Appendix A

Mechanical Hardware of the Positioning Subsystem in the Near-field Scanning System

The mechanical hardware of the positioning subsystem, including programmable motors, stepper drives, motorized slides and peripheral components, was commercially bought and then assembled and wired at GGIEMR. TABLE A.1 is a checklist of the commercially bought components. This section describes the mechanical structure and the most important characteristics of each component. Full specifications of all the components can be found in [1-4] most of which are available online.

TABLE A.1 Checklist of the main mechanical components

Item	Manufacturer	Model / Part No.	Quantity
Motorized slide	Velmex [1]	BiSlide	4
Programmable motor	Parker Hannifin [2]	SY872	1
Programmable motor	Parker Hannifin	SY563	2
Stepper drive	Parker Hannifin	ViX500	3
Power supply	LG motion [3]	N/A	1

Four motorized slides, which were driven by programmable motors, were used to construct the *x*-, *y*-, and *z*-axis tracks of the positioning workbench, as illustrated in Fig. A.1. The *x*-axis track was the base of the whole workbench so two parallel slides were used to provide solid construction. Axes of the two slides were center-to-center coupled to synchronize the motion. The *y*-axis slide was mounted on the *x*-axis track, and the *z*-axis slide was mounted on the *y*-axis slide. Thus the bench provided 3D positioning with 4 slides and 3 motors. Detailed structure of the slides is shown in Fig. A.2. At the “motor plate” end of each slide (except one

of the two *x*-axis slides), a motor was mounted onto the plate and coupled to the axis of the slide.

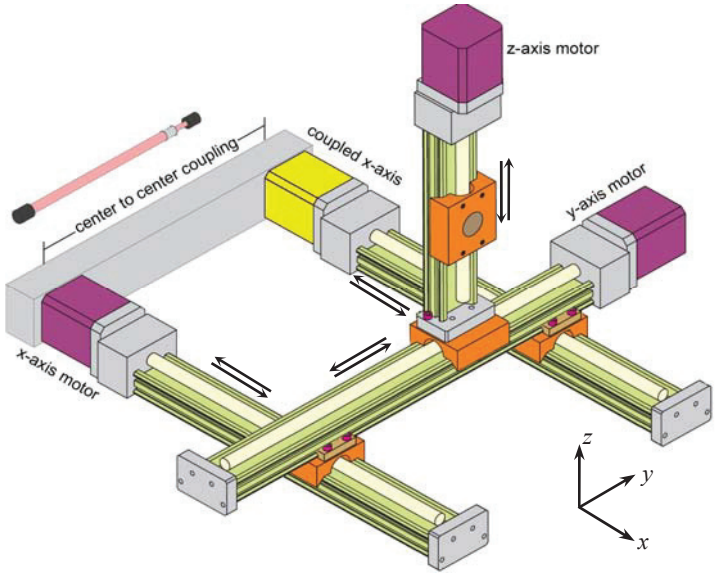
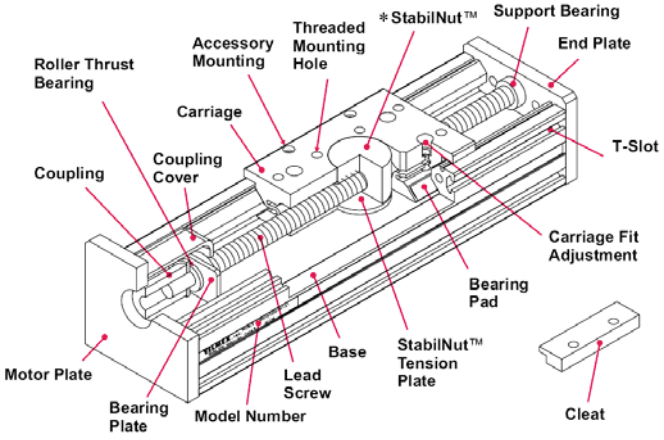


Fig. A.1 Construction of the positioning subsystem



* StabilNut™ is a Velmex exclusive low friction connection between the lead screw and carriage

Fig. A.2 Configuration of the slide [1]

The most important characteristics of the positioning subsystem are the load capacity and motor torque, which are shown in Fig. A.3 and Fig. A.4, respectively. Both quantities are a function of the maximum speed allowed, thus these specifications determine the motion speed of a particular scan. The *x*-axis track, which is the base of the workbench, is driven by a motor

with a greater torque.

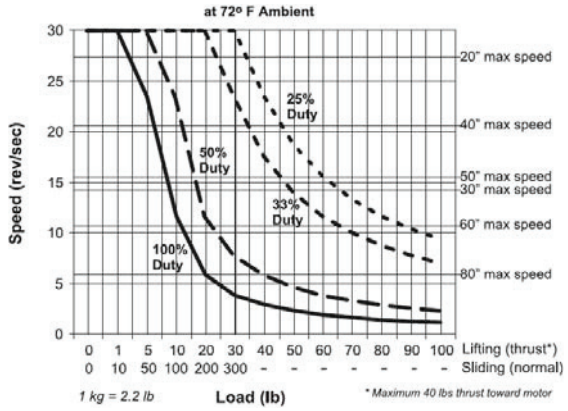
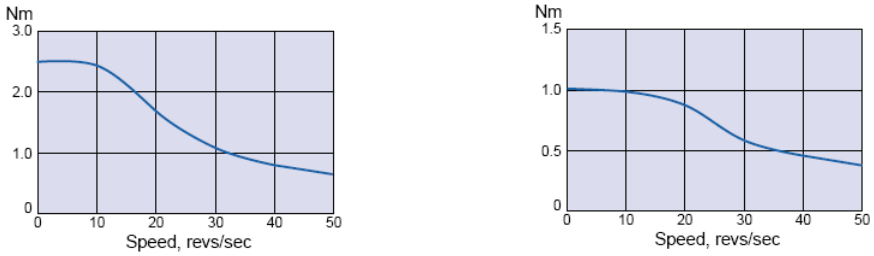


