GMT AGWS Control System Requirements

Release 1.4-1

jmf

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CHAPTER

ONE

INTRODUCTION

The Acquisition Guiding and Wavefront Sensing (AGWS) Control System (agws_cs) consists of a set of Supervisors and Controllers organized in a hierarchy (**Figure 1**). The AGWS Supervisors are responsible for the startup and shutdown procedures, overall health status, fault management and coordination of the components of the AGWS Control System. The AGWS Supervisors also provide a high level interface that receives new position demands and new commands from the Pointing Kernel and allows sending telemetry samples for operator feedback and persistent storage. Individual unit supervisors are responsible for stages positioning, mirror tilts and optics rotation, via the state variables of the AGWS through the EtherCAT master. These Controllers read the input-state variables; apply the control, alarm detection and logic functions; and update the output-state variables to implement the control of the corresponding mechanisms.

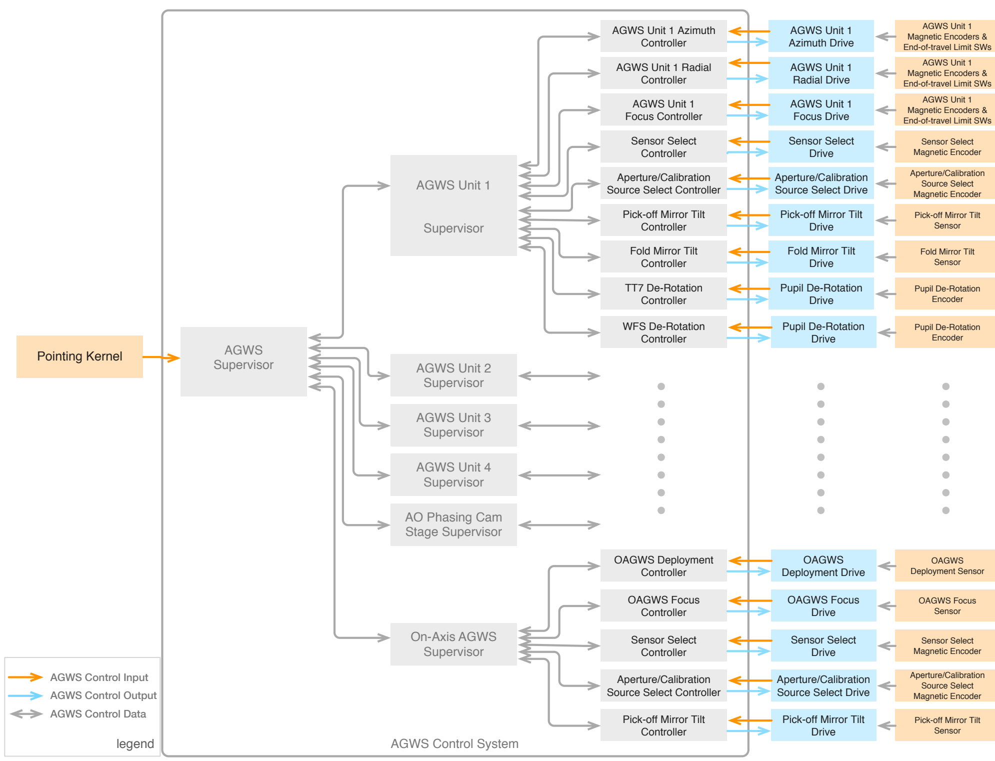

Figure 1. AGWS control system block diagram.

1.1 Detailed Description

The AGWS electronics will be distributed among the four local electronics boxes (E-boxes) shown in **Figure 2** and the AGWS Standard Electronics Cabinet (SEC) as shown in **Figure 3**. A packaging study has been performed that shows that the required electronics fit into the four local E-boxes and one SEC. Local electronics boxes are used to minimize cable run lengths from the electronics modules to the controlled hardware, reduce the volume of cabling that has to be routed from the AGWS to the rack in the GIR, and to make use of available volume for packaging of electronics. A typical E-box design is shown in **Figure 4**. The E-box includes (10) Copley 2-axis servo drives and an EtherCAT module. The E-box will be air cooled internally with the heat extracted by a liquid to air internal heat exchanger.

