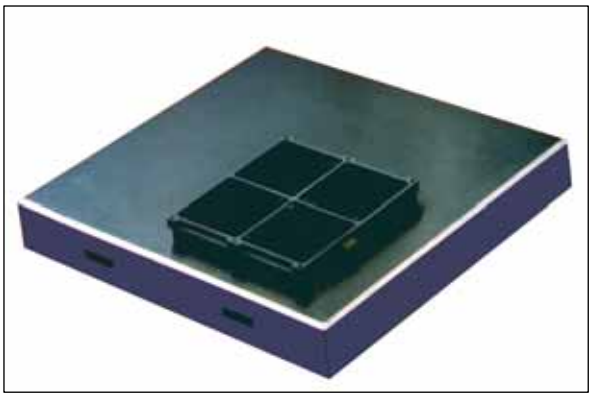
Ruchservomotor Ltd
Direct Drive Systems

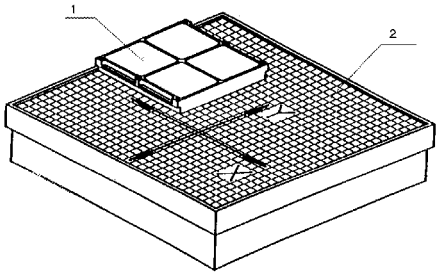
Two-coordinates linear stepping motor (planar motors)

Specific features



- Free motion in two coordinates.
- Positioning on any space plane.
- Compact, low profile design.
- Simple design of a multi-coordinate system in one plane provided by increasing the number of forcers.
- Several coordinate systems with intersecting trajectories in one plane are possible.

Short description.



A planar motor consists of a forcer (1) and an inductor (stator)(2). The inductor is made as a flat plate that carries on its working surface a spaced toothed structure. The forcer contains two groups of orthogonal electromagnetic modules. The forcer modules are encapsulated in hard anodized aluminium frame. The working surface of electromagnetic modules has a spaced toothed structure with a definite phase shift from pole to pole. A built-in pneumatic system with nozzles provides an air gap between the inductor and forcer.

Possible fields of application.

- Assembly operations in microelectronics and instrument engineering:
- LSI and VLSI unwelding.
- Probe monitoring.
- Crystal fitting.
- Surface mounting elements and units assembly.
- Printed circuit board control.
- Laser technological complexes.
- Measuring machines.

Common technical data

Characteristics, measurement units	Data
Forcer type	Hybrid stepping motor
Forcer / Stator thread period , mm	0,64; 1,00
Number of phases	2
Rated current/phase, A	3±0,3
Peak current/phase, A	6
Max. speed, m/s	1,5
Repeatability accuracy, $mm \cdot 10^{-3}$	3
Positioning accuracy, $mm \cdot 10^{-3}$	±15 *
Resolution, $mm \cdot 10^{-3}$	1.0
Air supply pressure, MPa	0,32±0,01
Air gap during operation, $mm \cdot 10^{-3}$	8-12
Air quality	1 micron fine filter, oil-free, dried
Ambient temperature operational band allowed	20°±15

** - depend from forcer model*

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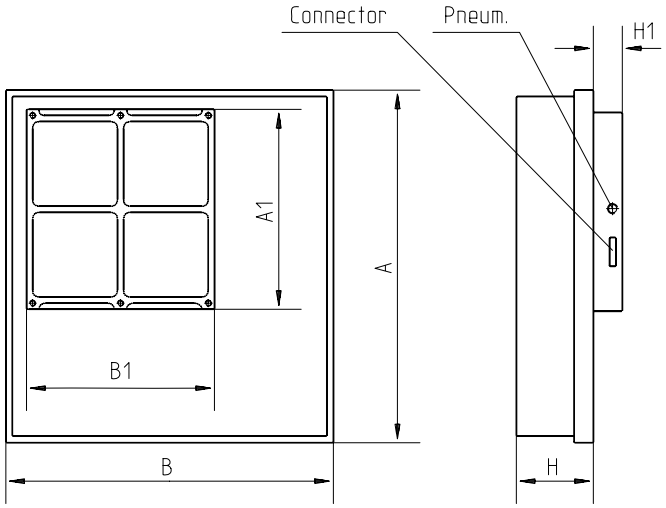
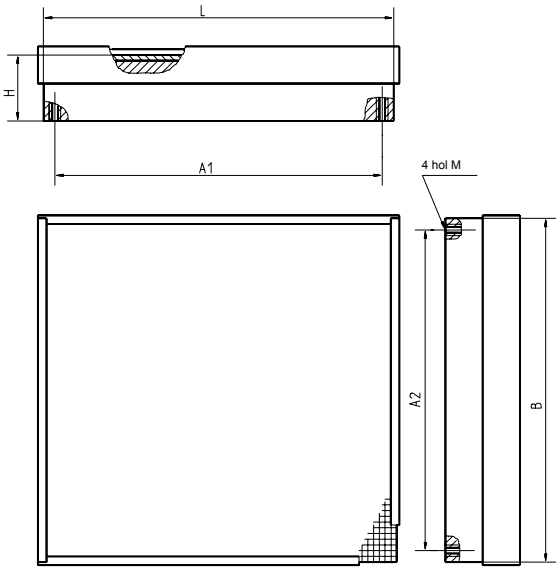
Technical data and overall dimension of the inductor

The inductors are available in different sizes and mounting arrangements up to 2000x1500 mm.

