

TECHNOLOGY. CONNECTED.

Smarte IoT-Lösungen für den ECM Prozess



1. Presentation of the EMAG Group
2. How does ECM work?
3. ECM Applications
4. EMAG IoT
 1. General
 2. ECM specific
5. Summary





Die EMAG Gruppe

Production companies	Technology companies	Market companies	
<p>EMAG Zerst Maschinenfabrik GmbH Zerst, DE</p> <p>EMAG China Machinery Co., Ltd. Jintan, CN</p>	<p>Competence center for the design and implementation of interlinked production systems Salach, DE</p> <p>EMAG Maschinenfabrik GmbH Technology center for turning centers, grinding, milling and oilfield machines Brands: EMAG, Reinecker, Karstens, Kopp, Naxos Union, Richardon Salach, DE</p> <p>EMAG KOEPFER GmbH Technology center for gear-cutting machines Villingen-Schwenningen, DE</p> <p>EMAG LaserTec GmbH Technology center for laser systems and joining machines Heubach, DE</p> <p>EMAG ECM GmbH Technology center for ECM / PECM Heubach, DE</p> <p>EMAG Weiss GmbH Technology center for cylindrical grinding Neckartailfingen, DE</p> <p>EMAG SU S.r.l Technology center for shaving, profile grinding and generating grinding Bologna, IT</p>	<p>EMAG Salach GmbH Salach, DE</p> <p>Sales and service branches Frankfurt, Austria, Sweden, Poland, Czech Republic, Hungary, Turkey, Romania, Russia</p>	<p>EMAG China Machinery Co., Ltd Taicang, CN Beijing, Dalian, Xi'an, Wuhan, Hangzhou, Changsha, Guangzhou, CN</p> <p>EMAG (Chongqing) Machinery Co., Ltd Chongqing, CN</p> <p>EMAG Korea Ltd, Seoul, KOR</p> <p>EMAG India Private Ltd Bangalore, IND</p> <p>Maquinaria EMAG Mexico S.de R.L. de C.V Queretaro, MEX</p> <p>EMAG do Brasil Maquinas, Ferramentas, Com. e Servicos Ltda. Sao Paulo, BRA</p> <p>TAKAMAZ-EMAG Co., Ltd Ishikawa, JPN</p>



