



MINMAX[®]

MDW12 Series

Electric Characteristic Note

MDW12 Series EC Note

DC-DC CONVERTER 12W, Regulated Output, DIP Package

Features

- ▶ Smallest Encapsulated 12W Converter
- ▶ Industrial Standard DIP-16 Package
- ▶ Wide 2:1 Input Voltage Range
- ▶ Fully Regulated Output Voltage
- ▶ I/O Isolation 1500 VDC
- ▶ Operating Ambient Temp. Range -40°C to +85°C
- ▶ Low No Load Power Consumption
- ▶ No Min. Load Requirement
- ▶ Under-voltage, Overload and Short Circuit Protection
- ▶ Shielded Metal Case with Insulated Baseplate
- ▶ Conducted EMI EN 55032 Class A
- ▶ UL/cUL/IEC/EN 62368-1 Safety Approval & CE Marking



Applications

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

Product Overview

The MDW12 series gives designers the flexibility to match the choice of converter to specific application requirements. The high power density of MDW12 series, at 59W/in³, is expected to make it popular with manufacturers of industrial, medical, transportation and power generation equipment where space-constrained designs. This product offers a full 12Watt isolated DC-DC converter within a small encapsulated DIP-16 package which occupied only 0.5in² of PCB space. There are 21 models available for 12, 24 & 48VDC with wide 2:1 input voltage range. Further features included under-voltage protection, overload protection, short circuit protection, very low no load power consumption, no min. load requirement and conducted EMI class A approved as well. High efficiency allows operating temperatures range of -40°C to 85°C. All models have been qualified per the CB scheme with safety approvals to UL/cUL/IEC/EN 62368-1.

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Model Selection Guide								
Model Number	Input Voltage (Range)	Output Voltage	Output Power	Output Current	Input Current		Max. capacitive Load	Efficiency (typ.)
					@Max. Load	@No Load		@Max. Load
	VDC	VDC	W	mA	mA(typ.)	mA(typ.)	μF	%
MDW12-12S05	12 (9 ~ 18)	5	12	2400	1205	20	1500	83
MDW12-12S051		5.1	12.24	2400	1229		1500	83
MDW12-12S12		12	12	1000	1149		680	87
MDW12-12S15		15	12	800	1136		680	88
MDW12-12S24		24	12	500	1136		220	88
MDW12-12D12		±12	12	±500	1149		#470	87
MDW12-12D15		±15	12	±400	1149		#220	87
MDW12-24S05	24 (18 ~ 36)	5	12	2400	602	10	1500	83
MDW12-24S051		5.1	12.24	2400	614		1500	83
MDW12-24S12		12	12	1000	575		680	87
MDW12-24S15		15	12	800	568		680	88
MDW12-24S24		24	12	500	568		220	88
MDW12-24D12		±12	12	±500	575		#470	87
MDW12-24D15		±15	12	±400	575		#220	87
MDW12-48S05	48 (36 ~ 75)	5	12	2400	301	7	1500	83
MDW12-48S051		5.1	12.24	2400	307		1500	83
MDW12-48S12		12	12	1000	287		680	87
MDW12-48S15		15	12	800	284		680	88
MDW12-48S24		24	12	500	284		220	88
MDW12-48D12		±12	12	±500	287		#470	87
MDW12-48D15		±15	12	±400	287		#220	87

For each output

Input Specifications						
Parameter	Conditions / Model	Min.	Typ.	Max.	Unit	
Input Surge Voltage (1 sec. max.)	12V Input Models	-0.7	---	25	VDC	
	24V Input Models	-0.7	---	50		
	48V Input Models	-0.7	---	100		
Start-Up Threshold Voltage	12V Input Models	---	---	9		
	24V Input Models	---	---	18		
	48V Input Models	---	---	36		
Under Voltage Shutdown	12V Input Models	---	8	---		
	24V Input Models	---	16	---		
	48V Input Models	---	34	---		
Start Up Time (Power On)	Nominal Vin and Constant Resistive Load	---	30	---	mS	
Input Filter	All Models	Internal Pi Type				

Output Specifications						
Parameter	Conditions		Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy			---	---	±1.0	%Vnom.
Output Voltage Balance	Dual Output, Balanced Loads		---	±1.0	±2.0	%
Line Regulation	Vin=Min. to Max. @Full Load		---	±0.2	±0.8	%
Load Regulation	Io=0% to 100%		---	---	±1.0	%
Load Cross Regulation (Dual Output Models)	Asymmetrical Load 25/100% Full Load		---	---	±5.0	%
Minimum Load	No minimum Load Requirement					
Ripple & Noise	0-20 MHz Bandwidth	Measured with a 2.2µF/50V MLCC	---	70	---	mV _{P-P}
Transient Recovery Time	25% Load Step Change		---	---	500	µsec
Transient Response Deviation			---	±3	±5	%
Temperature Coefficient			---	±0.01	±0.02	%/°C
Over Load Protection	Hiccup		---	160	---	%
Short Circuit Protection	Continuous, Automatic Recovery (Hiccup Mode 0.3Hz typ.)					

General Specifications						
Parameter	Conditions		Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds		1500	---	---	VDC
	1 Second		1800	---	---	VDC
Isolation Voltage Input/Output to case			1000	---	---	VDC
I/O Isolation Resistance	500 VDC		1000	---	---	MΩ
I/O Isolation Capacitance	100kHz, 1V		---	---	2200	pF
Switching Frequency			---	480	---	kHz
MTBF (calculated)	MIL-HDBK-217F@25°C, Ground Benign		2,537,215	---	---	Hours
Safety Approvals	UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1 & 60950-1(CB report)					

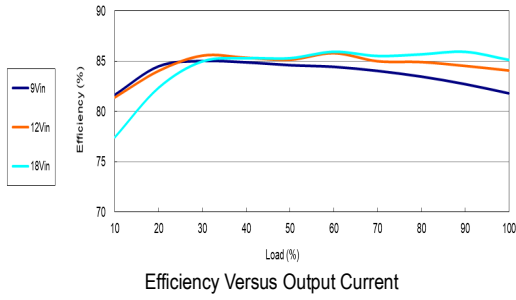
EMC Specifications					
Parameter	Standards & Level			Performance	
EMI ₍₅₎	Conduction	EN 55032	Without external components		Class A
	Radiation		With external components		
EMS ₍₅₎	EN 55035				A
	ESD	Direct discharge		Indirect discharge HCP & VCP	
		EN 61000-4-2 Air ± 8kV , Contact ± 6kV		Contact ± 6kV	
	Radiated immunity	EN 61000-4-3 20V/m			A
	Fast transient	EN 61000-4-4 ±2kV			A
	Surge	EN 61000-4-5 ±2kV			A
	Conducted immunity	EN 61000-4-6 10Vrms			A
PFMF	EN 61000-4-8 100A/m, 1000A/m for 1 sec			A	

Environmental Specifications				
Parameter	Model	Min.	Max.	Unit
Operating Temperature Range Nominal Vin, Load 100% Inom. (for Power Derating see relative Derating Curves)	MDW12-12S05, MDW12-12S051, MDW12-24S05 MDW12-24S051, MDW12-48S05, MDW12-48S051		+50	°C
	MDW12-12S12, MDW12-12S15, MDW12-12S24 MDW12-24S12, MDW12-24S15, MDW12-24S24 MDW12-48S12, MDW12-48S15, MDW12-48S24 MDW12-12D12, MDW12-12D15, MDW12-24D12 MDW12-24D15, MDW12-48D12, MDW12-48D15	-40	+65	
Case Temperature		---	+105	°C
Storage Temperature Range		-50	+125	°C
Humidity (non condensing)		---	95	% rel. H
Lead Temperature (1.5mm from case for 10Sec.)		---	260	°C

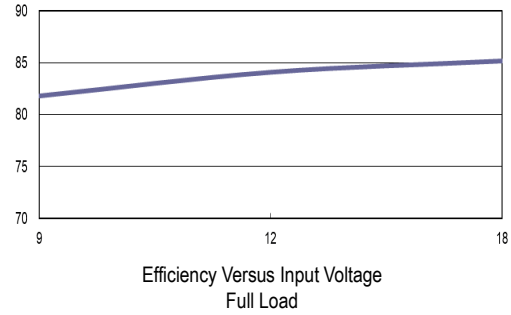
Notes	
1	Specifications typical at Ta=+25°C, resistive load, nominal input voltage and rated output current unless otherwise noted.
2	Transient recovery time is measured to within 1% error band for a step change in output load of 75% to 100%.
3	We recommend to protect the converter by a slow blow fuse 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.

Characteristic Curves

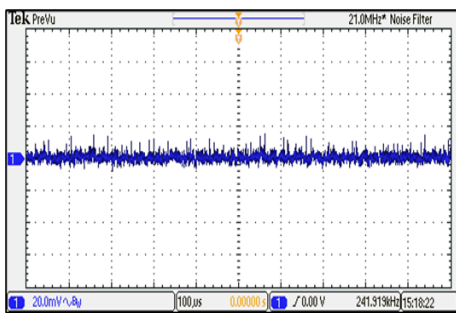
All test conditions are at 25°C The figures are identical for MDW12-12S05



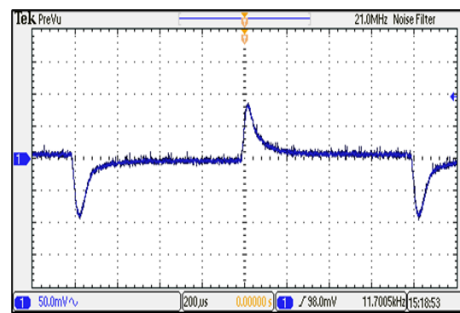
Efficiency Versus Output Current



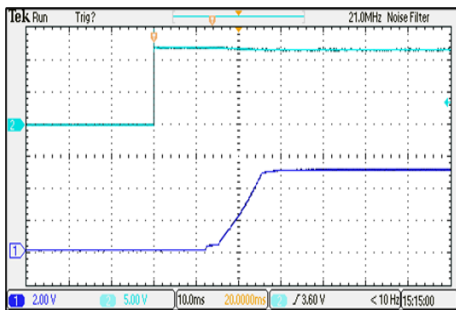
Efficiency Versus Input Voltage Full Load



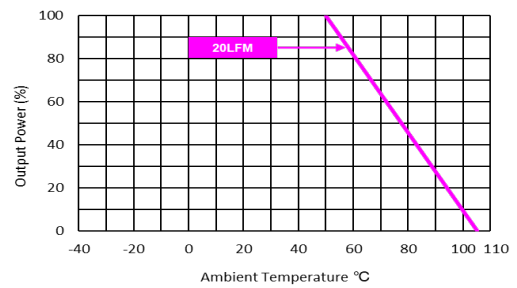
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



