MCW1000 Series

Electric Characteristic Note

DC-DC CONVERTER 2W, SIP Package

Features

- **Industry Standard SIP-8 Package**
- **Wide 2 : 1 Input Voltage Range**
- **Fully Regulated Output Voltage**
- **I/O Isolation 1000 VDC**
- **Operating Ambient Temp. Range -40℃ to +85℃**
- **Under-Voltage, Overload and Short Circuit Protection**
- **Remote On/Off Control**
- **UL/cUL/IEC/EN 62368-1(60950-1) Safety Approval**

Applications

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

Product Overview

The MINMAX MCW1000 series is a range of isolated 2W DC-DC converter modules featuring fully regulated output and wide 2:1 input voltage ranges. The product comes in a SIP-8 package with a very small footprint occupying only 2.0 cm^2 (0.3 square in.) on the PCB.
An excellent efficiency allows an operating temperature range of -40℃ to +85℃. Further features include remote On/Off control, under-voltage, overload and short circuit protection.
The very compact dimensions of these DC-DC converters make them an ideal solution for many space critical applications in battery-powered equipment and instrumentation.

Table of contents

Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current		Input Current		Reflected Ripple Current	Max. capacitive Load	Efficiency (typ.)
			Max.	Min.	@Max. Load	@No Load			@Max. Load
	VDC	VDC	mA	mA	mA(typ.)	mA(typ.)	mA(typ.)	μF	%
MCW1011	5 (4.5 ~ 9)	3.3	500	125	471	40	400	2200	70
MCW1012		5	400	100	548			1000	73
MCW1013		12	167	42	534			170	75
MCW1021	12 (9 ~ 18)	3.3	500	125	184	20	300	2200	73
MCW1022		5	400	100	217			1000	77
MCW1023		12	167	42	209			170	80
MCW1031	24 (18 ~ 36)	3.3	500	125	96	10	200	2200	72
MCW1032		5	400	100	109			1000	77
MCW1033		12	167	42	103			170	81
MCW1041	48 (36 ~ 75)	3.3	500	125	49	8	500	2200	71
MCW1042		5	400	100	57			1000	73
MCW1043		12	167	42	53			170	79

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	3.5	4	4.5	
	12V Input Models	4.5	7	9	
	24V Input Models	8	12	18	
	48V Input Models	16	24	36	
Under Voltage Shutdown	5V Input Models	---	3.5	4	
	12V Input Models	---	6.5	8.5	
	24V Input Models	---	11	17	
	48V Input Models	---	22	34	
Short Circuit Input Power	All Models	---	---	1500	mW
Input Filter		Internal Capacitor			

Remote On/Off Control

Parameter	Conditions	Min.	Typ.	Max.	Unit
Converter On	Under 0.6 VDC or Open Circuit				
Converter Off	2.7 to 15 VDC				
Standby Input Current	Nominal Vin	---	---	3	mA
Control Input Current (on)	Vin = 0V	---	---	-0.4	mA
Control Input Current (off)	Vin = 5.0V	---	---	1	mA
Control Common	Referenced to Negative Input				

Output Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy		---	---	±2.0	%Vnom.
Line Regulation	Vin=Min. to Max.@Full Load	---	±0.3	±0.5	%
Load Regulation	Io=25% to 100%	---	±0.5	±0.75	%
Ripple & Noise	0-20MHz Bandwidth	---	30	50	mV_{P-P}
Transient Recovery Time	25% Load Step Change	---	100	300	μsec
Transient Response Deviation		---	±3	±5	%
Temperature Coefficient		---	±0.01	±0.02	%/℃
Short Circuit Protection	Continuous, Automatic Recovery				

General Specifications					
Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds	1000	---	---	VDC
	1 Second	1200	---	---	VDC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
I/O Isolation Capacitance	100kHz, 1V	---	65	120	pF
Switching Frequency		100	300	650	kHz
MTBF (calculated)	MIL-HDBK-217F@25℃, Ground Benign	1,000,000	---	---	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)				

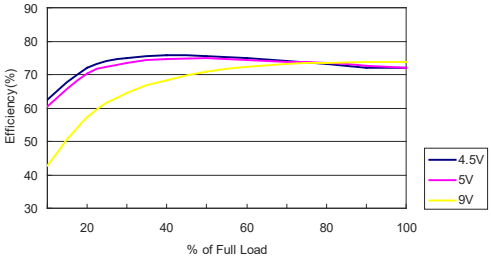
Environmental Specifications			
Parameter	Min.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	-40	+85	℃
Case Temperature	---	+90	℃
Storage Temperature Range	-55	+105	℃
Humidity (non condensing)	---	95	% rel. H
Lead Temperature (1.5mm from case for 10Sec.)	---	260	℃

Notes

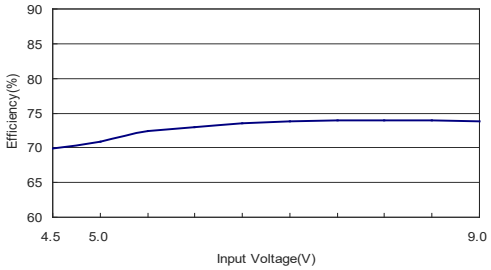
1 Specifications typical at Ta=+25℃, resistive load, nominal input voltage and rated output current unless otherwise noted.
2 Transient recovery time is measured to within 1% error band for a step change in output load of 75% to 100%.
3 These power converters require a minimum output loading to maintain specified regulation, operation under no-load conditions will not damage these modules; however, they may not meet all specifications listed.
4 We recommend to protect the converter by a slow blow fuse in the input supply line.
5 Other input and output voltage may be available, please contact MINMAX.
6 Specifications are subject to change without notice.

Characteristic Curves

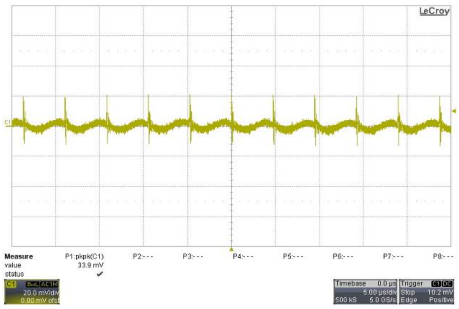
All test conditions are at 25℃ The figures are identical for MCW1011



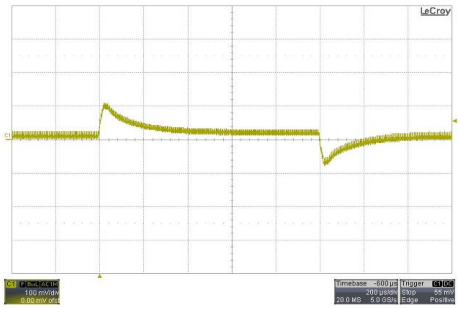
Efficiency Versus Output Current



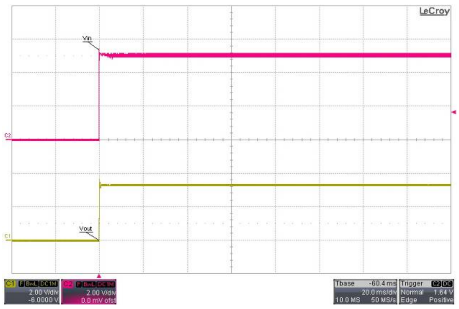
Efficiency Versus Input Voltage
Full Load



