VST Project

Test Procedure in Europe

Guiding / ADC

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	Name	**Date**	**Signature**
Written by	M. Brescia, P. Schipani	2006-10-09	
Checked by			
Released by			

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Reference Documents

id.	Document code	Title	Source	Date	Issue
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1 Introduction

This document contains procedures to test the functional quality of the VST guiding and optical corrector system in Europe. Generally speaking, the test procedure should describe in detail all basic operations needed to perform a verification by plan. Therefore, the test procedure reports all the following information:

- Scope of the test: a theoretical description of the test, its scope e purpose, identifying also all the verification items involved;
- All the applicable documentation list (i.e. relevant documents to verify or referred for the test procedure);
- Test procedure: detailed list of all operations required to perform the functional tests;
- Test conditions: conditions of the system to perform tests, operation tools, environmental conditions, special requirements on tested items, calibration requirements;
- Test results: all the procedures to process row data for the final presentation of the results;

2 Scope of the tests

Scope of the tests is to measure and verify telescope guiding and optical corrector functionality and performance in Europe.
With term optical corrector it is intended the option between two optical configurations foreseen on the VST, namely the switching system between 2Lens and Atmospheric Dispersion Corrector (ADC) devices. Depending on which corrector is used, the image scale changes, causing a consequent variation in the interpolation of reference positions for the guiding probe devices. Hence two different tests should be taken into account for guiding system. Just blind guiding capabilities of the telescope can be measured and verified, as the autoguider cannot be used with real image feedback taken from TCCD in the Italy integration facility.

3 Applicable Documents

The following documents are considered relevant to guiding/ADC system:

CODE	TITLE	SOURCE	DATE	ISSUE
VST-SPE-OAC-25000-1198	VSTADCL module description	VST	28/09/05	1.0
VST-SPE-OAC-25000-1199	VSTADCW module description	VST	28/09/05	1.0
VST-SPE-OAC-25000-1188	VSTAD module description	VST	28/09/05	1.0
VST-SPE-OAC-25000-1187	VSTP module description	VST	28/09/05	1.0
VST-SPE-OAC-25000-1186	VSTPROBE module description	VST	28/09/05	1.0
VLT-SPE-ESO-17230-0933	Autoguiding design description	ESO	05/05/97	2.0
VLT-MAN-ESO-17240-0672	CCD control SW User Manual	ESO	25/09/98	1.6
VST-SPE-OAC-21000-1028	Final Optics Design Summary	OAC	25/10/00	1.0

4 Test Conditions

In order to perform functional and performance tests on VST guiding system, no particular equipment is needed. Just Workstation (WS) GUIs and engineering applications, controlling guiding subsystems, are necessary, listed below.
From the telescope functional point of view, the guiding makes sense during tracking operations, because the correction offsets, calculated through guide star position analysis, are directly sent to main axes in order to adjust the trajectory during tracking of the target object. For this reason, the best way to evaluate guiding performances is with tracking system activated. Therefore, there are two possibilities during guiding tests:

- To simulate tracking of main axes at LCU level, i.e. tracking hardware (HW) switched on and software (SW) fully operative, but with not real AZ/ALT axis motions;
- To run a real tracking of main axes following an arbitrary target object;

For both options it is possible to perform a real test of guiding system, where the first option could be intended as a recovery procedure in case, for any technical reason (for example if telescope is unbalanced because not fully mounted), it is temporary unavailable some tracking system capability.

From the control point of view, the following basic equipment is directly involved, and their full functionality required:

- Guiding TCCD control LCU (environment ltvagc) with TCCD control in simulation mode
- Corrector/AD/PROBE/ROT axis LCU (environment ltvadc)
- AZ axis control LCU
- AZ HBS control LCU
- ALT axis control LCU
- TCS control WS (environment wtvst)

From the SW point of view, the following applications are usually employed, depending on the specific level of test/verification. They are partially derived/modified from VLT TCS SW package, so for most of them, their use and interface can be considered the same:

Control tools:

- vstguiStatus: TCS mode switching control interface
- vstprobegui: guiding probe control engineering user interface
- vstadgui: guiding probe device low-level control engineering user interface
- vstadcControl: ADC/2Lens corrector control engineering interface
- vstadclgui: ADC/2Lens corrector low-level control engineering interface
- vstguiAG: Autoguiding main control/diagnostic user interface
- vstguiTCS: main TCS control user interface

Diagnostic tools:

- VLTSW engineering applications (logMonitor, ccseiDb, sampCtrl, etc.)

All these engineering tools can be launched from WS console in order to execute commands on guiding system for all or single devices and/or to receive control and diagnostic information during test operations.

5 Definition of tests

The procedures, described below, generate a map recording guiding and optical corrector subsystem reference/actual positions for the all devices involved, based on preset to an arbitrary sky object. These are:

- Adapter (AD): axis related to angular motion of probe system, slaved to rotator axis. On the VST the adapter is not a tracking axis. After preset, it will braked and slaved to rotator tracking motion.
- Radial PROBE: axis related to radial motion of probe system, putting the pickup-mirror in/out the image plane.
- Focus: axis related to probe focusing system.
- Pickup mirror (PM): axis related to inclination of mirror positioned on the image plane.
- ADC/2Lens selector (ADCS): axis related to switching between 2Lens and ADC corrector
- ADC prisms (P1 and P2): two axes related to the rotation of ADC prisms

In the following test matrices, the tracking system online means one of the two options described above (partial simulation or real mode of tracking axes).

