

Kistler LabAmp for DynoWare

Type 5167Ax1

Charge amplifier and data acquisition for multicomponent force measurement

This instrument is ideal for multicomponent force-torque measurement with piezoelectric dynamometers or force plates.

Piezoelectric sensors produce an electric charge which varies in direct proportion with the load acting on the sensor. The amplifier converts this charge directly into digital values or a proportional output voltage.

- Fischer-plug for direct connection of dynamometers
- 4-channel version for cutting force measurements
- 8-channel version for multicomponent force-torque measurement
- Suitable for data acquisition software DynoWare Type 2825A
- Integrated 24-bit data acquisition with up to 100 kSps per channel
- Continuous digital signal processing at minimal latency
- Fully flexible low-pass, high-pass and notch filter adjustment via web-interface
- Low-noise design
- 4 or 8 analog outputs with fully flexible 2-point scaling and internal routing
- Status indication via LED
- Virtual channels for real-time calculations using one or more sensor channels
- Configuration and control in a standard web-browser or via data acquisition software DynoWare Type 2825A
- Virtual instrument driver for LabVIEW
- Two Ethernet interfaces with included switch functionality

Description

The Kistler LabAmp Type 5167Ax1 is not only an outstanding charge amplifier for multi-component force measurements but also a powerful data acquisition device delivering the digitized measurement values directly to a host computer for further analysis. It is configured and operated in a web-interface, conveniently accessible by a standard web-browser.

Thanks to advanced signal processing technology, the Kistler LabAmp Type 5167Ax1 offers impressive flexibility. The frequencies of the high-pass, low-pass and notch filters can be directly entered as numeric values in Hertz. The input signals can be flexibly routed to the analog outputs.

The graphical user interface not only offers a simple and intuitive way to configure the device but also displays differ-



ent measurement values (e.g. live value, min/max value, root mean square).

The virtual channel functionality allows real-time summation of different input signals. In the case of Kistler multicomponent dynamometers, the resulting force as well as the three components of the resulting torque vector can be calculated.

Application

The 4-channel instrument is particularly suitable for cutting force measurement with Kistler dynamometers and the data acquisition software DynoWare Type 2825A. The 8-channel instrument is suitable for 6-component force-torque measurement in the laboratory as well as in research and development. For example, wheel force measurement on a tire test stand, reaction force measurements on engine-transmission units, monitoring of forces and torques in vibration tests etc.

Acceleration measurements in addition to the actual force measurements can deliver further insightful information. The dynamic dual-mode charge amplifier Type 5165A... can be combined with Type 5167Ax1 and allows acquiring perfectly synchronized Piezotron (IEPE) or voltage signals conveniently in DynoWare.

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DynoWare

Kistler DynoWare is a universal and easy to use software which is particularly suitable for force measurements with Kistler stationary and rotary dynamometers or single and multi-component force sensors.

- Simple operation
- Configuration and control of Kistler measuring instruments as for example the Types 5167Ax1 and 5165A...
- Useful signal evaluation and calculation functions
- Realtime visualization of measured curves
- The software is ideal for acquisition and evaluation of physical measurands

For signal analysis, DynoWare offers the technician realtime visualization of the measured curves together with useful calculation and graphics functions. Apart from simple configuration of the most important measuring instruments, this software supports individual documentation of the measurement, along with storage of configuration data and measured data. The signal evaluation also enables compensation of undesirable signal drift due, for example, to undue influence of temperature.

The DynoWare software can be ordered optionally with the LabAmp Type 5167Ax1.

