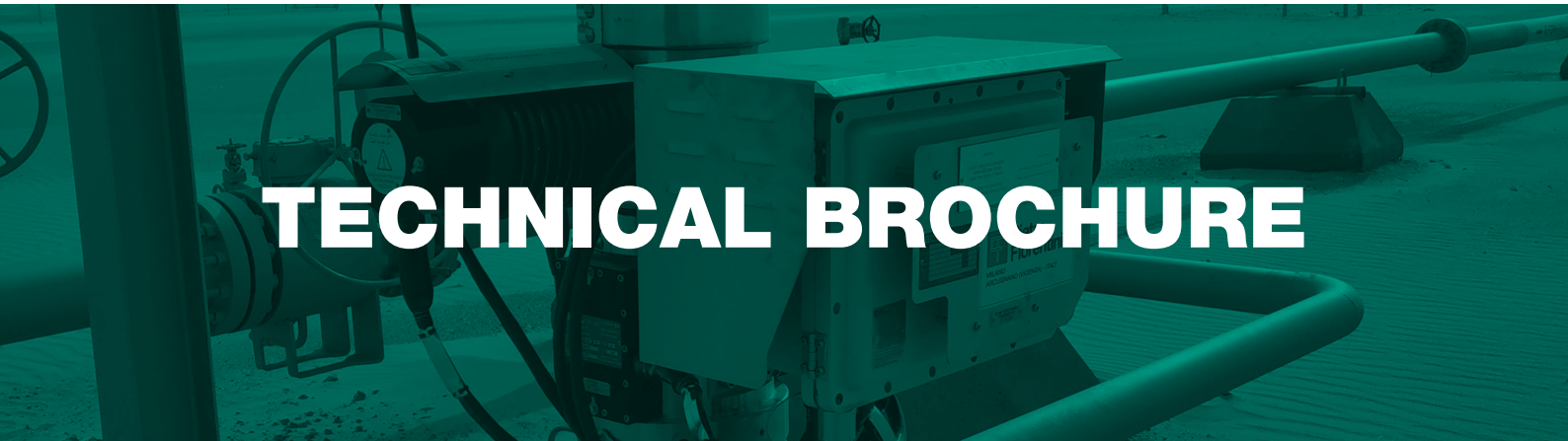
Pietro Fiorentini

Multiphase
flow metering



TECHNICAL BROCHURE

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mpfm_technicalbrochure_ENG_revA

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Who we are

We are a leading company in designing and manufacturing technologically advanced products and systems for natural gas treatment, transmission and distribution.
We are the ideal partner for operators in the Oil & Gas sector, with a business offer that goes across the whole natural gas chain.

