



APPLICATIONS

- Industrial equipment
- Telecommunications
- Test and measurement
- Automation
- Peripherals
- Audio/broadcast
- Linear and rotary motion



Rear Module Connection Area



Supply Front View

FEATURES

- Standard output voltages of 2.2 to 51 VDC
- Typical efficiencies up to 86%
- Extra-Low 1U profile: 1.6 inch
- High power density design of 17 Watts/cubic inch
- 1 to 6 isolated outputs with full user configurability
- Power Factor Correction (PFC) IEC 61000-3-2 compliant
- 1200W @90Vac or 1500W @180Vac of total output power
- Zero-load operation
- Single-wire current sharing
- Universal input AC range
- Individual control signals on each module

Figure 1. LPM615 Expanded Views

1. Description

The LPM615 Series is a modular 1500-watt AC-DC power supply that provides a market-leading power density of 17 watts per cubic inch and has an extra low 1U profile. The LPM615 offers the flexibility of a modular architecture and the combination of: high efficiency and high power density.

Designed for use where a unique set of voltage and current requirements are needed, the supply's six slots can be configured with PCB-based output modules to deliver up to 6 outputs. The LPM output modules operate in any chassis position and can provide up to 1500 watts total power from a 180 VAC input and 1200 watts from a 90 VAC input. Forced-air cooling with airflow direction from front to back is provided by an internal fan.

For LPM615 supplies using less than the six-slot capability, blanking plates are installed for safety purposes and to optimize airflow within the chassis. The supplies are pre-set with default output module settings or with the customer's desired output settings prior to delivery. The LPM615 chassis can be populated with the output modules listed in *Table 1*.

Table 1. Module Selection

| MODULE | NO. OF SLOTS REQUIRED | FACTORY-SET SINGLE-OUTPUT (VDC) | MODULE ADJUSTABLE RANGE (VDC) | OUTPUT CURRENT (MAX AMPS) | OUTPUT POWER (MAX WATTS) |
|--------|-----------------------|---------------------------------|-------------------------------|---------------------------|--------------------------|
| A | 1 | 5 | 2.2 to 5.2 | 50 | 250 |
| B | 1 | 12 | 5.2 to 15 | 20 | 250 |
| C | 1 | 24 | 15 to 32 | 10 | 250 |
| D | 1 | 48 | 32 to 51 | 8 | 250 |
| 0 | 1 | Blank Panel Slot Cover | | | |

NOTE: To determine your desired power supply's part number, please refer to *Figure 2* for a detailed part number description. Use the LPM615 Product Configurator located in the Modular Section on our web site, or use our contacts page at <http://www.power-one.com/chassis-mount/contacts.html> to locate a contact or distributor for further assistance.

1.1 Output Voltage and Current Limit Adjustments

Each LPM615 module's output voltage and current limit is adjustable by means of a trimmer located on the module and accessible through the adjustment holes located on the bottom of the power supply (see *Figure 10*).

1.2 Parallel Connections

Depending on certain situations where voltage and/or current requirements exceed one module's capability, the configurator will process a solution using parallel connections. Paralleling busbars are available to make the connections requiring higher current needs. For proper current sharing function it is necessary to interconnect Current Share pins of all modules by signal wires. For more details read the *Output Signal Connector* and *Accessories* section.

2. Part Numbering and Ordering Information

2.1 Chassis Identification Numbering -

First left-to-right sequence of the part number (6 characters)

- LPM615...Low Profile Modular 6-slot, 1500W, with single-phase AC input. (see *Figure 2*)

Note: Chassis and modules are RoHS-6 compliant.

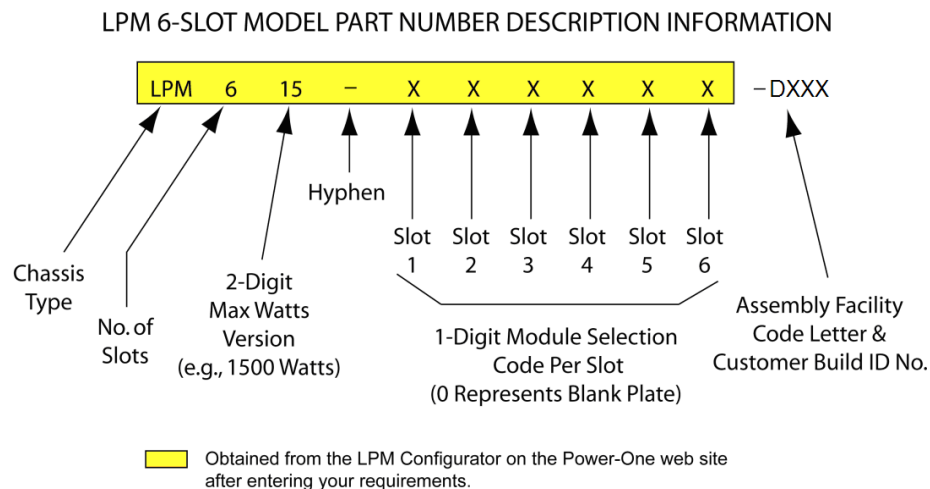


Figure 2. LPM 6-Slot Part Number Structure

Example: After entering your requirements, the web configurator optimized part number recommended could be: LPM615-0DABCD-DXXX which represents: Low Profile Modular Series with single-phase AC input, 6-slot, 1500W chassis with modules of: a blank panel, and modules D, A, B, C, and D in slots 1 to 6, respectively. Besides the blank panel in Slot 1, the example's modules in this case would represent desired DC output voltages as follows: Slot 2 = D for 48V, Slot 3 = A for 3.3V, Slot 4 = B for 12V, Slot 5 = C for 24V, and Slot 6 = D for 32V. Assembly facility code and customer build ID No. are established during actual power supply assembly.