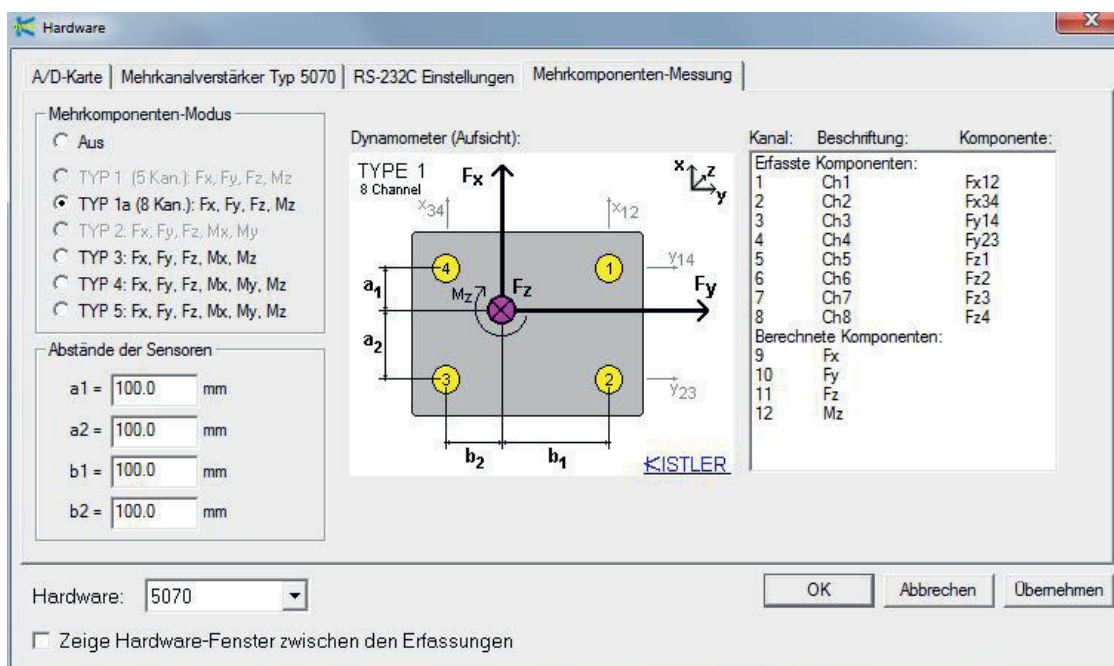


Fig. 1: Configuration of force and torque calculation for multi component dynamometers

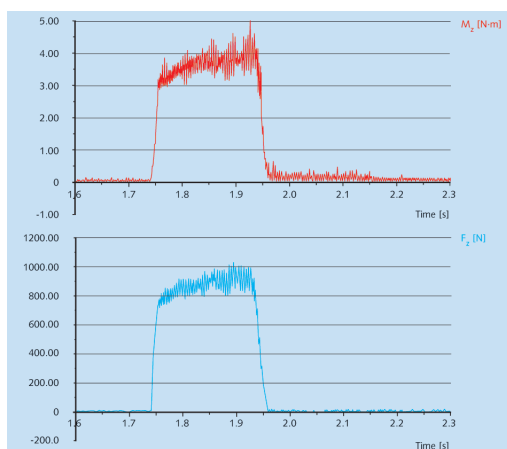


Fig. 2: Drilling measurement data, captured with DynoWare

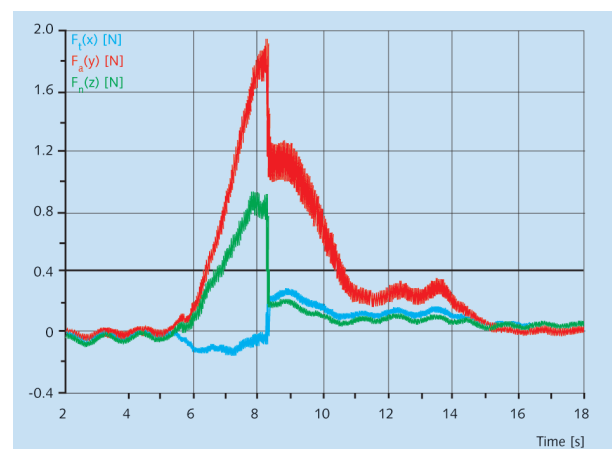


Fig. 3: Grinding disk breakage when grinding, measuring data, captured with DynoWare

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Technical data

Connections

Number of channels		
Type 5167A41		4
Type 5167A81		8
Input connector type		Fischer 9-pole neg.
Analog output connector type		BNC neg.
Ethernet interface		2xRJ45
Remote control		D-Sub 9f

