



MINMAX[®]

MIW06 Series

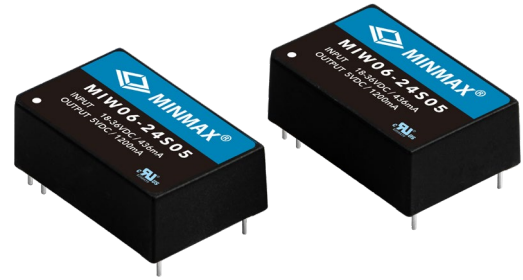
Electric Characteristic Note

MIW06 Series EC Note

DC-DC CONVERTER 6W, DIP-Package

Features

- ▶ Industrial Standard DIP-24 Package
- ▶ Wide 2:1 Input Voltage Range
- ▶ Fully Regulated Output Voltage
- ▶ I/O Isolation 1500 VDC (opt. 3000VDC)
- ▶ Operating Ambient Temp. Range -40°C to +85°C
- ▶ No Min. Load Requirement
- ▶ Under-voltage, Overload and Short Circuit Protection
- ▶ UL/cUL/IEC/EN 62368-1(60950-1) Safety Approval



Applications

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

Product Overview

The MINMAX MIW06 series is a range of high performance DC-DC converter modules with 6W output power, featuring wide 2:1 input voltage ranges and fixed output voltage regulation. The product comes in a DIP-24 package with industry standard footprint. Excellent efficiency allows an operation temperature range of -40°C to +85°C (with derating). Standard features include under-voltage protection, overload protection, short circuit protection and no min. load requirement as well. Typical applications for these cost optimized converters are battery powered equipment, instrumentation, datacom and industrial electronics.

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Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current	Input Current		Reflected Ripple Current	Max. capacitive Load	Efficiency (typ.)
				@Max. Load	@No Load			@Max. Load
	VDC	VDC	mA	mA(typ.)	mA(typ.)	mA(typ.)	μF	%
MIW06-12S033	12 (9 ~ 18)	3.3	1200	440	40	30	470	75
MIW06-12S05		5	1200	641			470	78
MIW06-12S12		12	500	609			100	82
MIW06-12S15		15	400	609			100	82
MIW06-12S24		24	250	595			47	84
MIW06-12D05		±5	±500	534			100#	78
MIW06-12D12		±12	±250	609			100#	82
MIW06-12D15		±15	±200	609			100#	82
MIW06-24S033	24 (18 ~ 36)	3.3	1200	214	20	20	470	77
MIW06-24S05		5	1200	313			470	80
MIW06-24S12		12	500	298			100	84
MIW06-24S15		15	400	298			100	84
MIW06-24S24		24	250	298			47	84
MIW06-24D05		±5	±500	260			100#	80
MIW06-24D12		±12	±250	298			100#	84
MIW06-24D15		±15	±200	298			100#	84
MIW06-48S033	48 (36 ~ 75)	3.3	1200	107	10	15	470	77
MIW06-48S05		5	1200	156			470	80
MIW06-48S12		12	500	149			100	84
MIW06-48S15		15	400	149			100	84
MIW06-48S24		24	250	149			47	84
MIW06-48D05		±5	±500	130			100#	80
MIW06-48D12		±12	±250	149			100#	84
MIW06-48D15		±15	±200	149			100#	84

For each output

Input Specifications

Parameter	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	7	8	9	
	24V Input Models	14	16	18	
	48V Input Models	32	34	36	
Under Voltage Shutdown	12V Input Models	---	---	8.5	
	24V Input Models	---	---	16	
	48V Input Models	---	---	35	
Short Circuit Input Power	All Models	---	---	3000	mW
Input Filter		Internal Pi Type			
Conducted EMI		Compliance to EN 55022, class A			

Output Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy		---	---	±2.0	%Vnom.
Output Voltage Balance	Dual Output, Balanced Loads	---	±1.0	±2.0	%
Line Regulation	Vin=Min. to Max. @Full Load	---	±0.1	±0.5	%
Load Regulation	Io=0% to 100%	---	±0.6	±1.2	%
Minimum Load	No minimum Load Requirement				
Ripple & Noise	0-20 MHz Bandwidth	---	---	80	mV _{P-P}
Transient Recovery Time	25% Load Step Change	---	300	600	μsec
Transient Response Deviation		---	±3	±5	%
Temperature Coefficient		---	±0.01	±0.02	%/°C
Over Load Protection	Foldback	110	145	---	%
Short Circuit Protection	Continuous, Automatic Recovery				

General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit	
I/O Isolation Voltage	60 Seconds	Standard	1500	---	---	VDC
		Suffix H	3000	---	---	VDC
	1 Second	Standard	1800	---	---	VDC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ	
I/O Isolation Capacitance	100kHz, 1V	---	1000	---	pF	
Switching Frequency		---	330	---	kHz	
MTBF (calculated)	MIL-HDBK-217F@25°C, Ground Benign	1,000,000			Hours	
Safety Approvals	UL/cUL 60950-1 recognition(CSA certificate), IEC/EN 60950-1(CB-report)					
	UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1(CB-report)					

Environmental Specifications

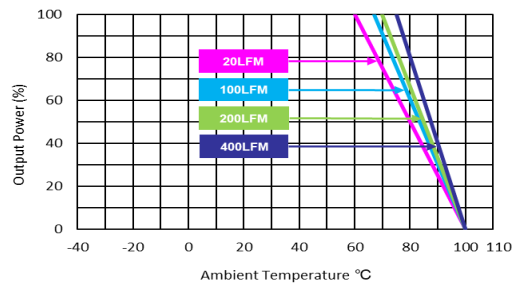
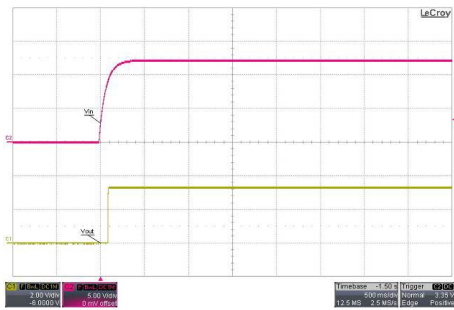
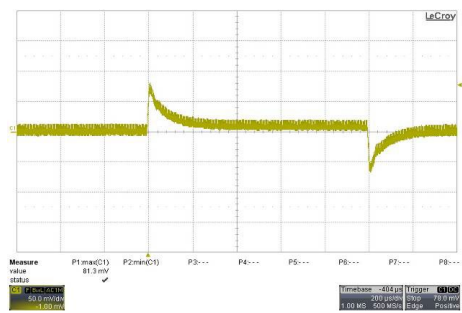
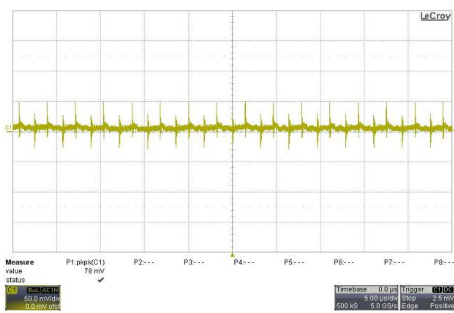
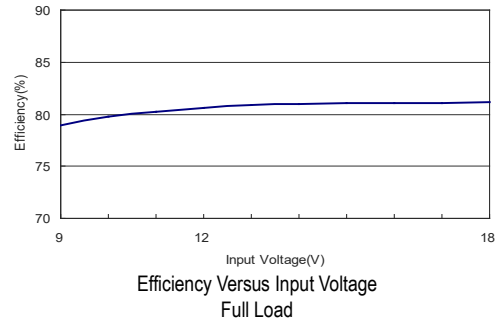
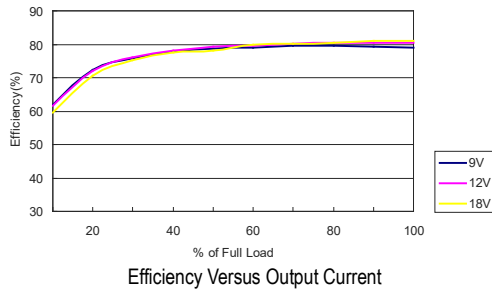
Parameter	Min.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	-40	+85	°C
Case Temperature	---	+100	°C
Storage Temperature Range	-50	+125	°C
Humidity (non condensing)	---	95	% rel. H
Lead Temperature (1.5mm from case for 10Sec.)	---	260	°C

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 Specifications are subject to change without notice.

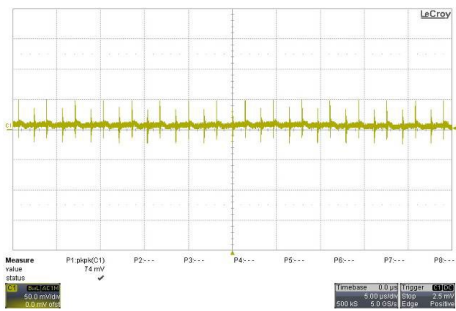
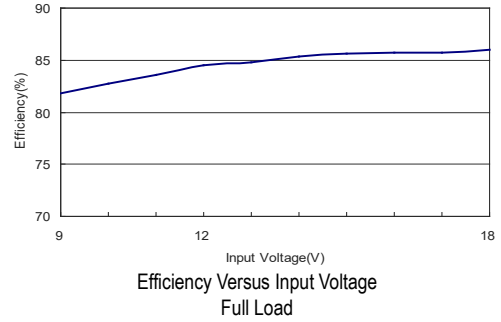
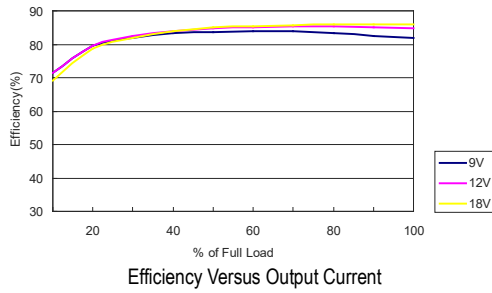
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-12S033

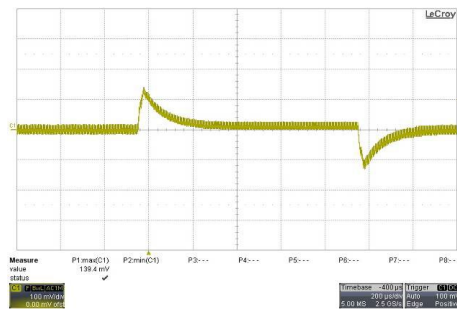


Characteristic Curves

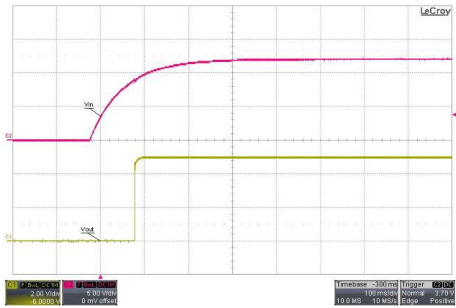
All test conditions are at 25°C The figures are identical for MIW06-12S05



