MINMAX®

MIWI03 Series

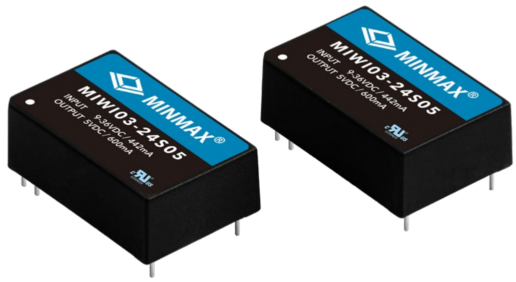
Electric Characteristic Note

MIWI03 Series EC Note

DC-DC CONVERTER 3W, DIP-Package

Features

- ►**Industrial Standard DIP-24 Package**
- ►**Ultra-wide 4:1 Input Voltage Range**
- ►**Fully Regulated Output Voltage**
- ►**I/O Isolation 1500 VDC (opt. 3000VDC)**
- ►**Operating Ambient Temp. Range -40℃ to +85℃**
- ►**No Min. Load Requirement**
- ►**Under-voltage, Overload and Short Circuit Protection**
- ►**EMI Emission EN 55032 Class A Approved**
- ►**UL/cUL/IEC/EN 62368-1(60950-1) Safety Approval & CE-Marking**



Applications

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

Product Overview

The MINMAX MIWI03 series is a range of high performance 3W DC-DC converter modules, designed as a cost optimized replacement for the highly popular MIW2300 series. The converter features ultra-wide 4:1 input ranges and fixed output voltage regulation. Excellent efficiency allows an operating temperature up to +70°C at full load. The product comes in a DIP-24 plastic package with industry standard footprint. Typical applications for these economical priced DC-DC converters are industrial electronics, instrumentation or communication equipment.

Table of contents

Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current	Input Current		Reflected Ripple Current	Max. capacitive Load	Efficiency (typ.)
			Max.	@Max. Load	@No Load			@Max. Load
	VDC	VDC	mA	mA(typ.)	mA(typ.)	mA(typ.)	µF	%
MIWI03-24S033	24 (9 ~ 36)	3.3	750	134	30	15	680	77
MIWI03-24S05		5	600	158			470	79
MIWI03-24S12		12	250	152			330	82
MIWI03-24S15		15	200	151			220	83
MIWI03-24S24		24	125	154			100	81
MIWI03-24D05		±5	±250	130			220#	80
MIWI03-24D12		±12	±125	152			150#	82
MIWI03-24D15		±15	±100	152			100#	82
MIWI03-48S033	48 (18 ~ 75)	3.3	750	67	20	10	680	77
MIWI03-48S05		5	600	78			470	80
MIWI03-48S12		12	250	75			330	83
MIWI03-48S15		15	200	74			220	84
MIWI03-48S24		24	125	76			100	82
MIWI03-48D05		±5	±250	65			220#	80
MIWI03-48D12		±12	±125	76			150#	82
MIWI03-48D15		±15	±100	76			100#	82

For each output

Input Specifications

Parameter	Model	Min.	Typ.	Max.	Unit
Input Surge Voltage (1 sec. max.)	24V Input Models	-0.7	---	50	VDC
	48V Input Models	-0.7	---	100	
Start-up Threshold Voltage	24V Input Models	---	---	9	
	48V Input Models	---	---	18	
Under Voltage Shutdown	24V Input Models	---	---	8.5	
	48V Input Models	---	---	17.5	
Short Circuit Input Power	All Models	---	---	2000	mW
Input Filter		Internal Pi Type			

Output Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy		---	---	±2.0	%Vnom.
Output Voltage Balance	Dual Output, Balanced Loads	---	±0.5	±2.0	%
Line Regulation	Vin=Min. to Max. @Full Load	---	±0.3	±1.0	%
Load Regulation	Io=0% to 100%	---	±0.3	±1.0	%
Minimum Load	No minimum Load Requirement				
Ripple & Noise	0-20MHz Bandwidth	---	---	70	mV_{P-P}
Transient Recovery Time	25% Load Step Change	---	200	500	µsec
Transient Response Deviation		---	±3	±5	%
Temperature Coefficient		---	±0.01	±0.02	%/℃
Over Load Protection	Foldback	120	150	---	%
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		---	---	300	pF
Switching Frequency			90	---	---	kHz
MTBF (calculated)	MIL-HDBK-217F@25℃, Ground Benign		1,000,000			Hours
Safety Approvals	UL/cUL 60950-1 recognition(CSA certificate), IEC/EN 60950-1(CB-report)					
	UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1(CB-report)					

EMC Specifications

Parameter	Standards & Level			Performance
EMI	Conduction	EN 55032	Without external components	Class A
	Radiation			
EMS(5)	EN 55024			
	ESD	EN 61000-4-2 Air ± 8kV , Contact ± 6kV		A
	Radiated immunity	EN 61000-4-3 10V/m		A
	Fast transient	EN 61000-4-4 ±2kV		A
	Surge	EN 61000-4-5 ±1kV		A
	Conducted immunity	EN 61000-4-6 10Vrms		A

Environmental Specifications

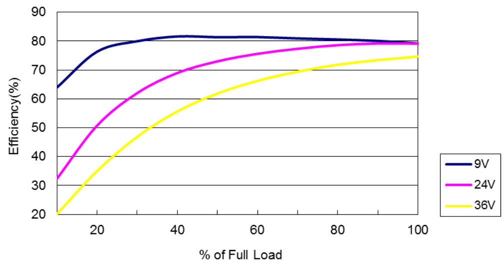
Parameter	Min.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	-40	+85	℃
Case Temperature	---	+100	℃
Storage Temperature Range	-50	+125	℃
Humidity (non condensing)	---	95	% rel. H
Lead Temperature (1.5mm from case for 10Sec.)	---	260	℃

Notes

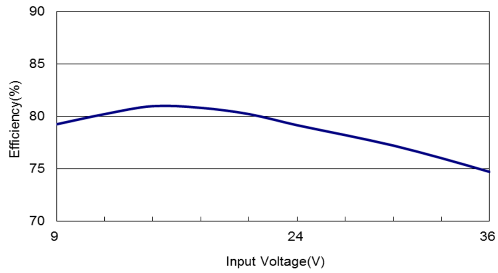
1. Specifications typical at Ta=+25℃, resistive load, nominal input voltage and rated output current unless otherwise noted.
2. Transient recovery time is measured to within 1% error band for a step change in output load of 75% to 100%.
3. We recommend to protect the converter by a slow blow fuse in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

Characteristic Curves

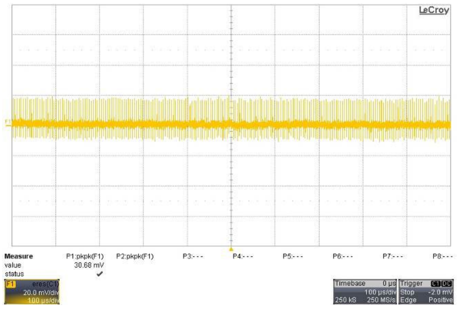
All test conditions are at 25℃ The figures are identical for MIWI03-24S033



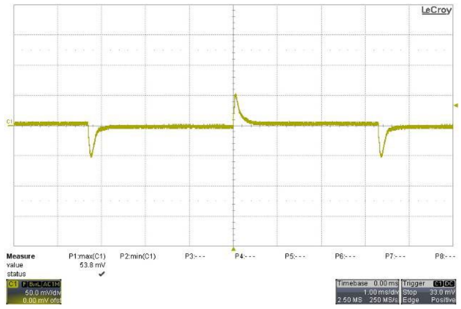
Efficiency Versus Output Current



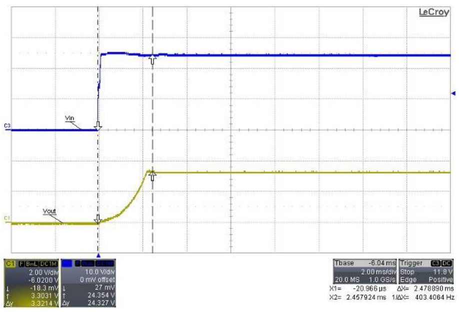
Efficiency Versus Input Voltage
Full Load



