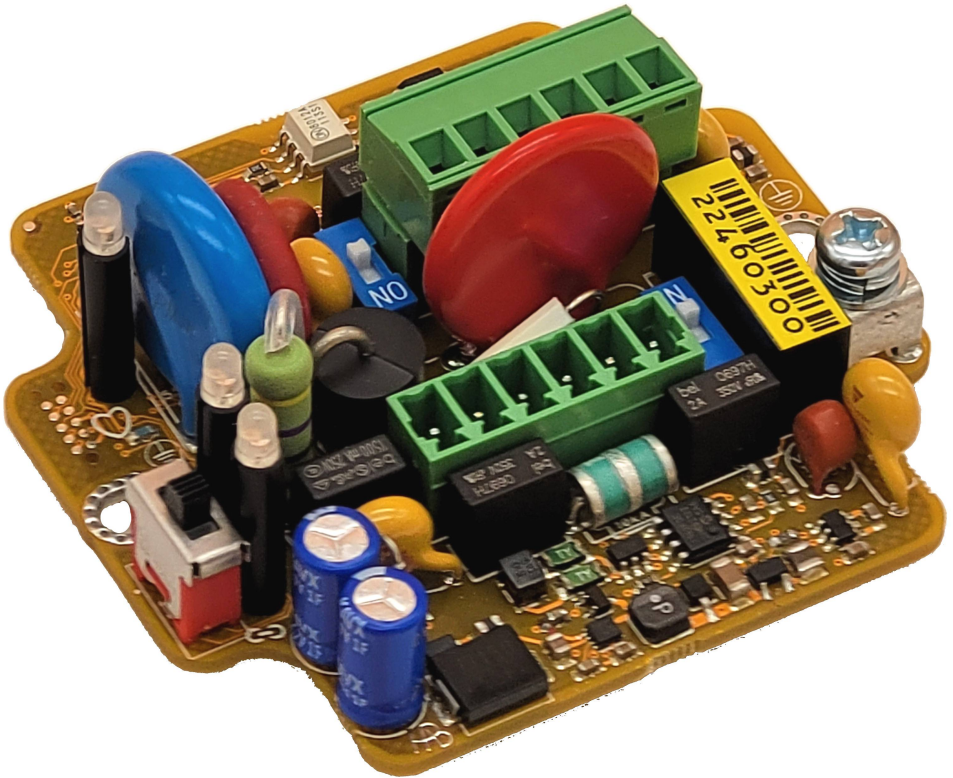


white bream

CAN•net

CAN-bus Repeater & Isolator (Rugged)



White Bream Oud-Beijerland The Netherlands https://whitebream.com		
Description:	Reference manual	P942RP006 Manual Repeater rugged.odt
Project:	P942	 * P 9 4 2 R P 0 0 6 *
Status:	Draft	

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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 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.



Warning

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



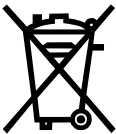
Caution

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 bench mat and wrist strap. 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

This device provides an isolated repeater function between two CAN-bus segments.

2.1 Functionality

- Two-way CAN-bus bridge
- First port for power + primary CAN-bus up to 1Mbps / 8 Mbps FD
- Second port for isolated secondary CAN-bus
- Automatic disable of erroneous segments (non-terminated or stuck dominant)
- 120Ω current-limited switchable termination on both segments
- One of the segments can be switched to silent mode
- 6kV Surge protection

2.2 Specifications

- Bus powered Um 12-48V_{DC}, power ≤500mW
- Designed for over-voltage category III ≤150V and 6kV surge immunity
- Allowed isolation voltage up to 500VRMS
- 3-Second backup power
- Propagation delay 100ns, equivalent to ~20m of cable length
- Connections via 6-way 3.81mm pluggable terminals
- ATEX enhanced safety 'ec' (IEC 60079-7) and dust ignition protection 'tc' (IEC 60079-31)

2.3 Dimensions

- OEM Module: 60×66mm circuit board
- Aluminium enclosure 75×80×52mm, IP68
- Polycarbonate enclosure 82×80×55mm, IP68
- Glass-filled polyester enclosure 80×75×55mm, IP66, 7 Joule
- Glass-filled polyester enclosure anti-static 80×75×55mm, ATEX, IP66, 7 Joule

2.4 Protection

The device offers 6kV surge protection, which allows for CAT II 150V overvoltages up to 5000m altitude and CAT III 150V overvoltages at an altitude up to 2000m. Additionally, the device is designed to withstand significant overvoltages, including reverse voltage without any damage and mains connection with no damage except a blown fuse.

