



MINMAX[®]

MDW15 Series

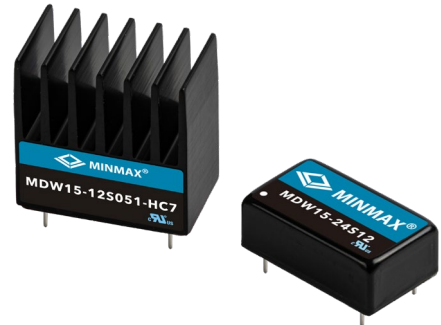
Electric Characteristic Note

MDW15 Series EC Note

DC-DC CONVERTER 15W, Regulated Output, DIP Package

Features

- ▶ Smallest Encapsulated 15W 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 Approved
- ▶ UL/cUL/IEC/EN 62368-1 Safety Approval & CE Marking



Applications

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

Product Overview

The MDW15 series gives designers the flexibility to match the choice of converter to specific application requirements. The high power density of MDW15 series, at 74W/in³, is expected to make it popular with manufacturers of industrial, transportation and renewable energy equipment where space-constrained is critical. This product offers a full 15 Watt isolated DC-DC converter within a small encapsulated DIP-16 package which occupied only 0.5in² of PCB space. There are 18 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.

Table of contents

Model Selection Guide	P2	Recommended Pad Layout for Single & Dual Output Converter.....	P23
Input Specifications.....	P2	Test Setup.....	P23
Output Specifications.....	P2	Technical Notes	P23
General Specifications.....	P3	Packaging Information.....	P24
EMC Specifications.....	P3	Wave Soldering Considerations	P25
Environmental Specifications	P3	Hand Welding Parameter	P25
Characteristic Curves	P4	Part Number Structure	P26
Package Specifications	P22	MTBF and Reliability	P26

Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current	Input Current		Max. capacitive Load	Efficiency (typ.)
				@Max. Load	@No Load		
	VDC	VDC	mA	mA(typ.)	mA(typ.)	μF	%
MDW15-12S051	12 (9 ~ 18)	5.1	2940	1453	20	1800	86
MDW15-12S12		12	1250	1437		820	87
MDW15-12S15		15	1000	1437		820	87
MDW15-12S24		24	625	1437		270	87
MDW15-12D12		±12	±625	1437		#560	87
MDW15-12D15		±15	±500	1437		#270	87
MDW15-24S051	24 (18 ~ 36)	5.1	2940	726	10	1800	86
MDW15-24S12		12	1250	718		820	87
MDW15-24S15		15	1000	718		820	87
MDW15-24S24		24	625	718		270	87
MDW15-24D12		±12	±625	718		#560	87
MDW15-24D15		±15	±500	718		#270	87
MDW15-48S051	48 (36 ~ 75)	5.1	2940	363	7	1800	86
MDW15-48S12		12	1250	359		820	87
MDW15-48S15		15	1000	359		820	87
MDW15-48S24		24	625	359		270	87
MDW15-48D12		±12	±625	359		#560	87
MDW15-48D15		±15	±500	359		#270	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	110	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	2,157,075	---	---	Hours
Safety Approvals	UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1(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 55024, EN 55035			
	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 30A/m		A	

Environmental Specifications

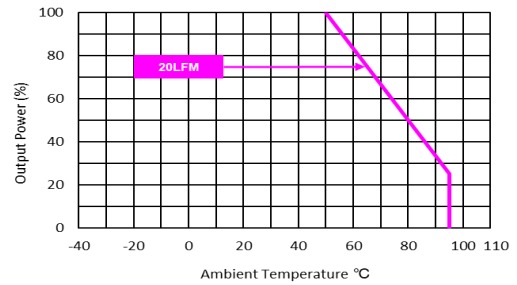
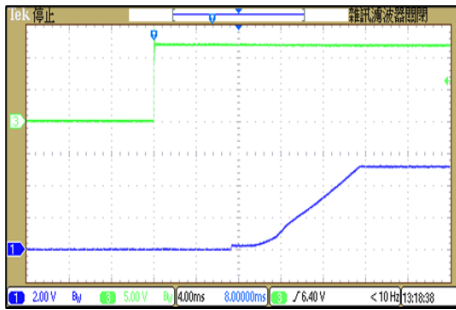
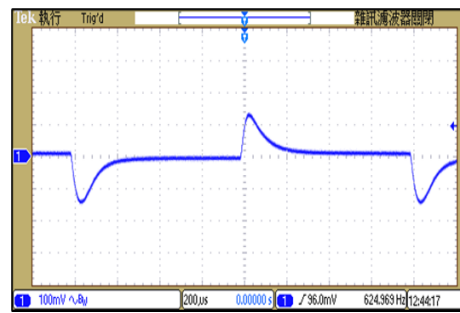
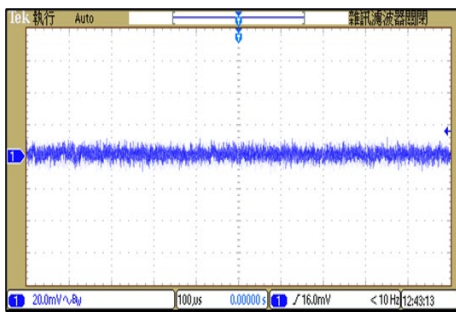
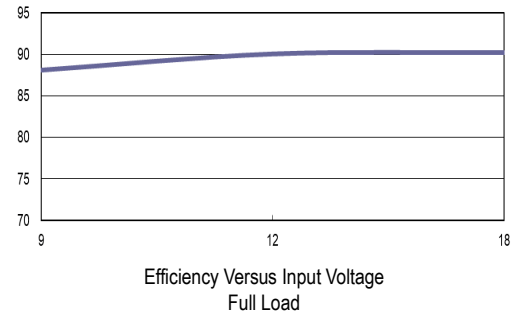
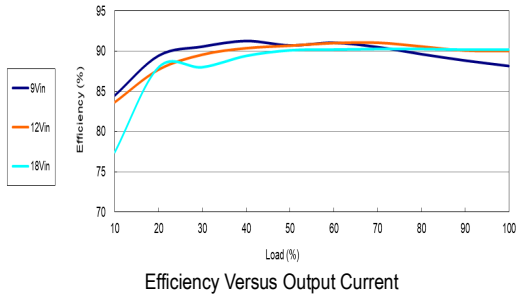
Parameter	Model	Min.	Max.		Unit
			without Heatsink	with Heatsink	
Operating Temperature Range Nominal Vin, Load 100% Inom. (for Power Derating see relative Derating Curves)	MDW15-12S051, MDW15-24S051, MDW15-48S051	-40	+50	+65	°C
	MDW15-12S12, MDW15-12S15, MDW15-12S24 MDW15-12D12, MDW15-12D15, MDW15-24S12 MDW15-24S15, MDW15-24S24, MDW15-24D12 MDW15-24D15, MDW15-48S12, MDW15-48S15 MDW15-48S24, MDW15-48D12, MDW15-48D15		+55	+70	
Case Temperature		---	+110		°C
Storage Temperature Range		-50	+125		°C
Humidity (non condensing)		---	95		% rel. H
Lead Temperature (1.5mm from case for 10Sec.)		---	260		°C

Notes

- Specifications typical at Ta=+25°C, resistive load, nominal input voltage and rated output current unless otherwise noted.
- Transient recovery time is measured to within 1% error band for a step change in output load of 75% to 100%.
- We recommend to protect the converter by a slow blow fuse in the input supply line.
- Other input and output voltage may be available, please contact MINMAX.
- The external components might be required to meet EMI/EMS standard for some of test items. Please contact MINMAX for the solution in detail.
- Specifications are subject to change without notice.

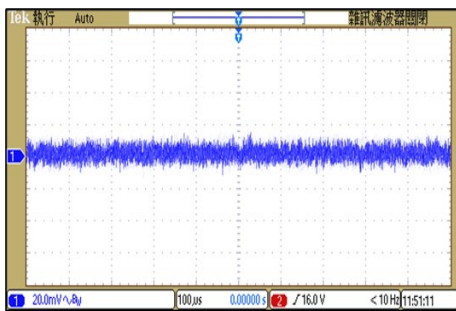
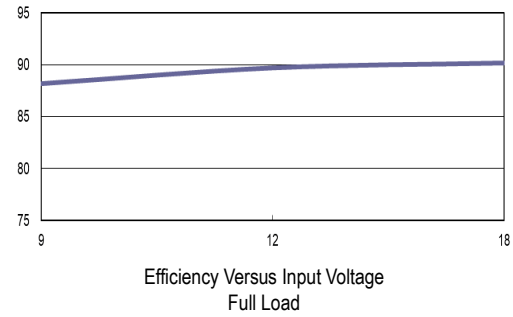
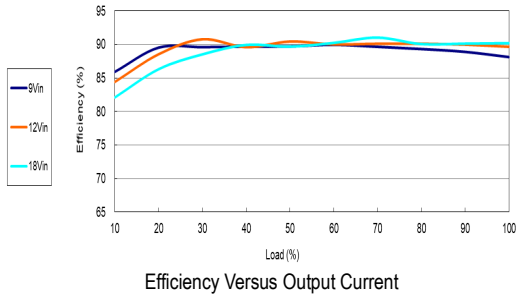
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW15-12S051