Overall and join dimensions of the inductor



Inductor type	A	B	H	Period division of inductor, mm	Weight
PRM-S -235x245x43,5	235	245	43,5	0,64	15
PRM-S -330x350x45	330	350	45	0,64 or 1,00	30
PRM-S -600x400x100	600	450	100	0,64 or 1,00	75
PRM-S -600x600x83	600	600	83	0,64 or 1,00	80
PRM-S -640x640x80	640	640	80	0,64 or 1,00	95
PRM-S -720x700x83	720	700	83	0,64 or 1,00	100
PRM-S -800x600x100	800	600	100	0,64 or 1,00	120
PRM-S -850x850x100	850	850	100	0,64 or 1,00	155
PRM-S -1000x700x120	1200	700	120	0,64 or 1,00	250
PRM-S -1050x850x120	1200	850	120	0,64 or 1,00	310
PRM-S -1200x900x120	1200	900	120	0,64 or 1,00	340
PRM-S -2000x1000x120	2000	1000	120	1,00	520



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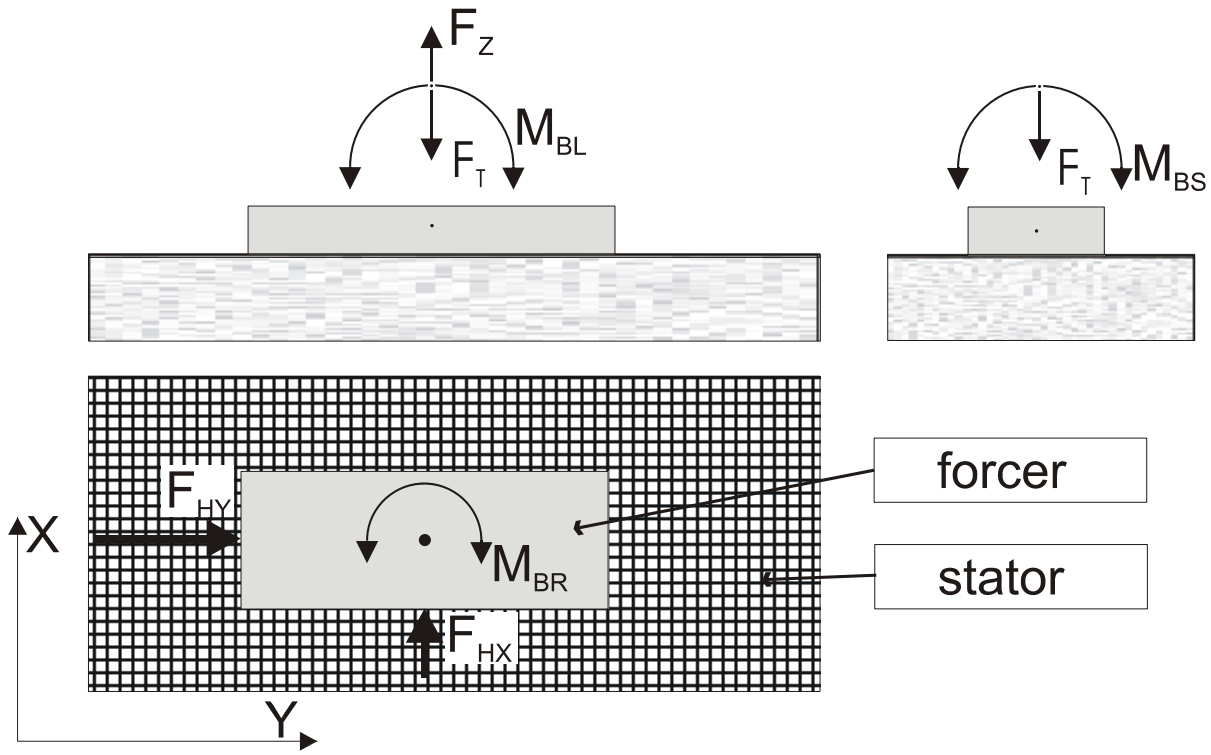

Planar motor forces and moments

Technical data and overall dimension of the forcer

Characteristics, measurement units	PRM-P-1.00-122-130-18	PRM-P-0.64-146-154-18	PRM-P-0.64-120-240-25	PRM-P-1.00-181-240-25	PRM-P-1.00-230-280-25	PRM-P-0.64-146-154-23	PRM-P-0.64-320-168-34	PRM-P-0.64-300-156-25	PRM-P-0.64-320-175-30-HS	PRM-P-0.64-200-154-25	PRM-P-0.64-154-184-28-HS	PRM-P-0.64-115-115-23	PRM-P-0.64-380-360-48-HS	PRM-P-0.64-115-154-23
Ref Nr.	PF20	PF21	PF22	PF23	PF24	PF25	PF26	PF28	PF29	PF210	PF211	PF212	PF213	PF214
Overall dimensions of the forcer (A1xB1xH1), mm	122 x 130 x 18	146 x 154 x 18	120 x 240 x 25	181 x 240 x 25	280 x 230 x 25	146 x 154 x 23	320 x 168 x 34	300 x 156 x 25	320 x 175 x 30	200 x 154 x 25	154 x 184 x 28	115 x 115 x 23	380 x 360 x 48	115 x 154 x 23
Forcer weight, kg	0,7	1,1	1,5	2,1	3.2	1.35	4.3	3.2	3.7	2.3	-	0.7	12	1.2
Air flow rate, liter/min	4	4	6	9	17,5	6.6	12,8	21	21	11,6	6.4	3.2	36.2	5.0
Rated current I, *A*	3.0	3.0	3.0	3, 0	3.0	3.0	3.0	3.0	3.0	3,0	3.0	3,0	6.0	3.0
Resistance, Ohm	3,9	5,6	4,0	3,9	2.5	1.5	2.3	1.3	1.5	1,4	0.8	0.5	0.4	0.5
Inductance, mH	8.1	11	8.4	8.1	6.3	1.3	4.6	3.4	3.6	3,6	1.9	0.8	1.0	0.8
Max. holding force [F_H] ±5%, N														
F_{HX} - coordinate X	25	50	68	90	170	75	180	140	140	140	75	28	350	25
F_{HY} - coordinate Y	25	50	68	90	170	75	180	140	140	70	75	28	350	25
Intrinsic holding force [F_S] at I=0, N	3	5	7	8~10	11~17	8	18	9~14	7~10	7~10	7~8	4~5	30	3
Repeatability, micron	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Positioning accuracy, $mm \cdot 10^{-3}$ *	±25	±20	±20	±20	±20	±10	±10	±15	±10	±10	±10	±10	±10	±10
Resolution, $mm \cdot 10^{-3}$	3	3	3	3	3	1	1	1	1	1	1	1	1	1
Attraction force [F_Z], N	187	360	510	675	1275	560	1350	1000	1000	830	560	200	2500	190
Max. load [F_T], N	145	290	390	530	980	430	1000	800	800	650	430	160	1500	150
Moment [M_{BR}], Nm	1.5	3.2	6.9	9.2	20.2	4.9	24.4	17.0	19.0	12.9	5.8	1.5	56.4	1.6

