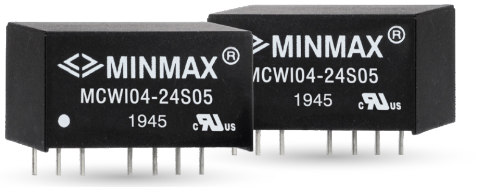
MCWI04 Series

Electric Characteristic Note

DC-DC CONVERTER 4W, SIP-Package



Features

- **Compact SIP-8 Package**
- **Ultra-wide 4:1 Input Voltage Range**
- **Fully Regulated Output Voltage**
- **I/O Isolation 1600 VDC**
- **Operating Ambient Temp. Range -40℃ to +85℃**
- **No Min. Load Requirement**
- **Overload and Short Circuit Protection**
- **Remote On/Off Control**
- **UL/cUL/IEC/EN 62368-1 Safety Approval, CE Marking**

Applications

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

Product Overview

The MINMAX MCWI04 series is a range of isolated 4W DC-DC converter modules featuring fully regulated output voltages and ultra-wide 4:1 input voltage ranges. The converters come in a very small SIP-8 package which occupies only 2.0 cm^2 of PCB space. An excellent efficiency allows operating temperatures up to +85°C. Further features include remote ON/OFF, 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 Power	Output Current	Input Current		Max. capacitive Load	Efficiency (typ.)
				Max.	@Max. Load	@No Load		@Max. Load
	VDC	VDC	W	mA	mA(typ.)	mA(typ.)	μF	%
MCWI04-24S05	24 (9 ~ 36)	5	4	800	211	20	1800	79
MCWI04-24S12		12	4	333	201		1000	83
MCWI04-24S15		15	3.99	266	200		820	83
MCWI04-24S24		24	3.98	166	200		470	83
MCWI04-24D12		±12	3.98	±166	200		560#	83
MCWI04-24D15		±15	3.99	±133	200		390#	83
MCWI04-48S05	48 (18 ~ 75)	5	4	800	107	10	1800	78
MCWI04-48S12		12	4	333	102		1000	82
MCWI04-48S15		15	3.99	266	101		820	82
MCWI04-48S24		24	3.98	166	101		470	82
MCWI04-48D12		±12	3.98	±166	101		560#	82
MCWI04-48D15		±15	3.99	±133	101		390#	82

For each output

Input Specifications

Parameter	Conditions / Model	Min.	Typ.	Max.	Unit
Input Surge Voltage (1 sec. max.)	24V Input Models	-0.7	---	50	VDC
	48V Input Models	-0.7	---	100	
Start-Up Threshold Voltage	24V Input Models	---	---	9	
	48V Input Models	---	---	18	
Start-Up Time (Power On)	Nominal Vin and Constant Resistive Load	---	30	---	ms
Input Filter	All Models	Internal Capacitor			

Remote On/Off Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Converter On	Under 0.6 VDC or Open Circuit				
Converter Off	6 to 15VDC				
Standby Input Current	Nominal Vin	---	2.5	---	mA

Output Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy		---	---	±1.0	%Vnom.
Output Voltage Balance	Dual Output, Balanced Loads	---	---	±2.0	%
Line Regulation	Vin=Min. to Max. @Full Load	---	---	±0.5	%
Load Regulation	Io=0% to 100%	---	---	±1.0	%
Load Cross Regulation (Dual Output)	Asymmetrical Load 25/100% Full Load	---	---	±5.0	%
Minimum Load	No minimum Load Requirement				
Ripple & Noise	0-20 MHz Bandwidth	---	---	80	mV_{P-P}
Transient Recovery Time	25% Load Step Change	---	250	---	μsec
Transient Response Deviation		---	±3	±5	%
Temperature Coefficient		---	---	±0.02	%/℃
Over Load Protection	Foldback	---	160	---	%
Short Circuit Protection	Continuous, Automatic Recovery				

General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds	1600	---	---	VDC
	1 Second	1920	---	---	VDC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
I/O Isolation Capacitance	100kHz, 1V	---	200	---	pF
Switching Frequency	PFM Mode	100	---	---	kHz
MTBF(calculated)	MIL-HDBK-217F@25℃, Ground Benign	2,859,569	---	---	Hours
Safety Approvals	UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1 & 60950-1(CB report)				

EMC Specifications

Parameter	Standards & Level			Performance
EMI	Conduction	EN 55032	With external components	Class A (1)
	Radiation			
EMS	EN 55024, EN 55035			
	ESD	Direct discharge	Indirect discharge HCP & VCP	A
		EN 61000-4-2 Air ± 8kV	Contact ± 6kV	
	Radiated immunity	EN 61000-4-3 10V/m		A
	Fast transient (2)	EN 61000-4-4 ±2kV		A
	Surge (2)	EN 61000-4-5 ±1kV		A
	Conducted immunity	EN 61000-4-6 10Vrms		A
	PFMF	EN 61000-4-8 3A/m		A

Environmental Specifications

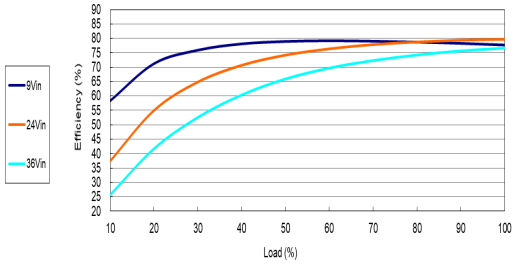
Parameter	Min.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	-40	+85	℃
Case Temperature	---	+100	℃
Storage Temperature	-55	+125	℃
Humidity (non condensing)	---	95	% rel. H

Notes

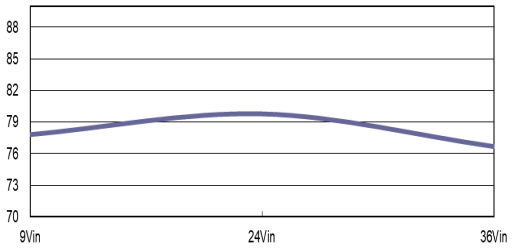
1 To meet EN 55032 Class A with an external filter, please contact MINMAX.
2 To meet EN 61000-4-4 & EN 61000-4-5 an external filter requested, please contact MINMAX.
3 Specifications typical at Ta=+25℃, resistive load, nominal input voltage, rated output current unless otherwise noted.
4 We recommend 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

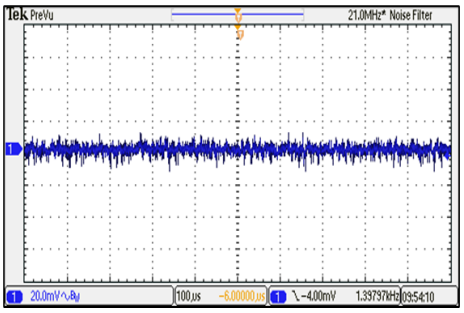
All test conditions are at 25℃ The figures are identical for MCWI04-24S05



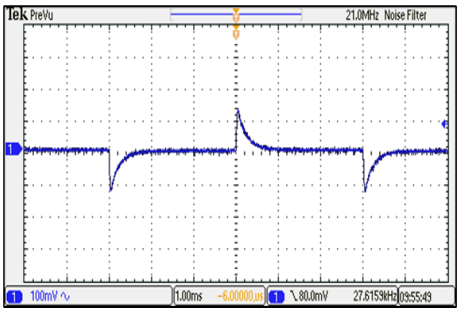
Efficiency Versus Output Current



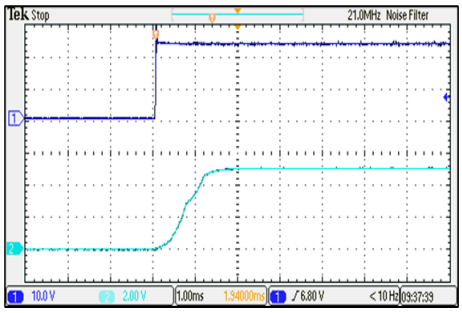
Efficiency Versus Input Voltage
Full Load