Technology company EMAG ECM GmbH

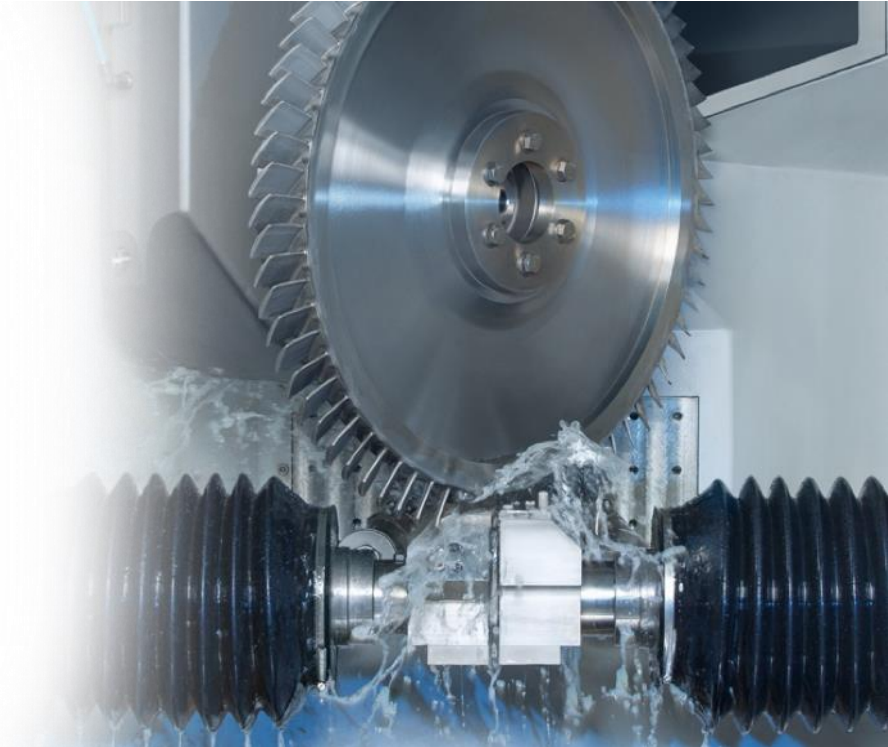


EMAG ECM GmbH
Heubach, Germany

EMAG ECM GmbH based in Heubach
Ostalbkreis
