A digital version of the game and more information can be found online at www.igus.eu/smart-plastics

Game instructions

smart plastics dominoes

This domino game is a fun way to become familiar with the smart plastics product range with all its functions and options.

Use the following steps:

1. Are you more interested in **a)** condition monitoring or **b)** predictive maintenance?
   - **a.** Proceed with the blue DIN A5 sensor cards.
   - **b.** Proceed with the large DIN A4 cards.
2. You can then use the coloured edges of the cards as you would in a normal game of dominoes and assemble your own smart plastics system.
3. Some cards have additional ***instructions and rules*** to facilitate game play.

Have fun playing smart plastics dominoes!

Max.:
2 x EC.P/CF.P
2 x EC.B

i.Sense:modul II

i.Sense: condition monitoring with smart plastics

Cut costs and reduce installation space in the control cabinet ...

... connect up to four additional monitoring sensors to a module.

Reduce installation effort ...

... configuration and download from smart phone or laptop.

Get underway with Industry 4.0 ...

... provide sensor data and alarms to the local network or with IoT for third-party applications.

Minimise network cost and effort ...

... with simple connection to the i.Cee:local module.

Optional connection to i.Sense:modul II for condition monitoring

Motion profile detection

Multiple choice possible!

i.Cee:local module

i.Cee: predictive maintenance with smart plastics

Maximise igus® product service life and plan replacementt with a good lead time ...

... precise service life calculation based on proven algorithms

Avoid unexpected downtime ...

... early warning if malfunctions start

Plan and reduce cost and effort for regular maintenance ...

... with integrated service management

Integrate igus® products easily into Industry 4.0 projects ...

... a standard module for all predictive maintenance concepts

Connectivity/data output i.Cee:local

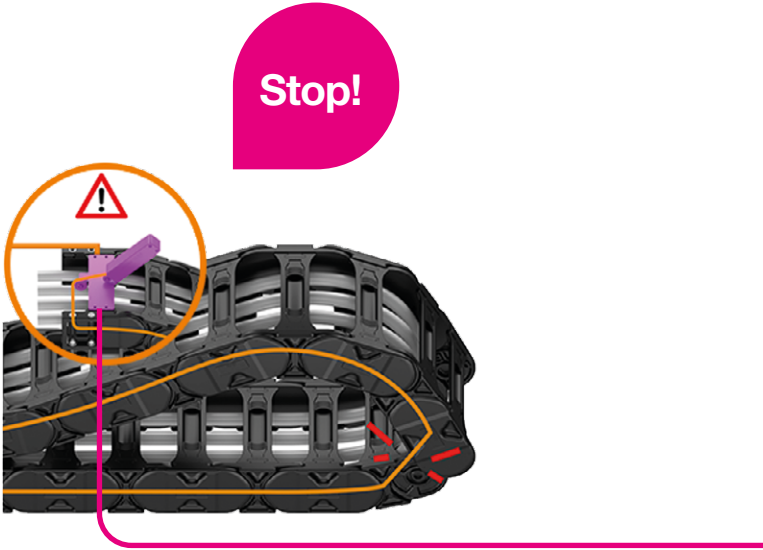
Min. 1x

Plastic abrasion feedback (sensor)

Avoid unscheduled machine downtime

Detect chain breakage early and prevent complete failure ...

The EC.B sensor at the moving end detects link breakage in your e-chain® immediately and, should the worst happen, sends a notification right away. This allows you or your system to intervene, frequently preventing both additional damage (to the opposite chain link) and system shutdown.



igus® e-chains® breakage detection EC.B

System requirements

igus® E4 and P4 e-chain systems® from 28mm inner height and 75mm inner width installed for gliding operation (from 350mm inner width, two sensors per chain)