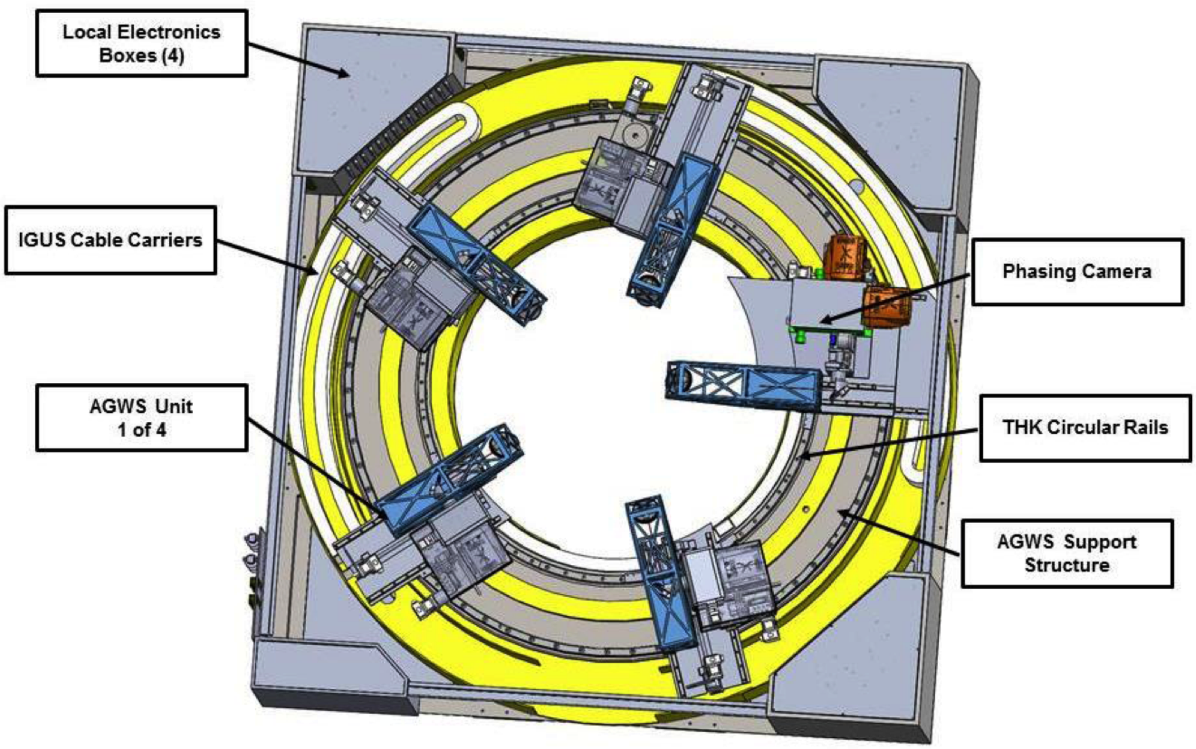

Figure 2. AGWS viewed from below

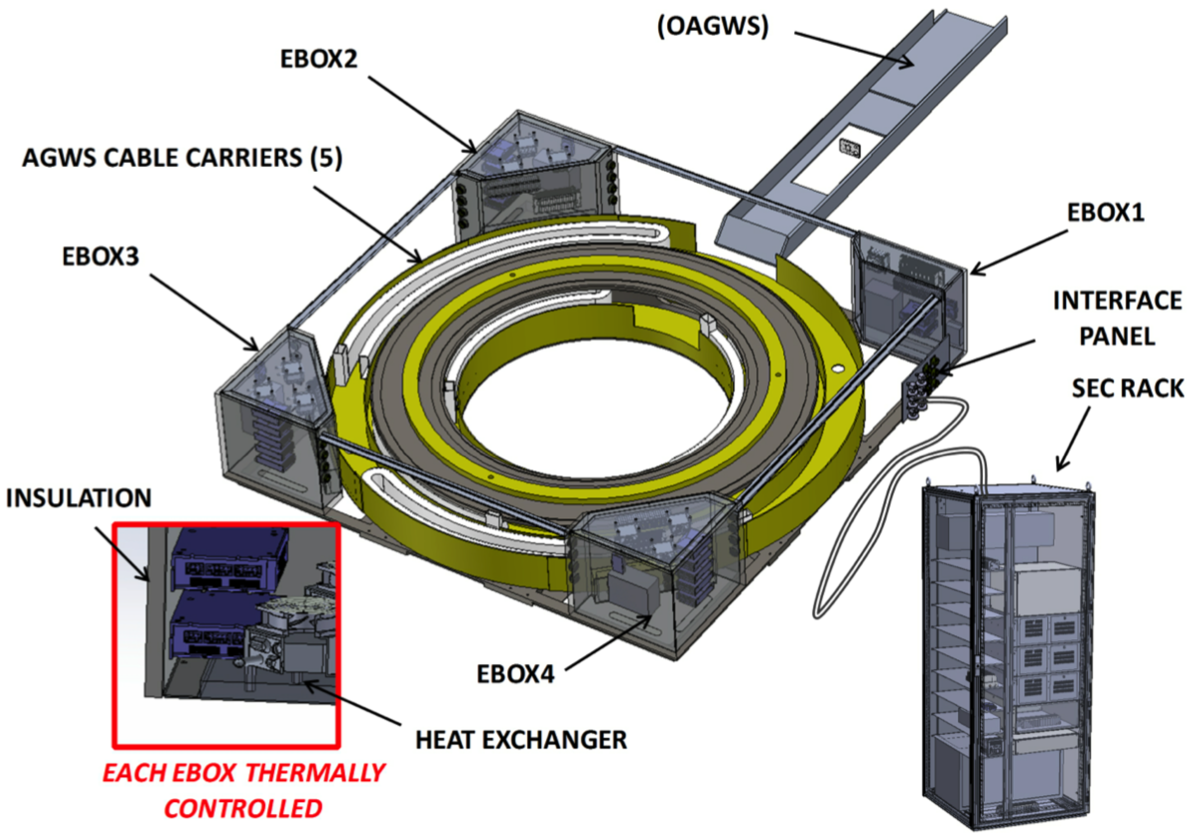

Figure 3. AGWS electronics design.

