



**MINMAX<sup>®</sup>**

MAW01 Series

Electric Characteristic Note

# MAW01 Series EC Note

DC-DC CONVERTER 1W, SIP Package

## Features

- ▶ Industrial Standard SIP-6 Package
- ▶ Wide 2 : 1 Input Voltage Range
- ▶ Fully Regulated Output Voltage
- ▶ I/O Isolation 1500VDC
- ▶ Operating Ambient Temp. Range -40°C to +95°C
- ▶ No Min. Load Requirement
- ▶ Overload and Short Circuit Protection
- ▶ UL/cUL/IEC/EN 62368-1(60950-1) Safety Approval



## Applications

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

## Product Overview

The MINMAX MAW01 series is a range of isolated 1W DC-DC-converter modules featuring fully regulated output and wide 2:1 input voltage ranges. This product comes in a very small SIP-6 package occupying only 1.2cm<sup>2</sup> (0.2 square inch) on the PCB. A high efficiency allow operating an operating temperature range of -40°C to +85°C without Derating. The very compact dimensions makes these converters an ideal solution for many space critical applications in battery powered instrumentations.

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**Model Selection Guide**

Model Number	Input Voltage (Range) VDC	Output Voltage VDC	Output Current Max. mA	Input Current		Max. capacitive Load $\mu$ F	Reflected Ripple current mA (typ.)	Efficiency (typ.)
				@Max. Load mA(typ.)	@No Load mA(typ.)			@Max. Load
								%
MAW01-05S05	5 (4.5 ~ 9)	5	200	263	40	1680	80	76
MAW01-05S12		12	83	259		820		77
MAW01-05S15		15	67	254		680		79
MAW01-05S24		24	42	265		470		76
MAW01-05D12		$\pm$ 12	$\pm$ 42	262		470#		77
MAW01-05D15		$\pm$ 15	$\pm$ 33	254		330#		78
MAW01-12S05	12 (9 ~ 18)	5	200	108	20	1680	40	77
MAW01-12S12		12	83	108		820		77
MAW01-12S15		15	67	105		680		80
MAW01-12S24		24	42	109		470		77
MAW01-12D12		$\pm$ 12	$\pm$ 42	106		470#		79
MAW01-12D15		$\pm$ 15	$\pm$ 33	106		330#		78
MAW01-24S05	24 (18 ~ 36)	5	200	54	10	1680	30	77
MAW01-24S12		12	83	52		820		80
MAW01-24S15		15	67	52		680		80
MAW01-24S24		24	42	55		470		77
MAW01-24D12		$\pm$ 12	$\pm$ 42	53		470#		80
MAW01-24D15		$\pm$ 15	$\pm$ 33	52		330#		80
MAW01-48S05	48 (36 ~ 75)	5	200	27	7	1680	20	77
MAW01-48S12		12	83	27		820		78
MAW01-48S15		15	67	27		680		78
MAW01-48S24		24	42	28		470		76
MAW01-48D12		$\pm$ 12	$\pm$ 42	27		470#		79
MAW01-48D15		$\pm$ 15	$\pm$ 33	26		330#		79

# For each output

**Input Specifications**

Parameter	Model	Min.	Typ.	Max.	Unit
Input Surge Voltage (1 sec. max.)	5V Input Models	-0.7	---	15	VDC
	12V Input Models	-0.7	---	25	
	24V Input Models	-0.7	---	50	
	48V Input Models	-0.7	---	100	
Start-Up Threshold Voltage	5V Input Models	---	---	4.5	
	12V Input Models	---	---	9	
	24V Input Models	---	---	18	
	48V Input Models	---	---	36	
Under Voltage Shutdown	5V Input Models	---	---	4	
	12V Input Models	---	---	8.5	
	24V Input Models	---	---	17.5	
	48V Input Models	---	---	35.5	
Input Filter	All Models	Internal Capacitor			

**Output Specifications**

Parameter	Conditions	Min.	Typ.	Max.	Unit	
Output Voltage Setting Accuracy		---	---	±1.0	%Vnom.	
Output Voltage Balance	Dual Output, Balanced Loads	---	---	±1.0	%	
Line Regulation	Vin=Min. to Max. @Full Load	---	---	±0.2	%	
Load Regulation	Io=0% to 100%	Single Output Models	---	---	±1.0	%
		Dual Output Models	---	---	±1.0	%
	Io=10% to 90%	Single Output Models	---	---	±0.5	%
		Dual Output Models	---	---	±0.8	%
Minimum Load	No minimum Load Requirement					
Ripple & Noise	0-20 MHz Bandwidth	---	---	110	mV <sub>P-P</sub>	
Transient Recovery Time	25% Load Step Change	---	250	---	µsec	
Transient Response Deviation		---	±3	±5	%	
Temperature Coefficient		---	---	±0.02	%/°C	
Over Load Protection	Foldback	---	130	---	%	
Short Circuit Protection	Continuous, Automatic Recovery					

**General Specifications**

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds	1500	---	---	VDC
	1 second	1800	---	---	VDC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
I/O Isolation Capacitance	100kHz, 1V	---	---	50	pF
Switching Frequency		---	220	---	kHz
MTBF(calculated)	MIL-HDBK-217F@25°C, Ground Benign	2,800,000			Hours
Safety Approvals	UL/cUL 60950-1 recognition (CSA certificate), IEC/EN 60950-1(CB-report)				
	UL/cUL 62368-1 recognition (UL certificate), IEC/EN 62368-1(CB-report)				

**Environmental Specifications**

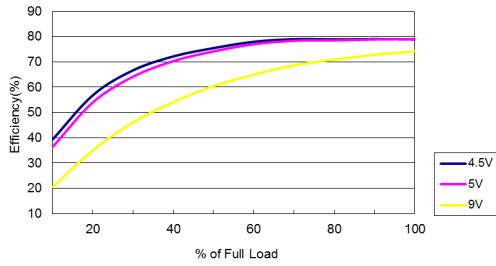
Parameter	Min.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	-40	+95	°C
Case Temperature	---	+105	°C
Storage Temperature	-55	+125	°C
Humidity (non condensing)	---	95	% rel. H
Lead Temperature (1.5mm from case for 10Sec.)	---	260	°C

**Notes**

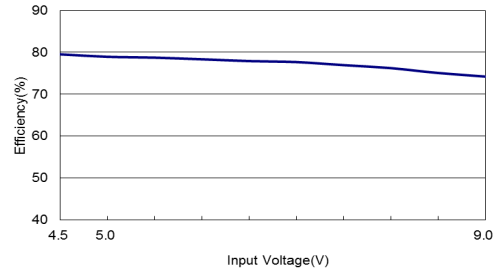
- 1 Specifications typical at Ta=+25°C, resistive load, nominal input voltage, rated output current unless otherwise noted.
- 2 We recommend to protect the converter by a slow blow fuse in the input supply line.
- 3 Other input and output voltage may be available, please contact MINMAX.
- 4 Specifications are subject to change without notice.

**Characteristic Curves**

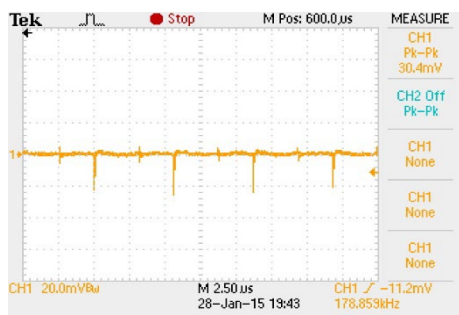
All test conditions are at 25°C The figures are identical for MAW01-05S05



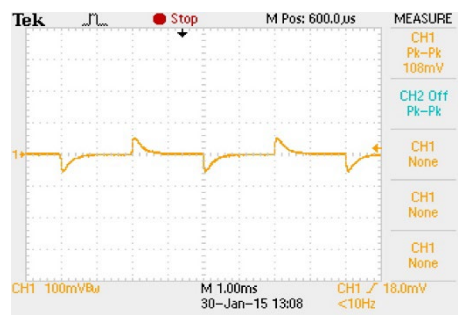
Efficiency Versus Output Current



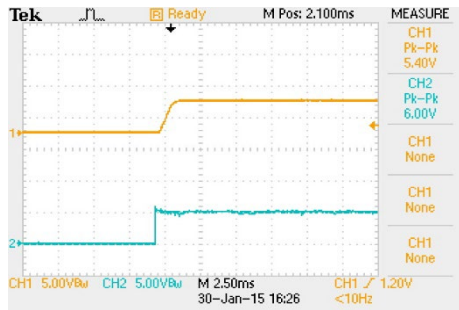
Efficiency Versus Input Voltage Full Load



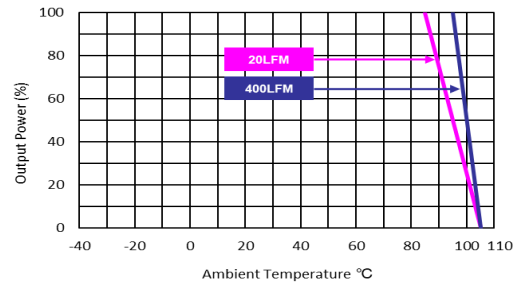
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



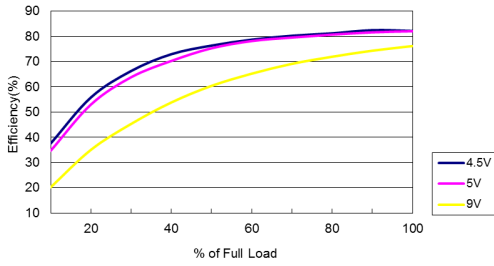
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



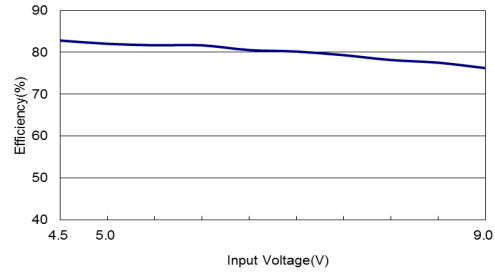
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

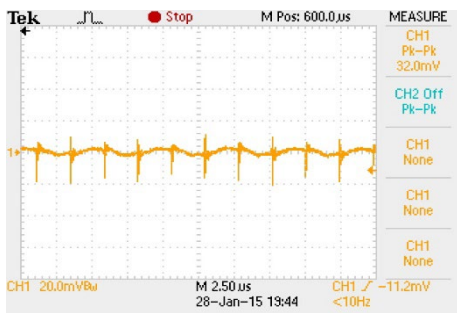
All test conditions are at 25°C The figures are identical for MAW01-05S12



