

Liquiphant

Point level detection in liquids



Liquiphant

Basics

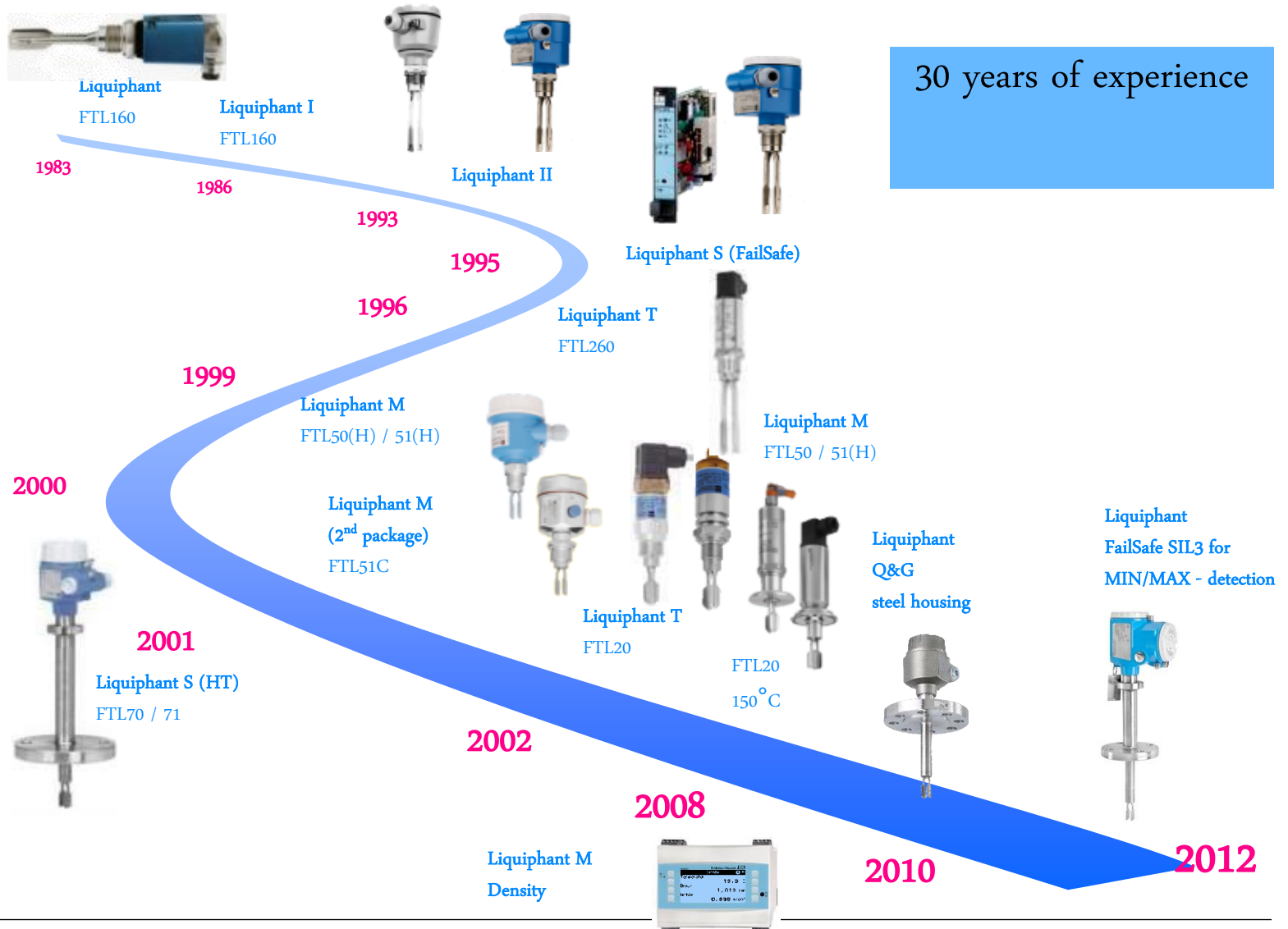
History

Measuring principle

Piezoelectric effect

Modular device design

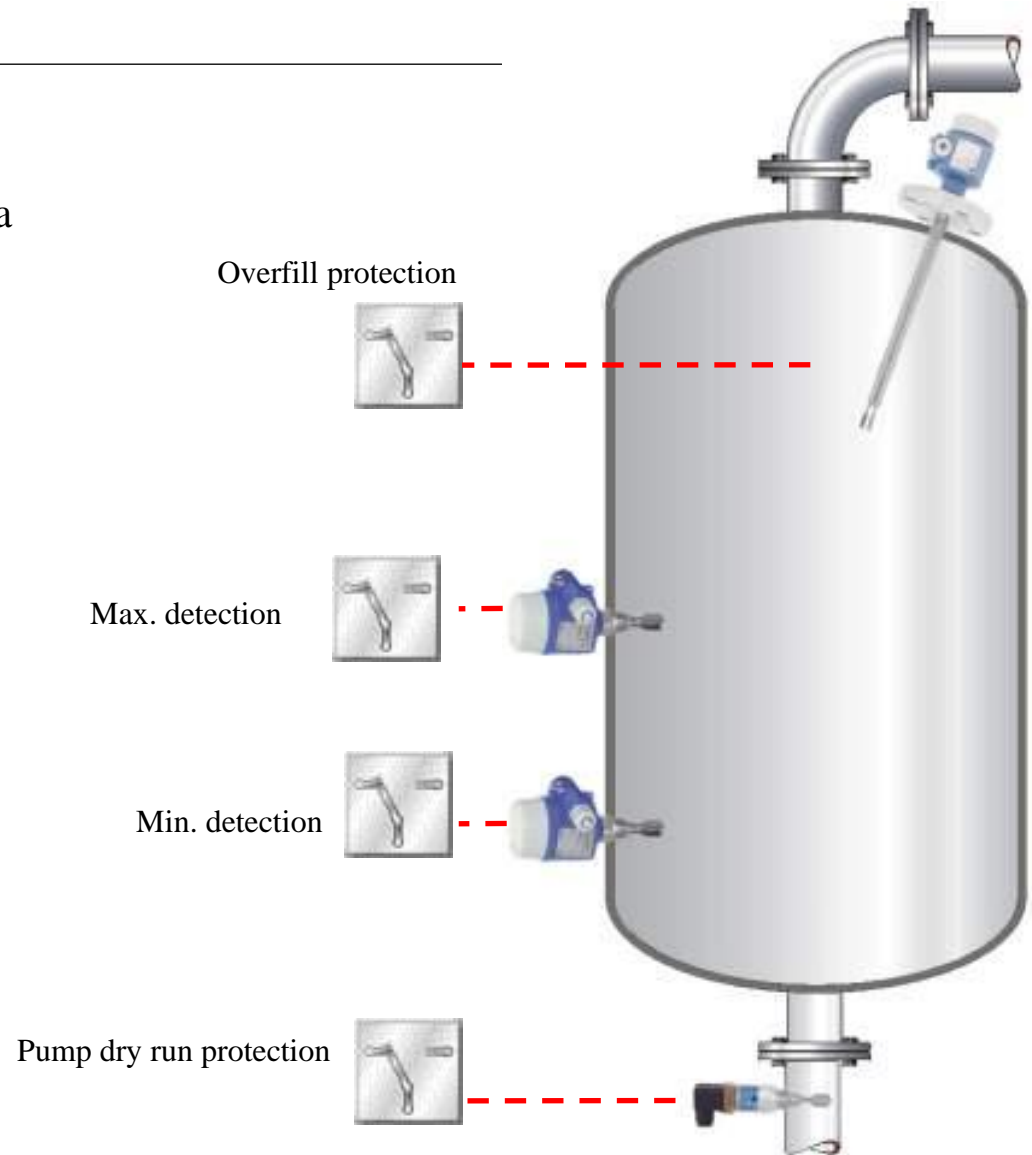
Liquiphant history, more than 3,500,000 sold sensors



