MINMAX®

MAU01M Series

Electric Characteristic Note

MAU01M Series EC Note

DC-DC CONVERTER 1W, Reinforced Insulation, Medical Safety

Features

- **Industrial Standard SIP-7 Package**
- **Unregulated Output Voltage**
- **I/O Isolation 4000VAC with Reinforced Insulation, rated for 300VrmsWorking Voltage**
- **Low I/O Leakage Current < 2μA**
- **Operating Ambient Temp. Range -40℃ to 95℃**
- **Short Circuit Protection**
- **Medical EMC Standard with 4th Edition of EMI EN 55011 and EMS EN 60601-1-2 Approved**
- **Medical Safety with 2xMOPP per 3.2 Edition of IEC/EN 60601-1 & ANSI/AAMI ES60601-1 Approved with CE Marking**
- **Risk Management Report Acquisition according to ISO 14971**

Applications

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

Product Overview

Introducing the MINMAX MAU01M series - an innovative range of 1W medical-approved isolated DC-DC converters encapsulated in a SIP-7 package, meticulously designed for medical applications. With 9 models available, supporting input voltages of 5, 12, and 24VDC, and providing output voltages of 5, 12, and 15VDC, this series ensures versatility to meet various medical device requirements.

The MAU01M series boasts an I/O isolation specified for 4000VAC with reinforced insulation, rated for a reliable 300Vrms working voltage. Additional features include short circuit protection, low I/O leakage current of 2μA max, and an operating ambient temperature range from -40℃ to 95℃ without derating. Aligning with the 4th edition medical EMC standard, the series holds medical safety approval with 2xMOPP (Means Of Patient Protection) per the 3.2 Edition of IEC/EN 60601-1 & ANSI/AAMI ES 60601-1.

In adherence to ISO 14971 Medical Device Risk Management, the MAU01M series undergoes a comprehensive risk assessment process. This ensures not only compliance with high-performance standards but also alignment with the rigorous safety benchmarks outlined in ISO 14971. By seamlessly integrating the MAU01M series into medical devices, you not only benefit from its compact design and versatile voltage options but also ensure compliance with comprehensive risk management protocols.

In summary, the MAU01M series offers an optimal solution for demanding applications in medical instruments, now fortified with the assurance of ISO 14971 compliance. Elevate your medical devices with the MINMAX MAU01M series – where innovation meets safety, performance, and meticulous Medical Device Risk Management Report Acquisition.

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Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current		Input Current		Max. capacitive Load	Efficiency (typ.)
			Max.	Min.	@Max. Load	@No Load		@Max. Load
	VDC	VDC	mA	mA	mA(typ.)	mA(typ.)	μF	%
MAU01-05S05M	5 (4.5 ~ 5.5)	5	200	4	253	50	220	79
MAU01-05S12M		12	84	1.68	252			80
MAU01-05S15M		15	68	1.36	252			81
MAU01-12S05M	12 (10.8 ~ 13.2)	5	200	4	105	35	220	79
MAU01-12S12M		12	84	1.68	104			81
MAU01-12S15M		15	68	1.36	108			79
MAU01-24S05M	24 (21.6 ~ 26.4)	5	200	4	55	20	220	76
MAU01-24S12M		12	84	1.68	53			79
MAU01-24S15M		15	68	1.36	54			79

* Min. Output Current for Lower Load Regulation

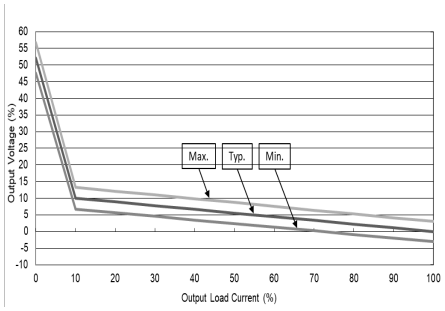
Input Specifications

Parameter	Model	Min.	Typ.	Max.	Unit
Input Voltage Range	5V Input Models	4.5	5	5.5	VDC
	12V Input Models	10.8	12	13.2	
	24V Input Models	21.6	24	26.4	
Input Surge Voltage (1 sec. max.)	5V Input Models	-0.7	---	9	
	12V Input Models	-0.7	---	18	
	24V Input Models	-0.7	---	30	
Input Filter	All Models	Internal Capacitor			

