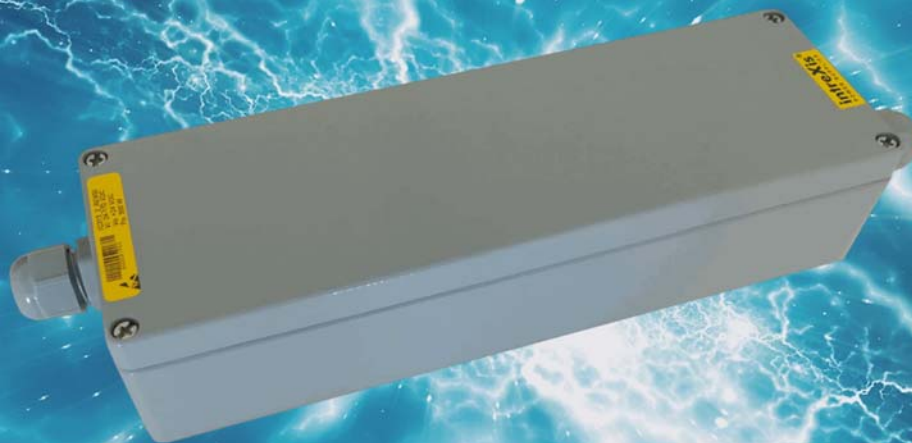


# intreXis<sup>®</sup>

Power Supplies with the



## Datasheet

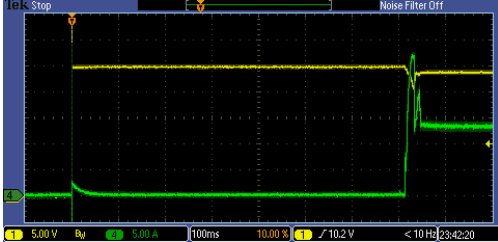
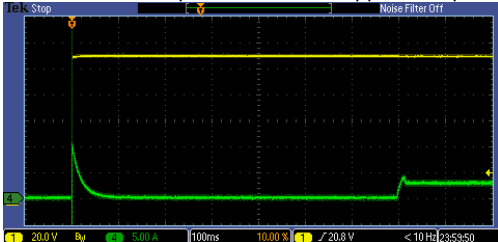
intreXis Boardnet Converter Platform  
IC313\_2, 300 W Single-Output, IP66  
24 Vin – 110 Vin

- ✖tra high efficiency: > 96 % @ 110 Vin, 300 W
- ✖tra wide input voltage range: 24 – 110 VDC
- ✖tra high extra power for overload: 450 W for 100 ms
- ✖tra high peak short circuit current: trips reliably circuit breakers:  
8 A characteristic B, 4 A characteristic C
- ✖tra high peak startup-current: can source up to twice the nominal output  
current during startup: satisfies high peak current absorption of  
demanding loads during startup.  
Startup-current: 25 A typ.

This datasheet covers the details of the IC313\_2 power supply with single output voltage and output power of 300 W. This DC/DC converter is designed according to EN 50155:2021 and IEC 60571:2012 for railway applications and is ideal for other demanding environments which require the highest performance and reliability.

Output voltage: 24 V. Other voltages on request.  
 Ordering code: IC313\_2

## INPUT CHARACTERISTICS

Continuous Input Voltage Range	16.8 – 137.5 VDC
Temporary Input Voltage Range according to EN 50155:2021, 5.2.3	14.4–154.0 VDC for 1.0 sec
Input Undervoltage Lockout	Vin_off = 13.5 VDC typ. Vin_on = 16.1 VDC typ.
Input Voltage Reverse Polarity Protection	Anti-parallel diode at input. Internal fuse blows with reverse polarity.
Inrush Current over the entire operating temperature range	<p>An active inrush limitation circuit limits the input inrush current at switch-on of the input voltage with a 10 Ω-resistor. The second peak 500 ms after switch-on is caused by the first converter-stage.                      (The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on)</p> <p><b>Inrush Current @ 24 Vin, full load</b>                      Switch-on: 2.4 Apk, after 700 ms: approx. 27 Apk</p>  <p>CH1 yellow: Input voltage 5 V/Div, CH4 green: Input current 5 A/Div,                      Timebase: 100 ms/Div</p> <p><b>Inrush Current @ 110 Vin, full load</b>                      Switch-on: 11 Apk, after 700 ms: approx. 4 Apk</p>  <p><b>Inrush Current Integral:</b>  <math>I_{inrush}^2 t &lt; 25 \text{ A}^2\text{s} @ V_{in} = 16.8 - 137.5 \text{ VDC}</math></p>