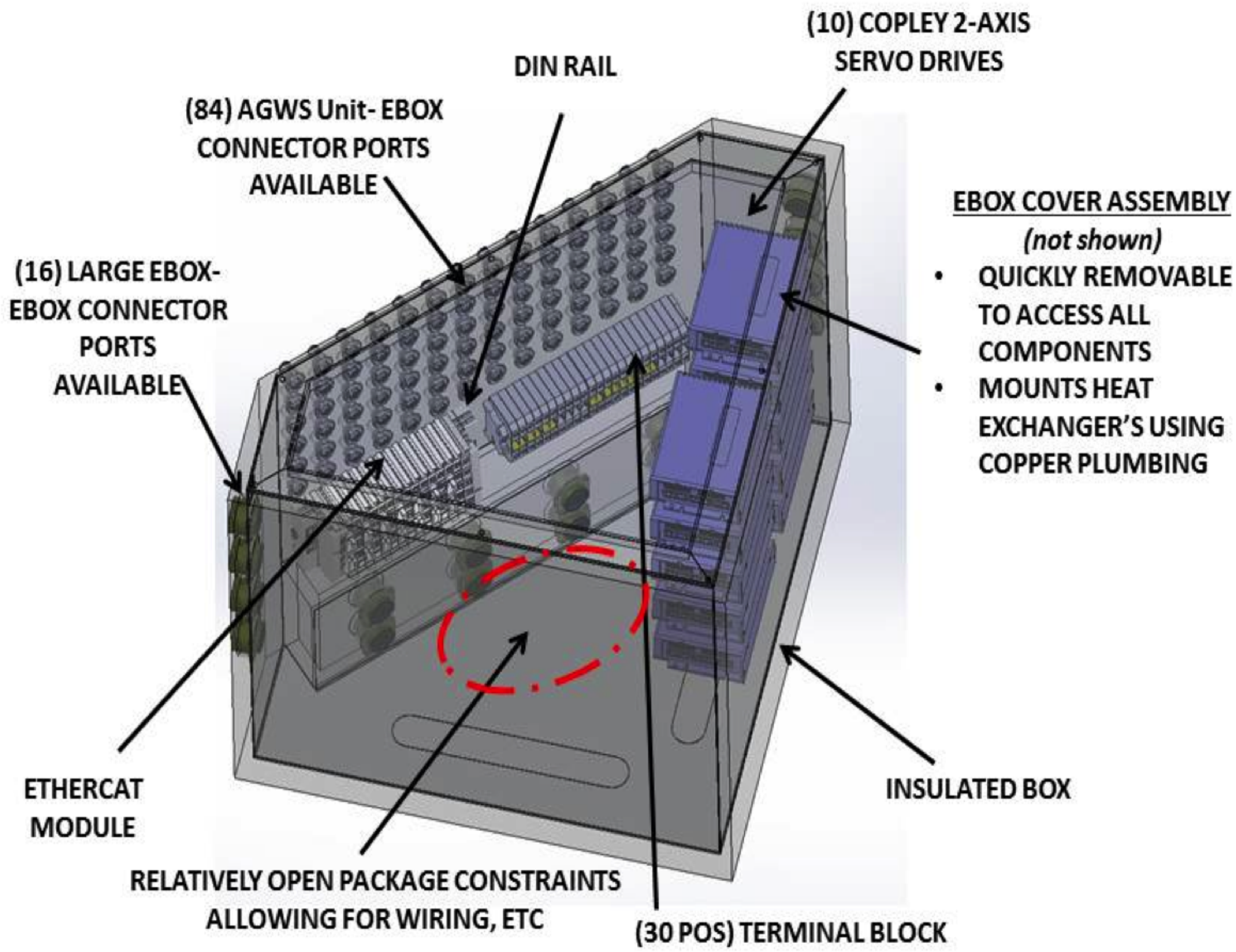

Figure 4. E-box packaging design.

Azimuth dynamic limits have to be carefully managed by the AGWS Control System in order to prevent collisions between the Units, the Phasing Camera, and the On-Axis Stage. Azimuth, radial and focus mechanisms will utilize a dual feedback control architecture, where the position loop will be closed with a linear encoder tape (absolute or incremental) and the velocity loop will be closed with the motor shaft resolver or encoder feedback. The Pick-off mirror and Fold mirror mechanisms control loop will have a single feedback sensor, which will be either an analog sensor (LVDT, capacitive) or an encoder linear gauge. All of the mechanisms above will be controlled by smart drives with EtherCAT interface and implementing the CiA402 motion profile. The selected mode of operation for the azimuth, radial and focus mechanisms will be Cyclic Synchronous position. For other mechanisms, the Position Profile Mode should be adequate. The de-rotation stage mechanisms are based on piezo actuators from Newport, whose controllers do not support the EtherCAT but provide serial communication via USB, RS232 and RS485. EtherCAT serial communication terminals can be used then, providing a simple and straightforward interface.