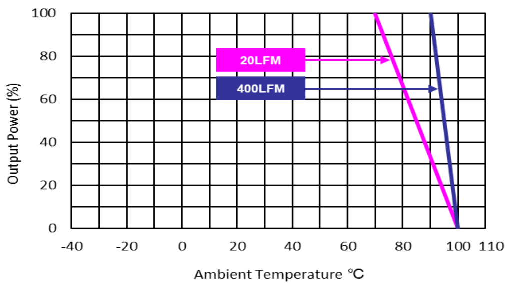
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



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

Characteristic Curves

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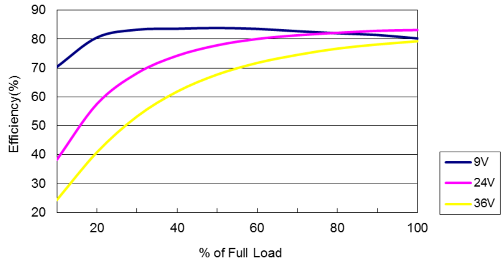
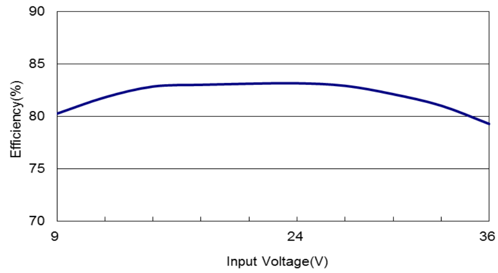
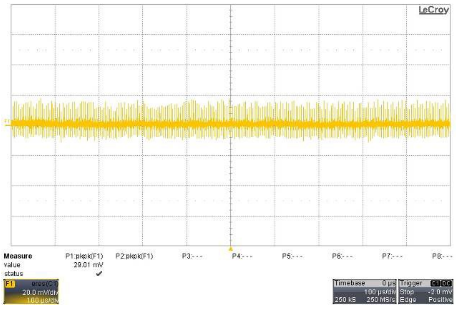


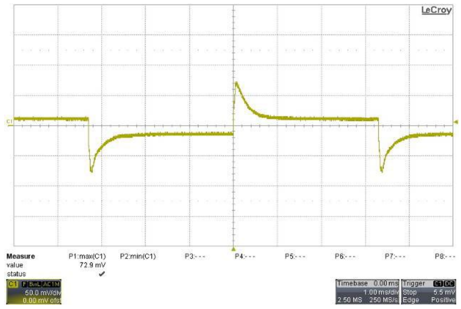
Efficiency Versus Output Current



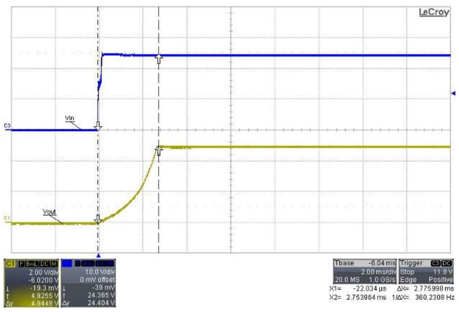
Efficiency Versus Input Voltage
Full Load



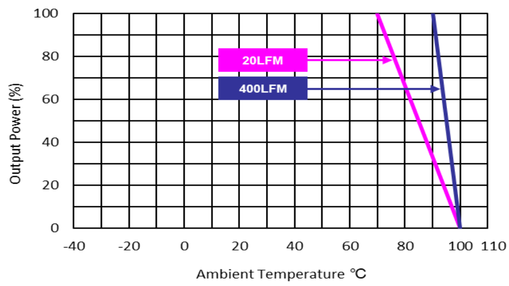
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



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



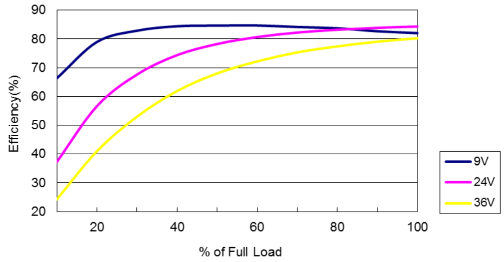
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



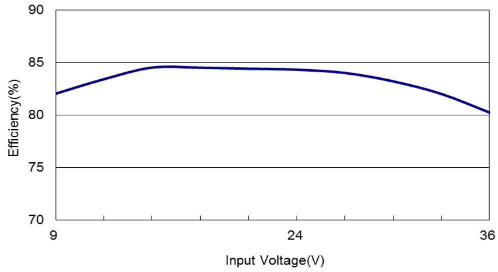
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

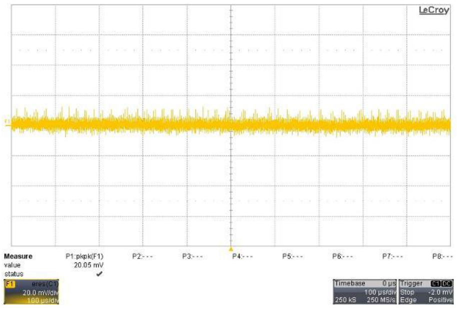
All test conditions are at 25℃ The figures are identical for MIWI03-24S12



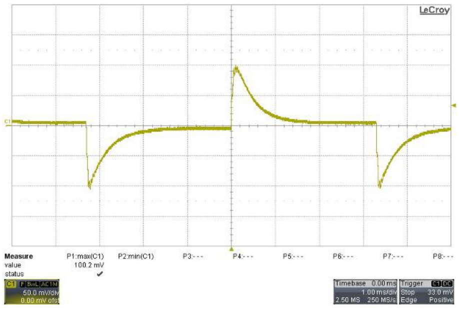
Efficiency Versus Output Current



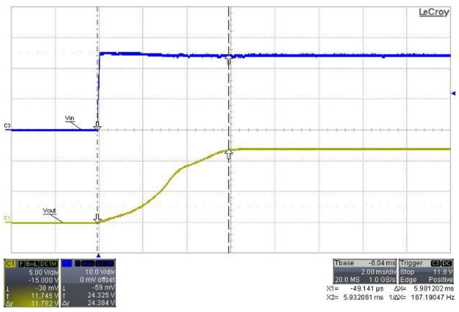
Efficiency Versus Input Voltage
Full Load



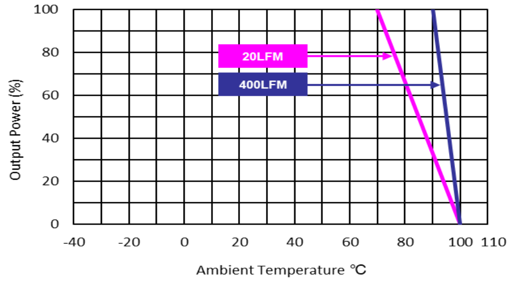
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



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



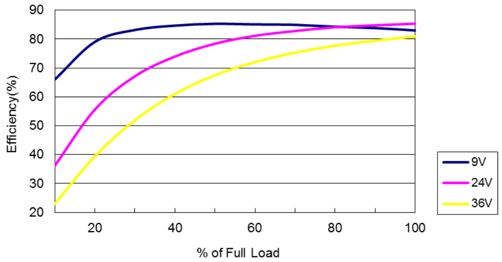
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



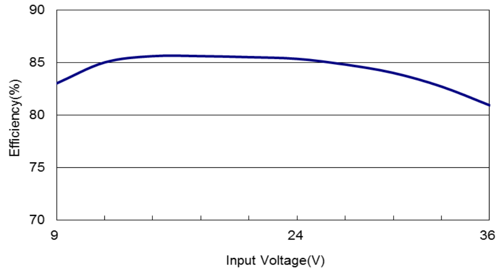
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

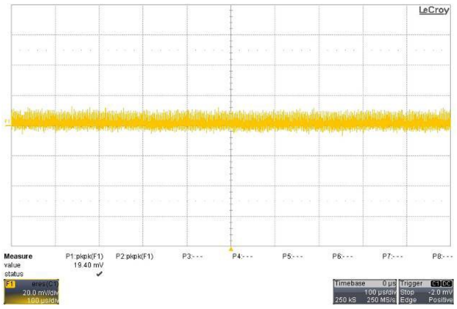
All test conditions are at 25℃ The figures are identical for MIWI03-24S15