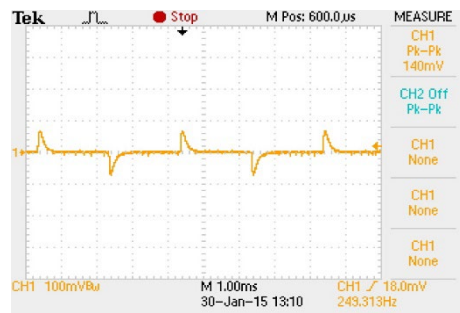
Efficiency Versus Output Current



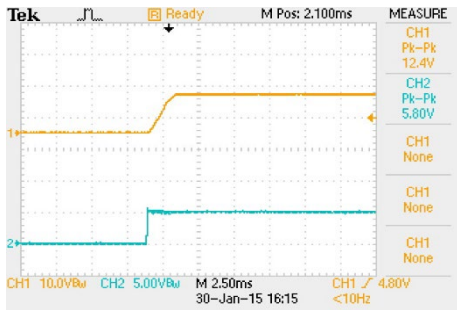
Efficiency Versus Input Voltage Full Load



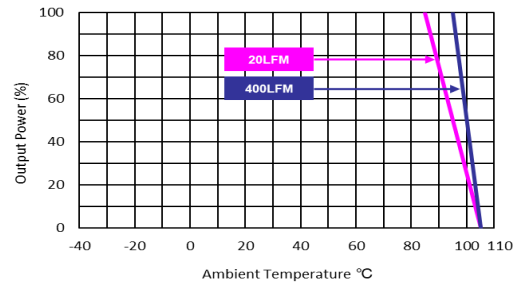
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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

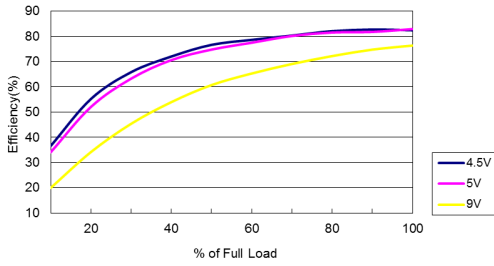


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

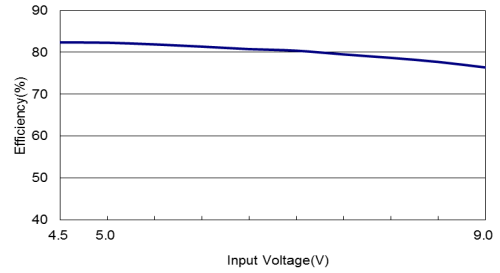


**Characteristic Curves**

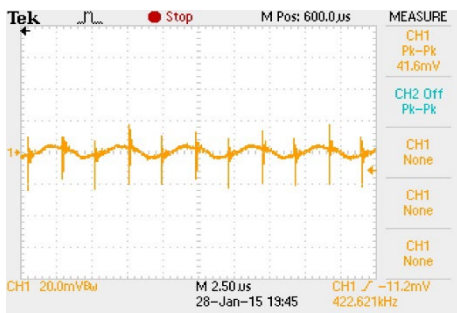
All test conditions are at 25°C The figures are identical for MAW01-05S15



Efficiency Versus Output Current



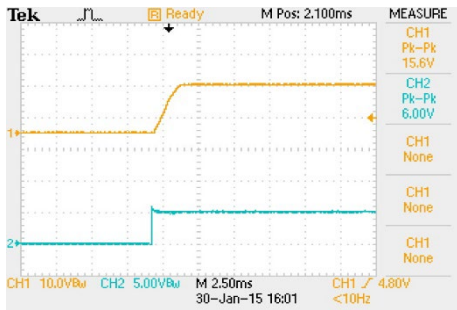
Efficiency Versus Input Voltage Full Load



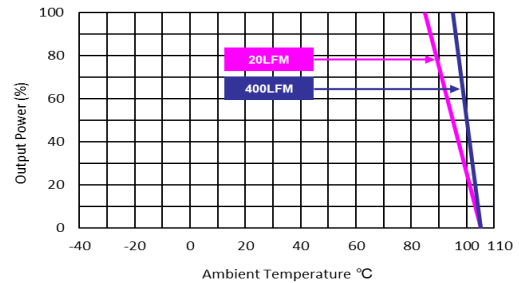
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



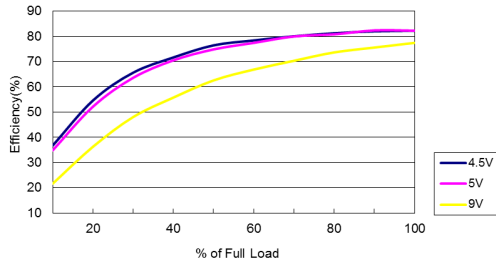
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



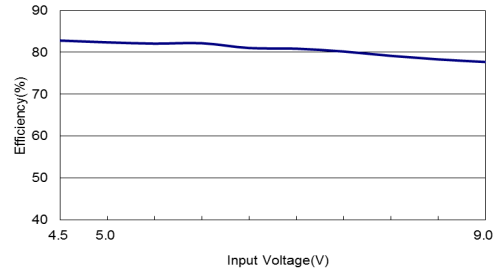
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

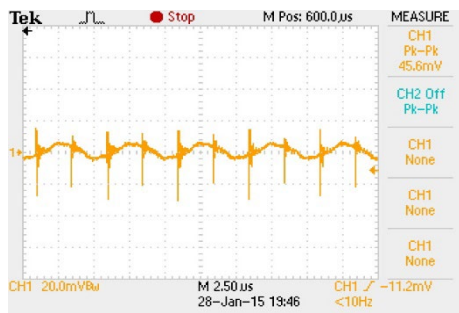
All test conditions are at 25°C The figures are identical for MAW01-05S24



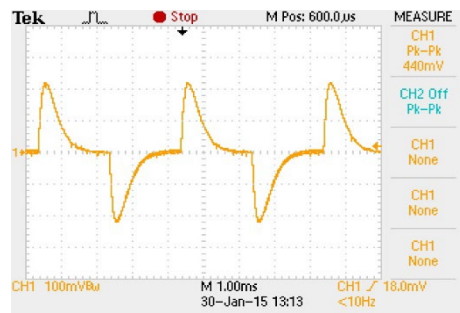
Efficiency Versus Output Current



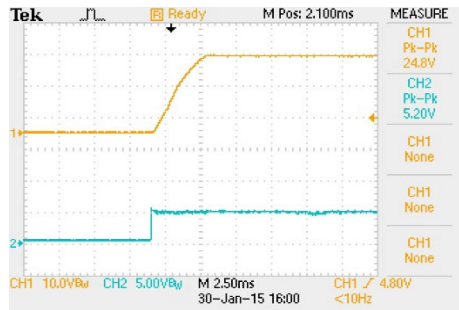
Efficiency Versus Input Voltage Full Load



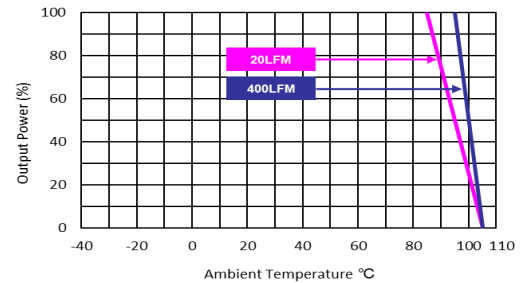
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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

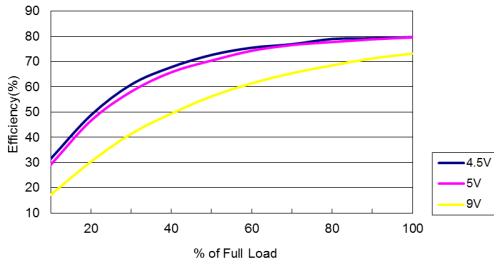


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

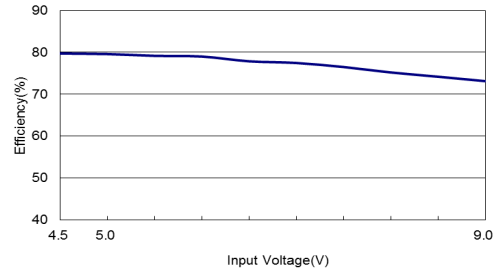


**Characteristic Curves**

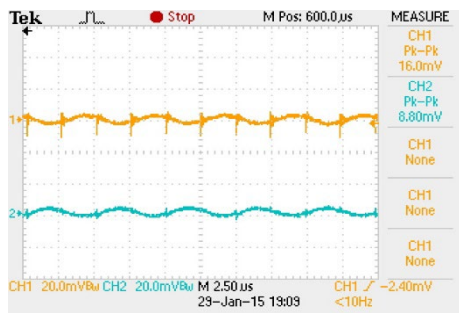
All test conditions are at 25°C The figures are identical for MAW01-05D12



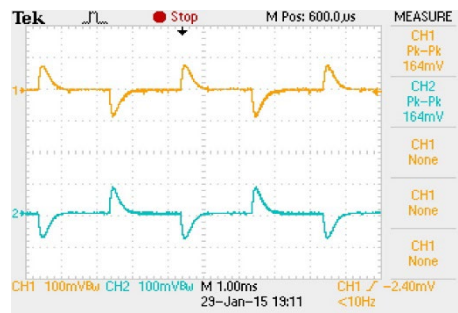
Efficiency Versus Output Current



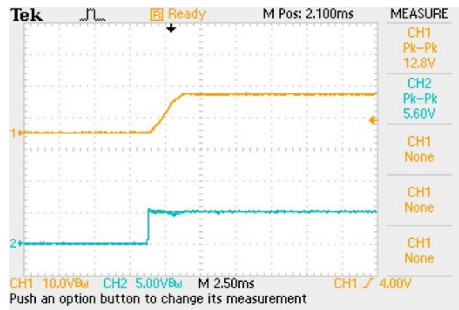
Efficiency Versus Input Voltage Full Load



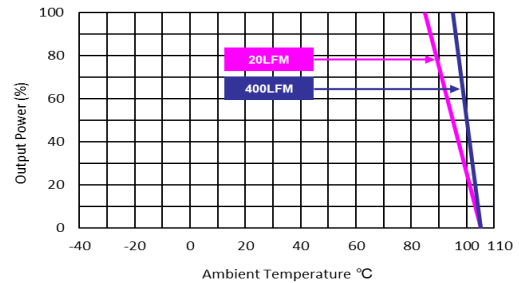
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



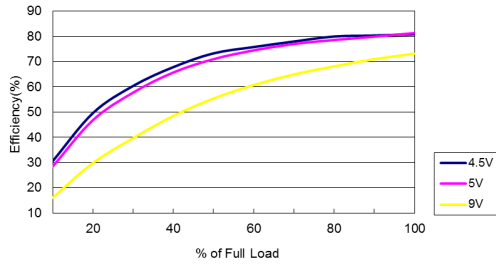
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



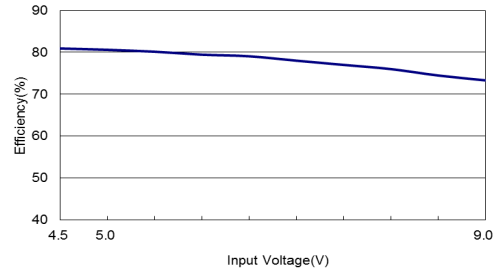
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

