EUROPEAN SOUTHERN OBSERVATORY

Organisation Européenne pour des Recherches Astronomiques dans l'Hémisphère Austral

Europäische Organisation für astronomische Forschung in der südlichen Hemisphäre

VERY LARGE TELESCOPE

VLT

Astronomical Site Monitor

Control Software

Installation Manual

Doc.No. VLT-MAN-ESO-17441-1774

Issue 1.0

Date 31.03.1999

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Change Record

Issue/Rev.	Date	Section/Page affected	Reason/Initiation/Document/Remarks
1.0	31.03.1999		

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1 INTRODUCTION

The **Astronomical Site Monitor (ASM)** provides information about the current meteorological data, outside air, seeing, cloud coverage etc. It also produces the data to be archived together with scientific and other data sets in the ESO on-line archive.

The hardware of the ASM consists of the Differential Image Motion Monitor (**DIMM**, a 35-cm telescope with enclosure, technical CCD detector), and several external sensor facilities like a meteorological station.

1.1 Scope

This document contains the description how to install the ASM control software, inclusive a short overview about related hardware installations. It is assumed that the reader is familiar with general VLT software concepts.

1.2 Reference Documents

Further information can be found in following documents:

[1] **DIMM Upgrade Plan** VLT-SPE-ESO-17410-1174
presents details about the theory of seeing measurement etc.

[2] **ASM Control Software Operation Manual** VLT-MAN-ESO-17441-1404
contains detailed information about ASM operation and configuration issues.

[3] **ASM Control Software Functional Specification** VLT-SPE-ESO-17441-1175
gives a detailed overview of ASM-internal aspects.

The following general documents are also useful:

[4] VLT Common Software Installation Manual, VLT-MAN-ESO-17200-0642

[5] LCU Common Software User Manual, VLT-MAN-SBI-17210-0001

[6] CCS User Manual, VLT-MAN-ESO-17210-0619

[7] CCD Detectors Control SW Functional Spec., VLT-SPE-ESO-17240-0227

[8] Real Time Display User Manual, VLT-MAN-ESO-17240-0866

[9] Technical CCD Systems User Manual, VLT-MAN-DJO-11700-0001

[10] LCU Axis User/Maintenance Manual VLT-MAN-ESO-17130-1211

[11] TPOINT Telescope Pointing Analysis System, version 5.2-3, 23rd Nov 1996, P.T.Wallace, Tpoint Software, UK

1.3 Abbreviations And Acronyms

The following abbreviations and acronyms are used in this document:

ACE	Array Control Electronics (for CCD Cameras)
ASM	Astronomical Site Monitor
CCD	Charge Coupled Device
CCS	Central Control Software
CPU	Central Processing Unit
DB	Database
DIMM	Differential Image Motion Monitor
FTP	File Transfer Protocol

GUI	Graphical User Interface
HW	Hardware
I/F	Interface
I/O	Input/Output
LAN	Local Area Network
LCC	LCU Common Software
LCU	Local Control Unit
N/A	Not Applicable
RTAP	Real Time Application Platform
SW	Software
TBC	To Be Confirmed/Clarified
TBD	To Be Defined
TCCD	Technical CCD
TCS	Telescope Control Software
TIM	Time Interface Module
TRS	Time Reference System
VLT	Very Large Telescope
VME	Versa Module Eurocard (Bus-System)
WS	Workstation

1.4 Stylistic Conventions

The following styles are used:

bold
: in the text, for commands, filenames, prefixes/suffixes as they have to be typed.

italic
: in the text, for parts that have to be substituted with the real content before typing.

`teletype`
: for examples.

`<name>`
: in the examples, for parts that have to be substituted with the real content before typing.

bold and *italic* are also used to highlight words.

2 HARDWARE INSTALLATION OVERVIEW

This description gives a brief overview of the ASM hardware installations that are necessary before starting with the software installation. It is not intended as a detailed instruction!

2.1 Workstation wasm installation

The following equipment must be installed and interconnected:

- HP C-110 or C-200 workstation with LAN interface
- HP 20" display, 1280 x 1024 resolution
- Keyboard and mouse
- DAT device for SW installations and backups (optional)
- Ethernet to router resp. switch to backbone network

2.2 LCU lasm1 cabinet installation

The LCU lasm1 is located outside on or next to the telescope tower. It consists of:

- Amplifier rack
- VME rack with the following boards:
    - MVME167 CPU
    - TIM time I/F
    - IK320 encoder I/F
    - ISER8 serial I/O
    - Acromag digital I/O
    - MVME analog I/O
- Cooling rack
- Bidirectional serial line optocoupler (Phoenix Contact Art.-Nr. 2761444)
- Enclosure control DC/DC converter (only at La Silla)

Connections are as follows:

- power cable (3 connections: LCU, amplifier rack, ventilator)
- ethernet and transceiver to WS
- time bus fiber
- cables from amplifier rack to eta and theta motors (4 each):
    - encoder cable eta (A1) goes to IK320 card socket X1
    - encoder cable theta (A2) goes to IK320 card socket X3
    - IK320 sockets X2, X4, X5 remain empty.
- digital and analog I/O cables between LCU and amplifier rack, flat ribbon cable with edge connectors.
- serial line connector to meteorological station (male D-9 type connector)
- enclosure interface:
    - serial connector to enclosure on board CPU at local panel (Paranal)
    - multi-thread cable (digital signals) to enclosure local panel (La Silla)

2.3 LCU lasm2 cabinet installation

The CCD LCU lasm2 is located inside the ASM control room. Connections are as follows:

- power cable
- ethernet and transceiver to WS
- time bus fiber (optional)
- two CCD power supply cables to ACE box
- CCD fibers (1-6) to outside (remark correct order)

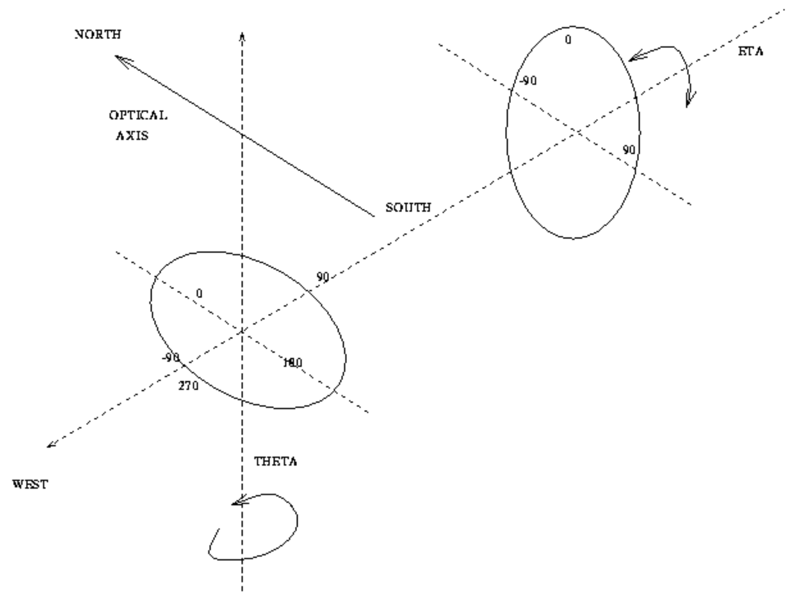
The ACE is located in direct vicinity of the TCCD at the base of the DIMM telescope. Connections are as follows:

- fibers (1-6) from LCU lasm2 (dismount ACE front panel before)
- two CCD power supply cables from LCU lasm2
- three cables to TCCD head
- cooling pipes in/out.