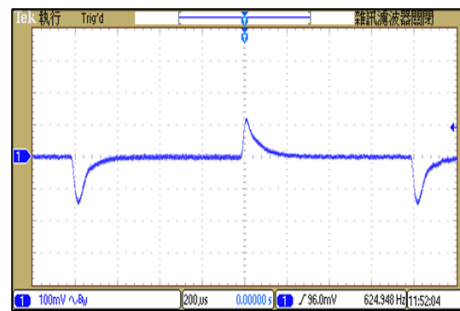


Characteristic Curves

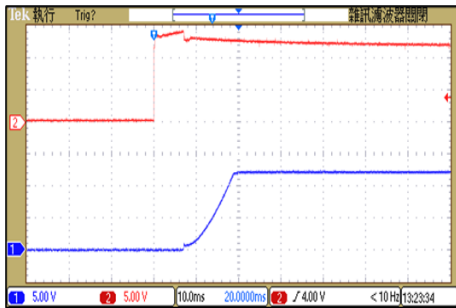
All test conditions are at 25°C The figures are identical for MDW15-12S12



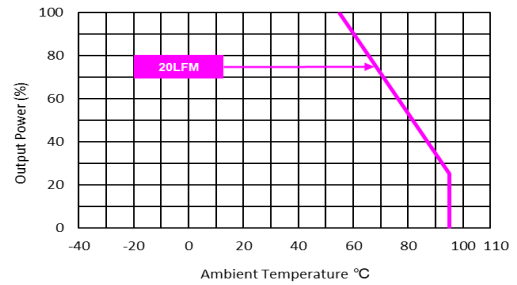
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



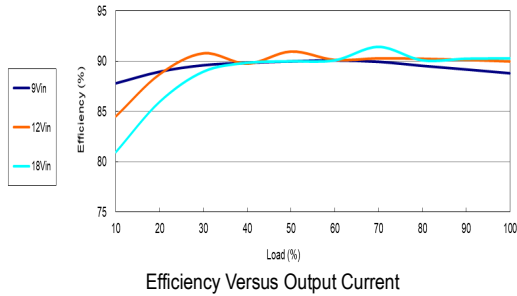
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



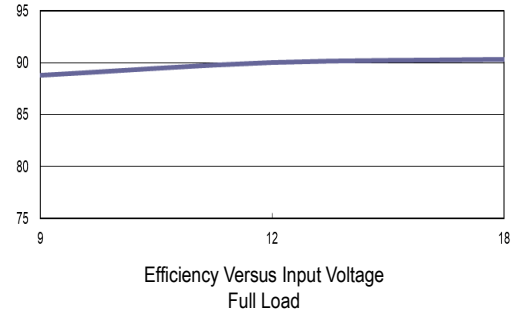
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in}=V_{in\ nom}$

Characteristic Curves

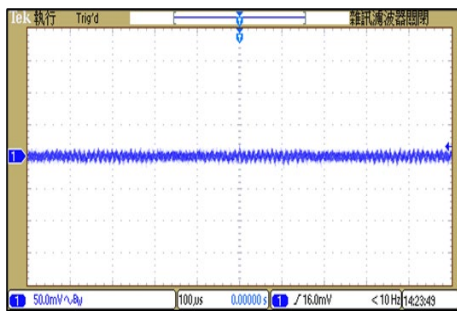
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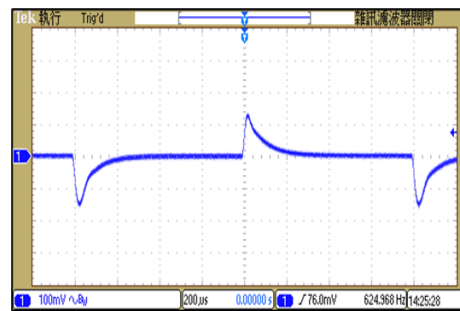
Efficiency Versus Output Current



Efficiency Versus Input Voltage Full Load



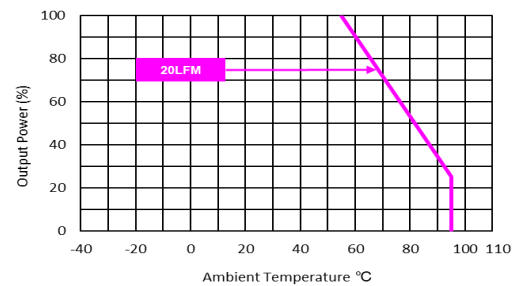
Typical Output Ripple and Noise
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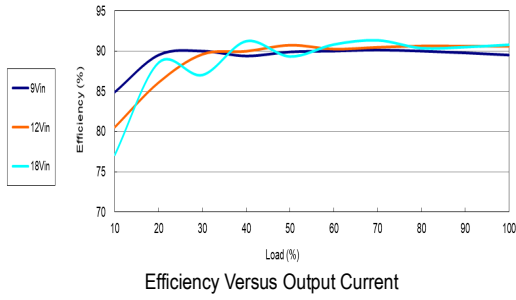
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



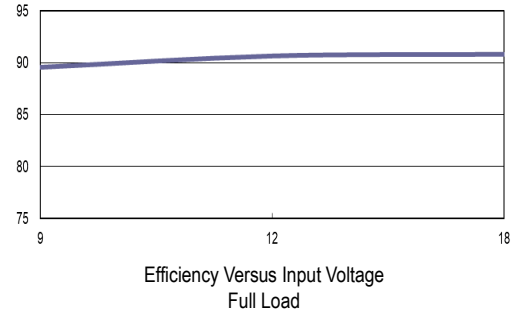
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in}=V_{in\ nom}$

Characteristic Curves

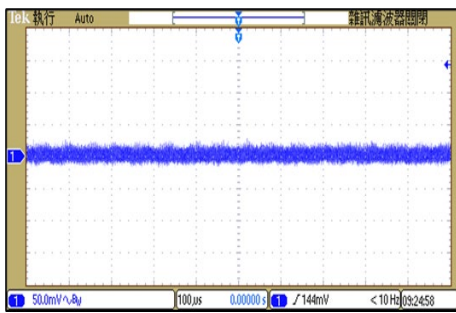
All test conditions are at 25°C The figures are identical for MDW15-12S24



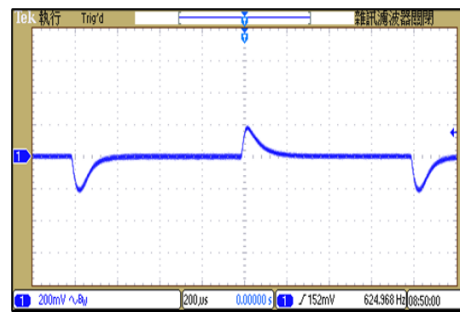
Efficiency Versus Output Current



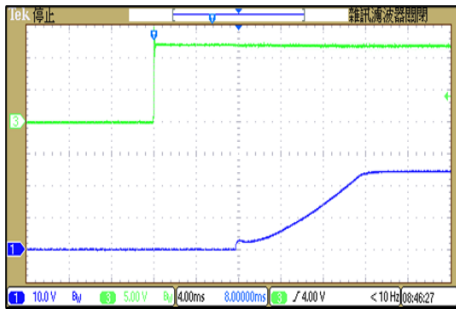
Efficiency Versus Input Voltage Full Load



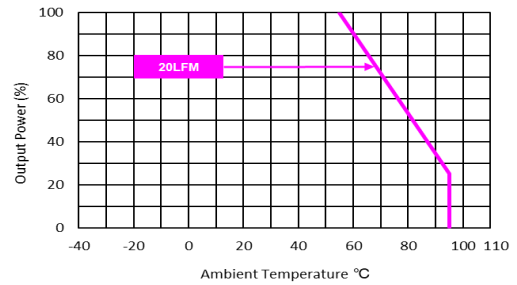
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



