

**white bream**

# Leakage Current Networks



<b>White Bream Oud-Beijerland The Netherlands</b> <a href="https://whitebream.com">https://whitebream.com</a>		
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# I Preface

## I.1 Disclaimer

White Bream products are not authorized for use in or in connection with surgical implants, or as critical components in any medical, nuclear, or aircraft or other transportation devices or systems where failure to perform can reasonably be expected to cause significant injury to the user, without the express written approval of an executive officer of White Bream. Such use is at buyer's sole risk, and buyer is responsible for verification and validation of the suitability of products incorporated in any such devices or systems. Buyer agrees that White Bream is not liable, in whole or in part, for any claim or damage arising from such use and shall have no obligation to warranty such products. Buyer agrees to indemnify, defend and hold White Bream harmless from and against any and all claims, damages, losses, costs, expenses and liabilities arising out of or in connection with buyer's use of White Bream products in such applications to the extent buyer has not obtained the express written approval of an executive officer of White Bream.

## I.2 Trademarks & copyrights

Throughout this manual, the trade names and trademarks of various companies and products may have been used, and no such uses are intended to convey endorsement of or other affiliations with this manual or product. Any brand names or product names used within this manual are trademarks or registered trademarks of their respective holders.

## I.3 Warranty

This product is warranted to be in good working order for a period of two years from the date of purchase. Should this product fail to be in good working order at any time during this period, we will, at our option, replace or repair it at no additional charge except as set forth in the following terms. This warranty does not apply to products damaged by misuse, modifications, accident or disaster.

## I.4 Liability

White Bream assumes no liability for any damages, lost profits, lost savings or any other incidental or consequential damage resulting from the use of, misuse of, or inability to use this product. White Bream will not be liable for any claim made by any other related party.

## 1.5 Technical support

White Bream technicians and engineers are committed to providing the best possible technical support for our customers so that our products can be easily used and implemented. We request that you first visit our website at [whitebream.com](http://whitebream.com) for the latest documentation, utilities and drivers, which have been made available to assist you. If you still require assistance after visiting our website then contact our technical support department by email at [support@whitebream.com](mailto:support@whitebream.com).



### Warning

Warning messages in the manual may contain important information against product malfunction or safety information for the (end-)user.



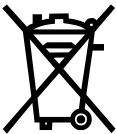
### Caution

Notices regarding proper use of the product and to warn the user about how to prevent damage to hardware or loss of data.



### Anti-static Precautions

The internals of the product are made of static sensitive components. When disassembling the product, it is strongly recommended to use an anti-static benchmat and wriststrap. If this is not possible, at least make sure you always touch an exposed metal part, such as the shield of an connector, each time before you touch anything else inside.



### ROHS - WEEE

White Bream products are manufactured using lead-free components and assembly processes. Please dispose of products according local waste regulations.

## 2 Description

Switchable leakage current measuring networks according to IEC 60990 and IEC 61010 requirements. A rotary selector switch selects between these four networks:

- 1) IEC 60990 Clause 5 Figure 3 and IEC 61010 Annex A.3
- 2) IEC 60990 Clause 5 Figure 4 and IEC 61010 Annex A.1
- 3) IEC 60990 Clause 5 Figure 5
- 4) IEC 61010 Annex A.4

The resistors in the network are ceramic-composition parts with have very high peak power rating. These will survive 230V mains connection until the protection kicks in.

### 2.1 Network 1

IEC 60990 Clause 5 Figure 3: Measuring network, unweighted touch current.

IEC 61010 Annex A.3: Current measuring circuit for electrical burns at high frequencies. The current is measured using the circuit of figure A.3. The current is calculated from  $I = U / 500$ . This circuit compensates for the effects of high frequency on the physiological response of the body.

Used for measuring the burn current of accessible parts (IEC 61010 Clause 6.3.1 b.2, Clause 6.3.2 b.2).

### 2.2 Network 2

IEC 60990 Clause 5 Figure 4: Measuring network, touch current weighted for perception or startle-reaction.

IEC 61010 Annex A.1: Measuring circuit for AC with frequencies up to 1MHz and for DC. The current is measured using the circuit of figure A.1. The current is calculated from  $I = U / 500$ . Note that this circuit can also be used instead of the simpler Annex A.2 circuit.

Used for measuring the current of accessible parts in dry locations (IEC 61010 Clause 6.3.1 b.1, Clause 6.3.2 b.1).

### 2.3 Network 3

IEC 60990 Clause 5 Figure 5: Measuring network, touch current weighted for letgo-immobilization.

### 2.4 Network 4

IEC 61010 Annex A.4: For wet location, the current is measured using the circuit of figure A.4. The current is calculated from  $I = U / 500$ .

Used for measuring the current of accessible parts in wet locations (IEC 61010 Clause 6.3.1 b.1, Clause 6.3.2 b.1).

