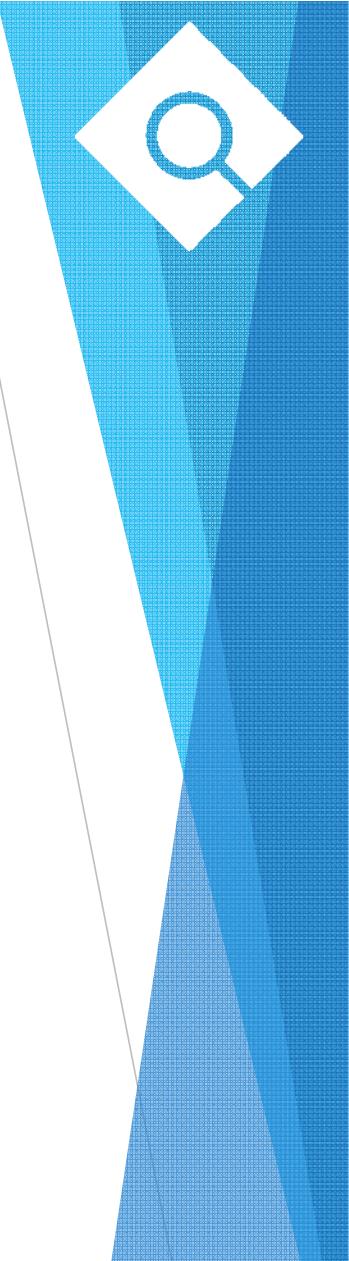
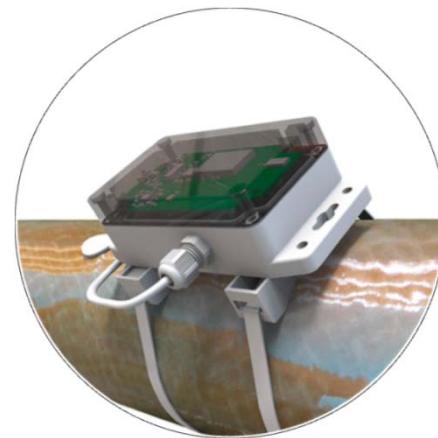




NDT DEVICE SERIES

the next generation NON DESTRUCTIVE TESTING
reduce risks and optimize lifetime of your equipment





Locations

**Kurotec-KTS Kunststofftechnik
Stade GmbH**
Am Bullenhof 25
21680 Stade
<http://www.kurotec-kts.de>

Kurotec- KTS Niederlassung
Schkopau

KUROTEC POLSKA Pyskowice /
Kozielice

KTS EOOD
Bulgaria

KUROTEC International
Abu Dhabi UAE

RTD Dülmen GmbH
Dülmen





Online monitoring of FRP Fiber Reinforced Plastic equipment

NDT VISION FOR FRP INSPECTION



Facts

What kind of system?

- ▶ It is a procedure for non destructive testing (NDT):
online 24/7 days, network based online monitoring

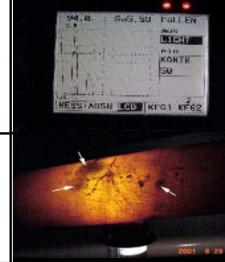
What` s new?

- ▶ Measuring of material disturbances as a result of outside influences –> online

What do we measure in the material FRP?

- ▶ static strain (statics, temperature, impacts)
- ▶ dynamic strain (e.g., oscillations by bearing damage of pumps)
- ▶ degradation (material aging, crack development, material damage)

