Mover system for BPM

Bino

BPM energy spectrometer meeting

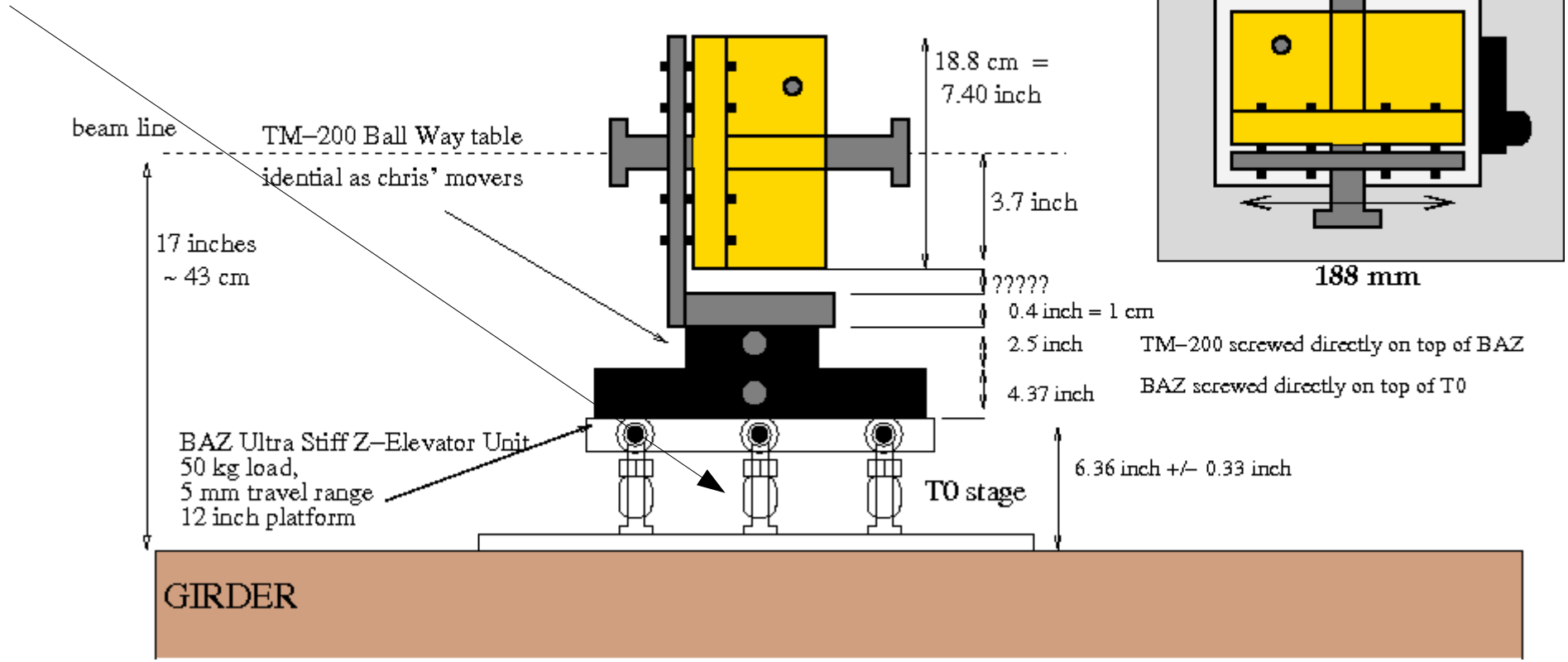
16 november 2006 - UCL

Total space available between girder and beamline : 17” (431.8 mm)
Space needed :
T0 (nominal) : 6.36” (161.5 mm) (travel range : +/- 0.33”)
BAZ stage (nominal) : 4.375“ (111.1 mm) (travel range : +/- 0.095 “
TM-200 stage : 2.500
plate for BPM support : 1 cm = 0.4 inch

tight space budget : ask SLAC to come up with something different than T0 ?

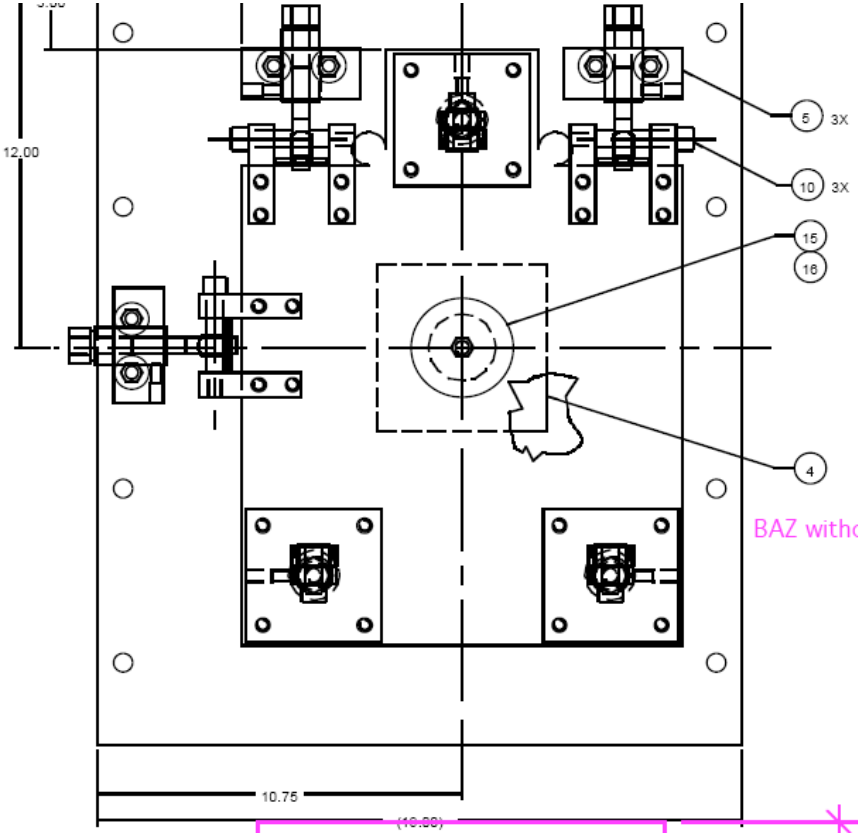
Asked Ray...

