



Intermodal Africa, Swakopmund, Namibia
28.&29.02.2024

**Know Your Loads, Weights and Forces for a Safe
and Secure Operation**

Facts & Figures

About BROSA

Headquarters

BROSA GmbH, Tett nang, Germany

- Production and R&D Sensors

Subsidiaries

BROSAtronic AG, Switzerland

- Production and R&D Electronics, SW

BROSA B.V., Oss, Netherlands

- Sales Office

BROSA Pte Ltd, Singapore

- Sales Office

BROSA (Nanjing) Co., Ltd., China

- Sales Office

Key Figures

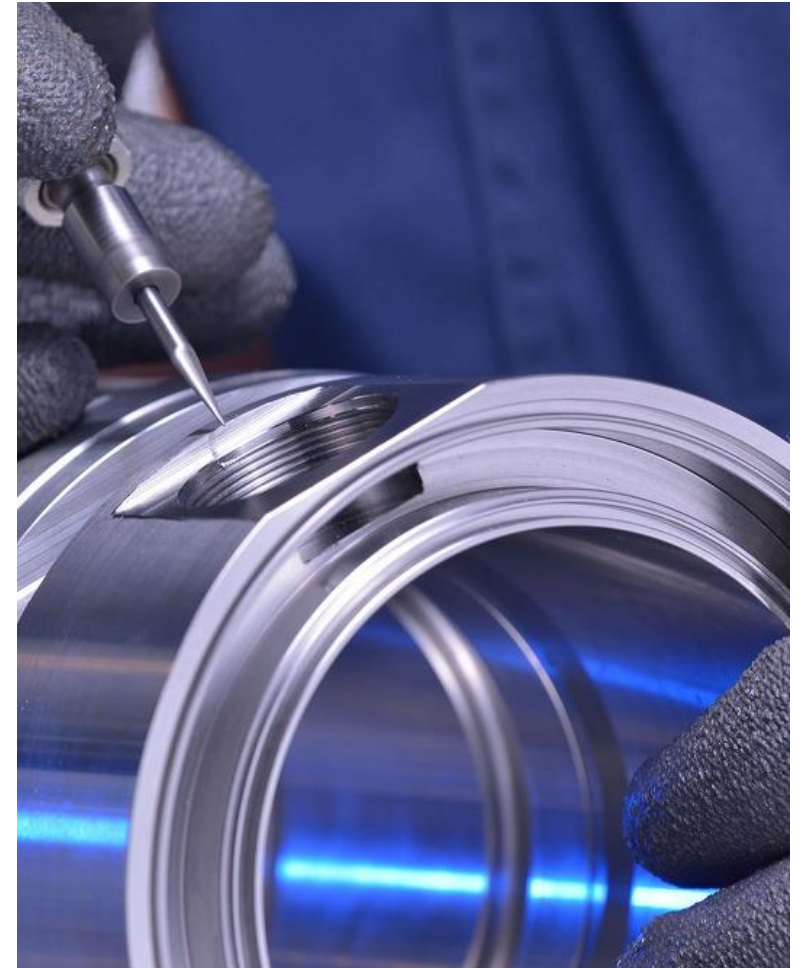
- Founded in 1935
- 100 Employees
- ISO 9001 and ISO 14001 certified



Facts & Figures

About BROSA

- Products are developed in close collaboration with our customers
- Understanding the Trends & Industries
- Compliance with worldwide safety standards
- “Made in Germany” The logo for "Made in Germany", featuring a stylized German flag (black, red, and gold horizontal stripes) and the text "Made in Germany" in a bold, sans-serif font.
- More than 90% in house manufacturing
- Full scope of product engineering and manufacturing
 - Specification
 - Technical proposals
 - Production: mechanical, electrical, assembly
 - Calibration
 - Certification, Type Approvals,
 - Customer Acceptance Tests



Safe Lifting of Loads

Why Safety Systems

- Safety systems on lifting equipment are a mandatory requirement when loads are lifted
- Nearly 25% of accidents in container ports are load dependant, but not in all cases containers are overloaded.
- Monitoring of Safe Working Limits and Operational Limits at all times
- Safety Systems must comply with Safety Standards
 - European and International Safety Standards
 - Performance Level d (DIN 13849)
 - Safety Integrity Level 2, SIL2 (IEC 61508)