* - cycle error inside motor thread period
HS – motor with built-in position feedback

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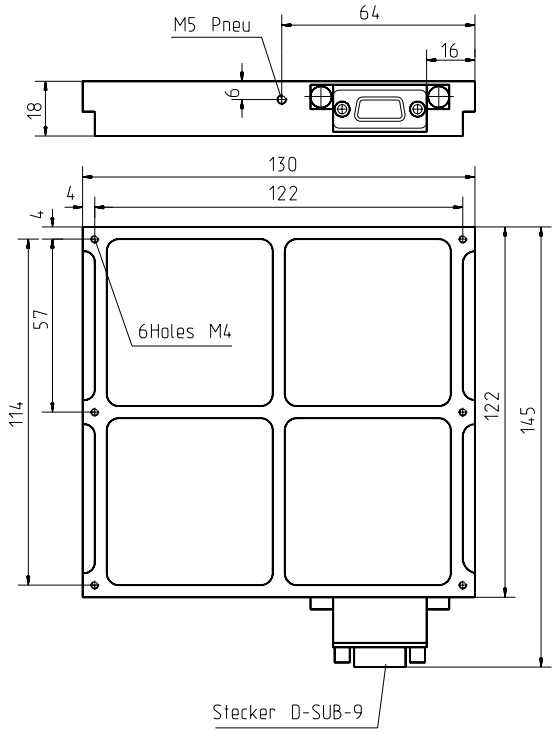
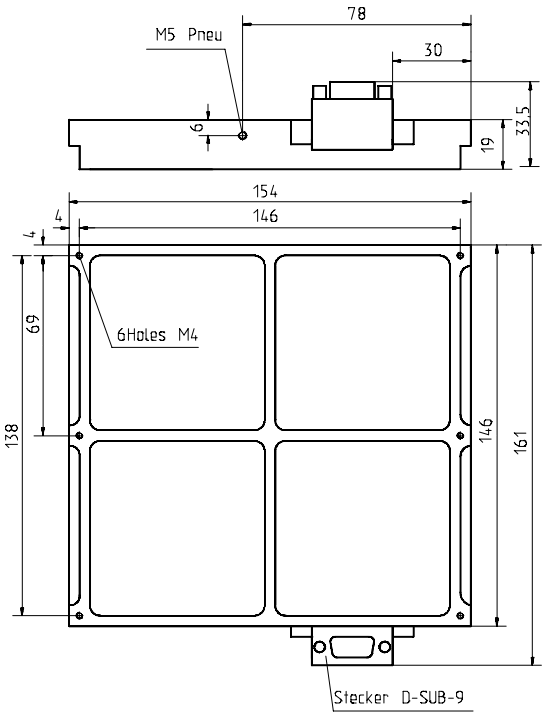
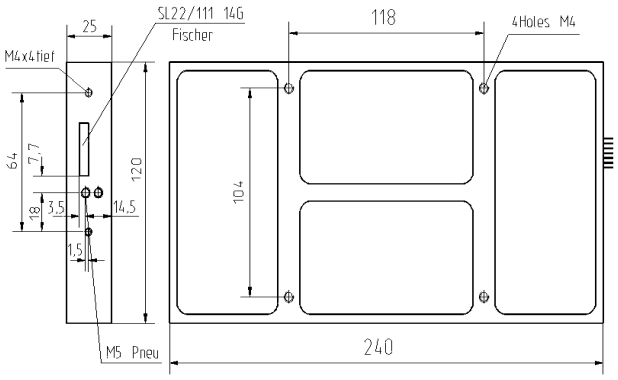
Overall and join dimensions of PRM-P-1.00-122-130-18



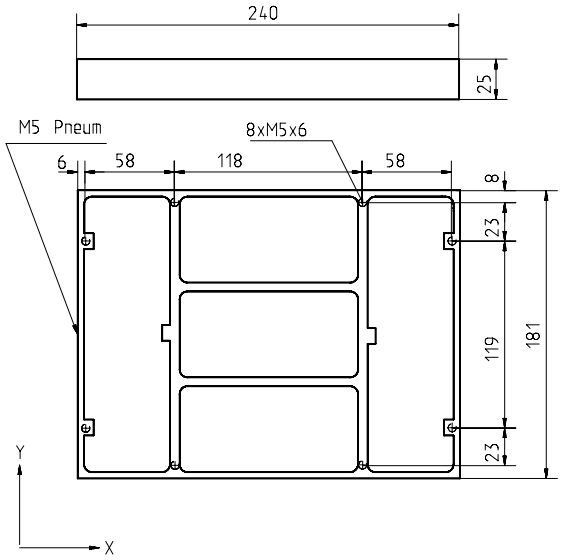
Overall and join dimensions of PRM-P-0.64-146-154-18