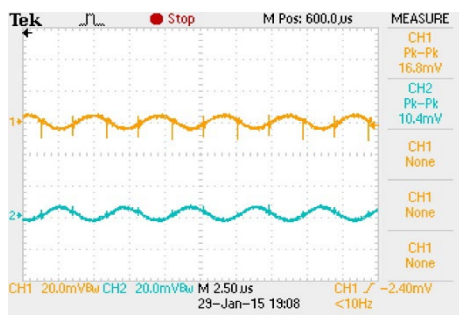
All test conditions are at 25°C The figures are identical for MAW01-05D15



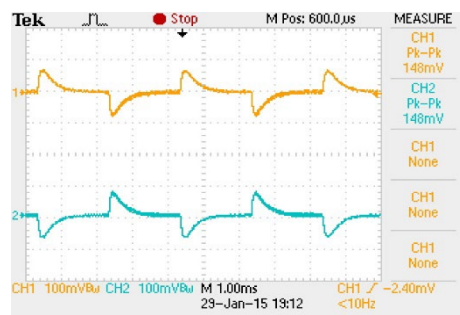
Efficiency Versus Output Current



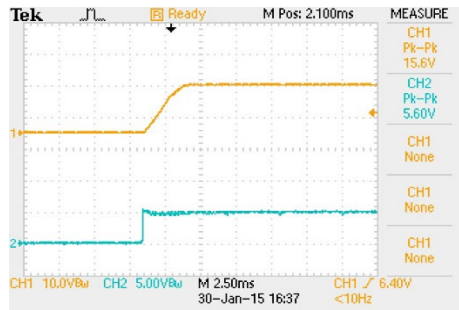
Efficiency Versus Input Voltage Full Load



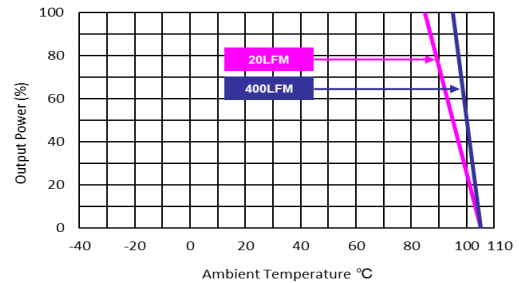
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



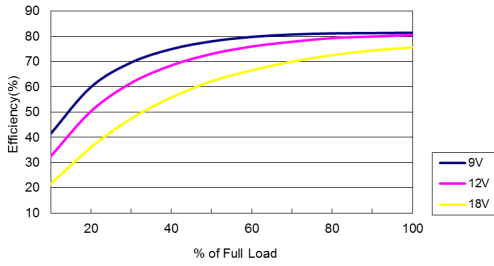
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



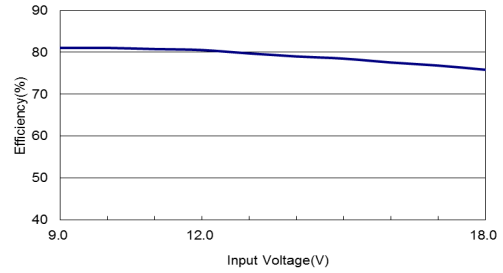
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

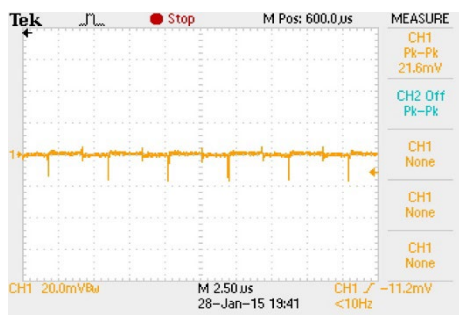
All test conditions are at 25°C The figures are identical for MAW01-12S05



Efficiency Versus Output Current



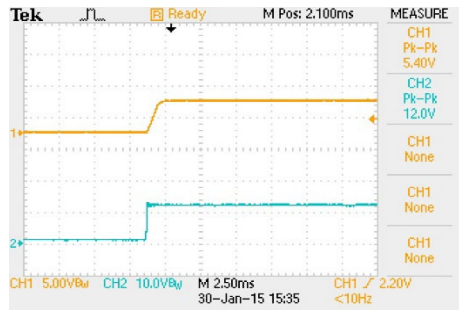
Efficiency Versus Input Voltage Full Load



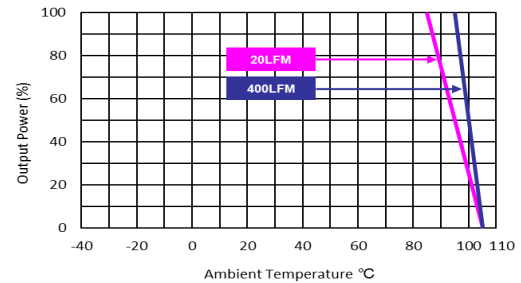
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



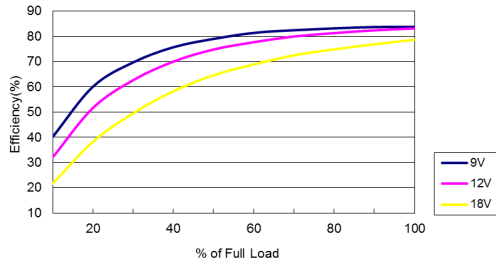
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



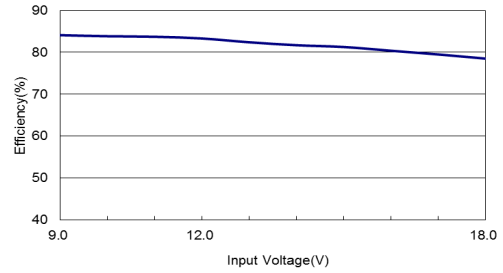
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

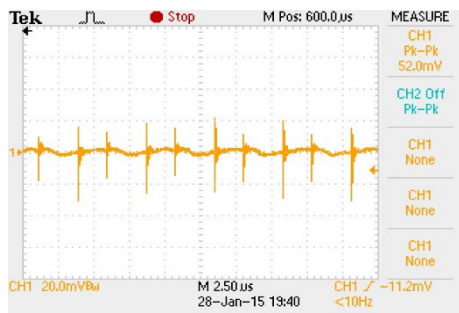
All test conditions are at 25°C The figures are identical for MAW01-12S12



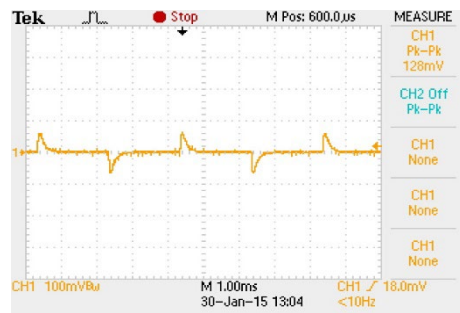
Efficiency Versus Output Current



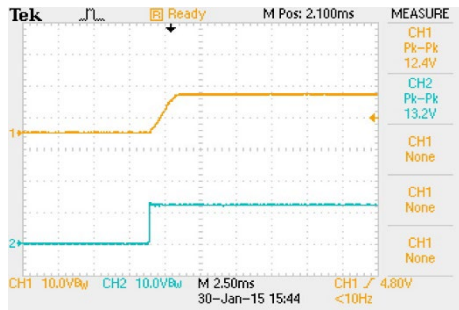
Efficiency Versus Input Voltage Full Load



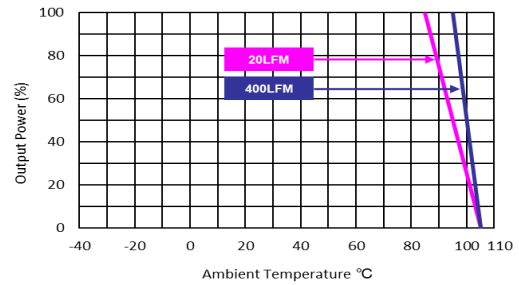
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



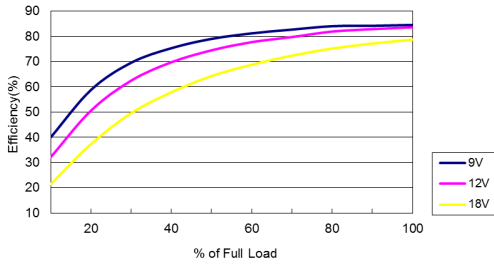
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



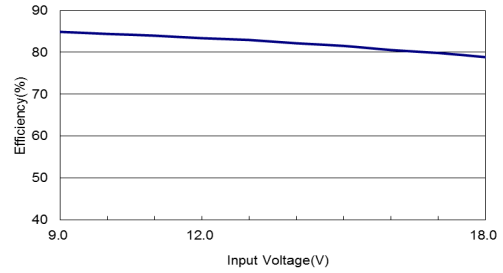
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

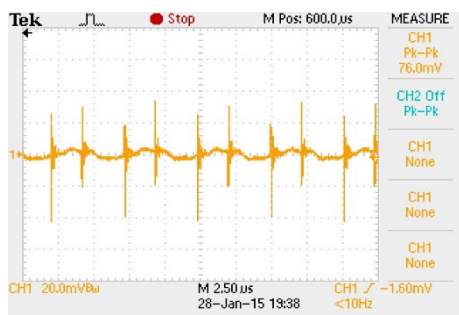
All test conditions are at 25°C The figures are identical for MAW01-12S15



Efficiency Versus Output Current



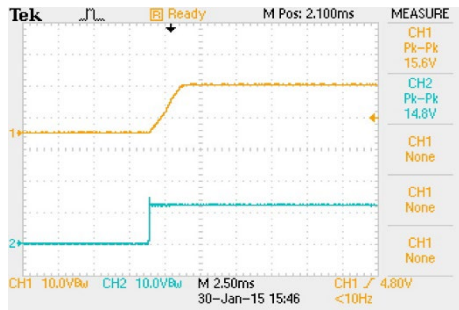
Efficiency Versus Input Voltage Full Load



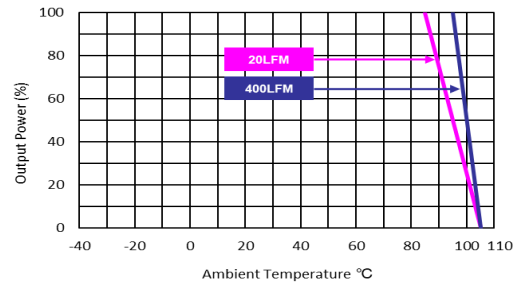
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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

