MINMAX®

MA01H Series
Electric Characteristic Note

MA01H Series EC Note

DC-DC CONVERTER 1W, SIP Package

Features

- **Industrial Standard SIP-7 Package**
- **Semi-regulated Output Voltage**
- **Very High Efficiency up to 88%**
- **I/O Isolation 3000VDC**
- **Operating Ambient Temp. Range -40℃ to +95℃**
- **UL/cUL/IEC/EN 60950-1 Safety Approval**

Applications

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

Product Overview

The MINMAX MA01H 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. These products provide have a typical load regulation of 3.5% to 5.5% depending on model.

The MA01H 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.

Table of contents

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	%
MA01-05S05H	5 (4.5 ~ 5.5)	5	200	4	238	30	6.2	11	220	84
MA01-05S09H		9	110	2	229		5.5			86.5
MA01-05S12H		12	84	1.5	231		5.5			87
MA01-05S15H		15	67	1	230		5			87.5
MA01-12S05H	12 (10.8 ~ 13.2)	5	200	4	99	12	5	5	220	84
MA01-12S09H		9	110	2	96		3.3			86
MA01-12S12H		12	84	1.5	95		3.6			88
MA01-12S15H		15	67	1	95		2.9			88
MA01-24S05H	24 (21.6 ~ 26.4)	5	200	4	50	11	5	4.7	220	84
MA01-24S09H		9	110	2	48		3.5			86.5
MA01-24S12H		12	84	1.5	48		3.5			87.5
MA01-24S15H		15	67	1	48		3			87.5

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
Line Regulation	For Vin Change of 1%	---	±1.05	±1.2	%
Load Regulation	Io=20% to 100%	See Model Selection Guide			
Ripple & Noise	0-20 MHz Bandwidth	---	30	60	mV_{P-P}
Temperature Coefficient		---	±0.01	±0.02	%/℃
Short Circuit Protection	0.5 Second Max., Automatic Recovery				

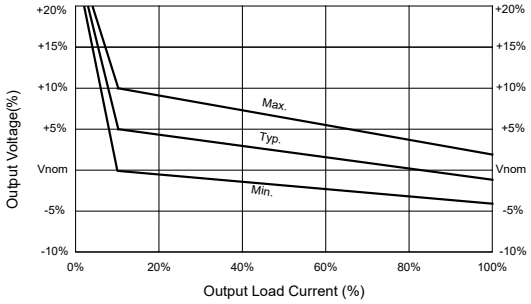
General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds	3000	---	---	VDC
I/O Isolation Test Voltage	Flash tested for 1 Second	3300	---	---	V_{PK}
I/O Isolation Resistance	1000 VDC	10	---	---	GΩ
I/O Isolation Capacitance	100kHz, 1V	30	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	℃

Output Voltage Tolerance

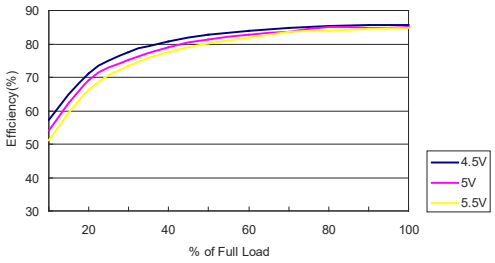


Notes

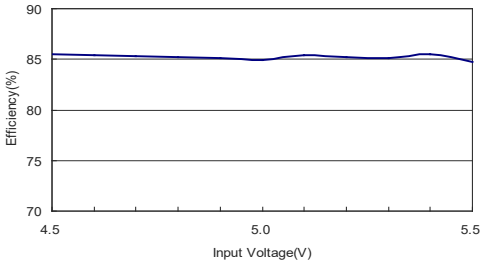
1 Specifications typical at Ta=+25℃, resistive load, nominal input voltage and rated output current unless otherwise noted.
2 These power converters require a minimum output loading to maintain specified regulation, operation under no-load conditions will not damage these modules; however they may not 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.

Characteristic Curves

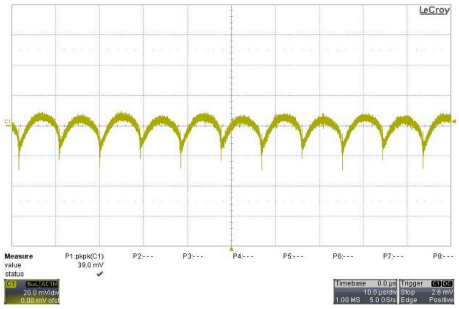
All test conditions are at 25℃ The figures are identical for MA01-05S05H