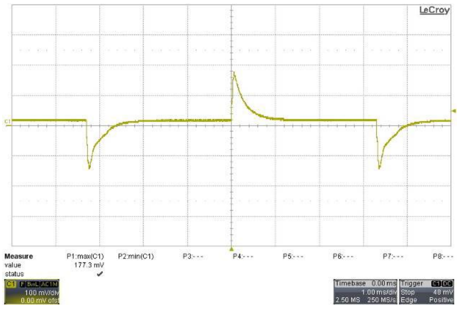
Efficiency Versus Output Current



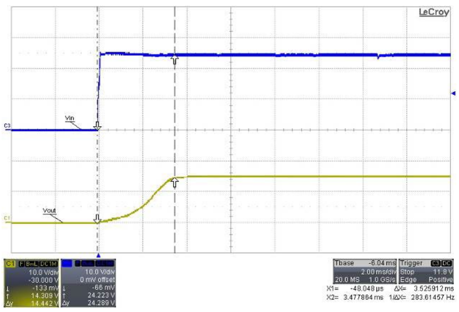
Efficiency Versus Input Voltage
Full Load



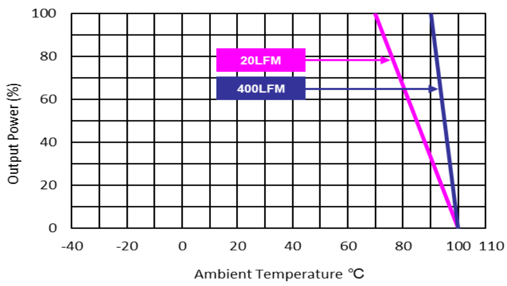
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



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



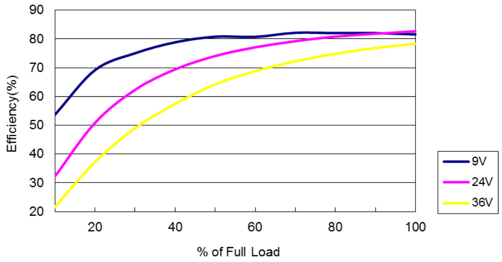
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



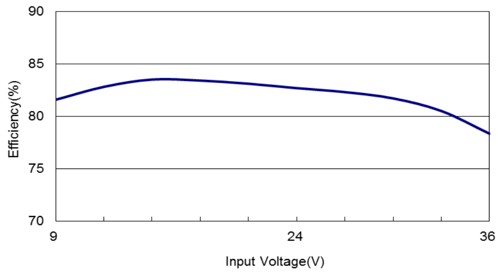
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

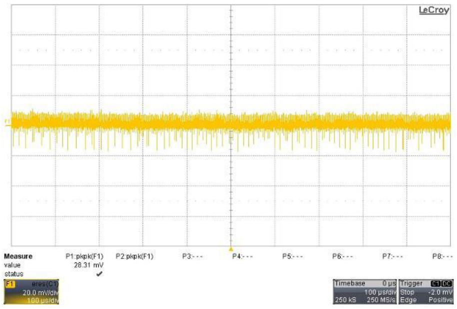
All test conditions are at 25℃ The figures are identical for MIWI03-24S24



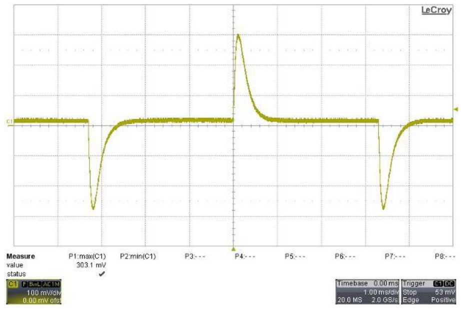
Efficiency Versus Output Current



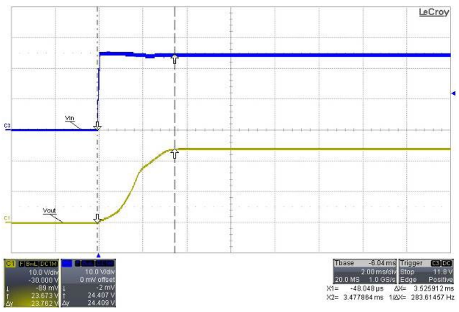
Efficiency Versus Input Voltage
Full Load



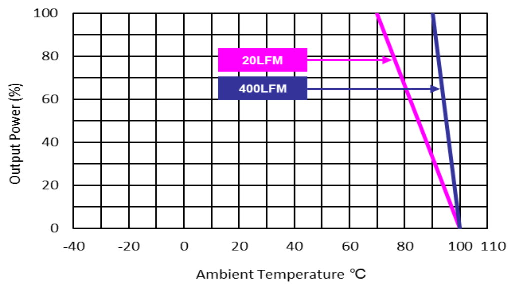
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



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



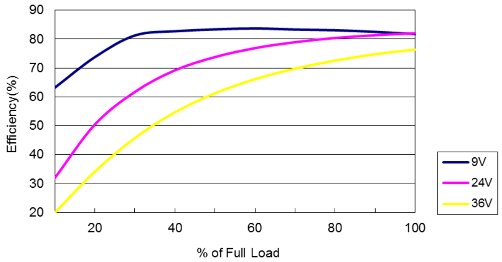
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



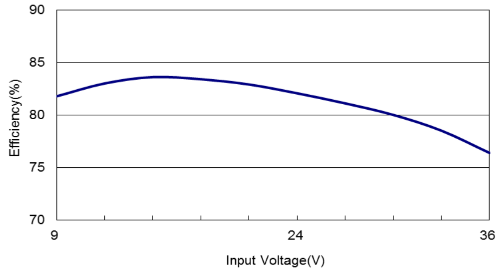
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

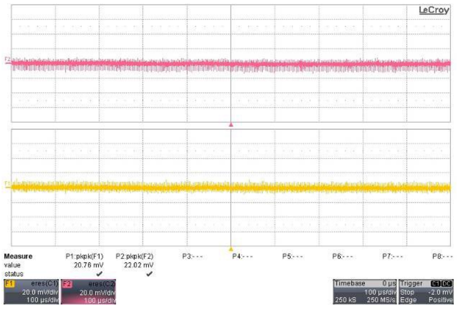
All test conditions are at 25℃ The figures are identical for MIWI03-24D05



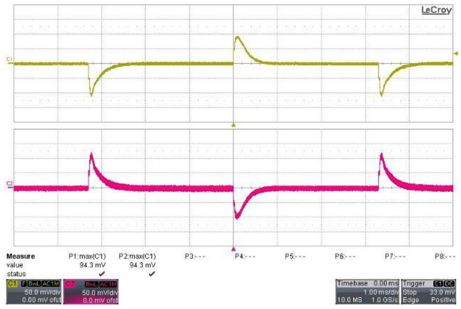
Efficiency Versus Output Current



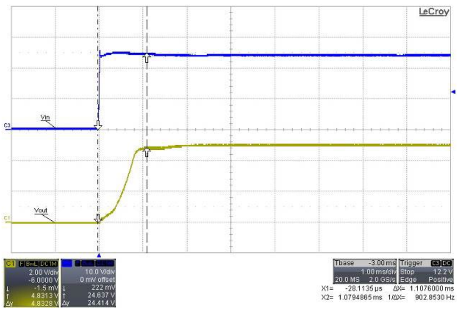
Efficiency Versus Input Voltage
Full Load



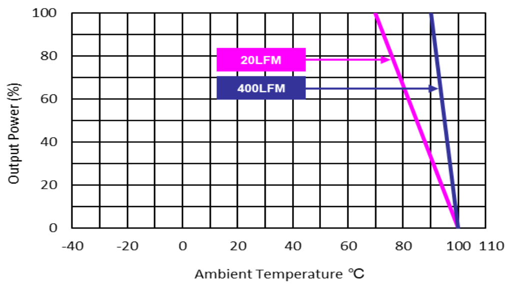
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



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



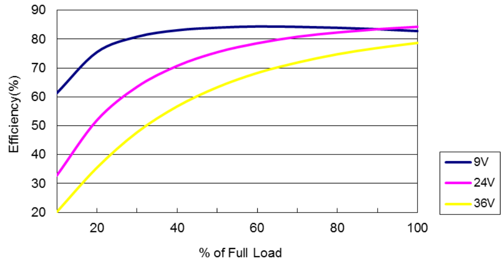
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