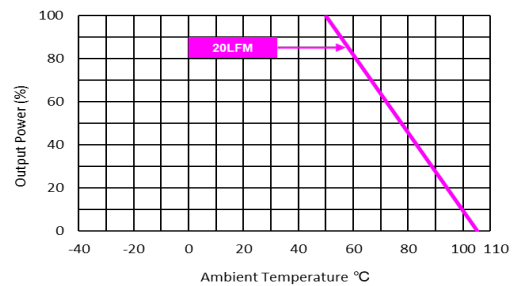
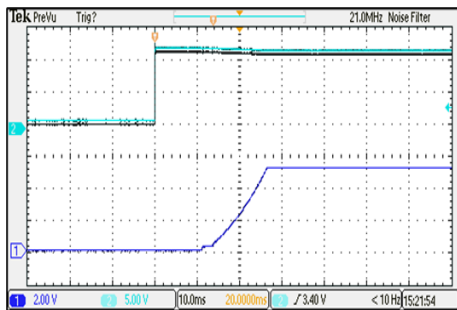
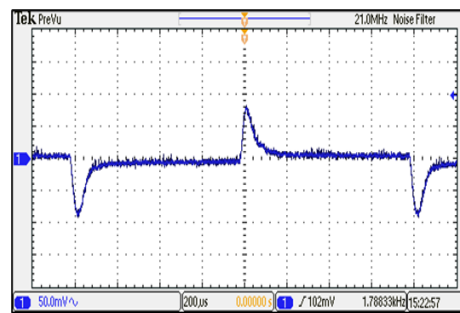
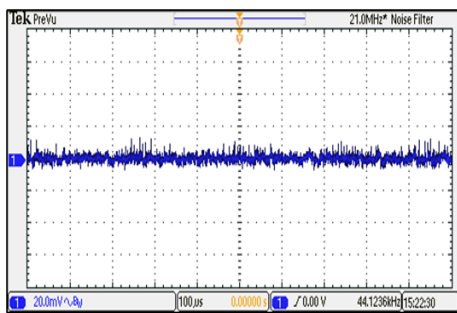
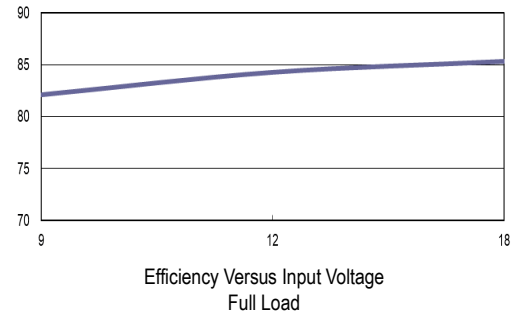
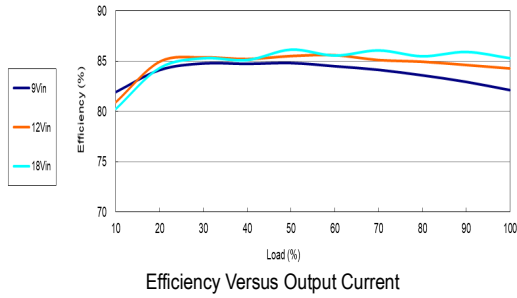
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

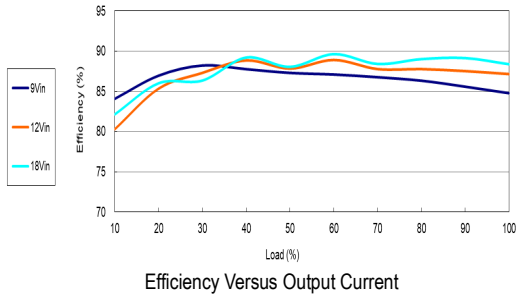
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW12-12S051

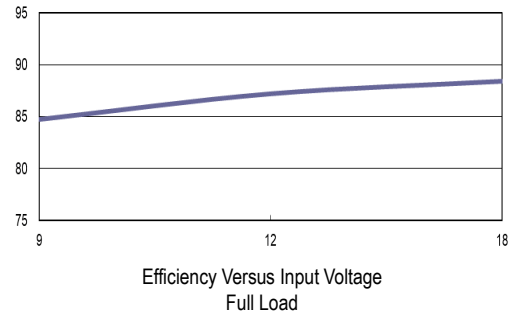


Characteristic Curves

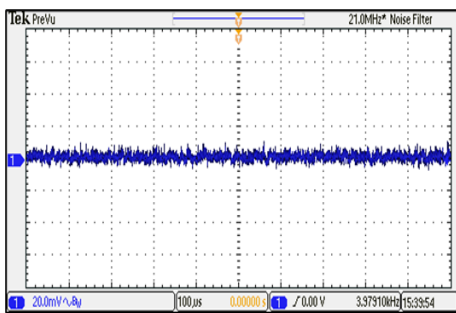
All test conditions are at 25°C The figures are identical for MDW12-12S12



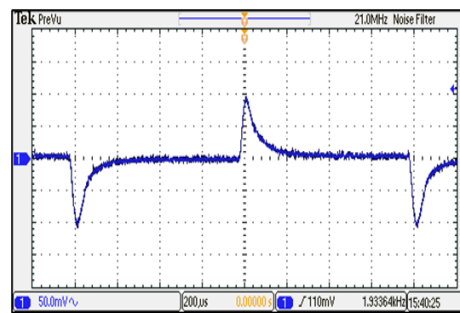
Efficiency Versus Output Current



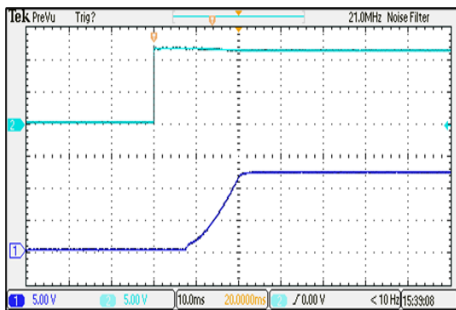
Efficiency Versus Input Voltage Full Load



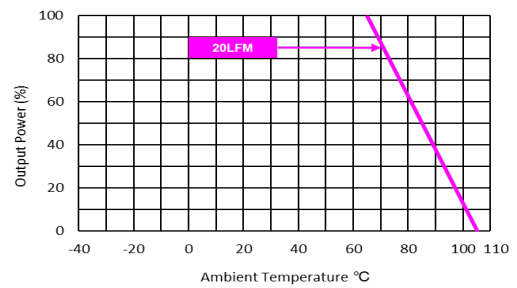
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



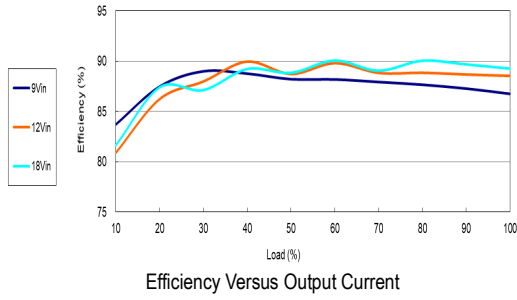
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



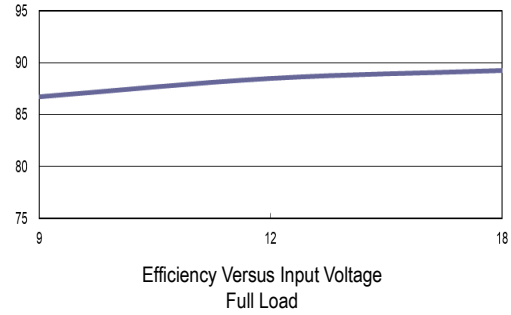
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in}=V_{in\ nom}$

Characteristic Curves

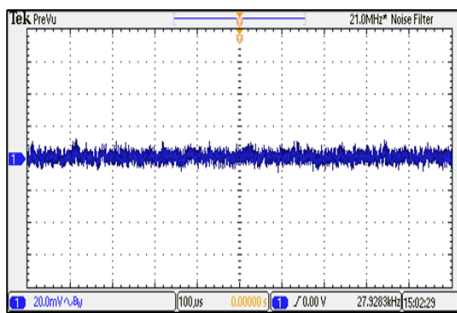
All test conditions are at 25°C The figures are identical for MDW12-12S15



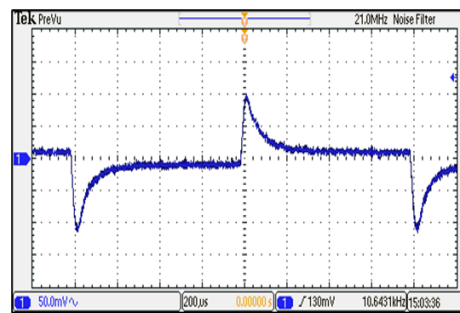
Efficiency Versus Output Current



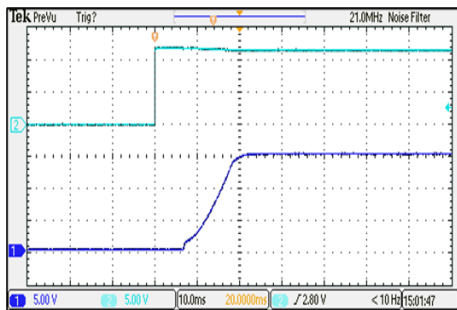
Efficiency Versus Input Voltage Full Load



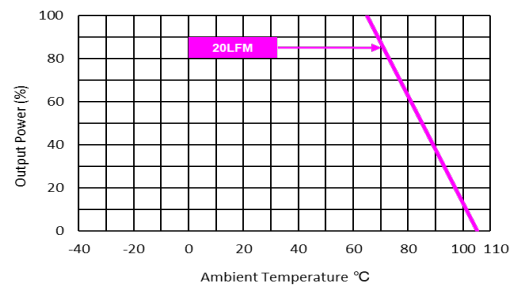
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



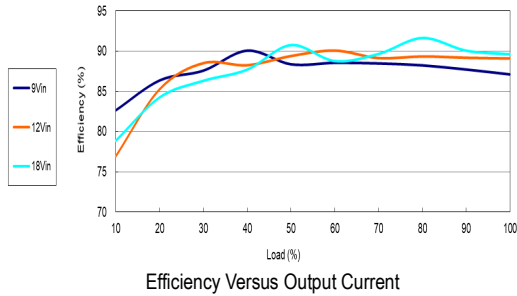
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



