

**FEATURES**

- ▶ Smallest Encapsulated 30W Converter
- ▶ Ultra-compact 1"×1" Package
- ▶ Ultra-wide 4:1 Input Voltage Range
- ▶ Fully Regulated Output Voltage
- ▶ Excellent Efficiency up to 90%
- ▶ I/O Isolation 1500 VDC
- ▶ Operating Ambient Temp. Range -40°C to +80°C
- ▶ No Min. Load Requirement
- ▶ Very low no load power consumption
- ▶ Under-voltage, Overload/Voltage and Short Circuit Protection
- ▶ Remote On/Off Control, Output Voltage Trim
- ▶ Shielded Metal Case with Insulated Baseplate
- ▶ UL/cUL/IEC/EN 62368-1 Safety Approval & CE Marking

**NEW**

**PRODUCT OVERVIEW**

The MINMAX MJWI30 series is the latest range of a new generation of 30Watt isolated DC-DC power modules with ultra-wide input range of 9-36 / 18-75Vin and 14 models available for 3.3/5/12/15/24/±12/±15VDC tightly output voltage in a highest power density 75W/in<sup>3</sup> and ultra-compact size with dimensions of just 1.0"×1.0"×0.4" shielded and encapsulated package. Key performance featuring high efficiency up to 90%, operating ambient temp. range of -40°C to +80°C, no min. load requirement, very low no-load power consumption, remote on/off, output voltage trim, build-in fault condition protection include under-voltage, overload, over voltage and short circuit protection

The MJWI30 series has been intensely qualified to safety approval UL/cUL/IEC/EN 62368-1 with CB report and CE marking which offer a solution for the applications where wide input voltage range, high efficiency for wide operating ambient temp. range, isolated power with fault condition protection, shield and encapsulated package and very board space limited / critical are required.

**Model Selection Guide**

| Model Number  | Input Voltage (Range) | Output Voltage | Output Current | Input Current |            | Over Voltage Protection | Max. capacitive Load | Efficiency (typ.) |
|---------------|-----------------------|----------------|----------------|---------------|------------|-------------------------|----------------------|-------------------|
|               |                       |                |                | Max.          | @Max. Load |                         |                      | @No Load          |
|               |                       |                | VDC            | VDC           | mA         |                         |                      | mA(typ.)          |
| MJWI30-24S033 | 24<br>(9 ~ 36)        | 3.3            | 7000           | 1106          | 10         | 3.9                     | 10000                | 87                |
| MJWI30-24S05  |                       | 5              | 6000           | 1420          | 10         | 6.2                     | 7200                 | 88                |
| MJWI30-24S12  |                       | 12             | 2500           | 1420          | 10         | 15                      | 1250                 | 88                |
| MJWI30-24S15  |                       | 15             | 2000           | 1420          | 10         | 18                      | 800                  | 88                |
| MJWI30-24S24  |                       | 24             | 1250           | 1420          | 10         | 30                      | 330                  | 88                |
| MJWI30-24D12  |                       | ±12            | ±1250          | 1420          | 10         | ±15                     | 680#                 | 88                |
| MJWI30-24D15  |                       | ±15            | ±1000          | 1404          | 10         | ±18                     | 470#                 | 88                |
| MJWI30-48S033 | 48<br>(18 ~ 75)       | 3.3            | 7000           | 553           | 8          | 3.9                     | 10000                | 87                |
| MJWI30-48S05  |                       | 5              | 6000           | 702           | 8          | 6.2                     | 7200                 | 88                |
| MJWI30-48S12  |                       | 12             | 2500           | 702           | 8          | 15                      | 1250                 | 90                |
| MJWI30-48S15  |                       | 15             | 2000           | 702           | 8          | 18                      | 800                  | 90                |
| MJWI30-48S24  |                       | 24             | 1250           | 694           | 8          | 30                      | 330                  | 90                |
| MJWI30-48D12  |                       | ±12            | ±1250          | 694           | 8          | ±15                     | 680#                 | 90                |
| MJWI30-48D15  |                       | ±15            | ±1000          | 694           | 8          | ±18                     | 470#                 | 90                |

