

Welding Force Calibration Transmitter Type 9831C...

System for Measuring the Electrode Force in Spot Welding

Measuring system for testing and calibrating the electrode force in spot welding machines (resistance welding).

Quartz Force Sensor

- Minimum electrode distance of only 3,0 mm
- Interchangeable inserts to fit different electrode shapes
- Highest safety standard due to flexibly mounted sensor unit
- Selectable, calibrated measuring ranges: 5 kN, 10 kN or 45 kN
- High repetition accuracy because the centering of the electrodes improves the transmission of force

Measuring System

- The welding process can be improved by means of an optimum electrode force-time curve in combination with the welding current switching signal.
- The force sensor can be combined with Welding & Fastening Monitor Type 5825A2 (mobile hand-held unit)
- Documentation facility via interface RS-232C
- Rugged and overload-proof design of components

Description

The system consists of a quartz force sensor, which can be connected to various evaluation units. The electronic system plots the force-time curve in combination with the welding current switching signal.

The ground-isolated sensor design prevents the flow of welding current during the measuring process. The charge amplifier electronics integrated in the sensor provides a calibrated output signal proportional to the force.

Applications

- Monitoring of welding robots in production lines (e.g. in the automotive production lines)
- Maintenance of welding units
- Setup of welding units for new workpieces
- Calibration of spot welding guns
- Optimization of cycle times and welding cycles
- Calibrated test device according to ISO 9001 quality management



Fig. 1: Welding force calibration transmitter Type 9831C111



Fig. 2: Complete mobile measuring system with welding force calibration transmitter Type 9831C111 and measuring set in case Type 9831C0001

Technical Data

Welding Force Sensor	Type	9831C1...	9831C2...	9831C3...
Measuring range	kN	5	10	45
Overload	kN	6	12	50
Calibrated range	kN	5	10	45
Response threshold	N	≤0,01		
Sensitivity via charge amplifier	V/kN	1	0,5	0,1
Linearity	±% FSO	≤1	≤1	≤2
Welding cap standard (Reference)		ISO5821		
Electrode distance during the measurement (depending on electrode shape and welding insert type)	mm	≥3,0		
Operating temperature range	°C	0 ... 60		
Sensor connector		8-pole, DIN 45326		
Degree of protection at the sensor (cable connected)		IP65 (EN60529)		
Weight (without cables)	kg	1,4		
Compliance with EU directives				
Safety		EN60950		
EMC interference emission		EN61000-6-3		
Interference immunity		EN61000-6-2		

Charge Amplifier

Output voltage	VDC	±5	±5	±4,5
Output voltage offset	mV	≤±10		
Output current	mA	±2		
Output impedance (Output PIN 4)	Ω	100		
Drift (25 °C)	mN/s	<±20	<±10	≤±2,222
Reset/Operate transition	mV	<±0,7	<±0,35	≤±0,0777
Supply voltage	VDC	10 ... 30		
Supply current	mA	≈10		

Operate Signal

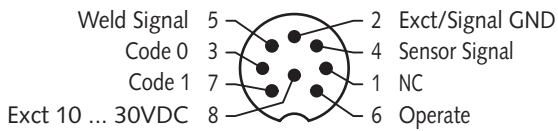
Operate				
Operate input on GND or	V	0 ... 0,8		
Reset	mA	<0,1		
Operate input open or	V	>2		
Operate/Reset time until signal Signal <0,5 % FS at max. Load (FS)	ms	<20	<40	<180

Welding Current Switching Signal

Weld Signal	VDC	5,5 ±10 %		
Output signal	Ω	2 700		
Max. permissible voltage between sensor underside and top side (supply voltage)	VDC	9		
	V _{eff}	10		
Switching threshold	VDC	3		
	V _{eff}	4		
Signal delay	ms	0,2		

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Pin Allocation



Code 0, Code 1= Automatic measuring range detection at Welding & Fastening Monitor Type 5825A2 (see data sheet 5825A_000-448)