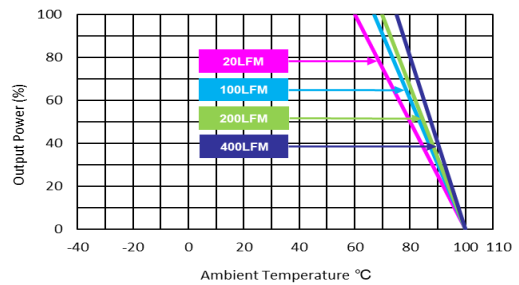
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



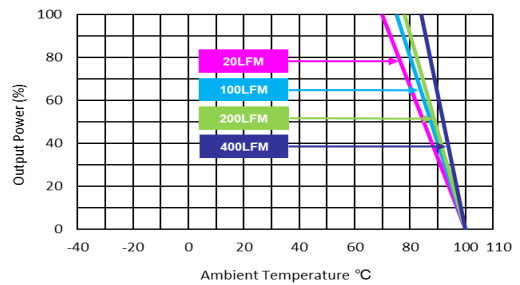
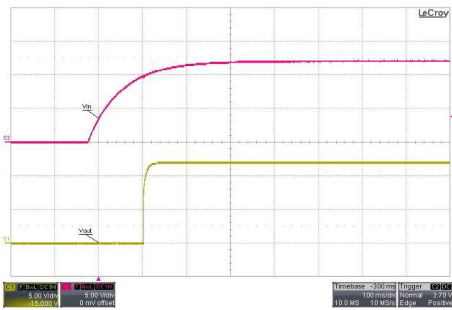
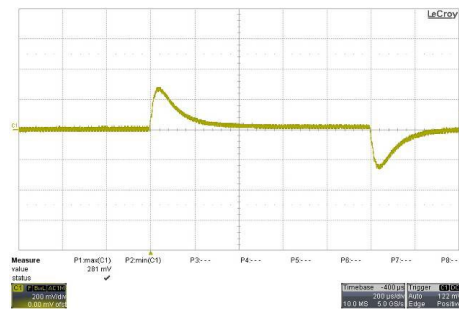
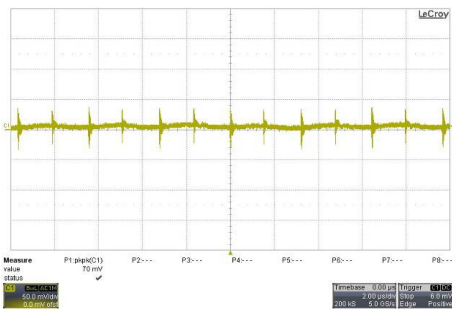
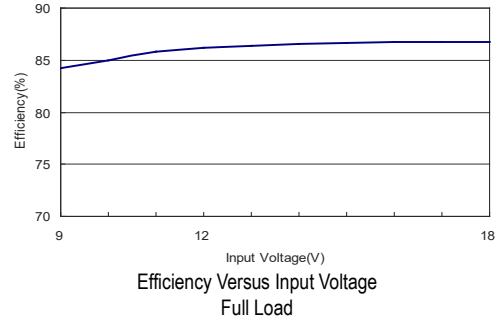
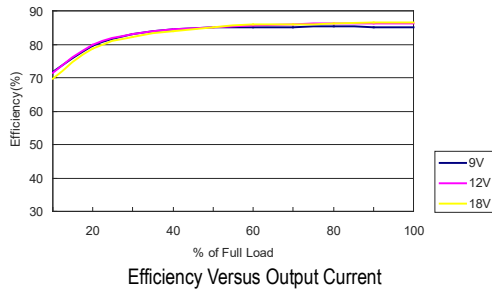
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

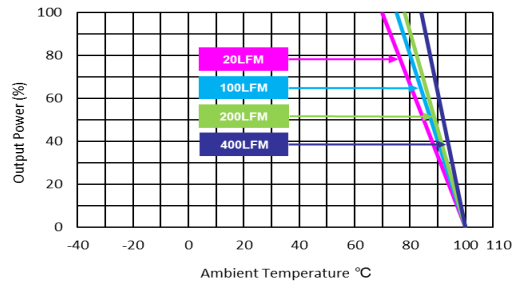
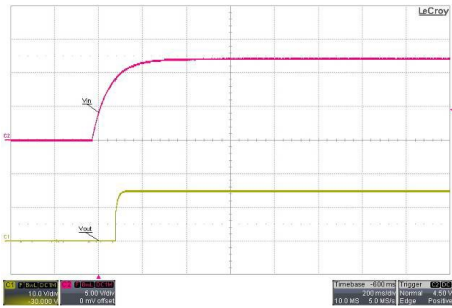
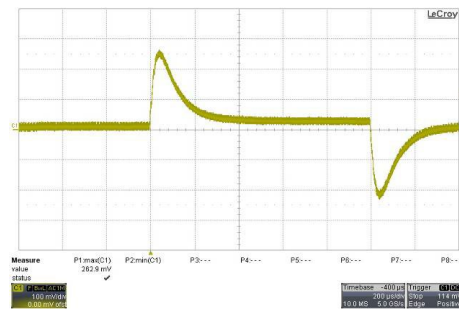
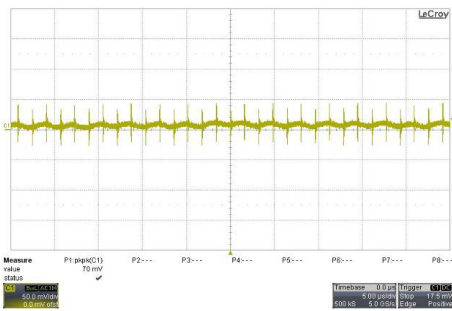
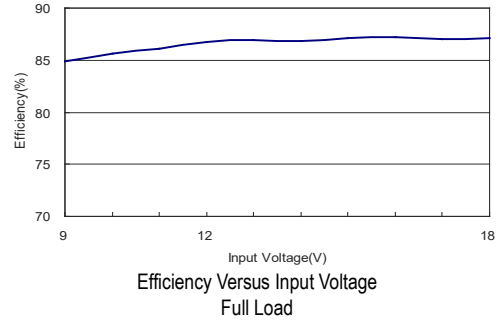
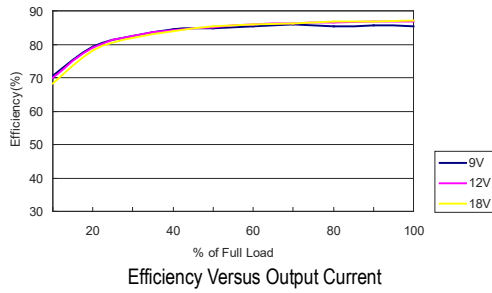
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-12S12



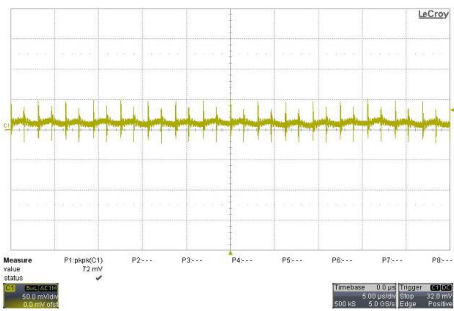
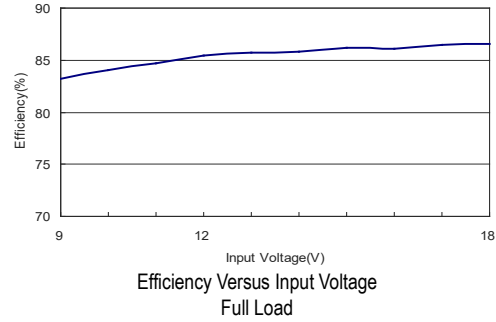
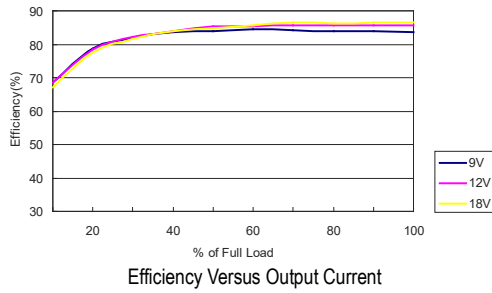
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-12S15



Characteristic Curves

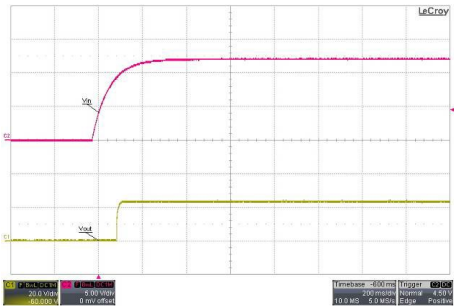
All test conditions are at 25°C The figures are identical for MIW06-12S24



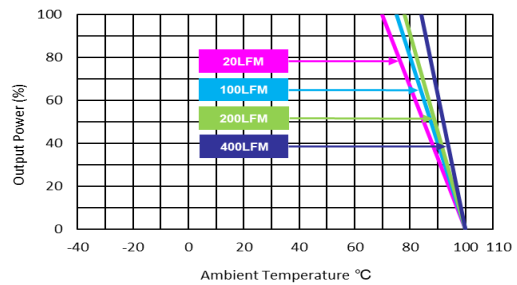
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



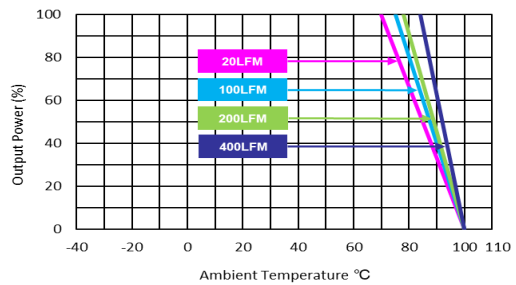
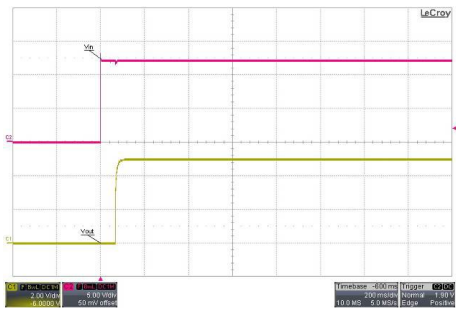
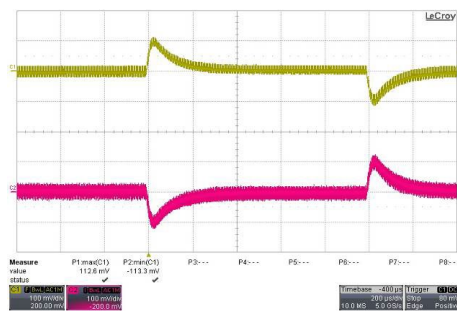
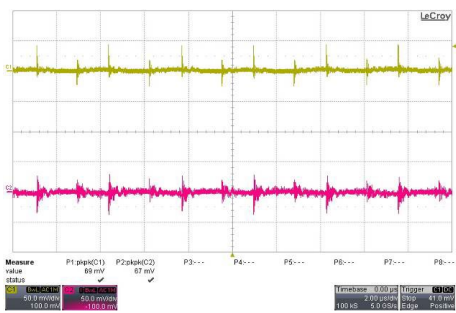
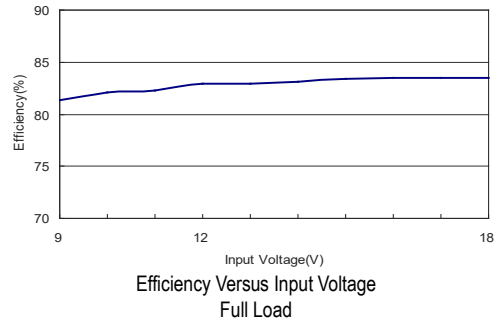
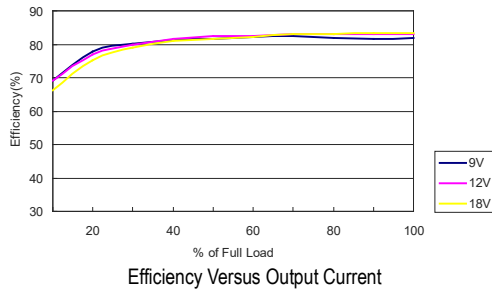
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