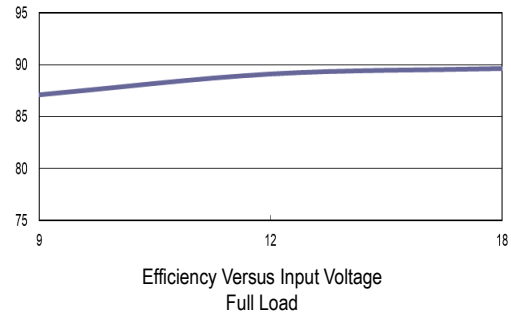
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in}=V_{in\ nom}$

Characteristic Curves

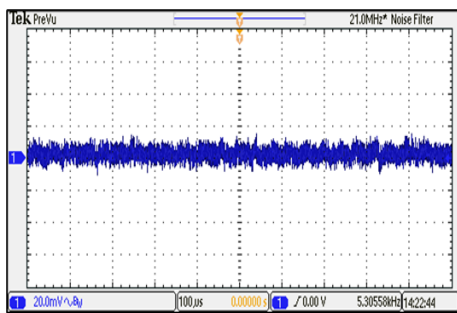
All test conditions are at 25°C The figures are identical for MDW12-12S24



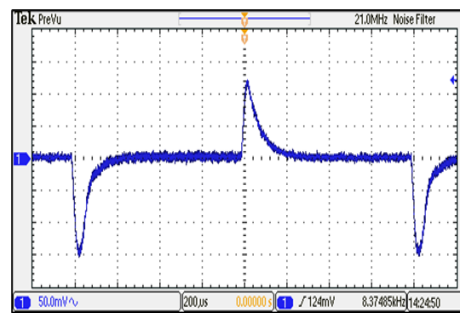
Efficiency Versus Output Current



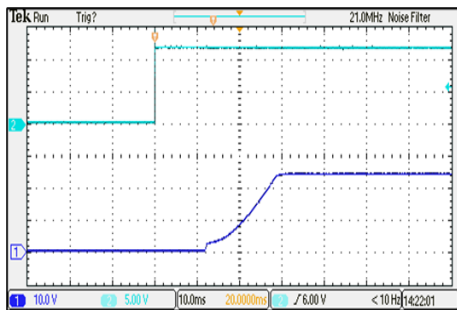
Efficiency Versus Input Voltage Full Load



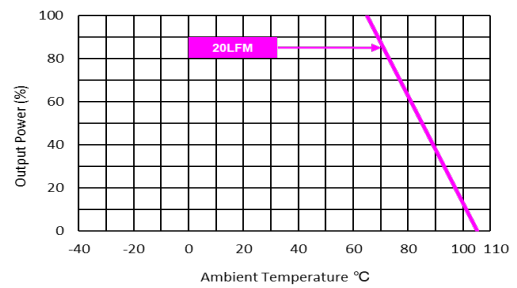
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



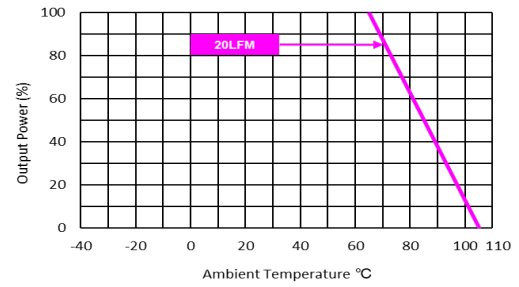
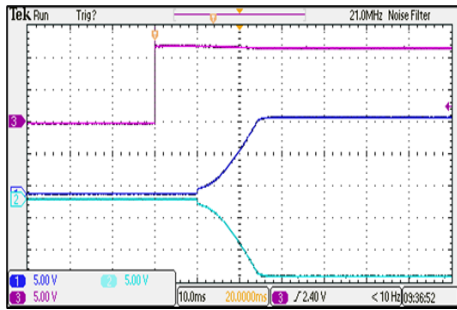
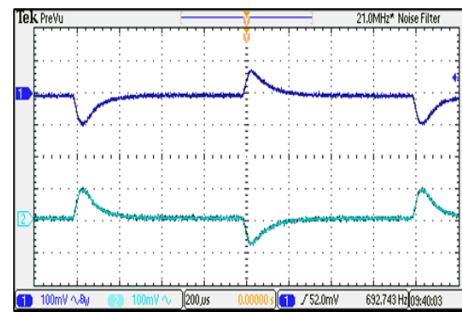
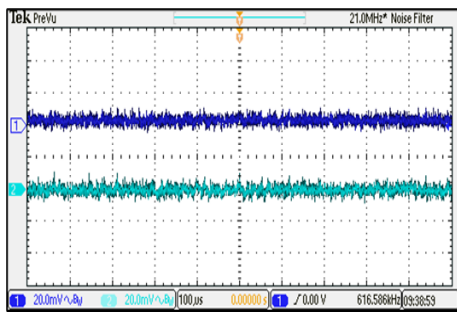
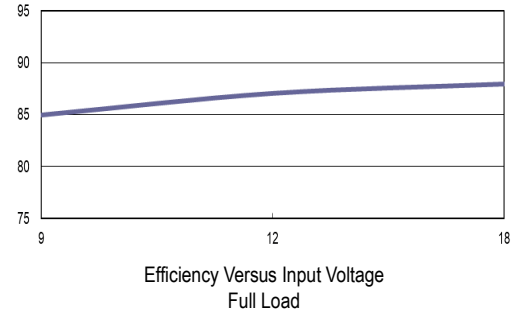
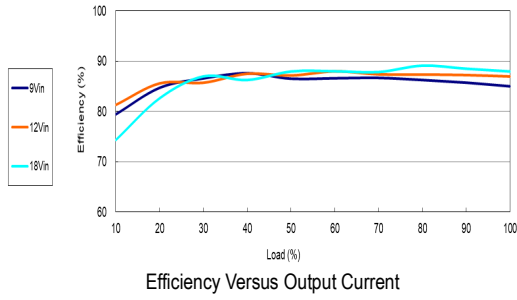
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

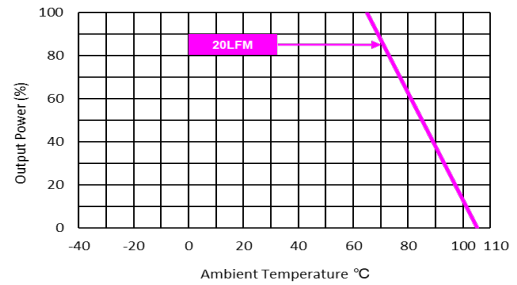
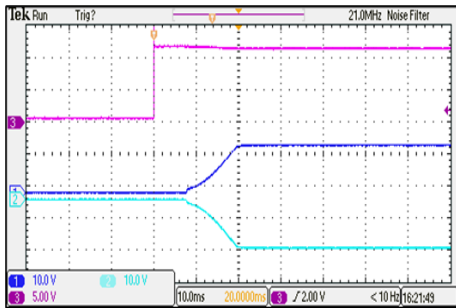
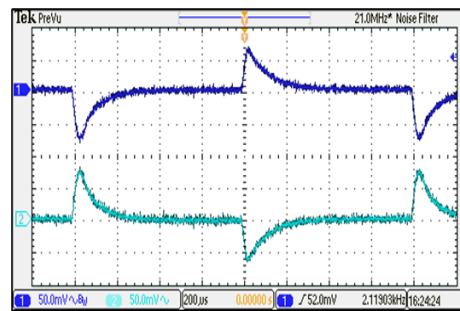
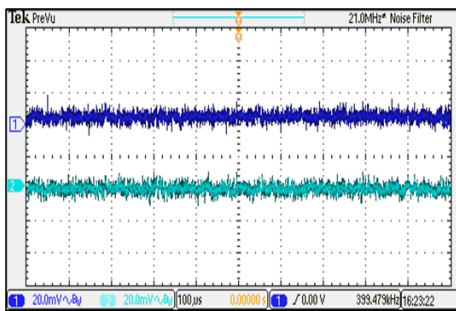
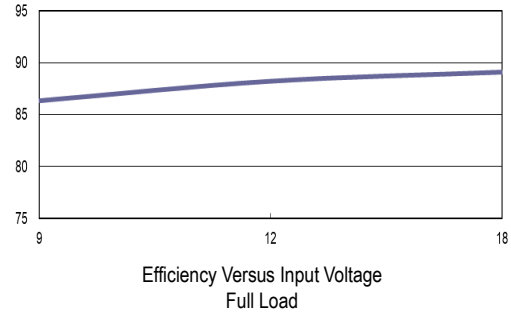
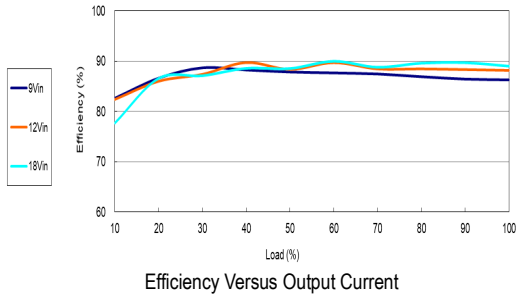
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW12-12D12



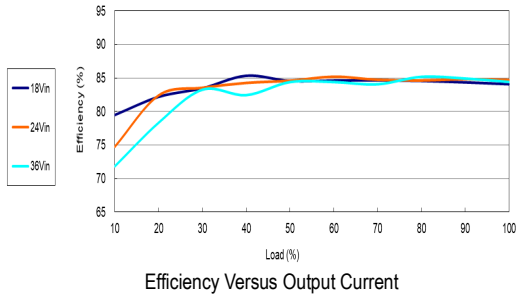
Characteristic Curves

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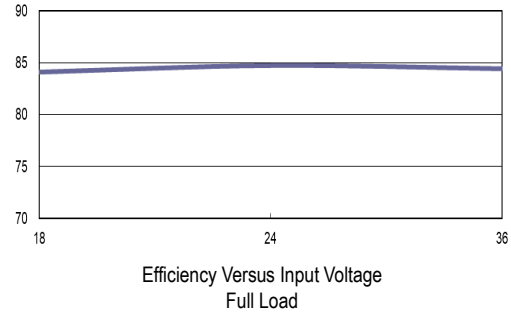


