

# Cool<sup>TM</sup> 600

## NFF Series

### Patented Resonant Technology



#### NFF Series; No Fan Featured

- 100% natural convection cooled
- No internal or external fans needed
- No base-plate needed

#### No Acoustic Noise or Vibrations & Breakthrough Level Reliability

- No fans required – 600W with natural convection
- MTBF >400000 hours - 25% better, than today's leading solutions
- **High Input Surge Protection**
  - 4KV Line to PE for harsh environments
- **Reverse Energy Protection**
  - No blocking diodes required
- **24W Standby Power**
- **Safety Approved to 5000m Altitude**
- **>93% Efficiency**
- **5 Year Warranty**

#### Flexibility

- **Analog and Digital Management**
  - PMBus monitoring and control capability
- **Field Configurable**
  - Plug and Play Power
- **Series and Parallel Outputs**
  - Higher voltages/currents
- **Mounting Options**
  - Base/Side and DIN-Rail mounting

#### Certifications

- **Medical**
  - IEC60601-1 3rd Edition compliant
  - IEC60601-1-2 4th edition EMC compliant
  - 2 MOPP
  - Dual Fused
  - BF rated
  - ISO13485
- **Industrial**
  - IEC60950, IEC62368-1
  - ISO9000
  - SEMI F47
- **Defence/Aero**
  - MIL810G certified
  - MIL461G, CE101, CE102

#### TYPICAL APPLICATIONS

- **Medical;** Clinical diagnostic equipment, Medical lasers, Dialysis equipment, Radiological Imaging, Clinical Chemistry
- **Industrial;** Test and Measurement, Industrial Machines, Automation equipment, Printing, Telecommunications, Audio equipment
- **Hi Rel;** Harsh Industrial Electronics, Radar (Naval, Ground Based), Communications Test & Measurement

The **World's Only Fanless modular power supply**, the CoolX600 NFF Series is the revolutionary new Convection-Cooled modular power supply from Excelsys. It provides an incredible 600W in a compact 4.5 x 8.5 x 1U package with no fan.

The silent CoolX600 generates no acoustic noise and offers system designers best in class performance in efficiency (>93%) and unrivalled reliability in addition to the most comprehensive feature set and specifications.

The series comprises two base models. The CX06S is certified to IEC60950 2nd edition for industrial applications whereas the CX06M carries IEC60601-1 3rd edition & IEC60601-1-2 4th edition (EMC) for medical applications. The CoolX600 can be populated with up to 4 CoolMods, providing up to 4 isolated DC outputs ranging from 2.5V to 58.0V. Continuing the Excelsys tradition of flexibility, the CoolX600 is completely user and field configurable. Outputs can be adjusted to the required set point voltages and can be configured in parallel or series for higher current and/or higher voltages. CoolPacs can be paralleled for higher power and N+1 Redundancy applications.

Stand-out features for medical applications include BF rating (Body Floating), input dual fusing, 2 x MOPP isolation and <300uA leakage current. Other features include 4KV input surge immunity, SEMI F47 compliance, MIL810G compliance and the ability to withstand input voltages of up to 300VAC making it ideal for use in remote locations and those subject to input voltage disturbances. No fans make it ideal for acoustic and vibration sensitive applications.

With Digital Communications available, the CoolX600 provides the most flexible, highest specification modular power supply in the market, all backed up by the Excelsys 5 Year Warranty ensuring quality and the lowest total cost of ownership

#### CoolX CoolPac

| CoolPac | Slots | Power | Medical Approval IEC60601-1 3rd edition & IEC60601-1-2 4th edition (EMC) | Industrial Approval IEC60950 2nd edition |
|---------|-------|-------|--|--|
| CX06S   | 4     | 600W  | -  | Yes                                      |
| CX06M   | 4     | 600W  | Yes  | -  |

