

Technical Note

F131T0001, valid for F-131.3SD1

EWei, 12/4/2018



F-131.3SD1

X,Y,Z Alignment System



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About this Document

This technical note supplements the user manuals (p. 3). These user manuals are also valid for the F-131.3SD1 except for the information superseded by this technical note.

Other Applicable Documents

The devices and software tools that are mentioned in this technical note are described in their own manuals.

Product	Document
M-122K025	M122T0009
M-122.2DD1	MP61E
WT-100	M110T0025 User Manual
WT-85	M110T0021 Technical Note
C-884.xDC	MS243E
E-727.AS	E727T0012
F-712.PM1	MP165E
C-990.FA1	C990T0001
PIMikroMove	SM148E software manual
Stages with electric motors	MP119EK Short Instructions

Downloading Manuals

INFORMATION

If a manual is missing or problems occur with downloading:

- Contact our customer service department (p. 13).

INFORMATION

For products that are supplied with software (CD in the scope of delivery), access to the manuals is protected by a password. Protected manuals are only displayed on the website after entering the password.

The password is included on the CD of the product.

For products with CD: Identify the password

1. Insert the product CD into the PC drive.
2. Switch to the Manuals directory on the CD.
3. In the Manuals directory, open the Release News (file including *releasenews* in the file name).

4. Find the user name and the password in the section "User login for software download" in the Release News.

Downloading manuals

1. Open the website **www.pi.ws**.
2. If access to the manuals is protected by a password:
 - a) Click **Login**.
 - b) Log in with the user name and password.
3. Click **Search**.
4. Enter the product number up to the period (e.g., P-882) or the product family (e.g., PICMA® Bender) into the search field.
5. Click **Start search** or press the key.
6. Open the corresponding product detail page in the list of search results:
 - a) If necessary: Scroll down the list.
 - b) If necessary: Click **Load more results** at the end of the list.
 - c) Click the corresponding product in the list.
7. Scroll down to the **Downloads** section on the product detail page.

The manuals are displayed under **Documentation**.

8. Click the desired manual and save it to the hard disk of your PC or to a data storage medium.

Safety

Intended Use

The F-131.3SD1 is a laboratory device as defined by DIN EN 61010-1. It is intended for indoor use and use in an environment that is free of dirt, oil and lubricants.

It is suited to the alignment of optical components. The M-111.1DG1 motorized positioners do coarse positioning with longer travel ranges. The integrated P-611 NanoCube® is capable of doing fast scans with high dynamics and precision. Thanks to the high-resolution analog input and the firmware routines of the E-727.AS, automatic alignment processes are made fast and reliable.

The intended use of the F-131.3SD1 is only possible when completely mounted and connected and only in conjunction with the electronics supplied (p. 8) that provide the required operating voltages. To ensure proper performance of the servo-control system, the electronics must also be able to read out and process the signals from the position sensors.

The specifications of the F-131.3SD1 apply to horizontal mounting.

The F-131.3SD1 may only be started up, operated, maintained and cleaned by authorized and qualified staff.

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Safety Precautions

Mechanical Dangers

NOTICE



Mechanical overload of the motion platform!

High torque and high loads can overload the motion platform of the F-131.3SD1. Mechanical overload can cause damage to the motor, guiding, flexure and other parts of the F-131.3SD1 and lead to loss in accuracy.

- Hold onto the base body of the M-111.1DG1 only.
- Do **not** exceed the maximum permissible stress and load capacities according to the specifications (p. 13).



Figure 1: Hold onto the base body of the M-111.1DG1 only when moving the F-131.3SD1 (green arrows).

NOTICE



Wrong screws or incorrectly mounted screws!

The F-131.3SD1 can be damaged if wrong screws are used or if screws are mounted incorrectly.

- Use the screws included in the scope of delivery to assemble the F-131.3SD1.
- Select the screw length according to the depth of the mounting holes (p. 15) of the mounting surface. The scope of delivery also includes two screws M3x5 for this purpose. If the length is not appropriate in your case, get screws with the right length.
- Do **not** let screw heads protrude.
- Only mount the F-131.3SD1 and the load on the F-131.3SD1 using the mounting fixtures (holes) intended for this purpose.
- Pay attention to the torque range (p. 15) given for the screws used during installation.

