

Press-Fit-, Jointing and Clinching Monitor DIGIFORCE®

Series 9310

Code:	9310-E
Manufacturer:	burster
Delivery:	ex stock
Warranty:	24 months

PROFI
PROCESS FIELD BUS
BUS



NEW with Ethernet interface
and clinch point control

- Especially economical press-fit and process monitoring
- For manual workstations and automated multi-channel system
- 8 measurement programs for 8 different parts
- For strain gauges, Piezo, potentiometric sensors and process signals
- Network connection via RS485, Ethernet or Profibus (option)
- Graphic display of press-fit curves
- Curve evaluation using flexible window respectively envelope curve technology and tendency tracking
- Transparent operating concept even for inexperienced staff
- Control via parallel IO port or Profibus
- Multi-channel expandability, PC data acquisition software, cluster formation
- Clinch point control with acquisition and evaluation of remaining plate thickness (option)
- Application convenient housing designs available, as front panel meter, desktop and black box version
- Auxiliary energy 100 V ... 240 V, black box module 24 VDC

Application

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

A very important field in the advancing clinch technology is the jointing of two mating parts without additional fasteners. A newly developed clinch point control function of DIGIFORCE® provides besides the classical process value evaluation also quality relevant parameters as e.g. systematic tool break-ages, remaining plate or pack thickness recognition, thus enabling the derivation of counter measures.

The different housing designs as e.g. the front panel meter, the desktop version and now the newly developed snap rail variant for our DIGIFORCE® series enable the user a smooth and trouble-free integration in almost every process surrounding.

Decentralized single control systems or multi-channel monitoring lines, like those often required in practice for simultaneously working press-fit monitoring stations, can now for example be realized even more economically with the new black box modules.

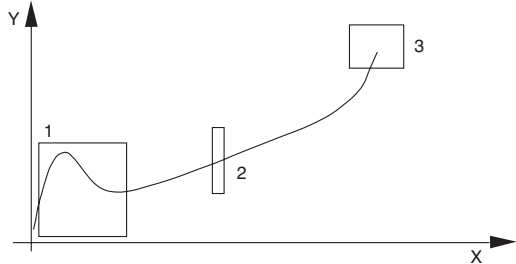
The user-oriented PC software DigiControl permits besides data back-up and parameterization also the filing, display and recording of measuring curves and process data for single and multi-channel applications.

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 envelope curve (see diagram at the upper right). 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.

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 of any type or 2 windows and one envelope curve mixed.



Window set: a maximum of 3 windows can be set.

Threading Window (1)

This type of window is specially designed for pressing and fastening routines. 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 entry and exit sides of the window without violating any of the other window boundaries. The entry 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 pressing operation, for example. For this type of window, the curve must enter the pre-determined side of entry and must not exit the window. The entry side can be specified (left, right, up, down, any side).

Envelope Curve (see diagram at the upper right)

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

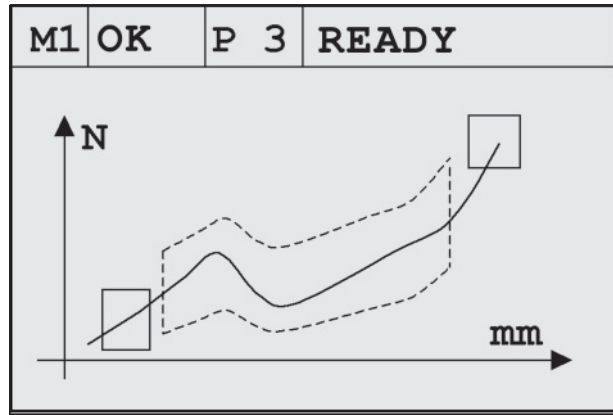
Users can scroll through the following diagnosis pages while a measurement is in progress:

- Graphic display of the last measurement curve (M1).
- Evaluation result comprising OK / NOK for every window (not represented on the data sheet).
- NOK representation for each window in the 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 (M5).
- Entry and exit values (X/Y) for each window (M6)

Process Information are available via:

	Display	parallel IOs	RS232, 485	Profibus
Press-in curve	•		•	
Result in total (OK/NOK)	•	•	•	•
Result per window	•		•	
NOK percentage	•		•	
Window entries and exits	•		•	•
Min-/max values of curve	•		•	•
Quantity counter	•		•	
Setpoint exceeded		•		•
Threading error	•		•	•
Current MP-No.	•		•	•
Measurement active	•	•	•	•

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.