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

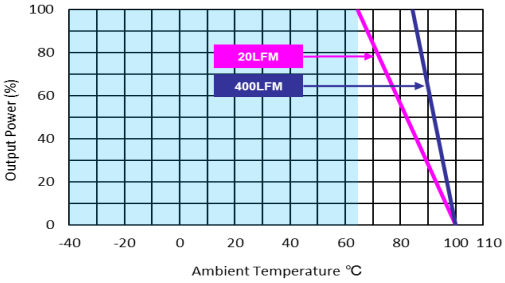


Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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

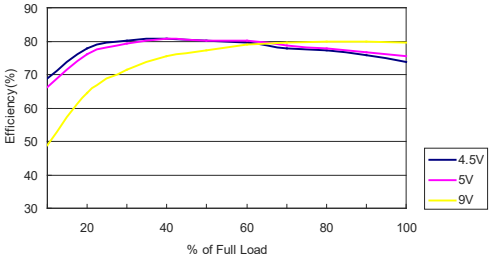
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



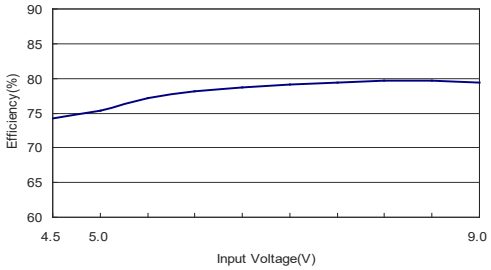
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

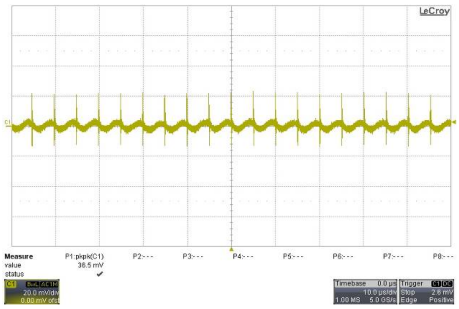
All test conditions are at 25℃ The figures are identical for MCW1012



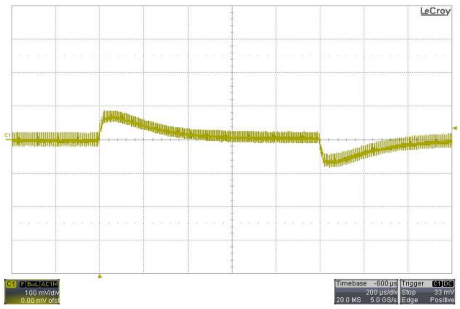
Efficiency Versus Output Current



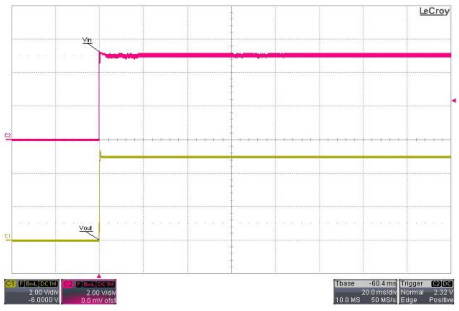
Efficiency Versus Input Voltage
Full Load



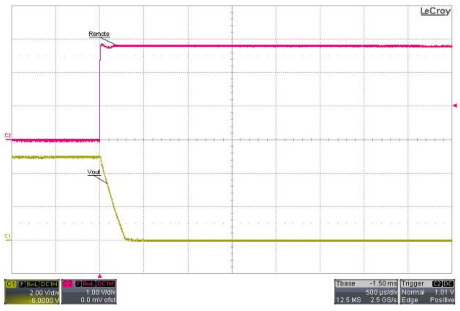
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



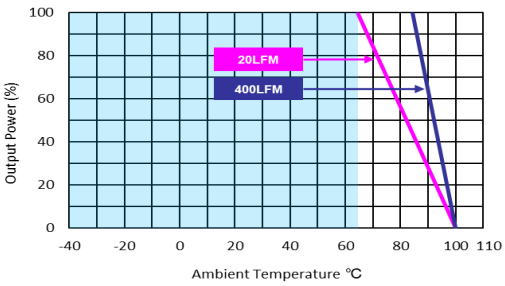
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



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



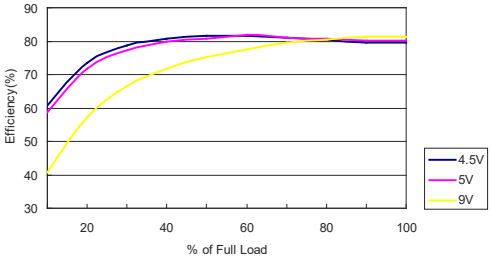
ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



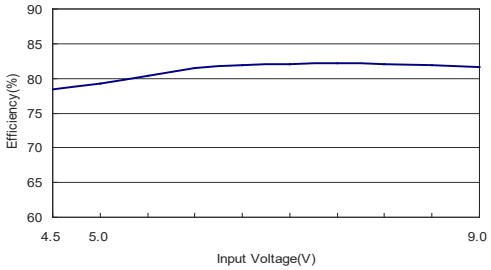
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

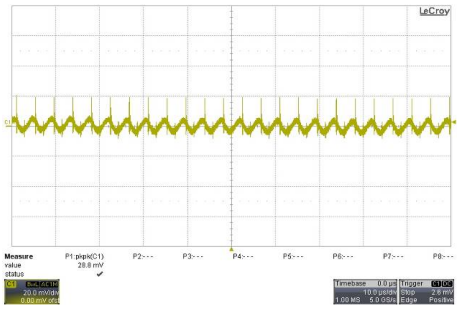
All test conditions are at 25℃ The figures are identical for MCW1013



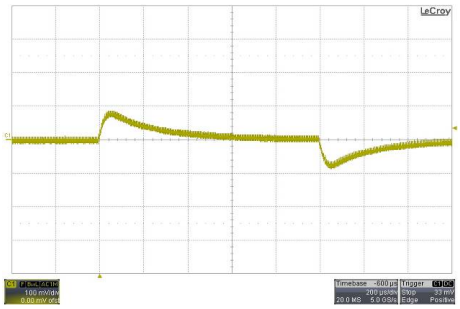
Efficiency Versus Output Current



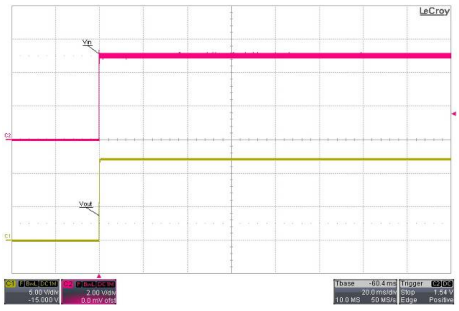
Efficiency Versus Input Voltage
Full Load



