# PXD-M and PXG-M
## Applications Notes

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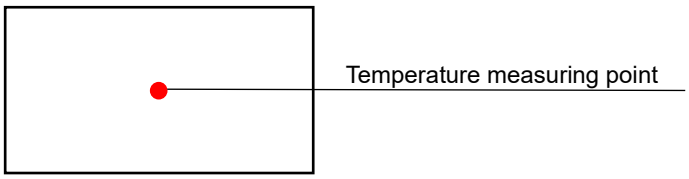
## Thermal Considerations

The power module operates in a variety of thermal environments; however, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding environment. Proper cooling can be verified by measuring the point on the top of the converter as shown in the figure below. The temperature at this location should not exceed 105℃. When operating, adequate cooling must be provided to maintain the test point temperature at or below 105℃. Although the maximum point temperature of the power modules is 105℃, limiting this temperature to a lower value enhances the reliability.

Thermal test condition with vertical direction by natural convection (20LFM).

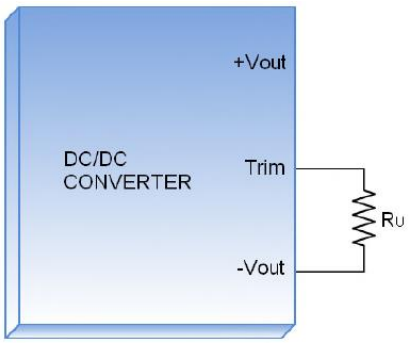



## Output Voltage Adjustment

It allows the user to increase or decrease the output voltage of the module. This is accomplished by connecting an external resistor between the TRIM pin and either the +Vout or -Vout pins. With an external resistor between the TRIM and -OUTPUT pin, the output voltage increases. With an external resistor between the TRIM and +OUTPUT pin, the output voltage decreases. The external TRIM resistor needs to be at least 1/16W of rated power.

### Trim Up Equation

$$R_U = \left[\frac{G\ x\ L}{V_{o,up} - L - K} - H\right]\Omega$$



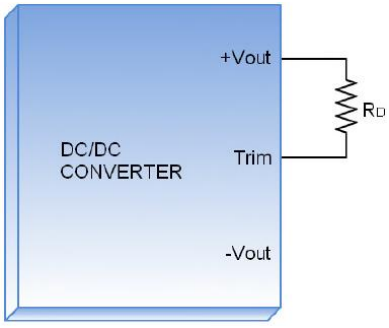

**Example: PXG-M15-24WS05 (Trim-Up to 5.1VDC)**

$$R_U = \left[\frac{5110\ x\ 2.5}{5.1 - 2.5 - 2.5} - 2050\right]\Omega$$

$R_U$ = 125.7kΩ

### Trim Down Equation

$$R_D = \left[\frac{(V_{o,down} - L)\ x\ G}{(V_o - V_{o,down})} - H\right]\Omega$$




**Example: PXG-M15-24WS12 (Trim-Down to 11.4VDC)**

$$R_D = \left[\frac{(11.4 - 2.5)\ x\ 10000}{(12 - 11.4)} - 5110\right]\Omega$$

$R_D$ = 143.223kΩ

## Trim Constants

| Models | G | H | K | L |
|---|---|---|---|---|
| PXG-M15xxWS05 / PXG-M20xxWS05 / PXD-M30xxWS05 | 5,110 | 2,050 | 2.5 | 2.5 |
| PXG-M15xxWS12 / PXG-M20xxWS12 / PXD-M30xxWS12 | 10,000 | 5,110 | 9.5 | 2.5 |
| PXG-M15xxWS15 / PXG-M20xxWS15 / PXD-M30xxWS15 | 10,000 | 5,110 | 12.5 | 2.5 |
| PXG-M15xxWS24 / PXG-M20xxWS24 / PXD-M30xxWS24 | 56,000 | 13,000 | 21.5 | 2.5 |

## Fuse Considerations

**Caution:** This power module is not internally fused. An input line fuse must always be used.

This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture. For maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

The table below is based on the information provided in the data sheet on inrush energy and maximum DC input current at low Vin

| Models | Fuse Rating (A) | Fuse Type |
|---|---|---|
| PXG-M15-24Wxxx | 3.15 | Slow-Blow |
| PXG-M15-48Wxxx | 1.6 | Slow-Blow |
| PXG-M20-24Wxxx | 4 | Slow-Blow |
| PXG-M20-48Wxxx | 2 | Slow-Blow |
| PXD-M30-24Wxxx | 6.3 | Slow-Blow |
| PXD-M30-48Wxxx | 3.15 | Slow-Blow |

