

### FEATURES

- On-Board DC/DC Converter
- E-Mobility and industry vehicles
- 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 90°C
- Water and dust proof (IP67), robust and reliable
- High and extremely constant efficiency
- Parallel operation without active current sharing
- High power density
- 2 years warranty



Dimensions (LxWxH): 198.0 x 113.0 x 45.0mm (7.8 x 4.45 x 1.77 inch)  
1300g (2.87 lbs)

### APPLICATIONS



### SAFETY & EMC



### DESCRIPTION

The RMOD500-W DC-DC converter is ideally for the use in all off-highway electric vehicles. This family is an extremely robust plug & play module with 500 Watts, which generates the isolated  $V_{out} = 12.4 / 13.7 / 24.5VDC$  low voltage network from the traction battery level. The wide input voltage range 32-96V covers the common 48V and 80V battery voltages in this off-highway segment. Thanks to the waterproof and dust proof housing construction, the devices can directly be connected mechanically and thermally to the chassis (i.e. at any point on the vehicle) and operate reliably even under the most adverse conditions.

### SELECTION GUIDE

Part Number	Input Voltage Range [VDC]	Output Voltage nom. [VDC]	Output Current max. [A]	Efficiency typ. <sup>(1)</sup> [%]	Output Power max. [W]
RMOD500-60-13.7SW	32-96	13.7	36.5	89.5	500
RMOD500-60-13SW/OR	32-96	13	38.5	89.5	500
RMOD500-60-12.4SW	32-96	12.4	40	88.2	496
RMOD500-60-11.7SW/OR	32-96	11.7	42.5	88.2	497
RMOD500-60-24.5SW	32-96	24.5	21	91.5	515
RMOD500-60-23.5SW/OR	32-96	23.5	21	91.5	494

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

### MODEL NUMBERING



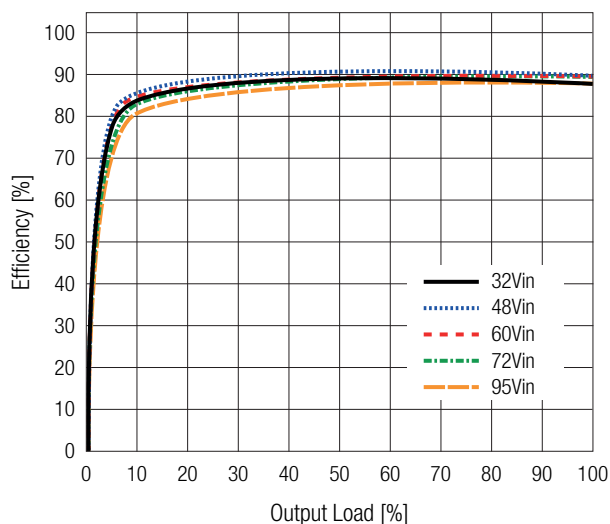
**BASIC CHARACTERISTICS** (measured @  $T_{AMB} = 25^{\circ}C$ , nom.  $V_{IN}$ , full load and after warm-up unless otherwise stated)

Parameter	Conditions	Min.	Typ.	Max.
Input Voltage Range	nom. $V_{IN} = 48, 80VDC$	32VDVC	48VDC	96VDC
Under Voltage Lockout (UVLO)	DC-DC ON	29VDC	30VDC	31VDC
	DC-DC OFF	27VDC	28VDC	29VDC
	hysteresis	1VDC	2VDC	3VDC
Input Current	$V_{IN} = 32VDC$		18A	19A
Inrush Current				1.5A <sup>2</sup> s
Quiescent Current	$V_{IN} = 48VDC$		80mA	
	$V_{IN} = 72, 80VDC$	$V_{OUT} = 12.4/13.7VDC$	40mA	
		$V_{OUT} = 24VDC$	50mA	
Standby Current	$V_{IN} = 48VDC$	$V_{OUT} = 12.4/13.7VDC$	6mA	
		$V_{OUT} = 24VDC$	20mA	
Minimum Load		0%		
Start-up Time	$V_{IN} = 48VDC$	from $V_{IN} =$ Turn-on, threshold to 10% $V_{OUT}$	650ms	800ms
		from CTRL = on to 10% $V_{OUT}$	250ms	400ms
Rise Time	10% to 90% $V_{OUT}$		160ms	300ms
Internal Operating Frequency			175kHz	
Output Ripple and Noise <sup>(2)</sup>	20MHz BW	$V_{IN} = 48VDC$ ; peak to peak	120mVp-p	240mVp-p
		$V_{IN} = 48VDC$ ; RMS	35mVp-p	70mVp-p
		$V_{IN} = 72VDC, 80VDC$ ; peak to peak	140mVp-p	280mVp-p
		$V_{IN} = 72VDC, 80VDC$ ; RMS	45mVp-p	90mVp-p
Reflected Back Ripple Current	$V_{IN} = 48VDC$		0.2Ap-p	
Maximum Capacitive Load				10000 $\mu$ F

