Technical Data Sheet

RMD150-UW Series / Plug & Play Railway

150W / Ultra-Wide Input 24V-110VDC

RECOM DC/DC Converter

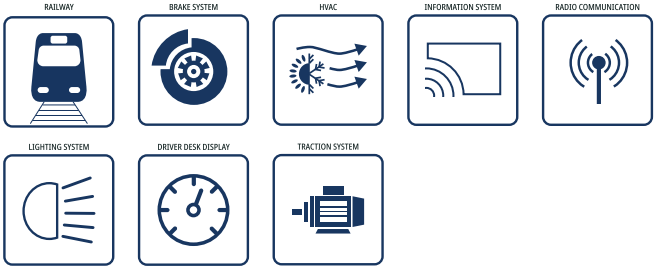
FEATURES

- Fully EN50155 compliant, no external circuits
- Ultra-wide input range 11:1 reduces product variety
- Excellent efficiency, lowest power loss, full lifetime
- Full power up to +85° no derating (option -50°C)
- Active input reverse polarity protection
- Active inrush current limitation - network protection
- 10ms hold-up time over the entire input range
- Reinforced insulation, 6mm air/creepage distances
- Trim-output for long cable runs or battery charging
- Parallel and redundant operation
- 10% Peak load capability for 10s
- Remote (on/off) and DC OK with relay changer
- 2 years warranty



Dimensions (LxWxH): 188.6 x 116.0 x 42.5mm (7.42 x 4.57 x 1.67 inch)
700g (1.54 lbs)

APPLICATIONS



SAFETY & EMC

CE RoHS² compliant 10 from 10 Reach compliant

DESCRIPTION

The chassis mountable RMD150-UW series DC/DC converter is designed for railway and transportation applications and is compliant with all relevant standards: EN50155, EN50121-3-2, DB-EMV06, EN50124-1, EN50125-1, EN61373 1B, EN62368-1, EN45545-2. The unit is designed with 11:1 input voltage range to cover the input voltages from 14.4VDC up to 154VDC for nominal 24, 36, 48, 72 and 110V in one range for all applications - on every vehicle worldwide. The isolated and regulated 24V output works with a reinforced isolation system. Due to the base plate mounting the unit operates with full power within the wide temperature for OT4+ST1&ST2 class from -40°C to +85°C and no additional cooling systems are necessary (Option suffix "-E" with -50°C run-up test). Input reverse polarity protection, inrush current limitation, 10ms hold-up time, remote control, and output OR-ing diode and efficiency of up to 94% round up the functionality of this fully railway compliant Plug&Play unit.

SELECTION GUIDE

Part Number	Input Voltage Range [VDC]	Output Voltage nom. [VDC]	Output Current max. (1) [A]	Efficiency typ. [%]	Output Power max. (1) [W]
RMD150-110-24SUW (2)	16.8-137.5	24	6.88	94	165

Note1: refer to **„Peak load Capability“**

MODEL NUMBERING

RMD150-110-24SUW-E

- 150 — nom. Output Power
- 110 — nom. Input Voltage for $110V_{IN}$
- 24 — nom. Output Voltage
- S — Single
- UW — Extended Ambient Temperature (2)
- E — Extended Ambient Temperature (2)

Note2: add suffix "-E" for extended ambient temperature range (-50°C..+90°C)
without suffix= standard operating range (-40°C..+90°C)

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RMD150-UW Series / Plug & Play Railway

