Creating EPICS Databases with Capfast

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Introduction

EPICS

- What is Capfast and why?
- How does it map to the EPICS database?
- Capfast tutorial

What is Capfast and why?

EPICS

- Schematic capture tool typically used for circuit design.
- Not the leading schematic capture tool today
  - I think it was stronger in the early days.
  - Started as a UNIX tool and other Windows tools passed it by
- … however it is very easily configurable
  - All schematics, symbols and configurations & menus are text files
  - Outputs a standard net-list format.
- … and has some powerful features:
  - Provides hierarchical drawings to structure a database
  - Provides bus-mechanisms for bundling links

EPICS

How does Capfast map to EPICS?

Electronic parts	EPICS Records
Part type (e.g. Resistor)	Record Type (e.g. Analog in)
Property (e.g. Resistance)	Field value (e.g PREC=3)
Pins	Links or Field inputs
Connections	Link connections
Fabrication	make

Differences

EPICS

- EPICS records typically have more fields than electronics parts have configurable properties, so this is area is handled poorly.
- EPICS data links push or pull data from fields (which are passive), so connection diagrams are a bit confusing at first:
  - Fundamentally, there can only be one field in a single, multiply connected, wire.
    - Any output link will push into this field.
    - Any input link will pull data from this field.
  - Links also imply processing depending on the properties of the link.
  - Processing links pass no data and can only be connected to SLINK

Capfast tutorial

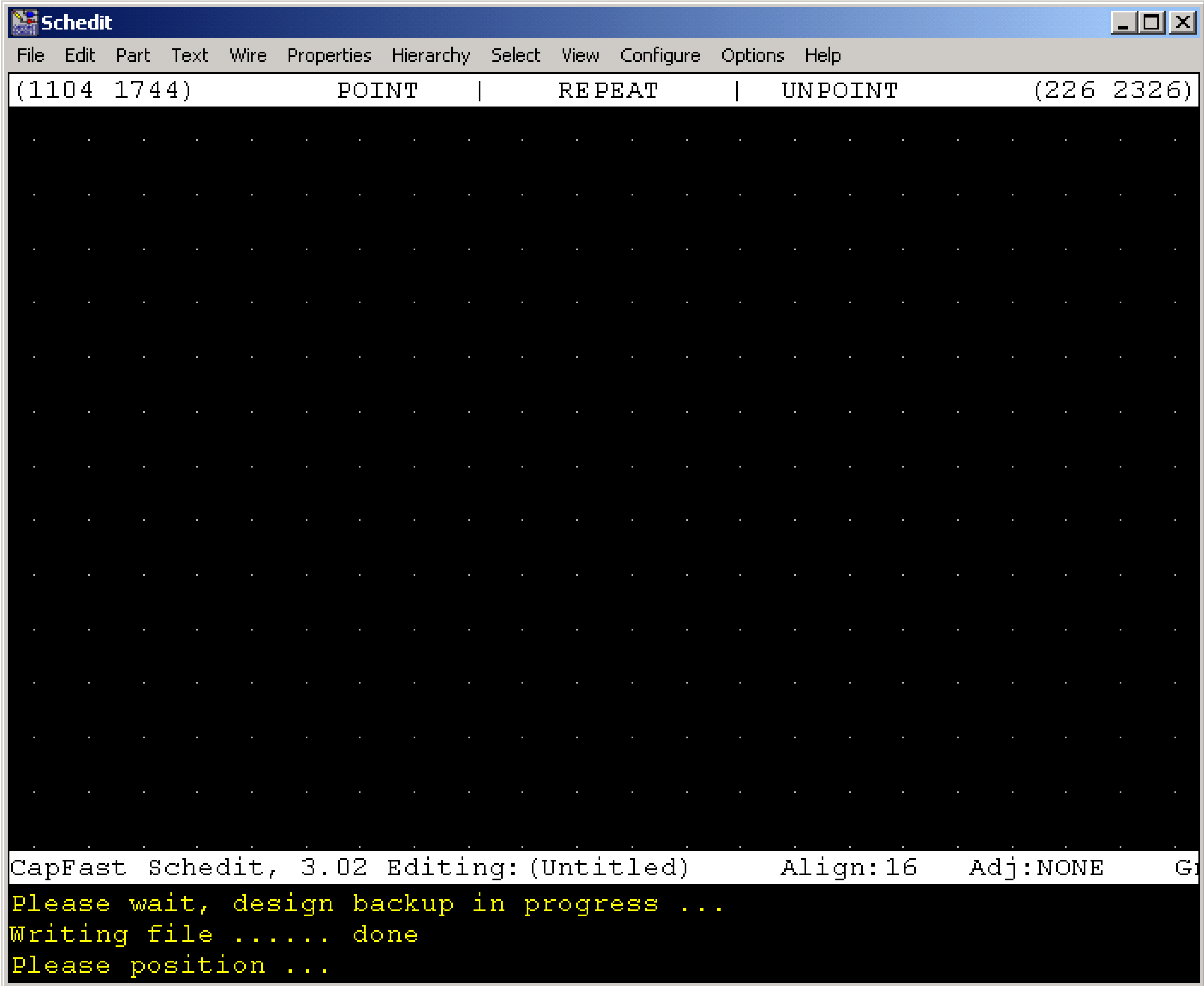
- Capfast has two editors:
  - `xschedit` for schematics
  - `xsymed` for symbols.
- You create new symbols to encapsulate other drawings and build a drawing hierarchy.

The basics

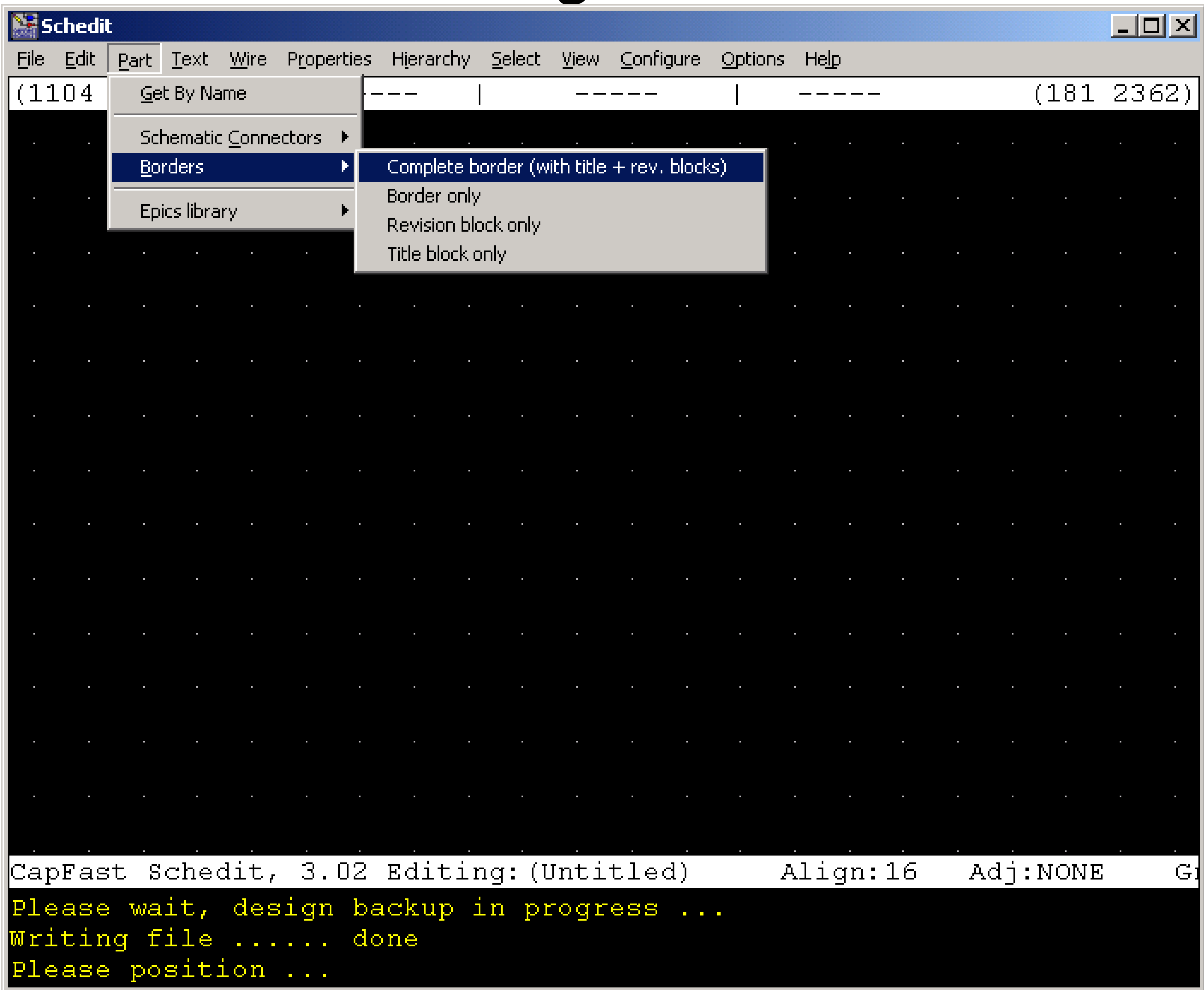
EPICS

- `<Esc>` key aborts current operation.
- Mouse buttons are context sensitive and their meanings are given at the top of the screen.
- Menu shortcuts available by using the underlined letter (no `<Alt>` required on Unix).
- Number keys or arrow keys can be used for scrolling (5 centers the schematic on the screen).
- `V R` shortcut (`View Redraw`) will force a redraw.
- Menu's are PC or Motif like.
- Clicking in the drawing area sets up markers for the next command (e.g. define a wire route).