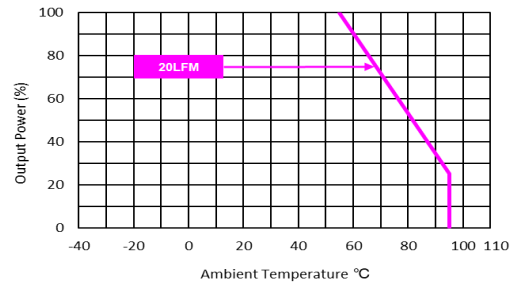
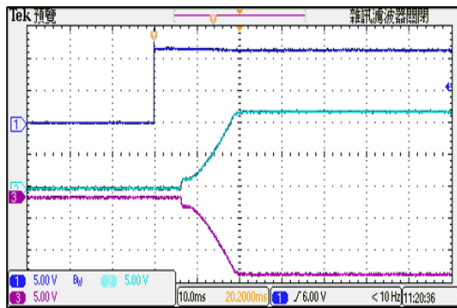
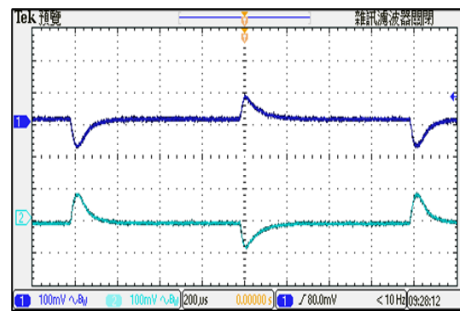
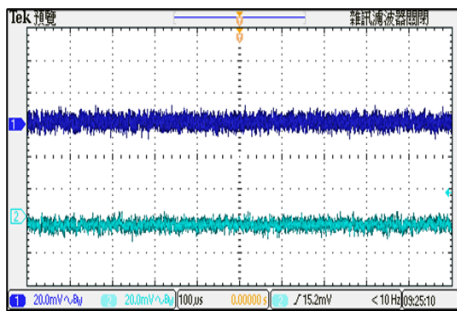
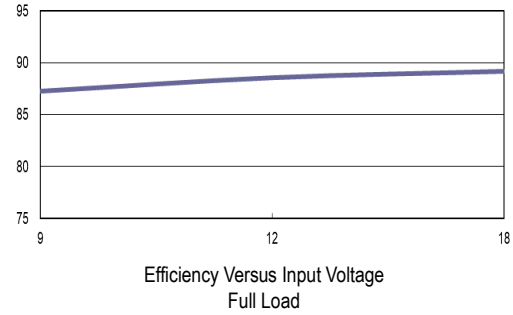
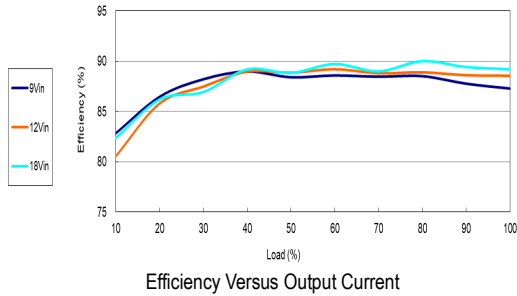
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

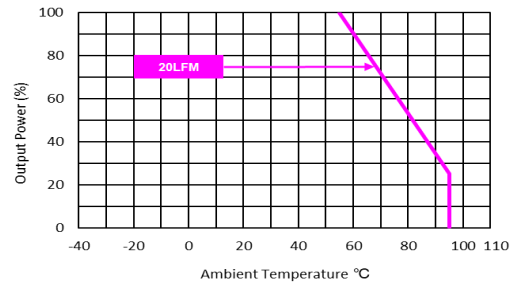
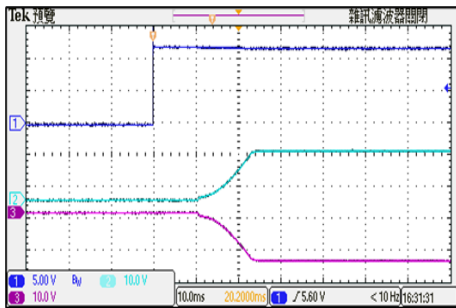
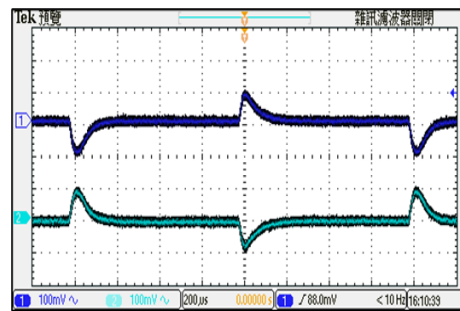
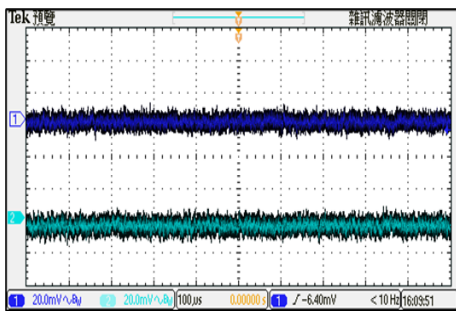
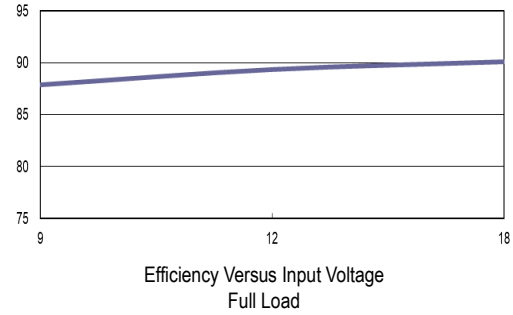
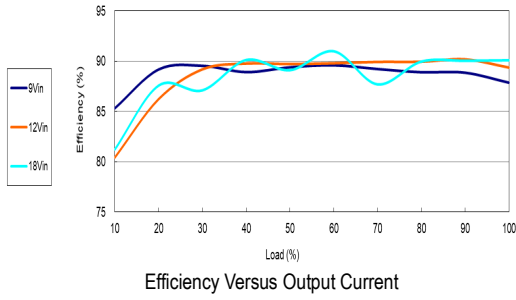
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW15-12D12



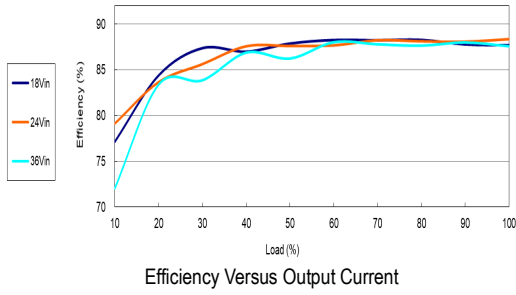
Characteristic Curves

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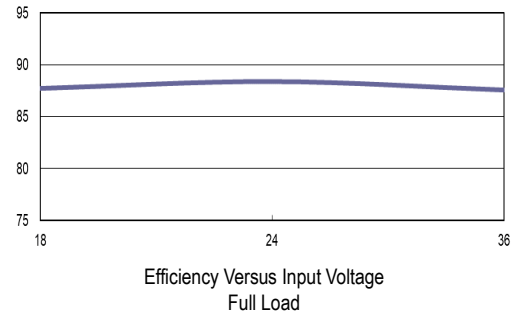


Characteristic Curves

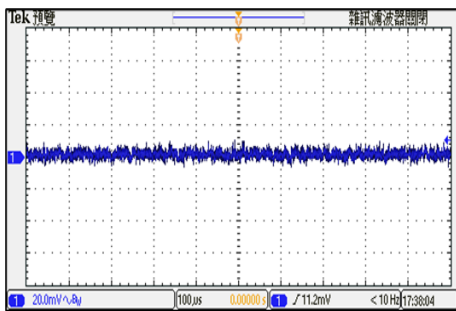
All test conditions are at 25°C The figures are identical for MDW15-24S051



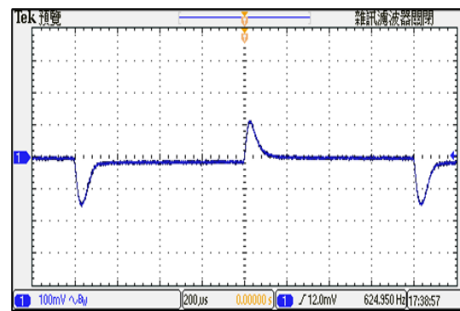
Efficiency Versus Output Current



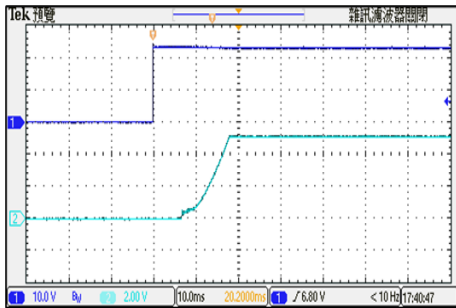
Efficiency Versus Input Voltage Full Load



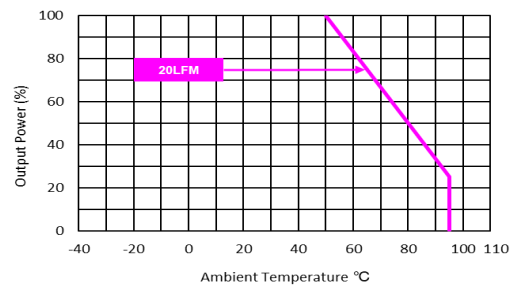
Typical Output Ripple and Noise
V_{in}=V_{in nom} ; Full Load