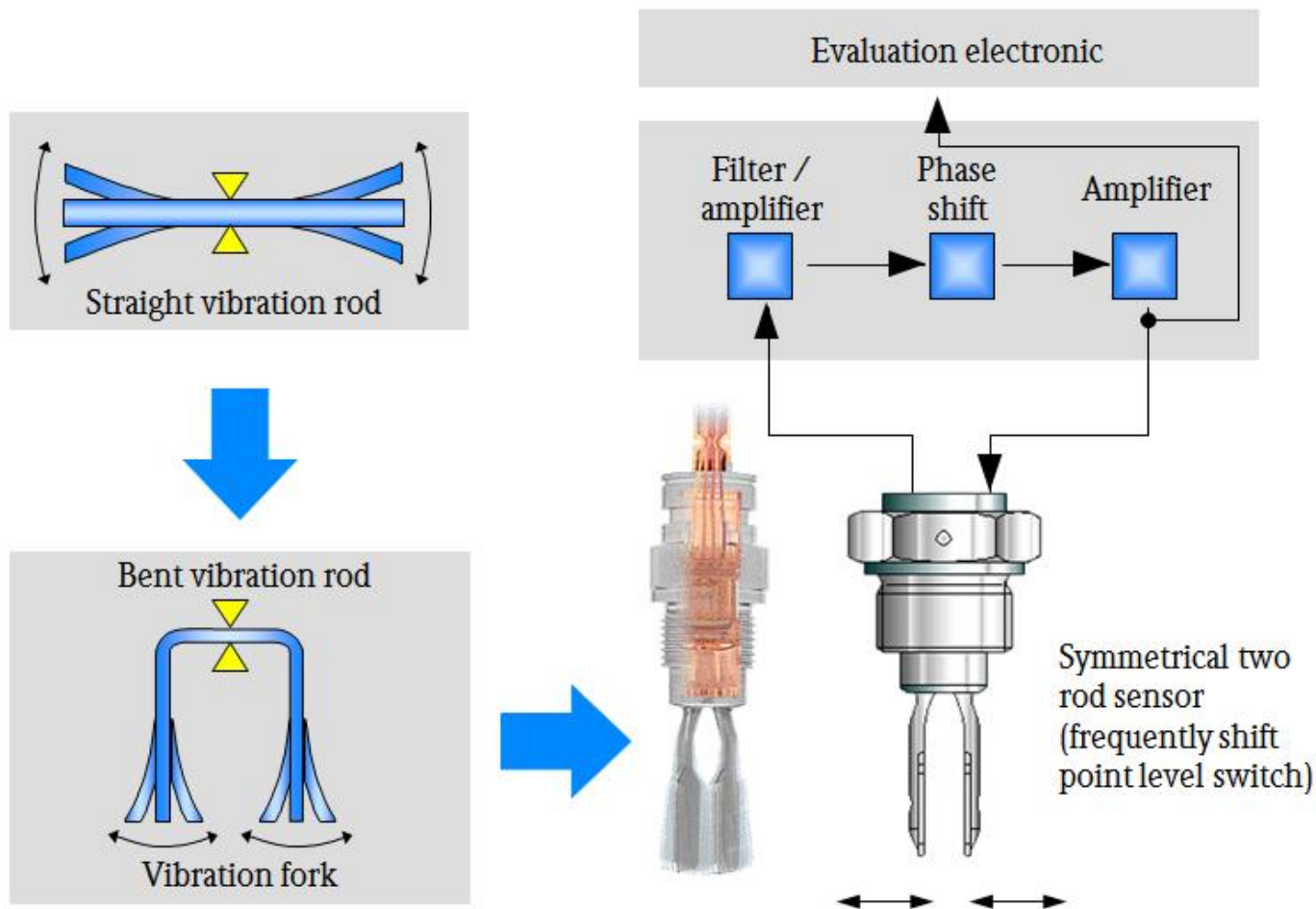
Measuring principle

A sensor in form of a tuning fork is excited to its resonance frequency by a piezoelectric drive.

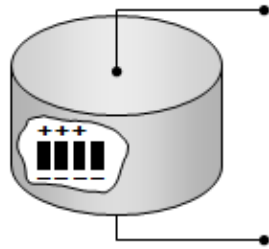
The frequency changes as liquid covers the fork. This frequency changing is analysed and converted into a switching output Signal.



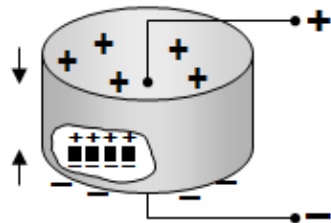
Function principle



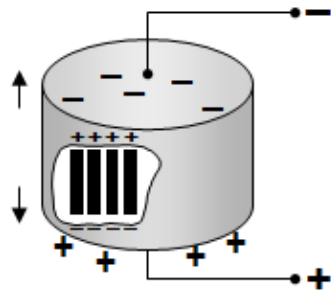
Piezoelectric effect – Stack drive



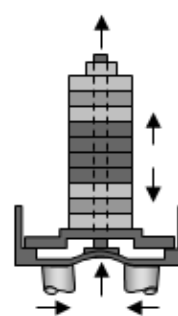
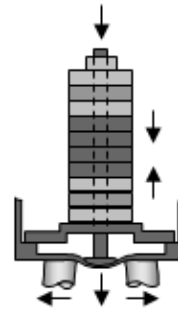
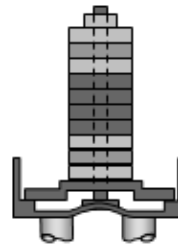
Individual crystals have a fixed alignment and are polarized



