intreXis®

Power Supplies with the X

Datasheet

intreXis Boardnet Converter Platform
IC29X, 50 W Single-Output
85 VAC – 264 VAC input

- Xtra high efficiency: > 90 % @ 110 VACin, 50 W
- Xtra wide input voltage range: 85 – 264 VAC
- Xtra wide temperature range: -50 – 85 °C
- Xtra small and light: 99 g (open frame)
- Xtra flat: 21 mm total mounting height (open frame)

This datasheet covers the details of the IC29X power supplies with single output voltage and output power of 50 W. These AC/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 voltage: 12 V, 24 V. Other voltages on request.
Ordering Codes:
IC291_2, IC293_2 (open frame, with push-in connectors);
IC291_3, IC293_3 (standard chassis mount, with terminal block headers).
IC291_8, IC293_8 (DIN-rail mount, with terminal block headers).
The differences between the variants are explained in this datasheet.

INPUT CHARACTERISTICS

Continuous Input Voltage Range	85.0 – 264 VAC 50 – 60 Hz	
Inrush Current @ T = +25 °C	An inrush limitation circuit limits the input inrush current at switch-on of the input voltage with a 10 Ω-NTC (The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on) Inrush Current @ 110 VACin: 11 Apk Inrush Current @ 230 VACin: 23 Apk Inrush Current Integral: I_{inrush}^2t < 4 A^2s @ VACin = 85 – 264 VAC	
Input Capacitance	94 µF	
Input Current typ. @ full Load	**Vin = 110 VAC**	**Vin = 230 VAC**
	1.0 Arms	0.4 Arms
Input Power typ. @ no Load over the input voltage range	**Vin = 110 VAC**	**Vin = 230 VAC**
	0.66 W	0.96 W
Internal Input Fuse	Fuse included, therefore no external fuse or circuit breaker required. I^2t-fuse = 33.7 A^2s 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 AC-input voltage	**Vin = 110 VAC**	**Vin = 230 VAC**
	2 A, type C	3 A, type C
Interruptions of Input Voltage Supply (Hold-up time)	**Vin = 110 VAC**	**Vin = 230 VAC**
	Class S2 (10 ms)	Class S3 (20 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)	< 1.8 s for all input voltages	

OUTPUT CHARACTERISTICS

Output Voltage Nominal	**IC291_X**	**IC293_X**
	12.0 VDC	24 VDC
Max. Continuous Output Power @ Vin = 85 – 264 VAC (no derating over the entire temperature range)	50 W	
Minimum Load	No minimum load required.	
Setpoint Accuracy	< 1.0 %	
Load Regulation @ off-load to full load over the entire temperature range	**IC291_X**	**IC293_X**
	< 0.5 %	< 0.3 %
Line Regulation @ full load over the entire temperature range	< 0.1 %	
Output Ripple & Noise @ 20 MHz bandwidth, including spikes	< 100 mVpp	
Overload and Short-Circuit	The converter is continuous overload and short-circuit proof. **Output overloaded:** The output voltage is reduced and the output current limited (constant current). **Output short-circuited:** When the output is shorted, the converter switches off and tries periodically to switch on again, every 250 ms for 90 ms typ. 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).	
Current Limit (varies due to component tolerances)	**IC291_X**	**IC293_X**
	4.38 – 5.21 A	2.19 – 2.60 A
Short-Circuit current	**IC291_X**	**IC293_X**
	< 5.2 Arms	< 2.6 Arms
Overvoltage Protection (OVP) (output voltage is limited, if main regulation loop fails)	**IC291_X**	**IC293_X**
	< 16 VDC	< 31 VDC
Paralleling of Outputs	Paralleling can be optionally included. Please contact intreXis for advice	
Active Decoupling Diode for redundant Systems	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	
Maximum load-capacitance	**IC291_X**	**IC293_X**
	20 mF	4 mF

EFFICIENCY

Converter	**IC291_X**		**IC293_X**	
Conditions	**110 VACin**	**230 VACin**	**110 VACin**	**230 VACin**
Efficiency typ. @ 100 % Load	90.4 %	89.9 %	91.0 %	90.1 %
Efficiency typ. @ 66 % Load	89.8 %	89.0 %	90.1 %	89.7 %
Efficiency typ. @ 33 % Load	88.4 %	86.3 %	88.8 %	86.4 %