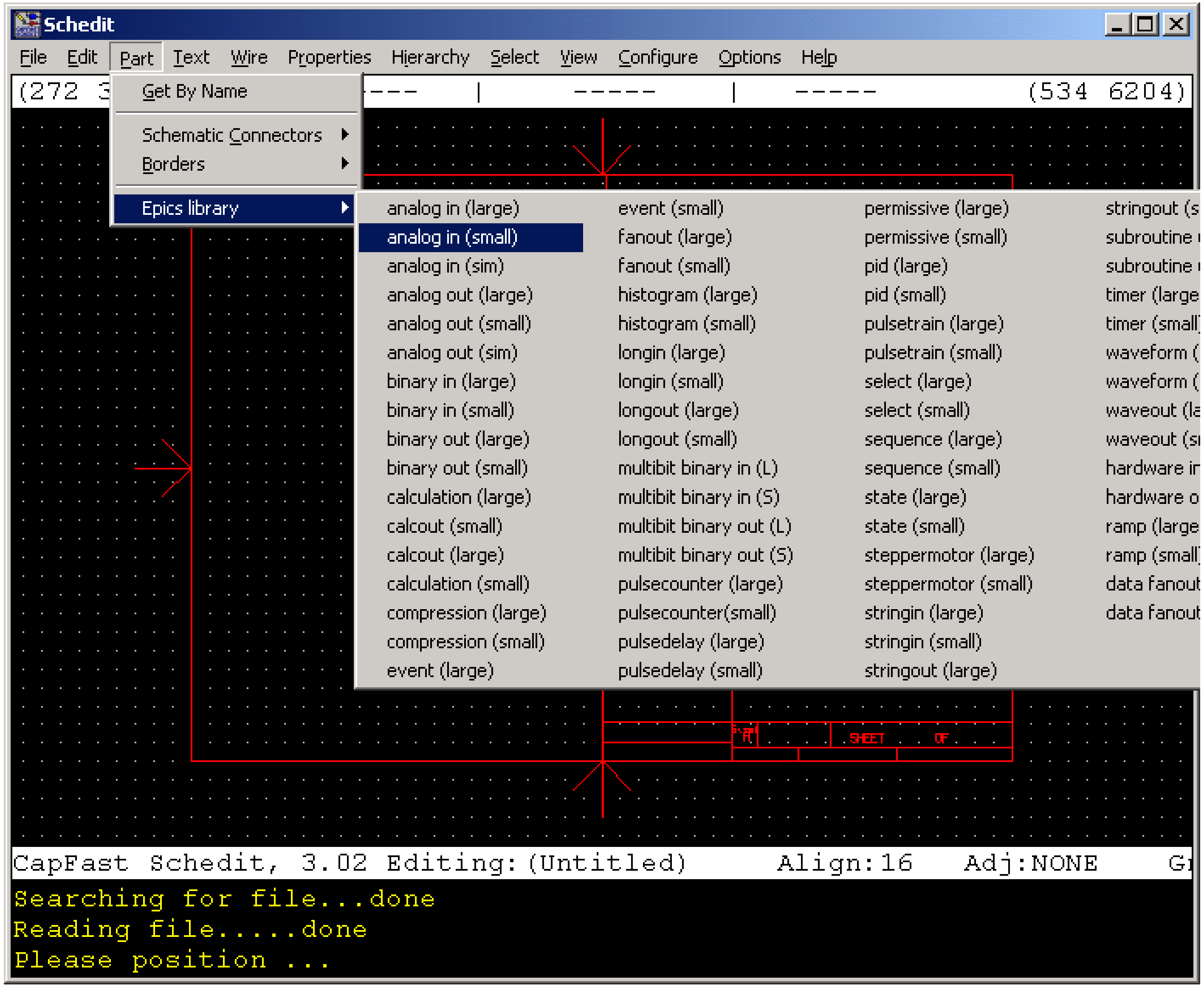
Schedit screen



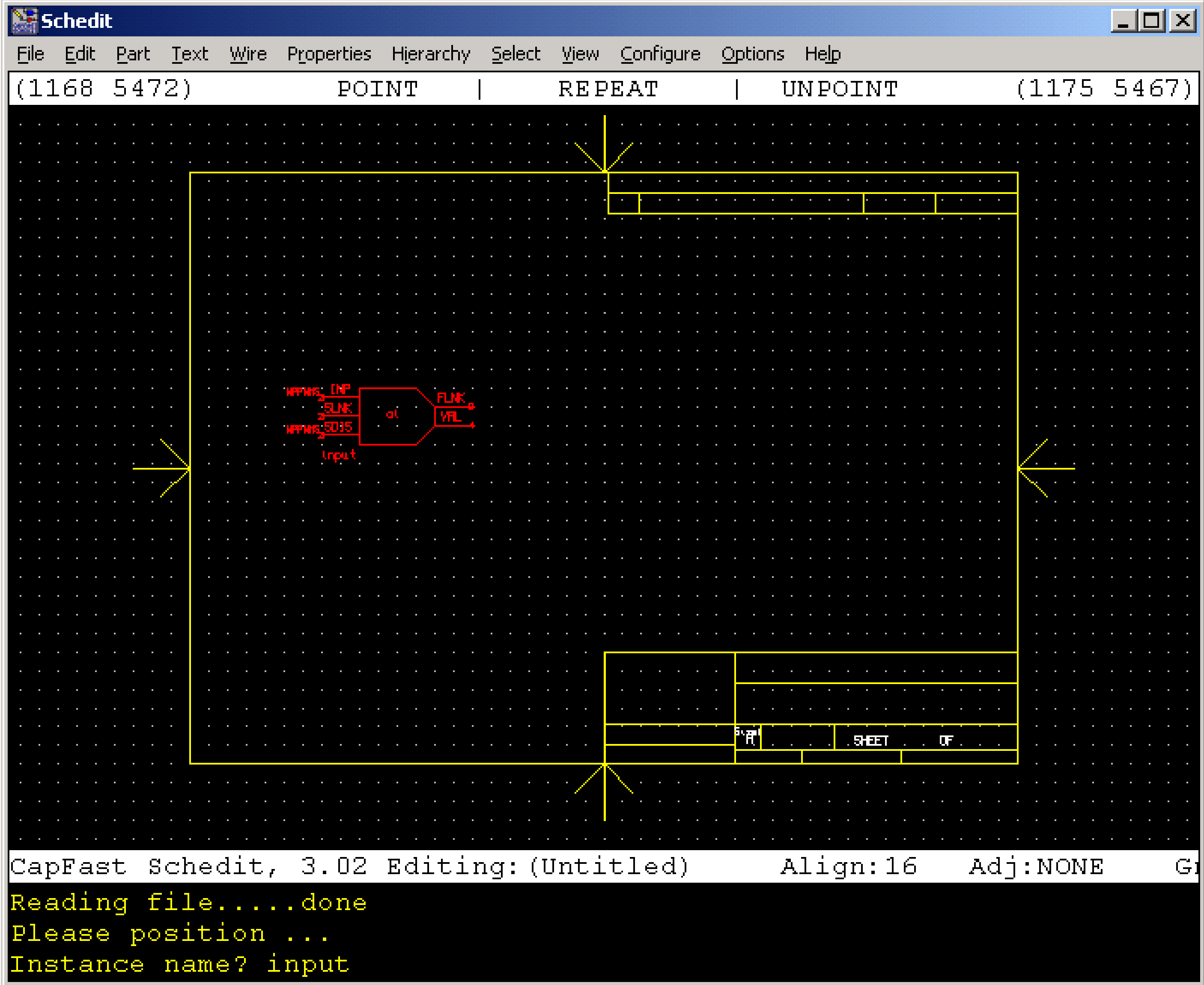
Getting a border



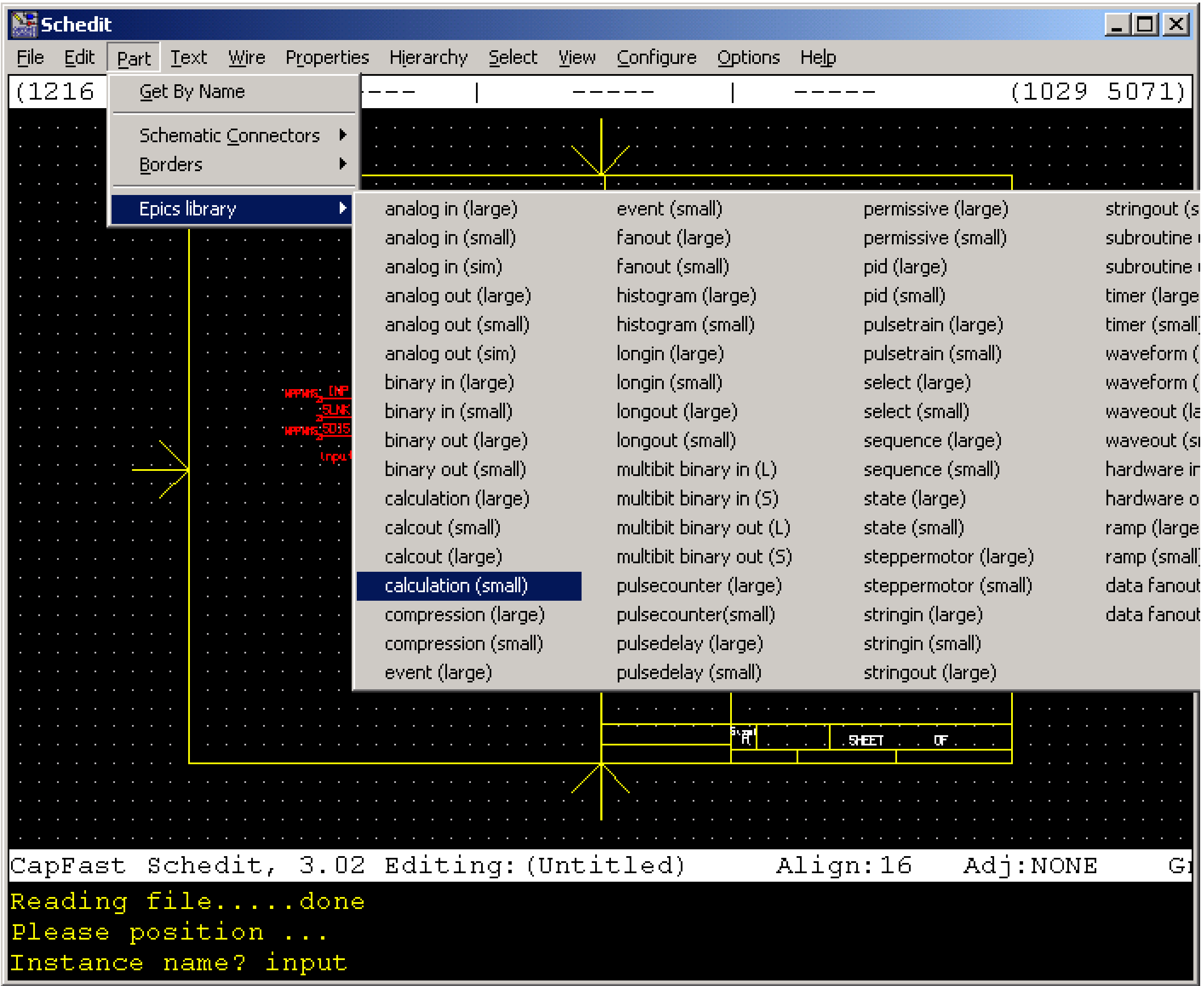
Got a border, now add a record



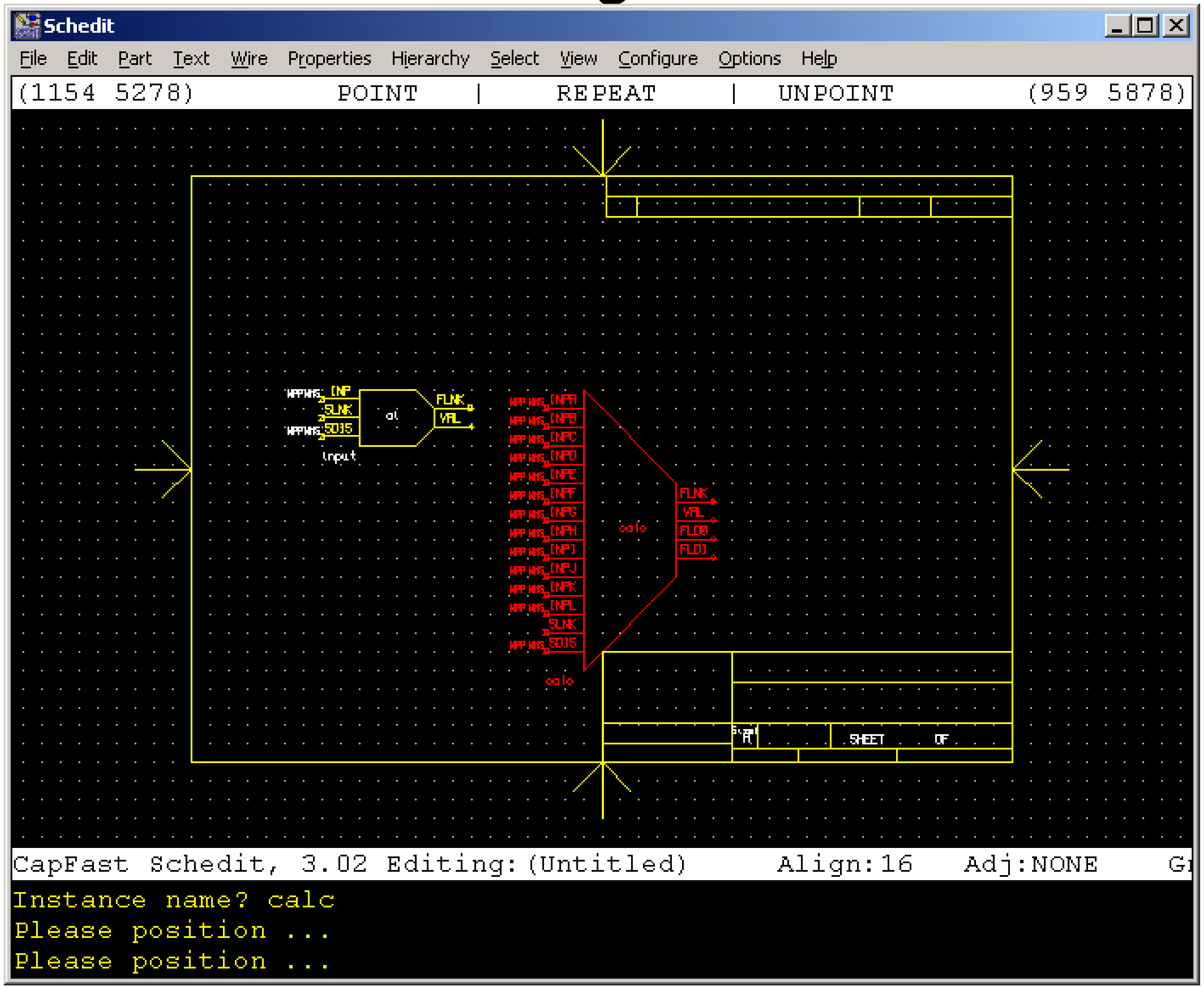