Voltage applied like poles reject - crystals compress -



Voltage applied unlike poles attract - crystals elongate -



Drive coating

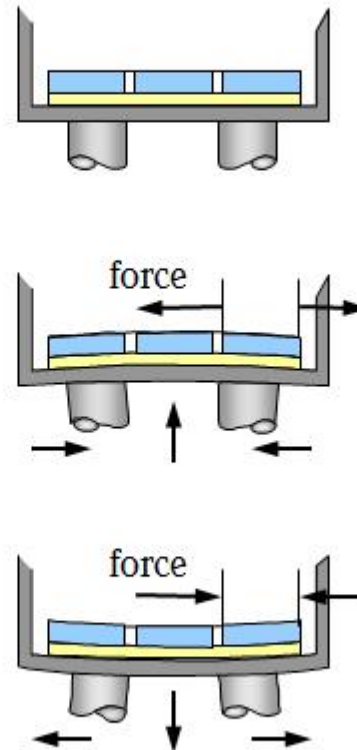
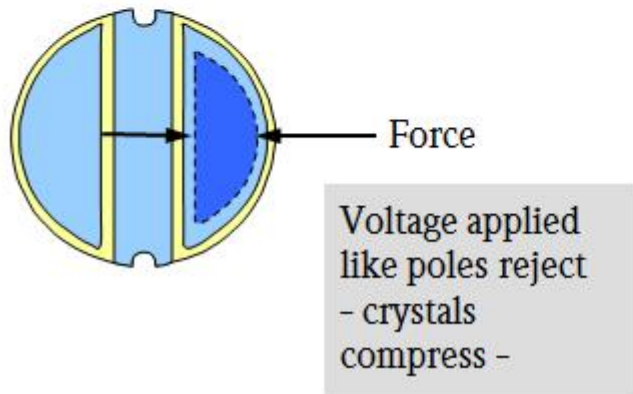
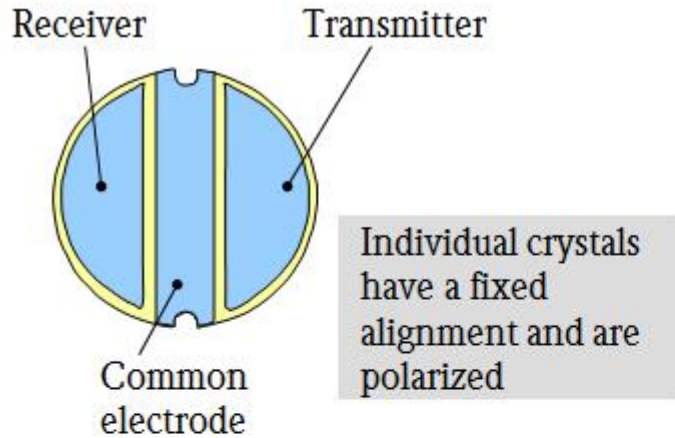


Drive high temperature



Alternating voltage causes the piezo to expand and contract.

