MINMAX®

APM-40 Series

Electric Characteristic Note

APM-40 Series EC Note

AC-DC Power Module 40W, Industrial & Medical Safety

Features

- **Fully Encapsulated Plastic Case for PCB, Chassis and DIN-Rail Mounting Version**
- **Universal Input 85~264VAC, 47~440Hz**
- **I/O Isolation 4000VAC with Reinforced Insulation**
- **Operating Ambient Temp. Range -40℃ to +80℃**
- **Overload/Voltage and Short Circuit Protection**
- **EMI Emission EN 55011/32 Class B Approved**
- **EMC Immunity EN 61000-4-2,3,4,5,6,8,11 Approved**
- **Medical EMC Standard with 4th Edition of EMI EN 55011 & EMS EN 60601-1-2 Approved**
- **Medical Safety with 2xMOPP per 3.2 Edition of IEC/EN 60601-1 & ANSI/AAMI ES60601-1 Approved**
- **UL508 Safety Approval Specifically for Industrial Application**
- **Risk Management Report Acquisition according to ISO 14971**
- **UL/cUL/IEC/EN 62368-1(60950-1) Safety Approval & CE Marking**

Applications

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

Product Overview

Introducing the MINMAX APM-40 series - an innovative lineup of fully encapsulated AC-DC power modules designed to meet the highest standards in performance, safety, and reliability. Engineered to excel in challenging environments, these high-performance products boast an extended operating temperature range of -40℃ to +80℃, ensuring optimal functionality in diverse applications.

With a universal input voltage of 85-264VAC and comprehensive safety approvals, including UL/IEC/EN certifications for medical safety and UL 508 listing, the APM-40 series is well-equipped for integration into products targeting global markets. These power supply modules have also earned the EMI Emission EN 55011/32 Class B approval, attesting to their compliance with stringent electromagnetic interference standards.

In alignment with ISO 14971 Medical Device Risk Management, the APM-40 series undergoes a rigorous risk assessment process. This ensures that these power modules not only meet the demanding criteria for performance but also adhere to safety benchmarks outlined in ISO 14971. In summary, the APM-40 series power modules provide an ideal solution for a wide range of space-critical applications in commercial, medical, and industrial electronic equipment.

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Model Selection Guide

Model Number	Output Voltage	Output Current	Input Current		Max. capacitive Load	Efficiency (typ.)
			115VAC, 60Hz	230VAC, 50Hz		
		Max.	@Max. Load			@Max. Load, 115VAC
	VDC	mA	mA(typ.)		µF	%
APM-40S05	**5**	**8000**	716	429	8000	81
APM-40S12	**12**	**3330**	689	414	3900	84
APM-40S15	**15**	**2660**	680	408	3900	85
APM-40S24	**24**	**1660**	687	413	680	84
APM-40D12	**±12**	**±1660**	687	413	1500#	84
APM-40D15	**±15**	**±1330**	680	408	1000#	85

For each output

Input Specifications

Parameter	Conditions / Model		Min.	Typ.	Max.	Unit
AC Voltage Input Range	All Models		85	---	264	VAC
Input Frequency Range			47	---	440	Hz
DC Voltage Input Range			120	---	370	VDC
No-Load Power Consumption			---	---	0.3	W
Inrush Current	115VAC	Cold Start at 25℃	---	---	30	A
	230VAC		---	---	60	A

Output Specifications

Parameter	Conditions / Model		Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy			---	±2.0	---	%Vnom.
Line Regulation	Vin=Min. to Max. @Full Load		---	±0.5	---	%
Load Regulation	Io=0% to 100%	Single Output Model	---	±1.0	---	%
		Dual Output Models	---	±2.0	---	%
Minimum Load	No minimum Load Requirement					
Ripple & Noise(3)	0-20 MHz Bandwidth	5V Output Models	---	1.5	1.8	$\%V_{PP}$ of Vo
		Other Output Models	---	1.0	1.3	$\%V_{PP}$ of Vo
Over Voltage Protection	Zener diode clamp		---	120	---	% of Vo
Temperature Coefficient			---	±0.02	---	%/℃
Overshoot			---	---	5	%
Over Load Protection	85VAC, Hiccup Mode, auto-recovery		105	---	---	% 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	Reinforced Insulation, Rated For 60 Seconds	4000	---	---	VAC
Leakage Current		---	80	---	µA
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
Switching Frequency		---	130	---	kHz
Hold-up Time	115VAC, 60Hz	---	25	---	ms
	230VAC, 50Hz	---	80	---	ms
MTBF (calculated)	MIL-HDBK-217F@25℃, Ground Benign	200,000			Hours
Safety Standards	UL/cUL 60950-1, CSA C22.2 No 60950-1				
	ANSI/AAMI ES60601-1, CAN/CSA-C22.2 No. 60601-1				
	IEC/EN 60950-1, IEC/EN 60601-1 3.2 Edition 2xMOPP				
	UL508, CSA C22.2 No.107.1-01				
Safety Approvals	UL/cUL 60950-1 recognition (UL certificate), IEC/EN 60950-1 (CB-report), UL/cUL 508 listed certificate				
	UL/cUL 62368-1 recognition (UL certificate), IEC/EN 62368-1 (CB-report)				
	ANSI/AAMI ES60601-1 2xMOPP recognition (UL certificate), IEC/EN 60601-1 3.2 Edition (CB-report)				