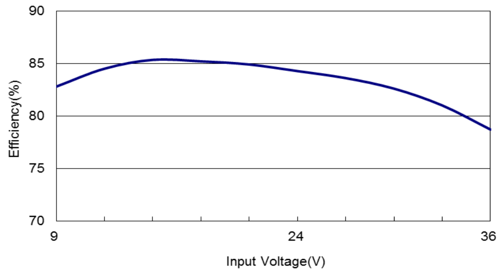
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

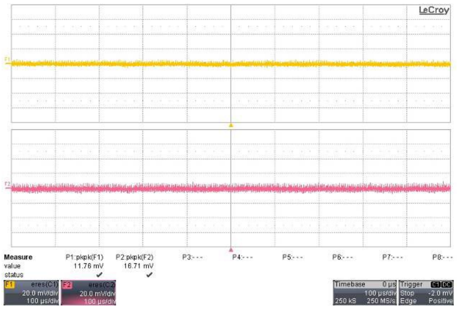
All test conditions are at 25℃ The figures are identical for MIWI03-24D12



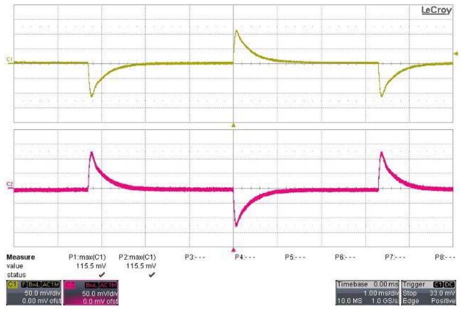
Efficiency Versus Output Current



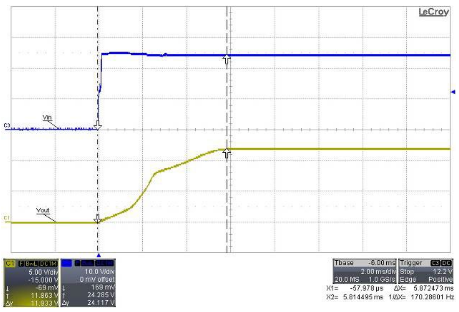
Efficiency Versus Input Voltage
Full Load



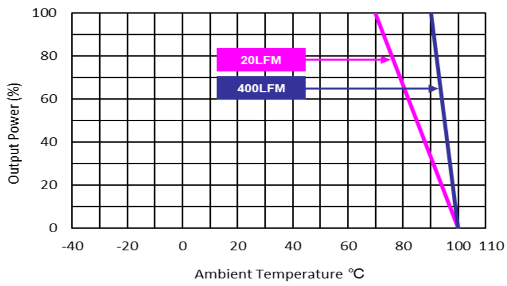
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



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



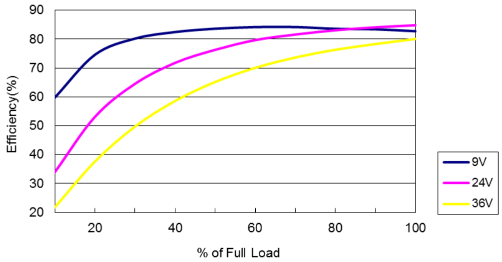
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



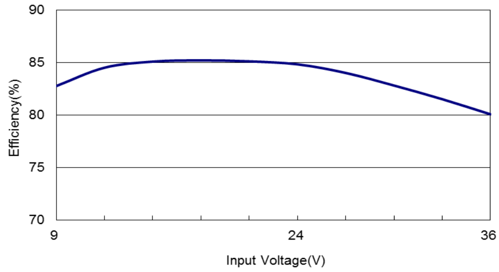
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

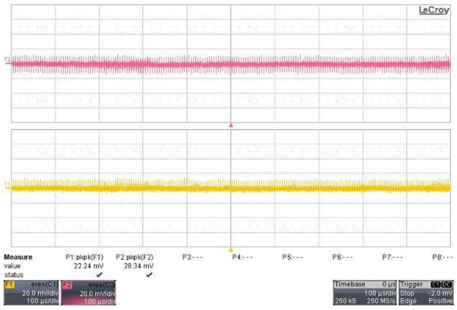
All test conditions are at 25℃ The figures are identical for MIWI03-24D15



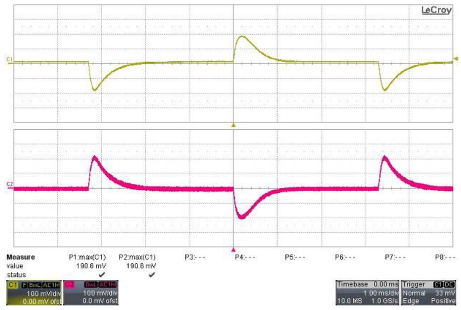
Efficiency Versus Output Current



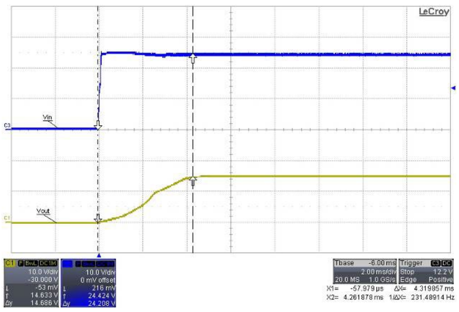
Efficiency Versus Input Voltage
Full Load



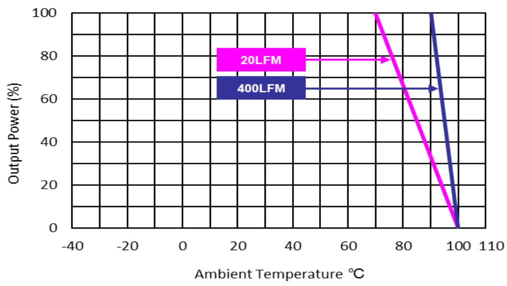
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



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



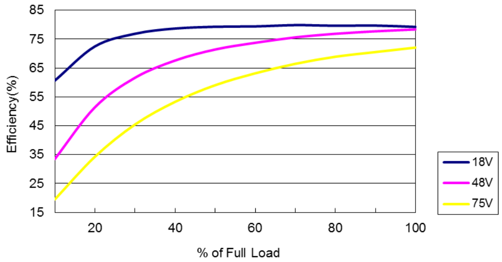
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



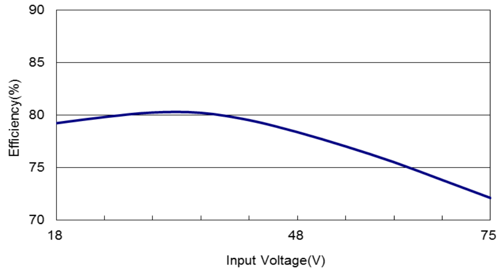
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

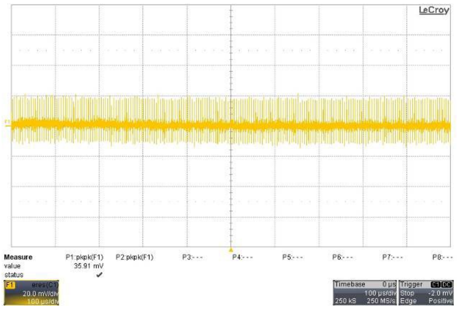
All test conditions are at 25℃ The figures are identical for MIWI03-48S033



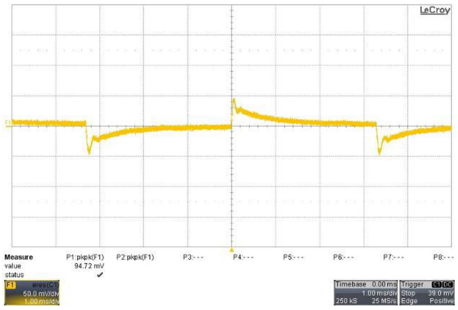
Efficiency Versus Output Current



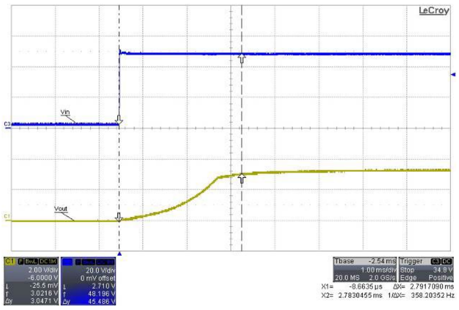
Efficiency Versus Input Voltage
Full Load