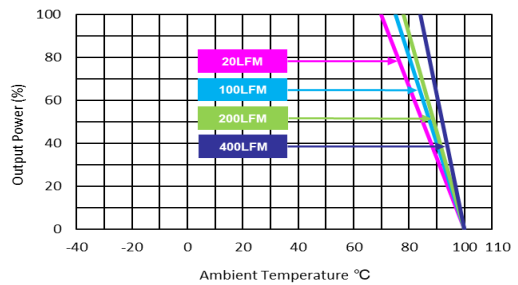
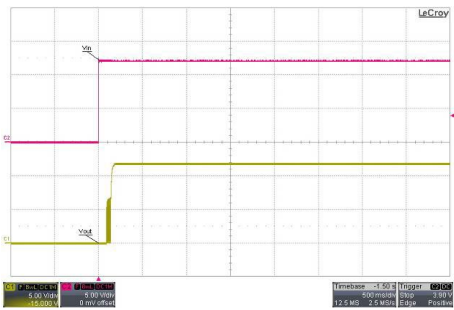
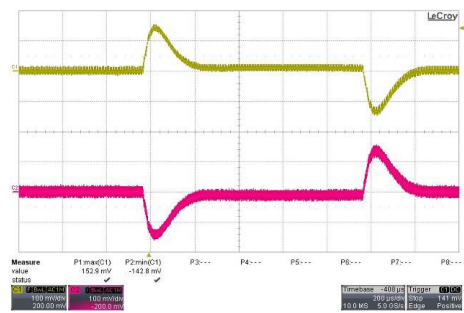
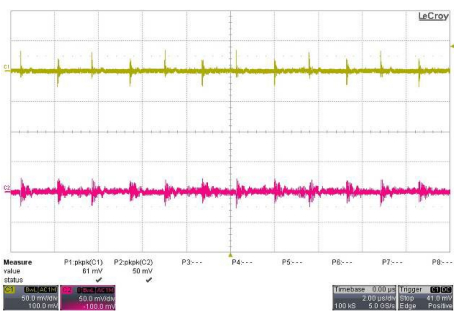
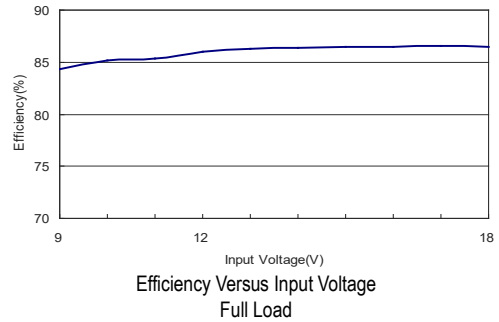
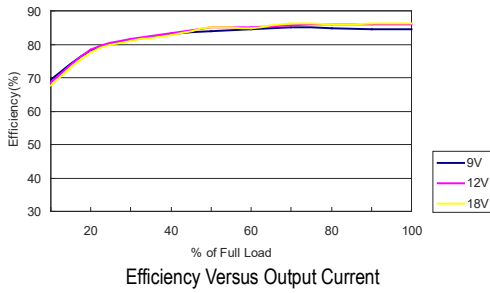
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-12D05



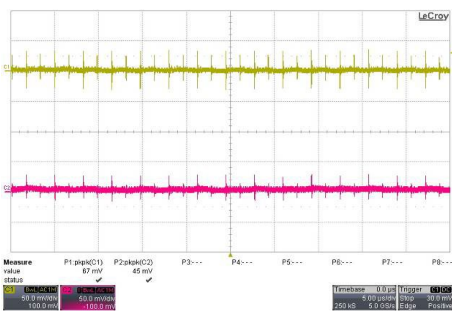
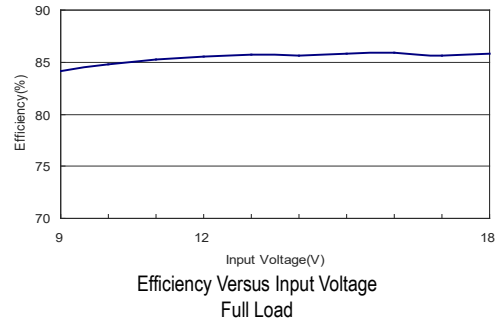
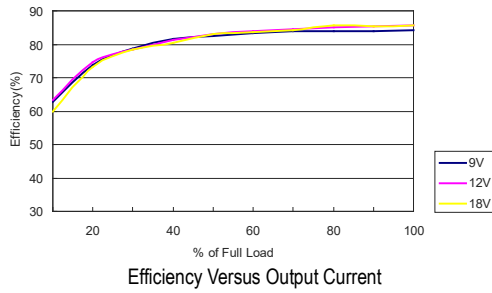
Characteristic Curves

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Characteristic Curves

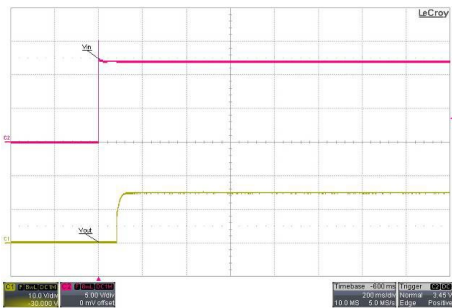
All test conditions are at 25°C The figures are identical for MIW06-12D15



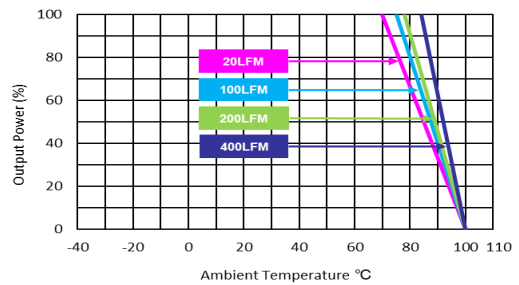
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



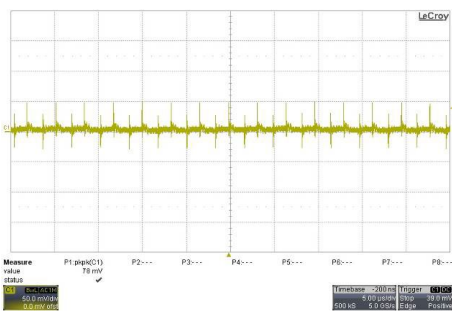
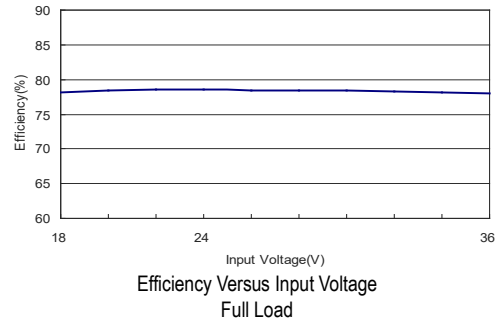
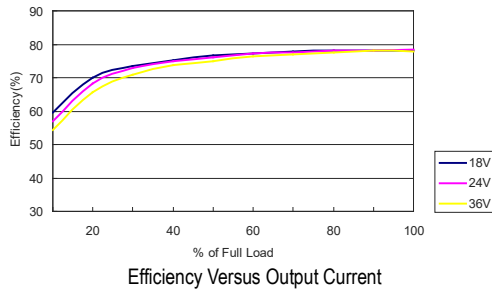
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



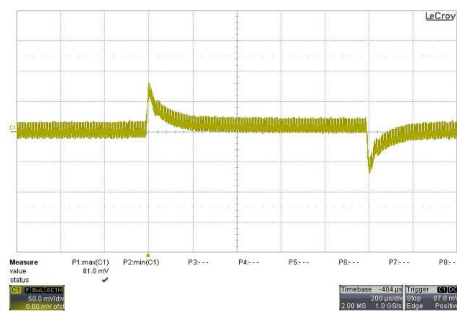
Derating Output Power Versus Ambient Temperature and Airflow
 $V_{in}=V_{in\ nom}$

Characteristic Curves

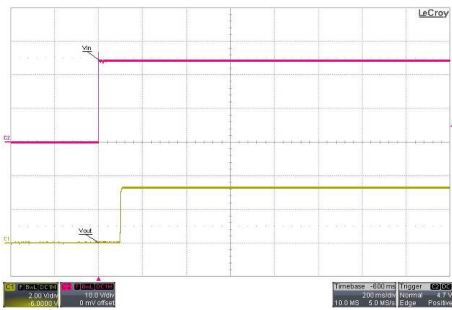
All test conditions are at 25°C The figures are identical for MIW06-24S033



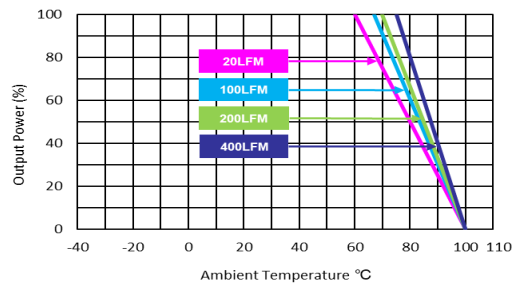
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



