Press-fit, Jointing and Clinching Monitor DIGIFORCE®

Series 9310

Application

DIGIFORCE® 9310 covers areas of application which, for financial reasons, have not allowed continuous force-displacement monitoring thus far. In the past, use has been made here of simpler systems which, for example, indicate the quality of joints purely on the basis of the maximum press-in force applied. Obviously, such methods can provide misleading results.

From manual workstations to fully automated production lines, the DIGIFORCE® 9310 is the ideal tool for monitoring force/displacement curves in press-insertion, joining, riveting and clinch processes. Thanks to the versatile window and envelope technology used to monitor the process, it is easy to keep an eye on critical factors such as operating mistakes, out-of-tolerance components, missing parts or even incomplete process operations. In addition to the main function of ultra-fast OK/NOK classification, the DIGIFORCE® 9310 also provides quality-relevant result values.

Even during the process, live signals enable an immediate response to unusual measurements so that countermeasures can be taken immediately, for instance retracting a press. The different housing designs as panel meter, desktop and snap rail versions of our DIGIFORCE® series enable the user trouble-free integration in almost every process environment. Decentralized single control systems or multi-channel monitoring lines such as those often required in simultaneously working press-fit stations, can now be realized even more economically using the new switch gear cabinet modules for example.

In addition to data backup and parameterization, the user-oriented PC software DigiControl permits archiving, displaying and recording of measuring curves and process data for single and multi-channel applications.

Especially economical press-fit and process monitoring
- For manual workstations and automated systems
- 8 measurement programs for 8 different parts
- For strain gauges, piezo, potentiometric sensors and process signals
- Network connection via Ethernet and/or Profibus
- Graphic display of press-fit curve

Curved evaluation using flexible window respectively envelope curve technology and tendency tracking
- Transparent operating concept even for inexperienced staff
- Control via parallel I/O ports or Profibus
- Multi-channel expandability
- Application convenient housing designs available, as front-panel meter, desktop and cabinet mounted version
- User-oriented PC data acquisition software DigiControl

Product Discontinuation from 1st Jan. 2019

Code: 9310 EN
Delivery: ex stock
Warranty: 24 months
Measurement Procedure
Following START of a measurement, the variables registered by the sensors are recorded as X-Y value pairs, displayed graphically and evaluated using a special window respectively envelope curve technology. Once the measurement curve has passed through the windows respectively through the envelope curve, like defined, the DIGIFORCE® 9310 shows a good sign (OK), else is shows a bad sign (NOK).

Test Criteria and Window Types
DIGIFORCE® 9310 possesses 3 different window types allowing an universal assessment of various curve shapes by using a special window technology. Each measurement curve can be assigned a combination of 3 windows and one envelope curve mixed.

Threading window (1)
It checks whether the fastened parts have been threaded properly and have not jammed. A real-time signal indicates this event and can be used, for example, to activate the upward stroke of the press.

Pass-through window (2)
This type of window checks the characteristics of the curve within the range of the window. The curve has to pass through the defined entrance and exit sides of the window without violating any of the other window boundaries. The entrance and exit sides can be specified (left, right, up, down, any side.)

Block window (3)
The block window monitors the block dimension and the block force of a press-fit operation, for example. For this type of window, the curve must enter the pre-determined side of entrance and must not exit the window. The entrance side can be specified (left, right, up, down, any side).

Envelope curve (4)
The measuring curve must stay within the envelope curve band (OK) and shall not violate it (NOK). The envelope curve band is taught-in and can be changed manually within its limits. A dynamic follow-up of the whole envelope curve band can be activated.