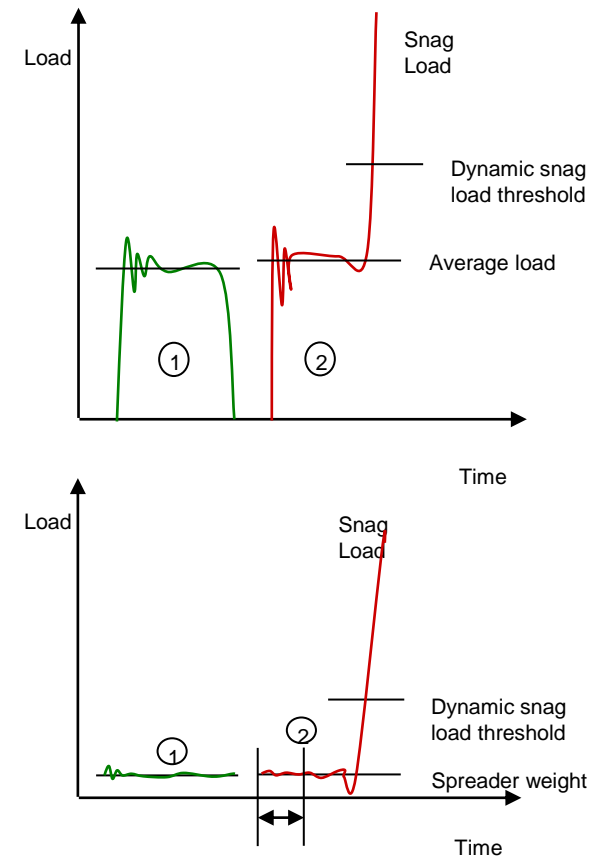


Additional & Special Functions

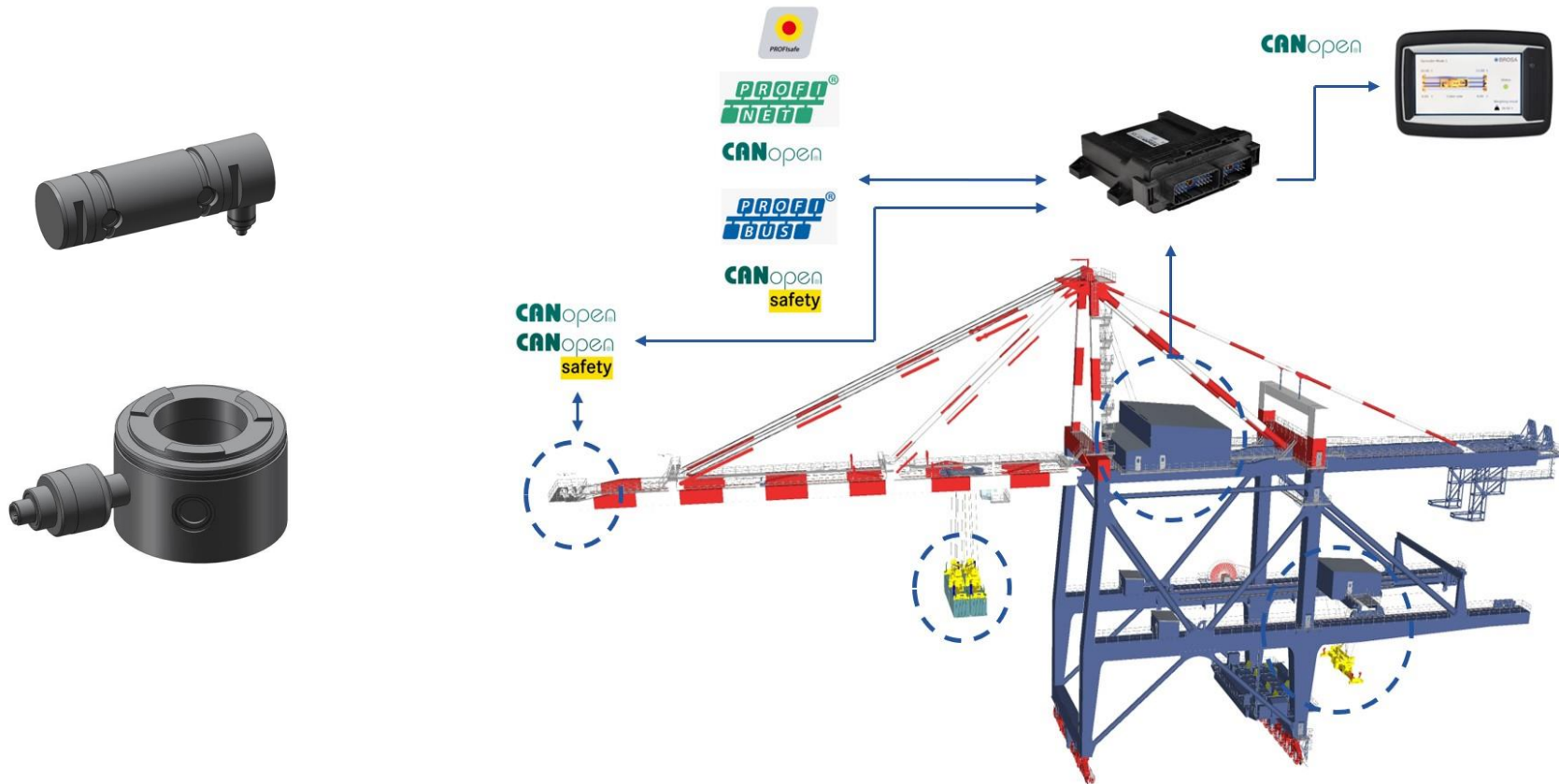
Snag Load Detection

Dangerous situations occurs when

- A container gets stuck in the railings of a vessel during the lift
- Parts of the spreader block the lift
- When the head covers are not completely removed and obstruct the lifting area
-
- The load sensors are immediately registering a second increase of the load signal
- Once a second increase is detected on any of the load sensors the snag warning can be triggered
- The threshold for the detection is dynamic, dependant on the weight of the container being lifted.