Baden-Württemberg

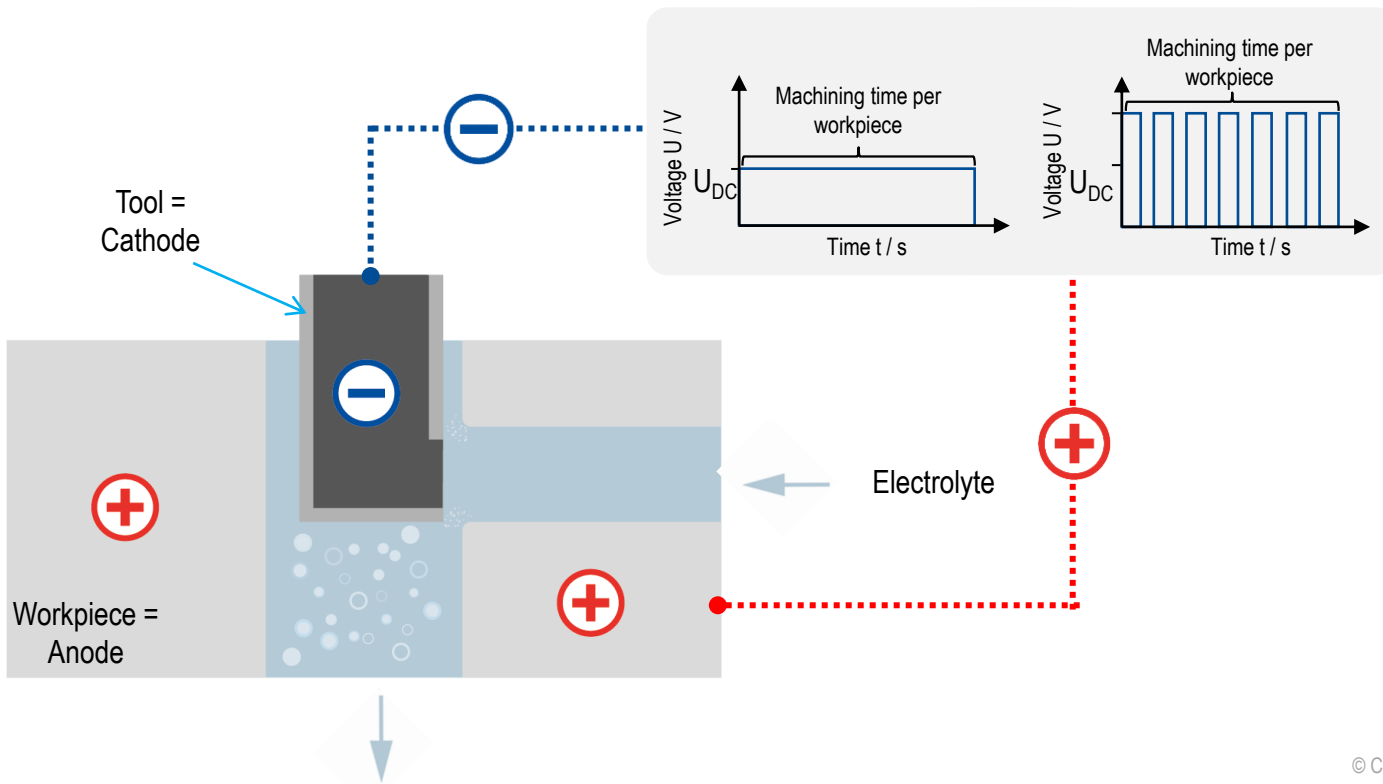


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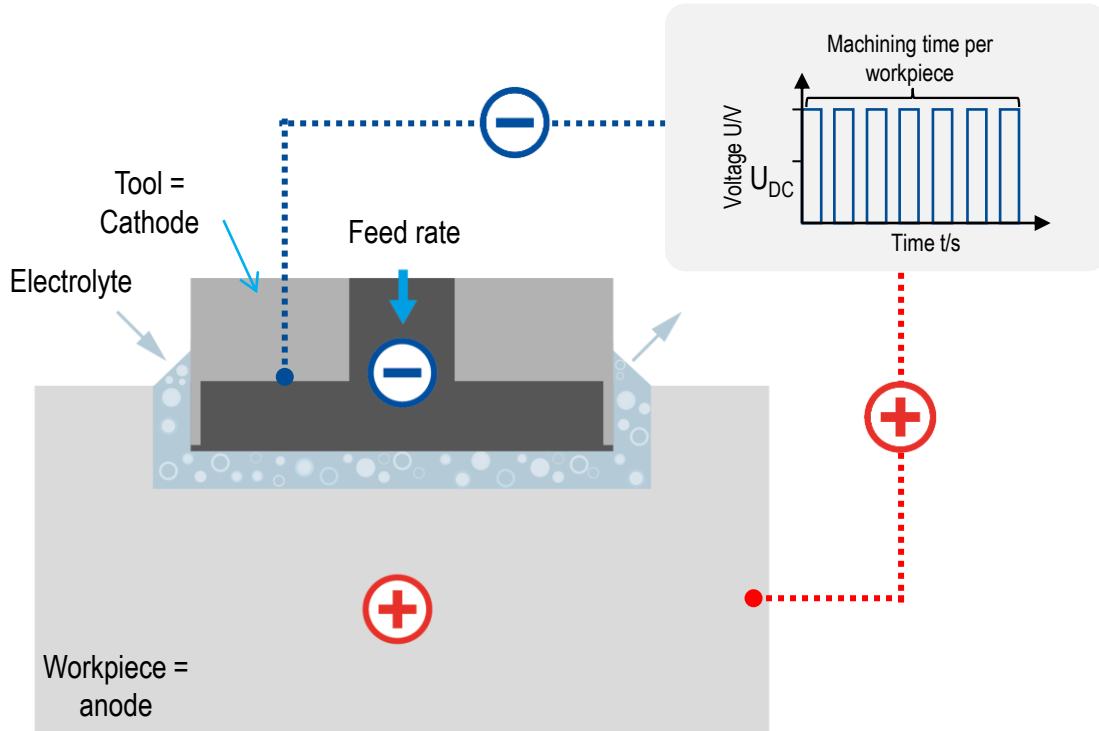
ECM Processes

