Stepper Motor Control – Local Control

User Manual

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Confidentiality

This document is classified as a public document. As such, it or parts thereof are openly accessible to anyone listed in the Audience section, either in electronic or in any other form.

Scope

This is user manual for stepper motor control local control GUI.

Audience

All users of stepper motor control GUI.

Table of Contents

Figures

Glossary of Terms

CSL	Cosylab
GUI	Graphical User Interface
HW	Hardware
SW	Software

References

[1] G. Jansa, Stepper Motor Control – System Design, 1.0

[2] G. Jansa, Stepper Motor Control – Installation and Configuration, 1.0

[3] Turbo PMAC/PMAC2, Software reference manual, 3Ax-01.937-xSxx, May 24, 2004

1. Overview

Local control GUI is used for local configuration and manipulation of motors. The system consists of a Java application running on user computer and a local control server using system driver running on the M-Box, see [1] for more information.

Layout of the local control is shown on figure below.

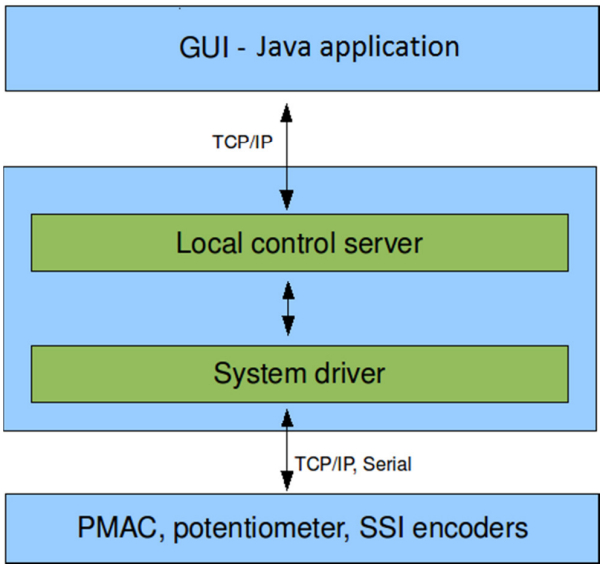

Figure 1: Layout of the local control

As seen on figure above the Java application communicates with the Local control server.

Communication follows the following steps:

1. Adding the appropriate IP and port number into the application or selecting an existing one.
2. By selecting the IP and clicking CONNECT button, the application tries to connect to the Local control server using TCP/IP protocol. If the connection fails the error message is logged. The application then periodically tries to connect to the Local control server.

2. GUI

Java application is used as a GUI for local control operations.

2.1. GUI operation description

Slits local control is composed of menu, a status screen at the top and three different screens in the center, which can be accessed by selecting the appropriate tab. The names of the screens are listed below:

- Main setup screen
- Motor drive screen
- Motor setup screen

2.1.1. Menu

Menu consists of the following items:

- File – used for general functionality (e.g. printing).
    - Print – used to open the print window.
    - Exit – closes the application.
- Help – used to help and general description of the application
    - User's Manual – open the user manual.

About – open the about dialog.

2.1.2. Log display

At the bottom of the application there is a log display, where errors, warnings received from local control server are logged and displayed as shown on the figure below. Information about reconnecting, saving and loading properties is also logged.

