KISTLER
measure. analyze. innovate.

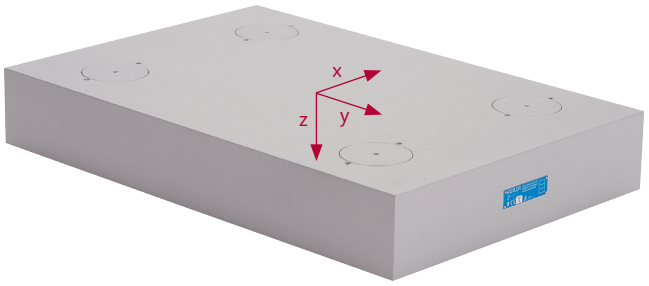
Multicomponent Force Plate

Type 9281E...

for Dynamic Applications in Biomechanics, F_z –10 ... 20 kN

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

- Extremely wide measuring range
- Excellent measuring accuracy
- High natural frequency
- Versatile
- Threshold F_z <250 mN



Description

The multicomponent force plate Type 9281E... consists of a 600x400 mm aluminum sandwich top plate of advanced, lightweight construction and four built-in piezoelectric 3-component force sensors. Thus it is extremely rigid overall, and allows measurements over a very wide useful frequency range.

Thanks to the special properties of the piezoelectric sensors, the plate is highly sensitive and can simultaneously measure very dynamic phenomena involved in a wide range of applications.

Application

This force plate is designed specifically for use in basic research and sport. Its extensive range and high rigidity allow it to be employed across a very wide spectrum of measuring tasks and application sectors. Despite the very generous measuring range of –10 ... 20 kN, it offers excellent accuracy and linearity, and even under a large preload allows precise measurement of minute forces. In all these situations the plate can be mounted in any position without affecting the measurement result in any way.

The Type 9281EA has an built-in charge amplifier compatible with all of the common motion analysis systems.

Technical Data

Dimensions		mm	600x400x100
Measuring range	F_x, F_y	kN	–10 ... 10
	F_z	kN	–10 ... 20
Overload	F_x, F_y	kN	–15/15
	F_z	kN	–10/25
Linearity	%FSO		<±0,2
Hysteresis	%FSO		<0,3
Crosstalk	F_x <–> F_y	%	<±1,5
	F_x, F_y –> F_z	%	<±1,5
	F_z –> F_x, F_y	%	<±0,5[1)]
Rigidity	x-axis (a_y = 0)	N/µm	≈250
	y-axis (a_x = 0)	N/µm	≈400
	z-axis		
	(a_x = a_y = 0)	N/µm	≈30
Natural frequency	f_n (x, y)	Hz	≈1 000
	f_n (z)	Hz	≈1 000
Operating temperature range		°C	0 ... 60
Weight		kg	16
Degree of protection	EN 60529:1992		IP65

[1)] inside sensor rectangle

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Force Plate with Built-in 8-Channel Charge Amplifier, Type 9281EA

Calibrated range	F_x, F_y	kN	0 ... 5
	F_z	kN	0 ... 20
Calibrated partial range	F_x, F_y	kN	0 ... 1,25
	F_z	kN	0 ... 5
Sensitivity range 1	F_x, F_y	mV/N	≈40[2]
	F_z	mV/N	≈18[2]
Sensitivity range 4	F_x, F_y	mV/N	≈2,0[2]
	F_z	mV/N	≈0,9[2]
Ratio ranges 1:2:3:4			1:5:10:20[3]
Threshold		mN	<250[4]
Drift		mN/s	<±10
Supply voltage		VDC	10 ... 30
Supply current		mA	≈45
Output voltage		V	0 ... ±5
Output current		mA	–2 ... 2
Control inputs (optocoupler)		V	5 ... 45
		mA	0,4 ... 4,4

