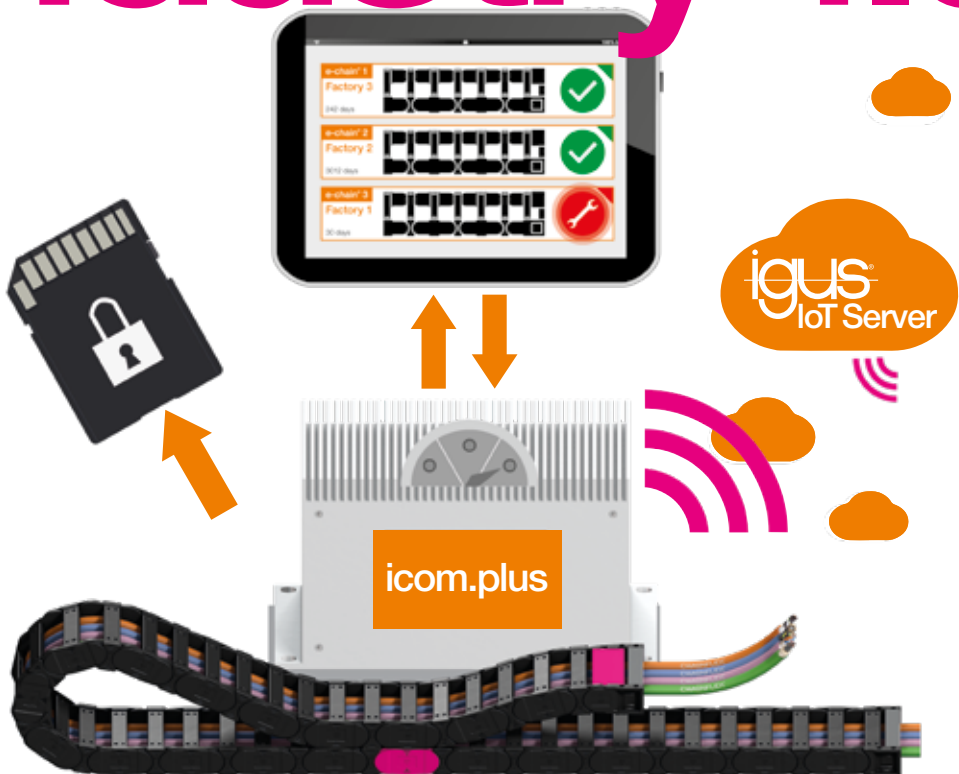


# Industry 4.0



Make maintenance and repair of your machines more efficient and cost-effective.

smart...  
plastics...  
igus®.eu...

# Intelligent smart plastics from stock ...



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As a manufacturer and supplier of plastic components such as energy chains, cables and bearings, igus® is going through a digital development process and orienting its products towards use in smart factories. The aim is to make the maintenance and repair of its plastic systems more efficient and cost-effective. Thanks to the newly developed igus® isense products, industrial maintenance and repair can be improved as well as gaining all the benefits to production from digitalisation. The isense family of sensors and monitoring products have been developed, making igus® plastic products into intelligent solutions. The result is that igus® components do not develop a defect unexpectedly but predict it and indicate the need for maintenance beforehand. With this new development, igus® offers predictive maintenance – intelligent production meets equally intelligent maintenance.



## ... and already in use at an Austrian automotive supplier.

**This factory in Steyr is the biggest and most important engine factory of a car manufacturer. On average, an engine comes off the assembly line every 14 seconds – in peak periods, more than 6,000 engines are produced every working day.**

This output can only be achieved with a high degree of automation using reliable components. This is why the company relies on smart plastics from igus® to avoid unforeseen failures and machine downtime. With the help of a polymer wire inside the energy chain the isense EC.B sensor unit monitors the condition of the chain. In the event of a chain breakage, the machine is stopped automatically to prevent subsequent damage. isense EC.W modules have also been fitted. A sensor built into the crossbar signals advanced wear of the chain. The measurement of wear data means that a chain's remaining service life can be predicted and replacement can be planned at an early stage.



isense online installation in the switch cabinet



# Tested! In the industry's largest test lab

Anyone who can make reliable and useful predictions about maintenance work is one step ahead of the competition. In the age of digitalisation, more than big data is required for such predictions. In order to be able to use the sensor data to derive the correct recommendations for maintenance to be accurately scheduled, long term empirical values from the igus® test database are used.



igus® lab, Cologne. A section of the motion plastics® test laboratory spread over 3,800m².

