

# Multi measuring spark plug

Type 6133A..., 6135A...,  
6138A...

## Spark plug with integrated pressure sensor and optics

Multi measuring spark plug with integrated high-temperature miniature pressure sensor and fiber-optic system for pressure measurement and optical combustion analysis in spark-ignition engines.

- 8 optical windows to the combustion chamber
- Radial and/or axial direction of observation
- Integrated 3 mm cylinder pressure sensor
- Compact design, installation in spark plug hole from D 20 mm
- Thread sizes M10x1, M12x1.25, M14x1.25
- Various heat ranges, spark positions and electrode spacing possible



### Description

Eight optical probes acquire combustion radiation in targeted areas of the combustion chamber. The acquired light intensity is conducted through optical fibers to highly sensitive optical amplifiers and converted to a voltage signal.

The flush-mounted position of the pressure sensor ensures a high-quality signal, even when knocking occurs and at high engine speeds. The heat range of the spark plug and the knocking behavior in the combustion chamber are unchanged due to a minimal dead volume.

### Application

Reliable combustion data are readily available thanks to the easy adaptability of the fiber-optic spark plug. In addition to the ignition process, abnormal combustion phenomena such as knocking, premature firing and soot formation can be made clearly apparent both over time and in space. The extreme sensitivity of the system allows for combustion analysis even during idle operation and cold start.

The reconstruction of the early flame propagation provides a global understanding of the charge motion and allows the analysis of the ignition under different operating conditions. The signals from the optical probes can also be used for misfire detection.

### Technical data

#### Optical windows

Max. number		8
Viewing angle arrangement with respect to longitudinal axis	Degree	70
Observation angle	Degree	25
Distribution	Degree	45
Operating temperature range	°C	-20 ... 500

#### Optical sensors

Transmission	nm	190 – 1,200
Fiber length, flexible routing	mm	1,200
Connector	–	Type ST

#### Pressure sensor

Measuring range	bar	0 ... 200
Calibrated partial range at 200°C	bar	0 ... 50 0 ... 100 0 ... 150
Overload	bar	250
Sensitivity	pC/bar	≈-10
Natural frequency	kHz	>120

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**Technical data (continued)**

Natural frequency (acoustic)	kHz	≈65
Linearity, all ranges (at 23 °C)	% FSO	<±0.5
Operating temperature range	°C	-20 ... 350
Thermal sensitivity shift 200 ±50 °C	%	<±1
Acceleration sensitivity	mbar/g	<0.001
Thermal shock error (at 1 500 min rpm, pmi = 9 bar) Δp (short-term drift)	bar	<±0.6
Δpmi	%	<±3
Δpmax	%	<±1.5

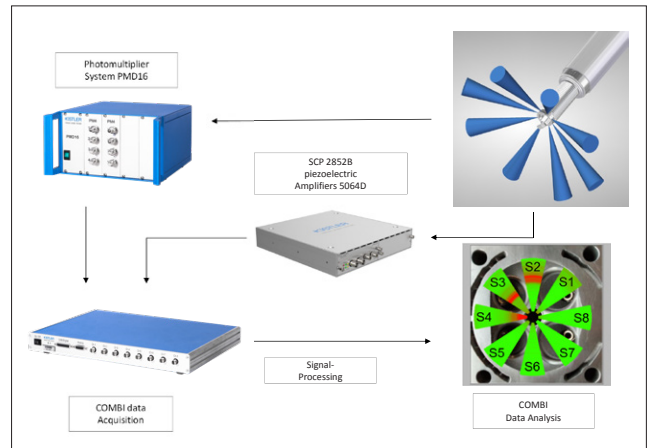


Fig. 2: Measuring setup with Multi measuring spark plug, PMD optical amplifier, piezoelectric amplifier Type 5064D and Combi data acquisition

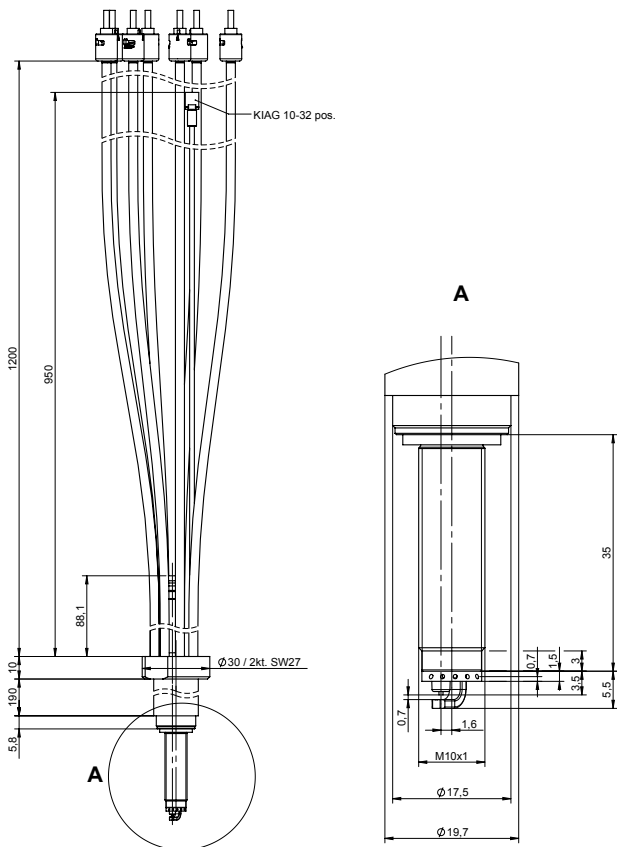


Fig. 1: Example: Multi measuring spark plug version M10x1. Other thread lengths, spark positions and electrode spacing possible

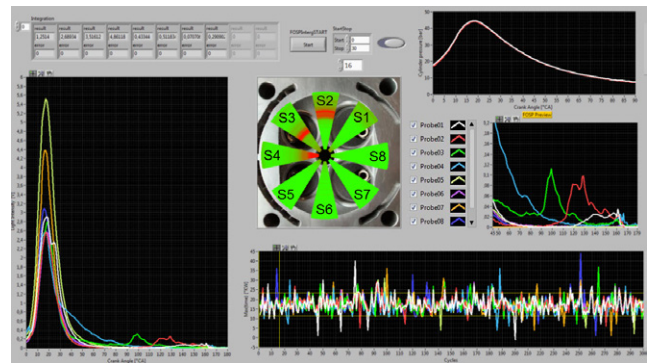


Fig. 3: Use of multi measuring spark plug in a gasoline engine with direct injection in transient operation: detection of soot formation in the combustion chamber



Fig. 4: Components used to capture local light intensity in the combustion chamber: Multi measuring spark plug, PMD optical amplifier, Combi data acquisition

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