Fast and simple implementation of a flying saw using an example program

08/2017
Entry-ID: 108744840
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<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DANGER</strong></td>
<td>indicates that death or severe personal injury <strong>will</strong> result if proper precautions are not taken.</td>
</tr>
<tr>
<td><strong>WARNING</strong></td>
<td>indicates that death or severe personal injury <strong>may</strong> result if proper precautions are not taken.</td>
</tr>
<tr>
<td><strong>CAUTION</strong></td>
<td>indicates that minor personal injury can result if proper precautions are not taken.</td>
</tr>
<tr>
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Introduction

1.1 Overview

Definition

A "flying saw" cuts product on a web that is continuously moving. In the process the saw axis as following axis is synchronized with the leading axis.

This application example provides a clearly structured solution for implementing a flying saw or shears with an S7-1500T. The associated example project "FlyingSawBasic" covers various areas of application.

- You can use the included programs straight away or add individual functions to these programs.
- You can integrate the included HMI project in your application case or use it directly for simulation and test purposes.
Properties of the example project "FlyingSawBasic"

The example project contains the following application cases and functions:

- Cutting method variants
- On-the-fly switching between the following master value sources:
  - real axis
  - external encoder
- On-the-fly switching of the operating parameters during runtime.
- Immediate cut in deactivated and in activated automatic mode.
- Symmetric synchronization
- Configurable return velocities
- Cutting and cutting length sum
- Marking detection when cutting to measuring input signal

Cutting method variants

- Cutting to length
  
  Fixed adjustable material lengths are cut when cutting to length. The saw operator can adjust the material length for each cut.

- Cutting to measuring input signal

  When cutting to measuring input signal, a sensor detects a marking on the material. The following axis and the cut are synchronized to the marking.
Variants for master value provision

- **Master value of the real axis**
  
  The position master value is used directly from the web drive.

- **Master value from external encoder**
  
  The application receives the signals from an external encoder. The following figure shows the connection of the external encoder to the distributed I/O. Alternatively, the encoder may be connected directly to be bus or to the SINAMICS frequency converter.

The operator can switch during operation between the application cases "Master value of real axis" and "Master value of external encoder".
**Included blocks**

For both application cases "Cutting to length" and "Cutting to measuring input signal", the application example "Flying saw" has in each case a CPU and a central function block:

- "PLC_1_FS_Length" for the application case "Cutting to length" with the function block "FlyingSawLength"

- "PLC_2_FS_MeasInput" for the application case "Cutting to measuring input signal" with the function block "FlyingSawMeasInput"

The basic functions of the axes are implemented in the function block "BasicControlSaw".
HMI interface and simulation

An HMI project is included in this application example. You can use this to operate the application example in various simulation environments or within your plant.

Additional blocks are prepared in the PLCs of the example project for simulating the provision of master values via external encoders:

- Function block "SimExtEncoder" with instance data block
- Data block "SimEncoderTel81"

The blocks in the "Simulation" group are not required for the integration of the flying saws in your application.

You will find additional information about the testing and simulating of the example project in section "Operation (Page 35)".

Restrictions of the program "FlyingSawBasic"

The following functions were not considered in the implementation of the program. The unchanged operation of the example project in a self-created user program is excluded for these functions:

- Switching between cutting to measuring input signal and cutting to length
  Cutting to measuring input signal and cutting to length are programmed in two separate blocks in this example project.

- Safety relevant functions and reactions
  Safety relevant functions and reactions of the plant in case of error, such as the extension of saw blade in error case, limit switch functions etc. are your responsibility.
1.2 How it works

Description

The cutting position is the position on the web at which the material is to be cut. The cutting position is detected either as marking via the measuring input or by the PLC via an adjustable material length. Since the web is moving, the cutting position is also moving. The saw synchronizes with the web in such a way that the saw blade travels to the precisely above the cutting position of the material. The cut is enabled as soon as this synchronized position is reached.

Once the cut has been completed the saw returns to its starting position.

P1 Cutting position
P2 Starting position of the saw
P3 Synchronized position, cut is enabled
P4 Cut is finished.
① Acceleration range of the saw
② Range of the synchronizing travel, cut can be triggered
③ Saw position
④ Web position
Delimitation

The following configurations are not contained in this example project:

- **Configuration of technology objects**
  The correct configuration of the technology object used in the example project is your responsibility. The technology objects configured in the example project are configured for the training case SINAMICS V90 PN.

**Note**

**Configuration of technology objects**

The configuration of the technology object is not described in this application example.

In particular, configure the safety-relevant tags at the technology object, such as software limit switches and dynamic limit values.

- To use the application example belonging to this program as template for your application, implement the areas of the example project shown in the screen outside of the described blocks:

- **Safety relevant functions and reactions**

**Note**

**Safety relevant functions and reactions**

Safety relevant functions are not described in this application example.