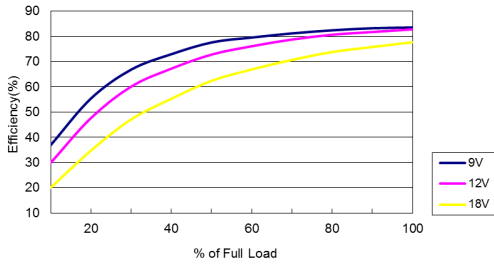


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

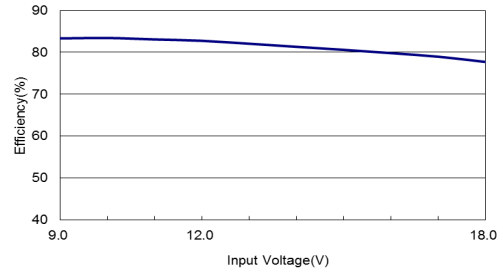


**Characteristic Curves**

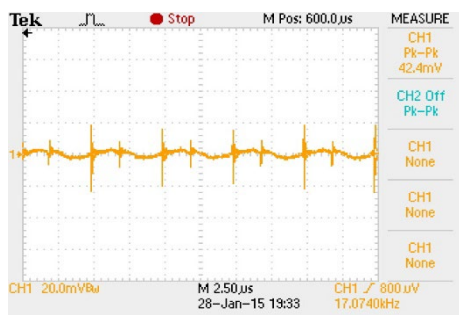
All test conditions are at 25°C The figures are identical for MAW01-12S24



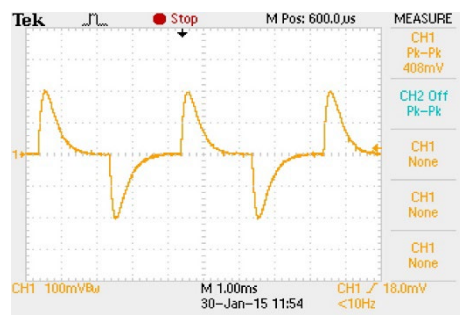
Efficiency Versus Output Current



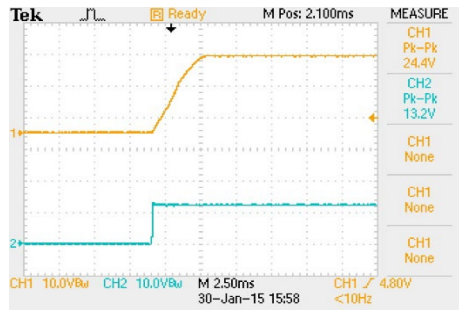
Efficiency Versus Input Voltage Full Load



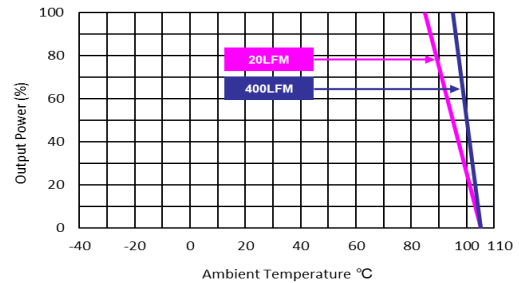
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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

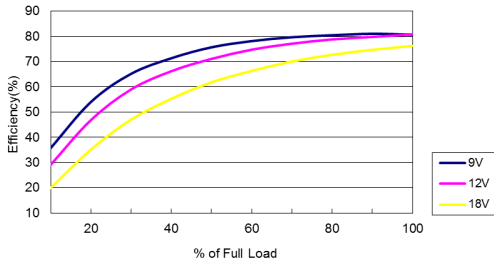


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

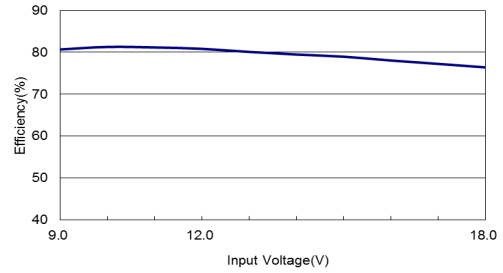


**Characteristic Curves**

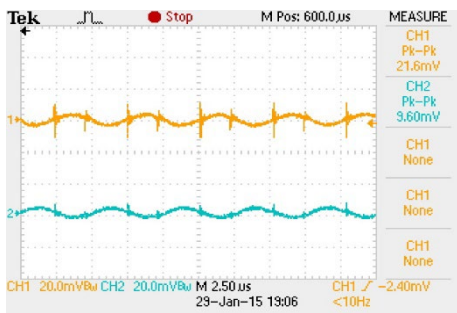
All test conditions are at 25°C The figures are identical for MAW01-12D12



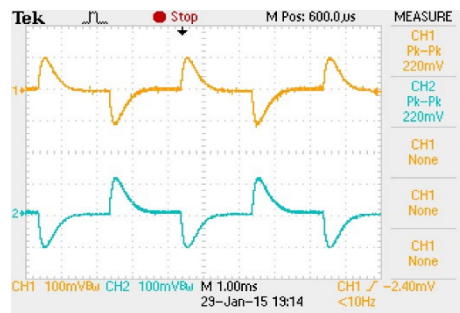
Efficiency Versus Output Current



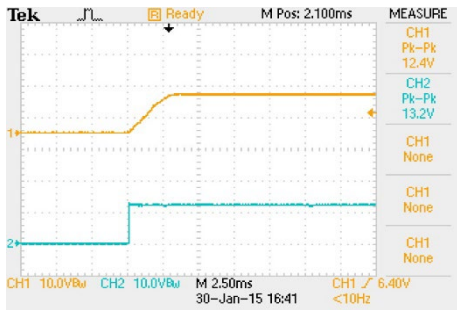
Efficiency Versus Input Voltage Full Load



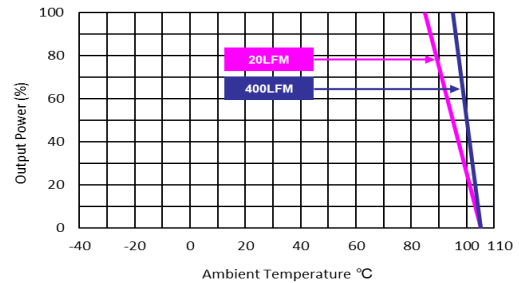
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



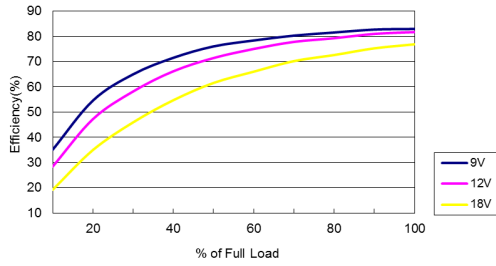
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



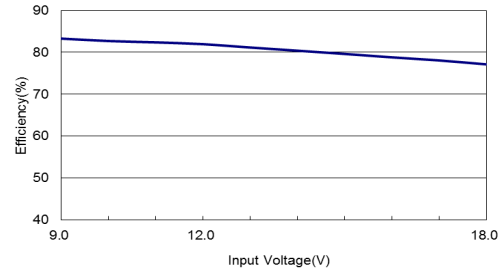
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

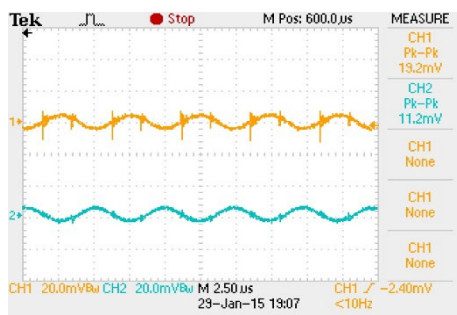
All test conditions are at 25°C The figures are identical for MAW01-12D15



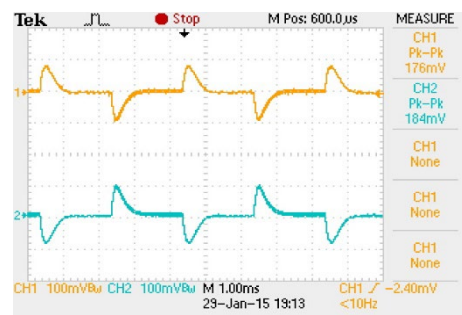
Efficiency Versus Output Current



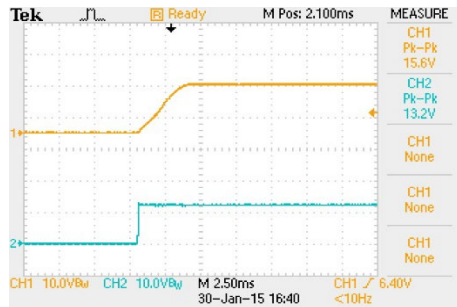
Efficiency Versus Input Voltage Full Load



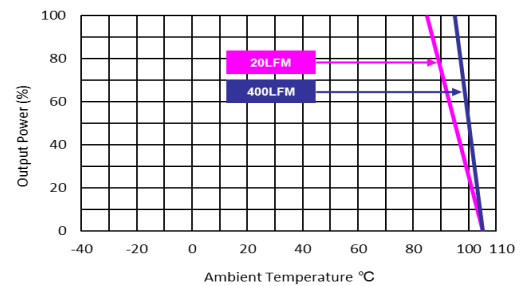
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



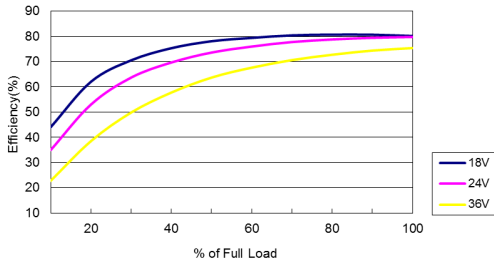
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



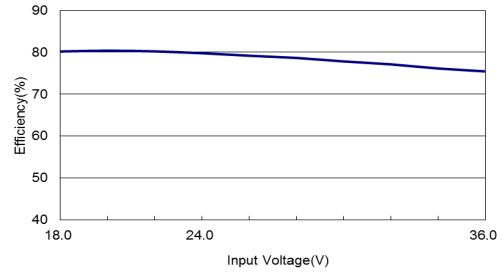
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

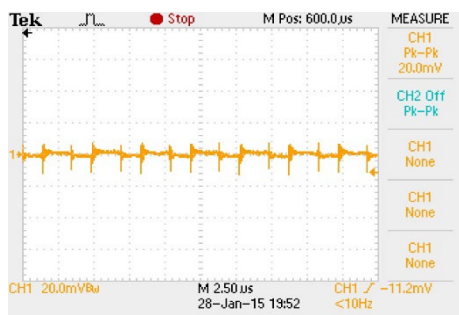
All test conditions are at 25°C The figures are identical for MAW01-24S05



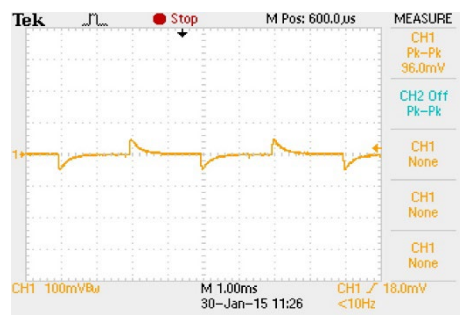
Efficiency Versus Output Current



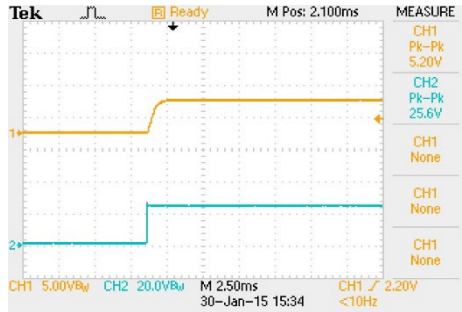
Efficiency Versus Input Voltage Full Load