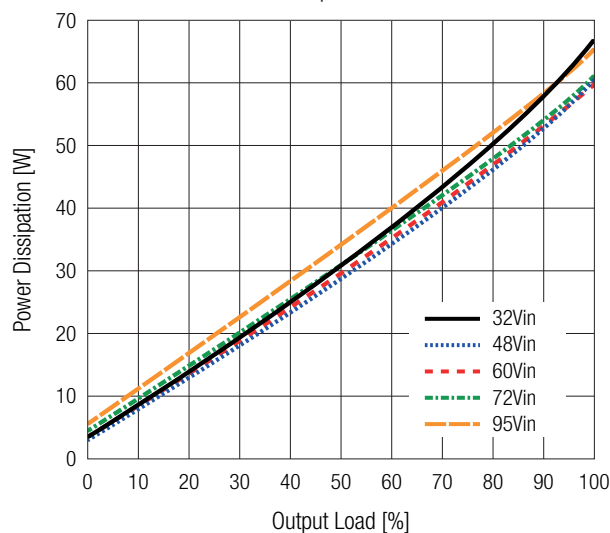
Note2: Measurements are made with a 0.1 $\mu$ F MLCC & 10 $\mu$ F tantalum in parallel across output. (low ESR)

### RMOD500-60-13.7SW

Efficiency vs. Load



Power Dissipation vs. Load



**CTRL ON/OFF (non-isolated to primary side)**

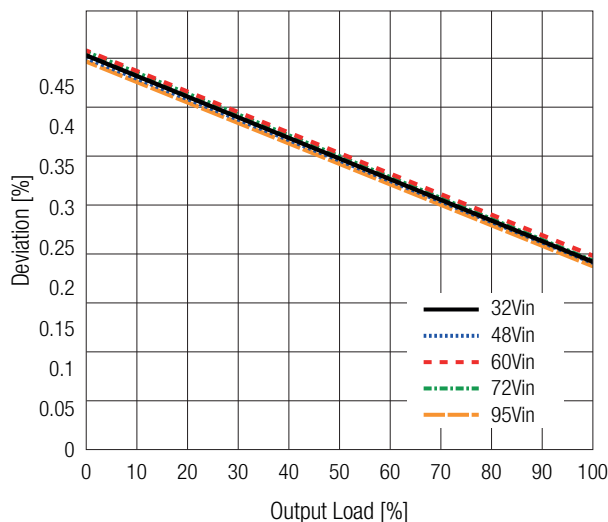
Parameter	Conditions	Value
ON/OFF CTRL	DC-DC ON	CTRL Pin to + $V_{IN}$ or floating
	DC-DC OFF	CTRL Pin to - $V_{IN}$

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

Parameter	Conditions	Min.	Typ.	Max.
Current Share Accuracy	only "OR" types		10%	15%
Transient Response Recovery Time	50-75% load dynamic, 0.1A/ $\mu$ s slew rate		250 $\mu$ s	500 $\mu$ s

**RMOD500-60-13.7SW**

Deviation vs. Load



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

Parameter	Type	Value	
Input Fuse	internal	500V/30A Fast-acting	
Short Circuit Protection (SCP)	auto recovery	hiccup mode	
Input Reverse Polarity Protection		-96VDC max.	
Over Voltage Protection (OVP)	auto recovery	RMOD500-60-12.4SW and RMOD500-60-11.7SW/OR	17VDC typ., hiccup mode
		RMOD500-60-13.7SW and RMOD500-60-13SW/OR	17-19VDC, hiccup mode
		RMOD500-60-24.5SW and RMOD500-60-23.5SW/OR	28-30VDC, hiccup mode
Over Current Protection (OCP)	auto recovery	RMOD500-60-12.4SW and RMOD500-60-11.7SW/OR	50A typ.; current limitation
		RMOD500-60-13.7SW and RMOD500-60-13SW/OR	39-51A typ.; current limitation
		RMOD500-60-24.5SW and RMOD500-60-23.5SW/OR	23-27A typ.; current limitation
Over Voltage Category	according to UL 62368-1	OVC I	
Over Temperature Protection (OTP) <sup>(3)</sup>	measured on NTC	118°C typ., automatic restart	
Isolation Voltage <sup>(4)</sup>	I/P to O/P; I/P to case	2.5kVDC	
	O/P to case	550VDC	
Isolation Resistance	I/P to O/P	10M $\Omega$ min.	
Isolation Capacitance	I/P to O/P	5000pF typ.	
Insulation Grade		basic	

