



MINMAX[®]

AMF-60 Series

Electric Characteristic Note

AMF-60 Series EC Note

AC-DC POWER MODULE 60W

Features

- ▶ Ultra Compact Size 2.99x2.13x1.10 "
- ▶ Fully Encapsulated Plastic Case for PCB, Chassis and DIN-Rail Mounting Version
- ▶ Universal Input 85-264VAC, 90-370VDC, 47-440Hz
- ▶ I/O Isolation 3000VAC with Reinforced Insulation
- ▶ No Min. Load Requirement & Low no-load power consumption
- ▶ Operating Ambient Temp. Range -40°C to +70°C
- ▶ Overload/Voltage and Short Circuit Protection
- ▶ EMI Emission EN55014-1/55032 Class B Approved
- ▶ EMC Immunity EN61000-4-2,3,4,5,6,8,11 Approved
- ▶ Safety Approval to UL/cUL/IEC/EN 62368-1, IEC/EN 60335-1 & CE Marking



Applications

- ▶ Distributed power architectures
- ▶ Workstations
- ▶ Computer equipment
- ▶ Communications equipment

Product Overview

The MINMAX AMF-60 series is a new generation of fully encapsulated AC-DC power supply modules with ultra-compact size for higher power density and space saving.

The product features universal AC input 85-264VAC and wider DC input 90-370VDC, regulated output voltages 5.1,12,15,24,48VDC ; I/O Isolation 3000VAC with Reinforced Insulation ; EMI emission EN55014-1/32 Class B and EMS immunity EN 61000-4 standards approved ; no min. load requirement and low no-load power consumption; abnormal protection mechanism with output overload, short circuit and overvoltage protections.

The AMF-60 series equips with PCB, Chassis and DIN-Rail Mounting Version for flexible installation and comply with UL/IEC/EN 62368-1 & IEC/EN 60335-1 for safety usage. It provides a cost effective solution especially for space critical applications in industrial and household electronic equipment.

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Model Selection Guide

Model Number	Output Voltage	Output Power	Output Current Max.	Input Current	Max. capacitive Load	Efficiency (typ.)
				115VAC, 60Hz @Max. Load		@Max. Load
	VDC	W	A	mA(typ.)	μF	%
AMF-60S051	5.1	51	10	961	12000	87
AMF-60S12	12	60	5	1127	2200	89
AMF-60S15	15	60	4	1127	1500	89
AMF-60S24	24	60	2.5	1127	1000	89
AMF-60S48	48	60	1.25	1127	220	89

Input Specifications

Parameter	Conditions / Model		Min.	Typ.	Max.	Unit
AC Input Voltage Range	ALL Models		85	---	264	VAC
AC Input Frequency Range			47	---	440	Hz
DC Input Voltage Range			90	---	370	VDC
No-Load Power Consumption	115VAC	PCB Mounting	---	---	100	mW
	230VAC		---	---	200	mW
	115VAC	Chassis Mounting	---	---	150	mW
	230VAC		---	---	250	mW
Inrush Current	115VAC	Cold Start at 25°C	---	---	45	A
	230VAC		---	---	90	A

Output Specifications

Parameter	Conditions / Model		Min.	Typ.	Max.	Unit
Output Voltage Accuracy			---	±1.0	±2.0	%
Line Regulation	Vin=Min. to Max. @Full Load		---	---	±0.5	%
Load Regulation	Io=0% to 100%		---	---	±1.0	%
Ripple & Noise	0-20 MHz Bandwidth	5.1VDC Output Model	---	---	1.8	%V _{PP} of Vo
		Other Output Models	---	---	1.0	%V _{PP} of Vo
Minimum Load	No minimum Load Requirement					
Over Voltage Protection	Zener diode clamp		---	125	---	% of Vo
Temperature Coefficient			---	±0.01	±0.02	%/°C
Overshoot			---	---	5	% Vout
Over Load Protection	auto-recovery		110	---	---	%Inom.
	(long term overload condition may cause damage)					
Short Circuit Protection	Hiccup mode, Automatic Recovery					

General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	Input to Output, 60 Seconds	3000	---	---	VAC
I/O Isolation Resistance	500 VDC	10	---	---	GΩ
Switching Frequency		---	65	---	kHz
Start-up Time		---	---	1	s
Hold-up Time	115VAC, 60Hz	10	---	---	ms
	230VAC, 50Hz	20	---	---	ms
MTBF (calculated)	MIL-HDBK-217F@25°C, Ground Benign	355,000	---	---	Hours
Safety Approvals	UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1(CB-report)				
	IEC/EN 60335-1, 61558-1, 61558-2-16 recognition(CB-report)				

