Technical Data Sheet

RCAD3200-TW / Battery Charger

3200W / Wide Range

AC/DC Battery Charger

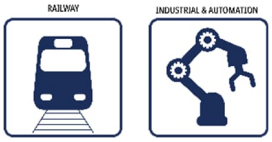
FEATURES

- Fully EN50155 compliant without external circuits
- High efficiency up to 94%
- Full power operation up to +55°C without derating
- Power factor up to 0.9
- Active inrush current limitation
- Suitable for parallel and redundant operation
- Reinforced input-to-output insulation
- RS485 interface with Modbus communication
- Remote ON/OFF control



Dimensions 471.0 x 250.0 x 85.0 mm (18.54 x 9.84 x 3.35 inches)

APPLICATION



SAFETY & EMC

- The converter complies with the LVD Directive 2014/35/EU and EMC Directive 2014/30/EU.
- The converter is CE compliant. Electromagnetic emissions must be evaluated and tested in the complete system since mounting and wiring have a large influence on radiation behaviour.
- Cybersecurity: RCAD3200 features an RS485 serial communication interface with Modbus protocol. CRA-relevant security aspects have been considered in the product design and documentation, including risk assessment. RCAD3200 complies with the Cyber Resilience Act (CRA, EU Regulation 2024/2847) when installed in accordance with the instruction sheet.

DESCRIPTION

The RCAD3200-TW series is a high-performance three-phase AC/DC converter designed for demanding railway and industrial applications. Delivering up to 3.2 kW of output power, it combines high efficiency of up to 94%, reinforced input-to-output insulation and integrated protection functions in a compact and robust package. The unit is fully EN50155 compliant without external circuits and includes an input filter stage for reduced conducted disturbances, active inrush current limitation and RS485 Modbus communication for remote monitoring and control. With operation from -40°C to +55°C at full power, parallel capability and reliable performance in harsh environments, the RCAD3200-TW series is an effective solution for advanced onboard power systems.

MODELS

Part Number	Input Voltage Nom. [3PH VAC]	Input Current Nom. [A]	Output Voltage range [VDC]	Output Current Nom. [A]	Output Power Nom [W]
RCAD3200-400-30-TW	400	5.5	27-30	100	2700-3000
RCAD3200-400-42-TW	400	5.4	36-42	75	2700-3150

RCAD3200-400- -TW

Family model
Nominal Input
Three-phase input
Nominal Output

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BASIC CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.
INPUT				
Rated Input Voltage	Three-phase, three-wire (RST)		400VAC	
Input Voltage Range		360VAC		440VAC
Input Frequency		47.5Hz		63Hz
Max. Input Current	RCAD3200-400-30-TW			6A
	RCAD3200-400-42-TW			5.8A
Max. Input Power				3.4kW
Power Factor	At nominal load (Max at 360VAC – Min at 440VAC)	0.85		0.90
Efficiency	At full load		94%	
Inrush Current				40A
OUTPUT				
Output Voltage Range	RCAD3200-400-30-TW	27VDC		30VDC
	RCAD3200-400-42-TW	36VDC		42VDC
Output Current Range	RCAD3200-400-30-TW		100A	120A[1]
	RCAD3200-400-42-TW		75A	90A[1]
Max. Output Power				3.2kW
Output Voltage Tolerance		-3%		+3%
Output Ripple & Noise (0÷20MHz)			250mV	
Hold-Up Time		10ms		
Line Regulation		-3%		+3%
Load Regulation		-3%		+3%
PFC Compensation	Implemented			

[1] Limited by overcurrent protection (OCP)

ENVIRONMENTAL CONDITIONS

Parameter	Conditions	Min.	Typ.	Max.
Operating Temperature Range	At Full Power	-40°C		+55°C
	With linear power derating of 2%/°C	+55°C		+70°C
Storage Temperature Range		-40°C		+85°C
Operating Altitude	Above sea level			2000m
Cooling	Forced ventilation			

