# **Multicomponent Force Plate**

Type 9285

## with Glass Top Plate for Biomechanics, $F_{\rm z} \ 0 \ ... \ 5 \ kN$

Multicomponent force plate with glass top plate for measuring ground reaction forces, moments and the center of pressure in biomechanics.

- Glass top plate allows recording of contact surface
- Wide measuring range
- Excellent measuring accuracy
- Excellent accuracy of center of pressure (COP)
- Threshold  $F_z < 10 \text{ mN}$

#### Description

Multicomponent force plate Type 9285 consists of a base frame on which four piezoelectric 3-component force sensors under a high preload are mounted. A 600x400 mm triple-layer composite glass plate is mounted on these sensors. The very low crosstalk values of the sensors in conjunction with the special design principle ensure excellent accuracy of the center of pressure. The output signals are processed in an external charge amplifier for subsequent acquisition with any common motion analysis system.

#### Application

This force plate is designed for special gait and balance analysis applications. The glass plate allows simultaneous force measurement and photographic or cinematographic recording of the contact surface from below. Despite the wide measuring range (0 ... 5 kN), this force plate offers excellent accuracy and linearity across the entire spectrum of applications and guarantees overload protection up to 7,5 kN. A larger force plate with external dimensions of 900x600 mm is available on request. It can be equipped with an built-in charge amplifier.