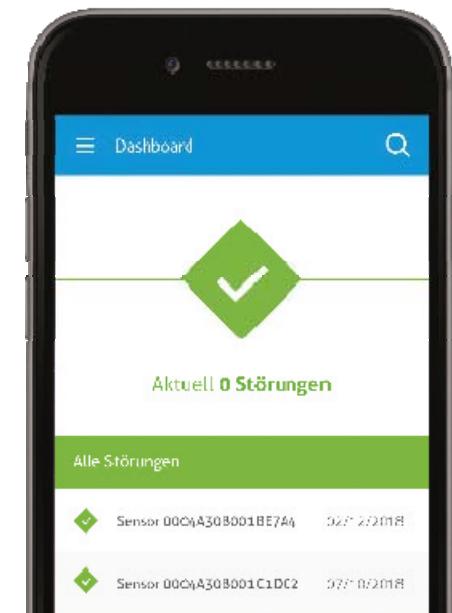
FRP Inspection methods – status quo

Method	Result	
External visual control	Cracks, discoloration delaminations, mechanical damages	
US-Measurement	Wall thickness reduction, compare actual value with specified value	
Illumination from outside (only in the dark)	Damages to be seen as dark spots	
X-ray	Wall thickness reduction, delaminations, deposits, quality of joint laminate	
Core hole drilling (2")	Condition of laminate, wall thickness measurement by hand	
Camera inspection, Endoscopy	Visual control from inside: condition of internal surface	

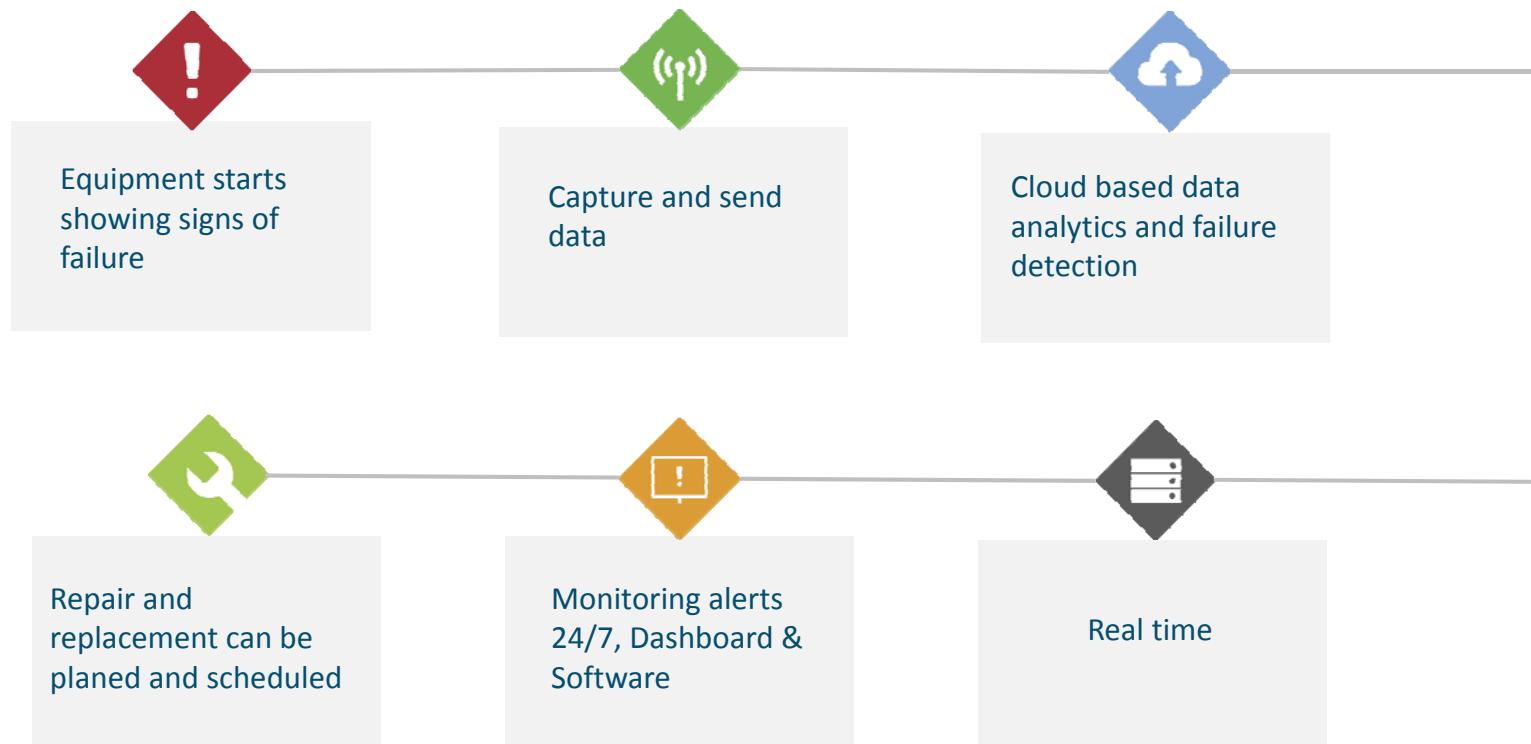
NDT Vision for FRP Inspection

A predictive approach to monitor FRP equipment with an online device using **SHM** (Structural Health Monitoring) and CMS (Condition Monitoring System)