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

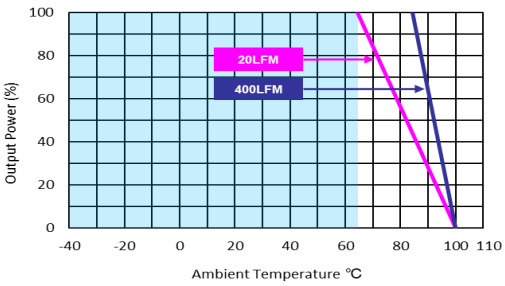


Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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

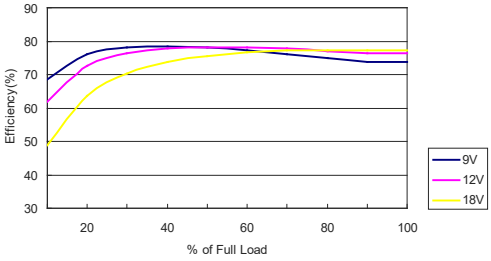
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



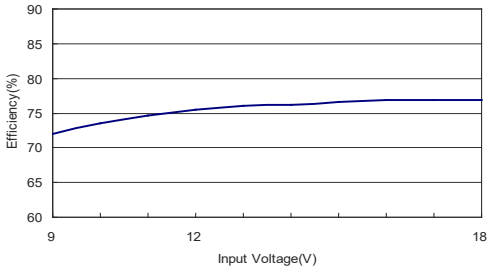
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

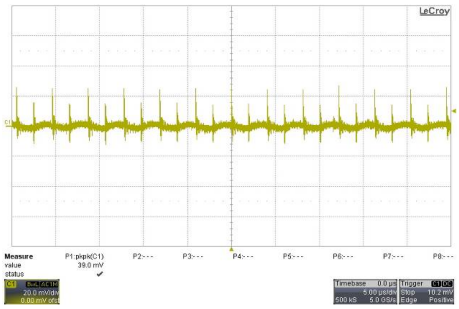
All test conditions are at 25℃ The figures are identical for MCW1021



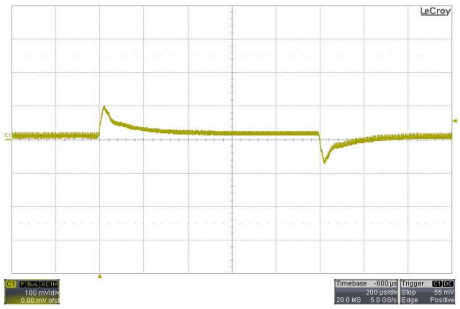
Efficiency Versus Output Current



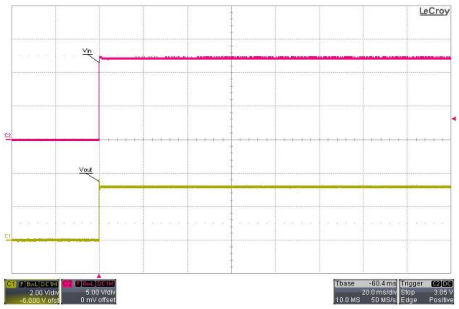
Efficiency Versus Input Voltage
Full Load



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

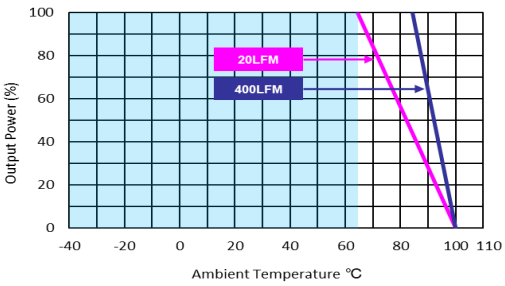


Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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

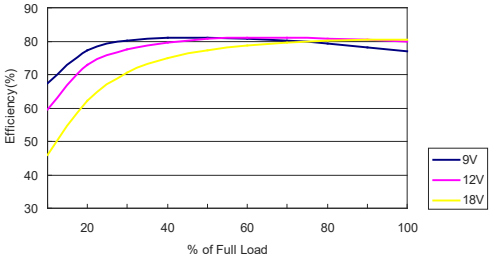
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



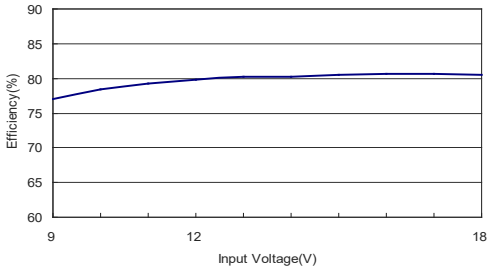
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

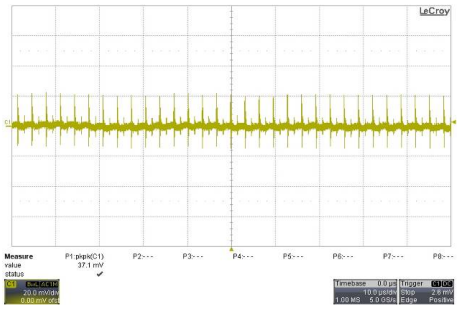
All test conditions are at 25℃ The figures are identical for MCW1022



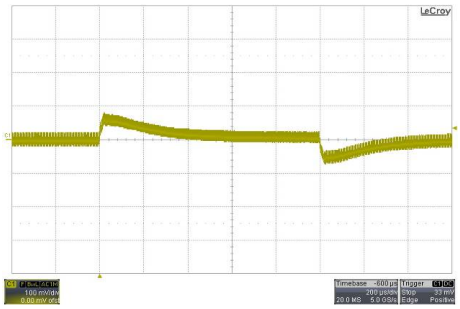
Efficiency Versus Output Current



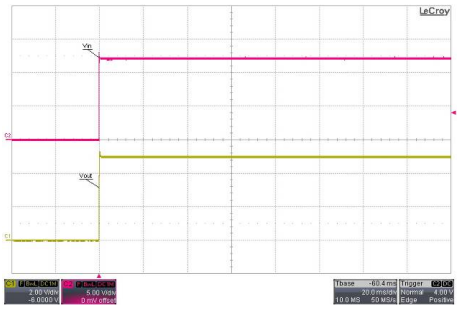
Efficiency Versus Input Voltage
Full Load



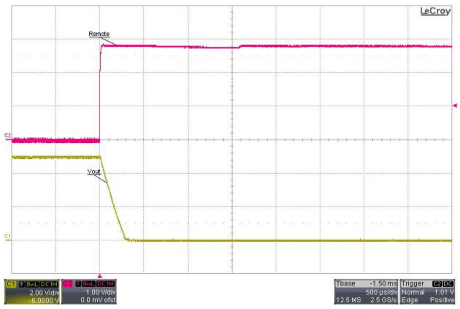
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



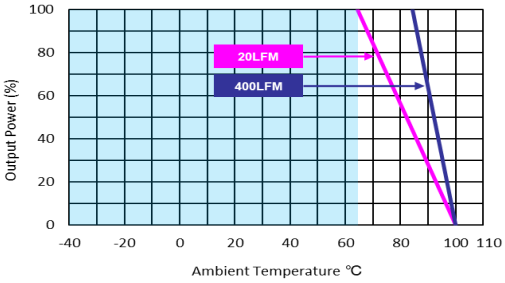
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