Input Capacitance	1890 $\mu$ F			
Input Current typ. @ full Load	<b>24 Vin</b>	<b>36 Vin</b>	<b>72 Vin</b>	<b>110 Vin</b>
	13.4 A	8.86 A	4.39 A	2.82 A
Input Power typ. @ no Load over the input voltage range	1.4 – 2.6 W			
Internal Input Fuse	Fuse included, therefore no external fuse required. $I^2t$ -fuse = 1126 A <sup>2</sup> s If you, nevertheless, install an external circuit breaker for any other reason, please select it according to the recommendation below.			
External Circuit Breaker recommendation Important: Circuit Breaker must be rated for the maximum DC-input voltage	<b>24 Vin</b>	<b>36 Vin</b>	<b>72 Vin</b>	<b>110 Vin</b>
	25 A, type B	20 A, type B	10 A, type B	6 A, type B
Interruptions of Input Voltage Supply (Hold-up time)	Class S2 (10 ms) according to EN50155:2021 The converter continues to operate as intended during and after the interruption, with no degradation of performance or loss of function (Performance criterion A).			
Startup time (Time input voltage ON to output voltage ON)	< 1 s for all input voltages			

## OUTPUT CHARACTERISTICS

Output Voltage Nominal @ off load	+24.4 VDC
Max. Continuous Output Power @ Vin = 16.8–137.5 V, 14.4–154 V for 1.0 sec	<p>300 W up to T<sub>amb</sub>= +60 °C</p> <p>300 W - 5 W / °C for T<sub>amb</sub>= +60 – +70 °C (derating)</p> <p>250 W for 10 minutes for T<sub>amb</sub>= +70 – +85 °C (class ST1, ST2 according to EN50155:2021)</p>
Max. Peak Output Power @ Vin = 16.8–137.5 V, 14.4–154 V for 1.0 sec	450 W for 100 ms
Minimum Load	No minimum load required.
Setpoint Accuracy	< 1.0 %
Load Regulation @ off-load to full load over the entire temperature range	< 3.6 %
Line Regulation @ full load over the entire temperature range	< 0.5 %
Output Ripple & Noise @ 20 MHz bandwidth, including spikes	<p>&lt; 50 mVpp @ 25 °C</p> <p>&lt; 250 mVpp @ -50 – +85 °C</p>

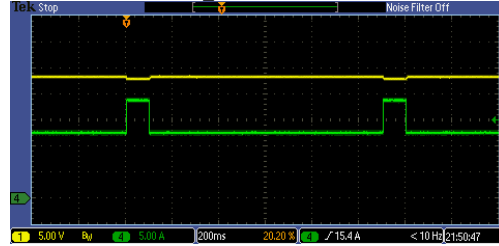
Overload, Startup Current and Short-Circuit

The converter is continuous overload and short-circuit proof.

**Output overloaded:**

Short overloads up to 450 W for 100 ms: no limitation, output voltage remains stable:

Measurement on IC313 5: 300 W for 1 s, 450 W for 100 ms:



CH1 yellow: output voltage 5 V/Div; CH4: output current 5 A/Div  
Timebase: 200 ms/Div

**High peak startup current:**

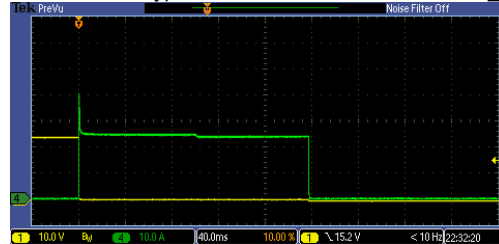
Sources up to twice the nominal output current during startup: satisfies high peak current absorption of demanding loads during startup:

25 A for 100 ms, then 23 A for 100 ms typ.

**Output short-circuited:**

When the output is shorted, the converter delivers 25 A for 100 ms, then 23 A for 100 ms typ.

Measurement: typical short circuit current on IC313 5



CH1 yellow: Output voltage 10 V/Div, CH4 green: Output current 10 A/Div,  
Timebase: 40 ms/Div

Then it switches off and tries periodically to switch on again, every 20 seconds for 200 ms typ.:

Measurement: typical short circuit current on IC313 5



CH1 yellow: Output voltage 5 V/Div, CH4 green: Output current 10 A/Div,  
Timebase: 4 s/Div

If the short-circuit is still present, the converter switches off again and tries again periodically. If the short-circuit is removed, the converter switches on at the next switch-on attempt (hiccup).