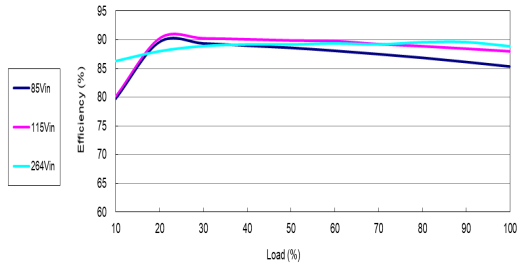
EMC Specifications				
Parameter	Standards & Level			Performance
General	Compliance with EN 61204-3 Switch mode power supplies			
EMI	Conduction	EN55014-1, EN 55032	Without external components	Class B
	Radiation			
EMS	EN 55014-2, EN 55035			
	ESD	Direct discharge	Indirect discharge HCP & VCP	
		EN61000-4-2 air ± 8kV	Contact ± 6kV	
	Radiated immunity	EN 61000-4-3 10V/m		
	Fast transient	EN 61000-4-4 ±2kV		
	Surge	EN 61000-4-5 ±1kV		
	Conducted immunity	EN 61000-4-6 10Vrms		
	PFMF	EN 61000-4-8 30A/m		
	Dips	EN 61000-4-11 30% 10ms		
Interruptions	EN 61000-4-11 >95% 5000ms			

Environmental Specifications					
Parameter	Min.	Typ.	Max.	Unit	
Operating Ambient Temperature Range (See Power Derating Curve)	-40	---	+70	°C	
Storage Temperature Range	-40	---	+85	°C	
Humidity (non condensing)	---	---	95	% rel. H	
Lead Temperature (1.5mm from case for 10Sec.)	---	---	260	°C	

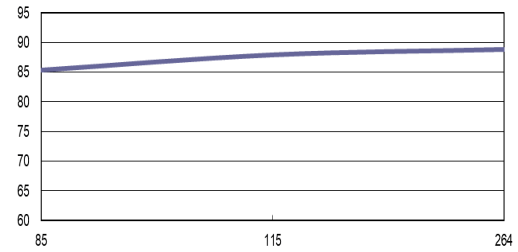
Notes	
1	All Specifications typical at Ta=+25°C, resistive load, 115VAC, 60Hz input voltage and after warm-up time rated output current unless otherwise noted.
2	We recommend to protect the converter by a slow blow fuse in the input supply line.
3	Other input and output voltage may be available, please contact MINMAX.
4	Specifications are subject to change without notice
5	The repeated high voltage isolation testing of the converter can degrade isolation capability, to a lesser or greater degree depending on materials, construction, environment and reflow solder process. Any material is susceptible to eventual chemical degradation when subject to very high applied voltages thus implying that the number of tests should be strictly limited. We therefore strongly advise against repeated high voltage isolation testing, but if it is absolutely required, that the voltage be reduced by 20% from specified test voltage. Furthermore, the high voltage isolation capability after reflow solder process should be evaluated as it is applied on system.

Characteristic Curves

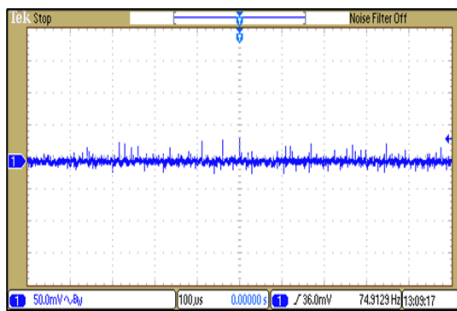
All test conditions are at 25°C The figures are identical for AMF-60S051



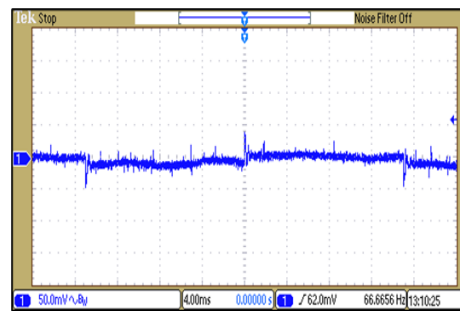
Efficiency Versus Output Current



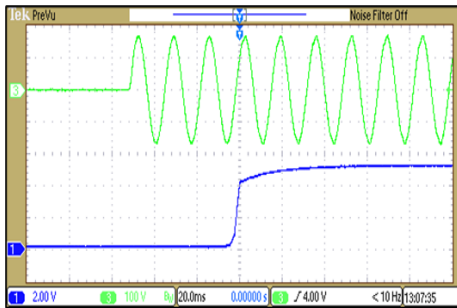
Efficiency Versus Input Voltage Full Load



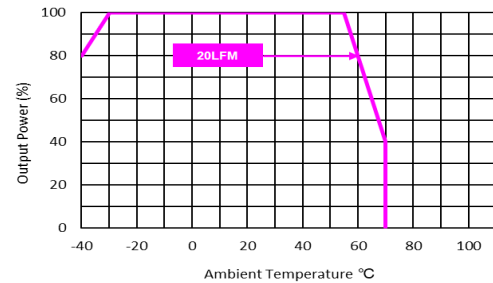
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



