Chapter 14 Appendices

14.1 NSFCAM Data FITS Headers

```
SIMPLE  =                    T / DATA IS IN FITS FORMAT
BITPIX  =                   32 / 32 BITS TWOS COMPLEMENT INTEGERS
NAXIS   =                    2 / NUMBER OF AXIS
NAXIS1  =                  256 / PIXELS ON 1st MOST VARYING AXIS
NAXIS2  =                  256 / PIXELS ON 2nd MOST VARYING AXIS
DATAMIN =                 7635 / MIN DATA VALUE IN FILE
DATAMAX =                42719 / MAX DATA VALUE IN FILE
DATAMEAN=                10420 / MEAN DATA VALUE IN FILE
ASEC_PIX=                 0.30 / PLATE SCALE in arcseconds/pixel
DIVISOR =                    1 / Normalization value
ORIGIN  = 'Institute for Astronomy'
TELESCOP= 'NASA IRTF'
INSTRUME= 'NSFCAM, The Superhero Camera'
OBSERVER= 'Leggett, Griep'
OBJECT  = 'Name of object'
COMMENT = 'Comment for fits frame'
IRAFNAME= 'data0001.a'
BEAM    =                  'A' / Object(A) or sky(B)
TIME_OBS=    '20:46:33.726123' / UT TIME OF ACQISTION ('hh:mm:ss.ss')
DATE_OBS=           '18/01/96' / UT DATE OF ACQUISITION ('dd/mm/yy ')
ITIME   =               1.0000 / INTEGRATION TIME IN SECONDS
CO_ADDS =                    1 / NUMBER OF INTEGRATIONS
OBSMODE =                    0 / obsmode is Obj(A)
CYCLES  =                    1 / Number of cycles
TOTALSH =                   10 / Shift&Adds parameter
SHIFTADD=                    1 / Number of Actual Shift&Adds in image
NUMARRAY=                    1 / Number of Sub Arrays
CAMMODE =                Basic / Camera Mode
ARRAY1  =          0,0,256,256 / x,y,wid,hgt of data array
SP_BINS =         38000,1000,C / ShiftAdd Peak,Binlen,Method
NDR     =                    8 / NonDestructive Reads
CVF_WHEL=                    5 / Name: Blocker  Pos: 33155
FIL_WHEL=                    1 / Name: J 1.26  Pos: 2500
CVFWLEN =               2.2000 / CVF Wavelength
LEN     =                    1 / Name: 0.300  Pos: 2055
DIT     =                    0 / Name: Open  Pos: 3750
PPLATE  =               0.00   / P plate's Angel. Pos: 0
CBMODE  =                    1 / 0=ARC_S,1=ARC_D,2=PRC,3=CDS
FRM_RATE=                 0.00 / In msec. Fastmode=Off SlowCnt=1 NDR=8
RESET_MS=                 1000 / Idle Resets in mseconds
LSTEMP1 =                30.50 / LakeShore Temp. Sensor 1 - Array
SITEMP1 =                76.40 / Sci. Inst. Temp Sensor 1 - Spare
SITEMP2 =                78.60 / Sci. Inst. Temp Sensor 2 - Coldbox
TPD     = ' 23:14:20.28 -06:03:19.2  00:34:17.66 1.125 2000.0 -O'
RA      =          23:14:20.28 / Right Ascension
DEC     =          -06:03:19.2 / Declination
HA      =          00:34:17.66 / Hour Angle
AIRMASS =                1.125 / Air Mass
EPOCH   =               2000.0 / Epoch
END
```

FIGURE 14.1: Example of NSFCAM FITS Header

14.2 Accurate Time Calibration (e.g. for Occultations)

Although the command “GPSTIME on” can be used so that the PC uses the GPS clock as opposed to its internal clock, the start of integration is only good to 0.1sec as the DSP has no access to the GPS clock. During a movie observation the time given in the FITS header can drift significantly and observers carrying out time-critical observations have had to calibrate this drift. An LED is available which can be connected to the GPS and made to flash every second; a series of nsfcam images can be taken to calibrate the drift by comparing the signal to the time given in the header.

