# Features

# Regulated Converter

- 400/450 Watt convection cooled (115/230VAC)
- 600 Watt forced air or peak power
- 5VSB Output
- Redundant operation; active current sharing
- Remote sensing, CTRL ON/OFF, PMBus™
- IEC60601-1 2x MOPP insulation, BF-ready

RECOM

AC/DC Converter

# RACM600-L

## 600 Watt 7.7” x 4” Open Frame Single Output

3 YEAR warranty


## Description

RACM600-L/OF Series AC/DC power supply units are designed for operation in natural convection and in systems with certain airflow ventilation to deliver 400 to 600Watt output power. Safety approvals to Medical IEC 60601-1-2 and to IT and industrial IEC 62368 standards and operation with worldwide input voltage conditions from 80 to 275Vac in altitudes up to 5000m make these chassis mount units ideal for global use in medical, industrial or IT related automation processes. For enhanced reliability requirements of applications redundant operation is supported with active current sharing. An additional 5V Standby output powers housekeeping circuitry to control remote on/off and monitoring functions which are available via PMBus™ I²C interface. EN55032 class “B” EMC compliance is achieved without any external components which underlines the versatility of these power supplies.

## Selection Guide

| Part Number | Input Voltage Range [VAC] | Nom. Output Voltage [VDC] | Max. Output Current [A] | Max. Output Power [W] | Efficiency typ. (1) [%] |
|---|---|---|---|---|---|
| RACM600-24SL/OF | 80-275 | 24 | 25 | 600 | 93 |

**Notes:**

Note1: Efficiency is tested at 230VAC and full load at +25°C ambient

## Model Numbering

RACM600-24 SL/OF

- 600 — max. Output Power
- 24 — nom. Output Voltage
- SL — **S**ingle
- OF — Open frame package

## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

| BASIC CHARACTERISTICS | | | | |
|---|---|---|---|---|
| **Parameter** | **Condition** | **Min.** | **Typ.** | **Max.** |
| Nominal Input Voltage | 50/60Hz | 100VAC | | 240VAC |
| Operating Range (2, 3) | 47-63Hz<br>DC | 80VAC<br>120VDC | | 275VAC<br>300VDC |
| Input Current | 80VAC<br>120VDC | | | 9A<br>5.7A |
| Inrush Current | cold start at 25°C | | | 20A |
| Input Frequency Range | AC Input | 47Hz | | 63Hz |
| Minimum Load | | 0% | | |
| Power Factor | EN61000-3-2, Class A compliant | | 0.9 | |
| Start-up Time | MAIN ON<br>CTRL ON | | | 2.5s<br>150ms |
| Rise Time | | | | 150ms |
| Hold-up Time | | | 20ms | |
| Periodic and Random Deviation (PARD) | 20MHz BW, 10µF Tan. and 1µF MLCC | | | 1%p-p |

**Notes:**

Note2: The products were submitted for safety files at AC and DC-Input operation.