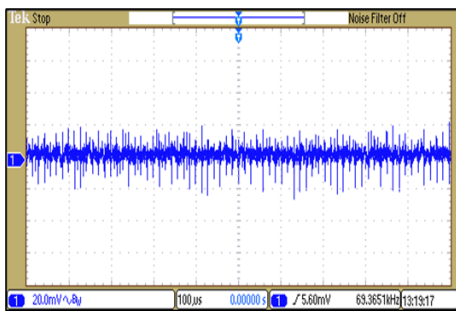
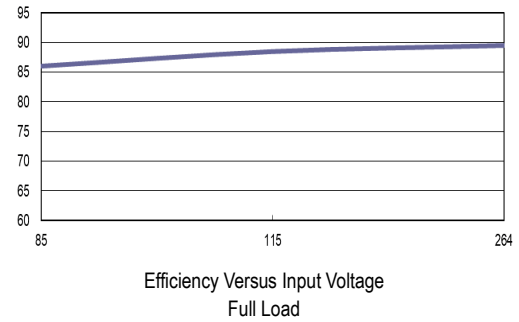
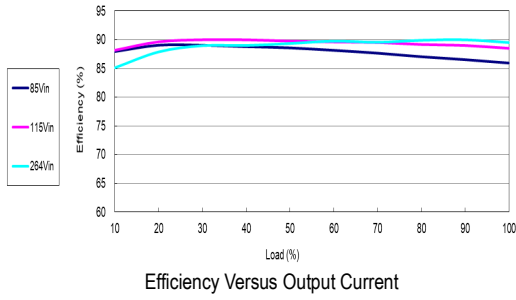
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



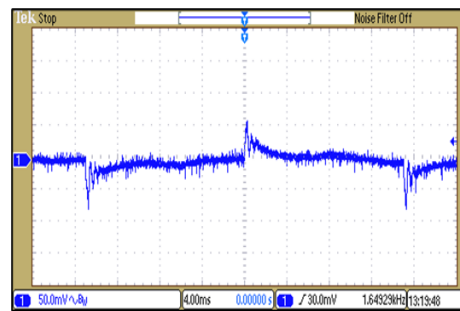
Derating Output Current Versus Ambient Temperature
 $V_{in}=V_{in\ nom}$

Characteristic Curves

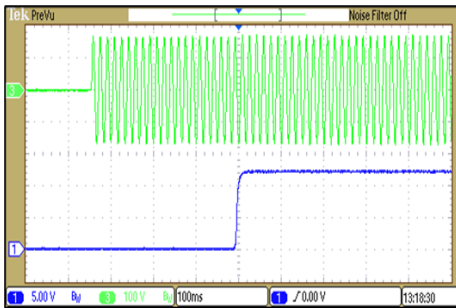
All test conditions are at 25°C The figures are identical for AMF-60S12



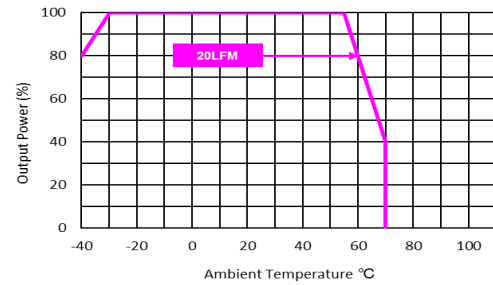
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



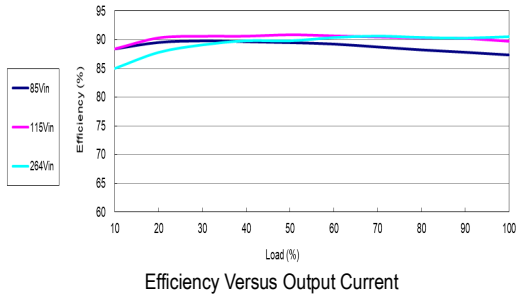
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



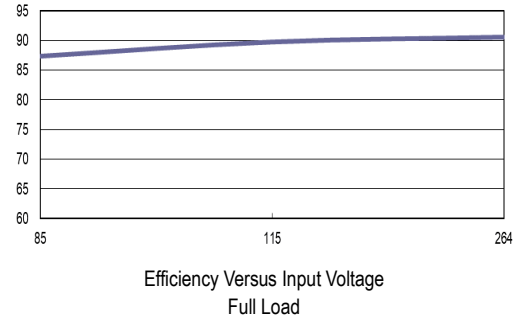
Derating Output Current Versus Ambient Temperature
 $V_{in}=V_{in\ nom}$