NOTICE



Damage due to tensile forces on the connecting cables!

Tensile forces on the connecting wires can damage the F-131.3SD1.

- Avoid tensile forces on the connecting cables.

NOTICE



Warping of the F-131.3SD1 due to mounting onto uneven surfaces!

Mounting the F-131.3SD1 onto an uneven surface can warp the F-131.3SD1. Warping reduces the accuracy.

- Mount the F-131.3SD1 onto an even surface. The recommended flatness of the surface is $\leq 5 \mu\text{m}$.
- For applications with large temperature changes:
Only mount the F-131.3SD1 onto surfaces that have the same or similar thermal expansion properties as the F-131.3SD1 (e.g., surfaces made of aluminum).

Product Description

The F-131.3SD1 system represents a 3-axis hybrid solution consisting of motorized coarse axes and dynamic piezo axes. The basis of the alignment system is an XYZ setup consisting of three motorized linear stages from the M-111 series for rough alignment and a P-611 NanoCube[®] nanopositioner for fast and precise alignment. The motorized drives make longer travel ranges possible and at the same time, the NanoCube[®] nanopositioner ensures fast scanning motion and precision positioning. Flexure guides and all-ceramic insulated PICMA[®] actuators guarantee a long lifetime. Because all drives are equipped with position sensors, it is possible for example, to reliably prevent collisions with expensive silicon wafers.

The F-131.3SD1 positioning system is shipped as individual stages and needs to be assembled. All the required brackets, screws, and cables are included. The controllers and an analog-in adapter box with 4 x BNC sockets and adapter cable are also in the scope of delivery.

Product View



Figure 2: F-131.3SD1

Scope of Delivery

Product number	Quantity	Description
M-111.1DG1	3	Compact linear stage, 62 mm width, folded drivetrain, 5 mm travel range, 30 N load capacity, DC gear motor, rotary encoder, leadscrew, 0.5 m cable length
P-611.3SF	1	NanoCube® XYZ nanopositioning system, 100 µm × 100 µm × 100 µm, strain gauge sensors, integrated fiber holder
C-884.4DC	1	Controller for DC motors, 4 axes, USB, RS-232, Ethernet, SPI, I/O, joystick
E-727.AS	1	Digital multi-channel piezo controller, 3 axes, -30 to 130 V, strain gauge sensors, Sub-D 37 socket[, delivery includes cable set, printed documentation and software CD
M-110.03	1	Vertical mounting bracket for M-111 to M-110, M-111, and M-112
M-105.NC	1	Adapter bracket for the P-611 NanoCube® nanopositioning stage to M-105, M-110 - M-112 stages
C-815.LDM1	3	Motor cable, DC motor to controller, HD Sub-D 26 (f) to Sub-D 15 (m), 3 m
F-603.BNC	1	Adapter set for BNC connectors, consisting of F131B0002 adapter box, Sub-D 25 to 4 x BNC and K040B0329 Y cable, Sub-D 25 (f) to Sub-D 15 (m) and Sub-D 26 (m)
F131T0001	1	Technical note for F-131.3SD1
E727T0012	1	User manual for E-727.AS
M110T0021	1	Technical note for M-110, M-111, M-112

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M110T0025	1	User manual for M-11x.xx1
P611T0006	1	Technical note for P-611
MP119EK	1	Short instructions for M-06x, M-11x, M-12x, M-4xx, M-5xx
PZ240EK	1	Short instructions for P-5xx, P-6xx, P-7xx
3763	2	Power cable
C-815.34	1	RS-232 cable
000011448	1	USB cable AB, 3 m
000036360	1	USB cable, 3m USB-A (m) to USB M
C-815.563, 2x	2	FTP patch cord, crossed
C-815.553	1	FTP patch cord 1:1
E-727.IO3X	1	Adapter cable, Sub-D 15m to open end
000023194	2	Desktop power adapter
3742	1	Screw set, including: 16 x screw M3x5 Hex key 2.0 Hex key 1.5
000036450	1	M4 screw set, protective earth CE
E-727.CD	1	Software CD V1.2.0.2 for E-727
C-884.CD	1	Software CD V2.0.0.4 for C-884

Recommended Software

Product number	Description
C-990.FA1	PI FA1 alignment tool, software for automatic fiber alignment, for use with C-884 controller for motorized axes and E-727.AS controller with fast alignment routines (spiraled area scan) for piezo axes with strain gauge sensors.