Efficiency Versus Output Current

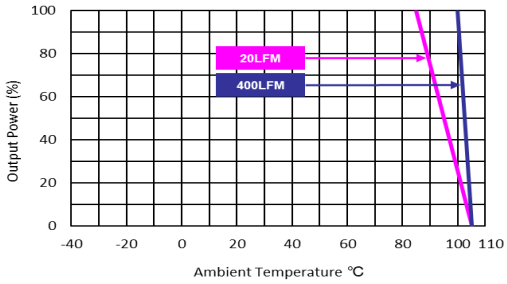


Efficiency Versus Input Voltage
Full Load



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

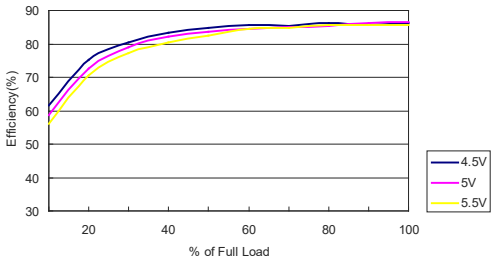
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



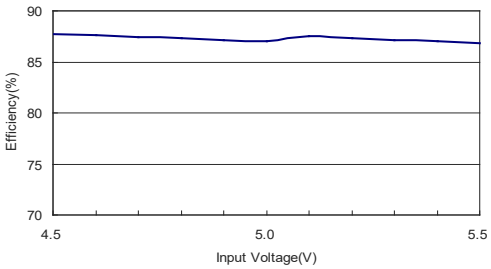
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

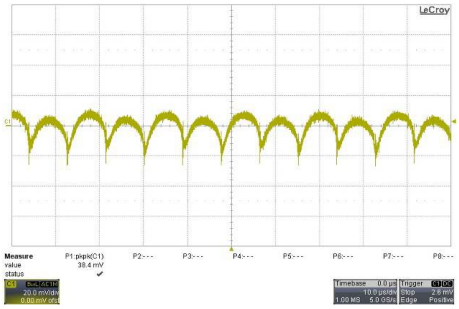
All test conditions are at 25℃ The figures are identical for MA01-05S09H



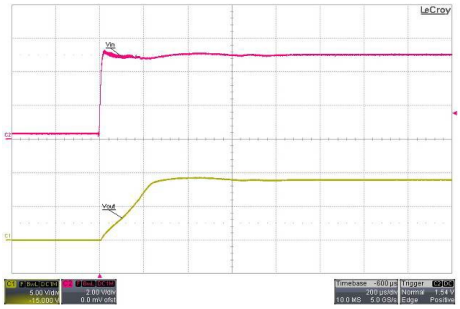
Efficiency Versus Output Current



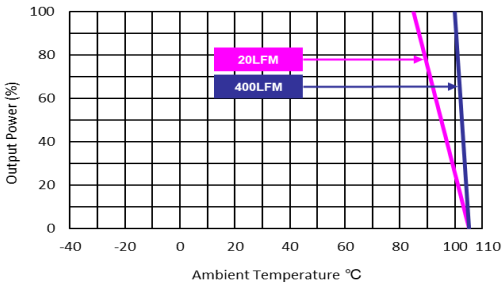
Efficiency Versus Input Voltage
Full Load



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



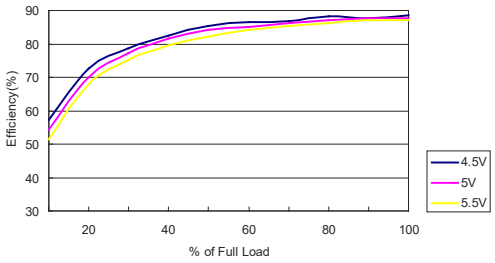
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



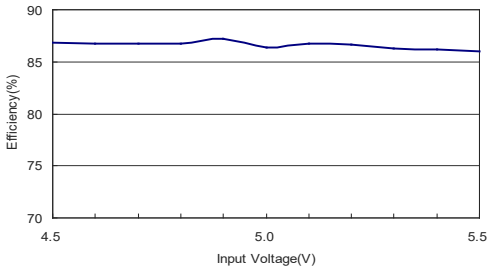
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

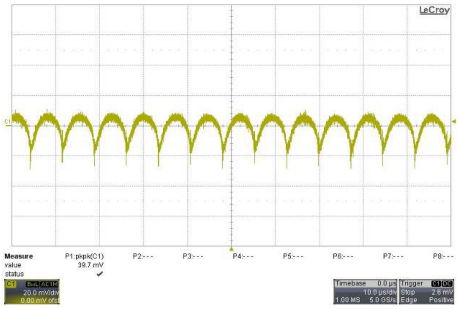
All test conditions are at 25℃ The figures are identical for MA01-05S12H



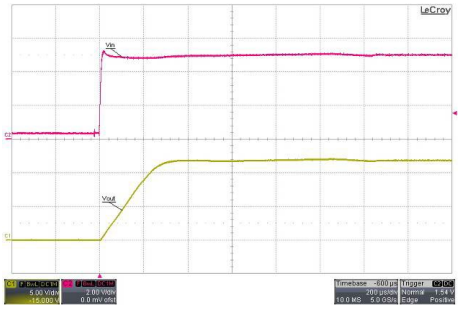
Efficiency Versus Output Current



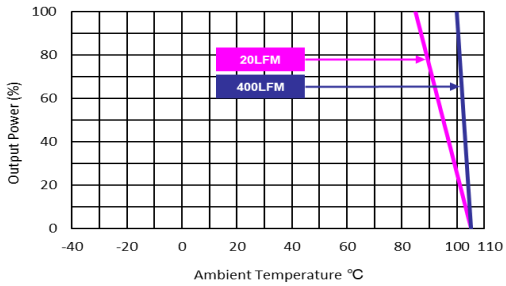
Efficiency Versus Input Voltage
Full Load