At the integration site in Europe it is not possible to acquire sky object images through guiding TCCD. For this reason, in principle it is possible to simulate the guiding preset to an arbitrary star object, selected from local star catalog (fk5.tcs, located in the introot/config path on the WS) . With these coordinates all guiding system devices will be positioned, depending on actual optical corrector configuration. It is also possible to send offset corrections to tracking system in order to verify the correct autoguiding functionality.

5.1 Guiding system with 2Lens corrector on path and tracking system online

5.1.1 Test principle

To test guiding functionalities and performances in terms of correct device positioning, when the ADC/2Lens selector is moved in order to put 2Lens corrector on path. In these conditions, it is foreseen that the telescope will point sky objects positioned at an ALT (elevation) angle range around 90° (i.e. around zenith, where no dispersion must be corrected).

The data are recorded using sampCtrl sampling tool.

5.1.2 Collected data

The following data are collected:

- Catalog used for guiding objects and actual magnitude/radius search ranges
- Guide object target coordinates
- Guiding Offset direction and amount sent to tracking axes
- Tracking object target coordinates
- AZ actual position
- AZ reference position
- ALT actual position
- ALT reference position
- ROT actual position
- ROT reference position
- Current optical corrector selected (ADC/2Lens)
- ADC/2Lens corrector actual position
- ADC/2Lens corrector reference position
- AD actual position
- AD reference position
- Focus actual position
- Focus reference position
- PM actual position
- PM reference position
- Radial PROBE actual position
- Radial PROBE reference position

5.1.3 Analysis

Data analysis is performed by comparing actual vs. reference positions for all subsystems involved in the tests. See Tab. 1

5.1.4 Step by step procedure

The detailed procedure, step by step is the following:

1. activation of tracking system:
    a. HBS online
    b. AZ/ALT/ROT online
    c. Tracking modules online
    d. Preset of main axes to target object (with ALT near zenith)
2. activation of ADC/2Lens corrector system:
    a. positioning of ADCS in 2Lens configuration
3. activation of guiding system
    a. guiding TCCD control online in simulation mode
    b. initialization and online of AD/PROBE devices
    c. selection of guide star object between object list generated automatically from local catalog and depending on the target object coordinates selected before.
    d. Preset of guiding devices to reference positions related to guiding star coordinates
    e. Start of Autoguiding function when preset is completed
4. Apply manual centering of a simulated guide star image or apply arbitrary offsets to verify tracking system correction functionality.

In the following test definition matrix, all the procedure items are listed.

Step no.	**Action**	**Actual Status / Value**
1	Record date and time	Date = Time =
2	Record software modules version	vstaxis: vstiklida: vstalaz: vstrot: vstco: trk: trkws: vstBUILD: vstIO: vsthb: vstadcl: vstadcw: vstad: vstprobe: vstp: agws: ag: vstgui: vstmsw:
5	Record test conditions	corrector used (ADC/2Lens): tracking system (simulated/real): guide offset type: (manual/automatic) guide star selection criteria: • magnitude= • radius=
6	Follows procedure in 5.1.4 using data in Tab. 1	
7	• Start sampling of data to files • Collect data for 10 minutes • Stop sampling of data to files • Write file name to Tab. 1 • Move file to /vltuser/agTests: mv *filename* /vltuser/agTests	
8	If Tab. 1 entries are not finished, go to step no.6	
9	Produce report with the analysis of positions	

5.2 Guiding system with ADC corrector on path and tracking system online

5.2.1 Test principle

To test guiding functionalities and performances in terms of correct device positioning, when the ADC/2Lens selector is moved in order to put ADC corrector on path. In these conditions, it is foreseen that the telescope will point sky objects positioned at an ALT (elevation) angle range from 20° up to 85° (i.e. in the ALT operative range where variable dispersion amount must be corrected).

The data are recorded using sampCtrl sampling tool.

5.2.2 Collected data

The following data are collected:

- Catalog used for guiding objects and actual magnitude/radius search ranges
- Guide object target coordinates
- Guiding Offset direction and amount sent to tracking axes
- Tracking object target coordinates
- AZ actual position
- AZ reference position
- ALT actual position
- ALT reference position
- ROT actual position
- ROT reference position
- Current optical corrector selected (ADC/2Lens)
- ADC/2Lens corrector actual position
- ADC/2Lens corrector reference position
- ADC prism actual positions
- ADC prism reference positions
- ADC prism tracking enabled/disabled
- ADC prism tracking parameters (if enabled):
    - Filter selected
    - Ambient conditions imposed
- AD actual position
- AD reference position
- Focus actual position
- Focus reference position
- PM actual position
- PM reference position
- Radial PROBE actual position
- Radial PROBE reference position