Characteristic Curves

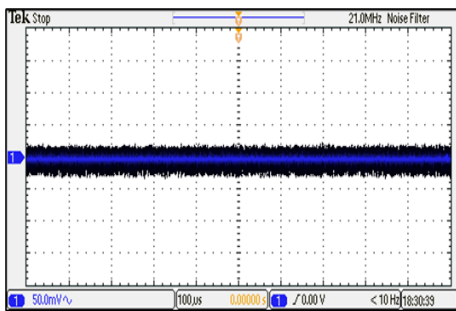
All test conditions are at 25°C The figures are identical for MDW12-24S05



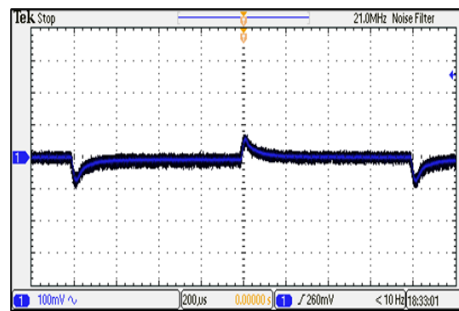
Efficiency Versus Output Current



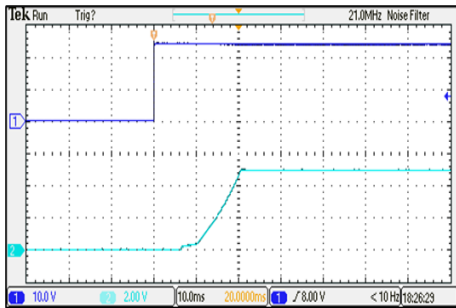
Efficiency Versus Input Voltage Full Load



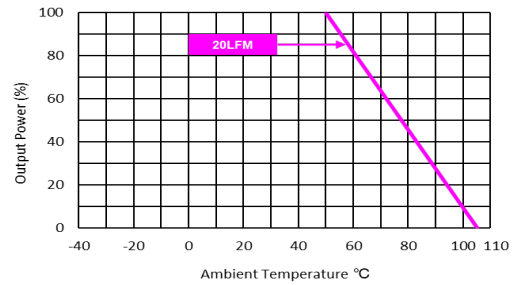
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



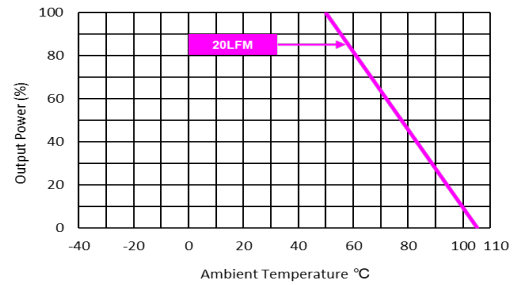
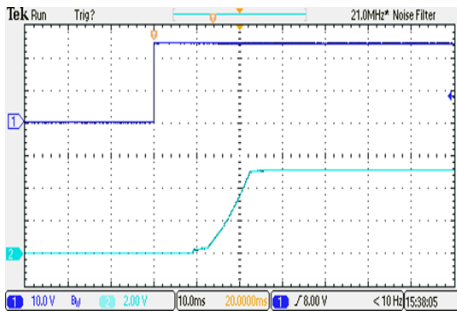
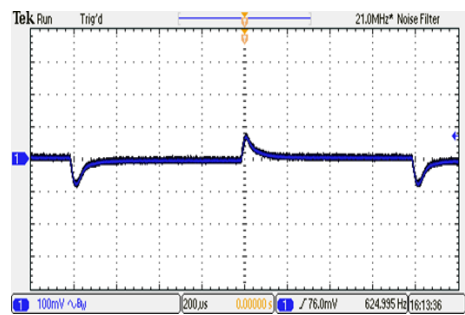
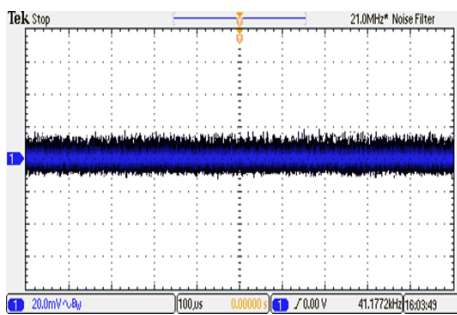
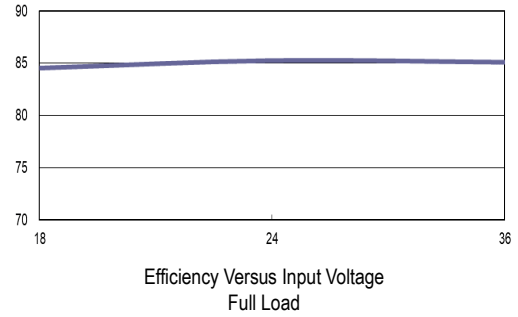
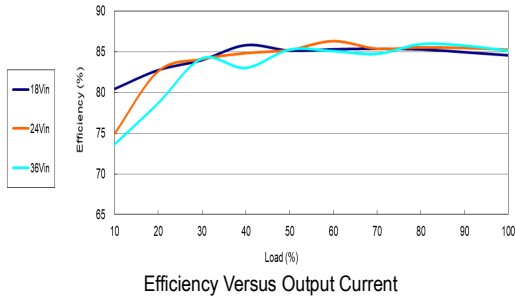
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

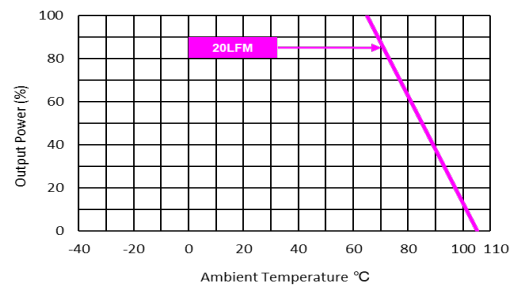
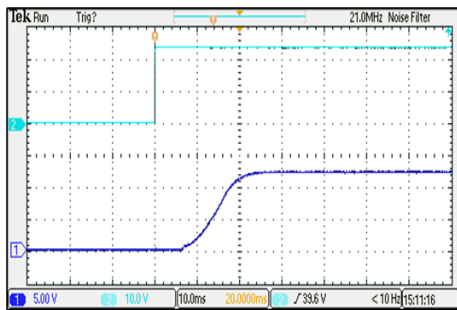
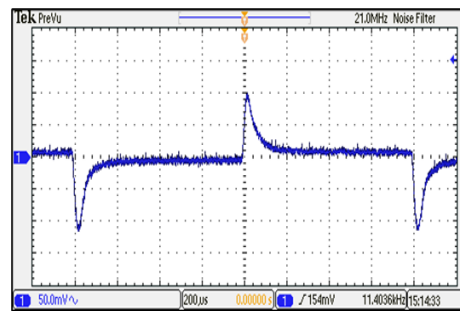
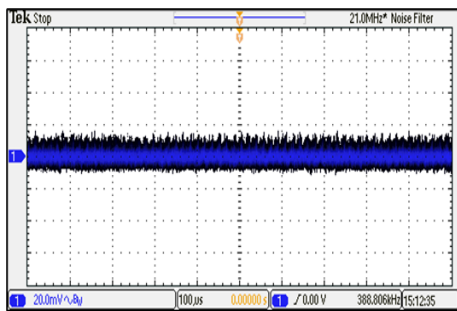
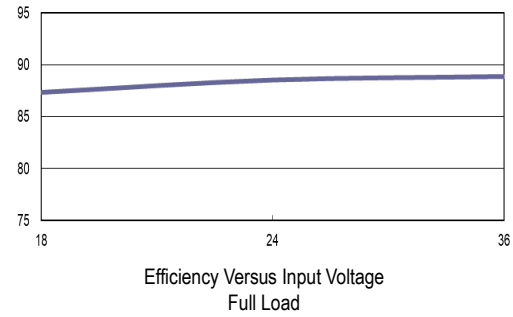
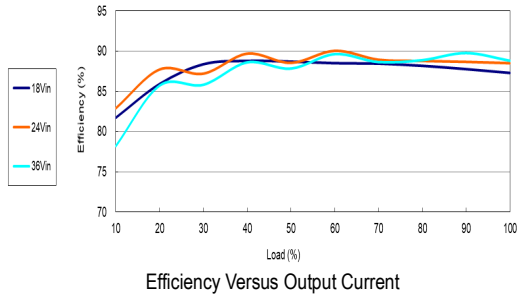
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW12-24S051



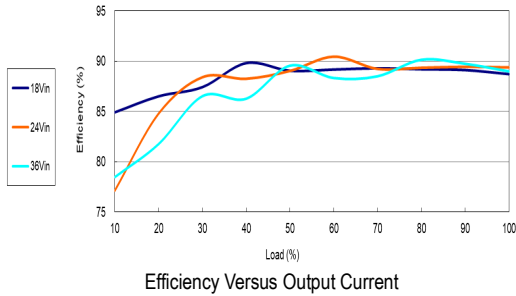
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW12-24S12

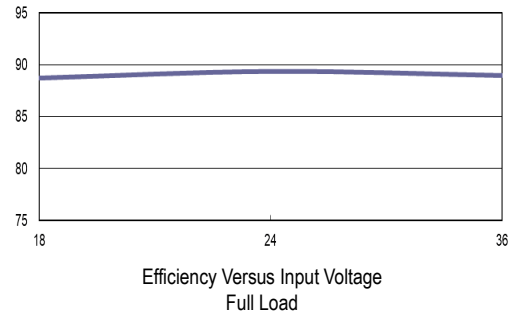


Characteristic Curves

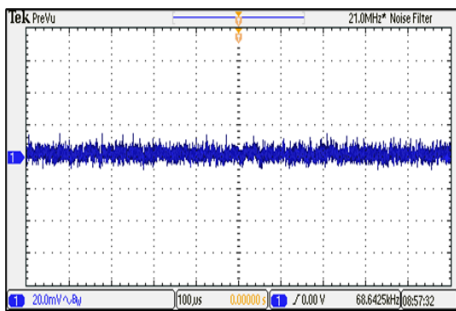
All test conditions are at 25°C The figures are identical for MDW12-24S15