Ensure the implementation and monitoring of all safety relevant configurations in your application.
1.3 Components used

The two application cases of this application example were created with the following components:

<table>
<thead>
<tr>
<th>Component</th>
<th>Number</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU 1515T-2 PN</td>
<td>1</td>
<td>Alternatively, you can also use any other CPU of the S7-1500T product family.</td>
</tr>
<tr>
<td>TP1500 Comfort</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>STEP 7 Professional V14SP1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>WinCC Comfort V14SP1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>TRAINING CASE SINAMICS V90 PROFINET (ET 200SP, SINAMICS V90 PROFINET)</td>
<td>1</td>
<td>Alternatively, use a CPU S7-1500T with simulated axes or a simulation on the engineering PC with SIMATIC S7 PLCsim/PLCsim Advanced.</td>
</tr>
</tbody>
</table>

Components of the application example

This application example consists of the following components:

<table>
<thead>
<tr>
<th>Component</th>
<th>File name</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Documentation</td>
<td>FlyingSawBasic_V10_en.pdf</td>
<td></td>
</tr>
<tr>
<td>STEP 7 project</td>
<td>FlyingSawBasic_V10_zap14</td>
<td>incl. HMI project</td>
</tr>
</tbody>
</table>
2.1 Basic functions block for axes and external encoders

The basic functions of all axes and the external encoder are contained in the block "BasicControlSaw" of the example project. The following figure shows the "BasicControlSaw" for cutting to length.

![Diagram](image)

The implementation of these functions is the responsibility of the user of the example project and is not described here.
2.2 Blocks for flying saws and shears

The functions for controlling the saw axis are contained in the following two blocks:
2.3 Function description

2.3.1 Symmetric synchronization

Description

Defines an acceleration-constant synchronization profile.

How it works

Based on the synchronization length, the program calculates the required synchronization parameters. As a result, the synchronization profile is always symmetric. With symmetric synchronization, no velocity overshoot of the saw axis is required. The saw synchronizes with a harmonious acceleration-constant movement. The synchronous positions are calculated by the block.

When the leading axis reaches the calculated position of the starting point, the synchronization of the two axes is triggered.

The synchronization length is the distance from the start of the synchronization to the synchronized position at which the two axes travel synchronously. The enable to cut is set as soon as the saw carriage has reached the synchronized position.
The saw hereby travels over the cutting position. The shorter the synchronization length the higher the resulting acceleration during the synchronization.

P1 Cutting point on the web
P2 Starting point of the synchronization
P3 Starting position of the saw carriage
P4 Synchronization reached
① Synchronization length
    Path of the web during the synchronization
② Path of the saw carriage during the synchronization
③ Velocity of web
④ Velocity of saw

Nota
Synchronizing for immediate cut
You set the dynamic parameters for the immediate cut separately. For more information, refer to "Immediate cut [Page 25]."

Relevant input parameters

- Defining synchronization length:
  
  \[ \text{syncLengthCutAuto} = \text{Value} \]
Relevant values at the interface "InterfaceConfigStatus"

Assigning parameters for symmetric synchronization:

- Setting the synchronization profile:
  \[ \text{config.syncConfigAuto.syncProfileReference} = 1 \text{ (default value)} \]

Alternative: Synchronization using dynamic parameters

Additional parameter assignments on the interface "InterfaceConfigStatus"

- Setting the synchronization profile:
  \[ \text{config.syncConfigAuto.syncProfileReference} = 0 \]

- Setting synchronized position:
  \[ \text{config.syncConfigAuto.masterSyncPos} = \text{<Value>} \]
  \[ \text{config.syncConfigAuto.slaveSyncPos} = \text{<Value>} \]

- Setting the synchronization dynamics:
  \[ \text{config.syncConfigAuto.syncVel} = \text{<Value>} \]
  \[ \text{config.syncConfigAuto.syncAcc} = \text{<Value>} \]
  \[ \text{config.syncConfigAuto.syncJerk} = \text{<Value>} \]

**Note**

**S7-1500 Motion Control documentation**

For more information on configuring the synchronization using dynamic parameters, refer to the description of the Motion Control instruction "MC_GearInPos" in the STEP 7 online help.

If you have activated the synchronization profile "Synchronization using dynamic parameters", extensive parameter assignments are required. This description does not cover synchronization using dynamic parameters.

**Relevant output parameters**

Cutting is enabled:

- \[ \text{cutPossible} = 1 \]
2.3.2 Cutting to define length

Description
Defines the length of the cut during the automatic operation of the saw.

Relevant input parameters
Defining the material length:
- \text{cutLength} = \text{<Value>}

2.3.3 Cutting to measuring input signal

Description
Enables the synchronization of the cut to a marking and the sawing of materials in different lengths. This function is applicable only in automatic operation.