SAFETY AND PROTECTIVE FUNCTIONS

Parameter	Conditions	Min.	Typ.	Max.
Dielectric withstand voltage	Input - Output		4000VDC	
	Input – P.E.		2500VDC	
Isolation	Output – P.E.		750VDC	
Overvoltage protection	RCAD3200-400-30-TW (safeguard in case OVP software does not work)	35V		
	RCAD3200-400-42-TW (safeguard in case OVP software does not work)	48V		
Inrush current protection				40A
Overcurrent protection (OCP)	Vs I In	1.05		1.2
Short circuit protection (SCP)		1.05		1.2
Over-temperature protection (OTP)				90°C
Under voltage alarm		75%		80%

COMMUNICATION AND REMOTE CONTROL

RCAD3200-TW features an RS485 serial communication interface that uses the Modbus protocol. The RS485 interface provides diagnostic information on converter status, including output voltage, output current, internal and external temperatures, and remote control status. The RS485 interface is available on connector X2 via pins IDC_A and IDC_B. When shielded communication cables are used, connection to the internal communication reference 0V_Ext is also available.
The 6-pin connector provides IDC_A, IDC_B and 0V_Ext for parallel connection of multiple units. For parallel operation, a termination resistor of 120Ω is recommended between IDC_A and IDC_B at the last unit.

The communication parameters are as follows:

- BAUD RATE: 19200
- WORD LENGTH: 8
- PARITY: NONE
- STOP BIT: 1
- DEVICE ID: 1 factory default, programmable

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RCAD3200-400-30-TW RS485 MODBUS PROTOCOL REGISTERS					
Register #	**R/W**	**ID**	**Description**	**Conditions**	
40001	R	VOUT	OUTPUT VOLTAGE MEASURED IN 0.01 V INCREMENTS		
40002	R	IOUT	OUTPUT CURRENT MEASURED IN 0.01 A INCREMENTS		
40003	R	TINT	TEMPERATURE MEASURED IN 0.1°C INCREMENTS		
40004	R	TBAT	EXTERNAL PROBE TEMPERATURE MEASURE IN 0.1°C (MODEL PT100)		
40005	R	FAULT REGISTER (INSTANTANEOUS)	**THE FOLLOWING CONDITION IS PRESENT ON THE UNIT NOW:**		
			BIT 0 REMOTE ON/OFF MANAGEMENT	X3 PIN 16: **0** DISCONNECTED / **1** CONNECTED	
			BIT 1 REMOTE ON/OFF	**0** REMOTE OFF	**1** REMOTE ON
			BIT 2 OVERCURRENT	**1** Iout > 100A	**0** Iout ≤ 100A
			BIT 3 UNDERVOLTAGE	**1** Vout < 20V	**0** Vout ≥ 20V
			BIT 4 INTERNAL OVERTEMPERATURE	**1** Tint > 90°C /	**0** Tint ≤ 80°C
			BIT 5 OVERVOLTAGE	**1** Vout > 32V	**0** Vout ≤ 32V
			BIT 6 BATTERY OVERTEMPERATURE	**1** Tbat > 80°C /	**0** Tbat ≤ 70°C
			BIT 7 *NOT USED*	-	
		FAULT REGISTER (HISTORICAL)	**THE FOLLOWING CONDITION WAS PRESENT ON THE UNIT AT LEAST ONCE SINCE POWER-ON**		
			BIT 8 REMOTE ON/OFF MANAGEMENT	**0** X3 pin16 disconnected	**1** X3 pin16 connected
			BIT 9 REMOTE ON/OFF	**0** Remote OFF	**1** Remote ON
			BIT 10 OVERCURRENT	**1** Iout > 100A	
			BIT 11 UNDERVOLTAGE	**1** Vout < 20V	
			BIT 12 INTERNAL OVERTEMPERATURE	**1** Tint > 90°C	
			BIT 13 OVERVOLTAGE	**1** Vout > 32V	
			BIT 14 BATTERY OVERTEMPERATURE	**1** Tbat > 80°C	
			BIT 15 *NOT USED*	-	
40006	R	STATUS	0 UNIT OFF 1 ON/OFF BYPASSED 2 UNIT ON	Due to low Vin, the Inhibit input or RS485 ON/OFF command is bypassed. The unit ON/OFF status can also be controlled via RS485 command.	
40007	R/W	ON-OFF	ON-OFF COMMAND	**1** ON	**0** OFF
40008	R/W	DEVICE ID	MODBUS DEVICE ID	**1** MIN	**32** MAX

