

# MULTIPHASE FLOW ARRAY SENSING TOOL

**OPTICAL PROBE FOR GAS HOLD-UP**

302degF (150degC) – 15Kpsi.  
 Sturdy design for robustness.

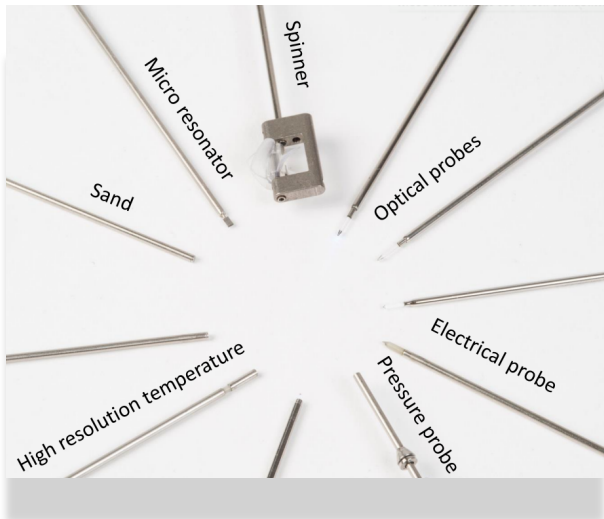
Liquid/gas discrimination from refractive index.  
 Integrated coupler.  
 Dynamic threshold.  
 Embedded computation of gas hold-ups and bubble count.

**MICRO-SPINNERS**

302degF (150degC) – 15Kpsi.  
 Diameter 7/16" (11mm).  
 Fluid velocities; min threshold 2cm/s and max spinning rate 10m/s.

**ULTRAFAST FLUID TEMPERATURE**

302degF (150degC) – 15Kpsi.  
 Accuracy 0.1degC, Resolution 0.01degC.  
 Data rate 16Hz.  
 Enables high resolution temperature imaging.  
 Early fluid entry detection.



**ELECTRICAL PROBE FOR WATER HOLD-UP**

302degF (150degC) – 15Kpsi.  
 True conductivity measurement.  
 Patented multi electrode technology.  
 Embedded computation of water hold-ups and bubble counts.  
 Reliable from fresh water to high salinity brine.

**MINIATURE DOPPLER TRANSDUCER**

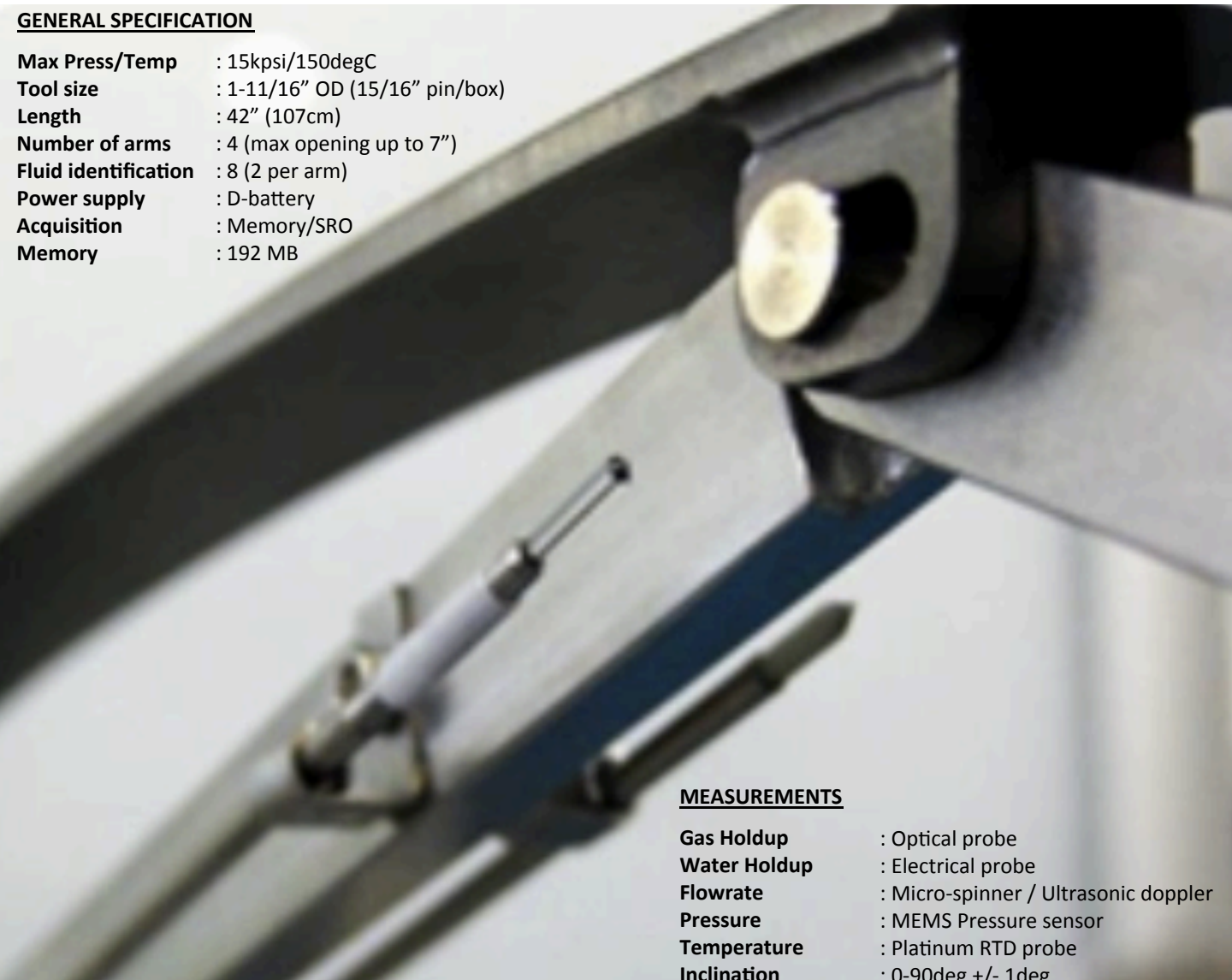
302degF (150degC) – 15Kpsi.  
 Computation of velocities from the Doppler shift.  
 Qualitative granulometry index of fluids from the Doppler amplitude.  
 Detection of very early fluid entries (a few tens of microns).