How it works
A measuring input detects a marking on the web. This signal triggers the synchronization of the saw with the web and the cut at the marking. The block calculates the synchronization of the saw to the marking by means of the distance of the measuring input from the origin of the measuring system.

![Diagram](image)

- \text{P1} Parameters of the measuring probe
- \text{P2} Origin of the measuring system defined as position 0.0, usually on the left limit stop of the saw
- \text{P3} Starting position of the saw
- ① Distance between measuring input and origin
- ② Distance between origin and starting position
2.3 Function description

**Relevant input parameters**

Defining the distance of the measuring input from origin of the measuring system of the flying saw:

- \( \text{distanceMeasInput} = \text{Value} \)

Defining cut offset to the marking:

- \( \text{distanceMeasInput} = \text{Value} + \text{Offset} \)

**2.3.4 Cut enable**

**Description**

Specifies that the saw runs synchronized with the material and a material cut is possible in the correct length.

**How it works**

When the saw axis is synchronized the signal "cutPossible" is set and it is hereby signaled that the cut can be triggered. The cut enable is terminated by the feedback signal "cutDone" of the executed cut or if the maximum cut position of the saw axis is reached.
2.3 Function description

Relevant input parameters

Define maximum cut position of the saw axis:

- \texttt{maxPosToCut} = \texttt{<Value>}

Job is completed:

- \texttt{cutDone} = 1

Relevant output parameters

Cutting is enabled:

- \texttt{cutPossible} = 1

2.3.5 Termination conditions

Description

The signal for cut enable is reset in the following cases:

- There is an error on the saw.
- The maximum position for the cut was overshot by the saw.

How it works

If there is an error on the saw, an error is output and the automatic material cut is canceled.

If the maximum cut position was overshot, a warning is output and the cut enable is revoked. Automatic mode continues to be active.

Relevant input parameters

Define maximum cut position of the saw axis.

- \texttt{maxPosToCut} = \texttt{<Value>}

Relevant output parameters

Cut enable is reset.

- \texttt{cutPossible} = 0

Cut was not executed:

- \texttt{errorID} = \texttt{<Value>}

See also

Error codes (Page 41)
2.3.6 Switching between external encoder and real axis

Description

Switches the master value provision between an external encoder and a real axis.

If your system is only designed with master value source, you can disable the other source at the module. It is then not necessary to create this technology object.

How it works

The saw axis synchronizes to a master value which is providing by an external encoder or the leading axis.

You can switch the master value provision while the axis is at a standstill or during operation. If you switch the master value provision during operation, the saw carries out the pending cut and then switches the master value. The positions are automatically synchronized with each other.

Relevant input parameters

Assigning parameters for master value provision:

- Activating switching to an external encoder:
  \[ \text{masterSelectExtEnc} = 1 \]

- Activating switching to a leading axis:
  \[ \text{masterSelectExtEnc} = 0 \]

Deactivating master value provision via an external encoder or a leading axis:

- Deactivating external encoders:
  \[ \text{extEncoder} = \text{NULL} \]
  \[ \text{leadingAxis} = \text{LeadingAxis} \]

- Deactivating real axis:
  \[ \text{extEncoder} = \text{ExternalEncoder} \]
  \[ \text{leadingAxis} = \text{NULL} \]

- Relevant values at the interface "InterfaceConfigStatus"
  \[ \text{leadingAxisConnected} = 0/1 \]
  \[ \text{extEncoderConnected} = 0/1 \]

Relevant output parameters

- Activating external encoders:
  \[ \text{activeMasterType} = 2 \]

- Leading axis activated:
  \[ \text{activeMasterType} = 1 \]
2.3.7 Automatic mode of the saw

Description
Activates and deactivates the automatic material cut on the saw axis.

How it works
The signal for the automatic material cut starts the automatic mode. This signal must remain unchanged until the automatic cycle has ended.

If the signal is canceled prior to this, the saw carriage reacts as follows:
- If the saw carriage is in motion, the saw carriage stops at the current position.
- If the saw is currently executing a cut, the saw first completes the cut before the saw carriage stops.

If automatic mode is terminated in the current cycle, the saw carriage completes the current cut and returns to the starting position. You then cancel the signal "enableAuto".

Relevant input parameters
- Activate automatic mode:
  - enableAuto = 1
- Cancel automatic mode in the current cycle:
  - stopAutoCycleEnd = 1

Relevant output parameters
- Automatic mode activated:
  - auto = 1
2.3.8 Immediate cut

Description

Triggers a manual material cut. You can trigger a manual material cut as follows:

- Activated automatic mode
  
  The operator can trigger additional cuts while the plant is cutting the material to length or at measuring input signal. The saw carriage then travels back to the starting position and waits for the signal for the next immediate cut or automatic cut.

- Deactivated automatic mode
  
  The operator triggers manual cuts while automatic material cut is not yet activated.