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



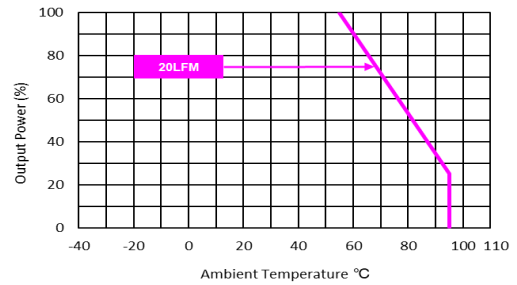
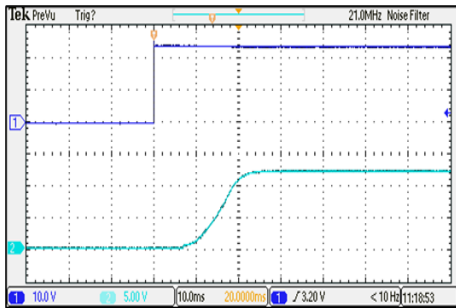
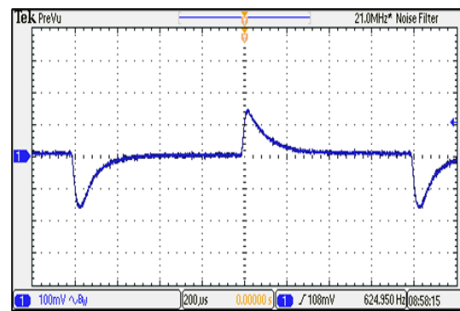
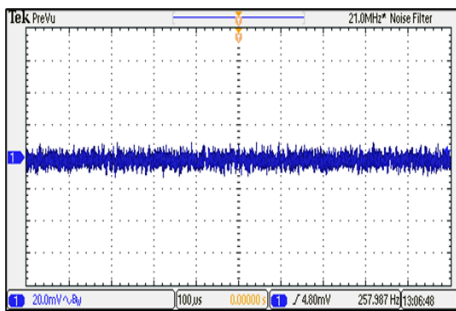
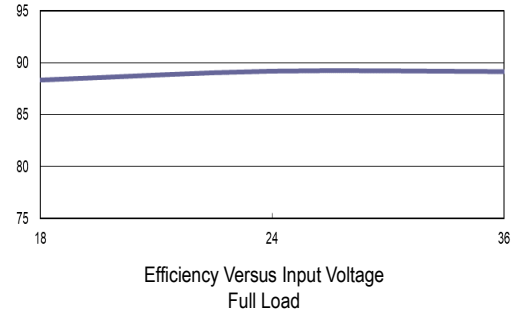
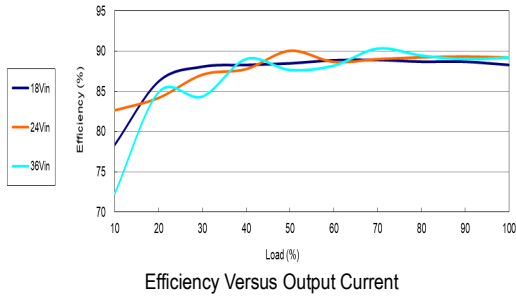
Typical Input Start-Up and Output Rise Characteristic
V_{in}=V_{in nom} ; Full Load



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

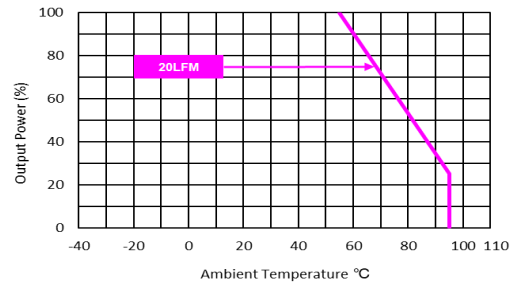
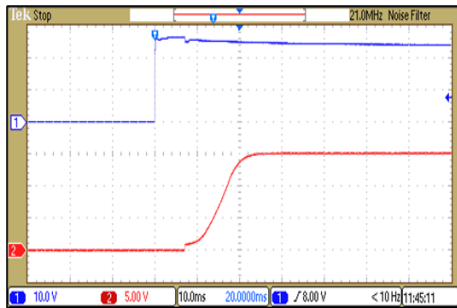
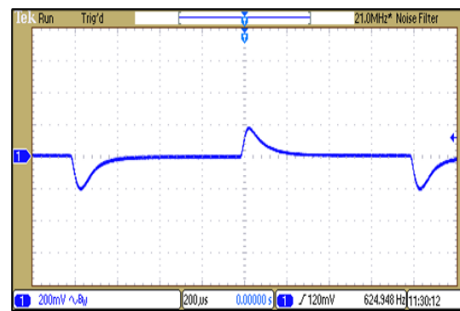
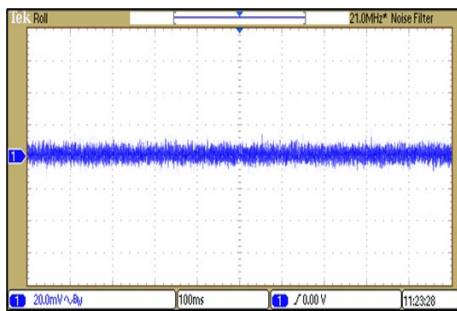
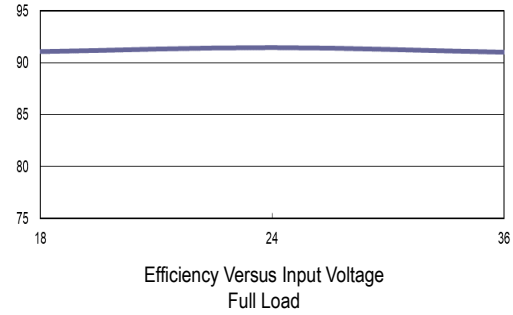
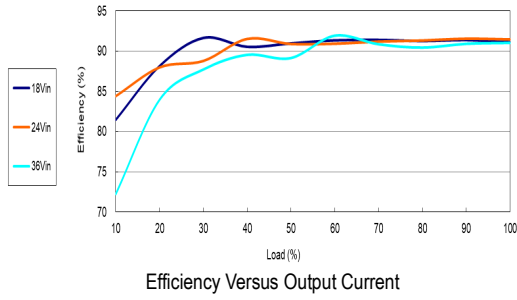
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW15-24S12



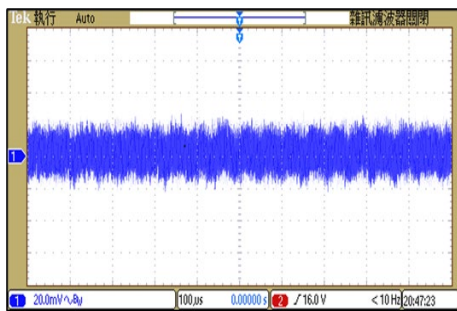
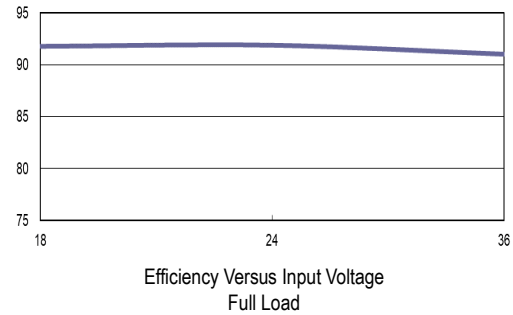
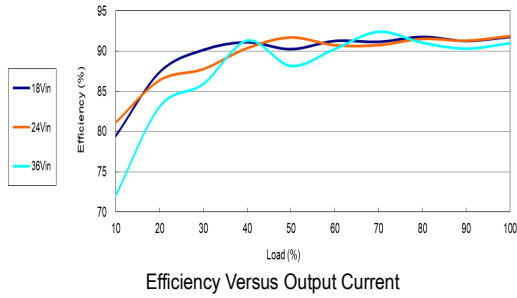
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW15-24S15

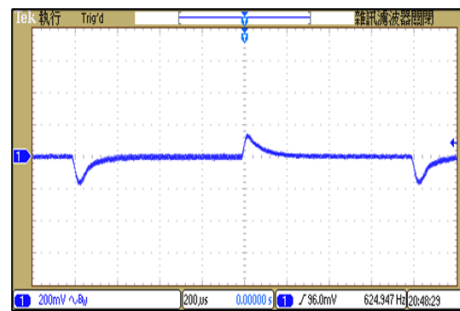


Characteristic Curves

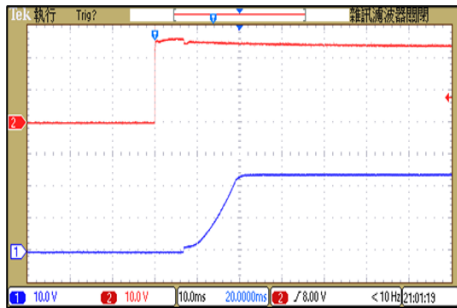
All test conditions are at 25°C The figures are identical for MDW15-24S24



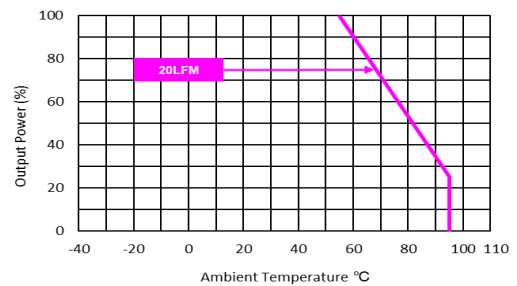
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