**Longer/Higher overloads:**

> 100 ms or > 450 W:  
converter switches off and retries (hiccup)

Current Limit for overload >100 ms (varies due to component tolerances)	13.1 – 15.0 A
Short-Circuit current	25 A for 100 ms followed by 23 A for 100 ms, every 20 sec < 4 Arms trips reliably following circuit breakers: characteristic B: up to 8 A characteristic C: up to 4 A
Overvoltage Protection (OVP) (output voltage is limited, if main regulation loop fails)	< 30 VDC
	SELV-compliant according to EN 60950-1:2006+A2:2013, IEC 60950-1:2005+A1:2009+A2:2013 CSV
Paralleling of Outputs	Paralleling up to 7 units. Falling output-voltage-characteristic ensures current-sharing. Lead lines to load with equal length and cross section ensure accurate current-sharing between units. If one or more units fail, the other units continue delivering power without limitations.
Internal Decoupling Diode	A FET on the output, acting as a decoupling diode, is included for redundant systems with two or more power supply sources driving a load.
Maximum load-capacitance	25 mF

## EFFICIENCY

Conditions	24 Vin	36 Vin	72 Vin	110 Vin
Efficiency typ. @ 100 % Load	93.2 %	94.0 %	95.0 %	96.7 %
Efficiency typ. @ 66 % Load	92.9 %	93.4 %	94.6 %	96.6 %
Efficiency typ. @ 33 % Load	91.2 %	91.8 %	92.7 %	95.3 %

## SIGNALS AND INTERFACES

DC-OK Signal	Optically isolated solid-state relay (between connector X20/pin 5-6, see block diagram)
DC-OK relay switch on threshold	$V_{out} > +23.0 \text{ VDC} \pm 2 \%$
DC-OK relay switch off threshold	$V_{out} < +22.5 \text{ VDC} \pm 2 \%$
DC-OK max. relay current, when on	50 mA max.
DC-OK max. relay voltage-drop, when on	$< 1.7 \text{ VDC} @ 50 \text{ mA}$ (between connector X20/pin 5-6, see block diagram)
DC-OK max. relay voltage, when off (max voltage which can be applied externally)	$\pm 154 \text{ VDC}$ (between connector X20/pin 5-6, see block diagram)

## ELECTROMAGNETIC COMPATIBILITY (EMC)

Test	Standard	Test severity levels	Performance Criteria
Surges	EN 50155:2021 EN 50121-3-2:2016/ A1:2019  IEC60571:2012 IEC 62236-3-2:2018	1.2/50 $\mu$ s 42 $\Omega$ , 0.5 $\mu$ F DC power supply port $\pm$ 2 kV line to ground $\pm$ 1 kV line to line	Criterion B required, but compliant with more strict criterion A
Electrostatic discharge	EN 50155:2021 EN 50121-3-2:2016/ A1:2019  IEC60571:2012 IEC 62236-3-2:2018	$\pm$ 6 kV contact discharge $\pm$ 8 kV air discharge	Criterion B required, but compliant with more strict criterion A
Fast transients	EN 50155:2021 EN 50121-3-2:2016/ A1:2019  IEC60571:2012 IEC 62236-3-2:2018	$\pm$ 2 kV 5/50 ns tr/th 5 kHz repetition frequency	Criterion A
Radio-frequency common mode	EN 50155:2021 EN 50121-3-2:2016/ A1:2019  IEC60571:2012 IEC 62236-3-2:2018	150 kHz – 80 MHz 10 Vrms (carrier voltage) 80 % AM, 1 kHz Source impedance 150 $\Omega$	Criterion A
Radio-frequency electromagnetic field	EN 50155:2021 EN 50121-3-2:2016/ A1:2019  IEC60571:2012 IEC 62236-3-2:2018	80 MHz – 1000 MHz 20 Vrms/m 80 % AM, 1 kHz unmodulated carrier;  1400 MHz – 2000 MHz 10 Vrms/m 80 % AM, 1 kHz unmodulated carrier;  2000 MHz – 2700 MHz 5 Vrms/m 80 % AM, 1 kHz unmodulated carrier;  5100 MHz – 6000 MHz 3 Vrms/m 80 % AM, 1 kHz unmodulated carrier	Criterion A
Conducted emissions	EN 50155:2021 EN 50121-3-2:2016/ A1:2019  IEC60571:2012 IEC 62236-3-2:2018	150 kHz – 500 kHz: 99 dB $\mu$ V quasi-peak 500 kHz – 30 MHz: 93 dB $\mu$ V quasi-peak	
Radiated emissions	EN 50155:2021 EN 50121-3-2:2016/ A1:2019  IEC60571:2012 IEC 62236-3-2:2018	30 MHz – 230 MHz: 40 dB $\mu$ V/m quasi-peak at 10 m  230 MHz – 1000 MHz: 47 dB $\mu$ V/m quasi-peak at 10 m	Class A required, but compliant with more strict Class B



