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Technical Data Sheet

# RMOD600-W Series / Plug & Play E-Mobility

## 600W / Wide Input 33.6V - 96VDC

RECOM DC/DC Converter

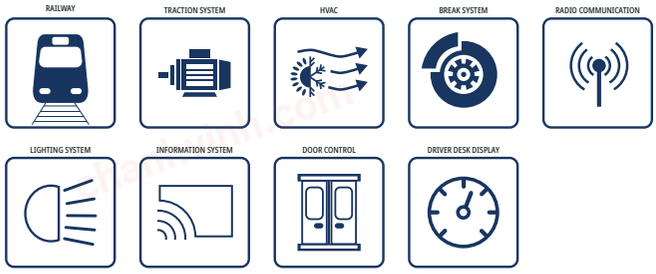
## FEATURES

- On-Board DC/DC Converter
- E-Mobility and industry vehicles
- Very wide input voltage range for 48V / 80V
- Plug & Play, ready to use
- Chassis mount and base plate cooled
- Full power at ambient temperature up to 85°C
- Water and dust proof (IP69K), robust and reliable
- High and extremely constant efficiency
- Parallel operation without active current sharing
- High power density
- 2 years warranty




Dimensions (LxWxH): 203.0 x 115.0 x 71.0mm (8.0 x 4.53 x 2.8 inch)
2000g (4.4 lbs)

## APPLICATIONS




## SAFETY & EMC

CE UKCA cULus E196683 RoHS2+ compliant 10 from 10 Reach compliant

## DESCRIPTION

The RMOD families are extremely robust plug & play modules which are used to generate the low voltage network from a vehicle's traction battery. The ultra-wide input voltage range up to 125VDC covers all common battery voltages in the off-highway vehicle (OHV) segment. Thanks to the waterproof and dust proof housing construction, the devices can be connected mechanically and thermally directly to the chassis, i.e., at any point on the vehicle, and will therefore operate reliably even under the most adverse conditions. This solution is ideal for electric vehicles with nominal 48V…80V battery-powered systems in "Off-Highway E-Mobility Applications" such as Material Handling, Forklift trucks, Golf cars, AGVs, Loaders, Construction vehicles, Airport equipment, People mover, Special vehicles, Transporters, Tractors, etc.

## SELECTION GUIDE

| Part Number | Input Voltage Range [VDC] | Output Voltage nom. [VDC] | Output Current max. [A] | Efficiency typ. (1) [%] | Output Power max. [W] |
|---|---|---|---|---|---|
| RMOD600-60-24SW | 33.6-96 | 24 | 25 | 89 | 600 |

Note1: Efficiency is tested at nominal input and 50%-100% +25°C ambient

## MODEL NUMBERING

RMOD600-60-24 SW

- 600 — max. Output Power
- 60 — nom. Input Voltage
- 24 — nom. Output Voltage
- SW — Single

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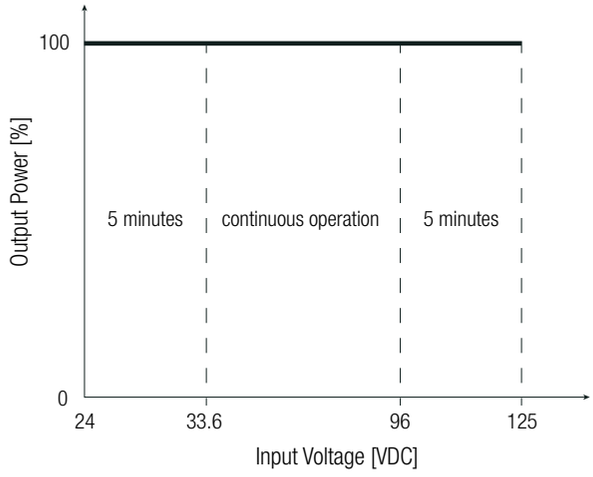
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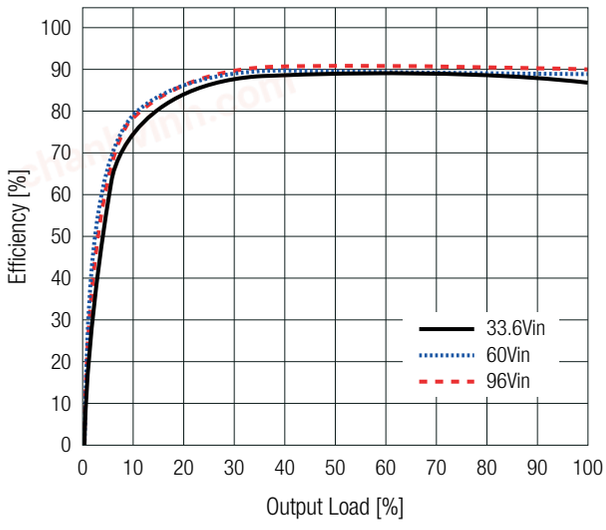
**BASIC CHARACTERISTICS (measured @ $T_{AMB}$= 25°C, nom. $V_{IN}$, full load and after warm-up unless otherwise stated)**