14.3 Diagram of the Cryostat and Camera Optics

This cross-section shows the f/36 beam entering the cryostat through the window and passing through the dichroic turret (dichroic not in the beam), collimator lens turret, cold stop, CVF wheel and filter wheel, before being focused onto the detector array by the fixed camera lens.

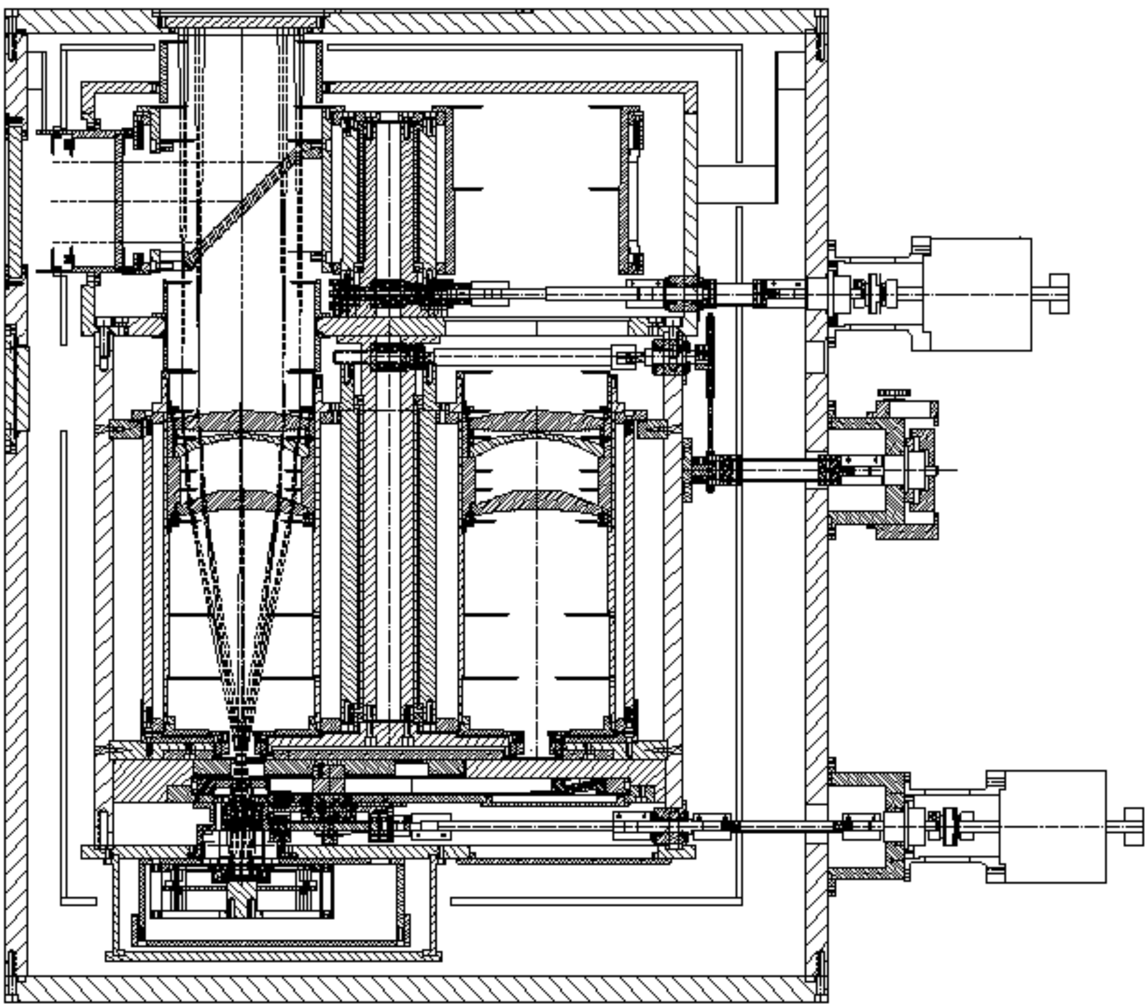

FIGURE 14.2: The Cryostat

The collimator lenses are mounted in a turret and the pixel scale is changed by rotating a collimator lens into position in front of the fixed camera lens.