EMC Specifications

Parameter	Standards & Level				Performance
EMI	Conduction	EN 55011, EN55032, EN 61000-6-4, EN 61000-6-3		Without external components	Class B
	Radiation				
EMS	EN 60601-1-2 4th, EN 55035, EN 61000-6-2, EN 61000-6-1				
	ESD	EN 61000-4-2 Air ± 15kV, Contact ± 8kV			A
	Radiated immunity	EN 61000-4-3 10V/m			A
	Fast transient	EN 61000-4-4 ±2kV			A
	Surge	EN 61000-4-5 ±1kV			A
	Conducted immunity	EN 61000-4-6 10Vrms			A
	PFMF	EN 61000-4-8 30A/m			A
	Dips & Interruptions	EN 61000-4-11	0% of 230VAC	0.5 cycle	A
			0% of 230VAC	1 cycle	A
			70% of 230VAC	25/30 cycle	A
			0% of 230VAC	250/300 cycle	B

Environmental Specifications

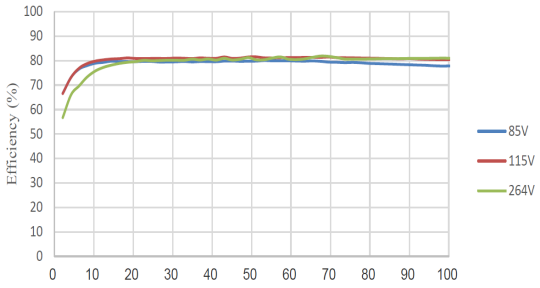
Parameter	Conditions	Min.	Typ.	Max.	Unit
Operating Ambient Temperature Range		-40	---	+80	℃
Power Derating	Above +60℃		1.5		W / ℃
Storage Temperature Range		-40	---	+95	℃
Thermal Shutdown	Shutdown, Internal IC Junction Temperature	---	142	---	℃
	Automatic Recovery, Internal IC Junction Temperature	---	67	---	℃
Humidity (non condensing)		---	---	95	% rel. H
Lead Temperature (1.5mm from case for 10Sec.)		---	---	260	℃

Notes

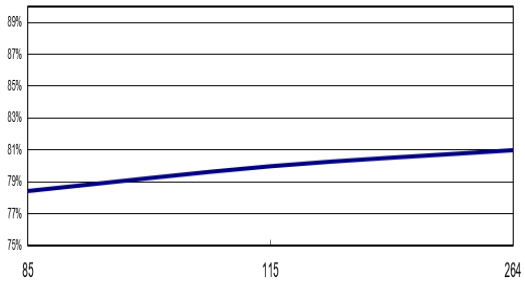
1. This product is not designed for use in critical life support systems, equipment used in hazardous environment, nuclear control systems or other such applications which necessitate specific safety and regulatory standards other the ones listed in this datasheet.
2. Specifications typical at Ta=+25℃, resistive load, 115VAC, 60Hz input voltage, after warm-up time rated output current unless otherwise noted.
3. Ripple & Noise measured with a 0.1μF/50V MLCC and a 1μF/50V Aluminum electrolytic.
4. Safety approvals cover frequency 47-63 Hz.
5. We recommend to protect the converter by a slow blow fuse in the input supply line.
6. Other input and output voltage may be available, please contact MINMAX.
7. Specifications are subject to change without notice.
8. 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 APM-40S05

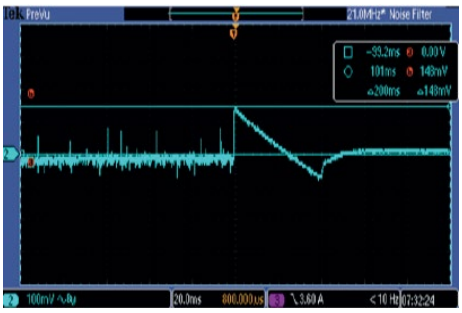


Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load

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

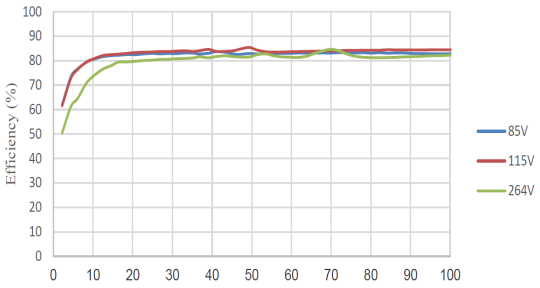


Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$

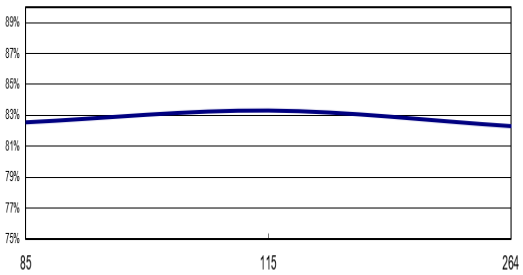
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load