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



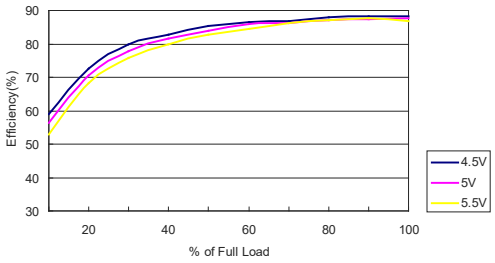
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



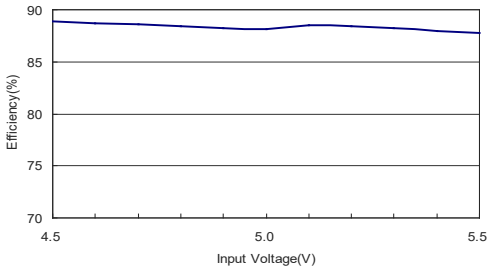
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

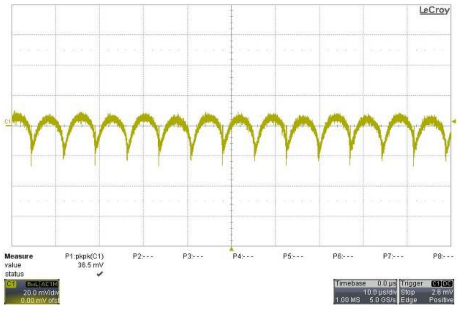
All test conditions are at 25℃ The figures are identical for MA01-05S15H



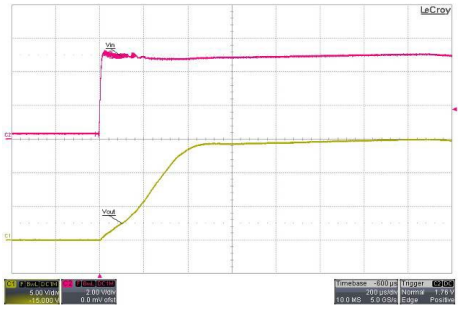
Efficiency Versus Output Current



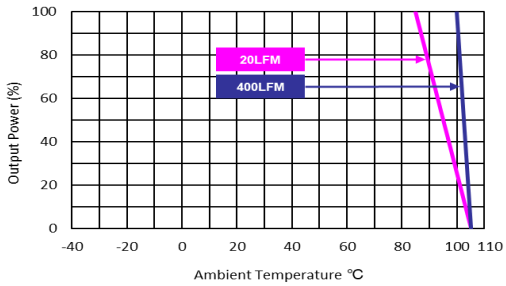
Efficiency Versus Input Voltage
Full Load



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



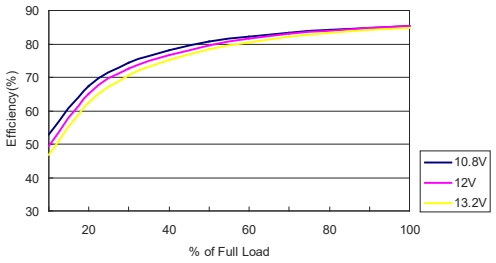
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



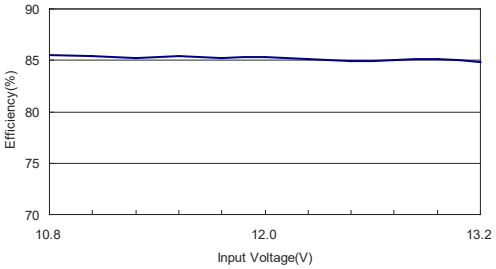
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

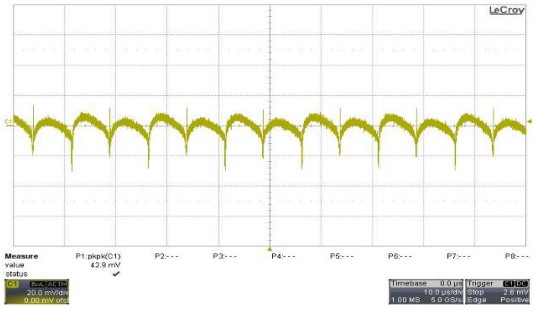
All test conditions are at 25℃ The figures are identical for MA01-12S05H