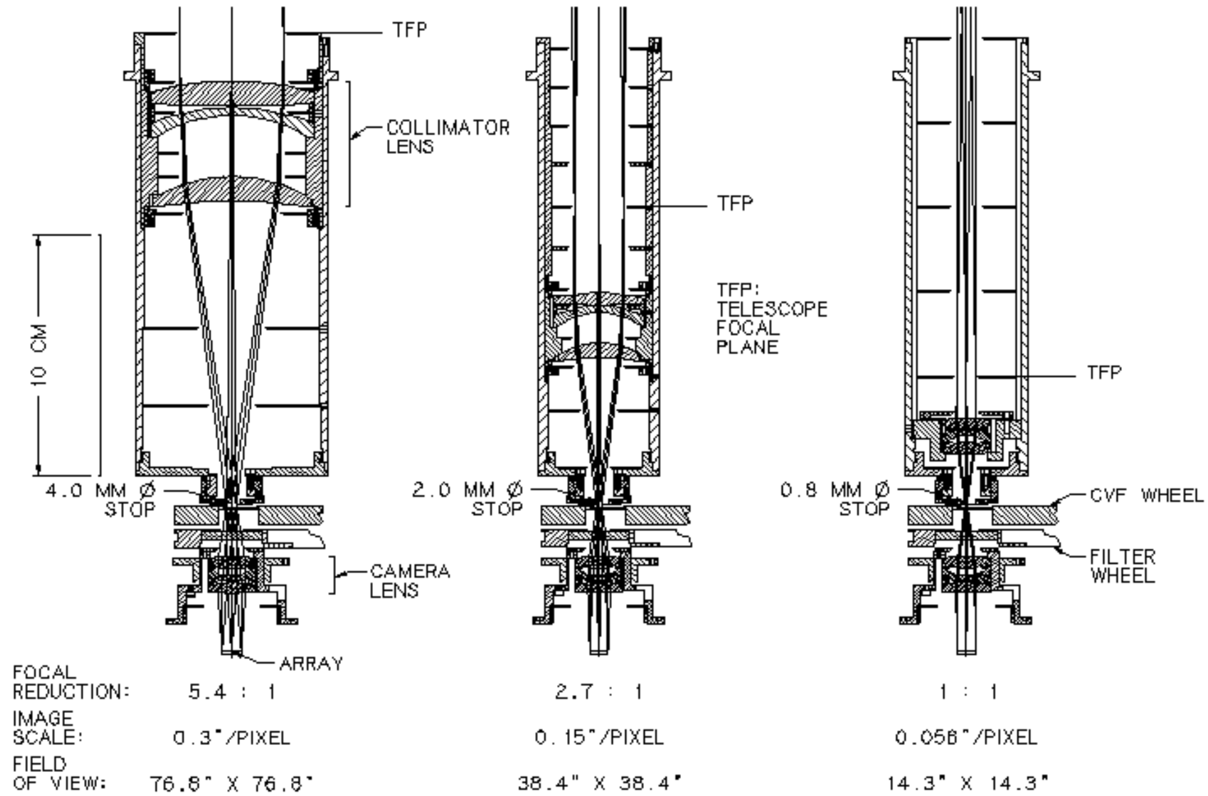

FIGURE 14.3 Lens Assemblies

14.4 Optical Port and Focus Positions

An optical port is available for simultaneous visible and infrared work with NSFCAM. A visible/IR dichroic can be rotated into the beam as described in Section 5.1.2. This dichroic has a transmission of about 90% from 500nm to 900nm. Usually the tip-tilt detector will be installed on this port, but visitor instruments can be mounted given sufficient notice. To obtain a copy of the bolt circle drawing contact Sandy Leggett in Hilo or Darryl Watanabe in Honolulu.