Characteristic Curves

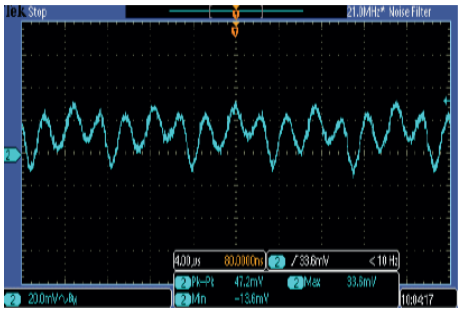
All test conditions are at 25°C The figures are identical for APM-40S12



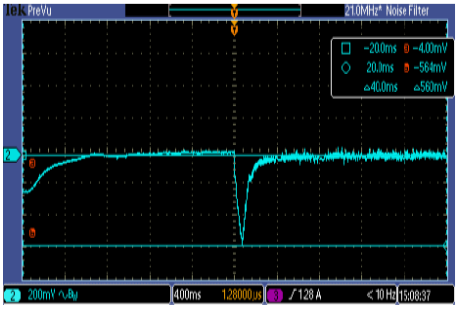
Efficiency Versus Output Current



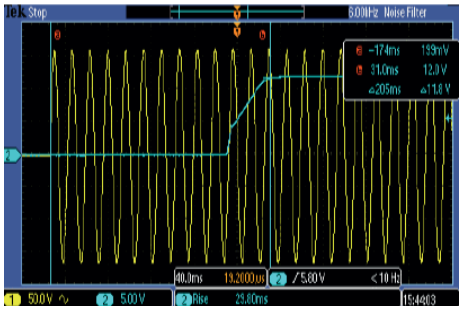
Efficiency Versus Input Voltage
Full Load



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



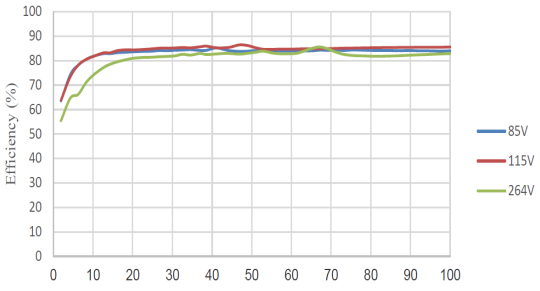
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



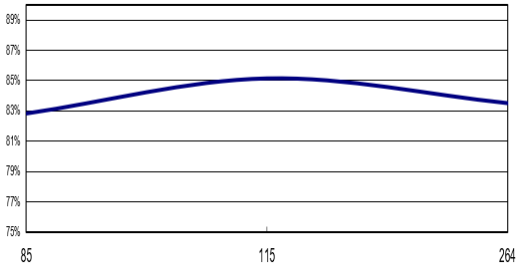
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load

Characteristic Curves

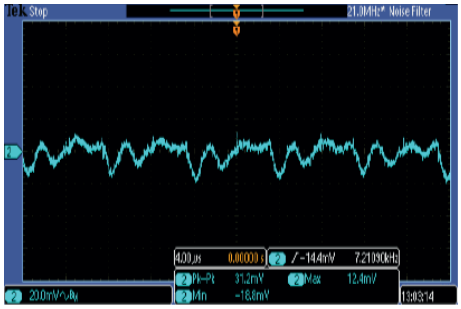
All test conditions are at 25°C The figures are identical for APM-40S15



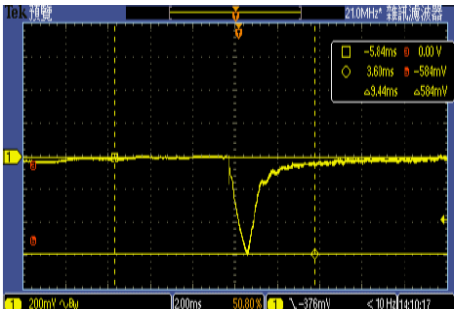
Efficiency Versus Output Current



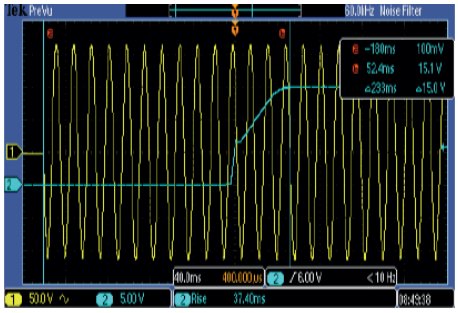
Efficiency Versus Input Voltage
Full Load



