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Charge Amplifier

Type 5080A...

Multichannel Laboratory Charge Amplifier

This universal laboratory charge amplifier can be used for force and torque measurements with piezoelectric dynamometers or force plates. Piezoelectric sensors produce an electric charge which varies in direct proportion with the load acting on a sensor. The amplifier converts this charge signal into a proportional output voltage.

- Multichannel charge amplifier
- Piezotron® input (option)
- Setup of instrument is modular
- 1 … 8 modules can be inserted
- 6-component analog summing calculation
- Wide measuring range
- USB and RS-232C interface for remote control
- Suitable for data acquisition software DynoWare Type 2825A

Description

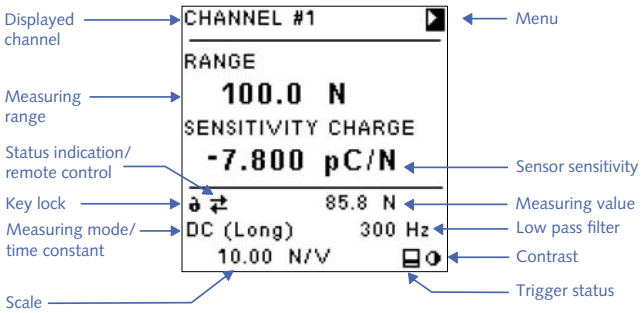
Charge Amplifier Type 5080A… is the successor to charge amplifier Types 5017B… and Types 5019B… . Thanks to the modular design up to eight amplifier modules can be inserted. Charge modules Type 5067A0 with BNC connector are standard, as an option it is as also possible to integrate Piezotron® modules Type 5067A2. A 6-component analog summing calculator Type 5245 is provided by default. This feature calculates the resulting force as well as the three components of the resulting torque real time. Dynamometer-specific values required for torque calculation can be set directly on the instrument.

The liquid crystal display shows all channel settings. Various channels can be switched onto the display as required. The instrument is set up by means of different menus with the universal press-and-turn knob. All functions can, however, also be controlled externally via RS-232C or USB 2.0.

Application

This instrument is particularly suitable for general force measurements, cutting force measurements with Kistler dynamometers and wheel force measurements on tire test stands when a wide measuring range or high quality of signals is needed. Charge amplifier Type 5080A… finds its application in research and development.

Operation



Technical Data

Charge Input

Connector Type		BNC neg.
Measuring range FS	pC	±2 … 2 200 000
Measuring error (0 … 50 °C)		
FS ≥2 ... <10 pC	%	<±2
FS ≥10 ... <100 pC	%	<±0,6
FS ≥100 ... <2 200 000 pC	%	<±0,3
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	typ. <±0,05
at 50 °C, max. relative Humidity RH of 50 % (non-condensing)	pC/s	<±0,3
Overload	%FS	≈±110

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Low Impedance (Piezotron®) / Voltage Input on Dual Mode Type 5067A2

Connector type		BNC neg.
Measuring range FS	mV	±20 … ±30 000 [1]
Measuring error (0 ... 50 °C)		
FS ≥20 mV ... <100 mV	%	<±3
FS ≥100 mV ... <1 V	%	<±1
FS ≥1 V	%	<±0,5
Drift, measuring mode DC (Long) @Range 100 V FS (Gain = 0,1)		
at 25 °C, max. relative Humidity RH of 60 % (non-condensing)	mV/s	<±0,03
at 25 °C, max. relative Humidity RH of 70 % (non-condensing)	mV/s	typ. <±0,05
at 50 °C, max. relative Humidity RH of 50 % (non-condensing)	mV/s	<±0,3
Max. common mode voltage between input and output ground	V	<±25
Piezotron mode		
Supply current (adjustable)	mA/%	1/±25
	mA/%	2 ... 15/±10
Input voltage swing	V	0 … 30 [2]

[1] Upper limit depending on bias current setting; min. 24 V
[2] Max. allowed input voltage

Voltage Output on Charge Amplifier/Dual Mode Module Type 5067

Connector Type			BNC neg.
Output voltage	V		±10/–8 ... 10
Output current	mA		0 ... ±2
Output impedance	Ω		≈10
Measure-jump			
Measure-jump (Long)			compensated
Correction time, inclusive reed-relay delay time	ms		<15
Offset error (Reset)	mV		<±2
Output interference (0,1 Hz ... 1 MHz), charge mode, range FS, LP-filter off (200 kHz)			
≥2 ... <10 pC	mVpp	typ./max.	30/50
≥10 ... <100 pC	mVpp	typ./max.	8/12
≥100 ... ≤2 200 000 pC	mVpp	typ./max.	4/8
Dual Mode output interference (0,1 Hz ... 1 MHz), Piezotron and voltage mode, range FS, LP-filter off (200 kHz)			
Gain 1 (Range FS 10 V)	mVpp	typ./max.	4/8
Gain 2 (Range FS 5 V)	mVpp	typ./max.	6/12
Gain 10 (Range FS 1 V)	mVpp	typ./max.	10/20