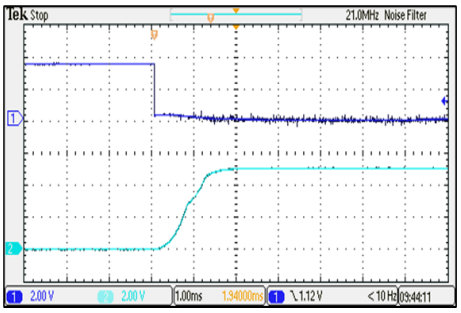
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



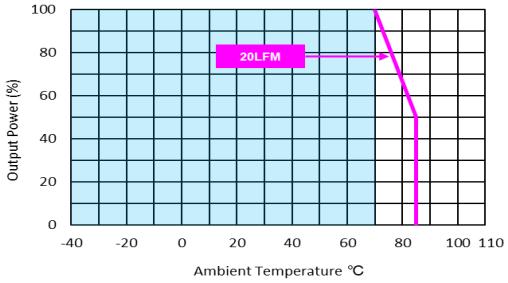
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

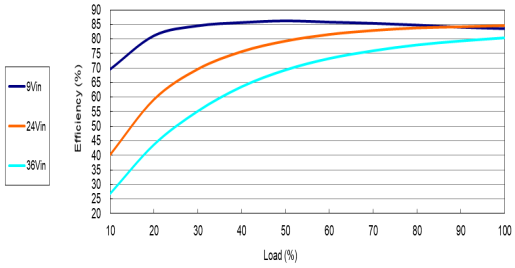


Derating Output Power Versus Ambient Temperature

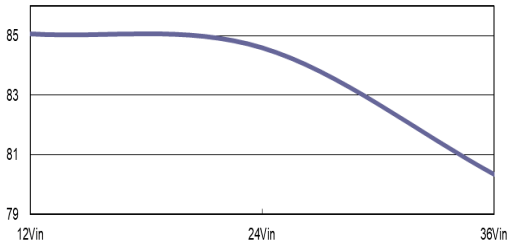
$V_{in}=V_{in\ nom}$

Characteristic Curves

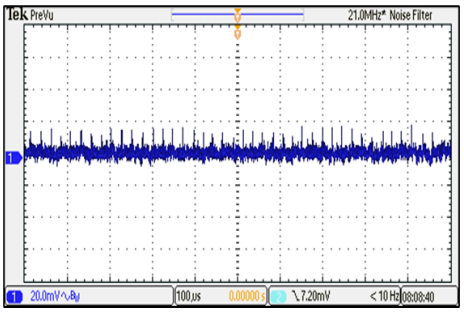
All test conditions are at 25℃ The figures are identical for MCWI04-24S12



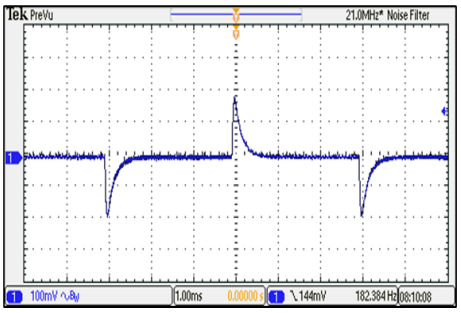
Efficiency Versus Output Current



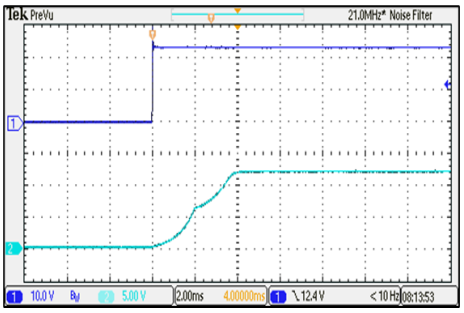
Efficiency Versus Input Voltage
Full Load



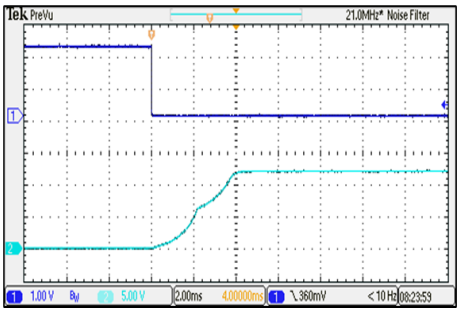
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



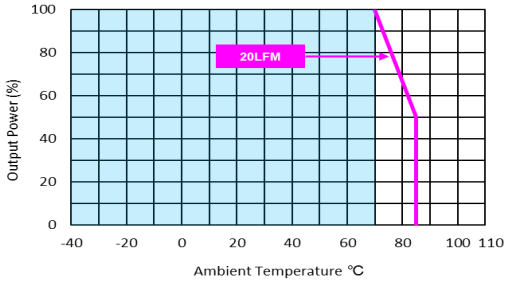
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

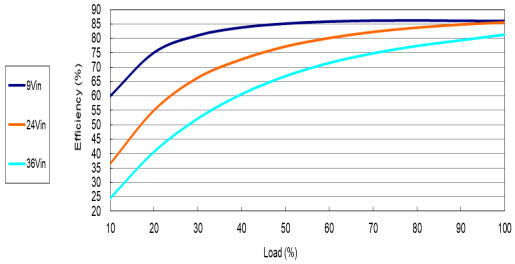


Derating Output Power Versus Ambient Temperature

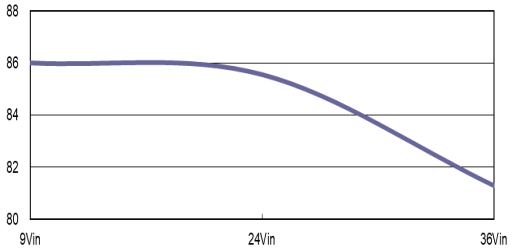
$V_{in}=V_{in\ nom}$

Characteristic Curves

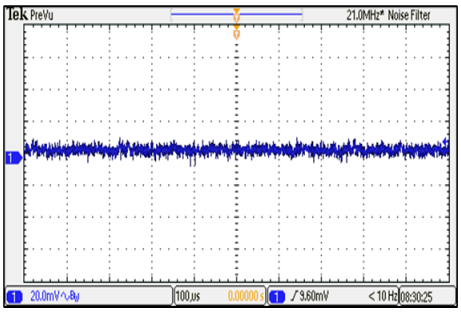
All test conditions are at 25℃ The figures are identical for MCWI04-24S15



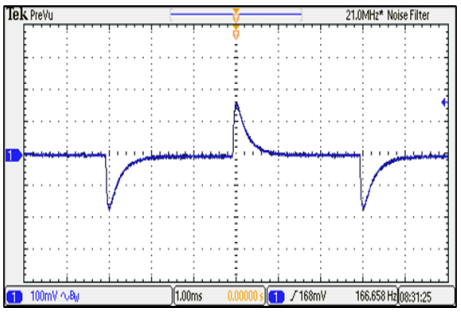
Efficiency Versus Output Current



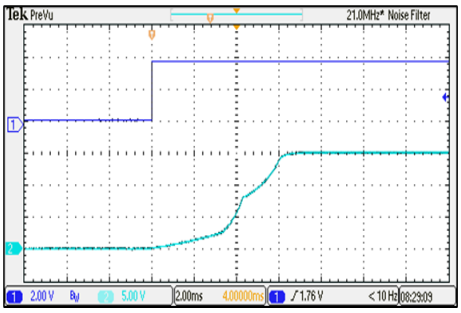
Efficiency Versus Input Voltage
Full Load