#### CoolX CoolMod

| Model | Vnom (V) | Set Point        |                      | Power (W) |
|-------|----------|------------------|----------------------|-----------|
|       |          | Adjust Range (V) | I <sub>max</sub> (A) |           |
| CmA   | 5        | 2.5-6.0          | 21                   | 105       |
| CmB   | 12       | 6.0-15.0         | 15                   | 180       |
| CmC   | 24       | 15.0-28.0        | 8.33                 | 200       |
| CmD   | 48       | 28.0-58.0        | 4.17                 | 200       |



## INPUT

| Parameter                   | Conditions/Description               | Min  | Nom | Max | Units |
|-----------------------------|--------------------------------------|------|-----|-----|-------|
| AC Operating Input Range    |                                      | 85   |     | 264 | VAC   |
| Nominal Input Voltage Range | Universal Input 47-440Hz             | 100  |     | 240 | VAC   |
| Extended AC Operating Range | Maximum for 5 seconds                |      |     | 300 | VAC   |
| DC Input voltage range      |                                      | 120  |     | 300 | VDC   |
| Input Current               | 90VAC @ 420W                         |      | 6.0 |     | A     |
| Inrush Current              | 230VAC @ 600W                        |      |     | 25  | A     |
| Power Factor                | 120VAC@ 500W                         | 0.98 |     |     |       |
| Undervoltage Lockout        | Shutdown                             | 65   |     | 74  | VAC   |
| Input Fuses Rating          | Dual Fused (Line and Neutral) 250VAC |      | 8   |     | A     |
| Efficiency                  | 230VAC, 600W with 3 x CmC CoolMods   |      | 93  |     | %     |

## COOLMOD OUTPUT

| Parameter                  | Conditions/Description  | Min        | Nom | Max             | Unit           |
|----------------------------|---|------------|-----|-----------------|----------------|
| Power Rating               | CX06: See derating curves   |            |     | 600             | W              |
| Minimum Load               |   |            | 0   |                 | A              |
| Line Regulation            | For $\pm 10\%$ change from nominal line   |            |     | $\pm 0.1$       | %              |
| Load & Cross Regulation    | For 25% to 75% load change  |            |     | $\pm 0.2$       | %              |
| Transient Response         | For 25% to 75% load change 0.5A/uS: Voltage Deviation<br>Settling Time                |            |     | 4<br>500        | %<br>$\mu$ S   |
| Ripple and Noise           | 100mV or 1.0% pk-pk. 20MHz BW   |            |     | 1               | %              |
| Overvoltage Protection     | Tracking OVP Level<br>Latching OVP Level  | 105<br>125 |     | 125<br>160      | %<br>%         |
| Remote Sense               | Max. line drop compensation   |            |     | 0.5             | VDC            |
| Overshoot                  |   |            |     | 1               | %              |
| Rise Time                  | Monotonic   |            |     | 10              | ms             |
| Turn-on Delay              | From AC in<br>From Global Enable<br>From CoolMod Enable                               |            |     | 800<br>10<br>10 | ms<br>ms<br>ms |
| Hold-up Time               | For nominal output voltages at full load  | 20         |     |                 | ms             |
| CoolMod Power              | As per CoolMod table  |            |     |                 |                |
| Output Adjustment Range    | Manual: Multi-turn potentiometer. As per CoolMod table<br>Vtrim: As per CoolMod table |            |     |                 |                |
| Overcurrent Protection     | Straight line with hiccup activation @ 35% Vo nom                                     | 110        | 130 | 150             | %              |
| Short Circuit Protection   | Yes, Autorecovery   |            |     |                 |                |
| OverTemperature Protection | Yes, Autorecovery   |            |     |                 |                |
| Capacitive Load            |   |            |     | 10              | mF             |

## AUXILIARY OUTPUT

| Parameter                      | Conditions/Description                       | Min           | Nom     | Max           | Units   |
|--------------------------------|--|---------------|---------|---------------|---------|
| Nominal Output Voltage         | Aux Voltage Option A<br>Aux Voltage Option B | 11.76<br>4.75 | 12<br>5 | 12.24<br>5.25 | V<br>V  |
| Load Regulation                |  |               |         | $\pm 2$       | %       |
| Line Regulation                | For $\pm 10\%$ change from nominal line      |               |         | $\pm 0.5$     | %       |
| Maximum Output Current         | Aux Voltage Option A<br>Aux Voltage Option B |               |         | 1.96<br>4.7   | A<br>A  |
| Maximum Output Capacitive Load |  |               |         | 1000          | $\mu$ F |
| Output Overcurrent Protection  | Hiccup                                       | 110           |         | 140           | %       |
| Short Circuit Protection       | Yes, Autorecovery                            |               |         |               |         |