**“plastics for longer life®”** – igus® products are manufactured in accordance with this guiding principle. Products are designed to extend the service life of machines, eliminate maintenance and therefore reduce cost.

The service life of all igus® products can be calculated online and delivered quickly. To this end, igus® operates the largest test lab in its industry. The heart of igus® innovation beats there. In an area of 3,800m² individual components and finished systems are tested under real conditions to provide the best plastic products. All test

results are documented and archived in the company's database. Based on this, the service life of our products is reliably calculated, new materials are researched and products are developed. In addition, the test results are included in the igus® online calculators and in the algorithms of the smart plastic systems.

[www.igus.eu/test](http://www.igus.eu/test)



Service life test for circular movement



Testing of chainflex® cables under torsion



Durability test in various oils and liquids



Climate chamber. Dynamic tests of cables in e-chains® at -40°C

## Facts and figures of the igus® laboratory at a glance:

- 3,800m² test area
- 4,100 energy chain system tests annually at 180 test stations: climate chamber, outdoor tests, noise chamber, travel lengths up to 130m, robot systems etc.
- 2 billion test cycles a year for highly flexible cables
- 1 million electrical measurements recorded annually
- 15,000 tribological tests (friction and wear) in 300 test set-ups
- 140 trillion test movements in the Bearings Business Unit
- Sensors on the test machines provide permanent measurement data, processing in the central database



High-speed tests for long travels



Continuous motion tests with defined bend radius

# igus® isense sensors ...

igus® isense modules, which use sensors to collect data from energy chains, cables, linear guides or slewing ring bearings, are equipped with a serial interface and can be easily integrated into a control cabinet. A data logger allows the storing of values on an SD card.

The data measured by the different isense systems are then sent wirelessly to the icom module, summarised and processed.



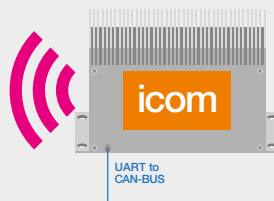
## The icom.plus concept



The concept icom.plus comprises real service life display via the system monitor and timely report on a necessary maintenance. A top-hat rail module supplied by igus® with exact service life data can already be used offline for maintenance planning. Connected to a system monitor, it indicates the service life, triggers alarms in case of deviations and recommends pending maintenance.

For full digital use of the concept, the module can be operated in online mode, creating the best opportunity for predictive maintenance.

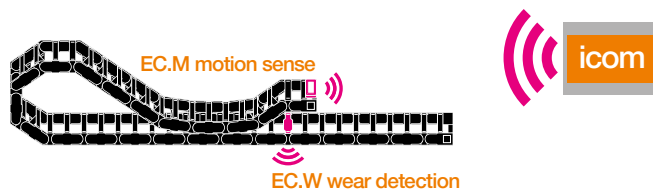
## icom: the data concentrator



The isense sensors become especially effective when connected to the icom module, a data concentrator.

The icom data concentrator is used in the isense online concept and forwards all data pre-aggregated via IoT to the igus® server. By means of data analysis, a service life remaining calculation using machine learning is carried out. This gives the number of days until the next maintenance in a statement via a web dashboard. Freely definable alarms by e-mail and SMS are also possible if limit values are exceeded or if the number of days until the next maintenance is below a freely selectable number.

## EC.M & EC.W: sensors for movement and wear on e-chains®



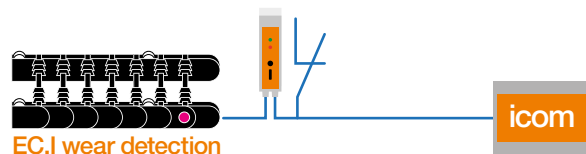
**Always moving: the EC.M sensor makes it possible**

The EC.M sensor is mounted on the moving end of the energy chain in order to record the application data. It detects values such as acceleration, velocity, temperature and number of cycles, and determines the distance completed as well as the remaining service life of the system.