SIGNALS AND INTERFACES

LED	Green LED on output side indicates that output voltage is ok

ELECTROMAGNETIC COMPATIBILITY (EMC)

Test	Standard	Test severity levels	Performance Criteria
Surges	EN 50155:2021 EN 50121-3-2:2016/ A1:2019 EN 50121-4:2016/ A1:2019 IEC60571:2012 IEC 62236-3-2:2018	1.2/50 µs 2 Ω, 0.5 µF AC power supply port ±2 kV line to ground ±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	±6 kV contact discharge ±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	±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 Ω	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 dBµV quasi-peak 500 kHz – 30 MHz: 93 dBµV quasi-peak	compliant with more strict EN 55032 Class A
Radiated emissions	EN 50155:2021 EN 50121-3-2:2016/ A1:2019 IEC60571:2012 IEC 62236-3-2:2018	30 MHz – 230 MHz: 40 dBµV/m quasi-peak at 10 m 230 MHz – 1000 MHz: 47 dBµV/m quasi-peak at 10 m	Class A required, but compliant with more strict Class B

Radiated emissions	Regelung Nr. EMV 06 Revision 2, Anhang E	Schutzklasse S1	

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 Additionally for the open frame variants IC29X_2, two gap-pads can be used to improve heat dissipation to the outside environment (refer to section 'Mechanical Characteristics and Mounting').
Storage Temperature Range	-50 °C – +100 °C
Altitude Class	Class Ax (>1400 m) according to EN 50125-1:2014: 5000 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 K/s +10 °C to +40 °C / 60 %RH, ±3 K/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