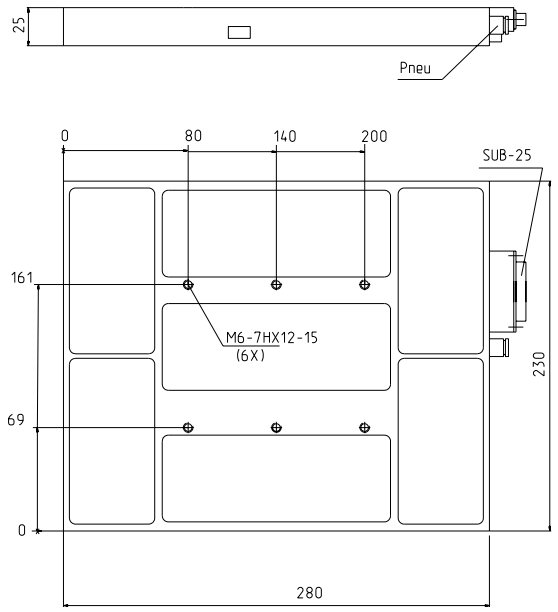
Overall and join dimensions of PRM-P-0.64-120-240-24



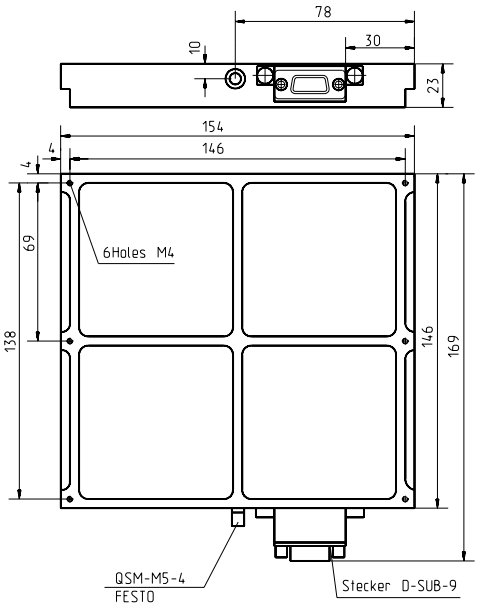
Overall and join dimensions of PRM-P-1.00-181-240-25



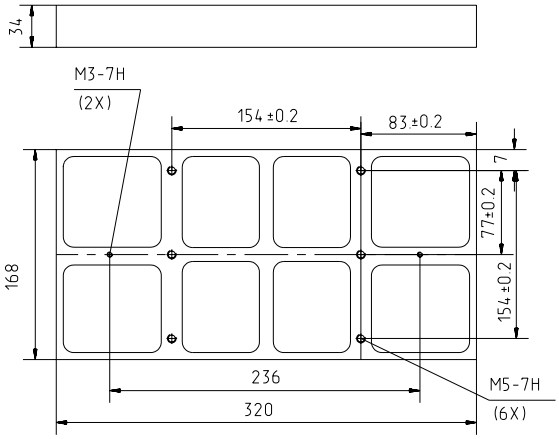
Overall and join dimensions of PRM-P-1.00-230-280-25



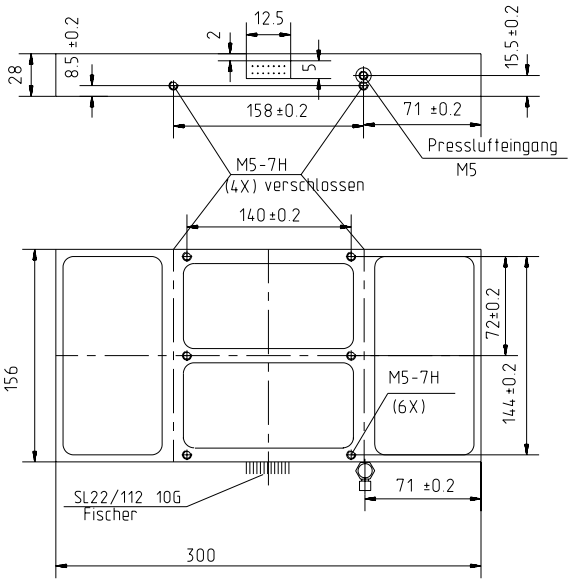
Overall and join dimensions of PRM-P-0.64-146-154-23



Overall and join dimensions of PRM-P-0.64-320-168-34



Overall and join dimensions of PRM-P-0.64-300-156-25



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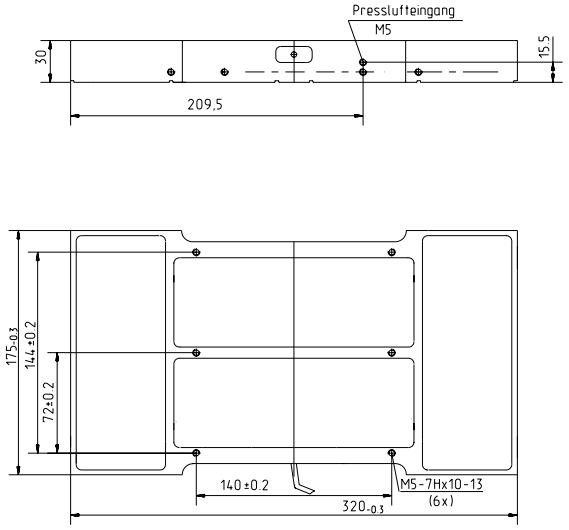
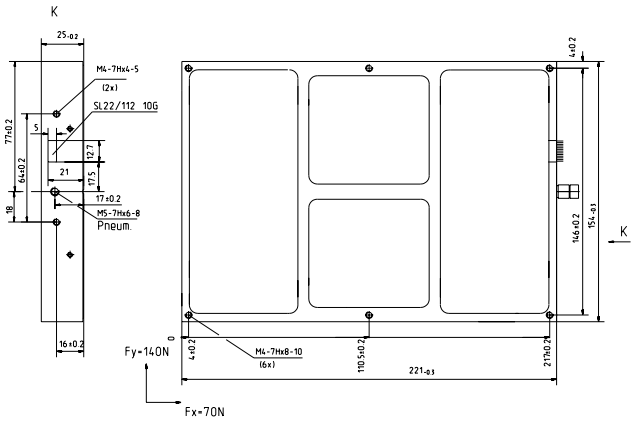
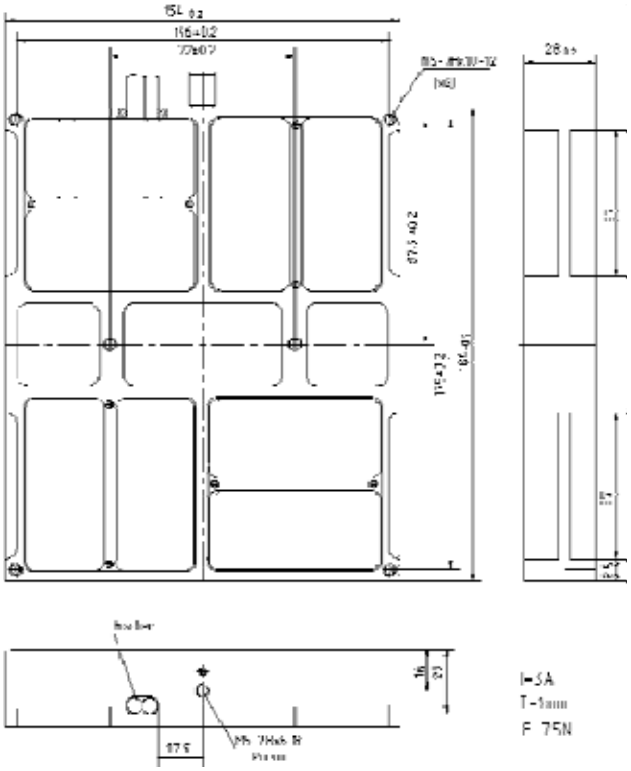
Overall and join dimensions of PRM-P-1.00-320-175-30-HS