Btw.. wrong orientation for T0 supports in this rough sketch

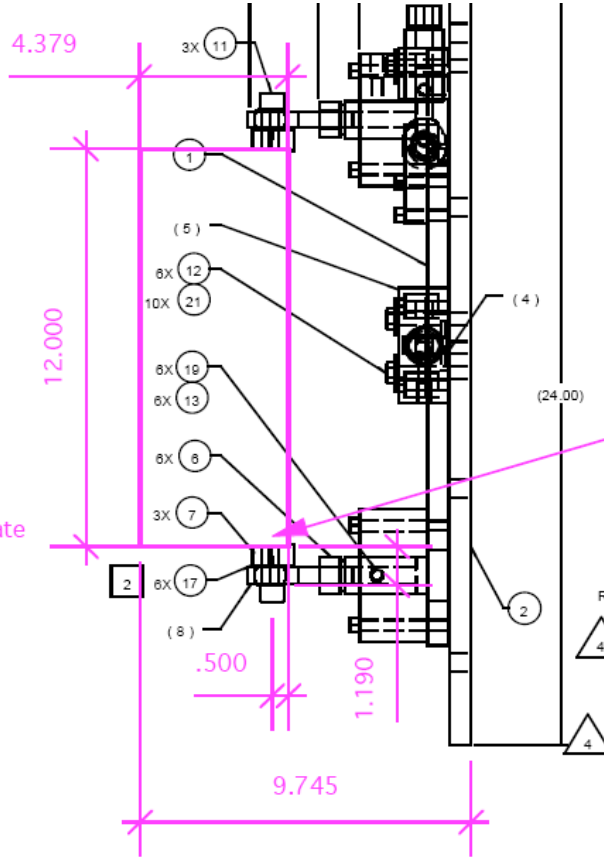


Solution for space budget... how to gain 1 in ?

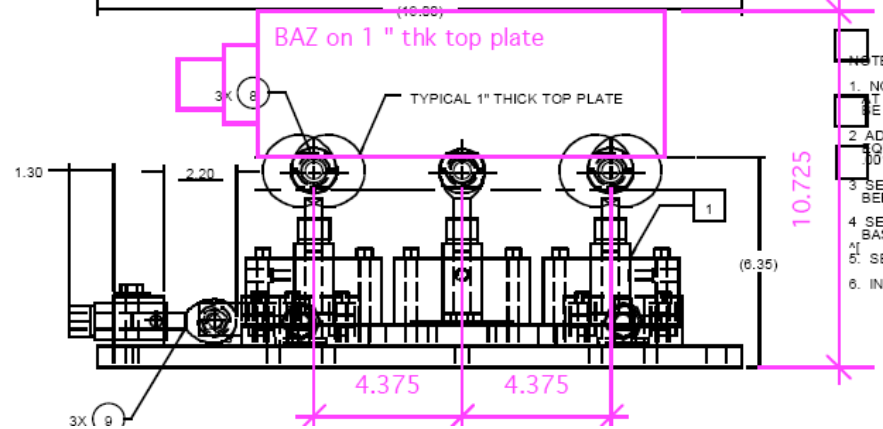
Screw BAZ directly into the T0 stage leaving out it's top plate... should be possible...
make 3 holes in side of BAZ, 0.5 in from the bottom and 3/8-16 thread 0.62 in deep



BAZ without top plate



Make threaded holes in base of BAZ mover with 3/8-16 thread 0.62 in deep.



