



National Centre for Radio Astrophysics

Internal Technical Report

GMRT/SERVO/PC104/004-OCT-2013

# GMRT Servo Console User Manual

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## Document Status History

S.No	Document Status	Description
1	Document Title	GMRT Servo Console User Manual
2	Document Reference No.	GMRT/SERVO/PC104/004-OCT-2013
3	Revision	0.0
4	Date	10-October-2013
5	Prepared By	Thiyagarajan Beeman
6	Reviewed By	Servo Group Members
7	Approved By	SMEC Committee

**Document Change Record**

<b>DCR No</b>	First Issue	
<b>Date</b>	10-October-2013	
<b>Document Title</b>	GMRT Servo Console User Manual	
<b>Document Reference No</b>	GMRT/SERVO/PC104/004-Oct2014	
<b>Document Revision No</b>	0.0	
<b>Page No</b>	<b>Paragraph</b>	<b>Reason For Change</b>

## ACRONYM

GMRTACU	GMRT Antenna Control Unit
GSC	GMRT Servo Console
AIO	Analog Input and Output
ADC	Analog to Digital Converter
DAC	Digital to Analog Converter
AZ Axis	Azimuth Axis
EL Axis	Elevation Axis
SSC	Station Servo Computer
GUI	Graphical User Interface
FIFO	First In First Out
RTAI	Real Time Application Interface
GPOS	General Purpose Operating System
HHT	Hand Held Terminal
IPC	Inter Process Communication
PLC	Position Loop Compensator
KMPH	Kilometer per Hour
rpm	Revolution per Minute

## **ABSTRACT**

This manual basically elucidates the steps for usage of console to the users. It also briefly describes the need and the tools used to make the servo console. The manual tries to explain the operational features of the console in a manner familiar to the users as they are already using the older HMI devices such as NEWSMU and HHT. The users should smoothly transit from the existing HMIs to the new HMI and this manual attempts to do that.

This console which has been specially made for the new PC104 based Servo Computer in place of the old 8086 based brings together many features onto one platform such as sending commands to the servo computer such as Positioning command, tracking etc., receiving data from the servo computer based on inputs such as data logging from the user plus real time display such as antenna angle, status display etc. This is advanced compared to the older HMI's that were being used. Hence this user attempts to explain these features in very simplified and pictorial manner so that it is understandable to all level of users. The dialog boxes have been shown along with the steps to execute a particular command.

This console and the manual have come after on-site testing and validation by the servo group. However there is always scope of newer version to come up as there is up-gradation in PC104 upgrade.

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## 1. Introduction

The common problems faced by GMRT servo engineers during testing, debugging and troubleshooting the problems in antenna as well as in test setup are, there is no proper debugging and monitoring tools. Presently available NEWSMU has a certain limitations, like it requires obsolete IBM PC compatible i386 personal computers, Disk Operating System (DOS) and limited facilities like operational commands and also it lags certain features like, setting the gain values of compensator, software position end limits, safety limits of motor-drive, amplifier systems and internal system parameters. If engineers want to test the servo software extensively they need to carry Hand Held Terminal (HHT), The HHT's are basically serial consoles, and it works on the basis of event driven mechanism. The software internal state variables and monitoring data's only available to users on request. The different group of commands and internal state machines are tested with specific commands as well as it lags to simultaneously provide the monitoring and debug information without request. Both debugging tools communicate with the servo computer through serial port. There is no ready tool in-built with the servo software for debugging and monitoring because of the limited 8086 based servo computer hardware and software.

In order to overcome the above problems, as part of X11 plan upgrade, GMRT servo system software is built with necessary debugging and monitoring tools. The present version of servo computer, accompanies the industry standard embedded computer with Linux Kernel extension Real Time Application Interface (RTAI). The Linux kernel supports the various desktop environment libraries and RTAI extension adds the real time features. With this configuration of GMRT station servo computer (hardware and software) the above mentioned limitations can be overcome easily. By keeping all requirements in mind as well as collecting the feedback from members who go on field a new Graphical User Interface (GUI) (i.e GMRT Servo Console (GSC)) was designed. The following sections discuss and lay down the procedures to use GUI for different level of users.

## 2. Development Tools

The present version of GMRT Servo Console was developed with open source "*Qt Designer*". The specifications and versions of the software used to build the GUI are listed below,

S.No	Description of Software	Version
1	Qt Designer	3.3.8
2	Qmake	2.01a
3	Host Operating System	Fedora Core 9
4	Target Operating System	Puppy Linux 4.3.1

Table 2-1 Software Requirements

### 3. Classification of GMRT Servo Console sub systems

The Figure 3.1 depicts the current version (ver-2.0) of the GSC. The various sub systems like monitoring, command and debug are grouped in the following order,

1. Antenna System Status and Event Reporting sub system,
2. Azimuth axis monitoring parameters, Axis State and Status Flags,
3. Elevation axis monitoring parameters, Axis State and Status Flags,
4. Stow and Wind Status sub system
5. Command and response sub system
6. Debug sub system

The tab based menus are provided, which houses different categories of commands, the major classification of tabs are,

1. Basic Tools
2. Advanced Tools

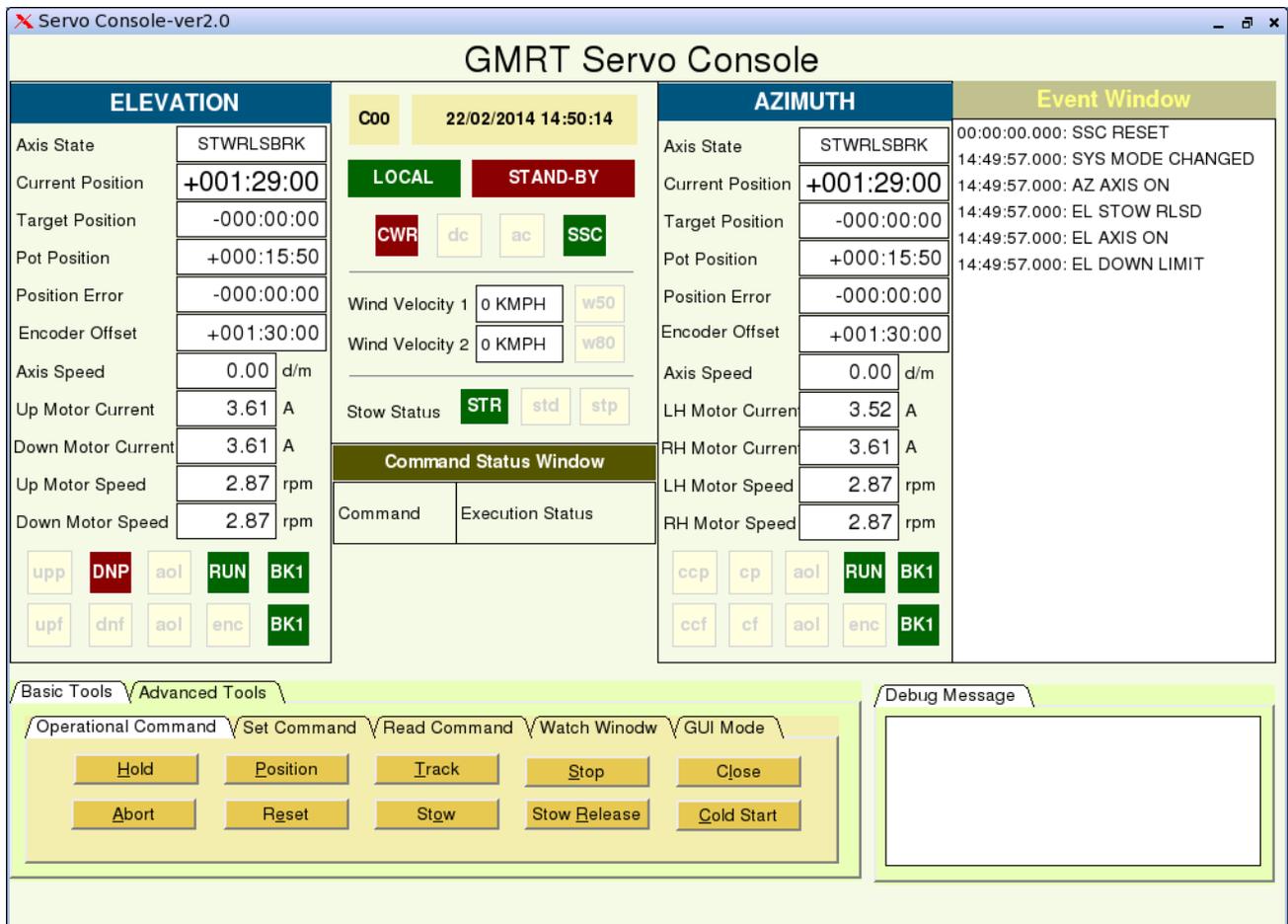


Figure 3-1 GMRT Servo Console Main Window

The basic tools tab includes,

1. Operational commands
2. Set Commands,
3. Read Commands,
4. Watch Windows,

The advanced tools tab includes,

1. Data Logging Commands,
2. Configurations Commands,
3. System Calibration Commands,

The different sub-system modules and communication between the modules are explained in below sections.