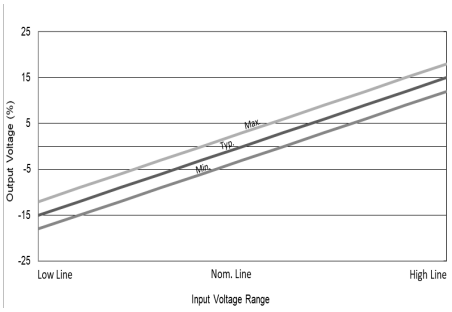
Output Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy		---	±1.0	±3.0	%Vnom.
Line Regulation	For Vin Change of 1%	---	±1.2	±1.5	%
Load Regulation	Io=10% to 100%	---	---	±10	%
Ripple & Noise	0-20 MHz Bandwidth	---	---	75	mV P-P
Temperature Coefficient		---	±0.01	±0.02	%/℃
Short Circuit Protection	Continuous, Automatic Recovery				

Output Voltage Tolerance



Output Voltage VS Output Load Current



Output Voltage VS Input Voltage Range

Isolation, Safety Standards

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds Reinforced insulation, rated for 300Vrms working voltage	4000	---	---	VAC
Leakage Current	240VAC, 60Hz	---	---	2	μA
I/O Isolation Resistance	500 VDC	10	---	---	GΩ
I/O Isolation Capacitance	100kHz, 1V	---	20	---	pF
Safety Standards	ANSI/AAMI ES 60601-1, CAN/CSA-C22.2 No. 60601-1				
	IEC/EN 60601-1 3.2 Edition 2xMOPP				
Safety Approvals	ANSI/AAMI ES 60601-1 2xMOPP recognition (UL certificate), IEC/EN 60601-1 3.2 Edition (CB-report)				

General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Switching Frequency		---	60	---	kHz
MTBF (calculated)	MIL-HDBK-217F@25℃, Ground Benign	4,373,058	---	---	Hours

EMC Specifications

Parameter	Standards & Level			Performance
EMI(5)	Conduction	EN 55011	With external components	Class A
	Radiation			
EMS(5)	EN 60601-1-2 4th			
	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

Environmental Specifications

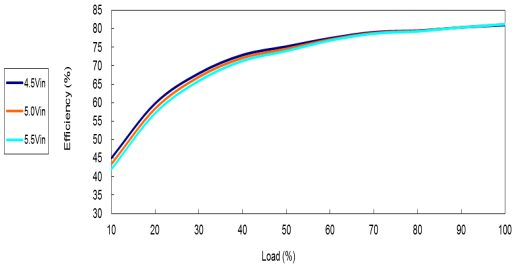
Parameter	Min.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	-40	+95	℃
Case Temperature	---	+105	℃
Storage Temperature Range	-50	+125	℃
Humidity (non condensing)	---	95	% rel. H
Lead Temperature (1.5mm from case for 10Sec.)	---	260	℃

Notes

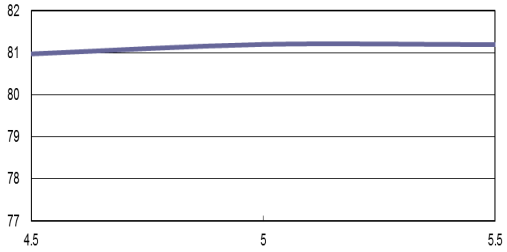
1 Specifications typical at Ta=+25℃, resistive load, nominal input voltage and rated output current unless otherwise noted.
2 These power converters require a minimum output loading to maintain specified regulation, operation under no-load conditions will not damage these modules; however they may not meet all specifications listed.
3 We recommend to protect the converter by a slow blow fuse in the input supply line.
4 Other input and output voltage may be available, please contact MINMAX.
5 The external components might be required to meet EMI/EMS standard for some of test items. Please contact MINMAX for the solution in detail.
6 Specifications are subject to change without notice.
7 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