Fig. 1: Multicomponent Force Plate Type 9285

#### Technical Data

FzKN0Overload $F_{xr}$ , $F_y$ $kN$ $-3,75/3,7$ $F_z$ $kN$ $0/7$ Linearity%FSO $\leq \pm 0$ Hysteresis%FSO $\leq \pm 0$ Hysteresis%FSO $< \leq \pm 0$ Crosstalk $F_x < -> F_y$ % $F_z -> F_x$ , $F_y -> F_z$ % $< \pm 0$ Rigidityx-axle ( $a_y = 0$ )N/µm $\approx 12$ y-axle ( $a_x = 0$ )N/µm $\approx 12$ y-axle ( $a_x = 0$ )N/µm $\approx 12$ Zoraxle ( $a_y = a_y = 0$ )N/µm $\approx 12$ Natural frequency $f_0$ ( $x, y$ )Hz $\approx 30$ $f_0$ ( $z$ )Hz $\approx 50$ Operating temperature range°C $-20 \dots 5$ Weightkg4Degree of protectionEN 60529:1992IP6Refractive index of glass top platen $\approx 1,5$ Calibrated range $F_x$ , $F_y$ kN $0 \dots 0,2$ $F_z$ $KN$ $0 \dots 0,2$ <th>Dimensions</th> <th></th> <th>mm</th> <th>600x400x150</th>	Dimensions		mm	600x400x150	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Range	F <sub>x</sub> , F <sub>v</sub>	kN	-2,5 2,5	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	-	Fz	kN	0 5	
Linearity% FSO $\leq \pm 0$ ,Hysteresis% FSO<	Overload	F <sub>x</sub> , F <sub>y</sub>	kN	-3,75/3,75	
Hysteresis% FSOCrosstalk $F_x < -> F_y$ % $F_x, F_y -> F_z$ % $F_z -> F_x, F_y$ %Rigidityx-axle ( $a_y = 0$ )N/µm $x - axle (a_y = 0)$ N/µm $\approx 12$ $y$ -axle ( $a_x = 0$ )N/µm $\approx 12$ $y$ -axle ( $a_x = 0$ )N/µm $\approx 12$ $y$ -axle ( $a_x = 0$ )N/µm $\approx 12$ $y$ -axle ( $a_x = 0$ )N/µm $\approx 12$ $z$ -axle ( $a_y = a_y = 0$ )N/µm $\approx 12$ $y$ -axle ( $a_x = 0$ )N/µm $\approx 22$ Natural frequency $f_0 (x, y)$ Hz $\approx 30$ $f_0 (z)$ Hz $\approx 50$ Operating temperature range°C $-20 \dots 5$ Weightkg4Degree of protectionEN 60529:1992IP6Refractive index of glass top platen $\approx 1,5$ Calibrated range $F_x, F_y$ kN $0 \dots 0,2$ $F_z$ kN $0 \dots 0,2$ $F_x, F_y, F_z$ mN<1		Fz	kN	0/7,5	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Linearity	%FSO		≤±0,5	
FactorFactorFactorFactor $F_{xr}, F_y \rightarrow F_z$ % $< \pm$ Rigidity $x$ -axle ( $a_y = 0$ ) $N/\mu m$ $\approx 12$ $y$ -axle ( $a_x = 0$ ) $N/\mu m$ $\approx 12$ $y$ -axle ( $a_x = 0$ ) $N/\mu m$ $\approx 12$ $z$ -axle ( $a_y = a_y = 0$ ) $N/\mu m$ $\approx 12$ Natural frequency $f_0$ ( $x, y$ ) $Hz$ $\approx 30$ $f_0$ ( $z$ ) $Hz$ $\pi 30$ $f_0$ ( $z$ ) $Hz$ $\pi 30$ $f_0$ ( $z$ ) $Hz$ $\pi 30$ $f_0$ ( $z$ ) $Hz$ <td< td=""><td>Hysteresis</td><td>%FSO</td><td></td><td>&lt;1</td></td<>	Hysteresis	%FSO		<1	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Crosstalk	$F_x \ll F_y$	%	<±2	
Rigidityx-axle $(a_y = 0)$ N/µm $\approx 12$ y-axle $(a_x = 0)$ N/µm $\approx 11$ z-axle $(a_y = a_y = 0)$ N/µm $\approx 21$ Natural frequency $f_0 (x, y)$ Hz $\approx 30$ $f_0 (z)$ Hz $\approx 50$ Operating temperature range°C $-20 \dots 5$ Weightkg4Degree of protectionEN 60529:1992IP66Refractive index of glass top platen $\approx 1,5$ Calibrated range $F_{xr}$ , $F_y$ kN $-2,5 \dots 2,$ $F_z$ kN00,Calibrated partial range $F_{xr}$ , $F_y$ kN $0 \dots 0,$ $F_z$ kN00,Threshold $F_{xr}$ , $F_{yr}$ , $F_z$ mN $<1$ Sensitivity $F_{xr}$ , $F_y$ pC/N $-7,4$		$F_x$ , $F_y \rightarrow F_z$	%	<±2	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		$F_z \rightarrow F_x$ , $F_y$	%	<±1	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Rigidity	x-axle ( $a_y = 0$ )	N/µm	≈120	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		y-axle ( $a_x = 0$ )	N/µm	≈115	
$\label{eq:response} \begin{array}{c c c c c c c c c c c c c c c c c c c $		z-axle ( $a_y = a_y = 0$ )	N/µm	≈25	
Operating temperature range°C-20Weightkg4Degree of protectionEN 60529:1992IP6Refractive index of glass top platen $\approx 1,5$ Calibrated range $F_{xr}$ , $F_y$ kN $-2,5$ $F_z$ kN0Calibrated partial range $F_{xr}$ , $F_y$ kN $0$ $F_z$ kN00,2 $F_z$ kN00,2 $F_z$ kN00,2Sensitivity $F_{xr}$ , $F_{yr}$ , $F_z$ mN<1	Natural frequency	f <sub>o</sub> (x, y)	Hz	≈300	
Weightkg4Degree of protectionEN 60529:1992IP6Refractive index of glass top platen $\approx 1,5$ Calibrated range $F_{xr}$ , $F_y$ kN $-2,5 \dots 2,$ $F_z$ kN0 \dotsCalibrated partial range $F_{xr}$ , $F_y$ kN $0 \dots 0, 2$ $F_z$ kN0 \dots 0, 2 $F_z$ kN0 \dots 0, 2Threshold $F_{xr}$ , $F_{yr}$ , $F_z$ mN<1		f <sub>o</sub> (z)	Hz	≈500	
Degree of protectionEN 60529:1992IPGRefractive index of glass top platen $\approx 1,5$ Calibrated range $F_{xr}$ , $F_y$ kN $-2,5 \dots 2$ $F_z$ kN0 \dotsCalibrated partial range $F_{xr}$ , $F_y$ kN0 \dots 0,2 $F_z$ kN0 \dots 0,2 $F_z$ kN0 \dots 0,2Threshold $F_{xr}$ , $F_{yr}$ , $F_z$ mN<1	Operating temperature range		°C	-20 50	
Refractive index of glass top platen $\approx 1,5$ Calibrated range $F_x$ , $F_y$ $kN$ $-2,5 \dots 2$ , $F_z$ $kN$ $0 \dots$ Calibrated partial range $F_x$ , $F_y$ $kN$ $0 \dots 0,2$ $F_z$ $kN$ $0 \dots 0,2$ $F_z$ $kN$ $0 \dots 0,2$ Threshold $F_{xr}, F_{yr}, F_z$ $mN$ $<1$ Sensitivity $F_x, F_y$ $pC/N$ $-7,4$	Weight		kg	45	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Degree of protection	EN 60529:1992		IP65	
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Refractive index of glass to	op plate	n ≈1,52		
Calibrated partial range         F <sub>xr</sub> , F <sub>y</sub> kN         0 0,2           Fz         kN         0 0,1           Threshold         F <sub>xr</sub> , F <sub>yr</sub> , Fz         mN         <1	Calibrated range	F <sub>x</sub> , F <sub>y</sub>	kN	-2,5 2,5	
Fz         kN         0 0,           Threshold         Fxr, Fyr, Fz         mN         <1		F <sub>z</sub>	kN	0 5	
ThresholdFxr, Fyr, FzmN<1SensitivityFxr, FypC/N-7,4	Calibrated partial range	F <sub>x</sub> , F <sub>y</sub>	kN	0 0,25	
Sensitivity F <sub>x</sub> , F <sub>y</sub> pC/N -7,4		F <sub>z</sub>	kN	0 0,5	
	Threshold	$F_x$ , $F_y$ , $F_z$	mΝ	<10	
	Sensitivity	F <sub>x</sub> , F <sub>y</sub>	pC/N	-7,4 <sup>1)</sup>	
		Fz	pC/N	-3,8 <sup>1)</sup>	