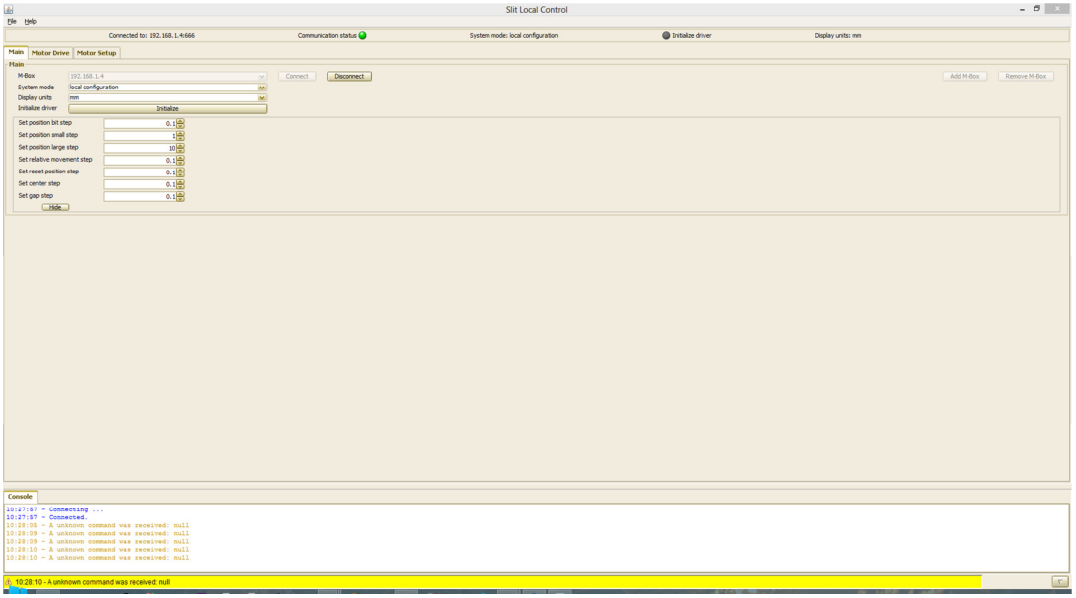

Figure 2: Log display

If an error has occurred the following items are displayed in the log:

- Time Stamp – time of the error.
- Description – error description.

For warnings the following items are displayed in the log:

- Time Stamp – time of the warning.
- Description – warning description.

For information the following items are displayed in the log:

- Time Stamp – time of the information.
- Description – information description.

2.1.3. Status display

The status display is used for status readback. The following readback items are available:

- Communication status
- Initialize drive
- Remote/local
- Display units
- Connected to

2.1.3.1. Communication status

Communication status shows the status of the connection of application to the local control server. It has two states:

- Green color – communication is established.
- Gray color – communication failed or connection is not available.

Most probable reason for communication to be in the Error state is that local control server is not running. To fix this problem user has to restart the local control server, for details consult [1].

2.1.3.2. Initialize drive

Readback status that displays the status of the driver initialization and has the following two states:

- Green color – drive initialization was successful.
- Gray color – drive initialization failed or connection is not available

2.1.3.3. Remote/local

Readback status which displays the current system mode. It has the following states:

- N/A – not available when connection not available
- local configuration
- local control
- remote
- LCD control

2.1.3.4. Display units

Readback status that displays the status of the display units. It has the following three states:

- N/A – not available when connection is not available.
- mm – display units is set to mm.

- counts – display units is set to counts.

2.1.3.5. Connected to

Readback status that displays the status of the remote/local. It has the following two states:

- N/A – not available when connection is not available
- name of device that it is currently connected to

2.1.4. Main setup screen

Main setup screen is used for general configuration. In the following sub chapters each of these configuration commands is described.

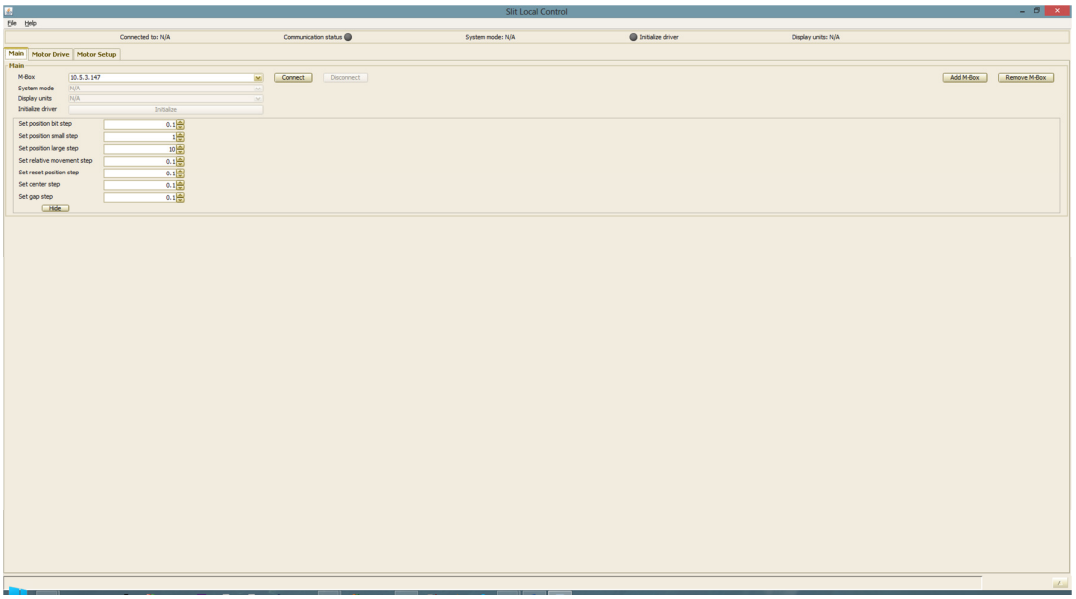

Figure 3: Main setup screen with advanced options displayed

2.1.4.1. M-Box

The M-Box is used to specify to which M-Box the application is currently connected to. A user is able to select from one of the M-boxes located in the M-Box selection box and connect to it. M-Boxes can be added by clicking the Add M-Box button or removed by clicking the Remove M-Box button. To add a new M-box, consult 2.1.4.4. To remove it, consult 2.1.4.5.