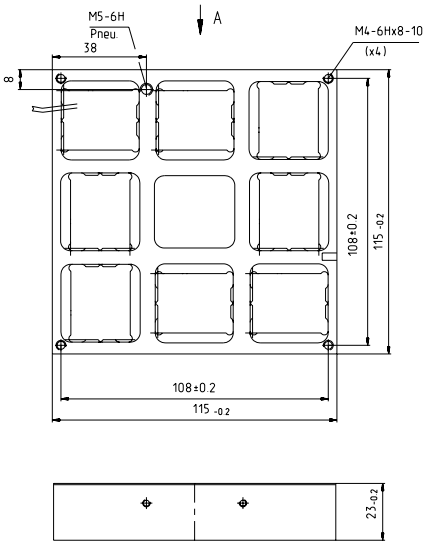
Overall and join dimensions of PRM-P-0.64-200-154-25



Overall and join dimensions of PRM-P-0.64-154-184-28-HS



Overall and join dimensions of PRM-P-0.64-115-115-23



F=28 H
T=0,64mm
I=3A

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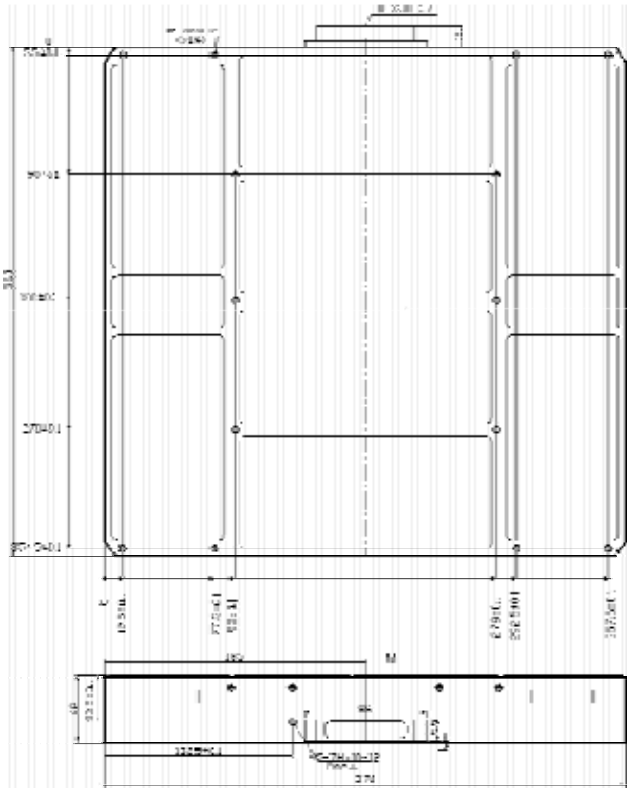
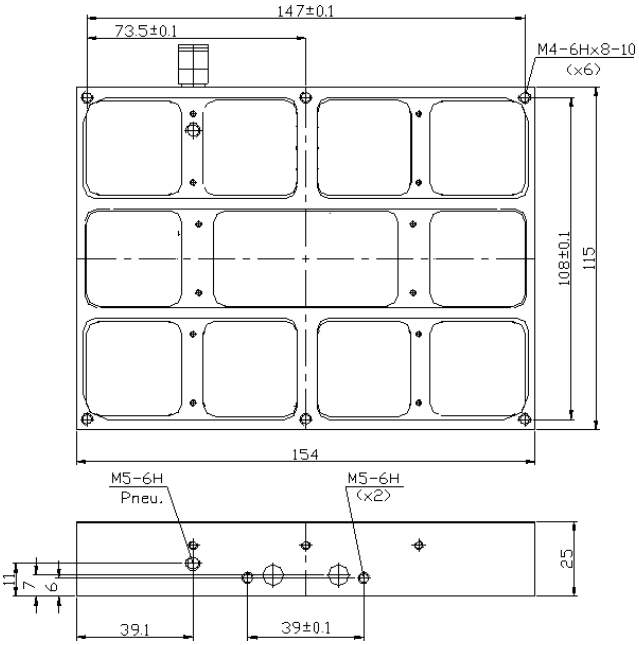
Overall and join dimensions of PRM-P-0.64-380-360-48



Overall and join dimensions of PRM-P-0.64-115-154-23



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Control system.