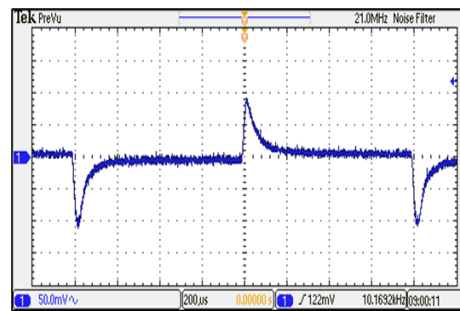
Efficiency Versus Output Current



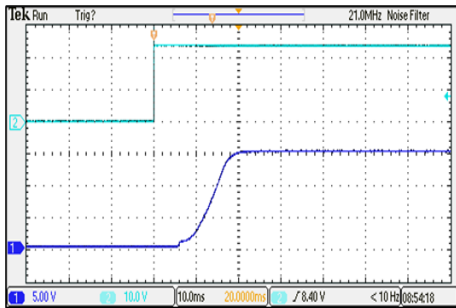
Efficiency Versus Input Voltage Full Load



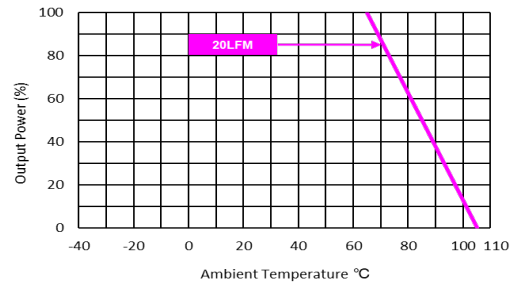
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



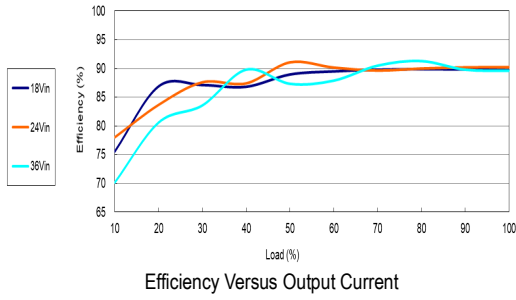
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



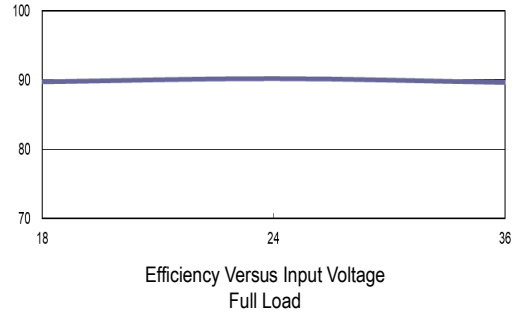
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in}=V_{in\ nom}$

Characteristic Curves

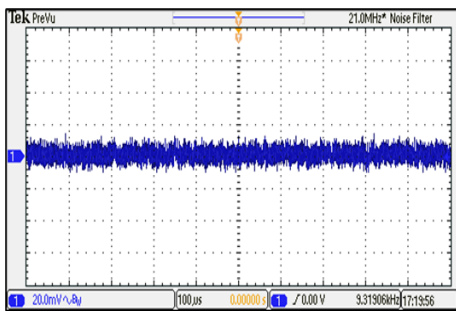
All test conditions are at 25°C The figures are identical for MDW12-24S24



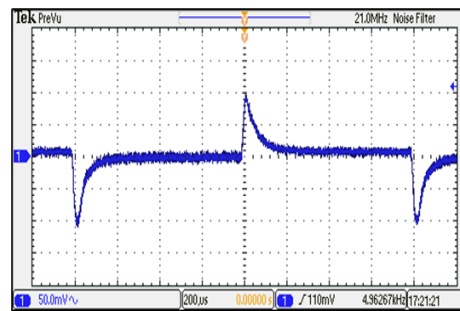
Efficiency Versus Output Current



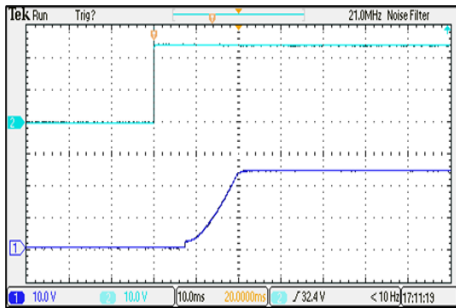
Efficiency Versus Input Voltage Full Load



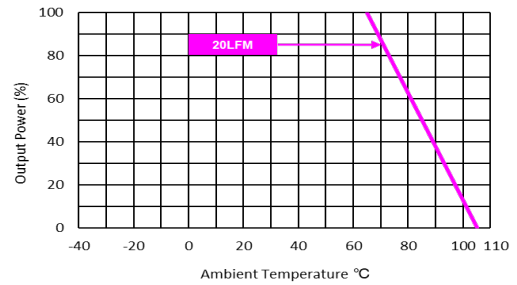
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



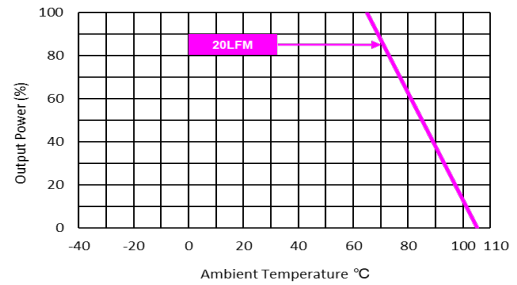
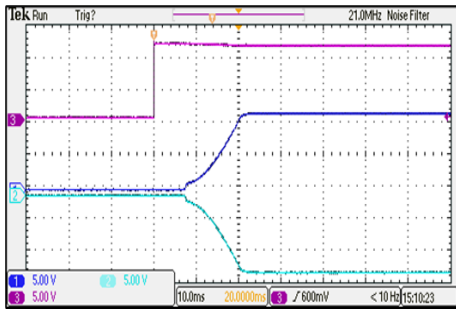
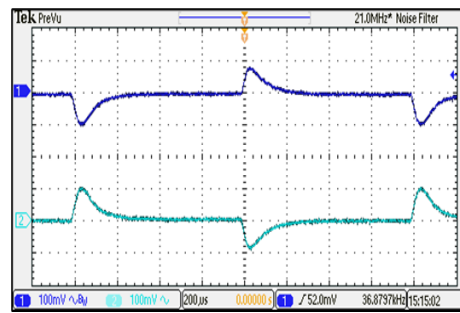
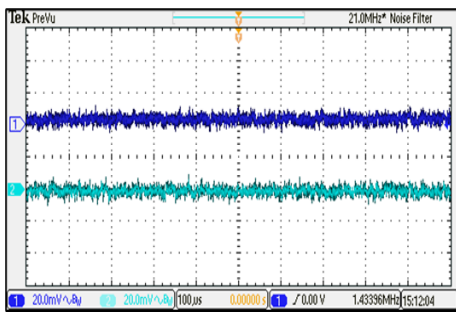
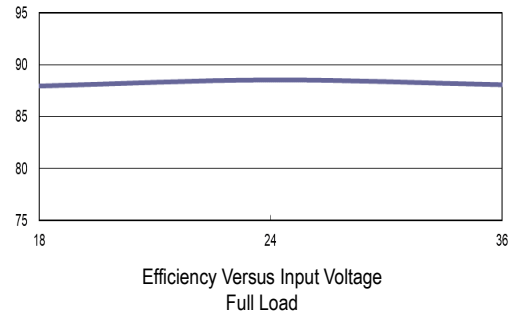
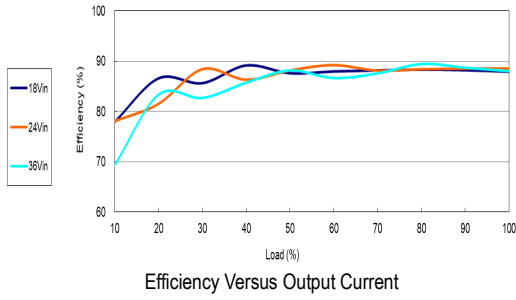
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

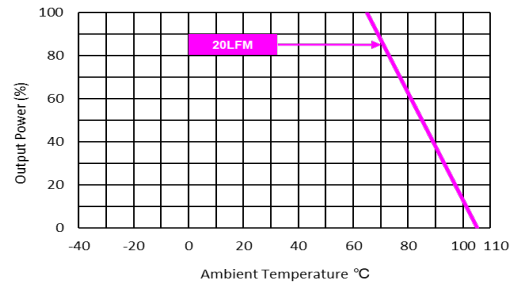
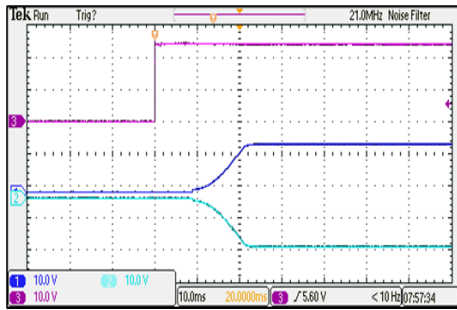
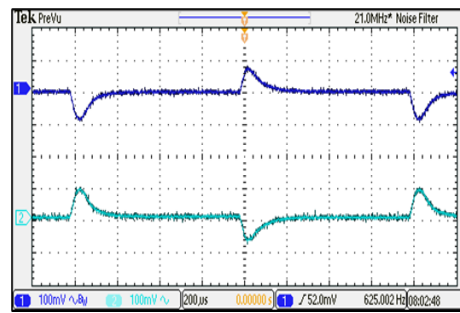
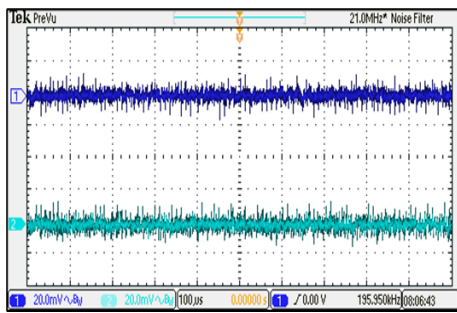
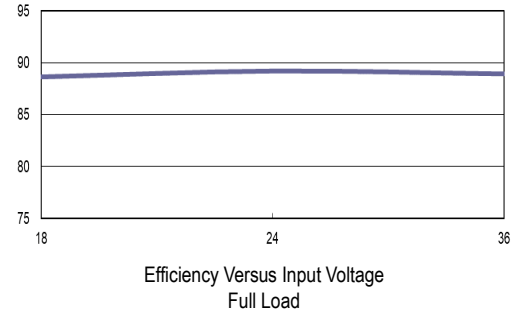
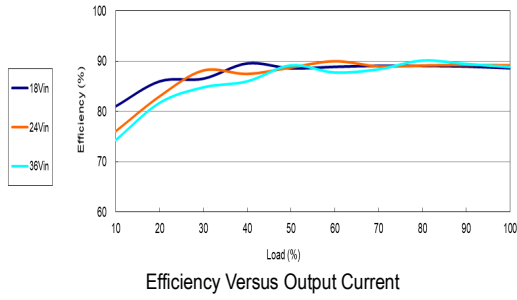
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW12-24D12