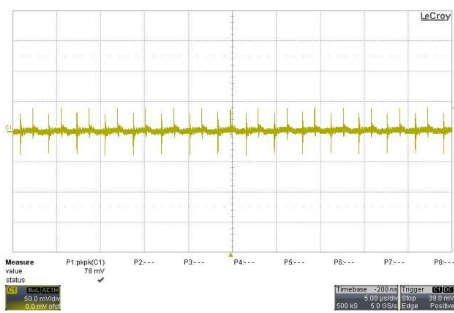
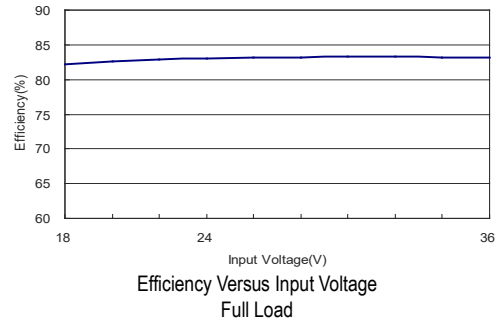
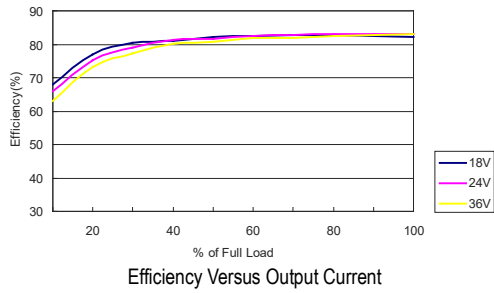
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



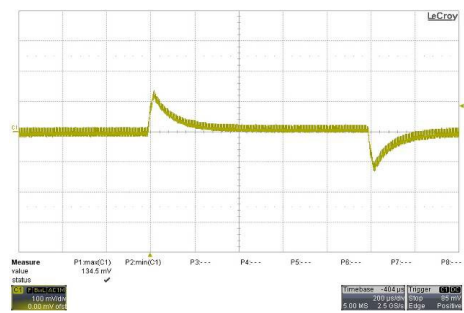
Derating Output Power Versus Ambient Temperature and Airflow
 $V_{in}=V_{in\ nom}$

Characteristic Curves

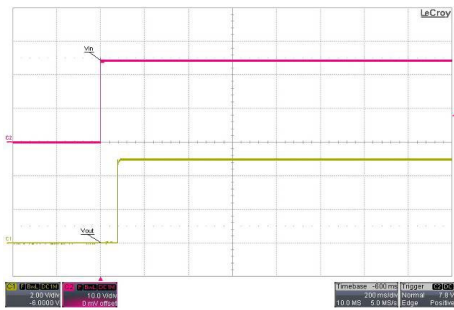
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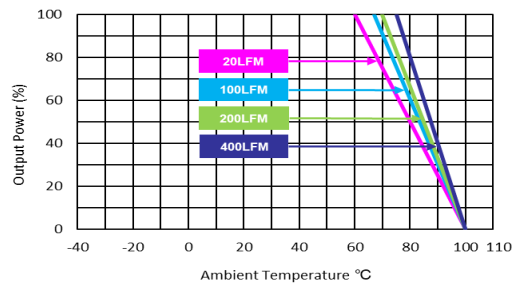
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



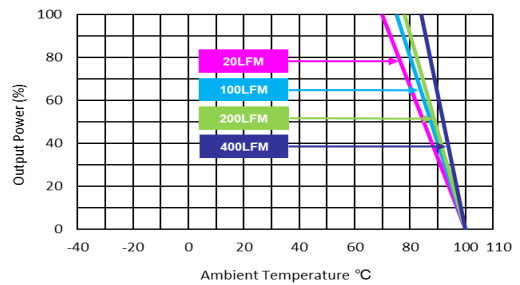
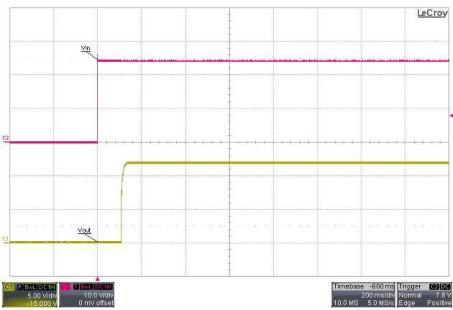
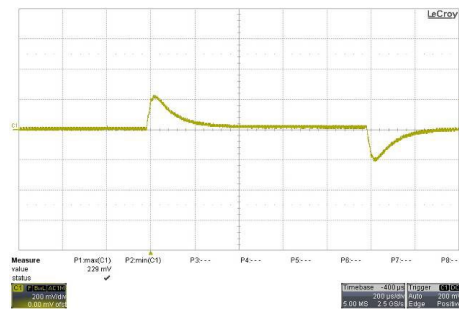
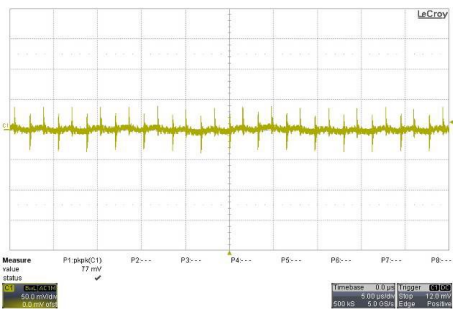
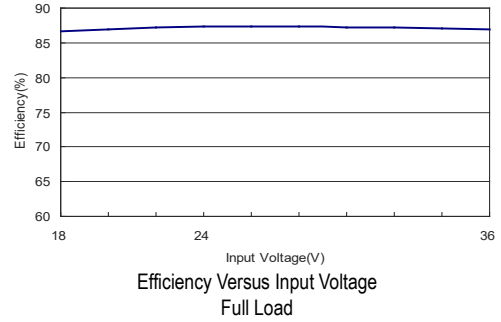
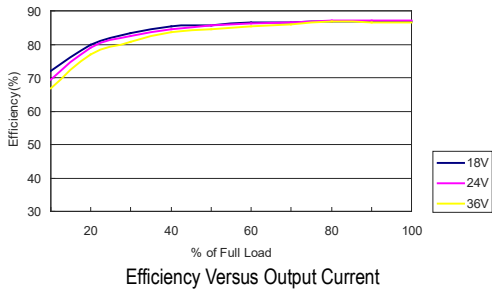
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

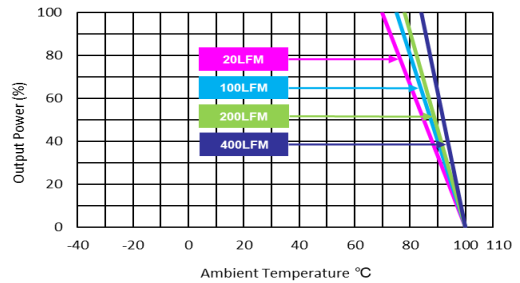
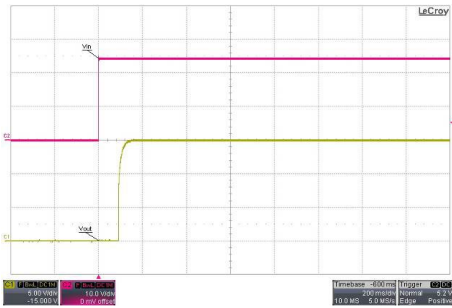
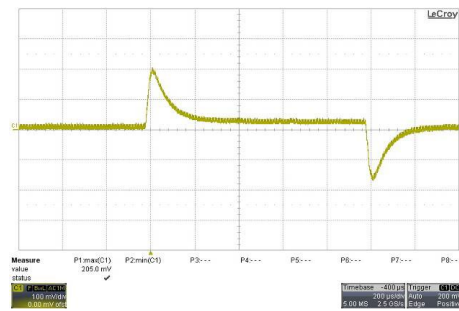
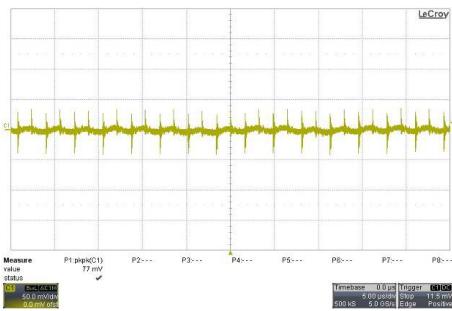
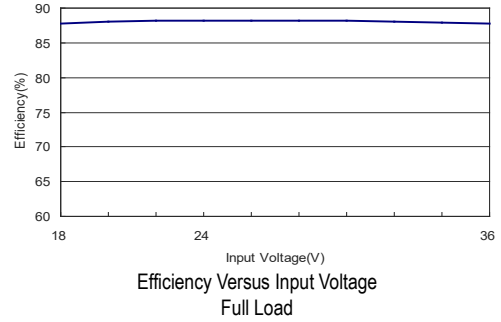
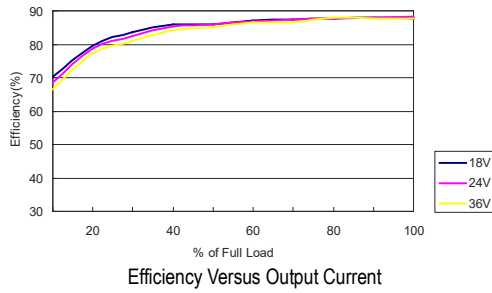
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-24S12



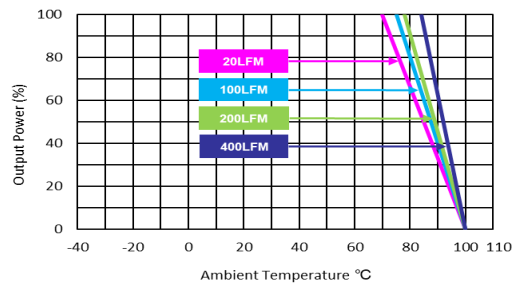
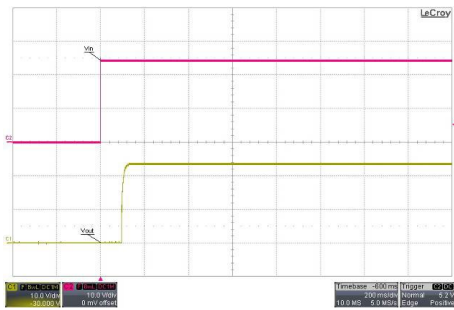
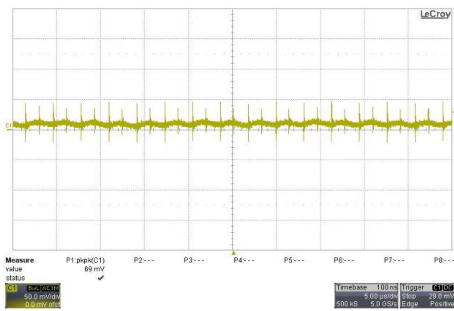
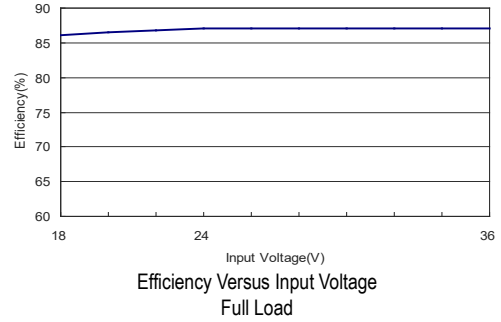
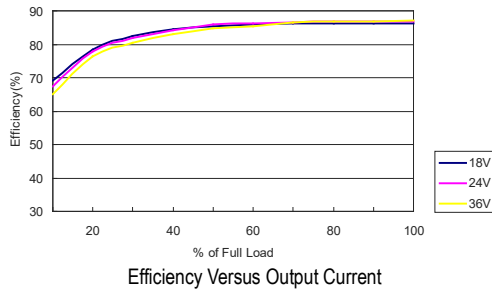
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-24S15