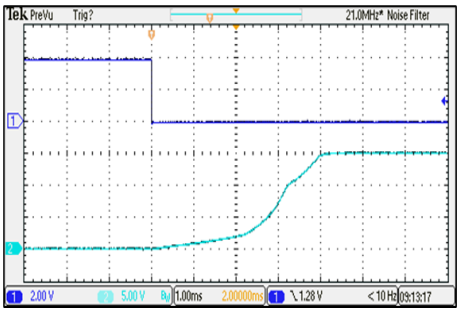
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



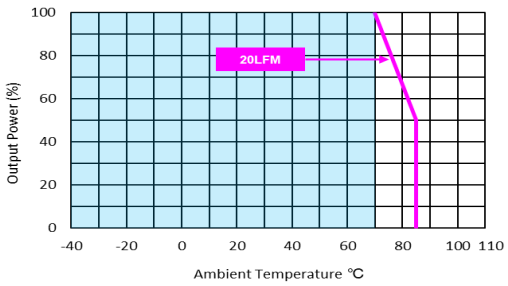
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

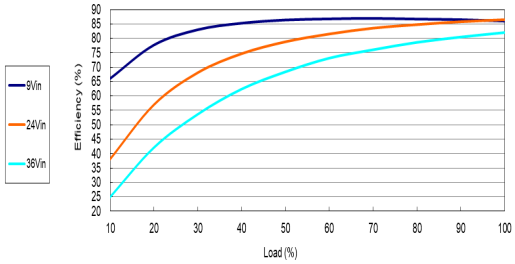


Derating Output Power Versus Ambient Temperature

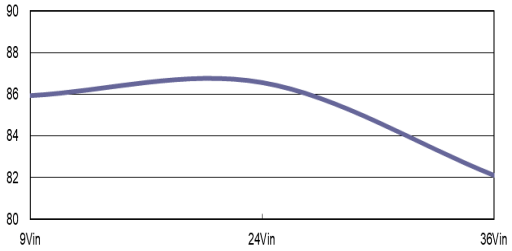
$V_{in}=V_{in\ nom}$

Characteristic Curves

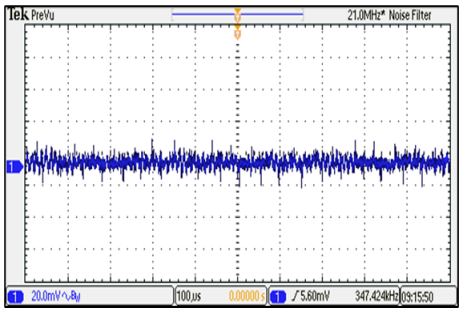
All test conditions are at 25℃ The figures are identical for MCWI04-24S24



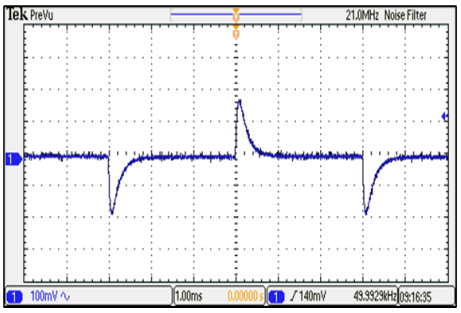
Efficiency Versus Output Current



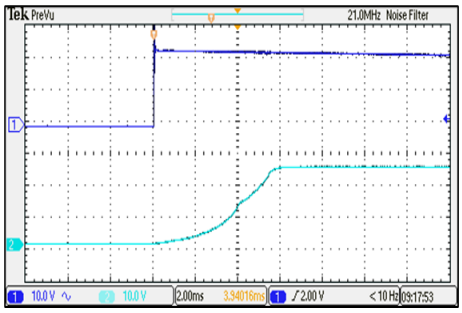
Efficiency Versus Input Voltage
Full Load



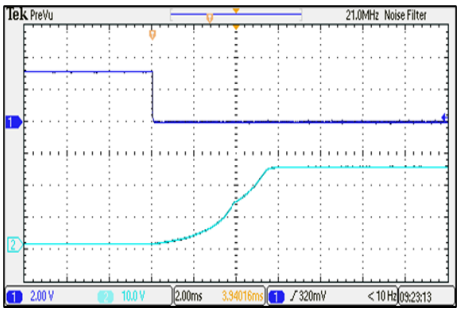
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



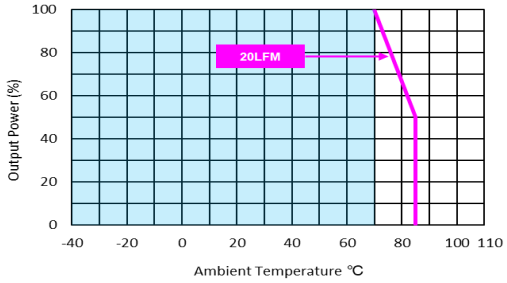
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

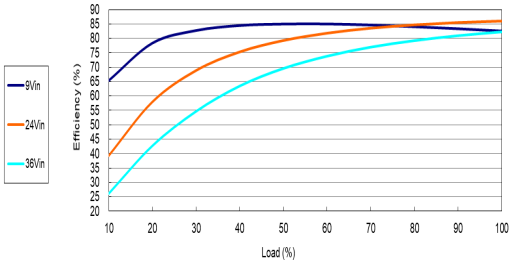


Derating Output Power Versus Ambient Temperature

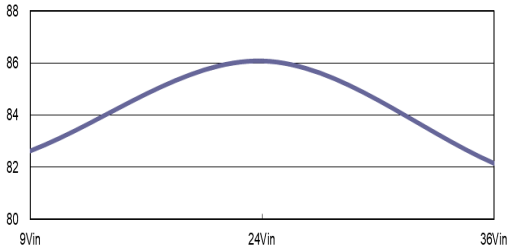
$V_{in}=V_{in\ nom}$

Characteristic Curves

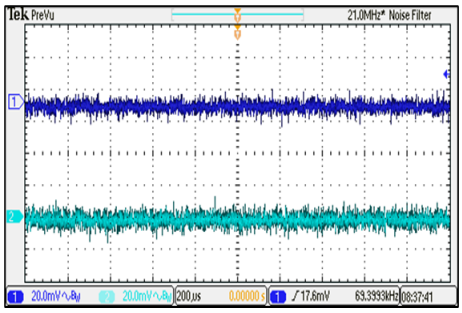
All test conditions are at 25℃ The figures are identical for MCWI04-24D12



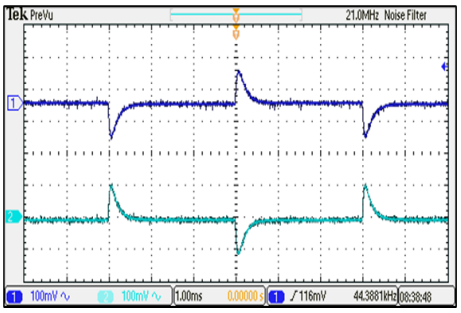
Efficiency Versus Output Current



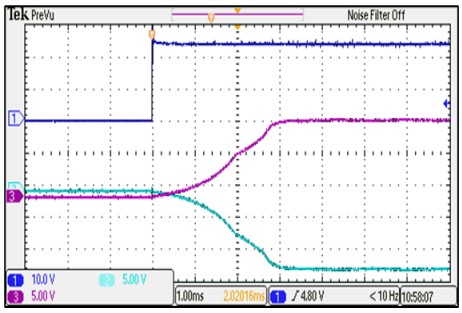
Efficiency Versus Input Voltage
Full Load