## ENVIRONMENTAL CHARACTERISTICS

Operating Temperature	-50 °C – +85 °C Class OT4: -40 – +70 °C and class ST1,ST2: +15 °C according to EN50155:2021 extended down to -50 °C
Cooling	Natural convection
Storage Temperature Range	-50 °C – +100 °C
Altitude Class	5000 m above sea level max.
Pollution Degree	PD3A according to EN50124-1:2017
Shock and Vibration	According to EN 61373:2010, category 1, class B
Rapid Temperature Variation	Class H2 according to EN 50155:2021: -25 °C to +15 °C / 95 %RH, ±3 °C/s +10 °C to 40 °C / 60 %RH, ±3 °C/s
Protective Coating	Class PC2 according to EN 50155:2021 The board is protected on both sides with a protective transparent fluorescent-pigment coating to prevent deterioration or damage due to moisture and atmospheric contaminants.  The coating is compliant with class 2, according to IPC-A-610H
Prohibited Substances	No substances defined as Prohibited according to the RoHS, REACH, UNIFE (RISL), or Prohibited for the Project, are present.  No substances defined as Declarable according to RoHS, REACH, UNIFE (RISL), or Declarable for the Project, are present.
Fire behaviour	EN 45545-2:2020 compliant with all Hazard Levels HL1-HL3 NFPA 130: 2023