Characteristic Curves

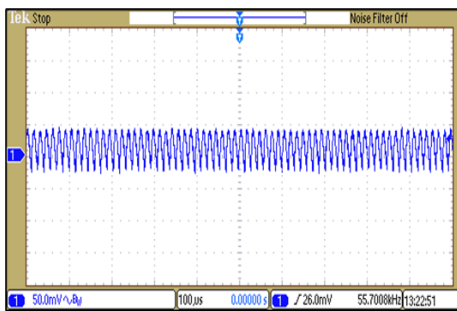
All test conditions are at 25°C The figures are identical for AMF-60S15



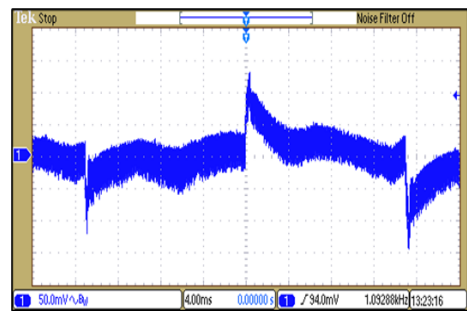
Efficiency Versus Output Current



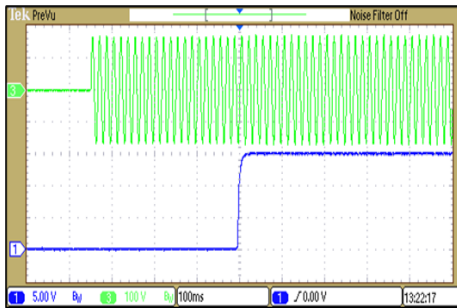
Efficiency Versus Input Voltage Full Load



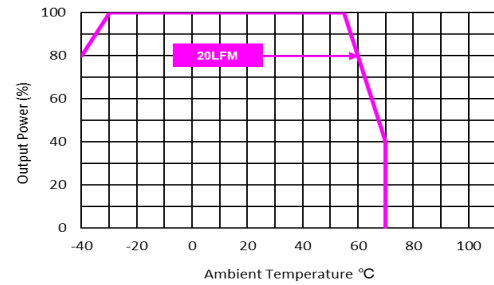
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



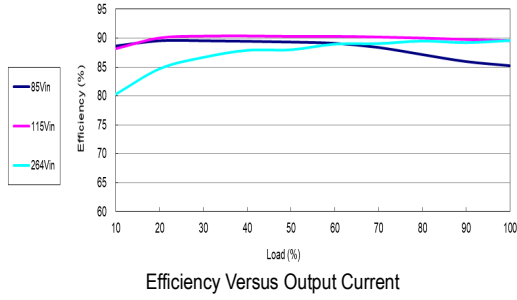
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



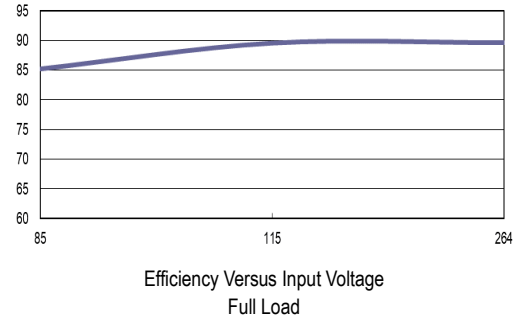
Derating Output Current Versus Ambient Temperature
 $V_{in}=V_{in\ nom}$

Characteristic Curves

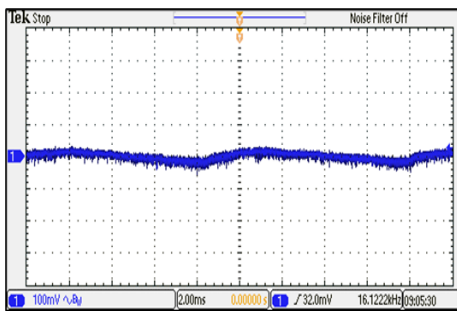
All test conditions are at 25°C The figures are identical for AMF-60S24



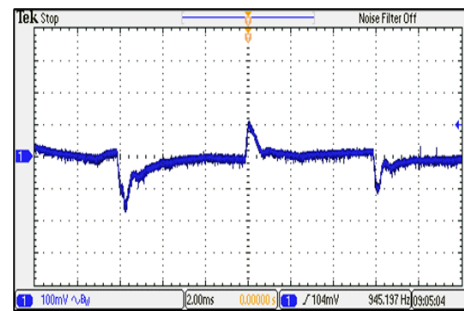
Efficiency Versus Output Current



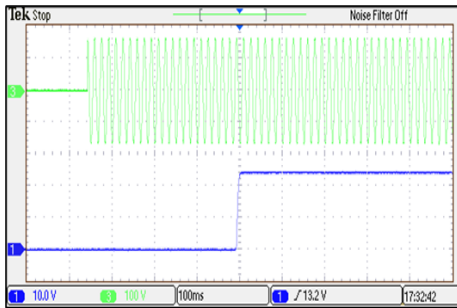
Efficiency Versus Input Voltage Full Load