M3	OK	P 1	READY
PC	126		4 NOK
W1	■		5 %
W2	■		27 %
W3			
EN	■		46%

Evaluation result displayed as a large smiley for international operators.

M4	OK	P 2	STATUS
PC	14		4 NOK

Entry and exit values each window separate.

M6	OK	P 1	READY
		X [mm]	Y [N]
W1	ENT	2.131	4.245
W1	EXI	3.140	5.151
W2	ENT	8.916	7.631
W2	BLO	9.281	8.381
W3	ENT		
W3	EXI		

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.

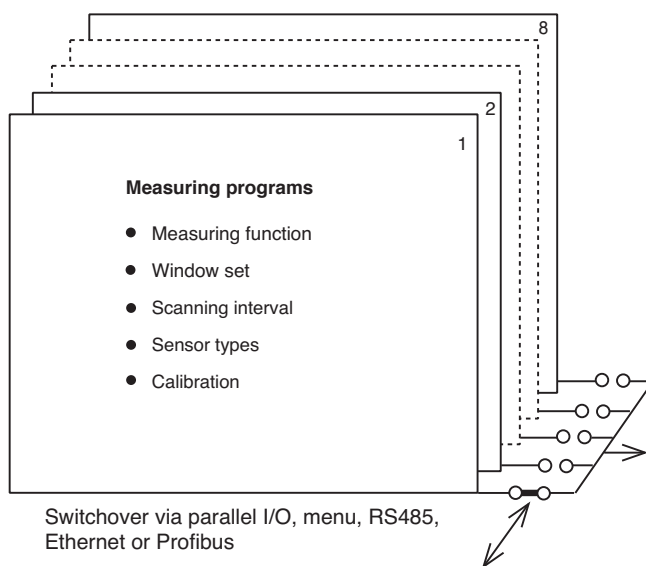
$y = f(t)$

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 distance 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.



Real-time monitoring of threshold values

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

Reference point (X) for the evaluation windows

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

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

BLOCK WINDOW reference: This is selected if the block dimension - for instance, the depth of the bore into which a bearing is pressed - is precisely reproducible. Here, the evaluation windows refer retroactively to the distance (x) on Ymin exceeding the block window side (dynamic evaluation window).

ABSOLUTE reference: This is used if components can be positioned repeatedly and precisely on the absolute distance zero-point of the press. Here, the evaluation windows refer to the absolute (calibrated) distance zero-point of the press.

Calibration of the measurement channels

The sensor interfaces are preset via menu (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 method, 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:

- Entry/exit values for each window (X/Y)
- Min/max values of the whole curve (X/Y)
- First and last curve value (X/Y)
- Current value for the remaining plate and plate pack thickness

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 Merging error. ONLINE signal. (Reaction time 10 ms)

Cabinet-mounted / Black box module

General information

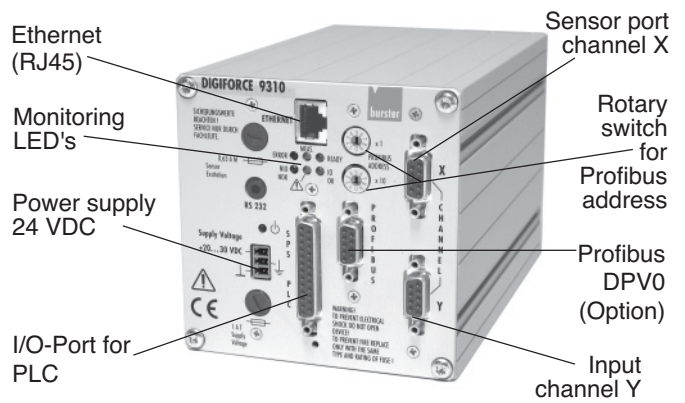
The new cabinet module designed for snap-fit rail-mounting provides the same functions as the standard front panel model, and also includes all features except the RS485 facility. The module can be fully configured and parameterized using the DigiControl PC software. Status information including evaluation results, instrument status (READY, measurement in progress), errors and power supply 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.

Connection options

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.