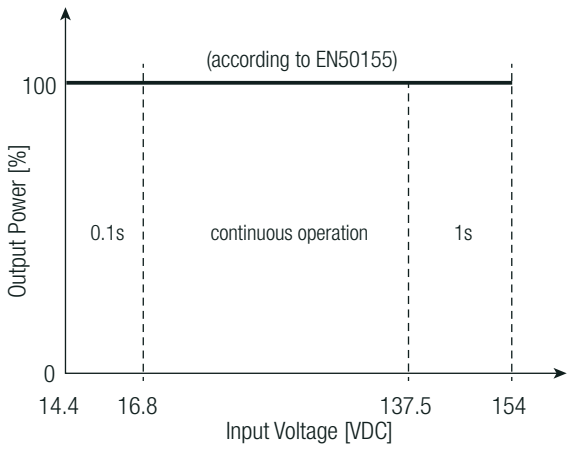
150W / Ultra-Wide Input 24V-110VDC

RECOM DC/DC Converter

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}= 24, 36, 48, 72, 110VDC		16.8VDC		137.5VDC
		according to EN 50155	100ms max	14.4VDC		16.8VDC
			1s max.	137.5VDC		154VDC
Input Capacitance	internal				440µF	
Under Voltage Lockout	rising edge			14.5VDC		15.5VDC
	falling edge			13.5VDC		14.4VDC
Input Current	V_{IN}=16.8VDC			9.9A		
	V_{IN}= 24VDC			6.7A		
	V_{IN}= 110VDC			1.4A		
Inrush Current	active inrush current limitation (<3.5 x Inom)					21.8A
No Load Power Consumption	V_{IN}= 24VDC				3.1W	
	V_{IN}= 110VDC				4.1W	
Standby Current (shutdown by remote)	V_{IN}=16.8VDC				38.7mA	
	V_{IN}= 24VDC				26.3mA	
	V_{IN}= 110VDC				10.7mA	
	V_{IN}= 137.5VDC				10.6mA	
Output Current Range	continuous operation			0A		6.25A
	10s max., refer to **„Peak load Capability“**					6.88A
Output Voltage					24VDC	
Output Voltage Trimming	refer to **„Output Voltage Trimming“**			19.2VDC		25.2VDC
Minimum Load				0%		
Start-up time	V_{IN}= 24VDC					600ms
	V_{IN}= 110VDC					300ms
	by using CTRL ON/OFF function					300ms
Rise time	V_{IN}= 24VDC					100ms
Hold-up time	V_{IN}= 24VDC			10ms	10ms	
	V_{IN}= 72/110VDC				20ms	
ON/OFF CTRL	DC-DC ON			high/open or 12VDC < V_{CTRL} <154VDC		
	DC-DC OFF (pin13 INH connected pin14 INH0)			low or -2VDC < V_{CTRL} < 2VDC		
Input Current of CTRL pin	DC-DC ON					10mA
Internal Operating Frequency					70kHz	
Output Ripple and Noise	over full input and load range, 20MHz BW					80mVp-p
Maximum Capacitive Load	constant current mode				50mF	

Input Voltage Range



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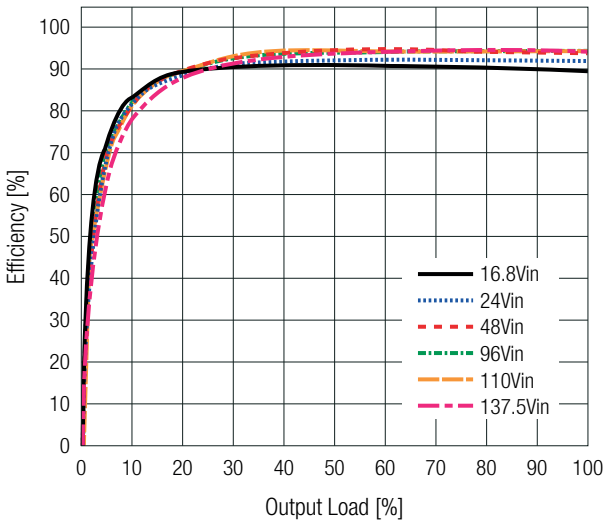
RMD150-UW Series / Plug & Play Railway

150W / Ultra-Wide Input 24V-110VDC

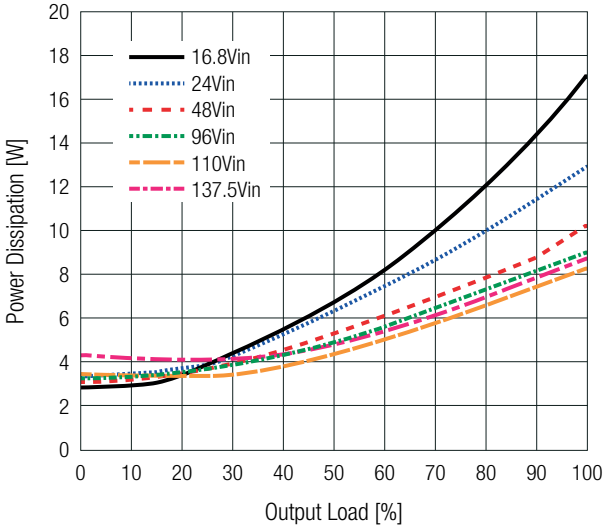
RECOM DC/DC Converter

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

Efficiency vs Load



Power Dissipation vs Load



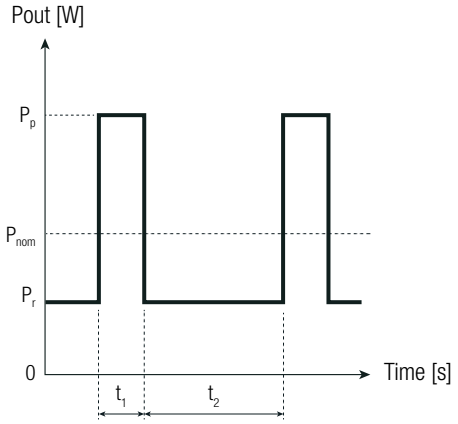
PEAK LOAD CAPABILITY

Peak power capability supports short power peaks of dynamic loads like motors, relays, storage devices or computer booting sequences. In addition allowing faster charge of load sided capacitors and reliable circuit breaker operation.

