FEATURES

- Smallest Encapsulated 20W Converter
- Ultra-compact 1" X 1" Package
- Ultra-wide 4:1 Input Voltage Range
- Fully Regulated Output Voltage
- Excellent Efficiency up to 89%
- I/O Isolation 1500 VDC
- Operating Ambient Temp. Range -40℃ to +85℃
- No Min. Load Requirement
- Overload/Voltage and Short Circuit Protection
- Remote On/Off Control, Output Voltage Trim
- Shielded Metal Case with Insulated Baseplate
- UL/cUL/IEC/EN 60950-1 Safety Approval & CE Marking

PRODUCT OVERVIEW

The MINMAX MJWI20 series is a new generation of high performance DC-DC converter modules setting a new standard concerning power density. The product offers fully 20W in a shielded metal package with dimensions of just 1.0"x1.0"x 0.4". All models provide ultra-wide 4:1 input voltage range and tight output voltage regulation.

State-of the-art circuit topology provides a very high efficiency up to 89% which allows an operating temperature range of -40°C to +85°C. Further features include remote On/Off, trimmable output voltage as well as overload protection and over-temperature protection.

Typical applications for these converters are battery operated equipment, instrumentation, distributed power architectures in communication and industrial electronics and other space critical applications.

Model Selection Guide

Model Number	Input Voltage (Range)	Output Voltage	Output Current		Input Current		Reflected Ripple Current	Over Voltage Protection	Max. capacitive Load	Efficiency (typ.)
			Max.	Min.	@Max. Load	@No Load				@Max. Load
	VDC	VDC	mA	mA	mA(typ.)	mA(typ.)	mA (typ.)	VDC	μF	%
MJWI20-24S033	24 (9 ~ 36)	3.3	4500	0	711	80	50	3.9	10300	87
MJWI20-24S05		5	4000	0	936	90		6.2	6800	89
MJWI20-24S12		12	1670	0	938	40		15	1200	89
MJWI20-24S15		15	1340	0	941	40		18	750	89
MJWI20-24S24		24	835	0	949	40		30	300	88
MJWI20-24D12		±12	±835	±60	938	40		±15	680#	89
MJWI20-24D15		±15	±670	±50	941	40		±18	380#	89
MJWI20-48S033	48 (18 ~ 75)	3.3	4500	0	352	40	30	3.9	10300	88
MJWI20-48S05		5	4000	0	468	45		6.2	6800	89
MJWI20-48S12		12	1670	0	469	25		15	1200	89
MJWI20-48S15		15	1340	0	471	25		18	750	89
MJWI20-48S24		24	835	0	474	25		30	300	88
MJWI20-48D12		±12	±835	±60	469	25		±15	680#	89
MJWI20-48D15		±15	±670	±50	471	25		±18	380#	89

For each output

Input Specifications

Parameter	Conditions / Model	Min.	Typ.	Max.	Unit
Input Surge Voltage (1 sec. max.)	24V Input Models	-0.7	---	50	VDC
	48V Input Models	-0.7	---	100	
Start-Up Threshold Voltage	24V Input Models	---	---	9	
	48V Input Models	---	---	18	
Start Up Time (Power On)	Nominal Vin and Constant Resistive Load	---	---	30	ms
Input Filter	All Models	Internal LC Type			
Conducted EMI		Internal LC Filter (for EN 55032,Class A and FCC level A compliance see page 8)			

Remote On/Off Control

Parameter	Conditions	Min.	Typ.	Max.	Unit
Converter On	3.5V ~ 12V or Open Circuit				
Converter Off	0V ~ 1.2V or Short Circuit				
Control Input Current (on)	Vctrl = 5.0V	---	---	0.5	mA
Control Input Current (off)	Vctrl = 0V	---	---	-0.5	mA
Control Common	Referenced to Negative Input				
Standby Input Current	Supply Off & Nominal Vin	---	10	---	mA