## GALVANIC ISOLATION

| Parameter        | Conditions/Description | Min  | Nom | Max | Units |
|------------------|------------------------|------|-----|-----|-------|
| Input to Output  | Reinforced (2 x MOPP)  | 4000 |     |     | VAC   |
| Input to Case    | Basic (1 x MOPP)       | 1850 |     |     | VAC   |
| Output to Case   | Basic (1 x MOPP)       | 1850 |     |     | VAC   |
| Output to Output | Basic (1 x MOPP)       | 1850 |     |     | VAC   |

## RELIABILITY

| Parameter            | Conditions/Description  | Min | Nom          | Max | Units        |
|----------------------|---|-----|--------------|-----|--------------|
| Reliability and MTBF | MTBF of >400 kHours, Telecordia SR-332, Issue 1 CoolMod CoolPac |     | 0.52<br>1.08 |     | Fpmh<br>Fpmh |
| Warranty             | 5 Years   |     |              |     |              |

## ENVIRONMENTAL

| Parameter             | Conditions/Description                                     | Min | Nom | Max  | Units |
|-----------------------|--|-----|-----|------|-------|
| Operating Temperature | Operates to specification below -20°C after 10 min warm-up | -40 |     | +85  | °C    |
| Storage Temperature   |  | -40 |     | +85  | °C    |
| Derating              | See Derating Curves including note 2                       |     |     |      |       |
| Relative Humidity     | Non-condensing   | 5   |     | 95   | %RH   |
| Shock & Vibration     | MIL-STD810G Method 514.6                                   |     |     |      |       |
| Altitude              |  |     |     | 5000 | m     |

## LEAKAGE CURRENTS

| Parameter                          | Conditions/Description       | Min | Nom | Max | Units        |
|------------------------------------|------------------------------|-----|-----|-----|--------------|
| <b>AC Leakage Current</b>          | <b>Input to earth ground</b> |     |     |     | <b>Units</b> |
| Normal condition (high line)       | Mains Voltage 264VAC/60Hz    | 44  |     |     | µA           |
| Single fault condition (high line) | Mains Voltage 264VAC/60Hz    | 231 |     |     | µA           |
| <b>Touch Current</b>               |                              |     |     |     |              |
| Normal Condition                   | Mains Voltage 264VAC/60Hz    | 83  |     |     | µA           |
| Single Fault Condition             | Mains Voltage 264VAC/60Hz    | 87  |     |     | µA           |

## EMC

| Parameter                      | Conditions/Description                         | Criteria |
|--------------------------------|--|----------|
| Radiated Emissions             | EN 55011, EN 55022 and FCC, Class B            |          |
| Conducted emissions            | EN 55011, EN 55022 and FCC, Class B            |          |
| Power line harmonics           | EN 61000-3-2, Class A                          |          |
| Voltage flicker                | EN 61000-3-3                                   |          |
| ESD                            | EN 61000-4-2, level 4, 8 kV contact, 15 kV air | A        |
| Radiated immunity              | EN 61000-4-3, level 2, 3 V/m                   | A        |
| Electrical fast transient      | EN 61000-4-4, level 4, ±4 kV                   | B        |
| Surge immunity                 | EN 61000-4-5, level 4, 2 kV DM, 4 kV CM        | B        |
| Conducted RF immunity          | EN 61000-4-6, level 2, 3 Vrms                  | A        |
| Power frequency magnetic field | EN 61000-4-8, level 2, 3 A/m                   | A        |