## 2.5 Overload protection

The ground-connected resistor of the current shunt is protected with a series ceramic PTC resettable fuse. This device starts tripping at  $\sim 100\text{mA}$  and disconnects the ground of the current shunt during overload condition. This serves two purposes; 1) this mode of protection diverts the full input voltage to the output voltmeter, making it obvious that the measurement is definitely not within IEC requirements. 2) the open-circuit voltage across the PTC is used to light the neon overload indicator.

Similar to other PTC protected measurement circuits such as multimeters, allow for the protection circuit to cool down after tripping before relying on the measurement values. Alternatively, perform verification until the measured value is in allowed range.

## 2.6 Cautions



The Leakage Current Networks are intended for use by trained personnel only! Mains voltages might be present during testing of EUT, particularly during fault conditions applied.

## 3 Specifications

### 3.1 Electronic

Parameter	Min	Typ	Max	Unit
Nominal input voltage		100		V <sub>RMS</sub>
Peak input voltage operating		300		V <sub>RMS</sub>
Nominal input voltage #4		40		V <sub>RMS</sub>
Overload protection trip current		100		mA
Overload protection hold current		x		mA
Overload indicator voltage	90			V
Surge line-neutral, 1.2/50µs 2Ω			6	kV

### 3.2 Environmental

Parameter	Min	Max	Unit
Operating temperature range	10	+40	°C
Non-operating temperature range	-40	+85	°C
Humidity	10	90	%RH
Ingress Protection	IP52		



## 4 Maintenance & support

In principle, the device has no serviceable parts inside.

### 4.1 Verification

Verification is used to check if the resistive current sense network is operational and within specification. It's a good habit to check this before and after tests are performed, and also after overload condition to check whether the protection has recovered to normal conditions.

#### 4.1.1 Networks 1, 2 & 3

Connect a low-impedance voltage in the range of 5V to 12V to the inputs and measure the output. The output should be  $500\Omega / (1.5k\Omega + 500\Omega) = 25\%$  of the input voltage within 1%. Assume a 12.00V source voltage, then we want to see an output voltage of  $3.00V \pm 1\% = 2.970$  to 3.030V.

For good measure, verify that the input resistance is  $2k\Omega \pm 1\%$  (1980 $\Omega$  to 2020 $\Omega$ ).

#### 4.1.2 Network 4

Connect a low-impedance voltage in the range of 5V to 12V to the inputs and measure the output. The output should be  $500\Omega / (375\Omega + 500\Omega) = 57.1\%$  of the input voltage within 1%. Assume a 12.00V source voltage, then we want to see an output voltage of  $6.86V \pm 1\% = 6.789$  to 6.926V.

For good measure, verify that the input resistance is  $875\Omega \pm 1\%$  (866 $\Omega$  to 884 $\Omega$ ).

## 4.2 Calibration

Tbd

## 4.3 Repairs

The device has been designed to enable relative easy repair of (protection) components such as varistors, fuses, surge resistors and transient suppressors. However, non-authorized repair is very likely to void our warranty! Also be aware that seemingly ordinary parts may have been selected for very specific characteristics, such as carbon-composition or ceramic-composition resistors for their exceptionally high pulse power ratings.