Frequency Response on Charge Amplifier/Dual Mode Module Type 5067

DC (Long), LP-filter off		
Frequency range (–3 dB)	kHz	≈0 ... >200
Group delay	µs	≈2

Voltage Output on Summing Calculator Interface (Type 5245) without Piezotron® Option

Connector Type			D-Sub 15f
Analog outputs			8
∑ Outputs (analog)			6
Output voltage	V		0 ... ±10
Output current	mA		0 … ±2
Output resistance	Ω		10
Offset error (RESET)	mV		<±4,5
Measuring error (0 … 50 °C)			
FS <10 pC	%	typ./max.	<±1,1/<±2,1
FS <100 pC	%	typ./max.	<±0,4/<±0,7
FS ≥100 pC	%	typ./max.	<±0,2/<±0,4
Output interference (0,1 Hz … 1 MHz)			
on analog output			
≥2 pC ... <10 pC	mVpp	typ./max.	35/55
≥10 pC ... <100 pC	mVpp	typ./max.	9/17
≥100 pC ... ≤2 200 000 pC	mVpp	typ./max.	5/9
on ∑ Output (analog)			
≥2 pC ... <10 pC	mVpp	typ./max.	50/70
≥10 pC ... <100 pC	mVpp	typ./max.	24/32
≥100 pC ... ≤2 200 000 pC	mVpp	typ./max.	20/28
Frequency range			
Analog output	kHz		0 ... >180
∑ Output (analog)	kHz		0 ... >80

Voltage Output on Summing Calculator Interface (Type 5245) with Piezotron® Option

Connector Type			D-Sub 15f
Analog outputs			8
∑ Outputs (analog)			6
Output voltage	V		0 ... ±10
Output current	mA		0 … ±2
Output resistance	Ω		10
Offset error (RESET)	mV		<±4,5
Measuring error (0 … 50 °C)			
Charge Mode			
FS <10 pC	%	typ./max.	<±1,3/<±2,1
FS <100 pC	%	typ./max.	<±0,5/<±0,7
FS ≥100 pC	%	typ./max.	<±0,3/<±0,4
Voltage / Piezotron Mode			
FS <100 mV	%	typ./max.	<±2/<±4
FS <1 V	%	typ./max.	<±1/<±2
FS ≥1 V	%	typ./max.	±0,8/<±1,5
Output interference (0,1 Hz … 1 MHz), Charge / Voltage Mode			
on analog output			
≥2 pC ... <10 pC	mVpp	typ./max.	35/55
≥10 pC ... <100 pC	mVpp	typ./max.	13/17
≥100 pC ... ≤2 200 000 pC	mVpp	typ./max.	9/13
on ∑ Output (analog)			
≥2 pC ... <10 pC	mVpp	typ./max.	50/70
≥10 pC ... <100 pC	mVpp	typ./max.	24/32
≥100 pC ... ≤2 200 000 pC	mVpp	typ./max.	20/28

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Output interference (0,1 Hz … 1 MHz), Piezotron® Mode			
on analog output			
Gain 1 (Range FS 10 V)	mVpp	typ./max.	10/15
Gain 2 (Range FS 5 V)	mVpp	typ./max.	11/17
Gain 10 (Range FS 1 V)	mVpp	typ./max.	15/25
on ∑ Output (analog)			
Gain 1 (Range FS 10 V)	mVpp	typ./max.	25/30
Gain 2 (Range FS 5 V)	mVpp	typ./max.	26/32
Gain 10 (Range FS 1 V)	mVpp	typ./max.	30/40
Frequency range (–3 dB)			
Analog output	kHz		0 ... >180
∑ Output (analog)	kHz		0 ... >80

Time Constants

Time constants for Short/Medium range FS charge, (Voltage)		
≥2 pC ... <217 pC (≥20 mV ... <2 170 mV)	s	≈0,033/3,3
≥217 pC ... <4 717 pC (≥2 170 mV ... <30 000 mV)	s	≈0,42/42
≥4 717 pC ... <102 400 pC	s	≈10/1 000
≥102 400 pC ... ≤2 200 000 pC	s	≈220/22 000
Time constants for Long range FS charge, (Voltage)		
<217 pC (<2 170 mV)	s	≈10 000
≥217 pC ... ≤2 200 000 pC (≥2 170 mV ... ≤30 000 mV)	s	≈100 000

Drift Compensation (DrCo) for Engine Signals

Working Range (4 stroke)	1/min	≈100 ... 20 000
Compensation Range	pC/s	≈±8 ... ±280
Operation Range	pC	±50 ... ±2 200 000