**Wear detection with the EC.W sensor**

An abrasion sensor measures the wear and depending on the product, at the crossbar, in the pin/bore connection or in the liners and sends a signal when the limit is reached.

## EC.I: non-contact wear measurement of e-chains®



**Non-contact wear measurement**

For roller chains, e.g. series P4.1, the pin/bore connection is the most mechanically stressed component. Integrated directly in the chain link, the EC.I sensor measures the percentage wear of the pin/bore connection without contact and in this way enables timely planning of replacement or repair. Can be connected to the icom modules.



## EC.P: push/pull force



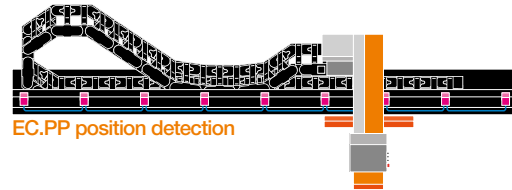
### When the forces are critical: EC.P sensor measures push/pull

Use of the EC.P sensor saves maintenance personnel from having to inspect long travel systems – information is always available and can automatically be passed to the isense system.

The principle has been successfully used as the “Push/Pull Detection System”, PPDS by igus® for 14 years.

In stand-alone mode, it switches off the system if predefined force limits are exceeded.

## EC.PP: sensor for position-sensitive push/pull force measurement



### To determine the position-dependent push/pull forces of long e-chains®

The EC.PP integrates a precise positioning system into the e-chain®. It provides information to the EC.P to accurately determine the push/pull forces. The position information may also be used out of the application, e.g. in cranes for positioning purposes.

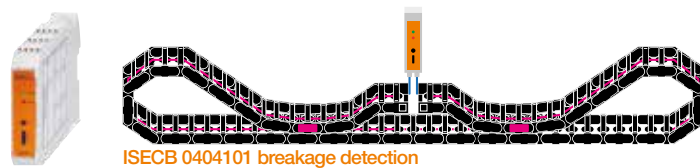
## EC.B: e-chain® breakage



### Chain breakage as an easily solvable problem with the EC.B sensor

The EC.B break detection sensor from igus® reduces the amount of work of maintenance technicians tasked with looking after crane installations and gantries. This applies from smaller indoor cranes in production facilities right up to the huge cranes used in ship-building. The EC.B sensor can detect breakage of a chain link caused by parts or debris falling into the system. In the past, this problem played a part in the failure of a crane, as breakage of a chain link automatically leads to overloading and therefore failure of the opposite side.

### Breakage detection for two e-chains®



### Promptly detect chain breakage on opposed or very long chains.

The EC.B sensor can detect breaks at two points of an e-chain® via two sensors. Both sensors report to a single top-hat rail module, a compact solution that saves space in the switch cabinet.

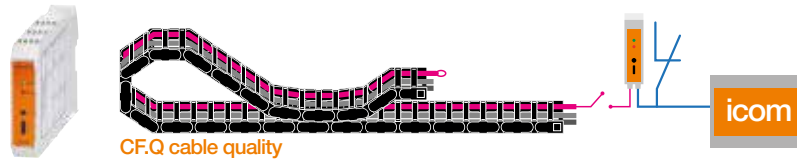
## EC.T: sensor for glide bar wear in troughs



### The new EC.T sensor measures the wear of the glide bar during long applications.

When a defined percentage state of wear is reached, a signal is transmitted to the icom module and the calculation algorithm for specifying the remaining service life in days is adjusted accordingly.

## CF.Q: sensor for the chainflex® cable service life



### Hidden cable damage detected at an early stage by CF.Q sensor

The CF.Q sensor indicates changes in the electrical properties; and allows detection of impending cable failure in advance. The electrical engineer can then decide what priority the replacement of a cable has and what the consequences of a defect might be.

## CF.P: sensor for measuring tensile forces on cables



### Longer life for the cables

Tensile forces acting on the cables of an e-chain system can significantly reduce the service life! The CF.P system measures the forces directly at the strain relief and indicates the need for action in a timely manner.