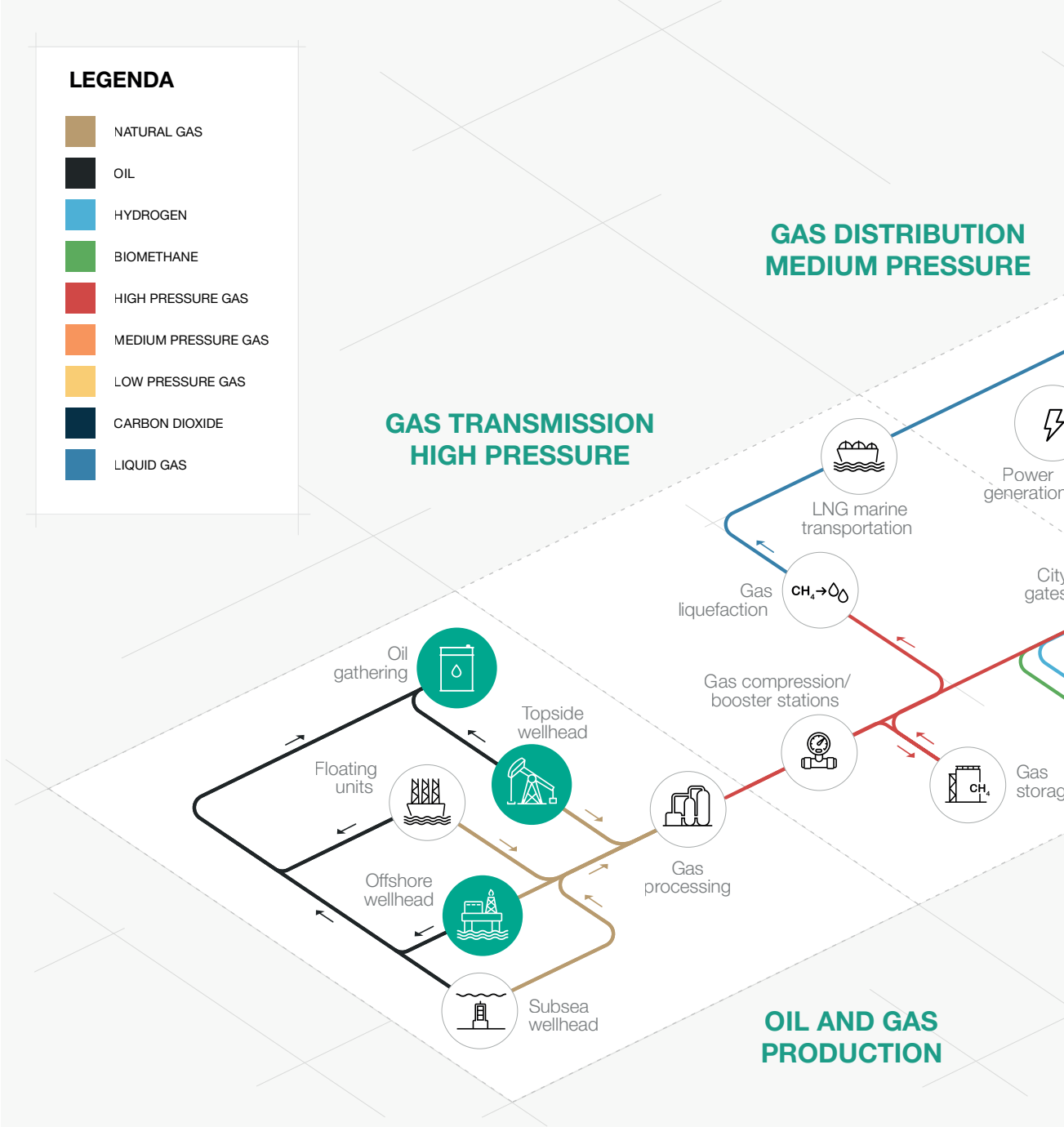
We are in constant evolution to meet our customers' highest expectations in terms of quality and reliability.

Our aim is to be a step ahead of the competition, with a customized technology and an after-sale service program always marked by a high grade of professionalism.

Pietro Fiorentini advantages

- Localised technical support
- Experience since 1940
- We operate in over 100 countries