Safety System

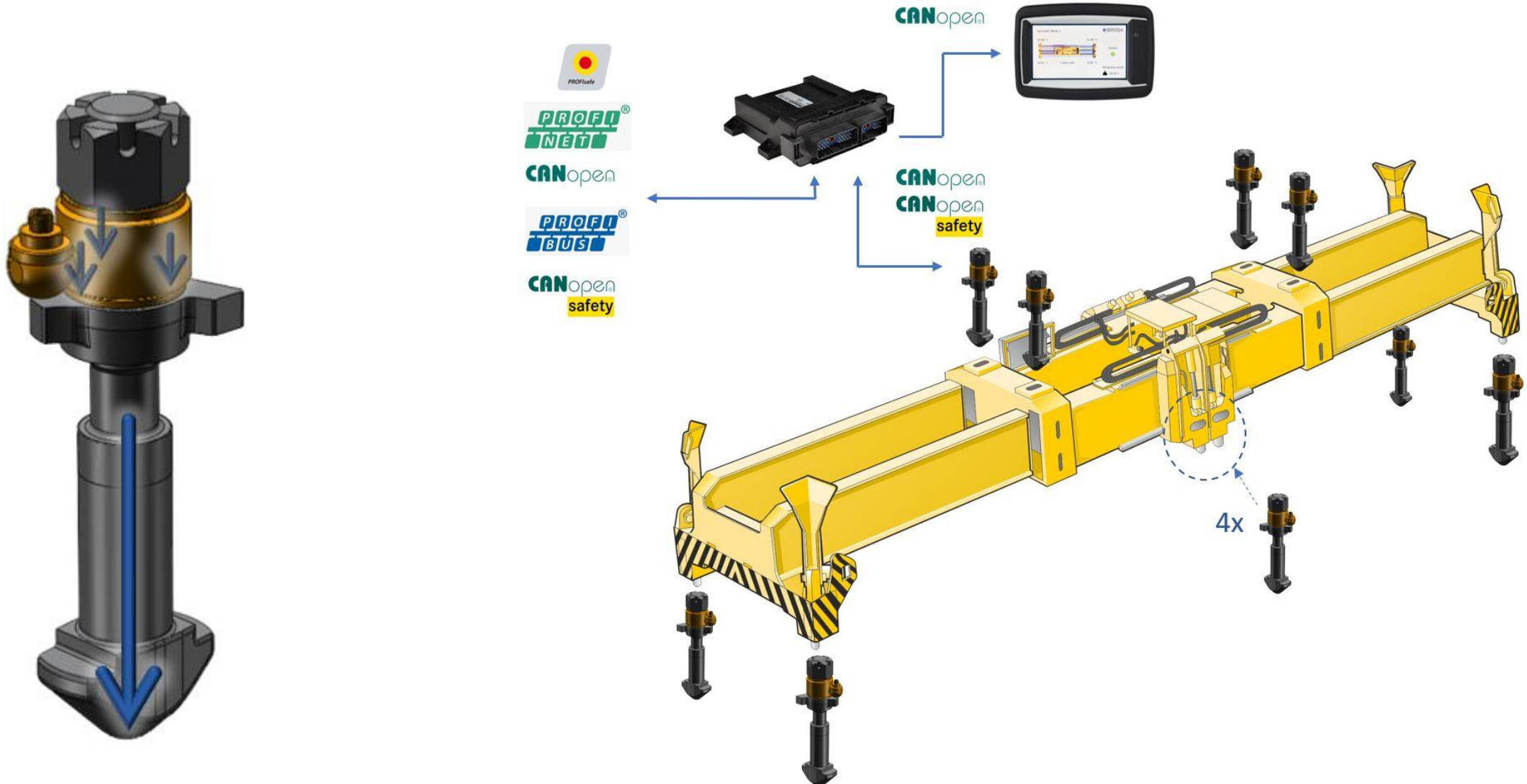


SOLAS Container Weighing

- Safety issues for extended functions (e.g. SOLAS)
 - Mandatory to verify the VGM of the container before its lifted to a vessel since 01.07.2016.
 - Different methods to verify the VGM (Method 1 & Method 2)
 - Detection of wrongly declared Container Weights
 - Improvement of Ship Stowage Plans
 - All VGM must be taken by a verified system



SOLAS Weighing System Spreader



Additional & Special Functions

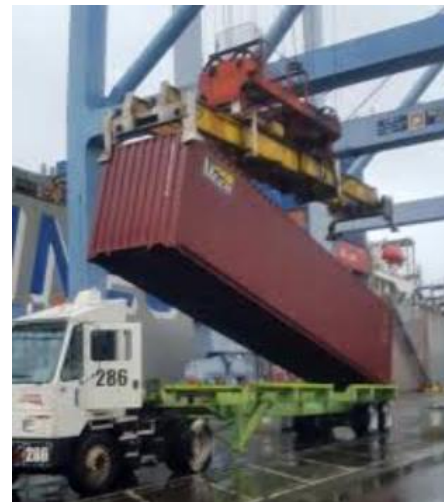
Lock detection for twistlocks

Dangerous situations occurs when

- One of the twistlocks is not correctly locked in corner
- For Twin-Spreaders: the twin detection system does not detect 2 containers, so that inner twistlocks will not lock

Enhancement for better detection and much more safe lifts

- Installation of force sensor washer on each twistlock
- Load measurement and plausible load checks by start lifting



Applications

- Crane safety system
- SOLAS weighing system
- Monitoring systems on brakes
- Snag load detection
- Twin twenty detection for spreaders
- Terminal automation
- Life cycle counters for predictive maintenance
- Correlating information creates a better picture of a machine status than parallel information

New Developments

Terminal Automation

- Automation or Industry 4.0 is making his way with big steps into the container handling industry
- Not the individual speed but rather a repeatable speed is the key factor to increase efficiency
- Results shall be sellable time of the operation
- Key Performance Indexes are (next to many others):
 - High equipment availability
 - Minimum downtime (Repairs, Maintenance)
 - Accident prevention
 - Extended equipment lifetime
- Maintenance
 - Corrective maintenance
 - Preventive maintenance
 - Predictive maintenance
- Load sensors and systems to calculate and record lifetime data



New Developments

Lift data vs. Lifetime

Integrated parameters

Sensor

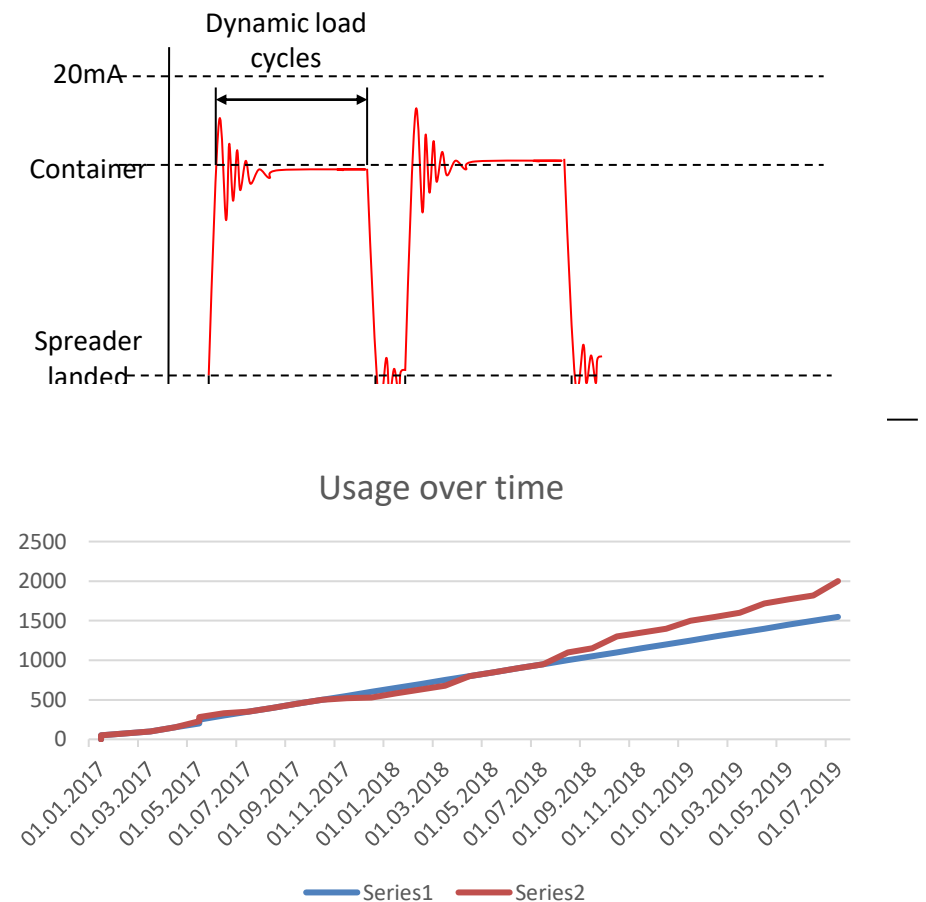
- Service hour meter
- Load collective
- Load cycles
- Overload counter