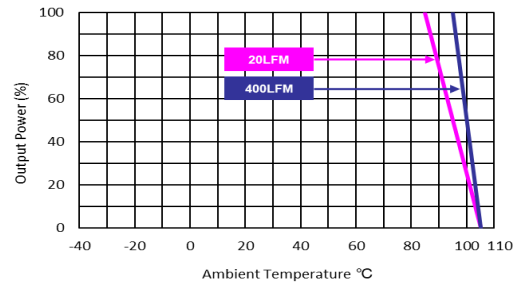
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



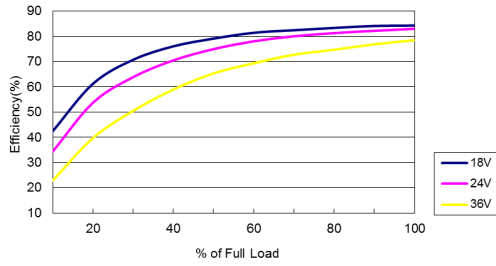
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



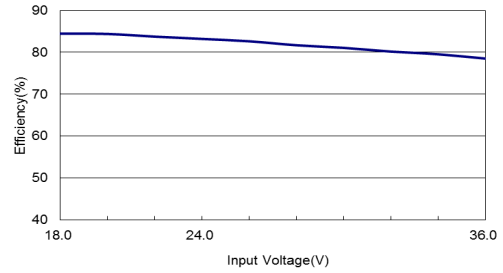
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

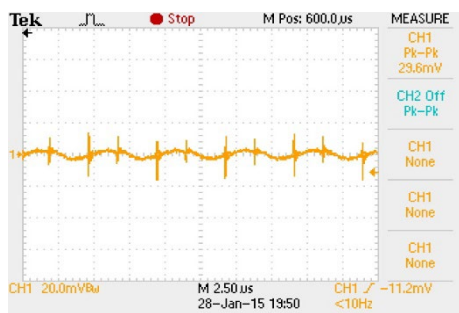
All test conditions are at 25°C The figures are identical for MAW01-24S12



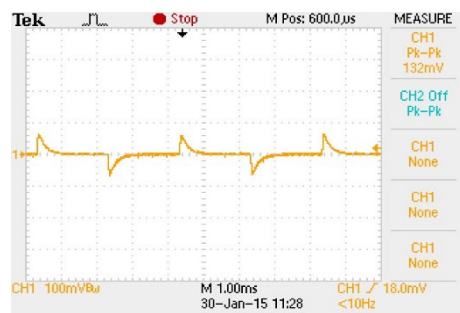
Efficiency Versus Output Current



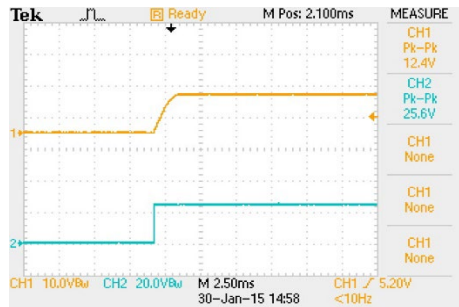
Efficiency Versus Input Voltage Full Load



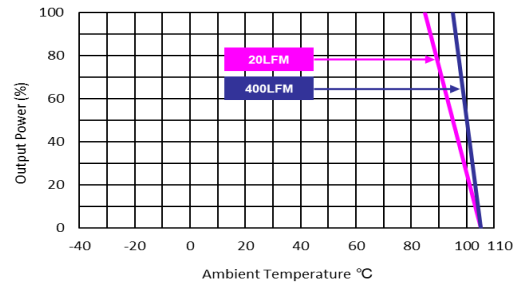
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



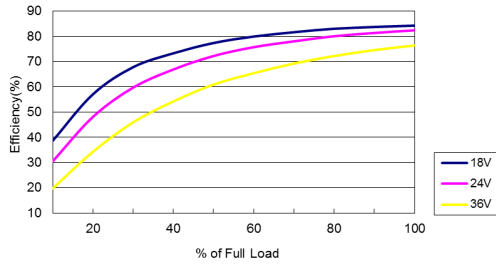
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



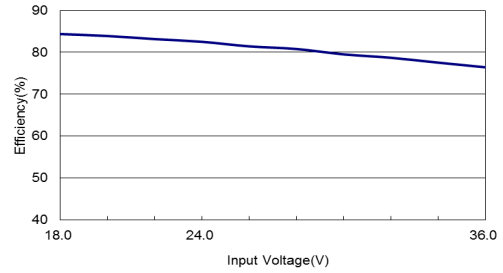
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

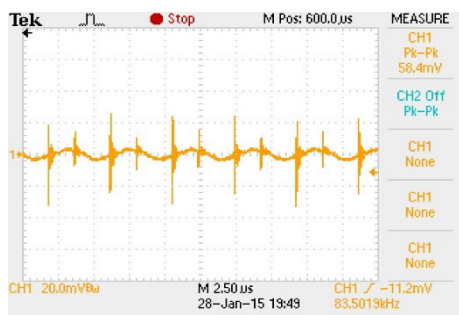
All test conditions are at 25°C The figures are identical for MAW01-24S15



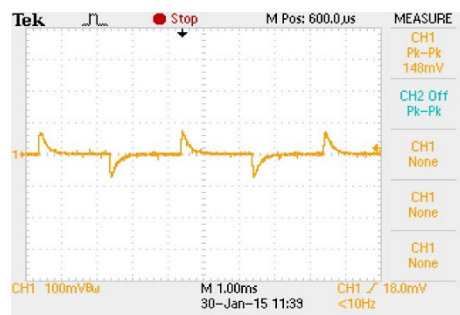
Efficiency Versus Output Current



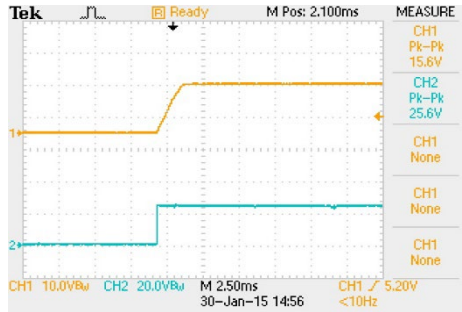
Efficiency Versus Input Voltage Full Load



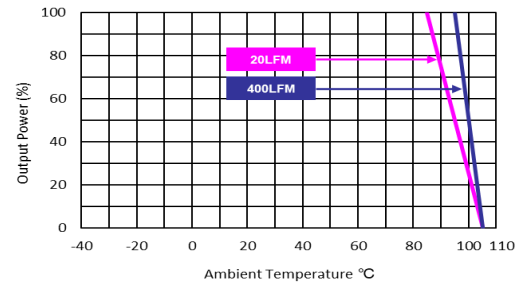
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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

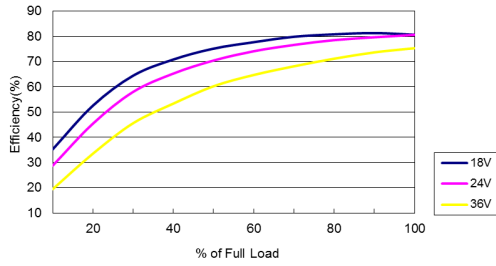


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

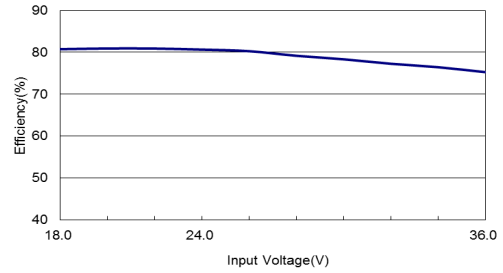


**Characteristic Curves**

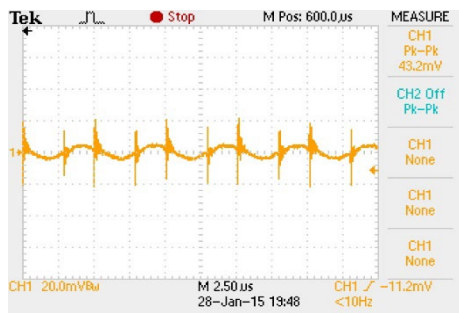
All test conditions are at 25°C The figures are identical for MAW01-24S24



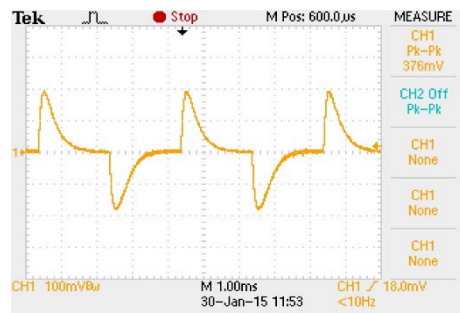
Efficiency Versus Output Current



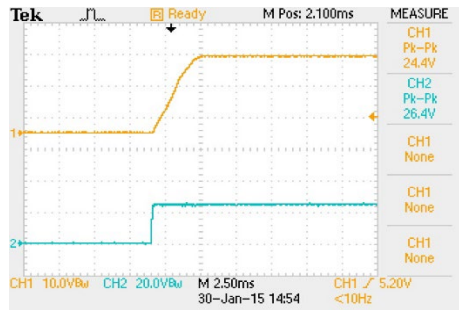
Efficiency Versus Input Voltage Full Load



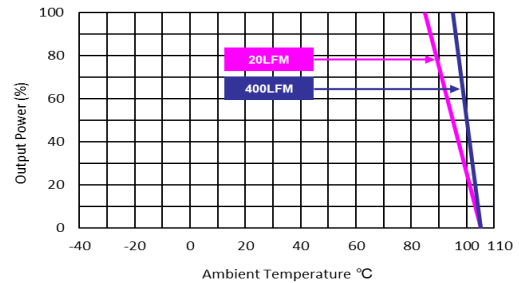
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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

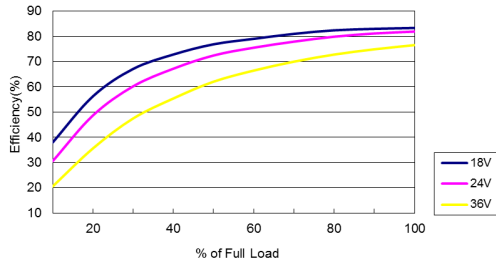


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

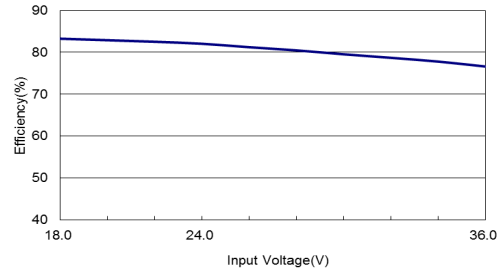


**Characteristic Curves**

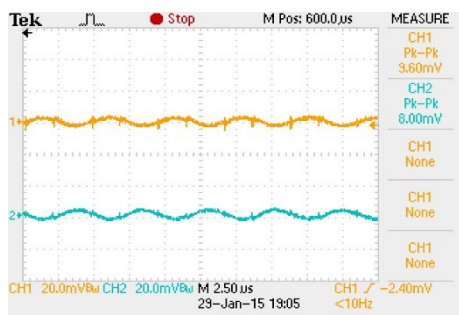
All test conditions are at 25°C The figures are identical for MAW01-24D12