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



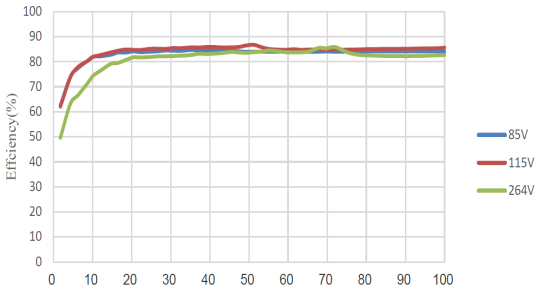
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



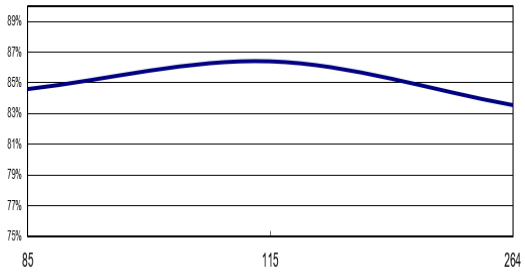
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load

Characteristic Curves

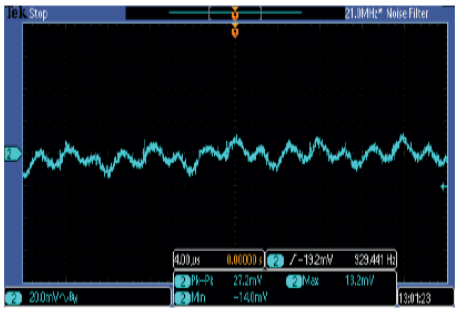
All test conditions are at 25°C The figures are identical for APM-40S24



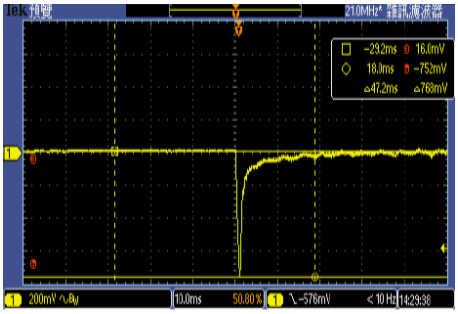
Efficiency Versus Output Current



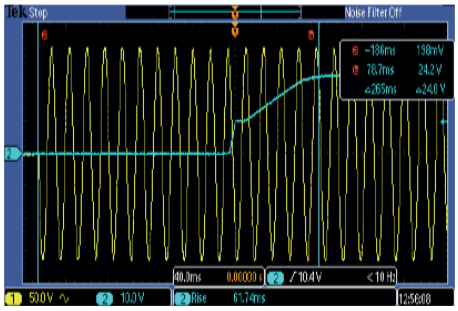
Efficiency Versus Input Voltage
Full Load



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



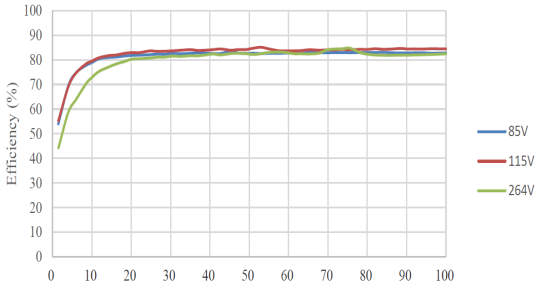
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



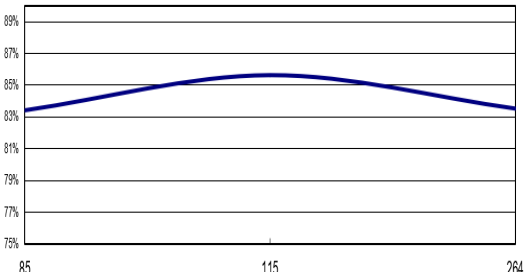
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load

Characteristic Curves

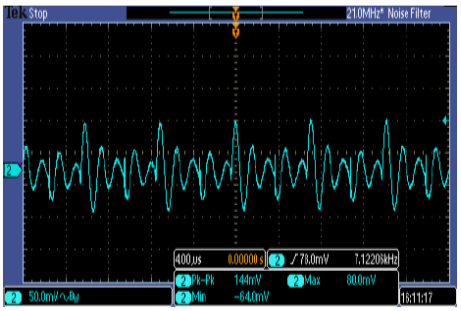
All test conditions are at 25℃ The figures are identical for APM-40D12



Efficiency Versus Output Current

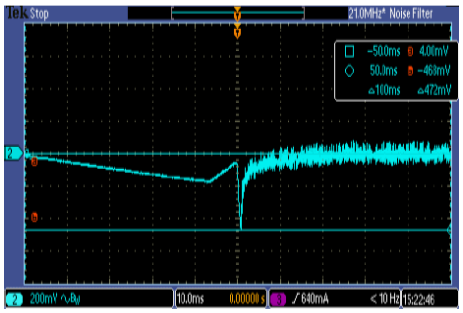


Efficiency Versus Input Voltage
Full Load

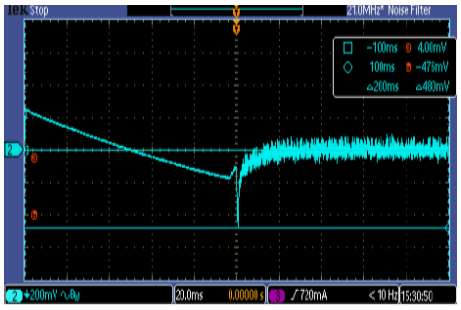


Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load (+Vout)