Area of Application



Green icon indicates the application where this product is suitable for

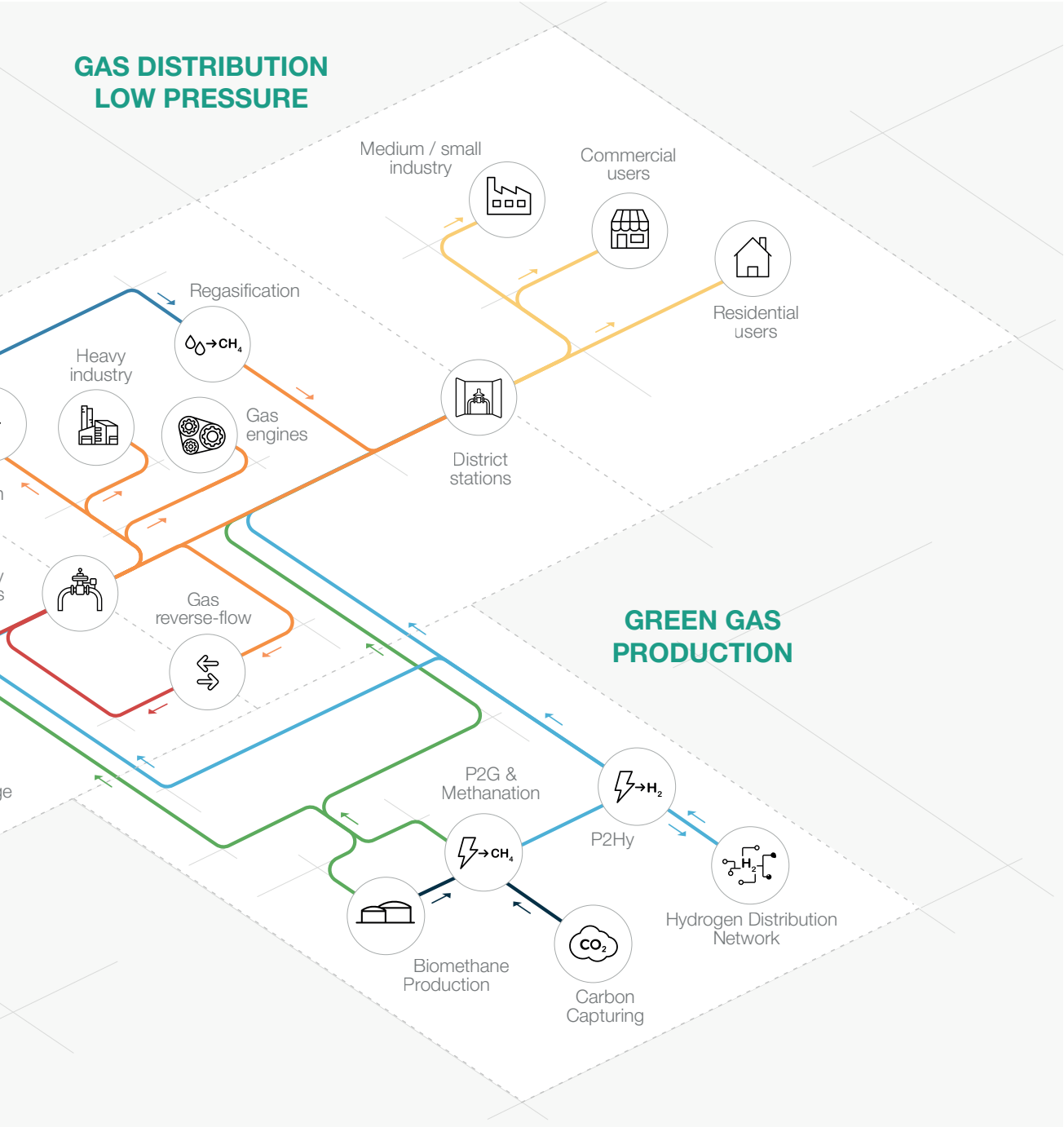


Figure 1 Area of Application Map

Introduction

Pietro Fiorentini **Multiphase Flow Meter (MPFM)** is an **inline flow metering device**, tailored for continuous real-time measurement of the amount of oil, water and gas in the well stream.

Reduce CAPEX. Compared to traditional separation systems, Pietro Fiorentini MPFMs allow to drastically reduce the overall dimensions, including footprint. This becomes even more important in case of offshore platform or mobile application, when the size and weight are off the essence.

Cut off OPEX. The low frequency of maintenance and the tiny energy consumption make it perfect for unmanned places and allow to reduce the everyday equipment expenses.

Low your risk. Pietro Fiorentini MPFMs do not need safety devices such as for traditional separation systems. Additionally, the real-time measurement allows to have a quick feedback in case of water or gas breakthrough, preventing additional expenses.

Boost your production. The key feature of Pietro Fiorentini MPFM is the real time measurement: the new era of 4.0 industry has already hit along with Big Data. Improve reservoir management, optimize production with real-time data and increase your profit!

Flowatch HS | Oil well

Applications by Purpose

MPFMs have a wide range of application, such as allocation, oil production optimization and flow assurance, and generates a high additional value: the real-time measurement is one of the key features that unlock advanced methods of production optimization, which boosts the profitability and prevents possible losses.

Production Optimization

The production of oil and gas is a complex and dynamic process with high goal to achieve. In this external market environment, characterized by a high level of competitiveness and instability, decisions must be fast and accurate not to miss opportunities and make the most of assets. New smart software and management practices requires more data than ever in real time to optimize the production, boost the yield and reduce the expenses. MPFM provides real time and accurate measurement of the flow, giving feedback about the well behavior.

Allocation

Well metering plays an important role not only on the production side. Oil production is a complicated multi-stage production process, with many stakeholders bound by shared opportunities, obligations and risks. These are allocated in proportion to production, recognizing the contribution of each party. The MPFM makes the first measurement of hydrocarbons once extracted from the underground.

Flow Assurance

Today, an instrument must not only guarantee an accurate measurement, but also give the possibility to analyze and understand when maintenance is required before the damage is done. The multiphase flow meter helps to understand when preventive maintenance is required not only for the meter itself, but also for the line. In this way a continuous hydrocarbon flow without interruption can be guaranteed.

Applications by Use

MPFM has a reduced footprint and weight, which, combined with low power consumption and need for maintenance, makes it perfect for installation in unmanned and remote locations with harsh environmental conditions.