Place it and give it a name



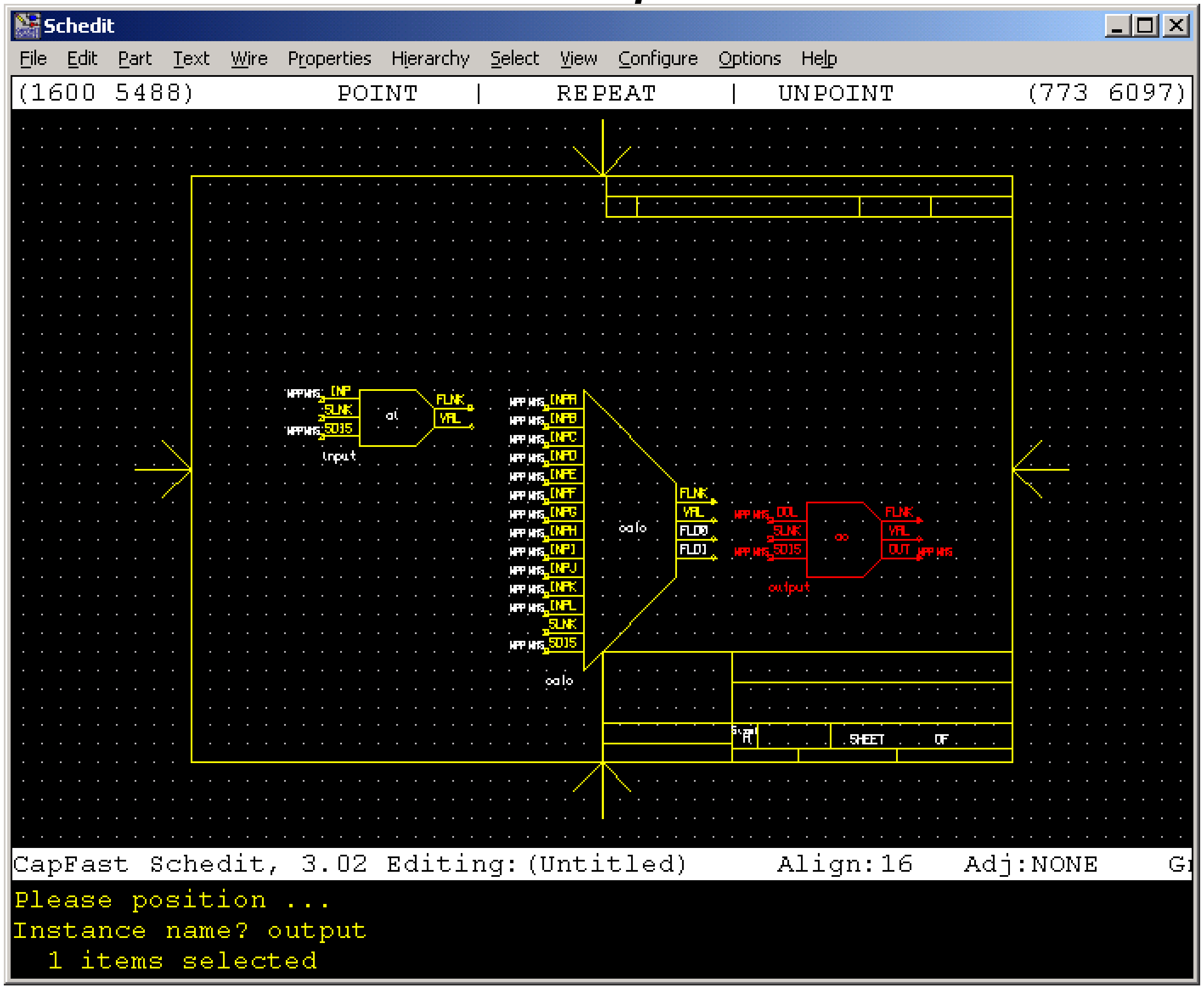
Get a calculation record



Place it and give it a name

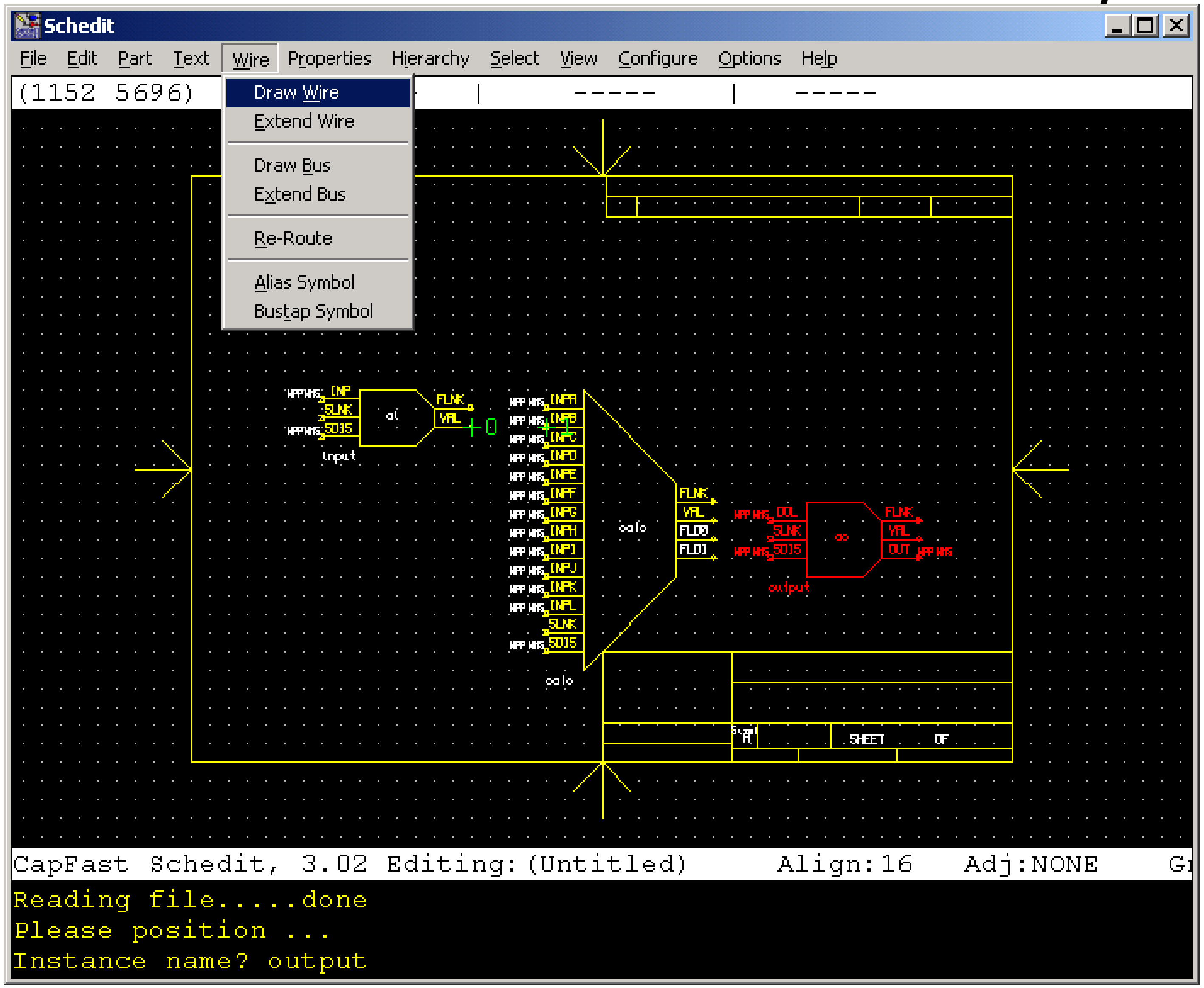


Add an output record