System

- Time based parameters

Calculation for

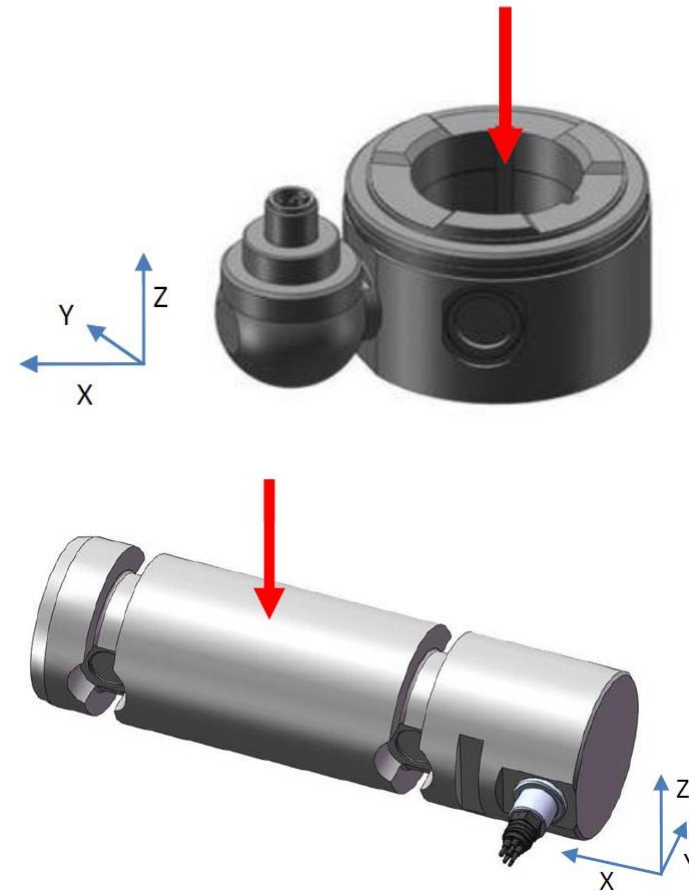
- Maintenance intervals
- Machine fatigue & lifetime
- Etc.....



New Developments

Intelligent Sensors

- For sensor installation in the headblock
- Acceleration = change in velocity
 - Change in speed
 - Change in direction
 - Change in both
- During a lift of a container the hoisting speed accelerates while the trolley movement changes the direction.
- This causes unwanted effects into the measurement of the force created by the container
- The amplifier inside the sensor needs to calculate the dynamic forces