## CF.D: measuring the transmission quality of Ethernet bus cables



**The transmission quality of Ethernet cables is monitored by the CF.D sensor.** It detects packet losses in good time and issues an alarm via LED, NC contact or the network. The bus cable can therefore be replaced before a sudden failure occurs. An additional measuring cable is not necessary.

## DLT.W: wear sensor for drylin® T linear systems



Used to detect when **the wear of a drylin® linear guide** has reached a level normally associated with the end of the guide's service life. A plastic element that has an integrated sensor and can be retrofitted, signals the need for replacement in good time.

## DLW.W: wear measurement for drylin® W linear systems



**The drylin® DLW.W sensor responds promptly when sliding elements of the drylin® W linear system have to be replaced.** The replacement of the sliding elements takes place smoothly directly on the rail. The simple maintenance process can be planned accordingly.

## PRT.W: wear measurement for iglidur® PRT slewing rings



**To determine the wear limit of iglidur® slewing ring bearings.** Mounted in a milled slot below the sliding elements of the PRT, the PRT.W sensor measures the wear and tear and can indicate the required replacement promptly via the icom communication module about the expected remaining life.

## isense plain bearing: wear measurement integrated in plain bearing



**Measuring wear in plain bearings can be done by the isense plain bearing.** Integrated sensors alert a local device in good time and enable the replacement before a failure occurs. The connection to an online system extends the possibilities using the sensor.

# Integration into your own infrastructure ...

You have the choice of various concepts for integration into your own infrastructure.

In this way there is an option for the icom to send the data from the sensors to a PC or integrate the data via computer into the existing software environment or intranet solution. In addition, a connection to the igus® Data Center is possible. In this case, the maintenance recommendations via Machine Learning and AI algorithms are constantly compared and defined with the experiences of many existing applications, especially those in the 3,800m² igus® test laboratory. Due to the

numerous test findings that are fed into the online service life calculators, igus® is able to predict precisely how long an e-chain® will work reliably in a particular application. The isense components provide the customer with additional safety through a permanent service life update. This is because it includes the current ambient conditions of the actual application. Maintenance and replacement occurs only when it is really essential. This saves time and maintenance cost.

isense offline



- Flexibility ■■■■■■
- Networking ■■■■■■
- Safety ■■■■■■
- Costs ■■■■■■

**With increased requirements for IT security**  
Where the service technician has to monitor a large number of energy chains, cables and bearings in a production facility, the isense-offline system is a great solution.

► Page 14

isense online



- Flexibility ■■■■■■
- Networking ■■■■■■
- Safety ■■■■■■
- Costs ■■■■■■

**The solution comes to the problem**  
Plan maintenance and service activities efficiently with isense-online and only carry out the work that is really necessary. Efficient work prioritisation after the alert, and supply or immediate installation of the appropriate replacement part from stock.

► Page 15

isense integration



- Flexibility ■■■■■■
- Networking ■■■■■■
- Safety ■■■■■■
- Costs ■■■■■■

**Early ordering of replacement parts**  
Thanks to a wide range of options (Pronet, Ethernet, EtherCat, CC-Link IE Field), integration into existing IT structures is possible with trained igus® specialists.

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isense stand-alone

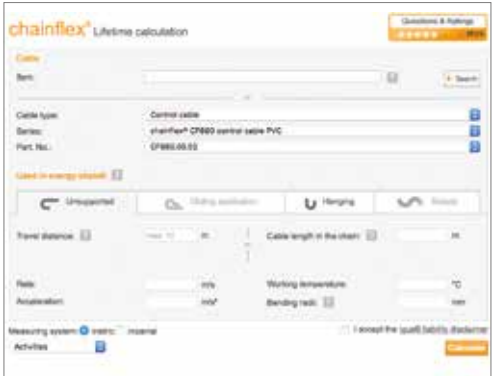


- Flexibility ■■■■■■
- Networking ■■■■■■
- Safety ■■■■■■
- Costs ■■■■■■

**Added value for service technicians in specialised production**  
The isense-stand-alone system lends itself to those businesses that are only concerned about preventing disruptions to production.