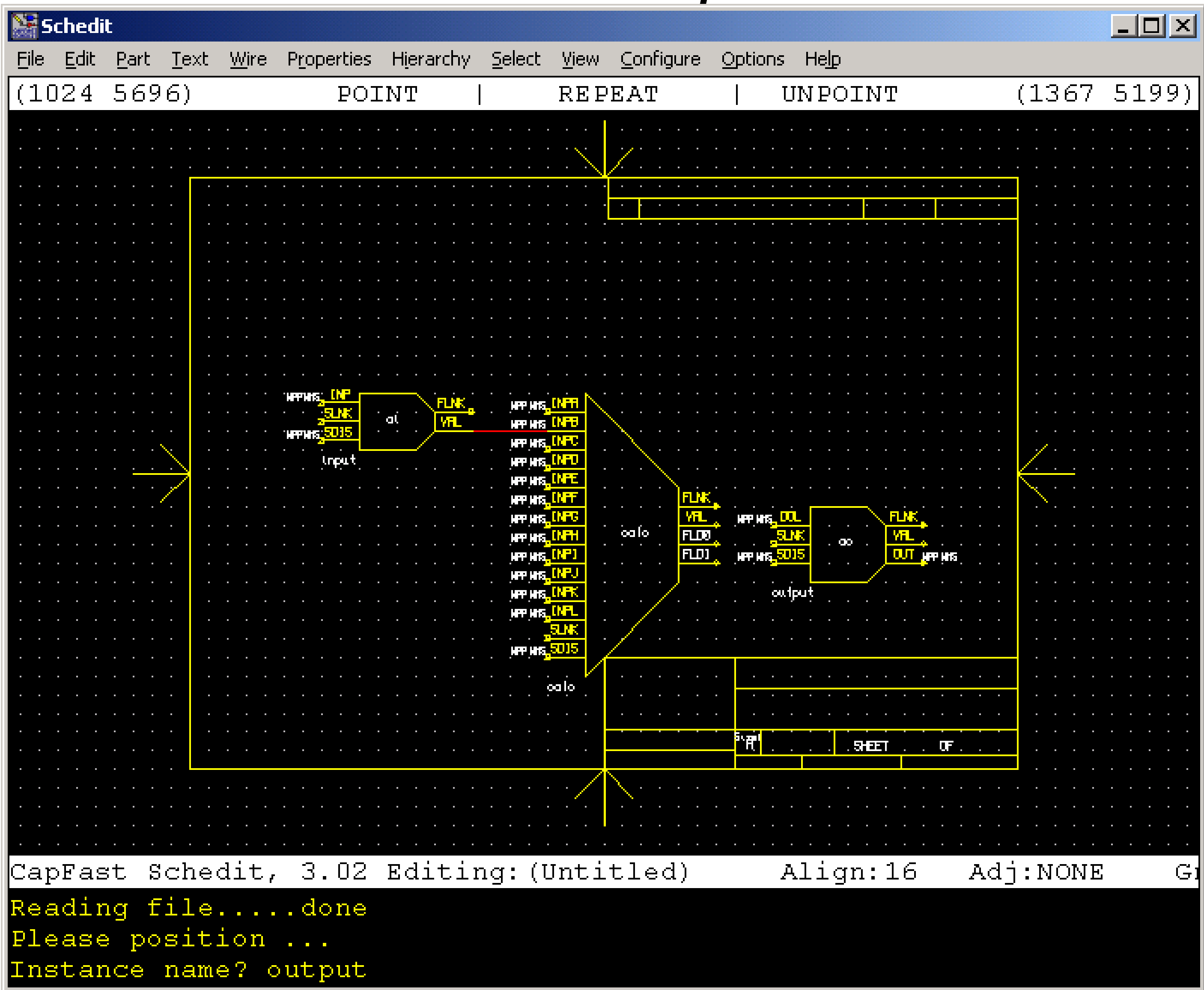


Click twice and connect them up

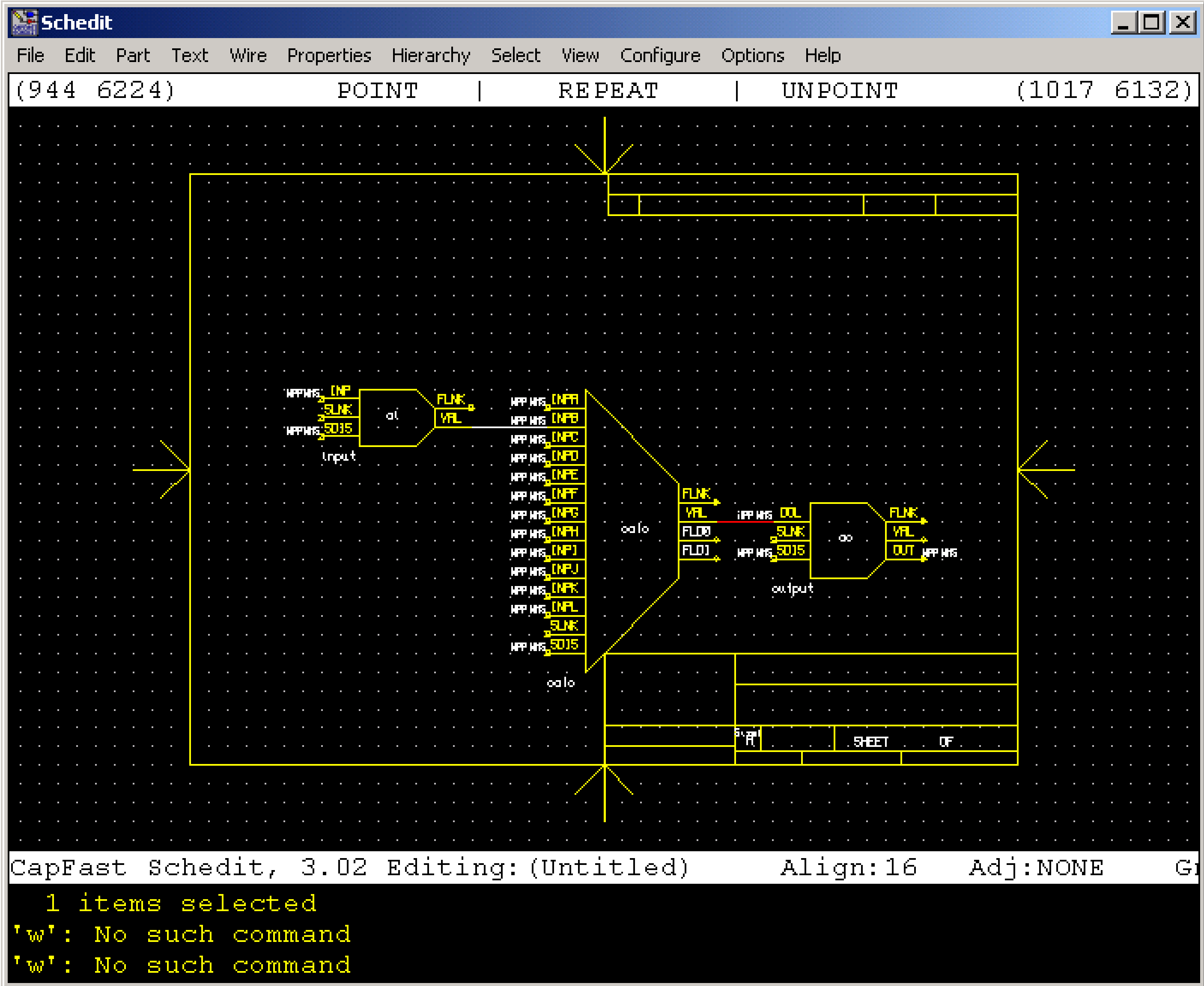
EPICS



Wired up...

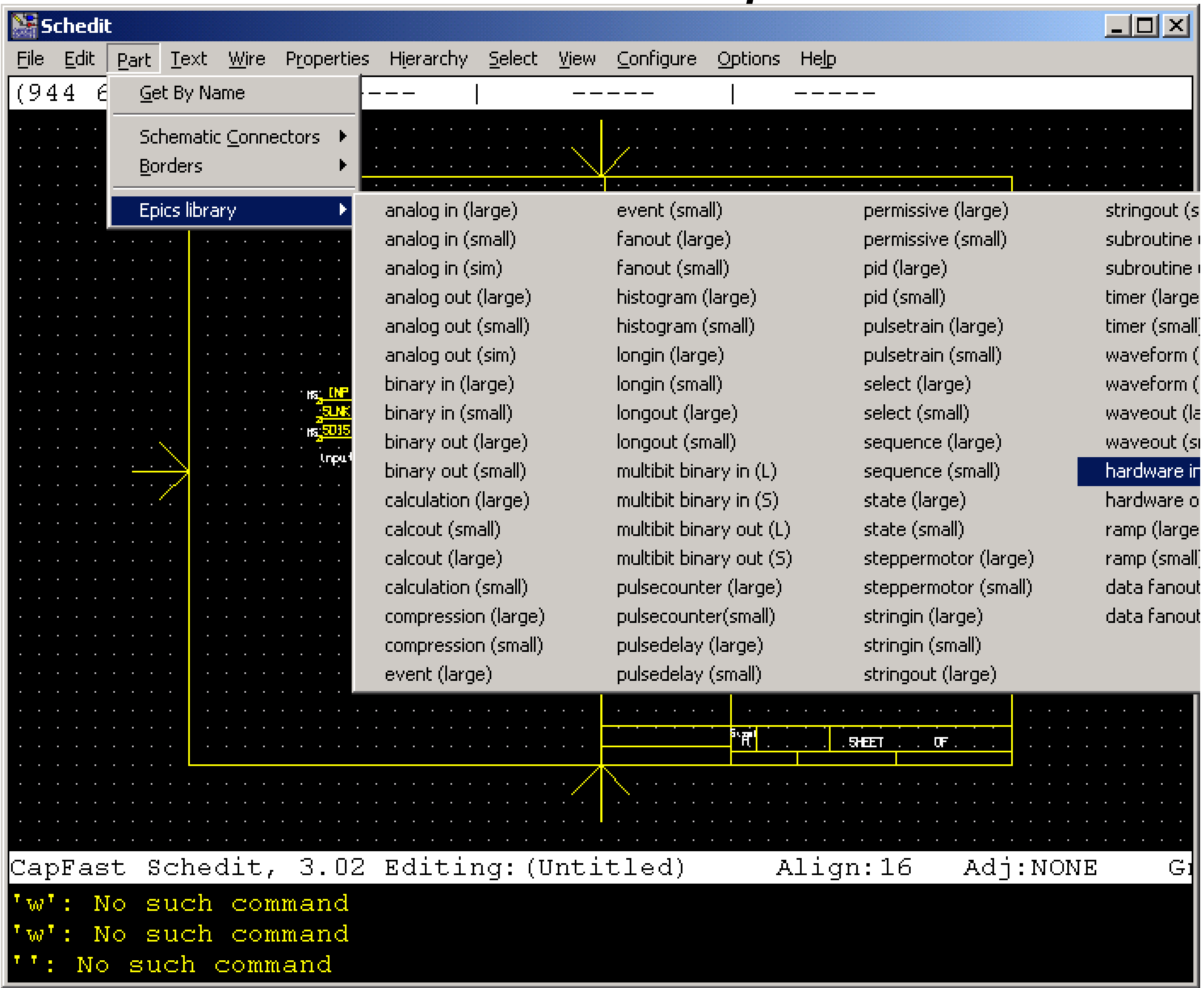

Schedit
File Edit Part Text Wire Properties Hierarchy Select View Configure Options Help
(1024 5696) POINT | REPEAT | UNPOINT (1367 5199)
ai
input
calc
ao
output
CapFast Schedit, 3.02 Editing: (Untitled) Align:16 Adj:NONE
Reading file.....done
Please position ...
Instance name? output