Process Information
Users can scroll through the following diagnosis pages while a measurement is in progress:
► Graphic diagram of the last measurement curve (M1)
► Evaluation result shown as OK / NOK for each window
► NOK representation for each window in form of a bar chart (M3)
► Evaluation result displayed as a large „smiley“ or text message for manual workstations (M4)
► Minimum / maximum values of complete measurement curves
► Entrance and exit values (X/Y) for each window (M6)

Process information are available via:

<table>
<thead>
<tr>
<th>Display</th>
<th>parallele IO’s</th>
<th>RS232, Ethernet</th>
<th>Profibus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Press-fit curve</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Result in total (OK/NOK)</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Results per window</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>NOK percentage</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Window entrances and exits</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Min and max values of curve</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Quantity counter</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Limit exceeded</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Threading error</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Current MP-No.</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Measurement in progress</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

- Graphic display of the last measurement curve (window technology and envelope are combined here)
- NOK representation for each window in form of a bar chart
- Classification result shown as a large PASS/FAIL display or SMILEY for international operating staff
- Entrance and exit values each window separate
Measurement Functions

DIGIFORCE® supplies 3 measurement functions for a variety of applications:

\[ y = f(x) \]

A measurement variable Y (force) is recorded as a function of a measurement variable X (distance) and evaluated. A selectable X-grid determines how the X-Y value pairs are scanned. Advantage: Scanning is only performed on changes in X.

\[ y = f(x,t) \]

A measurement variable Y is recorded as a function of a measurement variable X and evaluated. A selectable time grid t determines how the X-Y value pairs are scanned. Advantage: Even steep force slopes accompanied by practically no changes in distance (for instance, on the block dimension) are registered.

\[ y = f(t) \]

A measurement variable on channel Y is recorded as a function of the time t. Advantage: This eliminates the need for the X sensor (for instance, the displacement sensor on a press). A prerequisite for this is reproducible feed speeds, otherwise the curve would be compressed or expanded accordingly.

Measurement Programs

A total of 8 measurement programs for 8 various components can be activated. A measurement program consists of a component-specific parameter set.

![Measurement Programs Diagram]

Switch over via parallel I/O, Profibus, menu, Ethernet or RS232.

Real-time Monitoring of Limits

A total of 2 limits can be freely assigned to channels X and Y and monitored in almost real-time. A switching signal (S1, S2) is allocated to each limit.

Reference Point (X) for the Evaluation Windows

Reference

TRIGGER: This is used if the merging range is precisely defined. Once the press die has attained the component to be injected (trigger limit), the displacement channel of the press is set to zero. The displacement coordinates of the evaluation windows now refer to this (trigger) zero point.

Reference

FINAL FORCE: The X coordinates of the windows refer retroactively to the dimension or distance of the final press force (dynamic evaluation window).

Calibration of Measurement Channels

The sensor parameter are preset via menu or PC software (selection and adjustment of sensor type, gain and feed voltage). No hardware settings are required here. There are no jumpers or controls! Two calibration methods are available:

1. Teach-in mode
2. Sensor protocol method

Sensor Check

The feed unit moves to a reproducible position, for example, the upper press limit. With the teach-in mode, the values measured during this process are assimilated and assigned tolerance limits. Sensor tests are then initiated by corresponding signals at particular intervals precisely at this position. If a sensor lies outside the tolerance limits, DIGIFORCE® sends a warning signal to the PLC. This largely precludes measurement errors resulting from sensor defects and drifts.

PLC Communication (general)

From DIGIFORCE® to PLC

▶ Evaluation results OK / NOK and threading errors
▶ Measurement active, READY, sensor test result, trend limit
▶ Acknowledgement of measurement program selection
▶ 2 switch signals for force and displacement threshold (real-time)

From PLC to DIGIFORCE®

▶ Measurement program selection (3 binary-coded lines), transfer signal (STROBE)
▶ START, TARA, RESET, sensor test, AUTO

Profibus DPV 0 (option)

Baud rate max: 12 MBaud

Cyclical services for ▶ control function
▶ checking of measuring results

In all cyclical modes there are always 2 bytes being transferred from the master to the slave. These control the instrument completely via Profibus. The signification of these 2 bytes is the same in all modes. The information being transferred from the slave to the master in opposite direction, contain measuring results and status information. Following measuring results are provided:

▶ Entrance/exit values for each window (X/Y)
▶ Min/max values of the whole curve (X/Y)
▶ First and last curve value (X/Y)

Real-time Signals for fast Response

S1 and S2

Thresholds 1 and 2 attained on channel X or Y. Freely selectable threshold and channel. (Reaction time 10 ms)

NOK ONLINE

Threading error. ONLINE signal. (Reaction time 10 ms)
Cabinet Module

General
The new cabinet module provides the same functions as the standard front panel model. This module includes all the standard performance features, but is not fitted with a display and input keys. The module can be fully configured and parameterized using the DigiControl PC software. Status information including evaluation results, instrument status (READY, measurement in progress), errors, power supply and others is provided by a set of monitoring LEDs on the front panel. Two rotary switches, also mounted on the front panel, can be used for quick configuration of the Profibus address.