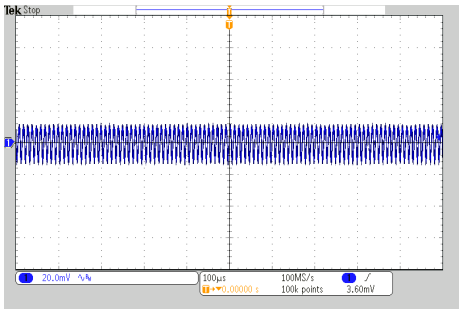
All test conditions are at 25°C The figures are identical for MAU01-05S05M



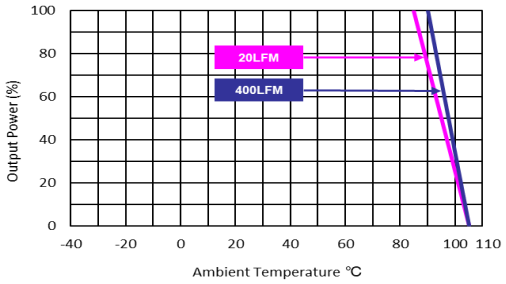
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



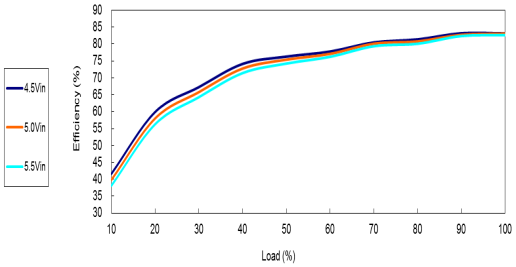
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



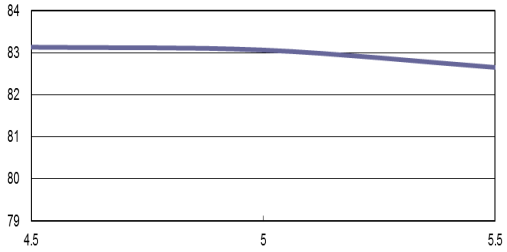
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

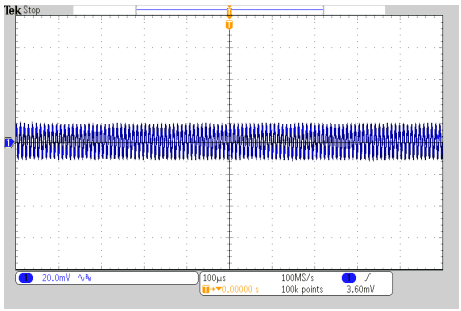
All test conditions are at 25°C The figures are identical for MAU01-05S12M



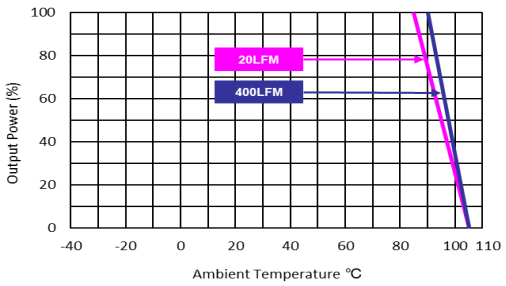
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



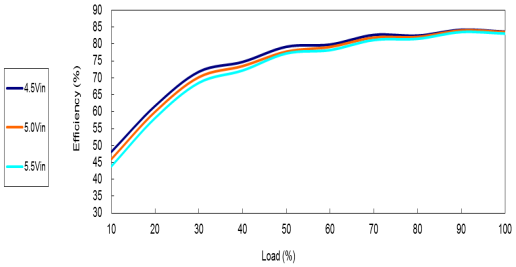
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