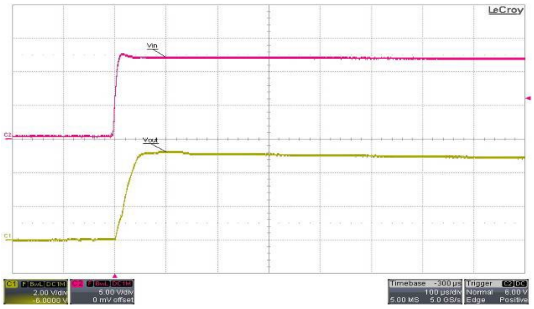
Efficiency Versus Output Current



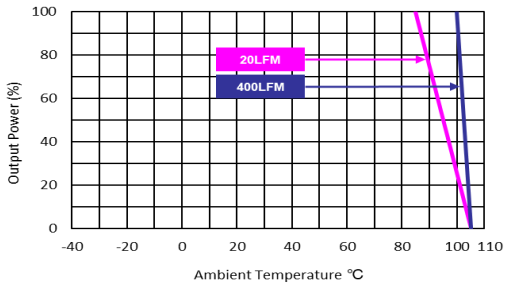
Efficiency Versus Input Voltage
Full Load



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



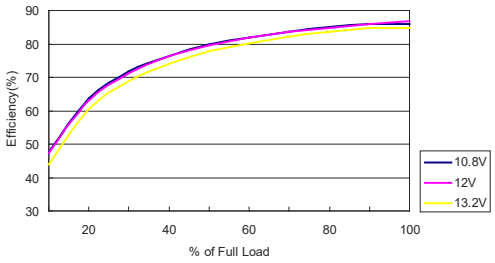
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



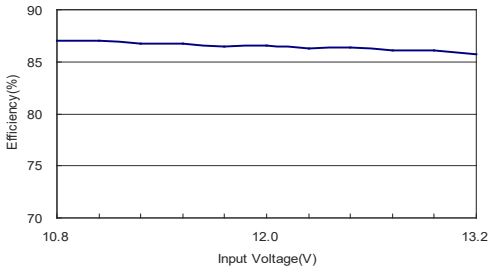
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

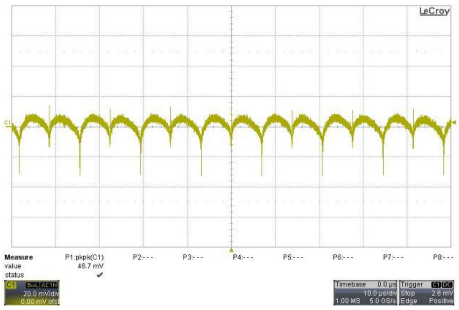
All test conditions are at 25℃ The figures are identical for MA01-12S09H



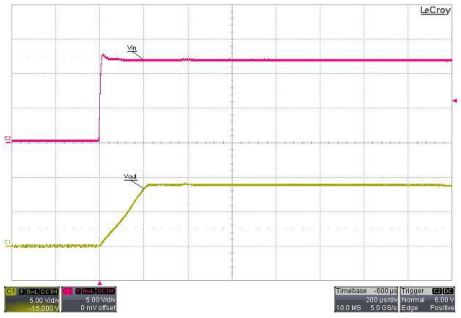
Efficiency Versus Output Current



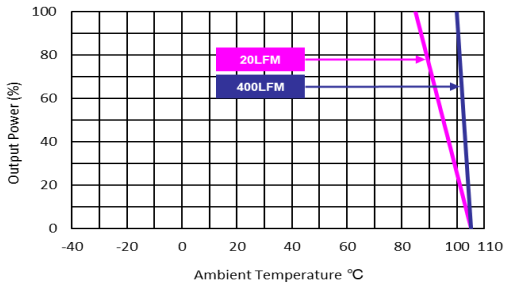
Efficiency Versus Input Voltage
Full Load



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



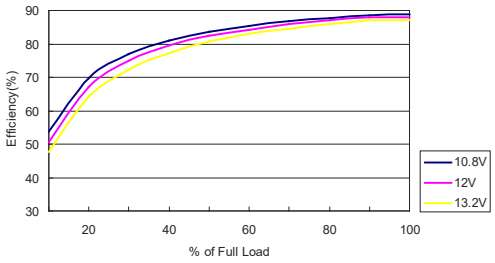
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



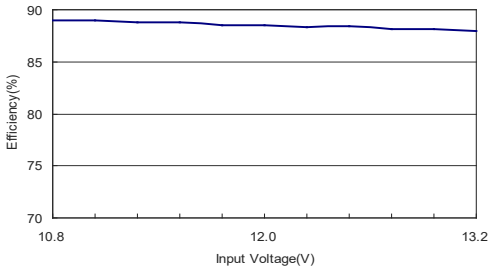
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

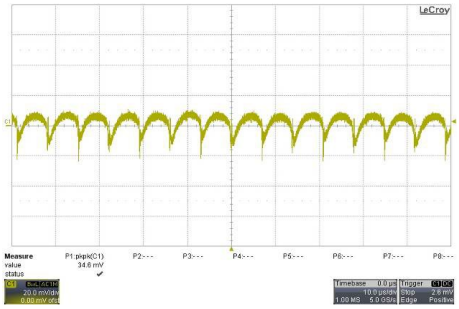
All test conditions are at 25℃ The figures are identical for MA01-12S12H



