# Features

# Regulated Converter

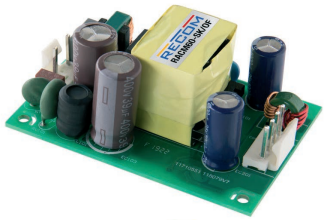
- 2”x3” optional 2“x4“, low profile design
- 60W power from -40°C up to +55°C ambient
- Operating temperature up to +85°C with derating
- 4 kVAC/1min reinforced isolation
- 2MOPP medical certified, B and BF compliant
- 4000m/5000m (medical/ITE) operating altitude
- Class B EMC filter built-in

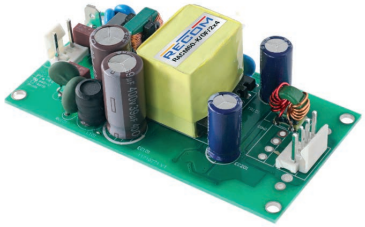
RECOM
AC/DC Converter

# RACM60-K/OF

## 60 Watt Open Frame 2“x3“ & 2“x4“ Single Output

3 YEAR warranty





## Description

The multi-purpose, industrial + household + medical grade AC/DC converter series RACM60-K/OF delivers 60 Watts of output power from -40°C to +55°C with natural air convection only, and up to +85°C with derating or forced cooling. With a clear focus on extended thermal performance for systems where space is limited, these 2” x 3” compact modules are designed to gain highest overall efficiency levels over the full output load range from universal AC inputs. The RACM60-K/OF has ANSI/AAMI/IEC 60601-1 medical safety and EN 60601-1-2 medical EMC certifications and offers 4kVAC/1 min isolation, 2MOPP and designed to meet B and BF requirements. It is additionally certified to IEC/EN62368-1(CB Report) and IEC61558-1/-2-16 for industrial applications and IEC/EN60335-1 for household appliances. The robust built-in Class B EMC filter has sufficient margin to allow both Installation Class II or Class I PELV with grounded output. A range of mechanical fixing options makes the RACM60 suitable for many different mounting conditions: the standard chassis mount part mates with Molex connectors and the /PCB option permits direct installation in printed circuit boards. Additionally, a 2” x 4” footprint for backwards-compatibility with legacy designs is available on request.

## Selection Guide

| Part Number | Input Voltage Range [VAC] | Output Voltage [VDC] | Output Current [mA] | Output Power [W] | Efficiency typ. (1) [%] |
|---|---|---|---|---|---|
| RACM60-05SK/OF (2, 3) | 80-264 | 5 | 8000 | 40 | 89 |
| RACM60-12SK/OF (2, 3) | 80-264 | 12 | 5000 | 60 | 90 |
| RACM60-15SK/OF (2, 3) | 80-264 | 15 | 4000 | 60 | 90 |
| RACM60-24SK/OF (2, 3) | 80-264 | 24 | 2500 | 60 | 90 |
| RACM60-36SK/OF (2, 3) | 80-264 | 36 | 1667 | 60 | 90 |
| RACM60-48SK/OF (2, 3) | 80-264 | 48 | 1250 | 60 | 90 |

**Notes:**

Note1: Efficiency is tested at nominal input and full load at +25°C ambient

## Model Numbering

RACM60- __ SK /OF/ ___ -___

- nom. Output Power
- Output Voltage
- Single
- Packaging options (3)
- Connection options (2)
- Case style (2)

**Notes:**

Note2: “/OF” = standard 2”x3” open frame version with standard header connectors
“/OF/PCB-T”= 2”x3” open frame with PCB mounting pins in single tray packaging (05, 12, 24Vout versions available)
“/OF/2x4” = 2”x4” open frame version with standard header connectors (12 and 24Vout versions available)
For other case/connection/footprint options, please contact RECOM technical support

Note3: without suffix, standard single pack (1pcs/cardboard box)
add suffix “-CTN” for project packaging (4 layers of tray within a carton, for “/OF” only + MOQ= 1152pcs)
for detail information, refer to ***“PACKAGING INFORMATION”***

**Ordering Examples:**

| | | | | | |
|---|---|---|---|---|---|
| RACM60-05SK/OF | 5Vout | 2” x 3” | open frame | standard header connector | 1pcs/cardboard box |
| RACM60-24SK/OF/PCB-T | 24Vout | 2” x 3” | open frame | PCB mounting pins | 12pcs/tray packaging |
| RACM60-12SK/OF/2x4 | 12Vout | 2” x 4” | open frame | standard header connector | 1pcs/cardboard box |
| RACM60-12SK/OF-CTN | 12Vout | 2” x 4” | open frame | standard header connector | 48pcs/carton (MOQ= 1152pcs) |

2MOPP
250VAC

IEC/EN62368-1 (pending)
ANSI/AAMI ES60601-1 Ed. 3.1 certified
CSA/CAN-C22.2 No. 60601-1:14 certified
IEC/EN60335-1 (pending)
IEC/EN61558-1 (pending)
IEC/EN61558-2-16 (pending)
EN60601-1-2 compliant
EN55032 compliant
EN55035 compliant
CB Report (pending)

# RACM60-K/OF Series

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

### BASIC CHARACTERISTICS

| Parameter | Condition | | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Internal Input Filter | | | | | Pi Type |
| Nom. Input Voltage | | | 100VAC | | 240VAC |
| Input Voltage Range (3,4) | | | 80VAC<br>120VDC | | 264VAC<br>370VDC |
| Input Current | 115VAC<br>230VAC | | | | 1400mA<br>600mA |
| Inrush Current | cold start | 115VAC<br>230VAC | | | 30A<br>60A |
| ErP Standby Mode Conformity<br>(Output Load Capability) | 115/230VAC | Input Power: 0.5W<br>1.0W | | 0.3W<br>0.7W | |
| No load Power Consumption | 230VAC | | | 100mW | |
| Input Frequency Range | AC Input | | 47Hz | | 63Hz |
| Minimum Load | | | 0% | | |
| Power Factor | 115VAC<br>230VAC | | 0.6<br>0.5 | | |
| Start-up Time | | | | 150ms | |
| Rise Time | | | | 100ms | |
| Hold-up Time | 115VAC<br>230VAC | | 12ms<br>50ms | | |
| Internal Operating Frequency | 100% load at nominal Vin | | | 100kHz | |
| Output Ripple and Noise (5) | 20MHz BW | 5Vout<br>others | | | 200mVp-p<br>1% of Vout |