Stationary Cathode



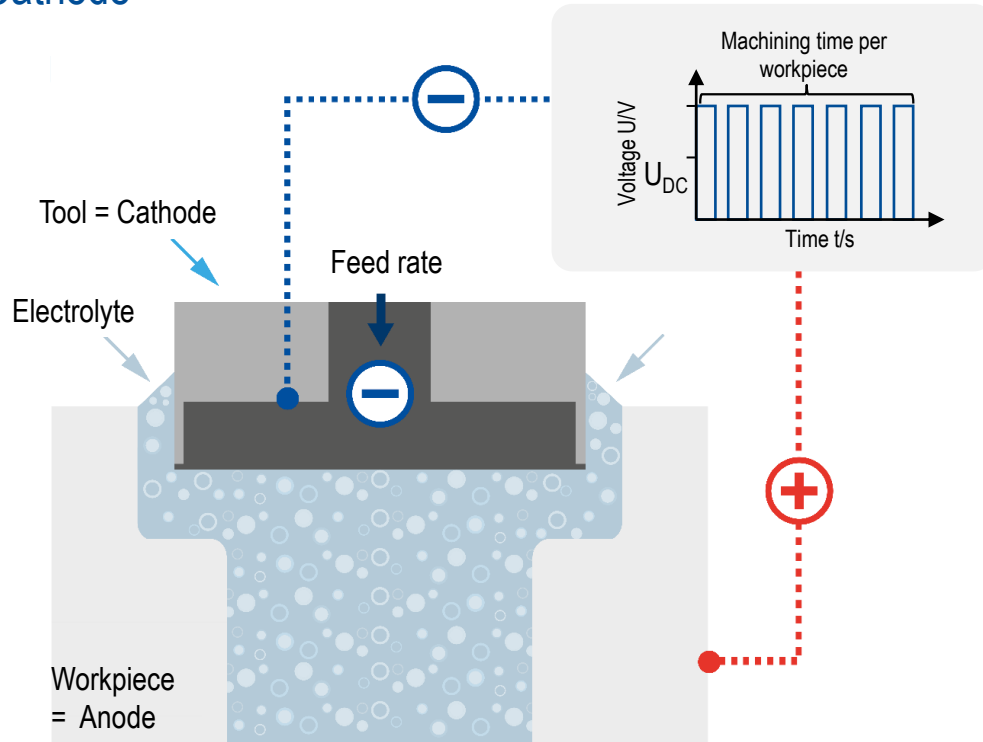
ECM Processes

Moving Cathode



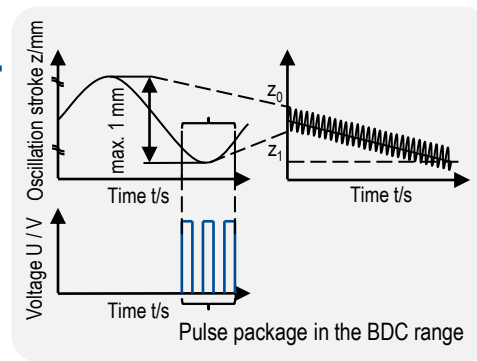
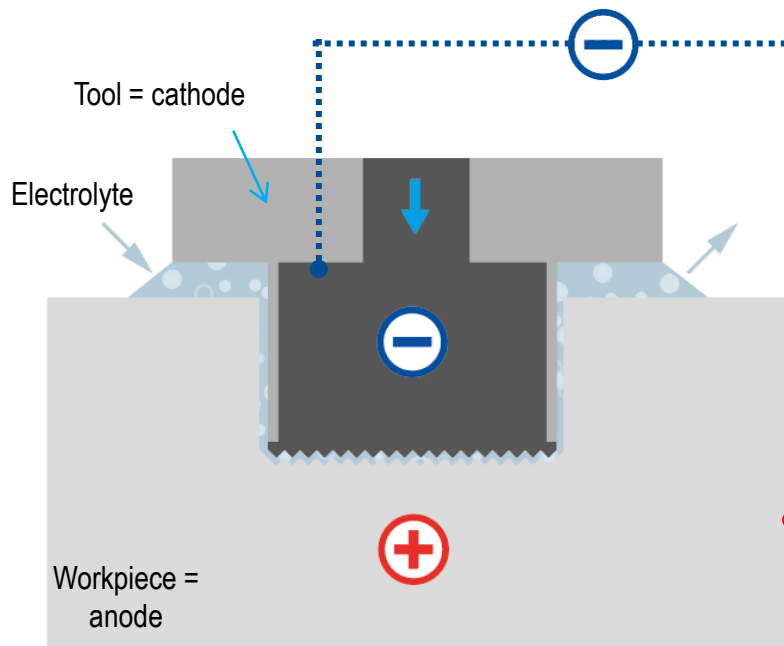
ECM Processes

Moving Cathode



ECM Processes

Precision Electro-Chemical-Machining (PECM)





How Does ECM Work?

Advantages of (P)ECM

- » Contact-free machining without thermal or mechanical influence
- » Less cathode (tool) wear
- » Roughness depths of up to $R_z 0,2 / R_a 0,05\dots$
(material-dependent)
- » Reproduction accuracy $< 20 \mu\text{m}$
- » Machining on hardened workpieces
- » Cycle time scalable due to fixture design

Process times

Deburring	20 – 50 Sec.
Countersinking/drilling	0,5 – 8 mm/min
Precision imaging	0,01 – 0,5 mm/min

How Does ECM Work?

(P)ECM Machining



Machine (process)

- » Current & voltage
- » Electrolyte pressure
- » Electrolyte flow
- » Electrolyte temperature
- » Current monitoring with quick short-circuit shutdown

Electrolyte management system (EMS)

- » Temperature
- » Conductance
- » pH value

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ECM Applications

Deburring

E – mobility

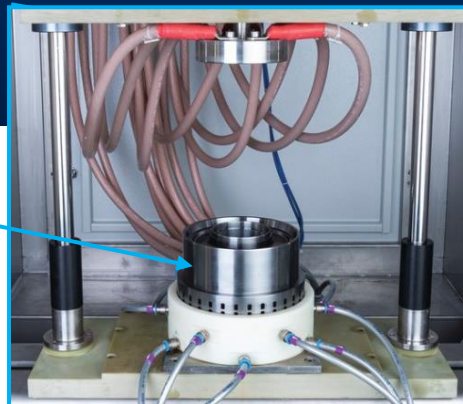
Application	ECM deburring
Machine	PI
Workpiece	Disk carrier
Material	High-strength steel
Handling	Manual
Tool layout	1x
Cycle time	60 sec.

Benefits

- » All deburring points with a single deburring cathode
- » Long tool life of the deburring cathodes
- » High process reliability



Disk carrier deburring areas



ECM Applications

Machining

Medical engineering

Machine	PTS 2500
Workpiece	Implant
Loading	Manual
Tool	6x
Line cycle	6 min

Benefits

- » No chips or burr formation
- » Polishing quality
- » No thermal damage to the material
- » Long tool life of the cathode
- » High reproducibility of $\pm 20\mu$



ECM Applications

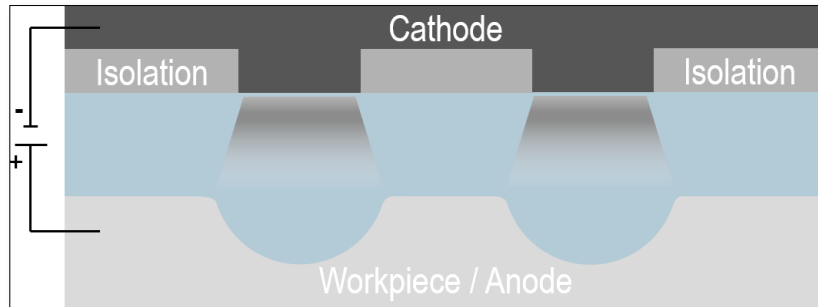
Machining

Compressor

Machine	PI
Workpiece	Fluid dynamic bearings
Loading	Manual
Tool	4x, 15 Sec./Workpiece
Line cycle	60 Sec.

