**EBPG CHEAT SHEET**

0. Check the high voltage with

```
pg get htval
```

It should be around 100kv. If not, please report the problem and go home.

1. Load the substrate in a holder. Check that the substrate and/or piece holder are pressing against the three points. *Optionally,* use the alignment microscope to measure the vector from the Faraday cup to a focus point (e.g. colloidal gold).

2. Start pumping the load lock and then

```
subl n
```

where n=1 for the mask holder, n=3 for the 3 inch wafer holder, n=6 for the six-inch wafer holder, n=4 for the four-inch wafer holder.

3. Select holder with

```
pg sel hol n
```

(where n=1, 3, 4, or 6)

4. Load the column conditions

Show the list of beam files for different currents, then restore those conditions

```
pg info arc beam

pg arc restore beam <file>
```

Note that the system switches and aligns the apertures automatically. On systems with a

manual aperture changer, you should use "pg adj ap"

5. Find the calibration mark

**mvm**

Watch the SEM screen to see the detection sequence

Adjust table coordinate- shift the stage origin

```
IF mvm WAS SUCCESSFUL THEN
     atc
ELSE
     ask for help
     because if you atc
     at some random place
     then the system will
     be very screwed up
OR
     use "mhome" to reset coordinates
```

6. Measure the current with

**mcur**

If the current is very different from the desired value, then something is wrong and you should ask for help.

7. Choose your pattern

**pg sel pattern <file>**

Hopefully you have already used "cd" to set the default directory under /home/pg/users/

8. *Optionally*, set the resist sensitivity

**pg set resist <lowest-dose>**

This will avoid warning messages about the clock rate. It's not really important.

10. Calibrate the field size, focus, etc with

**pg adj ebpg** or "**aeb**". This sequence ends at the Faraday cup.

11. OPTIONAL: Check the auto-focus function by moving to a blob of colloidal gold, or simply check the substrate height:

**mvrl <dx>,<dy>**

for example, **mvrl 45mm,32.87mm**

Move to a good looking blob and check the focus with

**afld**

You might want to save the location with

**sp foo** or any name you like, other than "foo"

Later, you can move back to this location with

**mvsp foo**

12. Move to where you want the center of your layout then save that location

```
sp start
```

Or you can type the stage coordinates directly into the wrapper script (see next step). It would be smart to turn off the SEM view so that you will not expose the resist.

13. Create a wrapper script for running your job. You could copy an example:

```
cp /public/wrapper.sh whatever_name_you_like.sh
```

Edit this file with emacs, kate or gedit
(or with vi if you are a freak)

If you copied an example then you **do not** have to make the script executable with

```
chmod a+x whatever
```

If you are using the symbol “start” in the wrapper script, be sure to move to where you want the center of the layout, then save the location

```
sp start
```

14. Start the exposure with

```
./whatever_name_you_used.sh
```

15. Unload the substrate

| | |
|---|---|
| **`subu n`** | Be sure that the load lock is pumped out first. If you vent the load lock before ‘subu’ then an annoying alarm will sound. |

16. Leave the holder in the loadlock and leave it pumping.

IF YOU LOAD ANOTHER WAFER then you can skip nearly all of this procedure. Just load the wafer with "subl" and run your wrapper script again.

MOST of this procedure is for checking that the tool is running properly before you start the exposure.  If the EBPG is not working, it's best to know this *before* wasting a lot of time.

UNIX COMMANDS YOU SHOULD KNOW

| | |
|---|---|
| **cp from_file to_file** | copy the file “from_file” to the file “to_file” |
| **mv from_file to_file** | move, that is, rename a file |
| **mkdir <name>** | make a new directory (folder) |
| **cd <name>** | change directory (change the default folder) |
| **pwd** | print working directory |
| **ls** | list files (directory), minimal information |
| **ll** | list files, with lots of information |
| **emacs <name>** | text editor (or use kate, gedit) |
| **which <command>** | show where this command comes from |
| **man <command>** | show the manual page for this unix command |

Unix tips:

`.` means "here"

`..` means "up one directory level"

& after a command causes the command to run in the background freeing the terminal for other commands

Do not use spaces in file names.

For file names, UseOnlyLetters_numb3r5_underscore-dash.and.dot, but be sure to begin and end the name with either a letter or a number.

Create a new directory (with "mkdir") for each project.

You MUST put the pattern file in the same directory as the cjob file.

## OTHER HANDY EBPG COMMANDS

| | |
|---|---|
| **pgreset** | *reset system after crash or freeze* |
| pg move pos <x>,<y> | *move somewhere* |
| manual_focus | *adjust focus & stig manually* |
| pg adj freq | *calculate exposure clock* |
| pg measure height subs --size=5mm,5mm | *height map* |
| pg marker calib <x>,<y> | *use alternate mark for calib.* |
| mvm 0,0 --rel marktype | *align to mark right here* |
| pg set stagelock 0 | *unlock stage* |
| pg marker create rec pos 8,8 foo | *define new mark type* |
| $pg save | *must follow marker create* |
| pg marker set p10 contra 99 | *require the least contrast for marker type "p10"* |
| pg marker reset p20 | *reset the filter settings which were 'learned' previously for marker type p20* |
| pg get htval | *display high voltage value* |
| restore_symbols | *restore stage coordinate symbols after losing the terminal window* |
| pg table /del "*" | *delete all position symbols* |
| findmark | *find and register the position of the holder mark, even if it is far from the expected location* |
| testrot | *measure the rotation of your substrate using two alignment marks* |
| mhome | *move stage to 'home' position and reset coordinates* |

WAFER CENTERS ON THE EBPG5000

*See other sheet for location symbols for the EBPG5200 holders.*

| | |
|---|---|
| 4 inch and 6 inch wafers: | 74.5mm,77.3mm |
| 3 inch wafers: | 71.0mm,77.5mm |