

DESCRIPTION

The MFA350 is a series of high efficiency, small form factor and single output AC-DC power supplies.

Offering 365 W of regulated DC power from an open frame, industry standard 3" x 5" x 1.28" form factor, the MFA350 series occupies 50% less space in a system.

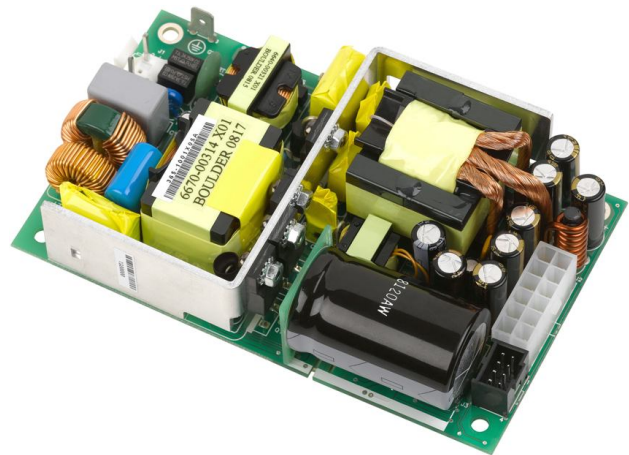
The extremely high power density enable designers to integrate more advanced features into a system without compromising on its size.

By converting energy at 91% typical efficiency, the MFA350 generates less heat facilitating thermal management and space constrained integrations.

The series is available in five different high power output voltages at 12, 24, 32, 36 and 48 V, and are equipped with an auxiliary low power 12V and a stand by 5 V outputs.

The MFA350 range comply with the 2nd and 3rd edition of the IEC 60601-1 and CAN/CSA-C22.2 No. 60601-1-08 safety standards for medical equipment.

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



KEY FEATURES

- Universal input voltage range
- 365 W active PFC power supply
- Very small form factor (3 x 5 x 1.40) in
- High efficiency (91% typical)
- 12, 24, 32, 36, and 48V standard output variants
- Low leakage, IEC 60601-1 compliant
- Over temperature protection
- OV, OC, and short circuit protections
- Stand-by +5 V Output
- Auxiliary fan +12 V output
- Remote enable signal
- DC power good signal
- RoHS-6 compliant (EU directive 2011/65/EU)
- CSA 60601-1-3rd ed. And ANSI/AAMI ES60601-1:2005 compliant

MARKET SEGMENT AND APPLICATIONS

- Medical electronics
- Dental electronics
- Laboratory Equipment
- Healthcare diagnostic

MODELS CODING AND OUTPUT RATINGS

Model Number	V1 [V]	I1 ¹ Convection [A]	I1 ¹ Forced air [A]	V1 ² Ripple [mV]	V2 [V]	I2 ¹ Rated [A]	V2 ² Ripple [mV]	5V _{SB} [V]	I5V _{SB} ¹ Convection [A]	I5V _{SB} ¹ Forced air [A]	5V _{SB} ² Ripple [mV]
MFA350-US12	12	16.6	30.4	120	12	1	240	5	1	2	50
MFA350-US24	24	8.3	15.2	240	12	1	240	5	1	2	50
MFA350-US32	32	6.2	11.4	320	12	1	240	5	1	2	50
MFA350-US36	36	5.5	10.1	360	12	1	240	5	1	2	50
MFA350-US48	48	4.16	7.6	480	12	1	240	5	1	2	50

¹ The combined output power of V1, V2 and 5V_{SB} must not exceed 200 W when natural convection cooled and 365 W when forced air cooled at typically 400 LFM, up to 50 °C ambient. Above 50 °C output de-rating applies (see details on the output specifications). In any case, the heat sink maximum temperature should not exceed +110 °C at 50 °C ambient temperature.

² 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 _{AC} at all load conditions	90	100/240	264	V _{AC}
Input Frequency		47	50/60	440	Hz
Input Current	RMS at 180 V _{AC} , maximum load RMS at 90 V _{AC} , maximum load	-	-	2.5 5	A
Inrush Current	230 V _{AC} , cold start, no damage	-	-	-	A
Fusing	2X Time Lag 6.3 A, 250 V on both L and N	-	-	6.3	A
Efficiency	50% max rated load	90	-	-	%
	20/100% max rated load Nominal V _{IN} , all versions.	88	-	-	
Stand by Consumption	Nominal Input voltages, no load	-	-	1	W
Power Factor	At full rated load, 115 V _{AC} , 60 Hz and 230 V _{AC} , 50 Hz input voltages	0.95	-	-	-
Harmonic Current Fluctuations and Flicker	Complies with EN-61000-3-2 Class C at 230 V _{AC} 50 Hz, load >50 W.				
	Complies with EN-61000-3-3 at nominal voltages and full load.				
Leakage Current	120 V _{AC} , 60 Hz, normal condition	-	-	110	μA
	230 V _{AC} , 60 Hz, normal condition	-	-	275	