Output Specifications

Parameter	Conditions / Model			Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy				---	---	±1.0	%Vnom.
Output Voltage Balance	Dual Output, Balanced Loads			---	---	±2.0	%
Line Regulation	Vin=Min. to Max. @Full Load	Single Output		---	---	±0.2	%
		Dual Output		---	---	±0.5	%
Load Regulation	Io=0% to 100%	Single Output	3.3V & 5V	---	---	±0.5	%
			12V,15V & 24V	---	---	±0.2	%
		Dual Output		---	---	±1.0	%
Load Cross Regulation (Dual Output)	Asymmetrical Load 25%/100% Full Load			---	---	±5.0	%
Ripple & Noise	0-20 MHz Bandwidth	3.3V & 5V Models(3)		---	75	---	mV P-P
		12V & 15V & Dual Models(3)		---	100	---	mV P-P
		24V Models(3)		---	150	---	mV P-P
Transient Recovery Time	25% Load Step Change			---	300	---	µsec
Transient Response Deviation				---	±3	±5	%
Temperature Coefficient				---	---	±0.02	%/℃
Trim Up / Down Range (See Page 8)	% of Nominal Output Voltage			---	---	±10	%
Over Load Protection	Hiccup			---	150	---	%
Short Circuit Protection	Hiccup Mode 1.5 Hz typ., Automatic Recovery						

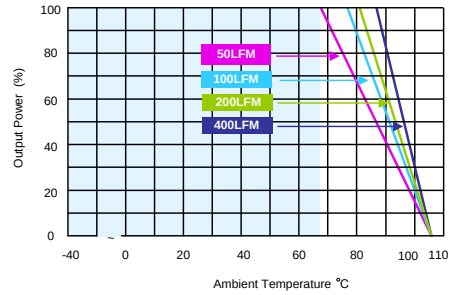
General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds	1500	---	---	VDC
	1 Second	1800	---	---	VDC
Isolation Voltage Input/Output to case	60 Seconds	1000	---	---	VDC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
I/O Isolation Capacitance	100KHz, 1V	---	---	1500	pF
Switching Frequency		---	330	---	KHz
MTBF(calculated)	MIL-HDBK-217F@25℃, Ground Benign	451,600			Hours
Safety Approvals	UL/cUL 60950-1 recognition(CSA certificate), IEC/EN 60950-1(CB-report)				

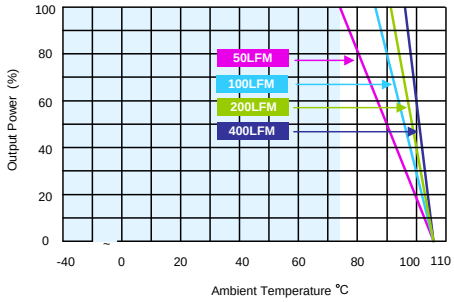
Environmental Specifications

Parameter	Conditions / Model	Min.	Max.		Unit
			without Heatsink	with Heatsink	
Operating Ambient Temperature Range Nominal Vin, Load 100% Inom. (for Power Derating see relative Derating Curves)	MJWI20-48S033	-40	+68	+74	℃
	MJWI20-24S033		+64	+71	
	MJWI20-XXS05, MJWI20-XXS12		+60	+67	
	MJWI20-XXS15, MJWI20-XXD12				
	MJWI20-XXD15				
	MJWI20-XXS24		+55	+63	
Thermal Impedance	50LFM Convection without Heatsink	18.2	---		℃/W
	50LFM Convection with Heatsink	15.3	---		℃/W
	100LFM Convection without Heatsink	13.9	---		℃/W
	100LFM Convection with Heatsink	8.8	---		℃/W
	200LFM Convection without Heatsink	12.1	---		℃/W
	200LFM Convection with Heatsink	6.8	---		℃/W
	400LFM Convection without Heatsink	9.1	---		℃/W
	400LFM Convection with Heatsink	4.6	---		℃/W
Case Temperature		---	+105		℃
Storage Temperature Range		-50	+125		℃
Humidity (non condensing)		---	95		% rel. H
RFI	Six-Sided Shielded, Metal Case				
Lead Temperature (1.5mm from case for 10Sec.)		---	260		℃