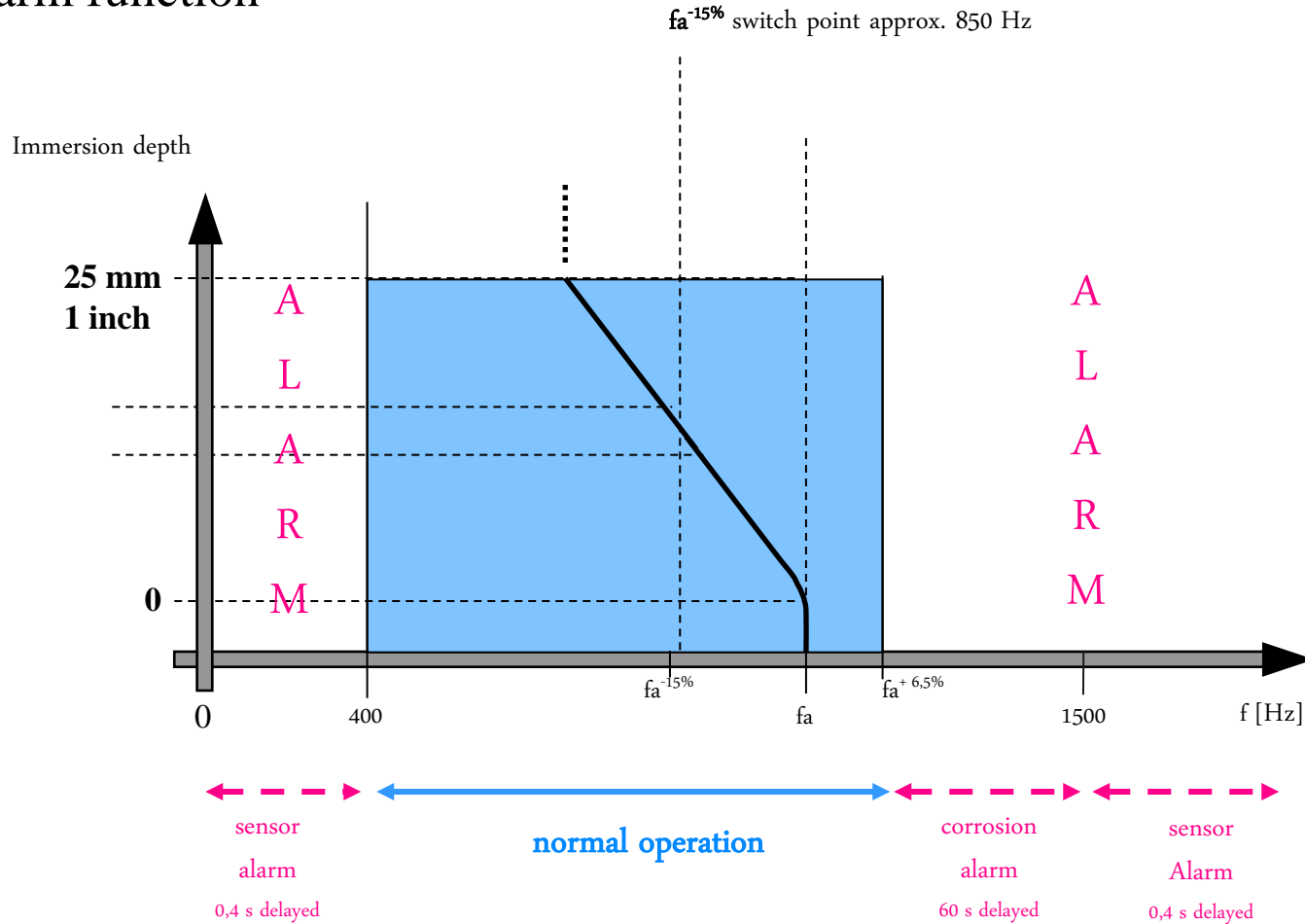
Piezoelectric effect – Bimorph drive



Alternating voltage causes the piezo to expand and contract

Self-Monitoring

Safe alarm function



Operation Independent of Medium Properties



built-up

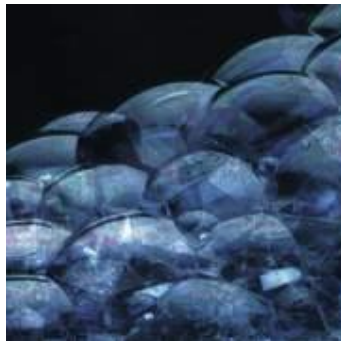


Changing media

air bubbles

suspension

viscosity change



foam

electrical properties

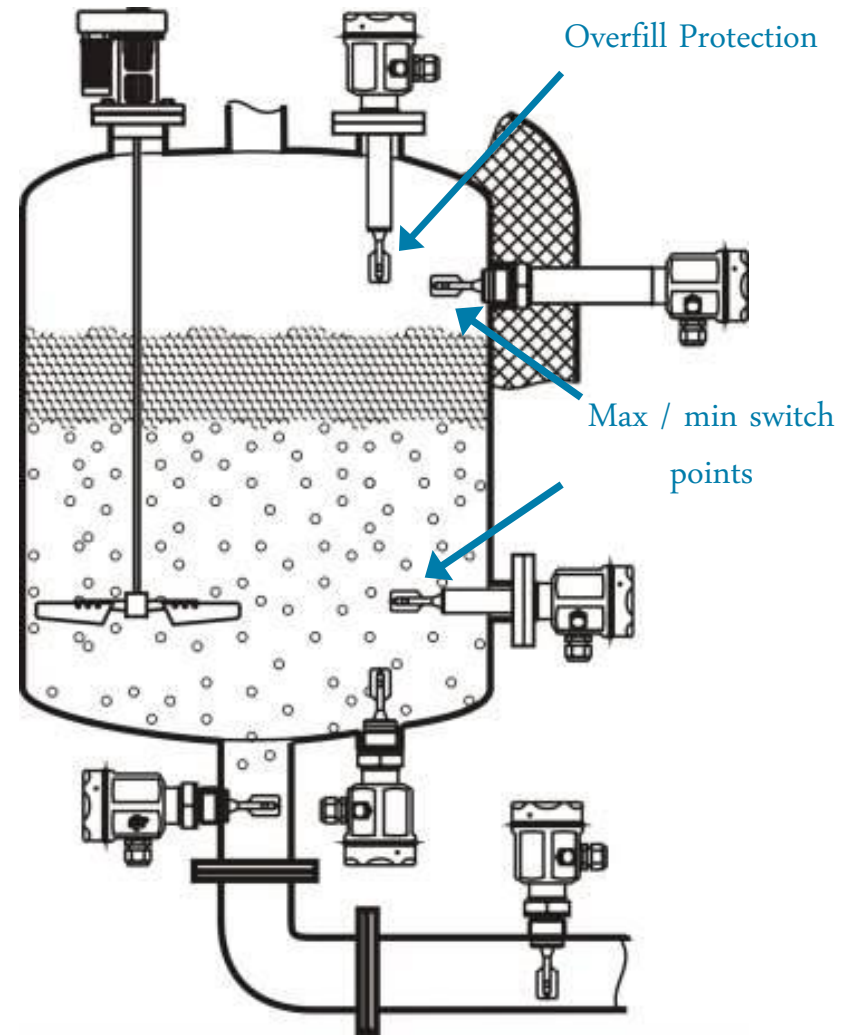
pressure and temperature change

plant vibration



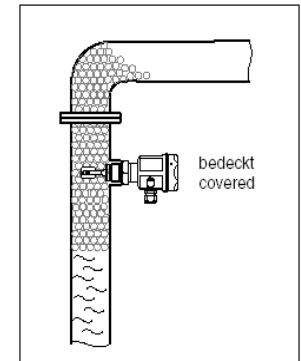
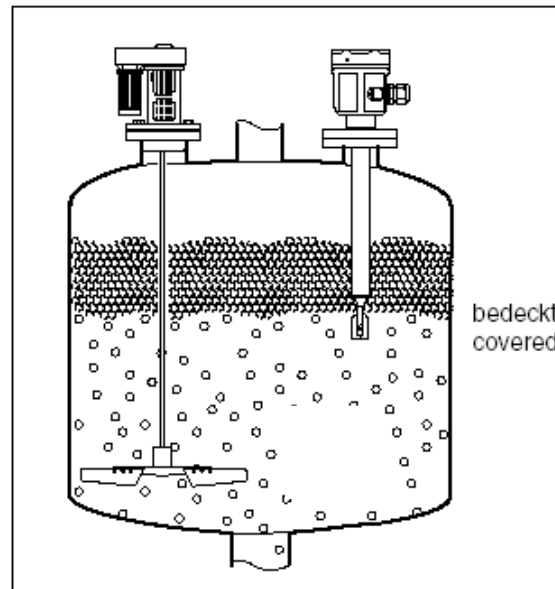
turbulences

