



messen prüfen automatisieren

Special Issue

Technology Report

Measurement in Fluid Power



Measurement in Fluid Power

Portable measuring equipment for machines needs to provide sufficient measurement equipment functions to reflect measurement precision and measurement dynamics of the measurement tasks and to portray the complexity of the measurement chains including the sensors in the measurement result. A new generation of portable data recorders is available for tasks of this type.

The requirements that apply for measuring equipment on one hand correlate with ongoing improvements in machine technology (providing for example a greater number of functions, shorter production cycles, and higher process precision) and on the other hand with higher expectations with regards to inspection, testing, fault-finding and documentation (such as documentation for final machine acceptance). Furthermore, measurements now need to include events and sizes that previously were of lesser importance or not sufficiently understood. Measuring equipment that is used in the design process, commissioning, maintenance, and service therefore need to provide a corresponding range of measurement options. In addition to a large range of functions, the main criteria for selecting the equipment include its flexibility (so it can be used for an extensive range of measurement tasks), and its user-friendliness. HYDAC ELECTRONIC have supplied powerful measurement equipment for measuring tasks in fluid power industry for more than 30 years and right now are setting a further milestone in the market for portable measuring equipment with two new data recorders.

There is no doubt that measuring equipment play a central role in the measurement task. Measurement tasks can only be carried out as needed if

the equipment has the appropriate range of functions and provide adequate interfaces. On the other hand, it is easy to forget that the quality of the measurement results is determined by the measurement chain as a whole, and that measuring equipment form only one part of this chain. Given that the quality of the measurement is only ever as good as the weakest link in the measurement chain, particular attention must be given to the quality of each of the sensors used, as their

measuring accuracy and dynamics are of significant influence. Prior to every measurement, it is mandatory to reconsider the measurement set-up and the equipment's settings in order to rule out systematic or random errors. When technicians in measurement technology say statements such as "never measure twice unless you wish to doubt which of both results is the correct one" or "who measures measures rubbish" then this serves as a reminder that these basic requirements



New generation of portable data recorders. All images: HYDAC ELECTRONIC

Measuring Devices- Overview



HMG 500

- 2 HSI analogue sensors (HSI SMART sensors read via CMWIN)
- Measurement and Display
- Display: LCD (b/w)
- Sampling rate 100 μ s
- Memory: Min- and max values of 2 connected sensors
- no trigger



HMG 2500

- 3 HSI analogue sensors or SMART sensors
- 1 Frequency input
- Measurement and Display, measured curves, event log
- Display: 3.5" colour display, full graphics display
- fastest sampling rate 100 μ s / 1 channel
- Memory: min. 100 curve-measurements with 500,000 measured values
- 2 triggers
- PC software HMGWIN / CMWIN



HMG 4000

- 8 measuring inputs for analogue sensors, HSI or the currently available standard sensors. Extendible by 28 further measuring inputs.
- 2 frequency input channels
- Up to 38 sensors can be recorded simultaneously
- Measurement and Display, measured curves, event log
- 5.7" touch screen display
- fastest sampling rate 100 μ s / with 10 channels at a time
- Memory: min. 500 measurements with 8 million measured values
- 6 triggers
- PC software HMGWIN / CMWIN

Portable data recorders for diverse measurement tasks. HMG 510, HMG 2500, HMG 4000

for a correct measurement are often not fully appreciated.

Complexity and selection of the measuring equipment

Suitable measuring equipment is mainly geared to the very measurement task. Machine development, process development, customer service, servicing, maintenance, repair, overhaul, inspection technology, and commissioning all involve a diverse

no manual settings required. An additional frequency input also is given which for example can be used to record drive speeds.

In the course of a measurement curve recording, a virtual “calculated” measurement channel can also be displayed, for example for power measurement. Two independent triggers allow the user to record measurement curves that are controlled by events and therefore highly specific. The measurement value memory can hold at least 100 individual curves with a



High-end portable data recorder, HMG 4000

range of measurement tasks – from straightforward inspection measurements through measurements needed for documentation to extensive fault-finding in complex machinery. HYDAC ELECTRONIC offer three different portable data recorders for all such jobs.

The measuring equipment HMG 510 is suitable for simple measurement tasks. Two HYDAC Sensor Interface HSI transmitters can be connected, for example to measure pressure and temperature. The transmitters are automatically recognised by the HMG 510 so no manual setting is required by the user.

The new portable data recorder HMG 2500 in addition to performance of normal measurement functions can record measurement curves and event logs (for long-term measurements). Up to three HSI transmitters can be connected, so this equipment also has automated measurement operation with

total of 50 million measurement values. An extensive range of useful tools, such as zoom, ruler and tracker (used for differential evaluations) allow curves to be analysed immediately and simply. Measurements are displayed on a 3.5” colour display will full graphics capability.