System components

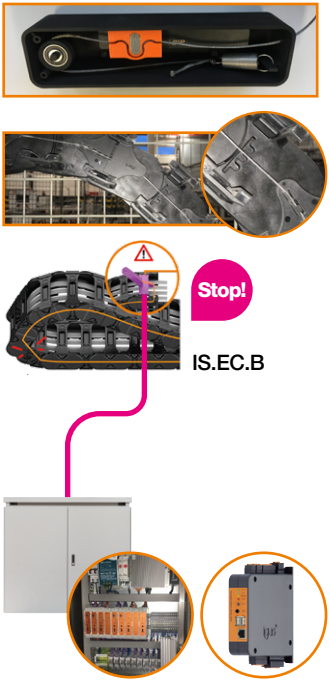
1. **Sensor unit** consisting of a web measurement system, guide roller, and tension springs.

2. **Non-stretch polymer cable** on the sensor box; includes special fixing separators in the neutral phase.

3. **Installation elements** that work with the chain series.

4. **Connecting cables** between sensor unit and evaluation module in the control cabinet.

5. **Evaluation module**: all sensor data is evaluated based on igus® algorithms; plant controls are informed instantly of any mechanical faults that occur.

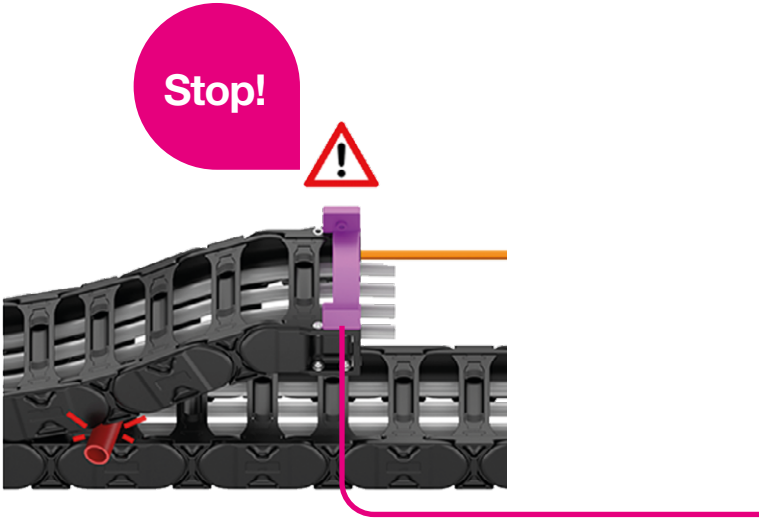


Function video, installation instructions and other information online:

Avoid unscheduled machine downtime

Detect blockages, misalignment and foreign bodies in time and prevent complete failure ...

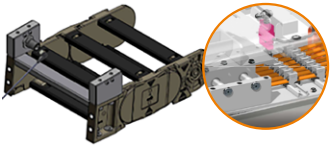
Forces arising in moving machine elements must be mastered. EC.P sensors on the moving end give you full control of your e-chain system® push/pull forces and can stop the equipment quickly. This is recommended for all e-chains® with long travels



Push/pull force monitoring EC.P

System requirements

igus® E4, P4 and E2 e-chain systems® installed for gliding operation types with KMA (special solutions upon request) from 50mm inner width

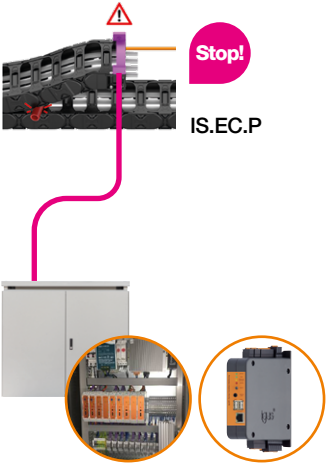


System components

1. **Sensor unit** consisting of DMS sensors on the KMA; optional for installation types on the FTA with load cell.

2. **Connecting cables** between sensor unit and evaluation module in the control cabinet.

3. **Evaluation module:** all sensor data is evaluated based on igus® algorithms; the plant controls are informed instantly of any mechanical faults that occur.