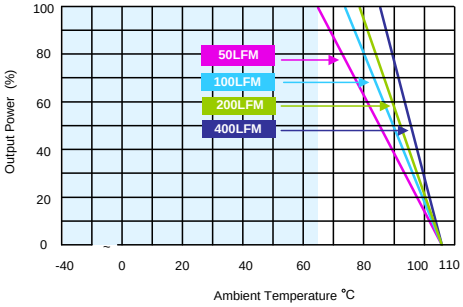
Power Derating Curve



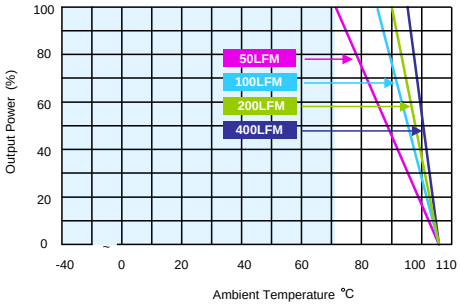
MJWI20-48S033 Derating Curve without Heatsink



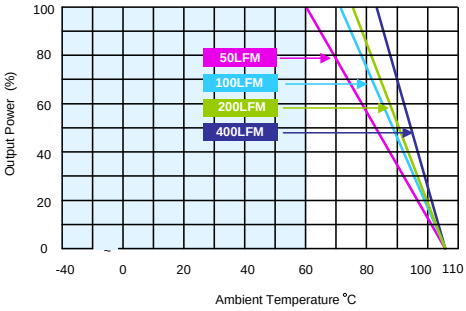
MJWI20-48S033 Derating Curve with Heatsink



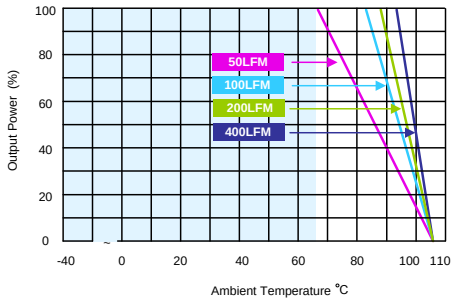
MJWI20-24S033 Derating Curve without Heatsink



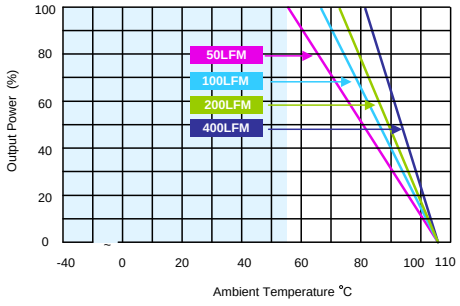
MJWI20-24S033 Derating Curve with Heatsink



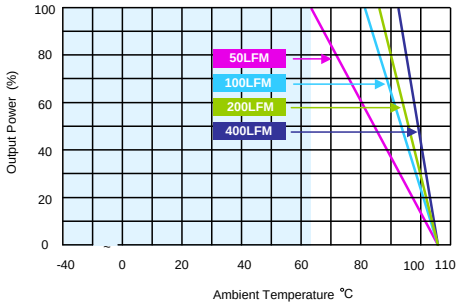
MJWI20-XXS05, MJWI20-XXS12, MJWI20-XXS15, MJWI20-XXD12, MJWI20-XXD15 Derating Curve without Heatsink



MJWI20-XXS05, MJWI20-XXS12, MJWI20-XXS15, MJWI20-XXD12, MJWI20-XXD15 Derating Curve with Heatsink