**Notes:**

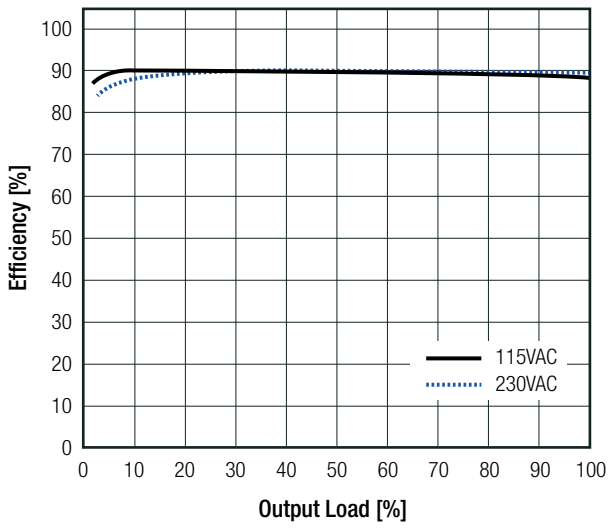
Note3: The products were submitted for safety files at AC-Input operation (90-264VAC)

Note4: Output power derating for Line-input of less than 90VAC (derate linearly from 100% at 90VAC to 80% at 80VAC)

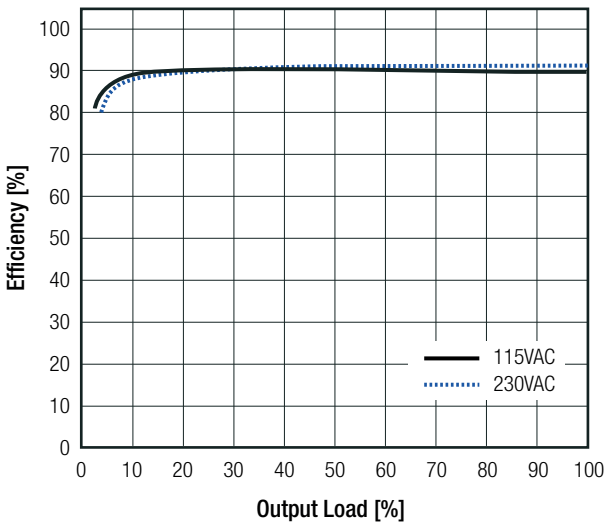
Note5: Measurements are made with a 0.1µF MLCC & 10µF E-cap in parallel across output. (low ESR)

### Efficiency vs. Load

RACM60-05SK/OF




others



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

### REGULATIONS

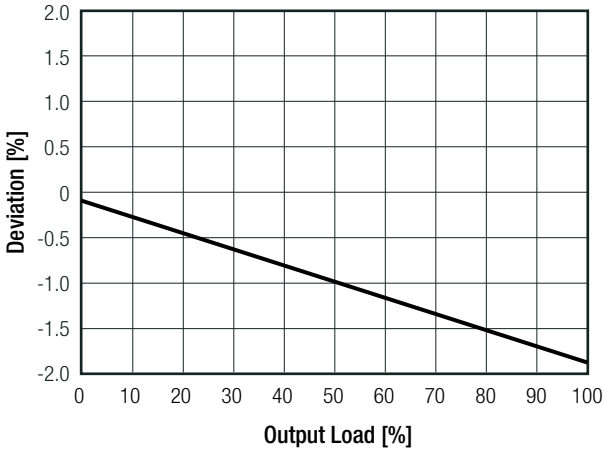
| Parameter | Condition | | Value |
|---|---|---|---|
| Output Accuracy | 100% load | | ±2.0% typ. |
| Line Regulation | low line to high line | | ±0.05% typ. |
| Load Regulation (6) | 10% to 100% load | 5Vout | 1.5% typ. |
| | | 12, 15Vout | 0.5% typ. |
| | | 24, 36, 48Vout | 0.1% typ. |
| Transient Response | 25% load step change | | 3.0% max. |
| | recovery time | | 500µs max. |

**Notes:**

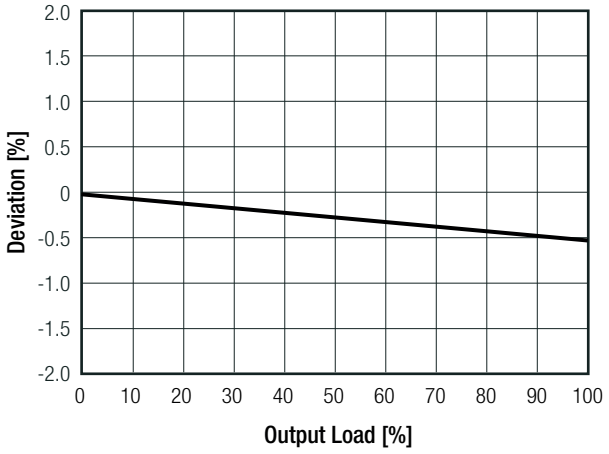
Note6: Operation below 10% load will not harm the converter, but specifications may not be met