#### 4. Integration with Servo Program

For GMRT like a large radio telescope, all the functional tasks (deadlines) should be completed within a stipulated time interval (real-time). Without degrading the real time features of servo program the GUI functionality are added in General Purpose Operating System (GPOS). The communication between the GMRT Servo Program (GMRTACU.ko) and GMRT Servo Console (GSC) are done through the First in First out (FIFO) device. The FIFO's are basically inter-process communication (IPC) modules which are provided by RTAI. This RTAI-FIFO's allows the data exchange between the RTAI kernel module and GPOS program. The pre-defined communication protocol was defined in both real-time module and GSC program. The monitoring data exchange between the modules is at regular interval of 100msec and command and configuration parameters are event driven modules. The Figure-4.1 shows the set of RTAI-FIFO's are assigned for the data and command communication between the modules.

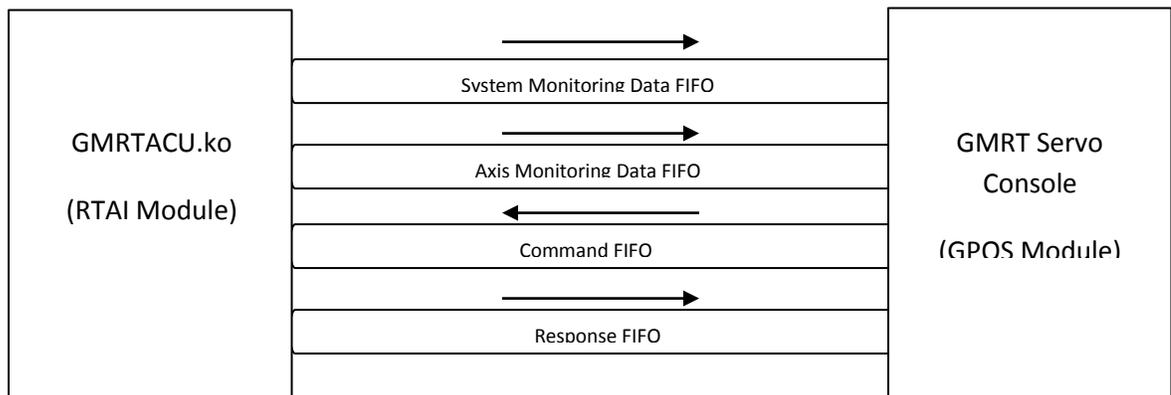


Figure 4-1 Communication Interface

## 5. Description of GSC Modes

GSC operates in the five different modes depends on the requirements of user. The different modes are listed below,

1. Display Mode
2. Operational Command Mode
3. Set Command Mode
4. Configure Mode
5. Read Mode
6. Hardware Debug Mode

Except "Display mode", all other mode requires the user authentication before preceding further, the user authentication window shown in Figure 5-1. The default username and password are "Servo" and "\*\*\*\*".



Figure 5-1 User Authentication Window

### 5.1 Display Mode

This is the default mode of the GSC. Irrespective of the other GUI modes all sub-system(Antenna System, Axis, Events and command responses) monitoring parameters are updated at every 100msec interval without any command. This mode eliminates the event driven mechanism of HHT. The different parameters updated by this mode are as show below Figure 5-2.

1. Current and Target Position of both Azimuth and Elevation axis in deg:min:sec,
2. Position Error in deg:min:sec,
3. Axis Speed in deg/min,
4. Encoder Offset in deg:min:sec
5. Motor Speed in rpm and Current in ampere.
6. Axis State and Status Flags.

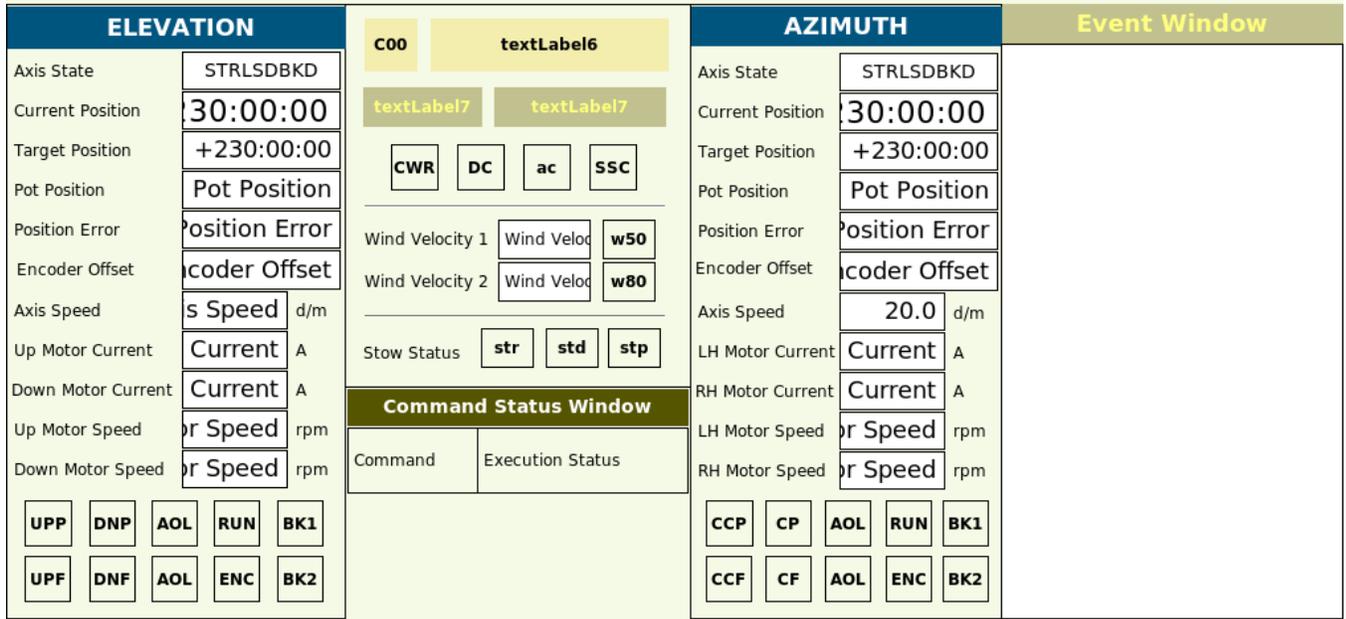


Figure 5-2 Display Mode Parameters

## 5.2 Operational Command Mode

This mode is most commonly used by servo engineers. The different commands available in this mode are listed below as well as shown in Figure 5-3.