2.4 Telescope installation

1. The basic telescope structure shall be exactly horizontal and aligned in north-south direction.
2. The eta motor is mounted so that the middle of the operational range is when the theta axis is vertical.
3. The theta motor is mounted so that the operational range is only limited at the west horizon.
4. The tube is mounted to the theta motor.

Fig. 1 DIMM telescope eta/theta axes. This mounting type is normally called alt-alt.



As shown in Fig. 1, the telescope mount correspond to a so called alt-alt mounting. The theta drive is physically attached to the eta drive. Roughly, an small eta motion correspond to a declination displacement and a small theta motion correspond to an hour angle change. Given that the motors are mechanically joined, is necessary to move both when trying to align the horizontal plane (as explained ahead in section 2.4.3).

After the software has been installed, an alignment procedure must be executed.

2.5 DIMM technical CCD installation

The CCD shall be mounted as follows into the tube:

- CCD-x parallel to the theta axis
- CCD-y parallel to the eta axis

Fig. 2 shows an schematic representation of the CCD mounting as viewed from the rear part of the telescope's CCD box.

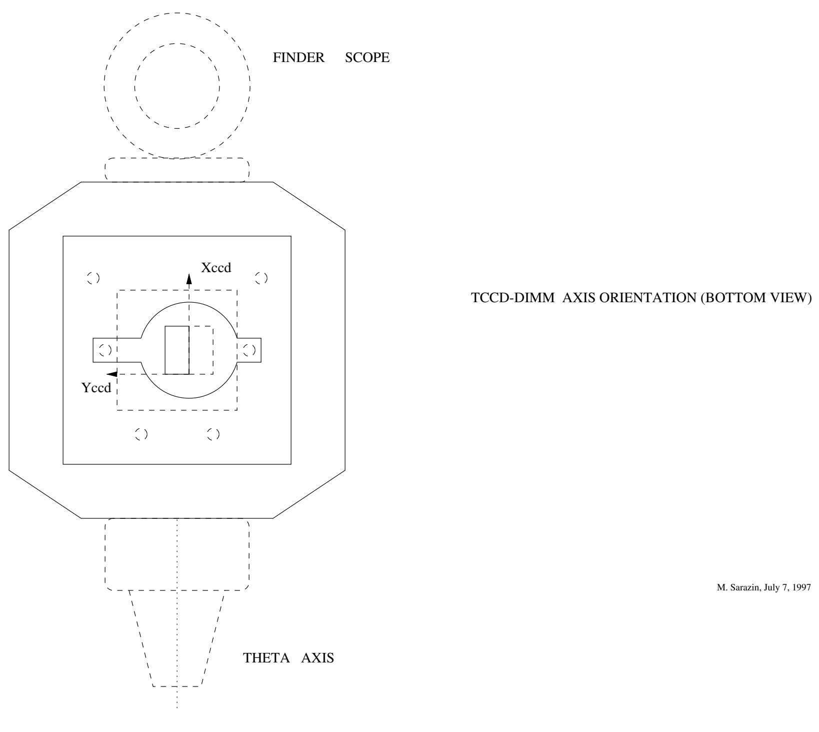
The optic splits the image in x-direction then. It means that:

- telescope offsets in eta produce CCD-x displacements
- telescope offsets in theta produce CCD-y displacement

Now, to make easy the linking between spots motion over a computer screen and the real motion on the sky the CCD x and y axes are presented rotated when using the RTD panel. For details refer to section 7.8 ("DIMM CCD stand-alone"). Proceeding as explained in 7.8 then CCD-x / CCD-y axes will coincide with vertical /horizontal axes over the computer screen, respectively.

Note: x-direction will change with the half-sky. This must be considered when viewing the image with the RTD.

Fig. 2 Technical CCD installation



For cooling of the CCD head and ACE box a chiller must be connected.

2.6 Telescope Enclosure Serial Line

The cabinet of the LCU lasm1 has been equipped with an opto-isolator that makes secure to directly attach the electrical serial cable coming from the enclosure hardware (9 pins D connector).

Note: This installation is temporary and will require a definitive panel that should be mounted at the rear part of the LCU rack. Making possible the simultaneous connection of several external serial line channels. This panel must include opto-electrical transceivers and opto-isolators.

2.7 Meteo Serial Line

An optical serial line has been wired between the VAISALA CPU and the top of the DIMM telescope tower. This serial link is directly attached to the appropriate lasm1 ISER's channel using the adequate transceiver.

Note: This installation is temporary and will require a definitive panel that should be mounted at the rear part of the LCU rack. Making possible the simultaneous connection of several external serial line channels. This panel must include opto-electrical transceivers and opto-isolators.

3 SOFTWARE INSTALLATION

This chapter describes how to install the ASM control software on a workstation and how to configure the connected LCUs.

3.1 Workstation Software Installation

3.1.1 Groups and Users

The VLT common SW foresees already several users [4]. Additionally, corresponding to the general VLT operators scheme, the following users/groups shall be created:

- **asm/vlt** - operators
- **asmmgr/vlt** - ASM software installation

Additional user accounts may be necessary for software additions.

VLT common SW installations shall be done with user *vltmgr* into *$VLTROOT*.

ASM control SW installation shall be done with user *asmmgr* into *$INTROOT*. This includes any upgrades of modules included in the VLT common SW.

3.1.2 Environment Variables

- Global configuration in /vlt/System/config/wasm.cshrc: This should set up everything normally needed, see section 5.2.
- For user asm and asmmgr: No further setting are normally required. Additions should be done in '~/config/wasm.cshrc.local'.
  The file '~/.login.local' should contain:

```
echo "-------------------------------------------"
echo " Type 'asm' to display all plots          "
echo " Type 'asmDimm' to display seeing value    "
echo " Type 'asmMeteoWind' to display wind data   "
echo "-------------------------------------------"
```

3.1.3 VLT SW

Refer to [4] for details.

Deviations from the instructions there are:

- The crontab job to be installed for user 'vlt' (log file backup) shall be installed for user 'asm' instead. Choose 10000000 (10 MB) as maximum logFile size, see 3.1.7.

