



**MINMAX<sup>®</sup>**

MAPU01H Series

Electric Characteristic Note

# MAPU01H Series EC Note

DC-DC CONVERTER 1W, SIP Package, High Isolation

## Features

- ▶ Industrial Standard SIP-7 Package
- ▶ Unregulated Output Voltage
- ▶ I/O Isolation 3000VDC
- ▶ Operating Ambient Temp. Range -40°C to +90°C
- ▶ Short Circuit Protection
- ▶ UL/cUL/IEC/EN 62368-1(60950-1) Safety Approval & CE Marking



## Applications

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

## Product Overview

The MINMAX MAPU01H series is a new range of isolated 1W DC-DC converter modules in SIP-7 package which feature a high I/O isolation voltage rated for 3000VDC and there are 32 models available for 3.3, 5, 12 or 24VDC input. Advanced circuit topology provides continuous overload, short circuit protection and a high efficiency up to 84% which allows operating ambient temperatures range of -40°C to +85°C without power derating. These converters offer a cost-effective solution for all applications where a high I/O isolation and fault condition protection are required.

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Model Selection Guide								
Model Number	Input Voltage (Range)	Output Voltage	Output Current	Input Current		Load Regulation	Max. capacitive Load	Efficiency (typ.)
				Max.	@No Load			@Max. Load
	VDC	VDC	mA	mA(typ.)	mA(typ.)	% (max.)	μF	%
MAPU01-033S033H	3.3 (2.97 ~ 3.63)	3.3	300	390	45	15	220	77
MAPU01-033S05H		5	200	394		12		77
MAPU01-033S09H		9	110	385		12		78
MAPU01-033S12H		12	84	382		10	80	
MAPU01-033S15H		15	68	391		10	79	
MAPU01-033D05H		±5	±100	394		11	100#	77
MAPU01-033D12H		±12	±42	387		9		79
MAPU01-033D15H		±15	±34	391		9		79
MAPU01-05S033H		5 (4.5 ~ 5.5)	3.3	300		261	30	12
MAPU01-05S05H	5		200	256	10	78		
MAPU01-05S09H	9		110	247	8	81		
MAPU01-05S12H	12		84	246	8	82		
MAPU01-05S15H	15		68	246	8	83		
MAPU01-05D05H	±5		±100	247	10	100#		81
MAPU01-05D12H	±12		±42	249	8			81
MAPU01-05D15H	±15		±34	252	9			81
MAPU01-12S033H	12 (10.8 ~ 13.2)		3.3	300	104	17		10
MAPU01-12S05H		5	200	104	8		80	
MAPU01-12S09H		9	110	101	7		82	
MAPU01-12S12H		12	84	99	7		84	
MAPU01-12S15H		15	68	102	7		83	
MAPU01-12D05H		±5	±100	103	7		100#	81
MAPU01-12D12H		±12	±42	102	6			82
MAPU01-12D15H		±15	±34	104	6			82
MAPU01-24S033H		24 (21.6 ~ 26.4)	3.3	300	54		10	10
MAPU01-24S05H	5		200	51	8	81		
MAPU01-24S09H	9		110	52	8	79		
MAPU01-24S12H	12		84	51	8	82		
MAPU01-24S15H	15		68	52	9	82		
MAPU01-24D05H	±5		±100	52	8	100#		80
MAPU01-24D12H	±12		±42	52	8			81
MAPU01-24D15H	±15		±34	53	8			80

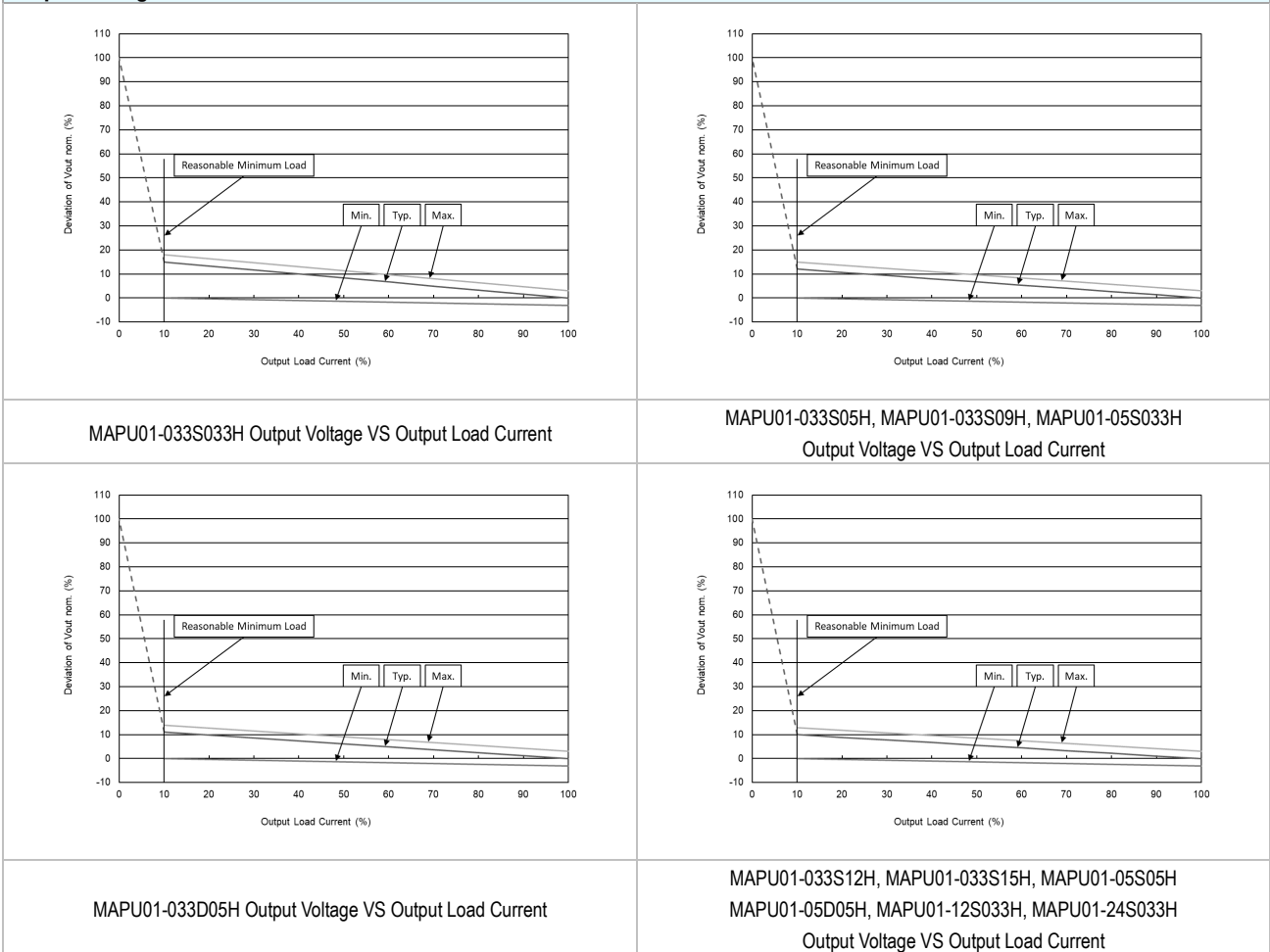
# For each output

Input Specifications					
Parameter	Model	Min.	Typ.	Max.	Unit
Input Voltage Range	3.3V Input Models	2.97	3.3	3.63	VDC
	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 Surge Voltage (1 sec. max.)	3.3V Input Models	-0.7	---	6	VDC
	5V Input Models	-0.7	---	9	
	12V Input Models	-0.7	---	18	
	24V Input Models	-0.7	---	30	
Input Filter	All Models	Internal Capacitor			

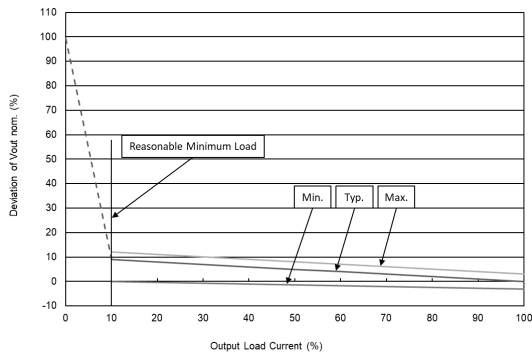
### Output Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy		---	±1.0	±3.0	%
Output Voltage Balance	Dual Output, Balanced Loads	---	±0.1	±1.0	%
Line Regulation	For $V_{in}$ Change of 1%	---	±1.2	±1.5	%
Load Regulation	$I_o=10\%$ to 100%	See Model Selection Guide (Operation at lower load will not damage the converter, but it may not meet all specifications)			
Ripple & Noise	0-20 MHz Bandwidth	---	65	100	mV <sub>P-P</sub>
Temperature Coefficient		---	±0.01	±0.02	%/°C
Short Circuit Protection	Continuous, Automatic Recovery				

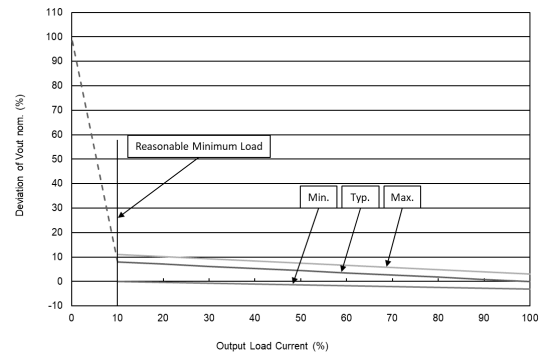
### Output Voltage Tolerance



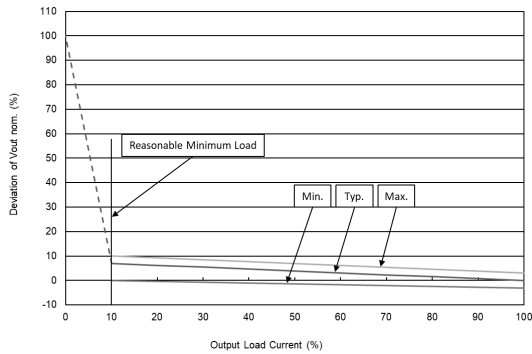
### Output Voltage Tolerance



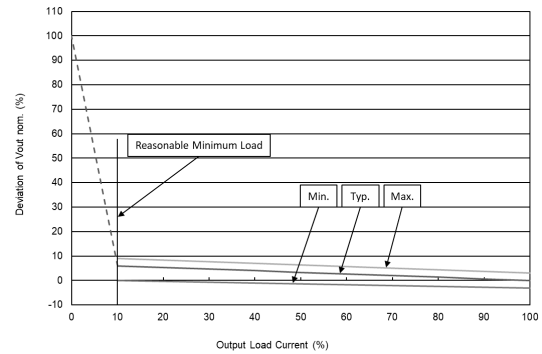
MAPU01-033D12H, MAPU01-033D15H, MAPU01-05D15H, MAPU01-24S15H  
Output Voltage VS Output Load Current



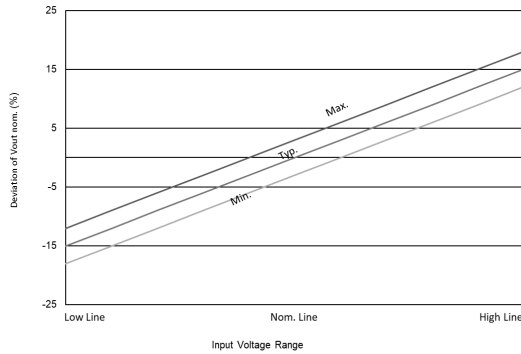
MAPU01-05S09H, MAPU01-05S12H, MAPU01-05S15H, MAPU01-05D12H  
MAPU01-12S05H, MAPU01-24S05H, MAPU01-24S09H, MAPU01-24S12H  
MAPU01-24D05H, MAPU01-24D12H, MAPU01-24D15H  
Output Voltage VS Output Load Current



MAPU01-12S09H, MAPU01-12S12H, MAPU01-12S15H, MAPU01-12D05H  
Output Voltage VS Output Load Current



MAPU01-12D12H, MAPU01-12D15H  
Output Voltage VS Output Load Current



Output Voltage VS Input Voltage Range

### General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds	3000	---	---	VDC
I/O Isolation Resistance	500 VDC	10	---	---	GΩ
I/O Isolation Capacitance	100kHz, 1V	---	20	---	pF
Switching Frequency		40	75	110	kHz
MTBF (calculated)	MIL-HDBK-217F@25°C, Ground Benign	3,711,000	---	---	Hours
Safety Approvals	UL/cUL 60950-1 recognition(UL certificate), IEC/EN 60950-1(CB-report)				
	UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1(CB-report)				

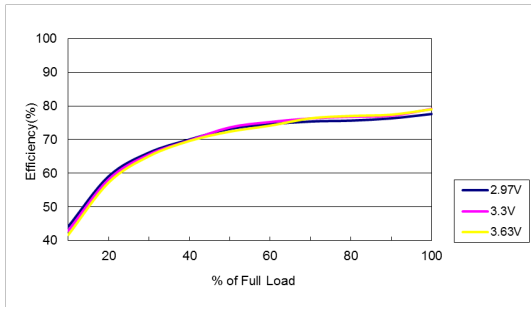
EMC Specifications				
Parameter	Standards & Level			Performance
EMI <sub>(5)</sub>	Conduction	EN 55032	With external components	Class A
	Radiation			
EMS <sub>(5)</sub>	EN 55024			
	ESD	EN 61000-4-2 Air ± 8kV , Contact ± 6kV		A
	Radiated immunity	EN 61000-4-3 10V/m		A
	Fast transient	EN 61000-4-4 ±2kV		A
	Surge	EN 61000-4-5 ±1kV		A
	Conducted immunity	EN 61000-4-6 10Vrms		A
	PFMF	EN 61000-4-8 3A/m		A

Environmental Specifications				
Parameter	Min.	Max.	Unit	
Operating Ambient Temperature Range (See Power Derating Curve)	-40	+90	°C	
Case Temperature	---	+95	°C	
Storage Temperature Range	-50	+125	°C	
Humidity (non condensing)	---	95	% rel. H	
Lead Temperature (1.5mm from case for 10Sec.)	---	260	°C	

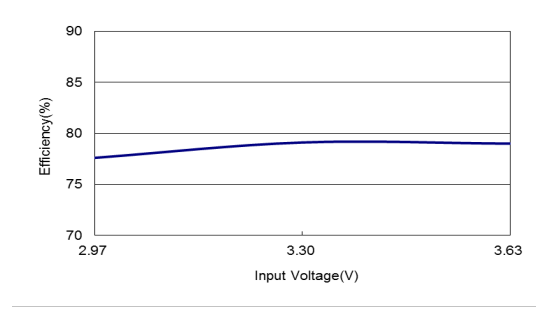
Notes	
1	Specifications typical at Ta=+25°C, resistive load, nominal input voltage and rated output current unless otherwise noted.
2	These power converters require a minimum output loading to maintain specified regulation, operation under no-load conditions will not damage these modules; however they may not meet all specifications listed.
3	We recommend to protect the converter by a slow blow fuse in the input supply line.
4	Other input and output voltage may be available, please contact MINMAX.
5	The external components might be required to meet EMI/EMS standard for some of test items. Please contact MINMAX for the solution in detail.
6	Specifications are subject to change without notice.
7	The repeated high voltage isolation testing of the converter can degrade isolation capability, to a lesser or greater degree depending on materials, construction, environment and reflow solder process. Any material is susceptible to eventual chemical degradation when subject to very high applied voltages thus implying that the number of tests should be strictly limited. We therefore strongly advise against repeated high voltage isolation testing, but if it is absolutely required, that the voltage be reduced by 20% from specified test voltage. Furthermore, the high voltage isolation capability after reflow solder process should be evaluated as it is applied on system.