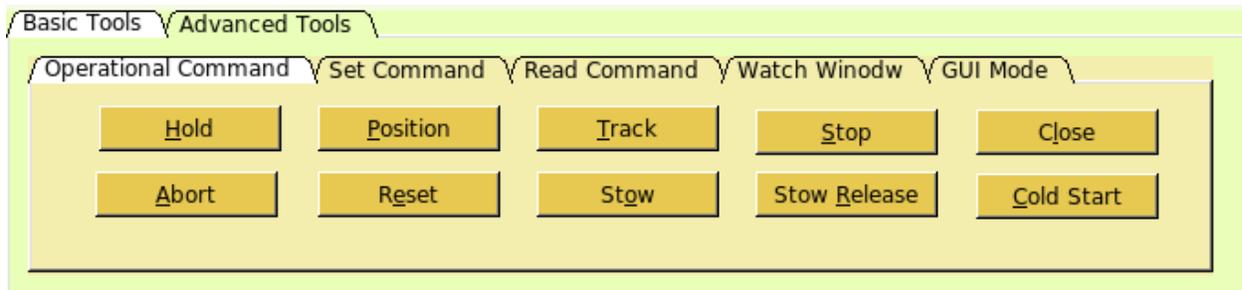


Figure 5-3 Operational Commands

1. Hold Command
2. Stop Command
3. Position Command
4. Track Command
5. Abort Command
6. Close Command
7. Cold Start Command
8. Reset Command
9. Stow Command
10. Stow Release Command

Unlike HHT/NEWSMU character based command syntax (example: H, A), this GSC offers dialog based command modules to user. So that users need not worry about the command syntax. Syntax for every command is taken care by GSC itself.

For all the operational commands, responses are updated in the command status window with the relevant results, like Command Accepted, Command Failure, Syntax Error and Range Error etc. and also incomplete commands are reported with additional warning dialogs.

### 5.2.1 Hold Command

This command basically releases the brakes of the commanded axis and enters into the POSITIONING state and reports Command Successes message in “Command Status Window”. Pre-requisite state of the axis to this command is STRLSDBKD, otherwise it reports command failure. The User can select the command axis from the axis drop down list as shown in Figure 5-4.

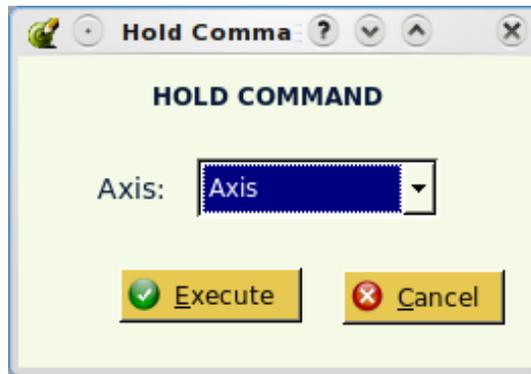


Figure 5-4 Hold Command Dialog

### 5.2.2 Stop Command

Stop command brings the axis from POSITIONING/TRACKING state to STRLSDBKD state. Like HOLD Command this command also takes the axis as a command parameter. Figure 5-5 shows the STOP Command dialog.



Figure 5-5 Stop Command Dialog

### 5.2.3 Position Command

Unlike Hold/Stop command, Position command takes the command axis and command parameter as an input. The Figure 5-6 shows the Position command dialog, depends on the command axis (AZ/EL/AZ\_EL) the inputs are read by the GSC. If command axis is AZ, GSC only reads AZ axis target position, and EL axis GSC read EL axis Target Position, if both axis (AZ\_EL) are selected it read both target positions. The target angle format is “ $\pm deg:min:sec$ ”. For AZ axis valid angle range is  $\pm 260:00:00$  and EL axis valid angle range is  $+16:30:00$  to  $+105:00:00$ .



Figure 5-6 Position Command Dialog

### 5.2.4 Track Command

Track command is basically a incremental position commands, the parameters of track command are axis, target position and target time. The target time must be within the two hours duration from the current servo time. Otherwise GSC reports invalid time to user. Figure 5-7 depicts the Track command dialog.

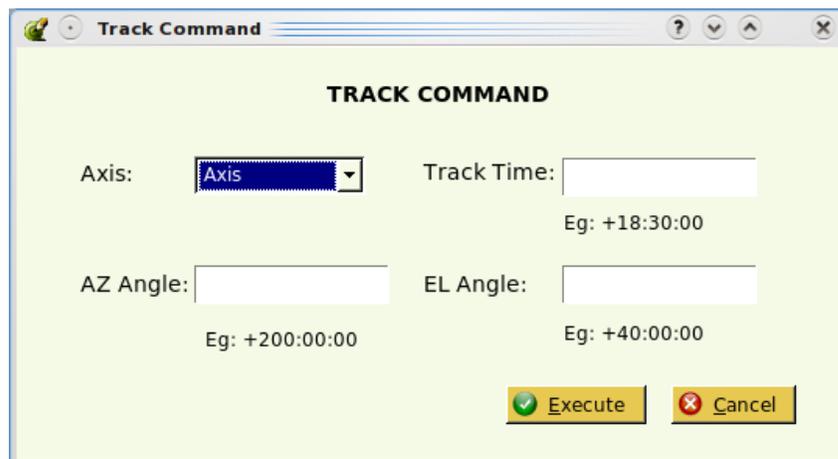


Figure 5-7 Track Command Dialog

### 5.2.5 Abort Command

This command aborts the previously taken command and enters into POSITIONING state from any of the following state POSITIONING, TRACKING, LIMIT RELEASING. The parameter of this command is axis only. The Figure 5-8 shows the abort command dialog.



Figure 5-8 Abort Command Dialog

### 5.2.6 Close Command

This command parks the antenna, applies the brakes and turns off the drive. This command can be executed only from STRLSDBKD state. It doesn't take any parameter except command code. Figure 5-9 shows the close command dialog.

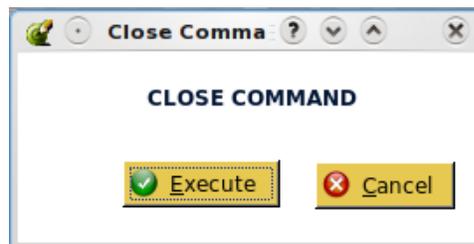


Figure 5-9 Close Command Dialog

### 5.2.7 Cold Start Command

Figure 5-8 shows the cold start command. This command can only be accepted in STOWED state. This command releases the STOW and holds both axes in current position. Like close command this command also doesn't take any parameters except command code.

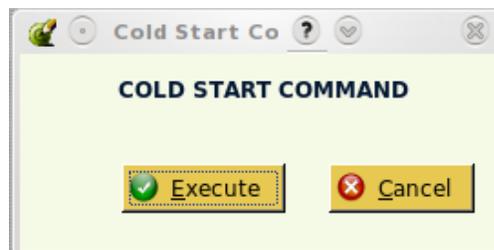


Figure 5-10 Cold Start Command

### 5.2.8 Reset Command

Figure 5-11 shows the reset command dialog. Unlike other commands, before executing this command GSC gets the conformation from user. This command resets both servo computer and servo program. Similar to Cold start and Close command this also takes command code as a parameter.



Figure 5-11 Reset Command Dialog

### 5.2.9 Stow Command

This command is only available to EL axis. It will only be executed if the stow position limit switch is reached and the EL encoder position is at 90:00:00. Otherwise, it will fail. The command takes the Command axis as a parameter along with the command code. Figure 5-12 shows the stow command dialog.



Figure 5-12 Stow Command Dialog

### 5.2.10 Stow Release Command

Similar to the Stow command, this command is also applicable to EL axis only. It releases the EL axis stow pins. Prior to execution of this command, the EL axis should be in STOWD state. Otherwise, this command will fail. Figure 5-13 shows the stow release command dialog.

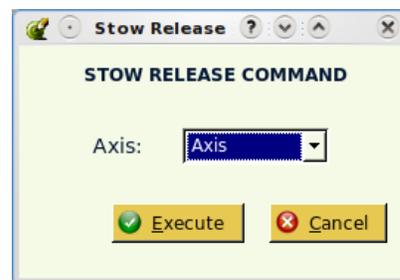


Figure 5-13 Stow Release Command

### 5.3 Set Mode Commands

The following set of commands is used to test the safety behavior of servo software as well as setting the system parameters which are changed during the mechanical/servo maintenance or servo computer change. The set of commands supported by GSC are listed below and shown in Figure 5-14



Figure 5-14 Set Mode Commands

List of Set Mode Commands,

1. Station Number
2. Servo Time
3. Wind Limits
4. Speed Limits
5. Current Limits
6. Encoder Offset
7. Software Low Limits
8. Software High Limits
9. Stow Position

For all set mode commands, GSC will update the responses like Command Accepted on successes and insufficient parameters, range error etc. for failure.

