Basics of Electronic Indicators

The electronic indicators (MIP systems) have replaced the traditional mechanical indicators over the last years. The advantages of the electronic systems are:

- Serving slow speed engines up to high speed engines as long as they are equipped with indicators cocks
- No mechanical wear & tear
- E-mail transfer of measuring results can be easily sent ashore
- Extensive analyzing possibilities because of different pressure diagrams such us:

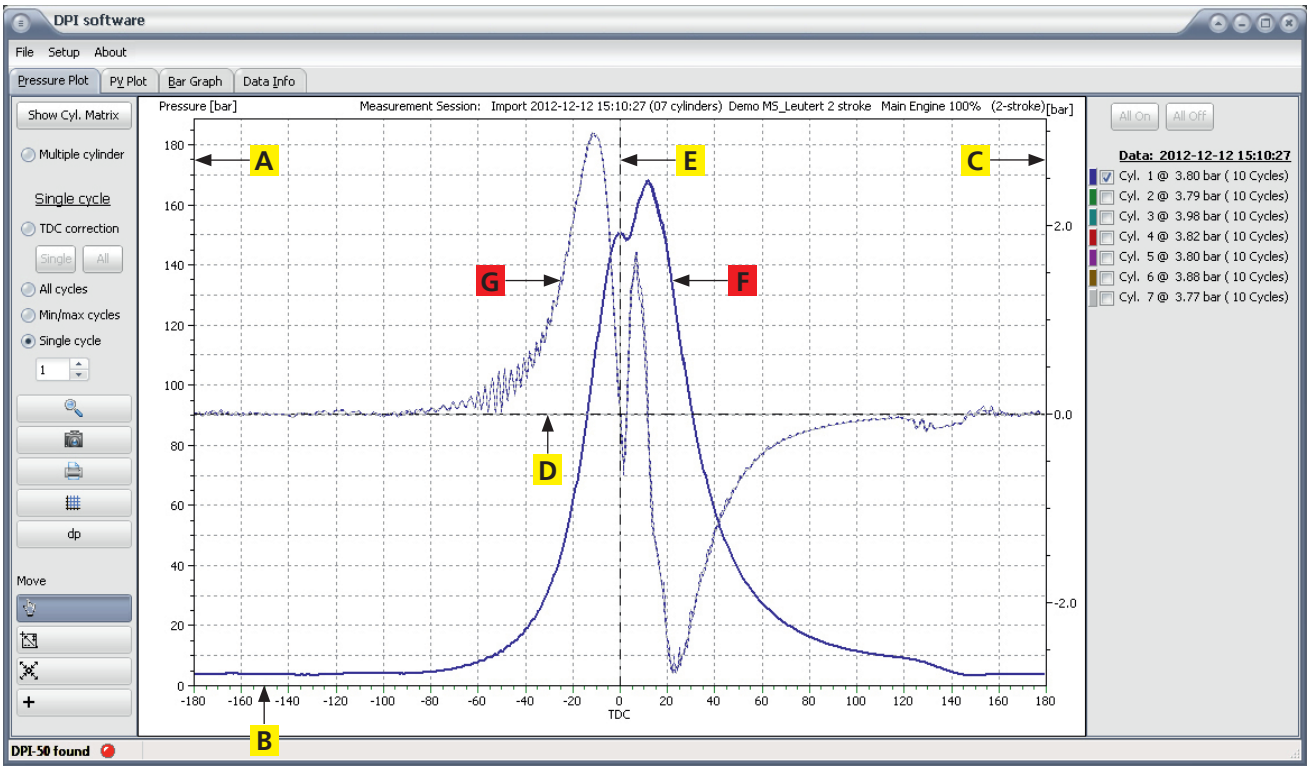
  Pmax bar graphs, MIP graphs, Pind graphs, derivative graphs (dp/da), overlay with reference readings, data tables and more
- TDC correction is possible to determinate the influence of TDC failures
- Date & time stamp
- Additional parameters (text etc.) and comments can be added

By means of electronic indicators the analyzing possibilities have dramatically increased.

In the following please find some basic information about the pressure readings and how they can be used in daily work.

Start screen of analyzing software with information about software version and type of equipment.

Pressure Plot



[Pressure plot] displays the cylinder pressure measured at the indicator valve in relation to crankshaft angle.

A: Axis for cylinder pressure, scaling in bar
This axis is automatically adjusted to the load axis for the cylinder pressure readings. No need for changing spring, scale etc. as it was necessary for the mechanical indicator types.