Next wire

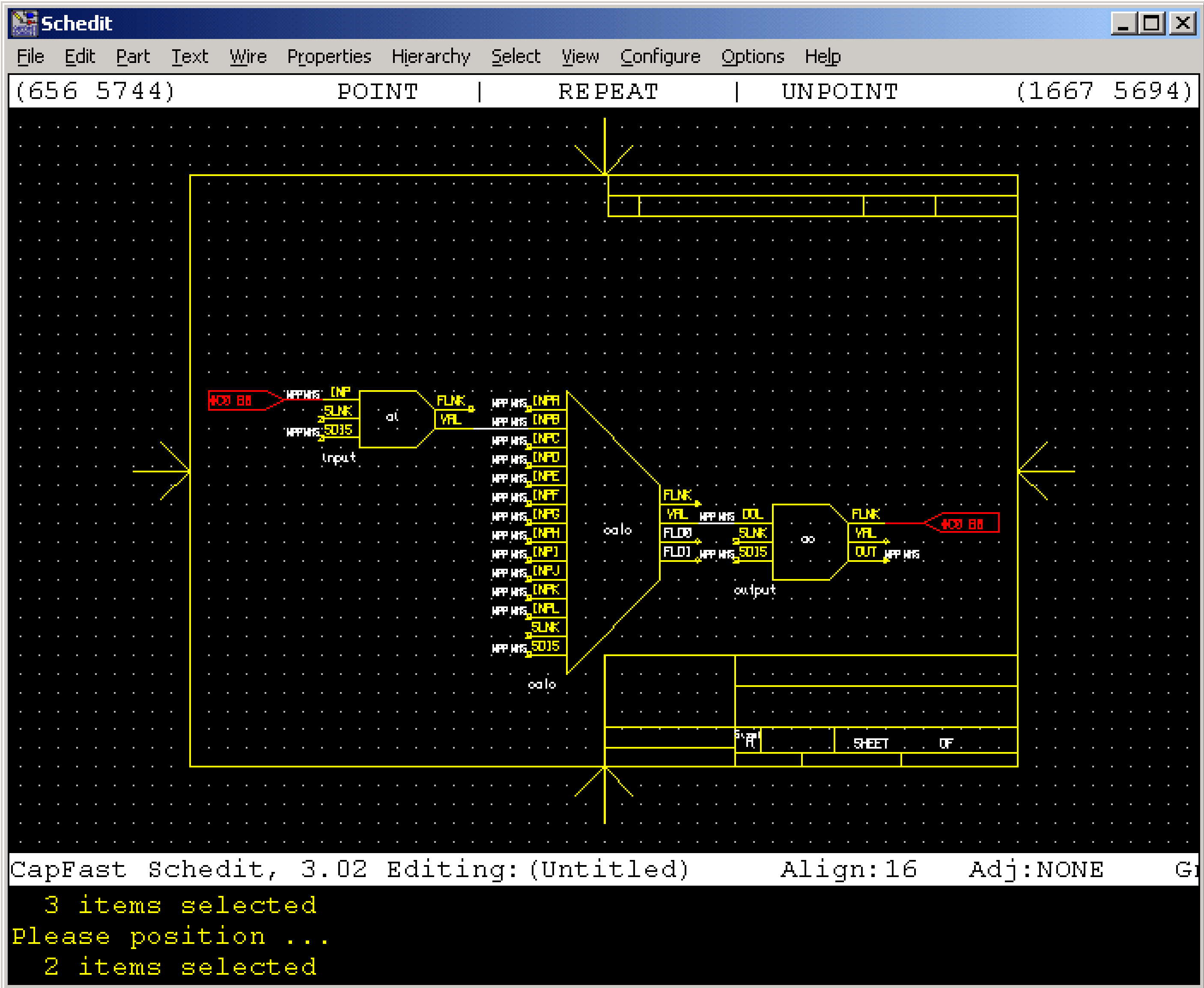


Schedit
File Edit Part Text Wire Properties Hierarchy Select View Configure Options Help
(944 6224) POINT | REPEAT | UNPOINT (1017 6132)
INP
SLNK
SDIS
ai
FLNK
VAL
input
INPA
INPB
INPC
INPD
INPE
INPF
INPG
INPH
INPI
INPJ
INPK
INPL
SLNK
SDIS
calc
FLNK
VAL
FLDB
FLDI
DOL
SLNK
SDIS
ao
FLNK
VAL
OUT
output
SHEET
OF
CapFast Schedit, 3.02 Editing: (Untitled) Align:16 Adj:NONE
1 items selected
'w': No such command
'w': No such command

Add hardware inputs and



Done

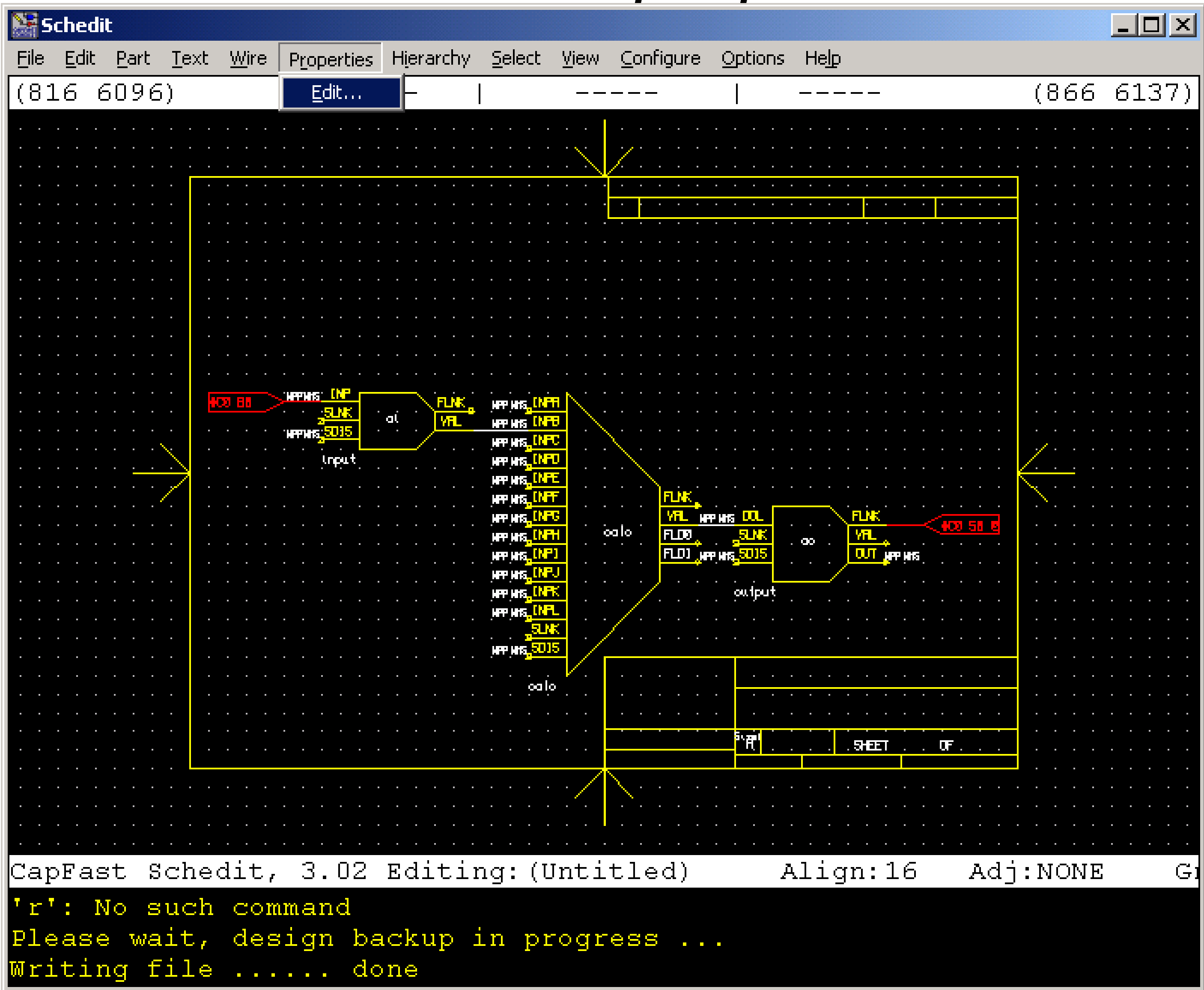

Schedit
File Edit Part Text Wire Properties Hierarchy Select View Configure Options Help
(656 5744) POINT | REPEAT | UNPOINT (1667 5694)
ai
input
calc
output
ao
SHEET
OF
CapFast Schedit, 3.02 Editing: (Untitled) Align:16 Adj:NONE
3 items selected
Please position ...
2 items selected

Hardware inputs and outputs

EPICS

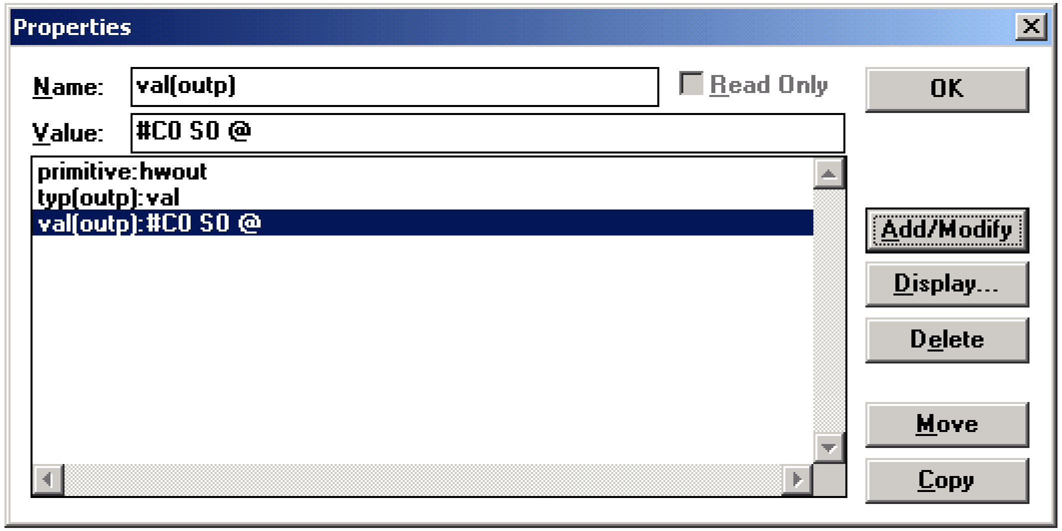
- These are a method of putting constant values into link fields.
  - The val(outp) and vap(in) properties contain the string value that the link field will be set to.
  - Normally used for hardware, but also can be used to link to a record of a know name, which doesn’t appear in the current drawing hierarchy.