Accessories

Product number	Description
C-887.MC	Manual control unit for hexapods, USB connector, 3 m cable
F-712.PM1	Optical power meter, 400-1550 nm wavelength range, to 1 mA input current, 20 kHz signal bandwidth, logarithmic output ± 5 V, benchtop device, including power adapter

Installation

Connecting the F-131.3SD1 to the Electronics

Requirements

- ✓ You have read and understood the safety precautions (p. 5).
- ✓ You have read and understood the user manual of the electronics used.
- ✓ The electronics are switched off, i.e., **not** connected to the power source.

Connecting the F-131.3SD1 to the electronics

- Connect the components of the F-131.3SD1 to the corresponding sockets of the electronics (p. 8) used.

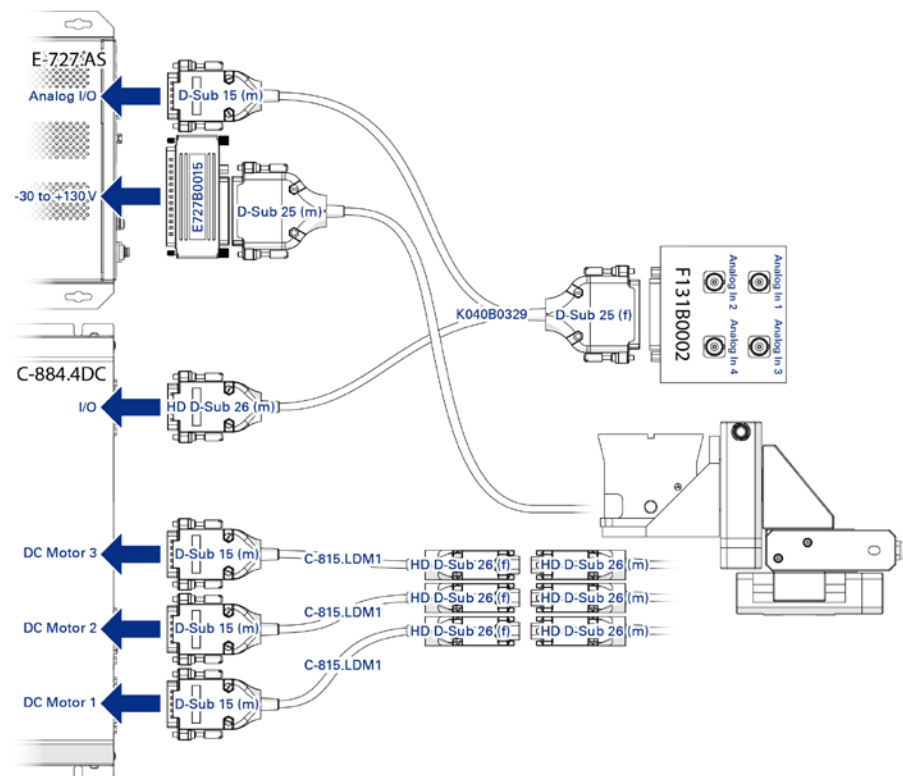


Figure 3: Wiring diagram of the F-131.3SD1

Assembling and Installing the F-131.3SD1

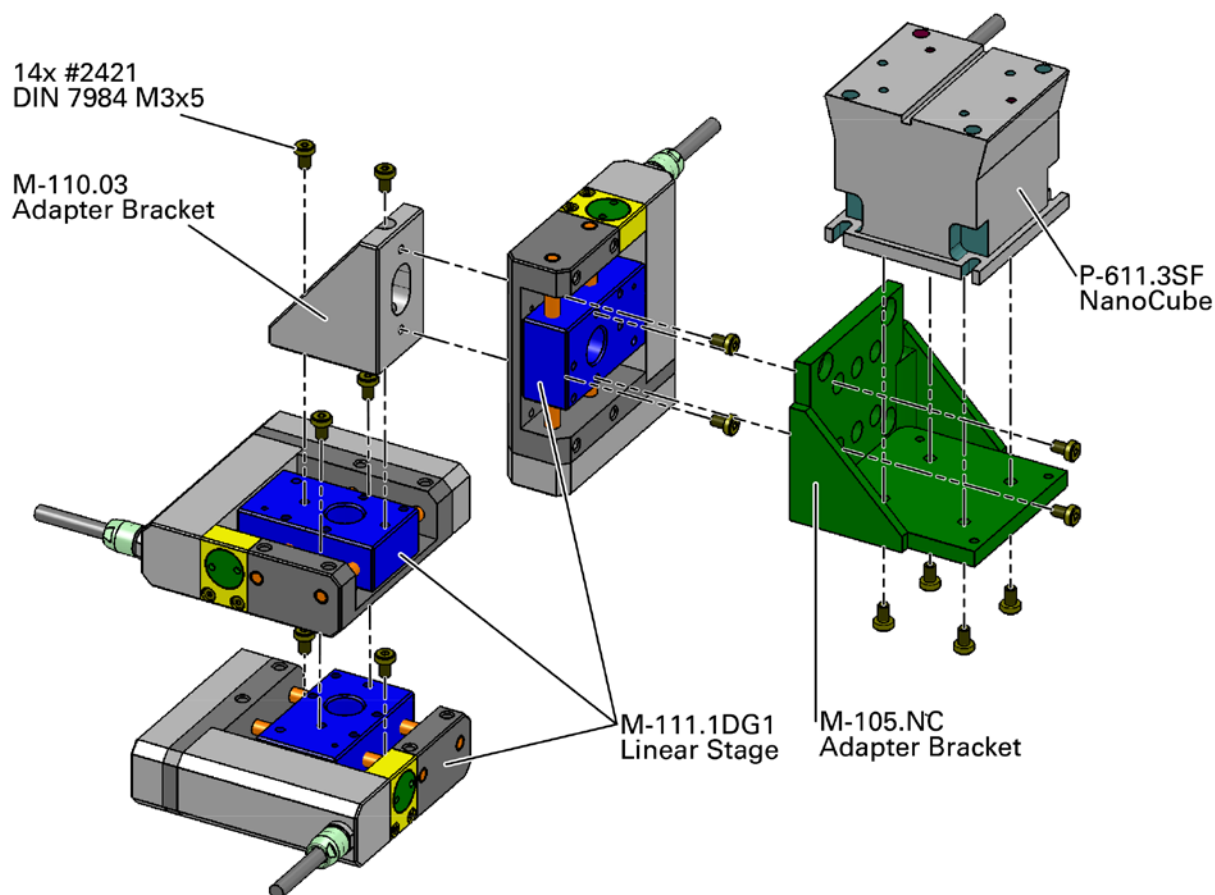


Figure 4: Assembly of the F-131.3SD1

Requirements

- ✓ You have read and understood the safety precautions (p. 5).
- ✓ You have provided a suitable surface with mounting holes for affixing the F-131.3SD1:
 - The flatness of the surface is $\leq 5 \mu\text{m}$.
 - For applications with large temperature changes: The surface has the same thermal expansion properties as the F-131.3SD1 (e.g., surface made of aluminum).

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- ✓ You have accounted for the space required to route cables without bending and according to regulations.
- ✓ You have connected the components of the F-131.3SD1 to the electronics.

Tools and accessories

- Screws of suitable size and length (p. 15)
- Suitable screwdriver

CAUTION



Crushing hazard through moving platform!

There is a risk of minor injuries from crushing between the moving platforms of the F-131.3SD1 and a stationary part or obstacle.