# For each output

| Input Specifications             |   |                  |      |      |      |  |
|----------------------------------|---|------------------|------|------|------|--|
| Parameter                        | Conditions / Model                      | Min.             | Typ. | Max. | Unit |  |
| Input Surge Voltage (100ms 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 Pi Type |      |      |      |  |

| 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       | Nominal Vin                  | ---  | 2    | ---  | 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                                       | ---  | ---   | ±0.2    | %                    |  |
|                                 |   | Dual Output   | ---  | ---   | ±1.0    | %                    |  |
| Cross Regulation (Dual)         | Asymmetrical Load 25% / 100% FL                         | ---   | ---  | ±5.0  | %       |                      |  |
| Minimum Load                    | No minimum Load Requirement                             |   |      |       |         |                      |  |
| Ripple & Noise                  | 20 MHz Bandwidth  | Measured with a 0.1µF/50V MLCC and a 47µF/50v MLCC. |      | ---   | ---     | 75 mV <sub>P-P</sub> |  |
| Transient Recovery Time         | 25% Load Step Change                                    | ---   | 250  | ---   | µsec    |                      |  |
| Transient Response Deviation    |   | ---   | ±3   | ±5    | %       |                      |  |
| Temperature Coefficient         |   | ---   | ---  | ±0.02 | %/°C    |                      |  |
| Trim Up / Down Range            | % of Nominal Output Voltage                             | ---   | ---  | ±10   | %       |                      |  |
| Over Load Protection            | Hiccup  | ---   | 150  | ---   | %       |                      |  |
| Over Voltage Protection         | Zener Diode Clamp                                       | ---   | 125  | ---   | % of Vo |                      |  |
| Short Circuit Protection        | Continuous, Automatic Recovery (Hiccup Mode 0.6Hz typ.) |   |      |       |         |                      |  |

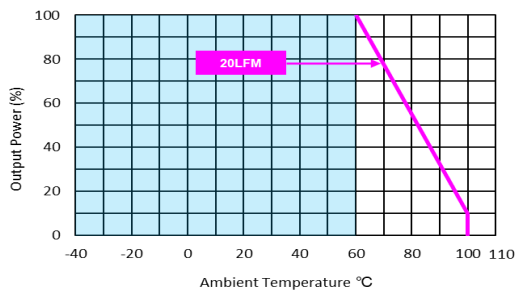
| General Specifications                 |   |           |      |      |       |  |  |
|--|---|-----------|------|------|-------|--|--|
| Parameter                              | Conditions  | Min.      | Typ. | Max. | Unit  |  |  |
| I/O Isolation Voltage                  | 60 Seconds  | 1500      | ---  | ---  | VDC   |  |  |
|  | 1 Second  | 1800      | ---  | ---  | VDC   |  |  |
| Isolation Voltage Input/Output to case | 60 Seconds  | 1000      | ---  | ---  | VDC   |  |  |
| I/O Isolation Resistance               | 500 VDC   | 1000      | ---  | ---  | MΩ    |  |  |
| I/O Isolation Capacitance              | 100kHz, 1V  | ---       | ---  | 1500 | pF    |  |  |
| Switching Frequency                    | 3.3 Vo Models   | ---       | 175  | ---  | kHz   |  |  |
|  | 5 Vo Models   | ---       | 248  | ---  | kHz   |  |  |
|  | 12 & 15 & 24 & Dual Vo Models                               | ---       | 285  | ---  | kHz   |  |  |
| MTBF(calculated)                       | MIL-HDBK-217F@25°C, Ground Benign                           | 1,310,710 | ---  | ---  | Hours |  |  |
| Safety Approvals(Pending)              | UL/cUL 62368-1 recognition (UL certificate), IEC/EN 62368-1 |           |      |      |       |  |  |

**EMC Specifications**

| Parameter | Standards & Level                               |                                      | Performance                                   |
|-----------|---|--------------------------------------|---|
| EMI       | Conduction & Radiation with external components |                                      | Class A <sub>(6)</sub>                        |
|           | EN 55032, FCC part 15                           |                                      |   |
| EMS       | EN 55035  |                                      |   |
|           | ESD   | Direct discharge                     | Indirect discharge HCP & VCP<br>Contact ± 6kV |
|           |   | EN61000-4-2 Air ± 8kV, Contact ± 6kV |   |
|           | Radiated immunity                               | EN 61000-4-3 10V/m                   |   |
|           | Fast transient <sub>(7)</sub>                   | EN 61000-4-4 ±2kV                    |   |
|           | Surge <sub>(7)</sub>                            | EN 61000-4-5 ±2kV                    |   |
|           | Conducted immunity                              | EN 61000-4-6 10Vrms                  |   |
| PFMF      | EN61000-4-8 100A/m Continuous; 1000A/m 1sec.    |                                      |   |