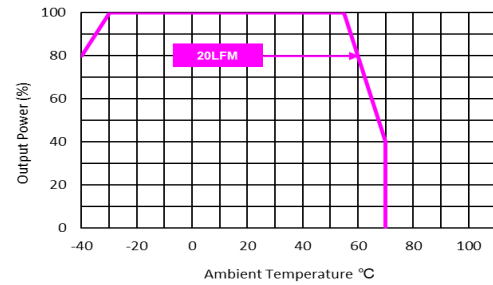
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



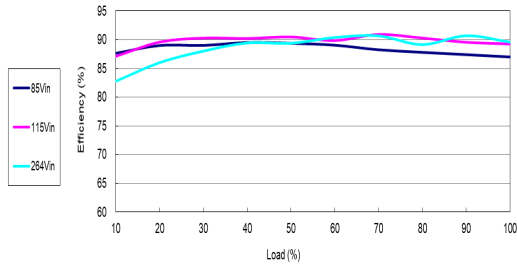
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



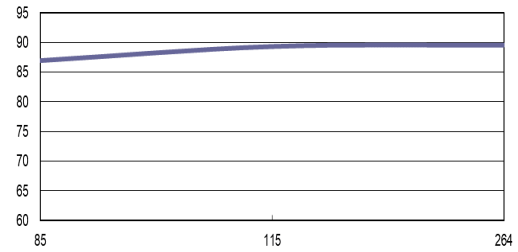
Derating Output Current Versus Ambient Temperature
 $V_{in}=V_{in\ nom}$

Characteristic Curves

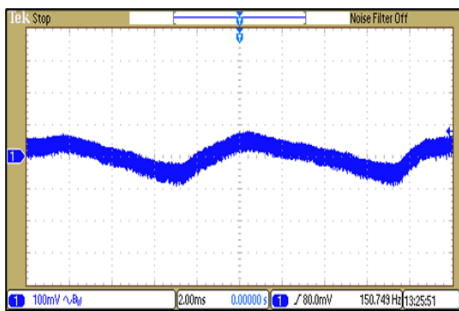
All test conditions are at 25°C The figures are identical for AMF-60S48



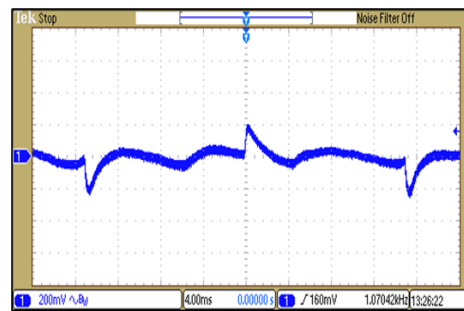
Efficiency Versus Output Current



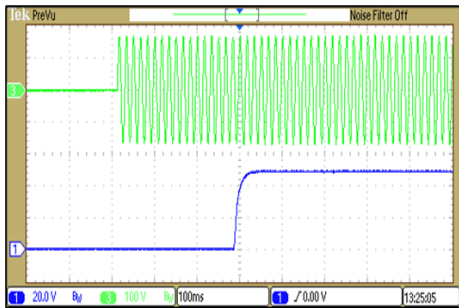
Efficiency Versus Input Voltage Full Load



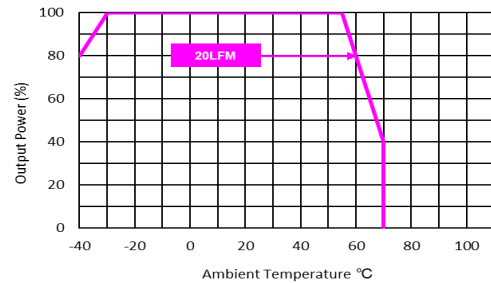
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



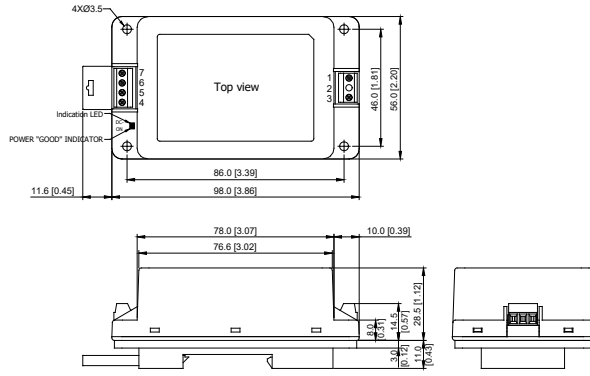
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



Derating Output Current Versus Ambient Temperature
 $V_{in}=V_{in\ nom}$

Package Specifications for screw terminal with DIN Rail Mounting (order code suffix AC-DIN-01)