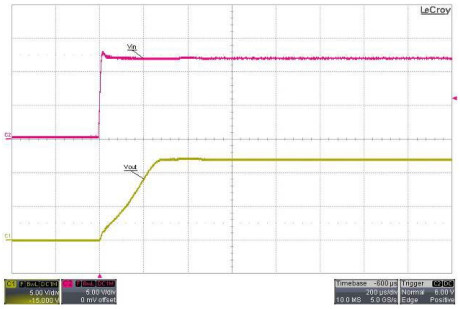
Efficiency Versus Output Current



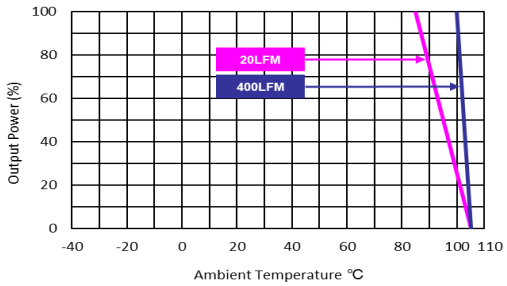
Efficiency Versus Input Voltage
Full Load



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



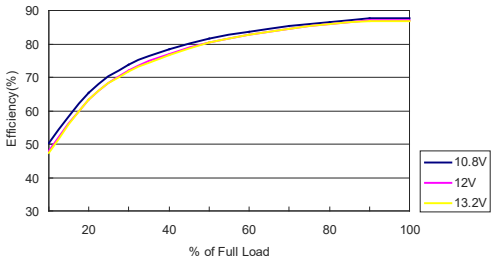
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



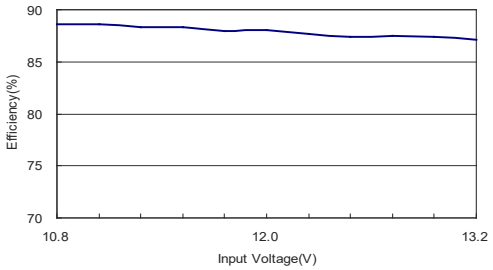
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

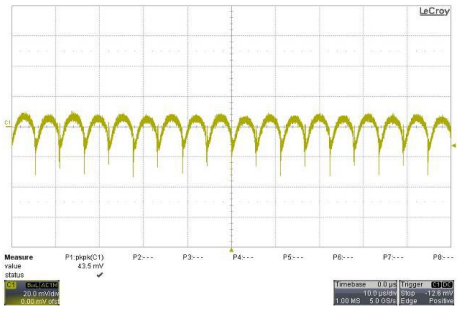
All test conditions are at 25℃ The figures are identical for MA01-12S15H



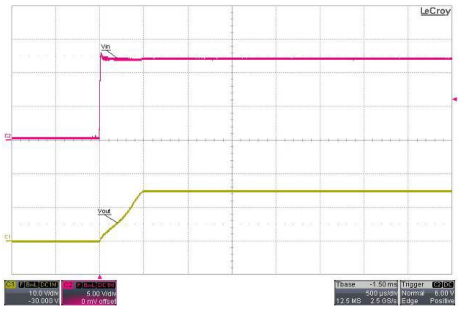
Efficiency Versus Output Current



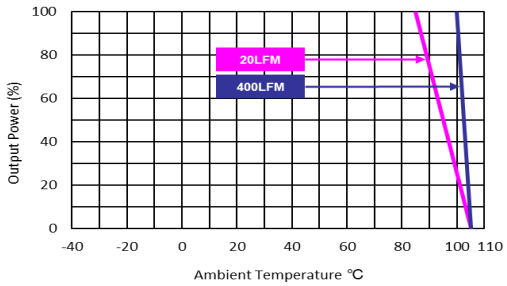
Efficiency Versus Input Voltage
Full Load



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



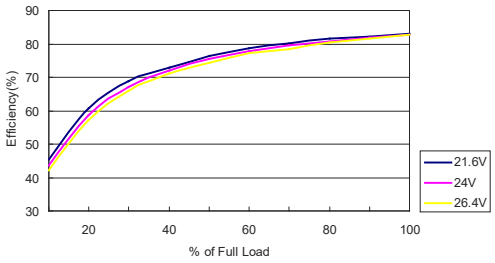
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



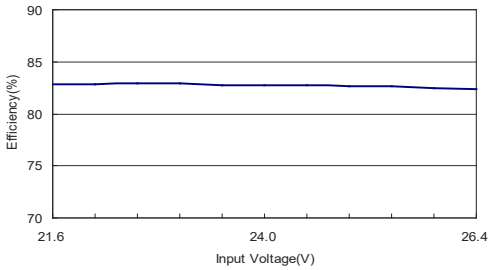
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