**Deviation vs. Load**

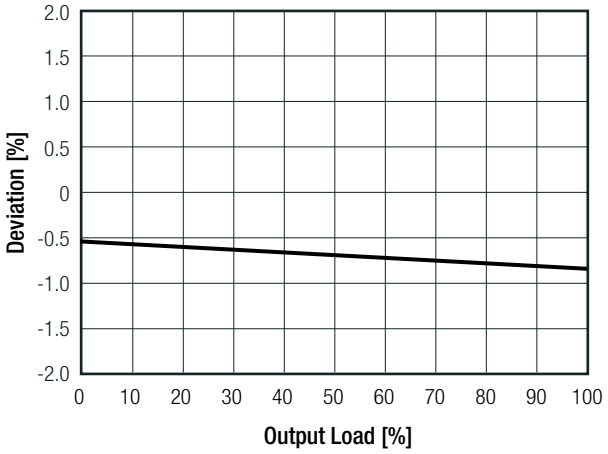
RACM60-05SK



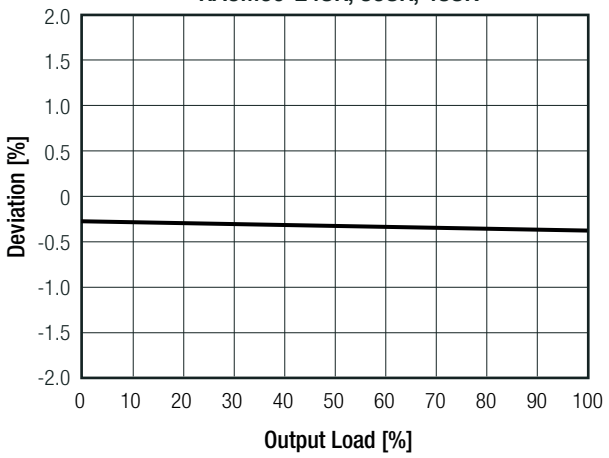

RACM60-12SK




RACM60-15SK




RACM60-24SK, 36SK, 48SK




### PROTECTIONS

| Parameter | Type | Value |
|---|---|---|
| Input Fuse | internal | T3.15A, slow blow type |
| Short Circuit Protection (SCP) | | hiccup, auto recovery |
| Over Voltage Protection (OVP) | | 105% - 120%, auto recovery |
| Over Voltage Category (OVC) | | OVCII |
| Over Current Protection (OCP) | | 130% - 180%, hiccup mode |

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

| Parameter | Type | | Value |
|---|---|---|---|
| Thermal Shutdown | TC point IC 101 | | +130°C, restart after cool down |
| Class of Equipment | | | Class II |
| Isolation Voltage (safety certified) (7) | I/P to O/P | 1 minute | 4kVAC |
| Isolation Resistance | I/P to O/P, $V_{ISO}$= 500VDC | | 1GΩ min. |
| Isolation Capacitance | I/P to O/P, 100KHz/0.1V | | 100pF max. |
| Insulation Grade | | | reinforced |
| Means of Protection | 319VAC working voltage | | 2MOPP |

**Notes:**

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

## ENVIRONMENTAL

| Parameter | Condition | | Value |
|---|---|---|---|
| Operating Temperature Range | @ natural convection 0.1m/s | refer to ***"Derating Graph"*** | -40°C to +85°C |
| Temperature Coefficient | | | ±0.02%/K |
| Operating Altitude (8) | according to IEC60601-1 / IEC62368-1 | | 4000m / 5000m |
| Operating Humidity | non-condensing | | 95% max. |
| Pollution Degree | | | PD2 |
| Vibration | according to MIL-STD-202G | | 10-500Hz, 2G 10min./1cycle, period 60min. along x,y,z axes |
| MTBF | according to MIL-HDBK-217F, G.B. | +25°C<br>+40°C | >900 x $10^3$ hours<br>>726 x $10^3$ hours |
| Design Lifetime | nom. Vin= 230VAC, +40°C | | >42 x $10^3$ hours |

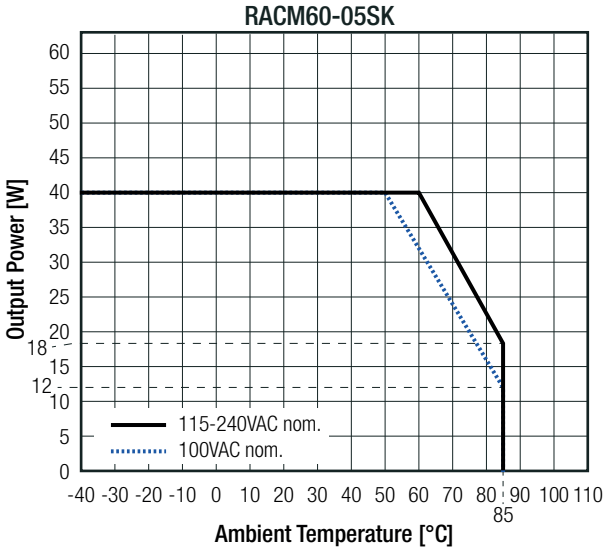
**Notes:**

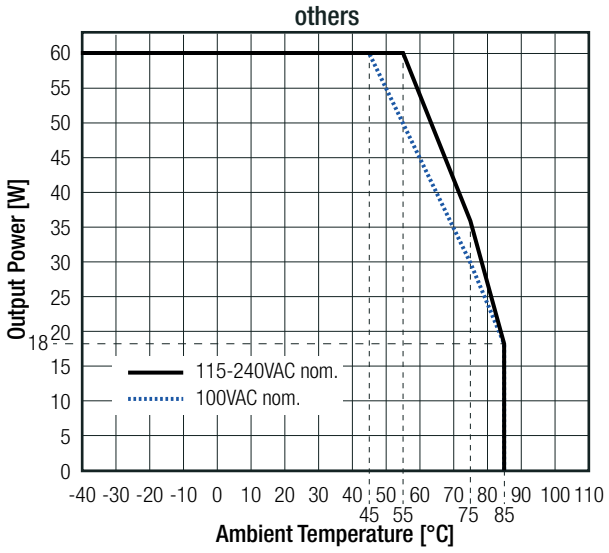
Note8: Recognized by safety agency for safe operation up to 4000/5000m. High altitude operation may impact the performance and lifetime Please contact RECOM tech support for advice

### Derating Graph

(@ Chamber and natural convection 0.1m/s)

Output power derating for Line-input of less than 90VAC
(derate linearly from 100% at 90VAC to 80% at 80VAC)