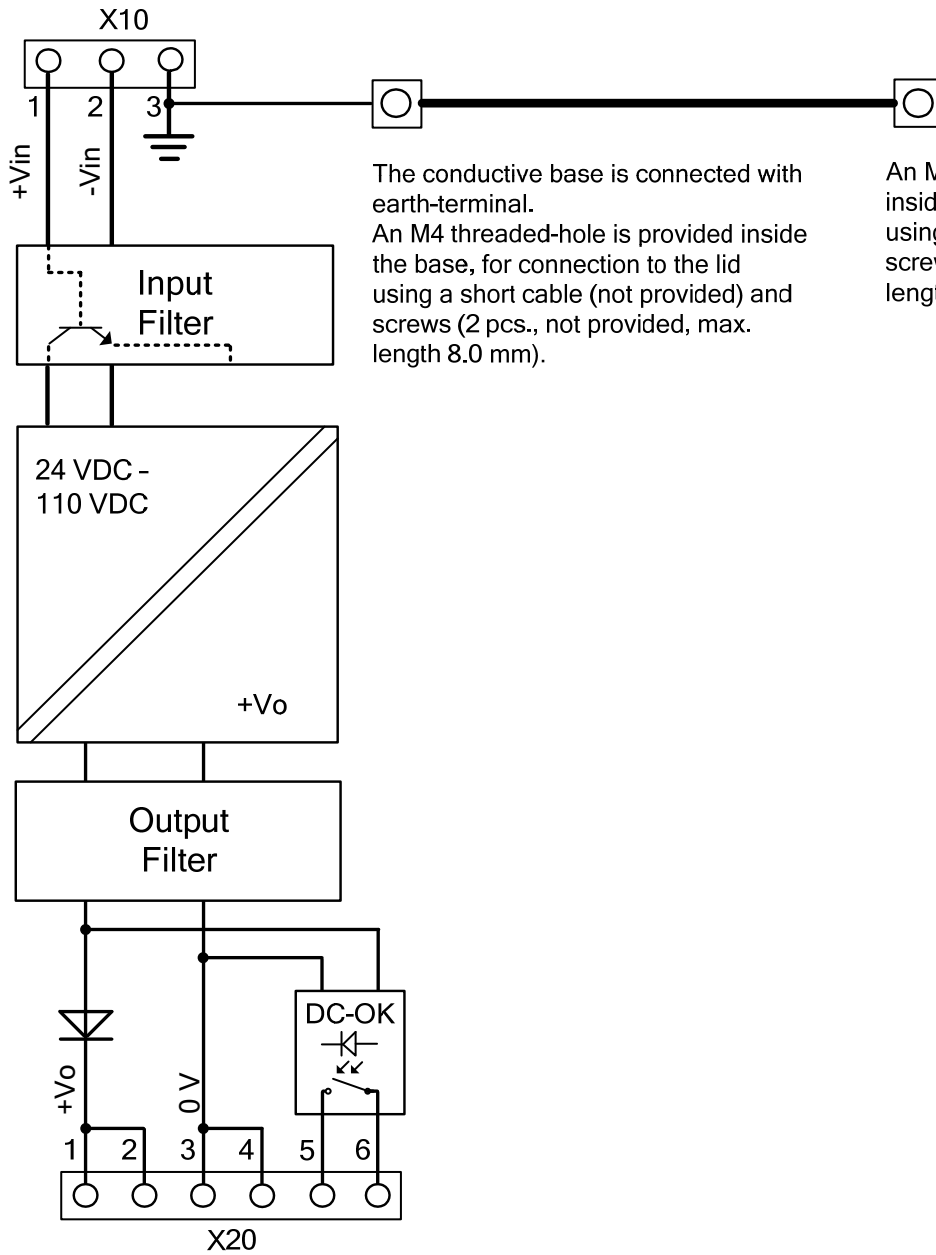
## GENERAL CHARACTERISTICS

General Standard	EN 50155:2021 Railway applications - Rolling stock - Electronic equipment IEC 60571:2012 Railway applications - Electronic equipment used on rolling stock			
Useful Life Class	Class L4 (20 years) according to EN50155:2021			
MTBF Calculation method: MIL-HDBK-217-F2 Using demonstrated Failure Rates of components	<b>Ground Benign (GB), +25 °C</b>	<b>Ground Benign (GB), +40 °C</b>	<b>Ground Fixed (GF), +40°C</b>	<b>Ground Mobile (GM), +40 °C</b>
	6 965 000 h	5 004 000 h	987 000 h	505 000 h
MTBF Calculation method: SN 29500 (IEC 61709)	1 241 000 h @ +50 °C			
Marking	Label with following information: - part number, input voltage range, output voltage, output power - serial number for identification and traceability (printed in text format and as barcode) - revision index			
Connector identification	Printings on PCB to identify connectors. Labels on connectors to identify pin-functions.			

## SAFETY AND INSULATION

Safety Standards	IEC 60950-1:2005+A1:2009+A2:2013 CSV, EN 62368-1:2014+A11:2017 IEC 62368-1:2018
Insulation Coordination	According to EN50124-1:2017
Input, Output, Chassis	The input is galvanically isolated to the output. Input, output and signals are galvanically isolated to the chassis.
Input to Output	Isolation Voltage: 3300 Vrms at 2000 m altitude, 60 s 2500 Vrms at 5000 m altitude, 60 s  Clearance: 5.5 mm Creepage: 5.5 mm  For the type test, the Y-capacitors must be removed according to EN 61287-1:2014. Please ask intreXis AG for advice.  For the routine test according to EN50124-1:2017 of Input to Output and Input to Chassis, intreXis AG recommends the following procedure: connect Output to Chassis, apply a test-voltage of 2125 VDC or 1500 VAC with trigger threshold >10 mA), 10 s between Input and Chassis. For this test, the Y-capacitors must not be removed. Please refer to the intreXis whitepaper "Insulation Test" for detailed information.
Input to Chassis	Isolation Voltage: 1500 Vrms, 60 s Clearance: 2.5 mm Creepage: 2.5 mm  For the routine test, see above.
Output to Chassis	Isolation Voltage: 1000 Vrms, 60 s Clearance: 1.6 mm Creepage: 1.6 mm
DC-OK Signal to Output DC-OK Signal to Chassis	Isolation Voltage: 1000 Vrms, 60 s Clearance: 1.6 mm Creepage: 1.6 mm
Insulation Resistance	Input-Chassis: >550 MΩ Input-Output: >550 MΩ Output-Chassis: >550 MΩ DC-OK Signal-Chassis: >550 MΩ DC-OK Signal-Output: >550 MΩ Test-voltage: 500 VDC

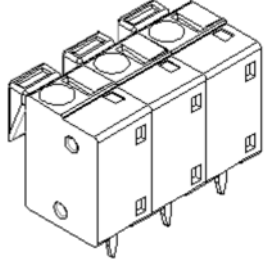
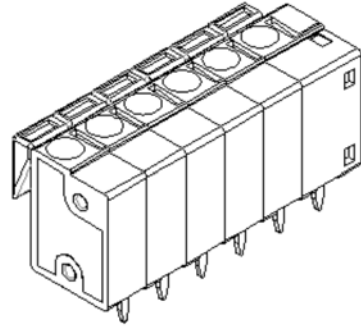
# BLOCK DIAGRAM



The conductive base is connected with earth-terminal.  
 An M4 threaded-hole is provided inside the base, for connection to the lid using a short cable (not provided) and screws (2 pcs., not provided, max. length 8.0 mm).