RCAD3200-400-42-TW RS485 MODBUS PROTOCOL REGISTERS					
Register #	**R/W**	**ID**	**Description**	**Conditions**	
40001	R	VOUT	OUTPUT VOLTAGE MEASURE IN 0.01V		
40002	R	IOUT	OUTPUT CURRENT MEASURE IN 0.01A		
40003	R	TINT	INTERNAL TEMPERATURE MEASURE IN 0.1°C		
40004	R	TBAT	EXTERNAL PROBE TEMPERATURE MEASURE IN 0.1°C (MODEL PT100)		
40005	R	FAULT REGISTER (INSTANTANEOUS)	**THE FOLLOWING CONDITION IS PRESENT ON THE UNIT NOW:**		
			BIT 0 REMOTE ON/OFF MANAGEMENT	X3 PIN 16: **0** DISCONNECTED / **1** CONNECTED	
			BIT 1 REMOTE ON/OFF	**0** REMOTE OFF	**1** REMOTE ON
			BIT 2 OVERCURRENT	**1** Iout > 75A	**0** Iout ≤ 75A
			BIT 3 UNDERVOLTAGE	**1** Vout < 34V	**0** Vout ≥ 34V
			BIT 4 INTERNAL OVERTEMPERATURE	**1** Tint > 90°C /	**0** Tint ≤ 80°C
			BIT 5 OVERVOLTAGE	**1** Vout > 44V	**0** Vout ≤ 44V
			BIT 6 BATTERY OVERTEMPERATURE	**1** Tbat > 80°C /	**0** Tbat ≤ 70°C
			BIT 7 *NOT USED*	-	
		FAULT REGISTER (HISTORICAL)	**THE FOLLOWING CONDITION WAS PRESENT ON THE UNIT AT LEAST ONE TIME AFTER POWER ON:**		
			BIT 8 REMOTE ON/OFF MANAGEMENT	**0** X3 pin16 disconnected	**1** X3 pin16 connected
			BIT 9 REMOTE ON/OFF	**0** Remote OFF	**1** Remote ON
			BIT 10 OVERCURRENT	**1** Iout > 75A	
			BIT 11 UNDERVOLTAGE	**1** Vout < 34V	
			BIT 12 INTERNAL OVERTEMPERATURE	**1** Tint > 90°C	
			BIT 13 OVERVOLTAGE	**1** Vout > 44V	
			BIT 14 BATTERY OVERTEMPERATURE	**1** Tbat > 80°C	
			BIT 15 *NOT USED*	-	
40006	R	STATUS	0 UNIT OFF 1 ON/OFF BYPASSED 2 UNIT ON	The unit can only be turned on via a RS485 command	
40007	R/W	ON-OFF	ON-OFF COMMAND	**1** ON	**0** OFF
40008	R/W	DEVICE ID	MODBUS DEVICE ID	**1** MIN	**32** MAX

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CERTIFICATIONS	
Compliance	**Standard / Criterion**
RoHS + RoHS2 Restriction of the use of certain hazardous substances in electrical and electronic equipment	RoHS 2011/65/EU + AM2015/863/EU
REACH Regulation	EC 1907/2006
CE conformity	CE