2.4.1 Power protection

The DC power input is protected by a 3-stage circuit. Stage 1 is provided by a 250Vac/10kA varistor. This guards against surges that exceed approximately 800V. The varistor is thermally coupled with a 125°C thermal fuse device, which provides some

protection against a worn-out varistor and against prolonged severe overvoltage. Stage 2 consists of a 4.7Ω ceramic-composition resistor followed by a 5kA 48V bidirectional transient voltage suppressor (TVS) diode. The resistor can handle about 150kW of pulse energy, which greatly extends the 30kW pulse handling of the TVS. Stage 3 is a 2.2Ω surge-rated resistor, a 5kW 48V TVS and reverse blocking diode. This stage provides the finishing touch in limiting transient voltages.

2.4.2 Earth protection

Coupling to protective earth (PE) is provided by 1nF classY1 capacitors (by standard rated for 500Vrms and 8kV surge) in parallel with a 560Vac/10kA varistor. Secondary circuit is rated for communication-level surges only (with 40Ω source impedance instead of 12Ω), so has a slightly lower rated varistor at 510Vac/6kA.

2.4.3 Bus protection

Bus connections are guarded by a 2-stage protection system. Primary protection consists of a 70V/10kA 3-pole gas discharge tube. With fast transients, this device doesn't do much until a surge has reached about 1kV. Once that level is reached, the GDT fires and shorts the input signal to ground. For slow or steady signals, the GDT will fire closer to its 70V rating, thus offering protection for severe AC and DC over-voltages. This stage is preceded by two 2A 23A²s socketed fuses. These will trip when the GDT triggers at overvoltages. The second stage of protection is made from steering diodes and a single thyristor based surge protection device. This thyristor will trip at around 30V. This stage is preceded by 100mA/60V resettable polyfuses.

2.5 Cautions



IEC 61010-1 requires the installer to check wiring for suitable ratings.






Marking for protective earth connections.

3 Operation

The device is operated by connecting power and communication ports. There are a couple of switches that allow for manipulating the electrical and protocol behavior of those communication ports and some indicators that give some insight in the workings of the device.

3.1 Indicators

LED Icon	Function	Description
	Power/heartbeat	Green blink = okay Orange blink = power fail Red = error
 I	Primary CAN RX activity	Green blink = RX (dominant) Orange blink = RX, registered earlier termination error Red = RX stuck dominant or TX termination error
 II	Secondary CAN RX activity	Green blink = RX (dominant) Orange blink = RX, registered earlier termination error Red = RX stuck dominant or TX termination error

3.2 Controls

Switch S1 allows for (de)activating the termination resistor on primary segment.

Switch S2 allows for (de)activating the termination resistor on secondary segment.

Switch S3 allows for setting one of the segments to listen-only mode.

3.3 Interfaces

Connection J1 contains the power signals and the CAN-bus for the primary side.

Connection J2 contains the CAN-bus for the secondary side. Pin-out is identical except that the +V pin is left not connected.

4 Specifications

4.1 Electronic

Parameter	Min	Typ	Max	Unit
Nominal input voltage	12	24	48	V
Peak input voltage operating	9		60	V
Peak input voltage non-operating	-60		60	V
Fault protection (fuse blows)	-300		300	V
Undervoltage threshold, rising		7.4		V
Undervoltage threshold, falling		7.1		V
Input current ($V_{in}=24V$)		20		mA
Power dissipation primary side		500	1000	mW
Power dissipation secondary side		0		mW
Isolation voltage			500	V_{RMS}
Surge line-neutral, 1.2/50 μ s 2 Ω		6		kV
Surge neutral-earth, 1.2/50 μ s 12 Ω		6		kV
CAN-bus				
Common mode voltage	-7		14	V
Fault protection	-48		48	V
Fault protection (fuse blows)	-300		300	V
Recessive bias voltage		2.5		V
Signaling rate CAN	5		1000	kbps
Signaling rate CAN-FD data			8000	kbps
Surge line-line, 10/700 μ s 40 Ω		6		kV
Surge line-neutral, 10/700 μ s 40 Ω		6		kV
Surge neutral-earth, 1.2/50 μ s 42 Ω		6		kV
Bus termination				
Resistance	96	120	144	Ω