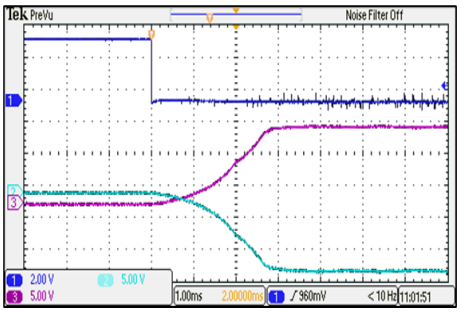
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



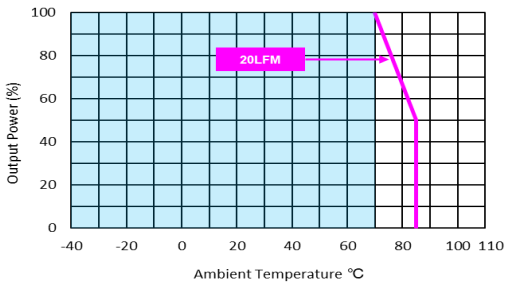
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

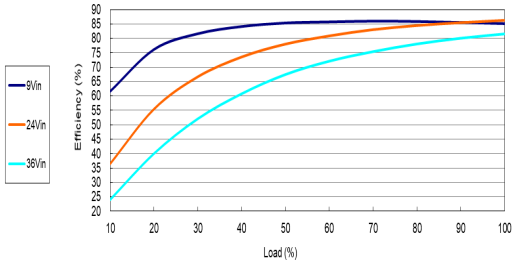


Derating Output Power Versus Ambient Temperature

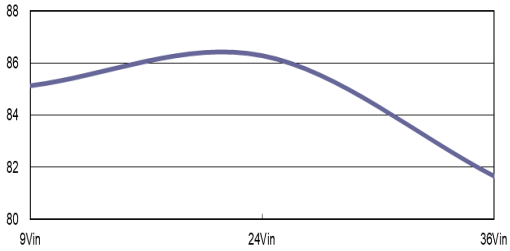
$V_{in}=V_{in\ nom}$

Characteristic Curves

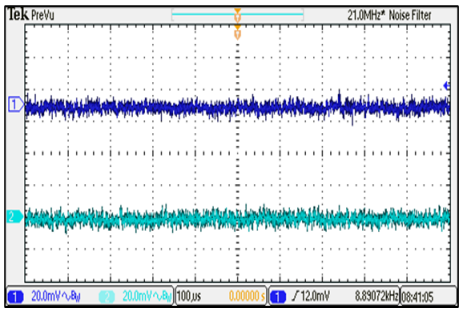
All test conditions are at 25℃ The figures are identical for MCWI04-24D15



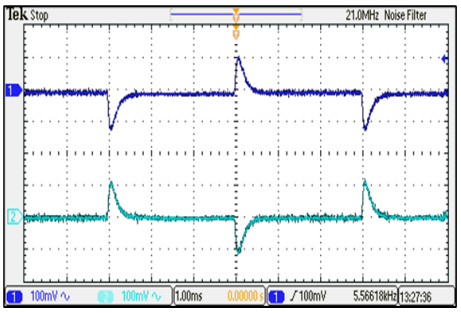
Efficiency Versus Output Current



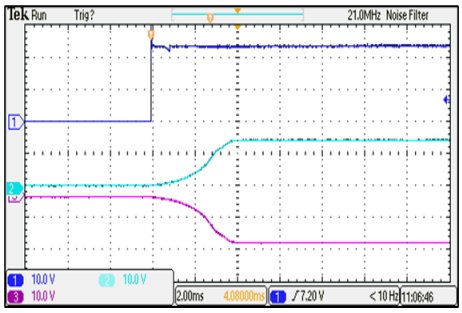
Efficiency Versus Input Voltage
Full Load



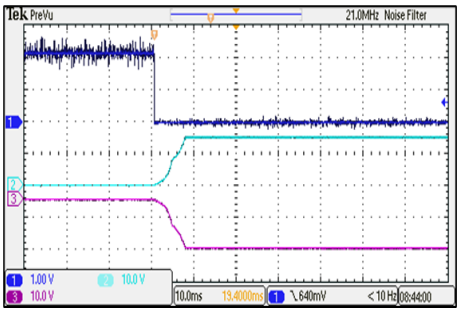
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



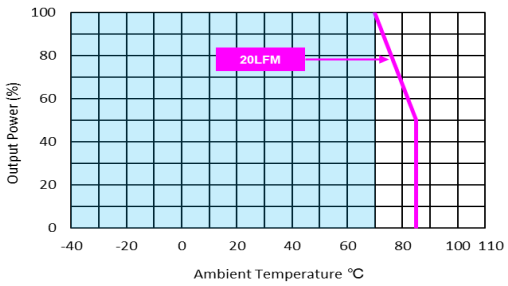
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

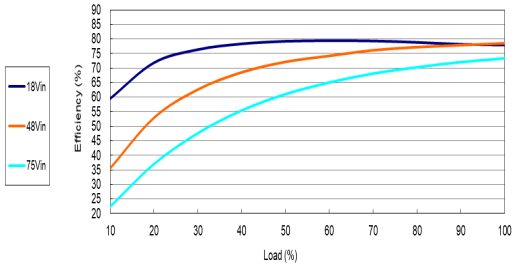


Derating Output Power Versus Ambient Temperature

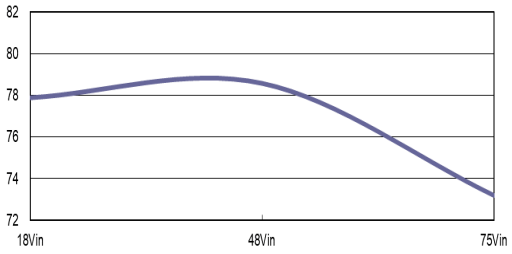
$V_{in}=V_{in\ nom}$

Characteristic Curves

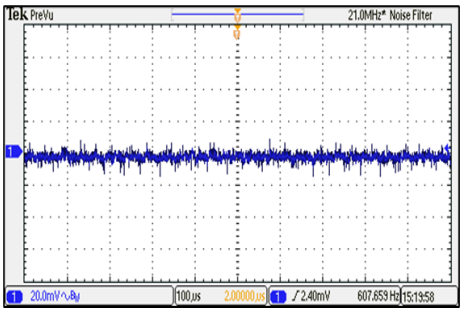
All test conditions are at 25℃ The figures are identical for MCWI04-48S05



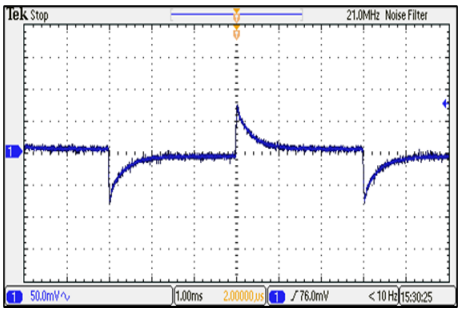
Efficiency Versus Output Current



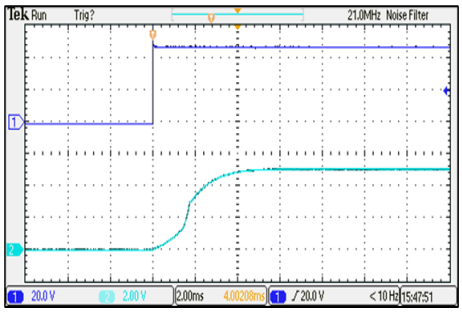
Efficiency Versus Input Voltage
Full Load



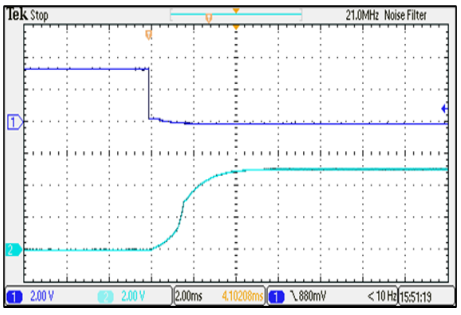
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