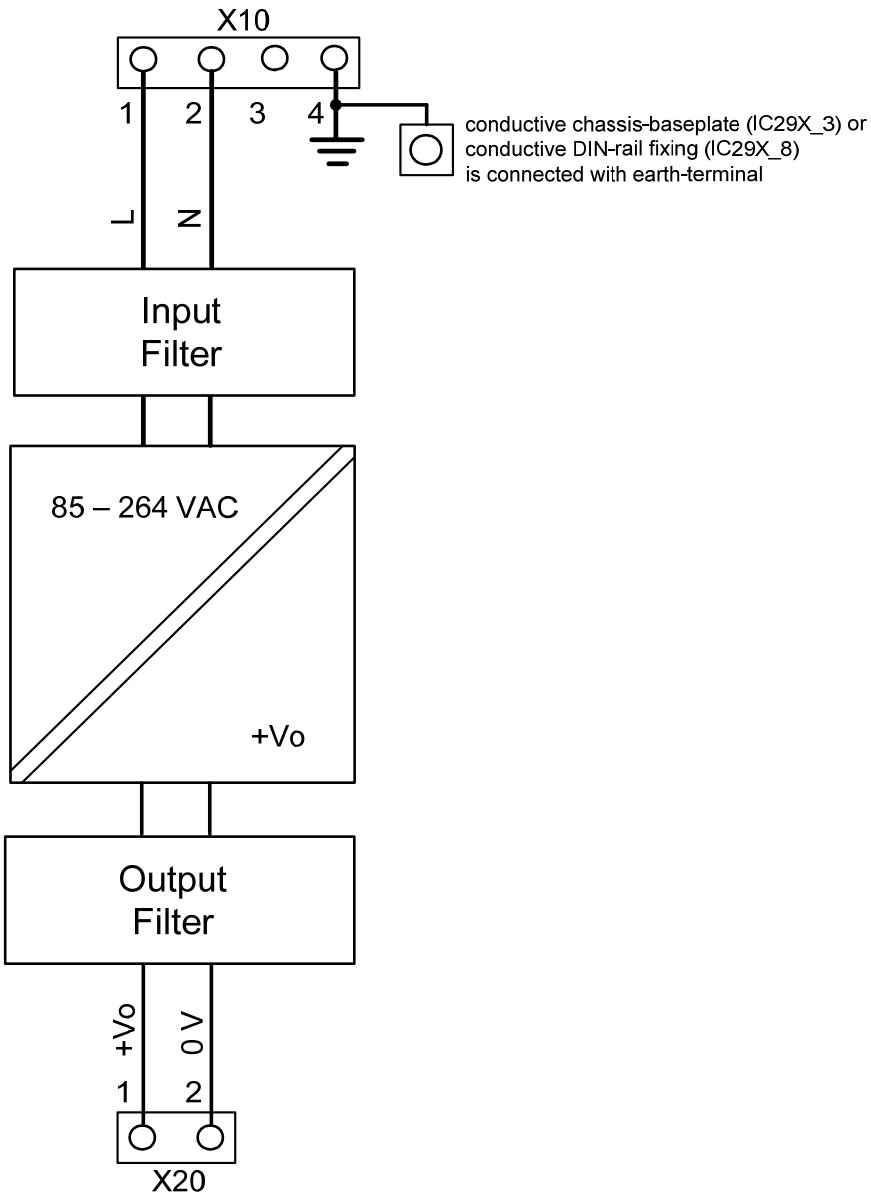
GENERAL CHARACTERISTICS

<table>
<tr><td>General Standard</td><td colspan="4">EN 50155:2021
Railway applications - Rolling stock - Electronic equipment
IEC 60571:2012
Railway applications - Electronic equipment used on rolling stock</td></tr>
<tr><td>Useful Life Class</td><td colspan="4">Class L4 (20 years) according to EN 50155:2021</td></tr>
<tr><td rowspan="2">MTBF
Calculation method: MIL-HDBK-217-F2
Using demonstrated Failure Rates of components</td><td>Ground Benign (GB), +25 °C</td><td>Ground Benign (GB), +40 °C</td><td>Ground Fixed (GF), +40°C</td><td>Ground Mobile (GM), +40 °C</td></tr>
<tr><td>17 171 700 h</td><td>12 816 300 h</td><td>2 567 000 h</td><td>1 205 400 h</td></tr>
<tr><td>MTBF
Calculation method: SN 29500 (IEC 61709)</td><td colspan="4">3 332 300 h @ +50 °C</td></tr>
<tr><td>Marking</td><td colspan="4">Label with following information:
- part number, input voltage range,
- output voltage, output power
(only for IC29X_3 and IC29X_8)
- unique serial number for identification and traceability
(printed in text format and as barcode)
- revision index</td></tr>
<tr><td>Connector identification</td><td colspan="4">IC29X_2:
printings on PCB to identify connectors and pin 1.
IC29X_3, IC29X_8:
printings on chassis to identify connectors and pin-functions</td></tr>
</table>

SAFETY AND INSULATION

Safety Standards	IEC 60950-1:2005+A1:2009+A2:2013 CSV EN 62368-1:2020+A11:2020 IEC 62368-1:2023
Insulation Coordination	According to EN 50124-1:2017
Input, Output, Chassis	The input is galvanically isolated to the output. Input and output are galvanically isolated to the base-plate (or chassis). IC29X_2: for the open frame variants, the isolation characteristics are ensured only if mounted according to section 'Mechanical Characteristics and Mounting'.
Input to Output	Isolation Voltage: 3300 Vrms at 2000 m altitude, 60 s 2500 Vrms at 5000 m altitude, 60 s Clearance: 6.42 mm Creepage: 6.42 mm For the type test, the Y-capacitors must be removed according to EN 61287-1:2014. Please refer to the intreXis whitepaper “Insulation Test” for detailed information. For the routine test according to EN 50124-1:2017 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 Base-plate (or Chassis)	Isolation Voltage: 2000 Vrms, 60 s Clearance: 2.5 mm Creepage: 2.5 mm For the routine test, see above.
Output to Base-plate (or 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 Test-voltage: 500 VDC

BLOCK DIAGRAM



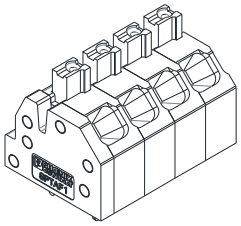
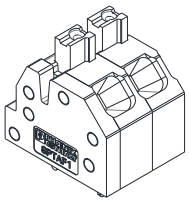
Notes:

- conductive chassis-baseplate only for IC29X_3
- conductive DIN-rail fixing only for IC29X_8