The high-end hand-held measuring unit HMG 4000 is the new “flagship” of the HYDAC portable data recorder fleet, setting a new milestone with regards to measurement options, measurement display and ease of use in the segment of hand-held data recorders for fluid power applications.

Latest operation technology for measuring equipment

The equipment displays measurement results on a high-resolution 5.7” touch screen colour graphics display. Like operating a smartphone, items

are selected by tapping on them and areas on the screen are enlarged or reduced by pinching or spreading with two fingers.

The HMG 4000 comes a long way towards meeting measurement technicians’ needs for maximum flexibility in their measuring equipment. One proof therefore is the number of sensors that can be connected. Up to 38 sensors at a time can be connected to the HMG 4000 and recorded. For the electrical connection a standard M12 connector is used. Eight connectors are provided to connect analogue transmitters. These can be HSI transmitters to which the HMG synchronises itself fully automatically. Alternatively, other transmitters or components can also be connected, with a signal range from -10 to +50 V or 0 to 20 mA. This includes the signals of standard transmitters, e.g. 0 to 10 V or 4 to 20 mA and also signal values for proportional valves from -10 to +10 V. For this purpose, the HMG 4000’s parameters are set accordingly by the user.

Two digital input channels with a measurement range from 0.01 to 30,000 Hz are provided for the measurement of frequencies, times, drive speeds, pulses or PWM duty cycles.

Integrated sensor recognition

A further connector is available to obtain data from sensors located in an existing CAN network on the machine side, such as J 1939 or CANopen. The measuring equipment provides a customised CAN parameter list for the identification of these sensors, in which the measurement technician places the data one-time. Alternatively, this input channel can also be used to stack sensors in connection with normal measurement tasks. In addition to the above-mentioned 8 analogue inputs, up to 28 signals from additional sensors can also be read in.

Various HCSI (HYDAC CAN Sensor Interface) sensors can be connected, that are all recognised and read out by the HMG 4000 fully automatically.

The equipment is fully ready for

measurement only seven seconds after being switched on and the measurement values of all connected sensors are shown to the user in a customisable display format. If requested, the respective minimum and maximum values and the progressive measurement can also be displayed.

In the tending graphs, the user gets initial qualitative information with regards to the dynamic response of the particular measured variable, for



CAN network on HMG

each input channel. Beyond this normal measurement function, the HMG 4000 offers a large number of additional measurement options and support functions.

The most demanding measurement mode certainly lies in the recording of measurement curves. The equipment can record individual curves, endless curves, event-controlled curves and event logs. For individual curves, one single measurement curve is recorded – which may be started manually and frequently is used in documentation-based measurement tasks.

In an endless recording, the curve continuously runs across the display window, like an oscilloscope display, and it can be stopped manually when needed. An event log is intended for recordings of measurement values over a longer period of time and that are recorded in tabular form.

The exact measurement of time-critical processes

Unlike the event log, event-controlled curves are ideal for measure-

ment tasks that are intended to highlight a short time period in which a particular event takes place. This equipment function is predominantly used for fault-finding or to find phenomena that were not originally expected, such as pressure peaks. The HMG 4000 user can utilise six individual triggers for this purpose, each of which can be linked with the others, enabling events to be defined with high precision. As there are ten input channels that can be recorded



Measurement value display with tending graphs measurement

simultaneously with a top sampling rate of 100 µs, nearly all time-critical processes in a machine or a system can be recorded. The internal data memory can record at least 500 individual measurement curves with a total of 4 billion measurement values. During recording of a curve, the individual signal curves can be scaled larger in each axis, measurement value and time, so that processes of interest can be observed in detail directly. Performance of such supporting functions is carried out with finger operation known from smart phones. Curves recorded completely can be analysed quickly and easily afterwards, too. Various analysis tools are available for this, such as a “tracker” that can be used to determine the time or measurement value differences.

The user can save all of the equipment settings made for a particular measurement set-up with an individual name, and at a later point in time open this device set-up again. For external data transfer two USB interfaces

are available. One is used to transfer data to a memory stick and the other is for bidirectional communication with a PC.

Software for evaluation and measurement report

The evaluation software HMGWIN, which is included in the scope of delivery for the two new portable data recorders, provides customised visu-



Simple curve analysis with touch screen functionality

alisation, survey, annotation and storage of the measurement curves. The HMGWIN software’s features also include the option of converting measurement values to other data formats or even the fully automatic compilation of measurement reports in PDF format.

As explained earlier, the highly versatile range of tasks in measurement technology results in highly varied requirements for measuring equipment. Users should therefore carefully consider which equipment can meet their particular requirements at best. Attention should be given to the measurement chain as a whole, in which above all the sensors play a particularly important role. HYDAC ELECTRONIC supply an extensive range of sensors, transmitters, and portable data recorders in a variety of performance levels.

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