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<tr>
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</tbody>
</table>
CoolRacks

IARC Controller

Backplane

ARC-22 Timing Brd

ARC-32 IR Clock Bd

ARC-46 8 ch Video Bd

H2RG has 5 ARC-46 boards.

(40 channels)

Aladdin has 1 ARC-46 board.

(8 channels)

H2RG Internal Dewar Cabling Block Diagram

MILSpec-to-IDC PCB Assembly is mounted on non-removable panel area of the Vacuum Jacket. H2RG has:
61 pin MILSpec (MS33-40H24C61P-0037)
100 pin MILSpec (231-100-H02L23-34CN)

Manganin Ribbon with IDC connectors.

IDC-to-IDC male connectors mounted on cold structure.

Manganin Ribbon with IDC connectors.

Array Assemble H2RG + PGA socket, PGA Flex 3 Legged Carrier

Dashed box represents item include on the focus stage.

Aladdin Internal Dewar Cabling Block Diagram

1 camera system shown
2nd System represented by this callout.
Instrument will have 2 camera systems (PC + controller + PS).
Aladdin (8 channel controller) will have a single MilSpec Connector

H2RG Internal Dewar Cabling Block Diagram

MILSpec-to-IDC PCB Assembly is mounted on non-removable panel area of the Vacuum Jacket. H2RG has:
61 pin MILSpec (MS33-40H24C61P-0037)
100 pin MILSpec (231-100-H02L23-34CN)

Manganin Ribbon with IDC connectors.

IDC-to-IDC male connectors mounted on cold structure.

Manganin Ribbon with IDC connectors.

Array Assemble H2RG + PGA socket, PGA Flex 3 Legged Carrier

Dashed box represents item include on the focus stage.
Bigdog - Spectrograph Computer X86 PC with Linux

Guidedog - Guider Computer X86 PC with Linux

“Idog” - Instrument Controller Computer X86 with Linux

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</table>
Image Acquisition Software – 2 versions on 2 computer (Spectrograph and Guider)

XUI Application

DV Application

IC Application

SHM_IC
Shared memory

Command
msgr

IC
main() /parent
process

Mq_ic_go
Go

SHM_IARC
Shared memory

mexe

pslow

Pfast

Sock_server

Udp_server

mexe

Parallel port device driver.

Parallel port

Astro_PIC device diver

IARC PCI Interface

SHM_LDOG

Ldog_ic
Main() / parent process

MQ_LDOG
COMMAND

MQ_LDOG
TC330A

MQ_LDOG
TC330B

MQ_LDOG
CALMIR

MQ_LDOG
OSF

MQ_LDOG
SLIT

MQ_LDOG
GRAT

MQ_LDOG
GFLT

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AFOC

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LOGGE

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### User Accounts for SpeX

spex – host the spex web site. Used by support scientist to provide documentation on spex to observers.

**Bigdog Account**

The bigdog account runs the imager software. It normally runs inside the VNC stefan:

- **/home/bigdog/**
  - **|-- current/** - The current version of bigdog.
  - **|-- old/** - order binaries are archived here.
  - **|-- dev/** - A test or development binaries.
  - **|-- macro/** - bigdog macros.
  - **|-- include/** - include files. (so we can’t use /usr/local).
  - **|-- lib/** - lib for bigdog (so we don’t used /usr/local).
  - **|-- src/** - source directory. Should be soft links to /home/s2.
  - **|-- tools/** - contains iarc’s dsp compiler.
  - **|-- bin/** - user scripts, like startic, etc.

**GuideDog Account**

The guidedog account runs the imager/guider software. The user guidedog should use the guidedog computer.

- **/home/guidedog/**
  - **|-- current/** - The current version of bigdog.
  - **|-- old/** - order binaries are archived here.
  - **|-- dev/** - A test or development binaries.
  - **|-- src/** - source directory. Should be soft links to /home/s2.
  - **|-- bin/** - user scripts, like startic, etc.

### ldog Account

The ldog (littledog) account runs the ldog.ic software on the ldog computer. Important directories in the account are:

- **/home/ldog/**
  - **|-- current/** - The current version of bigdog.
  - **|-- old/** - order binaries are archived here.
  - **|-- dev/** - A test or development binaries.
  - **|-- src/** - source directory. Should be soft links to /home/s2.
  - **|-- bin/** - user scripts, like startic, etc.