Charge input

Measuring ranges	pC	±100 ... 1,000,000
Frequency range (-3 dB)		
≤195,000 pC	Hz	≈0 ... >45,000
>195,000 pC	Hz	≈0 ... >15,000
Input noise (typ.)		
1 Hz ... 100 kHz		
100 pC	pC _{rms}	0.009
1,000 pC	pC _{rms}	0.019
10,000 pC	pC _{rms}	0.43
100,000 pC	pC _{rms}	4.0
1,000,000 pC	pC _{rms}	8.5
1 Hz ... 10 kHz		
100 pC	pC _{rms}	0.007
1,000 pC	pC _{rms}	0.012
10,000 pC	pC _{rms}	0.25
100,000 pC	pC _{rms}	3.0
1,000,000 pC	pC _{rms}	3.4
Drift, measuring mode DC (Long)		
at 25°C, max. relative humidity RH of 60% (non-condensing)	pC/s	<±0.03
at 25°C, max. relative humidity RH of 70% (non-condensing)	pC/s	<±0.05
at 50°C, max. relative humidity RH of 50% (non-condensing)	pC/s	<±0.2
Measure-jump		Compensated
Measure-jump	pC	<±0.1
Correction time	ms	<20
Measurement uncertainty		
Measuring range <100 pC	%	<1
Measuring range ≥100 pC	%	<0.5
Temperature coefficient, typ.	ppm/°C	<50
Linearity error, typ.	%FSO	<0.01
Crosstalk between channels	dB	<-80
Sensor impedance	Ω	>10 ¹³

Voltage output

Nominal output range	V	±10
Output impedance	Ω	10
Max. common mode voltage between input and output ground	V	50
Output noise (all ranges)		
1 Hz ... 100 kHz, typ.	mV _{rms}	0.030
1 Hz ... 10 kHz, typ.	mV _{rms}	0.012
Frequency range (-3 dB)	Hz	0 ... 100,000
Group delay (input to output, filters off)	μs	≤14
Zero error	mV	<±2
DAC resolution (analog out)	Bit	16

Data acquisition

ADC resolution	Bit	24
Internal ADC sampling rate	kSps	625
Acquisition data rate per channel (adjustable)	kSps	100

Note: For the data acquisition with ≥25 kSps an anti-aliasing filter is automatically set with a cut-off frequency of 0.3 ... 0.43 x selected output update rate.

High-Pass filter

Order		1.
Analog high-pass filter		
Time constant DC (Long)		
<45,000 pC	s	>10,000
≥45,000 pC	s	>100,000
Time constant Short		
<45,000 pC	s	10
≥45,000 pC	s	110
Tolerance (typ.)	%	20
Digital High-Pass Filter		
Cutoff-frequency (-3 dB) selection in 0.1 Hz steps	Hz	≥0.1 ... 10,000
Tolerance (typ.)	%	<1

Digital Low-Pass filter

Filter type		Bessel or Butterworth
Order		2./4.
Cutoff-frequency (-3 dB) selection in 0.1 Hz steps	Hz	≥10
Tolerance (typ.)	%	<1

Technical data (continuation)

Digital Notch filter

Center frequency (-3 dB) selection in 0.1 Hz steps	Hz	≥10
Tolerance (typ.)	%	<1
Q factor		0.9 ... 1,000

Virtual channels

Number of channels		
Type 5167A41		2
Type 5167A81		6

Ethernet interface

Data rate	MBit	100
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Remote control

(Digital input and 24 V supply)

Remote measure and trigger with 10 kΩ pullup to +5 V

Connector type		D-Sub 9f
Input level		
High (Reset, Stop trigger)	V	>3.5
or		Input open
Low (Measure, Start trigger)	V	<1
Max. input voltage	V	±30
Supply (output)	V DC	+24/±10%
Output current (short circuit proof)	mA	≤200

Operation

All settings can be configured in a standard web-browser through the graphical user interface. Simply connect to the Kistler LabAmp Type 5167Ax1 by its network name and start working.

A simple data acquisition functionality is also implemented, offering a data download controlled by a start/stop button in the user interface.

All relevant configurations as well as more sophisticated data acquisition functionality out of one window provides the data acquisition software DynoWare Type 2825A.

Power supply requirements

Supply voltage range	VDC	18 ... 30
Power consumption	W	<15
Socket for barrel jack plug (IEC 60130-10 Type A)	mm	5.5x2.5x9.5
Power supply requirements		– galvanic isolation – PE and GND not connected

General data

Operating temperature range	°C	0 ... 60
Storage temperature range	°C	-10 ... 70
Rel. humidity, not condensing	%	≤90
Degree of protection (EN 60529)		IP20
Outer dimensions incl. feet and connectors (WxHxD)		
Type 5167A41	mm	≈218x50x223
Type 5167A81	mm	≈218x93x223
Weight		
Type 5167A41	kg	1.2
Type 5167A81	kg	1.8