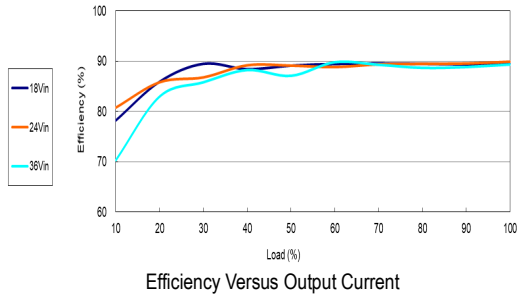
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



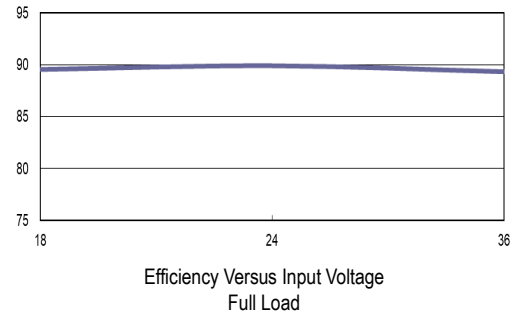
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in}=V_{in\ nom}$

Characteristic Curves

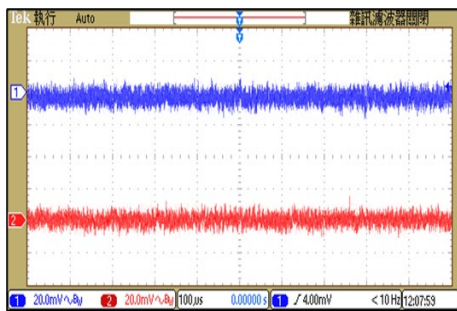
All test conditions are at 25°C The figures are identical for MDW15-24D12



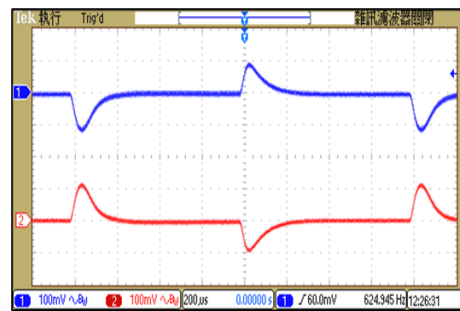
Efficiency Versus Output Current



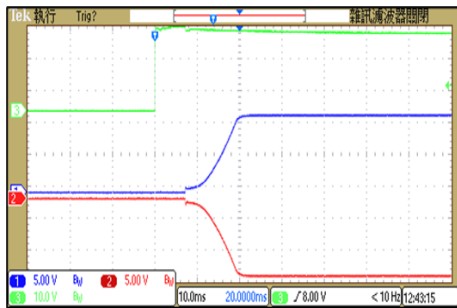
Efficiency Versus Input Voltage Full Load



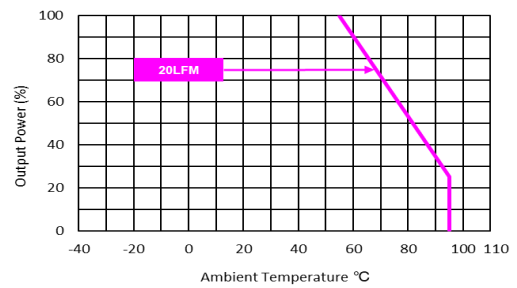
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



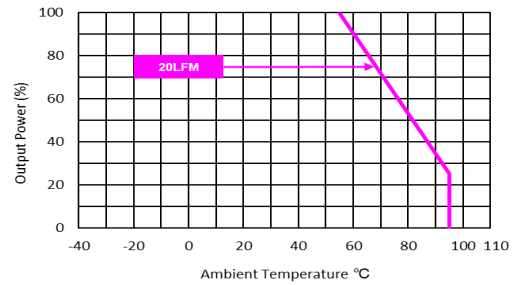
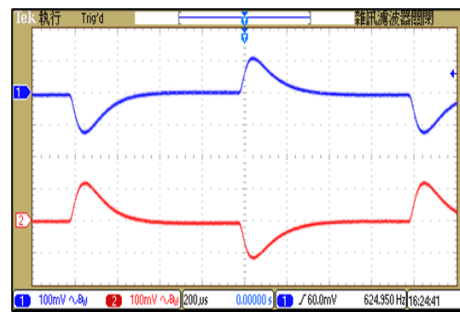
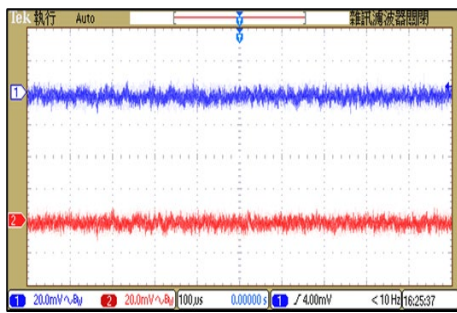
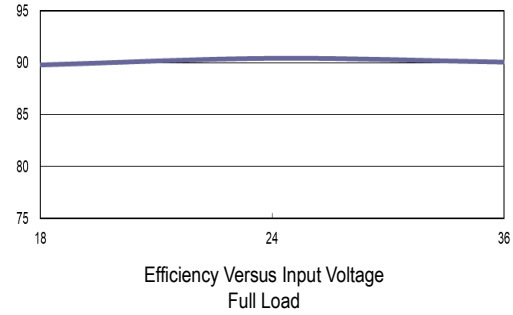
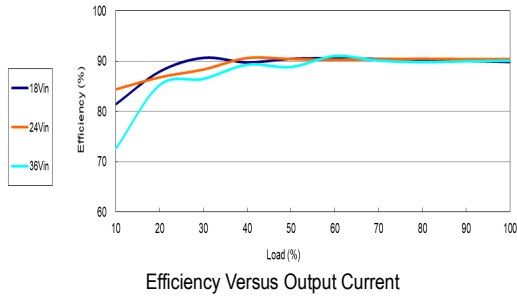
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

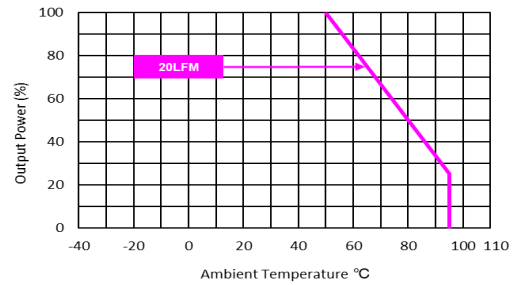
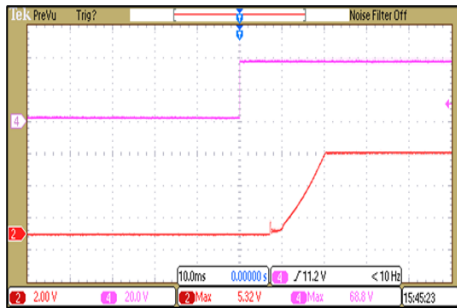
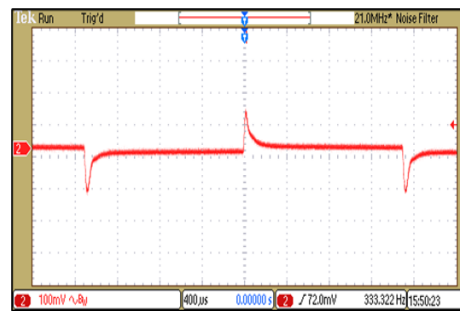
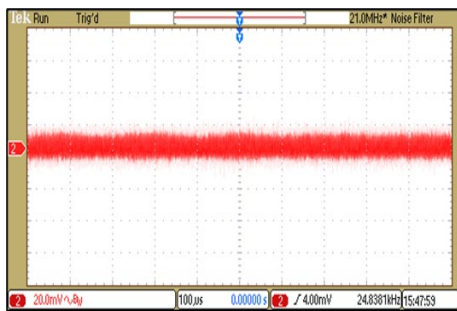
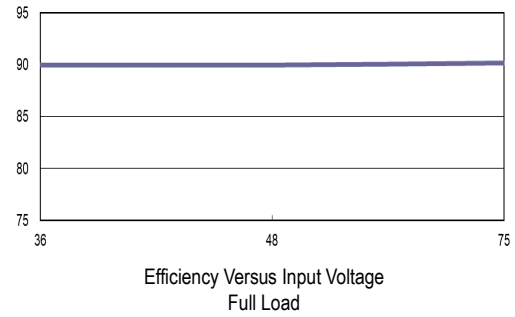
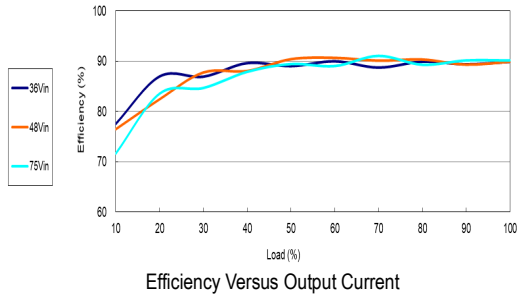
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW15-24D15