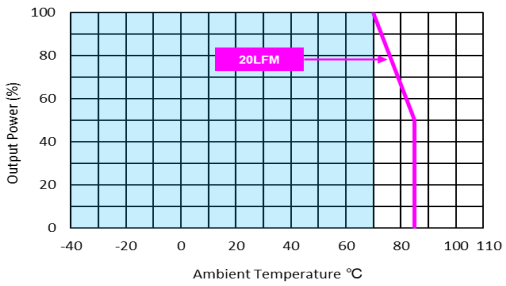
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

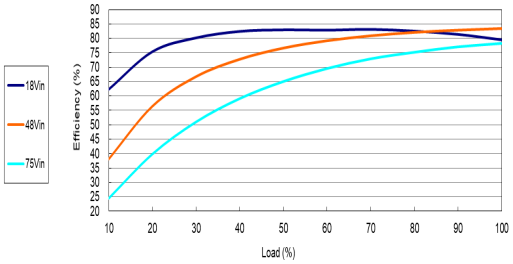


Derating Output Power Versus Ambient Temperature

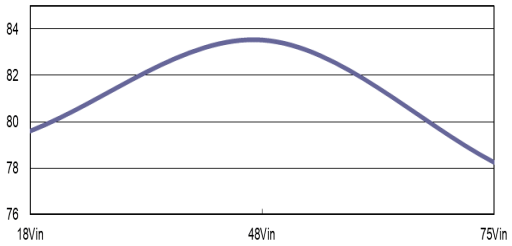
$V_{in}=V_{in\ nom}$

Characteristic Curves

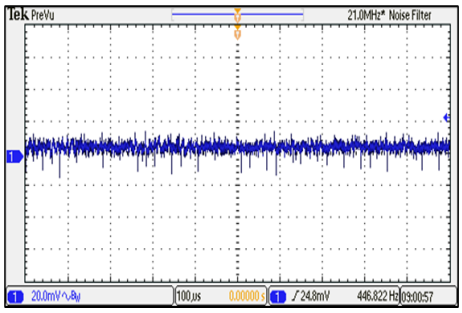
All test conditions are at 25℃ The figures are identical for MCWI04-48S12



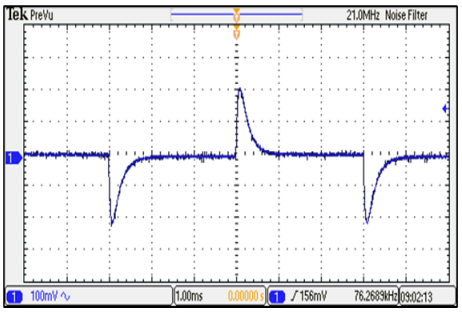
Efficiency Versus Output Current



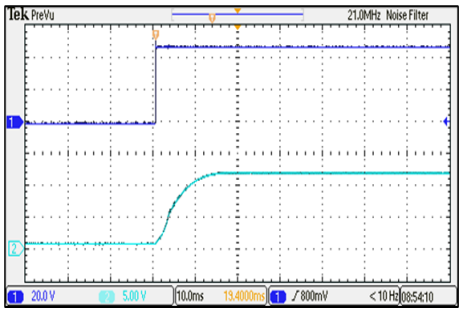
Efficiency Versus Input Voltage
Full Load



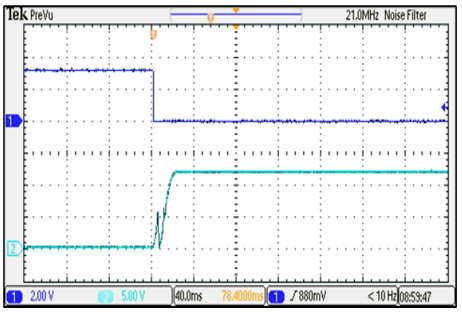
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



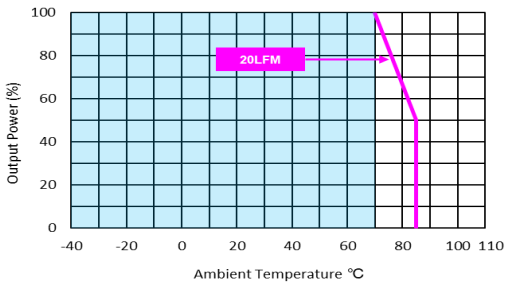
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

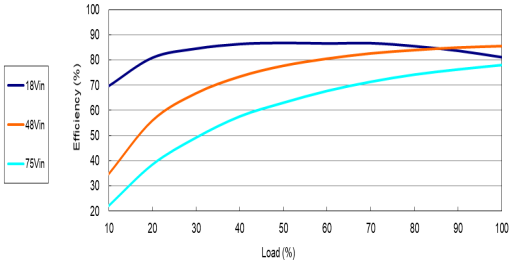


Derating Output Power Versus Ambient Temperature

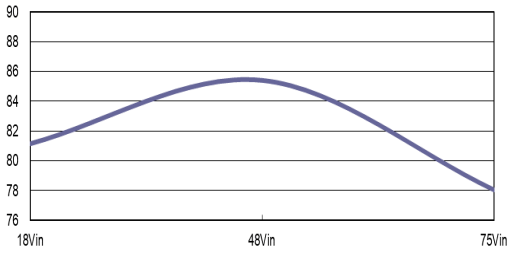
$V_{in}=V_{in\ nom}$

Characteristic Curves

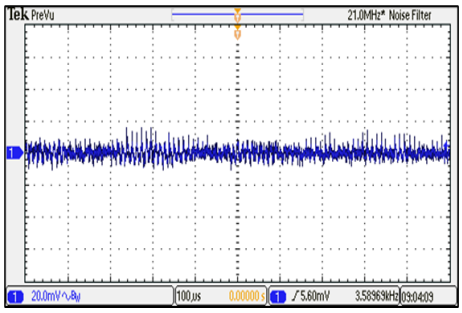
All test conditions are at 25℃ The figures are identical for MCWI04-48S15



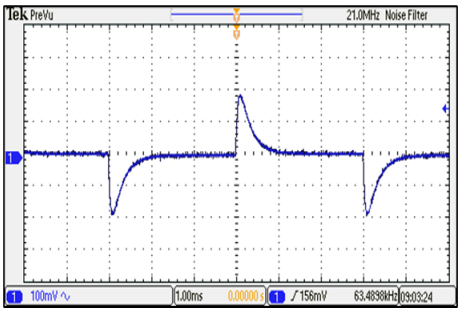
Efficiency Versus Output Current



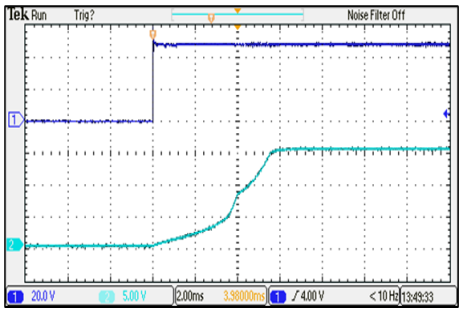
Efficiency Versus Input Voltage
Full Load



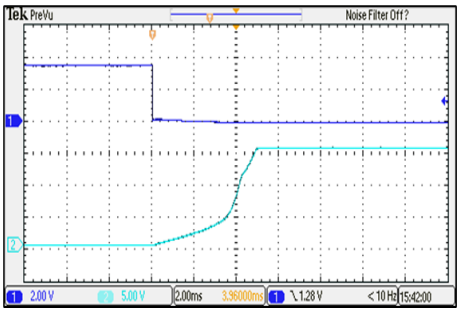
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