Block diagram

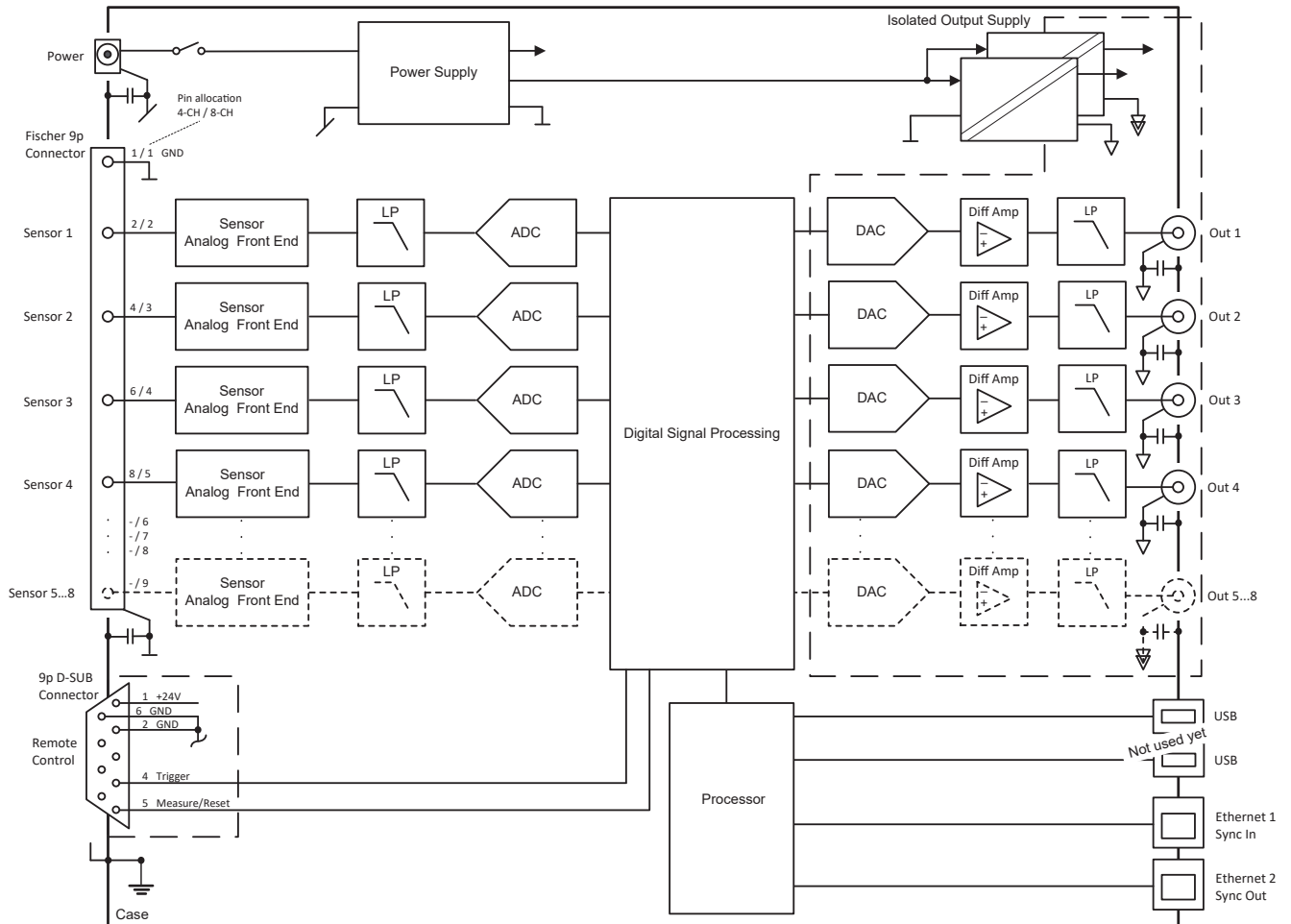