- Keep your fingers away from areas where they can get caught by moving parts.

INFORMATION

The F-131.3SD1 system may only be mounted horizontally.

Assembling and Installing the F-131.3SD1

1. Starting with the bottom M-111.1DG1: Move the platform so that the mounting holes can be accessed.
2. Screw the M-111.1DG1 to the surface. While doing so, observe the torque range (p. 15) specified for the screws.
3. Proceed the same way for the other components from bottom to top. Also see "Figure 4: Assembly of the F-131.3SD1"

Start-Up and Operation

Starting Up and Operating the F-131.3SD1

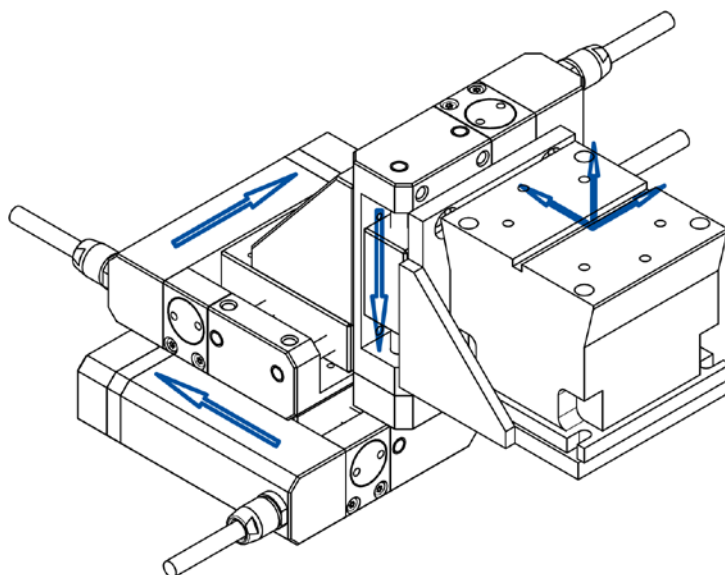


Figure 5: Arrows indicate the positive direction of movement when using standard settings.

Requirements

- ✓ You have read and understood the safety precautions (p. 5).
- ✓ You have installed (p. 9) the F-131.3SD1 correctly and connected it to the electronics (p. 9).
- ✓ You have read and understood the user manual of the electronics (p. 8) used.

Starting up and operating the F-131.3SD1

- Follow the instructions in the manual of the electronics used for start-up and operation of the F-131.3SD1.

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Customer Service

For inquiries and orders, contact your PI sales engineer or send us an email (service@pi.de).

- If you have questions concerning your system, have the following information ready:
 - Product and serial numbers of all products in the system
 - Firmware version of the controller (if present)
 - Version of the driver or the software (if present)
 - Operating system on the PC (if present)
- If possible: Take photographs or make videos of your system that can be sent to our customer service department if requested.

The latest versions of the user manuals are available for download (p. 3) on our website.

Technical Data

Specifications

	F-131.3SD1	Unit
Motion and positioning		
Rough positioning		
Active axes	X, Y, Z	
Travel range in X, Y, Z	15, 15, 15	mm
Typical minimum incremental motion	0.05	µm
Design resolution	0.0069	µm
Typical unidirectional repeatability	0.25	µm
Typical backlash X, Y, Z	3	µm
Max. velocity X, Y, Z	1.5	mm/s
Sensor type	Rotary encoder	
Guide	Ball guide	
Drive type	Drive type	
Fine positioning		
Active axes	X, Y, Z	
Travel range in X, Y, Z, closed loop	100	µm
Typical resolution, open loop	0.2	nm
Typical resolution, closed loop	1	nm
Typical linearity error, for the entire travel range	0.1	%
Typical repeatability (bidirectional)	<10	nm
Sensor type	SGS	
Drive type	PICMA®	

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	F-131.3SD1	Unit
Mechanical properties		
Load capacity	6**	N
Alignment		
Scanning time for spiraled area scan 500 µm Ø, 20 µm line distance	<5*	s
Scanning time for spiraled area scan 100 µm Ø, 10 µm line distance	<2*	s
Scanning time for spiraled area scan 10 µm Ø, 1 µm line distance	<0.5*	s
Miscellaneous		
Operating temperature range, mechanics	-20 to 65	°C
Operating temperature range, C-884.4DC controller	5 to 50	°C
Operating temperature range, E-727.AS controller	5 to 40	°C
Mass	1.5	kg
Cable length	3	m

Technical data specified at 20±3 °C.