- Result shall be an increase of the overall accuracy of the load measurement by splitting the load signal in a static and a dynamic signal



Product Portfolio



Force
measuring
pin



Tension load
cell



Force sensor
washer



Tubular load
cell



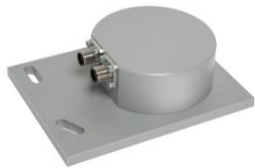
Compression
load cell



Weighing and Overload
Systems



Support jack
load cell



Angle sensor
MEMS



Normal force
sensor



Sensor
for Ex area



Pressure
transducer



Pressure
transducers



BROSA
electronics

Functional Safety acc. EN13849

Categories

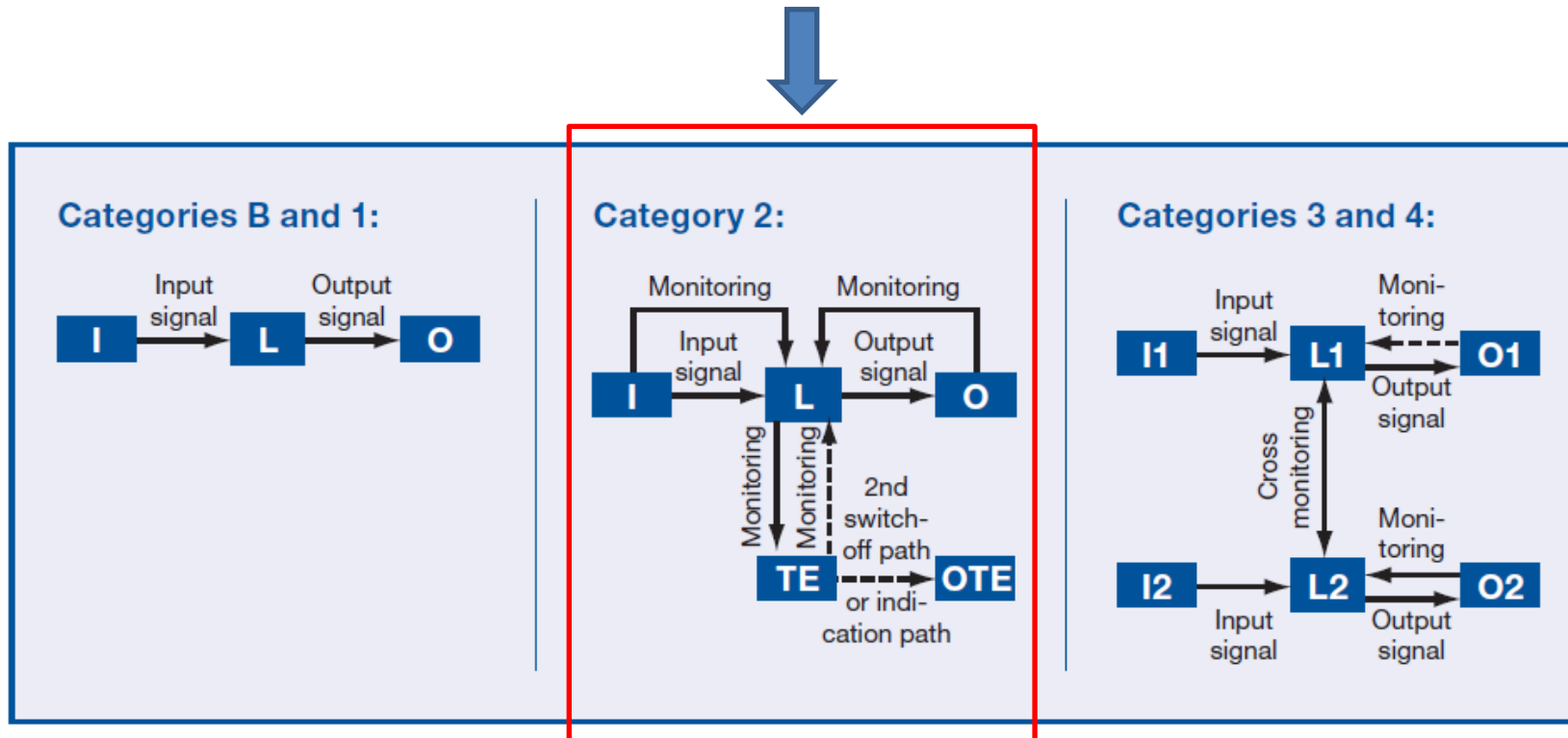
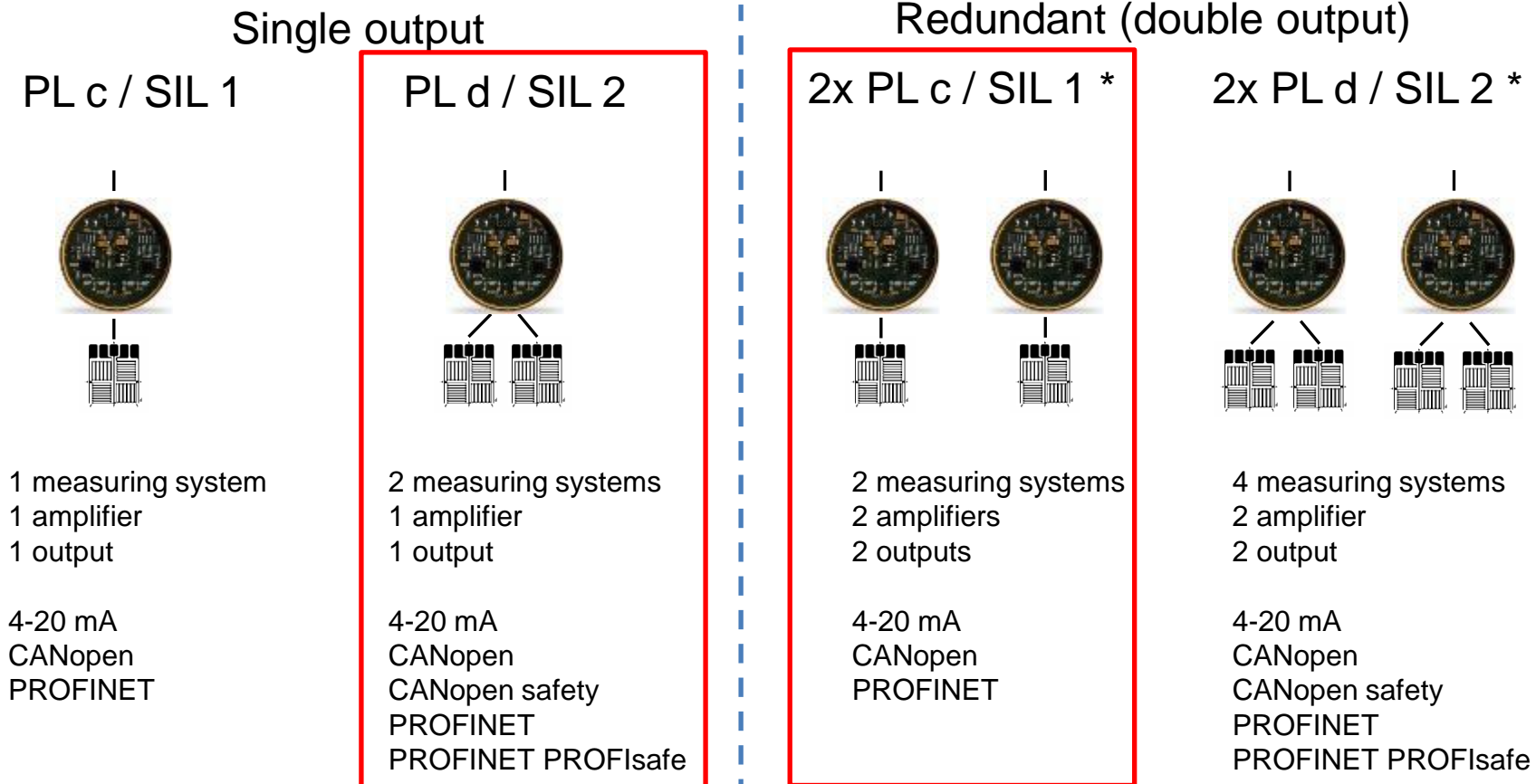