B: Crankshaft angle, scaling in °
This axis shows the position of crank angle of the measured cylinder.

C: Axis for the derivative curve (dp/da)

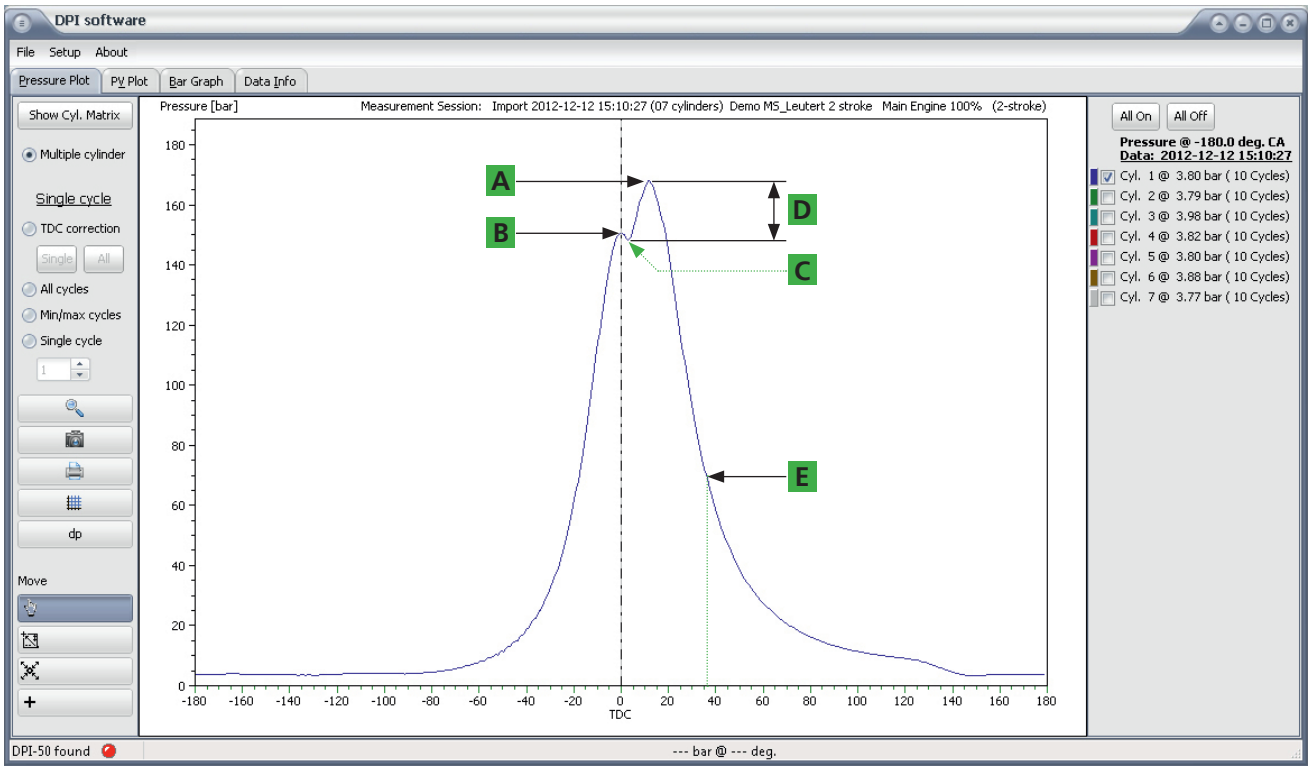
D: Zero bar line for derivative curve

E: TDC line

F: Cylinder pressure line; This curve represents the pressure rising and falling in relation to the crank angle of the measured cylinder.

G: Derivative pressure line, scaling in bar/° crank angle movement
The dp/da pressure line represent increase or decrease for 1° crank angle movement. This should not exceed 6 bar/° to avoid mechanical overstress of engine parts. In addition this line allows to find the position of TDC. TDC is the position where no pressure rising or falling can be found (except engines with early burning start).

Pressure Plot



In the graph above we have entered some important pressure values for you which you may read from the cylinder pressure curve.

A: Peak pressure
Depicts the maximum pressure value of the measurement curve, also known as ignition pressure.