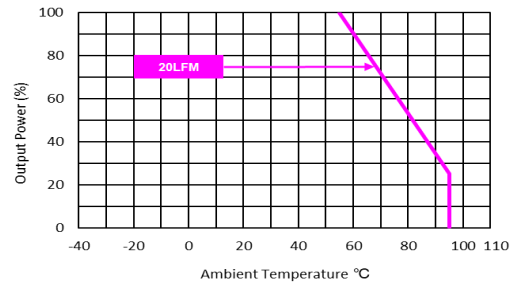
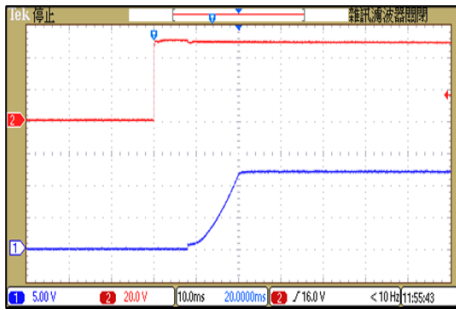
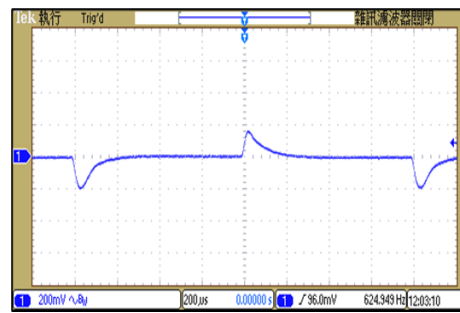
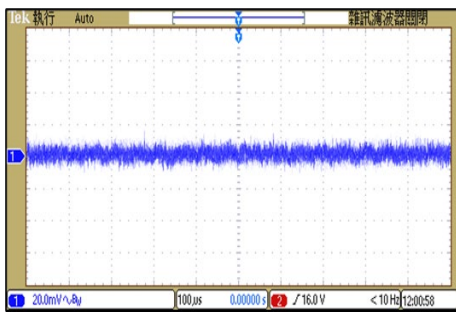
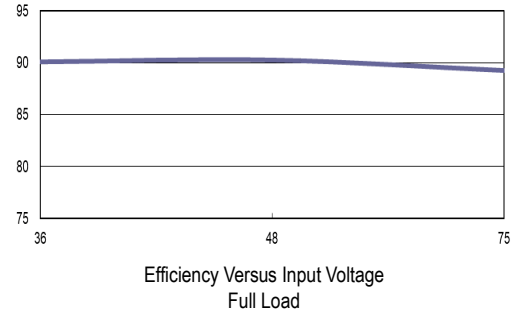
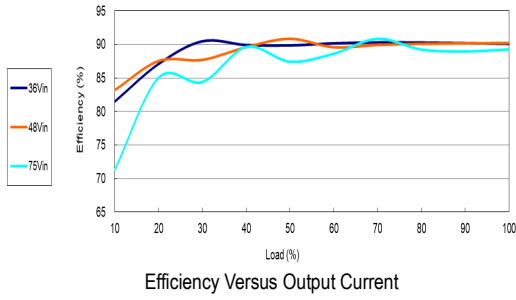
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW15-48S051



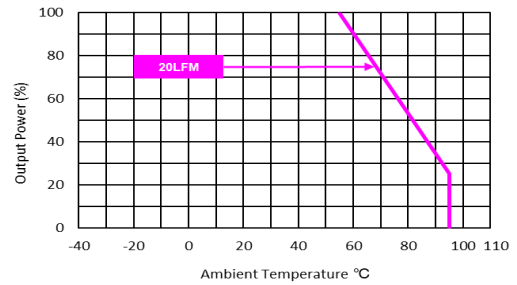
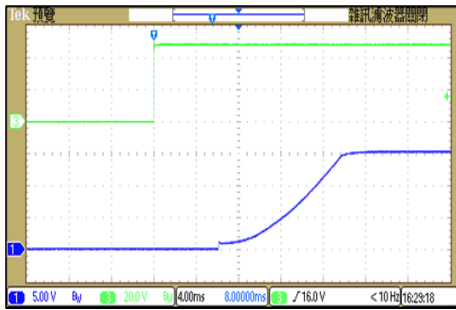
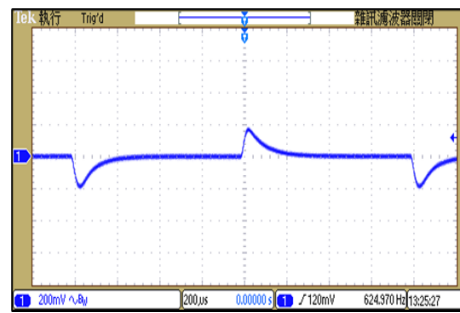
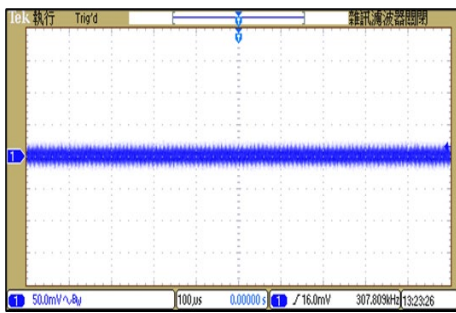
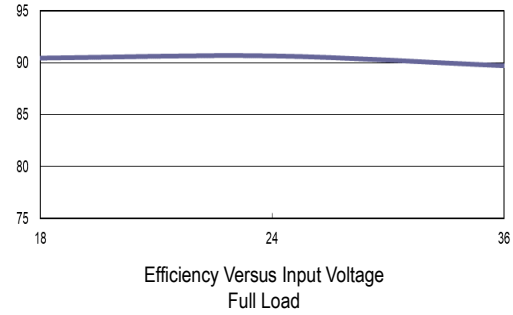
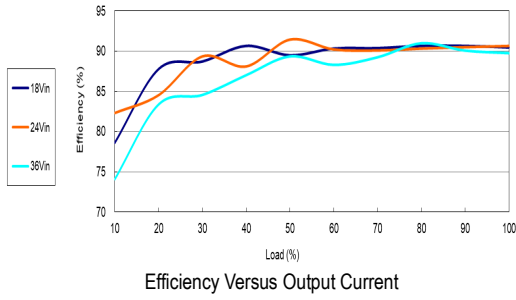
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW15-48S12



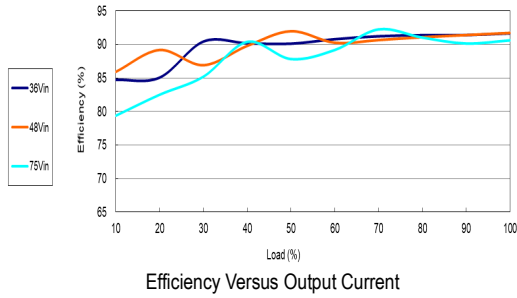
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW15-48S15

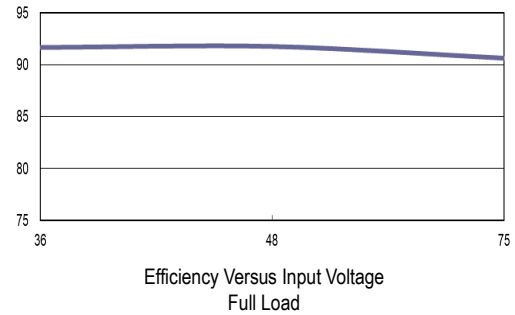


Characteristic Curves

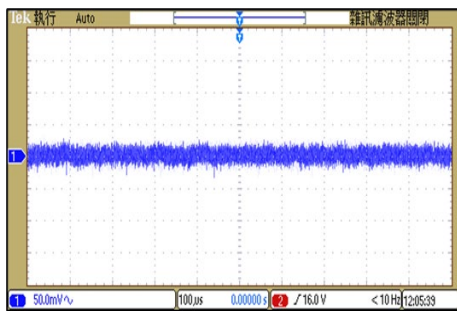
All test conditions are at 25°C The figures are identical for MDW15-48S24



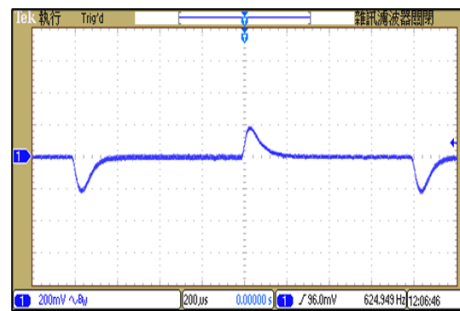
Efficiency Versus Output Current



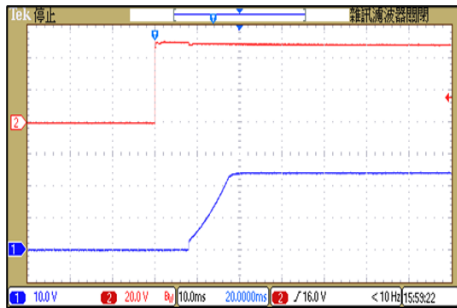
Efficiency Versus Input Voltage Full Load