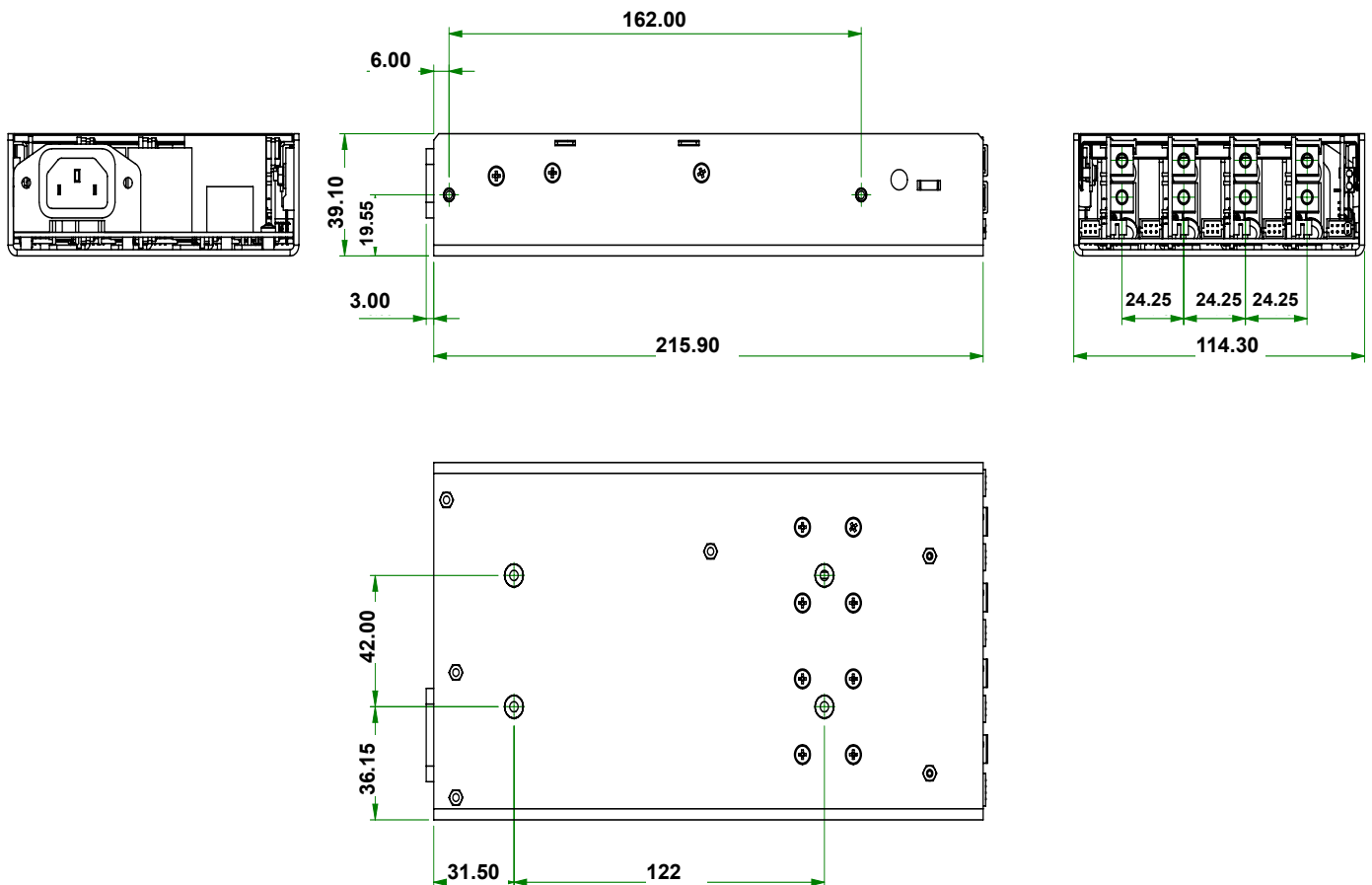
## STANDARDS &amp; DIRECTIVES 1)