3. Safety specifications

3.1 Safety approvals

- UL/CSA 60950-1, 2nd edition
- IEC 60950-1:2005
- CE Mark for LVD



3.2 Insulation Safety Ratings

| TEST POINTS | MINIMUM TEST VOLTAGE | INSULATION SAFETY RATING |
|-------------------|----------------------|--------------------------|
| Input-to-Chassis | 2120Vdc / min. 1s | Basic Insulation. |
| Input-to-Output | 4240Vdc / min. 1s | Reinforced Insulation. |
| Output-to-Chassis | 50Vdc / min. 1s | Functional Insulation. |
| Output-to-Output | 50Vdc / min. 1s | Functional Insulation. |

4. Environmental and Reliability specifications

4.1 Environmental specification

| PARAMETER | CONDITIONS / DESCRIPTION | MIN. | NOM. | MAX. | UNITS |
|-----------------------|---|------|------|------|-------|
| Cooling | Internal DC fan. Airflow is from the front of the supply and exhausts from the rear connector area. | | | | |
| Audible Noise | - Data sheet specification of fan: - Single unit in the system on a table at 1m distance | | | 70 | dBA |
| Operating Temperature | Full Power; derate linearly from 100% load @ 50 °C to 50% load @ 70 °C; cold start at -40 °C. | -10 | 25 | 50 | °C |
| Storage Temperature | | -40 | | 75 | °C |
| Humidity | 95% relative humidity @ 25 °C, non-condensing | | | | |
| Vibration | Operational: Sine 5Hz, 250Hz, 500Hz profile, 3 axes, 90min / axis. | | | 0.5 | Grms |
| | Non-operating: 20Hz, 350Hz, 500Hz profile, 3 axes, 10min / axis. | | | 3.13 | Grms |
| Shock | Non operational: 11ms, +/- 5 halfsinus, 3 axes, total of 10 shocks | | | 40 | Gpk |

4.2 Reliability

| PARAMETER | CONDITIONS / DESCRIPTION | MIN. | NOM. | MAX. | UNIT S |
|-------------------|---|-----------|------|------|--------|
| Calculated MTBF | According to MIL-HDBK217, Ground benign 30 °C | 100,000 | | | hours |
| Demonstrated MTBF | | 1,000,000 | | | hours |

5. Fault Protection

| PARAMETER | CONDITIONS / DESCRIPTION | MIN. | NOM. | MAX. | UNITS |
|-------------------------------|--|---|------|------|---------|
| Input Fuse | One fuse, non-user serviceable, located on line leg of AC input, Fast Acting type. | | 20 | | A |
| Inrush Current Limitation | Provided by NTC. | See <i>Input specification</i> section. | | | |
| Short Circuit Protection | Provided by Current Limit circuit | | | 150 | %Io_nom |
| Output Overvoltage Protection | Hiccup on 5 and 12V Modules Latching on 24V and 48V modules | 10 | | 25 | %Vo_nom |
| Over Temperature | OT with auto restart | | 60 | 65 | C |

6. EMC specifications

6.1 EMC Immunity

| PARAMETER | CONDITIONS / DESCRIPTION | CRITERION |
|------------------------------------|--|----------------------|
| Electrostatic Discharge (ESD) | IEC/EN61000-4-2; GR-1089 R2-1, R2-2, R2-3 Level 4: contact: ±8 kV, air: ±15kV | Perform, criterion B |
| RF Susceptibility | IEC/EN61000-4-3; Level 3: 10 V/m; 80 MHz to 1000 MHz; AM 80%, 1 kHz radiated; RF electromagnetic field | Perform, criterion A |
| Fast transient / burst | IEC/EN61000-4-4; Level 3; ±2 kV, 5 kHz electrical fast transient / burst immunity test | Perform, criterion B |
| Surge | IEC61000-4-5, level 3; line to earth: ±2kV, line to line: ±1kV surge immunity test | Perform, criterion B |
| RF conducted disturbance | IEC/EN61000-4-6; Level 3; GR-108; 10 V, 0.15 to 80 MHz, AM 80%, 1 kHz | Perform, criterion A |
| Voltage dips / short interruptions | IEC/EN 61000-4-11; Voltage dips, interruptions and variations. (Interpretation: dip below Vi min with Po nom = hold time 20 ms) | |
| | 1a: Dip 30%, 100 ms | Perform, criterion B |
| | 1a: Dip 30%, 200 ms | Perform, criterion B |
| | 1a: Dip 60%, 20 ms | Perform, criterion A |
| | 1a: Dip 60%, 100 ms | Perform, criterion B |
| | 1a: Dip >95%, 20 ms (interruption) | Perform, criterion A |
| | 1a: Dip >95%, 100 ms (interruption) | Perform, criterion B |

6.2 EMC Emission

| PARAMETER | CONDITIONS / DESCRIPTION | CRITERION |
|------------------------------------|--|--|
| Conducted Emission EN55022, FCC | EN55022, FCC - EN55022, and CISPR 22 Class B, FCC 47CFR15 unintentional radiators; standalone at all nominal input voltages and measured in Po1: 0, 50%, 100%; signal connections open | Class B; min. 3dB/μV margin |
| Radiated Emission EN55022, FCC | EN55022, FCC - EN55022, and CISPR 22 Class B, FCC 47CFR15 unintentional radiators; standalone at all nominal input voltages and measured in Po1: 0, 50%, 100%; signal connections open | Radiated Class A QSP / AVG min. 3 dB margin |
| Input Current Harmonics | EN61000-3-2, sine wave input, Class D; measured standalone at all Vin nominal at power levels between 0 and rated. | Pass |