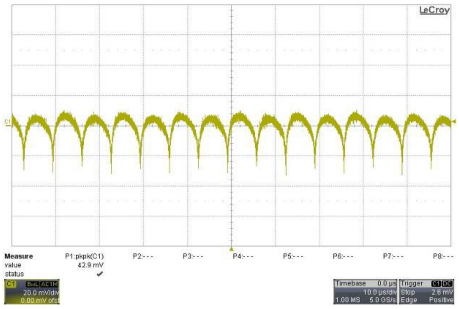
All test conditions are at 25℃ The figures are identical for MA01-24S05H



Efficiency Versus Output Current

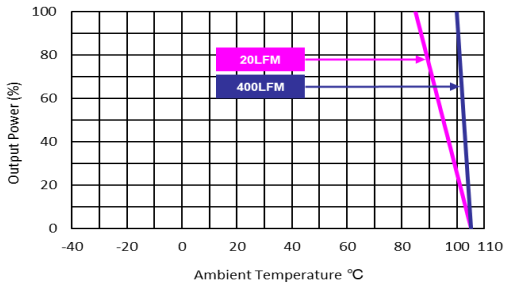


Efficiency Versus Input Voltage
Full Load



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

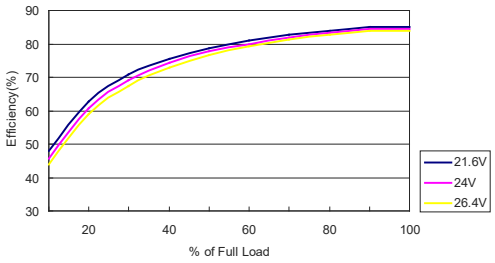
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



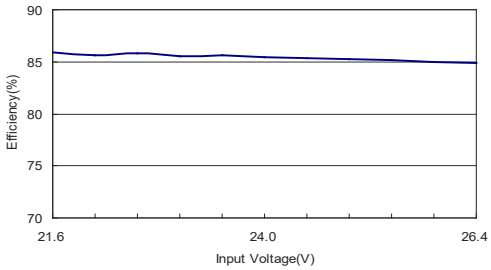
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

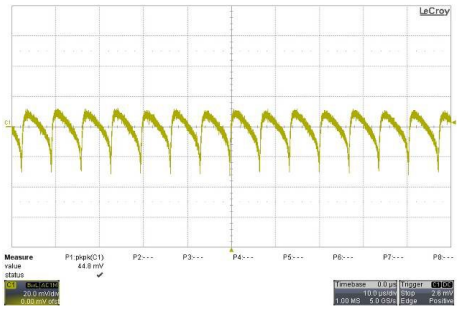
All test conditions are at 25℃ The figures are identical for MA01-24S09H



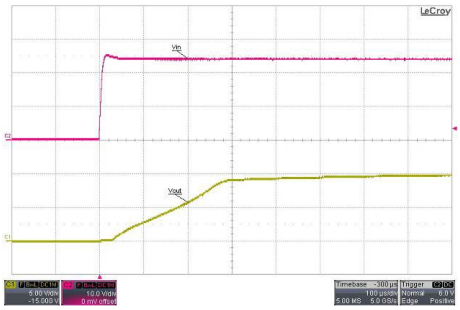
Efficiency Versus Output Current



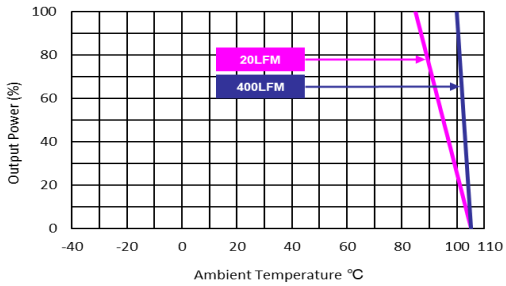
Efficiency Versus Input Voltage
Full Load



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



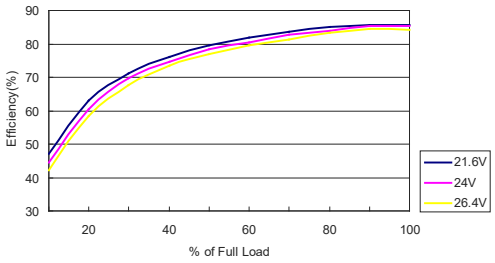
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



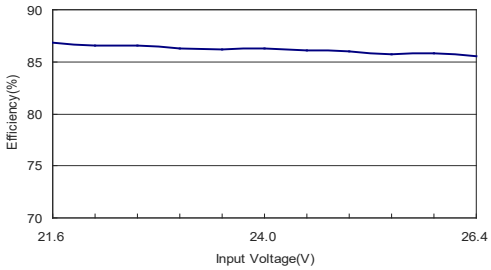
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

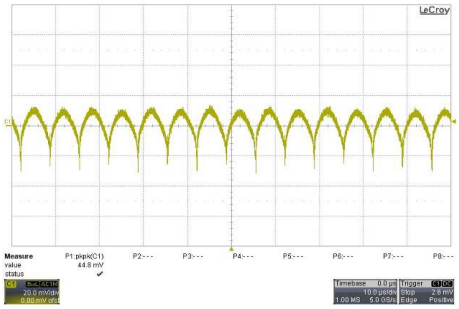
All test conditions are at 25℃ The figures are identical for MA01-24S12H