- ▶ Damage detection and characterization using:
- ▶ Lamb wave based sensor technology
- ▶ Analytical software
- ▶ IoT / Industry 4.0 dashboard and data transfer



IoT Architecture & Application



Stages of development

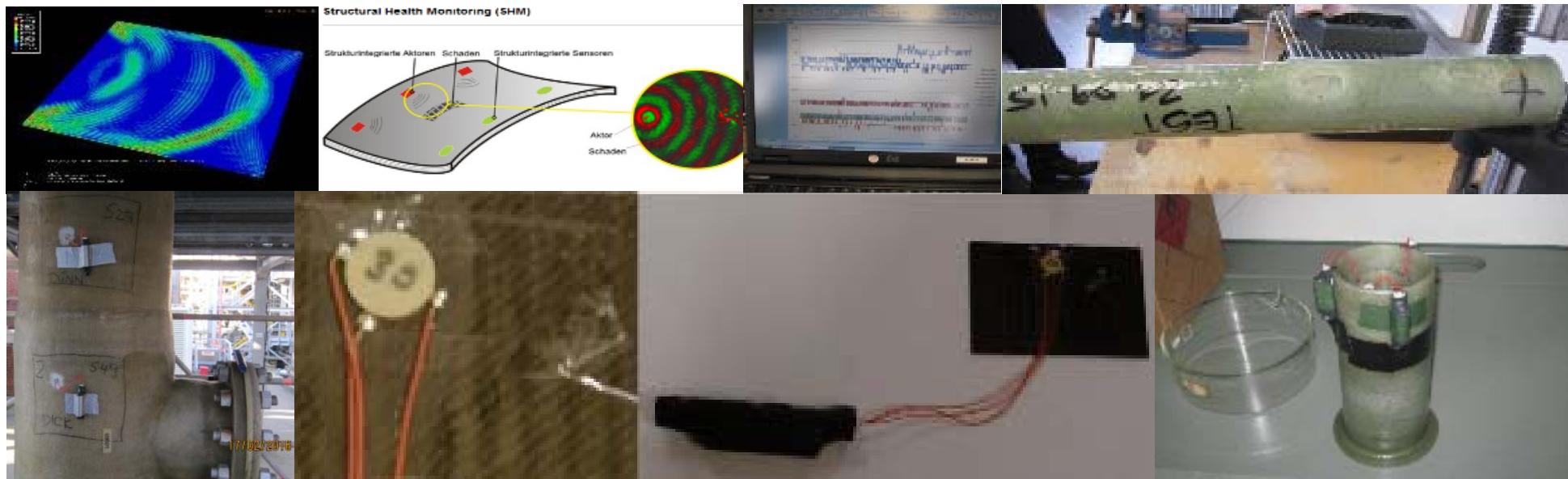
Ideation
2013

Lab Tests
2014

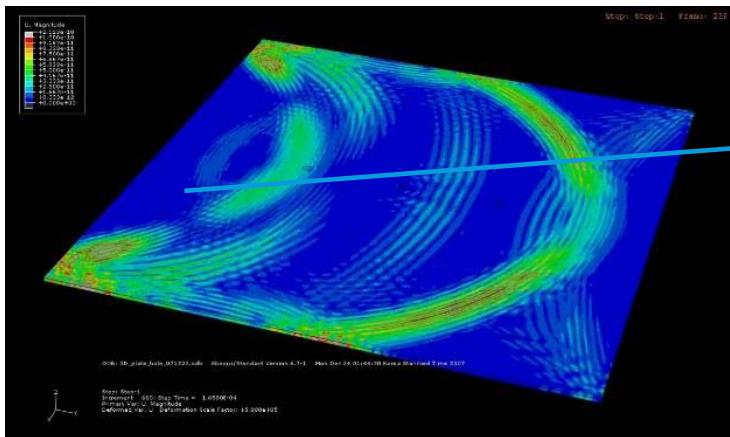
Scale up
2015

Field Tests & Pilot
2016

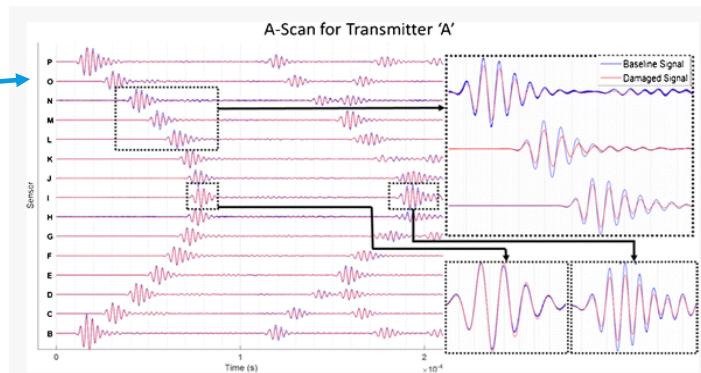
Realization
2017 Q1



SHM with Lamb-Waves