P_{nom}	= nominal output power	[W]
P_p	= peak output power (165W max)	[W]
P_r	= recovery power	[W]
t_1	= peak time (10s max)	[s]
t_2	= recovery time (calculated)	[s]

Calculation:

$$t_2 = \frac{(P_{nom} - P_P) \times t_1}{P_r - P_{nom}}$$



Practical Example:

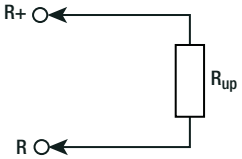
P_{nom} = 150W
P_p = 165W
P_r = 145W
t_1 = 10s

$$t_2 = \frac{\text{(150W - 165W) x 10s}}{\text{145W - 150W}} = \underline{\textbf{30s}}$$

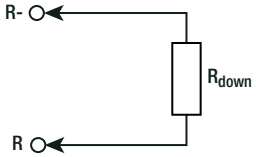
OUTPUT VOLTAGE TRIMMING

The output voltage of the RMD150-UW can be trimmed between +5% and -20% by using an external trim resistor. The values for the trim resistor are according to standard E96 values; therefore, the specified voltage may slightly vary. Resistor values may be calculated with the following equation:

Trim up



Trim down



Calculations:

$Vout_{nom}$	= nominal output voltage	[VDC]
$Vout_{set}$	= trimmed output voltage	[VDC]
R_{up}	= trim up resistor	[Ω]
R_{down}	= trim down resistor	[Ω]

$$R_{up} \cong \frac{322k\Omega \times V_{OUTnom} - 306k\Omega \times V_{OUTset}}{V_{OUTset} - V_{OUTnom}}$$

$$R_{down} \cong \frac{20k\Omega \times V_{OUTset} - 16k\Omega \times V_{OUTnom}}{V_{OUTnom} - V_{OUTset}}$$

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OUTPUT VOLTAGE TRIMMING

Practical Example trim up +5% for RMD150-110-24SUW

$$R_{up} = \left[\frac{322k\Omega \times 24V - 306k\Omega \times 25.2V}{25.2V - 24V} \right] = 14000\Omega$$

R_{up} according to E96 ≈ **14kΩ**

Practical Example trim down -10% for RMD150-110-24SUW

$$R_{down} = \left[\frac{20k\Omega \times 21.6V - 16k\Omega \times 24V}{24V - 21.6V} \right] = 20000\Omega$$

R_{down} according to E96 ≈ **20kΩ**

RMD150-110-24SUW

Trim up	1	2	3	4	5	[%]
$Vout_{set}$ =	24.24	24.48	24.72	24.96	25.2	[VDC]
R_{up} (E96) ≈	1M3	499k	226k	93k1	14k	[Ω]

Trim down	-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	[%]
$Vout_{set}$ =	23.76	23.52	23.28	23.04	22.8	22.56	22.32	22.08	21.84	21.6	[VDC]
R_{down} (E96) ≈	383k	182k	113k	80k6	60k4	46k4	37k4	30k1	24k3	20k	[Ω]

Trim down	-11	-12	-13	-14	-15	-16	-17	-18	-19	-20	[%]
$Vout_{set}$ =	21.36	21.12	20.88	20.64	20.4	20.16	19.92	19.68	19.44	19.2	[VDC]
R_{down} (E96) ≈	16k2	13k3	10k7	8k45	6k65	4k99	3k48	2k21	1k05	0	[Ω]

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

Parameter	Conditions	Value
Output Accuracy		±1.0% max.
Line Regulation	low line to high line, full load	±0.1% max.
Load Regulation	10%-100% load	0.2% typ.
Transient Response	10-90% load, V_{IN}= 16.8-137VDC	0.5VDC
	recovery time	40ms typ.