NC = Not connected

Dimensions

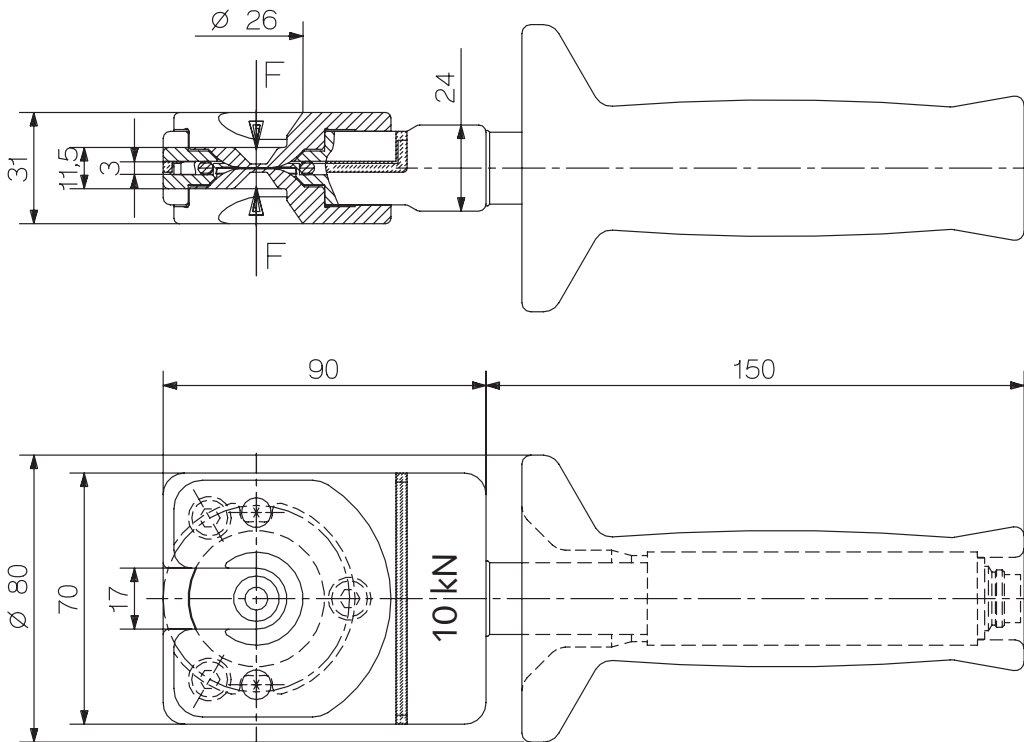


Fig. 3: Welding force sensor Type 9831C... with charge amplifier included and plastic handgrip (removable)

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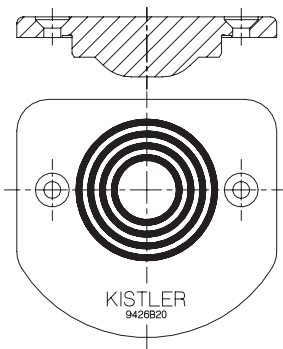
Electrode Inserts

The welding force sensor is equipped with 2 electrode inserts, which must be specified in the order, and is calibrated to these prior to delivery.

The design of the welding force sensor makes it very easy to change the electrode inserts. When inserts of the same type are replaced, measuring accuracy is unaffected. If a change is made to a different type of electrode insert, for which the

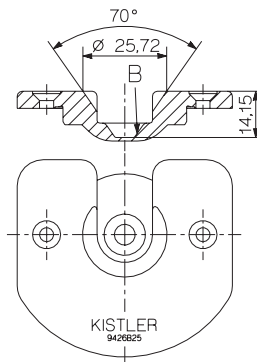
welding force sensor has not been calibrated, the sensitivity will vary within a range of $\pm 2\%$. The recalibration of the sensor to a new type of electrode insert, (a service offered by Kistler) improves the accuracy to the value for the measuring range stated in the table under "Technical Data".

Type 9426B20
max. permissible measuring range 45 kN



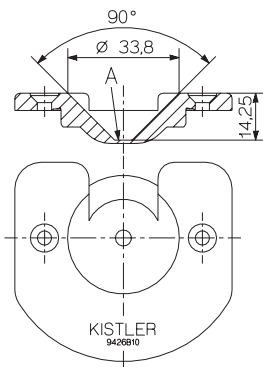
Application Range
Dummy insert for sensor applications on a flat surface.