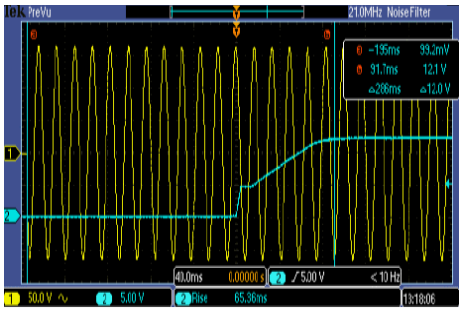
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load (-Vout)



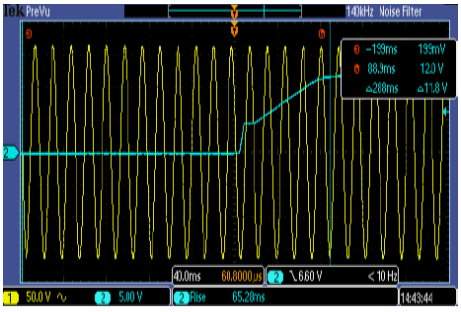
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$ (+Vout)



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



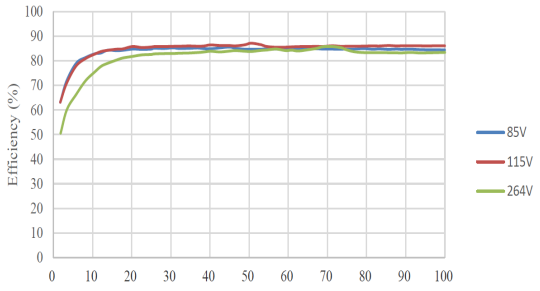
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load (+Vout)



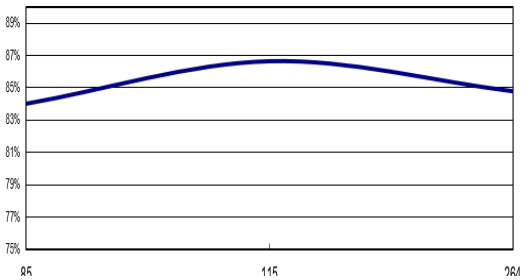
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load (-Vout)

Characteristic Curves

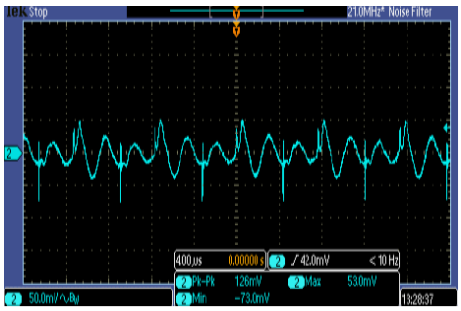
All test conditions are at 25°C The figures are identical for APM-40D15



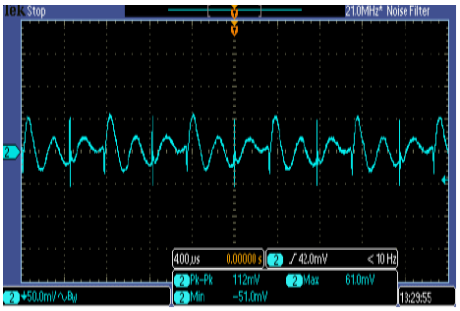
Efficiency Versus Output Current



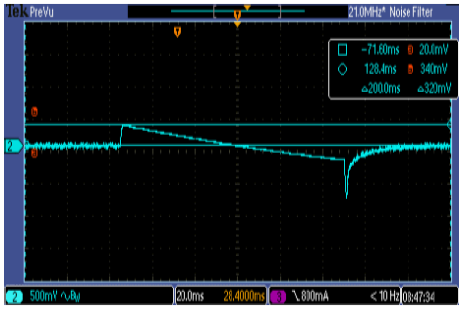
Efficiency Versus Input Voltage
Full Load



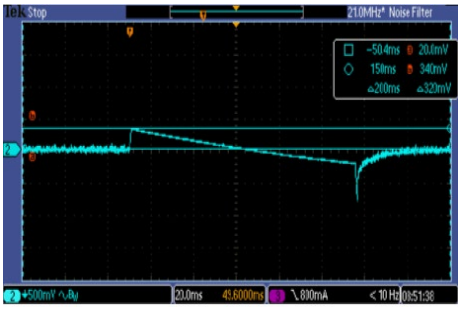
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load (+Vout)