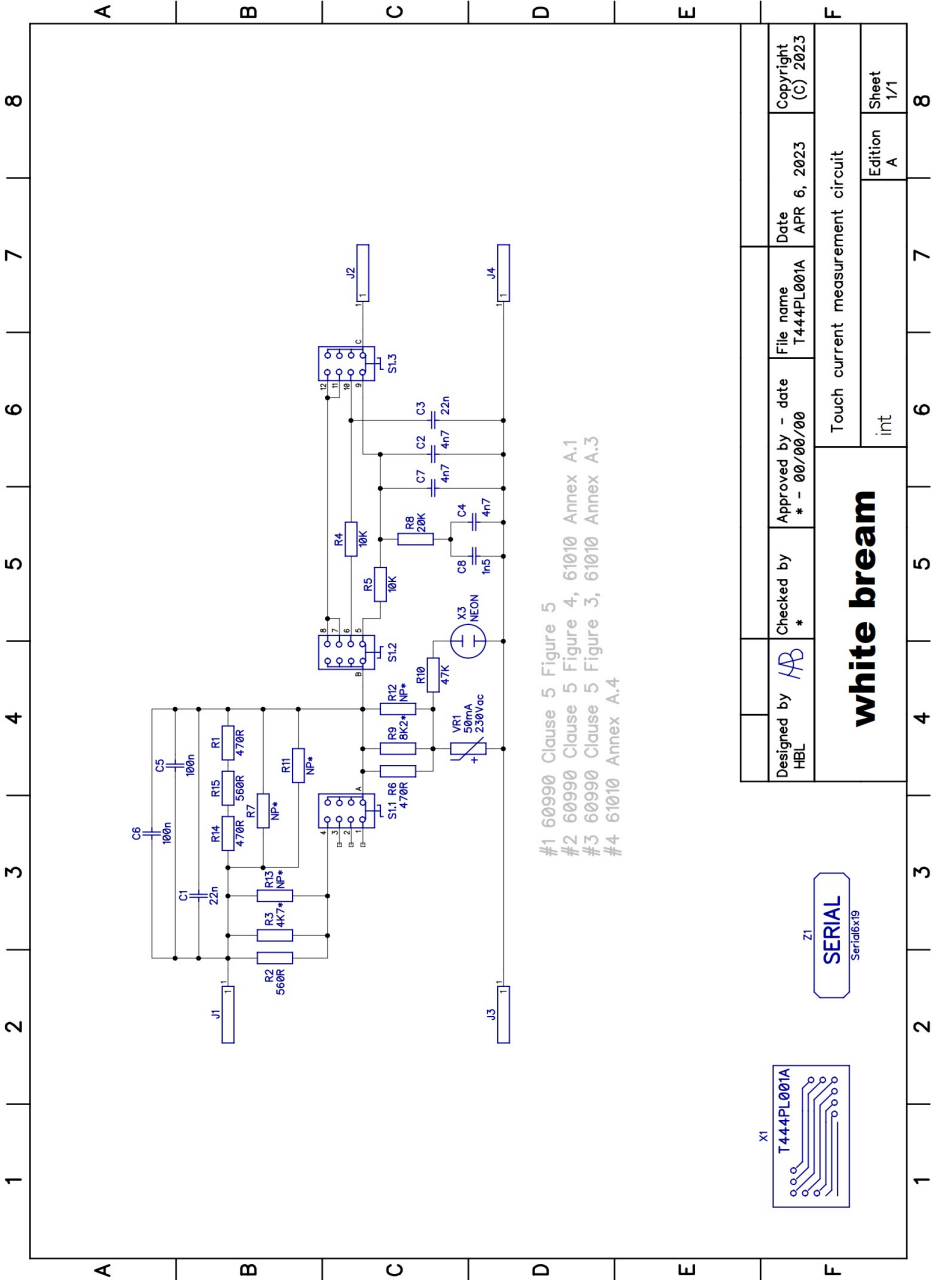
In case of doubt, please contact technical support.

#### **4.4 Schematic**

Next page shows the schematic of the Leakage Current Networks.

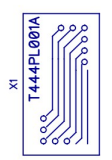
#### **4.5 Silkscreen**

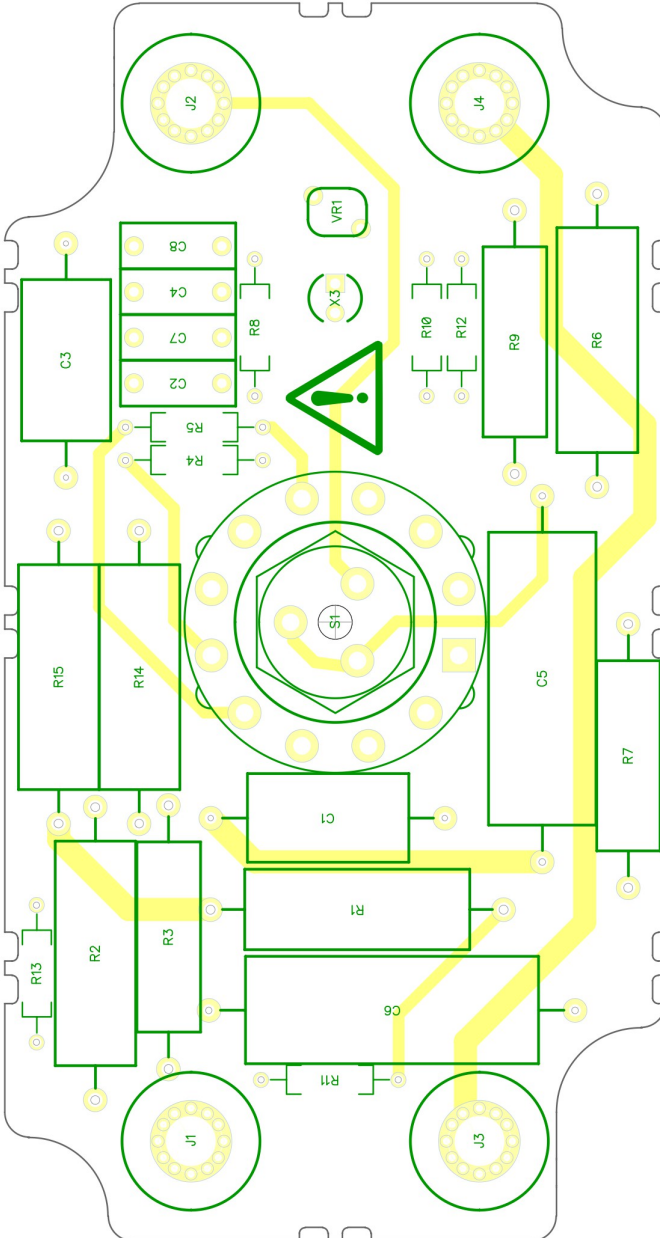
The page after that shows the PCB layout.  
(Not to scale.)