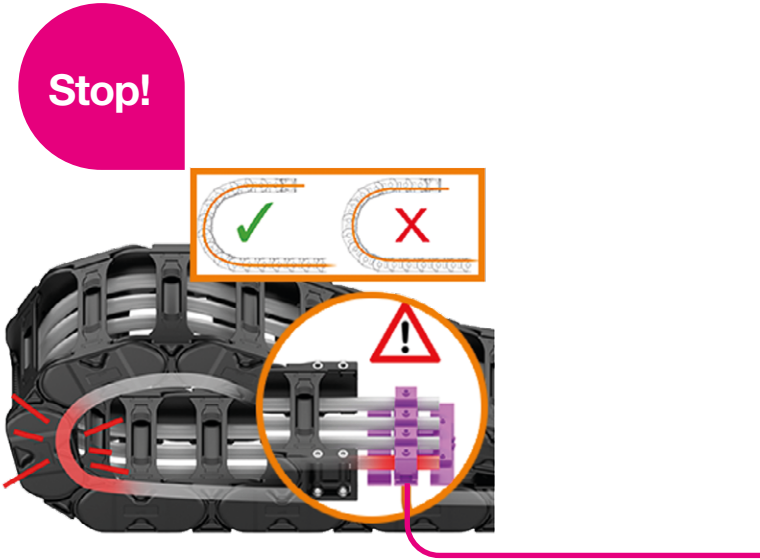


Function video, installation instructions and other information online:

Avoid unscheduled machine downtime

Permanently prevent cable failure due to tensile damage ...

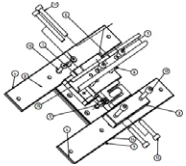
A cable's maximum e-chain® service life can be achieved only if the cable is laid properly in the neutral axis. If a cable rests on the inner e-chain® radius, jacket abrasion increases, causing premature cable failure. In such a case, the CF.P. sensor measures tensile force on the fixed end and can initiate an alarm or a shutdown.



Monitoring of cable tensile force CF.P

System requirements

igus® E4 and P4 e-chain systems® installed for gliding operation in connection with igus® aluminium or steel troughs from 100mm inner width

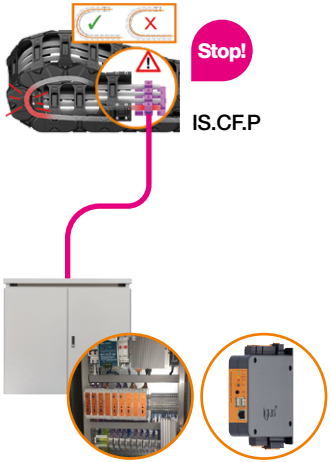


System components

1. **Sensor unit** consisting of C rail, load cell and installation elements.

2. **Connecting cables** between sensor unit and evaluation module in the control cabinet.

3. **Evaluation module:** all sensor data is evaluated based on igus® algorithms; the plant controls are informed instantly of any mechanical faults that occur.



Function video and other information online:

Avoid unscheduled machine downtime

Detect signal failure due to overstressed bus cables early on ...

Bus cables ensure smooth interaction among individual components within the overall system. Data loss due to such factors as damage can cause control malfunction or even shutdown of the entire plant. CF.D monitors the transmission quality with high-frequency technology so that no additional sacrificial cores are needed and the BUS is not disturbed. If a critical value is reached, the system sounds an alarm, and you can replace the cable in good time.

Transmission quality measurement CF.D

System requirements

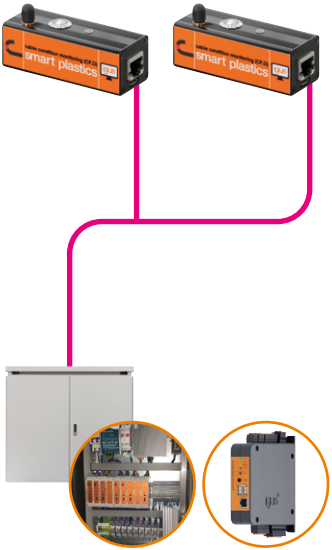
Suitable for all systems with bus cables.

