

# intreXis<sup>®</sup>

Power Supplies with the



## Datasheet

intreXis Boardnet Converter Platform  
IC33X\_2, 70 W Single-Output, 24 Vin – 110 Vin

- ✦ tra high efficiency: 93 % @ 110 Vin, 70 W
- ✦ tra wide input voltage range: 14.4 – 154 VDC
- ✦ tra high extra isolation: 16.8 kVAC primary to secondary

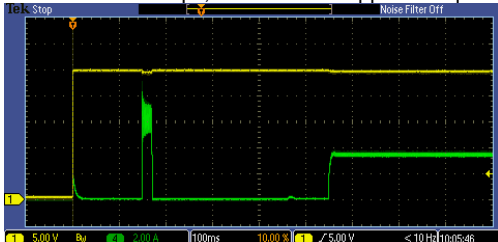
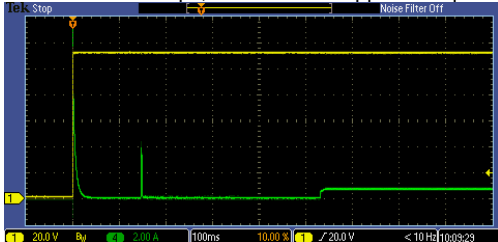
This datasheet covers the details of the IC33X\_2 power supplies with single output voltage and output power of 70 W. These DC/DC converters are designed according to EN 50155:2021 and IEC 60571:2012 for railway applications and are ideal for other demanding environments which require the highest performance and reliability.

Output voltages: 15 V, 24 V. Other voltages on request.

Ordering codes: IC332\_2, IC333\_2

The differences between the variants are explained in this datasheet.

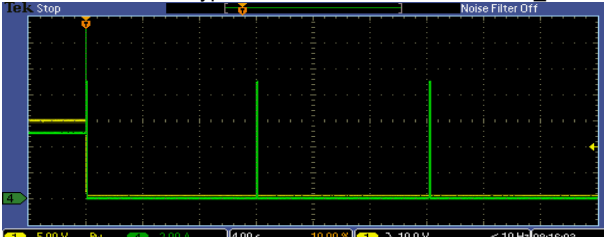
## INPUT CHARACTERISTICS

<p>Continuous Input Voltage Range</p>	<p>16.8 – 137.5 VDC</p>
<p>Temporary Input Voltage Range according to EN 50155:2021, 5.1.1.3</p>	<p>14.4 – 154 VDC for 1.0 sec</p>
<p>Input Undervoltage Lockout</p>	<p>V<sub>in_OFF</sub> = 13.2 VDC ±4 % V<sub>in_ON</sub> = 15.5 VDC ±4 %.</p>
<p>Input Voltage Reverse Polarity Protection</p>	<p>Nosels on connector ensure protection against polarity reversal</p>
<p>Inrush Current over the entire operating temperature range</p>	<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 150 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 150 ms: approx. 8 Apk</p>  <p>CH1 yellow: Input voltage 5 V/Div, CH4 green: Input current 2 A/Div, Timebase: 100 ms/Div</p> <p><b>Inrush Current @ 110 Vin, full load</b> Switch-on: 11 Apk, after 150 ms: approx. 4 Apk</p>  <p>CH1 yellow: Input voltage 20 V/Div, CH4 green: Input current 2 A/Div, Timebase: 100 ms/Div</p> <p><b>Inrush Current Integral:</b> <math>I_{inrush}^2 t &lt; 2.0 A^2s @ V_{in} = 16.8 - 137.5 VDC</math></p>