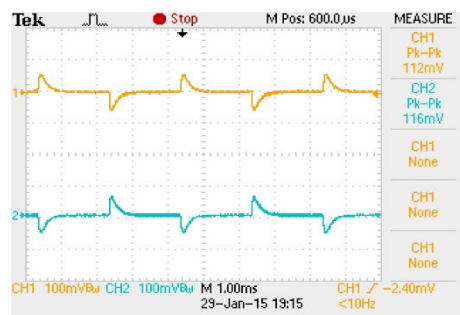
Efficiency Versus Output Current



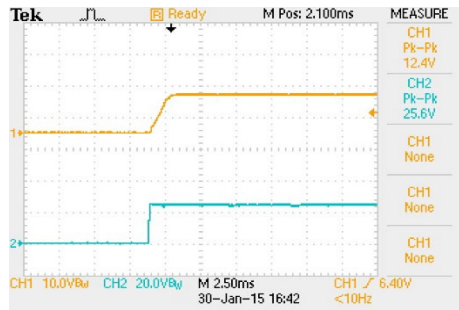
Efficiency Versus Input Voltage Full Load



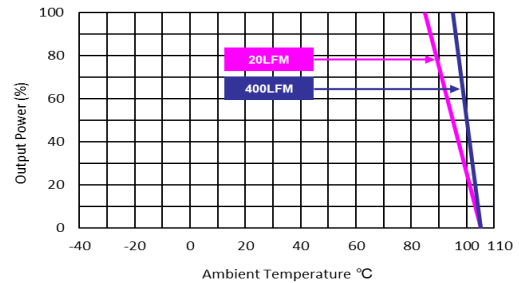
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



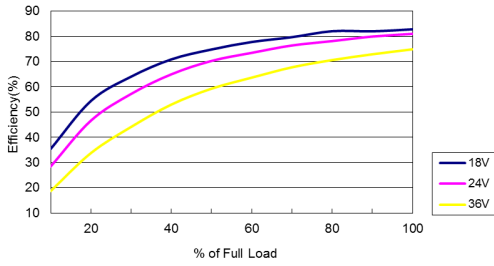
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



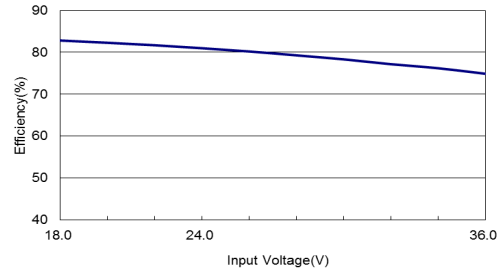
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

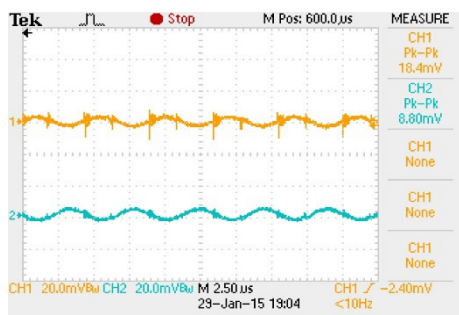
All test conditions are at 25°C The figures are identical for MAW01-24D15



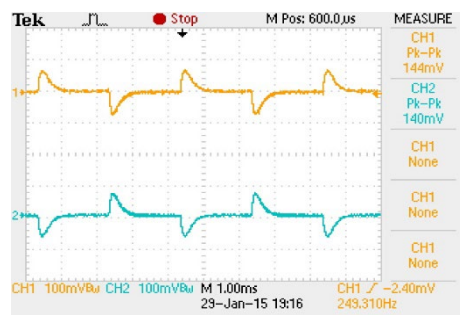
Efficiency Versus Output Current



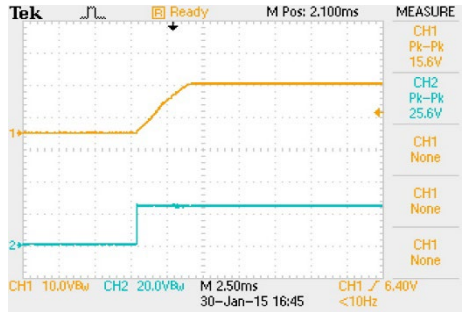
Efficiency Versus Input Voltage Full Load



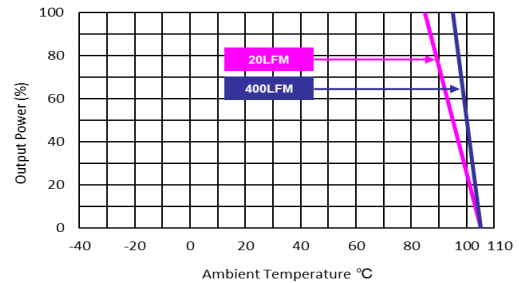
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



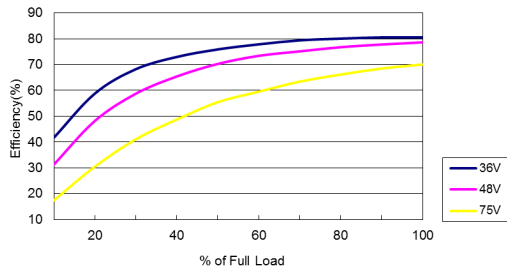
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



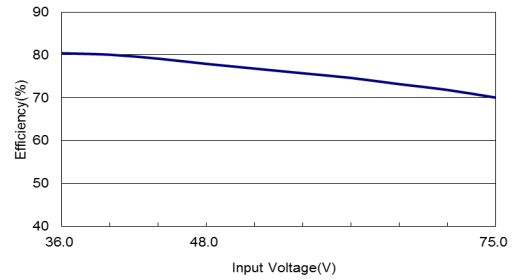
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

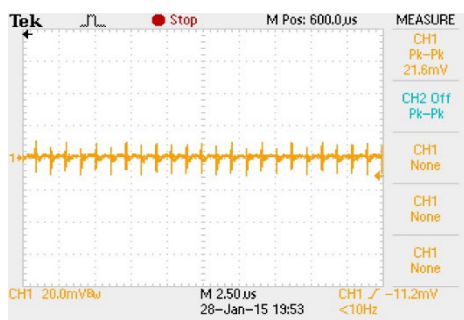
All test conditions are at 25°C The figures are identical for MAW01-48S05



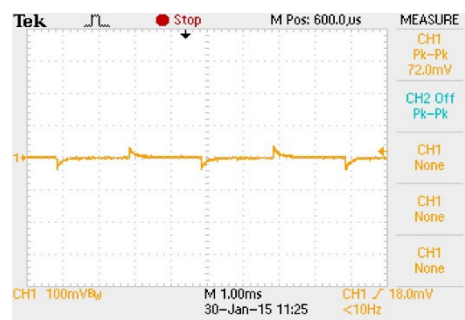
Efficiency Versus Output Current



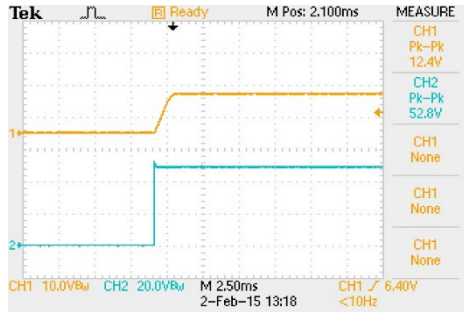
Efficiency Versus Input Voltage Full Load



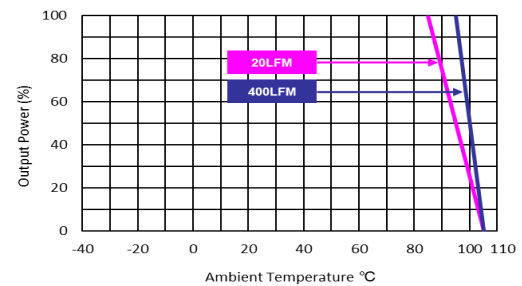
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



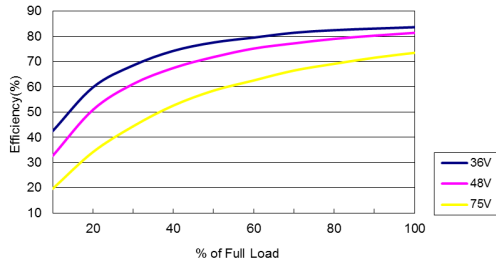
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



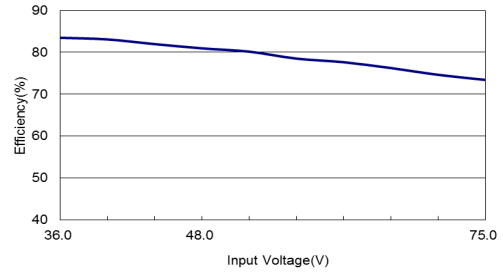
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

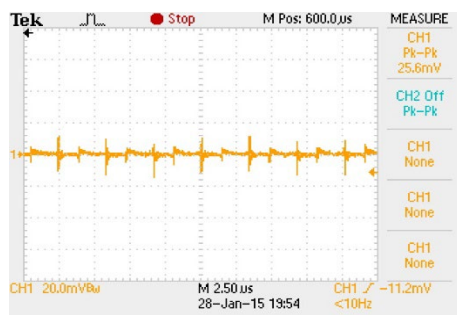
All test conditions are at 25°C The figures are identical for MAW01-48S12



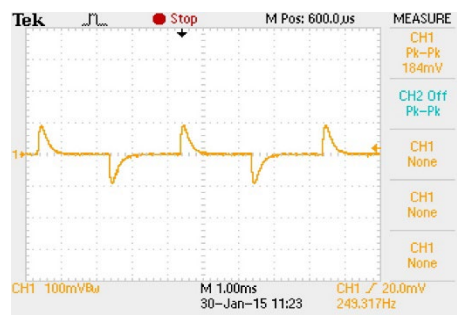
Efficiency Versus Output Current



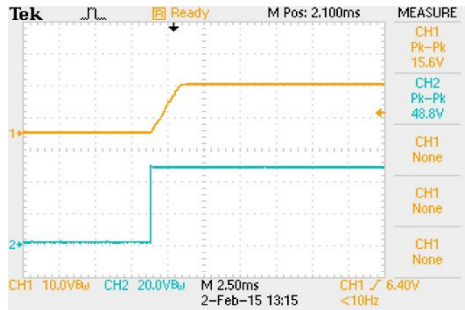
Efficiency Versus Input Voltage Full Load