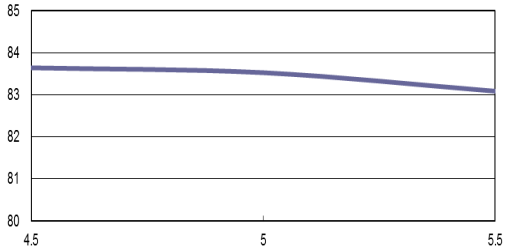
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

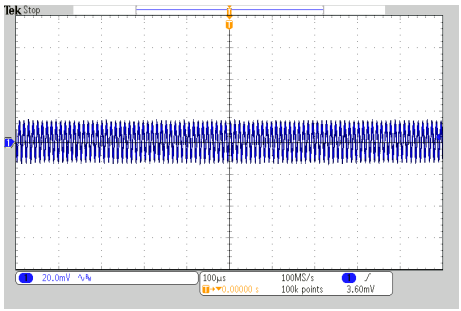
All test conditions are at 25°C The figures are identical for MAU01-05S15M



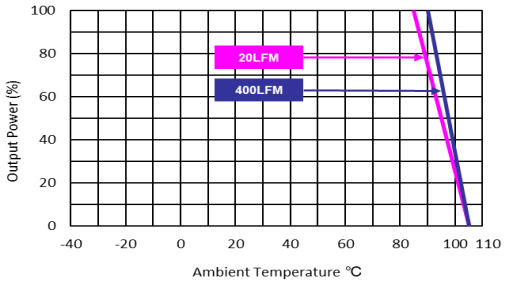
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



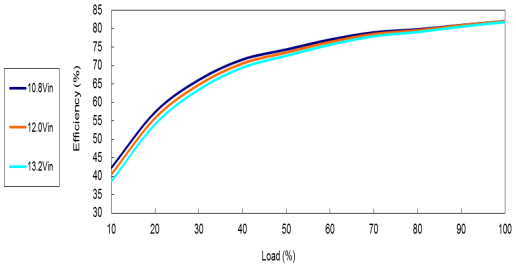
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



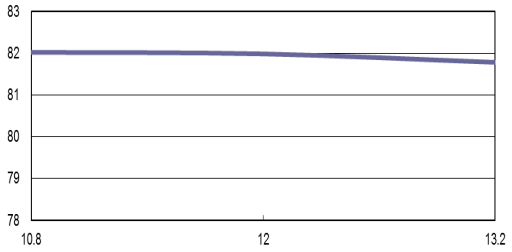
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

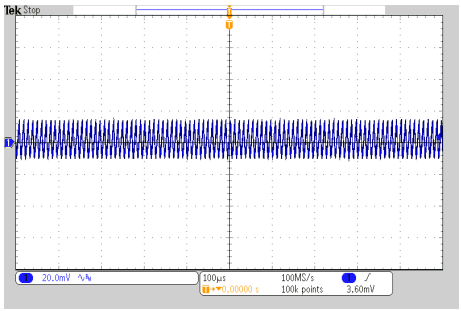
All test conditions are at 25℃ The figures are identical for MAU01-12S05M



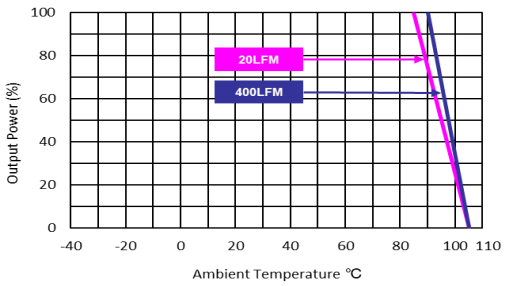
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



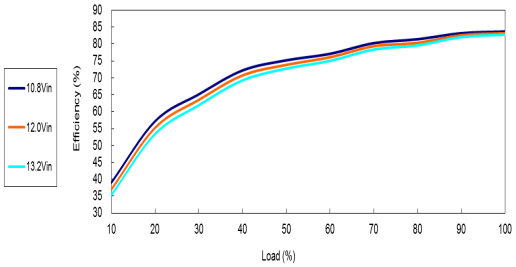
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