Input Capacitance	494 $\mu$ F			
Input Current typ. @ full Load	<b>24 Vin</b>	<b>36 Vin</b>	<b>72 Vin</b>	<b>110 Vin</b>
	3.21 A	2.13 A	1.05 A	0.68 A
Input Power typ. @ no Load over the input voltage range	2.2 – 2.5 W			
Internal Input Fuse	Fuse included, therefore no external fuse or circuit breaker required. $I^2t$ -fuse = 171 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>
	6 A, type B	4 A, type B	2 A, type B	2 A, type B
Interruptions of Input Voltage Supply (Hold-up time)	Class S2 (10 ms) according to EN 50155:2021 The converter continues to operate as intended during and after the interruption, with no degradation of performance or loss of function over the entire input voltage range (Performance criterion A).			
Startup time (Time input voltage ON to output voltage ON)	< 600 ms for all input voltages			

## OUTPUT CHARACTERISTICS

Output Voltage Nominal	<b>IC332_2</b>	<b>IC333_2</b>
	+15.0 VDC	+24.0 VDC
Max. Continuous Output Power @ Vin = 16.8–137.5 V, 14.4–154 V for 1.0 sec (no derating over the entire temperature range)	70 W	
Minimum Load	No minimum load required.	
Setpoint Accuracy over the entire, load- line- and temperature range	<b>IC332_2</b>	<b>IC333_2</b>
	14.0 – 17.0 VDC	22.5 – 26.5 VDC
Load Regulation @ off-load to full load over the entire temperature range	<b>IC332_2</b>	<b>IC333_2</b>
	< 1.8 VDC	< 2.0 VDC
Line Regulation @ full load over the entire temperature range	< 1.0 VDC	
Output Ripple & Noise @ 20 MHz bandwidth, including spikes	< 50 mVpp @ -25 – +85 °C < 100 mVpp @ -50 – -25 °C	

<p>Overload and Short-Circuit</p>	<p>The converter is continuous overload and short-circuit proof.</p> <p><b>Output short-circuited:</b>                  When the output is shorted, the converter delivers 9.0 A (IC332_2), 5.8 A (IC333_2) for 100 ms, typ.                  Then it switches off and tries periodically to switch on again, every 12 seconds for 90 ms typ.:</p> <p>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).</p> <p>Measurement: typical short circuit current on IC332_2</p>  <p>CH1 yellow: Output voltage 5 V/Div, CH4 green: Output current 2 A/Div, Timebase: 4 s/Div</p> <p><b>Output overloaded:</b>                  If the output current exceeds the current limit, the converter switches off and tries periodically to switch on again. If the overload is removed, the converter switches on at the next switch-on attempt (hiccup).</p>	
<p>Current Limit (varies due to component tolerances)</p>	<p><b>IC332_2</b></p>	<p><b>IC333_2</b></p>
<p>Short-Circuit current</p>	<p><b>IC332_2</b></p>	<p><b>IC333_2</b></p>
<p>Thermal shutdown threshold to protect against overload or over-temperature</p>	<p>Shutdown threshold (converter is OFF): 130 °C                  Restart threshold (converter is ON): 120 °C                  (temperature measured on bottom primary side)</p>	
<p>Overvoltage Protection (OVP) output voltage is shorted (crowbar) if converter fails</p>	<p><b>IC332_2</b></p>	<p><b>IC333_2</b></p>
<p>Active Decoupling Diode for redundant Systems</p>	<p>Decoupling diode on the output for redundant systems with two or more power supply sources driving a load can be optionally included.                  Please contact intreXis for advice</p>	
<p>Maximum load-capacitance</p>	<p><b>IC332_2</b></p>	<p><b>IC333_2</b></p>
	<p>15 mF</p>	<p>6 mF</p>

## EFFICIENCY

### IC332\_2:

Conditions	24 Vin	36 Vin	72 Vin	110 Vin
Efficiency typ. @ 100 % Load	90.3 %	91.2 %	92.0 %	92.8 %
Efficiency typ. @ 66 % Load	89.8 %	90.3 %	91,1 %	91.9 %
Efficiency typ. @ 33 % Load	86.4 %	86.8 %	87.7 %	88.2 %