Benefits

- » No chips or burr formation
- » No tool mark
- » No thermal damage to the material
- » Long tool life of the cathode
- » Contour depth in the range off 10µm to 300µm possible



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EDNA IoT - Products

We make our customers' lives easier

EDNA
EMAG IoT Products



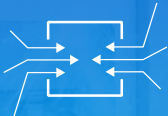
Our Vision

Bringing Industry 4.0 to life together with our customers



FLEXIBLE SYSTEMS

Lean, efficient and networked manufacturing systems



INTEGRABILITY

Provision of EDNA IoT Ready machines for a quick production start



DIGITAL ACCOMPANIMENT

Best (digital) support



IMPLEMENTATION

Collection of a lot of data to evaluate self-service functions in a simplified way



CUSTOMER ADDED VALUE

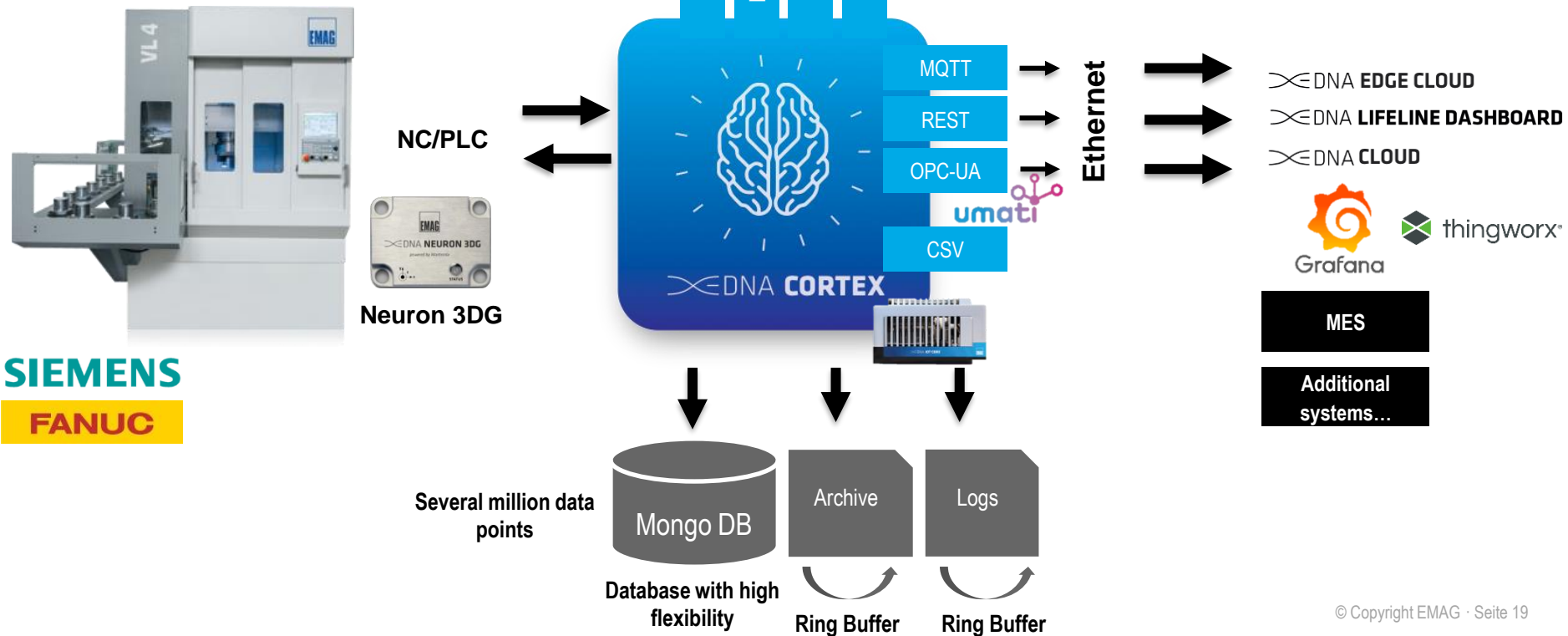


BENEFITS

Calculate predictions in order to optimize the production process



EDNA Cortex Architecture





EDNA IoT Product portfolio (EDNA IoT Core up to EDNA Cloud)

EDNA Health Check



EDNA Cloud



EDNA Health Check
Predictive Maintenance

EDNA Edge Cloud



EDNA Edge Cloud
Server



EDNA Cortex
Software License



Data Science Pipeline
Data Science Toolkit



(virtual) Server
Customer Provision

EDNA Visualize



Maschine Status
App



Cycle Time
App



Workpiece Counter
App



OEE
App



Smart-Tool-Change
App

...

