FEATURES

- **Industrial Standard SIP-7 Package**
- **Unregulated Output Voltage**
- **I/O Isolation 3000VAC with Reinforced Insulation, rated for 300Vrms Working Voltage**
- **Wide Operating Ambient Temp. Range**
- **Medical EMC Standard with 4th Edition of EMI EN 55011 and EMS EN 60601-1-2 Approved**
- **Medical Safety with 1xMOPP & 2xMOOP per 3.2 Edition of IEC/EN 60601-1 & ANSI/AAMI ES60601-1 Approved**
- **Risk Management Report Acquisition according to ISO 14971**
- **UL/cUL/IEC/EN 62368-1, UL/cUL 60950-1 Safety Approval & CE Marking**

PRODUCT OVERVIEW

The MINMAX MAU400 Series is an encapsulated 1W DC-DC converter in an industry-standard SIP-7 package, specially designed for medical and safety-critical applications. The series includes 12 models supporting either 5 VDC or 12 VDC input voltage, providing design flexibility across various system requirements. Featuring 3000 VAC I/O isolation with reinforced insulation rated for 300 Vrms working voltage, it ensures reliable protection and electrical separation in patient and operator environments.

Complying with Medical EMC 4th Edition Standards (EN 55011, EN 60601-1-2) and certified to IEC/EN/ANSI/AAMI ES60601-1 (3.2 Edition) for 1xMOPP & 2xMOOP, the MAU400 Series guarantees high safety performance. It also meets UL/cUL/IEC/EN 62368-1 and CE Marking requirements, and includes a Risk Management Report in accordance with ISO 14971. With its combination of compact size, strong isolation, and regulatory compliance, the MAU400 Series is an ideal solution for medical instrumentation, monitoring systems, and patient-connected devices.

Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current	Input Current		Load Regulation	Max. capacitive Load	Efficiency (typ.)
			Max.	@Max. Load	@No Load			@Max. Load
	VDC	VDC	mA	mA(typ.)	mA(typ.)	% (max.)	μF	%
MAU401	5 (4.5 ~ 5.5)	5	200	303	55	10	680	66
MAU402		12	80	291		8		66
MAU403		15	65	295		8		66
MAU404		±5	±100	303		10	220#	66
MAU405		±12	±40	267		8		72
MAU406		±15	±35	287		8		73
MAU411	12 (10.8 ~ 13.2)	5	200	126	30	10	680	66
MAU412		12	80	121		8		66
MAU413		15	65	123		8		66
MAU414		±5	±100	126		10	220#	66
MAU415		±12	±40	108		8		74
MAU416		±15	±35	117		8		75

*Please refer to the attached graph for the minimum load value. # For each output

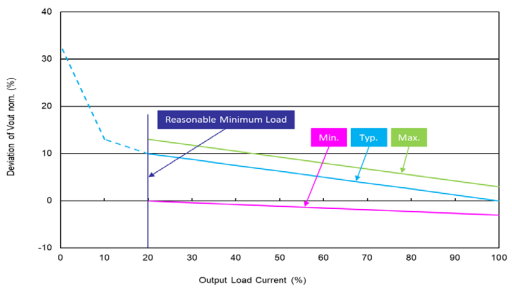
Input Specifications

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	
Input Surge Voltage (1 sec. max.)	5V Input Models	-0.7	---	9	
	12V Input Models	-0.7	---	29	
Input Filter	All Models	Internal LC Type			

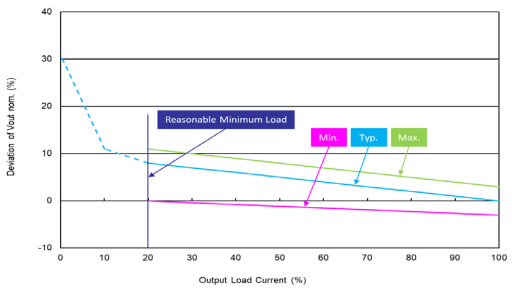
Output Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy		---	±1.0	±3.0	%Vnom.
Output Voltage Balance	Dual Output, Balanced Loads	---	±0.1	±1.0	%
Line Regulation	For Vin Change of 1%	---	±1.2	±1.5	%
Load Regulation	Io=20% to 100%	See Model Selection Guide			
Ripple & Noise	0-20MHz Bandwidth	---	---	150	mV P-P
Temperature Coefficient		---	±0.01	±0.02	%/°C
Short Circuit Protection	0.5 Second Max., Automatic Recovery				

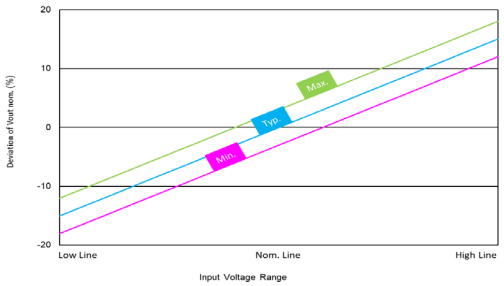
Output Voltage Tolerance



Output Voltage VS Output Load Current
For 5V & ±5V Output Models



Output Voltage VS Output Load Current
For 12V, 15V, ±12V, ±15V Output Models



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	3000	---	---	VAC
I/O Isolation Resistance	500 VDC	10	---	---	GΩ
I/O Isolation Capacitance	100kHz, 1V	---	15	20	pF
Safety Standards	UL/cUL 60950-1, CSA C22.2 No. 60950-1				
	ANSI/AAMI ES 60601-1, CAN/CSA-C22.2 No. 60601-1				
	IEC/EN 60950-1, IEC/EN 60601-1 3.2 Edition 1xMOPP & 2xMOOP				
Safety Approvals	UL/cUL 60950-1 recognition (UL certificate)				
	UL/cUL 62368-1 recognition (UL certificate), IEC/EN 62368-1 (CB-report)				
	ANSI/AAMI ES 60601-1 1xMOPP & 2xMOOP recognition (UL certificate), IEC/EN 60601-1 3.2 Edition (CB-report)				