Auxiliary supply
The 24 V DC power excitation for the module is connected via screw terminals. This voltage can normally be supplied directly from the cabinet. In addition to the other sensor excitations available as standard, sensor transmitters can also be supplied directly with 24 V DC from the module.

Panel mounting
The DIGIFORCE® 9310 with display is designed as a combined desktop/panel-mounted enclosure. Using the optional 9310-Z001 accessory kit (see Accessories), the unit can be fitted easily in a panel cutout, for instance in a control cabinet, to provide IP65 degree of protection on the controller front panel.

Connection technology
Where screw terminals are required for connecting sensors or PLC I/O ports, the appropriate adapter can be supplied on request (see accessories). This means you have a choice of connection technology for the PLC or sensor: either via the built-in 9 pin min sub-D connector or via screw-terminals using the adapter.

Multichannel application
On aluminium hoods for cars in the upper price range, clinch technology as an economic assembly process is employed in addition to the punch riveting technology used at crash stress points. Each individual point must be monitored with regard to its force/displacement curve and tool wear, and archived as both an individual result and a group result.

Using the DigiControl PC software, measurement data can be transferred to a central computer via an Ethernet connection.

Visualization and documentation of process data via DigiControl PC software
PC software

DIGIFORCE® and PC software DigiControl - a high-performance package

DIGIFORCE® is a fully autonomous test controller that displays status information and evaluation results in most applications, which can also be transmitted to a controller. The high-performance software package DigiControl has additional functions to further increase process availability and reliability.

Even the basic version supports full device configuration, creation of backups, reading and displaying measurement curves including all evaluation results and statistics storage. An especially convenient feature is the definition of envelopes or evaluation window limits and conditions based on a set of curves of measured master or reference parts.

In addition to the basic functions, the Plus version of the PC software DigiControl provides an automatic production mode, which logs production measurement data with clear parts reference for example. The resulting measurement logs are not only available in the internal program format, but can also be imported into EXCEL data. In addition to the DIGIFORCE® device interface, it also supports an additional control interface for more complex tasks. Thus device configurations can be reloaded or component designations can be transferred for measurement data logging for example.

1 The "measurement mode" shows the curve and status information of the most recent measurement. This can be displayed for multiple channels as well. The corresponding log is automatically saved in the background.

2 Clearly structured configuration dialogs enable convenient device setup. Modification can be made either at file level or directly with DIGIFORCE® in a step-by-step manner.

3 A protocol browser enables the filtered selection and display of saved measurement protocols. This can be used for very convenient analysis of process related spreads or the causes of NOK evaluations. A protocol printout with component information, curve and all evaluation results can be generated or each individual measurement protocol.

4 Live statistics in measurement mode inform of the current process status. In the example, an increased NOK assessment of the third joining station in a multi-channel application is detectable.
Technical Data

Sample rate: max. 10,000 value pairs/sec.
Digitalization: 12 bit (11 bit + sign)
Storage depth: 4,000 value pairs per curve
Evaluation time: typ. 90 ms
Input impedance (standard channels X, Y): 100 MΩ@DC
Power excitation:
- desktop, panel version: 100 V...240 V, 50-60 Hz/10 VA
- cabinet version: 20 V DC...30 V DC/15...25 VA
Operation temperature range: +5...+23...+40 °C
Storage temperature range: 0...+60 °C

Sensors for Y-channel

Strain gauges
Characteristics: ± 0.5 ... ± 40 mV/V
Bridge resistance: 350 Ω...5 kΩ
Excitation voltage: 2.5 V and 5 V
Max. excitation current: 20 mA
Connection technology: 4 wire (2 power lines, 2 sense lines)
Cut-off frequency: 5 ...5 000 Hz, in steps
Total error: < 0.5 % F.S.