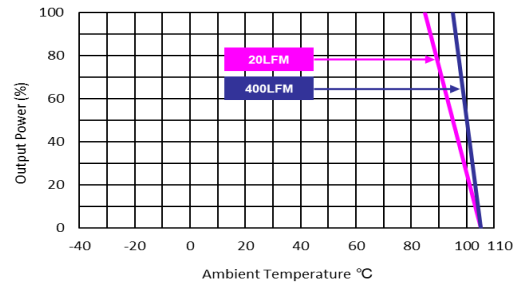
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



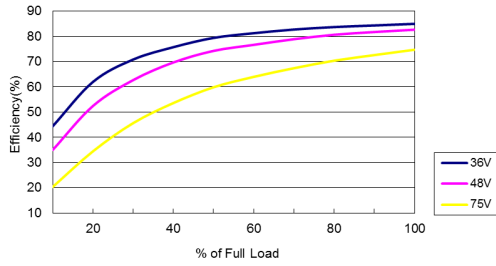
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



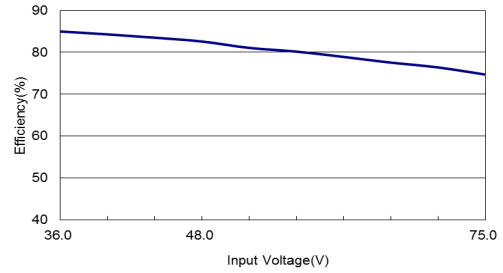
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

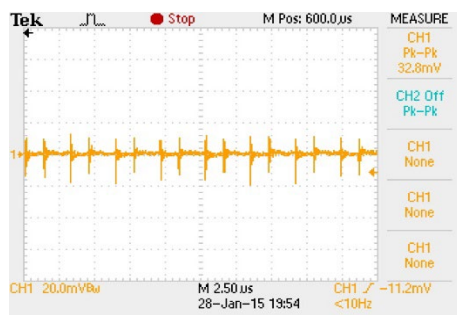
All test conditions are at 25°C The figures are identical for MAW01-48S15



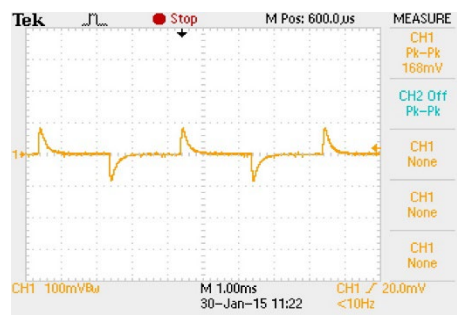
Efficiency Versus Output Current



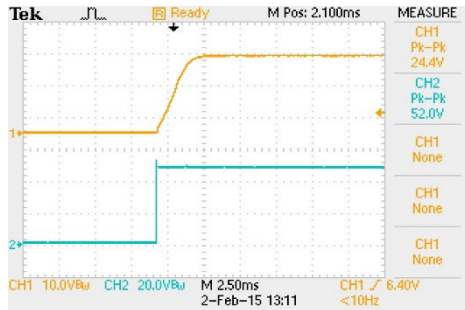
Efficiency Versus Input Voltage Full Load



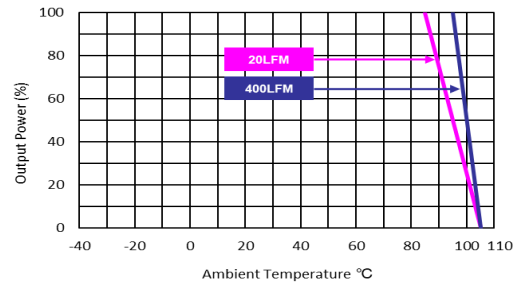
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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

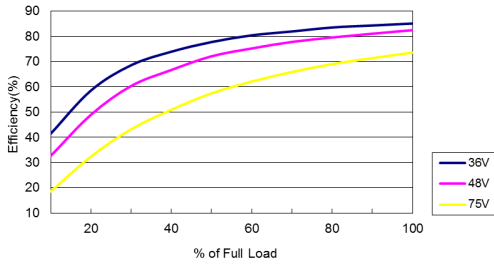


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

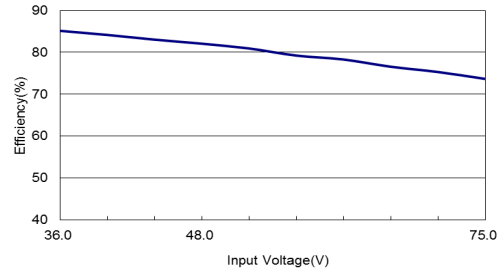


**Characteristic Curves**

All test conditions are at 25°C The figures are identical for MAW01-48S24



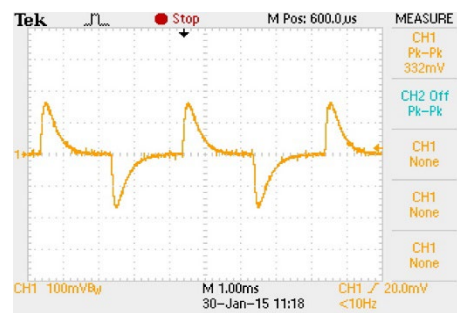
Efficiency Versus Output Current



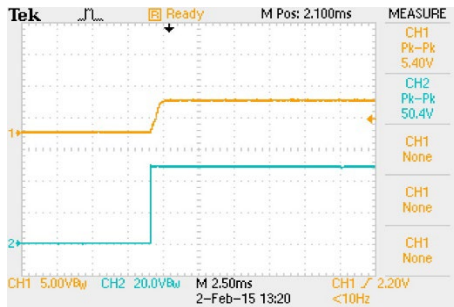
Efficiency Versus Input Voltage Full Load



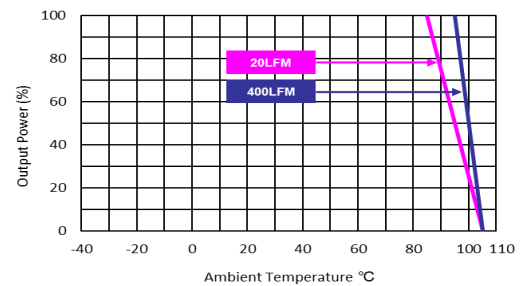
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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

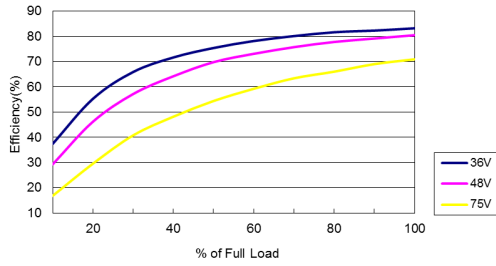


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

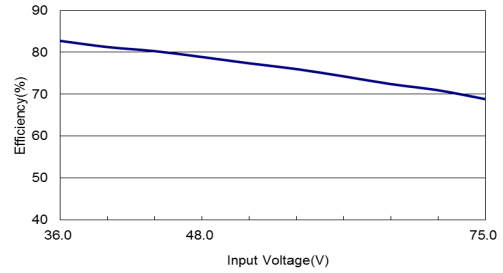


**Characteristic Curves**

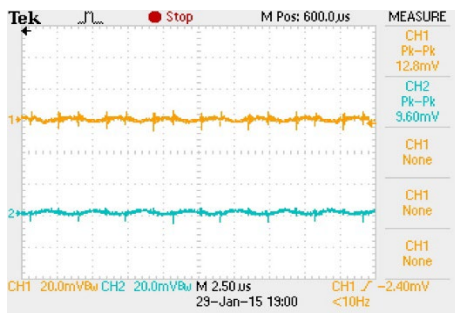
All test conditions are at 25°C The figures are identical for MAW01-48D12



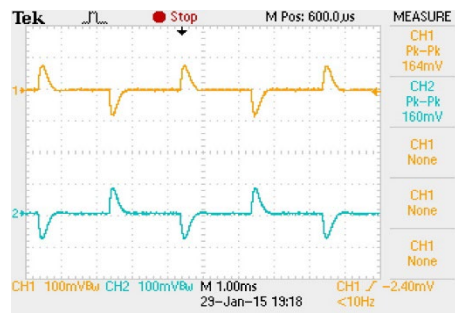
Efficiency Versus Output Current



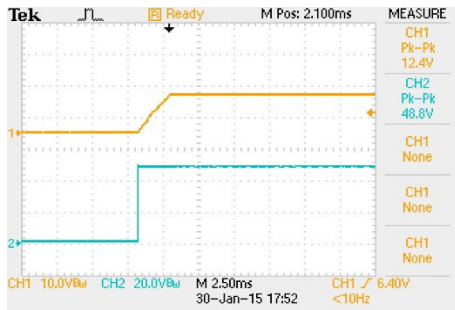
Efficiency Versus Input Voltage Full Load



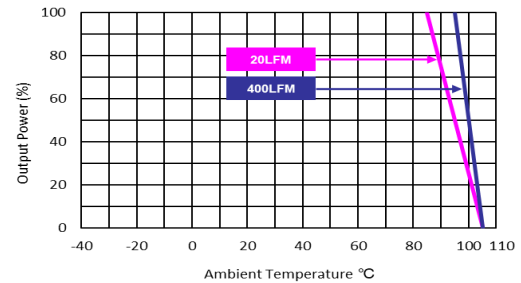
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



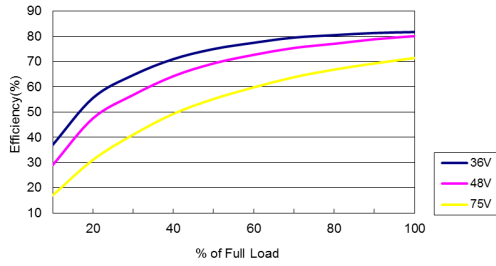
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



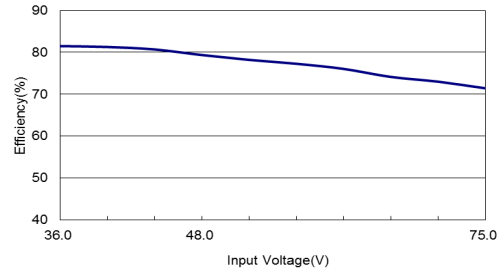
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

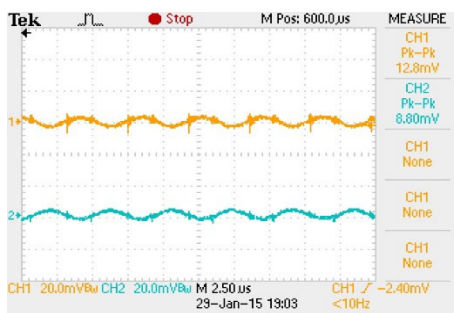
All test conditions are at 25°C The figures are identical for MAW01-48D15