Note3: If the temperature exceeds the preset temperature threshold the module will shut down

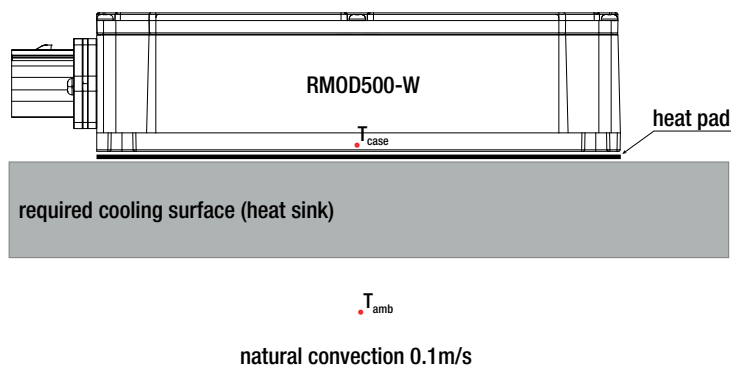
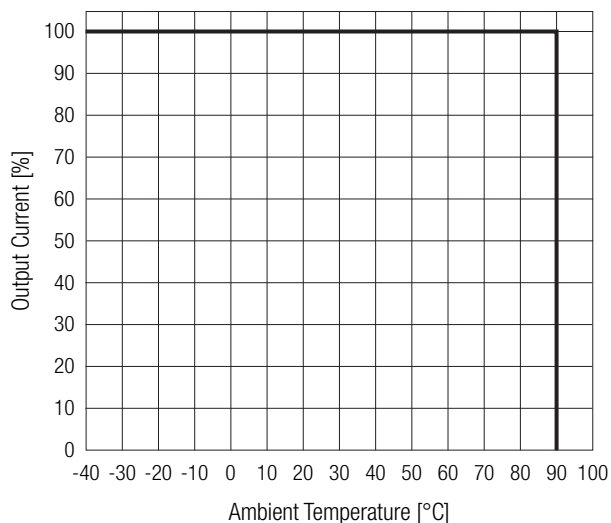
Note4: For repeated Hi-Pot testing, reduce the time and/or the test voltage

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

Parameter	Conditions	Value	
Operating Ambient Temperature Range	with derating, refer to „Thermal Consideration“	-40°C to +90°C	
Operating Humidity	non-condensing	95% RH max.	
Operating Altitude	according to UL 62368-1	5000m	
Pollution Degree	according to UL 62368-1	PD2	
IP Rating		IP67	
MTBF	$V_{IN}=72VDC$ , $T_{BASE}= +80^{\circ}C$	RMOD500-60-12.4SW and RMOD500-60-11.7SW/OR	121.4 x 10 <sup>3</sup> hours
		RMOD500-60-13.7SW and RMOD500-60-13SW/OR	137.1 x 10 <sup>3</sup> hours
		RMOD500-60-24.5SW and RMOD500-60-23.5SW/OR	143.6 x 10 <sup>3</sup> hours

**ENVIRONMENTAL** (measured @  $T_{AMB} = 25^{\circ}\text{C}$ , 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  $90^{\circ}\text{C}$ . The surrounding temperature should not exceed  $90^{\circ}\text{C}$ .