Interaction of defects with lamb waves in complex geometries



Presentation of lamb waves in defect areas

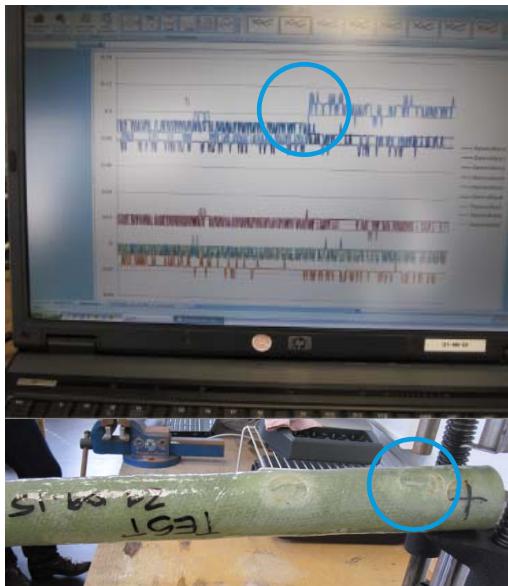


Fatigue crack detection with lamb waves

Lab Tests and Pilot

Impact test

Load applied in 3m distance
from sensor monitored



Chemical degradation test

Accelerated chemical
attack monitored



Field test

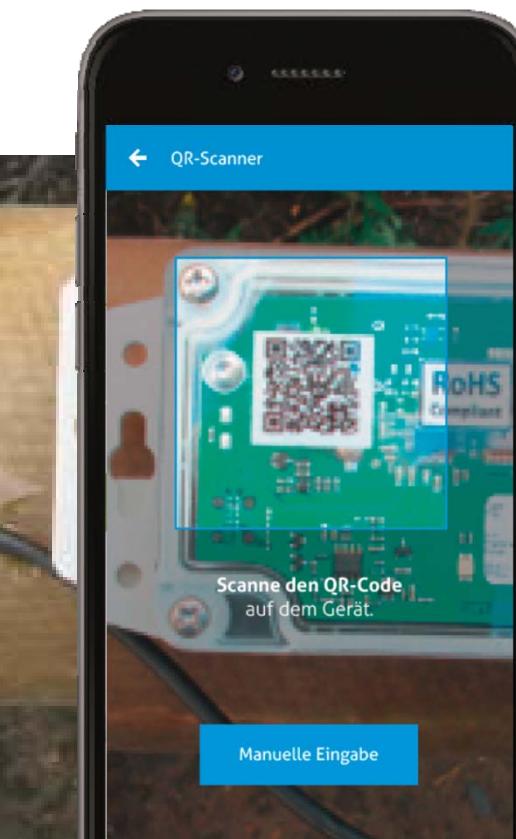
monitored results verified
by cut out sample