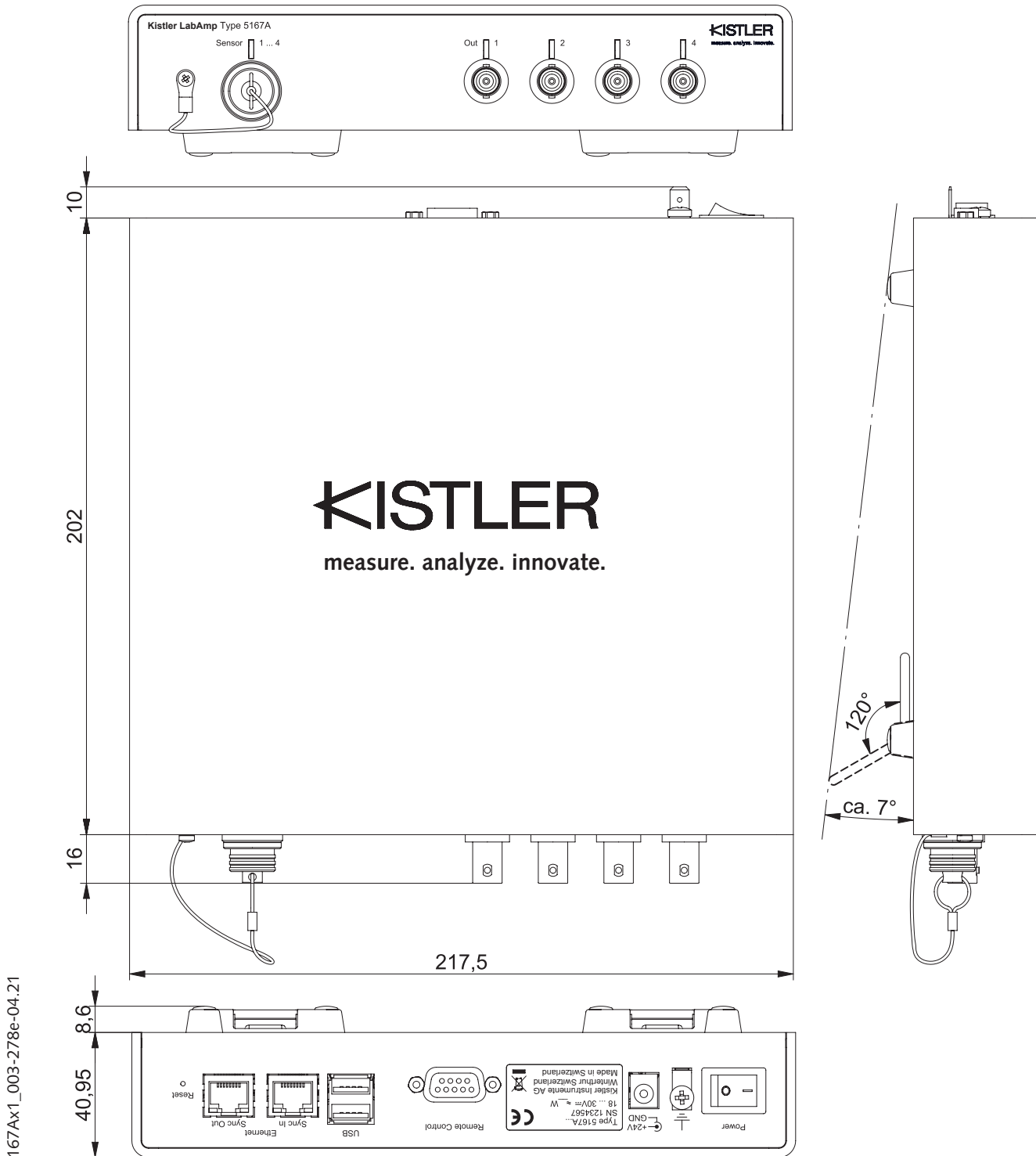