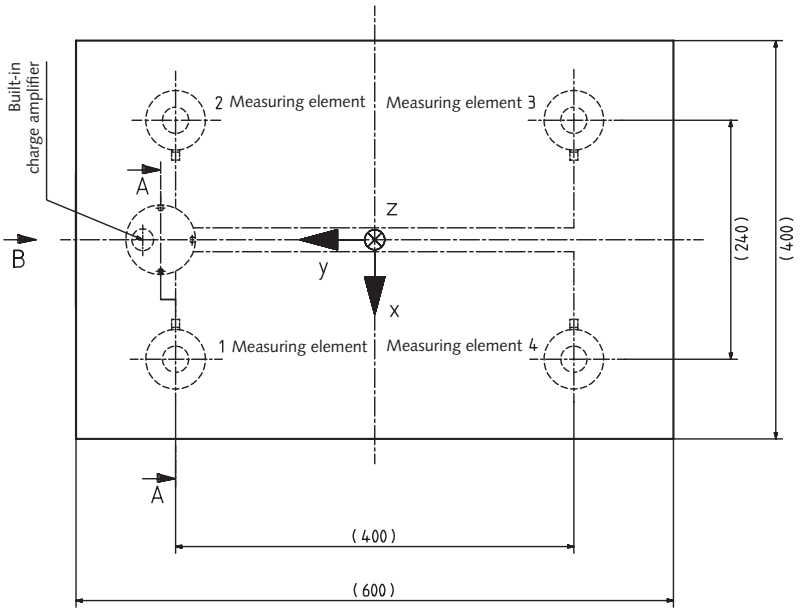
Force Plate without Charge Amplifier, Type 9281E

Calibrated range	F_x, F_y	kN	0 ... 10
	F_z	kN	0 ... 20
Calibrated partial range	F_x, F_y	kN	0 ... 1
	F_z	kN	0 ... 2
Threshold	F_x, F_y, F_z	mN	<50
Sensitivity	F_x, F_y	pC/N	–7,5[2]
	F_z	pC/N	–3,8[2]

[2] nominal value
[3] ±0,5 % accuracy
[4] only range 1

Conforms to the CE safety standards (73/23/EG) for electrical equipment and systems:
EN 60601-1:2005, EN 61010-1:2001
and the EMC standards (89/336/EG):
EN 60601-1:2005 (EN 55022 Class B), EN 61000-6-3:2004 (EN 55022 Class B), EN 61000-6-4:2001 (EN 55011 Class B), EN 60601-1:2005, EN 61000-6-1:2001, EN 61000-6-2:2005

Dimensions



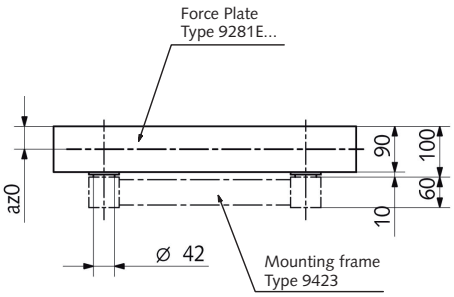


Fig. 1: Dimensions of multicomponent force plate Type 9281E...

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BioWare®

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.

Parameters of Gait

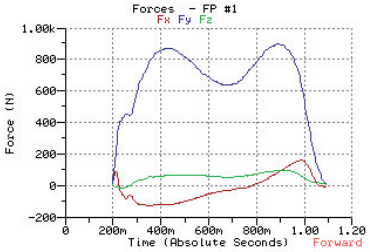

Fig. 2: Ground reaction forces (GRF)

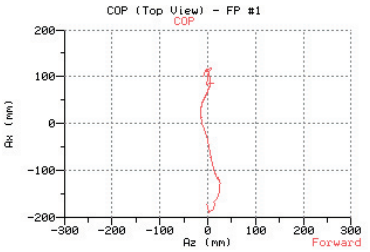

Fig. 3: Center of pressure (COP)

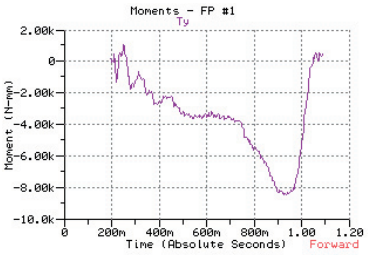

Fig. 4: Frictional torque T_z

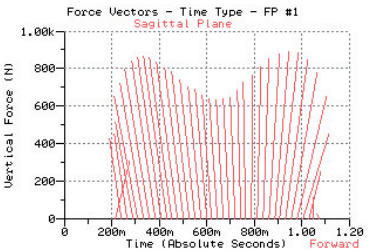

Fig. 5: Force vector

Other functions

- Coefficient of friction (COF)
- Frequency analysis, statistics, digital filters
- Full Windows® functionality

BioWare provides several performance specific evaluations.