CERTIFICATIONS		
Environmental (Railway Standards)		
Compliance	**Parameter**	**Standard / Criterion**
Low Temperature Start-up Test	Temperature: -40°C - Stabilization time 2h	EN 60068-2-1 (Test Ad)
Dry Heat Test	Temperature: +70°C - Continuous operational checks for 6 h	EN 60068-2-2 (Test Be)
Low Temperature Storage Test	Temperature: -40°C – Low-temperature exposure time 16 h	EN 60068-2-1 (Test Ab)
Cyclic Damp Heat Test	Temperature: +70°C/+25°C - Number of cycles: 2 - Time 2x 24h	EN 60068-2-30 (Test Db) variant 2
Simulated Long-Life Testing	Random Vibration, unit not powered during test Frequency range 5-150Hz with -6db/oct from 20 to 150Hz Each axis 5.72m/s² for 5h [ASD 0.964(m/s²)²/Hz]	EN 61373-1B
Shock Testing	Half-sine shock, unit powered during test Each axis 50m/s² for 30ms Number of shocks: 18 (3 x polarity for each axis)	EN 61373-1B
Functional Random Vibration Test	Random Vibration, unit powered during test Frequency range 5-150Hz with -6db/oct from 20 to 150Hz Each axis 1.01m/s² for 10min [ASD 0.0301(m/s²)²/Hz]	EN 61373-1B
Fire Protection on Railway Vehicles		EN 45545-2 Hazard Level HL3

CERTIFICATIONS		
Safety		
Compliance	**Parameter**	**Standard / Criterion**
Audio/video, information and communication technology equipment	Safety requirements	IEC/EN62368-1
Railway applications - Insulation coordination	Part 1: Basic requirements Clearances and creepage distances for all electrical and electronic equipment	EN50124-1
Railway Applications - Electrical Equipment used on rolling stock		EN50155

CERTIFICATIONS		
EMC Compliance		
Compliance	**Parameter**	**Standard / Criterion**
Railway applications - Electromagnetic compatibility		EN50121-3-2:2017
Electrostatic discharge (ESD) Immunity test	Air: ±8kV Contact: ±6kV	EN 61000-4-2:2008, Criteria A
Radiated, radiofrequency, electromagnetic field immunity test	20V/m (80-1000MHz) 10V/m (1000-2100MHz) 5V/m (2100-4000MHz) 3V/m (4000-6000MHz)	IEC/EN61000-4-3:2006, Criteria A
Fast Transient and Burst Immunity	Input AC Power Port: ±2kV Output DC Power Port: ±2kV	IEC/EN61000-4-4:2012, Criteria A
Surge Immunity	Input AC Power Port: differential mode ±1kV, common mode ±2kV	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

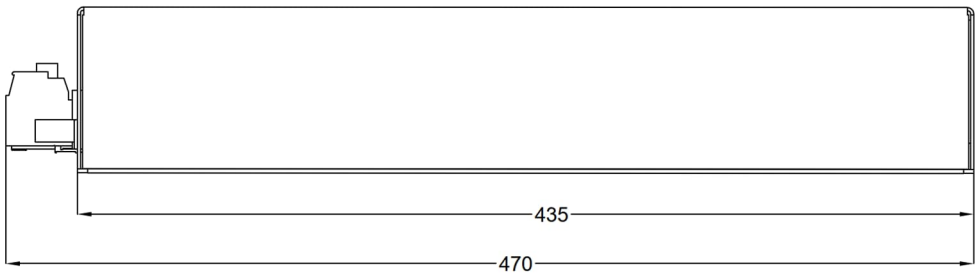
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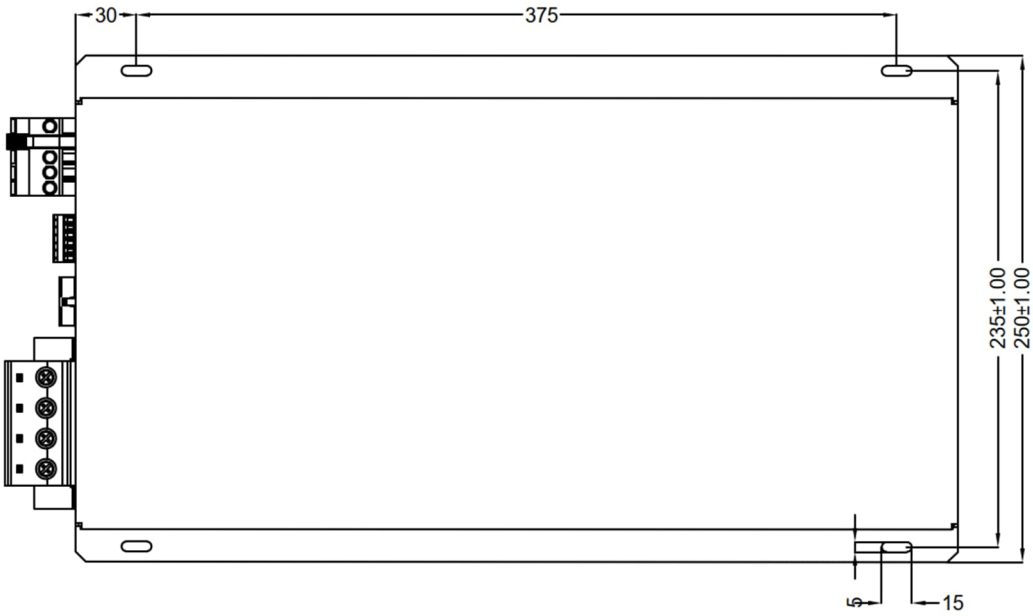
MECHANICAL DATA