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

Parameter	Type			Value
Internal Input Fuse				T15A, slow blow type
Short Circuit Protection (SCP)	constant current mode, auto recovery			>110%-125% of nom. output current
Short Circuit Input Current	V_{IN}= 24VDC			0.8A
	V_{IN}= 110VDC			0.4A
Input Reverse Polarity Protection	active protected			-137.5VDC
Over Voltage Protection (OVP)	latch off			28.8VDC - 32.4VDC
Over Voltage Category (OVC)	according to EN 50124-1:2018			OVC III
Over Current Protection (OCP)	auto recovery			>110%-125% of nom. output current
Over Temperature Protection (OTP)	auto recovery			105°C internal
Class of Equipment				Class I
Isolation Coordination	according to EN 50124-1:2018			V_{NOM}= 300VDC
Isolation Voltage (3)	DC tested / AC rated	I/P to O/P		5kVDC / 3.5kVAC
		I/P to PE		3kVDC / 2kVAC
		O/P to PE		1kVDC / 700VAC
	routine test	I/P to O/P, 10 seconds		2.8kVDC
		10 seconds	I/P to O/P	3kVAC
		O/P to PE		1kVDC
Isolation Resistance				100MΩ min.
Isolation Capacitance				650pF max.
Leakage Current				10µA max.
Insulation Grade				reinforced
Internal Clearance	I/P to O/P			6mm
	I/P to PE			4mm
	O/P to PE			3mm

Note3: For repeat Hi-Pot testing, reduce the time and/or the test voltage

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POWER GOOD

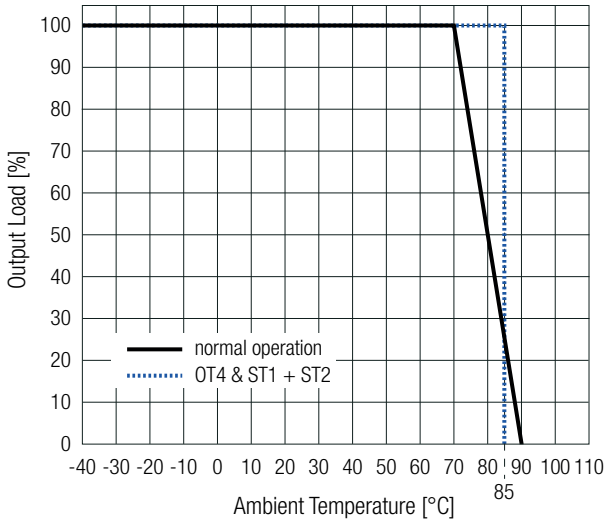
Parameter	Type	Value
Power OK LED	V_{OUT}= >17VDC	green
	V_{OUT}= <17VDC	light off
Relay Status	V_{OUT}= >17VDC	OK: OK1 connected OK or OK2 not connected OK
	V_{OUT}= <17VDC	NOK: OK2 connected OK or OK1 not connected OK
Relay Capability		0.5A/150VDC

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

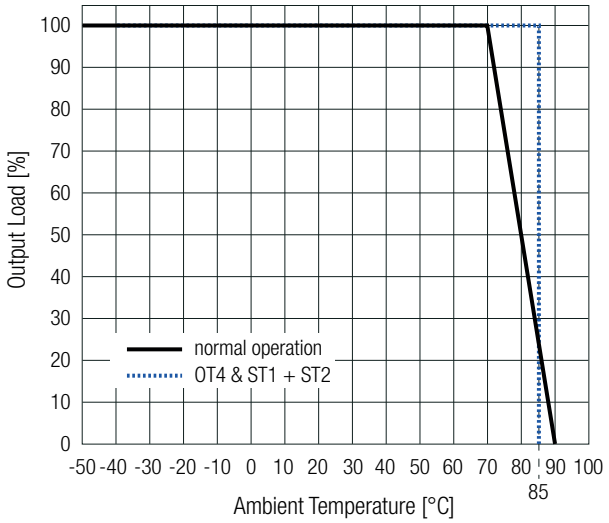
Parameter	Conditions			Value
Operating Ambient Temperature Range	standard version		with derating	-40°C to +90°C
		according to EN 50155 operating temperature class OT4 and extended operating temperature class ST1 & ST2	without derating	-40°C to +70°C
			without derating for 15 minutes	-40°C to +85°C
	"-E" version	with derating		-50°C to +90°C
		according to EN 50155 class OT4 and extended operating temperature class ST1 & ST2v	without derating	-50°C to +70°C
			without derating for 15 minutes	-50°C to +85°C
Maximum Baseplate Temperature				+95°C
Temperature Coefficient				0.2%/K
Operating Altitude	according to EN 50124-1:2018			2000m (OVC III)
				5000m (OVC II)
Operating Humidity	non-condensing			95% RH max.
Conformal Coating [4]	according to EN 50155			Class PC2
Pollution Degree				PD2
IP Rating				IP20
Design Lifetime				20 years
MTBF	according to IEC 61709/ UTE C80-810		T_{AMB}= +40°C	1400 x 10^3 hours
			T_{AMB}= +55°C	900 x 10^3 hours
Useful Life Class	according to EN50155:2018 (S1)			L4