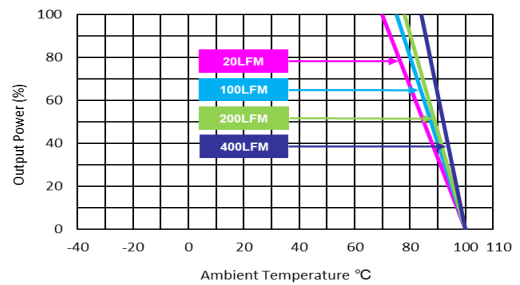
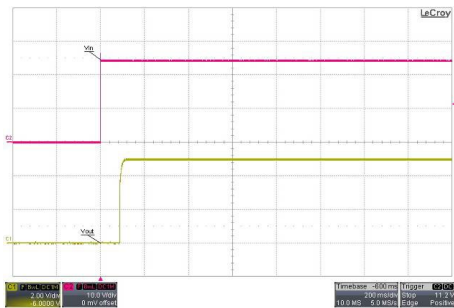
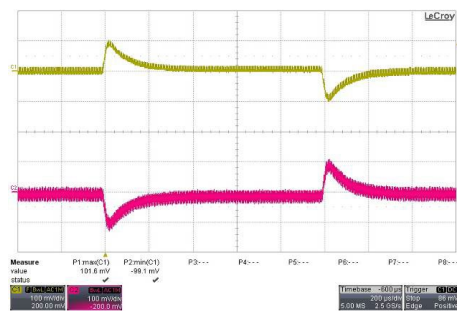
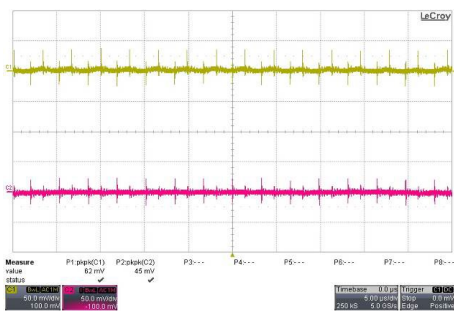
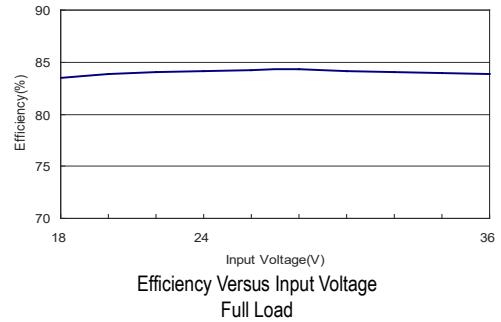
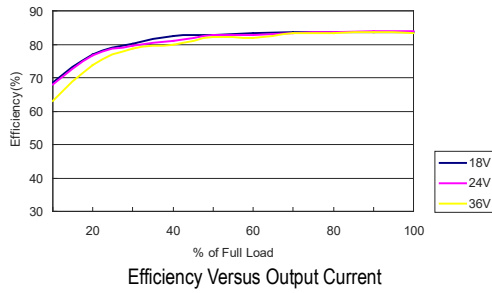
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-24S24



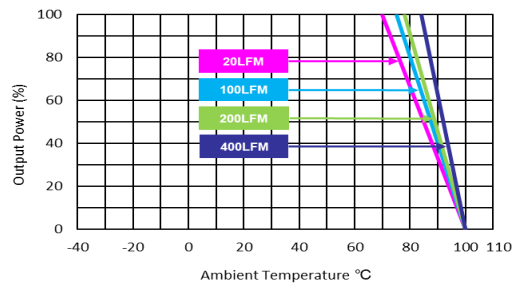
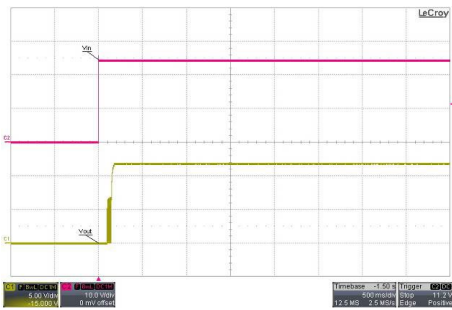
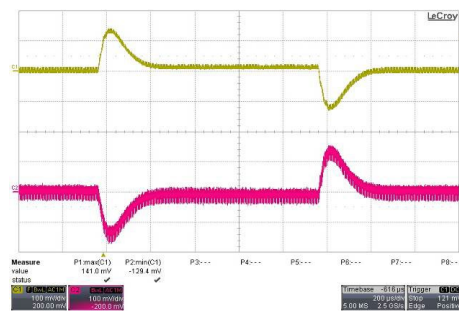
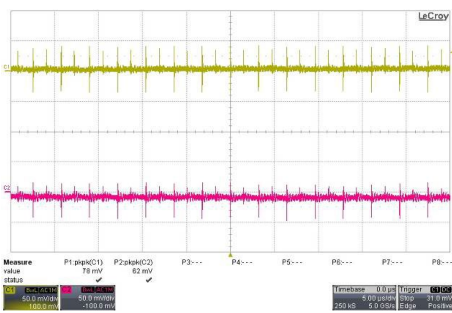
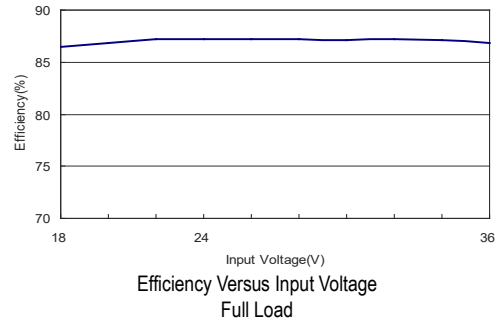
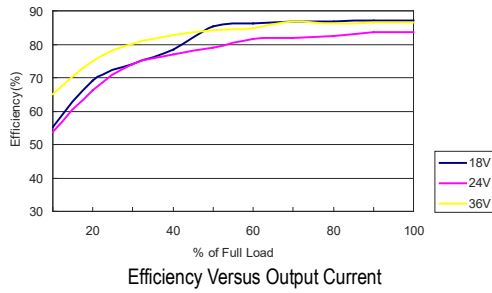
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-24D05



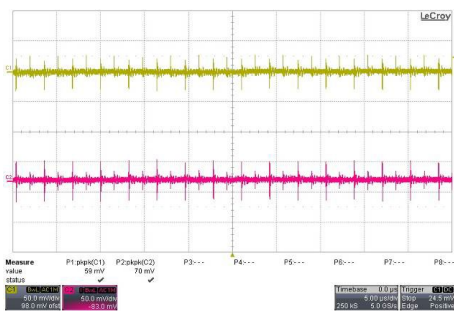
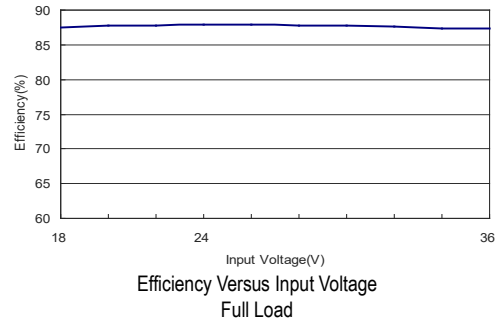
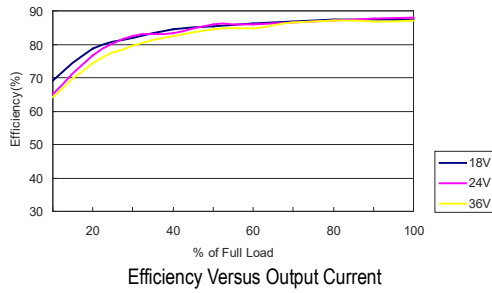
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-24D12

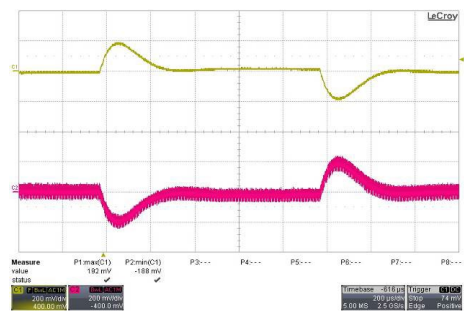


Characteristic Curves

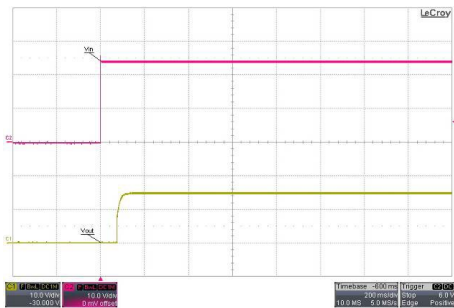
All test conditions are at 25°C The figures are identical for MIW06-24D15



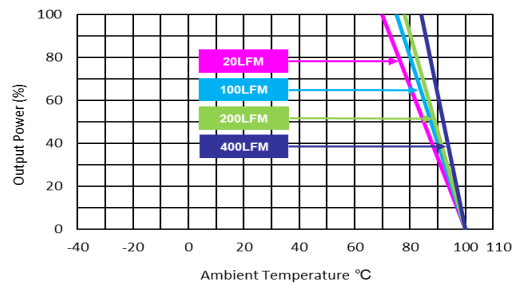
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



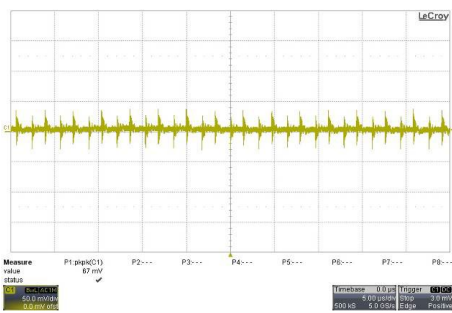
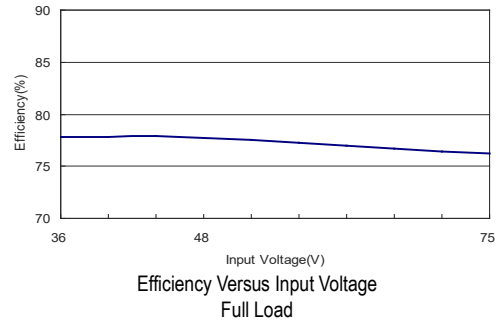
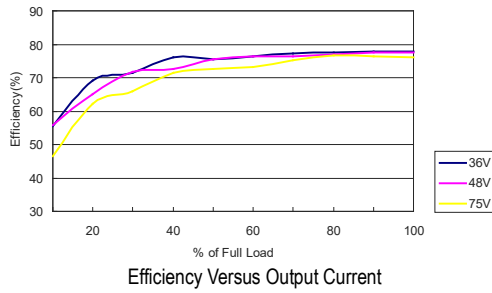
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