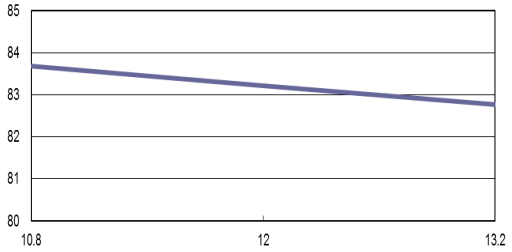
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

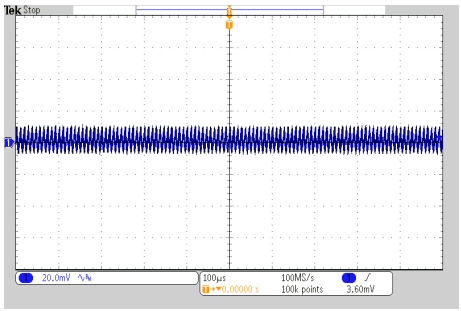
All test conditions are at 25°C The figures are identical for MAU01-12S12M



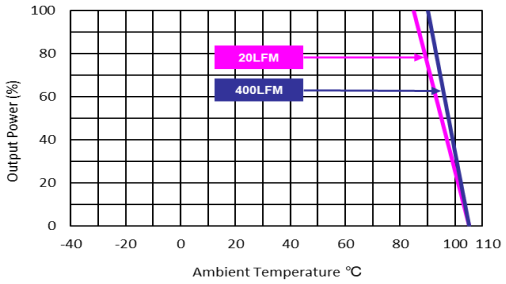
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



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



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

Characteristic Curves

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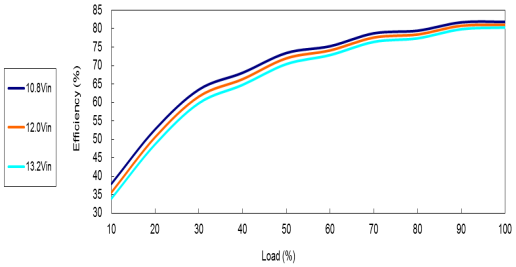
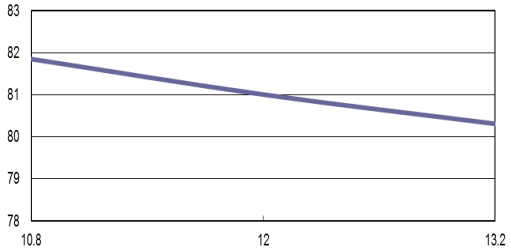
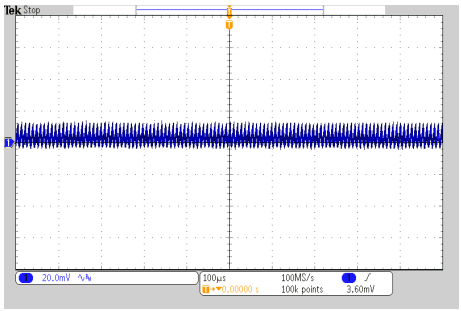


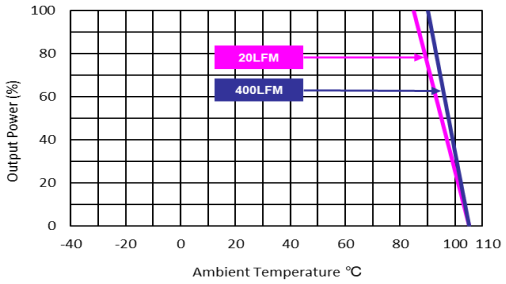
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



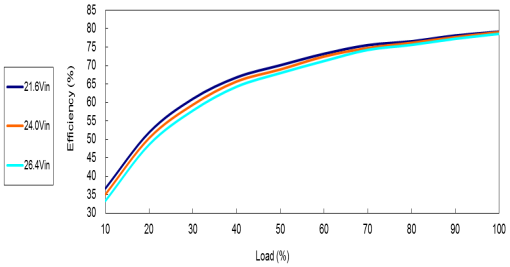
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