### IC333\_2:

Conditions	24 Vin	36 Vin	72 Vin	110 Vin
Efficiency typ. @ 100 % Load	90.9 %	91.9 %	92.8 %	93.5 %
Efficiency typ. @ 66 % Load	90.0 %	90.6 %	91.3 %	92.0 %
Efficiency typ. @ 33 % Load	86.1 %	86.7 %	87.3 %	87.5 %

## 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 EN 50155:2021 extended down to -50 °C
Cooling	Natural convection
Storage Temperature Range	-50 °C – +100 °C
Altitude Class	4500 m above sea level max.
Pollution Degree	PD2 according to EN 50124-1:2017
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

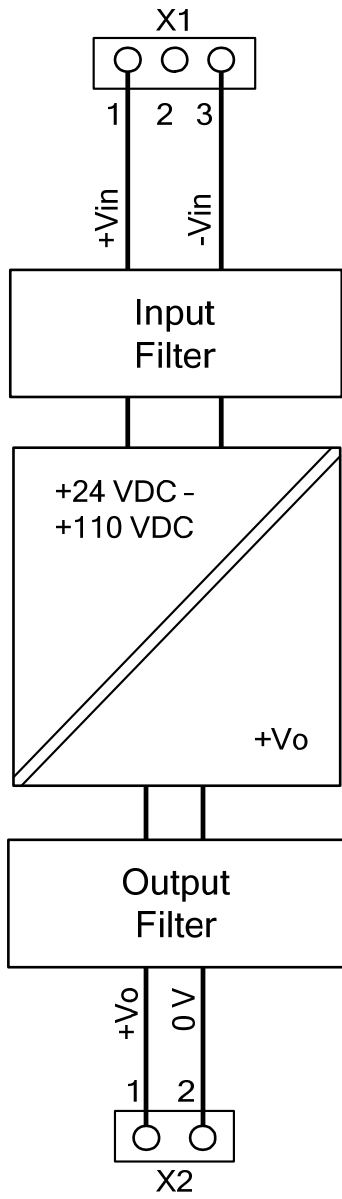
## GENERAL CHARACTERISTICS

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 EN 50155:2021			
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>
	8 764 000 h	6 062 000 h	1 114 000 h	602 500 h
Marking	Label with following information: - part number, input voltage range, output voltage, output power - unique serial number for identification and traceability (printed in text format and as barcode) - revision index			

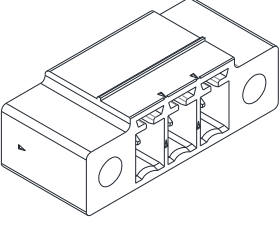
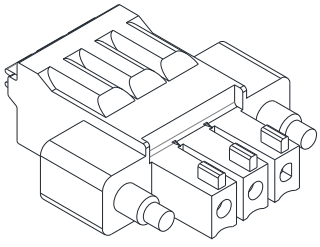
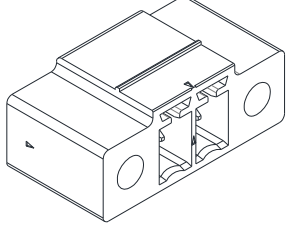
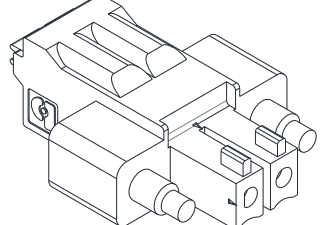
## SAFETY AND INSULATION

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 EN 50124-1:2017
Input to Output	The input is galvanically isolated to the output: Isolation Voltage 16.8 kVrms at 2000 m altitude, 60 s Clearance: 39.0 mm Creepage Material group I (600 ≤ CTI): 42.0 mm
Partial discharge transformer	Extinction voltage: > 5.1 kVAC @ 10 pC threshold
Functional insulation between +Vin and -Vin	Clearance: 3.0 mm Creepage Material group I (600 ≤ CTI): 3.0 mm
Insulation Resistance	Input – Output: > 550 MΩ Test-voltage: 500 VDC