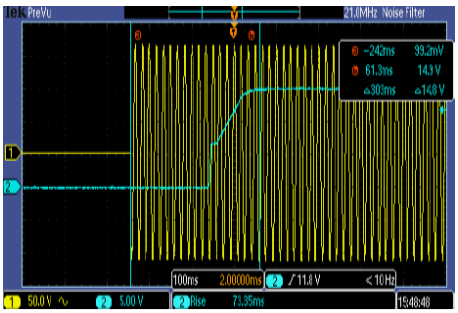
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load (-Vout)



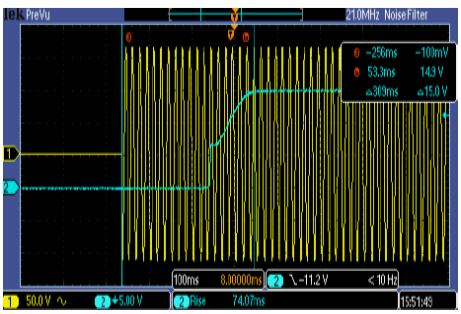
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$ (+Vout)



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



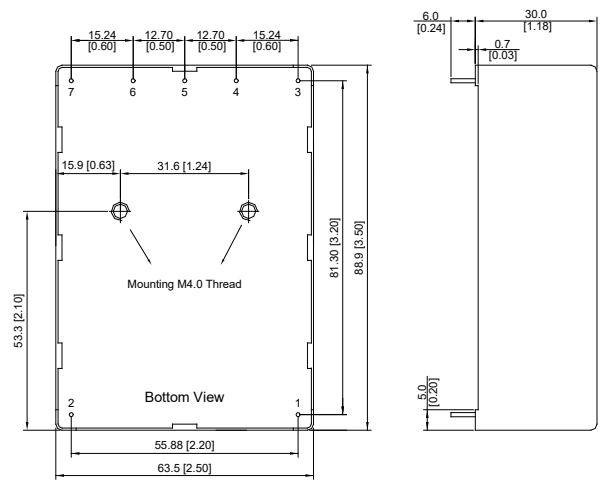
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load (+Vout)



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

Package Specifications PCB Mounting

Mechanical Dimensions



Pin Connections

Pin	Single Output	Dual Output	Diameter mm (inches)
1	AC (N)	AC (N)	Ø 1.0 [0.04]
2	AC (L)	AC (L)	Ø 1.0 [0.04]
3	+Vout	+Vout	Ø 1.0 [0.04]
4	No Pin	No Pin	Ø 1.0 [0.04]
5	-Vout	Common	Ø 1.0 [0.04]
6	No Pin	No Pin	Ø 1.0 [0.04]
7	NC	-Vout	Ø 1.0 [0.04]

NC: No Connection

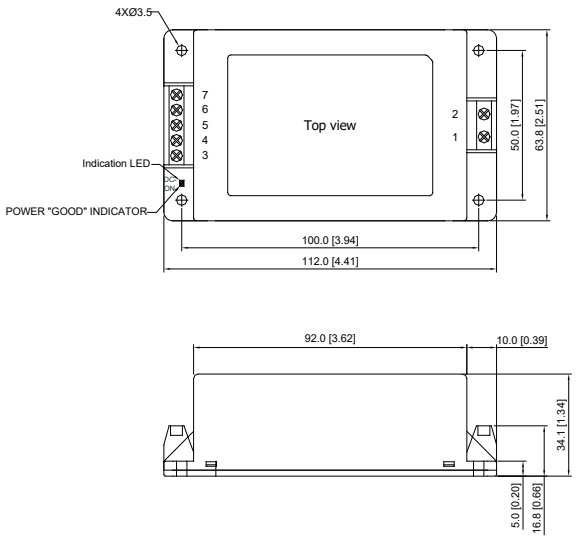
- All dimensions in mm (inches)
- Tolerance: ±0.5 (±0.02)
- Pin pitch tolerance: ±0.25 (±0.01)
- Pin diameter tolerance: X.X±0.1 (X.XX±0.004)

Physical Characteristics

Case Size	:	88.9x63.5x30.0mm (3.50x2.50x1.18 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Pin Material	:	Copper Alloy
Weight	:	310g

Package Specifications Chassis Mounting with screw terminal (order code suffix C)

Mechanical Dimensions



Note:
Screw type Terminal: Wires 1.5mm^2 max.
Recommended Terminal Screw tightening torque: 0.5Nm (3.5lb.in.) max.