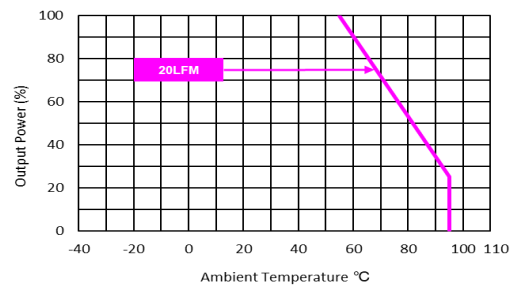
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



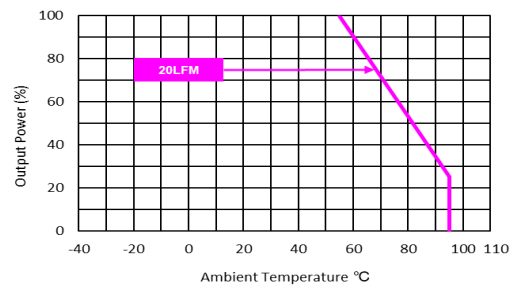
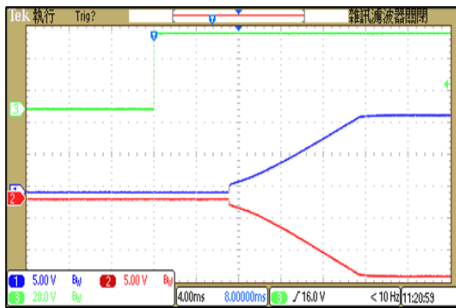
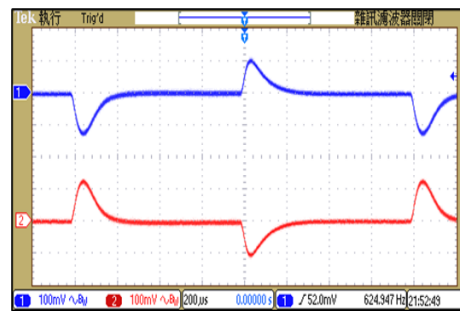
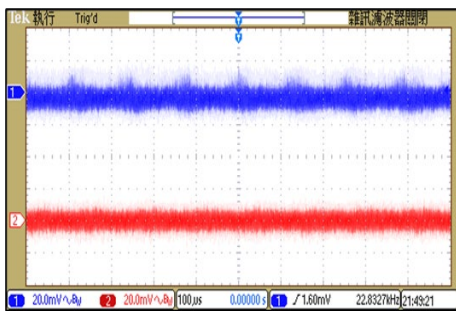
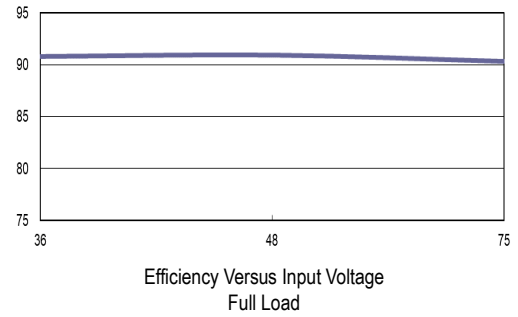
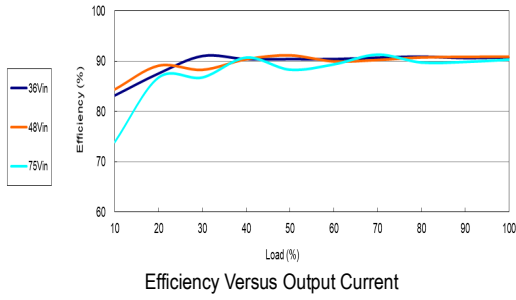
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

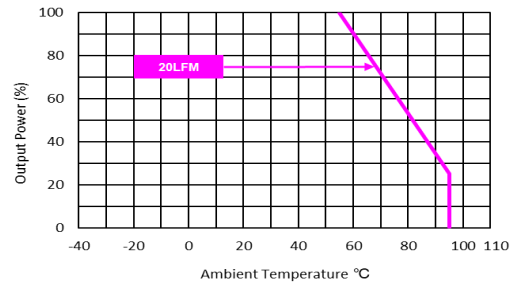
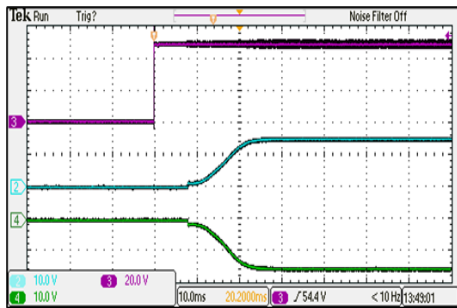
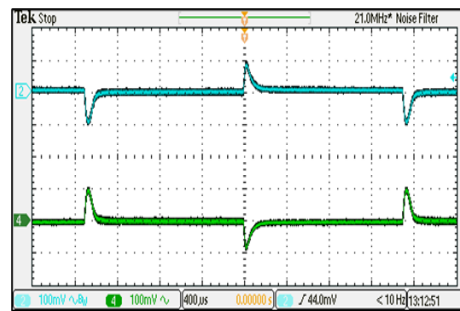
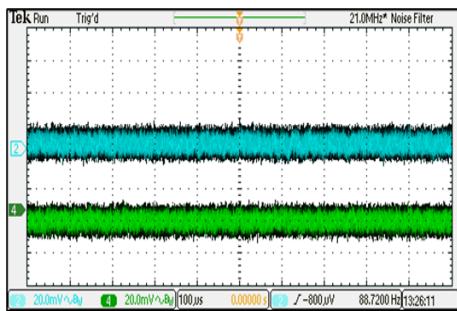
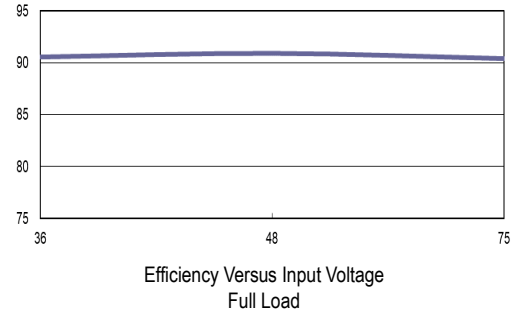
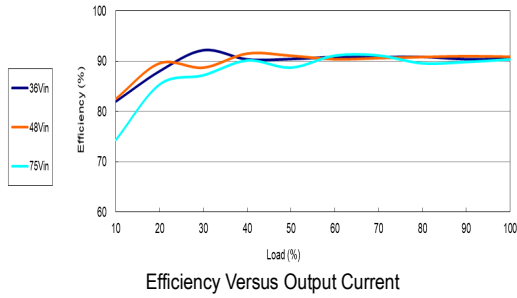
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW15-48D12