**Characteristic Curves**

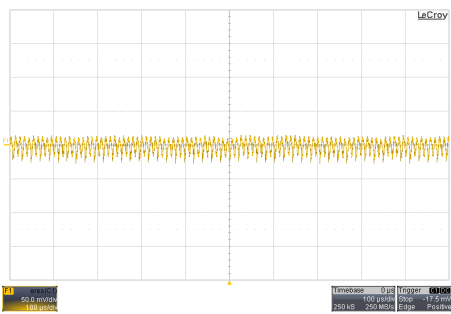
All test conditions are at 25°C The figures are identical for MAPU01-033S033H



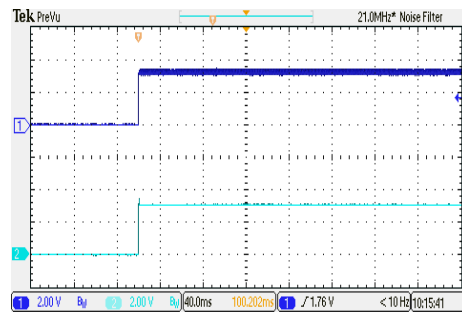
Efficiency Versus Output Current



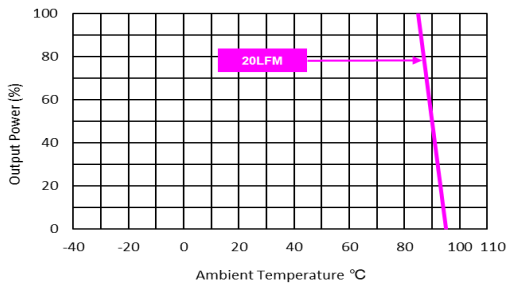
Efficiency Versus Input Voltage Full Load



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



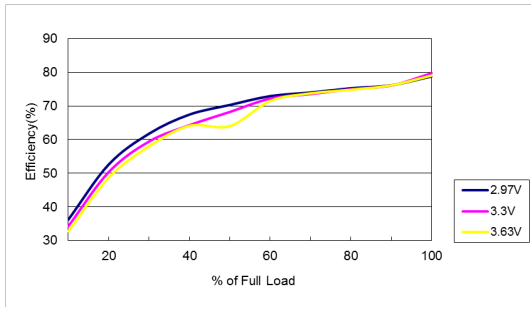
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



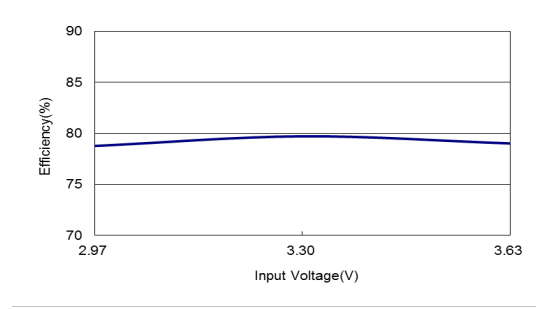
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

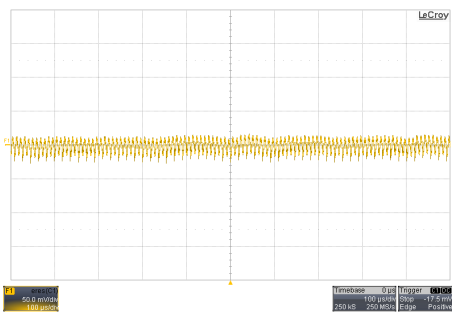
All test conditions are at 25°C The figures are identical for MAPU01-033S05H



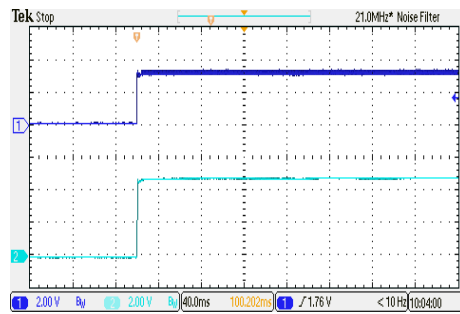
Efficiency Versus Output Current



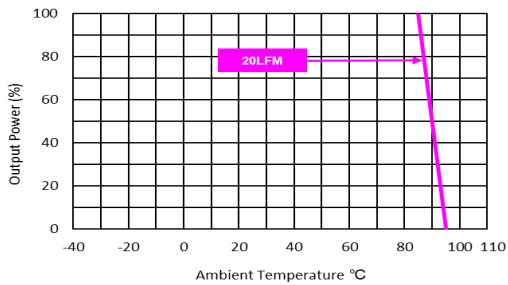
Efficiency Versus Input Voltage Full Load



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



Typical Input Start-Up and Output Rise Characteristic  
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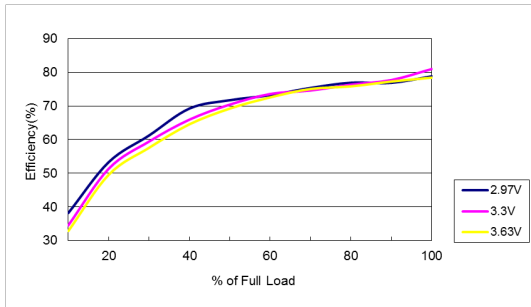


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

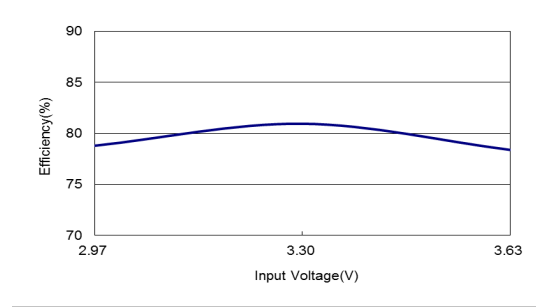


**Characteristic Curves**

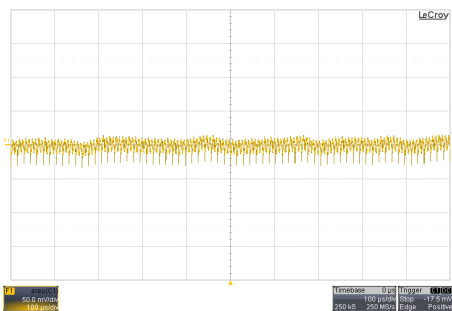
All test conditions are at 25°C The figures are identical for MAPU01-033S09H



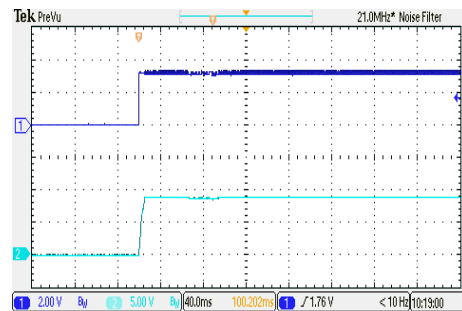
Efficiency Versus Output Current



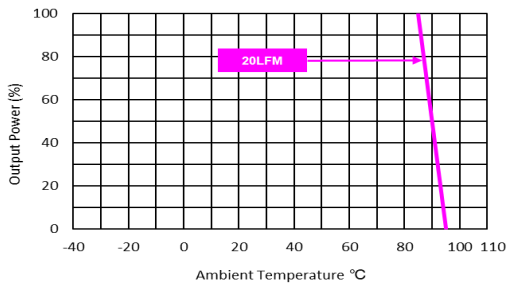
Efficiency Versus Input Voltage Full Load



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



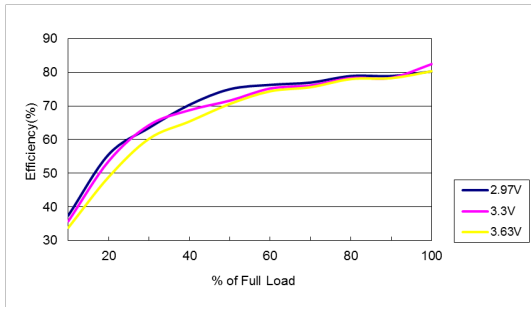
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



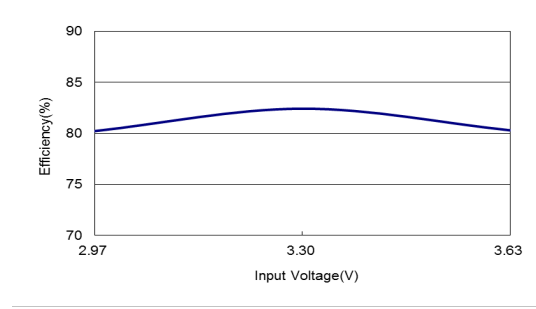
Derating Output Current Versus Ambient Temperature and Airflow  
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**Characteristic Curves**

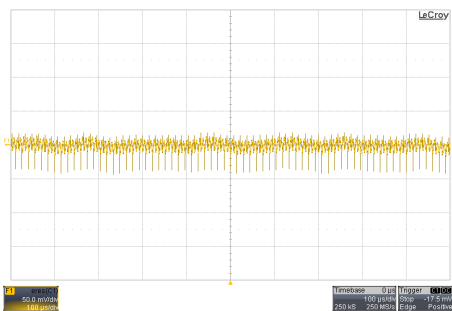
All test conditions are at 25°C The figures are identical for MAPU01-033S12H



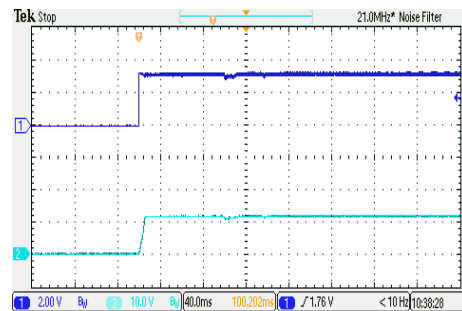
Efficiency Versus Output Current



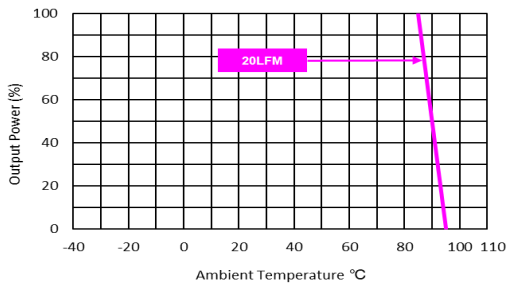
Efficiency Versus Input Voltage Full Load



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



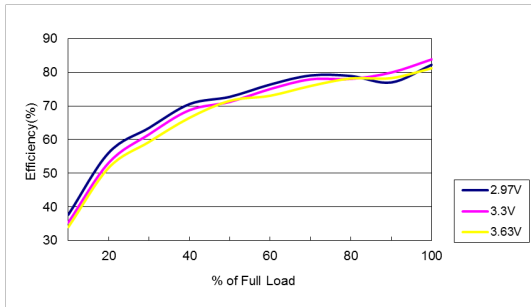
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



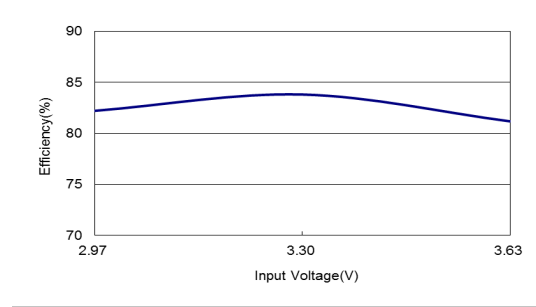
Derating Output Current Versus Ambient Temperature and Airflow  
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**Characteristic Curves**

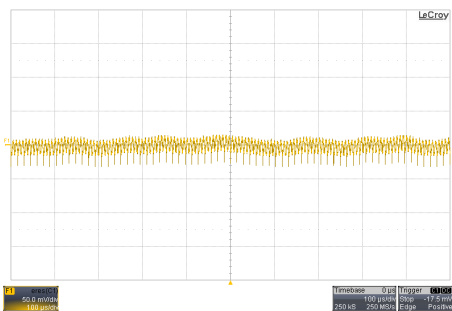
All test conditions are at 25°C The figures are identical for MAPU01-033S15H



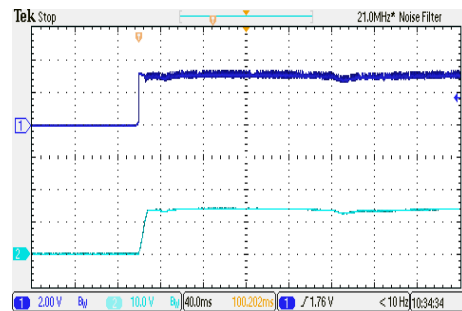
Efficiency Versus Output Current



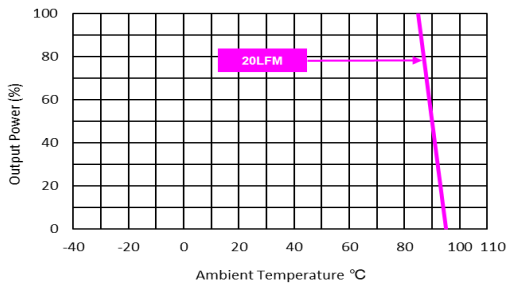
Efficiency Versus Input Voltage Full Load