2.1.4.2. Connect

By clicking the Connect button the user can connect to the currently selected M-box in the M-Box selection box.

2.1.4.3. Disconnect

By clicking the Disconnect button the user disconnects from the currently connected M-box.

2.1.4.4. Add M-Box

Add M-Box is used to add a new M-Box to the application. By pressing Add M-Box button a window which is displayed on Figure 4 is opened.

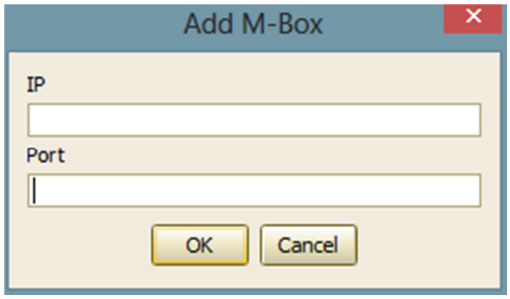

Figure 4: Add M-Box screen

After entering the port and IP number the user must press Ok button to perform save operation or press Cancel button to cancel the operation.

2.1.4.5. Remove M-Box

Remove M-Box is used to remove an M-Box from the application. By pressing the Remove M-Box button a window which is displayed on Figure 5 is opened.

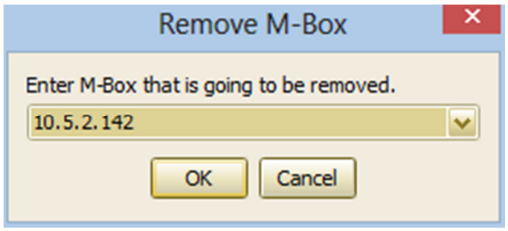

Figure 5: Remove M-Box

After selecting the M-Box to be removed the user must press Ok button to perform remove operation or press Cancel button to cancel the operation

2.1.4.6. Remote/local

Remote/local controls the system mode. New system mode is applied when changing the selection. User is able to select one of the following options:

- local configuration – all parameters can be changed, does not fall back to remote control
- local control – only motor driving actions can be performed, falls back to remote control after a certain timeout of inactivity (inactivity means that the user is not performing any actions e.g. driving the motor).
- remote – control is given to remote “user” (FESA device server). Motor driving and parameter changes are not allowed from the local control.
- LCD control – control is given to local LCD panel on the M-Box. Motor driving and parameter changes are not allowed from the local control.

2.1.4.7. Initialize driver

By pressing Initialize button driver is reinitialized and properties files are re-read. This is useful if the properties files were modified by hand. If an error occurs during initialization of the driver the error is logged.

2.1.4.8. Display units

The Display units selection box offers user to choose units to be displayed for certain fields in the motor drive screen. User can choose between:

- mm,
- counts.

The fields in motor drive screen that are affected by this setting are: Set position, PMAC position, Actual position, Move relative and Reset position.

2.1.4.9. More

By clicking on the More button the advance controls are shown.

2.1.4.10. Hide

By clicking on the Hide button the advance controls are hidden.

2.1.4.11. Set position step

Comprises of three edit fields where the user is able to set the bit, small and large set for the set position field. For more information on setting position see 2.1.6.6.

2.1.4.12. Set relative movement step

Comprises of one edit field where user is able to set the relative movement step. For more information on setting relative movement see 5.1.5.9.

2.1.4.13. Set reset position step

Comprises of one edit field where user is able to set the reset position step. For more information on setting reset position see 5.1.5.10.

2.1.4.14. Set center step

Comprises of one edit field where user is able to set the center position step. For more information on setting center position see 2.1.6.16.

2.1.4.15. Set gap step

Comprises of one edit field where user is able to set the gap position step. For more information on setting the gap see 2.1.6.18.

2.1.5. Motor Setup Screen

Motor Setup screen (see Figure 6) is used to setup the motor and motor pair configuration properties. It can also be used for loading/saving of properties from the currently connected M-Box or the local computer.