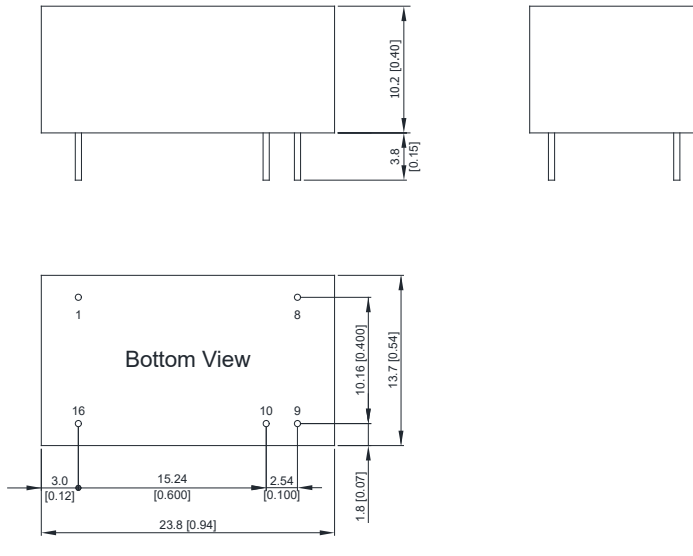
Characteristic Curves

All test conditions are at 25°C The figures are identical for MDW15-48D15



Package Specifications

Mechanical Dimensions



Pin Connections

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

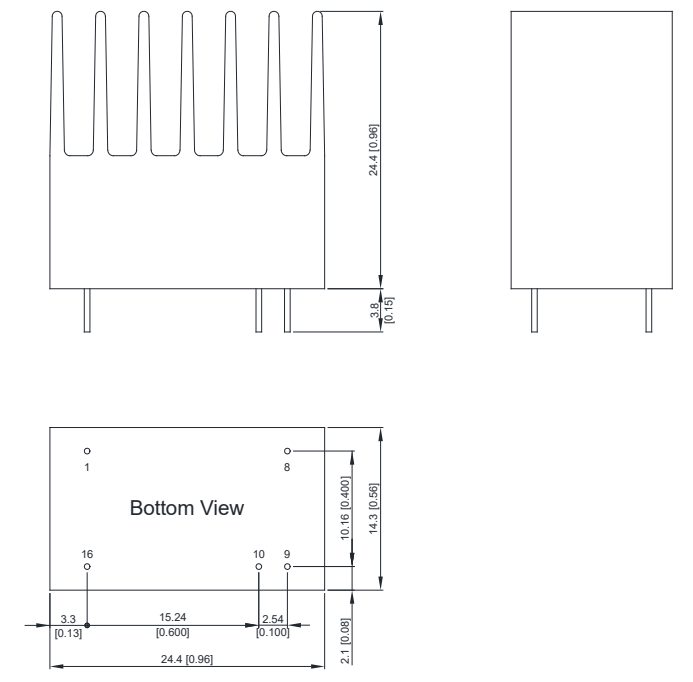
NC: No Connection

- ▶ 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	: 8.77g

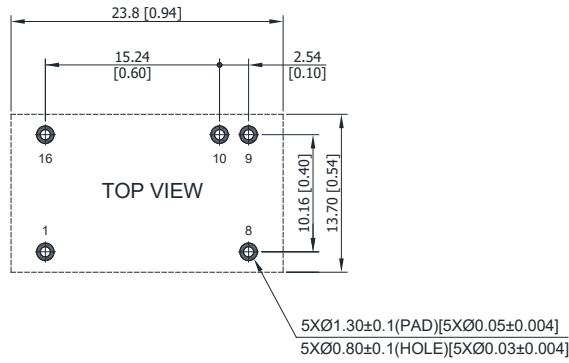
Heatsink (Option -HC7)



Physical Characteristics

Heatsink Material	: Aluminum
Finish	: Black Anodized Coating
Weight	: 14.2g

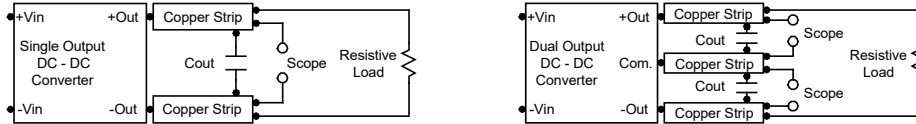
Recommended Pad Layout for Single & Dual Output Converter



Test Setup

Peak-to-Peak Output Noise Measurement Test

Refer to the output specifications or add 2.2µF 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.



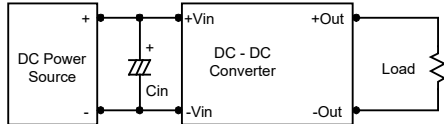
Technical Notes

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.

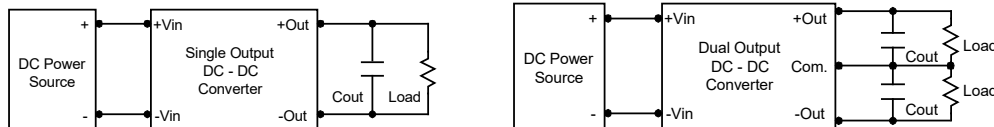
Input Source Impedance

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 a 27µF/200V/KXJ for the 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.

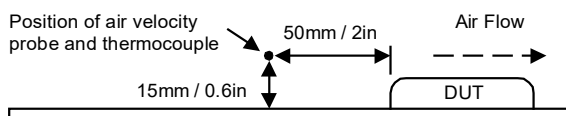


Maximum Capacitive Load

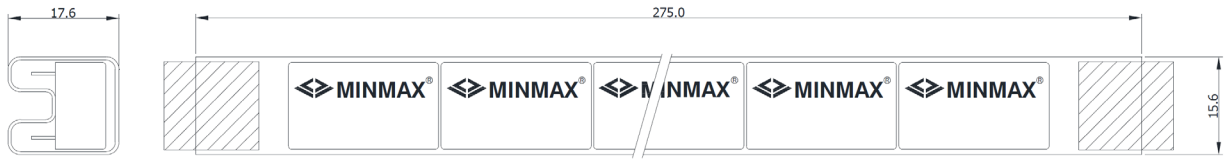
The MDW15 series has limitation of maximum connected capacitance on the output. The power module may operate in current limiting mode during start-up, affecting the ramp-up and the startup time. Connect capacitors at the point of load for best performance. The maximum capacitance can be found in the data sheet.

Thermal Considerations

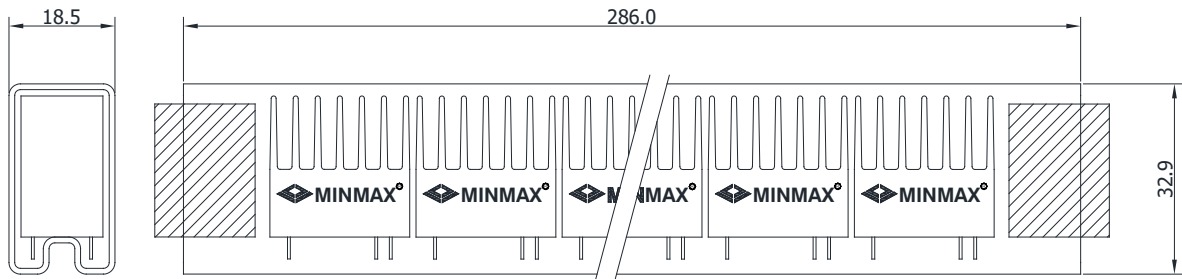
Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 110°C. The derating curves are determined from measurements obtained in a test setup.



Packaging Information



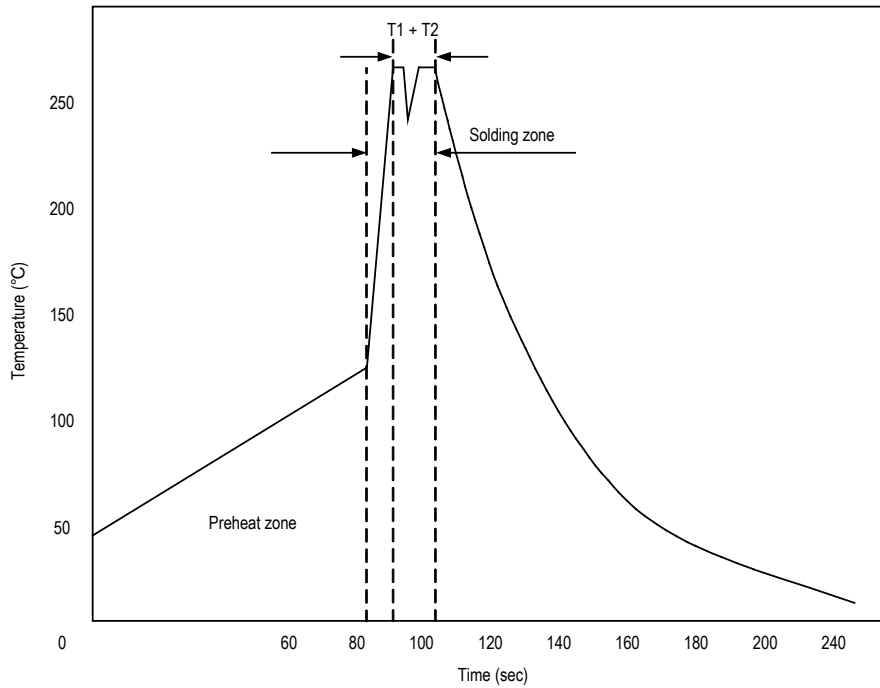
Unit: mm
10 PCS per TUBE (Without heatsink)



Unit: mm
10 PCS per TUBE (With heatsink)

Wave Soldering Considerations

Lead free wave solder profile



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

Hand Welding Parameter

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

Hand Welding: Soldering iron : Power 60W

Welding Time: 2~4 sec

Temp.: 380~400°C

Part Number Structure							
M	D	W	15	-	12	S	051
Package Type DIP-16	Wide 2:1 Input Voltage Range	Output Power 15 Watt	Input Voltage Range			Output Quantity	Output Voltage
			12: 9 ~ 18 VDC		S: Single	051: 5.1 VDC	
			24: 18 ~ 36 VDC		D: Dual	12: 12 VDC	
			48: 36 ~ 75 VDC			15: 15 VDC	
						24: 24 VDC	

MTBF and Reliability

The MTBF of MDW15 series of DC-DC converters has been calculated using

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

Model	MTBF	Unit
MDW15-12S051	2,881,388	Hours
MDW15-12S12	2,948,787	
MDW15-12S15	2,329,698	
MDW15-12S24	3,102,030	
MDW15-12D12	2,962,826	
MDW15-12D15	3,101,158	
MDW15-24S051	3,033,587	
MDW15-24S12	2,947,724	
MDW15-24S15	2,157,075	
MDW15-24S24	3,094,207	
MDW15-24D12	3,394,601	
MDW15-24D15	3,526,181	
MDW15-48S051	3,045,965	
MDW15-48S12	2,979,483	
MDW15-48S15	2,164,679	
MDW15-48S24	3,106,287	
MDW15-48D12	3,593,579	
MDW15-48D15	3,157,445	