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



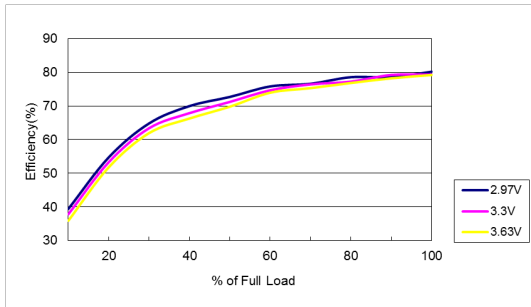
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



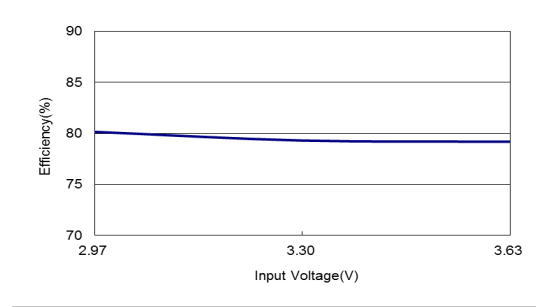
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

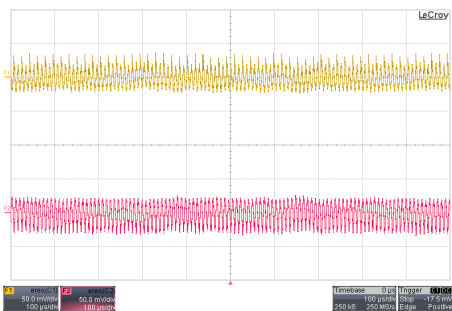
All test conditions are at 25°C The figures are identical for MAPU01-033D05H



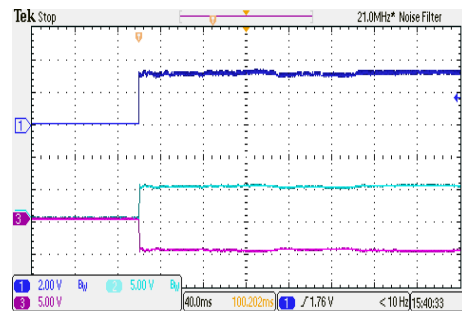
Efficiency Versus Output Current



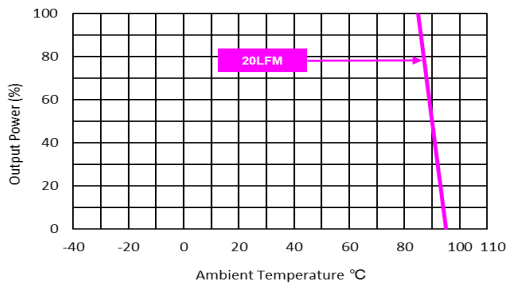
Efficiency Versus Input Voltage Full Load



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



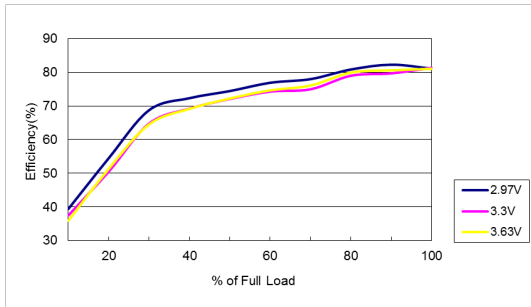
Typical Input Start-Up and Output Rise Characteristic  
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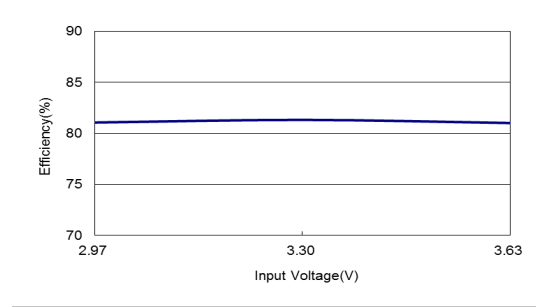
Derating Output Current Versus Ambient Temperature and Airflow  
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**Characteristic Curves**

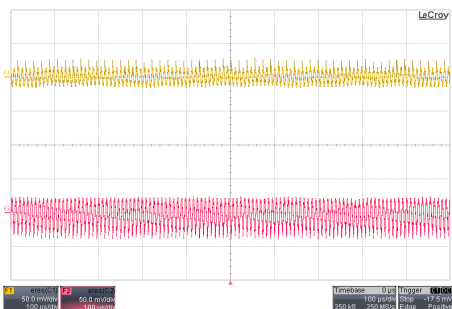
All test conditions are at 25°C The figures are identical for MAPU01-033D12H



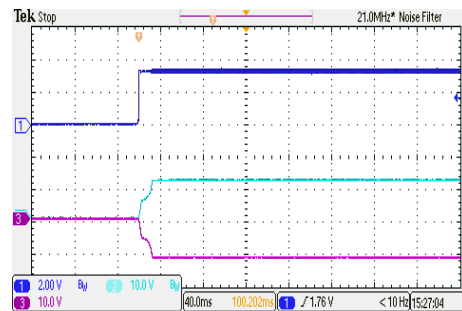
Efficiency Versus Output Current



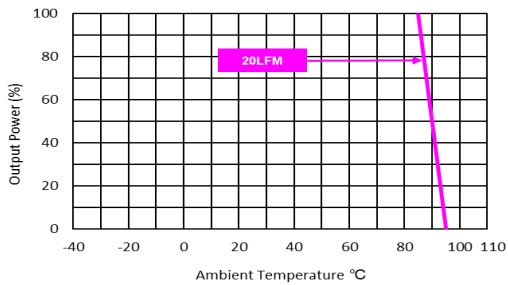
Efficiency Versus Input Voltage Full Load



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



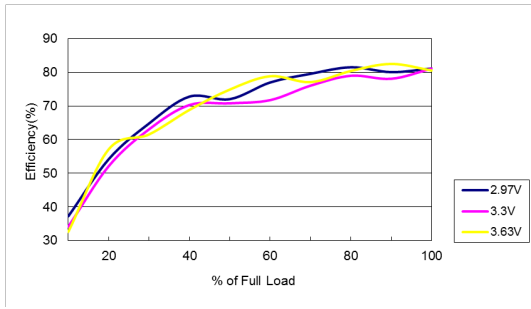
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



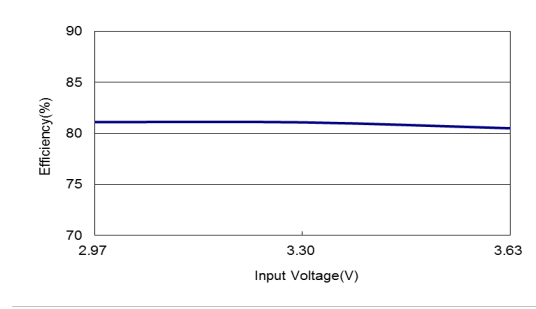
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

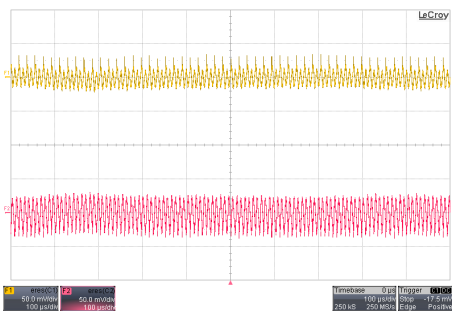
All test conditions are at 25°C The figures are identical for MAPU01-033D15H



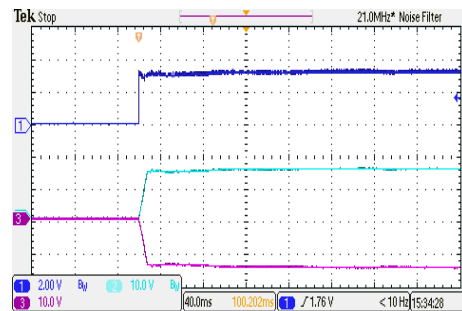
Efficiency Versus Output Current



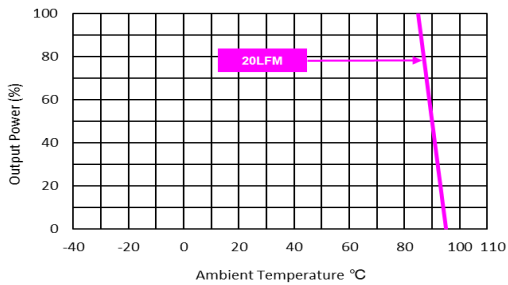
Efficiency Versus Input Voltage Full Load



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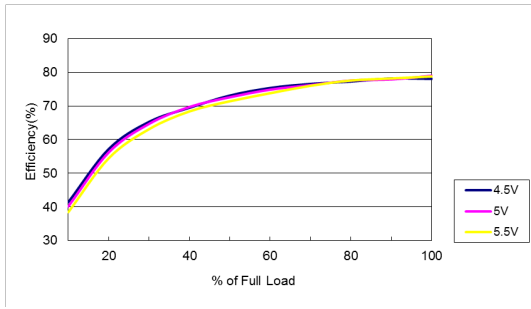
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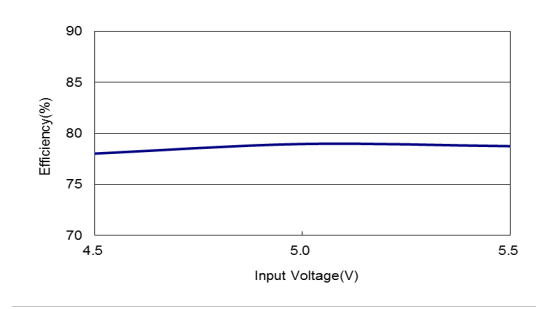
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

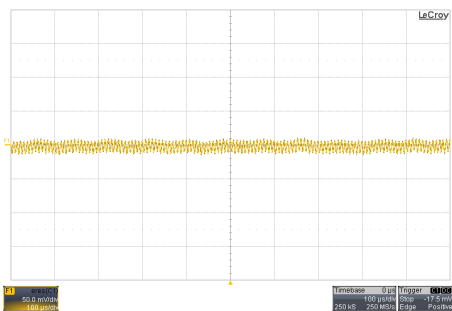
All test conditions are at 25°C The figures are identical for MAPU01-05S033H



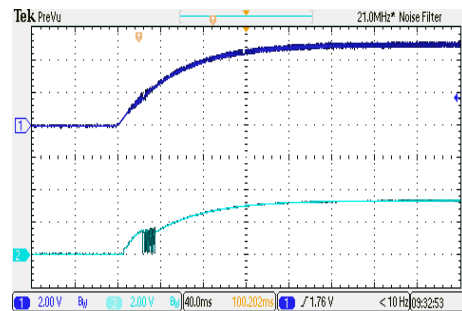
Efficiency Versus Output Current



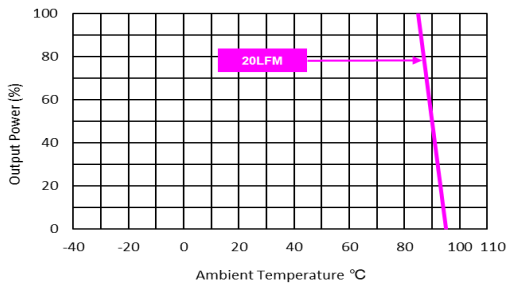
Efficiency Versus Input Voltage Full Load



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



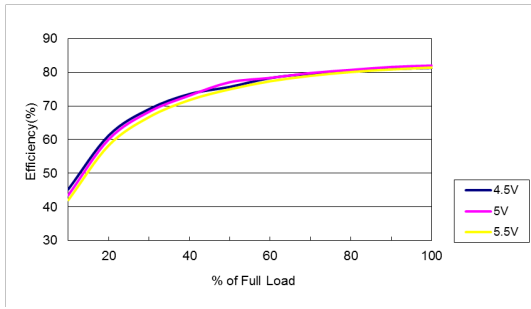
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



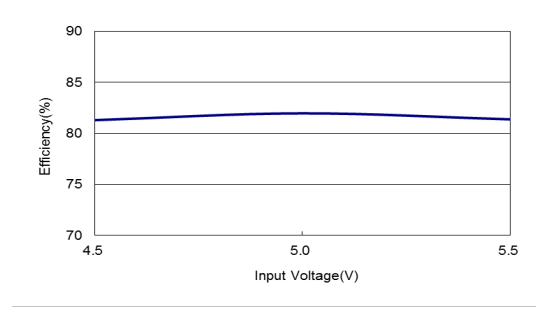
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

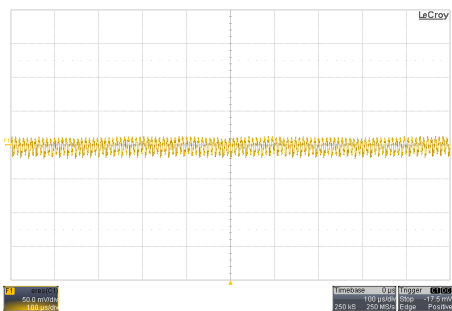
All test conditions are at 25°C The figures are identical for MAPU01-05S05H



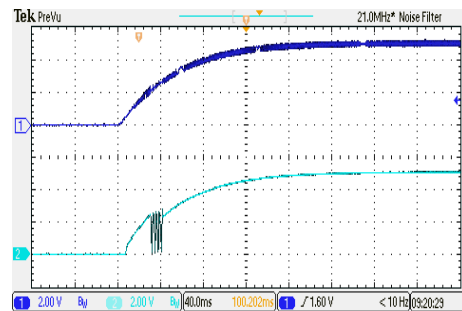
Efficiency Versus Output Current



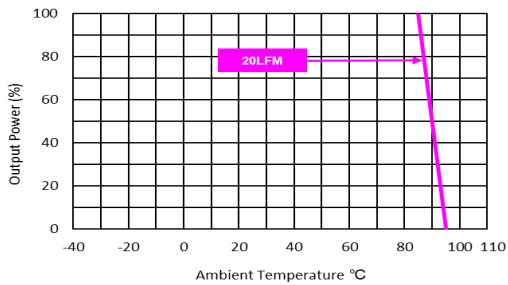
Efficiency Versus Input Voltage Full Load



