

Monitoring of Laser Welding
by Measurement of Plasma and Infrared Radiation

Plasma Monitor PM 7000

**IN PROCESS
MONITORING**

Sensor box: connection of
up to 2 sensors for IR and UV



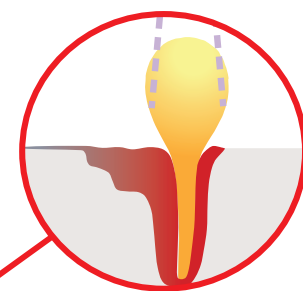
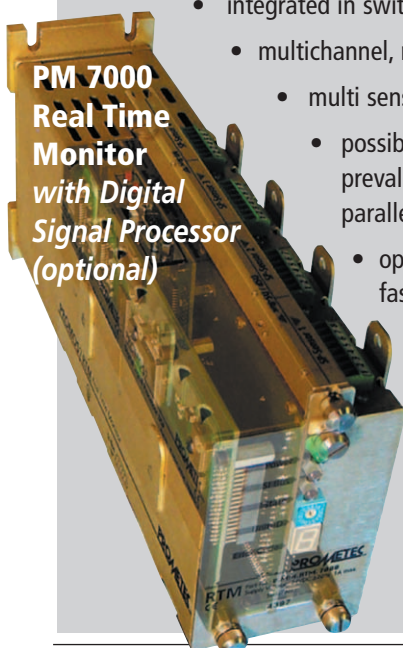
Fast and secure monitoring
of laser process quality
by detection of:

- bead interruptions
- shielding gas interruptions
- contamination of weld seam preparation
- laser interruptions
- degree of full penetration
- changes in laser process intensity

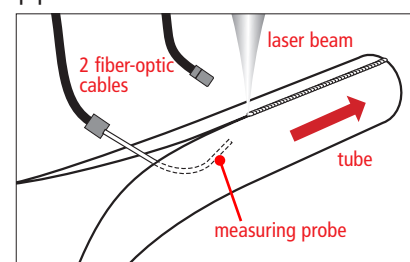
Monitoring hardware concept and capabilities:

- integrated in switch cabinet
- multichannel, modular hardware
- multi sensor
- possible to use any prevalent field bus or parallel connection
- optional, independent DSP enables fast, high quality signal processing for special monitoring tasks (e.g. FFT, wavelet analysis ...)
- monitoring and operating software can be integrated into open NC
- 2000 times sold reliable hardware solution

**PM 7000
Real Time
Monitor
with Digital
Signal Processor
(optional)**



Example (below): simultaneous
evaluation of process light emission
from top and bottom of a weld capillary.
Application: endless welding of
pipes.



	Welding Monitor PD 2000 <i>camera based laser process monitoring</i>	Plasma Monitor PM 7000 <i>photo detector based laser process monitoring</i>
General Attributes		
Price (as of 2014)	35,000 to 45,000 €	approximately 18,000 €
In-Process Monitoring	Yes	Yes
Suitability for CO ₂ , Nd:YAG, Fiber and Diode laser	Yes	Yes
Coaxial orientation of the sensors to the laser	Yes (standard)	Yes (standard)
Off-axis orientation of the sensor to the laser	–	Possible
Transparent generation of monitoring signals	Yes	No
Monitoring Features	Simultaneous monitoring/differentiation of up to 8 process- or weld-characteristics for one process	Simultaneous monitoring of up to 4 photo detector signals
Sensors retrofittable on laser optics	Yes	Yes
Multi channel capabilities	Up to 2 asynchronously running laser stations can be monitored with one system (one common machine control).	Up to 4 laser stations can be simultaneously monitored by one system (one common machine control).
Communication with the machine controls	Field bus or parallel interface	Field bus or parallel interface
Functional principle	Process deviations visible in the camera image are spatially evaluated and monitored („what you see is what you get“).	Integral evaluation of the process light emission
Observable spectral range	IR and VIS	IR and UV
Monitoring frequency	Up to 15 kHz	1 kHz
Flexibility / complexity		
Hardware	<ul style="list-style-type: none"> Industrial PC Frame grabber for the acquisition of process images 	<ul style="list-style-type: none"> Distinct PC is not required Compact module for switch cabinet integration Optional DSP for fast, high quality signal processing (e.g. FFT, wavelet analysis) Monitoring functions integrated into Real Time Monitor
Software	Software for monitoring function on PC: <ul style="list-style-type: none"> Processing of image data using mathematical algorithms for creation of monitorable signals Signal visualization Operation 	Software (not required for monitoring function) on open NC: <ul style="list-style-type: none"> Signal visualization Operation
Spatial resolution of the process zone	Yes	No
Direct insight into the physical effects of laser processes and therefore better process knowledge	Yes	No
Implementation as tool for process optimization	High	Medium
Suitability for solving complex monitoring tasks	High	Low
Flexibility in application	High	Medium
Need of experience for application	Medium	Low
Monitoring capabilities for specific process dimensions (focal position, weld position energy density, welding speed, etc.)	High	Low
Monitoring capabilities for weld dimensions (weld depth, degree of weld penetration, weld position, melt pool geometry, humping, spatter, holes, gap in overlap and butt joint)	High	Low
Monitoring capabilities for simple effects (bead interruptions, shield gas interruptions, contaminations of the seam preparation, laser interruptions, intensity changes in laser processes)	High	High
Susceptibility	Low, due to coaxial integration: <ul style="list-style-type: none"> Sensor protection by protective glass plate of weld optics (avoids pseudo-errors) Low interference contour by installation distanced from the process No shadowing by clamping devices 	
Documentation of monitoring results	Comprehensive, retraceable by serial numbers	Base data