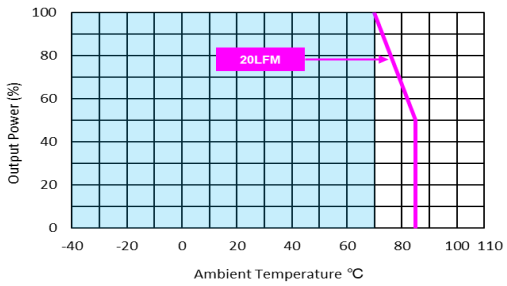
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

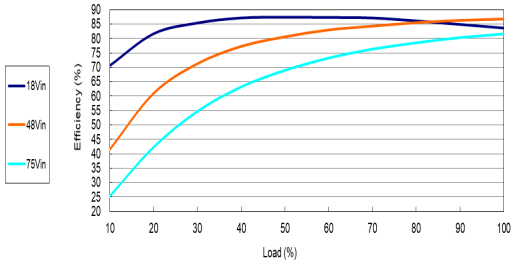


Derating Output Power Versus Ambient Temperature

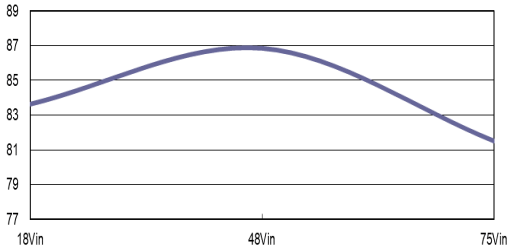
$V_{in}=V_{in\ nom}$

Characteristic Curves

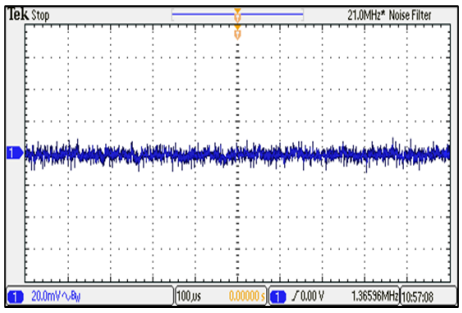
All test conditions are at 25℃ The figures are identical for MCWI04-48S24



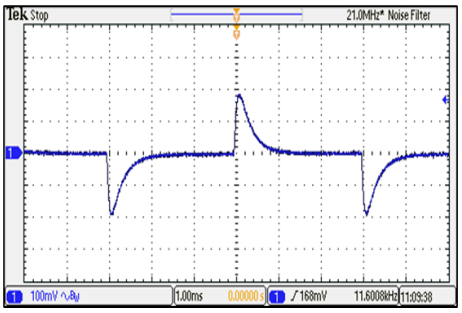
Efficiency Versus Output Current



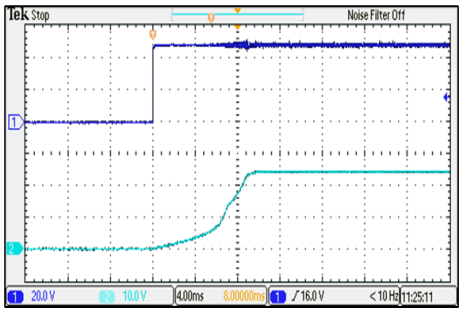
Efficiency Versus Input Voltage
Full Load



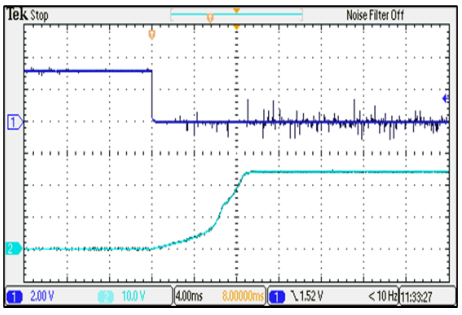
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



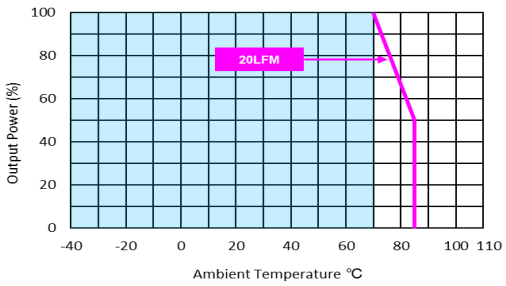
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

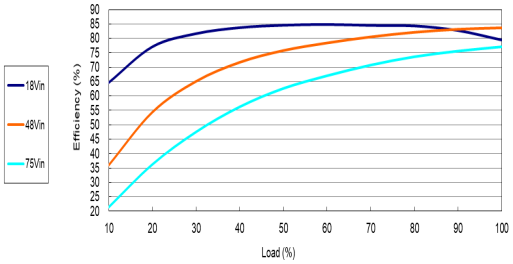


Derating Output Power Versus Ambient Temperature

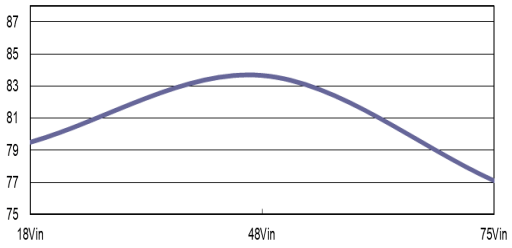
$V_{in}=V_{in\ nom}$

Characteristic Curves

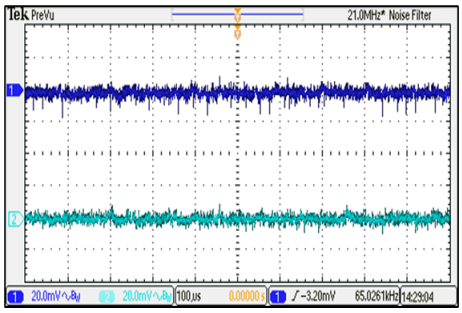
All test conditions are at 25℃ The figures are identical for MCWI04-48D12



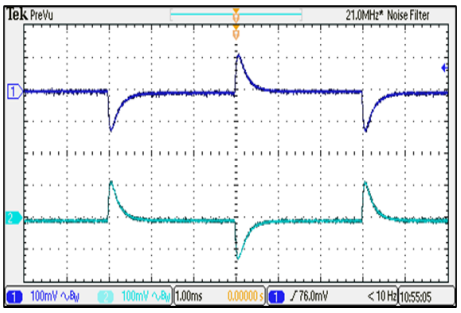
Efficiency Versus Output Current



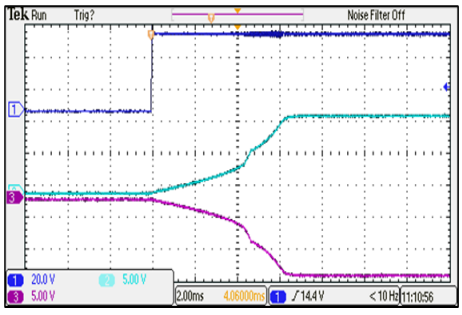
Efficiency Versus Input Voltage
Full Load



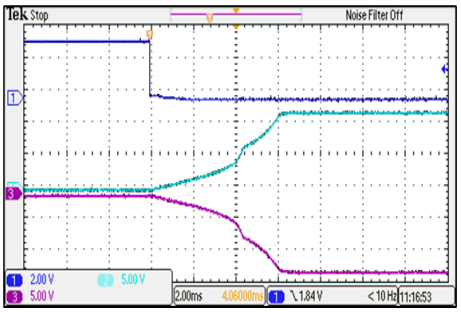
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



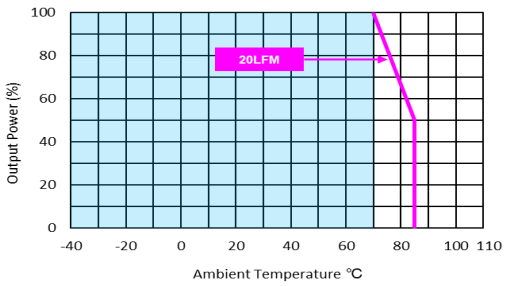
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