The azimuth, radial, and focus stages will have two levels of control. The outer level for each unit will bundle together the three axes into an axis group with three degrees of freedom, to be controlled in Cartesian coordinates. It will have trajectory generation and interpolation, as well as the kinematic transformation from X, Y, and focus, to the angles and linear motion of the individual mechanisms. The inner loops control just one degree of freedom.

The AGWS motion requirements are driven by the azimuth axis in fixed-GIR mode of observation, when the AGWS units must track. This mode leads to the selection of the Cyclic Synchronous Position mode for the drive. The drives running in this mode will interpolate the incoming signal, internally generating a smooth position profile at 1 kHz.

The source selector and the calibration selector mechanisms will operate under Position Profile, where a position is commanded and is expected to remain valid for extended periods of time. In the case of the fold and pick off mirror mechanism the preferred mode is the Position Profile.

Phasing Camera

The AGWS also contains an On-axis Guide and Wavefront Sensor assembly (OAGWS) to be used for telescope commissioning, engineering, and troubleshooting. This on-axis unit deploys to the center of the Direct Gregorian (DG) field on command. The OAGWS is located within the upper GIR structure. It deploys to the on-axis position through openings in the AGWS main structure. A dedicated AGWS electronics rack, located within the GIR, supports the AGWS. Refer to **Figure 5** for the location of the OAGWS in the GIR.