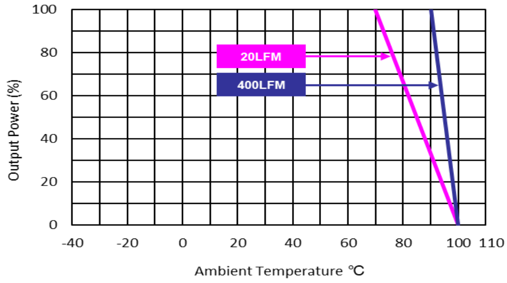
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



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



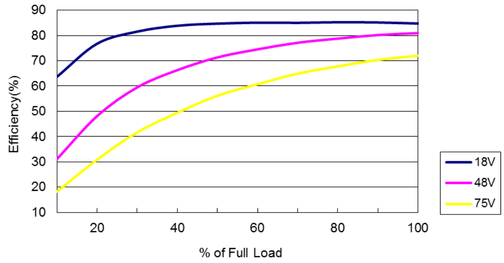
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



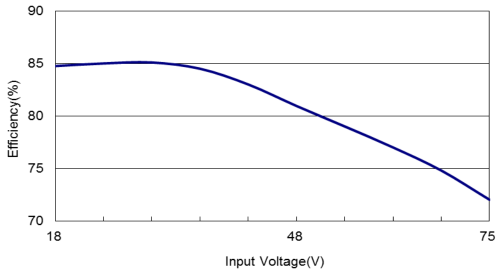
Derating Output Power Versus Ambient Temperature and Airflow
V_{in}=$V_{in\ nom}$

Characteristic Curves

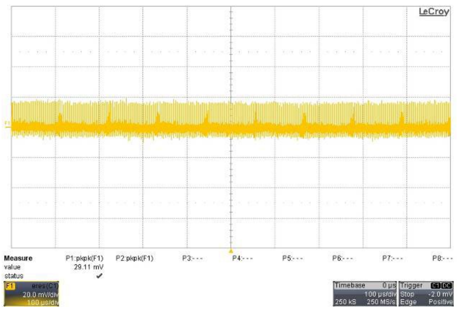
All test conditions are at 25℃ The figures are identical for MIWI03-48S05



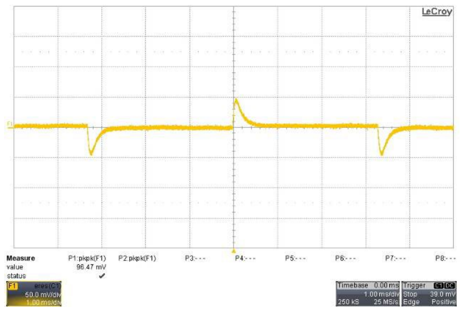
Efficiency Versus Output Current



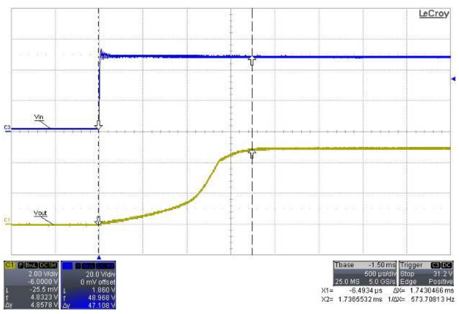
Efficiency Versus Input Voltage
Full Load



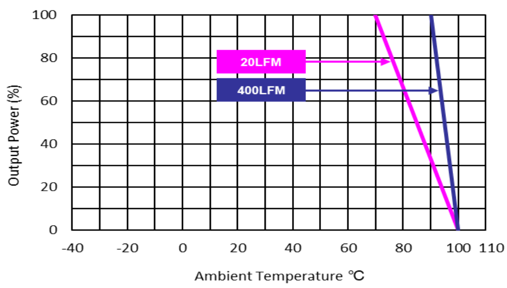
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



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



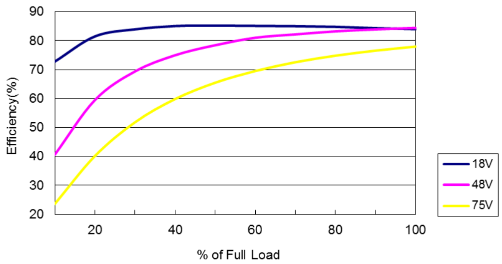
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



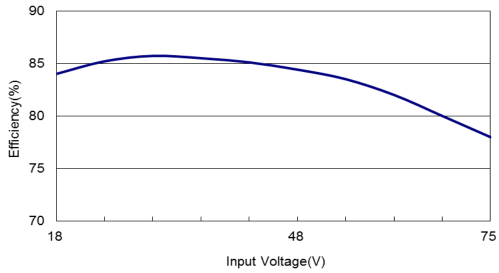
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

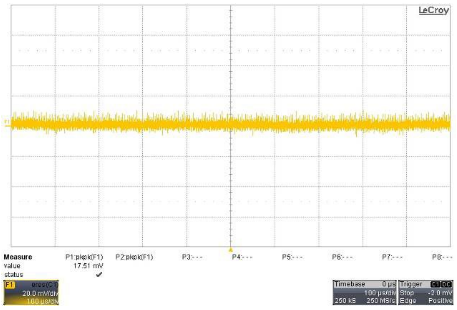
All test conditions are at 25℃ The figures are identical for MIWI03-48S12



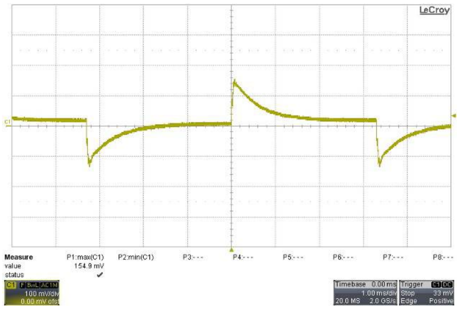
Efficiency Versus Output Current



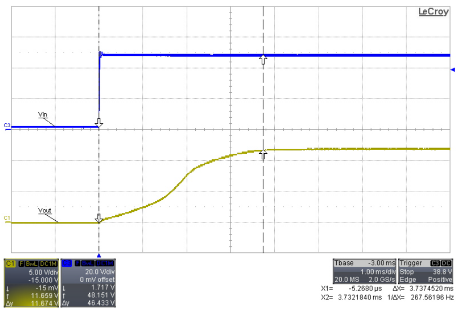
Efficiency Versus Input Voltage
Full Load



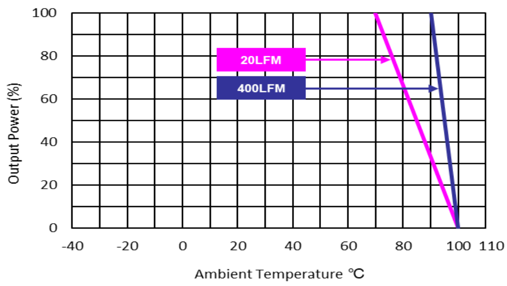
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



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



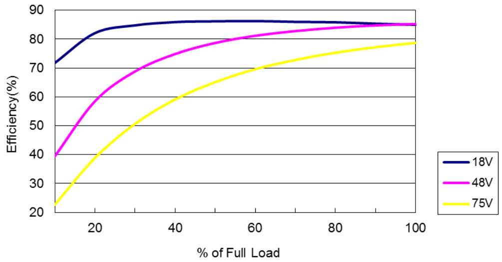
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



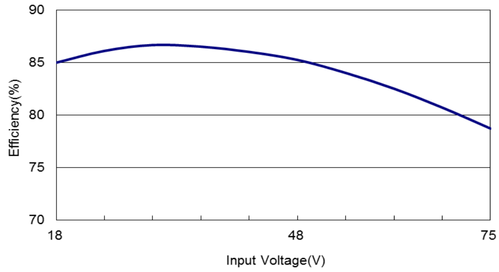
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