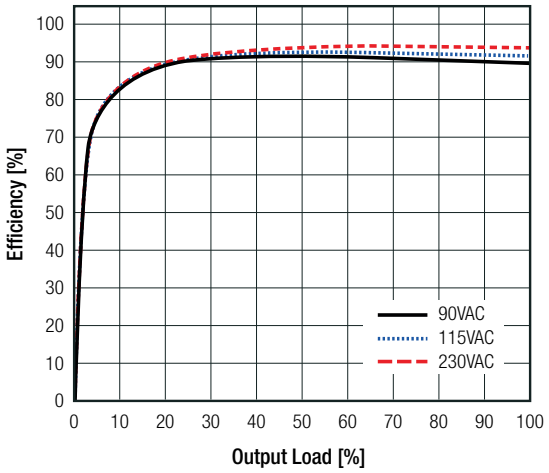
Note3: Refer to ***“Derating Graph”***

**continued on next page**

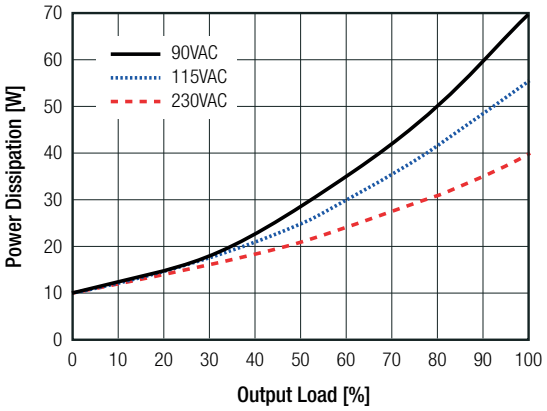
IEC/EN62368-1 pending
UL62368-1 certified
CSA/CAN C22.2 No. 62368-1 certified
ANSI/AAMI ES60601-1 pending
CSA/CAN C22.2 No. 60601-1:14 pending
IEC/EN60601-1 pending
EN55032 compliant
EN55024 compliant
EN60601-1-2 compliant
CB Report

## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

### Efficiency vs. Load




### Power Dissipation vs. Load




## ADDITIONAL FEATURES

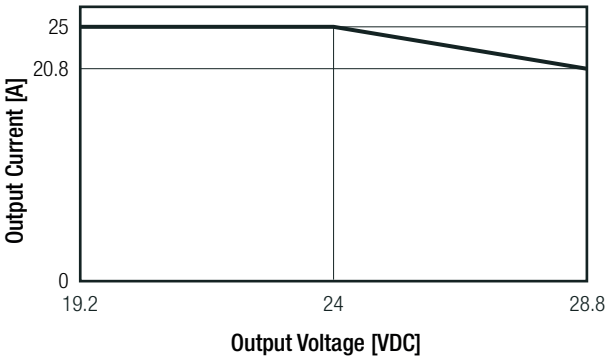
| Parameter | Condition | | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| ON/OFF CTRL<br>*(logic can be switched with PMBus™)* | CON3 | MAIN OUTPUT ON<br>MAIN OUTPUT OFF | CTRL (pin10) shorted to 5VSB_RTN (pin3,4,7) | | open |
| Output Voltage Adjustability (4) | on-board poti, refer to ***"Output Current vs. Output Voltage"*** | | 19.2VDC | | 28.8VDC |
| Remote Sense (5) | total voltage drop compensation for +Sense and -Sense connection | | | | 200mV |
| Power OK LED | LED = green | | turn ON as soon as PSU_GOOD Signal is set to high | | |

**Notes:**

Note4: By trimming up, decrease output power. By trimming down, do not exceed maximum continuous output current

Note5: Do not short or reversely connect +Sense to -Sense, this can cause damage to the supply

### Output Current vs. Output Voltage




## 5VSB OUTPUT (6)

| Parameter | Condition | Min. | Typ. | Max. |
|---|---|---|---|---|
| Nominal Output Voltage | | | | 5VDC |
| Max. Output Current | | | | 500mA |
| Max. Output Power | | | | 2.5W |
| Max. Capacitive Load | | | | 1000µF |
| Over Voltage Protection (OVP) | | | | 5.5-6VDC, latch off |
| Over Current Protection (OCP) | of rated $I_{OUT}$ | | | 1-1.3A, auto recovery |
| Short Circuit Protection (SCP) | | | | auto recovery |
| Over Temperature Protection (OTP) | | | | auto recovery |

**Notes:**

Note6: There is no galvanic isolation between AUX GND and Main Output GND. Regulations for 5VSB Output are stated under ***"REGULATIONS"***

## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

### REGULATIONS

| Parameter | Condition | Value |
|---|---|---|
| Output Accuracy (MAIN and 5VSB output) | | ±2.25% max. |
| Line Regulation (MAIN and 5VSB output) | low line to high line, full load | ±0.25% typ. |
| Load Regulation (MAIN and 5VSB output) | 0% to 100% load | 1.0% typ. |
| Dynamic Load Regulation | 50% step from 5% load (1A/µs), tested with 10µF Tan. and 1µF MLCC | 5.0% max. |

