Dwell time is 3 sec for 2 Hz modulation Dwell time is 1 sec for 1KHz modulation	EN 61000-4-3	3	A
<b>Electric Fast Transient Surge</b>	±2 kV on AC power port for 1 minute; ±1 kV on signal/control lines ±2 kV line to line; ±4 kV line to earth; on AC power port; ±0.5 kV for outdoor cables	EN 61000-4-4 EN 61000-4-5	3 3	A B
<b>Conducted RF Immunity</b>	3 V <sub>RMS</sub> , 0,15-80 MHz, 1 KHz/2 Hz 80% AM	EN 61000-4-6	3	A
<b>Dips and Interruptions</b>	Dip to 40% for 5 cycles (100 ms) Dip to 70% for 25 cycles (500 ms) Drop-out to 5% for 10 ms Interrupts > 95% for 5 s	EN61000-4-11 EN61000-4-11 EN61000-4-11 EN61000-4-11		B B B B

## SAFETY AGENCIES APPROVAL

Certification Body	Safety Standards and file numbers	Agency Files References
<b>UL</b>	ANSI/AAMI ES60601-1 (2005 + C1:09 + A2:10)	E304543-A5-UL
<b>IEC IECCE CB Certification</b>	IEC 60601-1 3 <sup>rd</sup> edition EN 60601-1:2006	NO69561 (CB test certificate) No. P12215594 (Nemko)
<b>CE</b>	Low Voltage Directive (LDV) 2006/95/EC Low Voltage Directive (LDV) 2007/47/EC MDD	

## OUTLINE DRAWING AND CONNECTIONS – DE-RATING CURVE

Overall dimensions:

(50.8 X 101.6 X 27.5) mm

(2.00 X 4.00 X 1.08) in

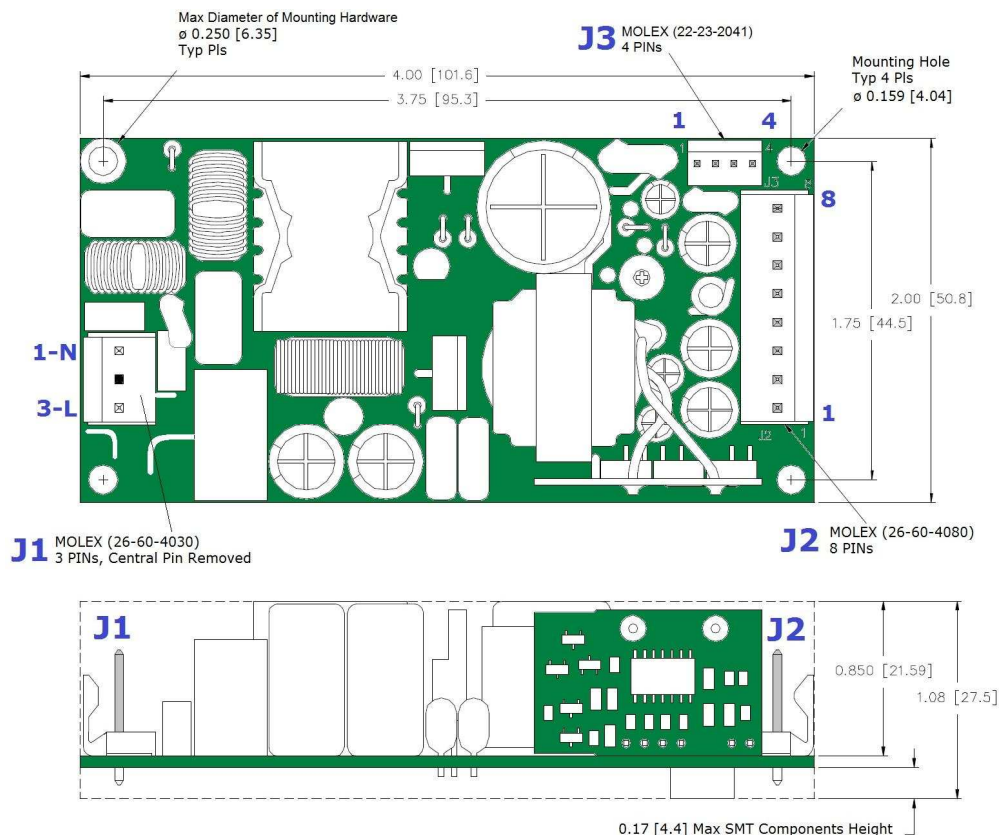
Weight:

160 g

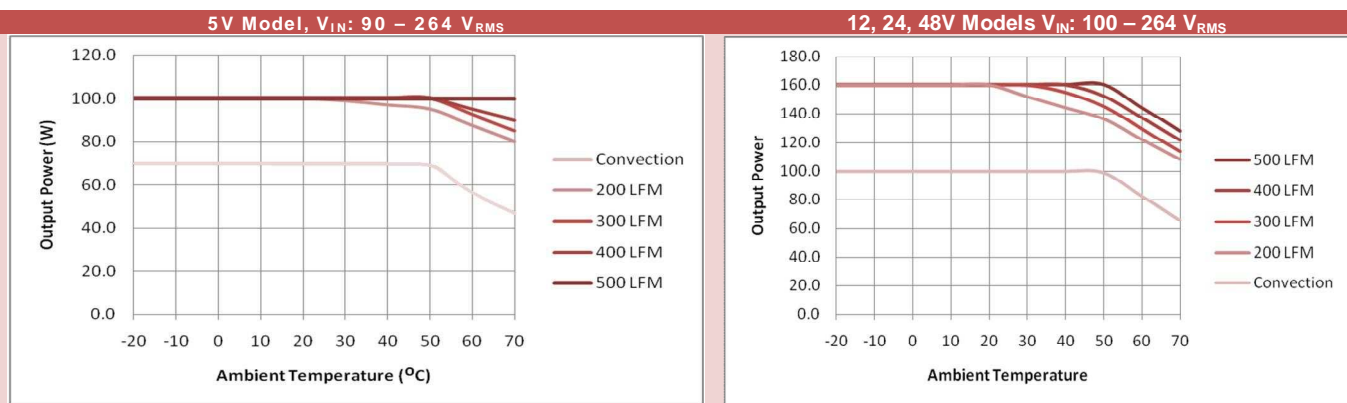
0.35 lb

Forced air cooling:

Air flow direction, longitudinal or transverse, must be coplanar to the PCB no matter its orientation.



Connector	Manufacturer and Part Number	Pin Assignment
AC Input Connector J1	Molex 26-60-4030 or equivalent	1: AC Neutral; 2: Not present; 3: AC Live
J1 Mating Connector	Molex 09-93-0300 (Crimp Terminal Housing) Molex 08-50-0105 (Crimp Terminal, 18-24 AWG)	
Output Connector J2	Molex 26-60-4080 or equivalent	1 – 4: V1 RTN; 5 – 8: + V1
J2 Mating Connector	Molex 09-91-0800 (Crimp Terminal Housing) Molex 08-50-0105 (Crimp Terminal, 18-24 AWG)	
Auxiliary Connector J3	Molex 22-23-2041 or equivalent	1, 2: GND; 3, 4: + V2
J3 Mating Connector	Molex 22-01-2047 (Crimp Terminal Housing) Molex 08-50-0113 (Crimp Terminal, 22-24 AWG)	



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Rev 04 \_ July 21, 2014