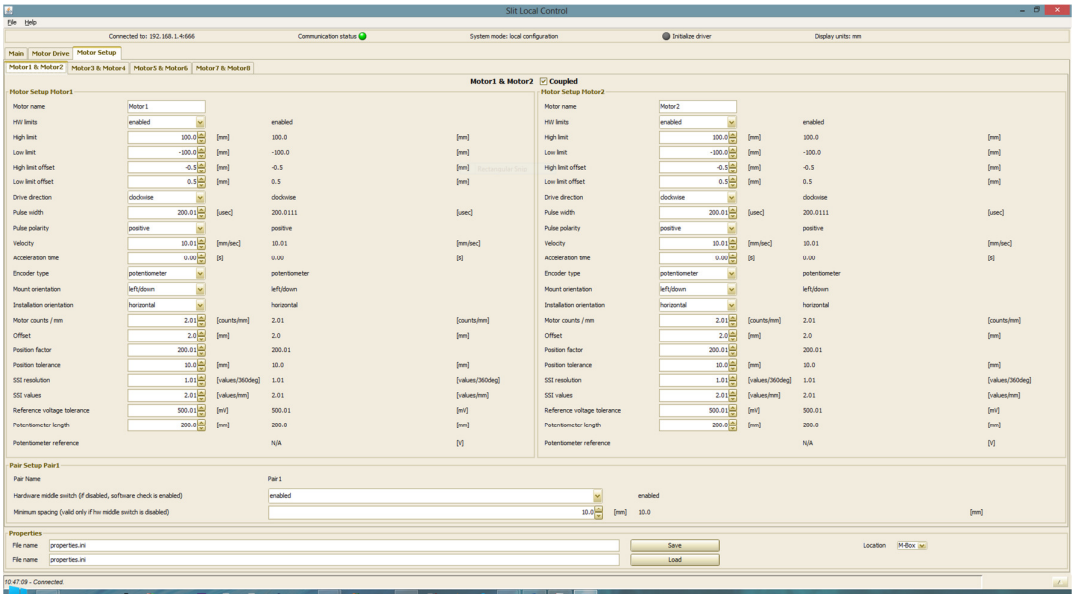

Figure 6: Motor setup screen

2.1.5.1. Coupled motors

By selecting the check boxes the user is able to specify which pairs of motors are coupled together.

2.1.5.2. Configuration

The following properties can be set for each motor (the value in brackets is value written in properties file):

- Motor name – display name of motor
- HW Limits
    - enabled (1) – if hard limits are enabled
    - disabled (0) - if hard limits are disabled
- High limit – max position for the motor in mm
- Low limit – min position for the motor in mm
- High limit offset – offset in mm to be added to maxPosition
- Low limit offset – offset in mm to be added to minPosition

- Drive direction – direction of driving
    - clockwise (1) – if drive direction is clockwise
    - anticlockwise (0) – if drive direction is anticlockwise
- Pulse width – pulse width in usec
- Pulse polarity – polarity of pulses
    - positive (1) – if polarity is positive
    - negative (0) – if polarity is negative
- Velocity – motor velocity in mm/s
- Acceleration time – acceleration time in s
- Encoder type
    - potentiometer (1) – if encoder is potentiometer
    - ssi (2) – if encoder is SSI
    - pmac (3) – if pmac is used as readback meaning no encoder is mounted to the motor
- Mounting orientation
    - right/up (-1) – if motor is right/up
    - left/down (1) – if motor is left/down
- Installation orientation (currently only for informative purposes)
    - horizontal (1) – if installation is horizontal
    - vertical (-1) – if installation is vertical
- Motor counts – motor steps to mm conversion (Steps/EGU)
- Offset – in mm (used in calculating position value from potentiometer)
- Position factor – use to compensate for voltage drops on potentiometer or for asymmetrical installed potentiometer
- SSI resolution – resolution of one revolution of SSI encoder (number of values / revolution)
- SSI resolution (mm/revolution) – number of mm per one revolution of SSI encoder
- Reference voltage tolerance – tolerance of the potentiometer voltage in mV
- Potentiometer length – potentiometer length in mm.
- Potentiometer reference – potentiometer reference readback in volts

The following properties can be set for each motor pair:

- Hardware middle switch
  - enabled (1) – minimum spacing is not checked by the driver
  - disabled (0) – minimum spacing is checked by the driver
- Minimum spacing – minimum space between motors in mm used by software

User has to change a selection to write new values for properties to local control server. To save new values to properties file consult 2.1.5.5.

2.1.5.3. Location

Location is used to select a location from which to load or save properties from, it has two states:

- M-Box – load or save properties from M-Box
- PC – load or save properties from local computer

2.1.5.4. Load properties

Load properties is used to load motor and motor pair properties from a properties file. If the location is set to PC the user can type the name of the file by hand or use the Load button to open a File selector window (see Figure 7). If the file name was typed by hand the user must press the Load button to perform the load operation.