Parameters of Countermovement Jump CMJ

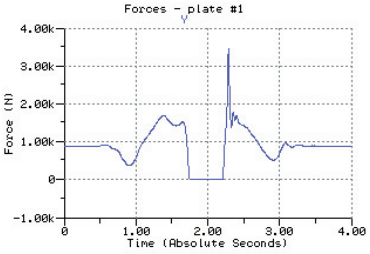

Fig. 6: Jump force

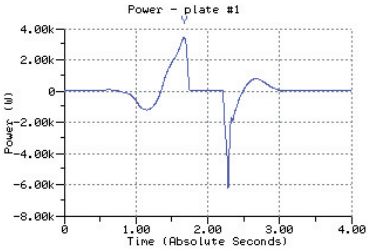

Fig. 7: Power

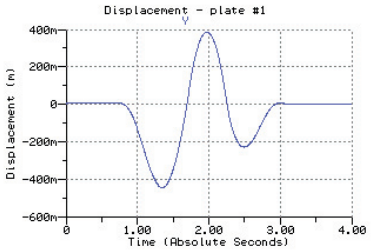

Fig. 8: Jump height (COM)

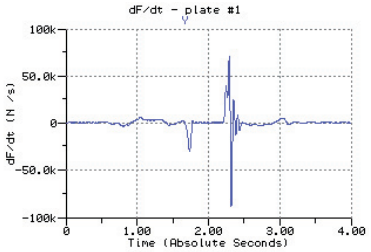

Fig. 9: Force gradient (Explosivity)

Other parameters

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

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Typical Measuring Chains

			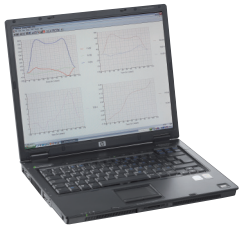
Force plate with charge amplifier Type 9281EA	Connection cable Type 1759A...	DAQ system (USB 2.0) Type 5691A1	Laptop (provided by user) with BioWare software

Fig. 10: Configuration of a typical measuring chain with Kistler DAQ system BioWare®

			Ch 1 = F_x 1+2 Ch 5 = F_z 1 Ch 2 = F_x 3+4 Ch 6 = F_z 2 Ch 3 = F_y 1+4 Ch 7 = F_z 3 Ch 4 = F_y 2+3 Ch 8 = F_z 4
Force plate with charge amplifier Type 9281EA	Connection cable Type 1757A...	External Control Unit (8xBNC neg.) Type 5233A2	DAQ system provided by user (8 analog channels)

Fig. 11: Configuration of a typical measuring chain with DAQ system provided by user

Included Accessories for Type 9281E...	**Type/Art. No.**
• 1 Set shims	7.050.011
• 4 Eye bolts M6 with washer	6.170.007 6.220.040
• 4 Hexagon socket head cap screws M12x25	6.120.106
• 1 Hexagon socket wrench	1391
• 1 Voltage equalizing cable	5.590.175

Optional Accessories for Type 9281EA with built-in charge amplifier	**Type/Art. No.**
• Connection cable, angle plug connector	1759A...
• DAQ system for BioWare (USB 2.0)	5691A1
• External control unit (BNC out)	5233A2
• Connection cable for Type 5233A...	1757A...
• DAQ system BioWare (PCI-Bus)	2812A...
For Type 9281E with charge output	
• External charge amplifier	9865E...
• Connection cable, angle plug connector	1686A...
• DAQ system BioWare (PCI-Bus)	2812A...
Mounting frame for Type 9281E...	
• Standard mounting frame	9423
• Other mounting frames for multiple installations	on request

Ordering Key

Type 9281E ☐

Multicomponent Force Plate	
with charge output	–
with built-in charge amplifier	**A**

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