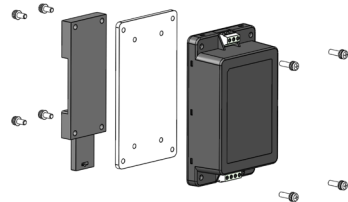
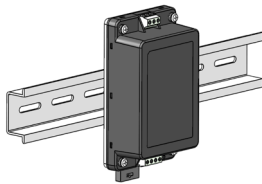
Mechanical Dimensions



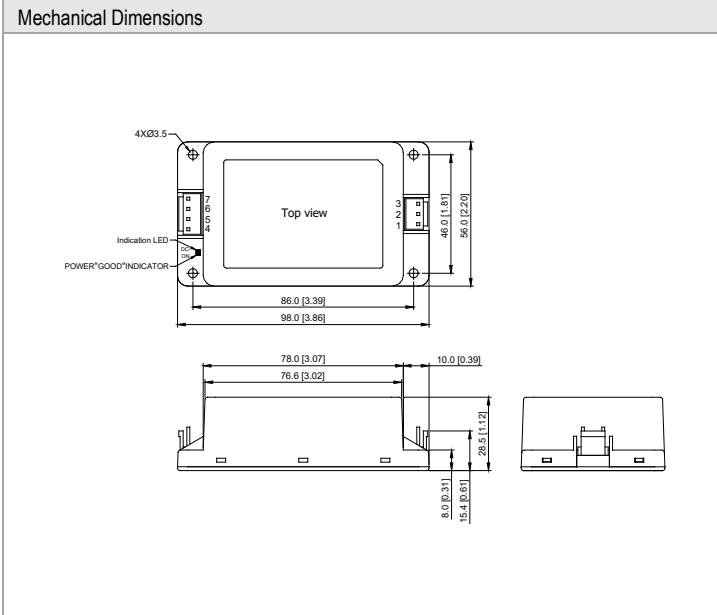
Physical Characteristics

Case Size	: 98.0x56.0x28.5mm (3.86x2.20x1.12 inches)
Case Material	: Plastic resin (flammability to UL 94V-0 rated)
Weight	: 226g

Screw terminal with DIN Rail Mounting



Package Specifications Chassis Mounting with JST connection (order code suffix CD)



Pin Connections

Pin	Function
1	AC(N) – AC Neutral
2	No Pin
3	AC(L) – AC Line
4	-Vout
5	-Vout
6	+Vout
7	+Vout

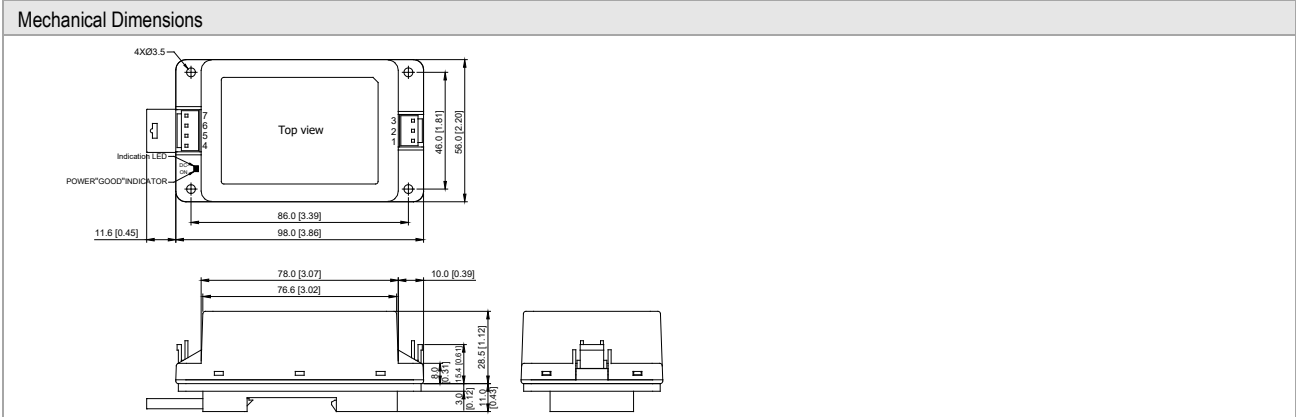
Input (pin 1, pin 3): JST Connector
 mates with JST crimp contacts: SVH-41T-P1.1
 terminal housing: VAR-2
 Output (pin 4, pin 5, pin 6, pin 7): JST Connector
 mates with JST crimp contacts: SVH-41T-P1.1
 terminal housing: VHR-4

- ▶ All dimensions in mm (inches)
- ▶ Tolerance: ± 0.5 (± 0.02)

Physical Characteristics

Case Size	: 98.0x56.0x28.5mm (3.86x2.20x1.12 inches)
Case Material	: Plastic resin (flammability to UL 94V-0 rated)
Weight	: 172g