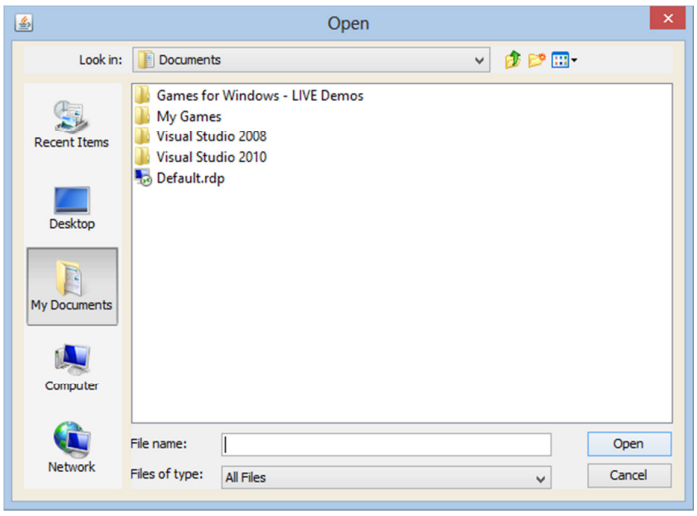

Figure 7: Load file selection window

If the location is set to M-Box the user must type the name of the file and submit the name by pressing the Load button.

2.1.5.5. Save properties

Save properties is used to save motor and motor pair properties into a properties file. If the location is set to PC the user can type the name of the file by hand or use Save button to open a File selector window (see Figure 8). If the file name was typed by hand the user must press Save button to perform save operation.

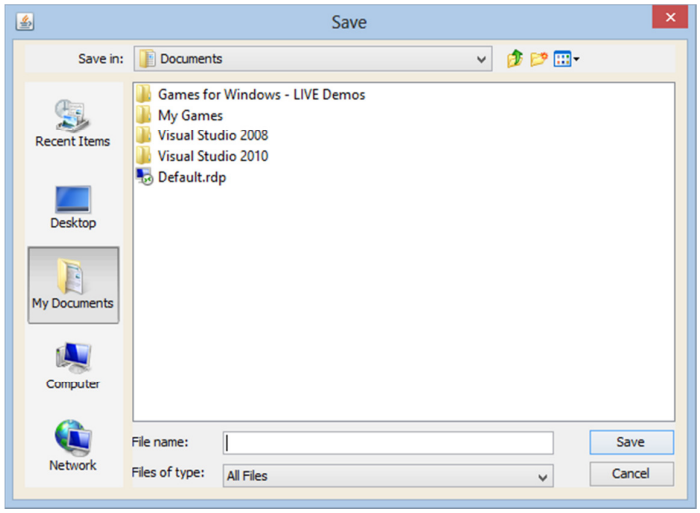

Figure 8: Save file selector window

If the location is set to M-Box the user must type the name of the file and submit the name by pressing the Save button.

2.1.6. Motor Drive Screen

Motor drive screen is used to drive individual motors or motor pairs. It also displays the actual position of motors and pairs and the status of motors, motor pairs and general status.