*Typical time span for scanning the entire area and moving to the highest intensity

** A mass of maximum 200 g is recommended for dynamic operation

Ambient Conditions and Classifications

The following ambient conditions and classifications for the F-131.3SD1 must be observed:

Area of application	For indoor use only
Maximum altitude	2000 m
Air pressure	1100 hPa to 0.1 hPa
Relative humidity	Highest relative humidity 80 % for temperatures up to 31 °C Decreasing linearly to 50 % relative humidity at 40 °C
Operating temperature	5 °C to 40 °C
Storage temperature	-25 °C to 85 °C
Transport temperature	-25 °C to 85 °C
Overvoltage category	II
Protection class	I
Degree of pollution	1 (mechanics)
Degree of protection according to IEC 60529	IP20

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Dimensions

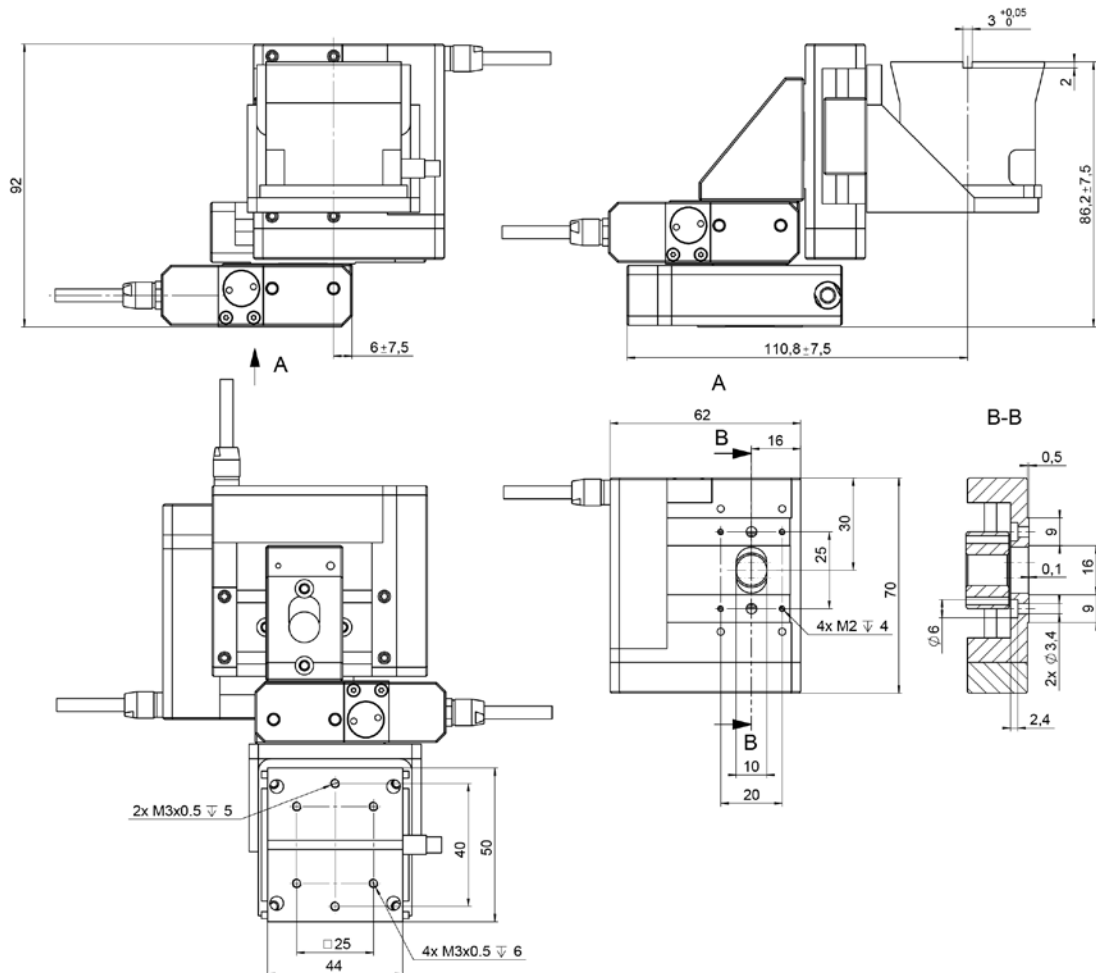


Figure 6: Dimensions of the F-131.3SD1 in mm. Note that the decimal places are separated by a comma in the drawings.

Torque for Stainless Steel Screws (A2-70)

Screw size	Minimum torque	Maximum torque
M6	4 Nm	6 Nm
M5	2.5 Nm	3.5 Nm
M4	1.5 Nm	2.5 Nm
M3	0.8 Nm	1.1 Nm
M2.5	0.3 Nm	0.4 Nm
M2	0.15 Nm	0.2 Nm
M1.6	0.06 Nm	0.12 Nm

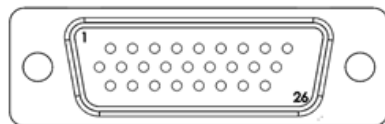
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Pin Assignment

M-111.1DG1:



Pin	Function	Direction
1	Motor +	Input
2	-	-
3	Motor -	Input
4	-	-
5	-	(Input)
6	-	-
7	-	(Input)
8	-	-
9	-	-
10	REF	Output
11	Limit E1 (neg)	Output
12	Limit E2 (pos)	Output
13	-	-
14	-	-
15	-	-
16	-	-
17	ID	Output
18	-	-
19	Encoder A+	Output
20	Encoder A-	Output
21	Encoder B+	Output
22	Encoder B-	Output