Efficiency Versus Output Current

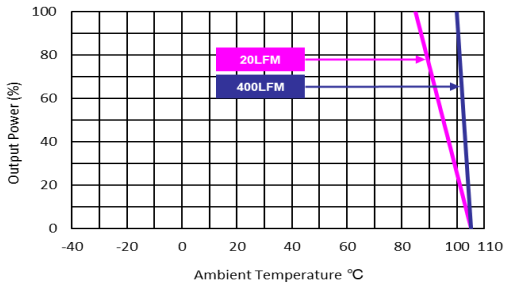


Efficiency Versus Input Voltage
Full Load



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

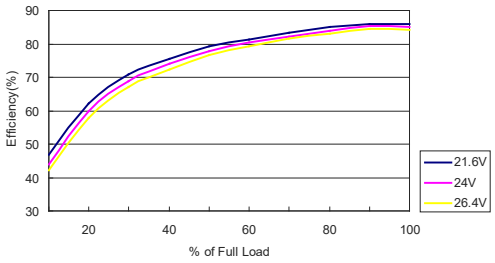
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



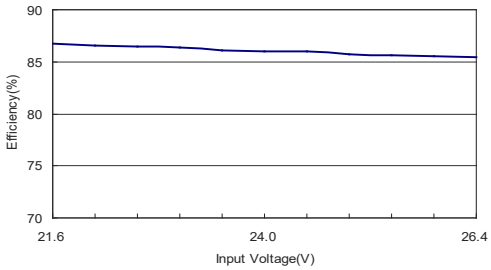
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

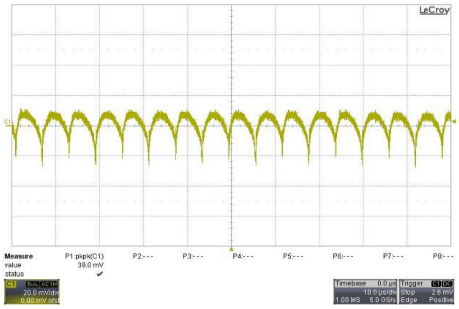
All test conditions are at 25℃ The figures are identical for MA01-24S15H



Efficiency Versus Output Current

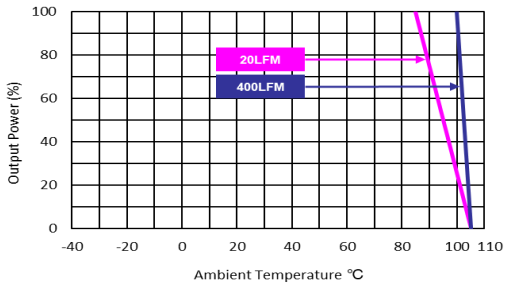


Efficiency Versus Input Voltage
Full Load



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

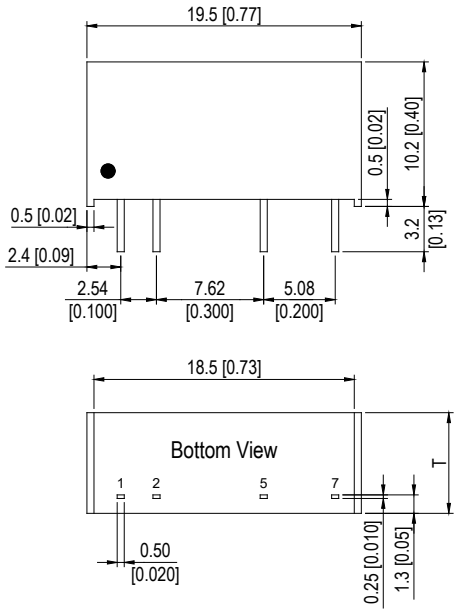
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



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

Package Specifications

Mechanical Dimensions



Pin Connections

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

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

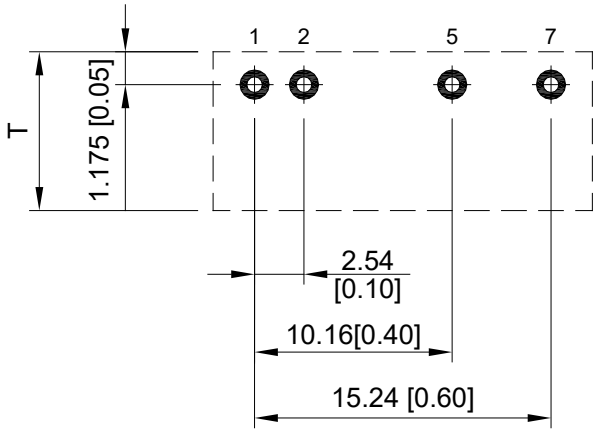
T=7.1(0.28) for 24V Input Models

- 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 (5V & 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 (5V & 12V Input)	:	2.2g
Weight (24V Input)	:	2.6g

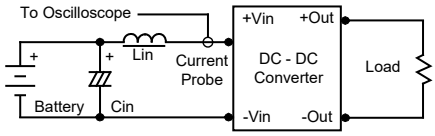
Recommended Pad Layout



Test Setup

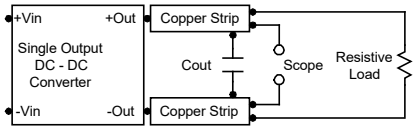
Input Reflected-Ripple Current Test Setup

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.