Low-pass Filter (selectable low-pass filter)

Filter Type		Butterworth
Order		2.
Cutoff frequency (–3 dB)	Hz	10, 20, 30, 100, 300, 600
	kHz	1, 2, 3, 6, 10, 22, 30, 60, 100, (off)
Tolerance (–3 dB)	%	<±10*

* (6 kHz Filter: ±15 % Tolerance)

Refresh Rate LCD

Instant value	s	0,3

Remote Control (Digital input and 24 V supply)

Remote/measure input 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/mA	<1 / <4
Max. input voltage	V	±30
Supply (output)	VDC	18 ... 30
Output current (short-circuit proof)	mA	<200
Pin allocation		
Pin 1	VDC	18 ... 30
Pin 2		EGND
Pin 5		/Measure
Pin 6		DGND

RS-232C Interface (galvanically separated)

EIA/TIA-standard		RS-232C (V.24)
Connector Type		D-Sub 9f
Pin allocation		
Pin 2		RxD
Pin 3		TxD
Pin 5		GND RS
Max. cable length at		
19 200 bps	m	<10
115 200 bps	m	<5
Max. input voltage, continuous	V	<±20
Max. voltage between signal ground and protective ground	V_{RMS}	<20
Baud rates	bps	1 200/9 600/ 19 200/38 400/ 57 600/115 200
Data-bit		8
Stop-bit		1
Parity		none
SW handshake		none

USB 2.0-Full Speed-Interface

Connector type	USB	Type B
Max. cable length	m	5
Driver		FTDI VCP (Virtual COM Port)

Power Supply Connection

Power plug (2P+E, protection class I)	Type	IEC 320C14
Supply voltage setable	VAC	100 … 240
Supply voltage tolerance	%	±10
Supply frequency	Hz	50 … 60
Consumption	VA	≈95
Voltage between signal ground and protective ground	V_{RMS}	max. 40
DC-Supply (optional)		
Supply voltage	VDC	11 ... 36
Current consumption	A	<8
Switch-on current	A	≈15

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General Data

IP-Degree of protection	IP	40 (IEC 60529)
Temperature range	°C	0 ... 50
Min./max. temperature	°C	–10/50
Vibration resistance (20 Hz ... 2 kHz, duration 16 min, cycle 2 min.)	gp	<10
Shock resistance (1 ms)	gp	<200

Housing dimensions		
with frame (WxHxD)	mm	≈497x141x300
without frame (WxHxD)	mm	≈482x132,5x 236,25
Weight	kg	≈10