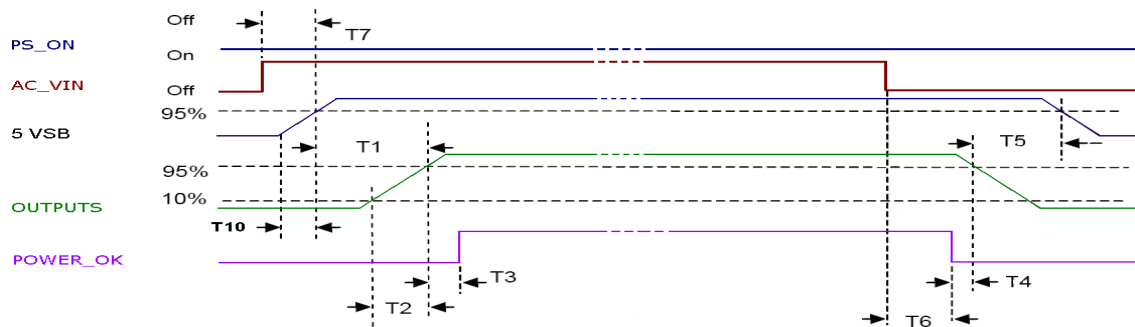
OUTPUT SPECIFICATIONS

Specification	Test Conditions / Notes	Min.	Nom.	Max.	Units
V1 Set Point Accuracy			±1	-	%
V1 Output Power Rating	All models, convection cooling	-	-	200	W
	All models forced air cooling (>400 LFM)	-	-	365	
V2 Output Voltage	All models (15% accuracy)	10.2	12	13.8	V
V2 Output Current	All models, natural convection cooling	-	-	0.5	A
	All models, >400 LFM forced air cooling	-	-	1	
5V _{SB} Output Voltage	All models (5% set point accuracy)	4.75	5	5.25	V
5V _{SB} Output Current	All models, natural convection cooling	-	-	1	A
	All models, >400 LFM forced air cooling	-	-	2	
V1 Voltage Adjustment Range		±5	-	-	%V1
V1 Load-Line-Cross Regulation	V _{AC} : 90 – 264 V _{RMS}				
	V1 Load: 0 – 100% rated	-	-	±3	%V1
	V2 Load: 0 – 1 A				
	5V _{SB} Load: 0 – 2 A				
5V _{SB} Load-Line-Cross regulation	V _{AC} : 90 – 264 V _{RMS}				
	V1 Load: 0 – 100% rated	-	-	±5	%5V _{SB}
	V2 Load: 0 – 1 A				
	5V _{SB} Load: 0 – 2 A				
V1 Line Regulation	V _{AC} : 90 – 264 V _{RMS}	-	-	±0.1	%V1
Transient Response (Voltage Deviation) V1, 5V _{SB}	25% load changes at 1 A/μs				
	12V at 2200 μF Load / I _{OUT} > 0.5 A				
	24 V at 1000 μF Load / I _{OUT} > 0.5 A				
	32 V at 820 μF Load / I _{OUT} > 0.5 A	-	-	±5	%V1
	36 V at 820 μF Load / I _{OUT} > 0.5 A				%5V _{SB}
	48V at 560 μF Load / I _{OUT} > 0.5 A 5V _{SB} at 560 μF Load / I _{OUT} > 0.1 A				
V1 Ripple & 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 _{IN} < 264, any load conditions.	5	-	85	ms
Start-up Delay	V1 in regulation after PS_ON is asserted			350	ms
	V1 in regulation after AC is applied 5V _{SB} in regulation after AC is applied	-	-	900 700	
Turn-on Overshoot	At 500 mA output current, V1 in regulation within 50 ms.		10		%V1
			10	-	%V2
			10	-	%V _{SB}
Hold-up Time	At nominal V _{IN} , 365 W, for all outputs	16	20	-	ms
Minimum Load	All models; V1, V2 and 5V _{SB}	0	-	-	A
Temperature Drift		-	±1.2	-	mV/°C