How it works

When the manual material cut is triggered the saw axis starts to synchronize and cuts the material as soon as the saw axis is traveling synchronized to the web.

Precise cut lengths are not possible with this function.

Relevant input parameters

Trigger immediate cut:

- cutNow = 1

Assigning parameters for immediate cut synchronization:

- Assigning parameters for immediate cut acceleration:
  
  accCutNow = <Value>

- Define jerk for the immediate cut at the interface "InterfaceConfigStatus":
  
  config.syncConfigCutNow.syncJerk = <Value>

Relevant output parameters

Immediate cut activated while automatic mode is active:

- cutNowAutoActive = 1
- cutNowActive = 0

Immediate cut activated while automatic mode is not active:

- cutNowActive = 1
- cutNowAutoActive = 0
2.3 Function description

2.3.9 Return velocity

Description

Defines the velocity with which the saw carriage returns to the starting position.

How it works

You configure various return speeds in the example project:

- Return velocity when starting automatic operation
  
  If the saw is not in the starting position when automatic operation is started, the saw carriage automatically returns to the starting position.

- Return velocity after each step in automatic mode or during immediate cut

Relevant input parameters

Define return velocity for start of automatic operation:

- toStartPosVelocity = <Value>

Define return velocity during automatic operation at the interface "InterfaceConfigStatus":

- velMoveBack = <Value>
2.4 Interface description

2.4.1 Layout of the interfaces

Overview

The configuration and the parameter assignment of the application example covers the following areas.

- Configuration of technology objects

Note

**Configuration of technology objects**

The configuration of the technology object is not described in this application example.

In particular, configure the safety-relevant tags at the technology object, such as software limit switches and dynamic limit values.

- Parameter assignment of the call of the function blocks "FlyingSawLength" or "FlyingSawMeasInput"

Parameters that need to be frequently adjusted.

- Parameter assignment of global data blocks "GlobalDBHMI_FSL" or "GlobalDBHMI_FSMI"

Parameters and specifications that generally only need to be adjusted during commissioning.
Interconnection of the blocks
2.4.2 Interface description for controlling the saw axis

Description

The function blocks "FlyingSawLength" or "FlyingSawMeasInput" control the saw axis of the flying saw.

Requirement

- The technology objects are created in STEP 7 and correctly configured:
  - Web
    Linear positioning axis as leading axis (setpoint coupling)
    An additional measuring input for the leading axis is required for the cutting variant "Cut at measuring input signal".
  - External encoder
    External encoder as master value encoder (actual value coupling)
    An additional measuring input for the external encoder is required for the cutting variant "Cut at measuring input signal".
  - Saw axis
    Linear synchronous axis as following axis

- The axes are enabled.
- The axes are homed.

General input parameters

The following parameters are available at the function blocks "FlyingSawLength" and "FlyingSawMeasInput":

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>extEncoder</td>
<td>TO_ExternalEncoder</td>
<td>-</td>
<td>Technology object of the external encoder</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NULL, if the technology object is not interconnected.</td>
</tr>
<tr>
<td>leadingAxis</td>
<td>TO_PositioningAxis</td>
<td>-</td>
<td>Leading axis technology object</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NULL, if the technology object is not interconnected.</td>
</tr>
<tr>
<td>flyingSawAxis</td>
<td>TO_SynchronousAxis</td>
<td>-</td>
<td>Saw axis technology object</td>
</tr>
<tr>
<td>masterSelectExtEnc</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE Master value provision activated via external encoder</td>
</tr>
<tr>
<td>enableAuto</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE Automatic mode is being activated.</td>
</tr>
<tr>
<td>stopAutoCycleEnd</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE Automatic mode will be terminated after the pending cut with return to the starting position.</td>
</tr>
</tbody>
</table>
### 2.4 Interface description

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cutNow</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE Immediate cut is triggered. Only possible if the saw is located in starting position.</td>
</tr>
<tr>
<td>accCutNow</td>
<td>LREAL</td>
<td>500.0</td>
<td>Synchronization acceleration for immediate cut</td>
</tr>
<tr>
<td>cutDone</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE Cut is finished. Synchronization is completed. Return is initiated.</td>
</tr>
<tr>
<td>syncLengthCutAuto</td>
<td>LREAL</td>
<td>200.0</td>
<td>Synchronization during automatic operation</td>
</tr>
<tr>
<td>startPos</td>
<td>LREAL</td>
<td>0.0</td>
<td>Starting position of the saw axis</td>
</tr>
<tr>
<td>velMoveBack</td>
<td>LREAL</td>
<td>500.0</td>
<td>Velocity of the axis in returning to staring position</td>
</tr>
<tr>
<td>resetCutCounter</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE Resets the cut counter and the cut-length sum.</td>
</tr>
<tr>
<td>interfaceConfigStatus</td>
<td>FS_typeConfigStatus</td>
<td>-</td>
<td>Advanced settings in the global data block &quot;GlobalID-BHMI_FSL&quot; or &quot;GlobalIDBHMI_FSMI&quot; (Page 32)</td>
</tr>
</tbody>
</table>