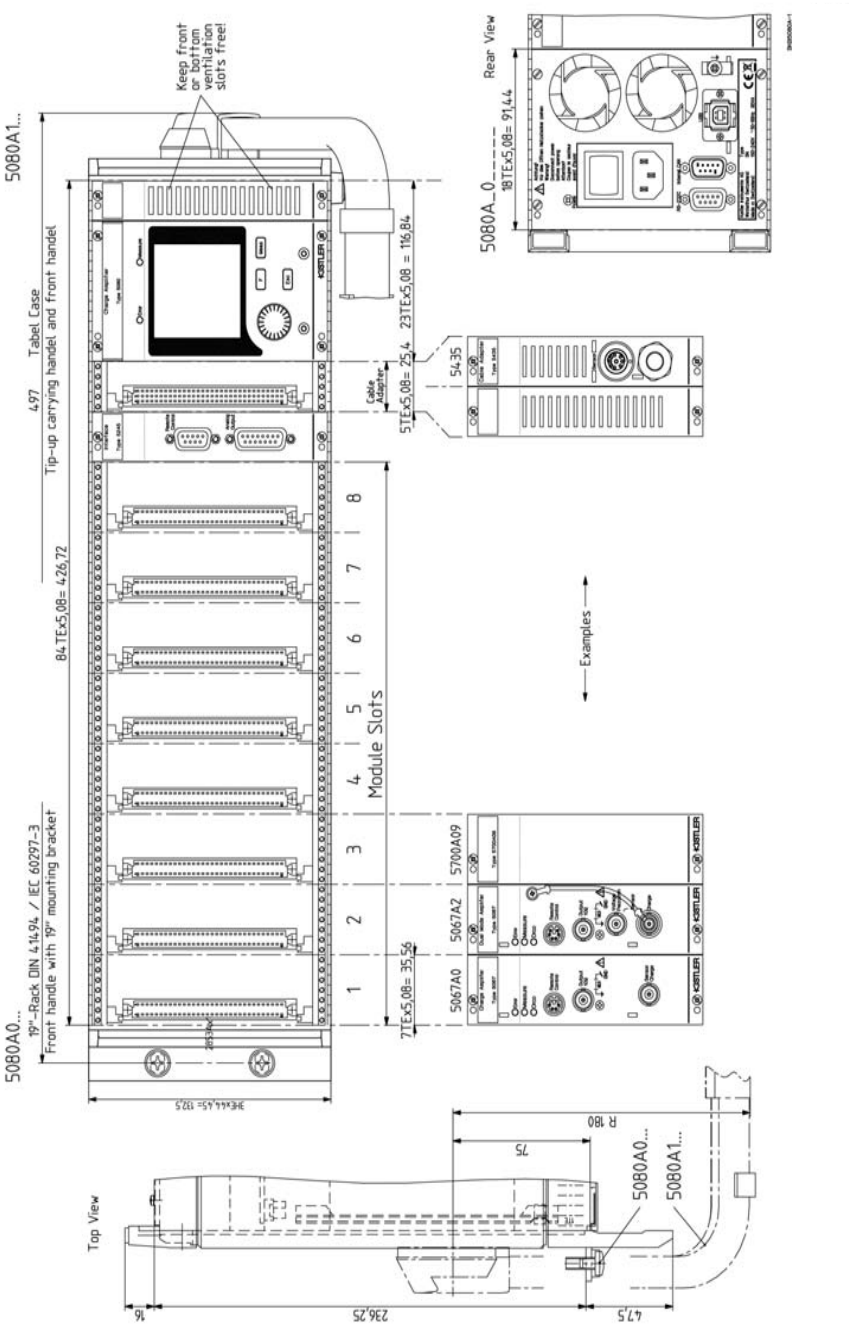

Fig. 1: Dimensions Type 5080A...

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

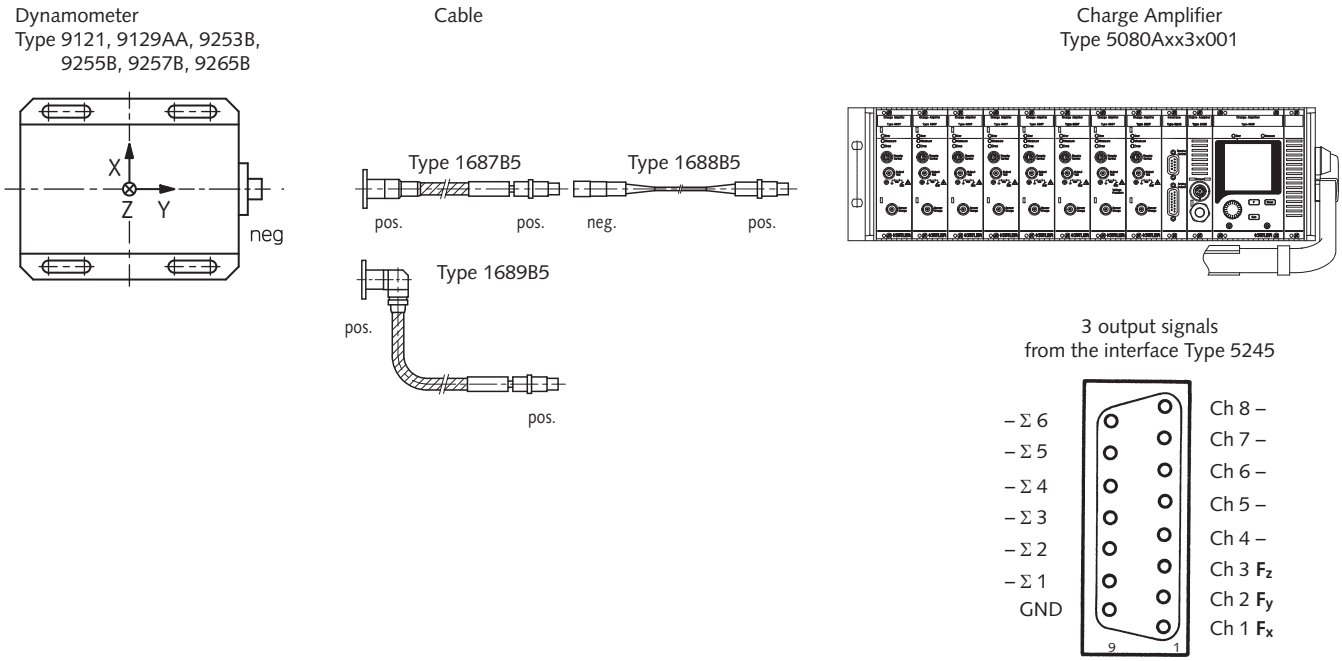

Fig. 2: Example of a measuring system with standard dynamometer Types 9121, 9129AA, 9253B, 9255B, 9257B, 9265B