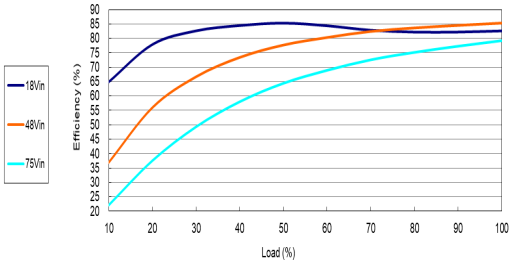


Derating Output Power Versus Ambient Temperature

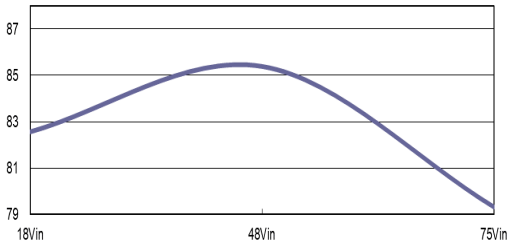
$V_{in}=V_{in\ nom}$

Characteristic Curves

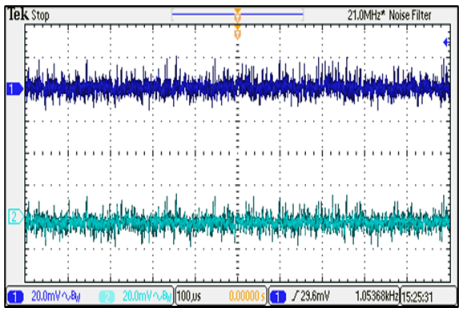
All test conditions are at 25℃ The figures are identical for MCWI04-48D15



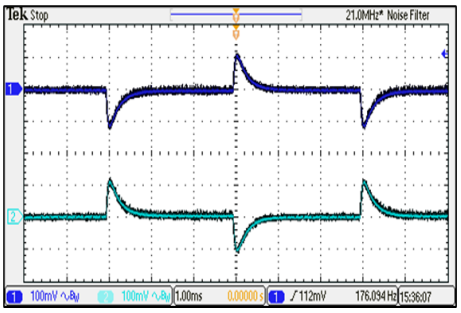
Efficiency Versus Output Current



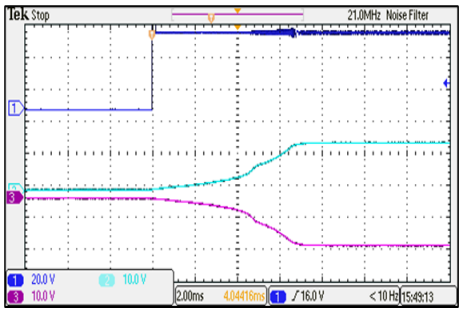
Efficiency Versus Input Voltage
Full Load



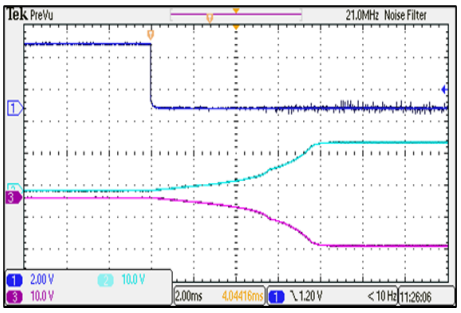
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



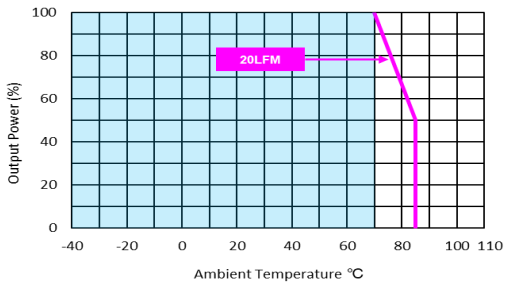
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



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

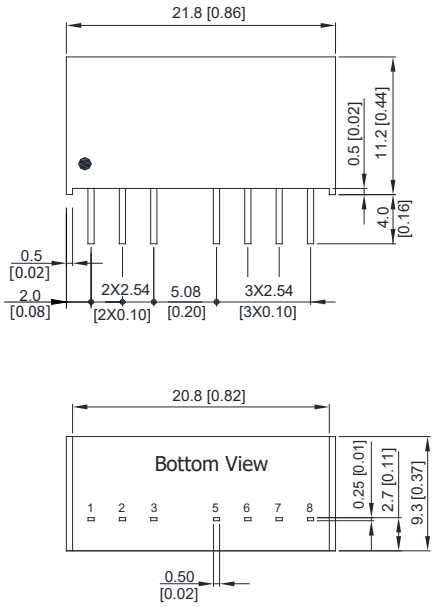


Derating Output Power Versus Ambient Temperature

$V_{in}=V_{in\ nom}$

Package Specifications

Mechanical Dimensions



Pin Connections

Pin	Single Output	Dual Output
1	-Vin	-Vin
2	+Vin	+Vin
3	Remote On/Off	Remote On/Off
5	NC	NC
6	+Vout	+Vout
7	-Vout	Common
8	NC	-Vout

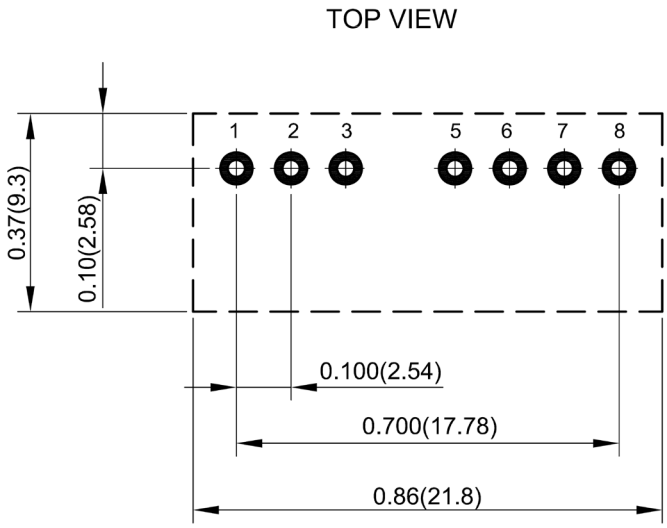
NC: No Connection

- 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	:	Phosphor Bronze with Tin Plate
Weight	:	4.8g

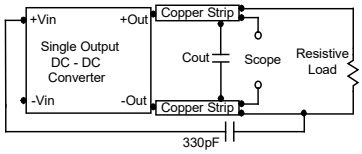
Recommended Pad Layout for Single & Dual Output Converter

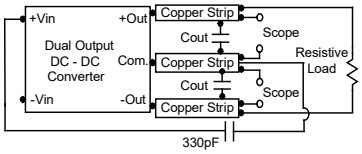


Test Setup

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 6V to 15V. A logic low is under 0.6 VDC or open circuit, drops down to 0VDC by 2mV/℃. 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 1mA.

Maximum Capacitive Load

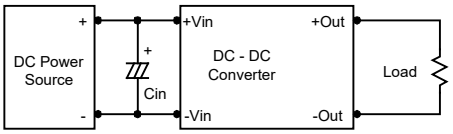
The MCWI04 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the data sheet.

Overcurrent 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.

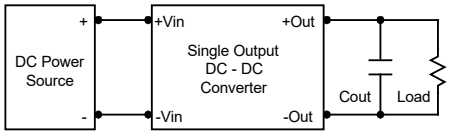
Input Source Impedance

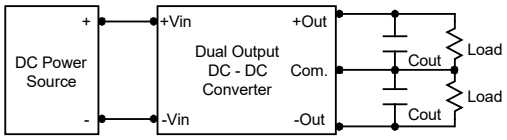
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.
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 1.5μF for the 24V and 48V input devices.