Parameter	Min	Typ	Max	Unit
Current (limited by power dissipation)		42		mA

4.2 Connections

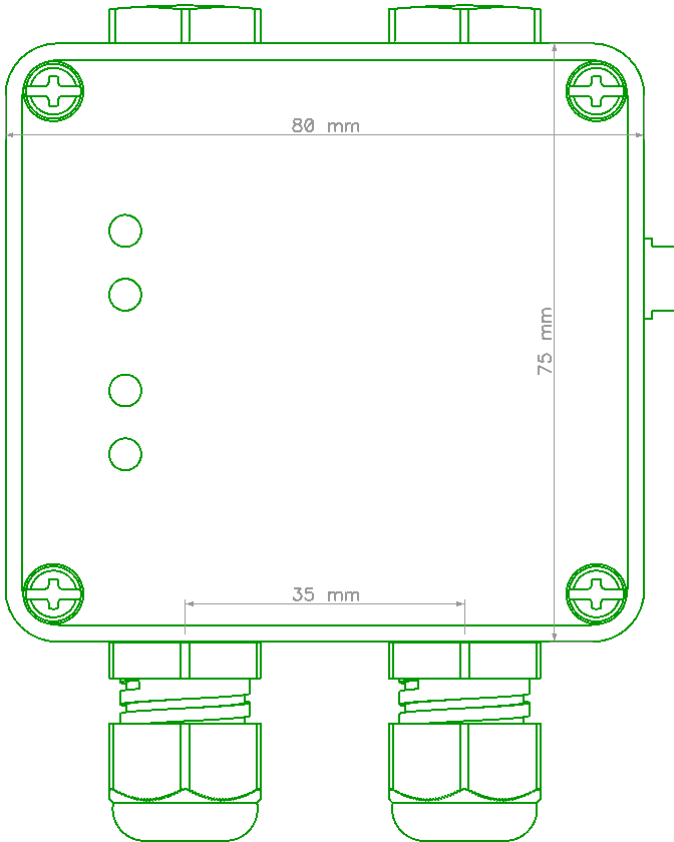
4.2.1 CAN-bus connections

#	Name	Description	Signal
1	PE	Earth	PE
2	SHIELD	Cable shield	InF Y1 to PE
3	+V	Bus power supply (line)	12-48VDC
4	-V	Bus ground (neutral)	0V, InF Y1 to PE
5	CAN-H	CAN H-signal	ISO 11898-2
6	CAN-L	CAN L-signal	ISO 11898-2

4.3 Environmental

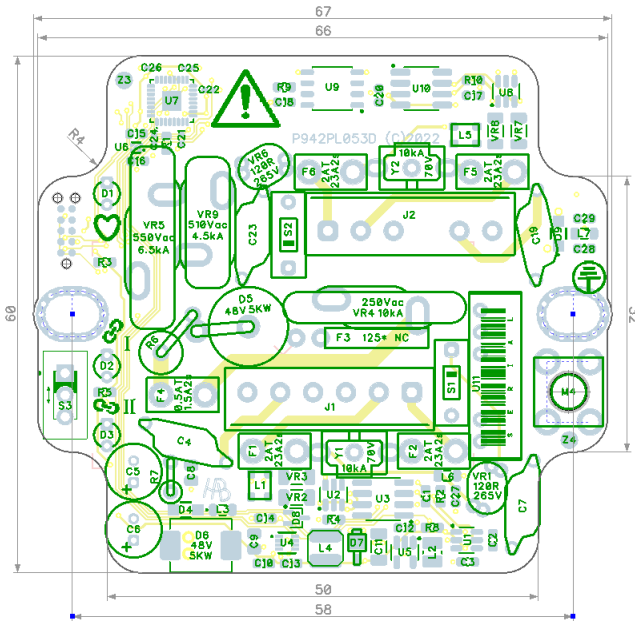
Parameter	Min	Max	Unit
Operating temperature range	-40	+85	°C
Non-operating temperature range	-40	+85	°C
Humidity	0	100	%RH
Ingress Protection	IP66		
Impact resistance	7		J
Conformal coating	Type 2		

4.4 Dimensions



* Earth terminal only present on anti-static ATEX version.