Type 9426B25
max. permissible measuring range 10 kN



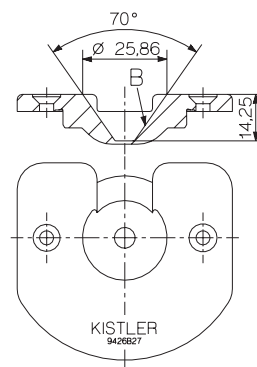
Application Range
Electrode contact area must be located ring-shaped on the cone side (Index B).

Type 9426B10
max. permissible measuring range 10 kN



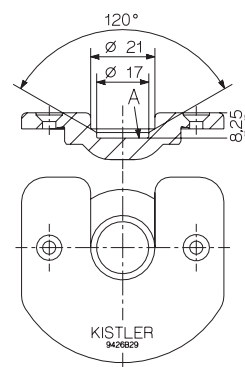
Application Range
Electrode contact area is located on the insert base (Index A).

Type 9426B27
max. permissible measuring range 10 kN



Application Range
Electrode contact area must be located ring-shaped on the cone side (Index B).

Type 9426B29
max. permissible measuring range 10 kN



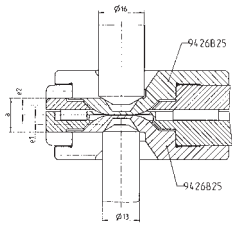
Application Range
Electrode contact area is located on the insert base (Index A).

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Customized electrode inserts are available on request.

Application Examples

A selection of various electrode shapes with matching electrode inserts in the sensor.



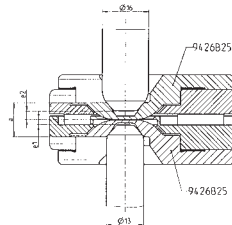
Closing force measurement with 30° milled Type B electrodes (ISO 5821) and with top and bottom inserts Type 9426B25.

Measuring range: $F \leq 10 \text{ kN}$

Force transmission ring-shaped via cone wall; minimum electrode distance during the measurement.

$$e_1 + e_2 = e_3 \cong 3,4 + 3,1 = 6,5 \text{ mm}$$

Approach distance for the pair of electrodes: $a = 11,5 \text{ mm}$



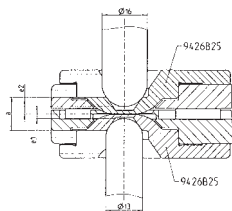
Closing force measurement with 48° milled Type F electrodes (ISO 5821) and with top and bottom inserts Type 9426B25.

Measuring range: $F \leq 10 \text{ kN}$

Force transmission ring-shaped via cone wall; minimum electrode distance during measurement.

$$e_1 + e_2 = e_3 \cong 1,7 + 2,8 = 4,5 \text{ mm}$$

Approach distance for the pair of electrodes: $a = 11,5 \text{ mm}$



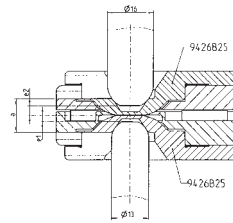
Closing force measurement with modified Type F electrodes (ISO 5821) with ball-shaped tips and with top and bottom inserts Type 9426B25.

Measuring range: $F \leq 10 \text{ kN}$

Force transmission ring-shaped via cone wall; minimum electrode distance during measurement.

$$e_1 + e_2 = e_3 \cong 1,5 + 2,6 = 4,1 \text{ mm}$$

Approach distance for the pair of electrodes: $a = 11,5 \text{ mm}$



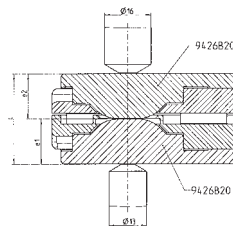
Closing force measurement with modified Type F electrodes (ISO 5821) with flat tip and with top and bottom inserts Type 9426B25.

Measuring range: $F \leq 10 \text{ kN}$

Force transmission ring-shaped via cone wall; minimum electrode distance during measurement.

$$e_1 + e_2 = e_3 \cong 2,1 + 3,2 = 5,3 \text{ mm}$$

Approach distance for the pair of electrodes: $a = 11,5 \text{ mm}$



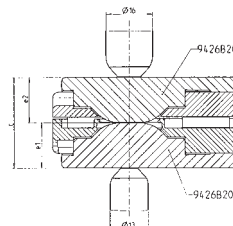
Closing force measurement with 30° milled Type B electrodes (ISO 5821) and with top and bottom inserts Type 9426B20.