Note4: The board is protected on both sides with a protective / transparent / fluorescent / coating. The coating is compliant with class 2, according to IPC-A-610G: 2017

Derating Graph



Derating Graph for -E Version



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ENVIRONMENTAL (RAILWAY STANDARDS)

Parameter	Conditions		Value
Low Temperature start-up test	standard version	Temperature: -40°C; Stabilization time 2h	EN 60068-2-1 (Ad)
	"-E" version	Temperature: -50°C; Stabilization time 2h	
Dry heat test	Temperature: +70°C; Continuous operational checks time: 6h		EN 60068-2-2 (Be) – Cycle A
Low temperature storage test	Temperature: -40°C; Low temperature exposition time: 16h		EN 60068-2-1 (Ab)
Cyclic damp heat test	Temperature: +70°C/+25°C; Number of cycles: 2; Time: 2x 24h		EN 60068-2-30 (Db)
Simulated long-life testing (Test performed at maximum level for each axis.)	Random Vibration, unit not powered during test Frequency range 5-150Hz with -6db/oct from 20 to 150Hz Vertical axis 5.72m/s² for 5h [ASD 0.964(m/s²)²/Hz] Transverse axis 2.55m/s² for 5h [ASD 0.192(m/s²)²/Hz] Longitudinal axis 3.96m/s² for 5h [ASD 0.461(m/s²)²/Hz]		EN 61373 clause 9, class B Body mounted
Shock testing (Test performed at maximum level for each axis.)	Half-sine shock, unit powered during test Vertical axis 30m/s² for 30ms Transverse axis 30m/s² for 30ms Longitudinal axis 50m/s² for 50ms Number of shocks: 18 (3x polarity for each axis)		EN 61373 clause 10, class B Body mounted
Functional random vibration test (Test performed at maximum level for each axis.)	Random Vibration, unit powered during test Frequency range 5-150Hz with -6db/oct from 20 to 150Hz Vertical axis 1.01m/s² for 10min [ASD 0.0301(m/s²)²/Hz] Transverse axis 0.45m/s² 10min [ASD 0.006(m/s²)²/Hz] Longitudinal axis 0.7m/s² 10min [ASD 0.0144(m/s²)²/Hz]		EN 61373 clause 8, class B Body mounted
Fire Protection on Railway Vehicles			EN45545-2 Hazard Level HL1 - HL3

SAFETY & CERTIFICATIONS

Certificate Type (Safety)	Standard
Audio/Video, information and communication technology equipment - Part1: Safety requirements 3rd Edition	IEC62368-1:2018 3rd Edition EN IEC 62368-1:2020+A11:2020
Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment	EN50124-1:2017
Railway Applications - Electrical Equipment used on rolling stock	EN50155:2017
RoHS2	RoHS 2011/65/EU + AM2015/863

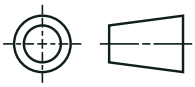
EMC Compliance	Conditions		Standard / Criterion
Railway applications - Electromagnetic compatibility			EN50121-3-2:2016+A1:2019
Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for industrial environments			EN61000-6-4:2007+A1:2011
ESD Electrostatic discharge immunity test	Air: ±2, 4, 8kV Contact: ±2, 4, 6kV		IEC61000-4-2:2009, Criteria A EN61000-4-2:2008, Criteria A
Radiated, radio-frequency, electromagnetic field immunity test	20V/m (80-1000MHz) 10V/m (1000-2000MHz)		IEC/EN61000-4-3:2006, Criteria A
Fast Transient and Burst Immunity	DC Power Port: ±2kV		IEC/EN61000-4-4:2012, Criteria A
Surge Immunity	DC Power Port: ±0.5, 1kV line sym. DC Power Port: ±0.5, 1, 2kV line unsym.		IEC/EN61000-4-5:2014, Criteria A
Immunity to conducted disturbances, induced by radio-frequency fields	10Vr.m.s. (0.15-80MHz)		IEC/EN61000-4-6: 2016, Criteria A
Operational Behaviour, Voltage Fluctuations and Interruptions	Operational behavior	0.7 UN and 1.25 UN for 1min	IEC61000-4-29:2000 EN61000-4-29:2000
	Voltage fluctuation	UN -> 0.6 UN and UN -> 1.4 UN for 0.1s (10 times)	
		1.25 UN -> 1.4 UN for 1.0s (10 times)	
	Short interruption of mains voltage	at UN fo 10ms (10 times)	
Railway applications - Electromagnetic compatibility			EN50121-3-2:2016+A1:2019
Technische Regeln zur Elektromagnetischen Verträglichkeit: Nachweis der Funkverträglichkeit von Schienenfahrzeugen mit Bahnfunkdiensten			Regelung Nr. EMV 06:2019