**Specific input parameters for the FB "FlyingSawLength"**

The following parameters are only available at the function block "FlyingSawLength":

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>cutLength</td>
<td>LREAL</td>
<td>1000.0</td>
<td>Material length in automatic mode</td>
</tr>
</tbody>
</table>

**Specific input parameters for the FB "FlyingSawMeasInput"**

The following parameters are only available at the function block "FlyingSawMeasInput":

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>measuringInputExtEnc</td>
<td>TO_ExternalEncoder</td>
<td>-</td>
<td>Measuring input of the technology object of the external encoder</td>
</tr>
<tr>
<td>measuringInputLeadingAxis</td>
<td>TO_PositioningAxis</td>
<td>-</td>
<td>Measuring probe of the technology object of leading axis</td>
</tr>
<tr>
<td>distanceMeasInput</td>
<td>REAL</td>
<td>-1000.0</td>
<td>Distance of the measuring input to the zero position of the saw axis</td>
</tr>
</tbody>
</table>
### Output parameters

The following parameters are available at the function blocks "FlyingSawLength" and "FlyingSawMeasInput":

Table 2-2 Output parameters "FlyingSawLength" and "FlyingSawMeasInput"

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>activeMasterType</td>
<td>INT</td>
<td>0</td>
<td>Returns the currently used master value source.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1 Real axis</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 External encoder</td>
</tr>
<tr>
<td>cutPossible</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE Leading axis and saw axis are synchronized. The material cut can be executed.</td>
</tr>
<tr>
<td>cutNowAutoActive</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE An immediate cut is active during automatic operation.</td>
</tr>
<tr>
<td>cutNowActive</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE An immediate cut is active. Automatic mode is deactivated.</td>
</tr>
<tr>
<td>busy</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE A function is executed in the block.</td>
</tr>
<tr>
<td>auto</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE Automatic mode is activated.</td>
</tr>
<tr>
<td>stepNr</td>
<td>INT</td>
<td>0</td>
<td>Internal step number</td>
</tr>
<tr>
<td>inStartPos</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE The saw carriage is at the starting position.</td>
</tr>
<tr>
<td>cutCounter</td>
<td>DINT</td>
<td>0</td>
<td>Cut counter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Counts the number of already executed material cuts since the last reset via &quot;resetCutCounter = 1&quot;.</td>
</tr>
<tr>
<td>cutLengthAutoCut</td>
<td>LREAL</td>
<td>0.0</td>
<td>Cut-length sum</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Adds the following cut lengths to a cut-length sum:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Material lengths which have been cut since the last reset via the parameter &quot;resetCutCounter = 1&quot; in automatic mode.</td>
</tr>
<tr>
<td>error</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE An error is pending.</td>
</tr>
<tr>
<td>errorID</td>
<td>WORD</td>
<td>0</td>
<td>ID of the pending error</td>
</tr>
<tr>
<td>errorSource</td>
<td>DINT</td>
<td>0</td>
<td>Error source</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>For information on this function, refer section &quot;Troubleshooting (Page 39)&quot;.</td>
</tr>
</tbody>
</table>
2.4.3 Structures of the global data blocks

Description

The following structures are contained in the global data blocks "GlobalDBHMI_FSL" and "GlobalDBHMI_FSMI".

The structures general and basicControl are not directly required for the flying saws and therefore not part of this description:

- general
  Operating mode selection
- basicControl
  Contains the interface to the basic functions. The basic functions are preconfigured in the example project.

All functions of the flying saws are contained in the structures flyingSawLength and flyingSawMeasInput:

- Structure "Inputs"
  This signal range is interconnected with the [input parameters](Page 29) of the function blocks "FlyingSawLength" and "FlyingSawMeasInput".

- Structure "ConfigStatus"
  - config
    Contains the initial parameter assignment of your plant during the commissioning or for further adjustments of the function blocks "FlyingSawLength" and "FlyingSawMeasInput".
  - status
    Contains extended status displays for actual positions and calculated values.

    This signal range is interconnected with the interface "InterfaceConfigStatus" of the functions blocks "FlyingSawLength" and "FlyingSawMeasInput".