An M4 threaded-hole is provided inside the lid, for connection to the base using a short cable (not provided) and screws (2 pcs., not provided, max. length 8.0 mm).

## CONNECTOR TYPES

<p><b>Input connector X10</b></p>	<p>Phoenix FFKDSA1/V1-7,62- 3 Terminal block with push-in spring connection Pitch: 7.62 mm, vertical Number of pins: 3 Max. wire size: 1.5 mm<sup>2</sup> Strip length: 10 mm</p> 
<p><b>Output connector X20</b></p>	<p>Phoenix FFKDSA/V1-5,08- 6 Terminal block with push-in spring connection Pitch: 5.08 mm, vertical Number of pins: 6 Max. wire size: 1.5 mm<sup>2</sup> Strip length: 10 mm</p> 

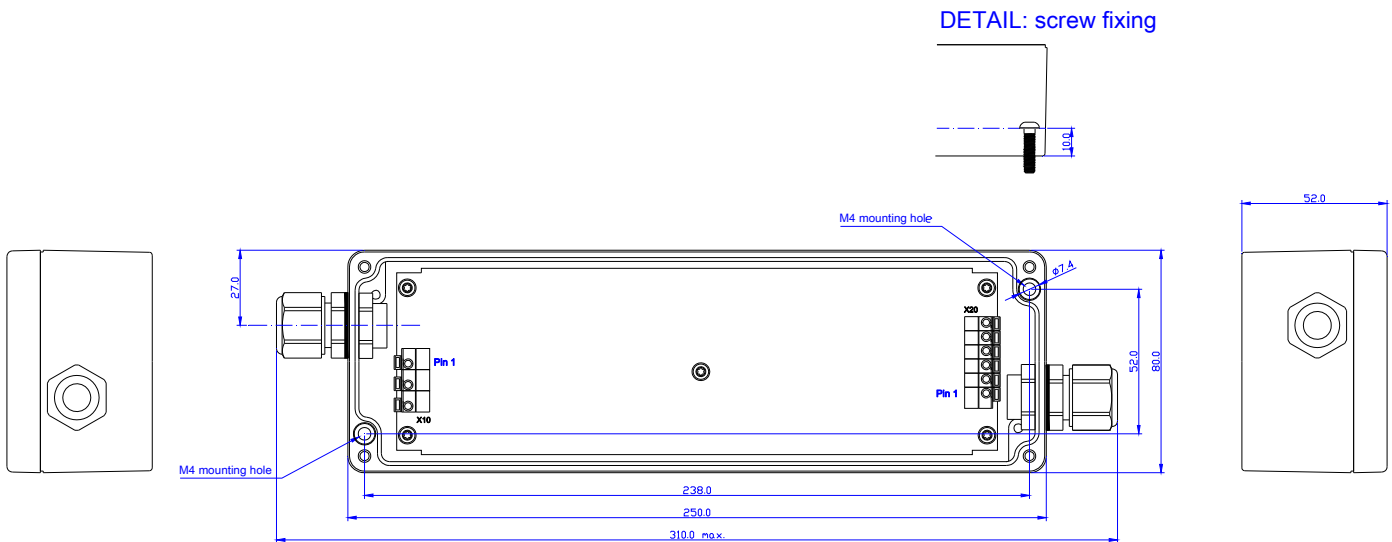
**Notes:**

- cable-glands accept cables with outer diameter of 5 mm min. and up to 10 mm max.

## MECHANICAL CHARACTERISTICS

Chassis	G Al Si 12
Overall dimensions	According to the drawing (millimeters, unless otherwise specified)
Weight	1260 g
IP code	IP66
Mounting	Mounting in any position is allowed

Mechanical drawings:



View from top without cover.

The unit must be fixed with 2x M4 screws (not included) with adequate length, considering that the thickness of the chassis is 10 mm where the screw is inserted, as indicated in the drawing. The head diameter must be less than 7.4 mm.

After connecting the wires, the cover must be screwed using 4 screws (included).