CONNECTOR TYPES

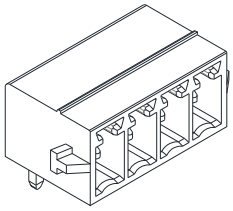
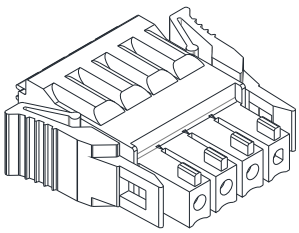
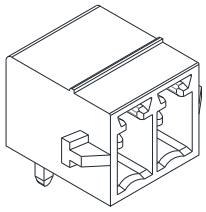
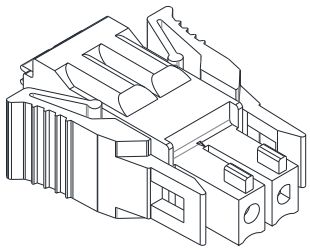
IC29X_2

(open frame, with push-in connectors)

Input connector X10	Phoenix SPTAF 1/ 4-3,5-EL or equivalent Pitch: 3.5 mm Number of pins: 4 Push-in spring connection for wire-size of 1.5 mm^2 max. Strip length: 8 mm. 
Output connector X20	Phoenix SPTAF 1/ 2-3,5-EL or equivalent Pitch: 3.5 mm Number of pins: 2 Push-in spring connection for wire-size of 1.5 mm^2 max. Strip length: 8 mm. 

IC29X_3
(standard chassis mount, with terminal block headers)

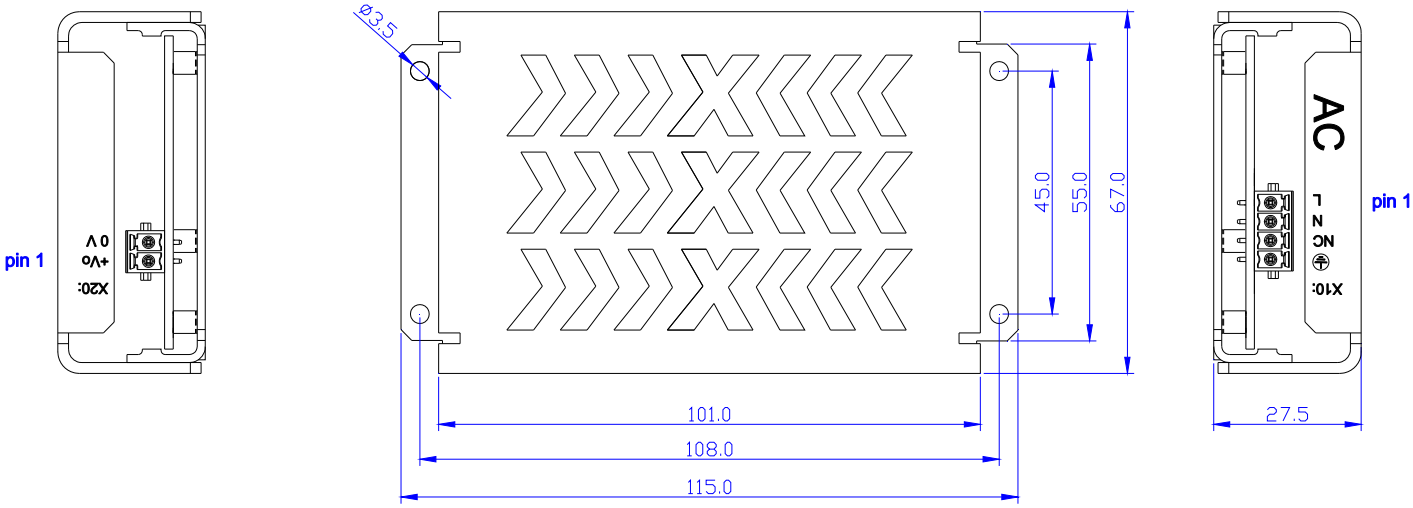
IC29X_8
(DIN-rail mount, with terminal block headers)

Input connector X10	Phoenix MC 1,5/ 4-G-3,5-RN or equivalent Pitch: 3.5 mm Number of pins: 4  Mating part: Phoenix FMC 1,5/ 4-ST-3,5-RF, Ordering code: 1952047 
Output connector X20	Phoenix MC 1,5/ 2-G-3,5-RN or equivalent Pitch: 3.5 mm Number of pins: 2  Mating part: Phoenix FMC 1,5/ 2-ST-3,5-RF, Ordering code: 1952021 