DIGIFORCE® 9310 (Black box module)



Auxiliary supply

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

DigiControl PC software

General information

Every instrument in the DIGIFORCE® 9310 series includes an RS232 interface. Depending on the version chosen, the DIGIFORCE® contains either an RS485 interface (front panel model, Ethernet optional) or an Ethernet interface (as standard in cabinet modules). Networking together almost any number of modules via Ethernet within an existing intranet makes the Ethernet interface perfect for measurement use.

DigiControl configuration software (type 9310-P101)

The software can be used for easy and convenient configuration of all device parameters via the available interfaces (software included free with cabinet module for one instrument). Back-up function allows back-up of measurement program settings. In single-measurement mode, the measurement curves recorded during test mode (machine setup phase) can be retrieved and saved manually.

DigiControl-Plus data acquisition software (type 9310-P100)

The full version of DigiControl (order code 9310-P100) contains important additional functions such as recording, visualizing and archiving measurement curves in production mode. It also includes facilities for logging single-measurement results or multi-channel applications and statistical processing of process-relevant variables. You can find detailed information in PDF format at www.burster.com under product area 9310, or ask for our short brochure.

Annotations on the screenshot:

- Clear display showing process curve including selected analysis tools and process results** (pointing to a line graph with shaded error bands).
- Report generation and archival of single or group reports containing quality-relevant user data** (pointing to a report preview window).
- Application-oriented calibration menu enables convenient instrument parameterization** (pointing to a calibration configuration dialog).
- Statistic distribution of OK/NOK evaluation results from multiple single channel in a multi-channel system** (pointing to a bar chart showing distribution).

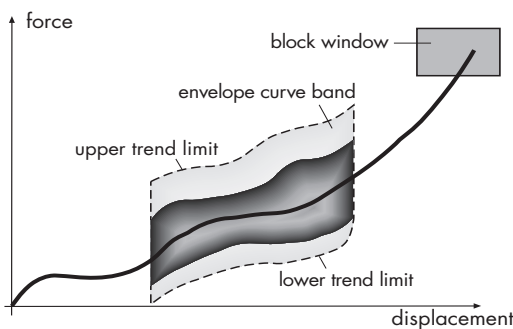
Clinch point monitoring option

General information

The clinch point monitoring option combines proven analysis tools such as window and envelope techniques with new and innovative analysis methods designed specifically for clinch technology. With the facility to detect and evaluate remaining core thickness and plate pack thickness, which are important measures of quality alongside other process- and tool-dependent parameters, extra information can be gathered on the quality of a clinch point joint. Enabling „intelligent trend tracking“ of the envelope provides a new angle for looking at assembly-tool wear.

Trend tracking

The envelope band can track the gradual drift of a clinch curve. This facility is required, for instance, when an assembly tool experiences gradual wear, but this wear does not have a significant impact on quality. An error message is only produced once a user-definable trend limit is reached. The weighting parameter is used to control the degree of envelope tracking.



Remaining plate thickness (RBD)

The RBD function checks and evaluates the base thickness, for example, of two plates to be joined during the clinch process without additional tools. User-definable warning limits and MIN/MAX switching points mean that process-oriented action can be taken in good time, for instance by the clinch-jaw controller. The RBD and BPD values are found using a measurement threshold that can be edited extremely easily graphically.

Plate pack thickness (BPD)

When the BPD function is enabled, the current plate thickness of two joining partners is measured, and evaluated if required. Differences caused by deep drawing, rolling or coating processes, for example, can be identified and evaluated.

Clinch application

On aluminum 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. A number of clinch points are made on both sides. Each individual point must be monitored with regard to its force/displacement curve, tool wear and remaining plate thickness, and archived as both an individual result and a group result. Measurements are transferred to a master computer via a network-compatible Ethernet connection and a switch.