Measuring range: $F \leq 45 \text{ kN}$

Force transmission via the plane parallel surfaces of base and cover plates; minimum electrode distance during the measurement.

$$e_1 + e_2 = c \cong 15,5 + 15,5 = 31 \text{ mm}$$

Approach distance for the pair of electrodes: $c = 31 \text{ mm}$



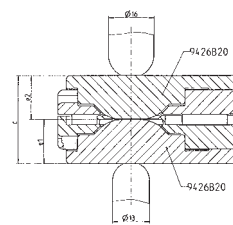
Closing force measurement with 48° milled Type F electrodes (ISO 5821) and with top and bottom inserts Type 9426B20.

Measuring range: $F \leq 45 \text{ kN}$

Force transmission via the plane parallel surfaces of base and cover plates; minimum electrode distance during the measurement.

$$e_1 + e_2 = c \cong 15,5 + 15,5 = 31 \text{ mm}$$

Approach distance for the pair of electrodes: $c = 31 \text{ mm}$



Closing force measurement with modified Type F electrodes (ISO 5821) with ball-shaped tips and with top and bottom inserts Type 9426B20.

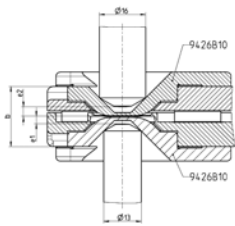
Measuring range: $F \leq 45 \text{ kN}$

Force transmission via the plane parallel surfaces of base and cover plates; minimum electrode distance during the measurement.

$$e_1 + e_2 = c \cong 15,5 + 15,5 = 31 \text{ mm}$$

Approach distance for the pair of electrodes: $c = 31 \text{ mm}$

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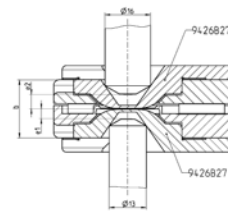
Closing force measurement with 30° milled Type B electrodes (ISO 5821) and with top and bottom inserts Type 9426B10.

Measuring range: $F \leq 10$ kN

Force transmission ring-shaped via cone wall; minimum electrode distance during measurement.

$$e_1 + e_2 = e_3 \cong 2,4 + 3,3 = 5,7 \text{ mm}$$

Approach distance for the pair of electrodes:
 $b = 20,5$ mm



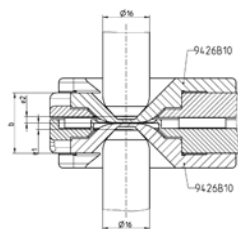
Closing force measurement with 30° milled Type B electrodes (ISO 5821) and with top and bottom inserts Type 9426B27.

Measuring range: $F \leq 10$ kN

Force transmission ring-shaped via cone wall; minimum electrode distance during measurement.

$$e_1 + e_2 = e_3 \cong 3,5 + 5,1 = 8,1 \text{ mm}$$

Approach distance for the pair of electrodes:
 $b = 20,5$ mm



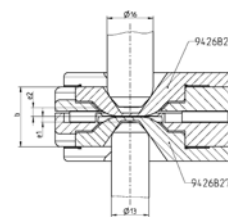
Closing force measurement with 48° milled Type F electrodes (ISO 5821) and with top and bottom inserts Type 9426B10.

Measuring range: $F \leq 10$ kN

Force transmission ring-shaped via cone wall; minimum electrode distance during measurement.

$$e_1 + e_2 = e_3 \cong 2,2 + 2,2 = 4,4 \text{ mm}$$

Approach distance for the pair of electrodes:
 $b = 20,5$ mm



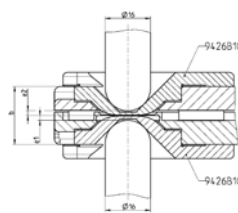
Closing force measurement with 48° milled Type F electrodes (ISO 5821) and with top and bottom inserts Type 9426B27.