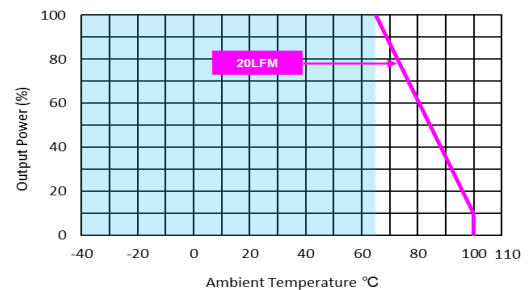
**Environmental Specifications**

| Parameter  | Model  | Min. | Max.             |               | Unit     |
|--|--|------|------------------|---------------|----------|
|  |  |      | without Heatsink | with Heatsink |          |
| Operating Ambient Temperature Range<br>Nominal Vin, Load 100% Inom.<br>(for Power Derating see relative Derating Curves) | MJWI30-24S05, MJWI30-24S12, MJWI30-24S15<br>MJWI30-24S24, MJWI30-24D12, MJWI30-24D15<br>MJWI30-48S05   | -40  | 60               | 65            | °C       |
|  | MJWI30-24S033, MJWI30-48S033, MJWI30-48S12<br>MJWI30-48S15, MJWI30-48S24, MJWI30-48D12<br>MJWI30-48D15 |      | 65               | 70            |          |
| Case Temperature   |  | ---  | +105             |               | °C       |
| Storage Temperature Range  |  | -55  | +125             |               | °C       |
| Humidity (non condensing)  |  | ---  | 95               |               | % rel. H |
| Lead Temperature (1.5mm from case for 10 sec.)   |  | ---  | 260              |               | °C       |

**Power Derating Curve**


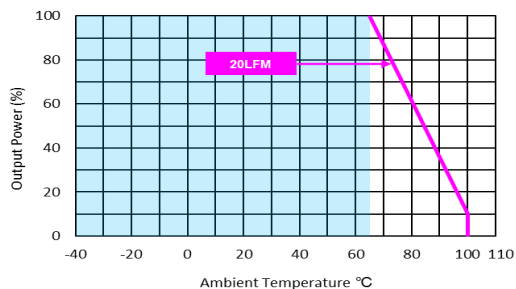
MJWI30-24S05, MJWI30-24S12, MJWI30-24S15  
MJWI30-24S24, MJWI30-24D12, MJWI30-24D15  
MJWI30-48S05

Derating Curve without Heatsink



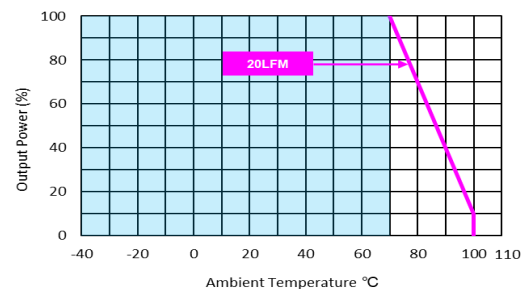
MJWI30-24S05, MJWI30-24S12, MJWI30-24S15  
MJWI30-24S24, MJWI30-24D12, MJWI30-24D15  
MJWI30-48S05