7. Electrical specifications

7.1 Input Specifications

| PARAMETER | CONDITIONS / DESCRIPTION | MIN. | NOM. | MAX. | UNITS |
|-------------------------|--|------|---------|------------------|----------|
| Input AC Voltage Range | Continuous AC voltage Range Po=1200W from 90-264 VAC Po=1500W from 180-264 VAC | 90 | 115/230 | 264 | VAC |
| Input Overvoltage Range | For < 60ms at max. Power, no input OVP shutdown | | | 300 | VAC |
| Ground continuity | | | | 0.1 ¹ | Ohm |
| Leakage Current | @ 264 VAC, 60Hz, Standard Commercial | | | 1500 | μA |
| Frequency | AC line | 47 | 50/60 | 63 | Hz |
| Power Factor | Active PFC meets requirements of EN61000-3-2 at full load, 120/230VAC input | 0.98 | | | |
| Input Current | Steady state, 90 VAC at 1200W | | 15 | 18 | Amps rms |
| Inrush Current | 180 VAC, Max Power, 25 °C, acc. prETS300-132-1 | | 40 | 50 | A pk |
| | 230 VAC, Max Power, 25 °C, acc. prETS300-132-1 (Repeat rate >1min) | | | 60 | A pk |
| Efficiency ² | Vi = 230 VAC 100% loading | 85 | 86 | | % |
| | Vi = 230 VAC 30-80% loading | 83 | 85 | | % |
| | Vi = 115 VAC 100% loading | 83 | 85 | | % |
| | Vi = 115 VAC 30-80% loading | 80 | 83 | | % |

¹ For any combination of output modules, any valid load and voltage setting.

² Efficiency typical for standard configuration AABBCD and output voltage settings

7.2 Output Specifications

| PARAMETER | CONDITIONS/DESCRIPTION | MIN. | NOM. | MAX. | UNITS |
|------------------------------|--|------------------------------|------|--------------|----------|
| Output Power | One fan for internal cooling | | 1500 | | W |
| Output DC Voltages / Modules | All output modules work in any chassis position and are max 1U high PCB-based. | - | | | |
| Current Share | Active single-wire current share. Maximum difference in currents between two modules – percentage of one module nominal current. | | | ±10 | % |
| Line Regulation | Input from 90 to 264 Vac , 80% load | | 1.0 | | % Vo_nom |
| Load Regulation | From 0-100% load, Input >180Vac, Vo_nom | | 1.0 | | % Vo_nom |
| Thermal Drift | After 15 minute warm-up period | | 0.02 | | %/°C |
| Total Regulation | Variation of line, load and temperature drift | | 2.0 | | % Vo_nom |
| Output Adjustment Range | | See Module Selection Table 1 | | | |
| Dynamic Response | Deviation for 10-90% or 90-10% load changes at a rate of 1A/μs, (constant current mode, Vo reach 1% band around Voset) | | | 4% 2000μs | - |
| | Deviation for 50-100% or 100-50% load steps with 1A/μs rate. (constant current mode, Vo reach 1% band around Voset) | | | 3% 400μs | - |
| Output Ripple & Noise | BW = 20 MHz; Filter 10nF/10uF; over line and load, 25 °C | | | 1% of Vo_nom | mVpk-pk |
| CM Noise | Output to chassis, over line and load (Measured across 50 Ohms, with 10μH / 10nF in parallel) | | 220 | 500 | mVpp |
| Overshoot | Output voltage overshoot at turn-on | | 4 | | % Vo_nom |
| Turn-On Characteristics | Turn ON at minimum and nominal output current | Monotonous characteristic | | | - |
| Turn-Off Characteristics | Turn OFF at minimum and nominal output current | Monotonous characteristic | | | - |
| Turn-On Time | Time required for output within regulation after initial application of AC input | | | 1.5 | s |
| | Time required for output within regulation after removing inhibit | | | 100 | ms |
| Hold-up Time | Vo is required to stay within 95% regulation after AC is removed. Measured from the last AC peak, VAC min and full load. | 20 ³ | | | ms |
| Remote Sense | Total compensation for cable losses | | 250 | 500 | mV |

³ 10ms for 48V module “D”

7.3 Input Signal, Features and Indicators description

| Signal Name | Pin | Description |
|-------------------------------------|---------------|---|
| Standby Output - 5V - | D4, C4, B4 | Output present when voltage of AC line is over 90Vac. Standby nominal voltage is 5.0V, nominal current is 1.0A. Current protected output over point 1.5A. When Standby output is shorted, the primary LED indicators are OFF. Pin referenced to logic return RTN_D. |
| Input AC good - PFAIL - | D2 | Open Collector output pin with 20mA pull-down capability referenced to logic return RTN_D. PFAIL OPEN OR HIGH state indicates the warning that the input has failed 5ms before the output goes below the lower regulation limit. PFAIL will turn-off the green Input OK LED. PFAIL LOW state indicates that the input voltage is within the operation range. The FAIL condition occurs when the input voltage falls below min. 70Vac and remains until the input voltage reaches max. 90Vac. |
| Fan Fail indication - FAN_FAIL - | C3 | Open Collector output pin with 20mA pull-down capability referenced to logic return RTN_D. FAN_FAIL OPEN OR HIGH state indicates the fan fail. A fan fail will turn-off the green FAN OK LED. FAN_FAIL LOW state indicates normal fan operation. |