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When the isense online system is used, the time shown until the next maintenance is based on the algorithms of the service life calculators for e-chain systems® and chainflex® cables which have been available on the Internet for many years:



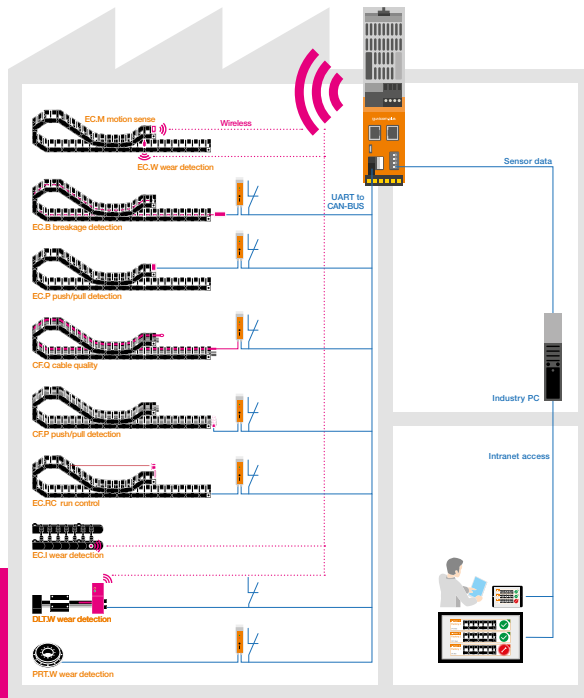
The service life calculator combines the results of many thousands of tests and applications in the field into a predicted life in double strokes or kilometres. In the isense system, the starting values are compared with the real application and a constant comparison takes place with the online models based on KI and machine learning algorithms.



Through numerous tests, the results of which are incorporated into the online service life calculator, igus® can predict very accurately how long an e-chain® will reliably work in a given application.



## Keep track of things at all times



## Customer site using smart plastics

## The benefits at a glance:

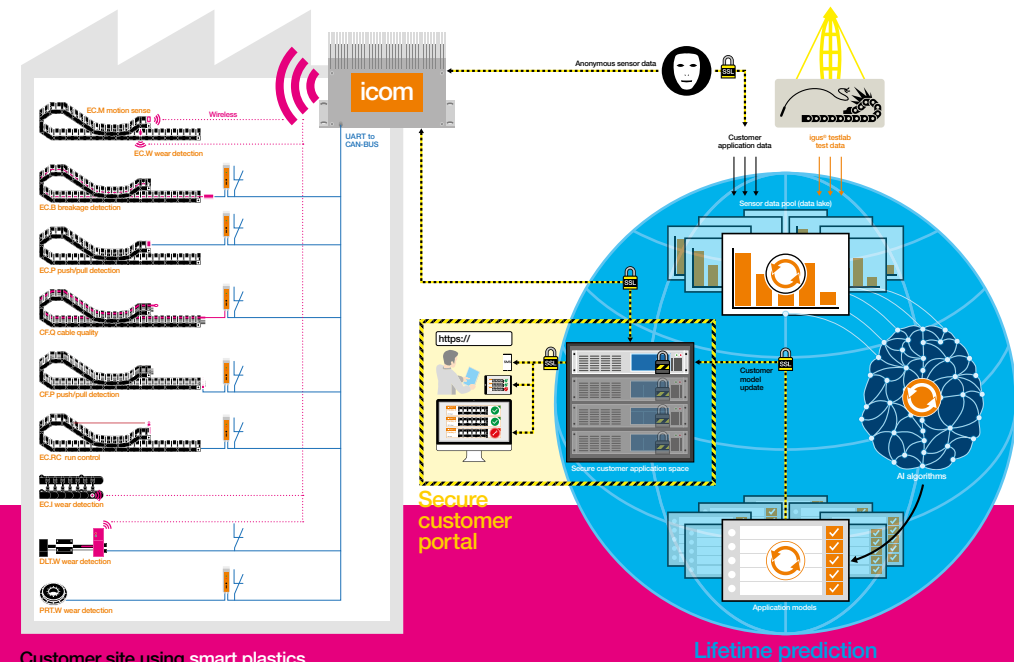
- Top-hat rail module is provided with service life information by igus®
- If there is no permanent connection to the Internet, the data remains in the system of the company
- Manually controlled update with the igus® server is possible for the comparison of the service life statement
- Integration into existing system concepts
- Good overview on the IPC: all impending failures in the production environment are displayed
- Ideal for production managers and shift supervisors who are interested in smooth day-to-day work in component manufacturing or service provision and want to efficiently deploy their maintenance technicians
- Quickly and easily installed lean SW solution
- All messages are displayed on an additional industrial PC