Understanding Vibronic Switches



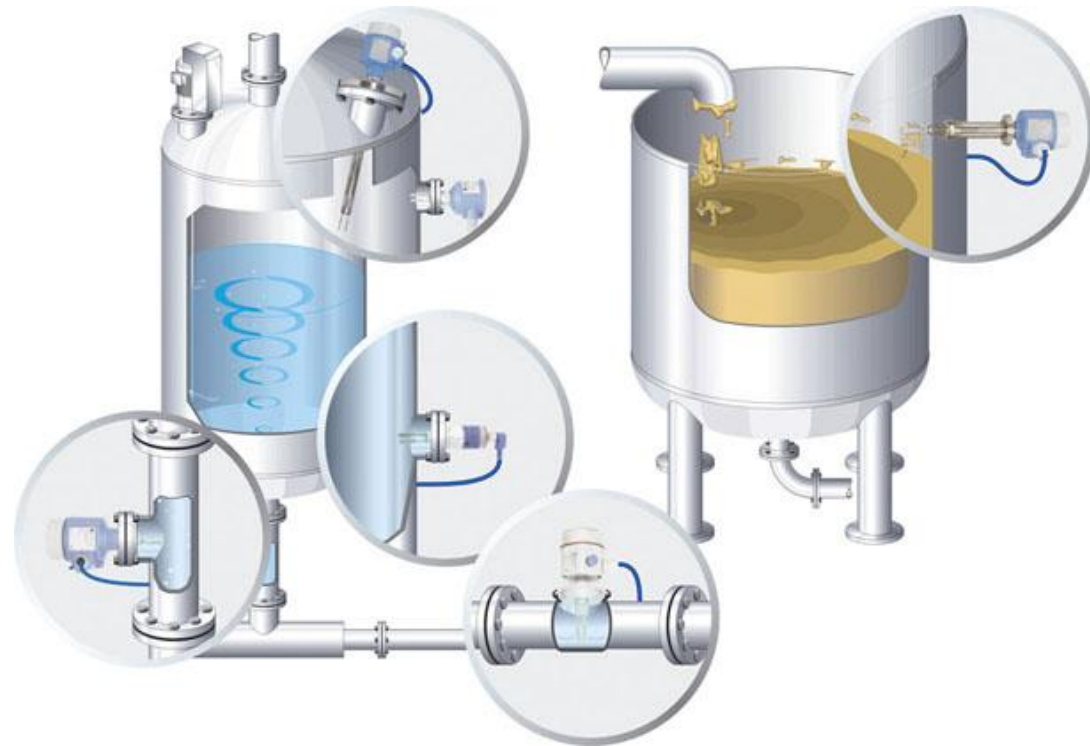
Understanding Vibronic Switches

- Ignoring dense foam –
adjustment for density $> 0.9 \text{ g/cm}^3$ the Liquiphant detects only the liquids and is insensitive to dense foam.
- Foam detection –
adjustment to density $> 0.2 \text{ g/cm}^3$
- Interface switch
- Modified switch points
- Switch delay
- NEW! Density Measurement

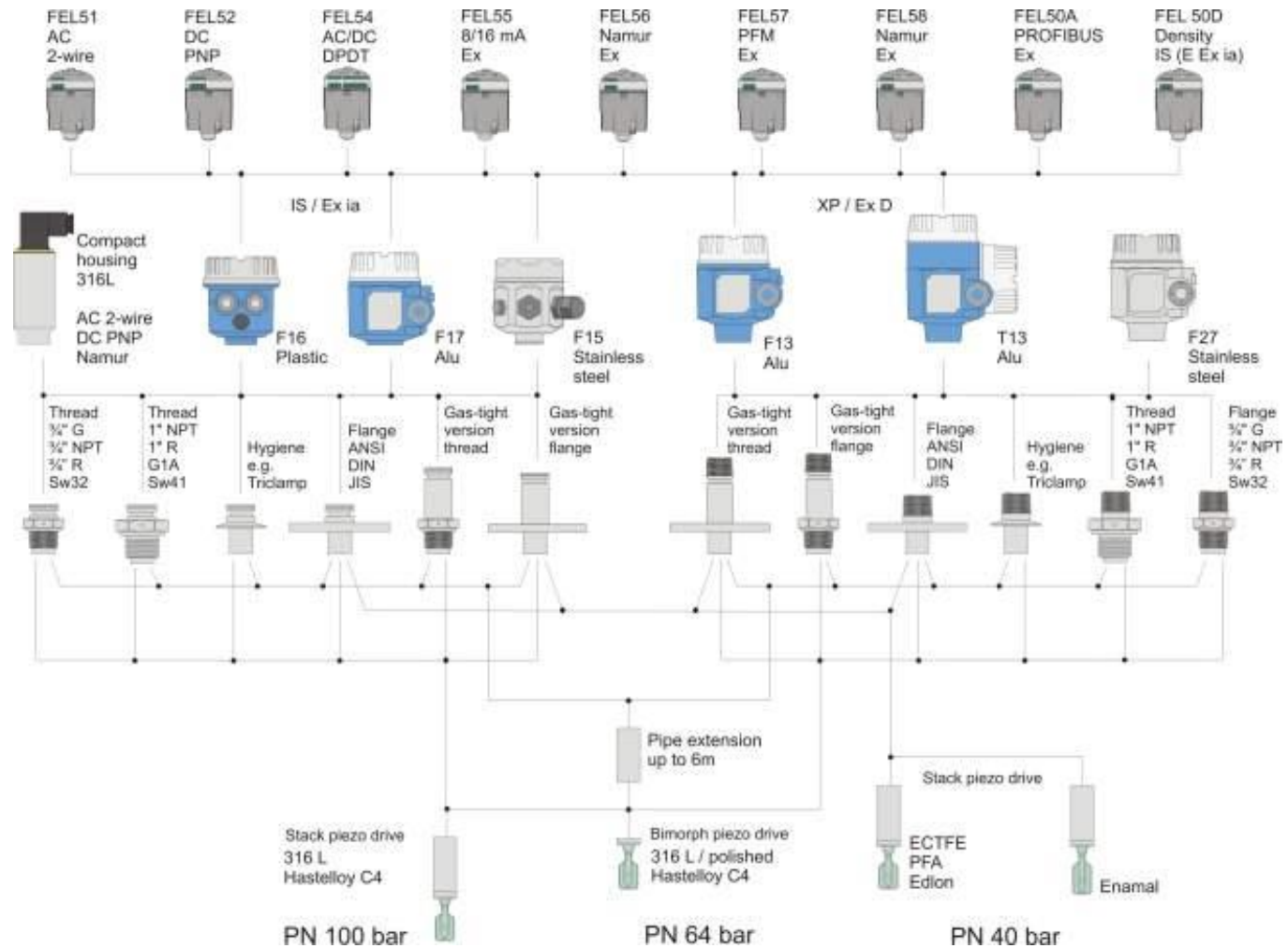


Installation

- **Top mounting** -
for monitoring maximum level
- **Bottom mounting** -
for monitoring minimum level
- **Side mounting** -
for monitoring maximum
and minimum level
- **Pipe mounting** -
protecting pumps from
running dry



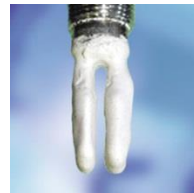
Modular device design



Liquiphant – first choice for safety applications

With sales of more than 3.5 million Liquiphants Endress+Hauser has generated a name for universal, reliable and safe point level switch

Independent of media properties and changing media



Build-up



Suspension
Air bubbles
Foam



Viscosity
Dielectric permittivity
Conductivity



External vibration



Pressure and temperature changes
Turbulences



- SAFETY - Self monitoring function, second line of defense, SIL2 and SIL3 rated.
- RELIABILITY – Maintenance free due to no moving parts, corrosion resistance and highly tolerant against build up.
- UNIVERSALITY – Unaffected by medium properties, mounting position, process pressure and temperature.