Edit these properties



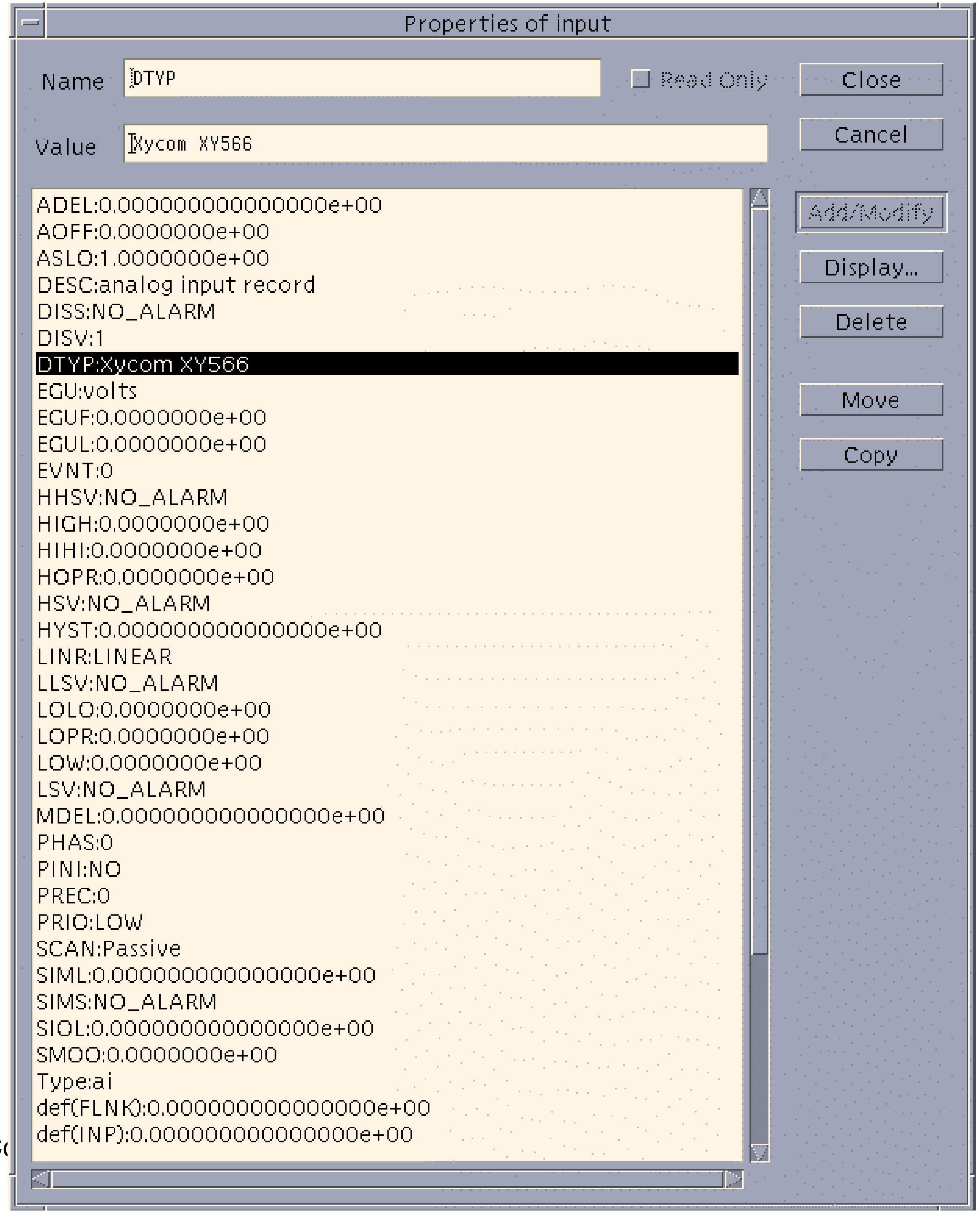
Property (field) editing

EPICS



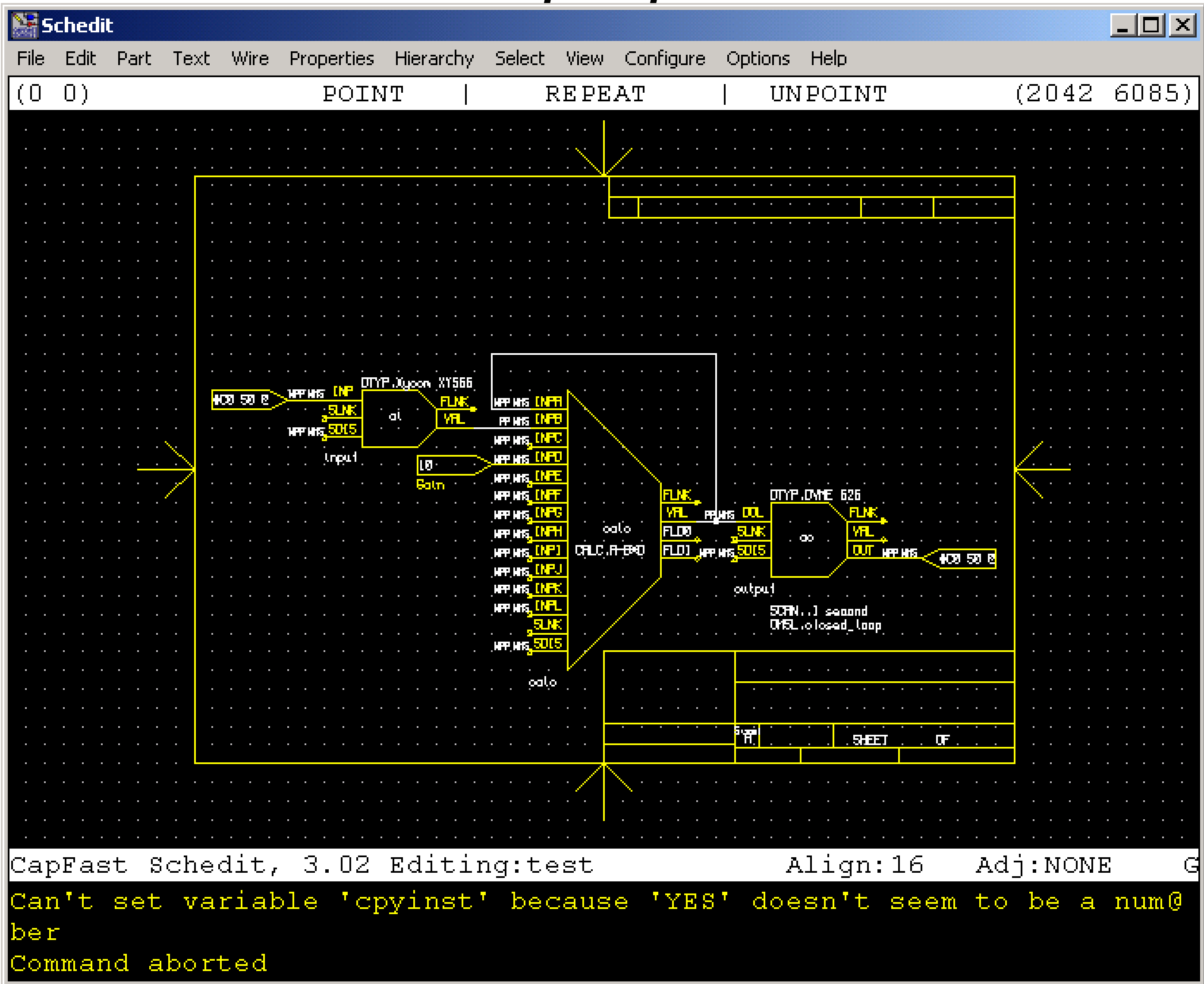
- Click on the property line and edit in the Value box.
- **Add/Modify** saves the change.
- **Display...** allows you to set the display attributes.
- **Delete** deletes the field - or returns it to the default value.
- **Move** moves the highlighted properties (fields).
- **Copy** allows you to copy properties to other records.

A more typical record (UNIX)



EPICS

Edit more properties etc...