NOTES:

1. NOMINAL DIFFERENTIAL TRAVEL IS ~ .33 AT 30 TURNS PER INCH. MORE ADJUSTMENT MAY BE HAD BY TURNING ROD ENDS NON-DIFFERENTIALLY.
2. ADJUST SET SCREWS, ITEM 16, TO PROJECT EQUALLY FROM SPACER, ITEM 7, AND FROM .001 TO .005 FROM ROD ENDS, ITEM 8.
3. SET DIFFERENTIAL SCREWS TO DIMENSION SHOWN BEFORE ASSY.
4. SET SLIDE PLATE ASSEMBLY, ITEM 1, ON BASE PLATE ASSEMBLY ITEM 2, TO DIMENSIONS SHOWN.
5. SEE DRAWING GP-235-098-95 FOR ATTACHMENT STAND.
6. INSTALL JAM NUTS, ITEM 20, IF REQUIRE

ITEM NO	PREF	STOCK OR PART NO	SUFF	TITLE OR DESCRIPTION
21	53	296-090	10	FLAT WASHER SST .375 I.D.
20	53	400-020	47	JAM NUT
19	PF	235-098	79	DELRIN ROD PLUNGER
18				
17	53	224-005	02	SET SCREW-SST #4-40X.25 L G
16	53	280-020	12	SCREW HXHD-SST 3/8-16X 1.25
15	PF	235-098	14	LARGE WASHER SST
14				
13	53	223-321	08	SET SCREW SST 3/8-16 .38 L G
12	53	280 020	18	SCR HXHD-SST 3/8-16 1.0 L G
11	UMBR 12705-L-SC-19			SCR SLDR 3/8-16 X 1.19 LG
10				SCR SLDR 3/8-16 X 2.25 LG
9	SA	235-098	04	WELDMENT ROD END
8	AURORA#MM-B			MALE ROD END
7	PF	235-098	10	SPACER 1/2" I.D.
6	PF	235-098	09	ADJ.SCREW-DIFFERENTIAL
5	PF	235-098	08	NUT BLOCK
4	PF	235-098	98	BASE SHIM (.021 THK) REF
3				
2	PF	235-098	87	BASE PLATE
1	PF	235-098	86	SLIDE PLATE ASSY

REF 4 4 3

DIMENSIONING AND TOLERANCING IS IN ACCORDANCE WITH ASME Y14.5M-1994.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES.
TOLERANCES:
BREAK EDGES .005-.015
INTERNAL CORNERS R.015 MAX
FRACTIONS ± ---

SCALE: 1 : 2
DO NOT SCALE DRAWING
CAD FILE NAME: sa23509885.e4

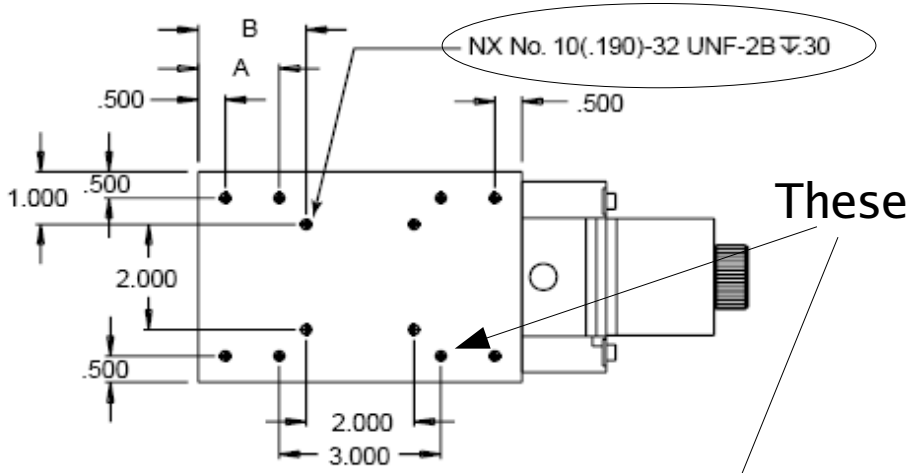
STANFORD LINEAR ACCELERATOR CENTER
U.S. DEPARTMENT OF ENERGY
STANFORD UNIVERSITY STANFORD, CALIFORNIA

SLC PRECISION MAGNET MN
TYPE TO
MOUNT ASSEMBLY

Horizontal stage : **NEAT TM-200 Precision Grade**

- 2” full travel range, 15 um accuracy, 3 um repeatability, 35 kg load
- 23 frame motor mount
- 2Mm precision leadscrew
- 0.1 um linear encoder option (Reinshaw RGH type)
  - Need to receive full specs from Heason
- Imperial mounting holes on bottom of the stage to match the custom pattern on top of the BAZ stage (.209”-32 [~ 5.3mm]) in 3”x3” square on center of stage
- *Mechanical* limit switches (no default hall type) : switch off the stepper motor **via controller**
  - Need to receive full specs on type + mounting location of these switches
  - **Screwed** (not glued) into position at +/- **7 mm** from the stage's nominal position
    - Machine protection, put hard mechanical stops at +/- 9 mm so beam can Never drill into the copper of BPM, even if beam +5mm on one side and BPM moved to other side
    - When in energy measurement position (+5 mm), then still +/- 2mm left For calibration (sufficient !)
- **8 Custom metric M6 holes** on the top face of the stage in same pattern as on next page...
- Both stepper motor and limit switches/encoder are 15pin D-type connector