SIGNALS/CONTROLS

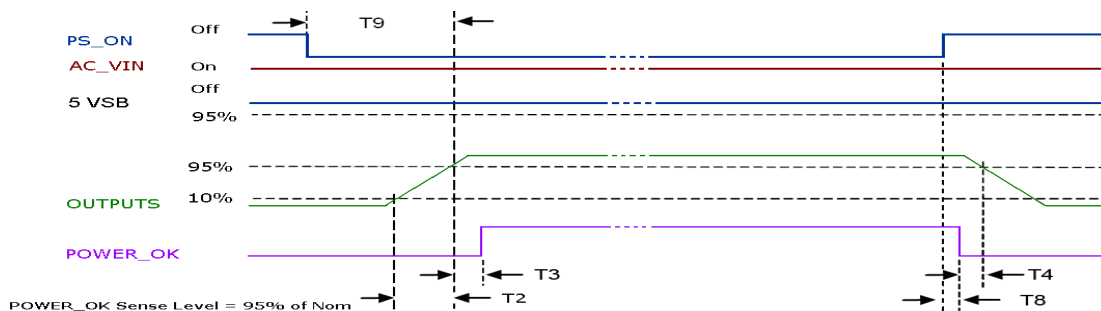
Signal	Notes	Min	Typ	Max	Unit
PS_ON	Active low, +5 V TTL signal compatible. Input low voltage	0	-	2.	V
	Input high voltage ($I_{IN}= 200 \mu A$)	2.5	-	-	V
	V1 and V2 disabled when PS_ON is open 5V _{SB} not affected by PS_ON				
P_OK	V1 and V2 enabled with PS_ON connected to RTN +5 V TTL compatible				
	Logic level low (<10 mA sinking)	-	-	0.4	V
	Logic level high (100 μA sourcing)	2.4	-	5	V
	Low to high time after V1 in regulation Power down warning time	0.1	-	0.5	s
		1	-	-	ms
5V_{SB} output	Active and in regulation after a $90 < V_{AC} < 264$ is applied	-	-	700	ms
	5V _{SB} not affected by PS_ON				

SIGNAL TIMINGS



Above waveforms are expected with AC Input ON/OFF:

Standby on - Main outputs on	$1 \text{ ms} \leq T1 \leq 200 \text{ ms}$
Main output Rise Time	$0.2 \text{ ms} \leq T2 \leq 20 \text{ ms}$
5 VSB Rise Time	$4 \text{ ms} \leq T10 \leq 20 \text{ ms}$
Main outputs On – P_OK delay	$100 \text{ ms} \leq T3 \leq 500 \text{ ms}$
Power down warning ¹	$T4 \geq 1 \text{ ms}$ (converter off)
Main Output off – Standby off ²	$T5 \geq 1 \text{ ms}$
Hold-up time (AC off – P_OK low)	$T6 \geq 20 \text{ ms}$ (115/ 230 V _{AC})
AC_ON - Standby turn on time	$T7 \leq 700 \text{ ms}$



Above waveforms are expected with PS_ON Signal ON/OFF state change:

Main Output Rise Time	$0.2 \text{ ms} \leq T2 \leq 20 \text{ ms}$
Main Outputs on – P_OK delay	$100 \text{ ms} \leq T3 \leq 500 \text{ ms}$
Power down warning ¹	$T4 \leq 1 \text{ ms}$ (converter off)
PS_ON - Main Output (off) Timing	$T8 \leq 60 \text{ ms}$
PS_ON - Main Output (on) Timing	$T9 \leq 350 \text{ ms}$

¹ T4 parameter measurement setup will assume at least 10% of the maximum load on each output.

² T5 parameter measurement setup will assume at least 50% of the maximum load on main output.

PROTECTION FEATURES

Specification	Test Conditions / Notes	Min.	Nominal	Max.	Units
Input Under Voltage Lockout	Auto Recovery, Hiccup Mode	60	75	-	V _{AC}
Input Fuse	2X Time Lag 6.3 A, 250 V on L and N	-	-	6.3	A
Over Current	At nominal input voltages, any load, max. 1 minute. Hiccup mode with auto recovery	-	-	150	%I _{MAX}
Short Circuit Over Voltage	Hiccup mode, auto-recovering.				
	12V				
	24V				
	32V	110	-	125	%V _{NOM}
	36V				
	48V				
	5V _{SB}	110	-	130	
	Unit shut down and latch off				
Over Temperature	Hiccup mode with auto recovery				
Isolation Primary to Secondary	Reinforced	4000	-	-	V _{AC}
Isolation Input to Earth	Basic	1500			V _{AC}
Isolation V1/V2		100	-	-	V _{DC}
Isolation Output to Earth		500	-	-	V _{DC}