Fig. 4: Block diagram of the Kistler LabAmp Type 5167Ax1

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Dimensions



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Fig. 5: Dimensions of Kistler LabAmp Type 5167A41

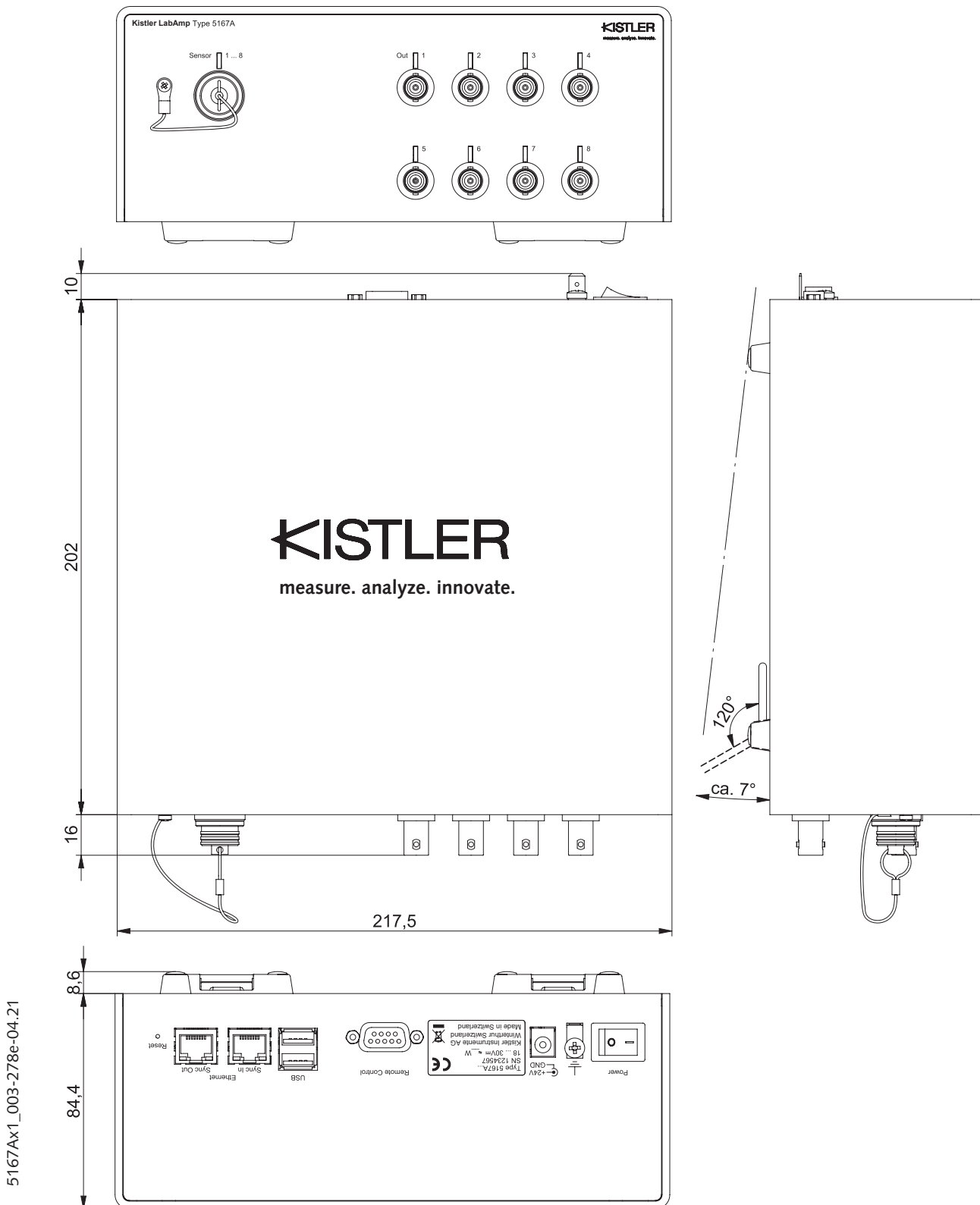


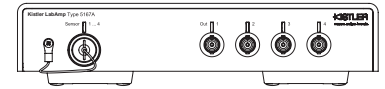
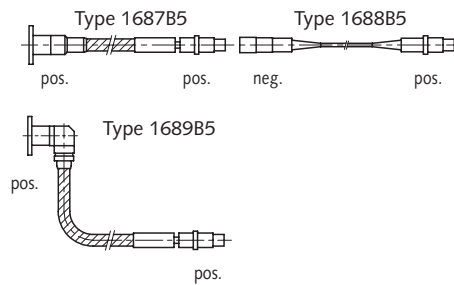
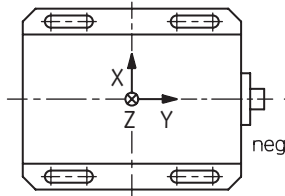
Fig. 6: Dimensions of Kistler LabAmp Type 5167A81