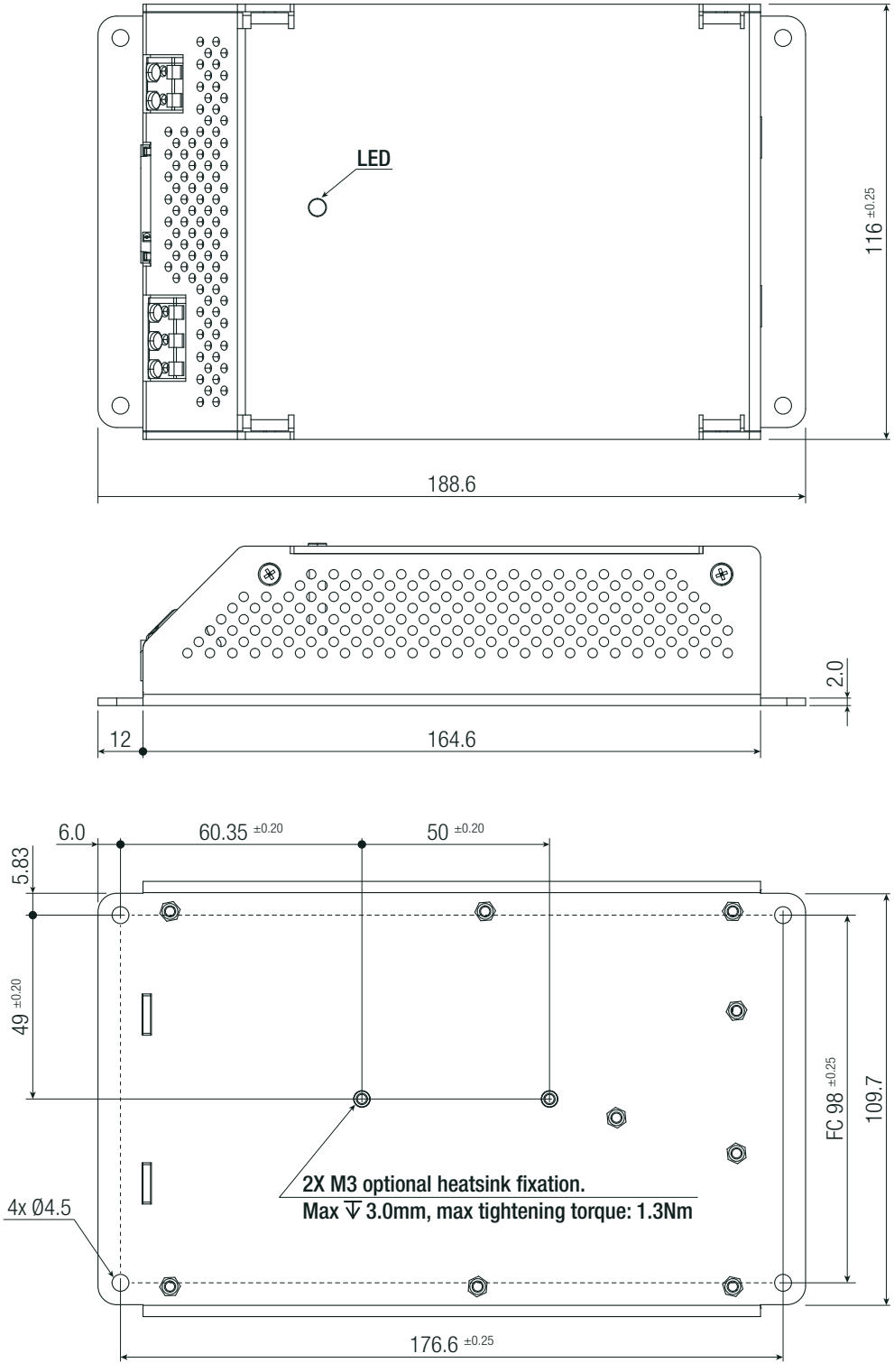
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DIMENSION & PHYSICAL CHARACTERISTICS

Parameter	Type	Value
Material	case	aluminum
Dimension (LxWxH)		188.6 x 116.0 x 42.5mm 7.42 x 4.57 x 1.67 inch
Weight		700g typ. 1.54 lbs

Dimension Drawing (mm)