4.4.1 OEM



5 Installation

Always follow applicable installation codes over instructions in this manual. Please let us know if you encounter a conflict between this manual and any such code. Contact support if the device must be integrated into systems that are subject to special conditions as referred to in IEC 61010-1 §5.4.6.

Our instructions assume that you have basic knowledge of industrial wiring and electrical installations. As such, we do not provide instructions for basic activities such as stripping of wires.

Many applications of this kind of devices may be subject to additional rules and regulations. Make sure that you account for such situations.

5.1 Mounting

Mount the device on a flat surface with properly aligned holes. This prevents excessive stresses in the enclosure and reduces the risk of voiding the ingress protection rating.

All M16x1.5 holes in the enclosure shall be fitted with either a suitable cable-gland containing a cable, M12-style pluggable connection or M16 blanking plug. All of which shall be equipped with a matching sealing ring.

If possible, only install the cables after the device has been mounted. At very least wait until the box has been mounted before tightening the cable glands. This reduces risk of excessive strain on cables or glands and also reduces the risk of failing to comply with the prescribed minimum bending radius of the cables.

5.2 OEM module specifics

For the bare-board OEM module, a couple of specific conditions apply in order to operate the device with specifications.

5.2.1 Enclosure

The OEM module must be installed in an IP54 environment. No requirement for the pollution degree as the conformal coating will guarantee PD2 for critical clearances.

5.2.2 Mounting

When mounting on a flat surface, use spacers between the circuit board and the surface beneath in order to create appropriate isolation distance between the circuit and that surface. A good measurement for appropriate distance is 6mm, which will leave at some 3mm separation between the solder joints and the surface, whereas 1.6mm is required per Annex K of IEC 61010-1:2010 for clearance of OCV III ≤150V circuits.

5.3 Wire selection and preparation

Use wires with outside diameter in less than 2.6mm and with cores within the allowed diameter as given in the specifications; stranded 0.25mm² to 1.0mm² with suitable ferrule or solid 0.5mm² to 1.5mm². Wire should be rated UL 2556 VW-I.

Wires must be stripped for 6.5±0.5mm.

Shielded cables shall be terminated using heat shrink shield-to-wire terminations or an equivalent means of reliably connecting the shield to a terminal connection.

5.4 Earthing

The M4 earthing terminal on the PCB is connected to the two oblong mounting holes and to the earth connections on the terminal blocks.

The U-shaped washer must be installed 'upside down', such that the flanges lock around the base of the terminal and thus prevent rotation of the U-washer and of any wires that are clamped underneath this washer.

The anti-static enclosed model of the repeater also has an external earthing terminal which is electrically connected to the internal terminal.

5.5 Cable length and sizes

The maximum bit-rate of the CAN-bus is determined by the length of the trunk and by the length of the stubs towards to individual CAN devices. Depending on communication requirements, it might be necessary to shorten the connection cable of this device to match the signal integrity requirements.

Bit-rate	Trunk length (max)	Spur length (max)	Spur length (total)
1Mbps	25m	1.5m	7.5m
800kbps			
500kbps	100m	5.5m	27.5m
250kbps	200m	11m	55m
125kbps	400m	22m	110m
100kbps	500m	27m	137m
50kbps	1km	55m	275m
20kbps	2.5km	135m	680m
10kbps	5km	275m	1375m

Bit-rate	Trunk length (max)	Spur length (max)	Spur length (total)
5kbps	10km	550m	2750m

Note that each CAN-bus repeater accounts for approximately 20 meters of cable length, which is to be subtracted from the allowable trunk or spur length.

Please be aware of cable resistance and associated voltage drop. Once the lengths go into the three-digit figures, these losses can become quite significant, especially with small conductor sizes!

CiA 303-I recommends the following wire cross-section:

- 0 to 40m » 0.25mm² to 0.34mm²
- 40m to 300m » 0.34mm² to 0.6mm²
- 300m to 600m » 0.5mm² to 0.6mm²
- 600m to 1km » 0.75mm² to 0.8mm²

5.5.1 CAN-bus Termination

Short trunk lengths up to 40m can be terminated with a resistor of $\sim 124\Omega$ at each end of the trunk. For longer lengths (and therefore lower bit-rates), a higher value of termination resistance is more suitable, probably in the range of 150 Ω to 300 Ω .