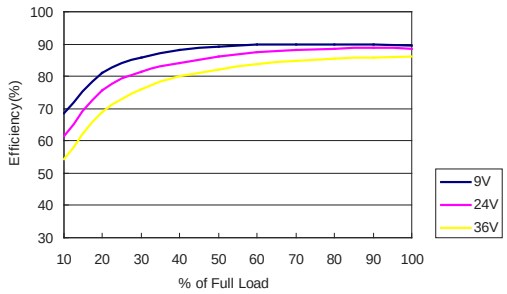


MJWI20-XXS24 Derating Curve without Heatsink

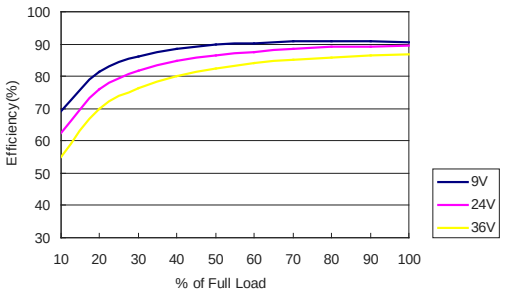


MJWI20-XXS24 Derating Curve with Heatsink

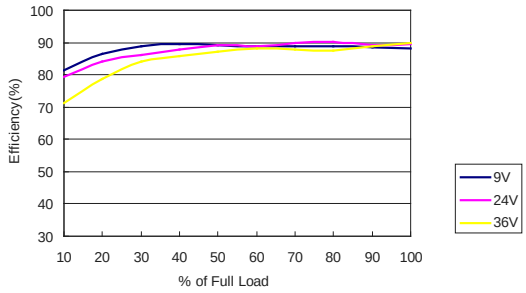
Efficiency Curve @25℃



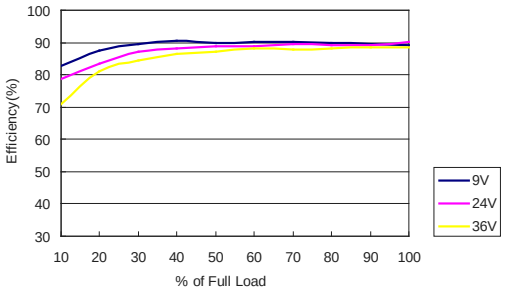
MJWI20-24S033 Efficiency vs Load Current