| Parameter | Conditions | | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Input Voltage Range | refer to **„Input Voltage Range“** | nom. $V_{IN}$= 48, 80VDC | 33.6VDC | | 96VDC |
| | | Extendend range: 5 minutes max. | 24VDC | | 33.6VDC |
| | | | 96VDC | | 125VDC |
| Input Current | | | | | 32A |
| Inrush Current | | | | | 1.5A²s |
| Quiescent Current | nom. $V_{IN}$= 80VDC | | | | 60mA |
| Minimum Load | | | 0% | | |
| Start-up time | | | | 250ms | 500ms |
| Rise time | | | | 70ms | |
| Internal Operating Frequency | BOOST stage | | | 100kHz | |
| | MAIN power stage | | | 200kHz | |
| | auxiliary | | | 300kHz | |
| Output Ripple and Noise | | | | | 500mVp-p |

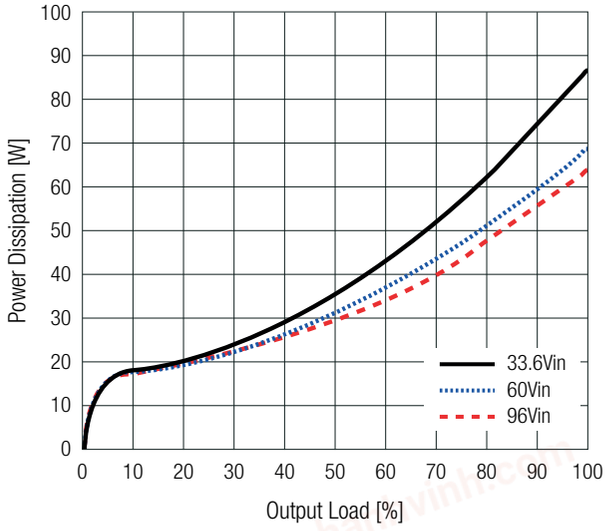
Input Voltage Range




Efficiency vs. Load




Power Dissipation vs. Load




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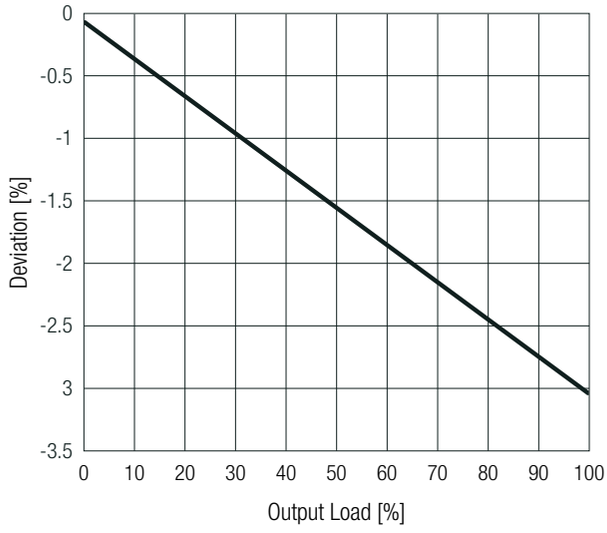
## 600W / Wide Input 33.6V - 96VDC

RECOM DC/DC Converter

### REGULATIONS (measured @ $T_{AMB}$= 25°C, nom. $V_{IN}$, full load and after warm-up unless otherwise stated)

| Parameter | Conditions | | Value |
|---|---|---|---|
| Output Accuracy | | | ±4.0% max. |
| Line Regulation | low line to high line, full load | $V_{IN}$= 33.6-96VDC | ±1.0% max. |
| | | $V_{IN}$= 24-33.6VDC and 96-125VDC | ±3.0% max. |
| Load Regulation | 10-90% load | | 2.5% typ. |
| Transient Response | 10-90% load, $V_{IN}$= 33.6-125VDC | | 1.92VDC |
| | recovery time | | 100ms typ. |