Measuring range: $F \leq 10$ kN

Force transmission ring-shaped via cone wall; minimum electrode distance during measurement.

$$e_1 + e_2 = e_3 \cong 1,7 + 3,2 = 4,9 \text{ mm}$$

Approach distance for the pair of electrodes:
 $b = 20,5$ mm



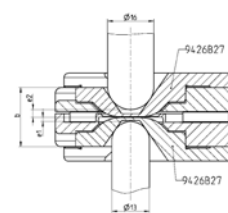
Closing force measurement with modified Type F electrodes (ISO 5821) with ball-shaped tips and with top and bottom inserts Type 9426B10.

Measuring range: $F \leq 10$ kN

Force transmission ring-shaped via cone wall; minimum electrode distance during measurement.

$$e_1 + e_2 = e_3 \cong 1,7 + 1,7 = 3,4 \text{ mm}$$

Approach distance for the pair of electrodes:
 $b = 20,5$ mm



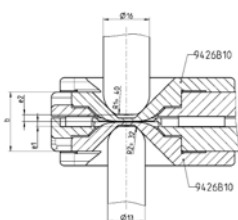
Closing force measurement with modified Type F electrodes (ISO 5821) with ball-shaped tips and with top and bottom inserts Type 9426B27.

Measuring range: $F \leq 10$ kN

Force transmission ring-shaped via cone wall; minimum electrode distance during measurement.

$$e_1 + e_2 = e_3 \cong 1,5 + 2,7 = 4,2 \text{ mm}$$

Approach distance for the pair of electrodes:
 $b = 20,5$ mm



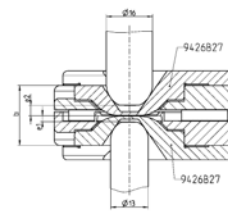
Closing force measurement with modified Type F electrodes (ISO 5821) with flat tip and with top and bottom inserts Type 9426B10.

Measuring range: $F \leq 10$ kN

Force transmission ring-shaped via cone wall; minimum electrode distance during measurement.

$$e_1 + e_2 = e_3 \cong 1,6 + 2,4 = 4,0 \text{ mm}$$

Approach distance for the pair of electrodes:
 $b = 20,5$ mm



Closing force measurement with modified Type F electrodes (ISO 5821) with flat tip and with top and bottom inserts Type 9426B27.

Measuring range: $F \leq 10$ kN

Force transmission ring-shaped via cone wall; minimum electrode distance during measurement.

$$e_1 + e_2 = e_3 \cong 2,1 + 3,3 = 5,4 \text{ mm}$$

Approach distance for the pair of electrodes:
 $b = 20,5$ mm

Electrode/Insert Spacing for Different Electrode Shapes and Electrode Inserts

Electrode shape E-caps according to ISO 5821	Electrodes external \varnothing d1	Electrodes contact \varnothing d2	R1	F \leq 5 kN	F = 0 ... 10 kN		F \leq 45 kN	
				Sensor Electrode Insert				
				Type 9426B27 Cone 70°	Type 9426B25 Cone 70° sunken cut	Type 9426B29	Type 9426B10 Cone 90°	Type 9426B20 Surface R = 0
Electrode/insert spacing $e_3 = e_1 + e_2$ between two identical electrode caps ($e_1 = e_2$) and electrode inserts in sensor								
mm								
<p>Type B</p>	13	5	32	7	6,2	x	4,8	31
	16	6	40	10,2	6,8	x	6,6	31
	20	8/10	50	(14,6)	(14,6)	x	9,4	31
<p>Type F, 48° gefräst</p>	13	5	32	3,4	3,4	x	x	31
	16	6	40	4,2	3,4	x	4,4	31
	20	8/10	50	7	7	x	4,4	31
<p>Type A Type C</p>	13	x	32	x	x	14,6	x	31
	16	x	40	x	x	14,6	x	31
	20	x	50	x	x	14,6	x	31
<p>Type F</p>	13	x	x	3	3	x	x	31
	16	x	x	5,4	5,2	x	3,4	31
	20	x	x	8,2	8,2	x	5,2	31
<p>Type F</p>	13	x	32	4,2	4,2	x	3,2	31
	16	x	40	7	6,4	x	4,8	31
	20	x	50	(9,2)	(9,2)	x	6	31