<sup>1)</sup> nominal value

Conforms to the **C€** safety standards for electrical equipment and systems: EN 60601-1-1:92 + A1:96, IEC 60601-1-1:92 + A1:95 and the EMC standards: 60601-1-2:01 + A1:06 class B, EN 61000-3-2:06, EN 61000-3-3:95 + A1:01 + A2:05, EN 61000-6-2:05, EN 61000-6-3:01 + A1:04, IEC60601-1-2:01 + A1:04 class B, IEC61000-3-2:05, IEC 61000-3-3:94 + A1:01 + A2:05, IEC61000-6-2:05, IEC 61000-6-3:06

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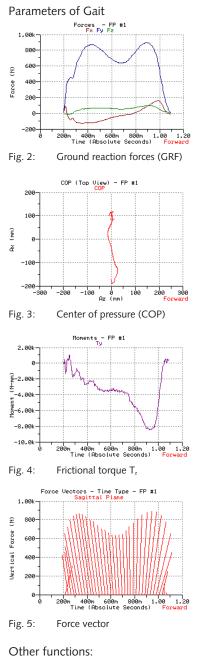
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#### **BioWare**<sup>®</sup>

BioWare software is the engine behind the force plate system. It collects data from the force plates, converts the trials into useful information and plots the results. The force plates and charge amplifiers are fully remote controlled by BioWare thus making the system extremely flexible and easy-to-use.



Coefficient of friction (COF)

9285\_000-157e-04.07

- 3-dimensional vector representation
- Real-time vectors and COP for biofeedback
- Frequency analysis, statistics, digital filters

3.00 Ê 2.00k 0 1.00 -1.00k 4.00 1.00 2.00 3.00 Time (Absolute Seconds) Jump force Fig. 6: Power - plate #1 4.00

BioWare provides several performance specific evaluations.

Parameters of Countermovement Jump CMJ

Forces - plate #1

4.00

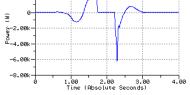
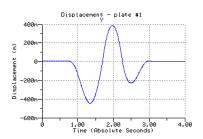
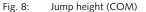
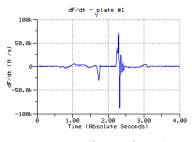
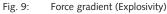


Fig. 7: Power









Other parameters:

- · Acceleration, velocity and displacement of the center of mass (COM)
- Work, energy, impulse
- · Statistics, digital filters

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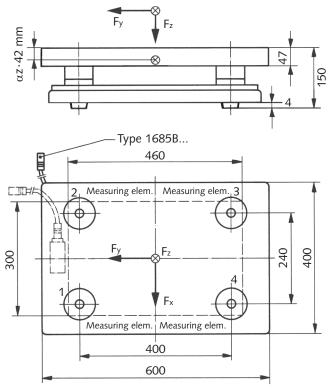


Fig. 10: Dimensions of multicomponent force plate Type 9285



Fig. 11: This photograph taken through the glass plate from below shows the main part of the standing phase of a step.

### Typical Measuring Chain

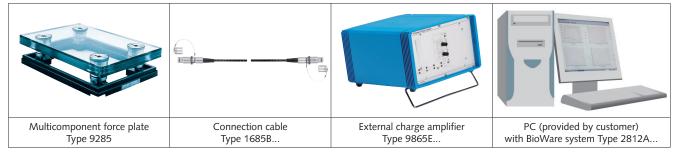


Fig. 12: Configuration of a typical measuring chain

<ul> <li>Included Accessories</li> <li>1 Set shims</li> <li>4 Eye bolts M6 with washer</li> <li>4 Hexagon socket head cap screws M12x25</li> <li>1 Hexagon socket wrench</li> </ul>	<b>Type/Art. No.</b> 7.050.011 6.170.007 6.220.040 6.120.106 1391	<ul> <li>Ordering Code</li> <li>Multicomponent force plate with charge output</li> </ul>	Туре 9285
<ul> <li>1 Voltage equalizing cable</li> <li>Optional Accessories</li> <li>For Type 9285</li> <li>External charge amplifier</li> <li>Connection cable, straight plug</li> <li>DAQ system BioWare<sup>®</sup> (PCI-Bus)</li> </ul>	5.590.175 <b>Type/Art. No.</b> 9865E 1685B 2812A		Page 3/3

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