# isense semi-offline

**isense online**

## Smart production: the solution comes to the problem



## Customer site using smart plastics

### The benefits at a glance:

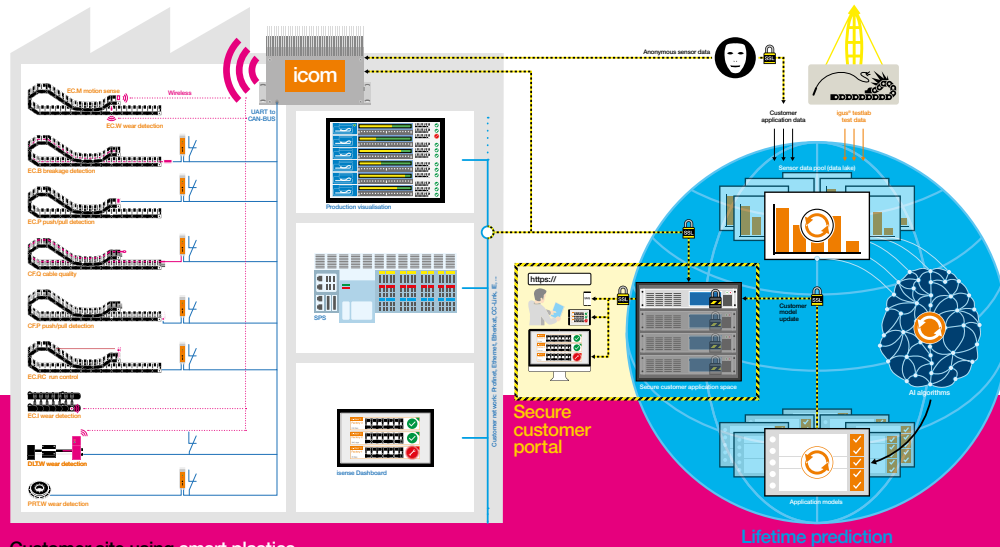
- Use the best method to plan servicing work and only do the work that is really necessary
- Efficient work prioritising after the sensor warning, and thanks to integration into the ERP, appropriate replacement parts from stock
- Predictive and plannable servicing work due to early information on required maintenance or replacement
- Data from the igus® laboratory is processed on a server with the anonymous customer data and also with open data from other customer applications in order to create a data model
- Data from the igus® laboratory is processed on a server with anonymised customer data in order to create a full data model
- Benefits from all of the test data in the igus® database and learns something new every day

Switch from the offline mode into online mode at the desired time to recalculate service life data from igus® via a secure line. Afterwards, the system can be operated again in offline mode.