Piezo (Option)
Measurement ranges: 1 ... 400 nC, in steps
Cut-off frequency: 5 ... 5 000 Hz, in steps
Total error: < 1 % F.S.
This option replaces the interface for strain gauge and process signals!

Process signals
Input ranges: ± 5 V
Total error: < 0.4 % F.S.

Sensors for X-channel

Potentiometer, DC/DC and process signals
Input voltage ranges: ±5 V and ±10 V
Excitation voltage (for potentiometer): 5 V
Excitation current: max. 8 mA
Cut-off frequency: 5 ...5 000 Hz, in steps
Total error: < 0.4 % F.S.

Transmitter excitation for X and Y channel
(only for cabinet version):
20 ... 30 V DC / 150 mA

Field bus interface

I/O Interface
Parallel PLC port according to EN 61131-2, open-E, p-switching,
24 V DC, -15 % / +20 %, opto-isolated, output current Imax 80 mA
connector, 25 pin Submin D socket
Profibus DPV 0 (Option)
Max. baud rate: 12 MBaud
Cyclical services for control functions, checking measurement results

Communication

RS232
Via front-panel jack for an easy device configuration, back-up and calibration from a laptop.
(See software order code 9310-P101/P100 incl. cable 9900-K343)

Ethernet 10 base T/100 base TX
Western jack (RJ 45) for complete device setting, Data backup (upload/download), Retrieval of curve data and results

Housing

Combined desktop/panel/cabinet version: 111x111x183 mm [WxHxD]
Front-panel cut-off: 112 x 112 [mm] (-0.5 mm tolerance)
Front-panel: 119 x 119 [mm]
Desktop with 4 rubber feet (delivery configuration)
Panel for front-panel mounting (delivery configuration)
rubber feet are replaced by the mounting rack
(order code 9310-2001), device is inserted through the front-panel cut-off (112x112 mm) and is fixed by screws.
Cabinet for snap-rail mounting, snap rail acc. to DIN EN 50022
Protection class IP30
for desktop and cabinet version (housing) on front-panel
(display version, if mounted in control panel)
Weight: approx. 1.5 kg

Accessories

- Mounting rack for front-panel mounting
  (only for display version) Model 9310-Z001
- Connection outlines for mounting several DIGIFORCE® 9310 (2 outlines, 4 screws)
  (only for display version) Model 9310-Z002

PC software
PC software DigiControl 9310 for convenient instrument configuration including backup function (upload/download) and laboratory mode for manual reading and analysis of measurement curves.
Supplied with the instrument and available free of charge from www.burster.de.
PC software DigiControl 9310 including RS232 data cable 9900-K343 Model 9310-P101
PC software DigiControl PLUS version; same as 9310-P101 plus high-speed, in-process logging of measurement data, data-log wizard and Excel data export; includes RS232 data cable Model 9310-P100

Cable and connection
Connection cable for burster displacement sensors 9310, 9312, 9318, 9319, length 3 m Model 99200-9900-009030
RS232 data cable for front panel port, length 2 m Model 9900-K343
Bridging cable for routing the displacement sensor signal from DIGIFORCE® 9310 to a following device, length 0.5 m Model 9900-K340
Connector for X- or Y-channel, 9 pin Min D* (2 units are included in scope of delivery) Model 9900-V209
Adapting connector for X- or Y-channel, 9 pin Min D*, to screw terminal, max. connection cross section 1 mm², cable diameter 5-8 mm Model 9900-V211

Order Code

DIGIFORCE® Series 9310 - V

| Standard | display version | 0 | 0 | 0 | 1 |
| Standard | cabinet version | 2 | 0 | 0 | 1 |

Option
Piezo interface 1

Profibus DP-V0

The CAD drawing (3D/2D) for this device can be imported online directly into your CAD system.
For further information about the burster traceparts cooperation refer to data sheet 80-CAD-EN.