EDNA IoT Ready¹⁾

EDNA IoT Basic Interface²⁾



EDNA IoT Core
Industrial PC¹⁾²⁾



EDNA Cortex
Software License¹⁾²⁾



EDNA Senses
Additional Sensors¹⁾



EDNA Health Check Lite
Health status on demand¹⁾



Transmission of measurement data

Process data remain in the customer plant

Internet

Customer network or a dedicated machine (line) network

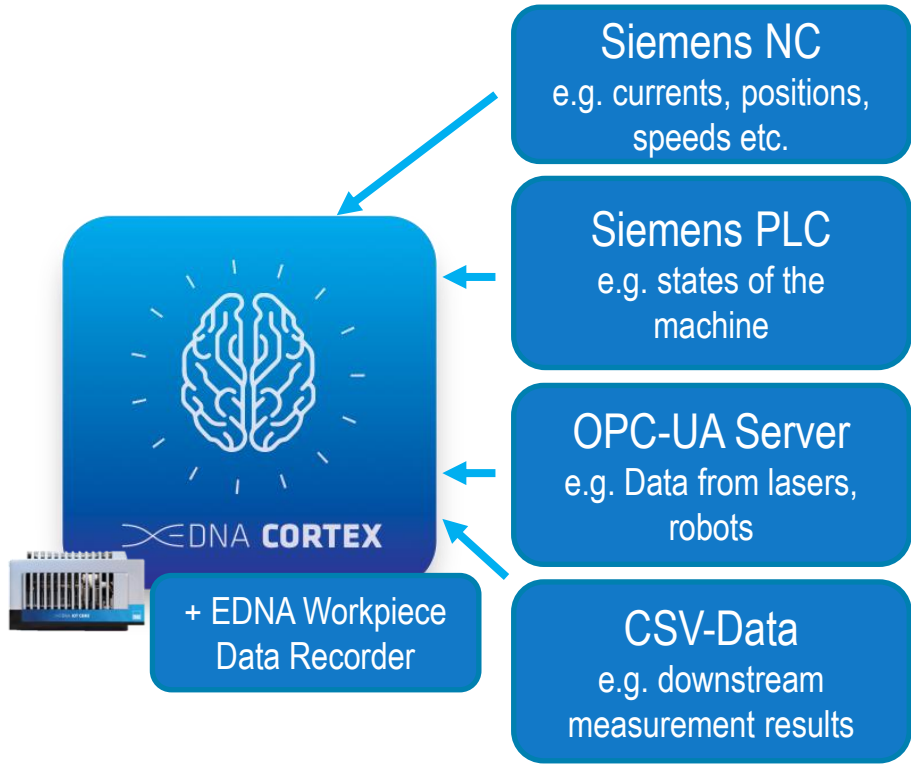


Data to ERP, MES, SCADA, MDE/BDE ...



EDNA Workpiece Data Recorder and Data Exporter

Workpiece-related data acquisition and analysis



+ EDNA Workpiece Data Exporter¹⁾
Exports the workpiece-related data containers via CSV from the EDNA Cortex to third-party systems

¹⁾ EDNA Workpiece Data Exporter is part of EDNA Workpiece Data Recorder.

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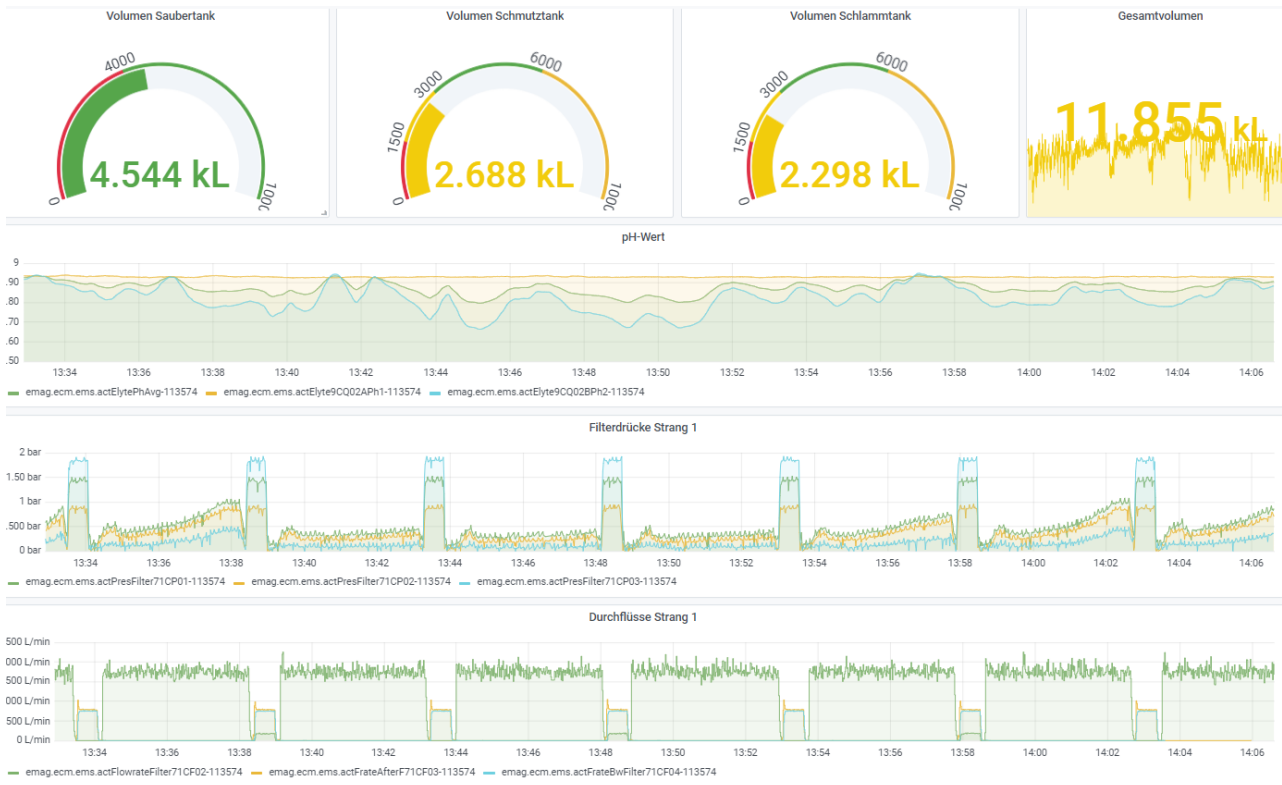
BENEFITS