The data of the structure "ConfigStatus" are described below.
### General parameters of the structure "config"

The following parameters are available for both cutting methods,

#### Table 2-3 Parameters of the substructure "config" of the FBs "FlyingSawLength" and "FlyingSawMeasInput"

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>config</td>
<td>FS_typeConfig</td>
<td>-</td>
<td>Advanced settings</td>
</tr>
<tr>
<td>config.gearingRatioMaster</td>
<td>DINT</td>
<td>1</td>
<td>Gear ratio of the leading axis. You can find additional information about the gear ratio in the description of the Motion Control instruction &quot;MC_GearIn&quot; in the STEP 7 online help.</td>
</tr>
<tr>
<td>config.gearingRatioSlave</td>
<td>DINT</td>
<td>1</td>
<td>Gear ratio of the following axis. You can find additional information about the gear ratio in the description of the Motion Control instruction &quot;MC_GearIn&quot; in the STEP 7 online help.</td>
</tr>
<tr>
<td>config.maxPosToCut</td>
<td>LREAL</td>
<td>1800.0</td>
<td>Locking point of the material cut enable via the parameter &quot;cutPossible&quot;. If the saw carriage overshoots this position, the parameter &quot;cutPossible&quot; is reset.</td>
</tr>
<tr>
<td>config.toStartPosVelocity</td>
<td>LREAL</td>
<td>100.0</td>
<td>Speed for the initialization travel to the starting position, for example, during the activating of automatic operation</td>
</tr>
<tr>
<td>config.backAcceleration</td>
<td>LREAL</td>
<td>-1.0</td>
<td>Return acceleration</td>
</tr>
<tr>
<td>config.backJerk</td>
<td>LREAL</td>
<td>-1.0</td>
<td>Return jerk</td>
</tr>
<tr>
<td>config.syncConfigCutNow</td>
<td>STRUCT</td>
<td></td>
<td>Advanced settings for the synchronization during an immediate cut</td>
</tr>
<tr>
<td>config.syncConfigCutNow.syncJerk</td>
<td>LREAL</td>
<td>-1.0</td>
<td>Jerk for the immediate cut</td>
</tr>
<tr>
<td>config.syncConfigAuto</td>
<td>STRUCT</td>
<td></td>
<td>Advanced settings for the synchronization during automatic mode</td>
</tr>
<tr>
<td>config.syncConfigAuto.syncProfileReference</td>
<td>DINT</td>
<td>1</td>
<td>Synchronization profile</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>symmetric synchronization</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0</td>
<td>Synchronization using dynamic parameters</td>
</tr>
<tr>
<td>config.syncConfigAuto.masterSyncPos</td>
<td>DINT</td>
<td>0</td>
<td>Synchronization point of the leading axis. Is automatically calculated during symmetric synchronization.</td>
</tr>
<tr>
<td>config.syncConfigAuto.slaveSyncPos</td>
<td>DINT</td>
<td>0</td>
<td>Synchronization point of the saw axis. Is automatically calculated during symmetric synchronization.</td>
</tr>
<tr>
<td>config.syncConfigAuto.syncVel</td>
<td>LREAL</td>
<td>-1.0</td>
<td>Velocity for the synchronization using dynamic parameters</td>
</tr>
<tr>
<td>config.syncConfigAuto.syncAcc</td>
<td>LREAL</td>
<td>-1.0</td>
<td>Acceleration for the synchronization using dynamic parameters</td>
</tr>
<tr>
<td>config.syncConfigAuto.syncJerk</td>
<td>LREAL</td>
<td>-1.0</td>
<td>Jerk for the synchronization using dynamic parameters</td>
</tr>
</tbody>
</table>
2.4 Interface description

General parameters of the structure "status"

The following parameters are available for both cutting methods,

Table 2- 4 Parameters of the substructure "status" of the FBs "FlyingSawLength" and "FlyingSawMeasInput"

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>status</td>
<td>FS_typeStatus</td>
<td>-</td>
<td>Extended status displays</td>
</tr>
<tr>
<td>status.ActPosMaster</td>
<td>LREAL</td>
<td>0.0</td>
<td>Actual position of the leading axis</td>
</tr>
<tr>
<td>status.lastCutActPosMaster</td>
<td>LREAL</td>
<td>0.0</td>
<td>Actual position of the web during last material cut</td>
</tr>
<tr>
<td>status.lastCutActPosSlave</td>
<td>LREAL</td>
<td>0.0</td>
<td>Actual position of the saw during last material cut</td>
</tr>
<tr>
<td>status.lastCutAccuracy</td>
<td>LREAL</td>
<td>0.0</td>
<td>Accuracy of the last material cut</td>
</tr>
<tr>
<td>status.syncConfigCalculated</td>
<td>STRUCT</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>status.syncConfigCalculated.syncProfileReference</td>
<td>DINT</td>
<td>1</td>
<td>Synchronization profile that was used</td>
</tr>
<tr>
<td>status.syncConfigCalculated.masterSyncPos</td>
<td>LREAL</td>
<td>100.0</td>
<td>Calculated synchronization position of the leading axis</td>
</tr>
<tr>
<td>status.syncConfigCalculated.slaveSyncPos</td>
<td>LREAL</td>
<td>100.0</td>
<td>Calculated synchronization position of the following axis</td>
</tr>
<tr>
<td>status.swLimitSwitchSlaveEnabled</td>
<td>BOOL</td>
<td>FALSE</td>
<td>TRUE</td>
</tr>
<tr>
<td>status.swLimitSwitchMinSlave</td>
<td>LREAL</td>
<td>0.0</td>
<td>Position of the SW limit switch on the left saw axis end for the representation in the HMI interface</td>
</tr>
<tr>
<td>status.swLimitSwitchMaxSlave</td>
<td>LREAL</td>
<td>2000.0</td>
<td>Position of the SW limit switch on the left saw axis end for the representation in the HMI interface</td>
</tr>
<tr>
<td>status.output</td>
<td>STRUCT</td>
<td>-</td>
<td>Output parameters in the function blocks &quot;FlyingSawLength&quot; and &quot;FlyingSawMeasInput&quot;.</td>
</tr>
</tbody>
</table>