| Parameter   | Conditions/Description  |
|---|---|
| Safety Agency Approvals                               | EN60601-1 3rd Edition, UL60601-1, CSA601, EN60950 2nd Edition, CSA C22.2 No. 60950-1,   |
| IEC/EN 60950-1, Edition 2 and all national deviations | UL 60950-1/CSA 22.2 No 60950-1, Edition 2; 5000 m (16,400 ft) altitude, 100 V to 240 ±10% Vac   |
| IEC/EN 60601-1, Edition 3 and all national deviations | IEC 60601-1(2005), EN60601-1(2006) ANSI/AAMI ES 60601-1(2005) CAN/CSA C22.2 No. 60601-1 (2008); 5,000 m (16,400 ft) altitude, 100 V to 240 Vac ±10% |
| IEC 62368 Edition 2                                   | IEC 62368-1 (2014) Edition 2 5000 m (16,400 ft) altitude, 100 V to 240 ±10% Vac   |
| IEC 60601-1-2 Edition 4                               | IEC 60601-1-2 (2014)  |
| Protection class                                      | Class I   |
| WEEE  | Waste Electrical and Electronic Equipment Directive (WEEE) 2002/96/EC   |
| ROHS  | EU DIRECTIVE 2011/65/EC RoHS compliance   |
| REACH   | Compliant   |

1) Designed to support Type B and Type BF Applied Part End Product Requirements

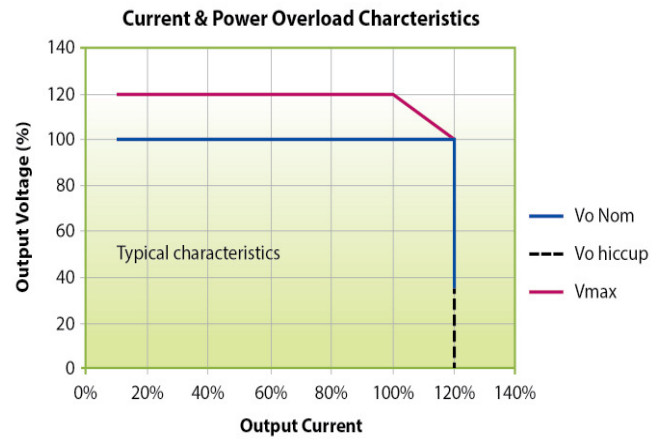
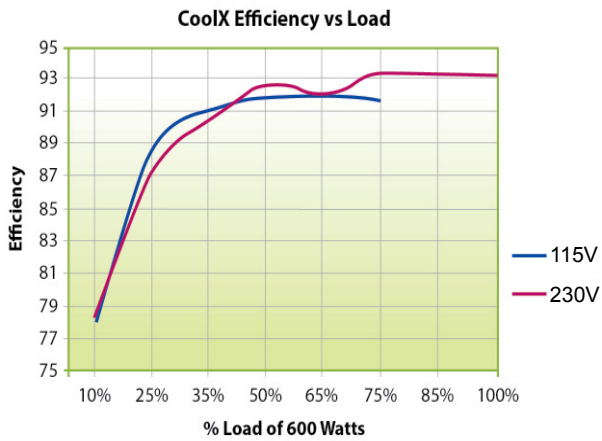
| MECHANICAL DATA                     |  |   |
|-------------------------------------|--|---|
| Parameter                           | Description                            |   |
| Dimensions (L x W x H)              | L x W x H                              | 215.9mm x 114.3mm x 39.1mm 4.5" x 8.5" x 1U   |
| Weight                              | Nominal Weight: CoolPac + 4 x CoolMods | 1Kg   |
| Connectors                          | Description                            | Mating Connectors (if applicable)   |
| AC/DC input terminal block          | TE 2-1437667-S, DINKLE DT-35-B07W-03   |   |
| AC/DC IEC input (Option)            | IEC 320 Inlet                          |   |
| Main DC output terminal block       | M4 Screws                              |   |
| System Signal Connector J1005       | Molex 87833-0831 8-way                 | Locking Molex 51110-0860; Non Locking Molex 51110-0850;<br>Crimp Terminal: Molex p/n 50394 or Molex 51110-0856 which includes Locking Tab & Polarization Keying |
| Output Signal Connectors J1001-1004 | Molex 87833-0631 6-way                 | Locking Molex 51110-0660; Non Locking Molex 51110-0650;<br>Crimp Terminal: Molex p/n 50394 or Molex 51110-0656 which includes Locking Tab & Polarization Keying |
| Output Sense Connectors J3          | JST-S2BPH-K(LF)(SN)                    | JST PHR2. Crimp Terminal JST BPH-002T-P.0.5S or SPH-002T-P.05S  |
| Auxiliary Output Connector J1       | Molex 1041880210 2pin                  |   |