Process data

In addition to the diagnostic screens described on page 2, the user can also retrieve the following data in measurement mode:

- Measurements for RBD/BPD including evaluation result (M7)
- Evaluation results for all enabled evaluation tools (M8)

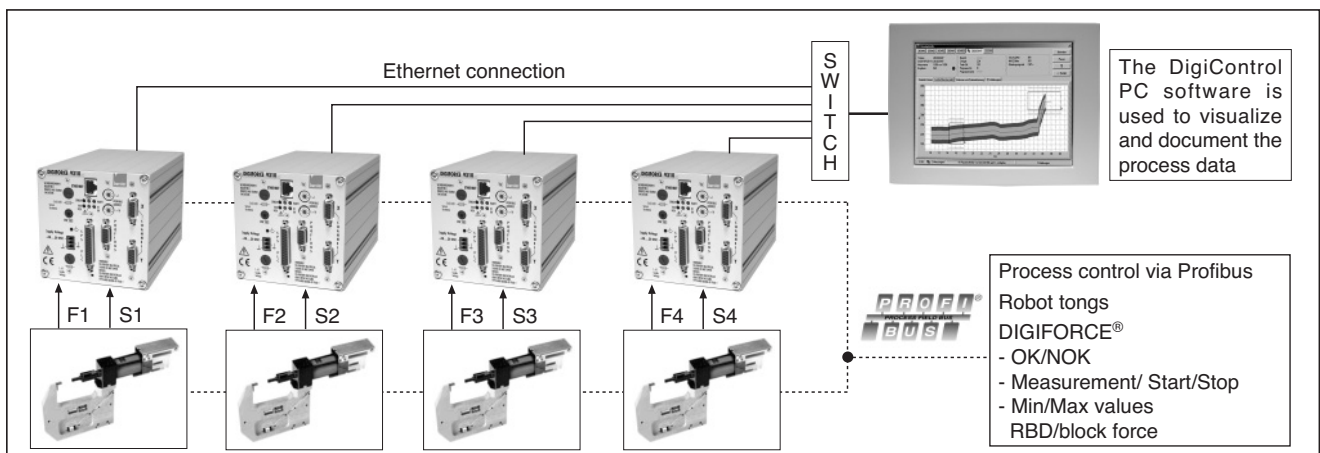
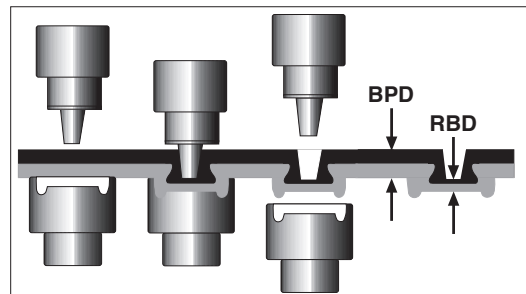
Measurement display for RBD & BPD including evaluation result

M7	OK	P 3	READY
PC	126		30 NOK
RBD		0.53 mm	OK
BPD		1.24 mm	OK

Diagnosis with all activated evaluation tools

M8	OK	P 3	READY
PC	112		30 NOK
RBD	0.53mm		NOK
BPD	1.24mm		OK
ENVELOPE			OK
TREND			NOK
W2	B		OK
W3	O		OK

The remaining plate thickness (RBD) and plate pack thickness (BPD) are measured and evaluated.



Technical specifications

Sample rate:	approx. 10.000 value pairs / s
Digitization:	12-bit (11 bits + sign)
Storage depth:	4.000 value pairs per curve
Evaluation time:	≤ 90 ms
Power supply:	
Desktop, panel version	100 V _{rms} ... 240 V _{rms} 50-60 Hz / 10 VA
Cabinet-mount, black box module	20 VDC ... 30 VDC / 15 - 25 VA
Operating temperature range:	+5 ... +23 ... +40 °C
Storage temperature range:	-10 ... +60 °C

Sensors for the Y channel

Strain gauge

Sensitivity:	± 0.5 ... ± 40 mV/V
Bridge resistance:	350 Ω ... 5 kOhm
Excitation voltage:	2.5 V and 5 V
Excitation current:	max. 20 mA
Excitation type:	4 wire (2 energy lines, 2 sense lines)
Cut-off frequency:	5 ... 5 000 Hz, stepped
Accuracy:	0.5 % F.S.

Piezo (Option)

Measuring range:	1 ... 400 nC, stepped
Limit frequency:	5 ... 5 000 Hz, stepped
Accuracy:	< 1 % F.S.

This option replaces the interface for strain gauge and process signals.

Process signals

Input range:	± 5 V
Accuracy:	0.4 % F.S.

Sensors for the X channel

Potentiometer, DC/DC and process signals

Input ranges:	±5 V and ±10 V
Excitation voltage (for potentiometers):	5 V
Excitation current:	max. 8 mA
Cut-off frequency:	5 ... 5.000 Hz stepped
Accuracy:	0.4 % F.S.