During VLTSW installation, check particularly the following:

- file-systems (presence and size) - local /home for La Silla
- /etc/auto_home and /etc/auto_master - remote NFS mount of users 'vltmgr' and 'asmmgr' on wgsops for Paranal, but all local for La Silla
- /etc/motd - welcome message
- enable NTP with 'sam', check with 'ntpq -p', adjust system clock if it is completely wrong.
- /sbin/init.d - include Tornado licenser and vcsolac in auto-start sequence, but not Rtap environment
- /etc/passwd must contain an entry for all users that need to communicate via Rtap.
- /etc/services - add all client WSs (that are going to access wasm via Rtap). ASM specific entries are:
  wasm 2301/tcp # ASM environment
  wasm0 2302/tcp # ASM user environment

lasm1 2160/tcp # Telescope LCU
lasm2 2160/tcp # Detector LCU

- /etc$RTAPROOT/RtapEnvList - check/add all ASM environments and possible clients:
  wasm /vltdata/ENVIRONMENTS/wasm
  wasm0 /vltdata/ENVIRONMENTS/wasm0
  lasm1 lasm1
  lasm2 lasm2
- /var/adm/cron/cron.allow - add 'asm' and 'asmmgr' to allow cron jobs for them (note that in this directory is a 'log' file which could eventually fill up the /var file-system)
- /vltdata/msql - install for external ACCDB on wgsops/wgsacc for Paranal, local for La Silla.
- /vlt/System/config/wasm.cshrc - must contain correct TARGET_ASM setting etc.

3.1.4 ASM SW

A detailed build-procedure is provided in the *asmBUILD* module:

Follow the instructions in section 5.1.

Invocation of it compiles and installs the complete ASM SW (this list might be extended):

- asm - public asm interface
- asmi - internal common function
- asmcat - star catalog and selection
- asmdim - DIMM instrument control and calculations
- asmmet - Meteo control
- asmtel - Telescope control
- asmten - Enclosure control
- asmarc - Archive interface
- asmlcu - top-level LCU command interpreter
- asmws - top-level WS control process
- asmei - engineering and operator panels
- asmbb - the 'Big Brother'
- asmINS - instrumentation configuration files
- asmENV - environment configuration

This includes the required TCS modules:

- acm - axis control module
- axis - axis control
- trk - tracking

As described in the instructions, the ASM software shall be installed under the following paths:

- ~asmmgr/asm/<*Rel*>/asmBUILD - the asmBUILD module initially checked out from the archive
- ~asmmgr/asm/<*Rel*>/INSTALL - modules checked out from the archive during the asmBUILD procedure
- /vlt/asm/<*Rel*> - integration root for all code of this release
- /data/ins - instrumentation files branch

where <*Rel*> is the respective VLT common software release, e.g. "FEB99".

Note: any ASM or TCS software installation must be performed only by asmmgr user into INTROOT.

3.1.5 Directories

The following directories must be created by *asmmgr*. All files and directories under */data* must be made group-writable.

- /data/ins - use 'oslxInsManager' to create an INS_ROOT structure with this name
- /data/asm - for ASM archive data files
- /data/dhs - for DHS volac/vcsolac
- /data/dhs/bad - dito
- /data/dump - for diagnostic files produced by asmdimExposDump
- /data/log - for ASM log files
- /vlt/asm - for ASM INTROOTs
- /vltdata/pointing - for ASM telescope pointing files

3.1.6 VUE configuration

The desktop environment should be configured using the vuewmrc files for users *asm* and *asmmgr* as provided in the module directory *asmENV/config*. The respective files have to copied manually to *~asm[mgr]/ .vue/vuewmrc*. Then the preferred colors, workspace names and backdrops should be set with the VUE style manager, the window manager restarted, and saved as home session. Finally one should log out and in again.

3.1.7 Crontab setup

Several jobs must be periodically scheduled by user asm. Enter 'crontab' and then the lines stated in section 5.1, terminated by a Ctrl-D; an example is:

```
0,5,10,15,20,25,30,35,40,45,50,55 * * * * /vlt/FEB99/bin/logVLTBackup asm vlt 12 10000000
0 12 * * * /vlt/asm/FEB99/bin/asmarcFileTransfer.sh /data/log/meteo.log te13.hq.eso.org:archive/ls
0 12 * * * /vlt/asm/FEB99/bin/asmarcFileTransfer.sh /data/log/dimm.log te13.hq.eso.org:archive/ls
0 15 * * * find /data/asm -mtime +1 -perm 664 -exec rm {} \;
0 15 * * * find /data/asm -mtime +7 -exec rm {} \;
0 15 * * * find /data/dhs -mtime +7 -exec rm {} \;
0 15 * * * find /vltdata/tmp -mtime +30 -perm 664 -exec rm {} \;
```

But note that latest version may vary. The purpose is to:

- limit size of logFile to 10MB and produce ops-logs at 12UT
- transfer meteo.log to Garching
- transfer dimm.log to Garching
- remove data/paf files older than one day, only if archived
- remove data/paf files older than one week, whether archived or not
- remove dhs files older than one week, whether archived or not
- remove any file in /vltdata/tmp older than one month

3.2 LCU Software Installation

The complete LCU SW (VxWorks and applications) are stored on the WS and downloaded from there at boot time (when the LCU is reset). There is however the need to initialize once the boot-line as described below.

3.2.1 LCU boot-line programming

The boot-line of an LCU contains the basic parameters like the IP address and node names. They have to be set once after installation, and possibly after a crash. They are stored in non-volatile memory.

1. Connect a serial terminal (or laptop with terminal program, Window's hyper-terminal would do) to LCU serial port 1 (console) on the back of the cabinet. The default serial line configuration for this port is as follows:
    - baud rate = 9600 bps
    - parity = none
    - stop bits = 1
2. Power on LCU, press RESET button on CPU front panel; the start-up message of the boot ROM should appear on the terminal.
3. Press RESET again, immediately press Return on the terminal.
4. Then enter 'c' for "change", and then the values given below. If a field shall be empty, but is presently not, then enter a '.' (point) to clear the field.

    For lasm1 (Paranal):

    ```
    boot device          : ei
    processor number     : 0
    host name            : wasm
    file name            : /vlt/vw5.3/config/mv167/vxWorks
    inet on ethernet (e) : 134.171.193.16:ffffff00
    inet on backplane (b):
    host inet (h)        : 134.171.193.1
    gateway inet (g)     :
    user (u)             : vx
    ftp password (pw) (blank = use rsh):
    flags (f)            : 0x8
    target name (tn)     : lasm1
    startup script (s)   : /vltdata/ENVIRONMENTS/lasm1/bootScript
    ```

    For lasm1 (La Silla):

    ```
    boot device          : ei
    processor number     : 0
    host name            : wasm
    file name            : /vlt/vw5.3/config/mv167/vxWorks
    inet on ethernet (e) : 134.171.80.31:ffffff00
    inet on backplane (b):
    host inet (h)        : 134.171.80.30
    gateway inet (g)     :
    user (u)             : vx
    ftp password (pw) (blank = use rsh):
    flags (f)            : 0x8
    target name (tn)     : lasm1
    startup script (s)   : /vltdata/ENVIRONMENTS/lasm1/bootScript
    ```