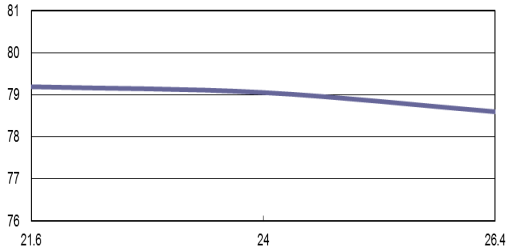
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

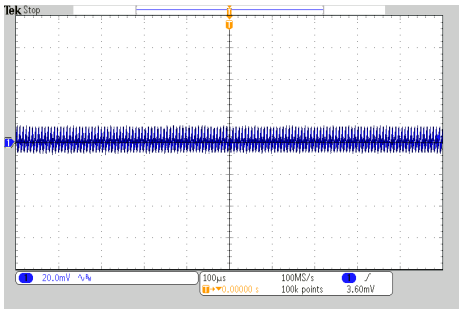
All test conditions are at 25℃ The figures are identical for MAU01-24S05M



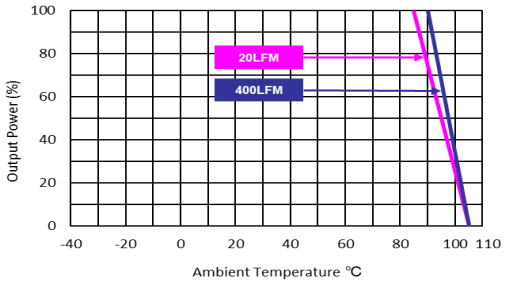
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



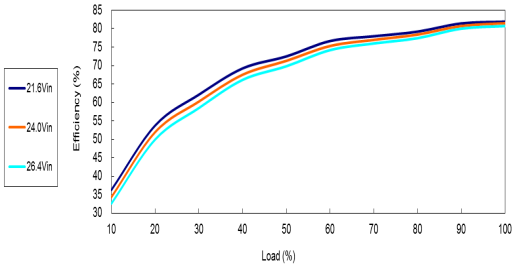
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



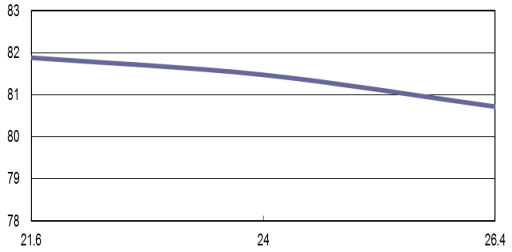
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

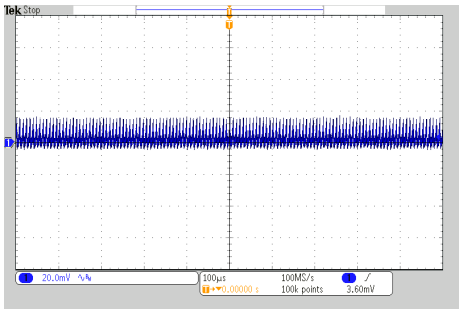
All test conditions are at 25°C The figures are identical for MAU01-24S12M



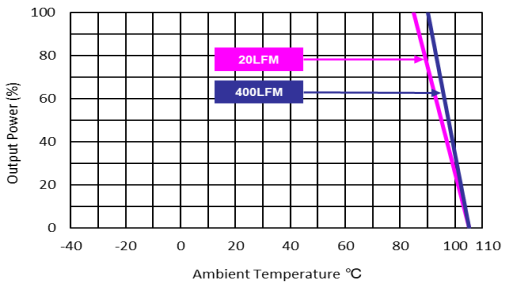
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



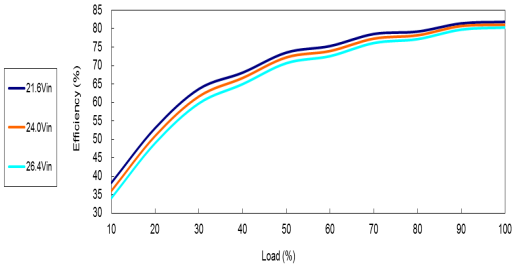
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