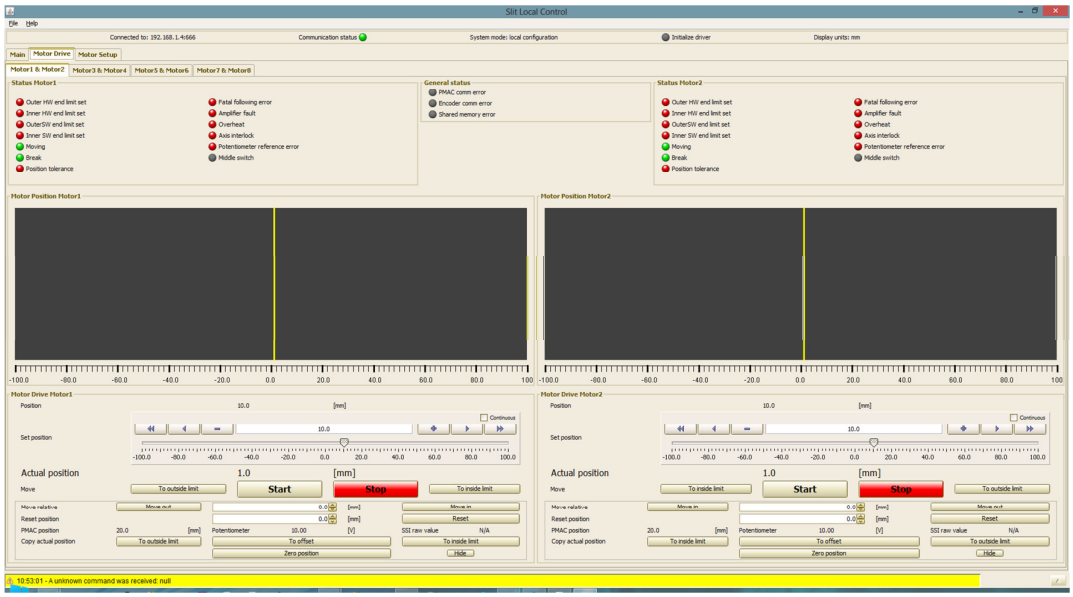

Figure 9: Motor drive screen with advance controls

2.1.6.1. Motor status

Motor status is displayed on the top on the left and right side. The list below shows displayed status items for each motor (see Figure 9). For each status below the first number in parentheses is the status word number and the second is the bit number.

- Outside HW end limit
  - Red color – if either hard or soft limit on HW level is set
  - Gray color – if both hard and soft limits on HW level are not set
- Inside HW end limit
  - Red color – if either hard or soft limit on HW level is set
  - Gray color – if both hard and soft limits on HW level are not set
- Outside SW end limit
  - Red color – if soft limit is set
  - Gray color – if soft limit is not set
- Inside SW end limit
  - Red color – if soft limit is set
  - Gray color – if soft limit is not set

- Moving
  - Green color – if motor is moving
  - Gray color – if motor is not moving
- Break
  - Green color – if break is applied
  - Gray color – if break is released
- Position tolerance
  - Red color – if there is a position tolerance error, meaning that position is outside configured tolerance
  - Gray color – if there is no potentiometer tolerance error
- Fatal following error
  - Red color – if there is a fatal following error
  - Gray color – if there is no fatal following error
- Amplifier fault
  - Red color – if motor is disabled because of the amplifier fault signal
  - Gray color – if there is no amplifier fault
- Overheat
  - Red color - if motor is overheated
  - Gray color – if the motor isn't overheated
- Axis interlock
  - Red color – if the axis interlock input is active
  - Gray color – if the axis interlock input is not active
- Potentiometer reference error
  - Red color – if there is a potentiometer reference error, meaning that reference is outside configured tolerance
  - Gray color – if there is no potentiometer reference error
- Middle switch
  - Red color – if middle switch is active
  - Gray color - if middle switch is not active

LEDs on front panel of microIOC M-Box are controlled by access control monitor. Red LED is blinking for specific motor if any of the following status bits is set:

- Outside HW end limit set
- Inside HW end limit set
- Outside SW end limit
- Inside SW end limit
- Position tolerance
- Fatal following error
- Amplifier fault
- Overheat
- Axis interlock
- Potentiometer reference error
- Middle switch

GF LED is lit if any of motor LED is blinking. Error statuses described in chapter 2.1.6.3 cannot be presented by this LED since if any of those error occurs communication between access control monitor and LEDs is broken (LEDs are controlled via PMAC).

2.1.6.2. Pair status

The list below shows displayed status for motor pair (see Figure 9). For each status below the first number in parentheses is the status word number and the second is the bit number.

- Amplifier fault
  - Red color – if any of the two motors in motor pair has amplifier fault error
  - Gray color – if none of motors in motor pair have amplifier fault error
- Moving
  - Green color – if any of the motors in motor pair is moving
  - Gray color – if both motors in motor pair are not moving
- Fatal following error
  - Red color - if any of the two motors in motor pair has following error
  - Gray color – if none of motors in motor pair have following error
- Minimum spacing
  - Red color - if minimum spacing is violated
  - Gray color – if minimum spacing is not violated.

2.1.6.3. General status

For general status the following is shown (source of all the status items below is the system driver):

- PMAC comm error
  - Red color – if there is an error in communication between local control server and PMAC
  - Gray color – if communication between local control server and PMAC is OK
- Encoder comm error
  - Red color – if there is an error in communication between local control server and encoder
  - Gray color – if communication between local control server and encoder is OK
- Shared memory error
  - Red color – if there is a problem with shared memory.
  - Gray color – if there is no problem with shared memory

The middle part of the screen is used to display the actual position of motor and pair drive. If the high and low limit of the motor drive aren't equal, the maximum absolute limit is used on the display and the area where the motor can't be driven is marked red (see Figure 10).