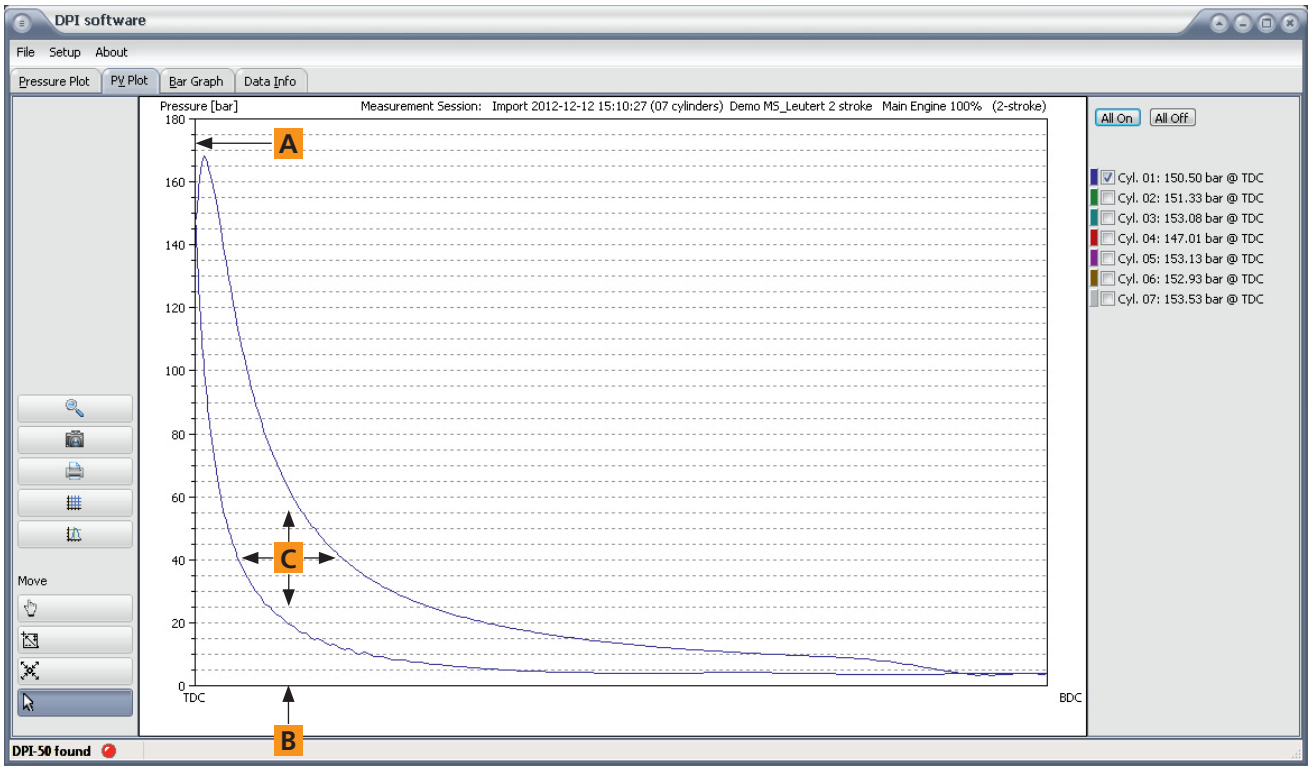
B: Compression pressure
Pressure at the upper dead center of the relevant cylinder measured.

C: Start of combustion

D: Differential pressure
Peak pressure minus the pressure value at beginning of combustion. When the value 0 is displayed, the beginning of combustion of the machine cannot be determined clearly.
This may also be the case with machines having a very early injection beginning or a combustion with a linear beginning.

E: Expansion pressure
Pressure value at a specific point of the expansion phase, i.e. 36 °CA (crankshaft angle) after the upper dead center.

PV plot



[PV plot] depicts the course of the cylinder pressure during a working cycle between the top dead center (TDC) and the bottom dead center (BDC).