### PROTECTIONS

| Parameter | Type | | Value |
|---|---|---|---|
| Internal Input Fuse | DC input compliant, dual-fusing | | 2x T10A |
| Short Circuit Protection (SCP) | | | hiccup, auto recovery |
| Over Voltage Protection (OVP) | | | 30VDC - 35VDC, latch off |
| Over Voltage Category (OVC) | | | OVCII |
| Over Current Protection (OCP) | of rated $I_{OUT}$ | | 108-140%, auto recovery |
| Over Temperature Protection (OTP) | | | auto recovery |
| Isolation Voltage (safety certified) (7) | I/P to O/P (reinforced)<br>I/P and O/P to Case (basic) | 1 minute | 4kVAC (2MOPP)<br>1.5kVAC (1MOPP) |
| Insulation Grade | | | reinforced |
| Leakage Current Input to Earth GND | low line 132VAC , 63Hz | Normal condition | 150µA max. |
| | | Single Fault | 250µA max. |
| | high line 264VAC , 60Hz | Normal condition | 300µA max. |
| | | Single Fault | 500µA max. |
| Leakage Current Output to Earth GND | 264VAC , 63Hz | Normal condition | 60µA max. |
| | | Single Fault (neutral open) | 80µA max. |
| | | Single Fault (ground open) | 150µA max. |
| | | AC Back-drive Fault | 550µA max. |
| Class of Equipment | | | Class I |
| Medical Device Classification | according to IEC60601-1 | | designed to support Type BF applied part |

**Notes:**

Note7: For repeat Hi-Pot testing, reduce the time and/or the test voltage

### ENVIRONMENTAL

| Parameter | Condition | | Value |
|---|---|---|---|
| Operating Temperature Range | refer to ***"Derating Graph"*** | $T_{BASE}$ temperature | -20°C to +70°C |
| Operating Altitude (8) | according to 62368-1<br>according to 60601-1 | | 5000m<br>3000m |
| Operating Humidity | non-condensing | | 95% max. |
| Pollution Degree | | | PD2 |
| Vibration (non-operating) | 2.09Gr.m.s., 5Hz to 500Hz, 20 minutes per side (3 planes) | | according to IEC 60068-2-6 |
| Shock (non-operating) | 50G, 11ms, 3 shocks for each direction | | according to IEC 60068-2-27 |
| MTBF | according to Telcordia SR-332, Issue 3, 25°C ambient, 90% confidence level | | 500 x $10^3$ hours |
| Design Lifetime (capacitor) | nom. Vin, 80% load, 45°C ambient | | 87.6 x $10^3$ hours |

**Notes:**

Note8: Recognized by safety agency for safe operation up to 5000m. High altitude operation may impact the performance and lifetime
Ambient temperature decreases by 1°C per 305m altitude increase

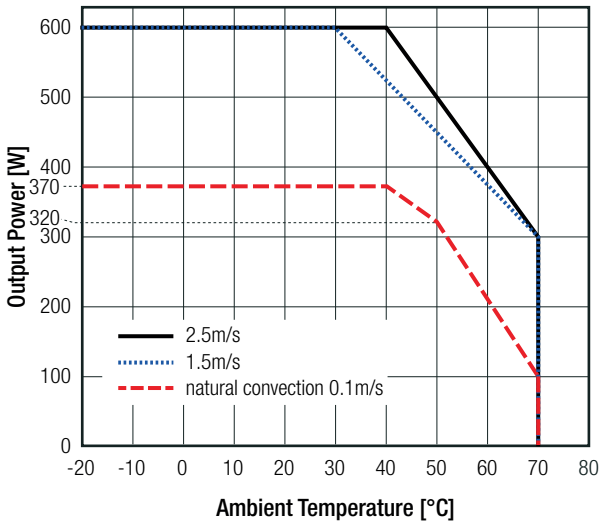
**continued on next page**

## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

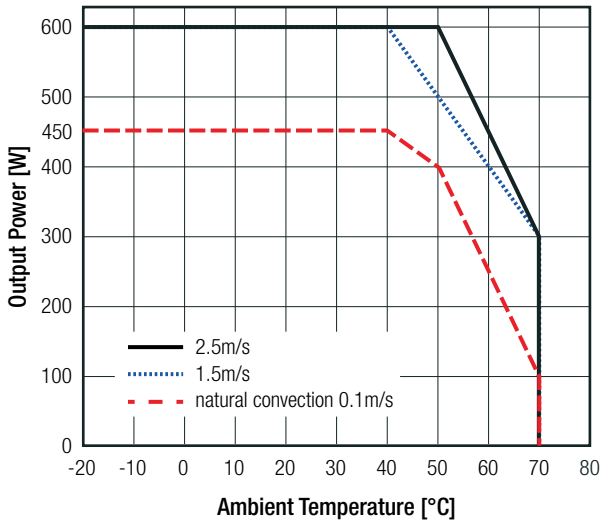
### Derating Graph

(@ Chamber, refer to ***"Mounting Orientations"*** for airflow direction)