System components

1. **Feed-through adapter** at the beginning and the end of the e-chain®

2. **Connecting cables** between an adapter and the evaluation module in the control cabinet.

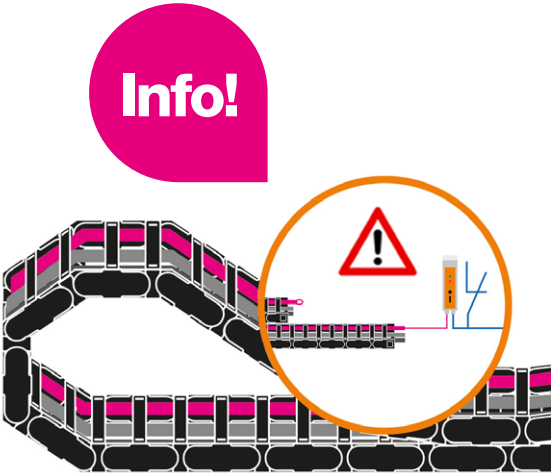
3. **Evaluation module:** all sensor data is evaluated based on igus® algorithms; the plant controls are informed instantly of any mechanical faults that occur.



Function video and other information online:

Prevention of mechanical stress to cables ...

i.Sense CF.Q is used for the early detection of the change in electrical specifications of chainflex® cables due to mechanical loads. For this purpose, the electrical resistance of a dedicated conductor loop is measured during operation. If the system detects a permanent change in the electrical specifications, it recommends that the cable be replaced soon by switching a potential-free contact. If the cable is not replaced, the system switches off the system as a precaution in the event of a complete core rupture.



Cable electrical property measurement CF.Q

System requirements

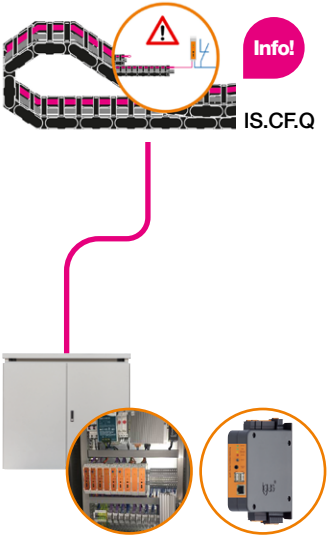
Suitable for all igus® systems.

System components

1. **Sensor unit** for measuring extremely fine temperature differences as a consequence of increased resistance in the cable.

2. **Connecting cables** between sensor unit and evaluation module in the control cabinet, either as sacrificial cable or as unused cores in a cable.

3. **Evaluation module:** all sensor data is evaluated based on igus® algorithms; the plant controls are informed instantly of any mechanical faults that occur.



Function video, installation instructions and other information online:

Improve reaction time

SMS alarm and remote reset directly via a mobile terminal device

SMS!

Alarm: condition monitoring of push/pull force, breakage and cable tensile force

Option: online dashboard connection

System requirements

Each igus® system with i.Sense:modul II

System components

1. **LTE module**

More information online:

Minimise installation cost and effort for very long travels

Satellite-supported, position-dependent push-pull force measurement

System requirements

Each igus® system with i.Sense:modul II

System components

1. GPS tracker

Position-dependent EC.PR force measurement with GPS for travels of 150m or more

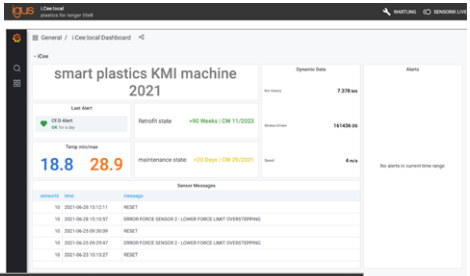
Application reports and other information online:

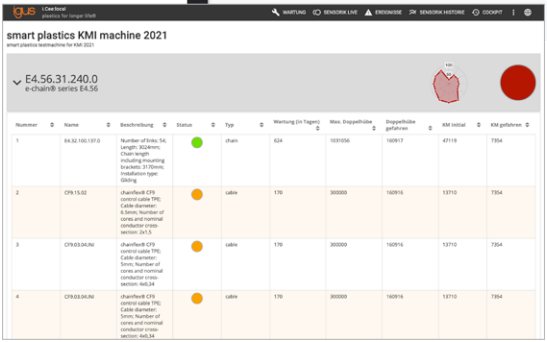
Data output according to customer request

HTML web dashboard

i.Cee:local: graphical output of all information in real time on an HTML dashboard. Two different access options:

- Local dashboard: by web browser via Ethernet from the local network (http access via local IP address).
- Online IoT dashboard: with a web browser via IoT. Secure connection via the cloud portal; access with a mobile wireless modem or VPN network connection





Data output according to customer request

Interface with PLC control

i.Cee:local: graphical output of all information on the customer application control panel.
Communication between the Siemens PLC and the igus® i.Cee:local hardware takes place via the TCP protocol extension according to RFC1006 via the Ethernet network topology.

Preliminary compatibility list

(BETA stage - last updated 30/6/2021)

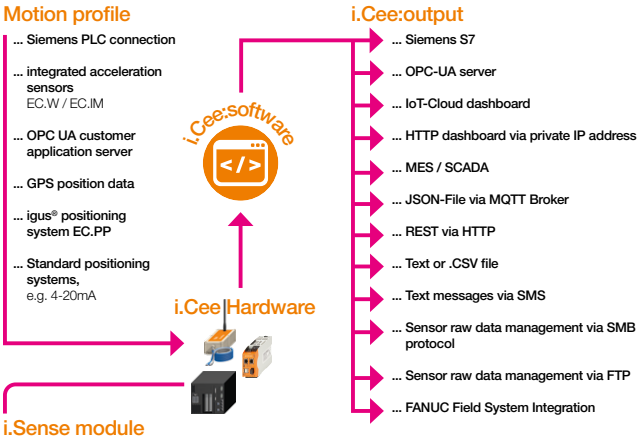
- S7-300 CPUs (from V2.5) with integrated PROFINET interface
- S7-400 CPUs (from V5.0) with integrated PROFINET interface
- S7-1500 CPUs (advanced controller, distributed controller, and S7 software controller)
- S7-1200 CPUs

Data output according to customer request

Individual interfaces

In addition to direct graphical output, all data can be made available to the machine operator in standardised exchange formats with the following methods:

- ... Text messages via SMS
- ... JSON files / MQTT broker
- ... REST via http
- ... TEXT / .CSV
- ... OPC-UA server
- ... Sensor raw data management via SMB protocol
- ... Sensor raw data management via FTP
- ... MES/SCADA
- ... FANUC Field System Integration
- ... Connection to other monitoring systems



Connection to your own machine control system

Reading out the control using one of the following methods is the most precise and cost-effective way of communicating the movement information of the system to the i.Cee system:

- **... Siemens SPS connection**
  in the Siemens S7 series control systems from type 1200 or higher, the values for travel and/or cycles are read directly from the corresponding variables (flags) and the current position of the trolley/moving end is transferred to the i.Cee system.

- **... Customer application OPC UA server**
  Other control systems often have an "OPC UA" server. In this case the values are transferred directly from the OPC UA server to the igus® system.

In addition to the options mentioned above, classic external systems such as laser, bar code and radar systems can also be used. The communication is usually carried out via classic systems - e.g. 4-20 mA technology.