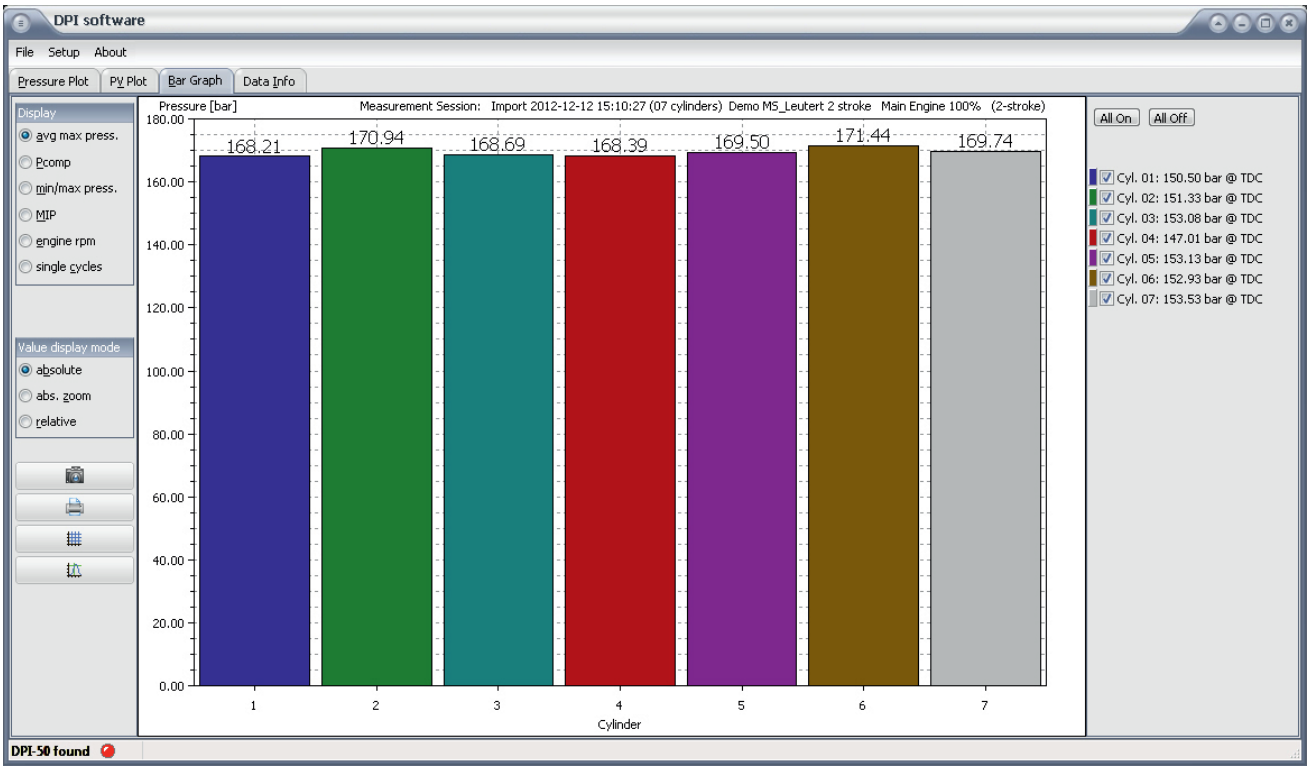
A: axis for pressure in bar

B: axis for changings of volume from BDC to TDC

C: the inner circle represents the “win of work”

The P/V diagram, known as banana curve, was applied in the past to measure the working area and calculate the indicated power by using a planimeter. This is not necessary by using electronic indicators. The calculation is done automatically.