Figure 10: Introduction to Designated Architectures

I = Input, L = Logic, O = Output, TE = Test Equipment, OTE = Output of Test Equipment

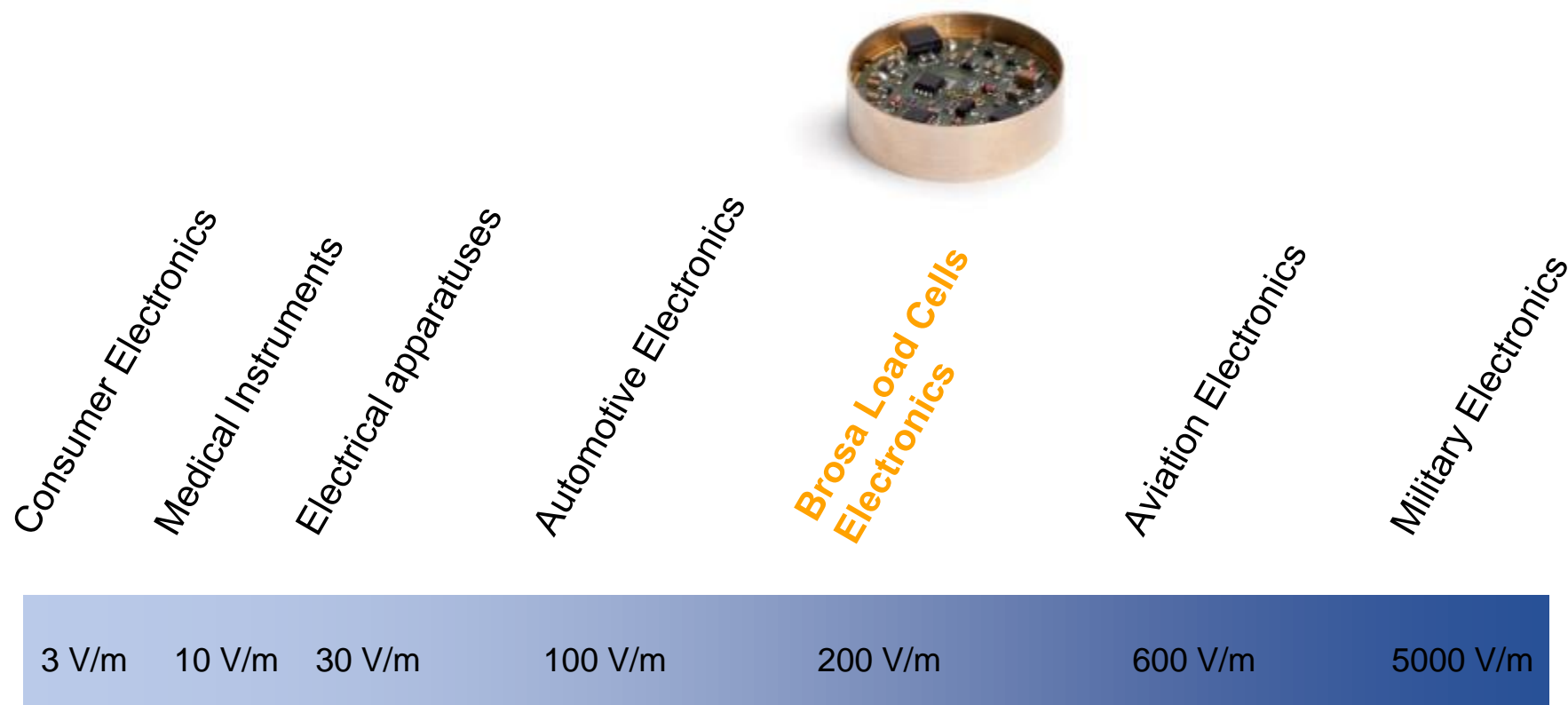
Safety Sensor Concept



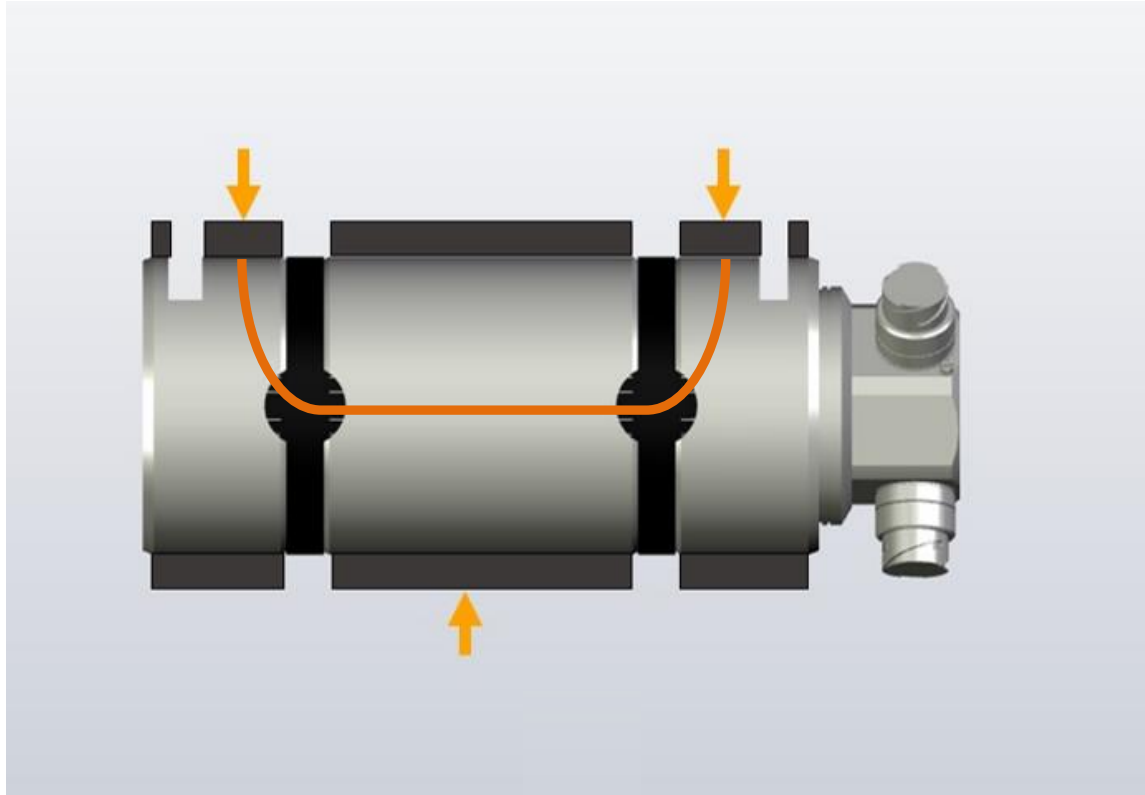
* PL e / SIL 3 is possible if used in parent systems DIN EN ISO 13849-1

EMC (Electro Magnetic Compatibility)

Immunity (perfectly shielded amplifiers & measuring zones)