Solar Power

A typical MPFM installation requires only 32W to operate. Such low power consumption fits perfectly with solar generated power. The use of solar panels allows to avoid heavy investment on power distribution systems especially in remote areas.

Unmanned Platforms

Since there are no moving parts, MPFM requires little maintenance. This feature combined with its small size and low power consumption, ideal for operating in unmanned platforms. A dedicated diagnostic system allows for more efficient maintenance planning, also reducing the hazard exposure time of personnel.

Desert

Constant exposure to sunlight, huge temperature fluctuations between day and night and the corrosive and erosive effect of sand makes the desert an extremely challenging environment to operate. Thanks to its design, the MPFM can successfully measure wells without losing accuracy even under these harsh conditions. More than half of Pietro Fiorentini MPFMs are installed in deserts.

Arctic

Temperature can be extremely low in arctic conditions, making maintenance a challenging task. For this type of applications, MPFMs are installed in preheated environments and therefore with limited available space. MPFM's low maintenance requirement combined with a compact design fits well for this kind of restrictions.

Mobile Testing

The efficiency of mobile units is measured not only by the accuracy of the instrument, but also by the speed at which the test is performed and the involved manpower. The MPFM has a reduced system connection and well stabilization time and only two service operators are required to perform the entire well measurement. The small size of the instrument allows the use of lighter and economic vehicles.

Extended measurement range

The compactness of the instrument allows to combine in sequence two MPFMs with different sizes into a single unit. The switch between one MPFM and the other is made through a three-way valve, with the possibility to automate the process. This type of arrangement extends the measuring range, with turn down ratio up to 1:90.

Skid mounted

This solution follows the “Plug & Play” philosophy. MPFM is installed in a metal structure with piping and one-point wiring connection. This greatly improves the installation, commissioning and start-up timing, perfect for fast tracking projects.

Figure 2 MPFM -skid solution

Technical Specification

Features	Values
Sizes (Note 1 and 2)	0.5” - 14”
Connection types	Flanges, Clamped and other on request
Design Pressure & Temperature	Up to Class 2500, up to 302 °F (150°C)
Body Materials	AISI316, Duplex, Inconel 825, Inconel 625, others on request
Meter Pressure Drop	< 1 bar
Density measurement (only for radioactive version)	• Gamma Source: Cs-137, 30 mCi, Half-life 30.1 years • Dose level 0,4µSv/h @1 m (natural background) • Detector: Pietro Fiorentini Fast Gamma • Counts per second: 0.5 million • ATEX/IECEx certification Ex d IIB T3-T6 Ga
Communication Interface	• Communication ports: ° RS-485 single or redundant ° RS-422 single or redundant ° Ethernet single or redundant • Communication protocols: ° Modbus RTU ° Modbus TCP/IP
Flow Electronic Transmitter	• Real Time controller • Ambient temperature -46° C / +85° C • Power supply: 18 - 36 VDC, or 110÷240 VAC, 50÷60Hz • Power consumption: from 14 up to 60 W (Note 3) • Enclosure for safe or hazardous area • Weather protection: IP 66 • Stainless steel AISI 316L or copper-free aluminium enclosure • Textual or graphical field display (optional) • ATEX/IECEx certification Ex db IIB T3 Gb
Coating	Standard or according to project requirements, including coating suitable for severe corrosion environment
HMI	• OS Windows • TCP/IP Wireless • Serial RS 485/422 for long distance

REMARKS:
- 0.5” and 0.8” sizes are available for non-radioactive type only.
- 0.5”, 0.8” and 1.3” sizes are with 2” IN/OUT connections
- Power consumption is defined by the MPFM model and the power supply

Table 1 Features

Models

Pietro Fiorentini has developed several models of **MPFM** designed to meet specific customer requirements depending on application. These models are classified according to the gas, oil and water content that they are able to measure, with solutions covering the whole range. Each model is available in both radioactive and non-radioactive versions, giving different level of accuracies.

Flowatch 3i and **Flowatch HS**

Flowatch 3i (non-radioactive) and Flowatch HS (radioactive) models mainly for black and volatile oils. Recommended GVF range 0-90% for Flowatch 3i and 0-95% for Flowatch HS. These models combine the following measurement principles: venturi differential pressure, impedance, phase-velocity and gamma (only for radioactive model).