Block-specific parameters of the structure "config"

The following parameters are only available for the cutting method "Cutting to length":

Table 2- 5 Parameters of the substructure "config" for the FB "FlyingSawLength"

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>config.status.cutLengthActivated</td>
<td>LREAL</td>
<td>0.0</td>
<td>Current setpoint material length</td>
</tr>
</tbody>
</table>

The following parameters are only available for the cutting method "Cutting to measuring input signal":

Table 2- 6 Parameters of the substructure "config" for the FB "FlyingSawMeasInput"

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Data type</th>
<th>Default value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>config.status.lastCutLengthAuto</td>
<td>LREAL</td>
<td>0.0</td>
<td>Length of the last piece of material that was cut in automatic mode</td>
</tr>
</tbody>
</table>
2.5 Operation

2.5.1 HMI interface

Overview

A user interface for the flying saw is contained in the example project.

The process screens are used to familiarize users with the functionality of the flying saw and to test the responses and options of the block. You can also integrate the HMI project directly into your plant.

Simulation environment

The program is ready to run directly on a CPU SIMATIC S7-1500T. The axes have to be connected in the simulation for this purpose. You can execute the program directly on the engineering PC using SIMATIC S7 PLCsim or PLCsim Advanced. The execution of the real movements is possible via the training case SINAMICS V90 PROFINET or connected comparable SINAMICS V90 PROFINET drives.

The following table shows the application cases of the example project which can be tested in the respective simulation environment.

<table>
<thead>
<tr>
<th>Application case</th>
<th>CPU SIMATIC S7-1500T*</th>
<th>Training case SINAMICS V90 PN incl. CPU</th>
<th>Software &quot;SIMATIC S7-PLCsim&quot;</th>
<th>Software &quot;SIMATIC S7-PLCsim Advanced&quot;**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provision of master value</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Real axis</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>External encoder</td>
<td>x</td>
<td>x</td>
<td>---</td>
<td>x</td>
</tr>
<tr>
<td>Cutting methods</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cutting to length</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Cutting to measuring input signal</td>
<td>---</td>
<td>x</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

* Technology objects need to be switched to simulation
Options of the HMI project

Depending on the simulation setup, all functions incl. switchover of the master value source can be simulated:

- Operation of the basic functions
- Switching the operating mode
- Operation of saw axis
- Assigning system parameters

All relevant parameters of the example program are interconnected there to display and operating elements.

Operation of the axes

You operate the basic functions of the axes and control the saw axis in the process screen "OPERATION".
Monitoring and advanced configuration

- Process screen "DIAGNOSE"
  Service for error analysis.

- Process screen "CONIFG_STATUS"
  Is used for advanced configuration and advanced status display.

The parameters in the process screen "CONIFG_STATUS" are contained in the structure "ConfigStatus" of the global data blocks. You can find the description at "Structures of the global data blocks (Page 32)".

Flying saw
Application examples, 08/2017, Entry-ID: 109744840
2.5.2 Operating the program

Introduction
The programs contained in the example project “FlyingSawBasic” are ready to run immediately on a SIMATIC S7-1500T.

Requirement
- The device environment is set up and interconnected for the simulation.
- Alternatively, SIMATIC S7 PLCsim or PLCsim Advanced is installed.
- Alternatively, SINAMICS V90 PROFINET drive is connected.

Procedure
To test the sample project “FlyingSawBasic”, follow these steps:
1. Download one of the included programs to the PLC and set the PLC to RUN.
2. Execute the basic functions of the axes:
   - PowerOn
   - Reset
   - HomeSaw
   - MoveLeading
4. Test the saw operation manually:
   - Test the immediate cut with "CutNow".
   - Set the feedback signal via "SIMCutDone".
5. Test the automatic operation of the saw and the immediate cut during automatic operation:
   - Activate automatic mode.
   - Test the immediate cut with "CutNow".
   - Set the feedback signal via "SIMCutDone".
2.6 Troubleshooting

2.6.1 Basic troubleshooting functions

Description

Errors in a Motion Control instruction are displayed at the block with error source and error ID.