The principle of controlling our LSM is the same as controlling two or three-phase permanent magnet stepping motor. It is possible to use LSMs in two different modes:

1. Open system without encoder (micro stepping motor);
2. Closed-loop system equipped with encoder (brushless DM motor).

In the first mode windings *A* and *B* are supplied by the sinusoidal current with constant amplitude and a phase shifted on 90°. The current phase changing from 0° to 360° produces a force, which moves the LSM's forcer from 0 to T_z. Software realises trapezoidal law of LSM velocity changing with control of the maximum velocity and acceleration/deceleration when motion for point-to-point movement.

The second mode of operating uses encoders to know the forcers position.

It is recommended to use the second mode of LSM control (brushless DM motor) when requirements of positioning accuracy and motion velocity are higher. In this mode phase φ of the currencies $Usin\varphi$ and $Ucos\varphi$ of LSM winding is defined by the position *x* of the LSM forcer: $\varphi=2\pi x/T_z$.. Position *x* is measured by the encoder and current amplitude the PID position or velocity regulator of LSM determines U.

For realisation of the both modes above the following control system is used. (Fig. 4)

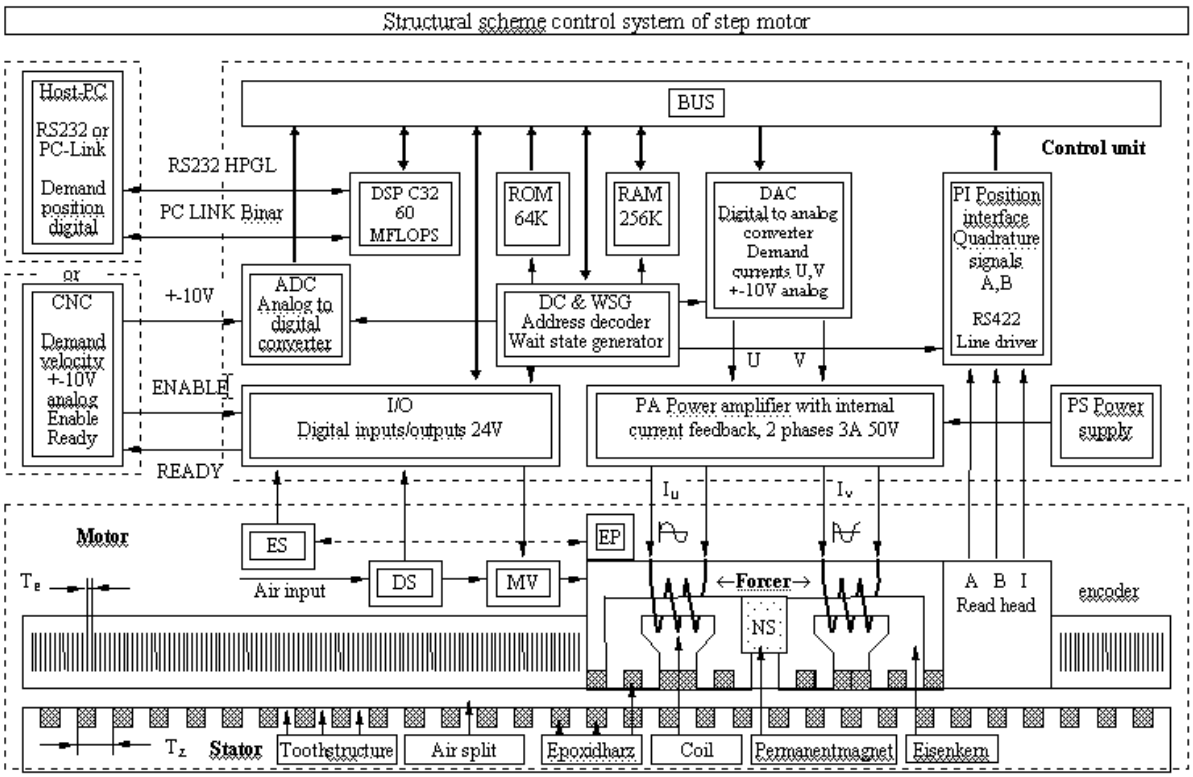


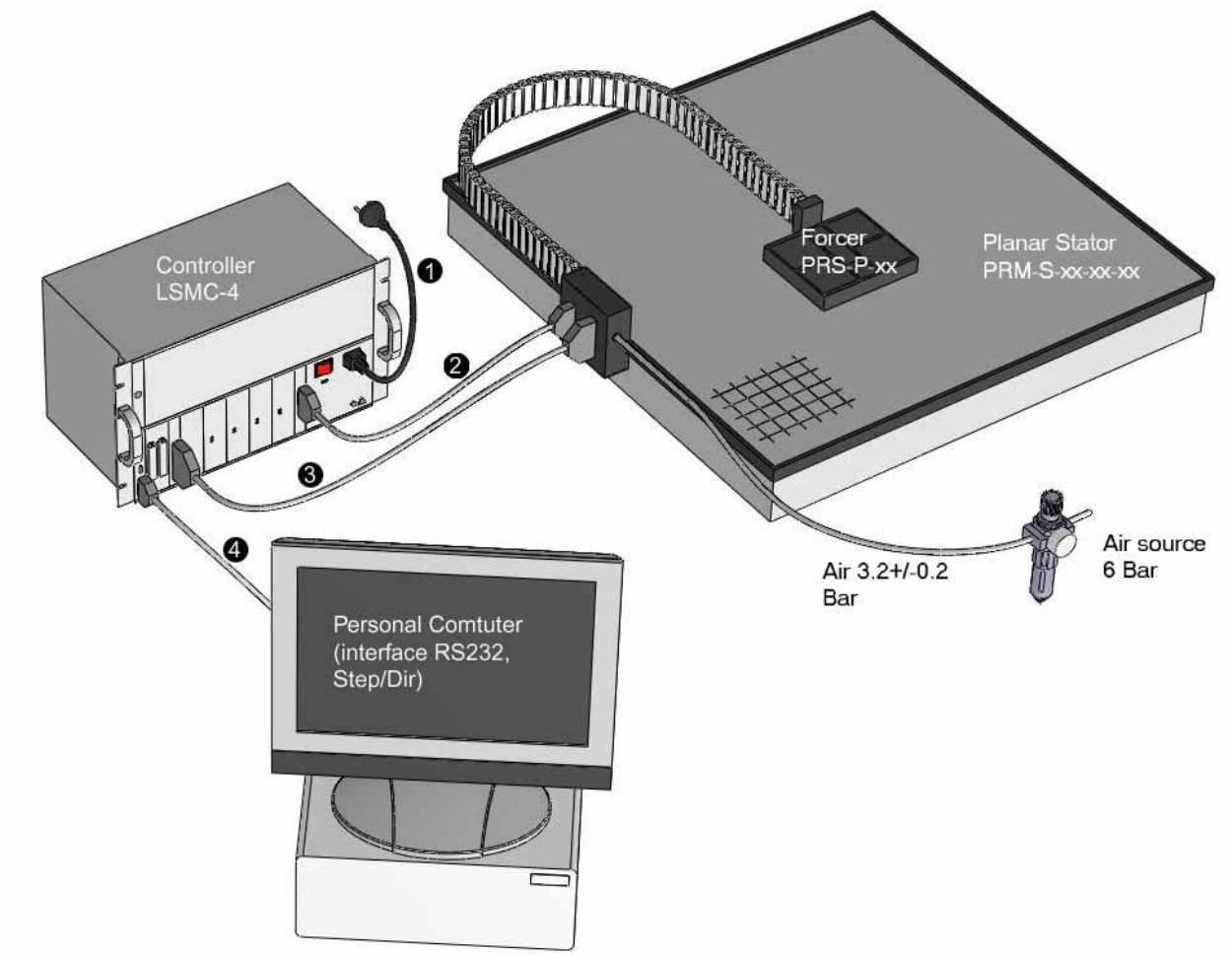
Fig. 3

The DSP C32 performing the function of the TPU control processor provides a calculation of demand currents for the phases A and B of LSM. Currents tasks DC_A and DC_B are converted to the analog form by the DAC four (eight) -channel digital-to-analog converter and input in to the power amplifiers PU. All PU amplifiers carry out a control function for the two phases of one co-ordinate LSM. They have current feedback and provide support for an independent of back electromotive force appearing during the motion for a given phase current.

If LSM is position closed-loop (mode of disconnect direct current motor), forcer measuring encoder checking device ENC and positioning interface board are added to the system. For purpose of the LSM position initialling RS end switches are used.

For high-level control system can be used a PC (RS-232 serial interface, program interfaces HP-GL, Excellon for the control as single LSM, as milling and drilling machines up to 2.5 axis). Or standard CNC (analog interface ±10v, velocity tasks, program interface DIN-ISO for the control as single LSM, as milling machines up to 5 axis). In the latter system it is required to add four-channel digital-to-analog converter board.