Deviation vs. Load
(nom. $V_{IN}$)




### PROTECTIONS (measured @ $T_{AMB}$= 25°C, nom. $V_{IN}$, full load and after warm-up unless otherwise stated)

| Parameter | Type | Value |
|---|---|---|
| Short Circuit Protection (SCP) | auto recovery | current limitation |
| Over Current Protection (OCP) | auto recovery | 29A typ.; current limitation |
| Over Temperature Protection (OTP) | | yes |
| Isolation Voltage (2) | I/P to O/P; I/P to case; O/P to case; 1 minute | 2.5kVDC |
| Isolation Resistance | | 10MΩ min. |
| Insulation Grade | | basic |

Note2: For repeated Hi-Pot testing, reduce the time and/or the test voltage

### ENVIRONMENTAL (measured @ $T_{AMB}$= 25°C, nom. $V_{IN}$, full load and after warm-up unless otherwise stated)

| Parameter | Conditions | Value |
|---|---|---|
| Operating Ambient Temperature Range (3) | refer to **„Thermal Consideration“** | -35°C to +85°C |
| Operating Altitude | | 3000m |
| Pollution Degree | | PD3 |
| IP Rating | | IP69K |
| MTBF | according to SR-332; $T_{AMB}$= +50°C | 500 x $10^3$ hours |

Note3: For operation above +70°C ambient, take care about sufficient cooling (never exceed max. allowed base plate temperature = 70°C)

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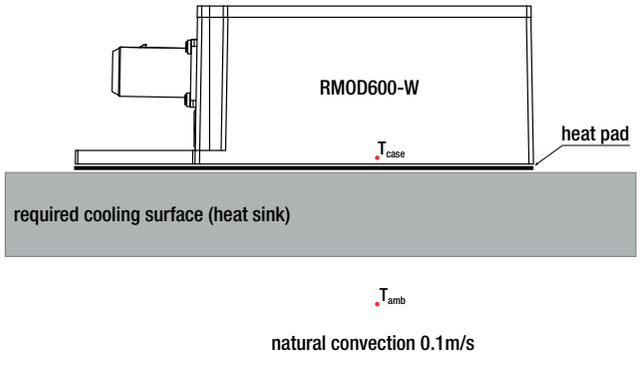
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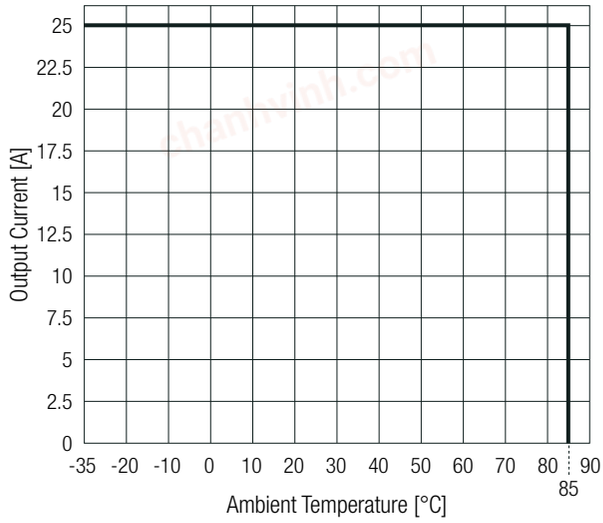
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## ENVIRONMENTAL (measured @ $T_{AMB}$= 25°C, nom. $V_{IN}$, full load and after warm-up unless otherwise stated)

### Thermal Consideration




The module can be used in enclosed applications with full load, as long as the cooling is sufficient to keep the baseplate temperature at $T_{CASE}$ below 70°C. The surrounding temperature should not exceed 85°C.

## ENVIRONMENTAL

| Parameter | Condition | Standard |
|---|---|---|
| Temperature Change | duration: 240 hours and 20 cycles minimum time at -35°C/85°C <30 minutes | EN60068-2-14 |
| Constant Temperature- warm | duration: 96 hours, ambient: 85°C | EN60068-2-2 |
| Temperature Shock | duration: 20 cycles; operation mode: in operation<br>test temperature: 85°C<br>test duration: 1 hour fully tempered + 15 minutes<br>transfer duration: < 5 seconds<br>test medium: water 0°C, 5% dissolved salt content<br>time under water: 5 minutes<br>water volumes: at least 5 times the component volume<br>no water ingress | EN60068-2-14 |
| Humidity/Heat Cycle | max. air temperature: 55°C; number of cycles: 6<br>operation mode: 1 hour in operation, 1 hour without function<br>air humidity: 93%; cycles duration: 24 hours<br>temperature change ≥ 5K/min; minimum air temperature 25°C | EN60068-2-30 |
| Vibrations, Sinusoidal | shock load: 10g; frequency range: 10-500Hz<br>length of time subject to load: 3x9 hours; number of cycles: 50<br>shock form: sinusoidal; operation mode: operational | EN60068-2-6 |
| Continuous Shock | shock load: 10g, duration: 16ms<br>number of impacts: 10000 shocks/axis | EN60068-2-29 |
| Shock | shock load: 30g, duration: 6ms<br>length of time subject to load: 3x6 directions | EN60068-2-27 |
| Salt Spray | at 35°C for 4 hours | EN60068-2-11 |