ENVIRONMENTAL SPECIFICATIONS

Specification	Test Conditions / Notes	Min	Nominal	Max	Units
Operating Temperature Range	No de-rating up to 50 °C	-20	-	50	°C
De-rated Operating Temperature Range	Linearly de-rate from full load at 50 °C to half load at 70 °C	-	-	70	°C
Storage Temperature Range		-40	-	80	°C
Humidity	RH, Non-condensing Operating Non-operating	-	-	90 95	% %
Operating Altitude		-	-	3000	m
Shock	<u>Operating</u> 10 g, 11 ms, half sine, one shock input in each axes, for a total of six shock inputs. <u>Non-Operating</u> 140 g, 2 ms, half sine, one shock input in each direction of each axes, for a total of six shock inputs.				
Vibration	<u>Operating</u> Sinusoidal: 0.5 g peak-to-peak, 10-300 Hz, 0.25 octaves/minute, one cycle, 10-300 to 10 Hz per axis in each of three mutually perpendicular axes for a total of three cycles. <u>Non-Operating</u> Sinusoidal: 1.5 g peak-to-peak, 10-500 Hz, 0.5 octaves/minute, one cycle, 10-500 to 10 Hz per axis in each of three mutually perpendicular axes for a total of three cycles.				
MTBF	75% Full Load, Nominal V _{AC} , 35 °C MIL-HDBK-217-E-1	250000	-	-	Hours
Cooling	Natural Convection (200 W) Forced air cooling (365 W)	10 400	- -	- -	LFM

ELECTROMAGNETIC COMPATIBILITY (EMC) - EMISSIONS

Phenomenon	Conditions / Notes	Standard	Equipment/Performance Class
Conducted	115 V _{RMS} , 230 V _{RMS} . Maximum load. 4 dB minimum margin	EN 55022 (ITE)	A
Radiated	At 10 m distance	EN 55022 (ITE)	A
Line Voltage Fluctuation and Flicker	At 20%, 50% and 100% maximum load. Nominal input voltages.	EN 61000-3-3	
Harmonic Current Emission	Nominal input voltages. All load conditions.	EN 61000-3-2	A

ELECTROMAGNETIC COMPATIBILITY (EMC) - IMMUNITY

Phenomenon	Conditions / Notes	Standard	Test Level	Performance criteria
	Reference standard for the medical version	EN 60601-1-2		
ESD	15 kV air discharge, 8 kV contact, at any point of the system.	EN 61000-4-2	4	A
Radiated Field	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
Electric Fast Transient Surge	±2 kV on AC power port for 1 minute; ±1 kV on signal/control lines	EN 61000-4-4	3	A
	±2 kV line to line; ±4 kV line to earth;	EN 61000-4-5	3	B
	on AC power port; ±0.5 kV for outdoor cables			
Conducted RF Immunity	3 V _{RMS} , 0,15-80 MHz, 1 KHz/2 Hz 80% AM	EN 61000-4-6	3	A
Dips and Interruptions	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 C

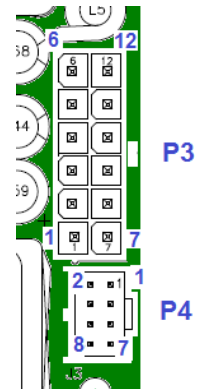
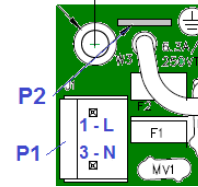
SAFETY AGENCIES APPROVAL

Certification Body	Safety Standards and file numbers	Category
CSA/UL	CSA C22.2 No. 60950-1, UL 60950-1; 2007, 2 nd edition	Information Technology Eq.
	CSA C22.2 No.601.1, ANSI/AAMI ES60601-1 3 rd edition	Medical
IEC IECEE CB Certification	IEC/EN 60950-1 2 nd edition	Information Technology Eq.
	IEC/EN 60601-1 3 rd edition	Medical
CE	Low Voltage Directive (LDV) 2006/95/EC	Information Technology Eq.
	Low Voltage Directive (LDV) 2007/47/EC MDD	Medical