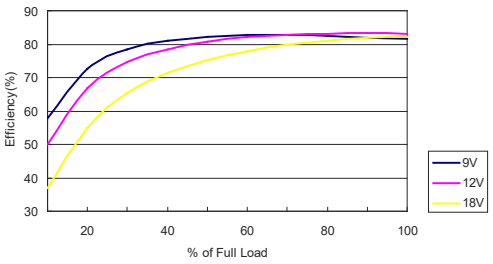
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



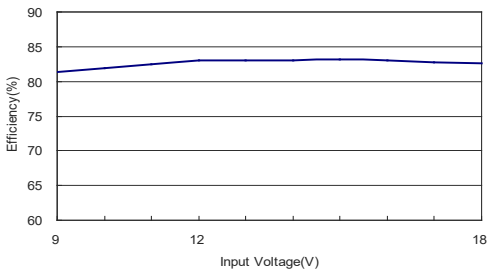
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

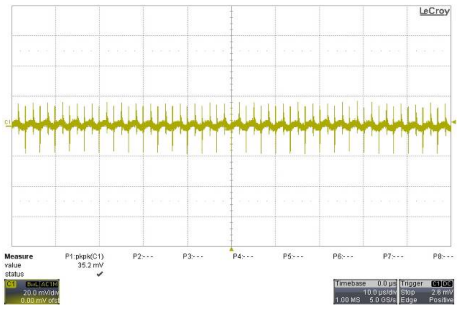
All test conditions are at 25℃ The figures are identical for MCW1023



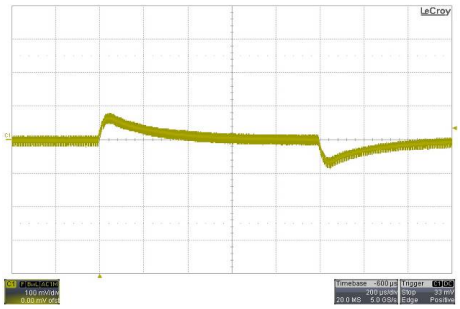
Efficiency Versus Output Current



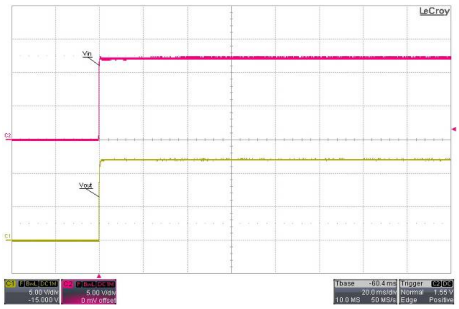
Efficiency Versus Input Voltage
Full Load



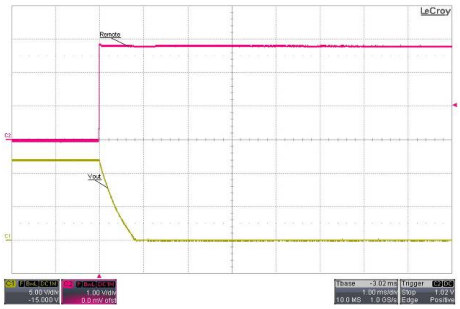
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



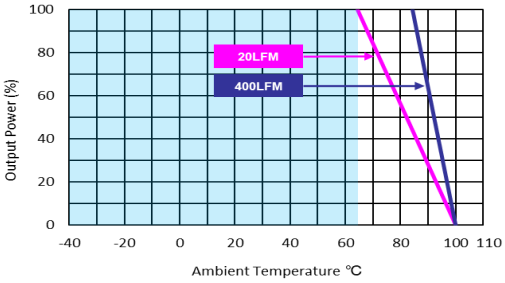
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



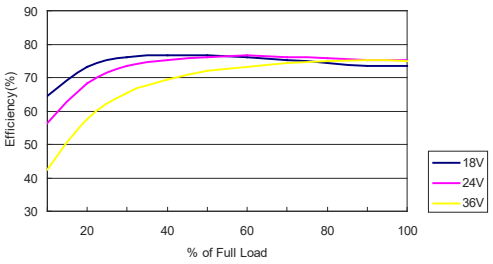
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



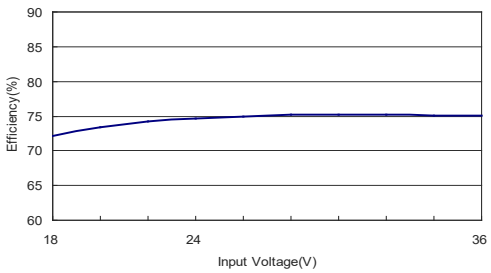
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

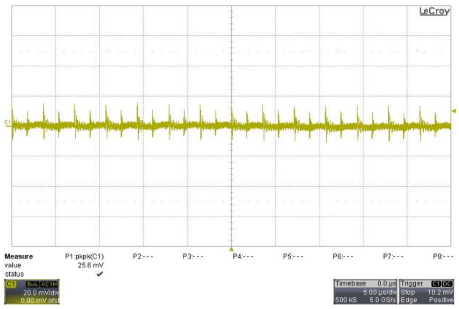
All test conditions are at 25℃ The figures are identical for MCW1031



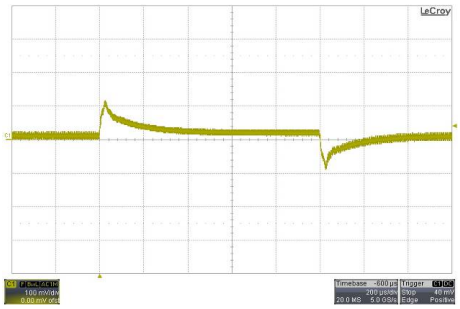
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load

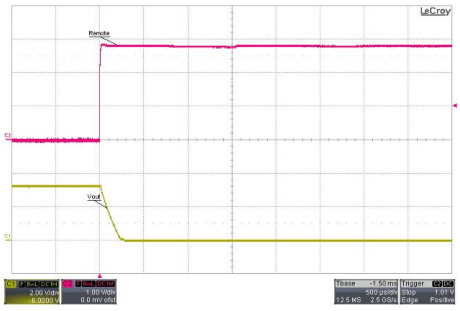


Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load

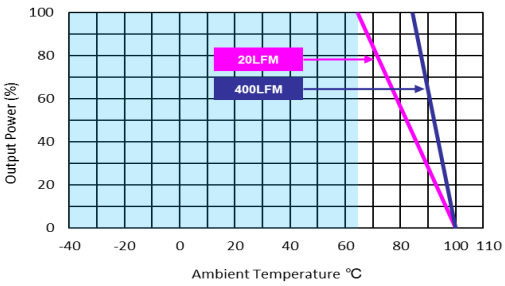


Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$

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



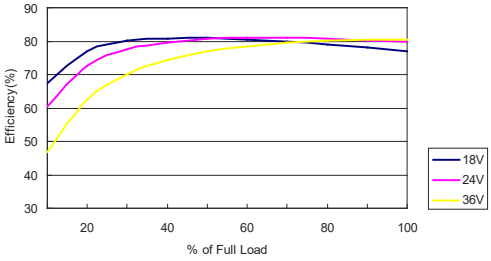
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