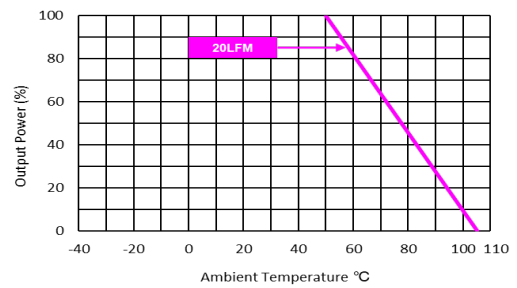
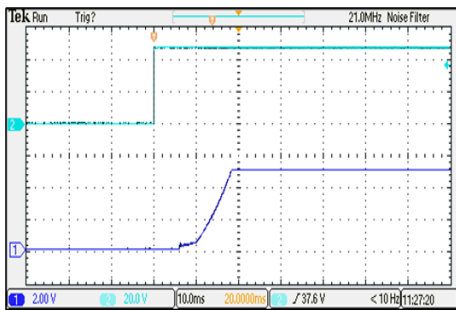
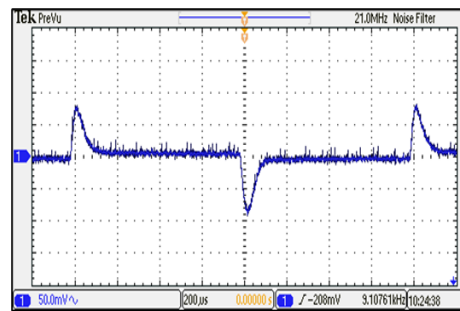
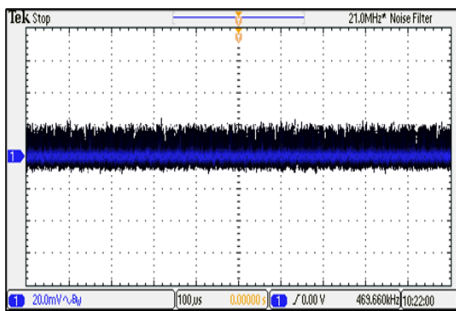
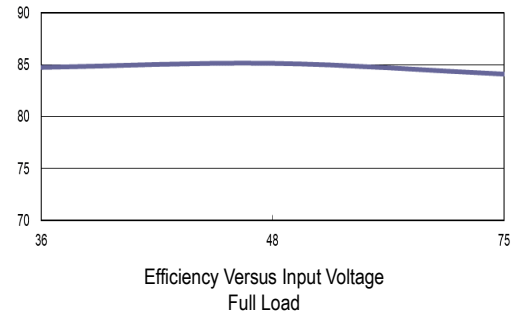
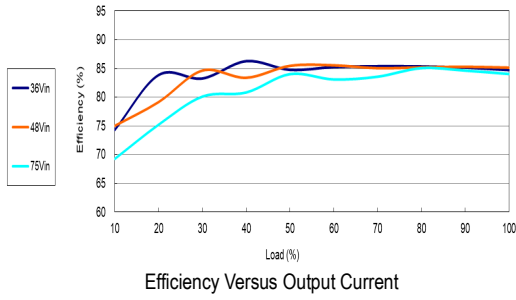
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW12-24D15



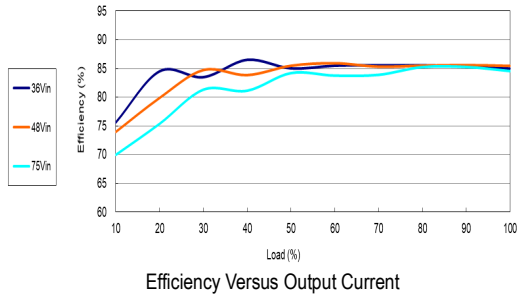
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW12-48S05

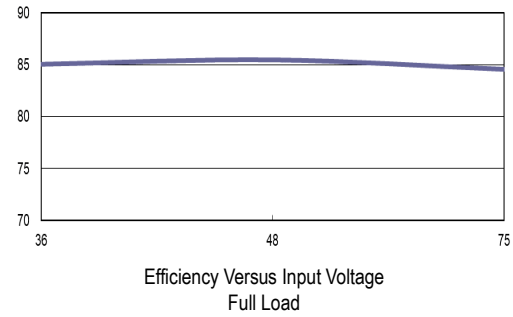


Characteristic Curves

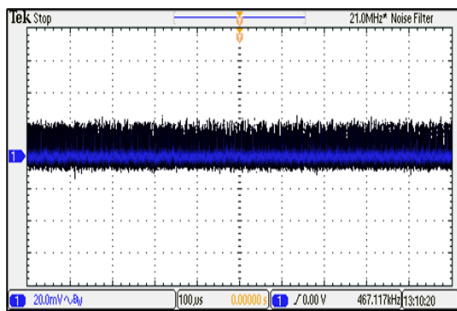
All test conditions are at 25°C The figures are identical for MDW12-48S051



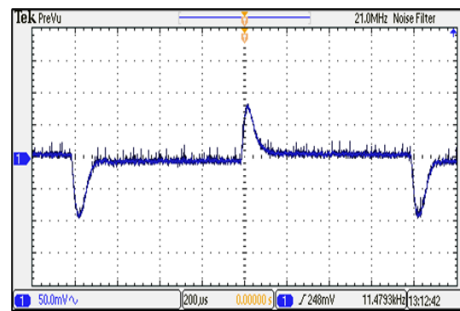
Efficiency Versus Output Current



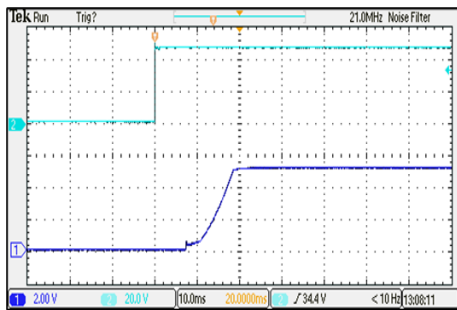
Efficiency Versus Input Voltage Full Load



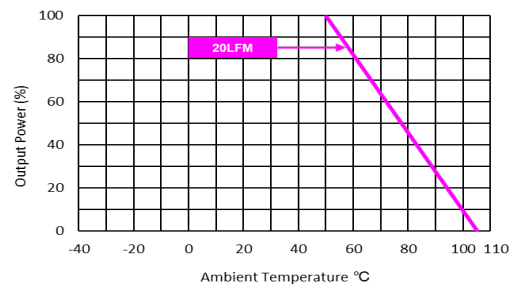
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



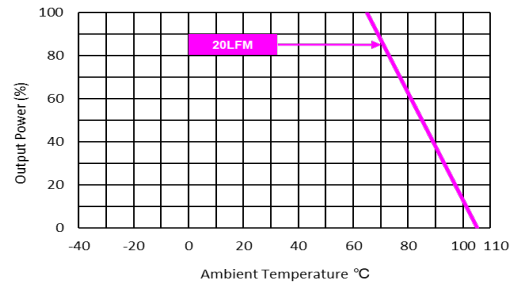
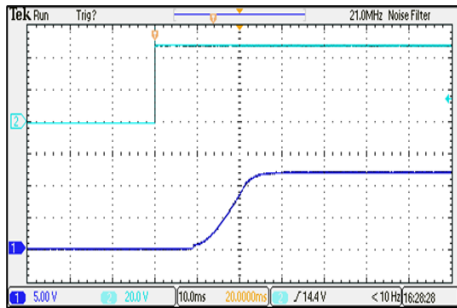
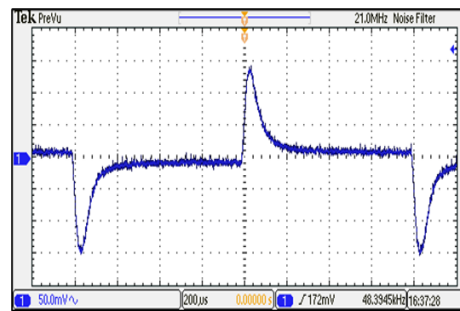
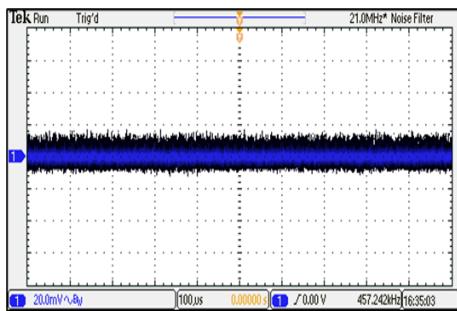
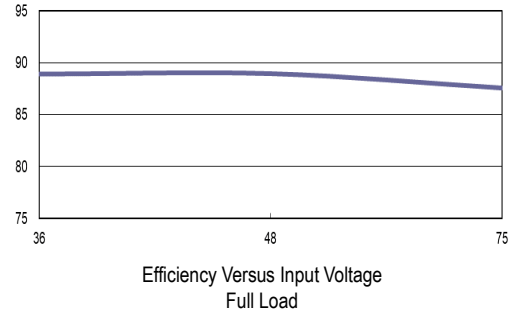
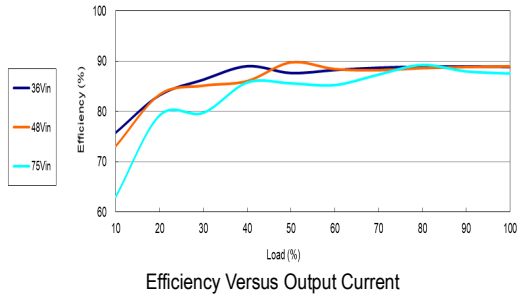
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

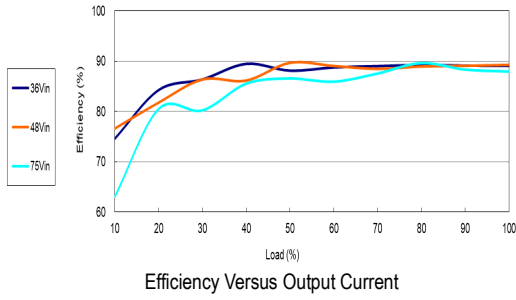
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW12-48S12