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

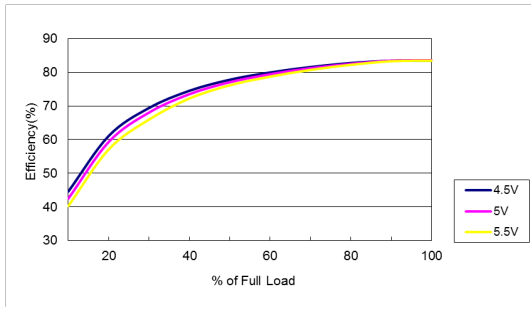


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

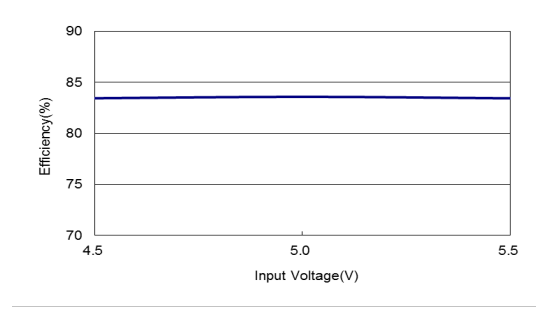


**Characteristic Curves**

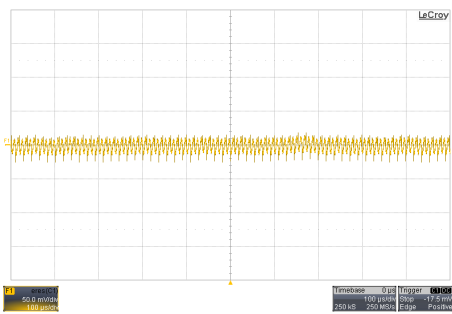
All test conditions are at 25°C The figures are identical for MAPU01-05S09H



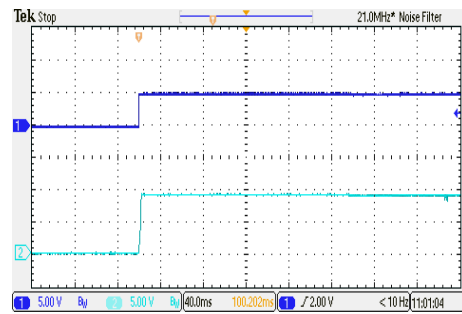
Efficiency Versus Output Current



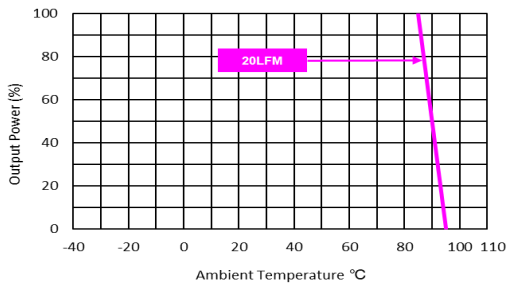
Efficiency Versus Input Voltage Full Load



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



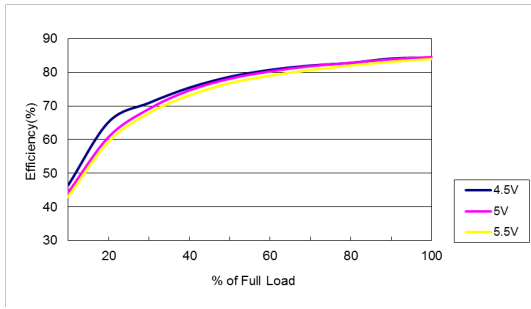
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



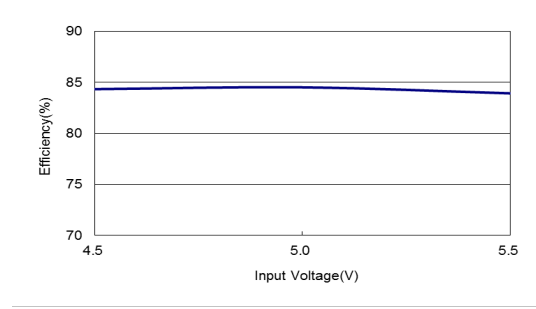
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

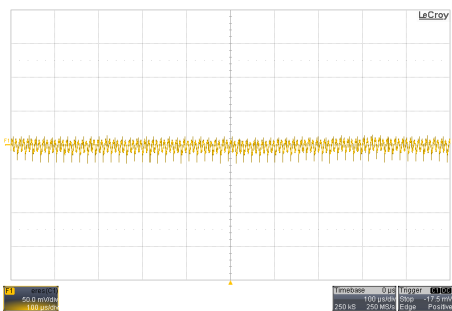
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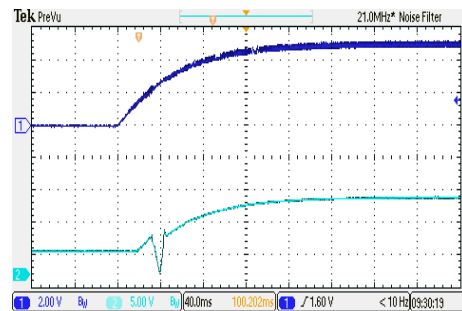
Efficiency Versus Output Current



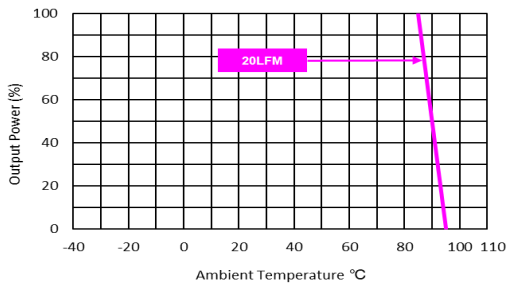
Efficiency Versus Input Voltage Full Load



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



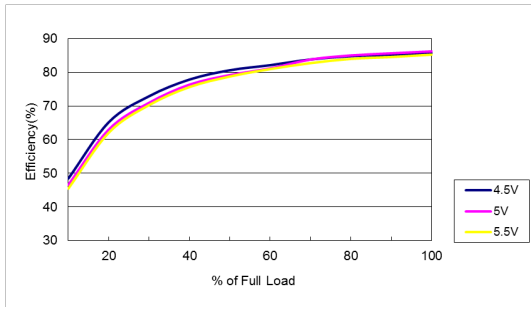
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



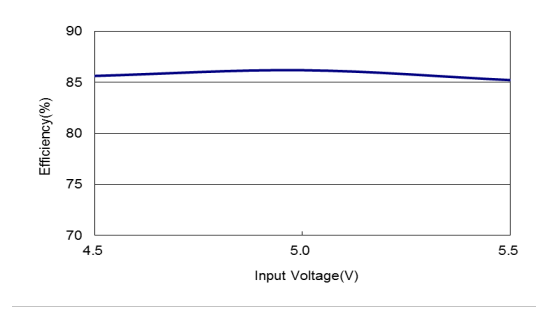
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

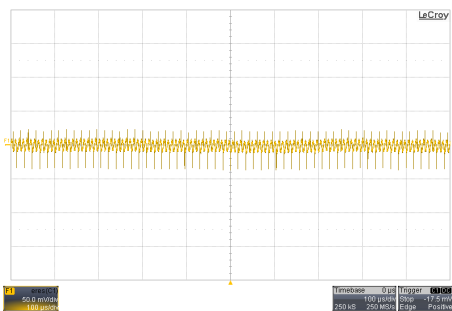
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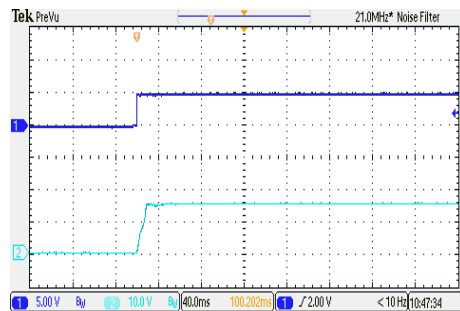
Efficiency Versus Output Current



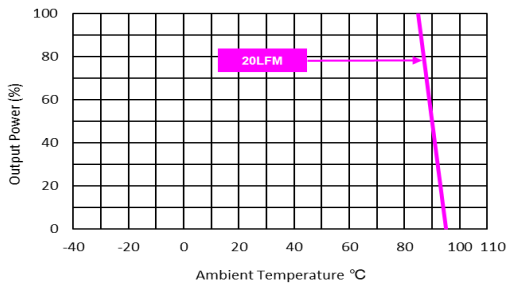
Efficiency Versus Input Voltage Full Load



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



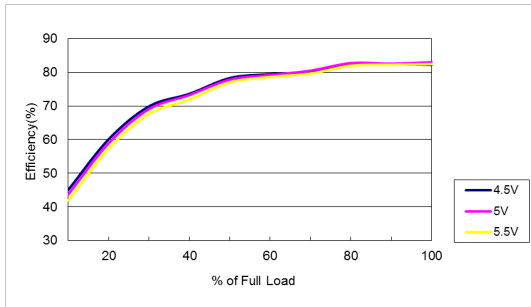
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



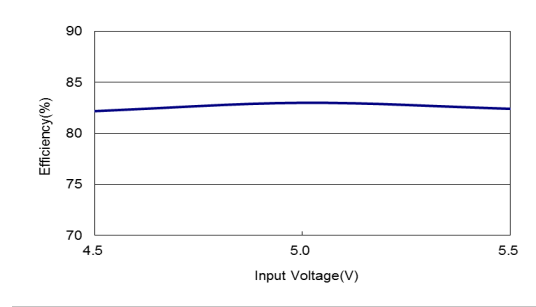
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

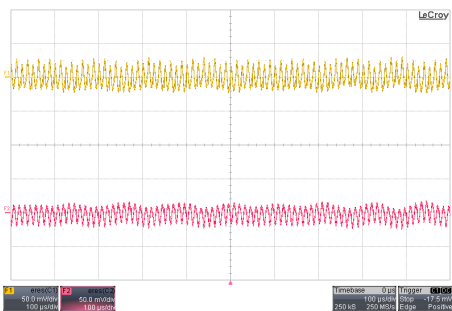
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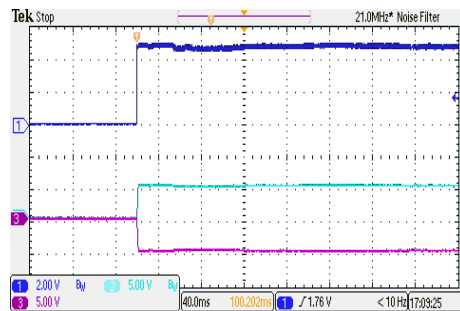
Efficiency Versus Output Current



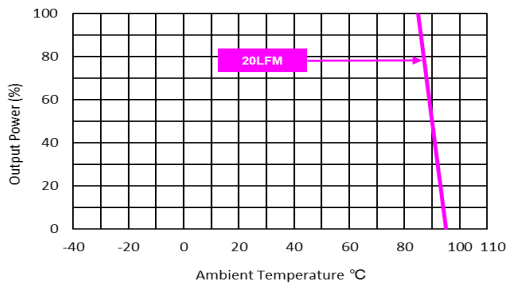
Efficiency Versus Input Voltage Full Load



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



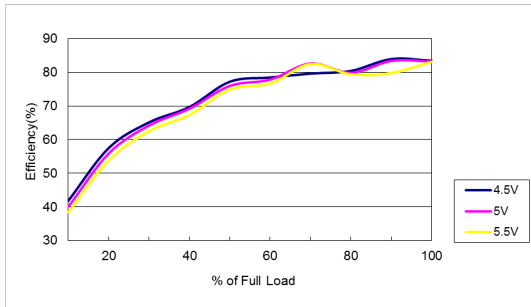
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



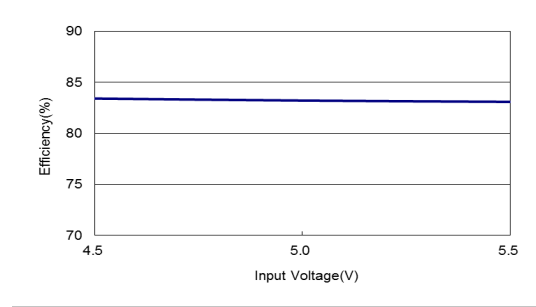
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

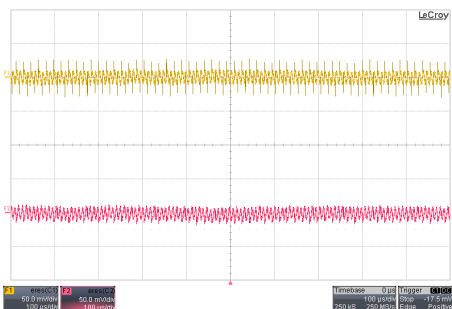
All test conditions are at 25°C. The figures are identical for MAPU01-05D12H



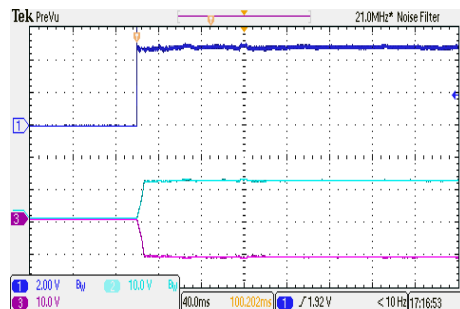
Efficiency Versus Output Current



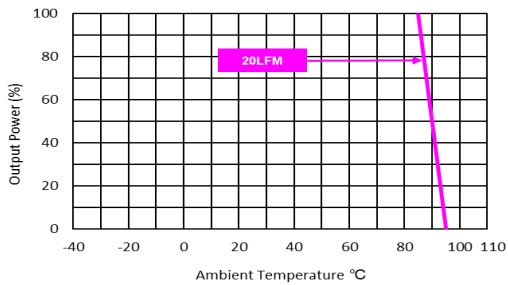
Efficiency Versus Input Voltage Full Load