The f-number of the optical beam will be f37 and the plate scale 1.84”/mm.

The different plate scales of NSFCAM have different focus positions, both for IR and visible work. For the largest plate scale, 0.30”/pixel, the optical focus will be 34.0mm inside the dewar wall from the optical port; for the 0.15”/pixel scale the focus will be 38.0mm outside the dewar wall; for the 0.06”/pixel scale the focus will be 107.8mm outside the dewar wall.

14.5 Temperature Controller and Closed Cycle Cooler

Two temperatures are given in the NSFCAM status display - that for the cold box and that for the array. The cold box should be within a few degrees of liquid nitrogen temperature, i.e. 74K. The array should be at 29.5 +/- 1.5 K, and should stay within a tenth of a degree through the entire night. Any larger variation could lead to excess noise.

You can reset the array temperature by typing “tcls setp 29.5” on the XUI command line. If you just see zeroes for the array temperature or you see the array suddenly start to warm up, check that the temperature controller (the box on the east side of nsfcam) is still powered up. It should always be set to use low power for its heater.

If the cold box gets warm check that it has liquid nitrogen. If this is not the problem check that the closed cycle cooler is not making any weird noises to indicate that it is sick. If it seems OK it is possible to adjust the pressure gauge to tweak the cooling efficiency. This should only be done by the operator. For example, if you want to raise the cold box temperature, turn the control knob on the appropriate cooler (next to the instrument) clockwise so that the value measured on the bottom of each swing of the pressure dial indicator has been reduced by a few tens.

14.6 Recent Software Changes: XUI & IC Vers. 0.9b-1.0

1. Release Date

A new version of the NSFCAM software will become the default operating system at the start of the next semester, February 1st 1996. This affects both CAMIC and CAMXUI. The current version, version 0.9b, will still be available as a backup.

There are very few commands that are no longer valid and therefore changes to macros should be minor. See Section 8.2 below for a list of outmoded XUI commands.

The new version is not very different from the current version and the interface looks very similar. Guest accounts will be setup to select the new version of the XUI automatically, and should you need to restart the IC the new version of the software will be selected if you use the "camic" command. (Normally you do not need to worry about the IC.) If you really need to use the old version for some reason contact Sandy Leggett at skl@skl.ifa.hawaii.edu. Please also contact Sandy with comments/questions about this release, and with any feedback on the new software after your run.

2. Improvements to the User Interface

Top XUI box:
- Status box: the values for maximum number of NDR as well as the number of NDR used in the last observation are displayed.
- Motors status box: updated for waveplate assembly
- Temperature control status box: updated for new controller

Lower XUI parameters box:
- 'eng'
  - 'temprecord' button now has time parameter
- 'setup'
  - The new clocking modes are displayed here but the user is restricted currently to the old readout mode 'arc_d' (see Section 9 below)
  - Removed 'IC pathname' and 'autosave IC' from this box
- 'obs'
  - Added 'IC pathname' and 'autosave IC' to this box; these options are only highlighted in movie mode
  - In basic mode 'autosave IC' is automatically turned off
  - The lens icons have been updated to give more accurate plate scale values
  - In movie/movieburst modes the 'display every', 'movieburst' and 'mboffset' options are correctly highlighted

3. New and Outmoded Shift and Add Utilities

After running Shift and Add VF will now automatically display the best (brightest or sharpest) image in the B0 canvas.

The 'x, y, peak' file now also includes the sum of the pixels in the guide array. A new utility exists called 'xypeak2asc' which converts this FITS file to an ascii text file.

The speckle viewer package 'spv' no longer exists. It has been replaced with 'sav' and 'fatvf'.

'sav' displays:

- list of binned images with number of frames in each bin
- plot of sum / peak as a function of time, to illustrate image quality
- histogram of peak values
- plot of x,y shifts as a function of time

'fatvf' displays:

- 8 VF canvasses with each of the eight S&A binned images

4. TCS VF Option

The offset telescope option in VF will now automatically pick up the correct plate scale and the default angle will be set to 0.