    For lasm2 (Paranal):

    ```
    boot device          : ei
    processor number     : 0
    host name            : wasm
    file name            : /vlt/vw5.3/config/mv167/vxWorks
    inet on ethernet (e) : 134.171.193.17:ffffff00
    inet on backplane (b):
    host inet (h)        : 134.171.193.1
    gateway inet (g)     :
    user (u)             : vx
    ftp password (pw) (blank = use rsh):
    flags (f)            : 0x8
    target name (tn)     : lasm2
    startup script (s)   : /vltdata/ENVIRONMENTS/lasm2/bootScript
    ```

    For lasm2 (La Silla):

    ```
    boot device          : ei
    processor number     : 0
    host name            : wasm
    file name            : /vlt/vw5.3/config/mv167/vxWorks
    inet on ethernet (e) : 134.171.80.32:ffffff00
    inet on backplane (b):
    host inet (h)        : 134.171.80.30
    gateway inet (g)     :
    user (u)             : vx
    ftp password (pw) (blank = use rsh):
    flags (f)            : 0x8
    target name (tn)     : lasm2
    startup script (s)   : /vltdata/ENVIRONMENTS/lasm2/bootScript
    ```

5. When ethernet is connected, the LCU should load VxWorks from the WS after the RESET button is pressed. If not then there is likely a misconfiguration. Refer to [4] in case of problems.

3.3 Verification

The purpose of the following verification procedure is to go through a complete initialization of the ASM software, trying to detect unexpected errors. The objective is to start every environment, check that the communication between them is OK and check that expected processes/tasks are running.

At this point is assumed that the ASM code and environments has been successfully created and installed as described in 3.1.4.

To check for possible errors the use of the logMonitor panel is recommended.

LCU verification always comes first.

3.3.1 LCU verification

Reboot the LCUs: start vccConfigLcu, select the LCU from the menu and press "Reboot LCU". Rebooting an LCU in this way, at least for the very first time, is recommended because additional booting information can be seen in the shell window from where vccConfigLcu was started. Repeat the same for the next LCU after the first one has finish booting. There is not a restriction on which LCU should be booted first, it's up to the user.

At this level what is happening when an lcu is booted is the following:

a. VxWorks is loaded from the workstation
b. the bootScript file is sourced from the VxWorks prompt. This file is different for every LCU environment and loads the needed software and starts VLT tasks.

If the booting is successful then the output on the shell window (from where vccConfigLcu was started) must show something like the following lines:

```
LCC INITIALISATION SUCCESSFULL.
value = 2 = 0x2
lcubootLogFinish
lcuboot end
value = 0 = 0x0
# ___END_OF_BOOT_SCRIPT___
```

If there is a problem when sourcing the boot script file then the last lines on the shell window must be (almost) self-explanatory.

If the sourcing of the boot-script file ends successful then it is necessary to check in the logMonitor whether some error has been logged. If this is not the case then is stated that the LCU has been booted successfully and the ASM loaded and started.

3.3.2 Workstation verification

Many VLT command SW verification steps are included in the VLTSW installation manual [4].

After build of the SW, the WS environment wasm must be started:

- vccEnvStart -e wasm

Use logMonitor to check that the workstation processes has been started successfully. The following list includes the most critical application processes:

- asmwsControl

- asmmetTransfer
- asmarcArchive
- ccdconCI_DIMM
- ccditWs_DIMM

Finally, the command *vccEnvCheck* must be used. This command checks for environment setups, database access and processes/tasks presence. The syntax of the command is as follow:

- vccEnvCheck -e <env_name>

Use the command to check all the environments: lasm1, lasm2 and wasm. The output of the command is self explanatory.

3.3.3 Network verification

The proper system operation is dependent on the correctness of network installations. Problems there might only be detected by loading it to its maximum bandwidth. To do this, here is a procedure to test the network performance by measuring the CCD image transfer from lasm2 to wasm:

- login on wasm as user asm or asmmgr
- make sure that Rtap environment is running: vccEnvCheck -e wasm
  if not: vccEnvStart -e wasm (as user asm !!!)
- make sure that CCD-LCU is ok: vccEnvCheck -e lasm2
  if not: reboot it (push reset button)
- start CCD control panel: ccdStart.sh
- un-select all “Options” checkbuttons in the Setup section
- From Options menu un-select: context sensitive
- From Maintenance menu select: CCD Engineering Interface
- Click there: Change Mode ...
- Click there: ACE simulated, then Accept (this is not avoid actually taking exposure in daylight)
- On CCD control panel click: Startup (or Shutdown and then Startup)
- In Setup/Exposure section select: Time=0.0, Options, Repeat, forever.
- In Setup/Image section select: Display
- In Status section select: Show - Engineer. (this shows the transfer time display)
- Start exposure loop - click: Start
- Check value of “Transfer (LCU->WS)”, should be less than 1 sec, ideally 0.25 sec.
- When done click: Stop loop
- Click: Shutdown
- On CCD Engineering Interface click: Change Mode ...
- Click there: no simulation, then Accept
- On CCD control panel click: Startup
- Exit all previously opened panels.

4 ALIGNMENT

After all hardware and software installations are done, there are some alignment tasks to be performed before operation can start. These have to be executed normally only once, unless the underlying installations are changed.

4.1 Telescope alignment

The telescope alignment consists in mechanical adjustment and determination of the axis offsets for eta and theta. The final fine adjustment will then be done with a pointing model.

Note: Despite the pointing model, the alignment should be done as precise as ever possible. Only this can assure good all-sky pointing performance.

4.1.1 Encoder mounting verification

After mounting of the encoder to the telescope drive, it must be verified once that the encoder reference mark has sufficient distance from the drive's limit switch. The procedure must be repeated in case the encoder is mechanically moved.

The initialization sequence consists in moving to the axis init-switch, moving back until the switch is negated, and then to find the next encoder reference mark (zero pulse). Corresponding to the drive transmission factor of 520, one telescope axis revolution corresponds to 520 encoder revolutions, i.e. one encoder revolution is 360/520 = 0.69 deg. The encoder has one reference mark per revolution.

The encoder should be mounted so that the encoder reference mark has sufficient distance to the negation of the axis init-switch (which is not very accurate) so that it may not happen that the switch is still asserted when the correct reference mark is passed, in which case the next one would initialize the encoder, resulting in a wrong position offsetted by one encoder revolution (0.69 deg).