Transmitter supply for X- and Y- channel

(only for cabinet-mount version): 20 ... 30 VDC / 150 mA

Communication

I/O interface

Parallel PLC port in compliance with EN 61131-2
Sourcing logic 24 V DC, -15 % / +20 %, opto-isolated
Maximum output capacity of 80 mA, 25-pole submin-D connector

RS232

Accessible via a front-panel jack for easy device configuration; backup and calibration from a Notebook (PC software order number 9310-P101, incl. data cable 9900-K343).

Ethernet 10 base T / 100 base TX

(Standard for cabinet-mounted modules)

Western jack (RJ 45) for	<ul style="list-style-type: none"> ● complete device setting ● checking of measurement results ● control functions
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RS485 (only for front panel meter version)

Two rear-panel western jacks (RJ 45) to network several devices for	<ul style="list-style-type: none"> ● complete device setting ● checking of measurement results ● control functions
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Profibus DPV 0 (option)

Baud rate max:	12 Mbaud
Cyclical services for	<ul style="list-style-type: none"> ● control function ● checking of measurement results

Housing

Combined desktop / panel version / cabinet-mount / black box module	111 x 111 x 180 mm (W x H x D)
Front panel cutout:	112 x 112 mm (- 0.5 mm tolerance)
Front panel:	119 x 119 mm
Weight:	approx. 1.5 kg
Desktop version	with 4 rubber feet (delivery configuration)

Panel meter for front panel assembly. The rubber feet are removed and replaced by a fixture (order number 9310-Z001); the device is inserted through the front panel cut-out (112x112 mm) and screwed into place.

Cabinet-mount version: for snap-rail mounting, delivery without rubber feet, mounting rail according to DIN EN 50022

Protection class: IP 20 for desktop and cabinet-mount version (housing)
IP 65 for front panel installation possible (display version on assembly in control panel)

Accessories

Fixture set for front panel assembly, (only for display version) **model 9310-Z001**

Connecting outlines for the alignment of several DIGIFORCE® 9310 (2 outlines, 4 screws) (only for display version) **model 9310-Z002**

PC software for easy device setting, including a backup function and data cable (on purchase of cabinet-mount version the software is included free for one instrument) **model 9310-P101**

PC software like the 9310-P101 but additionally with functions for recording of curves and numeric results **model 9310-P100**

Connecting cable for burster displacement sensors model 8710, 8712, 8718, 8719, length 3 meters **model 99209-591A-0090030**

Bridging cable for routing the displacement sensor signal from a DIGIFORCE® 9310 to a downstream device, length 0.3 meters **model 9900-K340**

Connecting plug for the X- or Y- channel, 9-pole, min-D.* (2 units included in scope of delivery) **model 9900-V209**

Adapter plug for X- or Y-channel, 9-pole MIN-D*, on screw terminal, connection cross section max. 1 mm² cable diameter 5 - 8 mm **model 9900-V211**

Connecting plug for the connection to the PLC, 25-pole min-D. (1 unit included in scope of delivery) **model 9900-V160**

Adapter plug for the connection to the PLC, 25-pole Min-D, on screw terminal, connection cross section max. 1 mm², cable diameter 4 - 10 mm **model 9900-V162**

Profibus connection plug, 9-pole Min-D, 12 Mbaud, connecting resistance with separating function **model 9900-V181**

Converter RS232 to RS485 including 1 patch cable (length 3 meters) for connection to RJ 45 jack **model 9900-K451**

USB / RS232 converter set **model 9900-K350**

Switch for the connection of several modules to a PC Ethernet interface (mounting rail assembly) including patch cable for networking **upon request**

Patch cable for networking several 9310 instruments via Ethernet or RS485 interface length 0.5 meters (other lengths upon request) **model 99450-450A-4500005**

* not valid for Piezo version

Order Code

DIGIFORCE® Series 9310 - V

Standard display version 0 0 0 0

Standard cabinet-mount module (with Ethernet) 2 0 0 0

Option Piezo interface 1

Clinch point control 1

Ethernet (for display version) 1

Profibus DPV 0 2

Ethernet + Profibus DPV 0 (for display version) 3