5. New Data Formats

5.1. 2D FITS images

Minor changes have been made to the FITS header to make it more standard.

5.2. Movieburst 3D images and the movie2fits utility

The end product of movieburst mode is now a three-dimensional FITS image cube, instead of the multiple binary files previously generated. A new utility has been written called movie2fits which extracts individual images from the cube and which also creates a VF macro for viewing the images as a movie.

```
movie2fits -s 20 data0001.movie
```

will extract image #1, #21, #41 etc from the image cube data0001.movie

```
movie2fits -g 20 data0001.movie
```

will extract only image #20 from the image cube

6. New Temperature Controller

For several months we had been working without actively controlling the temperature of the array. A new Lakeshore controller has been hooked up which controls the array temperature. The cold box is still monitored by the old Texas Instruments device.

To change the array temperature type:

`tcls setp 29.5` sets the array temperature to e.g. 29.5K

7. XUI and Temperature Log Files

7.1. XUI log file

All XUI commands will now be automatically saved to a file in the user's top directory called camxui.log. Commands that have scrolled off the top of the XUI window can be read this way.

7.2. Temperature log file

The 'recordtemp' command will produce a log file on NSFPC in the directory /v1.0 called temper.log. The command has two parameters:

-v Turns verbose on. Default is off.

-s sec The sample period in seconds. Default is 300 (5 minutes)

8. New and Outmoded Commands (for XUI command line or macros)

8.1. New or Changed Commands (since version 1.0 of NSFCAM Manual)

CBMODE{ARC_S|ARC_D|PRC|CDS}
: Sets the CLock Buffer Mode or readout mode for the array. Currently users are restricted to using ARC_D which resets the entire array on each read and doublesamples, as done currently in version 0.9b. See Section 9 for further discussion.

FPCAL{off|on} and FPSETBOX
: FPSETBOX enables the user to define 5 subarrays for which the sum is calculated if FPCAL is ON. Set up for Farby-Perot users.

GPSTIME{off|on}
: Use GPS clock as opposed to internal PC clock. However start of integration is only good to 0.1sec as DSP has no access to GPS.

ISREADY
: Check status of all hardware

MBOFFSET{number}
: Movie Burst pixel offset value to make data within 16-bit integer

MOVIEBURST{number}
: Number of images to take in movieburst mode

NDR{number}
: Number of non-destructive reads or number of readouts for each image

SKYAVG{number}
: Number of images for average sky frame

TCLS{string}
: New Lakeshore array temperature controller command.

TCSI{string}
: Old Texas Instruments cold box temperature controller command

TEMPRECORD{-s number}
: Make a temperature log sampling every n seconds

WPASSY{out|in}
: Polarizer waveplate assembly in or out of beam

8.2. Invalidated or Changed Commands

DSPSAMPLEMODE
: No longer valid with new readout mode (future) capability. (Currently and in the near future observers are restricted to double sampling)

INST
: Set Institute name in FITS header to IfA; not needed

INSTM
: Set instrument name in FITS header to NSFCAM; not needed

TELE
: Set telescope name in FITS Header to NASA IRTF; not needed

TEMPCMD
: Sent commands to old TI controller; replaced by TCLS

TEMPRECORD
Parameters for this command have changed, see Section 7.2

9. Future Options with Read Out Modes

In the near future we hope to make available four different modes of reading out the array. More information e.g. minimum integration times and overheads will be given when the new modes are operational.

The new modes will be:

9.1. Array Reset Clocking, Single Sampled
Reset array then readout after specified integration time.
Equivalent to current readout scheme if DSPSAMPLEMODE set to single (rarely used).

9.2. Array Reset Clocking, Double Sampled
Reset array, take image, then after specified integration time take a second image and store the difference. Equivalent to current readout scheme if DSPSAMPLEMODE set to double (nearly always used). Currently version 1.0 is restricted to use this mode only.