Input connector X10:

1. +Vin
2. -Vin
3. Earth

Output connector X20:

1. +Vo
2. +Vo
3. 0V
4. 0 V
5. DC-OK
6. DC-OK

# TEST COMPLIANCE SUMMARY (CERTIFICATE OF CONFORMITY)

Performed Test	Standard	Test conditions	Performance level	Reference document
Visual inspection	EN 50155:2021 IEC60571:2012	Aspect, dimensions, weight, markings	According to design specification	Test report
Performance test	EN 50155:2021 IEC60571:2012	Ambient temperature. Nominal supply voltage: 24 VDC and 110 VDC Supply voltage range: 16.8 – 137.5 VDC (static)	Criterion A	Test report
Power supply test Supply overvoltages	EN 50155:2021 IEC60571:2012	Supply voltage: 14.4–154 VDC 1s	Criterion B required, but tested with more strict criterion A	Test report
Insulation test	EN 50155:2021 IEC60571:2012	Input – Chassis 500 VDC Input – Output 500 VDC Output – Chassis 500 VDC DC-OK Signal – Output 500 VDC DC-OK Signal – Chassis 500 DC Repeated after Voltage withstand test  Voltage withstand test: Input – Chassis 1500 Vrms 60 s Input – Output 3300 Vrms 60 s Output – Chassis 1000 Vrms 60 s DC_OK – Chassis 1000 Vrms 60 s	Resistance > 20 MΩ (measured >550 MΩ, exceeding the requirement)  No disruptive discharge	Test report
Low temperature test Cold start test	EN 50155:2021 IEC60571:2012	T = -50 °C	Criterion A  (exceeds the requirements, extended range down to -50 °C for extremely cold environments)	Test report
Dry heat test	EN 50155:2021 IEC60571:2012	T = +70 °C (cycle A) T = +85 °C (cycles B and C)	Criterion A	Test report
Low temperature storage test	EN 50155:2021 IEC60571:2012	T = -50 °C	Criterion A after recovery period	Test report
Cyclic damp heat test	EN 50155:2021 IEC60571:2012	T = +55 °C and +25 °C (2 cycles)	Criterion A	Test report
EMC test	EN 50155:2021 IEC60571:2012	See section 'Electromagnetic Compatibility (EMC)'		R-EM-354-0318-01A
Vibration and shock test	EN 50155:2021 IEC60571:2012	EN 61373:2010, Category 1, class B		compliant

Additional tests:

Performed Test	Standard	Test conditions	Performance level	Reference document
Fire behaviour	EN 45545-2:2020	PCB: R25 (EN 60695-2-11, T16: No ignition at T=850 °C)	PASSED (HL1-HL2-HL3)	Fire_Certificate IC313_2

Furthermore, the product is compliant with the requirements of:

- EC 1907/2006 (December, 18th 2006) REACH regulation: Registration, Evaluation, Authorisation and Restriction of Chemicals.
- UNIFE Railway Industry Substance List