#### 5.3.1 Station number

The station number (i.e. Antenna number) can be set with this command. This command can be used during the installation of servo computer or change of it. The Figure 5-15 shows the station number change dialog. The required station number can be selected from the list box.

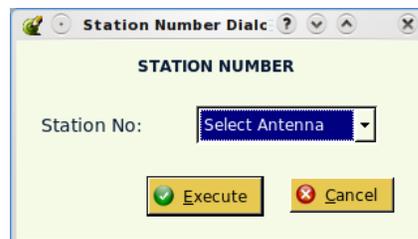


Figure 5-15 Station Number Dialog

### 5.3.2 Servo Time

The servo time and date can be set from the GSC with the help of following dialog shown in Figure5-16. This command writes Real Time Clock (RTC) in the servo computer in specified format.

Time Format : 24 Hrs F=format with “*hh:mm:ss*” separated (example: *21:00:00*)

Date Format : “*yyyy-mm-dd*” (example: *2013-11-16*)

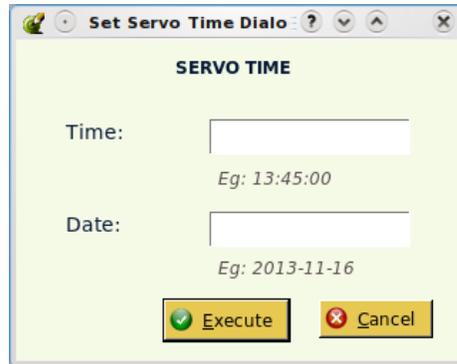


Figure 5-16 Servo Date and Time Dialog

### 5.3.3 Wind Limit

The specified operational wind limits of the servo system can be set from “set wind limit dialog “ as shown in Figure 5-17. The maximum value of wind limits are 140KMPH. This command only accepts whole numbers.

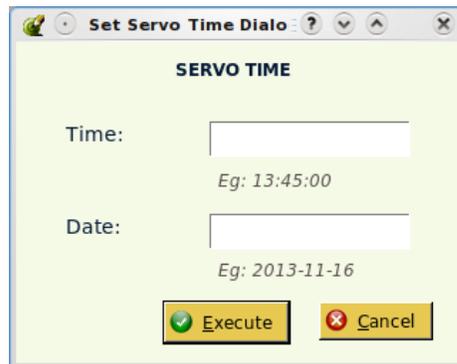


Figure 5-17 Wind Limits

### 5.3.4 Speed Limit

The software speed limits of the servo motors can be set from the “set speed limit dialog” as shown in Figure 5-18. This command used to verify the servo software operation on the occurrence of high speed. Individual axis speed limit can be set from this dialog.

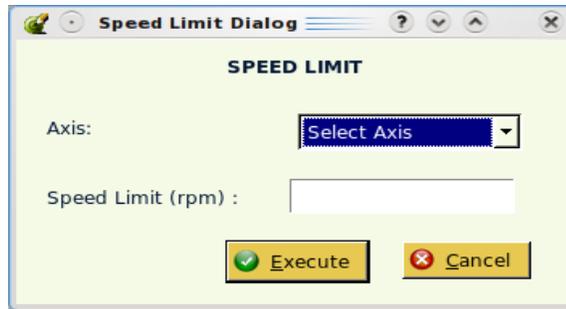


Figure 5-18 Speed Limit Dialog

### 5.3.5 Current Limit

This command is similar to “set speed limit”. Instead of setting the speed limits, in this case we can set the software current limits. Figure 5-19 shows the “set current limit dialog”.

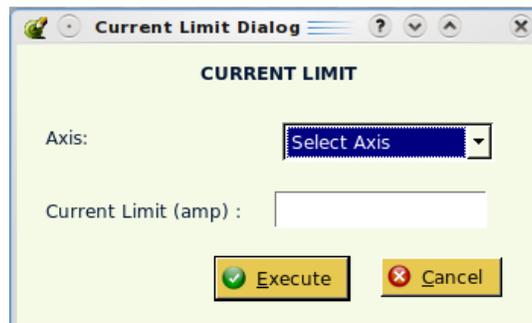


Figure 5-19 Current Limit

### 5.3.6 Encoder Offset

Unlike other set mode commands, encoder offset command offers to store the angle offsets in file. It offers to user to select axis, type of storage along with offset. Figure 5-20 shows the “set encoder offset” command dialog. The valid encoder offset is  $\pm 10:00:00$  from 00:00:00.

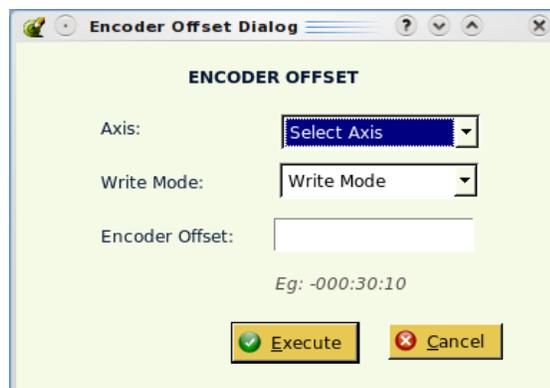


Figure 5-20 Encoder Offset

### 5.3.7 Software Low Limits

The software position end limits are easily set with the help of “set software low limit” dialog. This dialog offers the axis list box to select the axis and end positional limits in  $\pm dd:mm:ss$  format. The range of AZ axis soft low limit is -270:00:00 and EL axis soft low limit is 15:00:00. Figure 5-21 shows the “software low limit” dialog box.

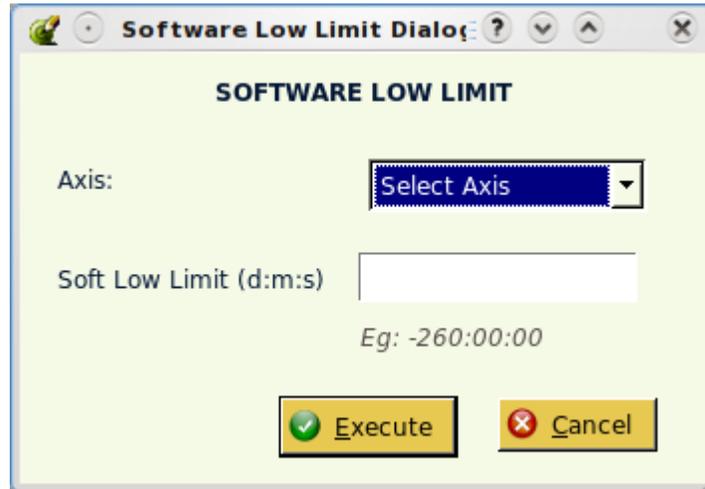


Figure 5-21 Software Low Limit Dialog

### 5.3.8 Software High Limits

Similar to software low limits, software high limits are also set with the help “set software high limit” dialog. Figure 5-22 shows the software high limit dialog box. The range of software high limits for AZ axis is +270:00:00 and EL axis is +105:00:00.