### s2 Account

The s2 account is used by the spex program for development and testing. This account has the source code, documentation, and the sim/ binaries.

- **/home/s2/**
  - **|-- current/** - The current version of bigdog.
  - **|-- old/** - order binaries are archived here.
  - **|-- dev/** - A test or development binaries.
  - **|-- src/** - source directory. Should be soft links to /home/s2.
  - **|-- bin/** - user scripts, like startic, etc.
<table>
<thead>
<tr>
<th>NAME</th>
<th>Motor Type</th>
<th>Model</th>
<th>Motor Vel</th>
<th>Steps/sec</th>
<th>Step/rot</th>
<th>RPM</th>
<th>Dir for +Steps</th>
<th>Gear</th>
<th>Total Steps</th>
<th>Measure Size</th>
<th>Full Travel (sec)</th>
<th>Neg Lm</th>
<th>Pos Lm</th>
<th>Hm</th>
<th>A/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>calmir</td>
<td>Stepper</td>
<td>M-222-6.0D</td>
<td>50000</td>
<td>50000</td>
<td>6400</td>
<td>468.8</td>
<td>CW</td>
<td>linear</td>
<td>40</td>
<td>256000</td>
<td>256000</td>
<td>5.19</td>
<td>1</td>
<td>1</td>
<td>F</td>
</tr>
<tr>
<td>dit</td>
<td>Stepper</td>
<td>M-222-6.0D</td>
<td>3000</td>
<td>3000</td>
<td>6400</td>
<td>28.1</td>
<td>CCW</td>
<td>detent wh</td>
<td>100</td>
<td>640000</td>
<td>640000</td>
<td>85.33</td>
<td>1</td>
<td>1</td>
<td>A</td>
</tr>
<tr>
<td>OSF</td>
<td>Stepper</td>
<td>M-222-6.0D</td>
<td>10000</td>
<td>10000</td>
<td>6400</td>
<td>93.8</td>
<td>CCW</td>
<td>detent wh</td>
<td>60</td>
<td>384000</td>
<td>384000</td>
<td>128.00</td>
<td>1</td>
<td>1</td>
<td>B</td>
</tr>
<tr>
<td>SLIT</td>
<td>Stepper</td>
<td>M-222-6.0D</td>
<td>3000</td>
<td>3000</td>
<td>6400</td>
<td>28.1</td>
<td>CCW</td>
<td>detent wh</td>
<td>100</td>
<td>640000</td>
<td>640000</td>
<td>64.00</td>
<td>1</td>
<td>1</td>
<td>C</td>
</tr>
<tr>
<td>GFLT</td>
<td>Stepper</td>
<td>M-222-6.0D</td>
<td>10000</td>
<td>10000</td>
<td>6400</td>
<td>93.8</td>
<td>CCW</td>
<td>detent wh</td>
<td>60</td>
<td>384000</td>
<td>384000</td>
<td>128.00</td>
<td>1</td>
<td>1</td>
<td>D</td>
</tr>
<tr>
<td>AFOC</td>
<td>Stepper</td>
<td>M-222-6.0D</td>
<td>5000</td>
<td>5000</td>
<td>6400</td>
<td>46.9</td>
<td>CCW</td>
<td>linear</td>
<td>60</td>
<td>384000</td>
<td>384000</td>
<td>64.00</td>
<td>1</td>
<td>1</td>
<td>E</td>
</tr>
<tr>
<td>ROT</td>
<td>Smart MT</td>
<td>SM34205D</td>
<td>80000</td>
<td>9765.625</td>
<td>8000</td>
<td>73.2</td>
<td>CCW</td>
<td>wheel</td>
<td>180</td>
<td>1440000</td>
<td>720000</td>
<td>73.73</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>GRAT</td>
<td>Smart Mt</td>
<td>SM34205D</td>
<td>80000</td>
<td>9765.625</td>
<td>8000</td>
<td>73.2</td>
<td>CCW</td>
<td>Wheel</td>
<td>180</td>
<td>1440000</td>
<td>720000</td>
<td>73.73</td>
<td>1</td>
<td>1</td>
<td></td>
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</tbody>
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2 6 6 7
Stepper motor drives a linear stage to position the calibration mirror Out or In of the beam. To initialize we drive the stage to the REV limit, and set the position to 0.