## CoolX Mechanical Drawings

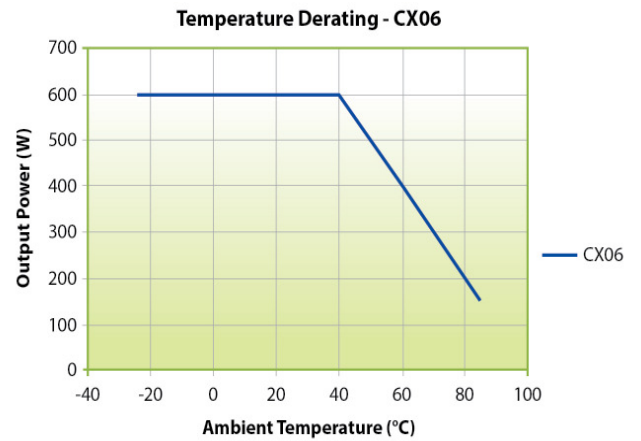
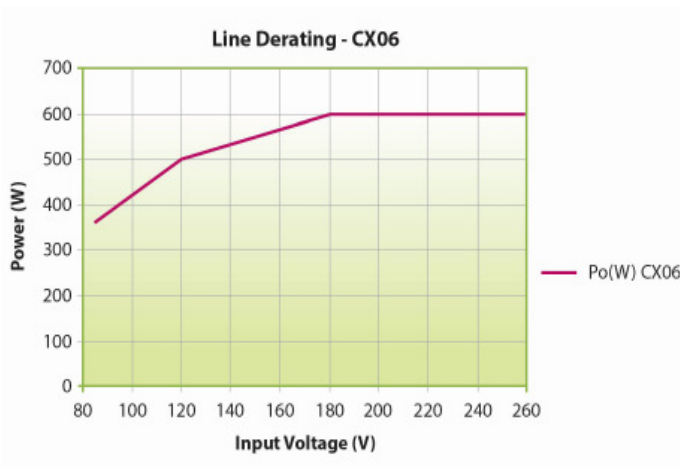


CoolX can be mounted on its base, vertically or on its side. CoolX can also be mounted on the Excelsys DIN Rail accessory (Z744).