The procedure to adjust the mechanical encoder position is then as follows ('axis' is either 'eta' or 'theta'):

1. Open acroxInducer panel to monitor limit switch (bit #2 for eta, #6 for theta)
2. Disable vicinity-limit checking in software, otherwise the axis backs off before reaching the switch:
   dbWrite @lasm1:ASM:Telescope:axesData.vicinityMargin 10 (or some higher value)
   WARNING: it is now possible to preset the axis into an interlock! Recovery can then only be done with the handset.
3. Initialize axis:
   msgSend axisServer INIT
4. Move toward limit until the init-switch is asserted:
   msgSend axisServer PRESET rel,<step> (repeated, 0.01 degree step-size suggested)
5. Move reverse until the init-switch is negated: dito.
6. Check this position:
   msgSend axisServer STATUS
7. Compare this position to the axis offset:
   dbRead @lasm1:ASM:Telescope:Axis<1/2>:POSLOOP:ABSENCODER.offset(1)
8. Revert the vicinityMargin to 0.1.

The difference should be ideally one half encoder revolution (0.35 deg). A value of 0.1 to 0.6 is acceptable. Otherwise the encoder must be mechanically adjusted (you have to guess the right direction!) and the procedure repeated. The mechanical adjustment is done by releasing the three screws of the encoder mounting, turning the encoder, and tightening the screws again.

After the adjustment, initialize the encoder multiple times and verify that you get always the same position.

4.1.2 North-South alignment procedure

The structure shall be placed on the tower so that its main axes correspond to N/S and E/W. A compass may be used to facilitate this. This first step needs only be a rough alignment.

4.1.3 Structure horizontal plane alignment

With a level-meter the telescope base-structure shall be aligned so that it is exactly horizontal.

1. Adjust the tilt around the E/W axis with the two foot-screws at the west-end of the structure, with the level-meter in the middle of the connecting bar.
2. Adjust the tilt around the N/S axis with the foot-screw at the east-end of the structure, with the level-meter near the center of the structure. This cannot be so precise, however.

4.1.4 Axis Offsets determination

In vertical orientation of the tube the absolute angles of the axes shall exactly match the theoretical zenith position. To do so, the system has two degrees of freedom represented by two unknown offset parameters. Those values are added to the encoders read-out and represent the absolute position at which each axis initialize.

To perform the alignment both axes should be moved independently from each other. To do so use the *ccseiMsg* panel or use the asmeiTelescope panel as explained in the ASM operation manual [2]. In any case, the use of the ccseiMsg panel is needed to get the final position of the corresponding axis. The STATUS command gives back important information about the actual status of the device, like the reference and actual position of the physical axis.

The alignment should be done with a level meter located on the tube spider below M2 and the whole procedure consists of an iteration of the following steps:

1. Adjust the offset of eta axis for N (S) half-sky.
   a. INIT eta and theta axes:
      lasm1 etaServer INIT
      lasm1 thetaServer INIT
   b. PRESET eta to the +90 (-90) degree position (i.e. theta axis horizontal):
      N: lasm1 etaServer PRESET abs,90,<timeout-sec>
      S: lasm1 etaServer PRESET abs,-90,<timeout-sec>
   c. PRESET theta to the 0 (180) degrees position (i.e. optical axis vertical):
      N: lasm1 thetaServer PRESET abs,0,<timeout-sec>
      S: lasm1 thetaServer PRESET abs,180,<timeout-sec>
   d. Give small relative presets to the eta axis until the theta plane is exactly horizontal (to be measured):
      lasm1 etaServer PRESET rel,+/-0.01
   e. Read back the actual encoder value in degrees:
      lasm1 etaServer STATUS
   f. Subtract this value from the current setting of the eta-offset and add +90 or -90 degrees for alignment on the north or south half-sky, respectively.
   g. Save the result as new offset and make it active, as described in [2].
2. Adjust the offsets of theta axis for N (S) half-sky.
   a. INIT eta and theta axes:
      lasm1 etaServer INIT
      lasm1 thetaServer INIT

b. PRESET eta to the +90 (-90) degree position (i.e. theta axis horizontal):
   N: lasm1 etaServer PRESET abs,90,<timeout-sec>

   S: lasm1 etaServer PRESET abs,-90,<timeout-sec>
c. PRESET theta to the 0 (180) degrees position (i.e. optical axis vertical):
   N: lasm1 thetaServer PRESET abs,0,<timeout-sec>

   S: lasm1 thetaServer PRESET abs,180,<timeout-sec>
d. Give small relative presets to the theta axis until the tube is exactly vertical (to be measured):
   lasm1 thetaServer PRESET rel,+/-0.01
e. Read back the actual encoder value in degrees:
   lasm1 thetaServer STATUS
f. Subtract this value from the current setting of the theta-offset and add 0 or 180 degrees for alignment on the North or South half-sky, respectively.
g. Save the result as new offset and make it active, as described in [2] (file */vltdata/config/Telescope.dbcfg*).

Iterate over steps 1 and 2 until the measurements with the level do not detect misalignment between the local gravity vertical line and the zenith position of the telescope in both directions eta and theta.

The repeatability of the vertical tube position must be within 1 arcsec. If this is not met then the drive mechanics and installation must be re-checked. A random behavior points to a loose mechanical mounting of the tube. A constant drift in one direction might indicate that the encoder is not properly coupled to its axis, in which case also the reference-mark distance from the init-switch would drift.

4.1.5 Telescope finder adjustment

To adjust the finder, the CCD must be removed from the optical path so that the telescope's ocular can be used. The prism shall also be removed. One should preset during day to a suitable landmark, center it in the ocular, and then adjust the finder so that the same point is also centered there. The procedure should be repeated at night on a star for fine-adjustment. After the procedure the CCD can be moved back.

4.1.6 Telescope structure adjustment on sky

The telescope structure shall be adjusted on the sky so that reasonable pointing accuracy (~3 arcmin) is achieved even without a pointing model. With the structure horizontal plane already adjusted, the remaining part is to rotate the structure around its vertical axis until the position on the sky is correct. The procedure requires optionally that the CCD is already aligned (see below), therefore it should be executed first with the finder only and then repeated with the CCD.

1. Disable any pointing model.
2. Preset to a star near the meridian.
3. Release the brake for the structure rotation.
4. Turn the structure until the star is (at least horizontally) centered in the finder
5. If the CCD is already aligned, put the CCD in endless loop and fine-adjust rotation until the star is also near center of the CCD.
6. Finally engage the brake again.

4.1.7 Check of axes limits

The telescope should now be moved to all possible limits to verify that the cable-wrap length is sufficient.

With the telescope alignment done so far, it should now be possible to preset to stars and have them inside or at least in the vicinity of the CCD fields; 10 arcmin accuracy should be reachable. The fine-adjustment must then be done with a pointing model, see ASM operation manual [2].

4.2 DIMM optical alignment

This contains only steps which are necessary during software-related integration. The final optical alignment will follow after, and is not in the scope of this manual.

4.2.1 CCD centering

The mounting plate of the CCD must be adjusted so that the center of the chip matches the center of the optical field. The prism must be removed during the procedure.

1. Cover the CCD with its small plastic cap.
2. Put a small lamp (torch) on the tube so that its light falls on the CCD cap.
3. Move the CCD mounting plate so that the center of the CCD cap is in the middle of the ring of light.