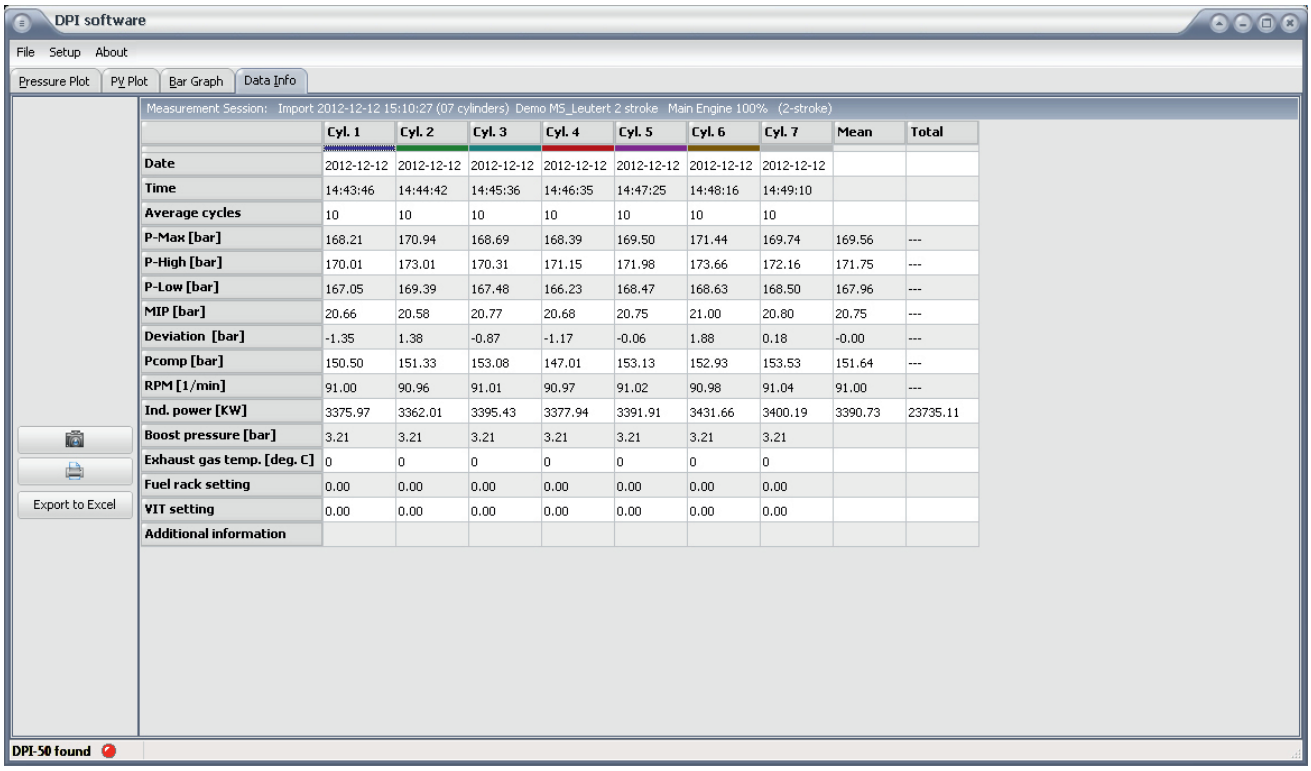
Bar Graph



[Bar Graph] indicates several selectable parameters as bar diagram. This picture allows you to compare the individual cylinders with each other at one glance.

The bar graphs above show an example dataset depicting the maximum firing pressure of all cylinders with automatic scaling. No need to use rulers. The main target is to have as less deviation in between the cylinders at the right pressure level according to engine manufacturer specification.

Data Info



	Cyl. 1	Cyl. 2	Cyl. 3	Cyl. 4	Cyl. 5	Cyl. 6	Cyl. 7	Mean	Total
Date	2012-12-12	2012-12-12	2012-12-12	2012-12-12	2012-12-12	2012-12-12	2012-12-12		
Time	14:43:46	14:44:42	14:45:36	14:46:35	14:47:25	14:48:16	14:49:10		
Average cycles	10	10	10	10	10	10	10		
P-Max [bar]	168.21	170.94	168.69	168.39	169.50	171.44	169.74	169.56	---
P-High [bar]	170.01	173.01	170.31	171.15	171.98	173.66	172.16	171.75	---
P-Low [bar]	167.05	169.39	167.48	166.23	168.47	168.63	168.50	167.96	---
MIP [bar]	20.66	20.58	20.77	20.68	20.75	21.00	20.80	20.75	---
Deviation [bar]	-1.35	1.38	-0.87	-1.17	-0.06	1.88	0.18	-0.00	---
Pcomp [bar]	150.50	151.33	153.08	147.01	153.13	152.93	153.53	151.64	---
RPM [1/min]	91.00	90.96	91.01	90.97	91.02	90.98	91.04	91.00	---
Ind. power [KW]	3375.97	3362.01	3395.43	3377.94	3391.91	3431.66	3400.19	3390.73	23735.11
Boost pressure [bar]	3.21	3.21	3.21	3.21	3.21	3.21	3.21		
Exhaust gas temp. [deg. C]	0	0	0	0	0	0	0		
Fuel rack setting	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
VIT setting	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Additional information									

[Data Info] displays all measuring data determined within one dataset.

This table shows the main parameters which are needed for engine diagnostic.

Cylinder: number of cylinder
Date: date of measurement
Time: time of measurement
Average cycles: number of measured cycles (average of all cycles)
P-Max [bar]: peak pressure
P-High [bar]: highest pressure of all measured cycles
P-Low [bar]: lowest pressure of all measured cycles
MIP [bar]: mean indicated pressure
Deviation [bar]: standard deviation in relation to the average of all peak pressures of a measurement series
Pcomp [bar]: compression pressure at TDC
RPM [1/min]: engine speed
Ind. power [kW]: actual power produced
Boost pressure [bar]: boost pressure (scavenging air pressure) of engine
Exhaust gas temp. [°]: exhaust gas temperature *)
Fuel rack setting: position of the fuel injection rack *)
VIT setting: variable injection timing *)

*) Additional information: These values are not measured but can easily be entered manually by the technician.