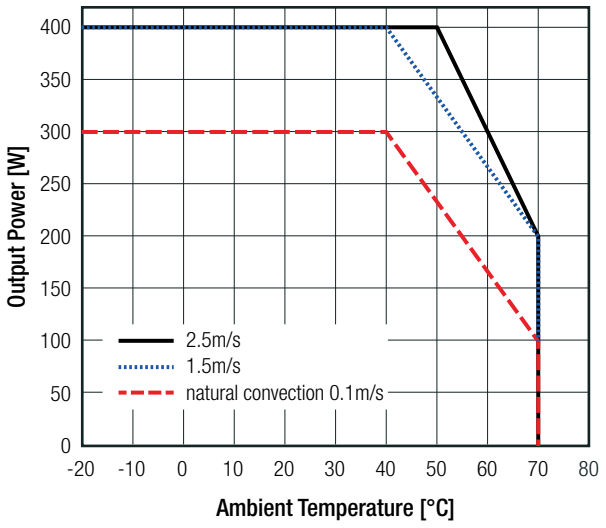
115VAC (±10%)




200-240VAC (±10%)




100VAC (±10%)




Output power derating for Line-input of less than 90VAC. Derate linearly from 100% at 90VAC to 80% at 80VAC to given thermal ratings

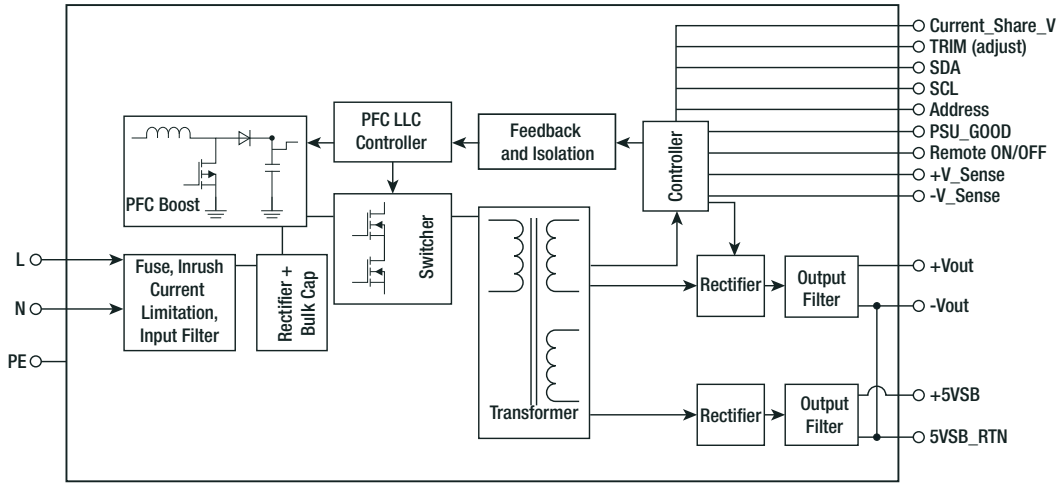
| SAFETY AND CERTIFICATIONS (DESIGNED TO MEET) | | |
|---|---|---|
| **Certificate Type (Safety)** | **Report Number** | **Standard** |
| Audio/video, information and communication technology equipment. Safety requirements (CB) | pending | IEC62368-1, 2nd Edition 2014 |
| Audio/video, information and communication technology equipment. Safety requirements (LVD) | pending | EN62368-1:2014 + A11:2017 |
| Audio/Video, information and communication technology equipment - Part1: Safety requirements | E224736-A6026-UL | UL62368-1:2014<br>CAN/CSA-C22.2 No. 62368-1:2014 |
| Medical Electric Equipment, General Requirements for Safety and Essential Performance | pending | ANSI/AAMI ES60601-1:2005A2:2010/(R)2012<br>CAN/CSA-C22.2 No. 60601-1:14, 3rd Edition |
| Medical electrical equipment Part 1: General requirements for basic safety and essential performance (CB Scheme) | pending | IEC60601-1:2005, 3rd Edition + AM1:2012 |
| Medical electrical equipment Part 1: General requirements for basic safety and essential performance | | EN60601-1:2006 + A1:2013 |
| RoHS2 | | RoHS 2011/65/EU |