Position the stage OUT Or IN using the step position in the table. When the motor is idle, the power to the stepper driver should be OFF.

A WTI unit is used to control the A/C power supplies to turn off/on the 4 calibration lamps.

Motor shaft has 6400 steps/revolution

<table>
<thead>
<tr>
<th>Position of mirror</th>
<th>Green LED</th>
<th>RED LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limits on JBOX</td>
<td>~256866</td>
<td>0</td>
</tr>
<tr>
<td>Out/In positions</td>
<td>out=252000</td>
<td>in=5000</td>
</tr>
</tbody>
</table>
The Dichroic Wheel is also known as DIT.

The DIT is a detent wheel. The detents provide reproducible positioning for each position. An HE sensor senses the home and indetent magnets. A single magnet defines the home position. Each detent, a magnet with reverse polarity are installed. Two comparator circuits are used to provide a "home" and "indetent" signal..

To initialize, we drive the wheel forward until the Forward limit is triggered. This defines the home position.

To move to a detented position, we use the (default) detent_center() or detent_moveto() algorithms.

When the motor is idle, the power to the stepper driver should be OFF.

### Table

<table>
<thead>
<tr>
<th>Menu Inx</th>
<th>Short Name</th>
<th>Long Name</th>
<th>Angle</th>
<th>Step Pos</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>pupil</td>
<td>Pupil Viewer</td>
<td>45</td>
<td>32000</td>
</tr>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.9 (Rf:0.47-0.92, Tx:0.92-6)</td>
<td>135</td>
<td>96000</td>
</tr>
<tr>
<td>2</td>
<td>Open</td>
<td>Open</td>
<td>225</td>
<td>160000</td>
</tr>
<tr>
<td>3</td>
<td>0.8</td>
<td>0.8, Rf:0.42-0.8 Tx:0.80-6.0</td>
<td>315</td>
<td>224000</td>
</tr>
</tbody>
</table>

### Diagram

- **Step/Rev**: 256000
- **64000 steps between detents**
- **1 motor REV = 6400 steps**
- **DMC 4183 Axis A**
  - F.Limit – used for “home”
  - AIN 0
  - Home – used for “Indetent”
- **Step Motor IMS M-2222-6.0D**
- **He Sensor Volts**
  - 4.47V “home”
  - 2.54V “middle”
  - 0.25V “in Detent”
- **Comparator Circuit**
  - Trigger = 4.20 V
  - D.out
  - V.out
  - Trigger = 1.75 V
  - High do help debounce
The Order Sorter Wheel is also known as OSF.

The OSF is a 15 position detent wheel. The detents provide reproducible positioning for each position. An HE sensor senses the home and inDetent magnets. A single magnet defines the home position. A each detent, a magnets with reverse polarity are installed. Two comparator circuit are used to provide a “home” and “inDetent” signal.

To initialize we drive the wheel forward until the Forward limit is triggered. This defines the home position.

To move to a detented position, we use the (default) detent_center() or detent_moveto() algorithms.

When the motor is idle, the power to the stepper driver should be OFF.
The Rotator is a continuous wheel Mechanism.

**Motor Steps** – The rotator is controlled using a stepper motor. The mechanism has a step range of 0 to 1,440,000.

**Rotator Angle** – The rotator angle is simple mapping of degrees (0 to 360) to the motor steps (0 to 1,440,000).

**Position Angle** – The position angle describes the orientation of the slit to the sky image. 0 degrees, the slit is vertical (North on Top). Positive angles rotate the slit clockwise. Negative angles rotate the slit counter-clockwise.

This diagram illustrates the relationship between theses position.
The Slit Wheel is also known as SLIT.

The SLIT is a detent wheel. The detents provide reproducible positioning for each position. An HE sensor senses the home and indetent magnets. A single magnet defines the home position. Each detent, a magnet with reverse polarity are installed. Two comparator circuits are used to provide a "home" and "indetent" signal.

To initialize, we drive the wheel forward until the Forward limit is triggered. This defines the home position.

To move to a detented position, we use the (default) detent_center() or detent_move_to() algorithms.