# BLOCK DIAGRAM



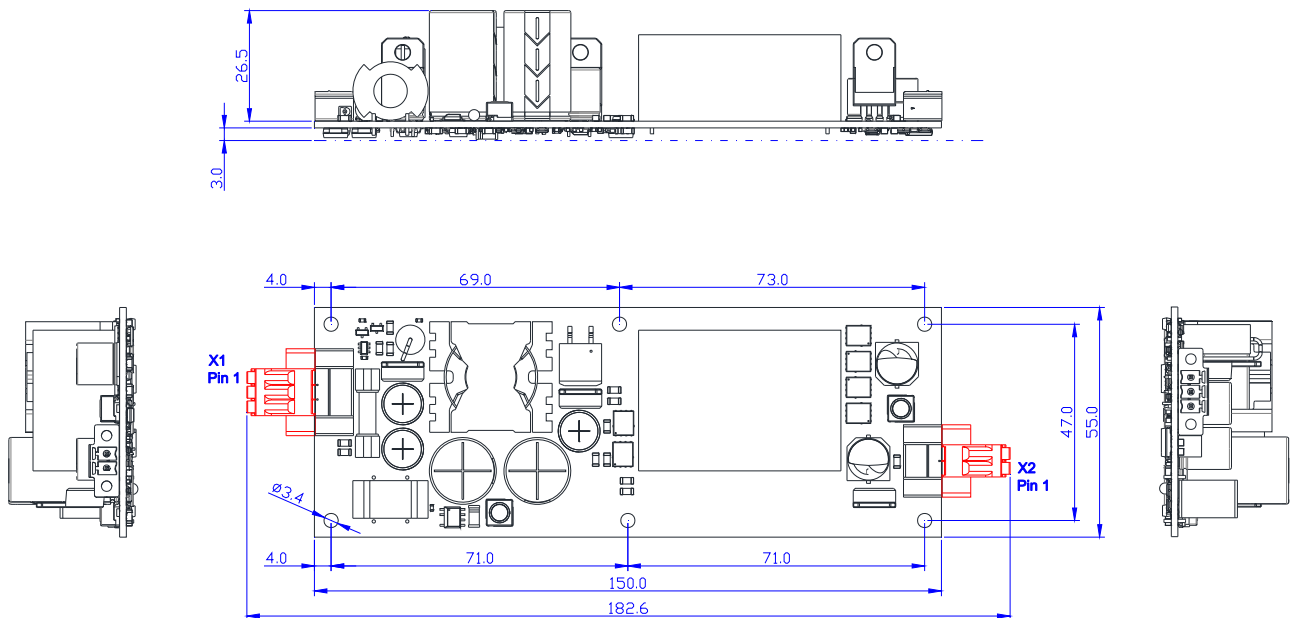
## CONNECTOR TYPES

<p><b>Input connector X1</b></p>	<p>Phoenix MC 1,5/ 3-GF-3,5 or equivalent Pitch: 3.5 mm Number of pins: 3</p>  <p>Mating part: Phoenix FMC 1,5/ 3-STF-3,5 (ordering code: 1966101) Mating connectors are not included in scope of delivery</p> 
<p><b>Output connector X2</b></p>	<p>Phoenix MC 1,5/ 2-GF-3,5 or equivalent Pitch: 3.5 mm Number of pins: 2</p>  <p>Mating part: Phoenix FMC 1,5/ 2-STF-3,5 (ordering code: 1966091) Mating connectors are not included in scope of delivery</p> 

## MECHANICAL CHARACTERISTICS

Overall dimensions	PCB-size = 150 x 55 mm Max. component height above PCB = 26.5 mm Max. component height under PCB = 3.0 mm
Weight	185 g
IP code	IP00
Mounting	Mounting in any position is allowed

Mechanical drawings:



Parts colored in red are mating connectors, that are not provided and are shown for illustration purpose only.