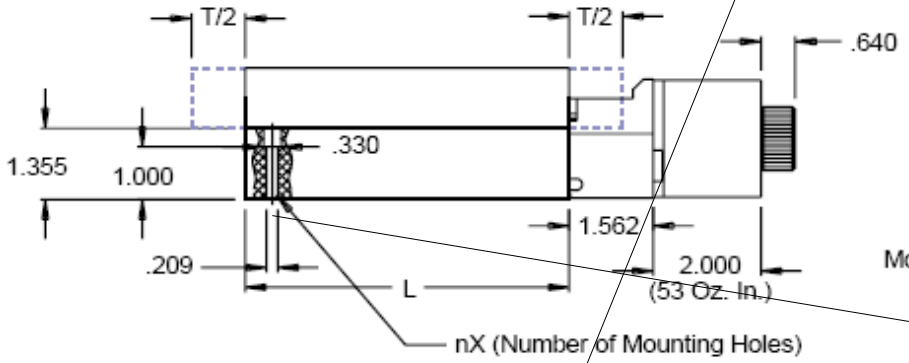
Top View



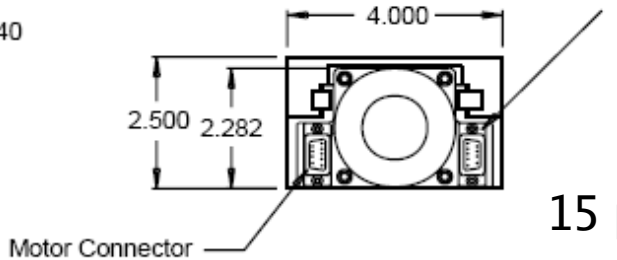
.190 “ screws (~ M5)
--> asked for metric M6 holes

These holes don't exist for TM-200

Side View



End View

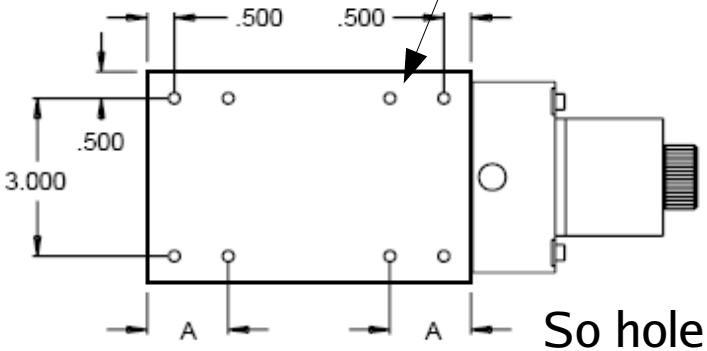


Limit switch + encoder

15 pin D type connectors

.209” screws to fix to BAZ stage
~5.3 mm

Bottom View



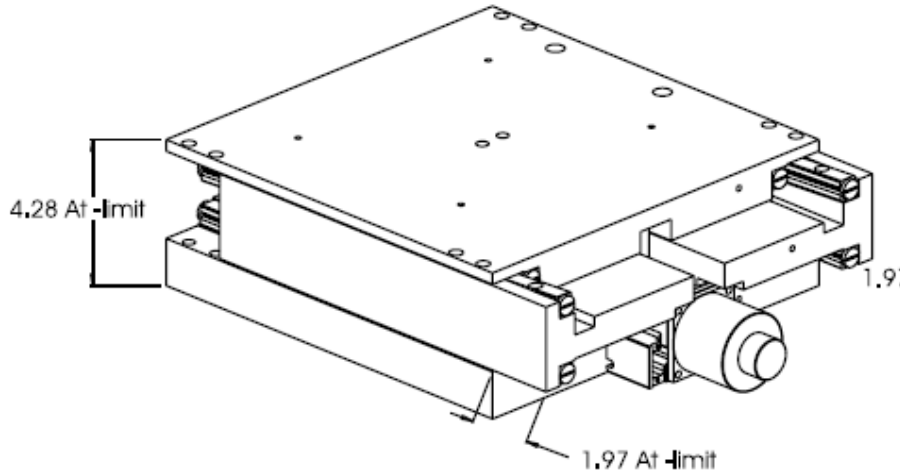
Third Angle Projection
Note: All Dimensions in Inches

So hole pattern in bottom is 3inch by 3 inch square

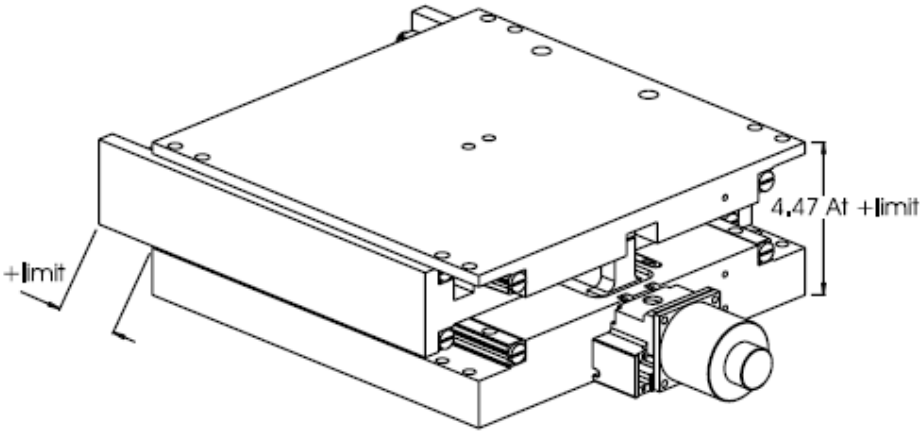
Vertical stage : **NEAT BAZ UltraStiff Vertical Elevation stage**

- 5 mm travel, 10 um accuracy, 2 um repeatability, 50 kg load
- 23 frame motor mount
- 2Mm pitch precision leadscrew
- 0.5 um linear encoder option (Reinshaw RGH type)
  - Need to receive exact specs from Heason
- Imperial mounting holes at bottom to fix to T0 stage (or eventually something else)
- Custom imperial hole pattern on top to match hole pattern on bottom of TM-200
- **Mechanical** end switches on side of the stage, around full 5 mm travel range
  - Need to receive exact specs from Heason
- 8 Holes for mounting to the bottom are .209 inch (~5.3 mm), 1 inch of thread, counter sunk, with .330 inch of screw head width, pattern see next image.
- Can be mounted by moving the table -> holes become visible....