**PRESSURE**

OPENFIELD™ MEMS Pressure sensor.  
 302degF (150degC) – 15Kpsi.  
 Accuracy 1psi, Resolution 0.01psi.  
 Metal-to-metal.

**GENERAL SPECIFICATION**

- Max Press/Temp** : 15kpsi/150degC
- Tool size** : 1-11/16" OD (15/16" pin/box)
- Length** : 42" (107cm)
- Number of arms** : 4 (max opening up to 7")
- Fluid identification** : 8 (2 per arm)
- Power supply** : D-battery
- Acquisition** : Memory/SRO
- Memory** : 192 MB



**MEASUREMENTS**

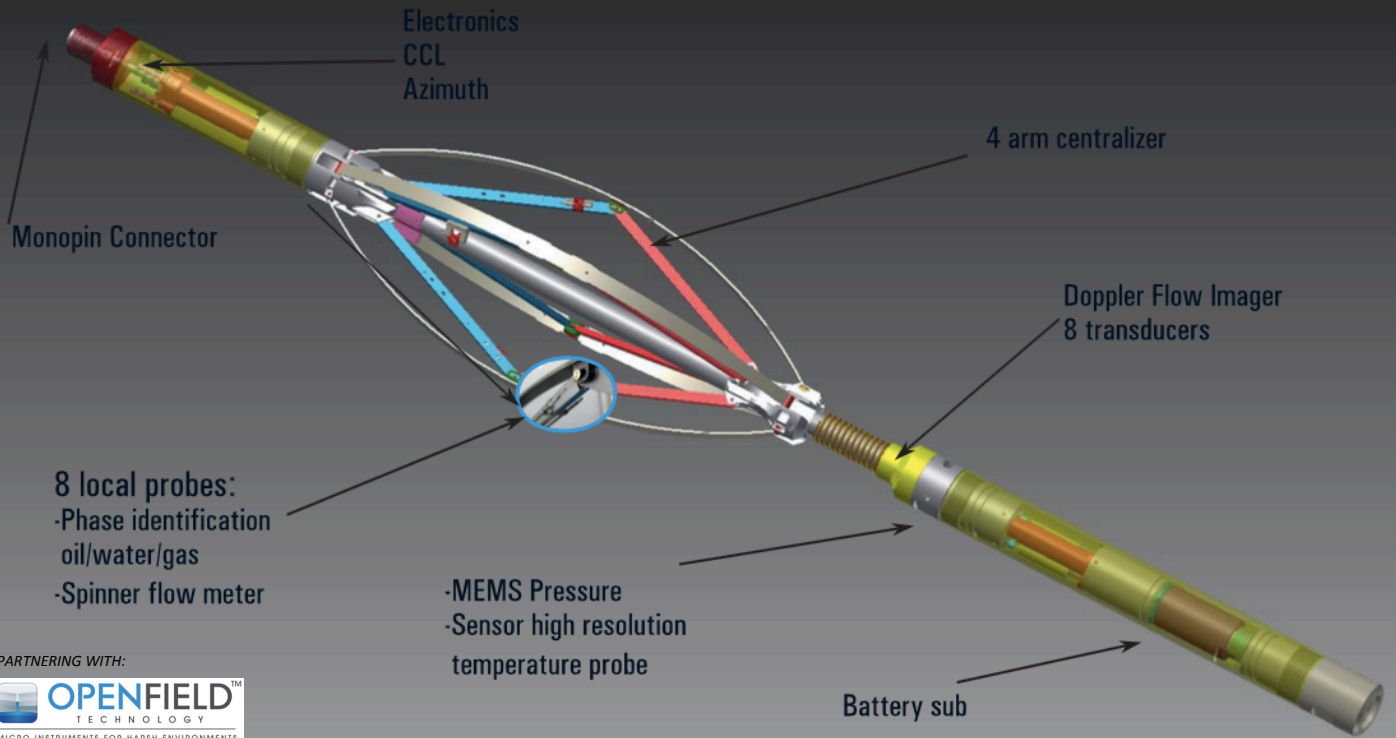
- Gas Holdup** : Optical probe
- Water Holdup** : Electrical probe
- Flowrate** : Micro-spinner / Ultrasonic doppler
- Pressure** : MEMS Pressure sensor
- Temperature** : Platinum RTD probe
- Inclination** : 0-90deg +/- 1deg
- Relative bearing** : 0-360deg +/- 3deg
- CCL** : Differential magnetometer

PARTNERING WITH:



# MULTIPHASE FLOW ARRAY SENSING TOOL

DEVIATED AND HORIZONTAL WELL - SMALL TUBING  
HIGH WATERCUT - LOW FLOWS - LOW HOLDUPS



The conductivity and the refractive index of the fluid in contact with the tips of the fluid identification probes are measured at high rate (1 ms) and compared to thresholds in order to discriminate fluid phases and compute bubble counts and holdups. Data are updated on the I2C bus every 62.5 ms. Average, minimum, maximum and majority values are also transmitted which can be used for finer analysis.