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

| SAFETY AND CERTIFICATIONS | | |
|---|---|---|
| **Certificate Type (Safety)** | **Report Number** | **Standard** |
| Medical electrical equipment Part 1: General requirements for basic safety and essential performance | E511305-D1000 -1/A0/C0-UL | CAN/CSA-C22.2 No. 60601-1:14, 3rd Ed. ANSI/AAMI ES60601-1:2005 + A2:2010/R2012 |
| Audio/Video, information and communication technology equipment - Safety requirements (CB Scheme) | pending | IEC62368-1:2014 2nd Edition |
| Audio/Video, information and communication technology equipment - Safety requirements (LVD) | pending | EN62368-1 |
| Household and similar electrical appliances – Safety – Part 1: General requirements (LVD) | pending | IEC60335-1:2010 5th Edition + AM1:2013 EN60335-1:2012 + A11:2014 |
| Measurement methods for electromagnetic fields of household appliances and similar apparatus with regard to human exposure | | EN62233:2008 |
| Safety of power transformers, power supplies, reactors & similar products for supply voltages up to 1100 V (CB Scheme) | pending | IEC61558-1:2005 2nd Edition + A1:2009 |
| Safety of power transformers, power supplies, reactors & similar products for supply voltages up to 1100V | pending | EN61558-1:2005 + A1:2009 |
| Safety of power transformers, power supplies, reactors & similar products for supply voltages up to 1100 V Part 2: Particular requirements (CB Scheme) | pending | IEC61558-2-16:2009 1st Edition + A1:2013 |
| Safety of power transformers, power supplies, reactors & similar products for supply voltages up to 1100 V Part 2: Particular requirements | pending | EN61558-2-16:2009 + A1:2013 |
| RoHS2+ | | RoHS 2011/65/EU + AM2015/863 |

| **EMC Compliance (Medical)** | **Condition** | **Standard / Criterion** |
|---|---|---|
| Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic compatibility - Requirements and tests | LCS200402131BE | EN60601-1-2:2015, Class B, Group 1 |
| ESD Electrostatic discharge immunity test | Air: ±2, 4, 8, 15kV<br>Contact: ±2, 4, 8kV | EN61000-4-2:2009, Criteria B |
| Radiated, radio-frequency, electromagnetic field immunity test | 9V/m (704-787MHz) 9V/m (5100-5800MHz)<br>10V/m (80-2700MHz)<br>27V/m (380-390MHz)<br>28V/m (430-470MHz)<br>28V/m (800-960MHz)<br>28V/m (1700-1990MHz)<br>28V/m (2400-2570MHz) | EN61000-4-3:2006+A2:2010, Criteria A |
| Fast Transient and Burst Immunity | AC Port: L-N 2kV | EN61000-4-4:2012, Criteria B |
| Surge Immunity | L-N: 1kV<br>L (N)-PE: 2kV | EN61000-4-5:2014, Criteria B |
| Immunity to conducted disturbances, induced by radio-frequency fields | AC Port:<br>3Vrms: (0.15-80MHz)<br>6Vrms: (ISM and amateur radio bands according to table 9) | EN61000-4-6:2014, Criteria A |
| Power Magnetic Field Immunity | 30A/m | EN61000-4-8:2010, Criteria A |
| Voltage Dips and Interruptions | Dips: 100% (0.5P 1.0P) 30%<br>Interruptions: 100% | EN61000-4-11:2004, Criteria B |
| Limits of Voltage Fluctuations & Flicker | | EN61000-3-3:2013 |

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

| EMC Compliance (Industrial according EN55032) | Condition | Standard / Criterion |
|---|---|---|
| Electromagnetic compatibility of multimedia equipment - Emission requirements | LCS200402130BE | EN55032:2015, Class B |
| Electromagnetic compatibility of multimedia equipment - Immunity requirements | | EN55035:2017 |
| ESD Electrostatic discharge immunity test | Air: ±2, 4, 8kV<br>Contact: ±2, 4kV | EN61000-4-2:2009, Criteria B |
| Radiated, radio-frequency, electromagnetic field immunity test | 3 V/m (80-5000MHz) | EN61000-4-3:2006+A2:2010, Criteria A |
| Fast Transient and Burst Immunity | AC Port: L-N 2kV | EN61000-4-4:2004+A1:2010, Criteria B |
| Surge Immunity | L-N: 1kV<br>L (N)-PE: 2kV | EN61000-4-5:2014 + A1:2017, Criteria B |
| Immunity to conducted disturbances, induced by radio-frequency fields | AC Port:<br>3Vrms (0.15-80MHz)<br>3-1Vrms (10-30MHz)<br>1Vrms (30-80MHz) | EN61000-4-6:2014+A1:2015, Criteria A |
| Power Magnetic Field Immunity | 1A/m | EN61000-4-8:2010, Criteria A |
| Voltage Dips and Interruptions | Dips: 100%<br>30%<br>Interruptions:100% | EN61000-4-11:2004 +A1:2017, Criteria B<br>EN61000-4-11:2004 +A1:2017, Criteria C<br>EN61000-4-11:2004 +A1:2017, Criteria C |
| Limits of Voltage Fluctuations & Flicker | | EN61000-3-3:2013 |

| EMC Compliance (Industrial according EN61204-3) | Condition | Standard / Criterion |
|---|---|---|
| Low voltage power supplies, d.c. output Part 3: Electromagnetic compatibility (EMC) | LCS200402132BE | EN/IEC61204-3:2018, Class B |
| ESD Electrostatic discharge immunity test | Air: ±2, 4, 8kV<br>Contact: ±2, 4kV | EN61000-4-2:2009, Criteria B |
| Radiated, radio-frequency, electromagnetic field immunity test | 10V/m (80-1000MHz)<br>3V/m (1400-2000MHz)<br>1V/m (2000-2700MHz) | EN61000-4-3:2006+A2:2010, Criteria A |
| Fast Transient and Burst Immunity | AC Port: L-N 2kV | EN61000-4-4:2012, Criteria B |
| Surge Immunity | L-N: 1kV<br>L (N)-PE: 2kV | EN61000-4-5:2014 + A1:2017, Criteria B |
| Immunity to conducted disturbances, induced by radio-frequency fields | AC Port:<br>10Vrms (0.15-80MHz) | EN61000-4-6:2014+A1:2015, Criteria A |
| Power Magnetic Field Immunity | 1A/m | EN61000-4-8:2010, Criteria A |
| Voltage Dips and Interruptions | Dips: 100% (0.5P)<br>100% (1.0P)<br>30% or 20%<br>Interruptions:100% | EN61000-4-11:2004 +A1:2017, Criteria B<br>EN61000-4-11:2004 +A1:2017, Criteria B<br>EN61000-4-11:2004 +A1:2017, Criteria C<br>EN61000-4-11:2004 +A1:2017, Criteria C |
| Limits of Voltage Fluctuations & Flicker | | EN61000-3-3:2013 |
| Limitations on the amount of electromagnetic interference allowed from digital and electronic devices | | FCC 47 CFR Part 15 Subpart B |
| Limitations on the amount of electromagnetic interference allowed from digital and electronic devices, industrial, scientific, and medical equipment | | FCC 47 CFR Part 18 |