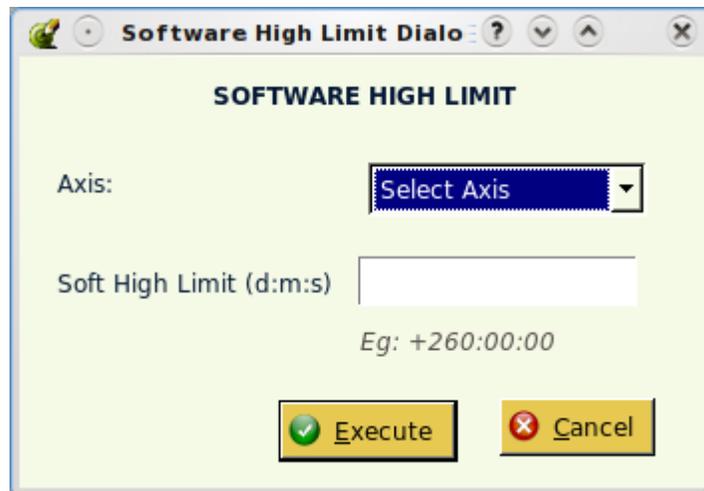


Figure 5-22 Software High Limits Dialog

### 5.3.9 Stow Position

The software stow position of both axis are set from “set stow position” dialog. The valid angle for AZ axis is 000:00:00 and EL axis 85:00:00 to 95:00:00. Figure 5-23 shows the set stow position dialog.

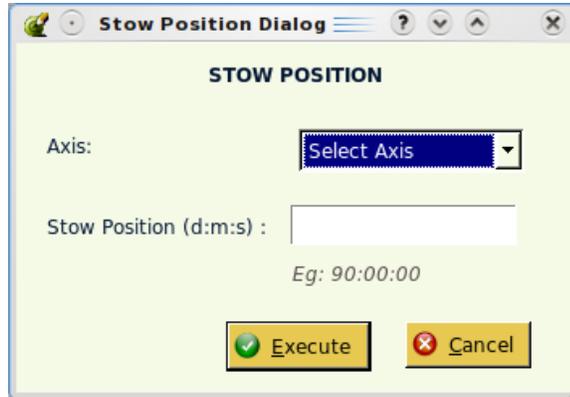


Figure 5-23 Set Stow Position Dialog

### 5.4 Read Mode Commands

The following set of commands basically displays the internal system parameters like software end limits, encoder offsets, speed and current limits for axis, gain values, pole and zero locations of compensator and soft start filter. The set of commands supported by GSC are listed below and shown in Figure 5-24.

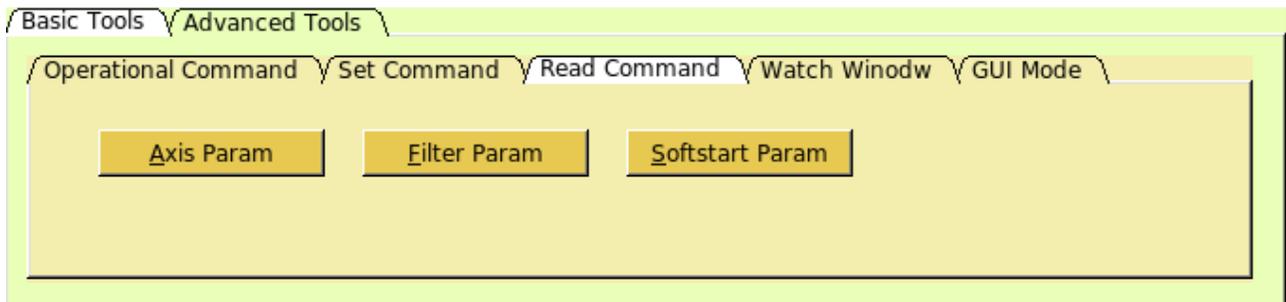


Figure 5-24 Read Mode Commands

List of Read Mode Commands,

1. Read Axis Parameter
2. Read Soft start Parameter
3. Read Compensator Parameter

The list of parameters displayed by the above three commands are given in Table 5-1, 5-2 and 5-3, the values listed in the tables are example only, it may vary depends on the antenna configurations.

### 5.4.1 Read Axis Parameters

S.No	Parameter	Value
1	Station Number	C00
2	Software Version	2.6
3	Display Mode	3
4	Wind Limit Low (KMPH)	40
5	Wind Limit High (KMPH)	45
6	Wind Hysteresis (KMPH)	5
7	AZ Encoder Offset	-3:00:00
8	AZ Software Low Limit	-265:00:00
9	AZ Software High Limit	+265:00:00
10	AZ Stow Position	00:00:00
11	AZ Encoder Jump (deg)	0.125
12	AZ Speed Limit (rpm)	1800
13	AZ Current Limit (amp)	45
14	EL Encoder Offset	-3:00:00
15	EL Software Low Limit	15:00:00
16	EL Software High Limit	+105:00:00
17	EL Stow Position	90:00:00
18	EL Encoder Jump (deg)	0.0625
19	EL Speed Limit (rpm)	1800
20	EL Current Limit (amp)	45

Table 5-1 Axis Parameters

### 5.4.2 Read Soft start Parameter

S.No	Parameter	Value
1	AZ CPP Gain	9.8
2	AZ CPP Pole	8.57
3	AZ CPP Zero	0.408
4	AZ Rate Limit	0.5
5	AZ Acceleration Limit	0.1
6	AZ CPP Bye Pass	False
7	EL CPP Gain	9.8
8	EL CPP Pole	8.57
9	EL CPP Zero	0.408
10	EL Rate Limit	0.33
11	EL Acceleration Limit	0.06
12	EL CPP Bye Pass	False

Table 5-2 Soft Start Parameters

### 5.4.3 Read Compensator Parameter

S.No	Parameter	Value
1	AZ Saturation Limit	0.5
2	AZ Slew Entry Value	1.0
3	AZ Slew Exit Value	0.1
4	AZ Proportional Gain	0.9
5	AZ Integral Gain	0.12
6	AZ Pole 0	0.4
7	AZ Pole 1	0
8	AZ Pole 2	0
9	EL Saturation Limit	0.33
10	EL Slew Entry Value	0.6
11	EL Slew Exit Value	0.06
12	EL Proportional Gain	1.2
13	EL Integral Gain	0.18
14	EL Pole 0	0.4
15	EL Pole 1	0
16	EL Pole 2	0
17	EL Zero 0	0
18	EL Zero 1	0
19	EL Zero 2	0

Table 5-3 Compensator Parameter

### 5.5 Watch Windows

Watch windows basically provides the monitoring information about the individual axis. It displays the Current Encoder Position, Target Position, Position Error and Motor Speed and Currents. Both the axis watch windows are identical in nature. Figure 5-25 shows AZ and EL axis watch windows.

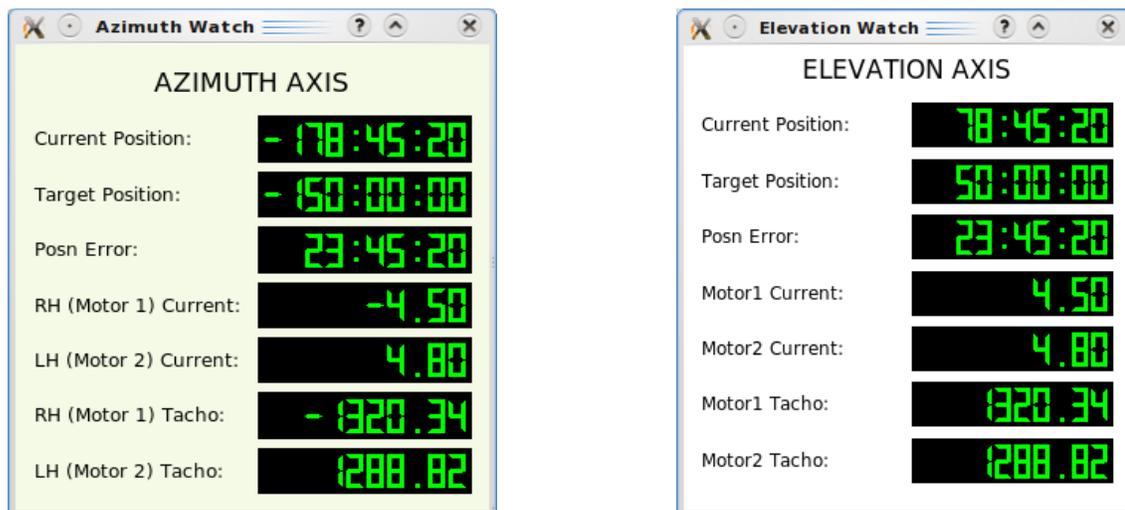


Figure 5-25 AZ and EL Axis Watch Window

## 5.6 Data Logger

The data logger facility allows users to log the various parameters like encoder position, target position, wind status, position error, speed demand, stow position status, system time in various formats. This log files contains the comma separated data's which can be studied in off line for calculation of position loop responses, behavior of system during high wind conditions, erratic behavior of encoders and limits etc.