The module contains a 120 $\Omega \pm 20\%$ PTC termination resistor with a DIP switch on both segments.

Both segments are independent from a transmission line point of view. So both must be terminated as if they were the only segment.

6 Maintenance & support

6.1 Fuses

Primary transient protection consists of a 10kA varistor which is protected by a 125°C thermal fuse. Servicing of either one involves PCB-level repair.

The device contains a 500mA slow-blow fuse in the power line. If serviced, this must be replaced by a fuse with I^2t value of 1.4A²s, for example Belfuse 0697H0500.

Additionally, the device contains two 2A slow-blow fuses on the balanced data interface signals. If serviced, these must be replaced by fuses with I^2t value of 23A²s, for example Belfuse 0697H2000.

6.2 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!

In case of doubt, please contact technical support.

6.3 CAN-bus issues

6.3.1 No communication at all

Check if CAN-bus pair is not swapped. If in doubt, just try reversing to eliminate a possible cause, noting will get damaged. Don't forget to undo the reversal if it does not help!

6.3.2 High error rate

Common causes are too high bit-rate versus cable length, badly placed termination resistors, too many (>2) or too few termination resistors.

7 Ordering information

Partno	Description	Revision
82-942-531	CAN-bus repeater & isolator (rugged OEM)	E, Oct 12, 2023
82-942-532	CAN-bus repeater & isolator (rugged)	E, Oct 12, 2023
82-942-533	CAN-bus repeater & isolator (rugged ATEX)	E, Oct 12, 2023

7.1 Hardware revision info

Rev	Date	Changes
D	Dec 23, 2022	First release version
E	Oct 12, 2023	Improve PSU stability at input voltages below range

8 Document revisions

8.1 Rev 1.1 (May 30, 2024)

Ref	Description
-	Correct partno for OEM version, fix some spec notations. Rev E hardware. DOC for GRP version.

8.2 Rev 1.0 (Jan 9, 2023)

Ref	Description
-	Initial version

Annex A: Declaration of Conformity for ATEX & CE (OEM)

The manufacturer hereby declares that this product is in accordance with the requirements of annex II of the EEC directive 2014/34/EC regarding ATEX, 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:

CAN-bus Repeater & Isolator (Rugged) ATEX

Models:

80-942-533

ATEX Marking:



II 3G Ex ec IIB T6 Gc U
Tamb -40° to +70°C

Um: 12-48V== P: ≤500mW

WARNING: DO NOT SEPARATE OR (DIS)CONNECT WHEN ENERGIZED
WARNING: DO NOT REMOVE OR REPLACE FUSE(S) WHEN ENERGIZED
WARNING: MUST BE MOUNTED IN SUITABLE 'Ex' ENCLOSURE

ATEX Certificate:

N/A, conformity evaluated according annex VIII of
directive 2014/34/EC (internal production control).
IecEx checklists are available on request with NDA.

CE & RoHS Marking:



December 29, 2022

Henk Blik, White Bream, Owner

Annex B: Declaration of Conformity for ATEX & CE

The manufacturer hereby declares that this product is in accordance with the requirements of annex II of the EEC directive 2014/34/EC regarding ATEX, 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:

CAN-bus Repeater & Isolator (Rugged) OEM

Models:

80-942-531

ATEX Marking:



II 3G Ex ec IIB T5 Gc
II 3D Ex tc IIIC T100°C Dc
Tamb -40° to +70°C



Um: 12-48V== P: ≤500mW

WARNING: DO NOT SEPARATE OR (DIS)CONNECT WHEN ENERGIZED

WARNING: DO NOT REMOVE OR REPLACE FUSE(S) WHEN ENERGIZED

ATEX Certificate:

N/A, conformity evaluated according annex VIII of
directive 2014/34/EC (internal production control).
IecEx checklists are available on request with NDA.

CE & RoHS Marking:



December 29, 2022

Henk Blijk, White Bream, Owner

Annex C: 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).