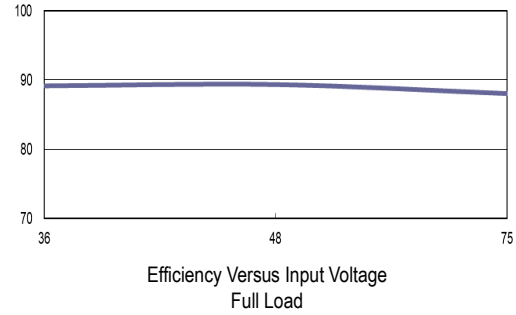


Characteristic Curves

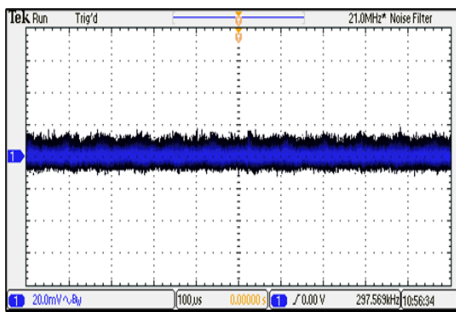
All test conditions are at 25°C The figures are identical for MDW12-48S15



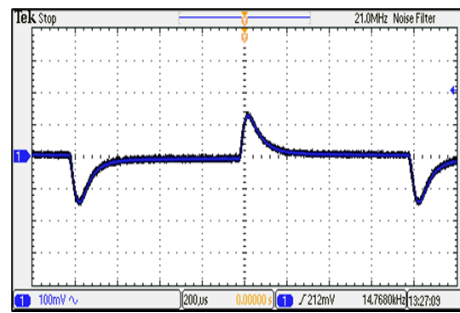
Efficiency Versus Output Current



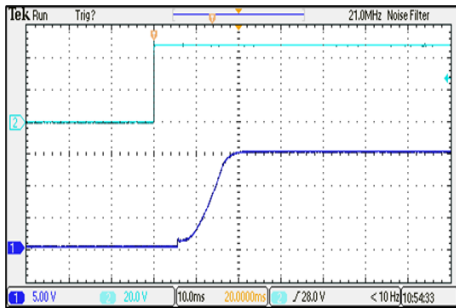
Efficiency Versus Input Voltage Full Load



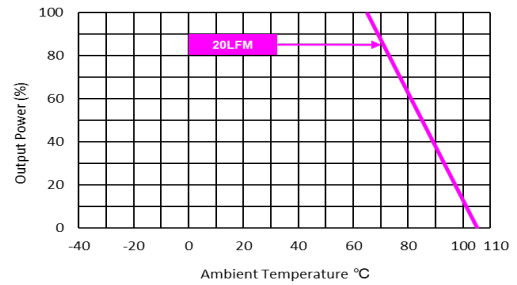
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



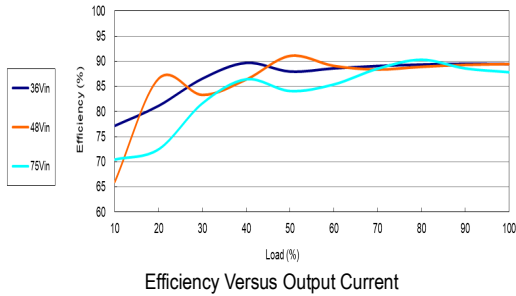
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



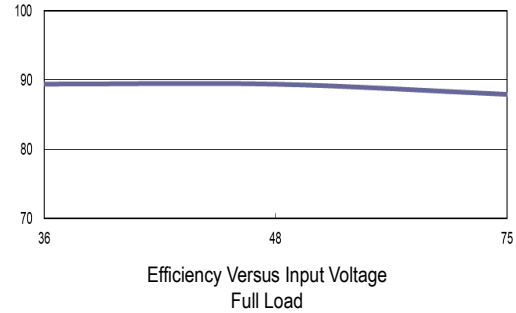
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in}=V_{in\ nom}$

Characteristic Curves

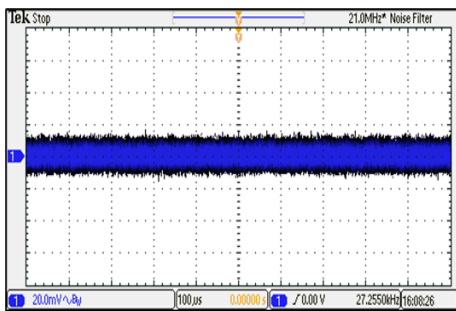
All test conditions are at 25°C The figures are identical for MDW12-48S24



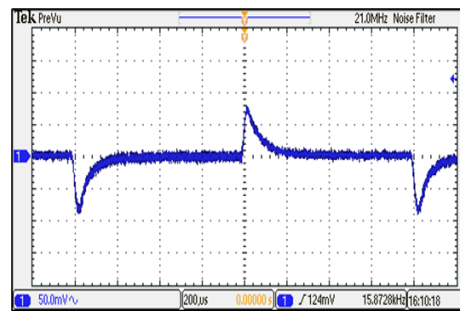
Efficiency Versus Output Current



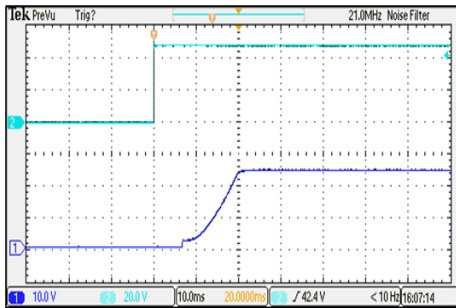
Efficiency Versus Input Voltage Full Load



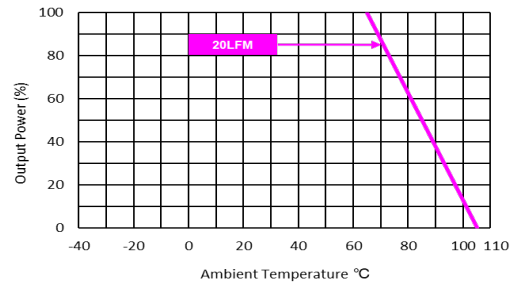
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



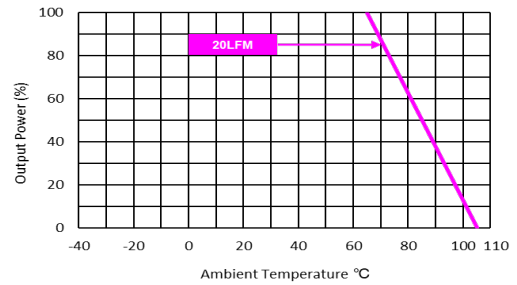
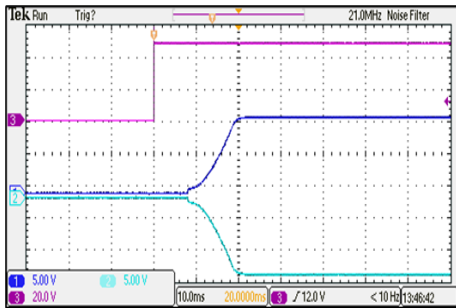
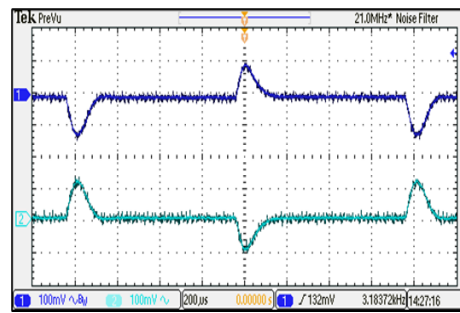
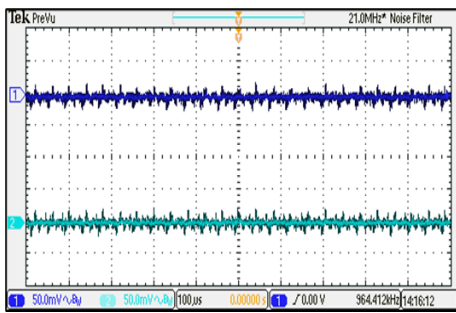
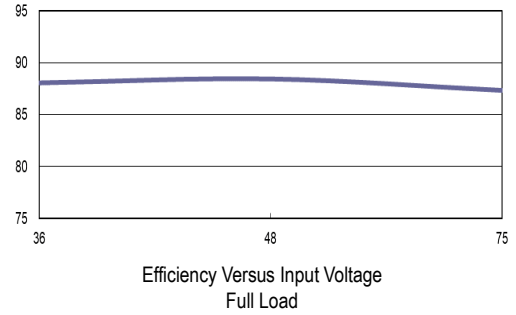
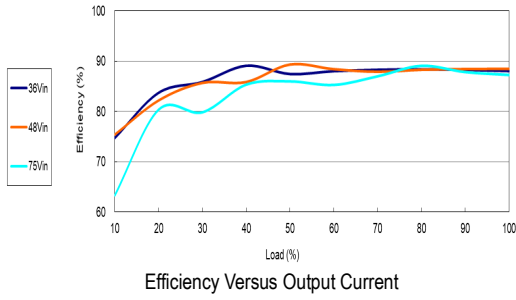
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

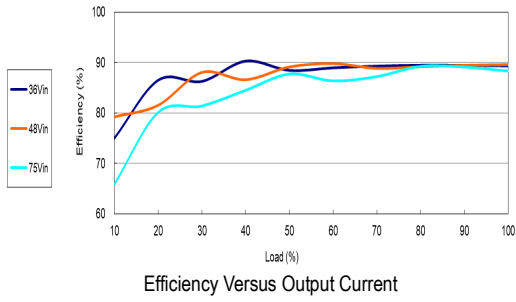
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW12-48D12

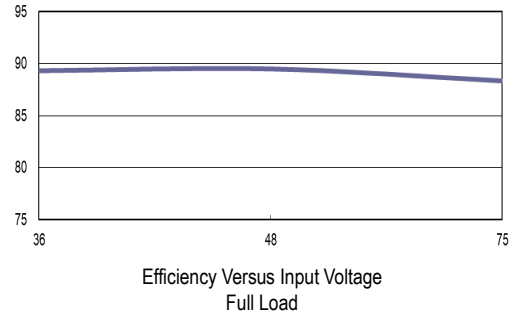


Characteristic Curves

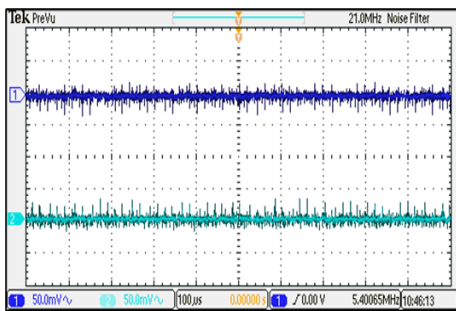
All test conditions are at 25°C The figures are identical for MDW12-48D15