The data logger dialog offers user to provide the filename, required parameters to log and initial. Log file has a default entry of Antenna number, Date and header at top of the file. The log file can be opened in the below given specified directories only, since servo program in antenna are sitting in the ramdisk. If user will provide the file name without path the data may be lost in successive reboots.

Log file can be opened in following locations,

1. /root/log/filename
2. /root/filename.

Figure 5-26 shows the data logger dialog, below window only creates the file in the specified directory, logging can be started or stopped with the help of START and STOP commands in Data logger tab.

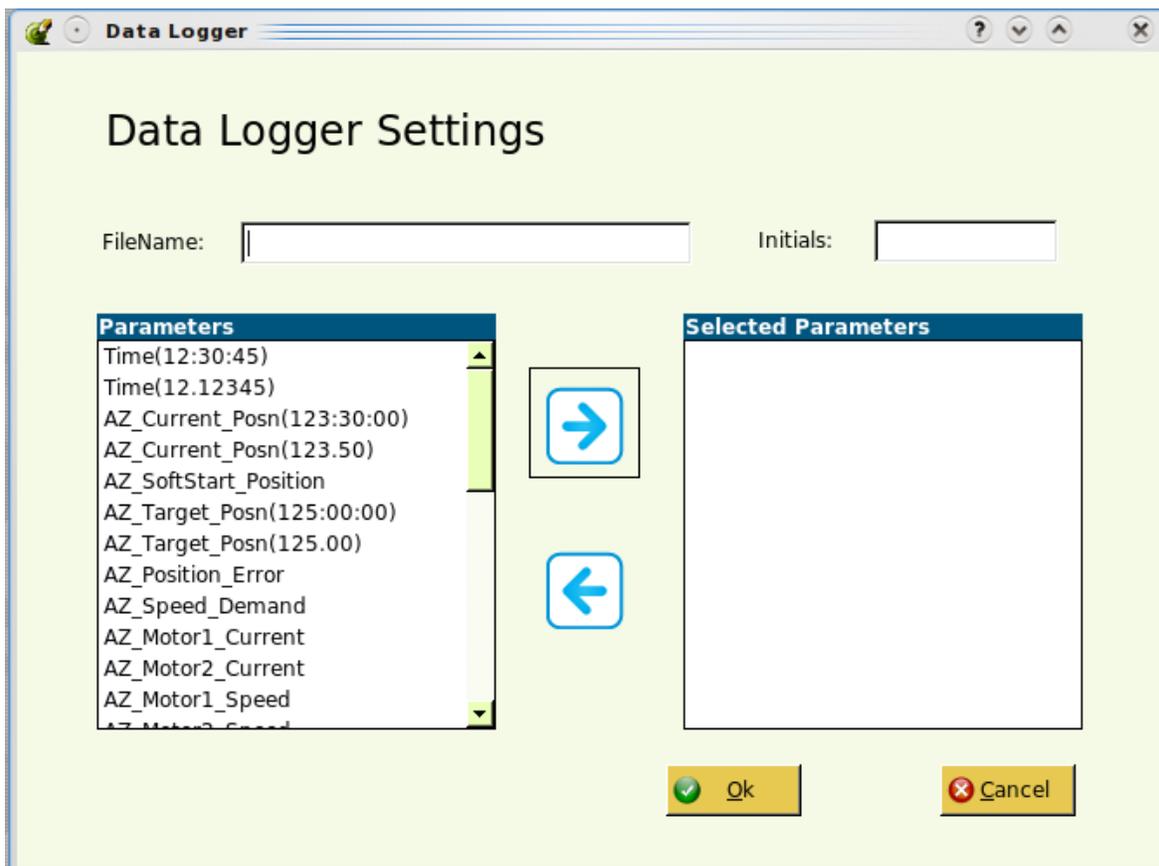


Figure 5-26 Data Logger Dialog

## 5.7 Configuration Dialogs

The configuration tab in the advanced tools, allows the user to configure the different parameters of axis, compensator, soft start, ADC's and DAC's. This configuration dialogs are used during the installation time of station servo computer as well as it allows tuning the system dynamic responses. The different menus or dialogs are available in this tab are,

1. Axis Configuration
2. Compensator Configuration
3. Soft start Configuration
4. ADC Configuration
5. DAC Configuration

Description of individual dialogs is given below.

### 5.7.1 Axis Configuration

Different parameters in this configuration wizard are group into three major categories namely system parameters, AZ and EL axis parameters. The system dialog block includes Command axis, station number, Wind limits and auxiliary display mode.

The screenshot shows a software window titled "Axis Parameters" with a subtitle "Axis Configuration Dialog". The window is organized into three main sections for parameter configuration:

- Azimuth Axis Parameters (Top):** Includes a "Station:" dropdown menu set to "Antenna Number", an "Axis:" dropdown menu set to "Axis", an "Aux Display Mode:" dropdown menu set to "Select", and two empty text input fields for "Wind Low Limit:" and "Wind High Limit:".
- Azimuth Axis Parameters (Middle):** Includes five empty text input fields for "Encoder Offset:", "Software Low Limit:", "Software High Limit:", "Speed Limit:", and "Current Limit:".
- Elevation Axis Parameters (Bottom):** Includes six empty text input fields for "Encoder Offset:", "Stow Position Value:", "Software Low Limit:", "Software High Limit:", "Speed Limit:", and "Current Limit:".

On the right side of the dialog, there are four buttons: "Update", "Save", "Clear", and "Close".

Figure 5-27 Axis Configuration Wizard

Figure 5-27 shows the axis configuration dialog. The AZ and EL axis parameters are identical in nature and EL axis group additionally includes stow position. The range of values for different parameters is given in table 5-4. This dialog gives two different options to users to save or update the parameters to servo program. The Save option allows the user to save the system parameters in a file. This value can be read at every time servo program starts. On the other hand update option allows the user to save the system parameters to current sessions only.

S.No	System Parameter	Values
1	Antenna Number	C00-C08, S01-S06, W01-W06 & E01-E05
2	Wind Limits	Max 120 KMPH
3	Command Axis	AZ/EL/AZ_EL
4	Auxiliary Display	Wind/Target/Error
5	Encoder Offset	±10:00:00
6	Software Low Limits	AZ: -270:00:00 & EL: 15:00:00
7	Software High Limits	AZ: +270:00:00 & EL: 105:00:00
8	Speed Limits	2000 rpm
9	Current Limits	250 amp
10	Stow Position	AZ: 00:00:00 & EL: 90:00:00 (±02:00:00)

Table 5-4 Nominal Range of Axis Configuration Parameters

## 5.7.2 Compensator Configuration Dialog

The compensator configuration wizard allows the user to set the compensator proportional, integral gains, pole and zeros of lead lag filters. Even though present version of dialog takes three lead lag filter poles and zeros, servo program uses only first pole and zero for co-efficient calculation. The slew entry and exit values are not used with servo software version 2.6.6 onwards.

The equation of position loop compensator given below for reference,

$$G_s = K_p + \frac{K_i}{s} \frac{1 + sT_{21}}{1 + sT_{23}}$$

$K_p$  = Proportional Gain

$K_i$  = Integral Gain

$T_{21}$  = Lead – Lag Filter Zero

$T_{23}$  = Lead – Lag Filter Pole

Similar to axis configuration dialog this wizard also allows user to configure the individual axis filters. The update option will only save the filter parameters for current session and save option save the filter parameters in a file. This value is used in next successive sessions.

Figure 5-28 shows the compensator configuration dialog.