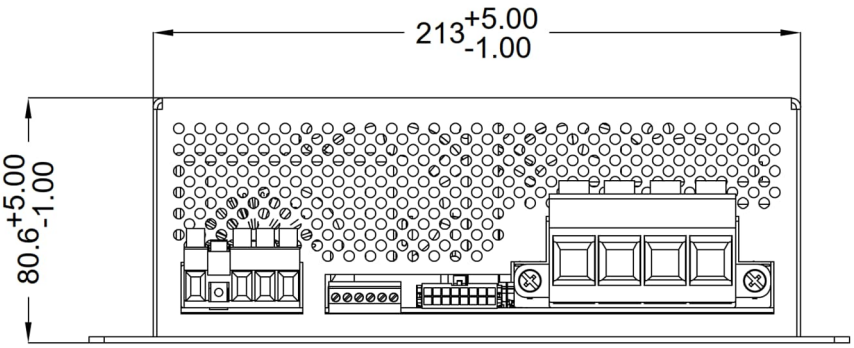
Parameter	Conditions	Min.	Typ.	Max.
Weight				8kg 17.63lbs
Enclosure Material	Cast Aluminium		---	
IP Rating			IP20	
Height			85.0mm 3.35inch	
Width			250.0mm 9.84inch	
Length			471.0mm 18.54inch	

DIMENSIONS

Dimension Drawing (mm)