continued on next page

## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

| EMC Compliance | Condition | Standard / Criterion |
|---|---|---|
| Electromagnetic compatibility of multimedia equipment – Emission Requirements | | EN55032:2015 |
| Information technology equipment - Immunity characteristics - Limits and methods of measurement | | EN55024:2010+A1:2015 |
| Medical electrical equipment Part 1-2: General requirements for basic safety and essential performance – Collateral Standard: Electromagnetic disturbances – Requirements and tests | | EN60601-1-2:2015 |
| ESD Electrostatic Discharge Immunity Test | Air: ±15kV<br>Contact: ±4,8kV | EN61000-4-2, Criteria A |
| Radiated, Radio-Frequency, Electromagnetic Field Immunity Test | level 3= 10V/m | EN61000-4-3, Criteria A |
| Fast Transient and Burst Immunity | level 4= ±4kV | EN61000-4-4, Criteria A |
| Surge Immunity | level 4= ±2kV DM, ±4kV CM | EN61000-4-5, Criteria A |
| Immunity to Conducted Disturbances, Induced by Radio-Frequency Fields | level= 3, 6Vrms in ISM band | EN61000-4-6, Criteria A |
| Power Magnetic Field Immunity | 30A/m | EN61000-4-8, Criteria A |
| Voltage Dips | 30%, 500ms<br>60%, 100ms<br>100%, 20ms | EN61000-4-11, Criteria A<br>EN61000-4-11, Criteria B<br>EN61000-4-11, Criteria A |
| Voltage Interruptions | 30%, 500ms<br>60%, 100ms<br>100%, 20ms<br>100%, 5000ms | EN61000-4-11, Criteria A<br>EN61000-4-11, Criteria B<br>EN61000-4-11, Criteria A<br>EN61000-4-11, Criteria B |
| Ring wave immunity test | level 3= 1kV DM, 2kV CM | EN61000-4-12, Class A |
| Voltage fluctuation immunity test for equipment with input current <16 A per phase | class 3 | EN61000-4-14, Class A |
| Limits of Harmonic Current Emissions | | EN61000-3-2:2014 |
| Voltage Fluctuations and Flicker in Public Low-Voltage Systems | | EN61000-3-3:2013 |