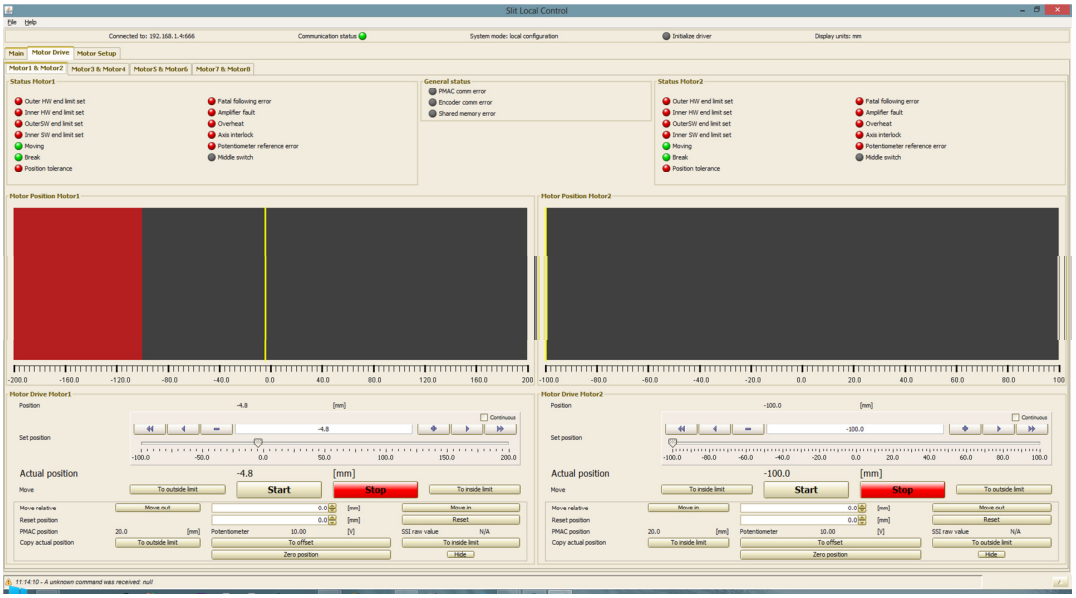

Figure 10: Motor drive screen where the high and low limit of the motors aren't equal. The area where the motor can't be driven is marked red

If the motors are coupled and they overlap, the color of the display is changed from yellow to orange (see Figure 11).

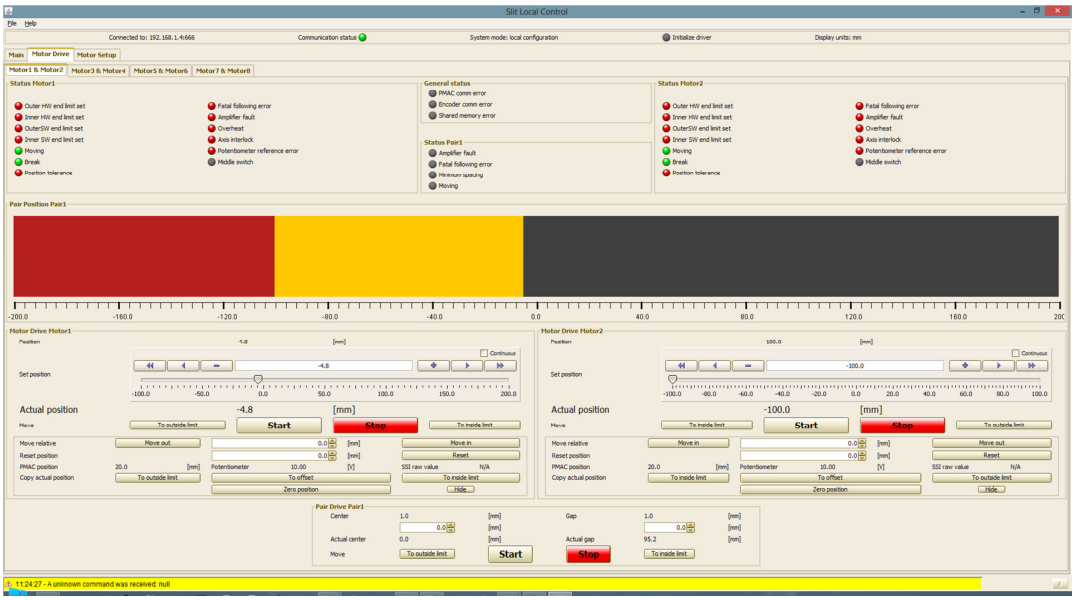

Figure 11: Motor drive screen where a pair of motors overlap.

The bottom part of the screen is used for motor drive and motor pair drive commands/readbacks. In the following sub chapters each of these commands is described.