| DIMENSION AND PHYSICAL CHARACTERISTICS | | |
|---|---|---|
| **Parameter** | **Type** | **Value** |
| Material | PCB | FR4 (UL94-V0) |
| Dimension (LxWxH) | "/OF" type<br>"/OF/PCB" type<br>"/OF/2x4" type | 78.4 x 53.0 x 31.5mm<br>78.4 x 53.0 x 35.4mm<br>101.6 x 53.0 x 31.5mm |
| Weight | "/OF" and "/OF/PCB" types<br>"/OF/2x4" type | 111g typ.<br>120g typ. |

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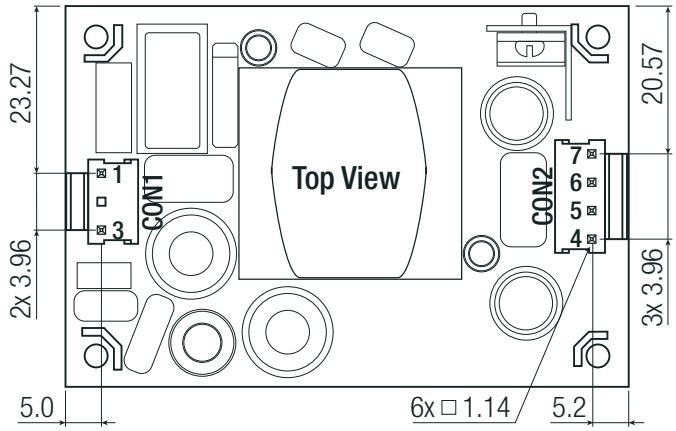
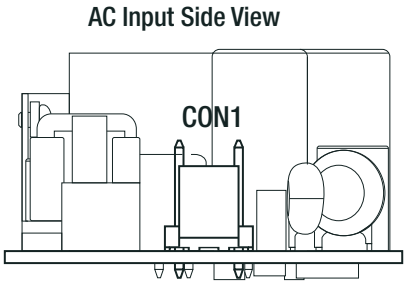
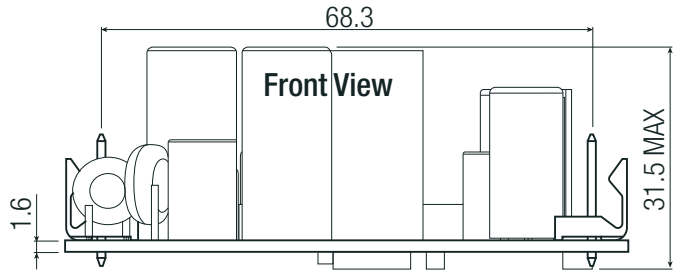
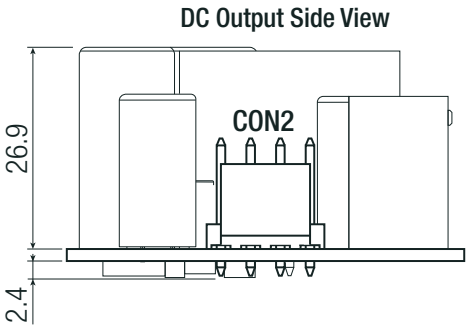
## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

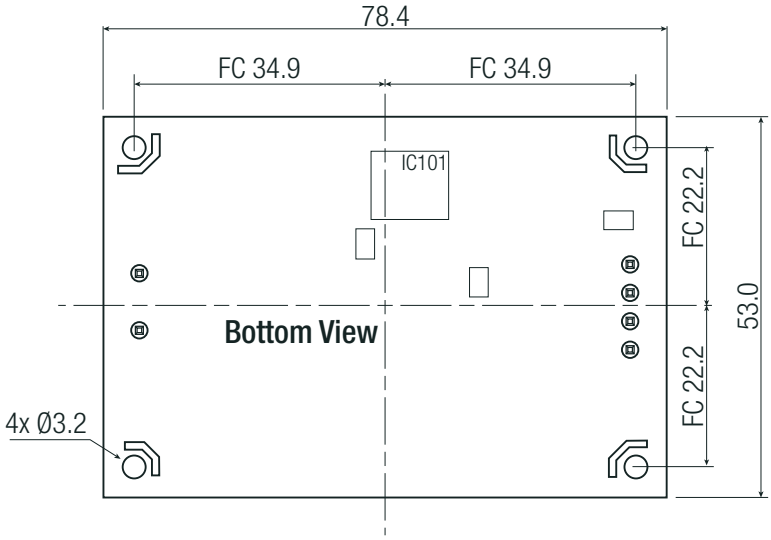
### Dimension Drawing "/OF" (mm)




### Connector Information

| # | Function | Terminal |
|---|---|---|
| | **AC Input (CON1)** | |
| 1 | VAC in (N) | 3 Pins (Pin2 removed) |
| 3 | VAC in (L) | with 3.96mm pitch |
| | **DC Output (CON2)** | |
| 4,5 | -VDC out | 4 Pins |
| 6,7 | +VDC out | with 3.96mm pitch |

FC= fixing centers

| Compatible Connector |
|---|
| **Housing** |
| Molex 51144 Series |
| **Crimp Terminal** |
| Molex 50539 |

| General tolerances according to ISO 2768-m (table for reference only) | |
|---|---|
| Dimension range | Tolerances |
| 0.5 - 6 mm | ±0.1 mm |
| 6 - 30 mm | ±0.2 mm |
| 30 - 120 mm | ±0.3 mm |
| 120 - 400 mm | ±0.5 mm |