– End of Travel

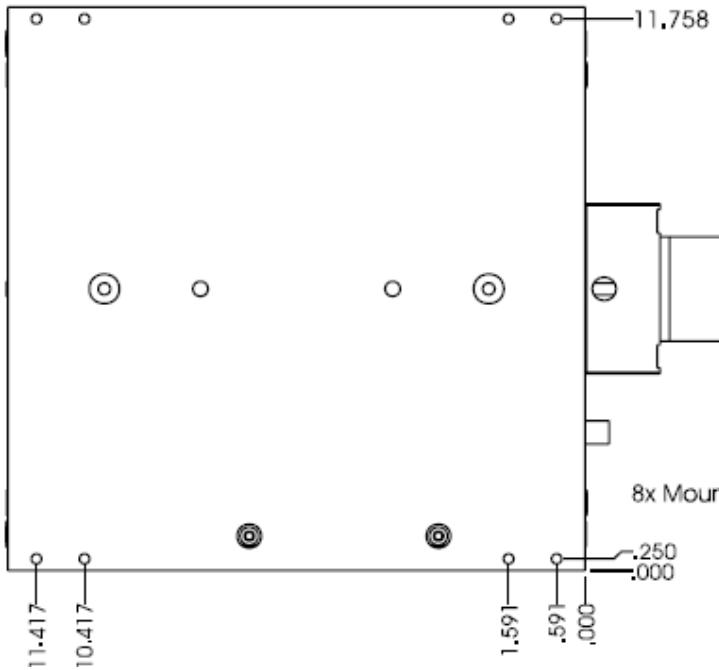


+ End of Travel

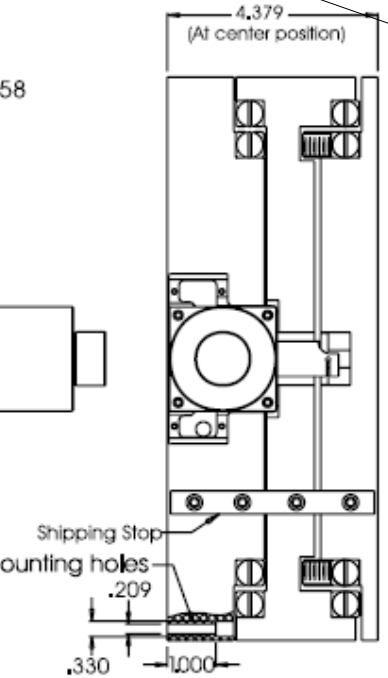


Use these holes to put mechanical stops

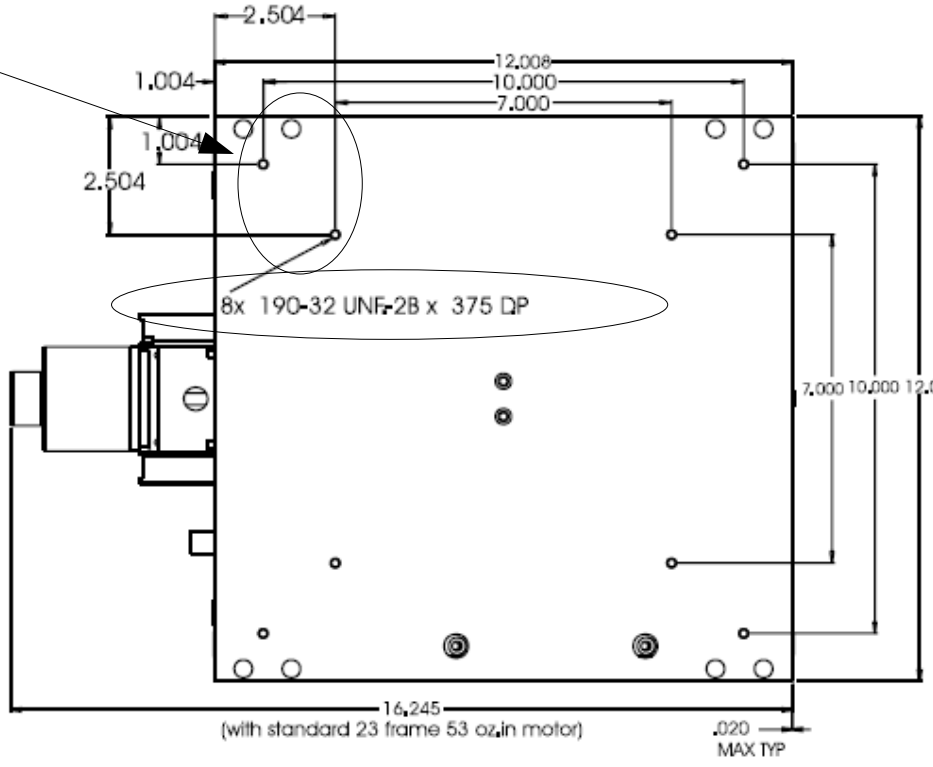
Bottom View



End View



Top View



Stepper motors : 2 **Baldor DSM 23F-248-M** motors

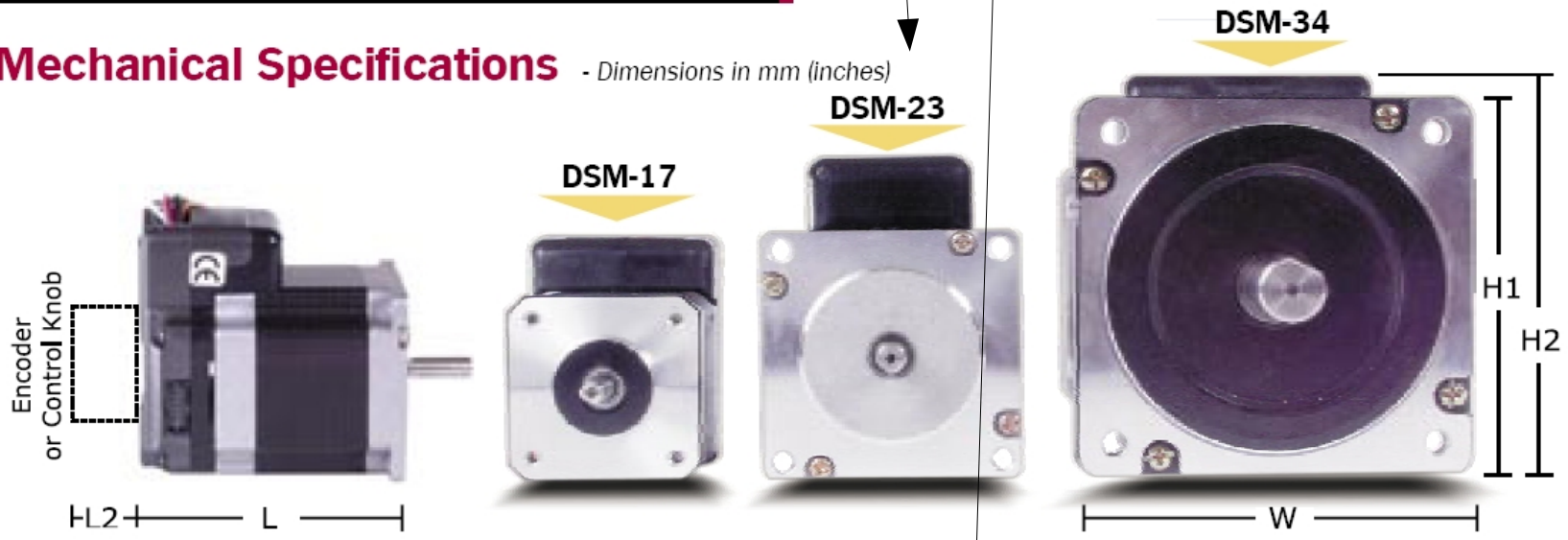
+48 V

- Can provide enough torque for both TM-200 and BAZ to lift 50 kg
- Micro stepping drive up to 51200 steps per revolution,
- Coupling matches 23 frame mount
- -M : manual knob present

Connecting wires go free, but Heason provides cable from stages to controller

- Need **intial setup**, cable & software delivered by Heason (number of steps etc...)
- 200 W, 48 V PSU quoted, can do 220V as well as 110V