MECHANICAL CHARACTERISTICS

Chassis	Aluminium: EN AW 5052 - AL5052 - AlMg2.5 or EN AW 5754 - AL5754 - AlMg3 IC29X_3: Baseplate: blank Cover: black anodized IC29X_8: DIN-rail fixing: blank Cover: black anodized
Overall dimensions	According to the drawing (millimeters, unless otherwise specified)
Weight	IC29X_2: 99 g IC29X_3: 188 g IC29X_8: 237 g
IP code	IC29X_2: IP00 IC29X_3, IC29X_8: IP20
Mounting	Mounting in any position is allowed

IC29X_3 (standard chassis mount)

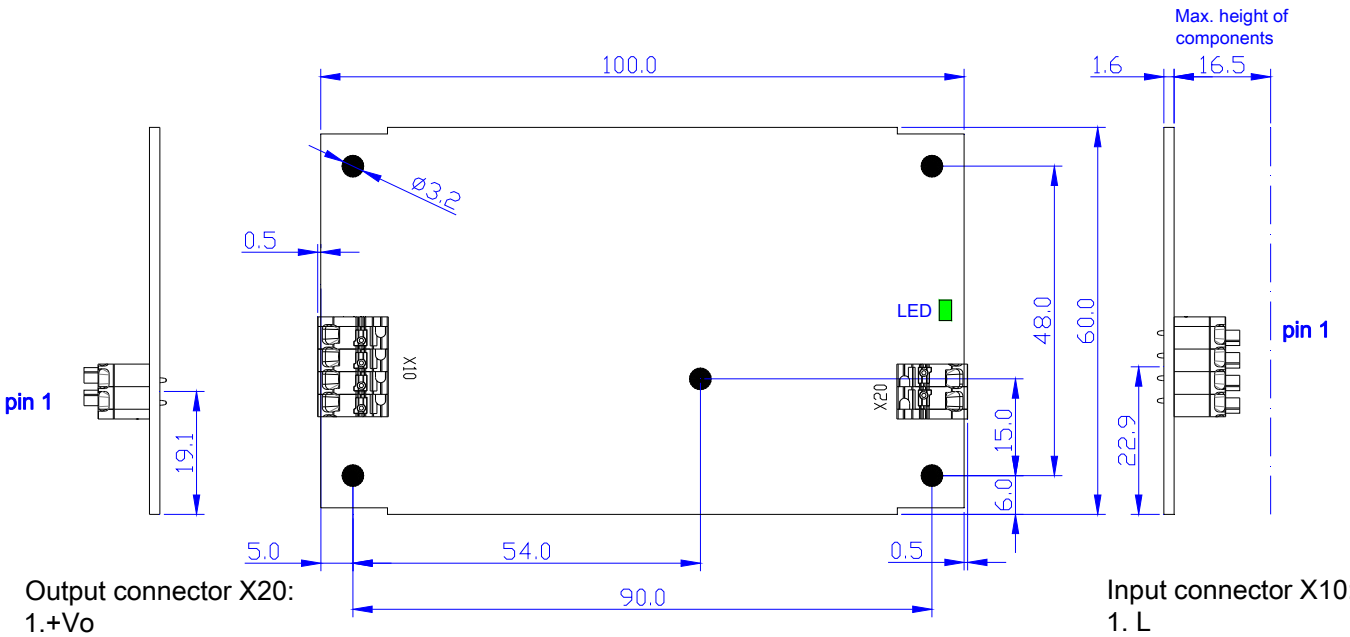


Output connector X20:
1. +Vo
2. 0 V

Input connector X10:
1. L
2. N
3. NC
4. Earth

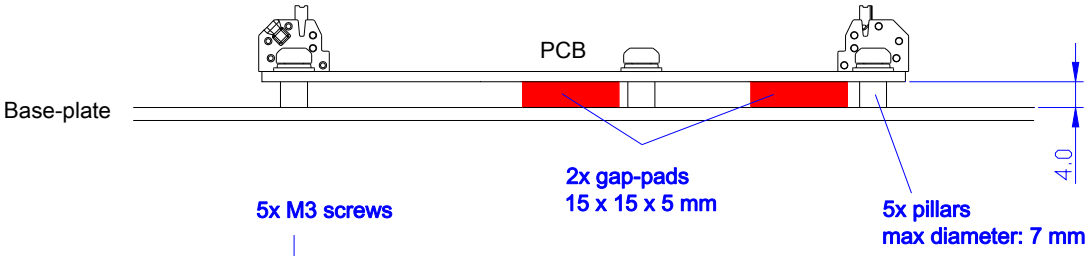
The unit must be secured using four M3 screws or bolts (not supplied) in the mounting holes.