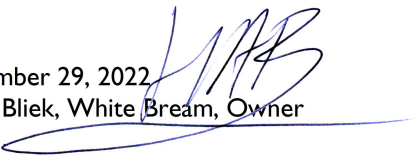
Manufacturer, facility: White Bream
L.J. Costerstraat 13d
3261 LH, Oud-Beijerland
The Netherlands

Product: CAN-bus Repeater & Isolator (Rugged) GRP

Models: 80-942-532

CE & RoHS Marking:  

December 29, 2022
Henk Bliek, White Bream, Owner



This product has been found in conformity with directive 2014/34/EU (ATEX) by testing and verification with the following standards:

- **EN 60079-0:2018+AC:2020** Explosive atmospheres – Part 0: General requirements
- **EN 60079-7:2015+AI:2018** Explosive atmospheres – Part 7: Equipment protection by increased safety “e”
- **EN 60079-31:2013** Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure “t”

This product has been found in conformity with directive 2014/30/EU (EMC) by testing and verification with the following standards¹:

- **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 61131-2:2017** Industrial-process measurement and control – Programmable controllers – Part 2: Equipment requirements and tests
- **EN 61326-1:2020** Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements

Extended and/or additional EMC immunity testing has been performed to performance criterion B of the following standards:

- **EN 61000-4-2:2009** Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test. Level 4
- **EN 61000-4-5:2014** Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test, 1.2/50 μ s surge \pm 6kV, 10/700 μ s surge \pm 6kV
- **EN 61000-4-16:2016** Electromagnetic compatibility (EMC) – Part 4-16: Testing and measurement techniques – Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz. Level 3
- **EN 61000-4-17:2002** Electromagnetic Compatibility (EMC) – Part 4-17: Testing and measuring techniques – Ripple on d.c input power port immunity test. Level 4, criterion A

¹ Some standards might be more recent than the harmonized versions. Blame Brussels.

- **EN 61000-4-29:2002** Electromagnetic Compatibility (EMC) – Part 4-29: Testing and measurement techniques; Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests. Criterion A for variations, 70% dips, interruptions $\leq 10\text{ms}$ and 40% dips at $12\text{V} \leq 10\text{ms}$

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
- **EN 61010-2-201:2017** Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-201: Particular requirements for control equipment
- **EN 61131-2:2017** Industrial-process measurement and control – Programmable controllers – Part 2: Equipment requirements and tests

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

Annex D: Declaration of Conformity for UKCA

The manufacturer hereby declares that this product is in accordance with the requirements of UK SI 2016 No. 1107 "Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016", 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: CAN-bus Repeater & Isolator (Rugged)

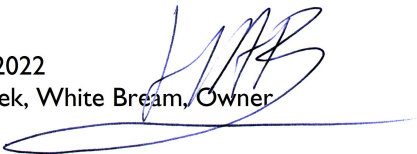
Models: 80-942-53X

UKCA Marking:



April 2, 2022

Henk Blik, White Bream, Owner

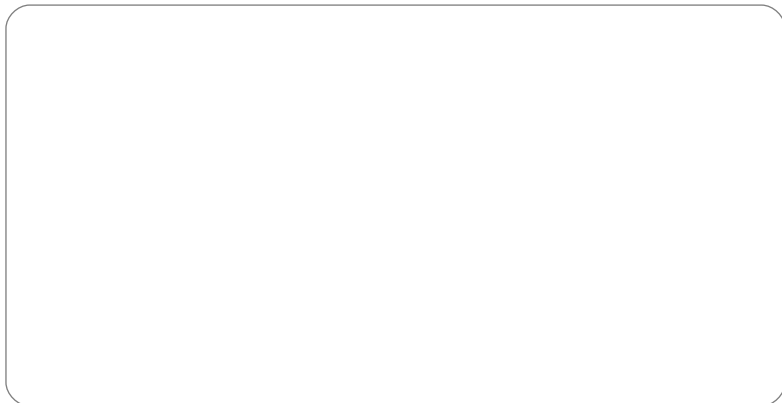
A handwritten signature in blue ink, appearing to read 'H.B.', is written over the printed name 'Henk Blik, White Bream, Owner'. A long horizontal line is drawn below the signature.

Annex E: 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



CAN•net

white bream

L.J. Costerstraat 13d
3261LH Oud-Beijerland
The Netherlands

<https://whitebream.com>
<https://whitebream.eu>