General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Switching Frequency		50	80	100	kHz
MTBF (calculated)	MIL-HDBK-217F@25℃, Ground Benign	2,000,000	---	---	Hours

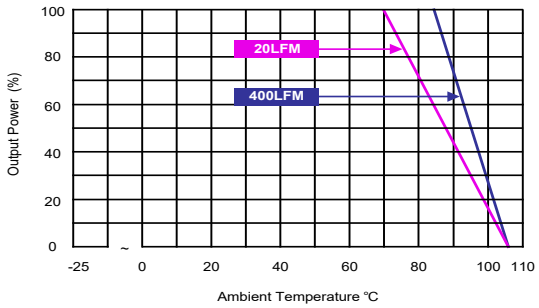
EMC Specifications

Parameter	Standards & Level			Performance
EMI	Conduction	EN 55011, EN 55032, EN 61000-6-3	Without external components	Class A
	Radiation	EN 61000-6-4		
EMS	EN 60601-1-2 4th, EN 55035, EN 61000-6-1, EN 61000-6-2			
	ESD	Direct discharge	Indirect discharge HCP & VCP	A
		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 100A/m.1000A/m(1 sec)		A

Environmental Specifications

Parameter	Min.	Max.	Unit
Operating Ambient Temperature Range (For Power Derating see relative Derating Curve)	-25	+85	℃
Case Temperature	---	+105	℃
Storage Temperature Range	-50	+125	℃
Humidity (non condensing)	---	95	% rel. H
Lead Temperature (1.5mm from case for 10Sec.)	---	260	℃

Power Derating Curve

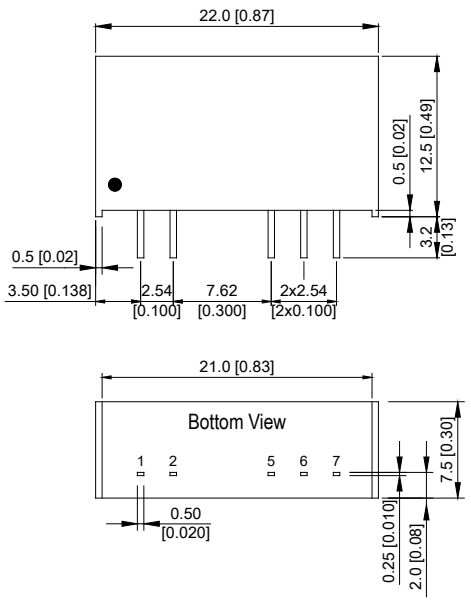


Notes

1. Specifications typical at Ta=+25℃, resistive load, nominal input voltage and rated output current unless otherwise noted.
2. Please do not operate the product without a minimum load condition.
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. Specifications are subject to change without notice.
6. 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.

Package Specifications

Mechanical Dimensions



Pin Connections

Pin	Single Output	Dual Output
1	+Vin	+Vin
2	-Vin	-Vin
5	-Vout	-Vout
6	No Pin	Common
7	+Vout	+Vout

- All dimensions in mm (inches)
- Tolerance: X.X±0.5 (X.XX±0.02)
  X.XX±0.13 (X.XXX±0.005)
- Pins ±0.05 (±0.002)

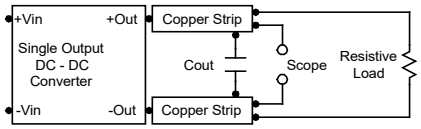
Physical Characteristics

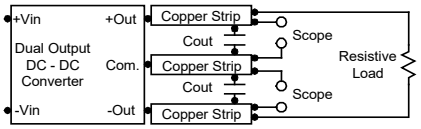
Case Size	:	22.0x7.5x12.5mm (0.87x0.30x0.49 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Pin Material	:	Alloy 42
Weight	:	3.9g

Test Setup

Peak-to-Peak Output Noise Measurement Test

Use a Cout 0.33μF ceramic capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC-DC Converter.





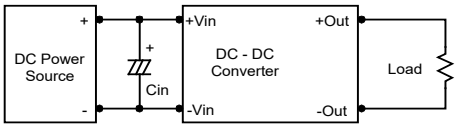
Technical Notes

Maximum Capacitive Load

The MAU400 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. For optimum performance we recommend 220μF maximum capacitive load for dual outputs and 680μF capacitive load for single outputs. The maximum capacitance can be found in the data sheet.

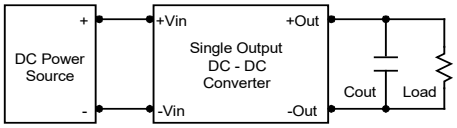
Input Source Impedance

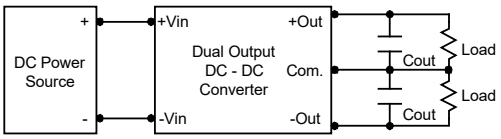
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.
Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 kHz) capacitor of a 2.2μF for the 5V input devices, a 1.0μF for the 12V input devices.



Output Ripple Reduction

A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 1.5μF capacitors at the output.





Thermal Considerations

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 105°C. The derating curves are determined from measurements obtained in a test setup.