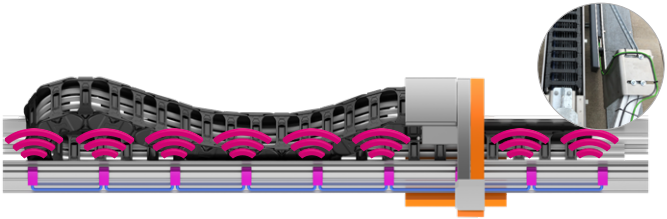
Sensors mounted directly on the product

In addition to a machine control system connection, there is also the option of using sensors provided by igus® and installed on the product to record the motion profile:

- **... integrated EC.W/EC.IM acceleration sensors**
  Abrasion sensors such as EC.W and EC.I are also equipped with acceleration sensors that use direction change and movement time measurement to generate a motion profile.

- **... GPS position data**
  For very long travels (>500m), the position and motion profile can also be determined via a GPS/Glonass satellite receiver.

- **... igus® positioning system EC.PP**
  This position measuring system can be used for travels with a guide trough. Beacons, which are connected by cable, are attached to the outer side parts of the guide troughs at 50cm intervals. These beacons remotely transmit their positions to a single antenna fixed to the floating moving end.



Tribological condition sensors

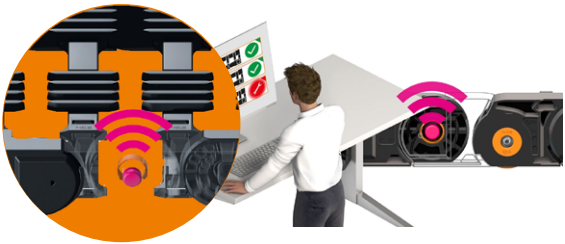
Measure abrasion at the pin/bore directly in the chain

The EC.W sensor detects the abrasion of the wear pads on the side parts of the energy chain via the resulting proximity of the crossbars. The end of the service life of the product is reached when the crossbars of the upper and lower run (the upper moving part of the energy chain and the lower part) touch each other:

- **EC.W.LTE (second generation) with solar-buffered battery operation for use with i.Cee.cloud**

- **EC.W.LoRa with solar energy supply**
  The sensor is installed vertically in the separator together with the evaluation unit and the LoRa transmitter unit.

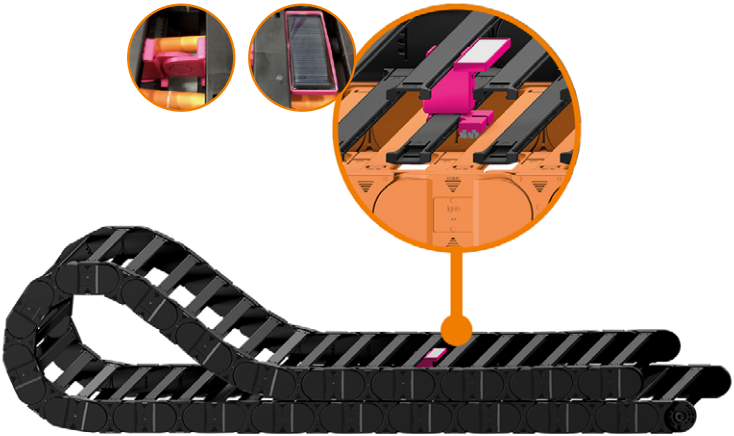
- **Integration of condition sensor, including electronics, into the P4HD roller chain link**
  The sensor is integrated into a standard side link of the chain, but this does not restrict the usable inner width in any way. Generate energy for the sensor from chain kinetic energy.



Tribological condition sensors

One separator is enough for abrasion measurement

No more troublesome battery changes. The abrasion status of the sliding feeder is communicated via LoRa radio transmission standard to i.Cee:box or i.Cee:plus II.
The energy supply is ensured via the solar panel. Graduated percentage service life information is implemented across four sensor layers.



Area of use
igus® E4, P4 and E2 e-chain systems® with KMA installed for gliding operation. Special solutions upon request.

Tribological condition sensors

Measure abrasion with i.Sense EC.B

The rope necessary for i.Sense EC.B function transmits the play between pin and bore to the EC.B sensor unit.
These values are transmitted to the i.Cee:local module and used as a percentage wear indicator for comparison with service life prediction.