## BLOCK DIAGRAM



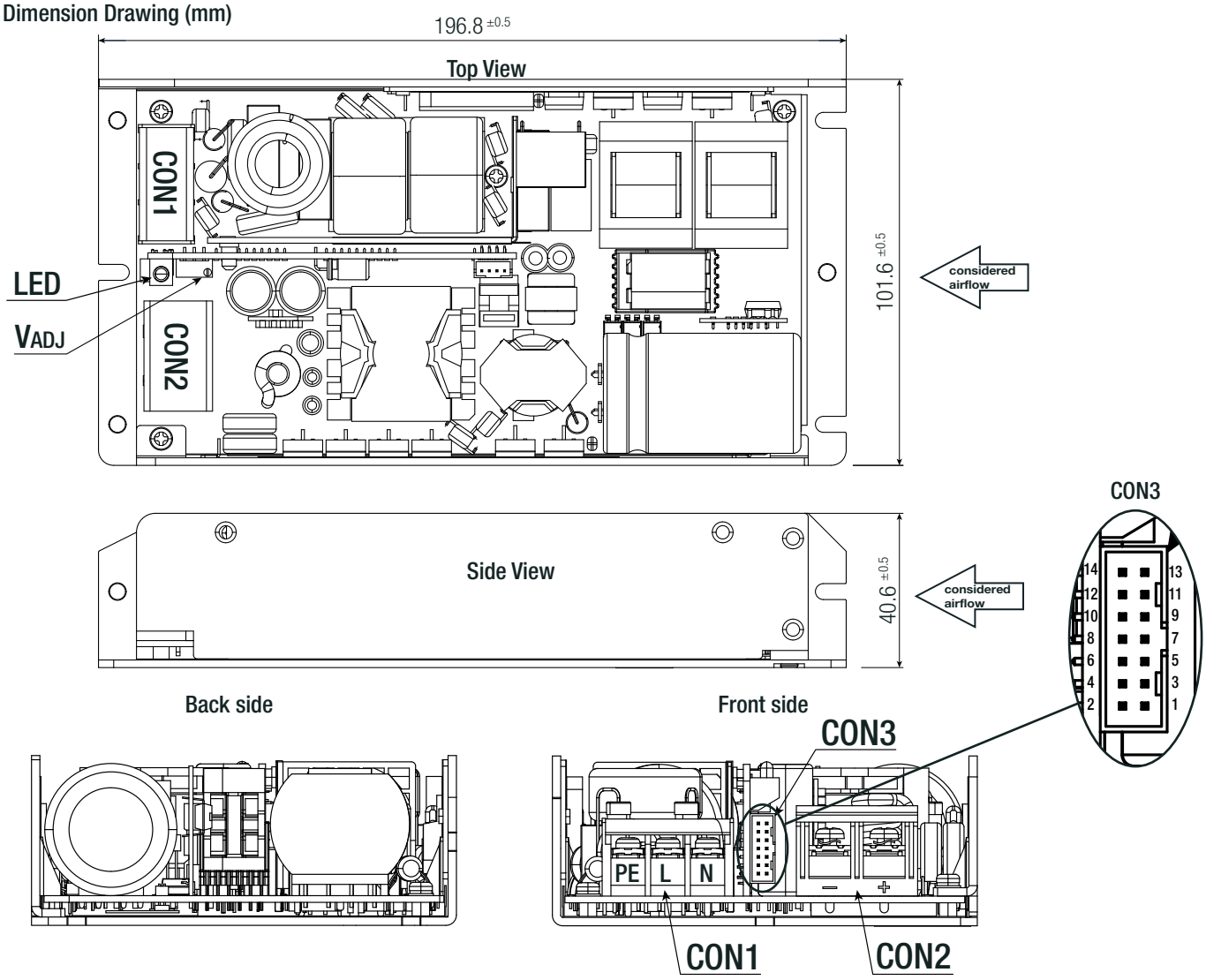

## DIMENSION AND PHYSICAL CHARACTERISTICS

| Parameter | Type | Value |
|---|---|---|
| Material | case/baseplate<br>PCB | aluminum<br>FR4 |
| Dimension (LxWxH) | | 196.8 x 101.6 x 40.6mm |
| Weight | | 1000g typ. |

continued on next page

## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

### Dimension Drawing (mm)




| Signal CON3 (Molex PCB Header 87833-1420) | | | |
|---|---|---|---|
| # | Function | # | Function |
| 14 | -Sense | 13 | +Sense |
| 12 | address | 11 | Current_share_V |
| 10 | Remote ON/OFF | 9 | PSU_GOOD |
| 8 | +5VSB | 7 | 5VSB_RTN |
| 6 | SDA | 5 | SCL |
| 4 | 5VSB_RTN | 3 | 5VSB_RTN |
| 2 | +5VSB | 1 | +5VSB |

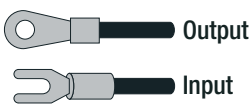
| Input Terminal Block CON1 (9) (M3.5 screws) Dinkle: DT-4C-B01W-03-GN) | |
|---|---|
| Function | AWG |
| PE | 12-18 |
| L (line) | 12-18 |
| N (neutral) | 12-18 |
| wire stripping length: 7-8mm<br>recommended tightening torque : 1.3Nm | |

| Output Terminal Block CON2 (9) (M4 screws) Dinkle: DT-7C-B01W-02-GN | |
|---|---|
| Function | AWG |
| -VOUT | 8-12 |
| +VOUT | 8-12 |
| wire stripping length: 10-11mm<br>recommended tightening torque 1.5Nm | |

| Compatible Connector CON3 |
|---|
| Housing |
| Molex 51110 Series or equivalent |
| Crimp Terminal |
| Molex 50394 Series or equivalent |