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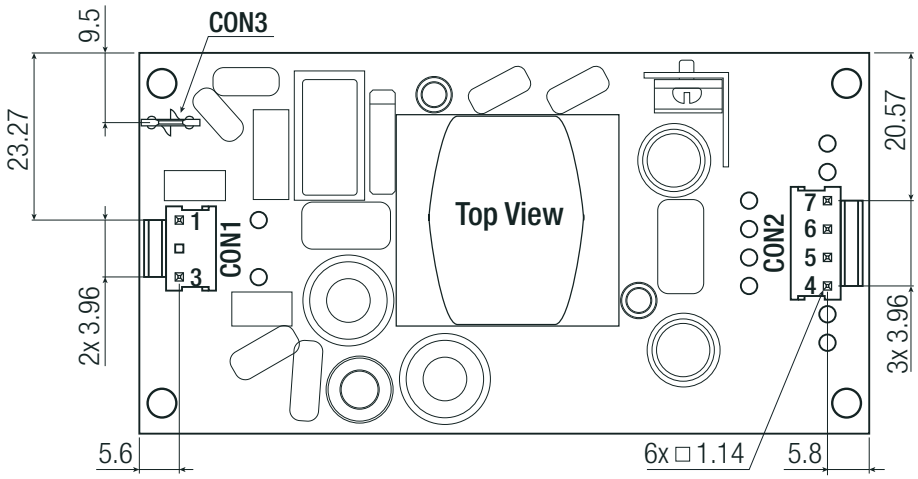
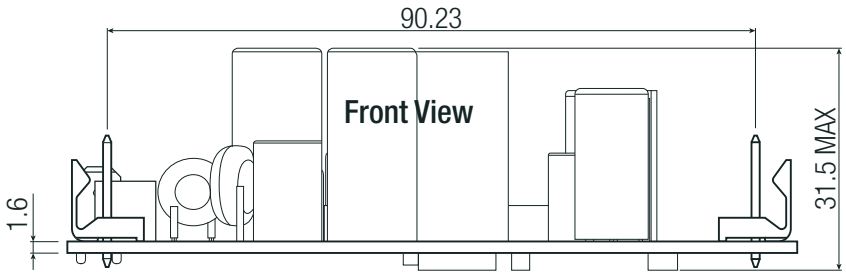
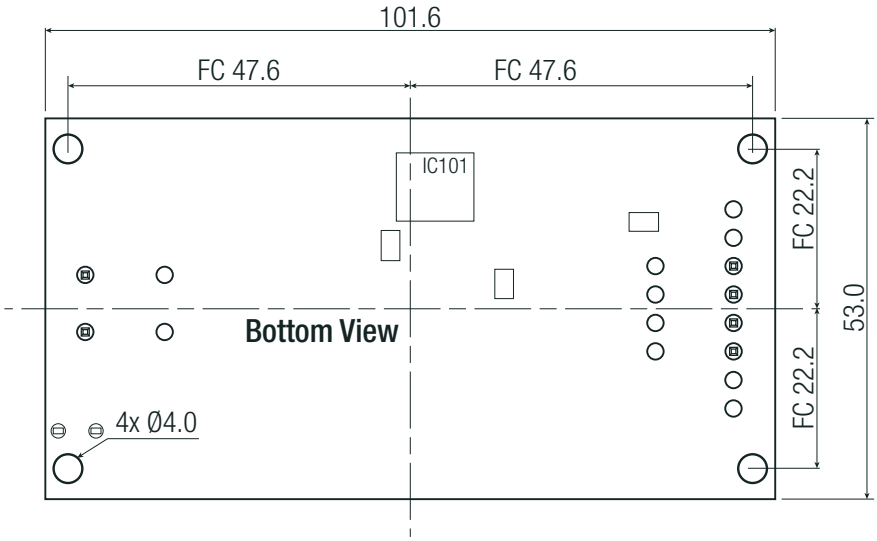
## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

### Dimension Drawing "/OF/2x4" (mm)



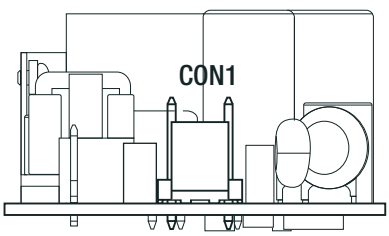




**Connector Information**

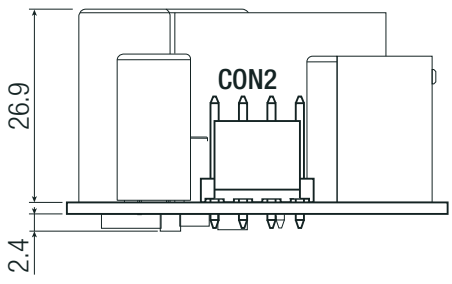
| # | Function | Terminal |
|---|---|---|
| | **AC Input (CON1)** | |
| 1 | VAC in (N) | 3 Pins (Pin2 removed) |
| 3 | VAC in (L) | with 3.96mm pitch |
| | **DC Output (CON2)** | |
| 4,5 | -VDC out | 4 Pins |
| 6,7 | +VDC out | with 3.96mm pitch |
| | **FE (CON3)** | |
| 8 | functional earth | fast on |

FC= fixing centers
Compatible connector please refer to "/OF" drawing)

AC Input Side View




DC Output Side View

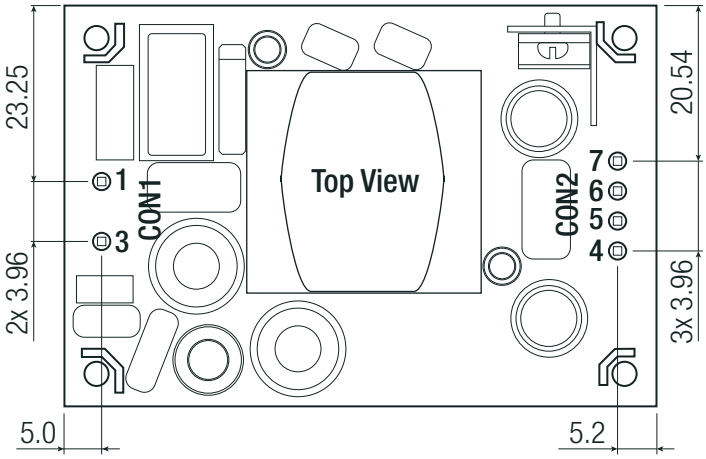



| General tolerances according to ISO 2768-m (table for reference only) | |
|---|---|
| Dimension range | Tolerances |
| 0.5 - 6 mm | ±0.1 mm |
| 6 - 30 mm | ±0.2 mm |
| 30 - 120 mm | ±0.3 mm |
| 120 - 400 mm | ±0.5 mm |