7.4 Output Signal, Features and Indicators description

| Signal Name | Pin | Description |
|-------------------------------------|-----|--|
| Output Good indication - PG_HI - | 5 | Open collector output with 5mA pull-down capability protected by 5.1V zener diode. Referenced to PG_LO. PG_HI OPEN OR HIGH state indicates that the module output voltage is below lower regulation limit. A PG_HI fail state turns the GREEN DC OK LED to RED. PG_HI LOW state indicates that the module output voltage is above the lower regulation limit. |
| Output Enable function - EN_HI - | 6 | Input internally pulled up and protected by 5.1V zener diode. Pin sourcing capability is 2mA referenced to EN_LO. EN_HI OPEN OR HIGH state ENABLES the module output. EN_HI LOW state INHIBITES the module output. |
| Positive sense wire - VS+ - | 1 | Output voltage sense wire. Internally connected to Vout+ via 51 Ω. It is recommended to connect sense wire at positive load point. |
| Negative sense wire - VS- - | 3 | Output voltage sense wire. Internally connected to Vout- via 51 Ω. It is recommended to connect sense wire at negative load point. |
| Current share - CS - | 4 | Common wire for parallel connected modules to achieve proper current sharing between the modules. Referenced to PG_LO or EN_LO. Interconnect CS pin on all parallel working modules. Active current share pin enables control of output voltage. Pulling-up this pin to 5V is possible to increase the output voltage. Pull-down of this pin has no effect. Voltage on this pin is 3.0V at nominal module current. |

7.5 Visual Alarms description

| Alarm Name | LED position | Description |
|---------------|---|---|
| Input AC good | Front panel – down (see figure 6) | ON state LED indicates operation within specified input voltage range. GREEN LED indicator goes to an OFF condition on PFAIL signal failure state. |
| Fan Fail | Front panel – up (see figure 6) | ON state LED indicates normal fan operation. GREEN LED indicator goes to an OFF condition on FAN_FAIL signal failure state. |
| Output Good | Module connector side (see figure 7) | GREEN LED indicates that module output voltage is over minimum regulation limit. GREEN LED indicator goes to RED on PG_HI signal failure state. |

8. Connector Details

8.1 Input Connector Information

LPM615 input connector pinout refer to *Figure 4* and *chapter 8.2 and 8.3*.

Input connector type: FCI 51939-313.

Note: See chapter *10.1 Mating Connections and cables* for Input cable information.

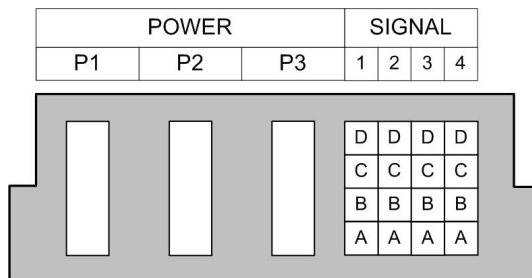


Figure 4. LPM615 Input Connector Pinout View

8.2 Input Connector - Power Pinout

| Signal Name | Pin # | Type | V max I max |
|-------------|-------|----------------------|------------------|
| AC Line | P1 | Input Power AC Fused | 264Vms 18Arms |
| AC Neutral | P2 | Input Power AC | |
| Chassis | P3 | Earth / Chassis | - |

8.3 Input Connector - Signal Pinout

| Signal Name | Pin # | Type | Signal reference | Low level High level | V max I max |
|-------------|-------|---------------------------|------------------|-------------------------|------------------|
| N/C | A1 | - | - | - | - |
| N/C | A2 | - | - | - | - |
| RTN_D | A3 | Logic Reference Potential | - | - | - |
| N/C | A4 | - | - | - | - |
| N/C | B1 | - | - | - | - |
| N/C | B2 | - | - | - | - |
| RTN_D | B3 | Logic Reference Potential | - | - | - |
| 5V | B4 | Aux Output | RTN_D | - | 5.0Vdc 1.0Adc |
| N/C | C1 | - | - | - | - |
| N/C | C2 | - | - | - | - |
| FAN_FAIL | C3 | Open Collector Output | RTN_D | <400mV@ 20mA Pull up | - 20mA |
| 5V | C4 | Aux Output | RTN_D | - | 5.0Vdc 1.0Adc |
| N/C | D1 | - | - | - | - |
| PFAIL | D2 | Open Collector Output | RTN_D | <400mV@ 20mA Pull up | - 20mA |
| RTN_D | D3 | Logic Reference Potential | - | - | - |
| 5V | D4 | Aux Output | RTN_D | - | 5.0Vdc 1.0Adc |

8.4 Output Connector Information

The LPM615 output connector (refer to *Figure 5*) provides signal information across its 8-pin output. Refer to *chapter 8.6* for pinout details.

Output Signal connector type: JST-S08B-PUDSS-1

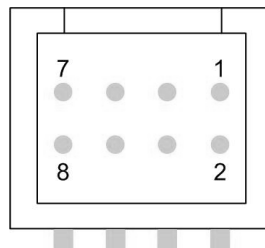


Figure 5. LPM615 Module Output Signal Connector Pinout

8.5 Module Output Bus-Bar Pinout

| Signal Name | Pin # | Type | Signal reference | Low level High level | V max I max |
|-------------|-------|-----------------|------------------|-------------------------|------------------------------|
| Vout+ | Vout+ | Output Power DC | Vout- | - | See Module Selection Table 1 |
| Vout- | Vout- | Output Power DC | - | - | See Module Selection Table 1 |

8.6 Module output signal connector pinout

| Signal Name | Pin # | Type | Signal reference | Low level High level | V max I max |
|-------------|-------|--|------------------|-------------------------|----------------|
| VS+ | 1 | Output voltage sense wire. Internally connected to Vout+ via 51 Ω. | Vout+ | - | 0.5V 10mA |
| PG_LO | 2 | PG_HI reference internally connected to signal ground. | - | - | - 10mA |
| VS- | 3 | Output voltage sense wire. Internally connected to Vout- via 51 Ω. | Vout- | - | 0.5V 10mA |
| CS | 4 | Active Current Share pin. | PG_LO / EN_LO | - | 5V - |
| PG_HI | 5 | Open collector output protected by 5.1V zener diode. | PG_LO / EN_LO | <400mV@5mA Pull up | - 5mA |
| EN_HI | 6 | Input internally pulled up and protected by 5.1V zener diode. | PG_LO / EN_LO | <400mV@2mA Open | - 2mA |
| EN_LO | 7 | EN_HI reference internally connected to signal ground. | - | - | - 10mA |
| N/C | 8 | - | - | - | - |

9. Mechanical Drawings

- **Overall Dimensions:** 11.0" x 5.0" x 1.6" (279.4 x 127 x 40.64mm)
- **Weight:** 2.5 kg

All drawing dimensions are shown in millimeters, unless otherwise noted.