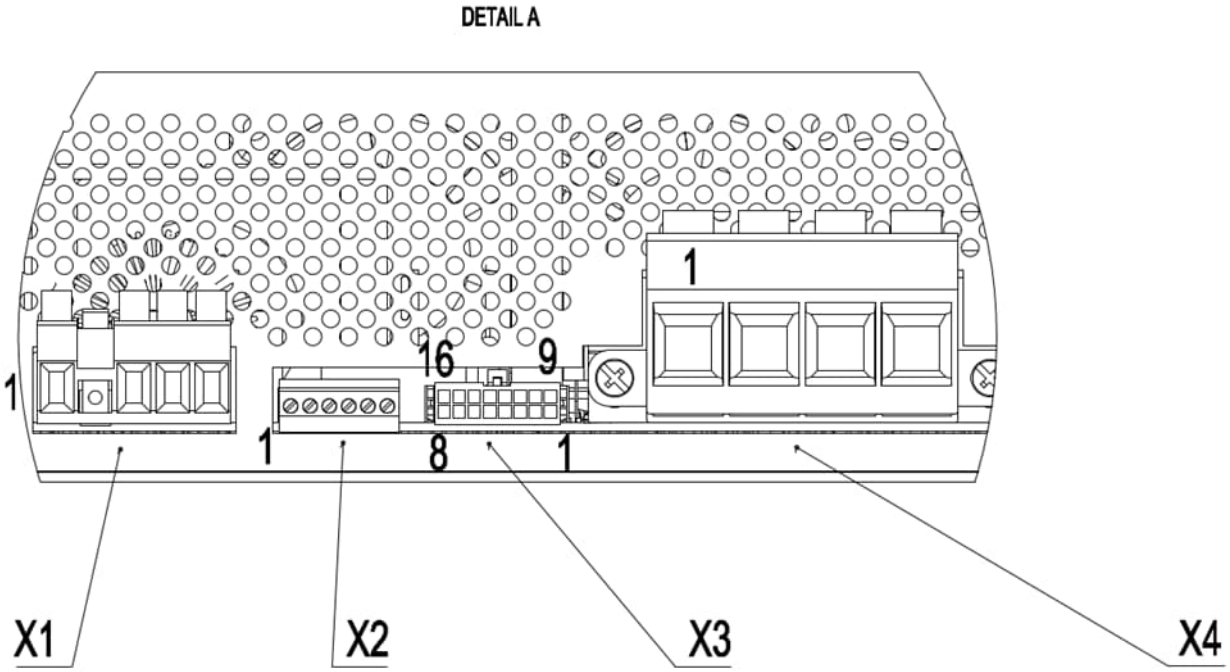






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CONNECTIONS



X1	
1	P.E.
2	Line R
3	Line S
4	Line T

X2	
1	0V_EXT
2	IDC_A
3	IDC_B
4	0V_EXT
5	IDC_A
6	IDC_B

X3			
1	Relay NO	9	Relay NC
2	Temp. PROBE	10	Relay COM
3	Temp. PROBE COM	11	BALANCE
4	-SENSE	12	+SENSE
5	-INHIBIT	13	INHIBIT
6	IPROG	14	VPROG
7	-IPROG	15	-VPROG
8	-ON/OFF	16	ON/OFF

X4	
1	-VOUT
2	-VOUT
3	+VOUT
4	+VOUT

X1
PART
WEIDMULLER
7.62IT/04/90MF2 3.5SN BK BX
COUNTERPART
WEIDMULLER
BVZ 7.62IT/04/180MF2 SN BK BX SO

X2
PART
RS PRO
CTB932HE 897-1149
COUNTERPART
RS PRO
CTB922HE 897-1095

X3	
PART	
MOLEX	
MICROFIT 43045-1621	
COUNTERPART	
MOLEX	TERMINALS
43025-1608	43030-000x

X4
PART
PHOENIX
PC35 HC/4-GF-15,00
COUNTERPART
PHOENIX
PC 35 HC/ 4-STF-15,00

DIMENSIONS AND INSTALLATION INFORMATION

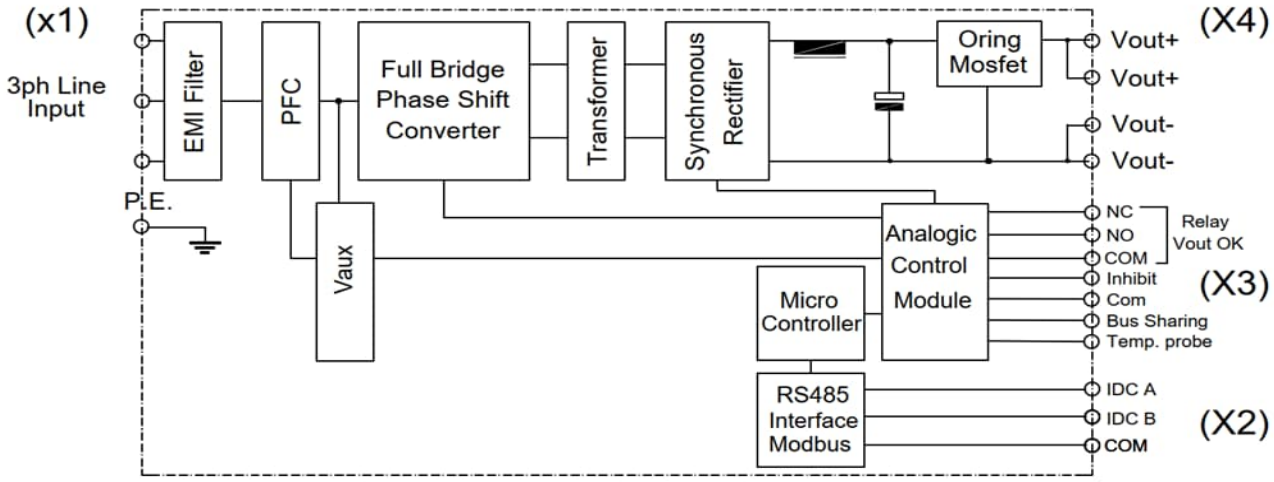
For converter installation, observe the following requirements:

- Install the converter in a secure location out of reach of users to prevent accidental contact with high-voltage parts or burns from hot surfaces.
- Install the converter in a dry area protected from splashing water, dirt, and impact.
- Secure all cables near the device with strain relief elements (not included).
- Allow enough slack in the cables and route them away from sharp edges.
- Ensure the mounting arrangement securely holds the device and minimizes vibration.
- Ensure the enclosure is adequately ventilated to prevent heat buildup.

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BLOCK DIAGRAM

A passive PFC (Power Factor Correction) stage followed by an isolated phase-shifted full-bridge DC/DC converter converts the AC input voltage into a DC output voltage. Auxiliary voltages are produced inside the unit; they are used for the converter control, the signal management and to supply the cooling fan. An input filter stage is provided to conducted disturbances reduction. LINE OK and VOUT OK LEDs allow input and output to be monitored. Similarly, the alarm relay switches over whenever the output voltage value is different from the exact one. A PT100 temperature probe must be connected to X3 connector to allow the output presence and regulation. The probe can be replace with fixed resistor to obtain fixed output voltage. A RS485 communication interface is provided for remote ON/OFF control and diagnostics. Parallel operation is allowed.



PARALLEL OPERATION

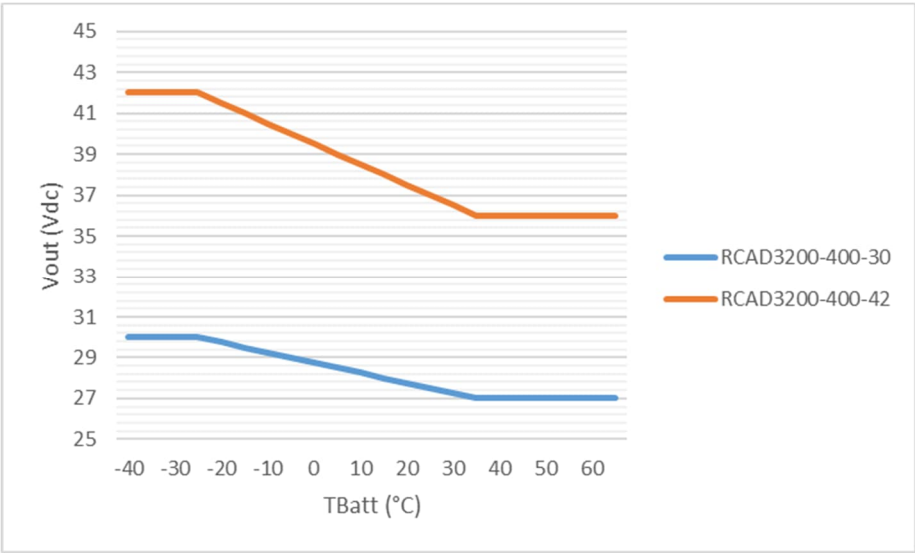
Each converter features a current-sharing circuit that allows up to eight units to be connected in parallel, ensuring balanced load current distribution. The technique is described as follows: there is a comparison between the currents supplied from the various units whose voltage reference is modified so that the same current is supplied from each converters.

Current sharing is allowed only if the unbalance of various power supplies output voltages, in comparison with the equilibrium voltage, is within ± 2.5%.

The current-sharing technique uses a unidirectional adjustment mechanism, increasing only the output voltage of the module supplying the lower current. To use this function, the operator must connect the BALANCE pins of X3 connectors of each unit, in addition to the connection in parallel of power output terminals.