Output Ripple Reduction

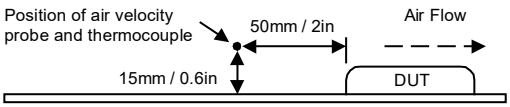
A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 3.3μF capacitors at the output.





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



Remote ON/OFF Implementation

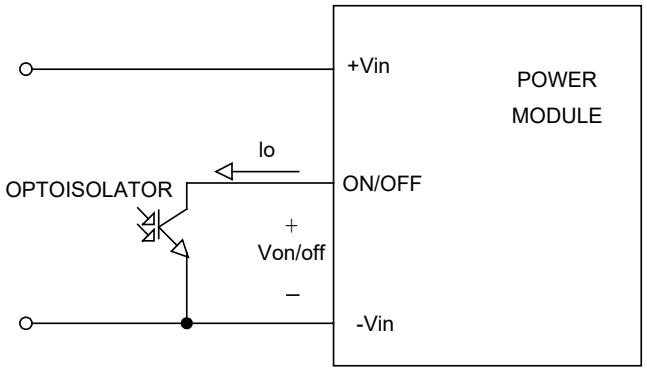
The positive logic remote ON/OFF control circuit is included.

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.

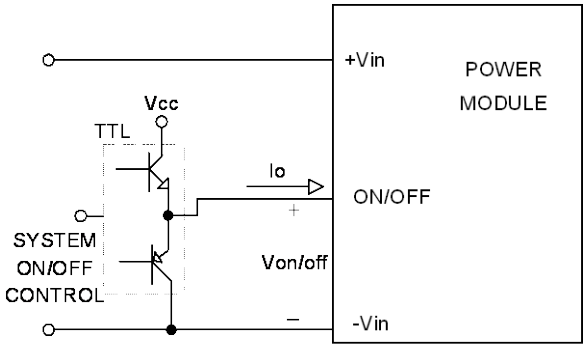
The negative logic remote ON/OFF control circuit is included.

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

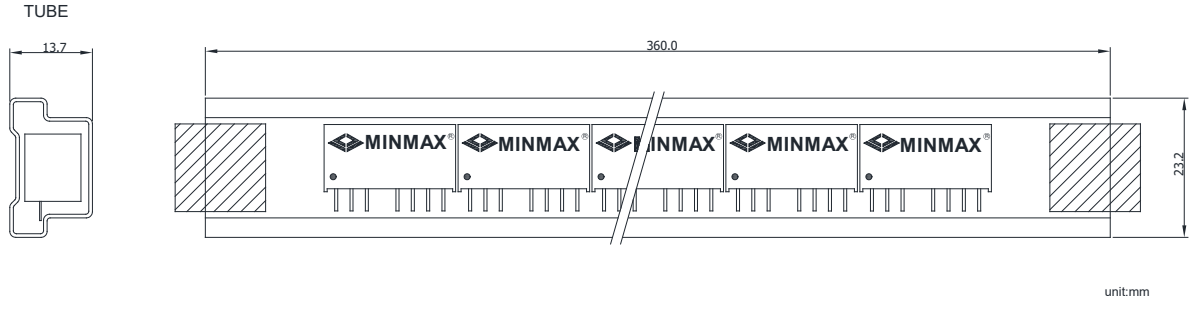


Isolated-Closure Remote ON/OFF



Level Control Using TTL Output

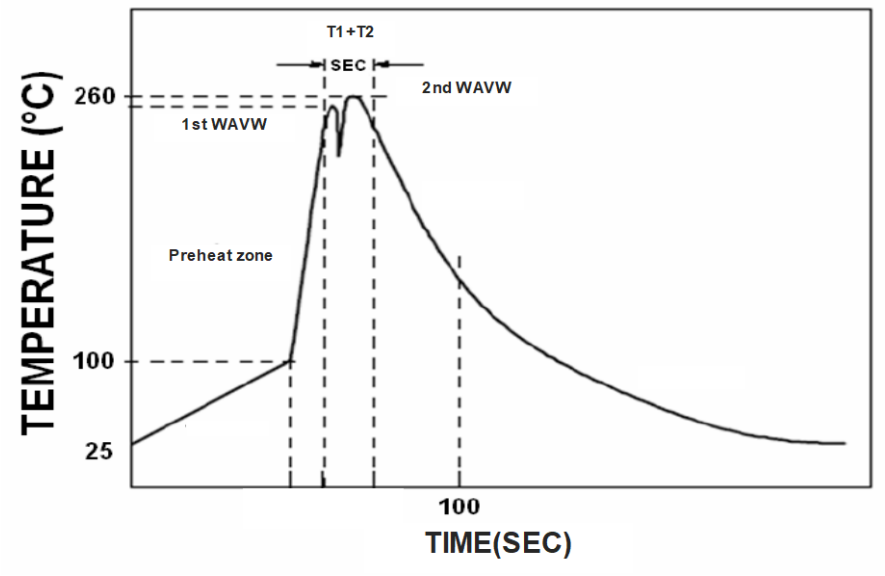
Packaging Information



10 PCS per TUBE

Wave Soldering Considerations

Lead free wave solder profile



Zone	Reference Parameter
Preheat	Rise temp. speed：3℃/sec max.
zone	Preheat temp.：100~130℃
Actual	Peak temp.：250~260℃
heating	Peak time(T1+T2)：4~6 sec

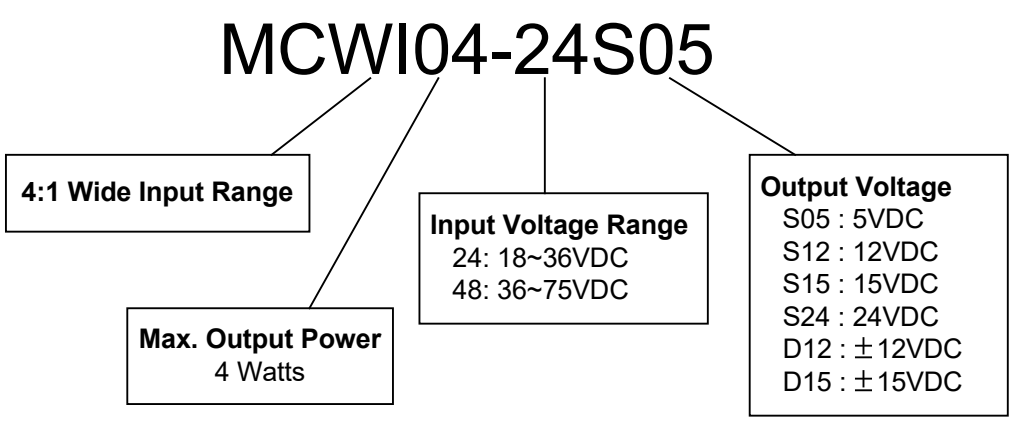
Reference Solder: Sn-Ag-Cu：Sn-Cu：Sn-Ag

Hand Welding: Soldering iron：Power 60W

Welding Time: 2~4 sec

Temp.: 380~400℃

Part Number Structure



MTBF and Reliability

The MTBF of MCWI04 series of DC-DC converters has been calculated using

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

Model	MTBF	Unit
MCWI04-24S05	2,859,569	Hours
MCWI04-24S12	3,564,351	
MCWI04-24S15	3,787,227	
MCWI04-24S24	3,712,520	
MCWI04-24D12	2,945,156	
MCWI04-24D15	3,682,175	
MCWI04-48S05	2,608,248	
MCWI04-48S12	3,488,039	
MCWI04-48S15	3,689,582	
MCWI04-48S24	3,360,430	
MCWI04-48D12	2,858,990	
MCWI04-48D15	3,206,793	