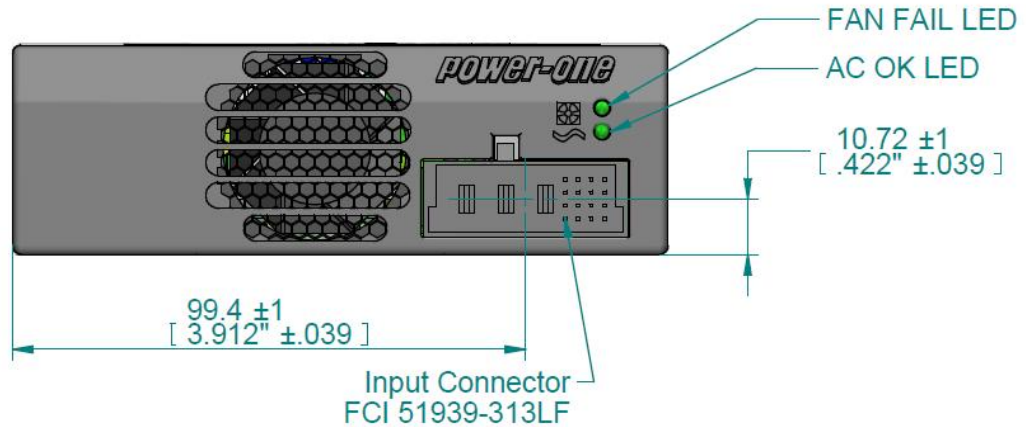


Figure 6. Front View

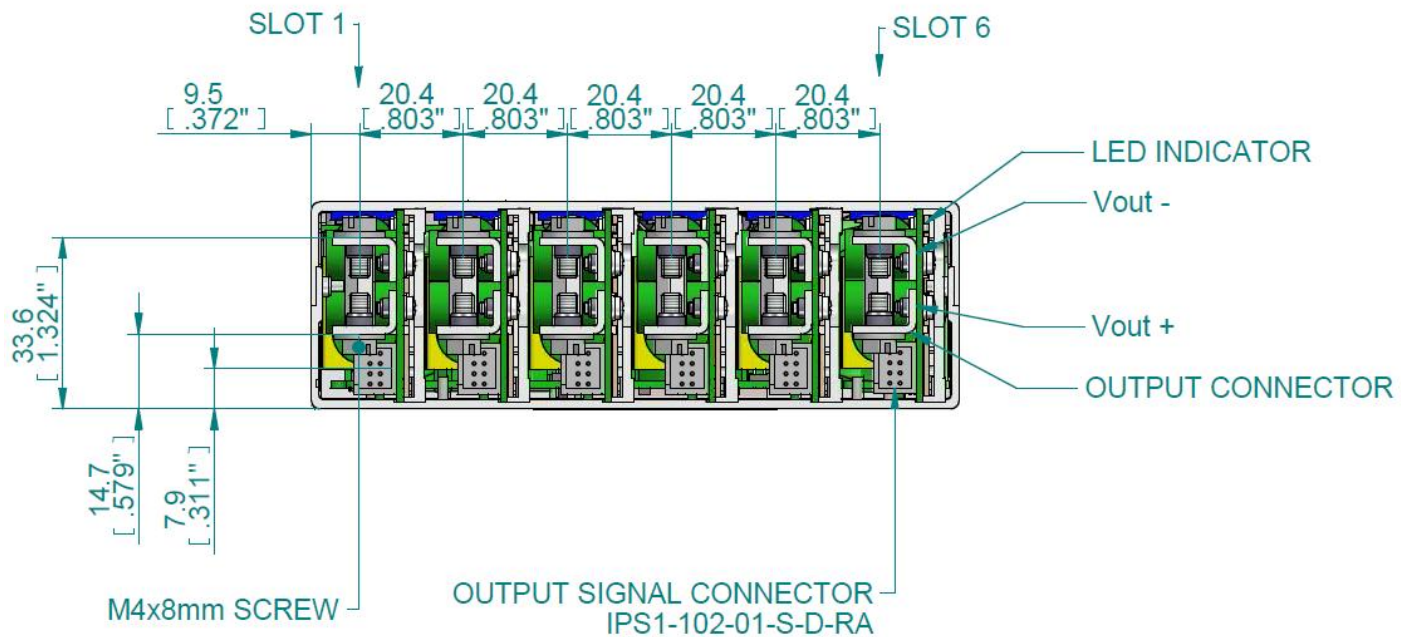


Figure 7. Rear View

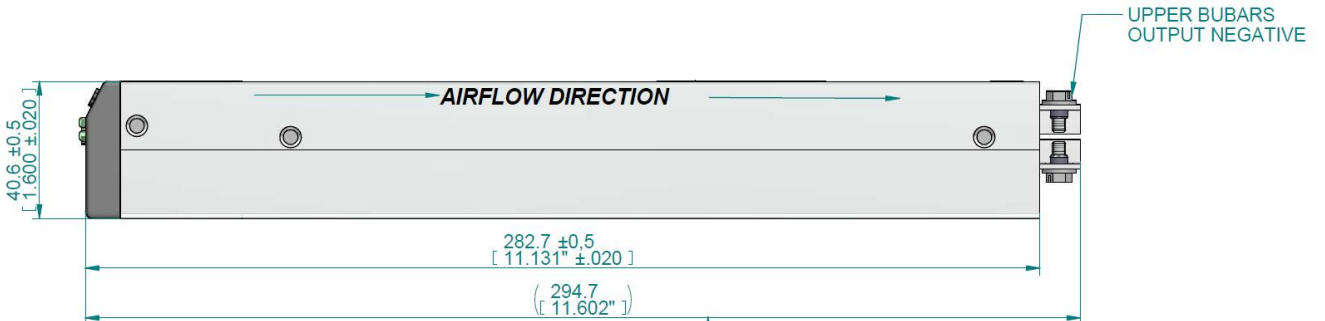


Figure 8. Side View

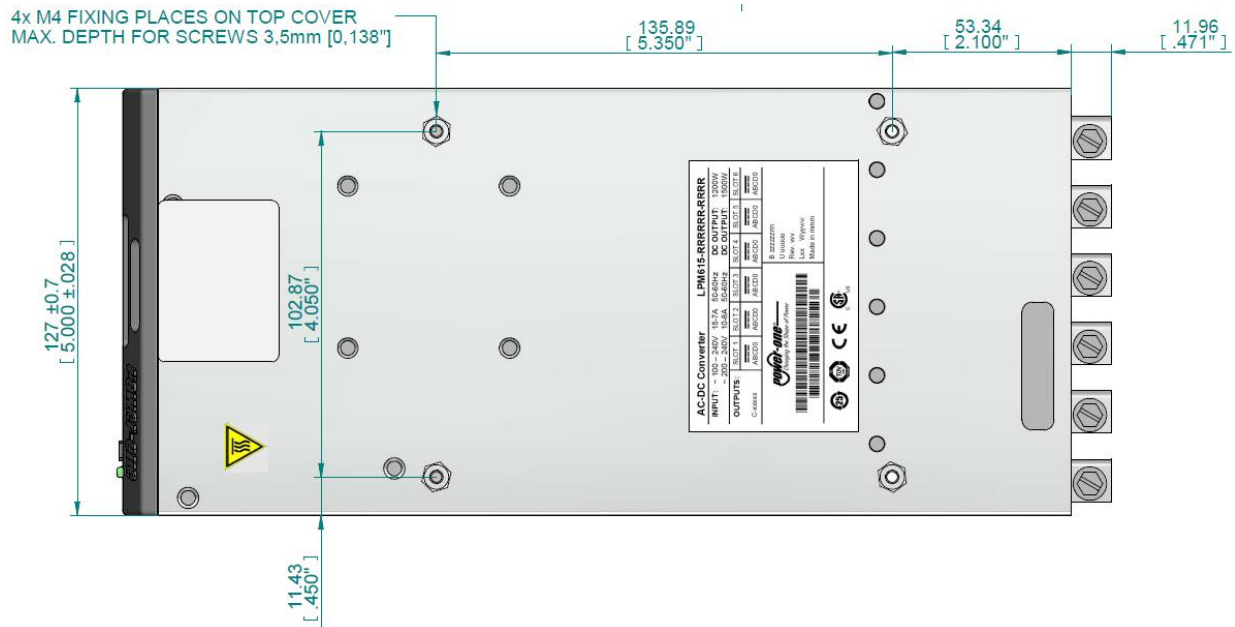


Figure 9. Top View