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



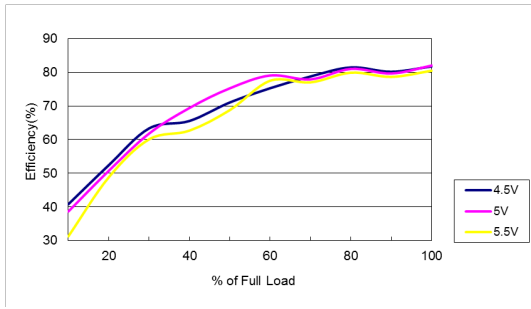
Typical Input Start-Up and Output Rise Characteristic  
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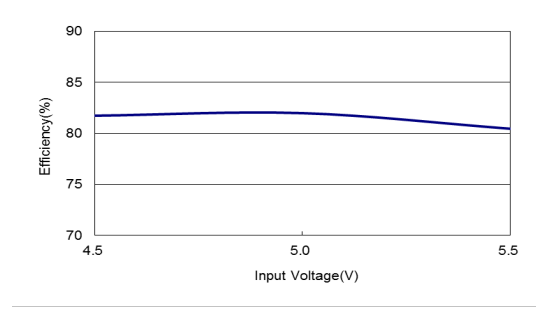
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

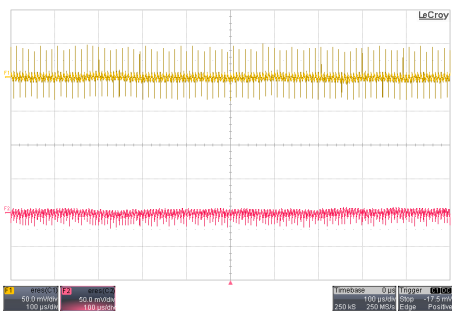
All test conditions are at 25°C The figures are identical for MAPU01-05D15H



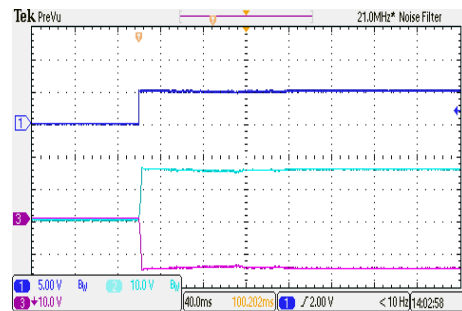
Efficiency Versus Output Current



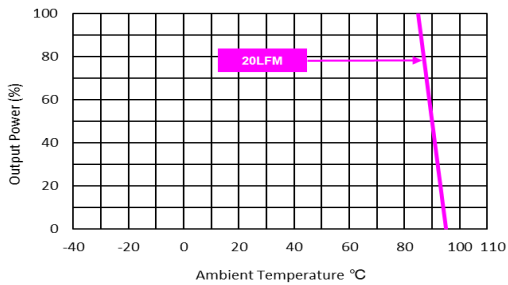
Efficiency Versus Input Voltage Full Load



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



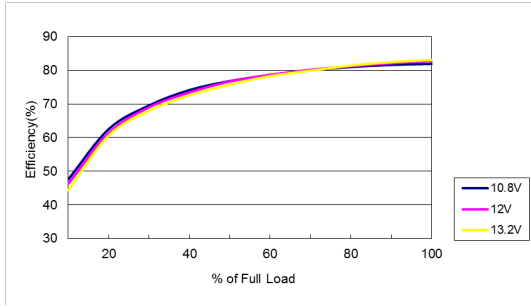
Typical Input Start-Up and Output Rise Characteristic  
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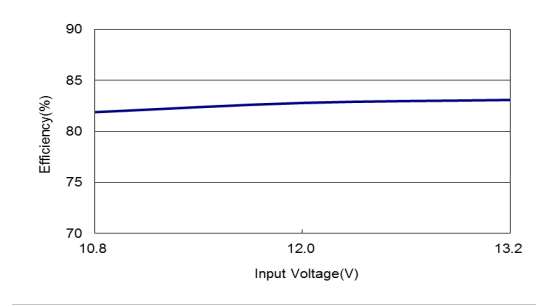
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

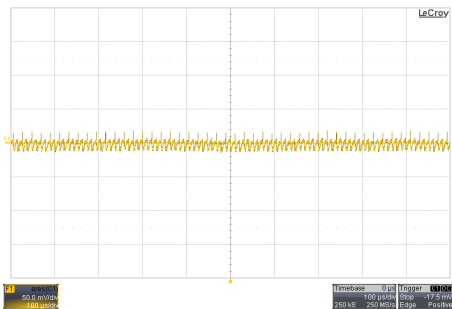
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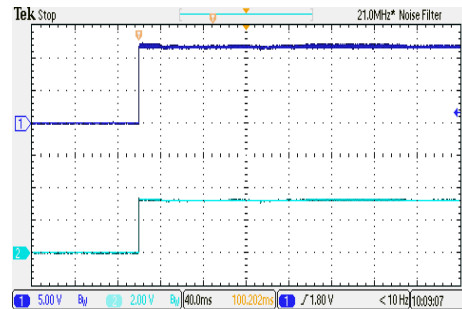
Efficiency Versus Output Current



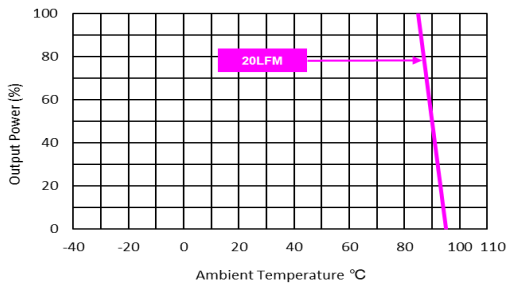
Efficiency Versus Input Voltage Full Load



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



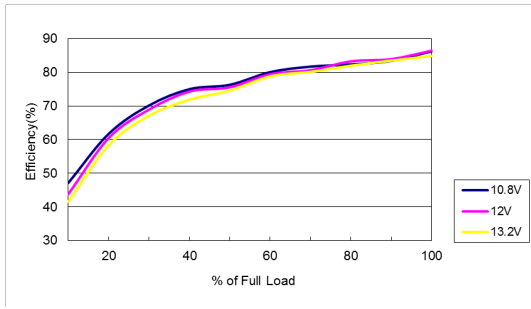
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



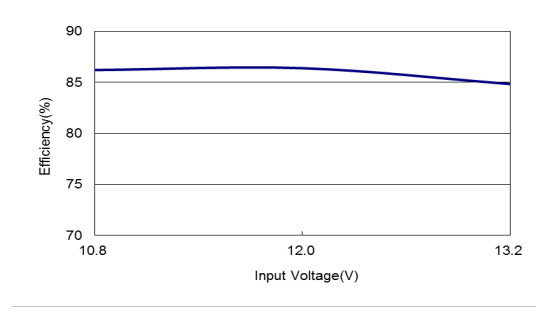
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

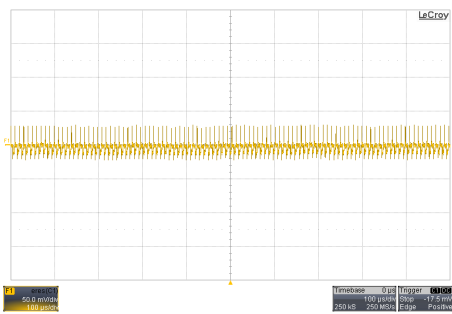
All test conditions are at 25°C The figures are identical for MAPU01-12S05H



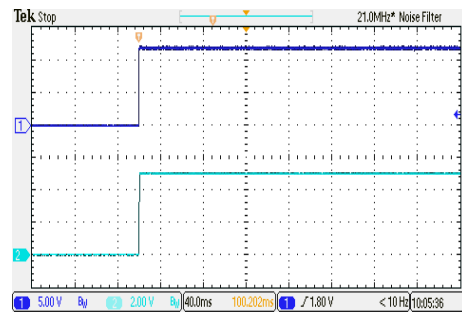
Efficiency Versus Output Current



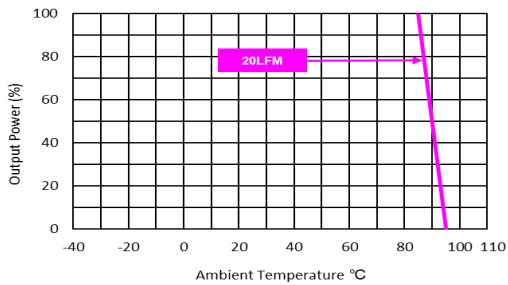
Efficiency Versus Input Voltage Full Load



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

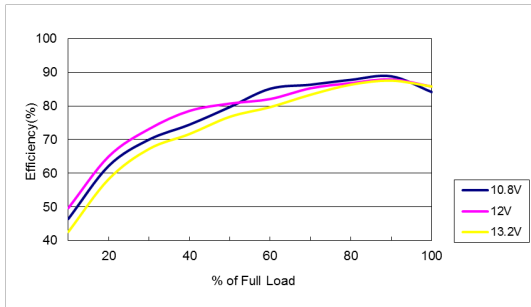


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

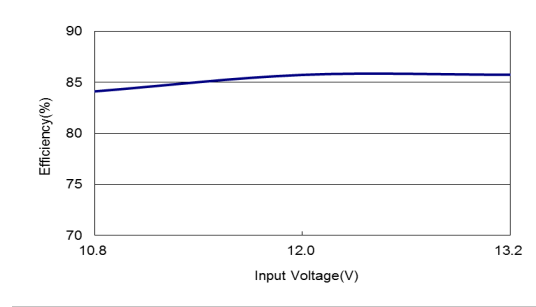


**Characteristic Curves**

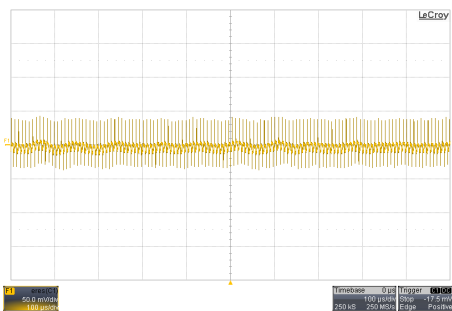
All test conditions are at 25°C The figures are identical for MAPU01-12S09H



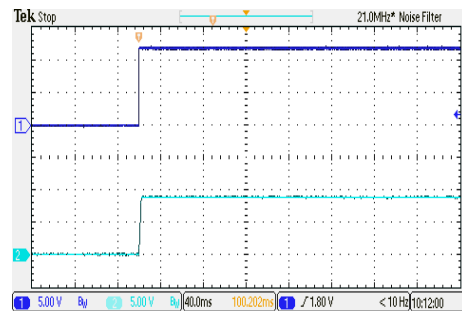
Efficiency Versus Output Current



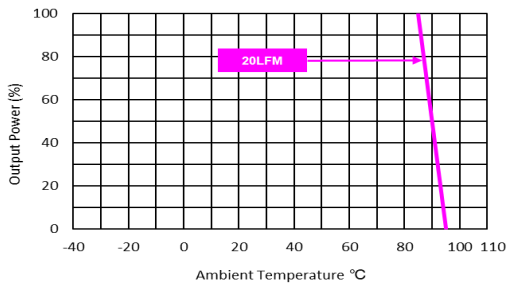
Efficiency Versus Input Voltage Full Load



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



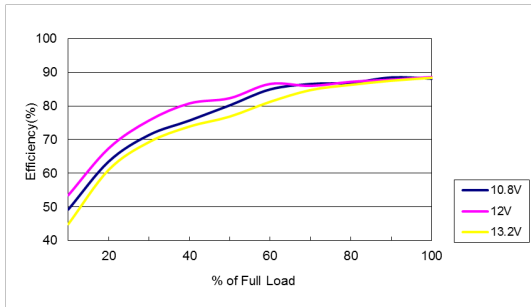
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



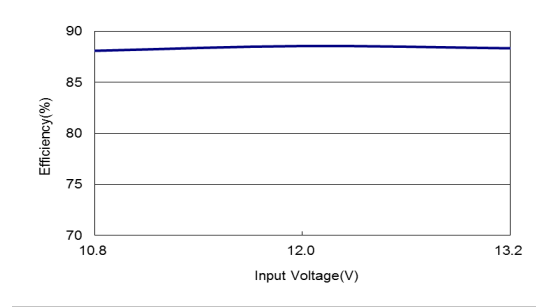
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

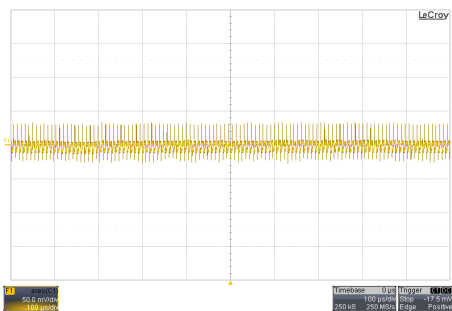
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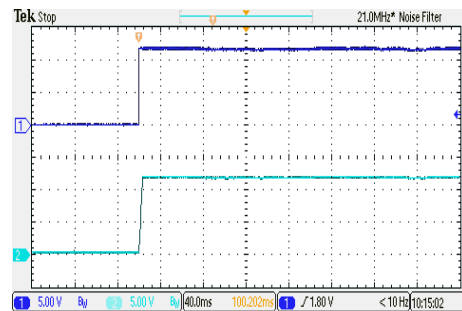
Efficiency Versus Output Current



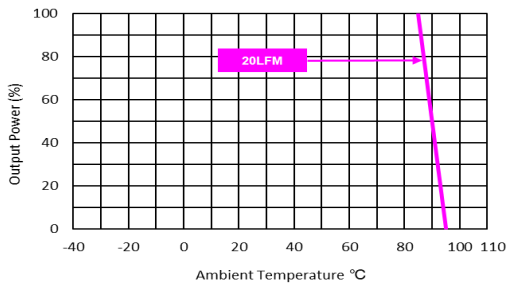
Efficiency Versus Input Voltage Full Load



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



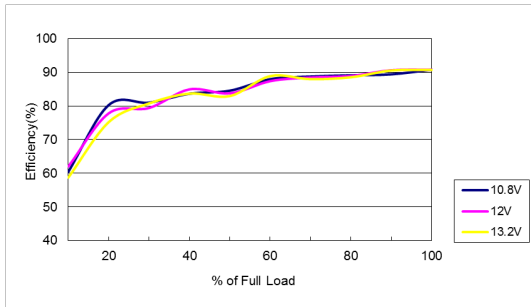
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