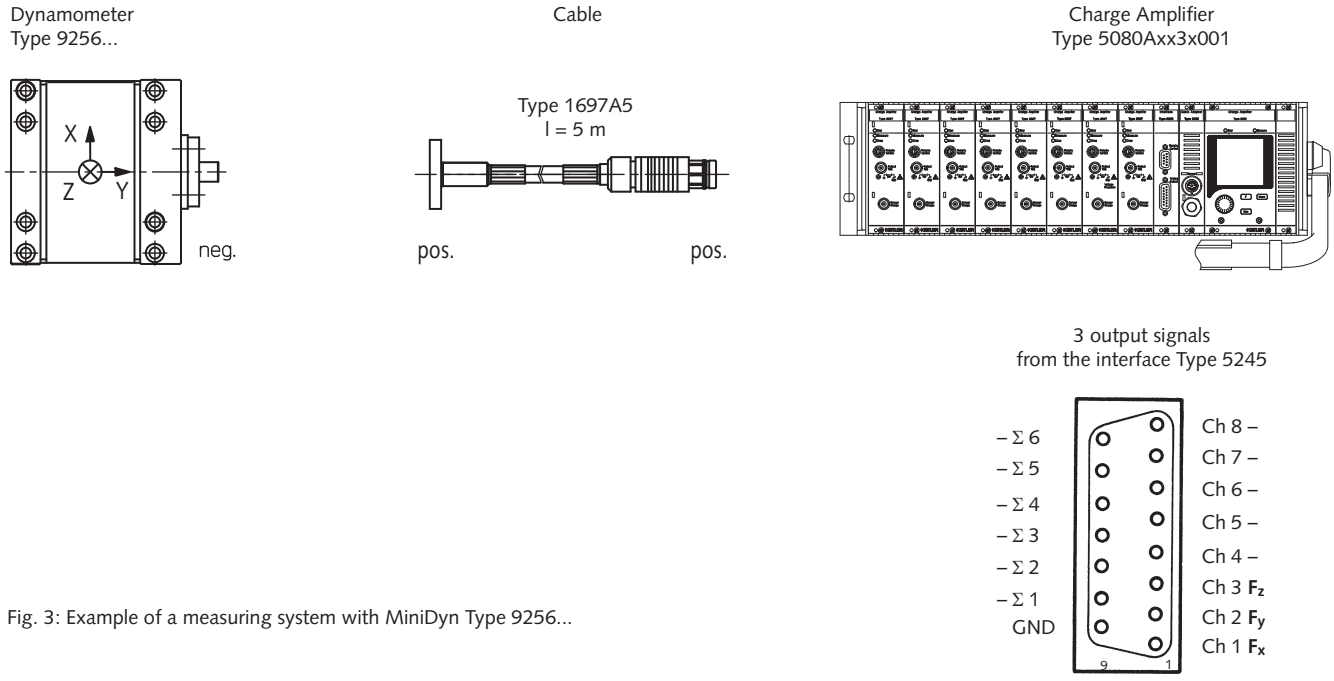

Fig. 3: Example of a measuring system with MiniDyn Type 9256...

Measured Value Processing

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

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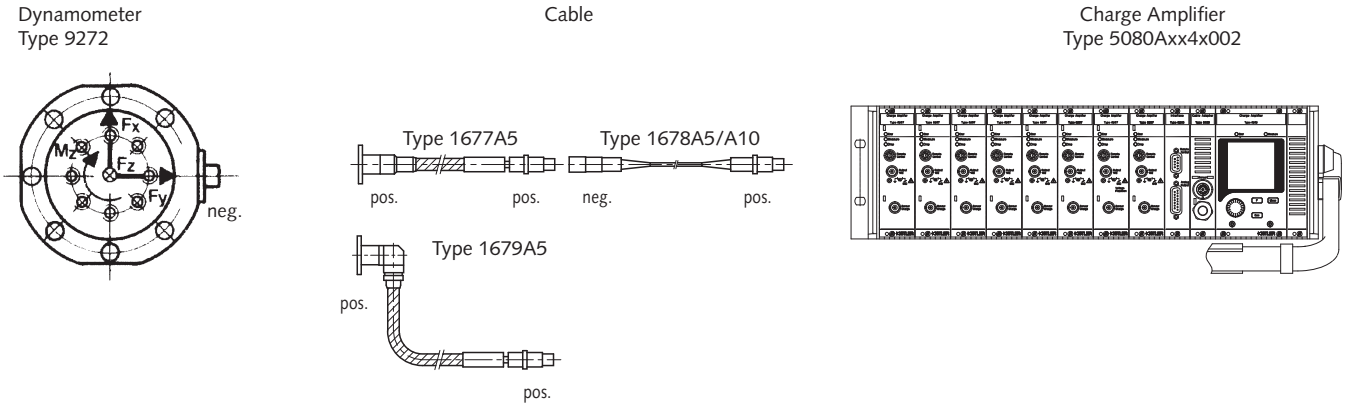
4-Component Force-Torque Measurement M_z, F_z, F_y, F_x with 4-Channel Charge Amplifier