**Notes:**

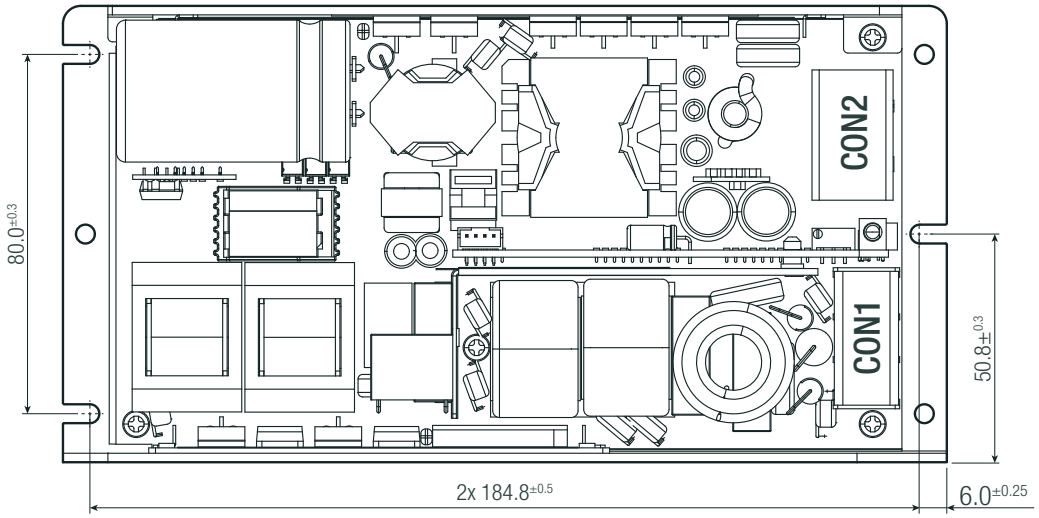
Note9: Use flexible cable with below lugs:

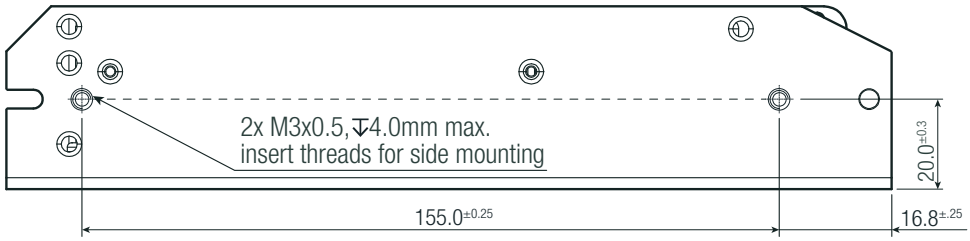


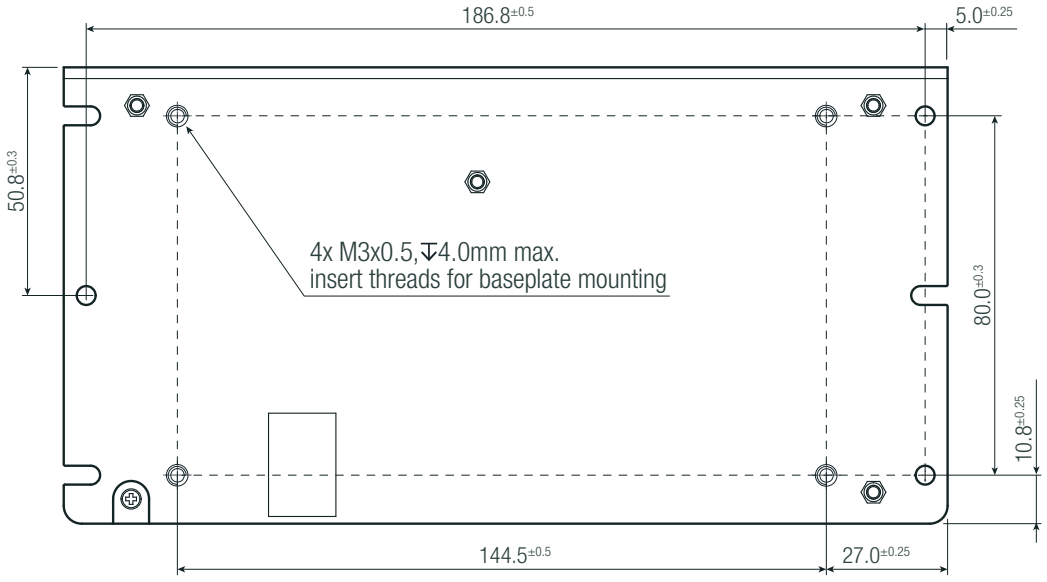
## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