Input Connector X1:

1. +Vin
2. NC
3. -Vin

Output connector X2:

1. +Vo
2. 0 V

The unit must be secured using six M3 screws or bolts (not supplied) in the mounting holes. If a metal baseplate is used, the pillars must be selected to ensure 24 mm gap between the base-plate and the PCB. Otherwise the specified isolation parameters of creepage and clearance are violated.

# 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 – Output 500 VDC Repeated after Voltage withstand test  Voltage withstand test: Input – Output 16.8 kVrms 60 s	Resistance > 20 MΩ (measured >550 MΩ, exceeding the requirement)  No disruptive discharge	Test report
Low temperature start-up 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
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 EN 50121-3-2:2016/ A1:2019 IEC60571:2012 IEC 62236-3-2:2018	See section 'Electromagnetic Compatibility (EMC)'		Testreport_EMC: R-EM-354-0523-01A
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_IC33X_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

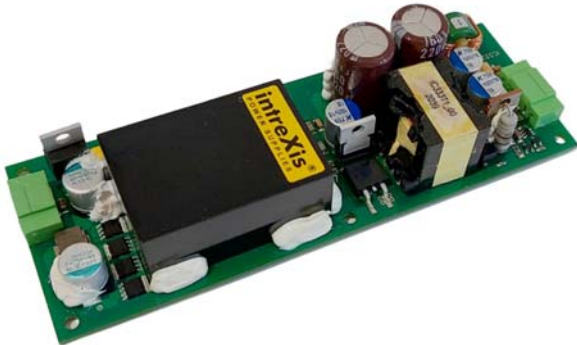

Neuhausen am Rheinfall, 17.05.2023

Thomas Schiegg  
intreXis AG



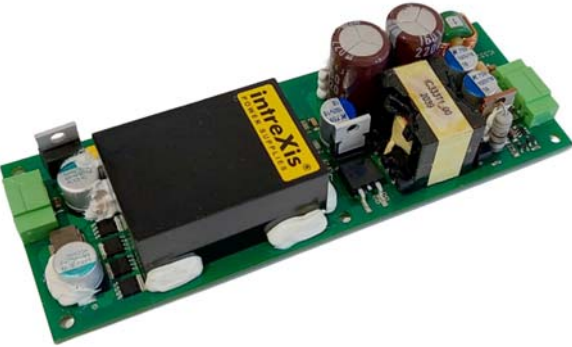



# EU DECLARATION OF CONFORMITY (DoC)


Product Models	IC332_2, IC333_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.		
IC332_2, IC333_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 60950-1:2006+A2:2013 EN 62368-1:2014+A11:2017 EN 63000:2018 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, 17.05.2023	
Name, Function, Signature	Thomas Schiegg, Managing Director: 	



# UK DECLARATION OF CONFORMITY (DoC)

Product Models	IC332_2, IC333_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.		
<p>IC332_2, IC333_2</p> 		
The object of the declaration described above is in conformity with the relevant UK legislation:	<p>UK SI 2016 No. 1101:</p> <p>UK SI 2012 No. 3032:</p> <p>UK SI 2016 No. 1091:</p>	<p>Electrical Equipment (Safety) Regulations 2016</p> <p>The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012</p> <p>Electromagnetic Compatibility Regulations 2016</p>
References to the relevant standards used or references to the other technical specifications in relation to which conformity is declared:	<p>Low Voltage Directive:</p> <p>RoHS Directive:</p> <p>EMC Directive:</p> <p>Railway Applications:</p>	<p>BS EN 60950-1:2006+A2:2013 BS EN 62368-1:2014+A11:2017</p> <p>BS EN 63000:2018</p> <p>BS EN 50121-3-2:2016/A1:2019</p> <p>BS EN 50155:2021</p>
Signed for and on behalf of:	intreXis AG Tobelraastrasse 4 CH-8212 Neuhausen am Rheinfall Switzerland	
Place, Date of issue	Neuhausen am Rheinfall, 17.05.2023	
Name, Function, Signature	<p>Thomas Schiegg, Managing Director:</p> 	

## 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.</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>