According to actual current value, calculating fuse ratings base on the following equations:

**Eq. 1:** $I_{FUSE} \geq I_{in} / (\text{Re rating} \times \text{Safety margin})$

**Eq. 2:** $\text{Melting } I^2t = I^2_{PULSE,act} \cdot t / 0.22$

$I_{FUSE}$ = current rating of fuse

$I_{in}$ = actual value of input current

Rerating = % of fuse rating base on ambient temperature (Fuse rating is variety under different ambient temperature)

Safety margin = % of fuse rating set by user

Melting $I^2t$ = pulse energy rating of fuse

$I_{PULSE,act}$ = actual input pulse current

t = width of the input pulse current

## Reverse Input Voltage Protection

**Avoid the reverse polarity input voltage; otherwise, it will damage the DC/DC converter. It is likely to protect the module from the reverse input voltage by installing an external diode. The diode can blow the line fuse to protect DC/DC converter. Recommend using Schottky diode below for reverse input voltage protection.**

| Models | Voltage Rating of Diode (V) | Current Rating of Diode |
|---|---|---|
| PXG-Mxx-24Wxxx and PXD-M30-24xxx | 60 | 1~1.5 x Fuse Rating |
| PXG-Mxx-48Wxxx and PXD-M30-48xxx | 100 | |

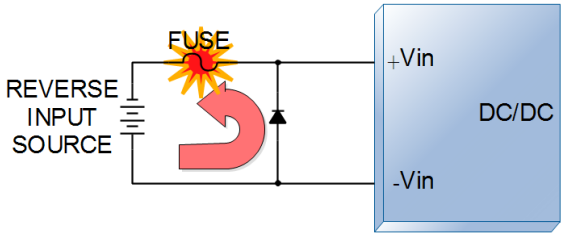



**Fig. 1: Reverse Input Voltage Protection**

| Remote ON/OFF |
| --- |
| For models with remote on/off option - suffix -N for Negative Logic (Example: PXG-M20-48WS05-N)<br>The module is ON during logic Low and turns OFF during logic High. The Ctrl pin is referenced to -Vin. If not using the remote on/off feature, the Ctrl and -Vin pins should be connected together (shorted) or apply 0-1.2V between these two pins for the module to be ON. |

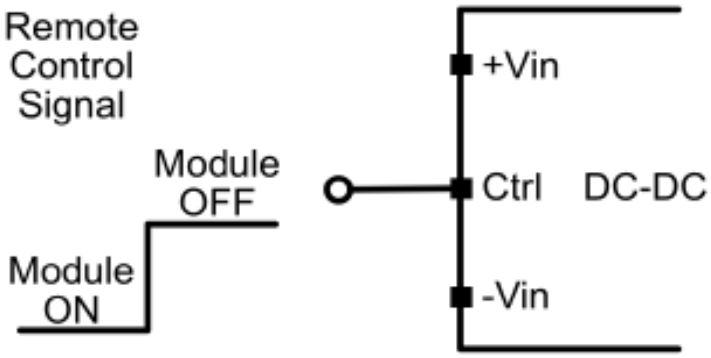



**Fig. 2a: Suffix -N (Negative Logic)**

| Remote ON/OFF |
| --- |
| For models with remote on/off option - suffix -P for Positive Logic (Example: PXG-M20-48WS05-P)<br>The module is ON during logic High and turns OFF during logic Low. The Ctrl pin is referenced to -Vin. If not using the remote on/off feature, the Ctrl and -Vin pins should be open or apply 3.5~12V between these two pins for the module to be ON. |

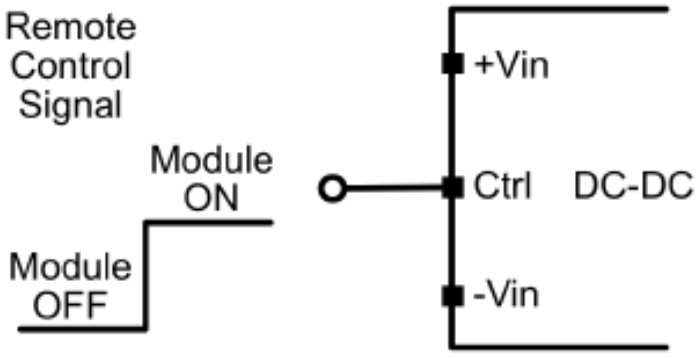



**Fig. 2b: Suffix -P (Positive Logic)**

| Immunity Considerations | | | |
|---|---|---|---|
| **Test** | **Standard** | **Test Level** | **Criteria** |
| ESD | EN61000-4-2 | Air ± 15kV and Contact ± 8kV | A |
| Radiated Susceptibility | EN61000-4-3 | 10V/m | A |
| EFT Burst | EN61000-4-4 | ± 2kV | A |
| Surge | EN61000-4-5 | ± 2kV | A |
| Conducted Susceptibility | EN61000-4-6 | 10 Vrms | A |
| Magnetic Fields | EN61000-4-8 | 100A/m continuous; 1000A/m 1s | A |