Field installation

Microcontroller radio - sensor with QR Code
direct link to dashboard

Gateway installation industrial park



Long Range Wide Area Network – LoRaWAN

**Online sensor technology to
improve ...**

- safety
- productivity & efficiency
- lifetime extension of your
FRP assets



◆ Gateway ◻ Network coverage

Applications

Realised

- SHM monitoring of FRP equipment

Pilot phase

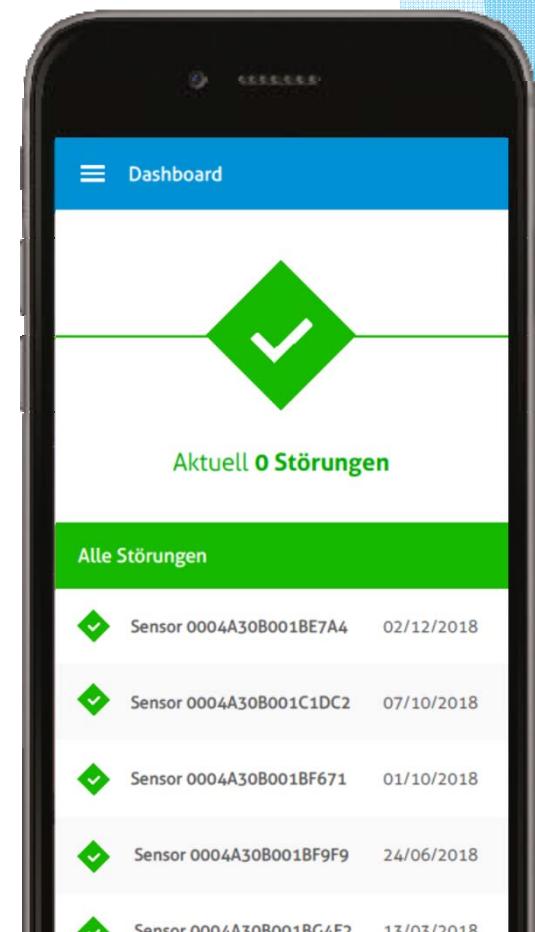
- Wall thickness measurement
of FRP and CS Equipment

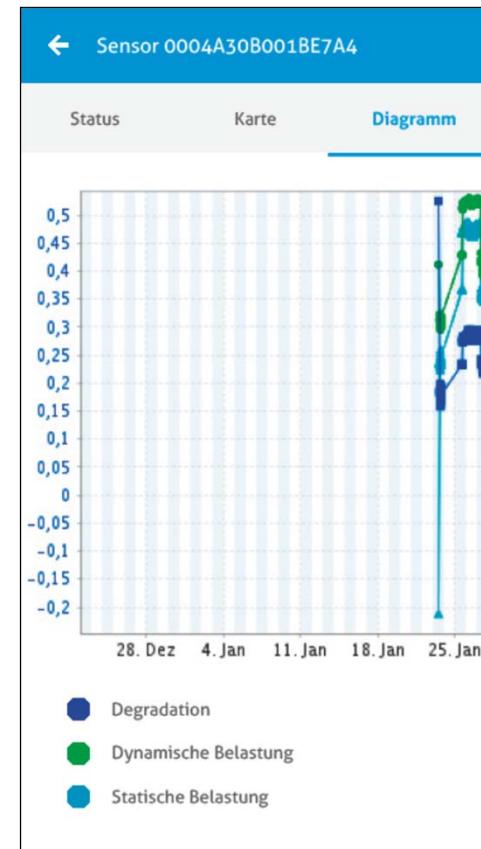
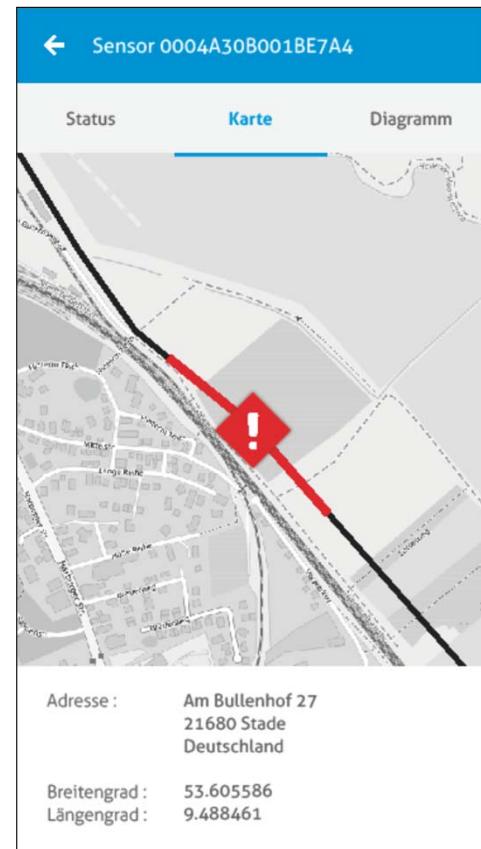
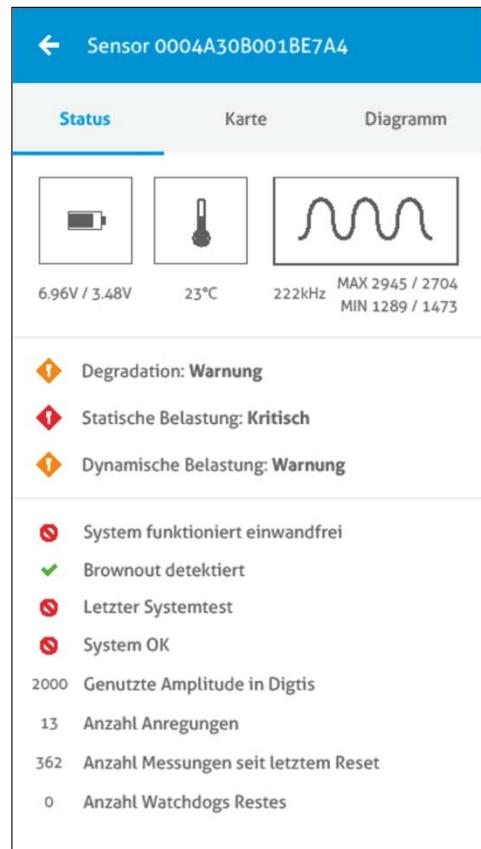
Future planning