Commonly used items

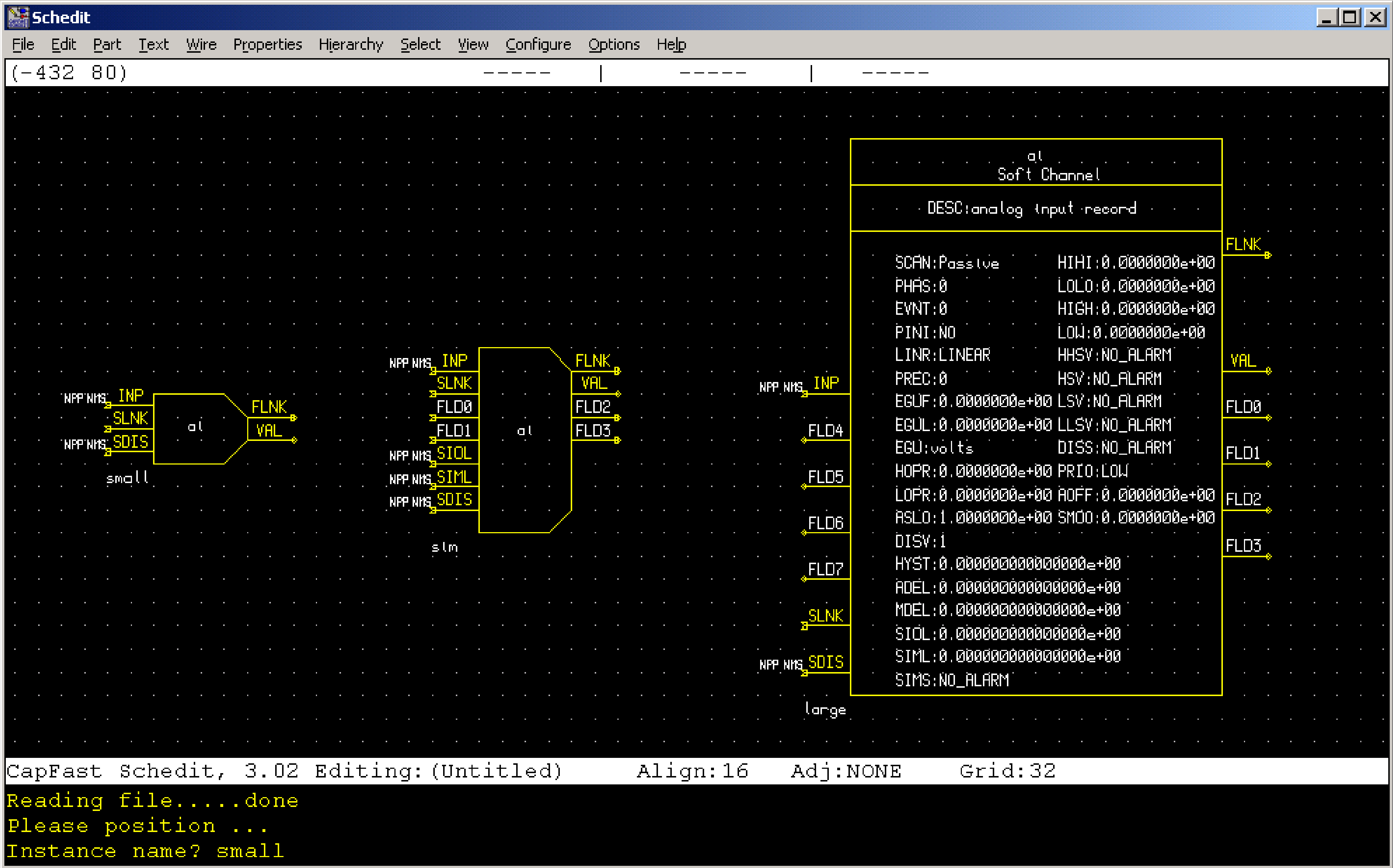
EPICS

- **File->Hierarchy->Descend** (or **Ascend**)
- **File->Hierarchy->Create Symbol from Schematic**
- **Edit->** anything!
- **View->Redraw**
- **View->Zoom Area**
- **Part->Schematic Connectors->Hierarchical Input**
- **Part->Borders**
- **Part->Epics Library->**
- **Text->** anything!
- **Wire->Draw Wire**
- **Wire->Reroute**

Commonly used items (ctd)

- **Properties->Edit**
- **Select->Items**
- **Select->More Items**
- **Select->Area**
- **Select->Symbol to Replace**
- **Select->Clear**

Different Symbol Styles



User defined ports

- Note that the larger symbols have ports with names like `FLD0, FLD1` etc.
- These are ports with user defined names.
  - Names are defined by editing a property called `username(u0)` (or `u1`, `u2` etc).
  - Replace the default value of that property (`FLD0`) with the name of the field you want the connecting link to refer to (e.g. `SCAN`).

Hierarchical Schematics

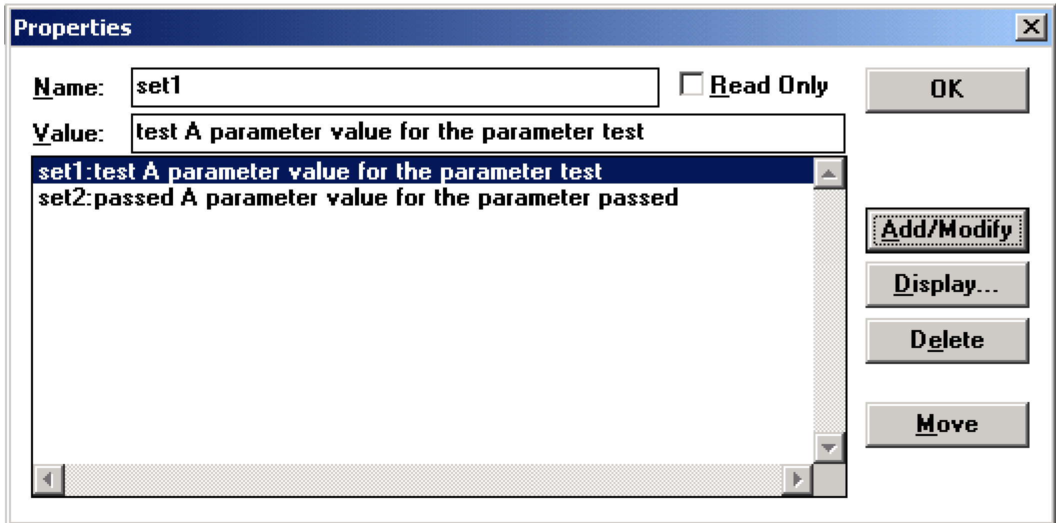
- Use `xschedit` to design the lower levels of the hierarchy.
  - Use hierarchical connectors for off page connections.
- Use `xsymed` to create a symbol of the same name which encapsulates the lower level schematic,
  - The pin-out should have pins with the same name as the hierarchical connectors.
  - This can be simplified slightly using:

    File->Hierarchy->Create Symbol from Schematic
  - EPICS symbols typically have flying leads that are two grid boxes long, with the field name written above the flying lead.
- Use `xschedit` to create another schematic which incorporates the new symbol.

Hierarchies (ctd)

EPICS

- Parameters can be passed into a hierarchical symbol by:
  - Using the form `$(parameter)` where ever the parameter is used in the included schematics.
  - Defining a property of the symbol (in `xsymed`) with a name beginning with '`set`' and a value of the parameter name, space and then the value.
  - Example: the parameter test will be set to the value: 'A parameter va



The last character of the `set` name is unimportant. It just makes the property name unique.

Hierarchical record names

- By default, record names have the form:
  - `<schematic name>:<symbol name>`
- Symbols in hierachically included diagrams have the form:
  - `<schematic name>:<symbol name level 1>:…:<symbol name>`
- There is a maximum length to record names of 28 characters - so if the hierarchy is deep, keep names short.
- `PV` and `name` properties can over-ride the default naming conventions, but I have never had to use them.

Printing

EPICS

- Aliases `schprint` and `symprint` to print a schematic as on letter sized paper on the default printer.
  - Look at their definition for more details.

Starting up

EPICS

- `xschedit` and `xsymed` take three command line options:
  - `-k` : specifies or adds to the menu search path
  - `-p` : specifies or adds to the symbol search path
  - `-w` : specifies the number of lines in the text region.
- Example:

```
xschedit   -p+${EPICS_BASE}/templates/capfast/sym \
           -k${EPICS_BASE}/templates/capfast+
```

- The + is significant since is says whether to pre-pend or append to the path.
- The file `cad.rc` contains the default options
  - Searched for first in your local directory, then in your home directory and finally in the the capfast directories.

Starting up (ctd)

EPICS

- Startup commands can be put into `schedit.rc` or `symed.rc` in your home directory.
- You can copy `schedit.rc` from `~npr`:

```
:constrainprops epics.rules
:set libchoice epics
:mload schedit2
:set asksnames YES
:set askwnames NO
:set askpnames YES
:set cellnames YES
:set wirenames NO
:set cpyinst YES
```

⇨Constrains property values
⇨Selects epics parts library
⇨Reloads the menus

Turning Schematics into Databases

EPICS

- Done using make
- Specify the database name (extension of `.db`) using the `DATA` make variable in `Makefile.Host`.
- The must be a schematic of the same name, but with extension `.sch`.
- Dependencies are currently broken, so hierarchies are not handled well - you have to `touch` the top schematic.

Exercise

- Create an example application with a `capfast`, `dl` and `startup` directories using `applSetup.pl`
- Create a schematic similar to the one shown in this talk. However, use your imagination if you like!
  - Use the simulation fields and add some simulated plant feedback.
- Edit the example startup.vws to include your database.
- Load onto the VME crate.
- Create a display to change the set-point, and graph the results.