Neuhausen am Rheinfeld, 07.06.2023

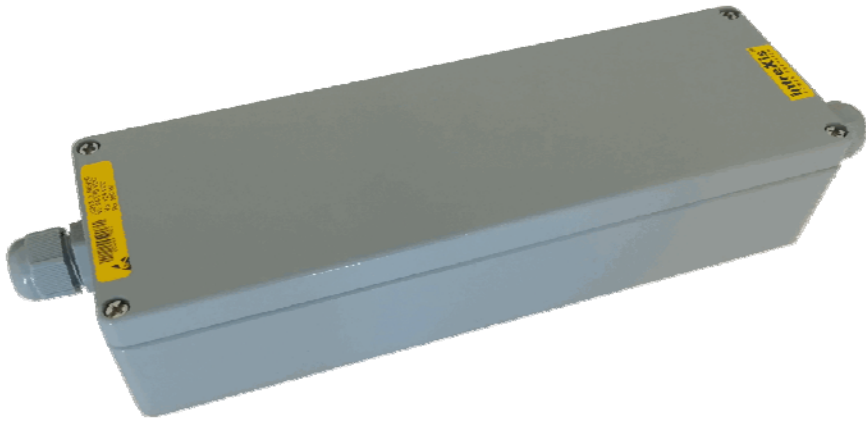

Thomas Schiegg  
intreXis AG





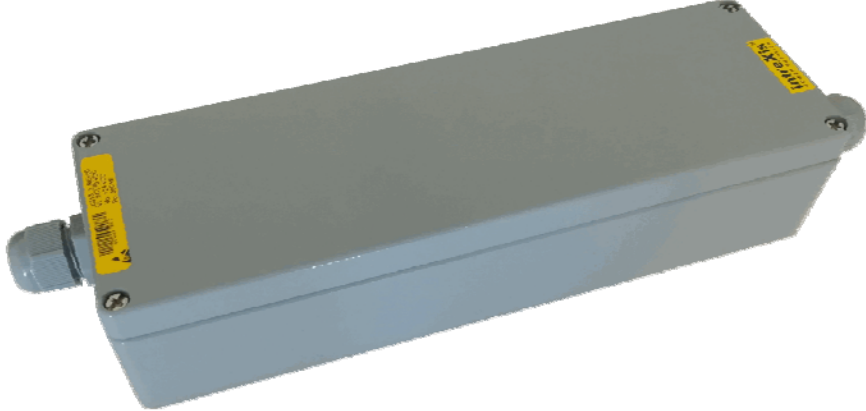



# EU DECLARATION OF CONFORMITY (DoC)


Product Models	IC313_2	
Name and address of the manufacturer	intreXis AG Tobelraastrasse 4 CH-8212 Neuhausen am Rheinfall Switzerland	
This declaration of conformity is issued under the sole responsibility of the manufacturer.		
IC313_2 		
The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:	Low Voltage Directive: RoHS Directive: EMC Directive:	2014/35/EU 2011/65/EU, (EU) 2015/863 2014/30/EU
References to the relevant harmonised standards used or references to the other technical specifications in relation to which conformity is declared:	Low Voltage Directive: RoHS Directive: EMC Directive: Railway Applications:	EN 62368-1:2020/A11:2020 IEC 63000:2016+AMD1:2022 CSV EN 50121-3-2:2016/ A1:2019 EN 50155:2021
Signed for and on behalf of:	intreXis AG Tobelraastrasse 4 CH-8212 Neuhausen am Rheinfall Switzerland	
Place, Date of issue	Neuhausen am Rheinfall, 07.06.2023	
Name, Function, Signature	Thomas Schiegg, Managing Director: 	



# UK DECLARATION OF CONFORMITY (DoC)

Product Models	IC313_2	
Name and address of the manufacturer	intreXis AG Tobelraastrasse 4 CH-8212 Neuhausen am Rheinfall Switzerland	
This declaration of conformity is issued under the sole responsibility of the manufacturer.		
IC313_2 		
The object of the declaration described above is in conformity with the relevant UK legislation:	UK SI 2016 No. 1101:	Electrical Equipment (Safety) Regulations 2016
	UK SI 2012 No. 3032:	The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
	UK SI 2016 No. 1091:	Electromagnetic Compatibility Regulations 2016
References to the relevant standards used or references to the other technical specifications in relation to which conformity is declared:	Low Voltage Directive:	BS EN 62368-1:2020/A11:2020
	RoHS Directive:	BS EN IEC 63000:2018
	EMC Directive:	BS EN 50121-3-2:2016/A1:2019
	Railway Applications:	BS EN 50155:2021
Signed for and on behalf of:	intreXis AG Tobelraastrasse 4 CH-8212 Neuhausen am Rheinfall Switzerland	
Place, Date of issue	Neuhausen am Rheinfall, 07.06.2023	
Name, Function, Signature	Thomas Schiegg, Managing Director: 	

## INSTALLATION AND OPERATION

<p>Safety</p>	<div style="display: flex; align-items: center;">  <div> <p>Warning / Caution !</p> <p>The power supplies should be installed and put into operation only by qualified personnel.</p> </div> </div> <p>Before installing or removing the unit, disconnect the power from the system. The base and the lid have to be electrically connected with a short wire (not provided), using the M4 threaded holes inside the base and the lid, and screws (2 pcs., not provided).</p>
<p>Servicing</p>	<p>In case of failures, malfunctions or defects, the converter must be returned to intreXis for analysis and repair. In particular, the converter should be sent to intreXis for analysis if any damage has occurred to the unit (e.g. the unit dropped). Any attempts to open and repair the unit could void the warranty and could expose the operator to hazardous voltages.</p>
<p>Spare Parts</p>	<p>List and drawings of spare parts are not provided, since the failed units have to be returned to intreXis for analysis and repair.</p>
<p>Disposal</p>	<p>Disused units must be collected separately and disposed at a suitable recycling facility.</p>
<p>Connecting the Cables</p>	<p>Ensure that proper wires are used according to the input current specifications. Prepare the cables according to the specifications of the particular connector used.</p>
<p>Operation of the Unit</p>	<p>Once the input power is applied, the output voltage is enabled.</p>