9.3. Pixel Reset Clocking
Single reset and read, for each pixel.

9.4. Correlated Double Sampling
Reset, read, wait, read, take difference, for each pixel.
Not yet operational. When operational this mode will be very useful for short exposures e.g. in the thermal regime - both efficiency and well depth should increase.

14.7 Environment Variables and Initialization Files

This section describes the initialization files for the IC and XUI program. Normally you will not need to modify these files since default values are already setup for your account. They are described here so that you may modify them as needed. Or so you can check them when thing are not working.

An environment variable NFSCAMXUI identifies the location of the XUI executable and associated information file. For example, if the camxui application is stored in /usr/local/faccam/XUI the following line in your .cshrc file would correctly setup this variable

```
setenv NSFCAMXUI /usr/local/faccam/XUI
```

The IC, XUI, and VF all use a similar method to initialize parameters when starting up. Each program looks for a special text file and executes the commands stored in that file. These file are plain text files which contain one command per line. You may modify them using your favorite Unix editor. The available command set is documented in the Dictionary in Chapter 13.

The IC program uses ".camic-init" from your current working directory. The XUI program uses ".camxui-init" from your home directory. ie: ~/.camxui-init. The VF program uses ".vf-init" from your home directory. ie: ~/.vf-init.

14.7.1 Moving the IC Between the Summit and Manoa

Because the PC is used both at the summit and Manoa, there are changes in some of the setup files which need to be done to allow it to work properly at each location. The manoa hostname is 'irlabpc'. The summit hostname is 'nsfpc'. This page identifies the changes required. This is mostly just a reminder for the IRTF programmer or technical staff.

File: /bin/rc

a. At the bottom of the file the rdate program is called to initialize the date at boot time. Change the comment to use the appropriate line. For example, on the summit it would be:

```
/usr/local/bin/rdate herschel
#/usr/local/bin/rdate irmanoa1
```

File: /net/rc.network

a. Insure the host name is correct. nsfpc is used on the summit. irlabpc is the manoa hostname. Look for the following lines and comment appropriately.

```
hostname nsfpc
#hostname irlabpc
```

b. Look for the following line:

```
#  Mount remote NFS directories using the following format:
#  mount remhost:rem_dir_path_name local_dir_path_name
```

mount noelani:/aux1 /noelani

The mount command should be commented on the summit.

14.8 Motor Detent Positions

The detent position of the Filter, CVF, dichroic, and lens wheels are summaried in the following tables.

TABLE 14.1: Dichroic, Lens, Filter and CVF Detent Positions

Dichroic Wheel Detent Information			
Detent	Step Position	Angle	Remarks
D1	0	0	CoCo#2
D2	694	50	
D3	1250	90	visual/IR
D4	2083	150	
D5	2500	180	CoCo#1
D6	3472	250	
D7	3750	270	open
D8	4861	350	

Filter Wheel Detent Information			
Detent	Step Positio	Angle	Remarks
D1	720	36	
D2	2000	100	
D3	3120	156	
D4	4080	204	
D5	4880	244	
D6	5520	276	
D7	6000	300	
D8	6320	316	
D9	6480	324	

Len Wheel Detent Information			
Detent	Step Position	Angle	Remarks
D1	0	0	
D2	69	5	
D3	444	32	0.15"/pix
D4	1167	84	0.06+mask
D5	2056	148	0.30"/pix
D6	2333	168	Blank
D7	2944	212	0.15+mask
D8	3667	264	0.06"/pix
D9	4556	328	0.30+slit

CVF Wheel Detent Information			
Detent	Step Positio	Angle	Remarks
D1	6666	60	
D2	12888	116	
D3	18222	164	
D4	22666	204	
D5	26222	236	
D6	28888	260	
D7	30666	276	
D8	31555	284	
D9	39555	356	

14.9 Rackmount Setup

The NSFCAM Instrument Control computer is a 20 slot 486/33 Rackmount PC-AT computer. This section documents the setup for the various peripheral boards installed in the PC.