In the case of parallel operation, provide a temperature probe on each converter.

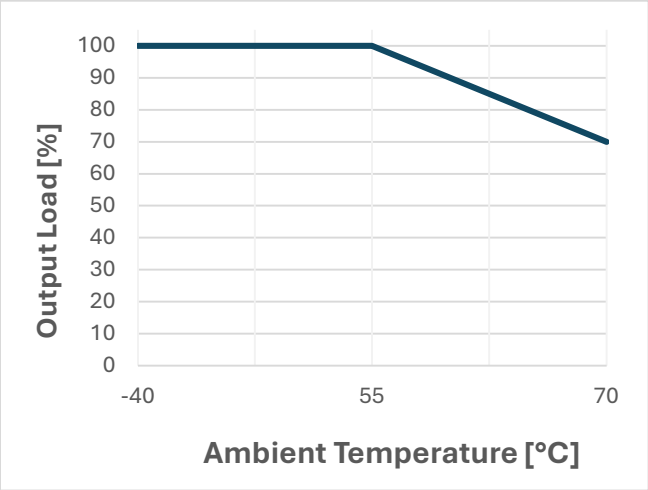
OUTPUT VOLTAGE VARIATIONS



The output voltage is regulated according to the measured temperature (PT100 sensor)

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OUTPUT POWER DERATING CURVE WITH ENVIRONMENTAL TEMPERATURE



WARRANTY AND GUARANTEE

Warranty is subject to RECOM's current general terms and conditions.

INSTRUCTIONS REGARDING DISPOSAL

Correct disposal is essential for the reuse and recycling of electronic equipment. In accordance with applicable electrical and electronic equipment regulations, this product must not be disposed of with household waste and must be collected separately by an authorized specialist service.
Specialist disposal helps to minimize risks to people and the environment. RECOM therefore recommends disposal through a recognized specialist service.

SAFETY INSTALLATIONS – POWER LIMITATIONS

MAINS OVERVOLTAGE PROTECTION

The converter includes integrated mains overvoltage protection. Overvoltage is detected by a fast monitoring circuit and causes immediate shutdown. High-energy transient events, such as lightning-induced surges, are absorbed by dedicated protective components.
Output overvoltage protection is also integrated. Overvoltage at the HV battery side, for example due to load dump or fluctuations, is detected by the monitoring circuit and causes immediate shutdown of the converter.

MAINS INPUT OVERCURRENT PROTECTION

Each input phase is protected by a fuse to prevent damage to the converter and the electrical system caused by overcurrent. If a fuse has operated, the converter must be returned to the supplier. Do not open the device; there are no user-serviceable parts inside.

OVERCURRENT PROTECTION

The converter includes integrated overcurrent protection. Any overcurrent condition is detected by the monitoring circuit and results in current limiting or shutdown, depending on the operating condition.

OVERTEMPERATURE PROTECTION (DERATING)

The converter is protected by temperature-dependent derating. When a defined internal temperature limit is reached, output power is reduced to prevent overheating. The converter continues to operate at reduced power. If the ambient temperature exceeds +70°C, the converter should be shut down to prevent damage. The recommended maximum ambient temperature is +55°C.

REQUIREMENTS FOR OPERATING PERSONNEL

All procedures described in this manual may only be carried out by qualified electricians. Qualified personnel must have:

- appropriate technical training
- knowledge and experience in electronics
- knowledge of the relevant regulations and associated hazards

Qualified personnel must be able to assess the assigned work independently, identify potential hazards, and define the necessary protective measures.

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USE AND LIMITATIONS OF THE PRODUCT

PROPER USE

If the product is intended for a use other than that indicated in the Application paragraph, please contact the supplier in advance.

- The operator must always ensure that the converter's operating limits are not exceeded.
- The converter must only be operated within the limits defined in the **ENVIRONMENTAL CONDITIONS** section.
- Compliance with the relevant EMC directive must be demonstrated by the vehicle integrator for the complete vehicle.

The product information and specifications are subject to change even without prior written notice. The product has been designed for various applications; each customer is responsible for determining its suitability. 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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