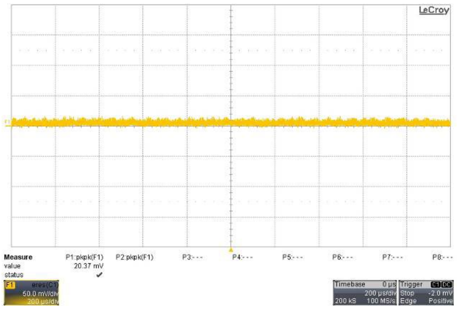
All test conditions are at 25℃ The figures are identical for MIWI03-48S15



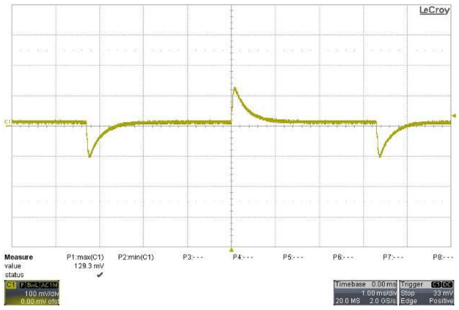
Efficiency Versus Output Current



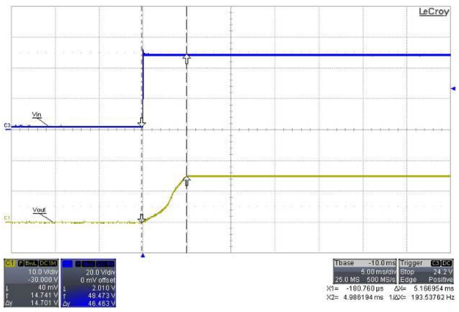
Efficiency Versus Input Voltage
Full Load



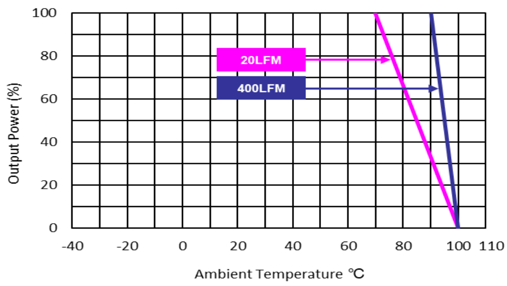
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



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



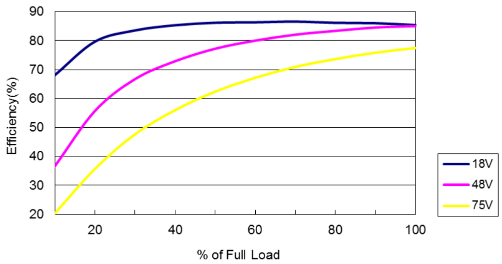
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



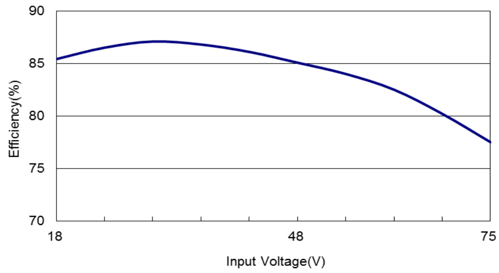
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

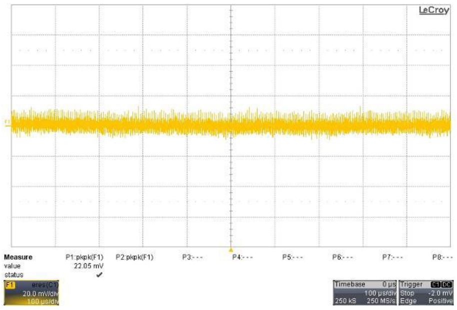
All test conditions are at 25℃ The figures are identical for MIWI03-48S24



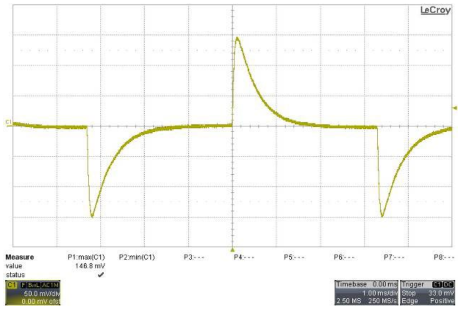
Efficiency Versus Output Current



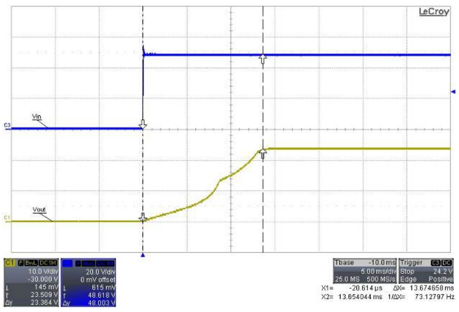
Efficiency Versus Input Voltage
Full Load



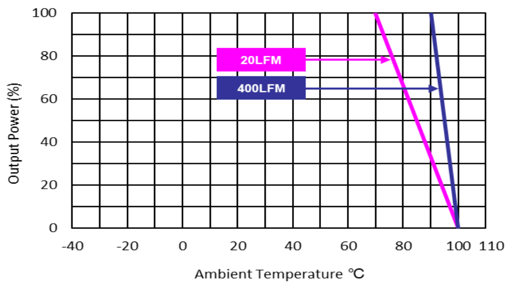
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



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



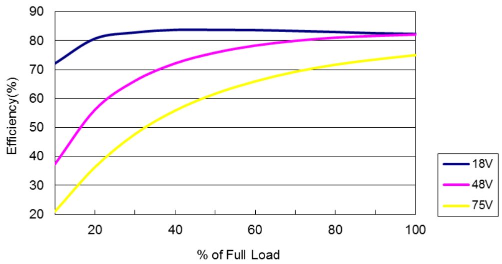
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



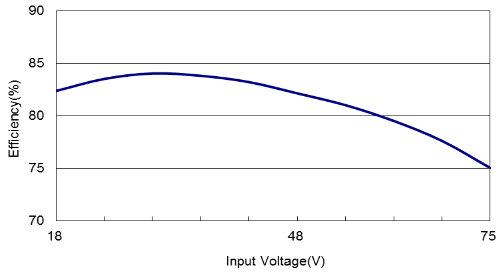
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

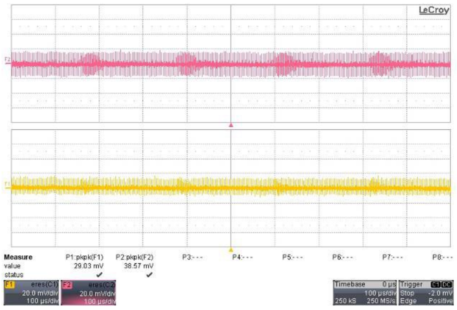
All test conditions are at 25℃ The figures are identical for MIWI03-48D05



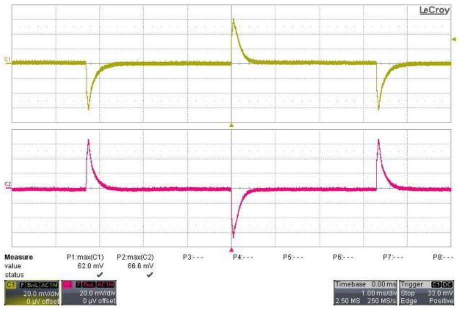
Efficiency Versus Output Current



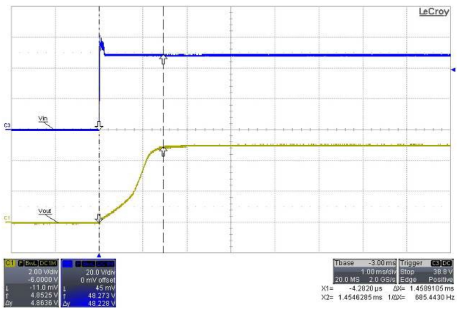
Efficiency Versus Input Voltage
Full Load