Ethernet Card

The ethernet card for the PC is a SMC EtherCard Plus Elite16. This is the default card supported by lynxOS. We have configured the board to be compatiable with Lynx. The board is setup as follows:

TABLE 14.2: Ethernet Setup

	A	B	C	D	E
1	Adapter	I/O Base Addr	DMA Channel	IRQ	Other Notes
2	WD EtherCard Plus Elite	0x240-0x25f	N/A	5	ROM Based addr = None/Disabled. Shared RAM at CC000.

W1 - set to SOFT. Use setup program to setup board to above settings.
W2 - Boot ROM option. This jumper should be set to NONE/SOFT.

Note: A SMC EtherCard Plus may also be used (this is the spare). An additional jumper is set to determine the type of cable.
W3 - AUI (Thick) or Thin(BNC) port. This is the only jumper you will need to set depending on the type of ethernet cable you are connecting to. Make sure this is set correctly.

```
          _____                                          _____
AUI:    |O O|  O       BNC:   O|O O|
        |O O|  O              O|O O|
```

MM-96 Detailed Setup

NSFCAM uses two MM-96 DSP to provide clocking and buffer board functions. The clock DSP makes no use of any DRAM. The BCARD DSP uses the additional DRAM (up to 16Mwords) in speckle and movie mode.

TABLE 14.3: DSP Board Information

	A	B	C
1		**Clock DSP**	**Bcard DSP**
2	PC I/O Address	0x148 (NFNFNNFN)	0x158 (NFNFNFFN)
3	DMA	No DMA - H1 & H2 Unlinked	No DMA - H1 & H2 Unlinked
4	H3 - IRQ	11 (Connect 7 & 8)	12 (Connect 5&6)
5	H4 - DSPnet Address	0 (connect pins 5 & 6)	0 (connect pins 5 & 6)
6	H5 - Hyperbus Port A	Delay = 0. (:]])	Delay = 0. (:]])
7	H6 - Hyperbus Port B	Delay = 0. (:]])	Delay = 0. (:]])
8	H7 - Real-time Clock/DRAM Speed	No clock int. Slow DRAM mem. (: : :)	No clock int. Slow DRAM mem. (: : :)
9	M1/M2 - Outer SRAM B	64k x 4	64k x 4
10	M3/M4 - Outer SRAM A	64k x 4	64k x 4
11	M5/M6 - Inter SRAM	64k x 4	64k x 4

The NSFCam project purchased the following DSP boards. Two full boards were initially purchased. Then a spare board was purchased

TABLE 14.4: DSP Boards Configuration

	A	B	C	D
1	**Serial NUMBER**	**Use**	**SRAM configuration**	**DRAM configuration**
2		Clock	64 K words in all 3 banks	4 Mwords or 16 MBytes
3	751	Buffer	64 K words in all 3 banks	4 Mwords or 16 MBytes
4	927	Spare	64 K words in all 3 banks	256 Kwords or 1 MBtye

PC-38 Stepper Motor Controller

An Oregon Micro System's PC38-8 board is installed to control the stepper motors for NSFCAM. The board is configured as follows:

TABLE 14.5 PC-38 Stepper Motor Board Configuration

	A	B	C	D
1	**Adapter**	**I/O Base**	**DMA Channel**	**IRQ**
2	PC-38	0x0320	n/a	n/a

```
J47 Limit sense jumpers:            [:] [:] [:] [:]  :   :   :   :

J15 Address Select Jumbers:         [:] [:] [:] [:]  :   :   :   :

J17 Interrupt and DMA Jumpers:        :   :   :  [:]  :   :   :   :

J67 User I/O Pull-up Jumpers:       [:] [:] [:] [:]  :   :   :   :

J57 I/O Configuration Jumpers:      [:]  :  [:]
```

SVGA Board

NSFCAM uses the SVGA board as a text only output device. Any generic VGA board will do.