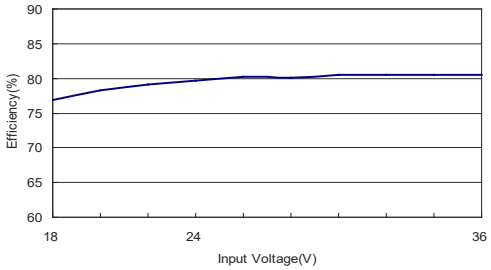
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

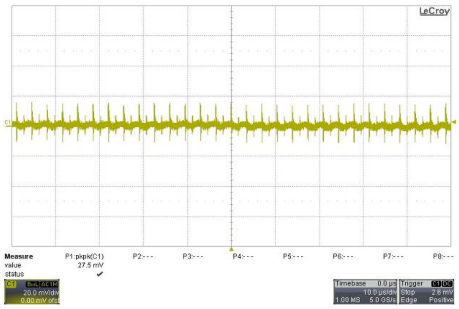
All test conditions are at 25℃ The figures are identical for MCW1032



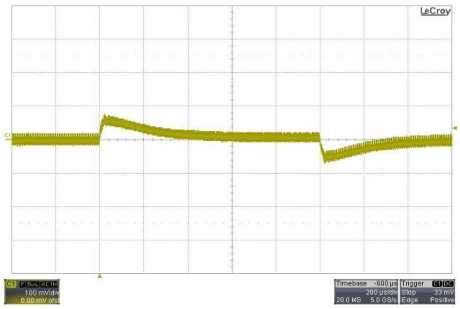
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load

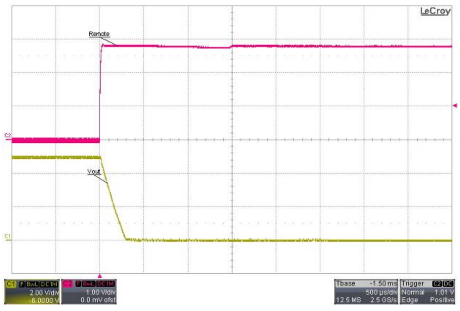


Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load

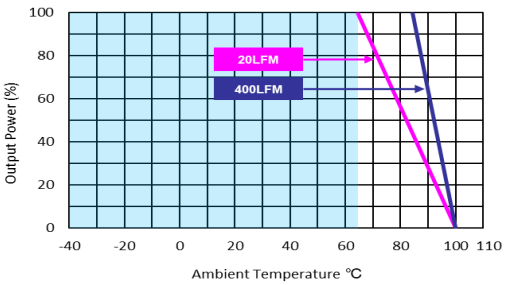


Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$

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



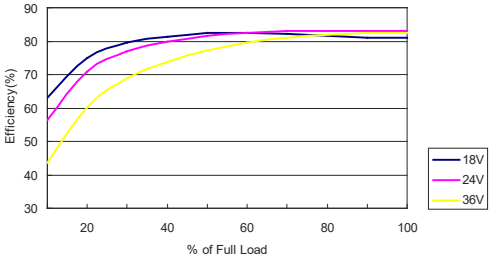
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



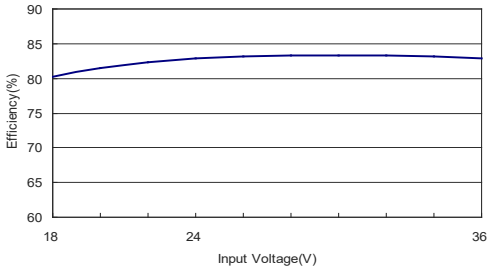
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

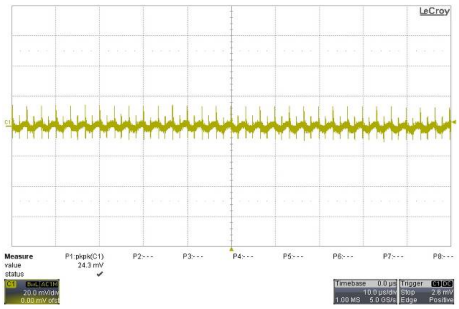
All test conditions are at 25℃ The figures are identical for MCW1033



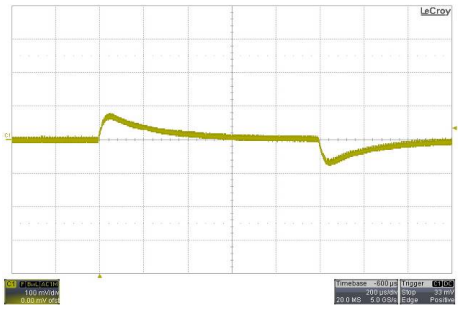
Efficiency Versus Output Current



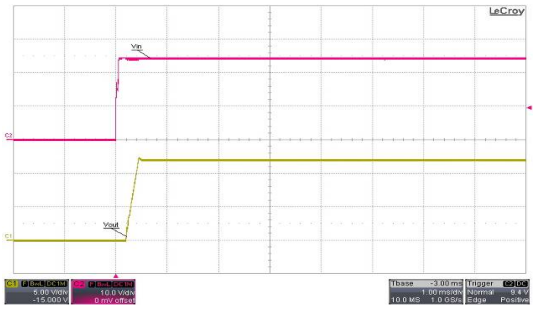
Efficiency Versus Input Voltage
Full Load



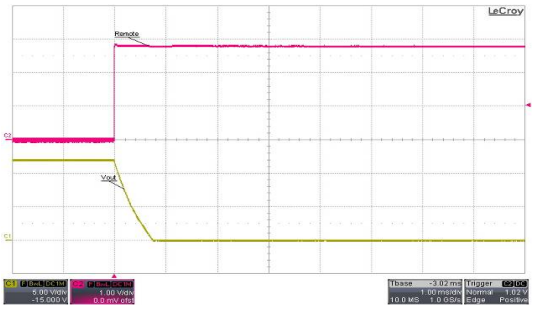
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



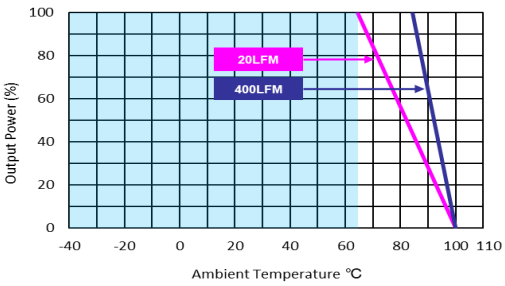
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



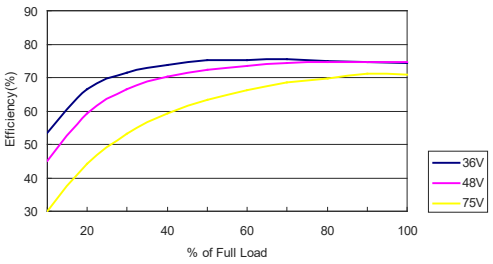
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