When the motor is idle, the power to the stepper driver should be OFF.
<table>
<thead>
<tr>
<th>Box Size</th>
<th>CenterX</th>
<th>CenterY</th>
<th>Upper-Left X</th>
<th>Upper-Left Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3x15&quot;</td>
<td>249</td>
<td>209</td>
<td>30</td>
<td>234</td>
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<td>221.5</td>
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</table>

Note:
The spex software defines the autoguide boxes in the the ic/command.c file do_autoguidebox_setup(). The code uses Upper-Left XY. This table provides an eazy CenterXY to Upper-Left XY translation.
The Grating is a continuous wheel mechanism.

### Grating Wheel (GRAT)

**HE Brd CH 08**
- CH Gain set to peak = 4.2v

**Comparator Circuit**
- +Trigger = 3.65v
- -Trigger = 1.0v

**Anamatic Smart Motor**
- SM34205D

**Graph of HE sensor voltages vs steps**
- Output of sm._hhome() function.

<table>
<thead>
<tr>
<th>Short Name</th>
<th>Long Name</th>
<th>Angle</th>
<th>Step Position</th>
<th>Desired Focus</th>
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</thead>
<tbody>
<tr>
<td>ShortXD</td>
<td>ShortXD</td>
<td>0.70-2.55 um</td>
<td>0.43</td>
<td>1700</td>
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<tr>
<td>Prism</td>
<td>Prism</td>
<td>0.70-2.6 um</td>
<td>90.20</td>
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<tr>
<td>LXD_long</td>
<td>LXD_long</td>
<td>1.98-5.3 um</td>
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<td>LXD_short</td>
<td>LXD_short</td>
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<td>156.93</td>
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<tr>
<td>SO_long</td>
<td>Single Order Long</td>
<td>3.1-5.3 um</td>
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<tr>
<td>SO_short</td>
<td>Single Order Short</td>
<td>0.9-2.5 um</td>
<td>303.53</td>
<td>1214100</td>
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</table>
The Guider Filter Wheel, GFLT, is a 15 position detent wheel. The detents provide reproducible positioning for each position. An HE sensor senses the home and indetent magnets. A single magnet defines the home position. At each detent, a magnets with reverse polarity is installed. Two comparator circuit are used to provide a “home” and “indetent” signal...

To initialize we drive the wheel forward until the Forward limit is triggered. This defines the home position.

To move to a detented position, we use the detent_moveto() algorithms.

When the motor is idle, the power to the stepper driver should be OFF.
There are 6500 steps per motor revolution.
1 revolution of the axis = 50 microns of linear travel.

Several Nth degree polynomial equations are used to convert between HE Sensors voltage output and the motor position counts. The $y = f(x)$ represents a Nth degree polynomial fit.

Data and fit documented in src/spex/ldog/afoc_fit/

The equations are:

$y = a + xb + x^2c + x^3d + x^4e + ...$

NEG Steps to Voltage Coeff

$\begin{align*}
a &= 2.4561558 \\
b &= 2.6225020e-06 \\
c &= -3.0148264e-12 \\
d &= -3.5663117e-18 \\
e &= -7.8737030e-23
\end{align*}$

POS Steps to Voltage Coeff

$\begin{align*}
a &= 2.4550567 \\
b &= 2.6298539e-06 \\
c &= 1.0336774e-12 \\
d &= 4.8733233e-18 \\
e &= 3.1596328e-23
\end{align*}$

NEG Volts to Steps

$\begin{align*}
a &= -870428.07 \\
b &= 1198416.7 \\
c &= -918526.42 \\
d &= 323556.58 \\
e &= -36435.731
\end{align*}$

POS Volts to Steps

$\begin{align*}
a &= 6370113.9 \\
b &= -10522098. \\
c &= 6013895.8 \\
d &= -1446830.1 \\
e &= 127282.28
\end{align*}$

<table>
<thead>
<tr>
<th>volts at trigger</th>
<th>approx step pos</th>
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</thead>
<tbody>
<tr>
<td>-Trigger</td>
<td>1.20</td>
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<tr>
<td>-271453</td>
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<tr>
<td>+Trigger</td>
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ZERO POS VOLTS 2.455
6 fibers for array clocking and data.