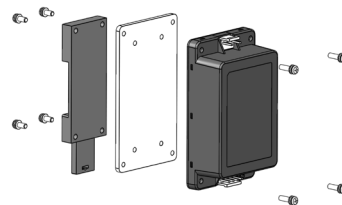
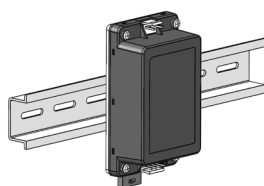
Package Specifications for JST connection with DIN Rail Mounting (order code suffix AC-DIN-01)



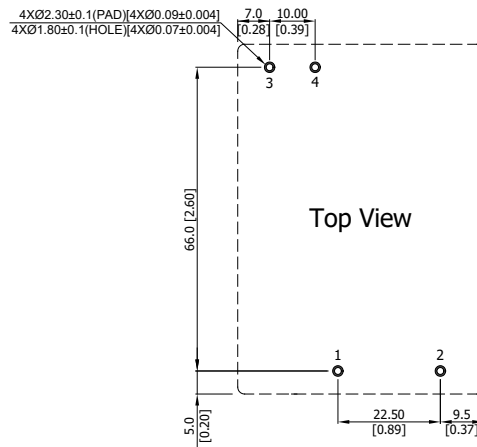
Physical Characteristics

Case Size	: 98.0x56.0x28.5mm (3.86x2.20x1.12 inches)
Case Material	: Plastic resin (flammability to UL 94V-0 rated)
Weight	: 226g

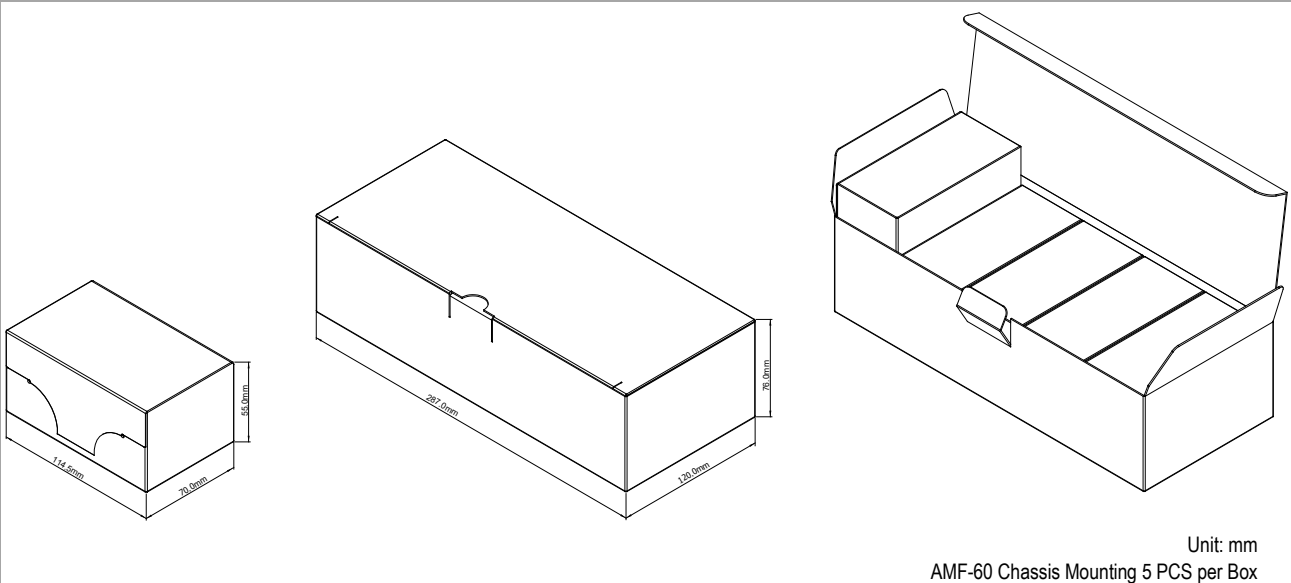
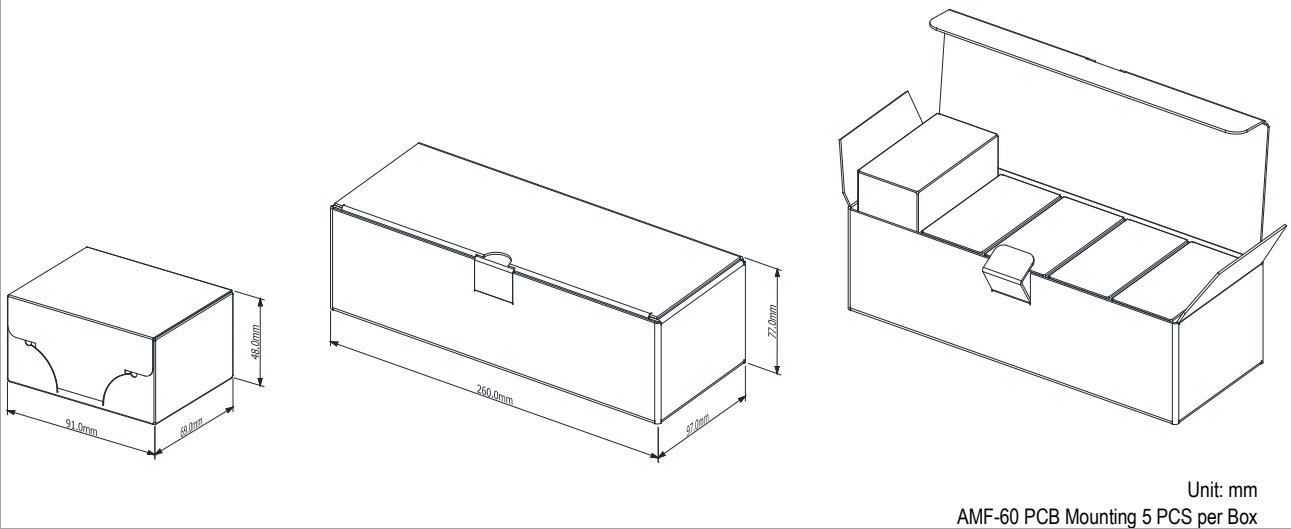
JST connection with DIN Rail Mounting