### MICRO-SPINNER.

- Small size of 7/16" (11mm), work well in fully closed arm with tool OD 1-11/16"
- Minimum velocity threshold of 2 cm/s (max spinning rate 10 m/s).
- Smart magnetic detection.

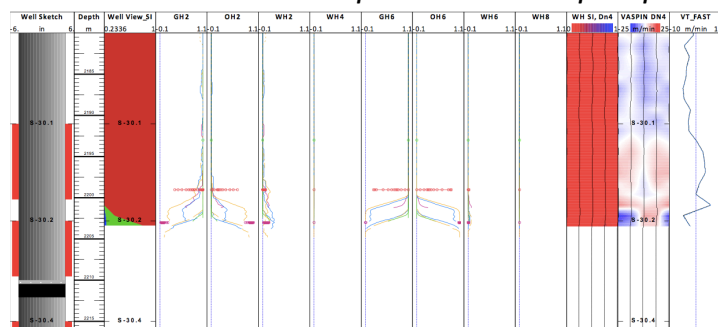
### ELECTICAL PROBE.

- Ceramic needle with inconel side electrodes for robustness in harsh environment.
- High spatial resolution, fast transient response.
- Reliable from fresh water to high salinity brine.
- Holdups & bubble counts embedded computation, digital output.

### OPTICAL / TRI-PHASE PROBE.

- Refractive index measurement.
- Sapphire needle, Y-coupled light emitter/photo-detector.
- Direct holdups and bubble-count computation.

### Sample FAST data with tri-phase probe



ABOVE: FAST with tri-phase probe data in gas well during shutin mode. Clear indication of liquid level can be seen to show unwanted condensate present at held-up depth.

BOTTOM: Both micro-spinners and tri-phase probes are showing fluid movement of light phase at the higher side & heavy phase on the lower side.