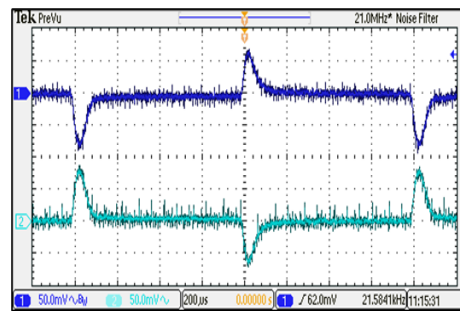
Efficiency Versus Output Current



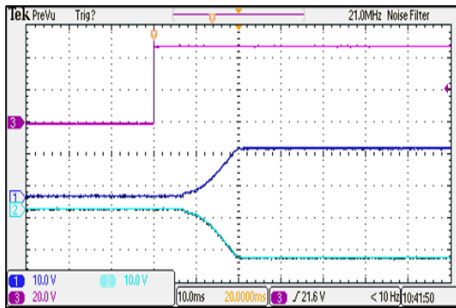
Efficiency Versus Input Voltage Full Load



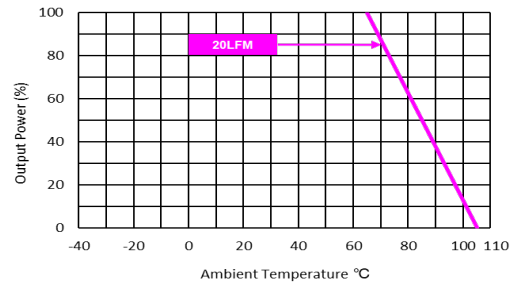
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



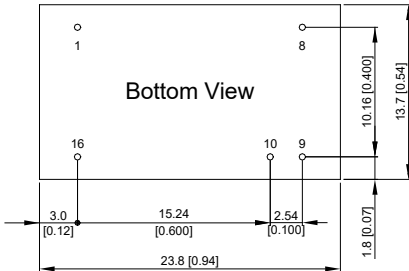
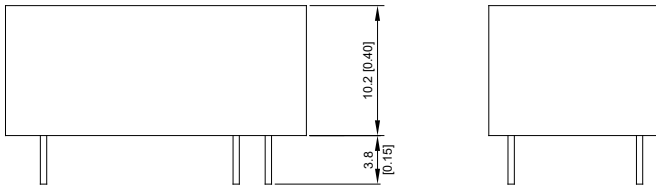
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

Package Specifications

Mechanical Dimensions



Pin Connections

Pin	Single Output	Dual Output	Diameter mm (inches)
1	-Vin	-Vin	∅ 0.5 [0.02]
8	NC	Common	∅ 0.5 [0.02]
9	+Vout	+Vout	∅ 0.5 [0.02]
10	-Vout	-Vout	∅ 0.5 [0.02]
16	+Vin	+Vin	∅ 0.5 [0.02]

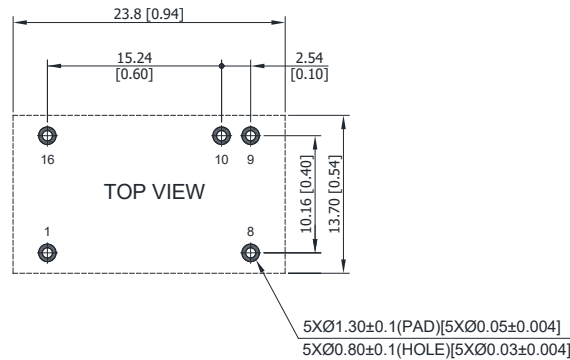
NC: No Connection

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

Physical Characteristics

Case Size	: 23.8x13.7x10.2 mm (0.94x0.54x0.40 inches)
Case Material	: Metal With Non-Conductive Baseplate
Pin Material	: Copper Alloy
Weight	: 8.6g

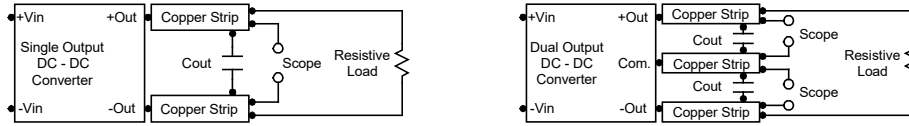
Recommended Pad Layout for Single & Dual Output Converter



Test Setup

Peak-to-Peak Output Noise Measurement Test

Refer to the output specifications or add 4.7µF capacitor if the output specifications undefine Cout. 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.



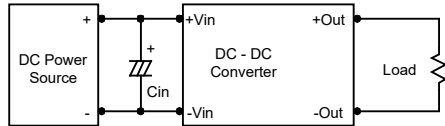
Technical Notes

Overload Protection

To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

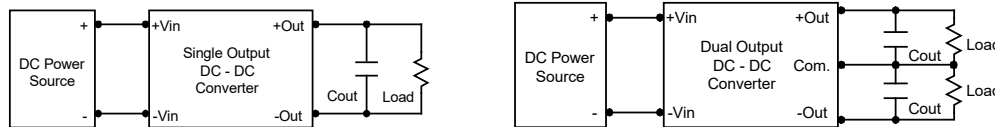
Input Source Impedance

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 on the input to insure startup. By using a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 kHz) capacitor of a 2.2µF for the 12V, 24V and 48V input devices, capacitor mounted close to the power module helps ensure stability of the unit.



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 2.2µF capacitors at the output.

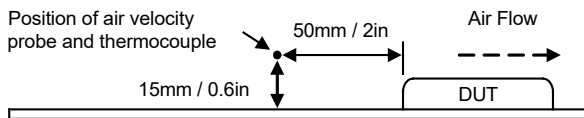


Maximum Capacitive Load

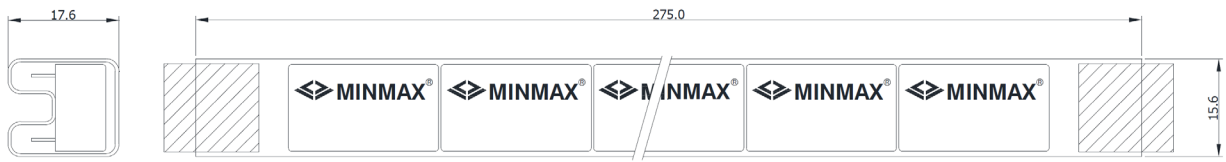
The MDW12 series has limitation of maximum connected capacitance on the output. The power module may operate in current limiting mode during start-up, affecting the ramp-up and the startup time. Connect capacitors at the point of load for best performance. The maximum capacitance can be found in the data sheet.

Thermal Considerations

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 105°C. The derating curves are determined from measurements obtained in a test setup.



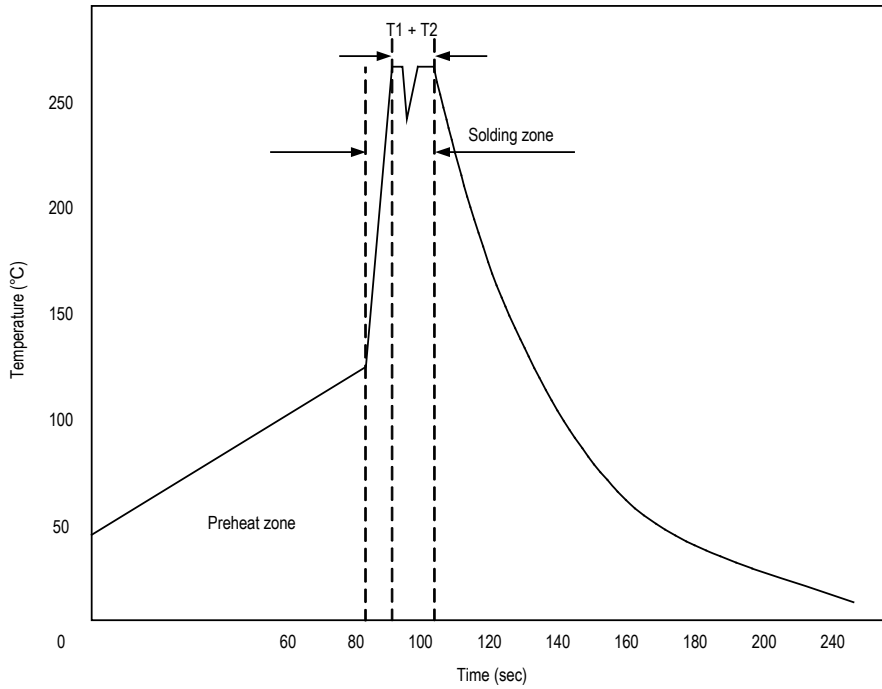
Packaging Information



Unit: mm
10 PCS per TUBE

Wave Soldering Considerations

Lead free wave solder profile



Zone	Reference Parameter
Preheat zone	Rise temp. speed : 3°C/sec max.
Actual heating	Preheat temp. : 100~130°C
	Peak temp. : 250~260°C
	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	D	W	12	-	12	S	05
	Package Type DIP-16	Wide 2:1 Input Voltage Range	Output Power 12 Watt		Input Voltage Range 12: 9 ~ 18 VDC 24: 18 ~ 36 VDC 48: 36 ~ 75 VDC	Output Quantity S: Single D: Dual	Output Voltage 05: 5 VDC 051: 5.1 VDC 12: 12 VDC 15: 15 VDC 24: 24 VDC

MTBF and Reliability

The MTBF of MDW12 series of DC-DC converters has been calculated using

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

Model	MTBF	Unit
MDW12-12S05	2,568,055	Hours
MDW12-12S051	2,537,215	
MDW12-12S12	4,446,803	
MDW12-12S15	4,709,331	
MDW12-12S24	4,969,719	
MDW12-12D12	4,345,180	
MDW12-12D15	4,184,918	
MDW12-24S05	2,587,097	
MDW12-24S051	2,554,215	
MDW12-24S12	4,476,021	
MDW12-24S15	4,743,549	
MDW12-24S24	4,930,268	
MDW12-24D12	4,376,509	
MDW12-24D15	4,213,971	
MDW12-48S05	2,600,787	
MDW12-48S051	2,567,558	
MDW12-48S12	4,500,516	
MDW12-48S15	4,767,732	
MDW12-48S24	5,031,512	
MDW12-48D12	4,399,923	
MDW12-48D15	4,236,880	