2.1.6.4. More

By clicking on the More button the advance controls are shown.

2.1.6.5. Hide

By clicking on the Hide button the advance controls are hidden.

2.1.6.6. Set position

Comprises one edit field where user is able to set new set position (units are mm or counts), readback field showing set position.

2.1.6.7. PMAC position

This is a readback position read from PMAC. The units are mm or counts.

2.1.6.8. Actual position

This is actual position calculated from encoder readback. The units are mm or counts.

2.1.6.9. Potentiometer

This is a raw potentiometer readback. The units are Volts.

2.1.6.10. SSI Raw value

This is a SSI encoder raw value.

2.1.6.11. Move

This section is used for moving the motor to a specified position and it is composed of these buttons:

- To outside limit – moves motor to outside soft limit
- Start – moves motor to current set position
- Stop – stops motor
- To inside limit – moves motor to inside soft limit

2.1.6.12. Move relative

Moves motor relative by amount entered in edit field. The units can be mm or counts. Pressing the Move out button moves the motor to the outside direction and pressing the Move in button moves motor to inside direction.

2.1.6.13. Reset position

Pressing the Reset button resets PMAC set point and readback position to value entered in the edit field. The units can be mm or counts

2.1.6.14. Copy actual position

This section is used for copying values from the actual position to a specified position in the configuration section. It is composed of these buttons:

- To outside limit – copies value from actual position readback to Low limit configuration edit field
- To offset – copies value from actual position readback to Offset configuration edit field
- To inside limit – copies value from actual position readback to High limit edit field.

2.1.6.15. Zero position

Pressing the Zero position button will set the offset to 0, set the new readback position as the new offset and reset the position of the motor to 0.

These buttons are mainly used during commissioning of the motor.

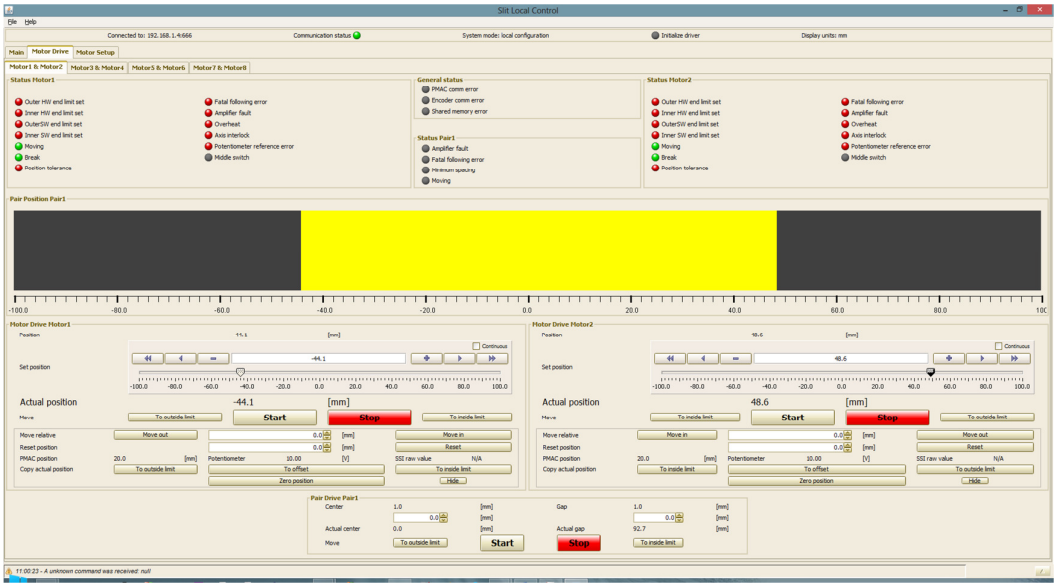

Figure 12: Motor drive screen with pair enabled

2.1.6.16. Set Center position

Comprises of one edit field where the user is able to set new center position (units are mm), readback field showing center position.

2.1.6.17. Actual center

This is actual center calculated from encoder readback. The units are mm or counts.

2.1.6.18. Set Gap

Comprises of one edit field where the user is able to set new gap (units are mm), readback field showing gap.

2.1.6.19. Actual gap

This is actual gap calculated from encoder readback. The units are mm or counts.

2.2. Start-up parameters

Application supports two different languages English (*en*) and German (*de*), which can be changed by the start-up parameter that is supplied at the start of the application. The default language is English. If the input is different, the default language is used.

Example running application with no start-up parameter:

```
java -jar local-control.jar
```

Example running application with start-up parameter for German language:

```
java -jar local-control.jar de
```