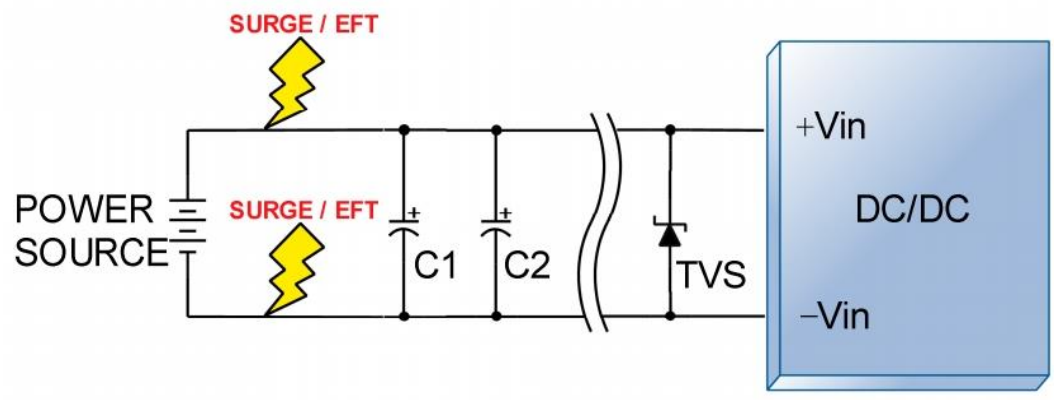



**Fig. 3a: Surge and EFT Protections**


**Fig. 3b: PCB Trace (incorrect PCB layout reduces ability to suppress Surge and EFT)**

| Component Selection | | | |
|---|---|---|---|
| **Model** | **Component** | **Specification** | **Reference** |
| PXG-Mxx-24Wxxx and PXD-M30-24xxx | C1 | 220µF/100V | Nippon Chemi-con KY series |
| | C2 | | |
| | TVS | 58V/3000W | SMDJ58A |
| PXG-Mxx-48Wxxx and PXD-M30-48xxx | C1 | 220µF/100V | Nippon Chemi-con KY series |
| | C2 | | |
| | TVS | 120V/3000W | SMDJ120A |

| EMI Considerations |
|---|
| Standard modules meet EN55011-A, EN55032-A without external components (EN55032-B with external components) |

## Recommended external EMI filter for EN55032-B

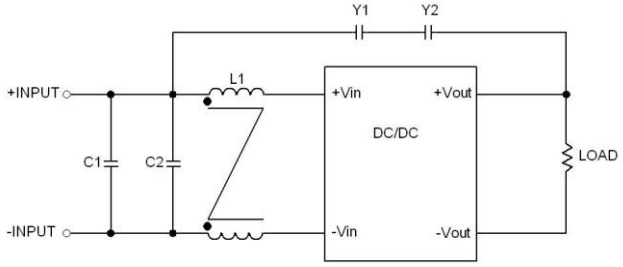



Fig. 4a: Single Output

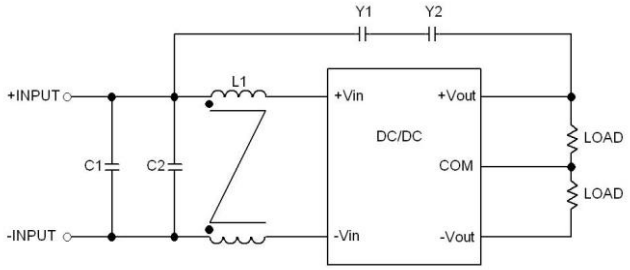



Fig. 4b: Dual Output

| Component Selection | | | | |
|---|---|---|---|---|
| **Model** | **C1** | **C2** | **Y1, Y2** | **L1** |
| PXG-Mxx-24Wxxx and PXD-M30-24xxx | N/A | 10µF/50V 1210 MLCC | 100pF/400VAC Y1 | 145µH, PMT-051 |
| PXG-Mxx-48Wxxx and PXD-M30-48xxx | 2.2µF/100V 1210 MLCC | 2.2µF/100V 1210 MLCC | | 373µH, PMT-026 |