## SAFETY & CERTIFICATIONS

| Certificate Type (Safety) | Report Number | Standard |
|---|---|---|
| Audio/Video, information and communication technology equipment - Part1: Safety requirements 2nd Edition | E196683 | UL62368-1:2014 2nd Edition<br>CAN/CSA-C22.2 No. 62368-1-14 2nd Edition |
| Audio/Video, information and communication technology equipment - Part1: Safety requirements 2nd Edition | | IEC62368-1:2014 2nd Edition<br>EN62368-1:2014+A11:2017 |
| RoHS2 | | RoHS 2011/65/EU + AM2015/863 |

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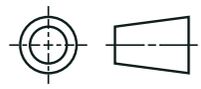
## SAFETY & CERTIFICATIONS

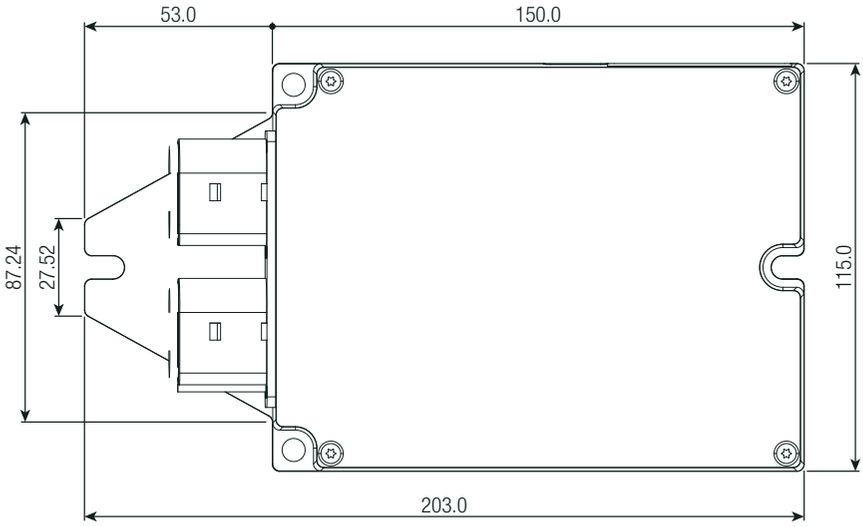
| EMC Compliance | Condition | Standard |
|---|---|---|
| Industrial trucks - Electromagnetic compatibility | | EN12895 |
| Vehicles, boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of on-board receivers | | CISPR25 / EN55025 |
| ESD Electrostatic Discharge Immunity Test | | EN61000-4-2 |
| Radiated, radio-frequency, electromagnetic field immunity test | | EN61000-4-3 |
| Fast Transient and Burst Immunity | | EN61000-4-4 |
| Surge Immunity | | EN61000-4-5 |
| Immunity to conducted disturbances, induced by radio-frequency fields | | EN61000-4-6 |
| Power Magnetic Field Immunity | | EN61000-4-8 |

## DIMENSION & PHYSICAL CHARACTERISTICS

| Parameter | Type | Value |
|---|---|---|
| Material | case | aluminum |
| Dimension (LxWxH) | | 203.0 x 115.0 x 71.0mm<br>8.0 x 4.53 x 2.8 inch |
| Weight | | 2000g typ.<br>4.4 lbs |

### Dimension Drawing (mm)





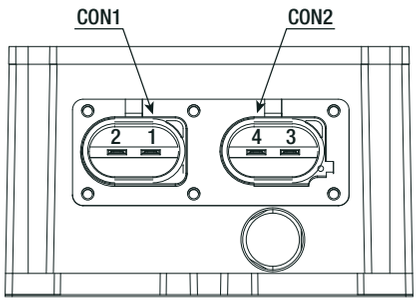

**Connector Information**

| Connector | # | Function |
|---|---|---|
| DC Input CON1 | 1 | $+V_{IN}$ |
| | 2 | $-V_{IN}$ |
| DC Output CON2 | 3 | $-V_{OUT}$ |
| | 4 | $+V_{OUT}$ |