Planar Servomotor System Configuration:



Default configuration of Control system LSMC-x for close-loop control:
- Digital processor board DSP C32F;
- Servo board UC48NQ;
- 4 power amplifier PU2 (±35V, 3A) or PU6 70V, 3A);
- Power supply PS512 (5B,±12B - 200W),
- Power supply PS235 ±35B x 10A;
- Digital cross-board MB5,
- Amplifier cross-board PAT;
- Case 6U 19".

Optional:
USB-interface board: UT1,
Step/Dir Interface board IDP-n (there n – number of controlled coordinates),
I/O board: SPSIO-16,
Power supply 24V, 60W: PS-24

Cables:
1. Power cable 250V, 10A, length 1.8m(optional 3m)
2. Motor cable CLSM-P-20 DS - length 2.0m (optional 5m)
3. Encoder cable CLSM-E-20 DS- length 2.0m (optional 5m)
4. RS232 cable CLSM-RS-20 DS- length 2.0m (optional 10m max.)

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Technical specifications of the control system boards

Type	Features
DSP-Board **C32 F**	• DSP TMS320C32, 60 MHz, 60 Mflops, Float Point commands, 2 Timers, 2 DMA, programmable Wait States, Boot from FLASH, Boot from Link. • 512K x 16 Bit Flash, 256K x 32 Bit zero wait states SRAM, 64K x 16 Bit Ports • Serial interface RS232, standard D-Sub-9M connector on front panel • Serial synchronous interface RS422 TI 10 Mbod for connecting multiple boards C32F • 8 TTL Inputs, 6 TTL Outputs • Watchdog • LEDs for Status, Error, power supply 5V, 12V on front panel • Multiple boards on one Bus possible • Timer signal on Bus • FLASH-Software for linear and circle interpolation, 3 Axes, DIN/ISO or HPGL
Servo board **DEP48**	• 4 incremental encoder inputs A,B,I rs422 • 8 channels DAC 12 bit 10 V bipolar • 4 optically isolated inputs 24 v • Complete solution for 4 axis Servo drive
Servo Board **UC48**	• Control step and brushless PM motors • 4 channels for analog inputs sin-cos-ref 11 mkA for 4 encoders • Software interpolations for encoder resolutions up to 4096 times • Nanometer resolutions with standard 20 mkm encoders • 8 inputs analog 12 Bit 10 V bipolar for demand currents or velocities of axes • 4 opto-coupled inputs 24 V for reference switches • Complete control up to 4 servo-axis (Portal X1,X2,Y,
Input/Output Board **SPSIO**	• 16 Inputs 24 v, 10 mA, optocoupled, negative polarity protected • 16 Outputs 24 v, 1 A, over-current protected, inductive load protected • Base address setting by jumper