## Recommended Layout Patterns (Single Output)

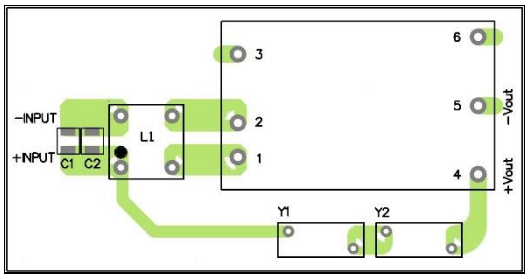



Fig. 5a: Top View

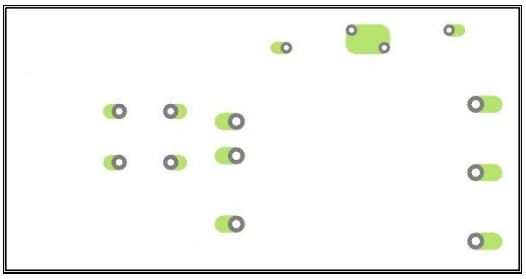


Fig. 5b: Bottom View

## Recommended Layout Patterns (Dual Output)

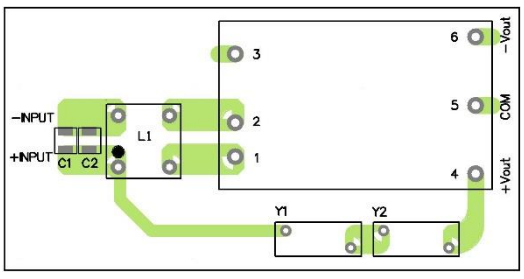



Fig. 6a: Top View

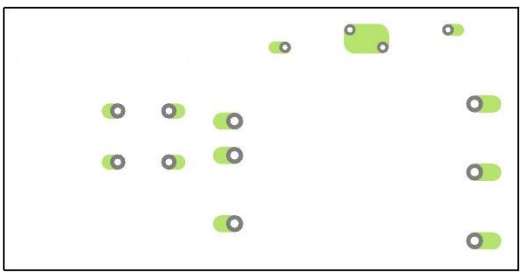
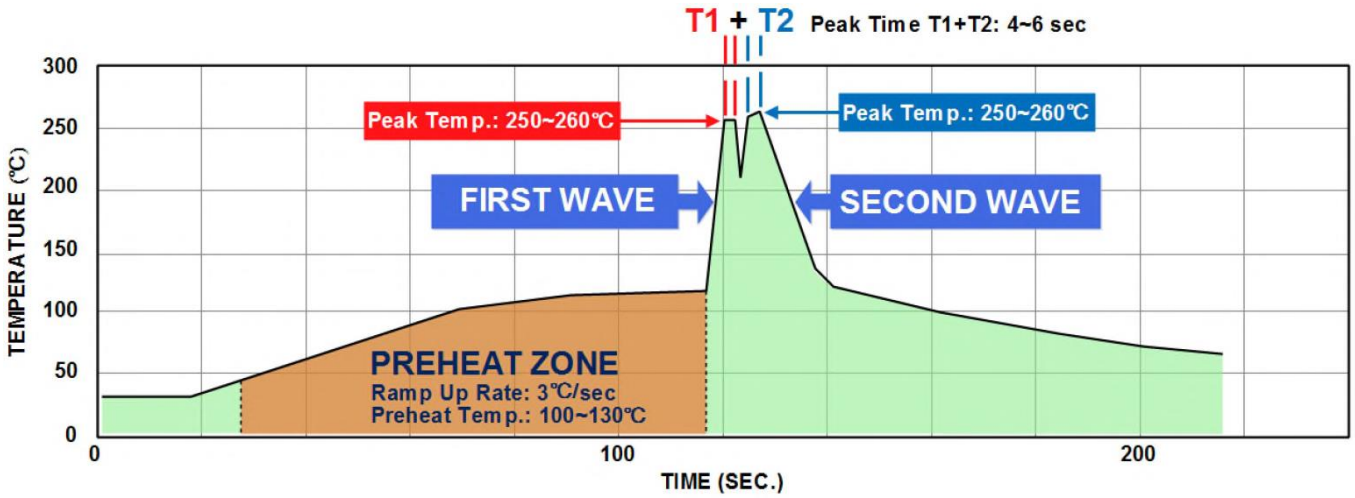


Fig. 6b: Bottom View

## Wave Solder Profile




Lead free wave solder profile

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

Hand Soldering (Reference):

Soldering iron: Power 150W

Soldering time: 3~6 sec

Temp: 410~430℃