Products

Overview family

Liquiphant T

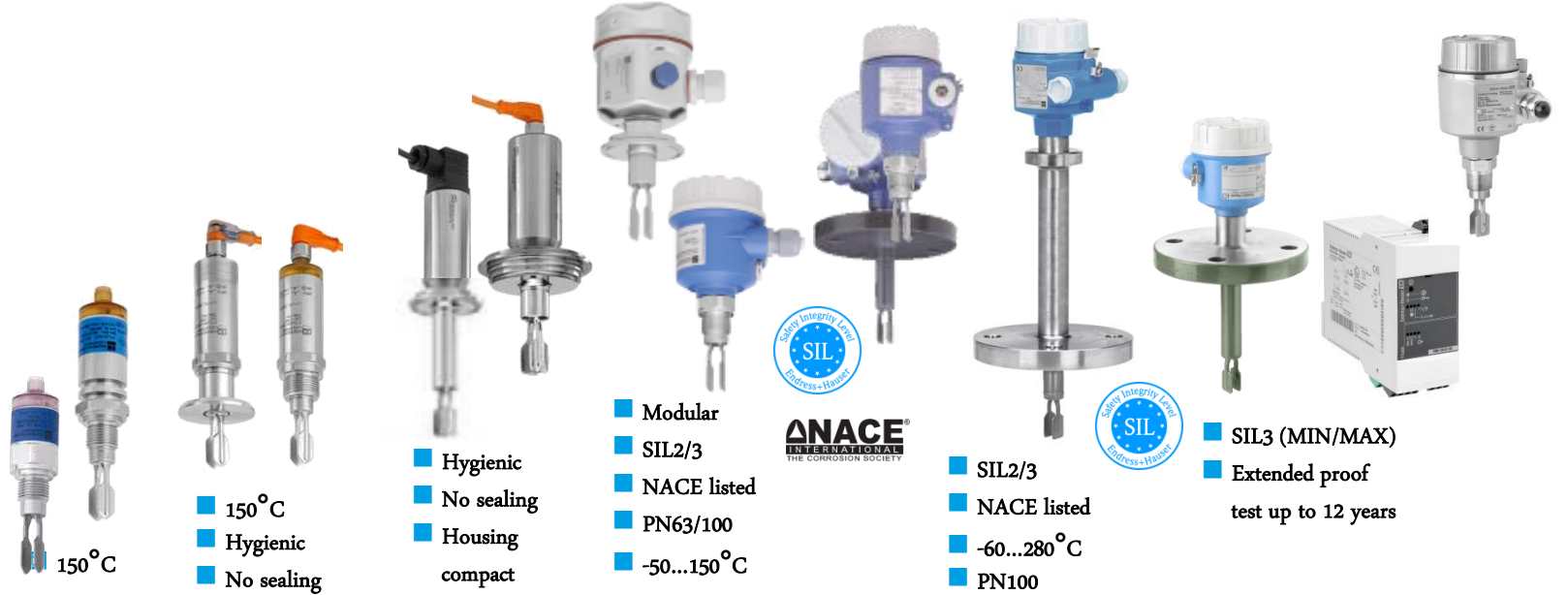
Liquiphant M

Liquiphant S

Liquiphant Fail Safe

Liquiphant Density

Liquiphant – Fits all industries



Liquiphant T
FTL20/20H

- 150°C
- Hygienic
- No sealing

Liquiphant M
FTL50/51
FTL50H/51H/51C

- Hygienic
- No sealing
- Housing compact
- Modular
- SIL2/3
- NACE listed
- PN63/100
- -50...150°C



Liquiphant S
FTL70/71

- SIL2/3
- NACE listed
- -60...280°C
- PN100



Liquiphant
FailSafe
FTL80/81

- SIL3 (MIN/MAX)
- Extended proof test up to 12 years

Liquiphant T – Type FTL20 / FTL20H

For all pump able liquids in tanks, containers and pipelines.

Important industries:

- Machinery
- Food and beverage



Technical data	FTL20	FTL20H
Process temperature	-40...+150°C / -40...+302°F	
Process pressure	-1...+40bar / -14.5...+580psi	
Measuring range	35mm / 1.4"	
Sensor material	316L	
Output	AC, DC, ASi	
Process connection	1/2", 3/4", 1" (G, R, NPT)	1/2", 3/4", 1" (G, R, NPT), front-flush solutions

Liquiphant M



**FTL50 /
FTL51**

**FTL50H /
FTL51H**

CRN

FTL51C



ABS



Liquiphant M

For all pumpable liquids in tanks, containers and pipelines.

Important industries:

- Chemical
- Power & energy
- Oil&Gas
- Food & beverage
- Life science



Technical data	FTL50/51	FTL50/51H	FTL51C
Process temperature	-50...+150°C / -58...+302°F		
Process pressure	-1...100bar/ -14.5...1450psi	-1...+64bar/ -14.5...928psi	-1...40bar/ -14.5...580psi
Measuring range	50.5...6,000mm / 2...236"		50.5...3,000mm / 2...118"
Output	AC, DC, AC/DC relay, NAMUR, 8/16mA, PFM, PROFIBUS PA		
Process connection	$\frac{3}{4}$, 1 (G, R, NPT),	$\frac{3}{4}$, 1 (G, R, NPT), Flange,	Flange

Liquiphant M



Features

- Modular instrument design
- Large variety of housings, electronic inserts and process connections
- Certificates for all areas

Advantages

- Simple maintenance by exchangeable of components
- Optimized device for all applications
- Universal use
- Tested and approved quality

Benefits

- Saving of time
- Saving of costs
- Safe and reliable limit detection
- High process and instrument safety

Liquiphant S – High Temperature

Point level detection in all liquids of the chemical and petrochemical industry, for example

- steam applications
- heating systems



Technical data	FTL70/71
Process temperature	-60...+280°C / -76...+536°F
Process pressure	-1...+100bar / -14.5...+1,450psi
Measuring range	50.5...6,000mm
Output	AC, DC, 8/16mA, relay, NAMUR, PA
Process connection	¾, 1 (G, R, NPT); Flange



Liquiphant for Q&G applications (overflow prevention)

New > Liquiphant FailSafe FTL8x – Customer benefit

- Safe plant operation up to SIL3 for MIN- and MAX-detection
- Highest safety and availability SFF > 99%
 - Reduction of unplanned downtime
- Environmental protection
 - One process connections and no dismantling of the sensor for proof tests
- Reduction of total cost of ownership
 - Extended proof test interval up to 12 years independent of sensor covered (pump protection) or uncovered (overflow prevention)