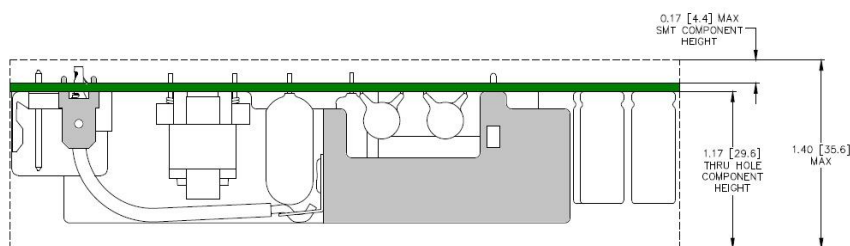


OUTLINE DRAWING AND CONNECTIONS – OPEN FRAME

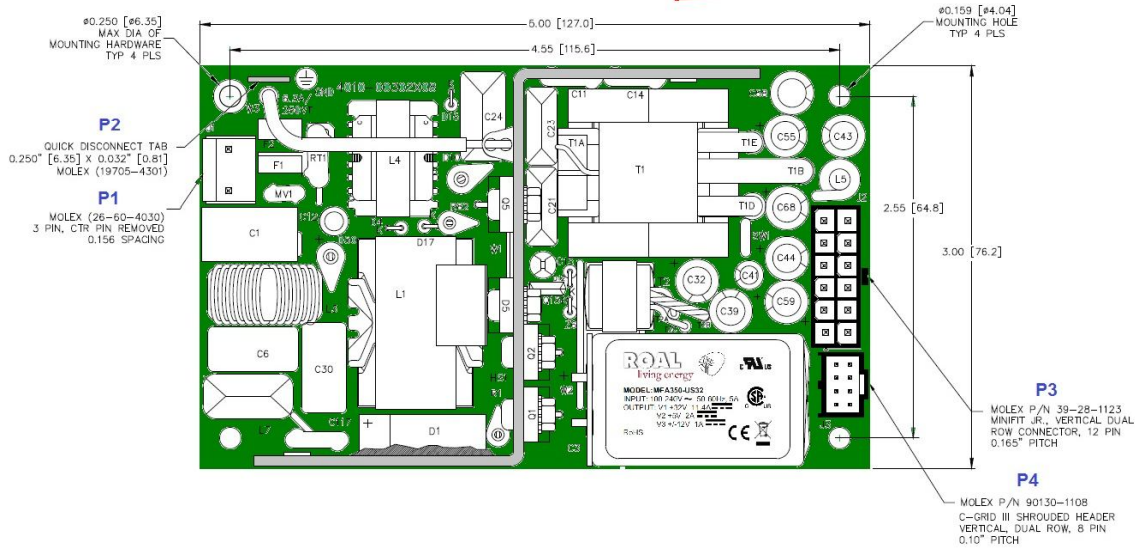
Connector	Manufacturer and Part Number
AC Input Connector P1	Molex 26-60-4030 or equivalent
P1 Mating Connector	Molex 09-93-0300 (Crimp Terminal Housing) Molex 08-50-0105 (Crimp Terminal, 18-24 AWG)
Protection Earth Connector P2	Molex 19705-4301 or equivalent
P2 Mating Connector	Any tin finished 6.35x0.81 mm receptacle
Output Connector P3	Molex 39-28-1123 or equivalent
P3 Mating Connector	Molex 39-01-2120 (Crimp Terminal Housing) Molex 39-00-0039 (Crimp Terminal, 18-24 AWG)
Signals Connector P4	Molex 90130-1108 or equivalent
P Mating Connector	Molex 90142-0008 (Crimp Terminal Housing) Molex 90119-0109 (Crimp Terminal, 22-24 AWG)



Note: PCB head connectors and their mating are the same for all the package options.



Recommended airflow direction 



AC Input P1

Pin	Function
1	AC Live
2	Not Present
3	AC Neutral

Protection Earth P2

GND	AC Ground
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Output Connector P3

Pin	Function
1	+V1
2	+V1
3	+V1
4	+V1
5	+V1
6	+V1
7	V1 RTN
8	V1 RTN
9	V1 RTN
10	V1 RTN
11	V1 RTN
12	V1 RTN

Signal Connector P4

Pin	Function
1	+5V _{SB}
2	P_OK
3	-V2
4	PS_ON
5	RS+
6	COM
7	+V2
8	COM

Overall dimensions: (76.2 X 127.0 X 35.6) mm; (3.00 X 5.00 X 1.40) in

Weight: 360 g; 0.79 lb

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