5.2.3 Analysis

Data analysis is performed by comparing actual vs. reference positions for all subsystems involved in the tests. See Tab. 2

5.2.4 Step by step procedure

The detailed procedure, step by step is the following:

1. activation of tracking system:
    a. HBS online
    b. AZ/ALT/ROT online
    c. Tracking modules online
    d. Preset of main axes to target object (with ALT near zenith)
2. activation of ADC/2Lens corrector system:
    a. positioning of ADCS in ADC configuration
    b. initialization of prisms and setup of configuration parameters (filter/ambient)
    c. start ADC tracking (optional)
3. activation of guiding system
    a. guiding TCCD control online in simulation mode
    b. initialization and online of AD/PROBE devices
    c. selection of guide star object between object list generated automatically from local catalog and depending on the target object coordinates selected before.
    d. Preset of guiding devices to reference positions related to guiding star coordinates
    e. Start of Autoguiding function when preset is completed
4. If ADC tracking not enabled, apply periodic ADC corrections
5. Apply manual centering of a simulated guide star image or apply arbitrary offsets to verify tracking system correction functionality.

In the following test definition matrix, all the procedure items are listed.

Step no.	**Action**	**Actual Status / Value**
1	Record date and time	Date = Time =
2	Record software modules version	vstaxis: vstiklida: vstalaz: vstrot: vstco: trk: trkws: vstBUILD: vstIO: vsthb: vstadcl: vstadcw: vstad: vstprobe: vstp: agws: ag: vstgui: vstmsw:
5	Record test conditions	corrector used (ADC/2Lens): tracking system (simulated/real): ADC tracking enabled: (Y/N) guide offset type: (manual/automatic) guide star selection criteria: • magnitude= • radius=
6	Follows procedure in 5.2.4 using data in Tab. 2	
7	• Start sampling of data to files • Collect data for 10 minutes • Stop sampling of data to files • Write file name to Tab. 2 • Move file to /vltuser/agTests: mv *filename* /vltuser/agTests	
8	If Tab. 2 entries are not finished, go to step no.6	
9	Produce report with the analysis of positions	

TEST MATRICES

No.	Target Object coords	Guide Object coords	AZ Pos	ALT Pos	GUIDE OFFSETS to Tracking	GUIDE/ADC Reference positions	GUIDE/ADC Actual positions	FILE	Remarks	Executer
1	α= HA~-5min δ= -280000	α= δ=	Ref=0 act=	Ref=87 act=	direction= arcsec=	AD= PROBE= FOC= PM= ADCS=2Lens	AD= PROBE= FOC= PM= ADCS=2Lens		Meridian crossing	
2	α= HA~-5min δ= -220000	α= δ=	Ref=180 act=	Ref=87 act=	direction= arcsec=	AD= PROBE= FOC= PM= ADCS=2Lens	AD= PROBE= FOC= PM= ADCS=2Lens		Meridian crossing	
3	α= HA~-10min δ= -240000	α= δ=	Ref=180 act=	Ref=89 act=	direction= arcsec=	AD= PROBE= FOC= PM= ADCS=2Lens	AD= PROBE= FOC= PM= ADCS=2Lens		Meridian crossing	

Tab. 1 –Guiding with 2Lens corrector map

No.	Target Object coords	Guide Object coords	AZ Pos	ALT Pos	GUIDE OFFSETS to Tracking	GUIDE/ADC Reference positions	GUIDE/ADC Actual positions	FILE	Remarks	Executer
1	α= HA~+2h δ= -150000	α= δ=	Ref=257 act=	Ref=60 act=	direction= arcsec=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=			
2	α= HA~+3h δ= 000000	α= δ=	Ref=247 act=	Ref=40 act=	direction= arcsec=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=			
3	α= HA~+4h δ= 000000	α= δ=	Ref=256 act=	Ref=27 act=	direction= arcsec=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=			
4	α= HA~+3h δ= -250000	α= δ=	Ref=280 act=	Ref=49 act=	direction= arcsec=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1=			

						ADC P2=	ADC P2=			
5	α= HA~+0.5h δ= -300000	α= δ=	Ref=311 act=	Ref=81 act=	direction= arcsec=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=			
6	α= HA~-5min δ= -600000	α= δ=	Ref=0 act=	Ref=55 act=	direction= arcsec=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=		meridian crossing	
7	α= HA~-5min δ= -400000	α= δ=	Ref=0 act=	Ref=75 act=	direction= arcsec=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=		meridian crossing	
8	α= HA~-1h δ= -600000	α= δ=	Ref=12 act=	Ref=53 act=	direction= arcsec=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=	AD= PROBE= FOC= PM= ADCS=ADC ADC P1= ADC P2=			
9	α= HA~-2h δ= -800000	α= δ=	Ref=6 act=	Ref=33 act=	direction= arcsec=	AD= PROBE=	AD= PROBE=			

						FOC= PM= ADCS=ADC ADC P1= ADC P2=	FOC= PM= ADCS=ADC ADC P1= ADC P2=			

Tab. 2 –Guiding with ADC corrector map

6 Test results

This section will be filled after tests.

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