FEATURES

- **Industrial Standard SIP-7 Package**
- **Semi-regulated Output Voltage**
- **Very High Efficiency up to 88.5%**
- **I/O Isolation 1000 VDC**
- **Operating Ambient Temp. Range -40℃ to +95℃**
- **UL/cUL/IEC/EN 60950-1 Safety Approval**

CSA 60950-1 CB Scheme

PRODUCT OVERVIEW

The MINMAX MA01 series is a range of isolated 1W DC-DC converter modules in a small SIP-package. There are 24 models available with 5V, 12V or 24VDC input and single-or dual-output voltages. These products provide have a typical load regulation of 2.5% to 5.0% depending on model.
The MA01 DC-DC converters are a compromise between a more expensive fully regulated converter and a non-regulated converter. They offer the designer a solution for many cost critical applications where the output voltage variation has to be kept in a certain limit under all load conditions.

Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current		Input Current		Load Regulation	Reflected Ripple	Max. capacitive Load	Efficiency (typ.)
			Max.	Min.	@Max. Load	@No Load				@Max. Load
	VDC	VDC	mA	mA	mA(typ.)	mA(typ.)	% (max.)	mA(typ.)	μF	%
MA01-05S05	5 (4.5 ~ 5.5)	5	200	4	238	30	6.5	7	220	84
MA01-05S09		9	110	2	228		5			87
MA01-05S12		12	84	1.5	232		5.2			87
MA01-05S15		15	67	1	230		5			87.5
MA01-05D05		±5	±100	±2	237		5.2		100#	84.5
MA01-05D09		±9	±56	±1	234		4.2			86
MA01-05D12		±12	±42	±0.8	233		4.6			86.5
MA01-05D15		±15	±34	±0.7	236		4.5			86.5
MA01-12S05	12 (10.8 ~ 13.2)	5	200	4	99	12	5	4	220	84
MA01-12S09		9	110	2	95		3.4			86.5
MA01-12S12		12	84	1.5	95		3.4			88.5
MA01-12S15		15	67	1	95		2.7			88
MA01-12D05		±5	±100	±2	99		3.9		100#	84.5
MA01-12D09		±9	±56	±1	98		2.8			86
MA01-12D12		±12	±42	±0.8	95		2.9			88.5
MA01-12D15		±15	±34	±0.7	94		2.6			87.5
MA01-24S05	24 (21.6 ~ 26.4)	5	200	4	50	11	3.7	8	220	84
MA01-24S09		9	110	2	48		2.5			86.5
MA01-24S12		12	84	1.5	48		2.4			87.5
MA01-24S15		15	67	1	48		2.3			87.5
MA01-24D05		±5	±100	±2	50		3.7		100#	83.5
MA01-24D09		±9	±56	±1	49		2.5			86
MA01-24D12		±12	±42	±0.8	48		2.4			87
MA01-24D15		±15	±34	±0.7	49		2.3			87

For each output

Input Specifications

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

Output Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Output Voltage Balance	Dual Output, Balanced Loads	---	±0.1	±1.0	%
Line Regulation	For Vin Change of 1%	---	±1.05	±1.2	%
Load Regulation	Io=20% to 100%	See Model Selection Guide			
Ripple & Noise	0-20MHz Bandwidth	---	30	60	mV P-P
Temperature Coefficient		---	±0.01	±0.02	%/℃
Short Circuit Protection	0.5 Second Max., Automatic Recovery				

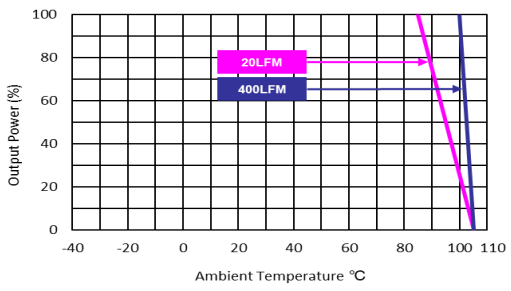
General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds	1000	---	---	VDC
	1 Second	1200	---	---	VDC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
I/O Isolation Capacitance	100kHz, 1V	40	60	120	pF
Switching Frequency		50	100	120	kHz
MTBF (calculated)	MIL-HDBK-217F@25℃, Ground Benign	2,000,000			Hours
Safety Approvals	UL/cUL 60950-1 recognition(CSA certificate), IEC/EN 60950-1(CB-report)				