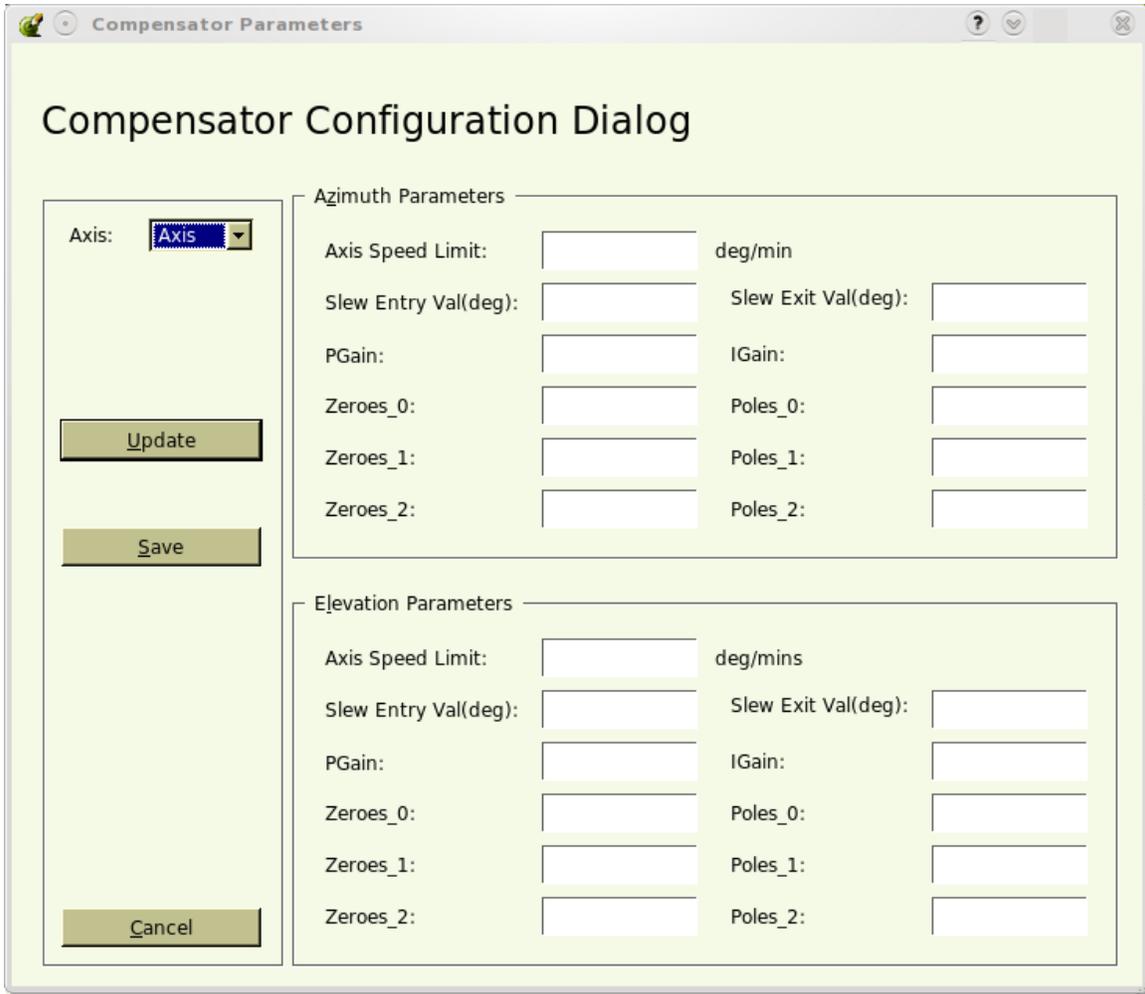


Figure 5-28 Compensator Configuration Dialog

### 5.7.3 Soft Start Configuration Dialog

The Soft start or command pre-processor profiles the large position and track commands before processed by the compensator. It limits the rate and acceleration of antenna within the specified limits. The profiler function changed as per the user requirement with the help of soft start configuration dialog. But it is highly encouraged to use the following values for both AZ and EL axis. Figure 5-29 shows the soft start configuration dialog and Table 5-5 depicts the values of gain, pole, zero, rate and acceleration limits of AZ and EL axis.

S.No	Soft start parameter	Values
1	Rate Limit	AZ: 0.5 & EL: 0.33
2	Acceleration Limit	AZ: 0.1 & EL: 0.06
3	Gain (For AZ & EL)	9.8
4	Pole (For AZ & EL)	8.57
5	Zero (For AZ & EL)	0.408

Table 5-5 Nominal Values of Soft start parameters

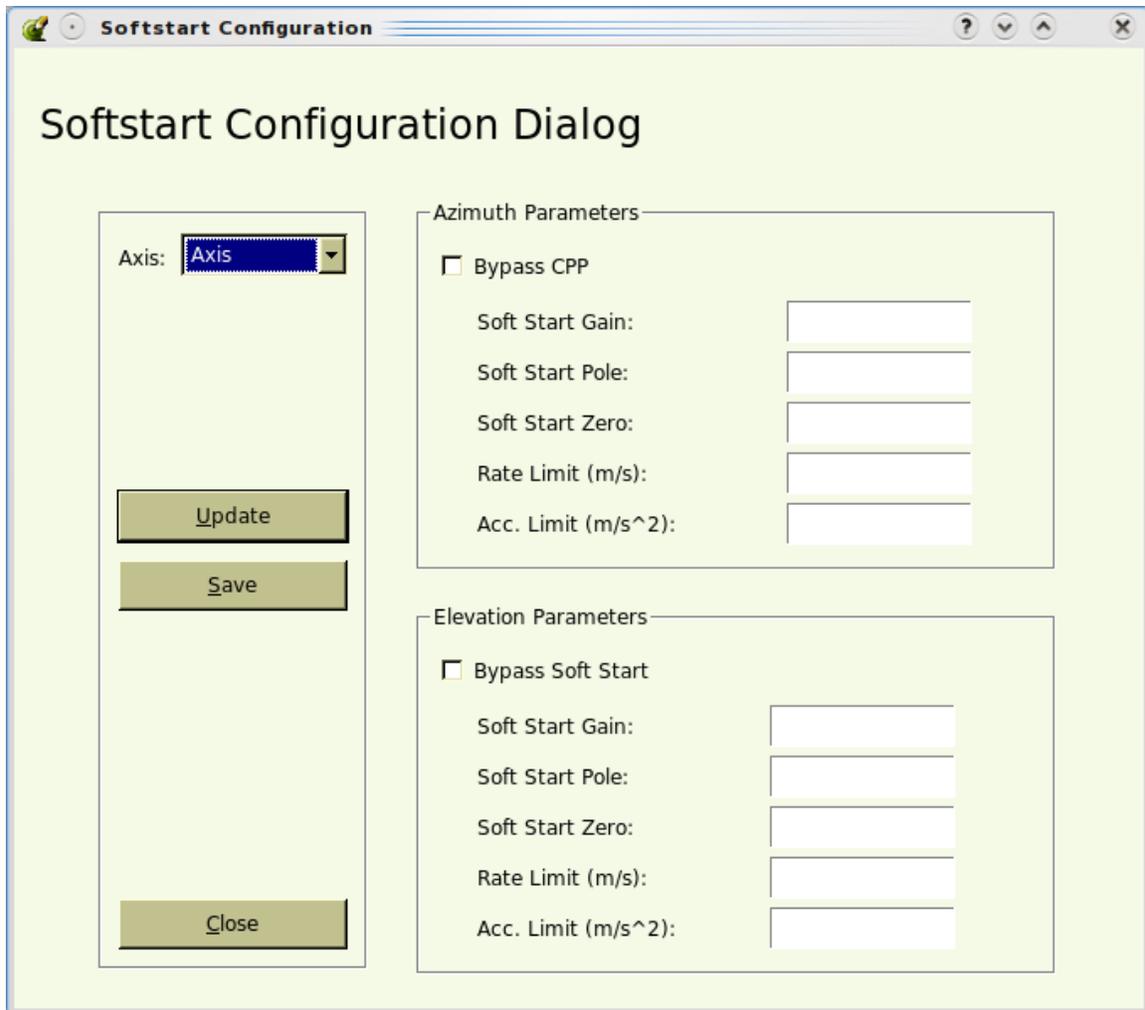


Figure 5-29 Soft start Configuration Dialog

This wizard also allows user to configure the individual axis soft start parameters. The update option only saves the soft start parameters for current session and save option save the soft start parameters in a file. This value can be used for next successive sessions.