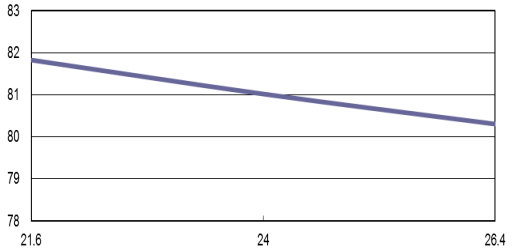
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

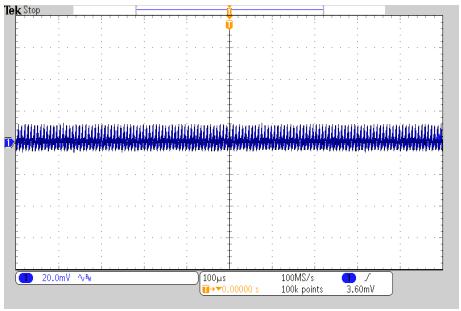
All test conditions are at 25℃ The figures are identical for MAU01-24S15M



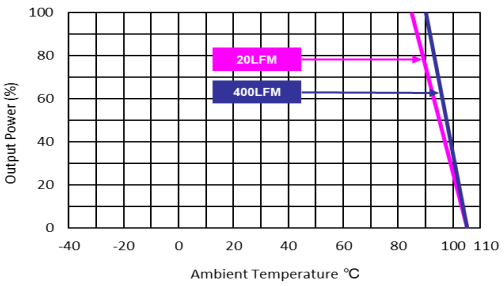
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



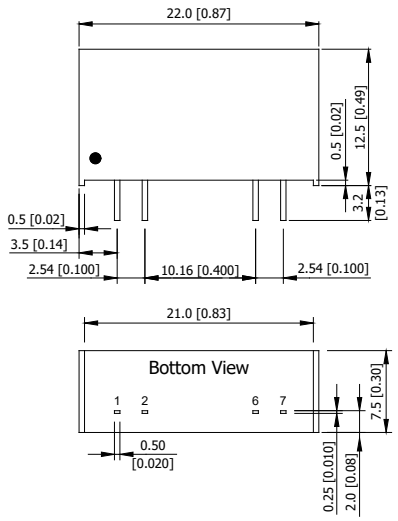
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



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

Package Specifications

Mechanical Dimensions



Pin Connection

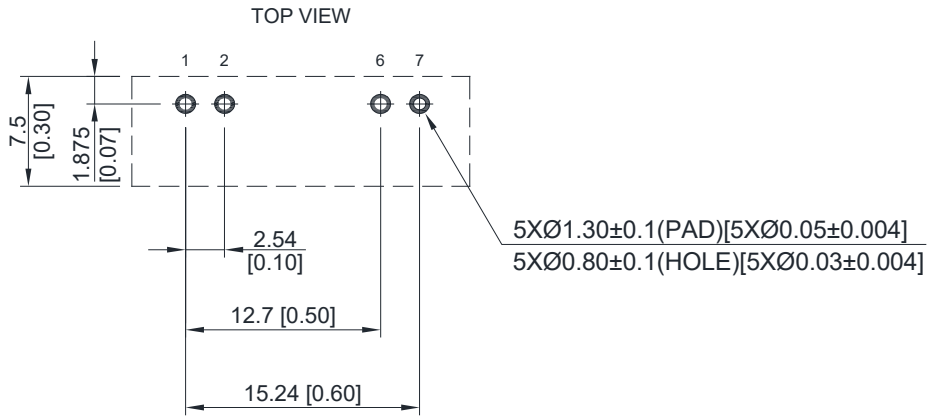
Pin	Function
1	+Vin
2	-Vin
6	-Vout
7	+Vout