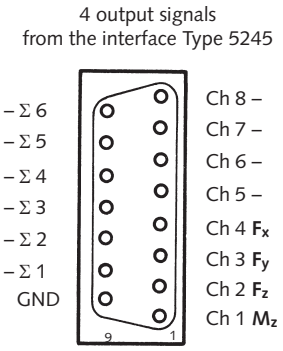


Fig. 4: Example of a measuring system with dynamometer Type 9272

Measured Value Processing

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

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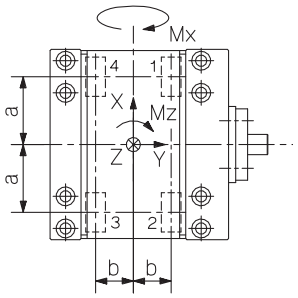
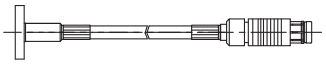
5-Component Force-Torque Measurement F_x, F_y, F_z, M_x, M_z with 6-Channel Charge Amplifier

Dynamometer
Type 9256C...

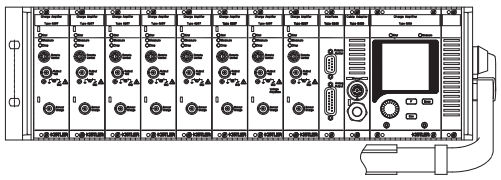


Cable

Type 1696A5



Charge Amplifier
Type 5080Axx6x003



6 output signals
from the interface Type 5245

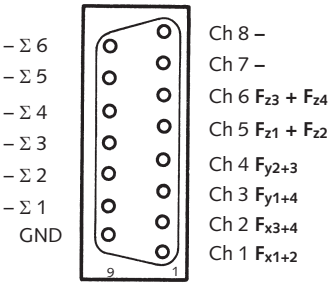


Fig. 5: Example of a measuring system with MiniDyn Type 9256C...

Measured Value Processing

The five components F_x, F_y, F_z, M_x, M_z must be calculated from the six output signals from the charge amplifier. The data acquisition software DynoWare Type 2825A... is ideal for this purpose. Charge Ampflifier Type 5080A is not capable to calculate M_x and M_z.

Formulae for Calculations

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

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

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

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

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

a = Distance of the sensor axis from the y-axis
b = Distance of the sensor axis from the x-axis
kM_x, kM_z = Correction factor of torque calibration
(only to the extent available)

Values a, b from MiniDyn

Type	a mm	b mm
9256C1	28,5	15,5
9256C2	28,5	23,5

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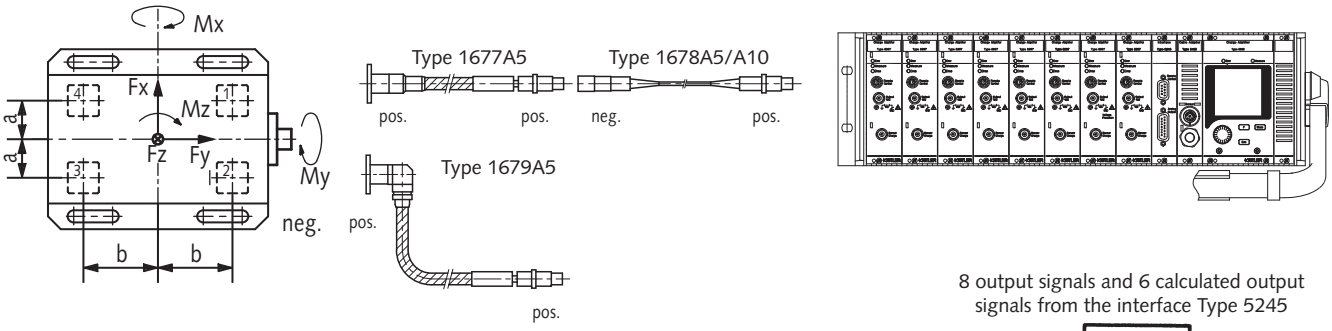
6-Component Force and Torque Measurement F_x, F_y, F_z, M_x, M_y, M_z with 8-Channel Charge Amplifier

As soon as 8 signals are acquired it is possible to calculate F_x, F_y, F_z, M_x, M_y, M_z in the interface Type 5245. The calculated signals can be taken from the D-Sub 15 connector of this interface.

Dynamometer
Type 9129AA, 9253B, 9255B, 9257B, 9265B

Cable

Charge Amplifier
Type 5080Axx80004



8 output signals and 6 calculated output signals from the interface Type 5245

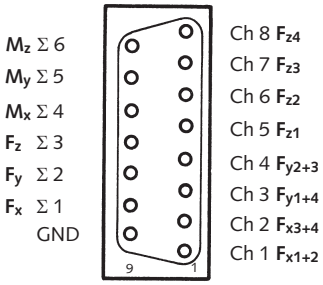


Fig. 6: Example of a measuring system with standard dynamometer

Measured Value Processing

The analogue summing calculator calculates F_x, F_y, F_z, M_x, M_y, M_z in real time mode. DynoWare Type 2825A... is ideal for the data acquisition.