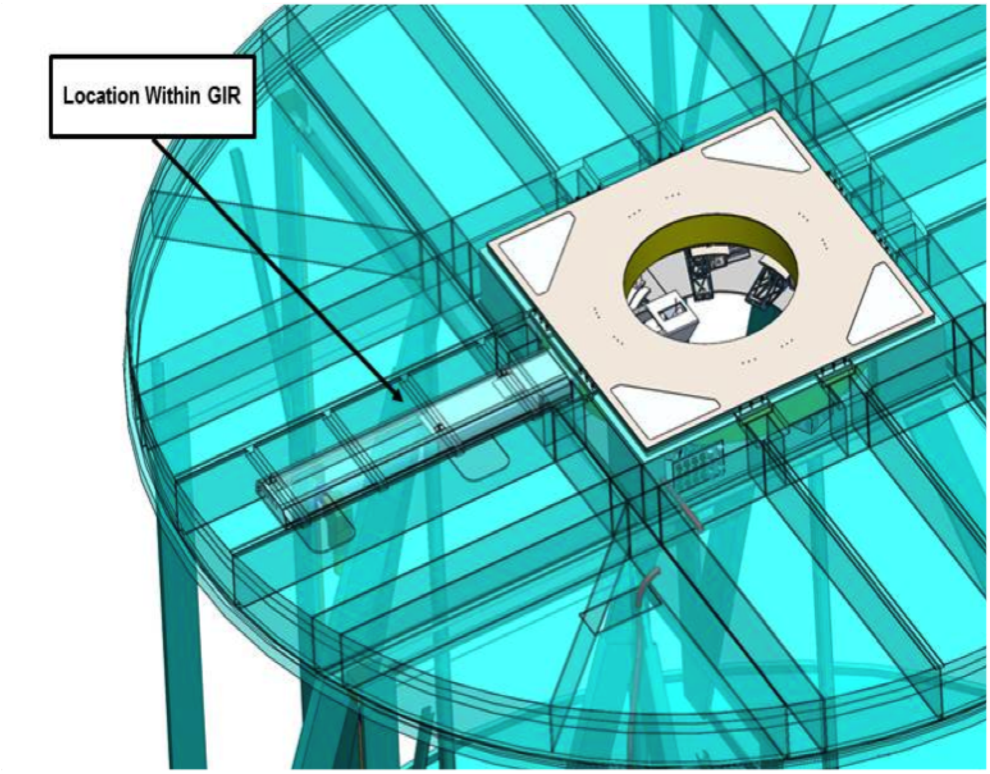

Figure 5. OAGWS location in the GIR.

A summary of all the AGWS mechanisms is shwon on **Table 1**.

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GMT Software and Controls Glossary and Definitions.

GMT Software and Controls Control Engineering Glossary and Definitions. Based on ECSS-E-60A

CHAPTER

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Table 4.1: Signatures

Author: ____	Date: ___________
Chief Engineer: _______________________________	Date: ___________
Project Manager: ______________________________	Date: ___________

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REVISIONS

Table 5.1: Revisions

Version	Date (mm/dd/yyy)	Affected section(s)	Engineering change #	Reason/Initiation/Remarks
1	6/25/2013	All	None	Initial Draft

CHAPTER SIX

DEFINITION OF TERMS

Throughout the document, requirements statements are shown in blue text to allow them to stand out. Statements preceded by *Note:* or *Advice:* are support text and statements preceded by "Rationale:" are the reasoning behind the requirements.

Terms should be used as specified below:

Table 6.1: Definition of Terms

Term	Definition
Shall	*Shall* denote requirements that are mandatory and will be the subject of specific acceptance testing and compliance verification.
Can, *May*, or *Should*	*Can*, *May*, or *Should* indicate recommendations and are not subject to any requirement acceptance testing or compliance verification by the supplier. The supplier is free to propose alternative solutions.
Is or *Will*	*Is* or *Will* indicate a statement of fact or provide information and not subject to any requirement acceptance testing or verification compliance by the supplier.

CHAPTER

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GOVERMENT DOCUMENTS

The following GMT documents contain supplemental requirements related to standardizing Software and Control Systems.

Table 7.1: Reference Documents

Reference#	Document Number	Version	Title
RD-1	GMT-SE-REF-00019	TBA	GMT Electrical Power Systems
RD-2	GMT-SE-REQ-00190	TBA	GMT Common Utilities and Equipment
RD-3	GMT-SE-REF-00191	TBA	GMT Electronics Standards

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INDUSTRIAL DOCUMENTS

The following GMT documents contain supplemental requirements related to standardizing Software and Control Systems.

Table 8.1: Reference Documents

Reference#	Document Number	Version	Title
RD-1	GMT-SE-REF-00019	TBA	GMT Electrical Power Systems
RD-2	GMT-SE-REQ-00190	TBA	GMT Common Utilities and Equipment
RD-3	GMT-SE-REF-00191	TBA	GMT Electronics Standards

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