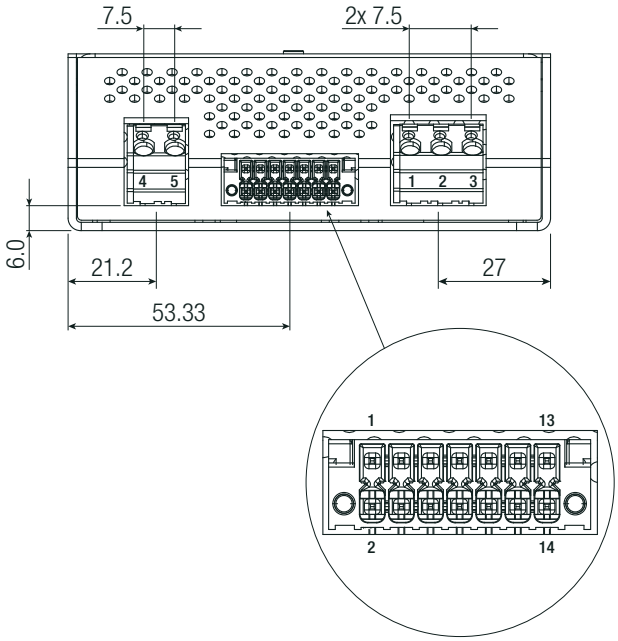


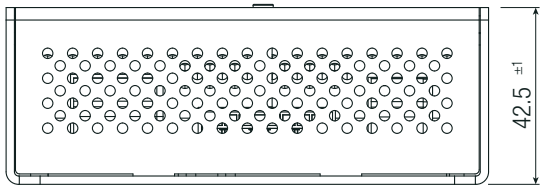
Tolerance Table	
Dimension range	Tolerances
0.5 - 6 mm	±0.1 mm
6 - 30 mm	±0.2 mm
30 - 120 mm	±0.3 mm
120 - 315 mm	±0.5 mm

FC = fixing centers

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DIMENSION & PHYSICAL CHARACTERISTICS





Signal CON3

(Phoenix DMC 1,5/ 8-G1F-3,5-LR)

#	Function	#	Function
14	INHO	13	INH
12	NC	11	NC
10	OK	9	OK2
8	OK	7	OK1
6	NC	5	NC
4	R	3	R-
2	R	1	R+

Signal CON3
Compatible Connector (not included)

Phoenix DFMC 1,5/ 7-STF-3,5 – 1790344

Input connector CAGE CLAMP® CON1

(WAGO 745-3153)

#	Function	AWG	Wire diameter
1	-Vin	28-12	0.08-4mm²
2	+Vin	28-12	0.08-4mm²
3	PE	28-12	0.08-4mm²

wire stripping length: 8-9mm
Conductor connection direction to PCB 45°

Output connector CAGE CLAMP® CON2

(WAGO 745-3152)

#	Function	AWG	Wire diameter
4	+Vout	28-12	0.08-4mm²
5	-Vout	28-12	0.08-4mm²

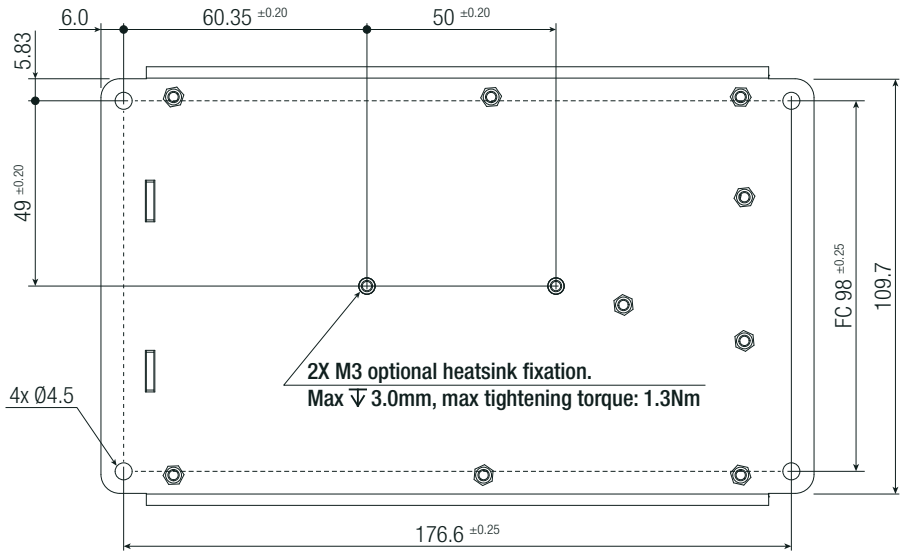
wire stripping length: 8-9mm
Conductor connection direction to PCB: 45°

Tolerance Table	
Dimension range	Tolerances
0.5 - 6 mm	±0.1 mm
6 - 30 mm	±0.2 mm
30 - 120 mm	±0.3 mm
120 - 315 mm	±0.5 mm

FC = fixing centers

INSTALLATION & APPLICATION

Mounting Instructions



For operation of the DC/DC converter the PE connection at the intended connection point as part of the overall EMC concept is mandatory.