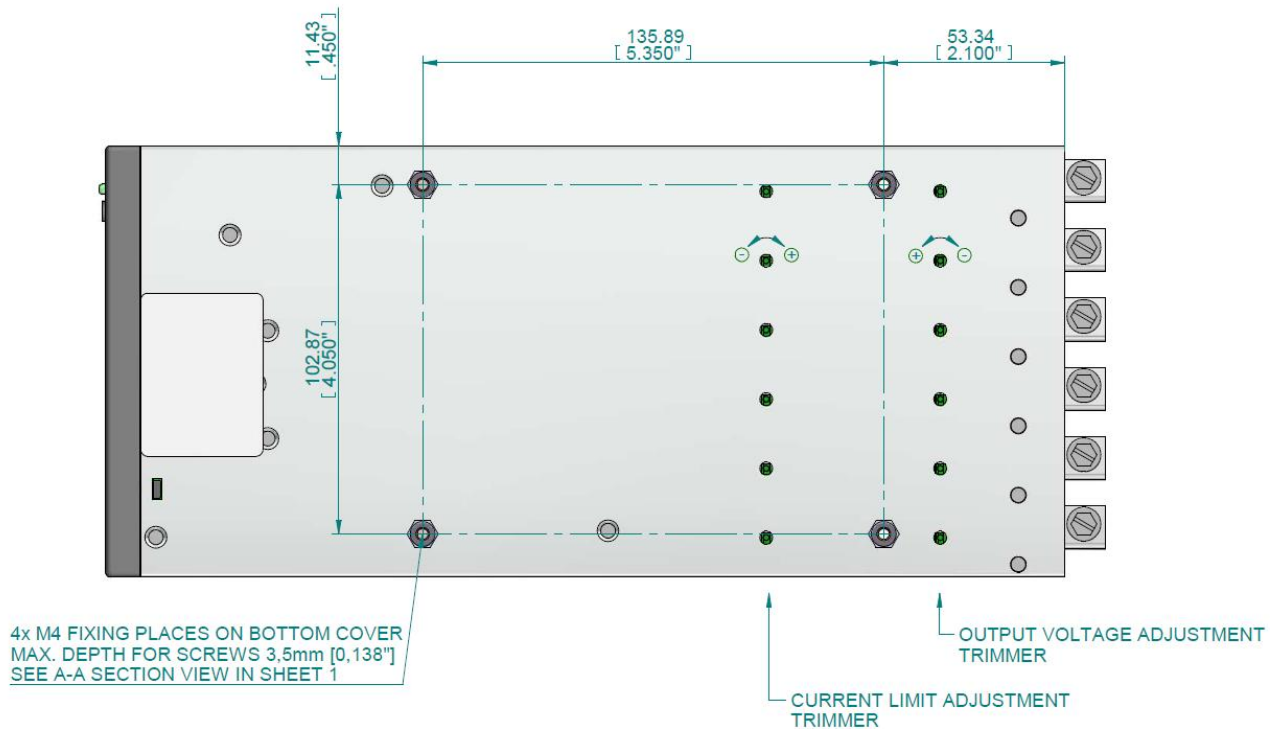


Figure 10. Bottom View

10. Accessories

10.1 Mating Connections and Cables

All the power and signal cables and mating connectors are not included in the LPM615 standard package. These all needs to be extra ordered.