Calculate predictions in order to optimize the production process



EMAG IoT – ECM specific

Extract from data basis - exemplary



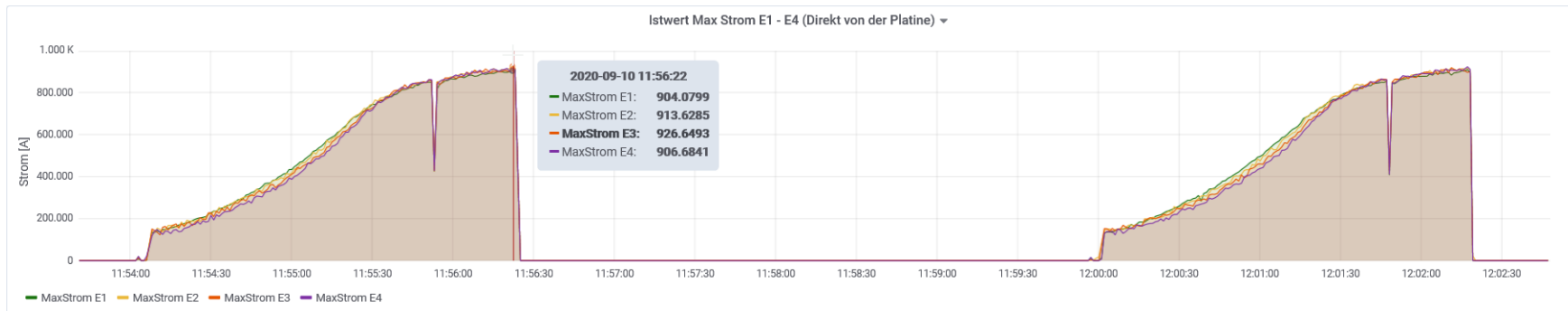
No findings based on averaged values
 → Cause evident from precise data
 → Sensor 1 defect