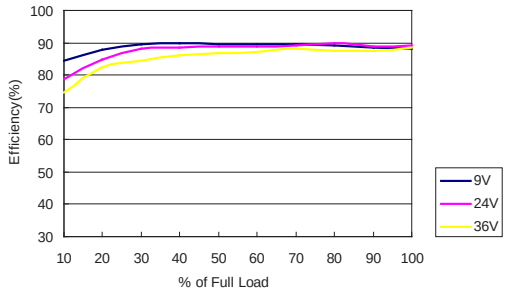
MJWI20-24S05 Efficiency vs Load Current



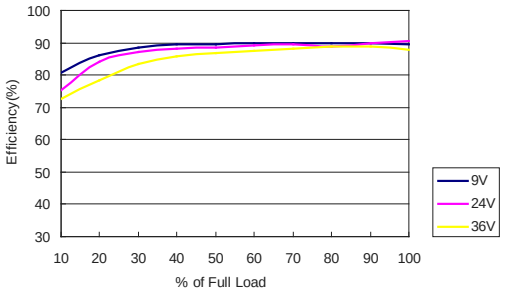
MJWI20-24S12 Efficiency vs Load Current



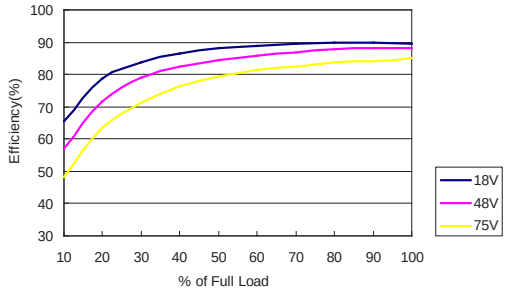
MJWI20-24S15 Efficiency vs Load Current



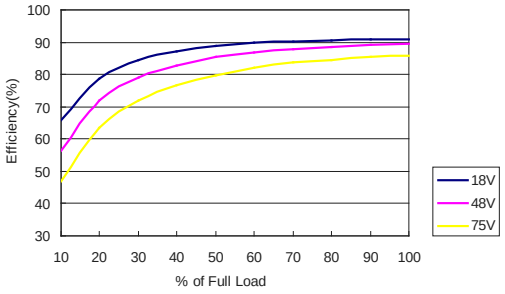
MJWI20-24D12 Efficiency vs Load Current



MJWI20-24D15 Efficiency vs Load Current

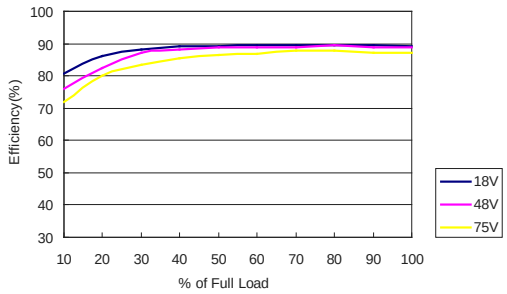


MJWI20-48S033 Efficiency vs Load Current

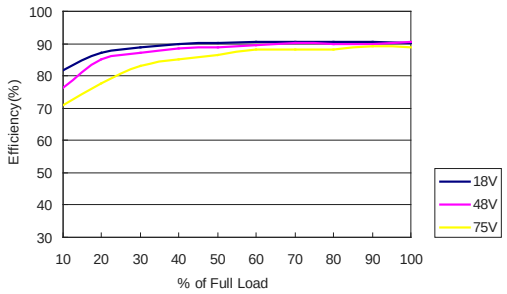


MJWI20-48S05 Efficiency vs Load Current

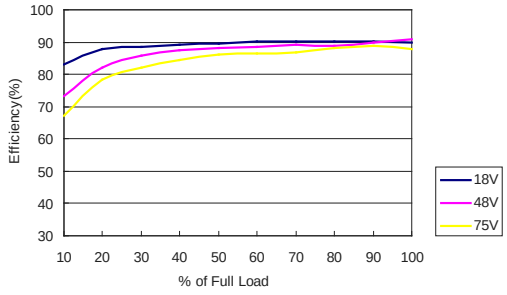
Efficiency Curve @25℃



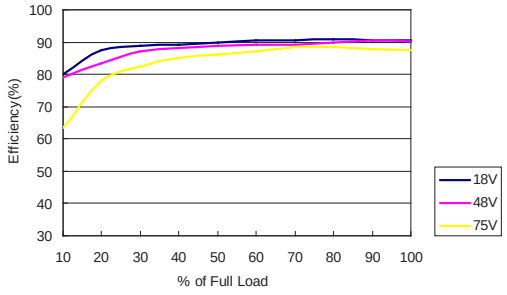
MJWI20-48S12 Efficiency vs Load Current



MJWI20-48S15 Efficiency vs Load Current



MJWI20-48D12 Efficiency vs Load Current



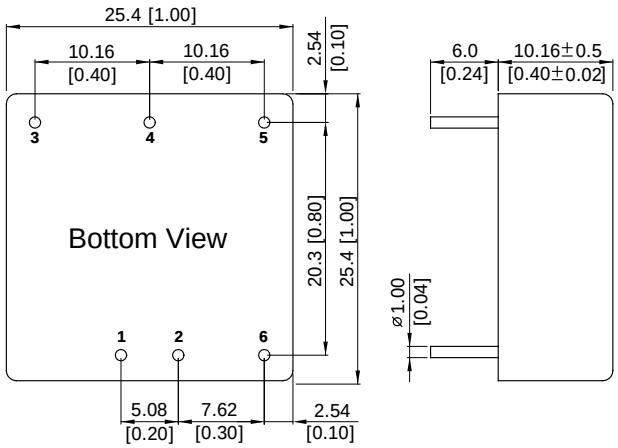
MJWI20-48D15 Efficiency vs Load Current

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 Ripple & Noise measurement with a 1μF MLCC and a 10μF Tantalum Capatitor.
4 We recommend to protect the converter by a slow blow fuse in the input supply line.
5 Other input and output voltage may be available, please contact factory.
6 The MJWI20 series can meet EN 55032 Class A with parallel an external LC Filter to the input pins. Please refer to Test Configurations on the last page.
7 Specifications are subject to change without notice.

Package Specifications

Mechanical Dimensions



Pin Connections

Pin	Single Output	Dual Output
1	+Vin	+Vin
2	-Vin	-Vin
3	+Vout	+Vout
4	Trim	Common
5	-Vout	-Vout
6	Remote On/Off	Remote On/Off

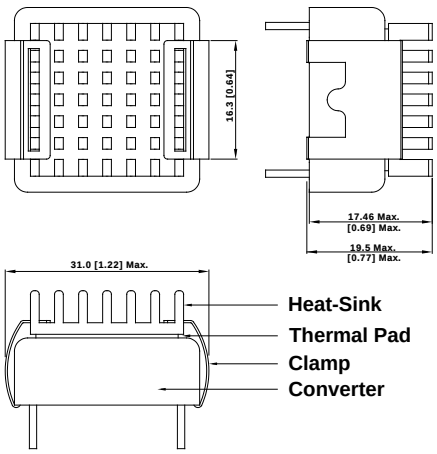
- All dimensions in mm (inches)
- Tolerance: X.X±0.25 (X.XX±0.01)
  X.XX±0.13 (X.XXX±0.005)
- Pin diameter ∅ 1.0 ±0.05 (0.04±0.002)