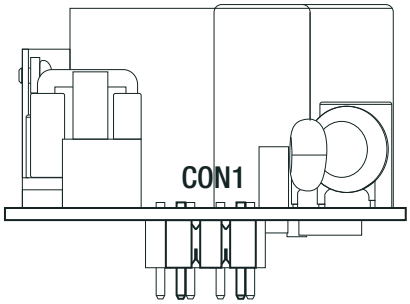
continued on next page

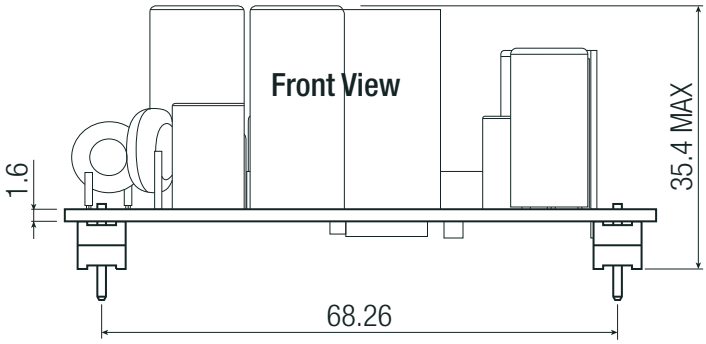
## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

### Dimension Drawing "/OF/PCB" (mm)

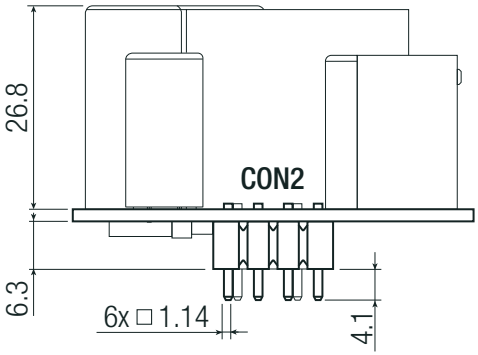


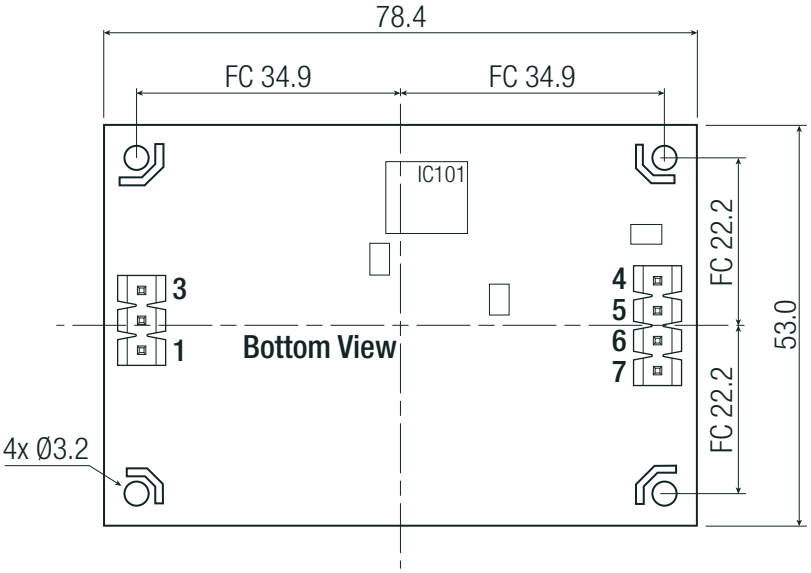

AC Input Side View




DC Output Side View




### Pin-header Information

| # | Function | Terminal |
|---|---|---|
| | **AC Input (CON1)** | |
| 1 | VAC in (N) | 3 Pins (Pin2 removed) |
| 3 | VAC in (L) | with 3.96mm pitch |
| | **DC Output (CON2)** | |
| 4,5 | -VDC out | 4 Pins |
| 6,7 | +VDC out | with 3.96mm pitch |

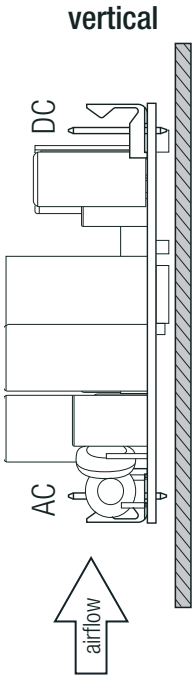
FC= fixing centers

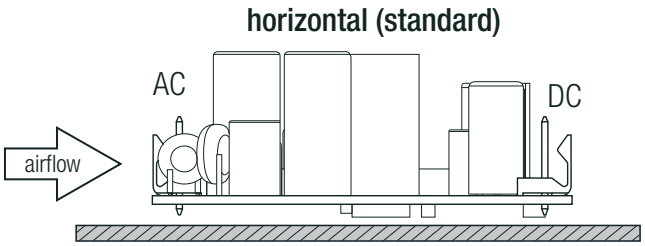
| General tolerances according to ISO 2768-m (table for reference only) | |
|---|---|
| Dimension range | Tolerances |
| 0.5 - 6 mm | ±0.1 mm |
| 6 - 30 mm | ±0.2 mm |
| 30 - 120 mm | ±0.3 mm |
| 120 - 400 mm | ±0.5 mm |