Natural air convection around the unit must be possible at any time and the temperature shall not be exceeded.

The RMD converter has to be installed with 4 x M4 screws and can be mounted in any mounting direction.

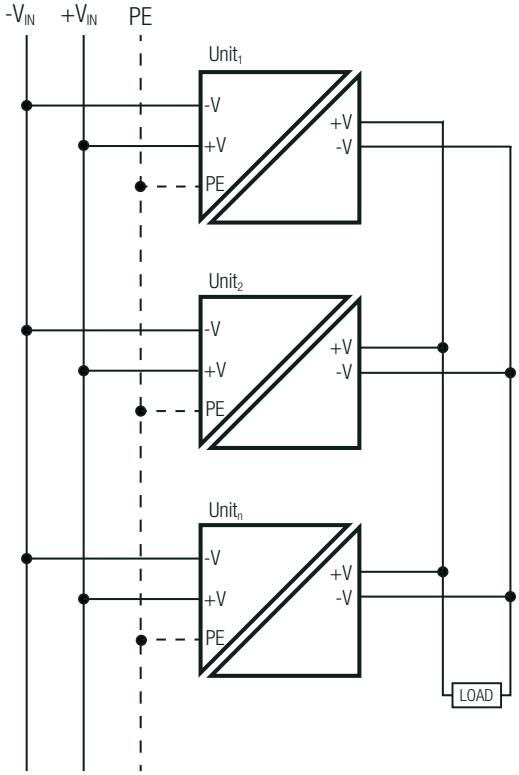
All control and signal terminals have been tested and have passed the requirements according to the EN50121-3-2 regulations, nevertheless for installation conditions with cable lengths above 30m, maybe additional protection against disturbances will be necessary.

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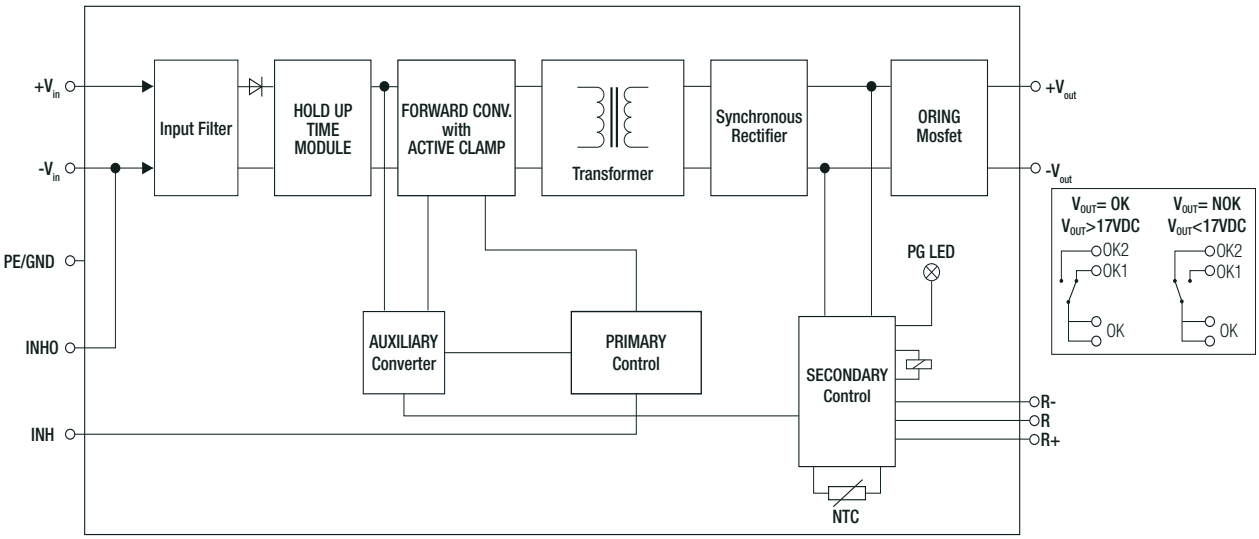
INSTALLATION & APPLICATION

Parallel Operation

Here the example of three parallel connected units.



BLOCK DIAGRAM



PACKAGING INFORMATION

Parameter	Type	Value
Packaging Dimension (LxWxH)	cardboard box	125.0 x 48.0 x 198.0mm
Packaging Quantity		1pc
Storage Temperature Range		-40°C to +85°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.

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