## CoolX 600 Efficiency, Derating and Power Limit Curves

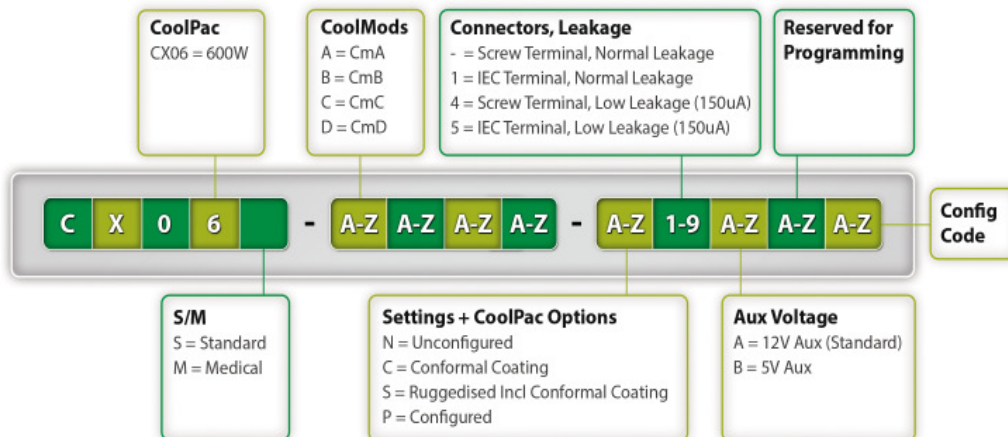


## CoolX Derating



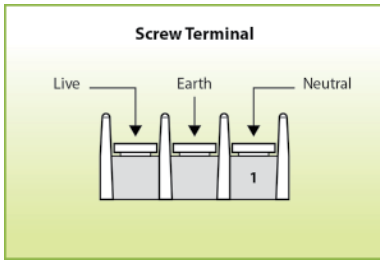
2) Enhanced thermal performance with system fans & base plate cooling. Consult Excelsys for details.

## Configuring Your CoolX

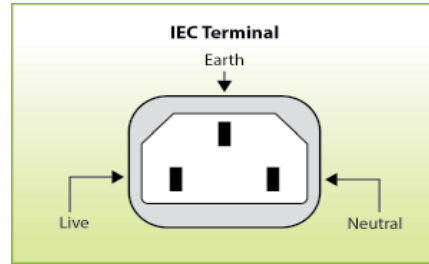


## CoolX Connectors

### Input Connectors



Standard (Screw Terminal)



Option 1 (IEC Terminal)

### CoolPac Connectors

#### J1005 - System Signal Connector

- |                      |               |
|----------------------|---------------|
| 1 - COMMON           | 5 - PG GLOBAL |
| 2 - SCL (PMBUS CLK)  | 6 - NU        |
| 3 - CONTROL          | 7 - OTP       |
| 4 - SDA (PMBUS DATA) | 8 - AC FAIL   |



#### J1011 - PMBus Address Header

- |             |              |
|-------------|--------------|
| 10 - COMMON | 9 - ADDR_3   |
| 8 - COMMON  | 7 - ADDR_2   |
| 6 - COMMON  | 5 - ADDR_1   |
| 4 - COMMON  | 3 - ADDR_0   |
| 2 - COMMON  | 1 - PRG_DATA |

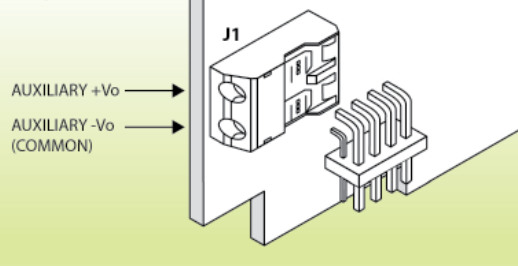


#### J1001, J1002, J1003 & J1004 - Module A, B, C & D Signal Connectors

- |              |              |              |              |
|--------------|--------------|--------------|--------------|
| <b>J1001</b> | <b>J1002</b> | <b>J1003</b> | <b>J1004</b> |
| 1 - COMMON   | 1 - COMMON   | 1 - COMMON   | 1 - COMMON   |
| 2 - PG1      | 2 - PG2      | 2 - PG3      | 2 - PG4      |
| 3 - COMMON   | 3 - COMMON   | 3 - COMMON   | 3 - COMMON   |
| 4 - EN1      | 4 - EN2      | 4 - EN3      | 4 - EN4      |
| 5 - ITRIM1   | 5 - ITRIM2   | 5 - ITRIM3   | 5 - ITRIM4   |
| 6 - VTRIM1   | 6 - VTRIM2   | 6 - VTRIM3   | 6 - VTRIM4   |

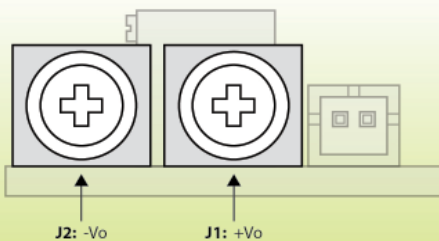


#### J1 - Auxiliary Output Connector



### CoolMod Connectors

#### J1 & J2 - Output Terminals



#### J3 - Sense Connector