#1 60990 Clause 5 Figure 5  
 #2 60990 Clause 5 Figure 4, 61010 Annex A.1  
 #3 60990 Clause 5 Figure 3, 61010 Annex A.3  
 #4 61010 Annex A.4

Designed by HBL	Checked by * AB	Approved by - date * - 00/00/00	File name T444PL001A	Date APR 6, 2023	Copyright (C) 2023
<b>white bream</b>			Touch current measurement circuit		
			int		





## 5 Ordering information

Partno	Description	Revision
84-444-010	Leakage current networks LCNX4	A, Apr 18, 2023

### 5.1 Hardware revision info

Rev	Date	Changes
A	Apr 18, 2023	PTC & overload indicator. First release version.

## 6 Document revisions

### 6.1 Rev 0.1 (May 4, 2023)

Ref	Description
-	Initial version

## Annex A: Declaration of Conformity for CE

The manufacturer hereby declares that this product is in accordance with the requirements of directive 2014/30/EU regarding electromagnetic compatibility (EMC), directive 2014/35/EU regarding low voltage equipment (LVD), directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS) and directive 2012/19/EU on waste electrical and electronic equipment (WEEE).

**Manufacturer, facility:** White Bream  
L.J. Costerstraat 13d  
3261 LH, Oud-Beijerland  
The Netherlands

**Product:** Leakage Current Networks

**Models:** LCNX4 (84-444-010)

**CE & RoHS Marking:**



May 2, 2023

Henk Blijk, White Bream, Owner

This product has been found in conformity with directive 2014/30/EU (EMC) by testing and verification with the following standards <sup>1</sup>:

- **EN 61000-6-2:2016** Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments
- **EN 61000-6-3:2020** Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission standard for equipment in residential environments
- **EN 61326-1:2020** Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements

This product has been found in conformity with directive 2014/35/EU (LVD) by testing and verification with the following standards:

- **EN 61010-1:2010/CI:2011** Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements

This product has been found in conformity with directive 2011/65/EU (RoHS) by testing and verification with the following standards:

- **EN 63000:2018** Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

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<sup>1</sup> Some standards might be more recent than the harmonized versions. Blame Brussels.



## Annex B: Declaration of Conformity for UKCA

The manufacturer hereby declares that this product is in accordance with the requirements of UK SI 2016 No. 1091 "Electromagnetic Compatibility Regulations 2016", UK SI 2017 No. 1206 "Radio Equipment Regulations 2017", UK SI 2016 No. 1101 "Electrical Equipment (Safety) Regulations 2016", and UK SI 2012 No. 3032 "The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012".

**Manufacturer, facility:** White Bream  
L.J. Costerstraat 13d  
3261LH, Oud-Beijerland  
The Netherlands

**Product:** Leakage Current Networks

**Models:** LCNX4 (84-444-010)

**UKCA Marking:** The UKCA marking consists of the letters 'UK' stacked above 'CA' in a bold, sans-serif font. To the right of this text is a crossed-out wheeled bin symbol, which is a standard icon for 'no incineration'.

May 2, 2023  
Henk Blik, White Bream, Owner

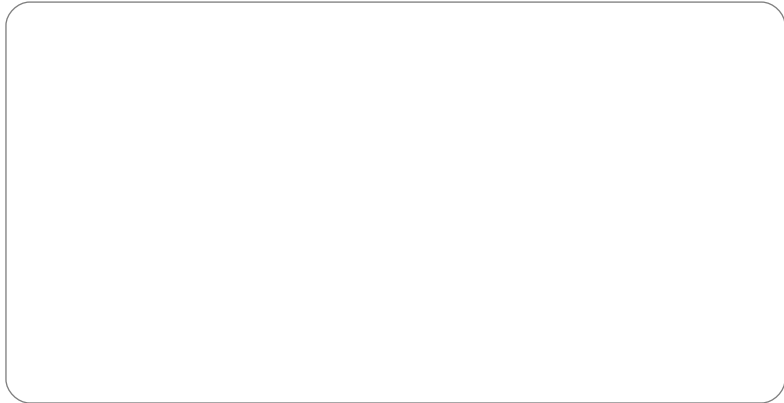


## **Annex C: Declaration of Conformity for FCC**

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**NOTE:** This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help



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