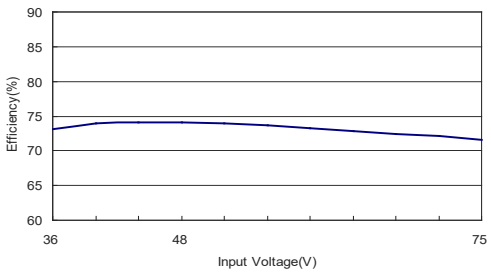
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

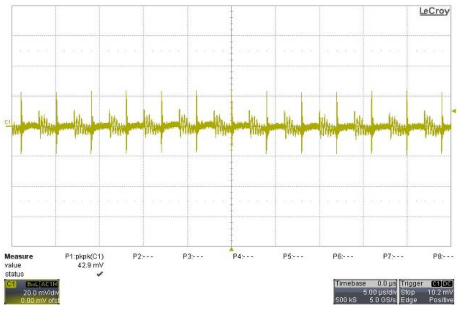
All test conditions are at 25℃ The figures are identical for MCW1041



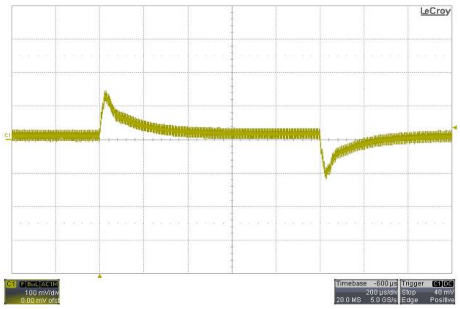
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load

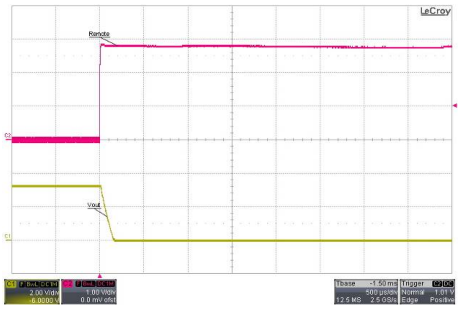


Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load

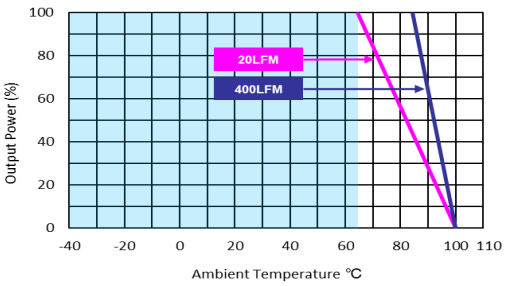


Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$

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



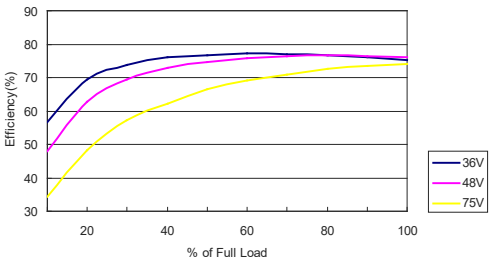
ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



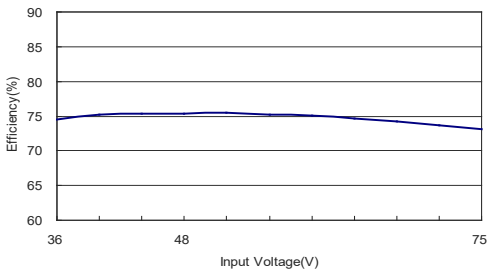
Derating Output Current Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

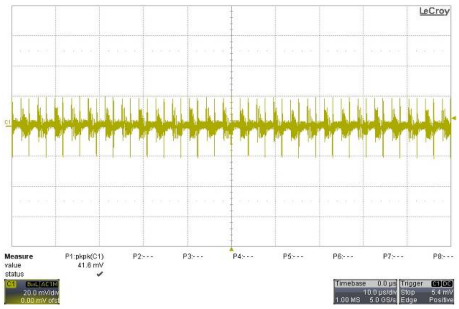
All test conditions are at 25℃ The figures are identical for MCW1042



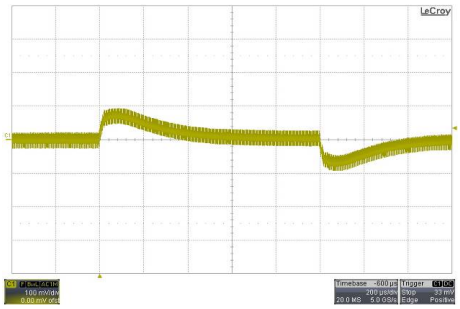
Efficiency Versus Output Current



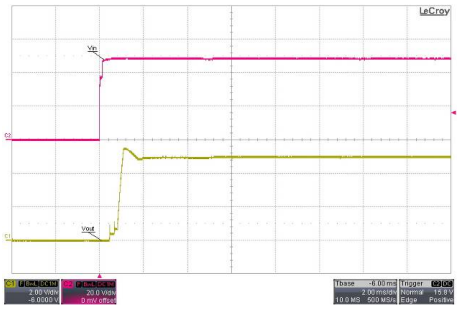
Efficiency Versus Input Voltage
Full Load



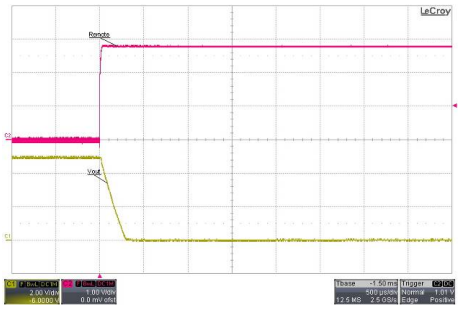
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



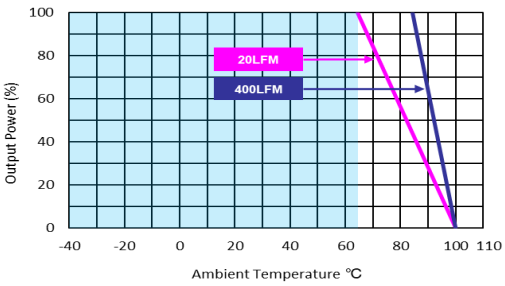
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



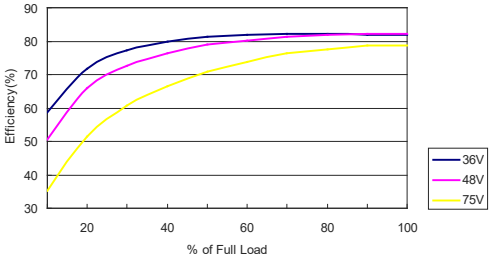
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