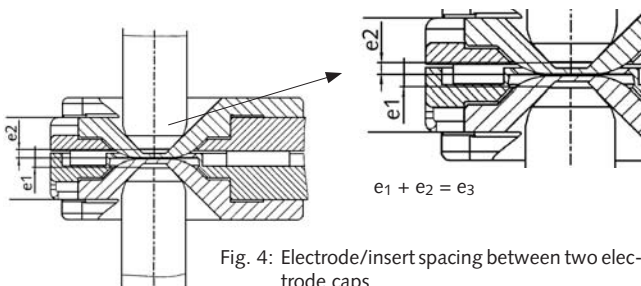


Fig. 4: Electrode/insert spacing between two electrode caps

Notes

- Electrode/insert spacing with two identical electrode caps and electrode inserts in sensor: $e_3^{(*)} = e_1 + e_2$ (where $e_1 = e_2$)
- Worked example of electrode/insert spacing with two different electrode caps and/or electrode inserts in sensor:
 - top electrode insert Type 9426B25 with electrode Type B ($d_1 \varnothing 16$ mm)
 - bottom electrode insert Type 9426B27 with electrode (round) Type F ($d_1 \varnothing 16$ mm)
 - $e_3 = 1/2 \cdot 6,8$ mm + $1/2 \cdot 5,4$ mm
 - $e_3 = \underline{6,1}$ mm

(*) e_3 as shown in table

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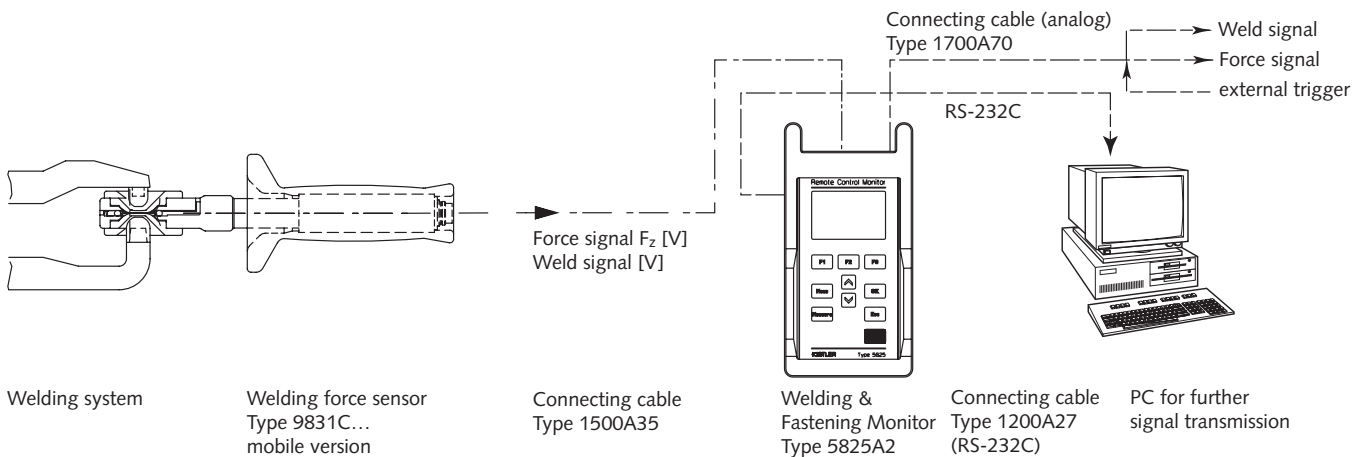
System Versions

Measuring System for Mobile Application

The welding force calibration transmitter Type 9831C... combined with the welding force measuring system in a case Type 9831C0001 (available as an option) provides a complete measuring system, which is primarily intended for mobile data acquisition of electrode closing forces using the Welding & Fastening Monitor Type 5825A2.