BROSA Load pins



Typical installations

Installations

Anchor points on dead end of hoist rope

Sheave at rope system

Brakes

Designs

Standard Design, 1 measuring direction

X-Y Measurement, 2 measuring directions with a 90° offset

MOP Design, with Mechanical Overload Protection



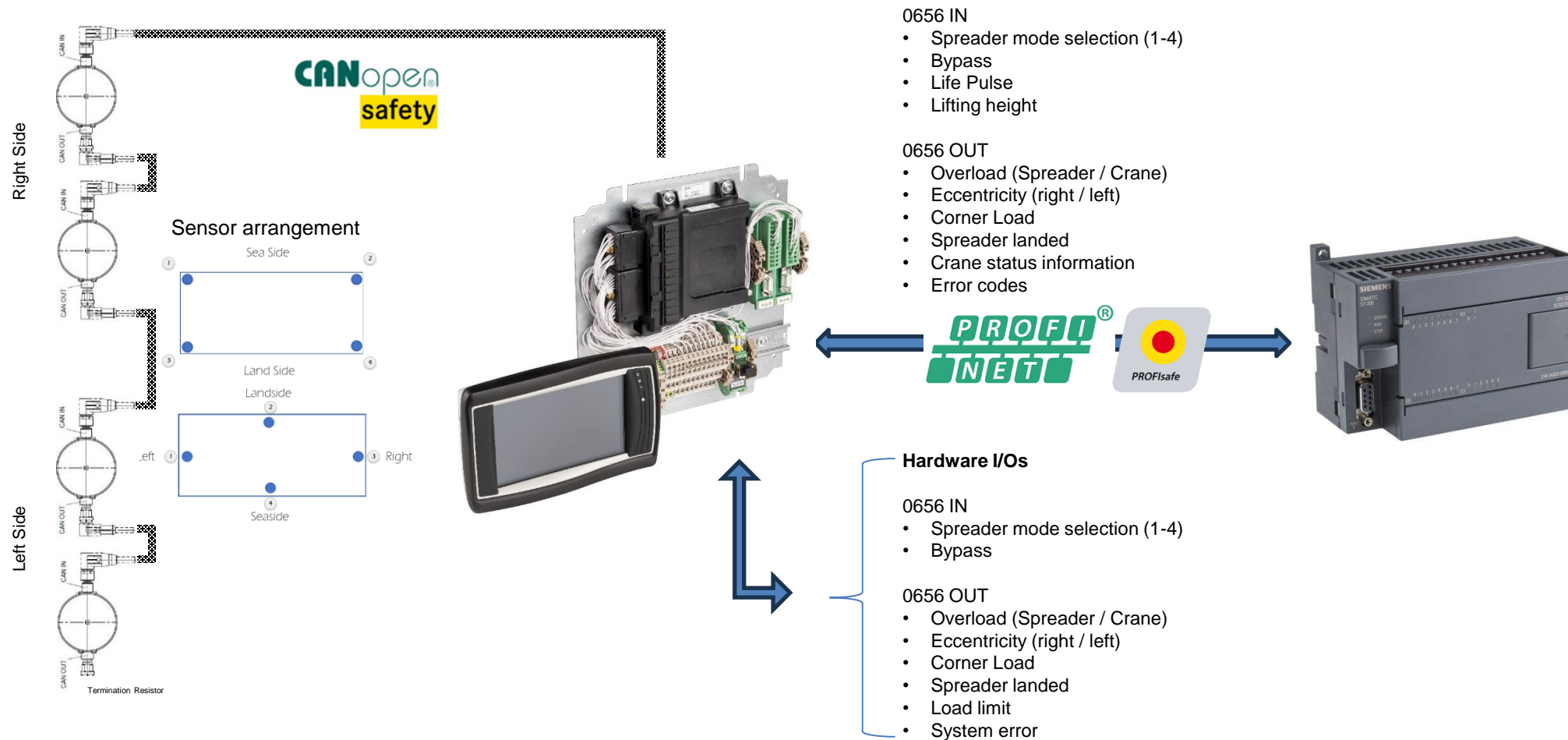
BROSA 3P sensor washer

Integration of the sensor in a twistlock

- No effect on twistlock cross-section
- Direct force measurement by integrating the sensor into the twistlock assembly
- Tension of the twistlock is transformed into a compression force
- Detachable mechanical assembly
 - Can be re-used during twistlock inspection
 - Can be re-used after twistlock exchange
- Designed and tested for > 2 Mio. load cycles



Safety System Concept




Certificates

Weighing & Safety, FMEA, OIML Certificate

Key Data from RP & FMEA

- Standard: IEC 61508 / EN 13849
- Architecture-Category
- Probability of a dangerous failure (PFH)
- Mean Time to a dangerous Failure (MTTF_d)
- Diagnostic Coverage of dangerous failures (DC)
- Mission time
- Resulting in Safety Integrity Level
 - SIL2 = PL_d



OIML BASIC CERTIFICATE OF CONFORMITY
OIML Member State
SWEDEN

Identification of the certificate


General description
The load cell type "0120 integrated into twistlock The ring-shaped load cell such as measurements in positions are possible as

Technical data
Max capacity, E_{max}
Min capacity, E_{min}
Interval, N_{max}
Minimum load cell verification interval, V_{min}
EMC class
Temperature range
Power supply
Apportionment factor (p₁)


Interfaces
The load cell may be equipped with CANopen (D5404), CAN

Applicant
Name:
Address:

Issuing authority
Name:
Address:
Person responsible:
Manufacturer of the certificate
Identification of the A graduated, self-indicating identification of the certified type
Accuracy class
Number of verification (identification continuous)
This certificate attests samples identified in the Recommendation(s) of R60, edition 2000.
This certificate relates instrument concerned.
This certificate does not
The conformity was as 2017-01-20. This is the
Borås, January 23, 2017

SP Technical Research Certification

Lennart Aronsson

OIML Certificate of Conformity n°
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E-mail/internet: info@sp.se/www.sp.se



OIML BASIC CERTIFICATE OF CONFORMITY
OIML Member State
SWEDEN

Project Nr.
LUD013D024

Issue:
02

DANGmicro (2 Messbrücken)

Reliability

The following failure rate: Messbrücken)
[Für das Projekt DANGmicro ermittelt]:

$\lambda_{SD} = 0,0502 \cdot 10^{-6} \text{ H}$
 $\lambda_{SU} = 0,1230 \cdot 10^{-6} \text{ H}$
 $\lambda_{DO} = 0,1797 \cdot 10^{-6} \text{ H}$
 $\lambda_{DU} = 0,0087 \cdot 10^{-6} \text{ H}$

The MTTF_d value of all dangerous failures
[Die MTTF_d aller gefährlichen Ausfälle]

MTTF_d = 606 (10 years)
* According to the DIN EN 13849-1
[Der MTTF_d ist nach DIN EN 13849-1]

The resulting diagnostic coverage
[Es ergibt sich ein Diagnosegrad]

DC = 95,40 %

These values correspond according to the table K1 in [Nach Tabelle K1 der DIN EN 13849-1 einem Performance Level d]

The probability of a dangerous failure
[Die Wahrscheinlichkeit eines gefährlichen Ausfalls beträgt]:

PFH = $4,04 \cdot 10^{-9} \text{ H}^{-1}$

The Safety Integrity Level, [Der Sicherheits-Integritätsgrad]

PL_d = SIL-2

Standards and Handbooks [Normen & Zuverlässigkeits]

IEC TR62380
FMD-91
IEC 62061

OIML Certificate of Conformity n°
SP Technical Research Institute
Box 857, SE-501 15 Borås, Sweden
Phone: +46 10-518 50 00
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Project No.
LUD552D02

Issue:
01

DANGmicro (2 Messbrücken)

Reliability

Project No.: LUD552D02
Issue: 01

FlexLim Safe 0656 inkl. Sensoren

Reliability Prediction

Date: 02.06.2023
Page 3 of 4

OVERVIEW

FlexLim Safe 0656 inkl. Sensoren	Safety values according to Kennwerte nach	
	EN 62061 / IEC 61508	EN ISO 13849-1
Classification / Standard	SIL 2 acc. relative to the determined PL	PLd
Architecture-Category / Architektur-Kategorie	1oo1	Categorie 2
λ_{SD}	$821,2236 \cdot 10^{-6} \text{ H}^{-1}$	
λ_{DO}	$1601,0028 \cdot 10^{-6} \text{ H}^{-1}$	
λ_{DU}	$105,1930 \cdot 10^{-6} \text{ H}^{-1}$	
Mean Time Between Failures / mittlere Zeit zwischen zwei Ausfällen (MTBF)	249.907 Hours / Stunden	28 Years / Jahre
Mission time / Gebrauchsdauer	20 Years / Jahre	
Probability of a dangerous failure / Wahrscheinlichkeit eines gefährlichen Ausfalls pro Stunde (PFH _h -Value) ¹	$1,05E-07 \text{ H}^{-1}$	*3
Safe Failure Fraction / Sicherer Fehleranteil (SFF)	95,83%	-
Maximum attainable Diagnostic Coverage / Maximal erreichbarer Diagnoseabdeckungsgrad (DC) ²	-	93,84%
Mean Time To a Dangerous Failure / Mittlere Zeit bis zum gefährlichen Ausfall (MTTF _d -Value) ³	-	67 Years / Jahre
Common Cause Failures / Ausfälle aufgrund gemeinsamer Ursache (CCF)	-	75 Points / Punkte
Anzahl angeschlossener DANGmicro-CAN MK2:	4	