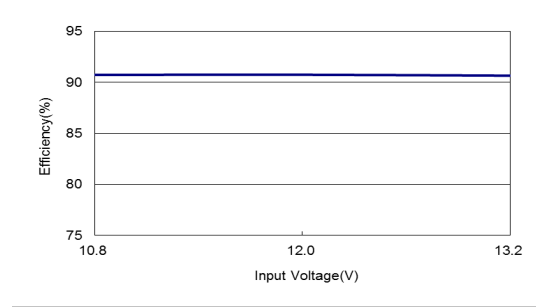
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

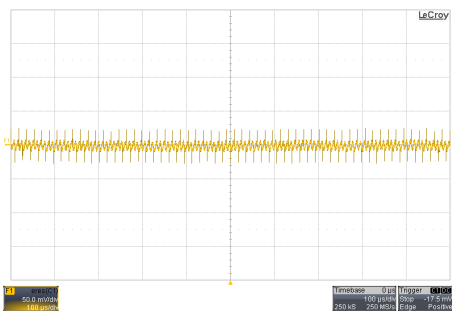
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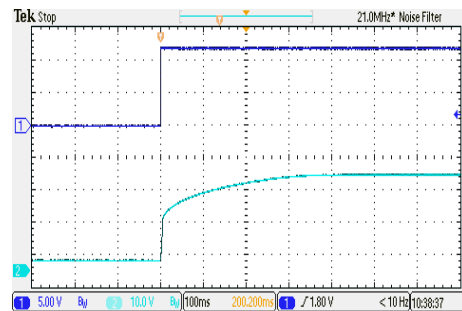
Efficiency Versus Output Current



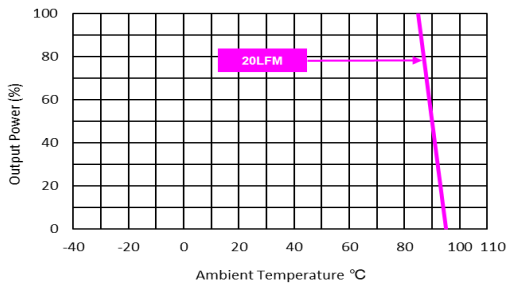
Efficiency Versus Input Voltage Full Load



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



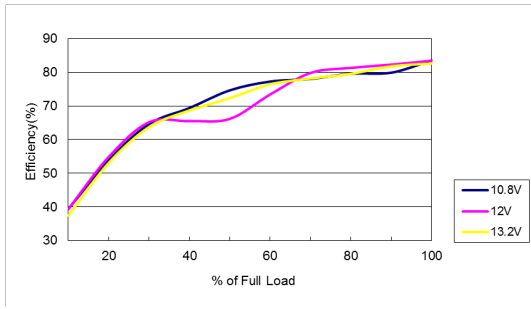
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



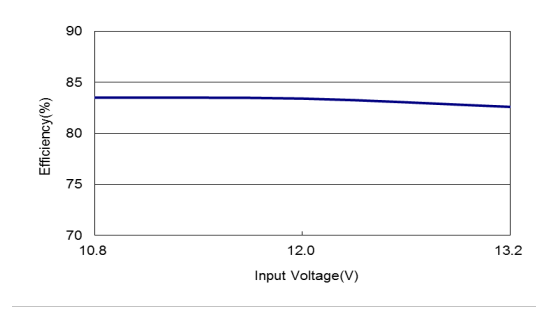
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

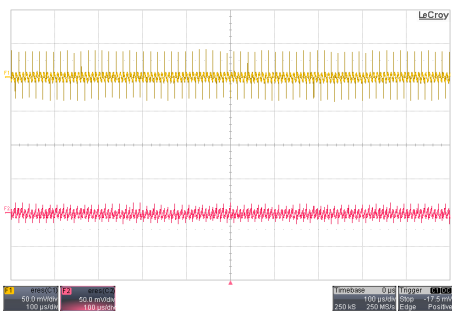
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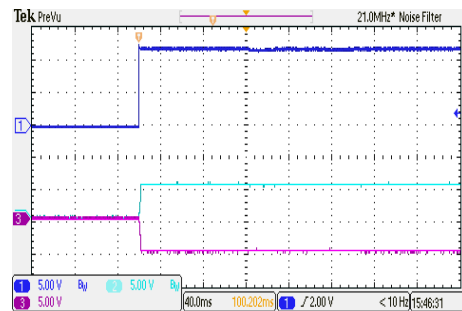
Efficiency Versus Output Current



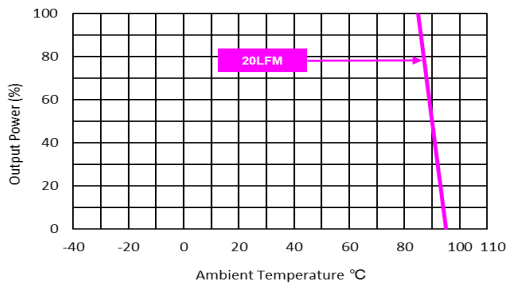
Efficiency Versus Input Voltage Full Load



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



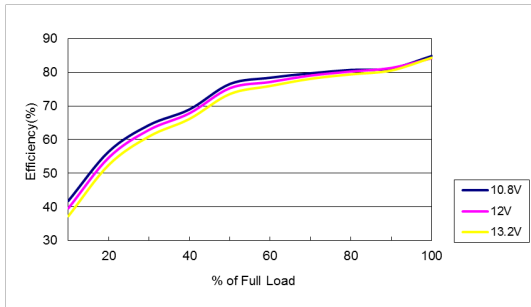
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



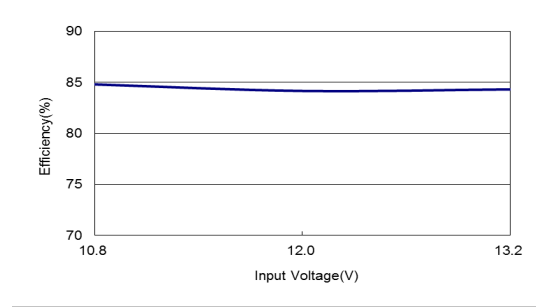
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

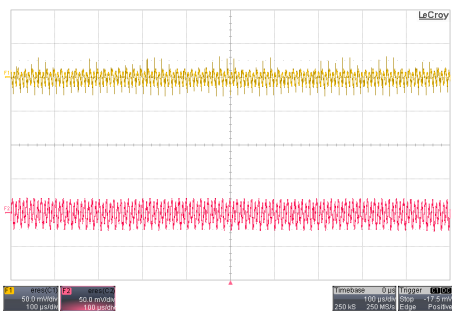
All test conditions are at 25°C The figures are identical for MAPU01-12D12H



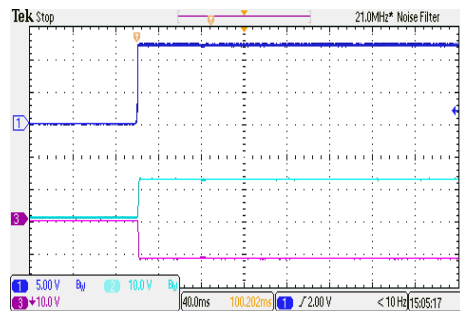
Efficiency Versus Output Current



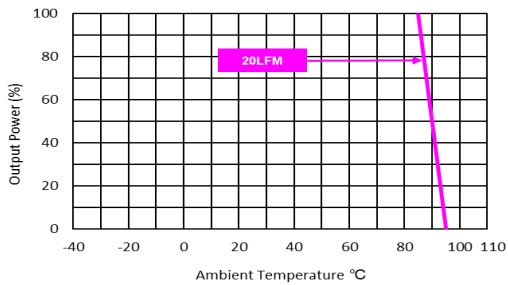
Efficiency Versus Input Voltage Full Load



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



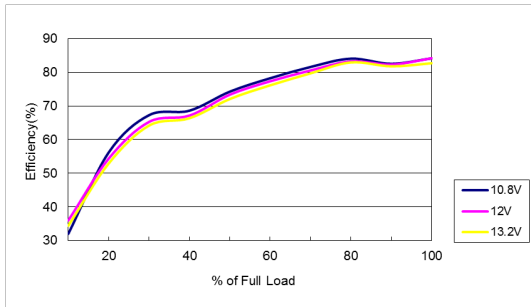
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



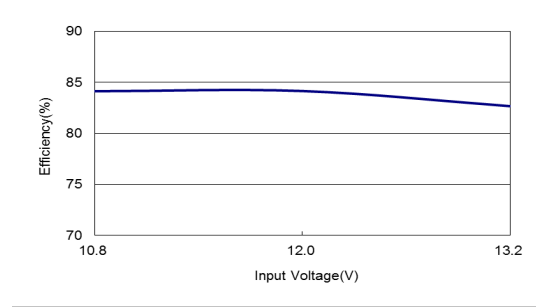
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

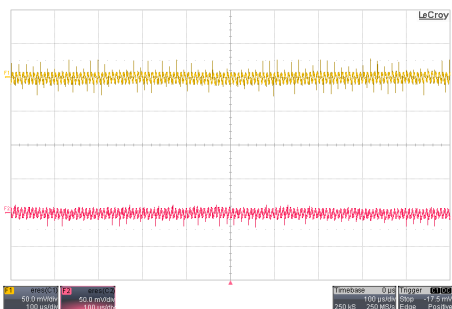
All test conditions are at 25°C The figures are identical for MAPU01-12D15H



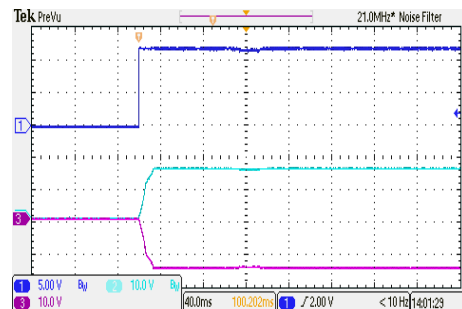
Efficiency Versus Output Current



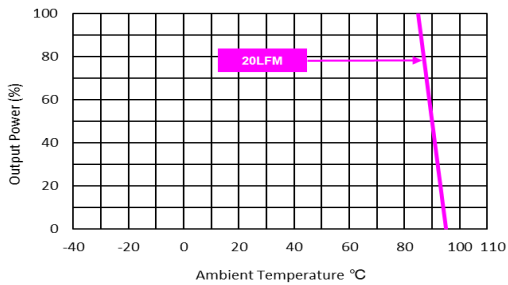
Efficiency Versus Input Voltage Full Load



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



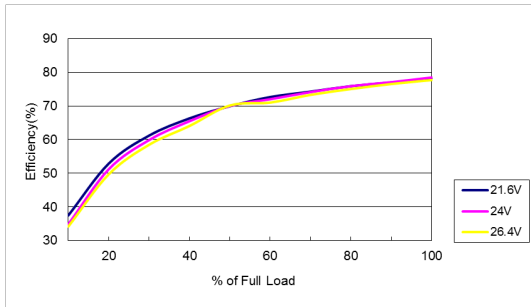
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in} = V_{in\ nom}$ ; Full Load



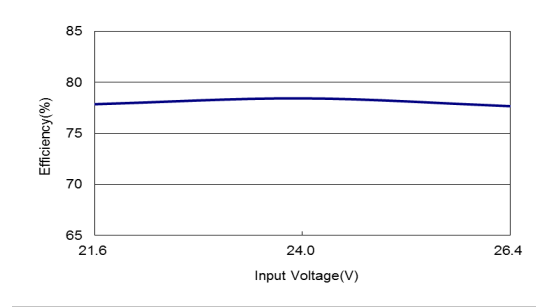
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in\ nom}$

**Characteristic Curves**

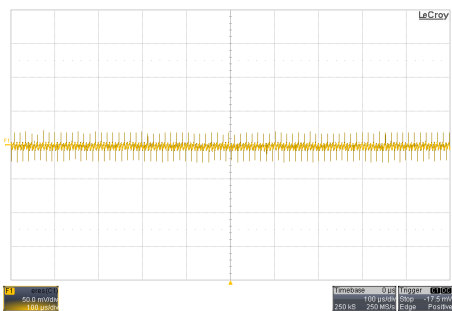
All test conditions are at 25°C The figures are identical for MAPU01-24S033H



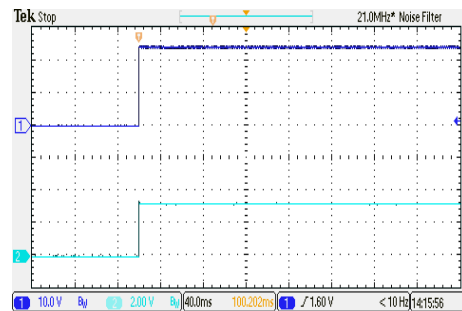
Efficiency Versus Output Current



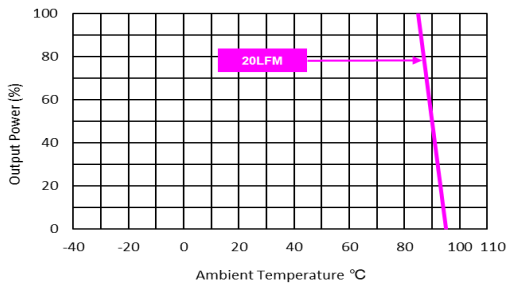
Efficiency Versus Input Voltage Full Load



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



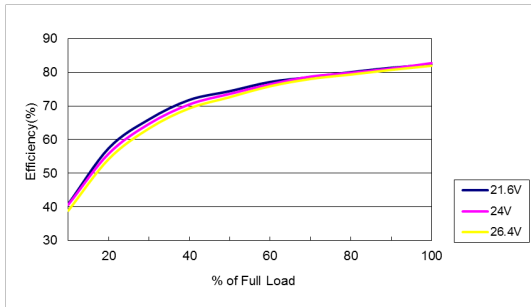
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



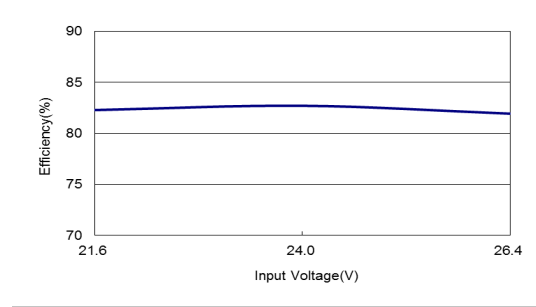
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