- Input Power and Signal cable: Power-One accessory LPM000-LEAD-01. See figure 11.
- Output Signal cable: Power-One accessory LPM000-LEAD-02. See figure 12.
- Output signal mating connector: JST-PU DP-08-S, JST-SPUD-001T-P0.5
- Output Power Cable: 14AWG – 10AWG depend on the output current, min. 85°C thermal class



Figure 11. LPM000-LEAD-01 Input Lead

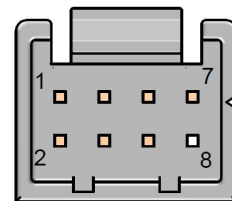
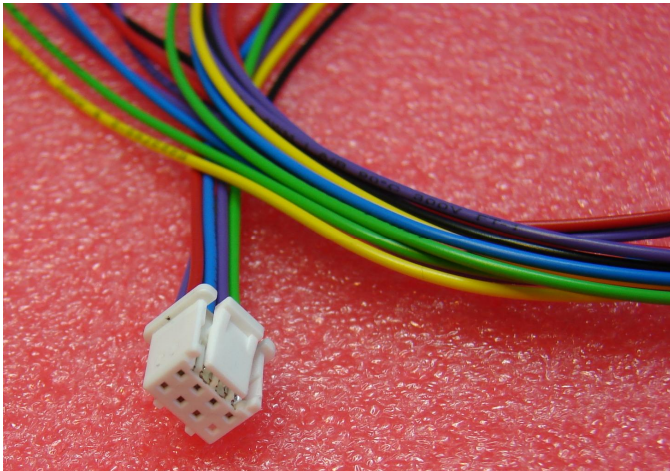


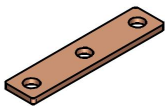
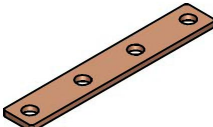
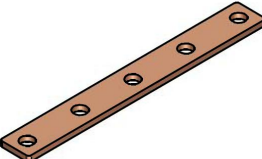
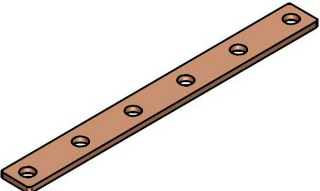


Figure 12. LPM000-LEAD-02 Output Lead

10.2 Signal Output wire colors

| Pin # | Signal Name | Wire Color |
|-------|-------------|------------|
| 1. | VS+ | Red |
| 2. | PG_LO | Violet |
| 3. | VS- | Blue |
| 4. | CS | Yellow |
| 5. | PG_HI | Violet |
| 6. | EN_HI | Black |
| 7. | EN_LO | Green |
| 8. | N/C | - |

10.3 Paralleling Busbars

| Item | Description | Model |
|----------------|--|---|
| LPM000-BBAR-01 | Busbar with 1 opening for module connection and one for cable connection screw M6x8mm, max. 250A. ⁴ |  |
| LPM000-BBAR-02 | Busbar for parallel connection of two modules. |  |
| LPM000-BBAR-03 | Busbar for parallel connection of three modules. |  |
| LPM000-BBAR-04 | Busbar for parallel connection of four modules. |  |
| LPM000-BBAR-05 | Busbar for parallel connection of five modules. |  |
| LPM000-BBAR-06 | Busbar for parallel connection of six modules. |  |

⁴ For load current over 250A connect two of LPM000-BBAR-01 and two cables.

The example of LPM615AAAAA-DXXX assembly configuration is on the *Figure 13*.

Note that for 300A output current this is the most preferred arrangement to achieve best thermal flow. Connect two power cables for each pole. Use 105°C thermal class insulation.

Another example of configuration LPM615BBBCCD-DXXX is shown on *Figure 15*.