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

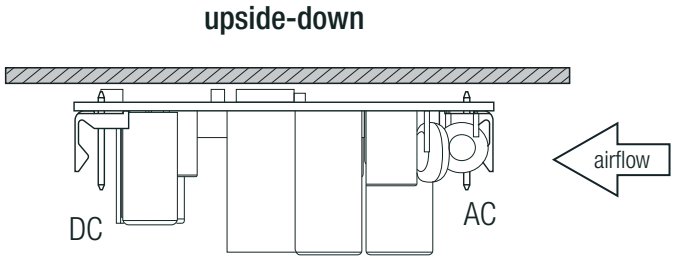
### APPLICATION AND INSTALLATION

#### Mounting

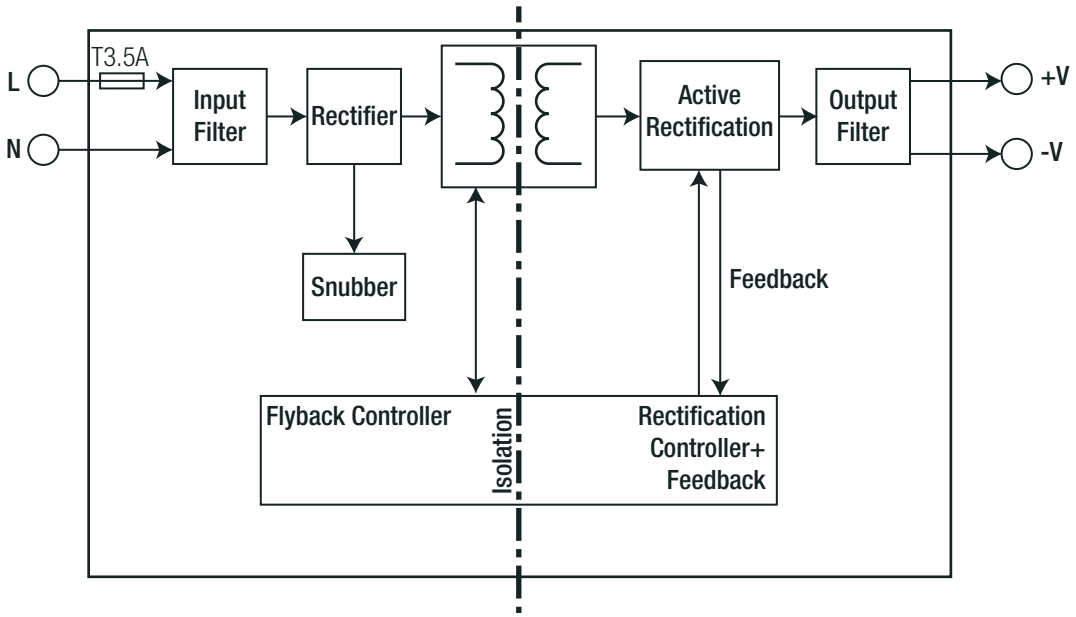



If module is mounted vertical or upside-down with natural convection cooling, the power must be derated ≥ 10%.




#### Blockdiagram (“/OF” and “/OF/PCB”)

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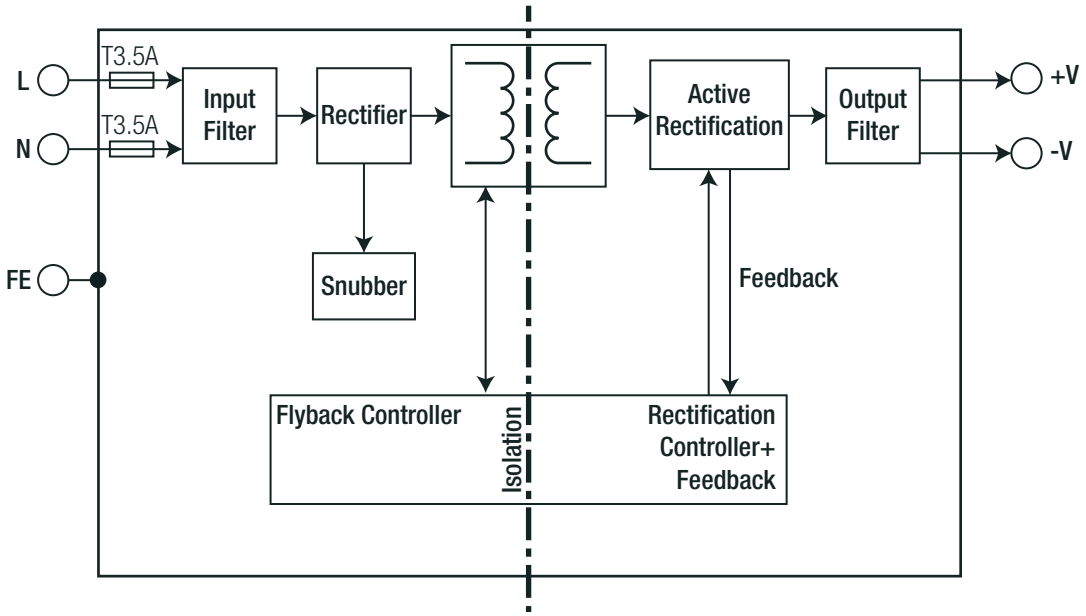
## Specifications (measured @ Ta= 25°C, nom. Vin, full load and after warm-up unless otherwise stated)

### APPLICATION AND INSTALLATION

Blockdiagram ("/OF/2x4")




### PACKAGING INFORMATION

| Parameter | Type | | Value |
|---|---|---|---|
| Packaging Dimension (LxWxH) | "/OF" type<br>"/OF/2x4" type | cardboard box (single pack) | 65.0 x 55.0 x 95.0mm<br>65.0 x 50.0 x 110.0mm |
| | "/OF/PCB-T" type | single tray (carton) | 365.0 x 210.0 x 56.0mm |
| | "/OF-CTN" type | tray in carton (project pack) | 375.0 x 220.0 x 245.0mm |
| Package Unit | "/OF" type and "/OF/2x4" type | | 1pcs |
| | "/OF/PCB-T" type | | 12pcs |
| | "/OF-CTN" type, MOQ= 1152pcs | | 48pcs |
| Storage Temperature Range | | | -40°C to +90°C |
| Storage Humidity | non-condensing | | 95% max. |