Connections

Pin	Single Output	Dual Output
1	AC (N)	AC (N)
2	AC (L)	AC (L)
3	+Vout	+Vout
4	NC	NC
5	-Vout	Common
6	NC	NC
7	NC	-Vout

NC: No Connection

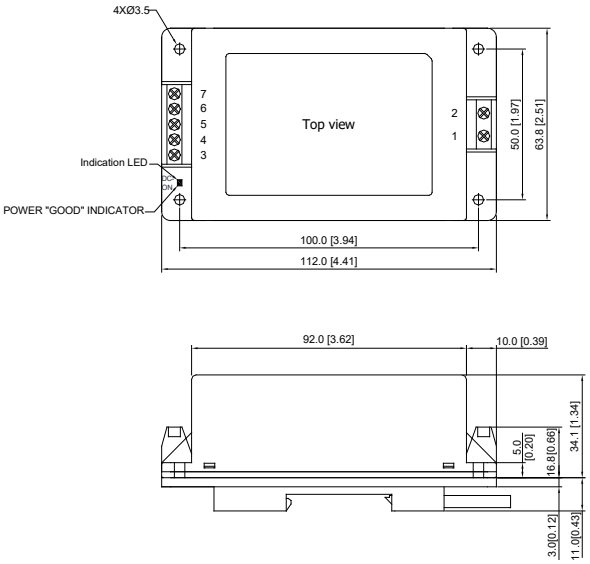
- All dimensions in mm (inches)
- Tolerance: ±0.5 (±0.02)

Physical Characteristics

Case Size	:	112.0x63.8x34.1mm (4.41x2.51x1.34 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Weight	:	320g

Package Specifications for screw terminal with DIN Rail Mounting (order code suffix AC-DIN-02)

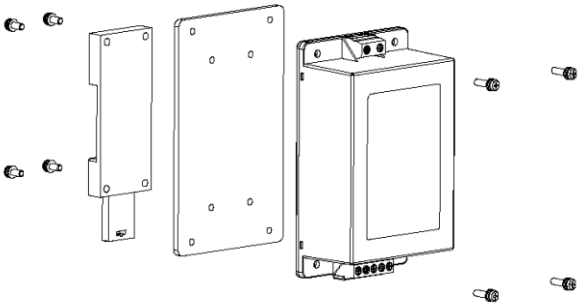
Mechanical Dimensions

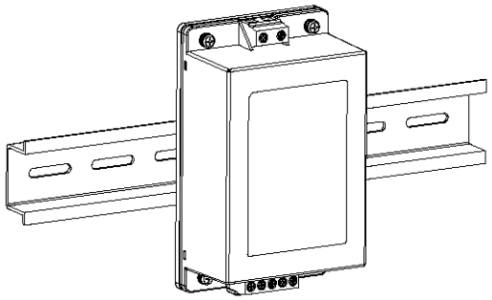


Physical Characteristics

Case Size	:	112.0x63.8x34.1mm (4.41x2.51x1.34 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Weight	:	374g

Screw terminal with DIN Rail Mounting

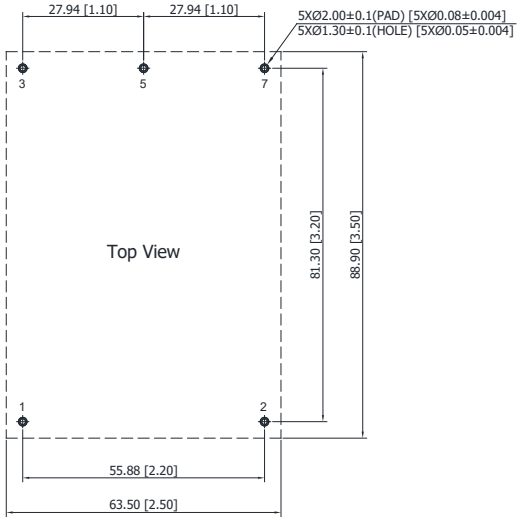




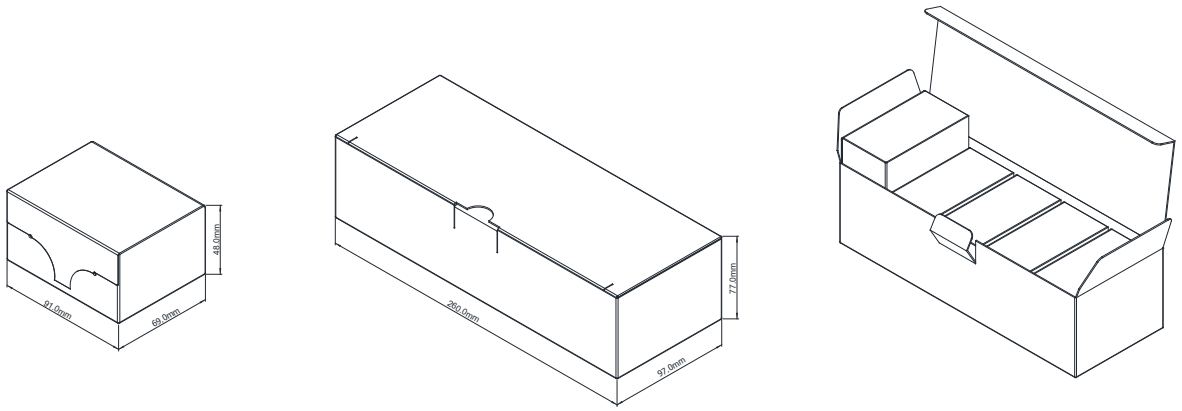
Note:

Recommended tightening torque: 0.35Nm (3.1lb.in.) max.