Physical Characteristics

Case Size	:	25.4x25.4x10.16mm (1.0x1.0x0.4 inches)
Case Material	:	Aluminium Alloy, Black Anodized Coating
Base Material	:	FR4 PCB (flammability to UL 94V-0 rated)
Pin Material	:	Copper Alloy with Gold Plate Over Nickel Subplate
Weight	:	15g

Heatsink (Option –HS)

Mechanical Dimensions



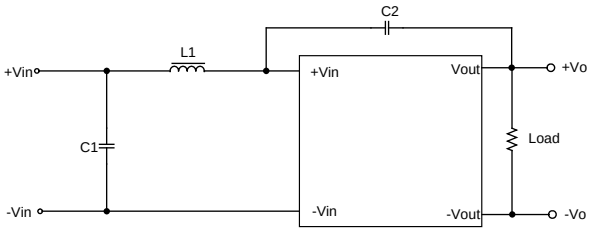
Heatsink Material: Aluminum
Finish: Anodic treatment (black)
Weight: 2g

- The advantages of adding a heatsink are:

1. To improve heat dissipation and increase the stability and reliability of the DC-DC converters at high operating temperatures.

2. To increase operating temperature of the DC-DC converter, please refer to Derating Curve.

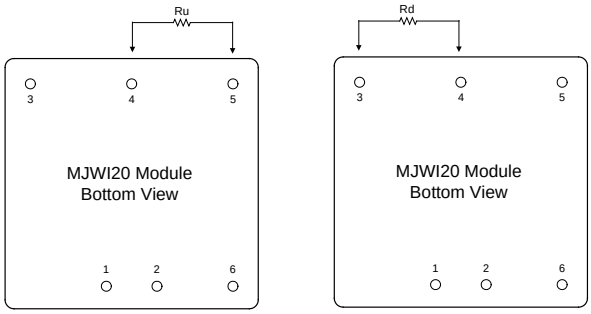
External Filter meets Conducted EMI EN 55032 class A ; FCC part 15 level A



Model	Component	Value
MJWI20-24XXX	C1	3.3μF/50V 1210 X7R MLCC
	C2(24S24 only)	220pF/2KV 1808 MLCC
	L1	6.8μH
MJWI20-48XXX	C1	2.2μF/100V 1210 X7R MLCC
	C2(48S24 only)	220pF/2KV 1808 MLCC
	L1	12μH

External Output Trimming

Output can be externally trimmed by using the method shown below



Trim Up Trim Down

MJWI20-XXS033 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	72.61	32.55	19.20	12.52	8.51	5.84	3.94	2.51	1.39	0.50	KOhms
Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	60.84	27.40	16.25	10.68	7.34	5.11	3.51	2.32	1.39	0.65	KOhms

MJWI20-XXS05 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	138.88	62.41	36.92	24.18	16.53	11.44	7.79	5.06	2.94	1.24	KOhms
Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	106.87	47.76	28.06	18.21	12.30	8.36	5.55	3.44	1.79	0.48	KOhms

MJWI20-XXS12 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	413.55	184.55	108.22	70.05	47.15	31.88	20.98	12.80	6.44	1.35	KOhms
Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	351.00	157.50	93.00	60.75	41.40	28.50	19.29	12.37	7.00	2.70	KOhms

MJWI20-XXS15 Trim Table

Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	530.73	238.61	141.24	92.56	63.35	43.87	29.96	19.53	11.41	4.92	KOhms
Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	422.77	189.89	112.26	73.44	50.15	34.63	23.54	15.22	8.75	3.58	KOhms