Xtreme S and **Xtreme SHS**

Xtreme S (non-radioactive) and Xtreme SHS (radioactive) models, for wet gas. Recommended GVF range 90-100%. These models combine the following measurement principles: venturi differential pressure, phase-velocity, water-cut and gamma (only for radioactive model).

Totem and **Totem HS**

Totem (non-radioactive) and Totem HS (radioactive) models. The most complete solution, performing in all stream conditions, regardless phases composition. GVF range 0-100%. These models combine all available Pietro Fiorentini's sensing technology: venturi differential pressure, impedance, phase-velocity, water-cut and gamma (only for radioactive model).

Figure 3 Flowatch 3i

Figure 4 Xtreme S

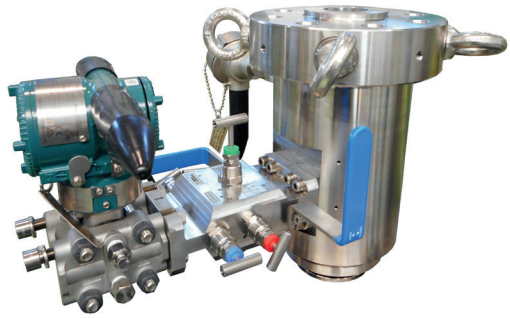
Figure 5 Totem HS

Modules

Pietro Fiorentini has developed a unique **MPFM's modular design**. Each module has a different measurement principle and is dedicated to measure one or more specific flow parameters.

The combination of all readings from different modules is used as inputs for the mathematical model, which gives an output for each single phase. The key benefits of such system are the redundancy of data and the flexibility: just add the required module, without the need to change the electronic or repeat the calibration of the entire system.

The dissimilar redundant sensors made with different technologies and cross verification feature guarantee a higher reliability and greater confidence in the whole range of Gas Volume Fraction (GVF) and Water Cut (WC).

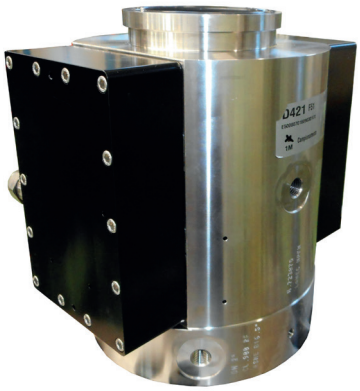


Venturi

The venturi throat generates a differential pressure, proportional to the mixture flow rate and density. This technology is simple and robust, with a very wide range of applicability. Combined with the fluid velocity, it can be used to back calculate the mixture density and the GVF

Impedance

A serial configuration of permittivity and conductivity sensors is used to calculate the water and gas content. This module gives good results in presence of emulsion. Since more electrodes are exploited, the cross correlation is used to measure the linear flow velocity. The velocity measurement has the best efficiency when there is significant phase fraction variation (medium and moderate GVF).



Gamma

(only for radioactive models)

Gamma module is used for the measurement of the mixed density and to determine GVF at high frequency rate, required for an accurate real-time measurement and to capture fast phase transition like slugs. The radioactive source is Cs-137 with 30-year half-life. Since the technology is based on gamma ray absorption, the fluid composition has a tiny influence on the measurement, allowing to minimize the need of calibration along the time and the effect of H2S and CO2 presence.

Velocity

This module is used to measure the flow velocity of a homogenous stream, with best performance at very low or high GVF. The technology measures the true gas phase velocity and does not depend on liquid load and slip effect.

Water - cut

This module provides a water cut measurement that is unaffected by transition zones and salinity. It may be used as a redundant measurement for oil application, or as main water measurement of wells with high gas content.

Flow computer

The flow computer is designed to process the data acquired from different modules and sensors to calculate the actual and standard flow rates of oil, water and gas. The results are then sent to client system. The new flow computer model, Flow Electronic Transmitter (FET), has a compact design, suitable to be installed directly on MPFM body, easy for maintenance and to plug-in. The flow computer operates without field display, which is supplied separately as option.

Field display

Field Display provides measurement and process related information and is able to perform simple operations. It is supplied separately from the flow computer and can be installed near the instrument or in a remote location, such as control room. Different options are available, both the choice of material (copper free aluminum) and the area classification where it will be installed (safe and hazardous area).

Installations

Here below, at glance, some typical installations by application or country of destination. On demand we are available to supply a more comprehensive experience list and/or references.

Flowatch HS | Oil well in Persian Gulf

Totem HS | Mobile application in Central America

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