### ENVIRONMENTAL

Parameter	Condition	Standard
Temperature Shock	Temperature range: $-40 \sim 125^{\circ}\text{C}$ Thermal rate: $20^{\circ}\text{C}/\text{minute}$ Dwell time: 60 minutes Total cycle: 300 cycles	ISO 16750-4
Vibration	Sine wave 1. Frequency ( Hz ) amplitude acceleration: 5-9Hz, $\pm 15\text{mm}$ 15-200Hz, 10G 2. Sweep rate: 1 Oct / minute 3. Duration: 50 cycles	IEC 60068-2-6: Sine-wave vibration, test Fc
Submersion test	Total cycles : 10; Dwell time at $T_{max}$ : 1 hour Transition duration: $<20$ seconds Test-fluid: De-ionized water, 5% NaCl Water Temperature: $<4^{\circ}\text{C}$ ; Immersion Time : 5 minutes	ISO 16750-4
Mechanical Shock	50G/11ms 3Shocks for each direction	IEC 60068-2-27: Shock, half sine, test Ea
Salt Spray	Operating / no load 1. Salt Spray Concentration: 5% 2. Test Temperature: $35^{\circ}\text{C}$ 3. Volume of spray: $1 \sim 2\text{ml}/\text{hour}/80\text{cm}^2$ 4. PH: 6.5~7.2 5. Test Time: 96 hours 6. Tolerance: Salt Spray Concentration= $\pm 1\%$ Test Temperature: $\pm 2^{\circ}\text{C}$ ;	IEC 60068-2-11:Test Ka
Bump	40G/6ms 1000 Shocks for each direction	IEC 60068-2-29: Bump, test Eb
Emission	30-1000MHz 34-45dBuV/m	EN12895-2015
Immunity	20V/m (27-1000MHz AM) 3V/m (1-2GHz AM) 1V/m (2-2.7GHz AM); EN12895-2015	EN61000-4-3
ESD	Direct: $\pm 8\text{kV}$ ; Air: $\pm 15\text{kV}$ (EN12895-2015)	EN61000-4-2