Filter performance:
 Correlated to process cycle



EMAG IoT – ECM specific

Interpretation current course



Finding:
Current drop?
Identical courses in different
cycles

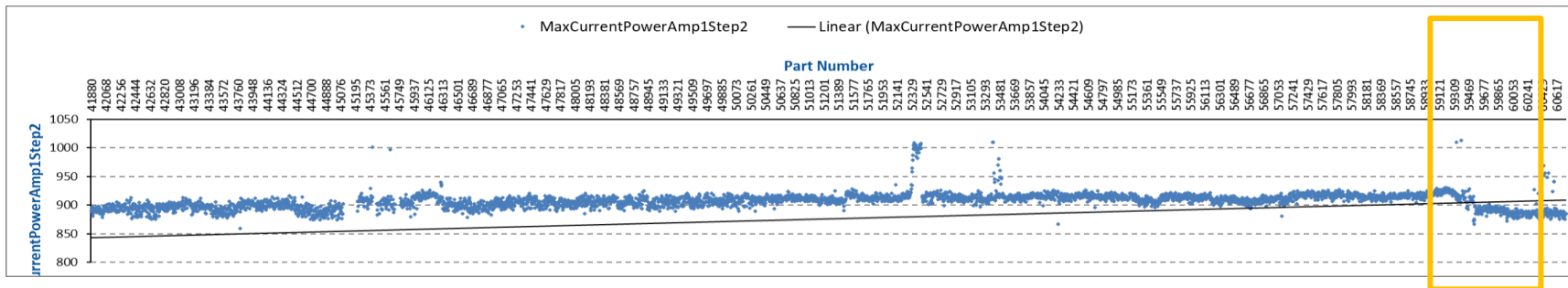
Cause:
Dynamic process with step
change

Action:
No action necessary



EMAG IoT – ECM specific

Interpretation max current values



Finding:
Max-current increases on average

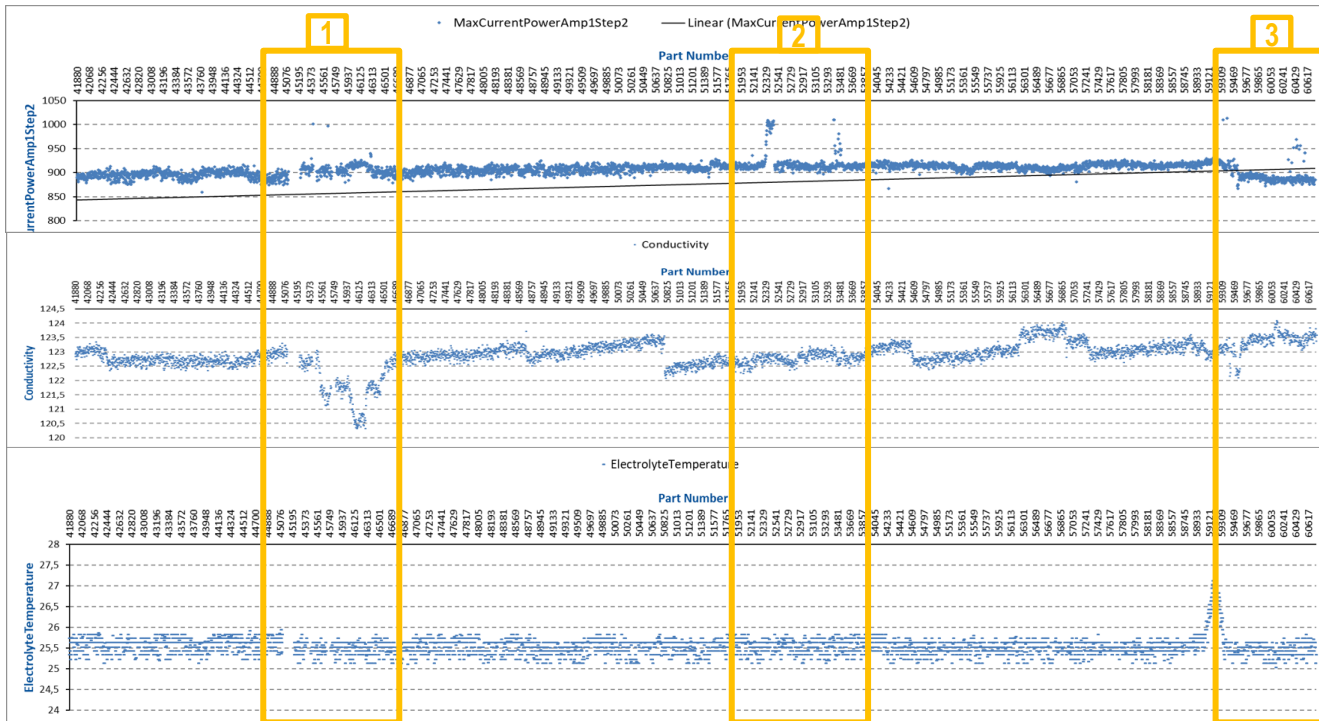
Cause:
Thin layer deposits on cathode
→ Gap becomes smaller
→ Current increases

Action:
Cathode change resp.
Cathode cleaning needed



EMAG IoT – ECM specific

Data analysis



Cause for NOK values Max-current

1. Cause conductivity?
In frame 1 visible but within warning limits
In frame 2 & 3 undetectable

2. Cause temperature?
Undetectable – within warning limits

3. Cause rel. process parameters?
...further relevant process parameters
undetectable → no systematic error

4. Cause?
→ Outside ECM process
→ Cause was in the precleaning

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EMAG IoT – Vorteile / Mehrwert

General added values

- » Process optimization
- » Component comparison
 - » Reference part vs. current part
 - » Process development / setup
 - » Commissioning
- » Quality optimization
- » Anomaly detection
- » Input quality detection
- » Reduction Downtime
- » Root cause detection

Predictive Maintenance

- » EMS – Electrolyte changes
- » Machine
 - » Hardware
(pumps / cables / motors / generator / pulse amplifier)
- » Tooling
 - » Cathode lifetime
 - » Minimization of scrap



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