Fig. A.3 Speed-load curve of the slide [1]



a) Motor for x-axis track

b) Motors for y- and z-axis tracks

Fig. A.4 Motor performance data [2]

Each motor is driven by a separate stepper drive. The stepper drives encode the motion algorithms received from the controlling software to motor-recognizable codes, and send them to the servo panel to drive the motors. Flowchart of the software design was presented in Section 2.3. Wiring from stepper drives to the computer, power supply, and motors was finished according to the pin layout of the stepper drive as illustrated in Fig. A.5.

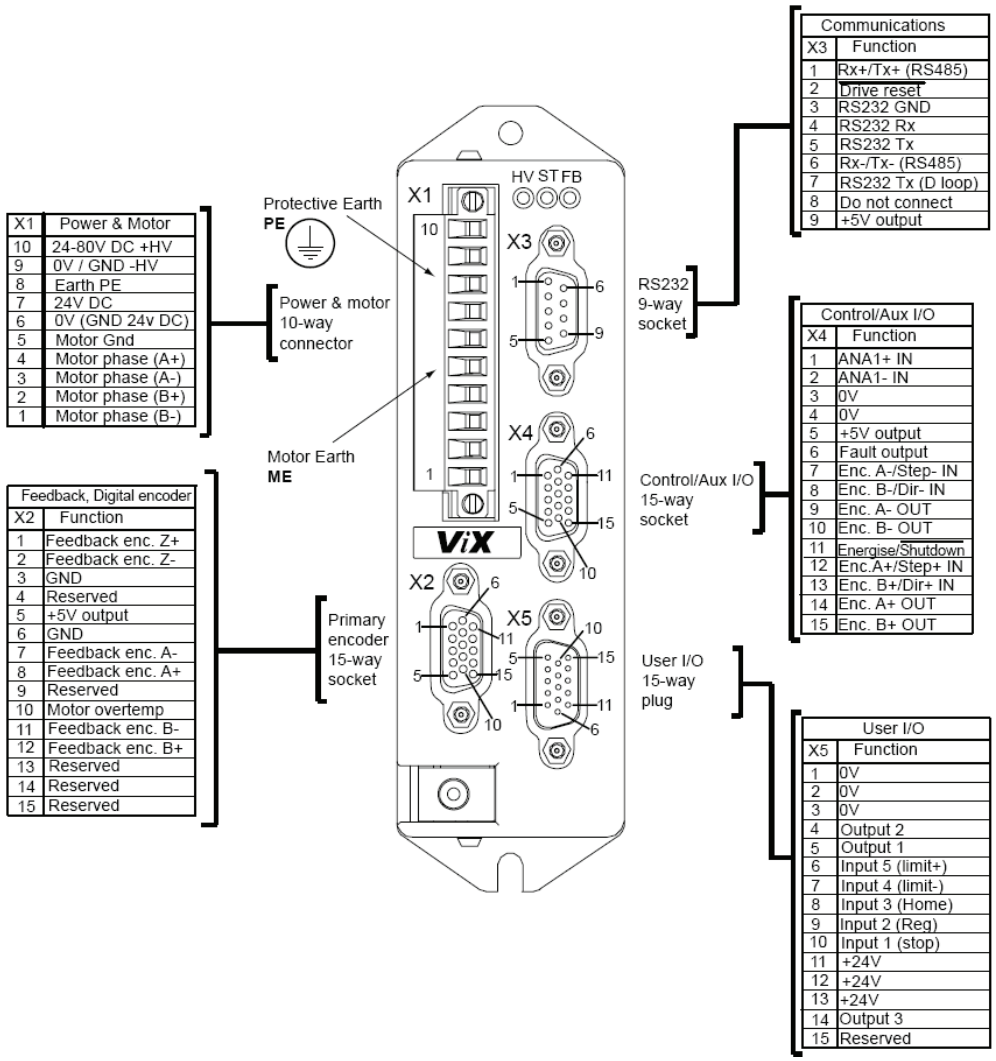


Fig. A.5 Connector pin layout of the stepper drive [4]

References

[1] (2010) *BiSlide Assemblies*, Velmex Inc., [online]. Available: http://www.velmex.com/bislide/motor_bislide.html.

[2] (2010) SY Stepper Motors Data Manual, Parker Hannifin Eletromechanical Division Europe, Offenburg, Germany, [online]. Available: http://www.parker-eme.com.

[3] (2010) LG Motion homepage. [online]. Available: http://www.lg-motion.co.uk.

[4] *ViX 250/500IM Stepper Drivers User Guide*, Parker Hannifin Eletromechanical Division Europe, Offenburg, Germany, 2004.