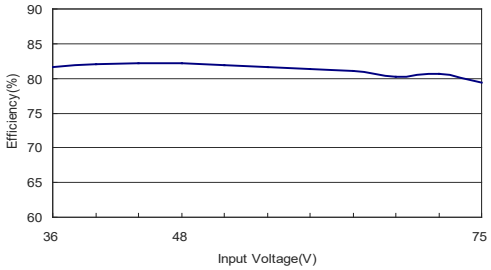
Derating Output Current Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

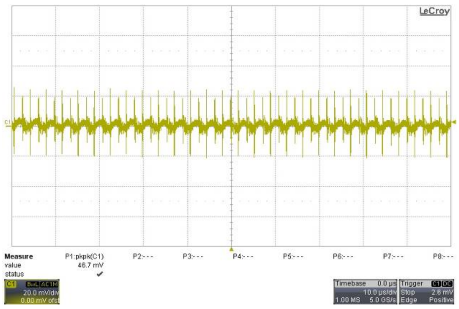
All test conditions are at 25℃ The figures are identical for MCW1043



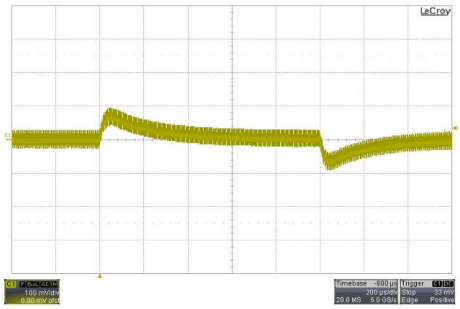
Efficiency Versus Output Current



Efficiency Versus Input Voltage
Full Load



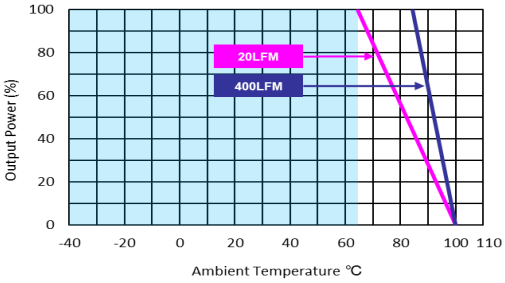
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



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

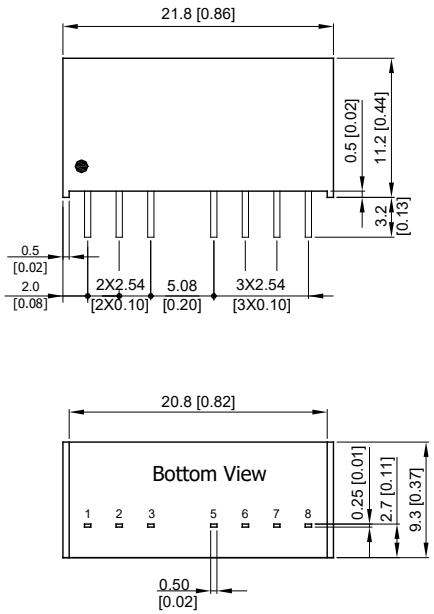
ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



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

Package Specifications

Mechanical Dimensions



Pin Connections

Pin	Function
1	-Vin
2	+Vin
3	Remote On/Off
5	NC
6	+Vout
7	-Vout
8	NC

NC: No Connection

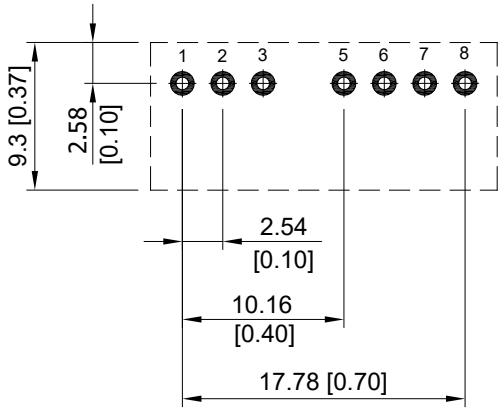
- All dimensions in mm (inches)
- Tolerance: X.X±0.5 (X.XX±0.02)
  X.XX±0.25 (X.XXX±0.01)
- Pins ±0.1(±0.004)

Physical Characteristics

Case Size	:	21.8x9.3x11.2 mm (0.86x0.37x0.44 inches)
Case Material	:	Non-Conductive Black Plastic (flammability to UL 94V-0 rated)
Pin Material	:	Alloy 42
Weight	:	4.8g

Recommended Pad Layout for Single & Dual Output Converter

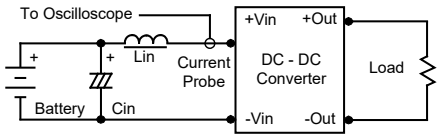
TOP VIEW



Test Setup

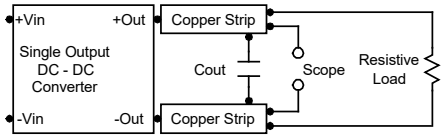
Input Reflected-Ripple Current Test Setup

Input reflected-ripple current is measured with a inductor Lin (4.7μH) and Cin (220μF, ESR < 1.0Ω at 100 kHz) to simulate source impedance. Capacitor Cin, offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 kHz.



Peak-to-Peak Output Noise Measurement Test

Use a Cout 0.47μF 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

Remote On/Off

Negative logic remote on/off turns the module off during a logic high voltage on the remote on/off pin, and on during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent.
A logic high is 2.7V to 15V. A logic low is under 0.6 VDC or open circuit, drops down to 0VDC by 2mV/°C. The maximum sink current at on/off terminal during a logic low is 1 mA. The maximum allowable leakage current of the switch at on/off terminal= (under 0.6VDC or open circuit) is 0.4mA.

Maximum Capacitive Load

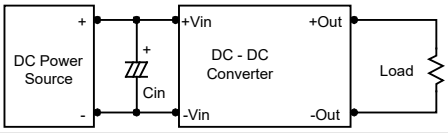
The MCW1000 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the data sheet.

Overload Protection

To provide protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure current limiting for an unlimited duration. At the point of current-limit inception, the unit shifts from voltage control to current control. The unit operates normally once the output current is brought back into its specified range.

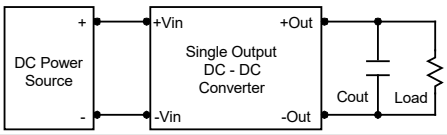
Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup. Capacitor mounted close to the power module helps ensure stability of the unit, it is commended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 kHz) capacitor of a 8.2μF for the 5V input device, a 3.3μF for the 12V input devices and a 1.5μF for the 24V and 48V devices.



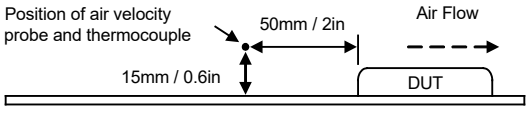
Output Ripple Reduction

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 3.3μF 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 90°C. The derating curves are determined from measurements obtained in a test setup.