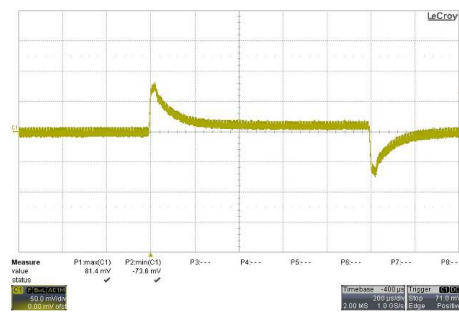
Derating Output Power Versus Ambient Temperature and Airflow
 $V_{in}=V_{in\ nom}$

Characteristic Curves

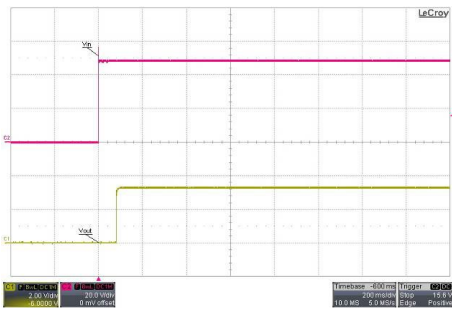
All test conditions are at 25°C The figures are identical for MIW06-48S033



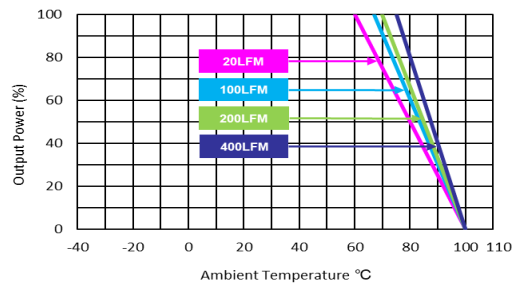
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



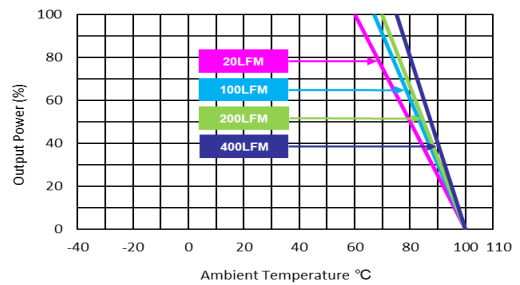
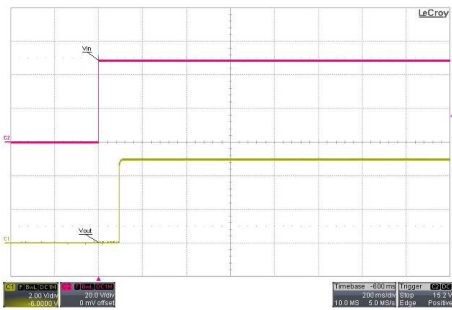
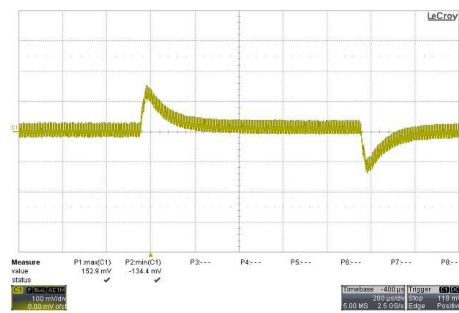
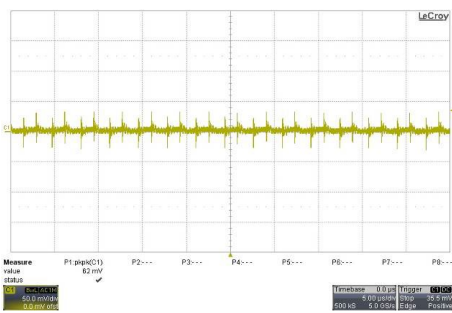
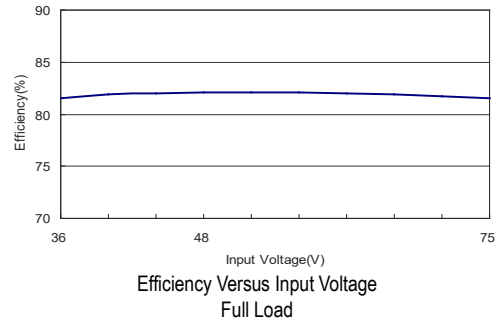
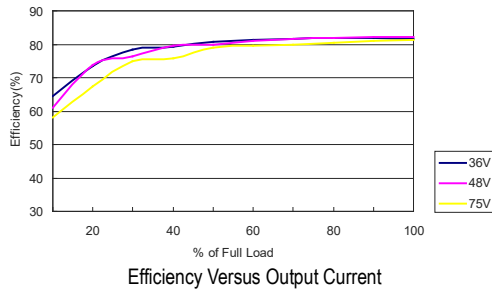
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

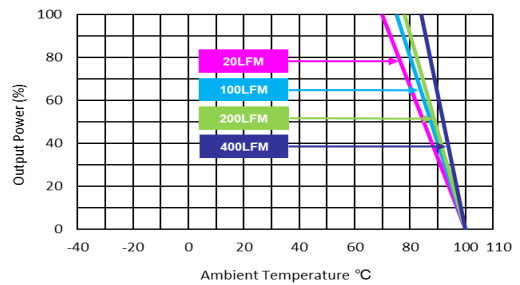
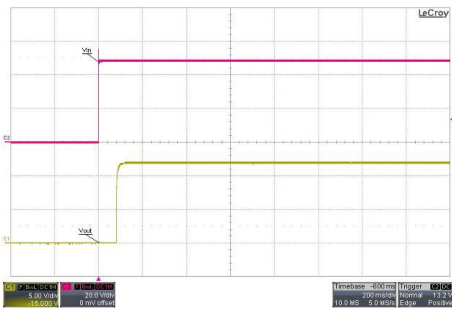
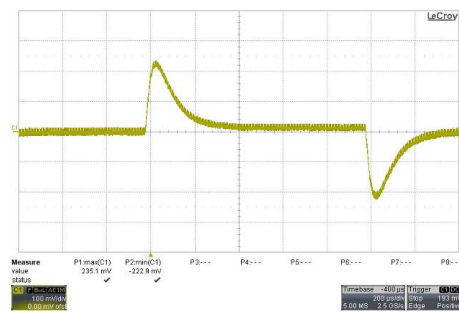
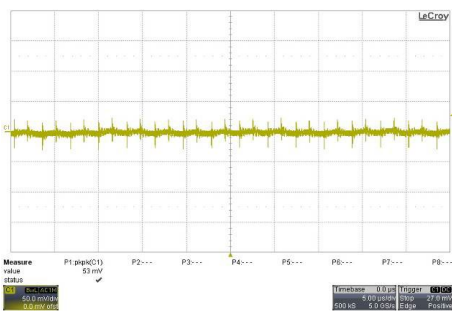
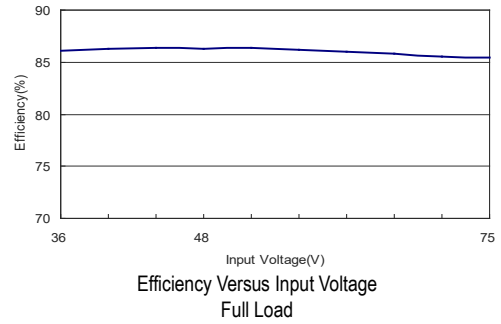
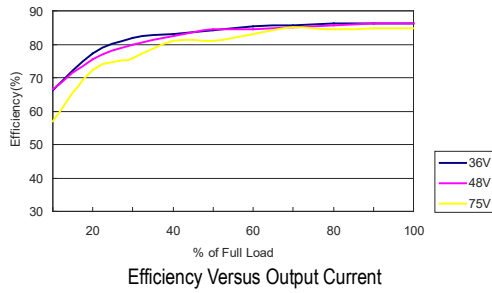
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-48S05



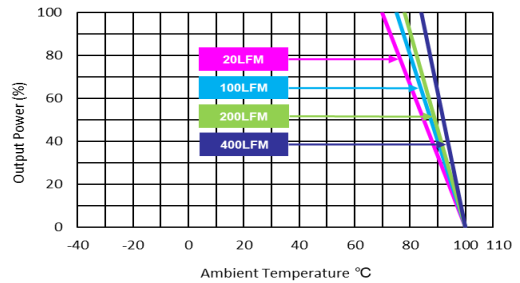
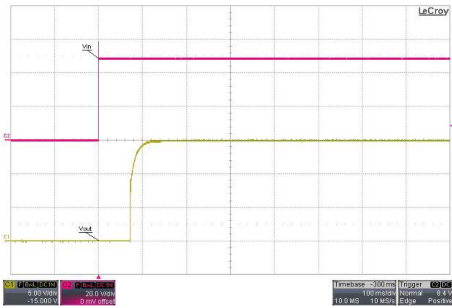
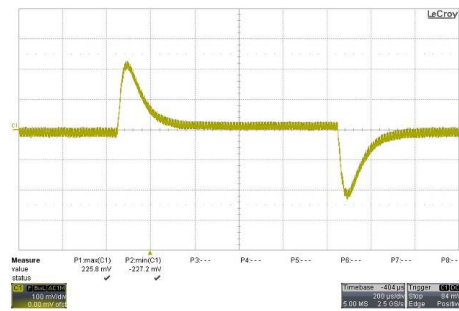
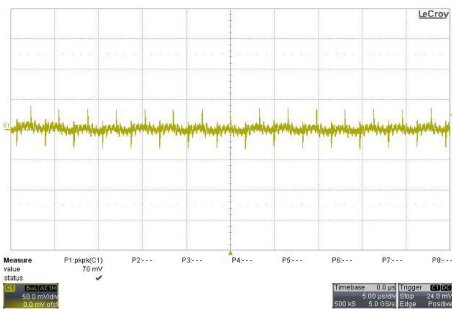
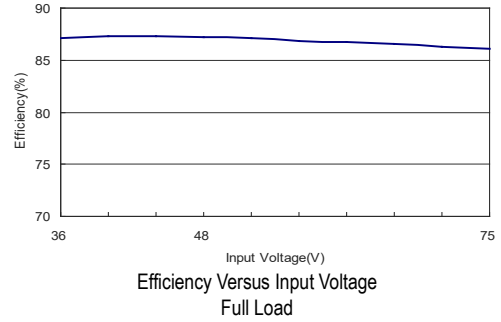
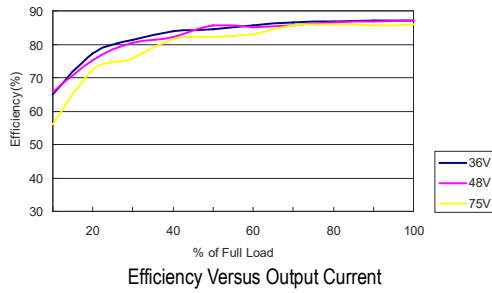
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-48S12