Recommended Pad Layout

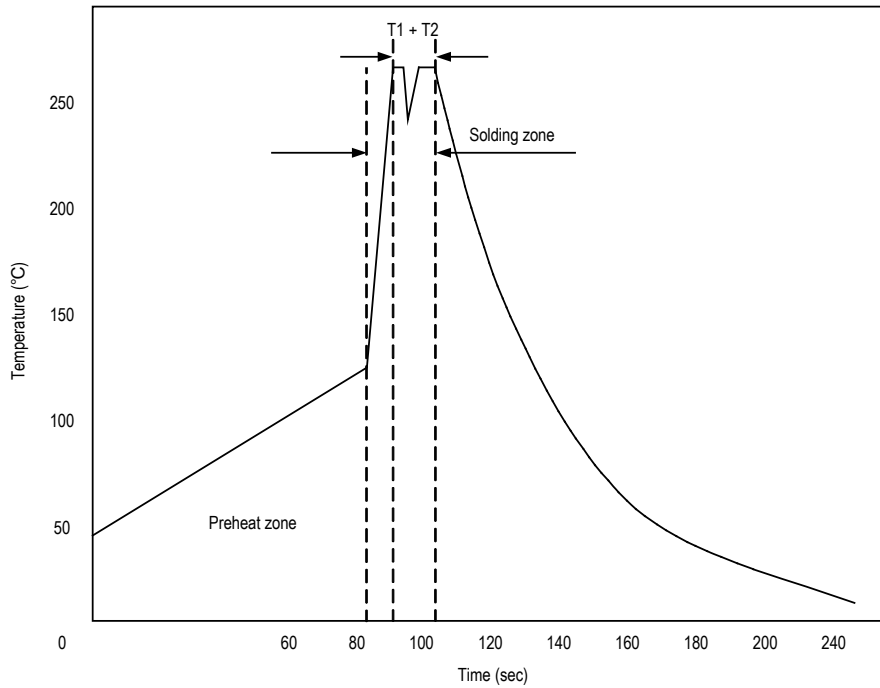


Packaging Information



Wave Soldering Considerations

Lead free wave solder profile



Zone	Reference Parameter
Preheat	Rise temp. speed : 3°C/sec max.
zone	Preheat temp. : 100~130°C
Actual	Peak temp. : 250~260°C
heating	Peak time(T1+T2) : 4~6 sec

Hand Welding Parameter

Reference Solder: Sn-Ag-Cu : Sn-Cu : Sn-Ag

Hand Welding: Soldering iron : Power 60W

Welding Time: 2~4 sec

Temp.: 380~400°C

Part Number Structure					
AMF	-	60	S	051	C
		Output Power 60 Watt	Output Quantity S: Single	Output Voltage 051: 5.1 VDC 12: 12 VDC 15: 15 VDC 24: 24 VDC 48: 48 VDC	Package Type N/A: PCB Mounting C: Chassis Mounting with screw terminal CD: Chassis Mounting with JST connection

MTBF and Reliability		
The MTBF of AMF-60 series of AC-DC Power Module has been calculated using MIL-HDBK 217F NOTICE2, Operating Temperature 25°C, Ground Benign.		
Model	MTBF	Unit
AMF-60S051	357,169	Hours
AMF-60S12	518,452	
AMF-60S15	438,578	
AMF-60S24	417,350	
AMF-60S48	453,901	
AMF-60S051C	355,702	
AMF-60S12C	515,753	
AMF-60S15C	436,164	
AMF-60S24C	415,600	
AMF-60S48C	451,831	
AMF-60S051CD	355,702	
AMF-60S12CD	515,753	
AMF-60S15CD	436,164	
AMF-60S24CD	415,600	
AMF-60S48CD	451,831	