However, DynoWare can also be used to calculate the six components from the eight output signals (ch 1 ... ch 8) from the charge amplifier.

Formulae for Calculations

$F_x = F_{x1+2} + F_{x3+4}$
$F_y = F_{y1+4} + F_{y2+3}$
$F_z = F_{z1} + F_{z2} + F_{z3} + F_{z4}$
$M_x = [b \cdot (F_{z1} + F_{z2} - F_{z3} - F_{z4})]\ kM_x$
$M_y = [a \cdot (-F_{z1} + F_{z2} + F_{z3} - F_{z4})]\ kM_y$
$M_z = [b \cdot (-F_{x1+2} + F_{x3+4}) + a \cdot (F_{y1+4} - F_{y2+3})]\ kM_z$

Input Values Type 5080A

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 only to the extend available)

Values a, b from standard dynamometer

Type	a mm	b mm
9129AA	33	50,5
9253B	120	200
9255B	80	80
9257B	30	57,5
9265B	30,5	58,5

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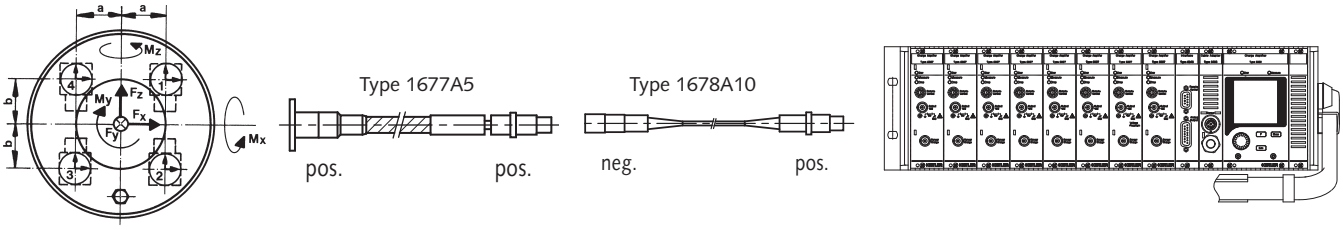
5-/(6-)Component Force and Torque Measurement F_x, F_y, F_z, M_x, (M_y), M_z with 8-Channel Charge Amplifier

RoaDyn Measuring Hub
Type 9295...

Cable

Charge Amplifier
Type 5080Axx80004



8 output signals and 5 (6) calculated output signals from the interface Type 5245

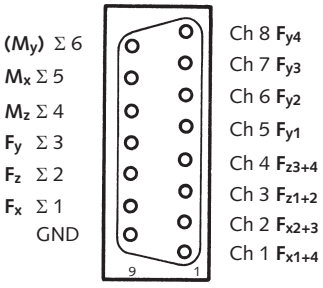


Fig. 7: Example of a measuring system with RoadDyn measuring hub Type 9295...

Measured Value Processing

The analog summing calculator calculates the five (six) components F_x, F_y, F_z, M_x, M_z, (M_y) in real time mode.

Formulae for Calculations

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

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

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

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

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

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

Input Values for Type 5080A

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 (only to the extend available)

Values a, b from Dynamometer

Type	a mm	b mm
9295...	80	80

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Included Accessories

Charge Amplifier Type 5080A... with
- Country-specific power cord
- USB connecting cable Type A to B; length 1,8 m Type 5.590.303
- Instruction manual
- CD-ROM with USB-driver and flash loader
- Calibration sheet

Optional Accessories	**Type/Art. No.**
• RS-232C cable, l = 5 m, null-modem, DB-9P/DB-9S	1200A27
• USB cable (USB-A/USB-B) l = 2 m, lockable	1200A127AL2
• USB cable (USB-A/USB-B) l = 5 m, lockable	1200A127AL5
• Connecting cable for signal outputs from card Type 5245 to the data acquisition *)	1500B15
• Connecting cable for signal outputs (calculated) from card Type 5245 to the data acquisition *)	1500A7
• Connecting cable for signal outputs from card Type 5245 to the data acquisition *)	1700A111A2
• Connecting cable for signal outputs from card Types 5067A0/5067A2 to the data acquisition *)	1500A67
• Inductive proximity switch generates an external trigger signal to start measurement DynoWare Type 2825A-02	2233B
• Distributing box Input: Fischer 9-pole neg. Output: 3 x BNC neg.	5407A
• Distributing box Input: Fischer 9-pole neg. Output: 8 x BNC neg.	5405A
• Connecting cable BNC pos./BNC pos.	1601B

