

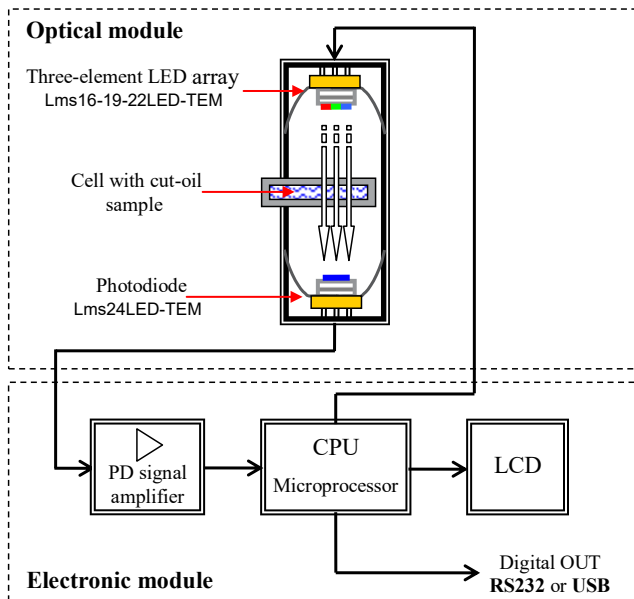


## WATER-IN-OIL MEASUREMENT

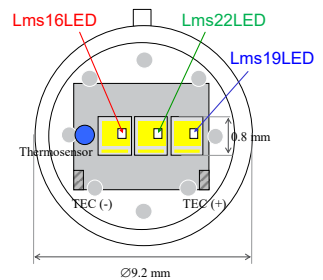


**Water measurement in crude oil and petroleum products** is an actual task for the petrochemical industry. The regular control of water concentration in oil well allows field operators to judge about the well performance and regulate the oil extraction process. In time water measurement in petroleum products helps to avoid costly breakdowns with loss of revenue. We offer our **mid-infrared LED-PD optopairs** for development of water meters based on the optical absorption principle.

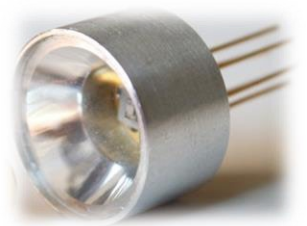
### Water in oil detection with a three-element mid-infrared LED-array



Prototype of a portable analyzer of water concentration in oil has been developed. The system includes an optical cell and an electronic module. Three-element LED array and a broadband photodiode comprise an optical cell.



Optical absorption of the water-oil emulsion can be defined by water absorption and oil absorption, in addition to this, scattering at water-oil drops' interfaces must be compensated during the measuring process (as it strongly influence on the LED emission propagation). Considering these facts, we've designed an LED array that consists of three LED dies: 1.9 um LED



(emission is intensively absorbed by the water), 1.6 um LED (emission is intensively absorbed by the oil) and a reference 2.2 um LED (slightly influenced by water and oil) that enables compensation of non-water and non-oil influences on the emission propagation. By processing of three signals from the LED-array we obtain the calibration dependence of the water concentration on the resulted signal. The pilot sample was tested at 0-80% water concentration range, the measurement error was 3%.

This approach can be utilized for the development of more complicated, robust and precise sensors for water detection in oil and petroleum products.

Using mid-infrared LED-PD based solutions provides certain **advantages** for this sort of application:

- **Non-destructive** analysis
- Possibility to arrange a **compact design** of an optical cell thanks to compact size of the LED chip – **0.35 × 0.35 mm**
- No need of using additional optical filters – LED emission band width is comparable to absorption band widths of analysed substances
- **Low power consumption (<1 mW)**
- **Short response time (10–50 ns)**
- Possibility to achieve modulation **ranges** of up to **100 MHz**
- Operation temperatures up to +150°C
- **Lifetime of 80 000 hours**