Technical data Liquiphant FailSafe FTL8x


The Liquiphant FailSafe is a point level switch for minimum and maximum detection (MIN/MAX) which can be used in liquids:

- SIL3 according to IEC 61508 Ed.2.0
- Process temperatures -60 to 280°C
- Ambient temperatures -60 to 70°C
- Process pressure up to 100bar
- Density from 0.4 g/cm^3
- Viscosity MAX-Detection
 - Up to $10.000\text{ mPa}\cdot\text{s}$
- Viscosity MIN-Detection
 - $\leq 350\text{ mPa}\cdot\text{s}$
 - $\leq 100\text{ mPa}\cdot\text{s}$ (High temperature or coating)




Liquiphant Fail Safety SIL 3

SIL3 MIN/MAX



**4...20mA +
LIVE-Signal**

**Liquiphant FailSafe FTL80/81/85
Nivotester FTL825**



**Safety
PLC**

**4...20mA +
LIVE-Signal
Optional**

**Liquiphant FailSafe FTL80/81/85
Directly integrated in PLC**



Liquiphant Fail Safe Pump Dry Run Protection

Saltigo GmbH
Leverkusen / Germany

Industry	Chemical industry (fine chemical)
	FTL85 in combination with FTL825 EX 1/2G, Enamel, DN50 PN40, 800mm
Application	Minimum-detection in pump drum
Medium	Acetyl chloride
Process	-10...35 °C, 1bar
Motivation	Instrument with extended proof test interval
Result	Field test passed – still running until MS4



Liquiphant Fail Safe for Overfill Prevention

Bayer Crop Science AG
Dormagen / Germany



Industry	Chemical industry (crop science)
	FTL81 directly integrated in PLC EX 1/2G, Alloy C22, DN50 PN40, 118mm
Application	MAX-Detection / overfill prevention Metallic reactor
Medium	Divers, multipurpose operation
Process	160°C, 10bar
Motivation	Instrument with extended proof test interval
Result	Field test passed – still running until MS4



Liquiphant for Density measurement

Liquiphant M Density – Computer FML621

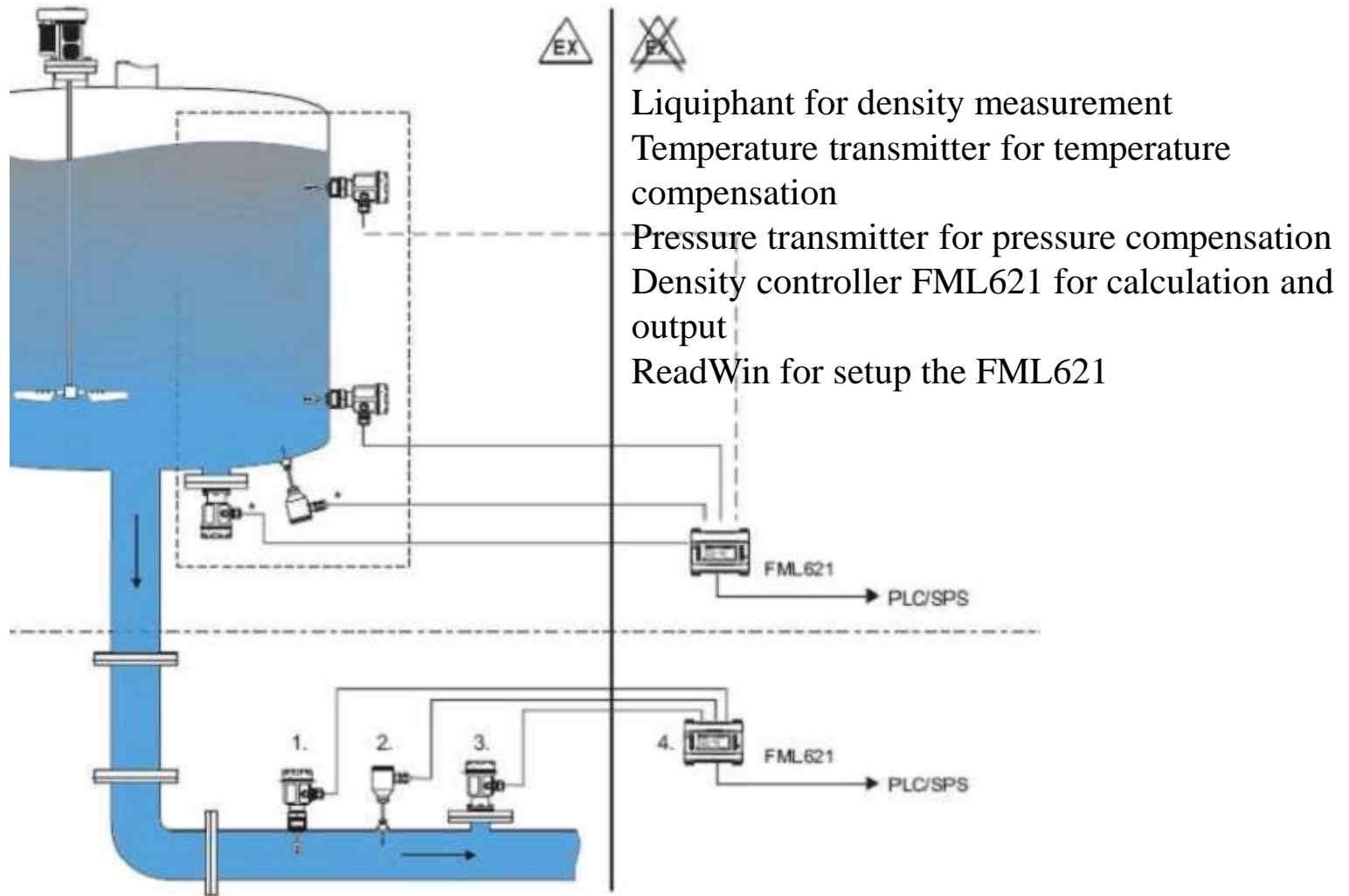
- The density calculator FML621 is the platform for calculating density and concentrations.
- Besides the standard features it offers additional software modules:
 - Norm density (e.g. 15°C)
 - Concentration calculation
 - Liquid detection
 - Customer specific values and calculation (e.g. °Brix, Baume, Plato, etc.)
- Furthermore the platform is offering all flexibility for further calculations.
- Depending on the application it is possible to add a temperature or pressure input for compensation purposes.