4.2.2 Focusing

The M2 must be adjusted with the screw on top of the spider until the FWHM of an imaged star is at minimum.

1. Preset to a star and center it with the finder.
2. Put the CCD in endless exposure loop using ccdCtrl.
3. Verify the image on the RTD while adjusting M2.

4.3 Pointing Model

The pointing model will provide the fine-adjustment for accurate presetting. The procedure to create a model requires some knowledge of operation aspects [2]. Familiarity with the TPOINT program [11] is recommended, although all normally necessary commands are listed below. If needed, tpoint has a basic help facility with the command *help*.

The procedure to generate a pointing model is as follows. It shall be executed as user *asm*:

1. Create a directory for the pointing data, with the date as the beginning of the night:
   mkdir $VLTDATA/pointing/<*yyyy-mm-dd*>
   cd $VLTDATA/pointing/<*yyyy-mm-dd*>
2. Create a file with a Tpoint-compatible header:
   asmtelPomHeader > *pom.dat*
3. Start the stand-alone panels for telescope and CCD control:
   asmeiTelescope
   ccdStart.sh
4. From the CCD panel start the RTD display and connect the camera; in the RTD draw with the graphics toolbox a diagonal cross for easier centering.
5. Preset to a star using the *asmeiTelescope* panel, tracking control (see also 3.7). Only stars with hour-angle 0 .. -4 should be taken for the model, since this is range where the DIMM normally presets.
6. Center the star in the camera field by giving tracking offsets, eventually using the finder to locate it.
7. When the star is exactly centered, record the tracking data with:
   asmtelPomMeasure -o pom.dat
   This reads the nominal tracking position (RA/Dec) and the actual encoder position of the telescope axes, performs a backward calculation to the actual RA/Dec, and outputs a data line to the output file with all relevant values (see asmtelPomMeasure(1) for more details).
8. Repeat the preset and centering for several well distributed stars (30 should be enough), either from the internal list available from the *asmeiTelescope* panel, or e.g. with the FK5 catalog available in *~asmmgr/asm/*<*Rel*>*/INSTALL/asmcat/ws/config/fk5.cat*.

9. The resulting data file can be directly input into the *TPOINT* program [11]. This does not directly support telescopes with alt/alt mounting, so several correction terms have to be enabled and disabled by the trial and error method, until the rms is minimized. The experience with the DIMM telescope shows that the following correction terms are needed:
   - AN, AW: azimuth axis misalignment in NS and EW directions, respectively.
   - CA: nonperpendicularity of elevation and pointing axes.
   - IE, IA: index error in elevation and azimuth, respectively.
   - TF, TX: sin and tan law of tube flexure, respectively.
   - NPAE: nonperpendicularity of azimuth and elevation axes.

   Using the tpoint application fit the pointing model to the available data: change to the default initialization directory of tpoint (the location might vary), and then execute the application:
   cd $VLTROOT/etc/tpoint
   tpoint

   From within the tpoint prompt proceed as follow:
   - Load the data file:
     INDAT /vltdata/pointing/<*yyyy-mm-dd*>*/pom.dat*
   - To view the data in graphical form:
     CALL a9
     This pops up a window with all graphs. This window should be grabbed and saved, using e.g. *xv*.
   - Select the modelling terms of interest, try first with:
     USE an aw ca ia ie tf
   - Fit the model to the data (give several times until the result converges):
     FIT
   - Terms may now be added (*USE*) or removed (*LOSE*) by trial and error, until *FIT* gives the best error rms. As guideline, 20 arcsec rms is a good value. Enabling an additional term and fitting might yield an error message, in which case the term should not be used.
   - It might be necessary to mask certain star samples, in case they are obviously false measurements or for other reason spoiling the result. Use *SLIST* to display a list of parameters (error contributions in arcsec) for each sample, find out the bad ones, and mask them by:
     MASK <*line*> *[*<*line2*>*]*
   - Repeat the term enabling/disabling and FIT now.
   - When the result is acceptable, generate an output file with the value of the fitted terms:
     OUTMOD /vltdata/pointing/<*yyyy-mm-dd*>*/pom.mod*
   - Use again *CALL a9* to view the graphs and save the window.
   - When done, exit with *QUIT*.

10. The model must now be installed, which must be done as user *asmmgr* for protection reasons:
    asmtelPomInstall -install $VLTDATA/pointing/<*yyyy-mm-dd*>*/pom.mod*
    By this utility the terms from TPOINT are converted *with reversed sign* (!) into a command line and sent to the *lasm1/asmtrkServer* task, e.g.
    NEWPCM "IA +2258.48 IE +81.53 CA +230.95 AN -1137.03 AW +1232.84 TF -43.54 TX +88.76 NPAE 0"
    The newly loaded pointing model has immediate effect. Note that the NEWPCM command will fail if the trk server is not initialized (which should not be the case at this point).
    The terms are at the same time made resident, i.e. a new *$VLTDATA/config/Pointing.dbcfg* database configuration file is created. The previous file is renamed to *Ponting.dbcfg.*<*yyyy-mm-dd*>.

11. Next time the *asmtrkServer* is INITialized, the new pointing model will be loaded from the file. Verify the correct term settings with the *asmtrkServer GETTERM* command.

12. To make the terms finally official they shall be archived with the asmENV module. Forward the *Pointing.dbcfg* file to asmmgr (a person to be assigned) for archiving.

Whenever is necessary to modify on-line one or more pointing model parameters then the NEWPCM command should be used. The format of the arguments of this command is as follow:

"<name1> <coeff1> <name2> <coeff2> ..."

Where "name" is the name of the parameter to be set, like IA or IE, and "coeff" is the value to be assigned to the named parameter.

The commands *ENATERM* and *DISTERM* can be used to temporarily enable and disable individual terms.

NOTE: these on-the-fly changes are lost when the LCU is booted. The changes are made permanent only if the *Pointing.dbcfg* is re-generated. If there is a need to go back to an old pointing model then the *$VLTDATA/config/Pointing.dbcfg* file could be replaced by an old version and the LCU booted. Because this, it is important to maintain a back-up copy of pointing models generated during the entire life of the system.

There are several points to be considered for the ASM telescope:

- It does not matter whether there is already a pointing model active while a new one is recorded.
- The pointing accuracy should be good in the east, while it is less important in the west. Therefore the procedure should be executed mainly on stars located in the east.
- When there is large backlash in the telescope axes, the produced data for East and West hemispheres might appear as two completely different sets. The generated pointing model will take the average of both.
- There is also a background process *asmwsAutopommer* available, which executes part of the procedure described above in an automatic way. While the DIMM sequence is running, it will produce the data in the file *$VLTDATA/tmp/Autopom.dat* without any need of user interaction. See its man-page for more.

4.4 Archiving of configuration changes

Any time the system is re-aligned, the configuration files *Telescope.dbcfg*, *Pointing.dbcfg*, and possibly others will change. These changes must be properly archived afterwards with the *asmENV* module in the CMM code archive. This will assure to be able to re-build a system including its configuration from scratch.