3-Component Force Measurement F_x , F_y , F_z with 4-Channel Charge Amplifier

Dynamometer
Type 9119AAx, 9129A, 9129AA, 9253B,
9255C, 9257B, 9139AA

Cable

Charge Amplifier



CH1: F_x
CH2: F_y
CH3: F_z
CH4: -

Fig. 7: Example of a measuring system with standard dynamometer

Measured value processing

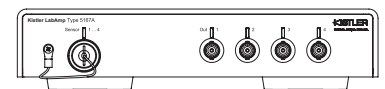
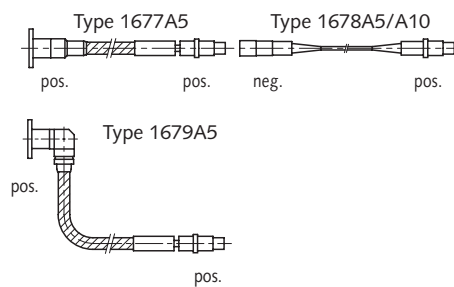
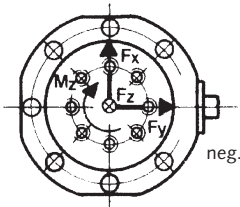
DynoWare Type 2825A... is suitable for data acquisition

4-Component Force-Torque Measurement M_z , F_z , F_y , F_x with 4-Channel Charge Amplifier

Dynamometer
Type 9272

Cable

Charge Amplifier



CH1: M_z
CH2: F_z
CH3: F_y
CH4: F_x

Fig. 8: Example of a measuring system with dynamometer Type 9272

Measured value processing

DynoWare Type 2825A... is suitable for data acquisition

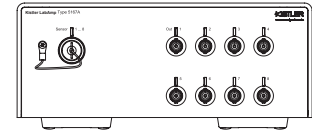
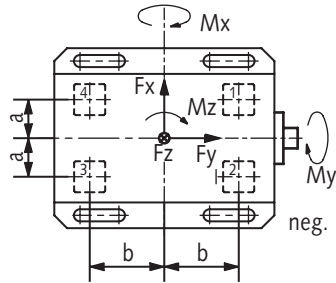
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6-Component Force-Torque Measurement $F_x, F_y, F_z, M_x, M_y, M_z$ with 8-Channel Charge Amplifier

Dynamometer
Type 9119AAx, 9129AA, 9253B,
9255C, 9257B, 9139AA

Cable

Charge Amplifier



- CH1: F_{x1+2}
- CH2: F_{x3+4}
- CH3: F_{y1+4}
- CH4: F_{y2+3}
- CH5: F_z1
- CH6: F_z2
- CH7: F_z3
- CH8: F_z4

Fig. 9: Example of a measuring system with standard dynamometer

Measured value processing

Using the data acquisition software DynoWare Type 2825A..., the six components $F_x, F_y, F_z, M_x, M_y, M_z$ can be calculated conveniently out of the 8 force signals.

Formulae for calculations

$$F_x = F_{x1+2} + F_{x3+4}$$

$$F_y = F_{y1+4} + F_{y2+3}$$

$$F_z = F_{z1} + F_{z2} + F_{z3} + F_{z4}$$

$$M_x = [b \cdot (F_{z1} + F_{z2} - F_{z3} - F_{z4})] kM_x$$

$$M_y = [a \cdot (-F_{z1} + F_{z2} + F_{z3} - F_{z4})] kM_y$$

$$M_z = [b \cdot (-F_{x1+2} + F_{x3+4}) + a \cdot (F_{y1+4} - F_{y2+3})] kM_z$$

a = Distance of the sensor axis from the y-axis

b = Distance of the sensor axis from the x-axis

kM_x, kM_y, kM_z = Correction factor of torque calibration
(special calibration required)

Values a, b from standard Dynamometers

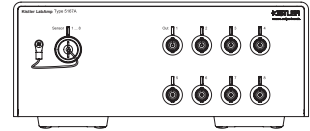
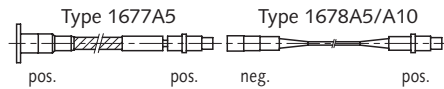
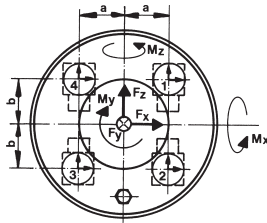
Type	a mm	b mm
9119AA1	28.5	24.5
9119AA2	28.5	32.5
9129AA	33	50.5
9253B	120	200
9255C	80	80
9257B	30	57.5
9139AA	60	78.5

5-/(6-)Component Force and Torque Measurement $F_x, F_y, F_z, M_x, (M_y), M_z$ with 8-Channel Charge Amplifier

RoadDyn Measuring Hub
Type 9295...