- All dimensions in mm (inches)
- Tolerance: X.X±0.5 (X.XX±0.02)
  X.XX±0.25 (X.XXX±0.01)
- Pins ±0.05 (±0.002)

Physical Characteristics

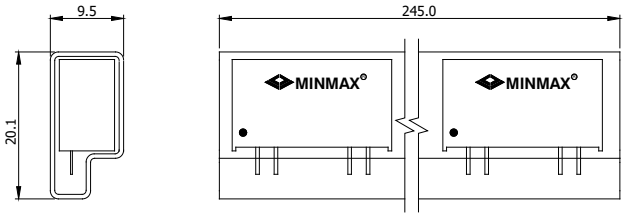
Case Size	:	22.0x7.5x12.5mm (0.87x0.30x0.49 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Pin Material	:	Alloy 42
Weight	:	4.1g

Recommended Pad Layout

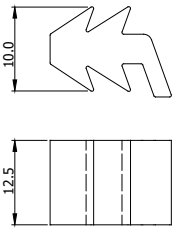


Packaging Information for Tube

Tube



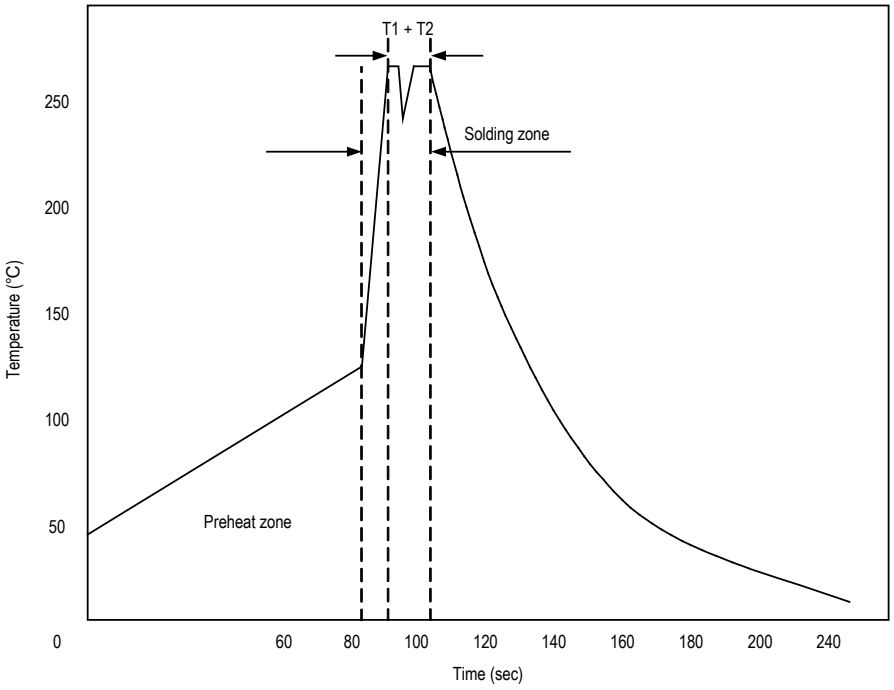
Plug



Unit: mm
10 PCS per TUBE

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

M	A	U	01	-	05	S	05	M
	Package Type SIP-7	Output Regulation Unregulated	Output Power 1 Watt		Input Voltage Range 05: 4.5 ~ 5.5 VDC 12: 10.8 ~ 13.2 VDC 24: 21.6 ~ 26.4 VDC	Output Quantity S: Single	Output Voltage 05: 5 VDC 12: 12 VDC 15: 15 VDC	Application Medical

MTBF and Reliability

The MTBF of MAU01M series of DC-DC converters has been calculated using

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

Model	MTBF	Unit
MAU01-05S05M	4,573,386	Hours
MAU01-05S12M	4,629,678	
MAU01-05S15M	4,681,932	
MAU01-12S05M	4,573,298	
MAU01-12S12M	4,695,408	
MAU01-12S15M	4,548,605	
MAU01-24S05M	4,373,058	
MAU01-24S12M	4,563,621	
MAU01-24S15M	4,548,908	