MJWI20-XXS24 Trim Table

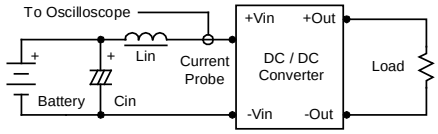
Trim down	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox0.99	Vox0.98	Vox0.97	Vox0.96	Vox0.95	Vox0.94	Vox0.93	Vox0.92	Vox0.91	Vox0.90	Volts
Rd=	598.66	267.78	157.49	102.34	69.25	47.19	31.44	19.62	10.43	3.08	KOhms
Trim up	1	2	3	4	5	6	7	8	9	10	%
Vout=	Vox1.01	Vox1.02	Vox1.03	Vox1.04	Vox1.05	Vox1.06	Vox1.07	Vox1.08	Vox1.09	Vox1.10	Volts
Ru=	487.14	218.02	128.31	83.46	56.55	38.61	25.79	16.18	8.70	2.72	KOhms

Order Code Table	
Standard	With heatsink
MJWI20-24S033	MJWI20-24S033-HS
MJWI20-24S05	MJWI20-24S05-HS
MJWI20-24S12	MJWI20-24S12-HS
MJWI20-24S15	MJWI20-24S15-HS
MJWI20-24S24	MJWI20-24S24-HS
MJWI20-24D12	MJWI20-24D12-HS
MJWI20-24D15	MJWI20-24D15-HS
MJWI20-48S033	MJWI20-48S033-HS
MJWI20-48S05	MJWI20-48S05-HS
MJWI20-48S12	MJWI20-48S12-HS
MJWI20-48S15	MJWI20-48S15-HS
MJWI20-48S24	MJWI20-48S24-HS
MJWI20-48D12	MJWI20-48D12-HS
MJWI20-48D15	MJWI20-48D15-HS

Test Setup

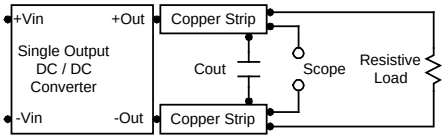
Input Reflected-Ripple Current Test Setup

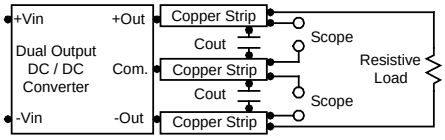
Input reflected-ripple current is measured with a inductor Lin (4.7μH) and Cin (220μF, ESR < 1.0Ω at 100 KHz) to simulate source impedance. Capacitor Cin, offsets possible battery impedance. Current ripple is measured at the input terminals of the module, measurement bandwidth is 0-500 KHz.



Peak-to-Peak Output Noise Measurement Test

Use a 1μF ceramic capacitor and a 10μF tantalum capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC-DC Converter.





Technical Notes

Remote On/Off

Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin, and off during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent. A logic low is 0V to 1.2V. A logic high is 3.5V to 12V. The maximum sink current at the on/off terminal (Pin 6) during a logic low is -500μA. The maximum allowable leakage current of a switch connected to the on/off terminal (Pin 6) at logic high (3.5V to 12V) is 10mA.

Overload Protection

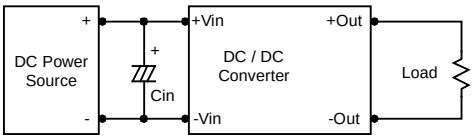
To provide hiccup mode protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure overload for an unlimited duration.

Overvoltage Protection

The output overvoltage clamp consists of control circuitry, which is independent of the primary regulation loop, that monitors the voltage on the output terminals. The control loop of the clamp has a higher voltage set point than the primary loop. This provides a redundant voltage control that reduces the risk of output overvoltage. The OVP level can be found in the output data.

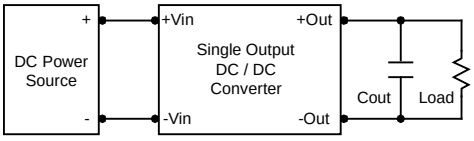
Input Source Impedance

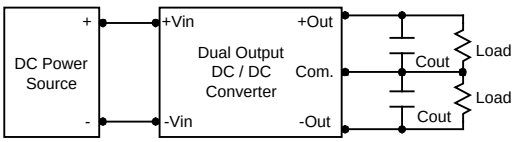
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module.
In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.
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 10μF 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 4.7μF capacitors at the output.





Maximum Capacitive Load

The MJWI20 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 105℃. The derating curves are determined from measurements obtained in a test setup.