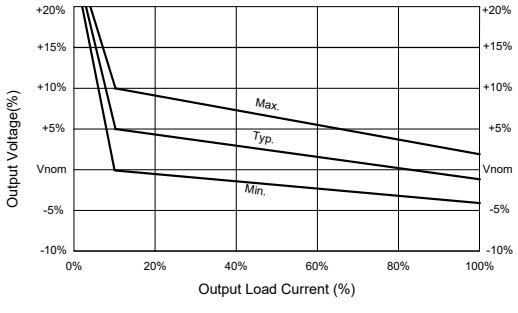
Environmental Specifications

Parameter	Min.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	-40	+85	℃
Case Temperature	---	+95	℃
Storage Temperature Range	-50	+125	℃
Humidity (non condensing)	---	95	% rel. H
Lead Temperature (1.5mm from case for 10Sec.)	---	260	℃

Power Derating Curve



Output Voltage Tolerance

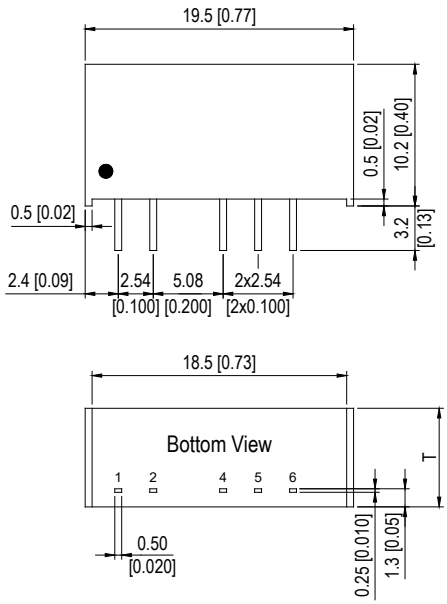


Notes

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 Specifications are subject to change without notice.

Package Specifications

Mechanical Dimensions



Pin Connections

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

T=6.1(0.24) for 5V & 12V Input Models
T=7.1(0.28) for 24V Input Models

▶ All dimensions in mm (inches)
▶ Tolerance: X.X±0.25 (X.XX±0.01)
X.XX±0.13 (X.XXX±0.005)
▶ Pins ±0.05(±0.002)

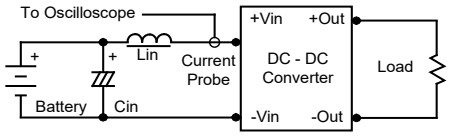
Physical Characteristics

Case Size (5&12V Input)	:	19.5x6.1x10.2mm (0.77x0.24x0.40 inches)
Case Size (24V Input)	:	19.5x7.1x10.2mm (0.77x0.28x0.40 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Pin Material	:	Alloy 42
Weight (5&12V Input)	:	2.2g
Weight (24V Input)	:	2.6g

Test Setup

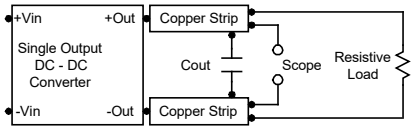
Input Reflected-Ripple Current Test Setup

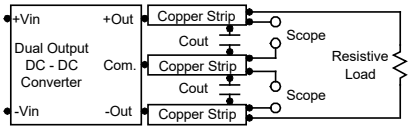
Input reflected-ripple current is measured with a inductor Lin (10μH) and Cin (1μF, ESR < 1.0Ω at 100 kHz) to simulate source impedance.
Capacitor Cin, offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 kHz.



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.





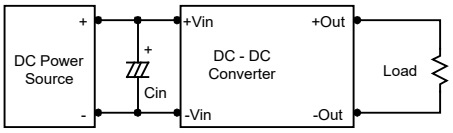
Technical Notes

Maximum Capacitive Load

The MA01 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 100μF maximum capacitive load for dual outputs and 220μF capacitive load for single outputs. The maximum capacitance can be found in the data sheet.

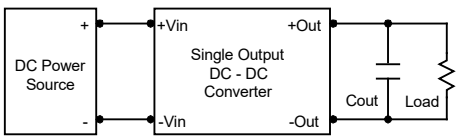
Input Source Impedance

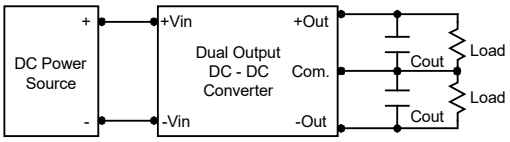
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module.
In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.
Capacitor mounted close to the power module helps ensure stability of the unit, it is commended 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 and a 0.47μF for the 24V 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 1.0μF 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 95°C. The derating curves are determined from measurements obtained in a test setup.