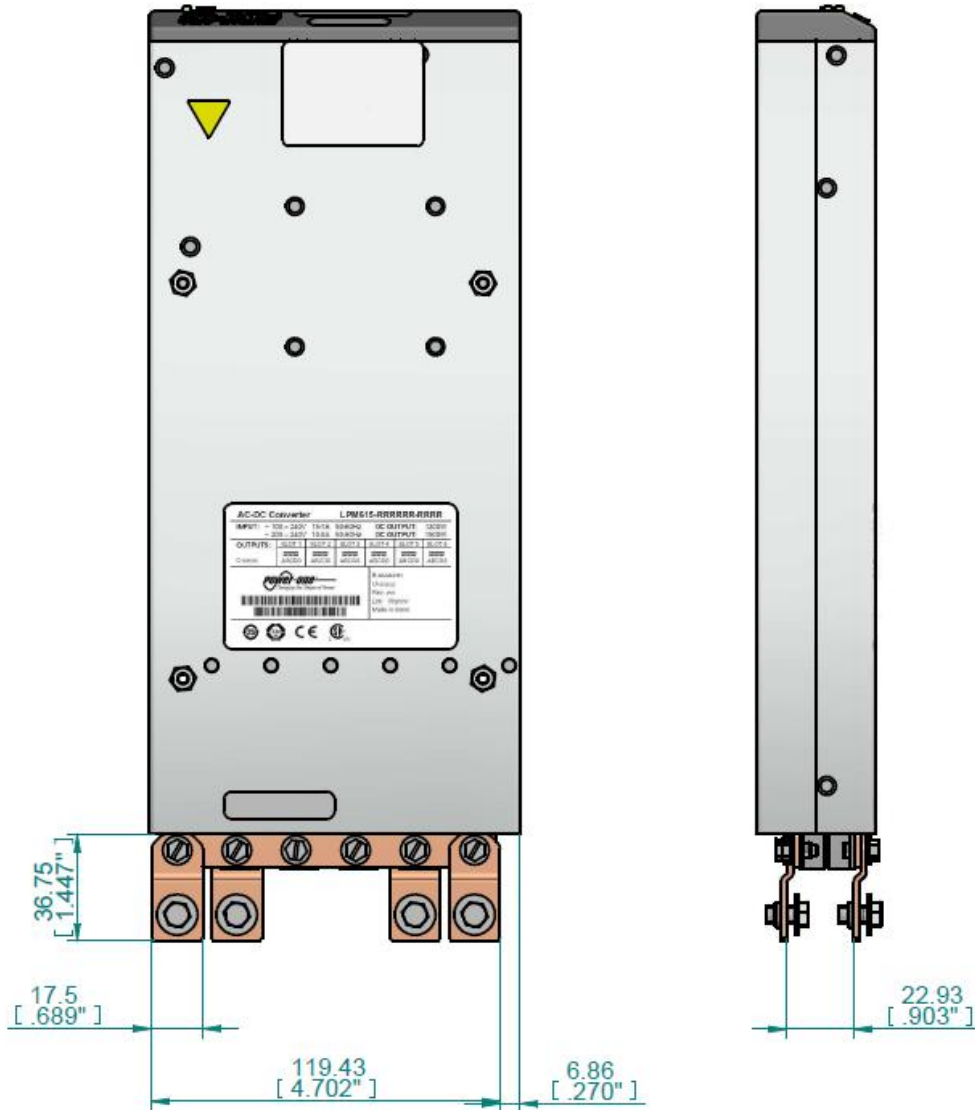


Figure 13. LPM615-AAAAAA-DXXX parallel configuration

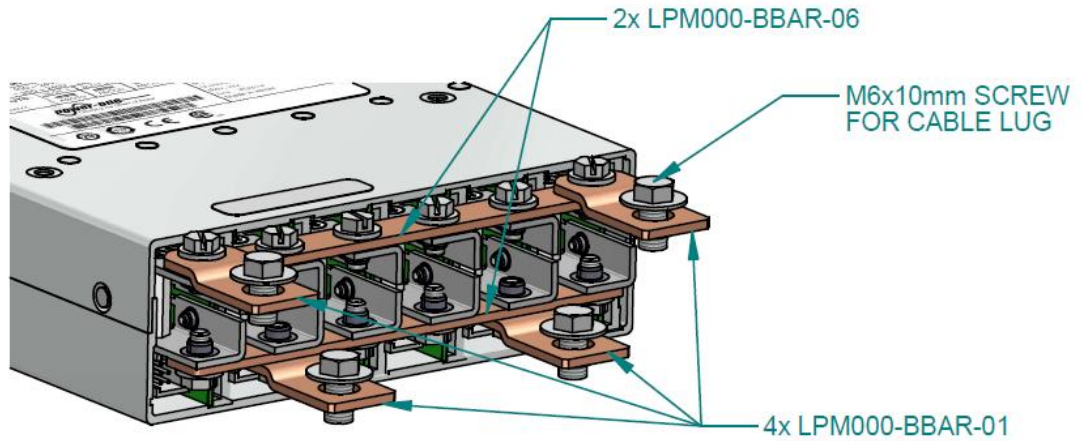


Figure 14. LPM615-AAAAAA-DXXX Output Busbars arrangement

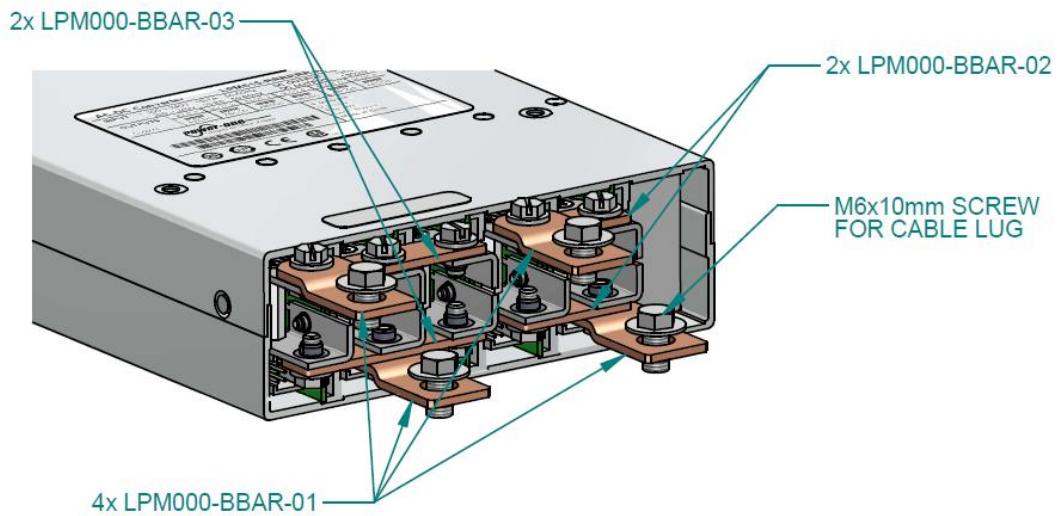


Figure 15. LPM615-BBBCCD-DXXX Output Busbars arrangement

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