# isense integration

Early ordering of replacement parts thanks to connection to ERP



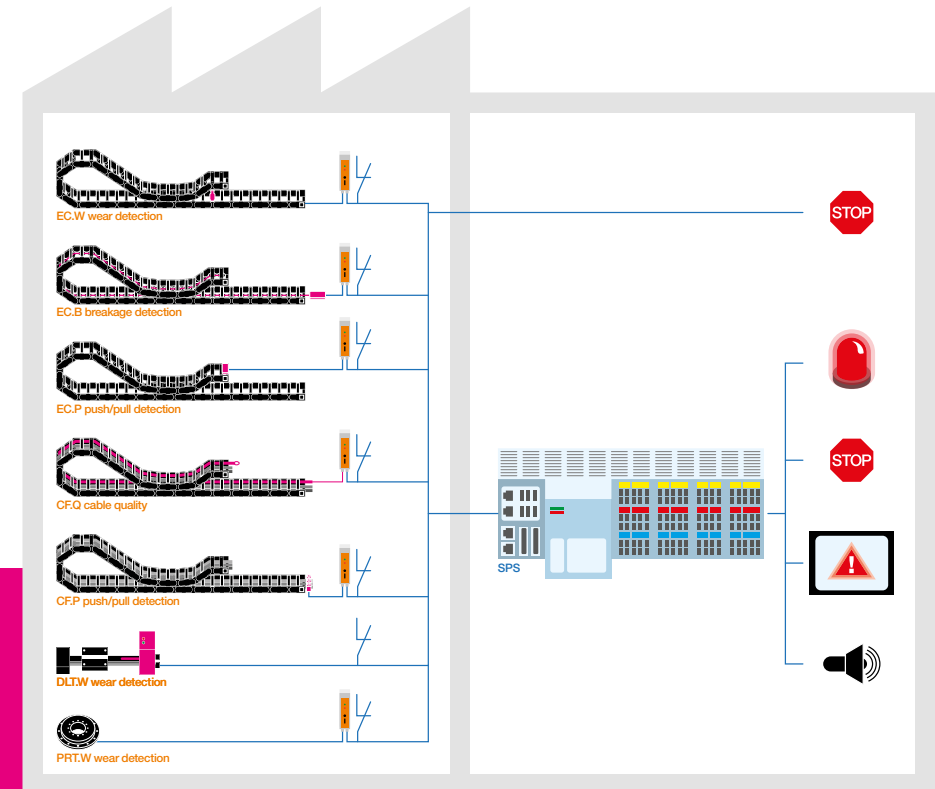
Customer site using smart plastics

## The benefits at a glance:

- Wide variety of protocols and standards (Profinet, Ethernet, EtherCat, CC-Link IE Field), OPC-UA, MQTT
- Integration into the existing software environment and the intranet
- Large number of protocols such as OPC-UA or MQTT
- Integration into the customer's production visualisation software
- Operating states of different igus® components at a click of the mouse
- Ordering of replacement parts via connected ERP system
- Connection to control software via customer's infrastructure (Ethernet, Profinet, CC-Link IE Field etc.)
- Shutdown of the machine or acoustic or visual warnings

# isense stand-alone

Keep production trouble-free the easy way



Customer site using smart plastics

## The benefits at a glance:

- Easily integrated by a machine programmer
- Sensors (EC.B - break, CF.Q - cable monitoring) on e-chains® and cables acquire the measured values
- The machinery can be switched off in two ways: directly by means of the NC contact or through evaluation via an I/O interface of the customer's PLC
- Customers can arrange for the data to be sent to them via a serial interface (RS2322/UART) so that they can evaluate the data themselves

# One concept, three options: icom.plus

Industry 4.0 has long ceased to be a pure buzzword – many companies are in the midst of applying the processes. Some plan, others implement already; some things go quickly, others need more time. One thing is clear: there are as many ways for digital transformation as there are companies. And they all know that digitisation is more than networking of things via the Internet, collecting big data, working in the cloud or building smart factories. At the centre of all efforts is a concern for all industries: safety.

With icom.plus, we have developed a concept in which the service life of a system and maintenance recommendations are reliably displayed via a top-hat rail module. In doing so, we responded to the various needs of the company's operators and their digital strategy, because the concept encompasses three different modes of data usage: online, semi-offline and offline. These are not different systems and modules, but it is only the way in which the module processes the sensor data that differs.

However if a customer would like to use the module, programming begins with the application-specific service life data. The basis for the calculations is the igus® test database, which receives measured values from the 3,800 m<sup>2</sup> test laboratory day and night.

## Offline mode

In addition to the maintenance recommendation, it is now possible to capture, collect and evaluate sensor data, such as wear information. With the new module there comes a technical solution that communicates sensor data, for example to the control system panel, where the operating conditions or maintenance instructions of all sensor-equipped e-chains®, iglidur® plain bearings or chainflex® cables are visualised. This has an advantageous effect, especially in large production facilities, where a large number of resulting sensor data should be displayed without Internet connection.