#### 5.7.4 ADC Configuration Dialog

The present hardware configuration of station servo computer has 12 analog channels in AIO card. These analog channels are used to monitor the motor speed, current and POT positions of both axis and two spare channels are available. The ADC configuration dialog in Figure 5-30 allows user to select channel and configure as per requirement. With existing SSC hardware, first four channels are configured for motor currents of AZ and EL axis, next four channels are configured for motor speeds of AZ and EL axis, channel 8 and 9 are used for reading and displaying POT positions. Channel 10 and 11 are spare channels. The channel number and analog inputs are to be selected as per the specification in table 5-6. The scaling factor for individual channel is also listed in table 5-6.

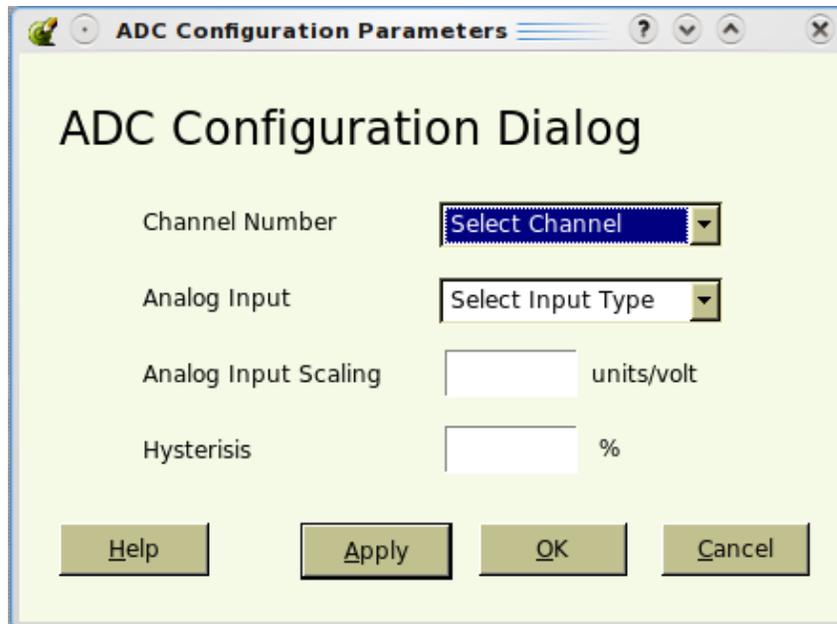


Figure 5-30 ADC Configuration Dialog

Channel	Parameter	Scaling Constant	Range
0	AZ Motor 1 Current	$\pm 10 \text{ V} = \pm 250 \text{ A}$	-250 to +250
1	AZ Motor 2 Current	$\pm 10 \text{ V} = \pm 250 \text{ A}$	-250 to +250
2	EL Motor 1 Current	$\pm 10 \text{ V} = \pm 250 \text{ A}$	-250 to +250
3	EL Motor 2 Current	$\pm 10 \text{ V} = \pm 250 \text{ A}$	-250 to +250
4	AZ Motor 1 Speed	$\pm 10 \text{ V} = \pm 588.2 \text{ rpm}$	-588.2 to +588.2
5	AZ Motor 2 Speed	$\pm 10 \text{ V} = \pm 588.2 \text{ rpm}$	-588.2 to +588.2
6	EL Motor 1 Speed	$\pm 10 \text{ V} = \pm 588.2 \text{ rpm}$	-588.2 to +588.2
7	EL Motor 2 Speed	$\pm 10 \text{ V} = \pm 588.2 \text{ rpm}$	-588.2 to +588.2
8	AZ Pot Position	$\pm 10 \text{ V} = \pm 260 \text{ deg}$	-260 to +260
9	EL Pot Position	$\pm 10 \text{ V} = \pm 260 \text{ deg}$	260 to +260
10	Spare Channel	$\pm 10 \text{ V} = \pm 260 \text{ deg}$	-260 to +260
11	Spare Channel	$\pm 10 \text{ V} = \pm 260 \text{ deg}$	260 to +260

Table 5-6 AIO Channel Configuration

For ADC configuration, this will update internal memory but not servo program. At the end of configuration user can submit the changes with OK pushbutton. If user directly submits (OK) the changes, dialog may not store the configuration parameters.

### 5.7.5 DAC Configuration Dialog

There are two DAC converters available in present SSC hardware for AZ and EL axis, which converts digital speed demand generated by the position loop compensator into analog voltage for next loop (i.e. Speed Loop). These DAC can be dynamically configured with help of DAC configuration dialog. Figure 5-31 shows the DAC Configuration dialog. This maximum value set in “DAC Full Scale Outputs” is 100%, which is equivalent to 30deg/min speed in AZ and 20deg/min speed in EL. These configuration values need not to be changed for GMRT antennas.

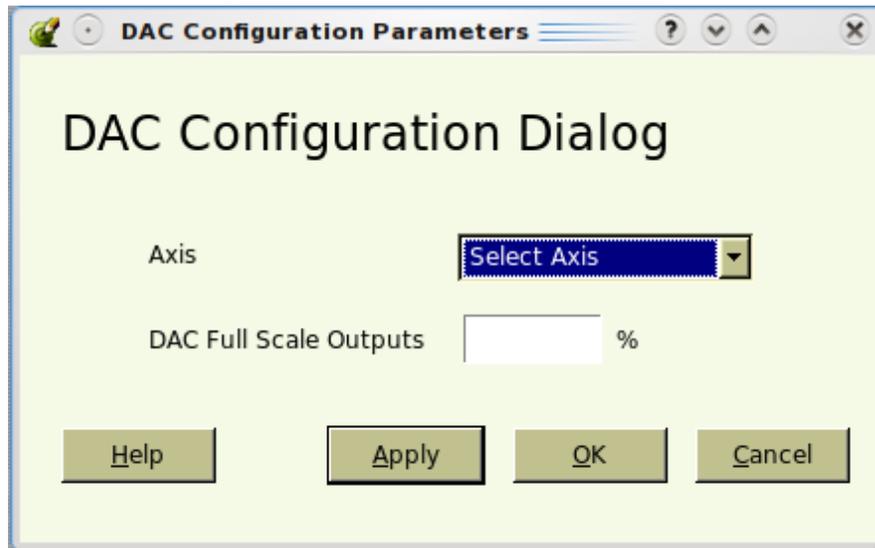


Figure 5-31 DAC Configuration Dialog

Table 5-7 shows the configuration values of AZ and EL axis DAC configuration values,

S.No	Axis	Scaling Constant	Full Scale O/P (Volts)
1	Azimuth	100%	10.00
2	Elevation	100%	10.00

Table 5-7 DAC Configuration Values

### 5.8 Debug Window

The upgraded servo program has the facility to log all system parameter like data, host and local command, event messages and status flags with time stamp in a file. This file can be re-run in the main servo console window, for debugging and troubleshooting purposes. While running log file, data, event message and status flags are displayed in respective locations of specified axis. The host and local commands may display with time stamp in debug tab.

## **6. Future Development**

The current GSC version can directly run on SSC hardware, the present sampling interval of servo program is 100msec (10Hz). The communication between GMRTACU and Servo Console are through RTAI-FIFOs. These FIFOs may not be read periodically by GPOS, if the sampling interval increases from 100msec to 10msec or even more, because of tight scheduling of RTAI task. In such cases, this servo console program may run in the stand alone Linux compatible computer and communication may establish with SSC either by means of serial or ethernet. In such cases the communication protocol may need to be written in both GMRTACU module and in GSC for data exchange.