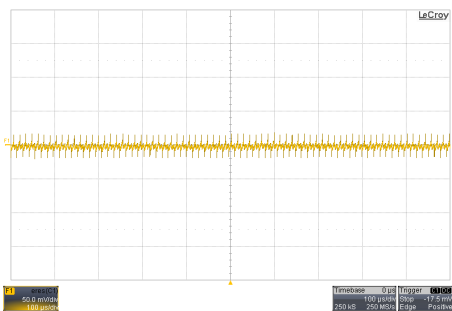
All test conditions are at 25°C The figures are identical for MAPU01-24S05H



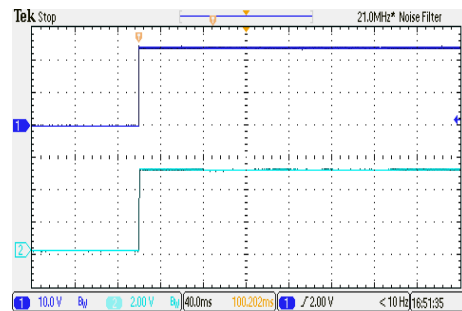
Efficiency Versus Output Current



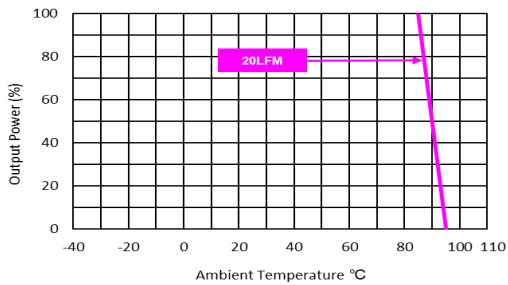
Efficiency Versus Input Voltage Full Load



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

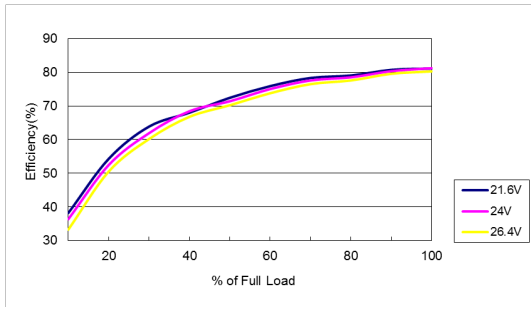


Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

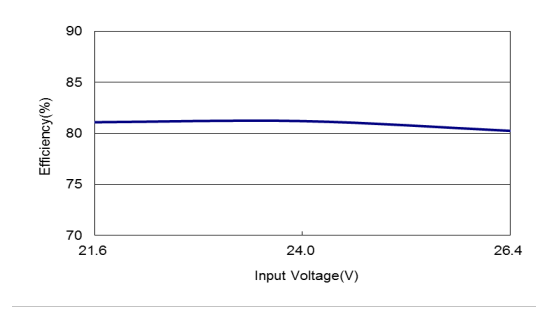


**Characteristic Curves**

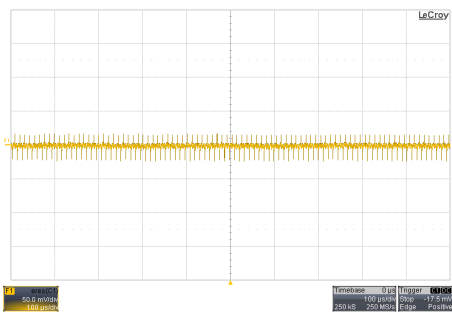
All test conditions are at 25°C The figures are identical for MAPU01-24S09H



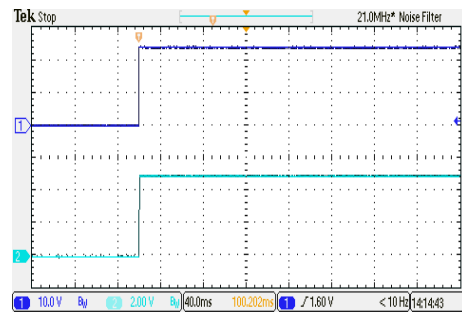
Efficiency Versus Output Current



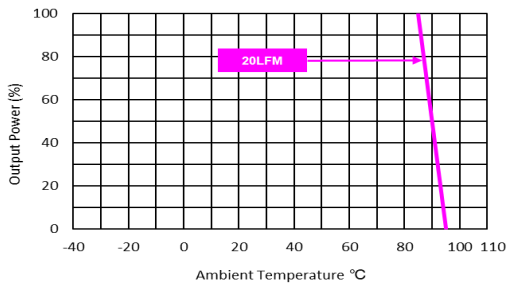
Efficiency Versus Input Voltage Full Load



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



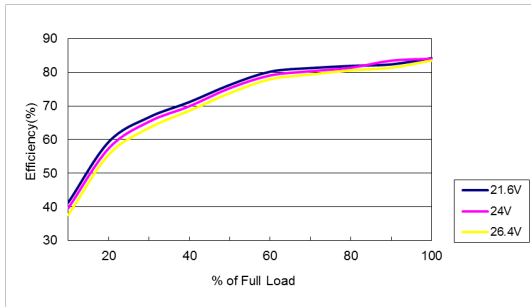
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



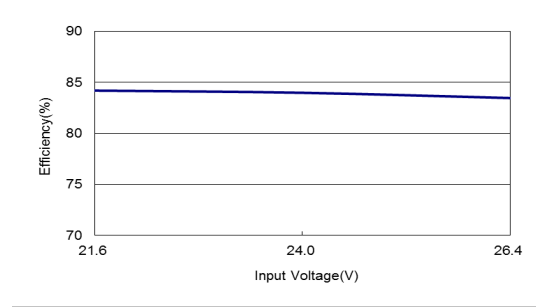
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

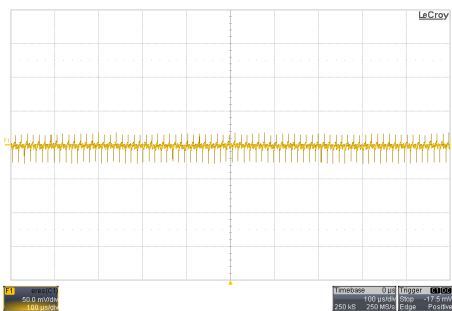
All test conditions are at 25°C The figures are identical for MAPU01-24S12H



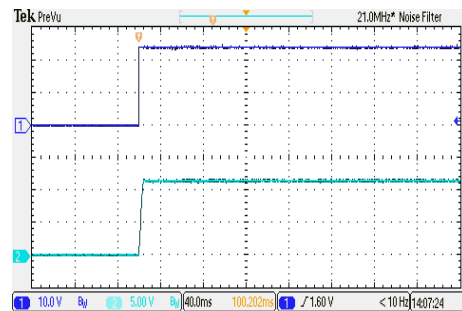
Efficiency Versus Output Current



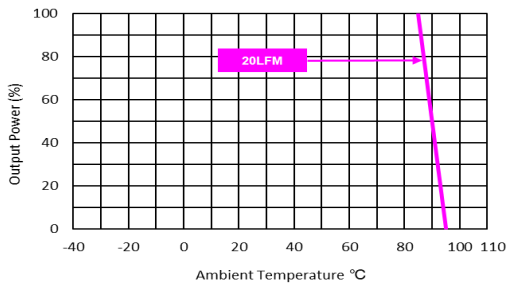
Efficiency Versus Input Voltage Full Load



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



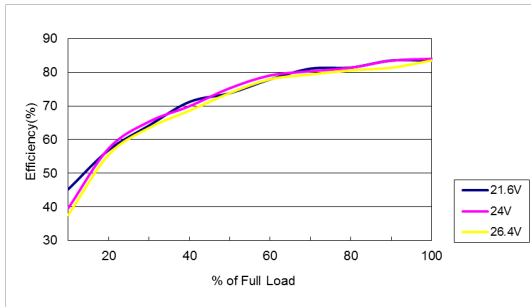
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



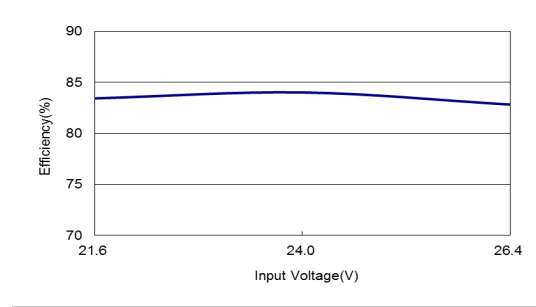
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

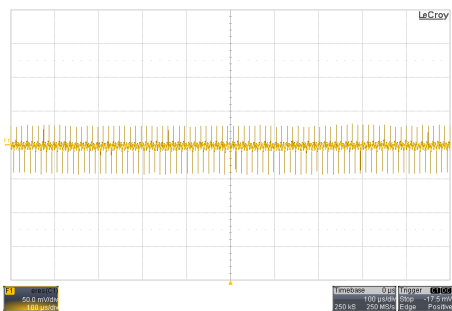
All test conditions are at 25°C The figures are identical for MAPU01-24S15H



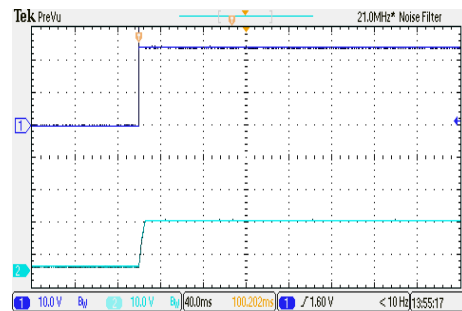
Efficiency Versus Output Current



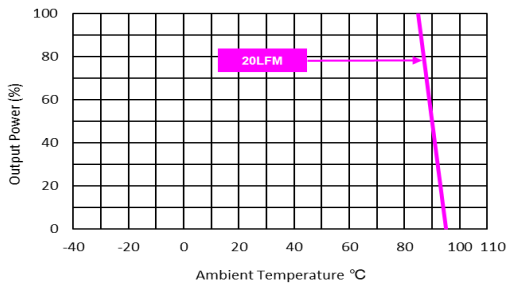
Efficiency Versus Input Voltage Full Load



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



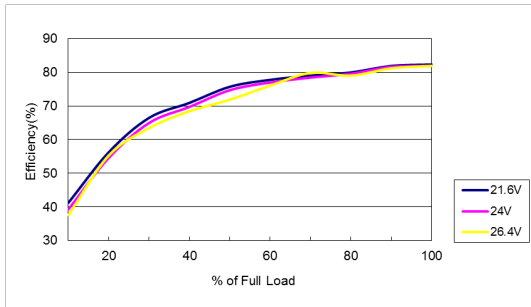
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



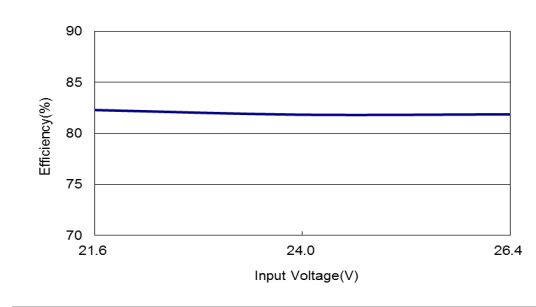
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

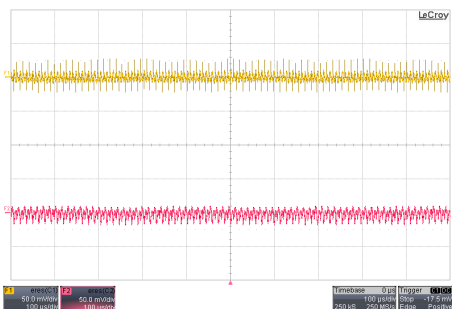
All test conditions are at 25°C The figures are identical for MAPU01-24D05H



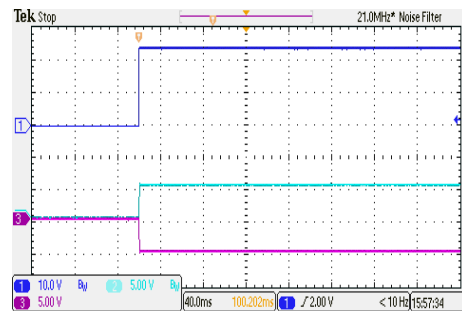
Efficiency Versus Output Current



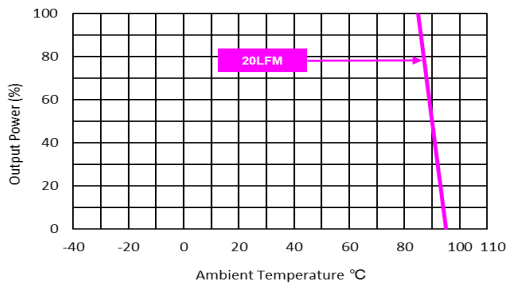
Efficiency Versus Input Voltage Full Load



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



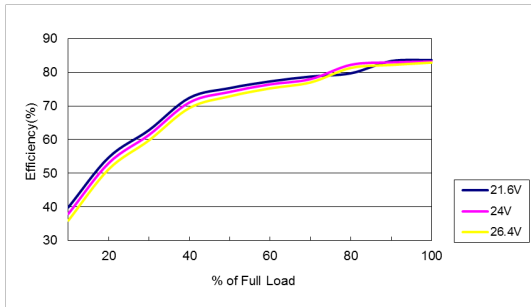
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



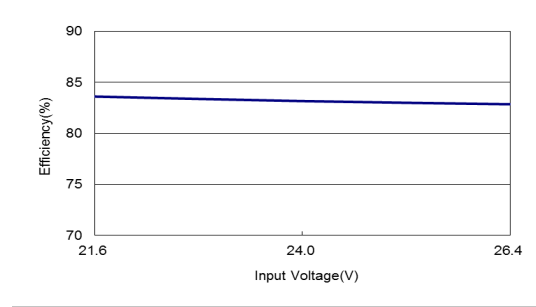
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

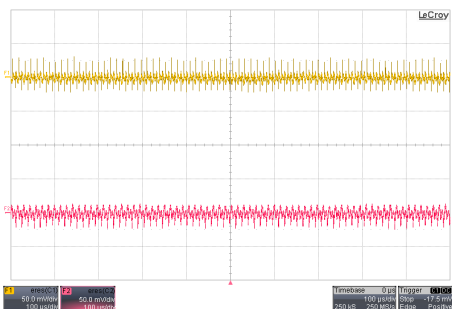
All test conditions are at 25°C The figures are identical for MAPU01-24D12H