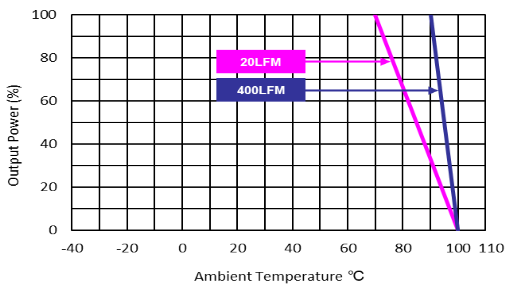
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



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



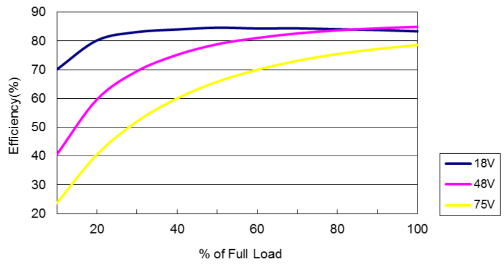
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



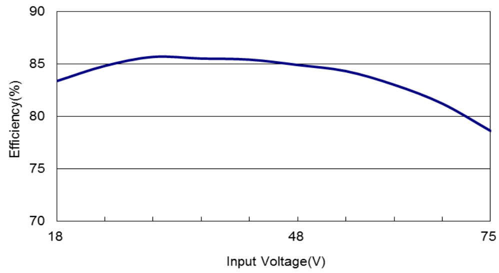
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

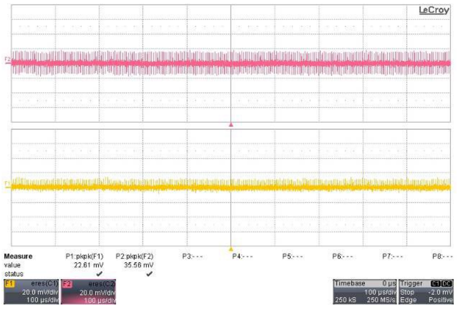
All test conditions are at 25℃ The figures are identical for MIWI03-48D12



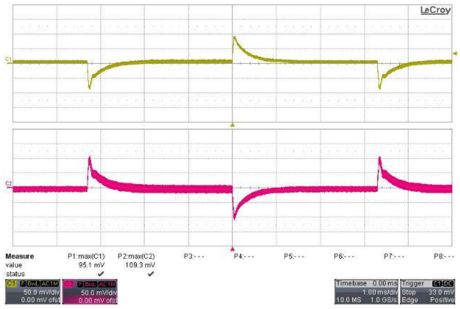
Efficiency Versus Output Current



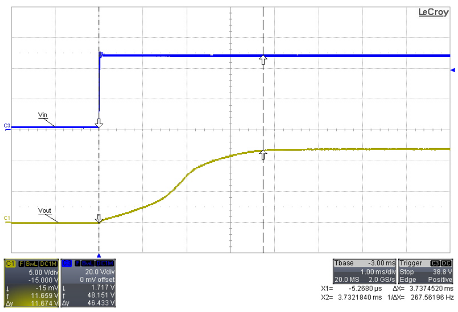
Efficiency Versus Input Voltage
Full Load



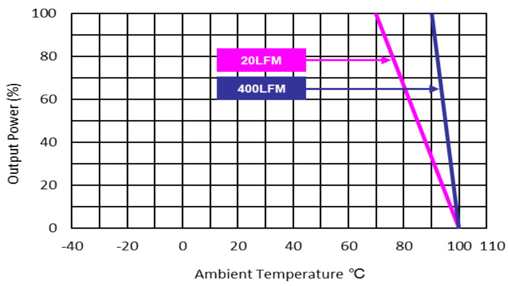
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



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



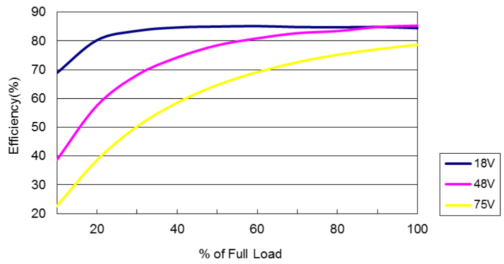
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



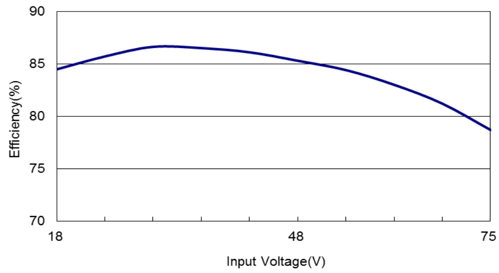
Derating Output Power Versus Ambient Temperature and Airflow
$V_{in}=V_{in\ nom}$

Characteristic Curves

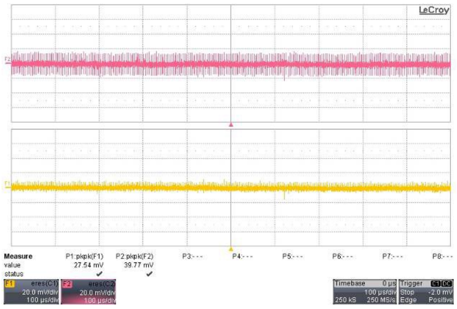
All test conditions are at 25℃ The figures are identical for MIWI03-48D15



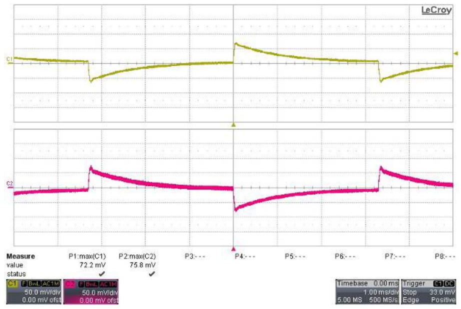
Efficiency Versus Output Current



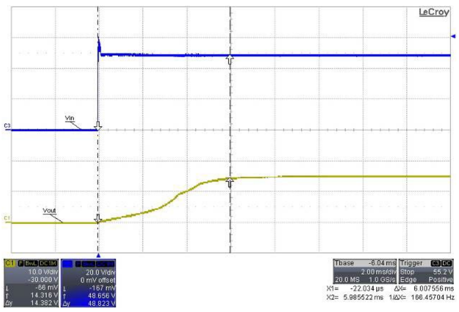
Efficiency Versus Input Voltage
Full Load



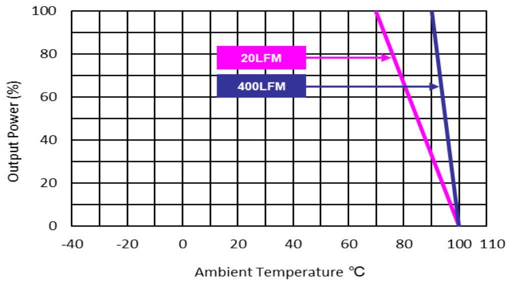
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



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



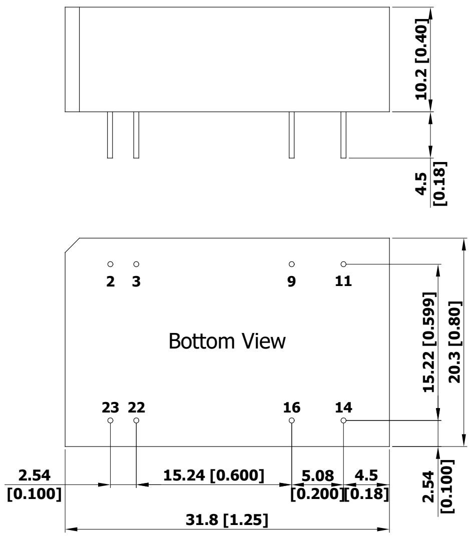
Typical Input Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