Derating Curve with Heatsink



MJWI30-24S033, MJWI30-48S033, MJWI30-48S12  
MJWI30-48S15, MJWI30-48S24, MJWI30-48D12  
MJWI30-48D15

Derating Curve without Heatsink

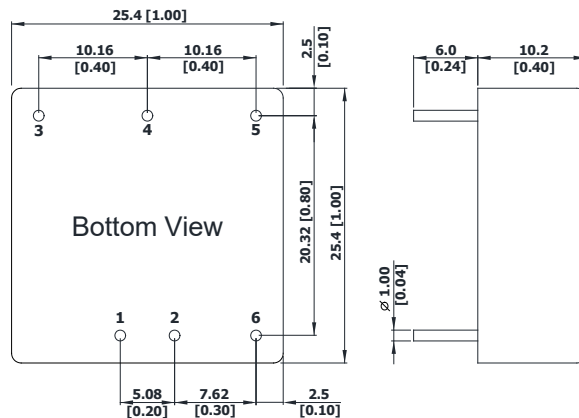


MJWI30-24S033, MJWI30-48S033, MJWI30-48S12  
MJWI30-48S15, MJWI30-48S24, MJWI30-48D12  
MJWI30-48D15

Derating Curve with Heatsink

**Notes**

- 1 Specifications typical at Ta=+25°C, resistive load, nominal input voltage, 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 factory.
- 5 The standard module meets EN 55032 Class A with external components. For further information, please contact MINMAX.
- 6 To meet EN 61000-4-4 & EN 61000-4-5 an external capacitor across the input pins is required, please contact MINMAX.
- 7 Specifications are subject to change without notice.

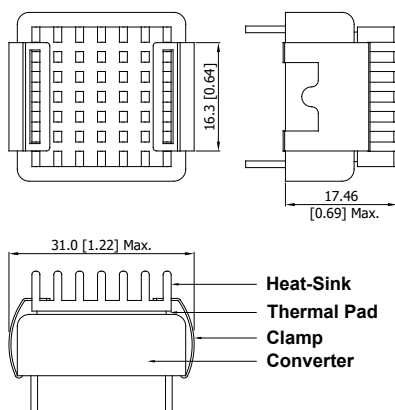
**Package Specifications**
**Mechanical Dimensions**

**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±0.5 (X.XX±0.02)  
X.XX±0.25 (X.XXX±0.01)
- ▶ Pin diameter  $\varnothing$  1.0 ±0.05 (0.04±0.002)

**Physical Characteristics**

|               |  |
|---------------|--|
| Case Size     | : 25.4x25.4x10.2mm (1.0x1.0x0.4 inches)    |
| Case Material | : Copper                                   |
| Base Material | : FR4 PCB (flammability to UL 94V-0 rated) |
| Pin Material  | : Tinned Copper                            |
| Weight        | : 25g                                      |

**Heatsink (Option -HS)**
**Mechanical Dimensions**


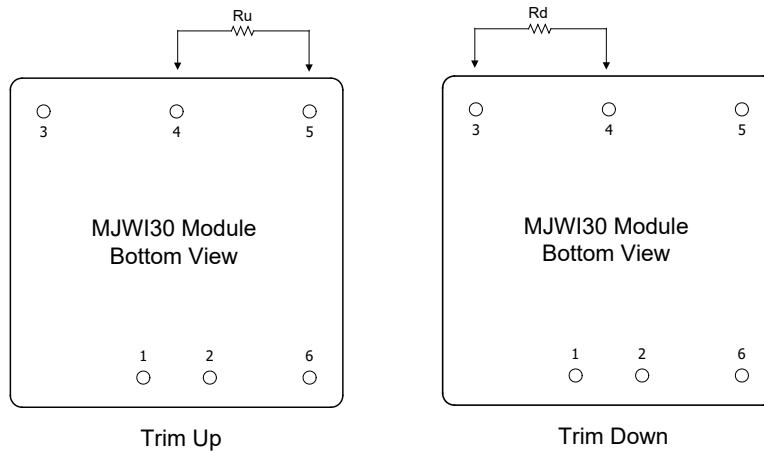
Heatsink Material: Aluminum  
 Finish: Anodic treatment (black)  
 Weight: 2g

- ▶ 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.

| Order Code Table |                  |
|------------------|------------------|
| Standard         | With heatsink    |
| MJWI30-24S033    | MJWI30-24S033-HS |
| MJWI30-24S05     | MJWI30-24S05-HS  |
| MJWI30-24S12     | MJWI30-24S12-HS  |
| MJWI30-24S15     | MJWI30-24S15-HS  |
| MJWI30-24S24     | MJWI30-24S24-HS  |
| MJWI30-24D12     | MJWI30-24D12-HS  |
| MJWI30-24D15     | MJWI30-24D15-HS  |
| MJWI30-48S033    | MJWI30-48S033-HS |
| MJWI30-48S05     | MJWI30-48S05-HS  |
| MJWI30-48S12     | MJWI30-48S12-HS  |
| MJWI30-48S15     | MJWI30-48S15-HS  |
| MJWI30-48S24     | MJWI30-48S24-HS  |
| MJWI30-48D12     | MJWI30-48D12-HS  |
| MJWI30-48D15     | MJWI30-48D15-HS  |