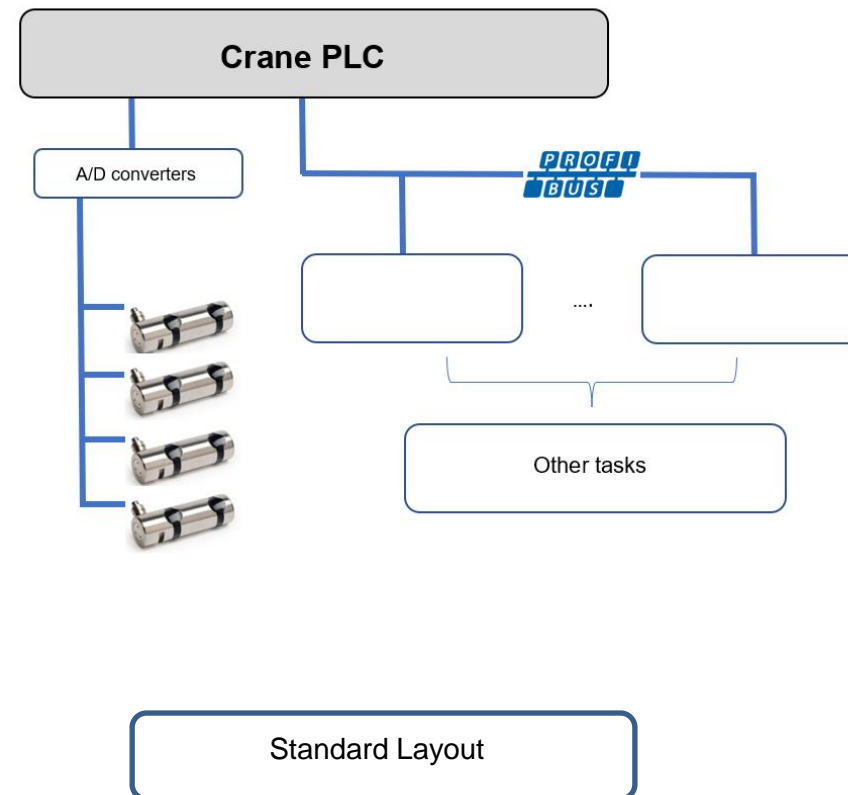
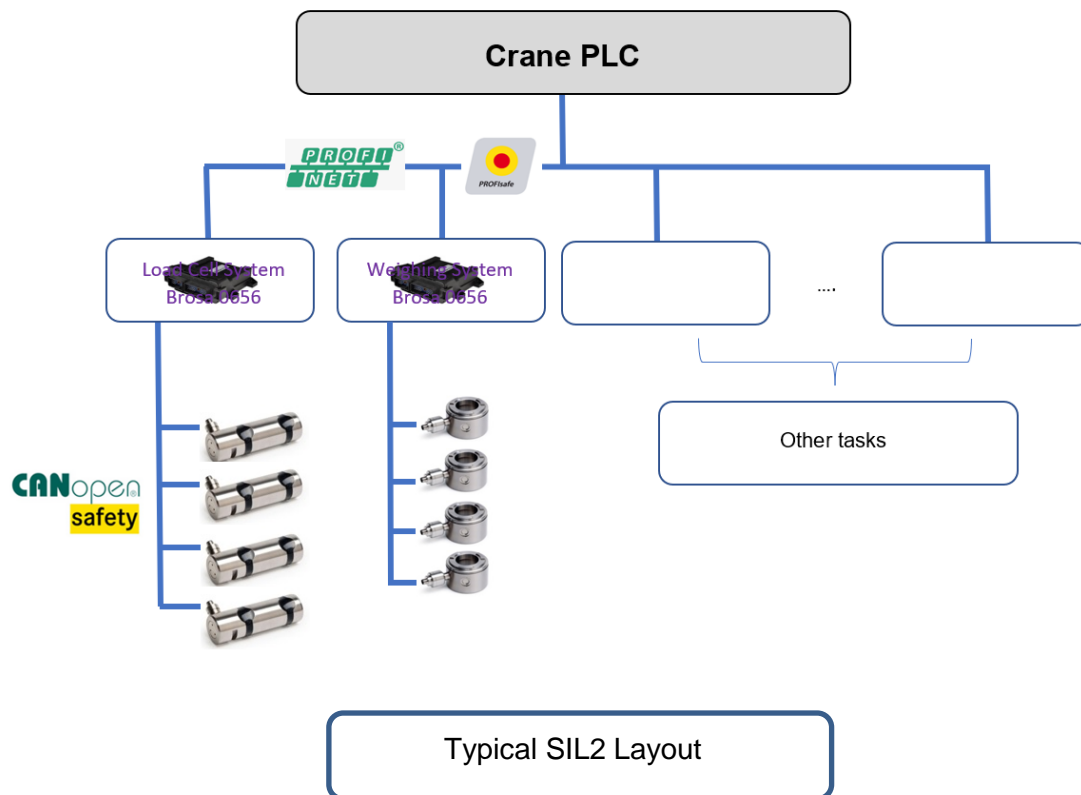
*1 The failure rates used to calculate the MTTF_d were obtained using an engineering evaluation according to the IEC-TR62380 reliability data handbook. A FMEA was performed to determine dangerous failures. Die Fehlerarten für MTTF_d wurden durch ingenieurmäßige Beurteilung nach dem IEC-TR62380 Zuverlässigkeits-Handbuch berechnet. Die gefährlichen Ausfälle wurden durch eine FMEA ermittelt.

*2 The ratio of the dangerous detected failures to the total dangerous failures. Das Verhältnis der Ausfallrate der bemerkten gefährlichen Ausfälle und der Ausfallrate der gesamten gefährlichen Ausfälle.

*3 Used in parent systems [Einsatz in übergeordneten Systemen nach] DIN EN ISO 13849-1

*4 This value is based upon a Diagnostic Coverage of 90% that must be achieved in conjunction with a logic subsystem, within the specified process reaction time. Der angegebene Wert bezieht sich auf einen Diagnoseabdeckungsgrad von 90%, der durch ein Auswertegerät erreicht werden muss. Die Diagnose muss innerhalb der Prozess-Reaktionszeit ausgeführt werden.

Diversification of Tasks SIL2 (IEC 61508)



Users & Customers



Competence

BROSA GmbH

- A competent partner for load sensing and monitoring
- A leading supplier to the container handling industry
- An innovation driven development partner for future oriented products
- Supplier to all major crane and port equipment manufactures
- Products are used in all major ports around the world.



Contacts:

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THANK YOU VERY MUCH FOR YOUR ATTENTION