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

Package Specifications

Mechanical Dimensions



Pin Connections

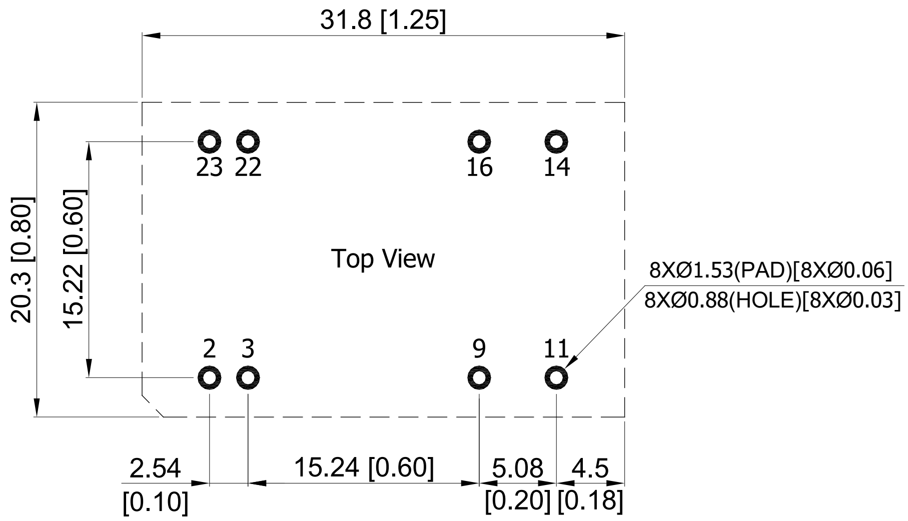
Pin	Single Output	Dual Output	Diameter mm (inches)
2	-Vin	-Vin	Ø 0.5 [0.02]
3	-Vin	-Vin	Ø 0.5 [0.02]
9	No Pin	Common	Ø 0.5 [0.02]
11	NC	-Vout	Ø 0.5 [0.02]
14	+Vout	+Vout	Ø 0.5 [0.02]
16	-Vout	Common	Ø 0.5 [0.02]
22	+Vin	+Vin	Ø 0.5 [0.02]
23	+Vin	+Vin	Ø 0.5 [0.02]

- ►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	:	31.8x20.3x10.2mm (1.25x0.80x0.40 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Pin Material	:	Copper Alloy
Weight	:	12.8g

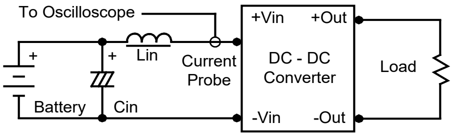
Recommended Pad Layout for Single & Dual Output Converter



Test Setup

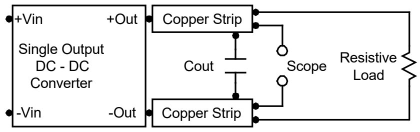
Input Reflected-Ripple Current Test Setup

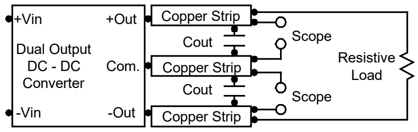
Input reflected-ripple current is measured with a inductor Lin (4.7μH) and Cin (220μF, ESR < 1.0Ω at 100 kHz) to simulate source impedance.
Capacitor Cin, offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 kHz.



Peak-to-Peak Output Noise Measurement Test

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





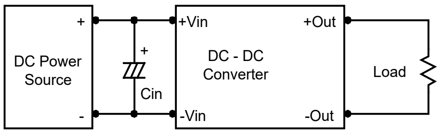
Technical Notes

Overload Protection

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

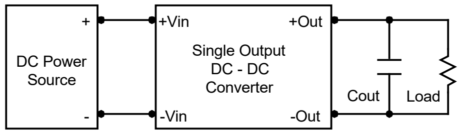
Input Source Impedance

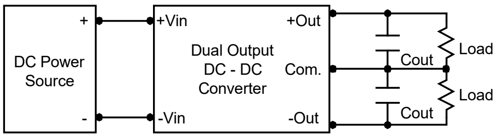
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module.
In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.
Capacitor mounted close to the power module helps ensure stability of the unit, it is recommended to use a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 kHz) capacitor of a 4.7μF for the 24V input devices and a 2.2μF for the 48V devices.



Output Ripple Reduction

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



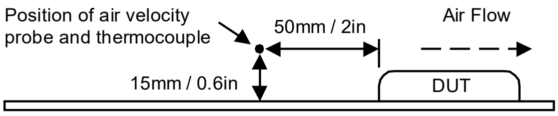


Maximum Capacitive Load

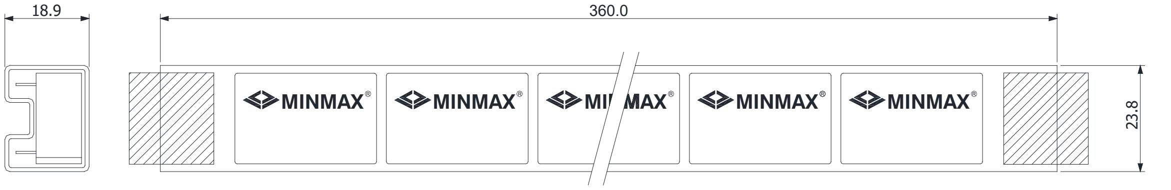
The MIWI03 series has limitation of maximum connected capacitance at the output. The power module may be operated in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the data sheet.

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.



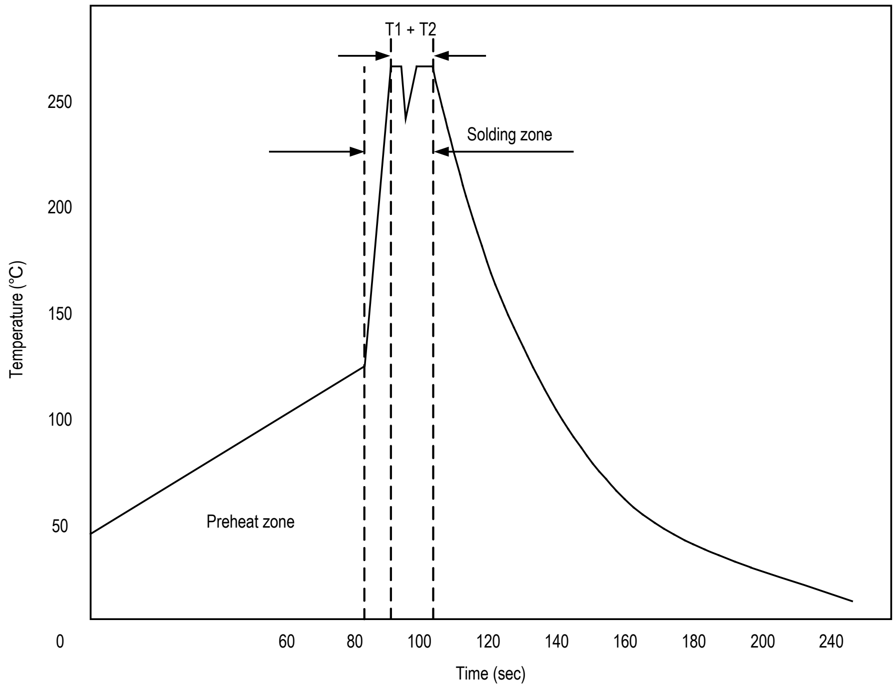
Packaging Information



Unit: mm
10 PCS per TUBE

Wave Soldering Considerations

Lead free wave solder profile



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

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	WI	03	-	24	S	033
	Package Type DIP-24	Ultra-wide 4:1 Input Voltage Range	Output Power 3 Watt		Input Voltage Range 24: 9 ~ 36 VDC 48: 18 ~ 75 VDC	Output Quantity S: Single D: Dual	Output Voltage 033: 3.3 VDC 05: 5 VDC 12: 12 VDC 15: 15 VDC 24: 24 VDC

MTBF and Reliability

The MTBF of MIWI03 series of DC-DC converters has been calculated using

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

Model	MTBF	Unit
MIWI03-24S033	2,839,000	Hours
MIWI03-24S05	2,550,000	
MIWI03-24S12	2,763,000	
MIWI03-24S15	3,026,000	
MIWI03-24S24	3,412,000	
MIWI03-24D05	3,198,000	
MIWI03-24D12	3,233,000	
MIWI03-24D15	3,143,000	
MIWI03-48S033	2,663,000	
MIWI03-48S05	3,127,000	
MIWI03-48S12	2,922,000	
MIWI03-48S15	3,089,000	
MIWI03-48S24	3,300,000	
MIWI03-48D05	2,724,000	
MIWI03-48D12	3,153,000	
MIWI03-48D15	2,876,000	