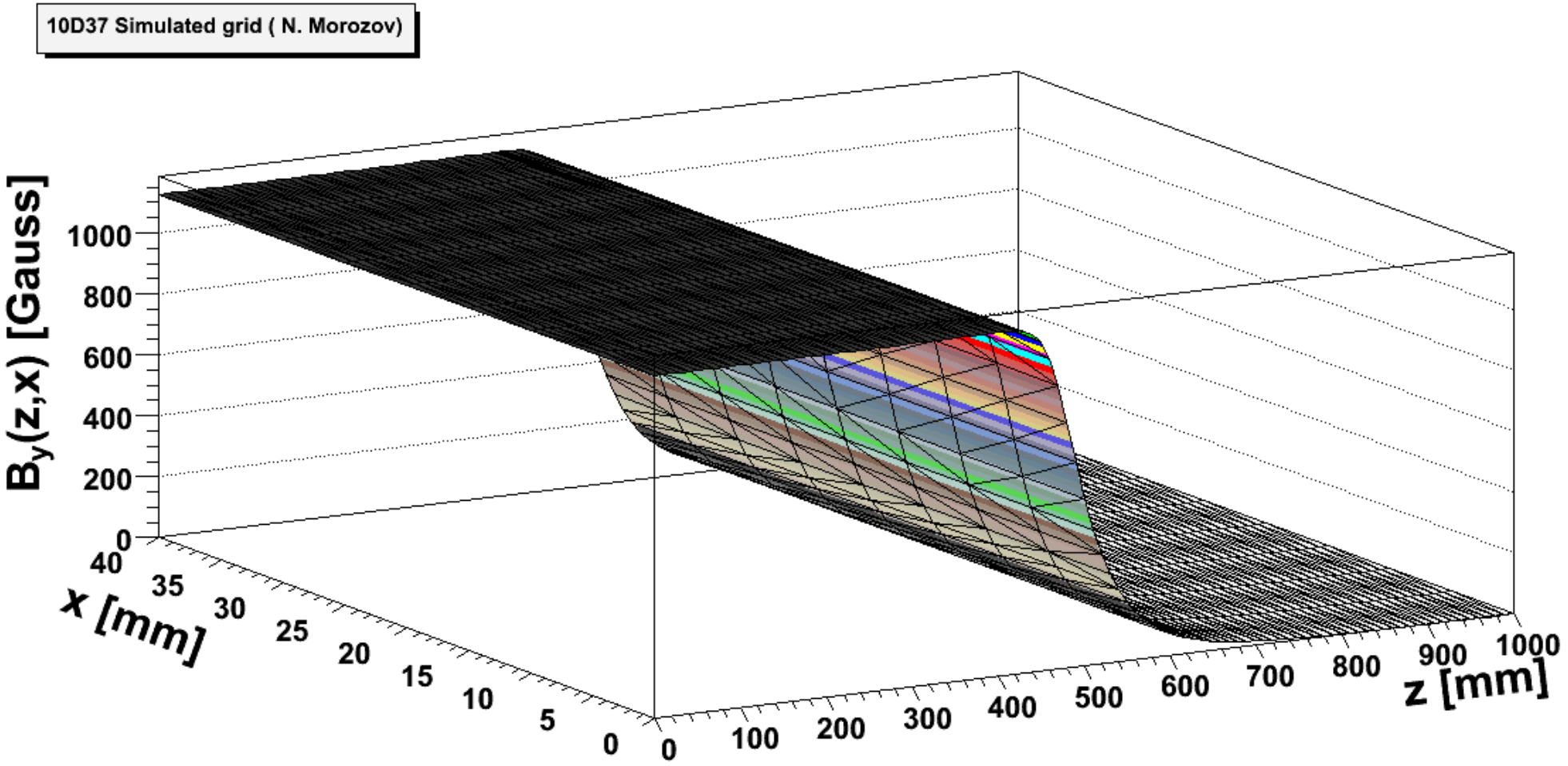
Mechanical Specifications - *Dimensions in mm (inches)*



	DSM-17			DSM-23			DSM-34		
Stack Size »	1	2	3	1	2	3	1	2	3
L	55.9 (2.20)	61.7 (2.43)	69.8 (2.75)	66.8 (2.63)	76.2 (3.00)	98.0 (3.86)	96.8 (3.81)	116.8 (4.60)	156.7 (6.17)
L2 - Control Knob	74.2 (2.92)	80.0 (3.15)	88.1 (3.47)	85.1 (3.35)	94.0 (3.70)	116.1 (4.57)	126.2 (4.97)	146.3 (5.76)	186.4 (7.34)
L2 - Encoder	74.2 (2.92)	80.0 (3.15)	88.1 (3.47)	85.1 (3.35)	94.0 (3.70)	116.1 (4.57)	96.8 (3.81)	116.8 (4.60)	156.7 (6.17)
H1	42.2 (1.66)			56.4 (2.22)			86.0 (3.39)		
H2	54.8 (2.16)			73.8 (2.91)			93.6 (3.69)		
W	42.2 (1.66)			56.4 (2.22)			86.0 (3.39)		