Therefore, if any change is done to the configuration files under *$VLTDATA/config*, the new version must be forwarded to the software module responsible for archiving. No change shall be archived in the main module trunk which is not backward compatible, unless explicitly approved after a corresponding SPR. Branch versions, however, do not underlie this restriction.

5 REFERENCE

5.1 asmBUILD - ASM SW Build Procedure

NAME

```
asmBUILD - Astronomical Site Monitor Build Module
```

SYNOPSIS

```
cd asmBUILD/src
make man install
cd ../../INSTALL
./build | tee build.log
```

OVERVIEW

```
This modules builds the complete ASM software and its environments
from scratch. This includes the required TCS modules, but not the
standard VLTSW and CCD-SW releases.

The list of modules and their version is taken from:

    asmBUILD/config/Modules.config

The following parts of the ASM system are built:
- the code under INTROOT
- the environments under VLTDATA
- the essential files under INS_ROOT

Here is how to use it:

Assume that you put the module under your home directory:

    cd ~
    cmmCopy asmBUILD

The build-procedure is then started by:

    cd ~/asmBUILD/src
    make install
    cd ../../INSTALL
    ./build | tee build.log
```

INSTRUCTIONS

```
Follow these step-by-step instructions to rebuild the ASM system.
Any existing version is kept so that it can be restored.
The instructions have to be executed under the user given in [...].
"FEB99" must be replaced with the current VLTSW release code.

1. Clean up or remove obsolete backup directories

    [asmmgr]        /data/ins.*
    [asmmgr]        /vltdata/ENVIRONMENTS.*
    [asmmgr]        /vltdata/config.*
    [asmmgr]        /vlt/asm/FEB99.*
    [asmmgr]        ~asmmgr/asm/FEB99/INSTALL.*

2. Shut down wasm environment:

    [asm]           vccEnvStop -e wasm

3. Move existing directories to different name for backup:

3.1 Create empty INTROOT:
```

```
    [asmmgr]        cd $INTROOT/..
                    mv FEB99 FEB99.yyyy-mm-dd   (current date)
                    getTemplateForDirectory INTROOT FEB99

3.2 Create empty ENVIRONMENT and config dirs:

    If necesary give group-write permission to /vltdata:

    [vltmgr]        chmod g+w /vltdata

    Now proceed with ENVIRONMENTS recreation and backup:

    [asmmgr]        cd /vltdata
                    mv ENVIRONMENTS ENVIRONMENTS.yyyy-mm-dd (current date)
                    mkdir ENVIRONMENTS
                    mv config config.yyyy-mm-dd
                    mkdir config
                    chmod g+w config                (!!!)

3.3 Create empty INS_ROOT, if not existing yet proceed as follow:

    [asmmgr]        oslxInsManager
                            Set INS_ROOT --> /data/ins
                    chmod -R g+w /data/ins

    If already existing then make a backup (do not move!):

    [asmmgr]        cp -r /data/ins /data/ins.yyyy-mm-dd (current date)

4. Build new system

    [asmmgr]        cd ~/asm/FEB99
                    mv INSTALL INSTALL.yyyy-mm-dd (current date)
                    mv asmBUILD asmBUILD.yyyy-mm-dd (current date)

    [asmmgr]        cd ~/asm/FEB99
                    cmmCopy asmBUILD
                    cd asmBUILD/src
                    make install

                    cd ../../INSTALL
                    ./build | tee build.log
                      (accept displayed settings or abort)
                      (wait until completed, ca 1 hour)

5. Reboot LCUs

    [asm]           rlogin lasm1
                      -> reboot
                    rlogin lasm2
                      -> reboot

6. Restart

    [asm]           vccEnvStart -e wasm

7. Manual configuration
    [asmmgr]        cd /vltdata
                    chmod -R ugo-w config/

    [asm]           asmPlotOption 2

    [asm]           Set or check crontab entries.
```

CRONTAB

```
The following crontab entries must be entered for user asm.
(logVLTBackup is not executed by user vlt, unlike normal VLTSW scheme)
```

```
At any change of release code the paths must be updated!

wasm asm: > crontab -l
0,5,10,15,20,25,30,35,40,45,50,55 * * * * /vlt/FEB99/bin/logVLTBackup asm vlt 12 10000000
0 12 * * * /vlt/asm/FEB99/bin/asmarcFileTransfer.sh /data/log/meteo.log te13.hq.eso.org:ar-
chive/pl
0 12 * * * /vlt/asm/FEB99/bin/asmarcFileTransfer.sh /data/log/dimm.log te13.hq.eso.org:ar-
chive/pl
0 15 * * * find /data/asm -mtime +1 -perm 664 -exec rm {} \;
0 15 * * * find /data/asm -mtime +7 -exec rm {} \;
0 15 * * * find /data/dhs -mtime +7 -exec rm {} \;
0 15 * * * find /vltdata/tmp -mtime +30 -perm 664 -exec rm {} \;

Their purpose is in order:
- limit size of logFile to 10MB and produce ops-logs at 12UT
- transfer meteo.log to Garching
- transfer dimm.log to Garching
- remove data/paf files older than one day, only if archived
- remove data/paf files older than one week, whether archived or not
- remove dhs files older than one week, whether archived or not
- remove any file in /vltdata/tmp older than one month
```

FILES

An INSTALL directory will be created on the same level as asmBUILD.
All further files will the put there.

ENVIRONMENT

Needed are: INTROOT, VLTDATA, INS_ROOT, etc.

SEE ALSO

asmENV(1), asmINS(1)

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5.2 /vlt/System/config/wasm.cshrc

This is the Paranal version. Few changes might be required for La Silla.

```
#*****************************************************************************
# E.S.O. - VLT project
#
# "@(#) $Id: wasm.cshrc,v 1.11 1999/01/31 17:57:32 vltsccm Exp $"
#
# who        when      what
# --------  --------  ----------------------------------------------
# gfilippi  25/02/99  created for UT1 installation in Paranal
#

#
# wasm: VLT Astronomical Site Monitor WS

unsetenv MAIL_SERVER

# Enable CMM archive access
setenv CMM_HOST te13.hq.eso.org
setenv CMM_PORT 3000

set VLTSCCM_EXISTS = FALSE

setenv TAPE /dev/rmt/0m
set X11_ONLY_EXISTS = TRUE

setenv VLTROOT    /vlt/FEB99
setenv INTROOT    /vlt/asm/FEB99
setenv VLTDATA /vltdata

setenv VX_HOST_TYPE hp9700
setenv WIND_BASE    /vlt/vw5.3
setenv WIND_LMHOST  wgsacc

set RTAP_EXISTS = TRUE
setenv RTAPENV `hostname`

#
# ACC Database: Paranal -> wgsops,  LaSilla -> 'hostname'
setenv ACC_HOST wgsops

setenv MIDASHOME /midas
setenv MIDVERS 98NOV

set STARCAT_EXISTS = TRUE
unsetenv SNIFF_DIR


# Target 1=Paranal 2=LaSilla
setenv TARGET_ASM 1

#
# definitions only for this machine:
setenv RTAPENV  wasm
setenv CCDLENV  lasm2
setenv CCDNAME  DIMM

setenv INS_USER SYSTEM

setenv INS_ROOT /data/ins

setenv ASM_LOG  /data/log
setenv ASM_DATA /data/asm

# DFS variables (see ~tamgr/DFS/admin/dataflowUser.csh)
setenv DFS_ROOT /vlt/DFS
```

```
# DHS variables
setenv DHS_DATA  /data/dhs
setenv BAD_DIR   ${DHS_DATA}/bad
setenv DHS_HOST  wu1dhs
setenv OLAS_ID   ASM

#
# Define your printer here
#
setenv PRINTER pgs1

#
#___oOo___
```