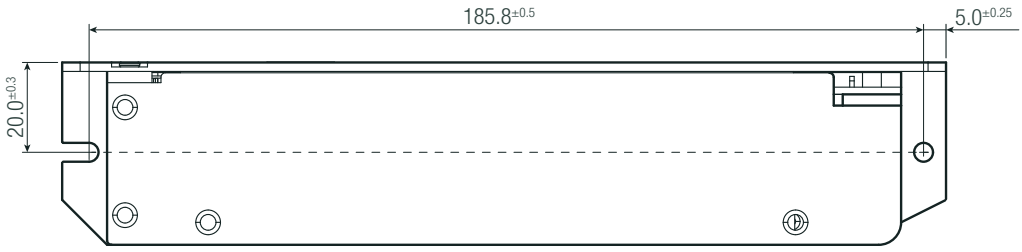
### MOUNTING INSTRUCTIONS

#### Mounting Dimensions



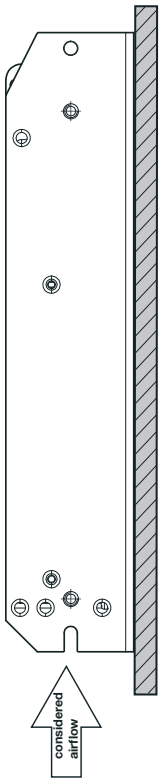

continued on next page

## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

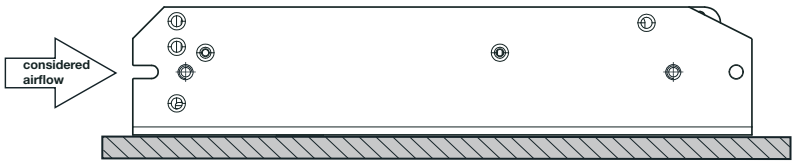
### MOUNTING INSTRUCTIONS

#### Mounting Orientations

vertical mounting




horizontal (standard) mounting



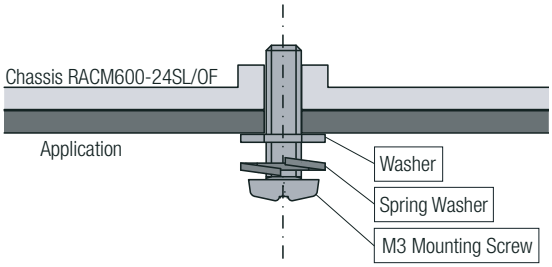

With forced air cooling, mounting orientation has no impact on output power. Upside down mounting is not recommended.

Forced air conditions as specified are valid for indicated airflow direction only (back side).

The PSU should be placed on a metal surface. It should not be placed on isolating and low thermal conductive surfaces.

Take care that no objects can fall into the PSU.

#### Mounting Equipment




Recommended mounting tightening torque= 0.6Nm.
Screw length= min. 2mm / max. 4mm

### PACKAGING INFORMATION

| Parameter | Type | Value |
|---|---|---|
| Packaging Dimension (LxWxH) | cardboard box | 400.0 x 318.0 x 150mm |
| Packaging Quantity | | 7pcs |
| Storage Temperature Range | | -40°C to +85°C |
| Storage Humidity | non-condensing | 95% RH max. |