5 Measurements in parallel



The measurement line



Technical data Liquiphant M Density

Installation options:	direct installations in tanks and pipes
Measurement range:	0.3 – 2.0g/cm ³
Viscosity max:	350mPa*s (50mPa*s for FTL51C)
Process temperature:	0...80°C (suitable for CIP/SIP cleaning up to 140°C)
Process pressure:	-1...25bar

Application limits: flow velocity <2m/s gas bubbles, build-up and corrosion are not allowed
installation (pipe, distance to wall, complete covered, inlet run...)

A today installed Liquiphant cannot be converted to a density measuring device by exchange the electronic insert

Adjustment and Accuracy

Adjustment parameters	Standard adjustment FTL5x-***A	Special adjustment FTL5x-***K or L	Field adjustment
f0, frequency in vacuum	Individually determined	Individually determined	Required: actual density of the medium, e.g.. from reference device
S, sensitivity of the fork			
C, linear temperature coefficient			
D, pressure coefficient			
A, quadratic temperature coefficient			
Maximum measured error (Consider the measurement conditions)	+/- 0.02 g/cm ³ (+/- 1.2% of measuring range, under general measuring conditions)	+/- 0.005g/cm ³ (+/- 0.3% of measuring range, under reference conditions)	+/- 0.002g/cm ³ (in the operating point)
Non-repeatability / reproducibility (Consider the measurement conditions)	+/- 0.002g/cm ³ (under general measuring conditions)	+/-0.0007g/cm ³ (under reference conditions)	Depends on the ordered adjustment, standard or special
	+/- 0.002g/cm ³ (in operating point)	+/-0.0007g/cm ³ (in operating point)	

Liquiphant Density for Acid Concentration Monitoring

Medium: Sulphuric acid (15 ... 50%)

Process conditions:

Temperature: 74°C up to 88°C

Pressure: 3.5bar rel.

Sensor: FTL51C (PFA, RubyRed coating)

Previous measurement:
manual spindle measurement



Customer benefits:

- Traceability of the product quality
- Minimization of manual spindle measurement
(past: 1 measurement per approx. 2 hours, now: 1 per day)
 - no transport of aggressive/toxic media
 - increased security for human health
 - time and cost saving

Independent high level alarms – best technology available

Liquiphant is always the first solution



Liquiphant for Overfill Prevention

Bayer Material Science AG Leverkusen /
Germany



Bayer MaterialScience

Industry	Specialty Chemicals
	FTL81 in combination with FTL825 EX 1/2G, 316L, DN25 PN40, 1500mm
Application	Maximum-detection Overfill prevention vessel
Medium	Phosgene
Process	-60...220 °C, 40bar
Motivation	Instrument with extended proof test interval
Result	Field test passed – still running until MS4



Point level detection in a metal cleaning plant

Application

- Level monitoring of the detergent and pump protector
- Industry: Mechanical engineering
- Media: Detergent or coolant

Requirements

- Securing the cleaning process
- Tight installation conditions
- Price-attractive limit switch

Application

Liquiphant T FTL20 with 1/2" process connection and potted electronics



Leakage monitoring of gear oil or coolant

Application

- Monitoring of a tank regarding leakage
- Industry: Mechanical engineering
- Media: Gear oil or coolant

Requirements

- Early detection of leakage to prevent machine damages
- Easy connection to a machine interface
- Acid- and alkali-resistant materials
- Reliable and maintenance-free limit switch

Application

Liquiphant T FTL260



Point level in caustic soda storage tank

Application

- Minimum and maximum point level detection
- Industry: Food (winery)
- Media: Caustic soda

Requirements

- Concentrated caustic soda used for the cleaning process
- Resistant device for corrosive medium
- Reliable point level switch

Application

Liquiphant T FTL20



Point level detection for the beverage production

Application

- Lower and top point level detection
- Industry: Food
- Media: Soft drink concentrate

Requirements

- Unaffected by foam
- Price-attractive solution
- Vacuum-tight

Application

Liquiphant T FTL20



Point level detection in a filling plant

Application

- Pipe monitoring in a filling plant
- Industry: Food
- Media: Soft drink concentrate

Requirements

- Tight installation conditions
- Low immersion depth (switch point)
- Short response time < 500ms
- CIP and SIP cleanable

Application

Liquiphant T FTL20H with Varivent process connection and polished surface $R_a \leq 1.5\mu\text{m}$



Overspill protection in storage tank

Application

- Overspill protection for a highly corrosive media
- Industry: Chemical
- Media: 50% sodium hydroxide

Requirements

- Unaffected by build-up
- Highest safety during operation of the plant
- Acid- and alkali-resistant materials
- Self-monitoring of the instrument

Application

Liquiphant M FTL51, all wetted parts out of Hastelloy C4



Point level detection in a fermentation tank

Application

- Lower point level detection at the tank outlet
- Industry: Food
- Media: Beer

Requirements

- Point level switch to drain the tank completely
- Unaffected by foam
- Changing media
- CIP cleanable

Application

Liquiphant M FTL50H in hygiene design and polished surface
 $Ra \leq 0.3\mu\text{m}$. Visual function test from outside by transparent cap.



Point level detection in stirrer tank

Application

- Stirrer tank with aggressive media
- Industry: Chemical
- Media: Acid

Requirements

- Temperature up to +280°C
- Stable switch point even at density changes, turbulent media and high plant vibrations
- Explosion protection Ex ia, intrinsically safe

Application

Liquiphant S FTL71 with second line of defense, gas tight feed through and separate connection compartment



Overfill prevention for a tank farm

Application

- Overspill protection
- Industry: Power & Energy
- Media: Airplane fuel

Requirements

- Redundant overspill protection
- Highest security for the tank farm
- Accurate point level detection

Application

Liquiphant S Failsafe FDL61
with switching unit FTL670



Point level detection in a dosing tank

Application

- Point level detection during a filling and draining process
- Industry: Power & Energy
- Media: Lime hydrate

Requirements

- Reliable detection even at external vibration and build-up
- Density of 480 k/m³

Solution

Liquiphant M FTL50 compact sensor



Point level detection in a process tank

Application

- Batch process in the medicine fabrication
- Industry: Life science
- Media: Vitamin substance

Requirements

- Integration into existing PROFIBUS PA concept
- Reduce wiring and service expenditure
- Hygiene process connection
- CIP and SIP cleaning

Solution

Liquiphant M FTL50 with PROFIBUS PA electronic insert FEL50A and Tri-Clamp process connection



Point level detection in filling pipe

Application

- Min./max. point level detection in bitumen filling pipe
- Industry: Primaries
- Media: Bitumen

Requirements

- Build-up formation
- Process temperature up to +200°C (+392°F)
- Integrated self-monitoring

Solution

Liquiphant S (HT) FTL71 with switching unit FTL325P



Thank you for your attention

Any questions?