FC= fixing centers

**Compatible Connector**

| Connector | Housing |
|---|---|
| DC Input CON1 | FEP 42122900 |
| DC Output CON2 | FEP 42123400 |







Tolerance: ±0.5mm

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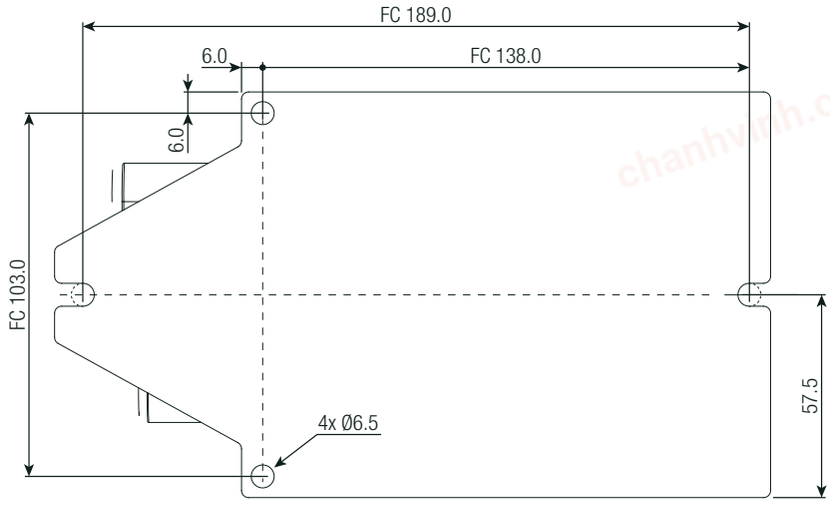


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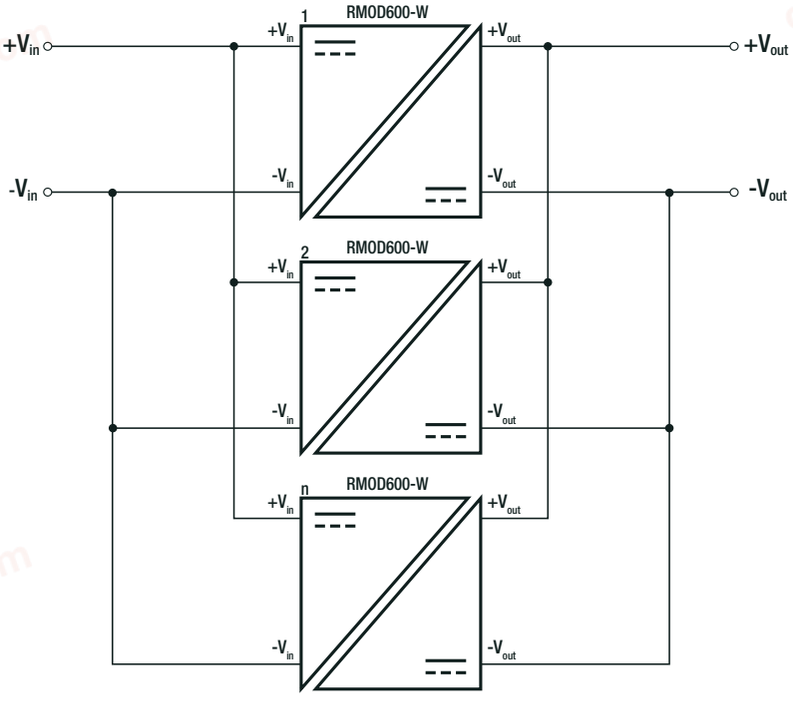



Tolerance: ±0.5mm

## INSTALLATION & APPLICATION

### Parallel Operation

Parallel operation is possible with all combinations of DC/DC converter versions providing they have the same rated output voltage.
There is no active current sharing and therefore the units connected in parallel could be contributing different amounts to the total load current.




## PACKAGING INFORMATION

| Parameter | Type | Value |
|---|---|---|
| Packaging Dimension (LxWxH) | cardboard box | 788.0 x 594.0 x 109.0mm |
| Packaging Quantity | | 10pcs |
| Storage Temperature Range | | -40°C to +85°C |
| Storage Humidtiy | | 95% max. |

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