If an error occurs, you can use these parameters to identify the Motion Control instruction in which the error occurred.

Relevant output parameters

An error is pending:

- error = 1

Error ID of the Motion Control instruction:

- errorID = <Value>

Field index assigned to the Motion Control instruction that caused the error:

- errorSource = <Value>

Type of the Motion Control instruction that caused the error, for example, "MC_Power":

- errorBlock = <Value>
2.6.2 Saw axis troubleshooting concept

Description

Multiple error types are displayed at the block with error source and error code. The following sources of error are possible:

- Motion Control instruction
- Technology objects
  The messages regarding technology objects are displayed with the message number and in the HMI with message text.
- Runtime error

Relevant output parameters

An error is pending:

- \( \text{error} = 1 \)

Error ID or message number:

- \( \text{errorID} = \text{<Value>} \)

Error source:

- \( \text{errorSource} = \text{<Value>} \)
### 2.6.3 Error codes

Error display at the function blocks "FlyingSawLength" and "FlyingSawMeasInput"

<table>
<thead>
<tr>
<th>errorSource (DINT)</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No error</td>
</tr>
<tr>
<td>1-32</td>
<td>Error at a Motion Control instruction</td>
</tr>
<tr>
<td></td>
<td>Block-internal assigned field index of the causative Motion Control instruction:</td>
</tr>
<tr>
<td></td>
<td>The error ID is stored as index in the causative Motion Control instruction, at the parameter &quot;ErrorID&quot; (range 8xxx).</td>
</tr>
<tr>
<td>1000</td>
<td>Error at the saw technology object</td>
</tr>
<tr>
<td>2000</td>
<td>Runtime error</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>errorID (WORD)</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No error</td>
</tr>
<tr>
<td>8xxx</td>
<td>Error at a Motion Control instruction</td>
</tr>
<tr>
<td></td>
<td>At the parameter &quot;errorSource&quot; you read the field index, assigned in the block, of the causative Motion Control instruction:</td>
</tr>
<tr>
<td></td>
<td>The error ID and the associated troubleshooting for Motion Control instructions are available in the S7-1500 Motion Control documentation.</td>
</tr>
<tr>
<td>9000</td>
<td>The synchronized position was missed - Warning -</td>
</tr>
<tr>
<td>9001</td>
<td>The saw has overshot the maximum cutting position - Warning -</td>
</tr>
<tr>
<td>9002</td>
<td>Error at the saw technology object - Warning -</td>
</tr>
<tr>
<td>9100</td>
<td>FB parameter &quot;extEncoder&quot; is faulty - Error -</td>
</tr>
<tr>
<td>9101</td>
<td>FB parameter &quot;LeadingAxis&quot; is faulty - Error -</td>
</tr>
<tr>
<td>9102</td>
<td>Parameter &quot;measuringInextEncoder&quot; is faulty - Error -</td>
</tr>
<tr>
<td>9102</td>
<td>Parameter &quot;measuringInLeadingAxis&quot; is faulty - Error -</td>
</tr>
<tr>
<td>9110</td>
<td>Error at the saw technology object - Error -</td>
</tr>
</tbody>
</table>
3.1 Service and Support

Industry Online Support

Do you have questions or need support?

You can contact the entire Service and Support know-how, as well as our Services through the Industry Online Support which is available round the clock.

The Industry Online Support is the central address for information on our products, solutions and services.

Product information, manuals, downloads, FAQs and application examples – all the information is accessible with a few clicks:

[https://support.industry.siemens.com/cs/](https://support.industry.siemens.com/cs/).

Technical Support

The Technical Support of Siemens Industry supports you quickly and competently in all technical requests with a wide range of customized offers – from basic support up individual support agreements.

Send any Technical Support requests using the Web form:

[https://support.industry.siemens.com/My/ww/en/requests](https://support.industry.siemens.com/My/ww/en/requests)

Service offer

Our service offer includes the following services, among others:

- Product trainings
- Plant Data Services
- Replacement part services
- Repair services
- Local services and maintenance services
- Retrofit and modernization services
- Service programs and contracts

Detailed information about our Service offer is available in the Service catalog.

[https://support.industry.siemens.com/cs/](https://support.industry.siemens.com/cs/)
3.2 Links and literature

Overview

1. Siemens Industry online support
   [https://support.industry.siemens.com/cs/]

2. Function manual S7-1500T Motion Control
   [https://support.industry.siemens.com/cs/ww/en/view/109481326]

3. STEP 7 Professional V14.1 System Manual
   [https://support.industry.siemens.com/cs/ww/en/view/109747136]

3.3 Documentation of changes

<table>
<thead>
<tr>
<th>Version</th>
<th>Date</th>
<th>Change</th>
</tr>
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<td>07/17</td>
<td>First edition</td>
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