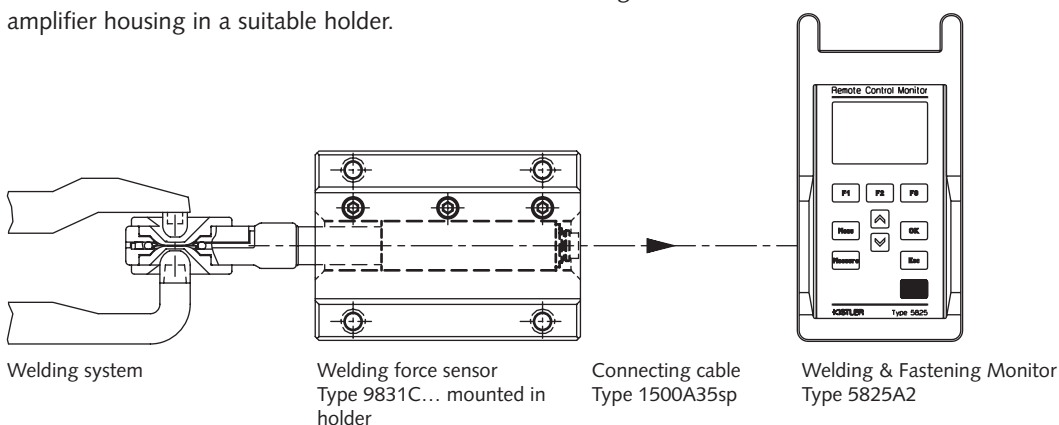
Main Characteristics of Welding & Fastening Monitor Type 5825A2

- Supply and control of the integrated charge amplifier of the welding force sensor
- Storage of up to 100 welding cycle evaluations
- RS-232C interface
- Analog signal outputs for electrode force and welding voltage
- Automatic measuring range detection of the sensor
- Connection for external trigger signal



Welding Force Measuring System, Stationary

The welding force sensor Type 9831C... can also be used in a stationary system, e.g. at a fixed location or on a robotic system. For this purpose, the plastic handgrip is simply pulled off and the sensor could be mounted at the tubular charge amplifier housing in a suitable holder.



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Explanation of Measurands

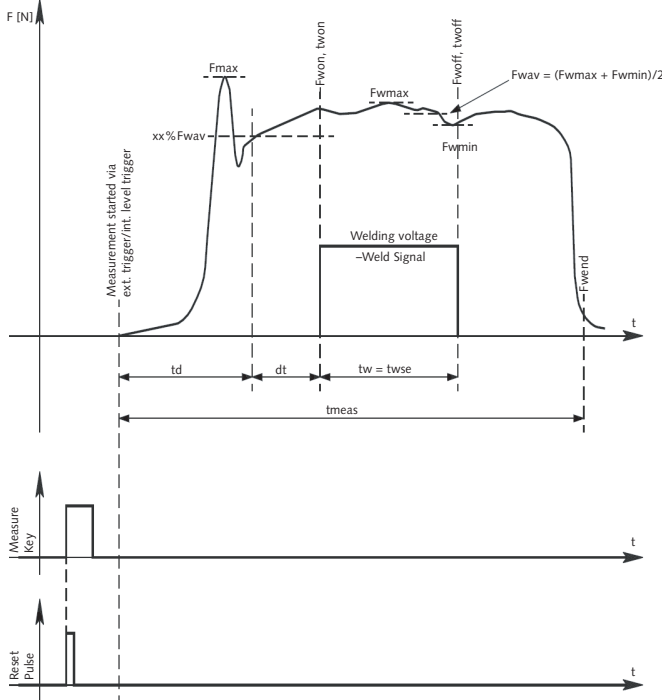


Fig. 5: Start of welding time late (dt is negative)

- td Time from the start of the measurement (reaching the set trigger level or external trigger pulse) until $xx\%F_{wav}$ (calculated value) is reached.
- dt Time difference between reaching $xx\%F_{wav}$ until the start of the welding process (calculated value); this time should be as short as possible.
 - dt: Welding voltage reached late (delayed by time dt), i.e. after reaching the $xx\%F_{wav}$ threshold. Action: Shorten the squeeze time in the welding control unit by time dt.
 - +dt: Welding voltage reached prematurely by time dt, i.e. before reaching the $xx\%F_{wav}$ threshold. Action: Extend the squeeze time in the welding control unit by time dt.
- tw Duration of the welding process (weld signal); with impulse welding, this is the total time of the individual pulses without pauses.
- twon Time elapsed to welding voltage turn on (from reaching the trigger level or external trigger).
- twoff Time elapsed to welding voltage turn off (from reaching the trigger level or external trigger).
- twse Total time of the welding process in pulse welding (total time of the individual pulses with pauses).
- tmeas Total measuring time from reaching the trigger level or external trigger pulse.