# RMOD500-W Series / Plug & Play E-Mobility

## 500W / Wide Input 32V-96VDC

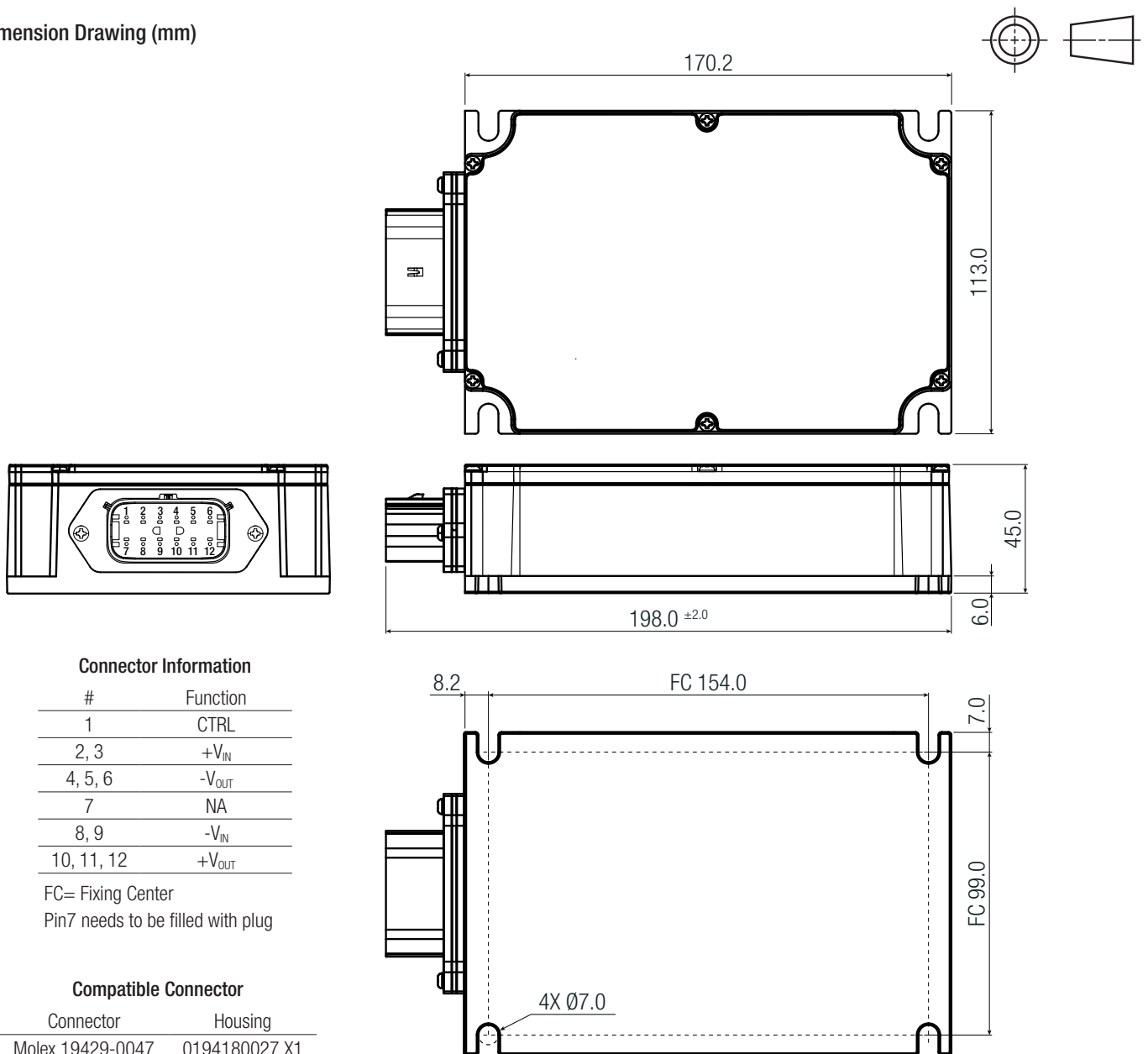
### SAFETY & CERTIFICATIONS

Certificate Type (Safety)	Report Number	Standard
Audio/Video, information and communication technology equipment - Part1: Safety requirements 2nd Edition	E224736-A6023-UL	UL62368-1:2014
		CAN/CSA-C22.2 NO. 62368-1:2014
RoHS2		EN62368-1:2014 + A11:2017 RoHS 2011/65/EU + AM2015/863

### DIMENSION & PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Material	case	aluminum
Dimension (LxWxH)	with connector	198.0 x 113.0 x 45.0mm 7.8 x 4.45 x 1.77 inch
Weight		1300g typ. 2.87 lbs

Dimension Drawing (mm)

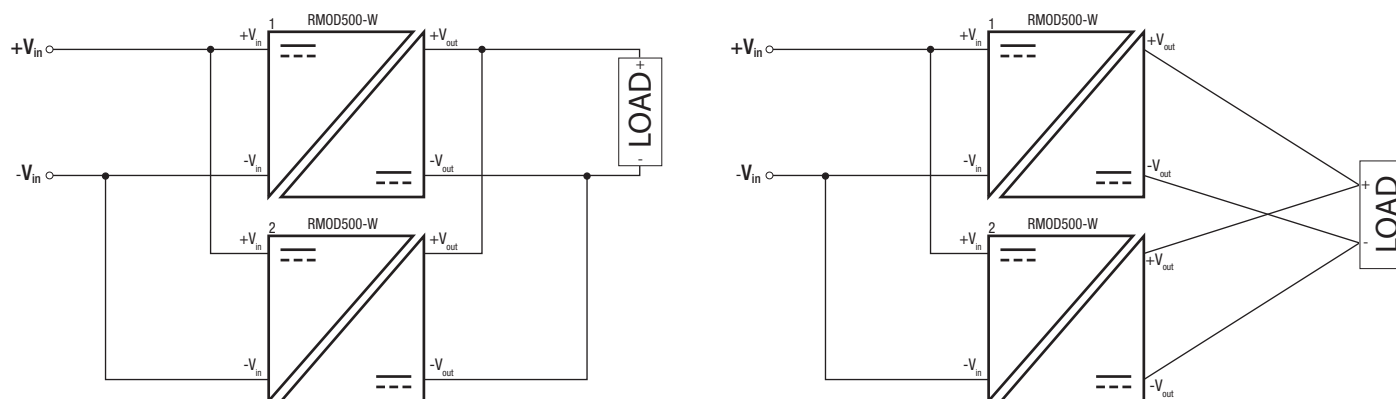


Tolerance:  
xx.x= ±0.5mm  
xx.xx= ±0.25mm

### INSTALLATION & APPLICATION

#### Parallel Operation

Parallel operation is possible with all combinations DC/DC converter versions providing they have the same rated input voltage.  
 Use the same wire length for each power supply (star connection) and energize all units at the same time to avoid triggering overload protection.  
 For operation with more than two power supplies in parallel operation, please contact RECOM technical support for advice.



### PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimension (LxWxH)	cardboard box	500.0 x 300.0 x 200.0mm
Packaging Quantity		6pcs
Storage Temperature Range		-40°C to +105°C

The product information and specifications may be subject to changes even without prior written notice. The product has been designed for various applications; its suitability lies in the responsibility of each customer. The products are not authorized for use in safety-critical applications without RECOM's explicit written consent. A safety-critical application is an application where a failure may reasonably be expected to endanger or cause loss of life, inflict bodily harm or damage property. The applicant shall indemnify and hold harmless RECOM, its affiliated companies and its representatives against any damage claims in connection with the unauthorized use of RECOM products in such safety-critical applications.