- Sound-level measuring
- Gasket settlement stress monitoring
- Bolt torque monitoring
- GPS Tracking
- Temperature
- Gas detection
- Custom made solutions and much more

Dashboard

- ▶ Data management e.g.:
- Localization
- Condition visualization
- Data analytics
- Alert management
- Multi functional platform







Score

Sensor [0004A30B001BE7A4]

Sensor

Materialtyp: ?

OK

DEG: OK
STAT: OK
DYN: OK

System funktioniert einwandfrei

Brownout detektiert

Letzter Systemtest

System OK

2000 Genutzte Amplitude in Digits

13 Anzahl Anregungen

3 Anzahl Messungen seit letztem Reset

0 Anzahl Watchdog Restes

Sensor [0004A30B001C1DC2]

Sensor

Materialtyp: ?

SEMI OK

DEG: OK
STAT: SEMI OK
DYN: OK

System funktioniert einwandfrei

Brownout detektiert

Letzter Systemtest

System OK

2000 Genutzte Amplitude in Digits

13 Anzahl Anregungen

3 Anzahl Messungen seit letztem Reset

0 Anzahl Watchdog Restes

Sensor [0004A30B001BF671]

Sensor

Materialtyp: ?

WARNUNG

DEG: OK
STAT: WARNUNG
DYN: SEMI OK

System funktioniert einwandfrei

Brownout detektiert

Letzter Systemtest

System OK

2000 Genutzte Amplitude in Digits

13 Anzahl Anregungen

110 Anzahl Messungen seit letztem Reset

0 Anzahl Watchdog Restes

Sensor [0004A30B001BF9F9]

Sensor

Materialtyp: ?

KRITISCH

DEG: WARNUNG
STAT: KRITISCH
DYN: WARNUNG

System funktioniert einwandfrei

Brownout detektiert

Letzter Systemtest

System OK

2000 Genutzte Amplitude in Digits

13 Anzahl Anregungen

362 Anzahl Messungen seit letztem Reset

0 Anzahl Watchdog Restes



Advantages

Reduce maintenance cost

Reduce labour cost, less maintenance time and universal test method

Reduce downtimes

Avoid output losses

Improves safety and reliability

Enables plant to stopped safely

Alarm settings

Overview about pipesystem and equipment in real time

Predictive maintenance

Thank you for your attention!

Kurotec- KTS Kunststofftechnik Stade GmbH
Dipl.-Ing. M. Müggenburg (TU)