Explanation of Measurands

- Finst Instantaneous value of the welding force F (not stored).
- Fmax Maximum electrode force over the entire measuring time t_{meas} (F_{max} selectable with peak value or instantaneous value display).
- Fwon Electrode force at welding voltage turn on.
- Fwoff Electrode force at welding voltage turn off.
- Fwav Mean value of the electrode force during the welding process (application of welding voltage).
- $xx\%F_{wav}$ $xx\%$ of F_{wav} (calculated value); recommended set point for the start of the welding process (default value: $xx\%F_{wav} = 90\%$; xx adjustable from 50 ... 95 %).
- Fwmin Minimum electrode force during the welding process.
- Fwmax Maximum electrode force during the welding process.
- Fwend Force at the end of total measuring time.

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Ordering Key

For Welding Force Calibration Transmitter without Measuring Case

Welding force calibration transmitter with plastic hand-grip, equipped and calibrated with 2 electrode inserts*), incl. calibration certificate, without additional accessories according to the following ordering key:

Type 9831C	
Range	
Measuring range 5 kN	1
Measuring range 10 kN	2
Measuring range 45 kN*)	3

The equipment complement of the welding force calibration transmitter with the two electrode inserts can be individually selected.

Equipment above

Type 9426B25	1
Type 9426B20	2
Type 9426B29	3
Type 9426B27	4
Type 9426B10	5

Equipment below

Type 9426B25	1
Type 9426B20	2
Type 9426B29	3
Type 9426B27	4
Type 9426B10	5

Description of the available electrode inserts see page 4 et seq. Additional special inserts on request.

*) for 45 kN measuring range on both sides only available with electrode inserts Type 9426B20.

Ordering Example

Welding force calibration transmitter equipped and calibrated with 2 electrode inserts **Type 9831C211**

Measuring range: 10 kN
 Electrode insert above: Type 9426B25
 Electrode insert below: Type 9426B25

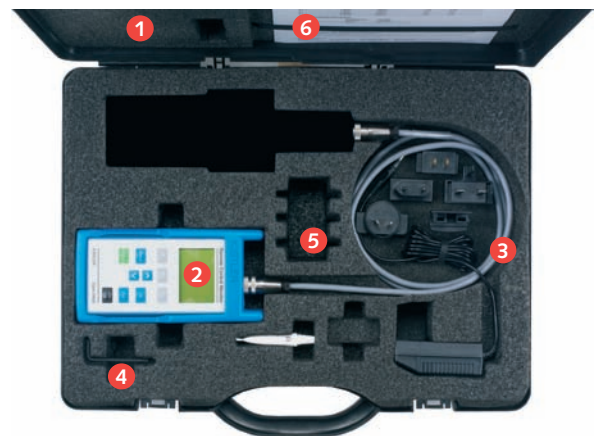
Ordering Key

For Measuring Case without Welding Force Calibration Transmitter

Welding Force Measuring Case **Type 9831C0001**

The welding force measuring case consists of:

	Type/Art. No.
1 Measuring case with foam inlay	3.070.281
2 Welding & Fastening Monitor (incl. power supply and 9 V battery)	5825A2
3 Connecting cable, length = 1,5 m	1500A35
4 Offset screwdriver for internal Torx	5.210.434
5 Countersunk screws ISO14581-M4x8-A4 (4 pcs.)	6.150.120
6 Calibration certificate	



Ordering Example

Welding Force Calibration Transmitter with Measuring Case Supplied as a Set

	Type
Item 1: Welding force calibration transmitter	9831C211
Item 2: Welding force measuring case	9831C0001
Item 3: Welding force sensor included in measuring case	9999



Optional Accessories

Type/Art. No.

- Connecting cable between welding force calibration transmitter Type 9831C... and Welding & Fastening Monitor Type 5825A2...:
Length according to order
(L_{min} = 0,5 m/L_{max} = 20 m) 1500A35sp
- Connecting cable RS-232C, Length = 5 m 1200A27
- Connecting cable for Type 5825A2...,
Length = 1,0 m 1700A70
- Electrode inserts 9426B...
according to details on page 4

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