**External Output Trimming**

Output can be externally trimmed by using the method shown below



MJWI30-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=       | 72.64   | 32.49   | 19.10   | 12.41   | 8.39    | 5.72    | 3.80    | 2.37    | 1.25    | 0.36    | 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=       | 60.49   | 27.14   | 16.03   | 10.47   | 7.14    | 4.91    | 3.33    | 2.14    | 1.21    | 0.47    | KOhms |

MJWI30-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=       | 139.38  | 62.91   | 37.42   | 24.68   | 17.03   | 11.94   | 8.29    | 5.56    | 3.44    | 1.74    | 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=       | 107.37  | 48.26   | 28.56   | 18.71   | 12.80   | 8.86    | 6.05    | 3.94    | 2.29    | 0.98    | KOhms |

MJWI30-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 |

MJWI30-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 |

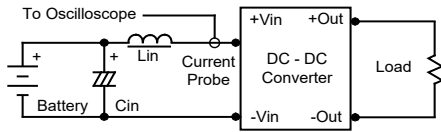
MJWI30-XXS24 Trim Table

| 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=       | 598.65  | 267.77  | 157.48  | 102.33  | 69.24   | 47.18   | 31.43   | 19.61   | 10.42   | 3.07    | 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=       | 487.13  | 218.01  | 128.30  | 83.45   | 56.54   | 38.60   | 25.78   | 16.17   | 8.69    | 2.71    | KOhms |

## Test Setup

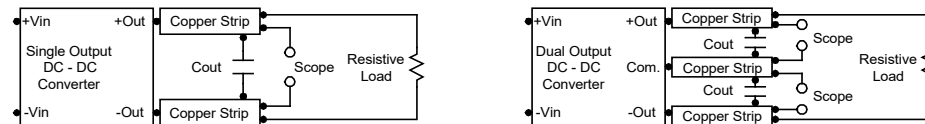
### Input Reflected-Ripple Current Test Setup

Input reflected-ripple current is measured with an inductor  $L_{in}$  ( $4.7\mu H$ ) and  $C_{in}$  ( $220\mu F$ ,  $ESR < 1.0\Omega$  at  $100\text{ kHz}$ ) 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  $0\text{-}500\text{ kHz}$ .



### Peak-to-Peak Output Noise Measurement Test

Use a  $47\mu F$  and  $0.1\mu F$  ceramic capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is  $0\text{-}20\text{ MHz}$ . Position the load between  $50\text{ mm}$  and  $75\text{ mm}$  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  $1V$ . A logic high is  $2.5V$  to  $50V$ . The maximum sink current at on/off terminal during a logic low is  $500\mu A$ . The maximum allowable leakage current of the switch at on/off terminal ( $2.5$  to  $50V$ ) is  $500\mu A$ .

### Overload Protection

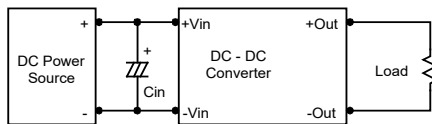
To provide protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure current limiting for an unlimited duration. At the point of current-limit inception, the unit shifts from voltage control to current control. The unit operates normally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

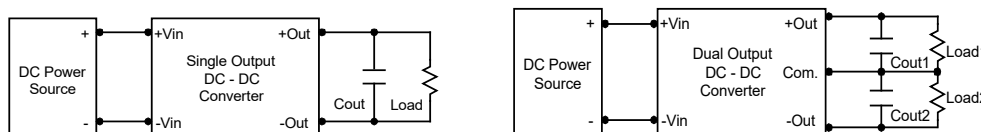
In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.

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 ( $ESR < 1.0\Omega$  at  $100\text{ kHz}$ ) capacitor of a  $6.8\mu F$  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  $4.7\mu F$  capacitors at the output.



### Maximum Capacitive Load

The MJWI30 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  $100^{\circ}C$ . The derating curves are determined from measurements obtained in a test setup.