## Semi-offline

Even if the module is operated offline, from time to time the user can compare their real measured data with the data of the igus® server when the system parameters change. To do this, it switches the module to semi-offline mode. The short-term online connection via a secure data connection to the igus® server now enables the transmission of encrypted data. After recalculating the service life, the updated service life data is encrypted and returned to the module by the igus® server. When the transfer is complete, the module goes back to offline mode.

## Online

Optionally, customers can use the module in online mode in their production from the start. Then, a continuous comparison of the service life is made via the igus® server. The data is encrypted with AES 25 and permanently synchronised. For customers, this means the chance to optimally utilise the system's service life and minimise failure risks.

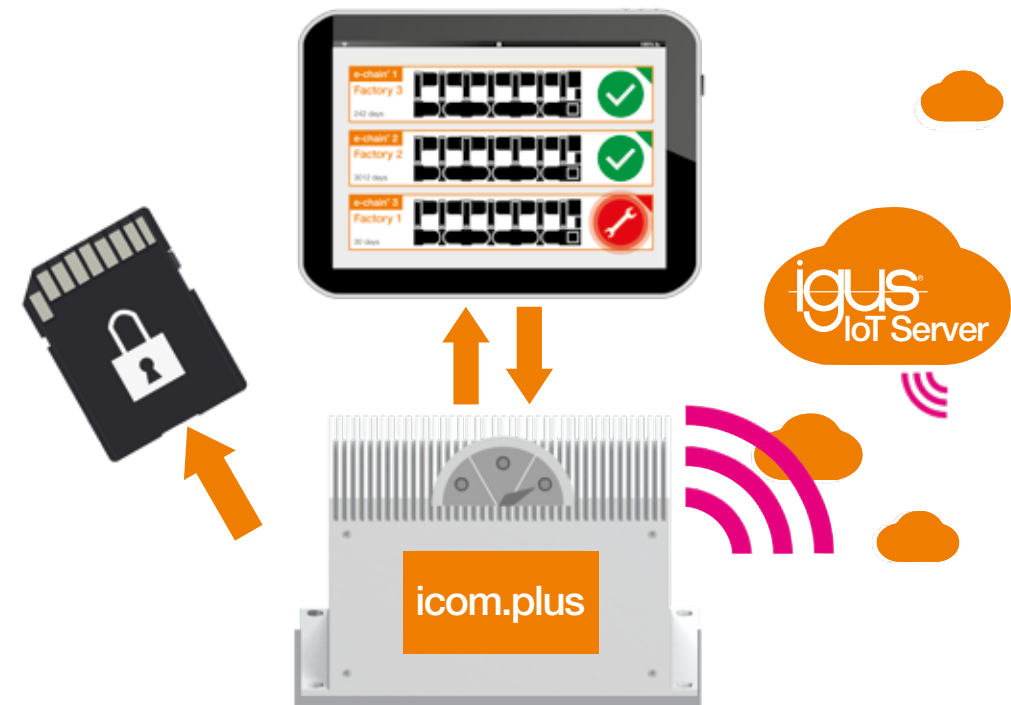
Regardless of the operating mode in which the module is used in a production plant, it is the technical basis for maximum runtime and compliance with all IT security standards.

At the same time, the combination of the data-rich module and online operation lays the foundation for predictive maintenance.

In the long run, this reduces service costs. Shift supervisors and maintenance crews are relieved and warehousing becomes much more efficient.

If you want to go one step further, you can be connected to igus® own ERP system and automatically receive a proposal in the form of an offer and date suggestion for the necessary maintenance.

Companies that embark on the path of digitisation get a new concept in their hands with icom.plus, which helped them along the way.



# igus®.eu/20h

Orders can be placed until 8pm. Ordering and deliveries weekdays from 7am to 8pm, Saturday from 8am to 12pm. No minimum order quantities, no surcharges. Quick delivery.

[www.igus.eu](http://www.igus.eu) Phone: +49 2203 9649-145 Fax -334

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# /9001:2015 /16949:2016

igus® is certified in accordance with ISO 9001:2015 and IATF 16949:2016 in the field of energy supply systems, cables and harnessing, as well as plastic bearings.

# /smart plastics

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