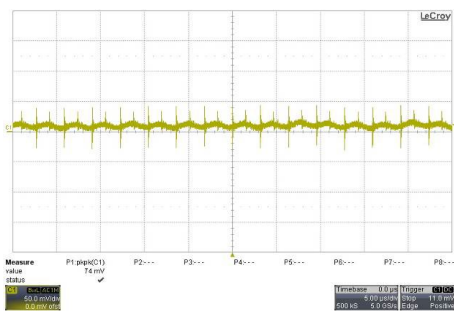
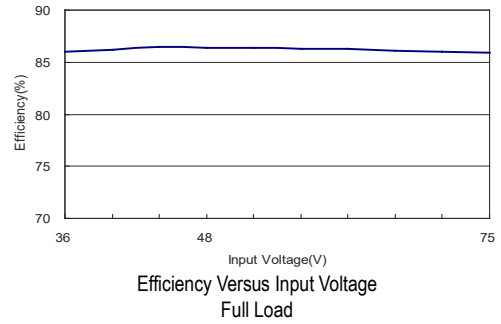
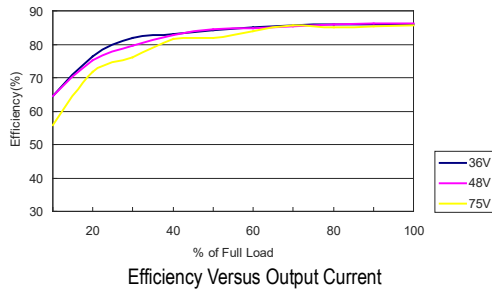
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-48S15



Characteristic Curves

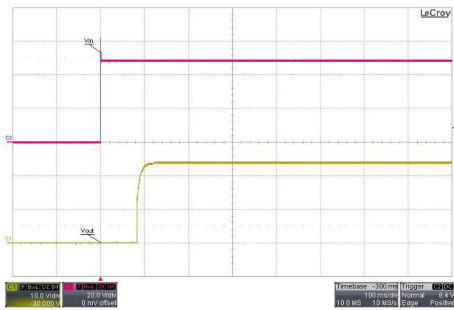
All test conditions are at 25°C The figures are identical for MIW06-48S24



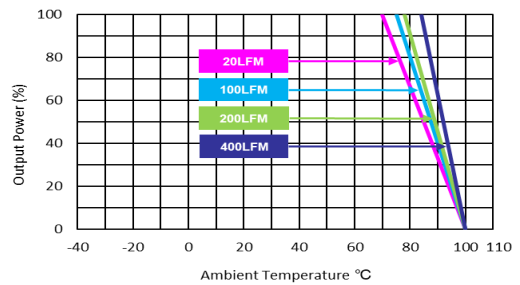
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



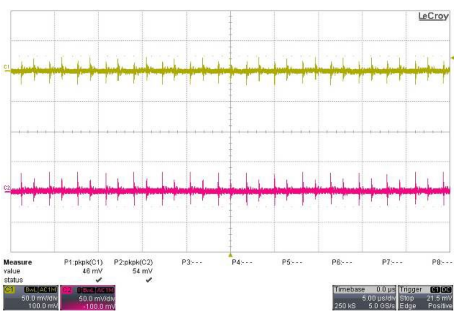
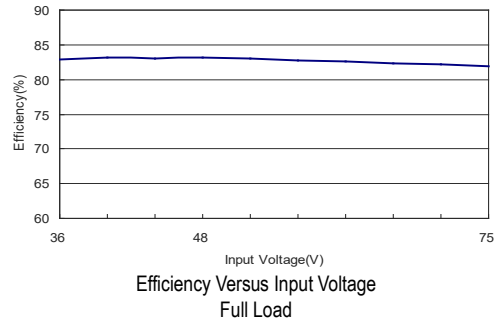
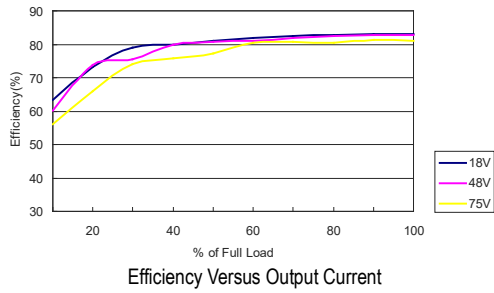
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



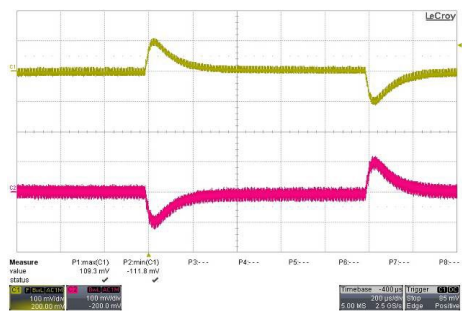
Derating Output Power Versus Ambient Temperature and Airflow
 $V_{in}=V_{in\ nom}$

Characteristic Curves

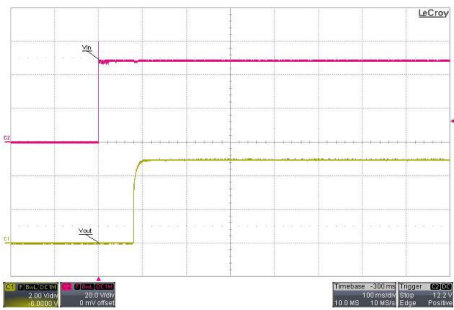
All test conditions are at 25°C The figures are identical for MIW06-48D05



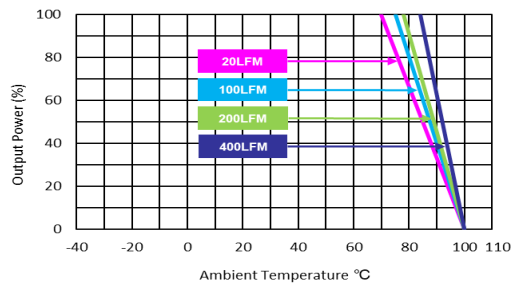
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



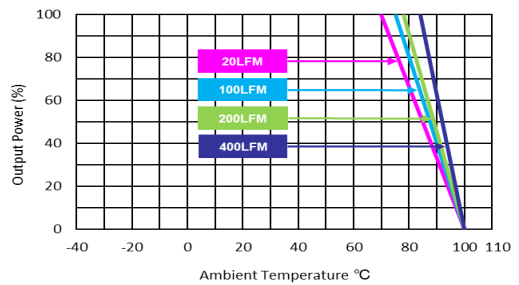
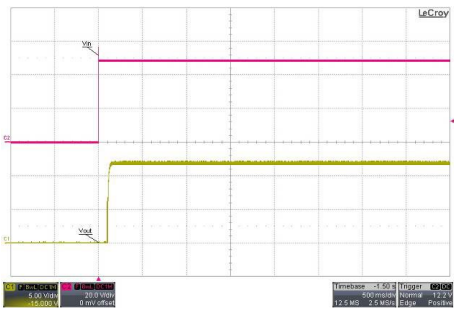
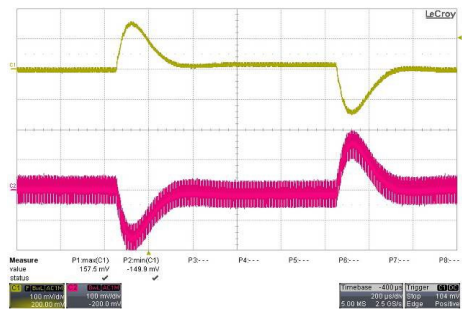
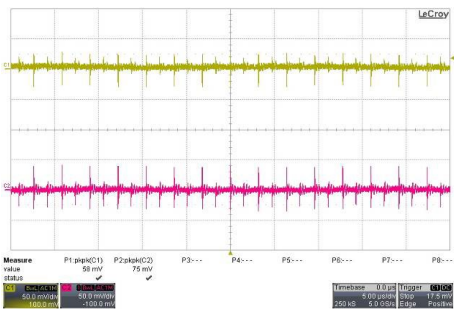
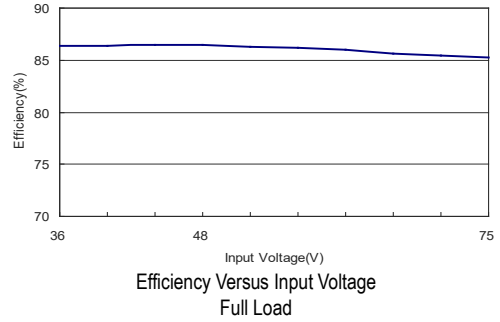
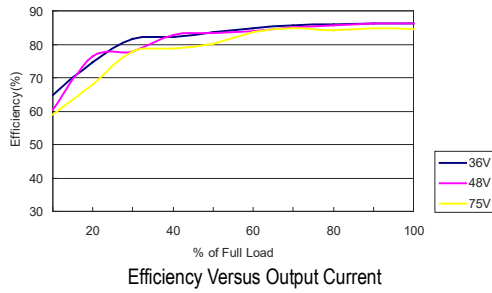
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

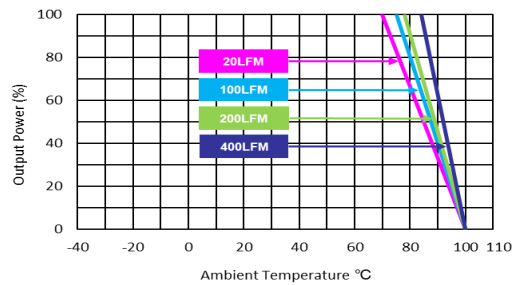
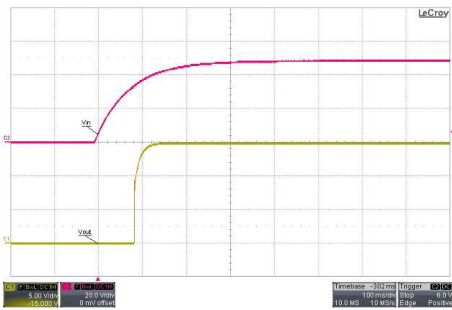
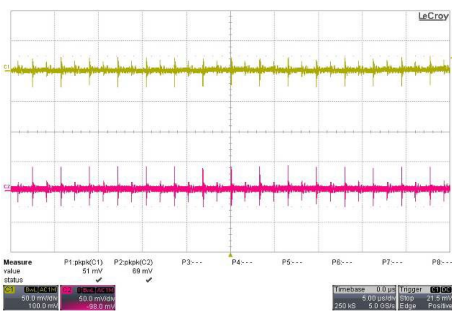
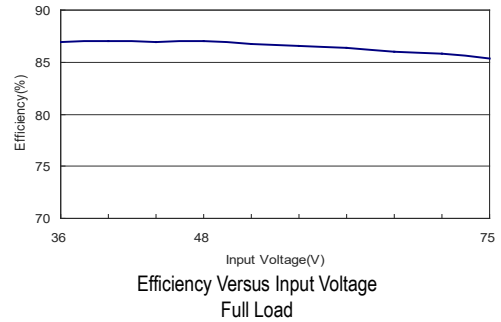
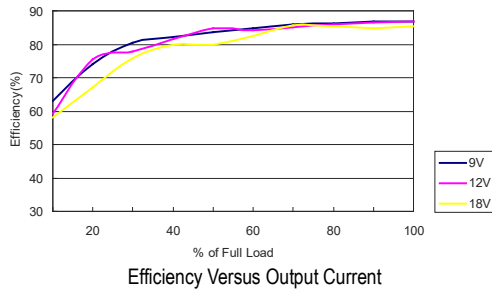
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-48D12