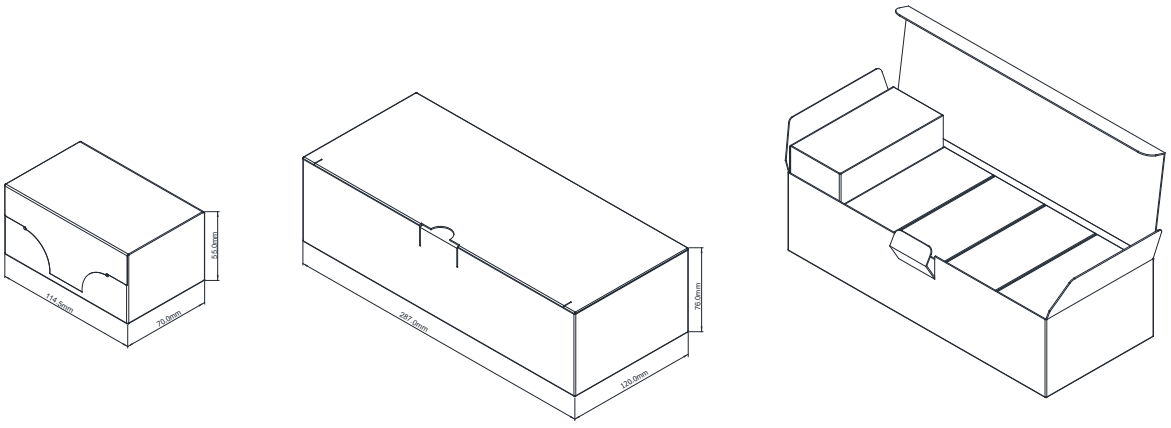
Recommended Pad Layout for Single & Dual Output Converter



Packaging Information for Box



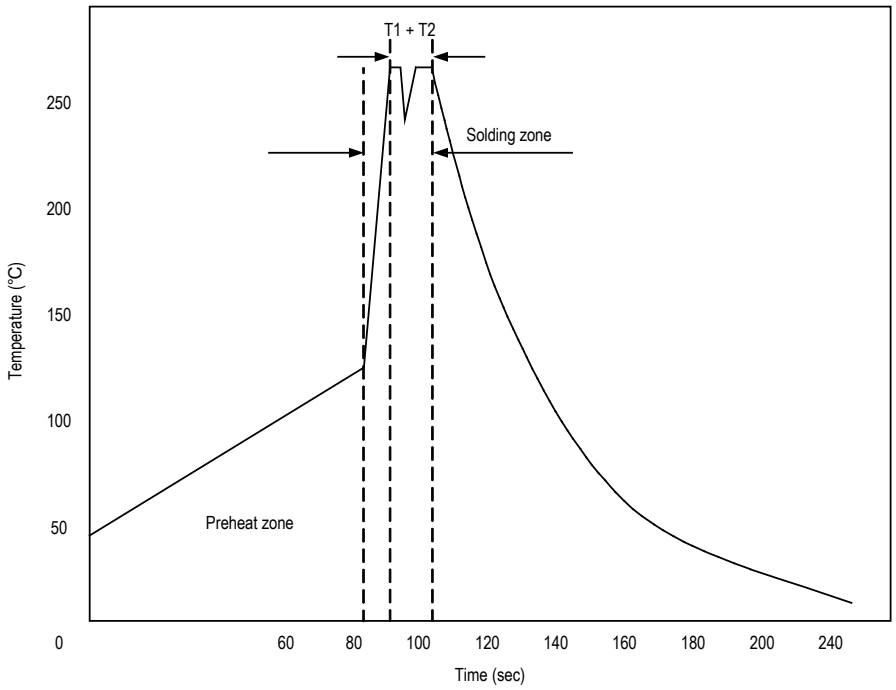
Unit: mm
APM-40 PCB Mounting 5 PCS per Box



Unit: mm
APM-40 Chassis Mounting 5 PCS per Box

Wave Soldering Considerations

Lead free wave solder profile



Zone	Reference Parameter
Preheat	Rise temp. speed：3℃/sec max.
zone	Preheat temp.：100~130℃
Actual	Peak temp.：250~260℃
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℃

Part Number Structure

APM	-	40	S	05	C

Output Power
40 Watt

Output Quantity
S: Single
D: Dual

Output Voltage
05: 5 VDC
12: 12 VDC
15: 15 VDC
24: 24 VDC

Package Type
N/A: PCB Mounting
C: Chassis Mounting with screw terminal

MTBF and Reliability

The MTBF of APM-40 series of AC-DC Power Module has been calculated using

MIL-HDBK 217F NOTICE2, Operating Temperature 25°C, Ground Benign.

Model	MTBF	Unit
APM-40S05	200,000	Hours
APM-40S12		
APM-40S15		
APM-40S24		
APM-40D12		
APM-40D15		