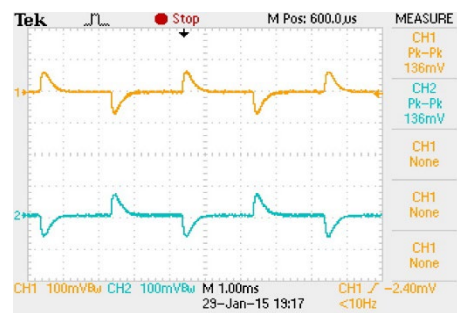
Efficiency Versus Output Current



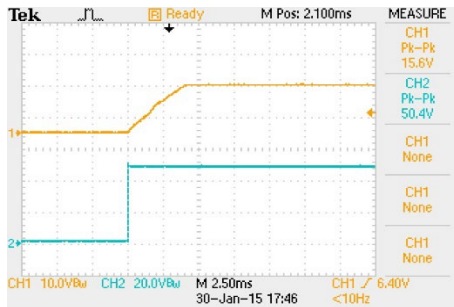
Efficiency Versus Input Voltage Full Load



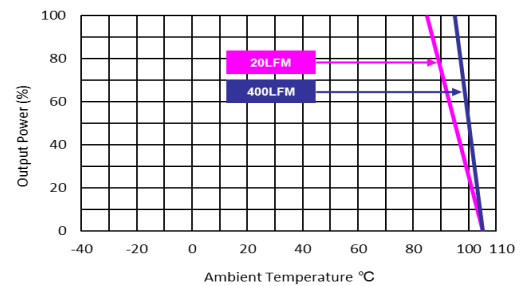
Typical Output Ripple and Noise  
 $V_{in}=V_{in\ nom}$ ; Full Load



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



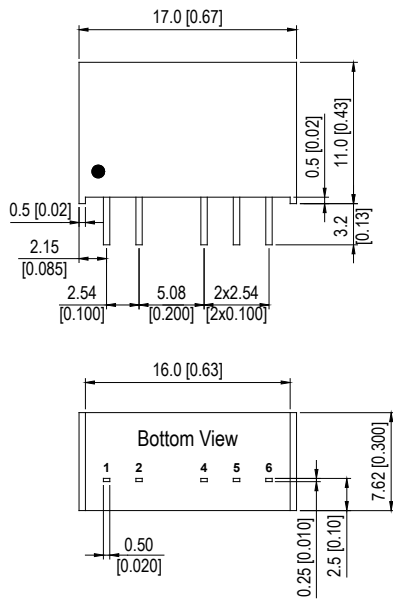
Typical Input Start-up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



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

### Package Specifications

#### Mechanical Dimensions



#### Pin Connections

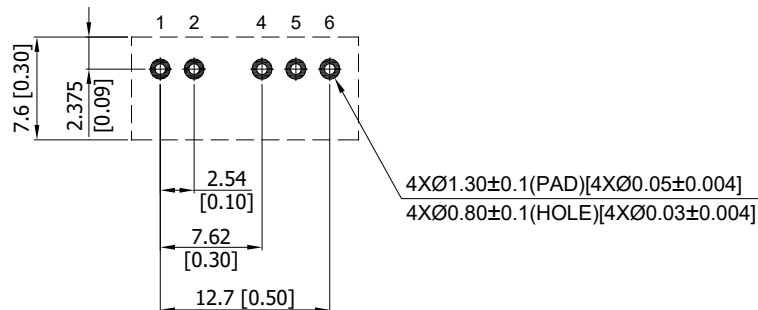
Pin	Single Output	Dual Output
1	-Vin	-Vin
2	+Vin	+Vin
4	+Vout	+Vout
5	No Pin	Common
6	-Vout	-Vout

- ▶ 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	: 17.0x7.62x11.0mm (0.67x0.30x0.43 inches)
Case Material	: Plastic resin (flammability to UL 94V-0 rated)
Pin Material	: Alloy 42
Weight	: 3.1g

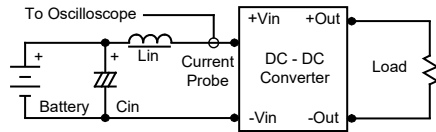
#### Recommended Pad Layout for Single & Dual Output Converter



## Test Setup

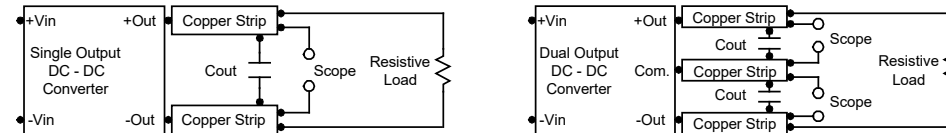
### Input Reflected-Ripple Current Test Setup

Input reflected-ripple current is measured with an inductor  $L_{in}$  (4.7 $\mu$ H) and  $C_{in}$  (220 $\mu$ F, ESR < 1.0 $\Omega$  at 100 kHz) to simulate source impedance. Capacitor  $C_{in}$ , 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  $C_{out}$  0.47 $\mu$ F 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.



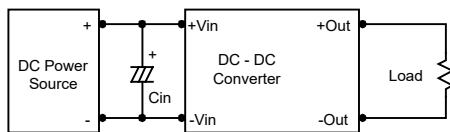
## Technical Notes

### Maximum Capacitive Load

The MAW01 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. The maximum capacitance can be found in the data sheet.

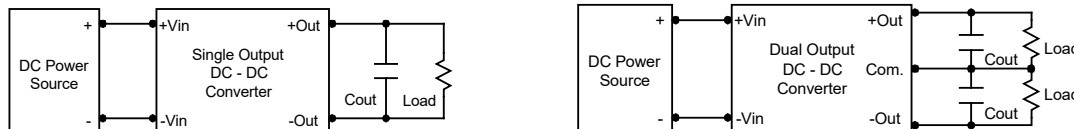
### Input Source Impedance

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 < 1.0 $\Omega$  at 100 kHz) capacitor of a 8.2 $\mu$ F for the 5V input device, a 3.3 $\mu$ F for the 12V input devices and a 1.5 $\mu$ F for the 24V and 48V devices.



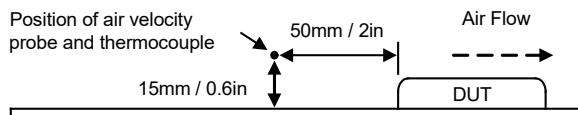
### Output Ripple Reduction

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 3.3 $\mu$ F capacitors at the output.

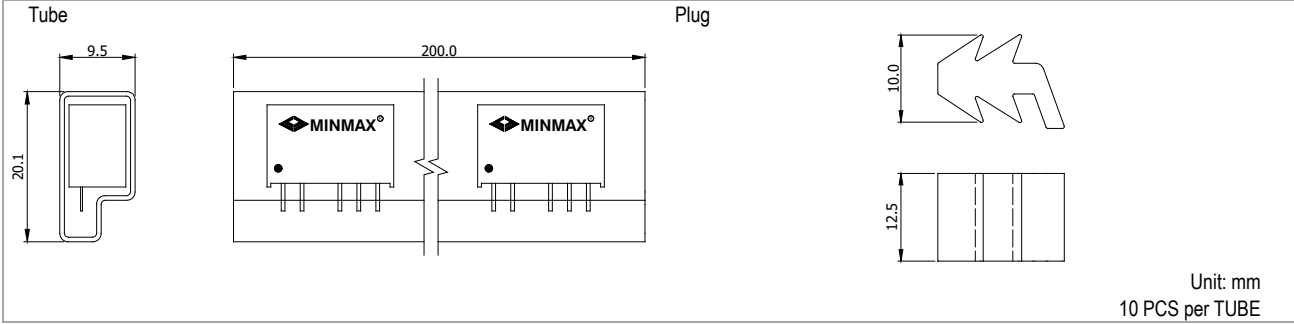


### Thermal Considerations

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 $^{\circ}$ C. The derating curves are determined from measurements obtained in a test setup.

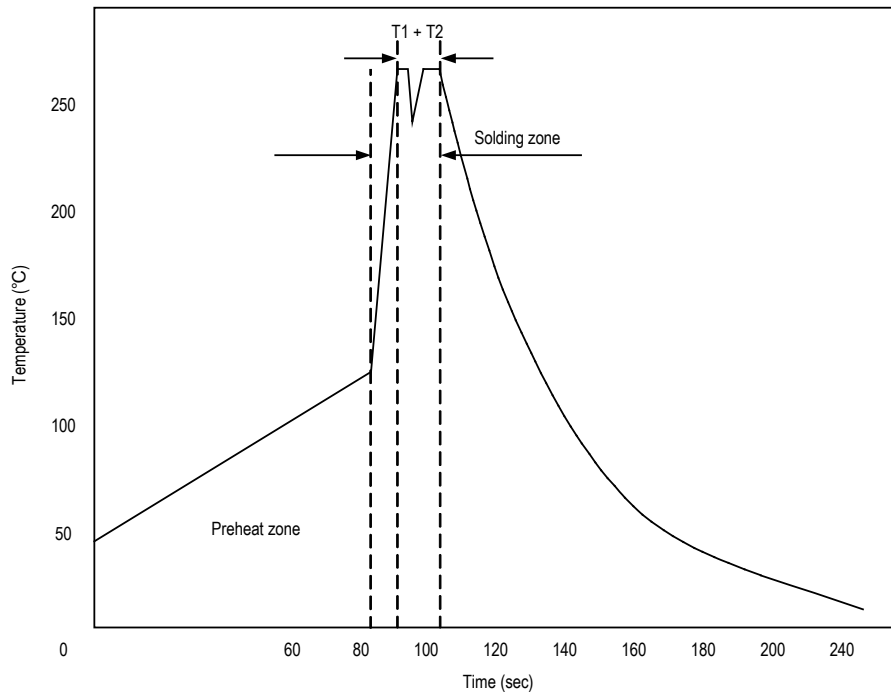


**Packaging Information for Tube**



**Wave Soldering Considerations**

Lead free wave solder profile



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

Part Number Structure							
M	A	W	01	-	05	S	05
Package Type SIP-7	Wide 2:1 Input Voltage Range	Output Power 1 Watt			Input Voltage Range	Output Quantity	Output Voltage
					05: 4.5 ~ 9 VDC	S: Single	05: 5 VDC
					12: 9 ~ 18 VDC	D: Dual	12: 12 VDC
					24: 18 ~ 36 VDC		15: 15 VDC
					48: 36 ~ 75 VDC		24: 24 VDC

**MTBF and Reliability**

The MTBF of MAW01 series of DC-DC converters has been calculated using

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

Model	MTBF	Unit
MAW01-05S05	4,174,702	Hours
MAW01-05S12	4,151,236	
MAW01-05S15	3,829,356	
MAW01-05S24	3,620,226	
MAW01-05D12	3,602,660	
MAW01-05D15	3,749,778	
MAW01-12S05	4,143,000	
MAW01-12S12	4,243,987	
MAW01-12S15	4,079,721	
MAW01-12S24	3,740,477	
MAW01-12D12	3,586,782	
MAW01-12D15	3,215,076	
MAW01-24S05	4,133,111	
MAW01-24S12	4,430,813	
MAW01-24S15	4,066,572	
MAW01-24S24	3,887,535	
MAW01-24D12	3,918,807	
MAW01-24D15	3,309,390	
MAW01-48S05	4,154,994	
MAW01-48S12	4,346,375	
MAW01-48S15	3,961,336	
MAW01-48S24	3,637,722	
MAW01-48D12	3,785,375	
MAW01-48D15	3,706,319	