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Step / Dir Interface Board **IDP4**	• Step / Direction Interface for 4 axis • Euro-board 160 x 100 mm, Eurobus connection with 64 pin connector • D-Sub-37 connector for four Step, Dir, Reset and Ready signals. • Complete control up to 4 stepper or servo-axis (Portal X1,X2,Y,Z) • 4 channels RS422 Interface • Base address settings per jumper, multiple boards at the same bus possible
Power Amplifier board **PU2**	• 2 current-feedback half-bridge amplifiers • Power supply voltage 35-50 V, output current 3 A • Two bipolar analog inputs 10V for demand current • Complete solution for two-phase micro-step and servo motors
Power Amplifier board **PU6**	• 2 current-feedback full bridge amplifiers • Power supply voltage 70 V, output current 6A • peak current 9A. • Two bipolar analog inputs 10V for demand current • Complete solution for two-phase micro-step and servo motors

More detailed datasheets is possible to download from internet site
http://www.ruchservomotor.com/html/controllers_boads.htm

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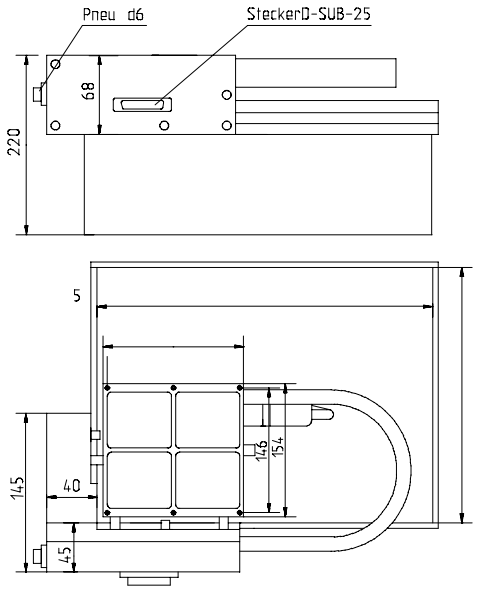
PLANAR BLOCK

Short description

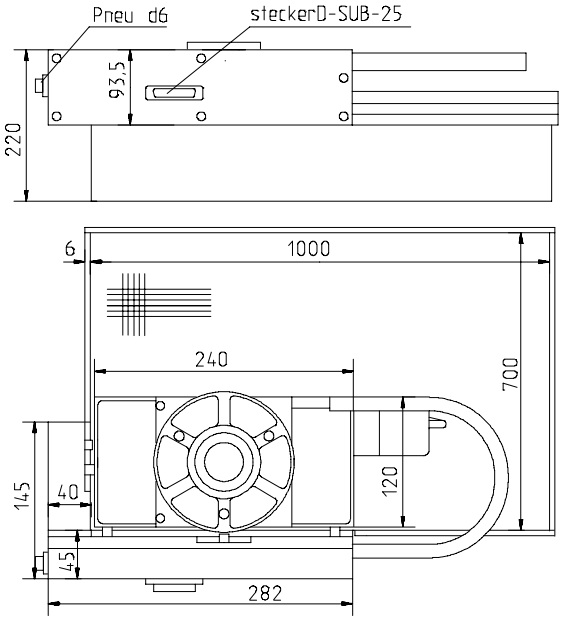
The planar motor with stator and joint equipment XY-600x600, XYF-1000x700 on the basis of stepping motor includes: stator, planar motor, rotary stepping motor (in XYF), basic racks, 2 inductive sensor of a zero - position, cable holder, air-filter/regulator and stator frame.

Overall and join dimension

XY-600x600



XYF-1000x700



Technical data

Characteristics, measurement unit	XY-600x600	XYF-1000-700
Overall dimensions, mm	140x645x650	220x1046x750
Mass, kg	82	250
Mass of a mobile part, kg	1.0	2.6
Air split, mm·10^{-3}	15	15
Air pressure, MPa	0.3±0.04	0.3±0.04
Compressed air consumption, litre/min	4	16
Rated current/phase, A	3.0	3.0
Force in movement direction, N	40	63
Max moment, N·м	-	1.3
Repeatability X,Y, mm·10^{-3}	3	3
Repeatability on F	-	20’
Max speed, m/s	0.5	0.5
Max speed, rad/s	-	12
Division period on X and Y, mm	0.64(1.28)	0.64(1.28)
Division period on F, deg	-	1 ^{0}
Positioning accuracy, mm·10^{-3}	±25	±25
Angular accuracy, arcmin	-	1
Resolution, mm-10^{-3}	3.0	3.0
Resolution F, arcsec	-	10”

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Handling instructions

1. Before the first placing of the forcer on the stator you must clean both surfaces with a cloth and oil free of resin. Before the forcer moving automatically for the first time it should be driven over the whole surface of the stator by hand. With that motion you have to ensure that the easy running is guarantied at every point. To do this the forcer must be connected to the compressed air. If the forcer is not moved easily you must clean the surfaces again and inspect the blow out air on the air nozzles of the air bearing by hand.
2. The surface has to be oiled and wiped regularly.
3. The forcer is only allowed to be removed from the stator with the level (optional) for model with holding force less 75N or parallel pulling the motor to a stator plate sideways for others .
4. The forcer must be placed on the surface slowly (pay attention to high magnetic forces).
5. Cables are allowed to be connected or to be removed only at switched off power of the amplifier.
6. If the motor operates without any air adapter you should pay attention to keeping the minimum pressure or otherwise the motor will be damaged. You will find the recommended operation air pressure in the type sheets.
7. The surface of the stator has to be protected against blow and shock.
8. The surface should not be allowed to be cleaned with solvents. There are only spirit and oil suitable. After a certain period of operation the stator surface may be polluted due to the environmental conditions. Pay attention to the environmental conditions. Pay attention to the following advises for the cleaning:
    - spray the stator with oil free of resin
    - the forcer should be moved over the whole surface of the stator with switched off control system, by hand (with switched on compressed air)
    - the detergent is removed with a cloth and with that the forcer always is replaced

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Ordering information

Each motor (module) basically consists from a primary part (forcer with coil) and a secondary part. For select the proper linear stepping motor model using the next code.

Note: at order the rotary motors you don't need order the secondary part. It is actuated in the forcer ordering code

Ordering code for stepping motors (linear and rotary)