Cable

Charge Amplifier



- CH1: $F_x 1+4$
- CH2: $F_x 2+3$
- CH3: $F_z 1+2$
- CH4: $F_z 3+4$
- CH5: $F_y 1$
- CH6: $F_y 2$
- CH7: $F_y 3$
- CH8: $F_y 4$

Fig. 10: Example of a measuring system with RoadDyn measuring hub Type 9295...

Measured value processing

Using the virtual channel functionality the five (six) components $F_x, F_y, F_z, M_x, (M_y), M_z$ can be calculated in real-time.

Formulae for calculations

$$F_x = F_{x1+4} + F_{x2+3}$$

$$F_z = F_{z1+2} + F_{z3+4}$$

$$F_y = F_{y1} + F_{y2} + F_{y3} + F_{y4}$$

$$M_z = [a \cdot (F_{y1} + F_{y2} - F_{y3} - F_{y4})] \cdot kM_z$$

$$M_x = [b \cdot (-F_{y1} + F_{y2} + F_{y3} - F_{y4})] \cdot kM_x$$

$$(M_y) = - [b \cdot (-F_{x1+4} + F_{x2+3}) + a \cdot (F_{z1+2} - F_{z3+4})] \cdot kM_y$$

a = Distance of the sensor axis from the z-axis

b = Distance of the sensor axis from the x-axis

$kM_x, kM_z, (kM_y)$ = Correction factor of torque calibration
(special calibration required)

Values a, b from Dynamometer

Type	a mm	b mm
9295...	80	80

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Included accessories

- Calibration sheet
- Quick-start guide

Optional accessories

- 19" rack mounting tablet for Type 5167A41
- Dummy panel for empty 19" position (1 height unit)
- 19" rack mounting tablet for Type 5167A81
- Dummy panel for empty 19" position (2 height units)
- Inductive proximity switch generates an external trigger signal to start measurement DynoWare 2825A



- Power supply* 24 V incl. country-specific plug 5779A2
- Data Acquisition functionality (if not purchased with the device) 5167A---S1
- KiStudio Lab Software Package (including post processing software jBEAM) 2910A
- jBEAM Professional T&M SW for Measurement Data Analysis 2897A2

* Available as combined kit together with the amplifier

Type/Mat. No.

–
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Type/Mat. No.

5748A1
5748A2
5748A3
5748A4
2233B

Ordering key

LabAmp

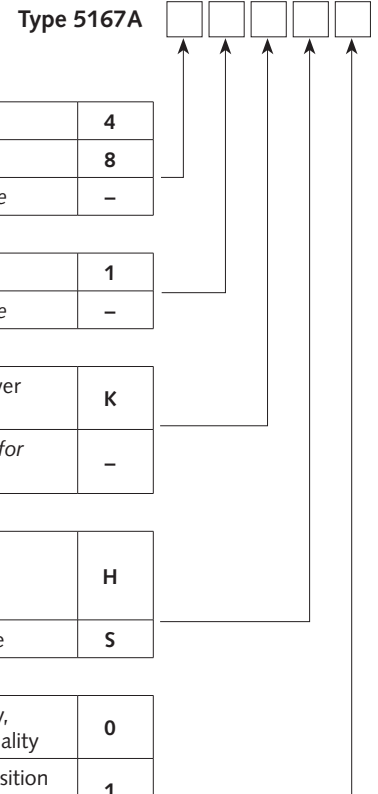
4 channels	4
8 channels	8
SW order for existing device	–

Fischer input connector	1
SW order for existing device	–

Kit with amplifier, 24 V power supply, 2 m Ethernet cable	K
Amplifier only or SW order for existing device	–

Hardware & Software (new device with potential SW features)	H
SW order for existing device	S

Eco version, analog out only, no data acquisition functionality	0
Full version (incl. data acquisition functionality)	1
Full version, incl. data acquisition & DynoWare Type 2825A	2



Configuration examples:

- 5167A81KH2: 8-Channel device with Fischer input connector, incl. power supply & Ethernet cable, incl. data acquisition functionality & DynoWare
- 5167A---S1: Data acquisition functionality for an existing 5167A device

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