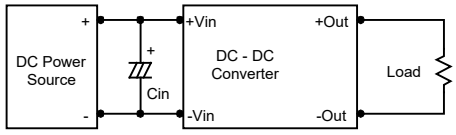
Technical Notes

Maximum Capacitive Load

The MA01H 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 devices. The maximum capacitance can be found in the data sheet.

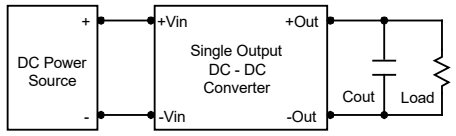
Input Source Impedance

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.



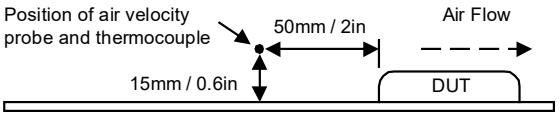
Output Ripple Reduction

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.



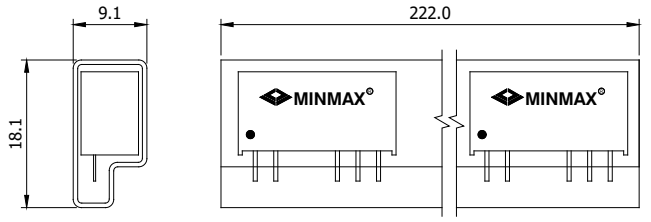
Thermal Considerations

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.

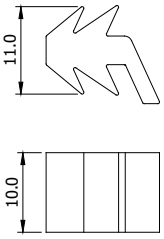


Packaging Information for Tube

Tube



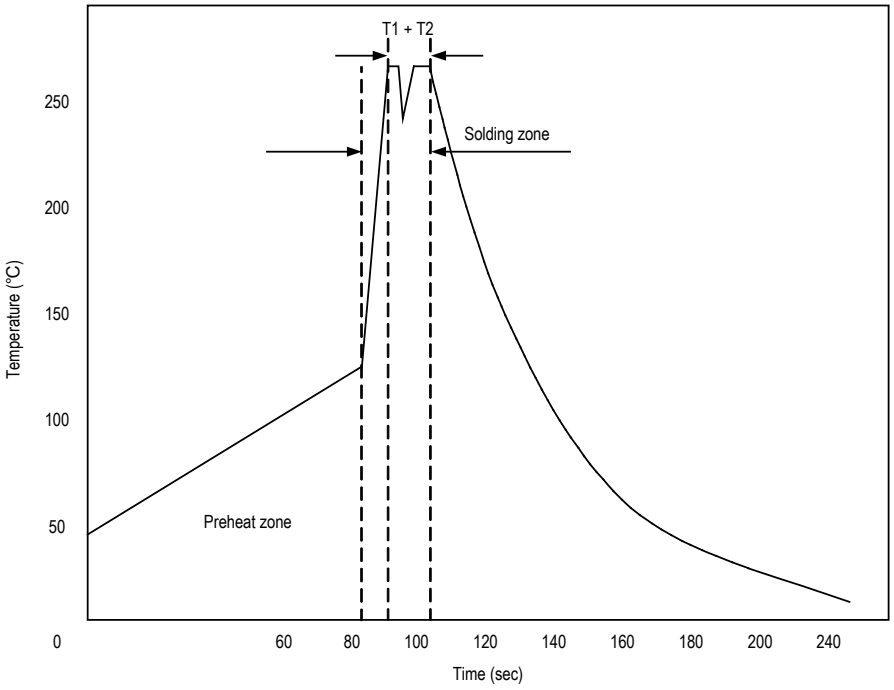
Plug



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	01	-	05	S	05	H
	Package Type SIP-7	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 09: 9 VDC 12: 12 VDC 15: 15 VDC	I/O Isolation Voltage 3000 VDC

MTBF and Reliability

The MTBF of MA01H series of DC-DC converters has been calculated using

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

Model	MTBF	Unit
MA01-05S05H	5,301,524	Hours
MA01-05S09H	3,944,773	
MA01-05S12H	2,857,143	
MA01-05S15H	2,343,292	
MA01-12S05H	5,333,334	
MA01-12S09H	3,962,358	
MA01-12S12H	2,865,330	
MA01-12S15H	2,348,796	
MA01-24S05H	4,901,961	
MA01-24S09H	3,838,771	
MA01-24S12H	2,737,850	
MA01-24S15H	2,262,443	