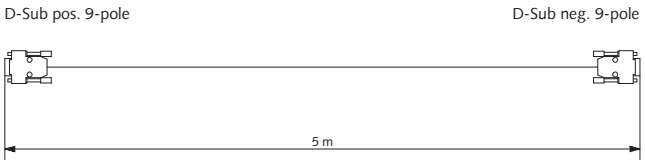

Fig. 8: RS-232C interface cable Type 1200A27

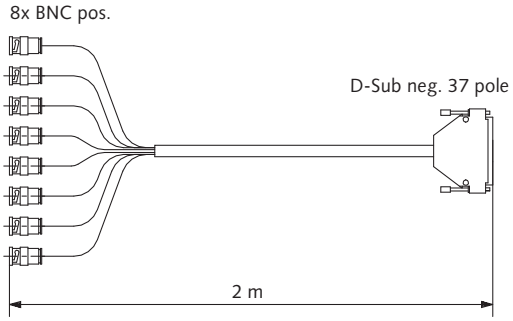

Fig. 9: Connecting cable Type 1500A67

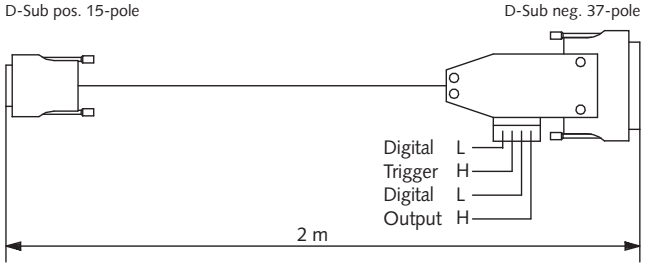

Fig. 10: Connecting cable Type 1500B15/1500A7

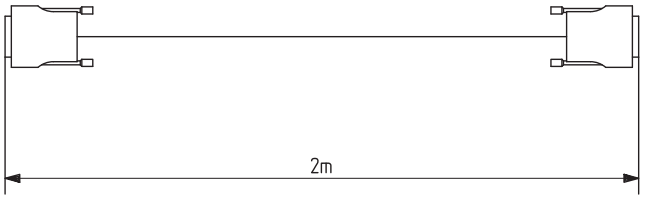

Fig. 11: Connecting cable Type 1700A111A2

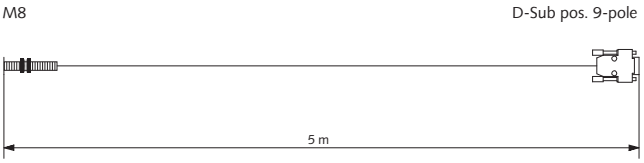

Fig. 12: Inductive proximity switch Type 2233B

*) Connecting cable for signal outputs from charge amplifiers (BNC neg.) to data acquisition. See data sheet of DynoWare Type 2825A... for detailed information.

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Ordering Key

Type 5080A □□□□ 0 0 □

Housing

19" rack module version according to DIN 41494; Width 84 TE, Height 3 HE	0
Desktop version with support bracket	1

Power Supply

100 ... 240 VAC +/–10 %	0
11 ... 36 VDC	1

Quantity of Charge Amplifier Modules with BNC*

No module	0
1 channel	1
2 channel	2
3 channel	3
4 channel	4
5 channel	5
6 channel	6
7 channel	7
8 channel	8

Quantity of Dual-Mode-Amplifier with Charge Input BNC and Voltage (Piezotron®) Input BNC*

No module	0
1 channel	1
2 channel	2
3 channel	3
4 channel	4
5 channel	5
6 channel	6
7 channel	7
8 channel	8

Cable Adapter Plate with Charge Input Fischer 9-pole neg. (Connecting to BNC)

Dummy panel (without Fischer connector)	0
3-channel	1
4-channel	2
6-channel	3
8-channel	4

* Max. quantity of modules: 8; dummy panels are supplied for slots that remain empty

Note:

- Summing calculator interface Type 5245 is an included accessory
- Ideally modules have to be inserted from left to right into the housing without interruptions
- It is possible to shuffle charge amplifier modules and dual-mode modules within these eight slots
- Front plate with Fischer 9-pole connector (cable adapter) must be inserted to the left of the LCD module

5067A0

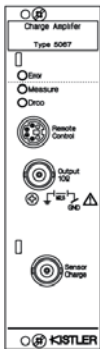

Fig. 13: Charge amplifier module Type 5067A0

5067A2

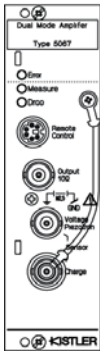

Fig. 14: Dual-mode amplifier module (Piezotron®) Type 5067A2

Fig. 15: Cable adapter plate Type 5435Ax, input Fischer 9-pole neg. and output BNC pos.

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