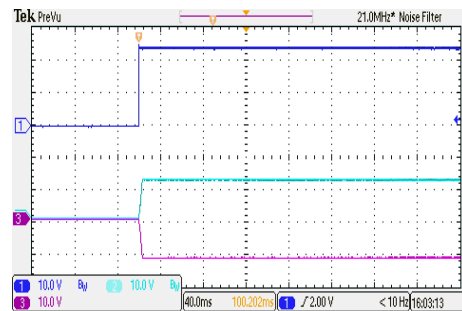
Efficiency Versus Output Current



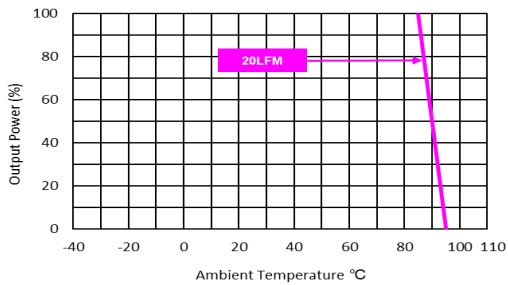
Efficiency Versus Input Voltage Full Load



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



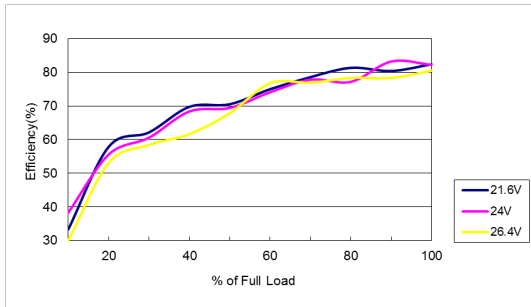
Typical Input Start-Up and Output Rise Characteristic  
 $V_{in}=V_{in\ nom}$ ; Full Load



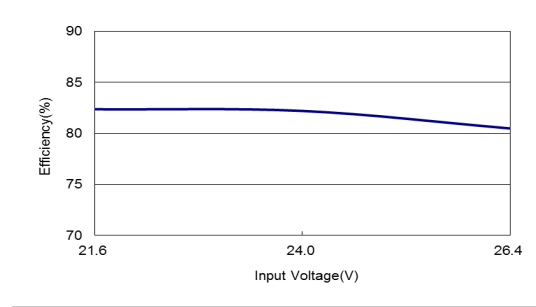
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in}=V_{in\ nom}$

**Characteristic Curves**

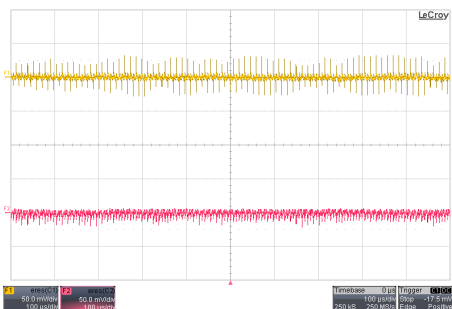
All test conditions are at 25°C The figures are identical for MAPU01-24D15H



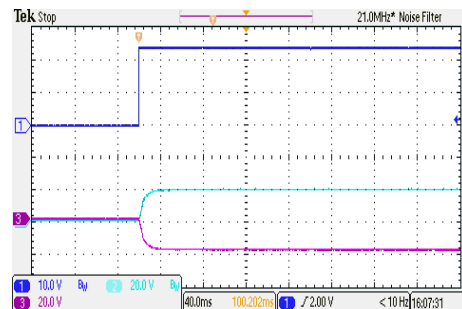
Efficiency Versus Output Current



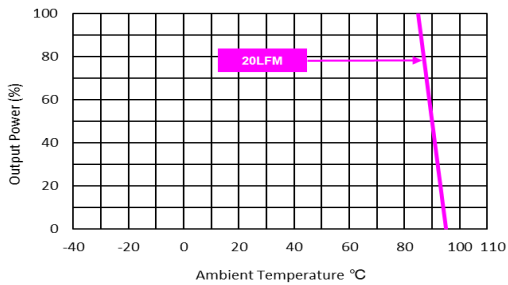
Efficiency Versus Input Voltage Full Load



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

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

### Package Specifications with "A" Pinning (order code suffix A)

**Mechanical Dimensions**

**Pin Connections**

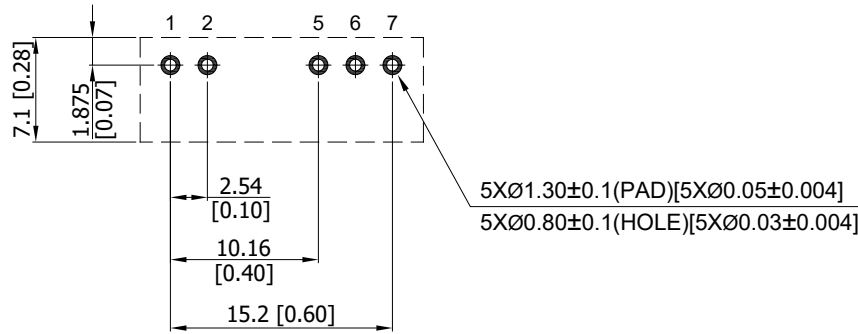
Pin	Single Output	Dual Output
1	+Vin	+Vin
2	-Vin	-Vin
4	-Vout	-Vout
5	No Pin	Common
6	+Vout	+Vout

▶ 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	:	19.5x7.1x10.2mm (0.77x0.28x0.40 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Pin Material	:	Alloy 42
Weight	:	3.1g

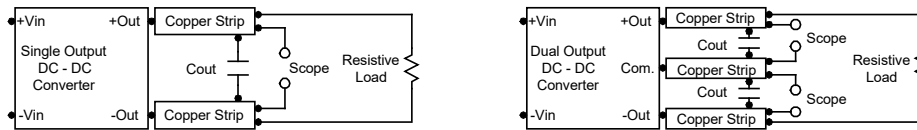
### Recommended Pad Layout for Single & Dual Output Converter



### Test Setup

#### Peak-to-Peak Output Noise Measurement Test

Use a  $C_{out}$  0.33 $\mu$ 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.



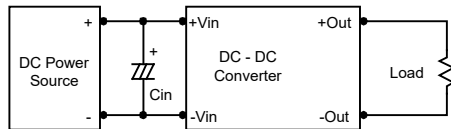
### Technical Notes

#### Maximum Capacitive Load

The MA01-HI 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.

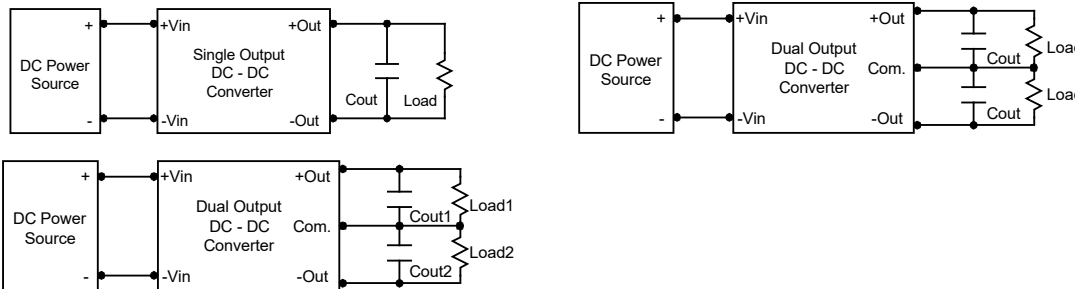
#### Input Source Impedance

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 recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0 $\Omega$  at 100 kHz) capacitor of a 2.2 $\mu$ F for the 5V input devices, a 1.0 $\mu$ F for the 12V, 15V input devices and a 0.47 $\mu$ F for the 24V devices.



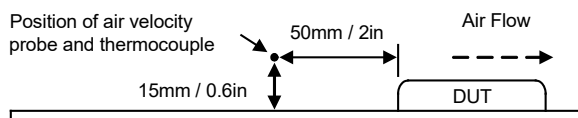
#### Output Ripple Reduction

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 1.0 $\mu$ F capacitors at the output.



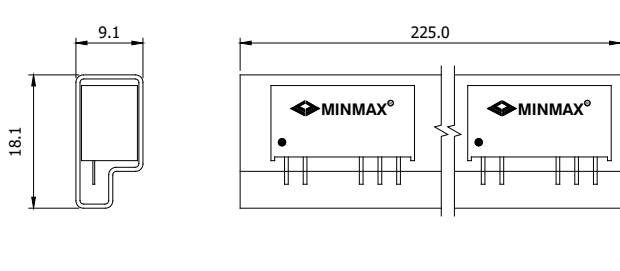
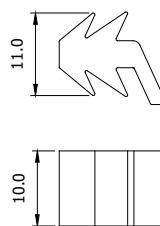
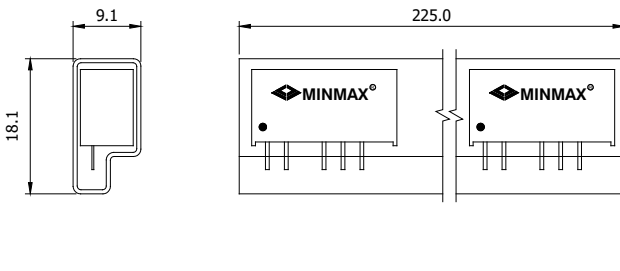
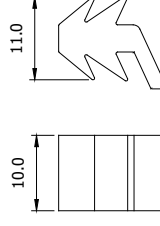
#### Thermal Considerations

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 100°C. The derating curves are determined from measurements obtained in a test setup.



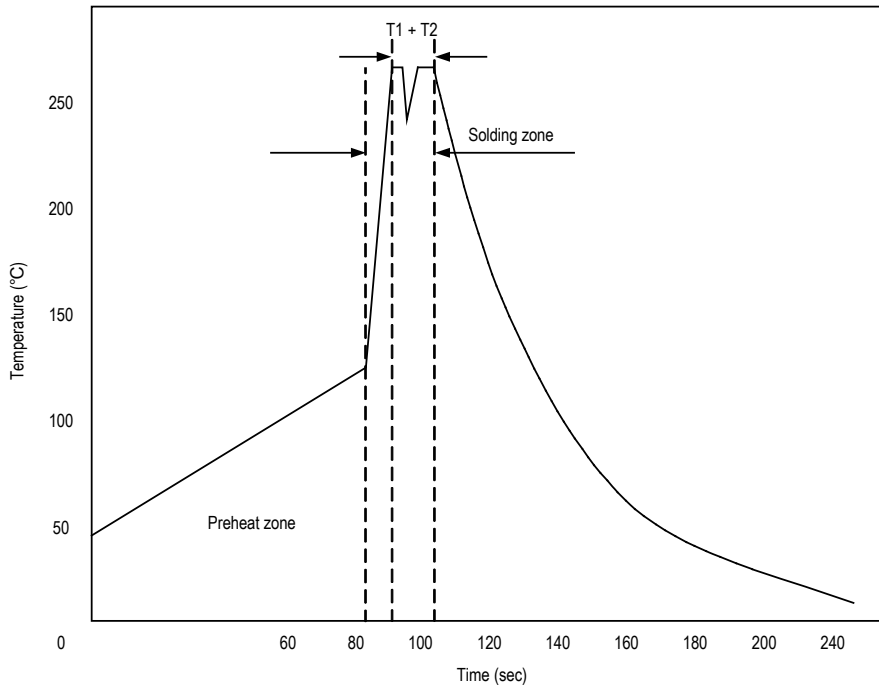


**Packaging Information for Tube**

Tube	Plug
 <p>18.1</p> <p>9.1</p> <p>225.0</p> <p>MINMAX<sup>®</sup></p>	 <p>11.0</p> <p>10.0</p> <p>Unit: mm</p> <p>10 PCS per TUBE (Without "A" Pinning)</p>
 <p>18.1</p> <p>9.1</p> <p>225.0</p> <p>MINMAX<sup>®</sup></p>	 <p>11.0</p> <p>10.0</p> <p>Unit: mm</p> <p>10 PCS per TUBE (With "A" Pinning)</p>

**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	PU	01	-	033	S	033	H	(A)
Package Type SIP-7	Protection Overload Protection Short Circuit Protection	Output Power 1 Watt	Input Voltage Range 033: 2.97 ~ 3.63 VDC 05: 4.5 ~ 5.5 VDC 12: 10.8 ~ 13.2 VDC 24: 21.6 ~ 26.4 VDC	Output Quantity S: Single D: Dual	Output Voltage 033: 3.3 VDC 05: 5 VDC 09: 9 VDC 12: 12 VDC 15: 15 VDC	I/O Isolation Voltage 3000 VDC	"A" Pinning		
	±10% Input Range	Output Regulation Unregulated							

### MTBF and Reliability

The MTBF of MAPU01H series of DC-DC converters has been calculated using

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

Model	MTBF	Unit
MAPU01-033S033H(A)	3,762,447	Hours
MAPU01-033S05H(A)	5,056,798	
MAPU01-033S09H(A)	5,009,365	
MAPU01-033S12H(A)	5,047,612	
MAPU01-033S15H(A)	5,029,840	
MAPU01-033D05H(A)	3,751,110	
MAPU01-033D12H(A)	3,803,556	
MAPU01-033D15H(A)	3,711,349	
MAPU01-05S033H(A)	4,810,436	
MAPU01-05S05H(A)	4,957,204	
MAPU01-05S09H(A)	4,063,003	
MAPU01-05S12H(A)	5,388,448	
MAPU01-05S15H(A)	5,237,198	
MAPU01-05D05H(A)	3,758,093	
MAPU01-05D12H(A)	3,767,768	
MAPU01-05D15H(A)	3,687,442	
MAPU01-12S033H(A)	5,027,981	
MAPU01-12S05H(A)	5,010,347	
MAPU01-12S09H(A)	5,010,347	
MAPU01-12S12H(A)	5,273,368	
MAPU01-12S15H(A)	5,357,821	
MAPU01-12D05H(A)	5,172,053	
MAPU01-12D12H(A)	3,828,842	
MAPU01-12D15H(A)	3,728,907	
MAPU01-24S033H(A)	5,173,654	
MAPU01-24S05H(A)	5,057,091	
MAPU01-24S09H(A)	5,142,866	
MAPU01-24S12H(A)	5,273,368	
MAPU01-24S15H(A)	5,337,821	
MAPU01-24D05H(A)	4,942,066	
MAPU01-24D12H(A)	5,008,905	
MAPU01-12D15H(A)	5,029,246	