5.3 asmENV(1)

NAME

```
asmENV - Astronomical Site Monitor Environments Module
```

SYNOPSIS

```
cd asmENV/src
make clean wasm lasm1 lasm2
```

DESCRIPTION

```
This module contains specific templates from which the
environments of the ASM system are built.
```

ENVIRONMENT

```
VLTDATA - points to the VLTDATA area
ACC_HOST - host where ACC database server is running
```

SEE ALSO

```
vccEnvCreate(1)
```

5.4 asmINS(1)

NAME

```
asmINS - Astronomical Site Monitor Instrumentation Module
```

SYNOPSIS

```
cd asmINS/src
make install
```

DESCRIPTION

```
This module contains files to be installed in $INS_ROOT, ie:
- CCD configuration
- CCD reference files (dark field FITS image for bias substraction)
- CCD setup files

INS_ROOT structure must already exist, use eg. oslxInsManger
to create it. The install sequence is:

- make a tar backup of the current INS_ROOT
- install all std CCD files for CCD head number 80 (this is our CCD!)
- copy FITS reference and setup files (should be gzip'ed in the module)
- gunzip all compressed files in INS_ROOT (forced overwrite)
```

ENVIRONMENT

```
INS_ROOT - points to the INT_ROOT structure that must already exist
        (it shall be the _physical_ path w/o links!)
```

CAUTIONS

```
The module shall contain FITS files in gzip'ed format.
```

SEE ALSO

```
ccdInstall.sh(1)
```

5.5 asmtelPomHeader

NAME

asmtelPomHeader - generate a Tpoint-compatible pointing file header

SYNOPSIS

asmtelPomHeader > <file>

DESCRIPTION

Tpoint needs a header in a file to be read with the INDAT command.
This program generates one for the actual site, time and conditions.
After that the file can be extended with data produced by
asmtelPomMeasure.

Tpoint header format:
<comment line>
<latitude: d m s> <year> <month> <day> <temp> <pres> <height> <rhum>

ENVIRONMENT

TARGET_ASM - 1 for Paranal, 2 for La Silla

CAUTIONS

The system must have been started in automatic mode before
and meteo must be running, otherwise the header data are undefined.
Then the wrong fields must be manually corrected by default values.

EXAMPLES

Example header for Paranal:
ASM Paranal 1999-03-27
-24 37 41 1999 03 27 14.88 743.81 2681 0.32

Example header for La Silla:
ASM La Silla 1999-03-12
-29 15 30 1999 03 12 10.0 772.0 2377.0 0.12

Example of usage:

```
asmtelPomHeader   > pom.dat
asmtelPomMeasure -o pom.dat
```

SEE ALSO

asmtelPomMeasure(1)

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5.6 asmtelPomInstall

NAME

```
asmtelPomInstall - install a Tpoint model file in trk
```

SYNOPSIS

```
asmtelPomInstall [-install] <model-file>
```

DESCRIPTION

```
This program takes a file as produced by the Tpoint OUTMOD command
extracts the terms from it, sends them to the asmtrkServer with the
NEWPCM command, and then creates a new Pointing.dbcfg file.
Before it makes a backup of the current Pointing.dbcfg file.
To avoid changes by mistake, no action is done if the '-install'
option is not given.
```

FILES

```
$VLTDATA/config/Pointing.dbcfg - pointing database file
$VLTDATA/config/Pointing.dbcfg.yyyy-mm-dd - backup
$INTROOT/config/Pointing.dbbck - input for dbBackup
```

ENVIRONMENT

```
VLTDATA - vlt data directory
INTROOT - asm introot directory
```

CAUTIONS

```
asmtrkServer on lasm1 must be up and running.
```

```
- - - - - -
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```

5.7 asmtelPomMeasure

NAME

```
asmtelPomMeasure - prepare a pom-formated output file
```

SYNOPSIS

```
asmtelMeasure [-v] [-n] [-o <outputFile>]
```

DESCRIPTION

```
This command-line program just makes easy the gather of data to be
feeded to a pointing model fitting program.
About the format of the output file see the pom documentation.
Hard-coded db attribute names were use. This command works
fine only with the actual DIMM field test setup (La Silla July 97).
The command is meant to be used in the following way:
once the telescope and ccd sw are in fully operational state then
an astronomic object should be preseted.
After manual (or whatever available) centering of the star in the
field of the ccd the asmtelMeasure command should be given.
The command process will perform the following tasks:
        - read from the LCU database the addecuate set of data
        - make the conversion between the read eta/theta positions
          to altaz angles
        - make the convertion between the altaz coordinates to
          right ascention and declination
        - build a pom-formated string with the results
        - append to the output file the formated-result string
The data read from the Telescope LCU it's the following:
- @lasm1:ASM:Telescope:Tracking:axes:asm:trkCoordinates.coordinates
- @lasm1:ASM:Telescope:Tracking:axes:asm:times.lst
_ @lasm1:ASM:Telescope:Tracking:siteConstants.siteConstants
- @lasm1:ASM:Telescope:Axis1:POSLOOP.pos
- @lasm1:ASM:Telescope:Axis1:POSLOOP.posSetPoint
- @lasm1:ASM:Telescope:Axis2:POSLOOP.pos
- @lasm1:ASM:Telescope:Axis2:POSLOOP.posSetPoint
```

OPTIONS

```
asmtelPomMeasure recognizes the following command-line options:
 -v              :  enable verbose logs
 -n              :  new file specifier. The output file (if any) will
                    be truncated to zero if it already exists.
 -o outputfile   :  name of the output file. No path should be given.
                    The current working directory it's the target path
                    for the output file. The file its open in
                    appending mode if the -n option was not specified.
```

CAUTIONS

```
The function that brings from eta/theta to altaz it's a hardcoded
implementation valid only for the south half-sky.
```

BUGS

```
The rotation matrix used to go from et to altaz it's hard coded.
This lead in that if a change it's made in the `configurable'
rotation matrix contained in the LCU database then this routine it's
not valid any longer.
```

```
- - - - - -
Last change:  27/03/99-22:54
```

___oOo___