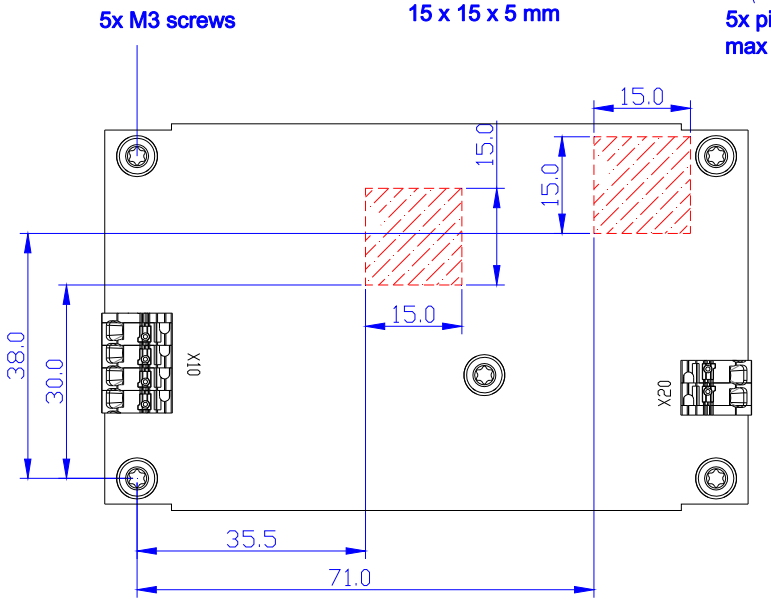
IC29X_2 (open frame, with push-in connectors)



Output connector X20:
1.+Vo
2. 0 V

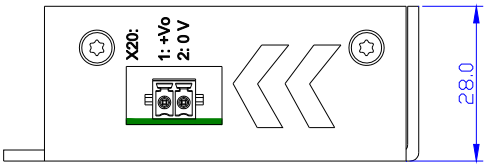
Input connector X10:
1. L
2. N
3. NC
4. Earth



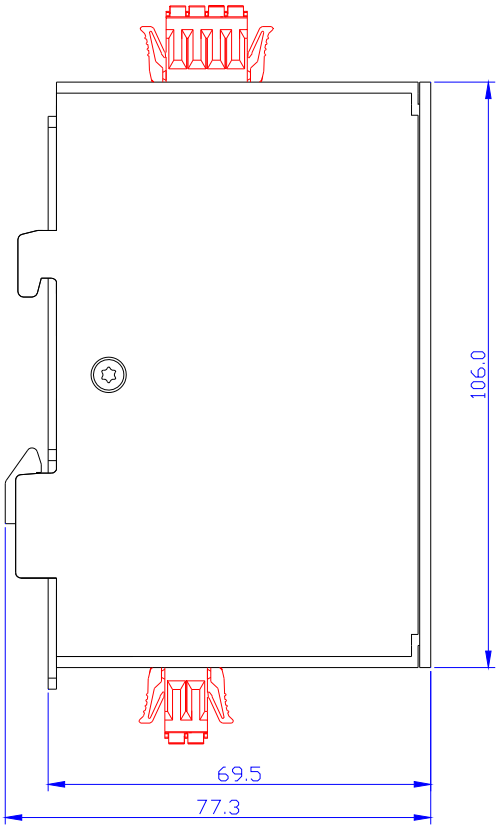


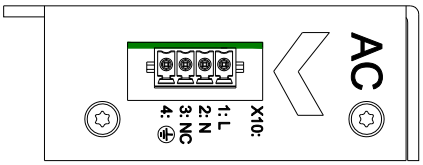
On the board, five mounting holes are provided to fix the units over pillars, using five M3 screws (pillars and screws not supplied). The pillars must be selected to ensure 4 mm gap between the base-plate and the PCB, as shown in the drawing.
If no gap-pads are used, the pillars must ensure that the distance between the base-plate and the PCB is ≥ 6 mm to ensure the specified isolation-parameters.