23	-	-
24	-	-
25	Limit/Encoder GND	-
26	Limit/Encoder Power (5 V DC)	Input

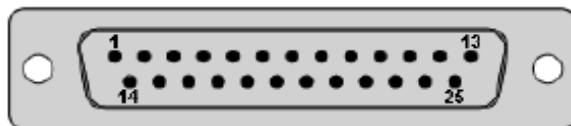
Figure 7: Pin assignment of the M-111.1DG1.

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P-611.3SF:



Pin	Signal	Function
1	Output	SGS 3-B1 sensor signal
2	Input	SGS 3 reference voltage
3	Output	SGS 2-B1 sensor signal
4	Input	SGS 2 reference voltage
5	Output	SGS 3-B1 sensor signal
6	Input	SGS 1 reference voltage
7 to 10	Free	–
11	Input	Piezo voltage +, channel 3
12	Input	Piezo voltage +, channel 2
13	Input	Piezo voltage +, channel 1
14	Output	SGS 3-B2 sensor signal
15	GND	SGS 3 GND
16	Output	SGS 2-B2 sensor signal
17	GND	SGS 2 GND
18	Output	SGS 1-B2 sensor signal
19	GND	SGS 1 GND
20 to 22	Free	–
23	Input	Piezo voltage –, channel 3
24	Input	Piezo voltage –, channel 2
25	Input	Piezo voltage –, channel 1

Figure 8: Pin assignment of the P-611.3SF.

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Old Equipment Disposal

In accordance with EU law, electrical and electronic equipment may not be disposed of in EU member states via the municipal residual waste.

Dispose of your old equipment according to international, national, and local rules and regulations.

In order to fulfil its responsibility as the product manufacturer, Physik Instrumente (PI) GmbH & Co. KG undertakes environmentally correct disposal of all old PI equipment made available on the market after 13 August 2005 without charge.

Any old PI equipment can be sent free of charge to the following address:

Physik Instrumente (PI) GmbH & Co. KG
Auf der Roemerstr. 1
D-76228 Karlsruhe, Germany