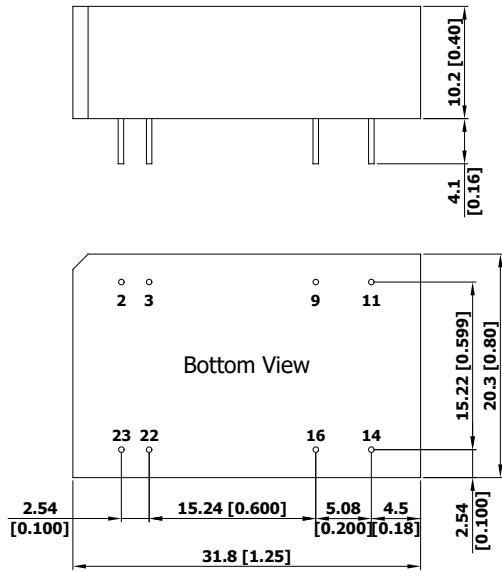
Characteristic Curves

All test conditions are at 25°C The figures are identical for MIW06-48D15



Package Specifications

Mechanical Dimensions



Pin Connections

Pin	Single Output	Dual Output	Diameter mm (inches)
2	-Vin	-Vin	∅ 0.5 [0.02]
3	-Vin	-Vin	∅ 0.5 [0.02]
9	No Pin	Common	∅ 0.5 [0.02]
11	NC	-Vout	∅ 0.5 [0.02]
14	+Vout	+Vout	∅ 0.5 [0.02]
16	-Vout	Common	∅ 0.5 [0.02]
22	+Vin	+Vin	∅ 0.5 [0.02]
23	+Vin	+Vin	∅ 0.5 [0.02]

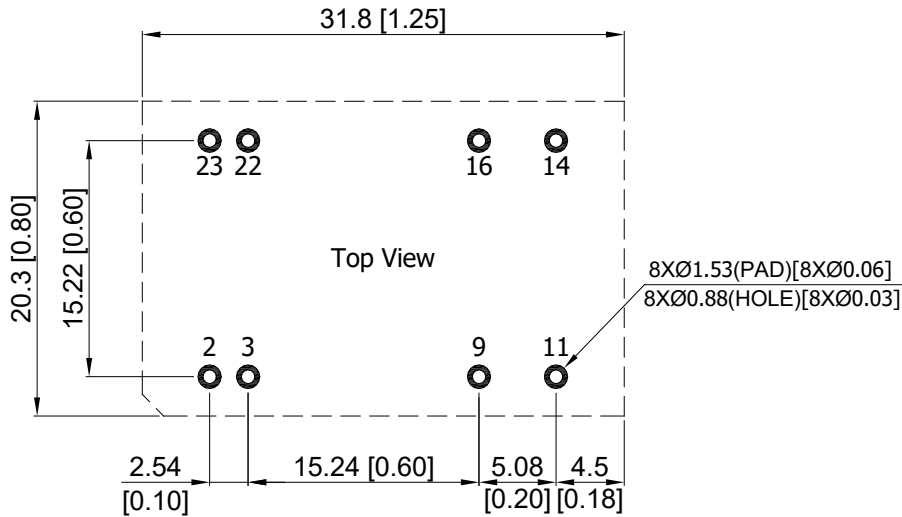
NC: No Connection

- ▶ All dimensions in mm (inches)
- ▶ Tolerance: X.X±0.25 (X.XX±0.01)
X.XX±0.13 (X.XXX±0.005)
- ▶ Pin diameter tolerance: X.X±0.05 (X.XX±0.002)

Physical Characteristics

Case Size	: 31.8x20.3x10.2mm (1.25x0.80x0.40 inches)
Case Material	: Plastic resin (flammability to UL 94V-0 rated)
Pin Material	: Copper Alloy
Weight	: 12.7g

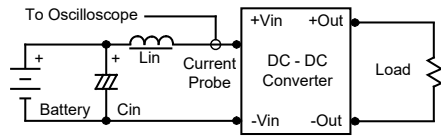
Recommended Pad Layout for Single & Dual Output Converter



Test Setup

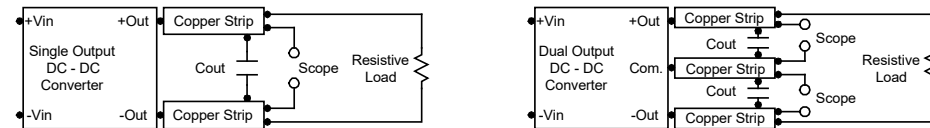
Input Reflected-Ripple Current Test Setup

Input reflected-ripple current is measured with an inductor L_{in} (4.7 μ H) and C_{in} (220 μ F, ESR < 1.0 Ω at 100 kHz) to simulate source impedance. Capacitor C_{in} , offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 kHz.



Peak-to-Peak Output Noise Measurement Test

Use a C_{out} 0.47 μ F ceramic capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC-DC Converter.



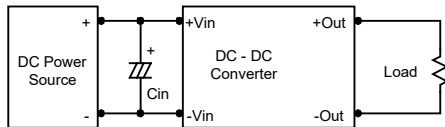
Technical Notes

Overcurrent Protection

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

Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup. Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0 Ω at 100 kHz) capacitor of a 3.3 μ F for the 12V input devices and a 2.2 μ F for the 24V and 48V devices.



Output Ripple Reduction

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



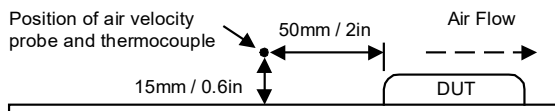
Maximum Capacitive Load

The MIW06 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the data sheet.

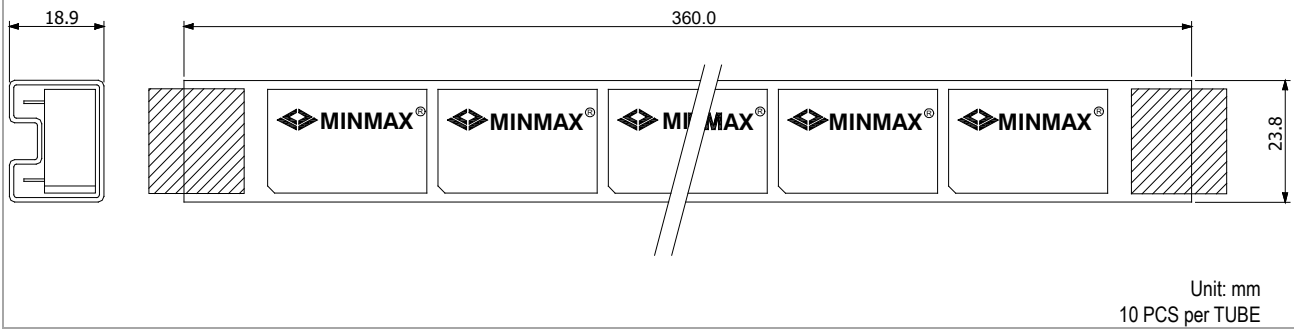
Thermal Considerations

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 100°C.

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

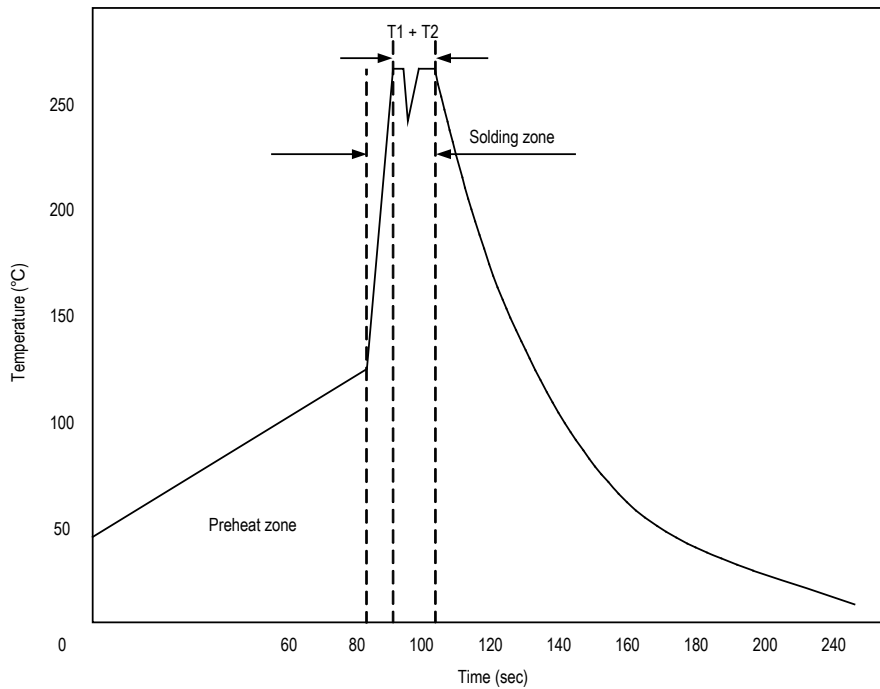


Packaging Information



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	I	W	06	-	12	S	033
Package Type DIP-24	Wide 2:1 Input Voltage Range	Output Power 6 Watt	Input Voltage Range			Output Quantity S: Single D: Dual	Output Voltage
			12: 9 ~ 18 VDC			033: 3.3 VDC	
			24: 18 ~ 36 VDC			05: 5 VDC	
			48: 36 ~ 75 VDC			12: 12 VDC	
						15: 15 VDC	
						24: 24 VDC	

MTBF and Reliability

The MTBF of MIW06 series of DC-DC converters has been calculated using

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

Model	MTBF	Unit
MIW06-12S033	1,010,918	Hours
MIW06-12S05	1,034,554	
MIW06-12S12	1,137,915	
MIW06-12S15	1,143,511	
MIW06-12S24	1,137,915	
MIW06-12D05	1,054,407	
MIW06-12D12	1,067,122	
MIW06-12D15	1,065,303	
MIW06-24S033	1,027,010	
MIW06-24S05	1,037,560	
MIW06-24S12	1,140,511	
MIW06-24S15	1,140,511	
MIW06-24S24	1,140,511	
MIW06-24D05	1,13,560	
MIW06-24D12	1,131,478	
MIW06-24D15	1,077,354	
MIW06-48S033	1,064,169	
MIW06-48S05	1,060,670	
MIW06-48S12	1,133,787	
MIW06-48S15	1,133,787	
MIW06-48S24	1,133,787	
MIW06-48D05	1,090,872	
MIW06-48D12	1,122,839	
MIW06-48D15	1,061,684	