IC29X_8 (DIN-rail mount)



Output connector X20:
1. +Vo
2. 0 V





Input connector X10:
1. L
2. N
3. NC
4. Earth

Gap-pads for cooling (only open frame versions):

For most applications, the gap-pads are not necessary and conductive cooling is sufficient for full power (no derating) over the entire ambient temperature range.
The gap-pads are only necessary for applications where it is desired to conduct as much heat as possible to the outside, to keep the internal chassis-temperature as low as possible (for instance closed chassis with other heat sources). In this case, two thermally-conductive gap-pads can be positioned under the PCB as specified in the drawing to allow heat transfer to the base-plate.
The gap-pads must be ordered separately from intreXis AG, ordering code: ***gappad_15x15x5.***
The base-plate must be thermally conductive (e.g. steel or aluminium).

Gap-pad properties:

Dimensions	15 x 15 mm
Thickness	5.0 mm
Hardness (Shore 00)	30
Operating temperature	-60 – 200 °C
Thermal Conductivity	≥ 2.0 W/mK
Breakdown voltage	≥ 7.5 kV/mm

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: 110 VAC and 230 VAC Supply voltage range: 85 – 264 VAC (static)	Criterion A	Test report
AC Power supply test Supply overvoltages	EN 50155:2021 according to Annex I IEC60571:2012	Supply voltage: 85 – 264 VAC	According to design specification	Test report
Insulation test	EN 50155:2021 IEC60571:2012	Input – Chassis 500 VDC Input – Output 500 VDC Output – Chassis 500 VDC Repeated after Voltage withstand test Voltage withstand test: Input – Chassis 2000 Vrms 60 s Input – Output 3300 Vrms 60 s Output – 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
Electromagnetic compatibility test	EN 50155:2021 EN 50121-3-2:2016/ A1:2019 IEC60571:2012 IEC 62236-3-2:2018 Regelung Nr. EMV 06 Revision 2, Anhang E Schutzklasse S1	See section 'Electromagnetic Compatibility (EMC)'		Testreport_EMC R-EM-354-0624-03A EMV06-Report_277-24_V2U
Shock and vibration 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_IC29X

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, 27.06.2024

Thomas Schiegg
intreXis AG

EU DECLARATION OF CONFORMITY (DoC)

CE

Product Models	IC291_2, IC291_3, IC291_8, IC293_2, IC291_3, IC291_8	
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.		
IC291_2, IC293_2 IC291_3, IC293_3 IC291_8, IC293_8		
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, 27.06.2024	
Name, Function, Signature	Thomas Schiegg, Managing Director:	

UK DECLARATION OF CONFORMITY (DoC)

Product Models	IC291_2, IC291_3, IC291_8, IC293_2, IC291_3, IC291_8	
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.		
IC291_2, IC293_2 IC291_3, IC293_3 IC291_8, IC293_8 		
The object of the declaration described above is in conformity with the relevant UK legislation:	UK SI 2016 No. 1101: UK SI 2012 No. 3032: UK SI 2016 No. 1091:	Electrical Equipment (Safety) Regulations 2016 The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 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: RoHS Directive: EMC Directive: Railway Applications:	BS EN 62368-1:2020/A11:2020 BS EN IEC 63000:2018 BS EN 50121-3-2:2016/A1:2019 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, 27.06.2024	
Name, Function, Signature	Thomas Schiegg, Managing Director: 	

INSTALLATION AND OPERATION

Safety	Warning / Caution! The power supplies should be installed and put into operation only by qualified personnel. Before installing or removing the unit, disconnect the power from the system. The main protective earthing terminal is provided on the connector X10/pin 4. In addition to the main protective earthing terminal (X10/pin 4), a separate protective earthing terminal must be permanently connected to the conductive chassis-baseplate (IC29X_3) or to the conductive DIN-rail fixing (IC29X_8) or to the plated mounting holes, e.g. through pillars (IC29X_2).
Servicing	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.
Spare Parts	List and drawings of spare parts are not provided, since the failed units have to be returned to intreXis for analysis and repair.
Disposal	Disused units must be collected separately and disposed at a suitable recycling facility.
Connecting the Cables	Ensure that proper wires are used according to the input current specifications. Prepare the cables according to the specifications of the particular connector used.
Operation of the Unit	Once the input power is applied, the output voltage is enabled.