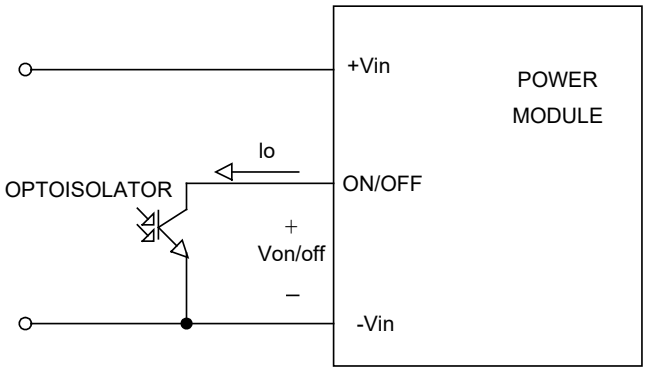
Remote On/Off Implementation

With no suffix, the positive logic remote ON/OFF control circuit is included. Turns the module ON during logic High on the ON/Off pin and turns OFF during logic Low. The ON/OFF input signal (Von/off) that referenced to GND. If not using the remote on/off feature, please open circuit between on/off pin and -Vin pin to turn the module on.

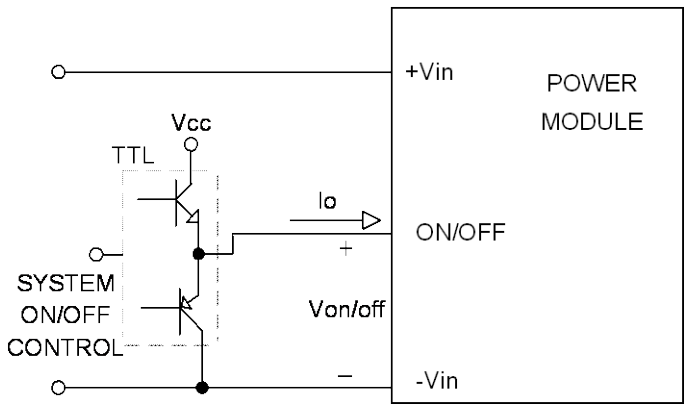
With suffix-N, the negative logic remote ON/OFF control circuit is included.

Turns the module ON during logic Low on the On/Off pin and turns OFF during logic High. The On/Off pin is an open collector/drain logic input signal (Von/off) that referenced to GND. If not using the remote on/off feature. Please short circuit between on/off pin and –Vin pin to turn the module on.

Remote ON/OFF implementation

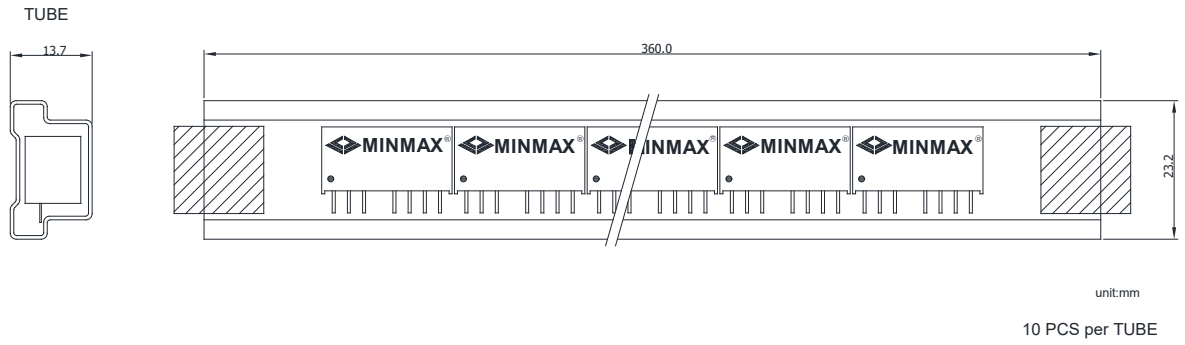


Isolated-Closure Remote ON/OFF



Level Control Using TTL Output

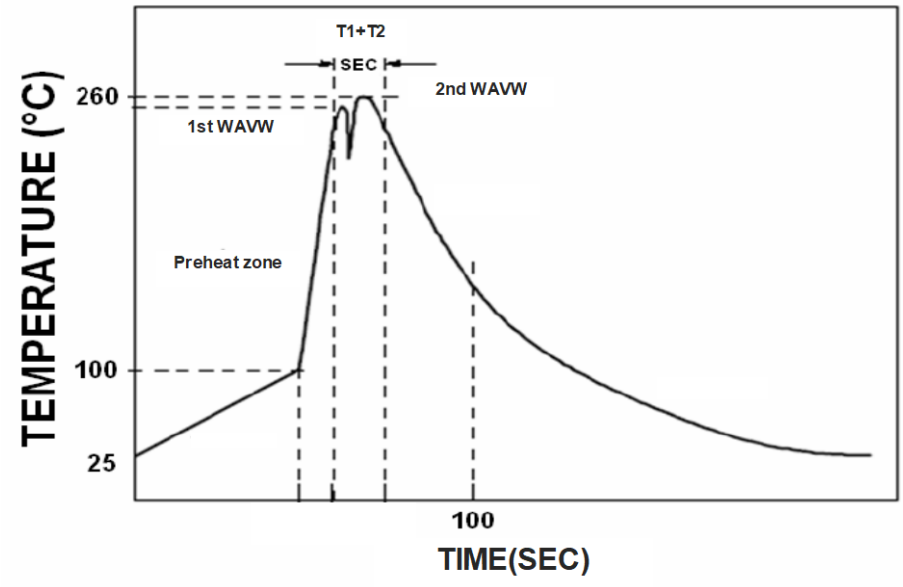
Packaging Information



10 PCS per 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

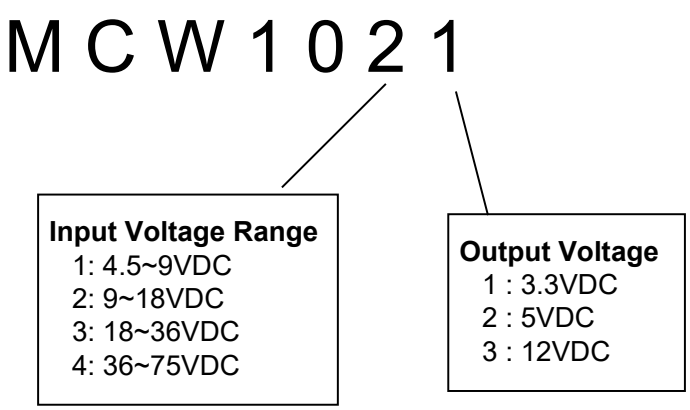
Reference Solder: Sn-Ag-Cu：Sn-Cu：Sn-Ag

Hand Welding: Soldering iron：Power 60W

Welding Time: 2~4 sec

Temp.: 380~400°C

Part Number Structure



MTBF and Reliability

The MTBF of MCW1000 series of DC-DC converters has been calculated using

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

Model	MTBF	Unit
MCW1011	1,889,645	Hours
MCW1012	1,889,645	
MCW1013	2,028,809	
MCW1021	1,855,632	
MCW1022	1,889,645	
MCW1023	1,990,446	
MCW1031	1,839,250	
MCW1032	1,867,762	
MCW1033	1,971,998	
MCW1041	1,822,822	
MCW1042	1,822,822	
MCW1043	1,953,507	