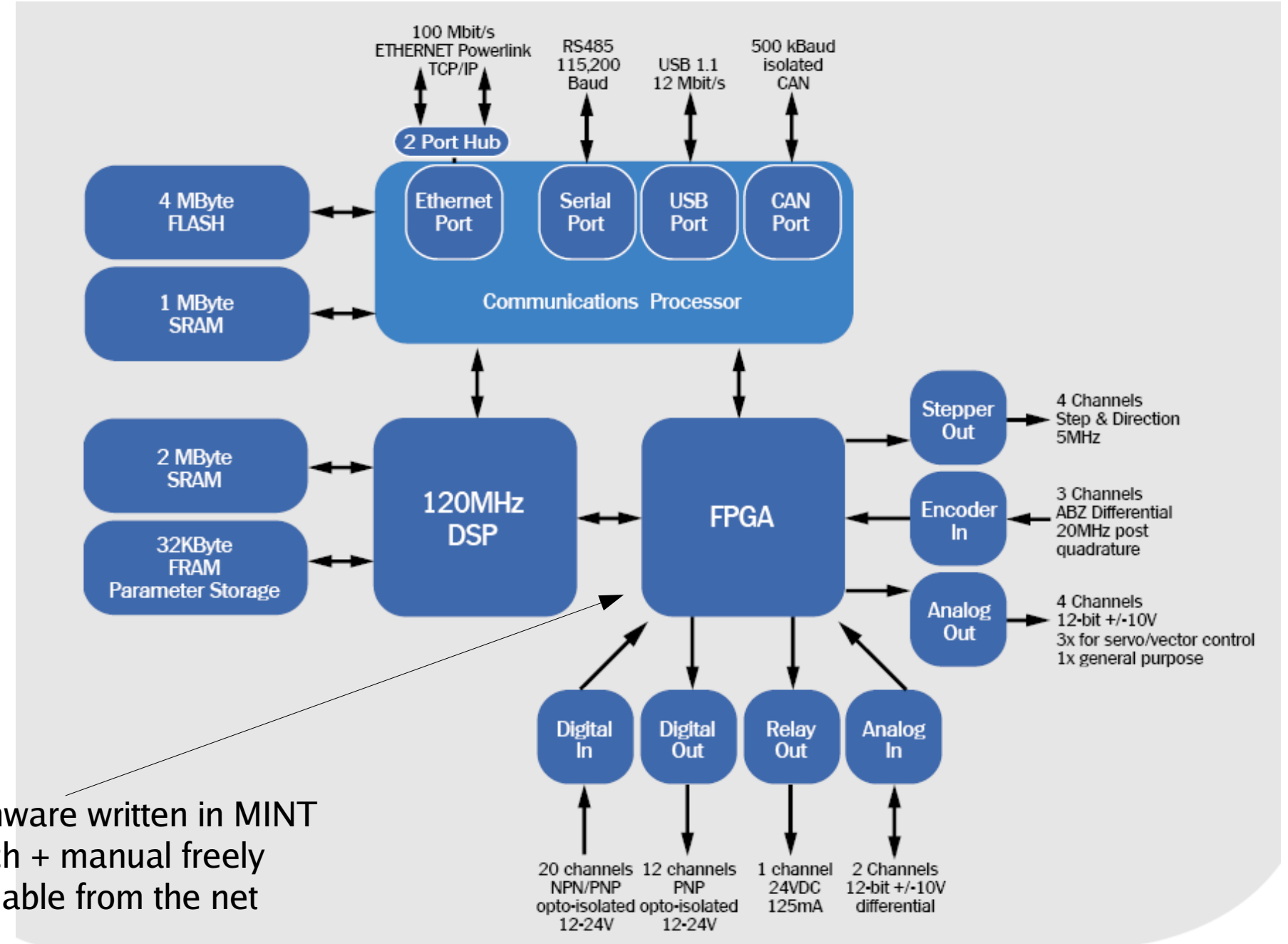
Magnetic shielding... consider mu-metal for stepper motors ???

- In any case use **mechanic end switches** and not hall effect ones to be sure...
- Simulation of 10D37 magnet : 37 inches long (93.98 cm),
- **0.4 Gauss at 100 cm** from magnet center
- Should be fine for steppers... maybe find out where exactly BPM located in z, but probe more then 0.5 m away...



Half magnet length : 466.9 mm

Motion control : **Baldor E100 ethernet controller**



Need firmware written in MINT workbench + manual freely downloadable from the net

Able to control 4 stepper axes, has USB and RS232 ports for uploading the firmware and ethernet for control and monitoring. Power supply quoted can do 220V and 110V.

Write a program in MINT (based upon BASIC) that checks/fills registers on communications processor and send then commands over ethernet which will put/read commands in the registers

Need to have a closer look, but according to the Baldor software engineers, it should be fairly straightforward what we want to do. Heason proposed that someone goes there for half a day free of charge after having got more familiar with this MINT language.

Response :

This all sounds very straight forward, the activeX supplied with Mint Workbench can connect to a controller over Ethernet TCP/IP, and then use any "ICM" instructions that are required, this can be in the form of individual MOVE instructions or COMMS commands which just write to registers and are then interpreted by a Mint program installed on the Mint controller. Providing you are only using stepper axes and not Ethernet EPL servo axes then there is no complication in doing this at all.

I suggest the easiest way is to write a Mint program to receive and load data into comms registers which are accessed over Ethernet from a LabView program using the our ActiveX control.

Functions could include Move To Home, Move To Position etc and a back ground task could copy the encoder counter values into other registers for feeding back to the LabView program.

Heason provides a **full set of cables up to 3 m** needed to setup the steppers, connect the motors and the encoders to the controller and a USB cable to program the controller.
This 3 m is sufficient to put the controller somewhere in ESA incapsulated in lead and is convenient to test here in the lab.

Delivery time : **stages 10-12 weeks**, **everything else** can be delivered in **4-6 weeks**, so we can start familiarizing ourselves with the control -> need to put it on the order to have separate invoices.

Don't order the fully integrated rack mounted version they propose. Also don't order straightaway the support (expensive). They offer half a day free of charge support at Heason (Horsham, south-east of Guildford). And if that doesn't suffice, they offer £450/day off site, £650/day on site...

Purchase PC for control of movers, aiming at £350 - £400

- Lot of PCI slots (4), at least 1 RS232 port... for the rest standard config
- Found proper motherboard on www.microdirect.co.uk (but not UCL contractor)
  - P4, bus speed 1066 Mhz, 1 serial port, 4 free PCI slots,
  - Graphics card -> AGP and 1 PCI Express port
  - 4 USB-2 ports
- Contacted Dell to wether they have something...
- Buy mini-tower to allow space for full size PCI cards (like NI-DAQ cards...)

Talk about design of L-bracket to support BPM